Zooplankton communities and pelagic fish diet in the Barents Sea during recent warming period

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Background

- The Barents Sea is arcto-boreal sea
- > 300 zooplankton species
- > 200 fish species, appr. 20 species plankton-feeders
- Warm period had observed since late 1990s
- Considerable changes in distribution and structure of plankton and fish communities were observed during 2000s

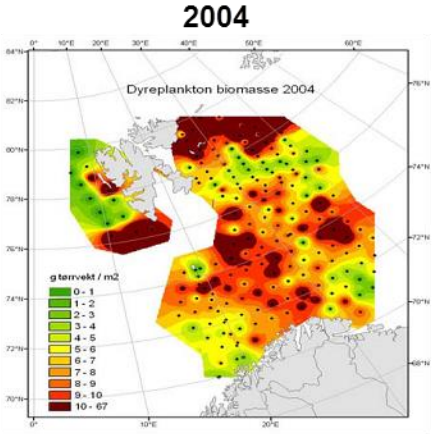
Objectives

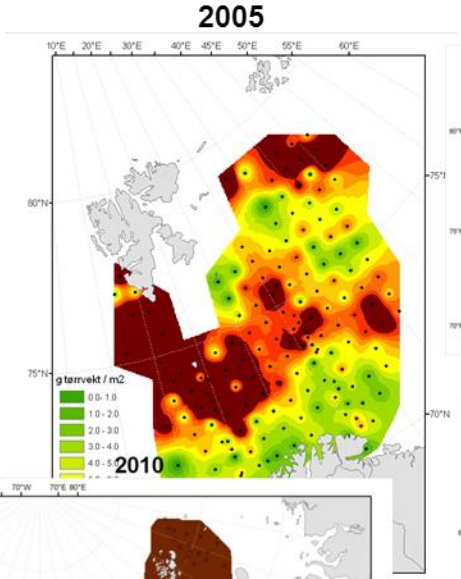
- To consider current state of zooplankton communities in the Barents Sea in recent warming period
- To consider a possible effect of changes in zooplankton on diet of the most abundant planktivorous fishes in the Barents Sea in this period

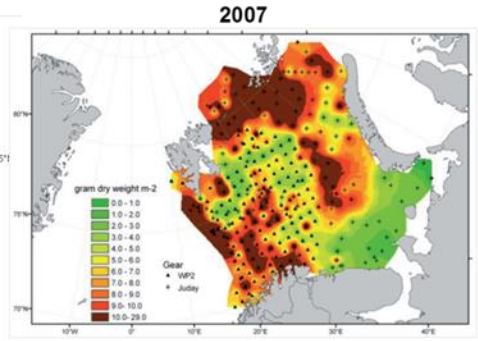
Materials and methods

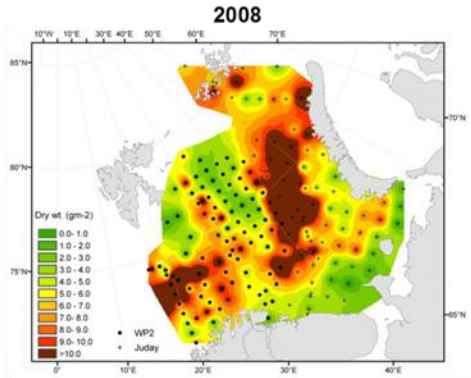
- Data on mesozooplankton from the international ecosystem survey in the Nordic Seas (May-June 2008-2015) and PINRO-IMR ecosystem surveys (August-September 2004-2015)
- Data on macroplankton from Russian TAS (October-December 1959-2014)
- Data on the diet of capelin (5 992 stomachs), polar cod (3 105 stomachs), herring (6 359 stomachs) and blue whiting (6 356 stomachs)

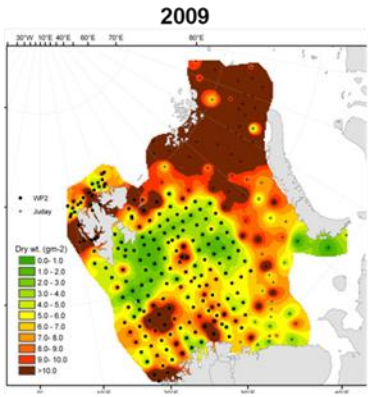
Total zooplankton biomass (g dw m^{-2}) in August-September 2004-2015

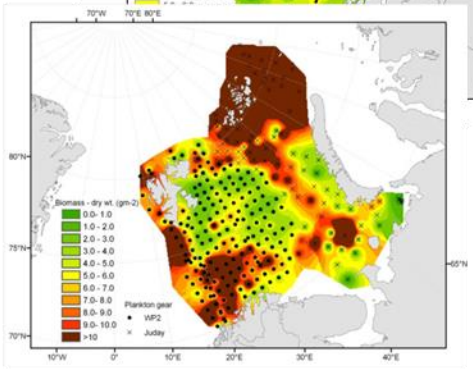


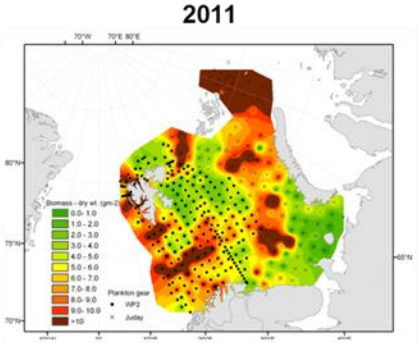


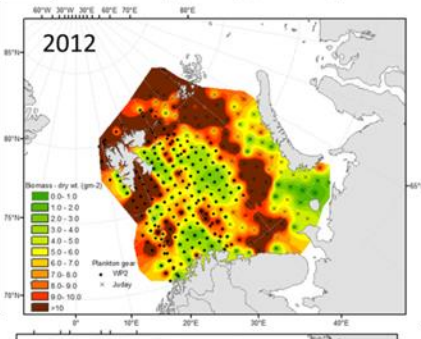


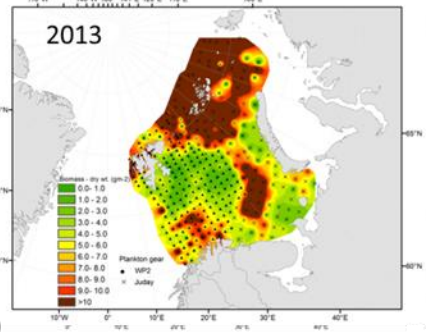


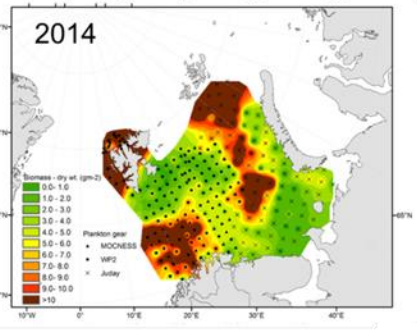


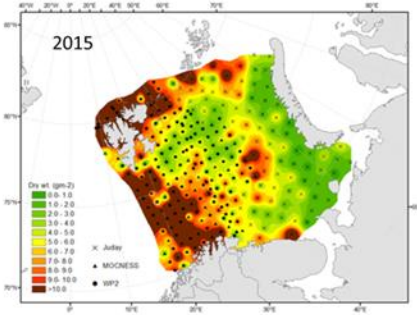










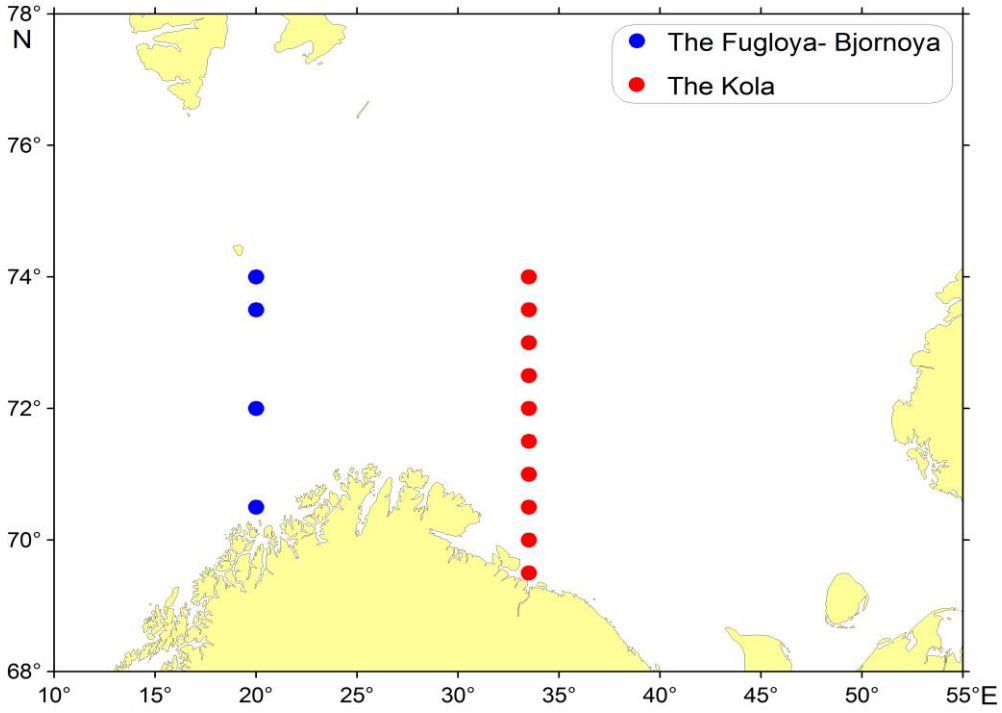


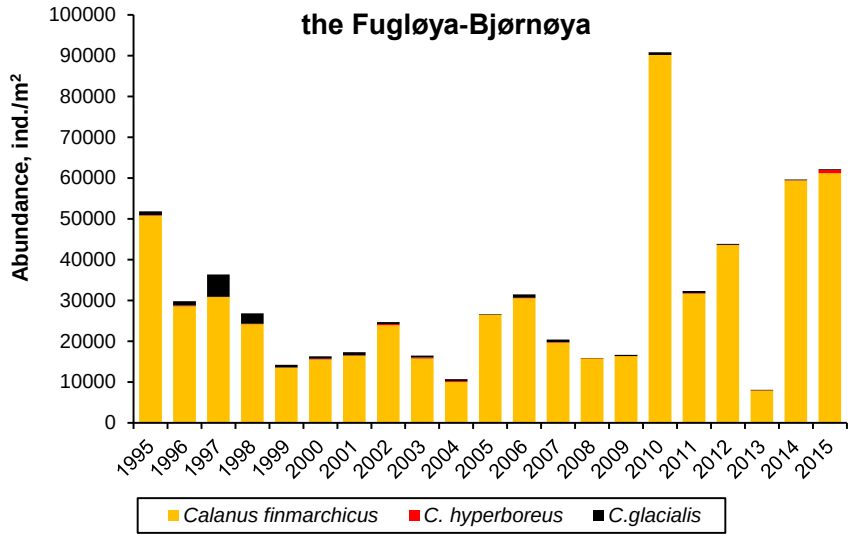
2015 - 7.3 gm-2 (263 st.)
2014 - 6.7 gm-2 (232 st.)
2013 – 7.1 gm-2 (305 st.)
2012 – 7.6 gm-2 (287 st.)

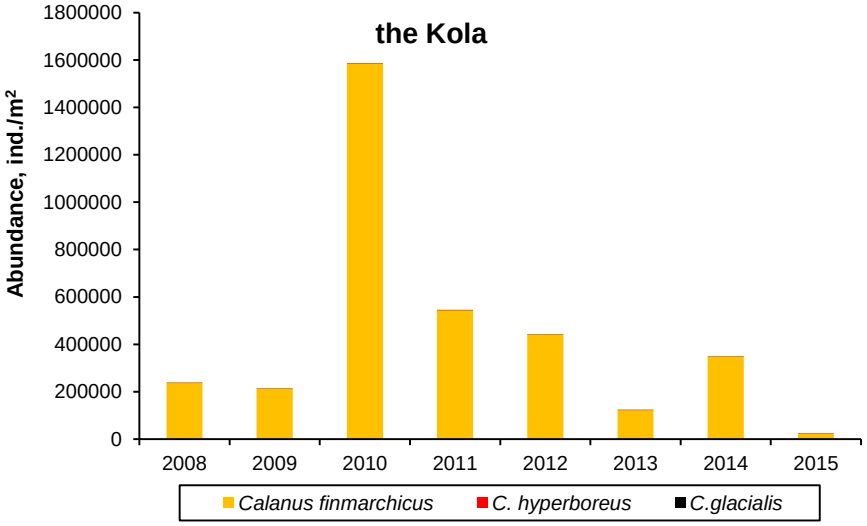
Mesozooplankton

- Main focus on taxons which are important prey species for pelagic fishes or which have ecological importance in the Barents Sea
- Copepods
- Euphausiids
- Hyperiids
- Chaetognaths (predators on zooplankton)
- Jellyfish (predators on zooplankton and fish eggs and larvae)

IMR and PINRO standard sections

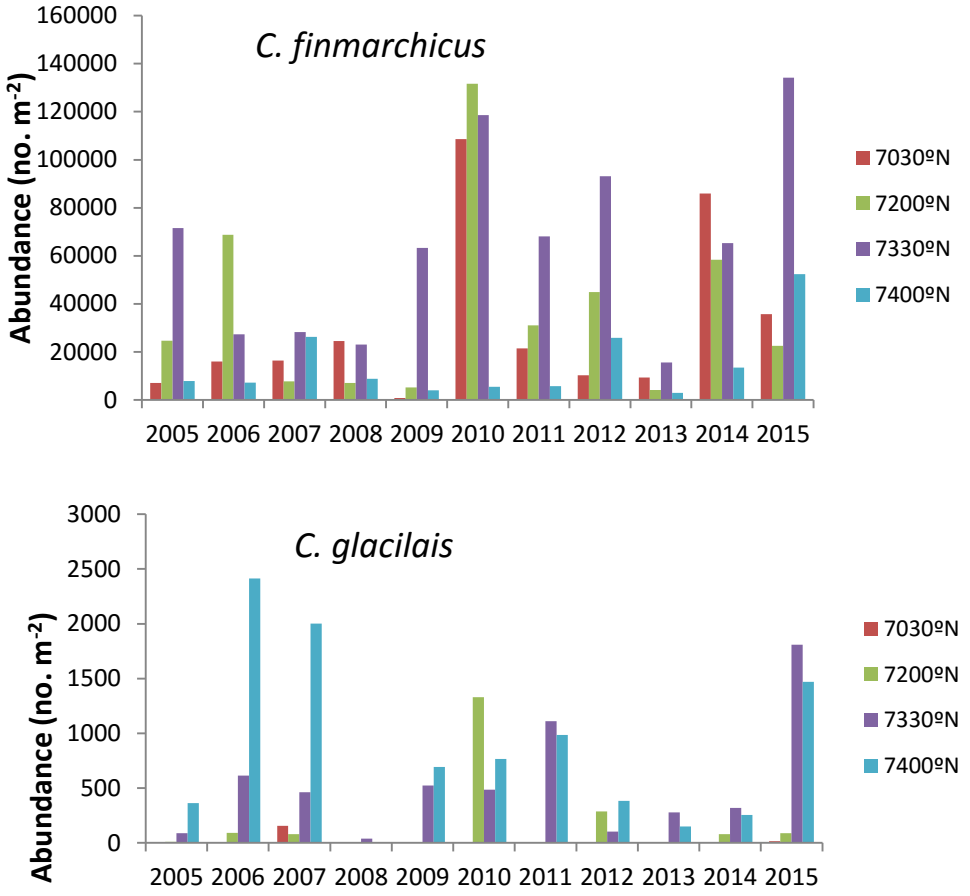




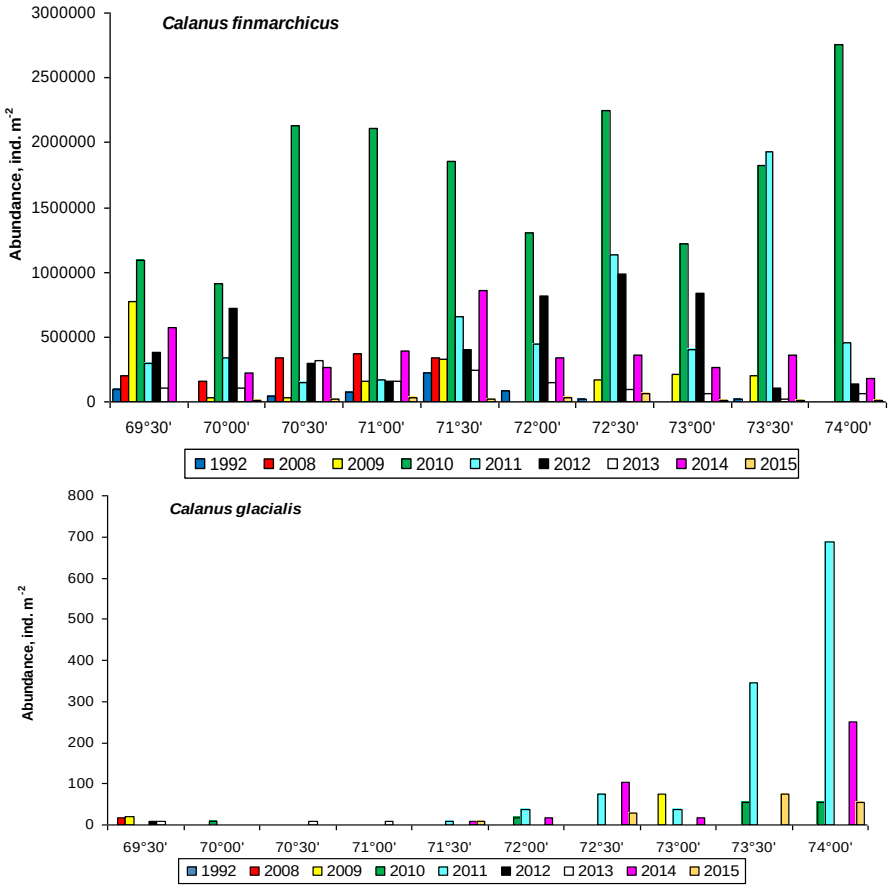


- Total abundance of *Calanus* spp. on the Fugløya- Bjørnøya section (IMR) and the Kola section (PINRO)

Fugløya-Bjørnøya section

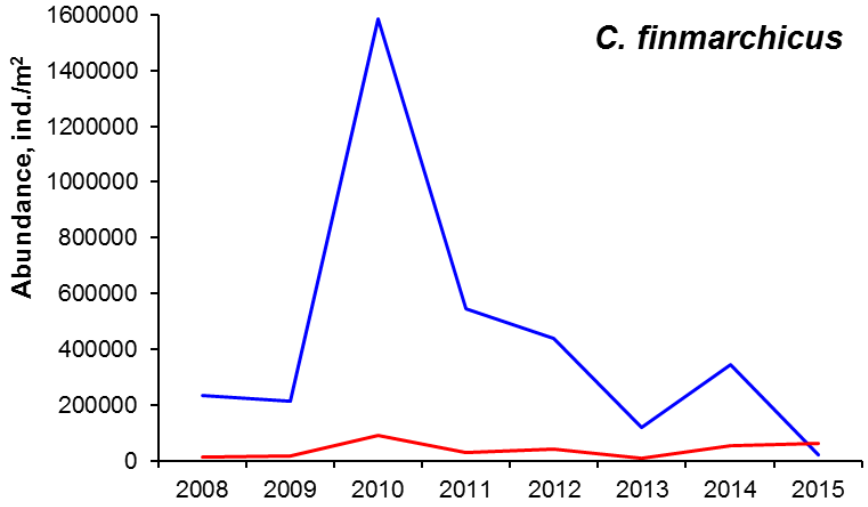


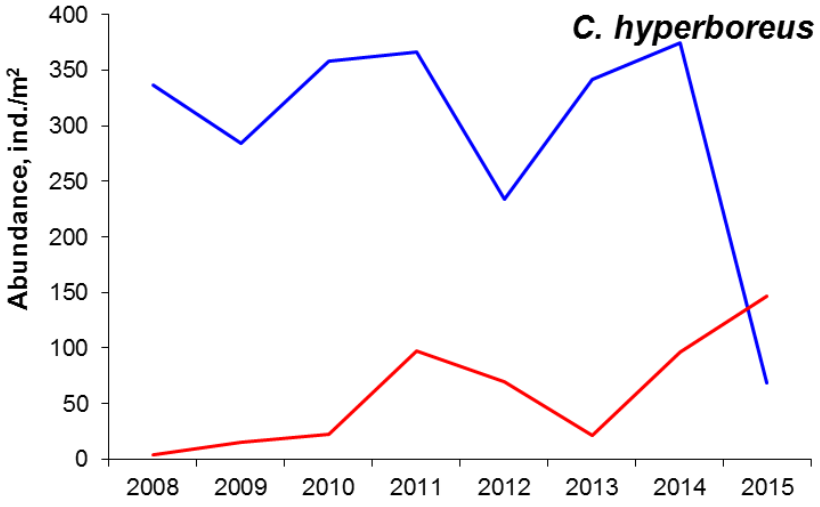
Kola section

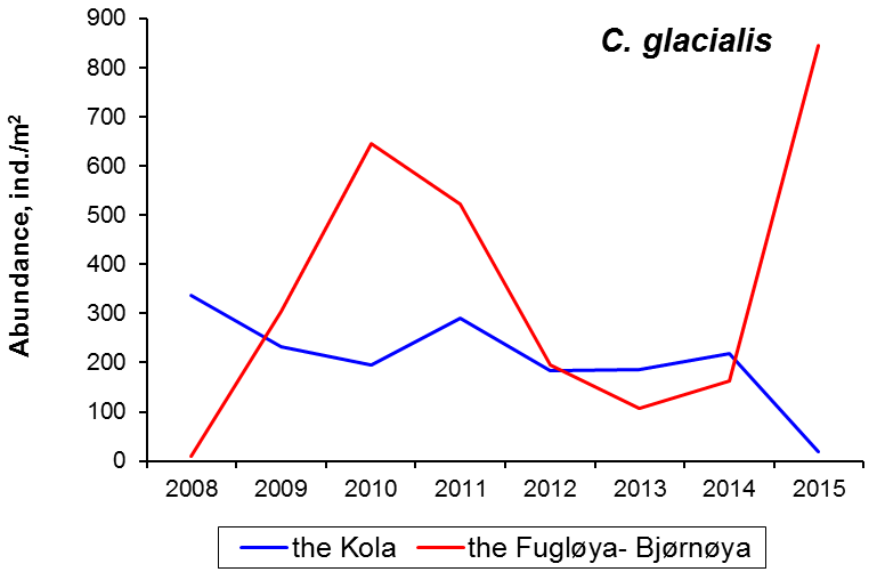


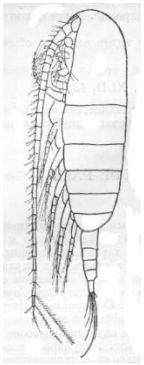
- Relatively high abundances of *C. finmarchicus* along the FB section in 2014 and 2015
- Highest abundance of *C. finmarchicus* observed in 2010 for both sections
- Highest abundances of C. glacialis > 73º N in both sections
- Low abundances of *C. glacialis* along FB section during 2012-2014 – more in 2015

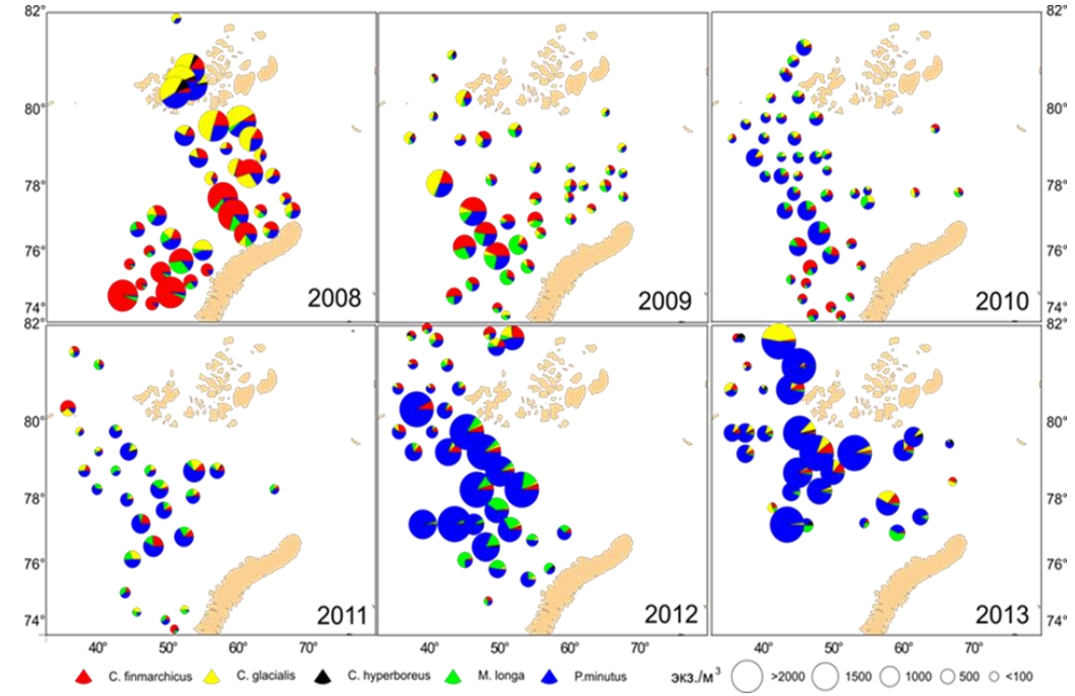
Abundance of *Calanus* species on the Fugløya-Bjørnøya and the Kola sections

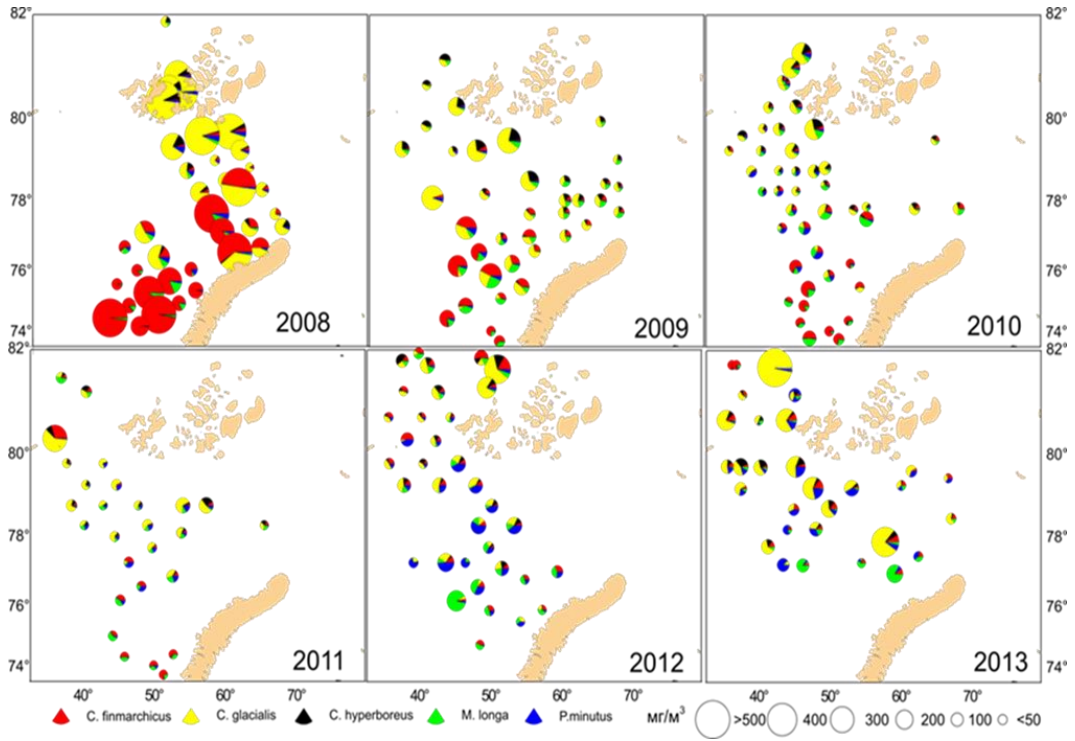








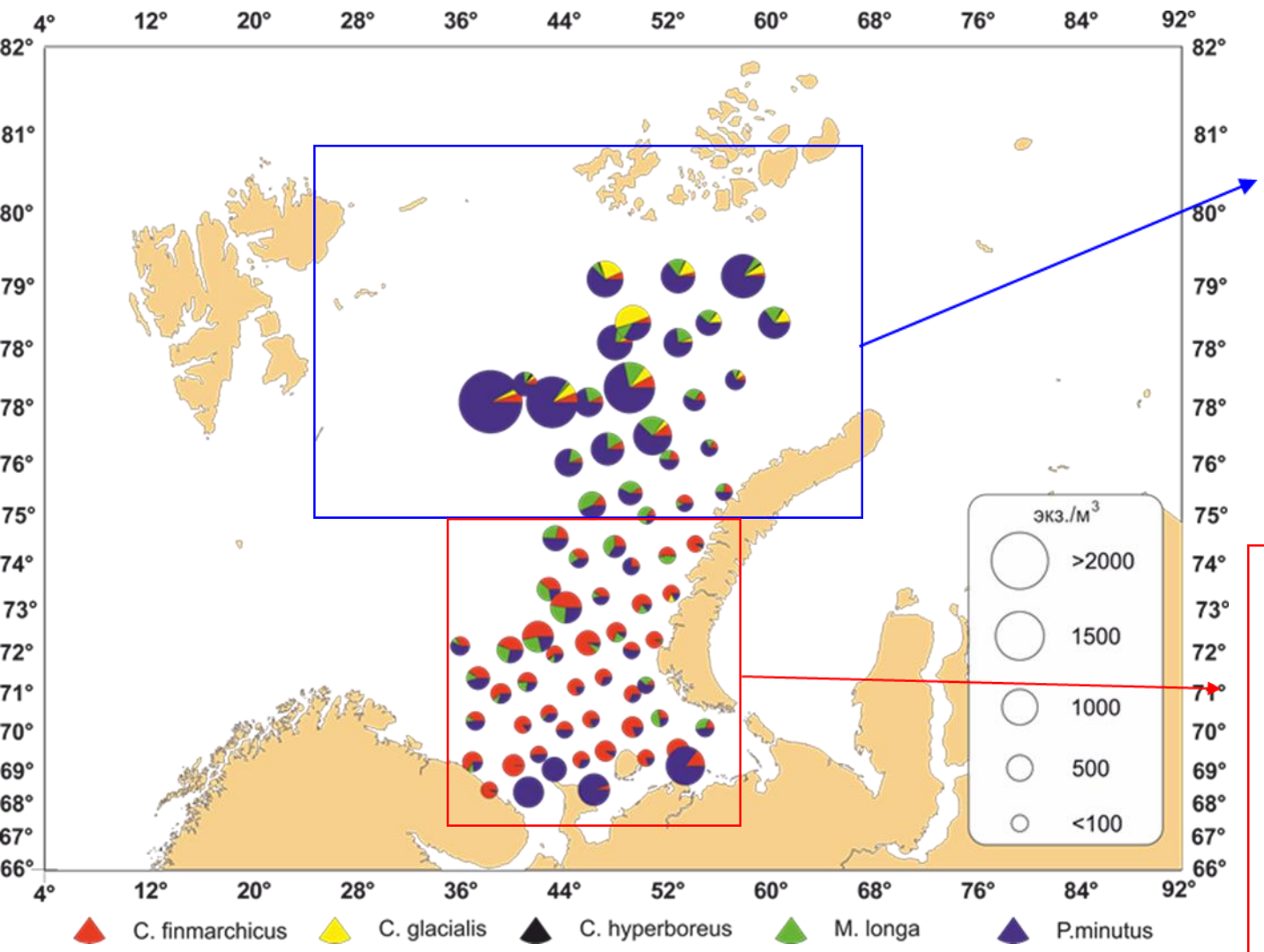




Copepods abundance and biomass in the northern BS in August-September

- Decrease in total abundance and biomass of copepods
- Decrease in the portion of large species (*Calanus. glacialis*, *C. finmarchicus*, *C. hyperboreus*)
- Increase in small species (*Pseudocalanus minutus*) abundance, but not biomass

Mesozooplankton abundance in 2014



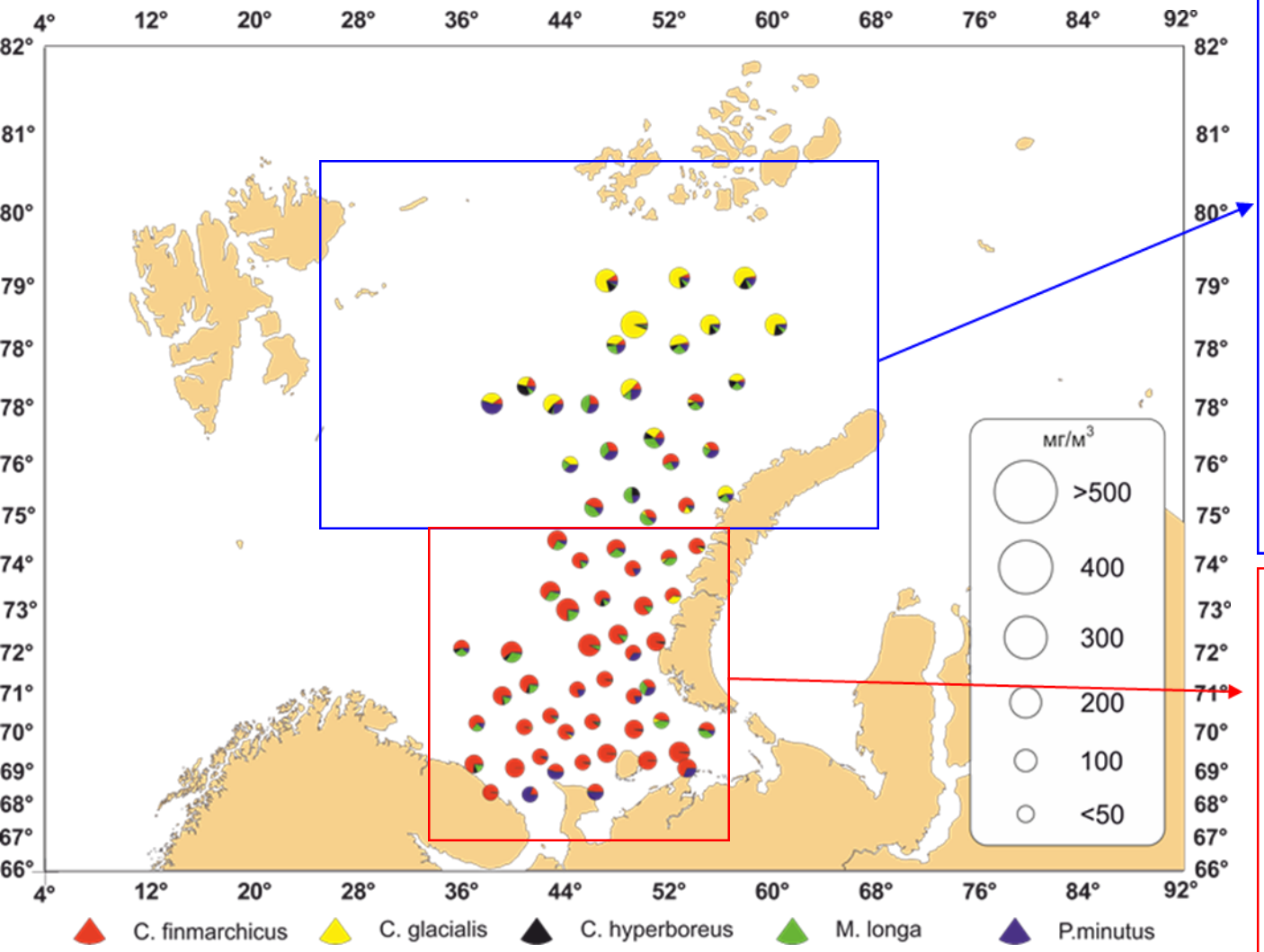
Northern part –
Copepods - 95 %
Pteropods - 3,6 %

P. minutus – 73 %
M. longa – 12 %
C. glacialis - 8
C. finmarchicus – 6 %
C. hyperboreus – 1 %

Southern part –
Copepods – 94 %,
Meroplankton – 2,1 %

P.minutus – 47 %
C.finmarchicus – 40 %
M.longa – 13 %

Mesozooplankton biomass in 2014



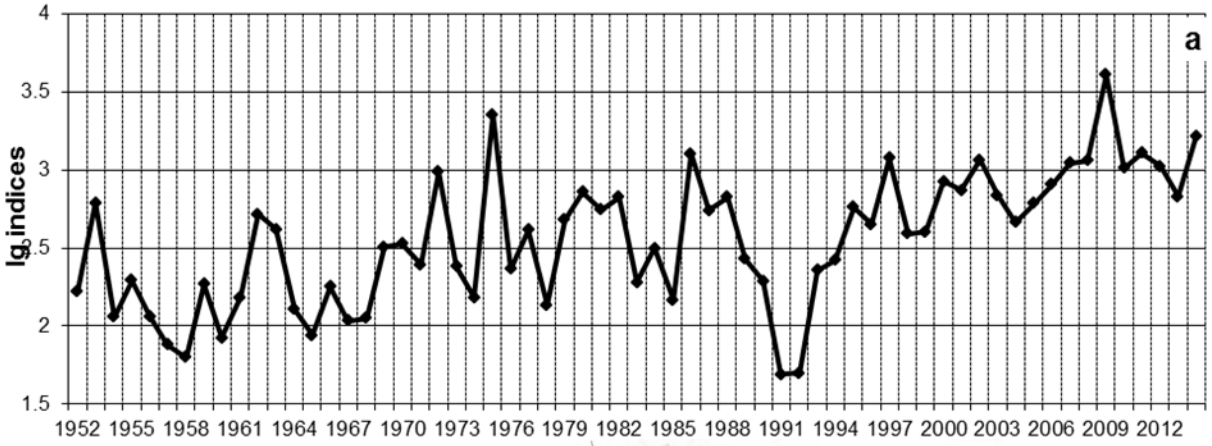
Northern part –
Copepods - 75 %
Chaetognaths – 16,2 %
Pteropods, hyperiids, euphausiids, hydromedusae – 2,0-3,7%

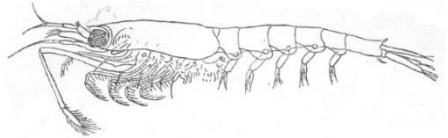
C. glacialis – 57 %
P. minutus – 15 %
M. longa – 11 %
C. finmarchicus – 10 %
C. hyperboreus – 7 %

Southern part –
Copepods – 68 %
Chaetognaths – 24 %
Euphausiids -4 %

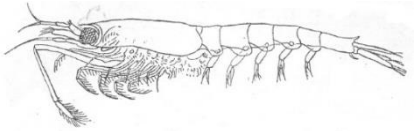
C.finmarchicus – 75 %
M.longa – 15 %
P.minutus – 7 %

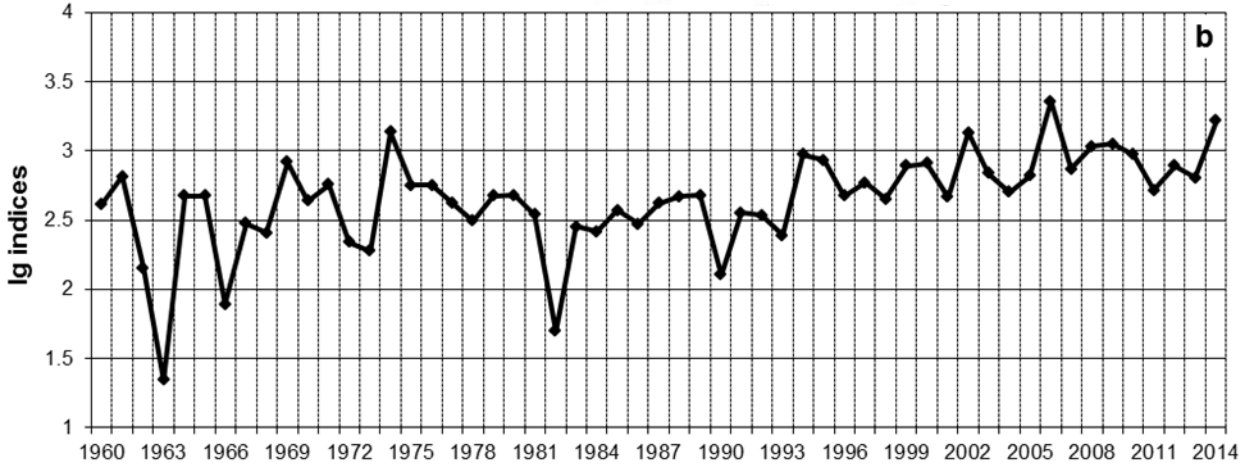
Euphausiids





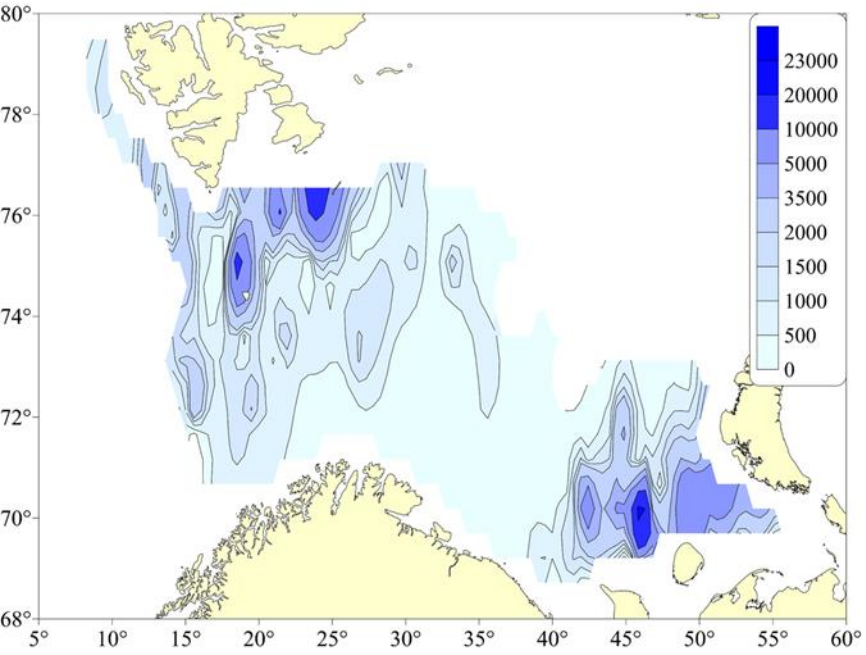
Southern part
2014 – 1637
2013 – 675
mean – 568 ind./1000 m^3



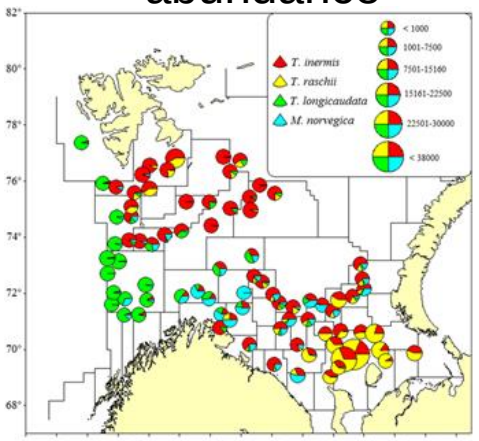


North-western part
2014 – 1656
2013 – 640
mean – 939 ind./1000 m^3

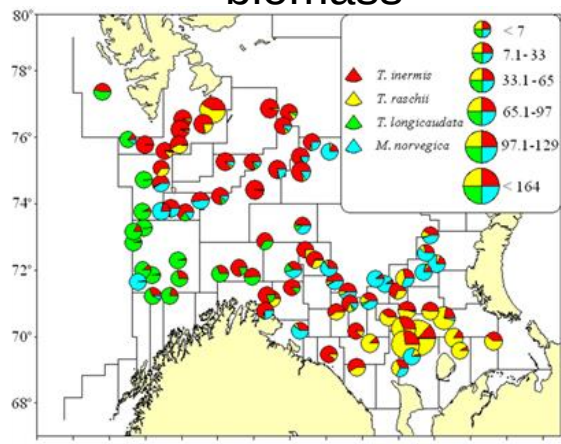
Distribution and species composition of euphausiids

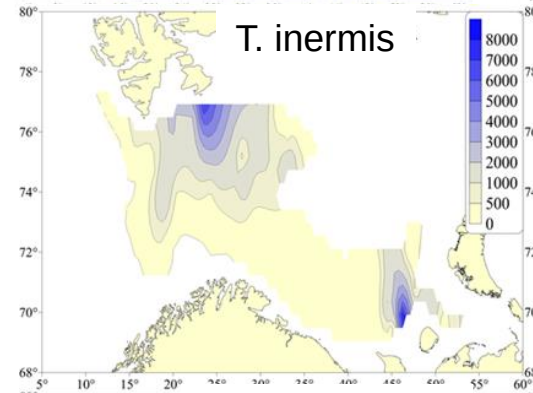


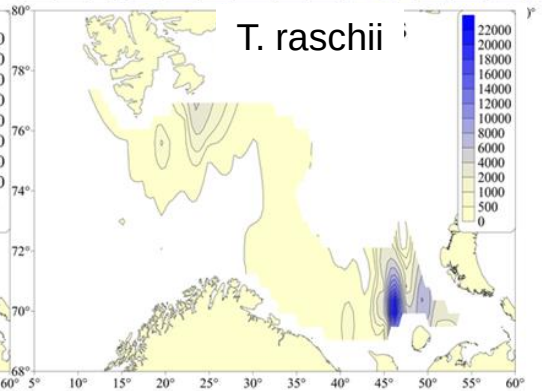
abundance

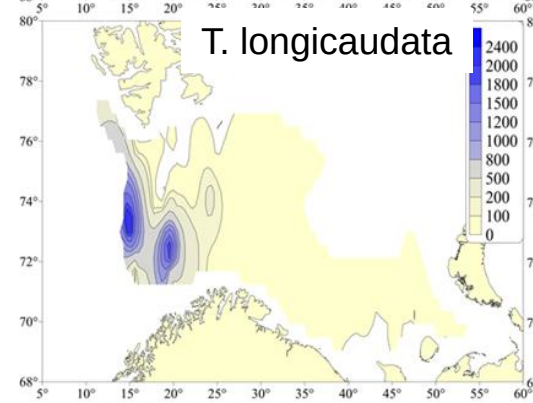


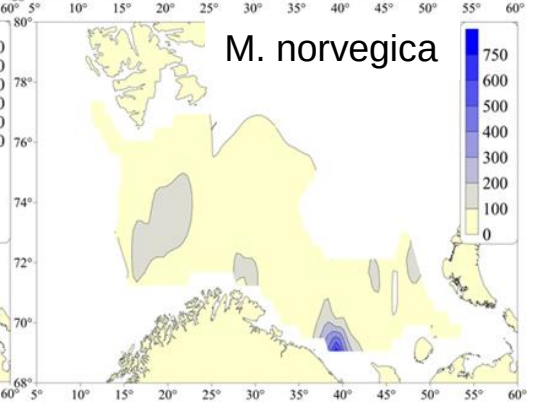
biomass





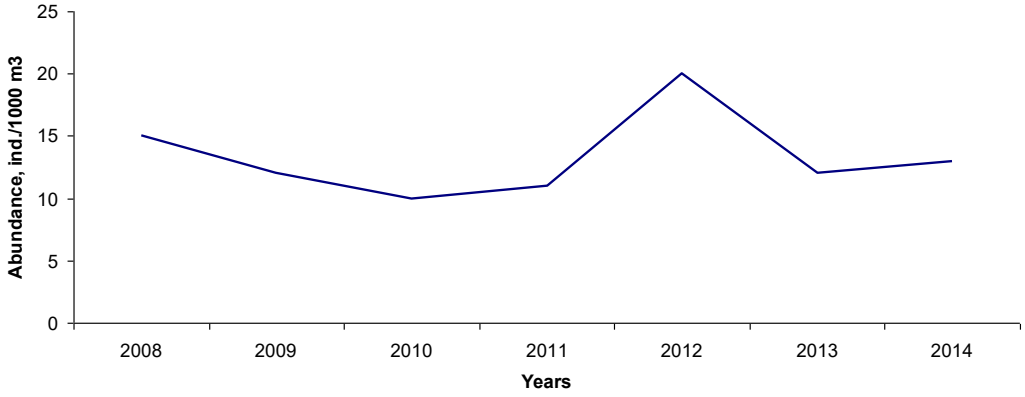




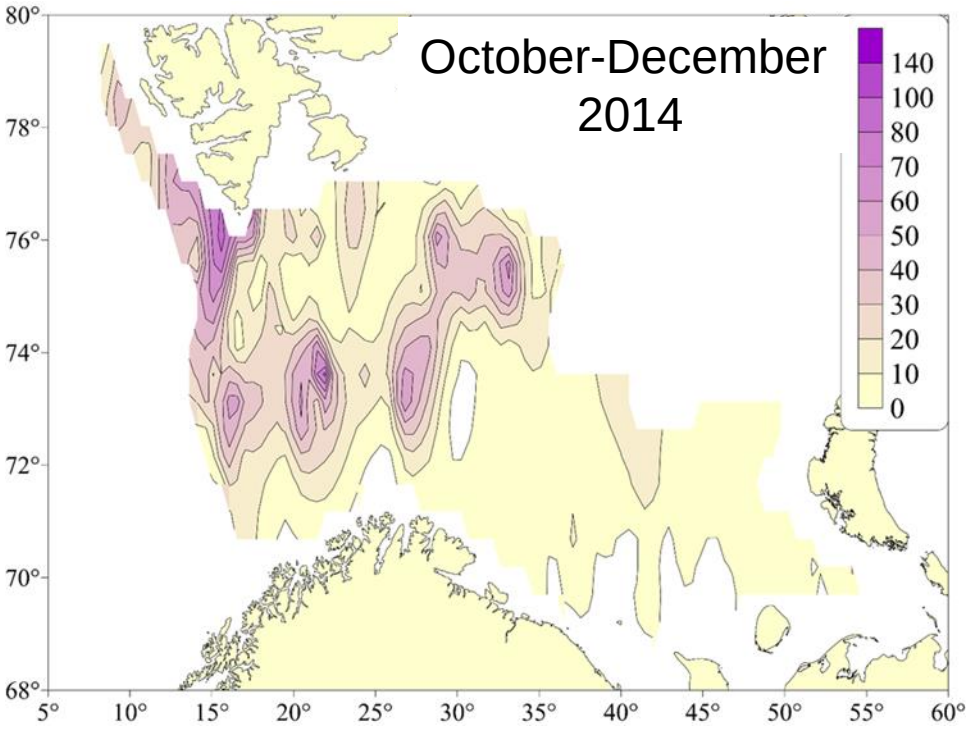


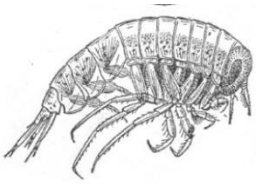
- Distribution of euphausiids was rather similar to last warm years (2004-2014)
- Higher abundance and portion of warmwater species
- Distribution area of warmwater species increased

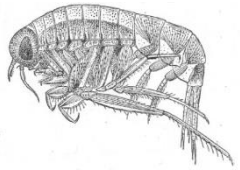
Hyperiids



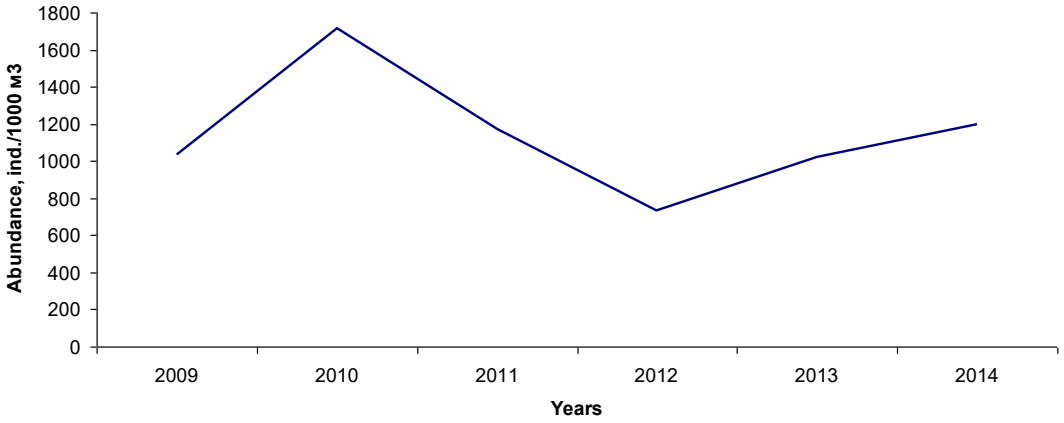
- Distribution area decreased last years
- Abundance of hyperiids decreased during the last warm years and now is very low

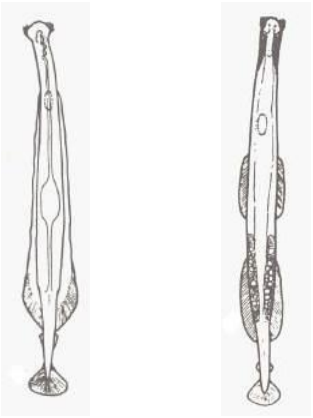


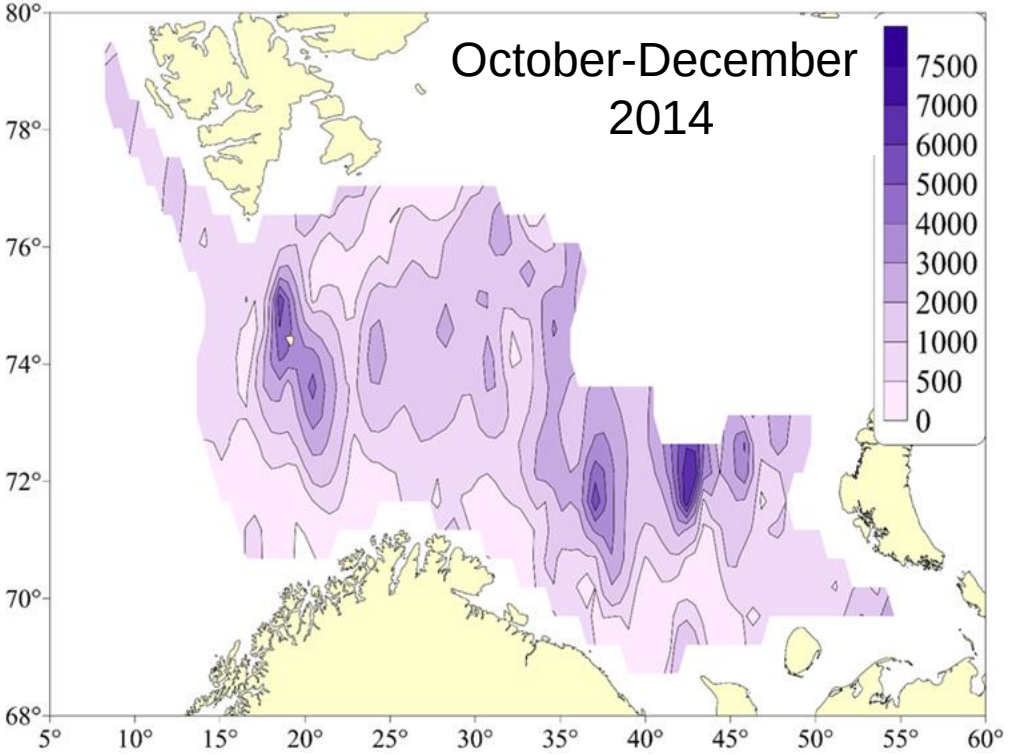




Chaetognaths

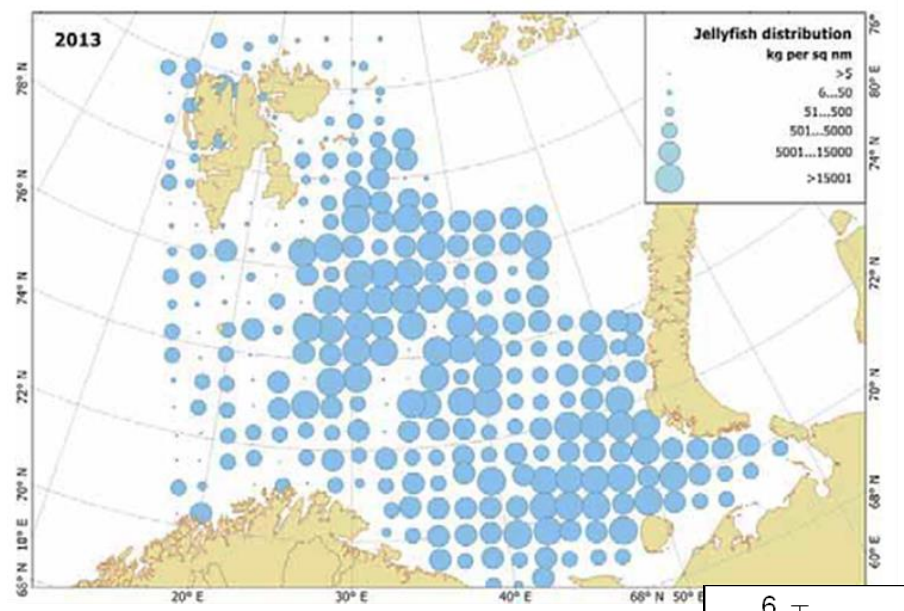






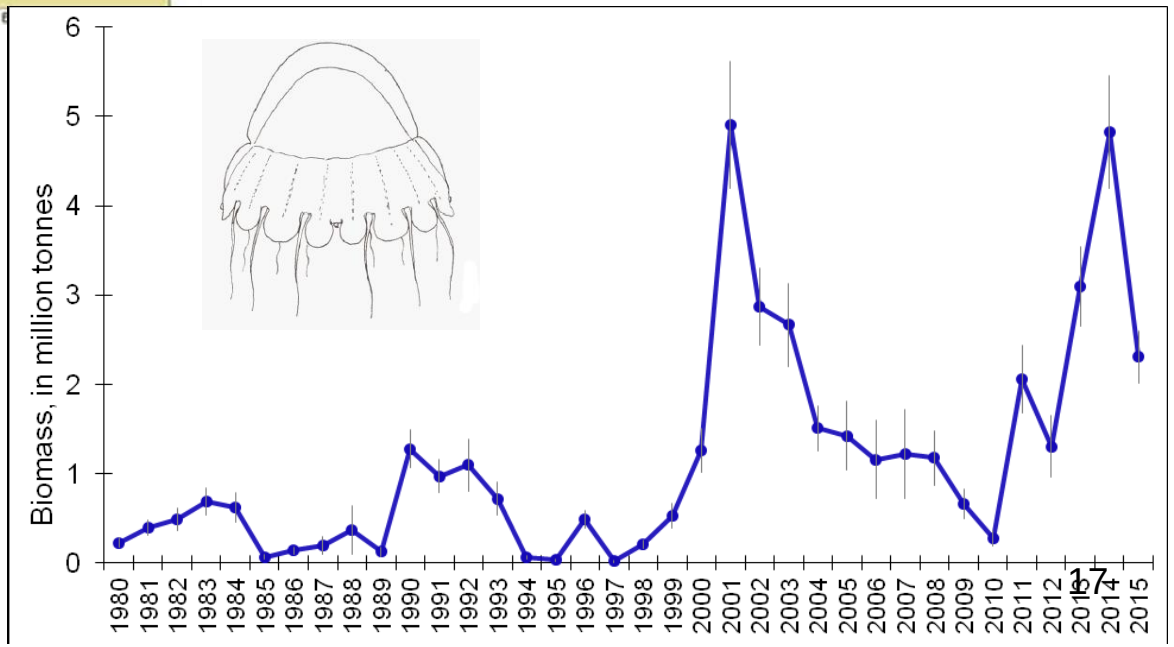
- Abundance of predatory chaetognaths increased during the last warm years and now is on rather high level
- Possibly their high abundance resulted to decreasing of copepods abundance and biomass

Jellyfish



Distribution of jellyfish, August-September 2013 (Eriksen, 2013)

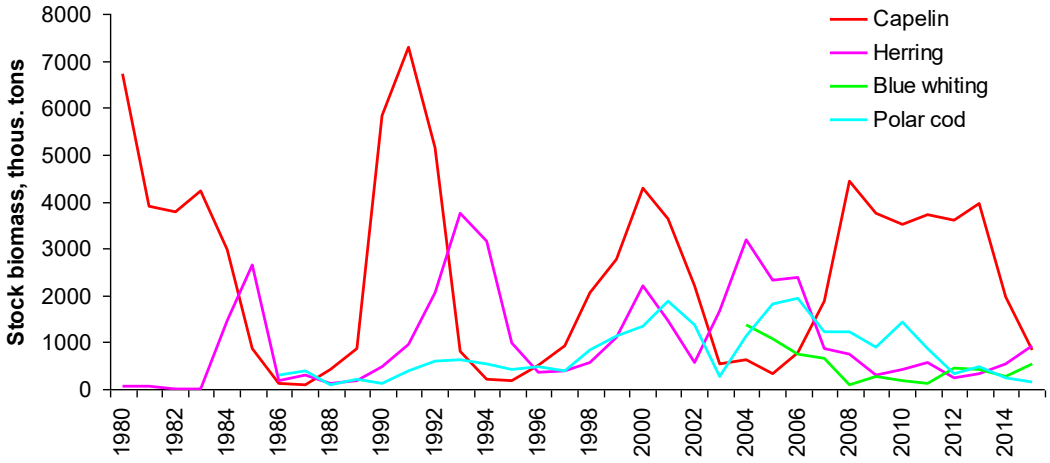
- Increasing of jellyfish abundance since 2000s
- Possibly negative impact on zooplankton abundance and fish recruitment

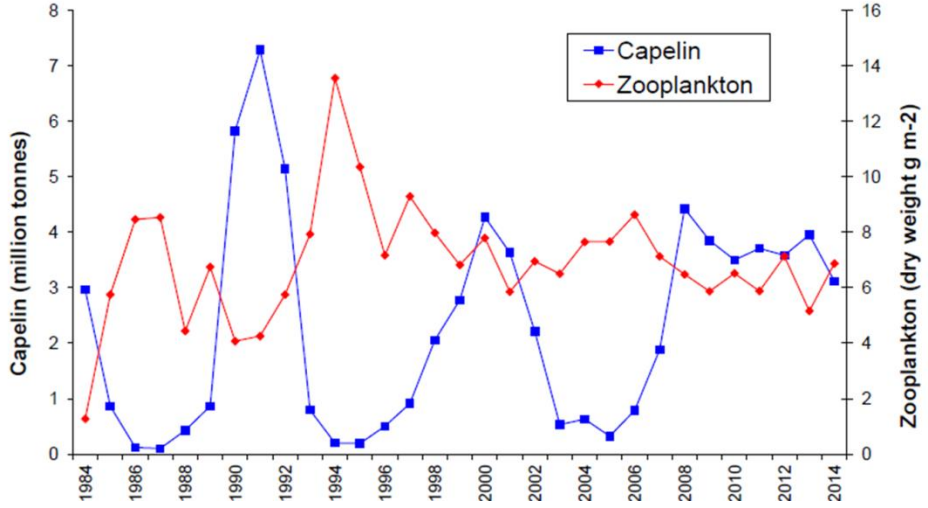


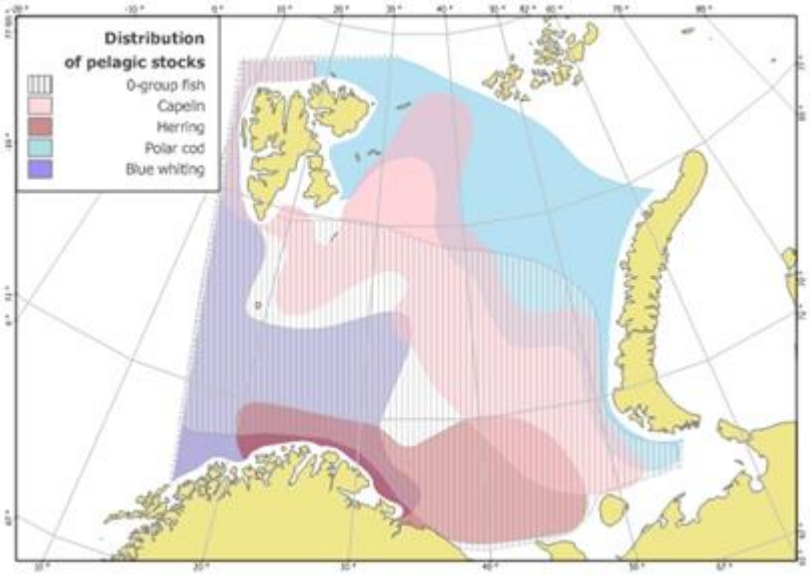
The total jellyfish biomass, mostly *Cyanea capillata* in 1980-2015, million tonnes (Eriksen et al., 2015)

Pelagic fishes in the Barents Sea

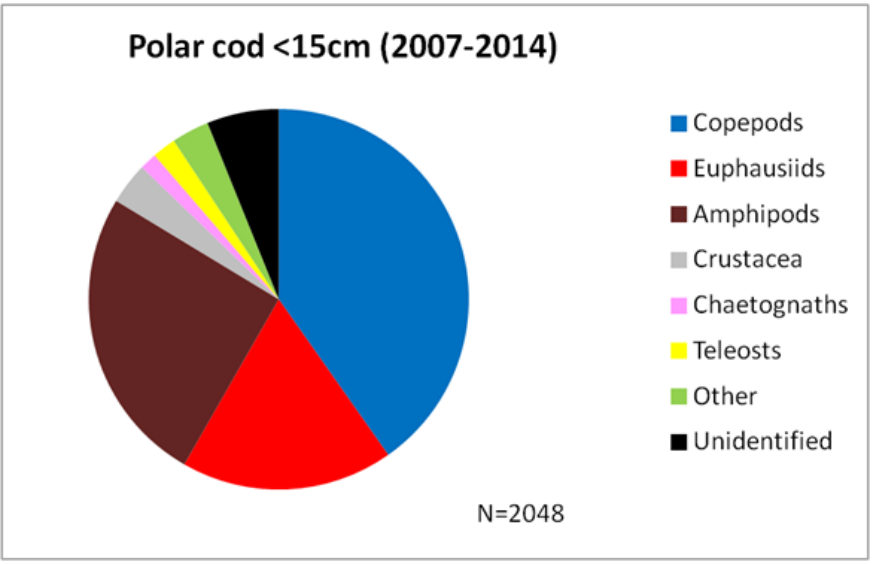
- The most abundant pelagic fishes are 3 boreal species (capelin, herring and blue whiting) and 1 arctic species (polar cod)

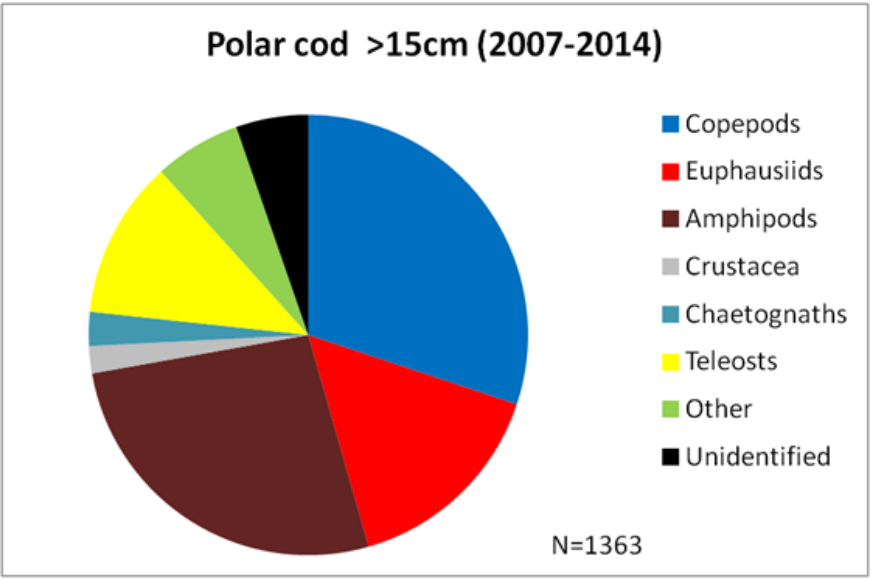


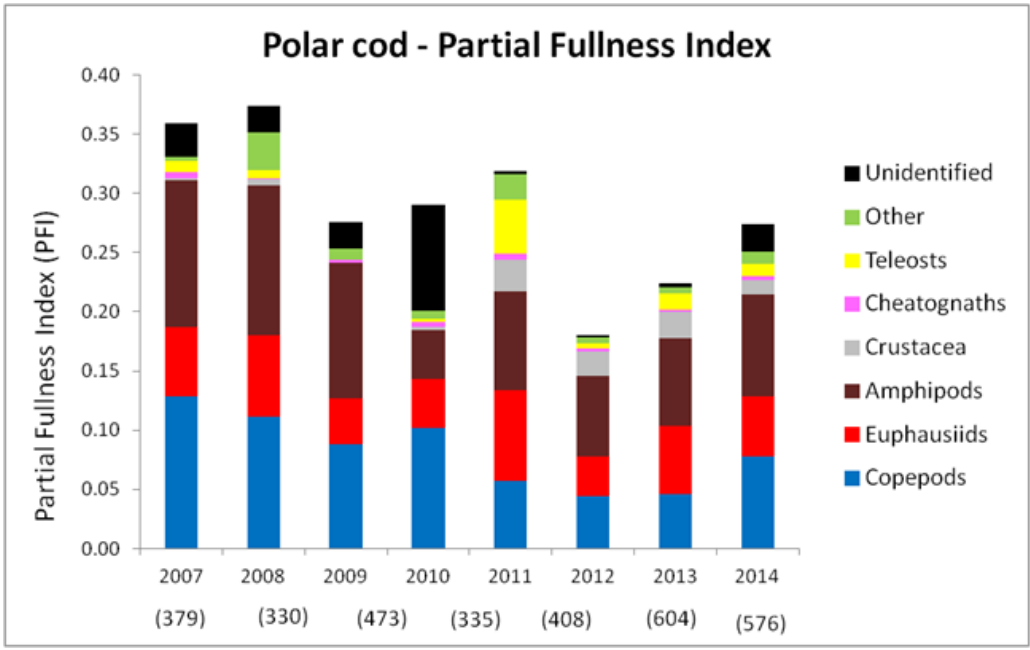




Polar cod

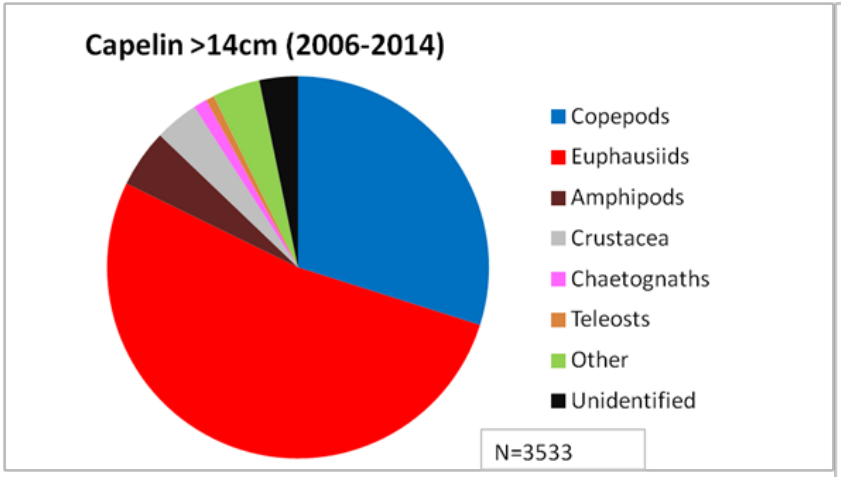


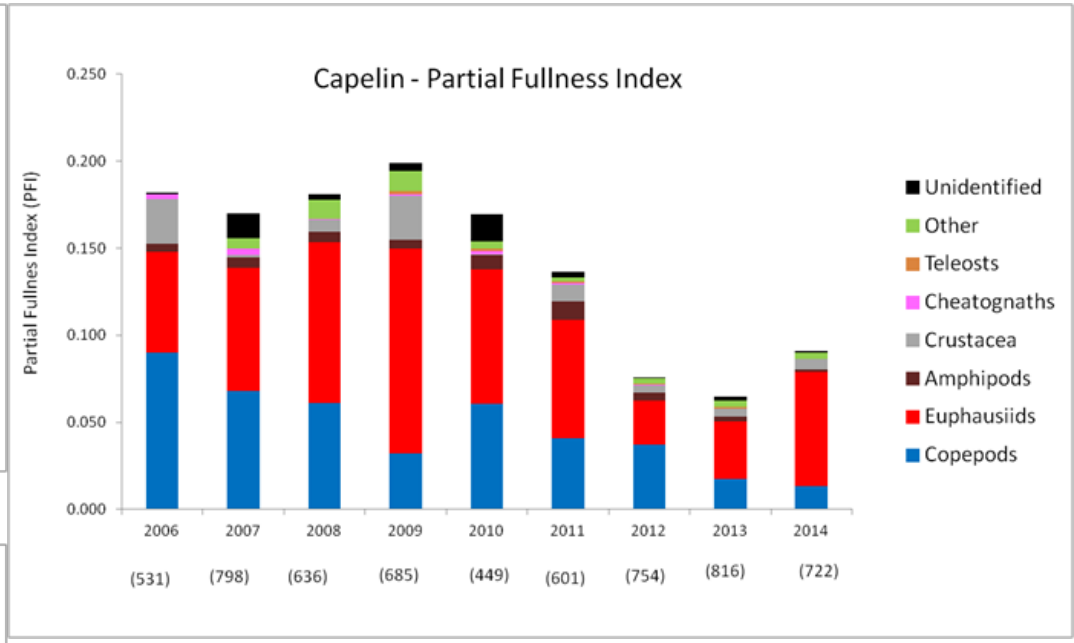


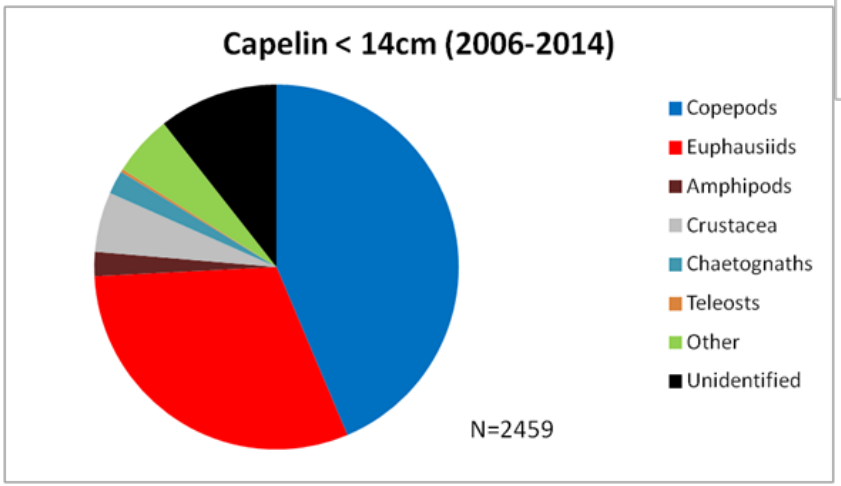


- Main food – copepods, hyperiids and euphausiids
- Decreasing of feeding intensity
- Decreasing of copepod role in diet

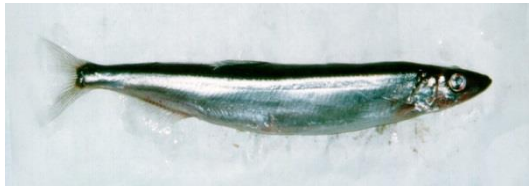
Capelin



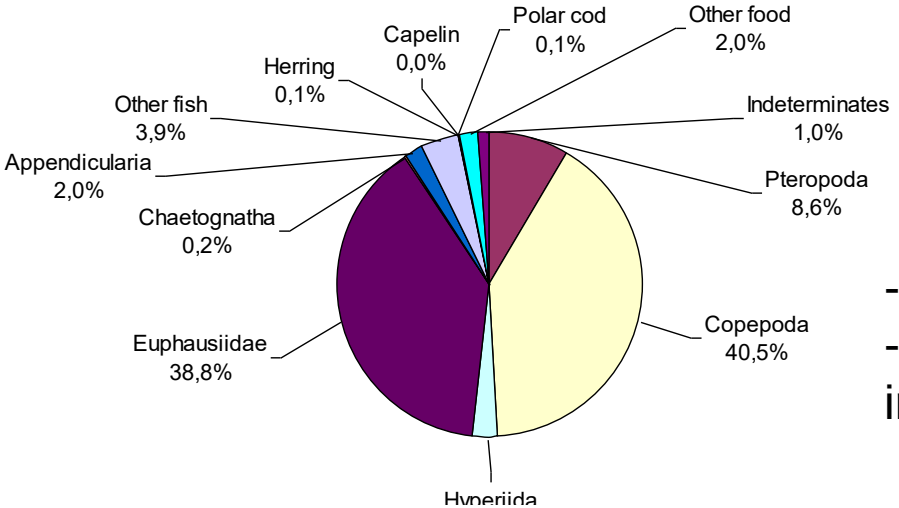




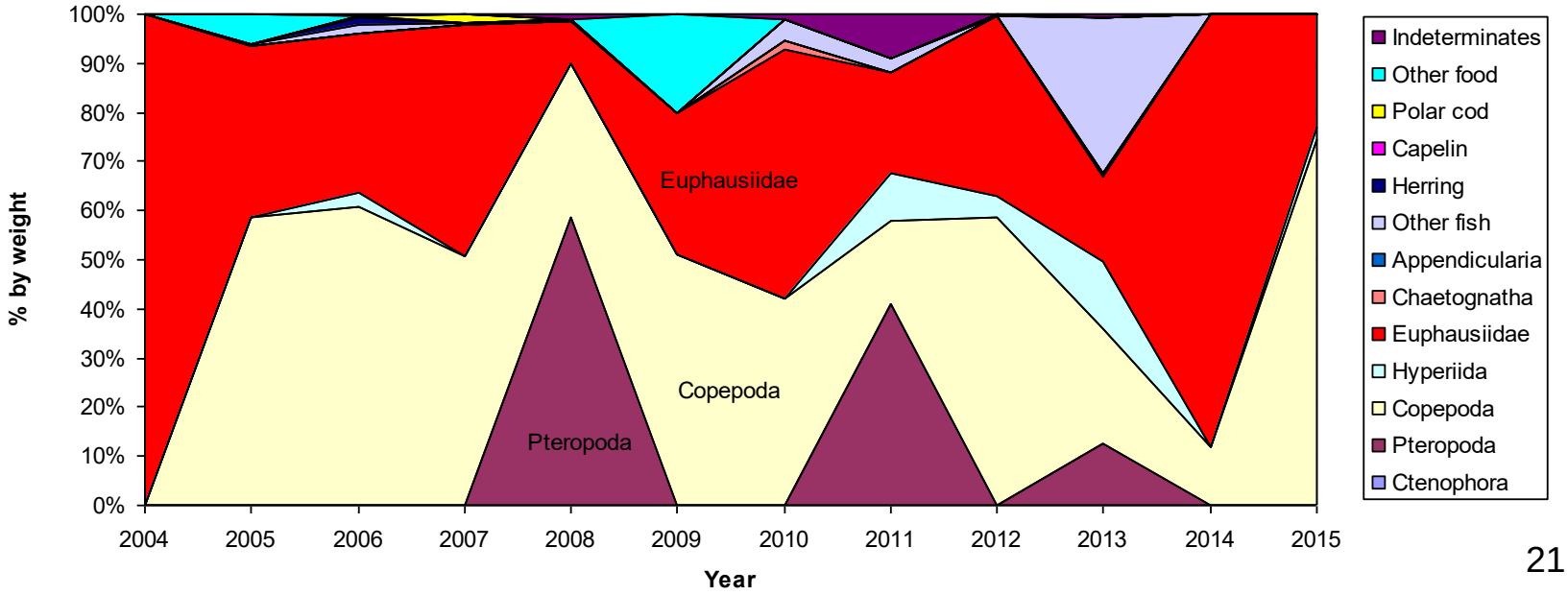
- Main food – copepods and euphausiids
- Decreasing of feeding intensity
- Decreasing of copepod role in diet



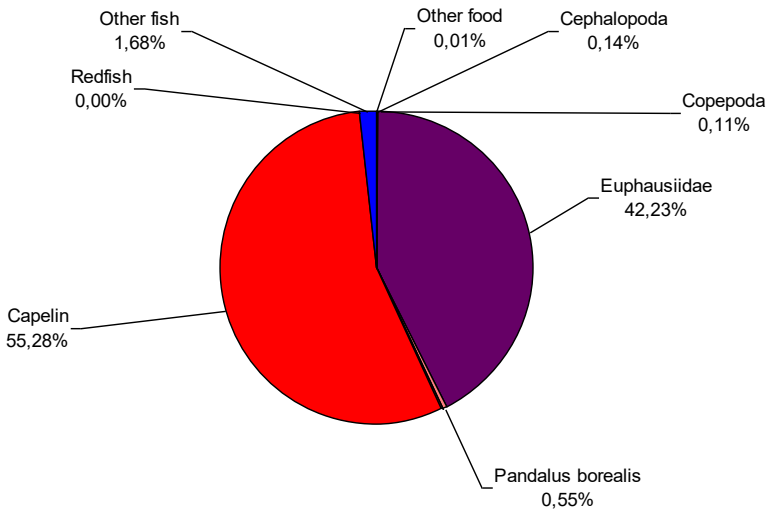
Atlantic herring



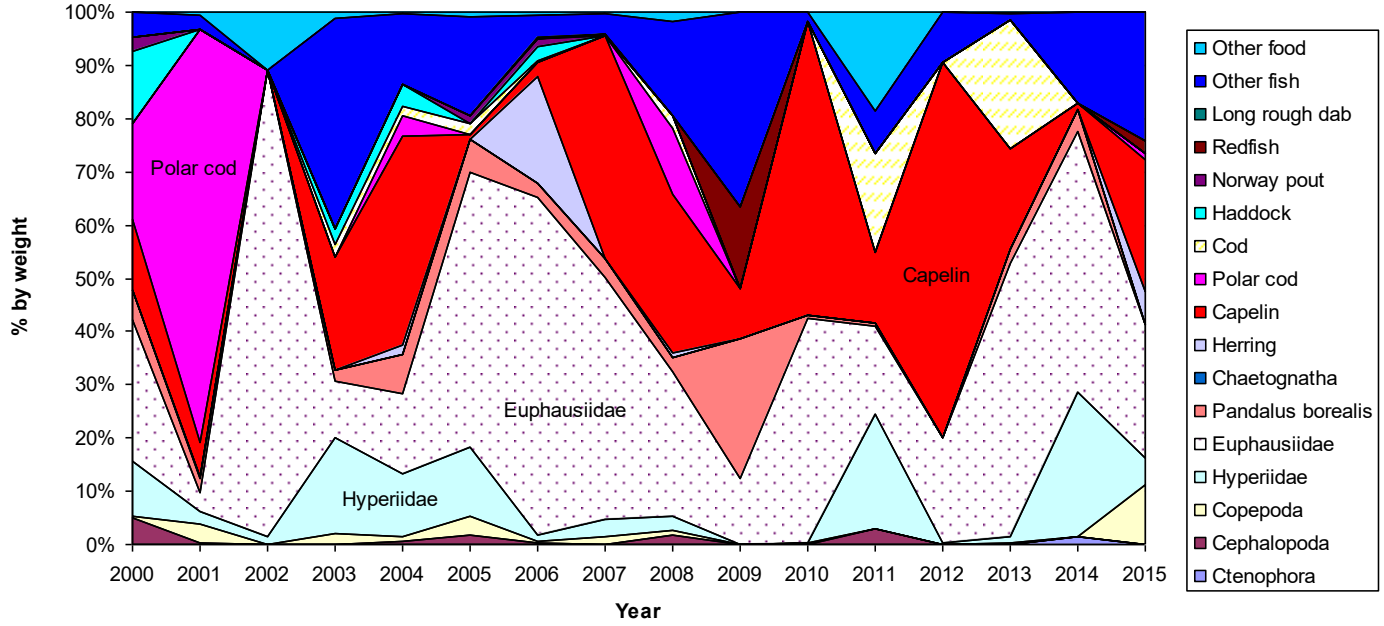
- Main food – copepods and euphausiids
- No obvious changes in diet and feeding intensity



Blue whiting



- Main food – fish and euphausiids
- No obvious changes in diet and feeding intensity



Conclusions

- Total biomass of zooplankton varied not so much in 2004-2015
- Abundance and biomass of mesoplankton on the northern Barents Sea decreased since 2006-2007
- In mesoplankton communities shift from larger copepods (*C. glacialis*, *C. finmarchicus*, *C. hyperboreus*) to smaller copepods (*Pseudocalanus minutus*) was observed in the northern Barents Sea
- Euphausiids abundance was higher than the long-term mean
- The abundance of arctic hyperiids decreased
- The abundance of predatory plankton (chaetognaths and jellyfish) increased
- Feeding conditions for pelagic fishes, especially capelin and polar cod, became worse