

Predator diet as an indicator of comb jellyfish (*Ctenophora*) abundance dynamics in the Barents Sea

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► Background

The Barents Sea

high-latitude, arctoboreal
shallow shelf sea

area: about 1.6 million km²

Atlantic Water entering from southwest

Arctic Water entering from northeast

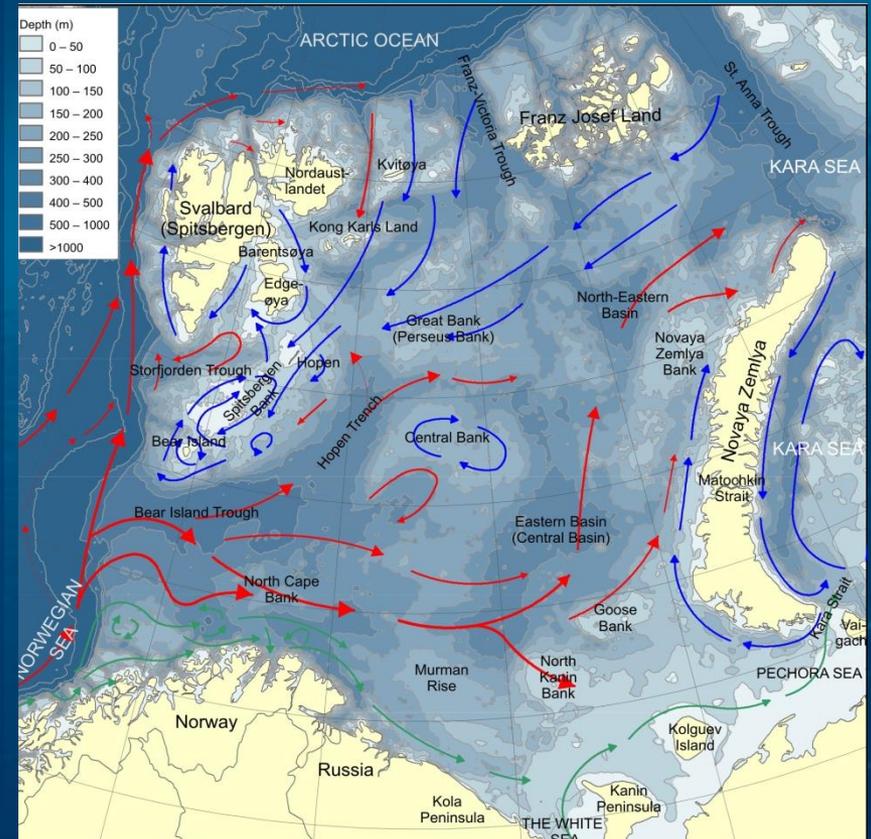
Inhabited by

- > 400 plankton species
- > 200 fish species
- > 4 000 invertebrates

Nursery area for many fish species

Commercial important area

fishery, petroleum, gas, shipping



► Background

Methodological challenges

To understand species interaction and ecosystem functioning needs

long, consistent and uninterrupted monitoring
temporal and spatial trends in species abundance

Monitoring of gelatinous plankton in the Barents Sea

- Plankton nets (WP11 and MOCNESS)
underestimates due to avoidance
- Pelagic trawls underestimates due to escapement
or damage of fragile ctenophores in the cod-end

SPORADICAL DATA ON CTENOPHORA

NO ABUNDANCE ESTIMATES



► Background

IMR-PINRO stomach content data base

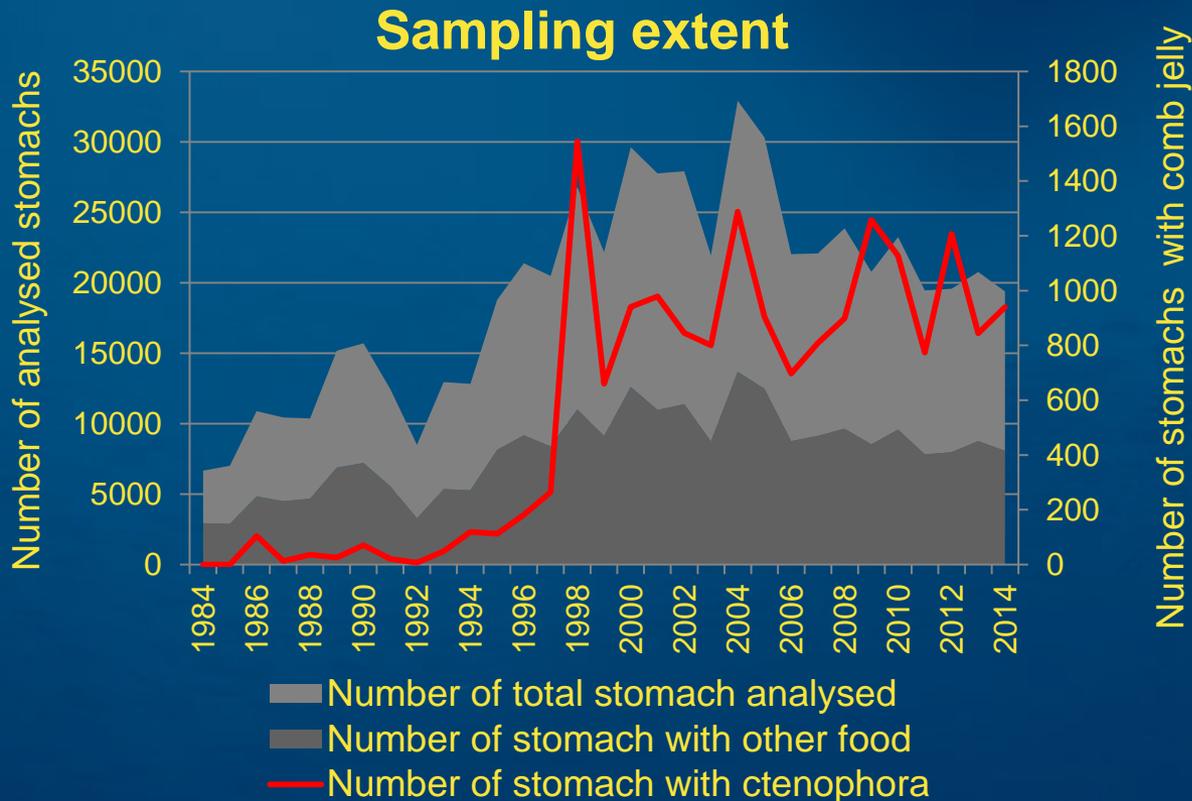
IMR-PINRO joint data base on fish diet from 1984-present

- Mainly cod in data base
- Data collected mainly during surveys
- Data collected also from commercial vessels (Russia)
- Good spatial coverage by surveys in all quarters
- ~10 000 stomachs analysed annually

WE TRIED TO EXTRACT DATA ON CTENOPHORA
FROM THE IMR-PINRO DATA BASE



► Materials and methods



The study period 1984-2014

Total number of stomachs analysed ~347 000

Empty stomachs 24%

Comb jelly were found in >17 thousand stomachs (5%)

Other food items were found in more than 247 thousand stomachs



► Materials and methods

Main indicators of prey occurrence and importance in cod diet

- Frequency of occurrence index (FO)
- Weight percentage index (WP)
- Partial Fullness Index (PFI for comb jelly)

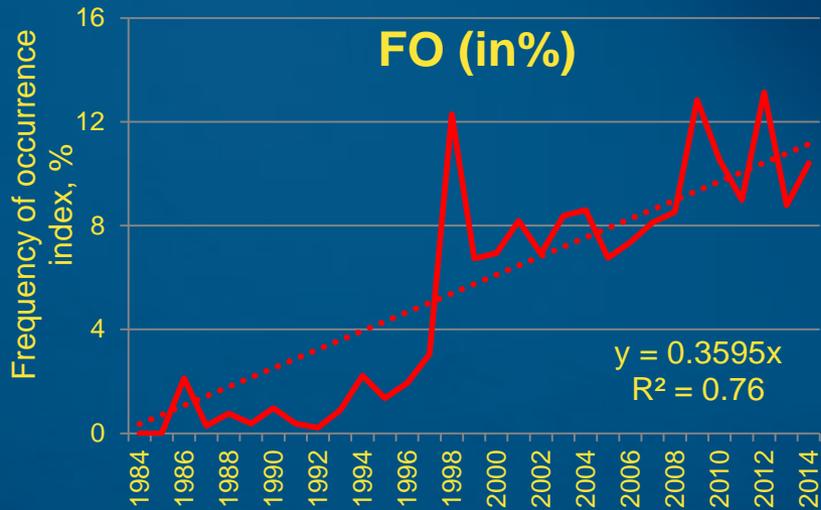
Spatial and temporal distribution (maps)

Principal Component Analyses (PCA)

Stratigraphically constrained clustering



► Results



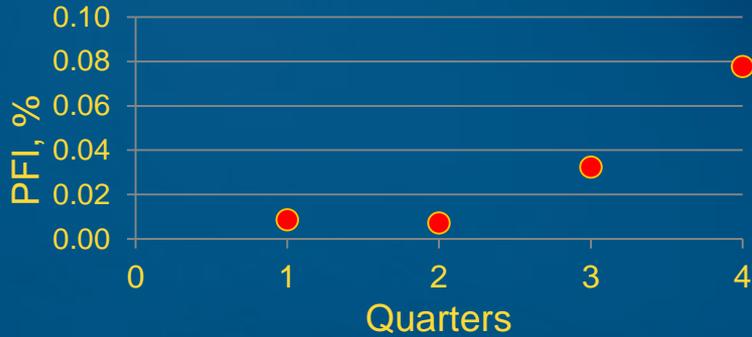
- Comb fish occurred regularly in cod diet
- Increasing trend in FO
- In 1988, 2009 and 2012, FO was over 12 %

- Cod consumes more comb jelly since late 1990s
- WP of 10% (1988, 2001), 13% (2010), 19 % (2012)



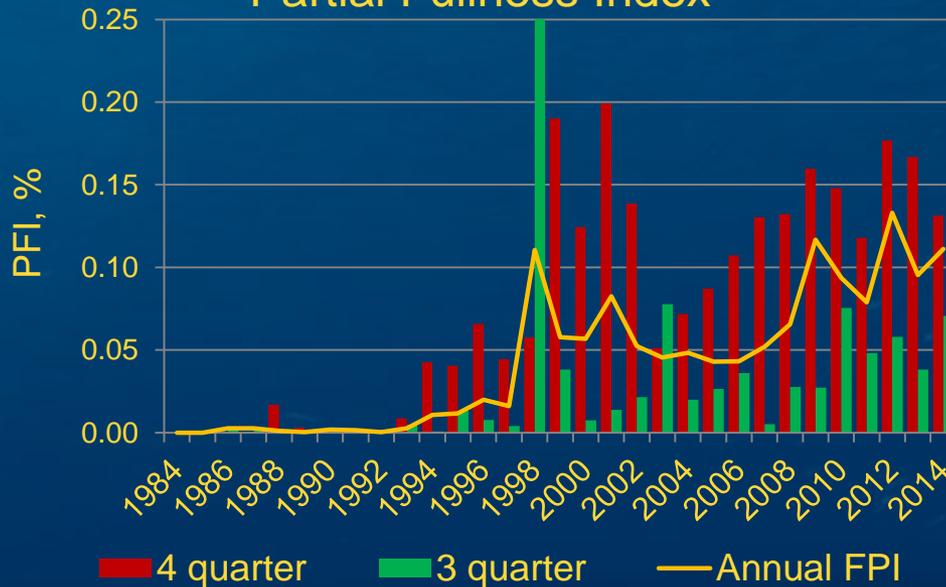
► Results

Partial Fullness Index



Content of comb jelly in cod stomachs was lowest in quarters 1-2 and highest in 4. quarter of the year

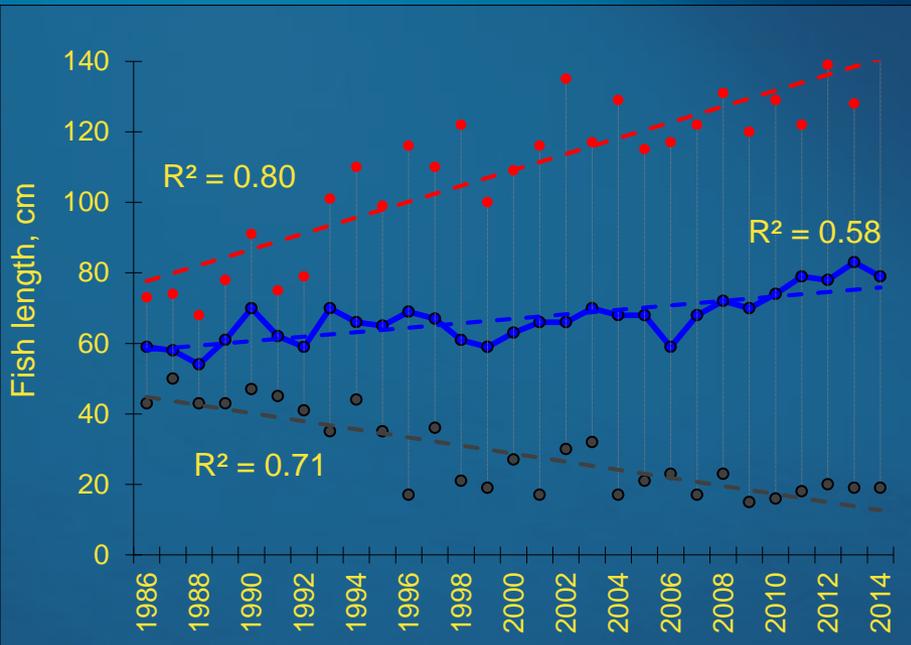
Partial Fullness Index



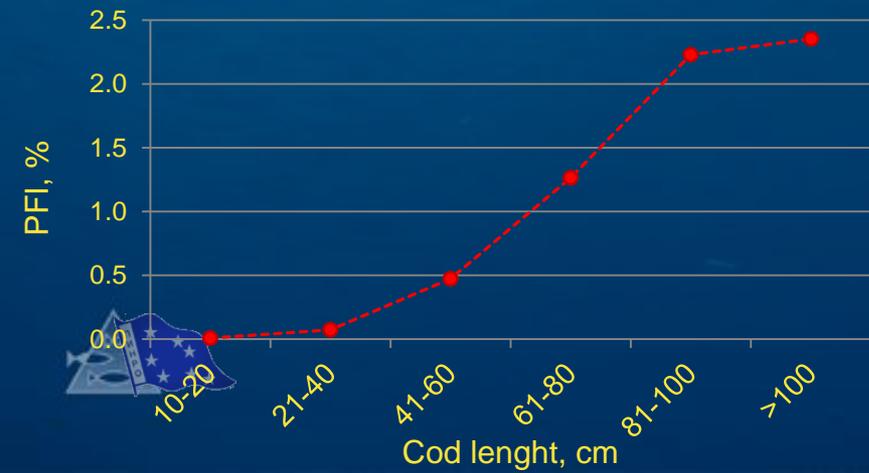
Cod consumed most comb jelly in 1998-2002 and 2009-2014



► Results



- Cod of 15 cm smallest which had eaten comb jelly
- Min length of cod decreased with years
- Mean and max length of cod increased with years

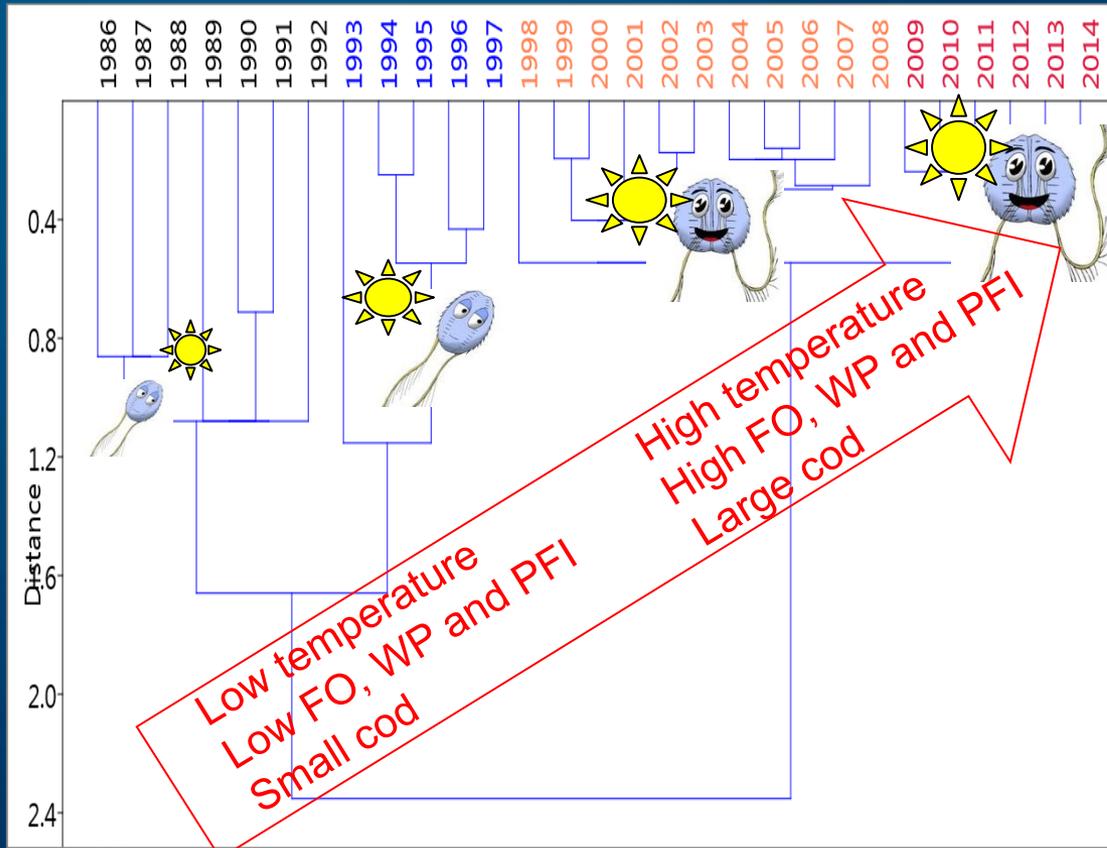


- Larger cod has higher proportion of comb jelly in diet



► Results

Stratigraphically constrained clustering of years based on abiotic and biotic variables for the period 1986-2014

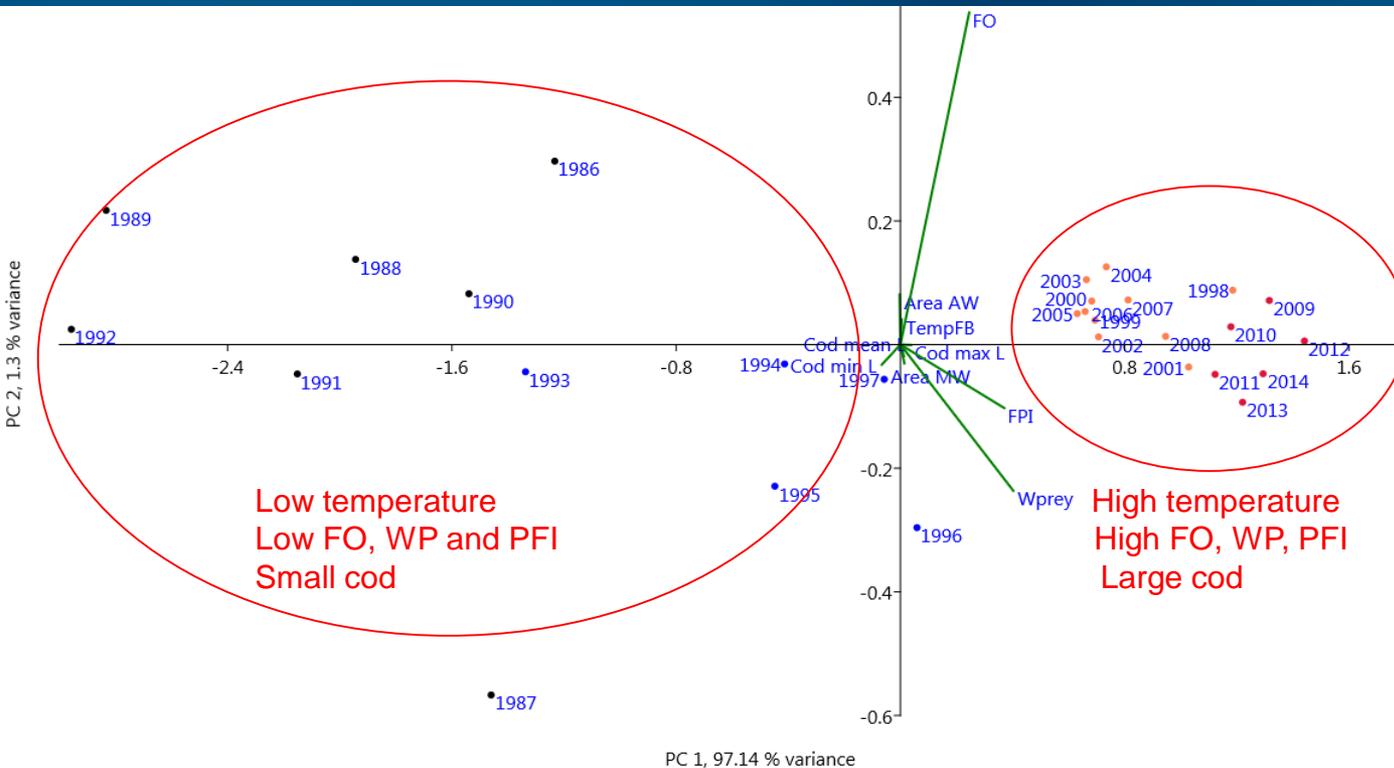


Abiotic: water temperature and area of AW and MW
Biotic: FO, WP, PFI and cod length (min and max)

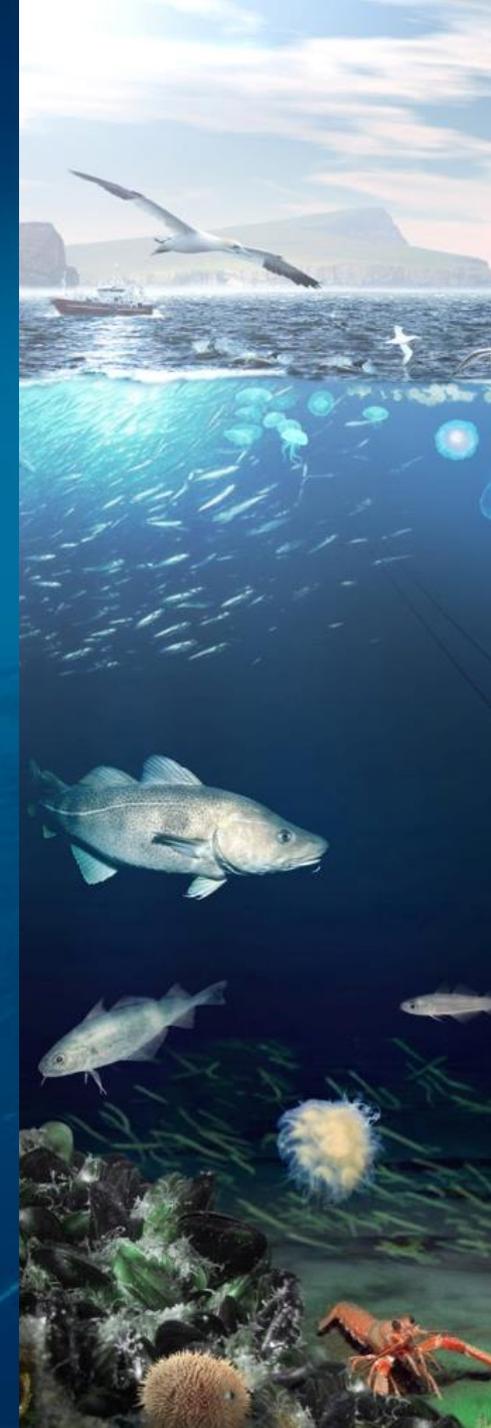


► Results

Principal Component Analyses (PCA)

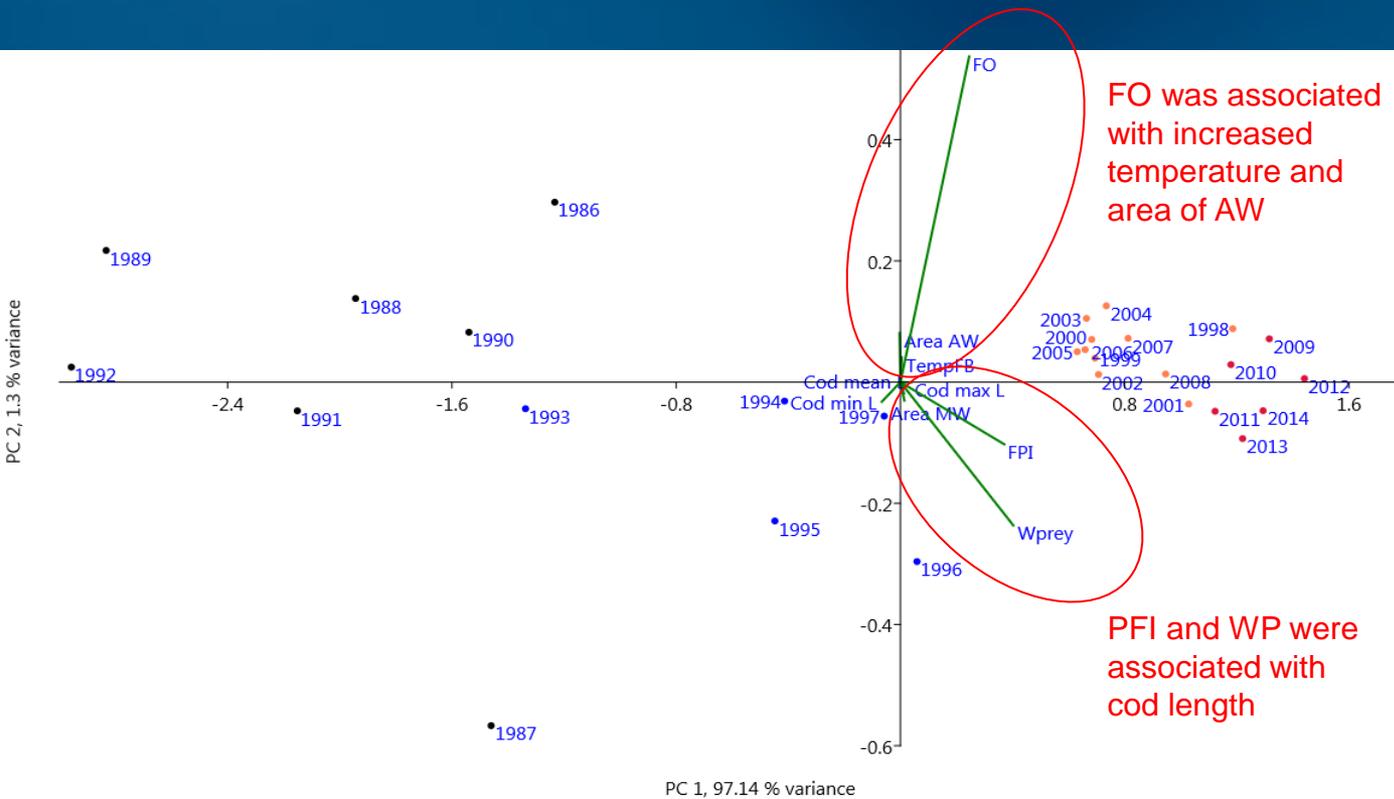


Abiotic: water temperature and area of AW and MW
Biotic: FO, WP, PFI and cod length (min and max)



► Results

Principal Component Analyses (PCA)

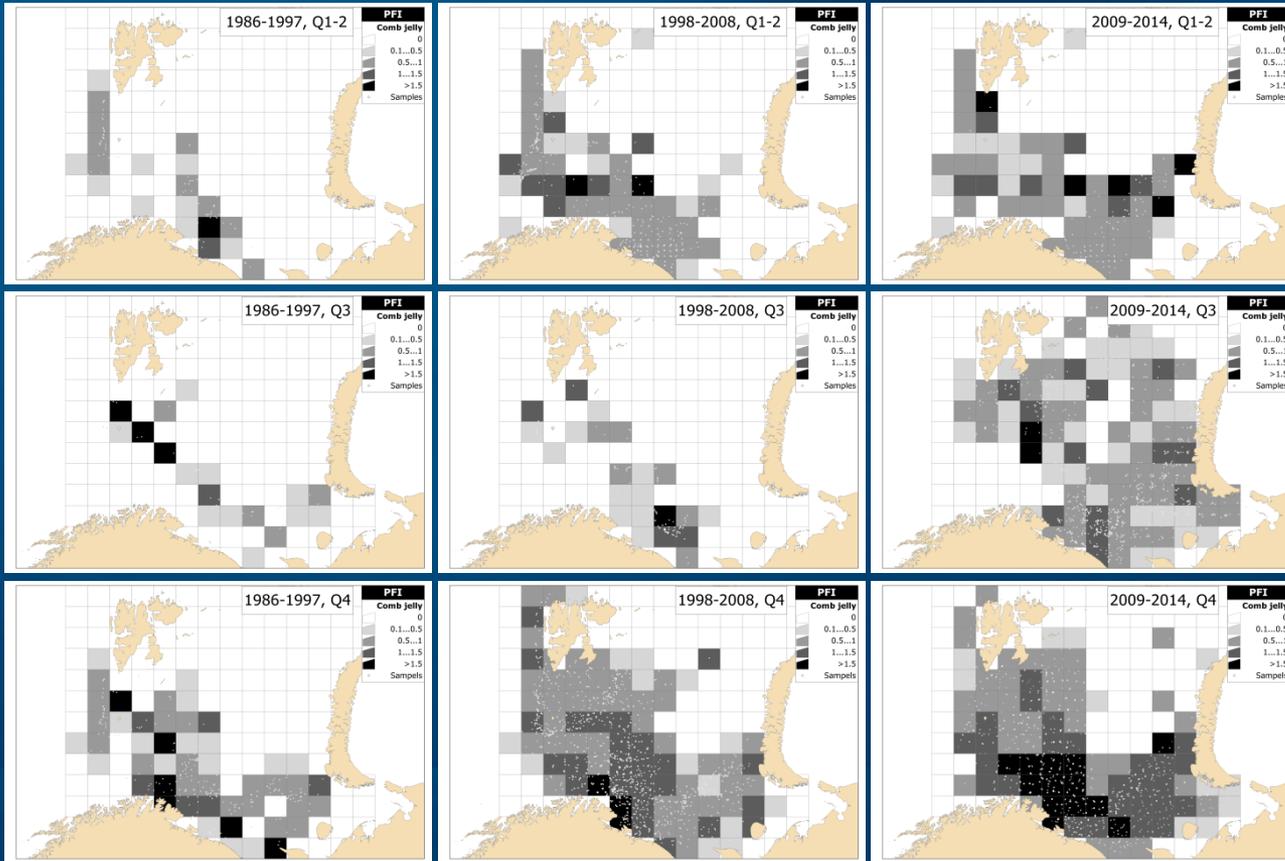


Abiotic: water temperature and area of AW and MW
Biotic: FO, WP, PFI and cod length (min and max)



► Results

Spatial distribution



Cod migration

Warming



► Conclusions

There was a significant increasing trend in the amount of ctenophores in cod stomachs over the time series

- indicating that feeding by cod on comb jelly is a common, routine, non-selective type
 - that is primarily dependent upon ambient abundance of comb jelly, and in effect depends on the cod encountering comb jelly

Content of comb jelly in cod stomachs was lowest in quarters 1-2 and highest in 4. quarter of the year, highest in southern and southeastern Barents Sea, and increased with cod size

Recent warming has a particularly important effect on increased abundance and distribution of comb jelly in the Barents Sea

Comb jellyfish are not important food sources for cod (due to low PFI), but cod stomachs are important **indicator of comb jelly abundance dynamics**



► Thank you !!!

