

# The role of cod in the decline in arctic fishes in the Barents Sea

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CoDINA - Cod: Diet and food web dyNAMics, Norwegian Research Council project no 255460/E40

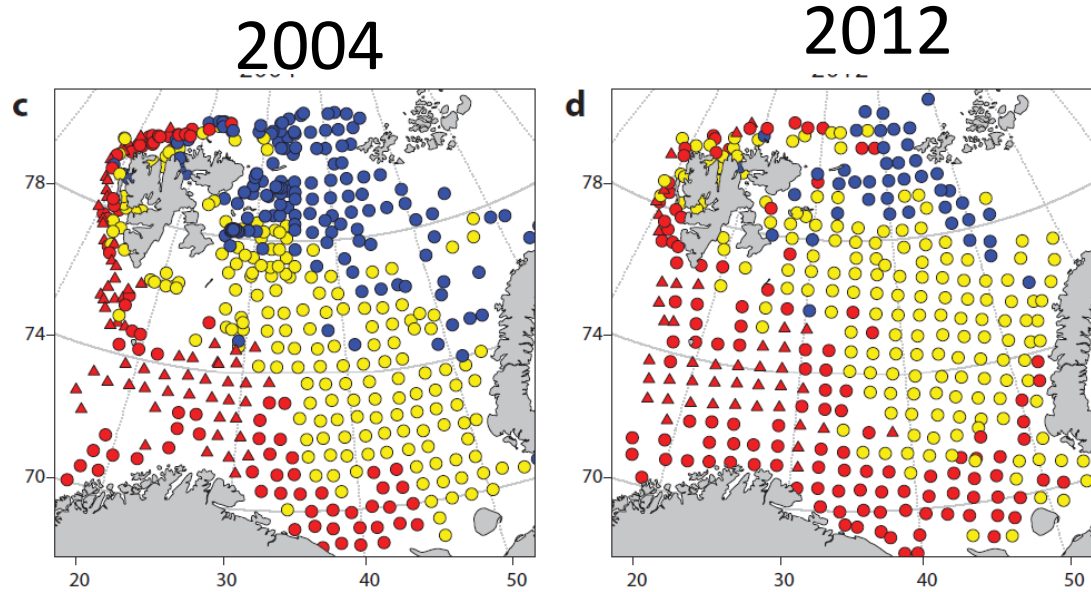
The 18<sup>th</sup> Russian Norwegian symposium  
Murmansk June 5-7 2018

# Background

The «borealization» of the Barents Sea...



# Boreal fishes are expanding north - Arctic fishes are retracting



Fossheim et al. 2015 Nature Clim. Change

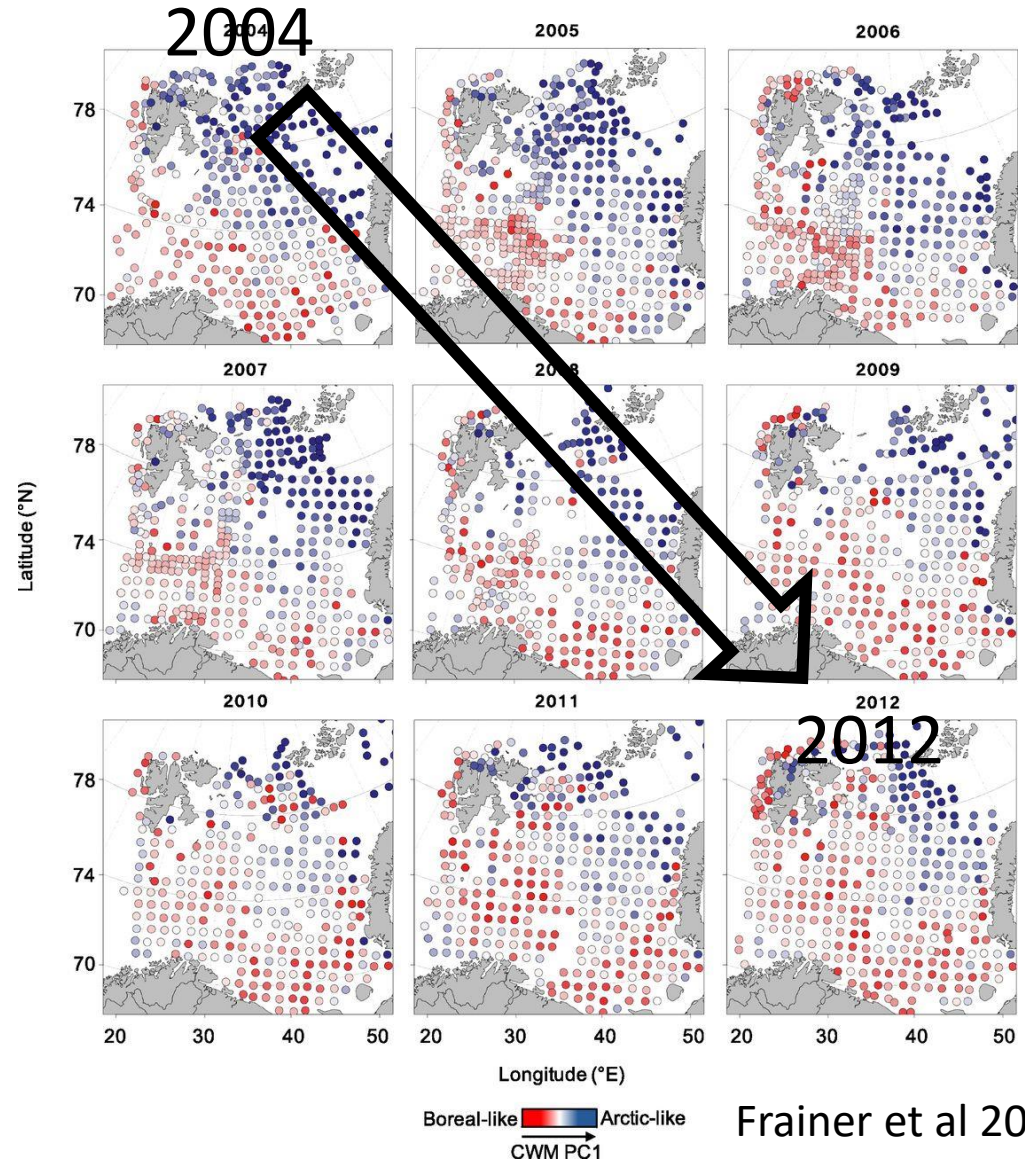
## Fish communities

Atlantic (red)

Central (yellow)

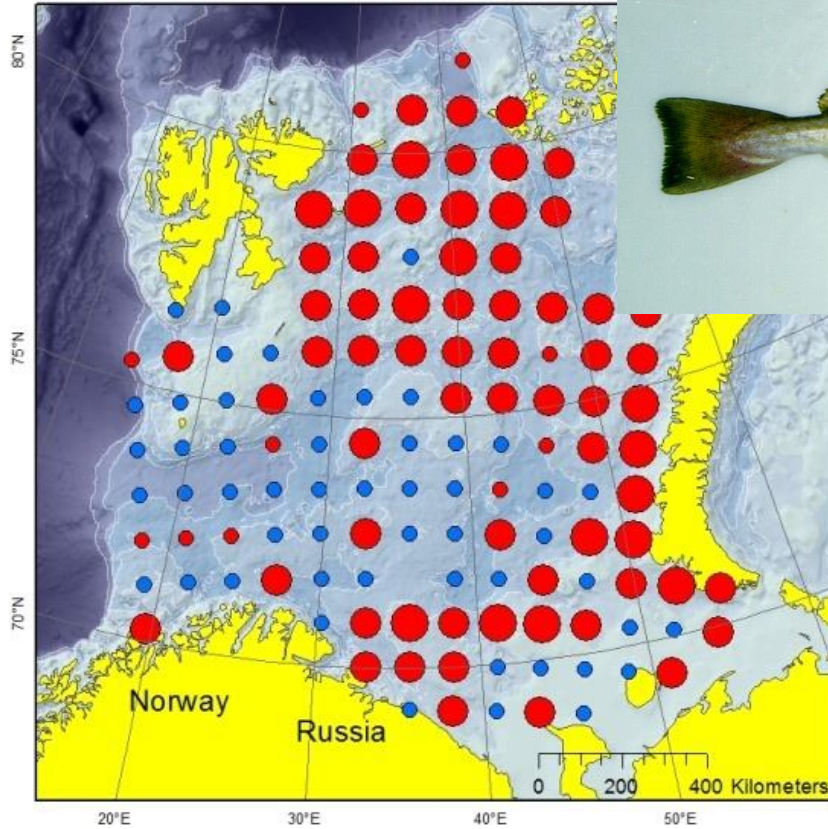
Arctic (blue)

Data from ecosystem survey 2004-2012



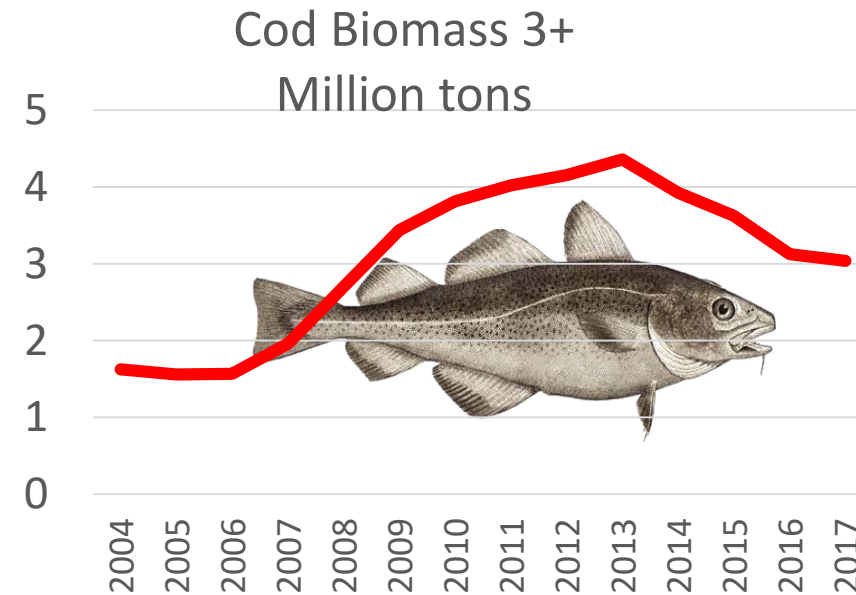
Frainer et al 2017 PNAS

# Cod has expanded North.....



Change in distribution cod 2004-2012

**Blue:** decline, **Red:** increase

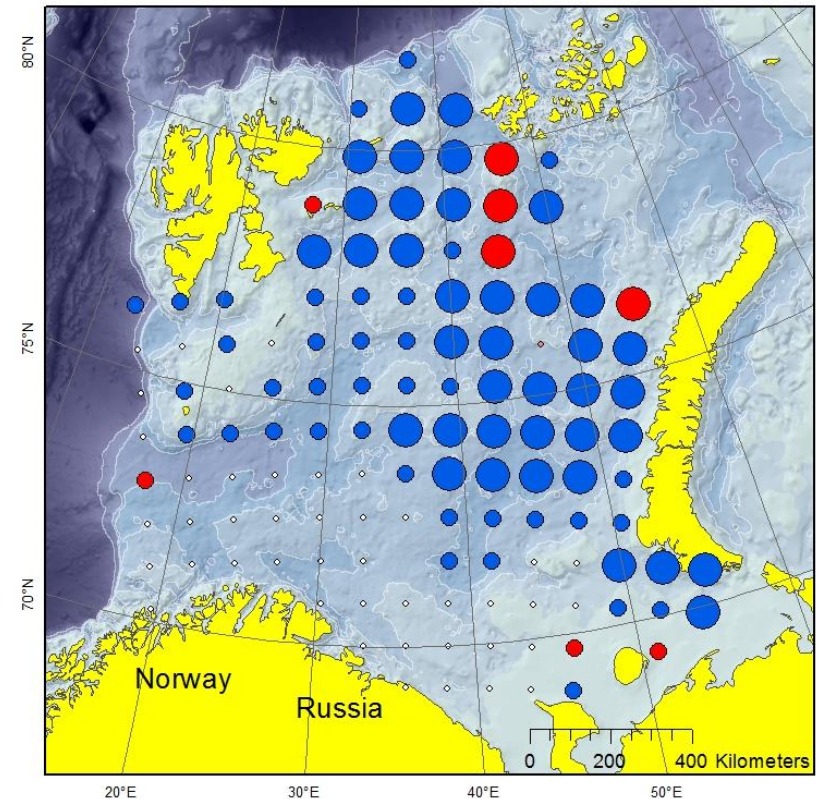
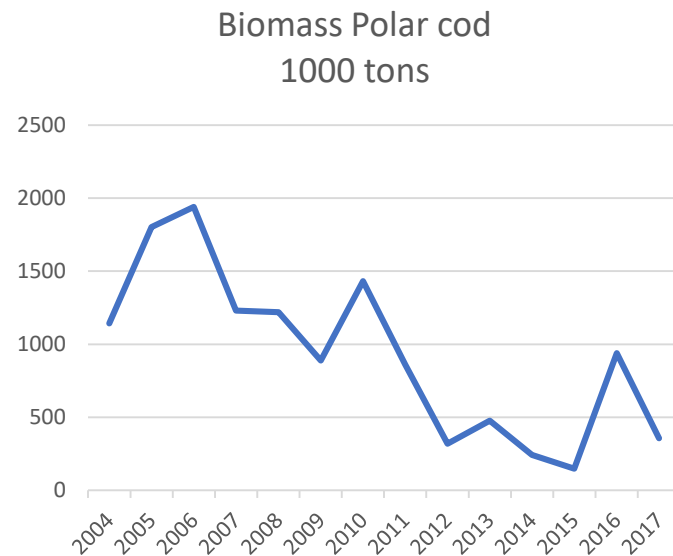


The most abundant Arctic fishes have declined...



# The most abundant Arctic fishes have declined

*Boreogadus saida* – Polar cod

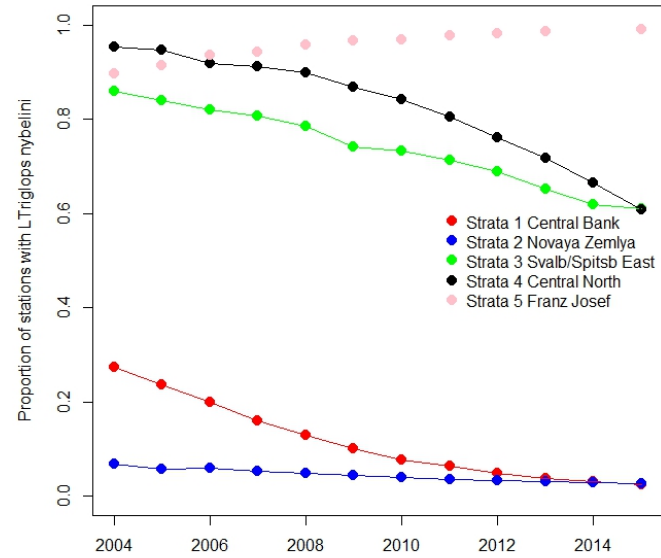


Change in distribution Polar cod 2004-2012

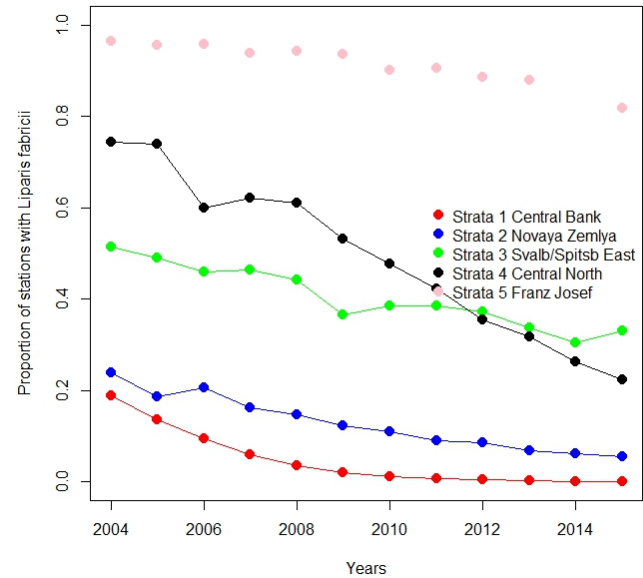
Blue: decline, Red: increase



*Triglops nybelini*  
Bigeye sculpin



*Liparis fabricii*  
Gelationus snailfish

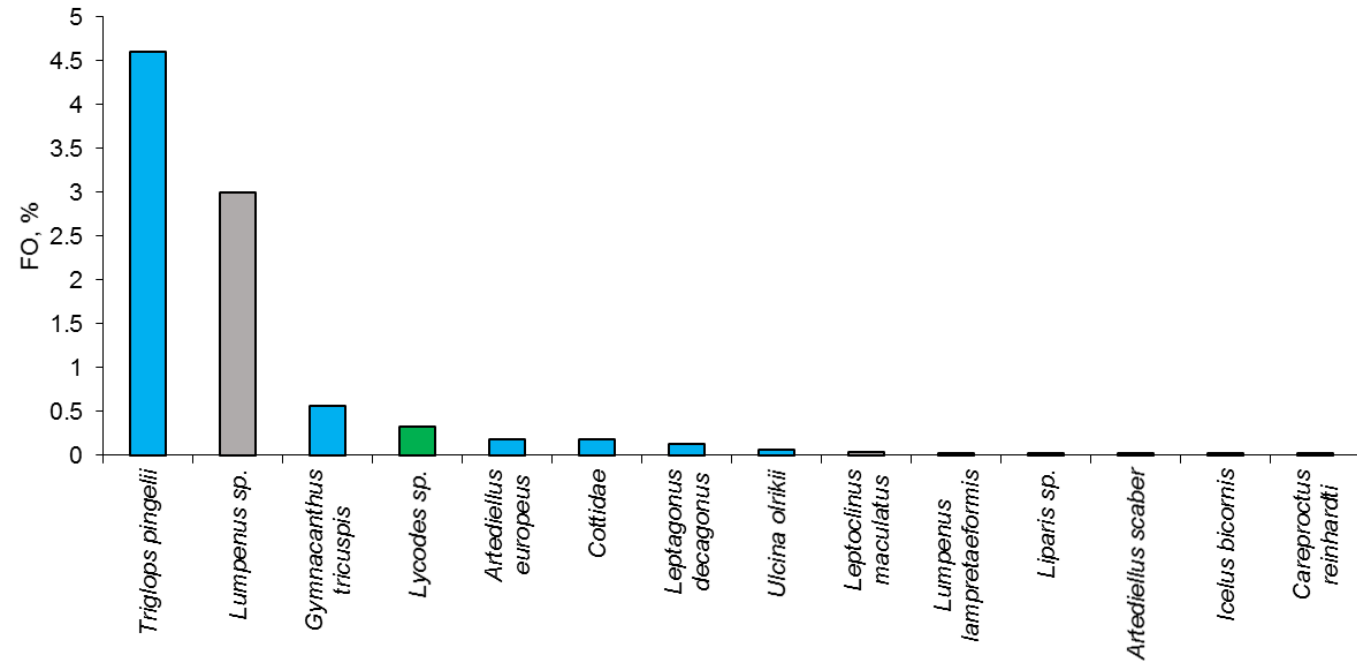


What is cod's impact on the local arctic fish fauna?

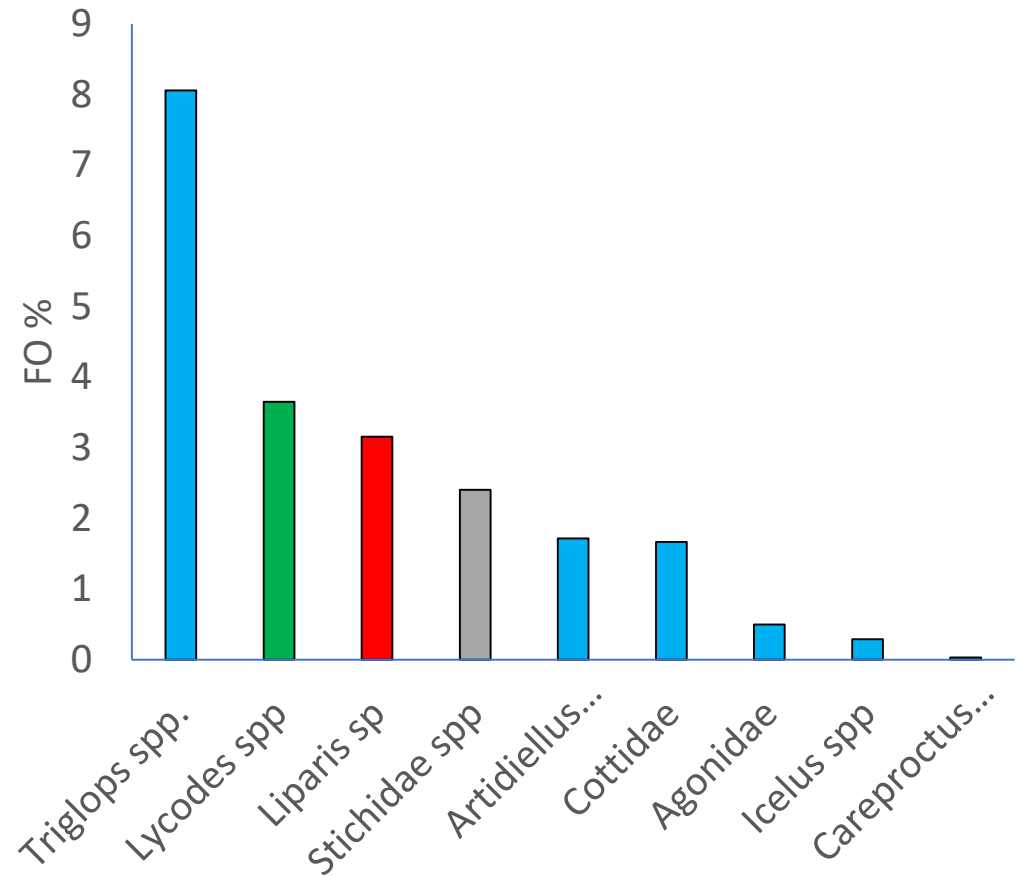


# Predation

Frequency of occurrence % of non-target demersal fish in cod diet  
North of 76°N



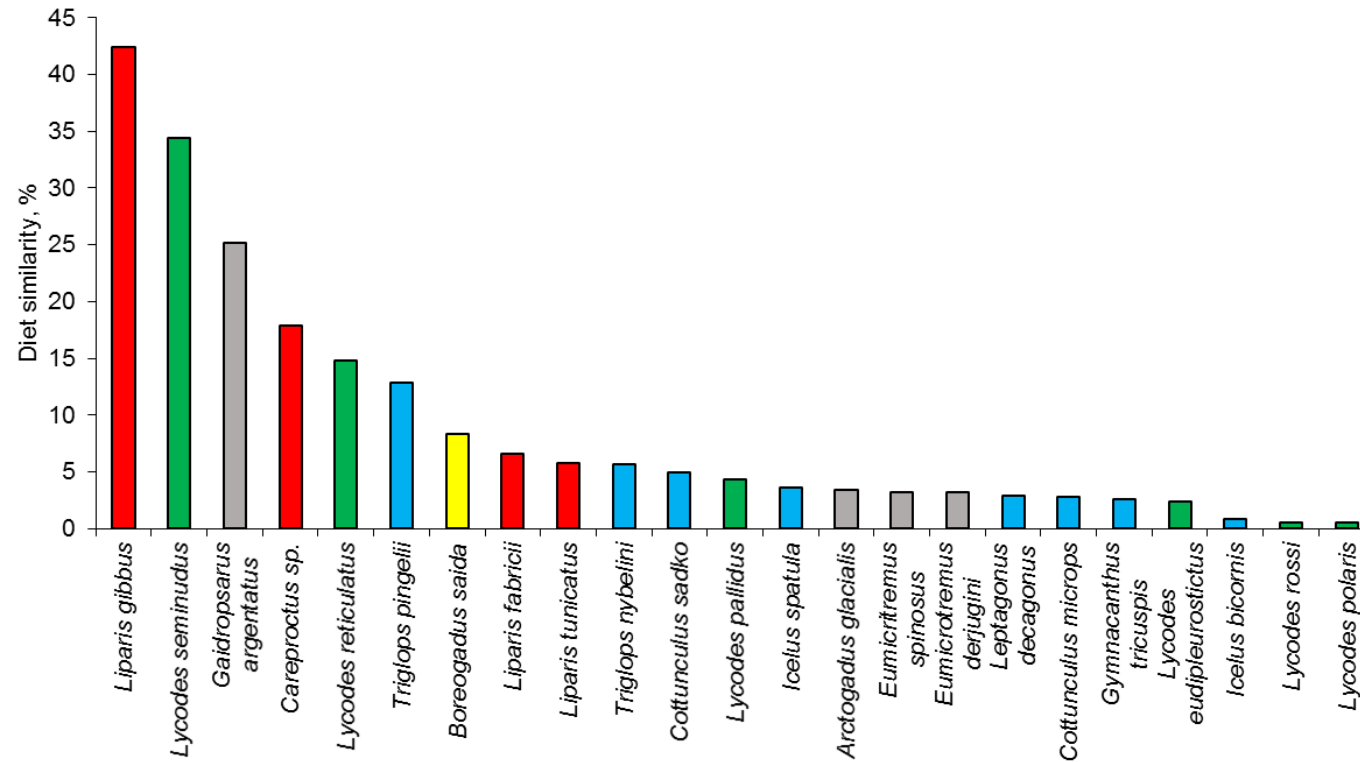
Based on Briskina (1939)



Ecosystem survey 2004 -2017

# Competition

Diet similarity cod and non target fishes North of 76°N



Based on Dolgov and Benzik 2014

# Cod and the resident arctic fishes

Cod eats some of the same food

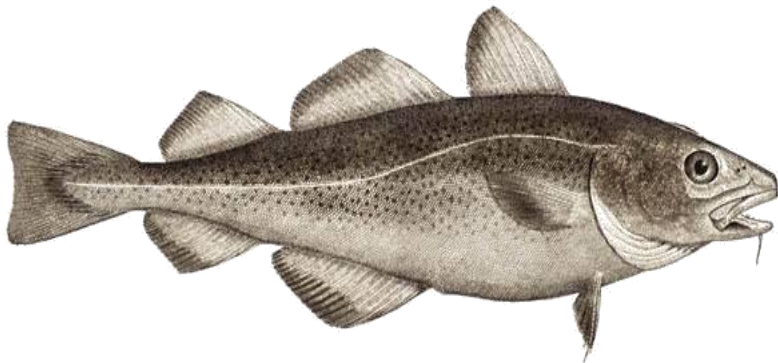


Cod feeds on the local arctic fishes (ca 25-30% of diet by weight in the Northern Barents Sea)

They interact...

*But what is the impact?*





$$N_1 = N_0 + B - D + I - E$$

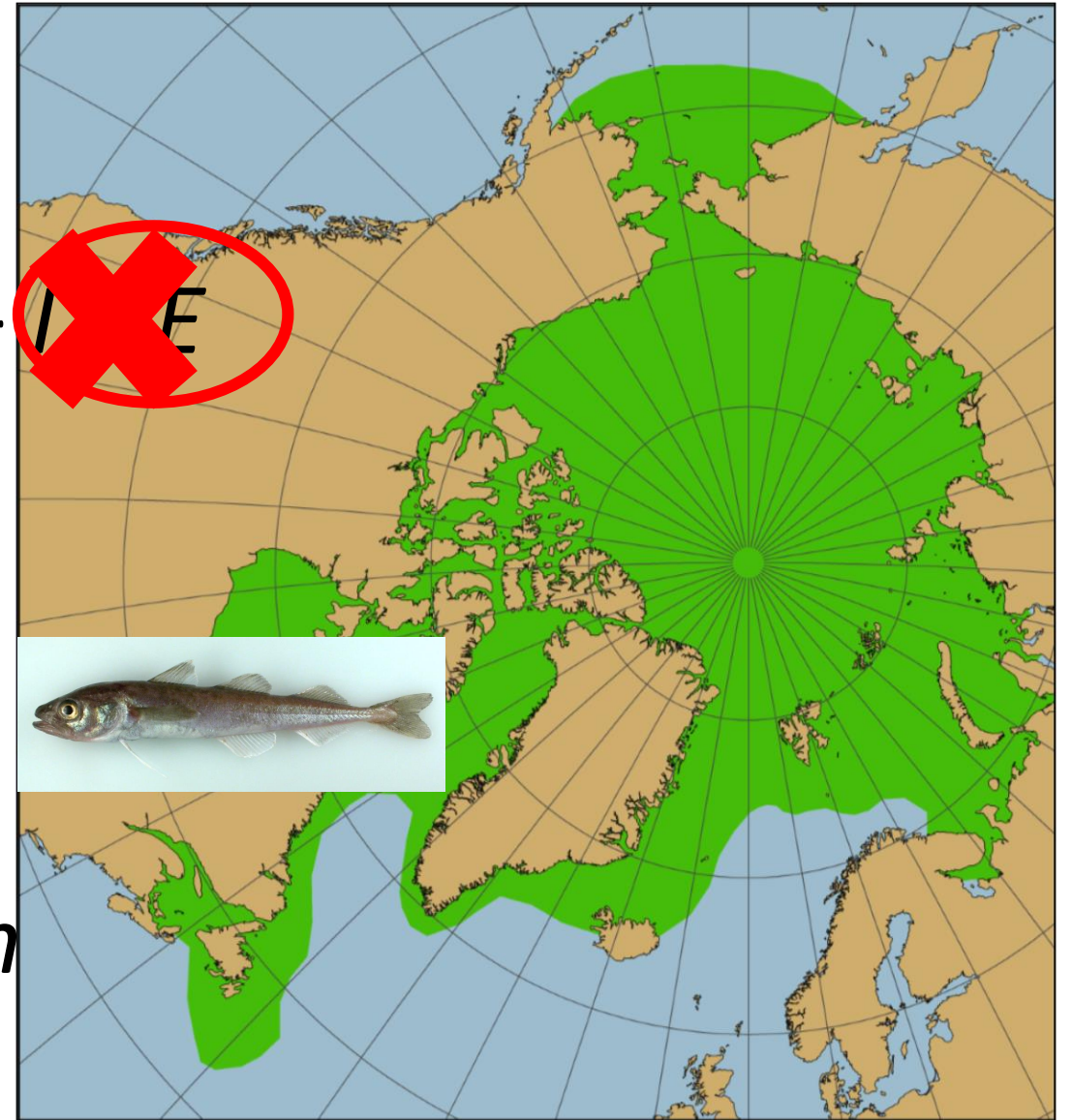


*Birth*

*Death*

*Immigration*

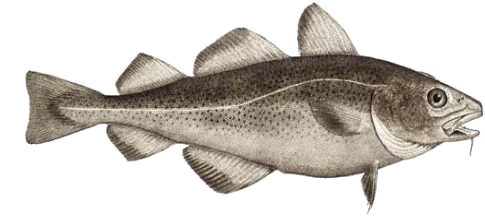
*Emigration*



+ Growth



# How large is the impact of predation from cod on arctic fishes?



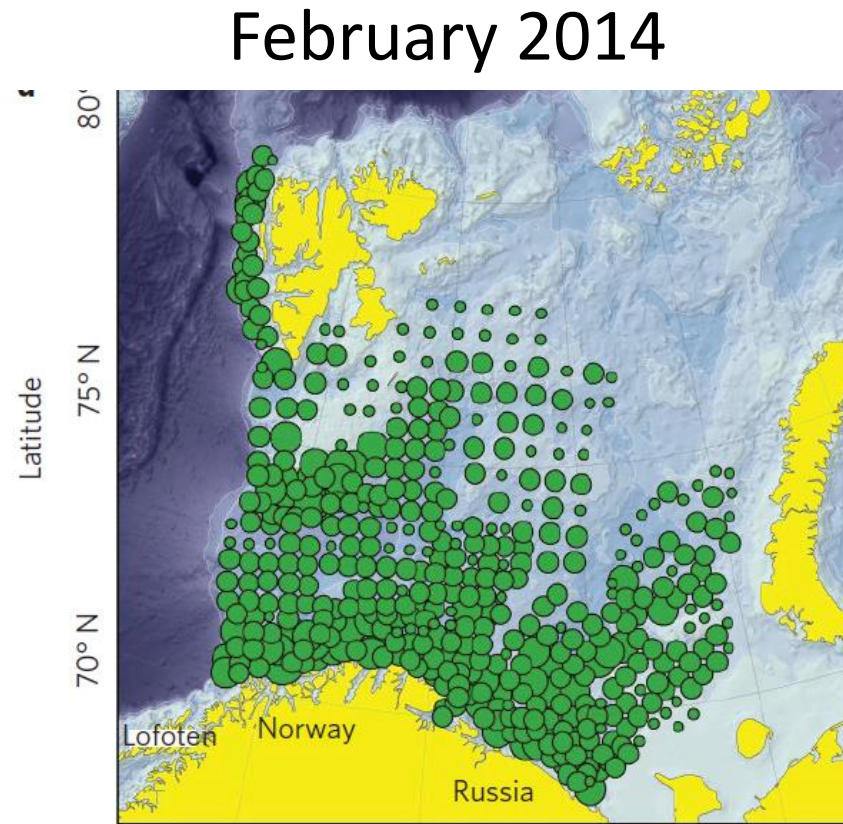
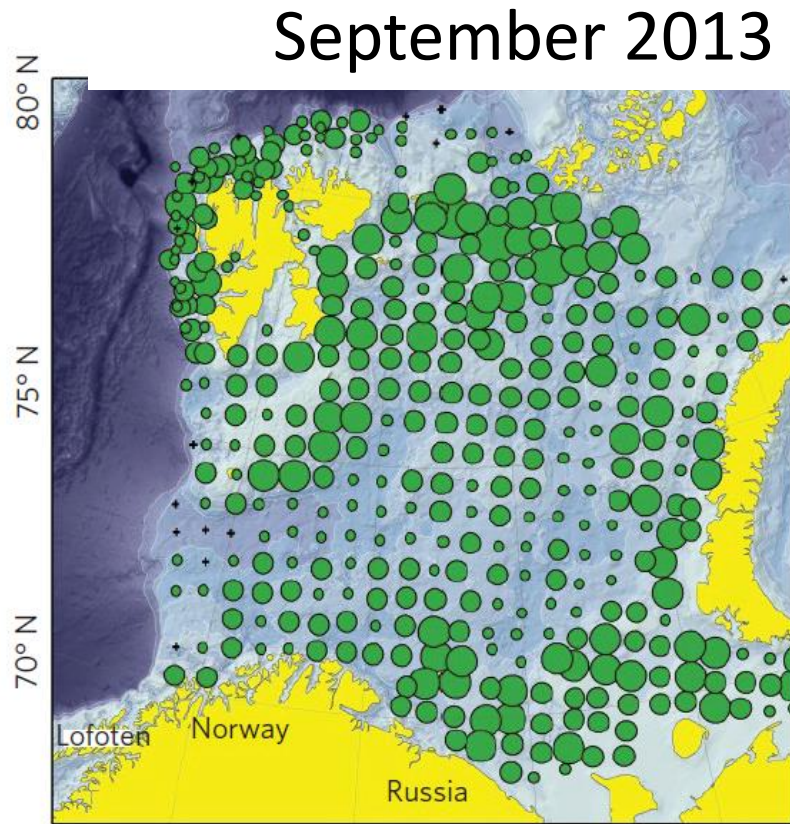
Currently 1663 million cod 3 years or older  
Eating over 5 millions tonn prey per year



*Potentially large but...  
depends on several factors...*

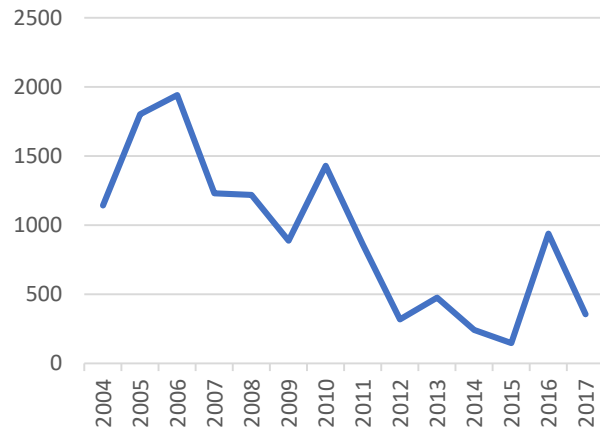
# *The predation on resident arctic fishes in Northern Barents Sea depends on:*

- How many cod are found there
- How long do they stay there

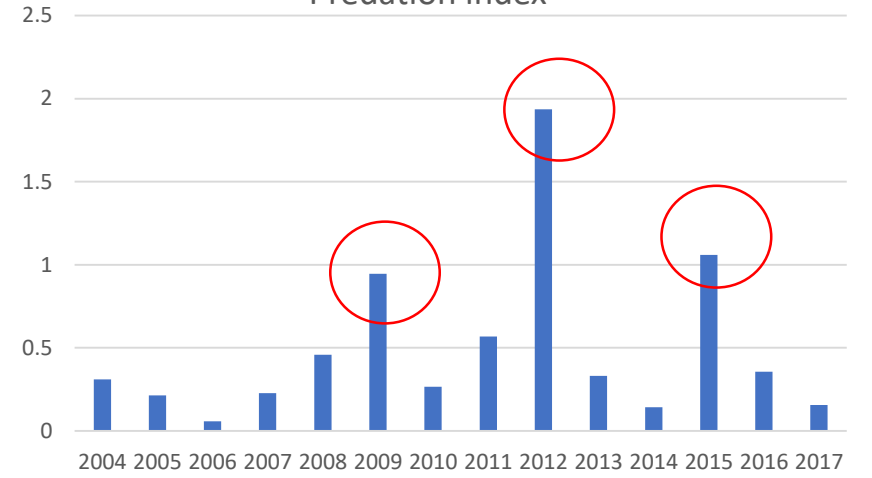


prey

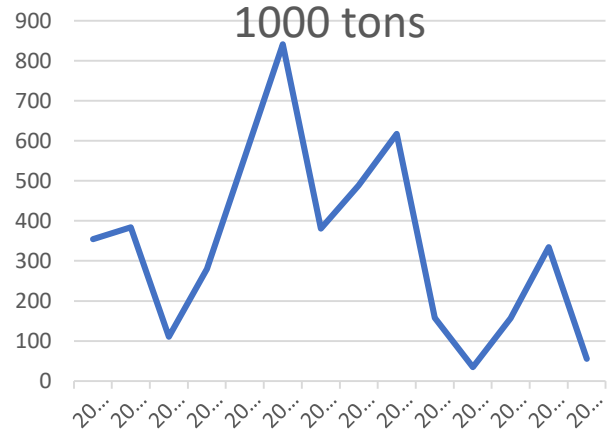
Biomass Polar cod  
1000 tons



Predation index



Biomass Polar cod  
Consumed by cod  
1000 tons



# Sculpins and Liparids



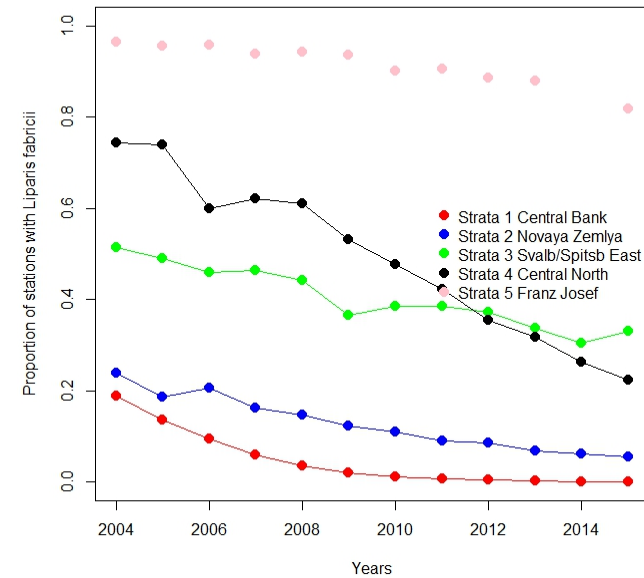
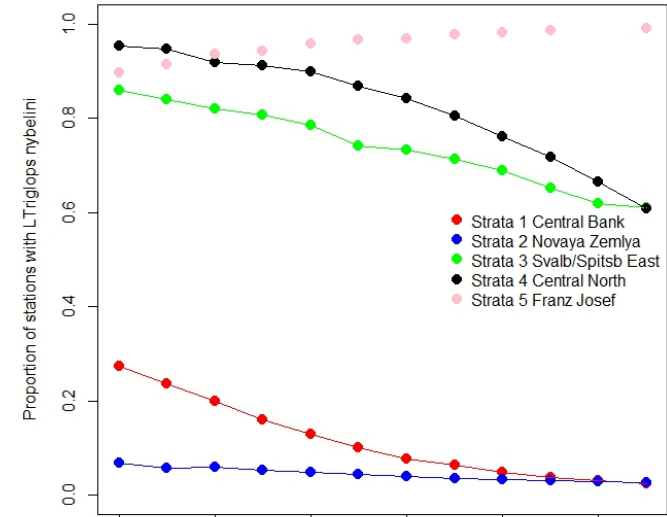
*Triglops nybelini*

Bigeye sculpin



*Liparis fabricii*

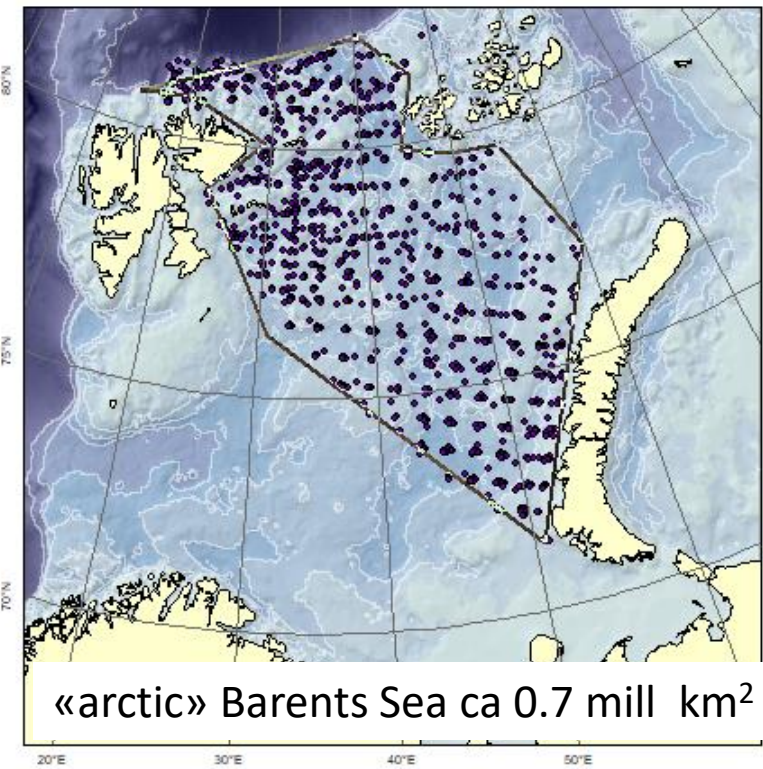
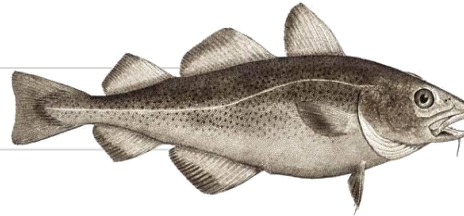
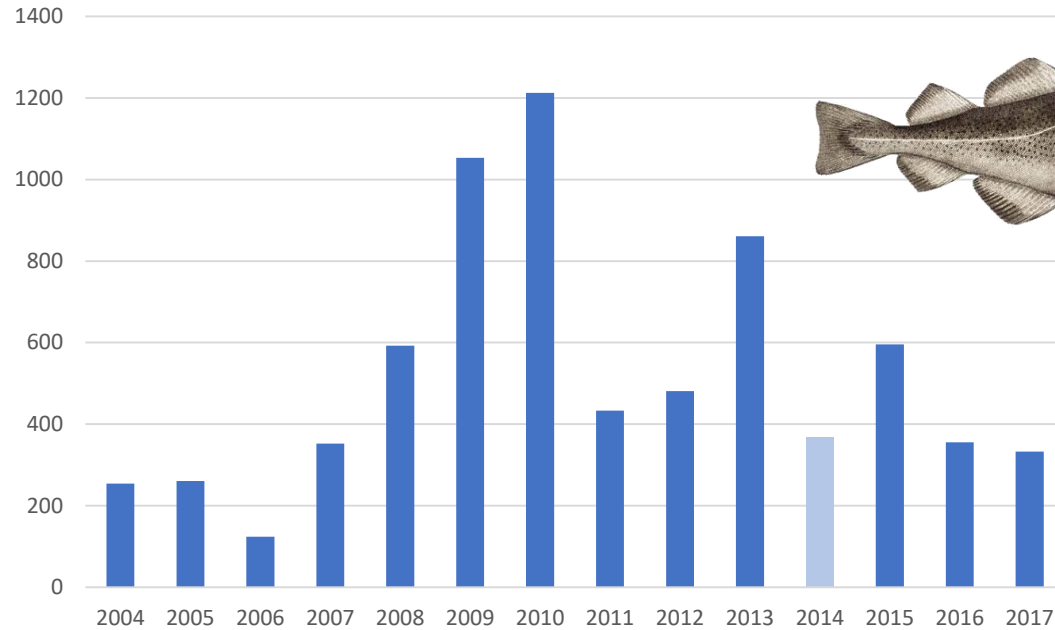
Gelationus snailfish



Johannesen et al 2017



Millions of cod 3+ in the "arctic" Barents Sea  
In September  
NB very crude estimate!



From ecosystem survey 2004-2017:

~200-2000 cod per km<sup>2</sup>

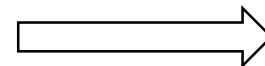
~20 kg cottids and liparids per km<sup>2</sup>



How long do they stay in the area?

Preliminary consumption estimate:

1 gram cottids + liparids per day



1000 cod eat 1 kg per day

# Conclusion

Cod eat arctic fishes in the Northern Barents Sea

Cod has partly overlapping diet with arctic fishes

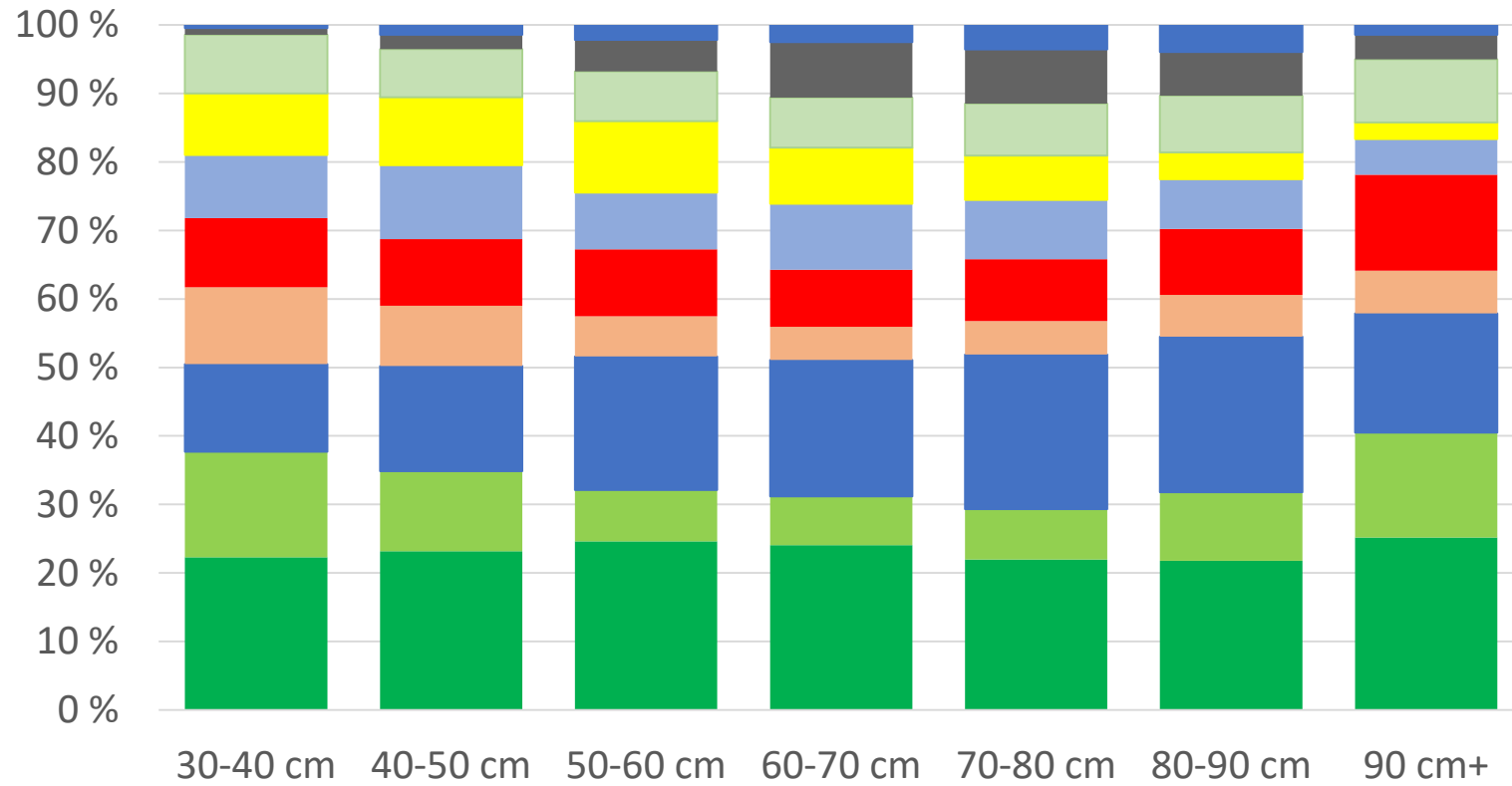
- large cod and predatory arctic fishes compete for fish prey
- small cod and planktivorous species compete for plankton

Cod likely contributed to the decline in arctic fish species

In addition to changes in abiotic factors and food

Thank you!





- Capelin
- Other crustaceans
- Polar cod
- Pandalus borealis
- Other fish
- Sculpins
- Krill
- Other invertebrates
- Hyperiiids
- Liparids