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Climate warming induced changes in marine fish biodiversity in the Norwegian and Barents Seas

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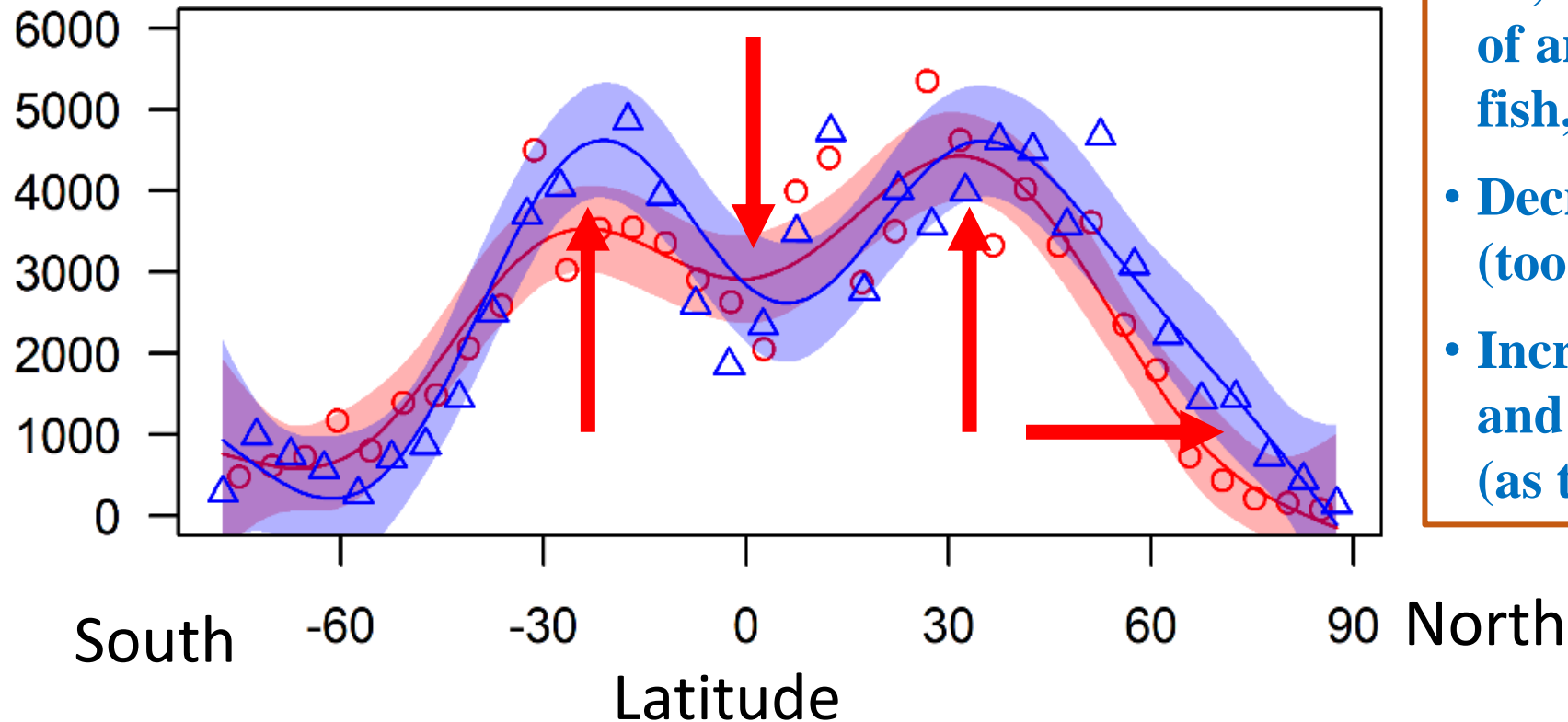
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This talk

1. How is climate warming affecting the **marine fish biodiversity** in the north-eastern Atlantic and Arctic oceans?
2. **Which species** are increasing and decreasing their geographic range with Climate Change?
3. Which species follow closer the geographic distribution in their **thermal envelope**?

Thousands of species moving polewards

Number of species ■ Before 1984 ■ After 1984

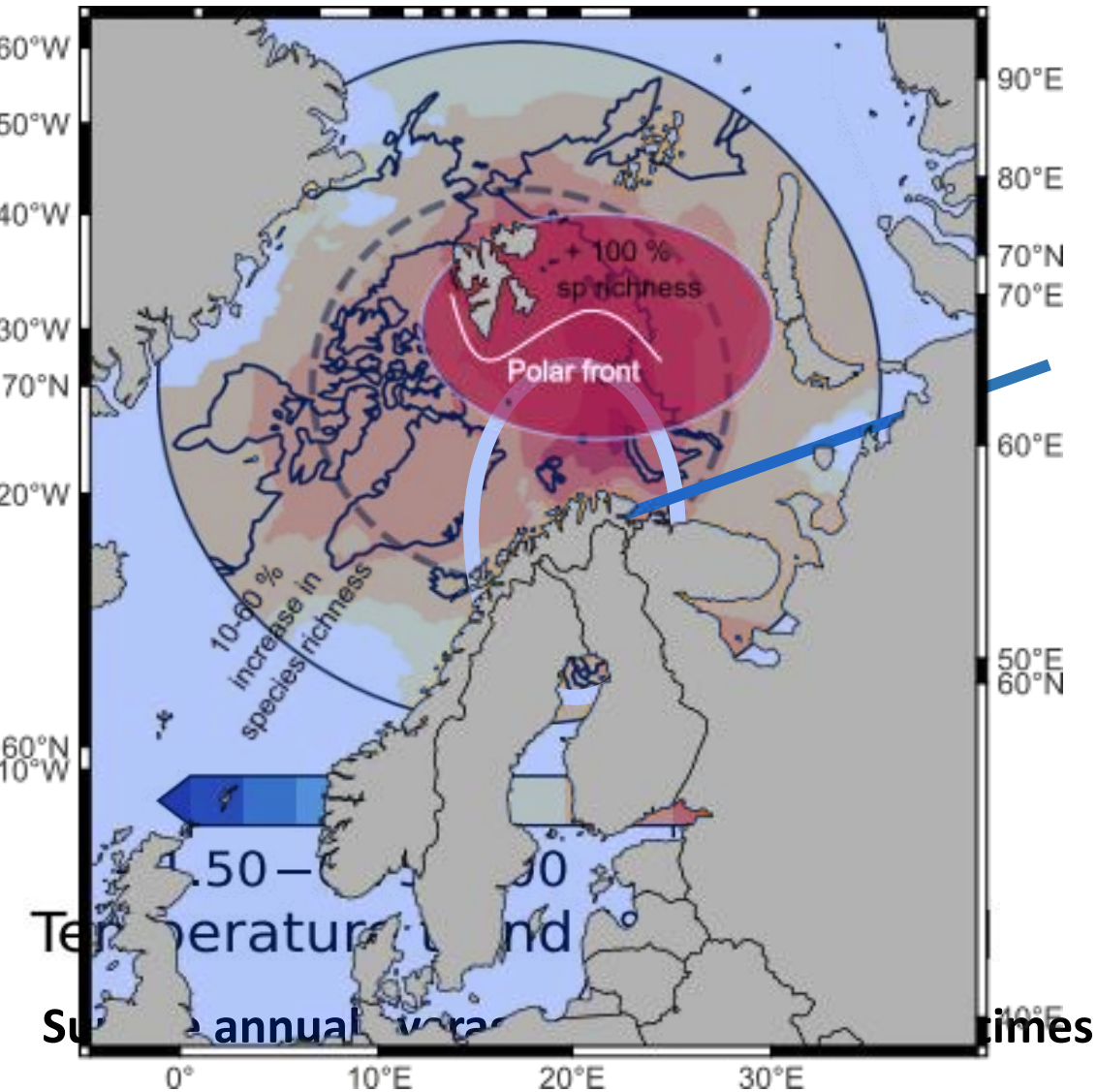


- 54,000 species of all kinds of animals (pelagic, benthic, fish, invertebrates)
- Decreasing at the equator (too hot)
- Increasing in mid-latitudes and northern high latitudes (as they warm)

Global warming is causing a more pronounced dip in marine species richness around the equator

Chhaya Chaudhary^{a,b,1}, Anthony J. Richardson^{c,d} , David S. Schoeman^{e,f} , and Mark J. Costello^{g,h} 

PNAS
3 2021



The Arctic is warming 4-times more than the global average

We used the IMR research trawl survey data from 1989 to 2020 with 193 fish species



We found

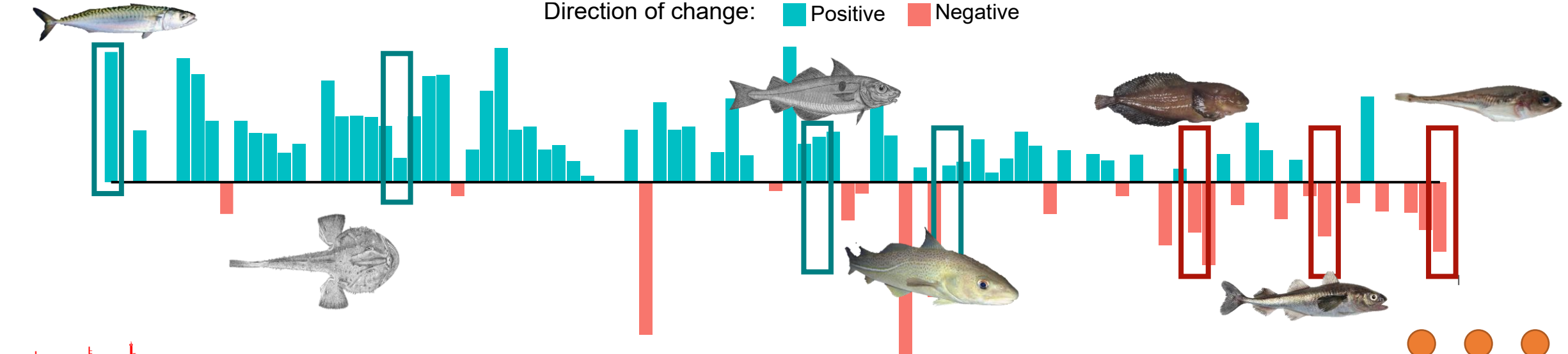
1. an increasing number of fish species,
2. Two times more species in the Arctic Barents Sea.
3. correlated with bottom temperature.

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Changes in species occurrences

Direction of change: ■ Positive ■ Negative



Expanding

Contracting

Mackerel – *Scomber scombrus*

Monkfish – *Lophius piscatorius*

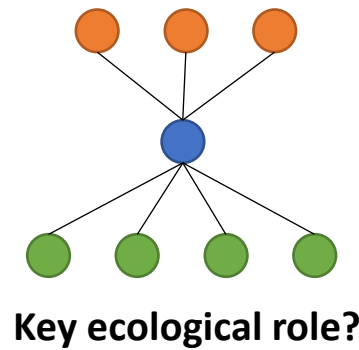
Haddock – *Melanogrammus aeglefinus*

Atlantic cod – *Gadus morhua*

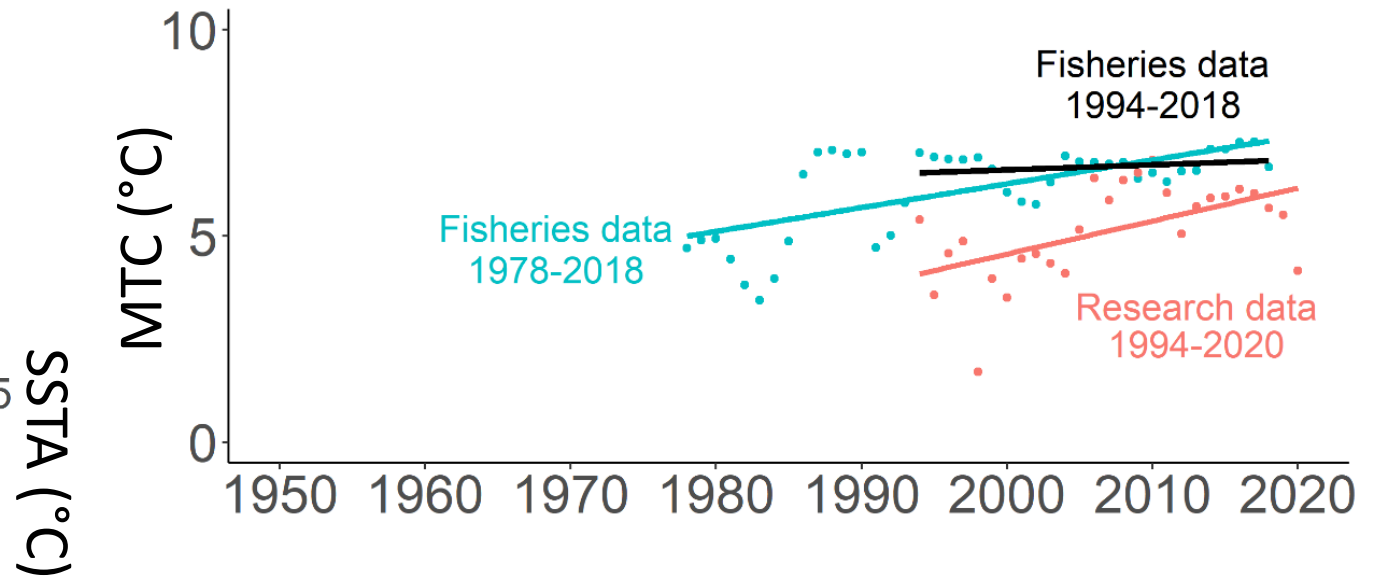
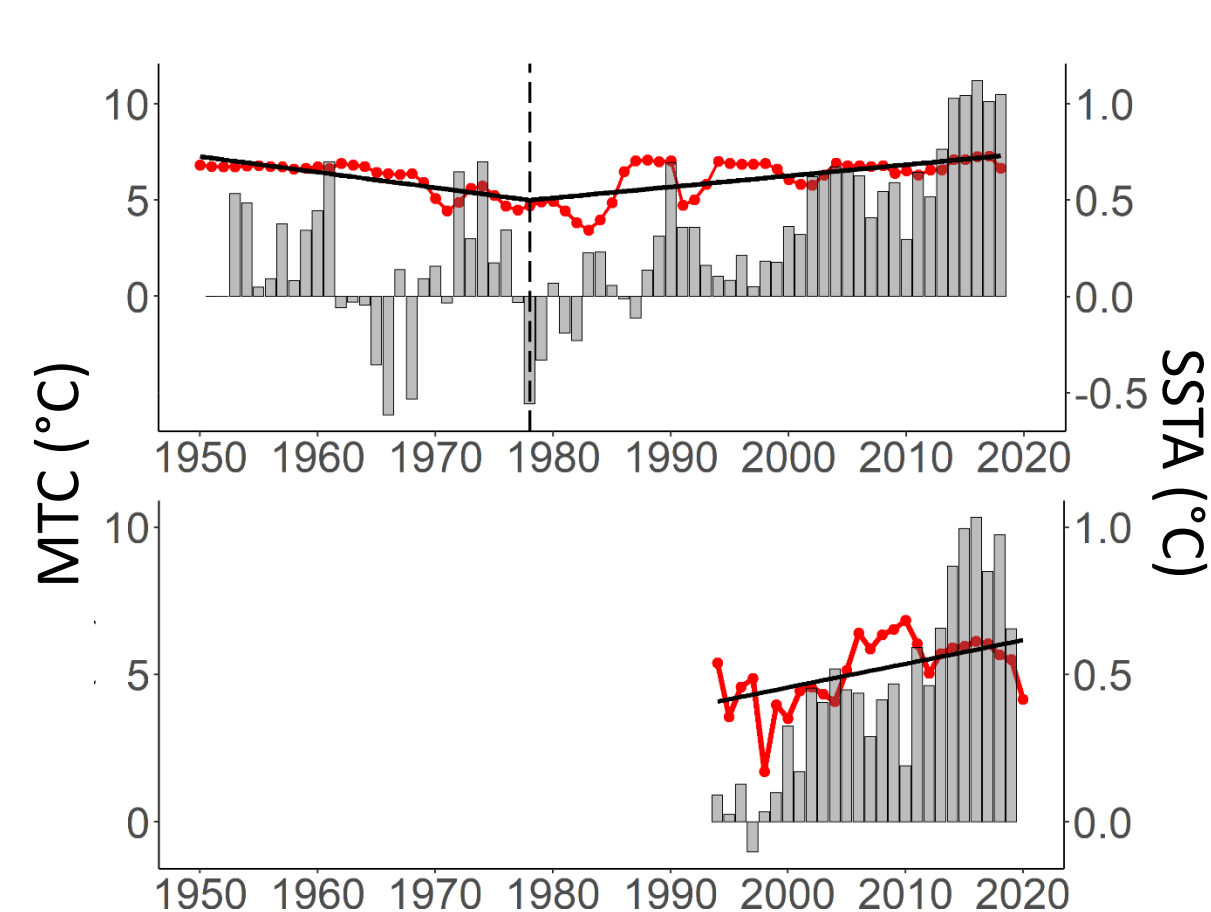
Stripped seasnail - *Liparis liparis*

Arctic cod – *Boreogadus saida*

Bigeye sculpin - *Triglops nybelini*



Are fisheries tracking these changes?



No, in comparable time period there is negligible change in the fishery catch MTC

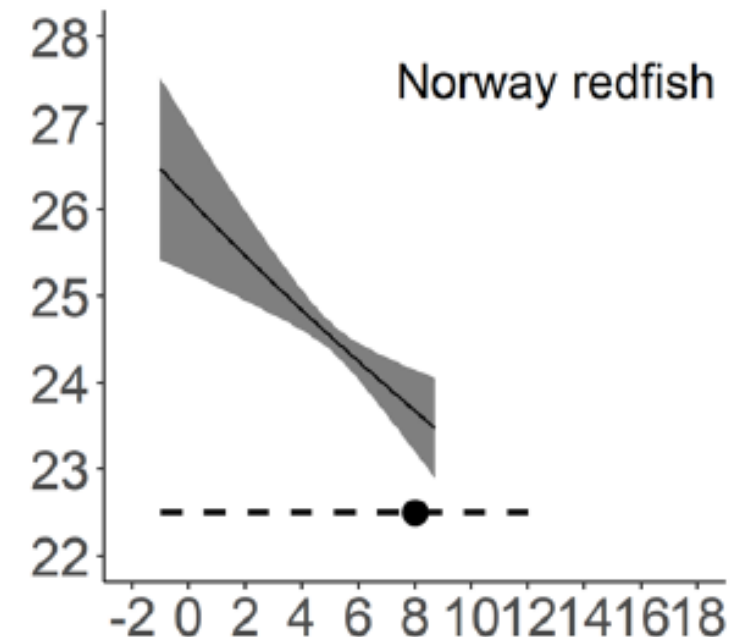
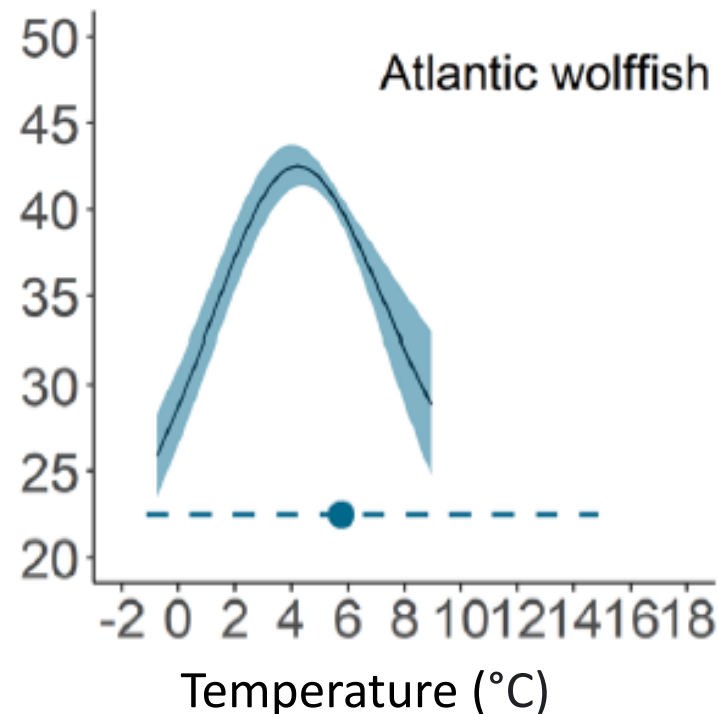
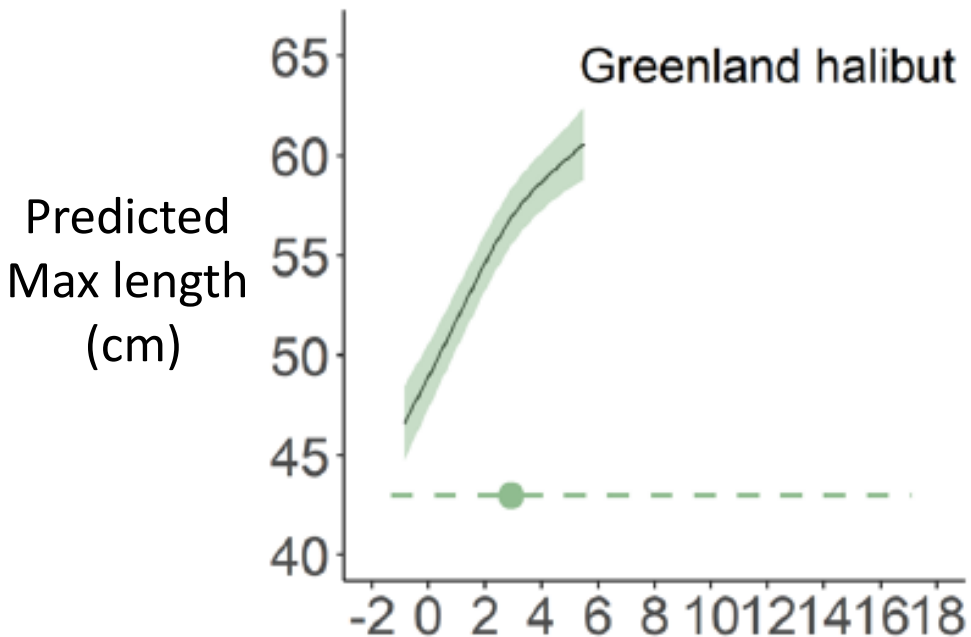
Lavin et al. under review

Body size of fishes

Reduction in maximum fish length (Pauly et al., 2021).



Although some Arctic species could benefit from increased temperatures! (Lavin et al., 2022). --> “Cold denaturation” ?



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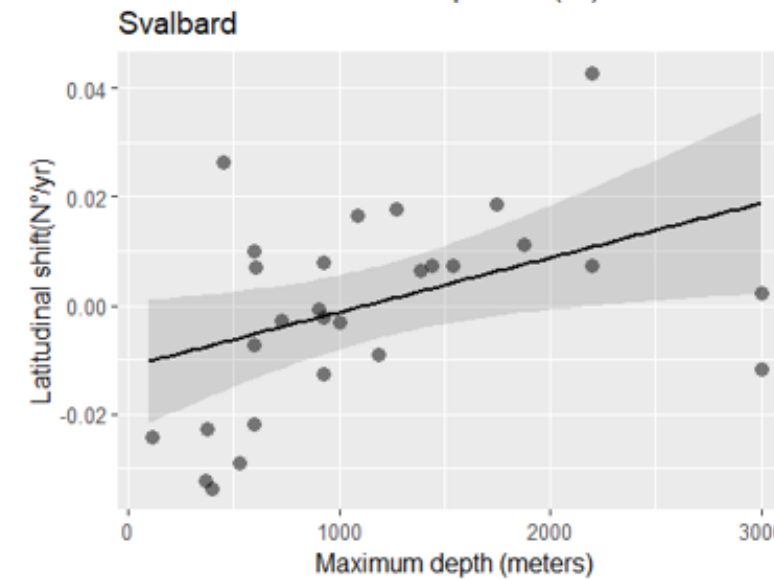
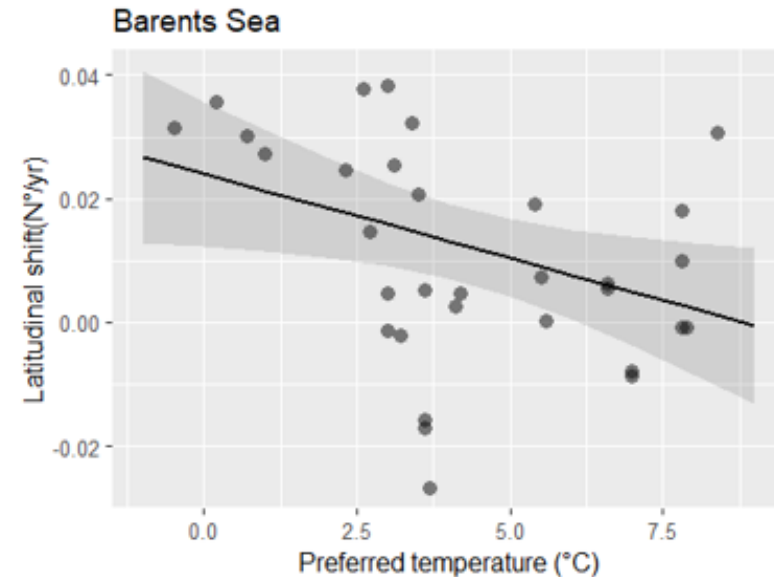
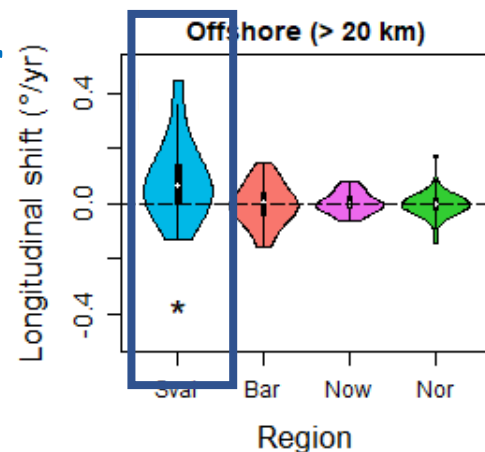
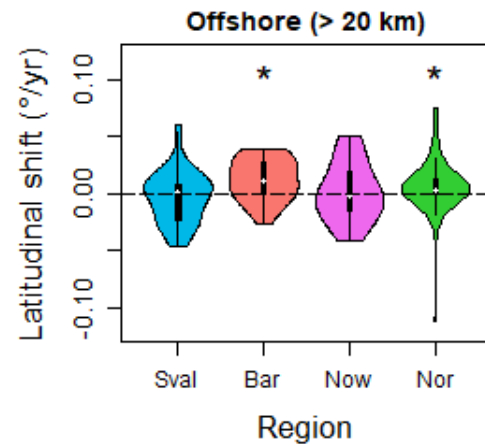


Species realized latitudinal shift vs thermal envelope latitudinal shift

Species generally migrated poleward in the Barents and North Sea, and eastward around Svalbard

Cold-water species shift faster than warm-water species

Bathymetric limitation of poleward shift in Svalbard?



Data in preparation

Conclusions

1. Marine species have been moving in line with sea temperature change for decades.
2. There are significantly more species of fish in Norway now than in 1980s, twice as many in Arctic seas.
3. Fishery catch is not tracking (adapting) to changes in fish stocks.

Conclusions

4. So far, several Arctic species declining, but some Arctic species becoming more common. Among winners, several species of interest for fisheries. Among losers, some species with key ecological roles.
5. There is an overall northward expansion in the Barents and North Seas, and a potential northward limitation of this poleward expansion by habitat bathymetry around Svalbard.



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