

Effects of fishing closures in Swedish waters

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VELMU Conference



New ambitious goals for protection

- EU:s biodiversity strategy - 30% protection by 2030 with 10% of these being strict protection
- Not clear what strict protection means but no-take zones would likely be included
- Important to integrate fisheries and conservation management. Healthy fish populations pre-requisites for viable habitats

Few strictly protected areas in Europe

- Swedish NTZs 1300 km² in total
- Constitutes 0.8% of Swedish waters
- Large proportion of NTZ area in Europe
- Not included in official MPA statistics



Evaluation of no-take zones

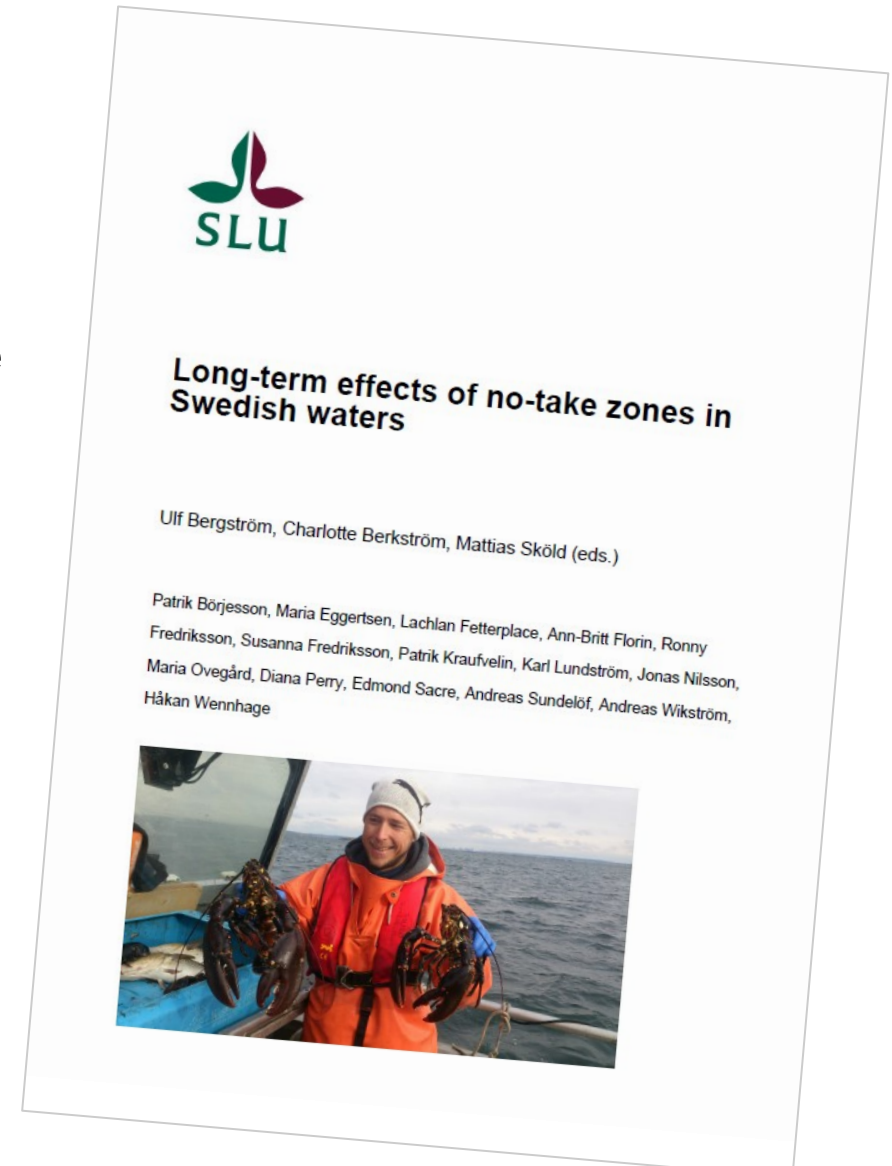
Long-term effects on fish populations and ecosystems in 8 no-take zones in Sweden

Effects on target species: Abundance and size structure

Effects on ecosystems: bottom trawling – benthic communities, restoration of ecosystem functions

Effects of areas re-opened to fishing

<https://res.slu.se/id/publ/120390>



No-take zones evaluated

Baltic



Bothnian Sea whitefish (2011-2020)



Stockholm pikeperch and pike (2010-2022)



Licknevarp perch and pike (1980-2020)



Gotska Sandön turbot and flounder (2006-2021)



Swedish West Coast



Kattegat cod (2009-2021)



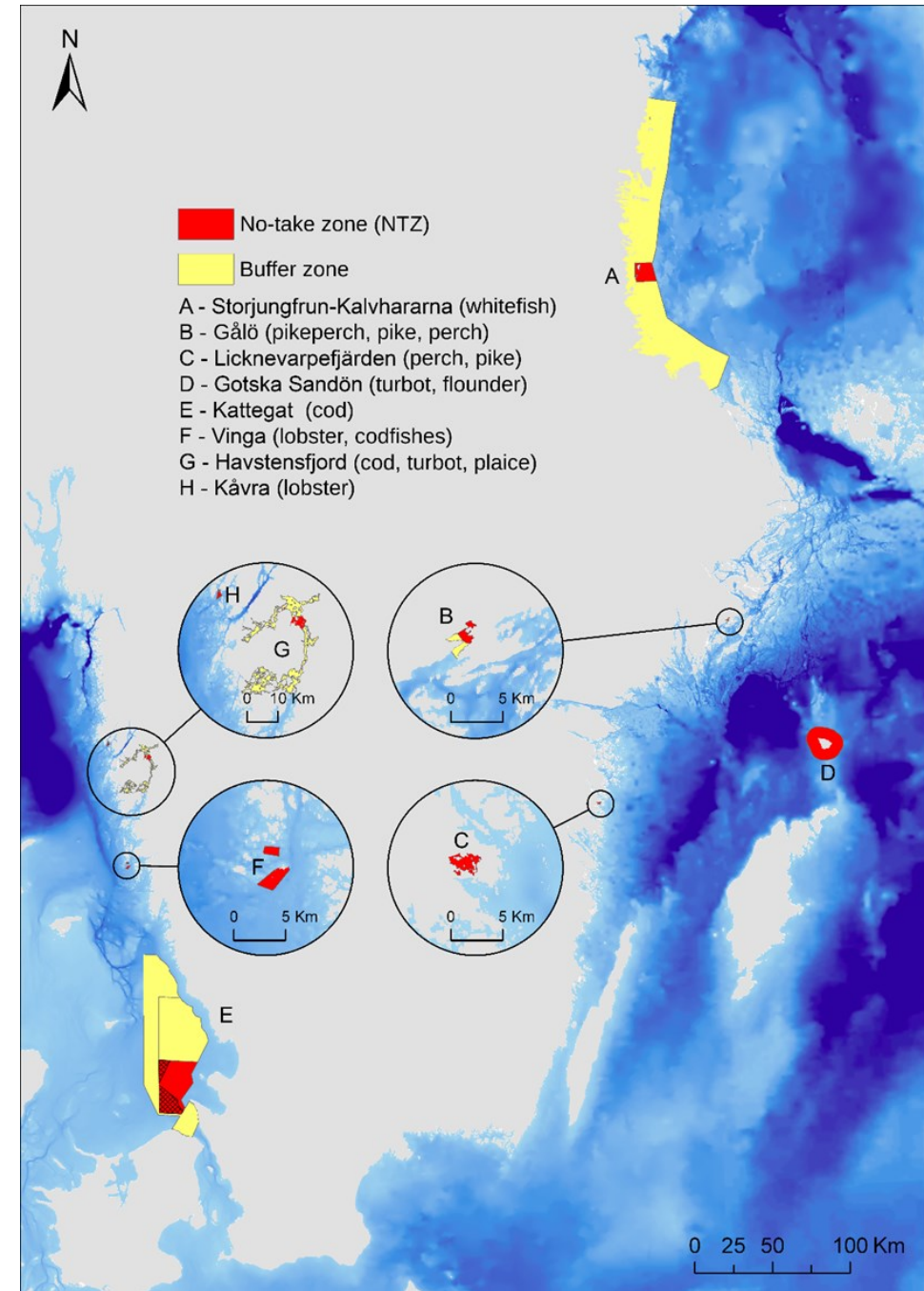
Vinga lobster and gadoids (2002-2015)



Havstensfjord cod and flatfish (2010-2021)



Kåvra lobster (1989-2021)



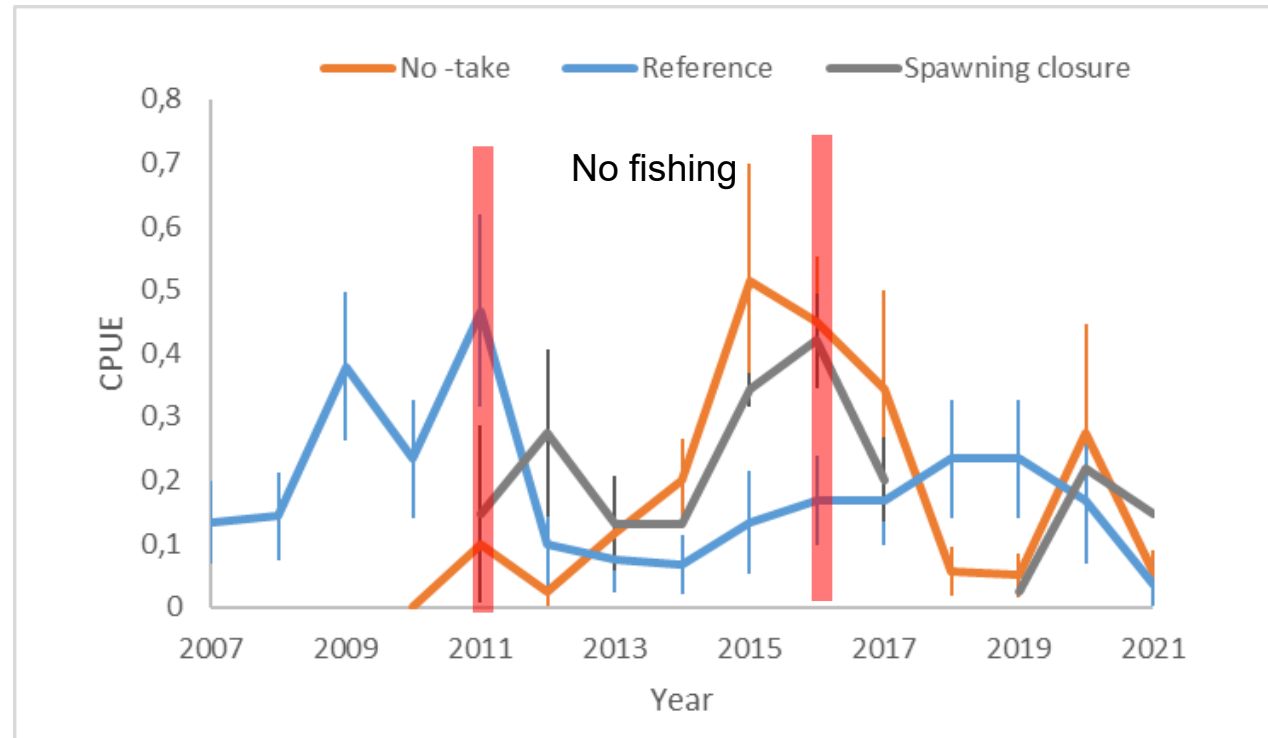
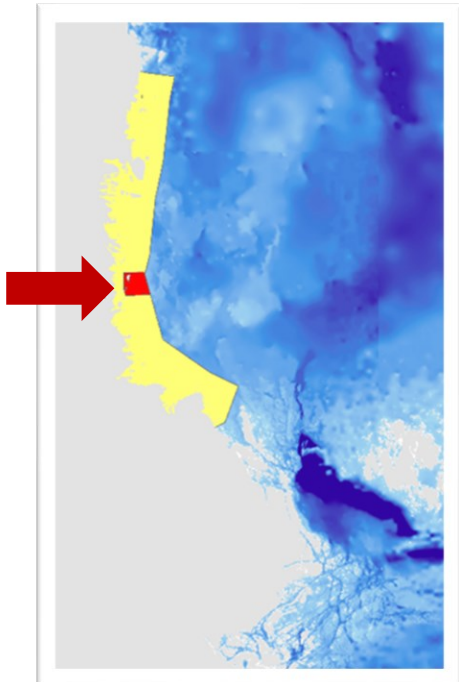
Baltic Sea

Whitefish in the Bothnian Sea

- Large increase of adult whitefish after fishing closure
- Sea trout also increased after closure
- Rapid decrease after reopened to fishing in 2016

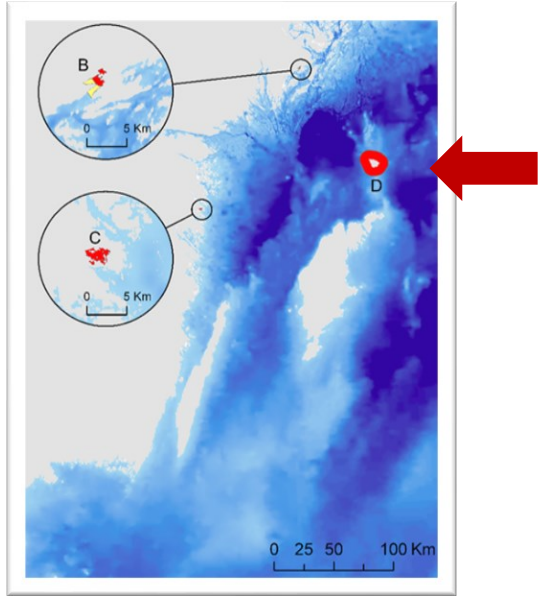


147 km², established 2011

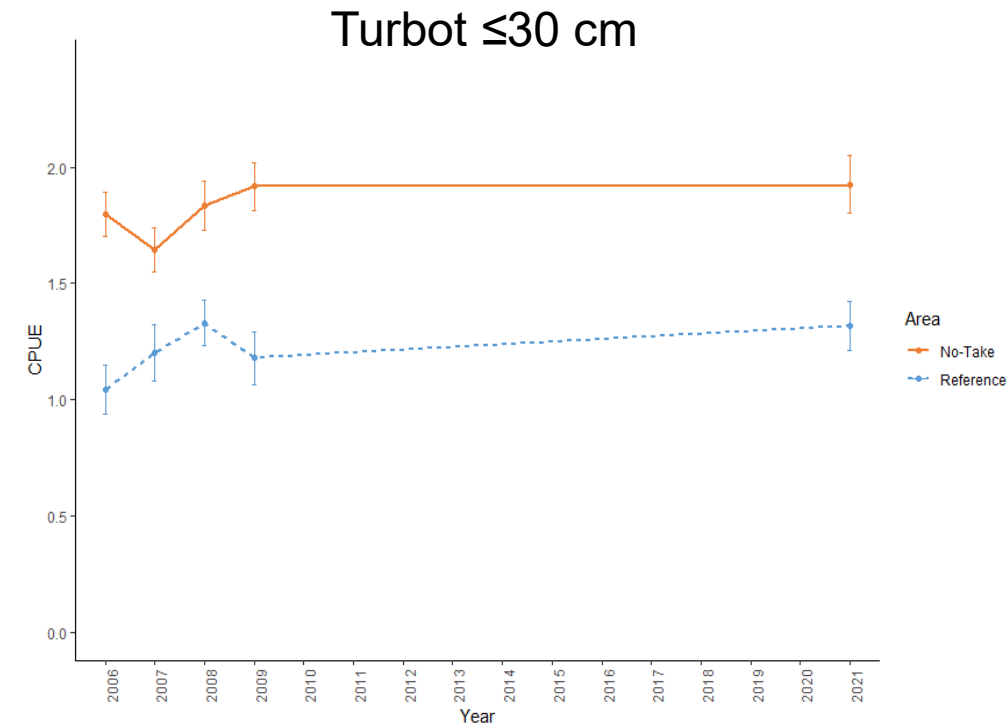
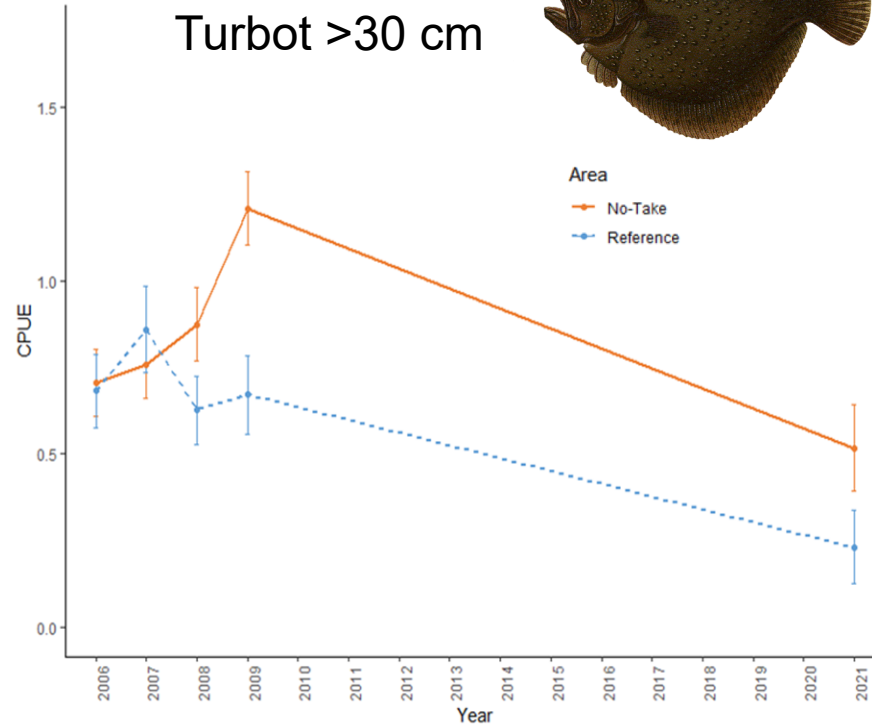
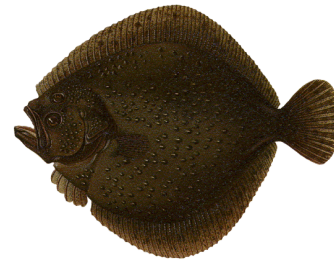


Turbot and flounder at Gotska Sandön

360 km², established 2006



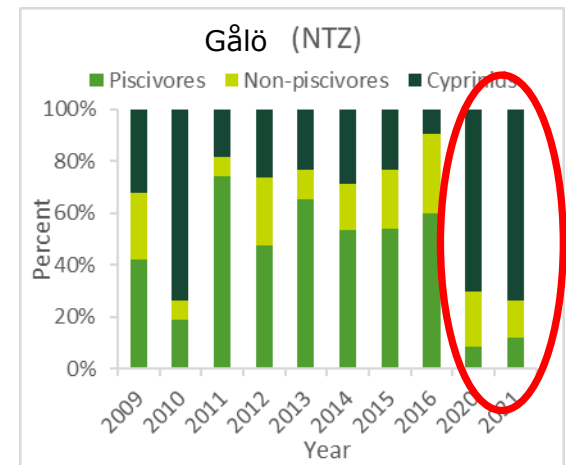
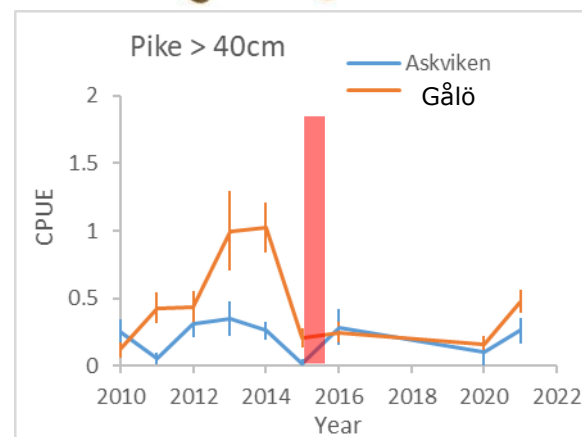
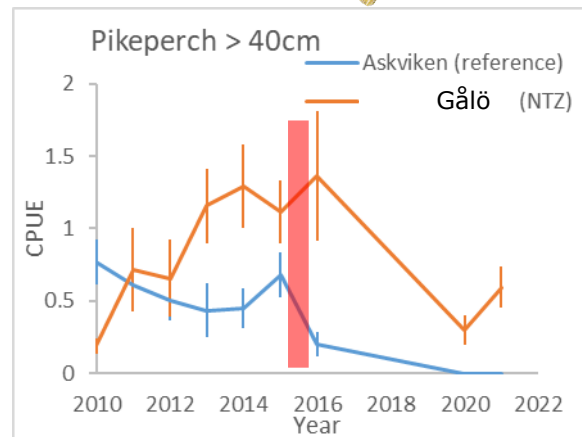
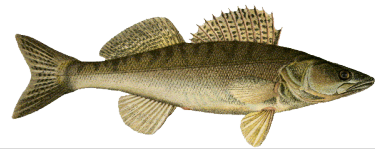
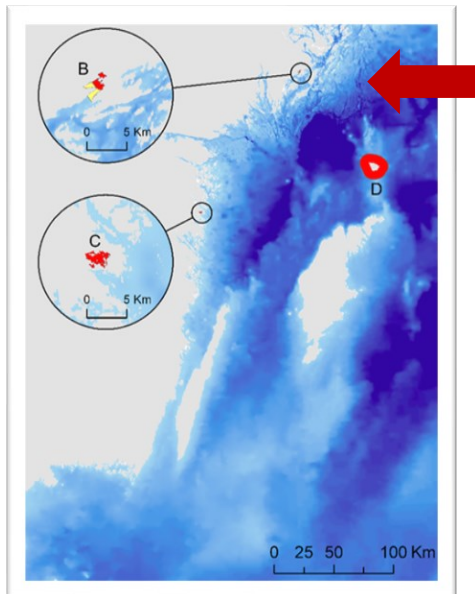
- Evaluation 2006-2009 found an increase in large turbot and flounder
- Evaluation 2021 found decrease in large turbot (but not small/young)
Predation?



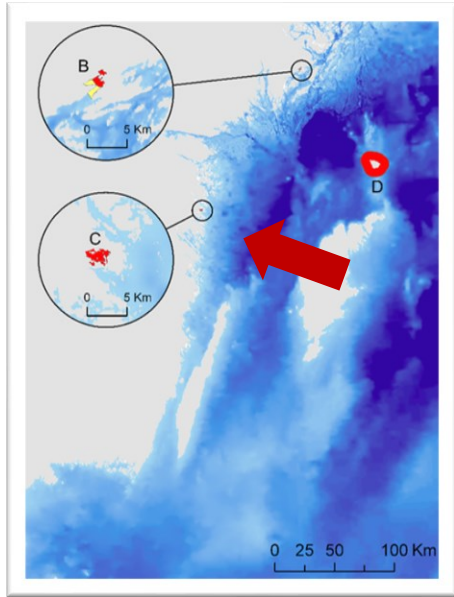
Pikeperch, pike and perch at Gålö

- Rapid increase in adult pikeperch and pike when no-take zone was established. No change in perch
- High predation and disturbance by seal (on pike) and cormorant (on perch)
- Abundances decreased rapidly after reopening to fishing
- Fish communities are now dominated by cyprinids

2 km², established 2010



4 km², established 1980

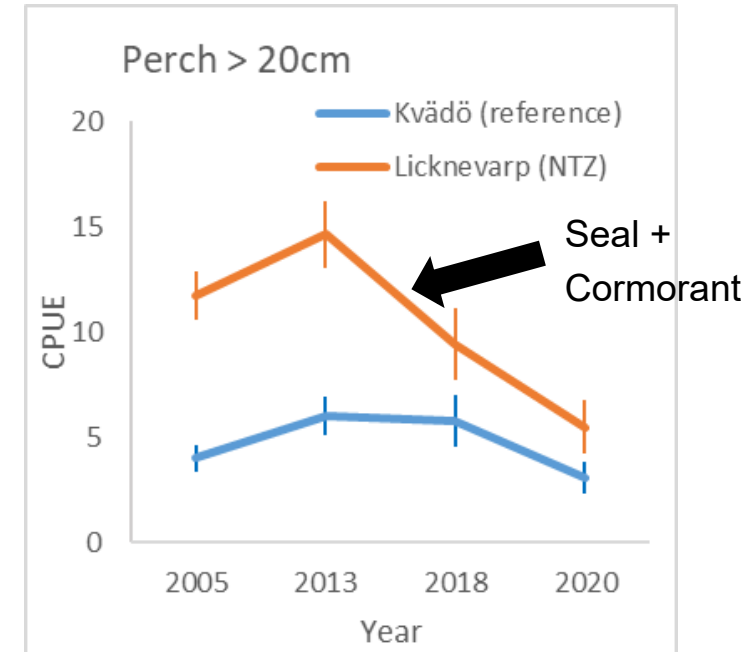
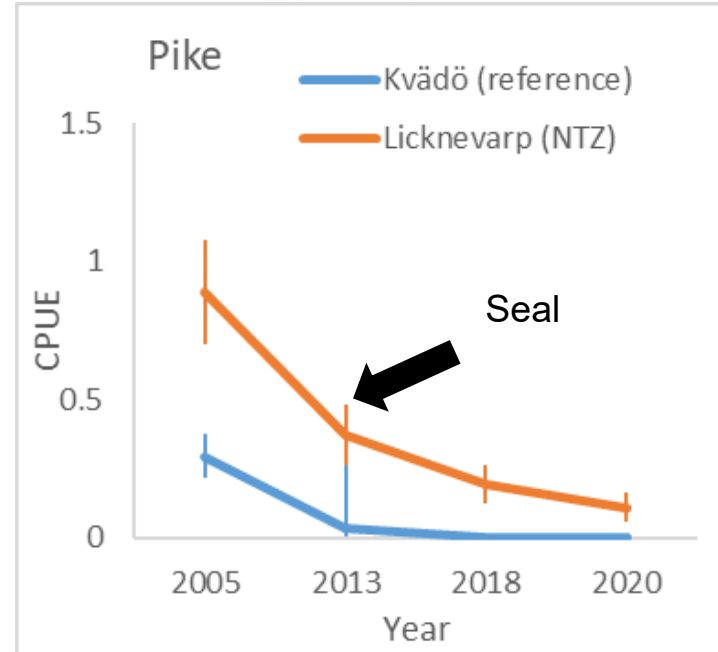
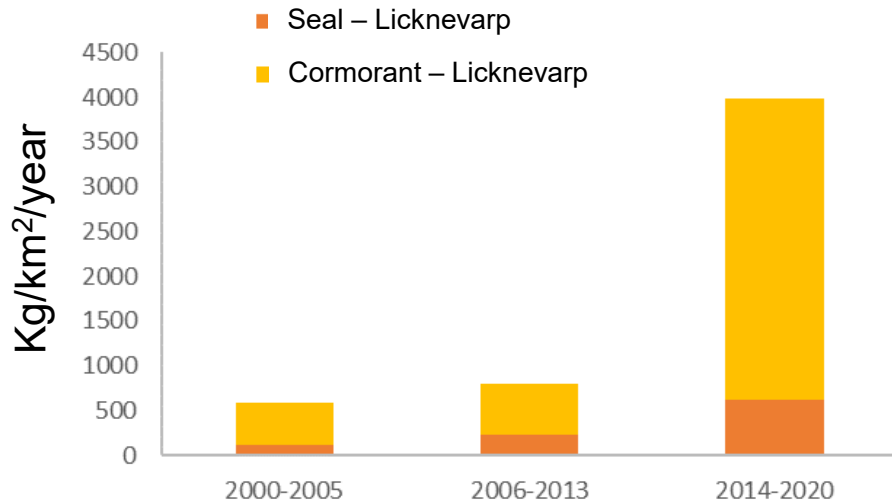


Pike and perch in Licknevarp

- 2-4 times higher abundances of pike and perch in the no-take zone
- Large increase in predation → decrease in fish populations

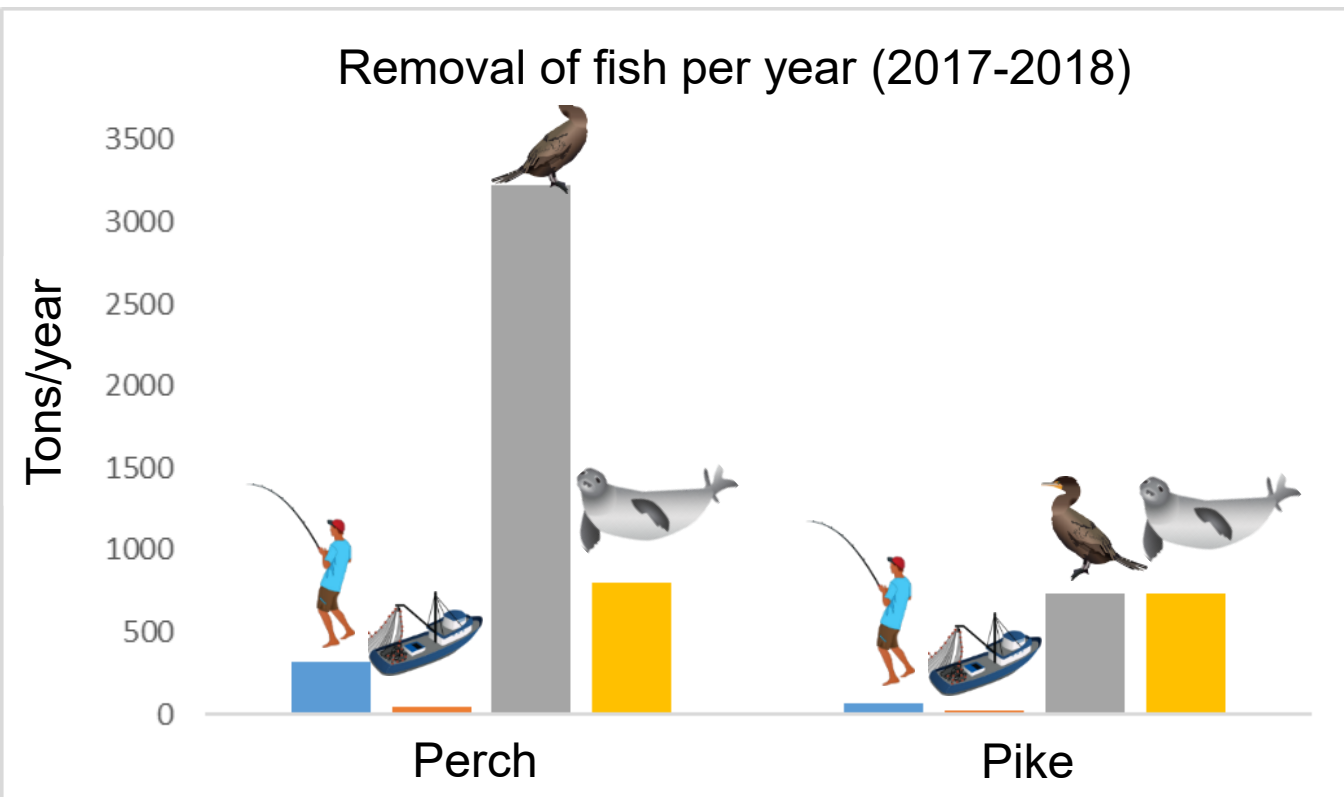
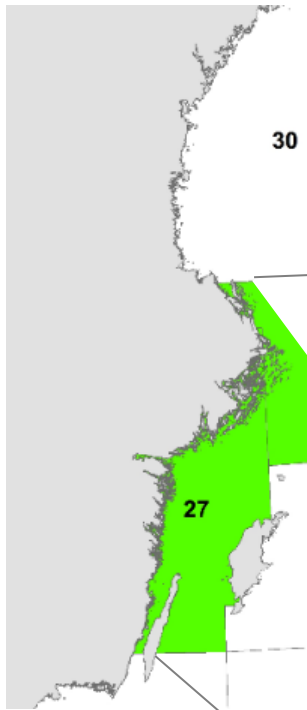


Removal of fish from seal and cormorant



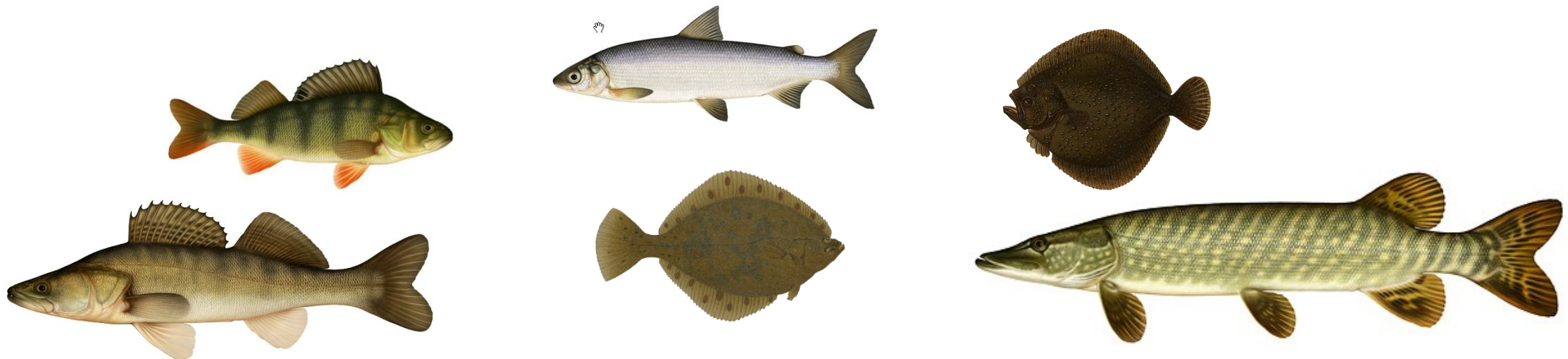
High predation by seal and cormorant

Predation is responsible for 90% of the total removal of fish along the coast from Kalmar to Uppland



Summary of results from the Baltic Sea

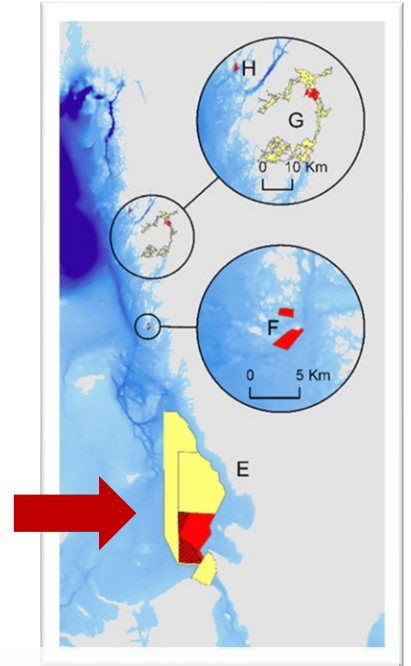
- More and larger fish, quick recovery (pikeperch, perch, pike, turbot, flounder, whitefish)
- Re-opening of two areas led to sharp declines
- Strong impact from grey seal and cormorant predation. Declines of large fish in all areas in recent years



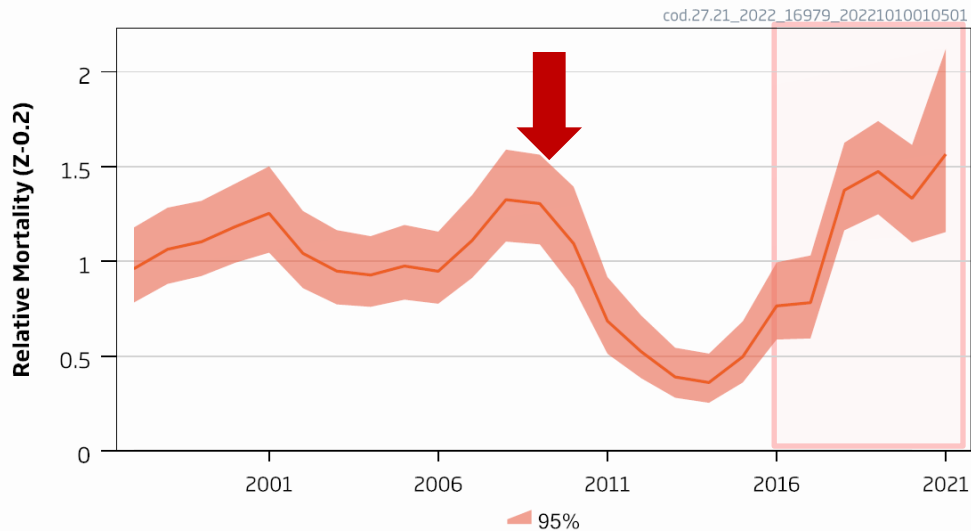
Swedish West Coast

Cod in Kattegat

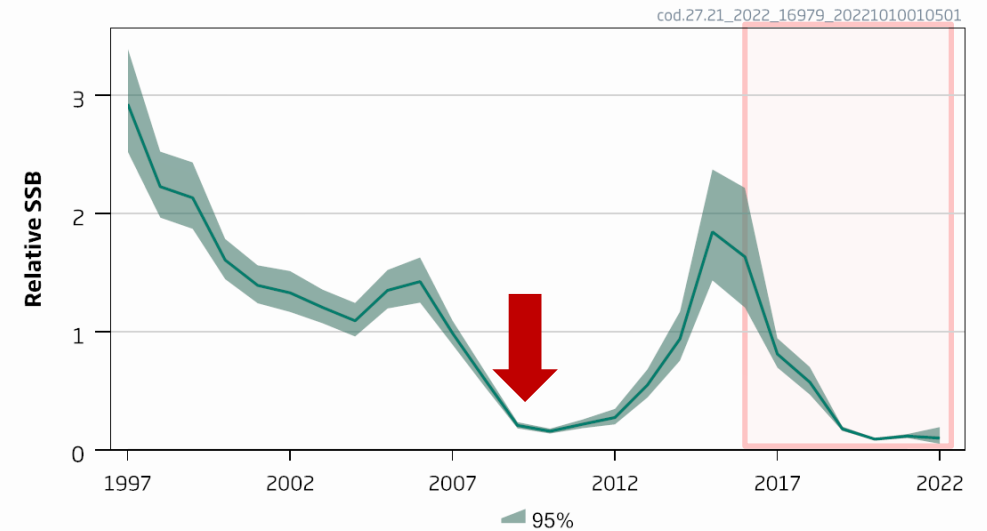
- No-take zone + gear restrictions in 2009. Positive trend initially
- Declines since 2016, following change in fishing regulations



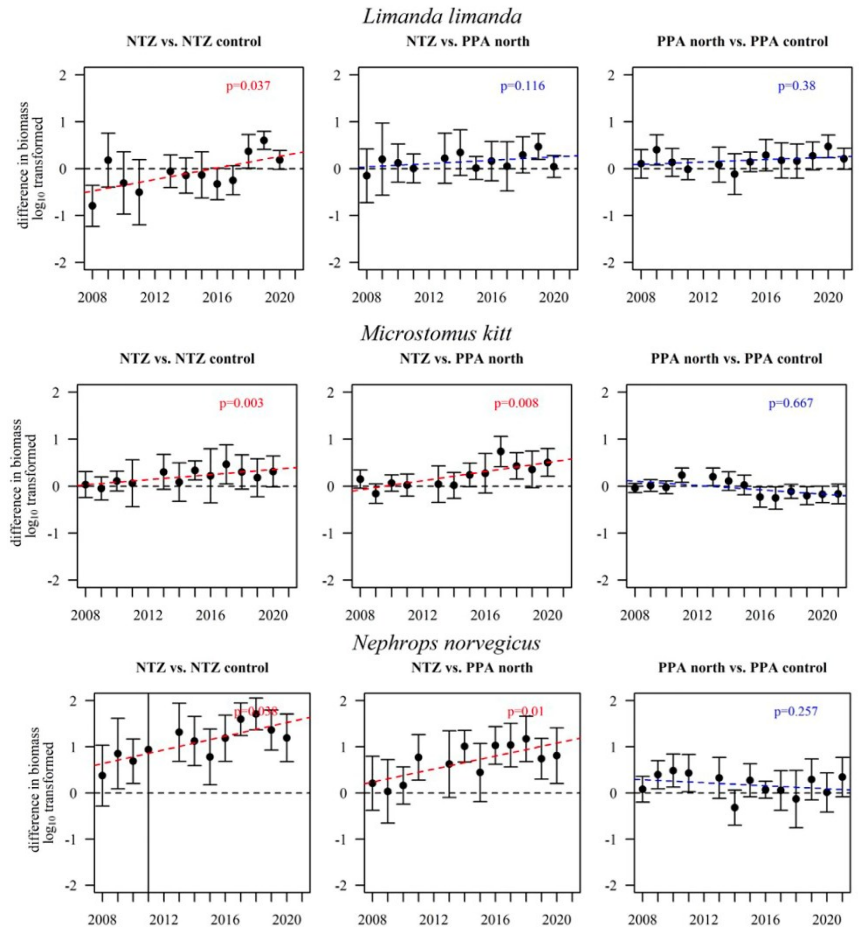
Relative Mortality (Z-0.2)



Relative Spawning Stock Biomass



Some positive effects on fish and benthos

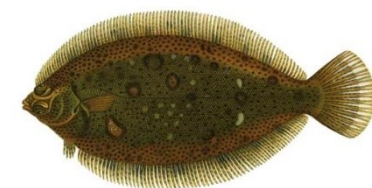


Sköld et al. 2022 ICES JMS.

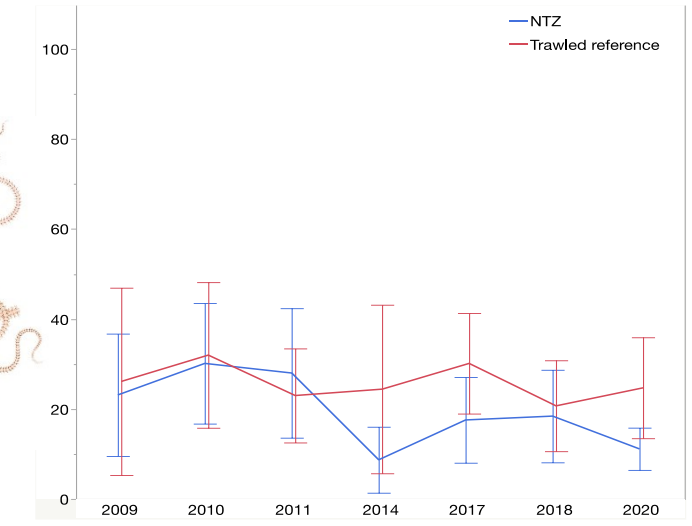
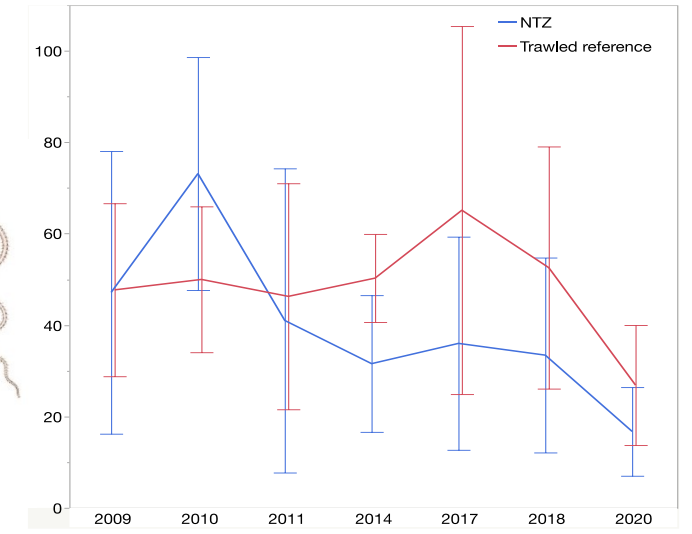
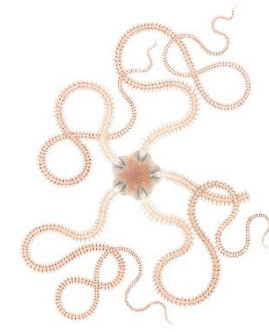
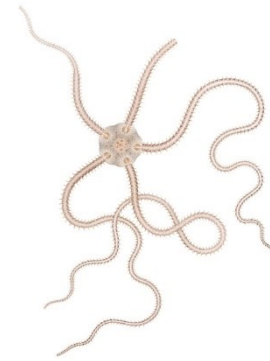
Dab



Lemon sole



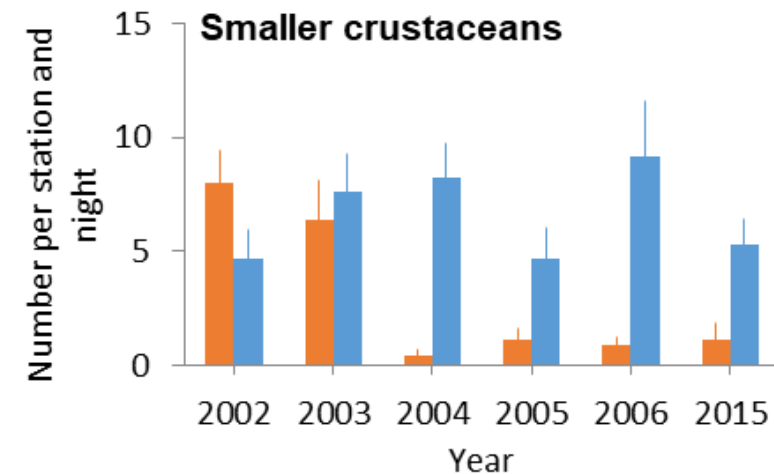
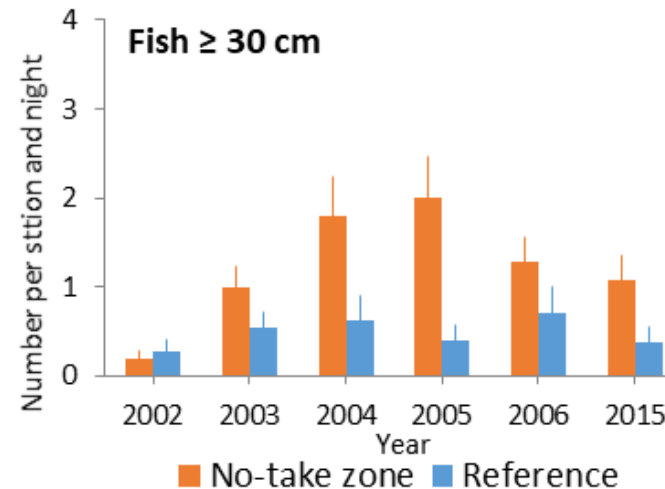
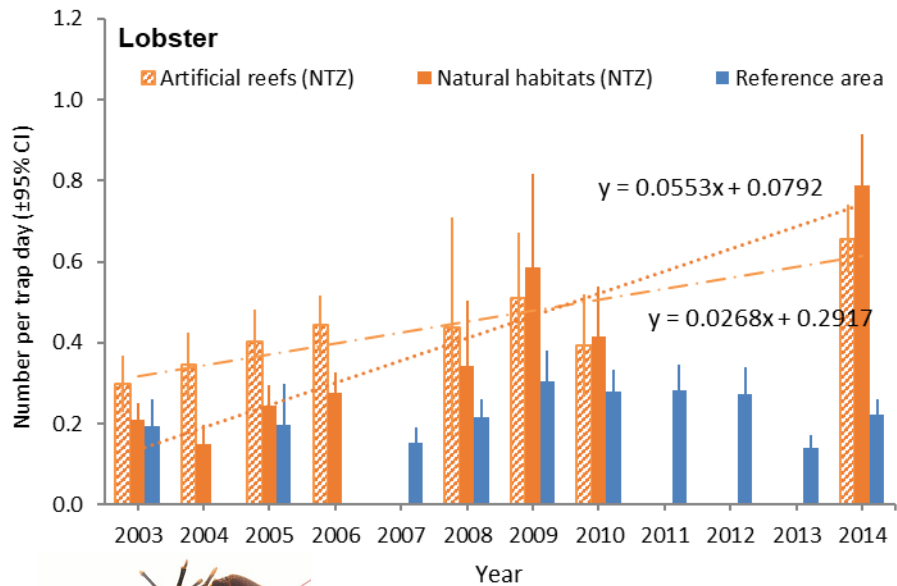
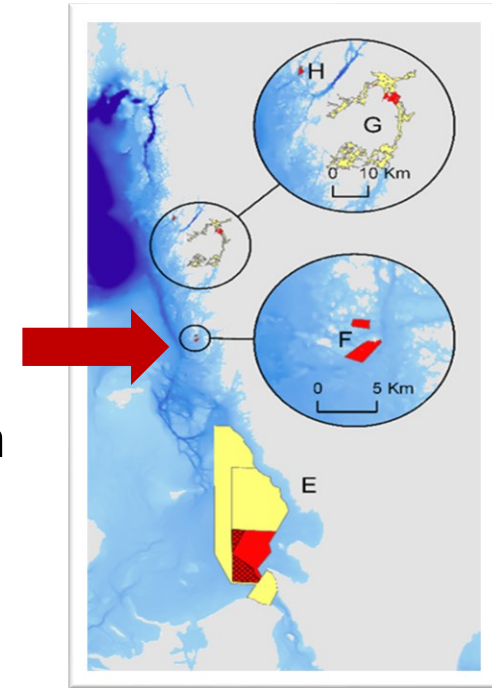
Norwegian lobster



Sköld et al. 2022 in prep.

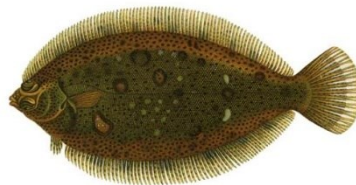
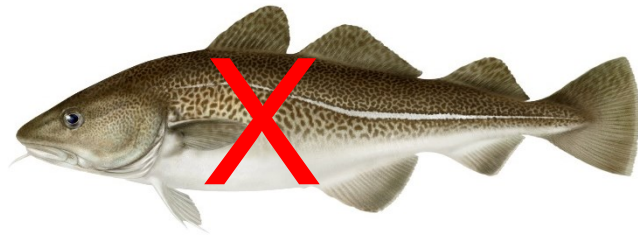
Lobster and gadoids at Vinga

- Increase in lobster abundance and size at both artificial reefs and natural habitats. 3 times higher egg production after 10 years
- More predatory fish, strong declines in small crustaceans = top-down effect



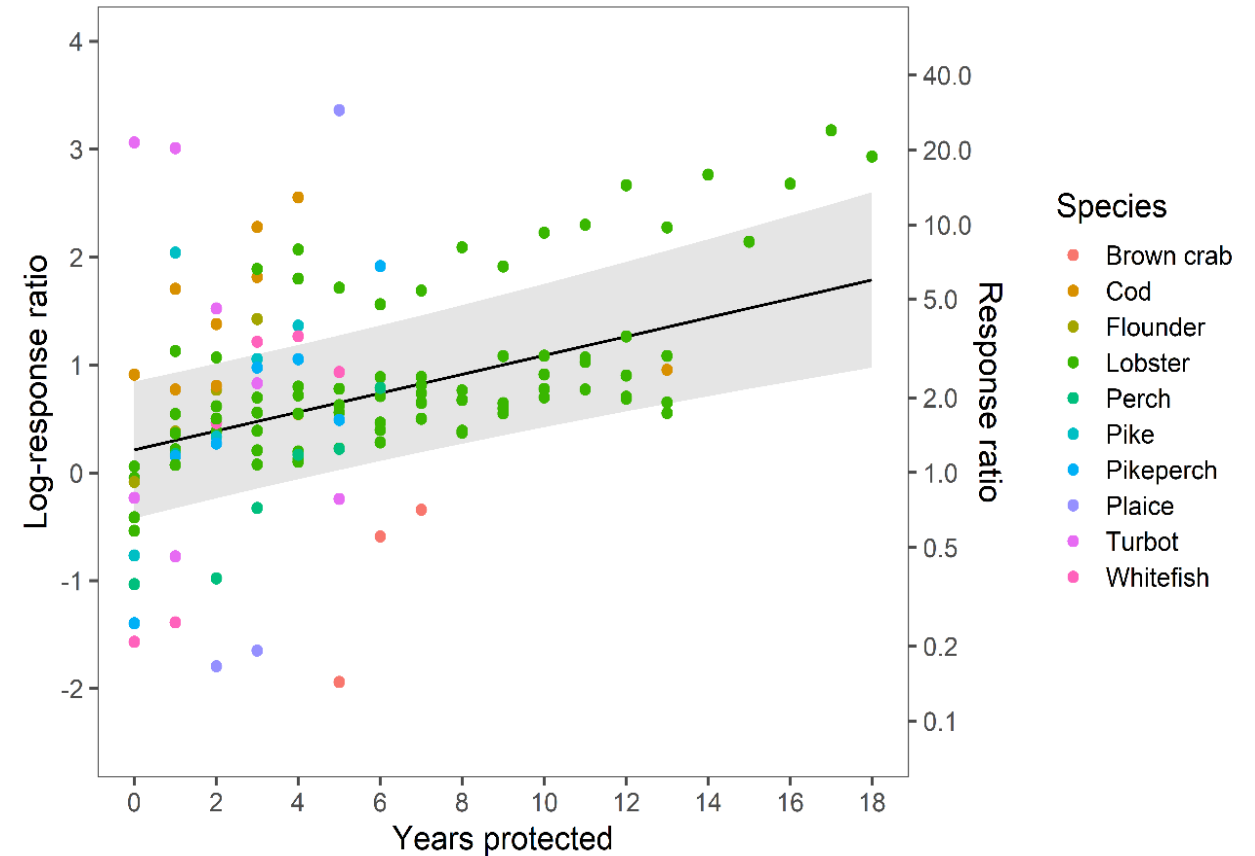
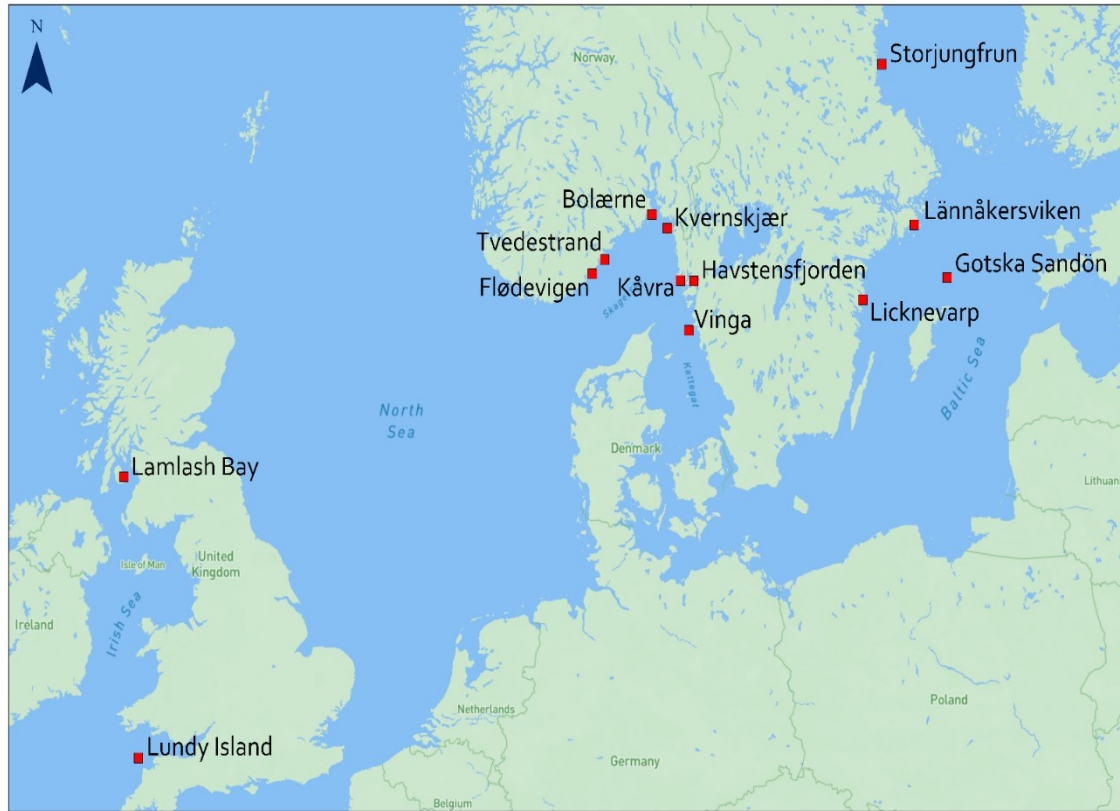
Summary of results from the West Coast

- No recovery in cod populations, likely due to highly decimated stocks
- Increase in flatfish (dab, lemon sole) and Norwegian lobster but decrease in brittle stars, likely due to increased predation
- More and larger lobster, quick recovery



Meta-analysis of coastal NTZs in northern Europe

CPUE of target species increases over time



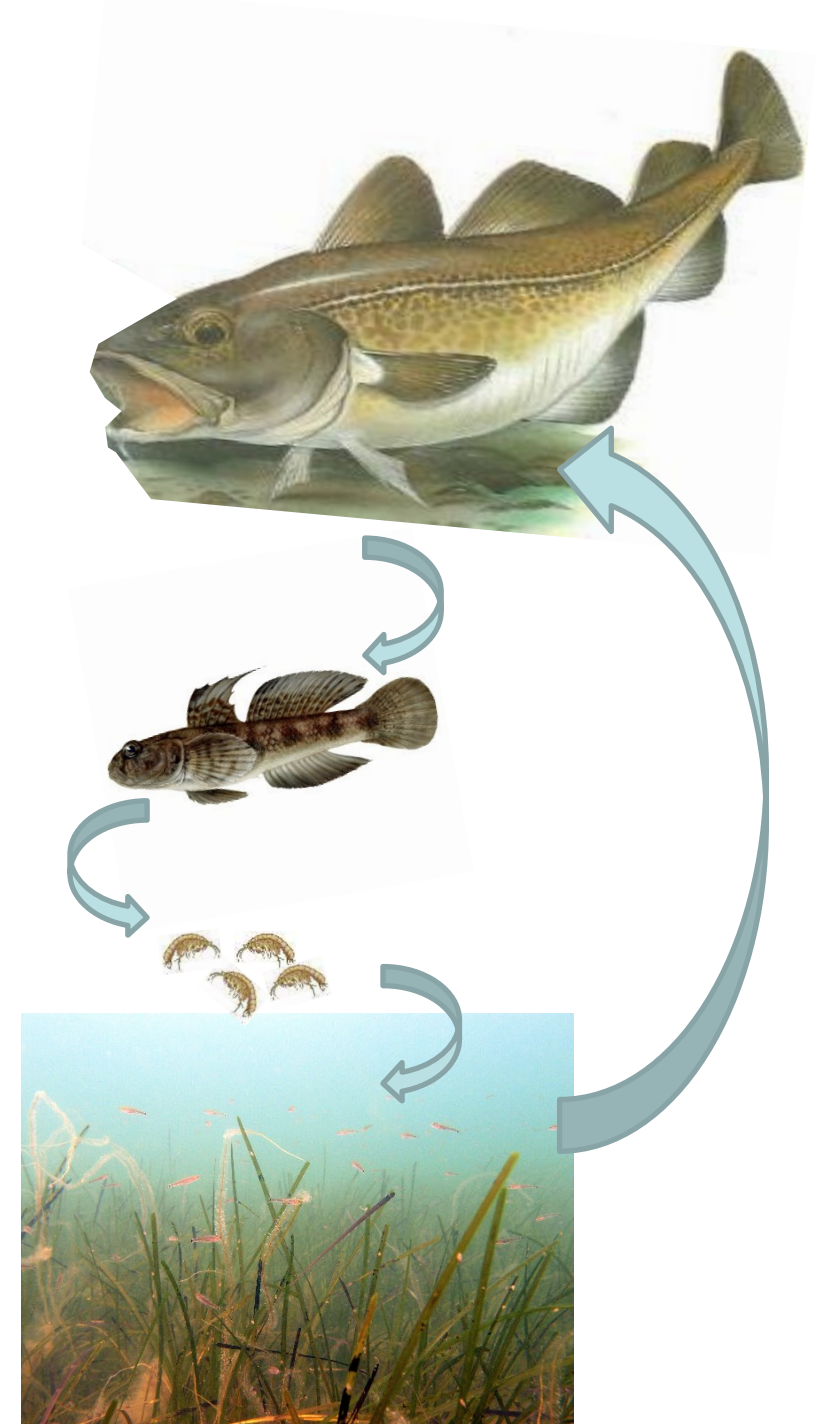
What have we learned?

Quick increase of target species after closure → efficient tool to restore threatened populations

Increase in reproduction which may contribute to recovery in adjacent areas

Restored top-down control - large predatory fish contribute to healthy habitats

To reach new restoration targets, we need to reconcile fisheries management and conservation



Thank you for listening!

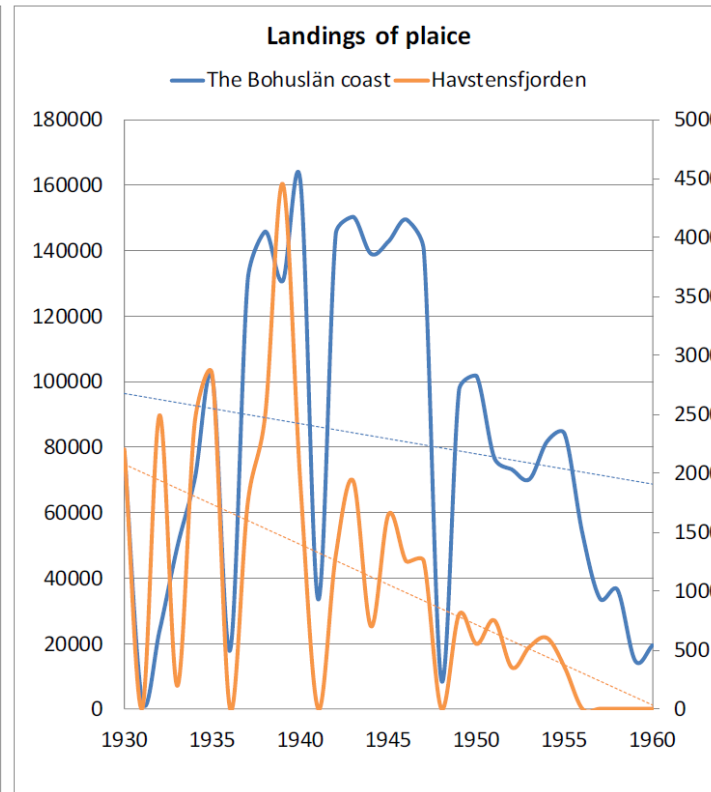
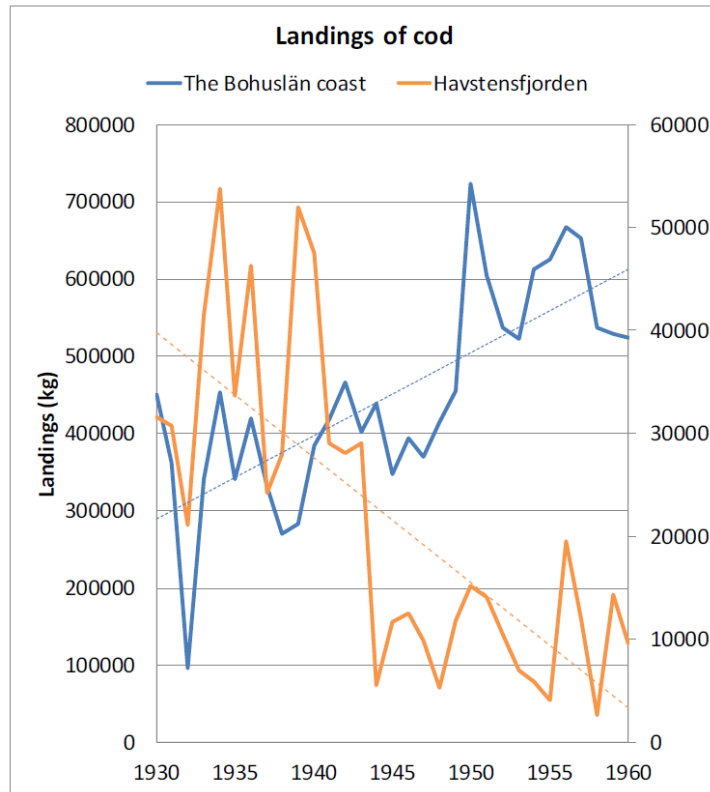
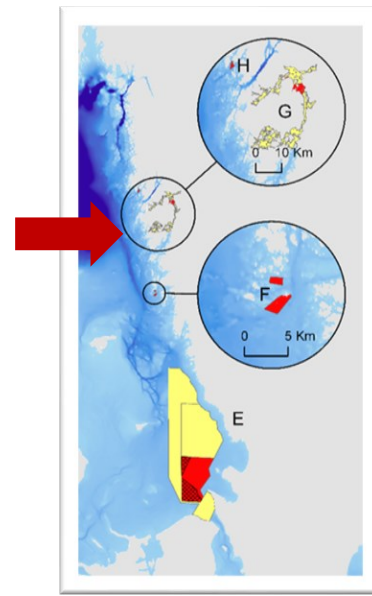


**Swedish Agency
for Marine and
Water Management**

..and of course thank you to all colleagues who have contributed to this work

Cod and flatfish in Havstensfjord

- Stock collapsed already in 1950s
- NTZ established in 2010, but no recovery yet



Lobster at Kåvra

- Established in 1989. Abundances have plateaued, but size of individuals still increases
- Low abundance of edible crab (just like at Vinga)
- No effect on wrasses

