
SLU
SCIENCE AND EDUCATION FOR SUSTAINABLE LIFE

Size-structural changes in the Gulf of Bothnia herring?

- and other factors affecting catches of Swedish coastal fisheries

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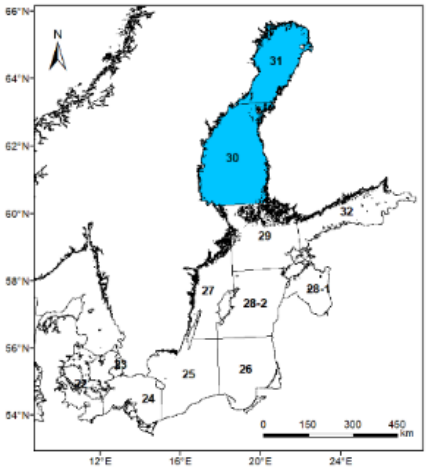
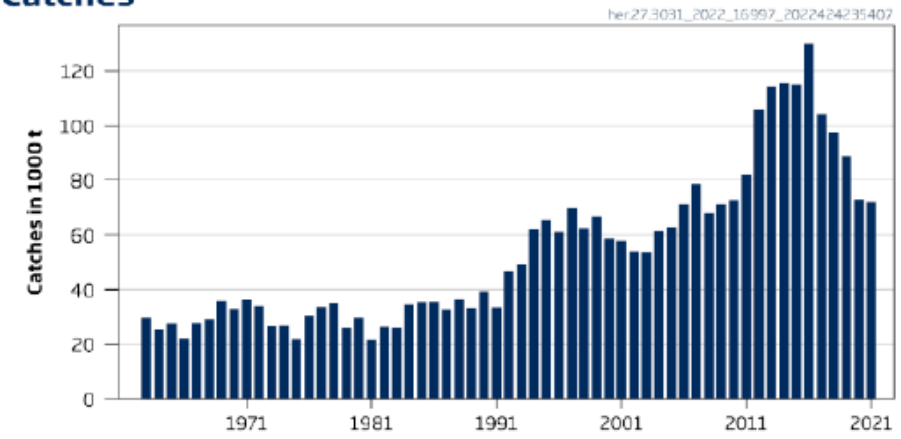
2022-10-03

SLU Aqua, Sweden

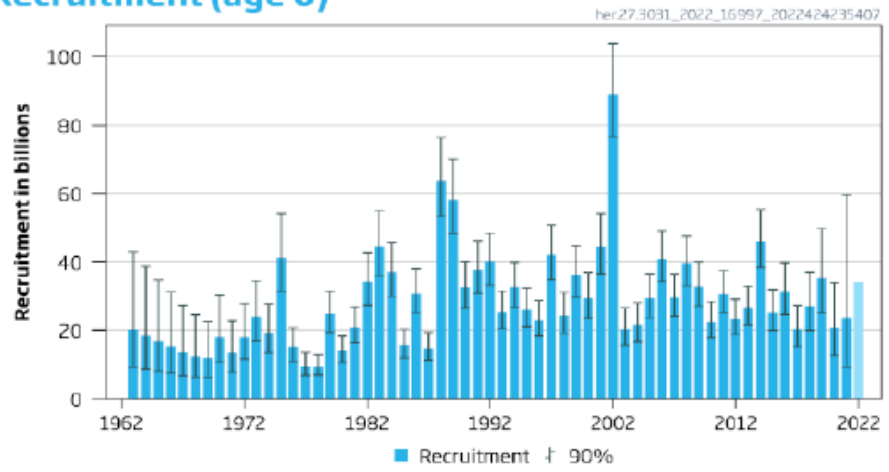
Stock status – Gulf of Bothnia herring ICES subdivisions 30-31



Catches



Recruitment (age 0)



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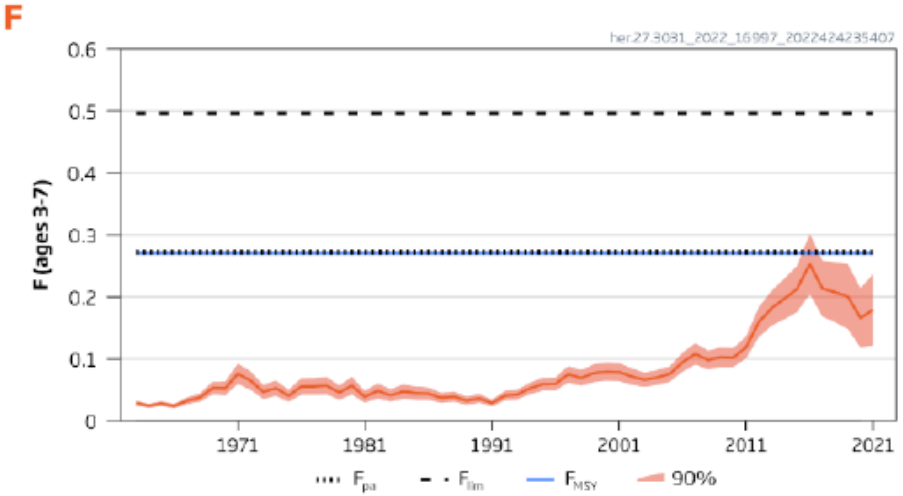
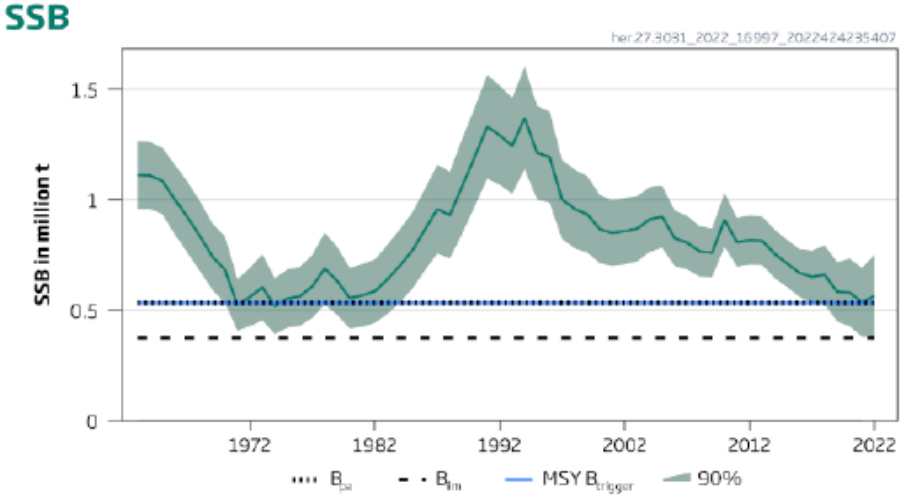


SSB



ICES 2022

Stock OK - Bad catches for the Swedish coastal fishery?

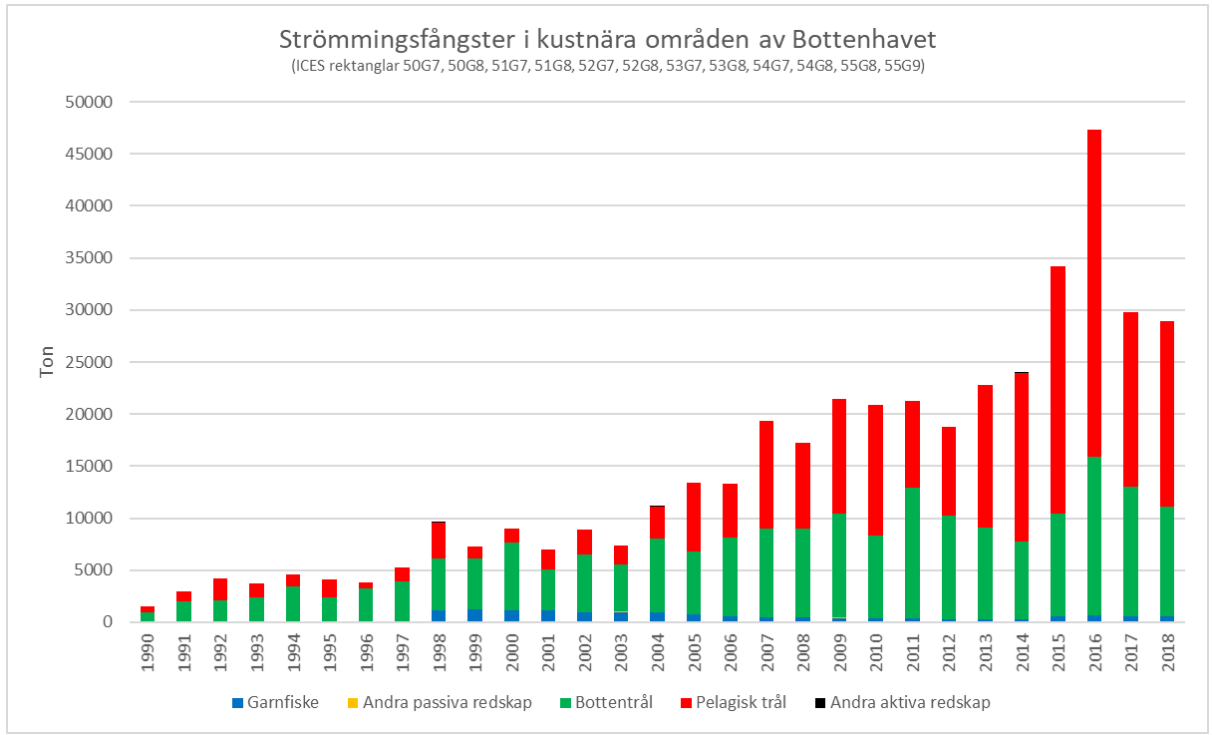
- Many Swedish coastal fishermen reporting 50-75% reduction in catches during the last two years, in the Gulf of Bothnia
- Official logbook catch data show decrease in mean catch per boat and year
  - ~15 ton / boat / year in 2016 (gillnets, SD30)
  - ~5 ton / boat / year in 2021 (gillnets, SD30)

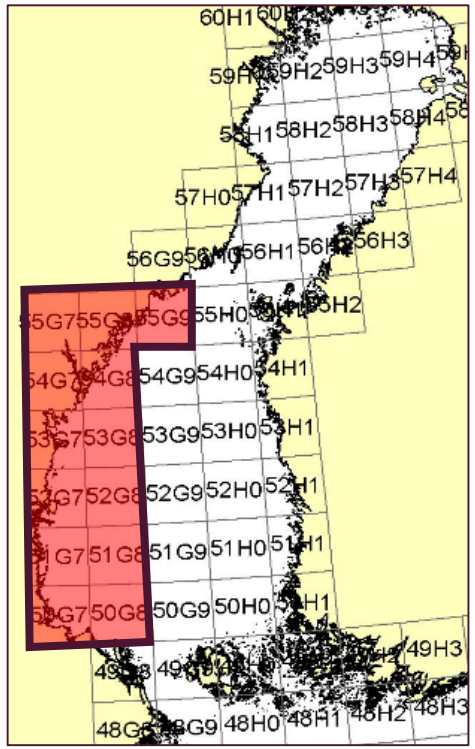
- Coastal fishery dependent on large herring
  - For human consumption
  - Larger than 18 cm

Increased fishing closer to the Swedish coast

- Increased herring catches in SD30 overall
  - 31k ton in 1990
  - 125k ton in peak year of 2016, 71k ton in 2021
- Effort movement towards Swedish waters
  - 6 % in 1990; 38 % in 2016, 32 % in 2018

Green – Bottom trawl
Red – Pelagic trawl
Blue - Gillnets

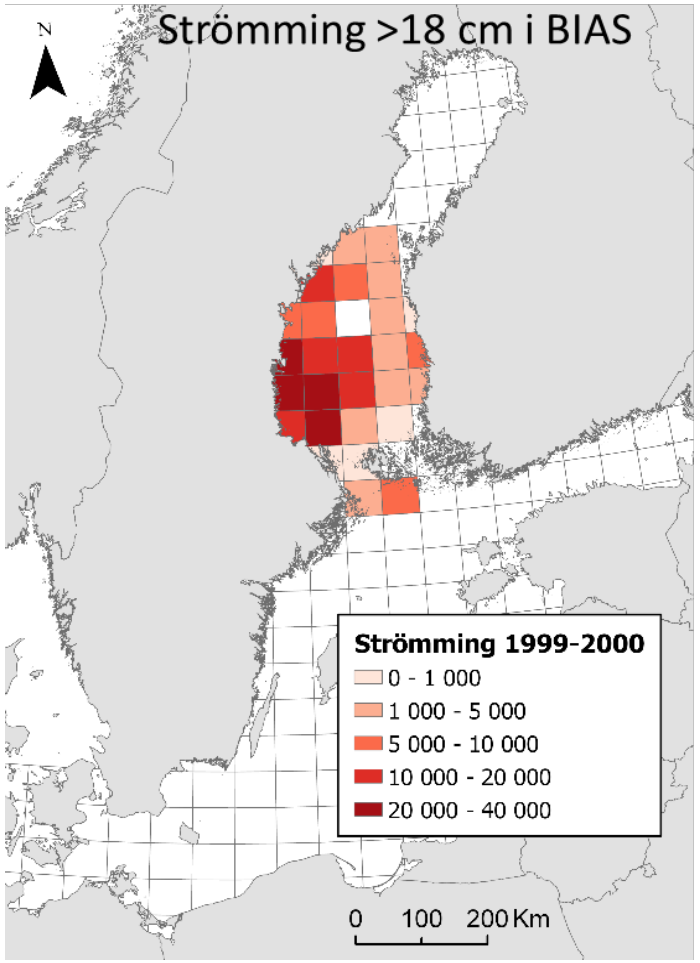




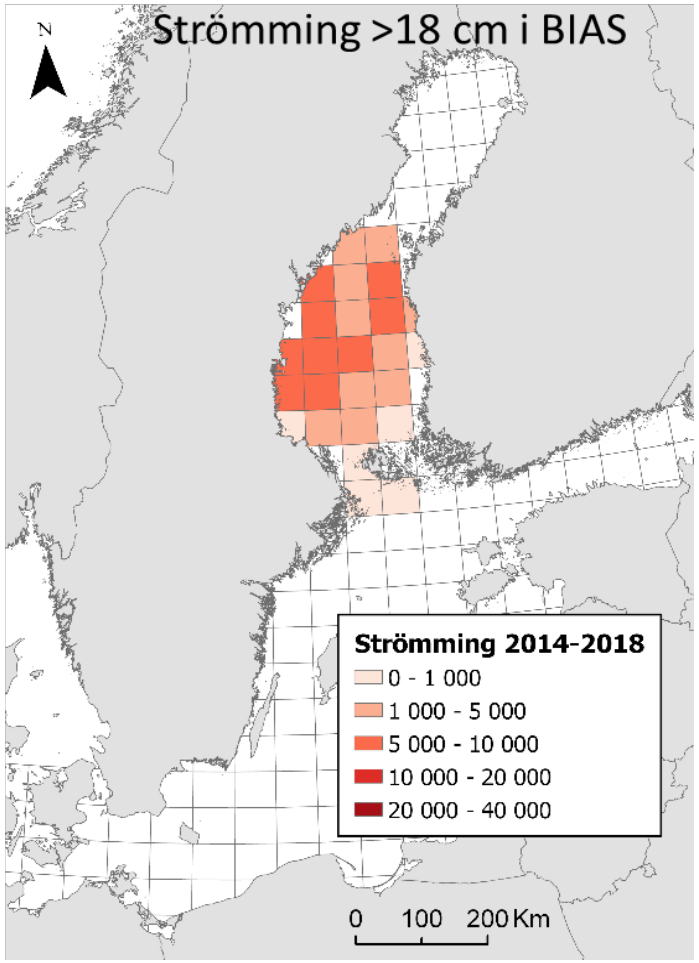
Reduced biomass of herring > 18 cm

- Fisheries independent data from the scientific survey BIAS (Baltic International Accoustic Survey)
- Abundance estimates per ICES rectangle
- Darker red = more herring > 18 cm

1999-2000



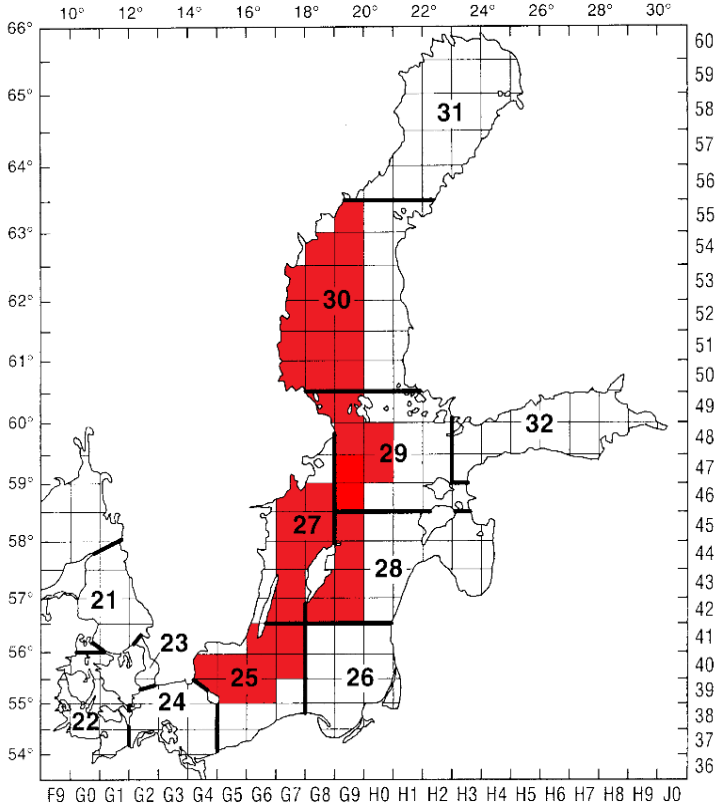
2014-2018



Data from the scientific survey BIAS

Reduced biomass of herring > 18 cm

Årtal	SD	N/km² (total)	B/km² (total)	Medelvikt (total)	N/km² (>18)	B/km² (>18)	Medelvikt (>18)	N andel (>18)	B andel (>18)
2011-2020	25	↘	↓	↓	↘	↓	↓	↘	↘
	27	↓	↓	↓	↘	↓	↓	↘	↘
	28	↘	↓	↓	↘	↓	↓	↘	↘
	29	↘	↓	↘	↘	↓	↓	→	↘
	30	↗	↑	↗	→	↓	↘	→	↘
2016-2020	25	↗	↑	↓	↘	↓	↓	↘	↘
	27	↓	↓	↑	↘	↓	↓	→	↘
	28	↗	↑	↑	→	↗	↓	→	→
	29	↓	↓	↓	↘	↓	↑	→	→
	30	↑	↑	↓	→	↓	↓	↘	↘



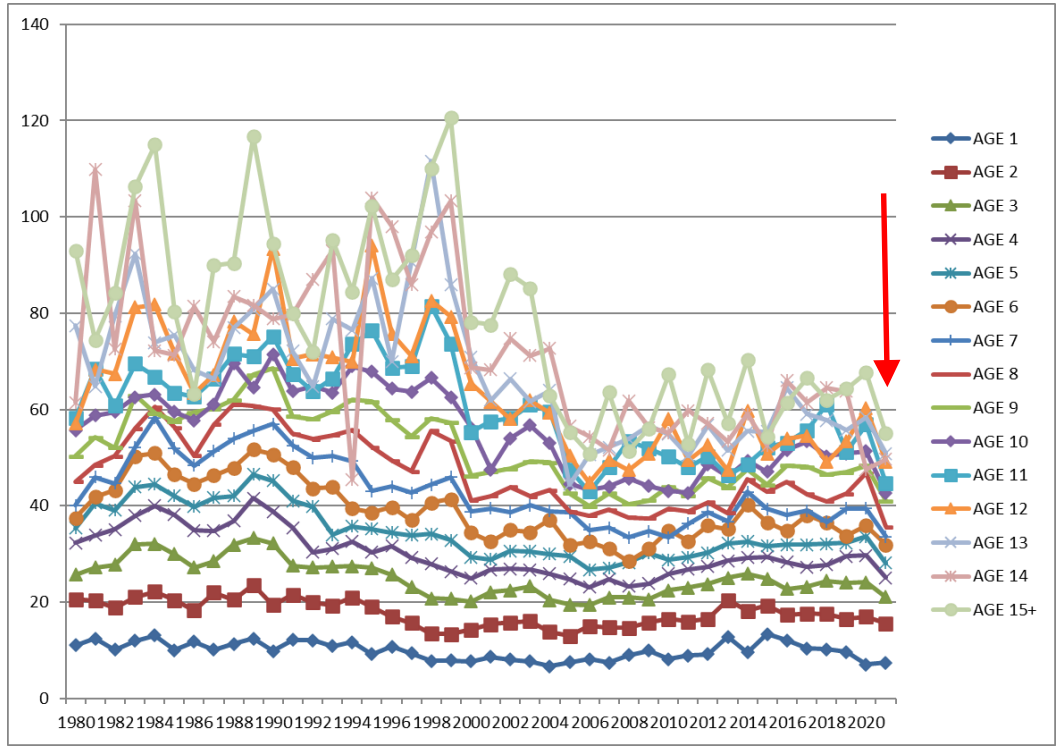
Data from the scientific survey BIAS

Decreased mean weight-at-age and condition of larger herring

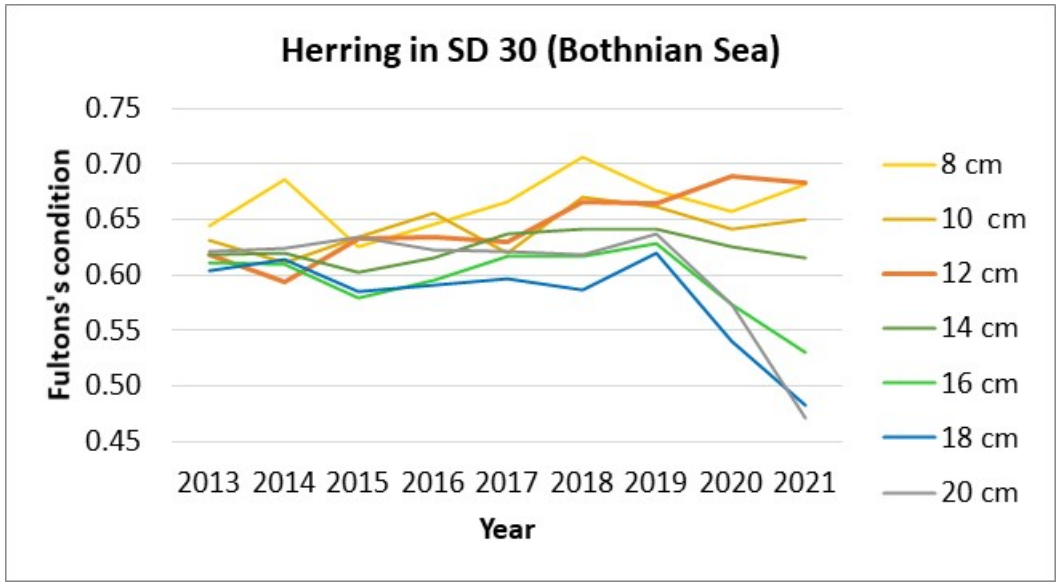
Reduced mean weight-at-age and condition of large herring

=> Less biomass of large herring

1979-2021



2013-2021



Pilot study - Effects of fishing mortality on herring age-structure in the Gulf of Bothnia

David Gilljam, Massimiliano Cardinale, Mikaela Bergenius Nord, Valerio Bartolino, Daniel Valentinsson

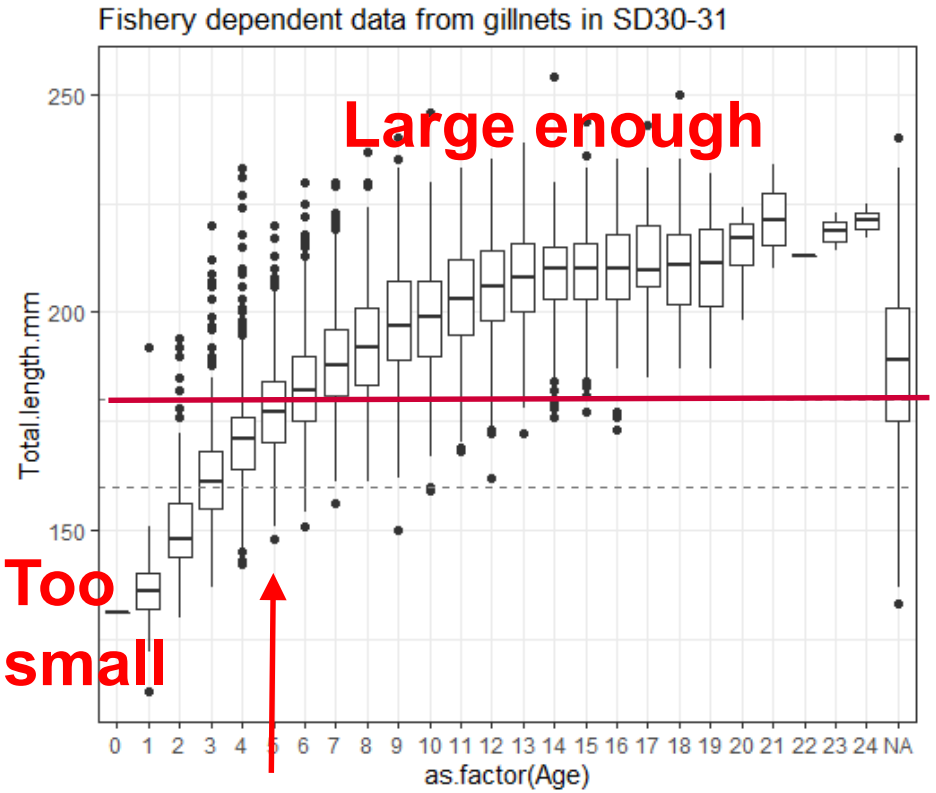
SLU Aqua, September 2022

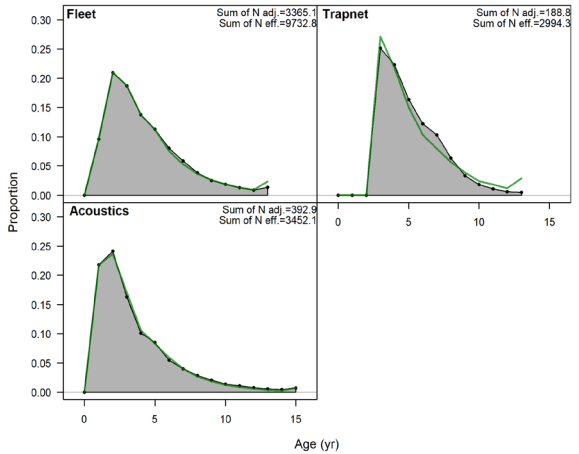
Background

- MSY-management of a stock can shift the size-structure towards smaller fish
  - Fisheries size selective
- Swedish coastal fisheries dependent on large fish
  - > 18 cm for human consumption
  - Fish of **age 5-7+** reach size for human consumption

- How has the age-structure of the stock changed?
- How would future different fishing scenarios change the age-structure of the stock?

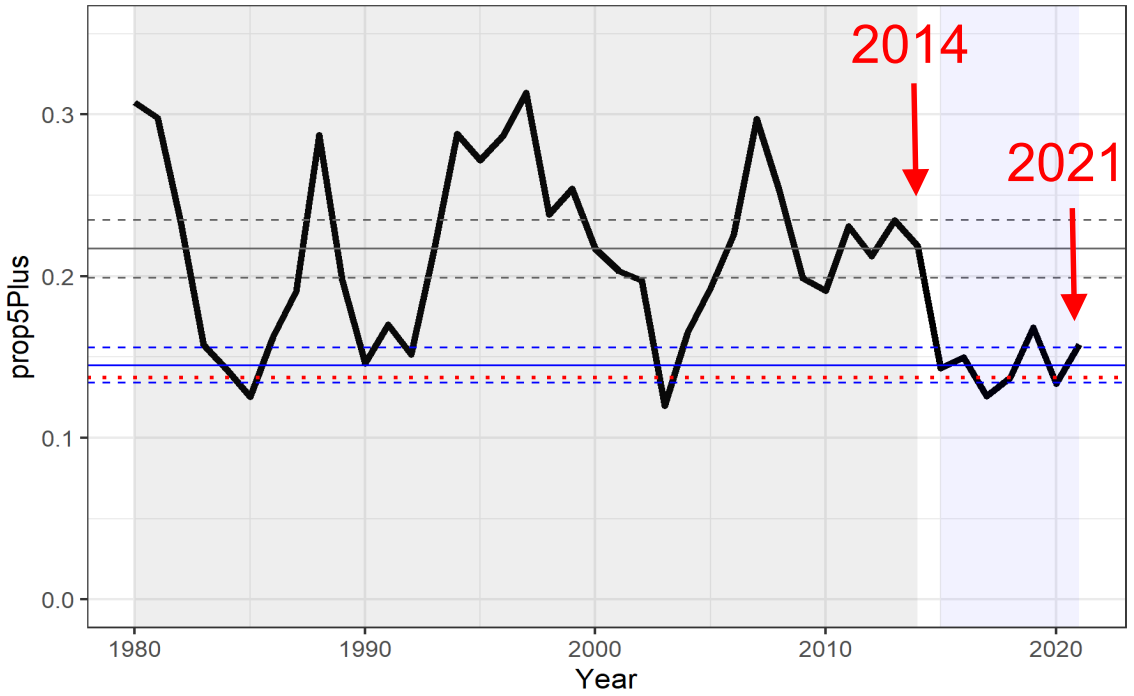
- Use age-class estimates from the ICES herring SD30-31 stock assessment model

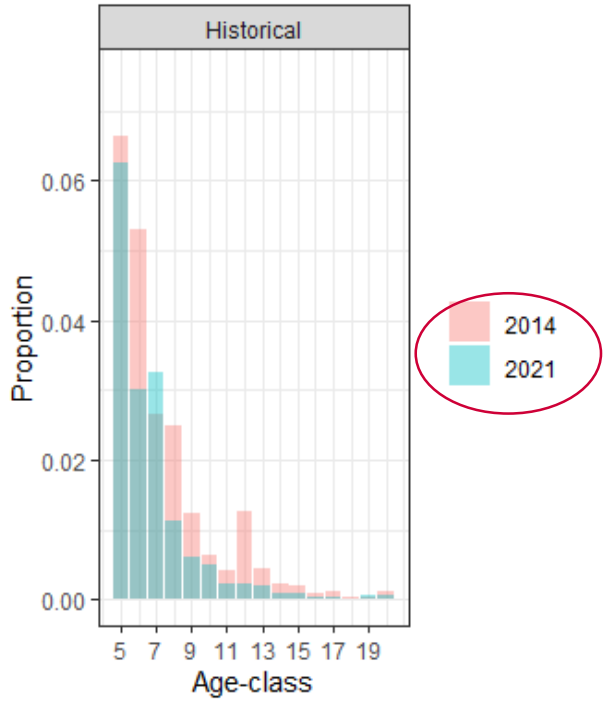




Historical patterns – proportion large herring

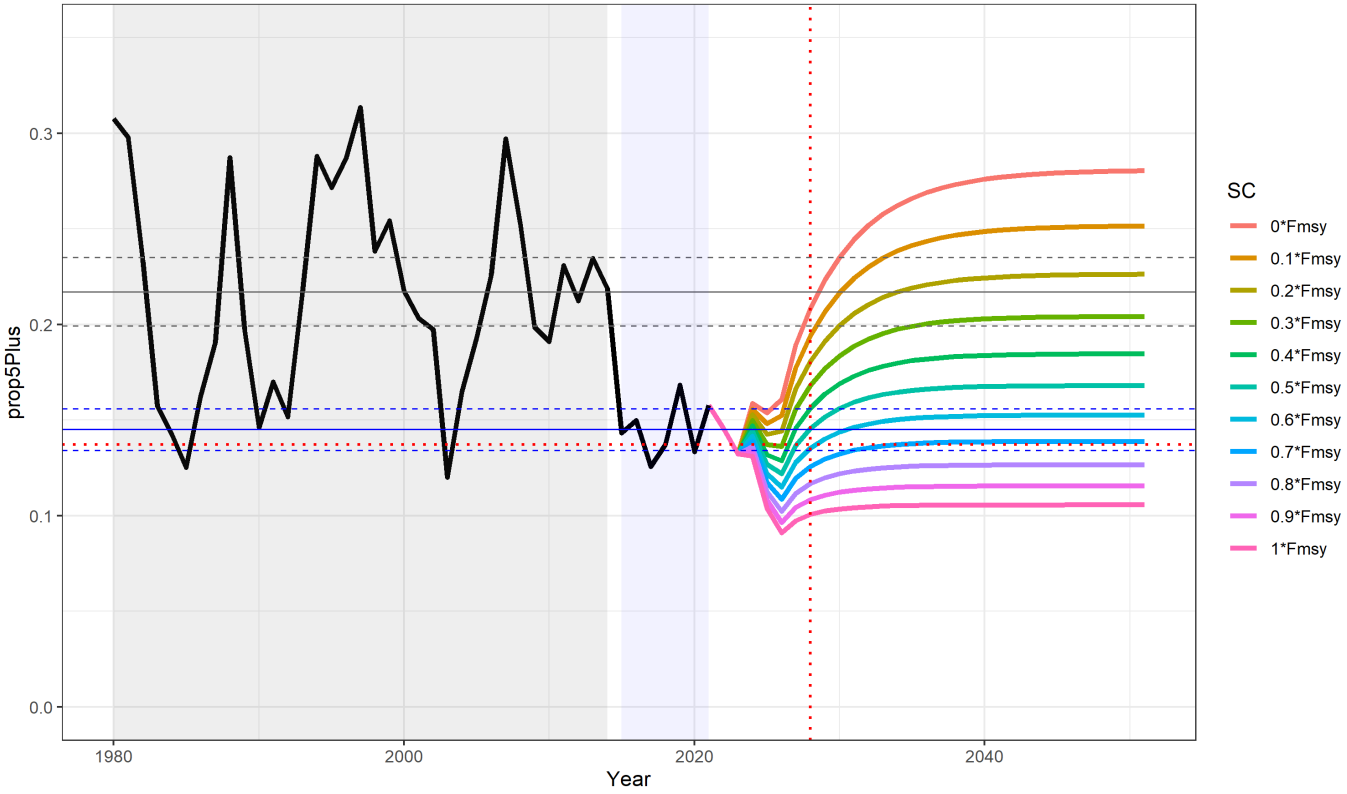
- Changes in proportion age-5+ of the stock (i.e. > 18 cm)
- Breaking point at 2014-2015
  - Mean prop. 5+ 1980 – 2014 = 21.7 [+- 0.2] %
  - Mean prop. 5+ 2015 – 2021 = 14.5 [+- 1.0] % (Reduction by 33%)





Forecasts – proportion large herring at different F

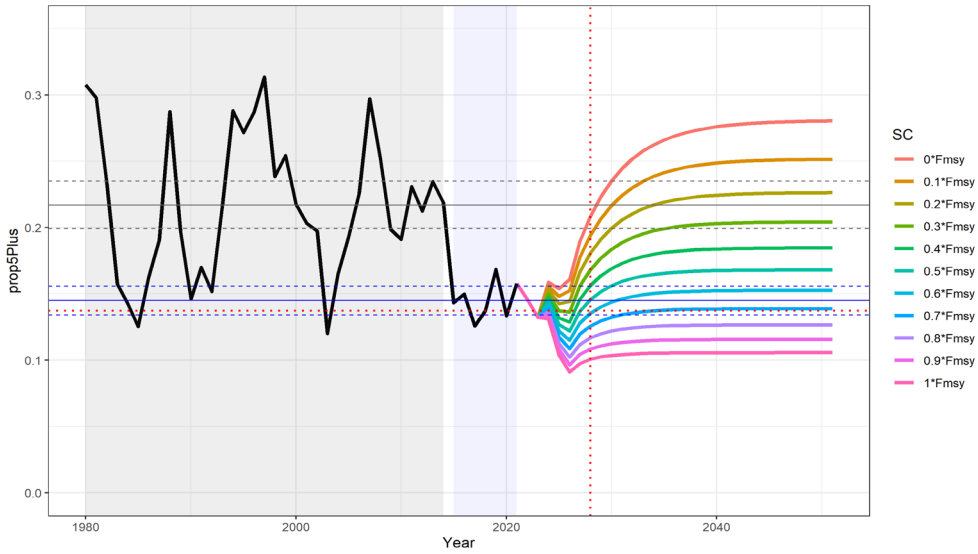
- Forecast scenarios
  - F = [0, 0.1, 0.2, … 1.0] * Fmsy
- Forecast assumptions
  - Recruitment based on stock size
  - Weight-at-age based on 3 year average
  - No environmental variation
  - No variation in estimated parameters



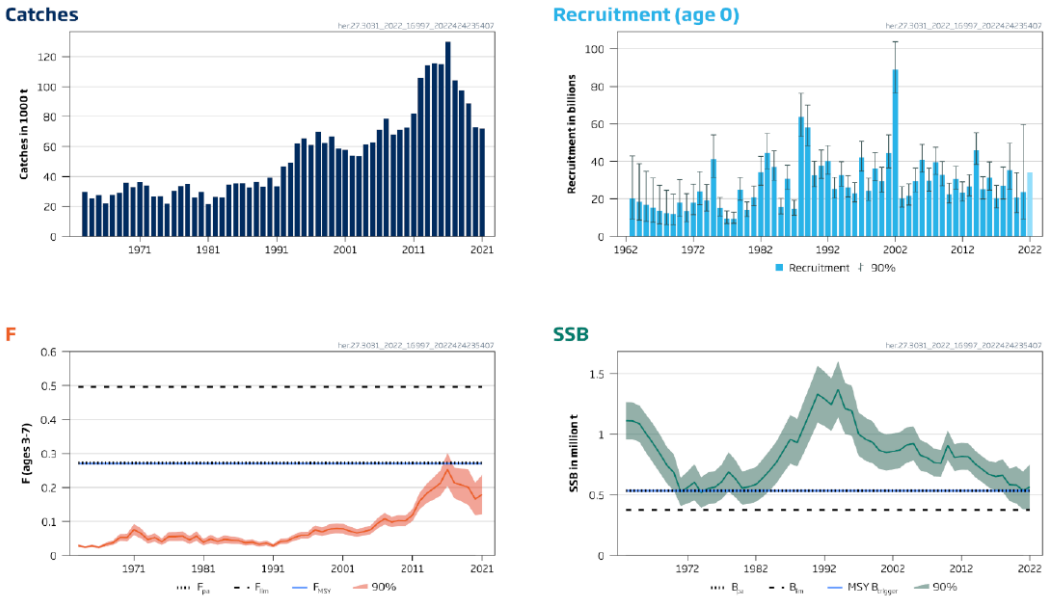
- Fishing at
  - Fmsy will reduce prop. 5+ further
  - 0.2-0.3 Fmsy will restore prop. 5+ to levels pre 2015
- Rebuilding the age-structure of the stock requires many years of reduced fishing mortality

Conclusions so far

- Fishing mortality impacts age-structure
  - GoB herring has been at a very low fishing pressure historically (from a MSY-perspective)
  - Fishing has increased towards Fmsy
    -> Are we now seeing 'the effects' of MSY-management in terms of a shift in age-strucure towards smaller fish?



- Other factors are important too, e.g.
  - Recruitment (strong/weak year-classes)
  - Variation in natural mortality
  - Further studies needed to estimate the relative contributions



- Age-structure can shift quickly, but may take many years to rebuild
  - Herring a relatively long-lived species – slow recovery

Other factors influencing catch of coastal fishery

- Potential local spawning subpopulations
  - Local overfishing?
- Shift from spring spawners to autumn spawners?
  - Small increase in autumn spawners seen in data, but no support for a shift
- Grey seal predation
  - General long-term increase in seal numbers in Gulf of Bothnia
  - Reduction in Bothnian Sea over the last 4-5 years
  - Can have large local impact on herring abundance and fishermen gear
  - Overall impact on the stock unknown

Ongoing projects at SLU Aqua

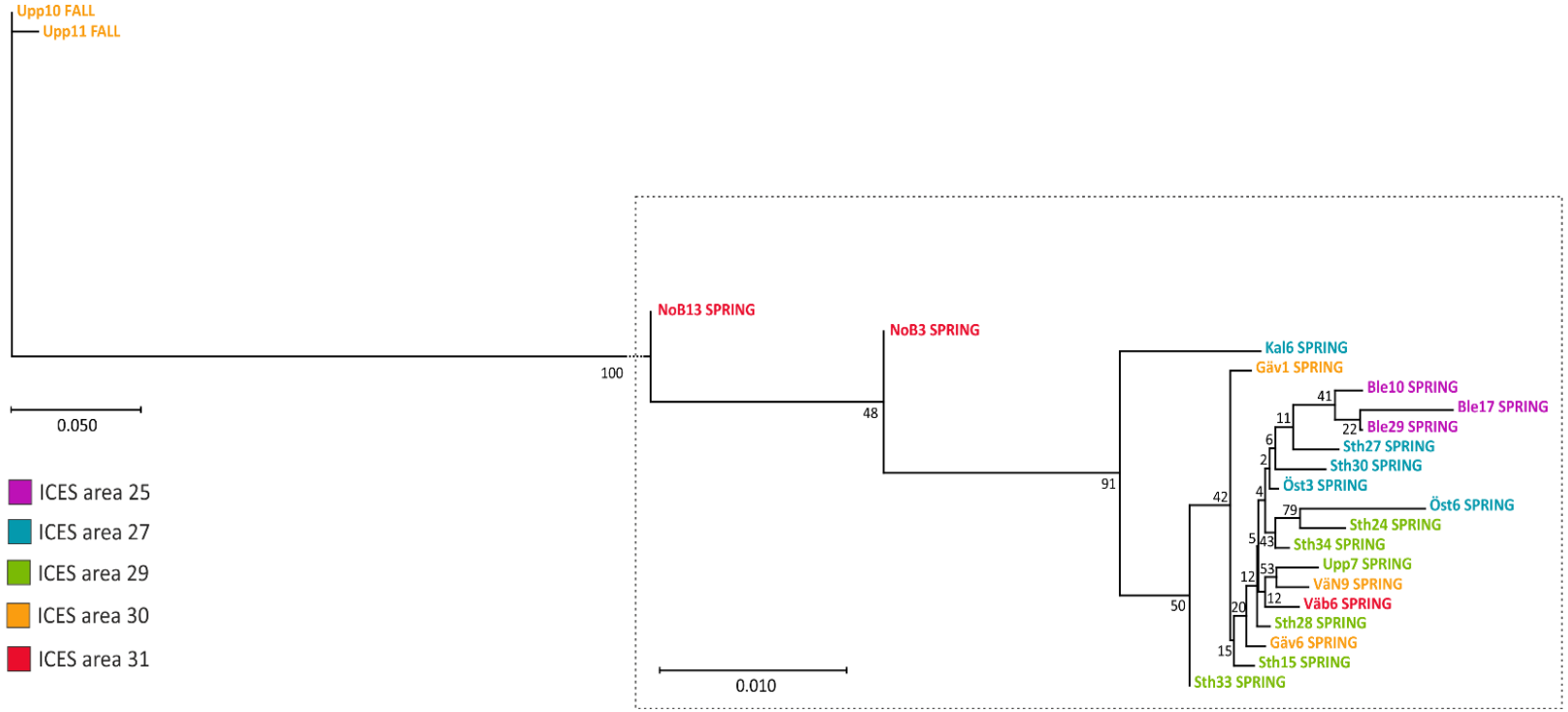
- Genetic stock identification
  - Genetic sequencing of a large number of samples along the entire Swedish coast.
  - Aim: To identify potential subpopulations differing in spawning location/time

- Studies of maturation stage and body condition in herring over time. Data from fisheries and BIAS (Baltic International Acoustic Survey).
  - Aim: Study temporal shifts in body condition and number of spawning herring as well as frequency of spring vs. autumn spawners.

- Studies of grey seal diet on species and size composition.
  - Aim: Increase knowledge on interactions between the fish community and predators.

Genetic stock identification

Pilot study in 2021/2022 with focus on SD 27 and 29 using available genetic markers primarily associated with **spawning time** showed marked **differences between spring- and autumn spawners**, as welll as **signs of local populations within spring spawners**.



Ongoing work: genetic sequencing of a large number of samples along the entire Swedish coast, using genetic markers selected to maximise genetic differences in the Baltic Sea.
Sampling of the pelagic fisheries to identify what populations are fished in the large scale fishery.

Thank you!

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