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NATURAL RESOURCES
INSTITUTE FINLAND

Herring in the Bothnian Sea and the Bothnian Bay

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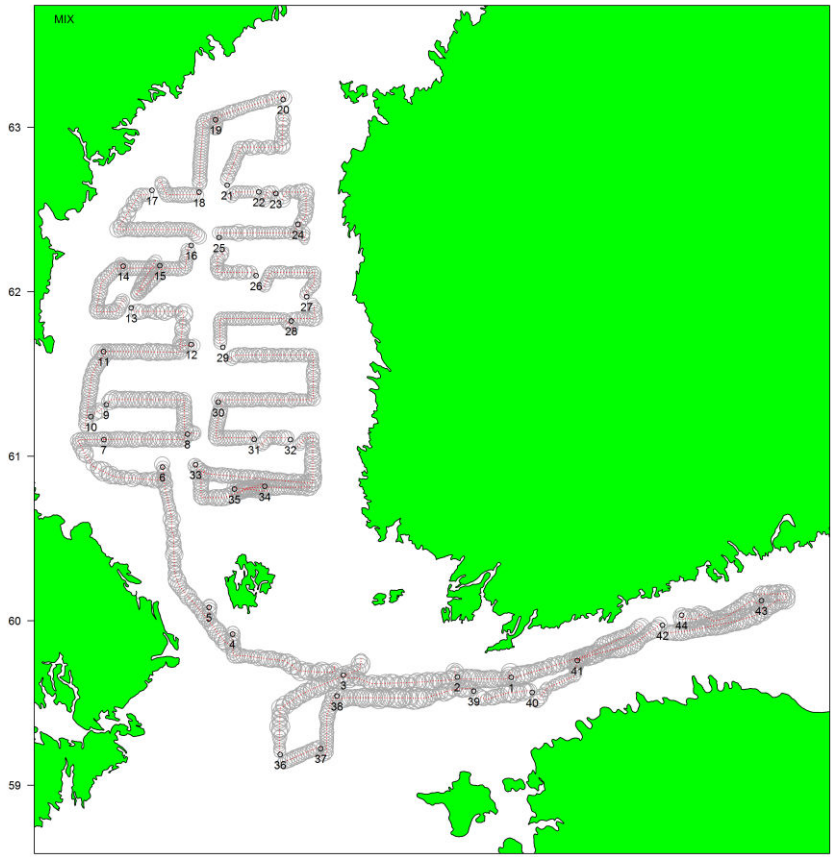
A serious change was noted in the Bothnian Sea herring in the autumn survey of 2021

The route of the annual survey (BIAS) in 2021.



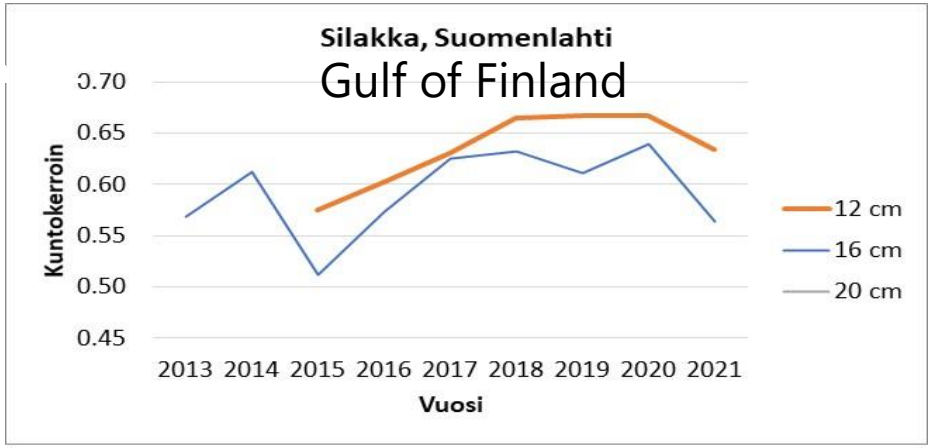
Selected poor conditioned specimens of herring

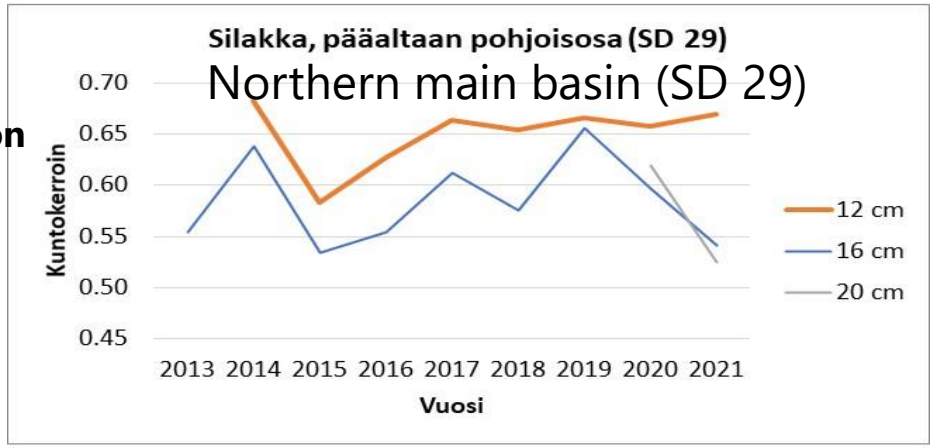
Sept-Oct survey 2021

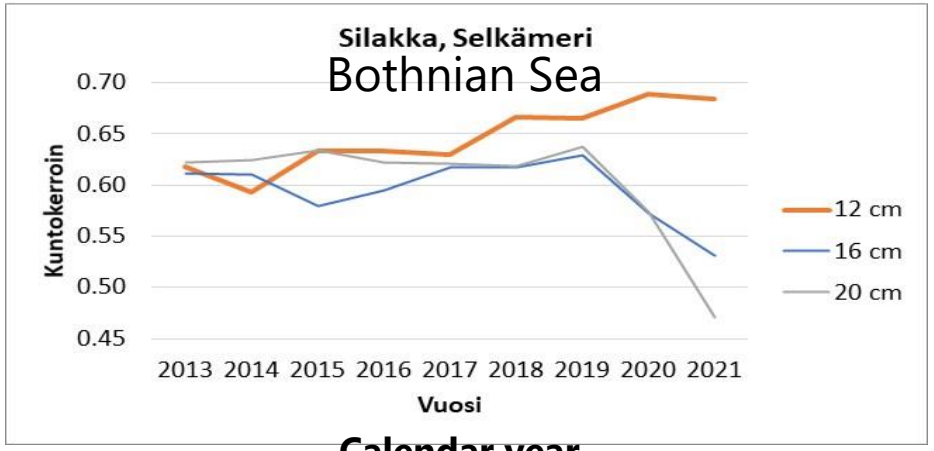
Fulton's condition

$$= \frac{\text{weight}}{\text{lenght}^3}$$

Notice: In this time of year, 20 cm long herring are almost missing in SD 29 and SD 32 (they are also Missing in the Gulf of Riga).



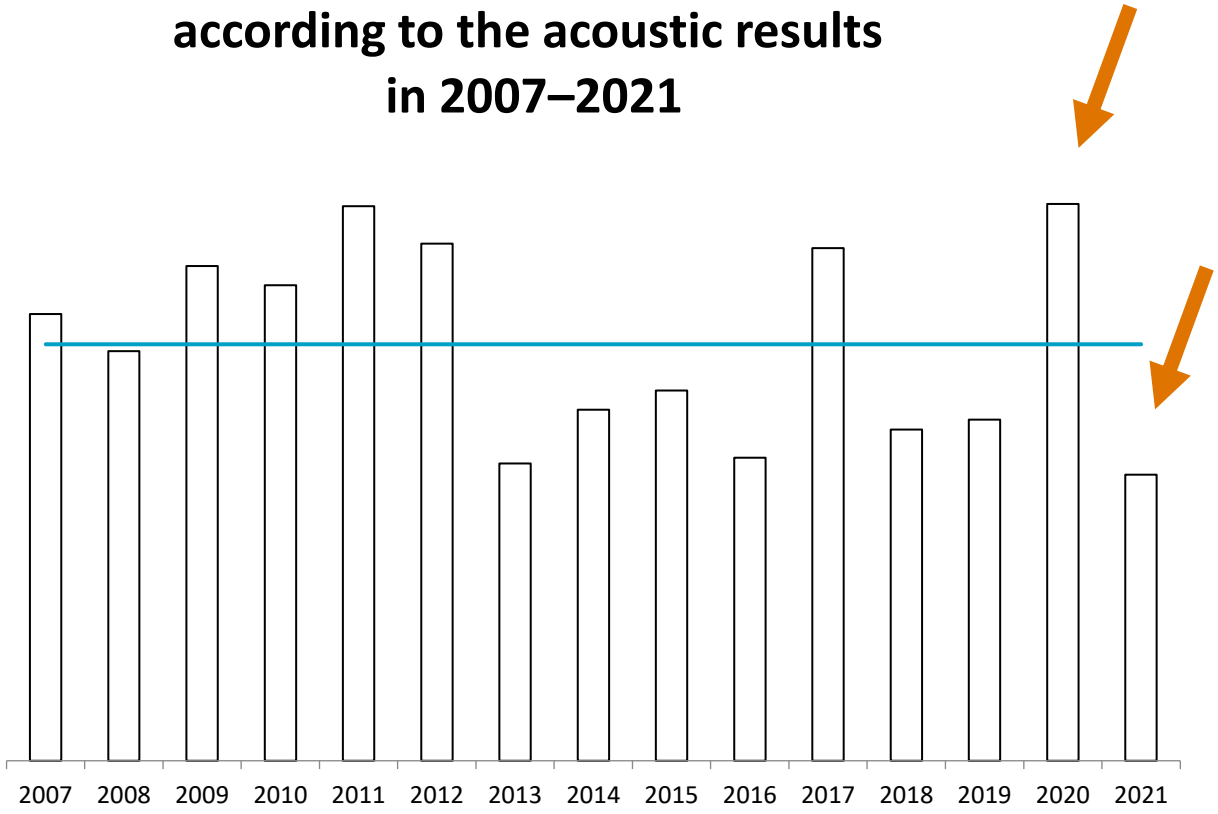




Calendar year

Herring surveys in the Bothnian Sea in the autumns of 2020 and 2021 gave odd results

The abundance of herring (in number) according to the acoustic results in 2007–2021



In September-October of 2020, it looked that there were a lot of young herring, especially of the year class 2018.

This, i.e. increased competition, was thougth as a probable reason to the decreased condition of herring.

One year later, the results suggested such a decrease in the number of herring that it could not be explained by fishing. And still, the condition of herring had continued to decrease.

Unlike the year before, fishers were also of the view that the number of herring had decreased.

Selected poor conditioned specimens of herring

Sept-Oct survey 2021

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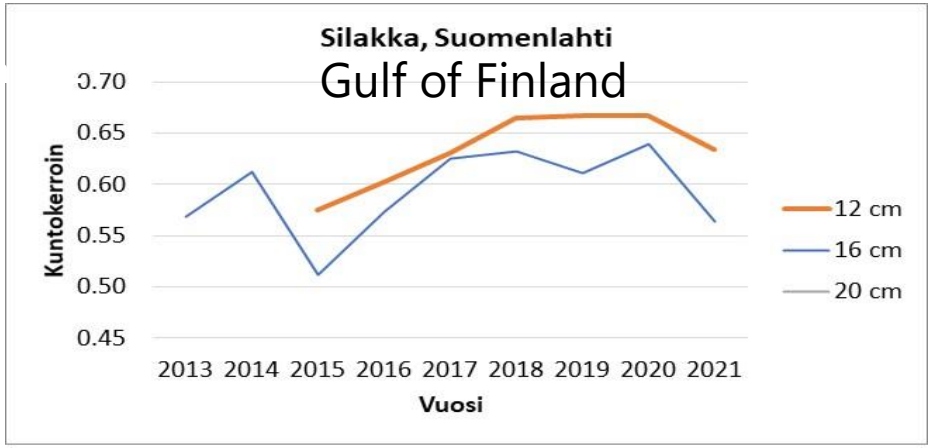
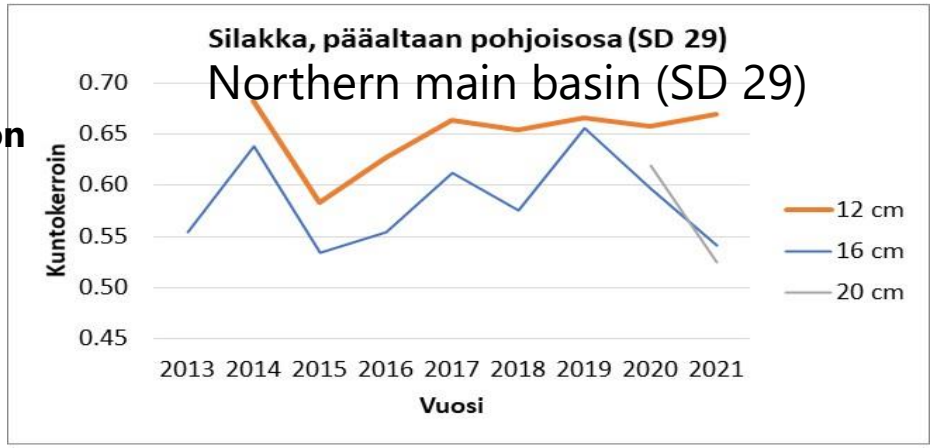
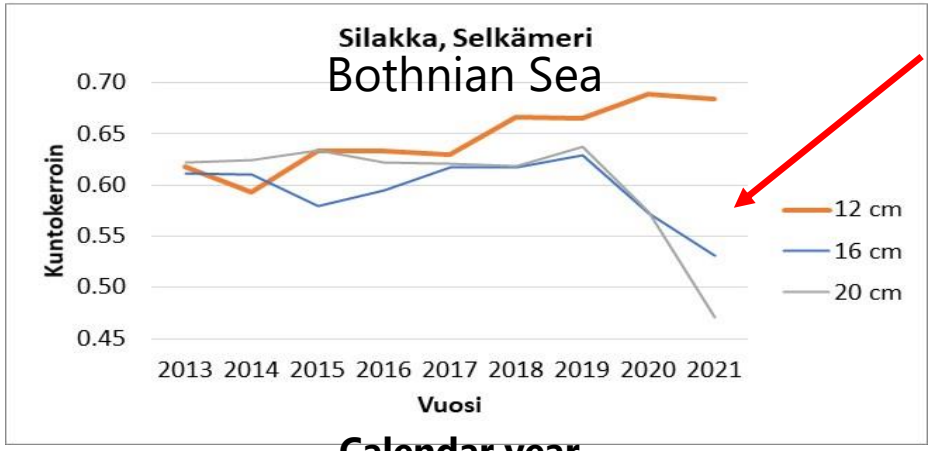
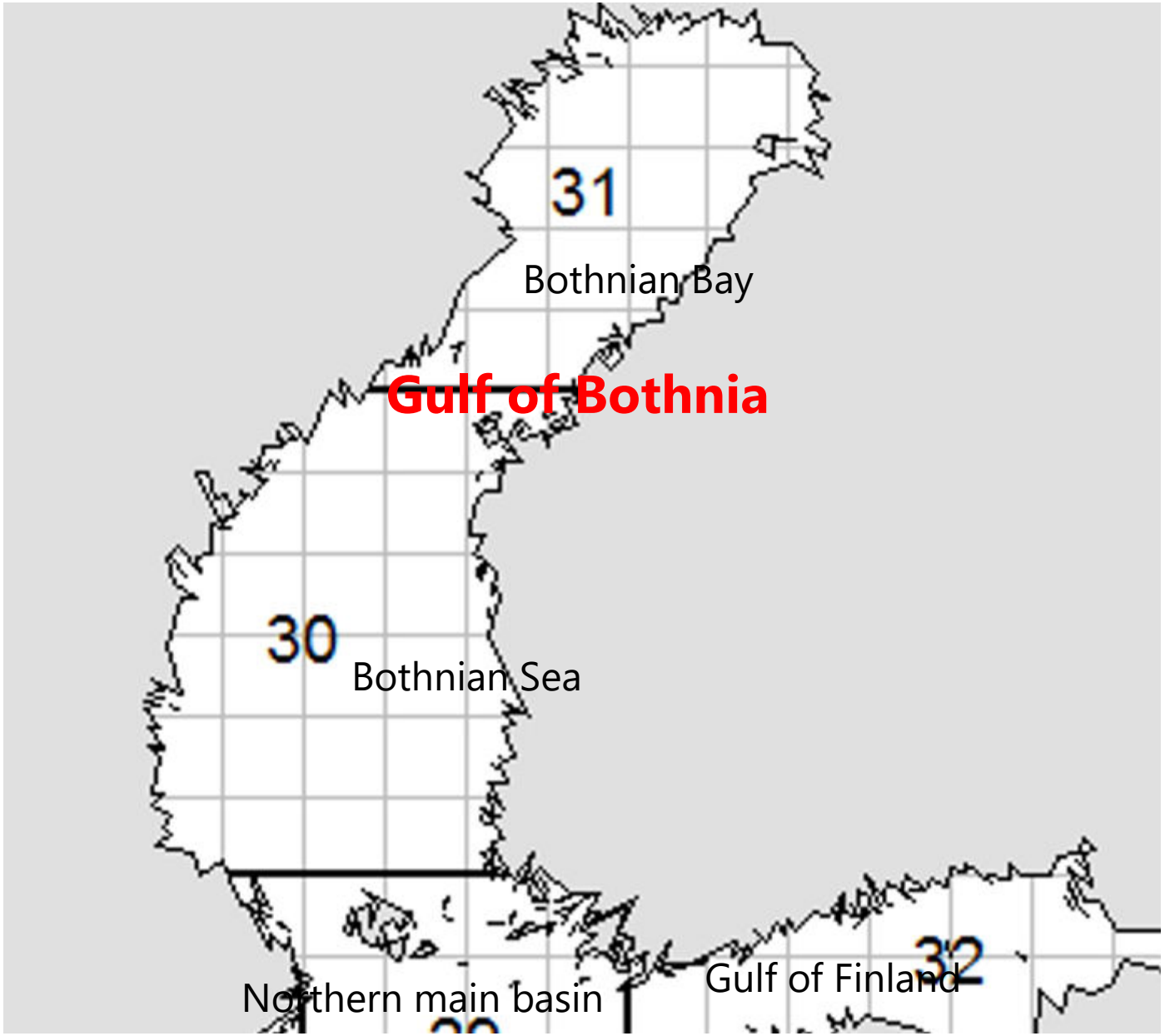




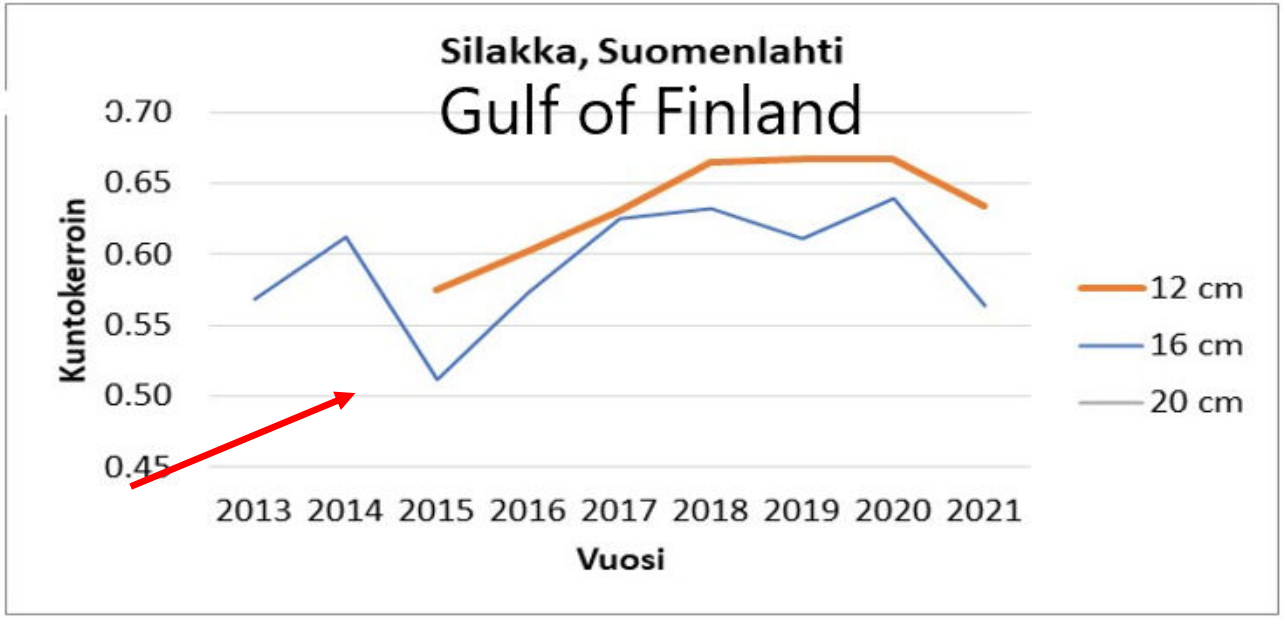


Calendar year



Large herring in poor condition, small in good condition: what have they eaten or what have they not been able to eat?

In the survey in the Gulf of Finland in 2015, the herring were in very poor condition. In the same survey, we saw very large numbers of sprat of the 2014 year class. Even large sprat were in poor condition, but small sprat in good contidion. Then, competition looked a very clear explanation.



What is the situation of the prey of large herring?

Among the trawl catch in herring surveys, **mysids** (c. 2 cm) are sometimes seen in large numbers. In such years during the time when Bothnian Sea surveys have taken place, the large herring have been in a good condition (about 2013–2015?). In 2021, mysids were practically missing, i.e. they were seen only among the catch of one haul.

Photo: Maiju Lehtiniemi, SYKE

The Finnish Environment Institute monitors the abundance of ***Monoporeia***. Their numbers vary in cycles, and in recent years, the abundance of *Monoporeia* has been very low.

Photo: Jan-Erik Bruun, SYKE

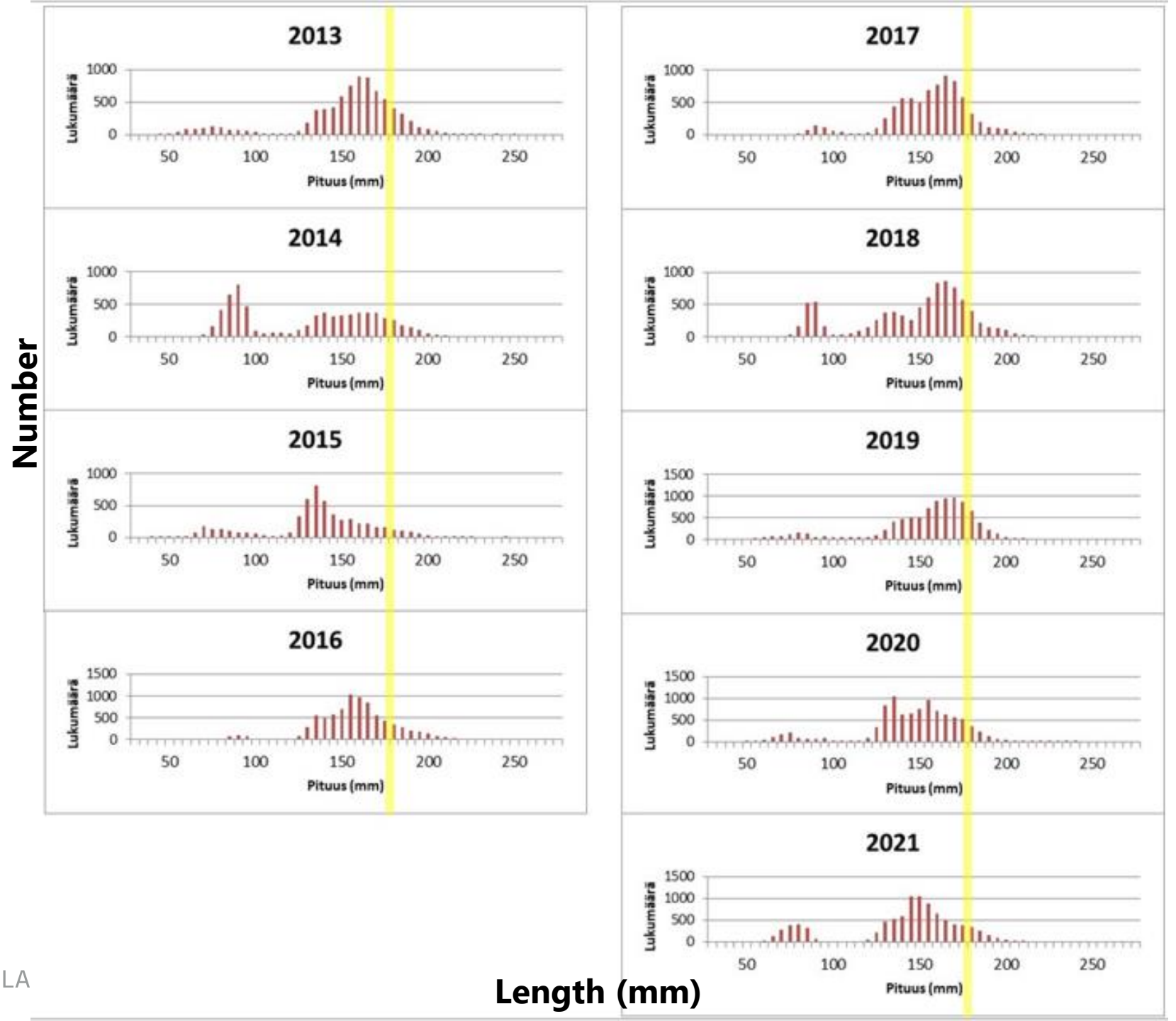
In the studies of e.g. the University of Turku, mysids and Monoporeia have been found very important prey for the large herring.

Cannibalism of herring in the Bothnian Sea

- In the survey of 2021, we got occasionally surprisingly large numbers of very small (3.5 cm long) herring fry and large, poor conditioned herring (above 20 cm) in the same trawl catch
- studies somewhat controversial: accorging to some, cannibalism is rare (Rajasilta pers. comm.), in a study from archipelago, fish fry were common food for large herring (Parmanne et al. 2004)
- Site, timing, depth?

Length distributions of herring in the surveys in the Bothnian Sea in 2013 - 2021

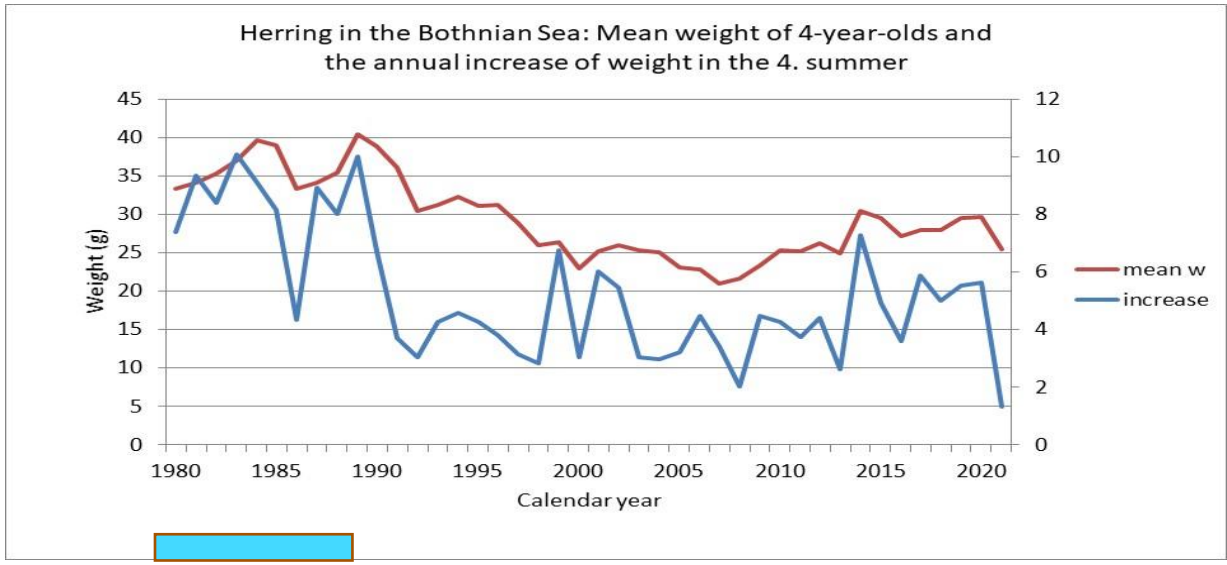
The survey of 2022 just going on or ending, but it looks that the number of the largest herring has continued to decrease.



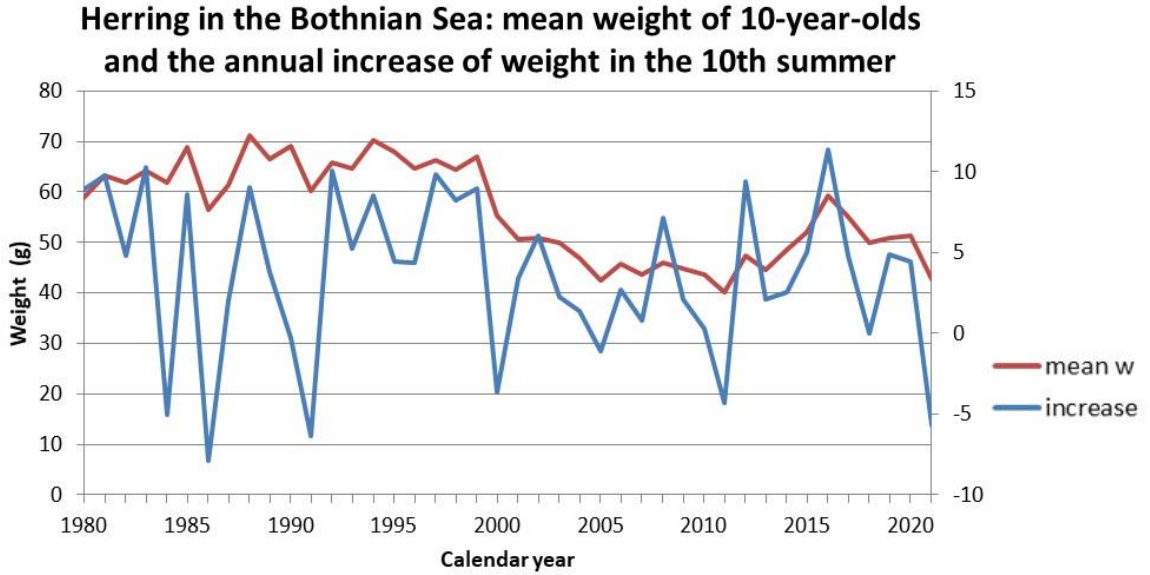
The growth of herring in the Bothnian Sea

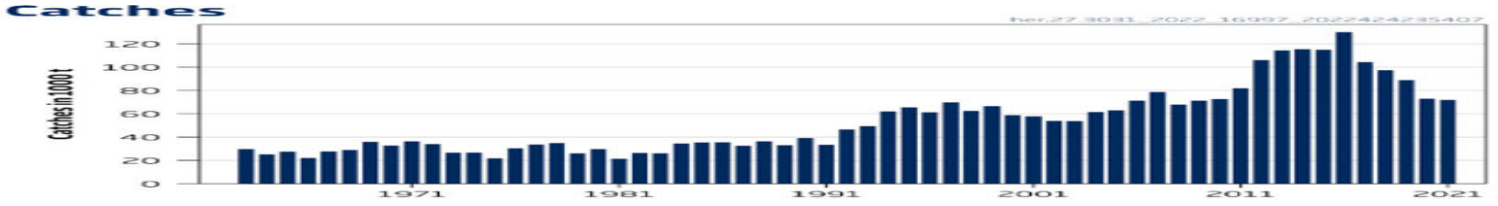
In practice, the largest herring size groups have not grown more size. E.g. on average 10-year-old specimens lost weight in 2021 when compared with 2020 (figure below). The year class of 2008 lost on average 9.5. g of weight in the same time.

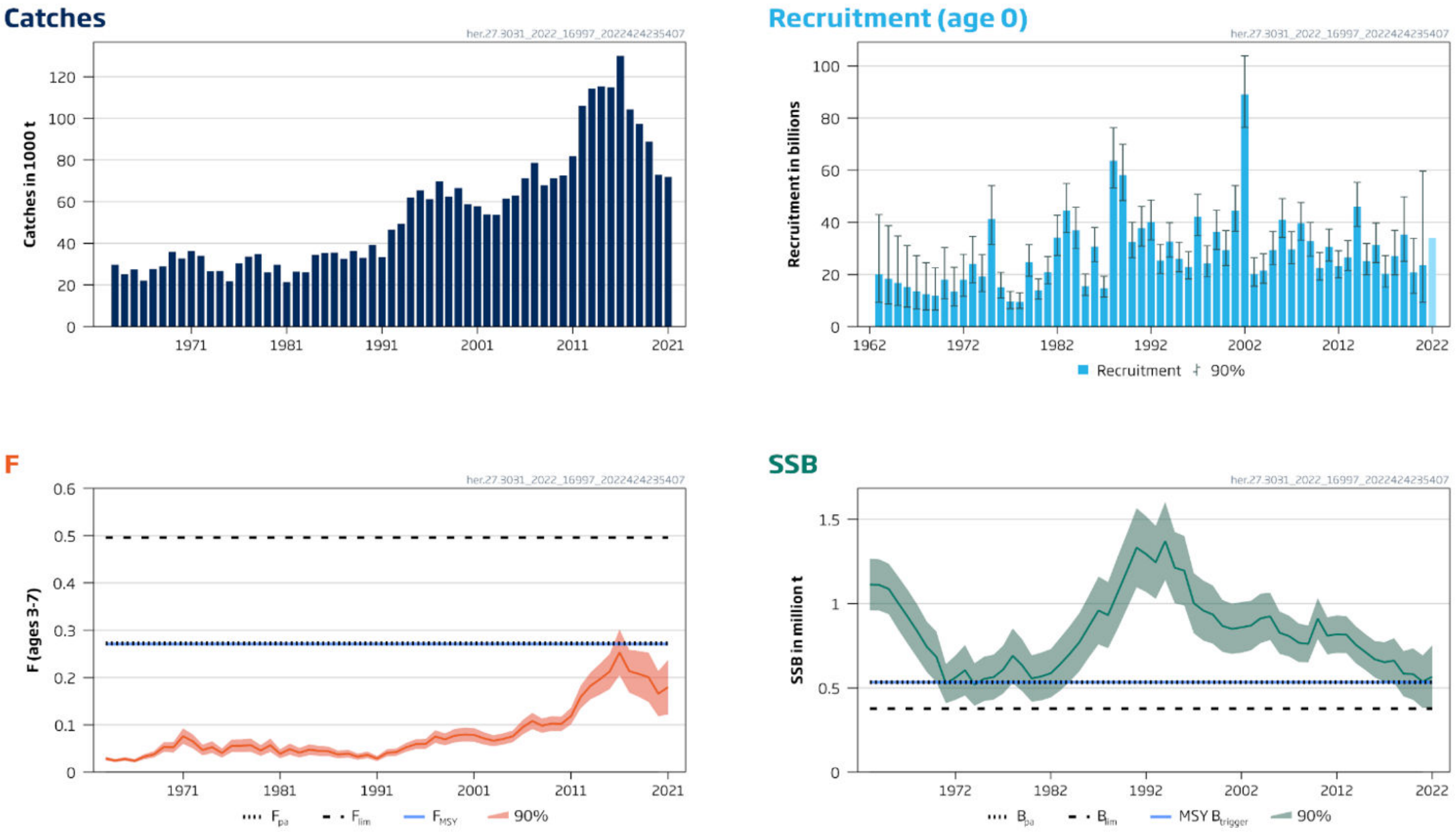
Thus, when the specimens of the size groups with biggest individuals have died or have been fished, younger age groups have not grown to replace them; instead, specimens in younger age groups remain smaller in size. In 2021 and 2022, a large number of starving herring may have died in starvation.



1 ‰ higher salinity







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Figure·1 → Herring·in·subdivisions·30·and·31.·Summary·of·the·stock·assessment.·The·assumed·recruitment·value·for·2022·is shaded·in·a·lighter·colour.¶

What is the situation of the prey of large herring?

The reduced numbers of prey for large herring in 2020 and 2021 are probably the consequence of bottom-up effects, not top-down.

The Finnish Environment Institute monitors the abundance of ***Monoporeia***. Their numbers vary in cycles, and in recent years, the abundance of *Monoporeia* has been very low.

In the studies of e.g. the University of Turku, mysids and Monoporeia have been found very important prey for the large herring.

Photo: Maiju Lehtiniemi, SYKE

Photo: Jan-Erik Bruun, SYKE

Grey seals have lost weigth: a consequence of herring with poor condition

Kauhala, K. & Kurkilahti, M. Mammal Research (2019). Delayed effects of prey fish quality and winter temperature during the birth year onadult size and reproductive rate of Baltic grey seals.
https://doi.org/10.1007/s13364-019-00454-1

”We conclude that both changes in prey fish quality and climate may affect body condition of pups and thus also cause delayed effects on adult fitness: body size and reproductive rate of Baltic grey seals.”

Kauhala, K., Korpinen, S., Lehtiniemi M. & Raitaniemi, J. 2019. Reproductive rate of a top predator, the grey seal, as an indicator of the changes in the Baltic food web. Ecological Indicators 102 (2019) 693–703.

“Our results showed that the birth rate of grey seals was significantly related to herring (*Clupea harengus membras*) and sprat (*Sprattus sprattus*) quality (weight)”

In neither studies a connection between herring abundance and the condition of grey seals was found. It seems that the seals find the herring ok, but catching the fish takes always energy, and thus the fat content of the herring is essential to the seals.

Fresh observations from the first week of BIAS in 2022

- The number of large (total length around 20 cm) herring has continued to decrease
    - Most of them are still in poor condition
- The herring of smaller size, ≤ 16 or 17 cm of lenght are pretty ok, although not the fattest we have seen
- the acoustic experts were not able to say yet, whether the abundance of herring had changed or not from 2021
- In the same night time hauls, when all pelagic fish are in the uppermost water layers, the catch often included all size groups of herring including large specimen in poor condition and e.g. small sticlebacks (c. 3 cm lenght), and in some hauls small herring (5–6 cm), as well (in 2021, 3.5 cm herring larvae were exceptionally abundant in the catches)
- The abundance of sticlebacks varied a lot in different parts of the Bothnian Sea, from very sparce densities to huge densitities in the central Bothnian Sea
- News from this morning: the large herring were missing in the Finnish side, as well, but the in the Finnish side the herring seemed to be in better condition than in the Swedish side
- There seemed to be more sticklebacks in the Swedish side, but this is just an impression of what was seen

How to proceed?

In Finland, we are planning to concentrate on 1) the stomach analyses of herring and 2) analysis of environmental and herring data .

In southern Bothnian Sea and the Archipelago Sea, researchers in the University of Turku have examined herring stomachs in recent years. This is planned to be continued.

In recent studies, several zooplankton species have been the most common prey of herring, and mysids and *Monoporeia* in larger specimens, fish have been very rare.

The biotic and abiotic data of the Finnish Environment Institute is to be analysed together with herring data.

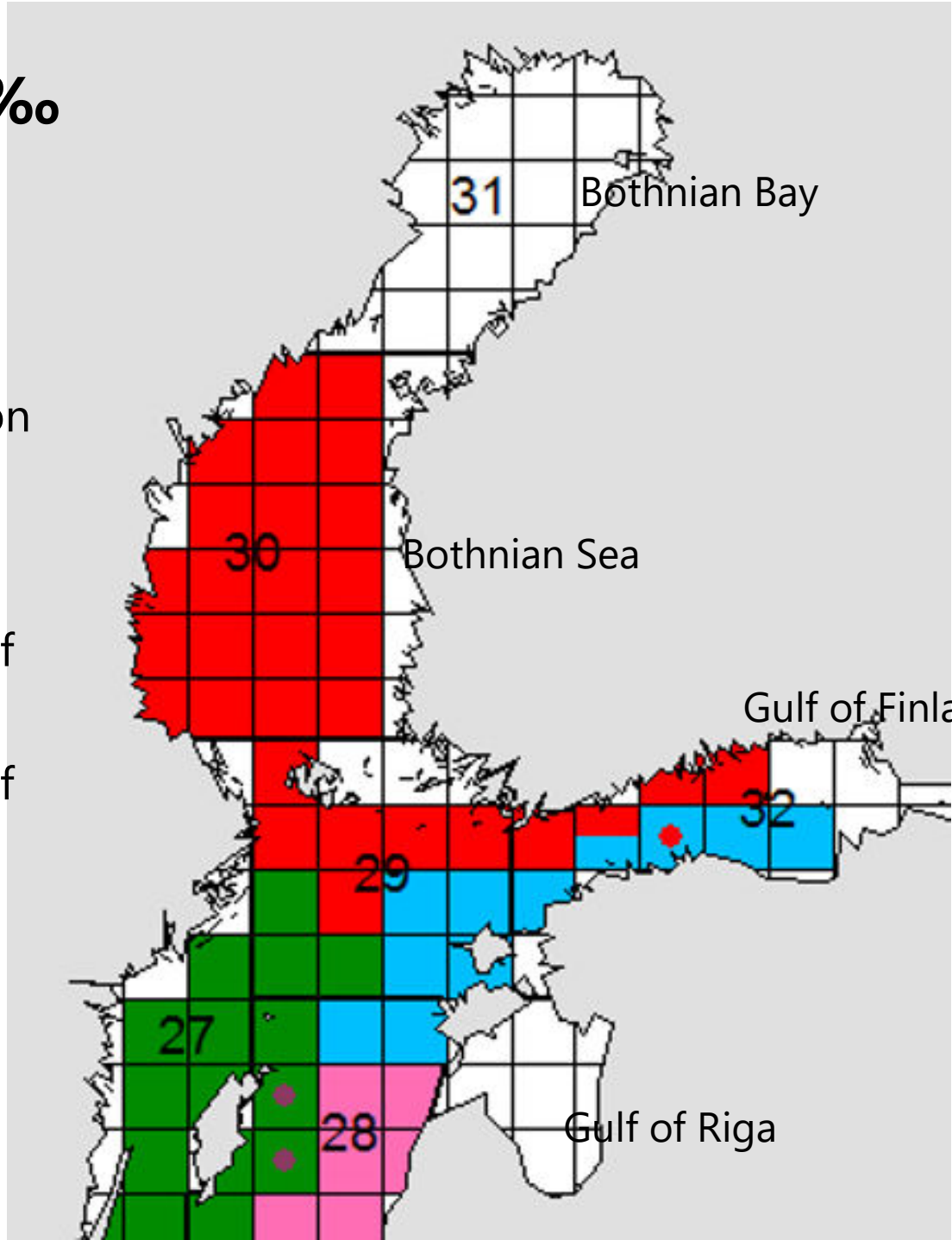
Thank you!

In the 1980's, when salinity was c. 1 ‰ higher than in later years, herring in SD:s 29-32 and the Gulf of Riga…

- were faster growing than at present
- were large sized when compared with present situation

Since then, herring in the Gulf of Bothnia

- have normally grown to larger sizes than in the Gulf of Riga (where they are the smallest)
- have normally grown to larger sizes than in the Gulf of Finland and the northern main basin (south of Åland)



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