# Acoustic monitoring in the central Arctic Ocean

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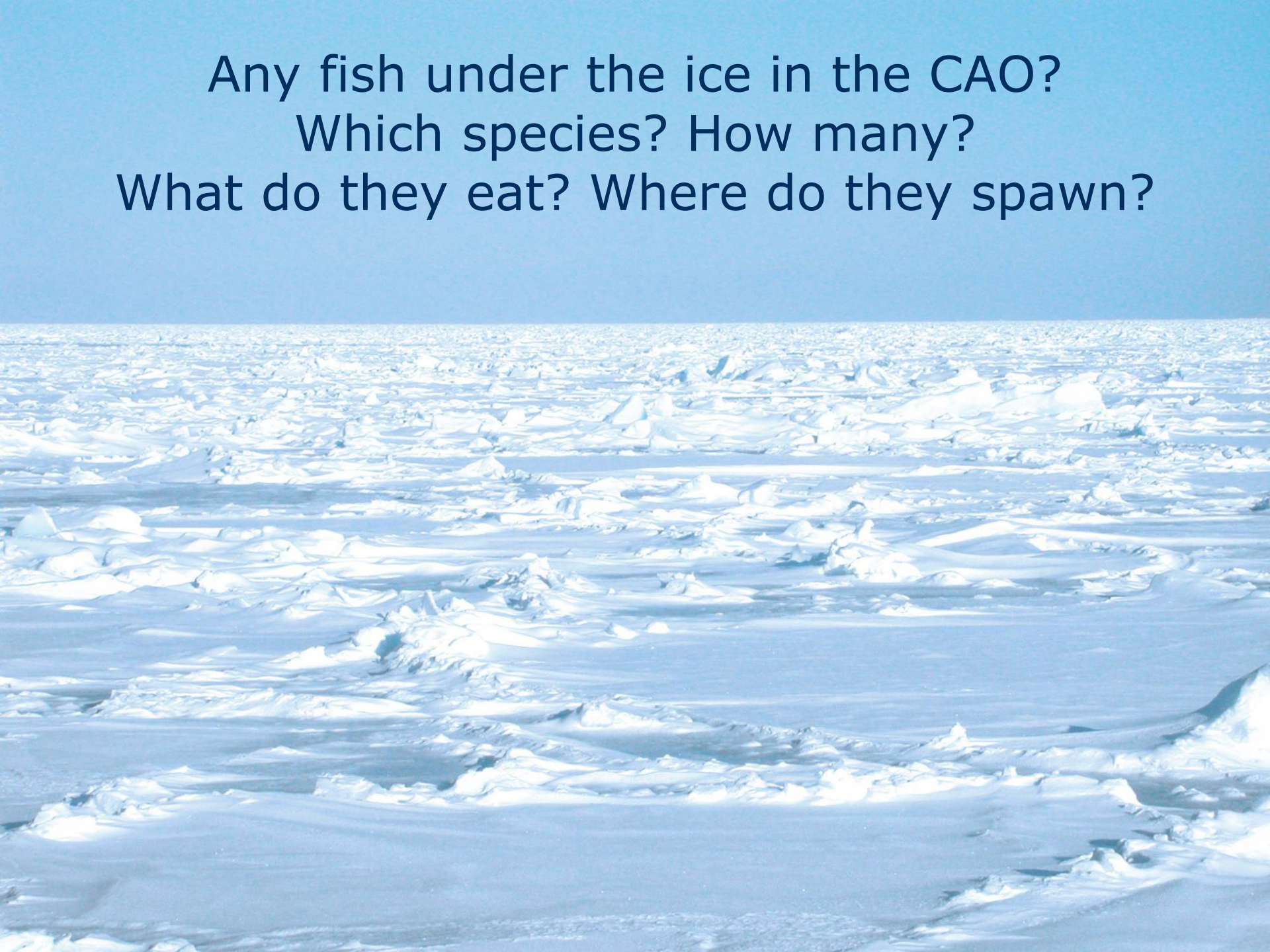
# Any fish under the ice in the CAO?
# Which species? How many?
# What do they eat? Where do they spawn?



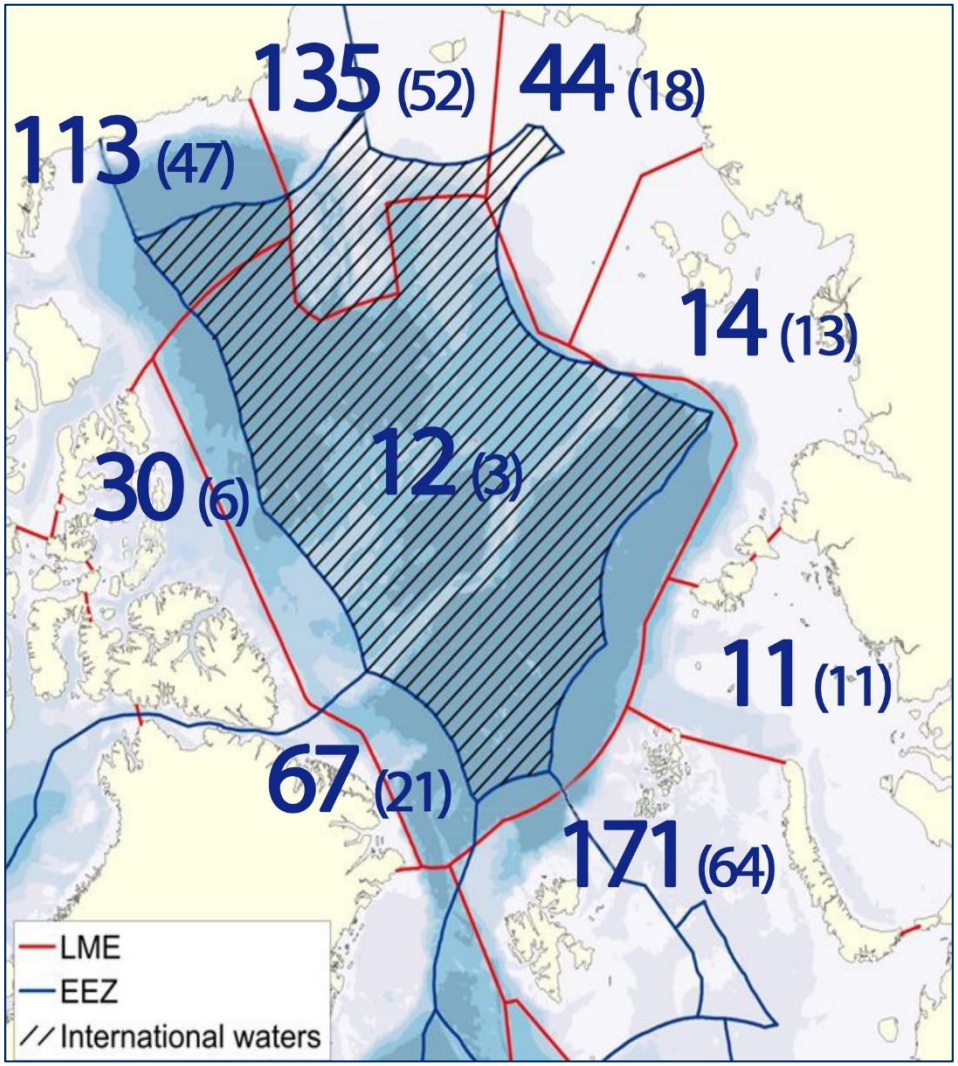
# To get there you need a strong icebreaker

SWEDISH MARITIME ADMINISTRATION
ODEN
www.sjofartsverket.se
ODEN
NORRKÖPING

POLARSTERN

# Fish species diversity documented today

(shelf seas 339, high seas 12 BUT many uncertainties!)




Data: FiSCAO Synthesis

# Commercial species in CAO?

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- As known today, there is probably very few of the species documented in the CAO that might serves as basis for any fishery; mainly the *Boreogadus saida* and the *Arctogadus glacialis*
- While *Boreogadus* has been fished commercially in the Barents Sea, any catches has hardly been taken during recent years, and it is an open question whether this species would be found worth exploiting in the CAO even if it should be found to be abundant there
- Besides, it is a forage fish that serves as food for sea mammals and sea birds

# What we know about Boreogadus and Arctogadus

## *Boreogadus saida*

Photograph by B.A. Sheiko and C.W. Mecklenburg

- Fish meal, oil (fisheries only Russia)
- Cryopelagic 0-1400 m
- Up to 40 cm
- Has a swim bladder (acoustics)

- Highly abundant (forms schools)
- Arctic circumpolar, incl. North Pacific and North Atlantic (Iceland)

- Feeds on epibenthic mysids, also amphipods, copepods and fishes
- Preyed upon by narwhals, belugas, ringed seals and seabirds

## *Arctogadus glacialis*

Photograph by C.W. Mecklenburg

- Little economic value
- Cryopelagic 0-1000 m
- Up to 30 cm
- Has a swim bladder (acoustics)

- Much less abundant than *Boreogadus*
- Arctic circumpolar, much smaller range than *Boreogadus* (Atlantic side)

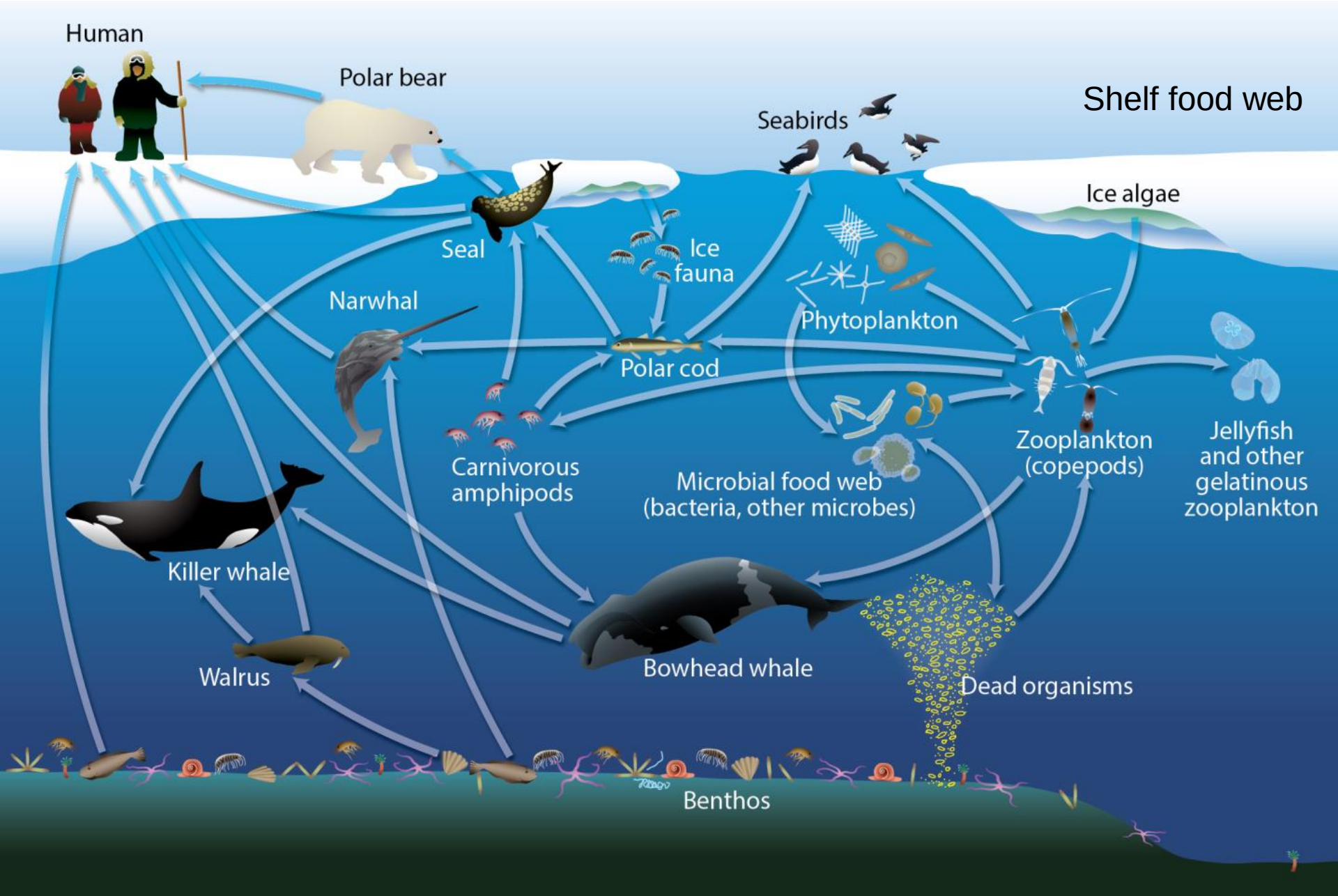
- Feeds on crustaceans and fishes
- Preyed upon by narwhals and other Arctic whales

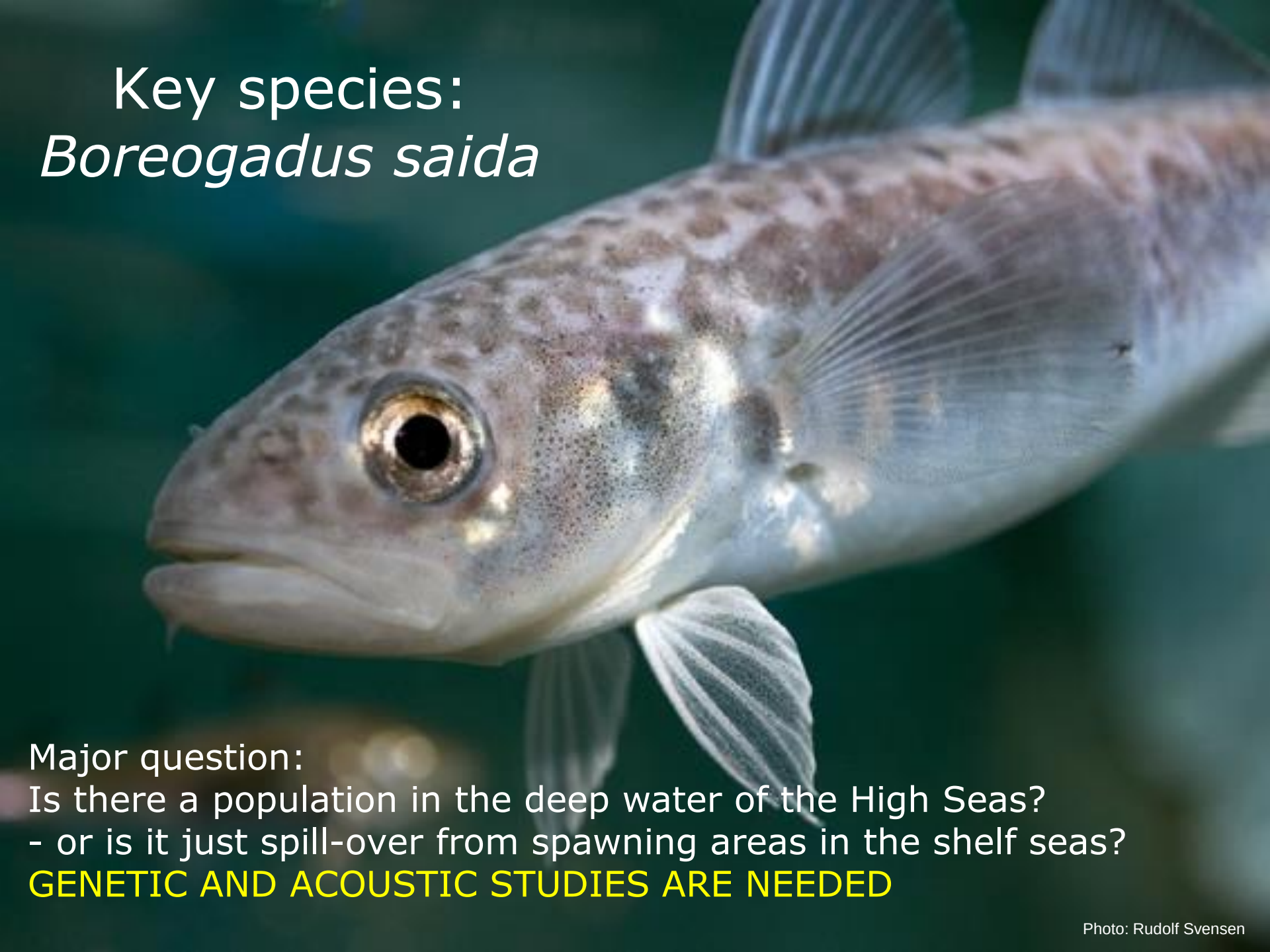
# Key species:
# *Boreogadus saida*

- Intermediate trophic position – central in the food web
- The only one !

Photo: Rudolf Svensen

# Food web in the CAO (ice edge)





# Key species:
# *Boreogadus saida*

Major question:
Is there a population in the deep water of the High Seas?
- or is it just spill-over from spawning areas in the shelf seas?
GENETIC AND ACOUSTIC STUDIES ARE NEEDED

Photo: Rudolf Svensen

# Present knowledge

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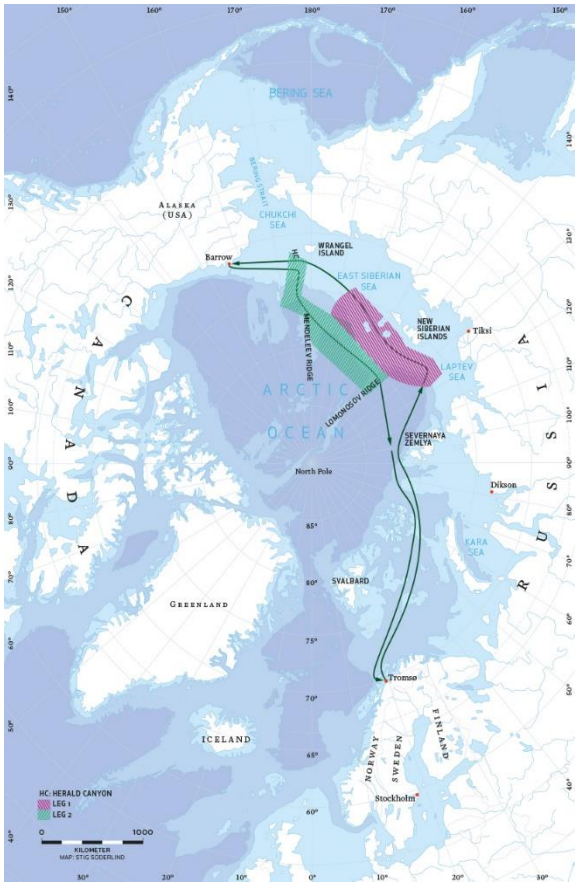
- A recent study found 1-2 year old *Boreogadus saida* associated with pack ice in the CAO (David et al. 2016). They were feeding on ice amphipods. Hypothesis: sea ice is nursery habitat that drifted from spawning areas in the Laptev and Kara Seas.
- Visual observations and sonar observations from submarines
- Echosounders on drifting ice-stations show scattering layers
- BUT no previous quantitative observations in the water column

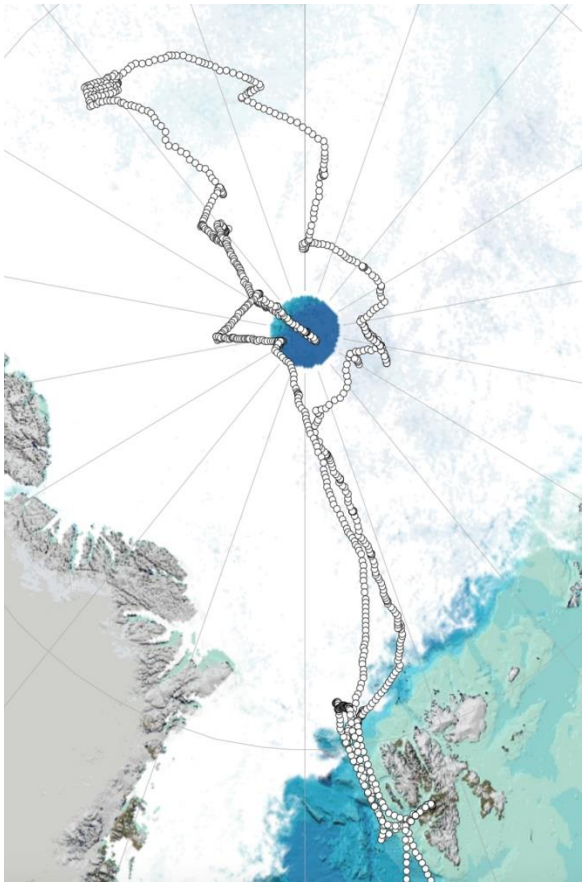
# Data collected during Oden cruises may clarify the amount of fish under the CAO ice and their distribution in the water column

Acoustics: EK80 data 2014 and 2016

Installed and operated for measuring methane bubbles




SWERUS 2014



CAO 2016

# Collaborators acoustic study

Data:
Martin Jakobsson (Stockholm University)
Katarina Gårdfeldt (Chalmers Technical University)

Data elaboration and interpretation:
Harald Gjøsæter, Randi Ingvaldsen
Tor Knudsen, Hein Rune Skjoldal
(Institute of Marine Research Bergen)

# Methods

- Simrad EK80 broadband equipment using a 18 KHz transducer. This means that fish targets will be shown, while most plankton organisms will not, unless they are resonant at this frequency.

- The data are extremely noisy by mechanical noise when breaking ice and disturbances, from other acoustic equipment and electrical noise from other sources, perhaps also from the propellers.

- Data when the ship was stationary or slowly drifting (speed < 1 knot) could be used. About 10 stations (some very close to the North Pole).

- After sieving these data through various noise-removing filters, parts of the echograms from about 300 m down to 800-1000 m could be interpreted. In a few cases also data from the upper 300 m could be used. This is ongoing work!

# Results

- We have evidence for fish in the water column near the North Pole as well as other places in the CAO. Single-fish traces at various depths on most of the echograms, forming loose layers in some cases.

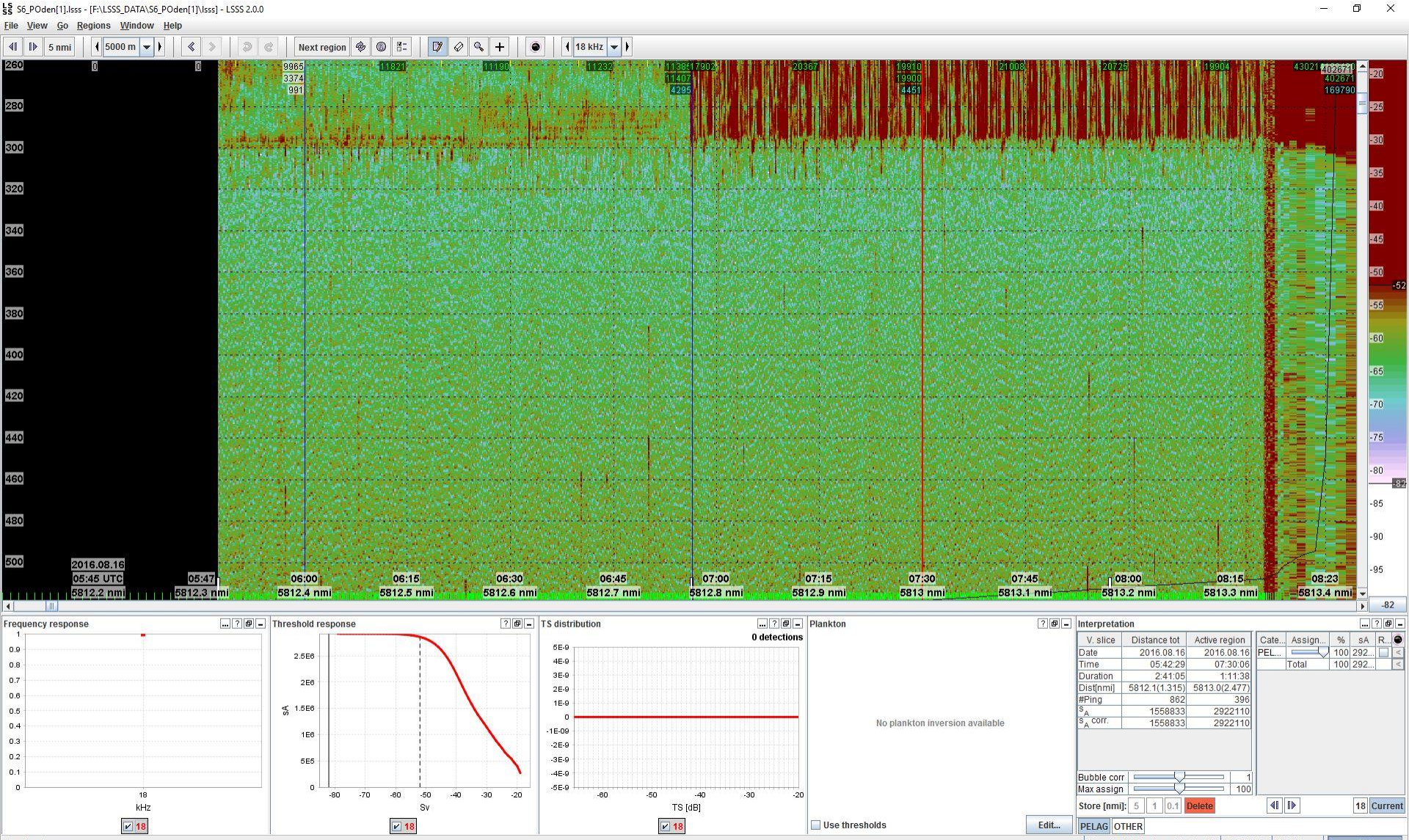
- In one echogram a school or a swarms of organisms can be seen. Since we have only one frequency (18 KHz) it is difficult to say whether those schools are fish or plankton.

- Since we have no biological samples, we don't know which species although the fish we see is most probably *Boreogadus saida*.

- The quantitative analyses are going on and we will publish this soon.

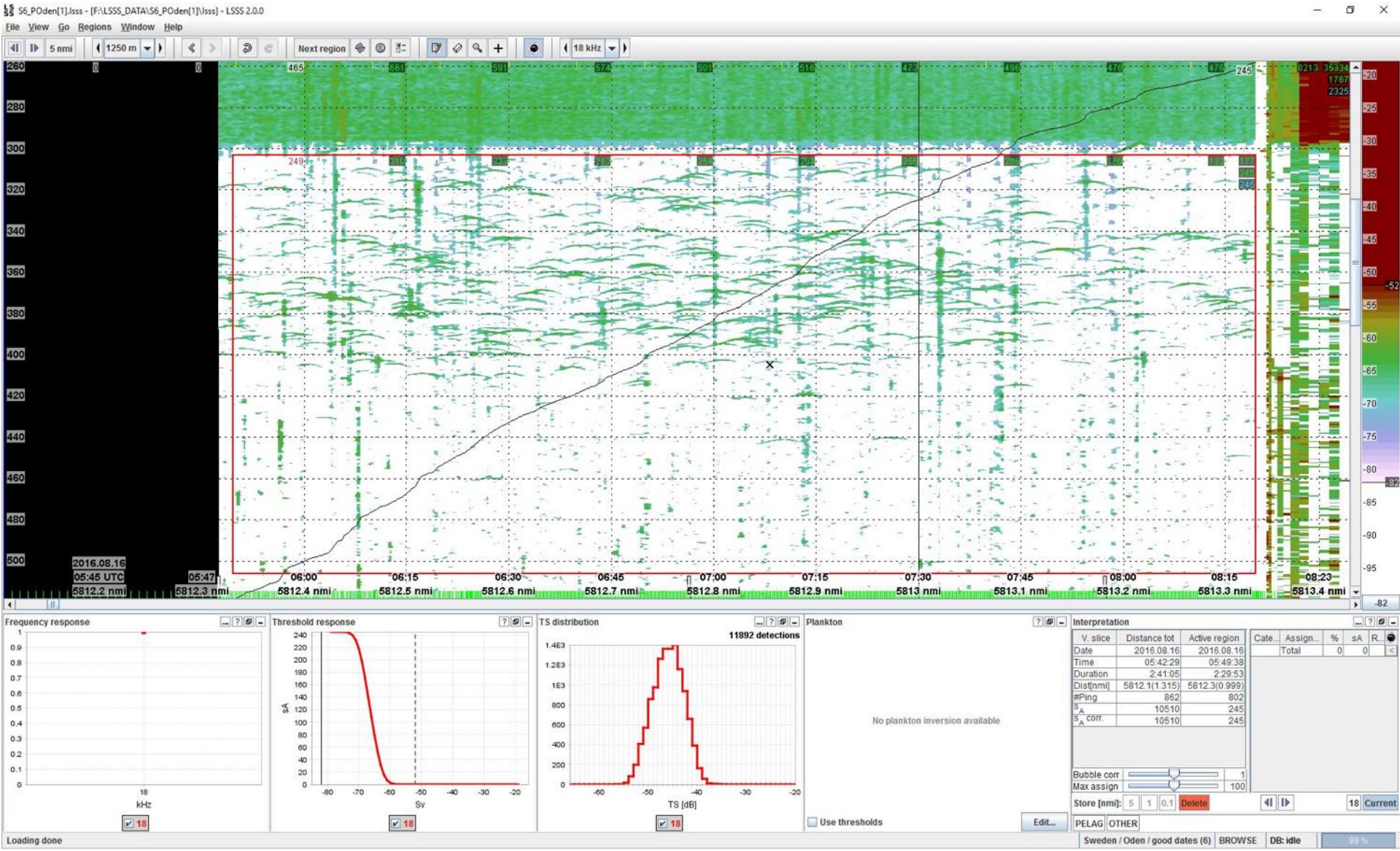
# Typical echogram of raw data (260-500 m)

## 89°25'N 66°E, 16 August 2016



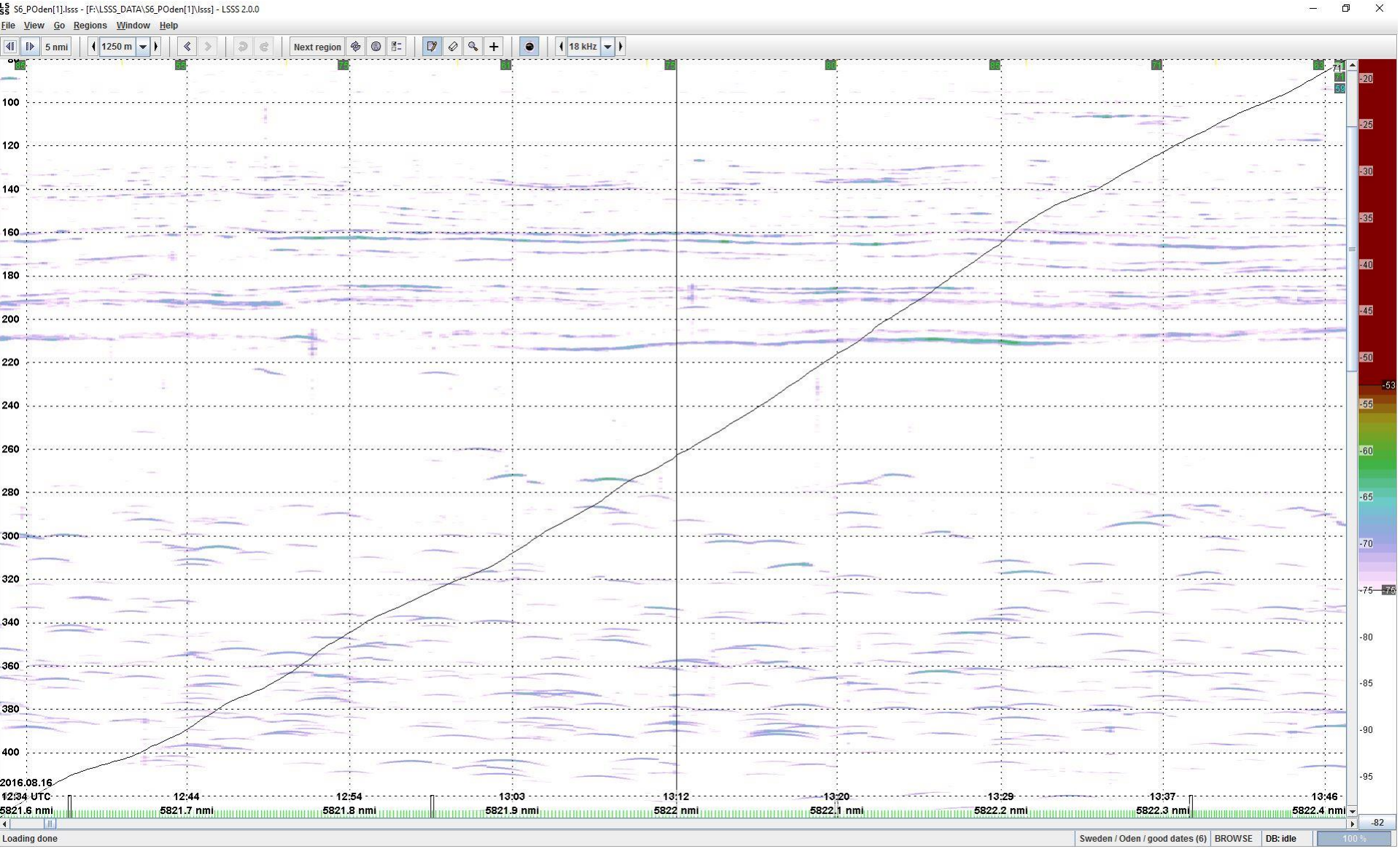
# The same echogram filtered (260-500 m)

## 89°25'N 66°E, 16 August 2016



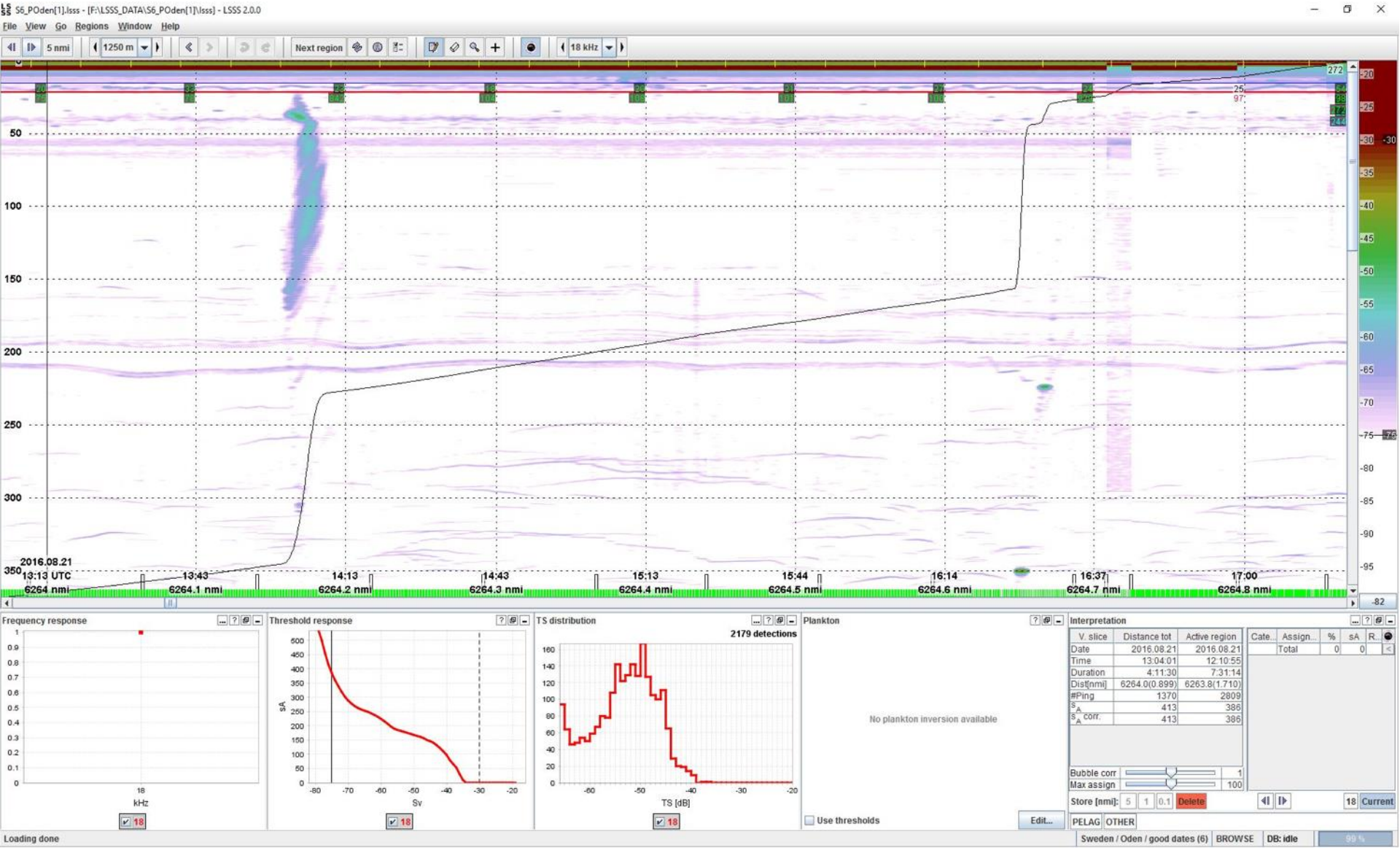
# The upper 400 m

## North Pole



# The upper 400 m

## North Pole - school



There clearly is a need for more acoustic work to obtain data with higher quality, identify species, sample fish, in different seasons, etc.

Thank you for your attention!