Vertical distribution of pelagic fish and zooplankton under the European Arctic pack ice

Pierre Priou [1], Erin Kunisch [2], Christian Katlein [3], Jørgen Berge [2,4], Rolf Gradinger [2], Hauke Flores [3], Maxime Geoffroy [1]

[1] Centre for Fisheries Ecosystems Research, School of Fisheries, Fisheries and Marine Institute of Memorial University of Newfoundland, St John's, Canada

[2] Department of Arctic and Marine Biology, The Arctic University of Norway, Tromsø, Norway

[3] Helmholtz Center for Polar and Marine Research, Alfred Wegener Institute, Bremerhaven, Germany

[4] University Centre in Svalbard, Longyearbyen, Norway

pierre.priou@mi.mun.ca

Introduction

Fish composition and distribution are thought to change in the Arctic Ocean following climate change. Boreal species are extending their northern range, and together with sea ice reduction, it could modify the life cycle and distribution of the key forage fish Arctic cod (*Boreogadus saida*). The potential migrations and occurrence of Arctic cod under the ice remain poorly documented in the European Arctic Ocean. Here, we document the vertical distribution of pelagic organisms under the pack ice in the European Arctic.

Materials and Methods
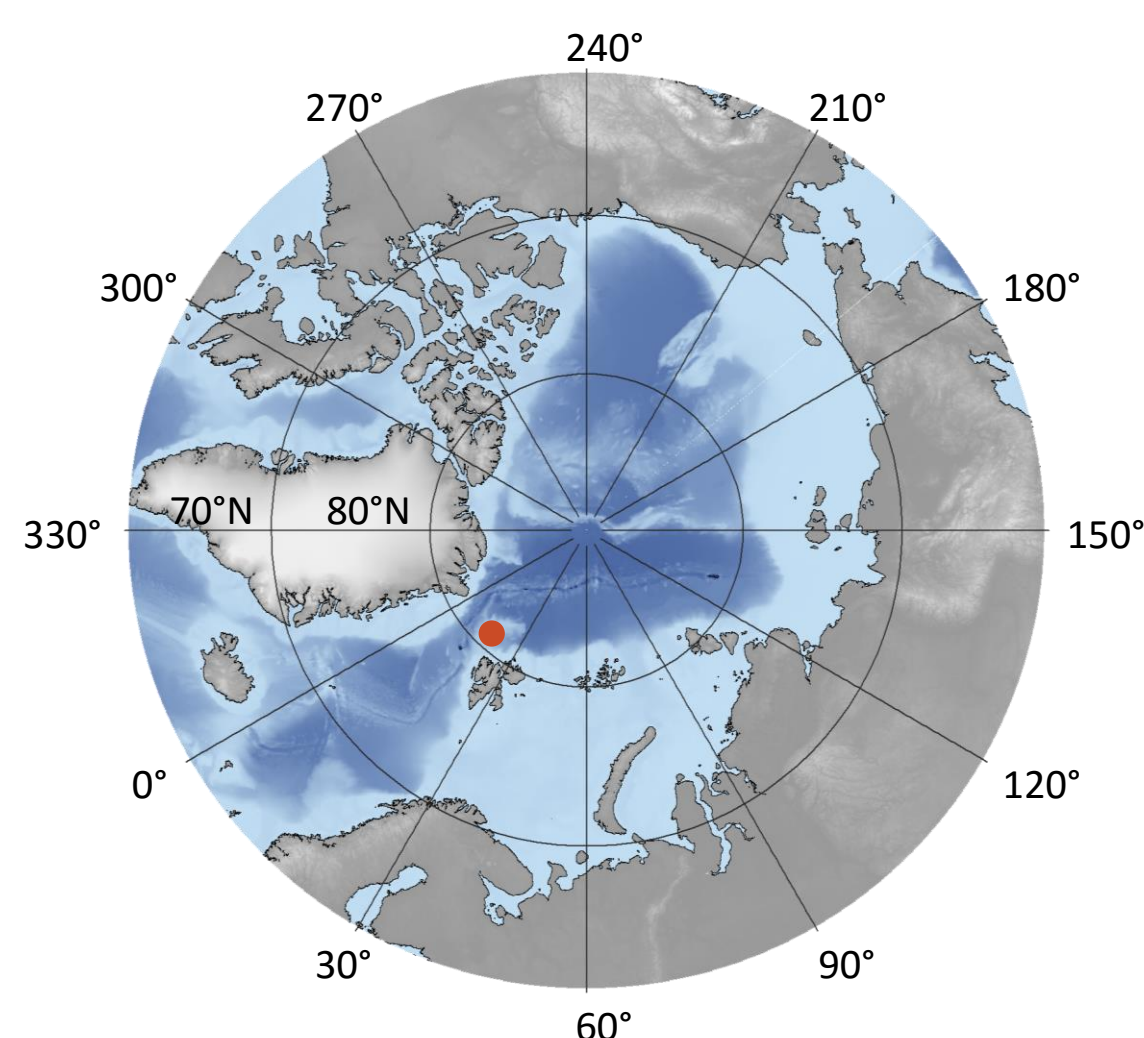
- Data were collected in the Arctic Ocean at 81.88 °N and 10.37 °E from the 9th until the 15th of June 2017.
- Two Acoustic Zooplankton and Fish Profilers (AZFP, ASL Environmental Sciences) with 4 frequencies (38, 125, 200, 455 kHz) were deployed for 6 days from an ice-tethered mooring.
- The BEAST ROV equipped with 2 cameras (horizontal and upward facing) dove 5 times during the data recording.
- The onboard echosounder (Simrad EK60 split beam) continuously recorded data at 18, 38, 70, 120, and 200 kHz during the mooring deployment.
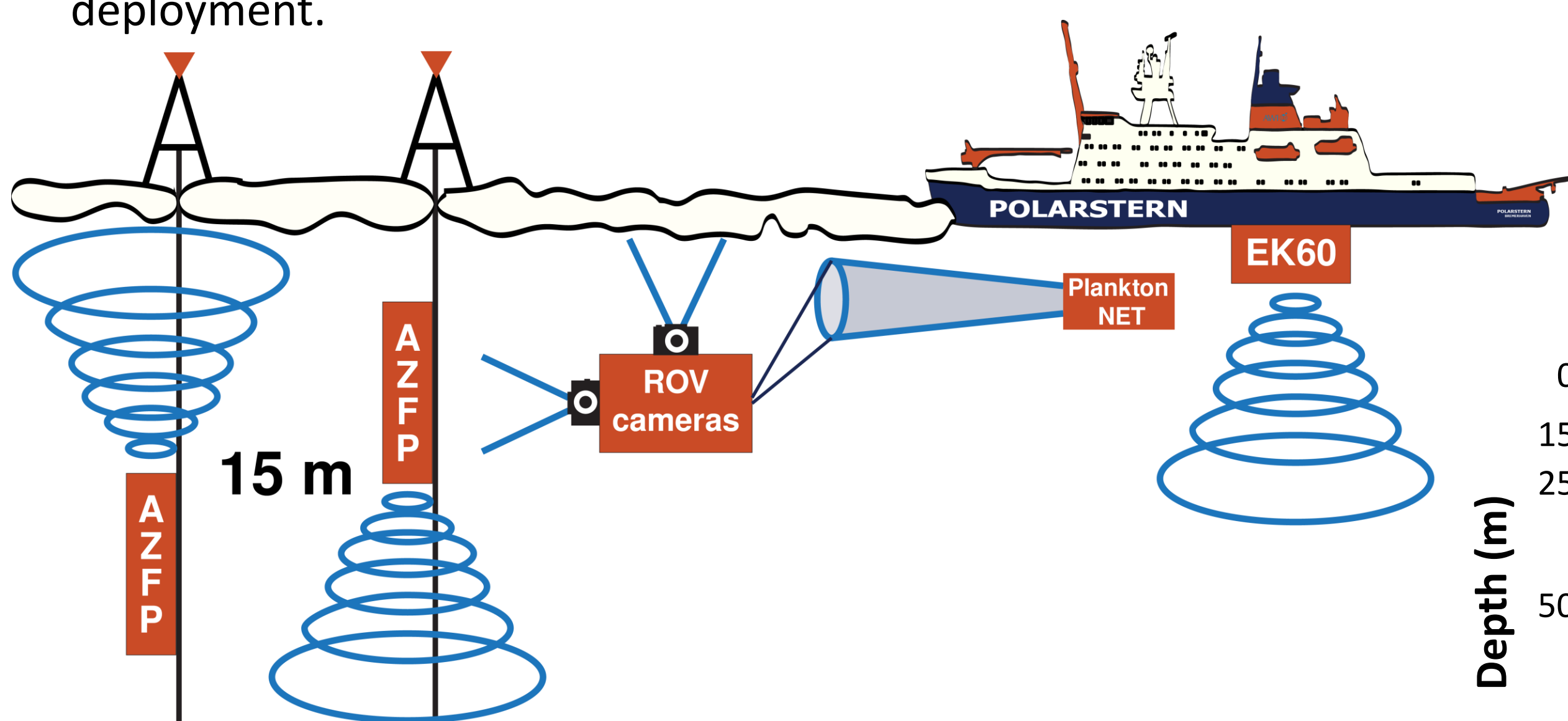

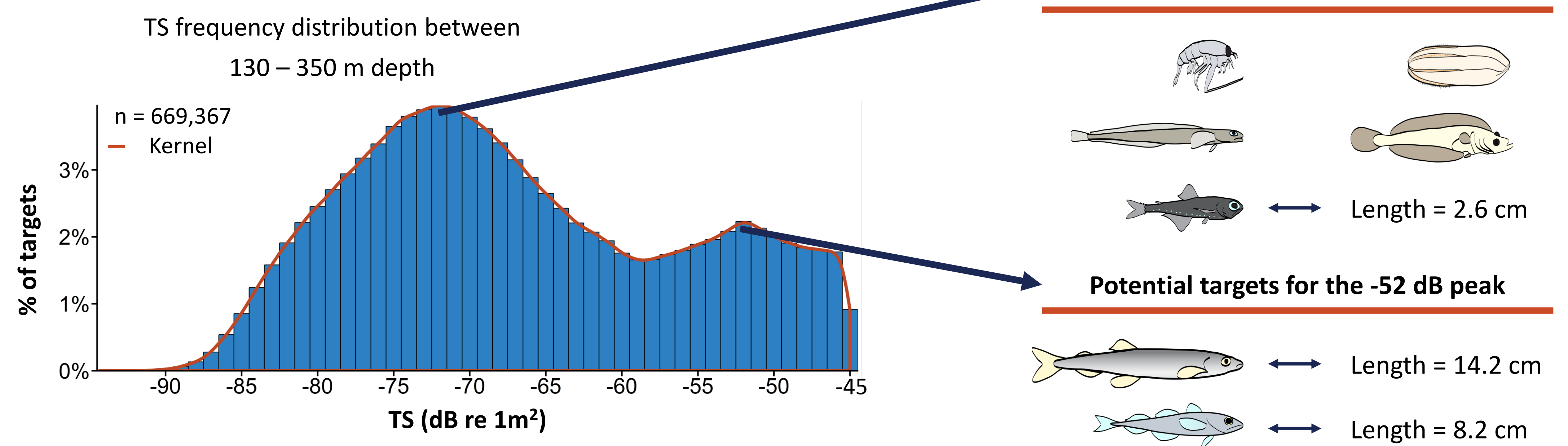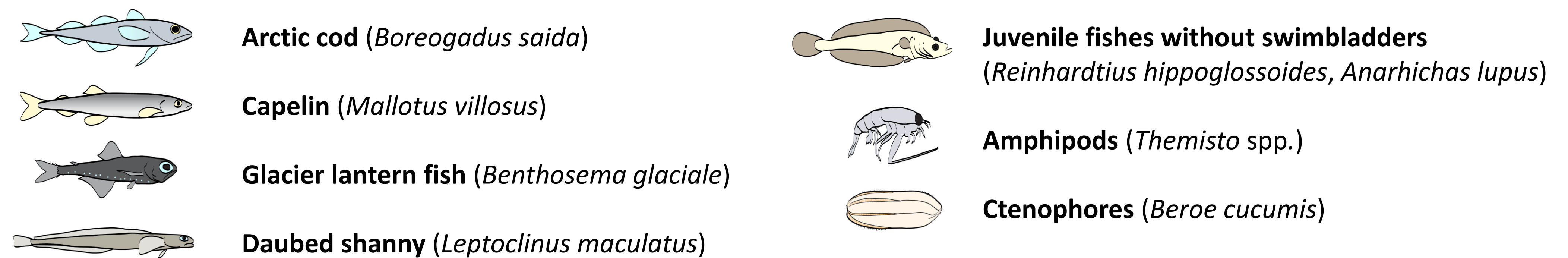**Target Strength (TS) analysis to identify fish species at depth**

- TS analysis was conducted on the EK60 38-kHz data using the acoustic software Echoview.
- A Sawada index and a maximum threshold of -43 dB were used to eliminate multiple target detections.
- Sizes were estimated using TS – length relationships.

Preliminary Results

Fish were absent under the ice, but formed a **dense mesopelagic sound scattering layer at depth** (350 m – 550 m), and some **schools** (160 m – 220 m)
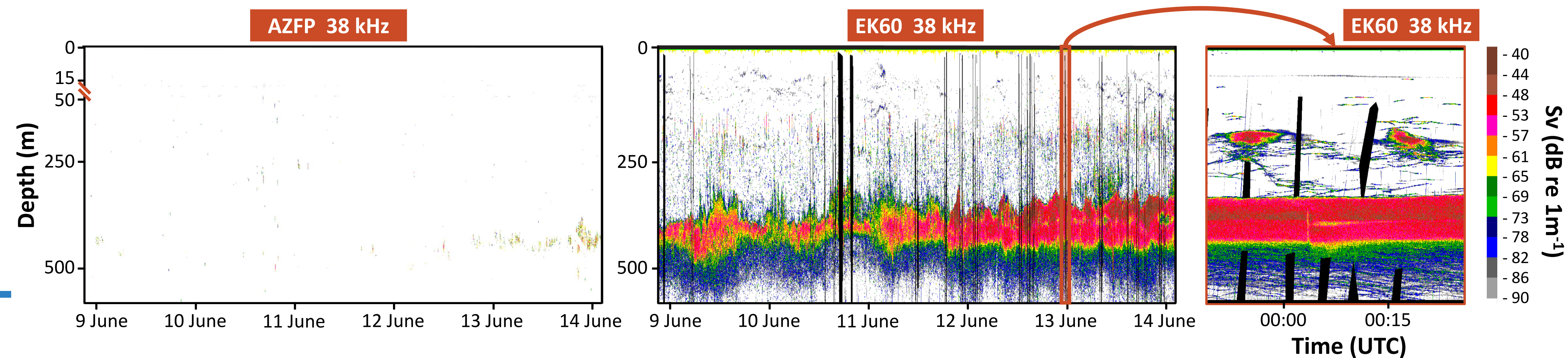
From previous trawl studies in the area we identified **several suspects** that could form the mesopelagic layer:

Arctic cod (*Boreogadus saida*)

Capelin (*Mallotus villosus*)

Glacier lantern fish (*Benthosema glaciale*)

Daubed shanny (*Leptoclinus maculatus*)

Juvenile fishes without swimbladders (*Reinhardtius hippoglossoides, Anarhichas lupus*)

Amphipods (*Themisto* spp.)

Ctenophores (*Beroe cucumis*)

TS frequency distribution between 130 – 350 m depth

n = 669,367
Kernel

Potential targets for the -72 dB peak

Length = 2.6 cm

Potential targets for the -52 dB peak

Length = 14.2 cm

Length = 8.2 cm

The TS analysis suggests **a mix of macrozooplankton and fish species** corresponding to previous net samples

Aggregation of *Calanus* spp. under the ice

Close up on the ctenophore *Mertensia ovum*
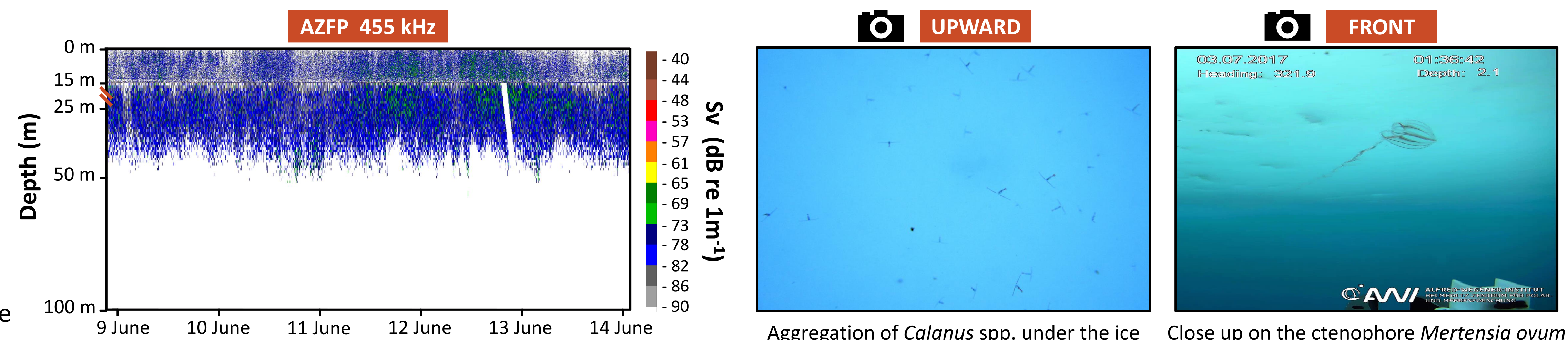
Mesozooplankton aggregated in **the surface layer** (first 50 m) and right **under the ice**

Future Work

- Analyze net and video data to identify under ice zooplankton and confirm the absence of larval or juvenile fish
- Acoustic multifrequency analysis to gain further insights on species composition
- Quantify zooplankton and fish biomasses