High-Tech in the High Sea:

Innovative Technology Helps Scientists Study the Bering Sea Food Web

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University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

NSF

Outline

- Introduction to the Bering Sea
- Research cruises
  - Fun
  - Work
  - Sobering stuff
- Serious science
  - What did we see
  - What did we learn
- Take home message
  - Not yet!

Introduction

- Jellyfish biomass in the Bering Sea increased, important fish stocks declined.
- What favor jellyfish bloom?
  - Where are they coming from?
    - Source location, spatial distribution, demographic structure
  - Where do they go?
    - Spatial distribution, advection
  - Recruitment success
    - Abundance and size structure
- Impacts on the food web

Bering Sea


SIKULIAQ


OCEANUS


R/V SIKULIAQ
NANOOK
WAS HERE
R/V SIKULIAQ
NANOOK
WAS HERE
R/V SIKULIAQ
NANOOK
WAS HERE


ATTENTION
DO NOT SECURE CONTAINERS OF DECK EQUIPMENT IWO DOORS OR ESCAPE ROUTES

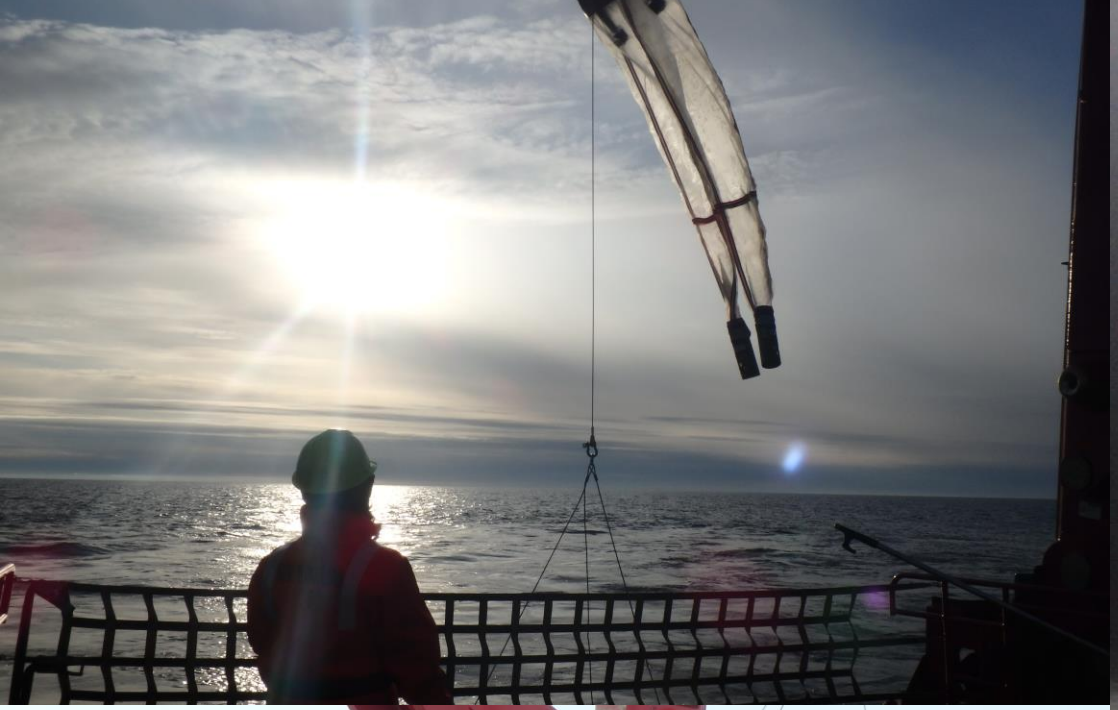

EXIT
BALTIC RM
IN PROGRESS
CKT CP212
DANGER
HIGH
VOLTAGE
ALASKA
SHIP
SUPPLY

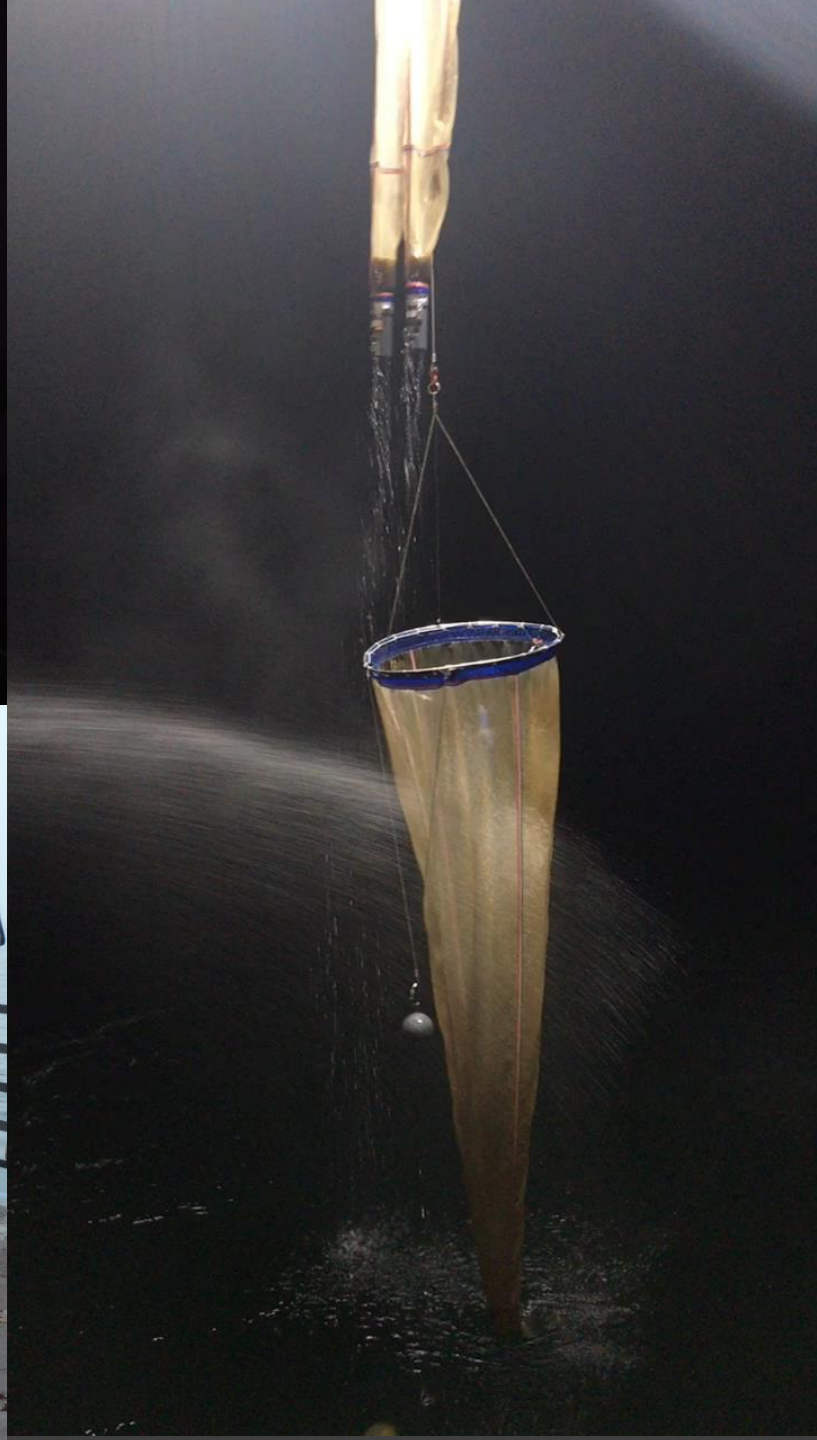

SOUND METRICS

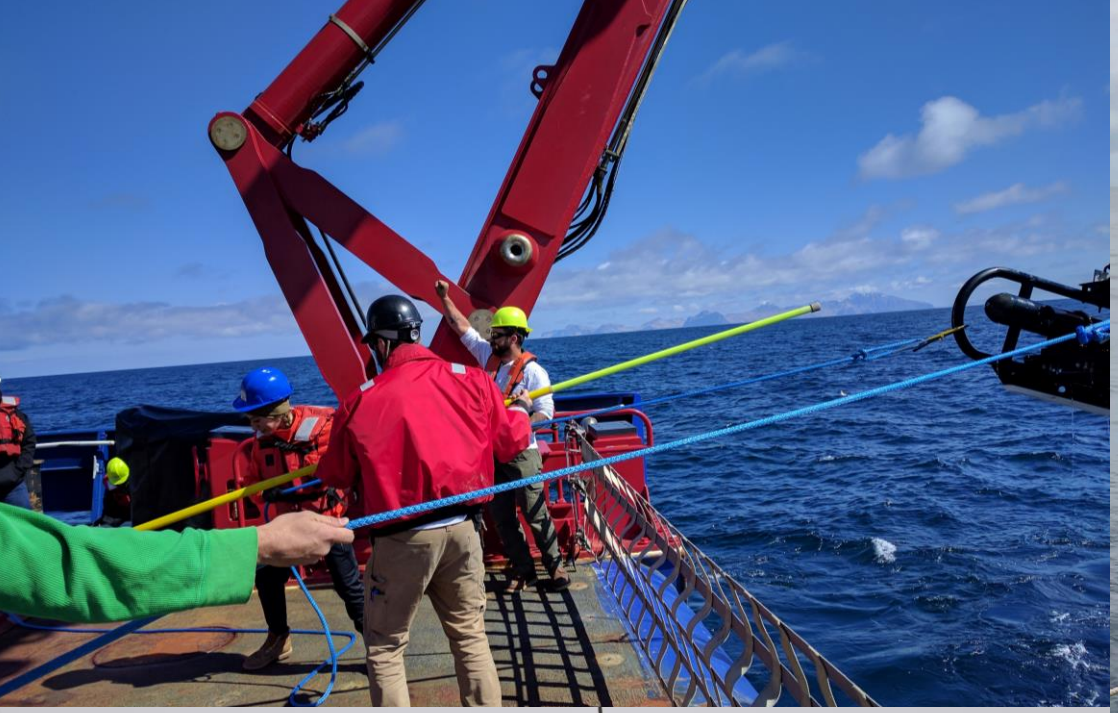

CHEST SIZ
30 - 52 in. (76 -

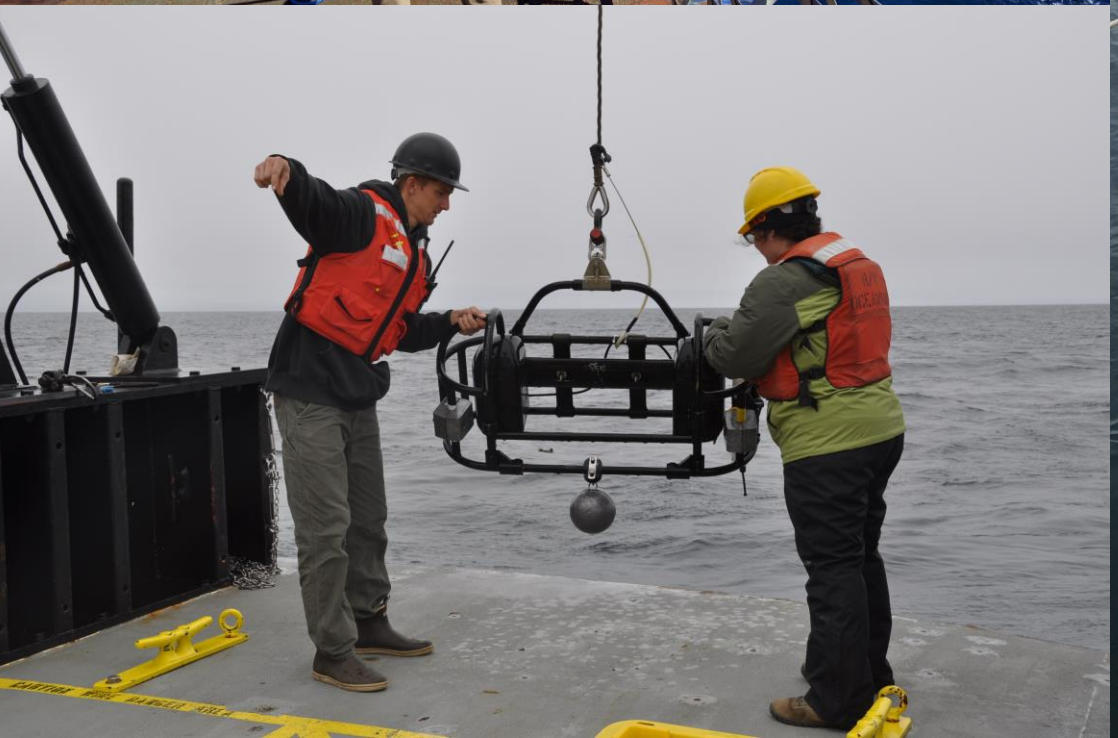

FRAGILE

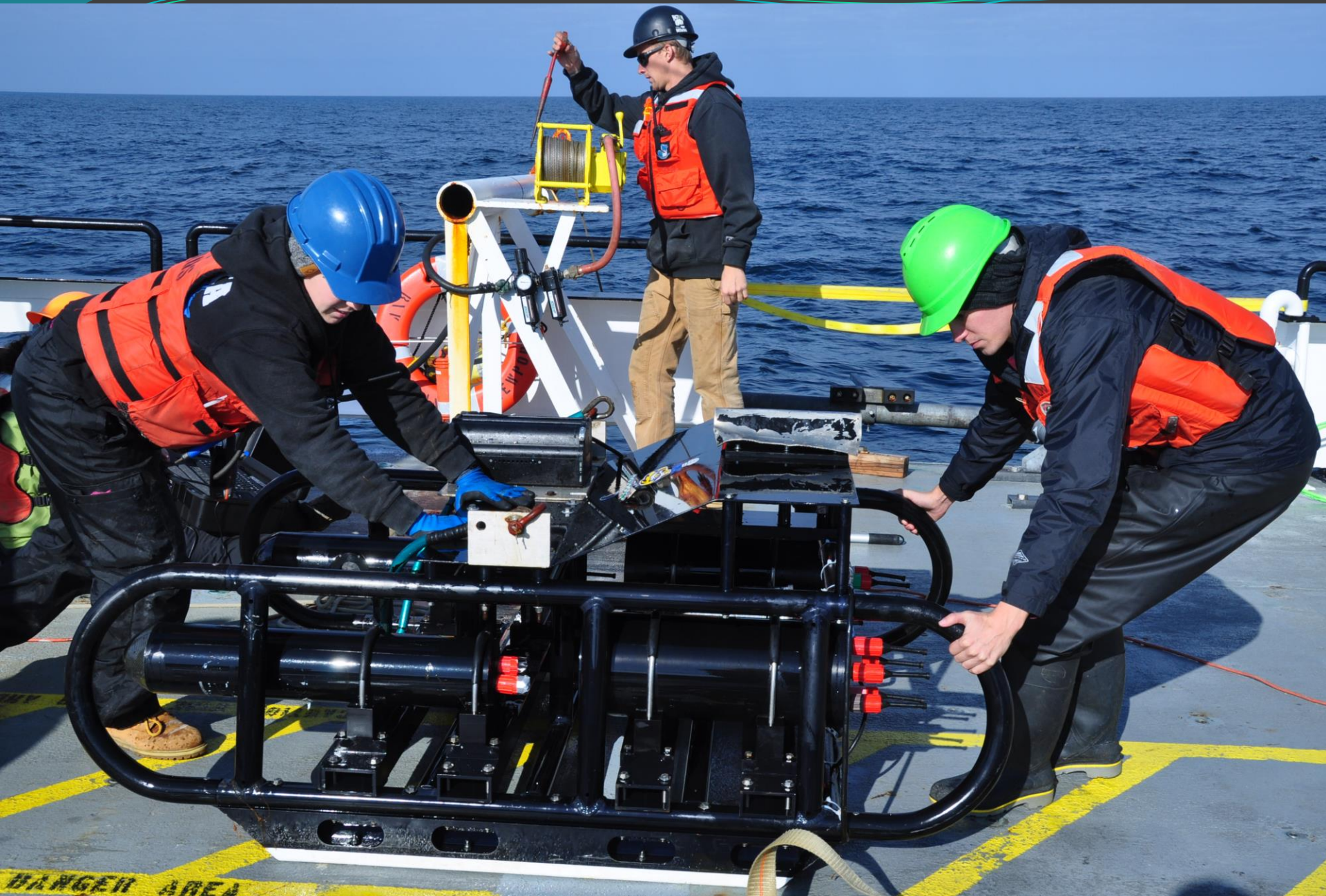

13
12
11
10
9
8
7
6





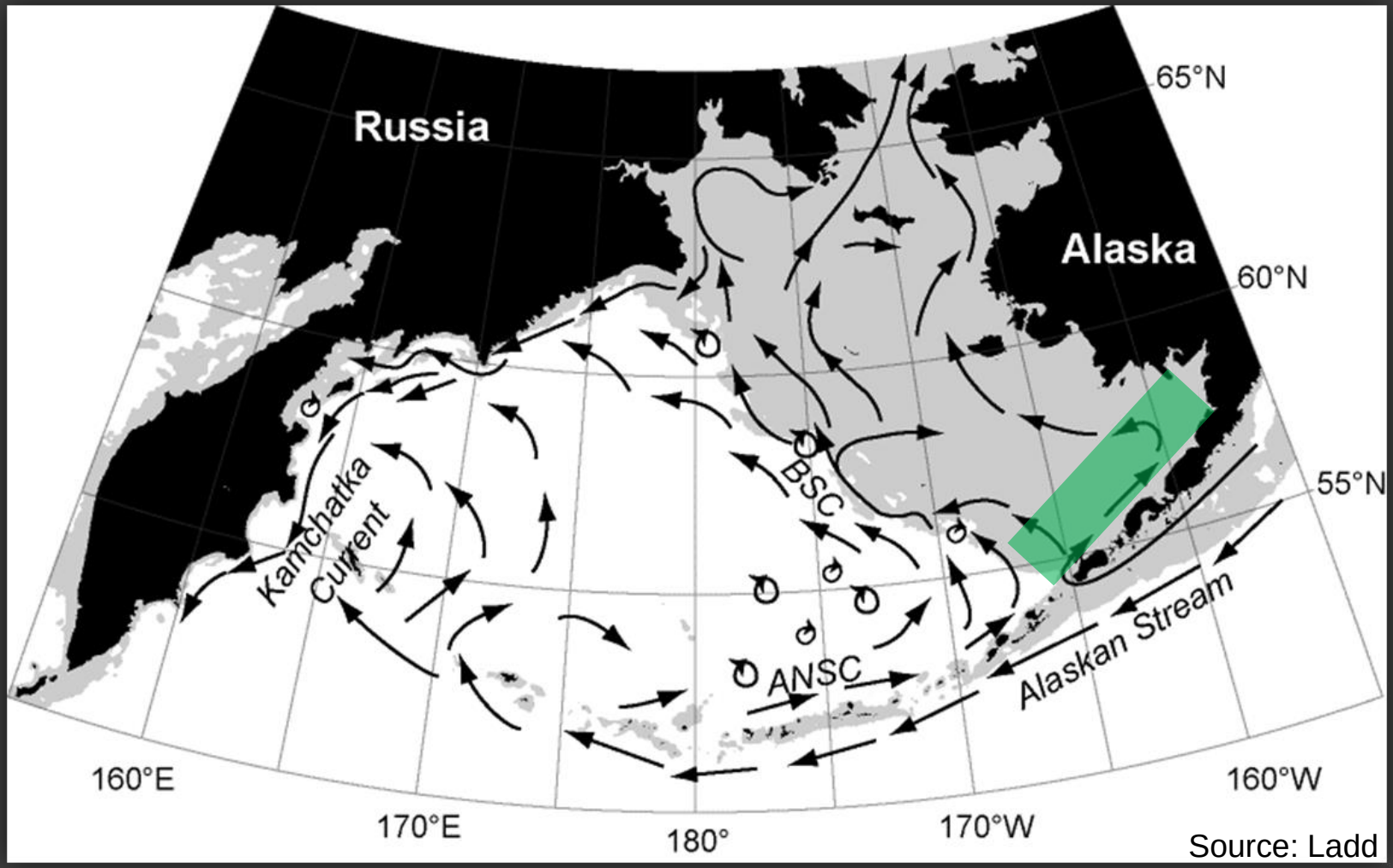





DANGER AREA

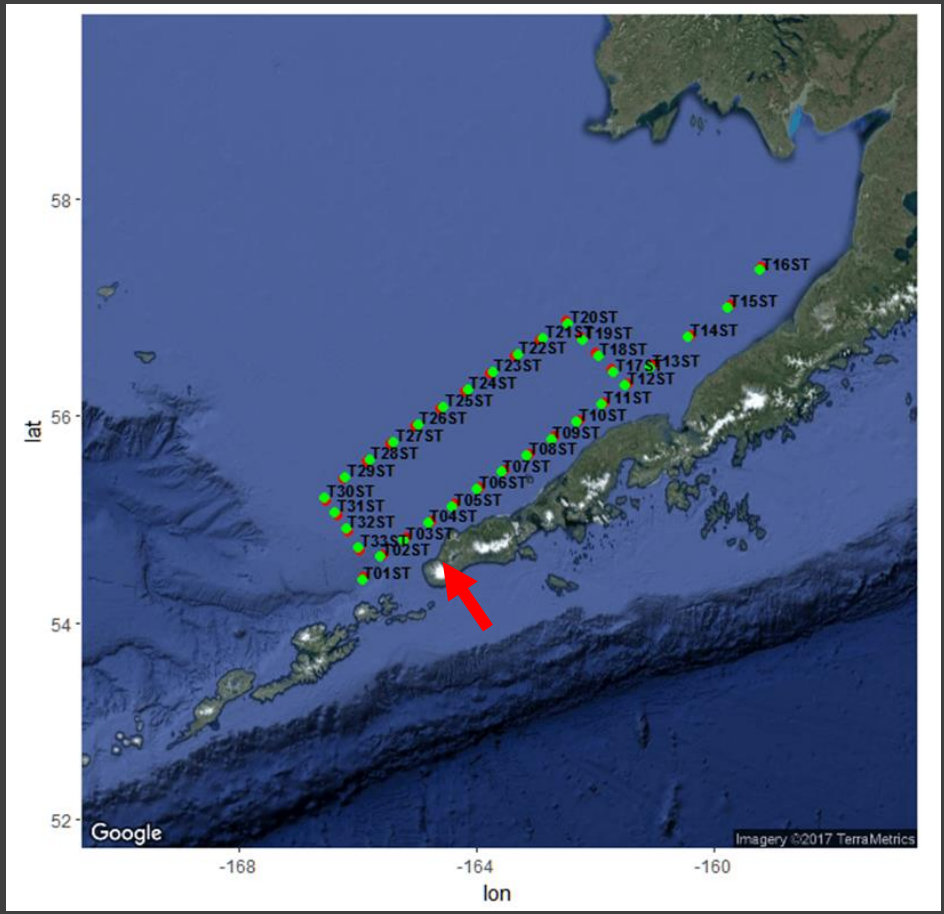

NO SMOKING
22
22

Study area and circulation



Source: Ladd

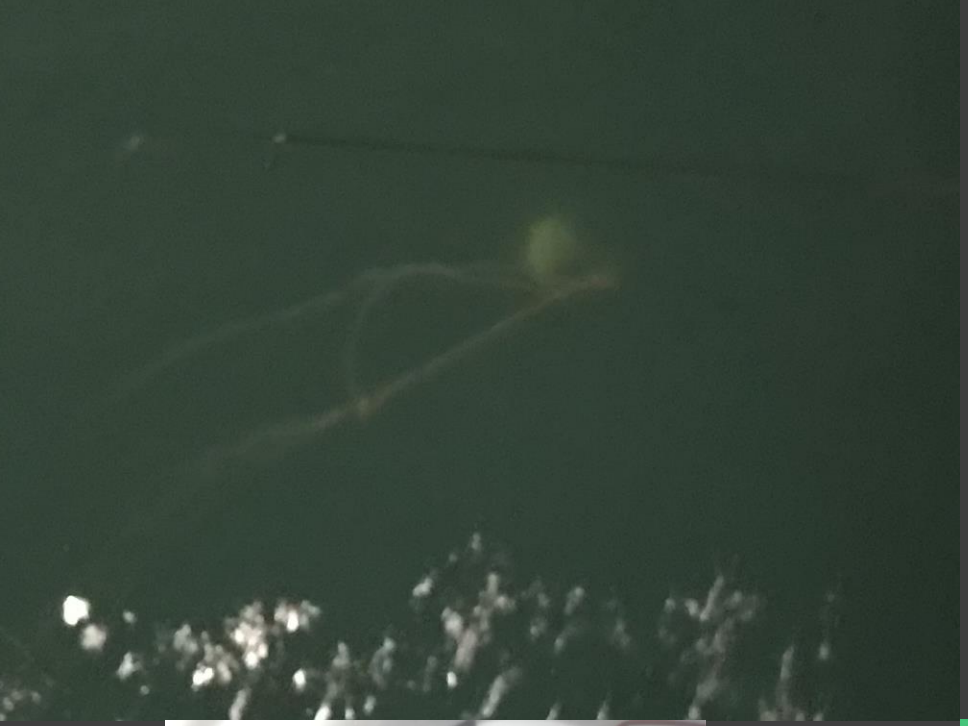
Study site and Sampling

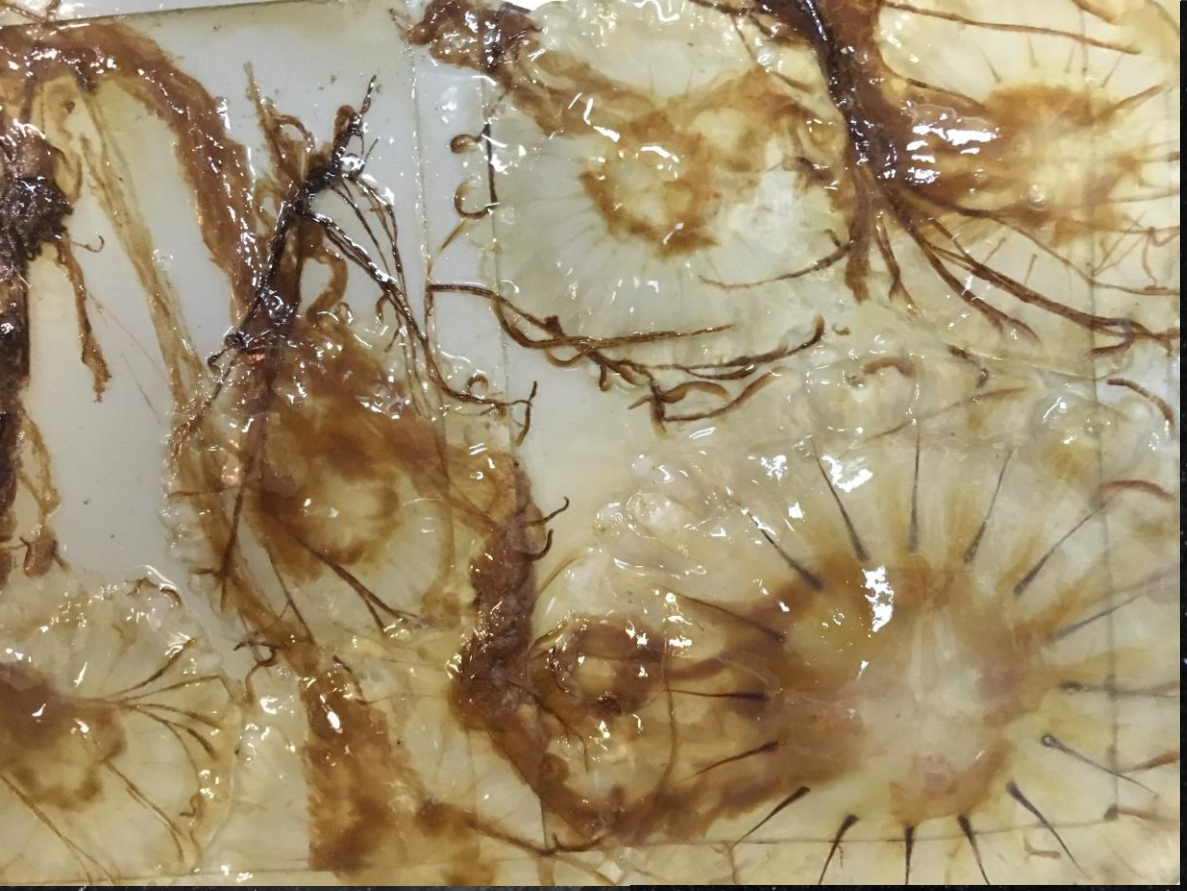


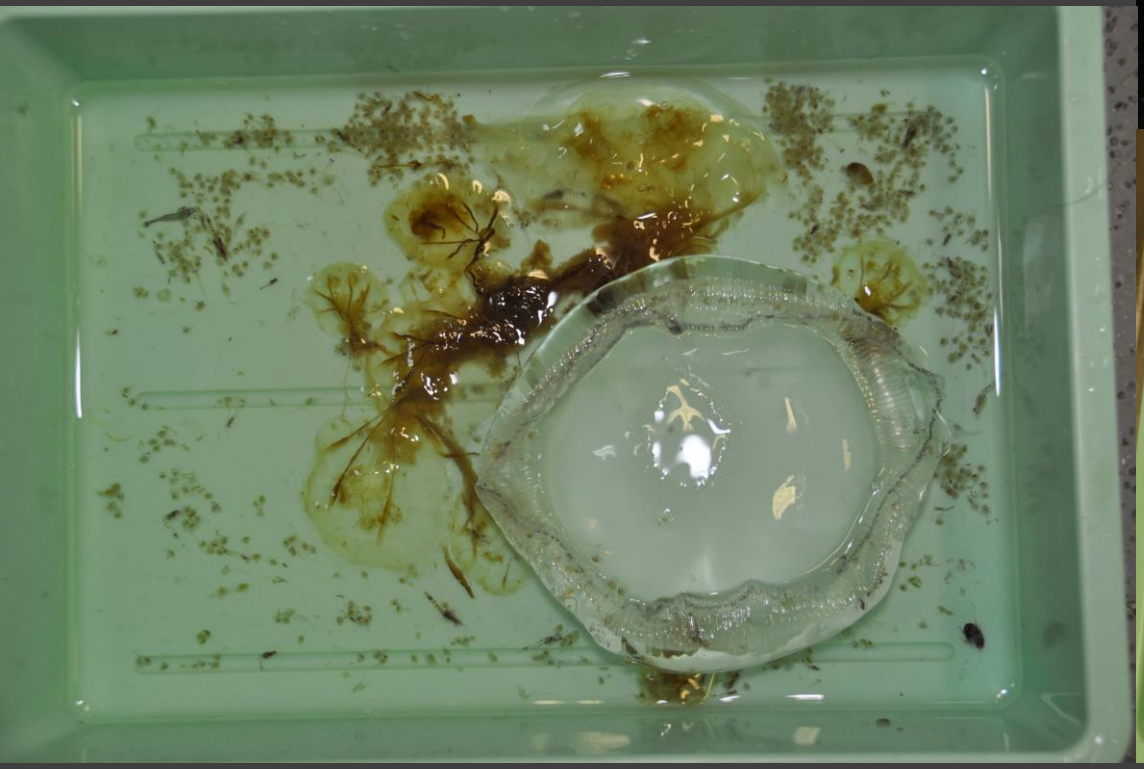
- Four cruises
  - Two in 2017 late spring and summer
  - Two in 2018 early summer and fall
- 33 stations
- At each station, ZOOVIS-ARIS coupled frame was towed ~1.5 -2 hour continuously
- Shipboard multi-frequency echo sounder recorded data continuously
- >10 TB along with CTD and ADCP data
- >100,000 ZOOVIS image frames

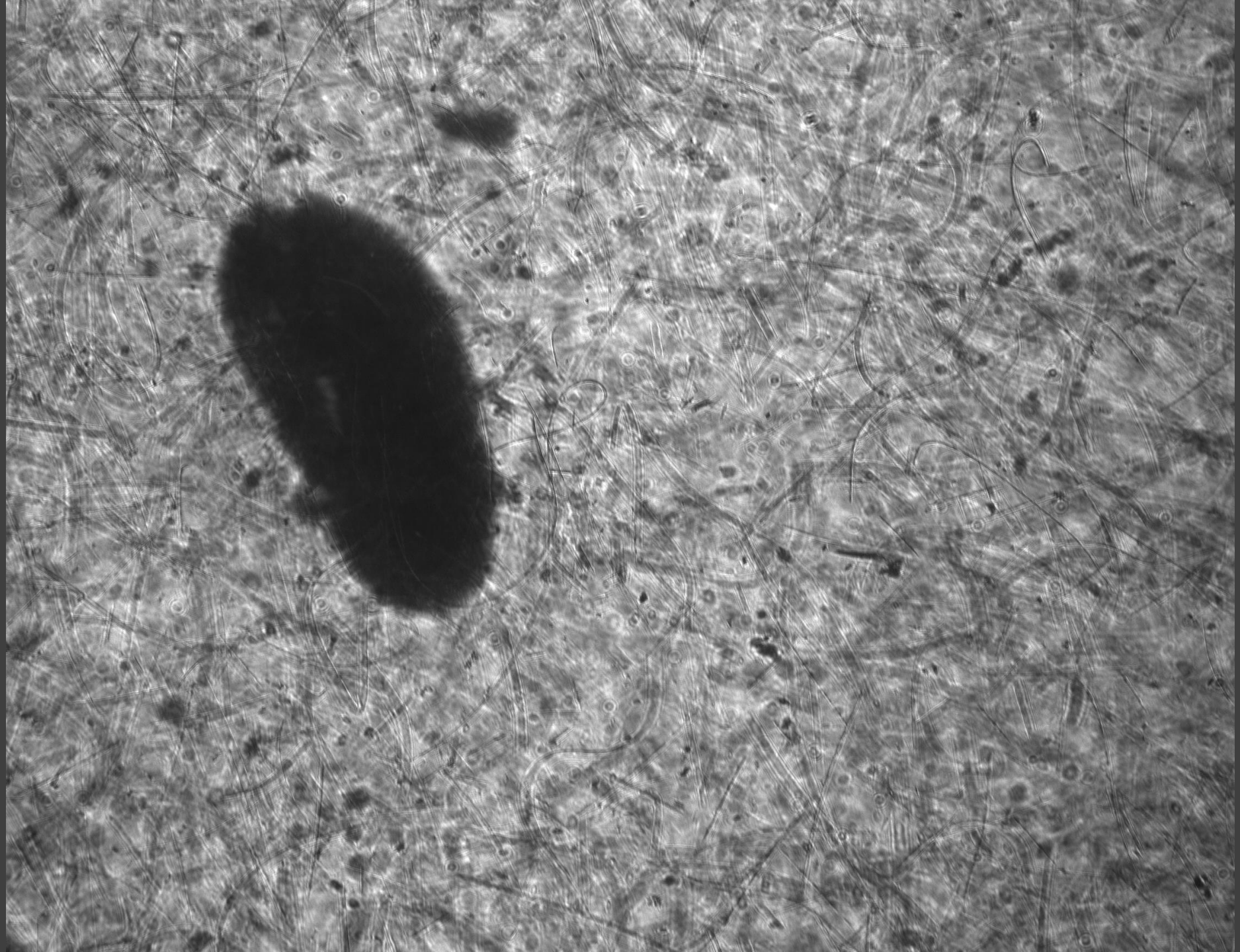
Sampling at ST02

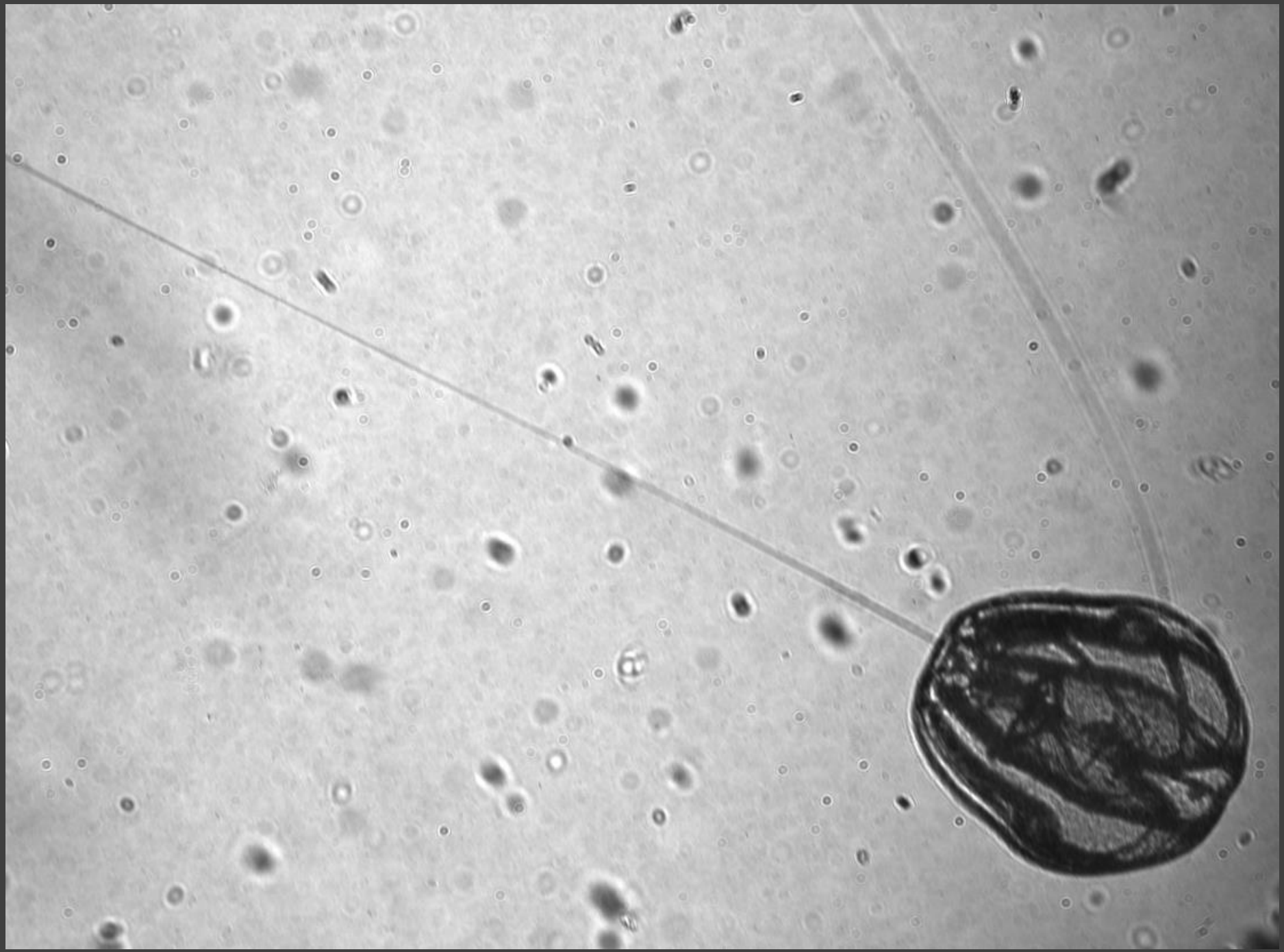
- Direct Sampling
  - CTD
  - 1 m^2 plankton net
  - 20 cm Bongo net
- Imaging
  - ZOOplankton VISualization (ZOOVIS) System
  - RBR CTD for ZOOVIS
- Acoustics
  - ARIS 1800 Imaging Sonar
  - Multi-frequency Simrad EK60
  - Shipboard ADCP

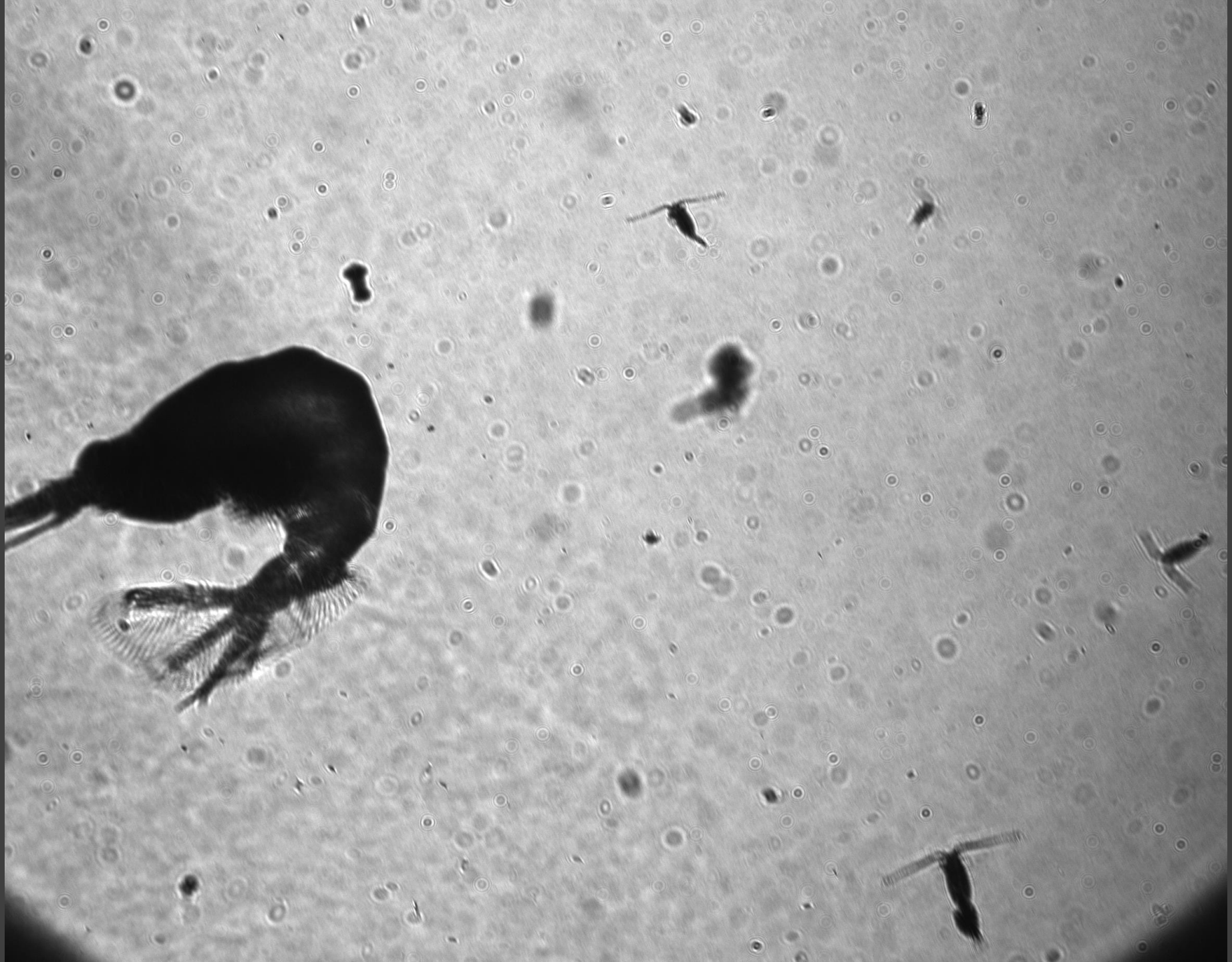


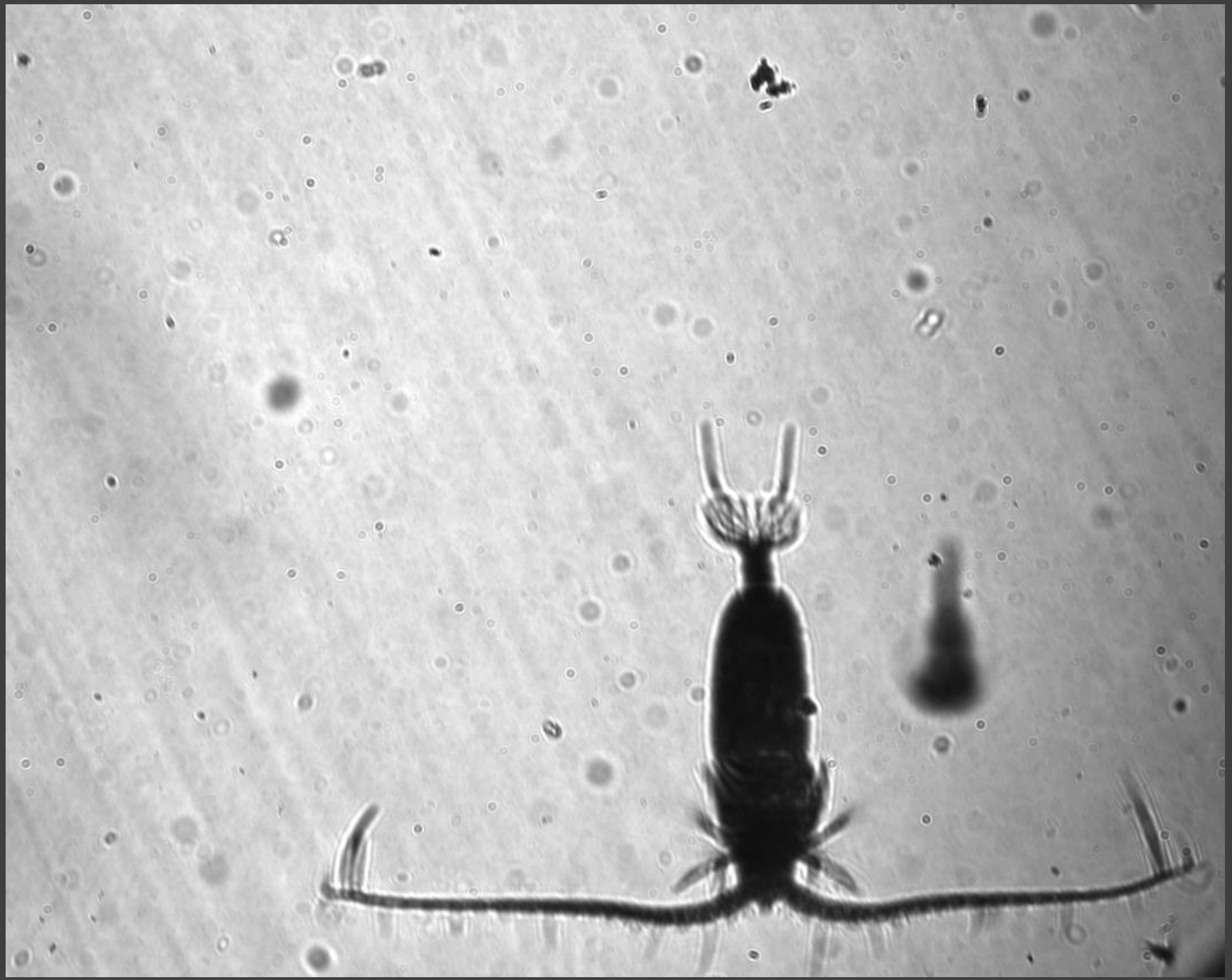


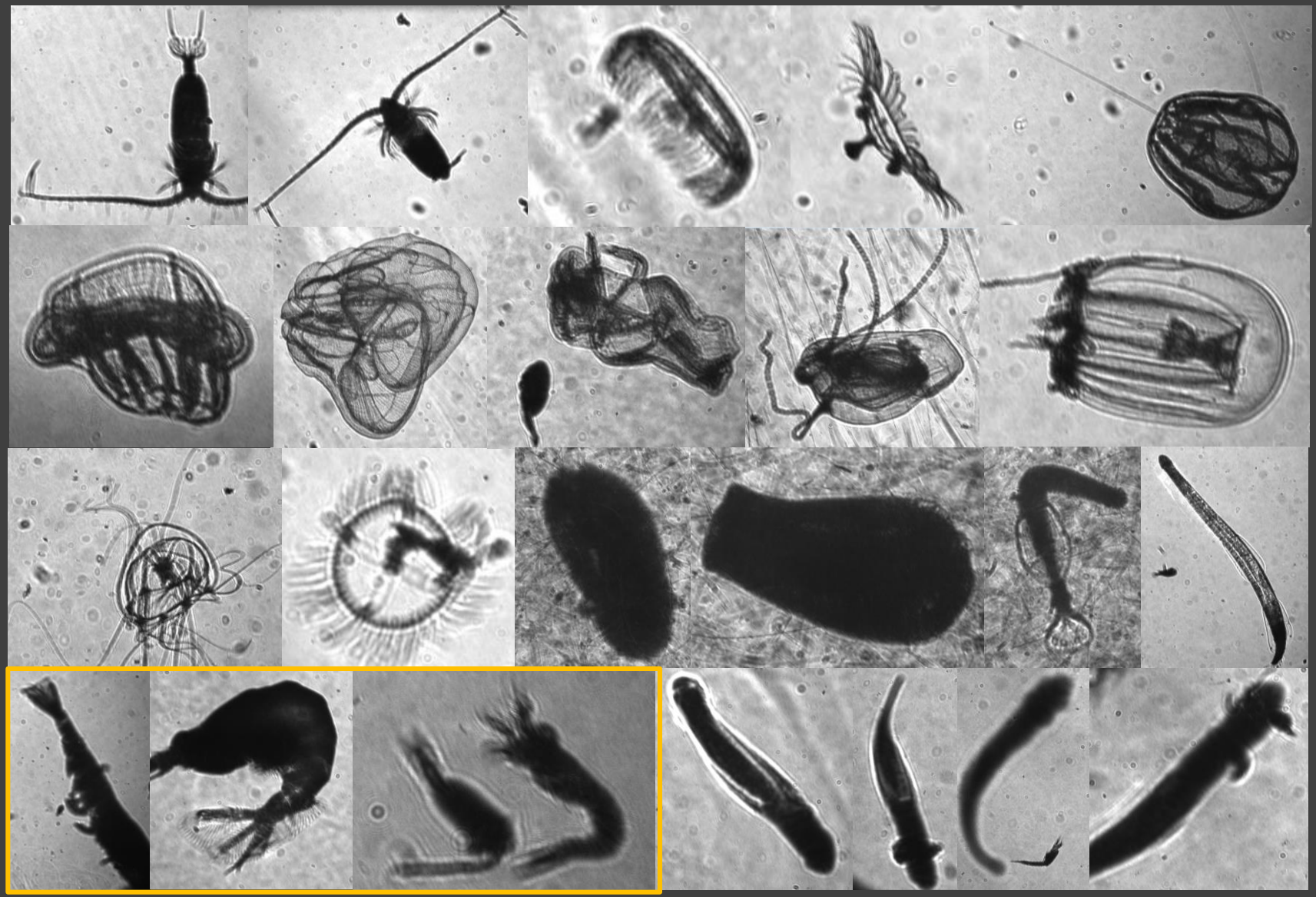






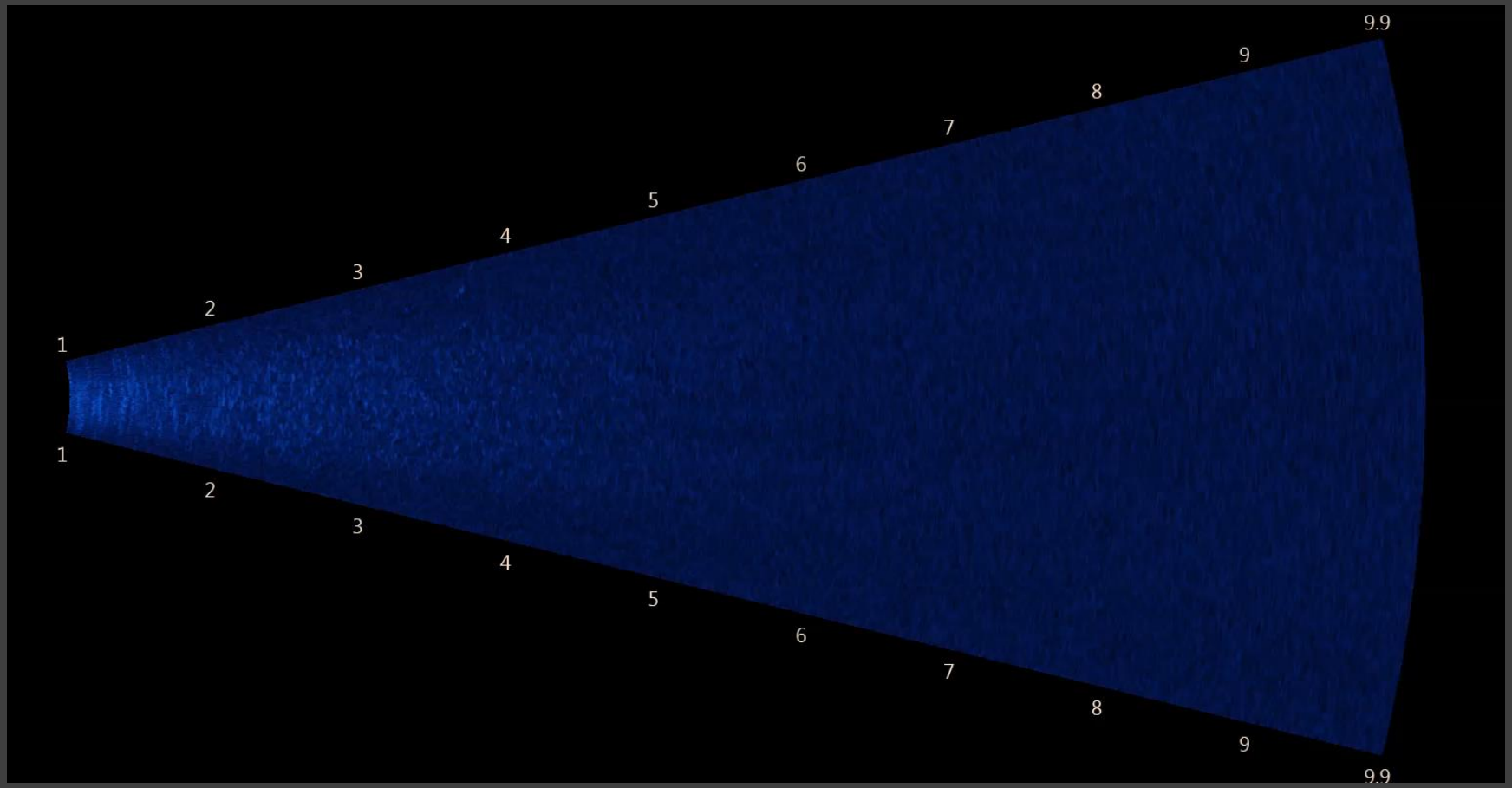






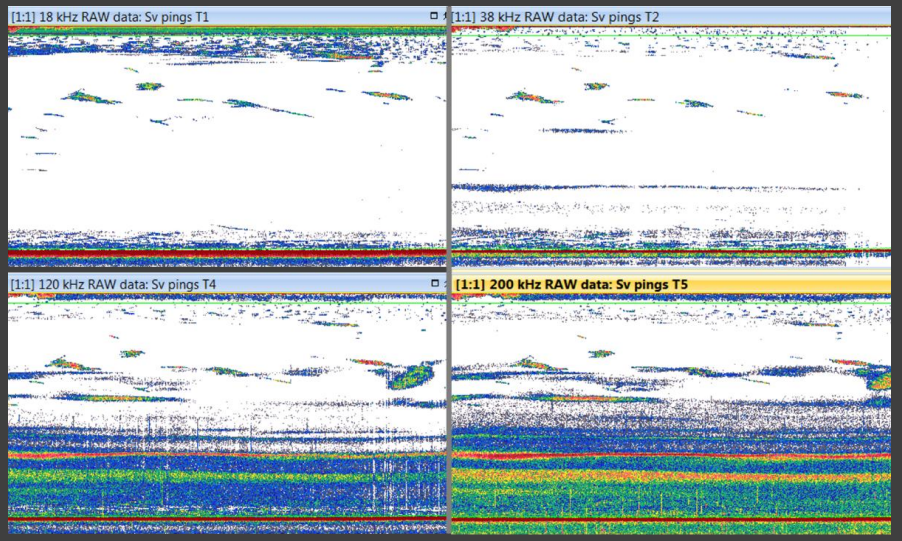
Note: images are not scaled to each other.

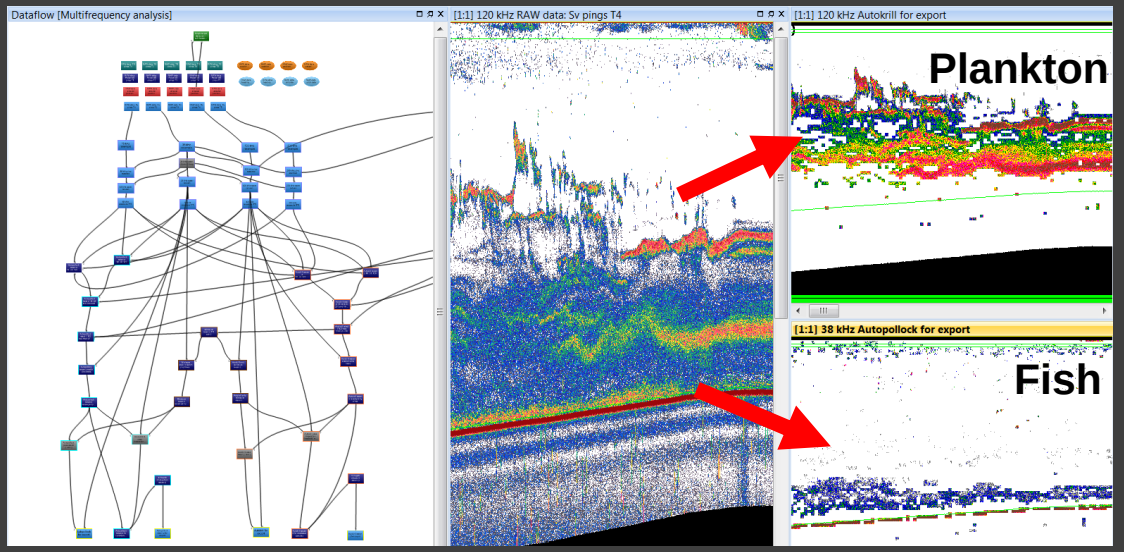
Sonar Imaging system



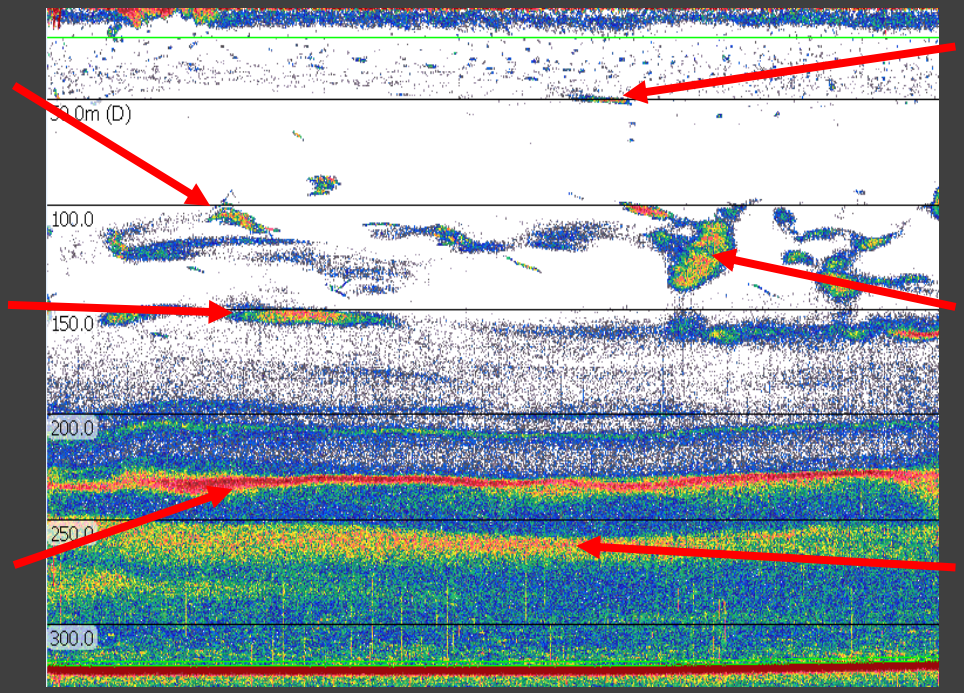
Acoustic Survey Methodology

- Continuous acoustic survey conducted during cruise.
- Data was partitioned to coincide with ZOOVIS sampling stations.
- 4 hull mounted SIMRAD EK60 Scientific Echosounders.
  - 18 kHz
  - 38 kHz
  - 120 kHz
  - 200 kHz
- Semi-automated krill/fish classification conducted in Echoview. (DeRobertis et al., 2010)

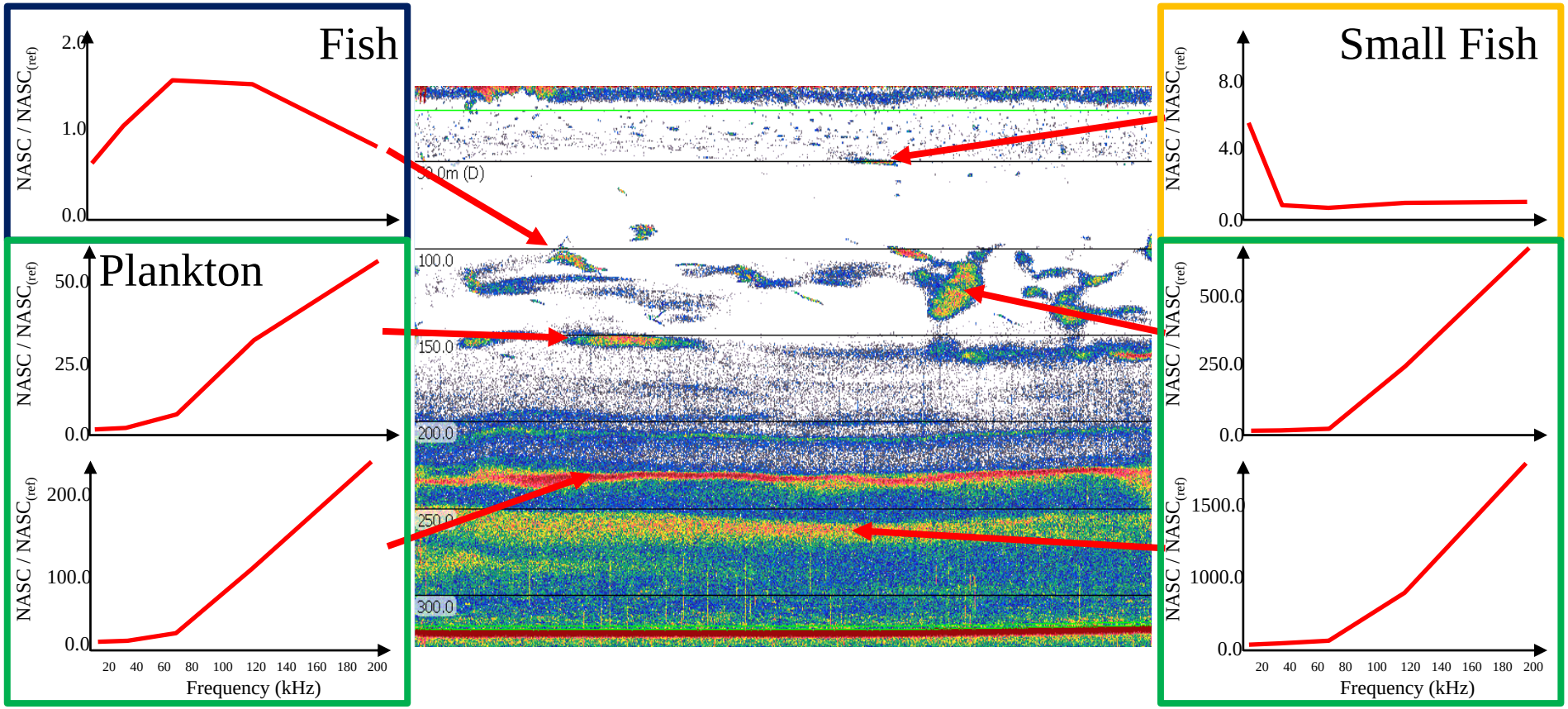




Taxonomic Classification of Acoustic Features

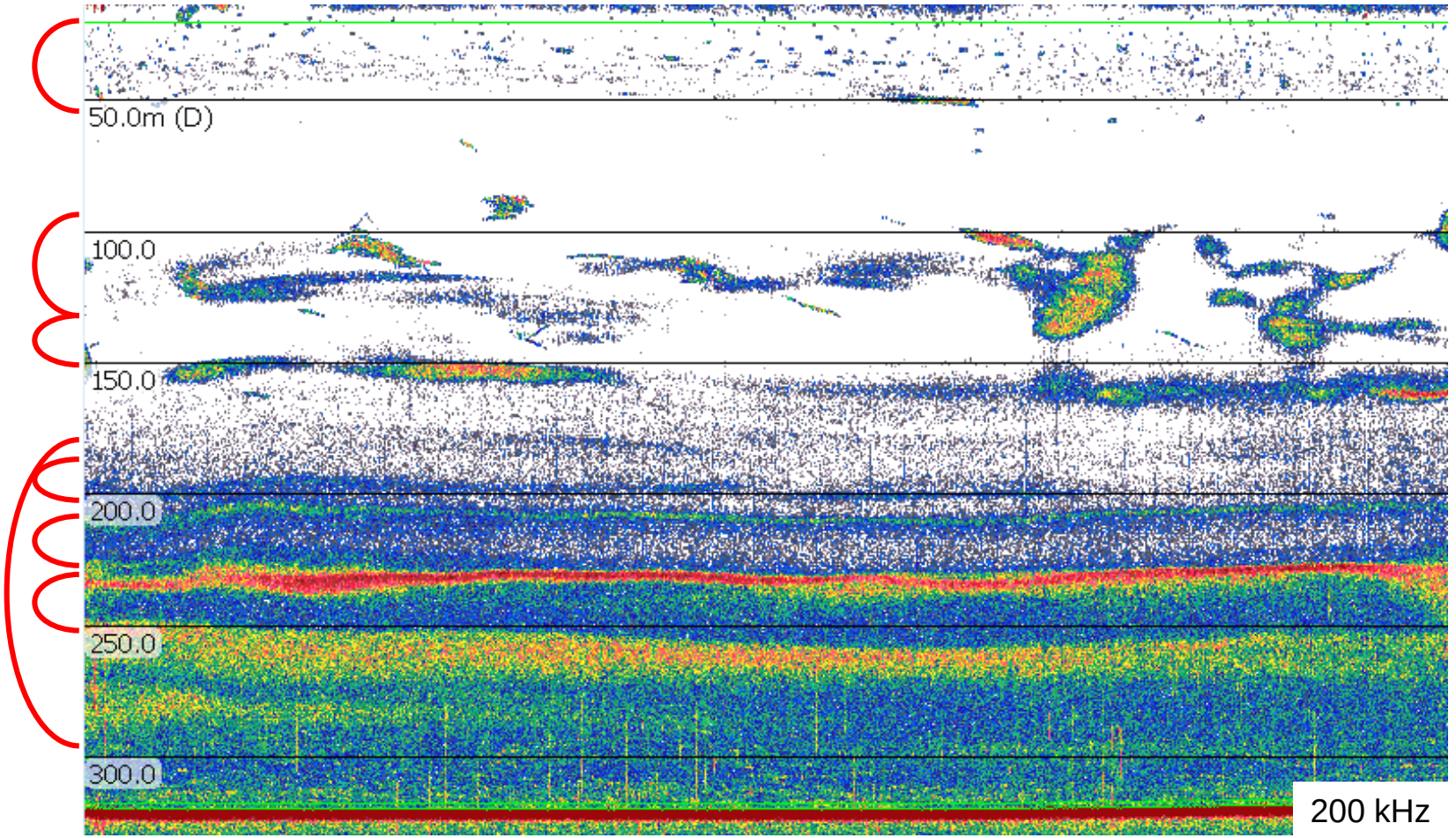


Taxonomic Classification of Acoustic Features

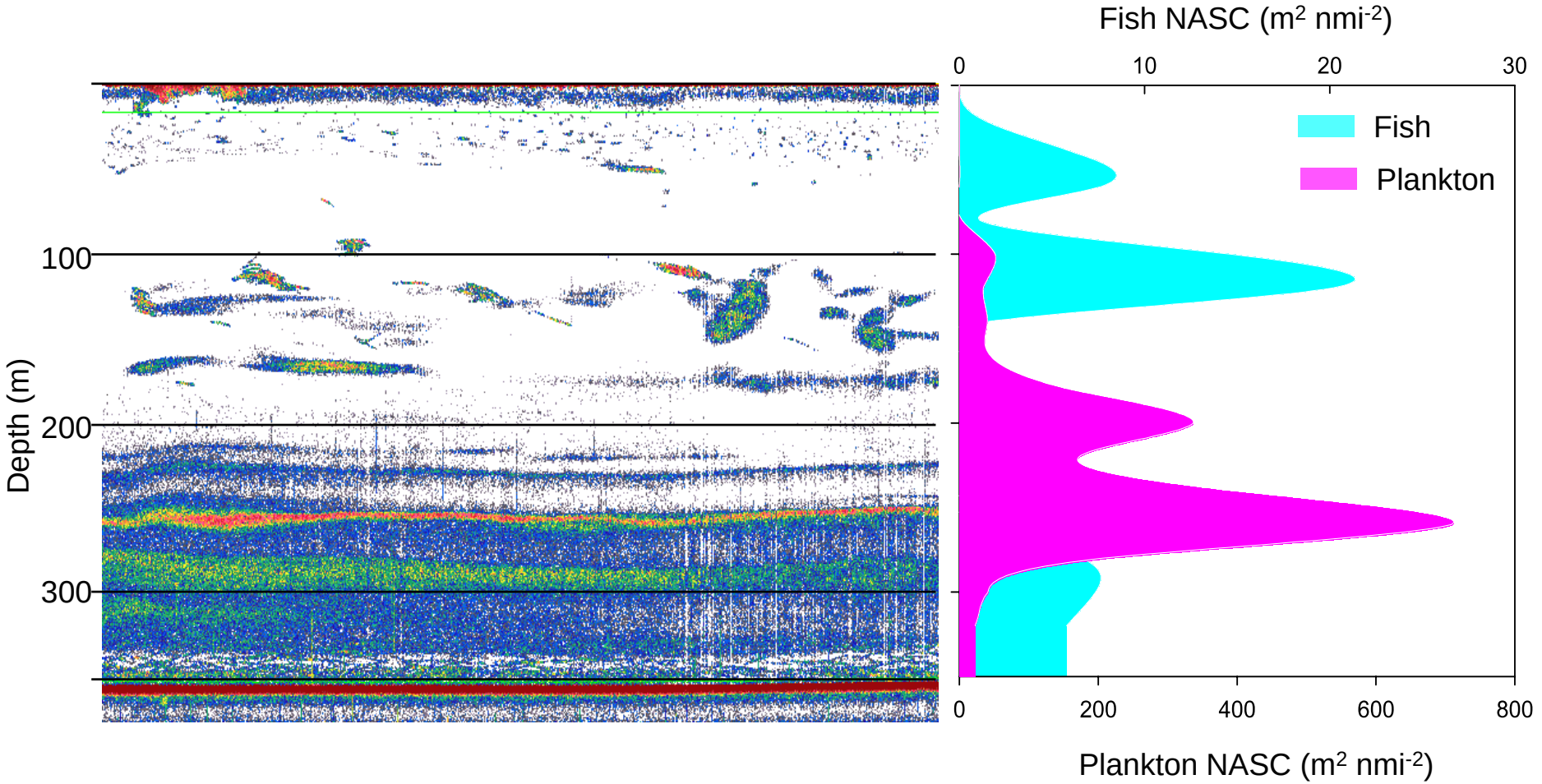


DeRobertis et al. (2010)

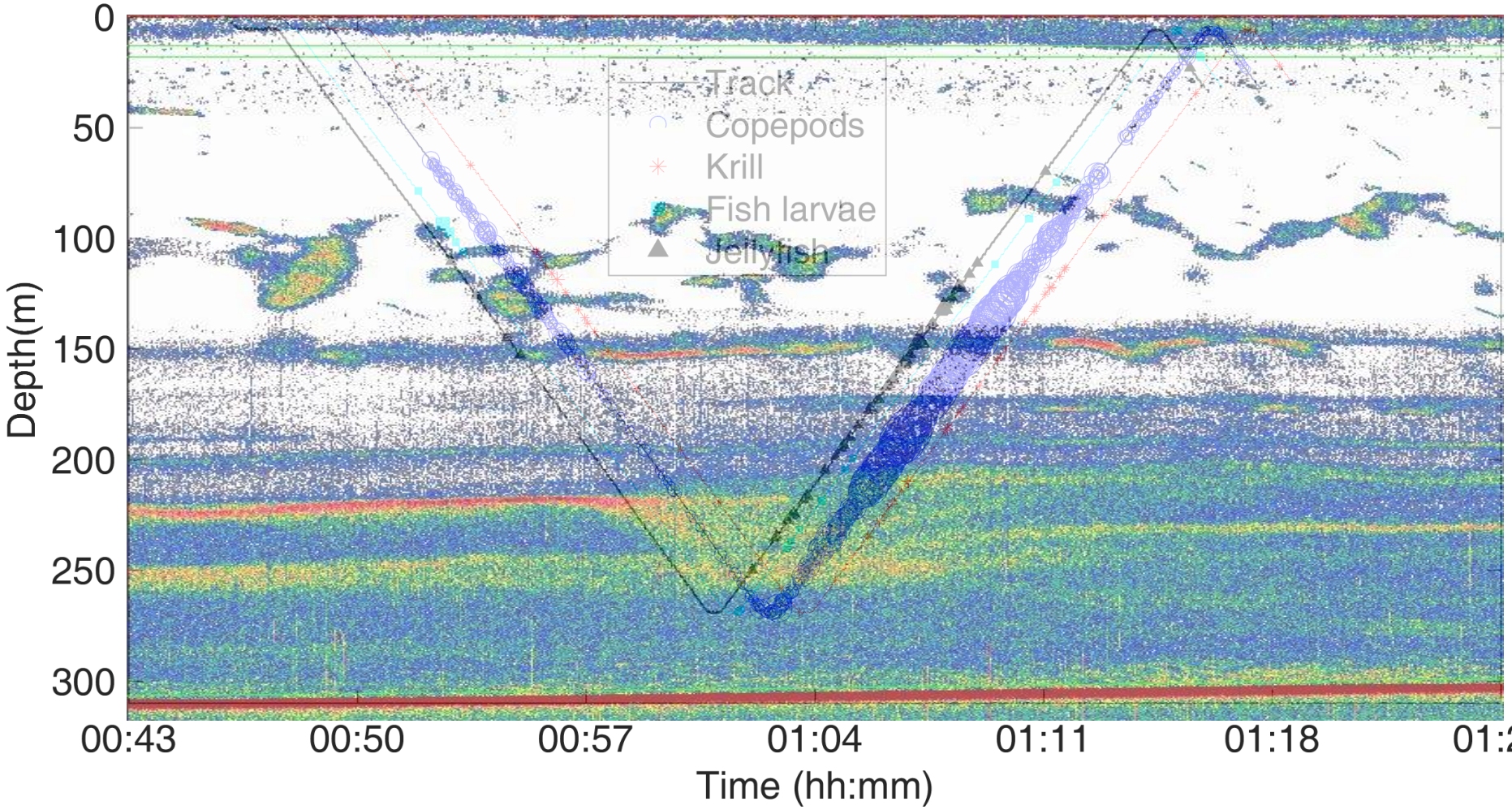
Results: Water Column Characterization



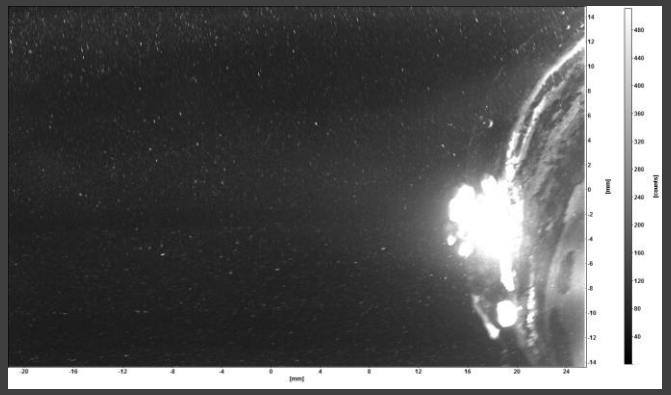
Vertical Distribution of Plankton and Fish

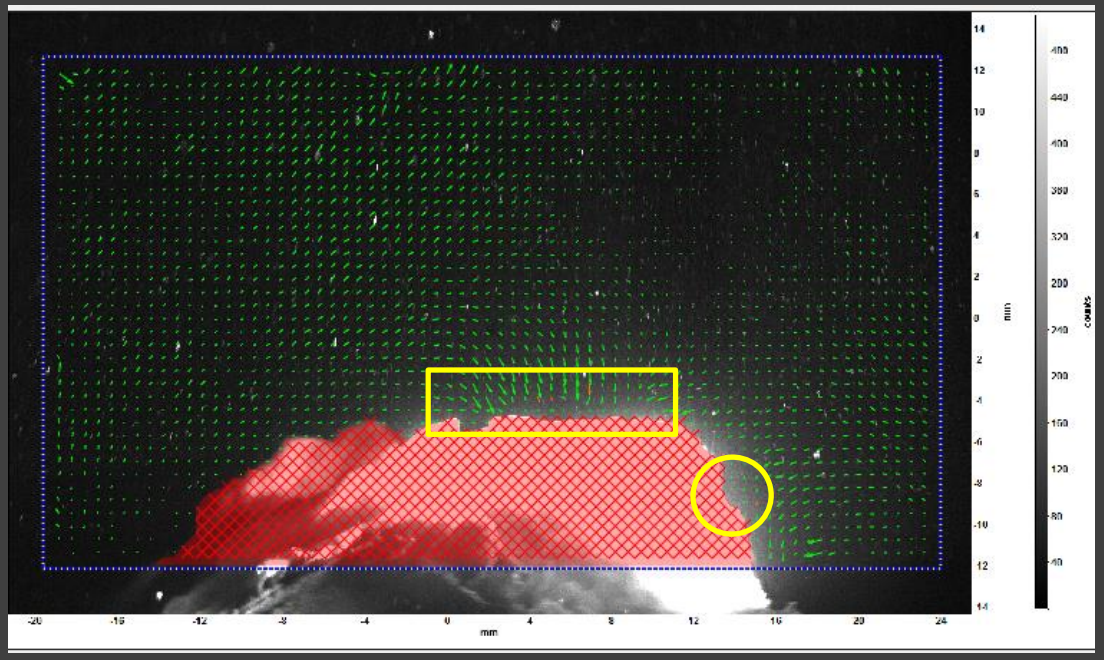


Results: ZOOVIS

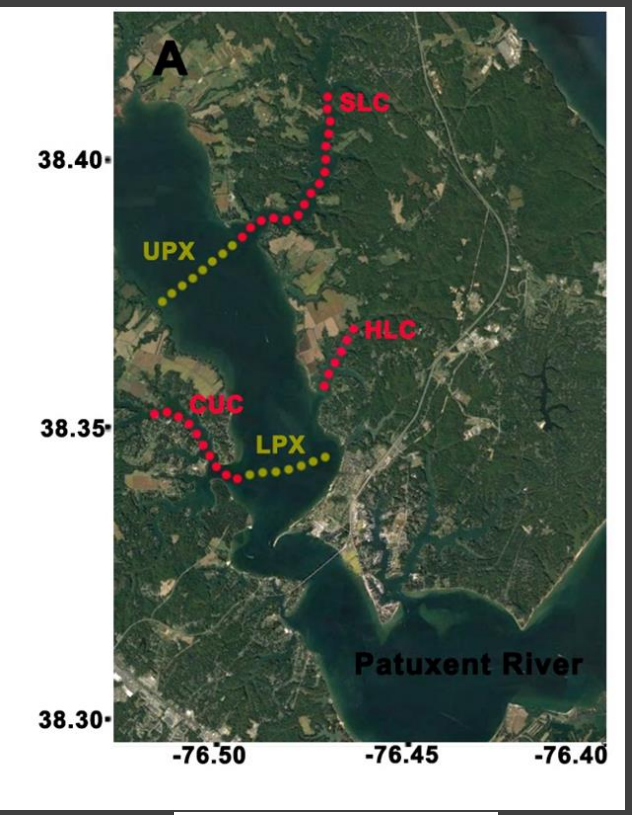


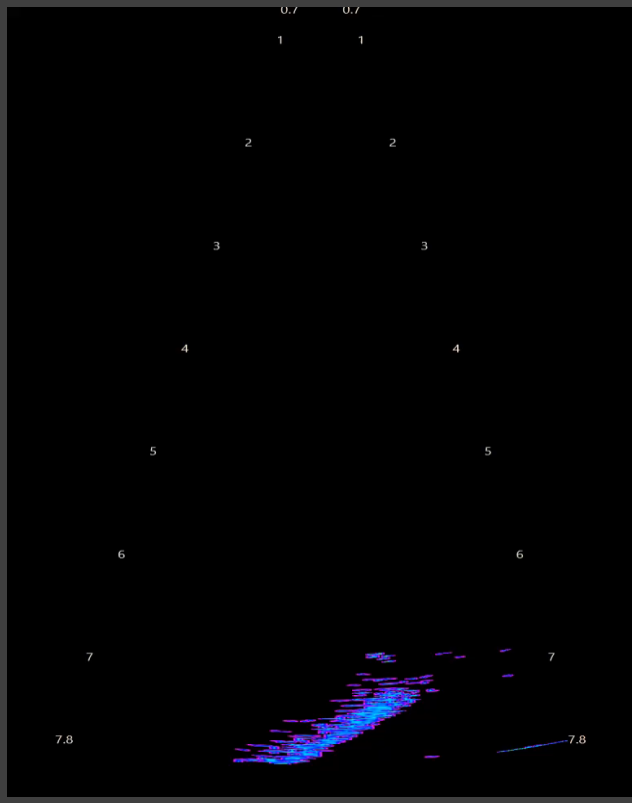
PIV-oyster feeding

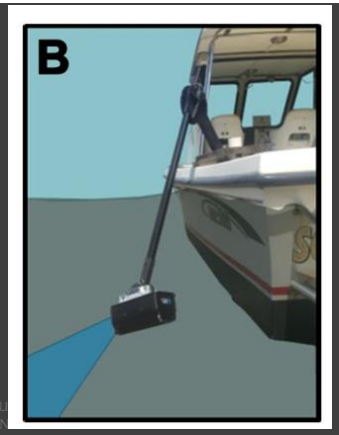


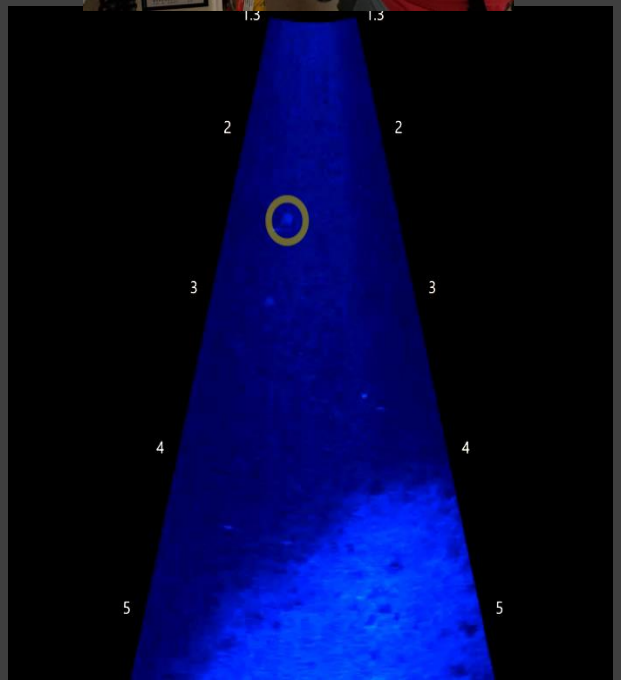


Local survey









1. Since 2016
2. May – October
3. Every other week
4. Supported two dissertation project
5. Expand survey next year

Acknowledgements

- National Science Foundation
- North Pacific Research Board
- R/V *Sikuliaq*

Sampling Team

How does krill taste? We know!

Done with cruise,
Done with you!

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

LUX ET VERITAS

FIU Arts, Sciences & Education
School of Environment, Arts and Society