



Korean Biological Oceanography Activity in western Arctic Ocean

Biological Oceanography Participants

Chief Scientist: Eun-Jin Yang

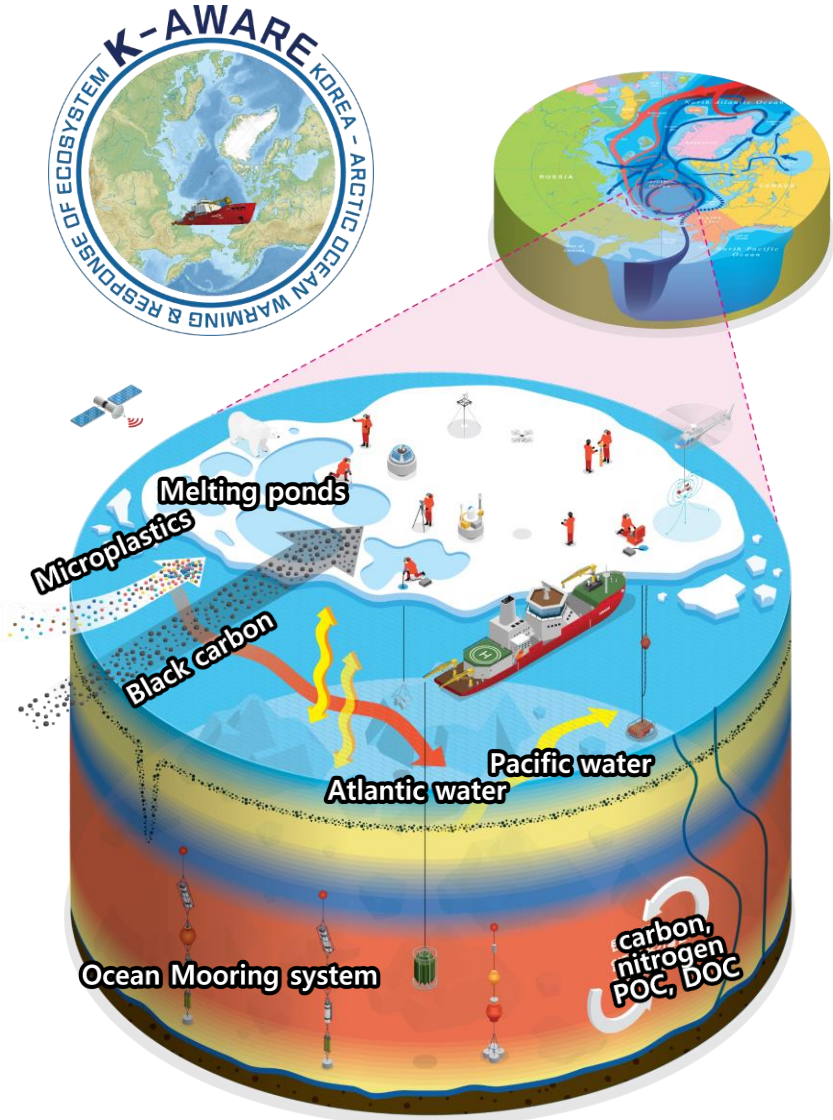
Research Scientists: Jisoo Park, Hyung Sul La,
Youngju Lee, Jee-Hoon Kim

Research Specialists: Jong Kuk Moon, Chorom Shin

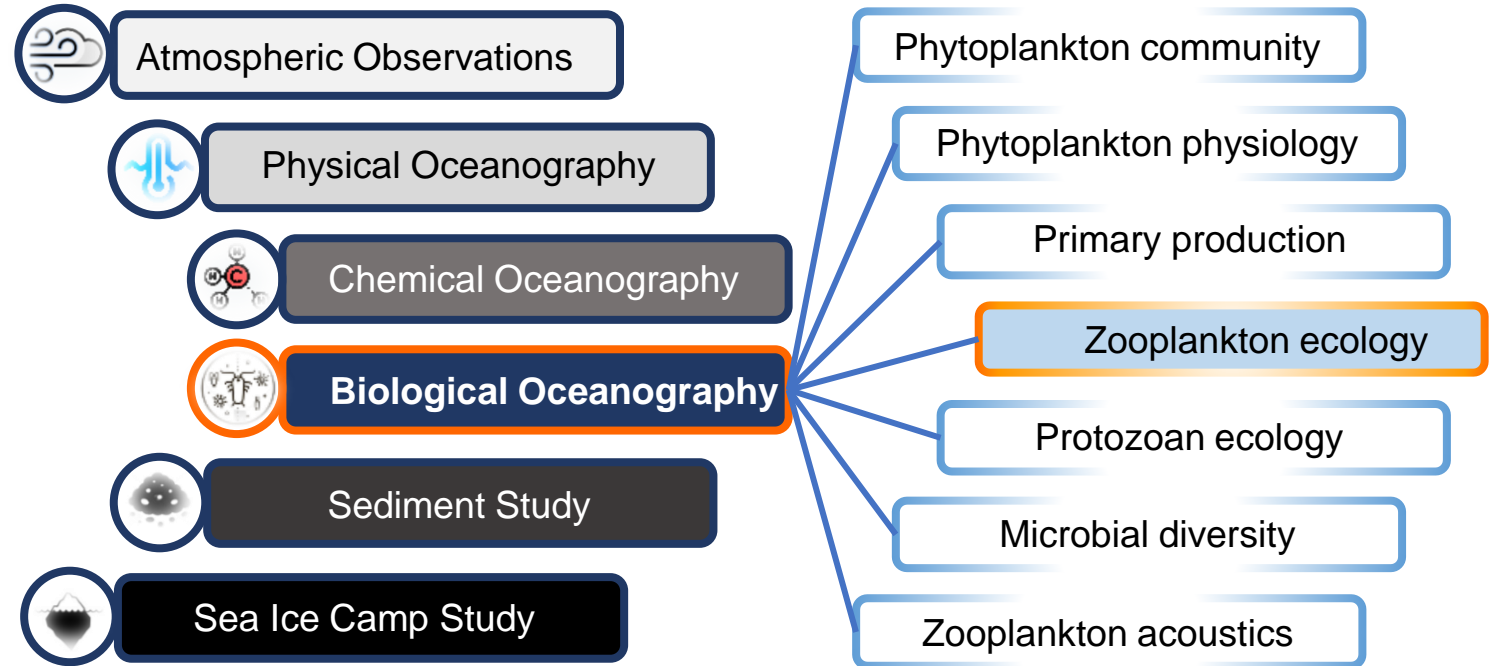
Students: Wuju Son, Jeong-Hyun Kim, Hyeju Yoo
and K-AWARE Team

[2022. 8. 16 Arctic Ocean Expedition]

1. Arctic Research Area of K-AWARE by ARAON



- Korea-Arctic Ocean **W**Arming & Responses of Ecosystem (**K-AWARE**, ~2026)
- **Western Arctic Ocean; Chukchi Sea, Chukchi Borderland, East Siberian Sea**



2. Overview on Biological Oceanography Studies

Phytoplankton community & physiology

- Total and size-fractionated Chl-a
- Picophytoplankton (FACs)
- Flowcytobot & Microscopy (species)
- Pigments (HPLC)
- Physiology (FIRe)



Carbon & Nitrogen Uptake rates

- Six depths for PP and NP
- 4-24h incubation with stable isotopes (^{13}C , $^{15}\text{NH}_3$ and $^{15}\text{NH}_4$)



Protozoa community & Grazing

- Abundance of heterotrophic protists (4-5 depths) -> Microscopy
- 1- 2 days incubation for grazing rate (deck incubation)



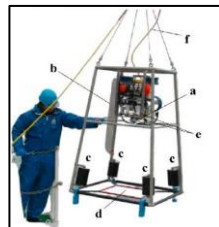
Mesozooplankton community & production

- Community (Bongo Net 150 & 330um) -> Microscopy & UVP 6
- Respiration
- Grazing Exp (deck incubation)



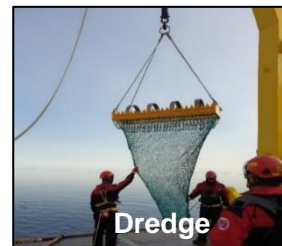
Ichthyoplankton and Fish

- Frame trawl net, and hand net
- eDNA sampling from water depth
- Deep sea Camera system



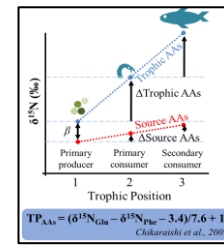
Benthic fauna

- Benthos samples were collected with a dredge (3cm mesh) for 1 hr on the East Siberian and Chukchi shelves

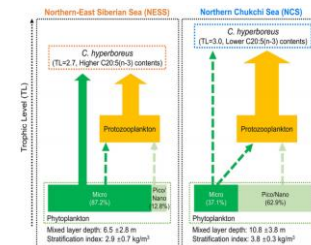


Marine Food web

- Amino acid $\delta^{15}\text{N}$ analysis to determine its trophic position



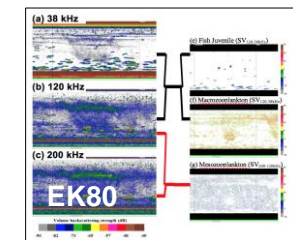
AA $\delta^{15}\text{N}$ enrichment pattern



[Choi et al., 2021]

Bio- and Fishery acoustics

- Zooplankton and fish distribution with ship-based echosounder (EK80)
- Soundscape for marine mammals on the East Siberian Shelf



3. Preliminary results: Phytoplankton community

Youngju Lee



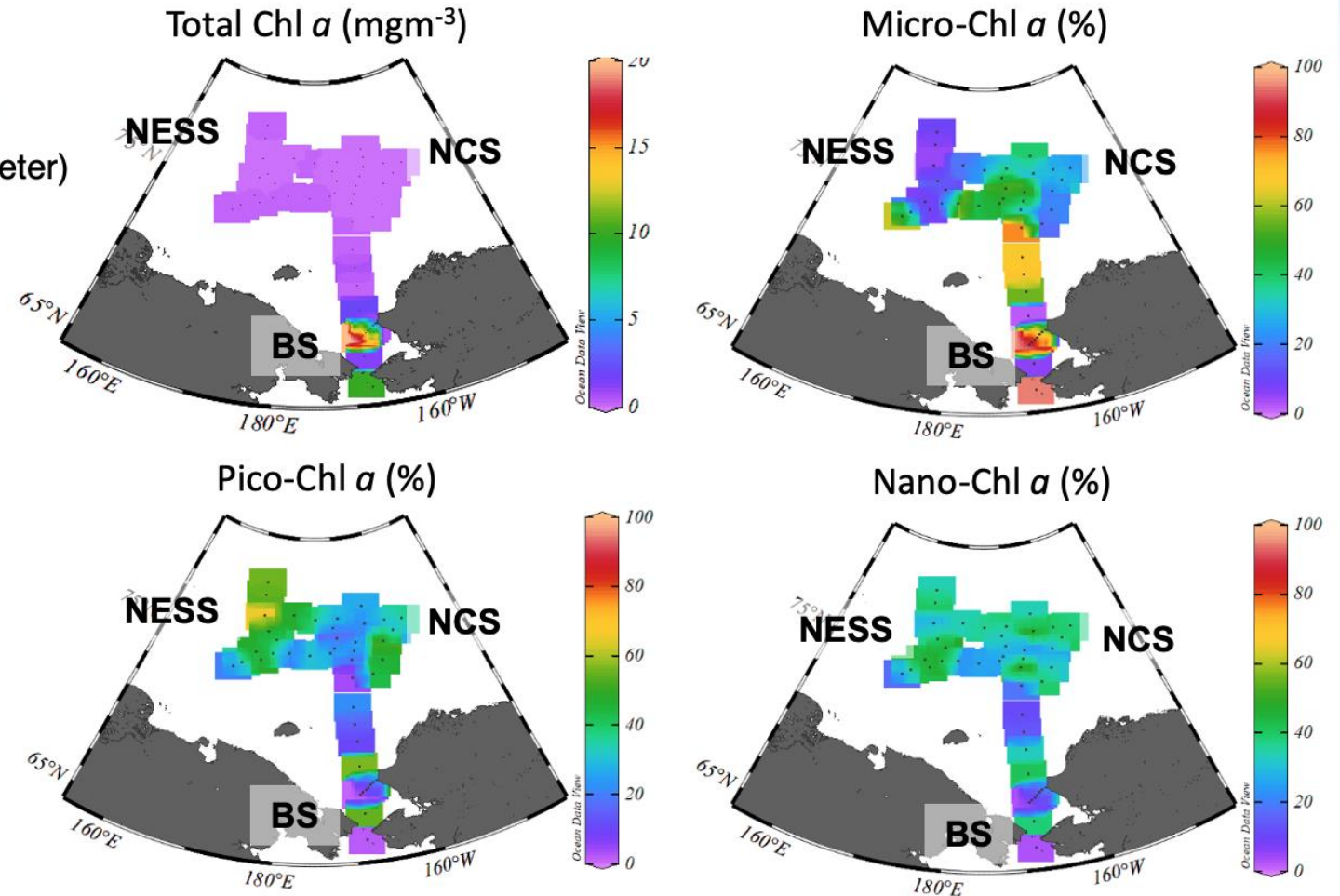
- Surface Chl-a concentrations were relatively higher in the Bering Strait and Chukchi Shelf than those in the Arctic Ocean.
- In the NCS and the NESS, the surface Chl-a concentrations were similar with the low values, but size-fractionated Chl-a exhibited large spatial variations, indicating different phytoplankton community structures in these regions.

Discrete samples

- Phytoplankton species abundance (Microscope)
- Total and size-fraction Chl-a concentrations (Fluorometer)
- Phytoplankton group biomass (HPLC)
- Picophytoplankton abundance (FCM)

Continuous underway measurements

- Phytoplankton group fluorescence (AOA)
- Phytoplankton species abundance (IFCB)

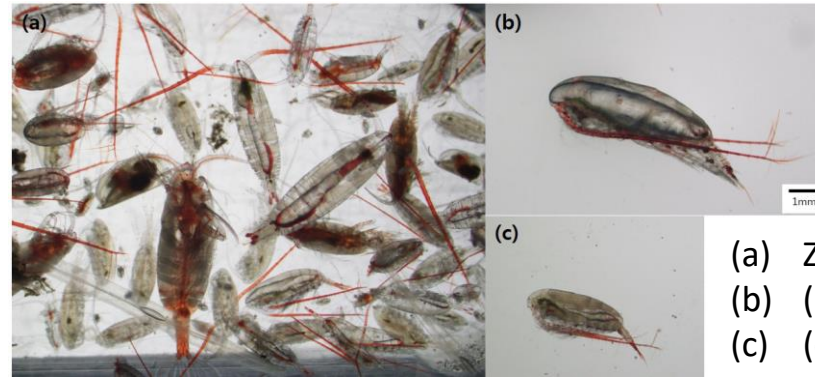
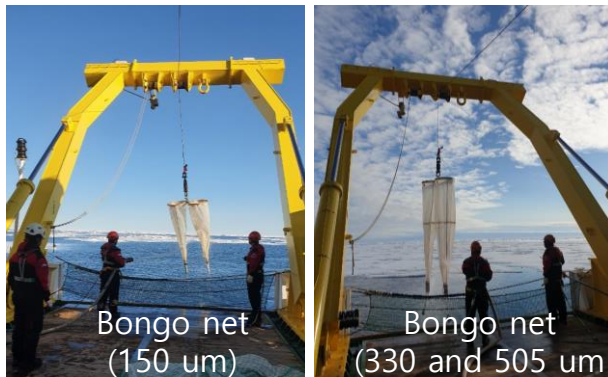
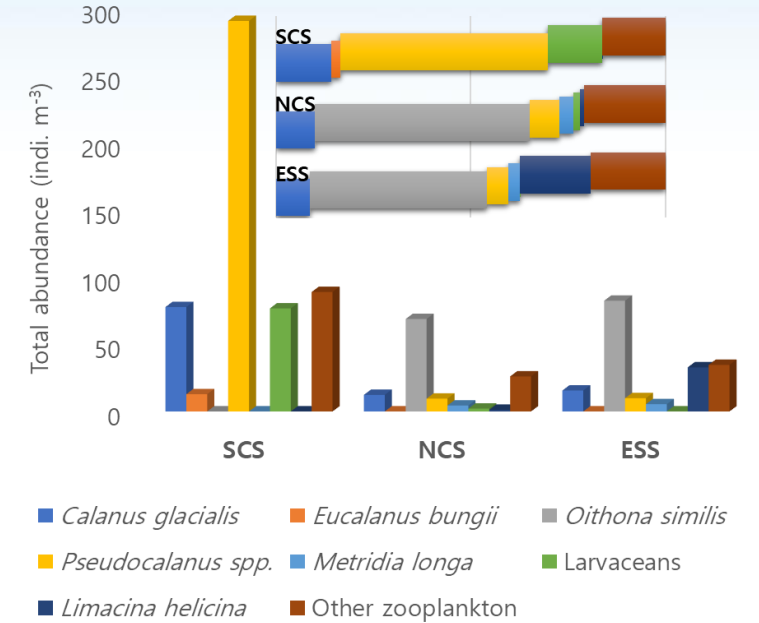
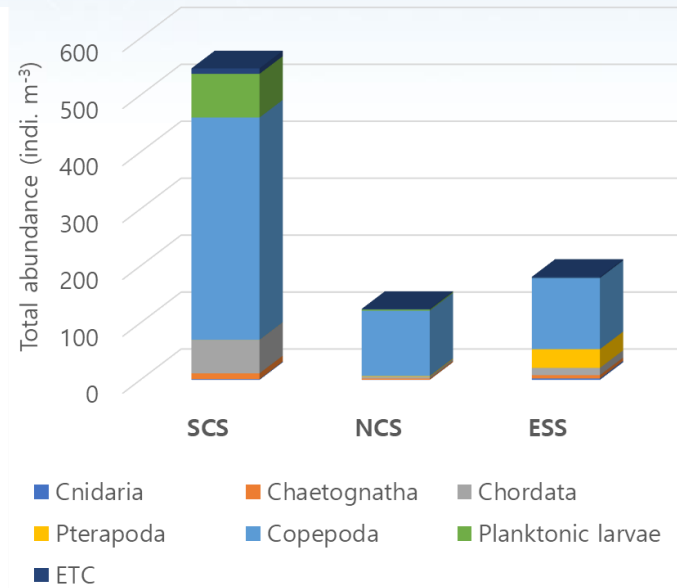
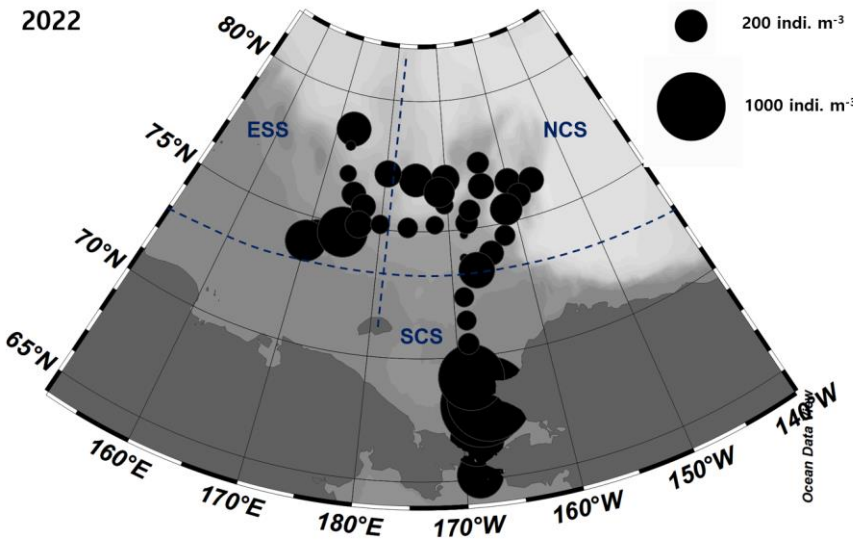


3. Preliminary results: Mesozooplankton community

Jee-Hoon Kim



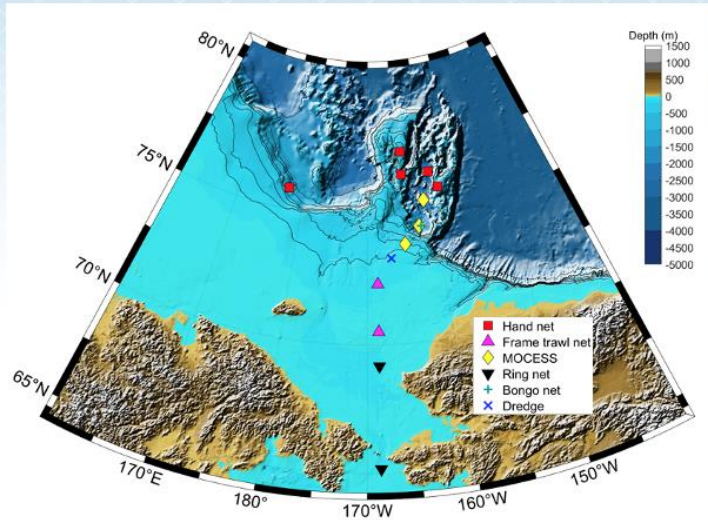
- The mesozooplankton abundance ranged from 13 to 1,481 ind. m⁻³, and the predominant group was copepods at 7–1,392 ind. m⁻³
- *Pseudocalanus* spp. were the predominant copepods in the Southern Chukchi Sea (SCS), *Oithona similis* was the predominant copepod in the Northern Chukchi Sea (NCS) & East Siberian Sea (ESS)



(a) Zooplankton assemblage by 330 µm bongo net
 (b) *Calanus hyperboreus*
 (c) *Calanus glacialis*.

3. Preliminary results: Fish sampling

Wuju Son, Jee-Hoon Kim, and Hyung Sul La



Pelagic

Arctic Cod (*Boreogadus saida*)



Capelin (*Mallotus villosus*)

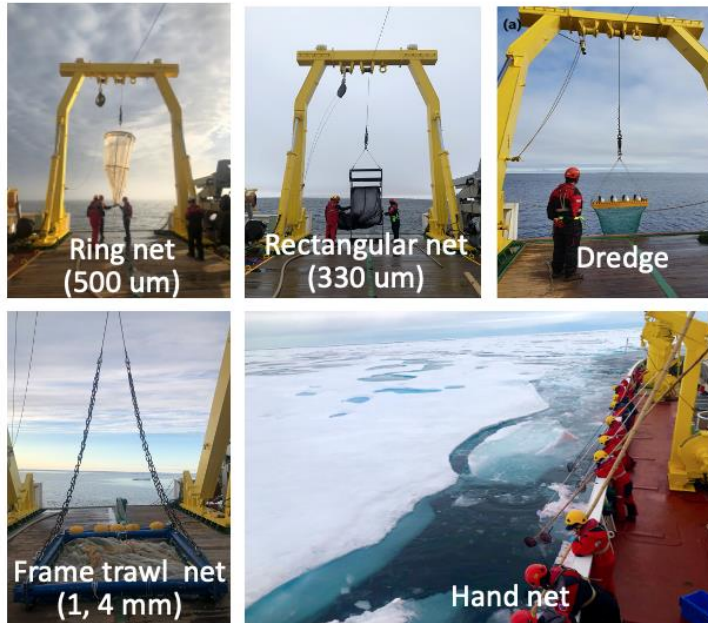


Benthic (Dredge)

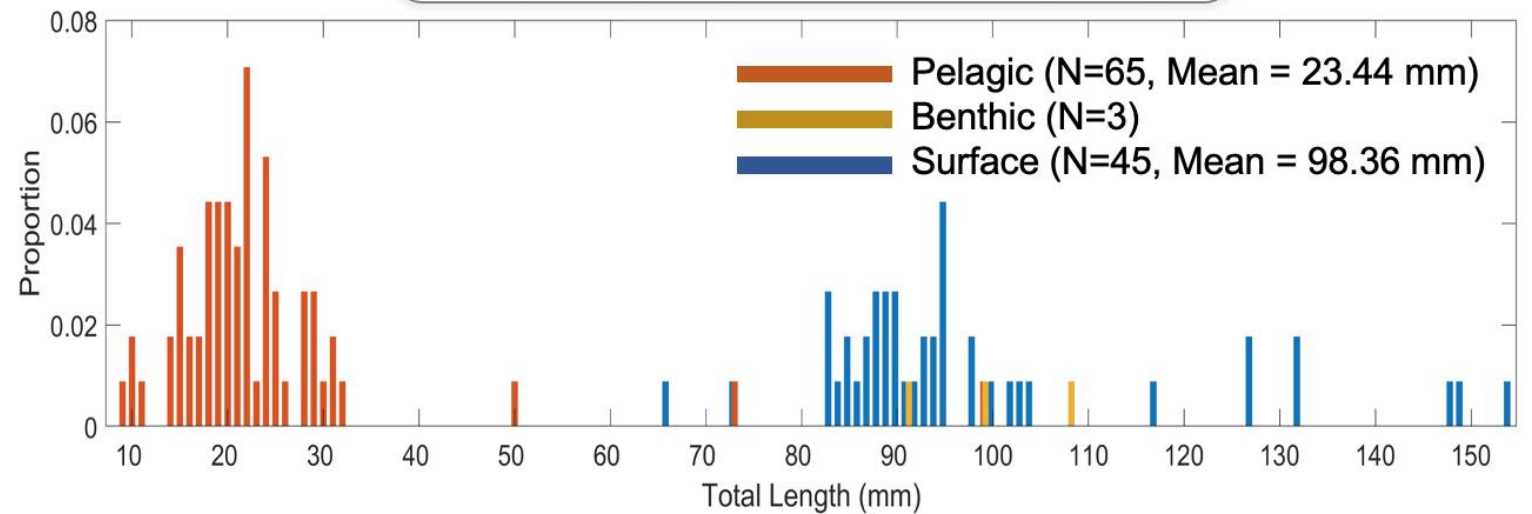


Surface (hand net)

Arctic Cod (*Boreogadus saida*)



Length-frequency distribution of fish (N=113)



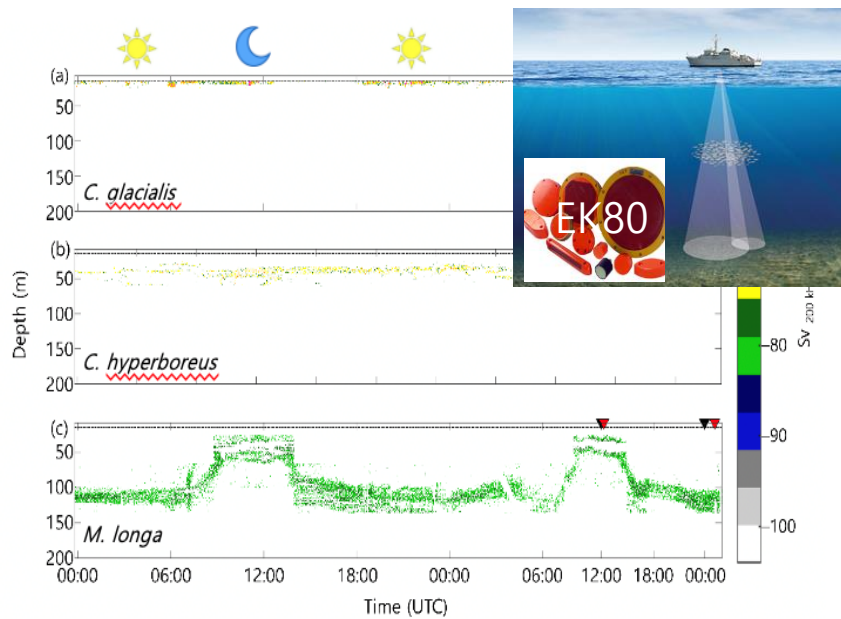
3. Preliminary results: Mesozooplankton community (Vertical Distribution)

High-Resolution Vertical Distribution of Polar zooplankton

- Most of the previous studies in the western Arctic Ocean have focused on horizontal distribution
- Acoustic data are collected in collaboration with Sonar system, EK80
- Scheduled to apply UVP6 (Underwater Vision Profiler 6) during the **AUG. 2023. Arctic cruise** (in preparation)

Vertical behavior of key zooplankton in the Arctic

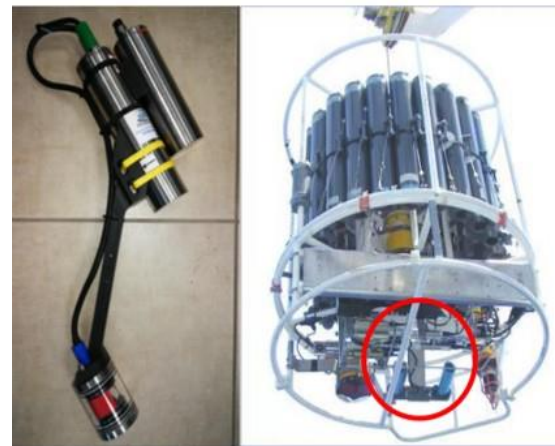
by EK80 & Net data (Arctic, 2021)



Son et al. 2023

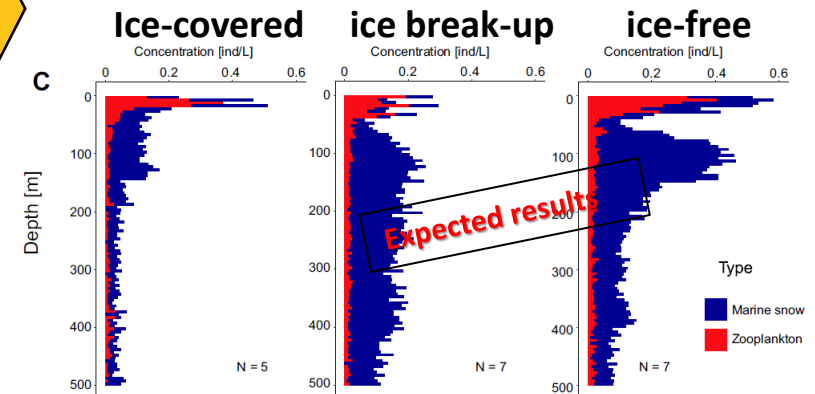
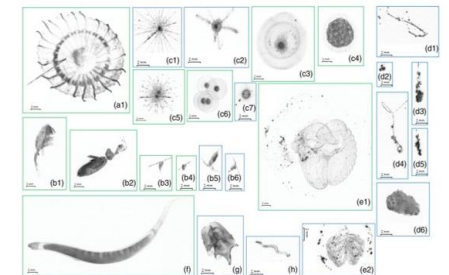
Underwater Vision Profiler (UVP)6 on CTD

Observation of variations in the vertical distribution of zooplankton communities in the Arctic Ocean



by UVP6 & CTD

Collaboration with AWI



Trudnowska et al., 2021

3. Preliminary results: Mesozooplankton community (Vertical Distribution)

High-Resolution Vertical Distribution of Polar zooplankton

- Most of the previous studies in the western Arctic Ocean have focused on horizontal distribution
- Acoustic data are collected in collaboration with Sonar system, EK80
- Scheduled to apply UVP6 (Underwater Vision Profiler 6) during the **AUG. 2023. Arctic cruise** (in preparation)

Vertical behavior of key zooplankton in the Arctic by EK80 & Net data (Arctic, 2021)

frontiers | Frontiers in Marine Science

TYPE Original Research
PUBLISHED 24 May 2023
DOI 10.3389/fmars.2023.1137045

Distinct vertical behavior of key Arctic copepods following the midnight sun period in the East Siberian continental margin region, Arctic Ocean

Wuju Son^{1,2}, Jee-Hoon Kim¹, Eun Jin Yang^{1,2} and Hyoung Sul La^{1,2*}

¹Division of Ocean Sciences, Korea Polar Research Institute, Incheon, Republic of Korea, ²Department of Polar Science, University of Science and Technology, Daejeon, Republic of Korea

Check for updates

OPEN ACCESS

EDITED BY
Jeff Shimeta,
RMIT University, Australia

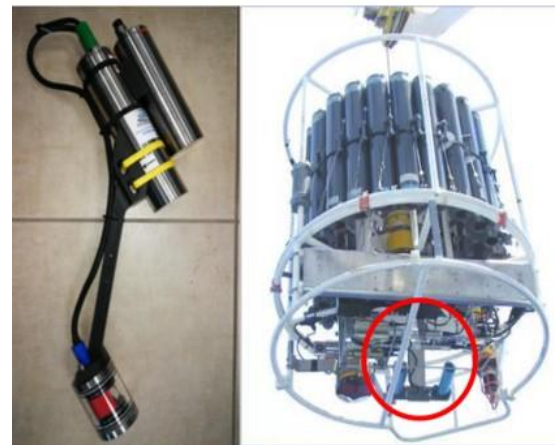
REVIEWED BY
Yong Jiang,
University of China, China
Laura Hobbs,
Scottish Association For Marine Science,
United Kingdom

*CORRESPONDENCE
Hyoung Sul La
hsla@kopri.re.kr

RECEIVED 03 January 2023
ACCEPTED 08 May 2023
PUBLISHED 24 May 2023

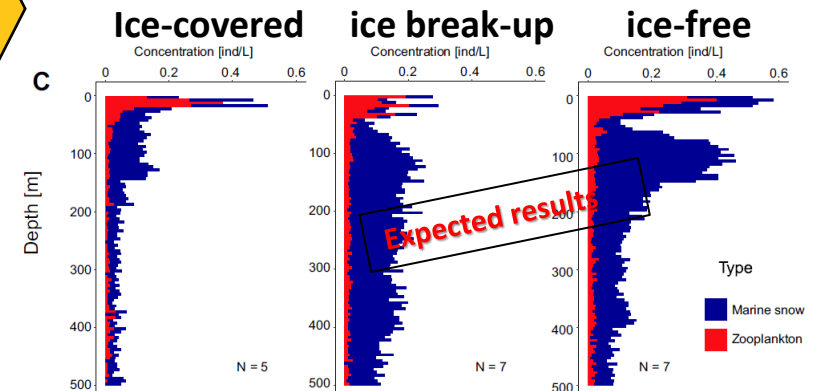
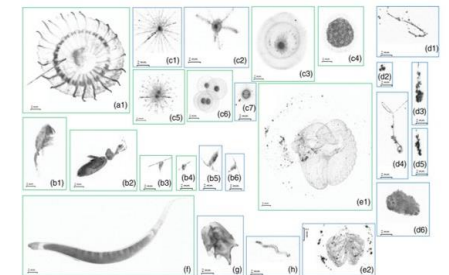
Underwater Vision Profiler (UVP)6 on CTD

Observation of variations in the vertical distribution of zooplankton communities in the Arctic Ocean



by UVP6 & CTD

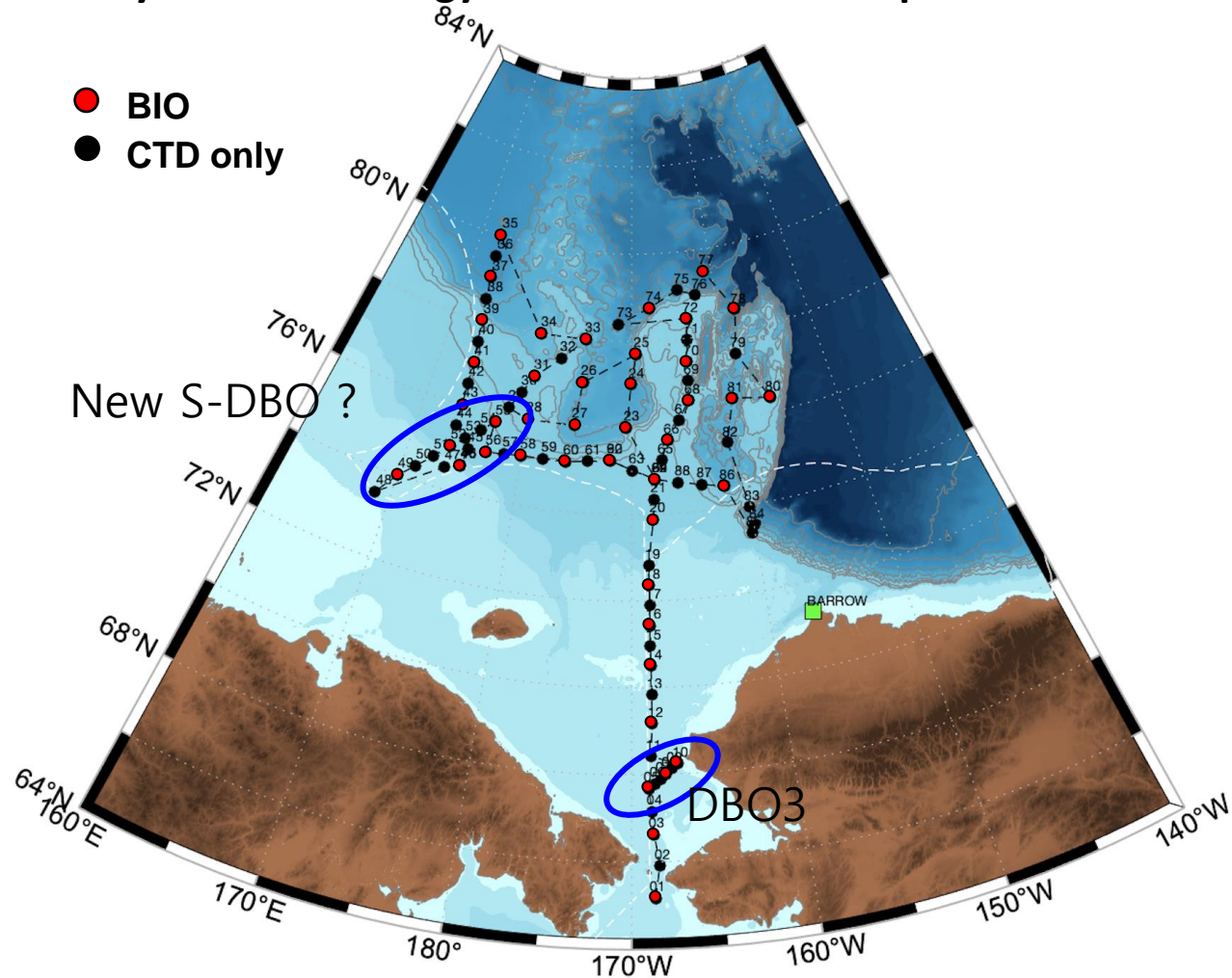
Collaboration with AWI



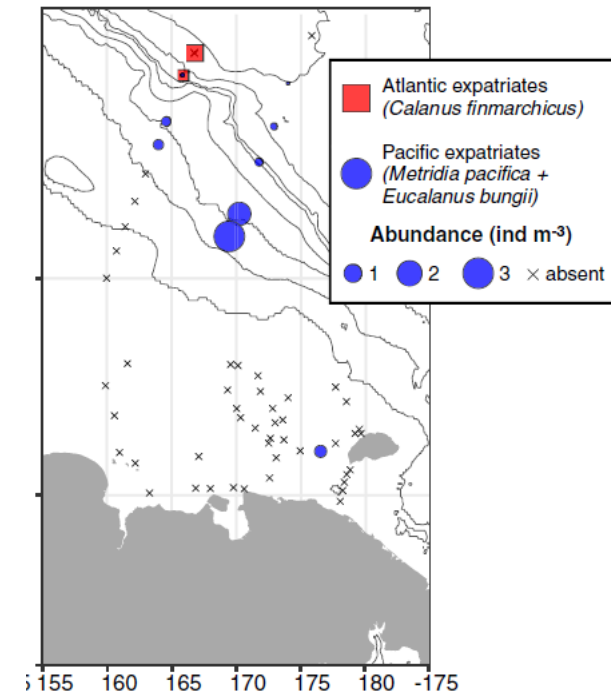
Trudnowska et al., 2021

Preparing New DBO Line in East Siberian Sea

- Preparing New DBO Line, in PAG meeting 2023, Korea Polar Symposium 2023(UAF, UMCES, KOPRI ...)
- Key Issues in biology: Invasion of Atlantic species and community changes due to influx of Atlantic waters



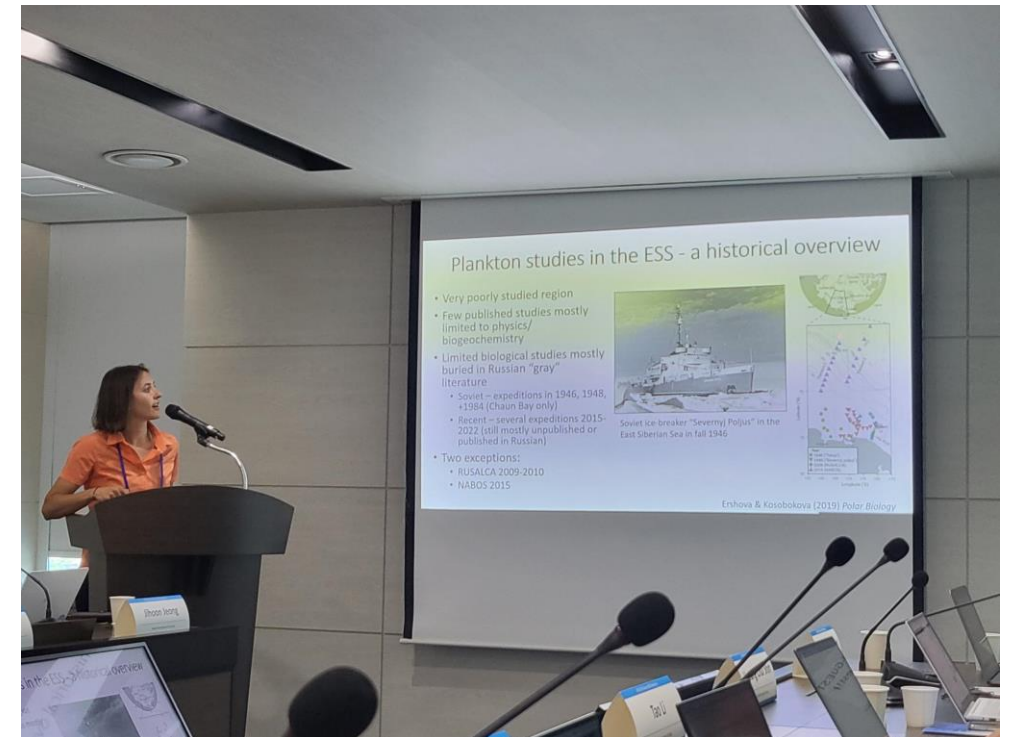
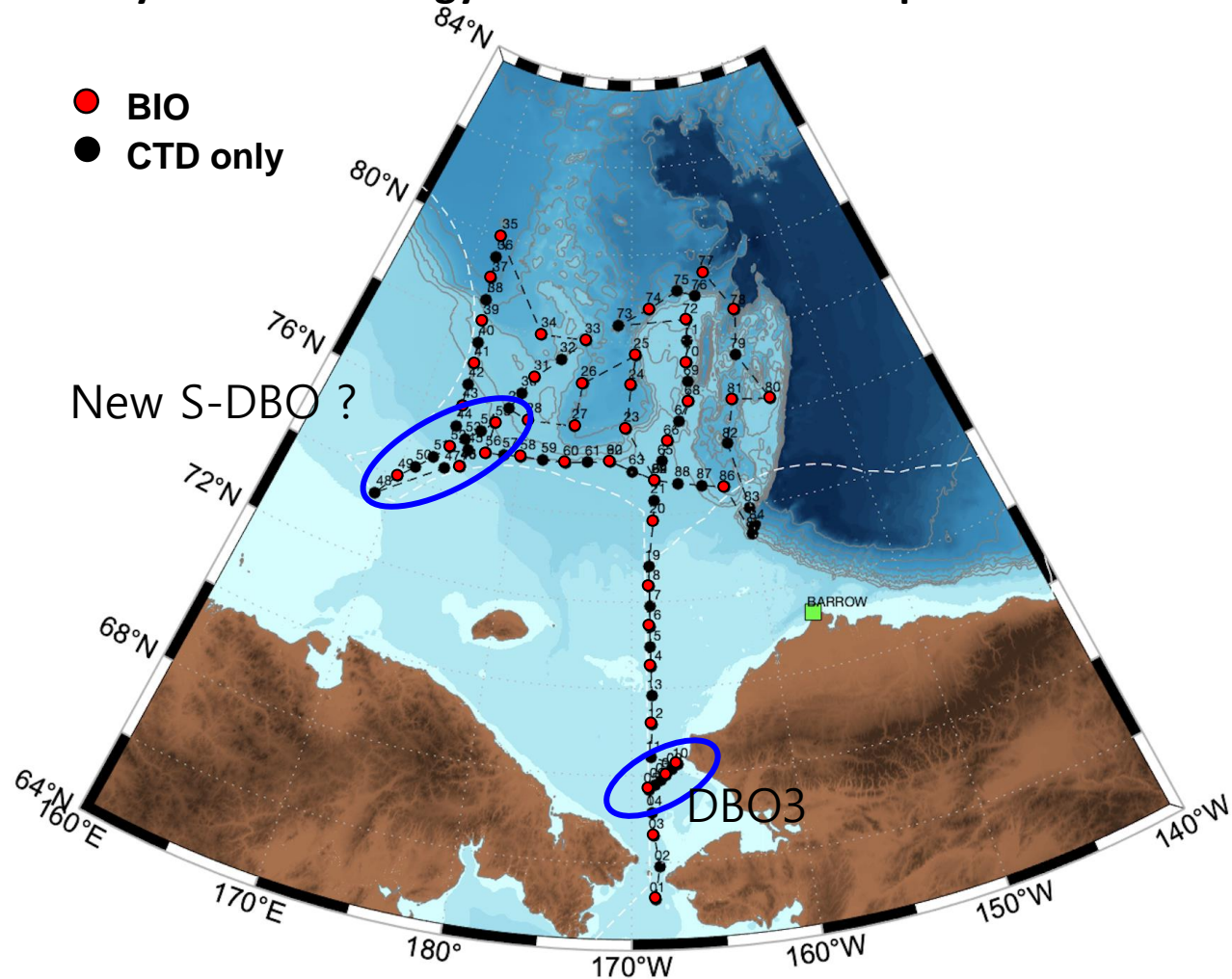
(e) Pacific/Atlantic expatriates



Ershova & Kosobokova, 2019

Preparing New DBO Line in East Siberian Sea

- Preparing New DBO Line, in PAG meeting 2023, Korea Polar Symposium 2023(UAF, UMCES, KOPRI ...)
- Key Issues in biology: Invasion of Atlantic species and community changes due to influx of Atlantic waters



Ershova & Kosobokova, 2019

Korea-Japan visit for collaboration and synthesis paper

- Preparing a collaborative paper on the zooplankton community in the western Arctic Ocean
- Study of zooplankton community change in summer by synthesizing July(RV Mirai) and August data(RV ARAON)

<In Hokkaido Univ. 2023. 28th May ~ 3th June>



KOPRI

Dr. Eun Jin Yang
Dr. Jee-Hoon Kim

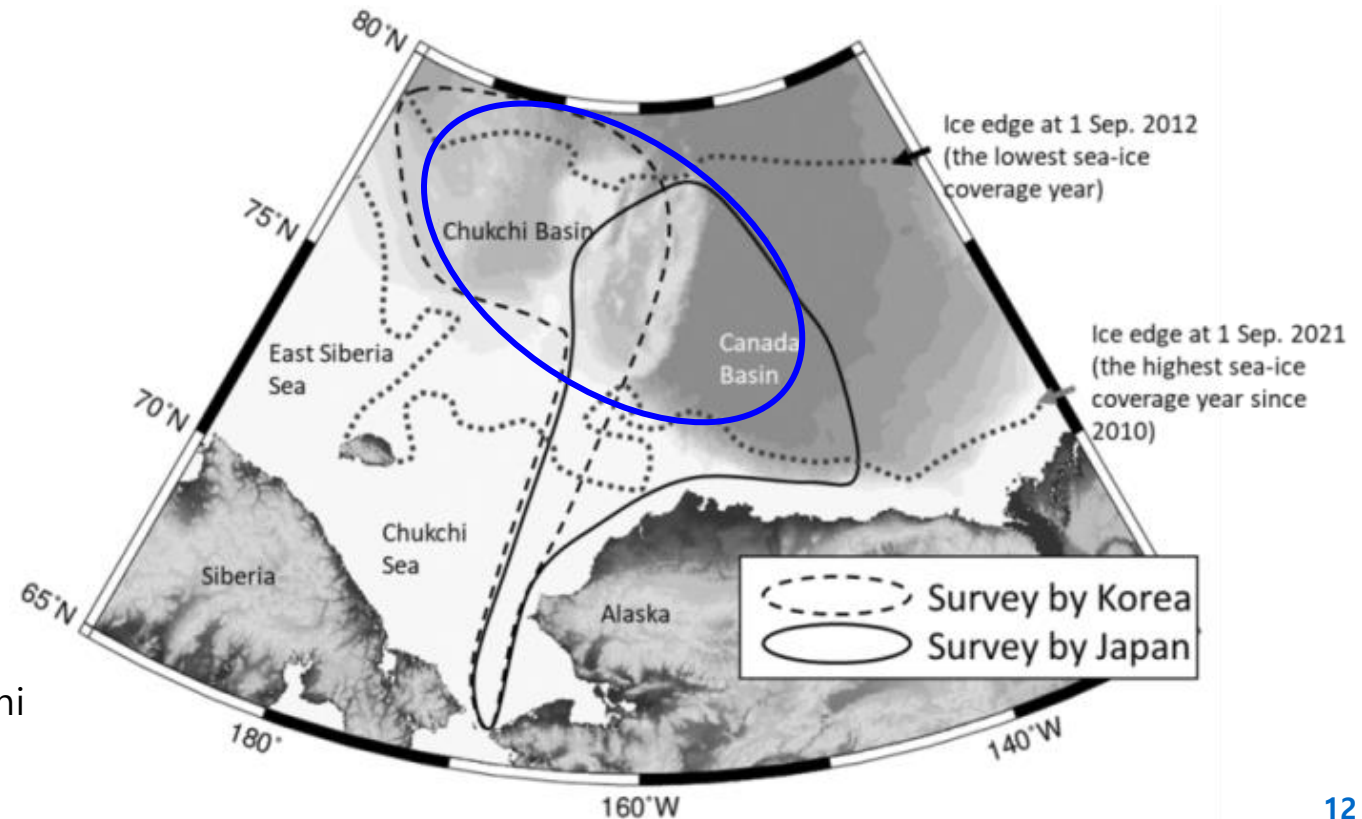
...

Hokkaido Univ.

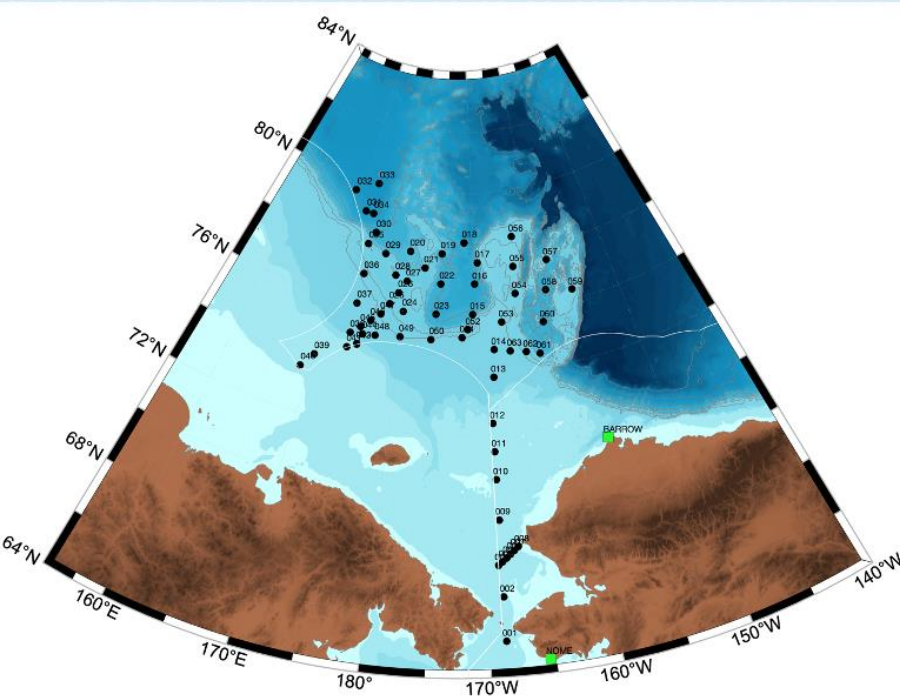
Dr. Atsushi Yamaguchi
Dr. Kohei Matsuno

...

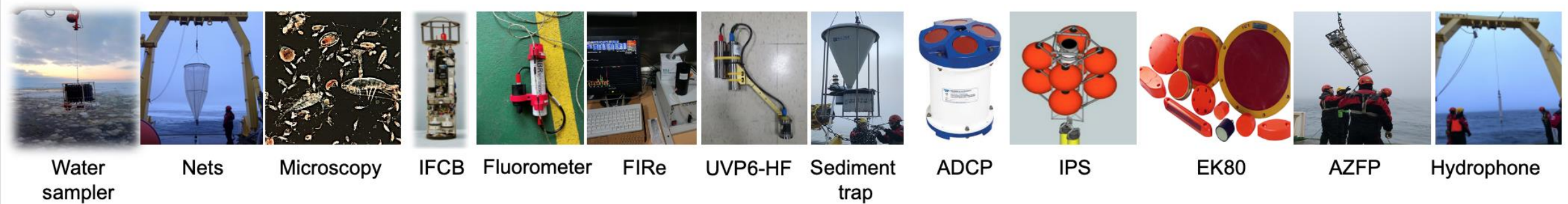
< Zooplankton data by RV ARAON + RV Mirai >



4. Field plan in 2023



- **Phytoplankton** community structure, primary production, and **physiology**.
- **Microzooplankton** community structure and grazing impact.
- **Mesozooplankton** population and community structure.
- Vertical behavior of **zooplankton and micronekton** based on acoustic and net.
- **Fish distribution** with acoustic, net, and eDNA in the CAO.
- **Soundscape (marine mammals)** in the NESS.



Water sampler

Nets

Microscopy

IFCB

Fluorometer

FIRE

UVP6-HF

Sediment trap

ADCP

IPS

EK80

AZFP

Hydrophone

THANK YOU Q&A



jeehoonkim@kopri.re.kr