



# Benthic Studies during the 2022 US Synoptic Arctic Survey

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# Benthic Processes

- Benthic fauna, sediments, and carbon cycling are long-term integrators of overlying water column processes
- Long-term measurements of benthic fauna and trophic pathways are excellent indicators of climate change since they reflect large scale changes in biological response
- Benthic processes and fauna influenced by:
  - water temperature and salinity
  - extent and duration of sea ice
  - water column production and grazing
  - net carbon flux to the sediments
  - sediment grain size and carbon content
  - predator-prey relationships
- Pelagic-benthic coupling can be studied via underlying sediment processes on various time scales
- Sediment metabolism can be an indicator of weekly-seasonal carbon depositional processes
- Benthic faunal populations act as multi-year, long-term integrators of a variety of marine processes



-Leonard Sussman

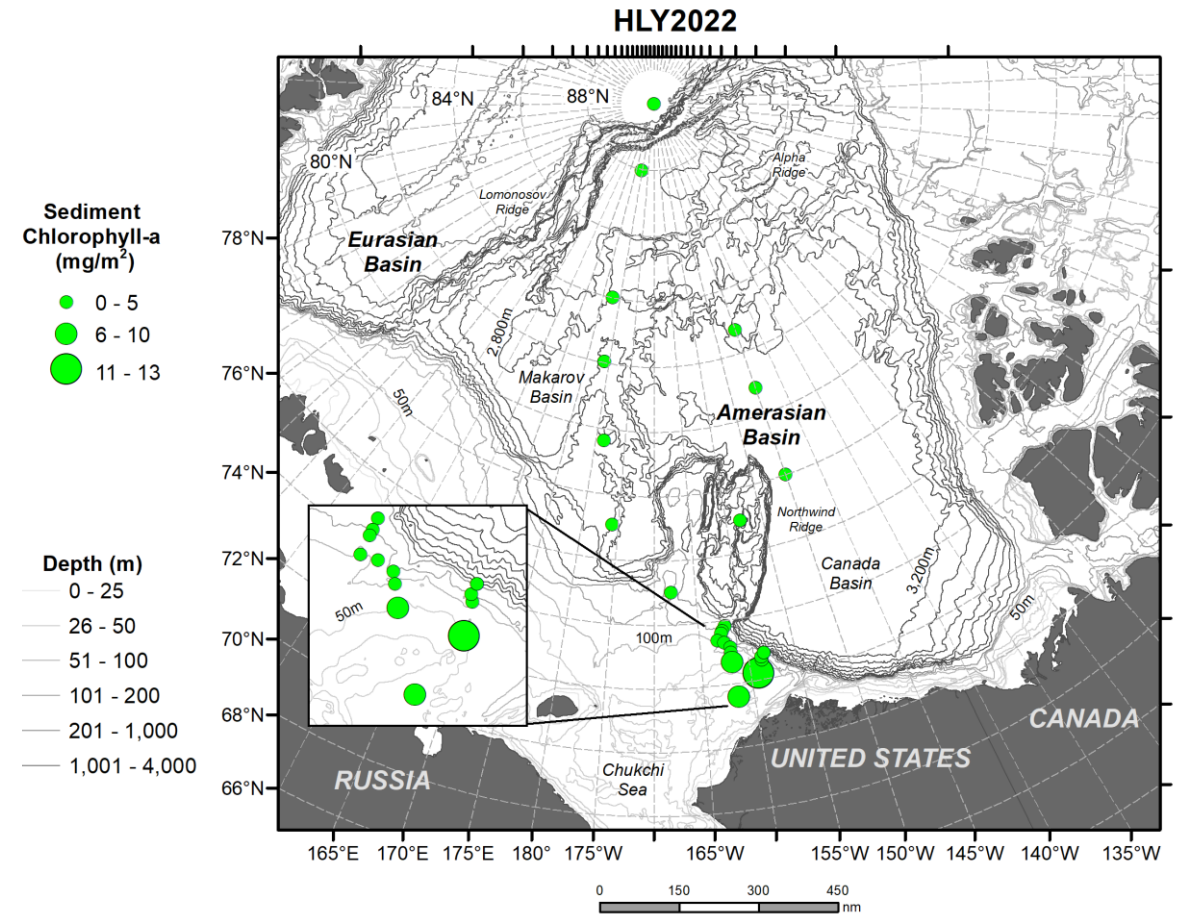
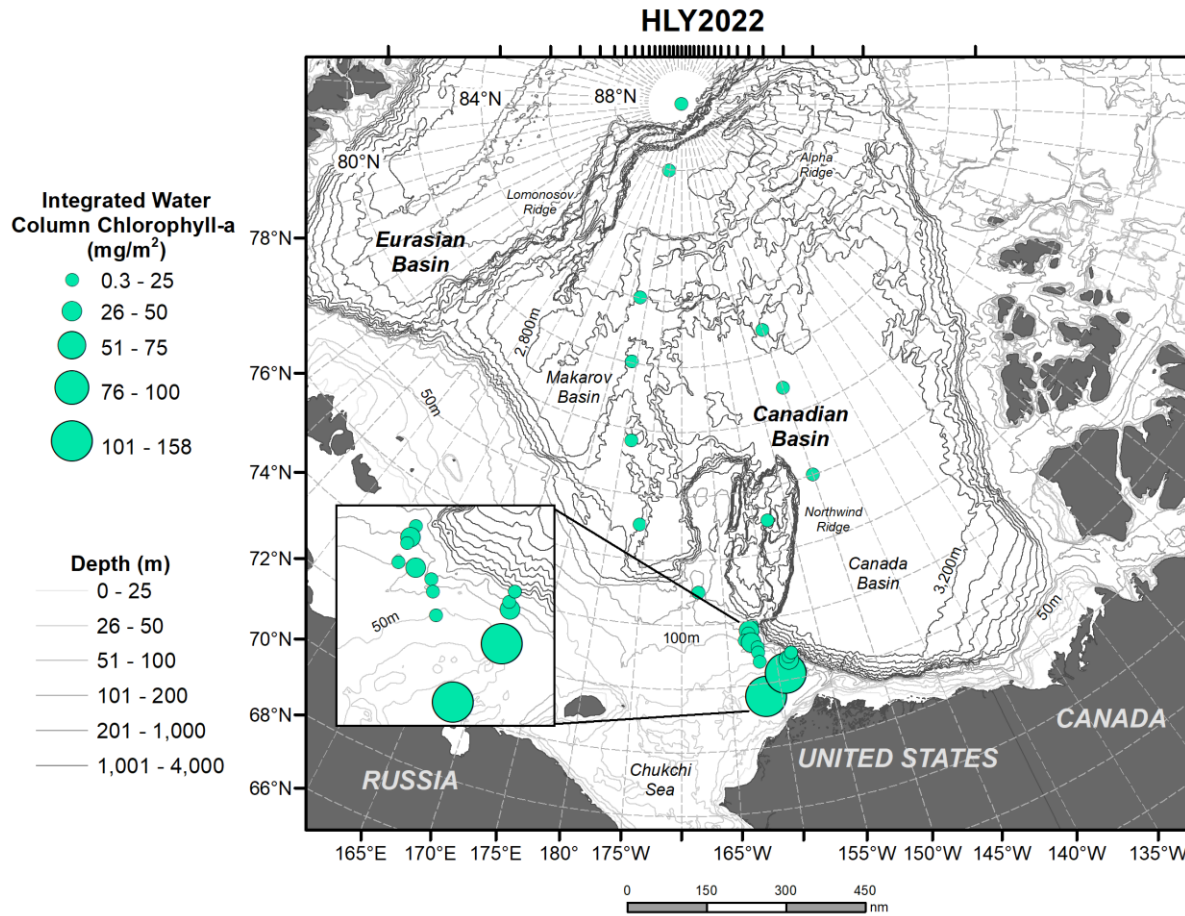
## Benthic Studies

Our team collected **vertical profiles of seawater** for determinations of **chlorophyll biomass, nutrients, oxygen-18/oxygen-16 ratios, and dissolved organic carbon (DOC)** for water mass characteristics, bottom water for subset of sediment incubation experiments, and subsamples for **phytoplankton taxonomy**.

Benthic sampling included **macro-,meio- and micro-faunal collections, surface sediments for key parameters (total organic carbon and nitrogen, grain size, sediment chlorophyll, and bacterial content), sediment oxygen uptake rate experiments, and individual bivalve respiration rate measurements.**

**Preliminary results** indicated very low chlorophyll water column and sediment biomass in the deep Arctic basin, with highest values on the shelf and slope. Macrofaunal population and sediment respiration rates were highest on the Chukchi shelf, declining to extremely low levels in the high Arctic, consistent with lower water column chlorophyll biomass in both the water column and surface sediments under more persistent ice cover. However, significant chlorophyll biomass was present on the shelf and slope as late as mid-October. Benthic images showed marine snow on the outer shelf and slope, with little detritus in the deep Arctic Basin.

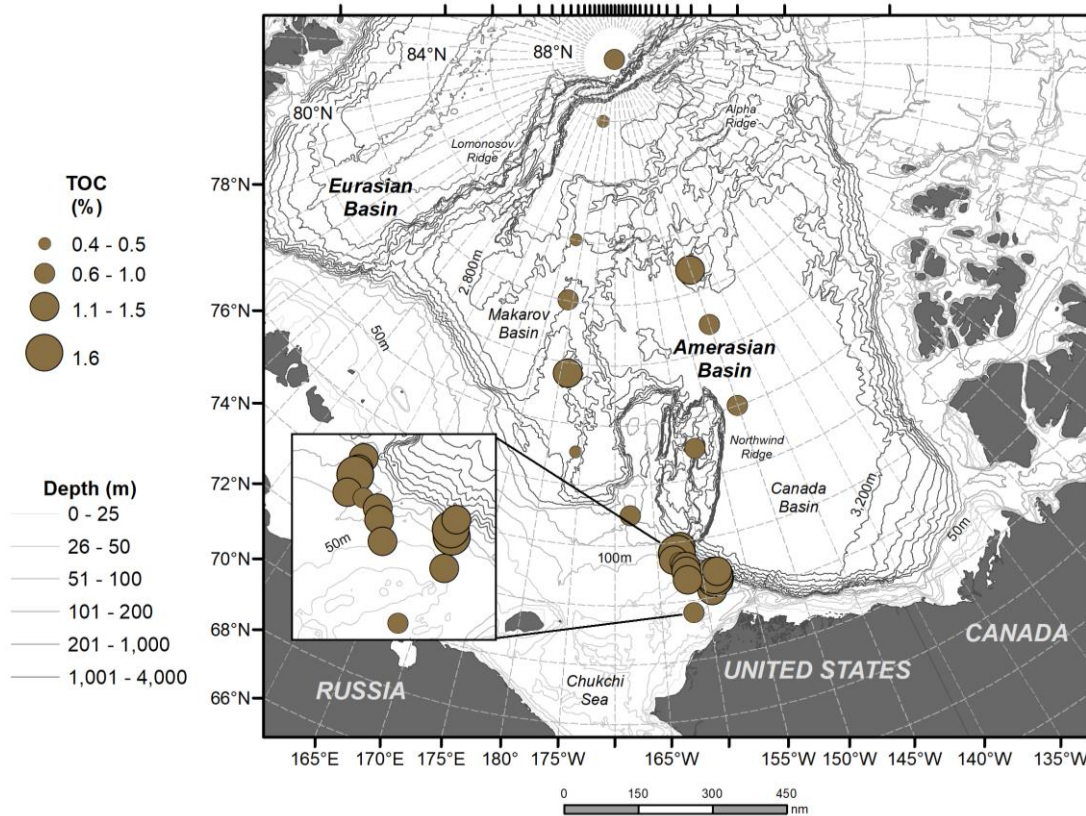
# Water column and Sediment Chlorophyll *a* Biomass – an indicator of productivity



- **Left figure:** Upper water column integrated chlorophyll was very low in the basins, with higher values on Chukchi Shelf and north of Hanna Shoal even in late fall
- **Right figure:** Sediment chlorophyll a highest on shelf, lowest in the basin

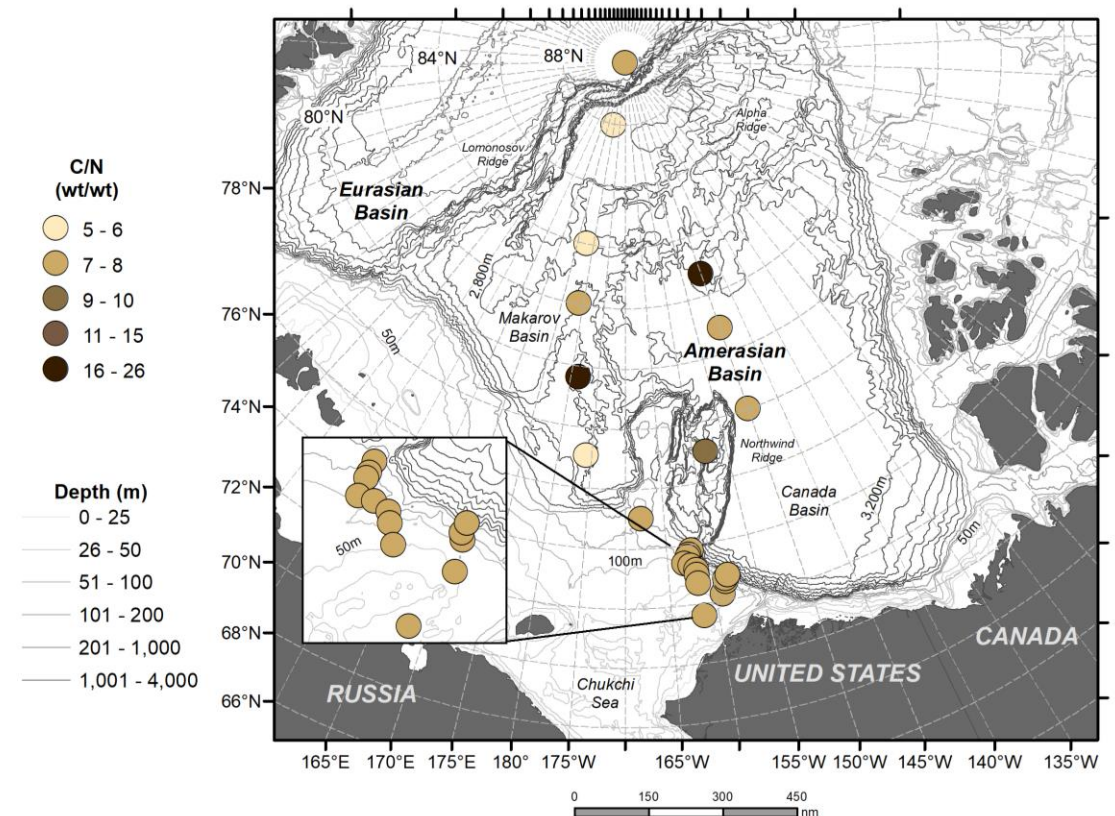
# Surface Sediment Total Organic Carbon and C/N content - indicator of long-term carbon deposition and carbon quality

## Surface sediment total organic carbon (% TOC)



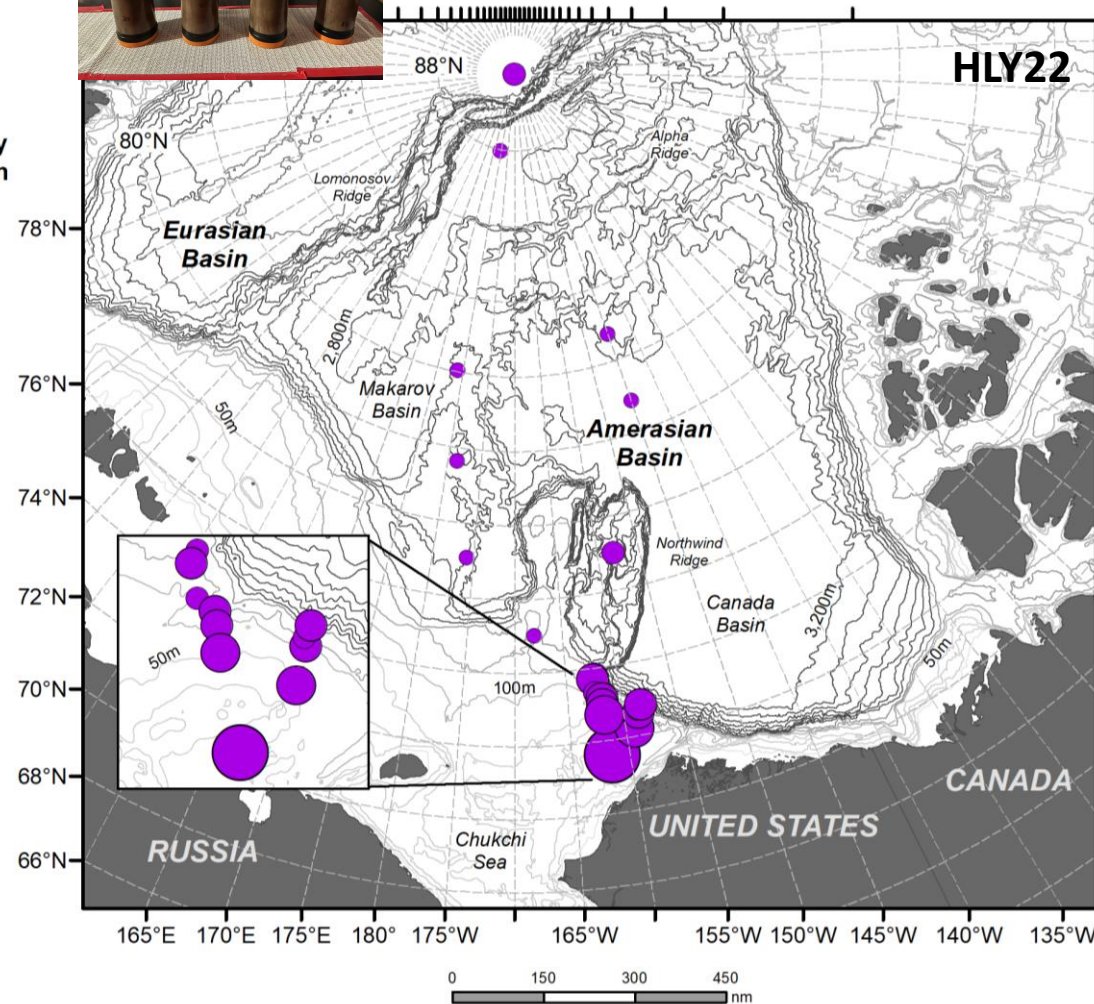
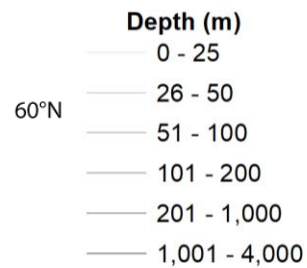
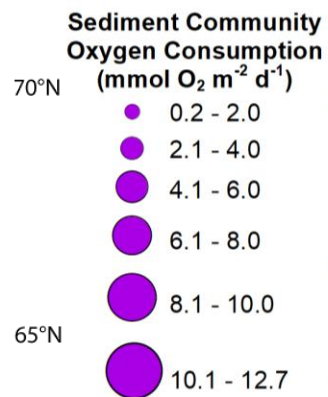
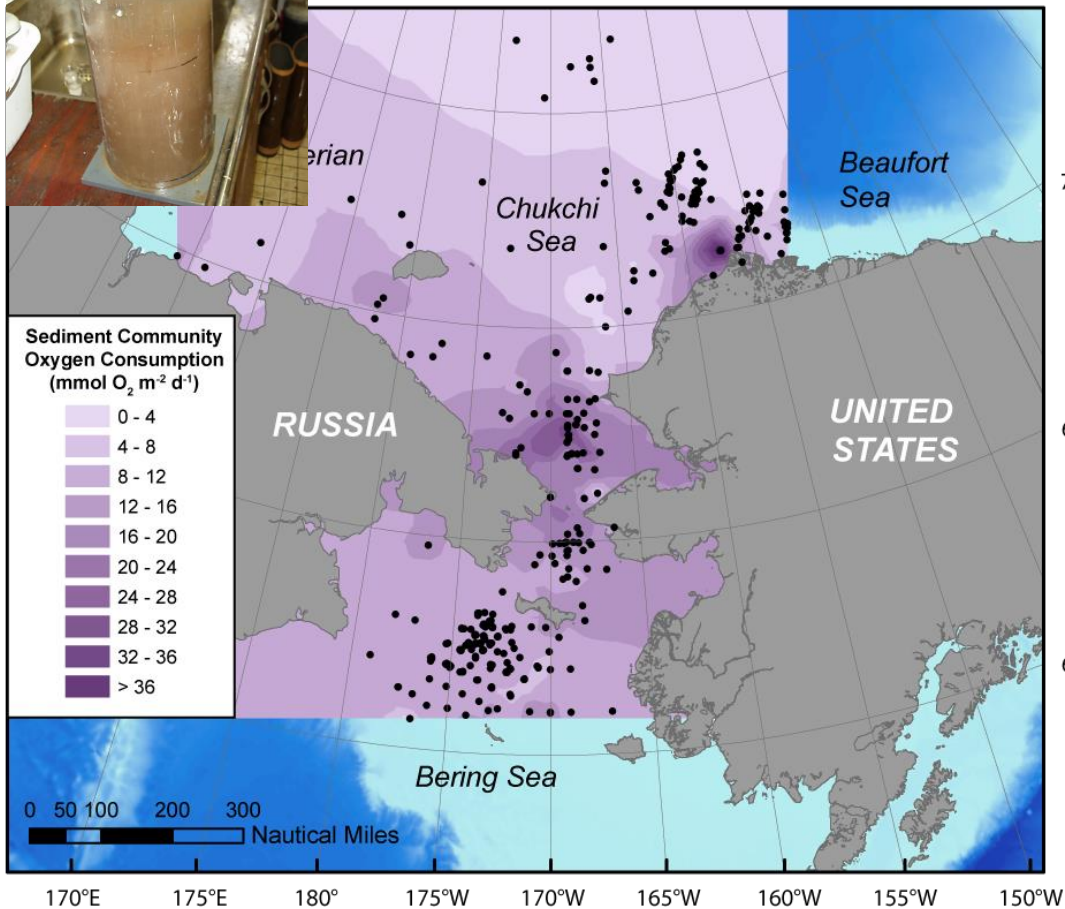
**Left.** Highest values on the Chukchi outer shelf and slope, declining northward. Most sediment are fine silt & clay content (not shown).

## Surface sediment C/N content



**Right.** More labile carbon (lower C/N) on the outer shelf/slope, with variable low to high quality carbon in the Arctic Basin spatially.

# Sediment Community Oxygen Consumption as an indicator of carbon export to the benthos declines shelf to basin



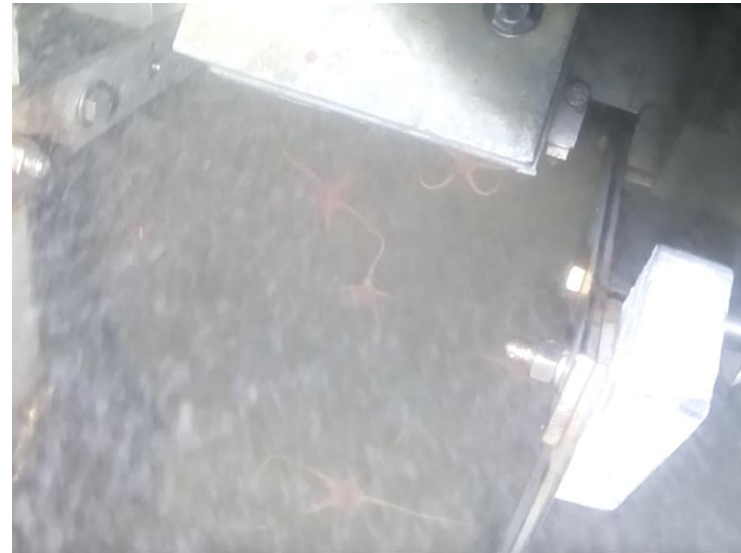
[updated from Grebmeier et al. 2012]

# Bottom sediments in the Arctic Ocean

Station 1, EHS1, 9/10/22, 50 m

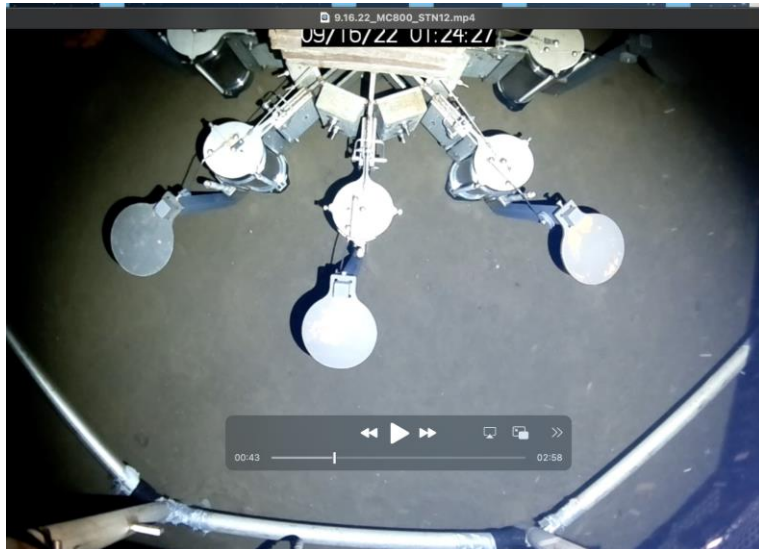


Station 6, EHS5, 9/13/22, 204 m



- High marine snow, carbon export and benthic faunal biomass on shelf and upper slope Chukchi sea stations in fine sediments

Station 12, CBL3, 9/16/22, 1731 m



Station 21, CBL11, 10/02/22, 4240 m



- Low carbon export in deep basin stations, with low benthic faunal populations in fine sediments

# Arctic Shelf and Deep Sea Benthic Animals

Stn 1, EHS1, 9/10/22, 50 m



Stn 14, CBL5, 9/18/22, 3828 m



Stn 18, CBL8, 9/22/22, 2724m

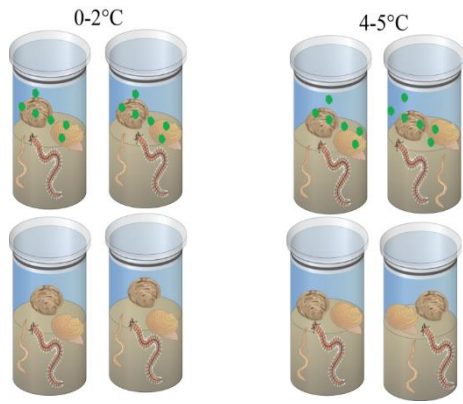
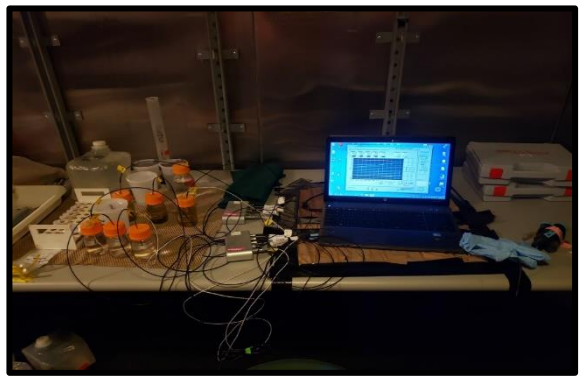
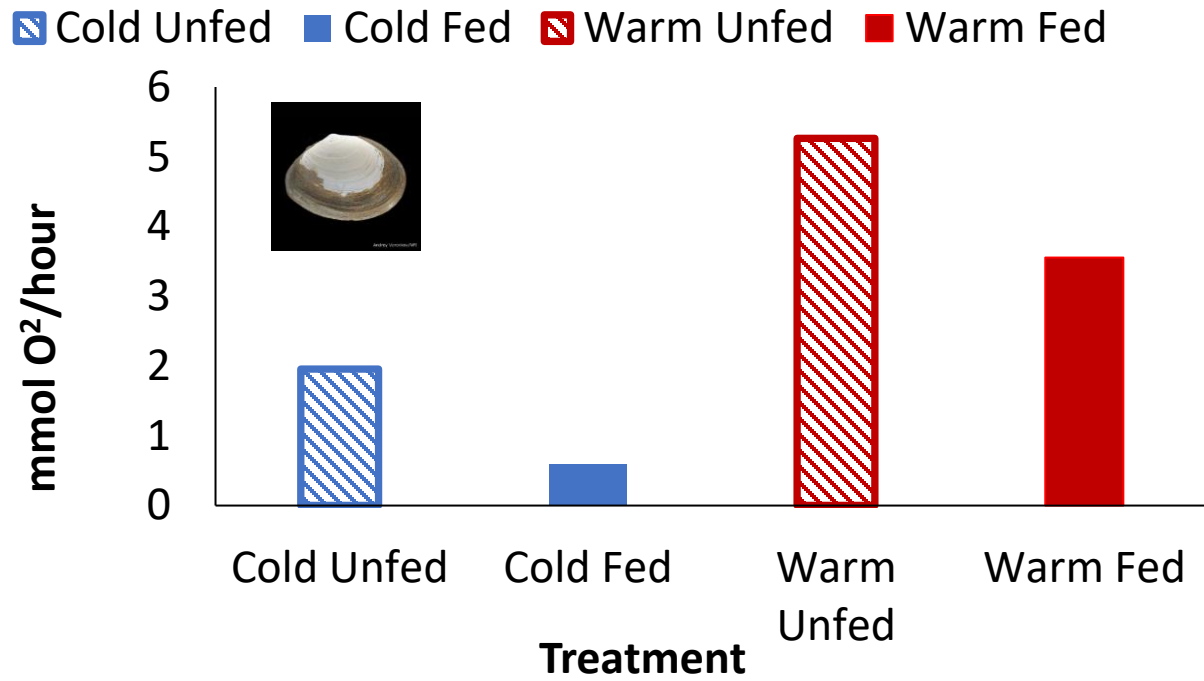
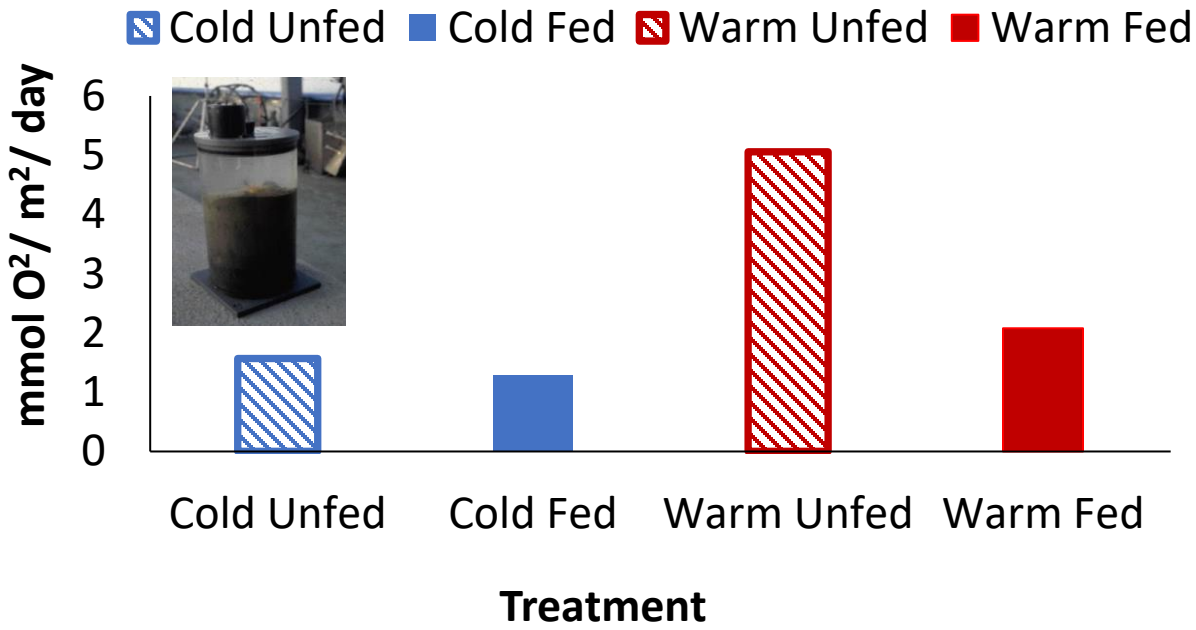


Stn 21-North Pole, 10/1/22, 4240m





# Sediment Core and Individual Dominant Organism Temperature and Food Experiments



- Respiration rates were higher in cores and individuals that were held in higher temperatures
- This is consistent with previous studies conducted in the northern Bering Sea and the southeastern Chukchi Sea in July, but not in October
- Indication of the potential for higher benthic carbon cycling with projected warming bottom water temperatures

## Potential SAS manuscripts

- Hydrographic comparison between the Makarov and Canada Basins (Cooper and Grebmeier)
- Benthic carbon cycling and sediment parameters from the outer shelf of the Chukchi Sea to the North Pole (Grebmeier et al.)
- Temperature and food supply as drivers for bivalve growth in the Pacific Arctic (Goethel et al.)
- Benthic faunal populations from the shelf to the deep sea from field sampling and video imagery (Grebmeier et al.)

# Acknowledgements

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**Questions?**



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