The 2022 US Synoptic Arctic Survey North Pole Cruise on *USCGC Healy*

-Photo by Lt. Lydia Ames, NOAA

Carin Ashjian, Woods Hole Oceanographic Institution

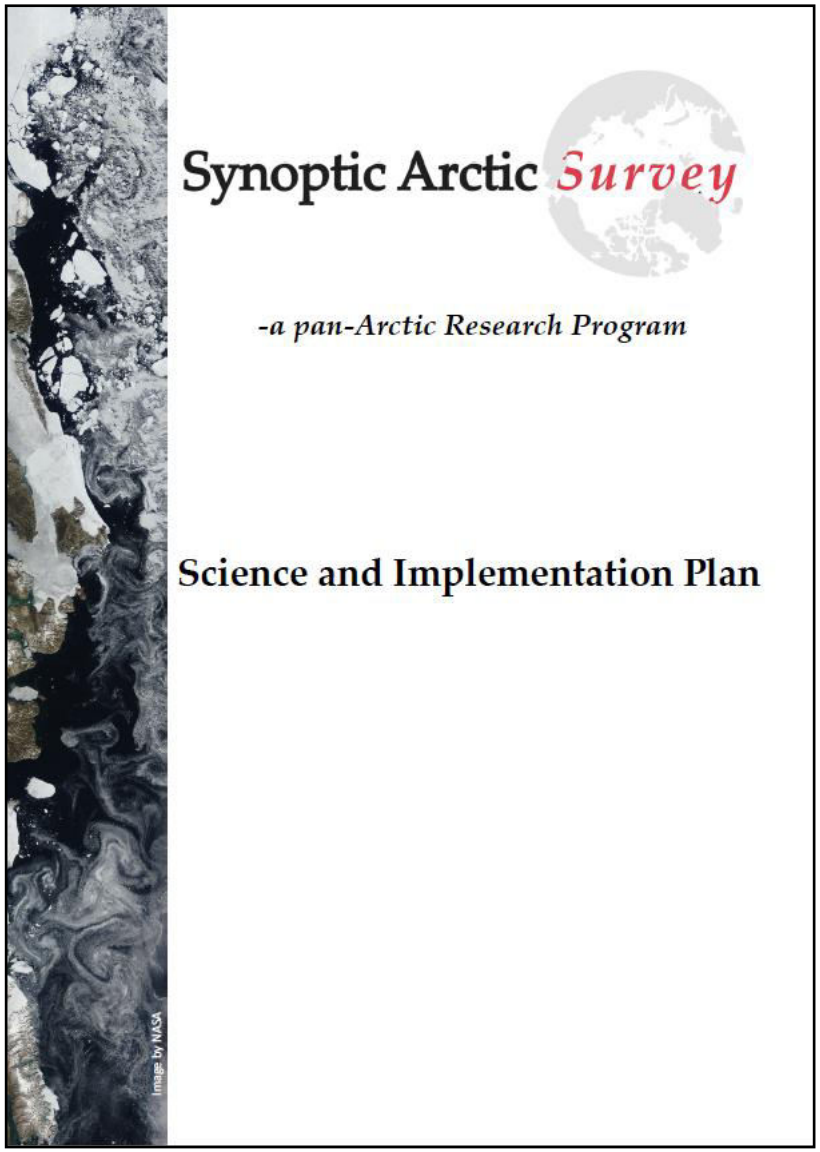
Jackie Grebmeier, University of Maryland

Co-Chief Scientists

Synoptic Arctic Survey

Funded by the U.S. National Science Foundation

What is the Synoptic Arctic Survey?



- An international collaborative effort to collect physical, biological, and carbon data from across the Arctic Ocean in late summer of 2020-2022 using research vessels
- These data can be used to detect ongoing and future climate change and its impact
- “Synoptic” here means “in the same season”

More Info: https://synopticarcticsurvey.w.uib.no

Overarching question and scientific structure

What are the present state and major ongoing transformations of the Arctic marine system? (specifically the ecosystem and carbon system)

- Describe the present state of the Arctic Ocean to provide the foundation against which future states can by compared to quantify change.
- Three key foci:
    1) State of the Ecosystem
    2) State of the carbon cycle and ocean acidification
    3) Physical characteristics which drive the ecosystem and carbon cycle

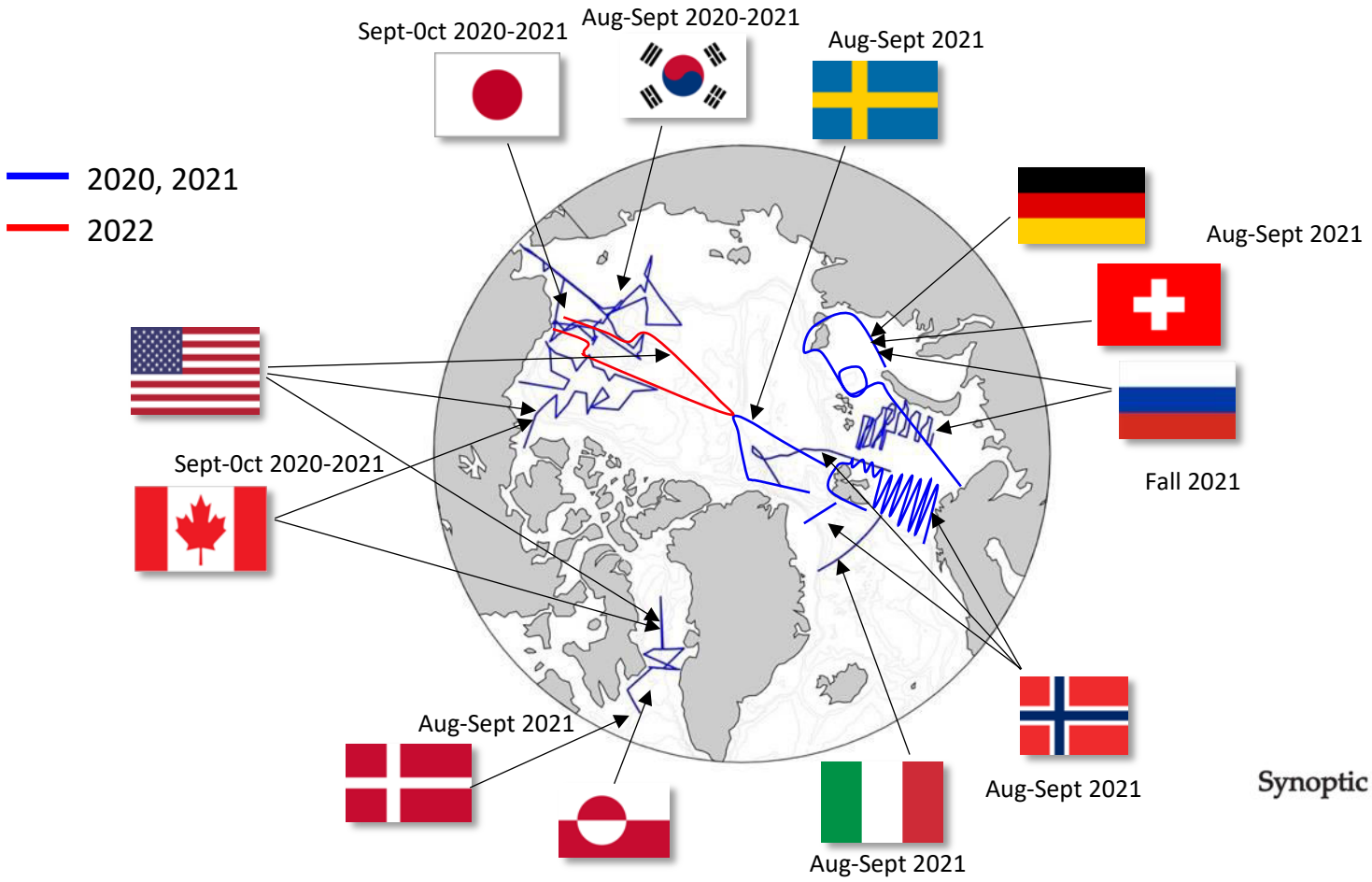
Synoptic Arctic Survey

Why does it matter?

Establishing the present state and future changes in the Arctic Ocean will help us to:

- Understand how climate change is impacting this system
- Project how these changes could change the system (for example, northward movement of commercially important fish)
- Better manage and conserve Arctic Ocean natural resources and ecosystem services

This cruise is a major U.S. Contribution to the SAS



International SAS Cruises (12 Nations)

Multiple disciplines requiring diverse sampling capabilities - PIs

Scientist	Affiliation	Topic Areas
Carin Ashjian	Woods Hole Oceanographic Institution	Zooplankton, US SAS coordination office, Co-Chief Scientist
Nick Bates	Bermuda Institute for Ocean Sciences	Seawater carbonate chemistry, air-sea CO_2 gas exchange, and net community production
Robert Campbell	University of Rhode Island	Zooplankton rates, condition, and genetics
Lee Cooper	University of Maryland	Chlorophyll, nutrients, and oxygen; sediment carbon
Seth Danielson	University of Alaska Fairbanks	Physical oceanography
Jackie Grebmeier	University of Maryland	Benthic composition, abundance, biomass, and rates, sediment types, Co-Chief Scientist
Laurie Juranek	Oregon State University	Dissolved gases, nutrients, photosynthesis and respiration rates, net community production
Cindy Pilskaln	University of Massachusetts Dartmouth	Water column particulate carbon quantity and sinking rates (flux)
Mary-Louise Timmermans	Yale University	Physical oceanography

Multiple disciplines requiring diverse sampling capabilities – Additional projects including early career

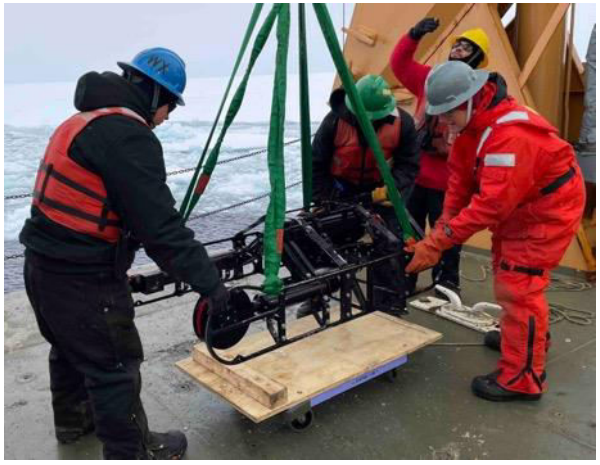
Scientist	Affiliation	Topic Areas
Adam Fagan/Adam Martiny	University of California Irvine	Near-surface DNA/RNA, large volume POM, EDA
Clare Gaffey/Karen Frey	Clark University	Optics and chlorophyll pigments
Christina Goethel	University of Maryland	Sediment community O2 Consumption under warming and different food levels; Bivalve respiration
Sue Moore	University of Washington	Marine mammal watch
Marty Reedy/Liz Labunski	US Fish and Wildlife Service	Marine bird surveys
Jona Silberberg	Christian-Albrecht-University, Kiel, Germany	Meiobenthos
Leonard Sussman	Independent	Science and landscape photography; blog
John Wigglesworth	Woods Hole Oceanographic Institution	Education and outreach; Float your Boat coordinator

Required *Healy* facilities and science systems

- Main lab, wet lab, biochem lab, future lab
- Forward space for methane sampling
- Two environmental chambers (-1°C, 4°C)
- Refrigerator
- Freezer
- All underway sensors (met, science seawater, seafloor, ADCP)
- Storage in the hold primarily, some on deck (mooring equipment)
- Observing station on the bridge
- Multiple winches for deploying gear

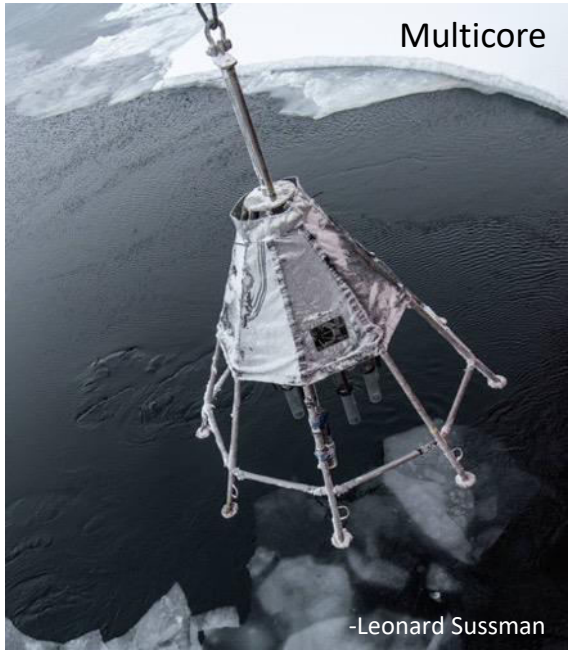
CTD and Water Collection using stbd. 0.322” wire

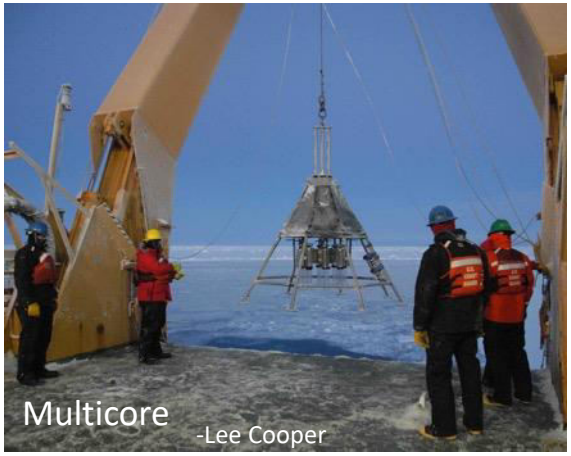
Zooplankton Sampling using Nets and ViPR (Video Plankton Recorder) from 0.322” and 9/16” wires off of the stern



-All photos by Carin Ashjian

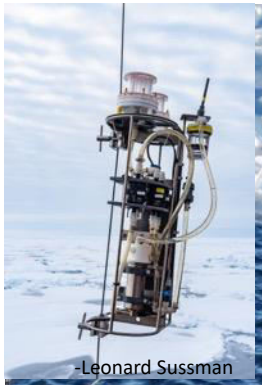
Benthic Sampling used 9/16” Wire, 0.68” Wire, and 0.322” wire, all off of the stern, and sample processing on deck





Large Volume in-situ pumps from 9/16” and 0.322” wire using plywood platform


-Jessica Drysdale


-Leonard Sussman


-Marcia Campbell

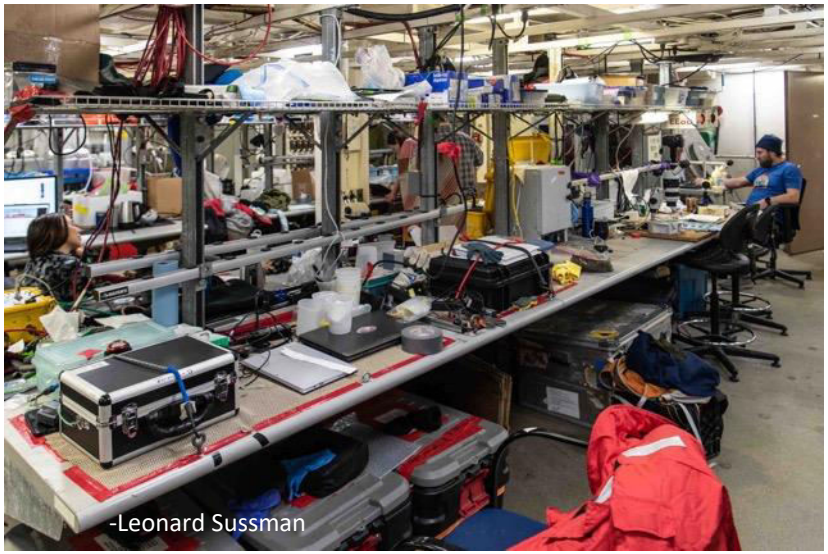
Marine mammal watch and marine bird survey on bridge

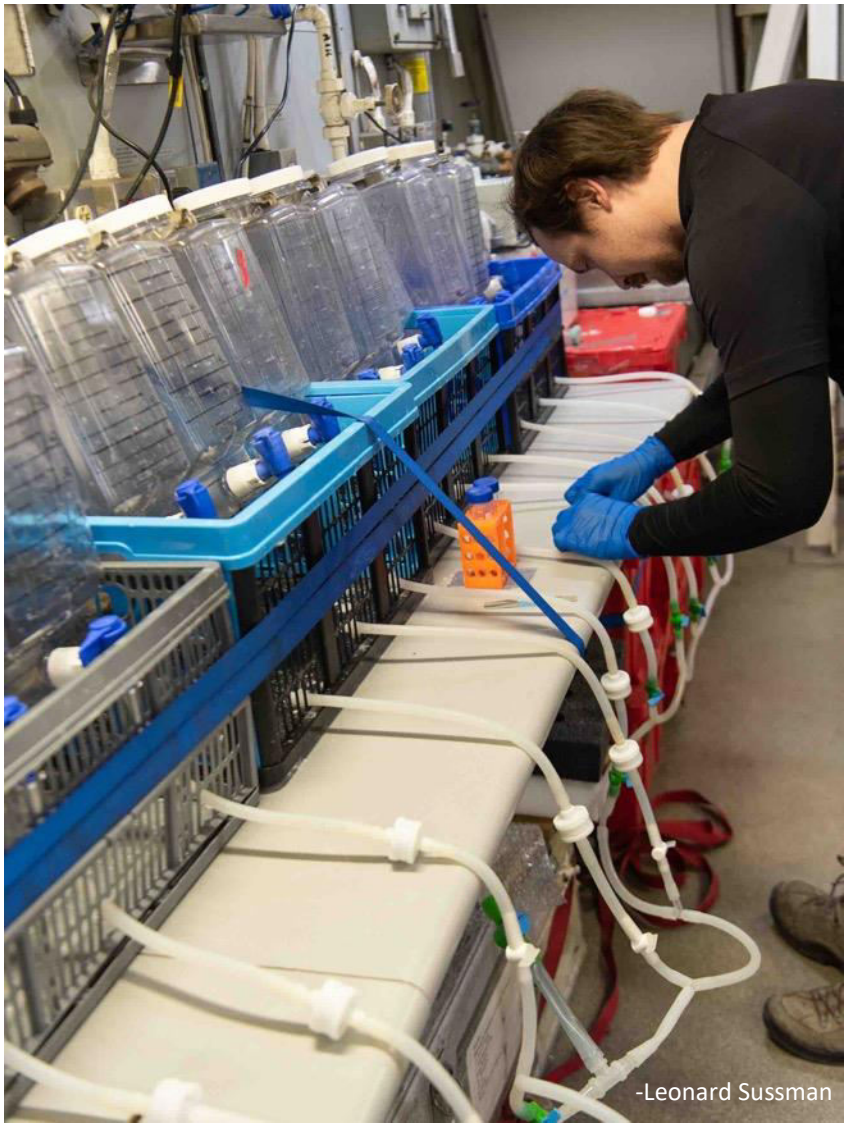

-Carin Ashjian

-Seth Danielson

Labs and environmental chambers were full


-Lee Cooper


-Leonard Sussman

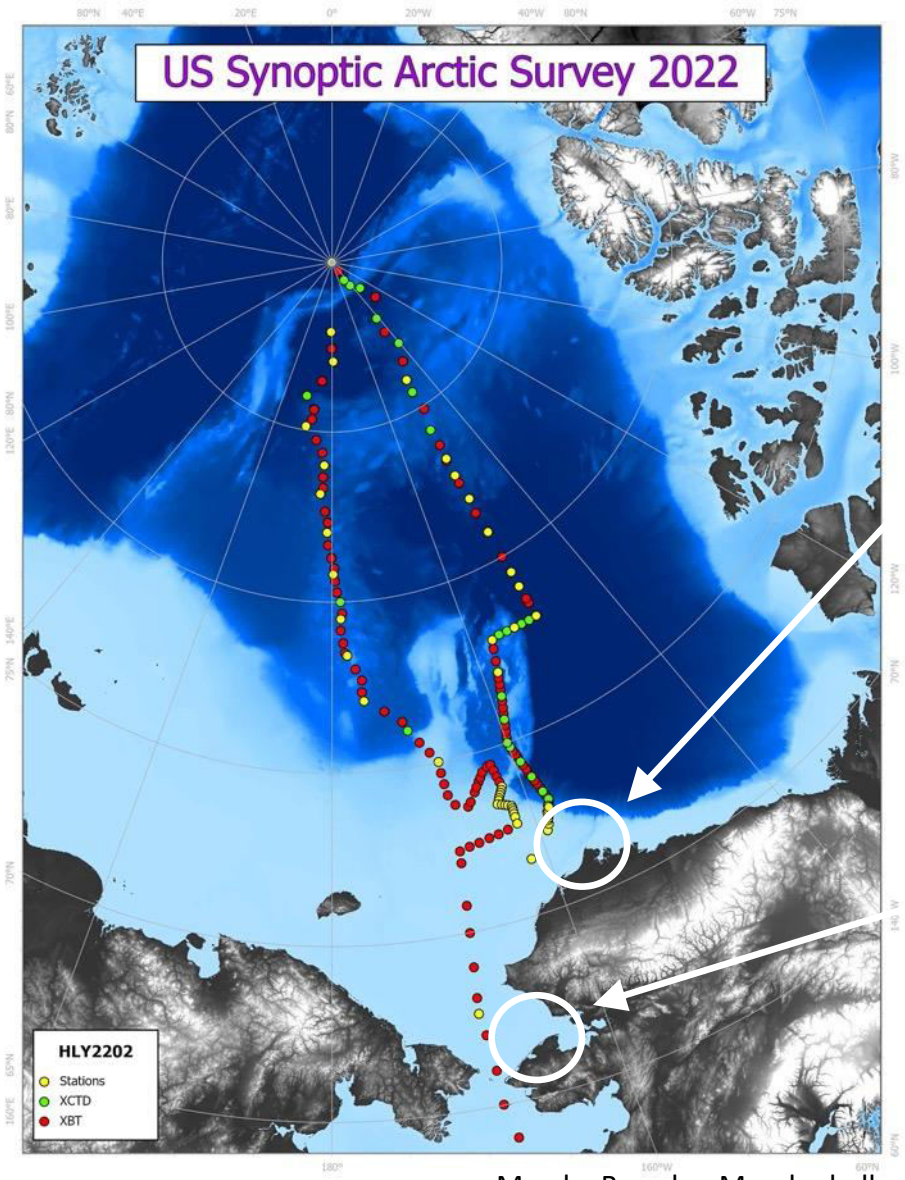

-Leonard Sussman

Mooring Deployments and Recoveries

-Deborah Cordone

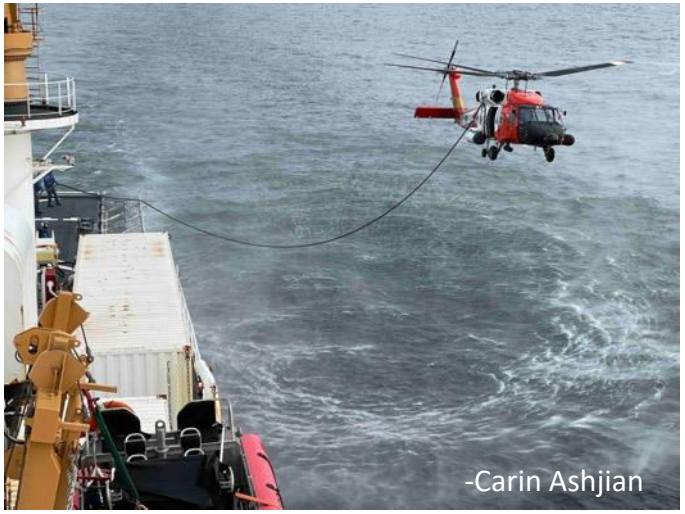

-Seth Danielson

A couple of interesting events in the first week or so



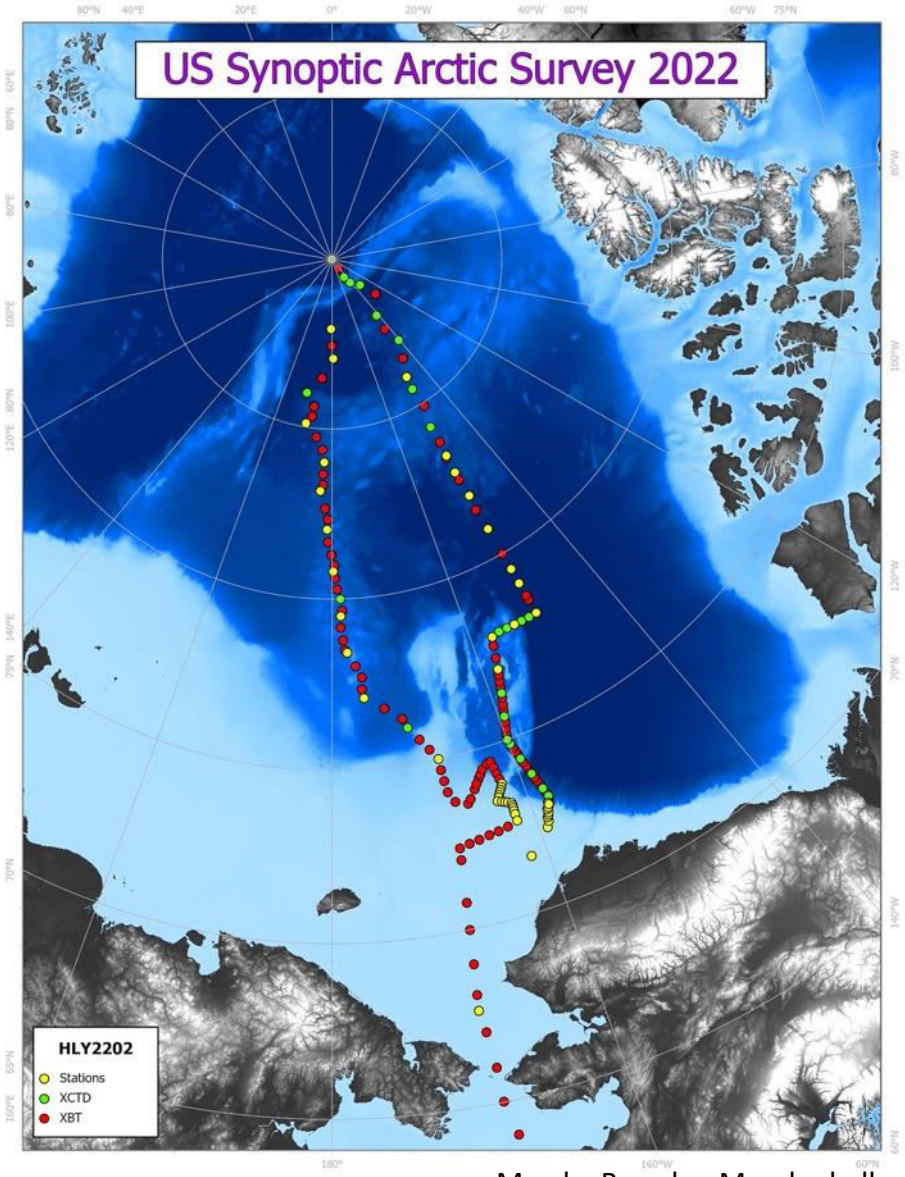
-Map by Brendon Mendenhall

-Carin Ashjian



-Carin Ashjian

Two Transects to/from the Pole – 9/4-10/25



-Map by Brendon Mendenhall

- 51 stations
- Stations could take up to 18-20 hours, depending on the seafloor depth
- The strategy except for high-resolution work was to do one long station every other day and do a short station (CTD, optics) between
- Augmented hydrography with XCTDs and XBTs
- Weather (wind) impacts

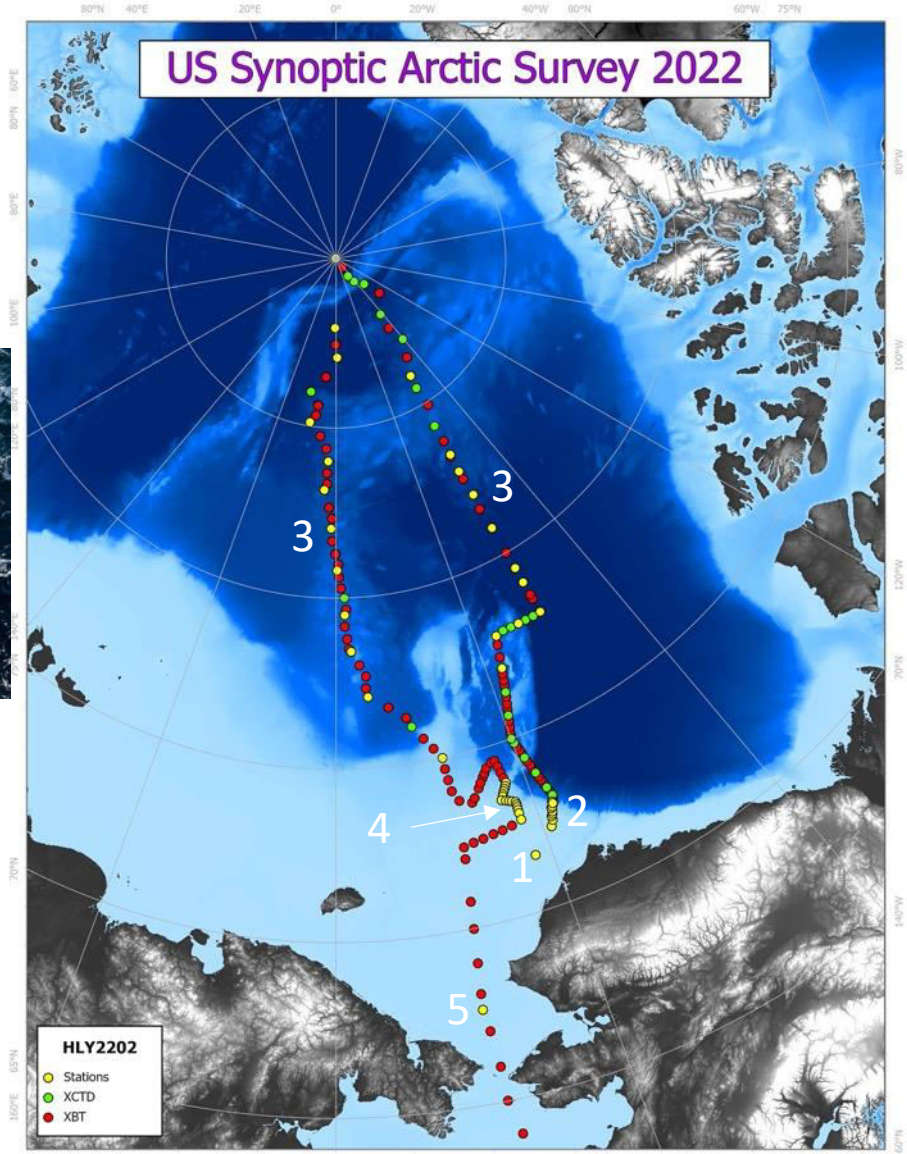
Stations

XCTDs

XBTs

Five Phases of the Cruise – Phases 1 and 2

1. Annual turnover of CEO Mooring (NPRB)



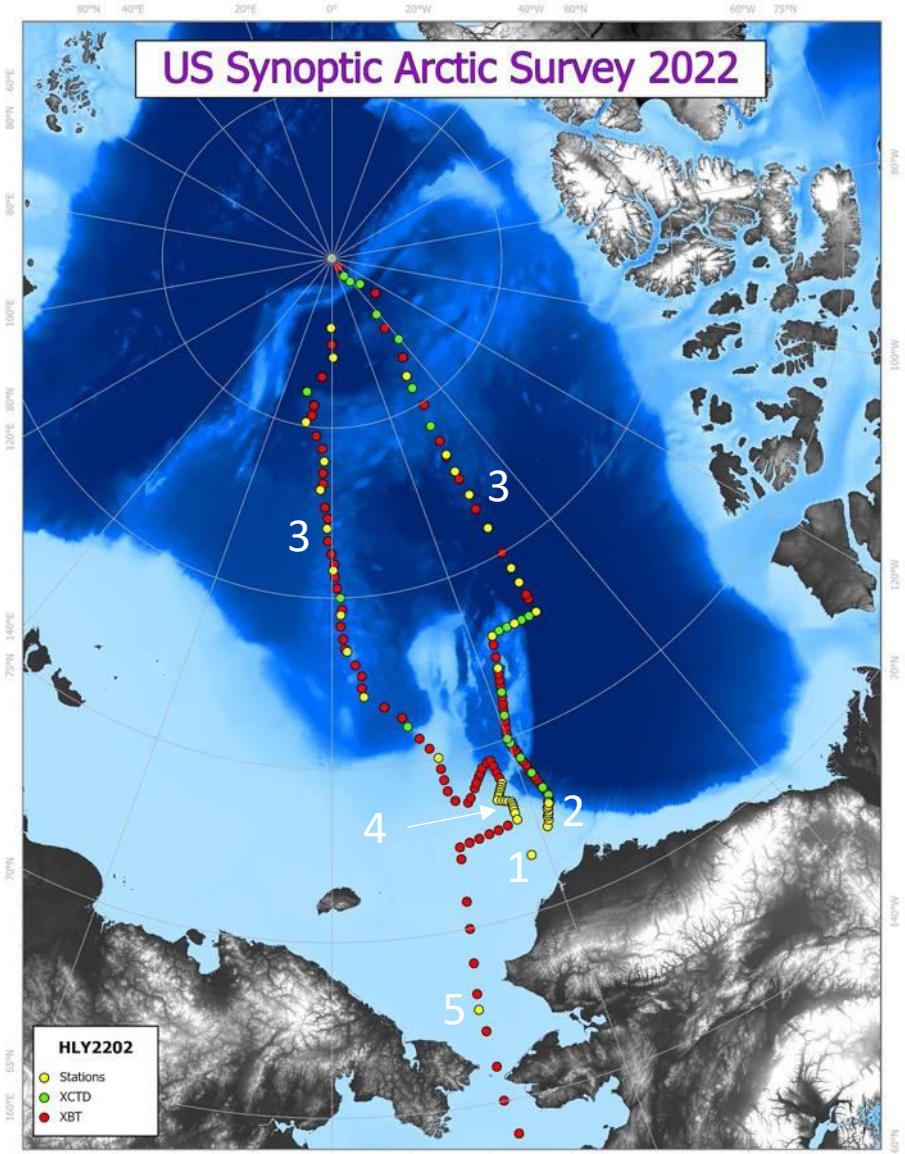
-Map by Brendon Mendenhall

2. High-spatial resolution survey along Shelf-Basin Interactions (2002-2004) EHS line
-24 hour ops
-Horrible weather (persistent high east winds)

Stations
XCTDs
XBTs

Five Phases of the Cruise – Phases 3-5

3. Broad-spatial resolution survey, augmented with XCTD and XBT, along two transect lines sampled previously by the AOS (1994) and GEOTRACES (2015)
-Long (18 hour) station ~ every other day
-Short station during day of intervening day
-Not 24 hour ops but some long days (thanks deck force!)



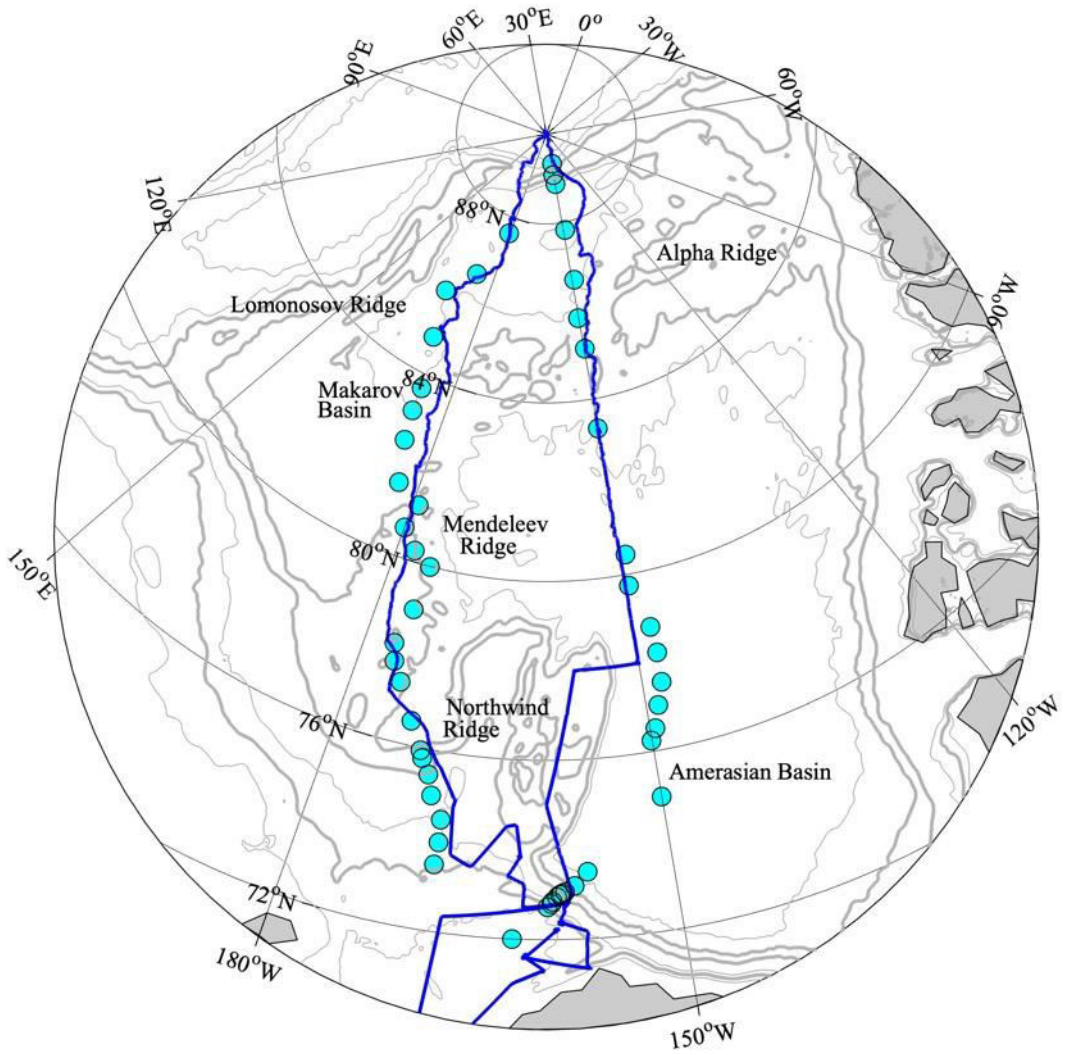
-Map by Brendon Mendenhall

4. High-spatial resolution survey in the Hanna Canyon Region
-24-hour operations for ~3 days

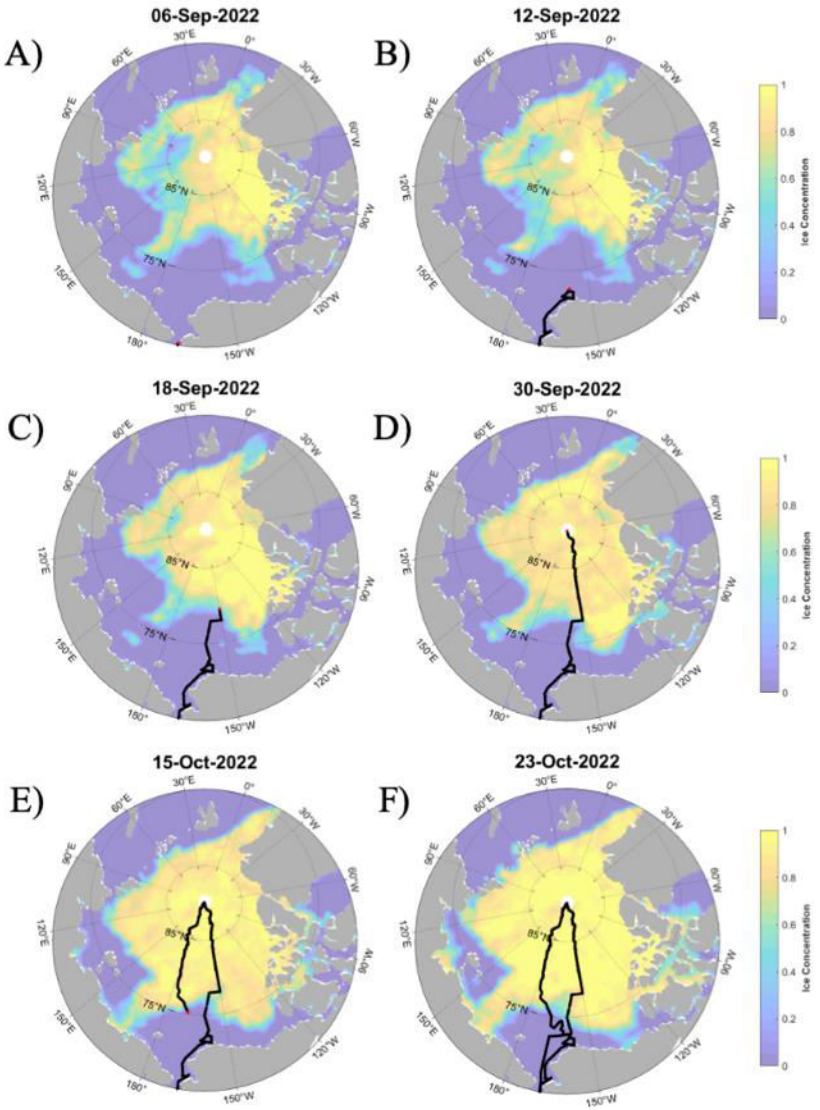
5. Station at DBO3.8 on the way south

Stations
XCTDs
XBTs

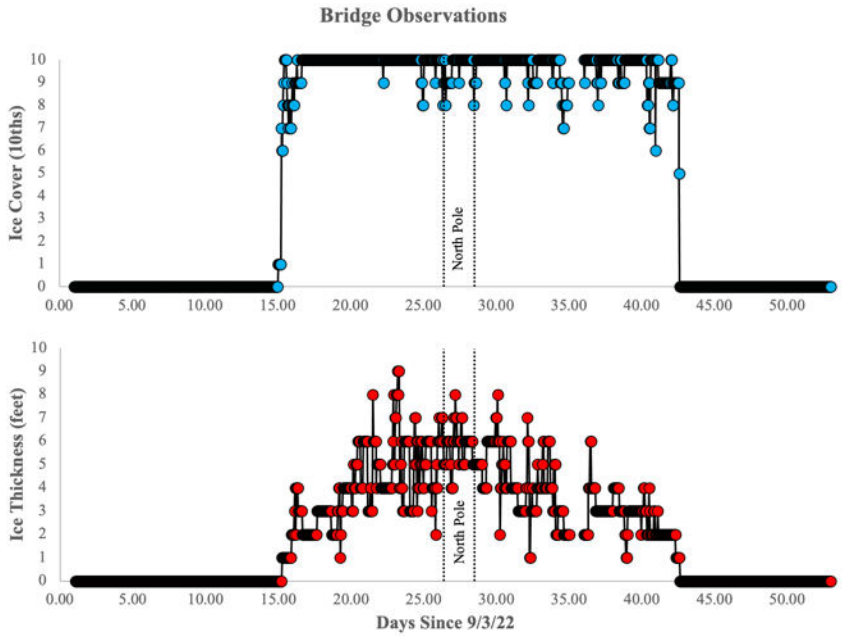
Track aligned fairly well with that of the 2015 GEOTRACES cruise



There were many leads and the ice was not all that thick



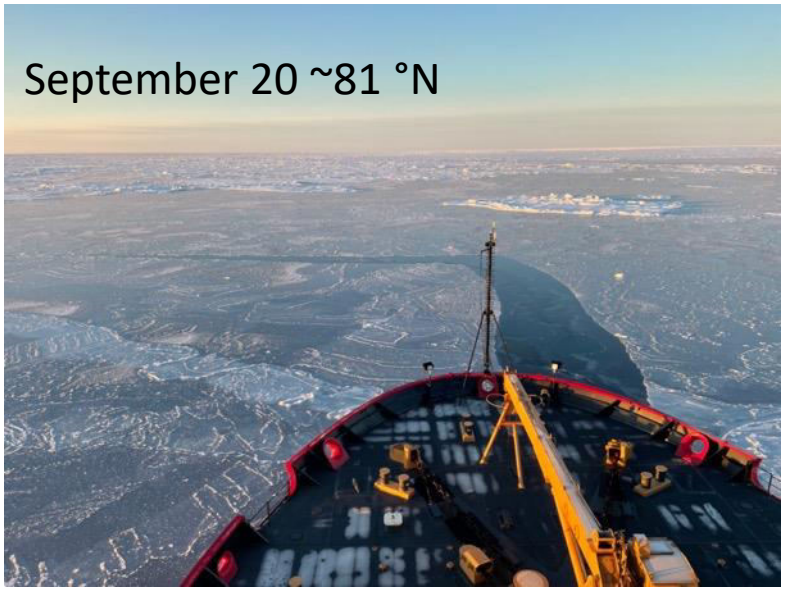
Annika Margevich

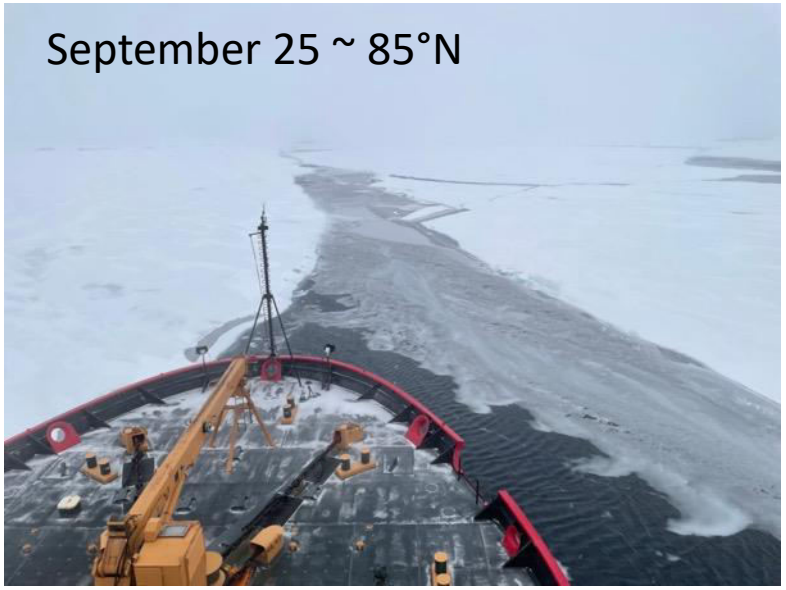


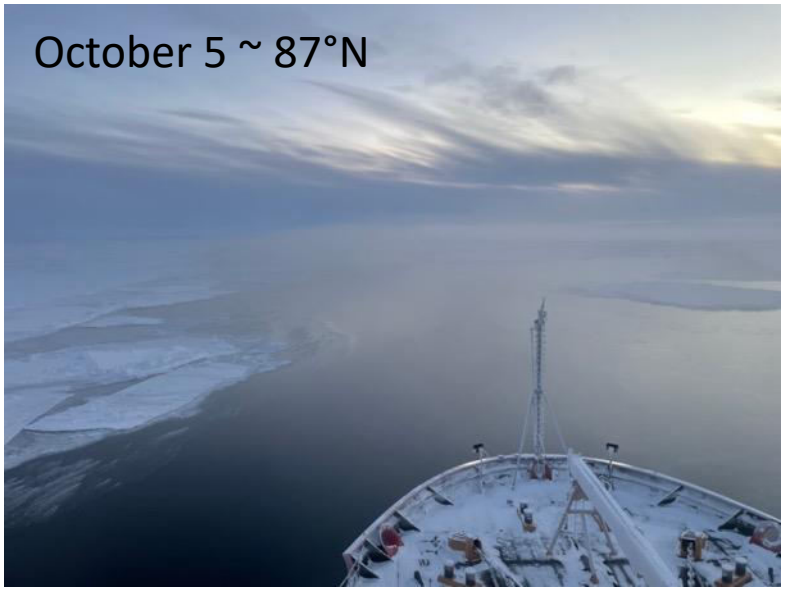
Nearing the Pole, 9/30

Oct. 5, ~87°N

There were many leads and the ice was not all that thick





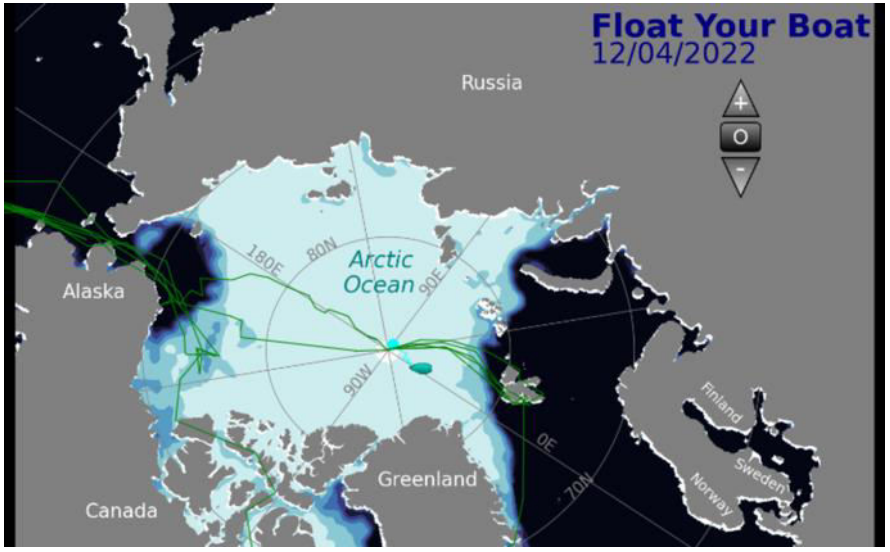


Photos by Carin Ashjian

Float your Boat Program https://www.floatboat.org/follow-your-boat

U.S. Coast Guard photo by Deborah Held Cordone, Auxiliary Public Affairs Specialist 1

-Photo by Carin Ashjian



-Photo by Leonard Sussman

The North Pole: September 30 – October 2

U.S. Coast Guard photo by Deborah Held Cordone, Auxiliary Public Affairs Specialist 1.

U.S. Coast Guard photo by Deborah Held Cordone, Auxiliary Public Affairs Specialist 1.

-Seth Danielson

U.S. Coast Guard photo by HS1 Roy Mesenscott

There were challenges:

Weather:

-Persistent strong east winds during the first week of sampling resulted in the loss of the CTD (very happy that there was a backup)

-Strong winds while in the ice further to the north sometimes limited sampling capability

-Very cold weather required measures to prevent freezing of CTD sensors (and water in the Niksins) and a complex plan of hose management for the seawater hoses on the stern

Winches:

The 9/16" winch experienced problems with the brake (fixed on board) and had bad wraps deep in the wire in the drum. We had to switch to the 0.68" winch for the benthic work and the 0.322" wire winch for the non-conducting wire nets and the pumps

Sensors:

There were a few sensors missing from the backup suite for the CTD and a couple of them, especially the CTD pressure sensor, were malfunctioning

Autosals:

The Autosals could not maintain stable enough temperature to permit analysis of the salt samples on board because of temperature fluctuations in the biochem lab. On some cruises, the Autosal is set up in an environmental chamber but for this project, those rooms were required to conduct experiments at cold temperatures

Internet Access:

Connectivity to the VSAT satellite was lost at ~80° N because satellite coverage did not extend that far north. Communication was then accomplished using an Iridium satellite service. All personnel (USCG and science) used the same satellite access.

Cruise was very successful

Instrument/Gear	# of Deployments
CTD Casts	54
XBT Launches	122*
XCTD Launches	24
Bongo Net Tows	32
Multinet Tows	16
Ring Net Tows	2
MultiHAPS Corers	21
Van Veen Grabs	53
Multicorers	20
Pumps	16
Optics Package Casts	37
Video Plankton Recorder Casts	34
Mooring Recoveries	3
Mooring Deployments	3
Drifter (Ice Ball) Deployments	2

*No useable data from 14 sondes

What next for Healy?

- Healy has unique capabilities that permit research in difficult to access (because of sea ice) regions and outside of the summer season
- Healy has contributed substantially to US research in the Arctic. From 2001-2019, she supported 58 science cruises and 1744 days of science (From Dave Forcucci)
- In the past, Healy conducted research outside of the summer-early fall and away from the Chukchi and Beaufort Seas (e.g., Nares Strait, April-May in the Chukchi Sea, 2011 Winter Cruise in November-December, 2015 GEOTRACES cruise to North Pole)
- Starting in 2004, the need for Extended Continental Shelf Mapping anchored Healy's schedule to the Western Arctic in summer and fall
- With Sikuliaq now available, the science community should think more broadly about science questions to address that can best be addressed using Healy's unique capabilities

Acknowledgments

- USCGC Healy Captain, Officers, and Crew
- NSF funded Shipboard technician group (STARC): Brendon Mendenhall, Emily Shimada, Mason Schettig, and Maxwell Hughes
- NSF funded coring technician T.R. Rasmussen)
- USCG C5I technicians Sarah Kaye and Brian Nuttall
- West coast winch pool for HAWBOLT winch
- NSF logistics providers Batelle (UIC Science) for logistic support in Utqiagvik and Dutch Harbor

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