ARP and GOMO Arctic Activities 2023-2024

David Allen, Sandy Lucas, David Legler, Cindy Garcia, Sarah Tucker

Arctic Icebreaker Coordinating Committee, July 19-20, 2023, Hilton, Alexandria, VA

Annual Activities:

Arctic Research Program (ARP) is typically involved with three cruises annually:

- EcoFOCI Spring Mooring Cruise
- NOAA Arctic & Ecosystem Research Cruise
- EcoFOCI Fall Mooring Cruise

EcoFOCI Spring Mooring Cruise

P. Stabeno, NOAA
phyllis.stabeno@noaa.gov, heather.tabisola@noaa.gov

Research Expedition Details

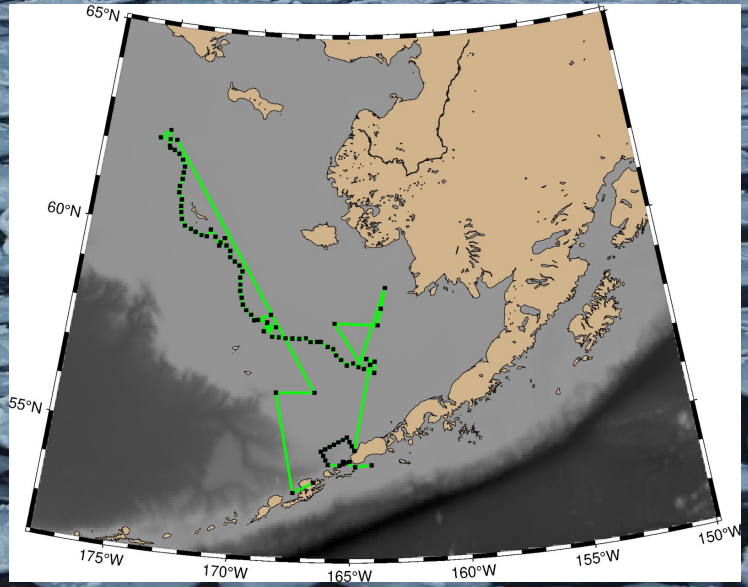
Dates: Dutch Harbor, 4/21/23 - Dutch Harbor, 5/7/23

Research Area Location: SE Bering Sea

Vessel: NOAA Ship Oscar Dyson

Communication and outreach plans: Yes. Please contact: Primary: heather.tabisola@noaa.gov; w/ CC: adi.hanein@noaa.gov, and marjorie.mooney-seus@noaa.gov

Social Media: @NOAAResearch, @NOAAFisheriesAK (IG) & @OARC_Alaska (Twitter)



Contact Information: phyllis.stabeno@noaa.gov, heather.tabisola@noaa.gov

Pacific Marine Environmental Laboratory

50 years of Science in Service to Society

Key Scientific Questions & Motivations

Mission: Annual survey to provide **baseline fisheries and oceanographic data to support sustainable management of living resources in the Bering Sea** and the rapidly changing US Arctic ecosystem.

Goals: Goals of the spring mooring cruise include a **turn around of various NOAA biophysical (PMEL) and passive acoustic (AFSC) moorings** located in the Bering Sea, **perform CTD (PMEL)/Bongo (AFSC) surveys at long-term EcoFOCI sampling sites**.

Brief summary of activities: This project is intended to recover five (5) PMEL subsurface **moorings** and one (1) PMEL surface mooring and to deploy eight (8) PMEL subsurface moorings and four (4) PMEL surface moorings at the Bering Sea sites of M2, M4, KU1, KU2, KU3,KU4 (recovery only), & UPP3 which is a site in the south of Unimak Pass. In addition, four (4) **marine mammal moorings** are to be recovered and four (4) **marine mammal moorings** will be deployed. A hydrographic/biological survey consisting of Conductivity/Temperature/Depth (CTD) casts, 20/60 cm **bongo tows and California Vertical Egg Tows** (CalVETs) in the Unimak Pass area, along the 70-meter isobath in the Bering Sea as far north as the sea ice permits, and in boxes around the 4 mooring sites at M2, M4, M5, & M8. Additionally, we will deploy up to two (2) **popup buoys**, up to four (4) satellite tracked drifters, up to two (2) **gliders** up to 48 **Sonobuoys**.

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NOAA Arctic & Ecosystem Research Cruise

Jacqueline Grebmeier, Principal Investigator, UMCES | Phyllis Stabeno, Principal Investigator, NOAA/PMEL | Seth Danielson, Principal Investigator, UAF | Katrin Iken, Principal Investigator, UAF

jgrebmei@umces.edu, phyllis.stabeno@noaa.gov, sldanielson@alaska.edu & heather.tabisola@noaa.gov

Funding: NOAA, Alaska Sikuliaq Program

Research Expedition Details

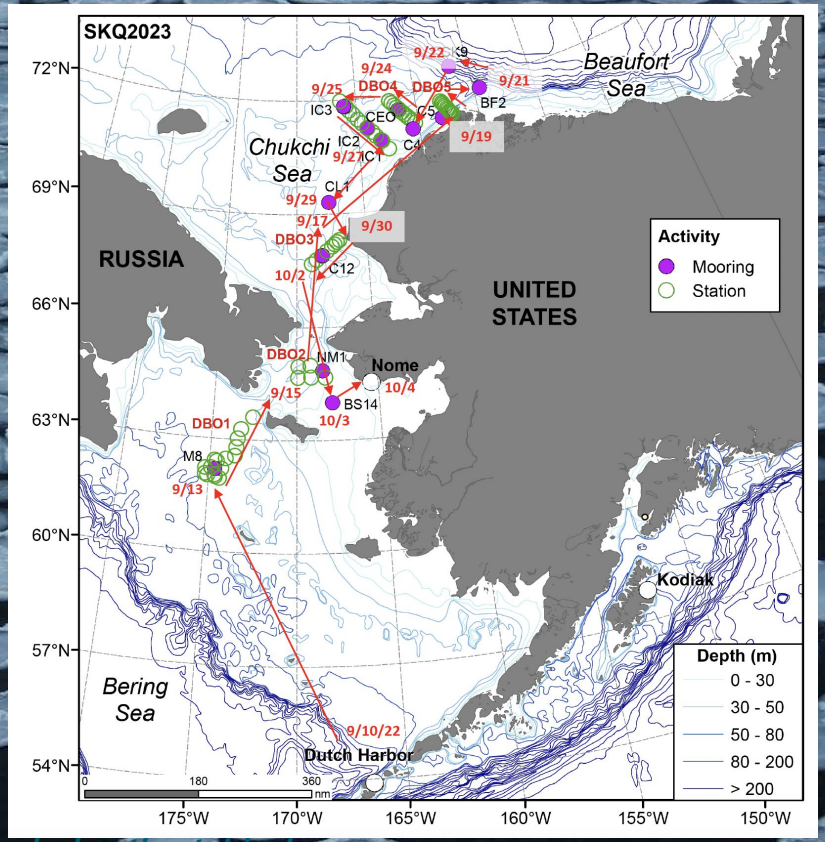
Dates: Dutch Harbor, 9/10/23 - Nome, 10/4/23, Offload Dutch Harbor 10/8/23

Research Area Location: US Arctic

Vessel: R/V Sikuliaq

Communication and outreach plans: Yes. Communications plan & POCs: Please contact heather.tabisola@noaa.gov; w/ CC: marjorie.mooney-seus@noaa.gov, adi.hanein@noaa.gov, and jessica.mkitarian@noaa.gov

- Daily community emails during the cruise
- Presentations to AEWC, planned Strait Science talk, Nome; also local community radio and news outlets



Contact Information: phyllis.stabeno@noaa.gov, jgrebmei@umces.edu, heather.tabisola@noaa.gov

Key Scientific Questions & Motivations

Mission: Tracking Change in the Arctic using an array of observational buoys, uncrewed systems and other tools that collect observations at hot spots chosen because of high productivity of marine life and previously recorded rapid change.

Goals: To **evaluate the ecosystem status and change at established long-term stations** as well as deploy/recover moorings in the US Arctic. Research questions:

- What ecosystem changes are occurring in the northern Bering and Chukchi seas?
- What conditions cause marine animal populations to vary?

Brief summary of activities: This cruise will support research for the following programs; Distributed Biological Observatory (DBO), Ecosystems & Fisheries Oceanography Investigations (EcoFOCI), Arctic Marine Biodiversity Observing Network (AMBON), the Chukchi Ecosystem Observatory (CEO) and the NOAA Arctic Research program.

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Data To Be Collected

Key parameters to be collected are:

Physical: CTD/rosette; currents; mooring retrieval and replacement (NOAA and UAF)

Water column: chemical: nutrients, oxygen-18, Chlorophyll-a (chl-a), eDNA, DIC, HABs, POM, PON,

Water column: phytoplankton, zooplankton and larval fish composition, abundance and biomass

Benthos: macrobenthos via van Veen grabs for for abundance, biomass and population structure

Sediment: organic carbon/nitrogen content, chl-a content, grain size, HABs

Epibenthic beam trawls for epifauna and fish

Seabird and Marine mammal surveys from bridge

Links to where data will be deposited:

https://arcticdata.io/catalog/portals/DBO/Data

http://neptune.gsfc.nasa.gov/csb/index.php?section=270

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EcoFOCI Fall Mooring Cruise

P. Stabeno, NOAA
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Research Expedition Details

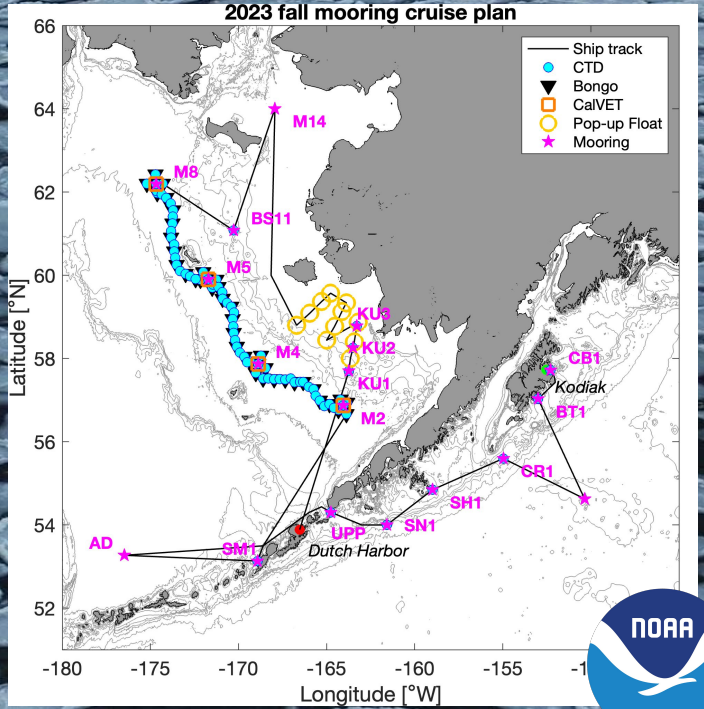
Dates: August 15, **Kodiak**- September 8, **Dutch Harbor**

Research Area Location: SE Bering Sea

Vessel: R/V Aquila

Communication and outreach plans: Yes. Please contact: Primary: heather.tabisola@noaa.gov; w/ CC: adi.hanein@noaa.gov, and marjorie.mooney-seus@noaa.gov

Social Media: @NOAAResearch, @NOAAFisheriesAK (IG)



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FY 2024 and 2025 Needs

- Similar to FY2023, but may also include Go-ship Arc01, if it is scheduled.

Long-term Ship-based NOAA Arctic Observational Needs

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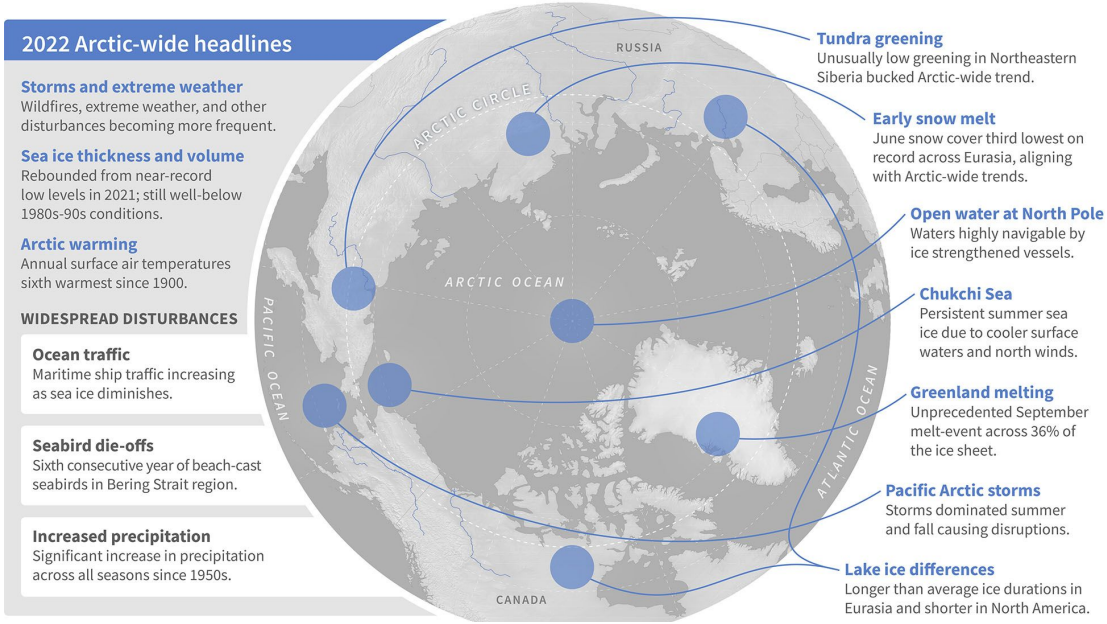
Context



Arctic Report Card, 2022, Unifying Graphic, https://arctic.noaa.gov/Report-Card

- Equity
- Changing Fisheries
- Poorly observed region
- Geopolitical tensions
- Vulnerable populations/cultures

NOAA Addressing the Climate Crisis

Arctic amplification is occurring at nearly 4x the global average.

National Directives:

- National Strategy for the Arctic (October, 2022)
- Interagency Arctic Research Policy Act (2022-2026 Research Plan)
- Executive Orders
  - *Northern Bering Sea Climate Resilience Area*
  - *Tribal Consultation and Strengthening Nation-to-Nation Relationships*
  - *Indigenous Knowledge Should Inform Federal Decision-Making*

NOAA Directives:

- NOAA Arctic Vision and Strategy (2011)
- NOAA Arctic Action Plan (2014)

NOAA Priorities and the Arctic

Build a Climate Ready Nation

Accelerate Growth in an Information-Based Blue Economy

Make Equity Central to NOAA's Mission

Investments in generating high-resolution environmental observations in the region will create opportunities for new industries to use these data to create additional products and services for Alaska, the Arctic, and beyond.

Arctic ecosystem shifts are having resounding impacts on food security and the cultural well-being of Indigenous communities. These changes are outpacing traditional knowledge, creating an increased need for environmental prediction and climate services.

Overview of NOAA's Arctic Work

6 Line Offices

- NMFS
- NOS
- OAR
- NWS
- NESDIS
- OMAO

- National Marine Fisheries Service – Alaska Fisheries Science Center
  - Fish and marine mammal surveys in Gulf of Alaska, Aleutian Islands, East Bering Sea, Northern Bering and Chukchi Sea, and the Beaufort
  - Arctic Strategic Plan, expand surveys into N. Bering and Chukchi as cod/pollack continue to move north, innovative tech, ecosystem assessment for adaptive management, Central Arctic Ocean Fisheries Agreement (CAOFA)
- National Ocean Service
  - Ocean & coastal mapping, water levels and ocean modeling, HABs, oil spill response
  - Presidential memo on Alaska and Arctic mapping

Overview of NOAA's Arctic Work

6 Line Offices

- NMFS
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- OAR
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- NESDIS
- OMAO

- Oceanic and Atmospheric Research
  - Distributed Biological Observatory, EcoFOCI, moorings, ice buoys, Saildrone, ocean acidification, HABS, sea ice modeling and forecasting, ocean exploration
  - Maintain long-term monitoring and observations, innovative tech, Bering Sea changes, HABs, mapping, modeling and forecasting of sea ice and mid-latitude impacts
- Office of Marine and Aviation Operations
  - Operates NOAA fleet
  - No ice-capable ship; Oscar Dyson & Fairweather in AK

Planned Capabilities for PSC's (shared by Commander Baxa)

- Thoughtful, interagency, pragmatic process
- Strong focus on non-portable capabilities
- Most of the requirements collected thus far align with the planned capabilities of the PSCs

Process Undertaken

- NOAA Arctic Action Team
- Drew from cross line regular Arctic planning activities
- Requirements still incomplete

Input Received

There remains a need for ice breaking vessels to improve temporal and spatial coverage of observations and allow access to perennially ice covered regions of the Arctic

- Sikuliaq is an excellent research vessel and can meet many requirements, but its icebreaking capabilities are limited.
- The NOAA ship Oscar Dyson can meet some requirements, but its weight carrying capacity is small, its berthing is limited for interdisciplinary research, OAR has limited access to Dyson, sensitive acoustic array requires ice avoidance.

Input Received (Largely focused on capabilities for medium or heavy icebreaker)

Overarching input:

- All of our needs are cross-line office (NOAA), interagency, and interdisciplinary
- Requirements are very diverse across the agency
- Advanced planning and coordination discussions to communicate and coordinate research activities (interagency, UNOLS, NOAA) 18-24 months
- Opportunistic observations through well-placed underway instruments with operationally relevant parameters available on the GTS (to support models, forecasts, etc)
- Current focus of CAO on shelf ecosystems and Pacific and Atlantic Gateways

Input received

Specific needs:

- Long endurance (30+ days)✔
- Berthing for 18+✔
- Wet and Dry Lab Space✔
- CTD Capabilities✔
- Support for benthic grabs✔
- Mooring deployment and retrieval capabilities (storage, weight capacity, A-frame)✔
- Underway Temperature/Salinity Observations✔
- Underway pCO2/DIC/Total Alkalinity

Input received

- Support for trawling (fisheries)✔
- Multibeam capabilities (mapping support)✔
- Hull mounted acoustic release
- Cleared space on the bridge for marine mammal and bird observers
- Deck space for containers (3, 40')✔
- Deck space for 1-3, 20'x8' lab vans if wet/dry lab space or fume hood isn't available✔

Input Received

- Robust satellite communications✔
- Underway uncontaminated seawater systems are necessary(for HABs (IFCBs), pCO2/DIC/TA, etc✔
- Deck space on the front and the side for installing remote sensing instruments (eg electromagnetic transmitter/receiver system (about 4m long end-to-end to measure sea ice thickness, laser altimeter/profiler to quantify roughness and ridge heights (good for ice navigation and satellite calibration/validation
- Storage for ice trackers and buoys and mooring equipment before deployment and after recovery✔
- Cleared zone for drones to take off and land
- Promote opportunistic transits on icebreakers to collect bathymetric data in unmapped areas of the EEZ in Alaska
- Fume hood

Input Received (atmospheric measurements)

- **Robust observational requirements from the atmospheric/ice/upper ocean community and a great deal of learning to draw from**
- Major Takeaways:

a) measure as far in front as possible - before airflow disturbed by ship

b) measure as high as possible – above ship disturbance

Airflow mapping recommended (e.g., National Oceanography Centre, Southampton, U.K.) Bow mast – still within disturbed streamlines, but disturbance reduced

High on main mast – may also be in reduced streamline disturbance, but may not represent ~10 m above surface often wanted

Input Received (atmospheric measurements, cont.)

Basic, on bow mast (10-20 m above water surface; 5-10 m above deck)
- heated anemometer (2D Metek sonic deicing works well) – hor. winds (correct with a flow distortion study)
- temperature, pressure, relative humidity (Vaisala heated system – more accurate at high RH)
- consider heated 3D sonic (also provides momentum and sensible heat flux)

On Main Mast
- high height wind sensors (for when ship-relative wind from stern)
- marine radar (ice radar) – archive images

Input Received (atmospheric measurements, cont.)

Elsewhere on ship
Away from superstructure shadows:
- broadband downwelling solar and longwave radiation
- ceilometer – cloud base, cloud presence

Top deck away from updrafts (NOT center leading edge of bridge top) & superstructure
- optical precipitation gauge
- pressure sensor (backup if bow mast damaged)

With good view of surface:
- Radiative surface temperature (e.g., KT-15 or CT-15; consider two instruments, key measurement & estimate ice thickness in non-summer; angle away from ship)
- wave-height sensor (bow?) – wave height, wave spectra
- electromagnetic ice thickness sensor (bow?) – ice thickness

Fantail or helideck:
- 2x daily soundings operational mode (GTS submission) (4x daily research mode)
- underway CTD (?) – upper-ocean T & S (to 75-100 m)

The Future

- Improved long-term planning and coordination
- Regular sharing and updating of observational plans and needs
- Many more opportunistic Arctic observations supporting a variety of national needs for mapping, improving models, weather and sea ice forecasts