Arctic Collaborative Ecosystem SKQ2023-12S Cruise Report:

Platform: R/V Sikuliaq

UNOLS Cruise ID: SKQ2023-12S

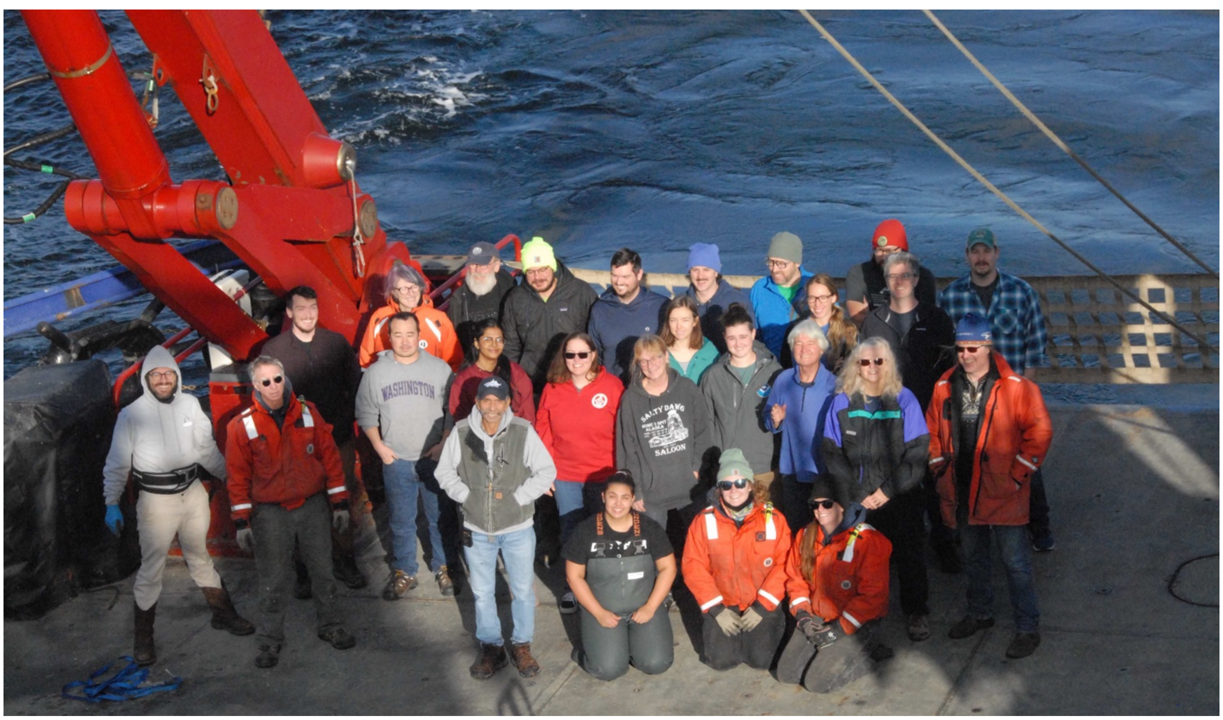
NOAA Project ID: DBO-EcoFOCI 2023 Ecosystem Cruise

Cruise Dates: September 10-October 4, 2023

Port Calls: Board: Dutch Harbor, Alaska; Disembark: Nome, Alaska

Project Names: Distributed Biological Observatory (DBO)
Ecosystems & Fisheries Oceanography Coordinated Investigations (EcoFOCI)
Arctic Marine Biodiversity Observing Network (AMBON)
Chukchi Ecosystem Observatory (CEO)

Funders of cruise ship days and/or science activities:
National Oceanic and Atmospheric Administration (NOAA)
Alaska Ocean Observing System (AOOS)
National Aeronautics and Space Administration (NASA)
National Science Foundation (NSF)
North Pacific Research Board (NPRB)
Office of Naval Research (ONR)
University of Alaska Fairbanks (UAF)



1.0. Overview

The NOAA Distributed Biological Observatory (DBO)/Ecosystems & Fisheries Oceanography Coordinated Investigations (EcoFOCI) joint cruise with the Arctic Marine Biodiversity Observation Network (AMBON) and the Chukchi Ecosystem Observatory (CEO) programs included hydrographic and biological surveys consisting of conductivity-temperature-depth (CTD) rosette sampling, zooplankton and larval fish net tows, Van Veen grabs and HAPS coring for sediment sampling, and beam trawling for epibenthic collections. The cruise conducted recoveries and deployments of year-round marine mammal listening moorings and oceanographic moorings (**Figure 1.1, 1.2**).

The goal of the cruise was to evaluate ecosystem status and change in the northern Bering and Chukchi Seas. The cruise was scheduled for 25 days at sea, loading in Dutch Harbor on Sept 8-9, 2023, depart to sea Sept 10, return to Nome, AK on 4 October 2023. Personnel and scientific samples were offloaded in Nome and five scientists remained on the ship for offloading of all gear, cargo and chemicals in Dutch Harbor, AK on 8 October 2023.

Cruise Schedule: **Load** Sept 8-9, 2023, in Dutch Harbor, Alaska
At Sea: Sept 10-Oct 4, 2023, Dutch Harbor-Nome, Alaska, 25 sea days
Participant and Sample Offload: Nome, Alaska: Oct 4, 2023 (afternoon)
Main offload: Oct 8 in Dutch Harbor, Alaska

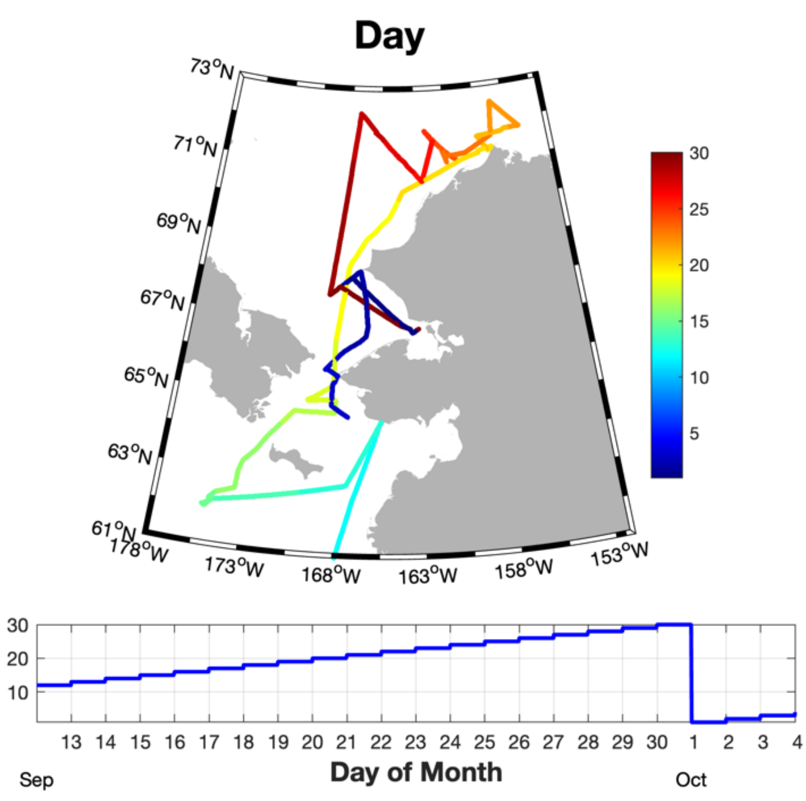


Figure 1.1. Location of R/V Sikuliaq by day from 12 September to 4 October 2023.

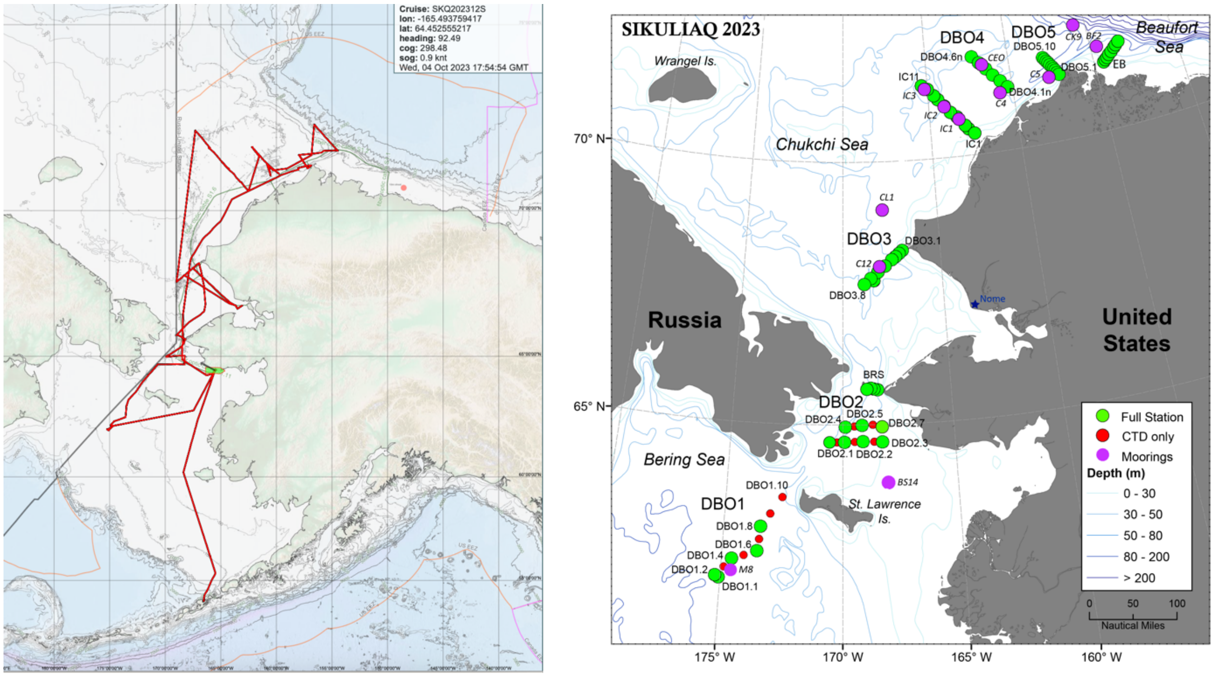


Figure 1.2. Schematic of cruise SKQ2023-12S cruise track (**left panel**), along with station and mooring locations (**right panel**).

Project Oversight Contact Information:

Dr. Jacqueline Grebmeier (Chief Scientist, DBO Lead)
Chesapeake Biological Laboratory (CBL),
University of Maryland Center for Environmental Science (UMCES),
PO Box 38, 146 Williams Street, Solomons, MD 20688.
ph: cell (443) 975-8007; office (410) 326-7334; jgrebmei@umces.edu

Dr. Seth Danielson (Co-Chief Scientist, CEO Lead)
College of Fisheries and Ocean Sciences,
University of Alaska Fairbanks,
2150 Koyukuk Dr., Fairbanks, AK, 99775-7220.
ph: cell (907) 388-7088; office (907) 474 7834; Email: sldanielson@alaska.edu

Dr. Phyllis Stabeno (NOAA EcoFOCI Program Lead)
National Oceanic and Atmospheric Administration (NOAA),
7600 Sand Point Way NE, Bldg. 3,
Seattle, WA 98115.
ph: (206) 526-6453. phyllis.stabeno@noaa.gov

Dr. Katrin Iken (AMBON Lead)
College of Fisheries and Ocean Sciences,
University of Alaska Fairbanks,
2150 Koyukuk Dr., Fairbanks, AK, 99775-7220.
ph: (907) 474-5192, e-mail: kbiken@alaska.edu

We collected water column and benthic samples at five DBO time-series regions (DBO1-5), the EcoFOCI Icy Cape line, and at all NOAA EcoFOCI, NMML and UAF mooring sites (**Figure 1.2**). The main objectives for the cruise were: (1) to occupy key transects on the northern Bering and Chukchi shelves (including DBO lines 1-5 and the NOAA IC Icy Cape line) with an extensive suite of water column and benthic measurements; (2) to service moorings owned by the Pacific Marine Environmental Laboratory (PMEL), the Alaska Fisheries Science Center (AFSC), the National Marine Mammal Laboratory (NMML) and the University of Alaska Fairbanks (UAF); (3) deploy pop-up buoys and sonobuoys. We collected underway measurements from the ship's seawater through-flow system. A seabird and a marine mammal observer made visual observations from the bridge. In addition to the core components of the DBO/EcoFOCI programs, a few ancillary projects (eDNA; Harmful Algal Blooms (HABs); BIOPOLE nutrient studies) collected samples throughout the cruise.

Cross-program collaborations occurred with the NOPP-funded Arctic Marine Biodiversity Observation Network (AMBON) project, which supports eDNA collections and epibenthic beam trawling as well as cross-data evaluation through the NOAA Arctic Research Program water column and benthic DBO data collections. Other collaborations involved the Alaska Harmful Algal Bloom (HAB) network for water column and sediment studies via NOAA support, the UAF Ocean Acidification Research Center (OARC) for inorganic carbon measurements, the US Fish and Wildlife service (USFWS) for seabird observations, the University of Washington for marine mammal observations, and additional water column biochemical measurements for the United Kingdom "Biogeochemical processes and ecosystem function in changing polar systems" (BIOPOLE) program, including the deployment of a BIOPOLE water sampler at the CEO mooring site. BIOPOLE is studying nitrogen and phosphorous dynamics in the water column, both through water analyses and genomics. NSF is also supporting an UMCES graduate student to collect dominant benthic animals for a genomics study in collaboration with Matt Galaska (NOAA) via the INTERN program and a graduate student undertaking an amphipod caloric study.

Weather, operations, and timing dictated the time and direction of sampling. Note due to the uncertainty of the start of the subsistence whale hunt we occupied DBO1 and DBO2, then headed directly north to DBO5. We then worked offshore for two mooring sites, then headed south to do another NOAA mooring, then occupied the DBO4 transect line and turned the CEO mooring. We ran the Icy Cape line, including turning 3 moorings, then proceeded to DBO3 before returning to Nome to demob.

The science team included 23 scientists, with the 24th scientist not sailing due to a medical issue. Most personnel offloaded in Nome, Alaska at the end of the cruise (**Table 1.1**). A subset of 5 scientists, along with Peter Shipton (UAF), who boarded the vessel in Nome, continued to transit to Dutch Harbor to offload all equipment and cargo. All science personnel were required to take an at home Covid-19 test prior to boarding the ship in Dutch Harbor, with a confirmed negative test (see covid protocols). All science personnel had a confirmed covid vaccination, with updated booster shots, unless individual medical issues warranted an exception.

Table 1.1. Science Party Participants (23) + SKQ Marine technicians (2); most participants offloaded in Nome, *=offload in Dutch Harbor at end of cruise (n=5).

#	Name	Email	Organization	Component
1	Jacqueline Grebmeier Chief Scientist	jgrebmei@umces.edu	CBL/UMCES	Benthic component
2	Lee Cooper	cooper@umces.edu	CBL/UMCES	Benthic component
3	Brian Marx	bmarx@umces.edu	CBL/UMCES	Benthic component
4	Nicholas Silverson	nsilverson@umces.edu	CBL/UMCES	Benthic component
5	Syeda Sadia Ali	ssali@umces.edu	CBL/UMCES	Benthic component
6	Seth Danielson Co-chief Scientist	sldanielson@alaska.edu	UAF	CTD, UAF mooring
*7	Peter Shipton	pshipton@alaska.edu	UAF	CTD, UAF mooring
*8	Savannah Sandy	ssandy3@alaska.edu	UAF	DIC, OA
*9	Luis Candela	luis.candela@noaa.gov	NOAA	CTD_EcoFOCI
*10	David Strausz	david.strausz@noaa.gov	NOAA PMEL	NOAA mooring
*11	Dana Wright	dana.wright@noaa.gov	NOAA AFSC	NOAA MM acoustics
12	Caitlyn McFarland	mcfarc4@uw.edu	UW/PMEL	Nutrients/ chlorophyll
13	Eric Wisegarver	eric.wisegarver@noaa.gov	NOAA PMEL	Nutrients/ chlorophyll
14	Haley Cynar	cynarh@oregonstate.edu	NOAA	Phytoplankton
15	Matt Galaska	matt.galaska@noaa.gov	UW/NOAA	eDNA, genomics
16	Patrick Charapata	Patrick.Charapata@noaa.gov	NOAA	HABs
17	Libby Logerwell	libby.logerwell@noaa.gov	NOAA AFSC	Zooplankton
*18	Deana Crouser	Deana.Crouser@noaa.gov	NOAA AFSC	Zooplankton
19	Katrin Iken	kbiken@alaska.edu	UAF	Epifauna
20	Daniel Fraser	danielfraser@utexas.edu	UTexas, Austin	Epifauna
21	Zach Stamplis	zstamplis@alaska.edu	UAF	Fish
22	Stuart Painter	stuart.painter@noc.ac.uk	UK NOC	Denitrification
23	Sue Moore	moore4@uw.edu	UW	Marine mammal
24	Marty Reedy	mtreedyjr@gmail.com	USFWS	Seabirds
25	Bern McKiernan	bkmckiernan@alaska.edu	SKQ marine tech	Ops
26	Carmen Greto	cjgretojr@alaska.edu	SKQ marine tech	Ops

The epibenthic team sorting animals collected from the seafloor. PC/S. Danielson

Table 1.2 provides a contact list for the land based leads of the different science components of the SKQ2023-12S cruise.

Table 1.2. Land leads for cruise components for SKQ23-12S.

Land based leads	Component	Institution	Email
Phyllis Stabeno	Eco-FOCI	PMEL/NOAA	phyllis.stabeno@noaa.gov
Calvin Mordy	Nutrients	CICOES/NOAA	calvin.w.mordy@noaa.gov
Lisa Eisner	Phytoplankton	AFSC/NOAA	lisa.eisner@noaa.gov
Kathi Lefebvre	HABs	NOAA	kathi.lefebvre@noaa.gov
Stephanie Grassia	NOAA Logistics	CICOES/NOAA/AFSC	stephanie.grassia@noaa.gov
Natalie Monacci	OA	UAF	nmonacci@alaska.edu
David Allen	NOAA	NOAA ARP Program Manager	david.allen@noaa.gov
Elizabeth Labunski	Seabirds	USFWS	elizabeth_labunski@fws.gov
Laurie Juranek	O2/Ar	OSU	laurie.juranek@oregonstate.edu
Heather Tabisola	Logistics	NOAA	heather.tabisola@noaa.gov
Adrian Martin	Denitrification	BIOPOLE	adrian.martin@noc.ac.uk
Enma Garcia-Martin	BIOPOLE	BIOPOLE	elencia@noc.ac.uk
Marjorie Mooney-Seus	NOAA Outreach	NOAA Outreach	marjorie.mooney-seus@noaa.gov
Franz Mueter	Fish	UAF	fmueter@alaska.edu
Evie Fachon	IFCB	WHOI	efachon@whoi.edu

Worm tubes protruding from the sediment in a core sample. PC/S. Danielson

Funding Sources:
This research cruise was a consortium between NOAA's EcoFOCI program (Ecosystems and Fisheries Oceanography) and the NOAA Marine Mammal Lab; the Distributed Biological Observatory (DBO) run from the University of Maryland Center for Environmental Science; the Arctic Marine Biodiversity Observation Network (AMBON) and Chukchi Ecosystem Observatory (CEO) projects both run from the University of Alaska Fairbanks. Other funding agencies supported additional activities. Contributions included:

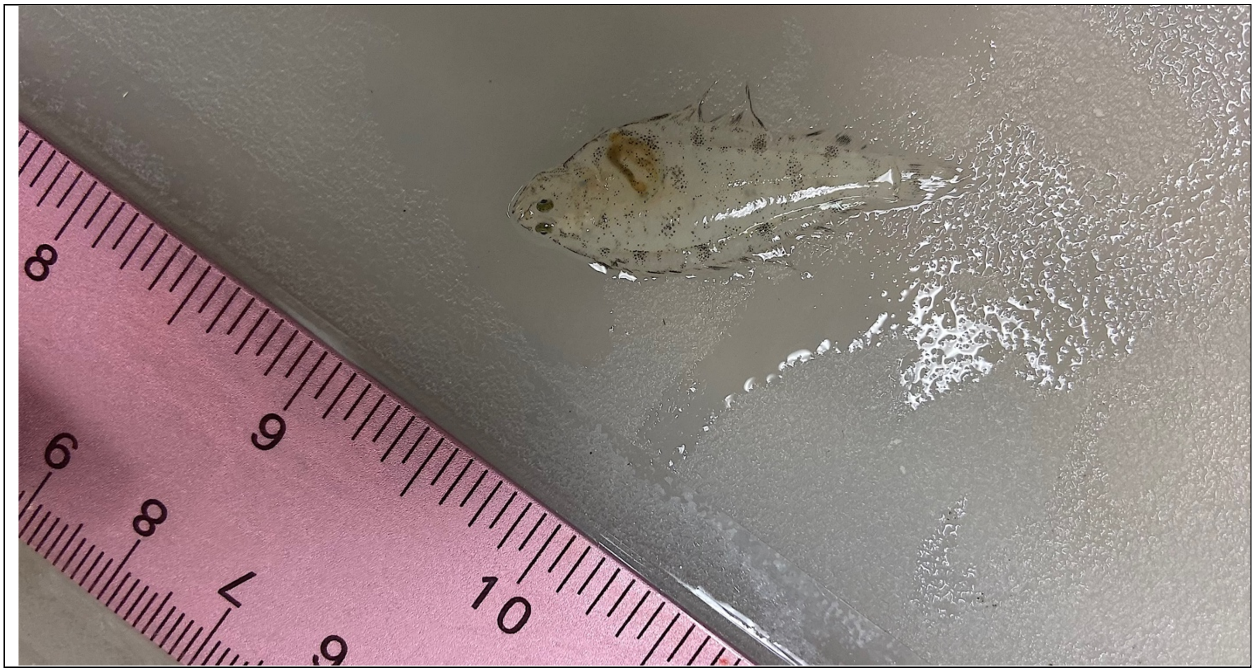
- NOAA OAMO/ARP provided support for 17 ship days + two days for vessel mobilization and one day for demobilization, along with the ~2.4 days of proportional transit costs from Seward to the Arctic operating region return.
- The AMBON/CEO consortium provided a total of 8 days through State of Alaska funds provided to the University of Alaska Fairbanks.
- UAF-CICOES supported the cruise with a financial contribution (totaling slightly less than one day of Sikuliaq ship time) equivalent to the normal administrative fee applied to the award of ship day rate funding to UAF from NOAA.
- The CEO project is funded by the Alaska Ocean Observing System (AOOS) and the North Pacific Research Board (NPRB).

- The CBL/UMCES component is funded from the NOAA Arctic Research Program through CINAR/WHOI agreement.
- The AMBON project is funded by NASA and ONR through the National Oceanographic Partnership Program (NOPP).
- NSF provided graduate student support for genomics study of benthic fauna as part of a biodiversity study supported via an NSF Graduate Research Fellowship Program award to the student as well as science support through the INTERN program associated with the DBO program.
- The US Fish and Wildlife Service (USFWS) supported a seabird observer, and the National Science Foundation (NSF) supported a marine mammal observer.
- The United Kingdom Research and Innovation (UKRI) Natural Environment Research Council (NERC) funded an investigator from the Biogeochemical processes and ecosystem function in changing polar systems have global impacts (BIOPOLE) program to participate in the research cruise.
- NOAA - through Phyllis Stabeno - provided logistical support in the form of delivery of science supplies and equipment from Seattle to Dutch Harbor and coordinating its return from Nome, Alaska to Seattle, WA.
- The Ocean Acidification project is funded by the NOAA Arctic Research Program through the Cooperative Institute for Climate, Ocean, and Ecosystem Studies to the University of Alaska Fairbanks Ocean Acidification Research Center.

The operating area consisted of the northern Bering and Chukchi sea continental shelf regions. The Bering Sea operations area is bounded on the South by 62 N and the US-Russia convention line to the West, and Nome to the East. In the Chukchi Sea, the Western boundary is the US-Russia convention line with the northern extent bounded at approximately 72.5 N. **Figure 1.1** shows the overall operating area and locations of stations and moorings.

Acronyms

AFSC	Alaska Fishery Science Center
AMBON	Arctic Marine Biodiversity Observation Network
CBL	Chesapeake Bay Laboratory
CEO	Chukchi Ecosystem Observatory
CTD	Conductivity Temperature Depth instrument
DBO	Distributed Biological Observatory
EcoFOCI	Ecosystems & Fisheries Oceanography Coordinated Investigations
IFCB	Imaging Flow Cyto Bot
NOAA	National Oceanic and Atmospheric Administration
NOC	National Oceanography Centre
PMEL	Pacific Marine Environmental Laboratory
SKQ	Sikuliaq
UAF	University of Alaska Fairbanks
UK	United Kingdom
UMCES	University of Maryland Center for Environmental Sciences
USFWS	US Fish and Wildlife Service
UW	University of Washington
WHOI	Woods Hole Oceanographic Institution



A small flatfish. PC/S. Danielson

2.0 Cruise Activities

The CTD was deployed at all DBO stations, EcoFOCI stations and the mooring sites (**Table 2.0)**. The CTD/rosette sampling was used to collect temperature, conductivity/salinity, dissolved oxygen, chlorophyll a fluorescence, light irradiance, and water transmissivity using electronic and optical sensors. Discrete water samples were taken for chlorophyll a concentration, phytoplankton taxonomy, macronutrients, oxygen-18/16 ratios, dissolved oxygen, environmental DNA (eDNA), harmful algal bloom (HAB) detection, dissolved inorganic carbon (DIC), methane, nitrogen cycling experiments, and oxygen/argon ratios. Vertical bongo nets were deployed to collect zooplankton and larval fish. Benthic sampling included use of a van Veen grab (and occasionally a HAPS corer) for collecting macrofauna (population studies) and sediments (carbon content, grain size, HABS), along with epifaunal collections using a beam trawl. Seabird and marine mammal observers on the bridge completed the core DBO and EcoFOCI standard activities.

The Sikuliaq has a flow through seawater system, and we had instruments to measure O_2/Ar ratios (one system) and microbes with an imaging flow cytobot (IFCB) optical sensor (two systems). Standard parameters that are measured by the Sikuliaq's permanently installed sensor suite includes meteorological instrumentation and seawater measurements of temperature, salinity, chlorophyll a fluorescence, colored dissolved organic matter (CDOM), pCO_2, nitrate, and dissolved oxygen.

Deana Crouser Inspects zooplankton collected by the bongo nets. PC/S. Danielson

Table 2.0.. SKQ2023-12S Station and mooring list in order occupied.

1	Type	Name	Latitude	Longitude
2	Mooring	M8	62.1960	-174.6745
3	Station	DBO1.1 (SLIP1)	62.0100	-175.0600
4	Station	DBO1.2 (SLIP2)	62.0500	-175.2100
5	Mooring	M8	62.1960	-174.6745
6	Station	DBO1.3 (SLIP2B)	62.2190	-174.8770
7	Station	DBO1.4 (SLIP3)	62.3900	-174.5700
8	Station	DBO1.5 (SLIP3B)	62.4680	-174.0830
9	Station	DBO1.6 (SLIP5)	62.5600	-173.5500
10	Station	DBO1.7 (SLIP5B)	62.7870	-173.5000
11	Station	DBO1.8 (SLIP4)	63.0300	-173.4600
12	Station	DBO1.9 (SLIP4B)	63.2800	-173.2800
13	Station	DBO1.10 (SLIP4C)	63.6040	-172.5910
14	Station	BCL-6C (DBO2.0)	64.6727	-170.6418
15	Station	DBO2.0a	64.6717	-170.2623
16	Station	DBO2.1 (UTBS5)	64.6700	-169.9200
17	Station	DBO2.1A	64.6758	-169.4730
18	Station	DBO2.2 (UTBS2)	64.6800	-169.1000
19	Station	DBO2.2A	64.6758	-168.5968
20	Station	DBO2.3 (UTBS2A)	64.6700	-168.2350
21	Station	DBO2.7	65.0000	-168.2220
22	Station	DBO2.6	65.0003	-168.6528
23	Station	DBO2.5 (UTBS1)	64.9908	-169.1377
24	Station	DBO2.4A	64.9745	-169.4873
25	Station	DBO2.4 (UTBS4)	64.9617	-169.8860
26	Mooring	C5 (PB1)	71.2594	-157.9991
27	Station	DBO5.1 (BarC1)	71.2470	-157.1650
28	Station	DBO5.2 (BarC2)	71.2880	-157.2480
29	Station	DBO5.3 (BarC3)	71.3300	-157.3320
30	Station	DBO5.4 (BarC4)	71.3720	-157.4150
31	Station	DBO5.5 (BarC5)	71.4100	-157.4900
32	Station	DBO5.6 (BarC6)	71.4550	-157.5830
33	Station	DBO5.7 (BarC7)	71.5000	-157.6720
34	Station	DBO5.8 (BarC8)	71.5370	-157.7530
35	Station	DBO5.9 (BarC9)	71.5780	-157.8380
36	Station	DBO5.10 (BarC10)	71.6200	-157.9250
37	Mooring	BF2	71.754	-154.4753
38	Mooring	CK9/NRS1 combo	72.4667	-156.5500
39	Station	DBO4.1n	71.1940	-160.2700
40	Station	DBO4.1na	71.2580	-160.4640
41	Station	DBO4.2n	71.3230	-160.6570
42	Station	DBO4.2na	71.3820	-160.8410
43	Mooring	C4 Mooring (WT1)	71.0450	-160.4900
44	Mooring	AU IC4	71.0412	-160.5055
45	Station	DBO4.3n	71.4540	-161.0390
46	Station	DBO4.3na	71.5210	-161.2300
47	Station	DBO4.4n	71.5880	-161.4020
48	Mooring	CEO mooring 1	71.6007	-161.54085
49	Mooring	CEO mooring 2	71.5838	-161.4995667
50	Mooring	CEO mooring Tripod	71.5910	-161.5224833

51	Type	Name	Latitude	Longitude
52	Station	DBO4.4na	71.6540	-161.5910
53	Station	DBO4.5n	71.7200	-161.7740
54	Station	DBO4.5na	71.7850	-161.9670
55	Station	DBO4.6n	71.8510	-162.1590
56	Mooring	BIPOLE mooring	71.6007	-161.4995667
57	Mooring	CEO mooring 1	71.6007	-161.54085
58	Mooring	CEO mooring 2	71.5838	-161.4995667
59	Mooring	CEO mooring Tripod	71.5910	-161.5224833
60	Station	IC11	70.5800	-162.4912
61	Station	IC10	70.7172	-162.8565
62	Mooring	C1	70.8361	-163.1294
63	Mooring	AU IC1	70.8350	-163.1251
64	Station	IC9	70.8490	-163.1872
65	Station	IC8	70.9725	-163.5642
66	Station	IC7	71.0847	-163.8018
67	Station	IC6	71.1950	-164.2018
68	Station	IC5	71.3367	-164.6127
69	Station	IC4	71.4485	-164.9190
70	Mooring	C2	71.2157	-164.2566
71	Mooring	AU IC2	71.2147	-164.2485
72	Station	IC3	71.6005	-165.3038
73	Station	IC2	71.7052	-165.6028
74	Mooring	C3	71.8282	-166.0663
75	Mooring	AU IC3	71.8288	-166.0569
76	Station	Icy Cape (IC) IC1	71.8302	-165.9698
77	Station	IC0.1	71.9640	-166.3190
78	Station	IC0.2	72.0943	-166.6501
79	Station	IC0.3	72.2067	-166.9605
80	Mooring	C15	72.3098	-167.2709
81	Station	DBO3.8 (SEC1)	67.6765	-168.9480
82	Station	DBO3.7 (SEC2)	67.7833	-168.5960
83	Station	DBO3.6 (SEC3)	67.8975	-168.2340
84	Station	DBO3.4 (SEC5)	68.1328	-167.4870
85	Station	DBO3.5 (SEC4)	68.0130	-167.8750
86	Mooring	C12	67.9104	-168.1843
87	Station	DBO3.3 (SEC6)	68.1867	-167.2950
88	Station	DBO3.2 (SEC7)	68.2468	-167.1220
89	Station	DBO3.1 (SEC8)	68.3042	-166.9240
90	Station	BS8	65.7827	-169.0077
91	Station	BS1	65.6189	-168.1503
92	Mooring	NM1	64.8550	-168.9243

2.1. Ocean Physics

- **Seth Danielson, Savannah Sandy; UAF**

CTD Sampling

A total of 84 hydrographic casts were taken at 82 different stations (**Figure 2.1.1**) on seven different transects (**Figures 2.1.2 through 2.1.8**), with 60 of these casts including tripping bottles to collect water. CTDs were taken at all stations on DBO lines 1,2,3,4,5 and EcoFOCI stations on the Icy Cape line, at stations in Bering Strait, and at all mooring sites. The SeaBird SBE 9-11 CTD was outfitted with pressure, dual temperature, dual conductivity, and dual oxygen sensors. Ancillary sensors included a WetLabs fluorometer, WetLabs ECO-Triplett optical sensor, a WetLabs C-Star transmissometer, a Biospherical PAR sensor, and a Tritech altimeter.

Niskin bottles were typically tripped at 0, 10, 20, 30, 40, 50-meter depths, within 5 m of the bottom and often at the depth of the subsurface chlorophyall a max. Niskin bottles were sampled for nutrients (run shipboard), chlorophyll (filter and frozen for post-cruise analyses), O-18, dissolved inorganic carbon, Flow Cytometry (IFCB) for phytoplankton and harmful algal bloom tracking, seawater for phytoplankton taxonomy at all depths, and periodically for methane. Larger seawater samples were collected at 2-3 depths (10 m, mid-depth, and bottom water) for eDNA genomic studies as well as for nitrification studies (BIOPOLE). For on-deck sampling efficiency, multiple rosette bottles were tripped at the same depth (2-3 bottles/depth), allowing gases to be retrieved from a separate bottle coincident with other non-gas parameters collected from the other bottles.

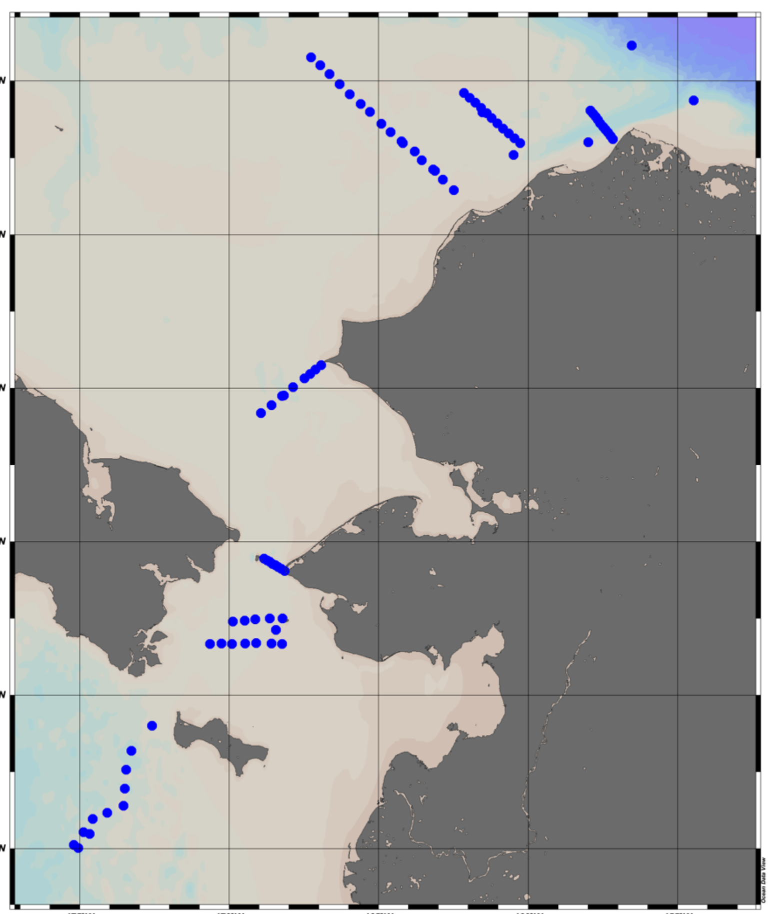


Figure 2.1.1. Locations of CTD stations occupied on cruise SKQ-202312S.

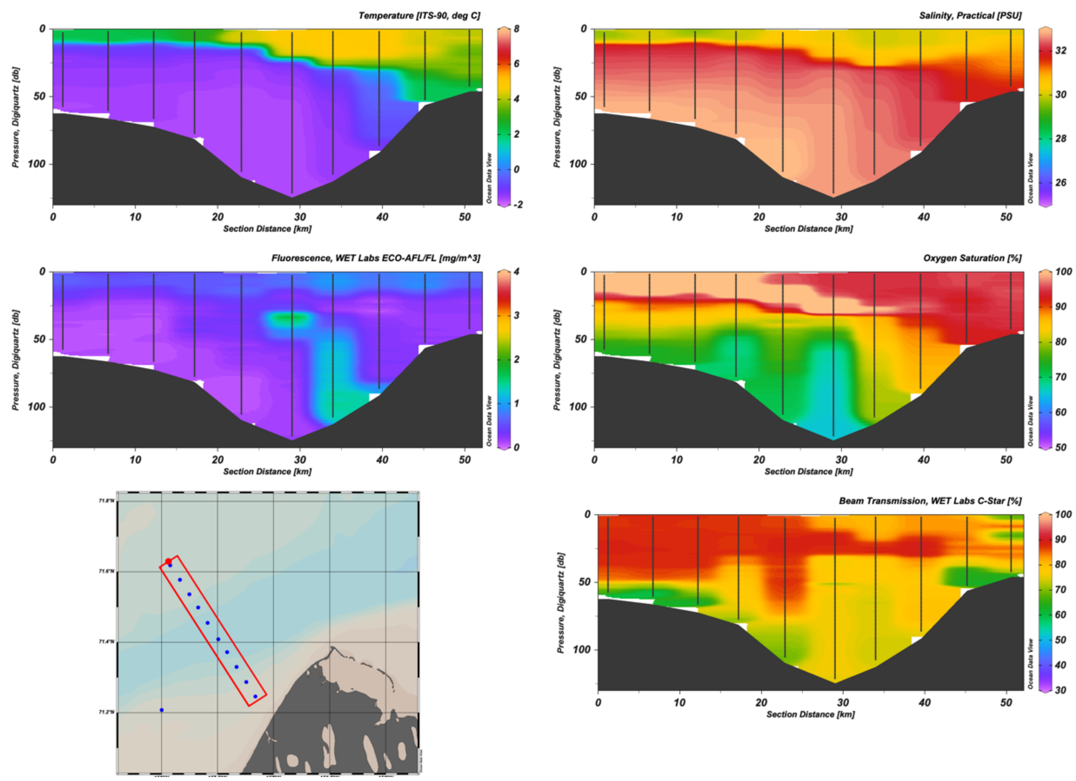


Figure 2.1.2. Water column hydrography of transect DBO-5.

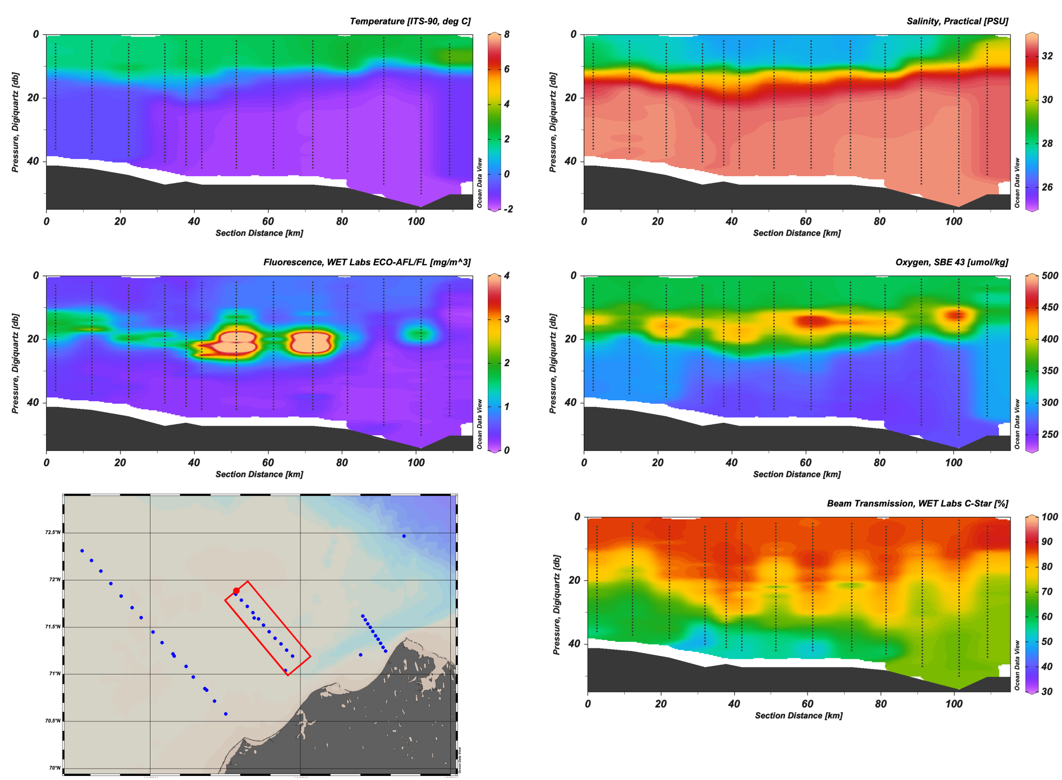


Figure 2.1.3. Water column hydrography of transect DBO-4.

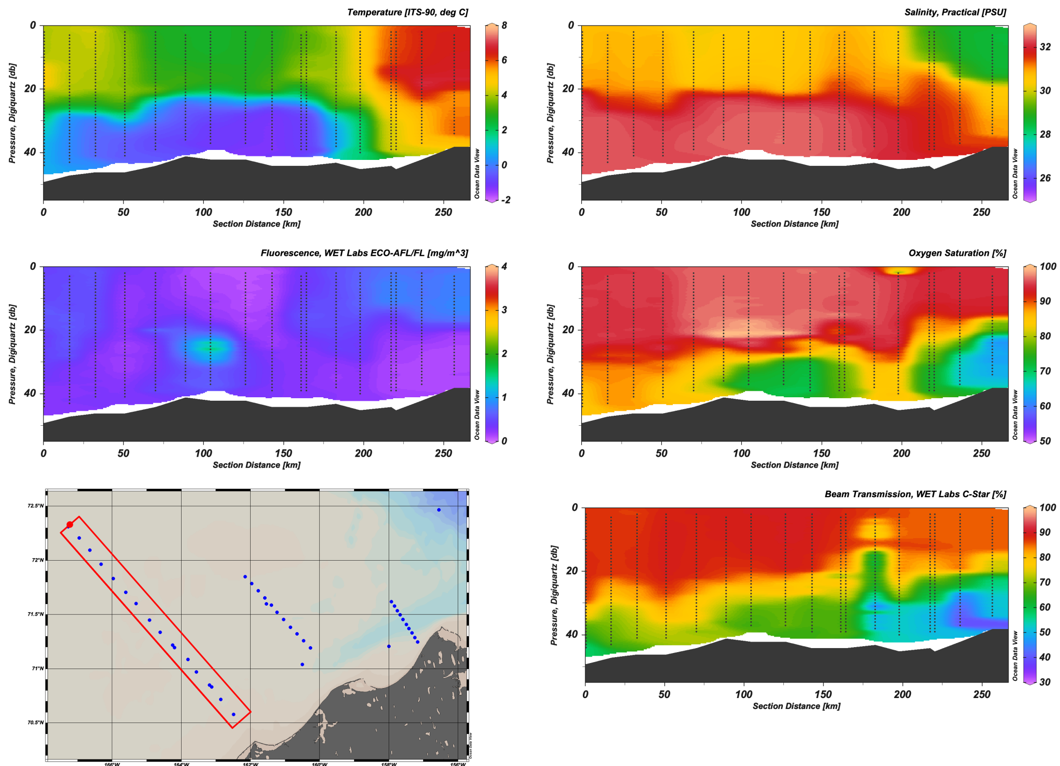


Figure 2.1.4. Water column hydrography of the Icy Cape transect.

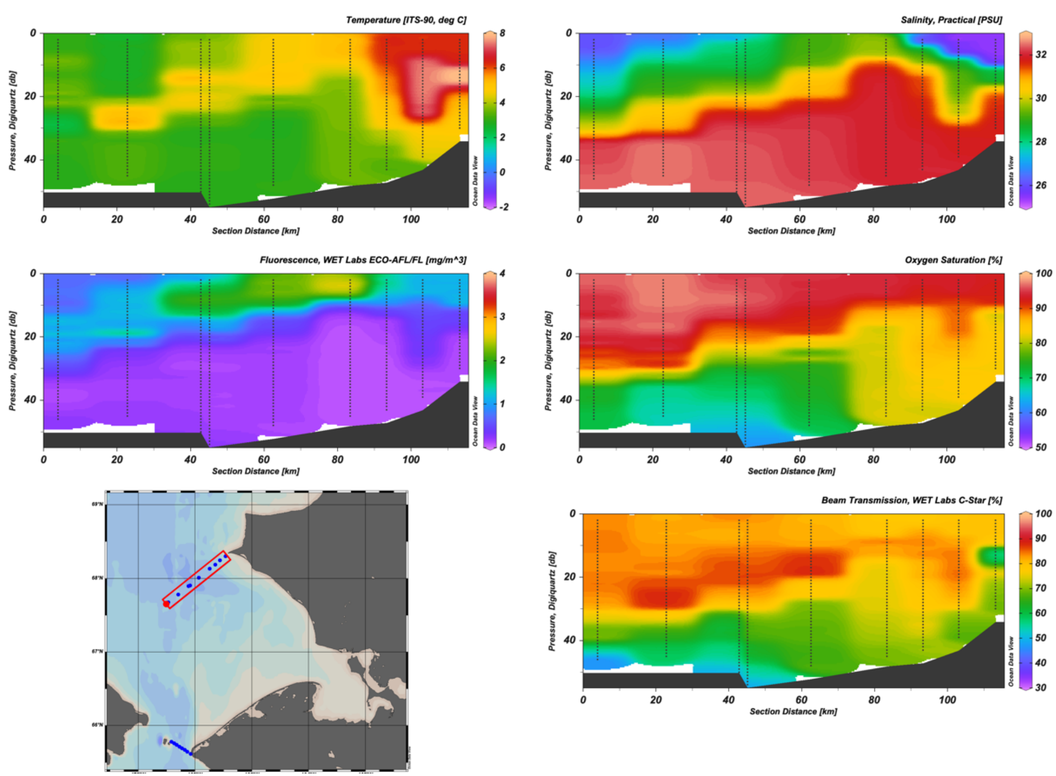


Figure 2.1.5. Water column hydrography of transect DBO-3.

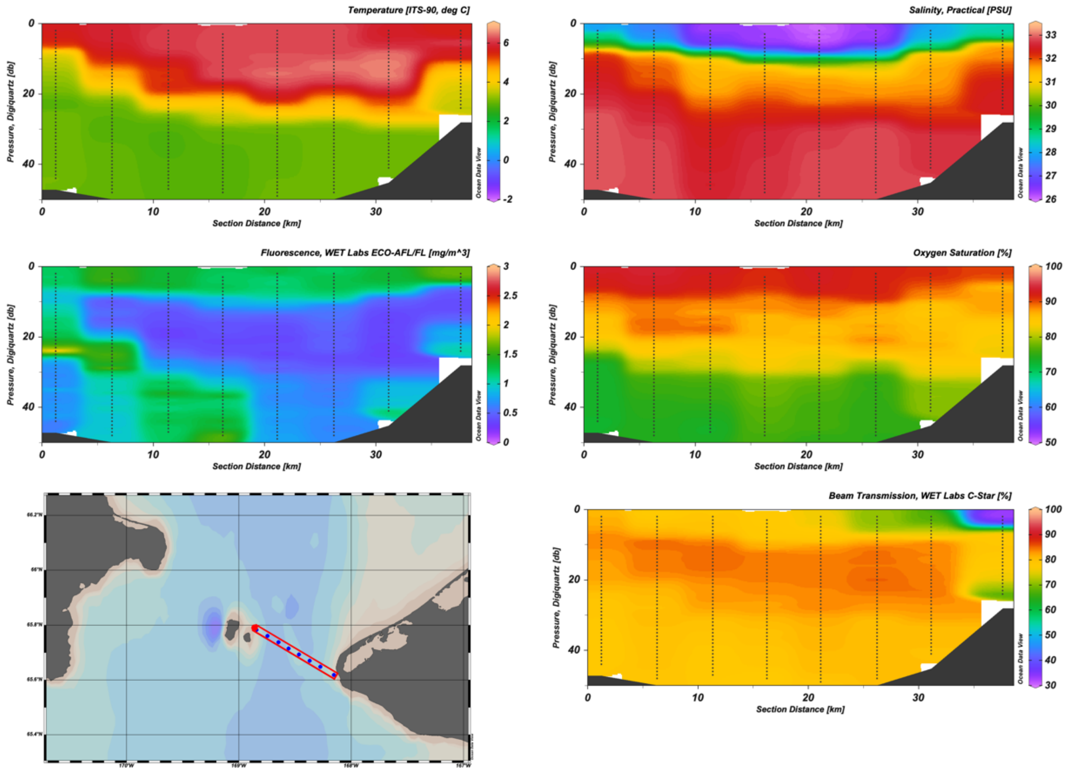


Figure 2.1.6. Water column hydrography of the Bering Strait transect.

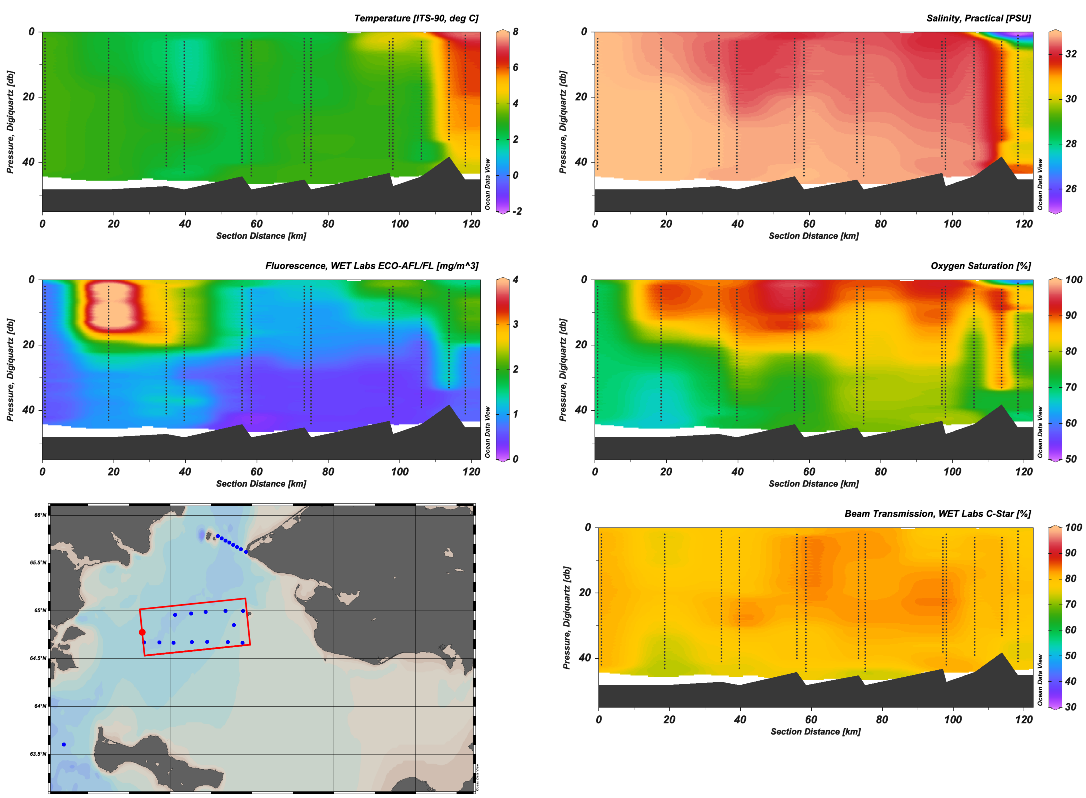


Figure 2.1.7. Water column hydrography of transect DBO-2.

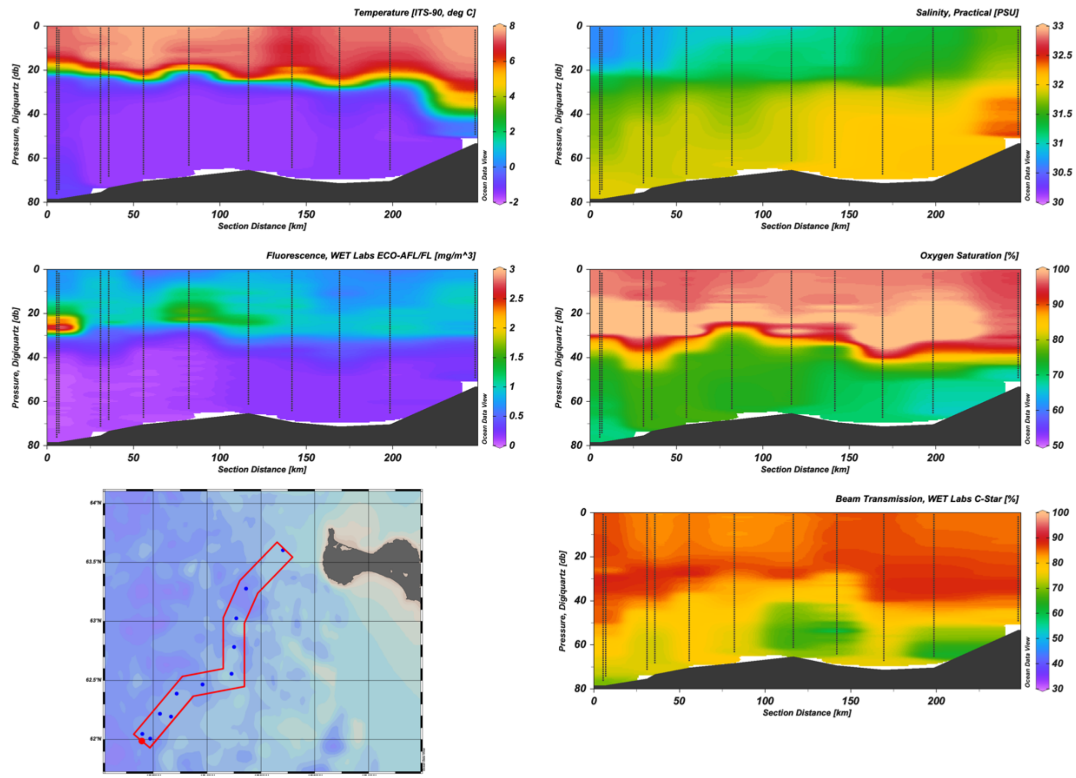


Figure 2.1.8. Water column hydrography of transect DBO-1.

Underway sampling:

Ocean velocity data was collected using a centerboard-mounted Teledyne RDI 300 kHz Workhorse acoustic Doppler current profiler, sampling in 2 m bins. The 300 kHz instrument measured good data starting at 11 m depth. We ran all transducers sequentially triggered from the K-sync system so as to provide an interference-free time interval for the acoustics pings. The ship's EK-80 split beam was measured backscatter from the water column at five frequencies (**Figure 2.1.9**).

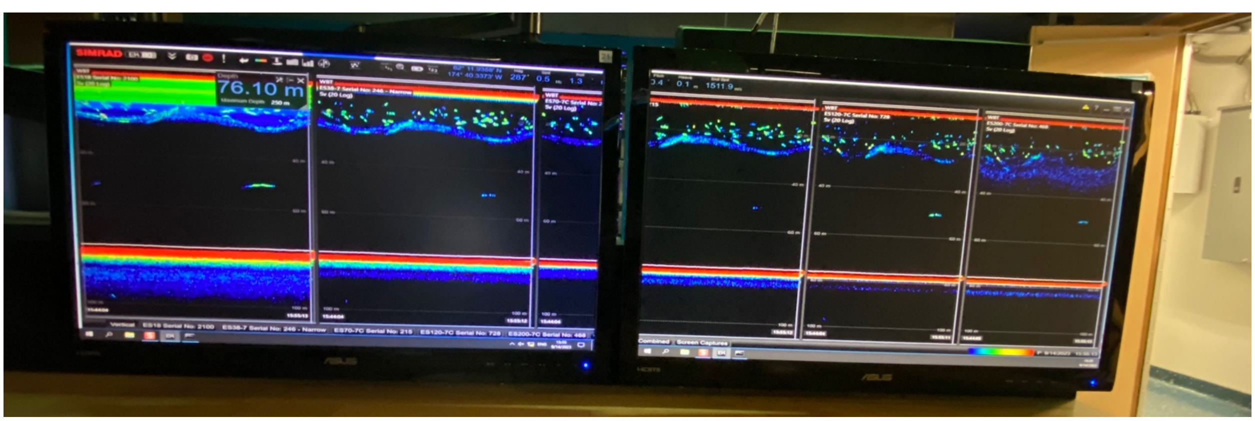


Figure 2.1.9. Example screenshot of the EK-80 data from the DBO1 region. PC/S. Danielson

Other underway data collected include the ship's operational and navigation data, meteorological data, and ocean surface data. Operational data of ship's equipment (e.g., navigation and winch payout and tensions) were logged and will be archived at the R2R data repository. Navigation data parameters include GMT date time, latitude, longitude, and water depth. Atmospheric data parameters measured by the ship's underway system included atmospheric pressure, wind speed/direction, air temperature, humidity, shortwave downwelling irradiance, longwave downwelling irradiance, and PAR. Surface seawater underway data samples included temperature, salinity, chlorophyll-a fluorescence, partial pressure of CO_2, and nitrate.

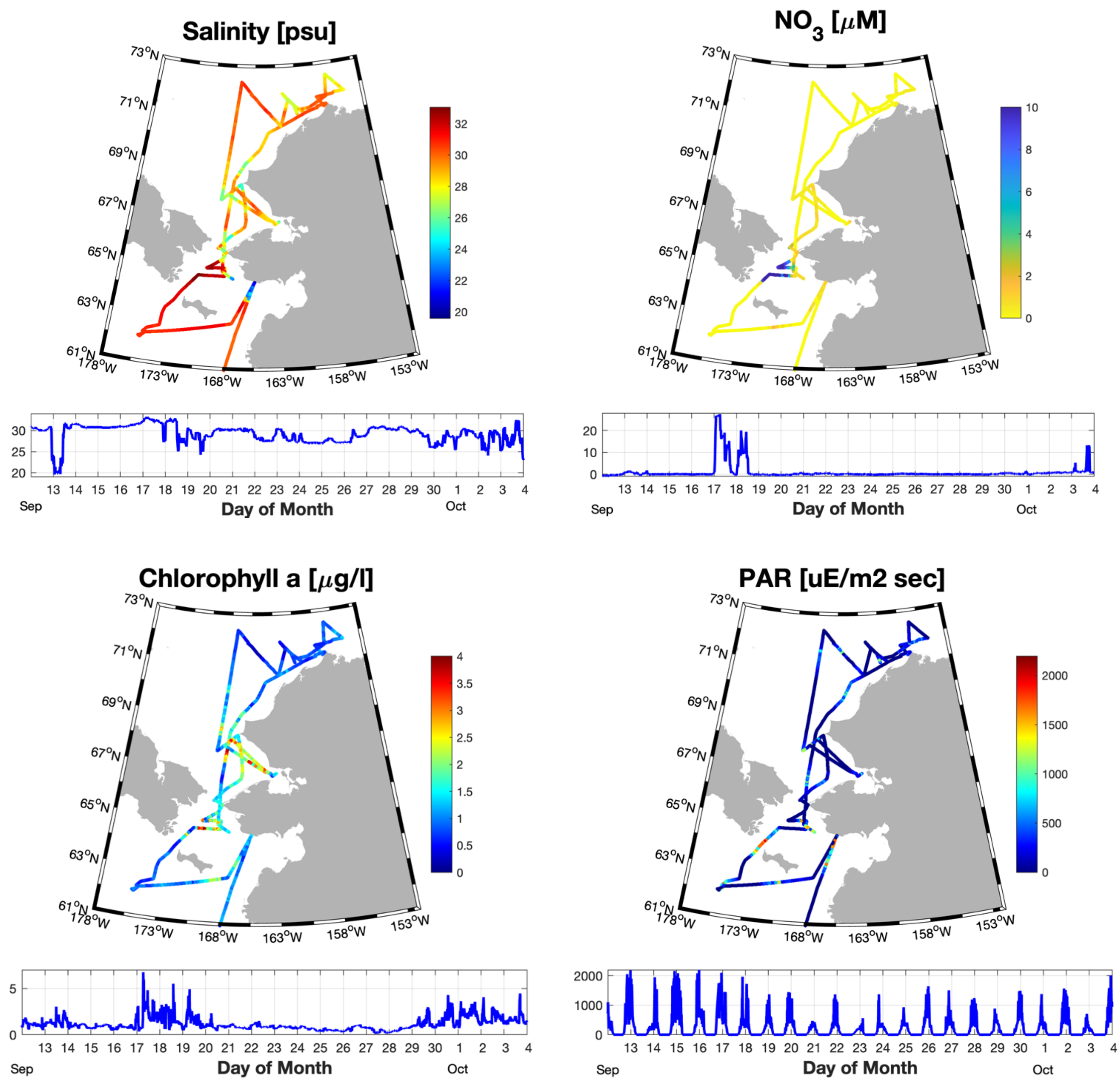


Figure 2.1.10. Underway near-surface measurements during SKQ2023-12S: salinity (**upper left**); nitrate (**upper right**); chlorophyll a (**lower left**); PAR (**lower right**).

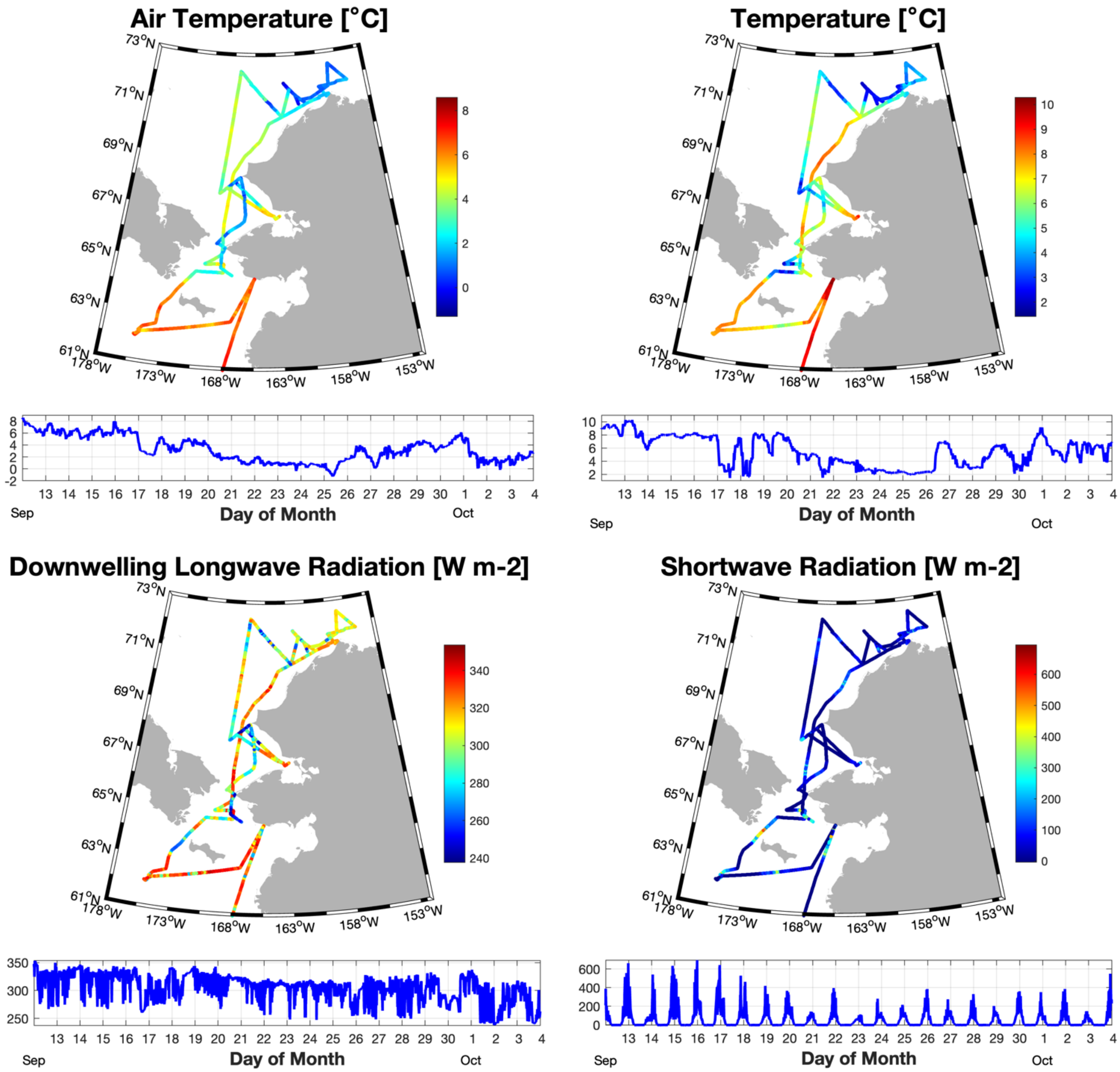


Figure 2.1.11. Underway near-surface measurements during SKQ2023-12S: air temperature (**upper left**); sea water temperature (**upper right**); downwelling longwave radiation (**lower left**); shortwave radiation (**lower right**).

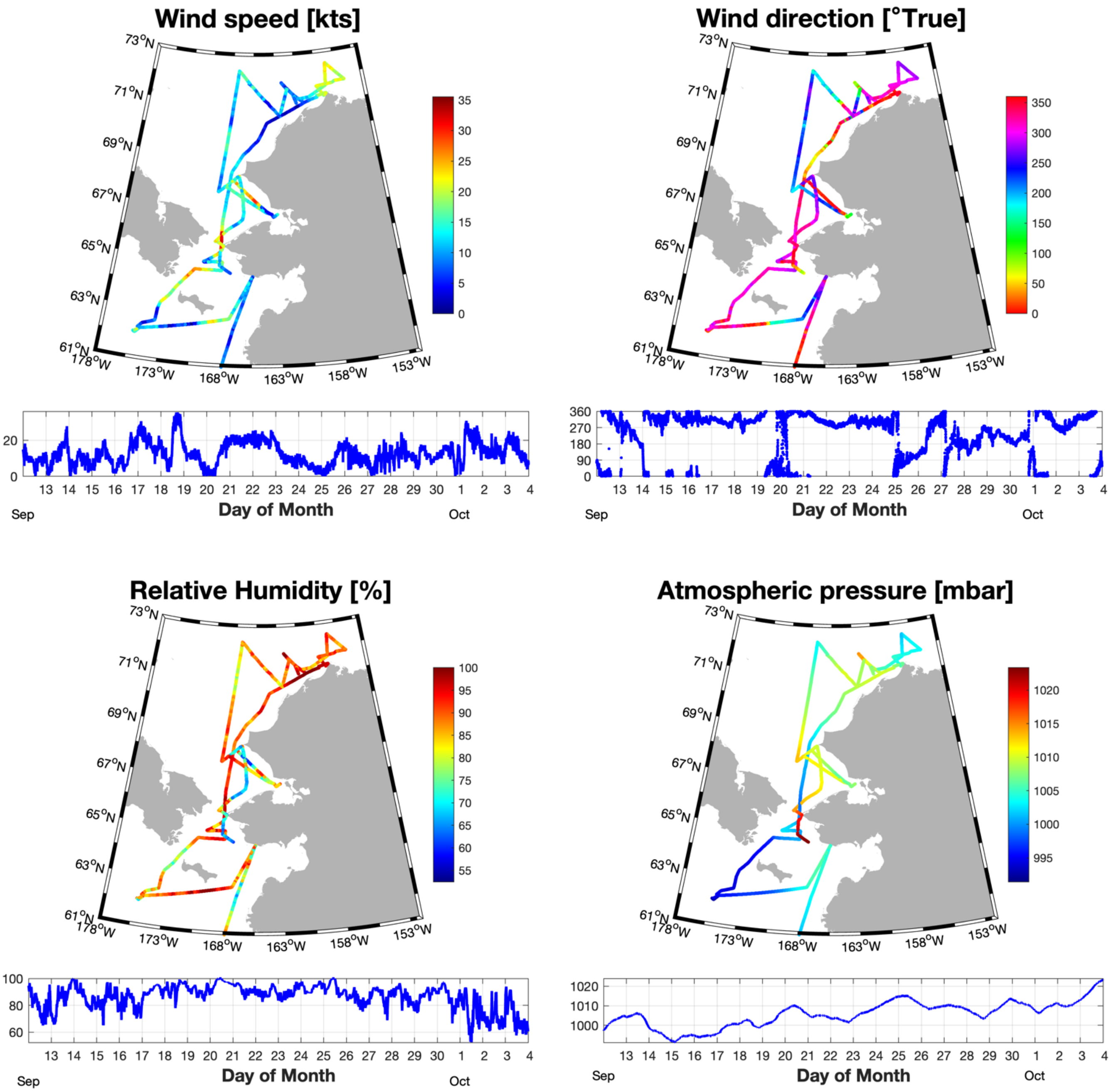


Figure 2.1.12. Underway near-surface measurements during SKQ2023-12S: wind speed (**upper left**); wind direction (**upper right**); relative humidity (**lower left**); atmospheric pressure (lower right).

2.2. Nutrient and Chlorophyll a Distributions

- **Eric Wisegarver, Caitlyn McFarland; NOAA**

i. Chlorophyll samples were collected in calibrated 250ml polyethylene bottles and collected at depths of 0, 10, 20, 30, 40, and 50m. Sample bottles were rinsed three times before filling and filtered as soon as possible after collection. Samples were filtered through 0.7um GF/F filters and stored at -80C. Filters were returned to the lab for analysis.

ii. Nutrients. Equipment and Techniques
Dissolved nutrients (phosphate, silicate, nitrate, nitrite, and ammonium) were measured by using a Seal Analytical AA3 HR automated continuous flow analytical system with segmented flow and colormetric detection. Detailed methodologies are described by Gordon et al. (1992).

Silicic acid was analyzed using a modification of Armstrong et al. (1967). An acidic solution of ammonium molybdate was added to a seawater sample to produce silicomolybic acid. Oxalic acid was then added to inhibit a secondary reaction with phosphate. Finally, a reaction with ascorbic acid formed the blue compound silicomolybdous acid. The color formation was detected at 660 nm. The use of oxalic acid and ascorbic acid (instead of tartaric acid and stannous chloride by Gordon et al.) were employed to reduce the toxicity of our waste steam.

Nitrate and Nitrite analysis were also a modification of Armstrong et al. (1967). Nitrate was reduced to nitrite via a copperized cadmium column to form a red azo dye by complexing nitrite with sulfanilamide and N-1-naphthylethylenediamine (NED). Color formation of nitrate + nitrite was detected at 520 nm. The same technique was used to measure nitrite, (excluding the reduction step), and nitrate concentrations were determined by the difference of these two analyses.

Phosphate analysis was based on a technique by Bernhart and Wilhelms (1967). An acidic solution of ammonium molybdate was added to the sample to produce phosphomolybdate acid. This was reduced to the blue compound phosphomolybdous acid following the addition of hydrazine sulfate. The color formation was detected at 820 nm.

Ammonium analysis was based on a technique by Kerouel and Aminot (1997). An o-phthaldialdehyde reagent containing sulfite is added to the sample. The reagent reacts with ammonium and the resulting fluorescence is detected using a fluorometer with a 370 nm excitation filter and 460 nm emission filter.

iii. Sampling and Standards
Nutrient samples were drawn in 60ml HDPE that had been stored in 10% HCl. The bottles are rinsed 3-4 times with sample prior to filling. Samples were filtered through a 0.45um cellulose acetate filter. Samples were then brought to room temperature prior to analysis. Fresh mixed working standards were prepared before each analysis. In addition to the samples, each analysis consisted of a 5-point standard curve with each concentration run in duplicate at the beginning of each analytical run. Also, one mixed working standard from the previous analytical run was used at the beginning of the new run to determine differences between the two standards. Low Nutrient Seawater (LNSW) was used as a medium for the working standards.

The working standards were made by the addition of secondary nitrite, ammonium, mixed standard (containing silicic acid, nitrate, and phosphate) into a 250ml calibrated volumetric flask of LNSW. Working standards were prepared daily.

Dry standards of a high purity were pre-weighed at PMEL. All standards were dissolved at sea. The secondary mixed standard was prepared by the addition of nitrate and phosphate primary standards to the silicic acid standard.

Nutrient concentrations were reported in micromoles per liter. Lab temperatures were recorded for each analytical run.

In total 1300 samples were analyzed. Approximately 320 samples collected during the SKQ2023-12S cruise and an additional 990 samples from SKQ2023-10S were frozen and left aboard the ship for analysis during SKQ2023-12S.

Reference:

Armstrong, F.A.J., Stearns, C.R., and Strickland, J.D.H. (1967) The measurement of upwelling and subsequent biological processes by means of the Technicon AutoAnalyzer and associated equipment. Deep-Sea Res. 14:381-389.

Bernhard, H. and Wilhelms, A. (1967) The continuous determination of low-level iron, soluble phosphate and total phosphate with AutoAnalyzer. Technicon Symposia, I. pp.385-389.

Gordon, L.I., Jennings Jr., J.C., Ross, A.A. and Krest, J.M. (1993) A suggested protocol for the continuous automated analysis of seawater nutrients (phosphate, nitrate, nitrite and silicic acid) in the WOCE Hydrographic program and the Joint Global Ocean Fluxes Study, WOCE Operations Manual, vol. 3: The Observational Programme, Section 3.2: WOCE Hydrograghic Programme, Part 3.1.3: WHP Operations and Methods. WHP Office Report WHPO 91-1; WOCE Report No. 68/91. November 1994, Revision 1, Woods Hole, MA., USA, 52 loose-leaf pages.

Kerouel, R. and Aminot, A. (1997) Fluorometric determination of ammonia in sea and estuarine waters by direct segmented flow analysis. Marine Chemistry 57:265-275.

iv. Oxygen

Oxygen samples were collected in calibrated 125ml glass iodine titration flasks at each station. One sample was collected at each station alternating surface and bottom. Replicate samples were collected on each line. During sampling flasks were rinsed before filling from the bottom and overflowing for three bottle volumes ensuring that no air bubbles were introduced to the sample. Before sealing the sample 1ml each of 3M Manganese chloride and 4M Sodium iodide/8M Sodium hydroxide solutions were added. Flask was then sealed and shaken vigorously. Deionized water was added to the neck of the bottle and the bottle was stored for analysis.

Samples were analyzed with an automated titrator using amperometric endpoint detection (Langdon, 2010). The temperature-corrected molarity of the thiosulfate titrant was determined as given by Dickson (1994). Thiosulfate was dispensed by a 2 mL Kloehn syringe driven with a stepper motor controlled by the titrator. The whole-bottle titration technique of Carpenter (1965), with modifications by Culberson et al. (1991), was used.

Samples were analyzed every 3-5 days. For each set of samples 3-4 replicate 10ml potassium iodate standards were run. Reagent blanks were measured at the beginning of the cruise.

During the cruise 116 samples were analyzed, 90 were collected from the CTD and 26 were collected from the underway seawater system. Data was reported in micromoles per liter.

Reference:

Carpenter, J. H., "The Chesapeake Bay Institute technique for the Winkler dissolved oxygen method," Limnology and Oceanography, 10, pp. 141-143 (1965).

Culberson, C. H., Knapp, G., Stalcup, M., Williams, R. T., and Zemlyak, F., "A comparison of methods for the determination of dissolved oxygen in seawater," Report WHPO 91-2, WOCE Hydrographic Programme Office (Aug. 1991).

Dickson, A. G., "Determination of dissolved oxygen in seawater by Winkler titration," WHP Operations and Methods (1994).

Langdon, C. (2010). Determination of dissolved oxygen in seawater by Winkler titration using the amperometric technique. The GO-SHIP Repeat Hydrography Manual: A Collection of Expert Reports and Guidelines. E. M. Hood, C. L. Sabine, and B. M. Sloyan, IOCCP Report Number 14, ICPO Publication Series Number 134

Eric Wisegarver analyzing seawater nutrients. PC/S. Danielson

2.3. Phytoplankton sampling and imaging; O_2/Ar measurements

- **Haley Cynar; NOAA**

An equilibrator inlet mass spectrometer (EIMS) was used to continuously measure oxygen/argon (O_2/Ar) ratios in the surface underway seawater, providing a high-resolution record along the cruise track. The O_2/Ar ratio is used to quantify net biological oxygen production, which represents the balance between community production and respiration in the surface mixed layer and can be used to estimate net community production (NCP) rates. Discrete samples (40) were collected from the underway seawater system for analysis in the lab at Oregon State University for O_2/Ar and triple oxygen isotopes ($\delta^{17}O$ and $\delta^{18}O$), both to provide calibration data for the EIMS measurements and to add additional productivity data with the triple oxygen isotope measurements.

A subset of CTD casts were selected to collect depth profiles (9 profiles, 24 samples) of O_2/Ar and triple oxygen isotopes as well.

i. Phytoplankton Sampling:

Underway samples were collected to coincide with the airborne hyperspectral flights conducted by Jiaxu Zhang (NOAA PMEL) for phytoplankton classification, which occurred from September 12-21. Samples were collected for absorption, size-fractionated chlorophyll (2 sizes, >20 µm and between 5-20 µm), and flow cytometry. Total chlorophyll and nutrient samples were also collected at some of these locations. There were 7 sets of samples collected for these coincident hyperspectral measurements.

Samples from the CTD were collected at the surface, at the subsurface chlorophyll maximum (when present), and near the bottom (when chlorophyll increased at the bottom) of the water column at stations throughout the cruise. From these water samples, water was filtered for absorption from the surface on intermittent stations, while water was filtered for size-fractionated chlorophyll at all sampled depths (105 samples). Flow cytometry samples were preserved from surface and chlorophyll max. depths as well for later analysis.

ii. Phytoplankton Imaging:

Two (WHOI, NOAA) Imaging FlowCytobots (IFCBs) were configured to sample from the underway seawater system, collecting real-time images of phytoplankton along the cruise track. The WHOI instrument took images of fluorescing particles (phytoplankton), while the NOAA IFCB captured images of all particles (including fluorescing). The NOAA IFCB was also used to capture images of phytoplankton from discrete depths in the water column (from the chlorophyll maximum, as well as bottom water when fluorescence was elevated) by collecting and analyzing water samples from CTD casts (~50 depth samples).

2.4 Denitrification

- **Stuart Painter, UK NOC**

An objective of the UK BIOPOLE project is to address the question of whether denitrification associated with particles in the water column contributes to the excess of phosphorous exported from the Arctic to the North Atlantic Ocean.

Participation in the 2023 integrated ECO-FOCI / DBO / AMBON / CEO cruise was sought to explore this question. During the cruise samples were collected for i) ^{15}N dual-isotope labelling experiments to estimate denitrification & anammox activity in the water column, ii) eDNA and eRNA samples for subsequent bacterial species identification and assessment of denitrification gene activity (transcriptomics), and iii) particulate concentrations and elemental stoichiometry.

^{15}N dual isotope labelling experiments

Separate time course incubations using $^{15}N\text{-}NO_2$ and $^{15}N\text{-}NH_4$ tracers were performed to measure the potential for denitrification and anammox at a select number of stations across the Bering and Chukchi shelves **(Table 2.4.1)**; due to the lengthy setup and incubation period (48 hrs) only a few stations could be sampled). At each sampled station parallel incubations using filtered and unfiltered seawater were conducted from 3 sampled depths representing surface waters, mid-depth waters and bottom waters to gauge the vertical distribution and magnitude of denitrification/anammox loss processes and the role of particles as potential hotspots for these processes. Unfiltered water samples were collected into 250ml pyrex bottles direct from the CTD niskin bottles. Filtered water samples were similarly collected using in-line gravity-fed filtration systems fitted with Whatman GF/A filters (1.6 μm pore size) to remove particles into duplicate 250ml pyrex bottles. All water samples were inoculated with ^{15}N tracers to final concentrations of ~10 μmol L^{-1}, with 8 ml subsamples subsequently pipetted into 12ml Exetainer vials (based on methods described by Dalsgaard and Thamdrup and others). Vials were degassed with high purity helium gas to induce anoxic conditions and then incubated for 48 hours in the dark and at temperatures representative of in-situ conditions (±2degC). Triplicate samples were killed at regular 12hr intervals (i.e. T_0, T_{12}, T_{24}, T_{36} and T_{48}) via injection of 100 μl of 3.7M (50% w/v) $ZnCl_2$ solution through the septum cap. Headspace gas samples will be analysed for $^{15}N_2$ content upon return to the UK.

Table 2.4.1. Stations sampled for denitrification/anammox activity.

Cruise Station	CTD cast	Sampled depths (m)	Sampled Niskins	Tracers
M8 mooring	1	1, 30, 67	22/23, 12/13, 4/5,	$^{15}N\text{-}NO_2$, $^{15}N\text{-}NH_4$
DBO1.4	5	1, 30, 66	1/3, 10/11, 20/22	$^{15}N\text{-}NO_2$, $^{15}N\text{-}NH_4$
DBO2/BCL6A	12	3, 30, 41	18/19, 7/8, 4/5	$^{15}N\text{-}NO_2$, $^{15}N\text{-}NH_4$
DBO5.8	32	3, 30, 65	21/22, 10/11, 3/4	$^{15}N\text{-}NO_2$, $^{15}N\text{-}NH_4$
DBO4.2n	39	3, 30, 43	21/22, 10/11, 2/3	$^{15}N\text{-}NO_2$, $^{15}N\text{-}NH_4$
IC4	58	2,30,37	15/16, 6/7,3/4	$^{15}N\text{-}NO_2$, $^{15}N\text{-}NH_4$
DBO3.8	68	2,30,45	21/22, 9/10, 4/5	$^{15}N\text{-}NO_2$, $^{15}N\text{-}NH_4$
DBO3.2	75	3,30,38	16, 6, 3	$^{15}N\text{-}NO_2$, $^{15}N\text{-}NH_4$

eDNA/eRNA sampling

To support the ^{15}N rate measurements and provide additional information on the molecular processes at work, samples for eDNA and eRNA were collected at the same stations and depths as for the ^{15}N rate measurements, with additional samples collected on an ad-hoc basis (**Table 2.4.2**). At each sampled depth 2L of seawater was filtered for eDNA samples on to a sterile 0.22 μm sterifix filter cartridge using a peristaltic pump. The sample was immediately fixed with 1ml of RNAlater, and frozen at -80degC. Triplicate 4L samples were also collected at each sampled depth for eRNA (transcriptomics) analyses, and immediately placed into the-80degC freezer without preservative. All samples will be analysed once samples are returned to the UK.

Table 2.4.2. Stations sampled for eDNA/eRNA.

Cruise Station	CTD cast	Sampled depths	Sampled Niskin
M8 mooring	1	1, 30, 67	22/23, 12/13, 4/5,
DBO1.1	2	2, 30, 74	19/20, 8/10, 2/3
DBO1.4	5	1, 30, 66	1/3, 10/11, 20/22
DBO2	12	3, 30, 41	18/19, 7/8, 4/5
DBO2.5	21	2, 30, 43	21/22, 9/10, 4/5
DBO5.2	26	2, 30, 51	19/20, 10/11, 4/5
DBO5.8	32	3, 30, 65	21/22, 10/11, 3/4
DBO4.2n	39	3, 30, 43	21/22, 10/11, 2/3
DBO4.4n	44	2, 30, 42	18/19, 8/9, 3/4
IC10	51	2,30,37	3/4, 5/7, 16/17
IC4	58	2,30,37	15/16, 6/7,3/4
DBO3.8	68	2,30,45	21/22, 9/10, 4/5

Particulate sampling

Samples for particulate organic carbon and nitrogen (POC/N), and particulate organic phosphorous (POP) concentrations were also collected to provide information on substrate conditions (**Table 2.4.3**). At each sampled depth 1L of seawater was filtered on to pre-ashed GF/F filters for POC/N and on to pre-ashed, acid rinsed GF/F filters for POP. All samples were oven dried on-board. POC/N sample filters were stored in 2ml cyrovials, POP samples were added to pre-baked glass test tubes and sealed with parafilm. Analyses of samples will be conducted following BIOPOLE protocols.

Table 2.4.3. Stations sampled for particulate concentrations

Cruise Station	CTD cast	Sampled depths	Sampled Niskin
M8 mooring	1	1, 30, 67	22/23, 12/13, 4/5,
DBO1.1	2	2, 30, 74	19/20, 8/10, 2/3
DBO1.4	5	1, 30, 66	1/3, 10/11, 20/22
DBO2	12	3, 30, 41	18/19, 7/8, 4/5
DBO2.3	18	3, 26, 34	16, 9, 3

DBO2.7	19	2, 29, 41	17, 6, 4
DB02.5	21	2, 30, 43	21/22, 9/10, 4/5
DBO5.2	26	2, 30, 51	19/20, 10/11, 4/5
DBO5.8	32	3, 30, 65	21/22, 10/11, 3/4
DBO4.2n	39	3, 30, 43	21/22, 10/11, 2/3
DBO4.4n	44	2, 30, 42	18/19, 8/9, 3/4
IC10	51	2,30,37	3/4, 5/7, 16/17
IC4	58	2,30,37	15/16, 6/7,3/4
DBO3.8	68	2,30,45	21/22, 9/10, 4/5
DBO3.2	75	3,30,38	16, 6, 3

Remote Access Sampler

A McLane Remote Access Sampler (RAS) was deployed on a short mooring close to the Chukchi Ecosystem Observatory (CEO) moorings on the DBO4 line of stations (**Figure 2.4.1, 2.4.2**). The purpose of this was to collect seawater samples at regular time points over the following year (Sep 2023 to Sep 2024) to provide a mean annual cycle of nutrient concentrations and stoichiometries and to provide additional water for molecular analyses. Due to the water volume requirements needed for the molecular analyses the RAS was setup to sample approximately every 3 weeks (23-day interval) and to fill 3 x 500 ml bags at each sampling point. This should produce a better than monthly resolution timeseries.

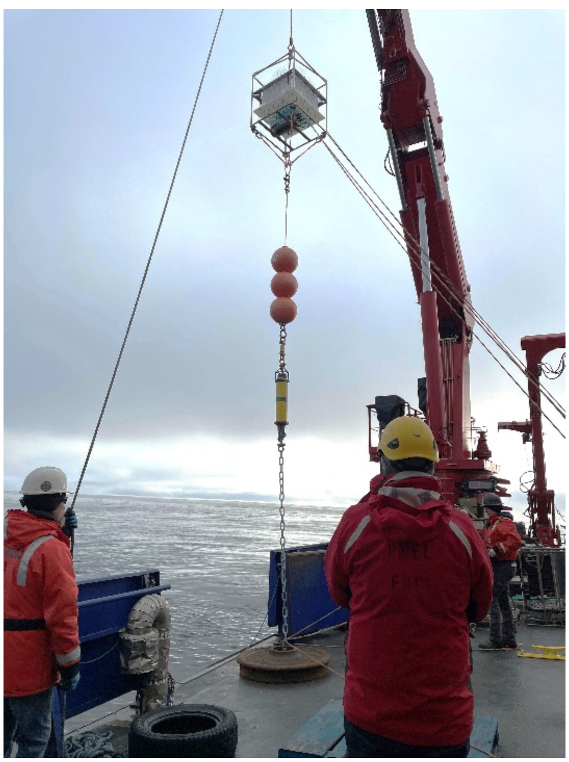


Figure 2.4.1. BIOPOLE RAS sampler deployment. Deployment details: 24/09/2023, 22:28 UCT, Position: 71 36.031N, 161 29.988W

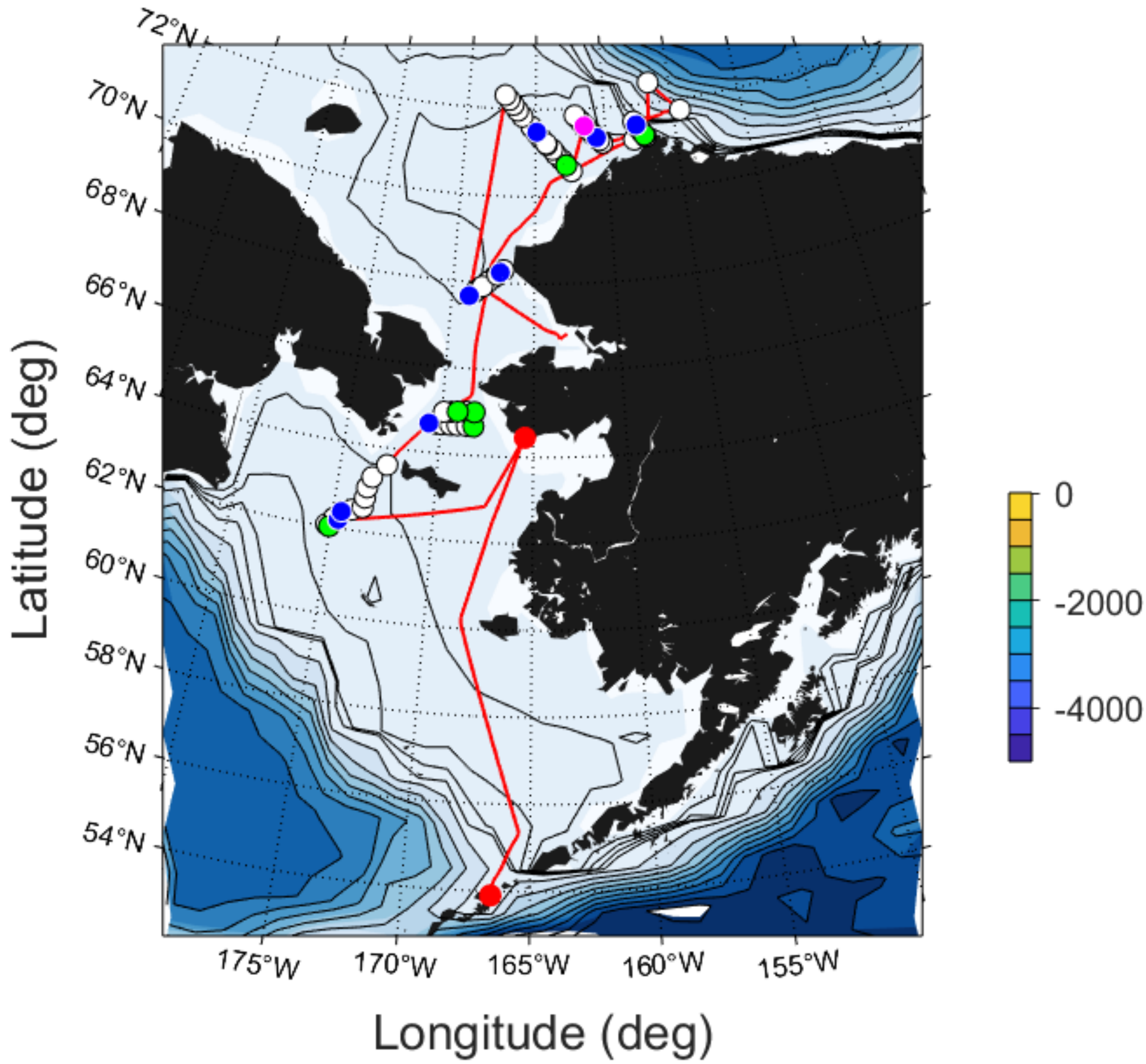


Figure 2.4.2. Map of sampled sites. Key**:** Cruise CTD casts (white circles), coincident denitrification & eDNA & particulate sampling sites (blue circles), additional eDNA or particulate sampling (green circles), RAS mooring (magenta circle), cruise track (red line).

2.5 Dissolved Inorganic Carbon (DIC)

- **Savannah Sandy; UAF**

Seawater was sampled for analysis of dissolved inorganic carbon (DIC) content at selected stations (see table) on behalf of Natalie Monacci for the Ocean Acidification Research Center (OARC) at the University of Alaska Fairbanks (UAF) (**Table 2.5.1**). Samples were drawn from the Niskin bottles on the CTD rosette at standard depths (also noted on the table) and collected into 250mL glass bottles after three rinses. The samples were then preserved using 200µL of a 7.5% $HgCl_2$ solution. Triplicate samples were taken periodically throughout the cruise, as noted in the table. The samples will be processed at UAF's OARC laboratory in Fairbanks, AK.

We also took samples from *Sikuliaq*'s underway seawater system during transit southward to Dutch Harbor to capture a coccolithophore bloom in the Bering Sea south of Nunivak Island, with at least one triplicate, with standard depths and two sets of triplicates. Although we planned to sample at the M2 mooring site, we unfortunately were unable to occupy that mooring site on the transit south due to ship related issues.

Special notes:
The sample from 20m for station DBO4.4n was lost due to a cracked bottle. The station at IC3 was sampled in two separate CTD casts due to Niskin bottles containing bottom water samples not being fully sealed. The cast was repeated at the same site to collect only bottom water. x = sampled.

Table 2.5.1. Summary of Dissolved Inorganic carbon (DIC) collections duing SKQ23-12S.

Station	Cast #	Depths								Comments
		Bottom	100	50	40	30	20	10	Surface	
M8	001	x		x	x	x	x	x	x	Test cast
DBO1.1	002	x		x	x	x	x	x	x	
DBO1.2	003	x		x	x	x	x	x	x	
DBO1.4	005	x		x	x	x	x	x	x	Triplicates @ 40m
DBO1.6	007	x		x	x	x	x	x	x	
DBO1.8	009	x		x	x	x	x	x	x	
DBO2.0	012	x				x	x	x	x	
DBO2.1	014	x				x	x	x	x	
DBO2.2	016	x				x	x	x	x	
DBO2.3	018	x					x	x	x	
DBO2.7	019	x				x	x	x	x	
DBO2.5	021	x				x	x	x	x	Triplicates @ Bottom
DBO2.4	023	x				x	x	x	x	
DBO5.1	025	x				x	x	x	x	
DBO5.2	026	x			x	x	x	x	x	
DBO5.3	027	x		x	x	x	x	x	x	
DBO5.4	028	x		x	x	x	x	x	x	
DBO5.5	029	x	x	x	x	x	x	x	x	
DBO5.6	030	x		x	x	x	x	x	x	

DBO5.7	031	x		x	x	x	x	x	x	
DBO5.8	032	x		x	x	x	x	x	x	
DBO5.9	033	x		x	x	x	x	x	x	
DBO5.10	034	x		x	x	x	x	x	x	Triplicates @ 40m
DBO4.1n	037	x			x	x	x	x	x	
DBO4.2n	039	x			x	x	x	x	x	
DBO4.3n	042	x				x	x	x	x	
DBO4.4n	044	x				x	x	x	x	20m sample lost
CEO2	046	x				x	x	x	x	Triplicates @ 33m
DBO4.5n	047	x				x	x	x	x	
DBO4.6n	049	x				x	x	x	x	
IC11	050	x					x	x	x	
IC10	051	x				x	x	x	x	
IC9	053	x				x	x	x	x	
IC8	054	x				x	x	x	x	
IC7	055	x				x	x	x	x	
IC6	056	x				x	x	x	x	
IC5	057	x				x	x	x	x	
IC4	058	x				x	x	x	x	
IC3	060/061	x				x	x	x	x	
IC2	062	x				x	x	x	x	Triplicates @ Bottom
IC1/C3	063	x				x	x	x	x	
C15	067	x				x	x	x	x	
DBO3.8	068	x			x	x	x	x	x	
DBO3.7	069	x			x	x	x	x	x	
DBO3.6	070	x			x	x	x	x	x	Triplicates @ Bottom
DBO3.4	071	x				x	x	x	x	
DBO3.5	072	x			x	x	x	x	x	
DBO3.3	074	x				x	x	x	x	
DBO3.2	075	x				x	x	x	x	
DBO3.1	076	x					x	x	x	
BS8	077	x				x	x	x	x	Triplicates @ Bottom
BS6	079	x				x	x	x	x	
BS3	082	x			x	x	x	x	x	
BS1	084	x					x	x	x	
M2		x		x	x	x	x	x	x	Triplicates @ Surface & Bottom

2.6. Environmental DNA and Methane Sampling

- **Matt Galaska; NOAA**

Environmental DNA (eDNA) was collected during the 2023 Sikuliaq SKQ23 cruise and will be used to investigate the biodiversity at all water CTD sampled stations, including the DBO, CEO, and long-term moored sites, in part in support of the goals of the Arctic Marine Biodiversity Observing Network (AMBON) project. Additionally, this year saw the deployment of two automated eDNA samplers (McLane PPS, each capable of taking 24 samples), at the M8 and C12 moored stations, along with the recovery and onboard filtering of 22 samples from Dr. Danielson's CEO 1-22 Green Eyes Aquamonitor. We greatly appreciate the efforts of the Sikuliaq ship crew, local partners, EcoFOCI and partial AMBON funding, that made these deployments possible (including the logistics to get a replacement CPU board for the C12 moored sampler). The addition of automated eDNA samplers in the Bering and Chukchi Seas provides new data on the timing of species movement and biodiversity composition over a temporal scale, from stations logistically infeasible to routinely monitor.

All samples collected, shipboard and moored, will be processed using five different degenerate amplicon regions that were assessed for their ability to capture broad marine biodiversity, from microbes to whales. Specifically, DNA will be amplified using the Leray COI, MiFish 12S, Machida 18S, Universal 16S (microbial), and the inclusion of a new marine mammal marker, currently under testing at NOAA's Pacific Marine Environmental Laboratory. These data will serve as a snapshot of biodiversity for the region, used to assess community assemblage changes in a multivariate context with co-collected physical ocean data. These data are the basis of an ongoing long-term dataset that are archived at PMEL and can be reanalyzed for new markers and questions, for years to come.

Shipboard eDNA samples were collected from Niskin bottles deployed on the CTD and preserved by filtering one liter of seawater across a 0.22-micron sterivex filter and backfilled with 2ml of 95% ethanol. Water for these samples were collected at 10- and 30-meter depths, along with a bottom water sample that varied in depth by station. Stations that had a bottom depth of under 40 m only had two eDNA samples collected, at the respective bottom and at 10 m. In total, 149 samples were collected (not including the 22 samples from the Aquamonitor) along with 4 negative controls taken prior to all sampling, after 50 samples, 100 samples and after all sampling had concluded. An additional 48 samples from the McLane PPS units will be taken over the course of the following year as a result of this cruise.

Methane: During the 2023 Sikuliaq SK23 cruise, methane was collected from all water CTD stations to build a pilot dataset exploring concentrations from the Bering and Chukchi Seas. Methane samples were collected from the subsurface and bottom water Niskins at each cast and preserved using NaOH to prevent any microbial interference of the data. In total 114 samples were collected, including five sets of replicates to account for variability, and a full depth profile from the CK9 mooring station at Barrow Canyon. These samples will be taken back to NOAA's Pacific Marine Environmental Laboratory and analyzed by Dave Butterfield's team, the Earth Ocean Interaction group. These initial results will guide future projects in the region and help to identify potential vent and seep locations.

2.7. Harmful Algae Bloom (HAB) Sampling

- **Patrick Charapata; NOAA**

General Project Description and Cruise Objectives: *The aim of this study is to quantify cell densities of two HAB species (Pseudo-nitzschia and Alexandrium) and concentrations of the corresponding algal toxins (domoic acid (DA) and saxitoxin (STX)) in multiple trophic levels in the food web in Arctic and subarctic Alaskan waters. Sampling of trophic levels includes phytoplankton, zooplankton, sediment, shellfish and planktivorous fish, as available. The goals for HABs sampling during the SKQ23-12S cruise were to 1) collect and process water samples for HAB species, Pseudo-nitzschia and Alexandrium catenella, 2) assist collaborators in collecting sediments for Alexandrium cyst counts and zooplankton, invertebrates, and planktivorous fish for algal toxin analysis (STX and DA), as available. Ultimately, these samples will be used to monitor HAB activity in the Alaskan Arctic and contribute to the predictive modeling of algal toxins in Alaskan marine food webs.*

Summary of Sampling Efforts

Sampling and processing of water samples during the SKQ23-12S for HAB species, *Pseudo-nitzschia* and *Alexandrium*, was successful. Water samples were collected from all planned sampling stations, except one (n=1) station. Water was collected and processed at three depths (surface, chl-a max, and 10m depths) from each station with two aliquots processed through two different filters for *Pseudo-nitzschia* analyses. One filter (HA filter) will be analyzed for DNA and *Pseudo-nitzschia* species identification, while the other (GFF filter) will be used for quantification of domoic acid. Surface and bottom water (bottom water at certain transects) were also collected at most stations for *Alexandrium* analysis. Surface and bottom water samples were filtered for phytoplankton through a 15 µm filter, fixed with Lugol's iodine solution, and will be used for *Alexandrium* cell counts and analysis of saxitoxins (STXs). In summary, we collected n = 430 samples from n = 51 different stations during the SKQ23-12S cruise onboard the *R/V Sikuliaq* (**Table 2.7.1**) throughout the Bearing, Chukchi, and Beaufort Seas. *Pseudo-nitzschia* and *Alexandrium* samples will be shipped to Dr. Kate Hubbard at the Florida Fish and Wildlife and Dr. Donald Anderson at Woods Hole Oceanic Institution for analysis, respectively.

Colleagues and collaborators collected additional samples for the ECOHAB project throughout the research cruise. The team led by Drs. Jackie Grebmeier and Lee Cooper collected sediments for *Alexandrium* cyst counts and invertebrates for algal toxin analysis from Van Veen grabs (see Grebmeier and Cooper's cruise report for number of collected invertebrates). We were able to collect n = 40 sediment samples from n = 40 different stations during the SKQ23-12S cruise (**Table 2.7.1**). Dr. Libby Logerwell and Deanna Crouser at NOAA collected zooplankton samples that will be processed for algal toxins (DA and STX) at NOAA Northwest Fisheries Science Center (NWFSC) (Table 1). Dr. Katrin Iken from University of Alaska Fairbanks opportunistically collected tunicates, *Halocynthia aurantium*, for algal toxin analysis at NOAA NWFSC (**Table 2.7.1**). Tunicates, specifically *H. aurantium*, were targeted for algal toxin analysis due to their role as a subsistence resource to coastal Native Alaskan communities.

The data obtained from these samples collected during SKQ23-12S cruise will be crucial for monitoring the ongoing threat of HABs in the Alaskan Arctic and contribute to building robust predictive models of algal toxins in Alaskan marine food webs. These predictive models will be a tool for understanding how algal toxins move throughout Alaskan marine food webs and estimate toxin exposure to critical marine resources (e.g., shellfish and marine mammals) during future HAB events consisting of different algal cell densities and toxicities.

Table 2.7.1. Counts of samples collected along different transects during the SKQ23-12S cruise for *Pseudo-nitzschia*, *Alexandrium catenella*, and algal toxin analysis.

Transect	***Pseudo-nitzschia***				***Alexandrium catenella***		**Algal Toxins**		**Total**
	GFF Filter	HA Filter	HA Filter Replicates	GFF Filter Replicates	Lugols	Sediments	Tunicates	Zooplankton	
DBO1	15	15			5	5		4	44
DBO2	21	21			14	7		8	71
DBO3	24	24	12	12	16	7	7	3	105
DBO4	18	18			6	6		8	56
DBO5	30	30			20	9		4	93
Icy Cape	30	30			10	6		3	79
M8	3	3			1				7
Bering Strait (BS)	4	4			4				12
Grand Total	145	145	12	12	76	40	7	30	**467**

2.8. Zooplankton and larval fish

- **Libby Logerwell and Deana Crouser; NOAA**

At approximately every other station on each line, bongo nets were towed for the collection of zooplankton and larval fish, for a total of 38 stations sampled (**Figure 2.8.1**). The gear for this survey was a 60-cm bongo array (SOI 3.2.2) with 0.505-mm mesh netting and a 20-cm bongo net array (0.333-mm mesh netting). A SEACAT (Sea-Bird SBE 19plus) was attached to the wire above the bongo frame to provide real-time tow data. Net 1 from both the 20 and 60 cm bongos was preserved in 1.8% formaldehyde buffered with sodium borate, and boxed for shipment at the end of the survey. Net 2 of the 60-cm bongo was sorted for all fish larvae, which were preserved in 100% ethanol. The remaining contents of Net 2 for both the 60-cm and 20-cm bongo were used for the "Rapid Zooplankton Assessment (RZA)" where copepods and euphausiids were counted in a subsample. The results of the RZA are shown below.

Figure 2.8.1. Bongo net sampling for zooplankton.

i. Copepods (Figures 2.8.2 and 2.8.3)

We observed the greatest abundance of large copepods (greater than 2mm) at DBO2.5 and DBO2.4 just south of the Bering strait with an average estimated abundance of 595 individuals per cubic meter. The least number of large copepods was observed at IC11 with an estimated abundance of 0.22 individuals per cubic meter.

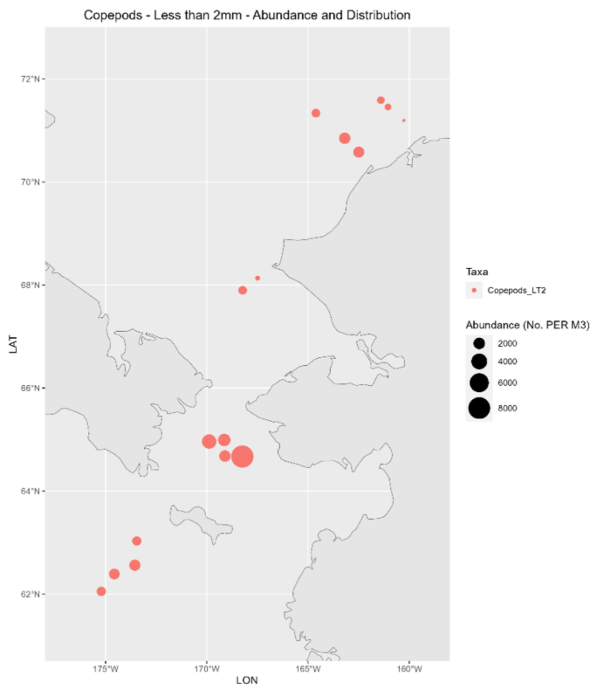


Figure 2.8.2. Abundance and distribution of copepods <2 mm size.

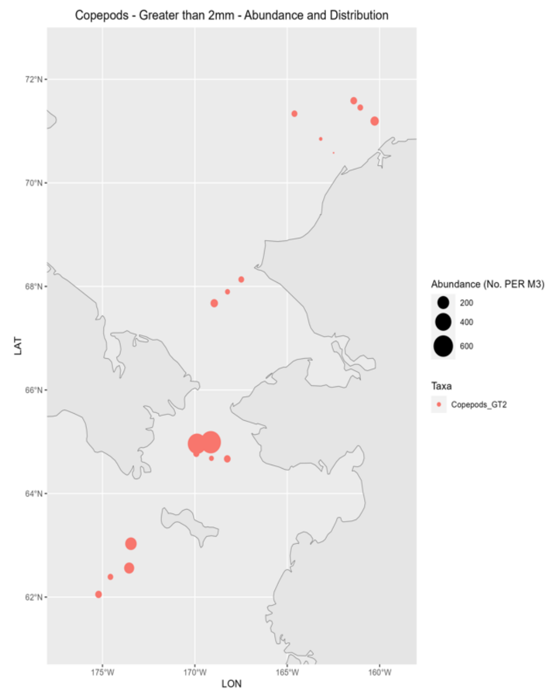


Figure 2.8.3. Abundance and distribution of copepods >2 mm size.

We observed the greatest abundance of small copepods (less than 2mm) just south of the Bering strait at DBO2.3 with an estimated 8,320 individuals per cubic meter. The second hotspot for small copepods was a less than half as many individuals, was at DBO2.4 with 3,201 per cubic meter. The least number of small copepods was observed at DBO4.1n with an estimated 57 individuals per cubic meter.

ii. Euphausiids (Figures 2.8.4 and 2.8.5)

We observed the greatest abundance of large euphausiids (greater than 15mm) at DBO2.4 & DBO2.5 just south of the Bering Strait with an average estimated abundance of 6 individuals per cubic meter. We did not observe any large Euphausiids at DBO1.4, DBO1.6, DBO1.8 andDBO3.4.

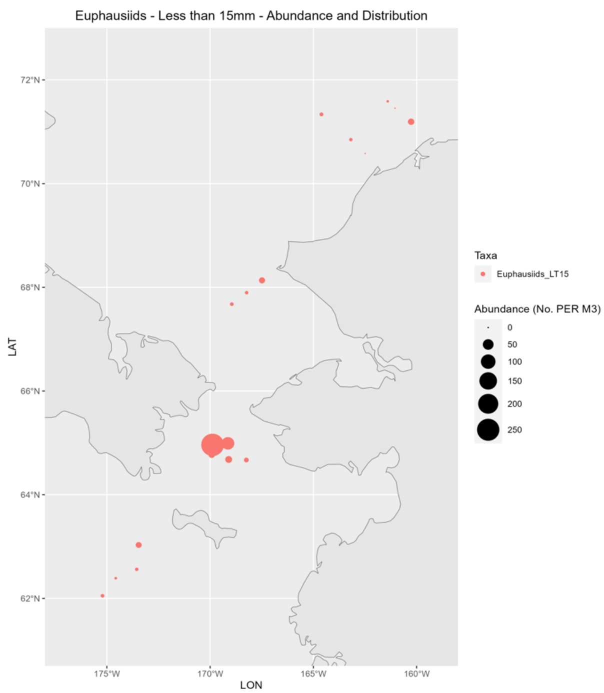


Figure 2.8.4. Abundance and distribution of euphausids <15 mm size.

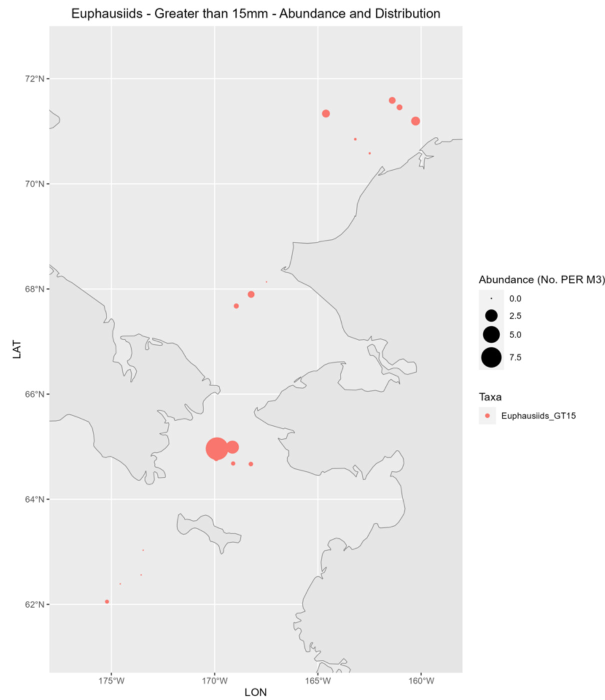


Figure 2.8.5. Abundance and distribution of euphausiids >15 mm size.

We observed the greatest abundance of small euphausiids (less than 15mm) at DBO2.4 & DBO2.5 with an average estimated abundance of 166 individuals per cubic meter. We did not observe any small euphausiids at DBO4.3n and IC11.

iii. Special Requests

We were able to process a wide variety of special requests on this cruise. For Kathi Lefebvre's ECOHAB Algal Toxins in Arctic/subarctic Food Webs project (NOAA Northwest Fisheries Science Center), we collected krill from 21 stations and provided a scoop of zooplankton from our 20BON Net 2 across 13 stations. For Cody Pinger's Zooplankton lipid project (NOAA Recruitment Energetics and Coastal Assessment and Auke Bay Laboratories), we were able to collect euphausiids and *Calanus* copepods at 7 stations. For Jared Weems Larval crab community assessment project in the northern Bering and Chukchi Sea (Alaska Department of Fish and Game), we preserved 60BON Net 2 samples from 9 stations. For Kelia Axler's genetic/otolith project (NOAA Alaska Fisheries Science Center) we collected larval fish at 14 stations. And for Dana Wrights marine mammal stable isotope diet project we collected *Calanus* from 10 stations.

2.9. Sediments and macrofauna

- **Jackie Grebmeier, Lee Cooper, Brian Marx, Nick Silverson, Syeda Sadia Ali**; **CBL/UMCES**

Overview: The UMCES team focused on collections of oxygen-18/oxygen-16 ratios for water mass characteristics, water for phytoplankton taxonomy, benthic sampling for macrofauna populations studies and sediment characteristics, and undertook sediment metabolism experiments in the DBO1 and DBO3 regions. The following provides a summary of our data collectons:

A. Water column sampling (Table 2.9.1)

A1. We collected seawater samples for oxygen-18/16 ratio analyses at a total of 47 stations, with collections at the surface, mid-depth, and the seafloor level at each station. In addition, full depth profiles were collected at the stations added in Bering Strait. Seawater was collected in 8 mL glass vials, capped, and sealed with parafilm.

A2. Water column phytoplankton samples were collected at 46 stations using an integrated sampling approach combining samples over the whole water column. Briefly, 100 ml of seawater from each standard depth was gently mixed in a small container together, with a subsequent 100 ml aliquot preserved by addition of 2.5 ml of Lugol's solution and subsequently stored in the refrigerator for 24 hrs. At the end of that period 2 mL of 37% formaldehyde was added to the 100 ml seawater sample to a final volume, gently mixed, sealed with tape, and stored for subsequent shipment to Poland for phytoplankton identifications at IOPAN.

A3. Bottom water nutrient samples were collected at sediment respiration stations (8 stations total).

Table 2.9.1. Station information and water column collections during the SKQ23-12S cruise. Key: DBO1=SLIP stations, DBO2=UTBS and DBO2.7 stations, DBO3=SEC stations, IC=5 stations, DBO5=10; 3 stations in Bering Strait (BS). Local Alaskan date and time.

Station #	DBO Station Name	Historic Station Name	Date (Local AK date)	Lat (N)	Long (W)	Depth (m)	Stable Oxygen Isotopes	Phytoplankton Taxonomy
1	M8	M8	9/14/23	62 11.70	174 40.40	73	x	-
2	DBO1.1	SLIP1	9/14/23	62 0.589	175 3.649	79	x	x
3	DBO1.2	SLIP2	9/14/23	62 3.008	175 12.527	80	x	x
5	DBO1.4	SLIP3	9/15/23	62 23.38	174 34.17	70	x	x
7	DBO1.6	SLIP5	9/15/23	62 33.57	173 33.01	65	x	x
9	DBO1.8	SLIP4	9/16/23	63 1.698	173 27.636	71	x	x
12	DBO2.0	BCL6c	9/16/23	64 40.33	170 38.52	47	x	x
14	DBO2.1	UTBS5	9/17/23	64 40.155	169 55.212	47	x	x
16	DBO2.2	UTBS2	9/17/23	64 40.76	169 6.00	45	x	x
18	DBO2.3	UTBS2a	9/17/23	64 40.12	168 14.247	38	x	x
19	DBO2.7	DBO2.7	9/17/23	65 00.07	168 13.325	45	x	x
21	DBO2.5	UTBS1	9/17/23	64 59.46	169 8.29	48	x	x
23	DBO2.4	UTBS4	9/17/23	64 57.69	169 53.009	48	x	x
25	DBO5.1	BarC1	9/20/23	71 14.81	157 9.842	46	x	x
26	DBO5.2	BarC2	9/20/23	71 17.26	157 14.749	56	x	x
27	DBO5.3	BarC3	9/20/23	71 19.797	157 19.893	91	x	x
28	DBO5.4	BarC4	9/20/23	71 22.337	157 24.952	112	x	x
29	DBO5.5	BarC5	9/20/23	71 24.542	157 29.663	124	x	x

30	DBO5.6	BarC6	9/20/23	71 27.309	157 35.455	109	x	x
31	DBO5.7	BarC7	9/21/23	71 29.94	157 40.36	81	x	x
32	DBO5.8	BarC8	9/21/23	71 32.183	157 45.089	72	x	x
33	DBO5.9	BarC9	9/21/23	71 34.65	157 50.24	66	x	x
34	DBO5.10	BarC10	9/21/23	71 37.15	157 55.447	65	x	x
37	DBO4.1n	DBO4.1n	9/22/23	71 11.549	160 15.965	54	x	x
39	DBO4.2n	DBO4.2n	9/23/23	71 19.31	160 39.04	48	x	x
42	DBO4.3n	DBO4.3n	9/23/23	71 27.221	161 2.249	47	x	x
44	DBO4.4n	DBO4.4n	9/24/23	71 35.184	161 23.687	47	x	x
47	DBO4.5n	DBO4.5n	9/24/23	71 43.160	161 46.329	44	x	x
49	DBO4.6n	DBO4.6n	9/24/23	71 51.003	162 9.410	41	x	x
50	IC11	-	9/25/23	70 34.78	162 29.446	38	x	x
53	IC9	-	9/26/23	70 50.917	163 11.044	44	x	x
55	IC7	-	9/26/23	71 5.09	163 48.164	43	x	x
57	IC5	-	9/27/23	71 20.174	164 36.586	44	x	x
60/61	IC3	-	9/ 27/23	71 36.097	165 18.300	42	x	x
63	IC1	-	9/27/23	71 49.83	165 58.07	44	x	x
68	DBO3.8	SEC1	9/29/23	67 40.62	168 56.94	50	x	x
69	DBO3.7	SEC2	9/29/23	67 46.99	168 35.80	50	x	x
70	DBO3.6	SEC3	9/29/23	67 53.86	168 14.2	57	x	x
71	DBO3.5	SEC4	10/1/23	68 7.96	167 29.15	48	x	x
72	DBO3.4	SEC5	10/1/23	68.1328	167 .4870	48	x	x
74	DBO3.3	SEC6	10/1/23	68 11.23	167 17.73	48	x	x
75	DBO3.2	SEC7	10/1/23	68 14.82	167 7.33	43	x	x
76	DBO3.1	SEC8	10/2/23	68 18.15	166 55.60	34	x	x
77	BS8	-	10/3/23	x	x	47	x	x
79	BS6	-	10/3/23	65 44.264	169 38.89	?	x	x
82	BS3	-	10/3/23	?	?		x	x
84	BS1	-	10/3/23	65 37.09	168 9.209	28	x	x
Total stations	**47**	**-**	**--**	**-**	**-**	**-**	**47**	**46**

B. Macrofaunal and sediment sampling. A 0.1 m^2 weighted van Veen grab was used for collecting seafloor macrofauna (population studies) and sediments (carbon content, grain size, HABs) (**Figure 2.9.1**). Sediment grabs were deployed successfully from the stern 9/16th wire and often had ~1200 lb pullout tension. Further details are provided below.

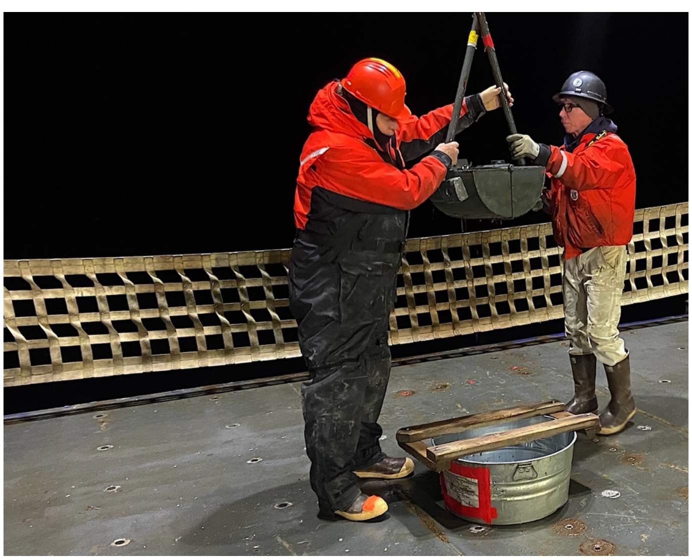


Figure 2.9.1. Use of van Veen grab for sampling sediments.

B1. Macrofaunal populations. Sediment grabs were collected on at all stations on DBO1, DBO2, DBO3, DBO4, DBO5 and the Icy Cape (IC) transect line (**Table 2.9.2**). Four sediment grabs were collected at most stations for post cruise analyses for macrofaunal composition, abundance, and biomass, except where coarse sediments limited collections. Sediments were sieved through one mm metal screens with running seawater, retained animals placed in labelled plastic containers and preserved in 10% buffered seawater formalin for post-cruise analyses at CBL. Specifically, four replicate grab samples were collected at the 5 DBO1 stations, 7 DBO2 stations, 3 DBO3 offshore western stations (DBO3.6-3.8), with single collections at stations DBO3.1-3.5 due to coarse sediments. All 6 stations on the DBO4 line had 4 quantitative grabs, whereas all 10 stations on the DBO5 line had single grabs collected. **A total of 42 stations were occupied and 123 grabs were collected.**

Table 2.9.2. Sediment collections during the SKQ23-12S cruise. Key: Sed chl=Sediment chlorophyll, TOC/N=total organic carbon and nitrogen, grain size, macrofauna (4 or 1 replicate grabs), HABS macrofauna ids, lipids (Copeman). Key: Amp=amphipods, Genetics & Isotopes, Lipids.

Cast #	Station Name	Historic Station Name	Sed Chl	Sed TOC/N, grain size	Macro-fauna (4 or 1)	Faunal HABs	Amp	Genetics & Isotopes	Lipids	HAPS cores
2	DBO1.1	SLIP1	x	x	x -4	x	-	x	x	-
3	DBO1.2	SLIP2	x	x	x -4	x	-	x	x	x-4
5	DBO1.4	SLIP3	x	x	x -4	x	-	x	x	-
7	DBO1.6	SLIP5	x	x	x -4	x	-	x	x	x-2
9	DBO1.8	SLIP4	x	x	x -4	x	-	x	x	-
12	DBO2.0	BCL6c	x	x	x -4		-	x	x	-
14	DBO2.1	UTBS5	x	x	x -4	x	-	x	x	-
16	DBO2.2	UTBS2	x	x	x -4	x	x	x	x	-
18	DBO2.3	UTBS2a	x	x	x -4	x	x	x	x	-
19	DBO2.7	DBO2.7	x	x	x -4	x	x	x	x	-
21	DBO2.5	UTBS1	x	x	x -4	x	x	x	x	-
23	DBO2.4	UTBS4	x	x	x -4	x	-	x	x	-
25	DBO5.1	BarC1	x	x	x-1	-	-	x	x	-
26	DBO5.2	BarC2	x	x	x-1	x	x	x	x	-
27	DBO5.3	BarC3	x	x	x-1	x	-	x	x	-
28	DBO5.4	BarC4	x	x	x-1	x	-	x	x	-
29	DBO5.5	BarC5	x	x	x-1	x	-	x	x	-
30	DBO5.6	BarC6	x	x	x-1	-	-	-	x	-
31	DBO5.7	BarC7	x	x	x-1	x	x	-	x	-
32	DBO5.8	BarC8	x	x	x-1	-	-	-	x	-
33	DBO5.9	BarC9	x	x	x-1	-	-	-	x	-
34	DBO5.10	BarC10	x	x	x-1	x	x	-	x	-
37	DBO4.1n	DBO4.1n	x	x	x -4	-	-	-	x	-
39	DBO4.2n	DBO4.2n	x	x	x -4	x	-	x	x	-
42	DBO4.3n	DBO4.3n	x	x	x -4	x	-	x	x	-
44	DBO4.4n	DBO4.4n	x	x	x -4	x	-	x	x	x-2
47	DBO4.5n	DBO4.5n	x	x	x -4	x	-	x	x	-
49	DBO4.6n	DBO4.6n	x	x	x -4	x	-	x	x	-
50	IC11	-	x	x	x -4	x	-	-	x	-
53	IC9	-	x	x	x -4	x	-	-	x	-
55	IC7	-	x	x	x -4	x	-	-	x	-
57	IC5	-	x	x	x -4	x	-	-	x	-
60/61	IC3	-	x	x	x -4	x	-	-	x	-

63	IC1	-	x	x	x -4	x	-	-	x	-
68	DBO3.8	SEC1	x	x	x -4	x	-	-	x	x-2
69	DBO3.7	SEC2	x	x	x-4	x	-	-	x	-
70	DBO3.6	SEC3	x	x	x-4	x	-	-	x	-
71	DBO3.4	SEC4	x	x	x-1	-	-	-	x	-
72	DBO3.5	SEC5	x	x	x-1	-	-	-	x	-
74	DBO3.3	SEC6	x	x	x-1	-	-	-	x	-
75	DBO3.2	SEC7	x	x	x-1	-	-	-	x	-
76	DBO3.1	SEC8	x	x	x-1	-	-	-	x	-
Total stations			**42**	**42**	**42**	**31**			**42**	**4**

B2. Sediment samples. One 0.1 m^2 van Veen grab deployment was made at each DBO benthic time series stations as well as the Icy Cape line in the Bering and Chukchi seas: SLIP (DBO1), UTBS (DBO2), SEC (DBO3), DBO4n, BarC (DBO5) and Icy Cape (IC) for surface sediment parameters: sediment chlorophyll a (chl a), total organic carbon (TOC)/nitrogen (TON) content, grain-size, HAB (Patrick Charapata and Kathi Lefebvre(NOAA), and lipid content (Copemann). Sediment subsamples were collected from the last grab through a trap door and processed as follows:

A subsample of sediments was collected for Harmful Algal Blooms (HABs) cyst content. In addition, this grab was sieved for collection of dominant bivalves and polychaetes for HAB determinations that will be undertaken at a shore side laboratory (**Table 2.9.2).** All sediment samples were collected from a trap door on the top of the grab before it was opened to minimize disturbance of the surface sediments.

i. **Surface sediment chl**. Replicate 0-1 cm surface sediments were collected using cut-off 10 cc syringes, with sediment plugs extruded into tared and labelled falcon tubes for fluorometric analyses. 10 mL of 90 acetone were added to each tube, mixed, and then extracted in the refrigerator for 12 hrs. Subsequently measurements for chl a were made on a Turner fluorometer at sea.
ii. **Surface sediment for TOC/TON and grain size**. A sample was collected from the top 0-1 cm of surface sediments and placed in 6-ounce whirlpak bag, and frozen for post-cruise analyses.
iii. A subsample of sediments was collected for **Harmful Algal Blooms (HABs) cyst content**. A 60 cm syringe was inserted to retrieve 2 cm of surface sediments for HAB analyses. The sediment filled syringe was passed to Patrick Charapata (NOAA) shipboard for subsampling and insertion into vials for analyses.
iv. Surface sediment (1 cm) was collected for **lipid determinations** by Dr. Louise Copeman, Oregon State University/NOAA, and frozen for post-cruise analyses.
v. **The remaining sediment in the first grab** was sieved through a one mm metal sieve screen boxes with running seawater. The retained macrofauna was placed in a seawater filled 32-ounce cup for post station identification of dominant macrofauna by Brian Marx for HAB analyses, an amphipod project (Brian Marx), and genetic studies (Nick Silverson).

B3. Caloric content amphipods: Brian Marx. As part of a master's thesis project, amphipods were collected from stations where they are dominant in the benthos and where gray whales are known to feed. These stations included UTBS-2, UTBS-2a, UTBS-1, DBO-2.7, UTN-7, SEC-2, and LB-9. The thesis project aims to quantify the energy density of these benthic amphipods, which are an important prey item for the Eastern Pacific population of gray whales. The amphipods were collected as part of the benthic sampling; after collection and rinsing, the amphipods were hand-picked from the sample and separated for identification and preparation. Collected amphipods were identified to the lowest taxonomic level possible aboard the ship; identifications will be confirmed with a microscope when they arrive to the Chesapeake Biological Laboratory in Solomons, MD. The taxa collected include the family *Gammaridae*, the genera *Ampelisca* and *Byblis* in F. Ampeliscidae, the genus *Protomedeia* in F. Isaeidae, and the species *Pontoporeia femorata* in F. Pontoporeiidae. Identified samples were counted and either frozen or preserved in formalin; the aim of the two preservation methods is to establish a conversion factor between fresh (frozen) and preserved (in formalin) samples. Sample counts from each station ranged from 25-70 animals, both frozen and preserved. The frozen and preserved samples, after final identification, will be combusted in a bomb calorimeter to determine the caloric content of the amphipods in KJ/g.

B4. HABs Animal Collections (ID'd by Brian Marx). As part of the benthic infaunal sampling program, a subsample of dominant macrofauna (polychaetes and bivalves) were collected for a Harmful Algal Bloom study for Kathi Lefebvre (NOAA) and preliminarily identified in between stations in a sorting tray containing seawater. The samples were then counted, packaged in Whirl-pak bags, and stored in a -20° C freezer (Table 1). At the conclusion of the cruise, the samples were handed off to Patrick Charapata (NOAA) for transport back to NOAA for analysis (**Table 2.9.3**).

Table 2.9.3. Listing of infaunal samples collected during SKQ23-12S for a HAB study.

DBO Station	Station Name	Date	Lat.	Long.	Depth (m)	Taxa	Count
DBO1.1	SLIP1	9/14/2023	62.010	-175.061	80	*Macoma sp.*	4
						Maldanidae	1
						Terebellidae	2
						Priapulidae	2
						Ennucula tenuis	5
DBO1.2	SLIP2	9/15/2023	62.050	-175.210	80	*Macoma sp.*	1
						Onuphidae	1
						Maldanidae	5
DBO1.4	SLIP3	9/15/2023	62.390	-174.571	70	*Nephtys sp.*	1
						Ampharetidae	1
						Lumbrineridae	2
						Eteone sp.	1
						Macoma sp.	1
DBO1.6	SLIP5	9/15/2023	62.561	-173.553	65	*Maldanidae*	5
DBO1.8	SLIP4	9/16/2023	63.030	-173.460	72	*Pectinaridae*	6
						Macoma sp.	3
						E. tenuis	5
						Maldanidae	3
DBO2.0	BCL-6C	9/16/2023	64.673	-170.647	47	*Polynoidae*	1
						Nuculana sp.	1
						E. tenuis	4
						Nephtys sp.	1
DBO2.1	UTBS5	9/17/2023	64.671	-169.920	47	*E. tenuis*	9
						Nephtys sp.	8
DBO2.2	UTBS2	9/17/2023	64.679	-169.101	45	*Ampharetidae*	1
						Nephtys sp.	1
						Maldanidae	2

DBO2.3	UTBS2A	9/17/2023	64.669	-168.243	38	*Maldanidae*	10
DBO2.7	DBO2.7	9/17/2023	65.001	-168.226	46	*Polynoidae*	6
						Ampharetidae	1
						Nephtys sp.	2
						String Bryozoan	1 (frag.)
DBO2.5	UTBS1	9/17/2023	64.994	-169.144	49	*Polynoidae*	5
						Serripes sp.	1
						Terebellidae	1
						Maldanidae	2
DBO2.4	UTBS4	9/17/2023	64.964	-169.891	48	*Nephtys sp.*	1
						Scoletoma sp.	1
						Macoma sp.	1
DBO5.1	BarC1	9/20/2023	71.248	-157.168	48	*Terebellidae*	2
						Nephtys sp.	1
						Nuculana sp.	3
						Gersemia rubiformis	1 (frag.)
DBO5.2	BarC2	9/20/2023	71.288	-157.244	56	*Maldanidae*	2
						Nephtys sp.	2
						Syllidae	2
						Pectinaridae	3
DBO5.3	BarC3	9/20/2023	71.334	-157.336	92	*Polynoidae*	1
						Scoletoma sp.	1
DBO5.4	BarC4	9/20/2023	71.373	-157.409	111	*Macoma sp.*	2
						Pectinaridae	1
						Syllidae	1
DBO5.5	BarC5	9/20/2023	71.412	-157.486	124	*Yoldia hyperborea*	1
						Pectinaridae	8
						Macoma sp.	8
DBO5.7	BarC7	9/21/2023	71.501	-157.675	82	*E. tenuis*	3
						Liocyma fluctuosa	2
						Y. hyperborea	1
						Cyclocardia sp.	4
						Maldanidae	10
						Macoma sp.	4
DBO5.8	BarC8	9/21/2023	71.536	-157.751	72	*Maldanidae*	8
						Macoma sp.	2
						Periplomatidae	2
						Y. hyperborea	6
						Pectinaridae	3
						E. tenuis	6
DBO5.9	BarC9	9/21/2023	71.579	-157.844	64	*Pectinaridae*	9
						Y. hyperborea	10

						E. tenuis	4
						Macoma sp.	5
DBO5.10	BarC10	9/21/2023	71.619	-157.925	62	*Pectinaridae*	2
						Periplomatidae	1
						Polynoidae	2
						Macoma sp.	1
						Y. hyperborea	4
DBO4.1n	DBO4.1n	9/23/2023	71.195	-160.270	53	*Maldanidae*	10
						Polynoidae	1
						Onuphidae	1
						Lyonsia arenosa	1
DBO4.2n	DBO4.2n	9/23/2023	71.323	-160.657	48	*Astarte borealis*	1
						Macoma sp.	20
						E. tenuis	10
DBO4.3n	DBO4.3n	9/23/2023	71.455	-161.050	47	*L. fluctuosa*	2
						Pectinaridae	3
						Musculus sp.	1
						Maldanidae	5
						Scalibregmatidae	5
						Macoma sp.	28
						Y. hyperborea	10
						E. tenuis	7
						Phyllodoce sp.	2
DBO4.4n	DBO4.4n	9/24/2023	71.588	-161.403	47	*L. fluctuosa*	1
						Pectinaridae	11
						Y. hyperborea	3
						Nephtys sp.	1
						Nuculana sp.	1
						Macoma sp.	24
						E. tenuis	21
						Musculus sp.	1
DBO4.5n	DBO4.5n	9/24/2023	71.722	-161.779	44	*Y. hyperborea*	13
						E. tenuis	21
						Nuculana sp.	1
						Macoma sp.	13
						Pectinaridae	2
						Maldanidae	1
DBO4.6n	DBO4.6n	9/25/2023	71.853	-162.169	42	*E. tenuis*	25
						Y. hyperborea	14
						Macoma sp.	20
IC11	IC11	9/26/2023	70.580	-162.493	38	*Cyclocardia sp.*	2
IC9	IC9	9/26/2023	70.848	-163.192	44	*Y. hyperborea*	3
						Macoma sp.	4

						Polynoidae	1
						Maldanidae	14
IC7	IC7	9/26/2023	71.087	-163.808	43	*A. borealis*	1
						Macoma sp.	5
						Maldanidae	10
						Y. hyperborea	3
						Astarte montagui	3
IC5	IC5	9/27/2023	71.337	-164.611	43	*A. montagui*	5
						Sternaspidae	3
						Macoma sp.	8
						Y. hyperborea	1
						Maldanidae	8
IC3	IC3	9/27/2023	71.601	-165.305	42	*Macoma sp.*	30
						Nuculana sp.	40
						E. tenuis	50
						Maldanidae	6
IC1	IC1	9/28/2023	71.828	-165.953	44	*Macoma sp.*	10
						Y. hyperborea	5
						Nuculana sp.	19
						E. tenuis	16
						Polynoidae	2
DBO3.8	SEC1	9/29/2023	67.675	-168.952	50	*Macoma sp.*	3
						Nephtys sp.	5
						Polynoidae	5
						Phyllodoce sp.	2
						Pectinaridae	2
						Brada villosa	10
DBO3.7	SEC2	9/29/2023	67.782	-168.600	50	*Maldanidae*	1
						Nephtys sp.	7
						Pectinaridae	1
						Macoma sp.	3
						Y. hyperborea	1
						E. tenuis	3
						Brada villosa	8
DBO3.6	SEC3	9/29/2023	67.895	-168.231	58	*Nephtys sp.*	4
						Brada villosa	25
						E. tenuis	15
						Macoma sp.	3
						Pectinaridae	5
						Ampharetidae	2
DBO3.4	SEC5	10/1/2023	68.135	-167.491		*Nephtys sp.*	1
						Nuculana sp.	6
						Scoletoma sp.	1

					Maldanidae	3
					Chone sp.	1
DBO3.5	SEC4	10/1/2023	68.010	-167.871	*Pectinaridae*	2
					Maldanidae	1
					Nephtys sp.	5
DBO3.3	SEC6	10/1/2023	68.187	-167.296	*Polynoidae*	2
					Y. hyperborea	2
					Ciliatocardium sp.	1
					Cyclocardia sp.	1
					Maldanidae	3
DBO3.2	SEC7	10/1/2023	68.245	-167.131	*Chone sp.*	1
					Y. hyperborea	1
					Cyclocardia sp.	1
					Maldanidae	3
DBO3.1	SEC8	10/2/2023	68.302	-166.924	*Scoletoma sp.*	2
					Syllidae	2
					Chone sp.	1
					Orbiniidae	1

B5. Genomics: Nick Silverson. A total of 249 benthic animals across taxonomic groups were sampled on a latitudinal gradient from DBO 1-5 in order to sequence and analyze their CO1 and 16s barcodes **(Table 2.9.4**). These results, especially of poorly represented species, will be published to the National Center for Biotechnology Information (NCBI) to aid in further monitoring efforts and eDNA studies. Dominant animals were collected at each station, but a broader survey of animals was conducted at select stations at each DBO region in order to capture a wider range of biodiversity. When populations allowed, 10 individuals of certain species like *Ennucula tenuis*, *Macoma calcarea*, *Centromedon* sp., and *Cerodotus* sp. were collected so population genomics could be analyzed on a latitudinal gradient. Specimens were placed into 95% ethanol, which was changed after 24 hours to account for dilution. Table **2.9.4** provides a listing of all animals collected for the genomic analyses for this study.

Table 2.9.4. List of macrofauna collected for genomic analyses.

Station	Taxa Sampled
SLIP1	Nemertea sp., Ennucula tenuis, Centromedon sp., Sipuncula
SLIP2	Macoma calcarea, Yoldia sp., Cerodotus sp., Maldanidae, Ophiura sarsi, Centromedon sp.
SLIP3	Nephtys sp., Ophiura sarsi, Maldanidae, Centromedon sp., Macoma calcarea
SLIP4	Priapulidae, Macoma calcarea, Ophiura sarsi, Ennucula tenuis, Nemertea sp., Cistenides sp., Nemertea sp., Centromedon sp.
SLIP5	Centromedon sp., Maldanidae, Priapulidae, Nemertea sp., Cistenides sp., Centromedon sp., Ennucula tenuis, Macoma calcarea
BCL-6C/DBO2.0	Nephtys sp., Gastropoda, Centromedon sp., Nephtys sp., Polynoidae, Centromedon sp.,
DBO2.1/UTBS5	Nephtys sp., Ennucula tenuis, Gastropoda, Centromedon sp., Polychate
DBO2.3/UTBS2A	Nephtys sp., Centromedon sp., Shrimp
DBO2.7	Gastropoda, Anenome, Crab, Sipuncula, Protomedeia sp., Nephtys sp., Ampelisca sp.,
DBO2.5/UTSBS1	Polynoidae, Ampelisca sp., Protomedeia sp., Maldanidae
DBO2.4/UTSBS4	Polynoidae, Ennucula tenuis, Nephtys sp.
DBO5.1/BARC1	Anenome, Centromedon sp., Sea peach, Nephtys sp., Polychate
DBO5.2/BARC2	Psolus sp., Centromedon sp., Cistenides sp.
DBO5.3/BARC3	Gastropoda, Sea cucumber, Nuculana sp., Bryozoa
DBO5.4/BARC4	Psolus sp., Ophiura sarsi, Sea onion, Macoma calcarea
DBO5.5/BARC5	Tunicate, Cistenides sp., Ophiura sarsi, Macoma calcarea
DBO5.7/BARC7	Centromedon sp., Tunicate, Maldanidae
DBO5.9/BARC9	Yoldia sp., Ennucula tenuis, Cistenides sp.
DBO4.1n	Anonyx sp., Sipuncula, Maldanidae, Centromedon sp.
DBO4.2n	Macoma calcarea, Ennucula tenuis, Sea cucumber, Starfish, Yoldia sp., Ameplisca sp.,
DBO4.3n	Sea cucumber, Liocyma fluctuosa, Ophiura sarsi, Cistenides sp., Macoma calcarea, Ampelisca sp., Yoldia sp., Pollonia corgata, Ennucula tenuis
DBO4.4n	Astarte montagui, Astarte borealis, Pollonia corgata, Nuculana sp., Macoma calcarea,
DBO4.5n	Nuculana sp., Ennucula tenuis, Macoma calcarea, Yoldia sp., Cistenides sp., Polynoidae,
DBO4.6n	Nuculana sp., Sipuncula, Macoma calcarea, Yoldia sp., Ennucula tenuis, Cistenides sp.
DBO3.8/SEC1	Cerodotus sp., Cistenides sp., Macoma calcarea, Nephtys sp., Tunicate
DBO3.7/SEC2	Nephtys sp., Tunicate, Cerodotus sp., Macoma calcarea, Serripes sp., Nephtys sp., Yoldia sp.
DBO3.6/SEC3	Macoma calcarea, Cistenides sp., Tunicate, Brada sp., Nephtys sp., Centromedon sp.,
DBO3.5/SEC4	E. parma, Sabellidae, Sternapsis scutata
DBO3.4/SEC5	Brachipodia, Sternapsis scutata, Yoldia sp., Gastropoda, Maldanidae, Protomedeia sp.
DBO3.3/SEC6	Clinocardium sp., Brachipodia, Sipuncula, Sabellidae, Yoldia sp., Protomedeia sp.,
DBO3.2/SEC7	Sipuncula, Ophiura sarsi, Protomedeia sp.
DBO3.1/SEC8	Protomedeia sp., Paranoidae

B6. Acknowledgments

We thank Captain Diego and crew of the R/V Sikuliaq for bridge and deck operations for sampling during the cruise. Financial support was for ship day costs were provided in composite through the NOAA Arctic Research Program (DBO and EcoFOCI programs), the Arctic Biodiversity Observing Program (AMBON), Chukchi Environmental Observatory (CEO) project, and State of Alaska. Additional personnel and science support was provided by the NOAA Arctic Research Program through CINAR grant #22309.07 UMCES Grebmeier, the US National Science Foundation DBO project (#NSF-ARC-1917469), and the USFWS for the seabird observer. We thank Phyllis Stabeno/NOAA provided cargo transport from Seattle to Dutch Harbor and return from Nome, Alaska, via barge and her NOAA support staff.

2.10. Epibenthic invertebrate and demersal fish community

- **Katrin Iken, Zach Stamplis, Danny Fraser; UAF**

The epibenthic invertebrate and demersal fish community work was part of the Arctic Maine Biodiversity Observing Network (AMBON) project with the goal to assess biodiversity across multiple trophic levels. The goal of this work was to 1. Determine epibenthic invertebrate and demersal fish community structure with a focus on biodiversity, 2. Collect samples of benthic invertebrates to be analyzed for stable carbon and nitrogen isotope values to discern food web patterns, 3. Collect benthic invertebrate reference samples to create a genome library for ongoing eDNA work as part of AMBON, 4. Assist with other, collaborative projects through sample collection for lipid analysis in juvenile snow crab, shrimp and age-0 Arctic cod (Dr. Louise Copeman, Oregon State University/NOAA), for the determination of mercury levels in Arctic benthic invertebrates (Dr. Ben Barst, University of Alaska Fairbanks), as well as genomic information of Arctic zoarcids (eelpouts) and liparids (snail fishes) (Dr. Jessica Glass, University of Alaska Fairbanks).

Epibenthic invertebrates and demersal fishes were sampled at a total of 19 stations using a 3-m modified beam trawl with a 2.6 m opening and a 7-mm mesh net and a 4-mm cod end liner. Trawls were conducted during the night for 3–7 min duration at 1.5 knots speed over ground. Time on the bottom was determined as the time (GPS-referenced) between wire out and haul-back. A Sensus Ultra time-depth recorder affixed to the net was used to correct time on the bottom as needed.

Hauls were rinsed on deck, and the catch (or a defined subsample of the catch) was sorted to the lowest taxonomic level on board. All hauls were fully assessed for snow crab, shrimp, and fish, even when other taxa were sorted as part of a subsample. All invertebrate taxa were enumerated and weight in bulk per species. Individual snow crabs (*Chionoecetes opilio*) were measured for carapace width to obtain size-frequency distributions at all stations. All fishes were immediately killed in a Tricaine Methanesulfonate solution (MS-222 at 250 mg/al), according to IACUC protocol of the University of Alaska Fairbanks. Fishes were identified as possible (small juvenile stages cannot always be identified with confidence) and individually measured for length and weight.

Total invertebrate species richness among stations ranged from 17 (IC1) to 56 (DBO4.2), with a tendency of slightly higher species numbers in the Chukchi compared to the Bering Sea (**Fig. 2.10.1**).

Community composition (based on presence and absence of species) was similar for stations along the same sampling lines, but with notable exceptions for some of the lines, specifically DBO3 and IC. For those lines, the epibenthic community at the more coastal stations that were characterized by coarser sediments were distinctly different from those farther offshore where sediments were muddier (**Fig. 2.10.2**). There was no distinct separation between Bering Sea and Chukchi Sea stations.

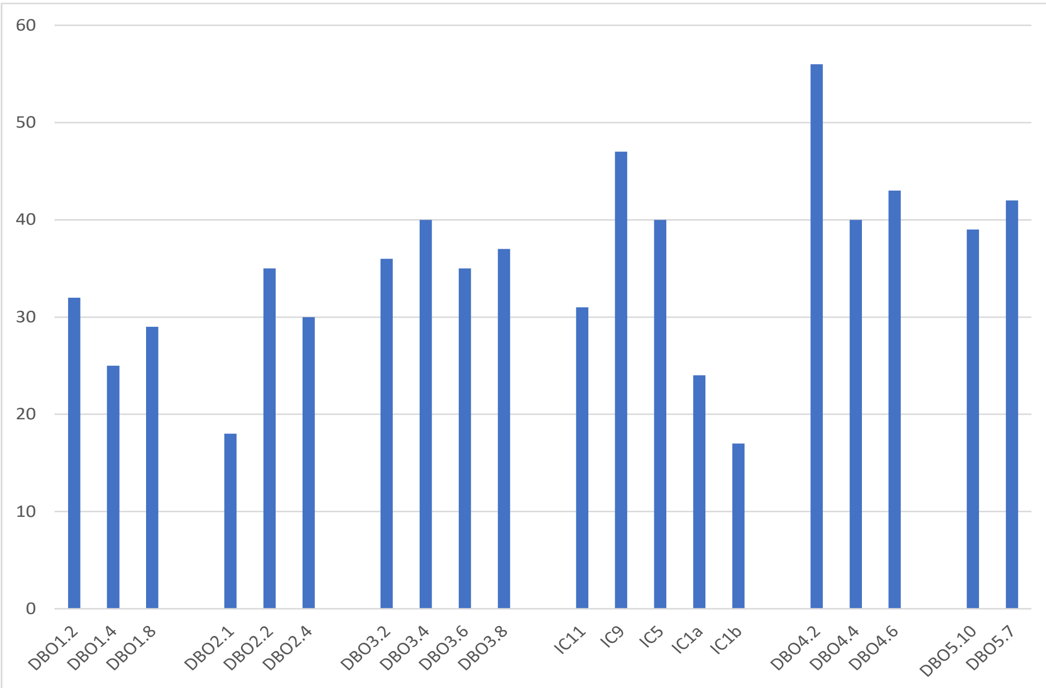


Fig. 2.10.1. Preliminary total epibenthic invertebrate species richness from beam trawls during SKQ2023 12S.

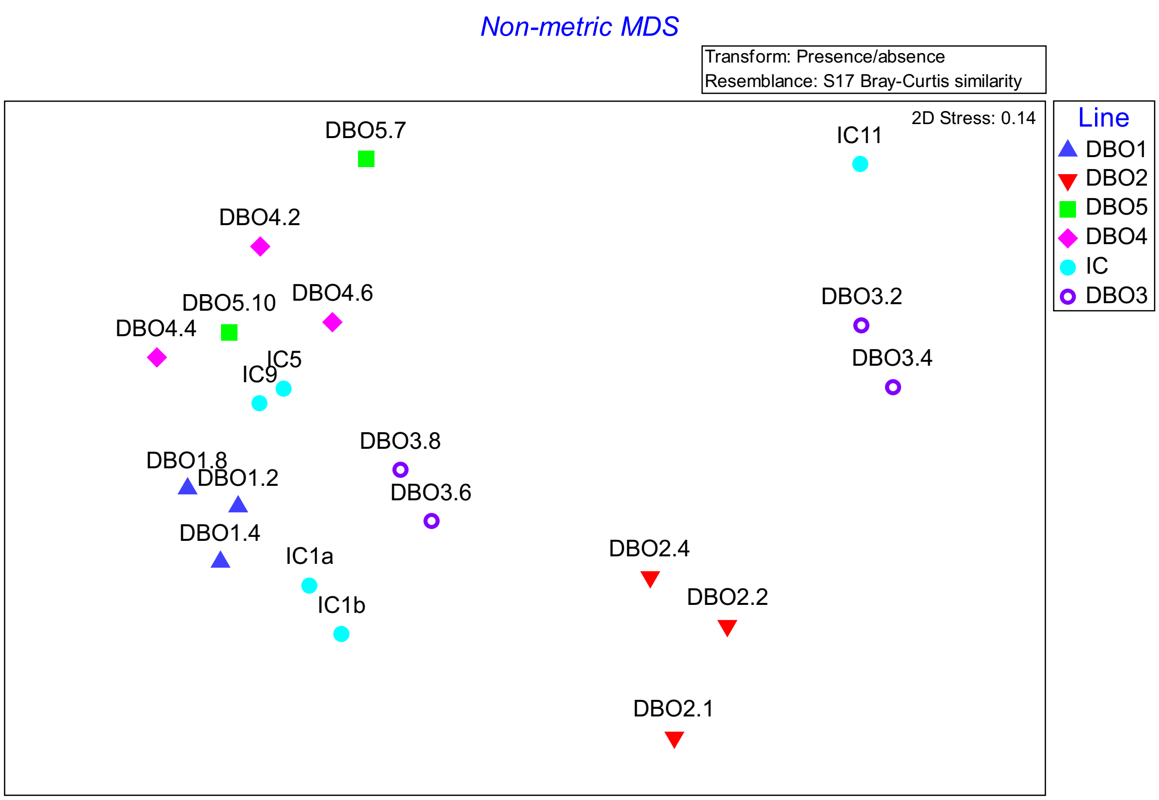


Fig. 2.10.2. Non-metric dimensional scaling (nMDS) plot of epibenthic community composition (based on preliminary presence/absence data of species). Stations grouping closer together are more similar in their community composition.

A total of 476 fish were collected from 30 species within 9 families (**Table 2.10.1**). The most common species were within the Cottidae (esp. *Gymnocanthus tricuspis* – Arctic Staghorn sculpin), Lumpenidae (esp. *Lumpenus fabricii* - Slender eelblenny and *Anisarchus medius* – Stout eelblenny), Gadidae (esp. *Boreogadus saida* – Arctic cod). Snailfishes (Liparidae) were also common, mostly as very small individuals.

Table 2.10.1. List of fish collected in the beam trawls during SKQ2023 12S.

Family	Species	Total count
Agonidae	*Aspidophoroides monopterygius*	2
	Aspidophoroides olrikii	14
	Hemilepidotus sp.	5
	Podothecus accipenserinus	2
Clupeidae	*Clupea pallasi*	1
Cottidae	*Artediellus scaber*	1
	Gymnocanthus tricuspis	106
	Myoxocephalus polycanthocephalus	17
	Myoxocephalus scorpius	15
	Sculpin unid.	1
	Triglops pingelii	3
Gadidae	*Boreogadus saida*	57
	Eleginus gracilis	2
	Gadid sp.	2
	Gadus chalcogrammus	21
	Gadus macrocephalus	2
Liparidae	*Liparis bathyarcticus*	34
	Liparis gibbus	5
	Liparis sp.	12
	Liparis tunicatus	10
	Lycodes polaris	1
Lumpenidae	*Anisarchus medius*	37
	Lumpenus fabricii	68
Pleuronectidae	*Hippoglossoides elassodon*	6
	Limanda aspera	1
Stichaeidae	*Gymnelus hemifasciatus*	16
	Stichaeus punctatus	10
Zoarcidae	*Lycodes mucosus*	2
	Lycodes palearis	1
	Lycodes polaris	22
Total fish caught		**476**

Select, common invertebrates were dissected for muscle tissue, body wall or other suitable tissue for later stable isotope analysis and kept frozen before drying to constant weight at 50°C. In addition, particulate organic matter (POM) was sampled from the subsurface chlorophyll max later at each station where invertebrates were sampled for isotope analysis to provide a pelagic production reference. For

POM, three samples of 1 L each were taken from the respective Niskin bottle of the CTD cast and filtered onto GF/F filters and kept frozen for later analysis.

We also collected a total of 107 benthic invertebrate species to start creating an Arctic-specific mitochondrial genome reference library to further expanding eDNA work (**Table 2.10.2**). Multiple individuals of each species (if available) were preserved in 190-proof ethanol and sent to the lab of Dr. Matt Galaska (NOAA PMEL) to complement his eDNA collections in the framework of the AMBON project.

Table 2.10.2. List of number of species collected within larger taxonomic groups for mitochondrial genome sequencing.

Phylum	Class/Group	# species
Porifera		1
Cnidaria	Actiniaria	1
	Hydrozoa	2
	Octocorallia	1
Mollusca	Bivalvia	12
	Gastropoda	27
	Polyplacophora	2
Annelida	Polychaeta	7
Arthropoda	Amphipoda	10
	Cirripedia	1
	Cumacea	1
	Decapoda	13
	Isopoda	1
	Pycnogonida	1
Echinodermata	Asteroidea	7
	Echinoidea	2
	Holothuroidea	3
	Ophiuroidea	6
Bryozoa		3
Sipuncula		1
Urochordata	Ascidiacea	5

For the service projects, all snow crab and shrimp were kept cold during the sorting process to avoid lipid degradation. Up to 30 snow crab < 15 mm carapace width, some larger snow crab if small ones were not present, as well as up to 10 individuals of shrimp in the genera *Argis*, *Crangon*, and *Eualus* were collected for lipid analysis at OSU (Copeman).

For the analysis of mercury in Arctic benthic invertebrates, we collected several species spatially across the study area and others were collected once opportunistically to expand the list of benthic species to see if there is any prevalence of mercury in certain taxa, feeding types, or lifestyles. A total of 49 species were collected. Of these, 10 species were collected spatially across multiple stations (the shrimp *Argis* sp.; the bivalves *Astarte borealis*, *A. montagui*, *Ennucula tenuis*, *Liocyma fluctuosa*, *Macoma calcarea*, *Nuculana radiata*, and *Yoldia hyperborea*; the snow crab *Chionoecetes opilio*; and the brittle star *Ophiura sarsi*), and single site collections were made of an additional 39 species. Collections were kept frozen and transported back to UAF for later analysis (Barst).

2.11. Marine Bird Surveys

- **Marty Reedy, USFWS**

Background
The U.S. Fish and Wildlife Service (USFWS) conducted marine bird surveys during the 2023 DBO cruise aboard the University of Alaska (UAF) icebreaker *Sikuliaq*. This research cruise is a consortium between NOAA's EcoFOCI program (Ecosystems and Fisheries Oceanography) and the NOAA Marine Mammal Lab; the Distributed Biological Observatory (DBO) run from the University of Maryland; and the Arctic Marine Biodiversity Observation Network (AMBON) and Chukchi Ecosystem Observatory (CEO) projects both run from the University of Alaska Fairbanks.

The primary study area for this cruise was the northern Bering and Chukchi seas. Sampling included- CTD water samples, sea surface temperature, salinity, plankton, zooplankton, marine birds and mammals, benthic sampling, larval fish, and bottom sediments. The goal of the project is to better understand regional trends, explore the potential effects of climate change, ocean acidification, and harmful algal blooms in the region. The vessel also serviced moorings in both the Bering and Chukchi seas during this cruise.

The marine bird survey component of the Sikuliaq cruise was funded by the USFWS Migratory Bird Management office. Marine bird surveys were conducted between 10 September - 3 October 2023 in the Bering, Chukchi, and the Beaufort seas while the vessel was underway. Survey data will be processed and archived with the USFWS and in the North Pacific Pelagic Seabird Database (NPPSD) available online (http://alaska.usgs.gov/science/biology/nppsd). This cruise report contains preliminary data and summaries collected during the marine bird surveys. Please contact the authors of the final report before citing summary data or statements.

During the cruise efforts were made to mitigate any potential interactions between the vessel and marine birds in the region, specifically ESA listed species. The USFWS observer was asked to address the crew and scientists at the beginning of the cruise and review suggested mitigation efforts outlined by the USFWS ESA Program. All cruise participants including the ship's crew and chief scientists took these protocols seriously and supported the mitigation efforts. Deck lights were kept at a minimum for safety and directed downward. Porthole windows were secured during the night to reduce light emissions. And any birds that circled or landed on the ship were reported to the marine bird observer. There were no bird fatalities reported during this cruise. We thank the ship's crew and science team for their proactive and persistent application of mitigation protocols.

Methods
Marine birds and mammals were surveyed from the port side of the bridge using standard USFWS protocols. Because we used seabird survey protocols, our observations cannot be used to calculate densities of marine mammals. Observations were conducted during daylight hours while the vessel was underway. The observer surveyed an area within a 300-m, 90° arc from the bow to the beam, using hand-held 10x binoculars when necessary for identification. All birds and mammals were recorded using modified strip transect methodology, with four distance bins from the center line: 0-50 m, 51-100 m, 101- 200 m, 201-300 m. Rare birds, large flocks, and mammals beyond 300-m or on the port side (off transect) were also recorded but will not be included in density calculations. We recorded the species, number of animals, and behavior (on water, in air, foraging). Birds on the water or actively foraging were counted continuously, whereas flying birds were recorded during

quick interval 'Scans' of the transect window. Scan intervals were based on ship speed, ranging from 49 sec to 97 sec. Geometric and laser hand-held rangefinders were used to determine the distance bin or to calibrate the observer as needed. Observations were directly entered into a GPS-interfaced laptop computer using the DLOG3 program (Ford Ecological Consultants, Inc., Portland, OR). Location data were also automatically written to the program in 20-second intervals, which allowed us to track survey effort and simultaneously record associated weather conditions, Beaufort Sea State, glare, and ice coverage. Other environmental variables recorded at the beginning of each transect included wind speed and direction, cloud cover, sea surface temperature, and air temperature. All data will be processed, and seabird density values (birds/km^2) will be archived in the NPPSD.

Preliminary Results

We surveyed a total of 2794 km over a 24 day period totaling 92 transects and ~155 hours. Regional survey effort included- 355 km in the southern Bering Sea, 1584 km in the northern Bering Sea, and 2794 km in the Chukchi Sea. We identified a total of 16570 birds on transect and 447 off transect birds representing 34 species or species groups (**Table 2.11.1**). There were 311 on-transect and off-transect marine mammals sightings with nine species observed. This report documents on-transect bird observations and both on and off transect marine mammal observations unless otherwise noted.

i. Marine birds

Two species of shearwaters (*Ardenna spp*.), sooty shearwaters (*A. grissa*) and short-tailed shearwaters (*A. tenuirostris*), were the most abundant taxa recorded with 122951 individual birds. During this time of the year, shearwaters have started their trans equatorial migration out of Alaska and are migrating south to their breeding grounds in Tasmania and Western Australia. The large numbers of these birds (78% of all birds on transect) speaks to the significance of their presence in the Bering and Chukchi seas ecosystem. The majority of shearwaters were observed near the Bering Strait and offshore of Pt. Lay (**Table 2.11.1, Fig 2.11.1**).

We recorded a total of 437 northern fulmars (*Fulmarus glacialis)* which comprised 3% of total observations. Northern fulmars were the third most predominate bird species observed in this survey following shearwaters and black-legged kittiwakes. Northern fulmars were consistently observed during the survey between Dutch Harbor and Pt. Hope, with only one record at N 71.8 in the Chukchi Sea (**Table 2.11.1, Fig 2.11.2**).

The aforementioned *Ardenna spp*. and *Fulmarus glacialis* all belong to the Procellariidae family and accounted for 13388 individuals during the survey. This group accounted for the greatest number of individual birds observed (81%) of the birds on survey (**Table 2.11.1**).

Observations of the Alcidae family included auklets (*Aethia spp.),* puffins *(Fratercula spp.),* murres *(Uria spp*.), ancient murrelets *(Synthiliboramphus sp.)*, and Kittlitz's murrelets (*Brachyramphus sp.*). The alcids accounted for 951 individual birds which comprise 6% of the total birds recorded during the survey. Crested auklets (*Aethia cristatella*) were the most common alcid with 352 individuals consisting of 2% of total birds observed or 72% of all alcids recorded during the survey. Crested auklets were primarily recorded north of N 70 in the Chukchi Sea where 340 of 352 sightings were recorded. Aside from the shearwaters, crested auklets were the largest number of birds observed in the Chukchi Sea (**Table 2.11.1, Fig. 2.11.3**). Other *Aethia* species recorded included parakeet auklets

Table 2.11.1. Seabirds (on transect) counts and percentages, by region and all combined, 10 Sept - 3 Oct 2023 during the fall *Sikuliaq* cruise SKQ2023-12S.

FAMILY	SCIENTIFIC NAME	ENGLISH NAME	S BERING SEA	% Total	N BERING SEA	% Total	CHUKCHI SEA	% Total	All Regions	% Total
Anatidae	*Anatidae (Subfamily)*	Unidentified Duck			2	<0.1	6	<0.1	8	<0.1
	Somateria or Polysticta spp.	Unidentified Eider			6	0.23	1	<0.1	7	<0.1
	Somateria fischeri	Spectacled Eider					7	<0.1	7	<0.1
Gaviidae	*Gavia spp.*	Unidentified Loon	2	0.10	2	<0.1	23	0.19	27	0.16
	Gavia pacifica	Pacific Loon			1	<0.1	29	0.24	30	0.18
Diomedeidae	*Phoebastria spp.*	Unidentified Albatross	1	<0.1					1	<0.1
	Phoebastria immutabilis	Laysan Albatross	9	0.43					9	<0.1
	Phoebastria nigripes	Black-footed Albatross	4	0.19					4	<0.1
	Phoebastria albatrus	Short-tailed Albatross	4	0.19	1	<0.1			5	<0.1
Procellariidae	*Fulmarus glacialis*	Northern Fulmar	230	10.98	152	5.78	55	0.46	437	2.64
	Ardenna spp.	Unidentified Shearwater	4	0.19					4	<0.1
	Ardenna tenuirostris	Short-tailed Shearwater	125	5.97	1946	73.96	10876	91.83	12947	78.14
Hydrobatidae	*Hydrobatidae spp.*	Unidentified Storm-Petrel	4	0.19					4	<0.1
	Oceanodroma furcata	Fork-tailed Storm-petrel	14	0.67	5	0.19			19	0.11
Scolopacida	*Arenaria spp.*	Undentified Turnstone			8	0.30			8	<0.1
	Phalaropus spp.	Unidentified Phalarope	49	2.34	86	3.27			135	0.81
	Phalaropus fulicarius	Red Phalarope			61	2.32	8	<0.1	69	0.42
Stercorariidae	*Stercorarius spp.*	Unidentified Jaeger			5	0.19	5	<0.1	10	<0.1
	Stercorarius pomarinus	Pomarine Jaeger	2	0.10	5	0.19	1	<0.1	8	<0.1
	Stercorarius parasiticus	Parasitic Jaeger					3	<0.1	3	<0.1
Laridae	*Laridae spp.*	Unidentified Gull	7	0.33	6	0.23	4	<0.1	17	0.10
	Rissa tridactyla	Black-legged Kittiwake	1406	67.14	150	5.70	318	2.68	1874	11.31
	Rissa brevirostris	Red-Legged Kittiwake	2	0.10					2	<0.1
	Larus brachyrhynchus	Mew Gull/Short-billed gull			1	<0.1			1	<0.1
	Xema sabini	Sabine's Gull	9	0.43					9	<0.1
	Larus argentatus	Herring Gull			6	0.23			6	<0.1
	Larus glaucescens	Glaucous-winged Gull	66	3.15	7	0.27	1	<0.1	74	0.45
	Larus hyperboreus	Glaucous Gull			7	0.27	18	0.15	25	0.15
	Larus schistisagus	Slaty-backed Gull			3	0.11			3	<0.1
	Sterna spp.	Unidentified Tern	5	0.24					5	<0.1
	Sterna paradisaea	Arctic Tern	14	0.67					14	<0.1
Alcidae	*Alcidae (Family)*	Unidentified Alcid	6	0.29	11	0.42	14	0.12	31	0.19
	Uria sp.	Unidentified Murre	8	0.38	3	0.11	2	<0.1	13	<0.1
	Uria aalge	Common Murre	12	0.57	23	0.87	1	<0.1	36	0.22
	Uria lomvia	Thick-billed Murre	6	0.29	12	0.46	14	0.12	32	0.19
	Brachyramphus brevirostris	Kittlitz's Murrelet	2	0.10			12	0.10	14	<0.1
	Synthliboramphus antiquus	Ancient Murrelet	1	<0.1	12	0.46	18	0.15	31	0.19
	Aethia or Ptychoramphus spp.	Unidentified Auklet			12	0.46	12	0.10	24	0.14
	Aethia psittacula	Parakeet Auklet	2	0.10	52	1.98	10	<0.1	64	0.39
	Aethia pusilla	Least Auklet			19	0.72	27	0.23	46	0.28
	Aethia cristatella	Crested Auklet			2	<0.1	350	2.96	352	2.12
	Fratercula spp.	Unidentified Puffin	1	<0.1					1	0.01
	Fratercula corniculata	Horned Puffin	17	0.81	2	<0.1	24	0.20	43	0.26
	Fratercula cirrhata	Tufted Puffin	82	3.92	23	0.87	5	<0.1	110	0.66
		TOTAL	**2094**	**100%**	**2631**	**100%**	**11844**	**100%**	**16569**	**100%**

(*A. psittacula*), least auklets (*A. pusilla*), and unidentified *Aethia* species totaling 134 animals or 0.8% of all birds surveyed (**Table 2.11.1, Fig. 2.11.3**). A total of 110 tufted puffins (*Fratercula cirrhata*) and 43 horned puffins (*F. corniculata*) were recorded during the survey. The majority of the tufted puffins were recorded north of Dutch Harbor, west of Nunivak Island, St. Lawrence Island, and west of Port Clarence. The less numerous horned puffins were seen primarily north of the Bering Strait with no birds observed north of N 70 (**Table 2.11.1, Fig. 2.11.4).** A total of 81 common murres (*Uria aalge*) and thick-billed murres (*U. lomvia*) combined were observed totaling 0.5% of all birds (Table 1). Both species of murres were observed in in relatively equal numbers throughout the survey. Thick-billed murres were more common in the Chukchi Sea where common murres were twice as often seen in the Bering Sea (**Table 2.11, Fig. 2.11.5**).

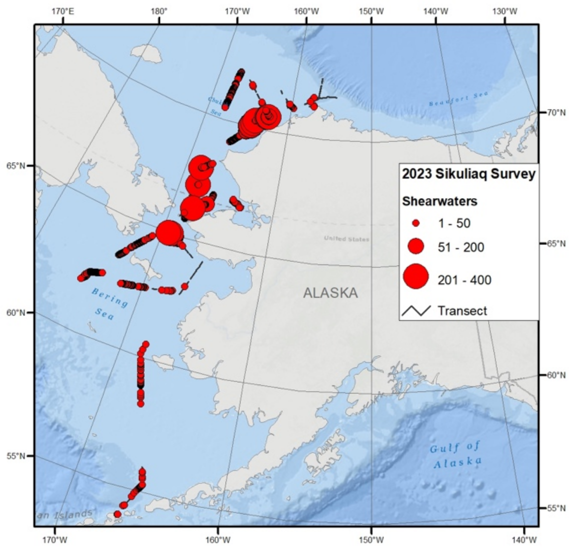


Fig. 2.11.1 Shearwaters on-transect distribution DBO2023.

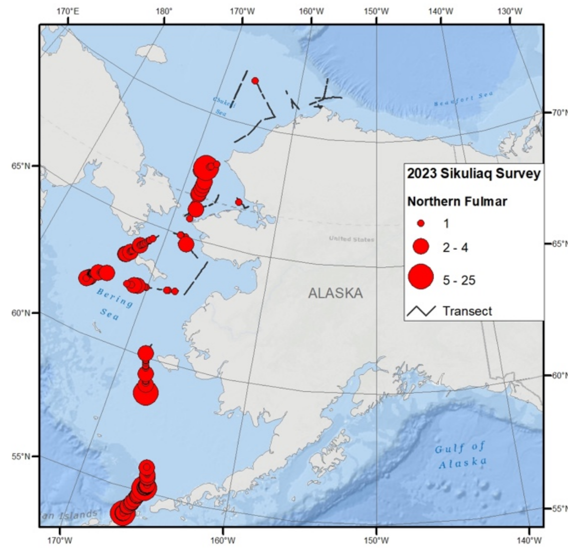


Fig 2.11.2 Northern Fulmars on-transect distribution DBO2023.

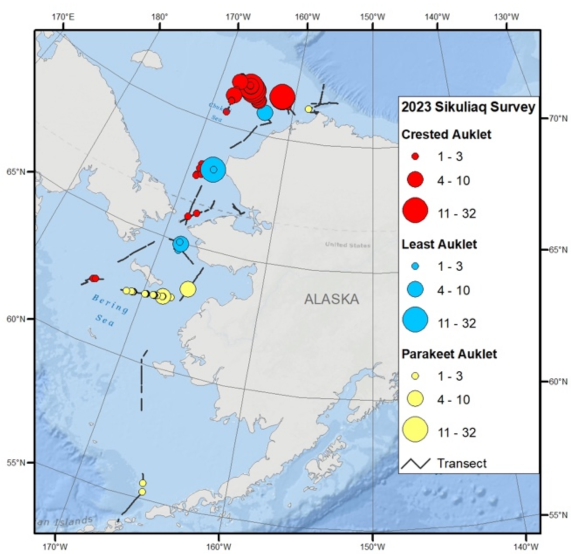


Fig 2.11.3 *Aethia spp*. on-transect distribution DBO2023.

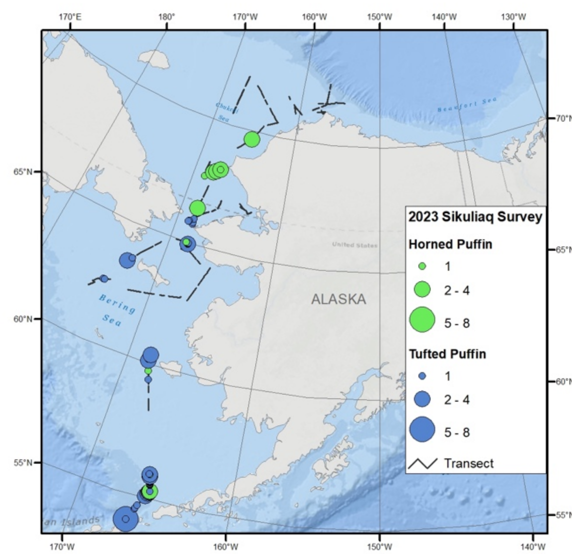


Fig 2.11.4 *Fratercula spp.* on-transect distribution DBO2023.

Thirty-one ancient murrelets (*Synthiliboramphus antiquus*) were observed during the survey (**Table 2.11.1**). There were also 14 Kittlitz's murrelets (*Brachyramphus brevirostris*) seen this year **(Table 2.11. 1**). Typically, these birds are not normally observed during pelagic surveys but are known to occur at higher latitudes in the region during this time of year. Ten Kittlitz's murrelets were observed west of Ledyard Bay and two were outside of Kasegaluk Lagoon (north of Ledyard Bay) in the Chukchi Sea. Two more Kittlitz's murrelets were recorded 80 nm north of Unimak Pass in the Bering Sea.

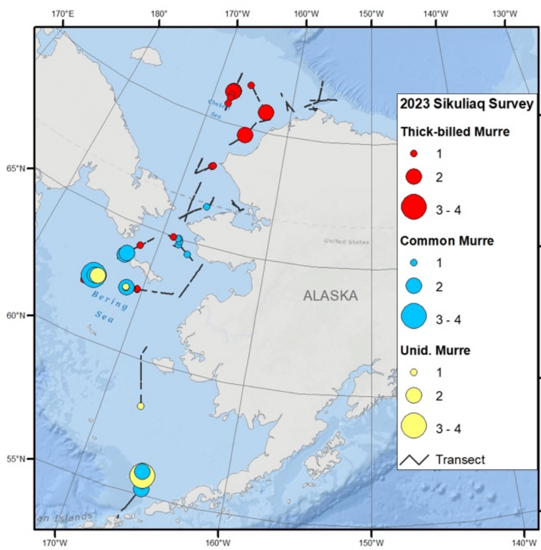


Fig 2.11.5 *Uria spp.* on- transect distribution.

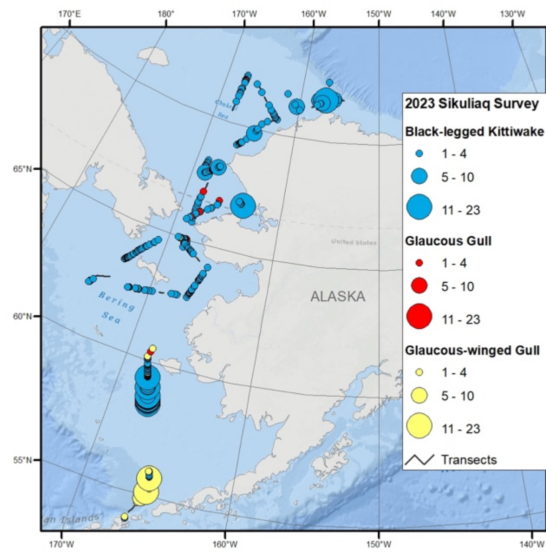


Fig 2.11.6 Select *Laridae spp*. on-transect distribution.

Eleven species of gulls (Laridae family) totaling 180 individuals were recorded on transect and comprised 13% of the total observations (**Table 2.11.1**). There were 1874 black-legged kittiwakes (*Rissa tridactyla*) on transect which comprised 11% of all birds - the second most numerous species observed aside from shearwaters. (**Table 2.11.1, Fig. 2.11.6**). Black-legged kittiwake distribution was fairly consistent throughout the survey from Dutch Harbor to Utqiagvik along with larger congregations of birds southwest of Nunivak Island, at the entrance to Norton Sound, and north of Utquiavik. Of particular interest was that the Nunivak Island kittiwake sightings consisted of 1393 birds or 67% of all birds in the south Bering Sea and 8% of all birds recorded throughout the entire survey (**Table 2.11.1, Fig. 2.11.6**).

Glaucous-winged gulls (*Larus glaucescens*) and glaucous gulls (*L. hyperboreus*) were the two more frequently seen large gulls during the survey (**Table 2.11.1, Fig. 2.11.6**). There were 25 glaucous gulls (0.2%) and 75 glaucous-winged gulls (0.5%) recorded. The majority of the glaucous-winged gulls were observed in the southern Bering Sea. The glaucous gulls were more common in the northern Bering and Chukchi seas (**Fig. 2.11.6**).

Seven spectacled eiders (*Somateria fischeria*) were identified to species. There were an additional 22 Anatidae (duck) sightings during the survey comprising of 14 unidentified eiders and eight unidentified ducks. All of the duck observations were in the northern Bering and Chukchi seas.

A total of 57 loons (Gaviidae spp.) were recorded during the survey. The observations primarily included Pacific loons and unidentified loon species. Fifty-two of the observations were recorded in the Chukchi Sea (**Table 2.11.1, Fig. 2.11.7).** Loons comprised 0.43% of birds observed in the Chukchi Sea, the fifth most common bird of 12 species seen in that region (**Table 2.11.1**).

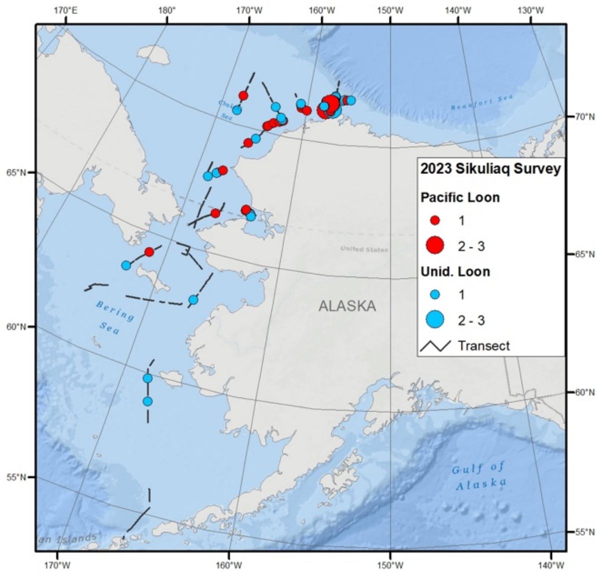


Fig. 2.11.7 *Gavia* spp. on-transect distribution.

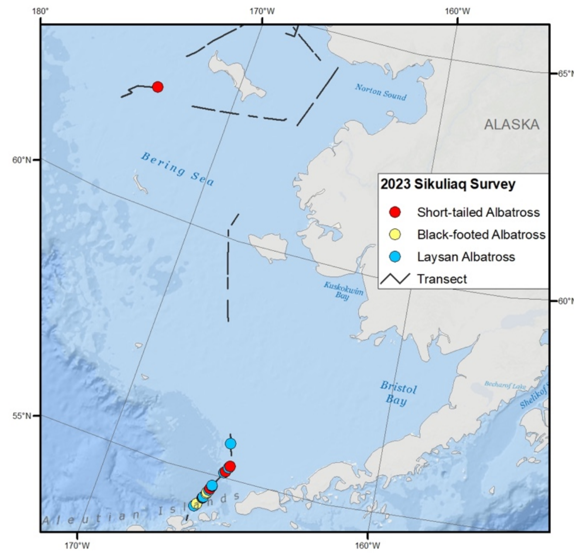


Fig 2.11.8 *Phoebastria spp*. distribution DBO 2023.

There were five on-transect and five off-transect sightings of short-tailed albatross (*Phoebastria albatrus*) during the survey. One individual bird was seen 69 nm southwest of St. Lawrence Island (N 62.534°, -W 173.668°) an uncommon high latitude sighting for this part of the Bering Sea (**Table 2.11.1, Fig. 2.11.8**). The short-tailed albatross is an endangered species, and the observations will be reported to the USFWS Ecological Services in Anchorage, AK.

On 26 Sept 2023 at 10:20 PM, a snowy owl *(Bubo scandiacus)* perched on the forward mast on the ship's bow (N 71.318°, W-164.133°) while the ship was on station. The bird left the ship at 4:20 AM the following morning. The location of the sighting was 84 nm (135 km) northwest of Wainwright, AK.

ii. Marine mammals

We conducted marine mammal observations as part of our USFWS survey on the 2023 *Sikuliaq* cruise. The official marine mammal watch was conducted by Sue Moore from the University of Washington and used standard marine mammal survey protocols. The mammal data presented in **Table 2.11.2** in this section of the report was collected using USFWS seabird survey protocols and represents on and off transect observations that supplement observations conducted by the official marine mammal observer.

We recorded a total of 311 marine mammals representing nine species (**Table 2.11.2**). The animals most frequently encountered were 108 gray whales (*Eschrichtius robustus*), 77 northern fur seals (*Callorhinus ursinus*), and 32 fin whales (Balaenoptera physalus). These three species accounted for 127 individuals or 70% of all marine mammals observed during the survey (**Table 2.11.2**). All 77 northern fur seals, fin whales (*Balaenoptera physalus*), and 30 of 32 fin whales were recorded in the southern Bering Sea (**Fig. 2.11.9**). Gray whales were recorded in the north Bering and Chukchi seas, primarily south of the Bering Strait as well as southwest of Pt. Hope (**Fig. 2.11.9**). All of the northern fur seals were recorded just northeast of Dutch Harbor.

Table 2.11.2. Marine mammals (on and off transect) recorded 10 Sept – 3 Oct 2023 during the fall *Sikuliaq* cruise.

Family	Scientific Name	English Name	S Bering Sea	N Bering Sea	Chukchi Sea	All Regions
Otariidae	*Callorhinus ursinus*	Northern Fur Seal	77			77
Odobenidae	*Odobenus rosmarus*	Walrus			9	9
Phocidae	*Phocidae spp.*	Unidentified Seal		1	5	6
	Phoca largha	Spotted Seal		1	4	5
Cetacea (order)	*Cetacean spp.*	Unidentified whales	9	7	11	27
	Eschrichtius robustus	Gray Whale		55	53	108
	Megaptera novaeangliae	Humpback Whale	8		9	17
	Balaenoptera acutorostrata	Minke Whale		3	8	11
	Balaenoptera physalus	Fin Whale	30		2	32
Delphenidae	*Orcinus orca*	Killer Whale	7			7
Phocoenidae	*Phocoenidae spp.*	Unidentified Porpoise	1			1
	Phocoenoides dalli	Dall's porpoise	11			11
		Total	**143**	**67**	**101**	**311**

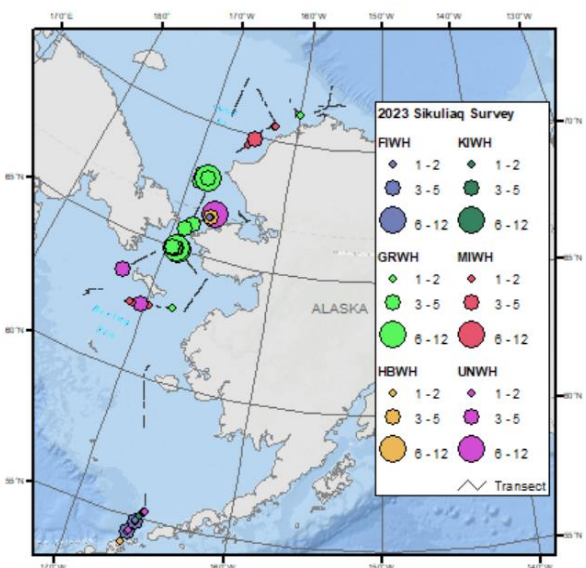


Fig 2.11.9 Cetaceans (Humpback/HBWH, Gray/GRWH, Fin/FIWH, Minke/MIWH, and unknown Whales/UNWH) as well as Killer Whale/KIWH distribution.

iii. Observation of interest

The only sighting of ice during the survey was of a small tabular/drydock structured iceberg. We used NOAA's Observers Guide to Sea Ice (https://response.restoration.noaa.gov/sites/default/files/Sea_Ice_Guide.pdf) to identify the large multi-year piece of ice. The iceberg was recorded 22 nm NE of Utqiagvik, AK, and was reported to the National Ice Center by the *Sikuliaq's* Master. There was a significant presence of Black-legged Kittiwakes (~100) loafing on the berg as well as numerous kittiwakes in the immediate area (**Fig. 2.11.6.**

Photos of large iceberg recorded in the Chukchi Sea. Photos by Marty Reedy.

2.12. Marine Mammal Watch

- **Sue Moore; UW**

A watch for marine mammals was conducted from the bridge of the R/V *Siquliaq* during the DBO-CEO-AMBON-EcoFOCI cruise from Dutch Harbor to the Chukchi and Beaufort seas, with a return to Nome. Watches were conducted during daylight hours when the ship was underway, augmented by periodic scans around the ship when on station. The lone marine mammal watch stander was aided in spotting mammals by a seabird observer and the ship's crew. The purpose of the watch is to detect marine mammals and identify sightings to species at temporal and spatial scales coincident with oceanographic sampling. The overarching goal is to improve integration of upper-trophic species' distribution, abundance, and behaviors with measures of biophysical variability in the Pacific Arctic marine ecosystem.

A total of 164 hours of watch effort was completed (**Table 2.12.1**). Overall, weather and sea conditions were very good for most of the cruise, with watch effort curtailed on only one day due to high sea states. Watches were limited on three days when the ship sampled multiple DBO stations in quick succession or remained at a mooring site for most of the day.

Nine marine mammal species were seen (**Table 2.12.1**). The first day of the cruise was remarkable for the number of humpback whales (65) and fin whales (55) seen, as the ship headed towards NOAA's M2 mooring in the southeast Bering Sea. The ship was diverted to Nome prior to arriving at M2, with few marine mammals seen along the way possibly due to a large coccolithophore bloom in the southeastern Being Sea. Three gray and five minke whales were seen as the ship passed south of St Lawrence Island on the way to DBO 1 region. There were no marine mammal sightings in the DBO 1 region, including near NOAA's M8 mooring. This lack of marine mammal sighting proved to be foretelling for much of the cruise, with the exception of the observations highlighted below.

Highlights

- A dense aggregation of 73 gray whales was seen on **17 September** in the northern Bering Sea between DBO 2.6-2.4a. Several distinct mud plumes were seen indicating the whales were feeding on infaunal crustaceans.
- A dispersed assemblage of 40 gray whales was seen on **29 September** in the southern Chukchi Sea, as the ship transited toward DBO 3.8, and then eastward to and including DBO 3.6. Several indistinct mud trails were seen indicating the whales might be feeding on epifaunal crustaceans (e.g., krill or mysids). Notably, there were rafts of short-tailed shearwaters associated with the feeding whales, krill were prevalent in the epi-fauna sampling nets and krill acoustic signature was evident on the ship's underway instruments. The ship returned to the DBO 3 region on **1 October**, where 14 gray whales were seen between DBO 3.4-3.5 and extending to NOAA's C12 mooring site – this was an eastward extension of the gray whale distribution seen on 29 September.
- After completing sampling in the DBO 3 region on **2 October,** the ship transited south to conduct a search for whales just north of the shoal areas along the northern Seward Peninsula, where aggregations of baleen whales had been seen on prior cruises. Humpback whales (52) and fin whales (11) were the common on the track approaching and along the mid-peninsula track, with gray whales (19) showing up closer to the peninsula's tip and mid-channel on the east branch of Bering Strait.

- Notable, were sightings of minke whales feeding in association with short-tailed shearwaters on **13, 19 and 29 September,** and **2 October**. On these occasions, the minke whales appeared to feed by swimming on their sides just sub-surface with their mouths open and shearwaters dabbling the water above their open gape – the whale's pointed white chins and white-spotted pectoral flippers often broke the surface confirming species identification.

Table 2.12.1. Marine Mammal Watch Summary
Hours of watch effort (EFT) and number of sightings/number of animals, by species.
Species Codes: HW=humpback whale, FW=fin whale, GW=gray whale, MW=minke whale, KW=killer whale, DP=Dall's porpoise, HP=harbor porpoise, WS=walrus, SP=spotted seal; CT=unidentified cetacean, PN=unidentified pinniped

DATE	EFT	HW	FW	GW	MW	KW	DP	HP	WS	SP	Comments
9/10/23	8	10/65	6/55			2/10	3/30				DUTCH-M2 run
9/11/23	7										coccolith bloom
9/12/23	7										Nome-Norton Sound
9/13/23	11			1/3	3/5						CT=1/3, likely HW
9/14/23	2										**M8 all day; Russian flyover**
9/15/23	6										DBO 1 stations
9/16/23	10										Anadyr; CT=1/4; PN=1/1
9/17/23	10			9/73						1/1	GW btwn **DBO 2.6-2.4a**
9/18/23	3										**Gale-force winds**
9/19/23	11				3/5				1/9		Transit to C5
9/20/23	4									1/5	UTQ - DBO 5.1
9/21/23	7										DBO 5.1 to BF2
9/22/23	9									1/1	NRS mooring-transit DBO 4
9/23/23	9			2/4						1/2	DBO4 & UTQ-boat, 'no joy'
9/24/23	1										**CEO site All Day**
9/25/23	0										**NO Watch–CEO tripod day**
9/26/23	6									2/5	Icy Cape Line
9/27/23	5										Icy Cape Line
9/28/23	11										C15-Long Transit -DBO 3
9/29/23	7	1/1		11/40	1/1						GW, **enroute DBO 3.8 & to 3.6**
9/30/23	7									1/2	KOTZ for eDNA board
10/1/23	5			4/14							GW, **DBO 3.4-3.5 + C12**
10/2/23	10	14/52	3/11	4/19	1/1			1/5			N Seward Penin-shoal srch
10/3/23	8										NM1 mooring – to – NOME
TOTAL	**164**	**25/118**	**9/66**	**31/153**	**8/12**	**2/10**	**3/30**	**1/5**	**1/9**	**7/16**	

Note: an excel spreadsheet of all marine mammal watch data is available upon request

2.13. EcoFOCI Mooring Operations

- **David Strausz, Luis Candela, Dana Wright; NOAA**

EcoFOCI serviced several long-running biophysical mooring sites in the Bering and Chukchi Seas. Depending on the location, these moorings had sensors that measured the following parameters at varying depths (**Fig. 2.13.1, Table 2.13.1**):

Conductivity, Salinity and Temperature: Sea-Bird SBE-16 or 37
Temperature only: Sea-Bird SBE-39 or 56
Chlorophyll concentration: Sea-Bird Eco-Fluorometer
CDOM and Turbidity: Sea-Bird Eco-Triplet
Currents: Teledyne RDI Workhorse and Long-Ranger ADCP, Aanderaa RCM-9 or Seaguard
Oxygen concentration: Aanderaa Oxygen Optodes
Nitrate concentration: Sea-Bird SUNA
Photosynthecally Active Radiation (PAR): Biospherical or LiCor PAR sensor

In addition, one McClane RAS mult-sampler was deployed at the M8 site for collecting nutrient samples. Another RAS sampler was picked up after 3 years of deployment at the C12 location.

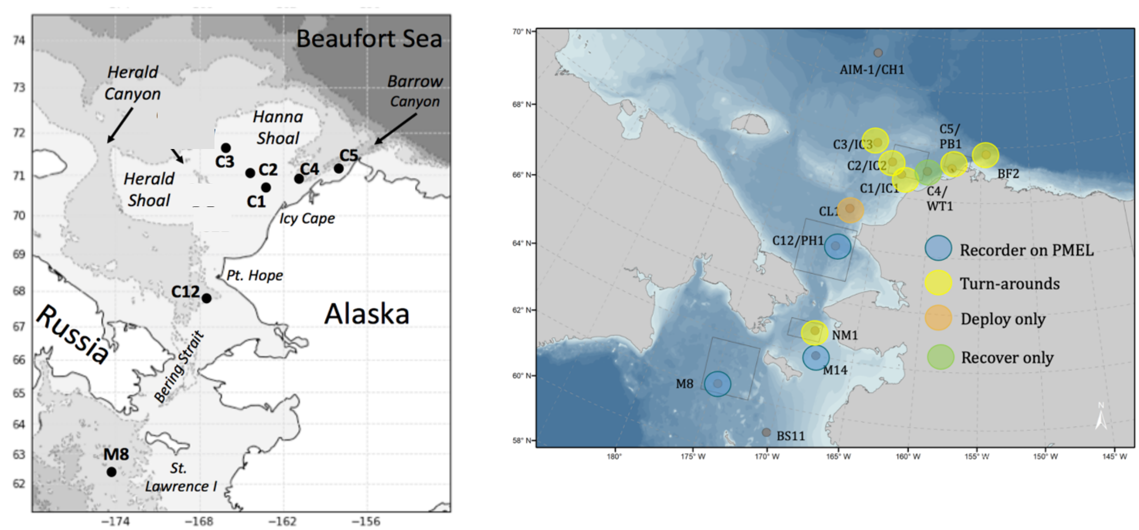


Figure 2.13.1. Left and Right panels. Biophysical mooring sites in the Bering and Chukchi Seas.

The following moorings were recovered for the EcoFOCI program:

Table 2.13.1. EcoFoci mooring recoveries:

Name	Lat	Lon	Depth (m)	Comments
22BSITAER-8A	62 12.113N	174 39.726W	75	RAS mooring
22BS-8A	62 11.91N	174 39.64W	75	Full water column mooring
21BSST-8A	62 92.04N	174 40.82W	73	Sediment Trap
22CKP-1A	70 50.2N	163 07.5W	44	ADCP, SUNA, etc

Name	Lat	Lon	Depth (m)	Comments
22CKP-2A	71 12.95N	164 14.94W	44	ADCP, SUNA, etc
22CKP-3A	71 49.65N	166 63.662W	45	ADCP, SUNA, etc
22CKP-5A	71 15.63N	157 59.78W	49	ADCP, Seacat, etc
20CKITAER-12A	67 54.1N	168 11.3W	59	RAS

Table 2.13.2. EcoFoci mooring deployments during SKQ22-12S.

Name	Lat	Lon	Depth (m)	Comments
23BSITAER-8A	62 12.107N	174 39.660W	73	RAS
23BS-8A	62 11.895N	174 39.760W	73	Full water column
23BSST-8A	62 12.002N	174 40.782W	73	Sediment Trap
23BSP-8A	62 12.279N	174 40.558W	73	ADCP + Aural
23CKP-1A	70 50.230N	163 07.521W	44	ADCP, SUNA, etc
23CKP-2A	71 12.934N	164 15.024W	44	ADCP, SUNA, etc
23CKP-3A	71 49.656N	166 01.127W	44	ADCP, SUNA, etc
23CKP-4A	71 02.700N	160 29.404W	51	ADCP, Seacat, etc
23CKP-5A	71 12.50N	158 0.0W	49	ADCP, Seacat, etc
23CKP-9A	72 28.201N	156 34.203W	920	Long-Ranger ADCP, Haru-Phone, SBE-37s
23CKP-12A	67 54.348N	168 10.853W	58	ADCP, SUNA, Aural
23CKP-15A	72 18.59N	167 16.250W	48	ADCP, Seacat, etc

Several moorings were deployed or renewed after a long gap in sampling due to the COVID pandemic. These include 23CKP-9A (also known as NRS01), a deep mooring with a 75Khz ADCP at around 270m and a Haruphone at around 420m. Also, a mooring at C5 was deployed for the first time in over 2 years. A long-ago deployed RAS multisampler was picked up at C12 after sitting in the cold, southern Chukchi Sea for over 3 years. All recovered instrument appeared to have worked as planned, but further data analysis will point out any anomalies in performance.

In addition to the moorings, EcoFOCI deployed two satellite tracked drifters at the C1 and C2 sites. Overall, it was a very successful cruise for EcoFOCI. We had no problems with releases, and it appears that all deployed instruments worked. In the coming months the data will be review for anomalies and trends.

2.14. Marine mammal listening moorings, sonobuoys, and satellite-tracked drifters

- **Dana L. Wright and Catherine Berchok, NOAA Marine Mammal Laboratory**

The objective of our participation in cruise SKQ202312S was to recover 8 and deploy 7 NOAA Marine Mammal Laboratory moorings equipped with AURAL and/or SoundTrap long-term passive acoustic recorders as well as monitor for marine mammal vocalizations during the cruise using sonobuoys. The passive acoustic data from the long-term recorders will be added to existing time-series of the spatio-temporal occurrence of marine mammals in the Arctic. The long-term moorings are part of an extensive network of NOAA passive acoustic recorders that extend from the Aleutian Chain to the northeastern Chukchi Sea that have been monitoring for over a decade. We successfully recovered and deployed all moorings (**Table 2.14.1**.). All recovered AURALs successfully recorded data, with most recordings spanning October 2022 through September 2023. In addition, two SoundTraps were deployed – moorings AL23_AU_IC02 and AL23_AU_NM01. Of the 48 sonobuoys brought onboard, 32 were deployed, all successful. Unfortunately, the primary directional antenna, the 'yagi' antenna' did not work for the majority of the cruise and thus the backup omnidirectional antenna was used. As a result, the listening range was reduced (~ 6 nm per buoy), and thus buoys were often deployed ~3 nmi from station positions to increase listening time (**Figure 2.14.1**). The majority of buoys were deployed in the Bering Sea and southern Chukchi to monitor for the occurrence of the critically endangered eastern North Pacific right whale. One possible right whale calls was heard in the southern Bering Sea while fin whale vocalizations were heard throughout the Bering Sea transit and southern Chukchi Sea, including the DBO 1, 2, and 3 station clusters. Gray whale vocalizations were heard among the DBO 3 station cluster. No marine mammal vocalizations were heard in the northeastern Chukchi Sea (**Figure 2.14.1**).

Table 2.14.1. Moorings deployed and recovered on SKQ202312S. Mooring IDs in parentheses are the PMEL names; * = passive acoustic recorder on PMEL mooring; AU = AURAL; ST = Sound Trap

Mooring Site	Year Deployed	Latitude	Longitude	Recovered	Recovered Instrument	Deployed	Deployed Instrument
PM08 (BSP-8A)	2022	71 12.3476 N	158 00.6674 W	X*	AU	X*	AU
PB01 (C5)	2022	71 12.3476 N	158 00.6674 W	X	AU	X	AU
BF2	2022	71 45.237 N	154 28.516 W	X	AU	X	AU
WT1 (C4)	2021	71. 02.47 N	160 30.33 W	X	AU		
IC1 (C1)	2022	70 50.0995 N	163 07.5050 W	X	AU	X	AU
IC2 (C2)	2021	71 12.882 N	164 14.911 W	X	AU	X*	ST
IC3 (C3)	2022	71 49.7251 N	166 03.4160 W	X	AU	X	AU
PH1 (C12)	2022	67 54.621 N	168 11.056 W	X*	AU	X*	AU
NM1	2022	64 51.3 N	168 26.8 W	X	AU	X	AU, ST

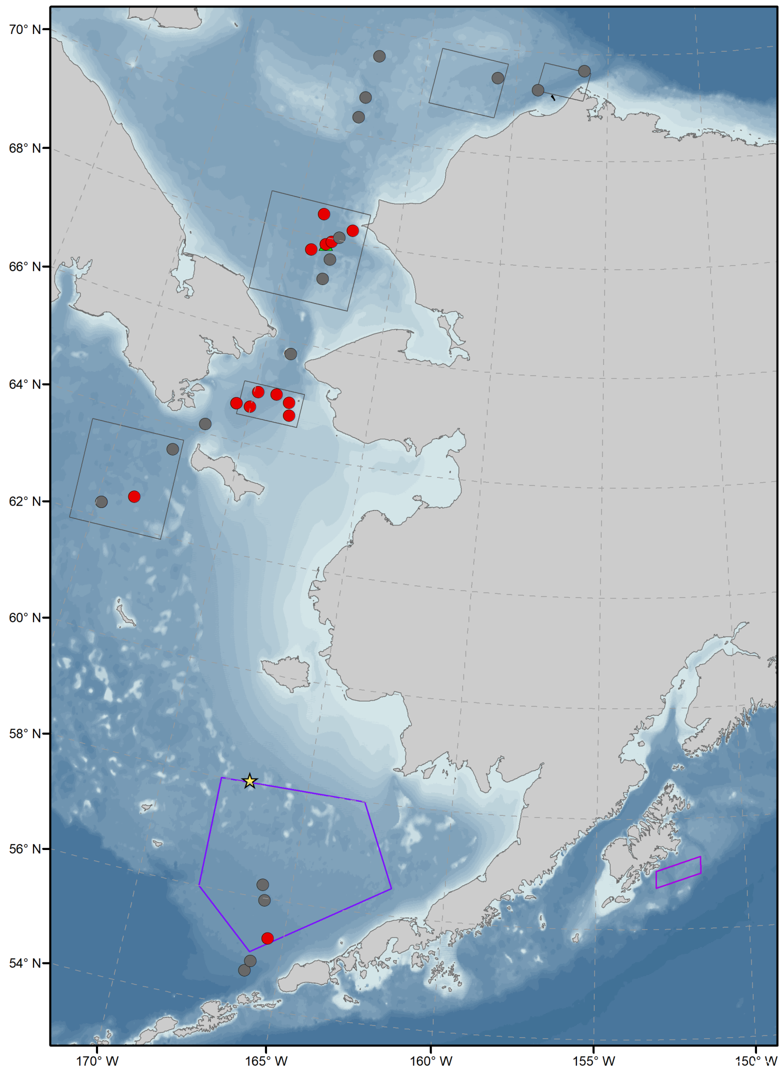


Figure 2.14.1. Locations of deployed sonobuoys; gray = no marine mammal detected, red = fin whale, yellow star = possible right whale, and green triangle = gray whale.

2.15. Chukchi Ecosystem Observatory (CEO) Moorings

- **Seth Danielson, Savannah Sandy, UAF**

The CEO project had three moorings to recover and four moorings to deploy in 2023. Moorings CEO1-22 and CEO2-22 were recovered without incident and delivered a full set (24) sediment trap samples, CTD data, water samples (September through March), passive acoustic data, PAR data, SUNA (NO3) data, pCO2 data, pH data, dissolved oxygen data. A programming error led to the optical EcoTriplett (chlorophyll a, CDOM, optical backscatter) to terminate sampling shortly after deployment, resulting in the loss of data from the year.

The CEO3-22 tripod was not recovered. One of the two acoustic releases never responded. The second acoustic release did respond but when the release command was sent (multiple times), the pop-up buoy did not surface. We spent a day echolocating the mooring and dragging hooks past it, with no luck. Eventually, we deployed the heavy dragging hooks and laid trawl cable on the seafloor in a 270-degree arc around the mooring site, stopped the vessel motion and then recovered the trawl hooks. The dragging operation hit the mooring and likely moved it some distance, but we did not securely hook it and the mooring was not recovered. We obtained three final echolocation fixes – which indicated that the mooring moved about 100 m to the east or southeast – before putting the acoustic release back to sleep and then departing the mooring site. We intend to bring an ROV on board in 2024 and try to recover the mooring by clipping a recovery line onto the package.

Table 2.15.1. 2023 CEO moorings deployed during SKQ22-12S.

Mooring Name	Latitude (degrees, minutes)		Longitude (degrees, minutes)		Bottom Depth (m)	Top Instrument Depth (m)	Instrumentation/sampling
CEO1-23	71	35.03	161	29.97	46	33	Underwater Sound, CTD (x2), Water Sampler for major macronutrients and environmental DNA
CEO2-23	71	36.04	161	32.45	46	33	pH, pCO2, Dissolved Oxygen, CTD, NO_3, Sediment trap, CDOM, Chlorophyll a, Optical Backscatter
CEO3-23 (Tripod)	71	36.00	161	27.64	46	44	Acoustic backscatter, Current Speed/Direction, CTD, Benthic Camera
CEO-BIOPOLE-23	71	36.04	161	29.97	46	34	Major macronutrients, molecular analyses

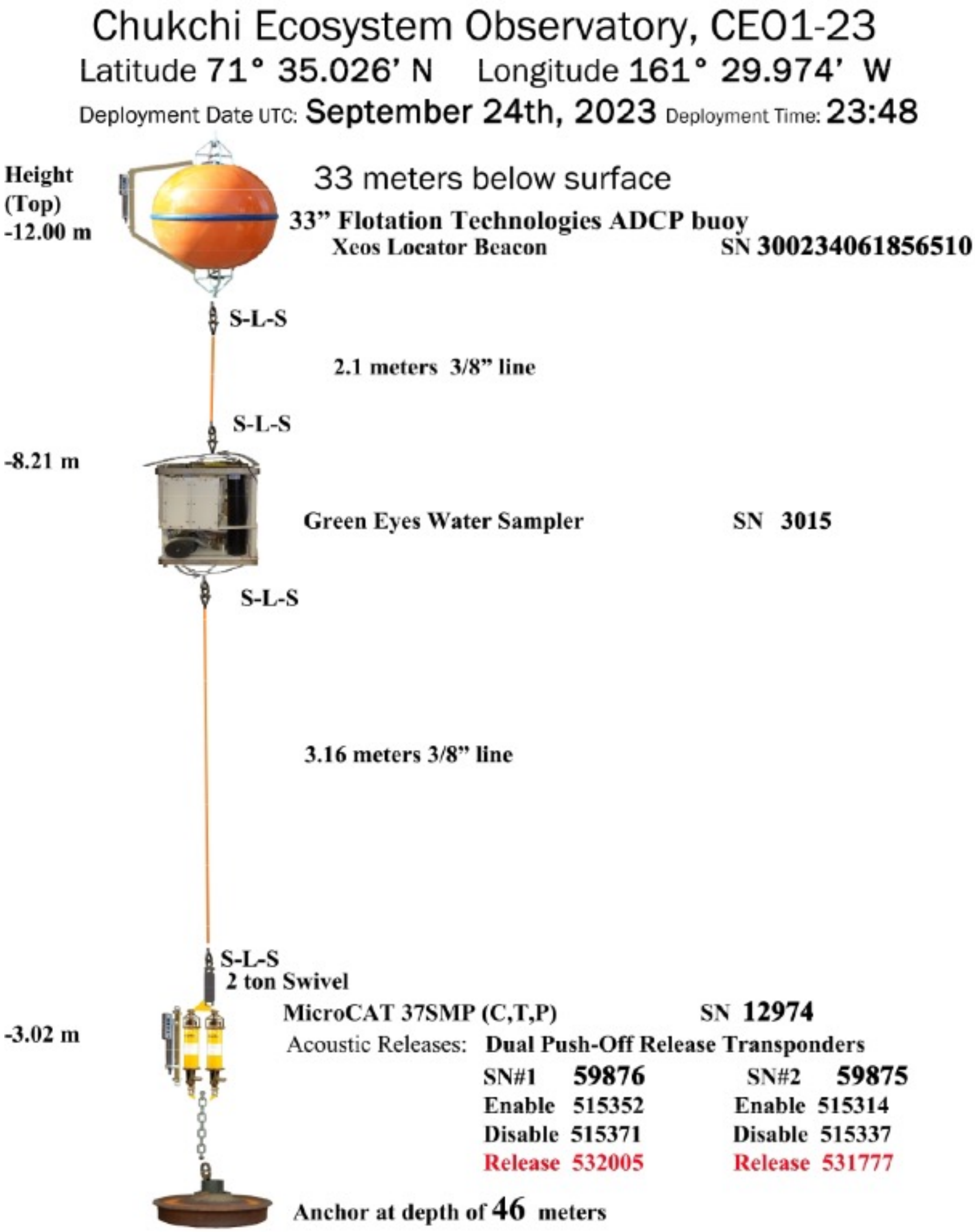


Figure 2.15.1 Mooring CEO1-23 as deployed during SKQ22-12S.

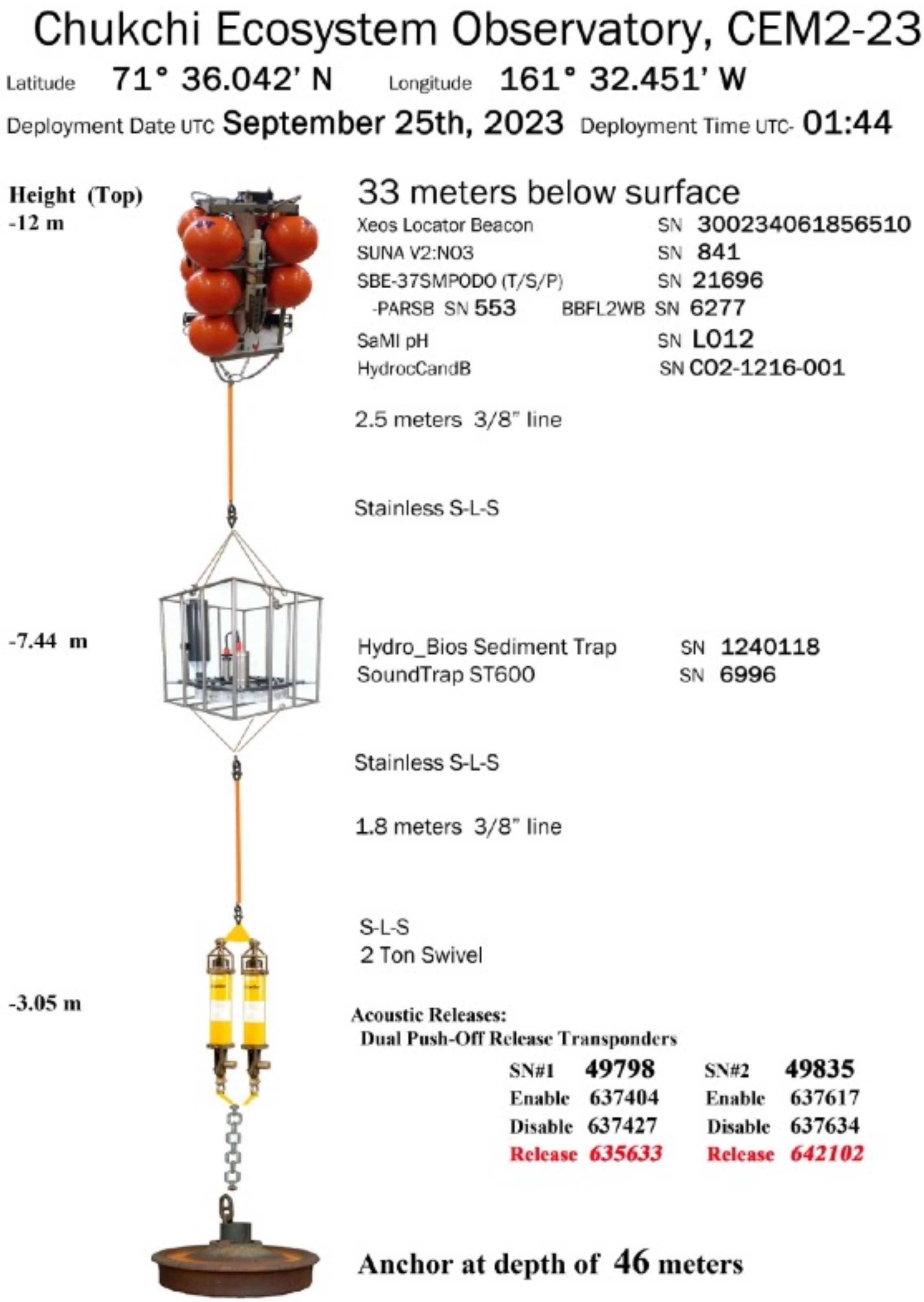


Figure 2.15.2 Mooring CEO2-23 as deployed during SKQ22-12S.

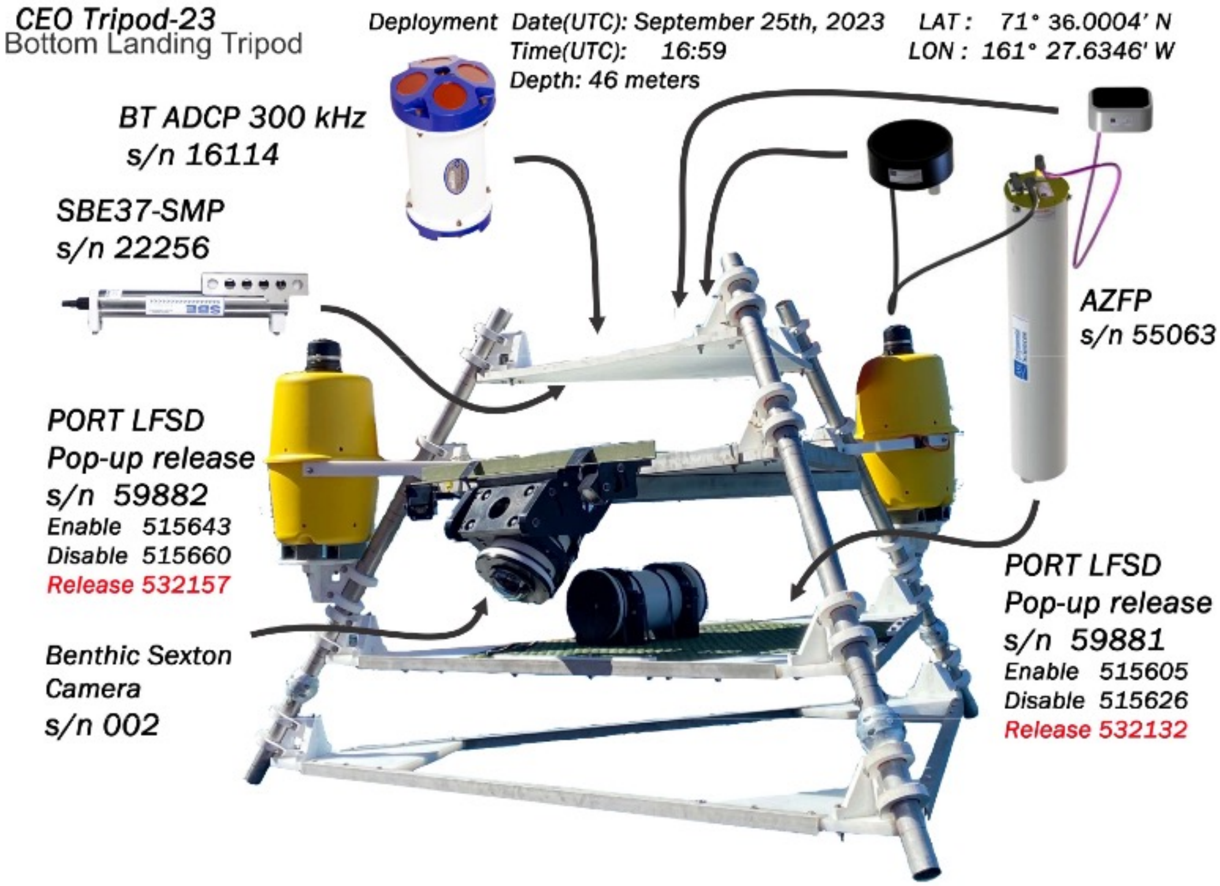


Figure 2.15.3 CEO3-23 Tripod mooring as deployed during SKQ22-12S.

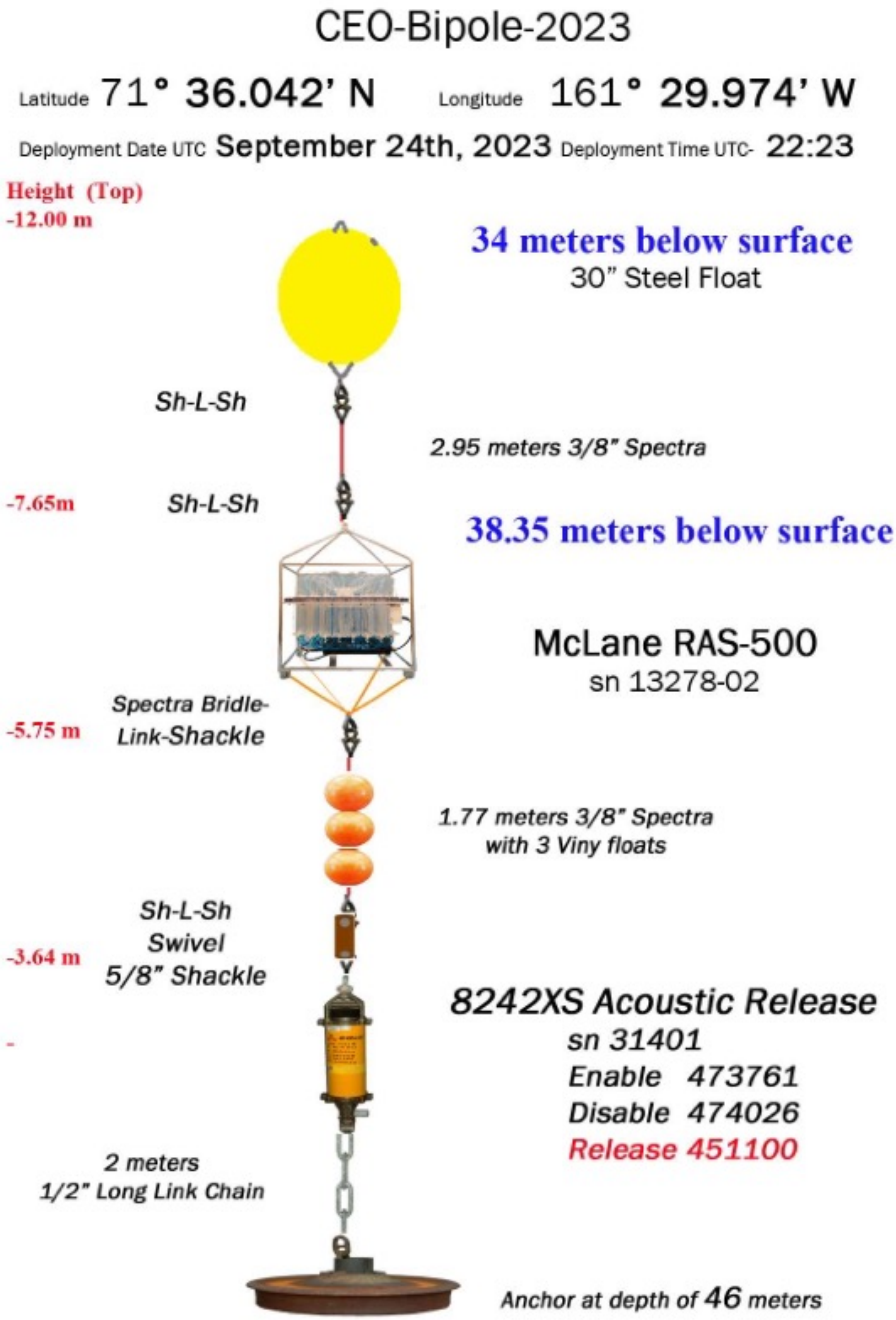


Figure 2.15.4 CEO-BIOPOLE-23 mooring as deployed during SKQ22-12S.

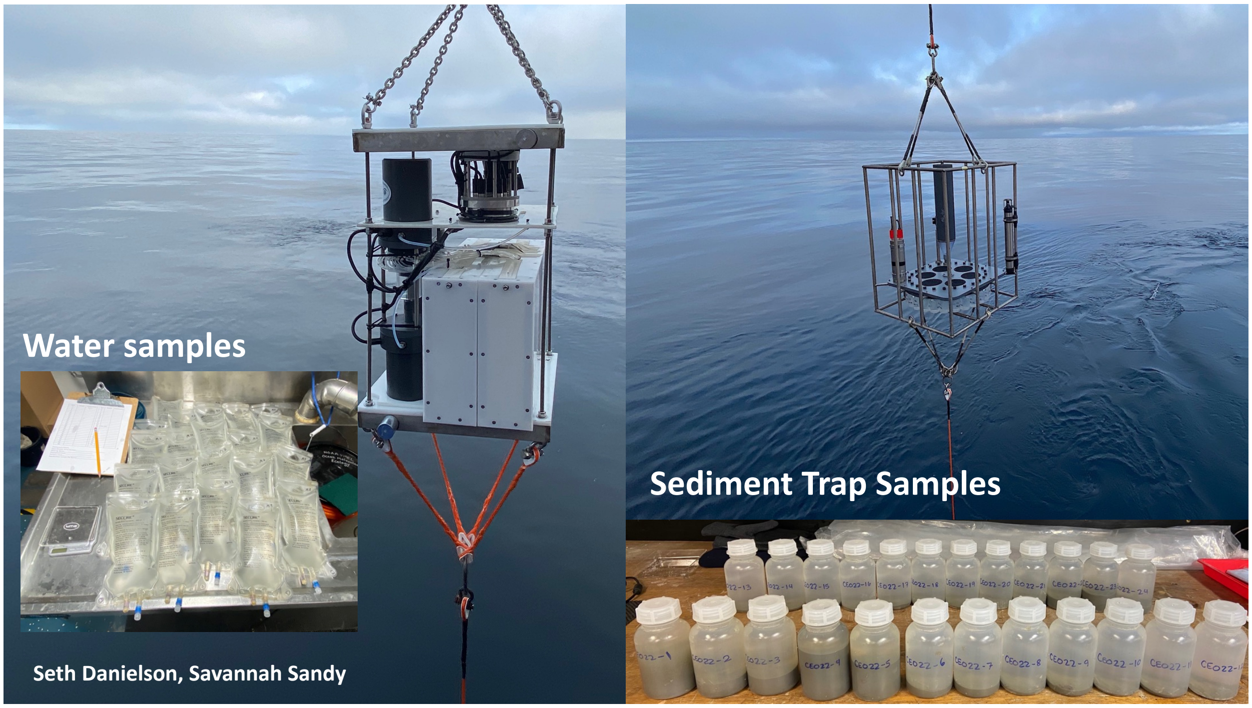


Figure 2.15.5. Water samplers (left photo) and sediment trap (right photo) at the CEO mooring site.

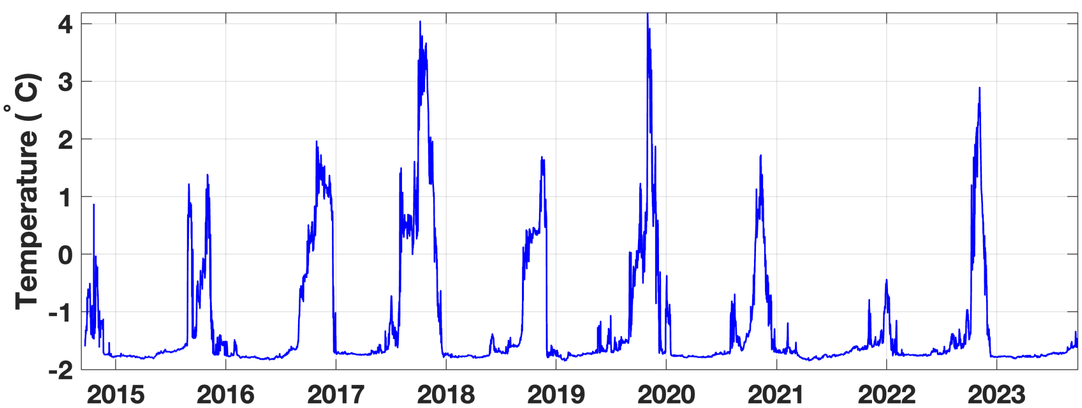


Figure 2.15.6. Updated time series of near-seafloor bottom temperature from September 2014 through September 2023.

3.0 Ship-to-Shore Outreach and Communications

Daily emails were broadcasted to an email listing that included contact information for residents in all coastal villages in our operating area, co-management groups (e.g., Alaska Eskimo Whaling Commission). The emails listed our position, sampling activities, plan for the next day, and observations of note. Below is a composite of the 2023 NOAA Arctic & Ecosystem Research Cruise Daily Updates, prepared by Libby Logerwell/NOAA with input from Seth Danielson/UAF and Jackie Grebmeier/UMCES.

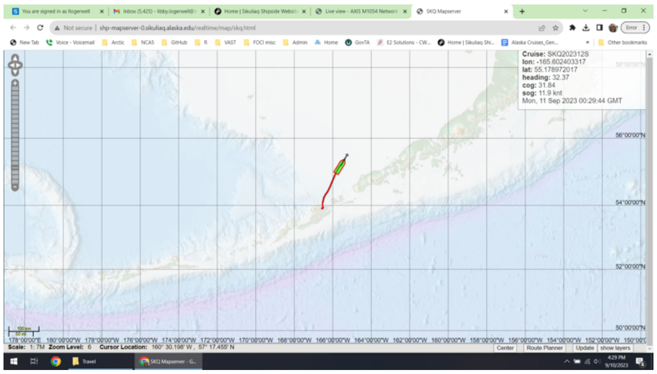
The standard statement on each daily email included the following text:
"The NOAA Arctic & Ecosystem Research Cruise is an annual research cruise in late summer/early fall, to understand how changes in physics and chemistry impact the food web (including adult fish, marine mammals, and seabirds). We are collecting samples at various locations. Samples include both physical data such as bottom sediments and water samples to better understand the potential effects of ocean acidification and harmful algal blooms. We are also collecting biological information on plankton, larval fish bottom dwelling species, seabirds, and whales. The team will also be servicing moorings in both the Bering and Chukchi Seas. Here is our daily update.

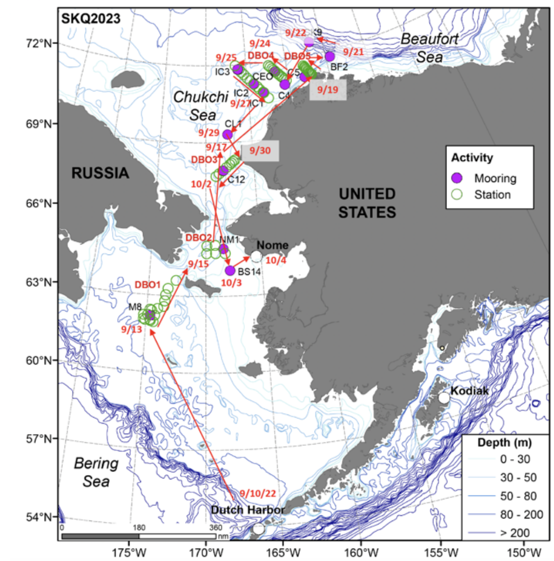
This research cruise is a consortium between NOAA's EcoFOCI program (Ecosystems and Fisheries Oceanography) and the NOAA Marine Mammal Lab; the Distributed Biological Observatory (DBO) run from the University of Maryland; and the Arctic Marine Biodiversity Observation Network (AMBON) and Chukchi Ecosystem Observatory (CEO) projects both run from the University of Alaska Fairbanks. The email were sent on behalf of SKQ202312S co-chief scientists Jackie Grebmeier (jgrebmei@umces.edu) and Seth Danielson (sldanielson@alaska.edu)."

R/V Sikuliaq in the Chukchi Sea at the CEO mooring site. PC/D. Strausz

3.1 Daily Updates

September 10, 2023
We set sail from Dutch Harbor at 0800 this morning with fair winds and calm seas.
Left: Current position of ship). **Right:** Planned stations for the cruise.



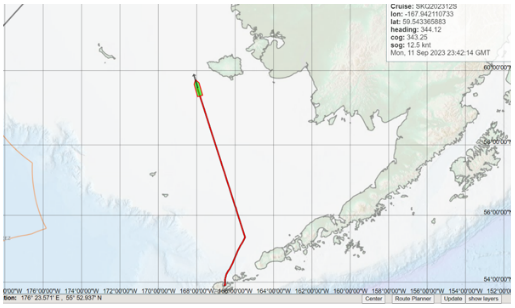


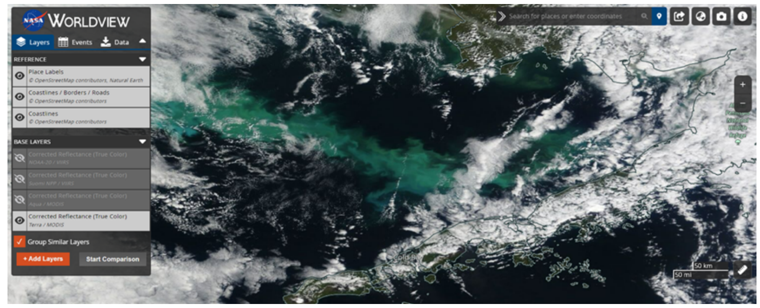
We are steaming towards the M2 mooring in the southeast Bering Sea, arriving tomorrow. We will turn around that mooring and deploy a CTD. Then we will steam towards M8 (see second figure for location of M8).

Seabird sightings today included adult and juvenile short-tailed albatross. Marine mammal sightings included fin whales and killer whales.

September 11, 2023
This is the daily email update for 11 September associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

Here is our daily update: We are currently steaming north to M8 and DBO transect 1. We estimate our arrival at M8 to be in two days. The map below shows our current location. The water is showing the milky white color typical of a coccolith bloom. It is also evident in the satellite image below. Surface water temperatures are 8 – 9 degrees Celsius. Seabird sightings today were dominated by kitiwakes. Some terns and jaegers were also observed. No marine mammals were seen, which is not surprising given the coccolith bloom and the usual low productivity of the Alaska Coastal Current that we are sailing through. **Figure below**: **Left:** Location map. **Right:** Satellite view of coccolithiphorid bloom in SE Bering Sea.

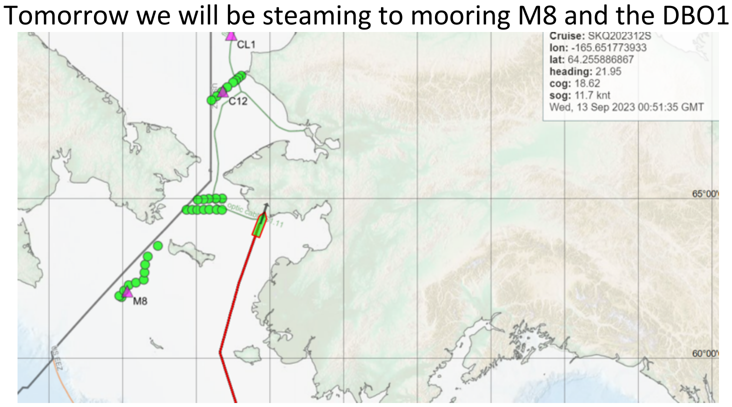




September 12, 2023
This is the daily email update for September 12 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

Here is our daily update: We are currently steaming towards Nome. We diverted to Nome temporarily for a medical issue and to pick up a replacement part for a piece of broken science equipment. We do not expect this to impact our overall cruise timing because of built in buffer in our schedule. We had a NOAA flyover today between 1600-1800. The goal of this project is to eplore how to merge new technologies with traditional ship surveys to assess real-time phytoplankton species distributions in response to surface ocean warming. The aircraft will capture images of the surface water with a hyperspectral camera, and we will collect water samples onboard to groundtruth the camera data. Marine mammals were scarce, no sightings were recorded today. There were also fewer seabird sightings compared to yesterday. Some phalaropes and turnstones were seen, which hadn't been seen yesterday.

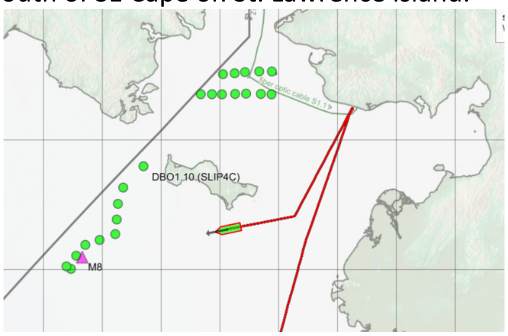
Tomorrow we will be steaming to mooring M8 and the DBO1 transect.

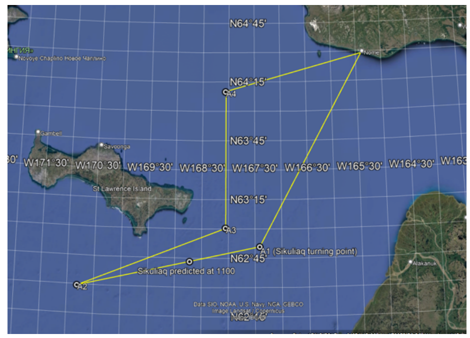


Left. This map shows our current position and the location of M8 and DBO1.

September 13, 2023
This is the daily email update for September 13 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

Here is our daily update: We are currently steaming towards mooring M8 and DBO 1 (left panel). We anticipate arriving there at 5:00 am tomorrow. We will do a CTD cast and then mooring operations. The first map below shows our location. The NOAA overflight departed Nome at 1230, following Nome - A1 - A2 - A3 - A4 - Nome (est. 430 nm), and concluded the flight around 1630. See the second map below for the flight path (right panel). The seabird most commonly seen today was the Parakeet Auklet. The obsever also saw some seaducks but they were too far away to identify to species. Marine mammal highlights include 3 gray whales observed 15 miles south of Punik Island; and 2 minke whales 18 miles south of SE Cape on St. Lawrence Island.



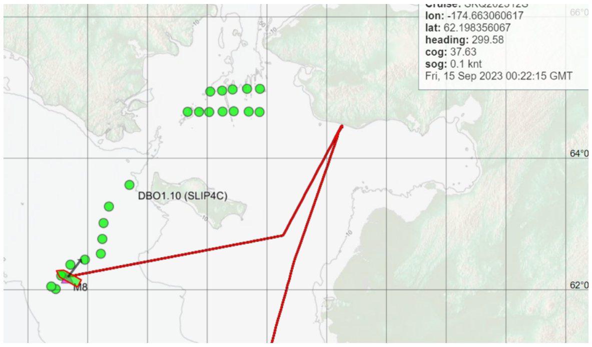


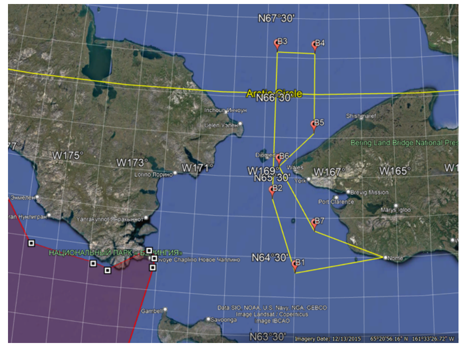
Left: Position of ship. **Right:** Location of of NOAA overflight map while Sikuliaq in transit.

September 14, 2023

This is the daily email update for September 14 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

Here is our daily update: Today we deployed our first CTD at mooring site M8 on DBO line 1. Water samples were collected for a variety of measurements: nutrients, phytoplankton (including harmful algal species), oxygen, carbon and eDNA. These samples will be taken on all CTD casts. The first map below shows our current location. Several moorings were retrieved, and new ones were deployed at M8 today. Instruments on the moorings included: a "Remote Access Sampler (RAS)" that collects and preserves water samples for nutrient analyses; instruments that measured temperature, salinity, and nitrogen; and a sediment trap. The NOAA aircraft survey plan took them near the Bering Strait area. The decision to proceed was based on the weather forecast, which indicates sporadic cloud-free areas. Below, you will find the planned route: Nome - B1 - B2 - B3 - B4 - B5 - B6 - B7 - Nome, covering an estimated distance of 470 nautical miles. We will start sampling the stations on DBO1 when we are finished deploying moorings. CTDs with water samples will be deployed, as will bongo tows for zooplankton, beam trawls for fish and invertebrates on the surface of the seafloor (epibenthic) and grabs for invertebrates living in the sediment (infauna). Left: Location map. Right: NOAA aircraft flight path today.

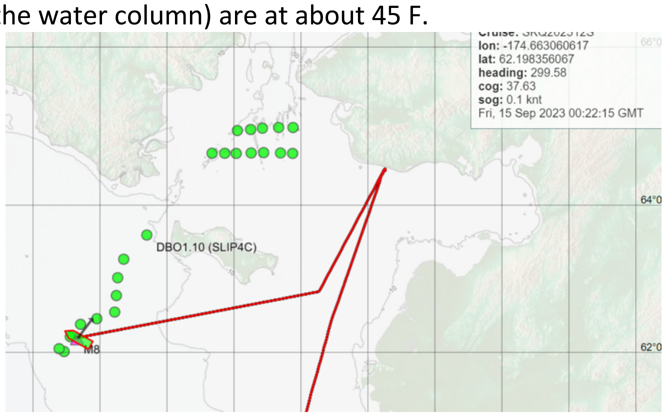




Left. Ship and sampling locations. **Right:** NOAA aircraft flight route.

September 15, 2023
This is the daily email update for September 15 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

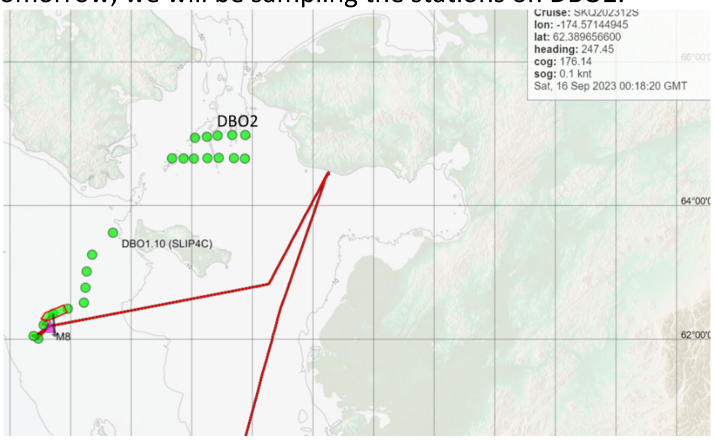
Here is our daily update: Today we deployed the last two moorings at M8. Instruments on those moorings will measure marine mammals with passive acoustics; and take samples for eDNA. Then we proceeded to sample stations DBO1.3, and DBO 1.4 with CTDs, bongo zooplankton tows, seafloor grabs and beam trawls. We will continue to work DBO1 and sample the rest of the stations on that line. Then we will steam through Anadyr Strait to the DBO 2 station set. Very few seabirds were seen today, mostly fulmars and shearwaters. No marine mammals were sighted. Zooplankton caught in the bongo nets were as expected, mostly copepods and some euphausiids. The grab samples for infauna found worms, brittle stars, amphipods, and a few clams. The beam trawl catches were dominated by brittle stars, although some fish were also caught. Water depth here is about 220 feet and the water temperature is close to 30 degrees F from about 100 feet depth to the seafloor, showing the characteristic cold temperatures of the Bering Sea "Cold Pool". Near-surface waters (upper 60 feet of the water column) are at about 45 F.



Left. Location of ship in transit to DBO1/M8 mooring.

September 16, 2023
This is the daily email update for September 16 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also

be servicing moorings in both the Bering and Chukchi Seas. Here is our daily update: We are currently steaming towards the DBO2 sampling stations. We are presently sailing through the nutrient-rich waters of the Anadyr Current. Surface temperatures have dropped, salinity has increased, and the nitrate levels are very high (~30 micromols per liter). Last night we finished sampling the stations on DBO1. The zooplankton samples contained large and small copepods, small (likely juvenile) euphausiids and pteropods. Beam trawl catches were dominated by brittle stars; few fish were caught but included one eelpout. Scientists on board wonder if that has something to do with being in cold pool waters. The grab samples contained worms and clams; the latter are prey for sea ducks who winter in the St. Lawrence Island polyna on the south side of the island. In fact, a Steller's eider was seen this morning. Marine mammal sightings today included some humpback whales, south of station DBO 1.10. A spotted seal was also seen. However, marine mammal observing conditions have degraded with the increasing wind (gusts to 30 knots) and waves with whitecaps, so little has been seen this afternoon. Tonight and tomorrow, we will be sampling the stations on DBO2.

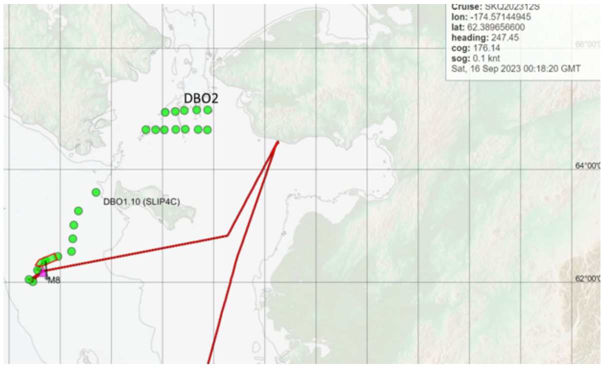


Left. Ship and sampling locations.

September 17, 2023

This is the daily email update for September 17 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

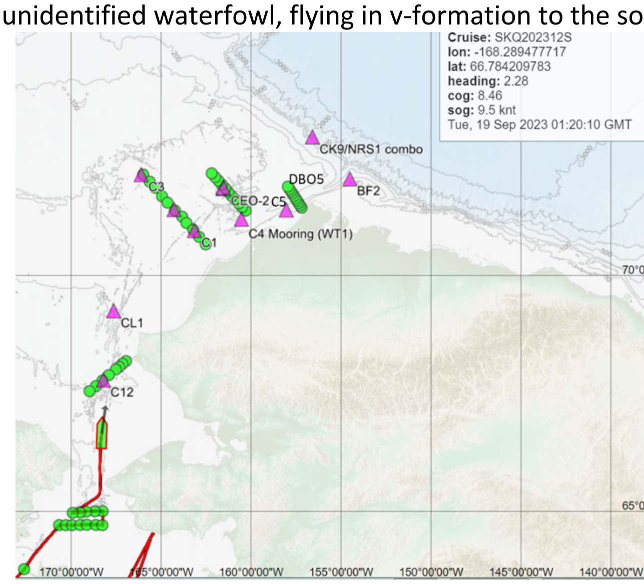
Here is our daily update: We sampled the stations along DB02 last night and today. The scientists and crew were treated to a spectacular display of the Northern Lights after midnight. We found a surface-enhanced fall phytoplankton bloom at the boundary between the nutrient-rich Anadyr waters and the less salty waters farther east. Here, near-seafloor temperatures are appreciably warmer (37 F) than in the cold pool (30 F). Bering Shelf waters Euphausiids were caught in the zooplankton tows, along with bioluminescent copepods, pteropods and *Eucalanus bungii* (this is the first we have seen these species on this cruise). Small snow crab (less than 5-inch body width), seastars, snailfish and shrimp were caught in the benthic beam trawl. In addition to the usual worms and clams, there were a lot of amphipods in the benthic grab samples, which is not surprising as this area is known to be a hotspot for amphipods and a good foraging area for benthic feeding birds and mammals. Surprisingly, almost no marine mammals were seen today (except one spotted seal near King Island). There was an uptick in the number of birds seen, mostly Tufted Puffins and Least Auklets. When we are finished sampling DBO2 (this evening) we will begin an approximately 48-hour steam north to a mooring in the NE Chukchi Sea near Barrow Canyon.



Left. Ship and sampling locations. **Right:** NOAA aircraft flight route.

September 18, 2023
This is the daily email update for September 18 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

Here is our daily update: We are currently steaming north to mooring C5 and DBO5 off of Point Barrow. We should arrive there Wednesday morning. The weather has come up, so conditions were not suitable for marine mammal observations. Seabird observations continued, however. Lots of shearwaters were observed near the Diomede Islands. In addition, 2 flocks of eiders were observed, of 7-10 birds. They were too far away to identify to species. There were also two large flocks (60-80 birds) of other, unidentified waterfowl, flying in v-formation to the south.

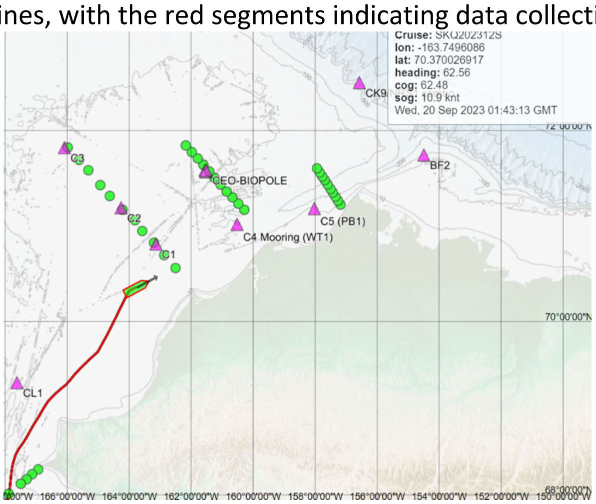


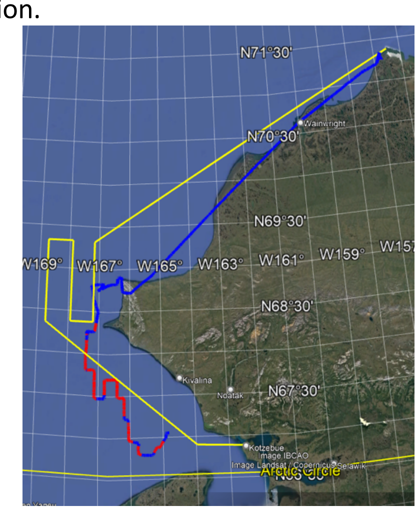
Left. Transit of RV Sikuliaq northward and shows the proposed stations for future occupation.

September 19, 2023
This is the daily email update for September 19 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful

algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

Here is our daily update: We are currently steaming north towards mooring C5 and transect DBO5, we should arrive there early tomorrow morning. We will turn around two moorings at C5 and then sample the stations on DBO5 across Barrow Canyon. It was a good day for marine mammal and seabird observations. Two Minke Whales were sighted, one off Ledyard Bay and one-off Point Lay. Nine walruses were also seen off Point Lay. Several thousand shearwaters were observed throughout the day. Small flocks of ducks were seen near Ledyard Bay, including 7 Spectacled Eiders. Seven Kittlitz's Murrelets were observed, which is noteworthy because they are near threatened (according to the International Union for the Conservation of Nature). Surface water temperatures have hovered near 40-44 F today and the salinity has been quite fresh, with a salinity of less than 30. The Alaska Coastal current has helped speed us along, providing a tailwind of about half a knot. Yesterday on September 18th, a flight was conducted departing from Utqiagvik, heading south in search of optimal weather conditions for the airborne remote sensing mission. The initial plan was to survey the Point Hope area, but unfortunately, the airplane encountered excessive cloud cover. Consequently, they adjusted their route and proceeded south to the Kotzebue Sound area, where they successfully conducted the survey. The planned route is marked in yellow below, the actual flight path is represented by the red and blue lines, with the red segments indicating data collection.





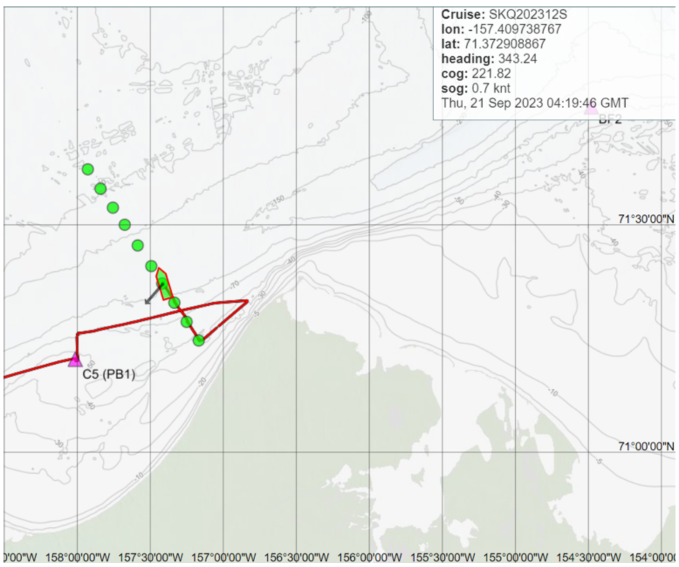
Left: Current location of ship.
Right: NOAA aircraft flight route

September 20, 2023
This is the daily email update for September 20 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

Here is our daily update: This morning we recovered and deployed two moorings at C5, one was a passive acoustic mooring to detect whale noises and other underwater sounds, the other was an oceanographic mooring. We have been sampling the stations along DBO5 this afternoon and evening. We are conducting CTDs with water samples, bongo tows for zooplankton and grabs for invertebrates in the sediment. The bottom is too steep and rocky in eastern Barrow Canyon for beam trawls, yet the shelf is less steep on the western side and two trawls will be done on the upper canyon wall and shelf.

The zooplankton tows contained a lot of small jellies and some large copepods (*Neocalanus* sp.) and euphausiids. The grab samples contained sea cucumbers, amphipods, and small sea stars. Diversity of organisms in the grab samples increased from the upper east side of the canyon as we moved downslope into the central canyon and deeper water. Very few seabirds were seen today, just one large flock of shearwaters. Similarly, not very many marine mammals were seen; there were five seals observed near Pt. Barrow. Viewing conditions for seabirds and marine mammals were not good due to wind, rain, and the higher wave sea state. Current flow in Barrow Canyon was observed to be to the northeast.

Tomorrow we will be finishing DBO5 and then we will go retrieve another passive acoustics mooring.

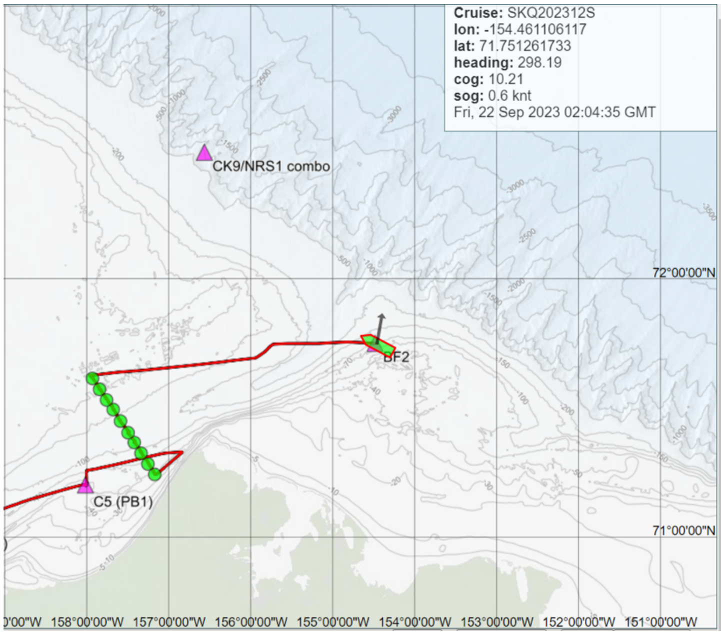


Left. Transit of RV Sikuliaq northward to initiate DBO5-BarC stations.

September 21, 2023

This is the daily email update for September 21 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

Here is our daily update: We are currently at mooring site BF2, which is a marine mammal passive acoustic mooring. We will conduct a CTD and turn around the mooring and then steam northwest to the CK9 mooring, arriving there some time after midnight. No marine mammals were sighted during the transit today. We passed by a very large iceberg (above the water portion: 20-30 feet tall and 100-150 feet long) which attracted large flocks of kittiwakes, but no marine mammals. Scientists on board speculate that the kittiwakes were attracted to the iceberg as a place to rest and feed on prey associated with the ice. In addition to kittiwakes, a lot of loons were seen today.



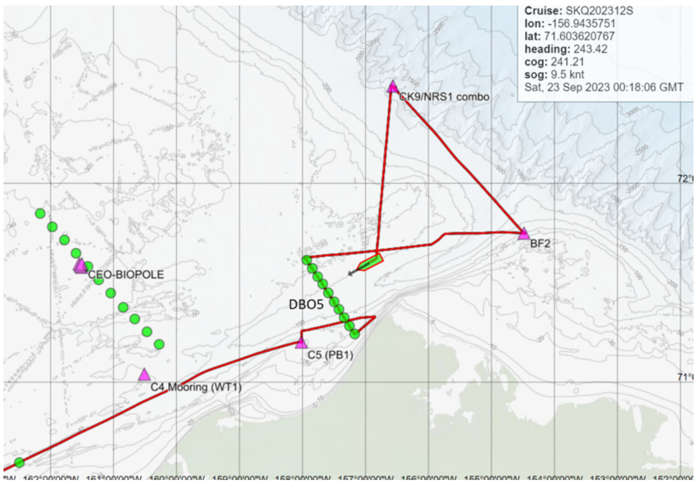
Left. Completion of DBO5-BarC stations and transit to mooring BF2.

September 22, 2023

This is the daily email update for September 22 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

Here is our daily update: Today we recovered and deployed moorings at BF2 and CK9, the former is a marine mammal acoustic listening mooring, and the latter is an ambient noise monitoring mooring. We are now steaming towards DBO4, we should arrive there around 11:30 pm tonight. We will then sample the stations on DBO4 from inshore to offshore and turn around the moorings at C4. No marine mammals have been observed during transit yet today. The seabird observer saw many loons and a few jaegers. There was also a flock of about 23 black-legged kittiwakes.

Yesterday, the NOAA overflight mission focused on the successful deployment of microSWIFT-TS buoys along the DBO5 section and the 150W line. The second leg of the day was allocated for hyperspectral data collection. However, as the aircraft approached the northwestern area of BRW at the conclusion of Leg 1, they encountered unfavorable conditions for data acquisition and regrettably had to cancel the Leg 2 mission. Today they transited from BRW to ANC to uninstall instruments. This concludes the September ArcticAIR campaign.



Left. Completion of turning mooring BF2, CK9/NRS1 and transit to DBO4 in the NE Chukchi Sea.

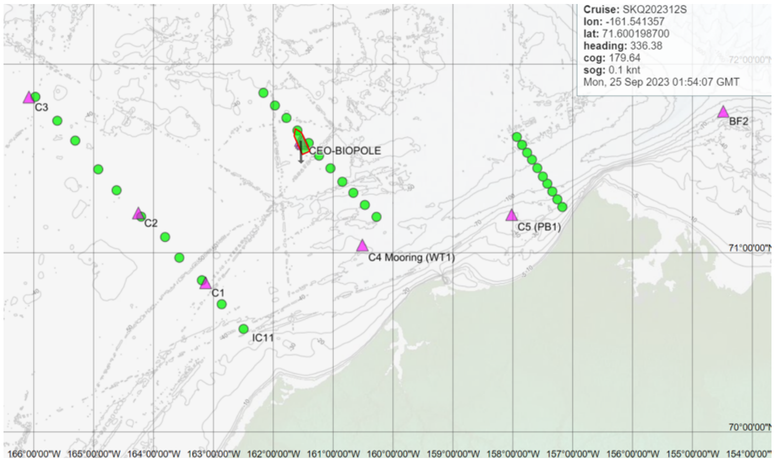
September 23, 2023

This is the daily email update for September 23 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

Here is our daily update: Last night we sampled some inshore stations on DBO4. At first light this morning we recovered and deployed moorings at C4. We recovered a mammal acoustic listening mooring and deployed an oceanographic mooring. We will spend the rest of the day and into the night sampling stations along DBO4. Marine mammals sighted today included spotted seals and gray whales. The whales (2 of them) were feeding as evidenced by the mud plumes released from their baleen. Seabirds seen included turnstones, loons, and crested auklets. Weather has markedly improved for operations and seabird and marine mammal observations. Tomorrow, we anticipate working at the CEO mooring site, which is about 60 nautical miles offshore.

September 24, 2023

This is the daily email update for September 24 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas. Here is our daily update:
We spent today recovering and deploying moorings at the CEO site on DBO4. The Chukchi Ecosystem Observatory (CEO) mooring array includes a sediment trap, environmental DNA sample collectors, ocean acidification sensors, and passive acoustics. After mooring operations, we will finish sampling the stations on DBO4. Tomorrow morning, we will return to CEO to deploy the final mooring. Our next transect to sample is the line at Icy Cape (see IC11 on the map).

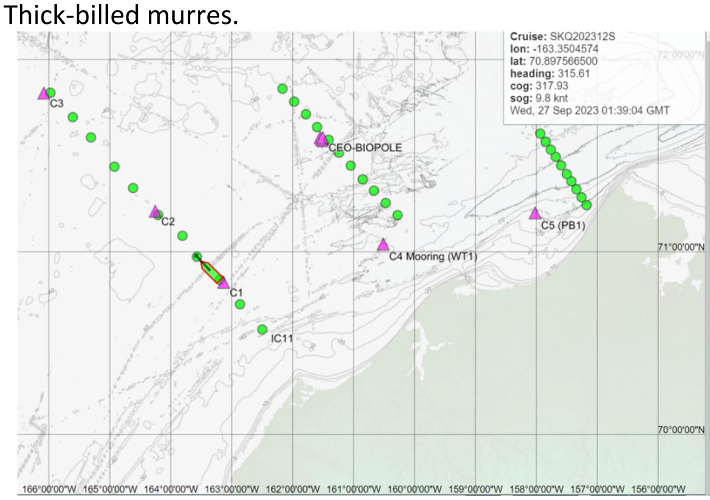


Left. Mid-way occupying stations on the DBO4 line.

September 25 and 26, 2023

This is the daily email update for September 25 and 26 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas. Here is our daily update:
Yesterday, September 25, we deployed the final CEO mooring, a tripod that carried a benthic camera system.

Today and tomorrow, we are sampling the stations on the Icy Cape line. We are also deploying and recovering oceanographic and marine mammal acoustic moorings along the line. At the nearshore stations the water was warmer than has been in more offshore areas, likely due to the Alaska Coastal Current. Somewhat unusually, we found more saline waters closer to the coast and fresher waters offshore. Zooplankton where mostly small copepods nearshore with more large copepods as we moved offshore. Lots of broken and dead sand dollars were caught in the benthic grab nearshore, possibly because we were upstream of the area where high concentrations of sand dollars have been observed in the past. The beam trawl catch included sea stars, sculpins, and Arctic cod. Few marine mammals were seen, which was not surprising based on previous aerial surveys of marine mammals. There were 3 spotted seals near the C1 mooring. A few kittiwakes, loons, and shearwaters were seen; also a couple of Thick-billed murres.

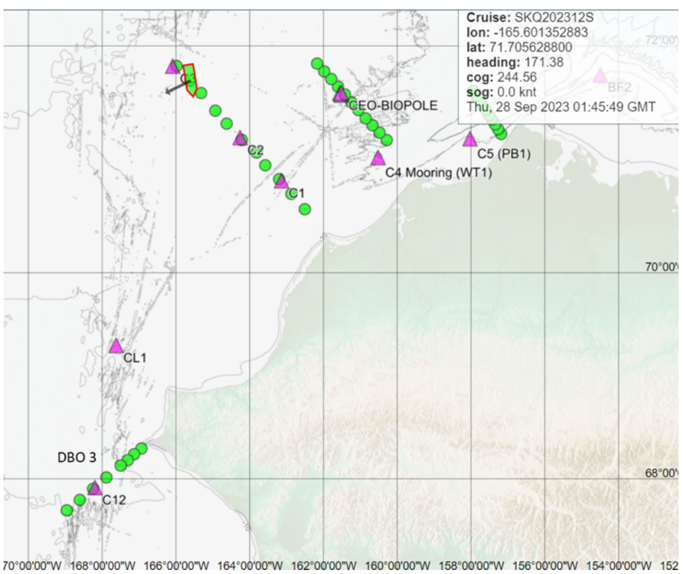


Left. Completion of DBO4 stations in NE Chukchi sea, long with the C5, C4, and CEO-BIOPOLE moorings. The map also shows the stations occupied along the Icy Cape (IC) line (stations IC1-IC11), along with the the C1, C2, C1 moorings.

September 27, 2023
This is the daily email update for September 27 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas. Here is our daily update:

Today we recovered two moorings and deployed one at C2 on the Icy Cape Line. These were oceanographic and marine mammal acoustic listening moorings. We then spent the rest of the day sampling stations on the Line. Zooplankton tows were mostly jellyfish and small copepods. The beam trawl and grab will be deployed at stations later this evening. Seabird observations featured lots of Crested Auklets. No marine mammals were observed. Winds have been very light over the last day, averaging 0-10 mph.

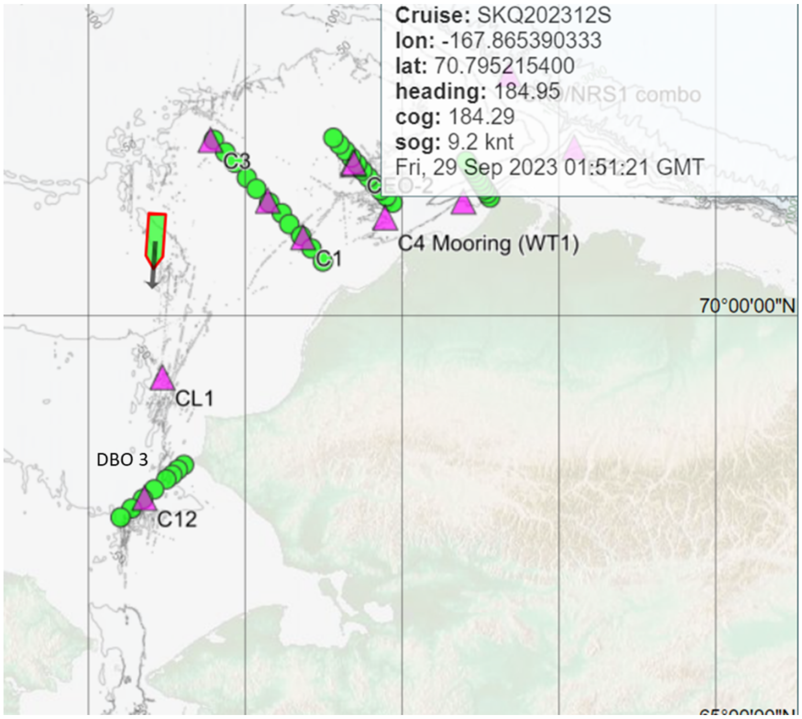
Tomorrow we will steam to DBO 3 (about 200 nautical miles away).



Left. Completion of Icy Cape (IC) line (stations IC1-IC11) after turning C1 NS moorings.

September 28, 2023
This is the daily email update for September 28 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas. Here is our daily update:
Early this morning, we deployed and oceanographic mooring at C15 (not shown on map) at the offshore end of the Icy Cape line. We are now steaming towards DBO 3 and should arrive there tomorrow afternoon. We will then start sampling those stations and working the mooring on the line. No marine mammals were observed during the transit today. Likewise none were heard on the sonobuoys that were deployed. These instruments are cast off the ship and listen for marine mammal acoustic signals in

real time. Seabirds observed include shearwaters, Crested Auklets (although fewer than yesterday) and murres (more than yesterday). The weather continues to be fine (low winds and seas) and most of the scientists spent the day resting, running samples, and entering data in preparation for another few busy days sampling DBO 3 coming up.



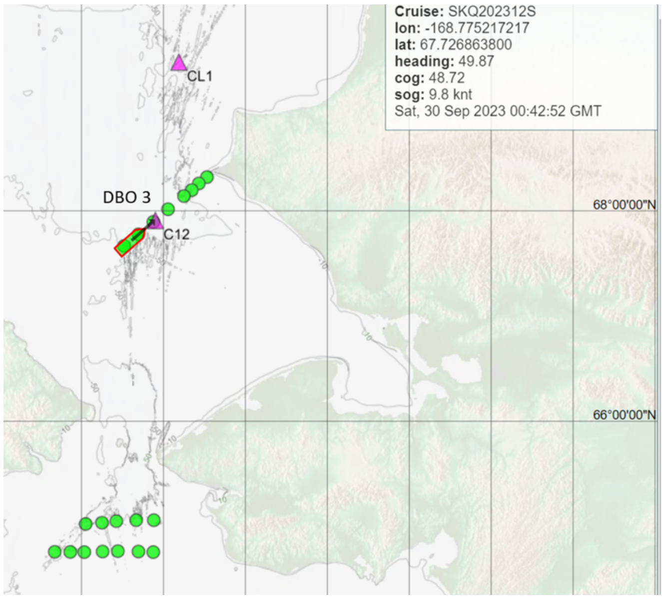
Left. The map shows the transit to stations at DBO3. Along the way we turned the CL1 mooring.

September 29, 2023

This is the daily email update for September 29 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

Here is our daily update: This afternoon we started sampling the DBO 3 line. The benthic grab catches on the first station (on the offshore end of the transect) had plentiful large clams (of the Macoma genus). The beam trawl catch was highly diverse, with crabs, shrimp, sea anemones, sea stars, snails, sculpin, flatfish, cods, and other organisms. The zooplankton catch was composed of euphausiids, large and small copepods, naked pteropods and comb jellies. It was a great day for marine mammal observations. A total of 32 gray whales were observed during the steam south towards DBO 3. They were in scattered groups of 3-5 whales. A humpback whale and a large flock of shearwaters (approximately 1200 birds) was observed when we arrived at the first, offshore, station. Other seabirds observed today included puffins and crested auklets. Seven spectacled eiders and 6 unidentified ducks were also seen. Winds came down through the day from about 15-20 kts to approximately 10 kts. As we have gotten closer to Bering Strait, the surface nutrient levels have increased somewhat, and we continue to see indications of an early fall phytoplankton bloom. Water salinity near the US-Russia Convention Line was very fresh at the surface (salinity ~ 26) and salty near the seafloor (salinity ~ 32). Water temperature from the surface to the seafloor is close to 37 F.

Tomorrow we will continue sampling along DBO 3 and work the mooring on the line.



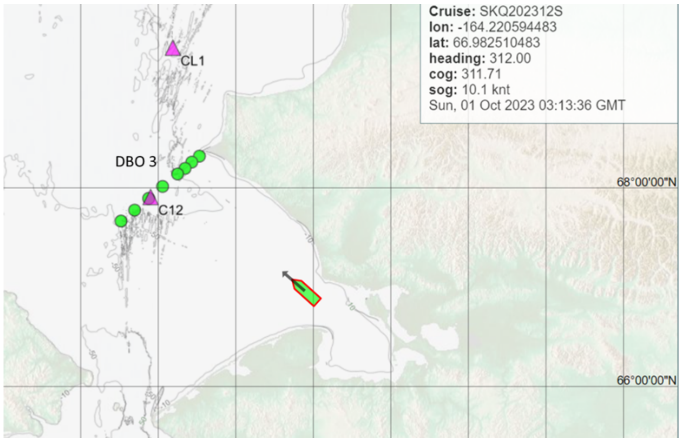
Left. The map shows the stations on the DBO3 line. Along the way we turned the CL12 mooring.

September 30, 2023

This is the daily email update for September 30 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

Here is our daily update: Today we steamed to Kotzebue to get a critical missing part for the eDNA sampler we will deploy on the mooring at C12. We greatly appreciate the efforts of Alex Whiting and Bobby Schaeffer of Kotzebue for delivering the part, and Lindsay Cameron and Kimberly Pikok from UIC in Utqiagvik for getting the part shipped to Kotzebue. One spotted seal was seen in Kotzebue Sound, no other marine mammals were observed. A large number of shearwaters were seen on the way into the Sound. Other birds seen today included cormorants, loons, unidentified sea ducks and white-winged scoters. The observers on the bridge were also treated to a beautiful rainbow this afternoon! The underway sampling system on the ship detected relatively elevated nutrient levels that were associated with low salinities (< 26), presumably from river water. An increase in near-surface phytoplankton concentrations was observed just outside of the Sound.

We are currently steaming away from Kotzebue back to the DBO-3 line. Tomorrow we will do station sampling on DBO-3 and turn around two moorings at C12.

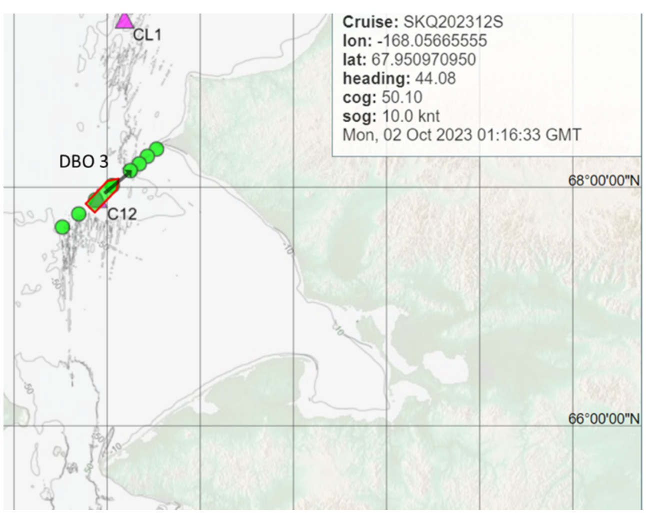


Left. The map shows the stations on the DBO3 line. Halfway along the line we diverted to Kotzebue to pick up a computer circuit board for the eDNA mooring sampler.

October 1, 2023

This is the daily email update for October 1 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

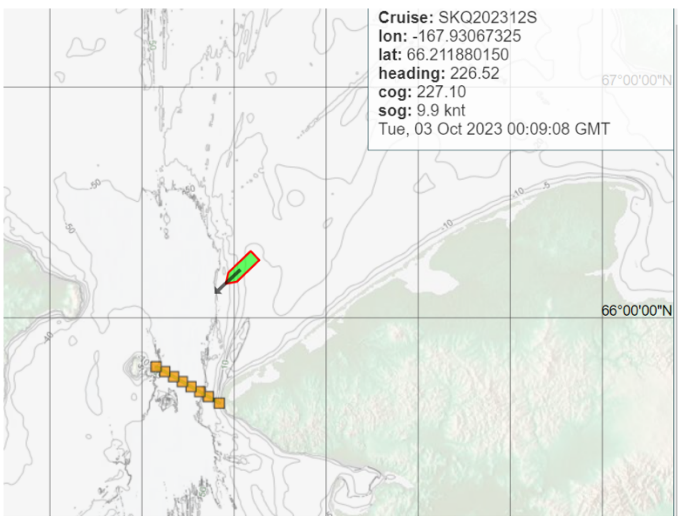
Here is our daily update: The first station (DBO 3.4) in the morning was diverse and interesting. The plankton nets had a lot of euphausiids and large copepods. The beam trawl caught sea urchins, basket stars, shrimp, cods and eelblennies. There were dozens of little sand dollars in the grab sample. We then recovered two moorings at C12: a RAS sampler that collects and preserves water samples for nutrients and an acoustic marine mammal mooring. The RAS sampler had been deployed for three years, so we are curious to see how the samples have fared! We deployed two moorings at C12: an eDNA sampling mooring and a marine mammal acoustic mooring. Observing conditions for seabirds and marine mammals weren't good this morning, due to wind waves and swells. Conditions improved this afternoon, and 14 gray whales were seen as we crossed longitude 168. A couple of loons and a smattering of kittiwakes were seen today as well as some jaegers. Winds were strong overnight (25 kts) and the seas were lumpy this morning. The wind backed down this afternoon to about 15 kts under blue skies and high atmospheric pressure. We will finish sampling DBO3 this evening.



Left. The map shows the stations on the DBO3 line. We completd the line after returning from the Kotzebue pickup of a necessary part for the eDNA sampler.

October 2, 2023
This is the daily email update for October 2 associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas. Here is our daily update:
We finished sampling the DBO 3-line late last night. Today we have been steaming south towards Bering Strait. It's been a great day for marine mammal observations. Over 40 humpback whales were seen, a few fin whales and gray whales and one minke whale. The whales were seen where the water shoals off the Seward Peninsula. A lot of shearwaters were seen in that area, too.

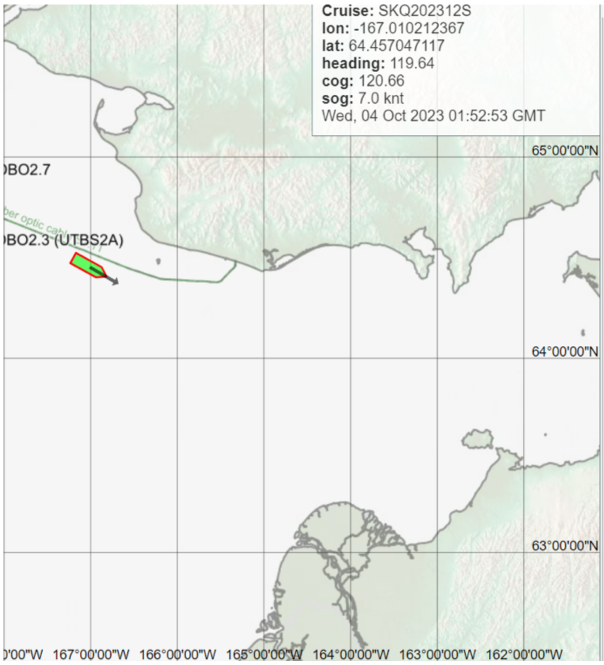
We have extra time before we end the cruise in Nome on Wednesday so we will sample a line of stations across Bering Strait (orange squares in the map below) tonight. We will conduct CTD casts with water samples and bongo tows. These stations, although not part of the DBO group of transects, have been sampled on previous cruises. Tomorrow we will deploy a marine mammal acoustic mooring and then steam towards Nome, likely arriving around midnight.



Left. The map shows the transit to the Bering Strait stations.

October 3, 2023
This is the final daily email update (October 3) associated with the fall 2023 Sikuliaq ecosystem research cruise to the northern Bering and Chukchi seas. Sampling includes temperature and salinity data, water samples, plankton, seafloor animals, larval fish, and bottom sediments to better understand the ecosystem status and trends and potential effects of climate change, ocean acidification and harmful algal blooms. We are also collecting observations of seabirds and marine mammals. The team will also be servicing moorings in both the Bering and Chukchi Seas.

Here is our daily update: We spent the day steaming towards Nome and packing up our gear, supplies and samples. We were lucky that the weather cooperated with clear skies and relatively calm seas. Despite the good observing conditions, no marine mammals were seen. There were few seabirds: some kittiwakes and one duck. There was a bit of drama as a jaeger engaged in a "dogfight" with a kittiwake in an attempt to steal any prey the kittiwake was carrying. Jaegers are kleptoparasites which is a way of feeding by deliberately taking food from another animal. On the Bering Strait hydrographic transect last night and today we crossed a number of "fronts" that separate coastal from offshore waters. Relative to conditions on either side, the fronts were often associated with changes in the near-surface nutrient and chlorophyll a concentrations. We will arrive in Nome tomorrow morning where most of the scientists will disembark and fly home.



Left. Transit for offloading science personnel in Nome, Alaska on Oct 4.

For those of you in Nome, you can learn more about our research at Strait Science on Thursday! See the announcement below.

****

Join us at UAF NW Campus Main Building or via ZOOM for the next presentation in our Strait Science series…

R/V SIKULIAQ RETURNS: NEWS FROM THE SEA!

Thursday, October 5 | 6:30 pm | ZOOM OR VIA PHONE OR NW CAMPUS MAIN BUILDING

SIKULIAQ is pulling into Nome soon! Working together, researchers collected at-sea information to better understand the status of the marine ecosystem in the Bering and Chukchi seas. Take advantage of this opportunity to get first-hand accounts of their science mission, what they collected (and why), what they saw, and thoughts on the status of our changing marine ecosystem.

Join Zoom Meeting
https://tinyurl.com/8aj4mt6n
Meeting ID: 874 9293 6730 Passcode: 056726
Or call: 253 215 8782

Jackie Grebmeier is a Professor at the Univ. of Maryland Center for Environmental Science. Seth Danielson is an Associate Professor at the UA College of Fisheries and Ocean Sciences.
****

October 4, 2023-Docked at 0800. Offload most science personnel with personal gear and samples. All cargo palletized and ready for DEMOB in Dutch Harbor. Departure at 2000.

October 5-7, 2023: 5 science personnel sailed to Dutch Harbor for possible M2 mooring retrieval and DEMOB in Dutch Harbor: David Strauz, Luis, Savannah Sandy, Deana Crouser, and newly arrived Pete Shipton.

October 8, 2023-Demob for SKQ23-12S occurred in Dutch Harbor, AK

Flier distributed by UAF/SeaGrant for the October 5th post-cruise *Strait Science* presentation.

4.0 Acknowledgements

We thank the Captain and crew of the RV Sikuliaq for excellent shipboard support to facilitate a fully successful cruise. We thank Gay Sheffield in Nome, Alex Whiting and Bobby Schaeffer in Kotzebue and Lindsay Cameron of UIC Science in Utqiagvik for logistics support during the cruise. Funding for the cruise activities was provided by NOAA, AOOS, NPRB, NSF, USFWS, ONR and UAF.

Appendix: Cruise Activity Event Log: SKQ23-12S

Message ID	GPS_Time	Instrument	Action	Transect	Station	Cast	Latitude	Longitude	Seafloor	Author	Comment
1	9/10/23 16:05	Ship	startCruise	NaN	NaN	NaN	53.903804	-166.525287		cGreto1	Last line @ 0805 local, 1605 UTC
2	9/10/23 16:13	UHDAS	start	NaN	NaN	NaN	53.902648	-166.524847		bMcKiernan1	Start logging CB is flush
3	9/10/23 16:13	EM302	start	NaN	NaN	NaN	53.902538	-166.524832		bMcKiernan1	start logging
4	9/10/23 16:13	EK80	start	NaN	NaN	NaN	53.902434	-166.524818		bMcKiernan1	start logging CB flush
5	9/10/23 16:38	pCO2	start	NaN	NaN	NaN	53.906307	-166.489229		bMcKiernan1	Start logging
6	9/10/23 16:39	Underway Science seawater	start	NaN	NaN	NaN	53.906756	-166.488584		bMcKiernan1	Start logging from bow intake
7	9/10/23 16:54	UHDAS	stop	NaN	NaN	NaN	53.926603	-166.488722		bMcKiernan1	Stopped recording for the UHDAS to lower CB
8	9/10/23 16:55	EK80	stop	NaN	NaN	NaN	53.926853	-166.48871		bMcKiernan1	Stopped recording to lower CB
9	9/10/23 17:07	Centerboard	deploy	NaN	NaN	NaN	53.934922	-166.48827		bMcKiernan1	CB Deployed
10	9/10/23 17:08	UHDAS	start	NaN	NaN	NaN	53.935717	-166.488306		bMcKiernan1	WH300 with CB Deployed
11	9/10/23 17:09	EK80	start	NaN	NaN	NaN	53.938051	-166.488641		bMcKiernan1	recording with CB deployed
12	9/10/23 17:18	IFCB	start	NaN	NaN	NaN	53.961392	-166.491594		bMcKiernan1	Started NOAA unit
13	9/10/23 19:37	UHDAS	other	NaN	NaN	NaN	54.336436	-166.332442		bMcKiernan1	Stop and start WH300 without bottom track and internal trigger due to 1000 meter water depth.
14	9/10/23 23:45	IFCB	start	NaN	NaN	NaN	55.050434	-165.736114		hCynar1	Started WHOI unit
15	9/11/23 1:26	UHDAS	other	NaN	NaN	NaN	55.347186	-165.454804		cGreto1	stopped/started to bring WH300 into K-Sync
16	9/11/23 5:42	UHDAS	other	NaN	NaN	NaN	56.135851	-165.89858		cGreto1	Stopped/started for BT on WH300
17	9/11/23 20:19	Underway Science seawater	service	NaN	NaN	NaN	58.882937	-167.530585		cGreto1	Strainer swap

18	9/12/23 23:14	Underway Science seawater	service	NaN	NaN	NaN	63.957814	-165.886116		cGreto1	Strainer swap
19	9/13/23 2:45	EK80	stop	NaN	NaN	NaN	64.452459	-165.472489		cGreto1	Stopped while hove to 3nm from Nome
20	9/13/23 2:46	EM302	stop	NaN	NaN	NaN	64.452527	-165.472488		cGreto1	Stopped logging while hove to 3nm from Nome
21	9/13/23 1:55	Underway Science seawater	other	NaN	NaN	NaN	64.386209	-165.559147		hCynar1	Overflight sampling (UW-1)
22	9/13/23 6:31	EK80	start	NaN	NaN	NaN	64.463898	-165.473229		cGreto1	Underway from Nome 3nm to M8
23	9/13/23 6:31	EM302	start	NaN	NaN	NaN	64.463685	-165.473649		cGreto1	Underway from Nome 3nm to M8
24	9/11/23 15:11	Underway Science seawater	other	NaN	NaN	NaN	57.92071	-166.945202		hCynar1	Dissolved gas sampling (#605)
26	9/12/23 2:42	Underway Science seawater	other	NaN	NaN	NaN	60.148974	-168.321254		hCynar1	Dissolved gas sampling (#571)
27	9/12/23 19:03	Underway Science seawater	other	NaN	NaN	NaN	63.200633	-166.476409		hCynar1	Dissolved gas sampling (#1310)
28	9/13/23 16:39	Underway Science seawater	other	NaN	NaN	NaN	62.923139	-167.324206		hCynar1	Dissolved gas sampling (#298)
29	9/13/23 18:42	Underway Science seawater	other	NaN	NaN	NaN	62.789552	-167.970953		hCynar1	Overflight sampling (UW-2)
30	9/13/23 20:29	Underway Science seawater	other	NaN	NaN	NaN	62.731002	-168.617346		hCynar1	Overflight sampling (UW-3)
31	9/13/23 2:52	Underway Science seawater	service	NaN	NaN	NaN	64.452762	-165.472428		cGreto1	Strainer swap
32	9/14/23 13:25	CTD	deploy	DBO1	M8 Mooring	001	62.194476	-174.674127	73	sDanielson1	
33	9/14/23 14:05	CTD	recover	DBO1	M8 Mooring	001	62.194534	-174.673999	73	sDanielson1	

34	9/14/23 16:21	Mooring	recover	NaN	Mooring 21BST -8A	NaN	62.198257	-174.673779		dStrausz1	
35	9/14/23 17:58	Mooring	recover	NaN	NaN	NaN	62.202176	-174.659594		dStrausz1	recover 22 BSITAER-8A
36	9/14/23 19:27	Mooring	recover	NaN	NaN	NaN	62.198674	-174.667511		dStrausz1	Recover 22BS-8A
37	9/14/23 22:01	Mooring	deploy	NaN	NaN	NaN	62.200074	-174.680166		dStrausz1	23BSST-8A Deployment
38	9/15/23 1:20	Mooring	deploy	NaN	NaN	NaN	62.19837	-174.663587		dStrausz1	23BS-8A
39	9/15/23 3:13	Mooring	deploy	NaN	NaN	NaN	62.201993	-174.661192		dStrausz1	23BSITAER-8A deploy
40	9/15/23 5:22	CTD	deploy	DBO1	DBO1.1	002	62.009815	-175.06073	79	sDanielson1	
41	9/15/23 5:53	CTD	recover	DBO1	DBO1.1	002	62.009803	-175.061233	79	sDanielson1	
42	9/15/23 6:23	Van Veen Grab	other	DBO1	DBO1.1	NaN	62.009793	-175.061236	80	jGrebmeier1	1/5 SLIP1
43	9/15/23 6:32	Van Veen Grab	other	DBO1	DBO1.1	NaN	62.009794	-175.061244	80	jGrebmeier1	2/5 SLIP1
44	9/15/23 6:47	Van Veen Grab	other	DBO1	DBO1.1	NaN	62.009795	-175.061253	80	jGrebmeier1	4/5 SLIP1
45	9/15/23 6:53	Van Veen Grab	other	DBO1	DBO1.1	NaN	62.009789	-175.061235	80	jGrebmeier1	5/5 SLIP1
46	9/15/23 6:40	Van Veen Grab	other	DBO1	DBO1.1	NaN	62.009792	-175.061241	80	jGrebmeier1	3/5 SLIP1
47	9/15/23 7:58	CTD	deploy	DBO1	DBO1.2	003	62.050093	-175.209056	80	sDanielson1	
48	9/15/23 8:28	CTD	recover	DBO1	DBO1.2	003	62.049975	-175.209841	80	sDanielson1	
49	9/15/23 10:29	Bongo Net	deploy	DBO1	DBO1.2	3	62.050213	-175.210322	80	eLogerwell1	
50	9/15/23 11:24	beam trawl	deploy	DBO1	DBO1.2	1	62.04817	-175.20452		kIken1	
51	9/15/23 11:30	beam trawl	on bottom	DBO1	DBO1.2	1	62.048664	-175.198946		kIken1	
52	9/15/23 11:37	beam trawl	off bottom	DBO1	DBO1.2	1	62.049322	-175.192987		kIken1	
53	9/15/23 11:44	beam trawl	recover	DBO1	DBO1.2	1	62.049301	-175.188299		kIken1	
54	9/15/23 17:17	Mooring	deploy	NaN	NaN	NaN	62.204765	-174.676423		dStrausz1	23BSP-8A Deployment
55	9/15/23 18:58	Mooring	deploy	NaN	NaN	NaN	62.205877	-174.667617		dStrausz1	23BSV-8A deploy
56	9/15/23 19:56	CTD	deploy	DBO1	DBO1.3	004	62.218795	-174.876662	75	sSandy1	No water collected
57	9/15/23 20:09	CTD	recover	DBO1	DBO1.3	004	62.218795	-174.876665	75	sSandy1	
58	9/15/23 9:32	Van Veen Grab	other	DBO1	DBO1.2	NaN	62.050213	-175.210313	80	jGrebmeier1	1/5 SLIP2
59	9/15/23 9:39	Van Veen Grab	other	DBO1	DBO1.2	NaN	62.050212	-175.210319	80	jGrebmeier1	2/5 SLIP2
60	9/15/23 9:45	Van Veen Grab	other	DBO1	DBO1.2	NaN	62.050206	-175.210314	80	jGrebmeier1	3/5 SLIP2
61	9/15/23 9:51	Van Veen Grab	other	DBO1	DBO1.2	NaN	62.05021	-175.210327	80	jGrebmeier1	4/5 SLIP2

62	9/15/23 9:58	Van Veen Grab	other	DBO1	DBO1.2	NaN	62.050209	-175.210328	80	jGrebmeier1	5/5 SLIP2
63	9/15/23 10:45	Haps Corer	other	DBO1	DBO1.2	NaN	62.050209	-175.21032	80	jGrebmeier1	Deployment 1, short cores
64	9/15/23 11:15	Haps Corer	other	DBO1	DBO1.2	NaN	62.049686	-175.21029	80	jGrebmeier1	Deployment 2, full cores
65	9/15/23 21:19	Bongo Net	deploy	DBO1	DBO1.3	BON002	62.301248	-174.741978	76	eLogerwell1	
66	9/15/23 22:09	CTD	deploy	DBO1	DBO1.4	005	62.389762	-174.569592	70	sSandy1	
67	9/15/23 22:10	CPICS	deploy	NaN	NaN	NaN	62.389767	-174.569592		eLogerwell1	
68	9/15/23 22:38	CTD	recover	DBO1	DBO1.4	005	62.38977	-174.569589	70	sSandy1	
69	9/15/23 22:46	Bongo Net	deploy	DBO1	DBO1.4	5	62.38966	-174.570466	70	eLogerwell1	
70	9/16/23 0:27	beam trawl	deploy	DBO1	DBO1.4	2	62.389237	-174.573495		kIken1	
71	9/16/23 0:30	beam trawl	on bottom	DBO1	DBO1.4	2	62.388669	-174.576124		kIken1	
72	9/16/23 0:40	beam trawl	off bottom	DBO1	DBO1.4	2	62.387045	-174.584376		kIken1	
73	9/16/23 0:46	beam trawl	recover	DBO1	DBO1.4	2	62.386084	-174.589235		kIken1	
74	9/16/23 2:34	CTD	deploy	DBO1	DBO1.5	006	62.467739	-174.084586	67	sSandy1	Dry cast
75	9/16/23 2:39	Underway Science seawater	service	NaN	NaN	NaN	62.467759	-174.084746		cGreto1	Strainer swap
76	9/16/23 2:47	CTD	recover	DBO1	DBO1.5	006	62.467771	-174.084862	67	sSandy1	Dry cast
77	9/16/23 4:45	CTD	deploy	DBO1	DBO1.6	007	62.559379	-173.550209	65	sSandy1	
78	9/16/23 5:12	CTD	recover	DBO1	DBO1.6	007	62.559515	-173.550006	65	sSandy1	
79	9/16/23 5:34	Bongo Net	deploy	DBO1	DBO1.6	7	62.561918	-173.55753		eLogerwell1	
80	9/16/23 10:51	CTD	deploy	DBO1	DBO1.8	009	63.028402	-173.460605	71	sSandy1	
81	9/16/23 11:20	CTD	recover	DBO1	DBO1.8	009	63.028394	-173.460593	71	sSandy1	
82	9/16/23 11:25	Bongo Net	deploy	DBO1	DBO1.8	9	63.028443	-173.459703		eLogerwell1	
83	9/16/23 13:06	beam trawl	deploy	DBO1	DBO1.8	3	63.031531	-173.459551		kIken1	
84	9/16/23 13:06	beam trawl	on bottom	DBO1	DBO1.8	3	63.031423	-173.459672		kIken1	
85	9/16/23 13:16	beam trawl	off bottom	DBO1	DBO1.8	3	63.03567	-173.455187		kIken1	
86	9/16/23 13:23	beam trawl	recover	DBO1	DBO1.8	3	63.038282	-173.452732		kIken1	
87	9/16/23 15:34	CTD	deploy	DBO1	DBO1.9	010	63.27951	-173.279517	70	sDanielson1	
88	9/16/23 15:48	CTD	recover	DBO1	DBO1.9	010	63.279516	-173.279513	70	sDanielson1	

89	9/16/23 8:58	CTD	deploy	DBO1	DBO1.7	008	62.786493	-173.499958	68	sDanielson1	
90	9/16/23 5:05	CTD	recover	DBO1	DBO1.7	008	62.559365	-173.550166	68	sDanielson1	
91	9/16/23 18:43	CTD	deploy	DBO1	DBO1.10	011	63.604201	-172.594505	52	sSandy1	Dry cast
92	9/16/23 18:54	CTD	recover	DBO1	DBO1.10	011	63.605163	-172.59713	52	sSandy1	Dry cast
93	9/14/23 2:30	Underway Science seawater	other				62.537993	-170.824905		hCynar1	Dissolved gas sampling (#191)
94	9/14/23 16:04	Underway Science seawater	other				62.198678	-174.673404		hCynar1	Dissolved gas sampling (#284)
95	9/15/23 20:52	Underway Science seawater	other				62.243223	-174.852377		hCynar1	Dissolved gas sampling (#262)
96	9/16/23 20:48	Underway Science seawater	other				63.854108	-172.228536		hCynar1	Dissolved gas sampling (#243)
97	9/15/23 21:01	Underway Science seawater	other				62.262603	-174.815689		hCynar1	Underway O2 Sample (#334)
98	9/15/23 21:02	Underway Science seawater	other				62.264759	-174.811632		hCynar1	Underway O2 Sample (#352)
99	9/16/23 20:55	Underway Science seawater	other				63.871298	-172.20273		hCynar1	Underway O2 Sample (#353)
100	9/16/23 20:57	Underway Science seawater	other				63.876229	-172.195339		hCynar1	Underway O2 Sample (#331)
101	9/17/23 0:01	Underway Science seawater	service	NaN	NaN	NaN	64.288341	-171.418086		cGreto1	Strainer swap
102	9/17/23 3:40	CTD	deploy	DBO2	DBO2.0	012	64.672407	-170.642511	47	sSandy1	
103	9/17/23 4:03	CTD	recover	DBO2	DBO2.0	012	64.670407	-170.639449	47	sSandy1	Choppy
104	9/17/23 4:15	Bongo Net	deploy	DBO2	DBO2.0	12	64.670539	-170.639436		eLogerwell1	
105	9/15/23 23:19	Van Veen Grab	other	DBO1	DBO1.4	NaN	62.38951	-174.571586	70	jGrebmeier1	1/5 SLIP3
106	9/15/23 23:26	Van Veen Grab	other	DBO1	DBO1.4	NaN	62.389539	-174.571549	70	jGrebmeier1	2/5 SLIP3
107	9/15/23 23:34	Van Veen Grab	other	DBO1	DBO1.4	NaN	62.38958	-174.571497	70	jGrebmeier1	3/5 SLIP3

108	9/15/23 23:41	Van Veen Grab	other	DBO1	DBO1.4	NaN	62.389612	-174.571475	70	jGrebmeier1	4/5 SLIP3
109	9/15/23 23:49	Van Veen Grab	other	DBO1	DBO1.4	NaN	62.389646	-174.571441	70	jGrebmeier1	5/5 SLIP3
110	9/16/23 5:48	Van Veen Grab	other	DBO1	DBO1.6	NaN	62.560735	-173.553564	66	jGrebmeier1	1/5 SLIP5
111	9/16/23 5:55	Van Veen Grab	other	DBO1	DBO1.6	NaN	62.560731	-173.553499	66	jGrebmeier1	2/5 SLIP5
112	9/16/23 6:02	Van Veen Grab	other	DBO1	DBO1.6	NaN	62.560717	-173.553457	65	jGrebmeier1	3/5 SLIP5
113	9/16/23 6:10	Van Veen Grab	other	DBO1	DBO1.6	NaN	62.56071	-173.553398	65	jGrebmeier1	4/5 SLIP5
114	9/16/23 6:17	Van Veen Grab	other	DBO1	DBO1.6	NaN	62.560705	-173.553336	65	jGrebmeier1	5/5 SLIP5
115	9/16/23 6:52	Haps Corer	other	DBO1	DBO1.6	NaN	62.560689	-173.553226	66	jGrebmeier1	LEGACY HAPS; SLIP5
116	9/16/23 6:59	Haps Corer	other	DBO1	DBO1.6	NaN	62.560689	-173.553221	66	jGrebmeier1	LEGACY HAPS; SLIP5
117	9/16/23 11:57	Van Veen Grab	other	DBO1	DBO1.8	NaN	63.030279	-173.460019	72	jGrebmeier1	1/5 SLIP4
118	9/16/23 12:05	Van Veen Grab	other	DBO1	DBO1.8	NaN	63.030258	-173.459992	72	jGrebmeier1	2/5 SLIP4
119	9/16/23 12:14	Van Veen Grab	other	DBO1	DBO1.8	NaN	63.030226	-173.460088	71	jGrebmeier1	3/5 SLIP4
120	9/16/23 12:22	Van Veen Grab	other	DBO1	DBO1.8	NaN	63.030203	-173.460052	71	jGrebmeier1	4/5 SLIP 4
121	9/16/23 12:31	Van Veen Grab	other	DBO1	DBO1.8	NaN	63.030176	-173.460026	72	jGrebmeier1	5/5 SLIP4
122	9/17/23 4:48	Van Veen Grab	other	DBO2	DBO2.0	NaN	64.672913	-170.645053	47	jGrebmeier1	1/5 BCL6-C
123	9/17/23 4:56	Van Veen Grab	other	DBO2	DBO2.0	NaN	64.673075	-170.645756	47	jGrebmeier1	2/5 BCL6-C
124	9/17/23 5:02	Van Veen Grab	other	DBO2	DBO2.0	NaN	64.673227	-170.646096	47	jGrebmeier1	3/5 BCL6-C
125	9/17/23 5:07	Van Veen Grab	other	DBO2	DBO2.0	NaN	64.673406	-170.646307	47	jGrebmeier1	4/5 BCL6-C
126	9/17/23 5:12	Van Veen Grab	other	DBO2	DBO2.0	NaN	64.673498	-170.646534	47	jGrebmeier1	5/5 BCL6-C
127	9/17/23 6:55	CTD	deploy	DBO2	DBO2.0A	013	64.672558	-170.263299	48	sSandy1	Dry cast
128	9/17/23 7:08	CTD	recover	DBO2	DBO2.0A	013	64.672639	-170.261987	48	sSandy1	Dry cast
129	9/17/23 8:27	CTD	deploy	DBO2	DBO2.1	014	64.669235	-169.920172	47	sSandy1	
130	9/17/23 8:54	CTD	recover	DBO2	DBO2.1	014	64.669377	-169.920005	47	sSandy1	
131	9/17/23 9:00	Bongo Net	deploy	DBO2	DBO2.1	14	64.669593	-169.919602		eLogerwell1	
132	9/17/23 10:08	beam trawl	deploy	DBO2	DBO2.1	4	64.671456	-169.924294		kIken1	
133	9/17/23 10:11	beam trawl	on bottom	DBO2	DBO2.1	4	64.672225	-169.927144		kIken1	
134	9/17/23 10:18	beam trawl	off bottom	DBO2	DBO2.1	4	64.674014	-169.932324		kIken1	
135	9/17/23 10:24	beam trawl	recover	DBO2	DBO2.1	4	64.675554	-169.937705		kIken1	

136	9/17/23 13:40	CTD	deploy	DBO2	DBO2.2	016	64.679371	-169.100056	45	sDanielson1	
137	9/17/23 14:00	CTD	recover	DBO2	DBO2.2	016	64.679336	-169.100103	45	sDanielson1	
138	9/17/23 14:24	Bongo Net	recover	DBO2	DBO2.2	016	64.679729	-169.105186		eLogerwell1	
139	9/17/23 12:12	CTD	deploy	DBO2	DBO2.1A	015	64.674214	-169.47117	44	sDanielson1	
140	9/17/23 12:22	CTD	recover	DBO2	DBO2.1A	015	64.673452	-169.471983	44	sDanielson1	
141	9/17/23 15:15	beam trawl	deploy	DBO2	DBO2.2	5	64.679362	-169.102793		kIken1	
142	9/17/23 15:20	beam trawl	on bottom	DBO2	DBO2.2	5	64.680262	-169.107307		kIken1	
143	9/17/23 15:28	beam trawl	off bottom	DBO2	DBO2.2	5	64.68151	-169.114046		kIken1	
144	9/17/23 15:32	beam trawl	recover	DBO2	DBO2.2	5	64.682188	-169.118194		kIken1	
145	9/10/23 21:32	sonobuoy	deploy	NaN	NaN	NaN	54.648684	-166.047545		dwright1	SKQ202312S
147	9/11/23 1:05	sonobuoy	deploy	NaN	NaN	NaN	55.283946	-165.505788		dwright1	
148	9/10/23 22:05	sonobuoy	deploy	NaN	NaN	NaN	54.74705	-165.976109		dwright1	
149	9/11/23 8:15	sonobuoy	deploy	NaN	NaN	NaN	56.607657	-166.170034		dwright1	
150	9/11/23 4:44	sonobuoy	deploy	NaN	NaN	NaN	55.958873	-165.799566		dwright1	
151	9/11/23 15:45	sonobuoy	deploy	NaN	NaN	NaN	58.027313	-167.01015		dwright1	
152	9/15/23 21:07	sonobuoy	deploy	NaN	NaN	NaN	62.275529	-174.791257		dwright1	
153	9/16/23 4:15	sonobuoy	deploy	NaN	NaN	NaN	62.542669	-173.652068		dwright1	
154	9/16/23 13:03	sonobuoy	deploy	NaN	NaN	NaN	63.03032	-173.460256		dwright1	
155	9/16/23 18:17	sonobuoy	deploy	NaN	NaN	NaN	63.565725	-172.673969		dwright1	
156	9/16/23 22:58	sonobuoy	deploy	NaN	NaN	NaN	64.157031	-171.674717		dwright1	
157	9/17/23 5:50	sonobuoy	deploy	NaN	NaN	NaN	64.675113	-170.628058		dwright1	
158	9/17/23 7:50	sonobuoy	deploy	NaN	NaN	NaN	64.670101	-170.056038		dwright1	
159	9/17/23 17:31	CTD	deploy	DBO2	DBO2.2A	017	64.67639	-168.595596	43	sDanielson1	
160	9/17/23 17:39	CTD	recover	DBO2	DBO2.2A	017	64.676374	-168.595622	43	sDanielson1	
161	9/17/23 18:53	CTD	deploy	DBO2	DBO2.3	018	64.668595	-168.237624	37	sSandy1	
162	9/17/23 19:10	CTD	recover	DBO2	DBO2.3	018	64.668921	-168.2366	37	sSandy1	
163	9/17/23 19:14	Bongo Net	deploy	DBO2	DBO2.3	018	64.668957	-168.237919		eLogerwell1	
164	9/17/23 22:27	CTD	deploy	DBO2	DBO2.7	019	64.99989	-168.221583	45	sSandy1	

165	9/17/23 22:49	CTD	recover	DBO2	DBO2.7	019	64.999895	-168.221571	45	sSandy1	
166	9/17/23 23:08	Bongo Net	recover	DBO2	DBO2.7	019	65.001086	-168.225662		eLogerwell1	
167	9/17/23 23:14	Underway Science seawater	service	NaN	NaN	NaN	65.001039	-168.225636		cGreto1	Strainer swap
168	9/18/23 1:14	CTD	deploy	DBO2	DBO2.6	020	65.000703	-168.652698	47	sSandy1	Dry cast
169	9/18/23 1:25	CTD	recover	DBO2	DBO2.6	020	65.001172	-168.653588	47	sSandy1	
170	9/18/23 2:52	CTD	deploy	DBO2	DBO2.5	021	64.990991	-169.138211	48	sSandy1	
171	9/18/23 3:14	CTD	recover	DBO2	DBO2.5	021	64.992129	-169.138858	48	sSandy1	
172	9/18/23 3:19	Bongo Net	recover	DBO2	DBO2.5	021	64.99193	-169.138003		eLogerwell1	
173	9/17/23 3:27	Underway Science seawater	other				64.666719	-170.651753		hCynar1	Dissolved gas sampling (#626)
174	9/17/23 20:44	Underway Science seawater	other				64.759719	-168.238001		hCynar1	Dissolved gas sampling (#294)
175	9/18/23 4:40	Underway Science seawater	other				64.990019	-169.204211		hCynar1	Dissolved gas sampling (#1468)
176	9/17/23 3:31	Underway Science seawater	other				64.672573	-170.641675		hCynar1	Underway O2 Sample (#351)
177	9/17/23 3:32	Underway Science seawater	other				64.672809	-170.641586		hCynar1	Underway O2 Sample (#332)
178	9/18/23 5:32	CTD	deploy	DBO2	DBO2.4A	022	64.975125	-169.487044	48	sSandy1	Dry cast
179	9/18/23 5:44	CTD	recover	DBO2	DBO2.4A	022	64.975075	-169.487275	48	sSandy1	Dry cast
180	9/18/23 7:02	CTD	deploy	DBO2	DBO2.4	023	64.961593	-169.883492	48	sSandy1	
181	9/18/23 7:24	CTD	recover	DBO2	DBO2.4	023	64.961703	-169.883601	48	sSandy1	
182	9/18/23 8:00	Bongo Net	recover	DBO2	DBO2.4	023	64.963948	-169.891287		eLogerwell1	
183	9/18/23 8:31	beam trawl	deploy	DBO2	DBO2.4	6	64.965784	-169.888841		kIken1	
184	9/18/23 8:34	beam trawl	on bottom	DBO2	DBO2.4	6	64.966958	-169.889023		kIken1	
185	9/18/23 8:43	beam trawl	off bottom	DBO2	DBO2.4	6	64.971002	-169.889332		kIken1	
186	9/18/23 8:48	beam trawl	recover	DBO2	DBO2.4	6	64.972978	-169.889164		kIken1	

187	9/18/23 15:26	Underway Science seawater	service	NaN	NaN	NaN	65.577268	-168.384302		bMcKiernan1	swapped filter
188	9/19/23 16:30	Underway Science seawater	service	NaN	NaN	NaN	69.149173	-166.448698		bMcKiernan1	swapped strainer
189	9/19/23 10:41	Underway Science seawater	other				68.305454	-167.756034		hCynar1	Overflight sampling (UW-4)
190	9/19/23 11:33	Underway Science seawater	other				68.445494	-167.661539		hCynar1	Overflight sampling (UW-5)
192	9/18/23 20:39	Underway Science seawater	other				66.132576	-168.395012		hCynar1	Dissolved gas sampling (#195)
193	9/19/23 20:25	Underway Science seawater	other				69.614233	-165.121716		hCynar1	Dissolved gas sampling (#1341)
194	9/19/23 22:33	Underway Science seawater	service	NaN	NaN	NaN	69.920505	-164.574273		cGreto1	Strainer swap
195	9/20/23 14:25	Mooring	deploy	NaN	C5	NaN	71.208546	-158.000114	49	dStrausz1	Deploy 23CKP-5A
196	9/20/23 14:59	Mooring	deploy	NaN	NaN	C5 PB01	71.204313	-157.999508		dwright1	Deploy PB01 MM mooring
197	9/20/23 16:33	Mooring	recover	NaN	PB01 recover	NaN	71.20793	-157.998744		dwright1	22 pb01 recover
198	9/20/23 17:31	Mooring	recover	NaN	NaN	C5	71.260824	-157.996324	74	dStrausz1	22ckp5a recover
199	9/20/23 21:07	CTD	deploy	DBO5	DBO5.1	025	71.246868	-157.16398	46	sSandy1	
200	9/20/23 21:27	CTD	recover	DBO5	DBO5.1	025	71.246835	-157.164385	46	sSandy1	Choppy
202	9/20/23 23:13	CTD	deploy	DBO5	DBO5.2	026	71.287718	-157.245942	56	sSandy1	
203	9/20/23 23:40	CTD	recover	DBO5	DBO5.2	026	71.287831	-157.244766	56	sSandy1	
204	9/21/23 1:08	CTD	deploy	DBO5	DBO5.3	027	71.329925	-157.331768	91	sSandy1	
205	9/21/23 1:36	CTD	recover	DBO5	DBO5.3	027	71.329981	-157.331326	91	sSandy1	
206	9/21/23 2:07	Bongo Net	recover	DBO5	DBO5.3	027	71.33377	-157.336072		eLogerwell1	
207	9/21/23 3:02	UHDAS	other	NaN	NaN	NaN	71.369888	-157.413408		cGreto1	Stopped and Started WH300 to turn off BT
208	9/21/23 3:15	CTD	deploy	DBO5	DBO5.4	028	71.372341	-157.415483	112	sSandy1	

209	9/21/23 3:45	CTD	recover	DBO5	DBO5.4	028	71.372941	-157.409604	112	sSandy1	
210	9/21/23 5:06	EM302	stop	NaN	NaN	NaN	71.409058	-157.492749		cGreto1	System crash. Rebooting...
211	9/21/23 5:17	EM302	start	NaN	NaN	NaN	71.409126	-157.490352		cGreto1	SYstem un-crash
212	9/21/23 5:35	CTD	recover	DBO5	DBO5.5	029	71.409175	-157.487505	124	sSandy1	
213	9/21/23 4:58	CTD	deploy	DBO5	DBO5.5	029	71.409026	-157.494776	124	sSandy1	
214	9/21/23 5:40	Bongo Net	deploy	DBO5	DBO5.5	029	71.408896	-157.486627		eLogerwell1	
215	9/21/23 7:26	CTD	deploy	DBO5	DBO5.6	030	71.455161	-157.590805	109	sSandy1	
216	9/21/23 8:00	CTD	recover	DBO5	DBO5.6	030	71.455203	-157.588959	109	sSandy1	
219	9/21/23 11:26	Bongo Net	recover	DBO5	DBO5.7	031	71.501768	-157.676496		eLogerwell1	
217	9/21/23 9:42	CTD	deploy	DBO5	DBO5.7	031	71.499136	-157.672825	81	sDanielson1	
218	9/21/23 10:18	CTD	recover	DBO5	DBO5.7	031	71.498999	-157.673774	81	sDanielson1	
220	9/21/23 11:28	beam trawl	deploy	DBO5	DBO5.7	7	71.502866	-157.678486		kIken1	
221	9/21/23 11:33	beam trawl	on bottom	DBO5	DBO5.7	7	71.504471	-157.681396		kIken1	
222	9/21/23 11:41	beam trawl	off bottom	DBO5	DBO5.7	7	71.508068	-157.685868		kIken1	
223	9/21/23 11:48	beam trawl	recover	DBO5	DBO5.7	7	71.510776	-157.689534		kIken1	
224	9/21/23 12:36	CTD	deploy	DBO5	DBO5.8	032	71.536403	-157.751433	71	sDanielson1	
225	9/21/23 13:05	CTD	recover	DBO5	DBO5.8	032	71.536404	-157.751362	71	sDanielson1	
226	9/21/23 14:20	CTD	deploy	DBO5	DBO5.9	033	71.577582	-157.836995	66	sDanielson1	
227	9/21/23 14:31	Underway Science seawater	service	NaN	NaN	NaN	71.577525	-157.837328		bMcKiernan1	swapped filter
228	9/21/23 14:52	CTD	recover	DBO5	DBO5.9	033	71.577329	-157.838398	66	sDanielson1	
229	9/21/23 15:01	Bongo Net	deploy	NaN	NaN	33	71.577464	-157.83772		eLogerwell1	
230	9/21/23 16:37	CTD	deploy	DBO5	DBO5.10	034	71.619166	-157.923982		sDanielson1	
231	9/21/23 16:58	CTD	recover	DBO5	DBO5.10	034	71.619016	-157.924615		sDanielson1	
232	9/21/23 16:58	CTD	recover	DBO5	DBO5.10	034	71.619016	-157.924615	62	sDanielson1	
233	9/21/23 17:42	beam trawl	deploy	DBO5	DBO5.10	8	71.620596	-157.931222		kIken1	
234	9/21/23 17:46	beam trawl	on bottom	DBO5	DBO5.10	8	71.621602	-157.933969		kIken1	
235	9/21/23 17:54	beam trawl	off bottom	DBO5	DBO5.10	8	71.624341	-157.940292		kIken1	

236	9/21/23 17:59	beam trawl	recover	DBO5	DBO5.10	8	71.626131	-157.944952		kIken1	
237	9/22/23 0:01	Underway Science seawater	service	NaN	NaN	NaN	71.7523	-155.362057		cGreto1	Strainer swap
238	9/21/23 4:33	Underway Science seawater	other				71.384082	-157.435236		hCynar1	Overflight sampling (UW-6)
239	9/21/23 7:08	Underway Science seawater	other				71.439012	-157.554187		hCynar1	Overflight sampling (UW-7)
240	9/22/23 1:54	CTD	deploy	NaN	BF2	035	71.751449	-154.460848	88	sDanielson1	NMML Mooring AU_BF2
241	9/22/23 2:24	CTD	recover	NaN	BF2	035	71.75052	-154.455536	88	sDanielson1	
242	9/22/23 3:35	Mooring	recover	NaN	NaN	NaN	71.751375	-154.4568		dwright1	Recover AL_22_AU_BF2
243	9/22/23 4:19	Mooring	deploy	NaN	NaN	BF2	71.75405	-154.475994	104	dwright1	AL23_AU_BF2 Deploy
244	9/22/23 14:07	CTD	deploy	NaN	NaN	CK9	72.465344	-156.546311	990	sDanielson1	
245	9/22/23 15:33	CTD	recover	NaN	NaN	CK9	72.464588	-156.547064	990	sDanielson1	
246	9/22/23 18:31	Mooring	deploy	NaN	CK9	NaN	72.470097	-156.570891		dStrausz1	Deploy 23CKP-9A
247	9/20/23 0:40	Underway Science seawater	other				70.242631	-164.10961		hCynar1	Dissolved gas sampling (#192)
248	9/20/23 19:34	Underway Science seawater	other				71.326344	-157.0908		hCynar1	Dissolved gas sampling (#210)
249	9/20/23 3:33	Underway Science seawater	other				70.516554	-162.87176		hCynar1	Dissolved gas sampling (#275)
250	9/21/23 13:45	Underway Science seawater	other				71.539144	-157.755692		hCynar1	Dissolved gas sampling (#211)
251	9/22/23 18:36	Underway Science seawater	other				72.470693	-156.574294		hCynar1	Dissolved gas sampling (#1369)
252	9/22/23 19:24	Underway Science seawater	service	NaN	NaN	NaN	72.374044	-156.60417		bMcKiernan1	swapped filter
253	9/22/23 21:24	EM302	stop	NaN	NaN	NaN	72.053768	-156.698654		cGreto1	Archive syncing issue.
254	9/22/23 23:20	EM302	start	NaN	NaN	NaN	71.732592	-156.784624		cGreto1	Sync issue resolved.

255	9/23/23 1:15	UHDAS	other	NaN	NaN	NaN	71.53216	-157.358566		cGreto1	Stopped and Started WH300 to turn on BT
256	9/23/23 7:57	CTD	deploy	DBO4	DBO4.1n	037	71.192468	-160.266103	54	sSandy1	
257	9/23/23 8:24	CTD	recover	DBO4	DBO4.1n	037	71.192444	-160.266251	54	sSandy1	
258	9/23/23 8:34	Bongo Net	deploy	NaN	NaN	36	71.192344	-160.266708		eLogerwell1	
259	9/23/23 10:46	CTD	deploy	DBO4	DBO4.1na	038	71.257509	-160.462204	51	sSandy1	Dry cast
260	9/23/23 10:57	CTD	recover	DBO4	DBO4.1na	038	71.257481	-160.462298	51	sSandy1	Dry cast
261	9/23/23 11:49	CTD	deploy	DBO4	DBO4.2n	039	71.321884	-160.651499	48	sDanielson1	
262	9/23/23 12:16	CTD	recover	DBO4	DBO4.2n	039	71.321497	-160.651985	48	sDanielson1	
263	9/23/23 12:23	Bongo Net	deploy	NaN	NaN	38	71.321305	-160.652407		eLogerwell1	
264	9/23/23 13:53	beam trawl	deploy	DBO4	DBO4.2	9	71.325534	-160.663662		kIken1	
265	9/23/23 13:56	beam trawl	on bottom	DBO4	DBO4.2	9	71.326183	-160.66648		kIken1	
266	9/23/23 14:02	beam trawl	off bottom	DBO4	DBO4.2	9	71.327758	-160.673246		kIken1	
267	9/23/23 14:07	beam trawl	recover	DBO4	DBO4.2	9	71.328957	-160.678223		kIken1	
268	9/23/23 17:06	CTD	deploy	NaN	C4	040	71.040683	-160.497583	50	sDanielson1	Mooring C4
269	9/23/23 17:16	CTD	recover	NaN	C4	040	71.040359	-160.497963	50	sDanielson1	
270	9/23/23 17:58	Mooring	recover	NaN	NaN	NaN	71.042547	-160.491295	50	dwright1	WT1 Recovery
271	9/23/23 18:43	Mooring	deploy	NaN	NaN	C4	71.045125	-160.49068		dStrausz1	Deploy 23CKP-4A
272	9/23/23 19:33	Underway Science seawater	service	NaN	NaN	NaN	71.149533	-160.597363		bMcKiernan1	swapped filter
273	9/23/23 21:12	CTD	deploy	DBO4	DBO4.2na	041	71.381468	-160.839812	47	sSandy1	Dry cast
274	9/23/23 21:23	CTD	recover	DBO4	DBO4.2na	041	71.381478	-160.8398	47	sSandy1	Dry cast
275	9/24/23 4:50	CTD	deploy	DBO4	DBO4.3n	042	71.453596	-161.037725	48	sDanielson1	
276	9/24/23 5:14	CTD	recover	DBO4	DBO4.3n	042	71.45286	-161.03936	47	sSandy1	
277	9/24/23 5:53	Bongo Net	recover	DBO4	DBO4.3	042	71.455133	-161.050167		eLogerwell1	
278	9/24/23 7:15	CTD	deploy	DBO4	DBO4.3na	043	71.520991	-161.230016	47	sSandy1	Dry cast
279	9/24/23 7:25	CTD	recover	DBO4	DBO4.3na	043	71.52079	-161.230784	47	sSandy1	Dry cast
280	9/24/23 8:12	CTD	deploy	DBO4	DBO4.4n	044	71.586395	-161.394818	47	sSandy1	

281	9/24/23 8:37	CTD	recover	DBO4	DBO4.4n	044	71.58584	-161.396611	47	sSandy1	
282	9/24/23 8:47	Bongo Net	deploy	NaN	NaN	44	71.585822	-161.396688		eLogerwell1	
283	9/24/23 10:06	beam trawl	deploy	DBO4	DBO4.4	10	71.589531	-161.405547		kIken1	
284	9/24/23 10:09	beam trawl	on bottom	DBO4	DBO4.4	10	71.59053	-161.408529		kIken1	
285	9/24/23 10:15	beam trawl	off bottom	DBO4	DBO4.4	10	71.592198	-161.413222		kIken1	
286	9/24/23 10:20	beam trawl	recover	DBO4	DBO4.4	10	71.593744	-161.417509		kIken1	
287	9/24/23 18:19	EM302	stop	NaN	NaN	NaN	71.591181	-161.533603		bMcKiernan1	stopped pinging for acoustic release of mooring
288	9/24/23 18:19	EK80	stop	NaN	NaN	NaN	71.591186	-161.533507		bMcKiernan1	stopped pinging for acoustic release of mooring
289	9/24/23 19:13	Underway Science seawater	service	NaN	NaN	NaN	71.588875	-161.525623		bMcKiernan1	swapped filter
290	9/24/23 19:15	EM302	start	NaN	NaN	NaN	71.588981	-161.525485		bMcKiernan1	Abandoned mooring reenabled pinging
291	9/24/23 19:15	EK80	start	NaN	NaN	NaN	71.589023	-161.525521		bMcKiernan1	Abandoned mooring reenabled pinging
292	9/24/23 19:40	CTD	deploy	DBO4	CEO2	046	71.598123	-161.536531	46	sSandy1	
293	9/24/23 20:09	CTD	recover	DBO4	CEO2	046	71.597957	-161.537502	46	sSandy1	
294	9/25/23 3:05	CTD	deploy	DBO4	DBO4.5n	047	71.71934	-161.772136	44	sSandy1	
295	9/25/23 3:26	CTD	recover	DBO4	DBO4.5n	047	71.719185	-161.77278	044	sSandy1	
296	9/25/23 4:30	Bongo Net	recover	DBO4	DBO4.4n	045	71.721617	-161.778881		eLogerwell1	
297	9/25/23 5:45	CTD	deploy	DBO4	DBO4.5na	048	71.785462	-161.965173	42	sSandy1	Dry cast
298	9/25/23 5:55	CTD	recover	DBO4	DBO4.5na	048	71.785456	-161.965212	42	sSandy1	Dry cast
299	9/25/23 6:42	CTD	deploy	DBO4	DBO4.6n	049	71.850073	-162.156733	41	sSandy1	
300	9/25/23 7:04	CTD	recover	DBO4	DBO4.6n	049	71.850071	-162.156745	41	sSandy1	
301	9/25/23 7:07	Bongo Net	deploy	DBO4	DBO4.6n	049	71.850071	-162.156748		eLogerwell1	
302	9/25/23 8:38	beam trawl	deploy	DBO4	DBO4.6	11	71.853619	-162.162066		kIken1	
303	9/25/23 8:41	beam trawl	on bottom	DBO4	DBO4.6	11	71.85369	-162.157262		kIken1	
304	9/25/23 8:47	beam trawl	off bottom	DBO4	DBO4.6	11	71.853848	-162.149791		kIken1	

305	9/25/23 8:51	beam trawl	recover	DBO4	DBO4.6	11	71.854087	-162.143375		kIken1	
306	9/25/23 16:59	Mooring	deploy	DBO4	CEO23-tripod	NaN	71.599922	-161.459851	47	sDanielson1	
307	9/25/23 22:12	UHDAS	stop	NaN	NaN	NaN	71.590428	-161.518421		cGreto1	Stopped to survey Tripod mooring
308	9/24/23 2:10	Underway Science seawater	other				71.180986	-160.110847		hCynar1	Underway O2 Sample (#328)
309	9/24/23 2:11	Underway Science seawater	other				71.182653	-160.117224		hCynar1	Underway O2 Sample (#371)
310	9/25/23 0:41	Underway Science seawater	other				71.599741	-161.539827		hCynar1	Underway O2 Sample (#355)
311	9/25/23 0:42	Underway Science seawater	other				71.60002	-161.540151		hCynar1	Underway O2 Sample (#356)
312	9/23/23 9:16	Underway Science seawater	other				71.194666	-160.270199		hCynar1	Dissolved gas sampling (#286)
313	9/24/23 2:03	Underway Science seawater	other				71.169578	-160.065638		hCynar1	Dissolved gas sampling (#293)
314	9/24/23 20:47	Underway Science seawater	other				71.599901	-161.516699		hCynar1	Dissolved gas sampling (#1383)
315	9/25/23 22:22	Underway Science seawater	other				71.592011	-161.530225		hCynar1	Dissolved gas sampling (#305)
316	9/17/23 9:21	Van Veen Grab	other	DBO2	DBO2.1	NaN	64.670461	-169.920595	47	jGrebmeier1	1/5 UTBS5
317	9/17/23 9:26	Van Veen Grab	other	DBO2	DBO2.1	NaN	64.670445	-169.920645	47	jGrebmeier1	2/5 UTBS5
318	9/17/23 9:32	Van Veen Grab	other	DBO2	DBO2.1	NaN	64.670511	-169.920521	47	jGrebmeier1	3/5 UTBS5
319	9/17/23 9:37	Van Veen Grab	other	DBO2	DBO2.1	NaN	64.670537	-169.920498	47	jGrebmeier1	4/5 UTBS5
320	9/17/23 9:43	Van Veen Grab	other	DBO2	DBO2.1	NaN	64.670576	-169.920451	47	jGrebmeier1	5/5 UTBS5
321	9/17/23 14:34	Van Veen Grab	other	DBO2	DBO2.2	NaN	64.678919	-169.101522	45	jGrebmeier1	1/5 UTBS2
322	9/17/23 14:39	Van Veen Grab	other	DBO2	DBO2.2	NaN	64.678959	-169.101474	45	jGrebmeier1	2/5 UTBS2
323	9/17/23 14:44	Van Veen Grab	other	DBO2	DBO2.2	NaN	64.678998	-169.101419	45	jGrebmeier1	3/5 UTBS2

324	9/17/23 14:49	Van Veen Grab	other	DBO2	DBO2.2	NaN	64.679022	-169.101385	45	jGrebmeier1	4/5 UTBS2
325	9/17/23 14:55	Van Veen Grab	other	DBO2	DBO2.2	NaN	64.679057	-169.101315	45	jGrebmeier1	5/5 UTBS2
326	9/17/23 19:28	Van Veen Grab	other	DBO2	DBO2.3	NaN	64.669548	-168.243558	38	jGrebmeier1	1/5 UTBS2A
327	9/17/23 19:34	Van Veen Grab	other	DBO2	DBO2.3	NaN	64.669615	-168.243462	38	jGrebmeier1	2/5 UTBS2A
328	9/17/23 19:40	Van Veen Grab	other	DBO2	DBO2.3	NaN	64.669614	-168.24345	38	jGrebmeier1	3/5 UTBS2A
329	9/17/23 19:45	Van Veen Grab	other	DBO2	DBO2.3	NaN	64.669658	-168.243403	38	jGrebmeier1	4/5 UTBS2A
330	9/17/23 19:52	Van Veen Grab	other	DBO2	DBO2.3	NaN	64.669498	-168.2433	38	jGrebmeier1	5/5 UTBS2A
331	9/17/23 23:08	Van Veen Grab	other	DBO2	DBO2.7	NaN	65.001086	-168.225665	46	jGrebmeier1	5-Jan
332	9/17/23 23:12	Van Veen Grab	other	DBO2	DBO2.7	NaN	65.001038	-168.225637	45	jGrebmeier1	5-Feb
333	9/17/23 23:18	Van Veen Grab	other	DBO2	DBO2.7	NaN	65.001017	-168.22569	45	jGrebmeier1	5-Mar
334	9/17/23 23:24	Van Veen Grab	other	DBO2	DBO2.7	NaN	65.000951	-168.225763	46	jGrebmeier1	5-Apr
335	9/17/23 23:29	Van Veen Grab	other	DBO2	DBO2.7	NaN	65.000911	-168.225753	46	jGrebmeier1	5-May
336	9/18/23 3:36	Van Veen Grab	other	DBO2	DBO2.5	NaN	64.99418	-169.144193	49	jGrebmeier1	5-Jan
337	9/18/23 3:42	Van Veen Grab	other	DBO2	DBO2.5	NaN	64.994188	-169.144236	49	jGrebmeier1	5-Feb
338	9/18/23 3:49	Van Veen Grab	other	DBO2	DBO2.5	NaN	64.99421	-169.144288	48	jGrebmeier1	5-Mar
339	9/18/23 3:55	Van Veen Grab	other	DBO2	DBO2.5	NaN	64.994234	-169.144341	48	jGrebmeier1	5-Apr
340	9/18/23 3:59	Van Veen Grab	other	DBO2	DBO2.5	NaN	64.994246	-169.144383	49	jGrebmeier1	5-May
341	9/18/23 7:53	Van Veen Grab	other	DBO2	DBO2.4	NaN	64.963946	-169.891198	48	jGrebmeier1	5-Jan
342	9/18/23 7:58	Van Veen Grab	other	DBO2	DBO2.4	NaN	64.963944	-169.891133	48	jGrebmeier1	5-Feb
343	9/18/23 8:01	Van Veen Grab	other	DBO2	DBO2.4	NaN	64.963947	-169.891355	48	jGrebmeier1	5-Mar
344	9/18/23 8:07	Van Veen Grab	other	DBO2	DBO2.4	NaN	64.963954	-169.891055	48	jGrebmeier1	5-Apr
345	9/18/23 8:11	Van Veen Grab	other	DBO2	DBO2.4	NaN	64.963952	-169.891008	48	jGrebmeier1	5-May
346	9/20/23 21:52	Van Veen Grab	other	DBO5	DBO5.1	NaN	71.248457	-157.167774	47	jGrebmeier1	1/3 BarC1
347	9/20/23 21:57	Van Veen Grab	other	DBO5	DBO5.1	NaN	71.248414	-157.167742	47	jGrebmeier1	2/3 BarC1
348	9/20/23 22:12	Van Veen Grab	other	DBO5	DBO5.1	NaN	71.248374	-157.167712	48	jGrebmeier1	3/3 BarC1
349	9/20/23 23:53	Van Veen Grab	other	DBO5	DBO5.2	NaN	71.287842	-157.244645	56	jGrebmeier1	1/2 BarC2
350	9/20/23 23:59	Van Veen Grab	other	DBO5	DBO5.2	NaN	71.287898	-157.244077	56	jGrebmeier1	2/2 BarC2
351	9/21/23 2:09	Van Veen Grab	other	DBO5	DBO5.3	NaN	71.333749	-157.335926	92	jGrebmeier1	1/2 BarC3

352	9/21/23 2:17	Van Veen Grab	other	DBO5	DBO5.3	NaN	71.33381	-157.335975	92	jGrebmeier1	2/2 BarC3
353	9/21/23 3:56	Van Veen Grab	other	DBO5	DBO5.4	NaN	71.372968	-157.409177	111	jGrebmeier1	1/2 BarC4
354	9/21/23 4:05	Van Veen Grab	other	DBO5	DBO5.4	NaN	71.372973	-157.408946	111	jGrebmeier1	2/2 BarC4
355	9/21/23 6:06	Van Veen Grab	other	DBO5	DBO5.5	NaN	71.411517	-157.486512	125	jGrebmeier1	1/2 BarC5
356	9/21/23 6:15	Van Veen Grab	other	DBO5	DBO5.5	NaN	71.411545	-157.485978	124	jGrebmeier1	2/2 BarC5
357	9/21/23 8:13	Van Veen Grab	other	DBO5	DBO5.6	NaN	71.455161	-157.588874	110	jGrebmeier1	1/2 BarC6
358	9/21/23 8:21	Van Veen Grab	other	DBO5	DBO5.6	NaN	71.45511	-157.589609	110	jGrebmeier1	2/2 BarC6
359	9/21/23 11:01	Van Veen Grab	other	DBO5	DBO5.7	NaN	71.501378	-157.675115	82	jGrebmeier1	1/2 BarC7
360	9/21/23 11:09	Van Veen Grab	other	DBO5	DBO5.7	NaN	71.501403	-157.674641	82	jGrebmeier1	2/2 BarC7
361	9/21/23 13:17	Van Veen Grab	other	DBO5	DBO5.8	NaN	71.536389	-157.751384	72	jGrebmeier1	1/2 BarC8
362	9/21/23 13:26	Van Veen Grab	other	DBO5	DBO5.8	NaN	71.536446	-157.750993	72	jGrebmeier1	2/2 BarC8
363	9/21/23 15:27	Van Veen Grab	other	DBO5	DBO5.9	NaN	71.579244	-157.842554	64	jGrebmeier1	1/2 BarC9
364	9/21/23 15:34	Van Veen Grab	other	DBO5	DBO5.9	NaN	71.57897	-157.84396	64	jGrebmeier1	2/2 BarC9
365	9/21/23 17:08	Van Veen Grab	other	DBO5	DBO5.10	NaN	71.618921	-157.925061	62	jGrebmeier1	1/2 BarC10
366	9/21/23 17:17	Van Veen Grab	other	DBO5	DBO5.10	NaN	71.618896	-157.925189	62	jGrebmeier1	2/2 BarC10
367	9/23/23 8:56	Van Veen Grab	other	DBO4	DBO4.1n	NaN	71.194668	-160.270202	52	jGrebmeier1	5-Jan
368	9/23/23 9:02	Van Veen Grab	other	DBO4	DBO4.1n	NaN	71.194667	-160.270216	53	jGrebmeier1	5-Feb
369	9/23/23 9:08	Van Veen Grab	other	DBO4	DBO4.1n	NaN	71.194666	-160.270224	53	jGrebmeier1	5-Mar
370	9/23/23 9:12	Van Veen Grab	other	DBO4	DBO4.1n	NaN	71.194671	-160.270211	53	jGrebmeier1	5-Apr
371	9/23/23 9:17	Van Veen Grab	other	DBO4	DBO4.1n	NaN	71.194667	-160.270212	53	jGrebmeier1	5-May
372	9/23/23 12:40	Van Veen Grab	other	DBO4	DBO4.2n	NaN	71.32341	-160.657075	48	jGrebmeier1	5-Jan
373	9/23/23 12:46	Van Veen Grab	other	DBO4	DBO4.2n	NaN	71.323405	-160.657128	49	jGrebmeier1	5-Feb
374	9/23/23 12:52	Van Veen Grab	other	DBO4	DBO4.2n	NaN	71.323331	-160.65733	49	jGrebmeier1	5-Mar
375	9/23/23 12:57	Van Veen Grab	other	DBO4	DBO4.2n	NaN	71.323359	-160.65725	49	jGrebmeier1	5-Apr
376	9/23/23 13:03	Van Veen Grab	other	DBO4	DBO4.2n	NaN	71.323331	-160.657321	48	jGrebmeier1	5-May
377	9/23/23 13:24	Haps Corer	other	DBO4	DBO4.2n	NaN	71.323588	-160.656336	49	jGrebmeier1	1/2 LEGACY HAPS
378	9/23/23 13:33	Haps Corer	other	DBO4	DBO4.2n	NaN	71.323587	-160.656332	49	jGrebmeier1	2/2 LEGACY HAPS
379	9/24/23 5:52	Van Veen Grab	other	DBO4	DBO4.3n	NaN	71.455131	-161.050157	46	jGrebmeier1	5-Jan

380	9/24/23 5:59	Van Veen Grab	other	DBO4	DBO4.3n	NaN	71.455139	-161.050153	47	jGrebmeier1	5-Feb
382	9/24/23 6:09	Van Veen Grab	other	DBO4	DBO4.3n	NaN	71.455102	-161.050018	47	jGrebmeier1	5-Apr
383	9/24/23 6:02	Van Veen Grab	other	DBO4	DBO4.3n	NaN	71.455117	-161.050094	48	jGrebmeier1	5-Mar
384	9/24/23 6:14	Van Veen Grab	other	DBO4	DBO4.3n	NaN	71.455086	-161.049966	47	jGrebmeier1	5-May
385	9/24/23 9:05	Van Veen Grab	other	DBO4	DBO4.4n	NaN	71.58794	-161.402441	47	jGrebmeier1	5-Jan
386	9/24/23 9:10	Van Veen Grab	other	DBO4	DBO4.4n	NaN	71.587925	-161.402488	47	jGrebmeier1	5-Feb
387	9/24/23 9:15	Van Veen Grab	other	DBO4	DBO4.4n	NaN	71.587875	-161.402676	46	jGrebmeier1	5-Mar
388	9/24/23 9:20	Van Veen Grab	other	DBO4	DBO4.4n	NaN	71.587831	-161.402844	47	jGrebmeier1	5-Apr
389	9/24/23 9:25	Van Veen Grab	other	DBO4	DBO4.4n	NaN	71.58782	-161.402894	47	jGrebmeier1	5-May
390	9/24/23 9:42	Haps Corer	other	DBO4	DBO4.4n	NaN	71.587979	-161.402291	47	jGrebmeier1	1/2 LEGACY HAPS
391	9/24/23 9:50	Haps Corer	other	DBO4	DBO4.4n	NaN	71.587999	-161.40221	47	jGrebmeier1	2/2 LEGACY HAPS
392	9/25/23 4:01	Van Veen Grab	other	DBO4	DBO4.5n	NaN	71.721497	-161.778675	44	jGrebmeier1	5-Jan
393	9/25/23 4:07	Van Veen Grab	other	DBO4	DBO4.5n	NaN	71.72152	-161.77872	44	jGrebmeier1	5-Feb
394	9/25/23 4:12	Van Veen Grab	other	DBO4	DBO4.5n	NaN	71.721533	-161.778792	44	jGrebmeier1	5-Mar
395	9/25/23 4:17	Van Veen Grab	other	DBO4	DBO4.5n	NaN	71.721557	-161.778832	44	jGrebmeier1	5-Apr
396	9/25/23 4:22	Van Veen Grab	other	DBO4	DBO4.5n	NaN	71.721582	-161.778878	44	jGrebmeier1	5-May
397	9/25/23 7:36	Van Veen Grab	other	DBO4	DBO4.6n	NaN	71.853412	-162.169456	41	jGrebmeier1	5-Jan
398	9/25/23 7:42	Van Veen Grab	other	DBO4	DBO4.6n	NaN	71.853424	-162.169326	41	jGrebmeier1	5-Feb
399	9/25/23 7:46	Van Veen Grab	other	DBO4	DBO4.6n	NaN	71.853425	-162.169238	41	jGrebmeier1	5-Mar
400	9/25/23 7:51	Van Veen Grab	other	DBO4	DBO4.6n	NaN	71.853429	-162.169162	41	jGrebmeier1	5-Apr
401	9/25/23 7:56	Van Veen Grab	other	DBO4	DBO4.6n	NaN	71.853428	-162.169154	42	jGrebmeier1	5-May
402	9/25/23 8:13	Haps Corer	other	DBO4	DBO4.6n	NaN	71.853434	-162.16908	41	jGrebmeier1	1/2 LEGACY HAPS
403	9/25/23 8:22	Haps Corer	other	DBO4	DBO4.6n	NaN	71.853438	-162.169079	42	jGrebmeier1	2/2 LEGACY HAPS
404	9/26/23 6:58	UHDAS	start	NaN	NaN	NaN	71.539767	-161.579805		cGreto1	
405	9/26/23 16:01	CTD	deploy	IC	IC11	050	70.579812	-162.490756	38	sDanielson1	
406	9/26/23 16:16	CTD	recover	IC	IC11	050	70.579866	-162.490702	38	sSandy1	
407	9/26/23 16:59	Bongo Net	recover	IC	IC1	050	70.580318	-162.4929		eLogerwell1	
408	9/26/23 17:27	beam trawl	deploy	IC	IC11	12	70.582159	-162.495733		kIken1	

409	9/26/23 17:30	beam trawl	on bottom	IC	IC11	12	70.583097	-162.498076		kIken1	
410	9/26/23 17:34	beam trawl	off bottom	IC	IC11	12	70.58435	-162.502087		kIken1	
411	9/26/23 17:37	beam trawl	recover	IC	IC11	12	70.585329	-162.50494		kIken1	
413	9/26/23 17:44	Underway Science seawater	other				70.587123	-162.509281		hCynar1	Underway O2 Sample (#332)
415	9/26/23 17:45	Underway Science seawater	other				70.58743	-162.509838		hCynar1	Underway O2 Sample (#353)
416	9/26/23 19:00	CTD	deploy	IC	IC10	051	70.717107	-162.857409	42	sSandy1	
417	9/26/23 19:21	CTD	recover	IC	IC10	051	70.717065	-162.852518	42	sSandy1	
418	9/26/23 19:35	Underway Science seawater	service	NaN	NaN	NaN	70.728706	-162.880548		bMcKiernan1	Strainer swap
419	9/26/23 20:40	CTD	deploy	IC	IC1	052	70.832565	-163.118855	44	sSandy1	C1 mooring site
420	9/26/23 20:53	CTD	recover	IC	IC1	052	70.833222	-163.118792	44	sSandy1	C1 mooring site
421	9/26/23 21:20	Mooring	recover	NaN	NaN	NaN	70.835567	-163.120332		dwright1	recover IC1 mml mooring
422	9/26/23 21:45	Mooring	recover	NaN	NaN	NaN	70.836647	-163.125453	recover 22ckp1a	dStrausz1	
423	9/26/23 22:43	Mooring	deploy	NaN	NaN	NaN	70.837166	-163.125895		dStrausz1	Deploy 23ckp1a
424	9/26/23 23:07	Mooring	deploy	NaN	NaN	NaN	70.834994	-163.1257		dwright1	deploy Al23_AU_IC1
425	9/26/23 23:34	CTD	deploy	IC	IC9	053	70.84862	-163.184083	44	sSandy1	
426	9/26/23 23:55	CTD	recover	IC	IC9	053	70.84875	-163.18491	44	sSandy1	
427	9/27/23 0:26	Bongo Net	recover	IC	IC9	053	70.848184	-163.192026		eLogerwell1	
428	9/27/23 0:58	beam trawl	deploy	IC	IC9	13	70.848264	-163.19591		kIken1	
429	9/27/23 1:01	beam trawl	on bottom	IC	IC9	13	70.848329	-163.19956		kIken1	
430	9/27/23 1:06	beam trawl	off bottom	IC	IC9	13	70.84839	-163.205825		kIken1	
431	9/27/23 1:10	beam trawl	recover	IC	IC9	13	70.848421	-163.210858		kIken1	
432	9/27/23 1:21	Drifter	deploy	NaN	C1	NaN	70.862086	-163.252371	44	dStrausz1	Deploy Drifter 206902
433	9/27/23 2:23	CTD	deploy	IC	IC8	054	70.971701	-163.566546	45	sSandy1	
434	9/27/23 2:45	CTD	recover	IC	IC8	054	70.971547	-163.566956	45	sSandy1	

435	9/27/23 3:55	CTD	deploy	IC	IC7	055	71.084824	-163.802747	43	sSandy1	
436	9/27/23 4:15	CTD	recover	IC	IC7	055	71.084823	-163.802745	43	sSandy1	
437	9/27/23 4:35	Bongo Net	recover	IC	IC7	NaN	71.087362	-163.80802		eLogerwell1	
438	9/27/23 6:42	CTD	deploy	IC	IC6	056	71.194889	-164.198639	44	sSandy1	
439	9/27/23 7:01	CTD	recover	IC	IC6	056	71.194889	-164.198631	44	sSandy1	
440	9/27/23 8:27	CTD	deploy	IC	IC5	057	71.336268	-164.609722	44	sSandy1	
441	9/27/23 8:47	CTD	recover	IC	IC5	057	71.33706	-164.611798	44	sSandy1	
442	9/27/23 8:53	Bongo Net	deploy	IC	57	NaN	71.337221	-164.613683		eLogerwell1	
443	9/27/23 9:56	beam trawl	deploy	IC	IC5	14	71.34051	-164.620491		kIken1	
444	9/27/23 9:59	beam trawl	on bottom	IC	IC5	14	71.341581	-164.62299		kIken1	
445	9/27/23 10:03	beam trawl	off bottom	IC	IC5	14	71.342987	-164.626246		kIken1	
446	9/27/23 10:07	beam trawl	recover	IC	IC5	14	71.344276	-164.629288		kIken1	
447	9/27/23 11:36	CTD	deploy	IC	IC4	058	71.447949	-164.914139	42	sSandy1	
448	9/27/23 11:58	CTD	recover	IC	IC4	058	71.448342	-164.916716	42	sSandy1	
449	9/27/23 16:33	CTD	deploy	IC	C2	059	71.218325	-164.247273	44	sDanielson1	
450	9/27/23 16:45	CTD	recover	IC	C2	059	71.218306	-164.246946	44	sDanielson1	
451	9/27/23 17:46	Mooring	recover	NaN	NaN	NaN	71.21583	-164.245505		dwright1	Recover al21_au_ic2, position not correct as entered late
452	9/27/23 18:53	Mooring	recover	NaN	NaN	NaN	71.215324	-164.250292	44	dStrausz1	Recover 22CKP-2A
453	9/27/23 18:54	Mooring	deploy	NaN	NaN	NaN	71.215325	-164.250301		dStrausz1	Deploy 23ckp2a
454	9/27/23 19:13	Drifter	deploy	NaN	NaN	NaN	71.239924	-164.325597		dStrausz1	Deploy drifter 206901, pressed late, position and time not accurate
457	9/27/23 20:45	Underway Science seawater	other				71.428651	-164.860366		hCynar1	Underway O2 Sample (#266)
458	9/27/23 20:46	Underway Science seawater	other				71.430726	-164.866262		hCynar1	Underway O2 Sample (#358)

459	9/26/23 20:38	Underway Science seawater	other				70.832679	-163.118895		hCynar1	Dissolved gas sampling (#1426)
460	9/27/23 20:37	Underway Science seawater	other				71.412185	-164.81277		hCynar1	Dissolved gas sampling (#576)
461	9/27/23 22:11	CTD	deploy	IC	IC3	060	71.600953	-165.304757	42	sDanielson1	
462	9/27/23 22:31	CTD	recover	IC	IC3	060	71.600905	-165.304767	42	sSandy1	
463	9/27/23 23:25	CTD	deploy	IC	IC3	061	71.601622	-165.304998	42	sSandy1	Recast for bottom water
464	9/27/23 23:33	CTD	recover	IC	IC3	061	71.60162	-165.305049	42	sSandy1	Recast for bottom water
465	9/27/23 23:37	Bongo Net	recover	IC	IC3	060	71.601616	-165.305043		eLogerwell1	
466	9/28/23 1:20	CTD	deploy	IC	IC2	062	71.705592	-165.601474	42	sDanielson1	
467	9/28/23 1:44	CTD	recover	IC	IC2	062	71.70563	-165.601358	42	sSandy1	
468	9/28/23 3:36	Mooring	deploy	NaN	NaN	NaN	71.827851	-166.049684		dwright1	Recover AL_22_AU_IC03
469	9/28/23 4:15	Mooring	recover	NaN	NaN	NaN	71.826955	-166.062486		dStrausz1	Recover 22CKP-3A
470	9/28/23 5:14	Mooring	deploy	NaN	NaN	NaN	71.827393	-166.018484	44	dStrausz1	Deploy 23ckp3a
471	9/28/23 5:53	Mooring	deploy	NaN	NaN	NaN	71.830639	-166.018192		dwright1	AL23_AU_IC03
472	9/28/23 6:17	CTD	deploy	IC	IC1	063	71.830702	-165.967561	44	sSandy1	Also collected water for mooring site C3
473	9/28/23 6:38	CTD	recover	IC	IC1	063	71.830281	-165.964014	44	sSandy1	Also collected water for mooring site C3
474	9/28/23 6:58	Bongo Net	recover	IC1	63	NaN	71.827742	-165.953561		eLogerwell1	
475	9/28/23 7:57	beam trawl	deploy	IC	IC1	15	71.824643	-165.950311		kIken1	
476	9/28/23 8:00	beam trawl	on bottom	IC	IC1	15	71.82358	-165.949722		kIken1	
477	9/28/23 8:05	beam trawl	off bottom	IC	IC1	15	71.821495	-165.948877		kIken1	
478	9/28/23 8:08	beam trawl	recover	IC	IC1	15	71.820057	-165.948417		kIken1	
479	9/28/23 8:30	beam trawl	deploy	IC	IC1	16	71.830793	-165.966093		kIken1	
480	9/28/23 8:33	beam trawl	on bottom	IC	IC1	16	71.83198	-165.967789		kIken1	
481	9/28/23 8:39	beam trawl	off bottom	IC	IC1	16	71.833989	-165.970796		kIken1	
482	9/28/23 8:44	beam trawl	recover	IC	IC1	16	71.835932	-165.973548		kIken1	

483	9/28/23 13:07	CTD	deploy	IC	IC0.3	066	72.206782	-166.955308	49	sDanielson1	
484	9/28/23 13:19	CTD	recover	IC	IC0.3	066	72.206839	-166.956093	49	sDanielson1	
485	9/28/23 14:24	CTD	deploy	IC	C15	067	72.309886	-167.270507	48	sDanielson1	
486	9/28/23 14:48	CTD	recover	IC	C15	067	72.309986	-167.26962	48	sDanielson1	
487	9/28/23 15:30	Mooring	deploy	NaN	NaN	NaN	72.309611	-167.270666	53	dStrausz1	Deploy 23ckp15a
488	9/29/23 21:41	CTD	deploy	DBO3	DBO3.8	068	67.677064	-168.94895	50	sSandy1	
489	9/29/23 22:05	CTD	recover	DBO3	DBO3.8	068	67.677148	-168.950049	50	sSandy1	
490	9/29/23 22:32	Bongo Net	recover	DBO3	DBO3.8	068	67.675039	-168.952289		eLogerwell1	
491	9/29/23 23:47	beam trawl	deploy	DBO3	DBO3.8	17	67.673213	-168.952764		kIken1	
492	9/29/23 23:50	beam trawl	on bottom	DBO3	DBO3.8	17	67.672017	-168.953017		kIken1	
493	9/29/23 23:55	beam trawl	off bottom	DBO3	DBO3.8	17	67.670076	-168.953506		kIken1	
494	9/29/23 23:59	beam trawl	recover	DBO3	DBO3.8	17	67.66824	-168.954012		kIken1	
495	9/30/23 1:22	CTD	deploy	DBO3	DBO3.7	069	67.783138	-168.597108	50	sSandy1	
496	9/30/23 1:44	CTD	recover	DBO3	DBO3.7	NaN	67.78239	-168.599193	50	sSandy1	
497	9/30/23 4:19	CTD	deploy	DBO3	DBO3.6	070	67.898124	-168.234363	58	sSandy1	
498	9/30/23 4:41	CTD	recover	DBO3	DBO3.6	070	67.898448	-168.23371	58	sSandy1	
499	9/30/23 4:53	Bongo Net	deploy	DBO3.6	70	NaN	67.89741	-168.232642		eLogerwell1	
500	9/30/23 6:21	beam trawl	deploy	DBO3	DBO3.6	18	67.893155	-168.229568		kIken1	
501	9/30/23 6:26	beam trawl	on bottom	DBO3	DBO3.6	18	67.891396	-168.228429		kIken1	
502	9/30/23 6:31	beam trawl	off bottom	DBO3	DBO3.6	18	67.88939	-168.226814		kIken1	
503	9/30/23 6:36	beam trawl	recover	DBO3	DBO3.6	18	67.887267	-168.224955		kIken1	
504	9/18/23 16:25	sonobuoy	deploy	NaN	NaN	NaN	65.672348	-168.381831	39 m	dwright1	
505	9/18/23 4:26	sonobuoy	deploy	NaN	NaN	NaN	64.992678	-169.148332	49 m	dwright1	
506	9/18/23 6:39	sonobuoy	deploy	NaN	NaN	NaN	64.963069	-169.784429	49 m	eLogerwell1	
507	9/19/23 4:09	sonobuoy	deploy	NaN	NaN	NaN	67.234266	-168.130176	41 m	dwright1	
508	9/19/23 6:28	sonobuoy	deploy	NaN	NaN	NaN	67.609956	-167.992275		dwright1	47 m
509	9/21/23 21:54	sonobuoy	deploy	NaN	NaN	NaN	71.682832	-156.325262	97 m	dwright1	
510	9/23/23 4:30	sonobuoy	deploy	NaN	NaN	NaN	71.288223	-158.758618		dwright1	103 m

511	9/23/23 6:31	sonobuoy	deploy	NaN	NaN	NaN	71.214798	-159.717454	49 m	dwright1	
512	9/28/23 17:05	sonobuoy	deploy	NaN	NaN	NaN	72.134771	-167.344998	50 m	dwright1	
513	9/28/23 21:04	sonobuoy	deploy	NaN	NaN	NaN	71.524629	-167.598641	48 m	dwright1	
514	9/29/23 2:22	sonobuoy	deploy	NaN	NaN	NaN	70.717446	-167.890982	48 m	dwright1	
515	9/29/23 4:56	sonobuoy	deploy	NaN	NaN	NaN	70.324238	-168.034272	47 m	dwright1	
516	9/29/23 16:58	sonobuoy	deploy	NaN	NaN	NaN	68.430906	-168.708101	54 m	dwright1	
517	9/29/23 21:12	sonobuoy	deploy	NaN	NaN	NaN	67.739648	-168.938345	50 m	dwright1	
518	9/30/23 4:52	sonobuoy	deploy	NaN	NaN	NaN	67.898112	-168.233248	56 m	dwright1	
519	9/30/23 22:06	EM302	stop	NaN	NaN	NaN	66.804146	-163.209754		cGreto1	stopped while in shallow water approaching Kotzebue
520	9/30/23 22:06	EM302	stop	NaN	NaN	NaN	66.804163	-163.209632		cGreto1	stopped while in shallow water approaching Kotzebue
521	9/30/23 22:17	EK80	other	NaN	NaN	NaN	66.814847	-163.170064		cGreto1	Taken out of K-Sync to increase ping rate in shallow water
522	10/1/23 1:35	EK80	other	NaN	NaN	NaN	66.839009	-163.645865		cGreto1	Back in K-sync as we move back into deeper water
523	10/1/23 1:35	EM302	start	NaN	NaN	NaN	66.839623	-163.647698		cGreto1	Back in deeper water
524	9/26/23 16:44	Van Veen Grab	other	IC	IC11	NaN	70.580334	-162.49302	38	jGrebmeier1	5-Jan
525	9/26/23 16:50	Van Veen Grab	other	IC	IC11	NaN	70.580335	-162.49303	38	jGrebmeier1	5-Feb
526	9/26/23 16:56	Van Veen Grab	other	IC	IC11	NaN	70.580333	-162.493027	38	jGrebmeier1	5-Mar
527	9/26/23 16:59	Van Veen Grab	other	IC	IC11	NaN	70.580318	-162.492878	38	jGrebmeier1	5-Apr
528	9/26/23 17:05	Van Veen Grab	other	IC	IC11	NaN	70.580308	-162.492791	38	jGrebmeier1	5-May
529	9/27/23 0:18	Van Veen Grab	other	IC	IC9	NaN	70.848191	-163.19178	44	jGrebmeier1	5-Jan
530	10/1/23 2:42	Underway Science seawater	stop	NaN	NaN	NaN	66.929049	-164.046035		cGreto1	Stopped flow momentarily to bypass and troubleshoot Aanderaa O2 Optode
531	9/27/23 0:24	Van Veen Grab	other	IC	IC9	NaN	70.84819	-163.191911	44	jGrebmeier1	5-Feb
532	9/27/23 0:29	Van Veen Grab	other	IC	IC9	NaN	70.848186	-163.192049	44	jGrebmeier1	5-Mar
533	9/27/23 0:34	Van Veen Grab	other	IC	IC9	NaN	70.848188	-163.192107	44	jGrebmeier1	5-Apr

534	9/27/23 0:39	Van Veen Grab	other	IC	IC9	NaN	70.848183	-163.192323	44	jGrebmeier1	5-May
535	9/27/23 4:40	Van Veen Grab	other	IC	IC7	NaN	71.087365	-163.808024	42	jGrebmeier1	5-Jan
536	9/27/23 4:45	Van Veen Grab	other	IC	IC7	NaN	71.087383	-163.808053	43	jGrebmeier1	5-Feb
537	9/27/23 4:50	Van Veen Grab	other	IC	IC7	NaN	71.087405	-163.808102	43	jGrebmeier1	5-Mar
538	9/27/23 4:55	Van Veen Grab	other	IC	IC7	NaN	71.087426	-163.808161	42	jGrebmeier1	5-Apr
539	9/27/23 4:59	Van Veen Grab	other	IC	IC7	NaN	71.08745	-163.808195	43	jGrebmeier1	5-May
540	9/27/23 9:13	Van Veen Grab	other	IC	IC5	NaN	71.336498	-164.611003	44	jGrebmeier1	5-Jan
541	9/27/23 9:18	Van Veen Grab	other	IC	IC5	NaN	71.33652	-164.611058	44	jGrebmeier1	5-Feb
542	9/27/23 9:22	Van Veen Grab	other	IC	IC5	NaN	71.336543	-164.611107	44	jGrebmeier1	5-Mar
543	9/27/23 9:27	Van Veen Grab	other	IC	IC5	NaN	71.336564	-164.611156	43	jGrebmeier1	5-Apr
544	9/27/23 9:33	Van Veen Grab	other	IC	IC5	NaN	71.336585	-164.611212	43	jGrebmeier1	5-May
545	9/27/23 23:41	Van Veen Grab	other	IC	IC3	NaN	71.601618	-165.305036	42	jGrebmeier1	5-Jan
546	9/27/23 23:50	Van Veen Grab	other	IC	IC3	NaN	71.601577	-165.305017	42	jGrebmeier1	5-Feb
547	9/27/23 23:56	Van Veen Grab	other	IC	IC3	NaN	71.601529	-165.304989	42	jGrebmeier1	5-Mar
548	9/28/23 0:02	Van Veen Grab	other	IC	IC3	NaN	71.601484	-165.304966	41	jGrebmeier1	5-Apr
549	9/28/23 0:07	Van Veen Grab	other	IC	IC3	NaN	71.60145	-165.304944	42	jGrebmeier1	5-May
550	9/28/23 7:08	Van Veen Grab	other	IC	IC1	NaN	71.827788	-165.952653	45	jGrebmeier1	5-Jan
551	9/28/23 7:15	Van Veen Grab	other	IC	IC1	NaN	71.82776	-165.952594	44	jGrebmeier1	5-Feb
552	9/28/23 7:21	Van Veen Grab	other	IC	IC1	NaN	71.827728	-165.95257	44	jGrebmeier1	5-Mar
553	9/28/23 7:28	Van Veen Grab	other	IC	IC1	NaN	71.827707	-165.952542	44	jGrebmeier1	5-Apr
554	9/28/23 7:34	Van Veen Grab	other	IC	IC1	NaN	71.827681	-165.952527	44	jGrebmeier1	5-May
555	9/29/23 22:27	Van Veen Grab	other	DBO3	DBO3.8	NaN	67.675075	-168.952276	50	jGrebmeier1	1/7 SEC1
556	9/29/23 22:32	Van Veen Grab	other	DBO3	DBO3.8	NaN	67.675043	-168.952306	50	jGrebmeier1	2/7 SEC1
557	9/29/23 22:37	Van Veen Grab	other	DBO3	DBO3.8	NaN	67.675	-168.952313	50	jGrebmeier1	3/7 SEC1
558	9/29/23 22:43	Van Veen Grab	other	DBO3	DBO3.8	NaN	67.674969	-168.952355	50	jGrebmeier1	4/7 SEC1
559	9/29/23 22:47	Van Veen Grab	other	DBO3	DBO3.8	NaN	67.674928	-168.952375	50	jGrebmeier1	5/7 SEC1
560	9/29/23 22:58	Van Veen Grab	other	DBO3	DBO3.8	NaN	67.674886	-168.952383	50	jGrebmeier1	6/7 SEC1
561	9/29/23 23:02	Van Veen Grab	other	DBO3	DBO3.8	NaN	67.674837	-168.952402	50	jGrebmeier1	7/7 SEC1

562	9/29/23 23:12	Haps Corer	other	DBO3	DBO3.8	NaN	67.674807	-168.952416	50	jGrebmeier1	1/3 SEC1, LEGACY HAPS
563	9/29/23 23:22	Haps Corer	other	DBO3	DBO3.8	NaN	67.67476	-168.952451	50	jGrebmeier1	2/3 SEC1, LEGACY HAPS
564	9/29/23 23:30	Haps Corer	other	DBO3	DBO3.8	NaN	67.674722	-168.952478	50	jGrebmeier1	3/3 SEC1, LEGACY HAPS
565	9/30/23 1:52	Van Veen Grab	other	DBO3	DBO3.7	NaN	67.782294	-168.599744	50	jGrebmeier1	1/7 SEC2
566	9/30/23 1:58	Van Veen Grab	other	DBO3	DBO3.7	NaN	67.782274	-168.599691	50	jGrebmeier1	2/7 SEC2
567	9/30/23 2:03	Van Veen Grab	other	DBO3	DBO3.7	NaN	67.782251	-168.599636	50	jGrebmeier1	3/7 SEC2
568	10/1/23 3:33	Underway Science seawater	start	NaN	NaN	NaN	67.020049	-164.330334		cGreto1	Intermittent flow adjustments complete. Aanderaa back online.
569	9/30/23 2:09	Van Veen Grab	other	DBO3	DBO3.7	NaN	67.782235	-168.59959	50	jGrebmeier1	4/7 SEC2
570	9/30/23 2:14	Van Veen Grab	other	DBO3	DBO3.7	NaN	67.78221	-168.599549	50	jGrebmeier1	5/7 SEC2
571	9/30/23 2:24	Van Veen Grab	other	DBO3	DBO3.7	NaN	67.782179	-168.599516	50	jGrebmeier1	6/7 SEC2
572	9/30/23 2:29	Van Veen Grab	other	DBO3	DBO3.7	NaN	67.782168	-168.599472	50	jGrebmeier1	7/7 SEC2
573	9/30/23 5:11	Van Veen Grab	other	DBO3	DBO3.6	NaN	67.895369	-168.231089	58	jGrebmeier1	1/5 SEC3
574	9/30/23 5:17	Van Veen Grab	other	DBO3	DBO3.6	NaN	67.895342	-168.231086	58	jGrebmeier1	2/5 SEC3
575	9/30/23 5:24	Van Veen Grab	other	DBO3	DBO3.6	NaN	67.895316	-168.23106	58	jGrebmeier1	3/5 SEC3
576	9/30/23 5:31	Van Veen Grab	other	DBO3	DBO3.6	NaN	67.895291	-168.231049	58	jGrebmeier1	4/5 SEC3
577	9/30/23 5:37	Van Veen Grab	other	DBO3	DBO3.6	NaN	67.895263	-168.231027	58	jGrebmeier1	5/5 SEC3
578	9/30/23 5:54	Haps Corer	other	DBO3	DBO3.6	NaN	67.895238	-168.231004	58	jGrebmeier1	1/2 SEC3, LEGACY HAPS
579	9/30/23 6:07	Haps Corer	other	DBO3	DBO3.6	NaN	67.895217	-168.230976	58	jGrebmeier1	2/2 SEC3, LEGACY HAPS
580	9/28/23 20:39	Underway Science seawater	other				71.587753	-167.564219		hCynar1	Underway O2 Sample (#354)
581	9/28/23 20:41	Underway Science seawater	other				71.582585	-167.566925		hCynar1	Underway O2 Sample (#313)
582	9/29/23 19:07	Underway Science seawater	other				68.084424	-168.813811		hCynar1	Underway O2 Sample (#282)
583	9/29/23 19:08	Underway Science seawater	other				68.081722	-168.814839		hCynar1	Underway O2 Sample (#311)

584	9/30/23 20:59	Underway Science seawater	other				66.74039	-163.454601		hCynar1	Underway O2 Sample (#332)
585	9/30/23 21:01	Underway Science seawater	other				66.741336	-163.450084		hCynar1	Underway O2 Sample (#353)
586	10/1/23 3:57	Underway Science seawater	other				67.06316	-164.461251		hCynar1	Underway O2 Sample (#328)
587	10/1/23 3:59	Underway Science seawater	other				67.066855	-164.472497		hCynar1	Underway O2 Sample (#376)
588	9/28/23 8:10	Underway Science seawater	other				71.819394	-165.948214		hCynar1	Dissolved gas sampling (#264)
589	9/28/23 20:33	Underway Science seawater	other				71.602969	-167.556845		hCynar1	Dissolved gas sampling (#338)
590	9/29/23 1:30	Underway Science seawater	other				70.849472	-167.850885		hCynar1	Dissolved gas sampling (#1499)
591	9/29/23 18:56	Underway Science seawater	other				68.114193	-168.802686		hCynar1	Dissolved gas sampling (#240)
592	9/30/23 4:36	Underway Science seawater	other				67.898296	-168.233682		hCynar1	Dissolved gas sampling (#1224)
593	9/30/23 20:41	Underway Science seawater	other				66.735074	-163.480952		hCynar1	Dissolved gas sampling (#239)
594	10/1/23 3:51	Underway Science seawater	other				67.051978	-164.427051		hCynar1	Dissolved gas sampling (#187)
595	10/1/23 15:37	CTD	deploy	DBO3	DBO3.4	071	68.132664	-167.486029	48	sSandy1	
597	10/1/23 16:37	Bongo Net	recover	DBO3	DBO3.4	071	68.134836	-167.490687		eLogerwell1	
596	10/1/23 15:58	CTD	recover	DBO3	DBO3.4	071	68.132772	-167.485422	48	sSandy1	
598	10/1/23 16:59	beam trawl	deploy	DBO3	DBO3.4	19	68.13645	-167.491296		kIken1	
599	10/1/23 17:03	beam trawl	on bottom	DBO3	DBO3.4	19	68.137996	-167.492373		kIken1	
600	10/1/23 17:07	beam trawl	off bottom	DBO3	DBO3.4	19	68.139662	-167.493324		kIken1	

601	10/1/23 17:10	beam trawl	recover	DBO3	DBO3.4	19	68.141191	-167.494281		kIken1	
602	10/1/23 18:51	CTD	deploy	DBO3	DBO3.5	072	68.012323	-167.873769	52	sSandy1	
603	10/1/23 19:07	CTD	recover	DBO3	DBO3.5	072	68.010378	-167.870604	52	sSandy1	
604	10/1/23 20:49	CTD	deploy	DBO3	C12	073	67.905728	-168.179221	58	sDanielson1	
605	10/1/23 21:02	CTD	recover	DBO3	C12	073	67.904805	-168.179132	58	sDanielson1	
606	10/1/23 22:16	Mooring	recover	NaN	NaN	NaN	67.908934	-168.181839	58	dStrausz1	Recover 20CKITAER-12A, entered late, position and time not accurate
607	10/1/23 22:17	Mooring	recover	NaN	NaN	NaN	67.90908	-168.182196	58	dStrausz1	Recover 22CKP-12A
608	10/1/23 23:10	Mooring	deploy	NaN	NaN	NaN	67.910467	-168.18176	58.5	mGalaska1	Deploy 23CKV-12A Omics Mooring
609	10/2/23 0:22	Mooring	deploy	NaN	NaN	NaN	67.905845	-168.181512	58	dStrausz1	Deploy 23CKP-12A
610	10/2/23 3:40	CTD	deploy	DBO3	DBO3.3	074	68.187125	-167.295598	47	sSandy1	
611	10/2/23 4:02	CTD	recover	DBO3	DBO3.3	074	68.186912	-167.295643	47	sSandy1	
612	10/2/23 5:40	CTD	deploy	DBO3	DBO3.2	075	68.246974	-167.122212	43	sDanielson1	
613	10/2/23 6:01	CTD	recover	DBO3	DBO3.2	075	68.245981	-167.123187	43	sSandy1	
614	10/2/23 6:25	Bongo Net	recover	DBO3.2	75	NaN	68.245574	-167.130535		eLogerwell1	
615	10/2/23 6:58	beam trawl	deploy	DBO3	DBO3.2	20	68.246304	-167.135063		kIken1	
616	10/2/23 7:02	beam trawl	on bottom	DBO3	DBO3.2	20	68.247231	-167.138723		kIken1	
617	10/2/23 7:06	beam trawl	off bottom	DBO3	DBO3.2	20	68.248364	-167.14289		kIken1	
618	10/2/23 7:10	beam trawl	recover	DBO3	DBO3.2	20	68.249336	-167.146454		kIken1	
619	10/2/23 8:17	CTD	deploy	DBO3	DBO3.1	076	68.302192	-166.926379	34	sSandy1	
620	10/2/23 8:33	CTD	recover	DBO3	DBO3.1	076	68.302133	-166.923964	34	sSandy1	
621	10/2/23 21:59	EK80	stop	NaN	NaN	NaN	66.414225	-167.216314		cGreto1	Stopped for machine maintenance
622	10/1/23 15:09	Underway Science seawater	other				68.101885	-167.396825		hCynar1	Underway O2 Sample (#356)
623	10/1/23 15:11	Underway Science seawater	other				68.104822	-167.405557		hCynar1	Underway O2 Sample (#364)

624	10/2/23 1:52	Underway Science seawater	other				68.016201	-167.862554		hCynar1	Underway O2 Sample (#287)
625	10/2/23 1:53	Underway Science seawater	other				68.01797	-167.856873		hCynar1	Underway O2 Sample (#313)
626	10/2/23 20:49	Underway Science seawater	other				66.520955	-166.815094		hCynar1	Underway O2 Sample (#332)
627	10/2/23 20:50	Underway Science seawater	other				66.519171	-166.820242		hCynar1	Underway O2 Sample (#353)
628	10/3/23 3:28	IFCB	stop				65.808337	-168.876876		hCynar1	stopped acquisition on NOAA IFCB while UW seawater not running
629	10/3/23 4:14	IFCB	start				65.780695	-168.926801		hCynar1	started acquisition on NOAA IFCB; UW seawater flowing again
630	10/3/23 3:25	IFCB	other				65.814529	-168.863152		hCynar1	WHOI IFCB was sampling residual seawater from bottle from 10/3/23 03:25-04:07
631	10/3/23 4:36	CTD	deploy	BS	BS8	077	65.782411	-168.840933	47	sSandy1	
632	10/3/23 4:58	CTD	recover	BS	BS8	077	65.781131	-168.844783	47	sSandy1	
633	10/3/23 5:34	Bongo Net	recover	BS	BS1	077	65.782712	-168.854217		eLogerwell1	
634	10/3/23 5:35	Bongo Net	recover	BS	BS1	077	65.782711	-168.854217		eLogerwell1	
635	10/3/23 6:14	CTD	deploy	BS	BS7	078	65.760869	-168.743287	53	sSandy1	Dry cast
636	10/3/23 6:24	CTD	recover	BS	BS7	078	65.760556	-168.744566	53	sSandy1	Dry cast
637	10/1/23 15:03	Underway Science seawater	other				68.093559	-167.371514		hCynar1	Dissolved gas sampling (#859)
638	10/1/23 19:03	Underway Science seawater	other				68.010984	-167.871571		hCynar1	Dissolved gas sampling (#664)
639	10/2/23 1:47	Underway Science seawater	other				68.007263	-167.890846		hCynar1	Dissolved gas sampling (#810)

640	10/2/23 5:57	Underway Science seawater	other				68.246148	-167.123057		hCynar1	Dissolved gas sampling (#248)
641	10/2/23 20:30	Underway Science seawater	other				66.554918	-166.718513		hCynar1	Dissolved gas sampling (#306)
642	10/3/23 7:07	CTD	deploy	BS	BS6	079	65.737913	-168.647413	52	sSandy1	
643	10/3/23 7:22	CTD	recover	BS	BS6	079	65.73748	-168.649181	52	sSandy1	
644	10/3/23 7:32	Bongo Net	deploy	BS	79	NaN	65.737933	-168.652141		eLogerwell1	
645	10/3/23 8:21	CTD	deploy	BS	BS5	080	65.714908	-168.555896	52	sSandy1	Dry cast
646	10/3/23 8:30	CTD	recover	BS	BS5	080	65.714983	-168.555486	52	sSandy1	Dry cast
647	10/3/23 9:03	CTD	deploy	BS	BS4	081	65.693041	-168.46383	54	sSandy1	Dry cast
648	10/3/23 9:12	CTD	recover	BS	BS4	081	65.692917	-168.464644	54	sSandy1	Dry cast
649	10/3/23 9:50	CTD	deploy	BS	BS3	082	65.670008	-168.367368	52	sSandy1	
650	10/3/23 10:06	CTD	recover	BS	BS3	082	65.66972	-168.369395	52	sSandy1	
651	10/3/23 10:19	Bongo Net	recover	BS	BS8	82	65.671505	-168.371214		eLogerwell1	
652	10/3/23 11:08	CTD	deploy	BS	BS2	083	65.647363	-168.274636	46	sSandy1	Dry cast
653	10/3/23 11:16	CTD	recover	BS	BS2	083	65.647303	-168.27501	46	sSandy1	Dry cast
654	10/3/23 11:55	CTD	deploy	BS	BS1	084	65.618445	-168.152311	28	sSandy1	
655	10/3/23 12:10	CTD	recover	BS	BS1	084	65.618099	-168.154417	28	sSandy1	
656	10/1/23 16:32	Van Veen Grab	other	DBO3	DBO3.4	NaN	68.134886	-167.490409	48	jGrebmeier1	1/2 SEC5
657	10/1/23 16:38	Van Veen Grab	other	DBO3	DBO3.4	NaN	68.134835	-167.490681	48	jGrebmeier1	2/2 SEC5
658	10/1/23 19:14	Van Veen Grab	other	DBO3	DBO3.5	NaN	68.010191	-167.870687	53	jGrebmeier1	1/2 SEC4
659	10/1/23 19:20	Van Veen Grab	other	DBO3	DBO3.5	NaN	68.010126	-167.871002	53	jGrebmeier1	2/2 SEC4
660	10/2/23 4:11	Van Veen Grab	other	DBO3	DBO3.3	NaN	68.186958	-167.295654	47	jGrebmeier1	1/2 SEC6
661	10/2/23 4:16	Van Veen Grab	other	DBO3	DBO3.3	NaN	68.186965	-167.295738	47	jGrebmeier1	2/2 SEC6
662	10/2/23 6:33	Van Veen Grab	other	DBO3	DBO3.2	NaN	68.245326	-167.13126	43	jGrebmeier1	1/2 SEC7
663	10/2/23 6:38	Van Veen Grab	other	DBO3	DBO3.2	NaN	68.245352	-167.131299	43	jGrebmeier1	2/2 SEC7
664	10/2/23 8:41	Van Veen Grab	other	DBO3	DBO3.1	NaN	68.302413	-166.923769	34	jGrebmeier1	1/2 SEC8
665	10/2/23 8:45	Van Veen Grab	other	DBO3	DBO3.1	NaN	68.302405	-166.923792	34	jGrebmeier1	2/2 SEC8

666	10/3/23 17:24	CTD	deploy	DBO2	NM1	085	64.85159	-168.445772	44	sDanielson1	
667	10/3/23 17:33	CTD	recover	DBO2	NM1	085	64.851406	-168.446204	44	sDanielson1	
668	10/3/23 18:11	Mooring	recover	NaN	NaN	NaN	64.858233	-168.448081		dwright1	recover AL22_AU_NM1; 5 min delay in making entry
669	10/3/23 18:45	Mooring	deploy	NaN	NaN	NaN	64.858229	-168.448085		dwright1	deploy AL23_AU_NM01
670	9/25/23 1:44	Mooring	deploy	DBO4	CEO1-23	NaN	71.60063	-161.541187	46	sDanielson1	
671	9/24/23 23:48	Mooring	deploy	DBO4	CEO2-23	NaN	71.583747	-161.49987	46	sDanielson1	
672	9/25/23 16:59	Mooring	deploy	DBO4	CEO3-23 tripod	NaN	71.59992	-161.45984	46	sDanielson1	
673	9/24/23 22:23	Mooring	deploy	DBO4	CEO-BIOPOLE-23 Mooring	NaN	71.600647	-161.499928	46	sDanielson1	
674	10/3/23 8:29	Underway Science seawater	other				65.714967	-168.55559		hCynar1	Dissolved gas sampling (#1437)
675	10/3/23 8:31	Underway Science seawater	other				65.715004	-168.555383		hCynar1	Dissolved gas sampling (#259)
676	10/3/23 19:27	Underway Science seawater	other				64.851164	-168.422163		hCynar1	Dissolved gas sampling (#1486)
677	10/3/23 19:29	Underway Science seawater	other				64.848897	-168.414636		hCynar1	Dissolved gas sampling (#1390)
678	10/3/23 22:08	Underway Science seawater	other				64.693758	-167.873578		hCynar1	Dissolved gas sampling (#599)
679	10/4/23 15:44	Underway Science seawater	stop	NaN	NaN	NaN	64.449693	-165.501034		bMcKiernan1	Nome
680	10/4/23 15:44	EM302	stop	NaN	NaN	NaN	64.449721	-165.501159		bMcKiernan1	Arrived Nome
681	10/4/23 15:44	EK80	stop	NaN	NaN	NaN	64.449742	-165.501259		bMcKiernan1	Arrived Nome
682	10/4/23 15:45	UHDAS	stop	NaN	NaN	NaN	64.449763	-165.501351		bMcKiernan1	Raising CB
683	10/4/23 15:48	Centerboard	recover	NaN	NaN	NaN	64.449742	-165.501157		bMcKiernan1	
684	10/4/23 14:45	IFCB	stop	NaN	NaN	NaN	64.449855	-165.499079		hCynar1	NOAA IFCB Stop sampling

685	10/4/23 17:50	IFCB	stop	NaN	NaN	NaN	64.452083	-165.492961		hCynar1	WHOI IFCB Stop sampling
686	10/4/23 18:34	Ship	End Cruise	NaN	NaN	NaN	64.451549	-165.492481		cGreto1	Ending cruise 3nm from Nome. Winds are too high to tie up.