NGA-LTER

Northern Gulf of Alaska Long-Term Ecological Research

Cruise Report 2 to 16 July 2020

Cruise ID: SKQ202010S

Funding Sources: NSF, NPRB, AOOS, EVOSTC/GWA

Purpose:

The NGA is a highly productive subarctic Pacific marine biome where intense environmental variability has profound impacts on lower trophic level organisms and community dynamics that, directly or indirectly, support the iconic fish, crabs, seabirds and marine mammals of Alaska. In the NGA, a pronounced spring bloom and regions of sustained summer production support a stable base of energy-rich zooplankton grazers that efficiently transfers primary production up the food chain and a substantial sinking flux of organic matter that exports carbon to the sea bottom communities. The LTER research cruises examine features, mechanisms and processes that drive this productivity and system-wide resilience to understand how short- and long-term climate variability propagates through the environment to influence organisms.

This cruise represents a continuation of sampling begun in fall 1997 under the NSF/NOAA NE Pacific GLOBEC program, and subsequently a consortium of the North Pacific Research Board (NPRB), the Alaska Ocean Observing System (AOOS), and the Exxon Valdez Oil Spill Trustee Council's (EVOSTC) Gulf Watch Alaska (GWA) program. This is the second year with expanded domain, measurements and investigators under the NSF's Northern Gulf of Alaska Long-term Ecological Program (NGA-LTER). This cruise marks the 3rd consecutive summer cruise for the Seward Line in the NGA and falls in the 50th year of observations at GAK1, which began December 1970.

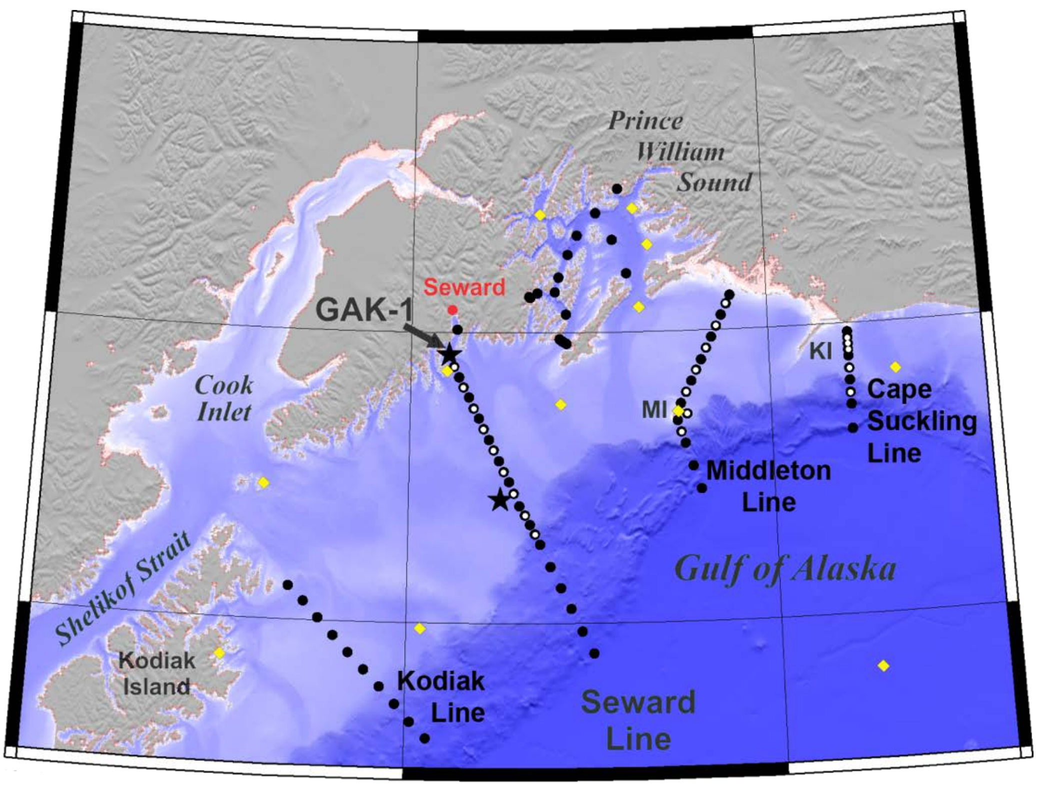


Figure 1. *LTER sampling stations. CTDs cast without water sampling shown as open symbols. Yellow diamonds represent locations of meteorological data from NOAA buoys or ground stations*. Black stars represent the GAK1 and GEO mooring sites.

Scientific Personnel:

1	Seth Danielson (LTER PI)	Physics, UAF, Chief Scientist
2	Jennifer Questel	Zooplankton, UAF, Night Watch Lead Scientist
3	Ana Aguilar-Islas (LTER PI)	Chemistry (Nutrients, Iron), UAF.
4	Will Burt	Plankton/Optics, UAF
5	Hana Busse	Phytoplankton/Microzooplakton, WWU
6	Delaney Coleman	Zooplankton (nights), UAF
7	Daniel Cushing	Seabirds/Mammals, US Fish & Wildlife Service
8	Russ Hopcroft (LTER Lead PI)	Zooplankton (days), UAF
9	Savannah Sandy	Physics (Moorings/CTD/Acrobat), UAF
10	Emily Ortega	Chemistry (Nutrients, Iron), UAF
11	Suzanne Strom (LTER PI)	Phytoplankton/Microzooplankton, WWU
12	Laura Strom	Phytoplankton/Microzooplankton, WWU
13	Ethan Roth	SKQ Marine technician, Lead
14	Bern McKiernan	SKQ Marine technician

SKQ202010S was conducted during the time of the COVID19 global pandemic. Measures were taken to reduce the risk of disease transmission, including sailing with a reduced number of scientists.

Cruise Overview:

1. Plume Study: Approximately 4 days of the cruise was dedicated to high-resolution sampling of the Copper River discharge plume, which followed 2 days of station work on the Middleton Island Line. Activities included mapping of the plume extent and depth using an undulating towed Acrobat CTD system and towing a surface sampler (Iron Fish) that collects clean water for iron analyses. We paused mapping activities daily to collect water and plankton samples using the CTD and nets. An important facet of the plume study operations involved the simultaneous towing of the **Iron Fish** (abeam starboard) and the **Acrobat** undulating vehicles (astern). The Iron Fish package is towed just below the surface away from the vessel by the starboard crane, and does not have enough line paid out to ever foul with Sikuliaq's propulsion system. The Acrobat is towed approximately 170 meters astern from the A-frame. Acrobat/Iron Fish tows involve multiple crossings of the river plume frontal region.

2. Station Transects: Approximately 8 days of the cruise was dedicated to transect station work (5 on the Seward Line, 2 on the Middleton Island Line and 1 in Prince William Sound). Due to cruise duration truncation because of COVID19, we did not sample the Kodiak Island Line. While occupying transect lines, operations are generally divided into distinct day and night tasks, thus requiring each station to be occupied twice. This structure requires some back-tracking but avoids each discipline needing to supply 2 shifts of scientists and ensures all organisms – especially larger diel-migrating zooplankton – are captured with minimal time-of-day bias. During each morning we will typically occupied a selected "intensive" station for experimental work. Intensive stations involve a greater number and range of collections than other stations occupied that day. Stations profiles are supplemented by underway measurements.

3. Moorings: This cruise involved the recovery of Gulf of Alaska Ecosystem Observatory (GEO) mooring GEO2, and the deployment of moorings GEO2 and GEO3. GEO3 has a radar reflector, flashing light and real-time telemetry of GPS, temperature, salinity, chlorophyll a fluorescence, PAR, and meteorological data. GEO2 is a physical and biogeochemical mooring with sediment trap, particle camera, passive and active acoustics and sensors for pCO_2, pH, whole water samples, temperature, salinity and velocity.

Bird observations underway from Sikuliaq's bridge on a sunny evening in Prince William Sound.

Cruise Narrative:

Tuesday, June 17: Science party enters 14-day pre-cruise quarantine, with Danielson, Strom, Strom and Busse isolating in Seward, Cushing in Anchorage, and all others in Fairbanks. All science party members get one COVID-19 nasal swab test as they go into quarantine and a second test approximately 5 days before the cruise is set to sail. All tests come back negative, although a few of the second test results were delayed and did not show up until after we had sailed.

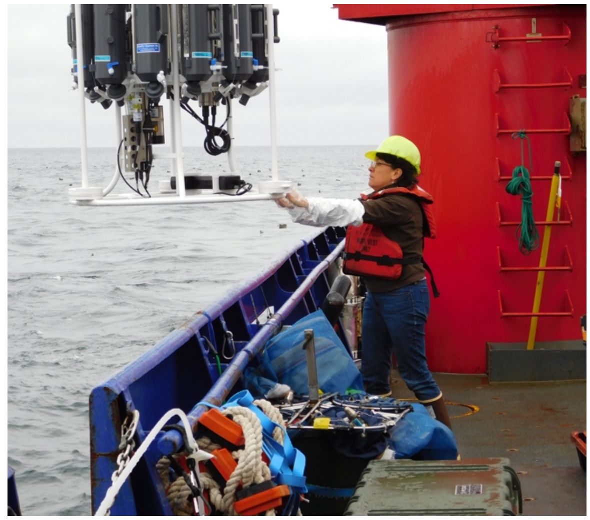
Monday, July 29: Ana Aguilar-Islas and Emily Ortega (the marine chemistry team) drive from Fairbanks to Seward in the U-Haul van and begin setting up the analytical room clean bubble.

Tuesday, June 30: Remainder of science party transits to Seward from Fairbanks and Anchorage via the Hopcroft DRZOOP van. Chemistry team begins set-up of clean bubble in the ship's analytical lab.

Wednesday, July 1: Mobilization day. Ship's crew and marine technicians have already loaded the 5 science winches to be used on this cruise. Science safety briefing took place in the morning. All remaining gear loaded.

Team Strom setting up the wet lab.

Thursday, July 2: Underway 9 AM. Initial sampling at station RES2.5. Jellyfish sucked into pump first CTD downcast resulted in a poor profile (most obvious in the dual oxygen channels), which we repeated. We completed an Intensive Station at GAK1 with Trace Metal Clean CTD (TM-CTD), primary productivity experiments, and extra net tows. Worked out more shakedown bugs in the process. We also sampled GAK1i and transited to GAK2 for the bird observations. Night crew worked stations GAK1, GAK2, GAK3 and GAK4. Due to a personnel switch of the First Mate position, operations dictate that we remain relatively close to Resurrection Bay for the first few days of the cruise, pending a negative test for the oncoming Mate.



Deployment of the TM-CTD at station GAK-1.

Friday, July 3: Following night work we transit to the GEO mooring site to do the mooring recovery prior to starting an Intensive Station at GAK5 (needs to begin before 2 pm). The mooring talks via the acoustic release but does not surface. A single dragging attempt results in non-recovery but the winch drum and level wind system fouls and the crew spends most of the day getting the winch to work well enough to spool the wire (~ 1300 m) back onto the drum. We steam shore-ward for the crew transfer.

Saturday, July 4: Begin day operations at 5 AM at station GAK2. We get GAK2 and GAK3, transit to GAK5 for the intensive station and then back to GAK4 for CTD, CalVet and Iron Fish samples. Night crew works stations GAK5, GAK6, GAK7, and GAK8.

Sunday, July 5: Begin day operations at 5 AM with setup of moorings for deployment at the GEO mooring site. Deployed mooring GEO3 and GEO2, with mooring ops finished at 10:30 AM, followed by a calibration CTD profile with water collections. Deployments went quite smoothly. We deployed both moorings SE of mooring GEO2-2019, which is still in the water. CTD profiles taken at GAK7, GAK7i, GAK8, GAK8i and GAK9i, with water samples at GAK7 and GAK8 Night crew works GAK9, GAK10, GAK11 and GAK12 with multi-net and Methot net jellyfish tows.

Monday, July 6: Intensive Station at GAK9, where we were visited by many black-footed albatross and one short-tailed albatross. Following the Intensive Station we occupied GAK10, GAK11 and GAK12. Night crew picks up GAK13, GAK14 and GAK15 to complete the Seward Line night work.

Short-tailed (left) and black-footed (right) albatross.

Tuesday, July 7: Finished the Seward Line day work with an Intensive station at GAK15 and deep profiles at GAK15, GAK14 and GAK13. At the end of the day, we greased the Dynacon winch cable (which is from the UNOLS winch pool) and then ran an in-water test of the Acrobat flight and data systems. Except for some inability for the normal autopilot function (may have been related to lack of depth soundings as the EM302 multibeam system was off at the time), the Acrobat performed well and we had no data system crashes as have happened in past Acrobat operations. The newly terminated Acrobat tow cable appears to be working well.

Sampling Niskin bottles for DIC.

Wednesday, July 8: July 8th began with a night-time transit to the Middleton Island Transect. We started with deep Multi-Net tows at MID10, followed by an Intensive Station work for the day crew. Wind picks up to above 20 for the first time this cruise, accompanied by a small increase in sea state, though nothing that is problematic for our operations on Sikuliaq.

Thursday, July 9: The night crew finished work offshore of Middleton Island. And the day crew worked from Middleton Island toward the coast, though not without the scare of losing our CTD altimeter signal in the strong flows near the island. The sensor continued to not work on the next few following stations so between stations MID4 and MID3i the sensor and its cabling was replaced by E. Roth.

Friday, July 10: Night crew wraps up the MID line stations. Before the Intensive Station at MID2, we put the work boat into the water so that the crew can survey some of the places at which we will be coming close to shore on the plume survey. With this information (and one or two other planned missions for the work boat) we will be able to confidently plan our turn points for the survey. W. Burt completes another LISST calibration. We begin Acrobat tows by starting on the continental slope south of Kayak Island.

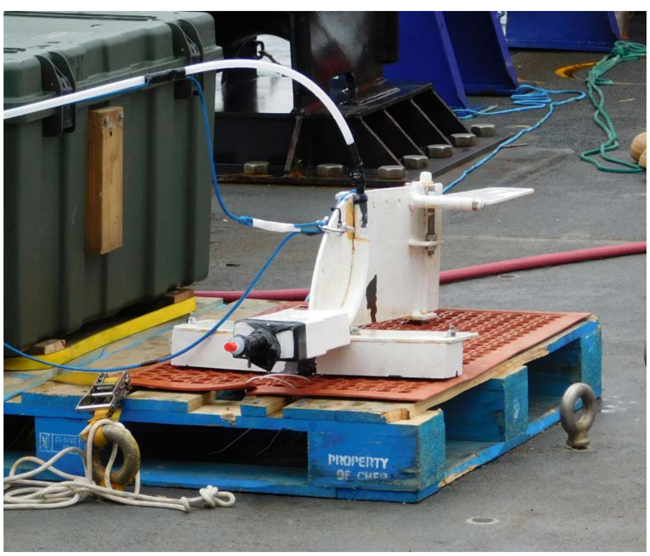
Saturday, July 11: First full day of Acrobat tows. Crossed from the upper slope onto the shelf, finding some fresh water at the shelf break and again closer to Kayak Island. Pinnacles make the Acrobat operator's heart accelerate! Small boat launch in the morning to survey our tracklines out ahead resulted in a small data gap on the north side of Kayak Island. Acrobat is flying well through turns made at a rate of 30 degrees per minute at 7 knots through the water. Make a brief stop in the late afternoon to collect some water samples, one Calvet net tow and recover the work boat.

Greasing the Dynacon winch cable.

Sunday, July 12: Plume mapping continues. We pass the mouth of the river and the MID transect line and find very low-salinity waters extending far offshore. Stop for water to fuel plankton experiments. We find the plume is so thin in some regions that the difference between surface and subsurface waters is clearly delineated by the mixing induced by the wake and ship's propellers.

Color change due to vessel-induced mixing upward of subsurface waters while towing the Acrobat through the surface plume.

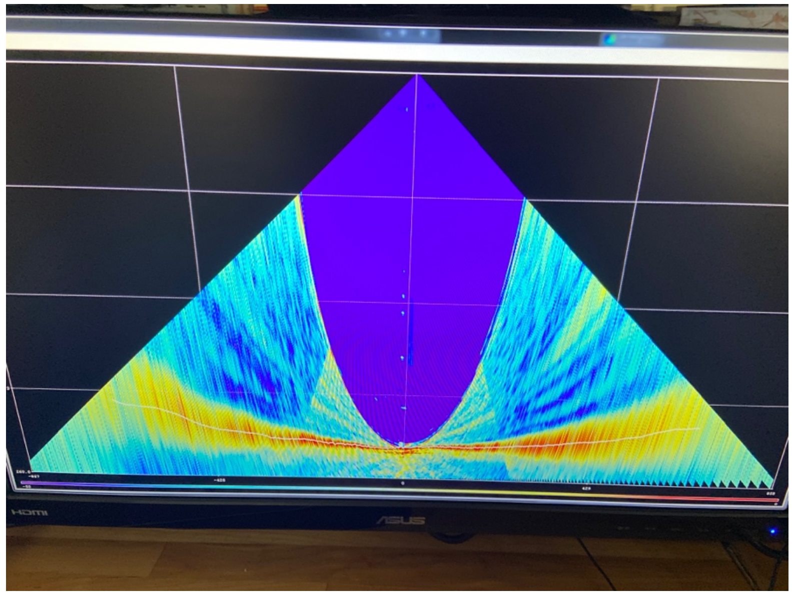
Monday, July 13: Finish the Acrobat survey, as we transit past Hinchinbrook Entrance and along Montague Island. Plan is to finish sampling at midnight. Weather comes up and due to slower progress and large swells that were causing the Acrobat cable to "snap" during heaves we terminate the sampling a few hours earlier than planned. We need to finish our sampling in offshore waters (beyond the 12 mile limit) so that the engineering department can pump the holding tanks early Tuesday morning, which have been filling since Friday.



The Iron Fish.

Tuesday, July 14: We steam from the end of the Acrobat line into Northern Prince William Sound where we plan an intensive station at PWS2. We occupy this station plus the others in Knight Island Passage (PWS3, PWS1 and KIP2) during the day and then steam north to PWS3 for the night crew to begin work.

Wednesday, July 15: We occupy the Montague Strait Line as we leave Prince William Sound then transit out to GEO for a final attempt at getting mooring GEO2 back. We decide that the best chance at getting the drag line across the mooring is to use the Sikuliaq special "silent Mike" DP spin, whereby we pay out the trawl cable onto the seafloor while SKQ spins 360 in a circle at the same rate as the wire payout. We opt for 1.5 rotations (540 degrees), and then move off by 100 meters. We then spool the trawl wire back onboard. A tension spike of 1800 lbs seems like the dual railroad wheel anchor but nothing surfaces and trawl winch tension goes back down to under 600 lbs. When the anchor is set to come off the seafloor, however, it appears that we have more than expected tension and then the mooring floats surface a short distance behind the vessel. Success! All instruments brought safely on board except for the acoustic release. The trawl cable had sawed through the mooring line about 6” below the bottom-most instrument (the Aural). This gives us some appreciation for how the mooring had been snagged.



Acoustic Image of the GEO2-2019 mooring just prior to recovery. Six distinct targets are visible in the purple water column.

Thursday, July 16: Return to port, following a CTD at GAK1 and RES2.5. At GAK1, the GEO2 SBE37 Microcat was strapped to the CTD for a short 100m cast as an as-deployed field calibration.

Safety Training and Abandon Ship Drills.

Disciplinary Reports

Physics

LTER PI: Seth Danielson
Participants: Seth Danielson, Savannah Sandy (UAF Graduate Student)

On SKQ202010S we conducted 64 CTD casts for water column hydrography (Figure 1) using a 24 place rosette with 10 liter Niskin bottles. Bottles were tripped on 50 of these 64 casts. For normal operations, bottles were made at standard levels: 0, 10, 20, 30, 40, 50, 75, 100, 125, 150, 200, 250, 500, 750, 1000, 1250 and 1500 m depths and within 5 m of the bottom when the bottom depth was less than 1500 m. On many casts we also collected water at the depth of the chlorophyll a maximum. The SBE9-11 CTD was outfitted with pressure, dual temperature, dual conductivity, and dual oxygen sensors. Ancillary sensors included a WetLabs fluorometer, a WetLabs C-Star transmissometer, a Biospherical PAR sensor, and a Tritech altimeter. One channel was assigned to a self-logging Sequoia LISST particle size spectra instrument; one channel provided power and communication to a self-logging SUNA nitrate sensor.

The CTD stations were occupied on two shelf transects (Middleton and Seward Line; Figures 1 and 2) plus stations in Western Prince William Sound and stations in the vicinity of the Copper River.

Ocean velocity data was collected using a hull-mounted Teledyne RDI 75 kHz Ocean Surveyor instrument and a centerboard-mounted Teledyne RDI 300 kHz Workhorse instrument. The 75 kHz instrument collected data using 16 m bin thickness and the 300 kHz instrument collected data in 2 m bins. Due to hull depth and bubble sweep along the hull, the first good bin of the 75 kHz ADCP was typically at 18 m below the surface or deeper. The 300 kHz instrument measured good data starting at 11 m depth.

We ran the ADCPs triggered from the K-sync system so as to provide an interference-free time interval for the EK-60 fisheries acoustics pings. Over shallow waters (< 1000 m depth) all acoustic instruments could be run simultaneously. In deep water (>1000 m depth) the time for the return acoustic pings become exceedingly long so we ran in one of two modes in deeper water. In “night operations mode” we secured the EM302 multibeam and operated only the ADCP and EK-60 so as to have concurrent acoustics data alongside the nighttime trawl operations. In the “day operations mode” we would run the EM-302 so as to map the seafloor along our trackline.

Regions previously unmapped by multibeam acoustics were preferentially selected for ship routes in order to map uncharted areas of the seafloor. Many portions of the cruise occurred in previously unmapped regions, including especially portions of Prince William Sound, between Middleton Island and the Copper River, and east of Kayak Island. Future cruises will continue to fill in mapping coverage gaps.

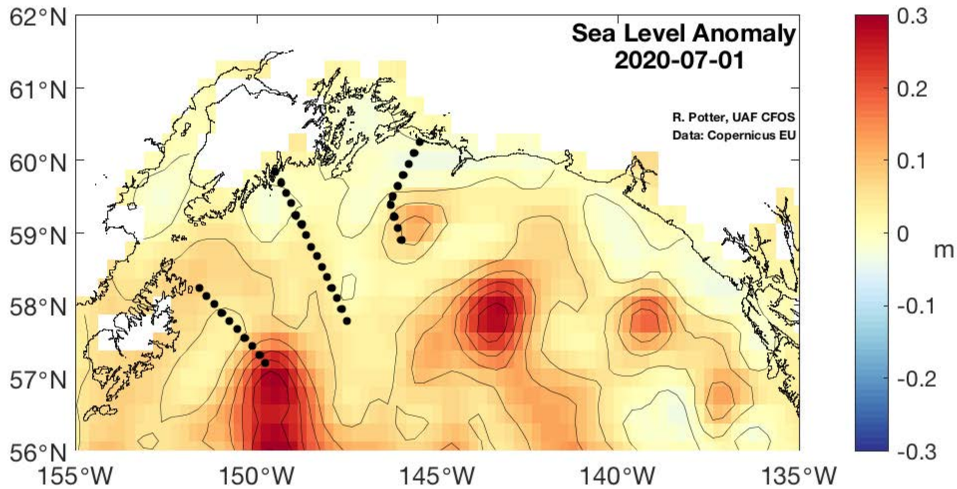
Other underway data collected include the ship’s operational data, meteorological data, and ocean surface data. Operational data of ship’s equipment (e.g., navigation and winch payout and tensions) were also logged. Navigation data parameters include GMT date time, latitude, longitude and water depth. Atmospheric data parameters measured by the ship’s underway system included atmospheric pressure, wind speed/direction, air temperature, humidity, CO_2, 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.

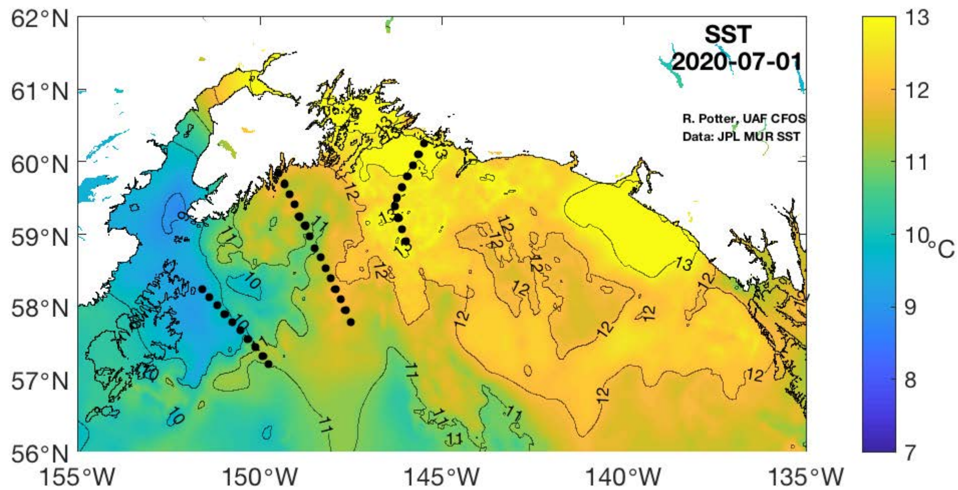
Two nitrate dataloggers were used on the cruise. An ISUS instrument was plumbed into the underway uncontaminated seawater throughflow system that feeds the thermosalinograph sensors. This instrument was set to take three samples every five minutes. The ISUS had a new lamp installed just prior to SKQ202010S. The lamp was burned in with only 10 hours of operation prior to the cruise, instead of the recommended 100 hours of burn-in. Assuming that the throughflow system is normally in nitrate-deplete near-surface waters, we did notice some small baseline drift that may have been a result of the new lamp further settling in. The second nitrate sensor was a deep SUNA instrument strapped to the CTD frame. This SUNA was powered by a stand-alone battery pack energized when the CTD sent power to the bulkhead connectors. These data were stored internally on the SUNA and this full dataset will require matching time stamps to align the nitrate profile with the rest of the CTD profile. However, a simple analog signal recorded in the CTD data file also provides preliminary estimates.

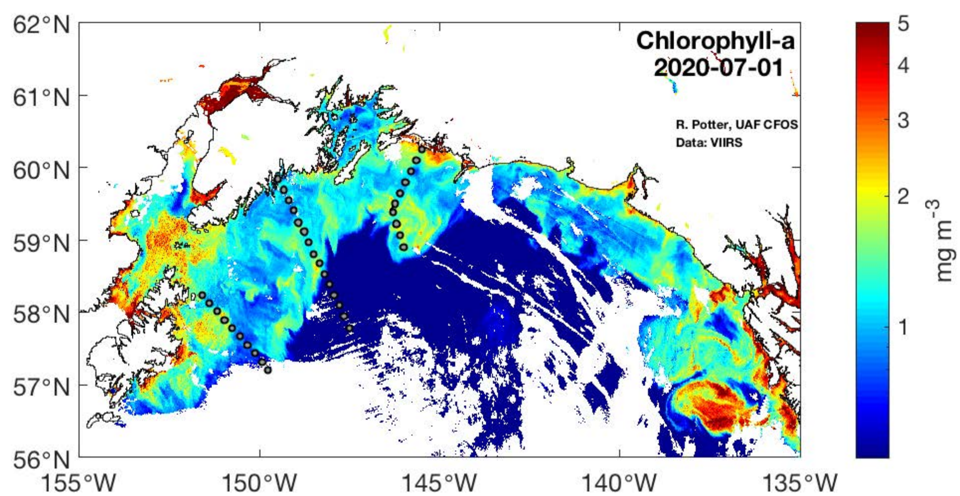
High resolution (~300 m horizontal spacing) CTD profiles over the upper water column (50 to 60 m depth) were collected using a towed Sea Sciences Acrobat system, which undulates at a rate of about 0.5 to 1.0 m s^{-1} while being towed at a ship speed of 3-4 m s^{-1}. The Acrobat was equipped with a SBE49 FastCat CTD and a WetLabs ECO-Triplett optical sensor with channels for chlorophyll a fluorescence, CDOM and optical backscatter (OBS) at 700 nm. We towed the Acrobat for the “plume study”, along the length of the Seward Line, and into a shelf slope eddy. For ship speeds of about 7 knots with 220 m of Acrobat cable paid out from the winch, we were able to consistently profile to about 50 m depth (Figure 3).

The Acrobat control station.

Views from Space:







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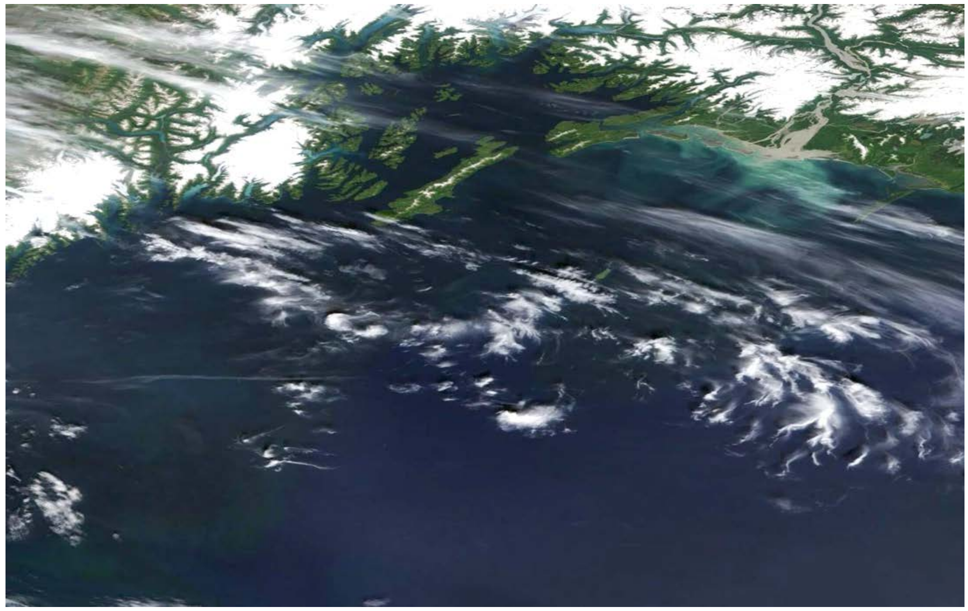

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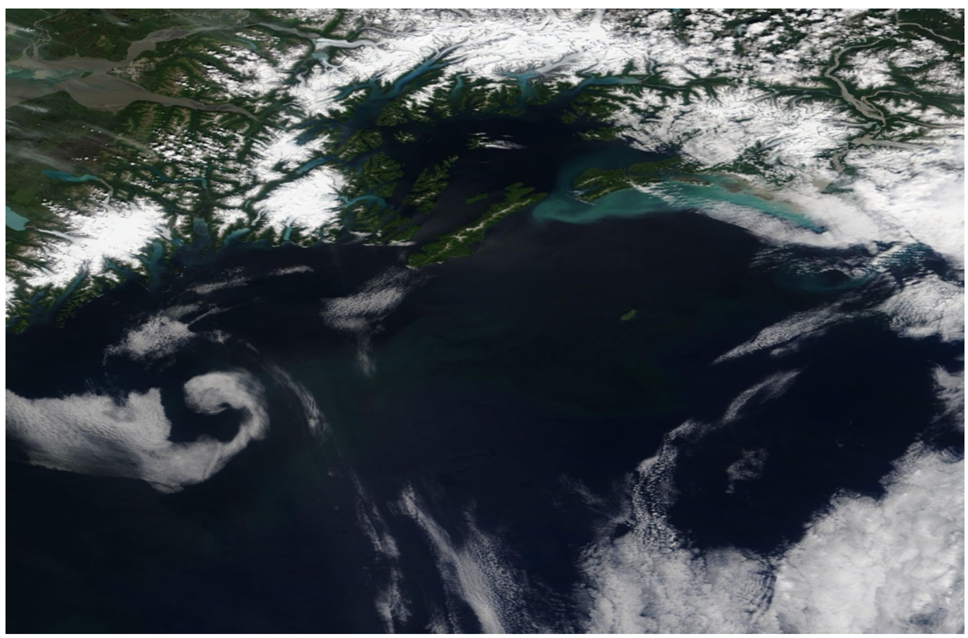
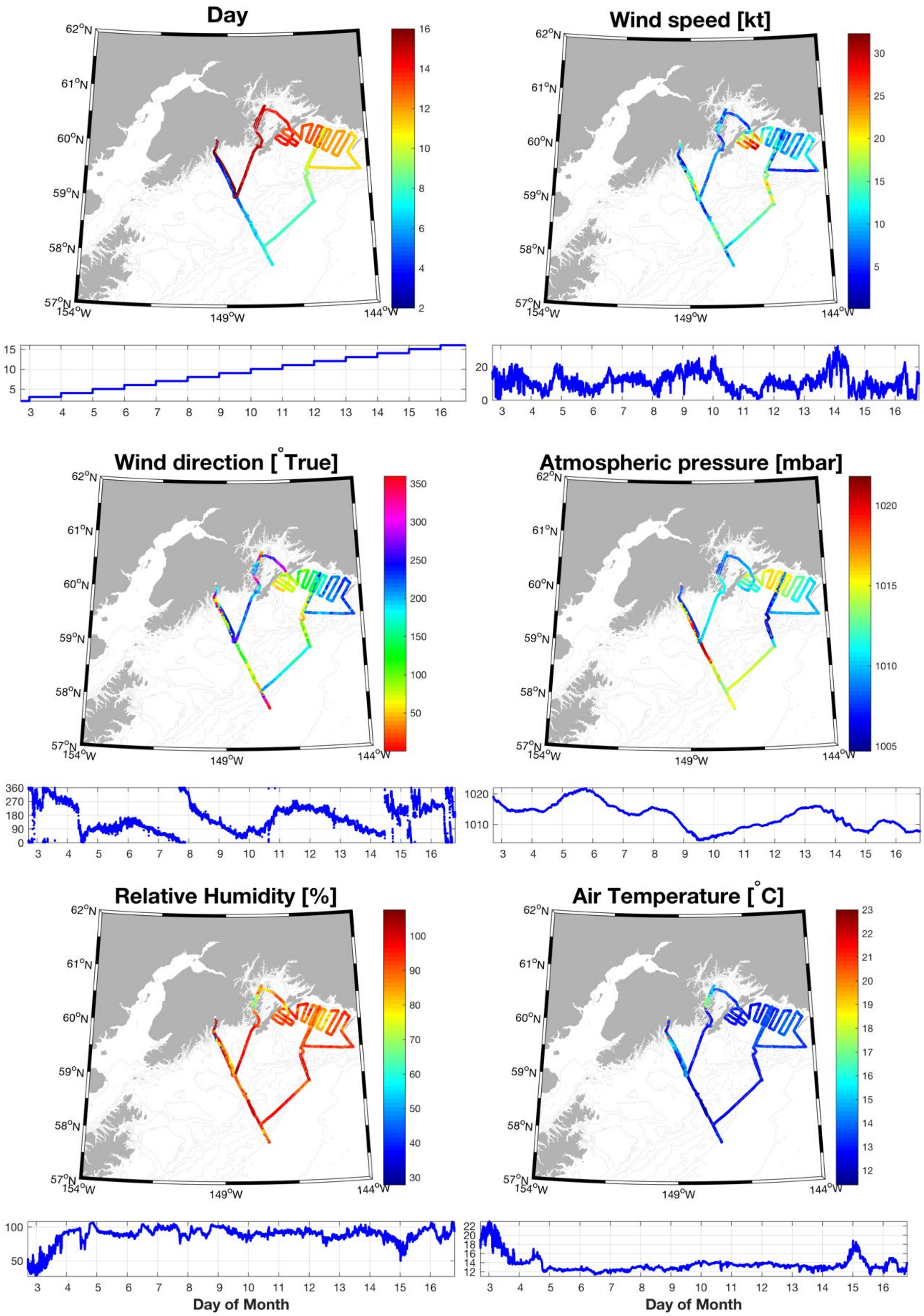
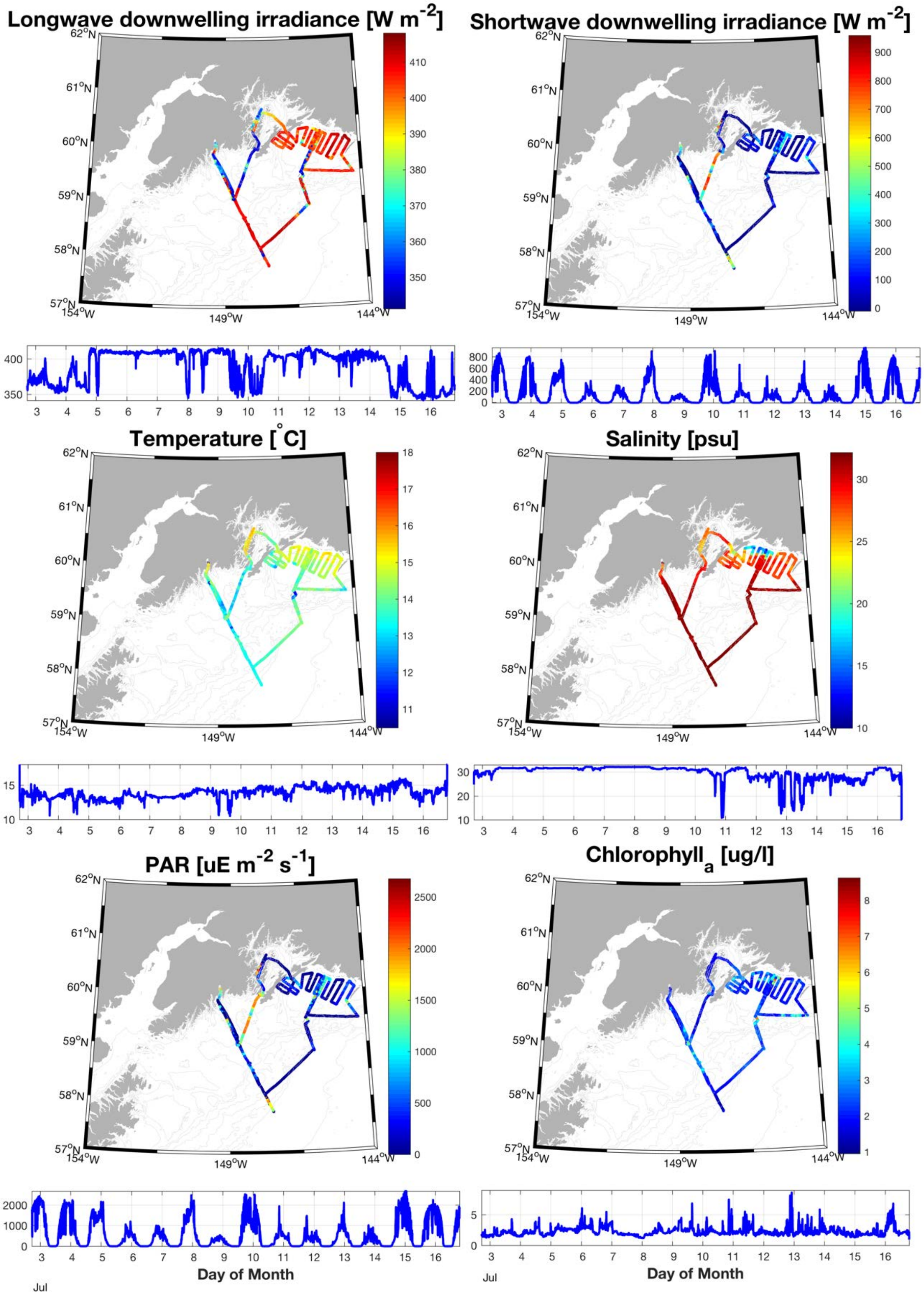


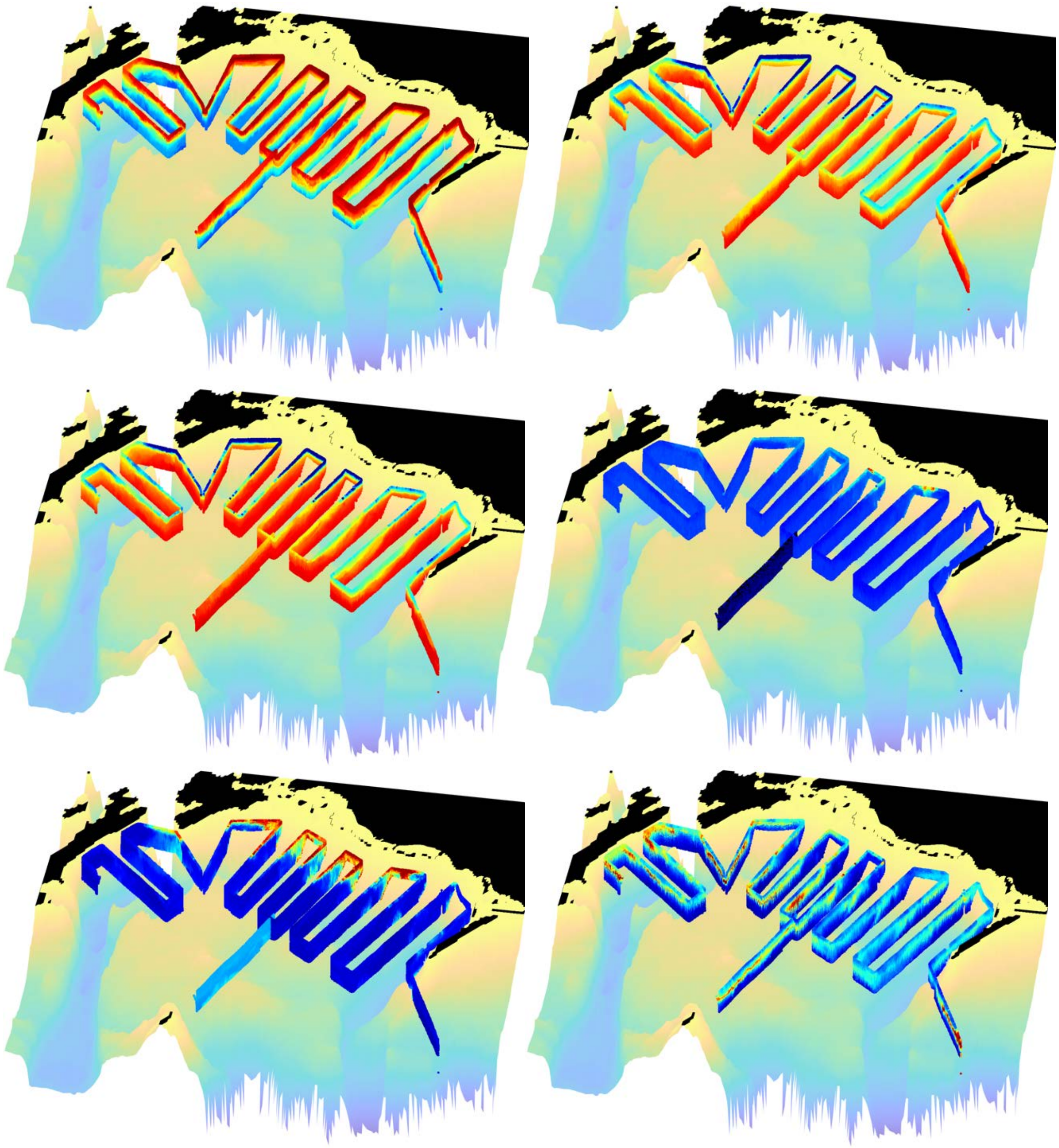
Underway Sensor Data:





Longwave downwelling irradiance [W m-2]
Shortwave downwelling irradiance [W m-2]
Temperature [°C]
Salinity [psu]
PAR [uE m-2 s-1]
Chlorophyll a [ug/l]
62°N
61°N
60°N
59°N
58°N
57°N
154°W
149°W
144°W
Day of Month
Jul

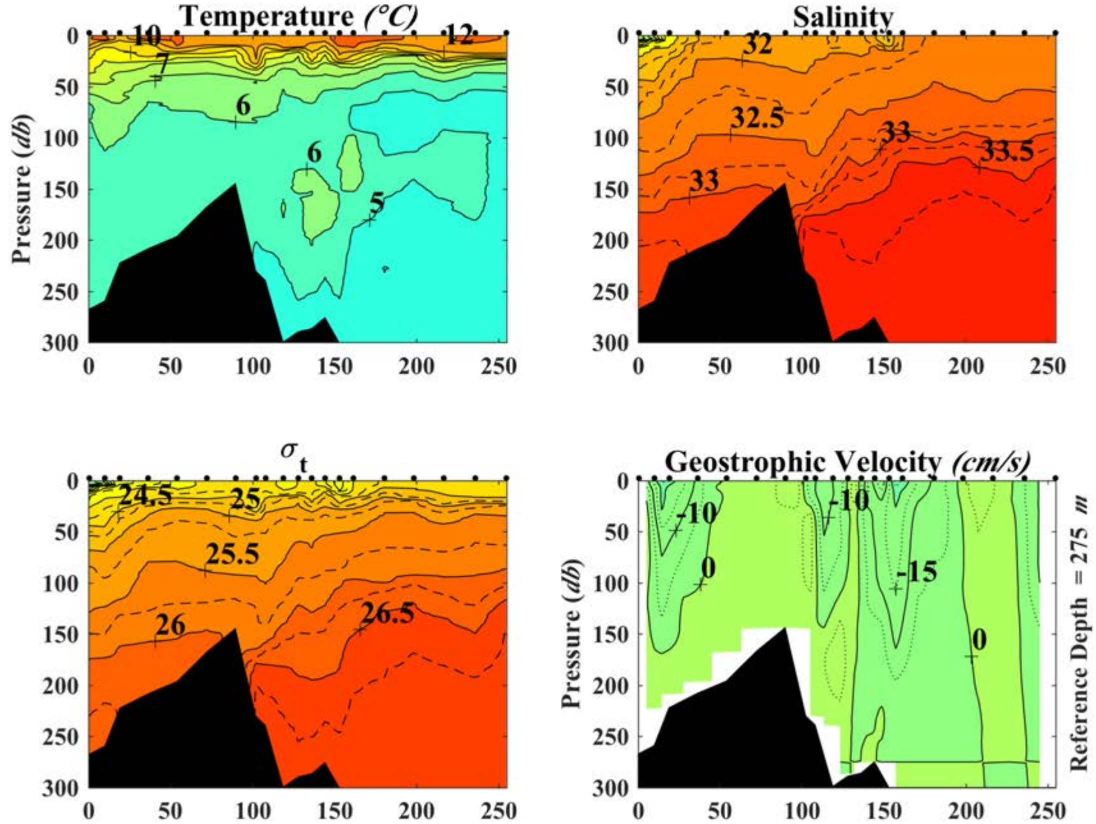
Acrobat Transect Data:



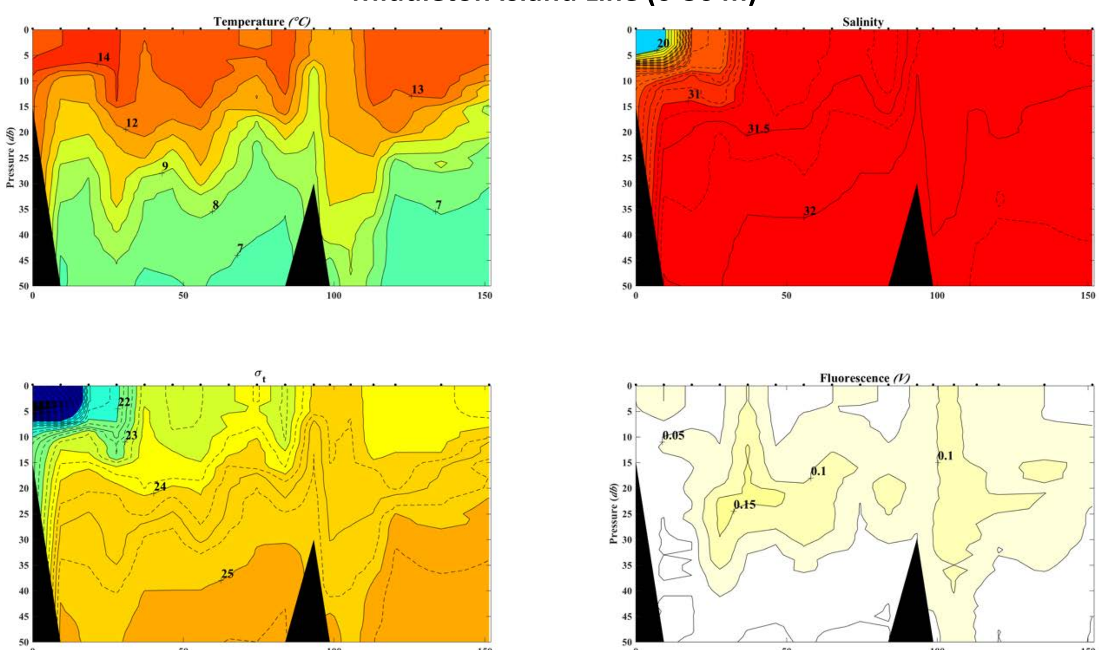
Clockwise from upper left: Temperature, Density (sigma-t), colored dissolved organic matter, Chlorophyll a fluorescence, optical backscatter, salinity.

Physical Hydrography: CTD transects

Seward Line (0-300 m)



Middleton Island Line (0-50 m)



Moorings:

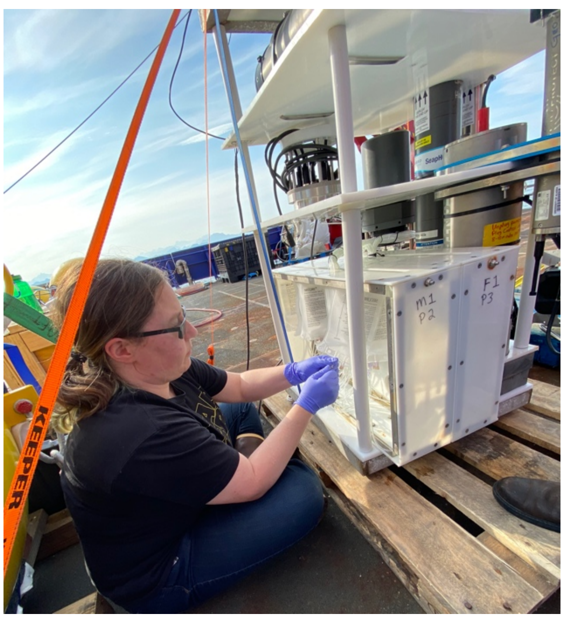
In comparing the actual (GPS from the surface float) location of the 2019 GEO1 and GEO3 moorings versus the target locations, we found that each of these moorings (each with 4300 lb anchors) experienced a lay-back of about 21 meters from the anchor drop site. Hence, for the 2020 deployment of GEO3 we drove past the target location by 20 meters before dropping the anchor. Vessel orientation was toward the NW (into the instantaneous current flow) during the deployment of GEO3-2020. Due to the non-recovery of mooring GEO2 on our first attempt (see narrative), we changed the position of moorings GEO2-2020 and GEO3-2020 to be to the SE of GEO1-2020, which was in the same place as GEO1-2019. With this, we were able to keep GEO2-2019 clear for another dragging attempt.

GEO2-2019 mooring recovery notes:

- The AZFP, ADCP and SBE-37 each had full 12-month records.
- All 24 bottles on the sediment trap were closed and had sample within.
- The Sexton Camera appeared to stop sampling in spring (approx. 3/4 year samples).
- The AURAL showed signs of a known manufacturer defect (bad hard drive) with “hidden” data that will need to be recovered at the factory. We presently assume that the instrument collected a full year of data.

<u>GEO-2020 Mooring Deployment Locations</u>

GEO1-2020: 59° 00.8253’ N, 148° 41.4079’ W
GEO2-2020: 59° 00.7600’ N, 148° 41.2150’ W
GEO3-2020: 59° 00.6888’ N, 148° 41.0135’ W



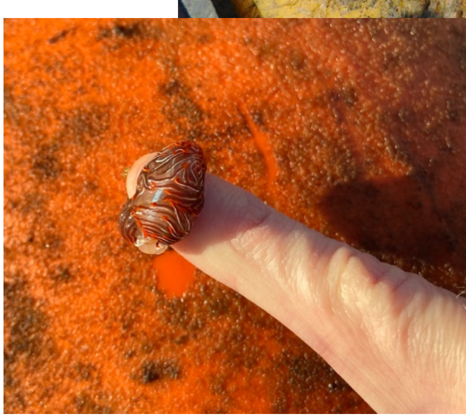
GEO2 instrument frame for 23 m depth. This frame has the AquaMonitor water sampler, Contros pCO2 sampler, SeaBird SeapHOx, and a Seabird SBE-37 CTD. Savannah prepares the AquaMonitor sample bags.

GEO3 surface float **and RT sensors.**



GEO2-2019 Recovery Photos





Macro- and Micronutrient sample collection and processing

LTER PI: Ana M. Aguilar-Islas
Participants: Ana Aguilar-Islas and Emily Ortega (UAF graduate student)

During this field effort, our goal was to determine ambient distribution of dissolved inorganic macronutrients (nitrate, nitrite, ammonium, phosphate and silicic acid) and the micronutrient iron. The influence of the Copper River plume on nutrient dynamics was the major focus of the cruise. Nutrient distributions in conjunction with hydrography are used to determine resource variability to the phytoplankton community in space and time and to identify the relative importance of various processes in supplying nutrients to surface waters. A secondary aim was to train students in field-related work.

Sample collection and processing for macronutrient analysis:
Filtered seawater samples were collected from 38 vertical profiles (see Table N1) from surface to 1500 m using the ship's CTD rosette bottles. Samples were filtered through 0.45 um cellulose acetate filter disks using a syringe, and were frozen (-80 ^{o}C) following collection. Samples were also obtained from primary production casts and surface water during the Copper River Plume study, and in between stations along the GAK line, the MID line and in PWS. Ortega and Aguilar-Islas were responsible for CTD macronutrient sampling with some help from members of the Strom and Burt teams. In total 646 samples were collected for nutrient analysis.

Table N1. Samples for Nutrient Analysis
Intensive stations are in bold. Additional samples collected from primary production (PP) casts and surface transects are under "OTHER"

STATION	# samples	STATION	# samples	STATION	# samples
RES 2.5-a	13	MID1	3	PL-20	9
GAK1-a	13	**MID2**	9	PL-21	7
GAK2	12	MID3	8	PL-22	7
GAK3	11	MID4	8	GEOa	12
GAK4	11	**MID5**	8	GEOb	12
GAK5	11	MID6	4	RES2.5b	13
GAK6	10	MID7	7	GAK1b	13
GAK7	12	MID8	15	OTHER	# samples
GAK8	13	MID9	17	Plume transect	88
GAK9	13	**MID10**	17	GAK transect	17
GAK10	17	**PWS2**	15	MID transect	21
GAK11	17	PWS3	15	PP casts	70
GAK12	17	PWS1	14		
GAK13	17	KIP2	15		
GAK14	17	MS2	9		
GAK15	17			**TOTAL**	**646**

Sample collection for iron analysis:
a) Seawater samples were collected from 8 vertical profiles (see Table N2) from 15 -1000 m using a trace metal clean (TMC) rosette made of powder coated aluminum and loaded with Teflon-coated Niskin bottles with external springs. A dedicated winch (MASH2K) with 5/16" Amsteel line and a TMC block

mounted on the starboard crane were used to deploy/recover the TMC rosette. The winch and block were borrowed from the UNOLS East Coast winch pool. All participants were involved in deck operations, with assistance from crew and marine technician. Emily Ortega learned to program the Auto Fire module, download cast data and to operate the winch.

b) Surface seawater samples were collected underway while arriving (or departing) the stations where TMC casts took place. These samples were used to complete vertical profiles. Surface seawater samples were also collected during the Copper River Plume study, and in between stations along the GAK and MID lines, as well as some around PWS2. These samples were obtained from a custom-made surface sampler (FeFish) deployed from the starboard crane, and kept at a distance between 3-5 m from the hull while being towed at 4-9 knots (see Photo 1). Water was pumped with the use of an air actuated diaphragm pump that delivered the sample into "the bubble" through Teflon-lined polyethylene tubing (see Photo 1). Ortega and Aguilar-Islas were involved in deck operations, with assistance from the crew and marine technician.

Table N2. Samples for iron parameters
DFe = dissolved iron (< 0.2 um), SFe = soluble Fe (< 0.02 um), TDFe = total dissolvable iron (unfiltered), PFe = particulate iron (> 0.2 um), Ligands = Iron-binding organic ligands (< 0.2 um).

STATION	DFe	SFe	TDFe	Ligands	PFe
GAK1	9	0	3	2	3
GAK5	9	0	3	1	3
GAK9	12	0	4	2	4
GAK15	12	0	3	1	3
MID10	12	0	5	1	5
MID5	6	0	3	1	3
MID2	6	0	3	1	3
PWS2	12	0	4	2	4
TOTAL	**78**	**0**	**28**	**11**	**28**
TRANSECT	**DFe**	**SFe**	**TDFe**	**Ligands**	**PFe**
GAK	25	0	1	2	1
MID	25	0	0	3	0
PLUME	89	0	14	8	14
PWS	3	0	1	1	1
TOTAL	**142**	**0**	**16**	**14**	**16**
DISEx	**DFe**	**SFe**	**TDFe**	**Ligands**	**PFe**
All treatments	**43**	**0**	**0**	**3**	**0**
GRAND TOTAL	**263**	**0**	**44**	**28**	**44**

<u>Sample processing for iron analysis:</u>
A positive-pressure, plastic enclosure supplied with HEPA filtered air (the "bubble") was constructed in the analytical lab to house the Niskin bottles, IronFish sampling spigots and filtration rigs. Immediately after collection, Niskin bottles were transferred to the bubble for subsampling. Filtered (through 0.2 um Acropak capsules) subsamples for dissolved Fe analysis were processed from all casts at all depths, and from all IronFish samples. Filtered subsamples for the analysis of iron-binding organic ligands, unfiltered samples for total dissolvable iron analysis, and filters for particulate iron analysis were obtained from a

subset of samples (see Table 2). Samples were filtered through 0.2 um polycarbonate filter discs (Nuclepore) using trace metal clean techniques. Ana Aguilar-Islas, and Emily Ortega were responsible for subsampling and filtration. Time consuming ultrafiltration for soluble iron was not carried out during this cruise due to personnel shortages

Seawater collection and processing for the particulate Fe dissolution:
A particulate iron dissolution experiment (DISEx) was conducted with suspended particles from the Copper River plume collected near MID 2, and offshore water collected near GAK15. 25L of offshore water were homogenized in a carboy and a subset was immediately transferred to 2L bottles, while the rest was stored at 13 ^{o}C in the dark until the experiment started (4 days later). Suspended particles from 1 L of offshore water were collected onto six 47 mm polycarbonate filter discs (0.2 um pore size), and were kept frozen until the experiment started. The offshore carboy was sampled for DFe, TDFe, and Fe-binding ligands. Plume water was homogenized in a 25L carboy and immediately transferred into 2 L bottles. Suspended particles from 1L of plume water were collected onto nine 47 mm polycarbonate filters and transferred to the freezer. Homogenized offshore water was transferred into six 2.5 L polycarbonate bottles, and one filters containing suspended particles were added to each. Three of the bottles received offshore particles and three plume particles. Bottles were subsampled (~100 ml) at various time intervals (30 min, 1.5 hr, 3 hr, 8 hr, 24hr, and 48 hr) and samples for DFe were collected from all six bottles at each time interval. A pooled sample for Fe-binding ligands was collected from each treatment (offshore and plume) at the 48 hr interval.

General Notes
We had a successful cruise and were able to accomplish all the programmed sampling for macro-nutrients and iron parameters. We tried a new FeFish design this cruise which was deployed using the new small winch located on the starboard crane. The new design made deployment and recovery easier, and allowed for efficient operations at stations when exchanging between fish and Calvets, now that the Calvet nets are being deployed also from the starboard crane instead of from the stern. During the plume study, the FeFish was able to sample the very low salinity water in areas where the plume was so thinly at the surface that neither the ship's underway systems nor the Acrobat was able to sample the core of the plume. The deck crew provided excellent support and their help ensured the success of our operations. The marine technicians also provided excellent support throughout the cruise. The crew was always helpful, responding promptly to requests in a happy and professional manner. We experienced no issues with ship's facilities needed for macro- and micronutrient work. Laboratory spaces were adequate, the ship's deck gear, -80 ^{o}C freezer and walk-in refrigerator were in good working condition. Internet access was adequate. The quality of the food was excellent.

Left: FeFish being towed at 7-9 knots during one of the many calm days of the cruise. **Center:** Emily Ortega assisting during FeFish operations. **Right:** Fish sampling station inside the “bubble”.

Underway Optical System

LTER Collaborator: William Burt

The underway optical system was mounted in the main lab, at the forward end of the starboard bench (see picture below). The system measured inherent optical properties (i.e. absorption, attenuation, and backscattering of light) from the ships uncontaminated seawater system throughout the duration of the cruise (see figure below). Overall, the system performed well, with minimal leaking or bubble contamination, and no discernable biological fouling.

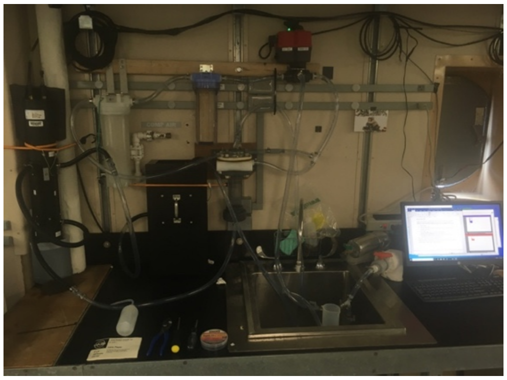
In total, over 18,000 minute-binned measurements were made. Preliminary onboard data processing reveals a high-resolution timeseries of chlorophyll concentration (see below). Additionally, during the plume study, 24 discrete chlorophyll samples were taken from the outlet of the underway system. Samples were timestamped, processed and analyzed onboard. Discrete chlorophyll samples overlain on the timeseries shows relatively strong agreement (see figure below) indicating that the optical system can be used to provide robust, biologically-relevant information at high-resolution across many dynamic areas of this region.

Oxygen Sampling

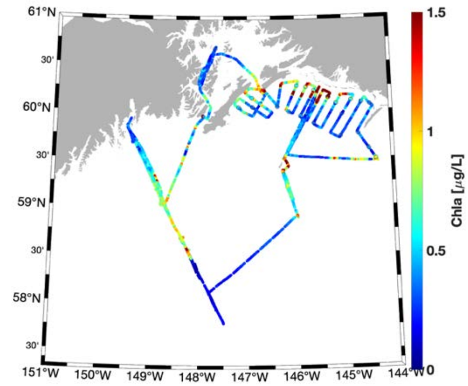
Discrete oxygen sampling was conducted from either the surface or bottom at nearly all stations. In total, 47 samples were collected, pickled, and stored for analysis at UAF. In addition to regular sampling, triplicate surface samples were taken from the GEO mooring site during both occupations to calibrate newly deployed oxygen probes.

DIC Sampling

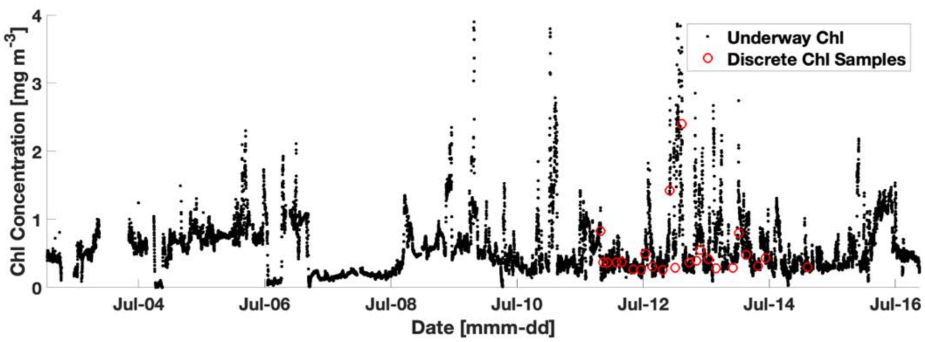
Full water column profiles of discrete dissolved inorganic carbon (DIC) samples were taken at stations GAK1 and GAK3 for the Ocean Acidification Research Center (OARC). These were poisoned and stored onboard for later analysis at UAF. Additionally, 137 DIC samples from select stations were collected, poisoned, and stored for later analysis by the Hauri Lab at the International Arctic Research Center (IARC). All IARC samples were prefiltered though a 45 micron filter using a peristaltic pump, except for samples at two stations (PL22 and PWS2), where both filtered and unfiltered samples were collected in triplicates to assess the need the prefiltering in future cruises.



System setup in main lab



Map of all underway Chl



High-Resolution Chlorophyll

Phytoplankton, Organic Carbon and Microzooplankton

LTER PI: Suzanne Strom
Participants: Suzanne Strom, Hana Busse, Laura Strom (all WWU)

State Measurements

Two of the three normal LTER transect lines were sampled on this cruise (GAK, MID) and a non-standard intensive station was added at the oceanic end of the MID line (MID-10). This cruise also involved a study of the Copper River plume. During the 3 day plume study, CTD casts were done at ~0900 each day and treated as intensive stations. Five stations in Prince William Sound were also occupied, while the Kodiak (KOD) line was not sampled.

Phytoplankton biomass and production: Phytoplankton biomass was characterized by size-fractionated chlorophyll at all non-intermediate shelf stations, all plume CTD stations, 5 stations in Prince William Sound, and two visits to the GEO mooring site (total = 38 vertical profiles). Samples were analyzed fluorimetrically on board (7 depths per station). Primary production estimates were made at all intensive and morning plume study stations (total = 10) using the 13-C method and 24 hr deck incubations. Six 'light depths' were sampled per station based on the attenuation coefficient as estimated from the CTD PAR profile. Chlorophyll (GFF only) and nutrient samples were also taken from each of these productivity depths during experiment set-up.

Community characterization: Photosynthetic organisms and other protists were sampled at approximately every other shelf station as well as in the plume and at PWS-2. Samples were fixed in acid Lugol's for standard microzooplankton biomass and composition estimates; these were taken from 10 m only at most stations, from 0 and 10 m at most plume stations, and from 4 depths at intensive stations. At a similar sampling frequency, samples from 10 m were fixed in borate-buffered formalin for diatom characterization. Additional microscopy samples, collected at a similar frequency to the diatom samples, were fixed in glutaraldehyde, DAPI-stained, and made into slides for biomass and composition of nano- and picoplankton. Samples for HPLC analysis of phytoplankton pigments (chemotaxonomy) were taken from all odd-numbered Seward Line stations and all other intensive stations; these were from 10 m and generally one other euphotic zone depth (often 4 m for eventual matching with data from Will Burt's system). At intensive stations only, additional samples were taken from 10 m (in duplicate) for molecular (18S rRNA) characterization of the protist community by the Rynearson laboratory at URI. We also did extensive sampling for Gwenn Hennon (not shown in table below), including glutaraldehyde-fixed samples for flow cytometry (generally 3 depths per station), frozen filtered samples for DNA analysis (also 3 depths per station) and fixed samples for Polony sequencing (2 depths per station, in triplicate). A detailed log of these samples is available.

Organic carbon characterization: Samples were filtered and frozen all intensive stations and two of the plume stations for DOC profiles (total profiles = 10); depths sampled were mainly 150 m and above except in the deep intensive casts, and corresponded to nutrient sampling depths (8-10 depths per profile). At these same stations, 4 depths (0, 10, 20, 40 m) were sampled for POC and PIC.

Process Studies

Seawater dilution experiments: These experiments (6 total) were conducted to understand how river plume-related salinity gradients in the near surface influenced plankton community composition and rate processes. The dilution experiments were combined with copepod (*Pseudocalanus* spp. adult female) additions in most cases (see table below). Rate data obtained from these experiments include:

phytoplankton community intrinsic growth rates, degree of phytoplankton growth rate limitation by N+P, and microzooplankton community grazing rates on phytoplankton. All rates were obtained for both <20 µm and >20 µm chlorophyll size fractions. Samples were also taken for flow cytometry which should yield growth and grazing rates specific to the cyanobacteria *Synechococcus* and to the eukaryote picophytoplankton, and allow rate correction for photoacclimation. Rates of grazing on the two phytoplankton size fractions by adult female *Pseudocalanus* copepods have been obtained; later analysis of Lugol's samples should allow us to compute rates of copepod grazing, including selective feeding, on various microzooplankton taxa and size classes under the different environmental regimes.

Table P1. Summary of seawater dilution experiments

Exp #	Date	Station	CTD#	Water collection depth	Salinity (approx)	*Pseudocalanus* treatment?
DE-1	7/8/20	MID-9	28	4	31.9	--
DE-2	7/9/20	MID-5	37	4	31.3	Y
DE-3	7/10/20	MID-2	45	4	29.1	Y
DE-4	7/11/20	PL-20	47	4	28.4	Y
DE-5	7/12/20	PL-21	49	0	13	--
DE-6	7/13/20	PL-22	51	4	26.4	Y

Preliminary observations:

Seward (GAK) line (Fig. P1): Offshore of the shelf break (GAK 10-15) we encountered true HNLC waters. Total chlorophyll concentrations in the upper 20 m were quite low at ≤0.25 µg/liter but, in spite of these low totals, 10-20% was contributed by large (>20 µm) cells. There was a subsurface chlorophyll maximum (SCM) at 40-50 m depth in which total chlorophyll was a bit higher than at the surface (0.25 – 0.35 µg/liter). Inshore of the shelf break the situation was quite different. Nearly all the chlorophyll was in small (<20 µm) cells, surface concentrations were higher (0.4 – 1.9 µg/liter), and the SCM was considerably shallower at approximately 15-20 m depth. Highest measured chl-a concentrations in the SCM were 2.2 – 2.3 µg/liter (GAK-6 and GAK-2), although we might have missed the peak at some stations with the Niskin sampling.

Comparison with previous summers:

This is the first of the 3 LTER summer cruises which did not feature an eddy sitting on the outer Seward Line. The effect of the 'non-eddy' situation is evident in the true HNLC water encountered seaward of the shelf break in 2020, and the much lower total chl-a concentrations at these stations (e.g. average integrated chl-a at GAK-11 through GAK-15 in 2020 was only 62% of that in 2019). However, a consistent feature of the slope stations in all 3 summers is a somewhat higher contribution of large phytoplankton cells offshore relative to the shelf. This probably represents the transition from summer N limitation on the shelf to moderate Fe limitation offshore of the shelf break.

As for the Seward Line, chlorophyll at most stations was almost entirely in small cells with a pronounced SCM at 10-20 m depth, as seen in previous years. Surface chl-a was ~0.5 µg/liter and SCM maxima ~1.0-1.5 µg/liter. Total chl-a on the inner MID line was similar to that in 2018 and higher than that in 2019. Stations MID-6 and MID-7 near the island differed from the rest of the line, with some process promoting the growth of large phytoplankton cells. While an enhancement of total chl-a was sometimes seen near the island in previous years, the increase in large phytoplankton cells is (so far) unique to 2020 in the summer LTER time series. This fits with more tidal mixing energy 2 d before our occupation of these stations in 2020 (tidal range in 2020 = 4.4 m versus 2.5 and 2.3 m in 2019 and 2018, respectively), but might also be related to increased freshwater delivery to the area in 2020.

Plume (PL) stations: Due to limited person-power, only 3 CTD casts were done during the plume survey. These confirm findings from 2019 that the fresher surface layer is stimulatory to large cells, as seen at PL-20 and -21 (and also hinted at in profiles from MID-1 and -2). By PL-22, which was substantially west of the Copper River mouth, essentially all chl-a was in small cells and there was a pronounced SCM at ~20 m, as seen on most of the shelf as represented by the GAK and MID lines. This suggests that, while a freshwater signature remained at the surface at PL-22, its 'fertilization' properties were largely exhausted.

GEO station: This station was sampled on 5 July, after an extended period of relatively calm weather, and again on 15 July after passage of a low pressure system and winds to 10-11 m/s (according to data from NDBC station 46076 off Cape Cleare). The two profiles show the transition from ~99% small phytoplankton cells and maximum chl-a = 0.9 µg/liter, to a community with 30-50% large cells and maximum chl-a = 1.7 µg/liter (Fig. P2). It is interesting to speculate whether the entire middle shelf in the NGA study area underwent such an enrichment in response to the wind event.

Table P2 Key:

- **SF Chl:** size-fractionated chlorophyll-a; water sample filtered in series through a 20 µm pre-size filter followed by a glass fiber filter (effective pore size 0.7 µm)
- **Lugol's µzoo:** water sample preserved in acid Lugol's iodine solution (final concentration 5%) for microscopy analysis of size and composition of ciliate and dinoflagellate microzooplankton (cells ≥15 µm).
- **Diatom:** water sample preserved in borate-buffered formalin (final concentration xx%) for microscopy analysis of diatom community.
- **Nano/pico:** water sample pre-screened through 100 µm Nitex mesh, preserved in glutaraldehyde (final concentration 0.5%), and stained with DAPI for on-board filtration and slide preparation. Slides stored frozen for epifluorescence microscopy analysis of cyanobacteria and protists <20 µm in size.
- **HPLC:** water sample filtered (glass fiber, 0.7 µm) and frozen in liquid N_2 for HPLC analysis of phytoplankton pigments (chemotaxonomy).
- **Euk Mol:** water sample filtered (0.2 µm) and frozen in liquid N_2 for molecular analysis of eukaryotic microbial community composition.
- **DOC:** water sample filtered directly from Niskin through pre-combusted glass fiber filter and filtrate stored frozen for analysis of dissolved organic carbon concentration.
- **POC/PIC:** Paired samples from a single Niskin filtered through pre-combusted glass fiber filters and filters stored frozen for analysis of particulate organic and particulate inorganic carbon.
- **13C prod:** Water column primary productivity measured via 24-h incubation of samples from different depths with 13C-labeled sodium bicarbonate.
- **SW dil expt:** Water collected from near surface for seawater dilution experiment (estimation of phytoplankton growth and microzooplankton grazing rates)

Table P2. Sampling effort for Strom component, by station. Intensive stations shown in **red**.

Station	SF Chl	Lugols µzoo	Diatom	Nano/ pico	HPLC	Euk Mol	DOC	POC/ PIC	13C prod	SW dil expt
RES2.5	x									
GAK1	x	x	x	x	x	x	x	x	x	
GAK2	x									
GAK3	x	x	x	x		x				
GAK4	x									
GAK5	x	x	x	x	x	x	x	x	x	
GEO	x									
GAK6	x									
GAK7	x	x	x	x		x				
GAK8	x									
GAK9	x	x	x	x	x	x	x	x	x	
GAK10	x									
GAK11	x	x	x	x		x				
GAK12	x									
GAK13	x	x	x	x		x				
GAK14	x									
GAK15	x	x	x	x	x	x	x	x	x	
MID10	x	x	x	x	x	x	x	x	x	
MID9	x									x
MID8	x									
MID7	x									
MID6	x									
MID5	x	x	x	x	x	x	x	x	x	x
MID4	x	x	x							
MID3	x	x	x							
MID2	x	x	x	x	x	x	x	x	x	x
MID1	x									
PL20	x	x	x	x		x				x
PL21	x	x	x	x	x	x	x	x	x	x
PL22	x	x	x	x	x	x	x	x	x	x
PWS3	x									
PWS2	x	x	x	x	x	x	x	x	x	
PWS1	x									
KIP2	x									
MS2	x	x	x							
GEO	x									
GAK1	x									
RES2.5	x									
Total:	**38**	**18**	**18**	**15**	**10**	**15**	**10**	**10**	**10**	**6**

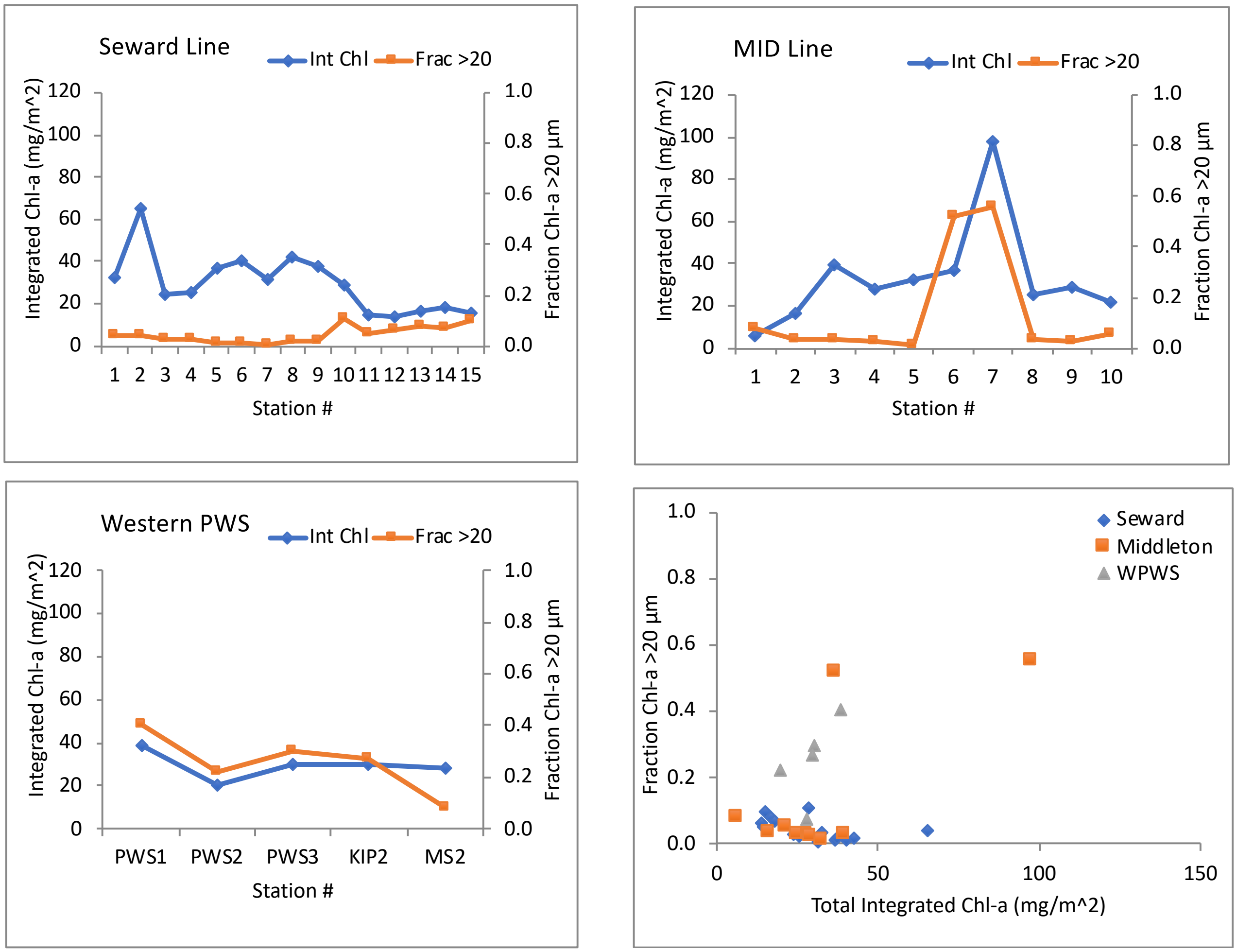


Figure P1. Total integrated (0 – 75 m) chlorophyll-a and the fraction >20 µm for the GAK, MID, and PWS stations. Lower right panel shows relationship between these two properties for all stations.

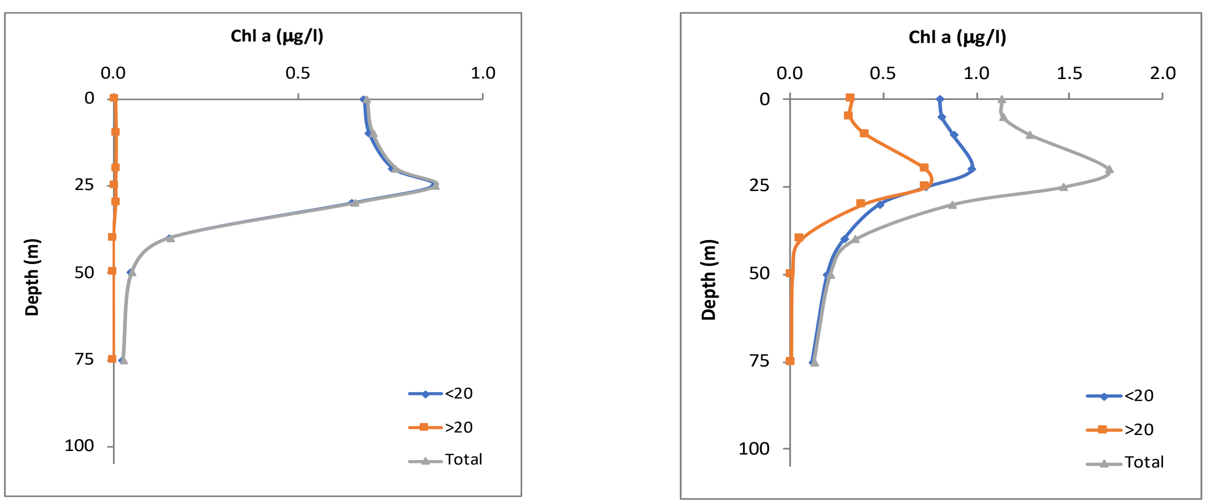


Figure P2. Vertical profiles of chl-a in two size fractions and in total (grey) at GEO mooring site on July 5 (left, before wind event) and July 15 (right, after wind event).

Meso/Macro Zooplankton

LTER PI: Russel Hopcroft
Participants: Russ Hopcroft, Jennifer Questel, Delaney Coleman

Zooplankton sampling operations were divided into distinct day and night activities. During daytime, Quadnets (Quad frame has 4 nets, 2 of 150 µm mesh and 2 of 53 µm mesh) casts were conducted at all stations (except "i" stations) to 100 m depth, or within 5 m of the bottom at shallower stations. At intensive stations, an additional Quadnet cast was taken, with the 150 µm net preserved in ethanol for molecular studies and the 53 µm nets used for live sorting. Additionally, at intensive stations along the Seward Line, at PWS2, and at MID10, a multinet equipped with 150 µm-mesh nets was deployed vertically to 200 m (shelf) with a second cast deployed to 750 m (PWS2) or 1200 m (GAK15, MID10) dividing strata at 600, 400, 300, 200, 100, 60, 40, and 20 m. During night-operations a Bongo net of 505 µm mesh was towed obliquely to 200 m depth (or 5 m above the bottom) at Middleton Island stations. Bongo depths were monitored using a Fastcat (SBE49) CTD mounted immediately above the nets. Along the Seward Line and within PWS, a multinet equipped with 505 µm-mesh nets was towed obliquely to 200m depth (or 5 m above the bottom) dividing strata at 100, 60, 40, and 20 m. Methot nets were collected at night concurrent with most Multinets or Bongos (see Table Z1).

Methot catches were processed fresh, with size-frequency data collected on all species; subsampling was needed. A total of ~80 kg of macro-jellies were collected at the 29 stations, with catches dominated numerically and as biomass by *Aequorea.*

At MID2, MID5, and during the mesoscale mapping of the Copper River plume, experimental studies were undertaken with *Pseudocalanus* adult females in conjunction with microzooplankton grazing experiments undertaken by Strom. At these 5 sites, ~120 randomly selected *Pseudocalanus* females were incubated in Tissue-culture flasks and checked for the presence of eggs after 24 and 48 hrs in the walk-in incubator set at ~12°C. Egg-producing females were preserved individually with their clutches, while remaining females were aggregated and preserved. As during 2019, egg production rates in the Copper River Plume were low, but increased somewhat outside the plume. See Strom's section for grazing experimental setup and results.

At all intensive stations, Calvet samples were sorted for *Neocalanus* species and life-stages to image for body size and lipid sac volume (~50 for each species/stage combination). In general, an entire net was sorted, allowing a preliminary estimate of their species abundances. On the Seward Line, Calvets nets were nearly devoid of *Neocalanus* on the shelf, but the Multinets were collecting large numbers of lipid-rich animals below 100 m. AT GAK1-4 we sorted and imaged up to 50 *N. plumchrus* CV and *N. flemingeri* females from the multinet drogue for size and lipid volume, but found these animals to be in generally poor condition. Realizing this, we began sorting animals from the vertical multinets (GAK5, 7, 9, 15). The deep vertical multinets at GAK15, MID10and PWS2 were fully imaged for all three *Neocalanus* species in each depth strata. Notably, *N. flemingeri* was typically found to peak at depths just below the peak of *N. plumchrus*. Sizes and lipid sacs volumes will be determined from these images post-cruise.

Table Z1. Sampling effort for Zooplankton. Intensive stations are highlighted. *samples taken for bulk genetics, sorting or imaging.

Station	Calvet-Quad	Multi Vert.	Multi Tow	Bongo	Methot
RES2.5	x				
GAK1	X*	x	x		x
GAK2	x		x		x
GAK3	x		x		x
GAK4	x		x		x
GAK5	X*	x	x		x
GAK6	x		x		X
GAK7	x	x	x		x
GAK8	x		x		x
GAK9	X*	x	x		x
GAK10	x		x		x
GAK11	x		x		x
GAK12	x		x		X
GAK13	x		x		X
GAK14	X		x		X
GAK15	X*	X*	x		X
MID1	x				
MID2	X*			X	X
MID3	x			X	X
MID4	x			X	X
MID5	X*			X	X
MID6	x			X	X
MID7	x			X	X
MID8	x			X	X
MID9	x			X	X
MID10	X*	X*		X	X
KIP2	X		x		x
PWS1	x		x		x
PWS2	X*	X*	x		x
PWS3	x		x		x
PL20-PL22	x				
TOTAL	**48**	**5**	**18**	**19**	**37**

Marine bird and marine mammal surveys

LTER Collaborator: Kathy Kuletz, USFWS
Participant: Dan Cushing, Pole Star Ecological Research

Background: We conducted marine bird and marine mammal surveys in the Northern Gulf of Alaska (NGA), July 2 - 16, 2020, aboard the 80-m R/V *Sikuliaq*, as a component of the NGA Long-term Ecological Research (NGA-LTER) cruise led by chief scientist Seth Danielson of the University of Alaska Fairbanks (UAF). The seabird and mammal surveys were supported by a grant to the UAF. The two major components of the cruise were: 1) station-based sampling of the Seward Line, Middleton Line, and Prince William Sound (PWS), and 2) high-resolution sampling of the Copper River plume region using towed instruments. Seabird and marine mammal surveys were conducted when the vessel was underway, including transits between sampling stations, sampling lines, and while conducting high-resolution sampling with towed equipment.

Methods: Observer D. Cushing conducted visual surveys during daylight hours while the vessel was underway. Surveys were conducted from the port side of the bridge (platform height: 9.7 m), using a modified line-transect protocol. The observer searched an area within a 300 m, 90° arc from the bow to the beam, using hand-held 10x binoculars when necessary for species identification. Observations were recorded using four perpendicular distance bins: 0-50 m, 51-100 m, 101-200 m, and 201-300 m. Observations of rare birds or large flocks, or marine mammals observed outside of the sampling window, were recorded as “off-transect”. The behavior of each animal was recorded as flying, on water, on ice, or foraging. Birds and mammals on the water or ice, or actively foraging from the air, were recorded continuously. Flying birds were recorded using instantaneous scans (frequency based on ship speed, typically about 1 per minute), to minimize bias due to movement of flying birds. Observations were recorded directly into a laptop computer using software Dlogv3 (R.G. Ford Consulting, Portland, OR) which logged the geographic coordinates of each sighting, as well as the track line and environmental conditions (Beaufort Sea state, weather, glare, ice coverage) at 20 sec intervals. Following completion of the cruise, survey transects were subdivided into 3 km segments, and density values (birds km^{-2}) were calculated for each taxon in each transect segment.

Preliminary results: We conducted 89 hours of surveys totaling 1370 linear km during the July 2020 cruise (Figure B1). On-transect, we observed a total of 2246 individuals of 26 species of birds, with an additional 15 species observed off-transect during surveys or while at stations (Table B1). Averaged across all 3 km transect segments, the mean density (all bird species combined) was 6.0 birds km^{-2}. In general, the highest concentrations of birds occurred near the shelf-break and in coastal waters within 15 km of the shore, while the lowest densities occurred over the middle shelf and in the high-nutrient low-chlorophyll offshore waters on the outer Seward Line (Figure B2). The dominant taxonomic groups in these regions differed, with larids such as gulls, kittiwakes, and terns abundant near the Copper River bar and other coastal breeding sites, and procellariids including fulmars, storm-petrels, and albatrosses predominating near the shelf-break. Colonially-breeding alcids such as common murres and tufted puffins were most abundant on the shelf. The area near Middleton Island, located on the outer continental shelf and home to some 50,000 breeding seabirds, was relatively diverse and used by all these groups.

The most abundant avian species observed during the cruise was the black-legged kittiwake (20.2% of total bird observations; Table B1). Kittiwakes primarily occurred over the shelf, especially near Resurrection Bay, Prince William Sound, and Middleton Island (Figure B3), all areas where kittiwake nesting colonies occur. The vessel also traveled near two colonies near Controller Bay, at Wingham and Fox Islands, which were last censused in 1974. The colonies were still active and were partially photographed from the ship. We also observed aggregations of foraging kittiwakes, with more than 1000 kittiwakes foraging near the shoreline of Montague Island south of Hinchinbrook Entrance, along with other seabirds and two humpback whales.

The second most abundant species of seabird during the cruise was the fork-tailed storm petrel, which comprised 18.2% of total birds. Storm petrels were common on the outer continental shelf and continental slope (Figure B4). While storm-petrels occurred irregularly over the inner shelf, relatively large flocks were also seen in inshore areas, primarily in locations with strong fronts, including the Copper River plume and Montague Strait in Prince William Sound, with a flock of 200 occurring at station MS3 in Montague Strait. Historical colony data (1970’s – 1980’s) show 2000 fork-tailed storm-petrels breeding on Wooded Island on the outer coast of Montague Island, with larger colonies numbering tens to hundreds of thousands of storm-petrels at the Barren Islands, St. Lazaria Island near Sitka, and The Triplets in the Kodiak Archipelago.

Glaucous-winged gulls were nearly as abundant as kittiwakes and storm-petrels during the cruise (17.5% of total birds). Like kittiwakes, glaucous-winged gulls were concentrated over the shelf, especially close to breeding sites, with the largest colonies on the barrier islands of the Copper River and Middleton Island (Figure B5).

Northern fulmars comprised 15.2% of total birds. Fulmars were widely distributed, with the exception of the plume-influenced inner shelf (Figure B6), and were most abundant near the shelf-break and Middleton Island. Large fulmar colonies occur in the Semidi Islands, about 165 km southeast of Kodiak Island.

Four additional species of seabirds each comprised 4-6% of total birds; red-necked phalarope (6.0%), common murre (5.7%), tufted puffin (4.9%) and black-footed albatross (4.2%). Phalaropes, which breed in coastal marshes and begin their post-breeding migration in mid-June, often occurred near fronts, especially in the Copper River plume and near Montague Island (Figure B7). Common murres were most abundant on the inner shelf, and usually occurred as individuals or pairs, with larger flocks near breeding sites in Resurrection Bay (Figure B8). The locations with the highest concentrations of tufted puffins also included Middleton Island and the portion of the Seward Line offshore of Resurrection Bay, where they breed, as well as the relatively shallow rise at the head of Amatuli Trough (Figure B9). Black-footed albatross (which breed November – June/July in the Hawaiian archipelago) occurred from the outer continental shelf to deep offshore waters, and were most abundant near the shelf-break (Figure B10).

Rare seabird species observed during the cruise included two Manx shearwaters west of Kayak Island, Aleutian terns and Caspian terns near the Copper River, and an immature short-tailed albatross with the alphanumeric leg band number E86 (Figure B11). This short-tailed albatross was likely banded at the Hatsune-zaki colony on Torishima Island (R. Suryan, personal communication), and the sighting details were forwarded to the Yamashina Institute in Japan.

We observed seven species of marine mammal (Table 2), with 31 individuals on transect and 114 off transect. The most abundant toothed whale (odontocete) species observed was the killer whale. Most killer whales were observed near PWS and the Copper River, with one group observed over the continental slope (Figure B12). Dall’s porpoises were widely distributed, and were observed in sound, shelf, and offshore locations. The most abundant baleen whale (mysticete) species was the fin whale. Most fin whale observations occurred mid-shelf or near the shelf-break (Figure B13). Humpback whales were observed near the coast. Northern fur seals were observed on the middle shelf along the Seward Line (Figure B14). Steller Sea lions occurred near Middleton and Kayak Islands and the Copper River. No harbor seals were observed during the cruise, which was unexpected given their use of the Copper River plume during the July 2019 cruise. Sea otters were observed in Resurrection Bay and PWS.

Table B1. Marine birds observed during the July 2020 NGA-LTER cruise. Numbers include on-transect observations only. Species only observed off-transect are indicated by an asterisk.

Common name	Scientific name	Number	% of total
Surf scoter	*Melanitta perspicillata*	*	-
White-winged scoter	*Melanitta fusca*	*	-
Black turnstone	*Arenaria melanocephala*	11	0.5%
Least sandpiper	*Calidris minutilla*	1	< 0.1%
Wandering tattler	*Tringa incana*	*	-
Red-necked phalarope	*Phalaropus lobatus*	134	6.0%
Phalarope spp.	*Phalaropus* spp.	5	0.2%
Parasitic jaeger	*Stercorarius parasiticus*	1	< 0.1%
Long-tailed jaeger	*Stercorarius longicaudus*	*	-
Common murre	*Uria aalge*	127	5.7%
Thick-billed murre	*Uria lomvia*	*	-
Pigeon guillemot	*Cepphus columba*	1	< 0.1%
Marbled murrelet	*Brachyramphus marmoratus*	15	0.7%
Marbled or Kittlitz's murrelet	*Brachyramphus* spp.	4	0.2%
Ancient murrelet	*Synthliboramphus antiquus*	19	0.8%
Parakeet auklet	*Aethia psittacula*	*	-
Rhinoceros auklet	*Cerorhinca monocerata*	31	1.4%
Horned puffin	*Fratercula corniculata*	18	0.8%
Tufted puffin	*Fratercula cirrhata*	111	4.9%
Black-legged kittiwake	*Rissa tridactyla*	453	20.2%
Sabine's gull	*Xema sabini*	1	< 0.1%
Mew gull	*Larus canus*	1	< 0.1%
Herring gull	*Larus argentatus*	9	0.4%
Glaucous-winged gull	*Larus glaucescens*	393	17.5%
Gull spp.	*Larus* spp.	3	0.1%
Aleutian tern	*Onychoprion aleuticus*	11	0.5%
Caspian tern	*Hydroprogne caspia*	1	< 0.1%
Arctic tern	*Sterna paradisaea*	20	0.9%
Tern spp.	*Sterna* or *Onychoprion* spp.	1	< 0.1%
Red-throated loon	*Gavia stellata*	*	-
Pacific loon	*Gavia pacifica*	*	-
Common loon	*Gavia immer*	*	-
Black-footed albatross	*Phoebastria nigripes*	94	4.2%
Short-tailed albatross	*Phoebastria albatrus*	*	-
Fork-tailed storm-petrel	*Hydrobates furcatus*	409	18.2%
Leach's storm-petrel	*Hydrobates leucorhous*	1	< 0.1%
Northern fulmar	*Fulmarus glacialis*	342	15.2%
Short-tailed shearwater	*Ardenna tenuirostris*	1	< 0.1%
Sooty shearwater	*Ardenna grisea*	20	0.9%
Dark shearwater spp.	*Ardenna* spp.	5	0.2%
Manx shearwater	*Puffinus puffinus*	*	-
Double-crested cormorant	*Phalacrocorax auritus*	*	-
Pelagic cormorant	*Phalacrocorax pelagicus*	3	0.1%
Bald eagle	*Haliaeetus leucocephalus*	*	-
Northwestern crow	*Corvus caurinus*	*	-
Barn swallow	*Hirundo rustica*	*	-
Total		**2246**	**100.0%**

Table B2. Marine mammal species observed during the July 2020 NGA-LTER cruise.

Common name	*Scientific name*	Number on-transect	Number off-transect
Fin whale	*Balaenoptera physalus*	2	12
Humpback whale	*Megaptera novaeangliae*	0	10
Killer whale	*Orcinus orca*	14	24
Whale spp.	*Cetacea* spp.	0	9
Dall's porpoise	*Phocoenoides dalli*	12	20
Northern fur seal	*Callorhinus ursinus*	0	2
Steller sea lion	*Eumetopias jubatus*	1	33
Sea otter	*Enhydra lutris*	2	4
Total		**31**	**114**

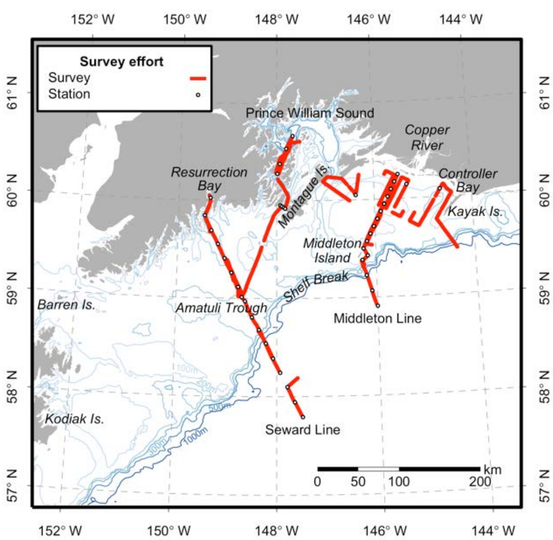


Figure B1. Location of seabird and marine mammal surveys (red) during the July 2020 NGA-LTER cruise.

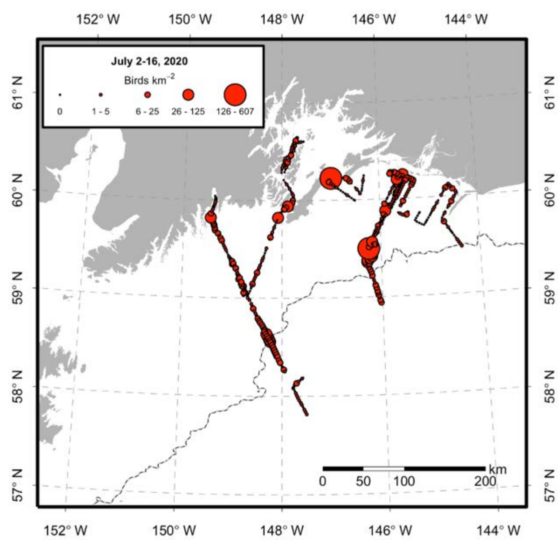


Figure B2. Densities (birds km^{-2}) of total seabirds (all species combined) during the July 2020 NGA-LTER cruise.

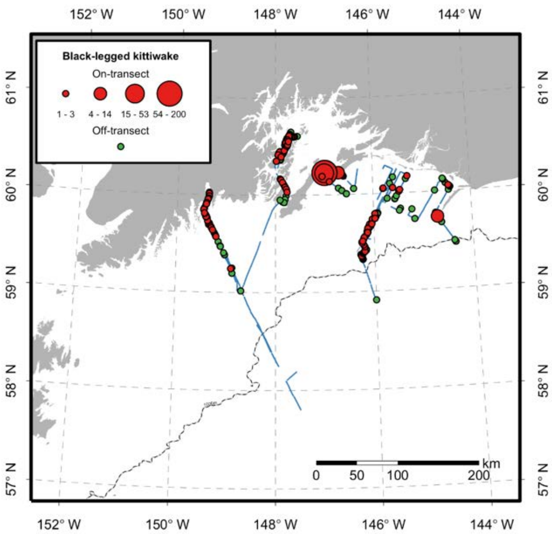


Figure B3. Black-legged kittiwake.

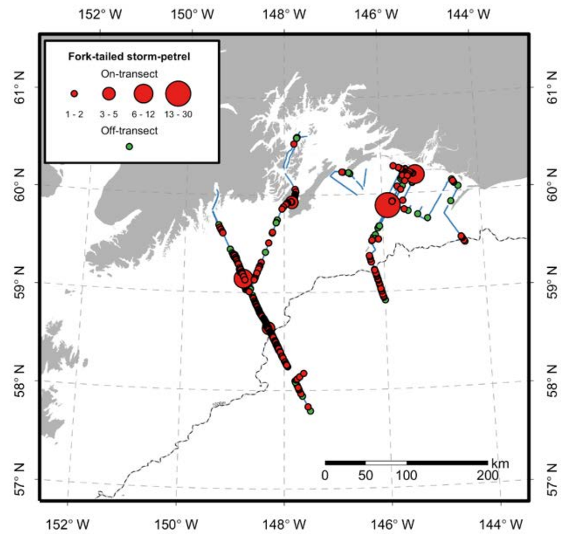


Figure B4. Fork-tailed storm-petrel.

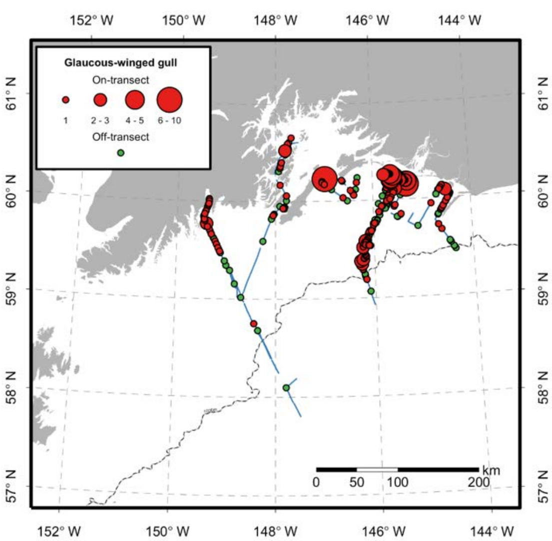


Figure B5. Glaucous-winged gull.

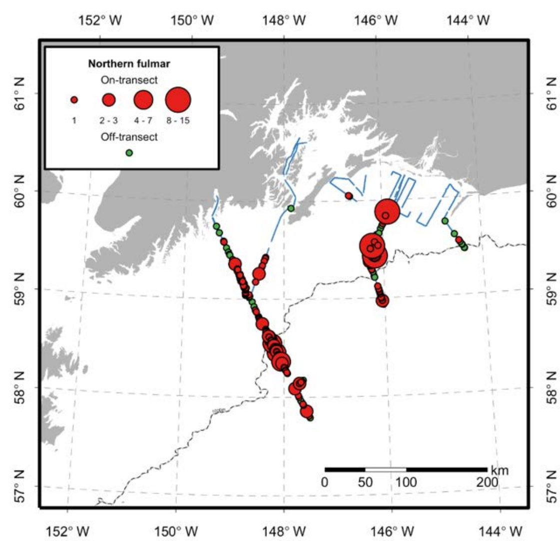


Figure B6. Northern fulmar.

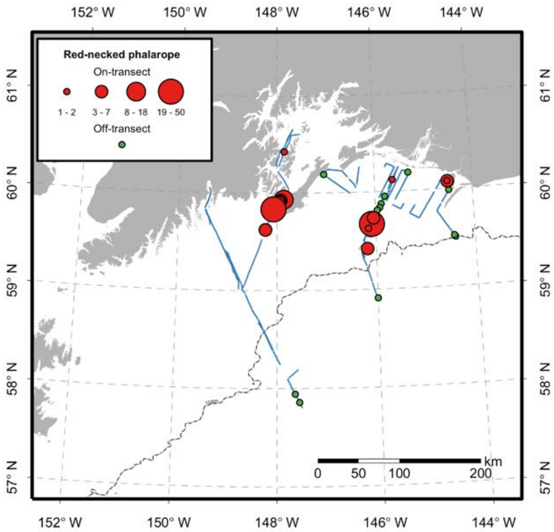


Figure B7. Red-necked phalarope.

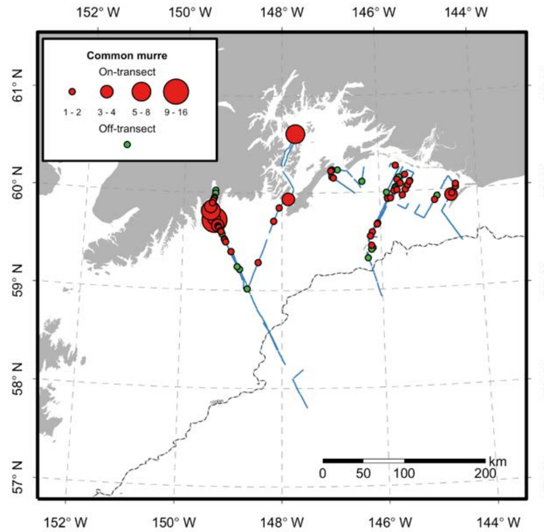


Figure B8. Common murre.

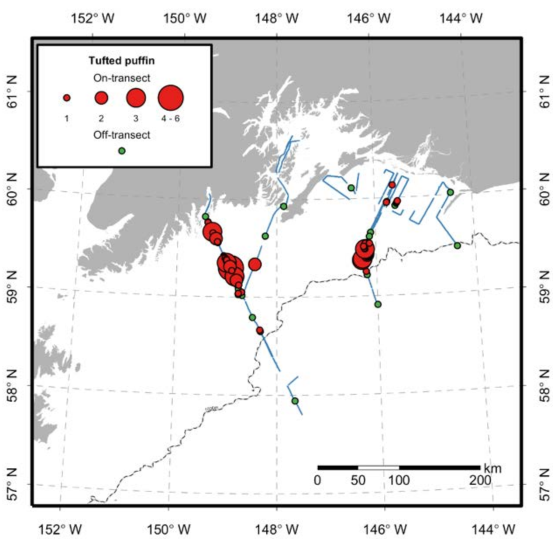


Figure B9. Tufted puffin.

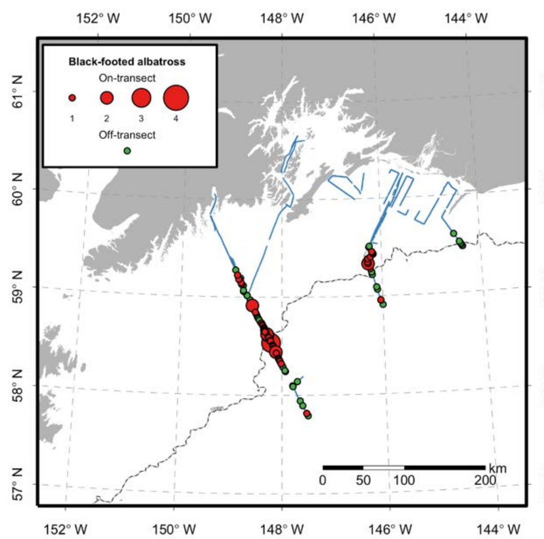


Figure B10. Black-footed albatross.

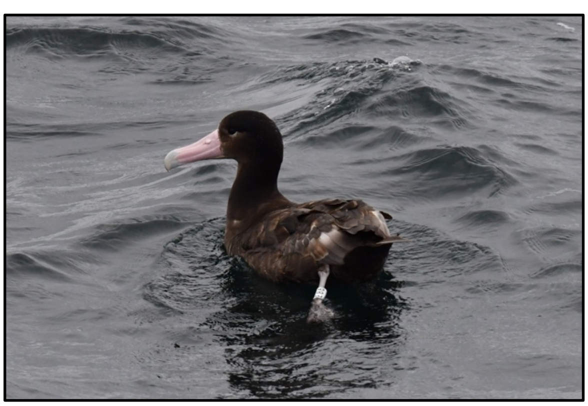


Figure B11. Immature short-tailed albatross with alphanumeric leg band number E86 at Seward Line station GAK9 on July 6, 2020.

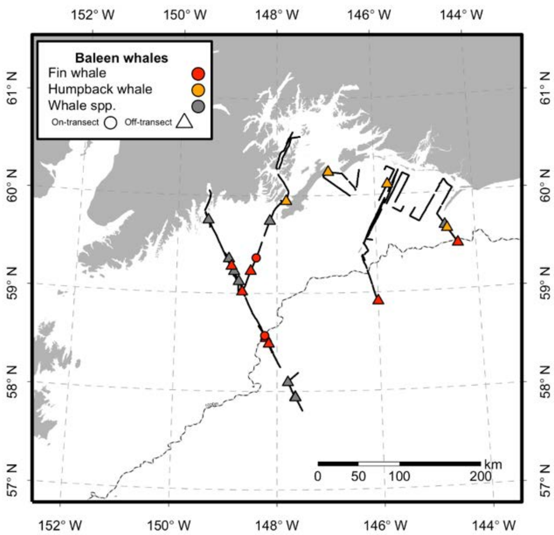


Figure B13. Baleen whales.

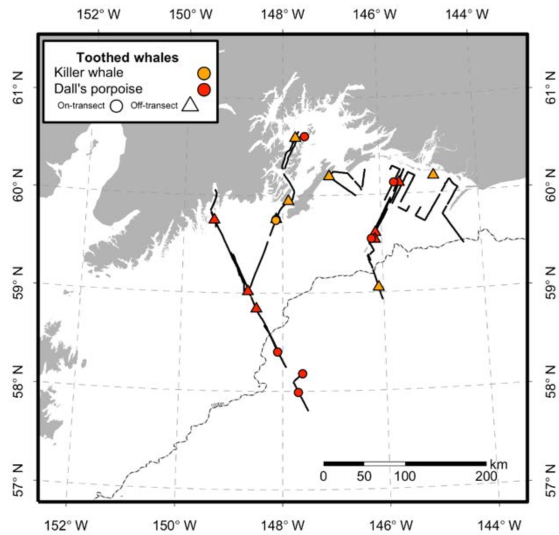


Figure B12. Toothed whales.

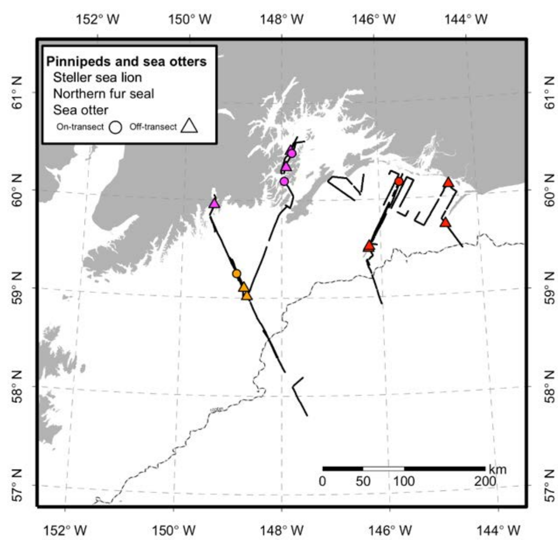


Figure B14. Pinnipeds and sea otters.

SKQ202010S Event Log

GPS_Time	Instrument	Action	Transect	Station	Cast	Latitude	Longitude	Seafloor	Author	Comment
7/2/20 17:48	CTD911	deploy	NaN	RES2.5	1	60.023216	-149.357281	293	SDanielson	Cast aborted - no saved data & dual sensor variances
7/2/20 18:15	CTD911	recover	NaN	RES2.5	1	60.02322	-149.357275	293	SDanielson	cast aborted
7/2/20 18:36	CalVet Net	start	NaN	RES2.5	1	60.023219	-149.357276	293	RHopcroft	
7/2/20 18:40	CalVet Net	end	NaN	RES2.5	1	60.023217	-149.357274	293	RHopcroft	
7/2/20 19:08	CTD911	deploy	NaN	RES2.5	1	60.02322	-149.357219	293	SSandy	
7/2/20 19:08	CTD911	recover	NaN	RES2.5	1	60.02322	-149.357219	293	SDanielson	
7/2/20 21:35	CTD911	deploy	Seward Line	GAK-1	2	59.845024	-149.466852	269.7	SSandy	
7/2/20 22:02	CTD911	recover	Seward Line	GAK-1	2	59.845027	-149.466851	269.7	SSandy	
7/2/20 22:37	MultiNet	start	Seward Line	GAK-1	MNV1	59.845028	-149.466853	269.7	RHopcroft	
7/2/20 22:51	MultiNet	end	Seward Line	GAK-1	MNV1	59.845022	-149.466856	269.7	RHopcroft	
7/2/20 23:38	CalVet Net	start	Seward Line	GAK1	2	59.842971	-149.465203	269	RHopcroft	CV#2
7/2/20 23:43	CalVet Net	end	Seward Line	GAK1	2	59.842976	-149.465227	269	RHopcroft	
7/3/20 0:05	CalVet Net	end	Seward Line	GAK1	2a	59.842983	-149.465252	269	RHopcroft	CV#2a
7/3/20 0:24	CTD911	deploy	Seward Line	GAK-1	3	59.842992	-149.465259	270.2	SSandy	
7/3/20 1:00	TM CTD	deploy	Seward Line	GAK1	TM01	59.843	-149.465248	269	AAguilar-Isles	
7/3/20 1:10	CTD911	recover	Seward Line	GAK-1	3	59.842988	-149.465245	270.2	SSandy	
7/3/20 1:45	TM CTD	recover	Seward Line	GAK1	TM01	59.843	-149.465246	269	AAguilar-Isles	
7/3/20 3:47	Methot Net Tow	deploy	Seward Line	GAK2	1	59.687688	-149.331571	269	RHopcroft	
7/3/20 3:47	Methot Net Tow	deploy	Seward Line	GAK1	2	59.687688	-149.331571	269	RHopcroft	
7/3/20 4:07	Methot Net Tow	recover	Seward Line	GAK2	1	59.673104	-149.34904	269	RHopcroft	
7/3/20 5:17	CTD911	deploy	Seward Line	GAK1i	4	59.764946	-149.398302	260	SDanielson	
7/3/20 5:17	CTD911	recover	Seward Line	GAK1i	4	59.764946	-149.398302	260	SDanielson	
7/3/20 7:01	Methot Net Tow	recover	Seward Line	GAK1	2	59.852941	-149.470248	269	RHopcroft	
7/3/20 7:21	MultiNet	start	Seward Line	GAK1	1	59.85008	-149.46867	278	JQuestel	
7/3/20 8:04	MultiNet	end	Seward Line	GAK1	1	59.826406	-149.466554	278	JQuestel	
7/3/20 9:06	MultiNet	start	Seward Line	GAK2	2	59.697845	-149.334889	234	JQuestel	

7/3/20 9:49	MultiNet	end	Seward Line	GAK2	2	59.674601	-149.314715	234	JQuestel	net hung up during deployment due to wind
7/3/20 10:46	Methot Net Tow	deploy	Seward Line	GAK1	3	59.563798	-149.193513	211	RHopcroft	
7/3/20 11:07	Methot Net Tow	recover	Seward Line	GAK3	3	59.550005	-149.178952	211	RHopcroft	
7/3/20 11:07	Methot Net Tow	recover	Seward Line	GAK3	3	59.550005	-149.178952	211	RHopcroft	
7/3/20 11:22	MultiNet	start	Seward Line	GAK3	3	59.547281	-149.176499	210	JQuestel	
7/3/20 12:02	MultiNet	end	Seward Line	GAK3	3	59.563518	-149.20636	210	JQuestel	
7/3/20 13:22	MultiNet	start	Seward Line	GAK4	4	59.409901	-149.054474	198	JQuestel	ran at angle to stn to avoid fishing vessel
7/3/20 13:54	MultiNet	end	Seward Line	GAK4	4	59.39919	-149.00705	198	JQuestel	
7/3/20 23:59	CalVet Net	start	Seward Line	GAK1	2a	59.013816	-148.700181	269	RHopcroft	
7/4/20 3:49	Methot Net Tow	deploy	Seward Line	GAK6	4	59.122123	-148.76369	147	RHopcroft	
7/4/20 4:10	Methot Net Tow	recover	Seward Line	GAK6	4	59.110842	-148.776182	147	RHopcroft	
7/4/20 5:46	Methot Net Tow	deploy	Seward Line	GAK5	5	59.266583	-148.905594	166	RHopcroft	
7/4/20 6:07	Methot Net Tow	recover	Seward Line	GAK5	5	59.252564	-148.911975	166	RHopcroft	
7/4/20 7:10	MultiNet	start	Seward Line	GAK5	5	59.26601	-148.908426	168	JQuestel	
7/4/20 7:43	MultiNet	end	Seward Line	GAK5	5	59.253202	-148.906701	168	JQuestel	
7/4/20 8:52	Methot Net Tow	deploy	Seward Line	GAK4	6	59.403458	-149.045957	203	RHopcroft	
7/4/20 9:13	Methot Net Tow	recover	Seward Line	GAK4	6	59.418745	-149.060737	203	RHopcroft	
7/4/20 13:07	CTD911	deploy	Seward Line	GAK2	5	59.691434	-149.326014	226	SDanielson	
7/4/20 13:43	CTD911	recover	Seward Line	GAK2	5	59.691481	-149.326763	226	SDanielson	
7/4/20 13:55	CalVet Net	start	Seward Line	GAK2	3	59.690723	-149.32758	224	RHopcroft	
7/4/20 13:58	CalVet Net	end	Seward Line	GAK2	3	59.690344	-149.327526	224	RHopcroft	
7/4/20 15:55	CTD911	deploy	Seward Line	GAK3	6	59.552233	-149.187251	214	SDanielson	
7/4/20 16:41	CTD911	recover	Seward Line	GAK3	6	59.552126	-149.187032	214	SDanielson	
7/4/20 16:51	CalVet Net	start	Seward Line	GAK3	4	59.552369	-149.187503	210	RHopcroft	
7/4/20 16:55	CalVet Net	end	Seward Line	GAK3	4	59.552656	-149.188063	210	RHopcroft	
7/4/20 16:59	Iron Fish Tow	deploy	GAK	GAK3	NaN	59.552824	-149.18839		AAguilar-Islas	
7/4/20 18:48	Iron Fish Tow	recover	GAK	GAK4	NaN	59.413743	-149.058635		AAguilar-Islas	
7/4/20 20:51	CTD911	deploy	Seward Line	GAK5	7	59.261344	-148.910572	171	SSandy	
7/4/20 21:19	CTD911	recover	Seward Line	GAK5	7	59.262882	-148.910172		SSandy	
7/4/20 21:40	TM CTD	deploy	GAK	GAK5	TM02	59.264974	-148.909631		AAguilar-Islas	

7/4/20 21:40	TM CTD	recover	GAK	GAK5	TM02	59.264987	-148.909626		AAguilar-Islas	
7/4/20 22:18	MultiNet	start	Seward Line	GAK5	MNV2	59.261865	-148.909416		RHopcroft	
7/4/20 22:31	MultiNet	end	Seward Line	GAK5	MNV2	59.263225	-148.909185		RHopcroft	
7/4/20 22:50	CTD911	deploy	Seward Line	GAK5	8	59.261757	-148.908454	167	SSandy	
7/4/20 23:31	CTD911	recover	Seward Line	GAK5	8	59.261686	-148.908468	167	SSandy	field cal of 3 mooring SBE37s on this cast
7/4/20 23:40	CalVet Net	start	Seward Line	GAK5	5	59.261999	-148.908356	169	RHopcroft	
7/4/20 23:44	CalVet Net	end	Seward Line	GAK5	5	59.262261	-148.908288	169	RHopcroft	
7/5/20 0:00	CalVet Net	start	Seward Line	GAK5	5a	59.261733	-148.908451	169	RHopcroft	LIVE
7/5/20 0:03	CalVet Net	end	Seward Line	GAK5	5a	59.262017	-148.908362	169	RHopcroft	
7/5/20 1:22	CalVet Net	start	Seward Line	GAK4	6	59.409405	-149.048833	199	RHopcroft	
7/5/20 1:27	CalVet Net	end	Seward Line	GAK4	6	59.410169	-149.047664	199	RHopcroft	
7/5/20 1:40	CTD911	deploy	Seward Line	GAK4	9	59.410422	-149.046731	203	SSandy	
7/5/20 2:22	CTD911	recover	Seward Line	GAK4	9	59.410417	-149.046739	203	SSandy	
7/5/20 4:20	Iron Fish Tow	deploy	GAK	GAK4	NaN	59.158863	-148.805371		AAguilar-Islas	
7/5/20 4:40	Iron Fish Tow	recover	GAK	GAK5	NaN	59.145049	-148.794563		AAguilar-Islas	
7/5/20 5:19	CalVet Net	start	Seward Line	GAK6	7	59.117986	-148.772444		RHopcroft	
7/5/20 5:23	CalVet Net	end	Seward Line	GAK6	7	59.118616	-148.772805		RHopcroft	
7/5/20 5:26	CTD911	deploy	Seward Line	GAK6	10	59.119377	-148.773239	148.7	SSandy	
7/5/20 6:06	CTD911	recover	Seward Line	GAK6	10	59.124282	-148.775801	147	SDanielson	
7/5/20 6:42	MultiNet	start	Seward Line	GAK6	6	59.140466	-148.783955	146	JQuestel	
7/5/20 7:11	MultiNet	end	Seward Line	GAK6	6	59.123161	-148.772237	146	JQuestel	
7/5/20 8:34	Methot Net Tow	deploy	Seward Line	GAK7	7	58.97207	-148.630183	251	RHopcroft	
7/5/20 8:55	Methot Net Tow	recover	Seward Line	GAK7	7	58.961325	-148.620611	251	RHopcroft	
7/5/20 9:10	MultiNet	start	Seward Line	GAK7	7	58.962107	-148.623266	251	JQuestel	
7/5/20 9:48	MultiNet	end	Seward Line	GAK7	7	58.980935	-148.636527	251	JQuestel	
7/5/20 11:02	MultiNet	start	Seward Line	GAK8	8	58.818685	-148.504988	297	JQuestel	
7/5/20 11:34	MultiNet	end	Seward Line	GAK8	8	58.800577	-148.479802	297	JQuestel	
7/5/20 15:32	Mooring	deploy	GEO	GEO3-2020	NaN	59.011671	-148.683847		SDanielson	from a few seconds afterdeploy... not official location
7/5/20 18:20	Mooring	deploy	GEO	GEO2-2020	NaN	59.012714	-148.686473	233	SDanielson	about 2 min after deploy

7/5/20 18:48	CTD911	deploy	Seward Line	GEO	11	59.013421	-148.696313	232	SSandy	
7/5/20 19:18	CTD911	recover	Seward Line	GEO	11	59.013738	-148.705765	228	SSandy	
7/5/20 20:07	CalVet Net	start	Seward Line	GAK7	8	58.972158	-148.629886	240	RHopcroft	
7/5/20 20:11	CalVet Net	end	Seward Line	GAK7	8	58.972397	-148.630355	240	RHopcroft	
7/5/20 20:19	CTD911	deploy	Seward Line	GAK7	12	58.972179	-148.630443	239	SSandy	
7/5/20 20:57	CTD911	recover	Seward Line	GAK7	12	58.972178	-148.630442	240	SSandy	
7/5/20 21:05	MultiNet	start	Seward Line	GAK7	MNV3	58.97221	-148.630568	240	RHopcroft	
7/5/20 21:21	MultiNet	end	Seward Line	GAK7	MNV3	58.972979	-148.633403	240	RHopcroft	
7/5/20 21:40	Iron Fish Tow	deploy	Seward Line	GAK 7	NaN	58.97054	-148.632548		EOrtega	
7/5/20 21:55	Iron Fish Tow	recover	Seward Line	GAK7	NaN	58.957332	-148.62313		EOrtega	
7/5/20 22:45	CTD911	deploy	Seward Line	GAK7i	13	58.88213	-148.559435	300	SDanielson	
7/5/20 23:02	CTD911	recover	Seward Line	GAK7i	13	58.882132	-148.559434	300	SDanielson	
7/5/20 23:50	CalVet Net	start	Seward Line	GAK8	9	58.808516	-148.490139	291	RHopcroft	
7/5/20 23:57	CalVet Net	end	Seward Line	GAK8	9	58.808515	-148.49014	290	RHopcroft	
7/6/20 0:00	CTD911	deploy	Seward Line	GAK8	14	58.808513	-148.490142	290	SSandy	
7/6/20 0:24	Iron Fish Tow	deploy	Seward Line	GAK8	NaN	58.808511	-148.490143		EOrtega	
7/6/20 0:43	CTD911	recover	Seward Line	GAK8	14	58.808514	-148.490143	290	SSandy	
7/6/20 1:04	Iron Fish Tow	recover	GAK	GAK8	NaN	58.798738	-148.473931		EOrtega	
7/6/20 1:10	Methot Net Tow	deploy	Seward Line	GAK8	8	58.800738	-148.47828	284	RHopcroft	
7/6/20 2:24	CTD911	deploy	Seward Line	GAK8i	15	58.74386	-148.420296	286	SSandy	
7/6/20 2:45	CTD911	recover	Seward Line	GAK8i	15	58.743287	-148.416652	286	SSandy	
7/6/20 3:57	CTD911	deploy	Seward Line	GAK9i	16	58.609672	-148.279946	672	SDanielson	
7/6/20 4:35	CTD911	recover	Seward Line	GAK9i	16	58.605105	-148.280115	672	SDanielson	
7/6/20 5:28	Methot Net Tow	deploy	Seward Line	GAK9	9	58.675561	-148.34725	280	JQuestel	
7/6/20 5:47	Methot Net Tow	recover	Seward Line	GAK9	9	58.684177	-148.352681	280	JQuestel	
7/6/20 6:10	MultiNet	start	Seward Line	GAK9	9	58.688852	-148.361405	280	JQuestel	
7/6/20 6:48	MultiNet	end	Seward Line	GAK9	9	58.665239	-148.338019	280	JQuestel	
7/6/20 7:33	EM302	stop	NaN	NaN	NaN	58.567572	-148.239353		BMcKiernan	Secured multibeam to reduce delay on K-Sync for EK-80 data collection
7/6/20 7:48	MultiNet	start	Seward Line	GAK10	10	58.553219	-148.225341	1448	JQuestel	

7/6/20 8:15	Uncontaminated Science Seawater	service	NaN	NaN	NaN	58.540441	-148.211417		BMcKiernan	Swapped strainer
7/6/20 8:25	MultiNet	end	Seward Line	GAK10	10	58.535455	-148.206162	1448	JQuestel	
7/6/20 9:29	Methot Net Tow	deploy	Seward Line	GAK11	10	58.399517	-148.085867	1413	JQuestel	
7/6/20 9:29	Methot Net Tow	recover	Seward Line	GAK12	11	58.399517	-148.085867	2185	JQuestel	
7/6/20 9:50	Methot Net Tow	recover	Seward Line	GAK11	10	58.386942	-148.078125	1093	JQuestel	1413
7/6/20 10:02	MultiNet	start	Seward Line	GAK11	11	58.383217	-148.074528	1096	JQuestel	1413
7/6/20 10:44	MultiNet	end	Seward Line	GAK11	11	58.401125	-148.066696	1418	JQuestel	
7/6/20 11:55	MultiNet	start	Seward Line	GAK12	12	58.257273	-147.950259	1983	JQuestel	
7/6/20 12:31	MultiNet	end	Seward Line	GAK12	12	58.245373	-147.928519	2185	JQuestel	
7/6/20 12:40	Methot Net Tow	deploy	Seward Line	GAK12	11	58.244182	-147.931563	2185	JQuestel	
7/6/20 15:15	EM302	start	NaN	NaN	NaN	58.606994	-148.27864		BMcKiernan	Started logging once back on shelf heading to GAK 9
7/6/20 16:54	CalVet Net	start	Seward Line	GAK9	10	58.67917	-148.349093		JQuestel	
7/6/20 16:58	CalVet Net	end	Seward Line	GAK9	10	58.6792	-148.349154	274	RHopcroft	
7/6/20 17:08	CTD911	deploy	Seward Line	GAK9	17	58.679337	-148.349533	274	SDanielson	
7/6/20 17:38	CTD911	deploy	Seward Line	GAK9	17	58.679721	-148.350571	274	SDanielson	
7/6/20 17:51	MultiNet	start	Seward Line	GAK9	MNV4	58.679763	-148.35068	276	RHopcroft	
7/6/20 18:08	MultiNet	end	Seward Line	GAK9	MNV4	58.678743	-148.348341	276	RHopcroft	
7/6/20 18:31	TM CTD	deploy	GAK	GAK9	TM03	58.679521	-148.3505		AAguilar-Islas	
7/6/20 18:55	TM CTD	recover	GAK	GAK9	TM03	58.676153	-148.356213		AAguilar-Islas	
7/6/20 19:07	CalVet Net	start	Seward Line	GAK9	10a	58.679794	-148.350557		RHopcroft	live
7/6/20 19:11	CalVet Net	end	Seward Line	GAK9	10a	58.678971	-148.351881	276	RHopcroft	
7/6/20 19:25	CTD911	deploy	Seward Line	GAK9	18	58.68033	-148.349781	276	SSandy	
7/6/20 20:05	CTD911	recover	Seward Line	GAK9	18	58.673611	-148.36282	276	SSandy	
7/6/20 21:01	Iron Fish Tow	deploy	GAK	GAK9	NaN	58.600185	-148.273513		EOrtega	
7/6/20 21:29	Iron Fish Tow	recover	GAK	GAK10	NaN	58.542	-148.213087		EOrtega	
7/6/20 21:37	CalVet Net	start	Seward Line	GAK10	11	58.541692	-148.215099	1448	RHopcroft	
7/6/20 21:42	CalVet Net	end	Seward Line	GAK10	11	58.541283	-148.217147	1448	RHopcroft	
7/6/20 21:53	CTD911	deploy	Seward Line	GAK10	19	58.542553	-148.213286	1440	SDanielson	
7/6/20 23:32	CTD911	recover	Seward Line	GAK10	19	58.541535	-148.212938	1440	SDanielson	

7/6/20 23:41	Methot Net Tow	deploy	GAK	GAK10	12	58.542132	-148.210893	1448	AAguilar-Islas	
7/7/20 0:03	Methot Net Tow	recover	GAK	GAK10	12	58.550746	-148.187989	1448	AAguilar-Islas	
7/7/20 0:25	Iron Fish Tow	deploy	GAK	GAK10	NaN	58.541402	-148.210487		EOrtega	
7/7/20 1:36	Iron Fish Tow	recover	GAK	GAK11	NaN	58.389765	-148.074458		AAguilar-Islas	
7/7/20 1:42	CalVet Net	start	Seward Line	GAK11	12	58.388318	-148.072424	1442	RHopcroft	
7/7/20 1:46	CalVet Net	end	Seward Line	GAK11	12	58.388293	-148.072446	1442	RHopcroft	
7/7/20 1:53	CTD911	deploy	Seward Line	GAK11	20	58.388224	-148.072492	1412	SSandy	
7/7/20 3:23	CTD911	recover	Seward Line	GAK11	20	58.388704	-148.07396	1412	SSandy	
7/7/20 3:38	Iron Fish Tow	deploy	GAK	GAK11	NaN	58.387706	-148.075245		EOrtega	
7/7/20 5:15	Iron Fish Tow	recover	GAK	GAK12	NaN	58.243475	-147.934449		EOrtega	
7/7/20 5:18	CalVet Net	start	Seward Line	GAK12	13	58.243652	-147.935089	1442	RHopcroft	
7/7/20 5:21	CalVet Net	end	Seward Line	GAK12	13	58.243763	-147.935481	2163	RHopcroft	
7/7/20 5:29	CTD911	deploy	Seward Line	GAK12	21	58.244422	-147.937211	2131	SSandy	
7/7/20 6:59	CTD911	recover	Seward Line	GAK12	21	58.245429	-147.938942	2131	SSandy	
7/7/20 8:08	Methot Net Tow	deploy	Seward Line	GAK13	13	58.105711	-147.799613	2065	RHopcroft	
7/7/20 8:27	Methot Net Tow	recover	Seward Line	GAK13	13	58.094875	-147.791002	2065	RHopcroft	
7/7/20 8:39	MultiNet	start	Seward Line	GAK13	13	58.094466	-147.79152	2068	JQuestel	
7/7/20 9:20	MultiNet	end	Seward Line	GAK13	13	58.124581	-147.805446	1950	JQuestel	
7/7/20 10:37	MultiNet	start	Seward Line	GAK14	14	57.951427	-147.654401	2873	JQuestel	
7/7/20 11:18	MultiNet	end	Seward Line	GAK14	14	57.922113	-147.6432	2873	JQuestel	
7/7/20 11:30	Methot Net Tow	deploy	Seward Line	GAK14	14	57.918183	-147.643069	2873	RHopcroft	
7/7/20 11:50	Methot Net Tow	recover	Seward Line	GAK14	14	57.930403	-147.647065	2873	RHopcroft	
7/7/20 12:50	MultiNet	start	Seward Line	GAK15	15	57.799786	-147.507417	4240	JQuestel	
7/7/20 13:26	MultiNet	end	Seward Line	GAK15	15	57.776648	-147.496592	4240	JQuestel	
7/7/20 13:37	Methot Net Tow	deploy	Seward Line	GAK15	15	57.774291	-147.496742	4240	RHopcroft	
7/7/20 13:57	Methot Net Tow	recover	Seward Line	GAK15	15	57.786023	-147.503472	4240	RHopcroft	
7/7/20 14:14	MultiNet	start	Seward Line	GAK15	MNV5	57.791025	-147.499922	4524	JQuestel	vertical 150 shallow
7/7/20 14:44	MultiNet	end	Seward Line	GAK15	MNV5	57.790476	-147.498734	4524	JQuestel	
7/7/20 15:00	MultiNet	start	Seward Line	GAK15	MNV5D	57.791047	-147.499944	4524	JQuestel	deep cast
7/7/20 16:16	MultiNet	end	Seward Line	GAK15	MNV5D	57.791064	-147.49999	4524	JQuestel	
7/7/20 16:26	CalVet Net	start	Seward Line	GAK15	14	57.791064	-147.499991	4450	RHopcroft	

7/7/20 16:30	CalVet Net	end	Seward Line	GAK15	14	57.791068	-147.499986	4450	RHopcroft	
7/7/20 16:49	CalVet Net	start	Seward Line	GAK15	14a	57.791065	-147.499991	4450	RHopcroft	
7/7/20 16:54	CalVet Net	end	Seward Line	GAK15	14a	57.791066	-147.499986	4450	RHopcroft	
7/7/20 17:05	CTD911	deploy	Seward Line	GAK15	22	57.791065	-147.499986	4523	SSandy	
7/7/20 17:51	CTD911	recover	Seward Line	GAK15	22	57.791272	-147.501421	4490	SSandy	
7/7/20 18:27	TM CTD	deploy	GAK	GAK15	TM04	57.792056	-147.506893		AAguilar-Islas	
7/7/20 19:08	TM CTD	recover	GAK	GAK15	TM04	57.792056	-147.506902		AAguilar-Islas	
7/7/20 19:23	CTD911	deploy	Seward Line	GAK15	23	57.791602	-147.503622	4437	SSandy	
7/7/20 20:52	CTD911	recover	Seward Line	GAK15	23	57.791605	-147.50362	4437	SSandy	
7/7/20 21:00	Iron Fish Tow	deploy	GAK	GAK15	NaN	57.792072	-147.503202		AAguilar-Islas	
7/7/20 21:05	Iron Fish Tow	recover	GAK	GAK15	NaN	57.794809	-147.505414		AAguilar-Islas	
7/7/20 22:29	CalVet Net	start	Seward Line	GAK14	15	57.943288	-147.649077	3125	RHopcroft	
7/7/20 22:33	CalVet Net	end	Seward Line	GAK14	15	57.943217	-147.649218	3125	RHopcroft	
7/7/20 22:43	CTD911	deploy	Seward Line	GAK14	24	57.943098	-147.649447	3060	SDanielson	
7/8/20 0:14	CTD911	recover	Seward Line	GAK14	24	57.943106	-147.649461	3060	SSandy	
7/8/20 0:49	Iron Fish Tow	deploy	GAK	GAK14	NaN	57.981205	-147.692504		EOrtega	
7/8/20 1:49	Iron Fish Tow	recover	GAK	GAK13	NaN	58.097	-147.792694		EOrtega	
7/8/20 2:02	CalVet Net	start	Seward Line	GAK13	16	58.098203	-147.792979		RHopcroft	
7/8/20 2:07	CalVet Net	end	Seward Line	GAK13	16	58.097946	-147.793069	2070	RHopcroft	
7/8/20 2:17	CTD911	deploy	Seward Line	GAK13	25	58.09757	-147.794015	2065	SSandy	Jellyfish impact. Cond./Salinity #1 is bad on whole upcast. Use probe 2 for bottles.
7/8/20 3:46	CTD911	recover	Seward Line	GAK13	25	58.097507	-147.794163	2063	SSandy	
7/8/20 11:21	PCO2	other	NaN	NaN	NaN	58.711567	-146.430625		BMcKiernan	Program Crashed, rebooting
7/8/20 13:06	Methot Net Tow	deploy	Middleton Island Line	MID10	16	58.905081	-146.017284	4407	JQuestel	
7/8/20 13:35	Methot Net Tow	recover	Middleton Island Line	MID10	16	58.912272	-146.000405	4407	JQuestel	
7/8/20 13:38	Bongo	deploy	Middleton Island Line	MID10	1	58.910744	-146.001011	4407	JQuestel	Bongo Tow
7/8/20 14:15	Bongo	recover	Middleton Island Line	MID10	1	58.89272	-145.995554	4407	JQuestel	
7/8/20 14:49	MultiNet	start	Middleton Island Line	MID10	MNV6	58.910911	-146.001805	4407	JQuestel	vertical shallow
7/8/20 15:05	MultiNet	end	Middleton Island Line	MID10	MNV6	58.910416	-146.006482	4407	JQuestel	

7/8/20 15:23	MultiNet	start	Middleton Island Line	MID10	MNV6D	58.909627	-145.99993	4407	JQuestel	deep vertical cast
7/8/20 16:37	MultiNet	end	Middleton Island Line	MID10	MNV6D	58.909523	-146.000301	4407	JQuestel	
7/8/20 17:01	CTD911	deploy	Seward Line	MID10	26	58.909808	-146.000442	4445	SDanielson	
7/8/20 17:25	CTD911	recover	Seward Line	MID10	26	58.910144	-146.000595	4445	SDanielson	
7/8/20 17:48	TM CTD	deploy	MID	MID10	TM05	58.910148	-146.000595		AAguilar-Islas	
7/8/20 18:44	TM CTD	recover	MID	MID10	TM05	58.910142	-146.000602		AAguilar-Islas	
7/8/20 19:02	CalVet Net	start	MID	MID10	17	58.910149	-146.000596		RHopcroft	
7/8/20 19:02	CalVet Net	start	Middleton Island	MID9	18	58.910152	-146.000585	3016	RHopcroft	
7/8/20 19:07	CalVet Net	end	Middleton Island	MID10	17	58.910155	-146.000586	4445	RHopcroft	
7/8/20 19:19	CalVet Net	start	Middleton Island	MID10	17a	58.910154	-146.000594	4445	RHopcroft	
7/8/20 19:25	CalVet Net	end	Middleton Island	MID10	17a	58.910147	-146.000588	4445	RHopcroft	
7/8/20 19:39	CTD911	deploy	Middleton Island	MID10	27	58.910153	-146.00059	4445	SDanielson	
7/8/20 19:39	CTD911	recover	Middleton Island	MID10	27	58.91015	-146.000587	4445	SDanielson	
7/8/20 22:36	CalVet Net	start	Middleton Island	MID9	18	59.068015	-146.100586	3016	RHopcroft	
7/8/20 22:45	CTD911	deploy	Middleton Island	MID9	28	59.068016	-146.100588	2936	SDanielson	
7/8/20 23:09	CTD911	recover	Middleton Island	MID9	28	59.068016	-146.10059	2936	SDanielson	
7/8/20 23:32	CTD911	deploy	Middleton Island	MID9	29	59.068013	-146.100585		SDanielson	
7/9/20 0:57	CTD911	recover	Middleton Island	MID9	29	59.068015	-146.100587		SDanielson	
7/9/20 1:08	Iron Fish Tow	deploy	MID	MID9	NaN	59.069151	-146.101663		EOrtega	
7/9/20 1:41	Iron Fish Tow	recover	MID	MID9	NaN	59.13461	-146.14104		EOrtega	
7/9/20 2:28	CalVet Net	start	MID	MID8	19	59.226749	-146.200605	650	RHopcroft	
7/9/20 2:33	CalVet Net	end	MID	MID8	19	59.227798	-146.19995	650	RHopcroft	
7/9/20 2:53	CTD911	deploy	Middleton Island	MID8	30	59.22608	-146.201526	628	SDanielson	
7/9/20 3:54	Iron Fish Tow	deploy	MID	MID8	NaN	59.23313	-146.197661		AAguilar-Islas	
7/9/20 4:07	Iron Fish Tow	recover	MID	MID8	NaN	59.243577	-146.204395		EOrtega	
7/9/20 4:48	EM710	start	NaN	NaN	NaN	59.345462	-146.278888		BMcKiernan	Mapping fresh area near middleton Island
7/9/20 5:22	CalVet Net	start	MID	MID7	20	59.383613	-146.272813	81	RHopcroft	
7/9/20 5:26	CalVet Net	end	MID	MID7	20	59.383639	-146.275154	81	RHopcroft	
7/9/20 5:26	Methot Net Tow	deploy	MID	MID7	16	59.383639	-146.275154	81	RHopcroft	
7/9/20 5:26	Methot Net Tow	recover	MID	MID7	17	59.383639	-146.275154	81	RHopcroft	

7/9/20 5:26	Methot Net Tow	recover	MID	MID7	17	59.383639	-146.275154	81	RHopcroft	
7/9/20 5:31	CTD911	recover	Middleton Island	MID8	30	59.383655	-146.276756	628	SDanielson	
7/9/20 5:32	CTD911	deploy	Middleton Island	MID7	31	59.38367	-146.277149	74	SSandy	
7/9/20 5:52	CTD911	recover	Middleton Island	MID7	31	59.383778	-146.287118	55	SSandy	
7/9/20 6:35	Iron Fish Tow	deploy	MID	MID7	NaN	59.383609	-146.264082		AAguilar-Islas	
7/9/20 6:48	Methot Net Tow	deploy	MID	MID8	18	59.376491	-146.281648	724	JQuestel	
7/9/20 6:48	Methot Net Tow	recover	MID	MID8	18	59.376491	-146.281648	724	JQuestel	
7/9/20 6:48	Bongo	deploy	MID	MID8	2	59.376491	-146.281648	704	JQuestel	
7/9/20 6:48	Bongo	recover	MID	MID8	2	59.376491	-146.281648	724	JQuestel	
7/9/20 6:48	Methot Net Tow	deploy	MID	MID9	19	59.376491	-146.281648	2910	JQuestel	
7/9/20 6:48	Methot Net Tow	recover	MID	MID9	19	59.376491	-146.281648	2910	JQuestel	
7/9/20 6:48	Bongo	deploy	MID	MID9	3	59.376491	-146.281648	2904	JQuestel	
7/9/20 6:48	Bongo	deploy	MID	MID9	3	59.376491	-146.281648	2904	JQuestel	
7/9/20 6:48	Bongo	deploy	MID	MID7	4	59.376491	-146.281648	62	JQuestel	
7/9/20 6:48	Bongo	recover	MID	MID7	4	59.376491	-146.281648	95	JQuestel	
7/9/20 6:48	Iron Fish Tow	recover	MID	MID7	NaN	59.376406	-146.281871		EOrtega	
7/9/20 7:35	CTD911	deploy	Middleton Island	MID7i	32	59.304713	-146.251862	432	SSandy	
7/9/20 8:01	CTD911	recover	Middleton Island	MID7i	32	59.303823	-146.261267	417	SSandy	
7/9/20 8:19	EM710	stop	NaN	NaN	NaN	59.271823	-146.234846		BMcKiernan	Secured logging on way south on Middleton Line
7/9/20 10:38	EM302	stop	NaN	NaN	NaN	59.103394	-146.135876		BMcKiernan	Secured MB in deep water
7/9/20 13:02	EM302	start	NaN	NaN	NaN	59.262224	-146.193112		BMcKiernan	Logging data on the shelf to Middleton
7/9/20 13:27	EM710	start	NaN	NaN	NaN	59.335591	-146.246618		BMcKiernan	Logging data Middleton line on shelf
7/9/20 14:56	CTD911	deploy	Middleton Island	MID6I	33	59.427343	-146.166727	60	SDanielson	
7/9/20 15:06	CTD911	recover	Middleton Island	MID6I	33	59.427441	-146.166983	60	SDanielson	
7/9/20 16:02	CalVet Net	start	MID	MID6	21	59.499231	-146.250793	37	RHopcroft	
7/9/20 16:06	CalVet Net	end	MID	MID6	21	59.499187	-146.250723	37	RHopcroft	
7/9/20 16:14	CTD911	deploy	Middleton Island	MID6	34	59.499081	-146.250481	36	SDanielson	
7/9/20 16:26	CTD911	recover	Middleton Island	MID6	34	59.499162	-146.250996	36	SDanielson	

7/9/20 16:35	Iron Fish Tow	deploy	MID	MID6	NaN	59.49909	-146.252388		AAguilar-Islas	
7/9/20 17:27	Iron Fish Tow	recover	MID	MID6	NaN	59.576207	-146.184522		AAguilar-Islas	
7/9/20 17:40	CTD911	deploy	Middleton Island	MID5I	35	59.576271	-146.179232	112	SDanielson	
7/9/20 17:50	CTD911	recover	Middleton Island	MID5I	35	59.576248	-146.17921	112	SDanielson	
7/9/20 17:58	Iron Fish Tow	deploy	MID	MID5i	NaN	59.576752	-146.180812		EOrtega	
7/9/20 18:31	Iron Fish Tow	recover	MID	MID5i	NaN	59.633268	-146.122849		EOrtega	
7/9/20 18:55	CTD911	deploy	Middleton Island	MID5	36	59.649995	-146.101624	94	SDanielson	Check CTD file station name as MID5
7/9/20 19:31	CTD911	recover	Middleton Island	MID5	36	59.653488	-146.114111	94	SDanielson	
7/9/20 20:13	TM CTD	deploy	MID	MID5	TM06	59.649159	-146.102935		AAguilar-Islas	
7/9/20 20:14	TM CTD	recover	MID	MID5	TM06	59.649188	-146.103039		AAguilar-Islas	
7/9/20 20:19	CalVet Net	start	MID	MID5	22	59.649361	-146.103646	96	RHopcroft	
7/9/20 20:23	CalVet Net	end	MID	MID5	22	59.649546	-146.104336	96	RHopcroft	
7/9/20 20:36	CalVet Net	start	MID	MID5	22a	59.651529	-146.111433	96	RHopcroft	live
7/9/20 20:40	CalVet Net	end	MID	MID5	22a	59.652032	-146.113245	96	RHopcroft	
7/9/20 21:00	CTD911	deploy	Middleton Island	MID5	37	59.650373	-146.097849	94	SDanielson	
7/9/20 21:19	CTD911	recover	Middleton Island	MID5	37	59.650514	-146.098805	94	SDanielson	
7/9/20 21:27	Iron Fish Tow	deploy	MID	MID5	NaN	59.650445	-146.099967		AAguilar-Islas	
7/9/20 22:20	CTD911	deploy	Middleton Island	MID4I	38	59.72542	-146.024233	73	SDanielson	
7/9/20 22:59	CTD911	recover	Middleton Island	MID4	39	59.775564	-145.96996	93	SDanielson	
7/9/20 23:10	Iron Fish Tow	recover	MID	MID5	NaN	59.798044	-145.950627		AAguilar-Islas	
7/9/20 23:19	CalVet Net	start	MID	MID4	23	59.801968	-145.950602	93	RHopcroft	
7/9/20 23:23	CalVet Net	end	MID	MID4	23	59.802276	-145.95068	93	RHopcroft	
7/9/20 23:38	CTD911	deploy	Middleton Island	MID4	39	59.801374	-145.950998	93	SDanielson	
7/9/20 23:53	CTD911	deploy	Middleton Island	MID4	39	59.80251	-145.951387	93	SDanielson	
7/10/20 0:08	Iron Fish Tow	deploy	MID	MID4	NaN	59.80515	-145.950249		EOrtega	
7/10/20 0:28	Iron Fish Tow	recover	MID	MID4	NaN	59.827574	-145.916503		EOrtega	
7/10/20 1:12	CTD911	deploy	Middleton Island	MID3I	40	59.875499	-145.875032	103	SDanielson	Altimeter removed
7/10/20 1:24	CTD911	recover	Middleton Island	MID3I	40	59.875356	-145.875044	103	SDanielson	
7/10/20 2:35	CalVet Net	start	MID	MID3	24	59.950485	-145.802085	87	RHopcroft	
7/10/20 2:38	CalVet Net	end	MID	MID3	24	59.950762	-145.802218	87	RHopcroft	

7/10/20 2:47	CTD911	deploy	Middleton Island	MID3I	41	59.951369	-145.802557	88	SDanielson	
7/10/20 3:07	CTD911	recover	Middleton Island	MID3I	41	59.952124	-145.802943	88	SDanielson	
7/10/20 3:19	Iron Fish Tow	deploy	MID	MID3	NaN	59.954174	-145.804219		EOrtega	
7/10/20 3:31	Methot Net Tow	deploy	MID	MID6	20	59.967055	-145.795546	35	JQuestel	
7/10/20 3:31	Iron Fish Tow	recover	MID	MID3	NaN	59.967042	-145.795546		EOrtega	
7/10/20 6:47	Bongo	deploy	MID	MID6	5	59.500909	-146.271191	36	JQuestel	
7/10/20 7:00	Bongo	recover	MID	MID6	5	59.499953	-146.254554	36	JQuestel	
7/10/20 7:32	Methot Net Tow	recover	MID	MID6	20	59.515047	-146.243999	35	JQuestel	
7/10/20 8:35	Bongo	deploy	MID	MID5	6	59.643074	-146.10748	95	JQuestel	
7/10/20 8:53	Bongo	recover	MID	MID5	6	59.653261	-146.100388	95	JQuestel	
7/10/20 9:01	Methot Net Tow	deploy	MID	MID5	21	59.657187	-146.095678	95	JQuestel	
7/10/20 9:20	Methot Net Tow	recover	MID	MID5	21	59.666646	-146.081665	95	JQuestel	
7/10/20 10:15	Methot Net Tow	deploy	MID	MID4	22	59.786286	-145.963033	95	JQuestel	
7/10/20 10:36	Methot Net Tow	recover	MID	MID4	22	59.802629	-145.947538	95	JQuestel	
7/10/20 10:41	Bongo	deploy	MID	MID4	7	59.807241	-145.942582	95	JQuestel	
7/10/20 11:10	Bongo	recover	MID	MID4	7	59.829917	-145.918042	95	JQuestel	
7/10/20 11:55	Methot Net Tow	deploy	MID	MID3	23	59.931963	-145.818442	88	JQuestel	
7/10/20 12:15	Methot Net Tow	recover	MID	MID3	23	59.94517	-145.803197	88	JQuestel	
7/10/20 12:21	Bongo	deploy	MID	MID3	8	59.949182	-145.798971	86	JQuestel	
7/10/20 12:27	PCO2	other	NaN	NaN	NaN	59.953167	-145.79509		BMcKiernan	crashed and rebooted
7/10/20 12:39	Bongo	recover	MID	MID3	8	59.961308	-145.787278	86	JQuestel	
7/10/20 13:13	CTD911	deploy	Middleton Island	MID2i	42	60.024871	-145.725808	97	SSandy	
7/10/20 13:27	CTD911	recover	Middleton Island	MID2i	42	60.025291	-145.725405	97	SSandy	
7/10/20 13:59	Methot Net Tow	deploy	MID	MID2	24	60.083498	-145.666425	105	JQuestel	
7/10/20 14:18	Methot Net Tow	recover	MID	MID2	24	60.092534	-145.659739	105	JQuestel	
7/10/20 14:44	Bongo	deploy	MID	MID2	9	60.103407	-145.649845	119	JQuestel	
7/10/20 15:02	Bongo	recover	MID	MID2	9	60.111431	-145.639567	119	JQuestel	
7/10/20 15:40	CTD911	deploy	Middleton Island	MID1i	43	60.174565	-145.575759	100	SSandy	
7/10/20 15:54	CTD911	recover	Middleton Island	MID1i	43	60.175501	-145.575892	99	SSandy	
7/10/20 17:11	CTD911	deploy	Middleton Island	MID2	44	60.099913	-145.649644	120	SDanielson	
7/10/20 17:39	CTD911	recover	Middleton Island	MID2	44	60.099969	-145.649611	120	SDanielson	

7/10/20 17:42	CalVet Net	start	MID	MID2	25	60.100043	-145.649585	119	RHopcroft	
7/10/20 17:46	CalVet Net	end	MID	MID2	25	60.100119	-145.649549	119	RHopcroft	
7/10/20 17:59	CalVet Net	start	MID	MID2	25a	60.09962	-145.649764	119	RHopcroft	
7/10/20 18:04	CalVet Net	end	MID	MID2	25a	60.09973	-145.649723	119	RHopcroft	LIVE
7/10/20 18:10	TM CTD	deploy	MID	MID2	TM07	60.099726	-145.649716		AAguilar-Islas	
7/10/20 18:38	TM CTD	recover	MID	MID2	TM07	60.099724	-145.649715		AAguilar-Islas	
7/10/20 18:50	CTD911	deploy	Middleton Island	MID2	45	60.099725	-145.649715	118	SDanielson	
7/10/20 19:21	CTD911	recover	Middleton Island	MID2	45	60.099726	-145.649718	118	SDanielson	
7/10/20 19:32	Iron Fish Tow	deploy	MID	MID2	NaN	60.100137	-145.649412		EOrtega	
7/10/20 19:46	Iron Fish Tow	recover	MID	MID2	NaN	60.110711	-145.639028		EOrtega	
7/10/20 21:04	CalVet Net	start	MID	MID1	26	60.249259	-145.500515	19	RHopcroft	
7/10/20 21:10	CalVet Net	end	MID	MID1	26	60.249399	-145.500522	19	RHopcroft	
7/10/20 21:12	CTD911	deploy	Middleton Island	MID1	46	60.249397	-145.500518	18	SDanielson	
7/10/20 21:25	CTD911	recover	Middleton Island	MID1	46	60.249402	-145.50053	18	SDanielson	
7/10/20 21:40	Iron Fish Tow	deploy	MID	MID1-6	NaN	60.249101	-145.499846		AAguilar-Islas	
7/10/20 21:45	Acrobat	deploy	Middleton Island	MID1	NaN	60.248196	-145.500653	18	SDanielson	
7/11/20 4:57	Acrobat	recover	Middleton Island	MID5I	NaN	59.562621	-146.179266		SDanielson	
7/11/20 5:16	Iron Fish Tow	recover	MID	MID1-6	NaN	59.549301	-146.19281		AAguilar-Islas	
7/11/20 15:17	Iron Fish Tow	deploy	Plume	PLUME	NaN	59.463277	-144.351821		EOrtega	
7/11/20 15:41	Uncontaminated Science Seawater	other	NaN	UW1	NaN	59.48924	-144.382383		WBurt	Chl sample from outflow of optics system
7/11/20 16:49	Uncontaminated Science Seawater	other	NaN	UW2	NaN	59.59835	-144.520367		WBurt	Chl sample from outflow of optics system
7/11/20 18:27	Uncontaminated Science Seawater	other	NaN	UW3	NaN	59.758614	-144.725673		WBurt	Chl sample from outflow of optics system
7/11/20 19:27	Iron Fish Tow	recover	Plume	PLUME	NaN	59.848323	-144.656395		AAguilar-Islas	
7/11/20 19:35	Iron Fish Tow	deploy	Plume	PLUME	NaN	59.854809	-144.648308		HBusse	
7/11/20 20:24	Iron Fish Tow	recover	Plume	PLUME	NaN	59.936313	-144.541839		AAguilar-Islas	
7/11/20 20:35	Iron Fish Tow	deploy	Plume	PLUME	NaN	59.954782	-144.519		EOrtega	
7/11/20 21:43	Uncontaminated Science Seawater	other	NaN	UW4	NaN	60.062137	-144.467046		WBurt	Chl sample from outflow of optics system
7/11/20 22:55	Acrobat	recover	Copper River Plume	CP0	NaN	60.087387	-144.636072		SDanielson	

7/11/20 23:04	Iron Fish Tow	recover	Plume	PLUME	NaN	60.080803	-144.644732		EOrtega	
7/11/20 23:10	CalVet Net	start	Copper River Plume	PL20	27	60.080464	-144.645374	129	RHopcroft	
7/11/20 23:16	CalVet Net	end	Copper River Plume	PL20	27	60.080799	-144.645239	129	RHopcroft	
7/11/20 23:24	CTD911	deploy	Copper River Plume	P20	47	60.080793	-144.645122	130	SDanielson	
7/11/20 23:37	Uncontaminated Science Seawater	other	NaN	UW5	NaN	60.080795	-144.645126		WBurt	
7/11/20 23:52	CTD911	recover	Copper River Plume	P20	47	60.080795	-144.645127	130	SDanielson	
7/11/20 23:53	Acrobat	deploy	Copper River Plume	CP0	NaN	60.080792	-144.645129		SDanielson	start of Copper River Plume survey
7/12/20 0:22	Iron Fish Tow	deploy	Plume	PL20	NaN	60.093267	-144.652166		EOrtega	
7/12/20 0:30	Acrobat	deploy	Copper River Plume	PL20	NaN	60.089134	-144.654468	118	SDanielson	
7/12/20 4:13	Uncontaminated Science Seawater	other	NaN	UW6	NaN	59.732201	-145.088358		WBurt	
7/12/20 7:12	Uncontaminated Science Seawater	other	NaN	UW7	NaN	59.961522	-145.044432		WBurt	Chl sample from outflow of optics system
7/12/20 8:50	Uncontaminated Science Seawater	other	NaN	UW8	NaN	60.108421	-144.857957		WBurt	Chl sample from outflow of optics system
7/12/20 10:33	Uncontaminated Science Seawater	service	NaN	NaN	NaN	60.157024	-145.069025		BMcKiernan	Swapped strainer
7/12/20 11:26	Uncontaminated Science Seawater	other	NaN	UW9	NaN	60.077756	-145.164302		WBurt	Chl sample from outflow of optics system
7/12/20 15:26	Uncontaminated Science Seawater	other	NaN	UW10	NaN	59.874478	-145.632511		WBurt	Chl sample from outflow of optics system
7/12/20 18:11	Uncontaminated Science Seawater	other	NaN	UW11	NaN	60.140911	-145.323305		WBurt	Chl sample from outflow of optics system
7/12/20 18:27	Iron Fish Tow	recover	Plume	PLUME	NaN	60.150642	-145.312802		EOrtega	
7/12/20 18:28	Acrobat	recover	Copper River Plume	PL21	NaN	60.150642	-145.312919	71	SDanielson	
7/12/20 18:48	CalVet Net	start	Copper River Plume	PL21	28	60.143595	-145.321326	71	RHopcroft	
7/12/20 18:52	CalVet Net	end	Copper River Plume	PL21	28	60.143603	-145.321677	71	RHopcroft	
7/12/20 19:11	CTD911	deploy	Copper River Plume	PL21	48	60.143518	-145.325525	71	SDanielson	
7/12/20 19:27	CTD911	recover	Copper River Plume	PL21	48	60.143926	-145.330874	71	SDanielson	
7/12/20 19:54	CTD911	deploy	Copper River Plume	PL21	49	60.142597	-145.322635	71	SDanielson	
7/12/20 20:13	Uncontaminated Science Seawater	other	NaN	UW12	NaN	60.142301	-145.322761		WBurt	Chl sample from outflow of optics system

7/12/20 20:16	CTD911	recover	Copper River Plume	PL21	49	60.142319	-145.322757	71	SDanielson	
7/12/20 20:30	Iron Fish Tow	deploy	Plume	PL21	NaN	60.143681	-145.324507		EOrtega	
7/12/20 20:42	Acrobat	deploy	Copper River Plume	PL21	NaN	60.155463	-145.310323	66	SDanielson	
7/12/20 22:44	Uncontaminated Science Seawater	other	NaN	UW13	NaN	60.102479	-145.543347		WBurt	Chl sample from outflow of optics system
7/13/20 1:40	Uncontaminated Science Seawater	other	NaN	UW14	NaN	59.950552	-145.9011		WBurt	Chl sample from outflow of optics system
7/13/20 4:19	Uncontaminated Science Seawater	other	NaN	UW15	NaN	60.213178	-145.613818		WBurt	Chl sample from outflow of optics system
7/13/20 5:46	Uncontaminated Science Seawater	other	NaN	UW16	NaN	60.252671	-145.777465		WBurt	Chl sample from outflow of optics system
7/13/20 8:53	Uncontaminated Science Seawater	other	NaN	UW17	NaN	59.996735	-146.144888		WBurt	Chl sample from outflow of optics system
7/13/20 11:42	Uncontaminated Science Seawater	other	NaN	UW18	NaN	60.26471	-145.975988		WBurt	Chl sample from outflow of optics system
7/13/20 12:49	Acrobat	deploy	Copper River Plume	CRP19		60.305265	-146.099782		SSandy	Software restarted due to MATLAB error under new name SKQ202010S2
7/13/20 15:53	Acrobat	recover	Copper River Plume	CRP21		60.046174	-146.374355	62	SSandy	
7/13/20 15:56	Iron Fish Tow	recover	Plume	PLUME	NaN	60.045696	-146.376157		EOrtega	
7/13/20 16:06	CalVet Net	start	Copper River Plume	PL22	29	60.046152	-146.377933	62	RHopcroft	
7/13/20 16:10	CalVet Net	end	Copper River Plume	PL22	29	60.046516	-146.377933	62	RHopcroft	
7/13/20 17:00	CTD911	deploy	Copper River Plume	PL22	50	60.048935	-146.377283	62	SDanielson	
7/13/20 17:17	CTD911	recover	Copper River Plume	PL22	50	60.048305	-146.378359	62	SDanielson	
7/13/20 17:52	CTD911	deploy	Copper River Plume	PL22	51	60.04722	-146.379878	62	SDanielson	
7/13/20 18:08	Uncontaminated Science Seawater	other	NaN	UW19	NaN	60.046328	-146.381167		WBurt	Chl sample from outflow of optics system
7/13/20 18:11	CTD911	recover	Copper River Plume	PL22	51	60.04604	-146.381569	62	SDanielson	
7/13/20 18:26	Acrobat	deploy	Copper River Plume	PL22	NaN	60.048206	-146.386148	62	SDanielson	
7/13/20 18:31	Iron Fish Tow	deploy	Plume	PLUME	NaN	60.054515	-146.390588		AAguilar-Islas	
7/13/20 20:32	Uncontaminated Science Seawater	other	NaN	UW20	NaN	60.224932	-146.668058		WBurt	Chl sample from outflow of optics system
7/13/20 23:05	Uncontaminated Science Seawater	other	NaN	UW21	NaN	60.141943	-146.909148		WBurt	Chl sample from outflow of optics system

7/14/20 3:46	Uncontaminated Science Seawater	other	NaN	UW22	NaN	60.042448	-146.895232		WBurt	Chl sample from outflow of optics system
7/14/20 6:34	Uncontaminated Science Seawater	other	NaN	UW23	NaN	60.040431	-147.183573		WBurt	Chl sample from outflow of optics system
7/14/20 7:13	Iron Fish Tow	recover	Plume	PLUME	NaN	60.001419	-147.105995		AAguilar-Islas	
7/14/20 7:30	Acrobat	recover	Copper River Plume			59.985499	-147.043971		SDanielson	Copper River Plume Transect End
7/14/20 15:15	MultiNet	start	PWS	PWS2	MNV7	60.535194	-147.8026	732	JQuestel	shallow cast
7/14/20 15:30	MultiNet	end	PWS	PWS2	MNV7	60.535188	-147.802603	732	JQuestel	
7/14/20 15:43	MultiNet	start	PWS	PWS2	MNV7D	60.535217	-147.80263	732	JQuestel	
7/14/20 16:27	MultiNet	end	PWS	PWS2	MNV7D	60.534658	-147.802099	732	JQuestel	
7/14/20 16:51	CalVet Net	start	PWS	PWS2	30	60.535111	-147.802521	732	RHopcroft	
7/14/20 16:57	CalVet Net	end	PWS	PWS2	30	60.535165	-147.802808	732	RHopcroft	
7/14/20 17:04	CTD911	deploy	PWS	PWS2	52	60.535168	-147.802806	729	SDanielson	
7/14/20 18:00	TM CTD	deploy	PWS	PWS2	TM08	60.535074	-147.8029		EOrtega	
7/14/20 18:42	TM CTD	recover	PWS	PWS2	TM08	60.535601	-147.802327		AAguilar-Islas	
7/14/20 18:50	CTD911	deploy	PWS	PWS2	53	60.535533	-147.802404	729	SSandy	
7/14/20 19:52	CTD911	recover	PWS	PWS2	53	60.535536	-147.802395	731	SSandy	
7/14/20 19:57	CalVet Net	start	PWS	PWS2	30a	60.535536	-147.802395	732	RHopcroft	live
7/14/20 20:01	CalVet Net	end	PWS	PWS2	30a	60.535537	-147.802395	732	DColeman	live
7/14/20 20:20	Iron Fish Tow	deploy	PWS	PWS2	NaN	60.535872	-147.802215		AAguilar-Islas	
7/14/20 21:23	Iron Fish Tow	recover	PWS	PWS2	NaN	60.656422	-147.671431		AAguilar-Islas	
7/14/20 21:28	CalVet Net	start	PWS	PWS3	31	60.655334	-147.672676	706	DColeman	
7/14/20 21:32	CalVet Net	end	PWS	PWS3	31	60.655325	-147.672663	706	DColeman	
7/14/20 21:37	CTD911	deploy	PWS	PWS3	54	60.655327	-147.672669	704	SSandy	
7/14/20 22:33	Uncontaminated Science Seawater	other	NaN	UW24	NaN	60.655324	-147.672664		WBurt	Chl sample from outflow of optics system
7/14/20 22:34	CTD911	recover	PWS	PWS3	54	60.655326	-147.672664	706	SSandy	
7/15/20 0:56	CalVet Net	start	PWS	PWS1	32	60.379715	-147.937036	355	RHopcroft	
7/15/20 1:01	CalVet Net	end	PWS	PWS1	32	60.379722	-147.937059	355	RHopcroft	
7/15/20 1:04	CTD911	deploy	PWS	PWS1	55	60.379721	-147.937055	355	SSandy	
7/15/20 1:51	CTD911	recover	PWS	PWS1	55	60.379722	-147.937055	355	SDanielson	

7/15/20 2:58	CalVet Net	start	PWS	KIP2	33	60.278894	-147.986919	580	RHopcroft	
7/15/20 3:02	CalVet Net	start	PWS	KIP2	33	60.278896	-147.986935	580	RHopcroft	
7/15/20 3:04	CTD911	deploy	PWS	KIP2	56	60.278896	-147.986932	582	SSandy	
7/15/20 3:57	CTD911	recover	PWS	KIP2	56	60.278889	-147.986937	581	SSandy	
7/15/20 6:32	Methot Net Tow	deploy	PWS	PWS3	25	60.635798	-147.690139	599	JQuestel	
7/15/20 6:53	Methot Net Tow	recover	PWS	PWS3	25	60.649288	-147.677749	599	JQuestel	
7/15/20 7:01	MultiNet	start	PWS	PWS3	16	60.651823	-147.675642	720	JQuestel	
7/15/20 7:38	MultiNet	end	PWS	PWS3	16	60.675308	-147.654254	720	JQuestel	
7/15/20 8:42	MultiNet	start	PWS	PWS2	17	60.542368	-147.796501	753	JQuestel	
7/15/20 9:19	MultiNet	end	PWS	PWS2	17	60.52246	-147.814406	753	JQuestel	computer crashed at 40 m during upcast
7/15/20 9:28	Methot Net Tow	deploy	PWS	PWS2	26	60.517358	-147.819041	600	JQuestel	
7/15/20 9:48	Methot Net Tow	recover	PWS	PWS2	26	60.506482	-147.828469	600	JQuestel	
7/15/20 9:48	Methot Net Tow	recover	PWS	PWS2	26	60.506437	-147.828508	600	JQuestel	
7/15/20 10:41	MultiNet	start	PWS	PWS1	18	60.38858	-147.926469	325	JQuestel	
7/15/20 11:19	MultiNet	end	PWS	PWS1	18	60.363609	-147.945016	325	JQuestel	
7/15/20 11:28	Methot Net Tow	deploy	PWS	PWS1	27	60.356975	-147.948424	266	JQuestel	10 MINUTE TOW
7/15/20 11:40	Methot Net Tow	recover	PWS	PWS1	27	60.34919	-147.952734	266	JQuestel	
7/15/20 11:49	Methot Net Tow	deploy	PWS	PWS1	27B	60.340674	-147.956649	439	JQuestel	Redid cast bc only got 4 jellies in 10 minute tow
7/15/20 12:09	Methot Net Tow	recover	PWS	PWS1	27B	60.325917	-147.962802	439	JQuestel	
7/15/20 12:41	MultiNet	start	PWS	KIP2	19	60.284644	-147.983404	586	JQuestel	
7/15/20 13:12	EM302	other	NaN	NaN	NaN	60.262134	-147.987755		BMcKiernan	system crashed
7/15/20 13:16	EM302	start	NaN	NaN	NaN	60.25854	-147.987818		BMcKiernan	online logging
7/15/20 13:27	MultiNet	end	PWS	KIP2	19	60.250798	-147.988596	586	JQuestel	
7/15/20 13:36	Methot Net Tow	deploy	PWS	KIP2	28	60.243187	-147.989453	586	JQuestel	
7/15/20 13:57	Methot Net Tow	recover	PWS	KIP2	28	60.22874	-147.982623	586	JQuestel	
7/15/20 16:12	CTD911	deploy	Montague Strait	MS4	57	59.920608	-147.827514	118	SDanielson	
7/15/20 16:28	CTD911	recover	Montague Strait	MS4	57	59.920292	-147.82785	118	SDanielson	
7/15/20 16:48	CTD911	deploy	Montague Strait	MS3	58	59.931901	-147.855241	165	SDanielson	
7/15/20 17:01	CTD911	recover	Montague Strait	MS3	58	59.931995	-147.855653	165	SDanielson	
7/15/20 17:32	CTD911	deploy	Montague Strait	MS1	59	59.954054	-147.924128	171	SDanielson	

7/15/20 17:50	CTD911	recover	Montague Strait	MS1	59	59.95423	-147.924789	170	SSandy	
7/15/20 18:22	CalVet Net	start	PWS	MS2	34	59.944264	-147.895406	192	RHopcroft	
7/15/20 18:28	CalVet Net	end	PWS	MS2	34	59.944839	-147.894865	192	RHopcroft	
7/15/20 18:37	CTD911	deploy	Montague Strait	MS2	60	59.943872	-147.893686	194	SSandy	
7/15/20 19:10	CTD911	recover	Montague Strait	MS2	60	59.944659	-147.890506	197	SSandy	
7/15/20 20:50	Uncontaminated Science Seawater	service	NaN	NaN	NaN	59.71622	-148.165856		ERoth	changed strainer
7/16/20 5:25	CTD911	deploy	Seward Line	GEO	61	59.015427	-148.693544	233	SSandy	
7/16/20 6:12	CTD911	recover	Seward Line	GEO	61	59.015424	-148.693535	233	SSandy	
7/16/20 15:04	CTD911	deploy	Seward Line	GAK1	62	59.844834	-149.466567	270	SDanielson	GEO2 SBE37 calibration cast
7/16/20 15:04	CTD911	recover	Seward Line	GAK1	62	59.844835	-149.466569	270	SDanielson	
7/16/20 15:04	CTD911	recover	Seward Line	GAK1	62	59.844835	-149.466569	270	SDanielson	
7/16/20 15:35	CTD911	recover	Seward Line	GAK1	62	59.844832	-149.46657	268	SDanielson	
7/16/20 15:40	CTD911	deploy	Seward Line	GAK1	63	59.844834	-149.466574	68	SDanielson	
7/16/20 16:25	CTD911	recover	Seward Line	GAK1	63	59.844835	-149.466572	68	SDanielson	
7/16/20 16:30	CalVet Net	start	Seward Line	GAK1	35	59.844834	-149.466573	268	RHopcroft	
7/16/20 16:35	CalVet Net	end	Seward Line	GAK1	35	59.844835	-149.466574	268	RHopcroft	
7/16/20 17:49	CalVet Net	start	Seward Line	RES2.5	36	60.025305	-149.357779	296	RHopcroft	
7/16/20 17:55	CalVet Net	end	Seward Line	RES2.5	36	60.02526	-149.358134	296	RHopcroft	
7/16/20 18:03	CTD911	deploy	NaN	RES2.5	64	60.025266	-149.358117	293	SDanielson	
7/16/20 18:33	CTD911	recover	NaN	RES2.5	64	60.02527	-149.358116	293	SDanielson	
7/16/20 19:26	Ship	endCruise	NaN	NaN	NaN	60.096956	-149.438824		ERoth	arrival at SMC