Cruise Report
R/V Sikuliaq SKQ201713S
August 25-September 18, 2017
Nome, AK – Nome, AK

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Note: All data and summaries in this report are preliminary unpublished data subject to revision or correction with intellectual property reserved to the scientist contributing to the report. Please contact the Chief Scientist (cashjian@whoi.edu) for additional information.

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Overview

The Beaufort Sea shelf break experiences frequent upwelling of deep, nutrient rich basin water onto the shelf. Such upwelling is not only a short-term source of heat, salt, and nutrients, and a mechanism promoting elevated primary production (*production response*), but it also transports populations between ocean regions and depth strata/regimes (*physical response*), potentially modifying ecosystem structure and availability of zooplankton and fish prey to upper trophic level consumers. Historically, the Beaufort Sea shelf break has been a domain of enhanced abundance of beluga whales, presumably in response to elevated availability of their prey. This project sought to explore and identify the mechanisms linking broad-scale atmospheric forcing, ocean physical response, prey-base condition and distribution, upper trophic level animal aggregations, and climate change along the Beaufort Shelf break. Our *overarching hypothesis* is that atmospherically-forced (wind-induced) upwelling along this shelf break leads to enhanced feeding opportunities for intermediate links in the pelagic ecosystem (zooplankton, forage fish) that in turn sustain the exploitation of this environment by animals such as beluga whales, seabirds, and seals. Seven supporting hypotheses further explore and support the overarching hypotheses.

To address the hypotheses, a set of objectives was identified, some of which would be addressed through shipboard sampling, some through analysis of longer-term data collected by moorings and meteorological instrumentation, and some through the synthesis of biophysical modeling and field observations. The core of the approach is the fieldwork conducted from the R/V Sikuliaq during this cruise; interpretation of the modeling and of the data from the moorings goes hand in hand with the mechanistic understanding obtained during the fieldwork. In order to quantify the ocean and ecosystem response to upwelling, sampling must be conducted during periods both of upwelling and relaxation. The objectives of the ship based fieldwork included:

1) Describe (a) the spatial distribution (horizontal and vertical), abundance, size, nutritional value (nitrogen, carbon, and lipid content), and stable isotope signatures of zooplankton; (b) the spatial distribution, abundance, size distribution, diet, feeding success, nutritional value, and stable isotope signatures of forage fish; and (c) the associated hydrography across the shelf, shelf break, and slope, particularly during upwelling/relaxation, in a representative portion of the Western Beaufort Sea. Identify upwards and shelfward displacement of water and plankton during upwelling.

2) Determine the degree to which the upwelling of nutritional prey of forage fishes (large lipid-rich copepods, euphausiids) along the shelf break influences the formation of forage fish aggregations by meeting Objective 1 during both upwelling events and non-upwelling-influenced periods.

3) Identify the sequence and timing of upwelling and relaxation events that promote the *physical* response and determine if this differs from the criteria for the *productive* response described by Pickart et al. (2013).

4) Identify associations between upwelling events (and by extension forage fish prey availability), forage fish abundance, and the occurrence of marine mammal predators of zooplankton (bowhead whales) and of forage fish (beluga whales, seals) along the shelf break. (This objective is also being addressed through data collected with long-term moorings deployed along the shelf break).

Field sampling was conducted from the R/V Sikuliaq, operated by the University of Alaska Fairbanks and owned by the National Science Foundation, from August 25 – September 18, 2017. The operating area was located along the Beaufort Sea shelf break to the north of Nuiqsut. The cruise embarked/disembarked in Nome, AK and transited through the Chukchi Sea to reach the operation area (Fig. 1).

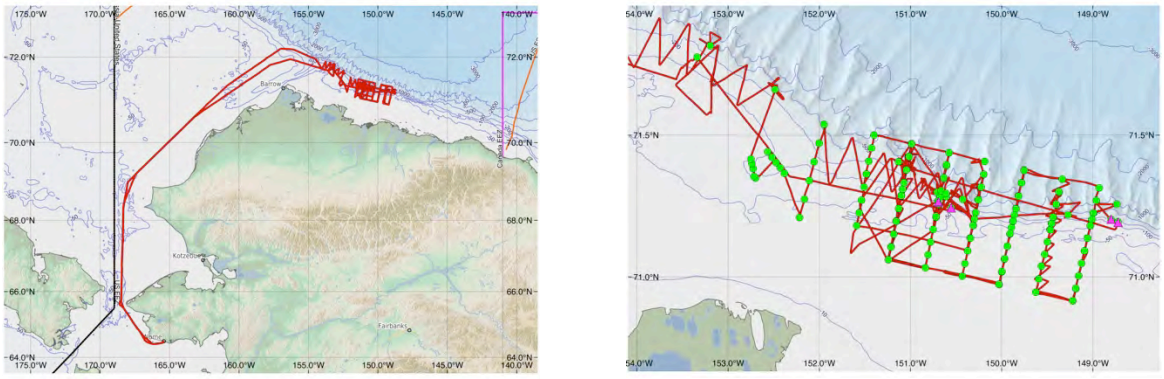


Figure 1. (Left) Cruise track from Nome AK to Nome AK. (Right) Enlargement of operating area. Track of ship is shown in red, stations are shown in green, and mooring locations are shown as the purple triangles. Saw tooth pattern along second N-S line from the east shows tacking during the strongest upwelling winds. Figures by S. Roberts (UAF).

The core of the sampling program focused on a series of transect lines oriented orthogonal to the bottom topography and extending from ~20 m bottom depth at the inshore end to the basin (>1000 m) at the offshore end. Each transect line contained 10-11 stations, named according to the waypoint furnished to the bridge (Fig. 2); station 1 on each line was offshore and station 10 on each line was inshore. Multiple occupations of the lines were conducted, with some lines being surveyed up to five times (Table 1). Two zigzag surveys along the shelfbreak using the multifrequency bioacoustics array (EK60) mounted on the centerboard and the hull mounted 150 kHz acoustic Doppler current profile were done; one survey was conducted through the box and a second was conducted along the shelf break from the operating area to the mouth of Barrow Canyon in the west during the transit back to Nome. Deployment of four sets of bottom-moored instrumentation for year-long collection of data was a key activity. Sampling along Line 6 of the Distributed Biological Observatory was conducted as the operating area was exited at the end of the cruise. Finally, work was done in a depression in the shelf break (WDDC) to the west of the study area to investigate difference in on-shelf transport of water and plankton between such features and straighter shelf-break topography.

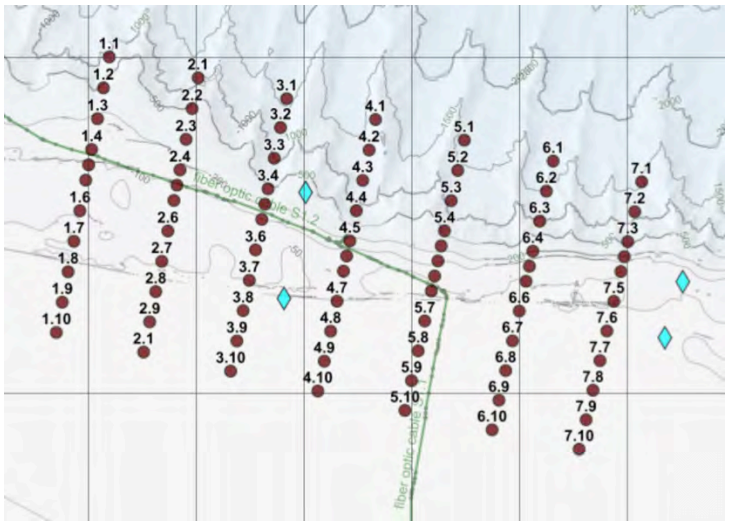


Figure 2. Waypoint names of stations along transect lines. Cyan diamonds show planned locations of moorings and differ from actual locations shown in Figure 1. Green line shows location of Quintillion fiber optic cable (note; stations were not located as close to the cable as this map shows). Map from the MapServer program developed by S. Roberts.

Table 1. Synopsis of Daily Activities

Date (Local)	Activity
25-Aug-17	Left Nome, Transit N
26-Aug-17	Transit N, Reached Cape Lisburne
27-Aug-17	Glider recovery, transit N, reach Pt. Lay
28-Aug-17	Rounded Pt. Barrow, Test Station
29-Aug-17	Mooring Deployments (2), West end of grid, Line 1 (acoustics only)
30-Aug-17	Line 2a; Line 3a
31-Aug-17	Line 4a; Upwelling (strong winds from E)
1-Sep-17	Line 1; Line 2b
2-Sep-17	Line 2b; Line 3b
3-Sep-17	Line 2c; Line 3c
4-Sep-17	Line 2d
5-Sep-17	Zigzag survey along shelf break within sampling region
6-Sep-17	Line 4b; Line 5a; Upwelling (strong winds, only CTDs)
7-Sep-17	Line 5a; Line 6a; Ship tacking in strong winds/high seas. Line 7a
8-Sep-17	Line 7a; Line 5b;
9-Sep-17	Line 2e; Mooring Deployments (2); Line 7b
10-Sep-17	Line 7b; Line 6b; Diel acoustic study at shelf break
11-Sep-17	Zigzag along shelf break to the W
12-Sep-17	Zigzag; DBO6
13-Sep-17	WDD Canyon; Zigzag along shelf break to the W
14-Sep-17	Zigzag along shelf break to the W; PolarTREC Events

15-Sep-17 Started Transit to Nome; Passed Pt. Barrow and Wainwright
16-Sep-17 Transit to Nome
17-Sep-17 Transit to Nome; Passed through Bering Strait
18-Sep-17 Arrived Nome

All three of the local Alaskan coastal communities along the Beaufort Shelf conduct bowhead whaling in the fall as part of the IWC sanctioned subsistence hunt. Kaktovik, far to the east, usually starts fall whaling on Labor Day (Aug. 24, 2017). Nuiqsut, in the mid-shelf, whales at Cross Island and usually starts on Aug. 25 (although it started on Aug. 29 this year). Utqiaġvik, at the western end, has variable starting dates (usually in late September) and sets that date each year at a meeting in early September (Sept. 11 this year; whaling was set to start on Sept. 29). To avoid conflict with whaling at Cross Island, the Chief Scientist agreed to remain to the west of 150° 10.2'W until after the Nuiqsut whalers had completed their whaling season. This occurred on Sept. 5 but because of delays in communication, the ship remained to the west of 150°10.2' until Sept. 6.

One of the initial concerns regarding the project was whether upwelling would occur during the cruise. Two major upwelling events occurred, one from August 28-Sept. 2 and the second from Sept. 6 – 9 (Fig. 3), that permitted sampling through all of the conditions required.

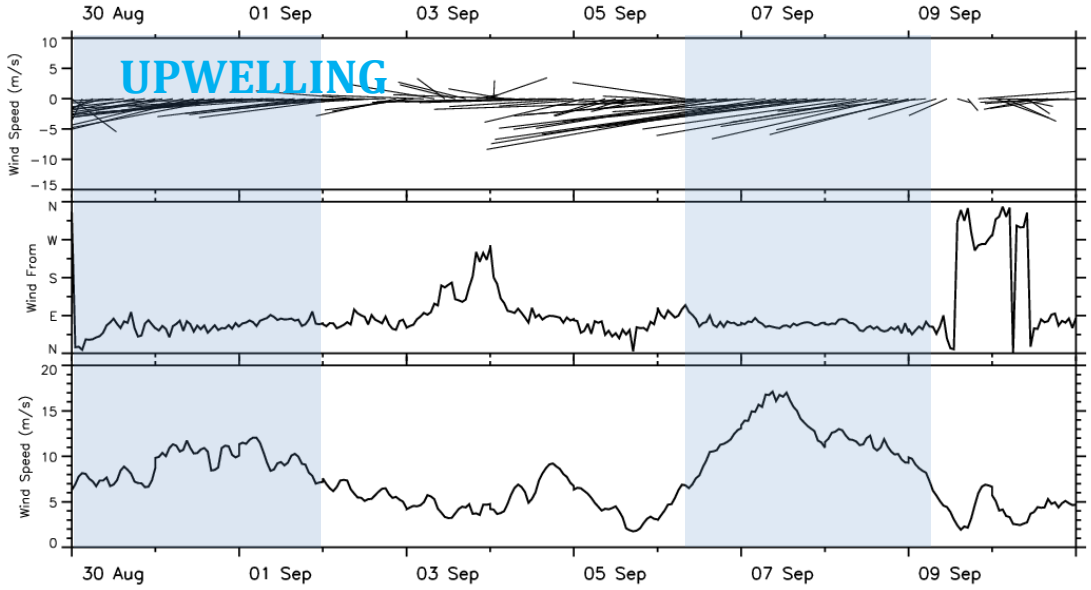


Figure 3. Wind conditions during the cruise, recorded using the Sikuliaq anemometer. Wind vectors (upper panel) are broken down into wind direction (middle panel) and wind speed (bottom panel). Periods of upwelling are indicated by the blue-gray shading.

Sampling was conducted using the CTD/rosette system on board the *Sikuliaq* to describe water column hydrography, oxygen concentration, chlorophyll concentration (from fluorescence), optical backscatter, and colored dissolved organic matter (from fluorometry) as well as to collect water samples at discrete depths for analysis of size fractionated chlorophyll, nutrients, phytoplankton composition, and phytoplankton DNA.

Zooplankton distributions, abundance, and composition were sampled using a Bongo net system equipped with 150 and 500 µm mesh nets and a 1 m^2 three-net Tucker Trawl equipped with 500 µm mesh nets; both net systems also were equipped with a strobe to increase the efficiency of capture of visibly capable euphausiids or krill. Forage fish/beluga prey were collected using a midwater trawl. Both zooplankton and fish distributions and relative abundances also were described using the 5 frequency, Kongsberg EK60 bioacoustics sonar system mounted on the centerboard of the *R/V Sikuliaq*. Ocean currents were described using the 150 kHz RDI acoustic Doppler current profiler mounted on the hull of the ship. Individual zooplankton and fish were sorted on board from samples and retained for analysis of carbon/nitrogen content, stable isotope characteristics, age through otolith analysis (fish), and prey composition from stomach contents (fish). These measures would explore nutritional values of zooplankton as prey for fish and fish diet under different upwelling conditions.d

At least three outreach activities were ongoing during the cruise. Lisa Seff from the Springs School in Easthampton NY participated as an alumna PolarTREC teacher (she had worked with Ashjian, Campbell, and Okkonen previously). Her journal entries are available at the PolarTREC web site. (https://www.polartrec.com/expeditions/upwelling-and-ecology-in-the-beaufort-sea). She also organized a PolarConnect event with 58 individuals connected through the website, reaching 504 students as well as more than 725 students and 125 teachers from the Springs School; the event is archived at the PolarTREC web site (https://www.polartrec.com/resources/event/polarconnect-event-lisa-seff-the-upwelling-and-ecology-in-the-beaufort-sea-research). Lisa worked closely with Heather Jameson at the Anvil City Science Academy in Nome, AK before and during the cruise, visiting the classroom before the cruise and organizing a visit by the entire student body (90 students) and teacher chaperones to the *R/V Sikuliaq* on Sept. 18, the day that the ship returned to port. Diana Campbell, a recent graduate from the MA program in Professional Communications at UAF, participated as the social media communicator. She developed and updated a Facebook page (https://www.facebook.com/ArcticWFFF/) targeted at the general public as well as posting to Instagram and Twitter throughout the cruise. Finally, Carin Ashjian sent daily updates to ~90 Alaskan coastal community members representing subsistence organizations and villages; those updates can be found in Appendix F.

Table 2. Summary numbers of different types of sampling activities.

Activity	**Number**
Stations	184
Bongo Tows	37
CTD Casts	184
Fish Trawls	16
Mooring Deployments	4
Ring Nets	4
Slocum Glider Recovery	1
Tucker Trawls	69

The cruise was highly successful. The *Sikuliaq* is a very stable platform and sampling was conducted with the CTD/rosette under all of the weather conditions encountered; sampling with the plankton nets became limited under high seas because of the pitch and heave of the stern of the ship and with the large fish net under moderate seas because of the difficulty of deploying the large net system safely on a dynamic deck.

Cruise Narrative

August 25, 2017

The ship sailed at 10 AM, following the safety inbrief for the science party and drills for all hands. On the way north we passed the R/V Norseman 2 that was heading south to Nome at the conclusion of the AMBON cruise. Our closest approach was a ~1315, near Sledge Island. There was a science meeting in the afternoon. The fish team worked to develop and document a very detailed plan for the launch and recovery procedures for the fish net.

Kate Stafford (UW), Mark Baumgartner (WHOI), and Peter Winsor (UAF) have a glider on a mission in the Chukchi (listening for marine mammals) that has suffered a failure of the Iridium communication system. The position of the glider lies along the track to the operating area for this cruise; to the NW of Cape Lisburne (between Point Hope and Point Lay). We will attempt to find and recover the glider tomorrow. A planning meeting for the glider recovery will take place at 1100.

Weather is clear but windy, with winds at about 22 kt. from the NE. Air temperature is 43 deg. F.

August 26, 2017

Continued to transit N. Strong winds from the NE slowed our progress, especially after going through Bering Strait. Anticipated arrival at the glider location is now ~midnight. A planning meeting for the glider recovery took place at 1100.

Weather very windy (20 knots and greater) with mostly sunny skies and 8-10' seas. Some birds and whales were seen by the bridge observers.

August 27, 2017

Arrived at glider location at about 0030. Kate Stafford and Ethan Roth made contact with the glider using the FreeWave and sent a signal to abort the mission and remain on the surface. Once this happened, they were able to query the glider and find the location. The ship turned on two spotlights and scientists and crew on the bridge searched for visual contact with the glider. After about 5 minutes, the glider was spotted on the starboard beam. The spotlight was trained on the glider and the ship maintained position to keep the spotlight within the pool of light, maintaining an approximately constant distance from the glider. The deck crew and scientists helpers (4) were assembled within 15 minutes and recovery commenced. The ship maneuvered close to the glider and the cargo net was deployed from the crane into the water and lowered; the ship then maneuvered so that the glider was very close to the net and eventually near the edge of the net. Together with some guidance from poles, the glider was coaxed into the net. The net then was lifted up and the glider recovered at 01:45 (Fig. 4).

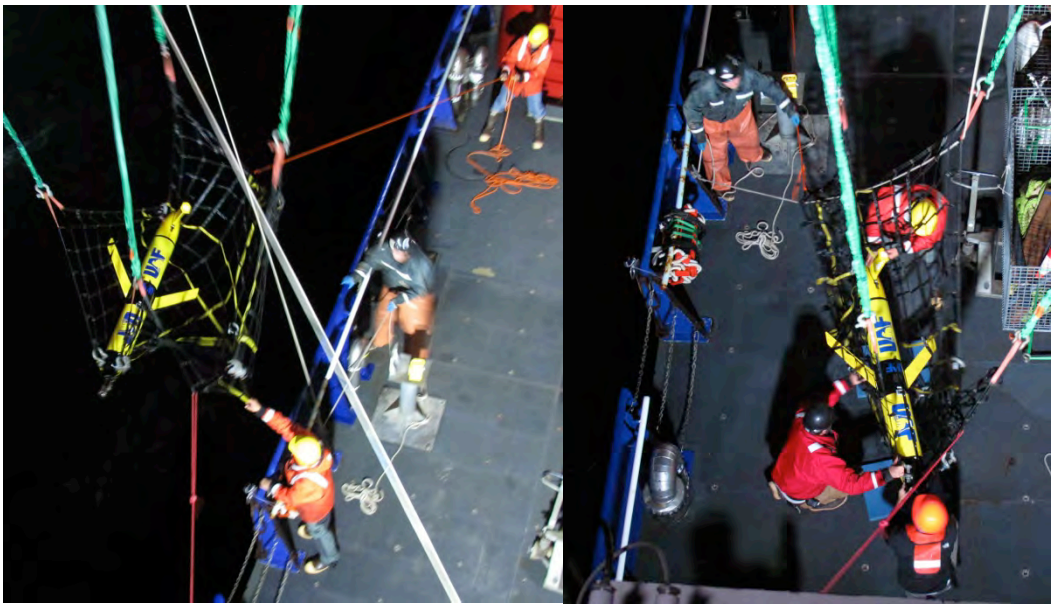


Figure 4. The glider being lifted on board (Left) and placed on the deck (Right).

Continued to transit towards the operating area after the glider recovery. The seas are much calmer and the waves reduced. Skies are clear and sunny. The fish team completed their checklist with Red, Amber, Green designations for all of the steps in the fish net deployment and recovery and did a walk through with the Bos'n to look at placement and use of the tuggers to use with the doors on the net.

This afternoon the observers on the bridge saw cow and calf walruses and a nice diversity of birds (Arctic Tern, Pacific Loon, Sabine's Gull).

August 28, 2017

Morning found us to the NW of Point Barrow. Skies were partly cloudy and the wind speeds were much reduced. We spent the day in preparation for the test station, having several meetings to discuss deployment procedures with the Captain and ship's crew. Topics included the drone, the moorings, and the Acrobat.

We set the test station to be done at the end of Line 8 (SNACS line), in about 56 m of water near the shelf break. We arrived at the test station at around 1630 and launched the Acrobat. Once the fish was in the water, Joel noticed that using the VHF radio interrupted the Ethernet signal (perhaps because the VHF antenna runs through the same conduit as the Ethernet cable) and causes the environmental data to stop being received by the computers. We got around this by using hand-held radios and operating them some distance from the Ethernet cables. The fish flew pretty well, although we could not test it to full capability because we only let out 60 m of cable. The fish trawl was next; it took some time to deploy and recover but the operation went very well. The net brought up many large jellyfish as well as some small Arctic cod. Both the Tucker trawl and Bongo net deployments also went very well; more small fish were caught in the Bongo. The station wrapped up with the tried and true CTD as the final operation.

As we moved across the shelf break, we came into some very fresh water (26.5) that persisted along the entire track of the station and now is continuing along the shelf break.

We are not sure if this is river discharge (salinity is very high) or ice melt water from the north.

August 29, 2017

Arrived at mooring waypoint M2 this morning and near site to find 80 m. The selected site where the mooring was deployed was 0.5 nm to the south of the Quintillion cable, with an accompanying CTD cast. We moved offshore to select the site for the mooring that was to be deployed at 120 m. This proved problematic since it seems as though the Quintillion cable was laid at 120 m depth. As a result, we surveyed to find a site that was a suitable distance from the cable and that was in approximately 100 m of water. The mooring was deployed at ~ 11 AM. After completing the CTD, we transited to the inshore end of Line 2 but did not go all the way to the most inshore waypoint since the bottom depth was 20 m and monotonous at a point about 10 miles to the N of the end (note: we ultimately removed the inshore two station locations/waypoints for all of the lines because 20 m bottom depth was reached further offshore).

The Acrobat was deployed at the innermost waypoint. Data collection was going well at first but we soon experienced data dropouts and freeze-ups of the control program so recovered the instrument. At one point, we must have hit the bottom because a tension of 500 was seen on the tensiometer (normal tension 70-130) and mud was seen on the fish upon recovery. We moved on to the northern end of Line 2 to run our first CTD-net sampling transect, conducting CTDs at all stations and nets at every other station, starting with waypoint 2.2.

August 30, 2017

Completed Transect 2a. At waypoint 2.2, the plankton nets collected krill (in every net), copepods, amphipods, some little fish, and chaetognaths. Many very large jellyfish were seen at the surface, some with 12" bells and 7' tentacles. The fish net was deployed at waypoint 2.3 and collected many jellies. Offshore stations had krill and many *Calanus*. At stations inshore, on the shelf, there were few *Calanus*. The most inshore station had *Oithona, Acartia*, and a lot of detritus

After finishing the transect, we transited over to 50 m on Line 3 to try the Acrobat again. On the advice of Chris and Roger back at SeaSciences, we had disabled the Java program on the Acrobat control computer because Roger thought that there might be a conflict between that version and the version embedded in the Acrobat control program. There were ongoing problems however so we brought the Acrobat on board and continued offshore along the line, conducting CTDs every 2.75 nm (Line 3a; Table 2).

August 31, 2017

The wind picked up overnight so progress along the line was very slow. At 645 AM, the most offshore CTD had been completed and the ship was transiting towards station 4.1. Because the original waypoint of that station had been at 150° 9.9' W, we moved the location to 150 11.0 W to avoid accidentally crossing over 150° 10.2' W. Arrived at the location just before 0800 to start the line. For the net tows as this location, the ship needs to move away from the station in order to have space to tow safely and not go over the line.

Overnight Steve plotted up the CTD transects that we have done so far. There is a nice upwelling signature in the temperature data from Line 3a (conducted last night). The signature is not so strong in the salinity section.

We spent the day working our way in on line 4. The weather is not particularly hospitable, with building seas and winds in the high 20s. The stations with net tows at the offshore end of the line took a long time, since each tow took about an hour and there were two at each station. At station 4.5, we tried valiantly to sample a scattering layer at about 130 m but crashed the tucker into the bottom 2x and failed to even reach 100 m the third time. We are in the middle of an upwelling event as the winds are from the E and the forecast is for winds to dissipate on the weekend (upwelling relaxation).

September 1

Line 1 was surveyed overnight using CTDs (and one tucker trawl) and shipboard sensors going from inshore to offshore. The upwelling might be a little less pronounced. After looking at the sections, we decided to add another station at the shelf break (at 2.5 km spacing vs. 5 km spacing) on all of the lines so that the rapidly changing structure can be better resolved. Arrived midday at location 2.1 at the offshore end of Line 2 and started transect 2b (offshore to inshore, CTDs and nets). A fish trawl was conducted in the afternoon between waypoints 2.2. and 2.3.

September 2, 2017

Finished Line 2b early this morning and then started in on Line 3b using CTDs. At around 9 we deployed the Acrobat at Waypoint 3.7 and towed offshore. Acrobat did OK but after we held it at the surface to cross the Quintillion cable the pressure sensor was sending bad data during the down profiles. We flew it manually for a bit and then pulled it at around WPT. 3.5 to do a fish trawl at 250 m bottom depth that collected a bit of mud, followed by a CTD and a Tucker trawl. There was a very strong krill reflection at 180-200 m in the EK60 that was targeted for the Tucker trawl and that did bring up krill.

After the fish station, we transited offshore to waypoint 2.1 to document relaxation going from offshore to inshore (Line 2c).

September 3, 2017

The Line 2c survey was completed by midday and we moved to the inshore end of Line 3c. Deployed the Acrobat just after lunch. It flew somewhat poorly but we were able to get a bunch of towyos done on the 60 m cable. Then let out cable to 150 m. The fish was doing OK, only had one data stoppage until we yanked its tail (the cable got tight during one of the downward casts) and we could not regain data. Pulled in the Acrobat at Waypoint 3.5 and did a CTD. Then moved offshore to do a fish trawl that just nicked the bottom. Despite that, there were about 1000 cod in the net. After the fish trawl, we resumed working offshore along Line 3c and then head to the offshore end of Line 2.

September 4, 2017

Line 3c was completed and Line 2d started. At waypoint 2.3, we saw that the bottom depth was 235 m and saw that fish were present. So we broke of the survey line to do a fish trawl that again nicked the bottom but still collected fish. Fish trawl went OK but hit bottom again. Got a bunch of fish anyway. Then we continued south on Line 2d,

going south. After finishing Line 2d, moved to point along Line 1 to do a zigzag acoustic survey of the shelf break.

It was very foggy, so foggy that the fog horn was used for much of the morning. Earlier, the Mirai had been working near waypoint 2.3. They moved off at about 1500z. Heard that the Cross Island whalers got two more whales.

September 5, 2017

We finished the acoustic survey at around 1030 AM and set up to launch the Acrobat. The thing wouldn't fly well at all unless flown manually. Finally at one point when the fish was nearing the surface the data transmission stopped for good and wouldn't start again so it was recovered it. After that we set up for a fish trawl to the NW of 4.6. While the trawl was in the water, Bob and Ethan were trouble shooting the Acrobat working on instructions from Chris Casagrande. Ethan found that there was a loose wire that caused power to the sensors to go down (and thus the data) and also found another mystery. He put some kind of silicone goo on the loose bits to hold them in place. Meantime the fish trawl came smoothly and safely but empty. We deployed the fish net a second time. This trawl went nicely and came up with about 100 fish.

We heard at around 4 PM that Cross Island had got their 4th whale but did not receive confirmation from AEWC that it is OK to move to the east of 150° 10.2' W. Thomas Napageak (Nuiqsut commissioner) confirmed the fourth whale by text. After the second fish trawl, we still had not heard from the AEWC so we surveyed Line 4b from north to south again, starting at 4.2 and starting net tows at 4.4.

September 6, 2017

Still no word from AEWC in morning. We heard that the AEWC wanted Thomas Napageak to call them and passed this message on by text. Kaktovik expressed concern and said that they did not want us to move further east. To explain where we wanted to go, we sent maps with distances between Kaktovik and our working area to the Kaktovik commissioner and the AEWC. However, Britte was unable to get any response to this message. The NSF and UAF suggested we go to the east; I asked for support in that decision. NSF and UAF directed us to conduct our work as originally described. At around 1500 we turned back to the east. Unfortunately, we had missed a nice window of extremely calm weather during which we could have deployed our second set of moorings.

The winds had been building all day, reaching 33 kts. from the east in a great upwelling event (Fig. 5). Copepods of the offshore genus *Calanus* were found at waypoint 4.10, the most inshore end of Line 4b. After completing Line 4b, we started the CTD/acoustics survey of Line 5. Winds and seas preclude sampling with anything else so sampling will be conducted with CTDs as the seas permit.

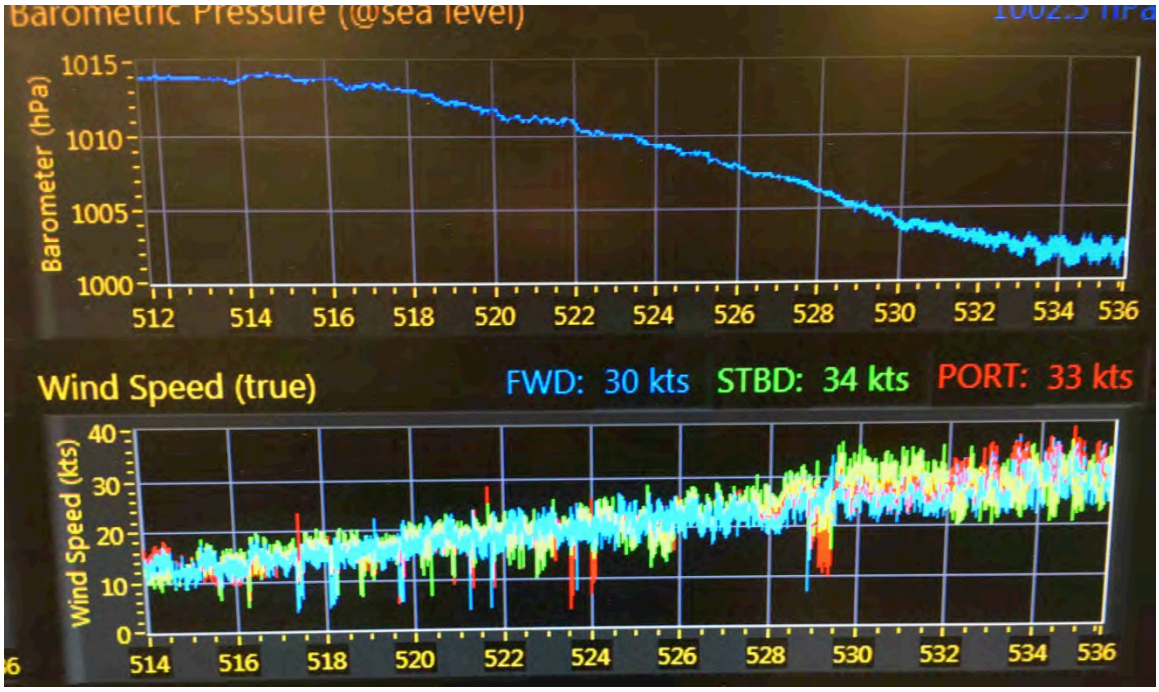


Figure 5. Screen shot of displays of barometric pressure and wind speed from the R/V Sikuliaq meteorological instruments.

September 7, 2017

Winds blew over 30 knots overnight so seas are substantial (6-8' seas with swells that combine regularly to be 14-16'). Did CTDs out Line 5a to offshore end, then turned east to offshore end of Line 6a. After first CTD there, the rolling was sufficient that the ship started tacking down the line rather than traversing in a straight line. We continued south doing CTDs. As we move onto shelf, the waves will steepen and at some point we may not be able to proceed further inshore. There were a few good rolls in the afternoon but overall the ship is riding great. Oranges have been spotted on the loose on the 01 deck. There was one in the companionway outside the berthing rooms last night and one was found in the sauna. Today an additional one was found in the companionway. They are escaping from somewhere.

We reached the inshore end of Line 6a (all CTDs) in the evening and turned to go north on Line 7a. The winds started to abate somewhat and the seas may follow, although there are still some substantial swells.

September 8, 2017

Finished Line 7a (all CTDs) and transited to the offshore end of Line 5b. The first net tows since the big blow began were done at waypoint 5.2. We sampled down the line with CTD and light nets but no fish net as the weather was still too dodgy. Winds have been coming down steadily through the day but were still in the 20s by evening. Although *Calanus hyperboreus* were still seen all the way inshore, no krill were seen on the shelf. We did catch some krill at the shelf break. The most inshore stations had a mix of offshelf and shelf species. Was the absence of krill because the net tows were conducted during the day?

After completing Line 5b, because we had seen no krill inshore, we decided to go back to Line 2 where we had seen krill at 2.10 during the previous upwelling event. Steve is wondering if the strong westward flow off of the shelf during the upwelling event has stopped the eastward progression of krill so that the supply available to be upwelled is very low. We will do CTDs and Tuckers (at alternate stations) from 2.10 to 2.4 at which point we will go to the fish trawl site and do a trawl. After the fish trawl is complete, we will head east to the mooring site and deploy the moorings. A complicated schedule but one that we believe the weather and time will permit.

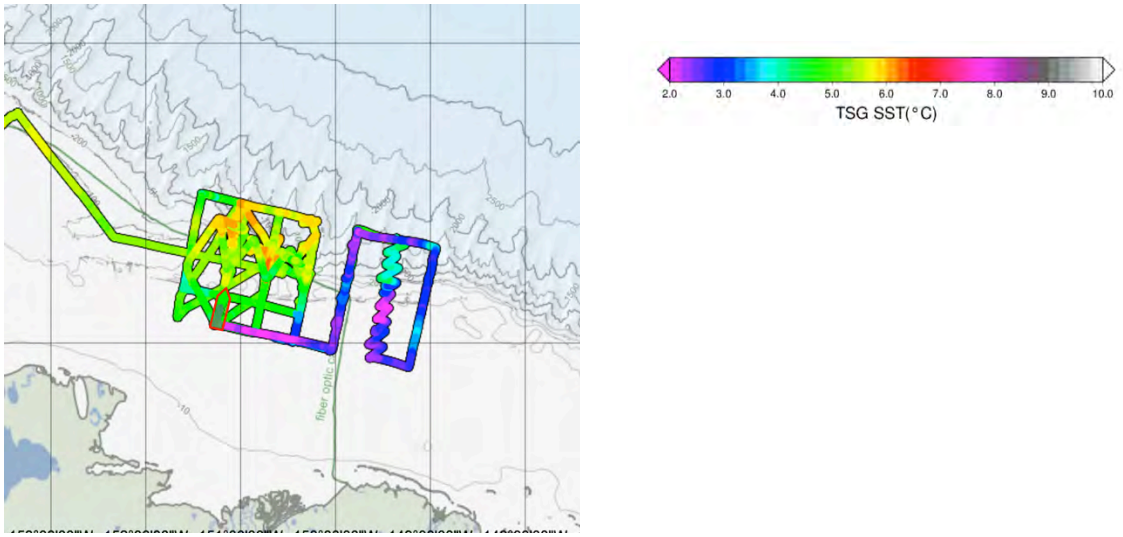


Figure 6. Sea surface temperature through September 8. Either the blow pushed the warm water offshore OR the subsurface temperature minimum was mixed upwards.

September 9, 2017

Arrived at fish trawl station this morning around 0600, after completing stations at 2.10 – 2.3 (including a CTD and Tucker trawl at 2.3). Fish trawl location crossed right over 2.3 so decided to use that as the CTD/Tucker in conjunction with the fish trawl. Fish trawl went very well, with some fish and some jellies caught (but it did not hit bottom). After fish trawl, transiting to E to eastern mooring sites to do mooring deployments.

Deployed first mooring at 80 m, then discovered 120 m was only 500 m away so moved a mile to the west to 120 m to deploy second mooring.

After doing the mooring we moved offshore to do a fish trawl. Once the fish trawl was completed, we started worked down Line 7b, hoping to sample with the tucker on the shelf during the night to see if krill are present (night tows vs. day tows as on Line 5).

September 10, 2017

We finished sampling Line 7b with Tucker trawls at waypoint 7.2 at 0630 local so still in the dark. Then transited to the inshore end of Line 6, arriving there at around 8 AM and deployed the Acrobat. It still could not fly well using the program (or even manually). The data worked pretty well for 1.45 hours but then all Ethernet data stopped transmission and we couldn't get it going again. Luckily we had surveyed the distance

between 6.10 and 6.6 and the plan was to pull it in at 6.5. We retrieved it and started at 6.5 doing CTDs at the waypoints on the way out to 6.2. At 6.2, we turned south to find a location for a fish trawl. Once the fish trawl was complete, we moved in to the shelf break to find a fish patch. We are now staying at a single location until morning sometime (diel study).

September 11, 2017

The overnight single point acoustic watch revealed some interesting movements of the fish blob. It moved upwards in the middle of the night. The acoustic watch ended at around 10 AM and the fish team launched the fish net to do a trawl. No bongo tows were done.

During the trawl, we had a visitor in the lab: A small brown bird flew through. Ethan and Tamara trapped it in the electronics shop. It was a red poll. After everyone viewed the bird, Tamara released it on deck.

After the trawl was completed, we did a test of the Acrobat to see if we had fixed it with the DIP switch adjustment and also to try flying it with 250 m of wire out. We first tried with only 65 m of wire out. Flying was still really difficult. We also had some data stoppages (Ethernet data stopped). There was one instance where we managed to freeze the control program also. The Ethernet stoppages seem to be related to the Ethernet range extenders losing connection with each other. Some of the Ethernet stoppages may also have been isolated to the data computer, with Ethernet continuing to the control computer (pitch and roll data kept coming in). We tried to ascertain if the stoppages only occurred when running DasyLab; may not because we think that we also had stoppages when running TeraTerm on the data computer. At the very end, DasyLab was running but none of the sensor data (CTD, ECO, PAR) could be accessed on the data computer using TeraTerm. On the control computer, the ECO and the PAR data could be accessed using TeraTerm but not the CTD. This suggests some sort of problem with the virtual ports.

We recovered the Acrobat and then proceeded to a spot where we had seen fish earlier in the cruise, doing a zigzag across the shelf break on the way. The plan for the evening is to find a fish patch, park over it and watch it rise up, and then do a night fish trawl. The trawl will be followed by a CTD cast and Tucker Trawl.

September 12, 2017

The fish trawl unfortunately fished too shallow and only a few fish were caught. Northern lights put on a great display after midnight. The plan now is to zigzag along the shelf break, moving to the west towards Barrow Canyon and to sample at DBO6 and at the small indent on the shelf (WDDC) along the way (Fig. 7). At 0600 we started the zigzag transects across the shelf break. Because we were actually to the west of ZZ1, we first had to transit to the east to start the survey.

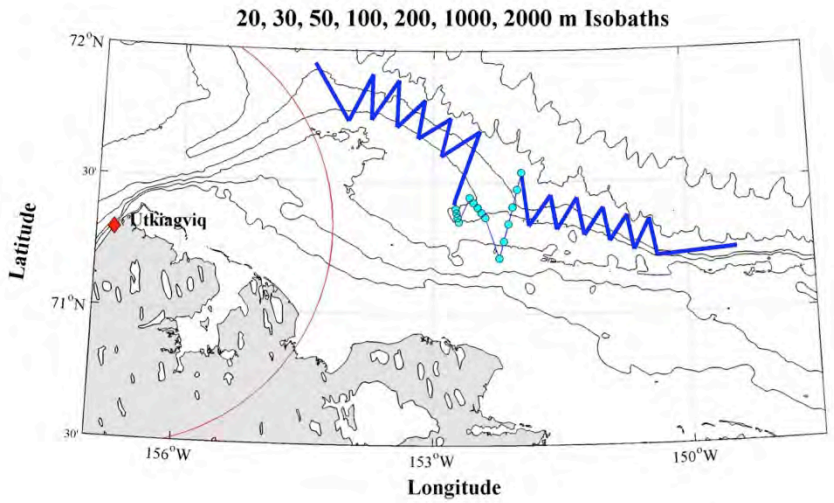


Figure 7. Plan for zigzag survey, DBO sampling, and sampling in the semi-canyon WDDC. Range circle shows 50 nm from Utqiaġvik.

As the day progressed, the winds started to pick up followed by the seas. At 12:21 the winds were 27 knots from the E-ESE. Not good for fish trawling. The winds abated in the early evening, making conditions more favorable for Bongos at the DBO6 line. The DBO 6 line was occupied starting at around 20:00. Pulled in an enormous krill (2") at the offshore DBO station.

September 13, 2017

We completed DBO6 in the early hours of the morning and transited to WDD Canyon to do a small survey. The survey started early in the AM and finished in the early afternoon. We found that there was Winter Water and even Atlantic on the eastern side of the transect near the mouth of the dip, with high backscatter in the upper 50 m at all frequencies and a massive krill ball in the middle of the transect, coincident with the front between Winter Water and Chukchi Summer water (at depth). Tried to get a net into the krill ball 2x but only managed to clip it during the second tow. Had a lot of trouble getting the net to depth until we actually hit bottom one time and saw what the wire looks like when it hits (on the camera in the winch room). After that I assumed wire angle is greater than we are measuring or that the current to the east into which we are towing the net is keeping the net higher than thought, I tried letting out more wire gradually when I was near the expected wire out, making sure I didn't hit the bottom. Managed to get some nice trawls then.

Weather turned truly lovely around 1700. Fish trawl was deployed to the NW of WDD Canyon about 8 miles at 1817. On the way to the location/shelf break, we saw the Korean icebreaker Araon that crossed our path. The ASAMM plane also flew over the ship. At ~1745 the ASAMM plane called in sightings of two belugas to the NW of us.

Fish trawl didn't fish deep enough. Decided to stay here over fish patch and repeat after dark when fish should be higher in the water and easier to get net down without worrying about hitting bottom.

September 14, 2017

The fish trawl overnight went very well and the fish team got a bunch of cod (several 100s) without hitting the bottom. PolarTREC connect event was at 5 AM; it went very well, there were 60 callers and about 500 students who heard the event. After that we resumed the zigzags, planning to do a fish trawl in the afternoon (1330). Found a good spot on one of the zigzags so decided not to continue further west but to double back to the east so that we would be ready at that location for the afternoon fish trawl. Fish trawl launched at around 1400, recovered just before dinner.

Tonight was a big turkey dinner so we took a break from science activities so that all could enjoy the dinner. During dinner, the ship surveyed along a triangle so that the bird and mammal observers could continue to work while the ship was underway. CTD commenced at a little after 1800 followed by a Tucker trawl. Tucker hit bottom at 523 m w/o with a 58 deg. angle and a bottom depth of 306: Clearly the angle was incorrect. Had to repeat the tucker trawl. Second one hit bottom also.

Now transiting, soon to deploy the fish net to rinse it out prior to packing it. Then will do some form of the zigzag until the drop dead location and head to Nome.

September 15, 2017

Transiting to Nome. Packing. Working on data.

September 16

Continued transit to Nome. At 1000 conducted last station, Station 184, to collect zooplankton to take home and to collect phytoplankton. A CTD cast and a Ring Net tow were done.

Weather continues to be pleasant but cloudy. Many Pacific loons have been sighted but few marine mammals.

In the early evening, the Captain noted that we were going to be early and did I want to do a CTD or some other scientific activity. I suggested that he inquire of the bird and mammal observers on the bridge about if there were places they would like to be during daylight to see if he could set up the ship track and speed to do that. Accordingly, we slowed to 8.4 knots or so.

September 17

Continued transit to Nome and packing gear.

September 18

Arrived Nome at ~0600. Hosted visit by Anvil City Science Academy at noon. Science party moved off of R/V Sikuliaq following that event.

Individual Science Component Reports

Hydrography – Steve Okkonen

The CTD used for the SKQ201713S surveys was a Sea Bird Electronics SBE 911 plus system with dual temperature and conductivity sensors. It was mounted on a SBE 32 rosette along with suite of auxiliary sensors: a Sea-Bird SBE43 dissolved oxygen sensor, a Wetlabs C-Star (25-cm) transmissometer, a Wetlabs FLRTD (chlorophyll) fluorometer, a Wetlabs FLCDRTD (CDOM) fluorometer, a Biospherical QSP-240 PAR sensor and a Tritech PA 200/20 altimeter. A SUNA V2 nitrate sensor, provided by Kate Lowry, was also attached to the rosette.

The CTD rosette was deployed to the shallower of 450 m or within ~5 m of the bottom as indicated by the Tritech altimeter. The 450-m maximum cast depth was chosen to provide a 50-m safety margin for the nitrate sensor which was limited to cast depths shallower than 500 m.

One hundred eighty three (183) CTD casts were taken during the cruise. One hundred fifty five (155) of these casts were taken during multiple occupations of hydrographic transects within the upwelling project study area box. Six (6) casts were taken along the DBO6 survey line.

One project goal was to use the CTD data to document the hydrographic response to an upwelling/relaxation episode. Figure 8 compares salinity sections along line 2 during the latter stages of an upwelling event (left panel) and nearly three days later as upwelling winds have somewhat relaxed (right panel). As expected, outer shelf and upper slope waters are more saline during the upwelling event.

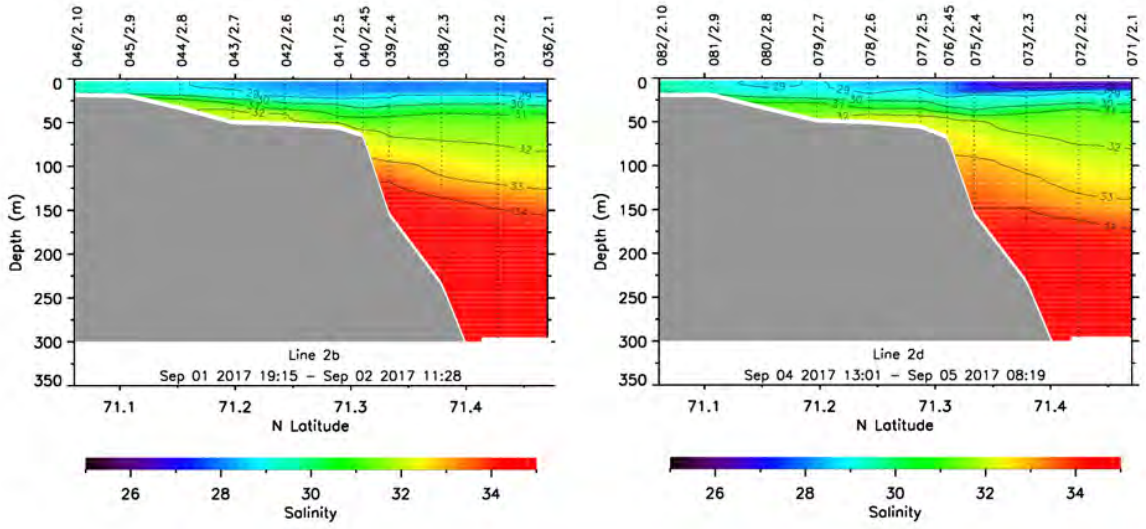


Figure 8. Salinity sections along line 2 during upwelling (left) and relaxation (right) conditions. Dates and times (UTC) of the first and last CTD casts along each transect are noted at the bottom of the salinity plots. CTD cast numbers and waypoints are located across the top of the plots.

Figure 9 depicts the onshore/offshore migration of sentinel isohalines representative of outer shelf and upper slope waters during transitions between strong upwelling winds on 31 Aug-1 Sep and again on 6-8 Sep. This migratory behavior suggests that the hydrographic response is spatially coherent across our 100-km wide study area.

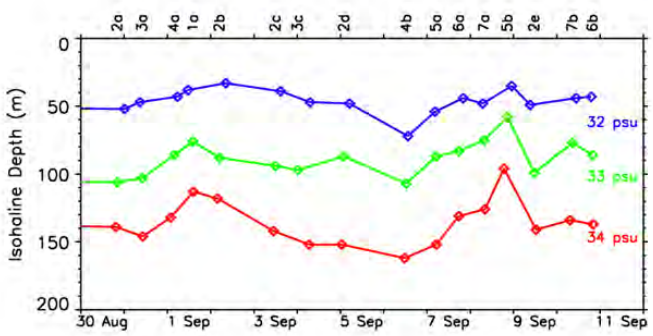


Figure 9. The depths at which the 32, 33 and 34 isohalines intersect the ocean bottom during 30 Aug – 10 Sep 2017. The hydrographic section line (number) and sequential occupation (letter) of each occupied section are listed at the top of the figure.

Moorings- Steve Okkonen, Kate Stafford, Mike Lowe, Jenny Stern

Four year-long moorings were deployed to monitor ocean currents using Acoustic Doppler Current Profilers (ADCP), near-bottom hydrography (Seabird Microcat CTD) and occurrences of zooplankton and fish with an Acoustic Zooplankton Fish Profiler (AZFP), and marine mammal vocalizations using a recorder (AURAL) (Table 3).

Acoustic Zooplankton Fish Profiler (AZFP): A bottom mounted acoustic zooplankton and fish profiler (AZFP; ASL systems) was deployed 7.8-m off bottom at the 80-m isobath (71.25339, -151.553481). The AZFP included two upward facing transducers comprising four frequencies; a single frequency 38 kHZ transducer and a multifrequency transducer containing the 125, 200, and 455 kHz channels. The unit is scheduled to ping 90 times (all four channels pinging sequentially with a 2 second ping period) every 20 minutes for the next 375 days or until retrieval. This operating schedule was designed to match the temporal resolution of the adjacent ADCP mooring. Vertical bin averaging was done at 1 m resolution and pulse length (1000 µs), maximum detection range (72 m for 455 kHz; 89 m for 38, 125, and 200 kHz), and signal digitization rate (64 kS/s) were selected to maximize power use and data storage. This unit will be used to quantify relative changes in zooplankton and fish abundance and depth distribution at both intra- and interannual time-scales.

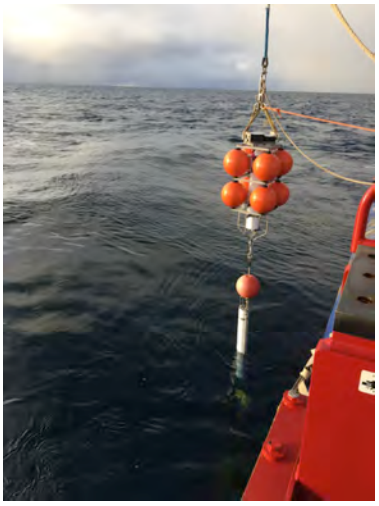
Hydrophones on moorings: Hydrophone packages (Multi-electronique Aural M2) were deployed on 3 moorings up80w, up120w and up120E. The western instruments were programmed to record for the first 25 min each hour at a sample rate of 16384 Hz for a bandwidth of 10 Hz-8192 Hz and were programmed to start on 1 September 2017 at 0000 GMT. The instrument on up120E was programmed to start recording on 7 September 2017 at 0000. On this duty cycle, all three instruments should record at least through 15 September 2018. For 2018, the design of the moorings with hydrophones needs to be altered so that there is more space between the sensor and the instrument table above. It is also recommended that rather than stainless steel chain, line be used to mate the different elements of the mooring.

The moorings will be retrieved, data recovered, and moorings re-deployed during the second year of the project.

Table 3. Names, equipment, and deployment location information for the four moorings.

Mooring Name	Instrumentation	Location	Deployment Depth
UPW 80	ASL Acoustic Zooplankton Fish Profiler, AURAL	71° 14.670'N 150° 32.750'W	80 m
UPW 120	300 kHz ADCP, SBE37SMP Microcat, AURAL	71° 16.000'N 150° 41.640'W	108 m
UPE 80	300 kHz ADCP, SBE37SMP Microcat	71° 11.673'N 148° 43.424'W	80 m
UPE 120	300 kHz ADCP, SBE37SMP Microcat, AURAL	71° 12.338'N 148° 48.018'W	122 m

Figure 10. Deployment of mooring UPW 80 just prior to being released. Photo: Lisa Seff



Phytoplankton Biomass and Community Composition and Nutrient Availability- Kate Lowry

The objective of the phytoplankton sampling was to calibrate the chlorophyll *a* fluorescence sensor on the CTD rosette for the characterization biological properties across the shelf, shelf-break, and upper slope. In addition to this planned work, a rigorous analysis of phytoplankton community composition was also undertaken. The goal of this opportunistic sampling was to observe changes in phytoplankton community structure across the shelf-break and in response to biophysical forcing, since variation in phytoplankton assemblages may play an important role in driving marine ecosystem dynamics and biogeochemical cycles. As part of the phytoplankton sampling, nutrient availability was also assessed to understand the bottom-up controls on phytoplankton in

our study area. Future work will aim to relate phytoplankton abundance and community structure to observations of zooplankton, fish, seabirds, and whales.

At 55 stations where net tows were performed, seawater was collected for phytoplankton analyses from two depths (surface and subsurface chlorophyll maxima) using the CTD rosette. Water samples were analyzed for total and small size-fractionated (<20 µm) chlorophyll *a* concentration using standard filtration protocols (25 mm GF/Fs; <5 Hg vacuum pressure; extracted in 90% acetone for 24 hours in dark at 4°C; solid standards and blanks analyzed regularly) and a Turner Designs 10-AU fluorometer. A total of 675 filters were analyzed to yield chlorophyll *a* concentrations for 225 triplicate samples, resulting in measurements at two depths and two size fractions for each station sampled. A few additional samples were collected and analyzed from the ship's underway system during transit. The relationship between preliminary discrete chlorophyll *a* concentration and the sensor fluorescence data is shown in Fig. 11.

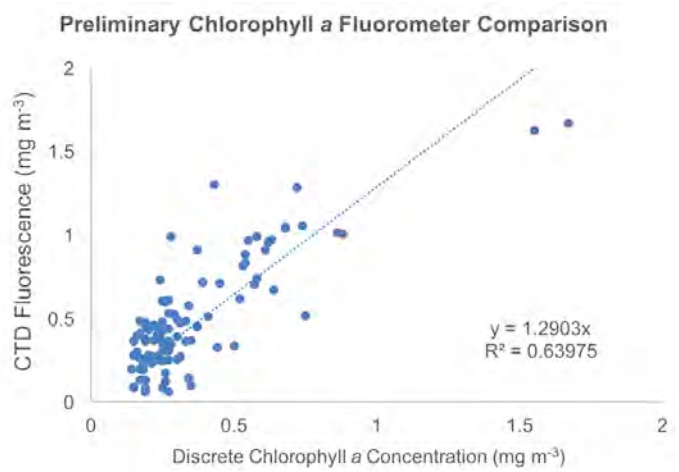


Figure 11. Comparison of discrete chlorophyll a concentration measurements versus CTD fluorometer data for sensor calibration.

At the same 55 stations, seawater was also collected at the surface and subsurface chlorophyll maximum to assess phytoplankton community composition. Two instruments were brought on board for this purpose: a Flow Cytometer (Accuri C6; loaned to the project by the WHOI Biology Department) and a FlowCAM (Fluid Imaging Technologies; loaned to the project by the NSF United States Antarctic Program). The picoplankton and nanoplankton (<20 µm) community was assessed via flow cytometry. Samples were pre-filtered using 100 µm Nitex mesh to remove particles that could clog the instrument flow cell and run for three minutes on fast. Cell-sorting setup beads were run daily to verify that there was no instrument drift and validate the collected data. The microplankton community was assessed via FlowCAM imagery. Samples were pre-filtered and run at two different magnifications (100x and 40x), which corresponded to imaged particle sizes of up to 100 µm and 300 µm, respectively. The FlowCAM was set to run 5 mL of seawater sample at each magnification, which took ~33 minutes for 100x (0.15 mL/min) and ~10 minutes for 40x (0.5 mL/min). Additional FlowCAM imagery was collected from the ship's underway system at 27 locations. Example FlowCAM images are shown in Figure 12. FlowCAM imagery will be analyzed using EcoTaxa.

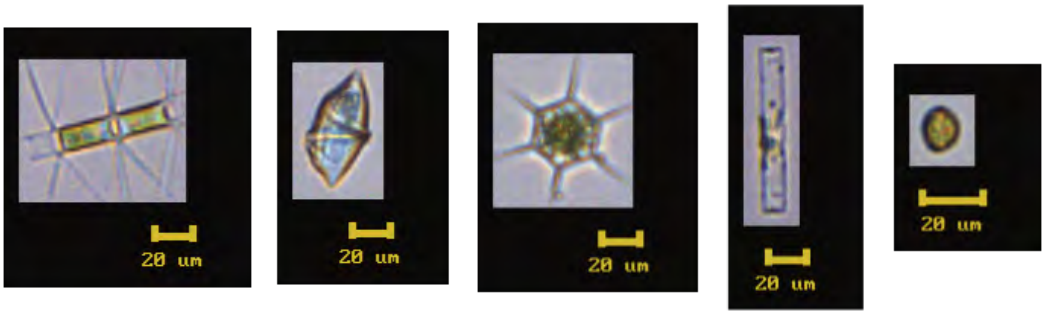


Figure 12. FlowCAM images: Chaetoceros, Gyrodinium, Dictyochales, Leptocylindrus, and Small Unidentified Phytoplankton

Additional phytoplankton samples from 44 stations at the same two depths were collected onto Sterivex filters using a peristaltic pump with a large sample volume (~4 L) and flash-frozen at -80°C for post-cruise DNA analysis of diatom species composition in collaboration with researchers at Old Dominion University (P. Dreux Chappel and M.S. Student Sveinn Einarsson).

Nutrient availability in the water column was assessed at 160 stations with an optical nitrate sensor (Suna V2; loaned to the project by Amala Mahadevan at WHOI) to estimate concentrations of nitrate, the primary limiting nutrient in the Arctic Ocean. The sensor was deployed on the CTD rosette and powered with an external 51 Ah battery pack. Depth profiles of nitrate were created based on UTC time recorded by the sensor and the CTD. Two sections of nitrate are presented in Fig. 13, illustrating observations made before (Line 2a) and after (Line 2b) an upwelling event. Nitrate availability was greater in the upper 100 m near the shelf-break (~71.35°N) following upwelling as compared to measurements before the storm two days earlier. At 12 stations, water samples from 4-6 depths were taken for analytical nutrient measurements to calibrate the nitrate sensor; post-cruise analysis at Oregon State University is through in-kind contribution by Laurie Juranek, the chief scientist of the previous trip on *R/V Sikuliaq*.

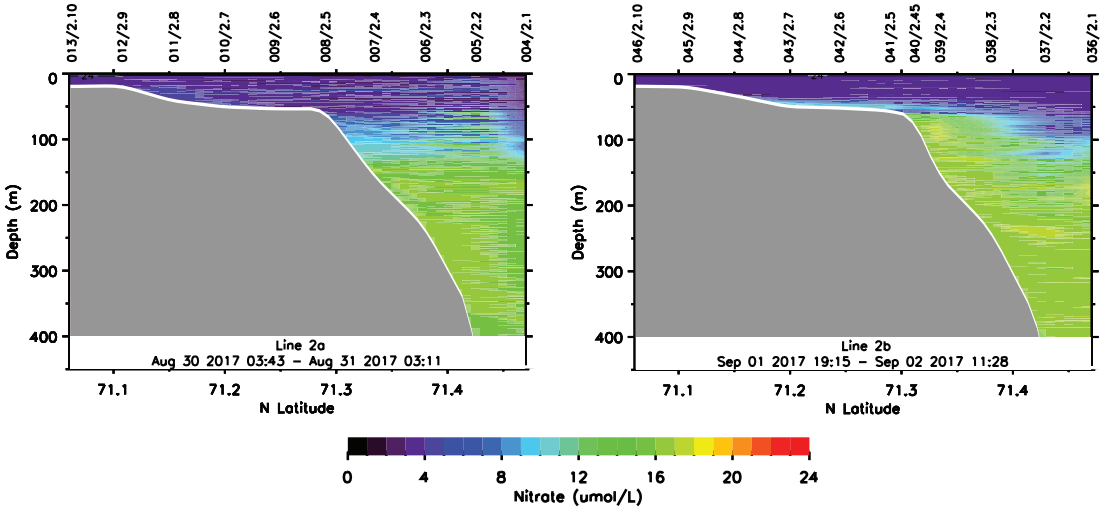


Figure 13. Nitrate concentration assessed on the shelf, shelf-break, and offshore waters with Suna V2 during repeat occupations of Line 2. More nitrate was available in the upper 100 m near the shelf-break following the upwelling storm event.

The phytoplankton sampling described above was conducted at 4-5 stations per transect spaced 10 km apart along eight hydrographic sections across the shelf break of the Beaufort Sea. This transect sampling included five occupations of Line 2, which we sampled before, during, and after two separate upwelling storm events. Phytoplankton sampling was also conducted during two occupations of Line 4 and single occupations of Lines 5, 6, and 7. Comparing phytoplankton and nutrient concentrations between transect lines and during repeat occupations under different biophysical conditions will contribute to an improved understanding of how the phytoplankton community is influenced by shelf-break upwelling and the physical environment. Similar phytoplankton and nutrient measurements were made at three stations along Distributed Biological Observatory (DBO) Line 6, located west of our study region.

An unexpected finding of the phytoplankton sampling was the presence of the potentially toxic dinoflagellate *Alexandrium* spp. at three stations and several underway sampling points, as demonstrated by the FlowCAM imagery (Fig. 14). We observed *Alexandrium* spp. in relatively warm waters (4.5-5.5°C) at the Test Station (001) at 71°46'N and 153°20'W and again at Station 013, located in-shore at 71°04'N and 151°14'W. Interestingly, we returned to the same location of Station 013 on four different occasions and found somewhat cooler waters (e.g. 2-3°C) without *Alexandrium* despite its clear dominance during our first occupation. We also observed *Alexandrium* spp. across a rather large spatial area on our way out of sampling area (Station 183 at 71°48'N and 153°12'W and at all nearby underway sampling points, all in 4-5°C water). Two dozen individual cells were isolated from seawater at this location and transported by plane in a cooler for possible future work at WHOI if the cells remain viable.

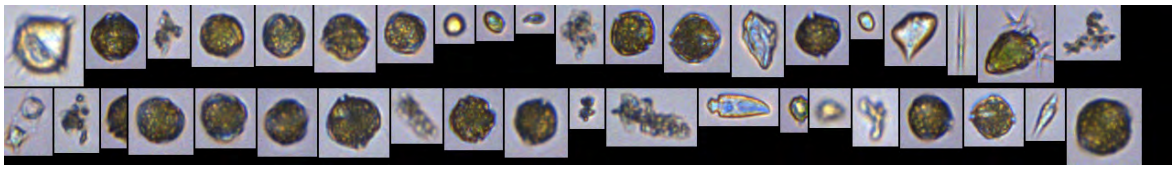


Figure 13. FlowCAM imagery revealed observations of water dominated by Alexandrium spp., a potentially toxic dinoflagellate.

Zooplankton – Bob Campbell, Phil Alatalo, Celia Gelfman, Kristina Kvile

The main goal of the zooplankton component was to determine the effects of wind-induced upwelling on zooplankton distribution, abundance, community composition, and condition. Zooplankton were collected on transect lines perpendicular to the coastline bathymetry from the basin (>1000-m) to the inner shelf (~20-m) and at other selected stations in the study area.

Three net systems for collecting zooplankton were utilized on the R/V Siquliak. At designated stations, a bongo-net equipped with both 150-um and 500-um mesh nets was deployed from the stern. The 60-cm diameter nets were equipped with a single strobe, used to blind krill and other fast-swimming zooplankton that can avoid the net. Tows were conducted between 20 and 300-m, depending on station bottom depth, at rates between 10 and 50 meters a minute, effectively sampling the water column for 10 to 15 minutes in most cases. A double oblique tow was executed in waters approximately 20-

m deep; all other tows were single oblique tows to 5-10 meters off the bottom or 300-m maximum depth.

The Tucker Trawl sampled a 1-meter square area with an opening/closing net system consisting of 3 nets of 500-um mesh. Like the Bongo Net system, the Tucker had 2 strobes mounted on its head rail to blind potential targets. The first net sampled the entire water column from surface to the target depth, while nets 2 and 3 sampled the bottom and top sections respectively. Often depths were selected by referring to the EK60, which showed scattering layers of zooplankton. Depths were estimated using wire angle and typical bottom targets were 5 to 10 meters off the bottom or 300-m maximum. Brass messengers sent down the towline were used to trip the nets at their respective depths. At shallow depths of about 20-m, only one net was used to capture zooplankton. Tow times were based on the same rates as above.

Lastly, a 1-meter ring net was used to gently collect zooplankton, mostly for live collections. These tows were vertical tows, using a weighted cable to which the net was attached. Mesh size for the ring net was 150-um. Tows did not descend below 100-m and were towed slowly at 10 to 20-m/min in order to minimize damage to organisms.

A total of 37 Bongo hauls, 65 Tucker Trawls and 4 ring nets were completed and sampled for animals (Table 4). For all net tows, any artic cod present were removed for analysis by the Llopiz laboratory. All samples were preserved in 5% formalin/seawater, following selected removal of target organisms for morphometric analysis, carbon and nitrogen content, ^{13}C and ^{15}N stable isotopes, and genetics (Table 5). The target organisms are abundant taxa, which are potentially important prey species for Arctic cod, and included copepods (e.g. *Calanus glacialis*, *Calanus hyperboreus*, *Metridia longa, Paraeuchaeta* sp.*)*, krill (*Thysanoessa raschii*, *Thysanoessa inermis*), and unidentified amphipods and benthic larvae. Before drying specimens in a drying oven (animals selected for isotope and carbon/nitrogen analyses) or preservation in ethanol (animals selected for genetic analyses), animals were photographed using a microscope-mounted digital camera. These pictures will allow the determination of the size of the animals and, in the case of the large copepods, the lipid sac volume.

Table 4. Total number of stations sampled with each net type.

	Stations
Bongo Net	37
Tucker Trawl	69
Ring Net	4

Table 5. Total number of samples collected.

	Stations	Samples
C/N, Stable Isotopes, Morphometrics	38	2536
Formaldehyde Preserved	62	326
Ethanol Preserved	23	49

A preliminary qualitative assessment of the samples shows the response of the zooplankton communities along the transect lines to periods of upwelling (Figures 14, 15). Over the course of a 12-day period, we encountered two, approximately three-day

periods of winds from the easterly quadrant that produced upwelling conditions. These upwelling periods were separated by about a 4-day period of non-upwelling winds when conditions relaxed. During this time frame, we conducted 9, cross-shelf transects. Under relaxed or early upwelling conditions, offshore and coastal communities were separated at the shelf-break between waypoints 4 and 6, at about 50 to 150-m of water depth (Transects 2A, 2C, 2D, 4B). The offshore communities residing in cold winter water between about 100 and 150-m began to move up and onshore after only about 1-day of upwelling winds (Transect 4A), and after about 2 days of upwelling conditions the offshore communities had moved to our innermost shelf stations, about 20 m in depth (Transects 2B, 5A, 2E). When upwelling winds relaxed, offshore communities retreated back to the shelf-break after about 2 days and remained there until another period of upwelling started (Transects 2C and 2D). A brief one day relaxation in upwelling winds was not long enough to cause offshore communities to retreat to the shelf break on Transect 7A. It appeared then that offshore communities started to respond to upwelling conditions after a 1-day time lag and after only 2 days of upwelling these communities completely occupied the shelf up to and including our innermost stations.

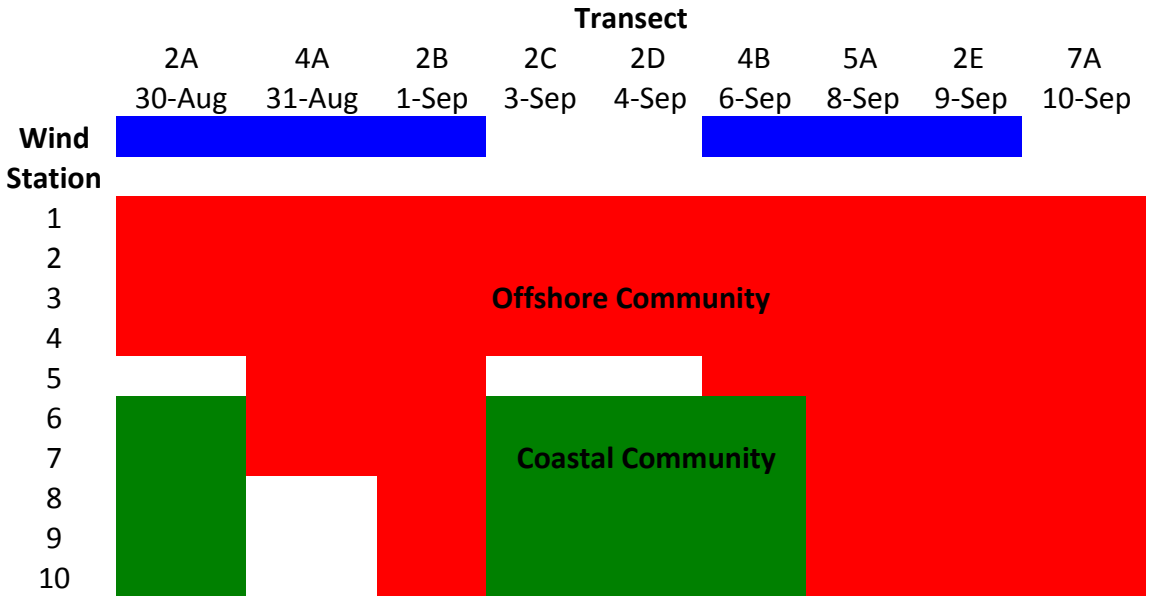


Figure 14. Zooplankton community composition along transect lines during upwelling and non-upwelling conditions. Transect lines are shown along top of figure with line number, date of transect start, and wind conditions (blue=upwelling, white=non upwelling). Waypoint location is shown on side, from 1=furthest offshore to 10=nearshore. Water that is dominated by offshore plankton (Calanus spp., Euphausiids, Paraeuchaeta spp., Metridia longa) is shown in red and by coastal plankton (Pseudocalanus spp., benthic larvae, Oithona similis, Acartia spp.) is shown in green. Gaps in sampling indicated by white.

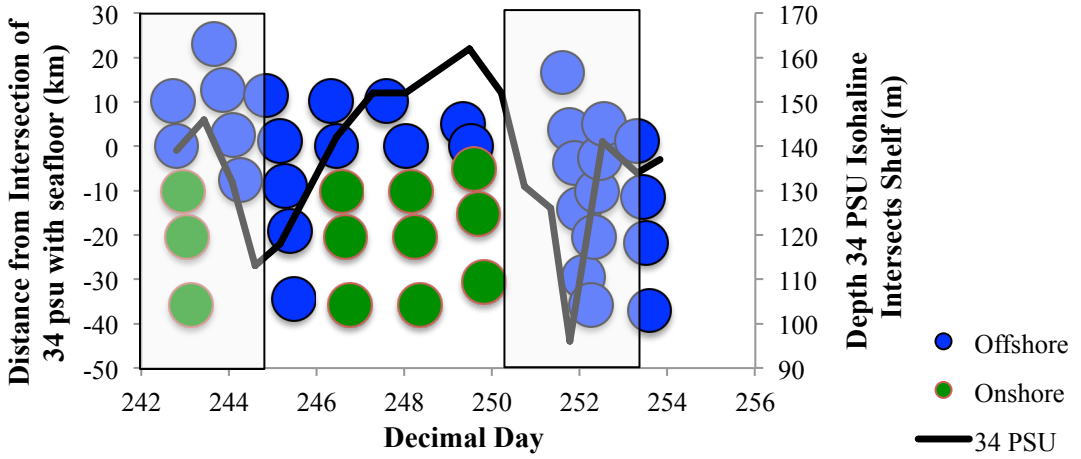


Figure 15. Type of plankton community at each station. Each station is plotted as a function of time (horizontal axis) and the distance along each transect from where the 34 PSU isopycnal intersected the sea floor (left vertical axis). Periods of upwelling winds are shown by the shaded boxes. Upwelling of water (black line) is indicated by the depth at which the 34 PSU isopycnal intersected the seafloor (right vertical axis), so that shallow depths indicate elevation of the isopycnals during upwelling.

In addition to the analyses described above, WHOI postdoctoral scholar Kristina Kvile initiated a separate study onboard R/V Siquliak, specifically targeting *Calanus hyperboreus* females sampled with the Bongo hauls and Tucker Trawls. She picked and photographed around 450 individual females to determine their size, lipid content and gonadal stage. A subsample of around 100 individuals was preserved in RNAlater in individual vials, and will be analyzed for RNA:DNA ratio. The goal of this study is to investigate if females who have already spawned (and have "spent" gonads) appear to accumulate lipids (have high lipid content and high RNA:DNA ratios), indicating that they prepare for a second spawning season. It is currently unknown to which degree Arctic *Calanus* populations display iteroparity (females being able to spawn subsequent years), and this study could therefore add to our knowledge of the life-history of this keystone species in Arctic marine ecosystems.

Fish Sampling – Joel Llopiz, Mike Lowe, Chrissy Hernandez, Jennifer Johnson, Justin Suca

Trawl net sampling summary

In total the "Fish team" performed 16 midwater trawls, with an average tow time of 1 hour and 49 minutes for all tows (including deployment and retrieval time). While towing, the ADCP OS150, 5 frequencies of the EK60, and EM302 multibeam were collecting data to pair with the trawls. Two TDR's were placed on the head rope and foot rope of the net to view and record the depth profile after each tow and to be able to calculate the mouth opening height.

The team performed a variety of tows both shallow and deep. We found that a real-time sensor relaying net depth during the operation is essential for successful tows that target fish layers, and to ensure that the net would fish where we wanted it to fish (based on the EK60) but also not hit the bottom. The net rarely did what we thought it was doing

due to the fact that it was highly sensitive to ship speed and current variability with depth (details below). Next year we think at the very least we could use the .680 wire with a SeaBird at the termination to provide real-time depth information. We would still use a TDR on the head and foot ropes and use the relationship between these values and the termination/SeaBird depth from the first couple of tows to know exactly where the net was fishing. This would be a major improvement to our ability to get close to the bottom (where more fish are, including the largest ones) without hitting the bottom. It would also allow us to experiment with fishing different layers of fish (e.g. those on the bottom vs. those in the water column) to see if depth differences are associated with feeding behavior.

Trawling on the *R/V Sikuliaq* - Lessons learned

Equipment: Having performed these tows on the R/V *Armstrong*, the R/V *Sikuliaq* and its equipment were slightly different. The A-frame and A-frame blocks were different sizes on the *Sikuliaq*—the A-frame being taller on the *Sikuliaq*. After an adjustment period, deployments were as quick and smooth as desired. Line lengths (e.g. drum idlers, tow bridles) were all suitable. The spacing of the Gifford blocks used in recovery was slightly asymmetrical, which affected the smoothness of the recovery a bit and the evenness of the lines on the TSE winch, which made the next deployment a little uneven. However, the doors generally entered the water together and began to spread immediately. For the record, the upper door legs were attached to the most aft hole on the upper edge of the door, and the lower door legs were attached to the third-most-aft hole of the lowest row of holes.

We used the A-frame winch with a quick release to pull the net out and over the water during deployment, and this saved time and effort, but the team had to be cautious to prevent twists and balling of the net while being dragged across deck. The first grab point was in the middle of the cod end, and a necessary second pull of the net was from a little aft of the mouth. We usually did not need to use the A-frame winch for the recovery, unless there was some mud in the net. In these cases, it was extremely helpful to hold the cod end up by the winch while we dragged it behind the ship to rinse most of the mud out prior to bringing on board.

On retrieval, after detaching the single warp bridle, we took a minute to remove the bridle from the termination, feed the termination up through the block with the fair-lead line, and get the tow wire completely out of the way of the TSE winch. We then didn't bother taping the 6-foot sections of the tow bridle that were attached to the single-warp bridle, and instead let them go up through the Gifford blocks loose. This worked out well and was safer. We then taped them right before they were spooled on the TSE.

We found the deck tuggers were necessary for retrieving and securing doors on deck, and the A-frame tuggers were also often needed when the angle of the net was off center during recovery or a door needed to be moved slightly amidships. The general procedure for recovering the doors was to use the TSE winch (and the A-frame in/out) to hang the doors just above the edge of the transom, then attach the deck tuggers and use them to pull the doors as close to the chains as possible, attach the chains, then slack up on the tuggers and TSE. If the doors (usually the port door) were too close to the railing by the A-frame, then the starboard A-frame tugger or the starboard deck tugger (if the starboard door was secured) could be used to pull the port door amidships before lowering.

Vessel Speed and Heading: The trawl net was extremely sensitive to its speed through the water. Our initial tows at 2.5-3 knots resulted in the net flying much higher in the water column than predicted (or desired). Thus, on one of our following attempts we let out too much wire in conjunction with slowing the ship down and we dragged the net along the bottom (another tow along the sea floor was due to the doors crossing just after deployment because the ship was slowed down to ~1 knot and kept there for a while before beginning to pay out). Some scenarios we tried in order to fly the net at the desired depth included:

1. Vessel speed is a bit faster while wiring out, then slow to tow speed (2 knots over ground).
2. Vessel speed is a bit slower while net is descending and go deeper than targeted layer, then bump up the tow speed (3 knots over ground).
3. Stay at a consistent speed during descent and towing (2 knots over ground, taking into consideration current variability with depth).

In order to eliminate one variable, most tows were performed with the third method, in an attempt to decipher the effects of various other factors. Speed during deployment and recovery of the net was 1.5 knots through the water, with situational changes. Regardless of the method we chose to get the net at targeted depth, it was important that once the doors were in the water, the ship maintains sufficient speed. If slowed, the doors could collapse. It was also best for the thrust from the props be directed astern during deployment and recovery to help with trailing the net and preventing the cod end from going into the props. Once the net is in the water, ship speed must not slow to less than 1.5 knots.

With the fish holding tight along specific isobaths on the steep part of the shelf break (usually ~250-300 m of water depth), the only fruitful way to tow was along the isobaths. If wind speeds are somewhat high (15-20 kts), setting up for the tow into the wind is critical. But this isn't always the best heading for towing along the isobaths (though we often got lucky and it was a good heading). As a result, for some tows we had to find the right balance, or plan for a slight turn of the ship once the net was near the desired depth. On one of the first tows, we deployed not fully into the wind, and as the ship was blown to the side, the net streamed off at an angle; in order to correct for this, the ship was pointed even more downwind. By the time the net was in the water, we had to make a rather large turn that wasn't planned. This turn was gradual enough to not collapse the doors. But it did take a long time to get back on track. With the net so sensitive to speed through the water, and the turn slowing down the net relative to the ship, we saw in the TDR data that the net went much deeper than expected. Overall, gradual turns seem to be fine, and we now know how the net responds to the slower speed it experiences during a turn and can respond to it.

Currents were generally slow (~0.5 kt), but still impacted the way the net would fly. We towed both into and along with the prevailing surface current. Going with the current, our effective net speed through the water had to be considered when predicting net depth based on wire out and angle. Towing into the current, we had to also be mindful of the net speed through the water, and did occasionally slow the ship down. More common was a change in current with depth. Often there was little current at the target depth, and so we kept the ship at 2.0 kts over ground. On a few tows, we were towing into the surface

current and then with a following current at depth. This change in current direction had the effect of pushing the down closer to our desired depth.

The general approach for planning for a trawl location was to first look for a good location and isobath to tow along, and then consult with the bridge on *our* desired course for the tow and *their* desired heading of the ship during deployment. If winds were light, we usually opted to deploy into the surface current. Heavier winds were usually in the same direction as the surface current. Upon determining a deployment heading, we gave the bridge three waypoints: one for beginning the deployment (the location where the ship can begin going 1.5 kts, which was once the net is ready to be released from the A-frame winch), one for the target beginning of fishing (with net not only deployed but also at/near the target depth), and one for a target end of fishing. With light winds and waves, these three waypoints were in line with each other. If the bridge wanted to deploy with a different heading than the desired course for the tow, we would deploy, get the net to a reasonable depth and then make a gentle turn.

Wire out: We calculated our predicted net depth based on the angle and length of the tow wire. Wire angle was measured during each tow when we reached our initial target length. The angle remained a consistent 45-50 degrees, regardless of the catenary in the line (which was often high or negligible, based on the TDR data). The wire was zeroed out when the termination was at the surface. It's worth noting that right before the termination went into the water, we made sure the bridle was still spread out—on one occasion, one of us noticed there being no spread right before it went under, and we should have brought it back up to check. After the tow we found that the doors were twisted the whole tow and we dragged the package along the bottom.

Tension on the tow wire was displayed inside the computer room in real time. The tension reading displayed trends that would (to some extent) help to decipher whether the doors were open and what the net might be doing. At 2 kts STW and no winch speed, tension was ~3000 lbs. This value could range from ~1500 to 5000 depending on the STW and pay out/haul in speed. When we did hit the bottom, it was not evident from the tension (e.g., a spike or a paired spike and drop), but it was consistently ~1800 lbs as we dragged bottom and then quickly climbed to above ~6000 lbs as we lifted all the weight off the bottom upon beginning recovery. When towing on the *Armstrong*, there was an average six thousand pounds of tension when the net was towing correctly, but we had much larger doors, which also allowed us to tow faster. If we want to tow any faster than 2.0 kts next year, we may have to consider larger doors. At the very least, some real-time knowledge of where the net is in the water column would allow us to fish the given setup at 2.5 kts (and having a lot of wire out—likely around 3-3.5:1). It is doubtful that 3.0 kts is possible, which could limit our ability to collect larger, faster fish.

Catch results

Trawl net

We targeted arctic cod (*Boreogadus saida*) at 15 stations, thus the below information excludes the few fish from the test station at the western edge of the Beaufort.

- Total number of trawls: 15
- Total number of arctic cod caught in trawl: 3649

- Minimum length measured (we did not measure the smallest ones): 45 mm
- Maximum length: 288 mm
- Total Number of fish measured: 752
- Number of stomachs sampled: 273
- Number of livers sampled: 185
- Number of muscle tissue samples taken: 195
- Number of heads for otoliths: 195
- Number of individual fish frozen whole (measured, then frozen in a bag with a label): 158
- Number of RNAlater samples for RNA/DNA ratios: 281
- Postlarvae frozen from midwater trawl: 169
- Slightly larger fish (~Age-1) frozen whole from midwater trawl: 187

Based on the size distribution of the catch of many other studies—which often have only very small arctic cod—we are excited about the few very large specimens we obtained (Figure 16). Upon dissection, it was evident that many of the larger individuals were observed to have other arctic cod in their stomachs. Notable is that arctic cod have not been generally thought of as being cannibalistic, perhaps because of the small individuals that dominate other studies. We can attribute our larger fish to two likely reasons: accidentally trawling along the bottom on two occasions (and touching the bottom on two others), and the use of a comparatively large net that reduces net avoidance. It also likely that the focus upon the steep slope area in 250-300 m of water, where dense aggregations of arctic cod near the bottom were, is also novel when compared to other studies. We did conduct two tows that were well offshore in ~1000 m of water where we saw a broad, less dense band of cod at 200-300 m, and the catches from these tows were noticeably lighter and with a small size distribution. Other specimens enumerated from the midwater trawls (from water column tows only):

- 22 fish that we believe to be *Arctogadus glacialis* (frozen for later analyses)
- 9 snailfish
- 5 myctophids
- 34 shrimp
- 1 sculpin

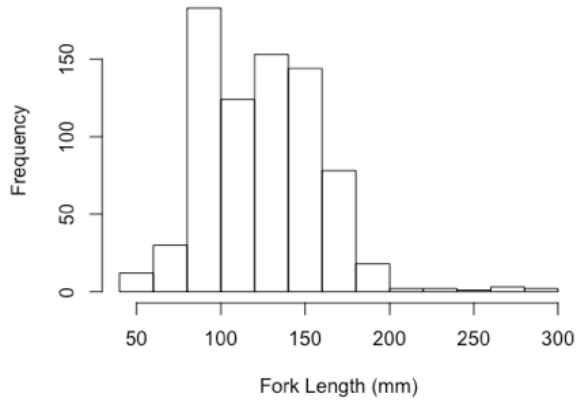


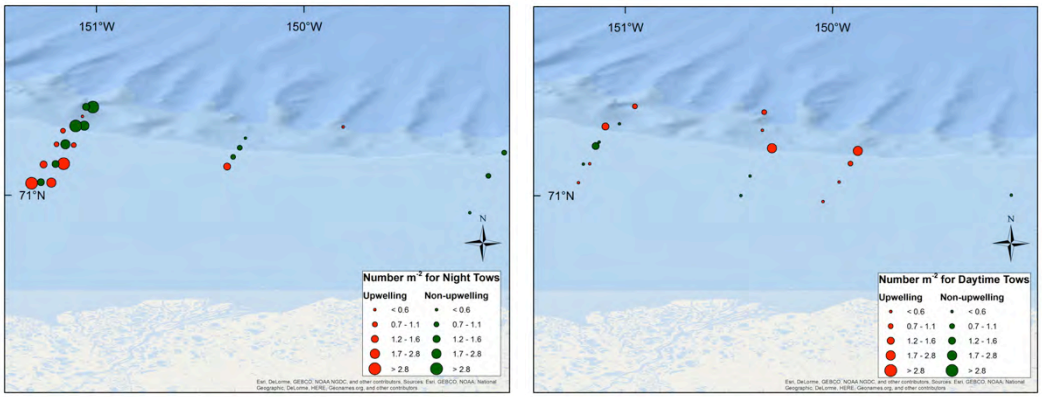
Figure 16. Length-frequency distribution of the 752 measured arctic cod from 15 midwater trawl net tows.

Arctic cod from plankton tows

In addition to the catch from the trawl net, many arctic cod larvae and postlarvae (~10-50 mm) were collected in the plankton nets. Essentially all of them were pulled (most were alive) and frozen at -80°C. The total number of larvae and postlarvae was 1080, and broken down by net was:

- Tucker Trawl: 895
- Bongo: 170
- Ring Net: 11

Higher catches during night tows were clearly evident (compare left with right panel of Figure 17), which is expected and due to greater net avoidance during the day when these capable swimmers can see the net coming. There was also some indication that during upwelling periods (with a 1-day lag), larval abundances were higher over the shelf than over the shelf break, with the opposite pattern occurring during non-upwelling periods (Figure 17 (left)—the nighttime catch being the most appropriate for making this comparison). Thus, it appears that larvae are transported onto the shelf during upwelling events. What this means for their feeding, growth, and survival is an interesting question that we should be able to answer. Another open question is whether these larvae, once transported on the shelf, stay on the shelf and "settle" here. How would overwintering in this habitat during their first year—a potential bottleneck for recruitment to later stages—differ from more offshore habitats? Answering this question would be a significant contribution and, as such, we should devote some time next year to sampling age-1 fish (and the other ages) on the shelf with the trawl net.



Fiure 17. Nighttime (left) and daytime (right) larval abundances by location along the Beaufort shelfbreak region. Circle size indicates larval abundance. Red corresponds to larvae collected during upwelling periods (with a 1-day lag) and green circles are for non-upwelling periods. The western-most transect has locations slightly offset for clarity (since it was sampled several times).

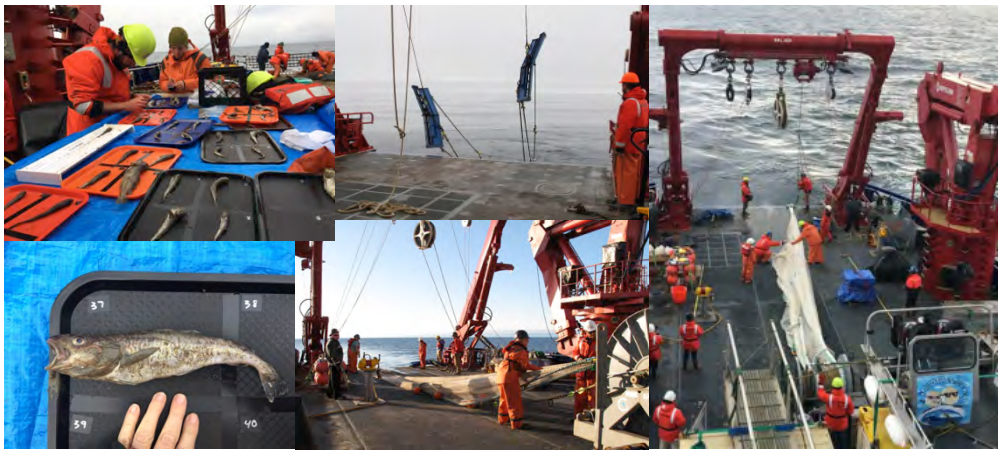


Figure 18. Clockwise from top left: Sorting fish, doors coming on board, fish trawl being deployed, deploying fish trawl, a large Arctic cod.

Detection of Zooplankton and Fish using the Sikuliaq Multifrequency Sonar (EK60) – Mike Lowe and Jennifer Johnson

The *Sikuliaq's* EK60 was calibrated well in advance of SK201713s on May 14th, 2017 in Port Madison, WA using the standard sphere method. The EK60 is equipped with five different frequencies (18, 28, 70, 120, and 200 kHz) and uses EK80 software with the installed transducers. During the cruise, the EK60 was set to ping and record data continuously during both day and night operations. Bottom detection was turned off and the maximum ping rate was used for the duration of the cruise. However, the EK60 was synched (using K-sync software) to the EM302 and ADCP OS150, which resulted in slower ping rates in deeper water (> 200 m).

Two configurations were used during the cruise. "Survey mode" used a 1.024 mS pulse duration and 600, 600, 525, 125, and 90 W power settings for the 18, 38, 70, 120, and 200 kHz transducers, respectively. This configuration allowed the EK60 to survey the water column for scattering layers of interest while maintaining vessel speeds ≥ 3 kts.

"Target strength mode" was used to provide high resolution acoustic data (i.e., individual targets) to be paired with the various net data for the development of taxon-specific scattering models. This mode was primarily used when the vessel was using dynamic positioning to maintain a location or towing small nets at low speed (< 3kts). Pulse duration and power differed among the 5 channels; 18 kHz (0.512 mS, 1000 W), 38 kHz (0.256 mS, 1000 W), 70 kHz (0.256 mS, 750 W), 120 kHz (0.256 mS, 250 W), and 200 kHz (0.256 mS, 150 W). In this mode, interference was noted in the 38, 120, and 200 kHz frequencies. The source of the interference in the 38 kHz channel remains unknown (mostly sub-bottom) while the ADCP (150 kHz) was the presumed source of interference in the latter channels. On several occasions during the latter stages of the cruise, power settings were increased to maximum (2000, 2000, 750, 250, and 150 W) for each channel and we noted continued interference in the 120 and 200 kHz channels, though noticeably reduced. This was done to collect data that could be matched to settings during the calibration.

Several patterns were noted for acoustic scattering during the cruise. First, a wide range of scattering intensities (-40 to -70 dB) were regularly observed for all frequencies in surface waters (≤ 100 m) throughout the area of operation (Figure 19). Visual observation and net collections indicate that this mixed scattering was comprised of jellyfish (presumably, the large scyphomedusa *Chrysaora melanaster*), zooplankton (both Calanoid copepods and Euphausiids), and young-of-year Arctic cod (≤ 50 mm TL). Second, strong scattering layers, consistent with zooplankton, were frequently observed in both the 120 and 200 kHz channels at depths ranging from 100 to 170 m water depth in the slope environment (Figure 19). Third, strong, fish-like scattering was consistently observed near the bottom in 200-300 m of water when transiting across the slope environment (Figure 20) and extending well into the open water (Figure 21). Multiple trawl samples confirmed that this scattering was likely attributed to high densities of large Arctic cod (> 100 mm). Lastly, on September 11, 2017 we located a dense fish aggregation on the slope in 280 m of water (71.216, -149.199). We used the ships dynamic positioning system to hold the ship over the aggregation for 13 hours (from 1900 to 0800; 2 hours before sunset and after sunrise) to look for diel vertical migration behavior in the aggregation. Starting around 2000, the aggregation began moving up in the water column (Fig. 21) and extended from the bottom to 97 m by 2300. The aggregation had moved back down to its daytime depth habitat by 0800 the following morning.

Recommendations for year 2 of field operations would include 1) allocating more time for additional DVM observations and 2) using higher power settings in "target strength mode" to eliminate crosstalk between the EK60 and the ADCP.

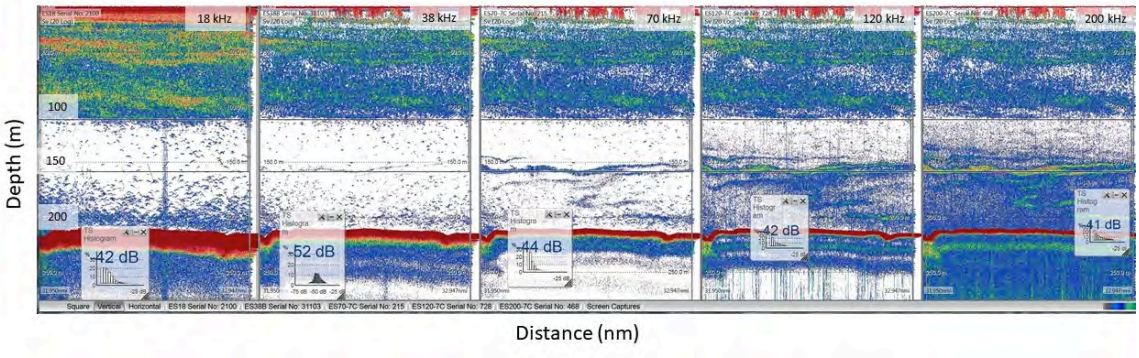


Figure 19. Raw acoustic backscatter during bongo net operations on transect line 2 (08/30/2017 2100 UTC (1300 ADST); 71.346, -151.035) in ~210 m of water (dark red band). Surface (< 100 m) scattering was attributed to a mixed assemblage (e.g., small fish, zooplankton, and jellyfish) collected in the nets. A strong layer, consistent with zooplankton, is also observed in the 120 and 200 kHz (two frames on the right) channels at ~160 m. The EK60 was in "target strength mode" during this operation. Backscatter grades from high (red) to low (white) concentrations.

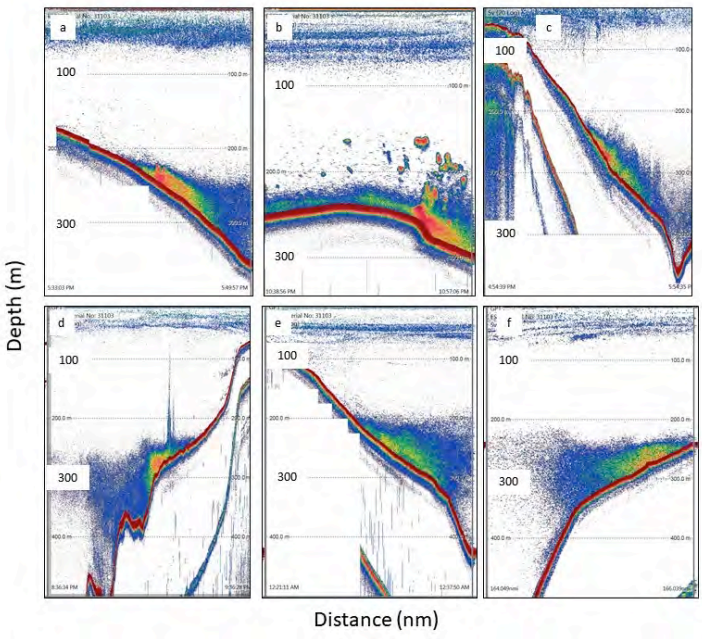


Figure 20. Raw acoustic backscatter from the 38 kHz transducer during six different shelfbreak crossings; a) 09/02/2017 1750 UTC, b) 09/02/2017 2257 UTC, c) 09/05/2017 1754 UTC, d) 09/09/2017 2136 UTC, e) 09/10/2017 0037 UTC, and f) 09/11/2017 0226 UTC. Backscatter grades from high (red; many fish) to low (white; few fish) concentrations and highlights dense aggregations near the bottom of the slope environment. The relative change in bottom topography (dark red band) reflects the angle at which the ship crossed the slope and the actual gradient of the slope. The EK60 was in "survey mode" during these shelfbreak crossings.

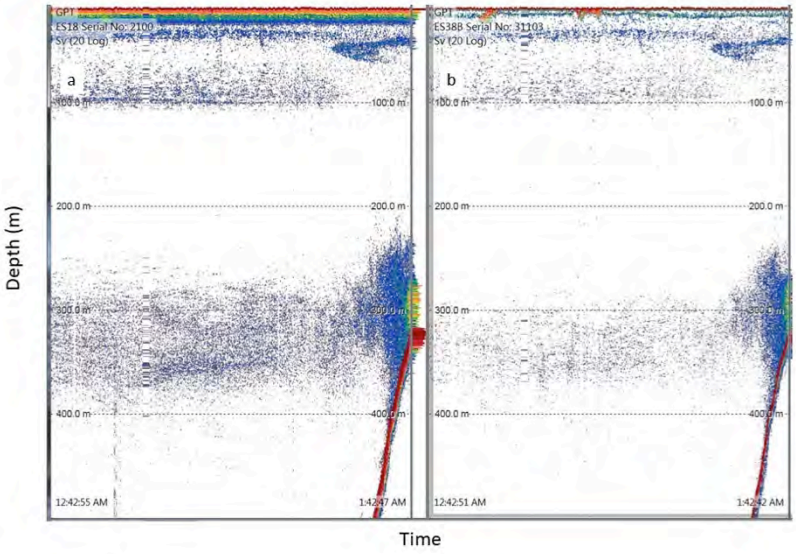


Figure 21. Raw acoustic backscatter from the a) 18 and b) 38 kHz transducers during a shelfbreak crossing that extended well into the open water environment. Backscatter grades from high (red; many fish) to low (white; few fish) concentrations and highlights dense aggregations near the bottom of the slope environment (at 300 m) that extends offshore well offshore (Time on the x-axis translates to approximately 3.5 nautical miles). The EK60 was in "survey mode" during this shelfbreak crossing.

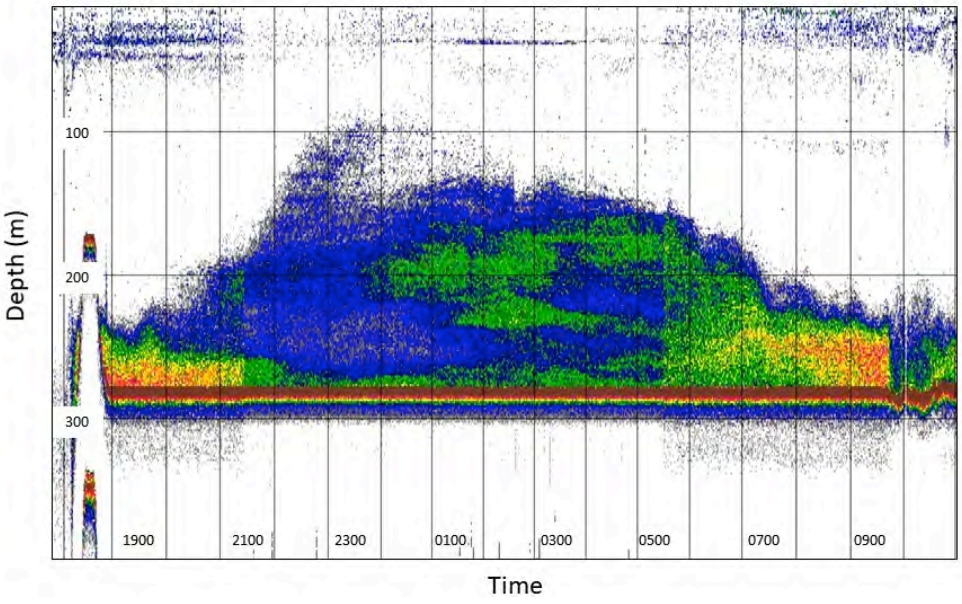


Figure 22. Acoustic backscatter from the 38 kHz transducer during 13 hours of continuous monitoring of a single fish-like aggregation in at 280 m. Backscatter grades from high (red; many fish) to low (white; few fish) concentrations and highlights dense aggregations near the bottom of the slope environment make an extended migration to the upper water column. The EK60 was in "target strength mode" with the highest power settings.

Seabird Observations – Tamara Zeller

Seabird observations were made aboard the R/V Sikuliaq from 25 August – 17 September, 2017 per protocols established by Dr. Kathy Kuletz, U.S. Fish and Wildlife Service. Observations were made from the ship bridge and encompassed a 300 m survey window when going >5 kts. Eighty transects were completed and 120 hr. 12 minutes spent observing birds on transect. A total of 5511 birds were counted while only 4939 were observed in the 300 m survey window. Twenty nine species were observed; 23 within 0-300 m and an additional 7 species of interest > 300 m. Short-tailed shearwaters accounted for 70% of the observations followed by Black-legged Kittiwakes (16%) (Table 6). Sightings of note include 2 Kittlitz's Murrelets in the Beaufort Sea and numerous loons (n=144). In general, the numbers of birds in the Beaufort were low but this may be normal; this data needs to be compared to other years to look for any trends or changes. Most of the birds observed, kittiwakes and shearwaters, are surface feeders and may not have been able to take advantage of the fish and zooplankton that the other scientists were observing as these prey items appeared to be deep in the water column and likely inaccessible to the birds. The species diversity grew when the ship entered the Chukchi and the Bering Strait though overall numbers remained low. There were 4 passerines that landed on the ship as well: Dark-eyed Junco (n=2), Savannah Sparrow, and Lapland Longspur.

Table 6. Bird Species Observed during the ARCSS cruise 25 August – 17 September, 2017

Species	**Number 0-300 m**	**Number >300 m***	**Total**	**%Total (0-300 m)**
Ancient Murrelet	10		10	0.20%
Arctic Tern	41		41	0.83%
Black-legged Kittiwake	802		802	16.24%
Common Eider	8		8	0.16%
Common Murre	39		39	0.79%
Crested Auklet	14		14	0.28%
Glaucous Gull	81		81	1.64%
Horned Puffin	6		6	0.12%
King Eider	0	1	1	0.00%
Kittlitz Murrelet	3		3	0.06%
Least Auklet	12		12	0.24%
Long-tailed Duck	85	71	156	1.72%
Northern Fulmar	55		55	1.11%
Parakeet Auklet	3		3	0.06%
Parasitic Jaeger	21		21	0.43%
Pacific Loon	47	42	89	0.95%
Passerine Species	1	4	5	0.02%
Pelagic Cormorant	4	1	5	0.08%
Pomarine Jaeger	15		15	0.30%
Red Phalarope	28		28	0.57%
Ross's Gull	0	1	1	0.00%
Sabine Gull	35		35	0.71%

Short-tailed Shearwater	3500		3500	70.86%
Snow Goose	0	145	145	0.00%
Surf Scoter	0	1	1	0.00%
Thick-billed Murre	52		52	1.05%
Tufted Puffin	6		6	0.12%
Unidentified Alcid	1		1	0.02%
Unidentified Auklet	2		2	0.04%
Unidentified Eider	0	169	169	0.00%
Unidentified Gull	15		15	0.30%
Unidentified Jaeger	1		1	0.02%
Unidentified Loon	7	137	144	0.14%
Unidentified Murre	11		11	0.22%
Unidentified Phalarope	31		31	0.63%
Unidentified Small Dark Alcid	3		3	0.06%
Totals Birds	**4939**	**572**	**5511**	

*Not all birds off transect (>300m) were recorded - only species of interest.

Marine Mammals Watch - Kate Stafford and Jenny Stern

A marine mammal watch was undertaken by a single observer on the starboard side of the bridge during daylight hours when the ship was traveling at speeds greater than 5 kts, visibility was at least1 nm and sea state was judged to be Beaufort 5 or less. These conditions precluded the majority of underway trackline as fog and/or high winds and seas were common. Additionally, the start-and-stop nature of the transect sampling meant that transits were often less than 3 nm long (Table 7).

In the Beaufort Sea there were only 5 sightings of a total of 6 bowhead whales. These occurred at the southern end of transects. The paucity of bowhead whales is likely due to the study area being well north of the migration corridor and because the voyage time frame was in advance of the main fall migration timing. No beluga whales were seen during the 2.5 weeks of time in the Beaufort. The study area overlaps a high use area for both Chukchi and Beaufort belugas.

The lack of sightings may have been due to overall very poor sighting conditions but is corroborated by the Aerial Survey of Arctic Marine Mammal project, which saw only 2 belugas in the Beaufort Sea in August and September, which suggests that for the second year in a row, beluga whales are not occupying the southern Beaufort Sea.
In contrast to the cetaceans, pinniped sightings were common within 2 nm of the vessel. There were 180 sightings of 320 pinnipeds including bearded seals (32 sightings of 52 animals), ringed seals (39 sightings of 56 animals), walrus (1 sighting of 2 animals) and unidentified phocids (102 sightings of 194 individuals). Tamara Zeller, the bird observer, and Britte Merculief, the community observer, contributed numerous pinniped sightings from the port side of the ship.

During the transits to and from the study area in the Chukchi and northern Bering Sea, gray whales, two humpback whales, one fin whales, unidentified large whales and walrus were seen (Table 8). Overall, there were surprisingly few large whales seen in the Chukchi and northern Bering Seas, however high sea states during the transits to and from the study area likely contributed to the paucity of sightings.

Table 7. Daily distances covered while on effort and mean Beaufort Sea state.

Date	Distance covered	Mean Beaufort Sea state
8/27/2017	30.1	4
8/28/2017	83.6	2.8
8/29/2017	52.3	3.6
8/30/2017	35.6	3.5
8/31/2017	3.3	5
9/1/2017	23.7	3.4
9/2/2017	18.6	2.2
9/3/2017	32.8	2
9/4/2017	17.1	3.1
9/4/2017	6.4	3.8
9/4/2017	0.4	4
9/5/2017	26.7	1.8
9/6/2017	10.5	4.8
9/8/2017	44.9	4.3
9/9/2017	49.5	2.4
9/10/2017	38.9	2.4
9/11/2017	24.5	3
9/12/2017	28.3	4.4
9/13/2017	31	1.8
9/14/2017	22	1.0
9/15/2017	112.3	2.9
9/16/2017	111.6	3.9
9/17/2017	110.2	5.0

Table 8. Species seen during Marine Mammal Watch 25 August – 17 September 2017

Species	Number of sightings
Gray whale	8
Unidentified large whale	20
Humpback whale	2
Bowhead whale	9
Fin whale	1
Walrus	3
Bearded seal	32
Ringed seal	39
Unidentified phocid seal	102

Community Observer Cruise Report - Britte Merculief

The Community Observer is onboard to help facilitate communications between science and subsistence hunters. The Community Observer assisted with communications from ship to shore pertinent to science and subsistence hunting activities. From when hunting commenced to when whales were landed in Nuiqsut and Kaktovik, this information was confirmed with AEWC and passed onto science. The Community Observer kept record of marine mammal observations as seen by the community observer.

During the cruise, there were communication processes noted that could be improved upon. These suggested improvements has been compiled for future cruises to consider. These include pre-season communication processes, in-season communication and mitigation process, and post season discussion of research and any conflicts. These include:

Cruise information provided by on boarding science to UIC be included in binder given to Community Observer as well as electronic copies with a PDF map denoting where vessel proposes to be during whaling subsistence hunts that CLEARLY indicate nautical distance from whaling grounds identified by communities where science activities are anticipated to occur to be given to whaling captains. This will help the Community Observer in communications with subsistence hunters relay the distance from vessel to hunting areas during whaling season for communities within the proposed vessel route.

Timing is critical therefore narrowing the time between crews landing whale, whale landed, AEWC confirmation, and confirmation email to the captain and chief scientist is crucial. When Nuiqsut landed their final whale this fall whaling season, the amount of time taken to receive confirmation from AEWC had placed the R/V Sikuliaq from calm waters to dangerous sea conditions in the middle of an anticipated mooring deployment. Safety became an issue during this trip when the weather turned and the decks on board had to be closed before science could deploy hydrophone moorings. An after-business hours communication plan is not currently in place and may be helpful in terms of planning vessel activities to ensure crew safety and increase cruise efficiency.

Raising awareness in the whaling communities where research is expected involves asking questions. For example, “How can science cruises further engage AEWC and whaling captains of communities when a research vessel has planned activities in whaling areas”? This is a question best addressed by AEWC and the whaling communities. The sensitivity and privacy issues can become an issue with email mailing lists, however an email may be the most effective means of communication. An email with an attached flyer can be passed out and shared with other captains emphasizing: dates of cruise, cruise routes, and distance of planned activities from whaling grounds. The Ashjian Cruise sent out emails with this information pre-cruise and Kaktovik was not included because interest to be included on the mailing list was not expressed.

Additionally, ensuring email addresses are active and telephone numbers are working pre-cruise is necessary as email addresses and phone numbers often change. Although not yet approved, an email specifically for whaling captains informing captains when a cruise is estimated to be within whaling areas and marked as critical may be beneficial in mitigation efforts further improving upon overall efficiency in communications. To improve consistency, when the AEWC and AWSP have annual

meetings include updates to the binder that is given to Community Observer pre-cruise after annual meetings have taken place.

As climate change continues and migration patterns change, the dates when whaling occurs will shift as well. This means an increased need for communications between science and subsistence hunters to share location information during the spring and fall whale hunts.

This need is heightened as the AEWC has requested the International Whaling Commission for 100 strikes from the previous 67 strikes to be split amongst the 11 Alaskan communities that are active participants in the subsistence hunt. Although not yet approved, this may result in extended whaling seasons furthering the need for effective communications.

Social Media Activities (Arctic Winds, Fish, Fins and Feathers) - Diana Campbell

Situational analysis: The science team included a role for a student from the University of Alaska Fairbanks Dept. of Communications and Journalism to conduct social media aboard R/V Sikuliaq during a 2017 fall research cruise. The science goal, as Carin Ashjian, chief scientist, put it, was to catch the Arctic food web in action at the shelf break in the Beaufort Sea. The collaborative science team included a physical oceanographer, phytoplankton and zooplankton researchers, marine mammal and seabird observers, and qualitative researcher.

Diana Campbell, a summer 2017 master's degree graduate, was chosen to conduct the social media. Campbell is Gwich'in Athabascan and Alutiiq and a member of the Native Village of Venetie.

Goals met: The National Science Foundation's public affairs office took notice of ArcticWFFF social media favorably. Social media comments, shares and followers indicated the team was well received and appreciated for their work in the Arctic

According the initial analytics for Facebook, Twitter and Instagram, we had over 500 people following us directly, with at least 20,000 views. Some of the Twitter and Facebook posts were picked up and re-posted on the Woods Hole Oceanographic Institutions Twitter and Facebook feeds; WHOI's Facebook page has ~72,000 followers and its Tweets are followed by ~12,000 people.

Tactics: The team came up with the name and hashtag for the project for social media. They agreed on Arctic Winds, Fish, Fins and Feathers, with the hashtag ArcticWFFF.

A press release was developed by D. Campbell, Okkonen and Ashjian and released to Alaska media on Aug. 18, 2017.

Dan Joling, who works in the Alaska office of the Associated Press, wrote his own story as as the result of the press release. He distributed nationally and the story appeared in many media outlets, including The Washington Post.

Campbell contacted the Nome Nugget, Arctic Sounder, Fairbanks Daily News-Miner, KNOM, Delta Discovery and the Arctic Sounder. Gay Sheffield, the Nome UAF agent, had already arranged for press availability for the science team upon return to Nome.

Shady Grove, of the Arctic Sounder, plans a story. Campbell wrote a story and provided photos for both The Fairbanks Daily News-Miner and The Delta Discovery. The story was shared via social media, as well. A second story focusing on the glider

recovery was published in the Fairbanks Daily News-Miner after the cruise, with D. Campbell assisting the staff writer on the story.

PolarTREC and Associated Outreach - Lisa Seff

Pre-Cruise

These activities were designed to educate and inform students and the general public about the upcoming research that would be conducted on the *R/V Sikuliaq* in August/September.

Springs School

- Between February 2017 and June 2017 I met three times with Springs School students in a large group setting that included grades K through 5 (450+ students). After consulting with Dr. Ashjian and others in the research team I presented and answered questions on various aspects of the upcoming research cruise to help students and teachers develop a base of knowledge about the Arctic and the research that would be conducted onboard the *R/V Sikuliaq*.
- Between February 2017 and June 2017 I presented to the Springs School school board and the attending public and press, at two school board meetings, about the upcoming research.
- As an alumna at a PolarTREC Orientation held in Fairbanks Alaska for a week in February, I conducted several live Skype sessions with Springs students, including one with 475+ students in grades k-5, in which she discussed Arctic and the upcoming research cruise onboard the *R/V Sikuliaq*. Additionally I presented information about our upcoming research to the 2017 PolarTREC teachers.
- In May and June, I met with students and teachers in individual classes six times, within grades k-8 at Springs School. I also provided all classroom teachers in the school with a Powerpoint presentation that reviewed the basics of the upcoming research and detailed some of the organisms the team would be studying in the Beaufort Sea so that they could incorporate information from the Powerpoint presentation into their own lesson plans. I made and distributed 750 postcards, one to every student in the school that represented the various aspects of the food web that would be studied by the research team at the Beaufort Sea Shelf Break.
- During the last week of school, I collected approximately 775 colored in postcards that the students in grades K-8 and teachers had colored. On the back of each postcard was a reminder to virtually join the research team on our PolarTREC expedition website beginning on August 24th. Students knew that when they received the postcard from Nome, it was time to tune into the PolarTREC website and the research expedition. Once I arrived in Nome Alaska I mailed (and personally postmarked) all 775 student postcards from the Nome post office.
- All teachers in the school were provided with a classroom writing assignment that could be used and adapted for their students in September, once we were in the field.

East Hampton, New York, Senior Center

- I presented a slideshow and answered questions relating to the upcoming research cruise onboard the *R/V Sikuliaq*. There were approximately 60 seniors in attendance.
- I brought the senior center the research related postcards for their art class. Approximately 125 postcards were completed and collected and mailed back to the artists once I arrived in Nome Alaska to remind them it was time to virtually join us online.

Social Media, Listserves, Colleagues

- I wrote to colleagues, friends and family members on various list-serves to announce the research expedition and the PolarTREC website which would be the platform for my journals relating to the research. Prior to the trip I included the PolarTREC website on several social media pages on Facebook.

Anvil City Science Academy (ACSA)

- After contacting Heather Jameson, a science teacher at the Anvil City Science Academy, I went to the school on August 22nd and presented to approximately 60 students in grades 5-8 about the upcoming research cruise.
- I brought blank white flags to the ACSA students. They colored ten flags with scenes that included their views of what we might see during the research at the Beaufort Sea shelf break.

During the Cruise

- I met with all members of the research team and a majority of the ship's crew to learn more about their work. Based on those interviews and observations I wrote 28 journals between August 20th 2017 (when I departed New York) and September 18th, 2017, when the ship arrived back in Nome Alaska. These journals included photographs and videos. All related journal materials were published on our PolarTREC Expedition webpage at: https://www.polartrec.com/expeditions/upwelling-and-ecology-in-the-beaufort-sea
- Within the PolarTREC Expedition webpage there is an interactive "Ask the Team" section where the public can ask the team specific questions about the oceanographic research. During the research period the research team and I answered more than 250 questions from students and the general public through the PolarTREC website and e-mails.
- I conducted five Skype sessions with individual classes from Springs School to discuss the ongoing research aboard the *R/V Sikuliaq*.
- The research team and I organized a Powerpoint presentation that was used during two live-time PolarTREC PolarConnect webinars from the ship on September 14th. The first PolarConnect event was attended by all 56 classes at Springs School that included more than 725 students and 125 teachers. There were an additional 28 individuals, schools and organizations that joined the event, however not all organizations reported the number of students/people that attended the event. PolarTREC reported more than 58 individual organizations with a total of 504 participants. The second live PolarConnect event was attended by 60 students and 4 teachers from the Anvil City

Science Academy in Nome Alaska. Each PolarConnect event was attended by members of each area of the research team. The PolarConnect event was then published on our PolarTREC Expedition webpage at: https://www.polartrec.com/resources/event/polarconnect-event-lisa-seff-the-upwelling-and-ecology-in-the-beaufort-sea-research

- On the day the *R/V Sikuliaq* came back into port in Nome we brought 60 middle school students and 4 teachers from the Anvil City Science Academy onboard the ship. Students were divided into 8 groups of 6-9 students per group. Students were rotated through eight different stations designed to introduce them to the ship and review the science conducted onboard during the previous 3.5 week period.

Figure 23. (Left) Third Mate Christoph Gabaldo shows the bridge instrumentation to students from the Anvil City Science Academy. The flags drawn by the students are hung along the aft bulkhead. (Right) Students and teachers on the aft deck of the R/V Sikuliaq.

Appendix A. Personnel

Science Party

Last Name	First Name	Affiliation	Role
Ashjian	Carin	WHOI	Scientist, Chief
Alatalo	Phil	WHOI	Technician
Campbell	Bob	URI	Scientist
Gelfman	Celia	URI	Technician
Llopiz	Joel	WHOI	Scientist
Hernandez	Chrissy	WHOI	Student, Graduate
Suca	Justin	WHOI	Student, Graduate
Lowe	Mike	LSU	Scientist
Kvile	Kristina	WHOI	Scientist, Post-Doc
Seff	Lisa	Springs School	Educator, K-12
Okkonen	Steve	UAF	Scientist
Campbell	Diana	UAF	Student, Graduate
Stafford	Kate	UW	Scientist
Stern	Jenny	UW	Student
Lowry	Kate	WHOI	Scientist, Post-Doc
Johnson	Jennifer	NOAA	Technician
Zeller	Tamara	USFWS	Bird Observer
Merculief	Britte	UIC Science	Community Observer

Marine Technicians

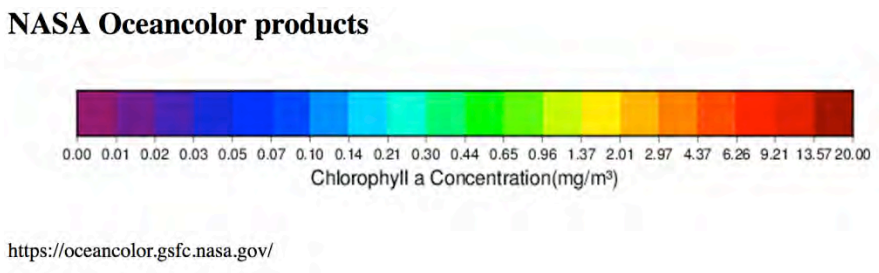
Last Name	First Name	Affiliation
Naber	Dan	UAF
Roth	Ethan	UAF

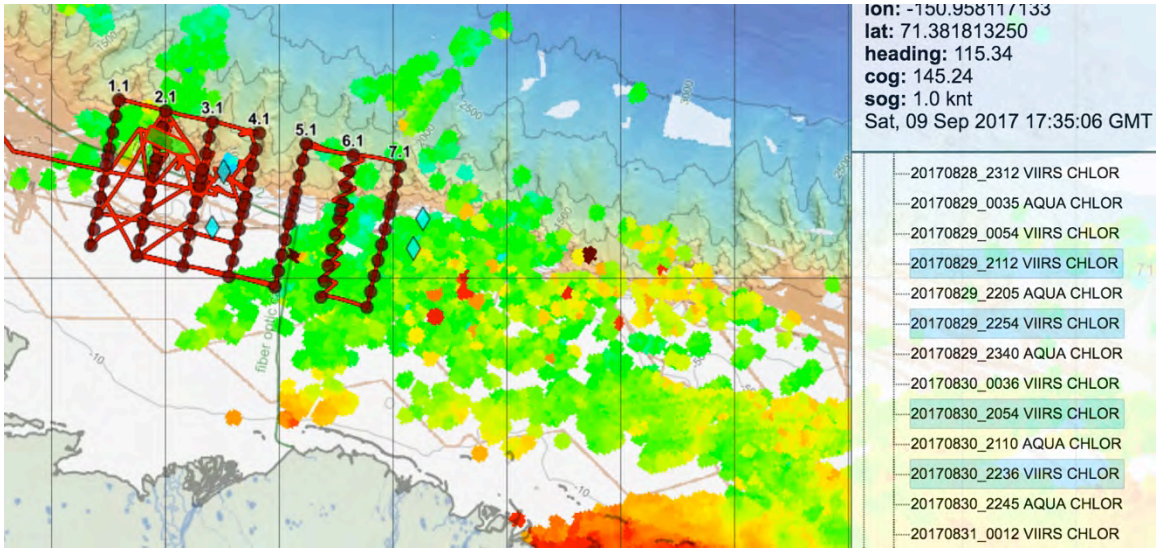
Ship's Crew

Last Name	First Name	Role
McMullen	Forrest	Master
Beaudin	Marcel	First Engineer
Bedard	Patrick	Electrician
Costales	Anton	Oiler
Danielson	Eric	AB
Eldred	James	Oiler
Elliott	Sam	AB
Gabaldo	Christoph	Third Mate
Hamill	John	Second Mate
Heine	Kim	Cook
Kurek	Annie	Mess Attendant
Levine	Artie	AB

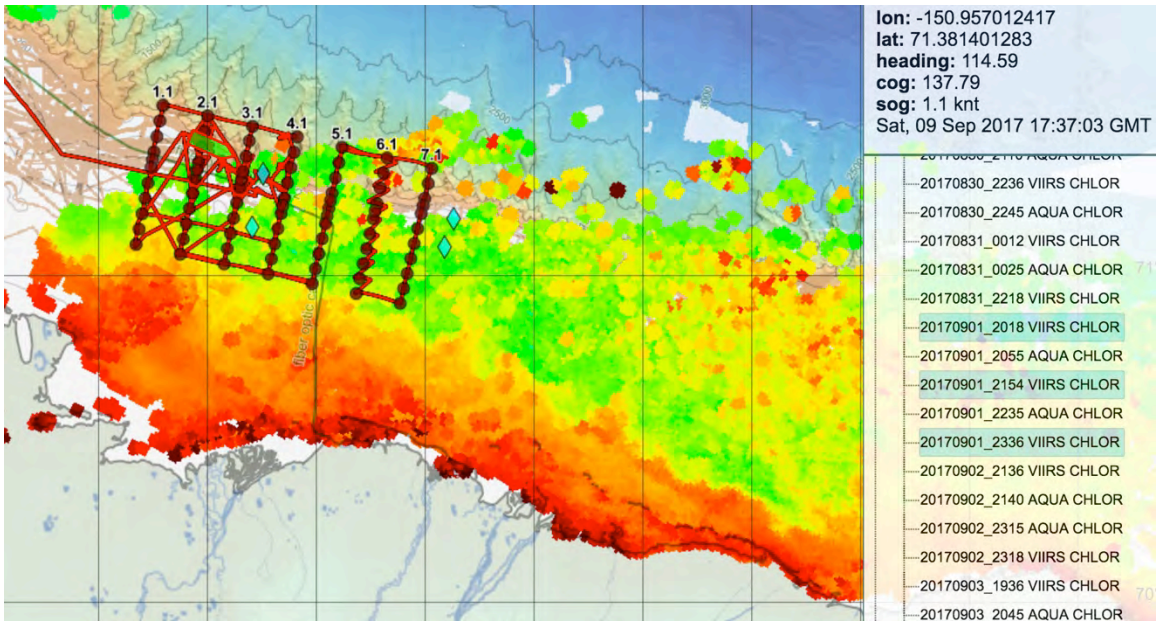
Liepins	Otto	First Mate
Olm	Samuel	Third Engineer
Pierce	Johnny Lee	Oiler
Song	Shelly	Second Engineer
St. Onge	Paul	Bosun
Teckenbrock	Mark	Chief Steward
Thorwick	Mike	Chief Engineer
Worrad	Rob	AB

Appendix B. Screen shots of ocean color from the MapServer.

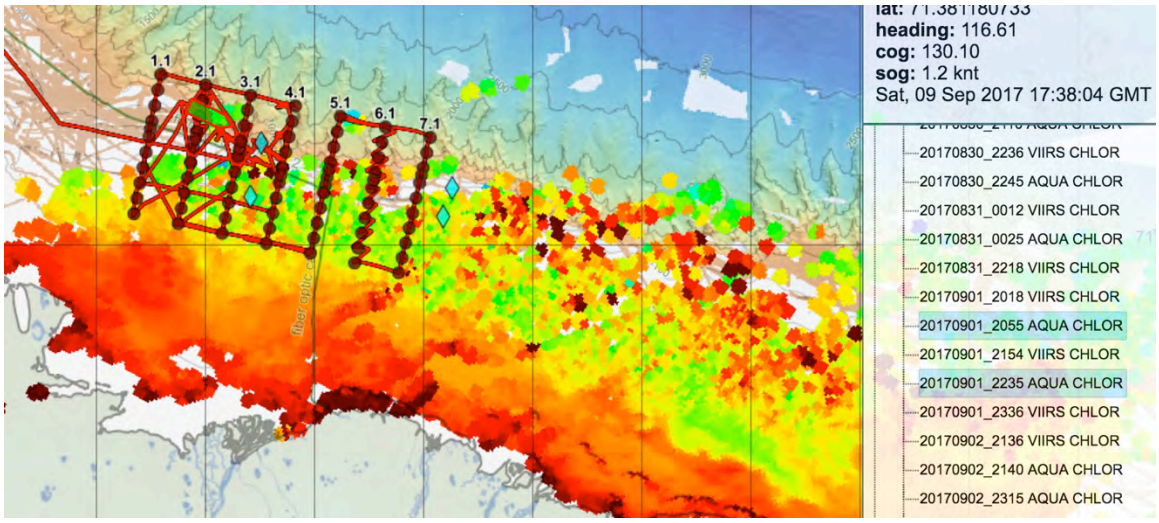




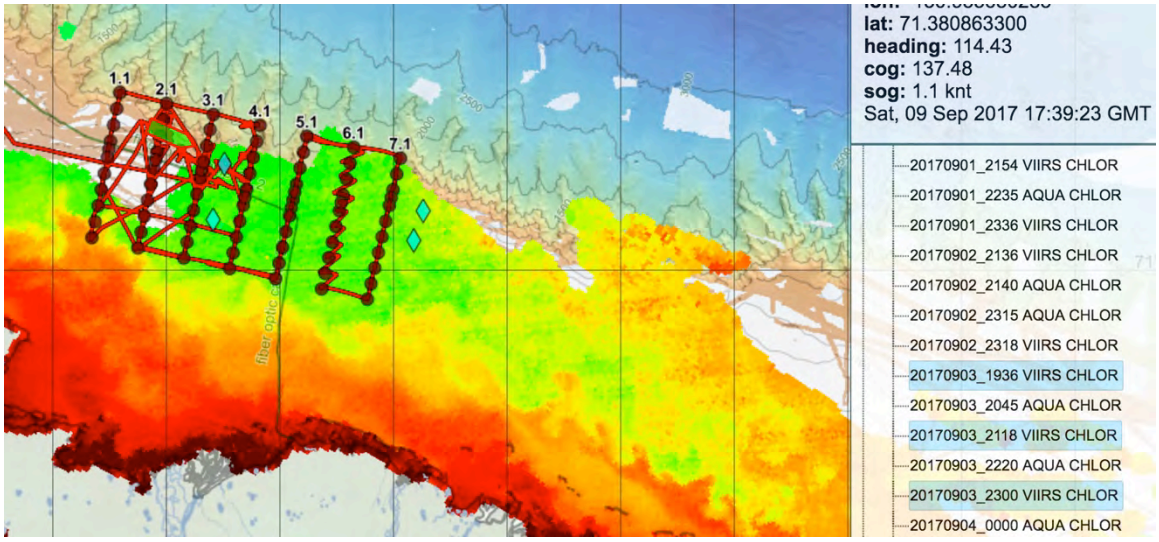
Screen shot of MapServer, Sept. 9, showing satellite chlorophyll from 8/29-8/30 (VIIRS).



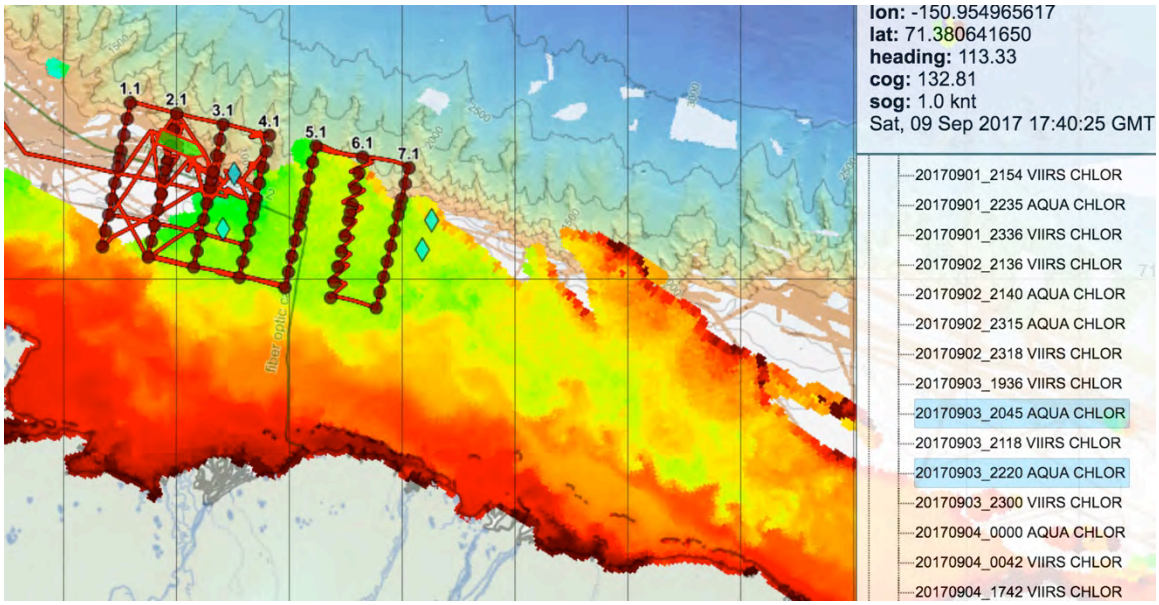
Screen shot of MapServer, Sept. 9, showing satellite chlorophyll from 9/1 (VIIRS).



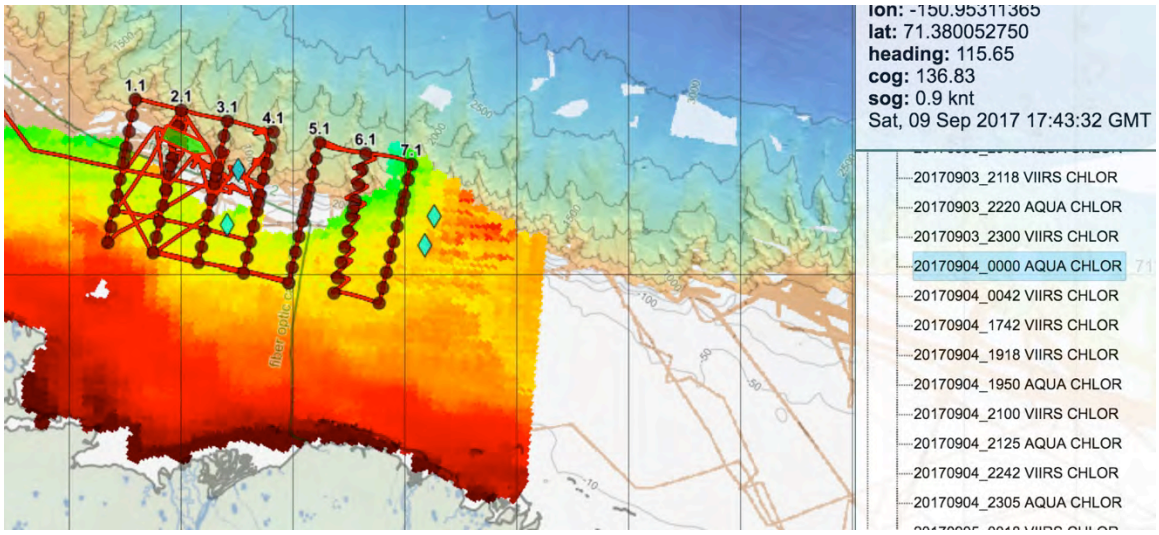
Screen shot of MapServer, Sept. 9, showing satellite chlorophyll from 9/1 (AQUA).



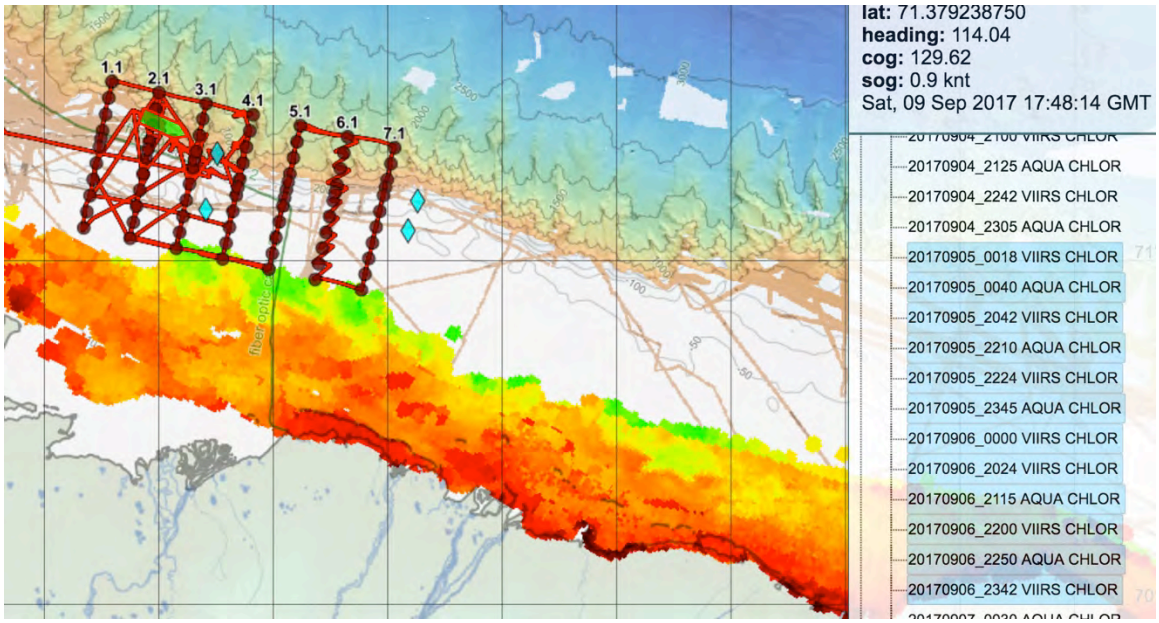
Screen shot of MapServer, Sept. 9, showing satellite chlorophyll from 9/3 (VIIRS).



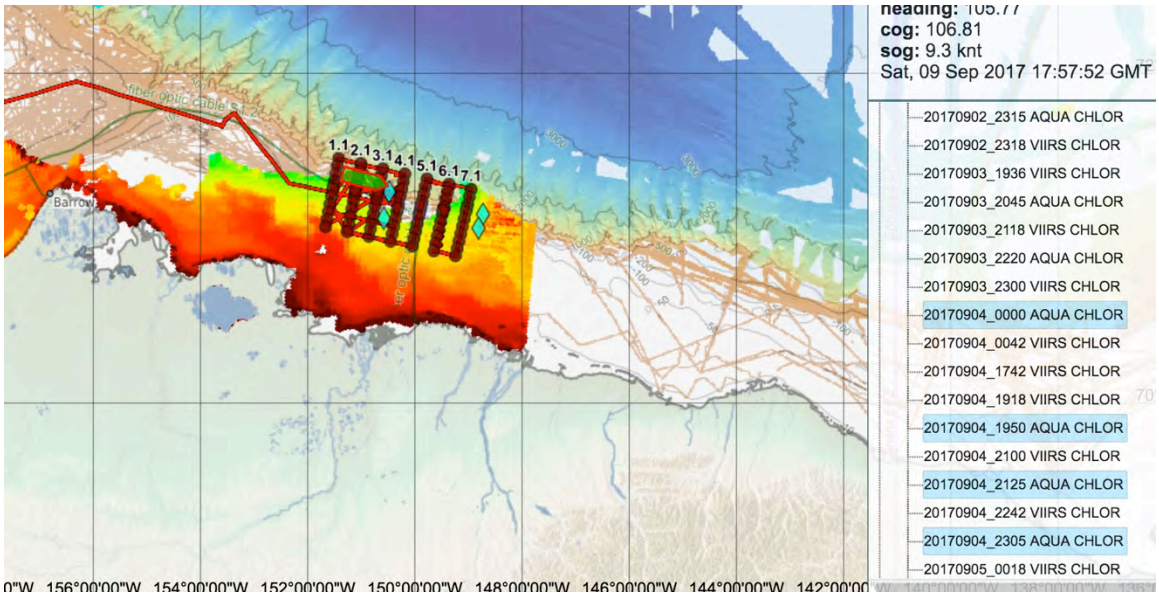
Screen shot of MapServer, Sept. 9, showing satellite chlorophyll from 9/3 (AQUA).



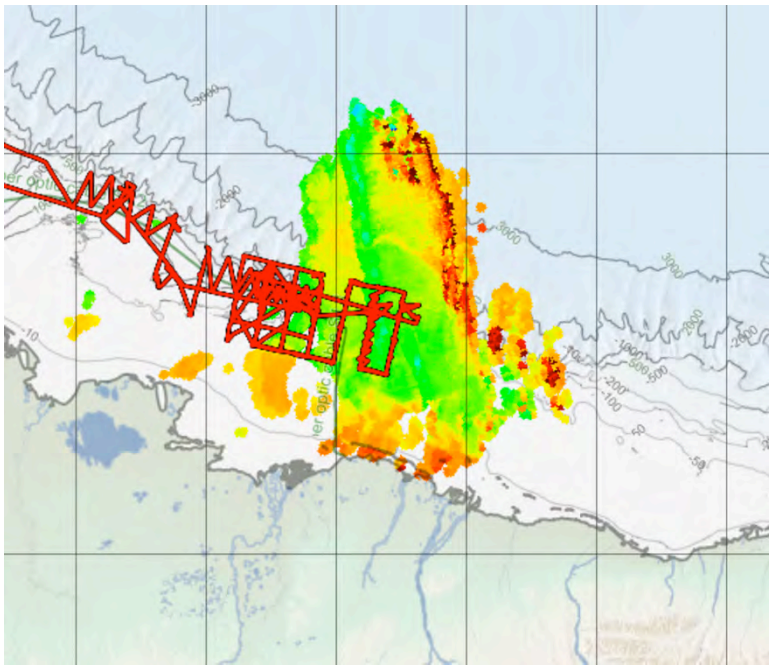
Screen shot of MapServer, Sept. 9, showing AQUA satellite chlorophyll from 9/4.



Screen shot of MapServer, Sept. 9, showing AQUA satellite chlorophyll from 9/5-9/6 (AQUA and VIIRS).

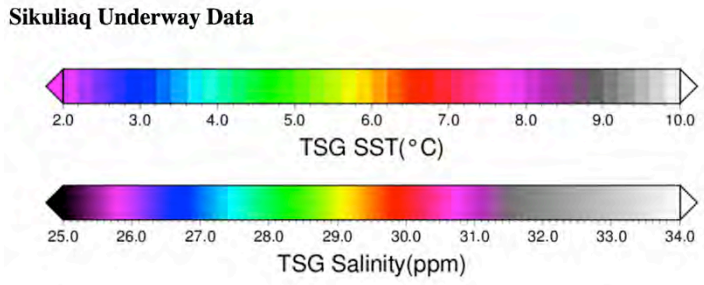


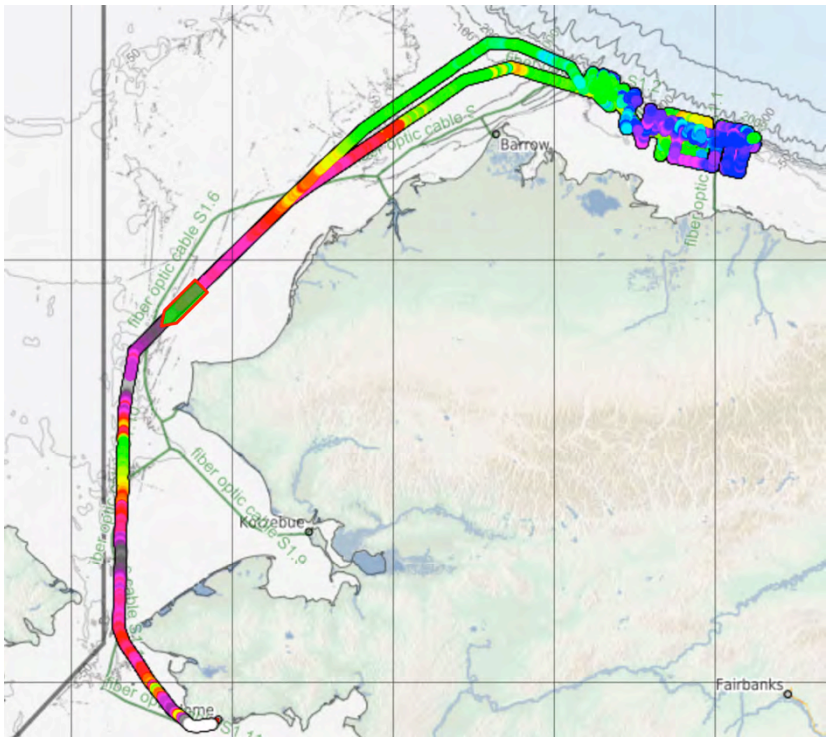
Screen shot of MapServer, Sept. 9, showing both AQUA satellite chlorophyll from 9/4 (AQUA).



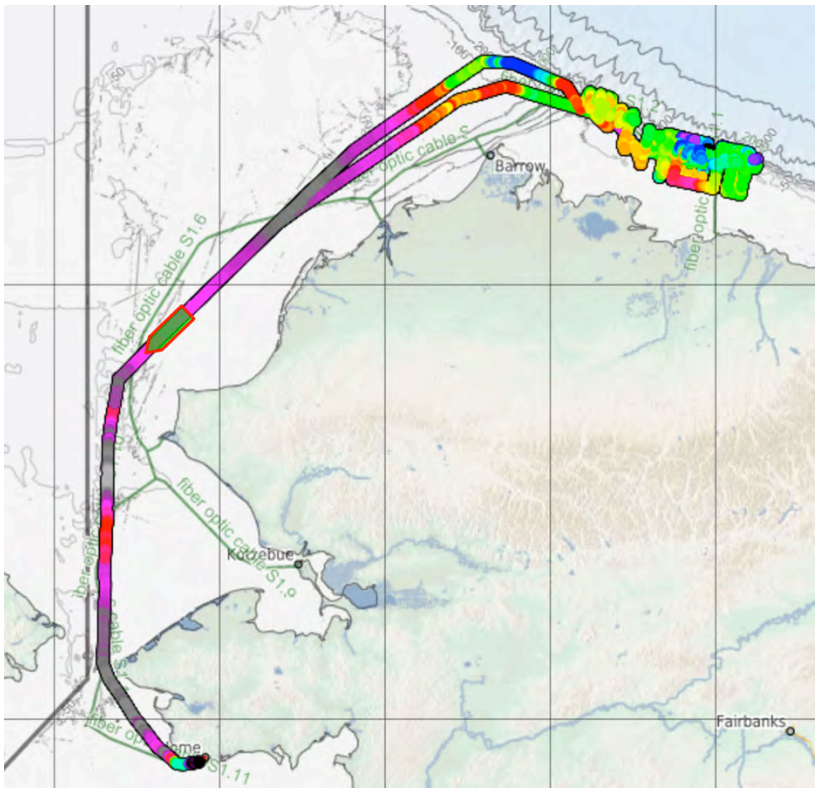
Screen shot of MapServer, Sept. 16, showing both VIIRS and AQUA satellite chlorophyll from 9/15.

Appendix C. Screen shots from MapServer showing sea surface temperature and salinity (end of cruise).



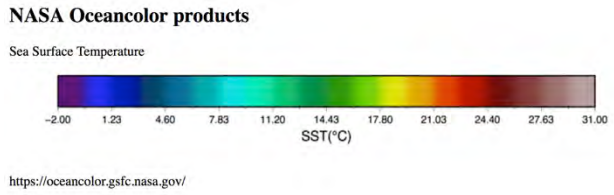


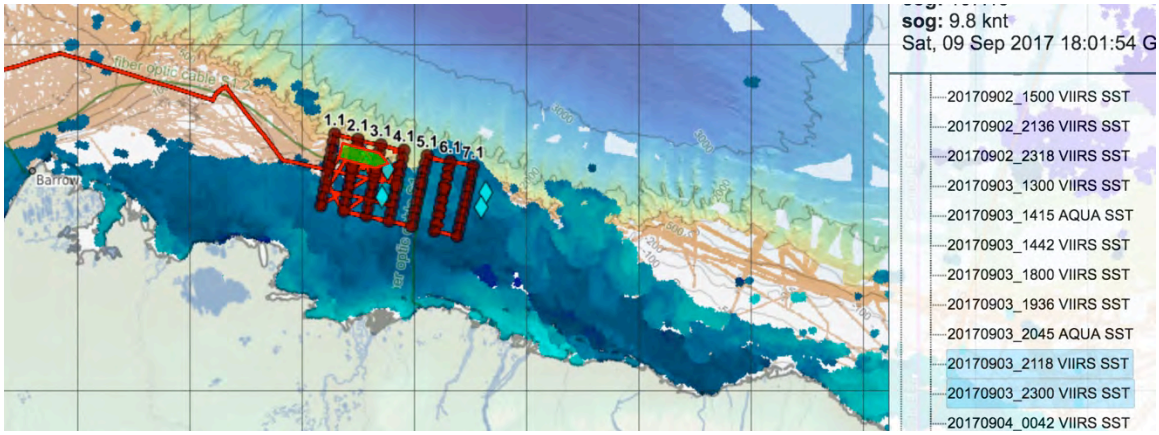
Sea surface temperature.



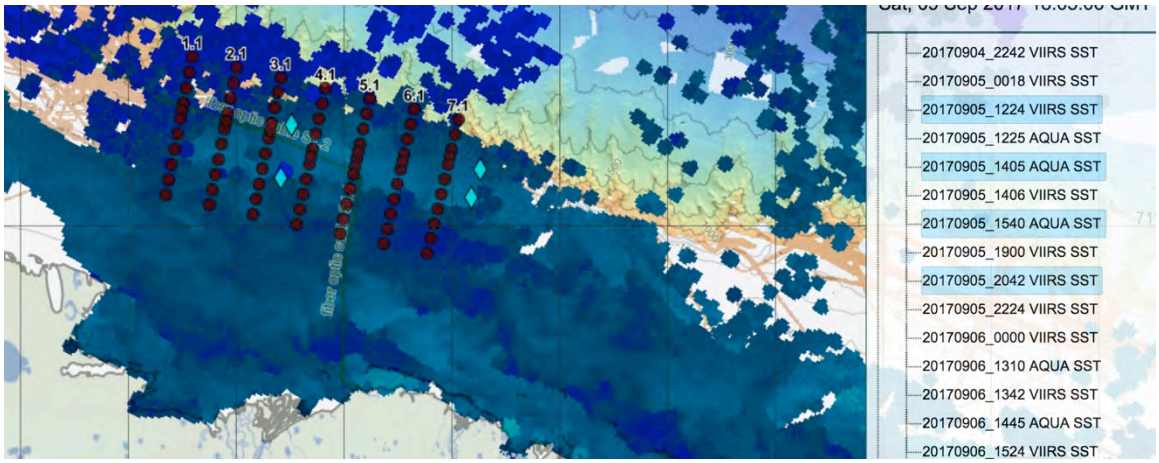
Sea surface salinity.

Appendix D. Screen shots of satellite SST from MapServer



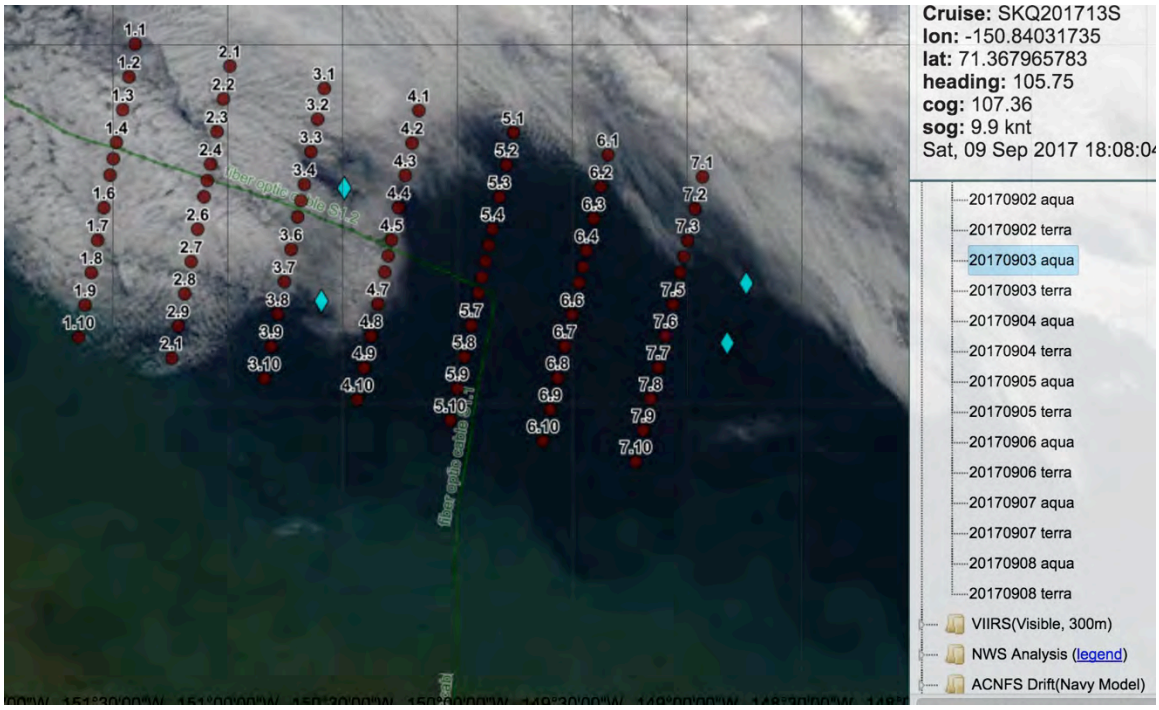


SST on 9/3 from VIIRS



SST on 9/4 from VIIRS

Appendix E. Visual satellite imagery (MODIS) from MapServer



Visual satellite image from 9/3.

Appendix F. Daily letters to local Alaskan community members

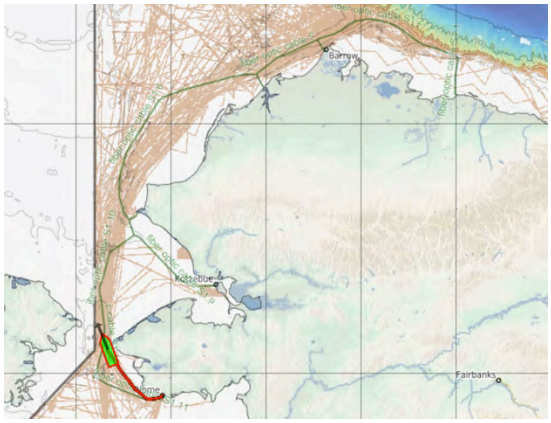
August 25, 2017

This is the first update on the progress and activities of the R/V Sikuliaq for our cruise to the Beaufort Shelf. Our project is studying why beluga whales are often seen along the shelf break of the Beaufort Sea. We set sail from Nome, AK at 10 AM today. We are heading towards Bering Strait as I write this.

The skies were beautifully clear until recently when the clouds settled in. Winds are fairly brisk, at about 25-28 knots. The air temperature is 43.5 degrees and the barometric pressure is 1007.8.

Our present position is 65° 28.839 N, 168° 17.839 W. Our plan is to continue north through the Chukchi, staying well offshore (we will be well out of sight of land except for in the Strait). We anticipate being to the NW of Cape Lisburne by tomorrow night. Because of the winds, we will not be doing any sampling with our nets until probably Sunday. We have people observing marine mammals and seabirds on the bridge but so far they have not reported anything extraordinary. The waves are making it difficult to see.

We have a Facebook page maintained by Diana Campbell, our social media expert: https://www.facebook.com/ArcticWFFF/. We also have on board a teacher, Lisa Seff, who is sending journal entries to the PolarTREC web site at https://www.polartrec.com/expeditions/upwelling-and-ecology-in-the-beaufort-sea . Check them out!

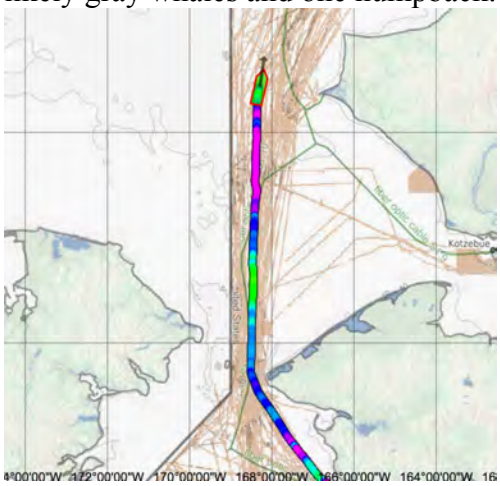


August 26, 2017

Day 2 of the cruise and we continue to transit north through the Chukchi Sea. Strong winds from the NE have slowed our progress so we are presently about 35 miles to the west of Point Hope. Our present position is 68° 28 N, 168° 14 W, our ship speed is 8 knots, and our course is about 8 deg. Our plan is to continue north through the Chukchi, staying well offshore.

Again, we had periods of clear skies today although this evening we are again in clouds. Winds have been very brisk all day, at about 25-28 knots. Seas are about 8-10 feet and we are experiencing some waves washing over the main deck. The air temperature is 44.4 degrees F, the sea surface temperature is 8.5 deg. C, and the barometric pressure is 1011.8 hPa.

Because of the weather, we have not done any sampling with equipment over the side. However, despite the poor viewing conditions (big waves), the observers on the bridge did see some whales today at around 68 deg. N. There were several whales that were likely gray whales and one humpback.



August 27, 2017

We continue to transit north through the Chukchi Sea. Our present position is 70° 51.4N, 162° 12 W, our ship speed is 9 knots, and our course is about 53 deg. We are 45 miles from Wainwright. Our plan is to continue north through the Chukchi and into the Beaufort Sea, staying well offshore.

We had periods of clear skies today and presently it is partly cloudy. The winds and seas subsided for much of the day, with winds at about 18-20 knots throughout the day and waves of a ~5 ft. Winds right now are 16-20 knots from the NE. The air temperature is 38.5 degrees F, the sea surface temperature is 7.5 deg. C, and the barometric pressure is 1015.1 hPa. Looking at the track line on the map (color coded by sea surface temperature), you can see that we have passed into cooler water (going from green to blue). The water temperature and salinity indicate that we are passing out of the Alaska Coastal Water as we move north.

We still have not done any sampling, as we are still transiting to the operating area. Early this morning we recovered a glider equipped with a marine mammal vocalization recorder that had malfunctioned and was not transmitting via Iridium. This was a challenging operation as it was dark and the winds were blowing at about 20 knots with seas of about 5'. Everything went very well thanks to the efforts of the scientists and technicians tracking the glider, the bridge crew maneuvering the ship, and the deck crew

recovering the glider. In addition to getting the instrument back safely, the several months of data also were recovered.

The observers on the bridge saw very little this morning while we were in the Alaska Coastal Water. As we moved pass Point Lay, the observers saw a walrus cow and calf and an interesting diversity of birds (including Arctic terns, Pacific loons, Red-Legged Kittiwakes, Sabine's Gull).

Tomorrow we expect to be in the Beaufort Sea. We will stop during the day to conduct a test station at which we will deploy our gear for the first time to make sure we can do it smoothly. After that, we will transit to or working area.

Please write if you have any questions. Have a great evening, Carin

P.S. The map today has our track color-coded by the sea surface temperature that we measured with our flow through seawater system. I have included a legend for the color of the temperatures (on page 2 of the pdf).

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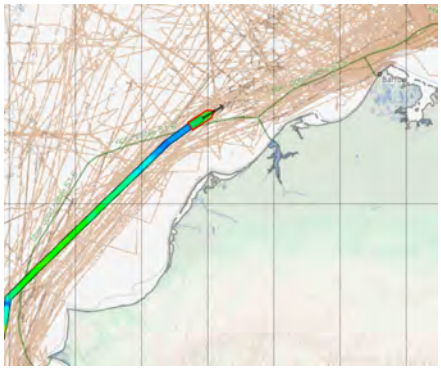

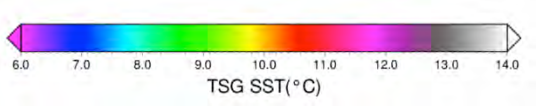

August 28, 2017

Today we rounded the corner around Point Barrow (way to the north) and entered the Beaufort Sea. Our present position is 71° 40.4N, 153° 6.4 W, our ship speed is 8 knots, and our course is about 142 deg. We are 66 miles NE of Nuvuk. Our plan is to continue east to the location where we plan to deploy a mooring.

We had brief periods of sun, many periods of clouds, and several snow squalls today. Winds were at about 10 knots throughout the day and waves of a ~2 ft. Winds right now are 10 knots from 340 deg. The air temperature is 35.1 deg. F, the sea surface

temperature is 5.7 deg. C, and the barometric pressure is 1013.7 hPa. As we crossed over the Beaufort Shelf break, we encountered some very fresh surface water (26.5 salinity). This fresh water may have come from one of the rivers along the Beaufort Shelf.

Today we conducted a test station, using all of our sampling gear to make sure that it worked and that we had set up the deployment procedures safely and correctly. We caught a number of large jellyfish in the fish net and some small Arctic cod. We also caught some small Arctic cod in our plankton nets. All of the gear deployments went very well and we are excited to start our sampling plan.

Again, the observers on the bridge saw only few seabirds and marine mammals. When we were to the NW of Point Barrow, on the western side of Hanna Shoal, we saw a few blows of large unidentified whales off in the distance.

Tonight we are transiting to our first mooring site (inshore cyan diamond) where we will put out a mooring equipped with sensors including marine mammal vocalization recorders. After that, we will start sampling along the lines, surveying with our towed profiler along the solid lines and sampling with our nets at the blue dots. We will not cross to the east of 150°10' until whaling is finished at Cross Island.

Please write if you have any questions. Have a great evening, Carin

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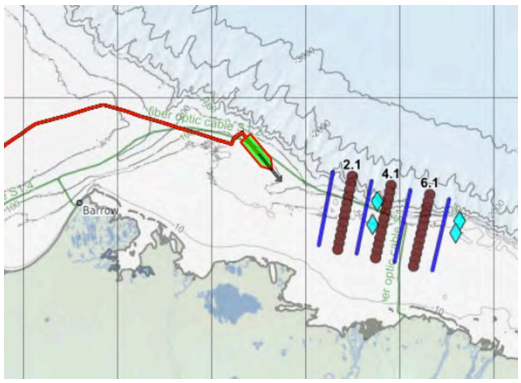

August 29, 2017

A very busy day here on the Sikuliaq. We started the day by deploying two moorings (the deployments went very well). When we retrieve them next year, if all goes well we should have a year round record of marine mammal calls from here on the shelf break along with physical data that will show when upwelling occurs. It is always a bit unnerving sending these instruments down into the deep, dark ocean for a year…will they come back?

Again, today was mostly cloudy with occasional rays of sun as well as snow squalls. Winds were at about 10-15 knots throughout the day and waves of a ~2 ft, very pleasant working conditions. Winds right now are 13 knots from the NE (42 deg.) The air temperature is 37.4 deg. F, the sea surface temperature is 5.7 deg. C/ 42.26 deg. F, and the barometric pressure is 1009.3 hPa. The salinity in our working area is still quite fresh, around 28. You can see the very fresh surface salinity that I mentioned last night as the blue shading on our track back to the west of our present location.

In addition to putting in the moorings, we started our survey work along the track lines. We had some equipment malfunctions and so didn't get as much accomplished as we had hoped. Right now, as I write, my teammates are using nets to catch the zooplankton that are the prey for the Arctic cod. We are all excited to see what we catch in the nets as we are near the shelf break where we expect to find abundant food for the cod.

Today the observers on the bridge saw only few seabirds.

Tomorrow we will continue to sample along the second line from the west (brown dots, the ship is over the second station on our second line. I will let you know what we find in the nets tomorrow.

Please write if you have any questions. Have a great Wednesday, Carin

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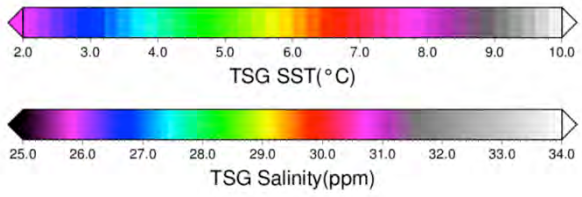
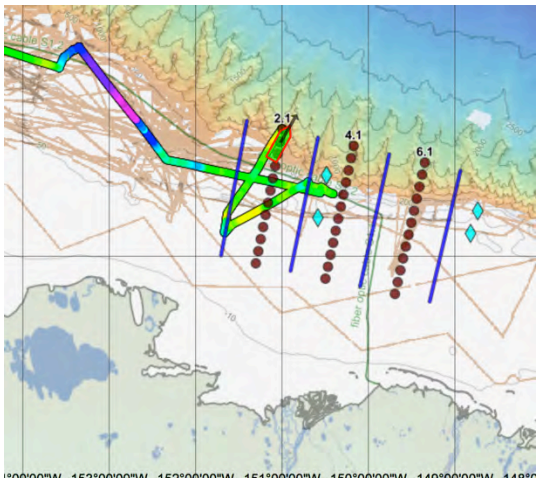
Sikuliaq Underway Data





August 30, 2017

Today we did our first net tows, working on a line that ran from the deep water onto the shelf. It was a bit of a marathon since we were sampling every 2.75 miles along the track. We used the CTD at every station and used a couple of different plankton nets at every other station. The samples were very interesting. Large copepods, the type eaten by bowhead whales, were collected in the deep water and also on the shelf break. Most excitingly for us, since we spent so many years studying krill at Barrow, we found krill in the mid-water off of the shelf break. Today the observers on the bridge saw only seabirds.

Today was mostly cloudy with occasional rays of sun as well as snow squalls.
Winds were at about 10-15 knots throughout the day and waves of a ~2 ft. As evening approached, the winds picked up into the 20s but have subsided a bit since then. Winds right now are 18 knots from the E (75 deg.) The air temperature is 34.7 deg. F, the sea surface temperature is 5.3 deg. C/ 41.5 deg. F, and the barometric pressure is 1007.3 hPa. Our position right now is 71° 12.691'N, 150° 43.313 W. We are working along a line heading towards the NE (note where the ship is located on the accompanying map). Tomorrow we will work from NE to SW along the line of brown dots labeled 4.1-4.12.

Please write if you have any questions. Have a great Wednesday, Carin

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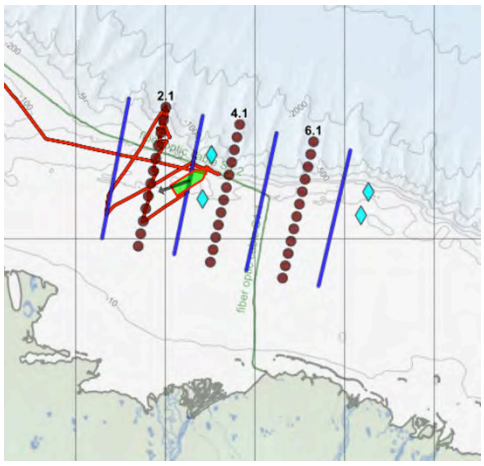

Ship location (ship shape), ship track (red line), and planned stations (brown circles) and survey lines (blue lines).

August 31, 2017

We continue to work along our transect lines. Last night we worked our way out on the third line from the west in our cruise plan, measuring temperature and salinity along the line. The wind has been blowing from the NE and now E for several days and we are seeing the signal of upwelling of deeper cold, salty water onto the shelf. This is pretty exciting as we are in the middle of an upwelling event, just the thing we have come to quantify! We have been busy taking plankton samples that, once we count the animals back in the lab, will let us describe how the upwelling moves the arctic cod prey higher in the water and onto the shelf.

Today we worked our way south along the fourth line from the west, doing plankton tows and CTDs to measure water. Again, we caught the large copepods that are prey for arctic cod and bowhead whales and that are carried up onto the shelf in the upwelling. We also caught some very small fish, making the fish team very excited! Unfortunately, there were few seabirds and no marine mammals seen.

Today was mostly cloudy. Winds were in the mid-high 20s throughout the day and waves built throughout the day to about 6-8', with white caps. Winds right now are 18 knots from the E (75 deg.) The air temperature is 36 deg. F, the sea surface temperature is 5.3 deg. C/ 41.5 deg. F, and the barometric pressure is 1005.7 hPa. Our position right now is 71° 8.362'N, 150° 20.475 W. We are working along a line heading towards the SW (note where the ship is located on the accompanying map). Later tonight, at the point labeled 4.8, we will turn and transit to the west to the westernmost blue line and from there start working along the line offshore.

Please write if you have any questions. Have a great Wednesday, Carin

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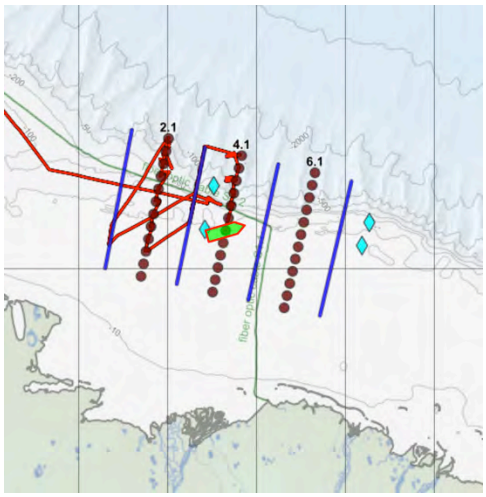

September 1, 2017

Life is becoming routine as we continue to sample along our transects. The wind died down today, coming from the teens in the morning to The wind has been blowing from the NE and now E for several days and we are seeing the signal of upwelling of deeper cold, salty water onto the shelf. This is pretty exciting as we are in the middle of an upwelling event, just the thing we have come to quantify! We have been busy taking plankton samples that, once we count the animals back in the lab, will let us describe how the upwelling moves the arctic cod prey higher in the water and onto the shelf.

Today we worked our way south along the fourth line from the west, doing plankton tows and CTDs to measure water. Again, we caught the large copepods that are prey for arctic cod and bowhead whales and that are carried up onto the shelf in the upwelling. We also caught some very small fish, making the fish team very excited! Unfortunately, there were few seabirds and no marine mammals seen.

Today was mostly cloudy. Winds were in the mid-high 20s throughout the day and waves built throughout the day to about 6-8', with white caps. Winds right now are 18 knots from the E (75 deg.) The air temperature is 36 deg. F, the sea surface temperature is 5.3 deg. C/ 41.5 deg. F, and the barometric pressure is 1005.7 hPa. Our position right now is 71° 8.362'N, 150° 20.475 W. We are working along a line heading towards the SW (note where the ship is located on the accompanying map). Later tonight, at the point labeled 4.8, we will turn and transit to the west to the westernmost blue line and from there start working along the line offshore.

Please write if you have any questions. Have a great Wednesday, Carin

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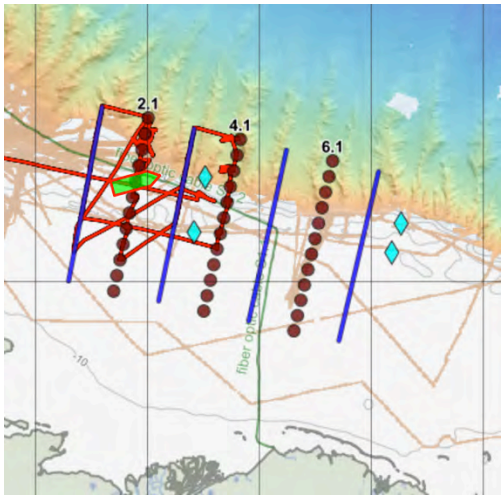

September 2, 2017

A busy day here. We did a survey of our Line 2 to document how upwelling impacts plankton and fish distributions. Then in the afternoon the fish team did a trawl with the fish net. Happily there were plenty of fish (especially Arctic cod). They are busily sorting fish even as I write this.

We are now transiting offshore of Line 2 to again survey from offshore to inshore to document water and plankton / fish distributions as upwelling relaxes. Our present position 71 21.2 N, 150 44.33 W and moving to the NW. The weather today was very pleasant, although cloudy. The winds have really come down and the seas are quite low. Today was mostly cloudy. Winds right now are 11.5 knots from the E (95 deg.) The air temperature is 37.8deg. F, the sea surface temperature is 5.9 deg. C/ 43 deg. F, and the barometric pressure is 1010.9 hPa.

Observations of note from the bird and mammal folks on the bridge were three bowheads (a single whale and later a pair), three ringed seals, and a juvenile Ross' gull.

Please write if you have any questions. Have a great Wednesday, Carin

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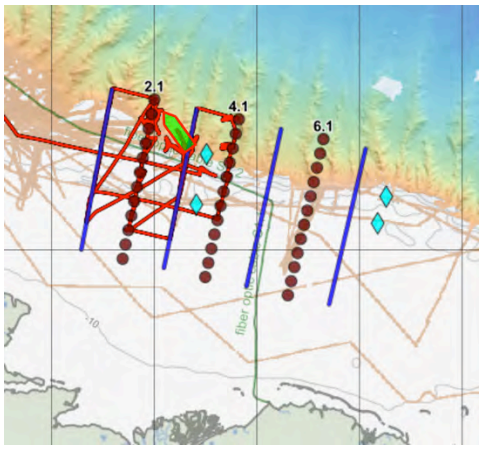

September 3, 2017

We completed our transect of Line 2 and moved on to survey Line 3 (third from west on map). We used our small towed profiler (it flies up and down in the water like an airplane) to measure temperature, salinity, and chlorophyll fluorescence along the line until the water became too deep for the instrument (it can only go down to about 150'). Then we switched to using the CTD. In the afternoon, we moved off of the shelf to about 750' of water to do another fish trawl. The trawl brought up about 1000 Arctic cod. The fish team is again very happy and is still measuring and weighing fish.

We are now transiting offshore along Line 3. Our present position 71 12.93 N, 150 43.3 W. The weather today was beautiful, the sun came out in the early afternoon and the skies were clear and the sea was blue. It was glorious outside, especially since the Sikuliaq has a heated main deck! Winds were very gentle all day and the seas are very low. We saw a beautiful sunset but now the fog has started to move in again (at 11 PM).

Winds right now are 12.5 knots from the SW (108 deg.) The air temperature is 40 deg. F, the sea surface temperature is 6.2 deg. C/ 43 deg. F, and the barometric pressure is 1014.6 hPa. The seas are very low.

The observers on the bridge saw two bowhead whales, two walrus, and some seals (in addition to some birds). We also saw a smallish (~42') sailboat that had sailed from Halifax earlier this summer and was next planning to stop in Nome.

Please write if you have any questions. Happy Labor Day, Carin

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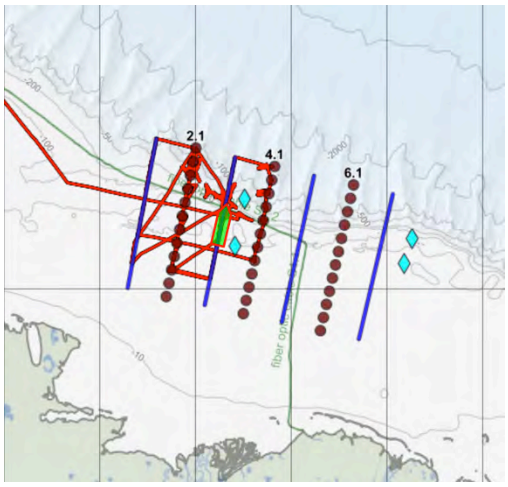

Ship location (ship shape), ship track (red line), and waypoints (brown circles) and survey lines (blue lines).

Bringing the Tucker Trawl (plankton net) on board after a successful tow. The beautiful sunset is in the background.

September 4, 2017

Good evening all. We are once again working south along Line 2, sampling as we go. We now believe that we have sampled through the complete cycle of upwelling and relaxation and are excited to work with our data. Tonight, after we finish sampling on Line 2, we will do a zigzag along the shelf break between Lines 1 and 4 to document fish and krill schools along that topographic feature.

We are seeing fresh, warm water at the surface coming in from the north; we think this may be river water from the Mackenzie. (The blues and purples in our track line are fresher water).

Today's weather was a bit windier, up to 20 knots, and very foggy. Our present position 71 11.835 N, 151 9.344 W. Winds right now are 10 knots from the NE (66 deg.) The air temperature is 38 deg. F, the sea surface temperature is 5 deg. C/ 41 deg. F, and the barometric pressure is 1008.2 hPa. The seas are very low.

Please write if you have any questions. Happy Labor Day, Carin

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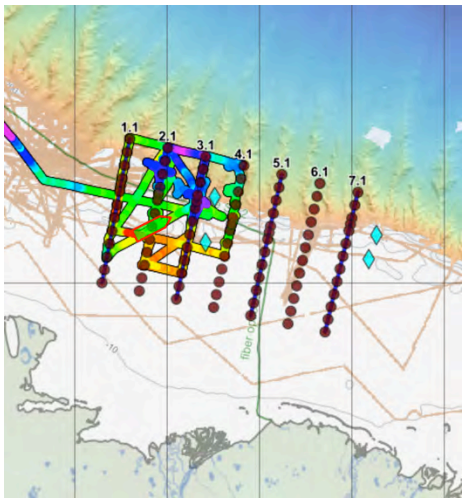

Ship location (ship shape), ship track (red line), and waypoints (brown circles) and survey lines (blue lines). Ship track is colored according to sea surface salinity.

September 5, 2017

Good evening all. This evening we are at 71 16.653 N, 150 24.685 W, 117 miles to the E of Point Barrow and 50 miles from the coast.

Winds right now are 7 knots from the SW (84 deg.) The air temperature is 36 deg. F, the sea surface temperature is 5.4 deg. C/ 41.72 deg. F, and the barometric pressure is 1012.7 hPa. We have waves of about 1'. We have been in fog all day, sometimes very heavy.

Tomorrow we hope to go east to around 148 deg. 44 minutes longitude along the shelf break to put out two moorings that have marine mammal vocalization recorders on them. We are also keeping an eye on the weather, as it is predicted to be rather windy during the rest of the week.

Please write if you have any questions. Happy Labor Day, Carin

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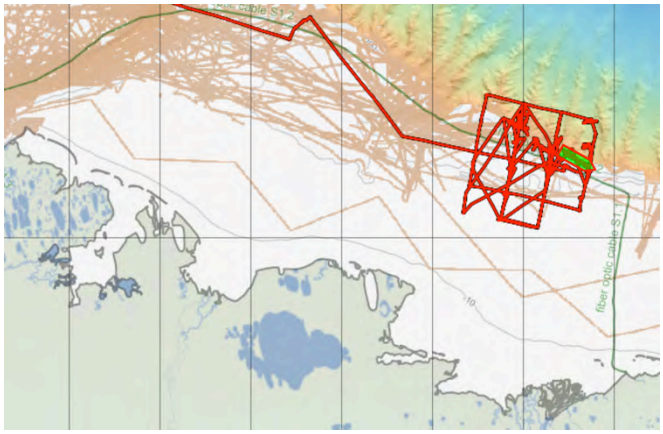

Ship location (ship shape) and ship track (red line).

September 6, 2017

Good evening all. This evening we are at 71 14.558 N, 149 50.666 W.

Winds right now are 33 knots from the east (38 deg.). The air temperature is 39.2 deg. F, the sea surface temperature is 4.6 deg. C/ 40.82 deg. F, and the barometric pressure is 1001 hPa and continuing to drop. Skies are cloudy. We have substantial seas and have suspended all operations except for sampling temperature and salinity with our CTD. This is a very strong upwelling event.

Our plans for tomorrow are completely dependent on the weather as it limits what we can safely accomplish. We will remain in approximately the same area as we are presently.

Our observers on the bridge today saw a few seals and, surprisingly, shearwaters and petrels (not seen before).

Please write if you have any questions. Best regards, Carin

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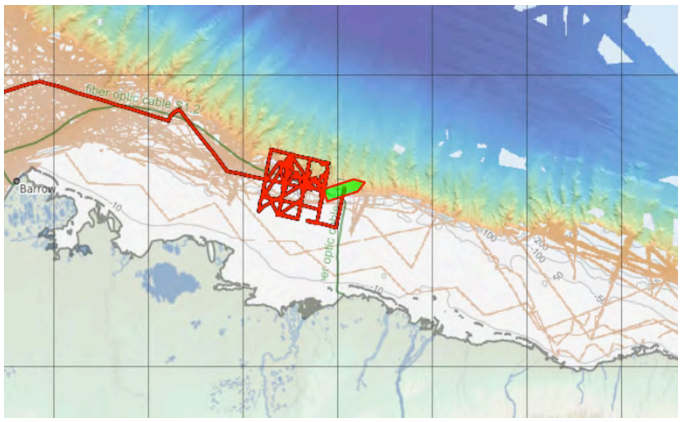

Ship location (ship shape) and ship track (red line).

September 7, 2017

Good evening all. This evening we are at 70 56N, 149 30 W. We have had a rough day and had to "tack" to gain favorable seas as we worked along our line (note the zigzag on the map). We were able measure water temperature and salinity but not use any nets.

Winds right now are 22 knots from the ESE (73 degrees). The air temperature is 36.1 deg. F, the sea surface temperature is 2.8 deg. C/ 37 deg. F, and the barometric pressure is 1001 hPa and rising. Skies are cloudy. We still have substantial seas although they may be lessening. We had sustained winds in the 30s and low 40s over the past day, with some gusts to 50 mph.

Our observers on the bridge today saw seabirds including shearwaters and petrels. Sighting conditions were very poor.

Please write if you have any questions. Best regards, Carin

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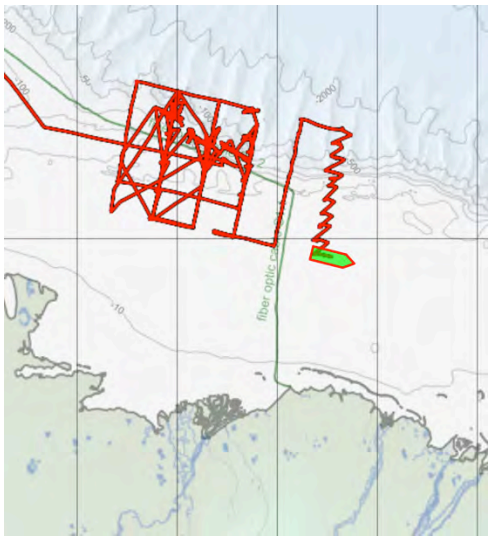
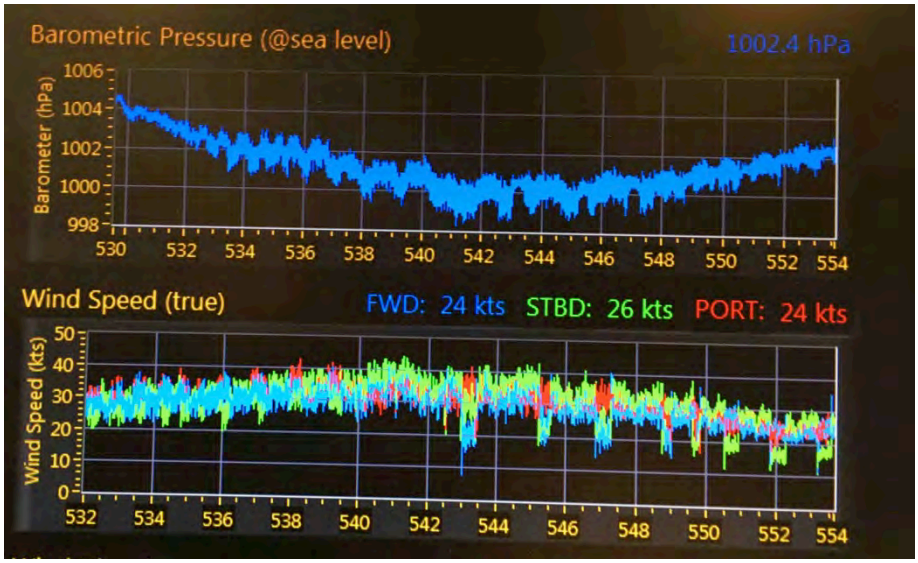


Ship location (ship shape) and ship track (red line).



Atmospheric pressure (top) and wind speed (bottom) for the past 24 hours.

September 8, 2017

Good evening all. This evening we are at 71 1 N, 150 46 W. Today the winds and seas calmed enough that we were able to sample with our nets again.

Winds right now are 12 knots from the NE (60 degrees). The air temperature is 31.6 deg. F, the sea surface temperature is 2.2 deg. C/ 36 deg. F, and the barometric pressure is 1010.6 hPa and rising. Skies are mostly cloudy, although the sun did break through this evening. We had snow squalls several times today.

Please write if you have any questions. Best regards, Carin

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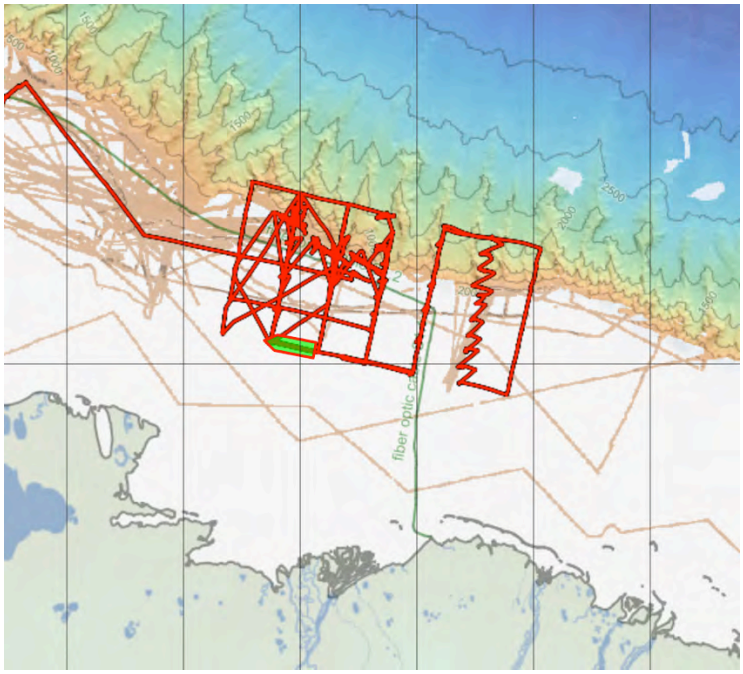

Ship location (ship shape) and ship track (red line).

September 9, 2017

Good evening all. This evening we are at 71deg. 12' N, 149 deg. 0' W. A lovely calm day. We were able to deploy two moorings, equipped with temperature, salinity, and a marine mammal vocalization recorder. Our observers were very happy with the visibility today. I heard today that they had seen two bowheads yesterday, when we were a bit further south of our present location but I did not hear of any such sightings today, only of a few seals.

Winds right now are 5 knots from the N (60 degrees). The air temperature is 35.4 deg. F, the sea surface temperature is 1.9 deg. C/ 35 deg. F, and the barometric pressure is 1009.6 hPa and level. Skies are mostly cloudy, although the sun did break through this evening. There is no fog.

Please write if you have any questions. Best regards, Carin

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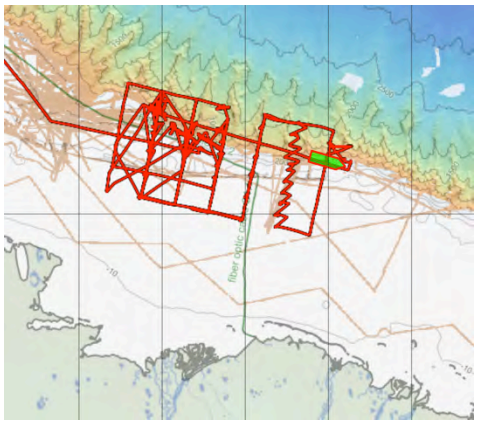

Ship location (ship shape) and ship track where we have been (red line).

September 10, 2017

Good evening all. This evening we are at 71deg. 13 N, 149 deg.16' W. Again, we had a great day weatherwise and were able to do some plankton tows and a fish tow as well as CTDs to measure water temperature and saltiness.

Winds right now are 10 knots from the east. The air temperature is 35.4 deg. F, the sea surface temperature is 2.6 deg. C/ 36.7 deg. F, and the barometric pressure is 1007.6 hPa and we have cloudy skies. Tomorrow we will be working in this same general region along the shelf break.

Please write if you have any questions. Best regards, Carin

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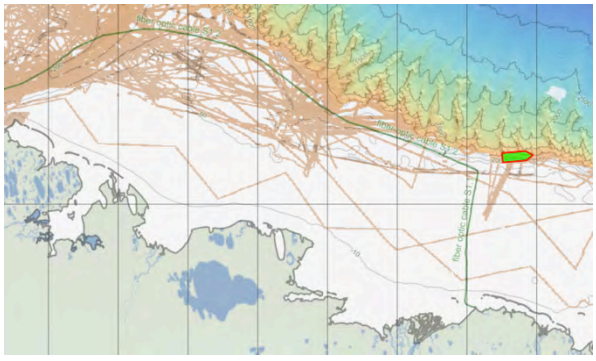

Ship location (ship shape). The different colors show bottom depth.

September 11, 2017

Good evening all. This evening we are at 71deg. 18 N, 150 deg.30' W. We spent the day conducting a net tow to catch fish and collecting some hydrographic (Temperature and Salinity) data. The weather today was cloudy with occasional fog, which made observing

for mammals and birds from the bridge difficult. The observers did see one unidentified seal.

Winds right now are 10 knots from the SSW. The air temperature is 34 deg. F, the sea surface temperature is 3.8 deg. C/ 38.84 deg. F, and the barometric pressure is 1007.3 hPa and we have cloudy skies. Tomorrow we will be working along the shelf break, moving slowly to the west.

Please write if you have any questions. Best regards, Carin

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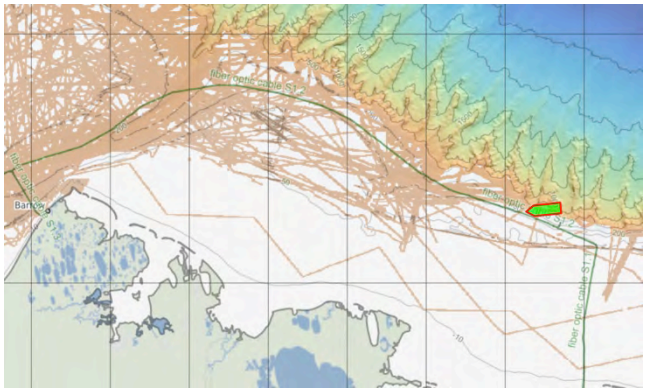


Ship location (ship shape). The different colors show bottom depth.

September 12, 2017

Good evening all. This evening we are at 71deg. 28N, 152 0' W. Today we surveyed along the shelf break until reaching the location of a line for the Distributed Biological Observatory which we are sampling right now, collecting water column temperature and salinity data, water samples for phytoplankton type and abundance, and zooplankton nets to describe the zooplankton present. Our weather today started calm and lovely, with a beautiful sunrise, but quickly turned gray and occasional foggy with increasing winds and waves. In the afternoon, we experienced some 30 knot winds. Luckily, the winds have died down somewhat.

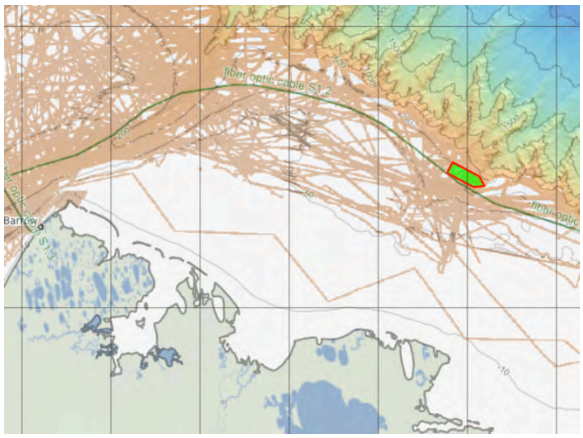
Winds right now are 15 knots from the SSW. The air temperature is 38 deg. F, the sea surface temperature is 2.5 deg. C/ 36.5 deg. F, and the barometric pressure is 995.5 hPa and level (after falling all day) and we have cloudy skies. Tomorrow we will be working along the shelf break, moving slowly to the west. Right now we are 85 miles from Nuvuk/Pt. Barrow.

Last night after midnight we were treated to some lovely Northern Lights. Despite a stunning start as far as visual observations go (clear and sunny!), the degrading conditions throughout the day made observations from the bridge difficult. The

observers saw only a few birds. We did pull in an enormous krill (2”) in the net this evening

Please write if you have any questions. Best regards, Carin

Facebook: https://www.facebook.com/ArcticWFFF/
PolarTREC: https://www.polartrec.com/expeditions/upwelling-and-ecology-in-the-beaufort-sea



Ship location (ship shape). The different colors show bottom depth.

September 13, 2017

Good evening all. This evening we are at 71deg. 40N, 152 29’ W. Today we sampled along the Distributed Biological Observatory line and then worked in a small indentation in the shelf where we think the krill that are found near Barrow (and eaten by the whales there) are upwelled onto the shelf. Our weather today was very nice with low winds and often glassy seas and high clouds. In the early evening, the sun broke through as we were doing a fish trawl. Since then, we crossed into a fog bank and are now in dense fog.

Winds right now are 6 knots from the NW. The air temperature is 37.4 deg. F, the sea surface temperature is 3.1 deg. C/ 37.6 deg. F, and the barometric pressure is 999.2 hPa and rising. Tomorrow we will be working along the shelf break, moving slowly to the west. Right now we are 77 miles from Nuvuk/Pt. Barrow.

Despite the fantastic observing conditions, the observers on the bridge saw only a few seals.

Please write if you have any questions. Best regards, Carin

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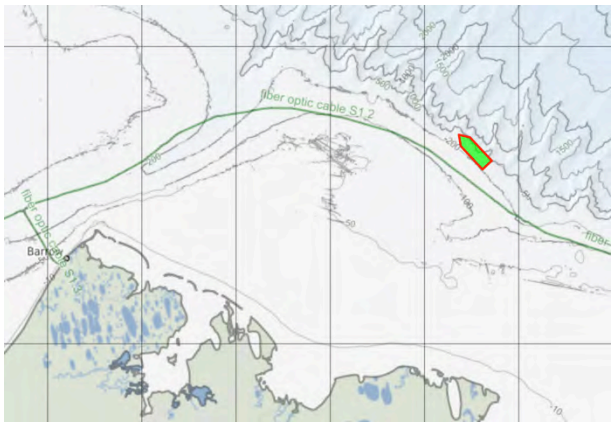
PolarTREC: https://www.polartrec.com/expeditions/upwelling-and-ecology-in-the-beaufort-sea



Ship location (ship shape). The different colors show bottom depth.

A bucket of krill and copepods that we collected in the small indentation in the shelf. The pink color is from the copepods; the krill can be seen by their black eyeballs that look like poppy seeds.

A bag of Arctic cod collected in the same spot as the bucket of krill.

September 14, 2017

Good evening all. This evening we are at 71° 44' N, 153° 23' W. Today continued to work our way west along the shelf break, doing occasional sampling. We had a very successful fish trawl this afternoon, brining up a number of Arctic cod that were intermingled with large jellyfish. Weather today was fantastic, low winds and glassy sea and a fantastic sunset.

Winds right now are 5 knots from the NE. The air temperature is 38 deg. F, the sea surface temperature is 4.5 deg. C/ 40 deg. F, and the barometric pressure is 1008 hPa and level. Late tonight we will pass through the mouth of Barrow Canyon and turn to the south towards Nome. Right now we are 62 miles from Nuvuk/Pt. Barrow.

The observers on the bridge today saw a number of seals and a higher diversity of birds, including some murrelets.

Please write if you have any questions. Best regards, Carin

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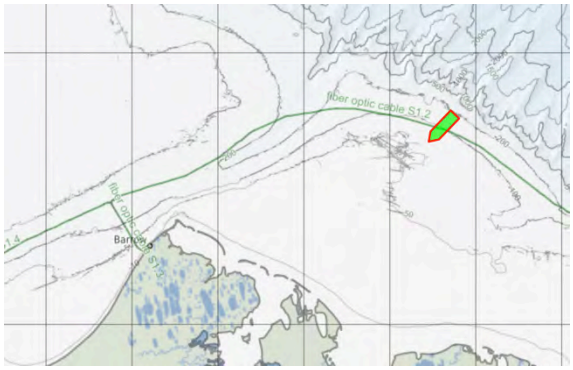
PolarTREC: https://www.polartrec.com/expeditions/upwelling-and-ecology-in-the-beaufort-sea



Ship location (ship shape). The different colors show bottom depth.

September 15, 2017

Good evening all. This evening we are at 71° 7' N, 161° 38' W. We crossed the mouth of Barrow Canyon during the night and transited south on the eastern side of Hanna Shoal. Right now we are over 40 miles NW Wainwright, heading towards Nome.

Winds were fairly low today. It was cloudy but had good visibility. We have seen occasional fog. The air temperature is 37 deg. F, the sea surface temperature is 5.7 deg. C/ 42 deg. F, and the barometric pressure is 1004.4 hPa and falling slowly.

At around 6 PM the observers on the bridge saw a number of bowheads a few miles to the SE of us.

Please write if you have any questions. Best regards, Carin

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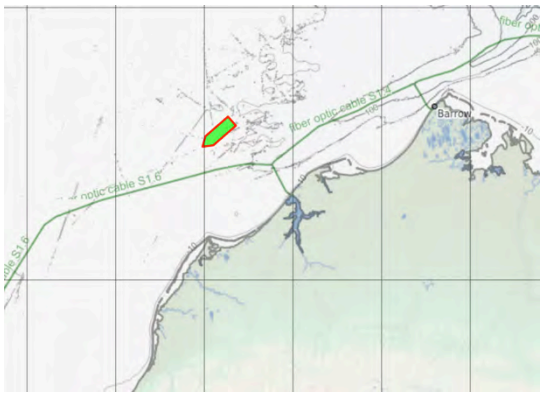
PolarTREC: https://www.polartrec.com/expeditions/upwelling-and-ecology-in-the-beaufort-sea



Ship location (ship shape).

September 16, 2017

Good evening all. This evening we are at 68° 23' N, 168° 19.3' W, 32 miles to the west of Point Hope.

Winds were fairly low today but started to increase and are presently at about 16 knots from the NNW. It was cloudy but with good visibility with no fog. This evening the sun broke through for a few hours. The air temperature is 41 deg. F, the sea surface temperature is 6.7 deg. C/ 44 deg. F, and the barometric pressure is 1007.4 hPa and rising.

This morning we did a short net tow and found a plankton community typical of Alaskan Coastal Water with abundant small copepods and very few of the large Calanus copepods that are prey for bowhead whales.

The observers on the bridge continue to see few marine mammals but have seen many Pacific loons. We also have a few land birds as stowaways on the ship (a Junco was seen this morning), hiding around the ship.

Please write if you have any questions. Best regards, Carin

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PolarTREC: https://www.polartrec.com/expeditions/upwelling-and-ecology-in-the-beaufort-sea

Ship location (ship shape).

September 17, 2017

Good evening all. This evening we are at 65° 9 N, 167° 45' W, about 85 miles from Nome. We passed through the Bering Strait in the late afternoon.

Winds were brisk today and are presently at about 25knots from the NNW. It was cloudy but with good visibility with no fog. This evening the sun broke through for a few hours. The air temperature is 39 deg. F, the sea surface temperature is 8 deg. C/ 46 deg. F, and the barometric pressure is 1006.7 hPa and moderating.

This morning we did a short net tow and found a plankton community typical of Alaskan Coastal Water with abundant small copepods and very few of the large Calanus copepods that are prey for bowhead whales.

Today the observers on the bridge saw a humpback whale, some unidentified whales, and a walrus north of the Strait, not close or in the Strait, and a fin whale south of the Strait. Many different bird species were seen, including an ancient murrelet and king eider.

This is my last report as we will dock at Nome tomorrow morning at 6 AM. Thank you for your interest in our cruise. It was very successful and I look forward to telling more about it as we analyze our data and samples.

Please write if you have any questions. Best regards, Carin

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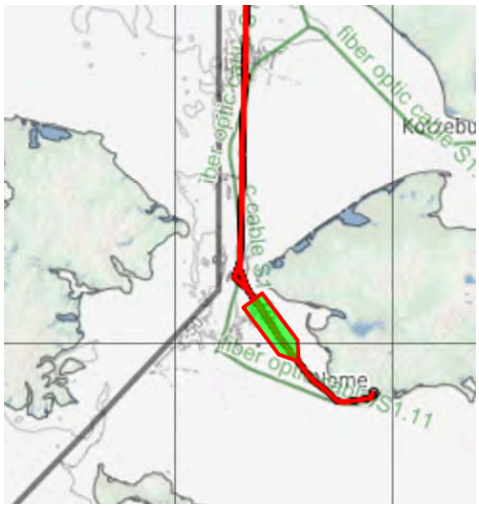
PolarTREC: https://www.polartrec.com/expeditions/upwelling-and-ecology-in-the-beaufort-sea



Ship location (ship shape).

Appendix G. Meal Diary

August 28
Breakfast: Quiche and fruit
Lunch: Tacos (beef, halibut, chicken), black bean quesadillas
Dinner: Stir fry pork, beef, halibut, or tofu with sticky rice. Marinade equal parts lime juice, fish sauce, and sesame oil.

August 29:
Breakfast: Eggs shaksuka with grilled polenta (poached eggs in a tomato sauce over grilled polenta), bacon, fresh fruit (melon, raspberries, strawberries, mango) and a non-dairy fruit smoothie.
Lunch: Smoked chicken with almond pine nut sauce and seared apricots in brandy, Israeli couscous with porcinis, crispy chickpeas dakah with mint and lemon, phyla kale triangles (with feta, rice, pine nuts, red peppers), shrimp.
Dinner: Pork chops with apples, rockfish, asparagus, Hawaiian buns

August 30:
Lunch: Various pizzas
Dinner: Vietnamese meatballs (chicken or beef) with sauce, halibut with amadamen (sp?) sauce, sticky rice with some veggies in it, warm beet salad with arugula and goat cheese.

August 31:
Breakfast: Scrambled eggs with goat cheese and spinach, bacon, and a variety of fruits (raspberries, strawberries, blueberries, rainier cherries).
Lunch: Pulled pork sandwiches with sweet vinegar slaw; scallops; chipotle mac and cheese; some kind of veggie salad

Sept. 1:
Breakfast: Bacon and eggs and coffeecake. Many fresh fruits and oatmeal
Lunch: Shrimp and Andouille sausage or chicken or veggie jambalaya. Cornbread. Cauliflower roasted with parmesan. Salad.
Dinner: Homemade papardelle pasta with Bolognese sauce, tuna with a tarragon EVOO pesto, asparagus with garlic and preserved lemon. Appetizer: Rye miso toast with carmelized onion, filberts, and goat cheese.

Sept. 2:
Breakfast: Toad in the hole (brioche bread) and quince jam, eggs cooked in avocado, homemade pastrami style lox, fresh fruit.
Lunch: Thai Lamb, pork, beef, or tofu larb, sticky rice, roasted eggplant, zesty accouterments
Dinner: Lemon garlic chicken, lemon pepper cod, roasted squash, mashed potatoes chicken gravy, vegetarian gravy, biscuits, snickerdoodle cookies

Sept. 3:
Breakfast: Bacon and eggs; oatmeal, fruit, fresh cinnamon rolls

Lunch: Steak, peppers, and cheese or pesto, tomato, and mozzarella grilled sandwiches. Salad bar. Onion rings.
Dinner: Braised pork shoulder with port cherry reduction, risotto with buttermilk, mushroom, and fried sage, baked carrot and cucumber with balsamic and parsley, seared rockfish with tarragon verde

September 4:
Dinner: Ginger lemon chicken, quinoa and friends, peas and asparagus, butter braised calamari and friends, vegetarian halfwich

Sept. 5
Lunch: Hot dogs and bratwurst with fixings
Dinner: Cornish hens cooked sous vide with chorizo/brioche stuffing, roast taters, seared squash with feta, halibut with olive oil and eggplant puree.

Sept. 6:
Breakfast: Crepes with a fruity filling, bacon, scrambled eggs, homemade bacon lox with cream cheese and capers and a bagel, *Breakfast* burrito.
Lunch : Grilled barley with ham, chicken etc. (delicious), halibut, yellow and green squash in tomato sauce.
Dinner: Ribs, pilaf, salmon, roasted veggies, bread pudding

Sept. 7:
Breakfast: Eggs, bacon, sausage, home fries, French toast, oatmeal, fruit, homemade blueberry muffins
Lunch: Beef or black bean enchiladas, rice, corn, taco lime rockfish
Dinner: Ginger duck, braised calamari, red and yellow peppers, and wild rice.

Sept. 8:
Breakfast: Scrambled eggs with ham, a crepe with fruit filling, fresh fruit, bacon, eggs, home fries
Lunch: Turkey tetrazzini, mussels in a corn, coconut milk, chipotle broth
Dinner: Chicken cordon bleu, baked cod, mashed potatoes, vegetables, salad, chocolate chip cookies

Sept. 9:
Breakfast: Eggs, bacon, sausage, home fries, killer pumpkin muffins, fruit, oatmeal
Lunch: Reuben sandwich, avocado and pepper jack sandwich, coleslaw, tater tots, salad bar.
Dinner: Filet mignon with a tomatillo demi glace and bleu crumbles, buttermilk mashers (yam and russet), Asparagus with lemon, Rockfish chermous. Birthday cake.

Sept. 10:
Breakfast: Lox with cream cheese and capers on bagel, the regular egg selections and some mini *Breakfast* burritos, fruit, oatmeal

Dinner: Magical mediterranean mixed medley (chicken, pork, beef, veggies), Roast squish with pine nuts, goat cheese, beets, mixed mediterranean fish, hummus, naan.

Sept. 11:
Breakfast: Eggs Benedict and homemade donuts (and other *Breakfast* items)
Lunch: Cuban sandwiches, pesto roasted red pepper and feta on foccacia, black beans and rice, arepas
Dinner: Braised brisket with maple miso glaze, knusprig spaetzle (crispy spaetzle with mushrooms, onion, garlic, and gouda), roast cauliflower with brandy, almonds, and parsley, salmon with sweet chili kewpie

Sept. 12:
Breakfast: Poached egg on a potato pancake
Lunch: Chicken. Tuna salad. Fingerling potatoes with pesto. Squash (delicious).
Dinner: Spaghetti with meat sauce or tomato sauce, kale, garlic bread, salad.

Sept. 13:
Breakfast: Sausage cheddar casserole, cinnamon coffee cake, eggs, bacon, chicken apple sausage, hash, oatmeal.
Lunch: Beef or chicken tacos, black bean and refried bean quesadillas, rice, refried beans, avocado, fixings
Dinner: Beef top steaks tandoori style, crispy polenta squares, roasted carrots with goat cheese, maple syrup, rosemary (and olive oil and butter), swordfish with hazelnut and apricot topping

Sept. 14:
Breakfast: Ricotta and hazelnut strudel, ham and cheese scramble, lox and friends, blueberry bagels, fruit and stuff
Lunch: Stick rice bowl with slow cooked Korean spiced pork, beef, shrimp, or mushrooms and fixings (shredded pea pods, lemon grass, shredded radish, sweet sauce, hot peppers, special sauce….)
Dinner: Turkey (brined). Salmon, Mashed potatoes, stuffing, green bean casserole, *Dinner* rolls, apple pie, pecan pie.

Sept. 15:
Breakfast: Biscuits and gravy, eggs, bacon, sausage, fruit, chocolate chip banana bread
Lunch: Pizza
Dinner: Yellow curry with beef, chicken, or veggie, potatoes, parsi rice with shrimp, spicy Brussels sprouts

Sept. 16:
Breakfast: Some kind of fruit strudel and the regular stuff.
Lunch: Pulled pork sandwiches with slaw and homemade sauce, sweet potato fries with parmesan, roasted cauliflower
Dinner: Chicken parmesan (no tomato sauce), carrots, scalloped potatoes, salad

Appendix H. Event Log

Station	Transect	Instrument	Action	Cast	GPS_Date_Time	Latitude	Longitude	Depth (m)	Comment
NaN	NaN	Ship	startCruise	NaN	8/24/13 17:59	64.493978	-165.438402		
NaN	NaN	centerBoard	start	NaN	8/24/13 18:29	64.470627	-165.46877		deployed position
NaN	NaN	UNCSW	start	NaN	8/24/13 19:10	64.445376	-165.605657		
NaN	NaN	PCO2	start	NaN	8/24/13 22:39	64.617594	-166.777115		
NaN	NaN	EK60	other	NaN	8/25/13 5:00	65.370531	-168.078573		Updated sound speed
		UNCSW	start		8/25/13 18:50	67.198612	-168.399212		FlowCAM
		UNCSW	start		8/25/13 21:15	67.521111	-168.371229		FlowCAM
		UNCSW	start		8/25/13 23:30	67.817948	-168.358943		FlowCAM
		UNCSW	start		8/26/13 4:59	68.513827	-168.253373		FlowCAM
NaN	NaN	Slocum Glider	recover	NaN	8/26/13 9:45	69.002925	-168.016823		UAF / Stafford Glider
NaN	NaN	UNCSW	service	NaN	8/26/13 15:48	69.622592	-166.237817		changed strainer
NaN	NaN	PS18	stop	NaN	8/27/13 21:49	71.808239	-154.766978		
NaN	NaN	UNCSW	service	NaN	8/27/13 22:27	71.78102	-154.463204		Changed strainer. Looking for krill. :-) None.
NaN	NaN	OS150	start	NaN	8/27/13 22:57	71.757319	-154.215642		NB mode only, 60x 4m bins, SKQ201713S_01 dataset
1	Test	Acrobat	deploy	1	8/28/13 0:33	71.693444	-153.572374		Test station
1	Test	Fish Net	deploy		8/28/13 2:49	71.739093	-153.482936		Test Stn
1	Test	Fish Net	recover		8/28/13 3:21	71.749781	-153.438961		Test Stn
1	Test	Tucker Trawl	deploy		8/28/13 4:40	71.758606	-153.385645	138	test station gpstime 04 40 55
1	Test	Tucker Trawl	other		8/28/13 4:50	71.761361	-153.375029	138	Messenger 1 Trip
1	Test	Tucker Trawl	other		8/28/13 4:54	71.763038	-153.369301	138	Messenger 2 Trip
1	Test	Tucker Trawl	recover		8/28/13 4:57	71.764112	-153.365315	138	test station

1	Test	Bongo Nets	deploy		8/28/13 5:12	71.765801	-153.354869	138	
1	Test	Bongo Nets	recover		8/28/13 5:20	71.769027	-153.342123	138	TDR depth 60.01 m
1	Test	CTD911	deploy	1	8/28/13 5:53	71.76923	-153.34016	160	Test Station
1	Test	CTD911	recover	1	8/28/13 6:16	71.769239	-153.340131	160	
NaN	NaN	Ship	other	NaN	8/28/13 9:03	71.500053	-152.668209		Start of survey line
NaN	NaN	Ship	other	NaN	8/28/13 10:49	71.356098	-152.32771		End of survey line
2		Mooring	deploy		8/28/13 16:44	71.245336	-150.553491	80	Mooring UPW80, with AZFP
2		CTD911	deploy	2	8/28/13 16:50	71.245339	-150.553481	83	Mooring UPW80, with AZFP
2		CTD911	recover	2	8/28/13 16:59	71.245345	-150.553489	83	
3		Mooring	deploy		8/28/13 19:17	71.266856	-150.69501	108	Mooring UPW120
3		CTD911	deploy	3	8/28/13 19:32	71.267798	-150.703004	107	
3		CTD911	recover	3	8/28/13 19:43	71.267794	-150.703015	107	
NaN		EK60	other	NaN	8/28/13 20:37	71.223518	-150.960624		Switched from TS mode(while at mooring locations) to survey mode
NaN	1	Acrobat	deploy		8/28/13 23:13	71.08687	-151.656642		
NaN	1	Acrobat	recover	NaN	8/28/13 23:51	71.133056	-151.636494		
NaN	1	Acrobat	recover		8/28/13 23:51	71.133056	-151.636494		
NaN	NaN	UNCSW	service	NaN	8/29/13 2:10	71.319847	-151.276939		changed to clean strainer
4	2	CTD911	deploy	4	8/29/13 3:41	71.46932	-150.988708	1196	WNPT 2.1
4	2	CTD911	recover	4	8/29/13 6:19	71.46932	-150.988719	1196	WInch malfunctioned held for a long time at depth
5	2	Bongo Nets	deploy	2	8/29/13 7:09	71.422418	-151.017361	1196	WPNT 2.2
5	2	Bongo Nets	recover		8/29/13 7:48	71.450646	-150.97245	1196	WPNT 2.2
5	2	Ring Net	deploy	1	8/29/13 8:25	71.421725	-151.020936	1196	WPNT 2.2
5	2	Ring Net	recover	1	8/29/13 8:41	71.416064	-151.030108	1196	WPNT 2.2
5	2	Tucker Trawl	deploy	1	8/29/13 9:20	71.413137	-151.040966	1196	WPNT 2.2

5	2	Tucker Trawl	recover	1	8/29/13 9:55	71.431743	-151.014076	1196	couldn't bring wire in to trip with messengers. single net oblique haul
5	2	Tucker Trawl	deploy	2	8/29/13 10:23	71.435436	-150.981845	1196	WPNT 2.2
5	2	Tucker Trawl	recover	2	8/29/13 11:05	71.422408	-151.025394	1196	WPNT 2.2
5	2	Fish Net	deploy		8/29/13 15:00	71.391365	-151.040714		WPNT 2.2
5	2	Fish Net	At Target Depth		8/29/13 15:18	71.384857	-151.01912		WPNT 2.2
5	2	Fish Net	End Target Depth		8/29/13 15:46	71.372318	-150.97046		WPNT 2.2
5	2	Fish Net	recover		8/29/13 16:08	71.364697	-150.949445		WPNT 2.2
5	2	CTD911	deploy	5	8/29/13 17:23	71.424308	-151.01707	374.3	WPNT 2.2
5	2	CTD911	recover	5	8/29/13 18:15	71.385216	-151.040374	374.3	WPNT 2.2
6	2	CTD911	deploy	6	8/29/13 18:31	71.378728	-151.04485	234	WPNT 2.3
6	2	CTD911	recover	6	8/29/13 18:46	71.378722	-151.044842	234	WPNT 2.3
7	2	CTD911	deploy	7	8/29/13 19:22	71.333312	-151.072399	157	WPNT 2.4
7	2	CTD911	recover	7	8/29/13 19:38	71.333301	-151.072371	157	WPNT 2.4
7	2	Bongo Nets	deploy		8/29/13 19:48	71.334585	-151.068832	207	WPNT 2.4
7	2	Bongo Nets	recover		8/29/13 20:12	71.346441	-151.035244	207	WPNT 2.4
7	2	Tucker Trawl	deploy	1	8/29/13 20:38	71.347241	-151.027895	207	WPNT 2.4
7	2	Tucker Trawl	recover	1	8/29/13 21:11	71.347867	-150.980656	207	WPNT 2.4, 169 m tdr
8	2	CTD911	deploy	8	8/29/13 22:01	71.288942	-151.099399	57	WPNT 2.5
8	2	CTD911	recover	8	8/29/13 22:11	71.288943	-151.099383	57	WPNT 2.5
9	2	CTD911	deploy	9	8/29/13 22:51	71.243052	-151.128653	54	WPNT 2.6
9	2	CTD911	recover	9	8/29/13 23:01	71.243052	-151.128692	54	WPNT 2.6
9	2	Tucker Trawl	deploy	1	8/29/13 23:16	71.242448	-151.126258	54	WPNT 2.6
9	2	Tucker Trawl	recover	1	8/29/13 23:29	71.243027	-151.108118	54	WPNT 2.6

9	2	Bongo Nets	deploy		8/29/13 23:41	71.243183	-151.102329	55	WPNT 2.6
9	2	Bongo Nets	recover		8/29/13 23:52	71.243883	-151.087043	55	WPNT 2.6
10	2	CTD911	deploy	10	8/30/13 0:28	71.198321	-151.157336	51	WPNT 2.7
10	2	CTD911	recover	10	8/30/13 0:33	71.198329	-151.157314	54	WPNT 2.7
11	2	CTD911	deploy	11	8/30/13 1:09	71.152803	-151.184526	44	WPNT 2.8
11	2	CTD911	recover	11	8/30/13 1:16	71.152797	-151.184486	44	WPNT 2.8
11	2	Bongo Nets	deploy		8/30/13 1:25	71.15226	-151.184665	36	WPNT 2.8
11	2	Bongo Nets	recover	5	8/30/13 1:32	71.153415	-151.175873	36	WPNT 2.8
11	2	Tucker Trawl	deploy	1	8/30/13 1:44	71.154027	-151.171427	38	WPNT 2.8
11	2	Tucker Trawl	recover	1	8/30/13 1:55	71.155888	-151.15803	38	WPNT 2.8
12	2	CTD911	deploy	12	8/30/13 2:29	71.106168	-151.213503	20.5	WPNT 2.9
12	2	CTD911	recover	12	8/30/13 2:35	71.106565	-151.214183	20.5	WPNT 2.9
13	2	CTD911	deploy	13	8/30/13 3:09	71.061159	-151.242795	21.48	WPNT 2.10
13	2	CTD911	recover	13	8/30/13 3:09	71.061159	-151.242795	21.48	WPNT 2.10
13	2	Tucker Trawl	deploy	1	8/30/13 3:24	71.061585	-151.239044	22	WPNT 2.10, deploy time 03:25:00
13	2	Tucker Trawl	recover	1	8/30/13 3:30	71.062076	-151.231988	22	cod end on wrong net ...ng
13	2	Tucker Trawl	deploy	2	8/30/13 3:35	71.062504	-151.226511	22.8	WPNT 2.10
13	2	Tucker Trawl	recover	2	8/30/13 3:44	71.063424	-151.217312	22.8	double oblique hawl
13	2	Bongo Nets	deploy	1	8/30/13 3:55	71.063233	-151.218822	22	WPNT 2.10, double oblique haul
13	2	Bongo Nets	recover	1	8/30/13 4:06	71.064905	-151.205144	22	WPNT 2.10, double oblique haul
NaN	2	Acrobat	deploy	2	8/30/13 5:37	71.166818	-150.748088		WPNT 2.10, deploy time 03:25:00
NaN	2	Acrobat	recover	2	8/30/13 7:20	71.307373	-150.663783		Lost depth data stream. unable to fly
14	3	CTD911	deploy	14	8/30/13 8:43	71.211743	-150.720094	57	WPNT 3.6

14	3	CTD911	recover	14	8/30/13 8:48	71.21192	-150.720221	57	WPNT 3.6
15	3	CTD911	deploy	15	8/30/13 9:40	71.257492	-150.691319	73	WPNT 3.5
15	3	CTD911	recover	15	8/30/13 9:45	71.257796	-150.691828	73	WPNT 3.5
16	3	CTD911	deploy	16	8/30/13 10:34	71.302867	-150.66311	366	WPNT 3.4
16	3	CTD911	recover	16	8/30/13 10:58	71.303775	-150.663599	366	WPNT 3.4
17	3	CTD911	deploy	17	8/30/13 11:39	71.348249	-150.635106	10001	WPT 3.3
17	3	CTD911	recover	17	8/30/13 12:01	71.348411	-150.635383	1001	WPT 3.3
18	3	CTD911	deploy	18	8/30/13 12:47	71.393297	-150.605154	1301	WPNT 3.2
18	3	CTD911	recover	18	8/30/13 13:11	71.394543	-150.605773	1301	WPNT 3.2
19	3	CTD911	deploy	19	8/30/13 13:52	71.4383	-150.576752	1569	WPNT 3.2
19	3	CTD911	recover	19	8/30/13 14:16	71.438359	-150.576819	1569	WPNT 3.2
20	4	CTD911	deploy	20	8/30/13 15:50	71.408074	-150.185832	1347	WPNT 4.1
20	4	CTD911	recover	20	8/30/13 16:18	71.409676	-150.186948	1347	WPNT 4.1
20	4	Bongo Nets	deploy	1	8/30/13 16:49	71.407675	-150.210342	1509	WPNT 4.1, Beaufort 6 seas
20	4	Bongo Nets	recover	1	8/30/13 17:43	71.403277	-150.31077	1509	WPNT 4.1
20	4	Tucker Trawl	deploy	1	8/30/13 17:59	71.403938	-150.329136	1509	WPNT 4.1
20	4	Tucker Trawl	recover	1	8/30/13 18:55	71.415744	-150.245823	1509	WPNT 4.1
21	4	CTD911	deploy	21	8/30/13 19:32	71.362722	-150.196158	1350	WPNT 4.2
21	4	CTD911	recover	21	8/30/13 20:04	71.365642	-150.199263	1350	WPNT 4.2
22	4	CTD911	deploy	22	8/30/13 20:52	71.317729	-150.228347	1180	WPNT 4.3
22	4	CTD911	recover	22	8/30/13 21:24	71.32023	-150.230117	1180	WPNT 4.3
22	4	Tucker Trawl	deploy	1	8/30/13 22:03	71.316261	-150.337784	1013	WPNT 4.3
22	4	Tucker Trawl	other	1	8/30/13 22:28	71.324277	-150.297215	1013	WPNT 4.3, First messenger trip
22	4	Tucker Trawl	other	1	8/30/13 22:41	71.327132	-150.275678	1013	WPNT 4.3, Net 3 trip
22	4	Tucker Trawl	recover	1	8/30/13 22:51	71.328819	-150.260234	1013	WPNT 4.3, Surface

22	4	Bongo Nets	deploy	1	8/30/13 23:17	71.326635	-150.329733	1014	WPNT 4.3
NaN	4	UNCSW	service	NaN	8/30/13 23:25	71.326739	-150.319551	1014	changed to clean strainer
22	4	Bongo Nets	recover	1	8/30/13 23:53	71.328259	-150.279715	1014	WPNT 4.3
23	4	CTD911	deploy	23	8/31/13 0:52	71.273629	-150.259718	885	WPNT 4.4
23	4	CTD911	recover	23	8/31/13 1:13	71.277072	-150.261715	885	WPNT 4.4
24	4	CTD911	deploy	24	8/31/13 2:01	71.227998	-150.286008	139	WPNT 4.5
24	4	CTD911	recover	24	8/31/13 2:15	71.228761	-150.290609	139	WPNT 4.5
24	4	Tucker Trawl	deploy	1	8/31/13 2:27	71.23166667	150.279983	142	WPNT 4.5
24	4	Tucker Trawl	recover	1	8/31/13 2:48	71.231658	-150.279616	142	WPNT 4.5, trawl hit bottom collecting mud. all samples discarded
24	4	Tucker Trawl	deploy	2	8/31/13 3:12	71.22981667	150.291467	142	WPNT 4.5
24	4	Tucker Trawl	recover	2	8/31/13 3:28	71.230904	-150.279133	142	WPNT 4.5, hit bottom again.
24	4	Bongo Nets	deploy	1	8/31/13 3:45	71.228948	-150.285098	147	WPNT 4.5
24	4	Bongo Nets	recover	1	8/31/13 3:59	71.230181	-150.270124	147	WPNT 4.5
24	4	Tucker Trawl	deploy	3	8/31/13 4:17	71.228679	-150.282398	142	WPNT 4.5
24	4	Tucker Trawl	other	3	8/31/13 4:28	71.229905	-150.269217	142	First messenger trip
24	4	Tucker Trawl	other	3	8/31/13 4:36	71.231364	-150.258281	142	Second messenger trip
24	4	Tucker Trawl	recover	3	8/31/13 4:41	71.232236	-150.251959	142	WPNT 4.5
25	4	CTD911	deploy	25	8/31/13 5:23	71.182731	-150.311038	52	WPNT 4.6
25	4	CTD911	recover	25	8/31/13 5:29	71.182938	-150.312962	52	WP 4.6
26	4	CTD911	deploy	27	8/31/13 6:11	71.13825	-150.344608	47	WPNT 4.7
26	4	CTD911	recover	27	8/31/13 6:17	71.13865	-150.34613	47	WPNT 4.7
26	4	Tucker Trawl	deploy	1	8/31/13 6:36	71.138052	-150.370532	47	WPNT 4.7

26	4	Tucker Trawl	other	1	8/31/13 6:42	71.138857	-150.364708	47	First messenger trip
26	4	Tucker Trawl	other	1	8/31/13 6:44	71.139185	-150.36164	47	Second messenger trip
26	4	Tucker Trawl	recover	1	8/31/13 6:47	71.139604	-150.357516	47	WPNT 4.7
26	4	Bongo Nets	deploy	1	8/31/13 7:02	71.139032	-150.368233	47	WPNT 4.7
26	4	Bongo Nets	recover	1	8/31/13 7:10	71.140124	-150.358198	47	WPNT 4.7
27	4	CTD911	deploy	27	8/31/13 7:56	71.092579	-150.373831	34	WPNT 4.8
27	4	CTD911	recover	27	8/31/13 8:00	71.092678	-150.374806	34	WPNT 4.8
NaN	NaN	OS150	stop	NaN	8/31/13 9:56	71.150531	-151.067912		Stopped to change # of Bins from 60 to 65
NaN	NaN	OS150	start	NaN	8/31/13 10:13	71.157561	-151.184949		File SKQ201713S_2 was stopped because I was not getting data. Shutdown program and started again with _3
NaN	NaN	EK60	stop	NaN	8/31/13 10:44	71.171944	-151.398259		EK60 stopped and computer restarted due to screen freeze up.
NaN	NaN	EK60	start	NaN	8/31/13 10:45	71.17243	-151.405115		
28	1	CTD911	deploy	28	8/31/13 11:25	71.182166	-151.591264	42	WPT 1.8
28	1	CTD911	recover	28	8/31/13 11:32	71.182219	-151.591274	42	WPNT 1.8
29	1	CTD911	deploy	29	8/31/13 12:16	71.227209	-151.564099	50	WPNT 1.7
29	1	CTD911	recover	29	8/31/13 12:20	71.227133	-151.564103	50	WPNT 1.7
30	1	CTD911	deploy	30	8/31/13 13:04	71.272334	-151.537187	50	WPT 1.6
30	1	CTD911	recover	30	8/31/13 13:09	71.272515	-151.5372	50	WPNT 1.6
31	1	CTD911	deploy	31	8/31/13 13:51	71.318511	-151.510074	56	WPNT 1.5
31	1	CTD911	recover	31	8/31/13 13:56	71.319259	-151.510457	56	WPNT 1.5
32	1	CTD911	deploy	32	8/31/13 14:33	71.363783	-151.483882	164	WPNT 1.4
32	1	CTD911	recover	32	8/31/13 14:46	71.366609	-151.4871	164	WPNT 1.4
33	1	CTD911	deploy	33	8/31/13 15:22	71.408913	-151.457446	200	WPNT 1.3
33	1	CTD911	recover	33	8/31/13 15:35	71.411198	-151.459949	200	WPNT 1.3

34	1	CTD911	deploy	34	8/31/13 16:17	71.454633	-151.427355	471	WPNT 1.2
34	1	CTD911	recover	34	8/31/13 16:39	71.455144	-151.427293	417	WPNT 1.2
35	1	CTD911	deploy	35	8/31/13 17:21	71.499901	-151.400096	924	WPNT 1.1
35	1	CTD911	recover	35	8/31/13 17:23	71.499987	-151.40015	924	wpnt 1.1
36	2	CTD911	deploy	36	8/31/13 19:14	71.46968	-150.989061	1192	WPNT 2.1
36	2	CTD911	recover	36	8/31/13 19:34	71.469676	-150.989045	1192	WPNT 2.1
37	2	CTD911	deploy	37	8/31/13 20:16	71.425731	-151.017244	383	WPNT 2.2
37	2	CTD911	recover	37	8/31/13 20:43	71.428493	-151.017999	383	WPNT 2.2
37	2	Tucker Trawl	deploy	1	8/31/13 20:56	71.42962	-151.0145	470	WPNT 2.2
37	2	Tucker Trawl	deploy	1	8/31/13 21:15	71.431247	-150.985749	470	First messenger trip
37	2	Tucker Trawl	other	1	8/31/13 21:25	71.431861	-150.971276	470	Second messenger trip
37	2	Tucker Trawl	recover	1	8/31/13 21:39	71.432146	-150.953176	470	WPNT 2.2
37	2	Bongo Nets	deploy	1	8/31/13 21:48	71.432071	-150.950088	461	WPNT 2.2
37	2	Bongo Nets	recover	1	8/31/13 22:10	71.433011	-150.921672	461	WPNT 2.2
NaN	NaN	EM302	stop	NaN	8/31/13 22:15	71.433785	-150.920983		speeding up transmit interval for ek60
38	2	Fish Net	deploy		8/31/13 23:55	71.404495	-151.105708		WPNT 2.25
38	2	Fish Net	At Target Depth		9/1/13 0:33	71.402357	-151.069451		WPNT 2.25
38	2	Fish Net	other		9/1/13 0:52	71.400399	-151.034162		370m wire out; 40-45 degree wire angle
38	2	Fish Net	End Target Depth		9/1/13 1:13	71.394793	-150.993924		WPNT 2.25
38	2	Fish Net	recover		9/1/13 1:44	71.408059	-150.96162		WPNT 2.25
38	2	CTD911	deploy	38	9/1/13 2:51	71.378972	-151.042679	237	WPNT 2.3
38	2	CTD911	recover	38	9/1/13 3:08	71.37898	-151.042686	237	WPNT 2.3
39	2	CTD911	deploy	39	9/1/13 3:42	71.333098	-151.072638	157	WPNT 2.4

39	2	CTD911	recover	39	9/1/13 4:04	71.334085	-151.076708	157	WPNT 2.4
39	2	Bongo Nets	deploy	1	9/1/13 4:20	71.333239	-151.097405	147	WPNT 2.4
39	2	Bongo Nets	recover	1	9/1/13 4:30	71.33487	-151.086634	147	WPNT 2.4
39	2	Tucker Trawl	deploy	1	9/1/13 4:43	71.334551	-151.096314	158	WPNT 2.4
39	2	Tucker Trawl	other	1	9/1/13 4:53	71.336288	-151.086558	158	1st net trips
39	2	Tucker Trawl	other	1	9/1/13 4:58	71.337078	-151.08191	158	2nd messenger trips 2 & 3rd nets
39	2	Tucker Trawl	recover	1	9/1/13 5:01	71.33759	-151.078993	158	WPNT 2.4
39	2	Tucker Trawl	recover	1	9/1/13 5:01	71.33759	-151.078993	158	WPNT 2.4
40	2	CTD911	deploy	40	9/1/13 5:28	71.310435	-151.087679	67	WPNT 2.45
40	2	CTD911	recover	40	9/1/13 5:40	71.310864	-151.089366	67	WPNT 2.45
41	2	CTD911	deploy	41	9/1/13 6:01	71.2881	-151.100721	58	WPNT 2.5
41	2	CTD911	recover	41	9/1/13 6:13	71.288782	-151.102129	58	WPNT 2.5
42	2	CTD911	deploy	42	9/1/13 6:50	71.24284	-151.12841	54	WPNT 2.6
42	2	CTD911	recover	42	9/1/13 6:52	71.242876	-151.129244	54	WPNT 2.6
42	2	Tucker Trawl	deploy	1	9/1/13 7:14	71.241499	-151.161651	52	WPNT 2.6
42	2	Tucker Trawl	other	1	9/1/13 7:19	71.241972	-151.157391	52	Messenger 1 Trip
42	2	Tucker Trawl	other	1	9/1/13 7:21	71.242101	-151.156055	52	Messenger 2 Trip
42	2	Tucker Trawl	recover	1	9/1/13 7:22	71.242191	-151.155117	52	WPNT 2.6
NaN	2	CTD911	other	NaN	9/1/13 7:26	71.242378	-151.153919	52	CTD kept at surface due to thruster alarm. Seabird Program stopped and restarted at end of alarm.
42	2	Bongo Nets	deploy	1	9/1/13 7:29	71.242412	-151.154978	52	Mud sample taken from weights.
42	2	Bongo Nets	recover	1	9/1/13 7:38	71.243552	-151.147667	52	

43	2	CTD911	deploy	43	9/1/13 8:16	71.197438	-151.157229	52	WPNT 2.7
43	2	CTD911	recover	43	9/1/13 8:22	71.197441	-151.157211	52	WPNT 2.7
44	2	CTD911	deploy	44	9/1/13 9:03	71.152239	-151.185256	36	WPNT 2.8
44	2	CTD911	recover	44	9/1/13 9:09	71.152238	-151.185244	36	WPNT 2.8
44	2	Bongo Nets	deploy	1	9/1/13 9:34	71.151665	-151.2119	36	WPNT 2.8
44	2	Bongo Nets	recover	1	9/1/13 9:39	71.151962	-151.205571	36	WPNT 2.8
44	2	Tucker Trawl	deploy	1	9/1/13 9:56	71.151662	-151.20843	51	WPNT 2.8, Single net (N3)
44	2	Tucker Trawl	recover	1	9/1/13 10:01	71.152048	-151.199944	51	WPNT 2.8, 52 Artic cod caught in single net deployment
45	2	CTD911	deploy	45	9/1/13 10:40	71.107152	-151.213806	21	WPNT 2.9
45	2	CTD911	deploy	45	9/1/13 10:43	71.10714	-151.213807	21	WPNT 2.9
46	2	CTD911	deploy	46	9/1/13 11:26	71.061584	-151.241143	22	WPNT 2.10
46	2	CTD911	recover	46	9/1/13 11:32	71.061594	-151.241122	22	WPNT 2.10
46	2	Tucker Trawl	deploy	1	9/1/13 11:55	71.060045	-151.267007	22	WPNT 2.10, Single net (N3)
46	2	Tucker Trawl	recover	1	9/1/13 11:59	71.060233	-151.261646	22	WPNT 2.10
46	2	Bongo Nets	deploy	1	9/1/13 12:14	71.060173	-151.266981	22	WPNT 2.10
46	2	Bongo Nets	recover	1	9/1/13 12:17	71.060414	-151.263153	22	WPNT 2.10
47	3	CTD911	deploy	47	9/1/13 13:45	71.032939	-150.837732	22	WPNT 3.10
47	3	CTD911	recover	47	9/1/13 13:48	71.03295	-150.837749	22	WPNT 3.10
48	3	CTD911	deploy	48	9/1/13 14:23	71.078697	-150.807416	24	WPNT 3.9
48	3	CTD911	recover	48	9/1/13 14:25	71.078755	-150.807541	24	WPNT 3.9
NaN	NaN	UNCSW	service	NaN	9/1/13 14:35	71.082958	-150.804521		changed strainer
49	3	CTD911	deploy	49	9/1/13 15:06	71.123952	-150.780285	34	WPNT 3.8
49	3	CTD911	recover	49	9/1/13 15:10	71.12385	-150.779992	34	WPNT 3.8
50	3	CTD911	deploy	50	9/1/13 15:52	71.169098	-150.751331	50	WPNT 3.7
50	3	CTD911	recover	50	9/1/13 15:56	71.169094	-150.751326	50	WPNT 3.7
NaN	3	Acrobat	deploy	NaN	9/1/13 16:22	71.175079	-150.747316	51	line 3 heading offshore

NaN	3	Acrobat	deploy	NaN	9/1/13 18:08	71.329747	-150.700257	51	Line 3, stopping for fish trawl
51	3	Fish Net	deploy		9/1/13 20:29	71.31882	-150.859818		WPNT 3.4
51	3	Fish Net	At Target Depth		9/1/13 21:22	71.318865	-150.78202		WPNT 3.4
51	3	Fish Net	End Target Depth		9/1/13 22:41	71.292105	-150.673681		WPNT 3.4
51	3	Fish Net	recover		9/1/13 23:36	71.310559	-150.62148		WPNT 3.4
51	3	CTD911	deploy	51	9/2/13 3:44	71.300423	-150.707462	275	FIsh Trawl Site
51	3	CTD911	recover	51	9/2/13 4:08	71.301253	-150.707892	275	Fish Trawl Site
51	2	Tucker Trawl	deploy	1	9/2/13 4:25	71.301526	-150.705227	282	location of fish trawl
51	2	Tucker Trawl	other	1	9/2/13 4:40	71.301785	-150.685347	282	Messenger 1 Trip
51	2	Tucker Trawl	other	1	9/2/13 4:49	71.301961	-150.673124	282	Messenger 2 Trip
51	2	Tucker Trawl	recover	1	9/2/13 4:55	71.302079	-150.66487	282	
52	2	CTD911	deploy	52	9/2/13 6:27	71.469774	-150.989597	1207	WPNT 2.1
52	2	CTD911	recover	52	9/2/13 7:10	71.423828	-151.016797	1207	WPNT 2.1
53	2	CTD911	deploy	53	9/2/13 7:34	71.423746	-151.01677	371	WPNT 2.2
53	2	CTD911	recover	53	9/2/13 7:59	71.424362	-151.016834	371	WPNT 2.2
53	2	Tucker Trawl	deploy	1	9/2/13 8:21	71.424738	-151.047038	499	WPNT 2.2
53	2	Tucker Trawl	other	1	9/2/13 8:35	71.424106	-151.034713	499	1st net trips
53	2	Tucker Trawl	other	1	9/2/13 8:42	71.424016	-151.02757	499	2nd messenger trips 2 & 3rd nets
53	2	Tucker Trawl	recover	1	9/2/13 8:48	71.424027	-151.022648	499	WPNT 2.2
53	2	Bongo Nets	deploy	1	9/2/13 9:06	71.425383	-151.044867	487	WPNT 2.2
53	2	Bongo Nets	recover	1	9/2/13 9:29	71.424178	-151.027791	487	WPNT 2.2
54	2	CTD911	deploy	54	9/2/13 10:01	71.378359	-151.04494	233	WPNT 2.3
54	2	CTD911	recover	54	9/2/13 10:15	71.378534	-151.04518	233	WPNT 2.3

55	2	CTD911	deploy	55	9/2/13 10:51	71.33346	-151.072674	157	WPNT 2.4
55	2	CTD911	recover	55	9/2/13 11:06	71.33347	-151.072641	157	WPNT 2.4
55	2	Bongo Nets	deploy	1	9/2/13 11:27	71.335774	-151.104096	160	WPNT 2.4
55	2	Bongo Nets	recover	1	9/2/13 11:38	71.334324	-151.092804	160	WPNT 2.4
55	2	Trawl Tucker	deploy	1	9/2/13 11:52	71.335009	-151.098176	162	WPNT 2.4
55	2	Trawl Tucker	other	1	9/2/13 12:00	71.334235	-151.089837	162	1st net trips
55	2	Trawl Tucker	other	1	9/2/13 12:04	71.333889	-151.086001	162	2nd messenger trips 2 & 3rd nets
55	2	Trawl	recover	1	9/2/13 12:07	71.333495	-151.081883	162	WPNT 2.4
56	2	CTD911	deploy	56	9/2/13 12:30	71.310499	-151.087392	67	WPNT 2.45
56	2	CTD911	recover	56	9/2/13 12:37	71.310503	-151.087367	67	WPNT 2.45
57	2	CTD911	deploy	57	9/2/13 13:01	71.288052	-151.100645	58	WPNT 2.5
57	2	CTD911	recover	57	9/2/13 13:08	71.288045	-151.100647	58	WPNT 2.5
58	2	CTD911	deploy	58	9/2/13 13:44	71.242683	-151.128665	53	WPNT 2.6
58	2	CTD911	recover	58	9/2/13 13:51	71.242682	-151.128666	53	WPNT 2.6
58	2	Trawl Tucker	deploy	1	9/2/13 14:10	71.243951	-151.150035	54	WPNT 2.6
58	2	Trawl Tucker	other	1	9/2/13 14:13	71.243543	-151.144739	54	1st net trips
58	2	Trawl Tucker	other	1	9/2/13 14:16	71.243185	-151.141658	54	2nd messenger trips 2 & 3rd nets
58	2	Trawl	recover	1	9/2/13 14:17	71.243051	-151.140182	54	WPNT 2.6
58	2	Bongo Nets	deploy	1	9/2/13 14:31	71.243634	-151.147007	53	WPNT 2.6
58	2	Bongo Nets	recover	1	9/2/13 14:36	71.241869	-151.138508	53	WPNT 2.6
59	2	CTD911	deploy	59	9/2/13 15:01	71.197486	-151.156016	53	WPNT 2.7
59	2	CTD911	recover	59	9/2/13 15:12	71.197232	-151.156048	53	WPNT 2.7
60	2	CTD911	deploy	60	9/2/13 15:40	71.152557	-151.183143	37	WPNT 2.8
60	2	CTD911	recover	60	9/2/13 15:53	71.152494	-151.183079	37	WPNT 2.8

60	2	Bongo Nets	deploy	1	9/2/13 16:11	71.153769	-151.194145	37	WPNT 2.8
60	2	Bongo Nets	recover	1	9/2/13 16:17	71.153352	-151.183514	37	WPNT 2.8
60	2	Tucker Trawl	deploy	1	9/2/13 16:38	71.152397	-151.202622	36	WPNT 2.8, Double oblique haul- 1 net
60	2	Tucker Trawl	recover	1	9/2/13 16:46	71.152209	-151.184261	36	WPNT 2.8, Double oblique haul- 1 net
61	2	CTD911	deploy	61	9/2/13 17:19	71.107186	-151.212385	21.5	WPNT 2.9
61	2	CTD911	recover	61	9/2/13 17:24	71.107178	-151.212392	21.5	WPNT 2.9
62	2	CTD911	deploy	62	9/2/13 17:59	71.061359	-151.241079	23	WPNT 2.10
62	2	CTD911	recover	62	9/2/13 18:05	71.061357	-151.241072	23	WPNT 2.10
62	2	Tucker Trawl	deploy	1	9/2/13 18:20	71.0633	-151.248575	22	WPNT 2.10
62	2	Tucker Trawl	recover	1	9/2/13 18:29	71.060378	-151.238882	22	WPNT 2.10
62	2	Bongo Nets	deploy	1	9/2/13 18:39	71.061292	-151.241238	21.5	WPNT 2.10
62	2	Bongo Nets	recover	1	9/2/13 18:48	71.065287	-151.252998	21.5	WPNT 2.10, Double oblique haul
NaN	3	Acrobat	deploy	3c	9/2/13 20:11	71.03461	-150.837099	21	
NaN	3	Acrobat	recover	3c	9/2/13 22:51	71.249278	-150.700178	21	
63	3	CTD911	deploy	63	9/2/13 23:08	71.260481	-150.692812	85	WPNT 3.5
63	3	CTD911	recover	63	9/2/13 23:16	71.260664	-150.693951	85	WPNT 3.5
64	3	Fish Net	deploy		9/3/13 1:09	71.309413	-150.759917		WPNT 3.4
64	3	Fish Net	recover		9/3/13 3:06	71.279986	-150.591171		WPNT 3.4
64	3	CTD911	deploy	64	9/3/13 5:20	71.284583	-150.609277	225	Fish Trawl
64	3	CTD911	recover	64	9/3/13 5:35	71.284583	-150.609296	225	Fish Trawl
64	3	Tucker Trawl	deploy	1	9/3/13 5:56	71.288571	-150.624558	249	Fish Trawl
64	3	Tucker Trawl	other	1	9/3/13 6:05	71.285566	-150.617287	249	1st net trips
64	3	Tucker Trawl	other	1	9/3/13 6:10	71.283958	-150.6124	249	2nd messenger trips 2 & 3rd nets

64	3	Tucker Trawl	recover	1	9/3/13 6:13	71.283032	-150.609714	249	Fish Trawl
65	3	CTD911	deploy	65	9/3/13 7:03	71.215091	-150.720502	58	WPNT 3.6
65	3	CTD911	recover	65	9/3/13 7:08	71.215444	-150.72085	58	WPNT 3.6
66	3	CTD911	deploy	66	9/3/13 7:52	71.282561	-150.677101	185	WPNT 3.45
66	3	CTD911	recover	66	9/3/13 7:52	71.282561	-150.677101	185	WPNT 3.45
67	3	CTD911	deploy	67	9/3/13 8:33	71.30547	-150.664201	385	WPNT 3.4
67	3	CTD911	recover	67	9/3/13 8:53	71.305474	-150.664211	385	WPNT 3.4
68	3	CTD911	recover	68	9/3/13 9:41	71.351136	-150.634454	1017	WPNT 3.3
68	3	CTD911	recover	68	9/3/13 10:03	71.351128	-150.634468	1017	WPNT 3.3
69	3	CTD911	deploy	69	9/3/13 10:36	71.396311	-150.605822	1317	WPNT 3.2
69	3	CTD911	recover	69	9/3/13 10:57	71.396315	-150.605827	1317	WPNT 3.2
70	3	CTD911	deploy	70	9/3/13 11:29	71.438668	-150.576548	1566	WPNT 3.1
70	3	CTD911	recover	70	9/3/13 11:50	71.438651	-150.576572	1566	WPNT 3.1
71	2	CTD911	deploy	71	9/3/13 13:00	71.469339	-150.987744	1207	WPNT 2.1
71	2	CTD911	recover	71	9/3/13 13:21	71.46934	-150.987749	1207	WPNT 2.1
72	2	CTD911	deploy	72	9/3/13 14:01	71.424874	-151.015371	378	WPNT 2.2
72	2	CTD911	recover	72	9/3/13 14:23	71.424783	-151.015432	378	WPNT 2.2
72	2	Tucker Trawl	deploy	1	9/3/13 14:47	71.425649	-151.040936	493	WPNT 2.2
72	2	Tucker Trawl	other	1	9/3/13 15:02	71.425353	-151.019348	493	1st net trips
72	2	Tucker Trawl	other	1	9/3/13 15:09	71.425173	-151.009723	493	2nd messenger trips 2 & 3rd nets
72	2	Tucker Trawl	recover	1	9/3/13 15:14	71.425179	-151.00293	493	WPNT 2.2
72	2	Bongo Nets	deploy	1	9/3/13 15:32	71.42712	-151.03837	501	WPNT 2.2
72	2	Bongo Nets	recover	1	9/3/13 15:52	71.426434	-151.012101	501	WPNT 2.2
73	2	CTD911	deploy	73	9/3/13 16:28	71.379043	-151.043829	238	WPNT 2.3
73	2	CTD911	recover	73	9/3/13 16:36	71.379236	-151.04404	238	WPNT 2.3
74	2	Fish Net	deploy		9/3/13 18:11	71.416139	-151.197548		WPNT 2.3

74	2	Fish Net	recover		9/3/13 20:04	71.39407	-151.031651		WPNT 2.3
74	2	CTD911	deploy	74	9/3/13 23:06	71.406778	-151.130892	275	Fish Trawl Site
74	2	CTD911	recover	74	9/3/13 23:22	71.407351	-151.130587	275	Fish Trawl Site
74	2	Tucker Trawl	deploy	74	9/3/13 23:42	71.410446	-151.155985	275	Fish Trawl Site
74	2	Tucker Trawl	other	74	9/3/13 23:53	71.40978	-151.139252	275	Fish Trawl SIte - First Net
74	2	Tucker Trawl	other	74	9/4/13 0:02	71.409569	-151.128186	275	Fish Trawl SIte - 2nd Net
74	2	Tucker Trawl	recover	74	9/4/13 0:08	71.40933	-151.119192	275	Fish Trawl Site
NaN	NaN	UNCSW	service	NaN	9/4/13 0:23	71.390206	-151.10024		changed to clean strainer
75	2	CTD911	deploy	75	9/4/13 1:00	71.333581	-151.074327	157	WPNT 2.4
75	2	CTD911	recover	75	9/4/13 1:16	71.33357	-151.074338	157	WPNT 2.4
75	2	Tucker Trawl	deploy	1	9/4/13 1:35	71.334141	-151.099907	155	extra lead weights added to bottom of trawl
75	2	Tucker Trawl	other	1	9/4/13 1:42	71.33403	-151.091127	155	1st net trips
75	2	Tucker Trawl	other	1	9/4/13 1:45	71.334005	-151.086428	155	2nd messenger trips
75	2	Tucker Trawl	recover	1	9/4/13 1:49	71.334018	-151.081112	155	WPNT 2.4
75	2	Bongo Nets	deploy	1	9/4/13 1:59	71.334022	-151.07599	155	WPNT 2.4
75	2	Bongo Nets	recover	1	9/4/13 2:10	71.33358	-151.074322	155	WPNT 2.4
76	2	CTD911	deploy	76	9/4/13 2:38	71.31055	-151.086306	70	WPNT 2.45
76	2	CTD911	recover	76	9/4/13 2:44	71.310548	-151.086318	70	WPNT 2.45
77	2	CTD911	deploy	77	9/4/13 3:07	71.287177	-151.100061	58	WPNT 2.5
77	2	CTD911	recover	77	9/4/13 3:11	71.287272	-151.100271	58	WPNT 2.5
78	2	CTD911	deploy	78	9/4/13 3:44	71.242525	-151.128688	53	WPNT 2.6
78	2	CTD911	recover	78	9/4/13 3:52	71.242528	-151.12867	53	WPNT 2.6
78	2	Bongo Nets	deploy	1	9/4/13 4:09	71.238972	-151.148474	53	WPNT 2.6
78	2	Bongo Nets	recover	1	9/4/13 4:20	71.241381	-151.135439	53	WPNT 2.6

78	2	Tucker Trawl	deploy	1	9/4/13 4:32	71.240312	-151.142441	54	WPNT 2.6
78	2	Tucker Trawl	other	1	9/4/13 4:37	71.241371	-151.136606	54	first messenger trips nets 1 & 2
78	2	Tucker Trawl	other	1	9/4/13 4:40	71.242409	-151.130976	54	2nd messenger trips 2 & 3rd nets
78	2	Tucker Trawl	recover	1	9/4/13 4:43	71.243106	-151.127159	54	WPNT 2.6
79	2	CTD911	deploy	79	9/4/13 5:16	71.197368	-151.15549	51	WPNT 2.7
79	2	CTD911	recover	79	9/4/13 5:22	71.197397	-151.155538	51	WPNT 2.7
80	2	CTD911	deploy	80	9/4/13 5:58	71.15233	-151.184311	37	WPNT 2.8
80	2	CTD911	recover	80	9/4/13 6:04	71.152325	-151.184269	37	WPNT 2.8
80	2	Tucker Trawl	deploy	1	9/4/13 6:23	71.150178	-151.196851	35	WPNT 2.8
80	2	Tucker Trawl	other	1	9/4/13 6:29	71.151421	-151.18785	35	end net 1- start net2
80	2	Tucker Trawl	other	1	9/4/13 6:32	71.152102	-151.182901	35	WPNT 2.8
80	2	Tucker Trawl	recover	1	9/4/13 6:34	71.1527	-151.178462	35	WPNT 2.8
80	2	Bongo Nets	deploy	1	9/4/13 6:50	71.14946	-151.200694	36.8	WPNT 2.8
80	2	Bongo Nets	recover	1	9/4/13 6:59	71.151617	-151.188452	36.8	WPNT 2.8
81	2	CTD911	deploy	81	9/4/13 7:36	71.10682	-151.214225	22	WPNT 2.9
81	2	CTD911	recover	81	9/4/13 7:40	71.106817	-151.214217	22	WPNT 2.9
82	2	CTD911	deploy	82	9/4/13 8:18	71.061707	-151.241024	22	WPNT 2.10
82	2	CTD911	recover	82	9/4/13 8:25	71.061699	-151.241028	22	WPNT 2.10
82	2	Bongo Nets	deploy	1	9/4/13 8:46	71.062116	-151.269672	22	WPNT 2.10
82	2	Bongo Nets	recover	1	9/4/13 8:57	71.060359	-151.256052	22	Double oblique haul
82	2	Tucker Trawl	deploy	1	9/4/13 9:14	71.06307	-151.267855	22	WPNT 2.10
82	2	Tucker Trawl	recover	1	9/4/13 9:20	71.063115	-151.260639	22	Single net (N3)
Waypoint	4	Acrobat	deploy		9/4/13 19:09	71.184122	-150.31369		More weight on tow body

4.6									
	4	Acrobat	recover		9/4/13 20:44	71.307833	-150.236607		Lost ethernet data
83	4	Fish Net	deploy	1	9/4/13 22:54	71.286132	-150.482445		WPNT 4.4
83	4	Fish Net	At Target Depth	1	9/4/13 23:31	71.277155	-150.429898		WPNT 4.4
83	4	Fish Net	End Target Depth	1	9/5/13 0:17	71.266566	-150.356658		WPNT 4.4
83	4	Fish Net	recover	1	9/5/13 0:48	71.259809	-150.315269		WPNT 4.4
83	4	Fish Net	deploy	2	9/5/13 2:38	71.305035	-150.545062		WPNT 4.4
83	4	Fish Net	At Target Depth	2	9/5/13 3:16	71.294195	-150.490702		WPNT 4.4
83	4	Fish Net	End Target Depth	2	9/5/13 4:07	71.27838	-150.416209		WPNT 4.4
83	4	Fish Net	recover	2	9/5/13 4:40	71.269691	-150.373273		WPNT 4.4
83	4	CTD911	deploy	83	9/5/13 5:50	71.275605	-150.427206	312	Fish Trawl
83	4	CTD911	recover	83	9/5/13 6:07	71.275607	-150.427201	312	Fish Trawl
83	4	Tucker Trawl	deploy	1	9/5/13 6:29	71.278314	-150.450401	334	Fish Trawl
83	4	Tucker Trawl	other	1	9/5/13 6:42	71.27627	-150.432468	334	1st net trips
83	4	Tucker Trawl	other	1	9/5/13 6:49	71.275196	-150.422874	334	2nd messenger trips 2 & 3rd nets
83	4	Tucker Trawl	recover	1	9/5/13 6:54	71.274568	-150.41689	334	Fish Trawl
84	4	CTD911	deploy	84	9/5/13 7:58	71.363006	-150.195453	1349	WPNT 4.2
84	4	CTD911	recover	84	9/5/13 8:20	71.363009	-150.195468	1349	WPNT 4.2
85	4	CTD911	deploy	85	9/5/13 9:00	71.318325	-150.224856	1184	WPNT 4.3
85	4	CTD911	recover	85	9/5/13 9:22	71.318323	-150.224849	1184	WPNT 4.3
86	4	CTD911	deploy	86	9/5/13 10:02	71.273489	-150.25438	890	WPNT 4.4
86	4	CTD911	recover	86	9/5/13 10:25	71.273496	-150.254316	890	WPNT 4.4
86	4	Tucker Trawl	deploy	1	9/5/13 10:48	71.27538	-150.281745	696	WPNT 4.4
86	4	Tucker	other	1	9/5/13 11:00	71.274263	-150.270437	696	1st net trips

86	4	Tucker Trawl	other	1	9/5/13 11:06	71.273457	-150.264151	696	2nd messenger trips 2 & 3rd nets
86	4	Tucker Trawl	recover	1	9/5/13 11:11	71.272868	-150.259679	696	WPNT 4.4
86	4	Bongo Nets	deploy	1	9/5/13 11:34	71.276034	-150.286117	890	WPNT 4.4
86	4	Bongo Nets	recover	1	9/5/13 11:52	71.274417	-150.269408	890	WPNT 4.4
87	4	CTD911	deploy	87	9/5/13 12:27	71.228099	-150.284577	142	WPNT 4.5
87	4	CTD911	recover	87	9/5/13 12:43	71.228083	-150.284581	142	WPNT 4.5
87	4	Tucker Trawl	deploy	1	9/5/13 13:03	71.228909	-150.308801	141	WPNT 4.5
87	4	Tucker Trawl	other	1	9/5/13 13:08	71.228815	-150.301071	141	1st net trips
87	4	Tucker Trawl	other	1	9/5/13 13:12	71.228934	-150.296496	141	2nd messenger trips 2 & 3rd nets
87	4	Tucker Trawl	recover	1	9/5/13 13:15	71.229131	-150.293175	141	WPNT 4.5
88	4	CTD911	deploy	88	9/5/13 13:43	71.205613	-150.299399	61	WPNT 4.55
88	4	CTD911	recover	88	9/5/13 13:48	71.205615	-150.299385	61	WPNT 4.55
89	4	CTD911	deploy	89	9/5/13 14:11	71.182873	-150.313167	52	WPNT 4.6
89	4	CTD911	recover	89	9/5/13 14:18	71.182867	-150.31313	52	WPNT 4.6
89	4	Tucker Trawl	deploy	1	9/5/13 14:37	71.184874	-150.340956	52	WPNT 4.6
89	4	Tucker Trawl	other	1	9/5/13 14:42	71.184492	-150.334196	52	1st net trips
89	4	Tucker Trawl	other	1	9/5/13 14:46	71.184242	-150.326591	52	2nd messenger trips 2 & 3rd nets
89	4	Tucker Trawl	recover	1	9/5/13 14:51	71.184001	-150.320124	52	WPNT 4.6
89	4	Bongo Nets	deploy	1	9/5/13 15:04	71.186024	-150.341104	52	WPNT 4.6
89	4	Bongo Nets	recover	1	9/5/13 15:14	71.185853	-150.325654	52	WPNT 4.6
90	4	CTD911	deploy	90	9/5/13 15:45	71.137819	-150.342798	47	WPNT 4.7
90	4	CTD911	recover	90	9/5/13 15:50	71.137812	-150.342791	47	WPNT 4.7

91	4	CTD911	deploy	91	9/5/13 16:32	71.092672	-150.373671	35	WPNT 4.8
91	4	CTD911	recover	91	9/5/13 16:37	71.092668	-150.373661	35	WPNT 4.8
91	4	Bongo Nets	deploy	1	9/5/13 16:56	71.094594	-150.398258	35	WPNT 4.8
91	4	Bongo Nets	recover	1	9/5/13 17:06	71.093606	-150.384653	35	WPNT 4.8
91	4	Tucker Trawl	deploy	1	9/5/13 17:23	71.094952	-150.397954	34	WPNT 4.8
91	4	Tucker Trawl	recover	1	9/5/13 17:39	71.093731	-150.373439	34	WPNT 4.8
92	4	CTD911	deploy	92	9/5/13 18:18	71.047575	-150.403493	26	WPNT 4.9
92	4	CTD911	recover	92	9/5/13 18:25	71.04757	-150.403476	26	WPNT 4.9
93	4	CTD911	deploy	93	9/5/13 19:10	71.002595	-150.433404	24	WPNT 4.10
93	4	CTD911	recover	93	9/5/13 19:15	71.002597	-150.433386	24	WPNT 4.10
93	4	Tucker Trawl	deploy	1	9/5/13 19:30	71.001466	-150.441372	24	WPNT 4.10
93	4	Tucker Trawl	recover	1	9/5/13 19:39	71.003134	-150.426916	24	WPNT 4.10
93	4	Bongo Nets	deploy	1	9/5/13 19:54	71.0022	-150.441798	24	WPNT 4.10
93	4	Bongo Nets	recover	1	9/5/13 19:59	71.003661	-150.433138	24	WPNT 4.10
NaN	NaN	Ship	other	NaN	9/5/13 23:47	70.996663	-150.30815		bled air from speed log
94	5	CTD911	deploy	94	9/6/13 1:01	70.973009	-150.029097	22	WPNT 5.10
94	5	CTD911	recover	94	9/6/13 1:03	70.97291	-150.029081	22	WPNT 5.10
95	5	CTD911	deploy	95	9/6/13 1:47	71.017803	-149.998924	30	WPNT 5.9
95	5	CTD911	recover	95	9/6/13 1:50	71.017906	-149.998942	30	WPNT 5.9
96	5	CTD911	deploy	96	9/6/13 2:25	71.063746	-149.969055	30	WPNT 5.8
96	5	CTD911	recover	96	9/6/13 2:29	71.063718	-149.969096	30	WPNT 5.8
97	5	CTD911	recover	97	9/6/13 3:01	71.10893	-149.937238	42	WPNT 5.7
97	5	CTD911	deploy	97	9/6/13 3:02	71.108963	-149.937468	42	WPNT 5.7
98	5	CTD911	deploy	98	9/6/13 3:48	71.153019	-149.9086	51	WPNT 5.6
98	5	CTD911	recover	98	9/6/13 3:52	71.153286	-149.908828	51	WPNT 5.6
99	5	CTD911	deploy	99	9/6/13 4:19	71.175459	-149.8923	53	WPNT 5.55

99	5	CTD911	recover	99	9/6/13 4:23	71.175772	-149.892593	53	WPNT 5.55
100	5	CTD911	deploy	100	9/6/13 4:48	71.197405	-149.876674	81	WPNT 5.5
100	5	CTD911	recover	100	9/6/13 4:54	71.198028	-149.877387	81	WPNT 5.5
101	5	CTD911	deploy	101	9/6/13 5:32	71.242549	-149.843874	575	WPNT 5.4
101	5	CTD911	recover	101	9/6/13 5:54	71.243707	-149.844983	575	WPNT 5.4
102	5	CTD911	deploy	102	9/6/13 6:40	71.287438	-149.815423	1126	WPNT 5.3
102	5	CTD911	recover	102	9/6/13 7:01	71.287698	-149.815875	1126	WPNT 5.3
103	5	CTD911	deploy	103	9/6/13 7:39	71.333029	-149.782703	1453	WPNT 5.2
103	5	CTD911	recover	103	9/6/13 8:00	71.333612	-149.785734	1453	WPNT 5.2
104	5	CTD911	deploy	104	9/6/13 8:49	71.378026	-149.753225	1632	WPNT 5.1
104	5	CTD911	recover	104	9/6/13 9:10	71.379983	-149.757513	1632	WPNT 5.1
105	6	CTD911	deploy	105	9/6/13 11:11	71.346065	-149.335305	1719	WPNT 6.1
105	6	CTD911	recover	105	9/6/13 11:33	71.350521	-149.342637	1719	WPNT 6.1
106	6	CTD911	deploy	106	9/6/13 13:12	71.299982	-149.368719	1447	WPNT 6.2
106	6	CTD911	recover	106	9/6/13 13:34	71.303369	-149.372852	1447	WPNT 6.2
107	6	CTD911	deploy	107	9/6/13 15:12	71.2566	-149.401706	824	WPNT 6.3
107	6	CTD911	recover	107	9/6/13 15:23	71.257618	-149.402906	824	WPNT 6.3
NaN	NaN	PCO2	stop	NaN	9/6/13 15:40	71.25924	-149.403869		Restarted PCO2 computer after it froze up.
NaN	NaN	PCO2	start	NaN	9/6/13 15:49	71.257131	-149.38041		
108	6	CTD911	deploy	108	9/6/13 17:11	71.210919	-149.431264	182	WPNT 6.4
108	6	CTD911	recover	108	9/6/13 17:28	71.21164	-149.433327	182	WPNT 6.4
109	6	CTD911	deploy	109	9/6/13 18:27	71.190349	-149.453088	57	WPNT 6.45
109	6	CTD911	recover	109	9/6/13 18:32	71.190386	-149.453178	57	WPNT 6.45
110	6	CTD911	deploy	110	9/6/13 19:17	71.167852	-149.46878	54	WPNT 6.5
110	6	CTD911	recover	110	9/6/13 19:21	71.167847	-149.468767	54	WPNT 6.5
111	6	CTD911	deploy	111	9/6/13 20:25	71.124616	-149.499274	44	WPNT 6.6
111	6	CTD911	recover	111	9/6/13 20:32	71.125416	-149.500148	44	WPNT 6.6
112	6	CTD911	deploy	112	9/6/13 21:44	71.080352	-149.527857	40	WPNT 6.7

112	6	CTD911	recover	112	9/6/13 21:49	71.081132	-149.528697	40	WPNT 6.7
113	6	CTD911	deploy	113	9/6/13 23:10	71.038263	-149.564391	33	WPNT 6.8
113	6	CTD911	recover	113	9/6/13 23:16	71.040036	-149.566381	33	WPNT 6.8
114	6	CTD911	deploy	114	9/7/13 0:44	70.992284	-149.593726	31	wpnt 6.9
114	6	CTD911	recover	114	9/7/13 0:47	70.993123	-149.594625	31	WPNT 6.9
115	6	CTD911	deploy	115	9/7/13 2:00	70.945363	-149.625883	30	WPNT 6.10
115	6	CTD911	recover	115	9/7/13 2:05	70.946115	-149.62654	30	WPNT 6.10
116	7	CTD911	deploy	116	9/7/13 3:27	70.914172	-149.220008	31	WPNT 7.10
116	7	CTD911	recover	116	9/7/13 3:30	70.91434	-149.220144	31	WPNT 7.10
117	7	CTD911	deploy	117	9/7/13 4:03	70.958194	-149.186779	34	WPNT 7.9
117	7	CTD911	recover	117	9/7/13 4:12	70.958964	-149.187527	34	WPNT 7.9
118	7	CTD911	deploy	118	9/7/13 4:50	71.004033	-149.155179	36	WPNT 7.8
118	7	CTD911	recover	118	9/7/13 4:53	71.004159	-149.155327	36	WPNT 7.8
119	7	CTD911	deploy	119	9/7/13 5:32	71.048309	-149.123353	38	WPNT 7.7
119	7	CTD911	recover	119	9/7/13 5:36	71.048599	-149.123755	38	WPNT 7.8
120	7	CTD911	deploy	120	9/7/13 6:11	71.092765	-149.091541	45	WPNT 7.6
120	7	CTD911	recover	120	9/7/13 6:16	71.092857	-149.091636	45	WPNT 7.6
121	7	CTD911	deploy	121	9/7/13 6:55	71.13787	-149.059073	49	WPNT 7.5
121	7	CTD911	recover	121	9/7/13 6:59	71.138168	-149.059457	49	WPNT 7.5
122	7	CTD911	deploy	122	9/7/13 7:34	71.18203	-149.028261	55	WPNT 7.4
122	7	CTD911	recover	122	9/7/13 7:39	71.18218	-149.028399	55	WPNT 7.4
123	7	CTD911	deploy	123	9/7/13 8:08	71.204125	-149.010401	194	WPNT 7.35
123	7	CTD911	recover	123	9/7/13 8:21	71.205251	-149.011971	194	WPNT 7.35
124	7	CTD911	deploy	124	9/7/13 8:50	71.226263	-148.994545	600	WPNT 7.3
124	7	CTD911	recover	124	9/7/13 9:11	71.227274	-148.99545	600	WPNT 7.3
125	7	CTD911	deploy	125	9/7/13 9:52	71.271425	-148.962756	600	WPNT 7.2
125	7	CTD911	recover	125	9/7/13 10:13	71.273256	-148.963768	600	WPNT 7.2
126	7	CTD911	deploy	126	9/7/13 10:53	71.315181	-148.930432	1525	WPNT 7.1

126	7	CTD911	recover	126	9/7/13 11:13	71.317872	-148.932073	1525	WPNT 7.1
NaN	NaN	UNCSW	service	NaN	9/7/13 11:27	71.323562	-148.967527		changed to clean strainer
127	5	CTD911	deploy	127	9/7/13 13:24	71.376116	-149.753109	1627	WPNT 5.1
127	5	CTD911	recover	127	9/7/13 13:44	71.37731	-149.753674	1627	WPNT 5.1
128	5	CTD911	deploy	128	9/7/13 14:22	71.332615	-149.783746	1440	WPNT 5.2
128	5	CTD911	recover	128	9/7/13 14:48	71.3353	-149.78895	1440	WPNT 5.2
128	5	Tucker Trawl	deploy	1	9/7/13 15:07	71.329357	-149.811433	1363	WPNT 5.2
128	5	Tucker Trawl	other	1	9/7/13 15:23	71.334785	-149.794891	1363	1st net trips
128	5	Tucker Trawl	other	1	9/7/13 15:31	71.337158	-149.787875	1363	2nd messenger trips 2 & 3rd nets
128	5	Tucker Trawl	recover	1	9/7/13 15:38	71.339429	-149.780994	1363	WPNT 5.2
129	5	CTD911	deploy	129	9/7/13 16:25	71.286511	-149.813441	1109	WPNT 5.3
129	5	CTD911	recover	129	9/7/13 16:46	71.287674	-149.815115	1109	WNT 5.3
130	5	CTD911	deploy	130	9/7/13 17:24	71.24126	-149.844067	545	WPNT 5.4
130	5	CTD911	recover	130	9/7/13 17:47	71.242204	-149.845688	545	WPNT 5.4
131	5	CTD911	deploy	131	9/7/13 18:14	71.219628	-149.861667	209	WPNT 5.45
131	5	CTD911	recover	131	9/7/13 18:29	71.220107	-149.8616	209	WPNT 5.45
131	5	Tucker Trawl	deploy	1	9/7/13 18:51	71.216893	-149.876771	207	WPNT 5.45
131	5	Tucker Trawl	other	1	9/7/13 19:03	71.220423	-149.861385	207	First messenger trip, maybe double trip
131	5	Tucker Trawl	other	1	9/7/13 19:10	71.223024	-149.850429	207	Second messenger trip, did not feel it
131	5	Tucker Trawl	recover	1	9/7/13 19:15	71.22458	-149.844118	207	WPNT 5.45
131	5	Bongo Nets	deploy	1	9/7/13 19:35	71.218406	-149.871443	207	WPNT 5.45
131	5	Bongo Nets	recover	1	9/7/13 19:52	71.22352	-149.848251	207	WPNT 5.45
132	5	CTD911	deploy	132	9/7/13 20:23	71.198573	-149.874045	83	WPNT 5.5

132	5	CTD911	recover	132	9/7/13 20:30	71.198893	-149.87485	83	WPNT 5.5
133	5	CTD911	recover	133	9/7/13 21:06	71.154511	-149.907272	49	WPNT 5.6
133	5	CTD911	deploy	133	9/7/13 21:13	71.154354	-149.906999	49	WPNT 5.6
133	5	Bongo Nets	deploy	1	9/7/13 21:34	71.150791	-149.928108	47	WPNT 5.6
133	5	Bongo Nets	recover	1	9/7/13 21:43	71.153942	-149.917489	47	WPNT 5.6
133	5	Tucker Trawl	deploy	1	9/7/13 21:54	71.15531	-149.912532	50	WPNT 5.6
133	5	Tucker Trawl	other	1	9/7/13 21:58	71.156584	-149.907093	50	First messenger trip
133	5	Tucker Trawl	other	1	9/7/13 22:01	71.157384	-149.903055	50	Second messenger trip
133	5	Tucker Trawl	recover	1	9/7/13 22:02	71.157737	-149.901443	50	WPNT 5.6
134	5	CTD911	deploy	134	9/7/13 22:51	71.109383	-149.938164	41	WPNT 5.7
134	5	CTD911	recover	134	9/7/13 23:00	71.110361	-149.939882	41	WPNT 5.7
135	5	CTD911	deploy	135	9/7/13 23:37	71.065028	-149.966251	30	WPNT 5.8
135	5	CTD911	recover	135	9/7/13 23:44	71.065661	-149.967447	30	WPNT 5.8
135	5	Tucker Trawl	deploy	1	9/7/13 23:50	71.065509	-149.967599	29	WPNT 5.8, Double Oblique
135	5	Tucker Trawl	recover	1	9/8/13 0:14	71.067594	-149.976884	29	WPNT 5.8, Double Oblique
135	5	Bongo Nets	deploy	1	9/8/13 0:23	70.991325	-149.63611	33	WPNT 5.8
135	5	Bongo Nets	recover	1	9/8/13 0:44	70.992284	-149.593726	33	WPNT 5.8
136	5	CTD911	deploy	136	9/8/13 1:24	71.019336	-149.998086	30	WPNT 5.9
136	5	CTD911	recover	136	9/8/13 1:27	71.019477	-149.998384	30	WPNT 5.9
137	5	CTD911	deploy	137	9/8/13 2:04	70.973662	-150.030337	26	WPNT 5.10
137	5	CTD911	recover	137	9/8/13 2:07	70.974012	-150.031109	26	WPNT 5.10
137	5	Bongo Nets	deploy	1	9/8/13 2:23	70.971448	-150.048211	26	WPNT 5.10
137	5	Bongo Nets	recover	1	9/8/13 2:37	70.974918	-150.026196	26	WPNT 5.10
137	5	Tucker Trawl	deploy	1	9/8/13 2:57	70.97139	-150.045151	26	WPNT 5.10
137	5	Tucker	recover	1	9/8/13 3:10	70.975072	-150.023785	26	WPNT 5.10

		Trawl							
138	2	CTD911	deploy	138	9/8/13 6:02	71.061375	-151.241572	22	WPNT 2.10
138	2	CTD911	recover	138	9/8/13 6:06	71.061368	-151.241574	22	WPNT 2.10
138	2.1	Tucker Trawl	deploy	1	9/8/13 6:20	71.057283	-151.262706	23	WPNT 2.10
138	2.1	Tucker Trawl	recover	1	9/8/13 6:29	71.059382	-151.253297	23	WPNT 2.10
139	2	CTD911	deploy	139	9/8/13 7:02	71.10655	-151.213688	22	WPNT 2.9
139	2	CTD911	recover	139	9/8/13 7:05	71.106548	-151.213678	22	WPNT 2.9
140	2	CTD911	deploy	140	9/8/13 7:36	71.151999	-151.184781	36	WPNT 2.8
140	2	CTD911	recover	140	9/8/13 7:42	71.151998	-151.184804	36	WPNT 2.8
140	2	Tucker Trawl	deploy	1	9/8/13 7:56	71.148021	-151.204854	34	WPNT 2.8
140	2	Tucker Trawl	other	1	9/8/13 7:59	71.149108	-151.200858	34	1st net trips
140	2	Tucker Trawl	other	1	9/8/13 8:03	71.150244	-151.196217	34	2nd messenger trips 2 & 3rd nets
140	2	Tucker Trawl	recover	1	9/8/13 8:04	71.150873	-151.193735	34	WPNT 2.8
141	2	CTD911	deploy	141	9/8/13 8:39	71.197521	-151.156423	53	WPNT 2.7
141	2	CTD911	recover	141	9/8/13 8:44	71.197516	-151.156432	53	WPNT 2.7
142	2	CTD911	deploy	142	9/8/13 9:17	71.242881	-151.128621	55	WPNT 2.6
142	2	CTD911	recover	142	9/8/13 9:23	71.243244	-151.129287	55	WPNT 2.6
142	2	Tucker Trawl	deploy	1	9/8/13 9:39	71.243239	-151.156974	53	WPNT 2.6
142	2	Tucker Trawl	other	1	9/8/13 9:45	71.244041	-151.150883	53	1st net trips
142	2	Tucker Trawl	other	1	9/8/13 9:47	71.244519	-151.146943	53	2nd messenger trips 2 & 3rd nets
142	2	Tucker Trawl	recover	1	9/8/13 9:51	71.245092	-151.142401	53	WPNT 2.6
143	2	CTD911	deploy	143	9/8/13 10:29	71.287813	-151.100519	58	WPNT 2.5
143	2	CTD911	recover	143	9/8/13 10:33	71.288092	-151.100323	58	WPNT 2.5

144	2	CTD911	deploy	144	9/8/13 10:57	71.310753	-151.086445	71	WPNT 2.45
144	2	CTD911	recover	144	9/8/13 11:04	71.310912	-151.086398	71	WPNT 2.45
144	2	Tucker Trawl	deploy	1	9/8/13 11:20	71.311186	-151.110752	75	WPNT 2.45
144	2	Tucker Trawl	other	1	9/8/13 11:25	71.311874	-151.103483	73	1st net trips
144	2	Tucker Trawl	other	1	9/8/13 11:29	71.312504	-151.095771	73	2nd messenger trips 2 & 3rd nets
144	2	Tucker Trawl	recover	1	9/8/13 11:32	71.312971	-151.090229	73	WPNT 2.45
144	2	Bongo Nets	recover	1	9/8/13 11:51	71.310319	-151.110083	73	birthday bongo for bob
144	2	Bongo Nets	recover	1	9/8/13 12:02	71.310768	-151.091662	73	WPNT 2.45
145	2	CTD911	deploy	145	9/8/13 12:28	71.333468	-151.072521	156	WPNT 2.4
145	2	CTD911	recover	145	9/8/13 12:41	71.333461	-151.072513	156	WPNT 2.4
146	2	CTD911	deploy	146	9/8/13 13:19	71.378701	-151.044579	235	WPNT 2.3
146	2	CTD911	recover	146	9/8/13 13:36	71.379669	-151.04409	235	WPNT 2.3
146	2	Tucker Trawl	deploy	1	9/8/13 13:54	71.380012	-151.067545	230	WPNT 2.3
146	2	Tucker Trawl	other	1	9/8/13 14:04	71.381224	-151.049121	230	1st net trips
146	2	Tucker Trawl	other	1	9/8/13 14:10	71.381779	-151.039777	230	2nd messenger trips 2 & 3rd nets
146	2	Tucker Trawl	recover	1	9/8/13 14:15	71.382385	-151.030362	230	WPNT 2.3
NaN	2	EM302	stop	NaN	9/8/13 14:24	71.385621	-151.022915		EM302 off for fish surveying
146	2	Fish Net	deploy		9/8/13 15:36	71.416585	-151.115809		WPNT 2.3
146	2	Fish Net	At Target Depth		9/8/13 16:15	71.406431	-151.062883		WPNT 2.3
146	2	Fish Net	End Target Depth		9/8/13 16:59	71.392269	-151.000883		WPNT 2.3
146	2	Fish Net	recover		9/8/13 17:35	71.381762	-150.957814		WPNT 2.3
147		Mooring	deploy		9/8/13 22:50	71.194128	-148.723621	80	UPE80 mooring
147		CTD911	deploy	147	9/8/13 23:02	71.195966	-148.723692	85	Mooring UPE80

147		CTD911	recover	147	9/8/13 23:08	71.195966	-148.723718	85	Mooring UPE80
148		Mooring	deploy		9/8/13 23:56	71.205247	-148.800037	122	UPE120 mooring
148		CTD911	deploy	148	9/9/13 0:08	71.203974	-148.799404	97	UPE120 Mooring
148		CTD911	recover	148	9/9/13 0:15	71.203971	-148.799423	97	UPE120
		Acrobat	recover		9/9/13 0:25	71.207859	-148.815443		Deep Water Test
149	7	Fish Net	deploy		9/9/13 1:47	71.258126	-148.93482		WPNT 7.2
149	7	Fish Net	At Target Depth		9/9/13 2:29	71.257949	-148.877426		WPNT 7.2
149	7	Fish Net	End Target Depth		9/9/13 3:12	71.257739	-148.799637		WPNT 7.2
149	7	Fish Net	recover		9/9/13 3:59	71.258357	-148.727745		WPNT 7.2
149	7	CTD911	deploy	149	9/9/13 4:41	71.25812	-148.737425	1000	Fish Trawl Near 7.2
149	7	CTD911	recover	149	9/9/13 5:04	71.258644	-148.736624	1000	Fish Trawl Near 7.2
149	7	Tucker Trawl	deploy	1	9/9/13 5:20	71.26016	-148.756499	822	WPNT 7.2
149	7	Tucker Trawl	other	1	9/9/13 5:29	71.259307	-148.749962	822	1st net trips
149	7	Tucker Trawl	other	1	9/9/13 5:35	71.258666	-148.745231	822	2nd messenger trips 2 & 3rd nets
149	7	Tucker Trawl	recover	1	9/9/13 5:38	71.258378	-148.742241	822	WPNT 7.2
150	7	CTD911	deploy	150	9/9/13 6:31	71.227041	-148.993538	610	WPNT 7.3
150	7	CTD911	recover	150	9/9/13 6:53	71.228108	-148.999165	610	WPNT 7.3
151	7	CTD911	deploy	151	9/9/13 7:22	71.204857	-149.008356	198	WPNT 7.35
151	7	CTD911	recover	151	9/9/13 7:36	71.205154	-149.009933	198	WPNT 7.35
151	7	Tucker Trawl	deploy	1	9/9/13 7:57	71.206417	-149.034811	218	trip fouled- re-do tow
151	7	Tucker Trawl	other	1	9/9/13 8:06	71.205647	-149.02012	218	1st net trips
151	7	Tucker Trawl	other	1	9/9/13 8:10	71.205436	-149.013173	218	2nd messenger trips 2 & 3rd nets
151	7	Tucker Trawl	recover	1	9/9/13 8:14	71.205236	-149.006814	218	fouled bar- re-do

151	7	Tucker Trawl	deploy	2	9/9/13 8:34	71.205396	-149.034314	201	WPNT 7.35
151	7	Tucker Trawl	other	2	9/9/13 8:42	71.205351	-149.0215	201	WPNT 7.35
151	7	Tucker Trawl	other	2	9/9/13 8:46	71.205303	-149.014248	201	2nd messenger trips 2 & 3rd nets
151	7	Tucker Trawl	recover	2	9/9/13 8:50	71.205174	-149.007935	201	WPNT 7.35
152	7	CTD911	deploy	152	9/9/13 9:16	71.182275	-149.026414	54	WPNT 7.4
152	7	CTD911	recover	152	9/9/13 9:21	71.182284	-149.026424	54	WPNT 7.4
153	7	CTD911	deploy	153	9/9/13 9:58	71.137705	-149.058641	49	WPNT 7.5
153	7	CTD911	recover	153	9/9/13 10:02	71.137714	-149.058643	49	WPNT 7.5
154	7	CTD911	deploy	154	9/9/13 10:39	71.092952	-149.091469	46	WPNT 7.6
154	7	CTD911	recover	154	9/9/13 10:41	71.09296	-149.09146	46	WPNT 7.6
154	7	Tucker Trawl	deploy	1	9/9/13 11:02	71.093261	-149.110598	44	WPNT 7.6
154	7	Tucker Trawl	other	1	9/9/13 11:10	71.092402	-149.095644	44	1st net trips
154	7	Tucker Trawl	other	1	9/9/13 11:14	71.091753	-149.086635	44	2nd messenger trips 2 & 3rd nets
154	7	Tucker Trawl	recover	1	9/9/13 11:17	71.09129	-149.080773	44	WPNT 7.6
155	7	CTD911	deploy	155	9/9/13 11:50	71.048513	-149.123866	39	WPNT 7.7
155	7	CTD911	recover	155	9/9/13 11:54	71.048521	-149.123863	39	WPNT 7.7
156	7	CTD911	deploy	156	9/9/13 12:27	71.003748	-149.156265	36	WPNT 7.8
156	7	CTD911	recover	156	9/9/13 12:32	71.00384	-149.156268	36	WPNT 7.8
156	7	Tucker Trawl	deploy	1	9/9/13 12:49	71.002612	-149.135708	35	Net 3 only
156	7	Tucker Trawl	recover	1	9/9/13 12:59	71.003211	-149.150838	35	WPNT 7.8
157	7	CTD911	deploy	157	9/9/13 13:34	70.959539	-149.188095	35	WPNT 7.9
157	7	CTD911	recover	157	9/9/13 13:36	70.959542	-149.188086	35	WPNT 7.9
158	7	CTD911	deploy	158	9/9/13 14:10	70.915034	-149.22102	31	WPNT 7.10

158	7	CTD911	recover	158	9/9/13 14:14	70.915034	-149.221022	31	WPNT 7.10
158	7	Tucker Trawl	deploy	1	9/9/13 14:30	70.915066	-149.201194	31	WPNT 7.10, N3 only, double oblique
158	7	Tucker Trawl	recover	1	9/9/13 14:45	70.914379	-149.224652	31	WPNT 7.10, N3 only, double oblique
	6	Acrobat	deploy		9/9/13 16:04	70.946268	-149.622692	30	
	6	Acrobat	recover		9/9/13 18:30	71.195709	-149.446809	30	
159	6	CTD911	deploy	159	9/9/13 19:06	71.167527	-149.464963	53	WPNT 6.5
159	6	CTD911	recover	159	9/9/13 19:11	71.167531	-149.464952	53	WPNT 6.5
160	6	CTD911	deploy	160	9/9/13 19:33	71.190108	-149.449699	57	WPNT 6.45
160	6	CTD911	recover	160	9/9/13 19:40	71.190111	-149.449692	57	WPNT 6.45
161	6	CTD911	deploy	161	9/9/13 20:06	71.212841	-149.435278	205	WPNT 6.4
161	6	CTD911	recover	161	9/9/13 20:18	71.212842	-149.435288	205	WPNT 6.4
162	6	CTD911	deploy	162	9/9/13 20:53	71.25755	-149.403311	880	WPNT 6.3
162	6	CTD911	recover	162	9/9/13 21:14	71.257543	-149.403314	880	WPNT 6.3
163	6	CTD911	deploy	163	9/9/13 21:46	71.302029	-149.373322	1470	WPNT 6.2
163	6	CTD911	recover	163	9/9/13 22:07	71.302025	-149.373296	1470	WPNT 6.2
162	6	Fish Net	deploy		9/9/13 22:53	71.257692	-149.445819		WPNT 6.3
162	6	Fish Net	At Target Depth		9/9/13 23:33	71.258058	-149.376872		WPNT 6.3
162	6	Fish Net	End Target Depth		9/10/13 0:41	71.259335	-149.254991		WPNT 6.3
162	6	Fish Net	recover		9/10/13 1:33	71.262824	-149.168332		WPNT 6.3
164	6	Fish Net	deploy		9/10/13 18:19	71.215694	-149.199045	280	Acoustic DVM Station
164	6	Fish Net	At Target Depth		9/10/13 18:48	71.218629	-149.245047	280	Acoustic DVM Station
164	6	Fish Net	End Target Depth		9/10/13 19:38	71.2245	-149.331965	280	Acoustic DVM Station
164	6	Fish Net	recover		9/10/13 20:12	71.228259	-149.375777	280	Acoustic DVM Station
164	6	CTD911	deploy	164	9/10/13 21:07	71.220706	-149.273142	279	Fish Trawl near 6.4

164	6	CTD911	recover	164	9/10/13 21:22	71.220919	-149.272766	279	Fish Trawl near 6.4
		Acrobat	deploy		9/10/13 21:39	71.222579	-149.28263		Deep Water Test
		Acrobat	recover		9/10/13 22:23	71.223429	-149.413007		Deep Water Test - Recover to trim tail
		Acrobat	deploy		9/10/13 22:30	71.223811	-149.421441		Deep Water Test - ReDeploy, test 250 m w/o
165	3	Fish Net	deploy		9/11/13 7:28	71.29907	-150.521297	290	WPNT 3.45
165	3	Fish Net	At Target Depth		9/11/13 7:58	71.297096	-150.573225	290	WPNT 3.45
165	3	Fish Net	End Target Depth		9/11/13 8:47	71.294657	-150.658278	290	WPNT 3.45
165	3	Fish Net	recover		9/11/13 9:28	71.293997	-150.726426	290	WPNT 3.45
165	3	CTD911	deploy	165	9/11/13 10:38	71.295837	-150.610415	287	Fish Trawl
165	3	CTD911	recover	165	9/11/13 10:54	71.295833	-150.610414	287	Fish Trawl
165	3	Ring Net	deploy	1	9/11/13 11:08	71.295828	-150.610429	289	Fish Trawl
165	3	Ring Net	recover	1	9/11/13 11:22	71.295832	-150.610426	289	Fish Trawl
165	3	Tucker Trawl	deploy	1	9/11/13 11:34	71.295928	-150.61427	287	Fish Trawl
165	3	Tucker Trawl	other	1	9/11/13 11:49	71.294978	-150.641804	287	1st net trips
165	3	Tucker Trawl	other	1	9/11/13 11:55	71.294606	-150.654046	287	2nd messenger trips 2 & 3rd nets
165	3	Tucker Trawl	recover	1	9/11/13 12:01	71.294414	-150.664195	287	Fish Trawl
NaN	NaN	UNCSW	service	NaN	9/11/13 19:36	71.288133	-150.877468		switched to clean strainer
166	DBO	CTD911	deploy	166	9/12/13 4:28	71.537339	-151.948342	577	DBO 6.6
166	DBO	CTD911	recover	166	9/12/13 4:52	71.537339	-151.948323	577	DBO 6.6
166	DBO	Bongo Nets	deploy	1	9/12/13 5:12	71.541757	-151.962543	583	DBO 6.6
166	DBO	Bongo Nets	recover	1	9/12/13 5:32	71.534395	-151.935867	583	DBO 6.6
167	DBO	CTD911	deploy	167	9/12/13 6:21	71.471758	-152.002736	247	DBO 6.5
167	DBO	CTD911	recover	167	9/12/13 6:35	71.471755	-152.002715	247	DBO6.5
168	DBO	CTD911	deploy	168	9/12/13 7:23	71.406344	-152.05766	168	DBO 6.4

168	DBO	CTD911	recover	168	9/12/13 7:37	71.406343	-152.057688	168	DBO 6.4
168	DBO	Bongo Nets	deploy	1	9/12/13 7:59	71.409708	-152.078475	168	DBO 6.4
168	DBO	Bongo Nets	recover	1	9/12/13 8:11	71.40714	-152.060964	168	DBO 6.4
169	DBO	CTD911	deploy	169	9/12/13 8:59	71.341002	-152.109951	70	DBO 6.3
169	DBO	CTD911	recover	169	9/12/13 9:05	71.341005	-152.109923	70	DBO 6.3
170	DBO	CTD911	deploy	170	9/12/13 9:56	71.275744	-152.163722	51	DBO 6.2
170	DBO	CTD911	recover	170	9/12/13 9:59	71.275755	-152.16367	51	DBO 6.2
171	DBO	CTD911	deploy	171	9/12/13 10:45	71.210673	-152.217867	40	DBO 6.1
171	DBO	CTD911	recover	171	9/12/13 10:50	71.210678	-152.217823	40	DBO 6.1
171	DBO	Bongo Nets	deploy	1	9/12/13 11:06	71.211951	-152.241239	40	DBO 6.1
171	DBO	Bongo Nets	deploy	1	9/12/13 11:17	71.211322	-152.224866	40	DBO 6.1
172	WDD	CTD911	deploy	172	9/12/13 12:59	71.366552	-152.383528	80	WDD1
172	WDD	CTD911	recover	172	9/12/13 13:08	71.366549	-152.383511	80	WDD1
172	WDD	Trawl Tucker	deploy	1	9/12/13 13:26	71.367712	-152.361936	75	WDD1
172	WDD	Trawl Tucker	deploy	1	9/12/13 13:32	71.367271	-152.371342	75	1st net trips
172	WDD	Trawl Tucker	other	1	9/12/13 13:34	71.36712	-152.374769	75	2nd messenger trips 2 & 3rd nets
172	WDD	Trawl	recover	1	9/12/13 13:39	71.366743	-152.382182	75	WDD1
173	WDD	CTD911	deploy	173	9/12/13 14:03	71.386094	-152.428758	115	WDD2
173	WDD	CTD911	recover	173	9/12/13 14:12	71.386091	-152.428773	115	WDD2
174	WDD	CTD911	deploy	174	9/12/13 14:37	71.403795	-152.475093	126	WDD3
174	WDD	CTD911	recover	174	9/12/13 14:48	71.403801	-152.475088	126	WDD3
174	WDD	Trawl Tucker	deploy	1	9/12/13 15:04	71.40252	-152.456597	126	WWD3
174	WDD	Trawl Tucker	other	1	9/12/13 15:11	71.402982	-152.467363	126	1st net trips
174	WDD	Trawl	other	1	9/12/13 15:15	71.40317	-152.473487	126	2nd messenger trips 2 & 3rd nets
174	WDD	Tucker	recover	1	9/12/13 15:24	71.403435	-152.488517	126	WWD3

		Trawl							
175	WDD	CTD911	deploy	175	9/12/13 15:47	71.422893	-152.521336	125	WDD4
176	WDD	CTD911	deploy	176	9/12/13 16:30	71.44209	-152.566729	88	WDD 5
176	WDD	CTD911	recover	176	9/12/13 16:36	71.442085	-152.566731	88	WDD5
176	WDD	Tucker Trawl	deploy	1	9/12/13 16:55	71.440507	-152.543969	88	WDD5
176	WDD	Tucker Trawl	other	1	9/12/13 17:04	71.441458	-152.559284	88	First messenger trip
176	WDD	Tucker Trawl	other	1	9/12/13 17:12	71.442196	-152.570705	88	Second messenger trip
176	WDD	Tucker Trawl	recover	1	9/12/13 17:18	71.44259	-152.581592	88	WDD5
174	WDD	Tucker Trawl	deploy	2	9/12/13 18:04	71.402357	-152.45625	127	Second Tow at WDD3
174	WDD	Tucker Trawl	other	2	9/12/13 18:13	71.403666	-152.473246	127	First messenger trip
174	WDD	Tucker Trawl	other	2	9/12/13 18:20	71.40472	-152.485989	127	Second messenger trip, WDD3
174	WDD	Tucker Trawl	recover	2	9/12/13 18:28	71.405756	-152.499748	127	Surface at WDD3
177	WDD	CTD911	deploy	177	9/12/13 19:13	71.34976	-152.699624	97	WDD6
177	WDD	CTD911	recover	177	9/12/13 19:22	71.349762	-152.69962	97	WDD6
177	WDD	Tucker Trawl	deploy	1	9/12/13 19:34	71.349501	-152.689157	97	WDD6
177	WDD	Tucker Trawl	deploy	1	9/12/13 19:42	71.349473	-152.699014	97	First messenger trip
177	WDD	Tucker Trawl	deploy	1	9/12/13 19:45	71.349492	-152.703006	97	Second messenger trip
177	WDD	Tucker Trawl	recover	1	9/12/13 19:51	71.349552	-152.711035	97	WDD6
178	WDD	CTD911	deploy	178	9/12/13 19:59	71.355146	-152.716985	100	WDD7
178	WDD	CTD911	recover	178	9/12/13 20:22	71.365957	-152.717043	100	WDD7
179	WDD	CTD911	deploy	179	9/12/13 20:42	71.38297	-152.726154	103	WDD 8
179	WDD	CTD911	recover	179	9/12/13 20:49	71.382976	-152.72613	103	WDD8

179	WDD	Tucker Trawl	deploy	1	9/12/13 21:01	71.381765	-152.717077	107	WDD8
179	WDD	Tucker Trawl	other	1	9/12/13 21:13	71.383523	-152.73574	107	First messenger trip
179	WDD	Tucker Trawl	other	1	9/12/13 21:20	71.3847	-152.74621	107	Second messenger trip
179	WDD	Tucker Trawl	recover	1	9/12/13 21:27	71.386044	-152.756553	107	WDD8
179	WDD	Tucker Trawl	recover	1	9/12/13 21:27	71.386044	-152.756553	107	WDD8
180	WDD	CTD911	deploy	180	9/12/13 21:59	71.399924	-152.739004	105	WDD9
180	WDD	CTD911	recover	180	9/12/13 22:08	71.399928	-152.73901	105	WDD9
180	WDD	Tucker Trawl	deploy	1	9/12/13 22:12	71.400584	-152.738701	105	WDD9
180	WDD	Tucker Trawl	other	1	9/12/13 22:30	71.397854	-152.742176	105	First messenger trip
180	WDD	Tucker Trawl	other	1	9/12/13 22:36	71.397435	-152.750582	105	Second messenger trip
180	WDD	Tucker Trawl	recover	1	9/12/13 22:43	71.396828	-152.762812	105	WDD9
181	WDD	CTD911	deploy	181	9/12/13 23:05	71.416304	-152.750547	93	WDD10
181	WDD	CTD911	recover	181	9/12/13 23:12	71.416314	-152.750509	93	WDD10
182	ZZ	Fish Net	deploy	1	9/13/13 2:17	71.677228	-152.548892	300	WPNT ZZ15
182	ZZ	Fish Net	At Target Depth	1	9/13/13 2:49	71.664463	-152.504391	300	WPNT ZZ15
182	ZZ	Fish Net	End Target Depth	1	9/13/13 3:03	71.659071	-152.487393	300	WPNT ZZ15
182	ZZ	Fish Net	recover	1	9/13/13 3:37	71.643807	-152.437594	300	WPNT ZZ15
182	ZZ	CTD911	deploy	182	9/13/13 4:22	71.658136	-152.485827	317	fish trawl midpoint zz15
182	ZZ	CTD911	recover	182	9/13/13 4:40	71.658138	-152.485803	317	fish trawl midpoint zz15
182	ZZ	Fish Net	deploy	2	9/13/13 7:05	71.6757	-152.543564	300	WPNT ZZ15
182	ZZ	Fish Net	At Target Depth	2	9/13/13 7:38	71.662921	-152.500635	300	WPNT ZZ15
182	ZZ	Fish Net	End Target	2	9/13/13 8:13	71.648969	-152.451482	300	WPNT ZZ15

			Depth						
182	ZZ	Fish Net	recover	2	9/13/13 8:47	71.636016	-152.4126	300	WPNT ZZ15
	ZZ	UNCSW	start		9/13/13 9:20	71.640045	-152.450435		FlowCAM
182	ZZ	Tucker Trawl	deploy	1	9/13/13 9:43	71.653861	-152.483496	307	fish-trawl #2 at ZZ-15
182	ZZ	Tucker Trawl	other	1	9/13/13 9:57	71.659273	-152.496644	307	1st net trips
182	ZZ	Tucker Trawl	other	1	9/13/13 10:04	71.66225	-152.504178	307	ZZ15
182	ZZ	Tucker Trawl	recover	1	9/13/13 10:10	71.664962	-152.51065	307	ZZ15
NaN	NaN	PCO2	stop	NaN	9/13/13 10:25	71.677871	-152.505296		PCO2 computer froze up. Restarted.
NaN	NaN	PCO2	start	NaN	9/13/13 10:30	71.684696	-152.496248		PCO2 started after reboot
		UNCSW	start		9/13/13 10:30	71.684696	-152.496248		FlowCAM
		UNCSW	start		9/13/13 19:32	71.575119	-153.253906		FlowCAM
		UNCSW	start		9/13/13 19:49	71.580155	-153.195583		FlowCAM
		UNCSW	start		9/13/13 20:59	71.643013	-153.183679		FlowCAM
183	ZZ	Fish Net	deploy		9/13/13 22:25	71.798376	-153.128638	330-350	WPNT ZZ19
		UNCSW	start		9/13/13 22:32	71.799395	-153.1384		FlowCAM
183	ZZ	Fish Net	At Target Depth		9/13/13 22:56	71.805129	-153.178002	330-350	WPNT ZZ19
		UNCSW	start		9/13/13 23:35	71.816982	-153.239677		FlowCAM
183	ZZ	Fish Net	End Target Depth		9/13/13 23:36	71.817314	-153.241301	330-350	WPNT ZZ19
183	ZZ	Fish Net	recover		9/14/13 0:10	71.826673	-153.289677	330-350	WPNT ZZ19
		UNCSW	start		9/14/13 0:58	71.807612	-153.197008		FlowCAM
183		CTD911	deploy	183	9/14/13 2:10	71.80827	-153.196393	305	Fish Trawl
183		CTD911	recover	183	9/14/13 2:37	71.808272	-153.196381	305	Fish Trawl
183		Tucker Trawl	deploy	1	9/14/13 2:53	71.802587	-153.181658	310	Fish Trawl

183		Tucker Trawl	other	1	9/14/13 3:11	71.809471	-153.198376	310	1st net trips
183		Tucker Trawl	other	1	9/14/13 3:17	71.811907	-153.203967	310	2nd messenger trips 2 & 3rd nets
183		Tucker Trawl	recover	1	9/14/13 3:26	71.81524	-153.210927	310	Net hit bottom- repeat tow
183		Tucker Trawl	deploy	2	9/14/13 4:03	71.803497	-153.18276	310	Fish Trawl
183		Tucker Trawl	other	2	9/14/13 4:22	71.810303	-153.199045	310	1st net trips
183		Tucker Trawl	other	2	9/14/13 4:32	71.8141	-153.20776	310	2nd messenger trips 2 & 3rd nets
183		Tucker Trawl	recover	2	9/14/13 4:40	71.817634	-153.216063	310	hit bottom again.
		UNCSW	start		9/14/13 6:06	71.712591	-153.436202		FlowCAM
		UNCSW	start		9/14/13 7:02	71.804901	-153.440707		FlowCAM
		UNCSW	start		9/14/13 7:02	71.804901	-153.440707		FlowCAM
		UNCSW	start		9/14/13 8:10	71.824145	-153.552654		FlowCAM
		UNCSW	start		9/14/13 9:32	71.818758	-153.746383		FlowCAM
		UNCSW	start		9/14/13 11:35	71.734884	-154.02972		FlowCAM
NaN	NaN	UNCSW	service	NaN	9/14/13 14:44	72.027106	-155.041966		Switched strainer
		UNCSW	start		9/14/13 21:43	71.877195	-158.449335		FlowCAM
		UNCSW	start		9/14/13 23:30	71.711201	-159.222649		FlowCAM
		UNCSW	start		9/15/13 2:34	71.432643	-160.500501		FlowCAM
		UNCSW	start		9/15/13 9:55	70.66355	-163.10071		FlowCAM
184	Barrow to Nome	CTD911	deploy	184	9/15/13 18:07	69.784005	-165.769112	40	Tow to collect animals
184	Barrow to Nome	CTD911	recover	184	9/15/13 18:16	69.784415	-165.771426	40	Tow to collect animals
184	Barrow to Nome	Ring Net	deploy	1	9/15/13 18:22	69.784583	-165.772221	41	Collect animals to take home
184	Barrow to Nome	Ring Net	recover	1	9/15/13 18:31	69.784783	-165.771933	41	Tow to collect animals

184	Barrow to Nome	Ring Net	deploy	2	9/15/13 18:38	69.784951	-165.771664	41	Tow to collect animals
184	Barrow to Nome	Ring Net	recover	2	9/15/13 18:43	69.785066	-165.771495	41	Tow to collect animals
	Barrow to Nome	UNCSW	start		9/16/13 1:12	69.036429	-167.64625		FlowCAM
	Barrow to Nome	UNCSW	start		9/16/13 8:05	68.040856	-168.34618		FlowCAM
	Barrow to Nome	UNCSW	start		9/16/13 21:58	65.993061	-168.47473		FlowCAM
	Barrow to Nome	UNCSW	start		9/17/13 5:59	64.982803	-167.473366		FlowCAM
	Barrow to Nome	UNCSW	start		9/17/13 9:40	64.520676	-166.757929		FlowCAM
NaN	NaN	EK60	stop	NaN	9/17/13 13:26	64.439646	-165.657727		raising centerboard
NaN	NaN	UNCSW	other	NaN	9/17/13 13:27	64.440346	-165.654432		turned off flow to main lab sensors
NaN	NaN	centerBoard	start	NaN	9/17/13 13:28	64.440866	-165.652561		flush position
NaN	NaN	EM302	stop	NaN	9/17/13 14:01	64.476057	-165.474752		
NaN	NaN	OS150	stop	NaN	9/17/13 14:02	64.477208	-165.46924		
NaN	NaN	Ship	endCruise	NaN	9/17/13 14:28	64.49397	-165.437844		arrival and docking in Nome, AK
NaN	NaN	UNCSW	stop	NaN	NaN	NaN	NaN		turned off pump and closed seachest valve; started fresh water flush
NaN	NaN	PCO2	stop	NaN	NaN	NaN	NaN		