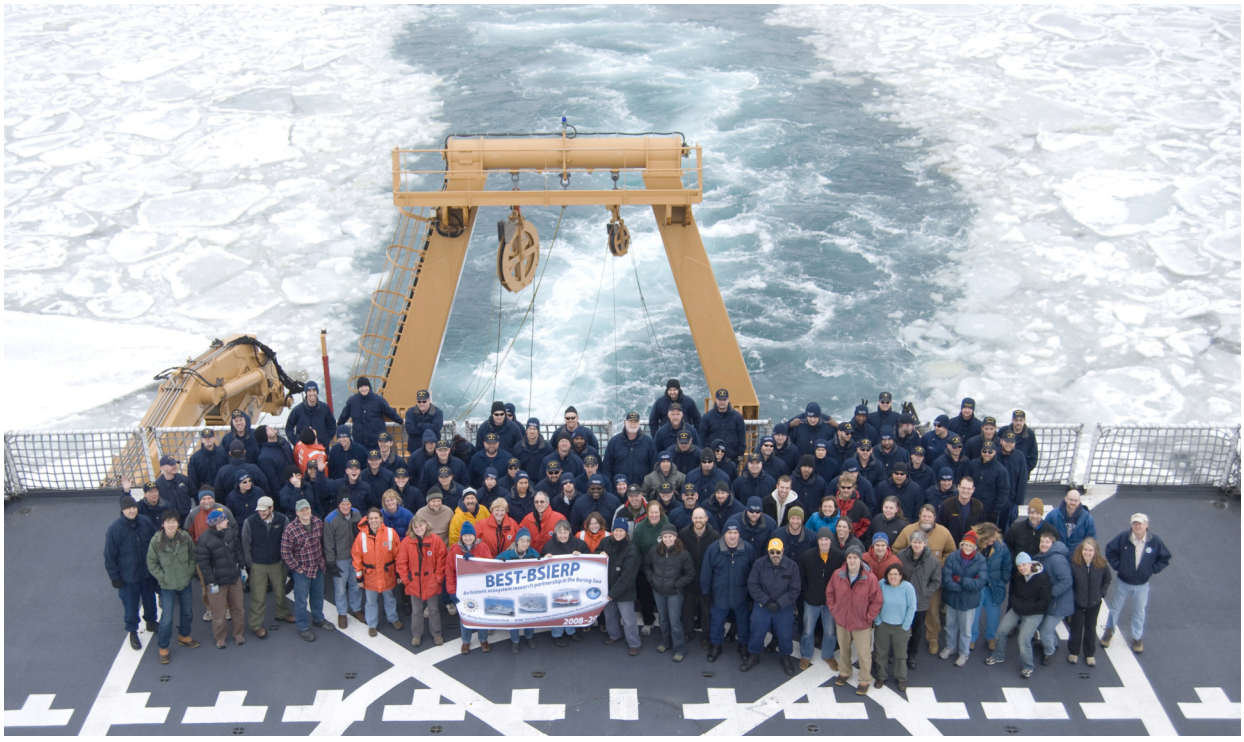
Mid-Cruise Report
Bering Ecosystem Study-Bering Sea Integrated Research Program
USCGC Healy Cruise HLY0802
March 31 – April 20, 2008
Dutch Harbor, AK – St. Paul, AK



Prepared by Carin Ashjian, Chief Scientist, and the HLY0802 Science Team

Funded by the National Science Foundation and the North Pacific Research Board

The overall objective of this cruise is to describe the lower trophic levels of the Bering Sea ecosystem under varying conditions of ice cover in order to better understand ecosystem response to ongoing changes in climate, ice cover (extent of ice cover and timing of ice formation and retreat), and accompanying oceanographic conditions. To this aim, twelve projects are supported on cruise HLY0802 on board the USCGC Healy in the Bering Sea during the period of March 31-May 6, 2008. The cruise is loosely divided into two segments because of a personnel exchange on April 20 at St. Paul, Alaska. Forty-six science party members were embarked for much of the first portion of the cruise; forty-one will be embarked during the second portion.

To date, we have surveyed across three major cross-shelf transects – the NP (southernmost east-west) line, the MN (central east-west) line, and the SL (northernmost east-west) line – as well as across the shorter W line (oblique line connecting to MN line) (Figure 1). Most recently we have conducted a repeat sampling of much of the NP line. Each transect consisted of a series of stations at which several sampling activities were routinely conducted, including Conductivity-Temperature-Depth with rosette casts, Video Plankton Recorder casts, and CalVET net tows. At many locations, the benthic camera also was deployed to survey the benthos. More intensive sampling was conducted every other day at "Process" stations, where a fuller suite of sampling and experimentation was conducted to measure phytoplankton, microzooplankton, mesozooplankton (copepods, krill), and benthic composition and selected rates (e.g., grazing, reproduction, nutrient regeneration, production). Other sampling (e.g., benthic grabs, plankton tows, benthic cores) also was conducted several times per day at selected locations. We have been able to deploy floating sediment traps only 1x so far because of extensive ice cover across the slope in the study region (and bad weather). We anticipate deploying the traps a second time in the next few days.

The first portion of the cruise also supported frequent ice sampling through long (6 hour) and short (2 hour) ice stations and helicopter based ice core sampling at locations remote from the ship. Usually, a long ice station was conducted every other day in conjunction with the process stations while the short ice stations were conducted on other day. On three occasions, when satisfactory ice could not be found in proximity to the ship, sampling was conducted from the helicopter. Up to seven research groups participated in the on-ice deployments.

Underway sampling of the surface water for temperature, salinity fluorescence, oxygen, and other chemical parameters, acoustic backscatter from krill and fish, water velocity, and seafloor topography from SeaBeam and underway observations of marine mammal and bird distributions and sea ice extent and type also have been conducted. Underway sampling using the flow-through seawater system was compromised because the system periodically became clogged with ice. It appears that this resulted from the ice separator in the seawater system becoming clogged because of the increased volume of seawater required to furnish cooling water for the water bath/incubators on the bow of the ship (these incubators are where the rate process experiments for phytoplankton, microzooplankton, and mesozooplankton are conducted under near-ambient temperature and light conditions). We have been working with the Coast Guard to set up a system

whereby ambient seawater is pumped into a ballast tank while the ship is at station (to avoid pumping in ice) and from there directly to the incubator, reducing the flow demand on the science seawater system and ice separator and preventing blockage of the underway science system by ice.

During the period of the cruise so far, the ice edge has retreated to the N somewhat and the ice itself has started to melt in the southern portion of the region (NP Line). Biological activity in the water column has been quite low, in contrast to that of the sea ice that supported a bloom of ice algae and the organisms that utilize the algae. Most recently, gales in the Bering Sea have limited our sampling. We had intended to sample at two deep stations in the now ice-free region off of the continental shelf but were unable to do so because of high winds and seas.

Janet Scannell from EOL has developed a field catalog that includes a comprehensive event log as well as data from underway sensors, satellite imagery, reports, CTD data, and other useful information. Steve Roberts has been serving satellite imagery, underway data, and ship location through the map server. This has been extremely useful.

Our plans for the remainder of the cruise include sampling at two deep locations between the MN and NP Line, sampling along the ice edge (hopefully finding a bloom), and sampling along the 70 m isobath line. We anticipated conducting two process stations and additional, selected sampling (e.g., occasional net tows, grabs, primary production measurements) along the 70 m line in addition to the routine CTD and attendant chemical and biological measurements.

Outreach activities for the cruise to date include at least three on-line web logs[1], a presentation of the cruise plans to the community of Unalaska (Dutch Harbor) prior to the cruise, and several articles published in local newspapers by Ann Fienup-Riordan, a BEST sociologist and specialist in Yupik culture who participated in the cruise for the first 2 weeks. To date, two articles[2] by Ann have been published in the Tundra Drums newspaper in Bethel AK (with more to come). We also anticipate visiting Gambell, St. Lawrence Island, prior to the start of the 70 m line. In addition, the Chief Scientist has been sending near daily reports of ship position, activities, weather, ice conditions, and marine mammal and oceanographic conditions to the communities of Gambell and Savoonga. Our contacts there have been very enthusiastic about the reports.

Synopses of individual projects, contributed by the scientists, follow. Table and figure numbering is unique to each section rather than sequential through this document.

[1]Web Sites
www.polartrec.com/bering-sea-benthic-studies
http://bsierp/nprb.org/cruises/healy/hly0802/0802logbook.html
http://www.ecofoci.noaa.gov/cruiseWeb/ice08/

[2]Newspaper Articles
"Icebreaker Healy pursues scientific adventure in the Bering Sea", Tundra Drums, Vol. 36, No. 5, April 10, 2008.
"Ever-changing sea ice provides show for observers", Tundra Drums, Vol. 36, No. 6, April 17, 2008.

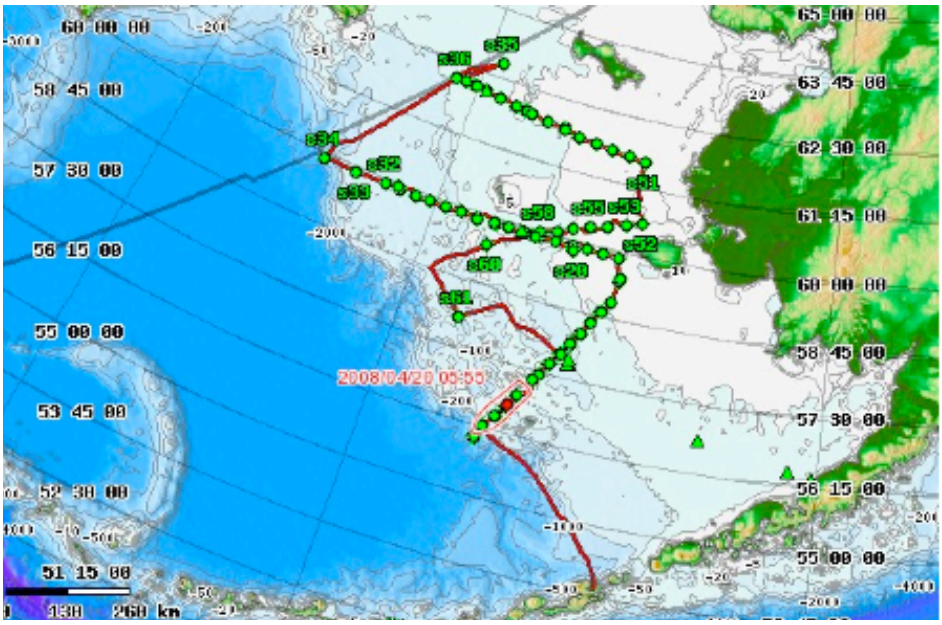


Figure 1. Cruise track of USCGC Healy during HLY0802, March 31 - April 20, 2008. Green symbols indicate locations where CTD casts were conducted. The red line indicates the track of the ship.

Hydro Group- 29 March-19 April, 2008

USCG Healy- Cruise HLY0802 (H10802-UNOLS Designation

Nancy Kachel, David Kachel, Carol Ladd, Jeremy Malczyk, Calvin Mordy and Dan Naber

As of April 19, the BEST Hydrography Group had conducted 90 CTD casts at the 60 stations occupied. We collected samples, and kept collective cast-sheets documenting metadata, bottle depths, and the bottles sampled by each group. In addition, we collected a suite of samples from the so-called "standard CTD cast", including a nutrient sample from each depth, six total chlorophyll samples, at least two Winkler oxygen samples for calibration of the SBE043 oxygen sensor, and three O18 samples for Tom Weingartner. At approximately one-third of the stations, we collected another six samples for fractionated chlorophyll analyses to compare with the total chlorophyll analyses historically done in the Bering Sea by scientists from NOAA's Alaska Fisheries Science Center. Scott Hiller and Lynne Butler, from Scripps, who operated the CTD console during the cruise, collected and analyzed salt samples for calibration. A summary of the sampling can be seen in Table 1. Representative plots of the water properties and nutrient distributions along the NP, MN, SL and W lines are shown in figure 1-8. The complete set of water properties on each transect can be found in the cruise Field Catalog

under the category of "Research Products (station)" by clicking on the "plots" link for the transect.

In addition to analyzing nitrate, nitrite, ammonia, silicate and phosphate on the standard CTD casts, Calvin Mordy quickly analyzed other nutrient samples for Evelyn Sherr and the Sambrotto group to assist them in determining levels of nutrient for their incubations and experiments, He also analyzed nutrient samples taken on the ice stations by Rolf Gradinger, David Shull, Masha Prokopenko, and the hydro group.

We collected and analyzed samples taken from the flow-through system to calibrate the underway oxygen, chlorophyll and nitrate sensors.

The hydro group participated in seven of the nine ice stations during this portion of the cruise. We typically recorded meta-data regarding the site and weather conditions; then we collected one core for temperature profile readings and total chlorophyll samples, and a second core for salinity and nutrient analyses. Each core was photographed and described during a visual inspection prior to sampling. PAR measurements were recorded both above and below the ice during the station. After auguring out several ice wells (also referred to as brine holes), we allowed to fill with ambient water. This water was sampled for chlorophyll, salinity, and nutrients upon return to the ship. At each ice station, we took a CTD cast by lowering a pumped SeaCAT-19+ through one of the holes to a depth of ~15m. Many of these data were collected in collaboration with the ice well oxygen experiments of Masha Prokopenko. Upon our return to the ship, 1000ml of filtered seawater were added to each section chlorophyll core sample. All samples were thawed in the dark, and sampled as soon as they melted, or stored in the refrigerator until sampling could take place.

Dan Naber also collected two cores at every ice station for Tom Weingartner and sampled the middle of each for O^{18} concentration.

Table 1. Sampling by Hydro Group, 29 March – 19 April 2008

Number of Hydrographic Stations	73
Number of CTD casts	106
Nutrient Samples Analyzed	845
Total Chlorophyll Samples	487
Fractionated Chlorophyll Samples	175
Winkler Oxygen Samples	194
Number of Ice Stations	9
Temp/Chlorophyll Cores Collected	8
Salt/Nutrient Cores Collected	8
Surface Water Samples Collected	5
Ice Well Samples Collected	13

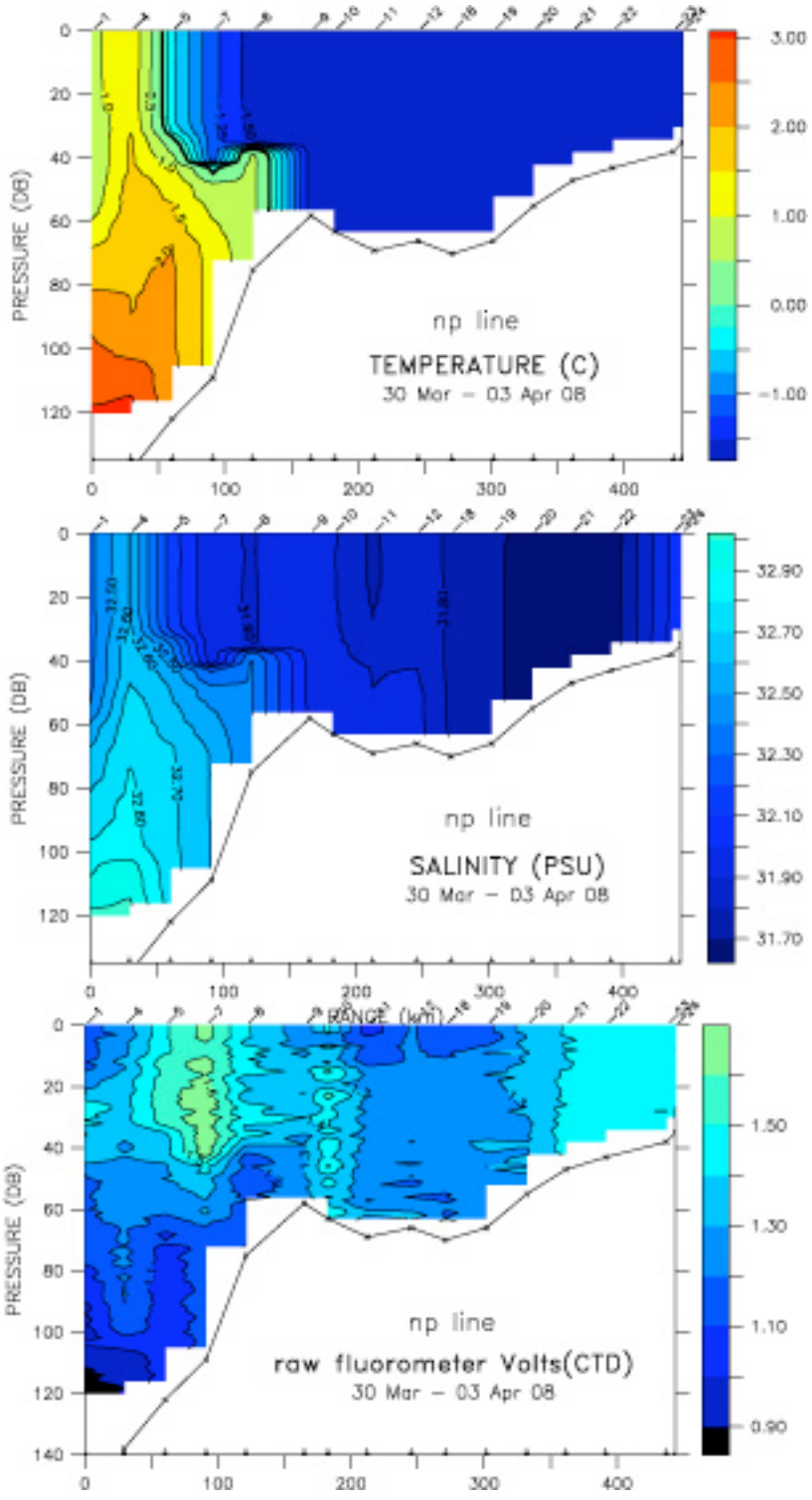


Fig 1. Temperature, salinity and fluorometer volts on the first occupation of the NP (Nunivak-St. Paul) transect.

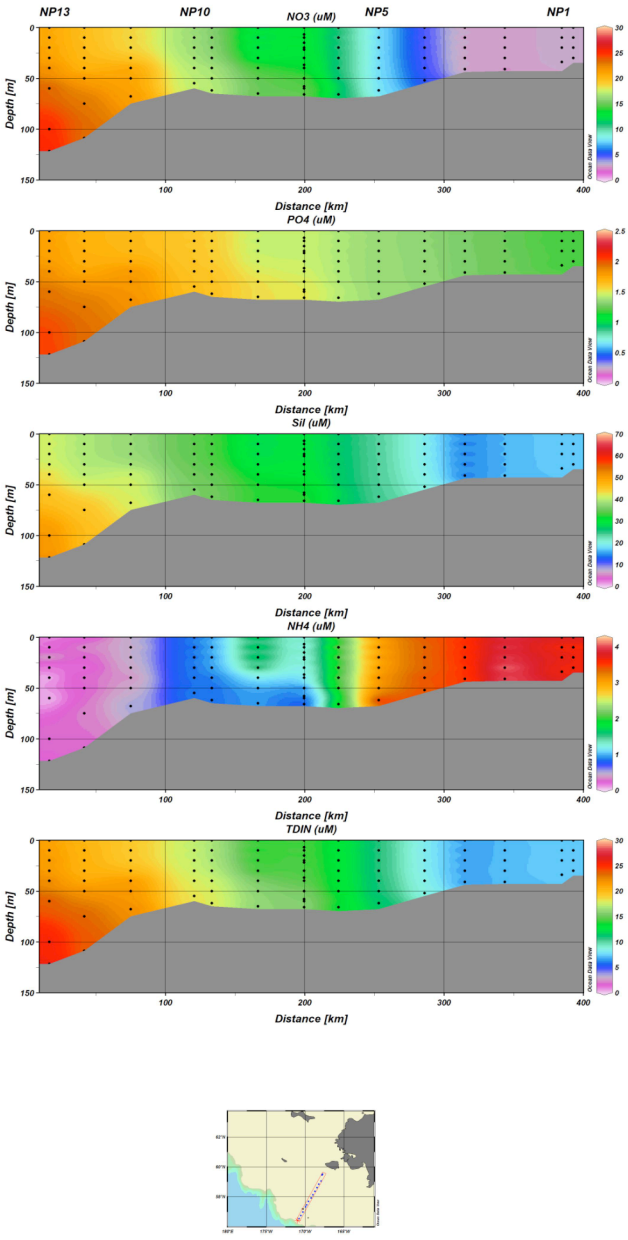


Fig.2. Nitrate, phosphate, silicate, ammonia and total dissolved inorganic nitrogen (TDIN) on the first occupation of the NP transect.

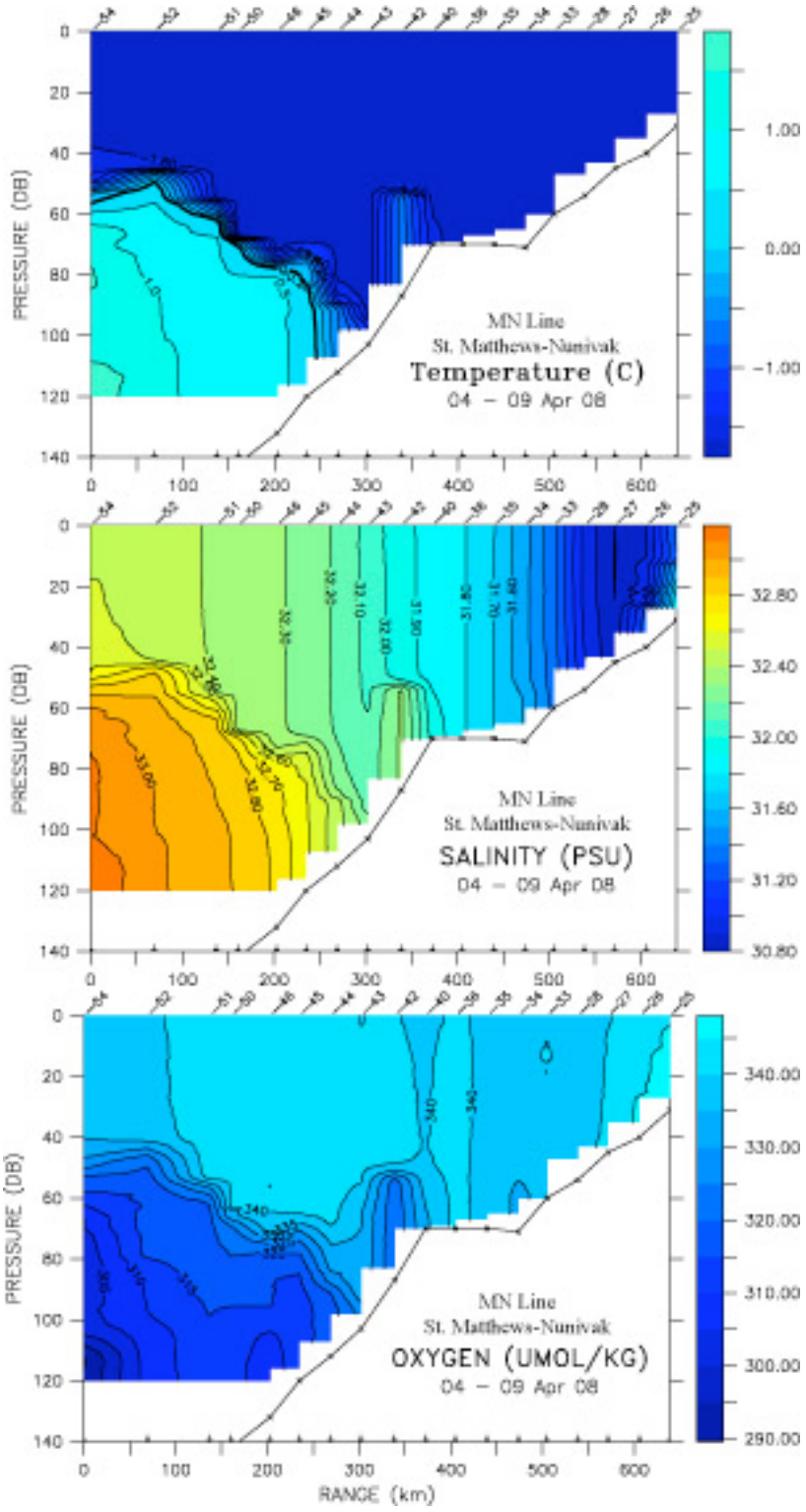


Fig 3. Temperature, salinity and oxygen distribution on the MN (St. Matthews - Nunivak) transect.

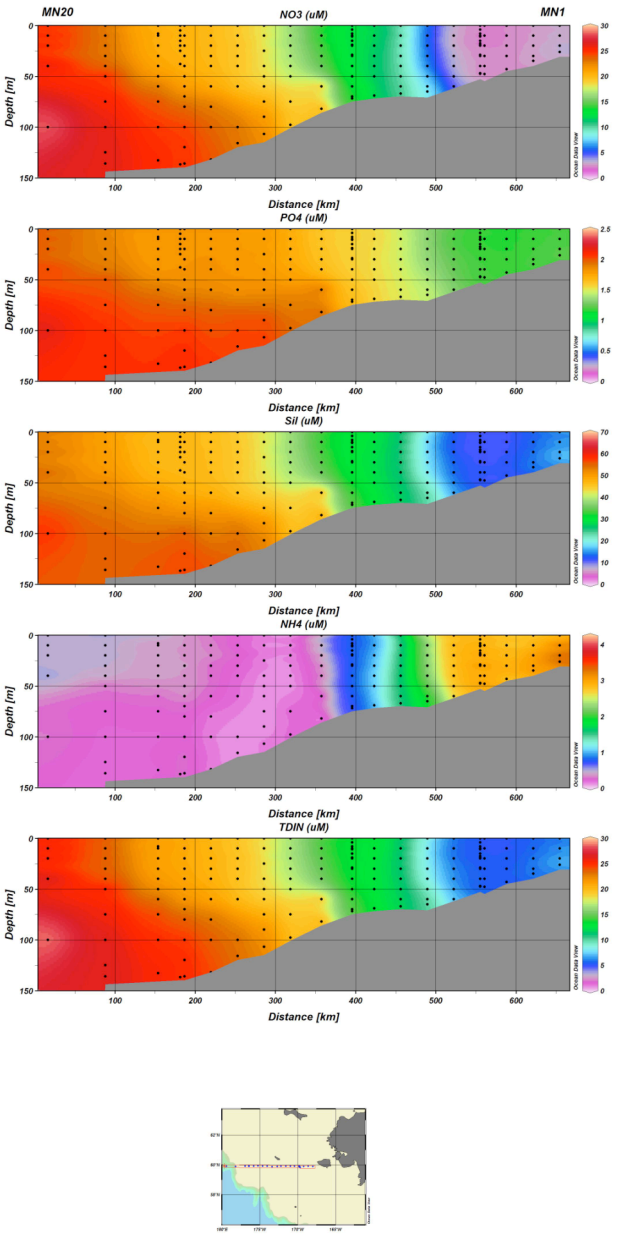


Fig.4. Nitrate, phosphate, silicate, ammonia and total dissolved inorganic nitrogen (TDIN) on the first transect of the MN line.

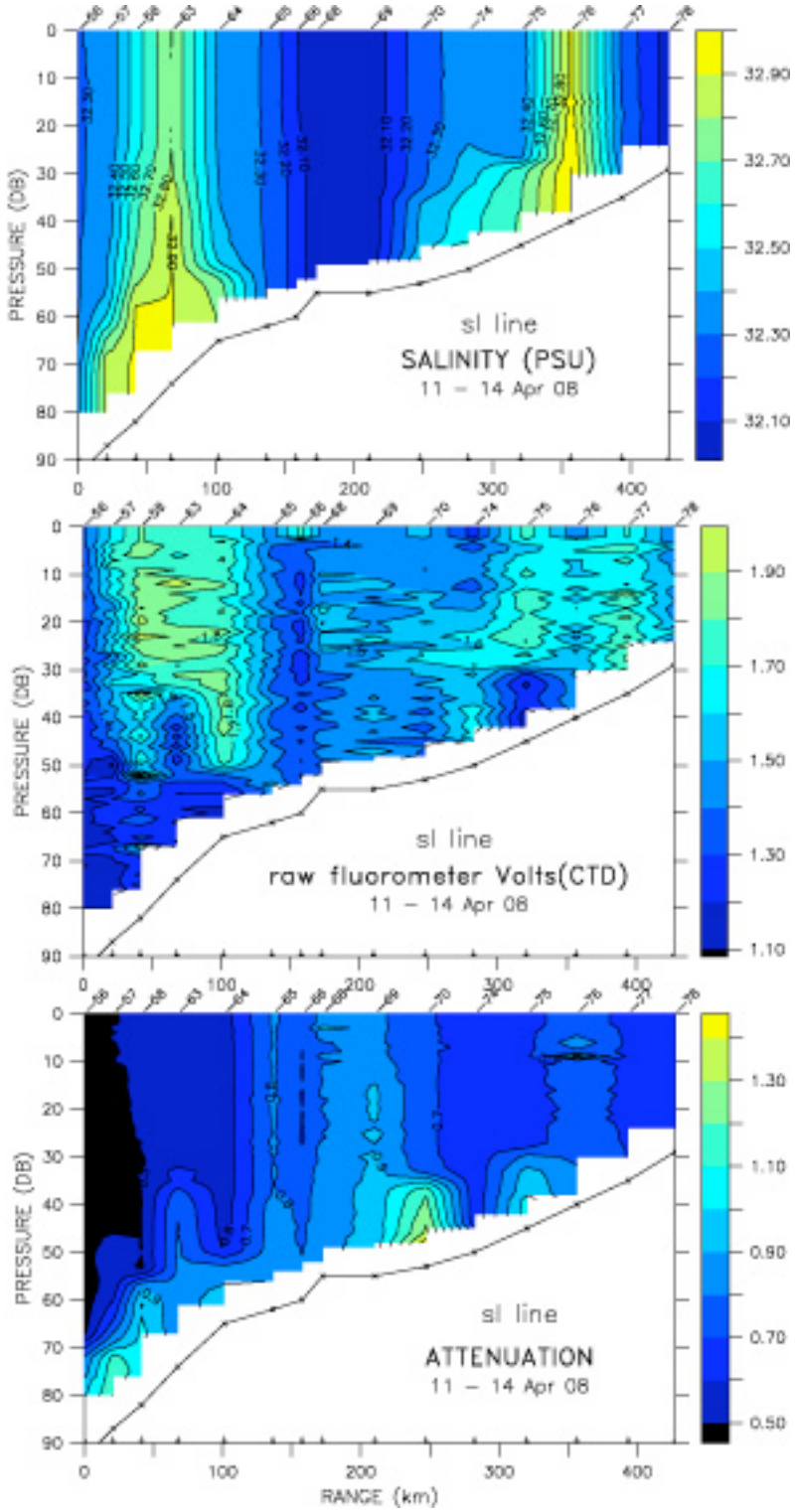
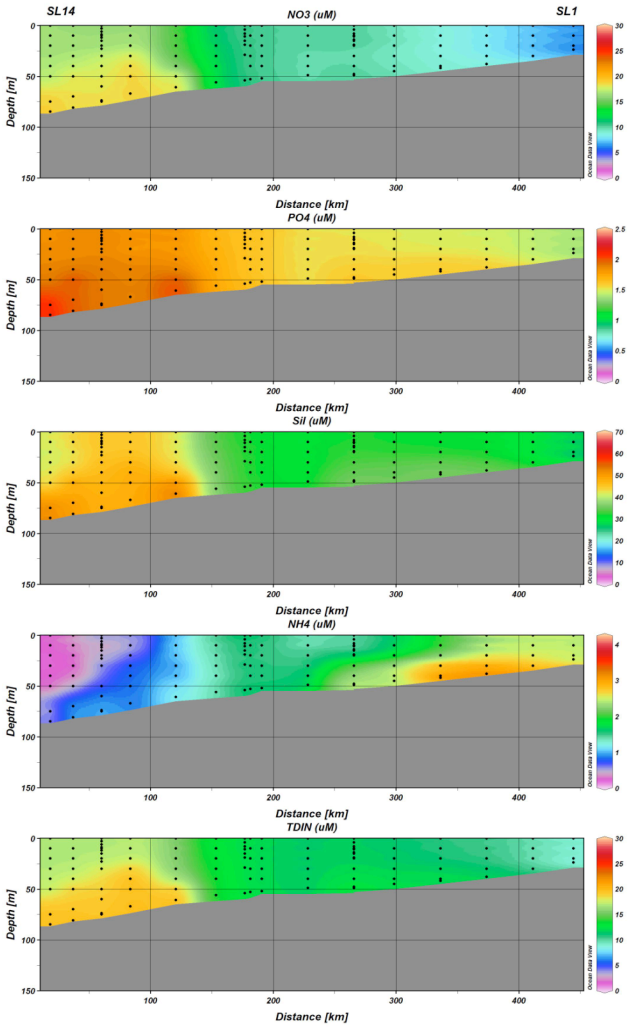


Fig 5. Salinity, fluorometer volts, and attenuation on the SL (St. Lawrence) transect.



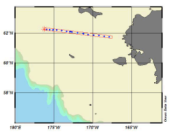


Fig.6. Nitrate, phosphate, silicate, ammonia and total dissolved inorganic nitrogen (TDIN) on the SL transect.

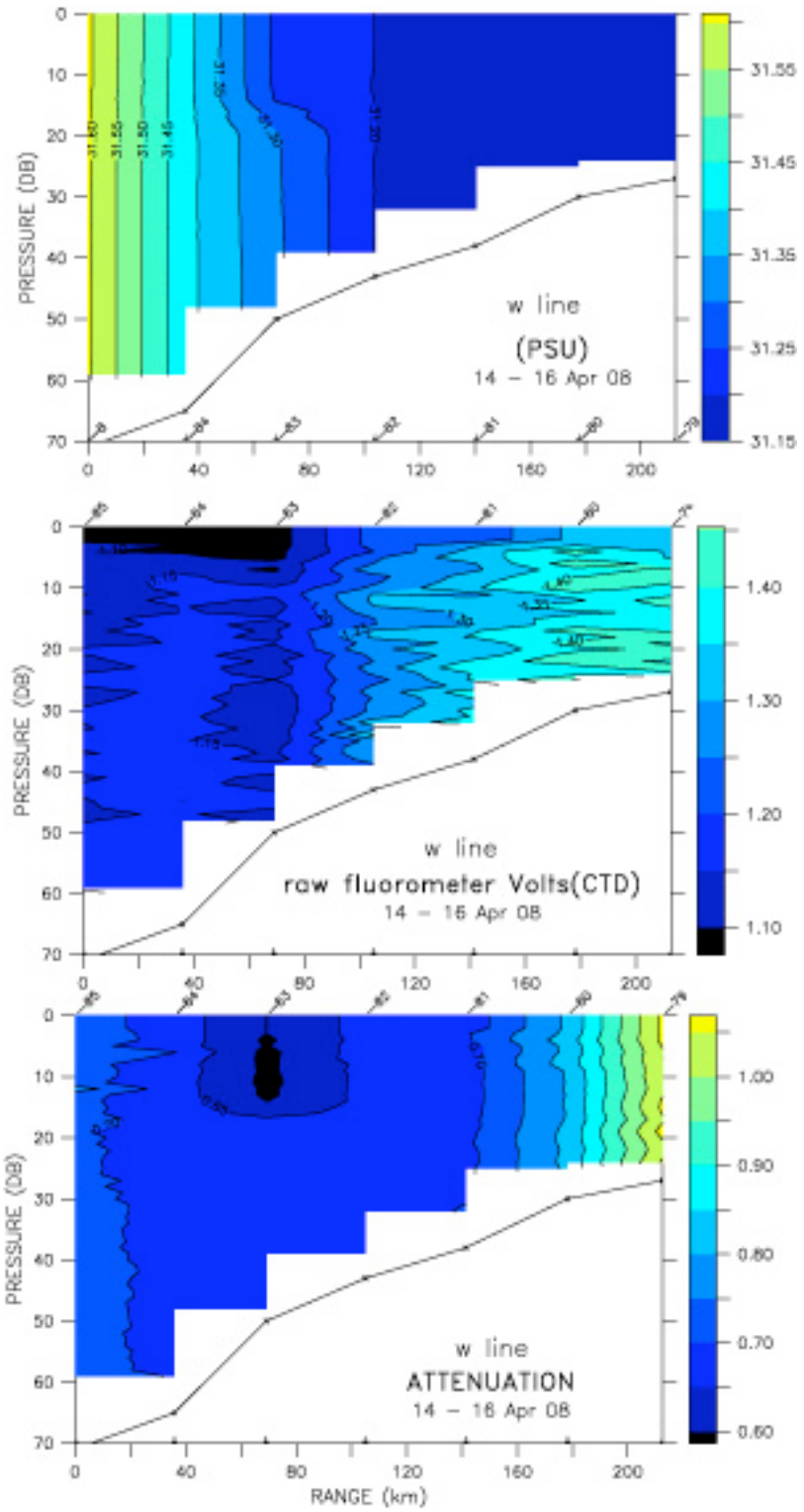
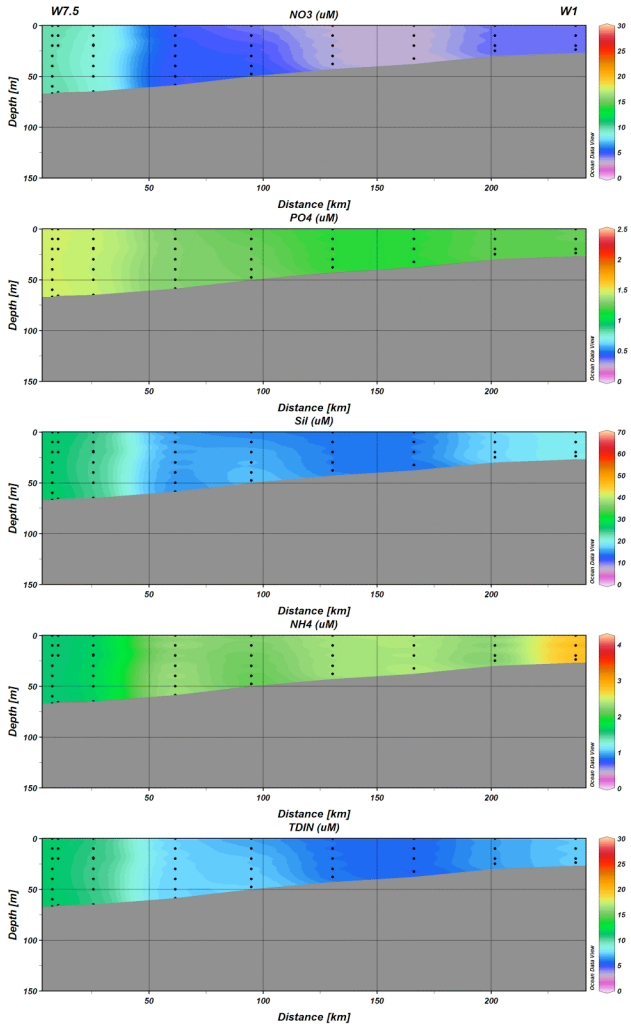


Fig 7. Salinity, fluorometer volts, and attenuation on the W (Weingartner) transect.



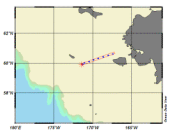


Fig.8. Nitrate, phosphate silicate ammonia and total dissolved inorganic nitrogen (TDIN) on the first transect of the W (Weingartner) line.

The Role of Ice Melting in Providing Available Iron to the Surface Water of the Bering Sea

PI: Jingfeng Wu
Participants: Ana Aguilar-Islas and Robert Rember
Sample collection of seawater and ice for the analysis of dissolved iron, total dissolvable iron, soluble iron, and iron speciation was successful during the HLY0802 BEST cruise. Sampling took place from 30 March to 19 April 2008.

Water Column Sampling
Collection of seawater samples was focused on outer shelf, shelf break and offshore waters along the NP, MN, and SL lines. Collection at the WOCE station P14-4 was cancelled prior to 19 April due to weather. Adequate south-to-north sampling of our area of interest was accomplished. Trace metal-clean vertical profiles were collected using our UAF/ATE vane samplers at 12 stations. Water samples were also collected at ice stations using a pump and acid-cleaned Teflon tubing. Over 40 seawater samples were collected from depths ranging from immediately below the ice to 2500 m. To avoid contamination from the ship, samples were filtered in a class 100 laminar flow hood. Samples were filtered through 0.4 μm PCTE filters, collecting 1 L for Fe organic speciation (natural Fe-binding ligands), 500 ml for archival purposes, and duplicate 30 ml samples for dissolved Fe measurements. Additionally, a 30ml subsample for dissolvable Fe was collected using 0.02 μm Whatman anodisc filters. The remaining unfiltered sample will be used for the analysis of total dissolvable Fe (pH 2). Speciation samples were frozen on-board ship, and will be transported frozen to the lab at the University of Alaska Fairbanks.

Ice Sampling
Ice samples were collected from 9 stations on ice floes adjacent to the ship, and from 9 stations on ice floes reached by helicopter. Ice stations were located in the outer, mid and inner shelf along the NP, MN, SL, and W lines. These stations provided a variety of ice types and thicknesses (~20 cm to < 1m) including sediment-laden ice at a shallow station near Nunivak Island, to 'clean' ice at most other stations. Our goal to collect ~50 ice cores with better spatial coverage than achieved last year was accomplished during this cruise. Cores were frozen on-board ship, and will be transported frozen to the lab at the University of Alaska Fairbanks for processing. After processing, samples will be analyzed for total dissolvable iron, dissolved iron, and soluble iron.

In summary, HLY0802 was a successful cruise providing our research group with an excellent platform for sampling sea ice and the water column. The availability of the helicopter as transportation during ice sampling facilitated acquiring ice cores of different characteristics and from different locations in a time-efficient manner. This was important to our group's goal of better constraining the large variability in Fe content observed on last year's ice samples.

Relevance of sea ice-derived organic matter for pelagic and benthic herbivores

(PIs: Gradinger and Iken, with Neumann and Story)

Our research project focuses on the quality and quantity of organic matter produced by ice algal communities and its relevance for pelagic and benthic herbivores. As of 20 April 2008, we collected during HLY0802 sea ice (10 stations), CTD water (32 stations), plankton (22 stations) and benthic (16 stations) samples (Table 1).

Table 1: Overview of sampling events, for details regarding ice sampling see Table 2

Sta #	St name	Date	CTD water sampling	plankton sampling	benthic sampling	ice sampling
1	NP15	30-Mar-08	yes	yes	yes	no
3	NP13	1-Apr-08	yes	yes	no	no
5	NP11	1-Apr-08	yes	no	no	no
6	NP10	1-Apr-08	yes	no	no	no
9	NP7	1-Apr-08	yes	yes	yes	no
11	NP5	2-Apr-08	yes	no	no	no
13	NP3	3-Apr-08	yes	yes	no	no
15	NP1	3-Apr-08	yes	no	no	no
16	NP1 – ice	3-Apr-08	no	yes	yes	yes
18	MN2	3-Apr-08	yes	yes	no	no
20	MN4	4-Apr-08	yes	yes	no	no
20	MN4 – ice	4-Apr-08	no	no	yes	yes
22	MN6	5-Apr-08	yes	no	no	no
23	MN7	5-Apr-08	yes	yes	yes	yes
25	MN8.5 – ice3	6-Apr-08	yes	yes	yes	yes
28	MN12	7-Apr-08	yes	yes	yes	no
31	MN15	8-Apr-08	yes	yes	yes	yes
34	MN20	9-Apr-08	yes	no	no	no
35	St 35	10-Apr-08	yes	yes	yes	no
36	SL14	10-Apr-08	yes	no	no	no
37	SL12	11-Apr-08	yes	yes	yes	no
40	SL10	11-Apr-08	yes	no	no	no
42	SL8.5	12-Apr-08	no	yes	no	no
43	SL8.25	12-Apr-08	yes	no	yes	yes
46	SL6	13-Apr-08	yes	yes	yes	yes
48	SL4	13-Apr-08	yes	no	no	no
51	SL1	14-Apr-08	yes	yes	no	no
52	W1	14-Apr-08	yes	yes	yes	yes
54	W3	15-Apr-08	yes	no	no	no
55	W4	15-Apr-08	yes	yes	no	yes
56	W6	15-Apr-08	yes	no	no	no
59	W7.5	16-Apr-08	yes	yes	no	yes
62	NP7/2	18-Apr-08	yes	yes	yes	no
63	NP3/2	18-Apr-08	yes	yes	yes	no
73	NP13/2	20-Apr-08	yes	yes	yes	no

Table 2: Ice-sampling activity details

Date	Station	Sea ice community analysis	Under-ice CTD	Sediment traps	*In situ* incubations	Under-ice video
4/3/08	NP1	X	X	-	X	X
4/4/08	MN4	X	X	X	X	X
4/5/08	MN7	X	X	-	-	X
4/6/08	MN8.5	X	X	X	X	X
4/8/08	MN15	X	X	X	X	X
4/12/08	SL8.25	X	X	X	X	X
4/13/08	SL6	X	X	-	-	X
4/14/08	W1	X	X	-	-	X
4/15/08	W4	X	-	-	-	-
4/16/08	W7.5	X	X	X	X	X

12. April 2008 ice station Healy 0802

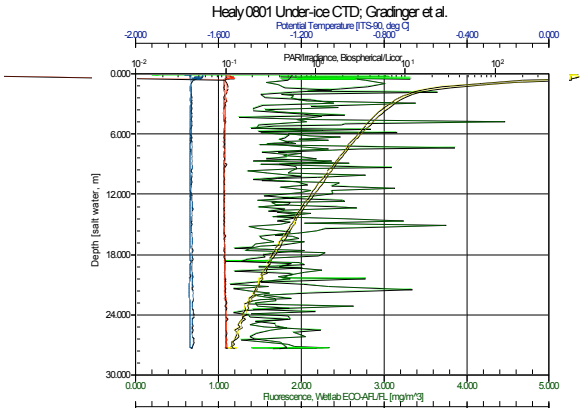


Fig 1: Example for under-ice CTD measurements with the following parameters: T (blue), S (red), PAR (yellow), algal fluorescence (green, rel. units).

Under-ice CTD

Under-ice CTD measurements were conducted with a Seabird 19plus equipped with additional PAR and algal fluorescence sensors. The instrument could be deployed at nine stations. The instrument malfunctioned at station W4 due to freezing of the pump.
The under-ice CTD measurements (Fig. 1) revealed a well mixed and homogenous water column structure.
The 1% light level was found at about 5 to 12m water depth below the ice.

Sea ice sampling

Ice cores for algal pigment, species composition and C and N stable isotope ratios were collected at ten stations. Ice cores were partitioned into 2 to 10cm long sections and melted in the dark partially with addition of filtered seawater. After complete melt, samples were filtered onto GF/F filters and frozen (-80deg C) for further analysis in the home lab. Nutrient concentrations in the ice segments were determined by the BEST Service team (Mordy et al.). Subsamples were taken and fixed for count of ice algal abundances. In addition, 200-500ml of melted ice were sieved through 20um gaze and the retained meiofauna was counted alive under a dissecting scope. Dominant meiofauna

taxa were rotifers and nematodes. In addition, we regularly observed polychaete juveniles and harpacticoid copepods.

In situ incubations and sediment trap deployments

Ice algal primary productivity and N-uptake were determined with *in situ* incubations (4-5h) at six locations. Ice algal samples were incubated just at the ice-water interface, water samples (from 5m depth) at 5m with additions of stable isotope trace amounts of 13C and 15N.

Sediment traps were deployed through holes in the sea ice at five locations for six hours in 5m depth. Collected material will be analyzed for algal pigment content, particle analysis, and POC/PON concentrations. At two locations, subsamples were provided to Moran et al. for Thorium measurements (see their report for details).

Under-ice video observations

A b&w video camera was lowered through a core hole and connected to a mini-DV camcorder at nine locations during Healy 0802. One hour of tape was recorded at each station with the camera positioned directly under the ice. The core hole was covered with snow to reduce light effects. The particle composition differed between stations from day to day. For example, on April 5 (MN7) marine snow dominated, while on April 6 (MN8.5), dense accumulations of euphausiids (*Thysanoessa rashii*) were seen attached to the bottom of the ice, likely feeding on ice algal biomass.

Ice observations

A total of 75 ice observations (period March 30 to April 19) were done every day during daylight hours, while the ship was in transit or on station. No observations were done during the dark night period. The observations together with two digital images per observation were logged on the Healy ice observational sheet and are available on the Healy 0802 event catalog at http://192.168.10.94/cgi-bin/best_hly-08-02/research/index.

CTD water sampling

CTD water was sampled at 32 stations. At all stations, water from ~20m depth was filtered onto pre-combusted GF/F filters and frozen for later C and N stable isotope analysis of POM. At process stations, 20m depth water was also collected for chlorophyll analysis and bottom water (usually 5 m above bottom) for C and N stable isotope analysis of POM. All samples are kept frozen until further processing at our home lab. A small water sample was taken from 10m depth for $\delta^{18}O$ analysis.

Plankton sampling

Plankton samples were collected with a 150um hand net at 3 stations and with a 150um ring net (vertical haul) at 20 stations. After collection, samples were sorted alive and dominant taxa were frozen. Taxa collected at many stations, depending on their occurrence, included copepods (*Calanus marshallae*, *Metridia pacifica*, *Neocalanus cristatus*, *N. plumchrus/flamingeri*, *Pseudocalanus* spp., *Eucalanus bungi*), euphausids (mainly *Thysanoessa rashii*), chaetognaths (*Sagitta elegans*), cnidarians (hydromedusae), and occasionally ctenophores (*Beroe cucumis*, *Bolinopsis infundibulum*, *Mertensia ovum*). Samples are in the process of being dried for later C and N stable isotope analysis at UAF.

Benthos sampling

For benthos, two van Veen grabs per station were collected at 16 stations and replicate surface sediment samples taken for chlorophyll and POM (stable isotope) measurements. The remaining parts of the grab sediments were sieved through 1mm sieves and biota sorted immediately for stable isotope analyses. Main target groups were mollusks (e.g. *Yoldia hyperborea*, *Macoma calcarea*), polychaetes (Maldanidae, Spionidae, Polynoidae, Phyllodocidae and other families), amphipods (incl. *Byblis* spp., *Ampelisca* spp., and others), and cumaceans (various species). After freezing, samples were dried and will be further processed in the home lab at UAF for C and N stable isotope analysis. Occasional interesting finds included Hemichordata and Cudofoveata, which were preserved in ethanol for molecular analysis. In addition, selected polychaete, amphipod and mollusk species were preserved for molecular analysis.

Mesozooplankton-Microbial Food Web Interactions in a Climatically Changing Sea Ice Environment. Evelyn Sherr, Barry Sherr, Robert Campbell, Carin Ashjian

A. Microzooplankton Grazing on Phytoplankton and Herbivorous Protists as Food for Mesozooplankton

Evelyn Sherr, Celia Ross

The overall objective of our project is to collaborate with our colleagues Carin Ashjian and Bob Campbell to improve understanding of specific feeding interactions and thus pathways of carbon flow in the pelagic food webs of the Bering Sea during early season conditions of sea ice and spring blooms, focusing on a comparison of the roles of mesozooplankton and microzooplankton as herbivores, as well as on the importance of microzooplankton as a food resource for mesozooplankton. Our research is designed to evaluate the rates and impact of microzooplankton grazing on algae suspended in the upper water column, including sea ice algae when present, to describe the microzooplankton community composition and abundance under varying conditions of spring sea ice extent, and to assess the importance of microzooplankton as a food resource for key copepod and krill species present during spring sea ice conditions by collecting samples from the Ashjian/Campbell mesozooplankton grazing experiments.

To date, we have completed 7 microzooplankton grazing experiments. We compared the rates of algal growth in whole water and in 10% whole water diluted with particle-free filtered water over a 24 hour day-night cycle at light levels about 15% of ambient. We incubated our 10% diluted water samples on the Ashjan/Campbell plankton wheel incubator (Figure 1) at surface seawater temperature since our incubator was not functional at the very low air temperatures prevailing during the cruise so far. In three of the experiments, there were separate treatments with and without added ice algae. Growth rates of algae were determined by change in chlorophyll-a concentrations from the initial to final times of the incubations. The results (Table 1) suggested low or no microzooplankton grazing in 5 experiments, and significant rates of microzooplankton grazing in 2 experiments. Phytoplankton growth rates in the 10% diluted water treatments varied from negligible to about 0.14 day-1, while ice algal growth varied from 0.01 to 0.16 day-1. We took samples for each experiment at initial and final times for microzooplakton abundance and for flow cytometric analysis of abundances of small sized phytoplankton and potential changes in cell-specific fluorescence of larger algae, which would affect chlorophyll values

Sampling to date has been under heavy ice conditions with low algal biomass in the water column. Inspection of water and sea ice samples via epifluorescence microscopy, as well as additional images obtained by Evelyn Lessard on her FlowCam, confirmed that the phytoplankton stocks in the water are either very small cells which most mesozooplankton likely can't utilize as food, or large and chain-forming diatoms which appear to be primarily sloughed off from the overlying ice. Images of such algae from previous work in the Arctic are shown in Figure 2. Similar ice algae are present in Bering Sea ice.

Microscopic and FlowCam analysis of water samples has also shown the presence of abundant microzooplankton, including large sized ciliates and heterotrophic dinoflagellates such as those shown in Figure 3. The heterotrophic dinoflagellates, which have been observed in all of our samples, are known to be able to ingest large sized diatoms and we speculate they could be feeding on ice algae suspended in the water. We have also inspected by epifluorescence microscopy fecal pellets produced by copepods and krill during the mesozooplankton grazing experiments (examples seen by light microscopy from previous work in the Arctic are shown in Figure 4). If the mesozooplankton were primarily ingesting algae, their fecal pellets would be expected to show chlorophyll or phaeopigment autofluorescence. Most of the fecal pellets we have observed showed little fluorescence, although some did have obvious red fluorescence indicative of feeding on algae.

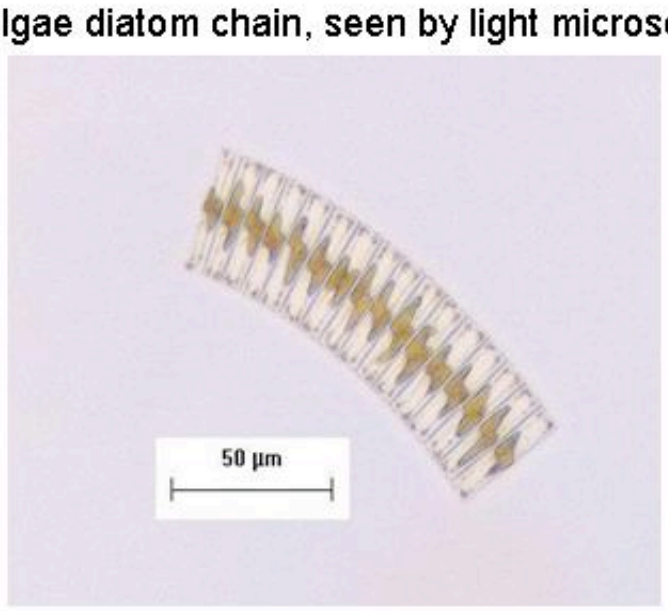
We have also collected profile samples for analysis of microzooplankton abundance and flow cytometric analyses of phytoplankton in the upper water column from depths sampled for primary production. These data will be used to put the water depth sampled for our grazing experiments either just after or just before the primary production cast in context of the overall distribution of microzooplankton in the water.

Table 1. Results of dilution experiments. Microzooplankton grazing rate is calculated as the difference between the 10% diluted water growth rate and the whole water growth rate. In three experiments, microzooplankton grazing was estimated for both ambient water algae and for ice algae added to the ambient water sample. Negative values (in bold) for micro-zooplankton grazing rate indicate microzooplankton grazing losses for algae in the water: values close to 0 or positive indicate net growth of algae and no apparent microzooplankton grazing. So far, there has been an indication of significant microzooplankton grazing at two out of the 7 stations sampled.

Exp	Date	Site	Sample Depth, m	To WW chl-a, ug/liter	10% diluted water growth rate, 1/day		Whole water growth rate 1/day		Microzoo grazing rate 1/day
					mean	stn dev	mean	stn dev	
0	4/2/2008	NP 7	15	0.28	0.095	0.159	-0.112	0.181	**-0.207**
1	4/4/2008	MN 4	16	0.20	-0.044	0.128	-0.038	0.026	0.006
2	4/6/2008	MN 8.5	10	0.17	0.080	0.155	0.092	0.228	0.013
3	4/8/2008	MN 15	2	0.88	0.136	0.065	-0.361	0.212	**-0.497**
			+ ice algae	10.2	0.009	0.047	-0.128	0.028	**-0.137**
4	4/11/2008	SL 12	10	1.6	0.060	0.005	0.069	0.036	0.009
5	4/13/2006	MG 6	14	0.76	-0.064	0.005	0.087	0.095	0.152
			+ ice algae	9.3	0.161	0.062	0.169	0.042	0.009
6	4/15/2008	W 7.5	2	0.15	0.115	0.325	0.139	0.148	0.024
			+ ice algae	5.3	0.074	0.134	0.099	0.146	0.025

Figure 1. Ashjian/Campbell plankton wheel incubator, showing incubation bottles wrapped to simulate 15% in situ light level being placed on the plankton wheel. Bottles are slowly rotated for a 24 hour period while being immersed in flowing water at near surface seawater temperatures.

Figure 2. Examples of sea ice algae imaged by top: light microscopy after fixation with acid Lugol solution, and bottom: epifluorescence microscopy after fixation with formalin and staining with a blue-fluorescing dye that shows the nucleus and cytoplasm of individual cells.



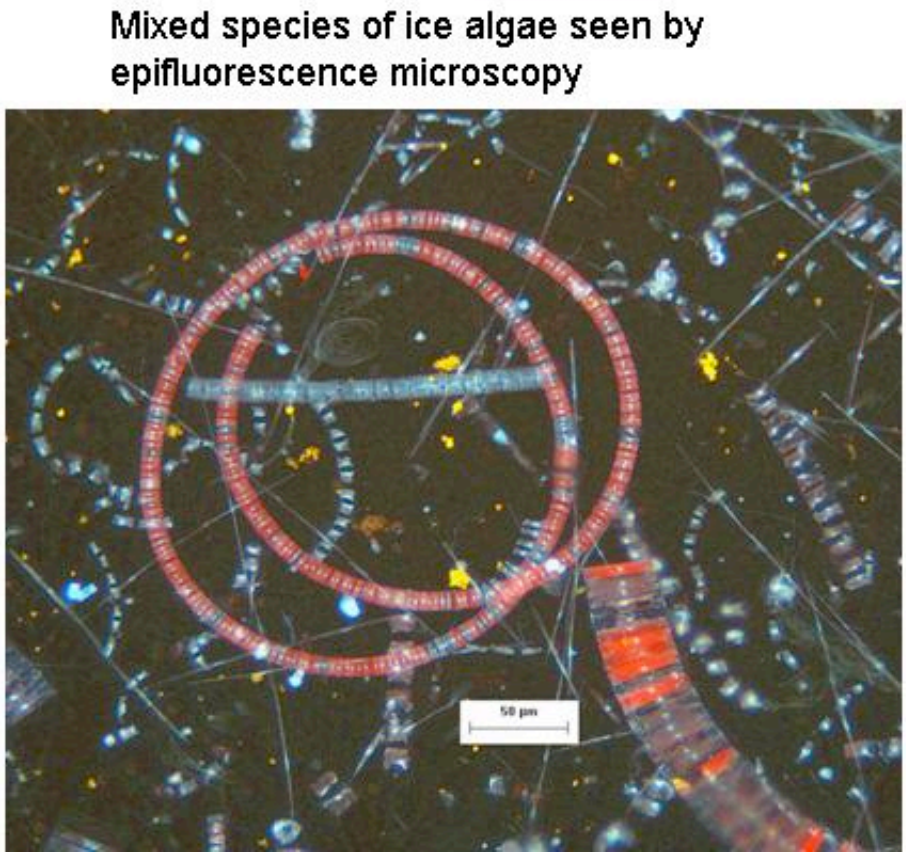


Figure 3. Examples of herbivorous protists in the microzooplankton seen in the Arctic Ocean. Similar protists have been observed during this cruise. Heterotrophic dinoflagellates known to ingest large sized diatoms appear to be especially abundant in our samples.

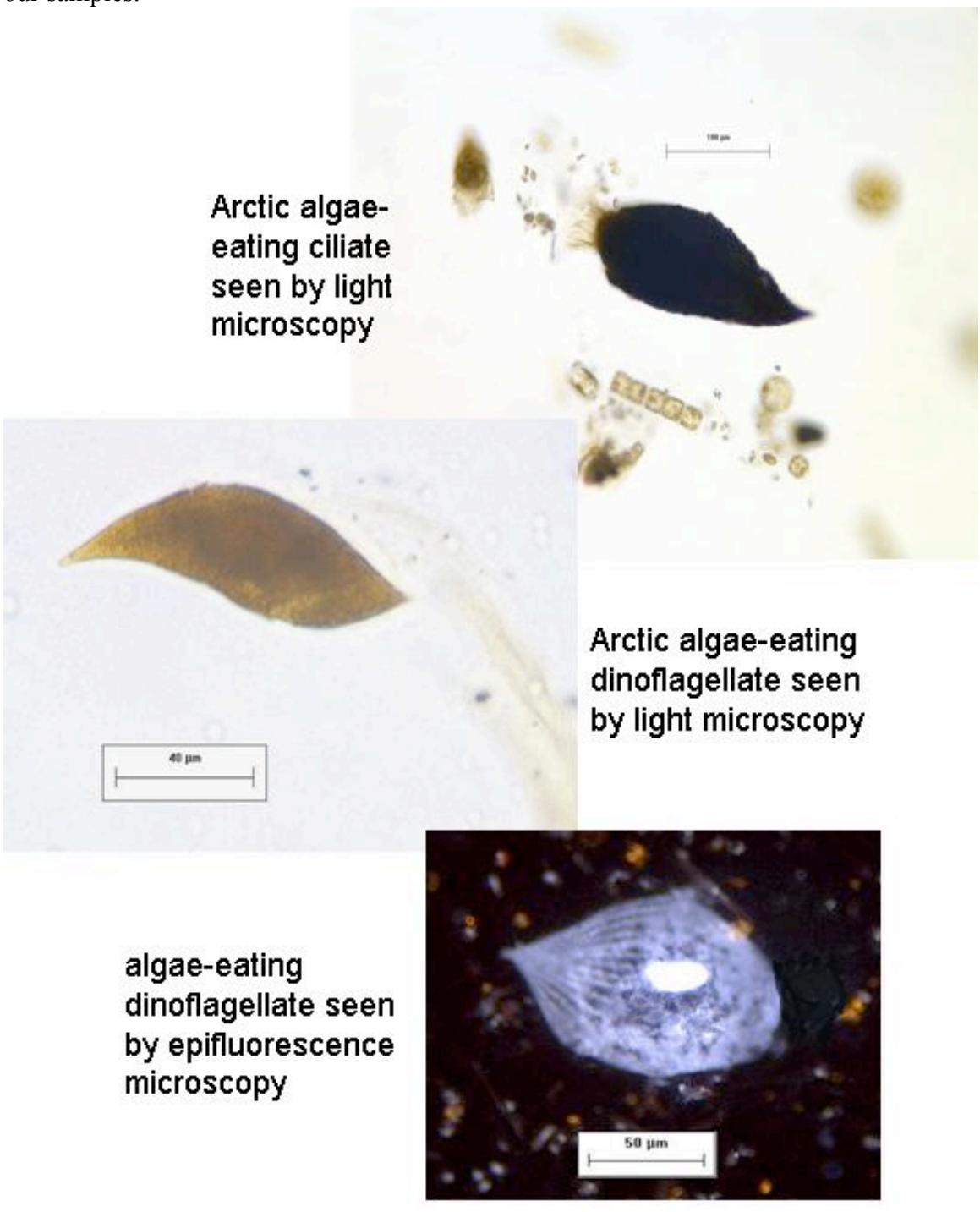


Figure 4. Examples of copepod fecal pellets like those we have inspected for the presence of chlorophyll autofluorescence in the mesozooplankton grazing experiments during this cruise, seen by light microscopy after preservation with acid Lugols solution.

B. Mesozooplankton Feeding and Reproduction

Bob Campbell, Carin Ashjian, Philip Alatalo, Donna Van Keuren

Feeding experiments using the dominant mesozooplankton taxa were conducted at process stations during the first half of the cruise. An on-deck plankton wheel/incubator was used to maintain the animals under *in situ* temperature and light conditions during the experiments. A total of 8 feeding experiments at the process stations have been conducted thus far. The experiments have been comprised of 3 different copepod (*Calanus marshallae*, *Pseudocalanus* spp., and *Metridia pacifica*) and 2 euphausiid (*T. raschii* and *T. longipes*) taxa. Chlorophyll concentrations have been quite low (<0.2 µg chl a/l) at most process stations with concomitant low grazing on chlorophyll at those stations. Grazing rates were substantially higher at 2 stations with higher chlorophyll concentrations and also on ambient water enriched with ice algae. Samples were taken to

estimate feeding on microzooplankton and phytoplankton/ice algae taxa to be analyzed in the laboratory.

There have been problems supplying ambient science seawater to the incubators to maintain incubator temperatures while in heavy ice. The science seawater system clogs with ice and flow slows or stops completely resulting in frozen supply hoses. The Coast Guard has been working with us to solve this problem using the ballast water system developed during SBI. It appears that they have the system working so that it can usually deliver water at temperatures a little more than 1 C above ambient or about 0.5 C higher than the science seawater system. Thus, it will allow us to keep the incubators running in heavy ice conditions. We still prefer to use the science seawater when it is available. We also note that during very cold weather (around –15 C or below) the drains on most of the incubators have been freezing resulting in water overflowing onto the deck and freezing creating a hazardous situation. Our Heatline designed drains have not had a single problem. Even after water had not been flowing for more than 12 hrs they remained open and ice free. We highly recommend that all incubators use these or similar drains on future cruises where similar temperature conditions are expected.

Egg production experiments have been conducted with the dominant copepod species at selected stations. A total of 18 measurements have been made with the three dominant species. Reproduction was initially low for *Calanus marshallae* but has increased over the course of the cruise to very high rates despite low chlorophyll concentrations in the water column. These high rates are probably at or near maximum for this species at these temperatures. Egg production in this species must be either fueled by feeding on ice algae at the ice/water interface or with lipid reserves. We plan to investigate this further during the second half of the cruise. Reproduction of *Pseudocalanus* spp. has been low at most stations. No reproduction was observed for *Metridia pacifica* in a single experiment.

Samples have also been collected for morphometrics, carbon and nitrogen, RNA/DNA, and genetic sequencing at process and selected stations.

C. Fine Scale Vertical Distribution of Plankton and Particles from a Video Plankton Recorder

Carin Ashjian and Philip Alatalo

The fine scale vertical distribution of plankton and particles in association with hydrographic features and water column structure is being described using a self-contained Video Plankton Recorder (see Ashjian et al., 2004 for more information on the instrument). Casts have been conducted at all stations across the cross-shelf transects, surveying the water column from the surface to 5 m off of the bottom or to 300 m depth where water depth exceeds that. To date, 62 casts have been conducted across the NP, MN, SL, and the second sampling of the NP lines. Casual viewing of the data has been conducted but only limited progress has been made on image identification because of

our intense work schedule. Complete analysis will be conducted in the laboratory following the cruise.

Qualitative assessment of the plankton and particles shows low particle/plankton concentrations at most locations and a predominance of small copepods. The most recent casts at 100 m on the NP line show increased concentrations of plankton and particles and the presence of diatom chains, suggesting that biological activity has increased recently.

Figure 1. Philip Alatalo (L, WHOI) and Marine Science Officer LTJG Stephan Elliott (R, USCG) deploy the Video Plankton Recorder.

Meso-Zooplankton Distribution and Abundance

Alexei Pinchuk

The primary task of the mesozooplankton component was to assess the abundance, biomass and species composition of the mesozooplankton on the shelf-break, middle and inner shelf of the southeastern Bering Sea. The data from these samples will aid in determining the fate of new and recycled production on the shelf. A total of 2 MOCNESS tows were taken on the offshore end of NP transect in the shelf break regime. Heavy ice prevented us from deploying MOCNESS at other stations. We obtained 60 CalVET samples at all CTD stations along all transect lines.

The large mesozooplankton component was sampled using a 1-m MOCNESS (Multiple Opening Closing Net and Environmental Sensing System), equipped with 0.5 mm mesh nets. The MOCNESS was equipped with salinity, temperature and fluorescence sensors to provide depth profiles of physical oceanographic data during the

tows. Samples were consistently taken in 20 m depth increments from the bottom to the surface.

The small mesozooplankton were sampled with a 25 cm CalVET (CalCOFI Vertical Egg Tow) net equipped with 0.15 mm mesh nets. The net was towed vertically from the bottom to the surface and from 100 m to the surface at sites deeper than 100 m. The nets were equipped with General Oceanics digital flow meters to monitor volume filtered. The CTD sample number was recorded with each net to facilitate comparison of CalVET samples with physical oceanographic data.

Samples were preserved in 10% formalin seawater and returned to the lab for processing. Samples will be split and organisms identified to the lowest possible taxonomic category. Copepods will be staged and wet weights will be determined for each species and stage. The above procedure will generate the species composition, abundance and wet weight biomass for all identified taxa from each tow.

Casual observation of the samples indicates that oceanic zooplankton species were common in the shelf-break and outer shelf region, but large copepods were rare or absent from the middle and inner domains stations. It appears that the mesozooplankton community was dominated by medium-sized and small copepods, gelatinous zooplankton and, at some stations, euphausiids. Oceanic *Neocalanus* spp., *Eucalanus bungii* and *Thysanoessa longipes* were common on the offshore ends of NP and MN transects indicating advection of oceanic water on the outer shelf (up to ~100 m isobath). *Calanus marshallae, Metridia pacifica* and *Thysanoessa raschii* were common on the middle shelf, while *Sagitta elegans* and small copepod *Pseudocalanus* spp. were abundant in all domains. A detailed assessment of zooplankton abundance, biomass and distribution will be made after the samples have been processed.

Underway Acoustics

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Project description: The focus of this work is to improve our understanding of the how temperature and sea ice cover alters the distribution of fish and euphausiids in the eastern Bering Sea. The Eastern Bering Sea supports very large fisheries, particularly for walleye pollock. Although the distribution of fish is well-known in the summer, little is known about their ecology and distribution during the months when much of the Bering sea is ice covered. In addition, little is known about how changes in ice extent might impact pelagic population of fish and their macrozooplankton prey. In this ancillary project, we instrumented Healy with calibrated scientific echosounders in order to continuously measure acoustic backscatter from fish and euphausiids. The work was supported by the Alaska Fisheries Science Center under the auspices of NOAA's loss of sea ice initiative.

Methods and instrumentation: Two transducers (120-7C and 38-120 were mounted 10 cm apart in a transducer well on Healy's hull which is at a depth of 8.4 m. The transducers were mounted 5 cm from the face of a composite urethane acoustic window which is bolted to the hull. The wells were filled with a 1.3 % propylene glycol and freshwater solution to prevent freezing of the water in the wells. The transducers were connected to Simrad EK60 120 and 38 kHz general purpose transceivers. The time on the logging computer was synchronized every 5 minutes to a timeserver aboard the ship to ensure that the echosounder time stamp matched that of other data streams. A standard sphere calibration of the system and transducer cabling was conducted prior to the installation. This calibration was conducted with a spare transducer window 5cm away from the transducer face to account for transmission losses associated with the acoustic window.

A sequential instrument triggering system was used avoid interference from other instruments. The trigger was based on the transmit pulse of a Seabeam 2112 system delayed by 0.75 seconds in order for the EK60 to receive after energy from the Seabeam transmission had attenuated. The EK60 ran at ~0.7 pings per second when not limited by travel time to the bottom (i.e. < ~750m depth). The Sperry SRD500 doppler speed log, which cannot be triggered, was turned off to avoid interference at 120 kHz. Acoustic data were logged continuously during Healy0801 and 0802.

Data processing: Two acoustic categories, one attributed to swimbladdered fish and one to euphausiids were developed based on the observed frequency response at 120 and 38 kHz (e.g. Figure 1). Experience on cruises on NOAA acoustic surveys the Bering Sea, where organisms are sampled to verify the acoustic backscatter in the Bering Sea as well as other studies suggest that this is a reasonable generalization (Korneliussen and Ona, 2002, Miyashita et al., 1997, De Robertis, unpublished data). Acoustic records were averaged into 5 ping by 5m cells, and the frequency difference was in each cell was computed. Cells with a S_{v120}-S_{v38} (Sv is a log10 unit of backscatter strength) in the range of –8 to -16 dB were assigned to the fish category and those in the range of 8to 30 dB were assigned to the euphausiid category (see figure 1). Acoustic backscatter in these categories were averaged in 0.5 nmi elementary sampling distance units (EDSU's) in 5m depth cells along the vessel trackline. Backscatter passing the "fish" category was integrated at 38 kHz and fish passing the "euphausiid" category was integrated at 120 kHz using a -80 Sv integration threshold. Acoustic backscatter strength is given in s_A with units of m^2 nmi^{-2} averaged over the water column. s_A is a linear measure of backscatter strength (see MacLennan et al, 2002 for a good discussion of acoustic units).

Preliminary observations: Preliminary processing up to the date of April 17 was conducted during the cruise. The resulting preliminary maps can be see in figure 2. Overall, backscatter from euphausiids and particularly backscatter from fish was lower in the northern and inshore parts of the vessel track, where cold water and ice cover was present.

Much of the fish backscatter (especially that near the shelf break near the Pribilof islands) is consistent in appearance and location with that of walleye pollock. The euphausiid backscatter performs clear vertical migrations, and a substantial portion of the population migrates above the transducer during the night. In contrast to observations in

on the 2007 Healy cruise, very little fish backscatter was observed north of 58 N. For example, the offshore portion of the MN line (>100 m depth) which was not ice covered in 2007 had substantial backscatter from fish, but this area of the outer shelf and shelf break was ice covered in 2008, and very little backscatter from fish was observed.

References:

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MacLennan, D. N., Fernandes, P. G., and Dalen, J. 2002. A consistent approach to definitions and symbols in fisheries acoustics. ICES J. Mar Sci 59: 365-369.

Miyashita, K., Aoki, I., Seno, K., Taki, K., and Ogishima, T. 1997. Acoustic identification of isada krill, *Euphausia pacifica* Hansen, off the Sanriku coast, north-eastern Japan. Fisheries Oceanography 6: 266-271.

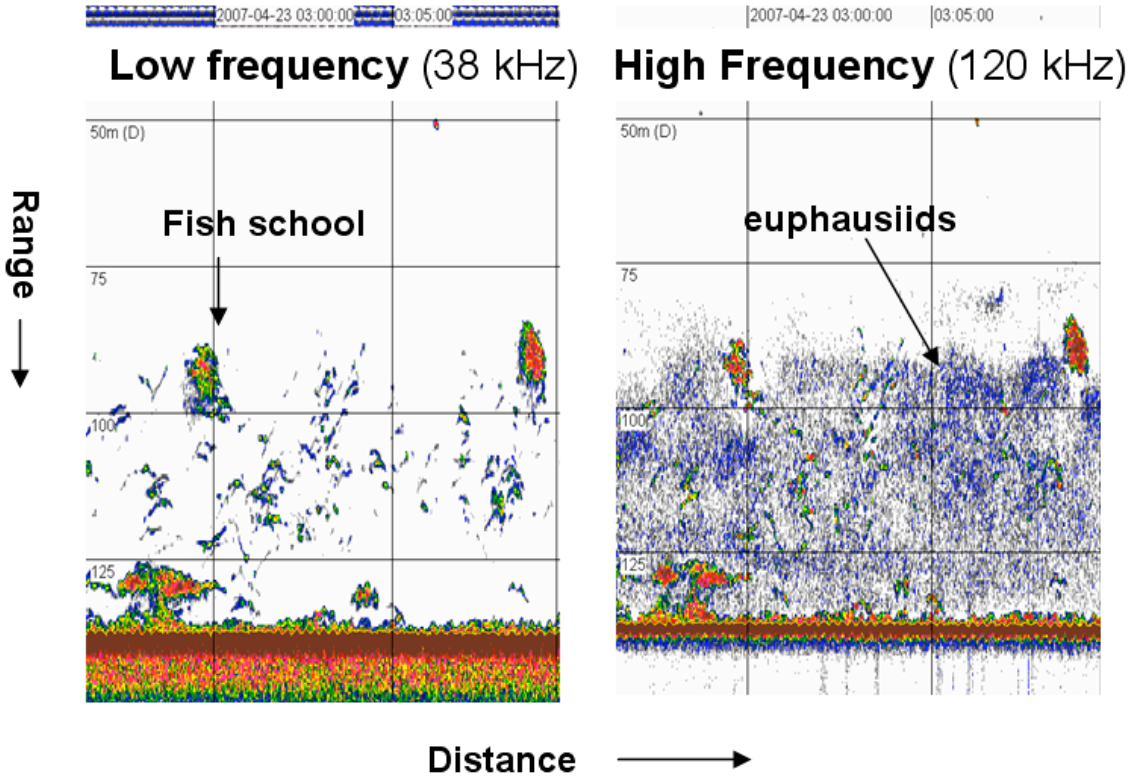


Figure 1: 38 and 120 kHz echograms from Healy showing backscatter from fish schools that are evident at 38 kHz. The fish are also visible at 120 kHz and 38 kHz, while the light blue backscatter from macrozooplankton which is much weaker at 38 kHz than 120 kHz. This frequency dependence is the basis for the classification used in this data set.

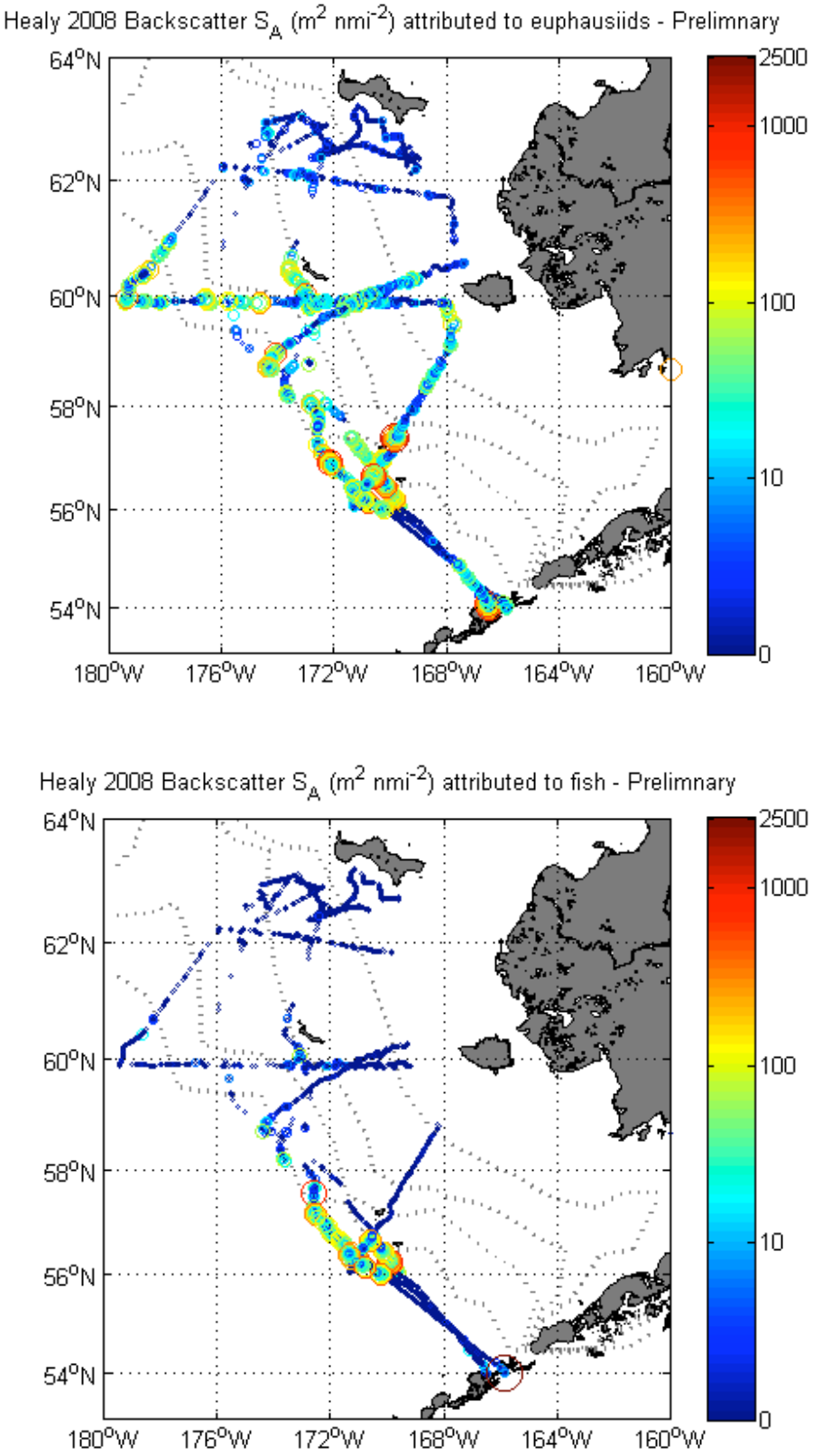


Figure 2. Acoustic backscatter (S_A m2 nmi-2) attributed to A) euphausiids and B) fish in along Healy's trackline in 2007 and 2008. The approximate position of the 200, 100, 70 and 50m isobaths are shown as gray dotted lines. Symbol size and color is proportional to the intensity of acoustic backscatter.

Denitrification and Globel Change in Bering Sea Shelf Sediments

Alan Devol and David Schull with Emily Davenport and Heather Whitney

The primary goal of the Schull/Devol benthic group is to measure benthic denitrification rates, nutrient fluxes, and sediment bioirrigation rates in order to evaluate the role of the benthos in the nitrogen cycle of the Bering Sea. A secondary goal is to determine gas exchange rates to help determine primary productivity in conjunction with measurements of the triple isotopes of dissolved oxygen. We also deployed an ROV under the ice to survey ice algae and krill and to test a method for future measurements of ice algal productivity.

Core samples

Ten stations have been sampled to date using an Ocean Instruments MC-800 multicorer equipped with eight 10-cm diameter polycarbonate core tubes. Two drops were made at each station resulting in as many as sixteen cores per station. The actual number of usable samples generally averaged approximately twelve. Cores were processed on deck and, depending upon the number of usable cores recovered, were generally allocated as follows:

2 - 3 flux cores (incubated for ca. 5d and overlying water sampled for, N2/Ar, O2/Ar, nitrate, nitrite, ammonium, phosphate, and silicate). Following flux measurements, these were frozen for later CT-scanning of burrow distributions

1 squeeze core
Profiles of dissolved oxygen measured by microelectrode and by optode
Profiles of dissolved nutrients (nitrate, nitrite, ammonia) by whole-core squeezing

2 section cores cut at 0.5- 1-cm intervals and centrifuged for pore-water nutrients, nitrate, nitrite, ammonium, phosphate, silicate, dissolved iron and manganese to 20 cm. Remaining sediment reserved for measurements of solid-phase elements (Fe, Mn, Al, C, N, Pb-210)

3 cores sectioned at 2-cm intervals for measurement of Rn-222/Ra-226 disequilibrium

2 cores sieved over 0.5-mm sieve and preserved in 10% formalin for later enumeration of benthic infauna

Water-column sampling

At all process stations, vertical profiles of 222Rn/226Ra were measured. The Rn-222/226Ra measurements will be used for determining gas exchange rates and, combined with oxygen isotope data collected by other BEST investigators, rates of net primary production.

Sea Ice surveys

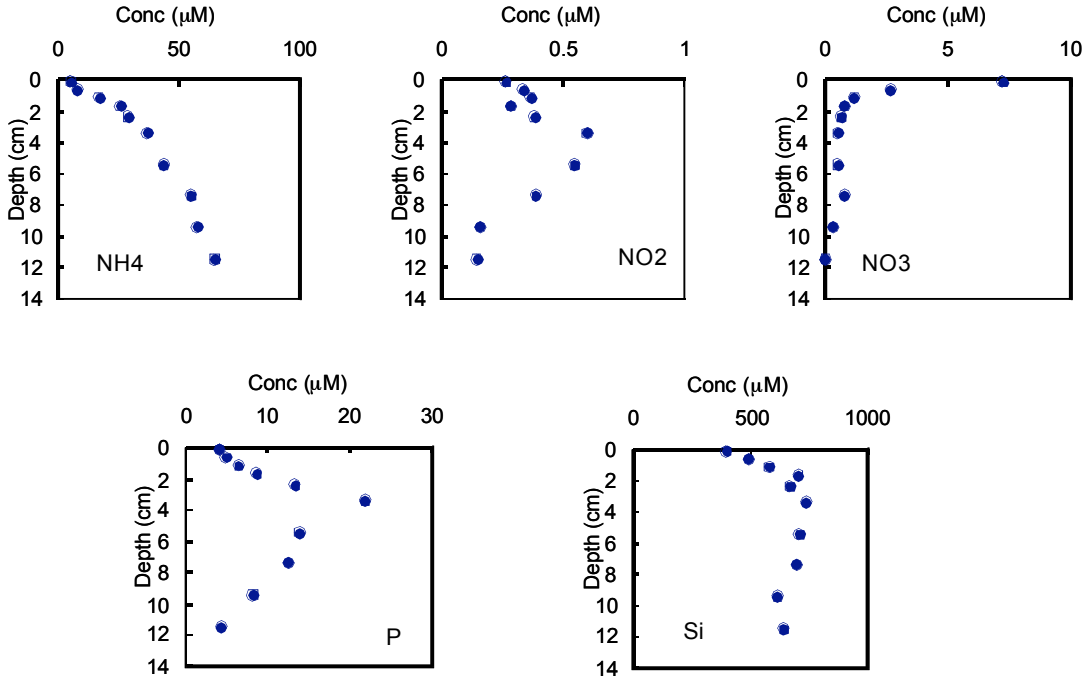
At three ice stations, a mini ROV was deployed and used to survey ice algae and krill observable under the ice. At two ice stations vertical profiles of brine were collected and run for 222Rn to investigate gas transport within sea ice.

Initial results
Multicore locations

Coring station information								Measurements				
Stn	Date	Latitude		Longitude		Depth (m)		[O2]pw	Flux	[Nut]pw	222Rn	Benthos
1	3/30/2008	56° 5.18'	N	171° 15'	W	2608		X	X	X	X	X
9	4/2/2008	57° 56.1'	N	169° 11.05'	W	67		X	X		X	X
21	4/5/2008	59° 52'	N	170° 22.1'	W	63		X	X	X	X	X
27	4/7/2008	59° 55'	N	174° 1.4'	W	103		X	X	X	X	X
31	4/8/2008	59° 55.9'	N	176° 32.4'	W	145		X	X	X	X	X
33	4/9/2008	59° 53.1'	N	178° 12.7'	W	145		X	X	X	X	X
38	4/11/2008	62° 14.4'	N	175° 5.4'	W	78		X	X	X	X	X
46	4/13/2008	61° 54.8'	N	171° 10.8'	W	53		X	X	X	X	X
59	4/16/2008	59° 52.5'	N	171° 6.9'	W	70		X	X	X	X	X
62	4/18/2008	57° 53.5'	N	169° 8.8'	W	70			X			

Attempted to core at other locations but were unsuccessful at collecting undisturbed sediment (Stations 2, 20, 25, 63)

Examples of nutrient profiles (Stn. 27, water depth = 103 m)



Benthic Ecosystem Investigation

Jackie Grebmeier and Lee Cooper (PIs), Edward Davis and Boris Sirenko (On-Ship Team Members)

This benthic sampling component of the research cruise included sampling of bottom sediments with both a van Veen grab and HAPS multi-corer. Four benthic grabs were collected at all benthic stations for quantitative benthic community collections. Organisms sieved from each of these grabs through 1-mm screens were preserved and will be returned to the laboratory for species identification and determinations of biomass. Expected laboratory processing time for these identification and data analyses will be approximately one year before data will be available. These species and biomass data will be compared to past collections at the sampled locations and in other areas of the northern Bering Sea. Additional grabs of the sediment were also undertaken at each station to provide surface sediments for determinations of sediment chlorophyll, total organic carbon, organic carbon: nitrogen ratios and potentially other sediment chemical parameters. Sediment chlorophyll was determined onboard, but the other data will be generated in shore laboratories. These sediment samples were collected out of the top of the grab before it was opened to obtain surface sediments; previous published studies have shown that bioturbation is significant enough in these sediments that additional care in collection of surface sediments by using coring devices does not provide any additional margin for providing undisturbed surface sediments. Surface sediments and organisms will also be made available from additional grabs to support the work of Rebecca Neumann and Katrin Iken (ice-benthos connections research group).

The benthic camera system that was deployed is a new experimental system manufactured by A.G.O. Environmental Electronics, Ltd., Victoria, British Columbia. It consists of a weatherized sub-sea camera mounted in a stainless steel cage with two 33 watt green lasers to provide a size scale on the seafloor. The sub-sea camera was connected by a multi-conductor cable to the shipboard control system and a separate Canon GL1 video camera recording the bottom images on mini-DV tapes that will be transferred to computer storage for analysis of epibenthic communities on the sea floor using video imaging software. A video overlay box provides the capability for providing GPS coordinates, temperature and depth data on the videotape.

The camera has been deployed at a total of thirty-two stations to date, with steadily improving results and it is now being used on a daily basis during the Healy 08-02 cruise. We thank Mr. Scott Hiller, the Scripps CTD technical support staff onboard for helping us work through initial problems with equipment freezing and focus. Several different ways of deploying the camera were experimented with; an efficient procedure for deployment using the starboard SeaMac winch was eventually resolved. Ship drift at high winds continues to pose some challenges for good video quality as well as surface swell.

Using the CTD casts at stations where we also deployed the camera and/or the Van Veen grab, we collected water samples for determinations of $d^{18}O$ values at most stations from surface, bottom and a mid-depth rosette bottle.

Seabird and Marine Mammal Surveys Aboard HLY0802 (March 30 – April 15, 2008) Mid-cruise Report

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As part of the HLY0802 Cruise we censused marine birds and mammals in conjunction with oceanographic and biological sampling conducted onboard the USCGC Healy. This survey (March 30 – April 15, 2008) extended from Dutch Harbor to an area south of St. Lawrence Island, and concluded near St. Paul. These data will be archived in the North Pacific Pelagic Seabird Database and are a part of the BESIRP study funded by the North Pacific Research Board.

We surveyed marine birds and mammals from the port side of the bridge (22m above the sea surface), using standard survey protocol during daylight hours while the vessel was underway at cruising speeds over 5 knots. One observer scanned the water ahead of the ship using hand-held 10x binoculars and recorded all birds and mammals within a 300-m arc, extending 90^0 from the bow to the beam. We also noted the animals behavior (flying, on water, on ice, feeding). We used strip transect methodology with three distance bins extending from the vessel: 0-100 m, 101- 200 m, 201-300 m. We determined the distance to bird sightings using geometric and laser hand-held rangefinders. Unusual sightings beyond the 300 m strip transect were also recorded for rare birds, for large bird flocks, and mammals.

Observations were directly entered into a GPS interfaced laptop computer using the DLOG2 program (Ford Ecological Consultants, Inc.). Location data were also automatically written to the program in 20 second intervals, and allowed us to simultaneously record changing weather conditions, Beaufort Sea State, ice type and coverage, and glare conditions. We recorded other environmental variables at the beginning of each transect, including wind speed and direction, air temperature, and sea surface temperature.

We surveyed a total of 1431 km of track-line over 16 days. During this time we recorded a total of 845 birds belonging to 14 species (Table 1.) The majority of birds observed were Common and Thick-billed Murres (Uria spp.) which composed 44 % of the on transect bird observations. Other species of interest observed included: Black Guillemots, Red-legged Kittiwakes, and Kittlitz's Murrelets.

We also observed a total of 330 mammals of 6 identified marine species and one arctic fox (Table 2), with spotted seal being most frequently encountered mammal. On April 10, we recorded a large concentration of Ribbon Seals (Figure 1) in the northwestern part of

the study area. We also had one observation of cetaceans during this survey. On April 14 we observed a group of 4 beluga whales north of Nunivak Island (Figure 1).

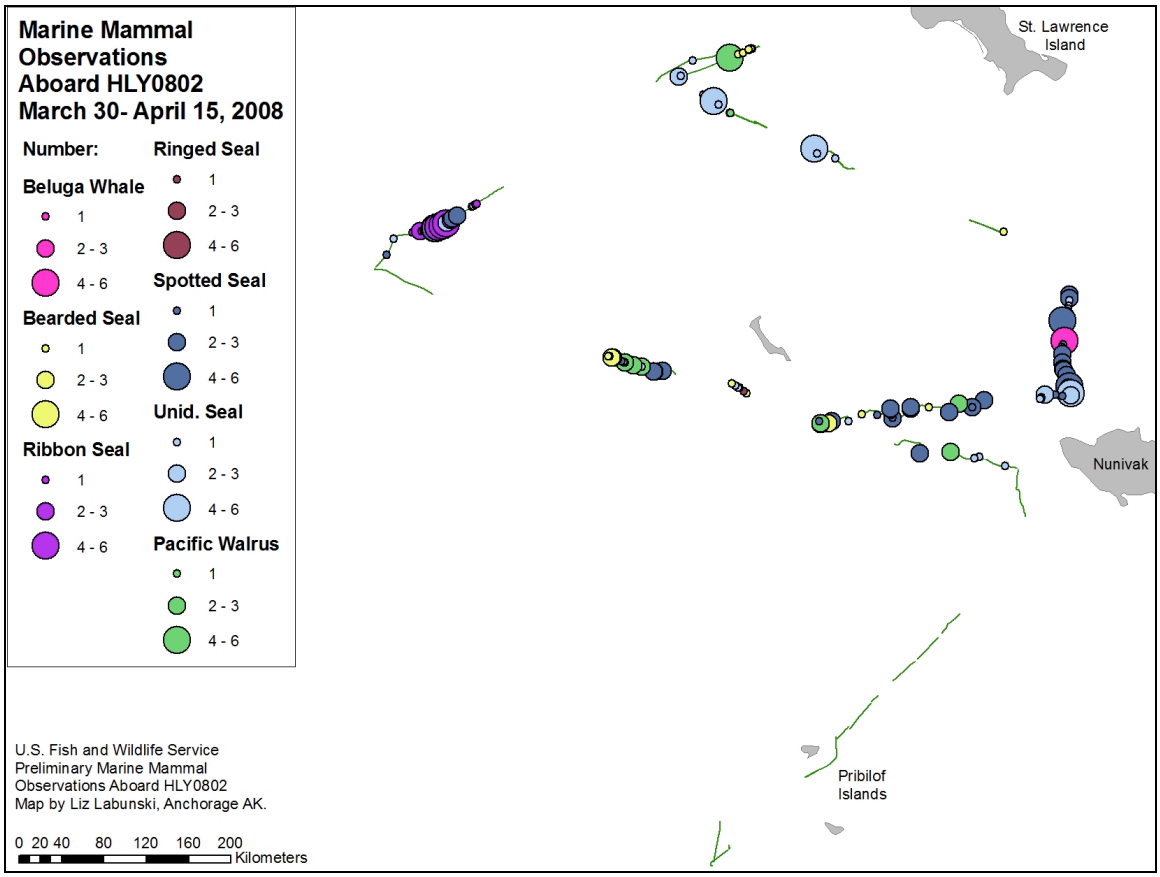
Table 1. On transect seabird observations during HLY0802 (March 30 – April 15, 2008)

Black Guillemot	61
Black-legged Kittiwake	130
Brachyramphus Murrelet	2
Common Murre	15
Glaucous Gull	114
Glaucous-winged Gull	40
Harlequin Duck	1
Herring Gull	2
Kittlitz's Murrelet	43
Northern Fulmar	44
Pigeon Guillemot	1
Red-faced Cormorant	3
Red-legged Kittiwake	11
Thick-billed Murre	224
Unid. Alcid	2
Unid. Cormorant	3
Unid. Guillemot	3
Unid. Gull	2
Unid. Kittiwake	9
Unid. Murrelet	4
Unid. Murre	131
total birds	845

Table 2. Total mammal observations during HLY0802 (March 30 – April 15, 2008)

Arctic Fox	1
Beluga Whale	4
Bearded Seal	27
Ribbon Seal	57
Ringed Seal	1
Spotted Seal	138
Unid. Pinniped	4
Unid. Seal	66
Pacific Walrus	32
total mammals:	330

Figure 1. Marine mammal distribution aboard HLY0802 (March 30 – April 15, 2008)



Nitrogen Supply for new production and its relation to climatic conditions on the eatern Bering Sea Shelf

Raymond Sambrotto and Daniel Sigman (PIs)

A) Sambrotto Component: Kris Swenson and Peng Wang (On-Ship Team Members)

Summary:

The principal goal of our group was to access the primary productivity of the Bering Sea by taking 15N & 13C uptake profiles, derived from on-deck incubations of water from various depths, depending on the CTD PAR light sensor readings. Other sampling methods included filtration of whole water for natural abundance, analysis of urea in the water column, DNA filtration, preserved samples taken for phytoplankton identification, as well as samples taken for Dissolved Organic Nitrogen and Phosphate.

A final component of our sampling involved ice station sampling. In-situ incubations were performed at various ice stations, and were run in parallel with on-deck

incubations, as far as incubation time, water depths, and light levels were concerned. Another component of our ice station sampling was analyzing ice cores for phytoplankton identification.

The procedures and the stations that they were performed at can be seen in the attached table.

Results and Conclusions:

In the first leg of this cruise, we successfully completed on-deck incubations at all designated productivity process stations, and performed in-situ incubations at three of them. Our other sampling procedures listed above were all performed at spatially designated short and long stations.

A few problems that we encountered dealt with the on-deck and in-situ incubations. The frigid conditions that were experienced early in the cruise made it difficult to keep the incubators running, despite attempts at insulating and heating the connections and hoses that allowed the water to reach and drain from the incubators. With assistance from crew members and fellow scientists, we seem to have resolved the problems. A switch to water from the ship's ballast tank has helped, as the science seawater system contained a high volume of ice at times, which froze the manifolds, and thus froze the rest of our incubation setup.

The conditions on the ice made it difficult for our in-situ incubations to take place, but we fought through the elements and collected three nice profiles, which will undergo isotopic analysis upon return to Lamont.

We look forward to reaching our sampling goals for the second leg of the cruise, and of getting a better understanding of the Bering Sea's primary productivity and how it aids in the understanding of the Bering Sea ecosystem as a whole.

Table 1. Summary of collections by station and cast for the first part of the cruise.

Station	Cast	On-Deck Prod. profile	In-situ Prod. profile	Urea Analysis	DON/P	Natural Abundance	Phyto ID	DNA filtration
1	1			x	x	x	x	x
1	3	x						
2	4			x	x	x		
5	8			x	x	x		
7	10			x	x	x		
9	16	x						
10	18			x	x	x		
13	21			x	x	x		
17	25			x	x	x		
18	26			x	x	x		
19	27			x	x	x		
20	31			x	x	x		
23	35			x	x	x		
24	36			x	x	x		
25	38	x	x					
25	39			x	x	x		x

26	42			x	x	x		
29	45			x	x	x		
31	49	x		x	x	x	x	x
34	54			x	x	x	x	
38	59			x	x	x	x	
40	64			x	x	x	x	
42	66	x	x					
44	68			x	x	x		
46	73	x		x	x	x	x	
48	75			x	x	x		
50	77			x	x	x		
52	79			x	x	x		
55	82			x	x	x	x	x
57	84			x	x	x		
59	88	x						
62	95	x						
64	91			x	x	x		
75	109			x	x	x	x	x
75	111	x		x				

B. Sigman Component

Julie Granger – postdoctoral fellow (Princeton University), Maria Prokopenko – sailing scientist (USC)

Objective 1:
To construct nitrogen budget for of the eastern shelf of the Bering Sea using natural abundance $\delta^{15}N$ and $\delta^{18}O$ of nitrate, $\delta^{15}N$ of the total dissolved nitrogen (TDN=Nitrate + DON + ammonium, if present), as well as Particulate Organic Nitrogen (PON). Isotopic analysis will be run in the laboratory of D. Sigman at Princeton University.

Corresponding activity (table 1): Collected samples for $\delta^{15}N$ and $\delta^{18}O$ analysis of nitrate and $\delta^{15}N$ of TDN in the water columns ranging from under-ice "winter" water column, across the winter ice floe edges, and in the outer parts of the first bloom encountered so far (by the 20th of April) during the cruise to the north-west from the NP line. Normally, in a well -mixed under-ice water column 2 or 3 depths were sampled. At the sites with 2 or 3 layer present, 6-10 samples were collected. At selected stations (table 1), samples of total PON and Size Fractionated PON (SFPON) were taken. For total PON, 60 ml of seawater collected from selected depths of the CTD casts was filtered through GF/F filters. For SFPON, 2L of sea water from CTD casts, was gravity filtered through 0.2 μm and 5 μm Millipore filters. Filters were frozen at -20 C for subsequent isotopic analysis. Also, at selected stations, mostly where SFPON was collected, individual zooplankton from Bongo nets (333 μm mesh) were hand picked and identified by Alexej Pinchuk (University of Alaska, Fairbanks). Individual animals were placed on GF/F filters and frozen in pre-combusted glass vials for subsequent isotopic analysis at

Princeton. The main groups were found to be: *Calanus marshallae, Sagitta elegans, Metridia pacifica, Thysanoessa raschii, Neocalanos flemingeri, Parathemisto libellula, Neonysis ragii*

Objective 2:
To compare the $\delta^{15}N$ signal of the water column nitrate to that of larger phytoplankton (namely diatoms). For this purpose, samples were collected for the $\delta^{15}N$ analysis of diatom-bound nitrogen, or DBN. DBN is present in organic matrix of diatoms silica frustules, and is believed to be protected from bacterial degradation during early diagenesis, preserving the original $\delta^{15}N$. This can provide information on the $\delta^{15}N$ of water column nitrate and regional nutrient status. Such property of DBN makes it an attractive paleoceanographic proxy for nutrient availability on geologic time scales. Information on $\delta^{15}N$ of nitrate at locations of diatoms collection will help to ground-truth the validity of this proxy. Variations in $\delta^{15}N$ of DBN in the context of ice distribution and associated hydrographic variability will be investigated as well.

Corresponding activity: at selected stations (table 1), a small 50 μm-mesh net (referred to in the Event Log as russian nyet) was towed on the A-frame through the upper 30-35 m of the water column vertically (or obliquely if ice conditions permitted); at a couple of stations, the net was hand-held and lowered to 10 m (see table 1 for these stations). Plankton biomass was collected and stored frozen at -20 C for subsequent isotopic analysis. Whenever available, surface sediments (upper 3 cm) were taken for our group at the locations of the net tow from multicore samples by the members of Devol/Shull group and from Van Veen grabs by the members of Davis/Sirenko group.

Objective 3:
To quantify the net community production by determining the O_2 fluxes using the underway O_2/Ar ratios measured with Equilibrator Inlet Mass Spectrometer (EIMS). This work has been initiated by Julie Granger and Maria Prokopenko during the HLY0701 cruise; the HLY0802 season provides an excellent opportunity for inter-annual comparison between the two spring seasons.

Corresponding activity:
EIMS is designed to continuously measure through the duration of the cruise dissolved gas ratios (N_2/Ar, O2/Ar and CO2/Ar). Discrete samples are collected into pre-evacuated gas-tight glass bottles from the underway system to calibrate the EIMS measurements to be run in the laboratory of M.Bender (Princeton University). Water column radon measurements by D. Shull, Washington Western University will be used to determine the rates of air-sea exchange necessary for calculations of oxygen fluxes. Also, discrete dissolved gases samples from the upper 8 - 10 m of the mixed layer are taken from selected CTD casts. Discrete gas samples from the CTD casts will be analyzed for O_2/Ar ratios, as well triple oxygen isotope ratios at the laboratory of M. Bender at Princeton University. The latter will be used to constrain the rates of gross photosynthetic production and evaluate net to gross community production ratios

Objective 4

To quantify the rates of photosynthetic production within seasonal sea ice by quantifying the O_2 fluxes through ice, and measuring O_2/Ar ratios and triple oxygen isotopes in the ice brines[1]. This work has been initiated during HLY0701 in collaboration with C. Mordy, N. and D. Kachel is continuing during HLY0802 expedition. During the first leg of HLY0802 cruise, the sampling of ice floes has been done with great assistance of A. DeRobertis (NOAA-PMEL).

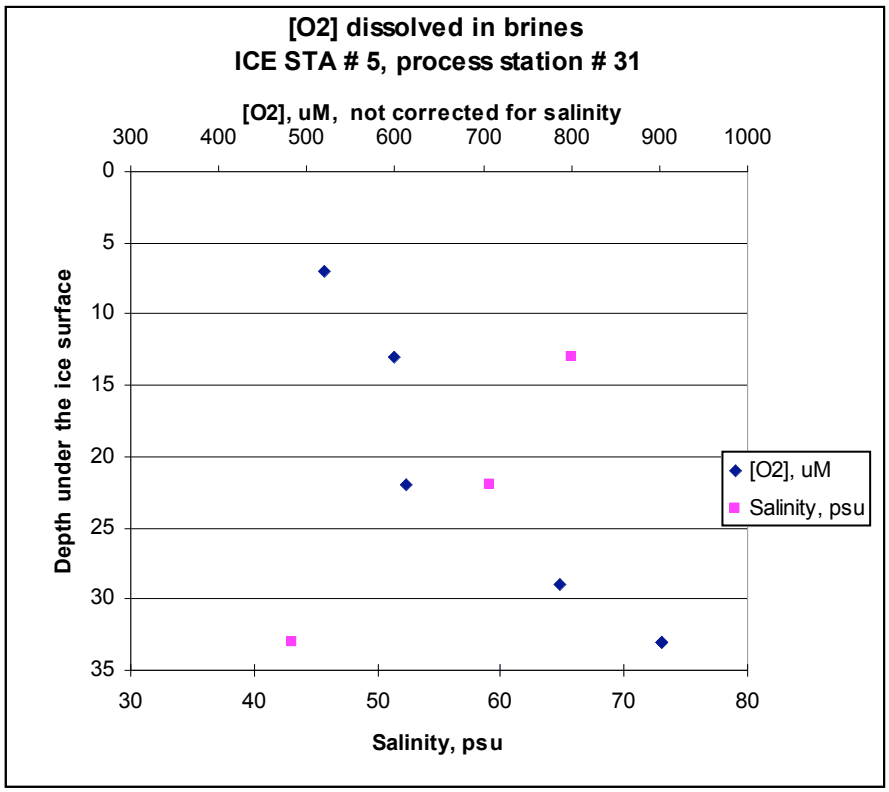
Corresponding activity: Spatial variability in O_2 concentrations within an individual ice floe was investigated at two ice stations (IS # 3 and IS # 4). [O_2] were measured by immersing an optode into an ice holes drilled with an auger. The O_2 concentrations will be interpreted in the context of data collected on the same ice floes by the NOAA-PMEL group: PAR values, temperatures and salinities of ice and brines, ice porosities, depth-binned chlorophyll, etc. O_2 concentrations (not yet corrected for salinity) were found to vary from 600 to 900 μm in the bottom layers of the ice, where the most of algae biomass is found. D. Shull group has been collecting brine samples for Rn measurements to to assist with quantification of gas exchange rates within atmosphere-ice-sea water system Composite depth-resolved brine O_2 profiles have been measured with the optode at two ice stations (IS # 5 and IS #9, see Fig.1 for the profile from IS # 5). Dissolved O_2/Ar ratios were determined for several discrete brine samples introduced directly into EIMS within 0.5-2 hours of collection. The measured (but not calibrated yet O_2/Ar indicated at 200 % O_2 supersaturation, produced by algae photosynthetic activity in ice. 2-4 samples for Winkler O_2 determination were collected at each of sampled ice stations. At each ice station, a sample was collected for triple oxygen isotope analysis into a pre-evacuated bottle to determine the contribution of gross photosynthesis to the oxygen dissolved in brines.

[1] "Brine" is defined as saline water within ice pore spaces in thermal equilibrium with ice at a given temperature.

Table 1

Location/Station/ Cast	d15N -NO3	d15N-TDN	d15N - PON	d15N - SFPON	Ind. Zoop.	Tow nyet	Surface sediments	O2/Ar and triple O2 isotopes
Slope/1/001	x	x						x (at 500 m)
Slope/1/002								x (at 300 m)
NP14/02/004	x	x						
NP13/03/005	x	x						
NP12/04/007	x	x						
NP11/05/008	x	x						
NP8/08/011	x	x						
NP7/09/012	x	x	x			x (hand held)	x	x
IS 1/16/24	x							x
MN3/19/027	x	x	x		x	x (hand held)		
MN4/20/032	x	x				x	x	
MN8/24/036	x	x				x	x (at sta 23)	
MN8.5/25/039	x	x			x	x	x	x
MN13/29/045	x	x				x	x (at sta 28)	
MN14/30/046	x	x				x		
MN15/031/047	x	x	x	x	x	x	x	x underway
MN16/32/051	x	x						x
MN18/33/053	x					x		
MN20/34/054	x	x						
SL14/36/056	x	x				x		
SL12/38/058	x	x		x	x	x	x	x
SL9/41/065	x					x		
SL8/44/068	x					x		
SL6/46/70 and 71	x					x	x	x
SL2/50/077	x	x						
SL1/51/078	x	x				x		
W3/54/081	x	x				x		
W7.5/59/086	x	x	x	x	x	x	x	x and x underway
NP3/63								x underway
NP5/65/098	x	x				x	x	
NP7/62/092	x	x		x	x	x	x	x
NP12/072/105	x	x		x		x	x	x
NP13/73/106	x	x			x	x	x	

Figure 1



The Impact of Changes in Sea Ice on Primary Production, Phytoplankton Community Structure, and Export in the Eastern Bering Sea

A. Moran Component

Pat Kelly

Project Objectives:

1) Quantify the flux of particulate organic carbon (POC) from the surface water to the deep waters of the Bering Sea using ^{234}Th as a tracer of particle export.
2) Determine POC/^{234}Th ratio and phytoplankton community values for particles collected in drifting sediment traps at five different depths.
3) Estimate particle export using measurements of total ^{234}Th – ^{238}U disequilibrium in water column.
4) Estimate gross primary production using triple-oxygenn isotope method
5) Measure dissolved oxygen using underway oxygen optode.
6) Estimate cross-shelf exchange using short-lived radium isotopes ($^{223, 224}$Ra).

Samples Collected:

Floating sediment traps

Station	Depths (m)	POC/234Th samples	Pigment samples
T1	25,40,50,60,100	2 per depth	2 per depth
041208 RT*	5, 20	1 per depth, ^{234}Th only	NC
041608 RT*	5, 20	1 per depth, ^{234}Th only	NC

* These samples graciously provided by Rolf Gradinger et al. Numerical code corresponds to date of collection.

Small Volume ^{234}Th

Station	Depths (m)
1-NP15	1,10,20,30,40,60,150,250,300
9-NP7	1,10,20,30,40,50,60
25-MN8.5	1,8,20,30,40,50,70
32-MN15	10,20,31,40,60,80,100,120,136
34-MN20	1,10,20,40,100,300,600,800,1200,1500,2000, 2500
38-SL12	10,20,30,40,60,75
46-SL6	10,20,30,40,48
59-W8	10,20,30,40,50,60,67
62-NP7	10,20,30,40,60,65

Triple-oxygen isotopes

Date	Station	Depth (m)
3/30/08	1-NP15	500
3/30/08		500
4/3/08	16-MN1	10
4/7/08	25-MN8.5	8
4/8/08	31-MN15	Underway**
4/9/08	32-MN16	8
4/11/08	38-SL12	8
4/13/08	46-SL6	10
4/16/08	59-W7.5	8
4/16/08	59-W7.5	Underway**
4/18/08	62-NP7	8
4/19/08	63-NP3	Underway**

** These samples collected using science seawater line.

Short-lived Radium isotope samples

Station	Depth (m)
NP-1	8

Data Summary

Trap Results:

Measurable quantities of ^{234}Th have been collected in the sediment traps, though further comment is unwarranted due to incomplete analysis. CHN and pigment analysis will be completed upon return to URI-GSO.

Small Volume Results:

Measurable quantities of ^{234}Th have been collected, though further comment is unwarranted due to incomplete analysis.

Triple Oxygen Productivity Results:

Samples will be analyzed post-cruise, no comment is warranted at this time.

Optode Results:

Underway oxygen data has been collected for the entireity of HLY-08-02. Some early cruise data may be compromised by sediment accumulation in optode flow-cell. Since that remediation, it has been observed that the optode does track generally well with the SeaBird oxygen sensor, though the optode offers less resolution. It is also hypothesized that the oxygen values from the flow through system are compromised by icebreaking activities (bubble injection, for example).

Short Lived Radium Results:

Analysis of only sample collected up to this point revealed low activities of ^{223}Ra and ^{224}Ra. More sampling is required to evaluate this observation.

B. Lomas Component

Jonathon Whitefield and John Casey

The Phytoplankton Ecology Lab (PEL) from the Bermuda Institute of Ocean Sciences (BIOS) sent two technicians on HLY0802. The project, part of a collaborative effort between BIOS and URI, is aimed at answering the question of whether climate-driven interannual variability in sea ice extent has altered the magnitude of gross and net primary production, its autotrophic community structure, and subsequently, carbon

export, and degree of pelagic-benthic coupling in the eastern Bering Sea. This research contains a central hypothesis:

Climate-driven interannual variability in sea-ice extent and duration shifts the eastern Bering Sea autotrophic community between one of two states; marginal ice-zone (MIZ) blooms vs. open-water blooms. The MIZ bloom state is characterized by high biomass, diatom-dominated blooms, high pelagic export and tight pelagic-benthic coupling, whereas the open-water bloom state is characterized by lower biomass, flagellate blooms, low pelagic export, and reduced pelagic-benthic coupling.

On HLY0802 PEL began the research in to this hypothesis by taking a range of samples: micro- and picoplankton (FCM), Chlorophyll A, and two types of primary production – both C13 stable isotope and traditional C14 (see table 1 for sample details). These samples will be analyzed at BIOS after the end of the cruise. PEL are also sharing the data from the URI sediment trap deployment – two samples from each of the 5 depths will have pigment samples run on an HPLC.

With the use of primary production to determine the rate of growth, and sediment traps to record the export, PEL is in a good position to answer its hypothesis.

Table 1. Summary of samples taken on the first leg of HLY0802.

Sample type	Number of samples	Stations sampled
C14 production	**952** 7 depths / cast 12 POC14 / depth 3 x light incubation 1 x dark incubation 1 x T_0 1 x Specific activity T_0 1 x incubated specific activity 5 x DOC14 / depth } Size fractionated – GF/F and 5µm	NP15, NP7, MN8.5, MN15, SL12, SL6, W7.5, NP7
ChlA	**112** 7 depths / cast 2 samples / depth } Size fractionated – GF/F and 5µm	
HPLC / Pigments	**112** 7 depths / cast 2 samples / depth } Size fractionated – GF/F and 5µm	
FCM (pico plankton)	**109**	NP15, NP11, NP7, MN1, MN4, MN8.5, MN13, MN15, MN20, SL12, SL8.5, SL6, W1, W5, W7.5, NP7, NP11
Microplankton	**109**	

TOC	**79**	NP15, NP11, NP9, NP8.5, NP7, MN1, MN4, MN9, SL12, SL8, SL8.5, SL6, W5, W7.5, NP7, NP11
DIC	**189** 105 x 250ml bottles 84 x 500ml bottles	Every station except W line
VOLUME COLLECTED	382.5 litres	

The Trophic Role of Euphausiids in the eastern Bering Sea: Ecosystem Responses to Changing Sea-Ice Conditions

Rodger Harvey and Evelyn Lessard

The Lessard and Harvey groups are studying the feeding ecology, growth rates and demographics of euphausiids on the eastern Bering Sea shelf region. To do this, we are performing shipboard krill feeding experiments to measure carbon ingestion rates and identify specific prey identify specific prey items (phytoplankton, heterotrophic protists, copepods) items. We are also determining the lipid profiles of both euphausiids and their prey in order to assess euphausiid health and nutrition. Identifying the lipid profiles and specific biomarkers for different prey taxa (particularly the poorly known heterotrophic protists) will enable us to infer diets from euphausiid lipid profiles. We are also measuring growth and egg production rates. In addition to the lipid profiles, Harvey is using the lipofuscin method to estimate euphausiid age. Lessard is isolating specific prey items, particularly heterotrophic protists, for lipid analyses to identify specific prey biomarkers.

A. WATER COLUMN PARTICLES AND KRILL COLLECTION

Rodger Harvey and Rachel Pluethner

<u>Grazing Experiments for Determination of Euphausiid Grazing Rates and Food Source Preferences</u>

Grazing experiment setup is detailed in the report from Lessard. For characterization, of food resources and tracking of comsumption, , water was taken from a designated Niskin bottle at the beginning of each grazing experiment (T_0)and filtered through combusted GF/F filters for carbon and detailed lipid analysis to characterize the algal and detrital food available to krill. This water was also used for grazing experiments. At the conclusion of each grazing experiment conducted by Lessard, (of which there are currently 8) , water was collected individually from each bottle containing animals and placed on separate particulate filters for lipid analysis to compare food amounts and potential for selective grazing

At the conclusion of each grazing experiment. the experiment, animals were either sacrificed or frozen for later lipid analysis. (Refer to Table 2 for dates of animal storage.) The eyes and eye stalks were removed for those who were sacrificed; both the lipofuscin (Part A) and protein content (Part B) in each pair of eyes was determined via flow-through fluorescence using an Agilent HPLC. The rest of each euphausiid was frozen in the -70ºC chest freezer for future lipid analysis.

Growth Experiments for the Determination of Age in Euphausiids Found in the Bering Sea

Currently, three growth experiments have gone to completion, with three in the works. Initial lipofuscin analysis has been completed for the first two, and lipofuscin is currently being extracted from selected members of the third experiment. These experiments have included animals of a larg4e size range to provide a first estimate of lipofuscin indices in field animals of differing ages. Alexei Pinchuk will conduct growth experiments spanning the next two years in order to allow age calibrate the field specimen that have been analyzed.

LIPOFUSCIN SAMPLE ANALYSIS

High Performance Liquid Chromatography for the Identification and Quantification of Lipofuscin

Part A
Toward the beginning of the cruise, the optimal excitation and emission wavelengths for lipofuscin – an oxidation product that accumulates in euphausiid neural tissue - from *T. inermis* was determined by running a three dimensional fluorescent scan of the extracted product present in a composite samples of krill neural tissue. (See Figure 1.) That scan allowed a qualitative identification of lipofuscin for that species, and will be used to measure lipofuscin content in euphausiids for the duration of the cruise. A calibration curve using quinine sulfate in allows quantitative measures of fluorescence intensity to be performed for each run.

Part B
For protein analysis, tryptophan fluorescence is measured using known excitation and emission wavelengths. This is a proxy for the quantification of protein in each pair of krill eyes. A calibration curve utilizing Bovine Serum Albumin (BSA) acts as a means to quantify protein in the eye tissues.

Analysis is performed for every krill sample, regardless of whether it originated from a grazing or a growth experiment. The dominant euphausiid species throughout the experiments has been mostly *T. raschii*; however *T. inermis, T. spinata, and T. longipes* have also been caught and/or used in experiments.

Table 1: Water Sample Collection for Experiments

Experiment Type and No.	Station	T_0 filtration date	T_f filtration date	Experiment Duration (hours)
Grazing Experiment #1	NP-13	3/31/2008	4/1/2008	24
Grazing Experiment #2	NP-7	4/1/2008	4/2/2008	24
Grazing Experiment #3a	MN-5	4/5/2008	4/5/2008	12
Grazing Experiment #3b	MN-5	4/6/2008	4/6/2008	24
Grazing Experiment #4	MN-8.5	4/7/2008	4/8/2008	24
Grazing Experiment #5	MN-16	4/9/2008	4/10/2008	24
Grazing Experiment #6	SL-9	4/12/2008	4/13/2008	24
Grazing Experiment #7	W-7.5	4/16/2008	4/17/2008	24
Grazing Experiment #8	NP-7	4/18/2008	4/19/2008	18
Grazing Experiment #9	NP-13	4/20/2008	TBD	TBD
Growth Experiment #1	MN-4	N/A	N/A	
Growth Experiment #2	MN-16	N/A	N/A	
Growth Experiment #3	EL-1	N/A	N/A	
Growth Experiment #4	NP-7	N/A	N/A	
Growth Experiment #5	NP-5	N/A	N/A	
Growth Experiment #6	NP-13	N/A	N/A	

*All filters frozen in -70 immediately following filtration

Table 2: HPLC Sample Run Log

Experiment No.	No. Animals	Dominant Species	Krill Eye Lipofuscin Analysis	Krill Eye Protein Analysis	Whole Samples Frozen	Amount	Storage date
Grazing Experiment #1	32	*T. inermis*	N/A	N/A	Yes	All	4/1/2008
Grazing Experiment #2	32	*T. raschii*	4/3/2008	4/4/2008	No		
Grazing Experiment #3a	24	*T. raschii*	4/6/2008	4/8/2008	No		
Grazing Experiment #3b	24	*T. raschii*	4/7/2008	4/8/2008	No		
Grazing Experiment #4	47	*T. raschii*	N/A	N/A	Yes	All	4/8/2008
Grazing Experiment #5	32	*T. inermis*	4/11/2008	4/11/2008	No		
Grazing Experiment #6	24	*50:50, raschii: inermis*	4/15/2008	4/15/2008	No		
Grazing Experiment #7	32	*T. raschii*	N/A	N/A	Yes	All	4/16/2008
Grazing Experiment #8	24	*T. raschii*	3/19/2008	In progress	No		
Grazing Experiment #9	12	*T. inermis*	TBD	TBD	TBD	TBD	
Growth Experiment #1	50	*T. raschii*	4/8/2008	4/9/2008	No		
Growth Experiment #2	51	*T. inermis*	4/13/2008	4/14/2008	No		
Growth Experiment #3	60	*T. raschii*	In progress	N/A	Some	35 of 60	4/20/2008
Growth Experiment #4	42	*T. raschii*	TBD	TBD	TBD	TBD	
Growth Experiment #5	75	*T. raschii*	TBD	TBD	TBD	TBD	
Growth Experiment #6	23	*T. inermis*	TBD	TBD	TBD	TBD	

B. Krill Collections and Experiments and Microplankton Distributions

Evelyn Lessard, Tracy Shaw, and Megan Bernhardt

Bongo tows

To date, we have performed 30 Bongo tows (Figure 1) to date to capture live euphausiids for feeding and growth experiments. As the MOCNESS sampling system is not towable in ice, we have taken 8 quantitative Bongo tows for assessing euphausiid species and biomass at selected ice-covered stations.

Feeding experiments with euphausiids

For the feeding experiments, we capture live euphausiids with a bongo net (Fig. 1) and incubate them for 12-24h on a rotating wheel in a flowing seawater incubator. The prey field for each experiment is unaltered seawater plankton, or ice protists that have been gently melted into seawater, or seawater supplemented with ice protists. As of the mid-point of this cruise, we have performed nine feeding experiments at stations of varying ice cover and open water (Table 1). Shipboard, feeding is assessed by measuring changes in size-fractionated chlorophyll and live plankton cell counting and identification using an automated imaging flow-cytometer (FlowCAM).

Growth experiments

We have performed 5 growth experiments, assessing growth on >270 animals (Table 2). We have provided >300 animals, with species and size determinations, from feeding and growth experiments to Harvey for lipid profiles and lipofuscin content (an index of age).

Preliminary findings

Most of the sampling during the first half of the cruise has been in ice-covered waters on the shelf. As expected, the dominant euphuasiid species on the mid to inner shelf was *Thysanoessa raschii*, with *Thysanoessa inermis* dominating on the outer shelf. Phytoplankton biomass has been low (<0.7µg chlor/l) and dominated by small (< 5 µm) pico- and nanoplankton (cyanobacteria, picoeukaryotes, small flagellates), with heterotrophic protists (dinoflagellates and ciliates) present in modest numbers. In the early experiments, herbivorous feeding on water column plankton was not detectable based on chlorophyll changes. However, preliminary FlowCAM assessments indicated that the larger heterotrophic dinoflagellates and ciliates were being consumed. When the plankton were supplemented with ice algae (primarily very large single or chain-forming pennate diatoms), or at those stations where ice algae appeared in the water column, very significant rates of herbivory were detected from chlorophyll measurements. Direct video observations by Shull and Gradinger showed euphausiids actively congregating and feeding on the bottom of the ice. Together, these observations show for the first time that euphausiids exploit ice biota as an important food resource in the early spring in the Bering Sea.

Table 1. Euphausiid grazing experiment locations and environmental conditions

Exp	Local Date	Local Time	CTD	Stn	Krill spp	Lat.	Long.	SST	Sal.	Depth	+ Ice Algae ?	Initial chlor
1	4/1/08	355	6	NP 13	T. inermis	56 30.39 N	170 48.91 W	-0.1	32.25	22m	No	0.64
2	4/2/08	155	13	NP7	T. raschii	57 55.15 N	169 11.58 W	-1.72	31.88	15m	No	0.28
3	4/4/08	2340	33	MN 5	T. raschii	59 54.22 N	170 23.89 W	-1.7	31.34	10m	No	0.20
4	4/6/08	2010	40	MN 8.5	T. raschii	59 55.13 N	172 46.34 W	-1.7	31.86	5m	No/ Yes	0.18/ 3.65
5	4/8/08	2100	50	MN 15	T. inermis	59 57.19 N	176 33.28 W	-1.72	32.37	15m	Yes	2.93
6	4/12/08	200	65	SL9	T. raschii/ T. longipes	62 05.27 N	173 19.69 W	-1.71	32.29	10m	No	0.44
7	4/16/08	306	86	W 7.5	T. raschii	59 53.21 N	171 17.88 W	-1.7	31.65	10m	Yes	0.64
8	4/18/08	230	92	NP7	T. raschii	57 54.47 N	169 14.12 W	-1.67	31.77	20m	Yes (2 types)	0.7/ 1.98
9	4/19/08	2340	106	NP 13	T. inermis	56 31.57 N	170 48.55 W				No	

Table 2. Euphausiid growth experiment locations

Expt #	Date (Local)	Location	Krill spp
1	4/4/08	MN4	T. raschii
2	4/9/08	MN16	T. inermis
3	4/17/08	EL1	T. raschii
4	4/18/08	NP7	T. raschii
5	4/19/08	NP5	T. raschii
6	4/20/08	NP13	T. inermis

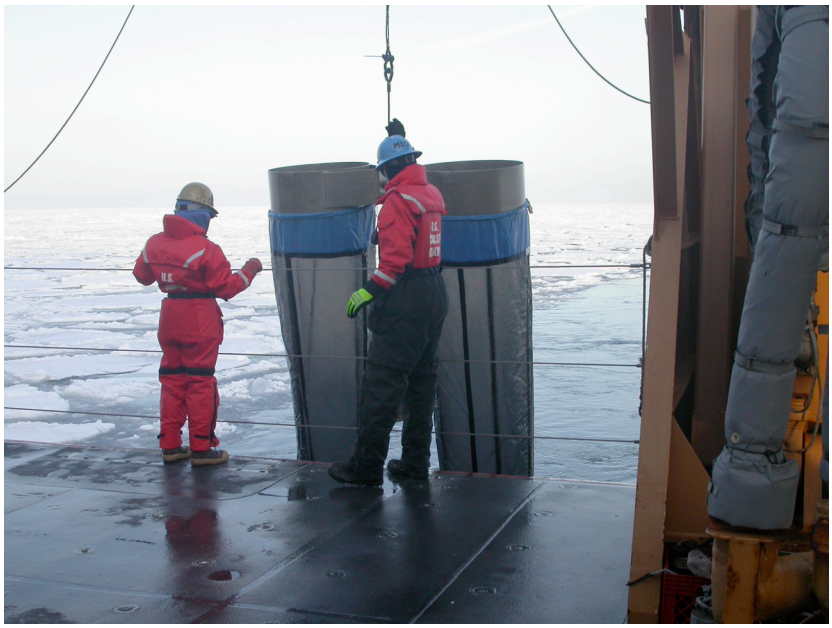


Figure 1. Sampling euphausiids with a Bongo net in the ice. Tracy Shaw (left) directing the operation with assistance from Tom Kruger, one of the excellent Coast Guard Marine Science Technicians.

LDEO Science Support Activities on HLY0802

Tom Bolmer and Steve Roberts

This is a brief summary of the performance of the Underway Science systems during first part of the research cruise HLY0802 on the USCGC Healy, 03/29/08 – 05/06/08 from Dutch Harbor to Dutch Harbor, AK. A more complete log of events that affected the recording of data can be seen in the ELOG entries by the shipboard technicians for this leg. The Data Synopsis Report for HLY0802 has additional information.

Acoustic Data

SeaBeam 2112 Multibeam Sonar

The SeaBeam worked well for this leg. However, much of the cruise was in shallow water (less than 100 meters deep.) This water depth is less than optimal for the SeaBeam system. This data should be aggressively edited for use in mapping. The Center Beam data that was averaged in the 1-minute average file is a good summary of that data. A brief power outage appears to have corrupted the Magneto Optical(MO) disk and the system was down for a couple of hours to identify the problem and replace the disk. Also the internal Exabyte tape drive appears to have failed so we are no longer generating a backup copy of the data. These failures should serve as a reminder as to how fragile this system has become and the need for it to be replaced.

Knudsen 320BR Sub-Bottom Profiler

The Knudsen was run in the Low Frequency "CHIRP" (3 - 6 KHz) mode for the whole cruise. These data look good. Again, care must be taken when using this data, particularly if the desire is to use it for water depth. We do not recommend using subbottom profiler data for bathymetry. For this cruise the multibeam data is a better choice. They should be edited for spikes due to ice affecting the transducers and occasional bad picks of water depth by the system. The trigger for this was slaved off of the SeaBeam transmission to reduce interference with the EK60 fish sonar.

The Knudsen "KEL" formatted file saved in the SCS data directory Knudsen has the wrong internal time. The Knudsen adds about 22.8 seconds to it's internal clock each day. The time to use for this data is the SCS time stamp in the first columns of the file. The depth and location in the file are right.

We occasionally operated this system in 12kHz pinger mode to allow accurate depth determination of the multicorer.

ADCP 75

The ADCP 75 was operated for the whole leg. From quick looks at the data it appears to have recorded satisfactorily. This was also triggered from the SeaBeam transmission. Worked with Alex De Robertis of NOAA to install a trigger delay box provided by him to allow the ADCP to trigger at a ping interval of not more than 1.7 seconds. This allowed the ADCP to trigger at its optimal ping rate even while we were operating in deep water and not interfere with the NOAA supplied EK60 fish stock assessment sonar.

ADCP150

Like the ADCP75 it was determined that the ADCP150 interferes with the EK60. Unlike the ADCP75, this sonar cannot be externally triggered. So to avoid interference with the EK60 it was decided to leave this sonar off for the duration of the science cruise. No data was generated or collected by this sonar.

EK60 (NOAA "Fish Finder")

During the first phase of the cruise this sonar was maintained by Alex De Robertis of NOAA. During the second phase Alex departed the ship and the operation and monitoring became our responsibility. This sonar is a temporary installation.

Navigation

POS/MV-320

The POSMV recorded the ship's position, heading, pitch and roll well during the cruise.

Ashtech ADU5

The ADU5 operated well except for an occasional drop outs which are logged in the ELOG. There were also events where the receiver stopped producing heading and attitude data even though the data streams remained active.

Sperry Gyrcompasses

Two new Sperry Gyroscopes were added to the Healy to replace the old Sperry MK27s prior to this season. They have been up to 1.5 degree different from the POSMV and the ADU5 and show surprisingly large "wander" in heading. With its current behavior the systems have been shown to not be an acceptable fall back in the event of a problem with the POSMV. We do not recommend using this data. The ETs have done several tests and adjustments trying to improve the quality of the data during this cruise. We have been monitoring and generating plots for the ETs during this period.

Sea Water Flow Through data

Uncontaminated Sea Water

Early in the cruise the system experienced major and frequent blockages from ice getting past the ice separator. This caused significant interruptions to the TSG underway data collection. This behavior was completely at odds with the prior cruise where the system operated in similar ice conditions but without a single incident of ice blockage. The only thing different with this cruise was the addition of incubators on the bow drawing a substantial amount of water from the system. After monitoring the situation the consensus was that this extra draw on the system was the most likely cause of these ice blockage events. Eventually a separate system was set up by the ship crew to allow the incubators to draw most of their water from the ship ballast. So far we have not experienced any new ice blockages but ice conditions have also lighted up so the jury is still out.

Thermosalinographs

New primary and a spare TSGs were installed by SIO/ODF (Scott Hiller) was installed for this season in the Biochem Lab. These appeared to operate satisfactorily when there was no ice blockage.

Dissolved Oxygen, Flurometer, and Flowmeter

In addition to temperature and salinity, dissolved oxygen, fluorescence and the rate of flow of the water through the TSG were also recorded. It appears that these systems worked satisfactorily.

Meteorological Sensors

New Meteorological sensors were installed for this season by SIO/ODF (Scott Hiller.) The sensors were operated in addition to the ship's existing sensors. These sensors operated satisfactorily for the leg. For the wind speed and direction 2D ultrasonic instruments were installed on the Yard Arm and the Jack Staff.

Mapserver

A web-based real-time GIS system (Mapserver) was actively maintained and kept up-to-date with the most current science cruise data and information.

RadarSat Images from the National Ice Center

RadarSat images were ftped from the National Ice Center roughly once a day and displayed using the Mapserver GIS interface.

Gravity

Two Bell BGM-3 marine gravity meters were installed in IC/Gyro prior to this season and appeared to operate satisfactorily.

Data Logging

LDS (Lamont Data System)

The LDS data logging system was run to record and store underway data for the leg. This system logged the Navigation, SeaBeam, the SIO MET data, gravity, and web camera images.

Underway Data Distribution

At the end of the cruise a set of DVDs containing all the underway data along with various documentation will be created and provided to the chief scientist.

Data QC

Continuously monitored all underway data streams and addressed anomalies as they became apparent.

Terrascan

Monitored and maintained the Terascan system plus a separate laptop with a second Terascan license. This second laptop was used to generate various ice imagery for general science use and inclusion into the Mapserver. Since we were operating in the Fairbanks, Alaska station range circle all DMSP data was collected in unencrypted mode.

Web Cameras

Web cameras were operated in Aloft Con, Aft Con and the Board of Lies. Images from the cameras were logged on LDS. In addition once an hour an image from Aloft Con was emailed to shore for use in a web site there.

Appendix A. Science Party Members, March 31 – April 20, 2008

Name	Institution
Carin Ashjian	Woods Hole Oceanographic Institution
Robert Campbell	GSO-University of Rhode Island
Philip Alatalo	Woods Hole Oceanographic Institution
Evelyn Sherr	COAS- Oregon State University
Celia Ross	COAS- Oregon State University
Evelyn Lessard	University of Washington
Megan Bernhardt	University of Washington
Tracy Shaw	Hatfield Marine Center, NOAA
Rachel L. Pleuthner	University of Maryland
Rodger Harvey	University of Maryland
Alexei Pinchuk	University of Alaska
Ed Davis	University of Tennessee
Boris Sirenko	University of Tennessee
Maria Prokopenko	University of Southern California
Jonathan Whitefield	Bermuda Institute of Ocean Sciences
John Casey	Bermuda Institute of Ocean Sciences
Roger Kelly	GSO-University of Rhode Island
Nancy Kachel	U. Wash/JISAO
David Kachel	NOAA-PMEL
Carol Ladd	NOAA-PMEL
Calvin Mordy	Contractor Aquatic Solutions
Jeremy Malczyk	U. Wash/JISAO
Daniel Naber	University of Alaska Fairbanks
Elizabeth Labunski	U.S. Fish & Wildlife Service
Robert Ambrose	U.S. Fish & Wildlife Service
Alex De Robertis	NOAA-AFSC
Rolf Gradinger	Univ. of Alaska Fairbanks
Katrin Iken	Univ. of Alaska Fairbanks
Rebecca Neumann	Univ. of Oldenburg, Germany
Sarah Story Manes	Univ. of Alaska Fairbanks
Steve Roberts	UCAR
Tom Bolmer	WHOI
Scott Hiller	Scripps Institution of Oceanography
Lynne Butler	GSO-University of Rhode Island
Paul Walczak	Oregon State University
Allan Devol	Univ. of Washington
Heather Whitney	Univ. of Washington
Ana Aguilar-Islas	Univ. of Alaska Fairbanks
Rob Rember	Univ. of Alaska Fairbanks
Peng Wang	Lamont Doherty Earth Observatory
Kris Swenson	Lamont Doherty Earth Observatory
David Shull	Western Washington University
Emily Davenport	Western Washington University
Ann Fienup-Riordan	Independent Researcher
Janet Scannell	NCAR
Donna Van Keuren	GSO-University of Rhode Island

Appendix B. Ship's Crew, Helicopter Support, and TAD

Angelo, James YNC
Arakaki, Rebecca SK2
Ayers, Silas LT
Bartlett, Charles MST1
Baldwin, Robin FS3
Bateman, Dale CDR
Beasley, Corey HSCS
Beckmann, Rachel LTJG
Bender, Zachary ENS
Berringer, Mike ETC
Blas, Paul FN
Brogan, John MKC
Buford, Aimee BM2
Carr, Michael LTJG
Carter, John FS2
Cole, Tyler SN
Conroy, William BM3
Coombe, Jeffrey MK2
Dabe, Jeffrey IT2
Daem, Steven ET2
Davidson, Ash BM1
Davis, Jonathon ET2
Dull, Steven FS2
Dunning, Lara BM3
Elliott, Stephen LTJG
Fernandez, Chelsey SN
Finley, Nathan EM2
Ford, Angela SN
Galvez, Oscar R. LT
Glenzer, William BM1
Gonzalez, Fernando MK2
Ghosn, Kathleen FN
Hamilton, H. Mark FS3
Hammond, Mark LCDR
Harbinsky, Mark ET2
Harris, Daniel SK1
Hurtado, Daniell EM1
Jacobs, Bryson ENS
Manangan, Sorjen OSC
Mandrie, Montarno DC3
Marsden, George DCC
Mastrota, Leigh FN
McNally, Terence SK1
McManus, Gene SN
Meadowcroft, Brian LTJG
Merten, James SN
Miller, Valerie CWO2
Murphy, Nicholas MK2
Newton, Elizabeth LTJG
Olson, James EM3
Passalacqua, Joseph ETCM
Pentecost, James DC1
Podhora, Curtis EMCM
Quichocho, Robert MK1
Redd, Davion DC2
Rieg, Mark MSTC
Rivera-Maldonado, Abner SKC
Rocklage, Eric MST1
Rudibaugh, Kenneth MK1
Shaffer, Hans EM1
Siciak, Anthony MK3
Smith, Corey MK3
Smith, Josh LTJG
Stewart, Jeffrey LCDR
Sullivan, Timothy BMCS
Swanson, Shawn ET1
Thomas, Tasha ENS
Thompson, Emily SN
Tomlin, Mathew SN
Travers, Cynthia LTJG
Von Kauffmann, Daniel IT1
Wagner, Alexander FN
Ward, John CWO3
Whiting, Allan, MK2
Williams, Tony FSCS
Worrell, Kenneth EM1

Johnston, Garrett SN
Jones, Greg MKCS
Kidd, Wayne BMC
Kruger, Thomas MST3
Laisure, Jeremy SK2
Lambert, Douglas MK1
Layman, Rich MST1
Liebrecht, Brian ET1
Lindstrom, Tedric CAPT
Loftis, Jon MK1
Lyons, Sean R CWO3
Wright, Tiffany MST2
Yeckley, Andy BM3
Zitting, Arrene FS1
Cleveland, Christopher FNMK
Hickey, Anthony
Merchant, Mike
Newby, Vance IT2
Spink, Mike
Springer, Bill
Stanco, Lesley HS2
Starling, Wendy MK2

Appendix C: Twelve Days of Healy

The Twelve days of Healy.

On the first day of the Healy cruise, my Chief Scientist gave to me,
a sediment trap deployment.

On the second day of the Healy cruise, my Chief Scientist gave to me,
2 cut loops on the trap line,
and a sediment trap deployment.

On the third day of the Healy cruise, my Chief Scientist gave to me,
3 refrigerator breakdowns,
2 cut loops on the trap line,
and a sediment trap deployment.

On the fourth day of the Healy cruise, my Chief Scientist gave to me,
4 hours in a small boat,
3 refrigerator breakdowns,
2 cut loops on the trap line,
and a sediment trap deployment.

On the fifth day of the Healy cruise, my Chief Scientist gave to me,
5 flooded decks,
4 hours in a small boat,
3 refrigerator breakdowns,
2 cut loops on the trap line,
and a sediment trap deployment.

On the sixth day of the Healy cruise, my Chief Scientist gave to me,
6 frozen inflow hoses,
5 flooded decks,
4 hours in a small boat,
3 refrigerator breakdowns,
2 cut loops on the trap line,
and a sediment trap deployment.

On the seventh day of the Healy cruise, my Chief Scientist gave to me,
7 frozen outflow hoses,
6 frozen inflow hoses,
5 flooded decks,
4 hours in a small boat,
3 refrigerator breakdowns,
2 cut loops on the trap line,
and a sediment trap deployment.

On the eighth day of the Healy cruise, my Chief Scientist gave to me,
8 overflowing incubators,
7 frozen outflow hoses,
6 frozen inflow hoses,
5 flooded decks,
4 hours in a small boat,
3 refrigerator breakdowns,
2 cut loops on the trap line,
and a sediment trap deployment.

On the ninth day of the Healy cruise, my Chief Scientist gave to me,
9 night time pages,
8 overflowing incubators,
7 frozen outflow hoses,
6 frozen inflow hoses,
5 flooded decks,
4 hours in a small boat,
3 refrigerator breakdowns,
2 cut loops on the trap line,
and a sediment trap deployment.

On the tenth day of the Healy cruise, my Chief Scientist gave to me,
10 unanswered alarm clocks,
9 night time pages,
8 overflowing incubators,
7 frozen outflow hoses,
6 frozen inflow hoses,
5 flooded decks,
4 hours in a small boat,
3 refrigerator breakdowns,
2 cut loops on the trap line,
and a sediment trap deployment.

On the eleventh day of the Healy cruise, my Chief Scientist gave to me,
11 presses of the snooze button,
10 unanswered alarm clocks,
9 night time pages,
8 overflowing incubators,
7 frozen outflow hoses,
6 frozen inflow hoses,
5 flooded decks,
4 hours in a small boat,
3 refrigerator breakdowns,
2 cut loops on the trap line,
and a sediment trap deployment.

On the twelfth day of the Healy cruise, my Chief Scientist gave to me,
12 all night shifts,
11 presses of the snooze button,
10 unanswered alarm clocks,
9 night time pages,
8 overflowing incubators,
7 frozen outflow hoses,
6 frozen inflow hoses,
5 flooded decks,
4 hours in a small boat,
3 refrigerator breakdowns,
2 cut loops on the trap line,
and a sediment trap deployment.