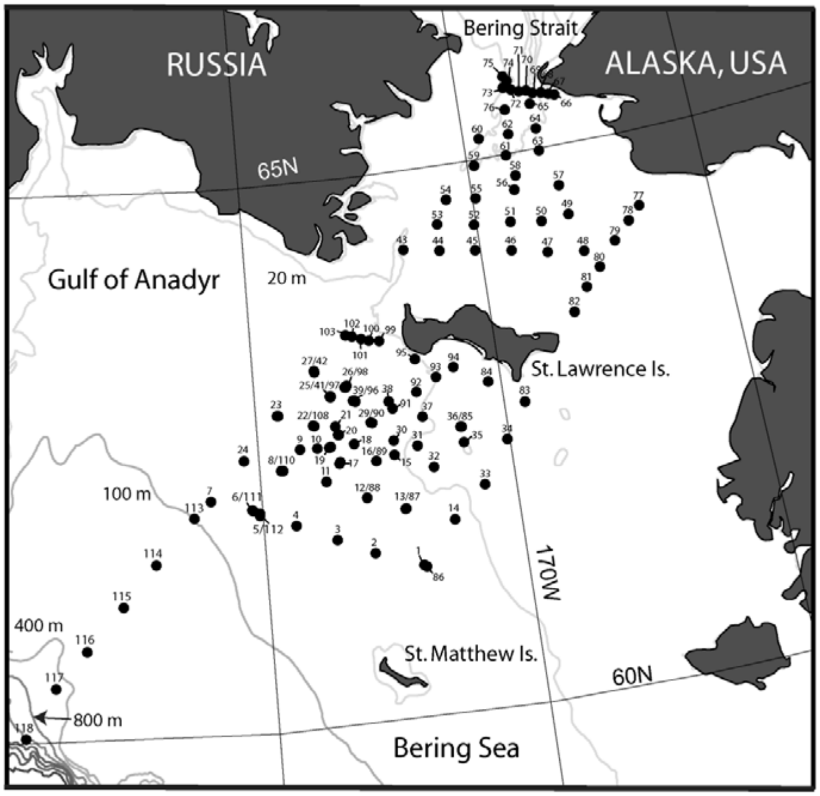
# CRUISE REPORT: HLY0601

*(Updated MAR 2015)*




## Highlights

### Cruise Summary Information

| | |
|---|---|
| Section Designation | **HLY0601** |
| Expedition designation (Alias) | **32H120060507 (SLIPP06)** |
| Chief Scientists | **Dr. Jackie M. Grebmeier / UTK** |
| Dates | 2006 MAY 7 -2006 JUN 5 |
| Ship | *HEALY* |
| Ports of call | Dutch Harbor |
| Geographic Boundaries | 65° 42' 40"<br>179° 39' 47" W 168° 54' 47" W<br>60° 2' 49" N |
| Stations | 118 |
| Floats and drifters deployed | 0 |
| Moorings deployed or recovered | 0 |

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### Links To Select Topics

Shaded sections are not relevant to this cruise or were not available when this report was compiled.

**HLY0601 (SLIPP06)**

**Climate-Driven Changes in Impacts of Benthic Predators in the Northern Bering Sea (NSF-OPP-ARC-0454454), 7 May-5 June 2006**

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**Dr. Lee W. Cooper**, University of Tennessee, Knoxville (Co-Chief Scientist)
**Dr. James R. Lovvorn**, University of Wyoming (PI and lead helo survey component)

**Participants:** Graduate student (GS), Undergraduate student (US), Elementary School Student (S), Technical support (T)

- Sherry Cui (GS), Adam Humphrey (US), Ruth Cooper (S), Rebecca Pirtle-Levy (T), Mikhail Blikshteyn (T), University of Tennessee Knoville
- Dr. Marjorie Brooks, Jason Kolts (GS), Christopher North (GS), Casey Quitmeyer (T), University of Wyoming
- Dr. Boris Sirenko, Zoological Institute, Russian Academy of Sciences, St. Petersburg
- Beth Cassie (GS), Kinuyo Kanamaru (GS), University of Massachusetts, Amherst (lead: Julie Brigham-Grette)
- Dr. Carleton Ray and Jerry McCormick-Ray , University of Virginia
- Hydrographic support: John Calderwood (T), Teresa Kacena (T), Scripps Institute of Oceanography
- TREC: Samantha Barlow, The Oak Ridge School, North Carolina and Patricia Janes, Scholastic, Inc, NY
- Markus Janout (GS), University of Alaska Fairbanks (lead: Tom Weingartner)
- Dr. Karen Frey, University of Virginia
- Gay Sheffield (T), Alaska Department of Fish and Game, Fairbanks
- Andrew Delorey (GS), University of Hawaii (lead: Margo Edwards)
- Science support: Steve Roberts (T), University of Colorado; Tom Bolner (T), Wood Hole Oceanographic Institute
- Elizabeth Labunski (T), US Fish and Wildlife Service, Anchorage
- Media: Karen de Seve (Liberty Science Center, NJ) and Annie Feidt (Alaska National Public Radio)
- Perry Pungowiyi, Savoonga local participant
- Helo component: Jim Dell (helo pilot), Charles Sims (mechanic), Alex Stone (helo manager)

## A. PROJECT SUMMARY

Perhaps the most striking evidence of global climate change is decreased extent of arctic sea ice and recent studies indicate associated environmental changes south of St. Lawrence Island (SLI) in the SLI polynya region (SLIP). Despite research on the consequences of sea-ice change for physical oceanography and weather, effects on arctic marine food webs from microbes to top predators are by comparison very poorly understood. Our field research is investigating a major mechanism by which sea-ice change might affect the very productive, benthic-dominated food webs on shallow arctic shelves -expansion of the ranges and numbers of mobile benthic predators owing to increased temperature of bottom water. When winter sea ice melts on the north-central Bering Sea shelf, a pool of cold bottom water (<1°C) forms that persists through summer and reduces the numbers and growth of crabs and groundfish. The size of the cold pool decreases with decreasing ice extent. This area is currently the sole wintering site of the world population of the benthic-feeding Spectacled Eider (SPEI), a principal top predator. Expansion of competing crab and fish predators as ice cover declines and the cold pool contracts may affect food availability for the eiders. In this project, our main research questions are

**Question 1: Is the benthic food web in the north-central Bering Sea limited by top-down control by predators?** We are collecting data needed to model the total impact of predators on their main benthic prey in the northcentral Bering Sea. These predators include SPEI, groundfish, snow crabs, sea stars, and gastropods.

**Question 2: Are the overwinter survival and/or prebreeding condition of SPEI being impacted by climate driven trends in ice cover that are allowing populations of competing crabs and groundfish to expand?** We are using past and current data to simulate impacts on the energy balance of the main endotherm predator (SPEI) of variations in crab and groundfish populations expected to occur with changes in ice cover and resulting temperature of bottom water.

**Question 3: Are the time-series benthic system changes observed south of St. Lawrence Island continuing and are they forced by bottom-up (hydrographic) or top-down (predator) interactions, or both?** We are

collecting data to continue our long-term (1950-2005) record of benthic communities and carbon cycling processes in this area, which is essential to analyses in this project. These data will also indicate whether declines in organic matter supply to sediments that we have measured at a subset of stations have occurred throughout the area, and whether these declines correspond to a decrease in direct precipitation of phytoplankton during and after the ice-edge spring bloom.

**B. OVERVIEW SUMMARY OF HLY0601 FIELD SAMPLING**

In our shipboard sampling, we used a profiling conductivity-temperature-depth (CTD) and rosette system for collecting physical and hydrochemical samples. Water samples were taken using 12 30-liter-Niskin bottles. Subsamples from multiple CTD/rosette casts were used for chlorophyll content, nutrients, particulate organic carbon, dissolved organic carbon, zooplankton, benthic population measurements and sediment tracers. A vertical net was used to collect zooplankton for population measurements. Benthic van Veen grabs and a HAPS benthic corer were used to collect benthic fauna and sediment samples for population, community structure, food web, sedment chemistry and metabolism studies. An otter trawl was used to collect epifauna for population and stable isotope and lipid content measurements. Besides the standard ship sensors (atmospheric, seawater temperature, chlorophyll, multibeam), we collected atmospheric methane (a greenhouse gas) and berrylium-7 (a natural radioisotope used for tracing particulate deposition to the sediments). Both bridge and helicopter operations were used for seabird, marine mammal and sea ice surveys. Further details beyond this summary are provided in the full cruise report to be posted at http://arctic.bio.utk.edu/ and the USCG website soon.

We occupied 118 stations during HLY0601 from the northern Bering Sea, starting south of St. Lawrence Island and extending to Bering Strait (Fig. 1).

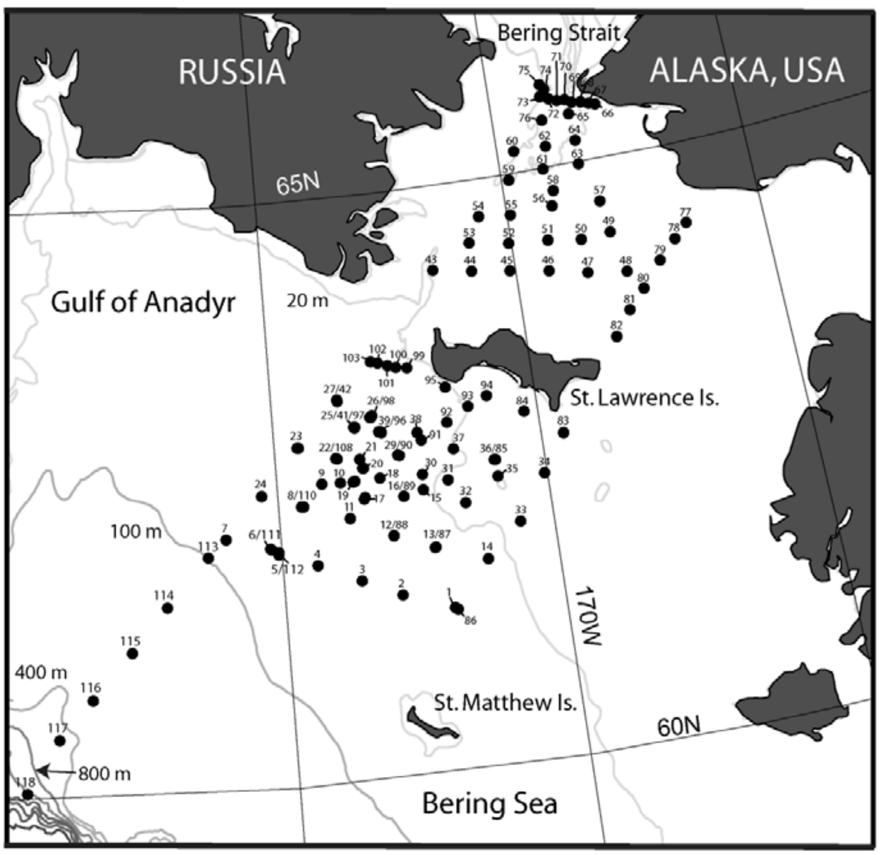



**Fig. 1.** Final station grid for HLY0601. Note that we remained 30 miles offshore from St. Lawrence Island (SLI) until the first week of June per an agreement with local hunters to minimize contact with marine mammal hunting. However, local Gambell and Savoonga IRA leaders approved our request to work within the 30-mile limit south of SLI upon our 2nd return to the region.

The overall approach in this study is as follows:

1. We are continuing our time-series benthic measurements with multiple van Veen and HAPS benthic corer deployments. We have provided sediment subsamples for paleoclimate studies to U Massachusetts participants to develop a training set of modern sediments and diatom content in order to infer sea-ice duration on diatom assemblages.
2. We are measuring the densities (by size class) of clams, predatory gastropods, sea stars (asteroids), snow crabs, and groundfish in the wintering area of (SPEI) collected via trawling.
3. Profiles of salinity and temperature, macronutrients, $\delta^{18}O$ values, and chlorophyll *a* in the water column were measured at each station from CTD rosette samples. These data provide an oceanographic water mass context for our study, including data to analyze contributions of nutrients, sea ice melt, brine and runoff contributions. In addition, we deployed a PAR/UV vertical measuring meter in the water column to 100 m depth after retrieval of the CTD.
4. We are investigating the diets of predators collected using analyses of gut contents, stable isotopes, and fatty acids of zooplankton and benthic collections. We are measuring prey size class of both predators and prey when possible. Based on the literature, we will develop estimates of the food intake per individual per day of the predators, considering the size classes of each predator.
5. We mounted a methane detector on the upper forecastle deck, upwind of the stacks for atmospheric methane measurements for the full duration of the cruise.
6. Satellite observations of ice were evaluated via normal bridge obtained imagery and free web accessed products during the course of the cruise. In addition, we also obtained SAR satellite imagery data to investigate linkages between sea ice variability, polynyas (persistent openings in sea ice cover), and chlorophyll biomass throughout the northern Bering Sea region.
7. We had observations of marine mammals in association with sea-ice, along with seabirds, through cooperative programs of the University of Virginia and the USFWS.
8. The multibeam system used through collaboration with a participant from the University of Hawaii, with a study focus on the region SW of SLI. The shipboard service team also maintained various sensor systems on the Healy, including the multibeam system.
9. Limited ice seal observations, tagging and tissue collections were undertaken via small boat operations with a colleague from the Alaska Dept. of Fish & Game to investigate ice seal stock structure, migration routes, and dispersal patterns of ice seals that occur in the northern Bering Sea.
10. We hosted a middle school teacher and an Editor from Scholastic, Inc. for the full length of the cruise as part of the TREC (Teachers and Researchers Experiencing the Arctic), with PI Cooper as the lead organizer. These educators maintained shipboard catalog postings on the web, wrote articles and hosted conference calls during the cruise. We also interacted with school children and teachers in Gambell and Savoonga on St. Lawrence Island during the first few weeks of the cruise while they were still in school. Our middle school participant prepared her own journals on the science project and answered many email questions from peers across the U.S. Further information is available at the TREC website: http://www.arcus.org/TREC.
11. We interacted with the local Native communities in the region and sponsored a participant from Savoonga, St. Lawrence Island in Alaska for 5 days during the cruise.
12. We included two media representatives on the ship the last week of May, 2006.

The Captain, officers and crew of the USCGC Healy provided outstanding support that was essential to the success of the cruise goals. We appreciated the continued, professional support provided by Commanding Officer Captain Daniel Oliver, Executive Officer CDR Jeffrey Jackson, Operations Officer LCDR James Dalitch, Engineering Officer LCDR John Reeves and Master Chief Navigator BMCS Timothy Sullivan. Valuable support for science was provided by the lead Marine Science Technician (MST) MSTC Don Snider and MSTC Mark Rieg, and the other MSTs (MST1 Eric Rocklage , MST1 Rob Olmstead, MST2 Josh Robinson, and MST3 Chad Klinesteker). We also appreciat ed the fine efforts of the late Science Officer LTJG Jessica Hill during preparation and deployment of this cruise. The Aviation Detachment , including Jim Dell (pilot), Charles Sims (mechanic), and Alex Stone (helo manager) provided excellent science survey support for seabird, marine and ice surveys. We thank Andy Heiberg of the University of Washington for assistance during the load period in Seattle. We are grateful for the assistance of Vera Metcalf (Executive Director) of the Eskimo Walrus Commission, George Noongwook, IRA Council and AEWC representative, Village of Savoonga and Tyler Campbell, IRA Council and Merlin Koonooka, AEWC representative, Village of Gambell, for their liaison activities with the local Native communities on St. Lawrence Island. This work was financially supported by the U.S. National Science Foundation Grant # OPP-ARC-0454454.

# HLY0601 MID-CRUISE REPORT, 21 MAY 2006

## 1. Sea Ice Observations-Karen Frey, University of Tennessee Knoxville and College of William and Mary, Virginia

As of 19 May 2006 at 18:30 UTC, sea ice observations have been made from the Healy bridge (05 deck) at 89 sites south of St. Lawrence Island (Table 1). The bridge is ~60 ft above sea level and has a maximum of ~9.6 miles of visibility. Sea ice observations are taken during daylight hours while the ship is in transit. Ideally, observations are taken once per hour, although while the ship is moving through dynamic ice conditions, more frequent observations have been made. The following general parameters (with further details within each category) are recorded at each site:

a) Time and geographic coordinates of report
b) Ship navigation (e,g,, speed, heading, progress)
c) Meteorological and hydrological variables (e.g., air temperature, air pressure, wind speed/direction, visibility, cloud cover, surface water temperature, surface water salinity, water depth)
d) Ice conditions (e.g., ice concentration, ice type, floe size, ice thickness
e) Snow conditions
f) Surface melting conditions
g) Sediment content
h) Algae content
i) Water conditions (e.g., width of leads, sea state, etc.)
j) Digital photographs logged at each site (one each taken from starboard and port, with additional photos of notable features) (e.g., Figures 1, 2)

These observations will continue throughout the remainder of the cruise. To date, ~800 digital photographs have been taken of ice conditions. The measured parameters and digital photographs will primarily be used to validate satellite imagery (e.g., AVHRR, MODIS, QuickScat, SSM/I, etc.) of sea ice conditions and cover once onshore upon completion of the cruise. As weather conditions have been quite cloudy over the last ~10 days, it is clear that visible/near-infrared imagery (e.g., AVHRR, MODIS) will not be useful during this time and radar imagery will instead be utilized. In addition, sea ice observations were made on one helicopter flight on 18 May 2006. Conditions were not ideal as visibility was low, however 53 sea ice observations (i.e., geographic coordinates and digital photographs) were still collected. These aerial photographs will be an invaluable addition in interpreting satellite imagery of sea ice cover upon return to shore from the cruise. It is hoped that further sea ice observations will be made with helicopter transects during the remainder of the cruise.

**Figure 1.** Example ice observation photograph from the bridge.

**Figure 2.** Example of snow cover, sea ice stratigraphy, and basal ice algal layer.

**Table 1. Ice Observation Summary Table (only representative parameters are shown)**
For the period **2006/05/08 17:31** thru **2006/05/19 21:32 UTC**

| Start Time (UTC) | Start Lat | Start Lon | Air Temperature(C) | Wind Speed(knots) | Total Ice Concentration | Dominant ice type | Floe size of dominant ice type |
|---|---|---|---|---|---|---|---|
| 2006/05/08 17:31:33 | 57:39.78751 | -169:25.15257 | -2.39 | 0012.7 | 5% | 3 - brash ice | 0 - brash(<10m) |
| 2006/05/08 18:57:12 | 57:58.54736 | -169:42.02734 | -3.55 | 0010.5 | 70% | 6 - pancakes | 1 - individual pancakes(<10m) |
| 2006/05/08 20:13:21 | 58:15.86603 | -169:57.06565 | -2.91 | 0009.1 | 75% | 6 - pancakes | 2 - ice cakes(<20m) |
| 2006/05/08 22:37:57 | 58:48.41824 | -170:25.66000 | -1.51 | 0007.5 | 80% | 6 - pancakes | 2 - ice cakes(<20m) |
| 2006/05/08 23:01:15 | 58:53.83966 | -170:29.15860 | -1.90 | 0007.3 | 25% | 0 - frazil | 0 - brash(<10m) |
| 2006/05/09 00:10:36 | 59:09.39021 | -170:38.10894 | -1.64 | 0007.1 | 75% | 9 - first-year white ice | 3 - small floes(<100m) |
| 2006/05/09 01:02:16 | 59:20.95674 | -170:44.63731 | -1.26 | 0008.7 | 80% | 6 - pancakes | 3 - small floes(<100m) |
| 2006/05/09 02:00:41 | 59:32.34548 | -170:50.88911 | -3.05 | 0018.7 | 80% | 6 - pancakes | --- |
| 2006/05/09 02:41:56 | 59:41.00346 | -170:57.56138 | -3.81 | 0018.4 | 75% | 9 - first-year white ice | 6 - large/giant floes (>1000 m) |
| 2006/05/09 06:26:21 | 60:18.61240 | -171:15.43361 | -5.09 | 0011.6 | 90% | 9 - first-year white ice | 6 - large/giant floes (>1000 m) |
| 2006/05/09 16:17:09 | 61:23.20745 | -171:56.46345 | -3.67 | 0015.4 | 25% | 2 - grease | 3 - small floes(<100m) |
| 2006/05/09 18:01:42 | 61:23.18920 | -171:56.54484 | -3.17 | 0011.5 | 30% | 2 - grease | 3 - small floes(<100m) |
| 2006/05/09 21:06:54 | 61:23.31117 | -171:58.25494 | -3.69 | 0002.4 | 10% | 2 - grease | 3 - small floes(<100m) |
| 2006/05/09 22:11:29 | 61:27.03250 | -172:18.47748 | -3.30 | 0009.7 | 25% | 2 - grease | 3 - small floes(<100m) |
| 2006/05/09 23:12:57 | 61:32.66241 | -172:48.49233 | -3.17 | 0019.1 | 0% | --- | --- |
| 2006/05/10 05:09:28 | 61:33.13504 | -172:58.10876 | -2.66 | 0012.9 | 0% | --- | --- |
| 2006/05/10 17:43:16 | 61:53.40435 | -174:24.07673 | -3.17 | 0007.4 | 25% | 9 - first-year white ice | --- |
| 2006/05/10 18:13:30 | 61:54.35119 | -174:25.02246 | -3.56 | 0008.4 | 25% | 9 - first-year white ice | 1 - individual pancakes(<10m) |
| 2006/05/10 18:59:04 | 61:56.83668 | -174:41.78045 | -3.81 | 0008.4 | 50% | 6 - pancakes | 1 - individual pancakes(<10m) |
| 2006/05/10 22:26:23 | 62:00.36202 | -175:04.25009 | -3.81 | 0004.0 | 50% | 9 - first-year white ice | 3 - small floes(<100m) |
| 2006/05/11 05:27:27 | 62:03.76532 | -175:15.51369 | -2.02 | 0010.8 | 10% | 6 - pancakes | --- |
| 2006/05/11 06:01:21 | 62:04.82441 | -175:25.29352 | -2.66 | 0012.1 | 25% | 6 - pancakes | 2 - ice cakes(<20m) |
| 2006/05/11 06:17:48 | 62:05.78581 | -175:32.50333 | -3.17 | 0011.7 | 100% | 9 - first-year white ice | 2 - ice cakes(<20m) |
| 2006/05/11 07:12:29 | 62:09.25340 | -175:56.75492 | -3.80 | 0013.8 | 90% | 9 - first-year white ice | --- |
| 2006/05/11 07:32:43 | 62:08.78371 | -176:01.33622 | -3.55 | 0012.5 | 25% | 6 - pancakes | 2 - ice cakes(<20m) |
| 2006/05/11 | 62:26.70994 | -174:44.10936 | -2.91 | 0015.7 | 75% | 8 - young | --- |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 17:34:33 | | | | | | grey-white ice | |
| 2006/05/11 17:51:22 | 62:24.86794 | -174:36.94005 | -2.78 | 0015.3 | 30% | 6 - pancakes | 2 - ice cakes(<20m) |
| 2006/05/11 21:51:16 | 62:24.05478 | -174:34.98929 | -1.37 | 0014.1 | 25% | 6 - pancakes | 1 - individual pancakes(<10m) |
| 2006/05/12 06:03:16 | 62:35.52777 | -174:09.88524 | -1.00 | 0019.2 | 75% | 9 - first-year white ice | 4 - small floes(<100m) |
| 2006/05/12 07:07:00 | 62:33.97953 | -173:55.48652 | -1.26 | 0026.7 | 90% | 6 - pancakes | 4 - small floes(<100m) |
| 2006/05/12 07:28:17 | 62:33.13870 | -173:50.71148 | -1.13 | 0028.6 | 30% | 6 - pancakes | 3 - small floes(<100m) |
| 2006/05/12 19:13:23 | 62:05.39759 | -172:56.62609 | -0.49 | 0034.9 | 0% | --- | --- |
| 2006/05/12 23:53:53 | 62:02.16261 | -172:53.91099 | -0.36 | 0033.7 | 0% | 3 - brash ice | --- |
| 2006/05/13 00:07:57 | 62:01.27031 | -172:48.19784 | -0.36 | 0035.2 | 0% | --- | --- |
| 2006/05/13 05:39:54 | 61:53.20012 | -172:09.12066 | -0.36 | 0028.3 | 0% | --- | --- |
| 2006/05/13 06:19:31 | 61:51.09001 | -171:57.71922 | -0.74 | 0034.1 | 0% | --- | --- |
| 2006/05/13 19:46:37 | 62:24.40877 | -172:37.43930 | -0.87 | 0021.3 | 0% | --- | --- |
| 2006/05/14 00:13:54 | 62:23.51035 | -172:42.57351 | -0.22 | 0022.5 | 0% | --- | --- |
| 2006/05/14 01:09:23 | 62:23.13806 | -172:56.79686 | -0.48 | 0020.2 | 10% | 9 - first-year white ice | 3 - small floes(<100m) |
| 2006/05/14 01:34:33 | 62:24.25379 | -173:06.63749 | -0.23 | 0016.7 | 95% | 9 - first-year white ice | 2 - ice cakes(<20m) |
| 2006/05/14 02:17:45 | 62:24.40921 | -173:25.18305 | -0.49 | 0018.7 | 0% | --- | --- |
| 2006/05/14 20:55:51 | 62:39.26686 | -173:24.87222 | -1.10 | 0015.2 | 0% | --- | --- |
| 2006/05/15 00:38:27 | 62:41.18961 | -173:23.63892 | -1.12 | 0003.8 | 0% | --- | --- |
| 2006/05/15 02:04:30 | 62:40.89801 | -173:23.17060 | -0.35 | 0020.8 | 0% | --- | --- |
| 2006/05/15 02:17:34 | 62:44.00846 | -173:24.62980 | -0.60 | 0021.7 | 0% | --- | --- |
| 2006/05/15 06:48:31 | 62:45.45099 | -173:24.87127 | -1.37 | 0006.7 | 0% | --- | --- |
| 2006/05/15 09:18:07 | 62:47.25278 | -173:51.94349 | -1.12 | 0006.1 | 0% | --- | --- |
| 2006/05/15 17:42:16 | 62:54.04990 | -174:32.97257 | -2.14 | 0021.4 | 50% | 3 - brash ice | 1 - individual pancakes(<10m) |
| 2006/05/15 18:09:10 | 62:49.40346 | -174:42.21440 | -2.01 | 0020.6 | 80% | 3 - brash ice | 2 - ice cakes(<20m) |
| 2006/05/15 18:38:06 | 62:44.46824 | -174:51.47251 | -1.64 | 0024.4 | 75% | 8 - young grey-white ice | 3 - small floes(<100m) |
| 2006/05/15 18:45:12 | 62:43.30359 | -174:53.79879 | -1.64 | 0020.2 | 0% | --- | --- |
| 2006/05/15 19:02:15 | 62:40.28223 | -174:59.30663 | -1.51 | 0023.8 | 50% | 3 - brash ice | 2 - ice cakes(<20m) |
| 2006/05/15 20:07:03 | 62:30.07534 | -175:17.36621 | -0.74 | 0020.0 | 60% | 3 - brash ice | 2 - ice cakes(<20m) |
| 2006/05/16 02:14:26 | 62:37.67357 | -175:15.89365 | -1.37 | 0026.7 | 5% | 3 - brash ice | --- |
| 2006/05/16 02:19:01 | 62:38.00775 | -175:14.17943 | -1.12 | 0037.8 | 25% | 6 - pancakes | 2 - ice cakes(<20m) |
| 2006/05/16 02:25:47 | 62:38.37303 | -175:11.14432 | -1.37 | 0038.6 | 0% | --- | --- |
| 2006/05/16 03:23:19 | 62:44.69162 | -174:47.28627 | -1.37 | 0038.1 | 5% | 3 - brash ice | 0 - brash(<10m) |
| 2006/05/16 03:34:16 | 62:46.55773 | -174:43.41954 | -1.24 | 0039.5 | 50% | 6 - pancakes | 2 - ice cakes(<20m) |

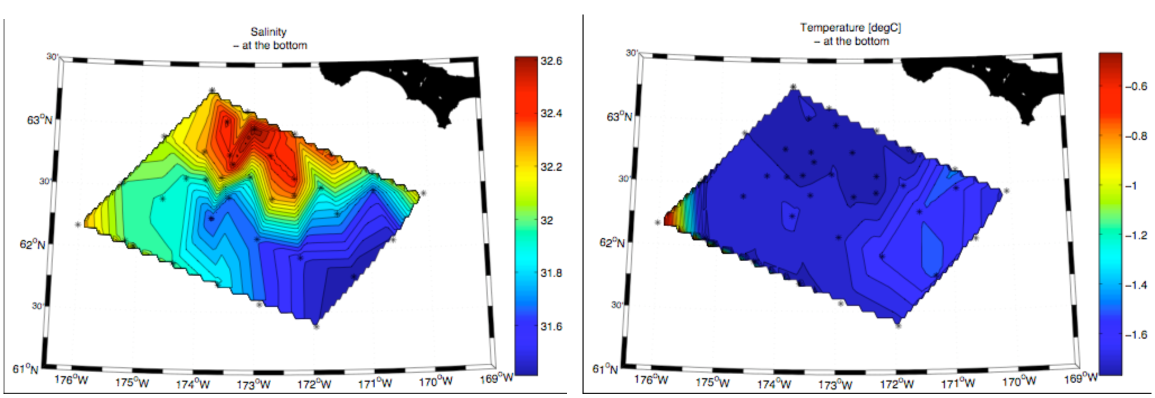
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2006/05/16 05:32:42 | 62:58.20557 | -173:51.09964 | -0.99 | 0039.6 | 0% | --- | --- |
| 2006/05/16 06:12:03 | 63:00.03810 | -173:31.83532 | -0.99 | 0037.5 | 0% | --- | --- |
| 2006/05/16 06:28:23 | 63:00.95020 | -173:26.50885 | -1.37 | 0022.7 | 0% | --- | --- |
| 2006/05/16 17:43:05 | 63:06.17568 | -173:08.10533 | -0.73 | 0018.4 | 0% | 3 - brash ice | 0 - brash(<10m) |
| 2006/05/16 18:57:04 | 63:06.77572 | -173:06.28346 | -0.48 | 0029.1 | 0% | --- | --- |
| 2006/05/16 19:43:21 | 63:08.28401 | -173:13.40370 | -0.35 | 0022.6 | 95% | 6 - pancakes | 1 - individual pancakes(<10m) |
| 2006/05/16 20:07:20 | 63:10.83314 | -173:24.29438 | -0.09 | 0022.9 | 10% | 3 - brash ice | --- |
| 2006/05/16 20:24:15 | 63:12.72108 | -173:31.82205 | 0.04 | 0021.7 | 10% | 6 - pancakes | 1 - individual pancakes(<10m) |
| 2006/05/16 20:43:19 | 63:14.64345 | -173:39.03133 | 0.55 | 0028.1 | 75% | 6 - pancakes | 1 - individual pancakes(<10m) |
| 2006/05/17 05:32:53 | 62:58.09377 | -173:00.55208 | -0.99 | 0026.5 | 0% | --- | --- |
| 2006/05/17 17:12:34 | 62:45.38222 | -172:41.73730 | -0.73 | 0031.7 | 0% | --- | --- |
| 2006/05/18 00:48:06 | 62:30.45463 | -171:56.87335 | -0.48 | 0030.6 | 5% | 3 - brash ice | --- |
| 2006/05/18 00:58:06 | 62:30.22933 | -171:52.21457 | -0.60 | 0028.0 | 10% | 6 - pancakes | 0 - brash(<10m) |
| 2006/05/18 01:07:35 | 62:29.78150 | -171:50.86149 | -0.48 | 0031.0 | 5% | 3 - brash ice | 0 - brash(<10m) |
| 2006/05/18 05:16:04 | 62:26.45566 | -171:49.89736 | -0.73 | 0026.6 | 5% | 9 - first-year white ice | 1 - individual pancakes(<10m) |
| 2006/05/18 05:21:10 | 62:25.89768 | -171:48.18421 | -0.60 | 0025.5 | 10% | 6 - pancakes | 1 - individual pancakes(<10m) |
| 2006/05/18 05:28:53 | 62:24.78677 | -171:46.41606 | -0.48 | 0025.1 | 25% | 6 - pancakes | 1 - individual pancakes(<10m) |
| 2006/05/18 05:34:06 | 62:24.21736 | -171:45.68403 | -0.60 | 0029.0 | 25% | 3 - brash ice | 0 - brash(<10m) |
| 2006/05/18 05:42:51 | 62:23.14846 | -171:43.17353 | -0.73 | 0025.6 | 10% | 6 - pancakes | 1 - individual pancakes(<10m) |
| 2006/05/18 06:15:17 | 62:19.25387 | -171:37.46256 | -0.60 | 0028.3 | 10% | 6 - pancakes | 1 - individual pancakes(<10m) |
| 2006/05/18 06:25:08 | 62:17.71948 | -171:35.82019 | -0.60 | 0027.0 | 1% | 3 - brash ice | 0 - brash(<10m) |
| 2006/05/18 06:32:46 | 62:16.72349 | -171:34.51772 | -0.60 | 0023.8 | 0% | --- | --- |
| 2006/05/18 16:22:35 | 62:08.45050 | -170:30.81067 | -0.73 | 0013.2 | 90% | 9 - first-year white ice | 3 - small floes(<100m) |
| 2006/05/18 16:40:28 | 62:10.52960 | -170:29.33750 | -0.73 | 0015.6 | 80% | 9 - first-year white ice | 4 - small floes(<100m) |
| 2006/05/18 17:26:45 | 62:16.54075 | -170:22.33230 | -0.86 | 0009.4 | 80% | 9 - first-year white ice | 4 - small floes(<100m) |
| 2006/05/18 17:43:09 | 62:19.16254 | -170:18.30103 | -0.99 | 0015.3 | 5% | 9 - first-year white ice | 1 - individual pancakes(<10m) |
| 2006/05/18 17:56:50 | 62:21.70116 | -170:15.36419 | -0.99 | 0012.1 | 10% | 9 - first-year white ice | 1 - individual pancakes(<10m) |
| 2006/05/18 18:12:38 | 62:23.79364 | -170:09.67374 | -0.86 | 0014.4 | 25% | 9 - first-year white ice | 2 - ice cakes(<20m) |
| 2006/05/18 18:39:03 | 62:25.64448 | -170:03.55628 | -0.99 | 0013.1 | 50% | 9 - first-year white ice | 2 - ice cakes(<20m) |
| 2006/05/19 18:45:45 | 62:56.46513 | -172:35.52514 | -1.12 | 0012.2 | 0% | --- | --- |
| 2006/05/19 21:32:07 | 62:59.01366 | -172:55.87001 | -1.12 | 0010.0 | 10% | 9 - first-year white | --- |

ice

## 2. Physical Oceanography-Markus Janout, University of Alaska Fairbanks

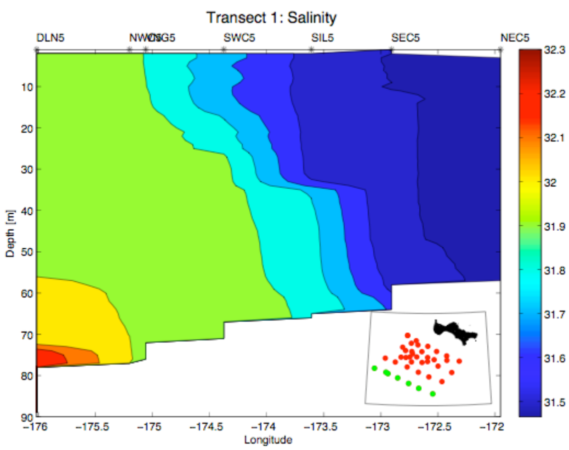
As of May 19th, stations 1-38 (see table) have been profiled using a SeaBird SBE911 Plus Conductivity-Temperature-Depth (CTD) sonde, equipped with each two temperature and conductivity sensors, a pressure sensor, as well as altimeter, transmissometer, fluorometer and an oxygen sensor. Water samples were taken using 12 30-liter-Niskin bottles. No significant technical problems occurred during the survey, apart from freshwater freezing on sensors when the CTD enters subzero surface waters. Occasionally the pumps delivering seawater to the conductivity sensor did not start, but flushing the system with freshwater solved the problem as usual. The data was processed using the SeaBird software and averaged into 1m bins.

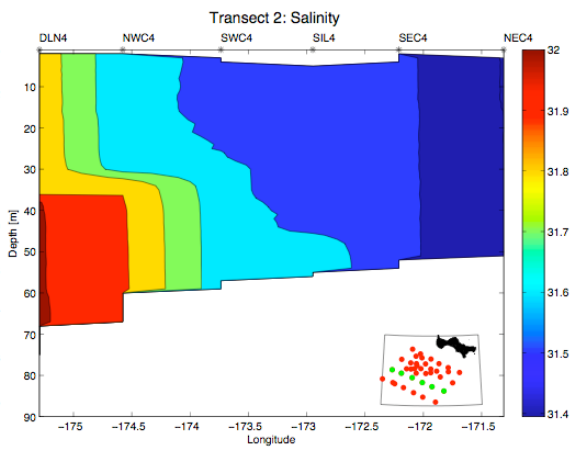
The study region appears to be distinguishable by fresher eastern waters, influenced by Alaska Coastal Water typical for the eastern Bering Sea shelf. The eastern area, i.e. east of the SIL-line is well mixed from surface to bottom with the lowest salinities throughout the water column found so far. The stations west of the SIL-line are mostly stratified, but show strong variations in their individual profiles.
Bottom water properties are shown in Figures 1 and 2. Cold water near the freezing point of seawater is found at the bottom of most stations. The only station with noticeable influence of Bering Slope water (?) washing up the slope was detected at station DLN5, the westernmost station of the sampling grid. Warm and saline water comprises a <10m thick bottom layer with salinity of 32.3 and temperatures of -0.2degC, the warmest water found so far. The highest bottom salinities (~32.6 psu) are found in the "hot spot"-region around station 21. Bottom temperatures are near the freezing point and salinity values are highest in the area (~32.6 psu). Densest waters are found there in connection with maximum integrated fluorescence and strongest stratification. Lowest salinities (31.5 psu) are found in regions influenced by Alaska Coastal Water in the southwest corner of the grid.

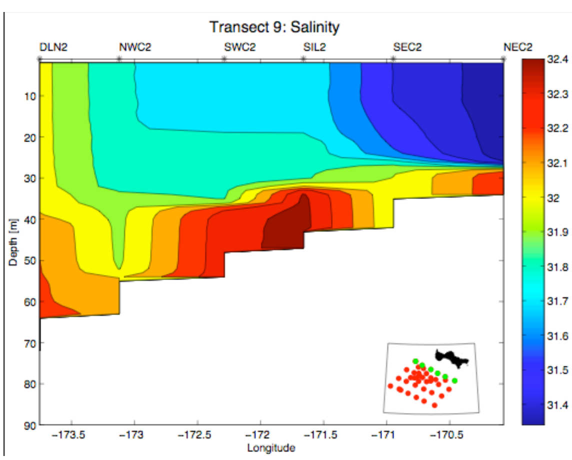



**Figures 1,2: Salinity and temperature of the bottom waters. (*) indicates station location.**

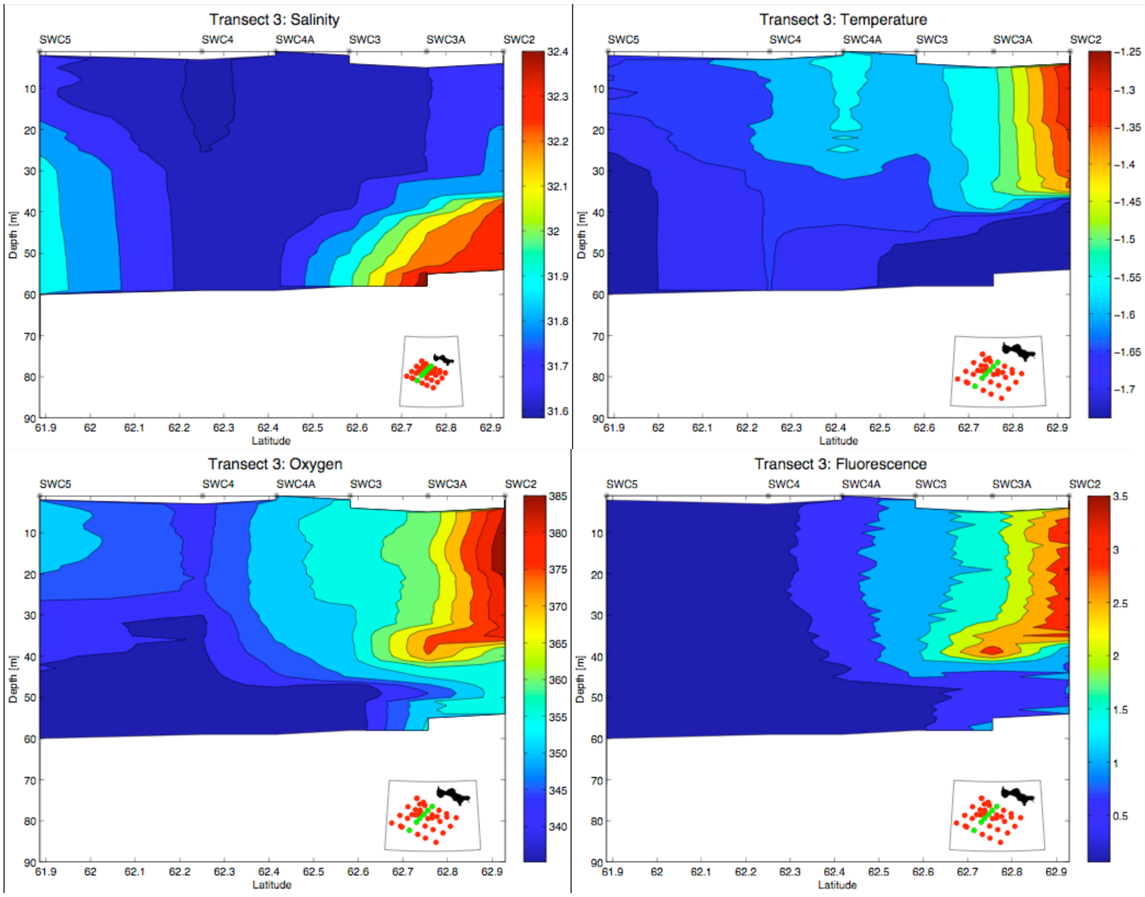
The vertical structure across the SLIP region is best explained by cross-section in the east-west (zonal) (Figures 3,4,5) and the north-south (meridional) (Figures 6-9) direction. The density of seawater in cold regions is mainly a function of salinity. Temperature variations throughout the region are small and their effect on baroclinic structure negligible. Zonal transects along stations numbered 4 and 5, i.e. along the seaward side of the grid show increasing salinity from east to west. The eastern water column is well mixed and fresh, and western stations are stratified. Bottom waters along the transect closest to the island are saline and at the freezing point. Whether these water masses are advected from the Anadyr current or whether they are formed locally needs to be determined.
A meridional cross-section shows cold and saline bottom water limited to two stations closest to the island. The overlying water column is warmest (-1.2 degC) close to the island at SWC2. The "warm water" occurs in concert with maximum relative fluorescence and maximum oxygen values, measured by the CTD.




**Figures 3,4,5: East-west salinity cross-sections. Little map in lower corner of figures shows location of the transects.**




**Figures 6,7,8,9: Meridional salinity, temperature, fluorescence and oxygen cross-section.**

The temperature-salinity relation (Figure 10) summarizes the influence of different water masses in the study region. Most bottom waters are located near the freezing point of seawater. Only a few data points (from the bottom of one station) show warmer, relatively saline water possibly originating from the Bering Slope region. The densest waters closest to St. Lawrence Island (SLI), with the highest salinities and coldest temperatures found in the area so far, could originate from a branch of the Anadyr Current or they could be remainders of bottom water formed in the winter. Repeat casts of the area around NWC2 show in part very different characteristics in the bottom water, in particular a significant increase in salinity, which might underline the importance of advection of waters from the Gulf of Anadyr into the SLIP region. Further insights might be expected from an extension of the grid closer to SLI towards the end of the cruise.

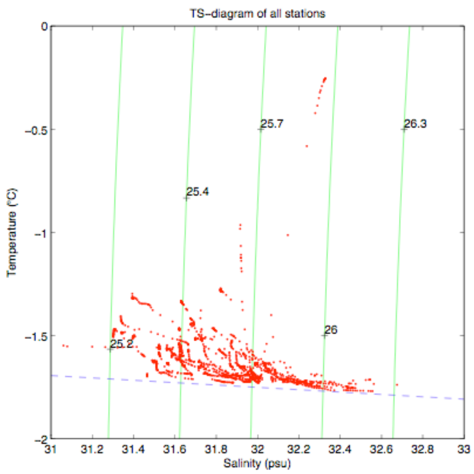



**Figure 10: Temperature-salinity diagram. Green contours show lines of constant density. Dotted line indicates the freezing point of seawater.**

Table 1: Station list

| Station Nr | Lat | Lon | Name |
|---|---|---|---|
| 1 | 61.388 | -171.95 | 'NEC5' |
| 2 | 61.564 | -172.92 | 'SEC5' |
| 3 | 61.721 | -173.61 | 'SIL5' |
| 4 | 61.893 | -174.36 | 'SWC5' |
| 5 | 62.018 | -175.06 | 'VNG1' |
| 6 | 62.056 | -175.2 | 'NWC5' |
| 7 | 62.149 | -176.02 | 'DLN5' |
| 8 | 62.388 | -174.55 | 'NWC4' |
| 9 | 62.563 | -174.18 | 'NWC4A' |
| 10 | 62.555 | -173.84 | 'VNG3' |
| 11 | 62.243 | -173.74 | 'SWC4' |
| 12 | 62.092 | -172.95 | 'SIL4' |
| 13 | 61.931 | -172.21 | 'SEC4' |
| 14 | 61.775 | -171.31 | 'NEC4' |
| 15 | 62.439 | -172.31 | 'SIL3' |
| 16 | 62.401 | -172.69 | 'POP4' |
| 17 | 62.413 | -173.44 | 'SWC4A' |
| 18 | 62.579 | -173.07 | 'SWC3' |
| 19 | 62.569 | -173.57 | 'VNG3.5' |
| 20 | 62.674 | -173.36 | 'CD1' |
| 21 | 62.751 | -173.4 | 'VNG4' |
| 22 | 62.782 | -173.88 | 'NWC3' |
| 23 | 62.9 | -174.58 | 'DLN3' |
| 24 | 62.516 | -175.3 | 'DLN4' |
| 25 | 63.03 | -173.45 | 'NWC2.5' |
| 26 | 63.117 | -173.14 | 'NWC2' |
| 27 | 63.272 | -173.75 | 'DLN2' |
| 28 | 62.969 | -172.99 | 'VNG5' |
| 29 | 62.757 | -172.71 | 'SWC3A' |
| 30 | 62.57 | -172.29 | 'POP3A' |
| 31 | 62.498 | -171.85 | 'SEC2.5' |
| 32 | 62.283 | -171.56 | 'SEC3' |

| | | | |
|---|---|---|---|
| 33 | 62.059 | -170.63 | 'NEC3' |
| 34 | 62.431 | -170.06 | 'NEC2' |
| 35 | 62.473 | -170.96 | 'NEC2.5' |
| 36 | 62.606 | -170.95 | 'SEC2' |
| 37 | 62.758 | -171.67 | 'SIL2' |
| 38 | 62.915 | -172.28 | 'SWC2' |

**3a. Water column chlorophyll, oxygen-18, sediment tracers, methane/UV-Lee Cooper, co-chief scientist. University of Tennessee Knoxville**

In addition to managing shipboard research operations 12 hours per day, I have been working with other shipboard participants in water and sediment sampling, and progress on these tasks is tabulated on the attached Excel file. I am specifically contributing to the chlorophyll measurement effort that is being undertaken shipboard for both water column and chlorophyll samples from surface sediments. Chlorophyll concentrations in the water column have been very high, up to 20 $\mu$g $L^{-1}$, and up to 800 mg $m^{-3}$ integrated over the whole water column. This reflects an on-going diatom bloom that remains for now in the upper water column. We are also beginning to see a sinking of the chlorophyll biomass at some stations in the water column and increases in chlorophyll deposited on the sea floor.

Other water sampling being undertaken is for stable oxygen isotopes in seawater and for nutrients. These water mass indicators are primarily being collected at three depths because of the simple water structure of the shallow water column and consideration of the budget available for analytical costs. Nutrient and stable isotope determinations will be made in shore-based laboratories following the cruise.

Surface sediment samples are being collected for total organic carbon, the natural, particle-reactive radionuclide beryllium-7, and pigment analyses by HPLC. These analyses will also be undertaken once the cruise is over onshore.

Atmospheric measurements underway aboard the ship include sea surface methane concentrations using an analyzer made available to us by LGR, Inc. of Mountain View, California through an educational loan. Data obtained so far show low-level variation in atmospheric methane, between 1.4 to 1.5 ppm. Slightly lower concentrations were observed over deeper portions of the Bering Sea enroute from Dutch Harbor, with a slight apparent increase while we worked south of St. Lawrence Island on the shelf. Concentrations appear to have declined following our transit north of the island. The air-sea flux of beryllium-7 in precipitation is also being measured and will be determined following the cruise at the University of Tennessee.

Outreach efforts with two educators onboard the ship have included helping to review journals, participating in a live conference call (more are planned) and otherwise accommodate needs so that the TREC outreach program is supported. We have also sent eight podcast interviews of scientists aboard the ship ashore for posting on the TREC website at http://www.arcus.org/TREC. Ruth Cooper, a middle school student who is participating in the cruise as part of the science party, is also receiving assistance from me in answering numerous questions from students in schools across the country and I have also helped her develop a on-ship web site to highlight the questions she is answering and her own experiences that are described in several journal entries. I am also coordinating the delivery of information to two media representatives that will join the cruise this coming week.

**Table. Matrix of sample collections to date for HLY0601 water and sediment components, Cooper and Grebmeier.**

| | | CTD Sampling | | | | Benthic Sampling | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station # | Station Name | Nutrients (BW, Mid depth, surface) | O-18 (BW, Mid depth, surface) | chl *a* (all depths) | BW for Incubations | Sed. chl *a* | Marinelli | TOC | HPLC | van Veen grabs (4) | X-HAPS for incubations (2) | X-HAPS for sectioning (1) |
| 1 | NEC5 | X | X | X | X | X | X | X | X | X | X | X |
| 2 | SEC5 | X | X | X | X | X | X | X | X | X | X | X |
| 3 | SIL5 | X | X | X | X | X | X | X | X | X | X | X |
| 4 | SWC5 | X | X | X | X | X | X | X | X | X | X | X |
| 5 | VNG1 | X | X | X | X | X | X | X | X | X | X | X |
| 6 | NWC5 | X | X | X | X | X | X | X | X | X | X | X |
| 7 | DLN5 | X | X | X | X | X | X | X | X | X | X | X |
| 8 | NWC4 | X | X | X | X | X | X | X | X | X | X | X |
| 9 | NWC4A | X | X | X | X | X | X | X | X | X | X | X |
| 10 | VNG3 | X | X | X | X | X | X | X | X | X | X | X |
| 11 | SWC4 | X | X | X | X | X | X | X | X | X | | |
| 12 | SIL4 | X | X | X | X | X | X | X | X | X | | |
| 13 | SEC4 | X | X | X | X | X | X | X | X | X | X | X |
| 14 | NEC4 | X | X | X | X | X | X | X | X | X | X | X |
| 15 | SIL3 | X | X | X | X | X | X | X | X | X | | |
| 16 | POP4 | X | X | X | X | X | X | X | X | X | X | X |
| 17 | SWC4A | X | X | X | X | X | X | X | X | X | X | |
| 18 | SWC3 | X | X | X | X | X | X | X | X | X | X | X |
| 19 | VNG3.5 | X | X | X | X | X | X | X | X | X | X | X |
| 20 | CD1 | X | X | X | X | X | X | X | X | X | X | X |
| 21 | VNG4 | X | X | X | X | X | X | X | X | X | X | X |
| 22 | NWC3 | X | X | X | X | X | X | X | X | X | X | X |
| 23 | DLN3 | X | X | X | X | X | X | X | X | X | X | X |
| 24 | DLN4 | X | X | X | X | X | X | X | X | X | X | X |
| 25 | NWC2.5 | X | X | X | X | X | X | X | X | X | | |
| 26 | NWC2 | X | X | X | X | X | X | X | X | X | X | X |
| 27 | DLN2 | X | X | X | X | X | X | X | X | X | X | X |
| 28 | VNG5 | X | X | X | X | X | X | X | X | X | X | X |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | SWC3A | X | X | X | X | X | X | X | X | X | X | X |
| 30 | POP3A | X | X | X | X | X | X | X | X | X | | |
| 31 | SEC2.5 | X | X | X | X | X | X | X | X | X | | |
| 32 | SEC3 | X | X | X | X | X | X | X | X | X | | |
| 33 | NEC3 | X | X | X | X | X | X | X | X | X | X | X |
| 34 | NEC2 | X | X | X | X | X | X | X | X | X | | |
| 35 | NEC2.5 | X | X | X | X | X | X | X | X | X | | |
| 36 | SEC2 | X | X | X | X | X | X | X | X | X | | |

### 3b. Profiling Ultraviolet Radiometer Measurements: Karen Frey and Lee Cooper, University of Tennessee Knoxville

As of 19 May 2006 at 18:30 UTC, UV radiometer profile measurements have been collected at 17 sites south of St. Lawrence Island (Table 1). The following parameters are measured with the UV radiometer:

k) Photosynthetically Active Radiation (PAR), 400-700 nm (_E/cm$^2$ sec)
l) 305 nm (_W/cm$^2$ nm)
m) 320 nm (_W/cm$^2$ nm)
n) 340 nm (_W/cm$^2$ nm)
o) 380 nm (_W/cm$^2$ nm)
p) Temperature (°C)
q) Pressure/Depth (meters)
r) Natural Fluorescence (NF) (nE/m$^2$ sr sec)

Measurements have been collected primarily during peak sunlight hours (ranging from 9:16–19:38 ADT), however cloud cover over recent days has precluded ideal profiles. Maximum depths of profiles range from 24.4–45.4 meters. Examples of profiles of UV radiation, PAR and NF can be seen in Figure 1. Preliminary data reveal that profiles may be highly dependent upon cloud cover (Figure 2). Nonetheless, the shape of the profiles and depth of convergence towards 0 will be helpful in interpreting patterns of chlorophyll concentrations in the water column. These profiles are currently being compared with chlorophyll concentrations measured from waters collected with the CTD and will continue onboard as new data are collected (e.g., Figure 3). Furthermore, once onshore, the UV radiometer data (particularly PAR) will be useful for interpreting ocean color satellite data (e.g., derived from the MODIS and SeaWIFS platforms), as these satellite data are an integrated water column interpretation of chlorophyll concentrations (i.e., to the maximum depth of light penetration).

**Table 1.** The 17 sites measured with the UV radiometer to date.

| Station Number | Station Name | Date | Start Time (ADT) | End Time (ADT) | Cloud Cover | Position | Depth of Measurements (m) |
|---|---|---|---|---|---|---|---|
| 1 | NEC5 | 5/9/2006 | 12:09 | 12:26 | ~100% | starboard | 32.8 |
| 2 | SEC5 | 5/9/2006 | 15:42 | 15:56 | ~90% | starboard | 30.3 |
| 4 | SWC5 | 5/10/2006 | 9:16 | 9:23 | ~30% | aft | 32.1 |
| 5 | VNG1 | 5/10/2006 | 12:03 | 12:10 | ~5% | aft | 38.7 |
| 6 | NWC5 | 5/10/2006 | 16:42 | 16:46 | ~5% | aft | 25.5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 8 | NWC4 | 5/11/2006 | 10:51 | 10:58 | ~100% | aft | 31.4 |
| 16 | POP4 | 5/13/2006 | 13:09 | 13:16 | ~100% | starboard | 24.4 |
| 17 | SWC4A | 5/13/2006 | 19:27 | 19:31 | ~100% | starboard | 33.8 |
| 19 | VNG3.5 | 5/14/2006 | 10:34 | 10:39 | ~100% | port | 45.3 |
| 20 | CD1 | 5/14/2006 | 14:33 | 14:39 | ~100% | aft | 39.7 |
| 21 | VNG4 | 5/14/2006 | 19:32 | 19:38 | ~100% | aft | 24.8 |
| 24 | DLN4 | 5/15/2006 | 12:59 | 13:06 | ~100% | starboard | 35.6 |
| 27 | DLN2 | 5/16/2006 | 13:43 | 13:49 | ~100% | starboard | 29.7 |
| 30 | POP3A | 5/17/2006 | 12:25 | 12:30 | ~100% | aft | 30.9 |
| 31 | SEC2.5 | 5/17/2006 | 17:39 | 17:43 | ~100% | starboard | 38.6 |
| 34 | NEC2 | 5/18/2006 | 11:14 | 11:18 | ~100% | starboard | 33.1 |
| 35 | NEC2.5 | 5/18/2006 | 16:44 | 16:49 | ~100% | starboard | 30.9 |

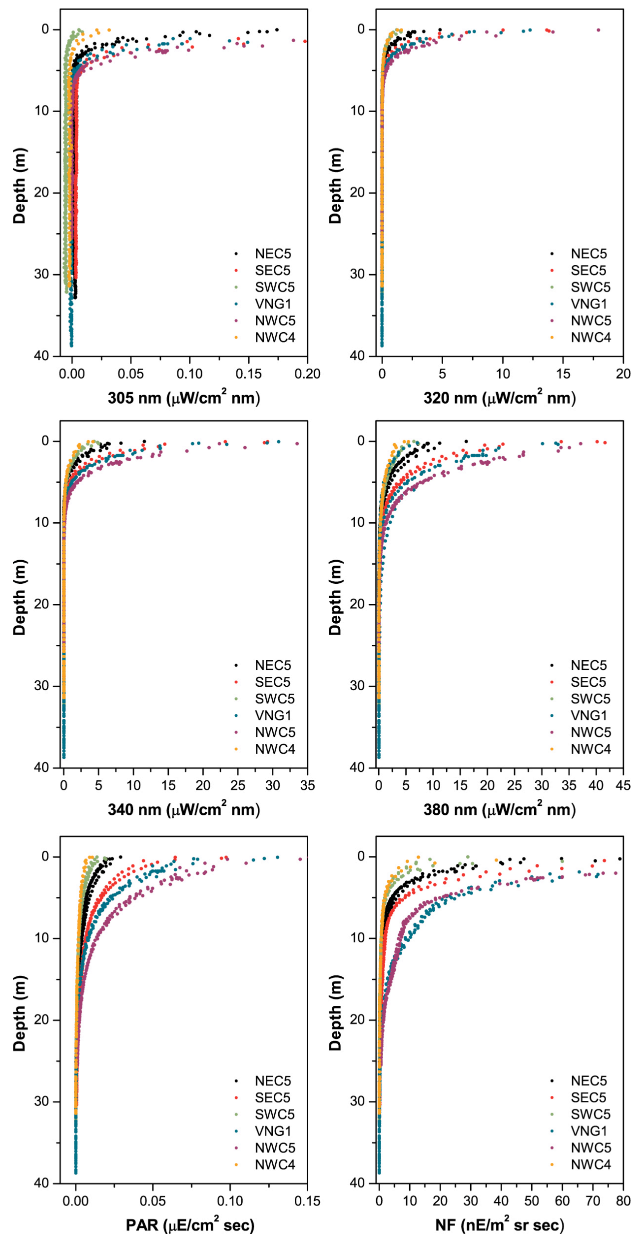



**Figure 1.** Examples of profiles at 305 nm, 320 nm, 340 nm, 380 nm, PAR (400-700 nm), and NF.

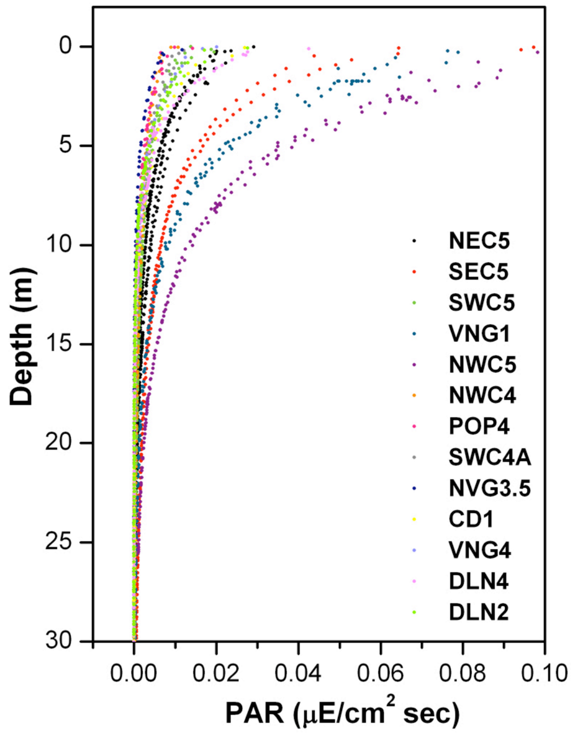



**Figure 2.** Example of depth profiles of photosynthetically active radiation (PAR). PAR at all sites converges to 0 at ~20 m depth in the water column.

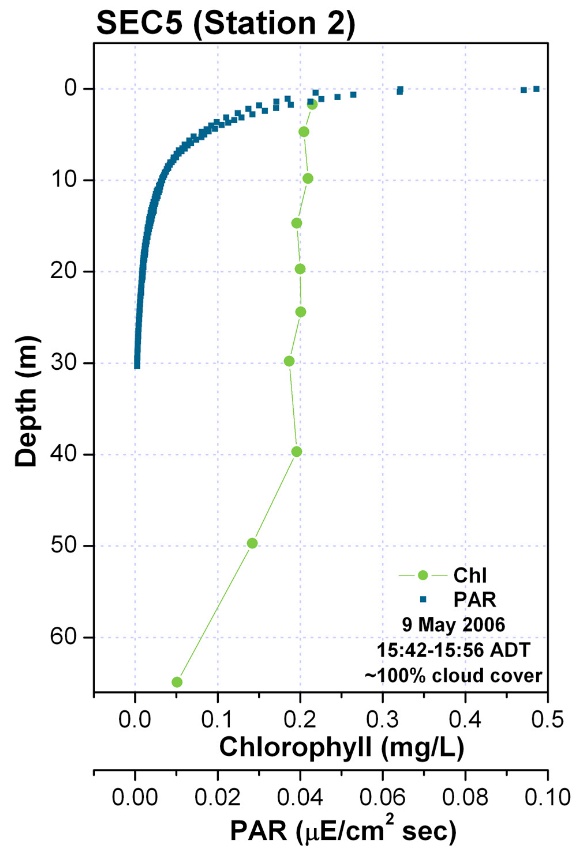



**Figure 3.** Example of depth profiles of PAR and chlorophyll concentrations. Chlorophyll concentrations are measured on waters collected with the CTD. PAR will be a valuable parameter in interpreting profiles of chlorophyll

**4. Water column POC, selenium, DOC-Dr. Marjorie Brooks, University of Wyoming**

As one portion of the data we are collecting to answer the question of how sea-ice changes will affect the functioning of food webs from microbes to top predators, we are collecting particulate matter from the top, middle and bottom of the water column at all stations and from sea ice whenever possible. To date, we have collected samples from all 38 of the stations listed in the cruise summary. Materials have been collected on ashed (500°C for 2 h) glass fiber filters (0.7$\mu$m). Post-cruise analyses will include ash-free dry mass and selenium concentration as well as isotopic (_$^{13}$C, _$^{15}$N) and fatty acid biomarkers. In total, we have collected 465 filters for water column assessment with samples from ice algae at 15 stations. In addition to analyses described above, we have provided Beth Caissie with samples for analyses of ice diatoms.

We will use these data to investigate several aspects of the role of particulate matter in the Bering Sea. Using biomarkers, we will trace the movement carbon and nitrogen from the algae through other portions of the food web. From ash-free dry masses we will quantify the proportions of organic versus inorganic particles per volume of water. When coupled with biomarker data, those fractions can be used to calculate the bioenergetic value of particulate matter. Finally, we are measuring the selenium content of the particulate compartment as part of our study of why marine biota are able to bioaccumulate high concentrations of selenium that would have teratogenic effects in freshwater animals.

**5. Sediment respiration, faunal populations: Jackie Grebmeier, Chief Scientist-University of Tennessee Knoxville; Boris Sirenko-Zoological Institute, Russian Academy of Sciences, Jerry McCormick-Ray-University of Virginia**

The purpose of the benthic component is to investigate pelagic-benthic coupling and carbon cycling in the SLIP study area. Methods used include population studies, carbon tracer collections, and sediment studies.. Forty-five stations have been occupied to date during HLY0601 for various data collections within our component, both water and sediment samples (Table under Cooper componenet, #2).

Sediments were collected at each station using both a 0.1 m$^2$ van Veen grab and a 0.0133 m$^2$ HAPS benthic corer. Four van Veen grabs were to collect replicate quantitative samples for benthic population studies. Sediment was sieved through 1 mm screens and retained animals preserved in 10% buffered formalin for analysis on land. Sediment collections from the van Veen grab was analyzed for chlorophyll pigment content shipboard (fluorometrically) and aliquots frozen for measurements of HPLC, total organic carbon and nitrogen content, grain size, and various radioisotopes at our land-based laboratory. Downcore samples for radioisotope tracers were cut in 1 cm sections to 4 cm depth the core, sealed in cans, and frozen for laboratory analyses on shore. Measurements of Be-7 and Cs-137 will be made on a high-resolution gamma detector in Tennessee. Large volume surface sediments were also collected in Marinelli beakers for gamma counting. Two additional HAPS cores were collected at each station for sediment metabolism experiments. Overlying water was replaced with bottom water and flux rates determined for oxygen, carbon dioxide and nutrients. Once the experiment was completed, cores were sieved to retain the benthic organisms, which were preserved as outlined above. In addition to sediments collected for our component, we provided sediment to scientists from the University of Massachusetts (Beth Cassie and Klinuyo Kanamaru), University of Wyoming (Jason Kolts and Chris), and University of Virginia (Jerry McCormick-Ray).

Twenty-six stations have been successfully cored by the Haps corer to obtain undisturbed surface cores for sediment respiration experiments (two replicates).

**Table. Species list for otter trawls in the SLIP region (courtesy Boris Sirenko, RAS).**

| **Faunal type** | **Number of species** |
|---|---|
| Cnidaria | 8 |
| Polychaeta | 11 |
| Gastropoda | 20 |
| Bivalvia | 12 |
| Crustacea | 17 |
| Echinodermata | 9 |
| Ascidiacea | 3 |
| Variable | 9 |
| **TOTAL** | **85** |

**6. Sediment Grab sampling-McCormick-Ray, University of Virginia**

This study provides descriptive measurements of taxa represented in each of (to date) 40 stations examined. This includes identification of the different represented taxa groups in the grab, individual size and weight (if possible) of mollusks measured, enumerating the numbers of individuals per taxa, estimated proportion of dead shells to live animals, and noting associated species attached or drilling into mollusks. Each site collection of species is documented by photography, and some are preserved for later analysis.

Preliminary results suggest that biota are dominated by various combinations of bivalve mollusk *(Nuculana radiata, Macoma calcarea and Leionucula tenuis*) and various types of tubed polychaetes, differing in proportions among sites.

Occasional mud sieving through 360 um sieves captured, from first sieving wash, small bivalves in juvenile stages of development, scattered among fecal pellets and foraminifera.

Observed and documented young mussels (*Musculus discors*) nested in the byssal threads attached to the mature mussel, and observed active deposition, under microscopic observation, of these young mussels by the mature mussel. This adds evidence for the time and location of reproduction in these bivalve mollusks.

Also of interest are the extensive drilling holes observed in mollusks, possibly by the gastropods (*Cryptonatica clausa* and *Lunatia pallido*), occur in some of the collections. The drilling shows so bias toward any particular bivalve group or individual size, as the smallest (microscopic bivalves) have holes. However, *Nuculana radiata* seems to be more extensively drilled than *Macoma calcarea*, especially when the two are found together.

Also of interest is the abundance of small, microscoptic bivalves, of one year or more of age as observed by their growth rings, and found in the sediment grab. Some of these very small shells have several growth rings, suggesting that they have grown little over several years of life and that size is no indicator of age.

**7. Eider survey, zooplankton, benthos prey base for spectacled eiders, Jim Lovvorn, University of Wyoming**

We did 37 vertical zooplankton tows south of the island, one at the dateline site, and as of NOM1 have done 6 tows north of the island (grand total of 42 so far). Although juvenile euphausiids are apparent in the samples, knowing what is there will require later examination in the laboratory. We will be especially interested in knowing the abundance and developmental stages of oceanic copepods (*Neocalanus plumchrus* and *N. cristatus*) which are advected over 500 km from the shelf break in the Anadyr Current. As we proceed through the Chirikov grid, we expect to see a gradient of species from *Neocalanus* spp. in Anadyr water in the west to *Calanus marshallae* (a shelf-resident species) in Bering Shelf and Alaska Coastal water.

From 9 to 17 May, we flew about 12 h of helicopter surveys south of St Lawrence Island. We covered all but the northeast corner of the study grid, and included a much tighter set of lines in the "hot spot" of high benthic productivity and past eider abundance during March-April. As expected, walruses were most abundant in the northwestern part of the area. Also as expected, no Spectacled Eiders (SPEI) were sighted.

On 17 May, I used a fixed-wing plane (twin-engine Navajo) to survey near the edge of shorefast ice along the coast due west from Nome, and the northcentral part of the Chirikov Basin. I started near the CPW line and worked south, running into dense fog while heading east around KNG1 and KNG2. On 18 May I attempted to survey the area south of the KNG line, but the entire area from there down to 64°N (about 30 miles north of St. Lawrence Island) was covered in dense fog. We then flew east along 64°N to the area of Norton Sound between Cape Darby and Stuart Island, where I was told by a pilot that SPEI gather in mid-June (probably post-breeding males, juveniles, and failed breeding females). We found no eiders there on 18 May, nor anywhere else that I surveyed.

20 May, we began helicopter surveys of the southern area of the Chirikov Basin that I had been unable to survey by fixed-wing plane. On the first flight we covered the area between the bottom two sampling lines, and found no eiders.

The goal of these surveys was to find where SPEI go during the 6 to 12 weeks between leaving their wintering area and arriving at breeding sites (late March to late May for the Y-K Delta, and late March to late June on the North Slope and Siberian coast). However, by talking with pilots and Savoonga residents, I gained better insight into the eiders' possible movements after they leave the wintering area. Our models of ice dynamics indicate that flight costs owing to the closing of leads go up dramatically when strong southerly winds oppose the generally southward movement of the ice pack, thereby forcing leads to close. Local residents said that eiders often fly to the north of the island during strong south winds at any time during winter. When we started surveys about 6 April 1999, it appeared that only about 40,000 of the estimated 380,000 wintering birds were still on the main wintering area, suggesting that most of the birds had already moved north. During that time, I would think that the area most likely to have both open water and abundant food is the south-central Chirikov Basin. However, areas along the coast of the Chukchi Sea, including the Ledyard Bay area between Point Lisburne and Wainwright that is a fall molting area for SPEI, also open up very early. Thus, substantial numbers of SPEI breeding on the arctic coasts of the US or Russia may move farther north rather quickly after leaving the wintering area. Based on the absence of eiders in the Chirikov Basin or Norton Sound in mid-May, efforts to characterize spring use of the Chirikov Basin by SPEI will require surveys earlier in the year, probably March and April.

**8. Walruses - Sea Ice Associations, G. Carleton Ray-University of Virginia**

Previous research has allowed Ray and Hufford (1989) to propose that Pacific walruses (*Odobenus rosmarus divergens*) prefer the Bering Sea's "broken pack" as habitat. Broken pack is critical for walruses for reproduction and to give them access to their benthic food supply. Statistical analysis has shown that this ice type dominates the central Bering Sea between St. Lawrence and St Matthew islands from early winter (January-February) through early spring (March-April), by which time the walruses have begun to migrate into the Chukchi Sea (mostly females, juveniles, and young-of-the-year) or to land haulouts in Alaska or Siberia (almost all males). However, during recent years, beginning in about the 1990s, Beringian ice has been receding and getting thinner, threatening walrus habitat as well as the many ecological functions provided by walruses, including consumption, resuspension of sediments, and nutrient release.

The methods employed are straightforward. Satellite imagery at various spatial resolutions (Quickscat, AVHRR, and Radarsat, available on board the Healy at reasonable intervals) sets the stage. An examination of this imagery allows an overall view of sea-ice extent and concentration, meteorological forcing, and generalized low-resolution ice type. Ship- and helicopter-based observations, supported by photography, allow ground-truthing of the imagery. These observations are continuous from the bridge during daylight hours, due to cooperation among the investigators aboard. To date helicopter flights have been conducted on 9, 10, and 11 May (2 flights each day); high winds, fog, and icing conditions have prevented flights on succeeding days. Our results to date have given support to previous analyses of walrus/sea-ice associations. Further interpretations will be given at the termination of this voyage.

Ray, G.C., and G.L. Hufford 1989. Relationships among Beringian marine mammals and sea ice. *Rapp. P.-v. Reun. Cons. int. Explor. Mer.* 188:22-39.

**9. Trawl survey: Chris North, Jason Kolts-University of Wyoming**

We have sampled at the stations shown on the spreadsheet. Zooplankton samples were rinsed, bagged and frozen. Grab sediment and organism samples were also bagged and frozen. Trawl contents were sorted to the lowest taxon possible (typically species), bagged, and frozen. After we have completed sampling, we will begin measuring all the organisms collected and determine the size class distributions of each species at each site. When we return to Laramie, we will begin analyzing gut contents and start analyzing all of our samples for fatty acids and stable isotopes ($^{13}$C and $^{15}$N). Eventually these data, combined with energetics estimates, will form the backbone of a food web model of our system. We will return and sample the same stations next year to obtain a second year of data which will be processed in the same manner.

Table. Trawl data collected during SLIPP06.

| Site | Date | Zooplankton (HHMM) | Grabs* | Trawl Time (min) | Trawl Speed (kn) |
|---|---|---|---|---|---|
| NEC5 | 9-May-06 | 6:50 | special | 20:21 | 1.9 |
| SEC5 | 9-May-06 | 16:50 | standard | 20:17 | 2.1 |
| SIL5 | 10-May-06 | 0:45 | standard | 20:19 | 2.4 |
| SWC5 | 10-May-06 | 7:20 | standard | 5:12 | 2 |
| VGN1 | 10-May-06 | 13:55 | standard | N/A | N/A |
| NWC5 | 10-May-06 | 18:10 | standard | 5:00 | 2 |
| DLN5 | 11-May-06 | 1:19 | special | 5:00 | 2.2 |
| ***DLN4*** | ***11-May-06*** | ***N/A*** | ***N/A*** | ***N/A*** | ***N/A*** |
| NWC4 | 11-May-06 | 13:00 | standard | 5:00 | 2.2 |
| NWC4A | 11-May-06 | 20:58 | standard | N/A | N/A |
| VGN3 | 12-May-06 | 0:22 | standard | N/A | N/A |
| SWC4 | 12-May-96 | 5:30 | standard | 3:00 | 2 |
| SIL4 | 12-May-06 | 13:00 | special | 10:00 | 2 |
| SEC4 | 12-May-06 | 18:30 | standard | 20:00 | 2.1 |
| NEC4 | 13-May-06 | N/A | special | 20:00 | 2 |
| SIL3 | 13-May-06 | 8:30 | standard | 20:00 | 2.1 |
| POP4 | 13-May-06 | 12:50 | special | 20:00 | 2.1 |
| SWC4A | 13-May-06 | 19:20 | standard | 20:00 | 2 |
| SWC3 | 14-May-06 | 2:15 | standard | 20:00 | 2 |
| VGN3.5 | 14-May-06 | 7:00 | standard | 20:00 | 2 |
| CD1 | 14-May-06 | 14:30 | standard | 10:00 | 2 |
| VGN4 | 14-May-06 | 19:00 | standard | 10:00 | 2 |
| NWC3 | 15-May-06 | 1:55 | standard | 10:00 | 1.9 |
| DLN3 | 15-May-06 | 8:55 | special | 10:00 | 2 |
| DLN4 | 15-May-06 | 13:00 | standard | N/A | N/A |
| NWC2.5 | 16-May-06 | 0:00 | N/A | N/A | N/A |
| NWC2 | 16-May-06 | 8:35 | special | N/A | N/A |
| DLN2 | 16-May-06 | 14:20 | standard | N/A | N/A |

| | | | | | |
|---|---|---|---|---|---|
| VGN5 | 16-May-06 | 22:40 | standard | N/A | N/A |
| SWC3A | 17-May-06 | 7:20 | special | 10:00 | 2.2 |
| POP3A | 17-May-06 | 13:20 | standard | 20:00 | 2.1 |
| SEC2.5 | 17-May-06 | 18:20 | standard | 20:00 | 2.2 |
| SEC3 | 17-May-06 | 23:30 | special | 20:00 | 2.1 |
| NEC3 | 18-May-06 | 6:10 | standard | N/A | N/A |
| NEC2 | 18-May-06 | 11:30 | standard | N/A | N/A |
| NEC2.5 | 18-May-06 | 16:40 | standard | N/A | N/A |
| SEC2 | 18-May-06 | 20:30 | standard* | 20:00 | 2 |
| SIL2 | 19-May-06 | 1:00 | standard* | 20:00 | 1.9 |
| SWC2 | 19-May-06 | 6:55 | standard* | N/A | N/A |
| VGN5 | 19-May-06 | N/A | N/A | 5:00 | 1.9 |
| NWC2 | 19-May-06 | N/A | N/A | 10:00 | 1.9 |
| NWC2.5 | 19-May-06 | N/A | standard | N/A | N/A |
| ***North of St. Lawrence Island*** | | | | | |
| DLN0 | 20-May-06 | 6:55 | N/A | N/A | N/A |
| KIV1 | 20-May-06 | 10:30 | standard | 11:00 | 2.1* |

* Grabs
Standard (per grab): 3 - 1 cm standard sediment samples (SI, FA, Se)
Special (per grab): 2 - 1 cm standard sediment samples (Se, FA/SI),
1 - depth profile (FA/SI),
1 - chloroform methanol preserved sample (FA)

## 10. Climate-driven Impacts of Groundfish on Food Webs in the Northern Bering Sea, Sherry Cui, University of Tennessee Knoxville

Climate change in the Arctic has been dramatic, and perhaps the most obvious aspect has been the reduced extent and earlier melting of seasonal pack ice. Because of the strong structuring role of sea ice on arctic marine ecosystem, a major question is how sea-ice changes will affect the functioning of food webs if current warming trends continue. When winter sea ice melts on the north-central Bering Sea shelf, a pool of cold bottom water (<1°C) forms that persists through summer and reduces the numbers and growth of groundfish. The size of the cold pool is decreasing with decreasing ice extent. This area is also currently the sole wintering site of the world population of benthic-feeding Spectacled Eiders (SPEI). Expansion of competing fish predators as ice cover declines and the cold pool contracts may affect food availability for the eiders.

During two planned cruises in May 2006 and 2007, I will investigate expansion of the ranges and numbers of mobile benthic predators-groundfish as a result of increased temperatures. There are few data currently on the densities or diets of groundfish where fish population is expanding. Among the parameters, I will investigate the diets of groundfish through analyses of gut contents and stable isotopes to determine the diets of predators. I will measure prey size class of both predators and prey when possible. Based on this approach I plan to determine the community of groundfish and its preys in the Northern Bering Sea and estimate the relationship between predators and preys. And I will model groundfish impacts on benthic clams (or main prey items) that might result under different bottom temperature regimes, and resulting effects on the energy balance of SPEI (hopefully).

<u>Fish collection by otter trawl at HLY0601:</u>
During the cruise HLY0601, fish were collected by otter trawl ((4.3m long, mesh size 1.9 cm, opening 3.1 m wide and 0.7 m high) by towing 3-20 min at a speed of 2.0-2.5Knot. We trawl sampled once at every station except the stations have too much ice, or the weather condition was too bad (VWG1, NWC4A, VNG3, NWC2.5, NEC3, NEC2, NEC2.5,). When sampling, we lost a net at station DLN4 and at the following three stations (NWC2, DLN2, VNG5) did not collect any samples since the new net had been opened by artificial fault. At one more station SWC2, we did not get any sample since the net did not perform in right way. The most number of fish in SLIP area is Arctic cod and second is Snailfish. For the sample size, I did not catch a lot of fish compared with the sample collected in 1999. It might be because during the cruise HLY0601 the bottom water is too cold (mostly below-1.5°C). I need to analyze these data information more in detail after the cruise. But it is possible that during the late summer the pool of bottom cold water decreases, which will cause the expiation of fish predators to impact food web. Therefore, it is significant to collect more fish samples at same area (or close area) especially during the late summer through other process. To figure out what will effect groundfish most is going to be important to understand their distribution and their impact on food web.

**11. Using Modern Sediments to Develop Paleo-Ice Coverage Proxies and Examine the Source of Biogenic Aggregates, Beth Caissie/Kinuyo Kanamaru-University of Massachusetts, Amherst**

***Stations sampled (as of 19 May 2006)***

| Number | Station | Sediment | Ice | Water | IRD |
|---|---|---|---|---|---|
| 1 | NEC5 | full core sliced and vertical core section | | | |
| 2 | SEC5 | top 1 cm | | 3 bottles | |
| 3 | SIL5 | top 1 cm | | 3 bottles | |
| 4 | SWC5 | top 1 cm | | | yes |
| 5 | VNG1 | top 1 cm | boat | 3 bottles | yes |
| 6 | NWC5 | top 1 cm | | | |
| 7 | DLN5 | top 1 cm | bucket | 3 bottles | |
| 8 | NWC4 | 1 cm and vertical core section | boat | | yes |
| 9 | NWC4a | | bucket | 3 bottles | |
| 10 | VNG3 | top 1 cm | bucket | | yes |
| 11 | SWC4 | | bucket | 3 bottles | |
| 12 | SIL4 | top 1 cm | | | |
| 13 | SEC4 | | | | yes |
| 14 | NEC4 | top 1 cm | bucket | | |
| 15 | SIL3 | No samples taken | | | |
| 16 | POP4 | top 1 cm | | | yes |
| 17 | SWC4A | | | | yes |

| | | | | | |
|---|---|---|---|---|---|
| 18 | SWC3 | top 1 cm | | | |
| 19 | VNG3.5 | full core sliced and vertical core section | | 3 bottles | yes |
| 20 | CD1 | 1 cm and vertical core section | | | |
| 21 | VNG4 | top 1 cm | | | |
| 22 | NWC3 | top 1 cm | | | yes |
| 23 | DLN3 | top 1 cm | bucket | | yes |
| 24 | DLN4 | top 1 cm | bucket | | yes |
| 25 | NWC2.5 | | | | yes |
| 26 | NWC2 | top 1 cm | bucket | | yes |
| 27 | DLN2 | top 1 cm and vertical core section | | | yes |
| 28 | VNG5 | top 1 cm | | | |
| 29 | SWC3A | 1 cm and vertical core section | | | yes |
| 30 | POP3a | ~1cm from sieve | | 3 bottles | |
| 31 | SEC2.5 | | bucket | | |
| 32 | SEC3 | No samples taken | | | |
| 33 | NEC3 | top 1 cm | bucket | | |
| 34 | NEC2 | top 1cm from Grab | bucket | 3 bottles | |
| 35 | NEC2.5 | No samples taken | | | |
| 36 | SEC2 | top 1 cm | | | |
| 37 | SIL2 | mud from Van Veen Grab | | diatoms from zooplankton net | |
| 38 | SWC2 | top 1 cm | | 3 bottles | yes |

***Analyses completed:***

No analyses are being conducted on the ship short of sample storage and preservation. The top 1 cm of a Haps core has been collected from 29 stations, two full cores have been collected and bagged in 1 cm intervals, and 5 full cores (10 - 20 cm long) have been extruded into tubes (Table 1). Sea water has been collected from the top, middle, and bottom waters of 10 stations. This has been preserved in 150 mL bottles. Sea ice has been collected either by bucket or by boat and a small amount of the brownest colonies have been bagged and preserved. The rest of the ice has been melted. Both water and sea ice has been filtered by Marjorie Brooks and Casey Quitmeyer and the filters dried and stored in petri dishes.

***Analyses to be completed at UMass:***

**Diatom assemblage counts from smear slides:**

At UMass, we will determine the number of valves per gram of sediment and conduct species counts from the top 1cm of sediment extruded from the Haps core. This will also be done on the 2 full core samples to determine if bioturbation has a sorting effect on diatom frustules or if the top cm is in fact representative of the modern bloom. This data will become the basis of a diatom training set that will have machine learning techniques applied to it to determine a relationship between diatom assemblages and annual duration of sea ice in the Bering Sea.

We will also measure the number of valves per mL water (or ice) and conduct species counts from water subsamples and sea-ice samples from every available station.

This data will be shared with Marjorie Brooks and Jim Lovvorn in order to determine the major algal species responsible for organic geochemical tracers.

**Diatom morphology observations:**

Observations will include counting the number of areolae per micron on centric diatoms (if present) such as *Thalassiosira trifulta* and *T. gravida,* measuring the ratio of length vs. width of pennate diatoms such *Fragilariopsis* spp., and determining if *Chaetoceros* spp. have curved or straight setae. These observations will be compared between samples taken from sea ice and samples taken from CTD water samples to determine if diatoms have created morphological adaptations for living in sea-ice brine channels and if these adaptations can be identified as distinct morphologies from the same species living in open water just outside of the ice.

**Measurement of Alkenone concentration:**

The top 1cm of sediment from the Happs core and the 2 full cores will be analyzed for $C_{37}$ unsaturated alkenones and the $U^{K'}_{37}$ will be calculated. This will serve two purposes: as a northern Bering Sea calibration point for the $U^{K'}_{37}$ temperature index derived from alkenones and to determine if the extensive 1997-2001 coccolithophorid blooms left a sediment signature.

**Measurement of biogenic aggregate**

Using undisturbed cores (in tubes), we will use the Scanning Electron Microscope (SEM) to describe the sediment, and size and shape of biogenic aggregates (e.g. fecal pellets produced by zooplankton), and examine relationship between benthic organisms and biogenic aggregates. Particularly, we are focused on the biogenic aggregates ranging from 1 mm to a few cm in length that are considered to be from different genera or life stages of copepods and nauplii, zooplankton, or groundfish (e.g. Sancetta, 1989; Cuomo, 1991). These aggregates are abundant and ubiquitous constituents under dysoxic bottom water (e.g. Pilskaln, 1991) and are found under highly productive surface water

The split core sediments will be first described, vertically sub-sectioned, freeze dried, and impregnated into epoxy to be mounted on thin sections. The sediments will be gently dried under –50 °C to prevent destructions of the biogenic microstructure.

**Grain Size Analysis:**

This will be carried out at 1cm intervals on the full Happs cores collected to determine the sorting effect by bioturbation of the sediment and to determine the capacity of ice to carry large pieces of sediment significant distances. We are testing whether there is a relationship between grain size of ice rafted debris and duration of sea ice or even just seasonal vs. multiyear sea ice. Additional samples will be needed to complete this part of the study.

In addition to the conventional grain size analysis, image analysis on sediment thin sections will be performed using Scanning Electron Microscope images to examine the grain size and shape of each biogenic aggregate. Image analysis has been used to reconstruct palaeoenvironmental changes on Holocene lake sediments (Noji et al., 1991; Francus et al., 2002).

**12. Marine Bird and Mammal Survey Aboard HLY0601, Liz Labunski-USFWS, Anchorage, AK**

The U.S. Fish and Wildlife Service (USFWS) have been conducting at-sea surveys aboard the USCG Healy to collect data on marine bird and mammal distribution and abundance. The goal of USFWS is to implement an at-sea monitoring program utilizing vessels of opportunity to collect at-sea data to provide a long-term dataset for researchers and managers investigating ecosystem changes in the Bering Sea. The region covered in this cruise, from Dutch Harbor to St Lawrence Island, was surveyed in the 1970's and 1980's during the Outer Continental Shelf Ecosystem Assessment Program. Data collected on seabird and mammal distribution during this cruise will thus provide comparisons to historical data currently in the North Pelagic Seabird Database (NPPSD).

Observations began aboard the Healy on 8 May, 2006 while the vessel was in transit to sample stations south of St. Lawrence Island. Observations are being conducted from the port-side of the bridge 66 ft above the water. All birds and mammals located within 300m of the vessel in a $0^{o}$ to $90^{o}$ are recorded as being "on transect" and are entered into a GPS integrated laptop computer using the program dLog. Species of interest (ex. walrus, auklets) beyond the 300m survey area are also recorded, but are considered an "off transect" observation, and those records will not be used in the final species density calculations. The behavior of each species is recorded using the categories: in air, on water, on ice, or feeding. The dominate sea, ice and weather conditions are also continually updated using dLog during the survey, and can be correlated to each species observation.

We have conducted a total of 45 transect from May 8– 15, 2006. Transect lengths have totaled 884 km surveyed. Transects are surveyed during daylight hours and occur from 0735 to 2330. Survey conditions have been hampered at times by rough seas and fog. During poor visibility the survey area has been decreased from 300m to 200m and 100m interval bins to maintain data quality.

We have observed a total of 867 marine birds (17 species), and 90 marine mammals (5 species) during the survey. The most abundant marine birds are murres including common and thick-billed species (Figure 1). Walruses have been the most common marine mammal observed and were recorded throughout the survey area (Figure 2). Other species of interests that have been observed include: ribbon seal, bearded seal, northern pintails, McKay's bunting, black and pigeon guillemots, ivory gull and the *vega* sub-species of herring gulls.

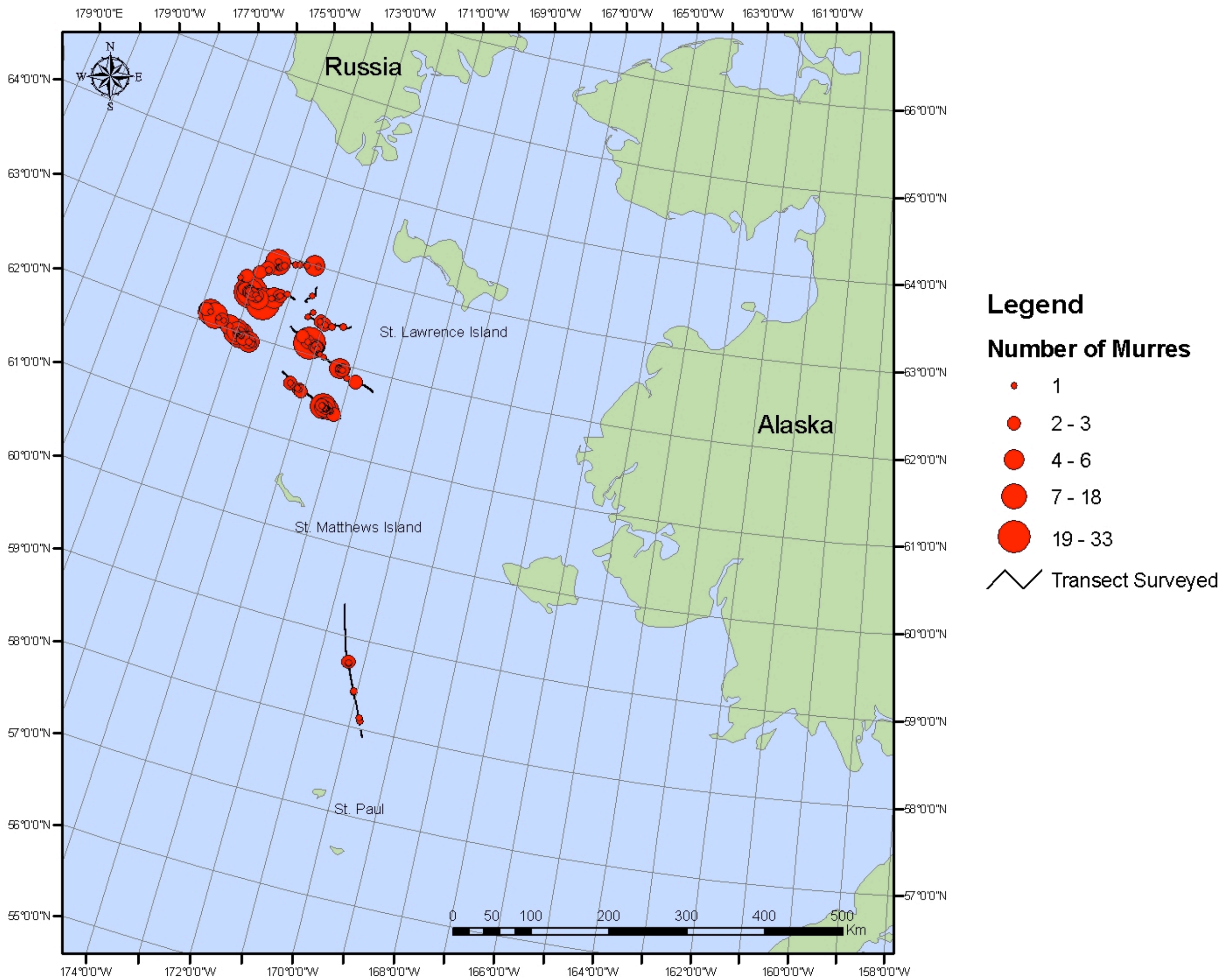



Figure 1. Distribution of common and thick-billed murres for surveys conducted 8-15 May, 2006.

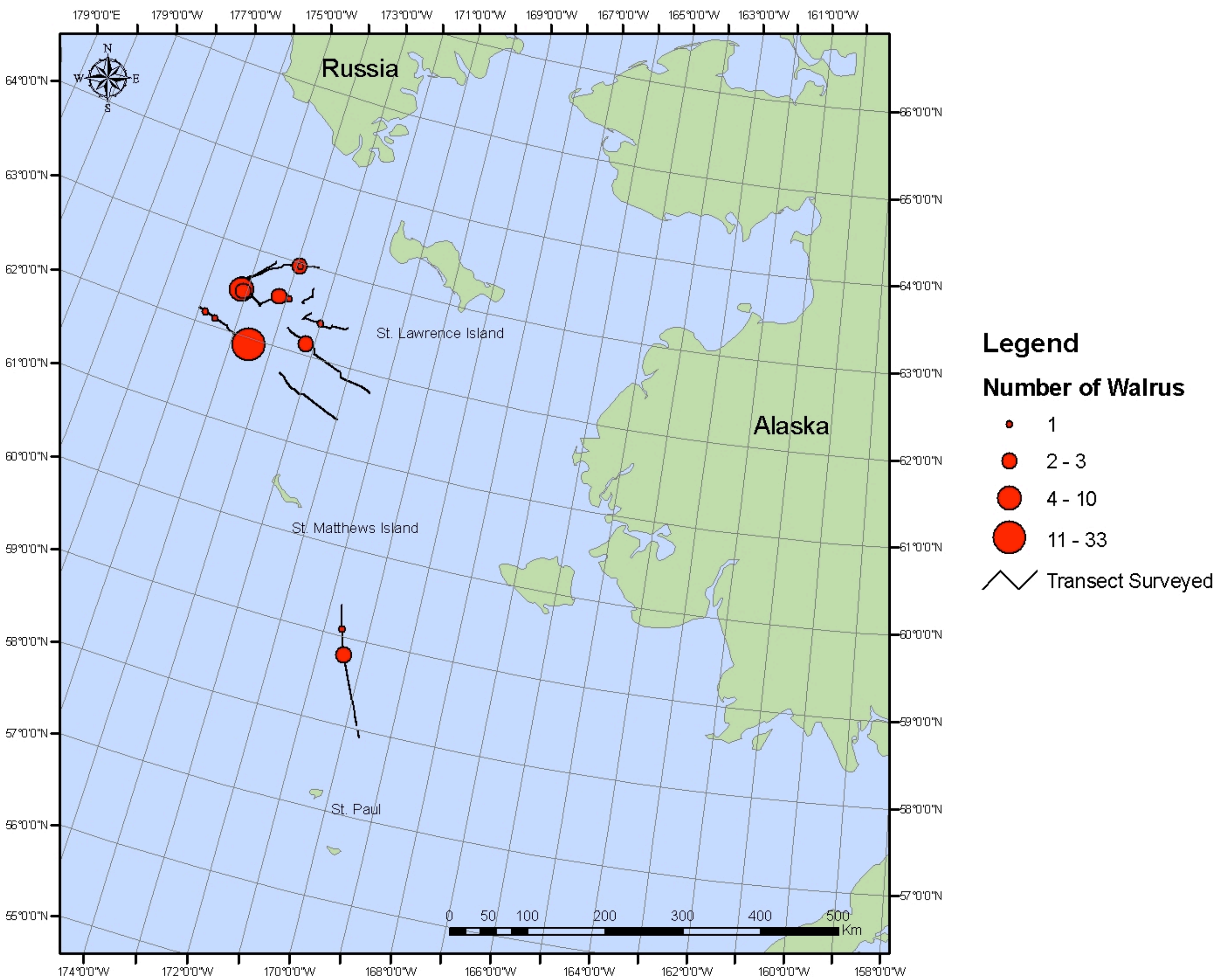



Figure 2. Distribution of Pacific walrus for surveys conducted 8-15 May, 2006.

**13. Multi-beam Mid-Cruise Status Report, HLY0601-Andrew Delorey, University of Hawaii**

We have collected multi-beam data continuously since our departure from Dutch Harbor using the Healy's Seabeam 2112 system. During watch-standing, I monitored the multi-beam, side-scan, and sub-bottom systems. I reviewed, cleaned, and gridded the multi-beam data, then generated maps combining navigation and bathymetry data.

Each day, I split my time between watch-standing and data-processing. Watch-standing includes monitoring the multi-beam, side-scan, the data storage of these systems, and logging any significant events that relate to these systems. The most important duty of the watch-stander is to monitor the noise levels in the multi-beam data. If noise levels are high, like when we are breaking ice, the multi-beam parameters must be manually adjusted since the automation of these adjustments becomes problematic, and can lead the system to a state in which the multi-beam must be shut down and restarted. These multi-beam parameters include the listening gate, power output, and signal gain. Since the depth varies very gradually in this area, the system can be left in manual mode for long periods of time with minimal adjustments. The multi-beam was switched back and forth from manual to automatic setting many times per day as conditions dictated. The only notable problem that occurred in the first half of this cruise is that the tape drive, used to create a backup copy for multi-beam data, failed twice. There are already multiple copies of the data being generated, so there was never a risk of losing any data; this problem was addressed by Dave Roberts.

The data were initially cleaned using a filter that removes data points that are outside of a tight depth window centered around the median depth for each swath. This filter is designed with the assumption that there are no large features or dramatic changes in depth on the ocean floor in this area. The filtering process was manually reviewed to ensure that these assumptions are reasonable, and additional, manual edits were made. The data quality is such that we will not be able to resolve features that are on the order of meters to tens of meters in size. For each individual swath, the noise level is high enough that its best interpretation is to use the median value as a center-beam depth. The noisiest parts of the swath were consistently near the center-beam, and at the outermost edges. Data density collected during transits between stations is low. Data collected while drifting at each station, and while trawling, is complete or nearly complete in the along path direction.

Maps were gridded at three different scales based on an A0 sheet size according to standard procedures for the Hawaii Mapping Research Group. Since we are not doing any contiguous surveys, and due to the small swath width (80-200 meters), the data is probably best presented in these three ways (subject to the needs of the PI):

1. Large map of the navigation path
2. Small bathymetry maps of each station
3. Large bathymetry map interpolating all data collected

Data collected as of 5/19/2006 are presented with this mid-cruise report. The large bathymetry map will change based on any additional data collected.

Results at this half-way point suggest that the bathymetry varies very slowly in the study area, ranging from ~35m to ~80m in depth, with the deepest depths to the west and the shallowest depths to the east. Some of the "features" seen on the Smith and Sandwell bathymetry map appear to be false. That is, there are no significant valleys or ridges in this area, just gradually varying topography. It is not clear if and how bathymetry is related to the biological "hotspot" identified by the science party. This "hotspot" is in a location with intermediate depths in relation to the greater study area. As we fill in some of the gaps in our dataset, we will be able to improve our bathymetry maps of the study area.

**14. Biopsy and instrumentation of ice seals in the St. Lawrence Island Polynya, Gay Sheffield, Alaska Department of Fish and Game,** Fairbanks, AK

In Alaska, four species of seals (i.e. Bearded, ribbon, ringed, and spotted) are closely associated with the sea ice and are commonly referred to as "ice seals". Gay Sheffield will investigate ice seal stock structure, migration routes, and dispersal patterns of ice seals that occur in the northern Bering Sea. Seals will be live-captured and instrumented with satellite transmitters to provide information about seasonal movements, dive depths/duration, and regional habitat use. Additionally, skin biopsies will be collected from all species for genetic analysis.

**15. Educators: Samantha Barlow-Oakwood School, Greenville, NC and Patricia Janes, Scholastic, Inc., New York**

A major component of the educator outreach by Samantha Barlow and Patricia Janes is the TREC website (www.arcus.org/trec). This site includes journal entries, a question forum, and a photo gallery.

Education outreach on the TREC website began prior to the Healy setting sail, with the first journal entries being posted on April 23 during the TREC training in Fairbanks, Alaska. Since arrival in Dutch Harbor educator journals have been posted almost daily. To date, there are 38 combined educator journal postings on the TREC web site and 134 questions and comments posted from students nationwide on the online forum. The TREC website also includes input from scientist Lee Cooper, who participates in the question forum, and a middle school student who posts journal entries and answers student questions. Six podcasts have been created by scientists onboard the Healy and are available at the TREC website for download.

To date, 33 journal entries from the educators have also been added to the Science Data Network Web (http://healy-mx), which is supported on the Healy. Additionally, approximately 30 scientists and Coast Guard crew members attended a presentation on Friday, May 12 at 7:00 PM to hear more about TREC and the role of educators onboard the Healy.

ARCUS hosted an "Arctic Alive" event at 9:30 AM on Monday, May 15. The live event consisted of a conference call with a simultaneous power point presentation. There were approximately ten participating schools, organizations, and individuals from Alaska, Arizona, Georgia, Michigan, New York, and North Carolina. Attendees from the Healy included Samantha Barlow, Patricia Janes, Captain Dan Oliver, Jackie Grebmeier, Lee Cooper, Gay Sheffield, and Ruth Cooper.

To date, one newspaper article has been published. The article focused on Samantha's upcoming expedition and appeared in The Daily Reflector on April 19. Patricia has secured approximately nine articles for future publication in various Scholastic classroom magazines, and one more is slated for publication in *Instructor* magazine.

Samantha has engaged in eight pre-cruise presentations to school groups of various grades ranging from kindergarten to college.

Overall outreach efforts thus far have been successful. We are poised for at least one more Arctic Alive event, future postings on the TREC website, and public outreach upon return from the Healy.

**16. USCGC Healy cruise HLY0601 LDEO Science Technical Support Report**
V1.1 Steve Roberts & Tom Bolmer 20 May06

This is a brief report on the performance of the Underway Science Systems during the Healy HLY0601 Cruise 5/7/06 – 6/5/06 Dutch Harbor to Dutch Harbor, Chief Scientist James Lovvorn.

**SeaBeam 2112 Multibeam Sonar**
The Seabeam worked well for the duration of the cruise. However, since the entire cruise was spent in shallow water(less than 100meters) the spatial extent of the data was limited. Swath widths ranged from only 300 meters down to 120 meters. Since this system was designed for deep water the data collected is of modest to low quality. Most of the time was spent in open water or loose ice so the effect of ice on the system was minimal.

A watchstander(Andrew Delorey) was trained on the operation of the Seabeam and stood a 12hour watch. When there was not a watchstander the system was kept in manual setting for gates, sonar power, ping gain and ping width. Due to the small variation of depth during the cruise this method worked well.

In past cruises when the surface sound velocity(ssv) dropped below 1440m/s beam forming would fail. However, on this cruise even when the ssv dropped below this value there was no apparent degradation in beam formation.

**Knudsen (Sub-Bottom Profiler)**
The Knudsen was used for the whole cruise. The Bathy 2000 was never turned on. The Knudsen

**Figure 1. Example plot of Knudsen 3.5kHz data from 18:23 to 18:32 UTC on May 18, 2006 while approaching station NEC2**.

### POS/MV-320

Prior to the start of HLY0601 the system was upgraded to Version 4. Problems were experienced with the PCS unit during the April shakedown cruise and was sent back to Applanix. The unit was returned to the Healy and reinstalled just prior to the start the of the transit to Dutch Harbor. The system was restored with the calibrations setting obtained during the shakedown cruise. The system has been running and stable since this time with heading, pitch and roll errors all staying within its specified tolerance.

### Ashtech ADU5

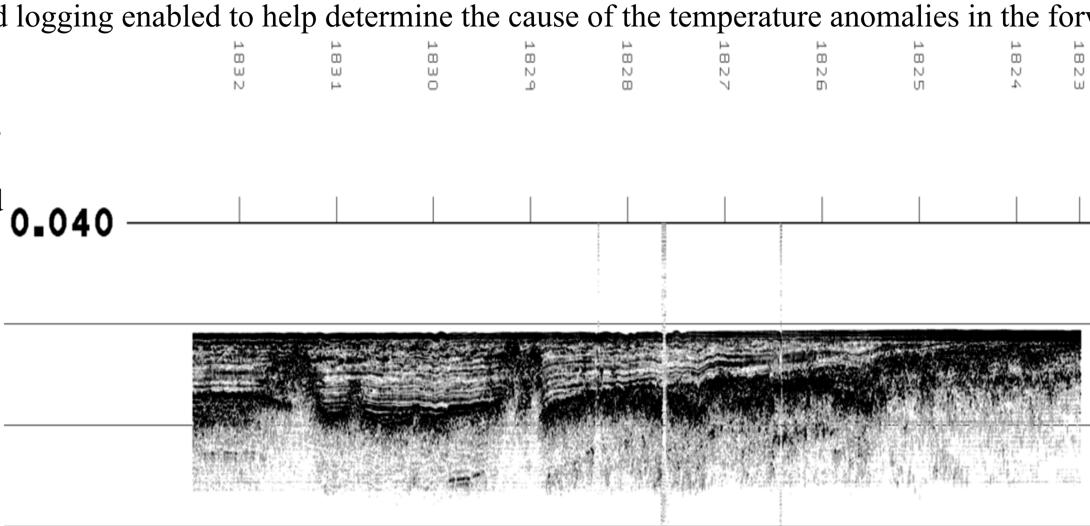
ADU5 worked as expected. Only one "no-attitude" event was observed on this trip so far. Reseting the unit returned it to normal operation. A calibration of the system was performed prior to the transit to Dutch Harbor and a heading offset of -0.68 was entered. After this calibration the observed difference in heading between the POS/MV and ADU5 was around 0.2 degrees. This difference has remained consistent for most of the cruise with only brief periods where the difference would increase to near 1 degrees.

### TSG ( Thermosalinograph)

The forward TSG has operated for most of the cruise. The system was shutdown for a brief period due to a cracked faucet. This was repaired by the MST's. However, large short period peaks in the water temperature are being observed. These can be as large as 1C and have duration of up to _ hour. These appear to only occur while the ship is stopped during a station. They first started showing up at our first station. At the time of this writing the cause has not been determined.

### Aft TSG(in aft hose reel room)

Several days into the cruise the aft TSG that operates in the aft hose reel room was turned on and logging enabled to help determine the cause of the temperature anomalies in the forward TSG. It has consis tently record ed a tempe rature that is about 0.4



degrees higher than the primary TSG. Temperature peaks were also noted in this system. These peaks were only moderately correlated with the peaks on the forward TSG.

**Scufa**

The Scufa Flourometer in the Bio Chem Lab is operating satisfactorily.

The Scufa Flourometer in the aft hose reel room is showing large spikes in the data output.

**Uncontaminated Seawater**

The uncontaminated science seawater system operated for the duration of this cruise.

**Hull Temp**

A Sea Bird Electronics magnetic mount hull temperature sensor has been temporarily mounted in the Aft Hose Reel Room on the shell plating below the water line to evaluate it’s performance. However there was no logging of data until several days into the cruise. Logging was enabled to help determine the cause of the anomalies in the forward TSG. It has consistently recorded a temperature that is about 0.2 degrees higher than the primary TSG. It was observed last year that the hull mounted temperature reading increased slightly when the ship was stopped at a station. This behaviour was not observed on this cruise. In addition, none of the large peaks in the forward TSG are being observed in the hull readings.

**Mapserver**

The same interactive web mapping tool that was utilized last year was actively supported on this cruise. This interface provides access to realtime ship track and multibeam, high resolution radarsat, sea ice analysis, visible satellite, bathymetry, planned waypoints, CTD locations and previous Healy cruise tracks.

**RadarSat Images from the National Ice Center**

We have been working with the National Ice Center to obtain high resolution RadarSat images and analysis of sea ice conditions in near realtime that covers the Healy's current operating area. We started receiving this data May 10. The images are provided as both jpeg's and georeferenced MrSID's. Ice analysis is also provided with the jpeg's and as a separate ESRI shapefile.
These are put on the US Coast Guard server in Seattle by the National Ice Center. The MrSID's have a resolution of 100 meters. Access to these images on the ship are provided via the Mapserver web site on the ship's LAN. The following are the statistics on the satellite pass times and the time the images are uploaded to the USCG server:

| ***Satellite pass time*** | ***ftp upload*** | ***delay(hours)*** |
|---|---|---|
| 2006/05/10 04:53:35 | 05/10/2006 21:44:34 | 16.9 |
| 2006/05/13 05:06:16 | 05/13/2006 11:47:00 | 6.7 |
| 2006/05/15 17:48:40 | 05/15/2006 23:54:34 | 6.1 |
| 2006/05/16 05:18:58 | 05/16/2006 13:51:57 | 8.5 |
| 2006/05/17 04:49:21 | 05/17/2006 14:13:47 | 9.4 |
| 2006/05/18 18:01:21 | 05/18/2006 22:12:36 | 4.2 |

**Ice Report Forms**
The same Sea-Ice Observation Web Form from last year was utilized during this cruise. The form worked well with no significant problems.

**Terascan**
While in port in Seattle the system was upgraded with a larger 1.5 meter diameter antenna. Eric Baptiste of SeaSpace rode out on the transit to Dutch Harbor to thoroughly test the system prior to the start of the science leg. During the transit the system experienced an extended loss of NMEA heading input.
Exasperated by a software bug, the system went into a satellite hunting mode shearing off its stops and damaging its control harness. In the short amount of leed time we had before getting to Dutch Harbor it was not possible to fly in the needed spare parts. System was not operational for duration of cruise. System will be repaired on return to Seattle.

Another temporary Terascan 3.3 license for the postprocessing laptop was installed. This system is used to generate custom imagery for the Mapserver and data archive. The temporary license was transferred from the Polar Star and will expire in November. The laptop was verified to operate satisfactorily. However, due to the non-operational status of the receiving system this laptop was not utilized for HLY0601.

**ADCP(75kHz and 150kHz)**
Significant noise has been observed in the data for these systems during past cruises. During the transit to Dutch Harbor considerable effort was spent by Ron Hippie of RDI to isolate the cause of this noise. EMI was identified as a major source of noise with other sonars as a secondary source. It was not possible to completely eliminate all sources of interference during the transit. Ron return the systems to same configuration as previous cruises. Both 150kHz and 75kHz were operated for the duration of science cruise.

**Multibeam Router/logger (*he-gate*)**
Operated satisfactorily.

**LDS Logging and Navigation Computer (*posmvnav*)**

Operated satisfactorily.

**Web Camera (Science Planning Board aka board of lies)**

Operated satisfactorily. It was noted that the original TCP/IP address was using a value reserved for DHCP. This was changed to a static value.

**Web Camera (Aloft Conn)**

Operated satisfactorily. It was noted that the original TCP/IP address was using a value reserved for DHCP. This was changed to a static value. There were some brief outages due to problems with the network switch that services the aloftcon.

**Watch Stander Workstation (WSWS)**

The lower large display (Apple 23" Cinema LCD) display has been showing signs of problems. Otherwise it worked satisfactorily.

## CCHDO Data Processing Notes

| Date | Contact | Data Type | Action |
|---|---|---|---|
| 2015-03-11 | Jerry Kappa | Cruise Report | Website Update |

I've posted an updated PDF version of the cruise report to the CCHDO website. It includes all the PI-provided documentation, a linked table of contents, links to figures and tables, plus the standard CCHDO summary page and these Data Processing Notes.

| Date | Contact | Data Type | Action |
|---|---|---|---|
| 2015-03-10 | Jerry Kappa | Cruise Report | Website Update |

I've posted a text version of the cruise report to the CCHDO website. It includes all the PI-provided documentation, plus the standard CCHDO summary page and these Data Processing Notes.

| Date | Contact | Data Type | Action |
|---|---|---|---|
| 2006-09-15 | Stephen C. Diggs | Cruise Report | Submitted |

I got some preliminary Healy data from Teresa Kacena. She was the ODF tech on this cruise. I've attached their PDF cruise report, but Jim will make the final determination regarding the disposition of this cruise in our archives, if any. I won't post this to either the CCHDO on googlegroups or Mantis until Jim gives his ruling.