Cruise Report:
USCGC Healy 09-01, March 10-31, 2009
Northern Bering Sea

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North Pacific Research Board

National Science Foundation

Cover photo credit: Andrew Trites, University of British Columbia

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Editor's Note: All data and summaries provided herein are subject to revision or correction and should be treated as unpublished data with intellectual property reserved to the scientist contributing to the report. Please contact the individuals listed as having responsibility for each report section for additional information or Lee Cooper. Report prepared April 2009, Solomons, Maryland. Note that for ease of use, all tables have been sequentially numbered from 1 to 12 throughout the report; figure numbers however restart at 1 within each sub-section.

USCGC Healy Cruise HLY0901
March 10-31, 2009

Summary:

Healy Cruise 09-01 departed Kodiak, Alaska on March 10, 2009 and returned to Dutch Harbor on March 31, 2009. With funding provided by the National Science Foundation (NSF) and additional support from the North Pacific Research Board (NPRB), the aim of the cruise was to investigate patch dynamics of apex predators, specifically walrus, in relation to the distribution of food supplies on the sea floor. The research effort was jointly coordinated by the Bering Sea Integrated Ecosystem Research Program (BSIERP) and the Bering Sea Ecosystem Study (BEST), with support from the NPRB and the NSF, respectively. Because of high demand for berth space and wire time on BEST cruises later in 2009, special efforts were made to accommodate a number of projects compatible with the use of the ship during the patch dynamics study, and these individual projects are outlined below. In addition to science programs, additional efforts were made to communicate scientific efforts and research issues by providing berth space for news media representatives from ABC News, the professional journal Environmental Science and Technology, and National Public Radio. In addition, an independent photography and writing team (Tom Litwin, Smith College and Tom Walker, Tom Walker Photography) posted blogs to the International Polar Year office webpage (www.ipy.org) during the scientific work, including features on climate change and individual scientists participating on the cruise. A professional fine arts photographer, Ms An-my Lê, documented the scientific research activities as part of an independent project documenting the interactions of scientists and the military, particularly in the polar regions. An elementary school science teacher from Indian Head, Maryland, Ms.Deanna Wheeler participated in the scientific work and communicated results back to her classroom and beyond through the PolarTREC (www.polartrec.com) program with both NSF and NPRB support. Additional ship-based blogs on research activities were provided by two agency representatives from the NPRB on their Bering Sea research webpage. Outreach from the ship also included a telephone interview with a reporter from the Baltimore Sun, a radio interview with the community radio station in Unalaska, Alaska, a "Live from IPY" presentation sponsored to multiple schools through the PolarTREC program, and a multi-lingual presentation in German and French to a teenaged audience of several hundred at a science museum in Paris, France that was organized by the International Polar Year office in coordination with Arctic and Antarctic researchers for Polar Oceans Day. An additional phone call was placed to an arctic climate change course being taught by Dr. Karen Frey of Clark University on March 30 with presentation of preliminary results by several of the lead researchers on the ship. Since the cruise, a web link has been set to allow the tracking of walruses that were tagged (http://alaska.usgs.gov/science/biology/walrus/tracking.html). In addition, the National Public Radio program Morning Edition and the Baltimore Sun have featured stories that featured work conducted on the cruise (appended to end of cruise report). Additional media coverage is expected in the coming weeks.

Acknowledgements:

We thank the US Coast Guard crew, officers and commanding officer onboard Healy for well-executed hard work and flexibility under cold and often difficult conditions. We wish to specifically thank the Marine Science Technician team who assisted us aboard the ship during the research operations. Maritime Helicopters (Bill Springer and Charles Sims), and the Aviation Management Directorate of the Department of the Interior (David Kreutzer) also contributed significantly to completing successfully the science mission objectives. Lamont-Doherty Earth Observatory provided very effective support for underway systems and sampling and the Scripps Institution of Oceanography provided excellent support for operation and data collection from the ship's CTD system.

We also thank the Native Village of Savoonga and the Native Village of Gambell for their cooperation and assistance while the ship was operating in the vicinity of Saint Lawrence Island and for facilitating the transfer of the media representatives and others to and from the ship to shore.

Core Projects:

BEST Benthic Ecosystem Response to Changing Ice Cover in the Bering Sea (National Science Foundation ARC-0802290), Jackie Grebmeier and Lee Cooper, PIs

BSIERP: Patch Dynamics (North Pacific Research Board project O4.67), Andrew Trites and Chad Jay, lead shipboard PIs

Other Participating Projects:

BEST: Sea Ice Algae, a Major Food Source for Herbivorous Plankton and Benthos in the Eastern Bering Sea (NSF ARC-0732767)
PIs: Rolf Gradinger, Bodil Bluhm, Katrin Iken

Measuring and Modeling Habitat Use by Spectacled Eiders Wintering in the Bering Sea
PI: Jim Lovvorn, (NPRB Project 820)

North Pacific Pelagic Seabird Observer Program (BSIERP B64: Seabird Broad-scale Distribution)
PI: Kathy Kuletz

Optics under sea ice and heat absorption impacted by bioprocess (Chinese International Polar Year Program)
PI: Jinping Zhao, Ocean University of China

Thin Ice: An Exploration of the Bering Sea at the Dawn of Global Warming A public education project for the International Polar Year- 2007-2008
PI: Thomas Litwin

Intersection Between Science, Military and the Sea
PI: An-my Lê, Fine-Arts Photographer

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Figure 1. Detail of shiptrack within study area. Station numbers correspond to stations tabulated in Table 1. From underway data, courtesy of Steve Roberts, graphics courtesy of Tom Bolmer.

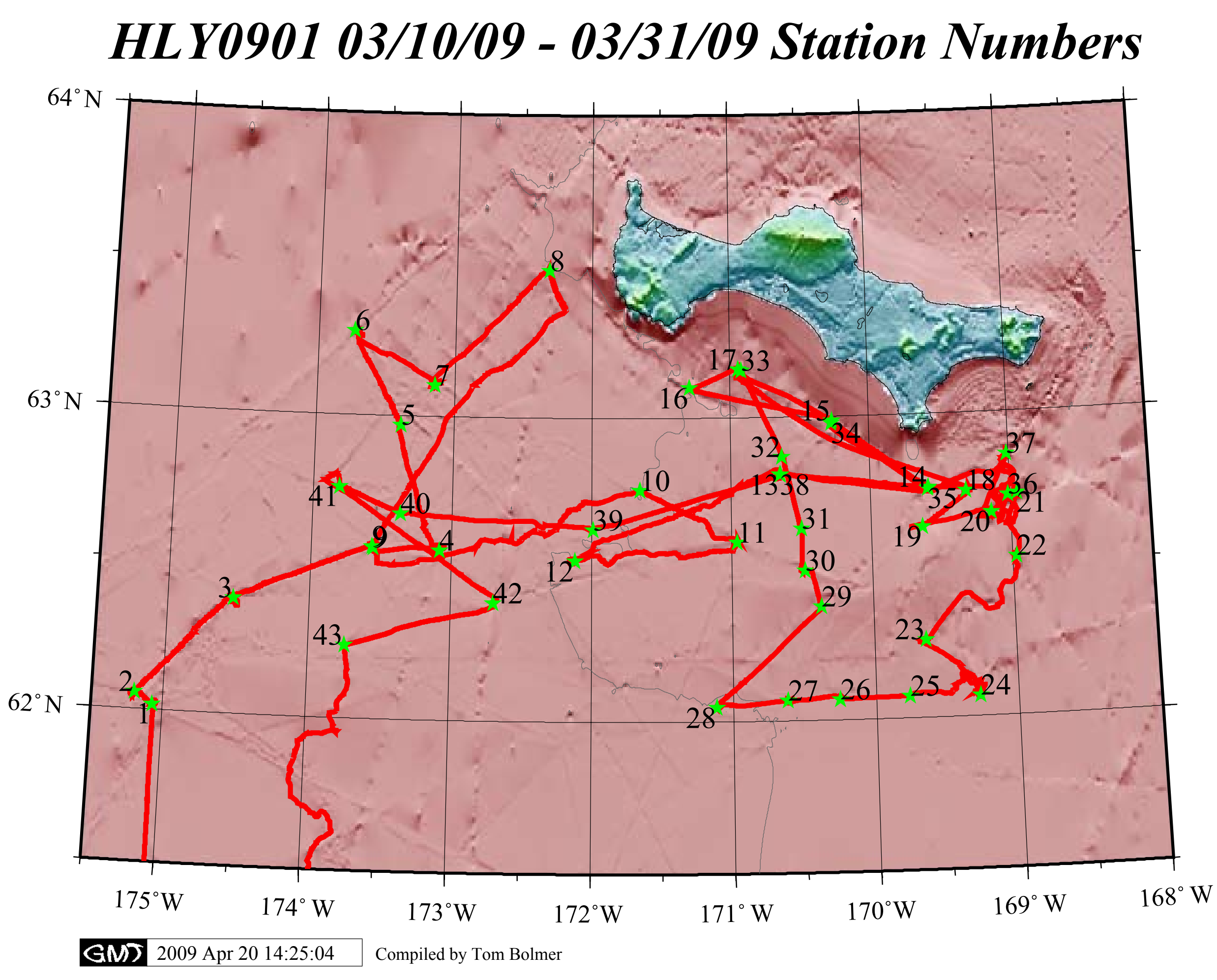


Figure 2. Overall Ship track (from underway data courtesy of Steve Roberts, UCAR). Graphics courtesy of Tom Bolmer

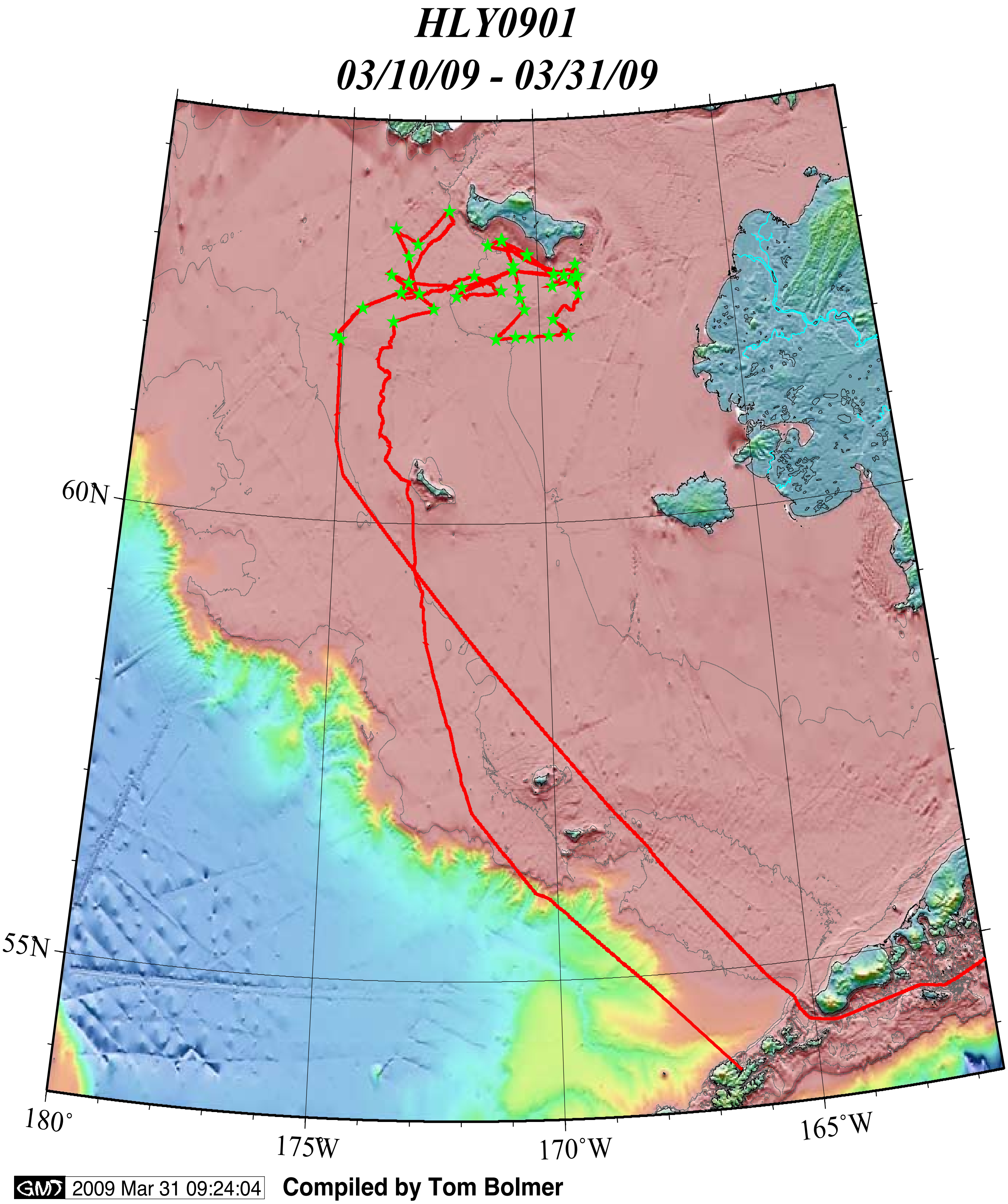
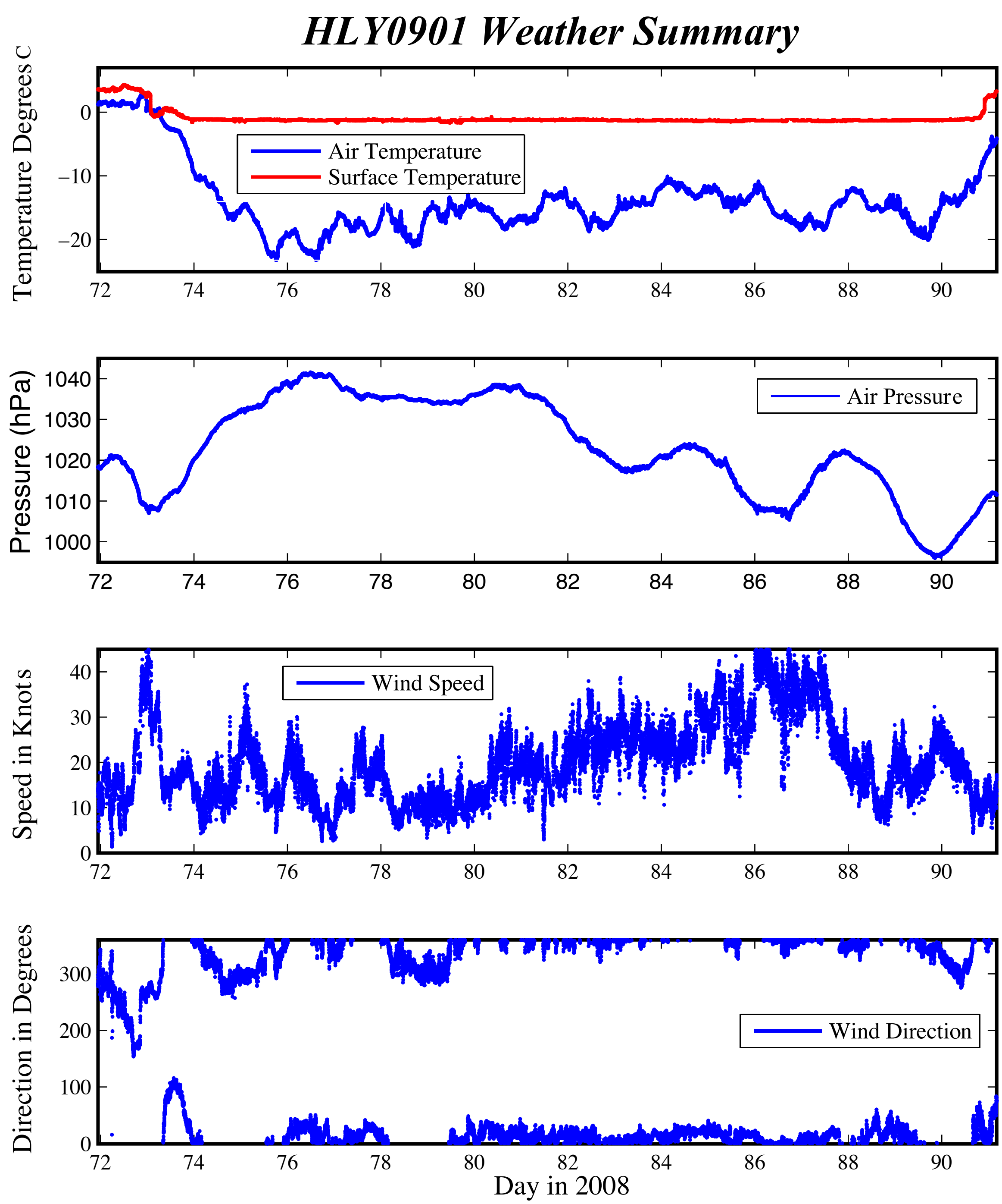


Figure 3. Meteorological time-series data collected during cruise from underway sensors. Graphics courtesy of Tom Bolmer.



Individual Project Reports

USCGC Healy – cruise HLY0901
Summary of Support
CTD Operations – Science Seawater Sensors – Meteorological Sensors
Scripps Institution of Oceanography
March 8-31, 2009

CTD Operations

Data Set overview
44 CTD Casts on 43 stations were completed. Cast depth range was 35-80 meters and water samples were taken from each cast. See Table 2 for StationCast log.

Instrumentation
CTD casts were performed with a rosette system consisting of a 12-place rosette frame with 30 liter bottles and a 12-place SBE-32 Carousel pylon. Underwater electronic components consisted of:

- Sea-Bird Electronics, Inc. (SBE) 911plus CTD
- WETLabs C-Star transmissometer with a 25cm path length and 660nm wavelength
- Biospherical Instruments, Inc. Photosynthetically Active Radiation (PAR) sensor
- Chelsea MkIII Aquatrack fluorometer
- Benthos, PSA-916, 1-100 meter altimeter

The CTD utilized redundant temperature and conductivity sensors, along with a SBE-43 dissolved oxygen sensor, plumbed to the primary temperature and conducitivty sensors. The PAR sensor was located at the top of the rosette. The surface PAR sensor was located atop the helicopter shack. See Table 1 for CTD sensor configuration.

This instrument package provided pressure, dual temperature and dual conductivity channels as well as light transmissivity and fluorometric signals at a sample rate of 24 scans per second.

The bottles on the rosette were General Oceanic 30 liter bottles. The bottles were equipped with internal nylon coated springs and silicone o-rings which are used to minimize toxicity to the sample. Bottle numbering is 1 to 12 with 1 tripped first usually at the deepest sampling level and 12 tripped last at the shallowest sampling level. The rosette system was suspended from a standard UNOLS 3 conductor 0.322" electromechanical cable.

Problems and/or Procedural changes
On the first CTD cast several Niskin bottles had problems with o-rings resulting in many leaks. This problem was fixed prior to the second CTD cast. Viton o-rings were installed initially and

were replaced with Silicone o-rings for the remaining CTD casts. The Viton o-rings did not work well in -1.7 degC water.
Several bottle mistrips were noted throughout the cruise due to sticky carousel latches. Fresh water cleaning of the carousel between CTD casts fixed the sticky latch problem.
Other problems noted were sensors on the CTD that failed to operate due to freezing water temperatures. The primary conductivity sensor #2545 froze and cracked during staion/cast 00401 and was replaced with sensor #2575. Similar on deck freezing problems caused oxygen sensor #456 to stop working during station/cast 01801. The sensor was replaced with sensor #458. Deployment and recovery operations required quick transitions between the starboard staging bay and on deck. The rosette could not sit on deck for any length of time without causing sensor problems on the CTD. Sensors were left dry between casts to prevent frozen water in the plumbing system of the CTD.

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USCGC Healy - HLY0901

CTD Sensor configuration

The following sensors did not change for the duration of HLY0901:
CTD 911+ #639
T1, Primary Temperature #2841
T2, Secondary Temperture #2824
C2, Secondary Conductivity #2619
Altimeter #843
Transmissometer #CST-390DR
Fluorometer #088234
PAR #70115
Surface PAR #20270


The following sensors changed as follows:

CTD StaCast No.    C1
00101-00401       2545
00501-04301       2575

CTD StaCast No.    O2
00101-01801       456
01901-04301       458
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USCGC Healy - HLY0901 - CTD Cast log **Table 1. Station locations and occupation dates and times (UTC-GMT)**

1 - Station Name
2 - GMT Date
3 - GMT Time
4 - Latitude
5 - Longitude
6 - CTD max depth (meters)
7 - Bottom Depth (Seabeam)

HLY0901_00101_VNG1	Mar 14 2009	03:27:49	62 00.98 N	175 04.26 W	74	79
HLY0901_00201_NWC5	Mar 14 2009	11:10:47	62 03.30 N	175 11.83 W	75	80
HLY0901_00301_NWC4	Mar 14 2009	21:12:33	62 22.84 N	174 32.15 W	68	71
HLY0901_00401_SWC3	Mar 15 2009	13:56:45	62 33.47 N	173 05.19 W	58	62
HLY0901_00501_NWC2.5A	Mar 16 2009	04:08:09	62 58.19 N	173 23.06 W	67	71
HLY0901_00601_DLN2	Mar 16 2009	16:54:11	63 16.66 N	173 44.22 W	69	74
HLY0901_00701_NWC2	Mar 17 2009	05:13:58	63 06.21 N	173 08.74 W	69	70
HLY0901_00801_NWC1	Mar 17 2009	16:16:03	63 29.19 N	172 19.01 W	45	50
HLY0901_00901_VNG3.5	Mar 18 2009	11:37:28	62 33.94 N	173 34.08 W	64	67
HLY0901_00902_VNG3.5	Mar 18 2009	12:35:55	62 33.78 N	173 33.56 W	64	67
HLY0901_01001_SIL2	Mar 19 2009	12:04:51	62 45.69 N	171 39.26 W	46	50
HLY0901_01101_SEC2	Mar 19 2009	18:43:07	62 35.38 N	170 57.72 W	42	45
HLY0901_01201_CD2	Mar 20 2009	05:23:14	62 31.78 N	172 07.29 W	46	51
HLY0901_01301_SEC1.5	Mar 20 2009	19:15:39	62 48.69 N	170 38.68 W	39	45
HLY0901_01401_NEC1	Mar 21 2009	03:20:20	62 45.46 N	169 35.17 W	38	42
HLY0901_01501_SEC1	Mar 21 2009	09:22:44	62 59.18 N	170 15.97 W	37	40
HLY0901_01601_SIL1	Mar 21 2009	14:33:25	63 05.97 N	171 17.71 W	45	47
HLY0901_01701_JGR3	Mar 21 2009	18:08:48	63 09.57 N	170 56.45 W	34	40
HLY0901_01801_WAL7	Mar 22 2009	03:55:10	62 44.58 N	169 18.95 W	35	38
HLY0901_01901_WAL8	Mar 22 2009	08:42:59	62 37.62 N	169 38.16 W	35	40
HLY0901_02001_WAL9	Mar 22 2009	12:49:01	62 40.07 N	169 08.38 W	33	40
HLY0901_02101_MK1	Mar 22 2009	18:16:36	62 43.68 N	168 57.04 W	37	40
HLY0901_02201_WAL10	Mar 23 2009	02:24:01	62 31.27 N	168 58.21 W	29	33
HLY0901_02301_WAL11	Mar 23 2009	11:38:40	62 15.31 N	169 38.25 W	36	40
HLY0901_02401_WAL12	Mar 24 2009	02:28:33	62 04.02 N	169 16.33 W	36	40
HLY0901_02501_XSL1	Mar 24 2009	09:59:14	62 04.37 N	169 45.69 W	39	40
HLY0901_02601_XSL2	Mar 24 2009	12:06:50	62 04.05 N	170 15.11 W	43	45
HLY0901_02701_NEC3	Mar 24 2009	15:14:59	62 04.03 N	170 37.26 W	45	50
HLY0901_02801_XSL3	Mar 24 2009	17:30:28	62 02.77 N	171 07.10 W	47	50
HLY0901_02901_SLP1	Mar 24 2009	21:30:47	62 22.42 N	170 22.23 W	36	41
HLY0901_03001_SLP1A	Mar 25 2009	00:38:45	62 29.60 N	170 28.90 W	37	40
HLY0901_03101_SLP2	Mar 25 2009	03:13:56	62 37.83 N	170 30.10 W	38	42
HLY0901_03201_SLP3	Mar 25 2009	05:16:15	62 52.18 N	170 38.02 W	38	43
HLY0901_03301_JGR3	Mar 25 2009	08:31:59	63 09.33 N	170 55.05 W	33	40
HLY0901_03401_SEC1	Mar 25 2009	11:09:51	62 58.63 N	170 16.18 W	33	40
HLY0901_03501_NEC1	Mar 25 2009	14:02:20	62 45.24 N	169 35.35 W	38	40
HLY0901_03601_MK1B	Mar 25 2009	17:48:22	62 43.48 N	169 01.00 W	32	36
HLY0901_03701_WAL113	Mar 26 2009	18:28:23	62 51.54 N	169 00.98 W	28	35
HLY0901_03801_SEC1.5	Mar 27 2009	03:37:42	62 48.64 N	170 38.89 W	40	43
HLY0901_03901_SIL2.5	Mar 27 2009	08:16:09	62 37.93 N	171 59.45 W	46	50
HLY0901_04001_CD1	Mar 27 2009	15:46:13	62 40.57 N	173 22.30 W	62	70
HLY0901_04101_NWC3	Mar 27 2009	21:42:38	62 45.61 N	173 48.93 W	66	72
HLY0901_04201_POP4	Mar 28 2009	10:33:15	62 23.29 N	172 41.97 W	54	60
HLY0901_04301_SWC4A	Mar 28 2009	17:16:51	62 14.36 N	173 44.47 W	58	60

Cruise report Healy 09-01 Benthic and rosette sampling

Jackie Grebmeier and Lee Cooper, University of Maryland Center for Environmental Science

The core sampling at each station included water sampling from the CTD deployment for inorganic nutrients, $^{18}O/^{16}O$ ratios, and water column chlorophyll. Typically nutrients and samples for $^{18}O/^{16}O$ ratios were collected at three depths (near surface, mid-depth, and bottom water) based upon observations that the water column was well mixed as a result of sea ice formation and resulting mixing from brine injection. Chlorophyll was measured typically at 6 depths, with filtering on the ship of 250mL water at measured depths through Whatman GF/F filters, flash freezing to fracture cell membranes on the filter surface and incubation in the dark at 4°C for 24 hours prior to measurement on a Turner Designs AU-40 without acidification (Welschmeyer method). Samples were also collected at selected stations for Ray Sambrotto's research group for urea and these were left onboard in the walk-in freezer. Nutrient samples were also left onboard in the walk-in freezer for analysis during HLY 09-02 by the nutrient analysis team (not aboard for HLY 09-01).

Benthic sediments collections included measurement of sediment characteristics of in-faunal populations through deployment of multiple van Veen grabs. An initial van Veen grab was deployed to allow for the collection of surface sediments from the screened top of the van Veen grab before it was opened. These sediments were collected for total organic carbon, sediment chlorophyll, and several other independent sediment analyses (see reports from Gemery, Morata, Gradinger). Four additional van Veen grabs were collected for quantitative studies of infaunal benthic communities by sieving through 1-mm stainless steel screen and preservation of recovered organisms in buffered formalin.

At selected stations, a HAPS corer was used to obtain undisturbed cores from the sea floor for use in shipboard respiration incubations undertaken to simulate seafloor exchange conditions between the sediments and overlying seawater. Comparisons were also made of oxygen respiration and nutrient exchange rates between sediments and the overlying water column at manipulated temperatures. More details on these incubations are provided in the Ceballos (Boynton) report.

Additional specifics on the collections made are documented in the following table.

Table 2. Samples collected during Healy 09-01 to support benthic studies and water column collections.

Station #	Station Name	Nutrients collected	Urea samples	Urea from cores	depths sampled-chlorophyll	sediment chlorophyll	O-18 samples	1total organic carbon	in-faunal grabs	cores collected
1	VNG1	3	1	4	9	2	3	1	4	2
2	NWC5	3	1	3	12	2	3	1	4	2
3	NWC4	3	4	4	12	2	3	1	4	2
4	SWC3	3	1	3	7	2	3	1	4	2
5	NWC2	3	4	3	6	2	3	1	4	2
6	DLN2	3	4	4	8	2	3	1	4	2
7	NWC2	3		4	6	2	3	1	4	2
8	NWC1	3	4		5	2	3	1	4	
9	VNG3.5	3	3	4	7	2	3	1	4	2
10	SIL2	3			6	2	3	1	4	
11	SEC2	3			5	2	3	1	4	
12	CD2	3	3		6	2	3	1	4	
13	SEC1.5	3	3		5	2	3	1	4	
14	NEC1	3	3		5	2	3	1	4	
15	SEC1	3			5	2	3	1	4	
16	SIL1	3			6	2	3	1	4	
17	JGR3	3	3		5	2	3			
18	WAL7	3	3		6	2	3	1	4	
19	WAL8	3			6	2	3	1	4	
20	WAL9	3			5	2	3	1	4	
21	MK1	3	3		6	2	3	1	4	
22	WAL10	3	3		5	2	3	1	4	
23	WAL11	3	3		5	2	3	1	4	
24	WAL12	3			6	2	3	1	4	
25	XSL1	4			6		4			
26	XSL2	3			5	2	3	1		
27	NEC3	3			6		3			
28	XSL3	3			6		3			
28	SLP1	3			6	2	3	1	4	
29	SLP1A	3			6	2	3	1	4	
30	SLP2	3			6		3			
31	SLP3	3			6	2	3	1	4	
32	JGR3	3			5		3			
33	SEC1	3			5		3			

34	NEC1	3			6		3			
35	MK1B	3			5		3			
36	WAL13	3			6	2	3	1	4	
38	SEC1.5	3			7		3			
39	SIL2.5	3			7	2	3	1	4	
40	CD1	3			7	2	3	1	4	
41	NWC3	3			7	2	3	1	4	
42	POP4	3			6	2	3	1	4	

Cruise Report HLY0901 - March 10-31, 2009 – Reported by Maria AC Ceballos, UMCES CBL

The Effects of Temperature and Carbon Addition on Arctic Sediment Oxygen and Nutrient Exchanges

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Project Summary

During the past several decades much has been learned about the effects benthic processes have on nutrient cycling and production in marine ecosystems. In general, the relative importance of sediment processes such as oxygen consumption and net nutrient releases on water column and sediment metabolism is inversely related to water depth and proportional, often in complex ways, to organic matter supply rates. However, at cold temperatures there is evidence of increased rates of sediment metabolism at deeper depths with increased delivery of labile organic matter (phytoplankton derived carbon). It is also clear that benthic metabolism rates are sensitive to temperature with substantial increases in rates observed with relatively small increases in temperature.

We hypothesize that with increased water temperatures, Arctic sediments will be subject to changes in benthic metabolism from both increased organic matter input (carbon additions) and increased temperature. Temperature and organic matter supply induced changes in benthic-pelagic coupling could have large effects on both macro and micronutrient cycling and thus productivity in this region.

The research objectives of this project are to address the following questions:

- What are the rates of sediment-water exchanges of oxygen, nitrogen, phosphorus, and silica at selected stations in the Bering Sea?
- How are the above rates affected by changes in water temperature?
- How are the above rates correlated to sediment properties such as chlorophyll-*a*, particulate carbon, nitrogen and phosphorus and benthic organisms?
- How are the above rates affected by enhanced additions of phytoplankton derived carbon?
- How do the above rates compare to rates measured in temperate ecosystems?
- How do the rates we measure utilizing the “mini-SONE technique” compare with Dr.

Grebmeier's rates and methods?

Experiments were conducted on board the USCGC Healy as part of the BEST and BSIERP project. Concurrent sediment cores were collected with Dr. Grebmeier and incubated for 24 hours in temperature controlled shipboard facilities under both ambient and experimental (elevated temperature) conditions, 3˚C. Time series flux measurements were made of dissolved oxygen, NH4+, NO3-, PO4+ and silica, using standard "mini-SONE" core incubation methods. Ambient site condition samples were taken for water column DIN, DIP and silica.

Our mini-SONE technique utilizes high frequency measurements of dissolved oxygen that will be useful in comparison to Dr. Grebmeier's mini-Winkler dissolved oxygen measurements (initial and final DO concentrations). We expect to find strong agreement between the two methods and that will lead to an effective and rigorous technique we can use in a collaborative field program investigating large spatial and seasonal patterns of benthic sediment processes in the Bering Sea.

Preliminary Results

Preliminary results indicate that rates of sediment oxygen demand (SOD) are in the range of rates measured previously by Dr. Grebmeier and others in these areas. Rates ranged from 0.2 to 0.6 g O_2 m^{-2} day^{-1} with higher rates in the cores incubated at higher temperatures. Nutrients were frozen and will be analyzed by the Nutrient Analytical Services Lab at UMCES-Chesapeake Biological Lab.

Arctic Paleoclimatology and Sea Ice History: Application of Ostracode and benthic foraminifera (Laura Gemery, USGS)

Background: During the past few decades Arctic temperatures has increased rapidly while annual and seasonal sea ice extent has decreased, leading to greater coastal erosion, changes in terrestrial and marine ecosystems and habitats, decreasing permafrost, greater export of freshwater, among other trends. Decreases in sea ice extent and thickness, especially during summer months, has even outpaced the rate that climate models had predicted due to anthropogenic greenhouse gas forcing (GHG). However there is considerable disagreement among climate models as the to rate of sea ice decline and eventual disappearance of summer sea ice in the Arctic. For example, some of the latest modeling results suggest summer sea ice will be mostly melted by the year 2037 (Wang and Overland, in press, Geophys. Res. Letters).

However, Arctic sea ice and climate are influenced by several factors in addition to direct radiative forcing from GHGs over various timescales. For example, decadal internal climate variability associated with the Arctic Oscillation and North Atlantic Oscillation modes of variability influences wind, atmospheric circulation and sea ice thickness. The influx of freshwater from large Siberian rivers also alters sea ice patterns and Arctic surface ocean circulation. The strength of warm Atlantic layer water inflow, which in governed by global-ocean meridional overturning circulation, flows into and across the Arctic at 100- 500 meters water depth, and also affects sea ice conditions from below. Despite the importance of these and other factors, there is very little known about the spatial and temporal sea ice history in key parts of the Arctic Ocean during past periods of climatic change, except for a few low-resolution paleoceanographic records from sediment cores. Such uncertainty applies also to Arctic-subarctic regions such as the Bering Sea in terms of the past history of seasonal sea ice. As a consequence, there is minimal baseline information about how fast, when and why sea-ice can decline or disappear or what the impacts might be on polar ecosystems.

USGS Project Arctic Paleoclimatology and Sea ice History

Objectives: This USGS project will investigate the paleoceanographic and climatic history of the Arctic Ocean and surrounding seas during the last 40,000 years including periods of rapid warming (~ 11,500 years ago following the Younger Dryas cooling), the early Holocene “hypsithermal period (~9000-6000 years ago), and progressive cooling during the Neoglacial period (late Holocene, the last 5000 years). The Neoglacial interval includes the Little Ice Age (1500-1900 AD) and Medieval Warm Periods (600-1500 AD, also called the Medieval Climate Anomaly, a key period in the understanding of human-induced climate warming.

Work will be carried out in conjunction with USGS colleagues conducting paleoclimate studies in Alaska and the Yukon Basin and colleagues outside the USGS in various US and international groups involved with past and future Arctic Ocean expeditions by the Polarstern, Polar Sea, Healy, Oden and other ships. For paleoceanographic reconstruction, we will use radiocarbon dated sediment cores from the Lomonosov, Mendeleyev, Northwind and Gakkel Ridges, the Chukchi Margin, the Yermak Plateau, Morris Jesup Rise and possibly the Bering Sea. Several proxy methods will be used to reconstruct bottom and surface circulation, temperature and sea ice conditions, and these will be used in climate modeling studies to evaluate causes and mechanisms. The most important proxies of climate in polar regions include magnesium/calcium, strontium/calcium ratios in CaCO3 shells of ostracodes, stable isotopes in ostracodes and foraminifers, faunal/floral analyses, and possible alkenones and other organic biomarkers. The three potential microfossil sea-ice indicators are *Neogloboquadrina pachyderma* left-coiling (planktic foraminifer that lives in, under, or near sea ice), *Acetabulastoma arcticum* (an epipelagic ostracode species that lives commensally in amphipods), and dinoflatellate cysts of species tolerant of various degrees of sea ice cover. Indirect proxies of sea ice include various benthic foraminifers and ostracodes that live under sea-ice or sea-ice free regions whose ecology is tied to surface ocean productivity.

All proxy methods rely on careful calibration of the proxy measured to the physical parameter to be reconstructed, such as sea-surface temperature or sea-ice coverage. Calibration of microfossil species might involve a relationship between species abundance and months of sea ice coverage, or surface ocean productivity. Geochemical proxies might carry signals of surface ocean circulation or the presence of dinoflagellate biomarkers unique to of sea-ice dwelling species. Individual species of ostracodes and foraminifers are also useful to reconstruct bottom water temperature, salinity and circulation due to their unique ecology in polar marine climates.

Calibration is usually carried out with material collected on cruises that recover surface sediment in coretops, multicores, grab sample and, sediment collected from sea ice, and to a lesser extent, laboratory experiments. Consequently, collection of modern [living] material for proxy calibration is one of the most important aspects of paleoceanography, providing the basic tools for application to reconstruction of past patterns from sediment cores dated by radiocarbon dating and other methods.

Healy 0901 Cruise.

Objectives. The Healy 0901 cruise to the central Bering Sea affords an opportunity to collect material for calibration of a number of potential proxies in the Bering Sea itself and also in the Arctic Ocean proper. Our main objective is to survey the ostracode and benthic foraminiferal assemblages of the Northern Bering Sea during the winter season. Table 1 lists the specific collection station sites for these studies. Faunal analyses for ostracodes and benthic foraminifers will be carried out by Laura Gemery, Dr. Thomas Cronin, USGS, Reston, and Dr. Elizabeth Brouwers, USGS Denver.
Collections from this cruise are probably the first winter season foraminifera and ostracode collections, so, in addition to their value in proxy calibration, they can also serve as a baseline for future work as climatic conditions and Bering Sea ecosystems change over the next few decades. They can also be compared to modern collections from past and future Healy cruises taken during different times of the year to analyze seasonal and interannual variability in benthic meiofauna.

Surface samples.

For the Healy 0901 grab and 0-1 cm MUC surface samples, we will establish ostracode biogeographic affinities by comparing Bering Sea species to assemblages we have already studied from the Arctic [Chukchi and Beaufort Seas], and western and eastern North Pacific areas, including the Gulf of Alaska. Dr. Brouwers of USGS has studied marine ostracodes around Alaska for 30 years, but not from this part of the Bering Sea.

The grab and MUC surface samples also have a small possibility of containing *Neogloboquadrina pachyderma* [planktic foraminifera] and *Acetabulastoma* shells that died and sank from the surface ocean. This would not be expected in shallow shelf regions but if any specimens are found it would be valuable to learn more about the geography and ecology of *Acetabulastoma* as a possible Arctic system sea ice proxy and *N. pachyderm* for stable isotopic and trace element shell chemistry.

Multicores: 0 to 10 cm stratigraphy.

Samples about 1-cm thickness will be examined for both living ostracodes and for subfossil assemblages that lived over the past few decades to centuries. It might be possible to detect temporal changes during the past few decades to centuries, depending on the sedimentation rate at the MUC sites and whether lead-210 or cesium-137 dating is carried out.

Preliminary Shipboard Results.

In a preliminary examination of two grab samples at least 4 ostracodes species were found. Two of these - *Acanthocythereis* cf. *A. dunelmensis* (Figure 1.) and *Sarsicytheridea macrolaminata* – are typical Arctic species found through northern hemisphere polar seas and tolerant of water temperatures below 8-10 C and typically lower. Preliminary Mg/Ca analyses have been carried out on *Sarsicytheridea* in the 1990s and oxygen isotope analyses in the last 5 years. So these samples may be excellent for improved calibration studies.

Figure 1. Acanthocythereis found in washed sediment, Station 07_NWC2 (63 06.21 N, 173 08.74 W) Photo by Dr. Andrew Trites

The bottom grab samples also contained a large number of the benthic foraminifera *Elphidium*. *Elphidium* is a ubiquitous genus especially common in high latitudes of the northern hemisphere. Certain species of *Elphidium* have been used in paleoenvironmental reconstruction but in the last few years extensive study of its shell chemistry [stable isotopes and Mg/Ca ratios} have made this genus an important proxy for shallow marine paleoceanography.

Two dirty ice samples were collected for Dr. Dennis Darby (Old Dominion University), Drs Claude Hillaire-Marcel and Anne de Vernal (University of Quebec). This ice-rafted sediment has the potential to contain fauna [such as *N. pachyderma*, *Acetabulastoma*] and will be analyzed for geochemical proxies [including biomarkers for dinoflagellates] used in paleoceanographic studies in the Arctic. Although many prior Arctic cruises have recovered dirty sea ice, there is very little data on sea ice proxies from the Bering Sea.

Table. Collection stations

HLY0901_00101_VNG1	1	62 00.98 N	175 04.26 W	79	x					
HLY0901_00301_NWC4	3	62 22.84 N	174 32.15 W	71	x					
HLY0901_00401_SWC3	4	62 33.47 N	173 05.19 W	62	x				x	
HLY0901_00601_DLN2	6	63 16.66 N	173 44.22 W	74	x				x	
HLY0901_00701_NWC2	7	63 06.21 N	173 08.74 W	70	x				x	x
HLY0901_01301_sec15	13	62 48.69 N	170 38.68 W	45	x				x	
HLY0901_01401_NEC1	14	62 45.46 N	169 35.17 W	42	x					
HLY0901_01801_WAL7	18	62 44.58 N	169 18.95 W	38	x					
HLY0901_02201_WAL10	22	62 31.27 N	168 58.21 W	33	x					
HLY0901_02901_SLP1.	29	62 22.42 N	170 22.23 W	41	x					
HLY0901_03001_SLP1A	30	62 29.60 N	170 28.90 W	40	x					
HLY0901_00101_VNG1	1	62 00.98 N	175 04.26 W	79		x	0-10cm			
HLY0901_00301_NWC4	3 (1)	62 22.84 N	174 32.15 W	71		x	0-8cm			
HLY0901_00301_NWC4	3 (2)	62 22.84 N	174 32.15 W	71		x	0-10cm			
HLY0901_00501_NWC25A	5	62 58.19 N	173 23.06 W	71		x	0-16cm			
HLY0901_00601_DLN2	6	63 16.66 N	173 44.22 W	74		x	0-11cm			
HLY0901_00901_VNG35	9	62 33.94 N	173 34.08 W	67		x	0-10cm		x	x
HLY0901_02101_MK1	21	62 43.68 N	168 57.04 W	40				x		
HLY0901_03601_MK1B	36	62 43.48 N	169 01.00 W	36				x		

Sedimentary biomarkers

Nathalie Morata

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Water and sediment were collected at 24 stations for biomarkers study (Table 3). Sedimentary biomarkers can be used as good indicators of variations in pelagic-benthic coupling. The biomarkers chosen for this study are sedimentary chlorophyll *a* (chl-*a*), diatoms and lipids (fatty acids). Sedimentary chl-*a* is an indicator of deposit of fresh phytodetritus to the seafloor. Sedimentary diatoms can come from water column phytoplankton or ice, and are thus an indicator of ice vs. water column inputs of diatoms in the sediment. Fatty acids are major components in phytoplankton and zooplankton, and are indicators of freshly biosynthesized autochthonous material

Table 3: List of samples collected at each station

Station	Water POM 5 or 10 m	Sedimentary lipids Depth (cm)	Sedimentary diatoms 0-1 cm	Sedimentary chl *a* Depth (cm)
1	√	0-10	√	0-7
3	√	0-10	√	0-10
4	√	0-10	√	0-7
5	√	0-16	√	0-10
6	√	0-11	√	0-8
7	√	0-10	√	0-10
8	√	0-8	√	0-6
9	√	0-10	√	0-9
10	√	0-8	√	0-5
11	√	0-6	√	0-6
12	√	0-6	√	0-4
13	√	0-4	√	0-3
14	√	0-4	√	0-3
15	√	0-8	√	0-5
16	√	0-10	√	0-6
18	√	0-7	√	0-4
19	√	0-4	√	0-3
21	√	0-7	√	0-5
22	√	0-7	√	0-4
23	√	0-7	√	0-4
24	√	0-7	√	0-4
26	√	0-9	√	0-6
29	√	0-7	√	0-6

1. POM At each station, 200 to 400 ml of surface water (5 or 10m) was filtered onto pre-ashed GFF filters. The filters were immediately frozen at -80°C for future lipids analysis.

2. Sedimentary lipids Sediment cores (Figure 1) were sliced per centimeter, and frozen at 80°C for future lipid analysis.

Figure 1 :
Picture of a core

3. Sedimentary diatoms Surface sediment was collected with a syringe. The top 1st cm was preserved in formalin for future diatom frustules analysis. The study of the diatom frustules allow differentiating diatoms from phytoplanktonic origin and from ice-associated origin.

4. Sedimentary chlorophyll a Profiles of sedimentary chl-a contents were performed as deep as possible (minimum 4 cm, maximum 10 cm, Figure 2).

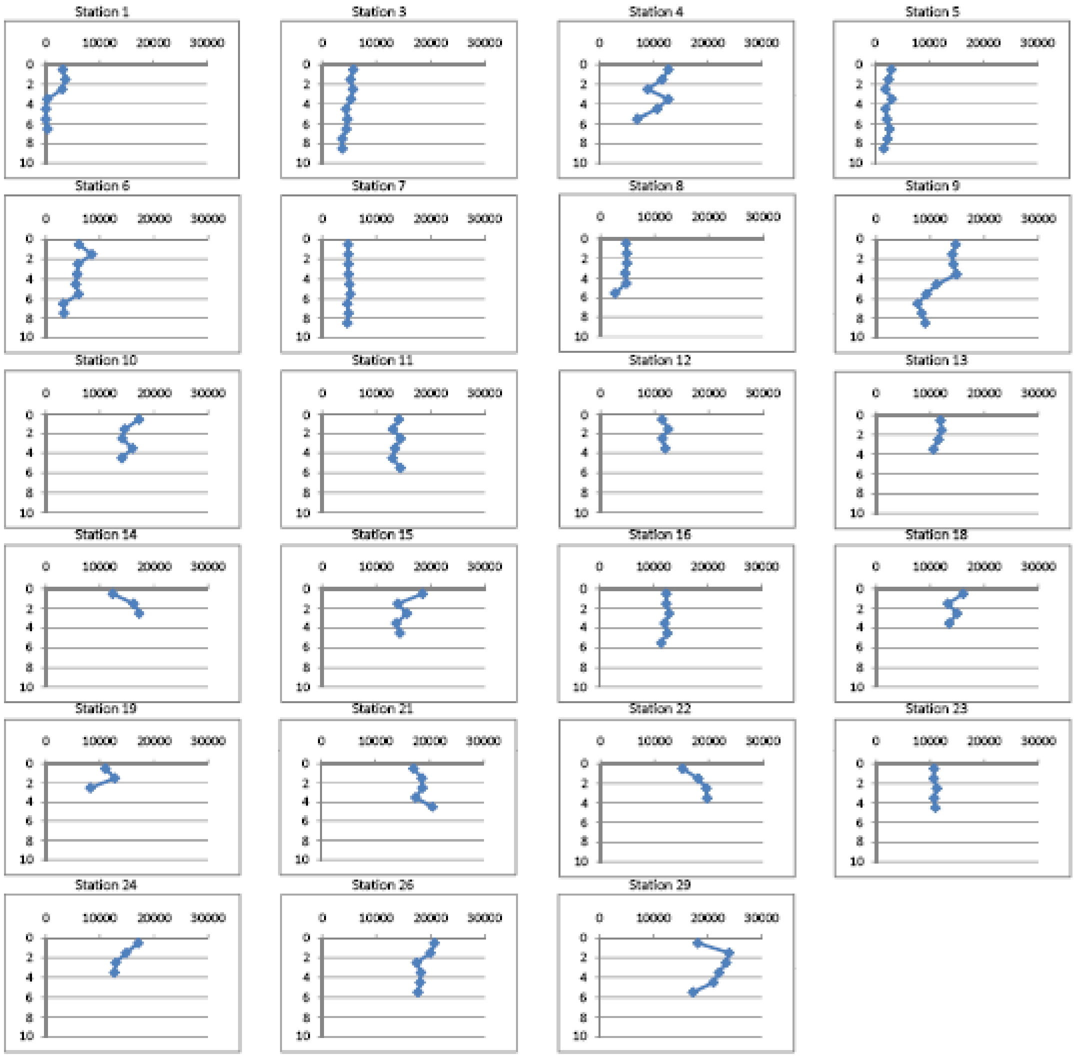

Figure 2: Sedimentary chlorophyll a profiles (in µg/m2 per cm)

HLY09-01 Walrus Radio-tagging Summary

Tony Fischbach and Chad Jay, Alaska Science Center, US Geological Survey

With support from the North Pacific Research Board and National Science Foundation, USGS attached satellite radio-tags to 17 walruses (9 males, 8 females) in the region of the St. Lawrence Island polynya. The purpose of the tagging is to determine where walruses forage relative to the distribution of their benthic prey and conditions of sea ice. The radio-tags will provide estimates of walrus locations and hourly walrus foraging and haulout status information for 6 to 8 weeks.

The USCG Healy reached the first sampling station on 14 March. Observers flew 17.6 hours of helicopter reconnaissance flights on 11 different days to locate walrus herds for tagging (Table 4, Fig. 1). Radio-tags were deployed on walruses on 7 different days in areas on the west and east of the polynya.

In addition to deploying radio-tags, biopsy samples were collected from 12 walruses for a population genetics archive and to verify the sex of tagged animals. Also, 69 scat samples were collected from the surface of ice floes to determine prey species ingested by walruses from DNA analysis of the scat. The Healy departed the study area on about 29 March to transit to Dutch Harbor.

Table 4. Summary of walrus flights, March 2009.

Day	Flight time / # flights	Region	Walrus Biology
14	2.2 h / 1 flight	South Western SLIP	Recon
15	5.1 h / 3 flights	Western SLIP	Radio tagged 2 walruses
16	3.2 h / 2 flights	Western & NW SLIP	Radio tagged 4 walruses
17	1.0 h / 1 flight	Western SLIP	Radio tagged 4 walruses
18	0.9 h / 1 flight	Western SLIP	Radio tagged 3 walruses
19	3.0 h/ 1 flight	Central SLIP	Recon
20	1.0 h / 1 flight	Eastern SLIP	Radio tagged 1 walruses
21	0.9 h / 1 flight	Eastern SLIP	Radio tagged 1 walruses
22	2.7 h / 2 flights	North Eastern SLIP	Recon
23	1.9 h / 1 flight	South Eastern SLIP	Radio tagged 2 walruses
24	No flights: WX		
25	No flights: WX		
26	No flights: WX		
27	3.0 h / 2 flights	South Western SLIP	Recon

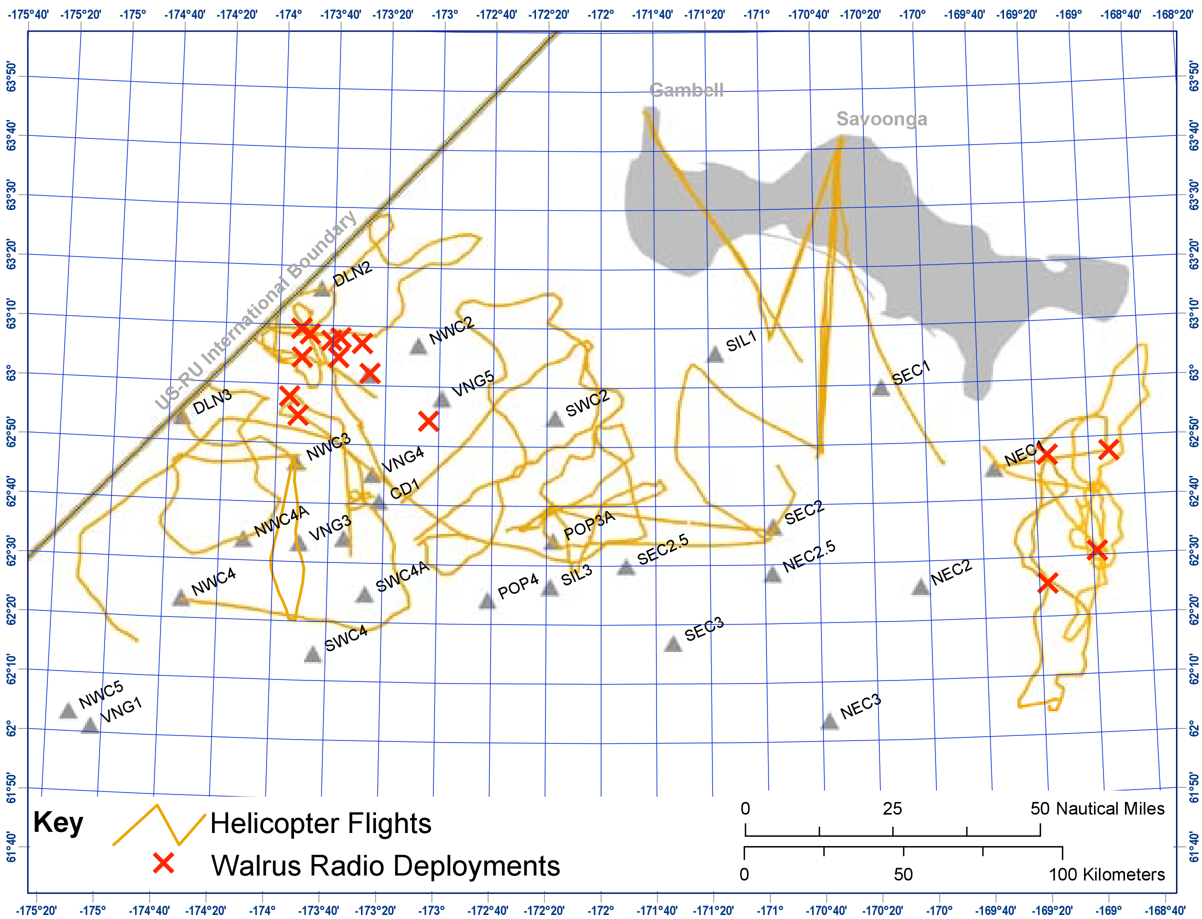

Figure 1. Walrus and spectacled eider reconnaissance and crew transit flights within the St. Lawrence Island polynya, March 2008.

Cruise report:

Relevance of sea ice derived organic matter for pelagic and benthic herbivores
(Gradinger, McConnell, Weeds)

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. During Healy0801 we collected sea ice (7 station), plankton (10 stations) and benthic (10 stations) samples(Table 5).

Table 5: Overview of sampling events

Date	Station	Sea ice samping	Under-ice CTD	Plankton	Benthos
3/13/09	VNG1			X	X
3/14/09	NWC4			X	X
3/16/09	NWC2.5	X	Pump frozen	X	X
3/17/09	NWC1	X	X	X	X
3/18/09	VNG3.5			X	X
3/19/09	SEC2	X	X	X	X
3/22/09	MK1	X	X	X	X
3/23/09	WAL12	X	X	X	X
3/25/09	MK1B	X	X	X	X
3/27/09	NWC3	X	X	X	X

Under-ice CTD

Under-ice CTD measurements were conducted with a Seabird 19plus equipped with additional PAR and algal fluorescence sensors. The instrument was deployed at all ice stations.
The under-ice CTD measurements (Fig. 1) showed a well mixed and homogenous water column structure with the exception of increased bottom water salinities and close to the ice water interface, likely due to brine drainage from growing sea ice. Freezing conditions within the CTD pump systems caused problems at the first station.

Sea ice sampling

Ice cores for algal pigment, species composition and stable isotope ratios were collected at seven stations. Ice thickness varied between 56 and 101 cm. Ice cores were sectioned into 1 to 10cm long sections and melted in the dark. After complete melt, samples were filtered onto GF/F filters and frozen (-80deg C) for further analysis in the home lab..

Plankton and Benthos sampling

Plankton samples were collected with Bongo net (mesh size) at 10 stations. For benthos, three van Veen grabs were sieved at 10 stations. After collection, samples were sorted alive and dominant taxa were frozen for later stable isotope analysis at UAF.

Stable isotope turnover experiment

Stable isotope turnover in the benthic bivalve *Nuculana radiata* is determined in feeding and starvation experiments. At station HLY0901-09 VNG3.5, 350 clams were obtained from van Veen grabs and distributed into individual containers. Animals are subjected to three experimental treatments: enriched 13C and 15N feed, non-enriched feed and starvation. These experiments will continue through HLY0902 with the addition of a pilot euphausiid study following the same design.

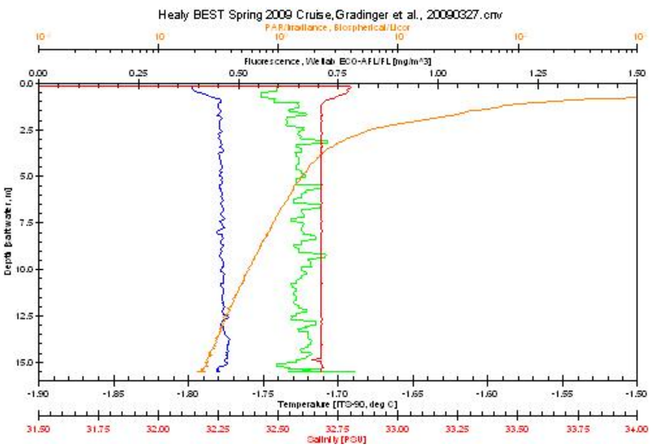

Fig 1:Example for under-ice CTD measurements from ice station on 27 March 2009.

Diets, body condition, prey communities, and population numbers of Spectacled Eiders

James R. Lovvorn

Locating Spectacled Eiders was greatly facilitated during this cruise by the fact that about 35 eiders carried satellite transmitters deployed by Matt Sexson and Margaret Petersen of USGS last summer. Most satellite-tagged eiders stayed within the same radius of about 20 mi during our cruise, as they had through the entire winter. This spatial association among flocks is similar to that observed in previous years when the eiders have been located (1996, 1997, 1998, 1999, 2001, 2008). These observations continue to indicate that aerial surveys of a general area encompassing the main concentration of eiders yield reliable population estimates, and that ice conditions, bird diets, and benthic prey sampled locally reflect conditions experienced by much of the wintering population.

On 19 March 2009, we collected 42 Spectacled Eiders, including 24 adult males, 14 adult females, 2 juvenile males, and 2 juvenile females. Cloacal swabs were taken from all these birds and will be sent to Tuula Hollmen of the Alaska SeaLife Center to be analyzed for viruses and other diseases. Subcutaneous fat samples were also taken for fatty acid analyses. The birds were then frozen for later processing on campus. Collected eiders will be used for studies of plumage development; diet; metal and selenium levels in pectoral muscle, kidney, and liver; stable isotope and fatty acid biomarkers; and levels of total body fat and protein.

In 2009, the collection site for all eiders (62.52º N, –172.12º W) was named station CD2; results will be compared to data for eiders collected on the same date (19 March) in 2001 at station CD1 (62.67º N, –173.36º W). In 2009, benthic invertebrates in the area of eider locations were sampled at stations CD2, SIL2, and SIL2.5, and in the area where eiders had been collected in 2001 at CD1 and VNG3.5. SIL2, CD1, and VNG3.5 were also sampled in 2001, when stations were sampled more comprehensively throughout the study area. Comparison of diets and body condition of eiders relative to prey availability at collection areas in 2001 vs. 2009 should yield insights into the breadth of prey types used by eiders, and effects of prey type and abundance on their physiological condition.

Initial impressions are that the general area used by the eiders in 2009 differed substantially in community structure and abundance of prey from the area used in 2001. In 2001, the local prey community was dominated by bivalves, and the eiders collected were eating almost entirely the most abundant bivalve, *Nuculana radiata*; benthic biomass in that area was very high. In 2009, the area used by eiders appeared to have lower prey availability, and especially much lower density of bivalves at some local stations. Samples at the collection site in 2009 (CD2) contained very few bivalves but abundant polychaetes, whereas nearby SIL2 had low abundance of all taxa. However, SIL2.5, still within the cloud of eider satellite locations, had rather high abundance of bivalves. Perhaps eiders can find localized sites with higher prey abundance, despite low overall biomass in the area. Better mapping of potential prey, based on more comprehensive benthic sampling in 2001, 2006, and 2007, should reveal more detailed patterns of regional differences in prey availability between the main wintering areas in 2001 and 2009.

The diet samples are key to knowing what prey are acceptable to eiders, so that the quantity and quality of foraging habitat can be characterized and mapped. Because the eiders were collected when flying among leads in the ice and not when feeding per se, most will probably contain no food so that sample sizes for diet will be unavoidably low. Because all eiders were collected on a single day, the time for processing them was limited. Thus, they were frozen for later processing and diet samples will be removed at that time.

Satellite radio-locations were also very helpful in designing a fixed-wing census of Spectacled Eiders, whose world population winters entirely within our study area. This survey began on 28 March 2009 with a Commander aircraft based in Nome. The population has not been censused since 1998, when the estimate was 370,000 birds. Of this total, about 90% nest along the Russian Arctic coast. Federal listing of this species as Threatened in 1993 was based mainly on a decline from 48,000 to 2,000 pairs in the Yukon-Kuskokwim Delta between the early 1970s and early 1990s. That population is now only 5% of the world population, which was first counted in 1996 after the wintering area was discovered in 1995.

Sea Ice Observations HLY0901

Rolf Gradinger, Brenna McConnell, Jared Weems

Between March 13 to March 30 2009 on HLY0801, sea ice observations have been made from the Healy bridge (05 deck) at 77 sites (Figs. 1-3, Table 6). The bridge is ~60 ft above sea level and has a maximum of ~9.8 miles of visibility. Sea ice observations were taken during daylight hours while the ship was in transit. Observations were made several times per day, depending on ship's progress and day light conditions. For each observation with sufficient light, digital pictures were added to the observational log. All data have been submitted to the Healy's observational data archive and will be forwarded to the BEST data archive.

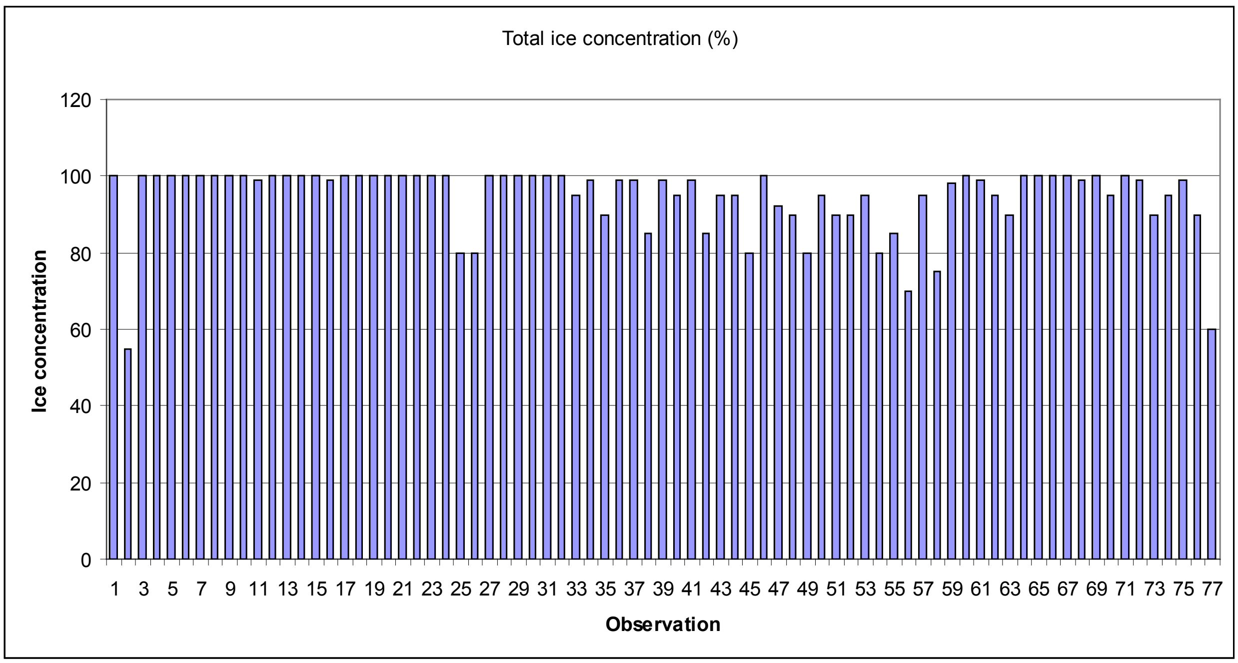

Fig. 1: Ice concentration in the study area, listed in the number of observation

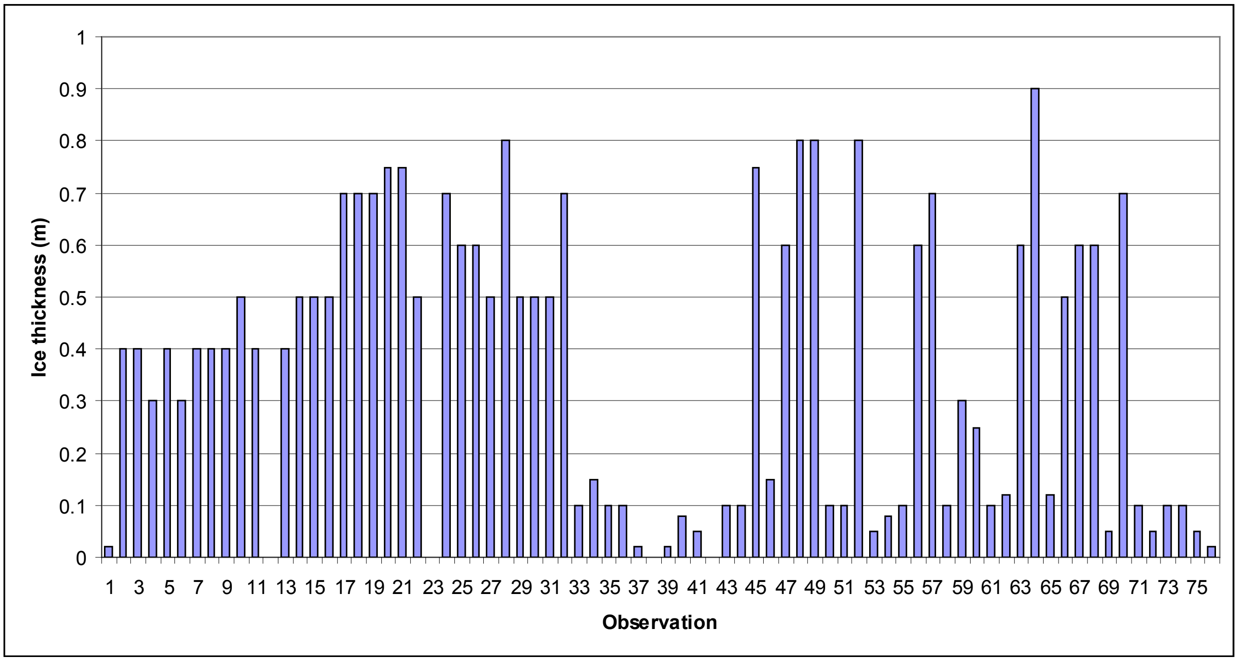

Fig. 2: Ice thickness of the dominant sea ice class – thin ice areas reflect observations in regions with new ice formation (mainly nilas) south of St. Lawrence Island.

Figure 3. Example ice observation photograph from the bridge.

Table 6: Sea ice observations done during the HLY0901

Start Time	Start Lat	Start Lon	Air Temperature(C)	Total ice concentration (%)
3/13/2009 23:48	01:35.8	-175:03.73881	-9.48	100
3/13/2009 20:18	00:46.5	-174:59.22317	-5.74	55
3/14/2009 20:08	02:23.1	-174:33.15742	-16.41	100
3/14/2009 17:11	02:11.1	-174:56.47826	-15.97	100
3/14/2009 17:46	02:13.5	-174:52.01117	-16.63	100
3/14/2009 16:14	02:06.3	-175:05.91715	-15.3	100
3/14/2009 2:50	02:01.6	-175:03.18032	-10.77	100
3/14/2009 19:18	02:19.5	-174:41.01004	-16.23	100
3/15/2009 21:47	02:33.0	-173:06.17348	-19.69	100
3/15/2009 3:29	02:23.2	-174:32.56056	-14.88	100
3/15/2009 4:25	02:24.9	-174:22.71481	-15.45	99
3/15/2009 5:02	02:26.3	-174:16.86052	-15.59	100
3/15/2009 16:34	02:34.0	-173:06.09879	-22.15	100
3/16/2009 16:08	03:14.7	-173:42.63440	-21.32	100
3/16/2009 2:20	02:48.9	-173:18.90606	-18.73	100
3/16/2009 4:10	02:58.2	-173:23.09506	-18.82	99
3/17/2009 16:52	03:28.6	-172:18.72021	-18.88	100
3/17/2009 3:50	03:06.9	-173:06.26100	-16.11	100
3/17/2009 5:31	03:06.1	-173:08.85405	-16.69	100
3/17/2009 1:46	03:11.8	-173:27.18605	-16.68	100
3/18/2009 19:23	02:30.8	-173:31.63800	-19.91	100
3/18/2009 4:05	03:06.7	-172:51.10007	-15.48	100
3/18/2009 20:42	02:30.8	-173:16.71814	-19.14	100
3/18/2009 18:14	02:31.3	-173:31.70875	-20.7	100
3/18/2009 1:49	03:15.6	-172:24.85586	-15.47	80
3/18/2009 0:34	03:21.5	-172:11.42998	-16.07	80
3/18/2009 5:25	03:02.6	-172:57.45411	-16.85	100
3/19/2009 3:41	02:36.8	-172:27.85959	-14.91	100
3/19/2009 17:19	02:36.0	-170:57.29550	-15.16	100
3/19/2009 0:29	02:34.9	-172:48.39664	-15.41	100
3/19/2009 5:15	02:37.7	-172:23.36086	-15.86	100
3/19/2009 2:48	02:35.7	-172:30.39559	-15.04	100
3/20/2009 17:19	02:46.8	-170:55.85454	-17.61	95
3/20/2009 18:57	02:49.2	-170:38.45679	-17.25	99
3/20/2009 1:05	02:33.0	-171:14.62509	-14.25	90
3/20/2009 23:33	02:48.7	-170:36.23951	-16.56	99
3/21/2009 23:14	03:02.6	-170:40.45572	-13.07	99
3/21/2009 1:17	02:46.9	-170:01.89173	-16.41	85
3/21/2009 18:10	03:09.6	-170:56.43902	-13.41	99
3/21/2009 17:14	03:09.4	-170:58.89883	-13.43	95
3/22/2009 0:39	02:54.8	-170:14.00487	-14.5	99
3/22/2009 1:21	02:52.0	-169:59.23346	-14.53	85

HLY0901
Final cruise report
Marjorie Brooks, Ph.D.

UV effects with climate change on the Bering Sea
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My research focuses on how UV radiation could affect primary production first because of a longer exposure period as the number of ice-free days increases and by UV alteration of the spectral qualities of the water column. Colored dissolved organic matter (CDOM) secreted by phytoplankton and zooplankton absorbs UV and deceases its penetration depth. However, when CDOM absorbs UV, the radiation can destroy a fraction of the organics, converting them to inorganic CO_2 and CO as well as alter their chemical composition—"photo bleaching" CDOM so that it absorbs less UV, causing greater penetration into the depths of the water column. To evaluate how much CDOM exists during this time of year, I collected optical readings of four UV wavelengths and integrated photosynthetically active radiation (PAR, 400-700 nm) with depth. To determine how exposure to ambient light conditions alters the amount of CDOM, I conducted incubations of seawater collected from surface waters and from the mid-water column. Surface waters likely contain higher concentrations of CDOM derived from ice-associated biota, whereas, CDOM at middle depths is probably less, particularly during this time of year. Thus, the water samples from middle depths provide contrasting conditions, potentially consistent with ice-free conditions in winter that are expected due to global warming.
I collected light profiles from 26 stations (Table 7). Using waters from two depths collected at 6 stations, I conducted time-series incubations of waters for 0, 24, 48, and 72 h sealed in quartz hungate tubes submersed in a continuous flow system on the bow (Fig. 1). An integrated measure of the UV dose received during each incubation was determined using polysulfone dosimetry. On return to my laboratory, I will analyze water samples for photochemical changes in CDOM, UV-visible spectra (280 to 700 nm), and dissolved organic carbon concentrations. Previous results from HLY0702 showed that photoreactivity of CDOM correlated strongly with chlorophyll α concentration.

Table 7. Record of stations for UV light profiles and water incubations. UV wavelengths were 305, 320, 340, 380. An intergrated measure of photosynthetically active radiation (PAR; 400 to 700 nm) was also collected. Water samples for incubations were collected from surface (5-10 m below surface) and middle water column (~30 m).

Station	UV profiles	Incubations of water samples
NEC 5	√	
SEC 5	√	
SIL 5	√	
NWC 5	√	
DLN 5	√	
VNG 1	√	
NWC4	√	√
SWC 3	√	
NWC 2.5A	√	√
DLN 2	√	√
NWC 1	√	√
SEC 2	√	√
CD 2	√	√
SEC 1.5	√	
SEC 1	√	
JGR 3	√	
WAL 7	√	
MK 1	√	
WAL 10	√	
WAL 12	√	
SLP 1	√	
SLP 2	√	
MK 1B	√	
CD 1	√	
NWC 3	√	
SWC 4A	√	

Figure 1. Incubation of quartz tubes for assessing photochemical changes in seawater samples. Time series exposures were 0, 24, 48, and 72 h. Waters from two sites were exposed for 96 h. Water temperatures in the flow-through system were maintained above freezing (2±1 °C Mean ±

Zooplankton work Healy 09-1 Best-Bsierp Cruise March 2009

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Vertical net hauls were done with a 0.5m 150 um bongo set up from 5 meters off the bottom to surface, except station ZOO3 which was done to 500 m in water 2334 m deep. Sample were preserved in 95% ethanol and 10% formalin. In all but the ZOO series of stations CTD casts were done in concert with net hauls. Back on shore these samples will be examined both taxonomically and for population genetics and phylogeny of the Calanus marshallae / Calanus glacialis species complex. Most of the hauls were done in and around the St. Lawrence Island Polyna. However three tows were made as Healy progressively crosses the Bering shelf heading south at the end of the trip. Preliminary observation suggest that there are a relatively large number of female *C. glacialis* in the area of the polyna which is hundreds of miles from the deep (100m +) Bering Sea water. Further work on the samples collected on this trip will help shed light on the question as to whether these individuals have over wintered on the shelf or in deeper Bering waters (or possibly a combination of these two life history strategies).

USCGC Healy - HLY0901 -Zooplankton log

CAST	STN	DATE (UTC)	UTC	LAT	LONG	Bottom
101	VNG1	Mar 14 2009	3:27:49	62 00.98 N	175 04.26 W	79
201	NWC5	Mar 14 2009	11:10:47	62 03.30 N	175 11.83 W	80
301	NWC4	Mar 14 2009	21:12:33	62 22.84 N	174 32.15 W	71
401	SWC3	Mar 15 2009	13:56:45	62 33.47 N	173 05.19 W	62
501		Mar 16 2009	4:08:09	62 58.19 N	173 23.06 W	71
601	DLN2	Mar 16 2009	16:54:11	63 16.66 N	173 44.22 W	74
701	NWC2	Mar 17 2009	5:13:58	63 06.21 N	173 08.74 W	70
801	NWC1	Mar 17 2009	16:16:03	63 29.19 N	172 19.01 W	50
901	VNG35	Mar 18 2009	11:37:28	62 33.94 N	173 34.08 W	67
1001	SIL2	Mar 19 2009	12:04:51	62 45.69 N	171 39.26 W	50
1101	SEC2	Mar 19 2009	18:43:07	62 35.38 N	170 57.72 W	45
1201	CD2	Mar 20 2009	5:23:14	62 31.78 N	172 07.29 W	51
1301	sec15	Mar 20 2009	19:15:39	62 48.69 N	170 38.68 W	45
1401	NEC1	Mar 21 2009	3:20:20	62 45.46 N	169 35.17 W	42
1501	sec1	Mar 21 2009	9:22:44	62 59.18 N	170 15.97 W	40
1601	SIL1	Mar 21 2009	14:33:25	63 05.97 N	171 17.71 W	47
1701	JGR3	Mar 21 2009	18:08:48	63 09.57 N	170 56.45 W	40
1801	WAL7	Mar 22 2009	3:55:10	62 44.58 N	169 18.95 W	38
1901	WAL8	Mar 22 2009	8:42:59	62 37.62 N	169 38.16 W	40
2101	MK1	Mar 22 2009	18:16:36	62 43.68 N	168 57.04 W	40
2201	WAL10	Mar 23 2009	2:24:01	62 31.27 N	168 58.21 W	33
2401	WAL12	Mar 24 2009	2:28:33	62 04.02 N	169 16.33 W	40
2601	XSL2	Mar 24 2009	12:06:50	62 04.05 N	170 15.11 W	45
2901	SLP1	Mar 24 2009	21:30:47	62 22.42 N	170 22.23 W	41
3001	SLP1A	Mar 25 2009	0:38:45	62 29.60 N	170 28.90 W	40
3201	SLP3	Mar 25 2009	5:16:15	62 52.18 N	170 38.02 W	43

3301	JGR3	Mar 25 2009	8:31:59	63 09.33 N	170 55.05 W	40
3601	MK1B	Mar 25 2009	17:48:22	62 43.48 N	169 01.00 W	36
3701	WAL113	Mar 26 2009	18:28:23	62 51.54 N	169 00.98 W	35
3901	SIL2.5	Mar 27 2009	8:16:09	62 37.93 N	171 59.45 W	50
4101	NWC3	Mar 27 2009	21:42:38	62 45.61 N	173 48.93 W	72
4301	SWC4A	Mar 28 2009	17:16:51	62 14.36 N	173 44.47 W	60
no ctd	ZOO1	Mar 29 2009	22:00:00	60 22.90 N	173 17.05 W	55
no ctd	ZOO2	Mar 29 2009	4:04:00	59 36.60 N	173 04.66 W	98
no ctd	ZOO3	Mar 30 2009	1:54:00	55 56.62 N	170 27.00	2334

Seabird and Marine Mammal Observations During HLY0901

Kathy Kuletz (Kathy_Kuletz@fws.gov), Ivan Kuletz, and Tom Van Pelt
Maps by Elizabeth Labunski
Migratory Bird Management, U.S. Fish and Wildlife Service, Anchorage, AK

Background

As part of the early spring BEST-BSIERP cruise we surveyed marine birds and mammals onboard the USCGC Healy. The surveys constitute the 'Seabird Broad-scale Distribution' component of the Bering Sea Integrated Ecosystem Research Program (BSIERP). This project will examine seabird and marine mammal distribution relative to oceanographic and biological features of the Bering Sea. Our goal is to examine the current influence of oceanographic and prey dynamics on the distribution and abundance of top predators. By using multiple years of data to examine seabird and mammal response to these variables, we aim to predict how changes in the Bering Sea ecosystem will alter the distribution of apex predators.

This project began in April 2008 and field work will continue through October 2010 on a variety of research vessels, primarily NSF-funded projects and NOAA fisheries research vessels. The project is funded by the North Pacific Research Board and U.S. Fish and Wildlife Service, and data will be submitted to the BSIERP database and will be archived in the North Pacific Pelagic Seabird Database (USFWS and USGS, Anchorage, Alaska).

For the HLY0901 cruise, we began our surveys on 11 March, the day after the Healy left Kodiak. We conducted surveys during daylight hours while the vessel was in transit. This report summarizes our results from March 11 – 26, but we will continue surveys until our arrival in Dutch Harbor on March 31.

Methods

We surveyed marine birds and mammals from the port side of the bridge using standard survey protocol during daylight hours while the vessel was underway. One primary 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. On occasion more than one observer assisted in observations, and we noted when this occurred. We used strip transect methodology with three distance bins extending from the vessel: 0-100 m, 101- 200 m, 201-300 m. Unusual sightings beyond the 300 m transect were also recorded for rare birds, large bird flocks, and mammals. We noted the animal's behavior (flying, on water, on ice). Birds on the water were counted continuously, whereas flying birds were recorded during quick 'Scans' of the transect window at approximately 1-min intervals, depending on the ship's speed. Because of low bird densities while in the ice, we also recorded birds in the air that were not observed during Scans; these were recorded as simply 'Flying' and future density estimates will apply correction factors for these observations.

We entered observations directly into a laptop computer using the DLOG2 program (Ford

Ecological Consultants, Inc.) with a GPS interface from the ship's system. For the first week of surveys, we relied on our hand-held Garmin GPS, which was adequate but less reliable than the direct feed from the ship's system. Location data from the GPS were automatically written to the program in 20 second intervals, as well as our entries on weather conditions, Beaufort Sea State, ice type and coverage, and glare conditions. At the beginning of each transect we recorded wind speed and direction, air temperature, and sea surface temperature. Data were exported into an Excel spreadsheet, edited for minor corrections, and summarized. We provide maps showing survey effort and distributions for a few key species.

Results and Discussion

During 11 – 26 March, we surveyed a total of approximately 1,390 km of transects, with 490 km surveyed before we reached ice, and about 900 km surveyed while in the ice (Fig. 1). We recorded a total of 945 birds belonging to 18 marine species and 3 non-marine species (Table 8). The majority of unidentified birds were murres (*Uria* spp.) which were difficult to identify to species (Common and Thick-billed) under certain conditions. Of the total birds, 803 were recorded as 'on transect' and will be used to calculate densities (birds • km^{-2}). We recorded 283 marine mammals of 6 species, of which 87 animals were on transect (Table 9).

Bird numbers were lower once we entered the ice, and species composition changed (Table 8). While in open water the most frequently encountered birds were common murres, northern fulmars, black-legged kittiwakes, and glaucous-winged gulls. Once we were in the ice, the most frequently encountered birds were spectacled eiders, glaucous gulls, black guillemots, and Kittlitz's murrelets. The murrelets were of particular interest because little is known about the winter ecology or distribution of this rare and declining species. We found Kittlitz's murrelets and unidentified *Brachyramphus* murrelets (likely Kittlitz's) primarily along the eastern edge of the polynya south of St. Lawrence Island (Fig. 2). The general habitat consisted of open leads (approximately 0.2 – 2 km wide) among Big Floe and mixed ice coverage. We actually had little survey effort over most of this region because of nighttime transits through the area, thus the numbers of Kittlitz's murrelets we observed could indicate significant use of the area during winter. This same region was also used by black guillemots (Fig. 3), another relatively rare seabird in the Bering Sea for which we have little data on winter habitat. The Kittlitz's murrelet and black guillemot were often found in the same open leads, suggesting use of similar habitats and possibly similar prey.

Marine mammals were more abundant once we entered the ice (Table 9). In open water we observed Dall's porpoise and killer whales, with bowhead whales observed as we entered the ice edge west of St. Matthew Island. Once in the ice, walrus dominated mammal observations, although we also observed bearded seals and spotted seals. Most of the mammal observations were "off transect" (> 300 m from the ship). In contrast to the previous two spring cruises, nearly all of the walrus and seals we observed were in the water, which made it difficult to identify seals. The largest walrus aggregations were found along the eastern edge of the St. Lawrence polynya, but they were also aggregated in several other areas and were observed throughout the St. Lawrence polynya (Fig. 4).

Table 8. Bird observations made on 11-26 March, 2009 during the HLY0901 cruise.

	Total observed, all bins			Total on Transect	
Species - common name	Days with No Ice	Days with Ice	Grand Total	Count	Percentage
Laysan Albatross	3		3	3	0.4
Northern Fulmar	163		163	163	20.3
Short-tailed Shearwater	1		1	1	0.1
Unidentified Shearwater	1		1	1	0.1
Pelagic Cormorant	3		3	3	0.4
Unidentified Cormorant	3		3	3	0.4
Spectacled Eider		90	90	41	5.1
Unidentified Eider		1	1	0	0.0
Glaucous Gull	7	21	28	19	2.4
Glaucous-winged Gull	38		38	38	4.7
Herring Gull	2		2	2	0.2
Mew Gull	1		1	1	0.1
Black-legged Kittiwake	34		34	34	4.2
Unidentified Gull	1	1	2	1	0.1
Common Murre	246	1	247	246	30.6
Thick-billed Murre	7		7	7	0.9
Unidentified Murre	205	4	209	164	20.4
Black Guillemot		38	38	30	3.7
Unidentified Guillemot		15	15	5	0.6
Marbled Murrelet	2		2	2	0.2
Kittlitz's Murrelet		23	23	17	2.1
Brachyramphus murrelet	2	5	7	7	0.9
Ancient Murrelet	2		2	2	0.2
Unidentified Murrelet	4	5	9	5	0.6
Crested Auklet	6		6	0	0.0
Horned Puffin	1		1	1	0.1
Unidentified Alcid	5		5	5	0.6
Unidentified bird	2	2	4	2	0.2
Total marine birds	739	206	945	803	100.0
Non-marine birds					
Bald Eagle	1		1	1	
Snowy Owl		1	1	0	
Common Raven		2	2	0	

!

Table 9. Marine mammal observations made on 11-26 March, 2009 during the HLY0901 cruise.

Species	Total observed, all bins: Days with No Ice	Days with Ice	Grand Total	Total on Transect: Count	Percentage
Dall's Porpoise	13	0	13	0	0.0
Killer Whale	5	0	5	1	1.1
Bowhead Whale	0	6	6	0	0.0
Unidentified Whale	5	0	5	0	0.0
Spotted Seal	0	4	4	4	4.6
Bearded Seal	0	9	9	5	5.7
Unidentified Seal	1	25	26	10	11.5
Pacific Walrus	0	207	207	64	73.6
Unidentified Pinniped	0	8	8	3	3.4
Total Mammals	24	259	283	87	100.0

Figure 1. Survey effort by the seabird and marine mammal observers during the first half of the HLY0901 cruise, 11-16 March 2009. Figures 2-4 show transect coverage through 26 March in the northern study area. Surveys were continued during transit to Dutch Harbor on 28-31 March (not shown).

Figure 2. Distribution of Kittlitz's murrelets during 11-26 March, 2009 on HLY0901.

Figure 3. Distribution of black guillemots during 11-26 March, 2009 on HLY0901.

Figure 4. Distribution of Pacific walrus during 11-26 March, 2009 on HLY0901.

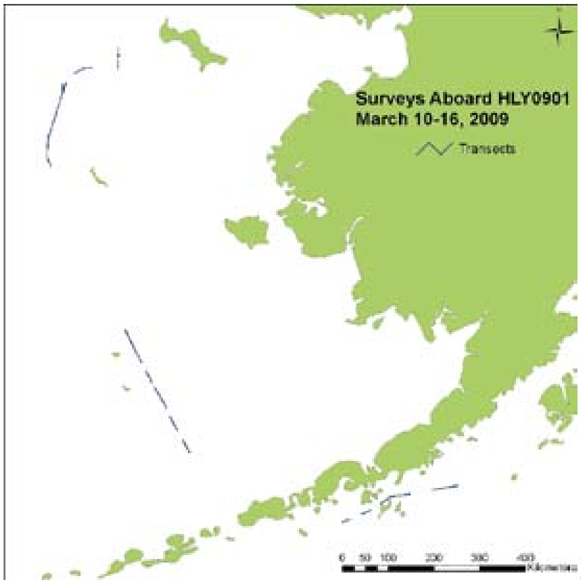


Figure 1

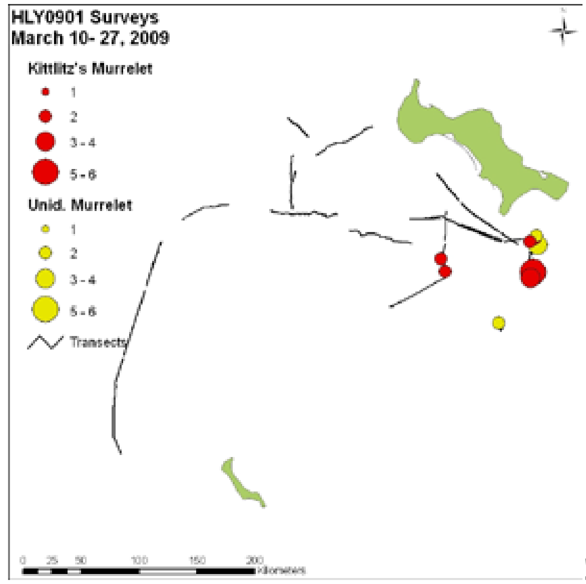


Figure 2

Figure 3

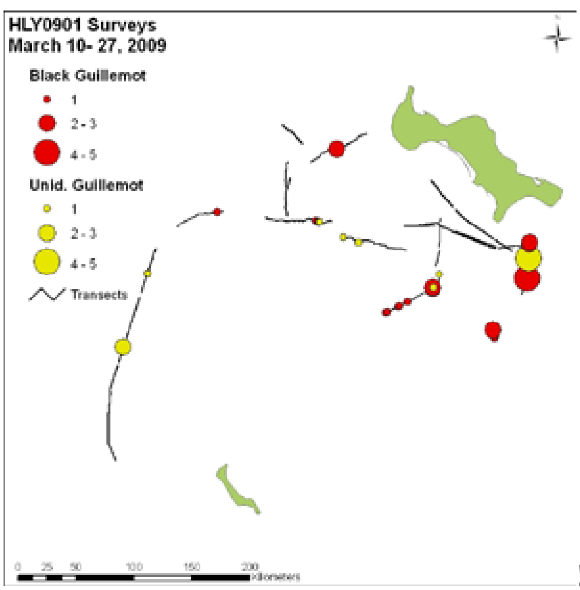
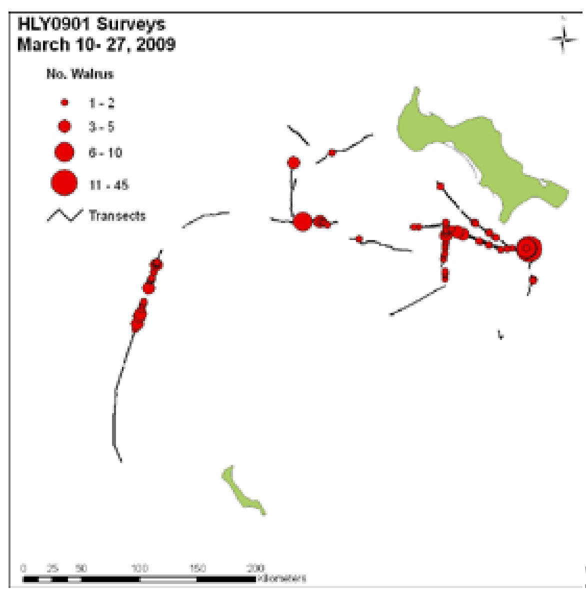


Figure 4



Summary of Optical Observation

(Jiuxin Shi and Hongli Fu, Ocean University of China, March 30, 2009)

A project of the Chinese International Polar Year Program, Optics under sea ice and heat absorption impacted by bioprocess, proposed by Dr. Jinping Zhao, Ocean University of China, was accepted as one of the participating projects of this cruise. Dr. Jiuxin Shi and Ph. D candidate Hongli Fu were invited by chief scientist to conduct the optical observation in this cruise.

Optical profiling

The instruments used for optical observation are high resolution Profiling Reflectance and Radiometer (PRR) made by Biospherical Instruments Inc. (BSI, USA). The system includes the units, PRR-800 (for upwelling radiance, downwelling irradiance) for underwater profiling and PRR-810 (for downwelling irradiance) for surface reference observation simultaneously. They are a multispectral system (313, 380, 412, 443, 490, 510, 520, 532, 555, 565, 589, 625, 665, 683, 710, 765, 780 and 875nm) to measure the change of sunlight in sea water.

Figure 1. The optical instruments. The left figure shows the surface unit PRR-810 fixed on the left side of stern. It was mounted on the right side of stern if the sunlight came from the starboard. The right figure shows the PRR-800 (right) and MCTD (left), which is mounted on the same frame for profiling. The frame is specially designed to keep the instruments' balance in water and not to shade the PRR-800. Two weight balls were fixed on the frame to increase the vertical stability of the underwater unit. Another weight cylinder (shown on right-up corner in the right figure) was hung on the frame with a gray rope for the same purpose.

The PRR-800 mounted on a frame was deployed by the winch from the stern, while the red cable linking the instrument and computer was sent out by hands. The data collection unit and computer were put in a container lab at stern deck. In most stations, PRR-800 was deployed to the depth of 2 m above the bottom at deployment speed of 0.5 m/s. When the sun was visible, PRR-800 was deployed always with the stern facing the sun.

Figure 2. The PRR-810 was deployed from stern by a winch (left figure) and the optical data were recorded in a laptop in a container lab (right figure) via a deck unit and cable connected with PRR-800 and PRR-810.

Optical profiling casts were conducted at all stations in daytime, from 9:00 to 21:00 in this cruise. Usually only one cast was arranged for a station. Additional cast was added at two stations when the weather, open water and sunlight were excellent for the deployment. Totally 24 casts at 22 stations were finished in this cruise as listed in Table 1 and shown in Fig. 3.

Table 1. Station information for optical measurement

#	Station	SN	Date UTC	Time UTC	Position		Deployment	
					Lat(N)	Lon(W)	Depth (m)	File name
1	VNG1	01	14	04:15	62 01.174	175 03.981	63	2009_03_14_0413.mdb
2	NWC4	03	14	21:45	62 21.968	174 30.592	50	2009_03_14_2144.mdb
3	SWC3	04	15	21:13	62 33.278	173 07.014	53	2009_03_15_2104.mdb
4	NWC2.5A	05	16	04:49	62 58.083	173 23.286	60	2009_03_16_0449.mdb
5	DLN2	06	16	22:05	63 16.009	173 42.214	66	2009_03_16_2202.mdb
6	NWC2	07	17	05:34	63 06.781	173 07.987	60	2009_03_17_0528.mdb
7	NWC1	08	18	00:10	63 20.763	172 13.484	66	2009_03_18_0009.mdb
8*	SEC2	11	19	19:09	62 35.020	170 58.261	38	2009_03_19_1900.mdb
9	SEC15	13	20	19:40	62 48.641	170 38.712	38	2009_03_20_1931.mdb
10	NEC1	14	21	03:39	62 45.510	169 34.621	36	2009_03_21_0334.mdb
11	JGR3	17	21	20:31	63 09.543	170 56.397	35	2009_03_21_2024.mdb

12	WAL7	18	22	04:13	62 44.580	169 18.950	34	2009_03_22_0407.mdb
13	MK1	21	22	19:56	62 41.429	168 58.109	38	2009_03_22_1956.mdb
14	WAL10	22	23	02:43	62 31.183	168 57.861	27	2009_03_23_0236.mdb
15*	WAL12	24	23	21:44	62 05.668	169 15.785	35	2009_03_23_2138.mdb
16	SLP1	29	24	22:13	62 22.858	170 23.040	36	009_03_24_2208.mdb
17	SLP1A	30	25	01:09	62 29.592	170 30.181	35	2009_03_25_0105.mdb
18	MK1B	36	25	18:52	62 42.446	169 01.372	33	2009_03_25_1845.mdb
19	WAL13	37	26	19:14	62 51.415	169 01.039	24	2009_03_26_1909.mdb
20	CD1	40	27	18:40	62 41.405	173 25.055	57	2009_03_27_1834.mdb
21	NWC3	41	28	00:54	62 47.423	173 52.765	70	2009_03_28_0044.mdb
22	SWC4A	43	28	18:56	62 14.362	173 44.411	55	2009_03_28_1856.mdb

*Two casts at Station SEC2 and WAL12.

The data seems perfect and reflects the optical status in this region. The optical data is benefit to understand the solar heating in the upper layer of the ocean and correlated to the climate system.

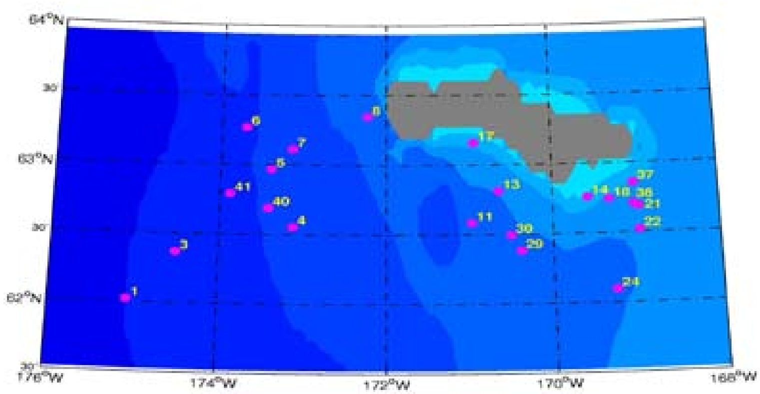


Figure 3. Stations of optical observation in cruise HLY0901.

The MCTD was mounted together with PRR-800 on the frame for the first 4 stations. Unfortunately, MCTD failed to work correctly under cold weather. Only the MCTD data at first station might be correct.

Airborne photographic observation for sea ice

Airborne photographic observation for sea ice and open water was also conducted in this cruise. Pictures were taken automatically with a digital camera mounted on the helicopter when it flied out for observations of walrus and eiders, as well as transferring of passengers between ship and St. Lawrence Island.

Canon PowerShot G10 digital camera was mounted on the helicopter to take pictures through the transparent floor of the helicopter. A laptop controlled the camera to take pictures every 6 (or10, 8) seconds and stored the pictures. A Garmin 72 GPS was mounted on the window of helicopter for recording latitude, longitude, altitude, etc in the time interval of 2 or 3 seconds. Before the flights, the camera, GPS and laptop were mounted on the helicopter and the system began to work.

Figure 4. The instruments and helicopter used for airborne photographic observation.

More than 15 thousands pictures were taken in 16 flights in this cruise. With the pictures taken at flight deck, sea ice and island deleted, about 9800 pictures of sea ice and open water were selected and stored finally.

Table 2 Information for airborne photographic observations

SN 1	Date UTC	Pictures				GPS			Laptop
		Start time	End time	Sum	TI(s)	Start time	End time	TI (s)	
2	15	18:41	20:45	744	10	18:41	20:45	2	Lenovo
3	16	18:23	20:15	366	8	18:23	22:50	2	Lenovo
4	17	00:24	00:33	80	8	00:24	00:32	2	Sony
5	18	18:24	18:46	181	8				Lenovo
6	19	01:49	04:09	916	8	01:49	04:11	2	Sony
7	19	18:35	19:14	399	8	18:35	19:14	2	Lenovo
8	20	21:07	22:43	824	6	21:07	23:36	2	Lenovo
9	20	22:59	01:34	729	6	21:07	23:36	2	Sony
10	21	02:56	04:59	420	6	02:56	04:44	2	Lenovo
11	21	17:16	20:20	1090	6	17:16	18:40	3	Sony
12	22	17:44	19:45	718	6	17:44	19:21	3	Lenovo
13	22	21:52	23:55	904	6	21:52	23:55	3	Sony
14	23	20:38	23:16	754	6	20:38	00:05	3	Lenovo
15	27	17:39	18:00	212	6	17:39	23:21	3	Lenovo
16	27	21:30	23:15	1045	6	17:39	23:21	3	Lenovo
17	28	02:23	03:07	438	6	02:23	03:07	3	Sony

* TI: Time Interval of record

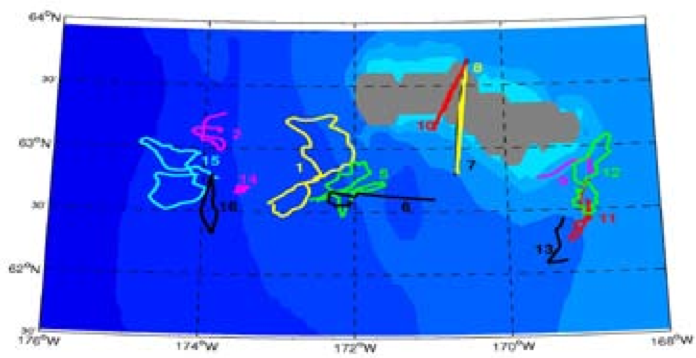


Figure 5 Flight tracks for airborne photographic observation in cruise HLY0901.

Many pictures could be merged together to present a continuous view of sea ice and leads along the flight track. The spatial resolution of the picture is about 0.5 m. These pictures provided images with fine structure of sea ice and leads, which will be used in verifying the satellite remote sensing data and numerical modeling results.

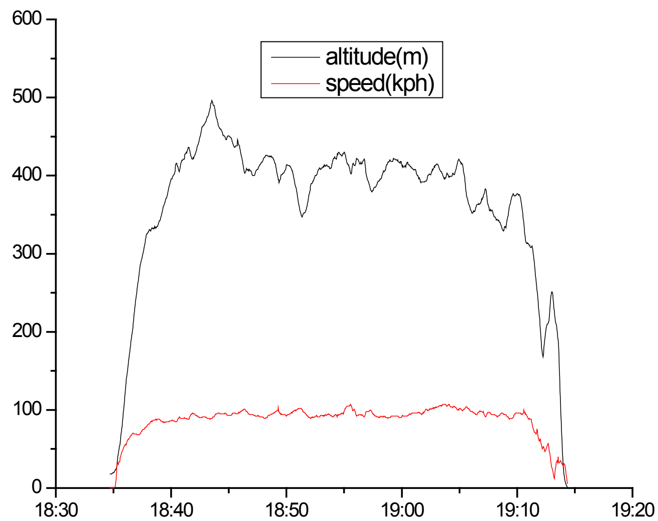


Figure 6 Altitude and speed of a flight for eider observation in Mach 19.

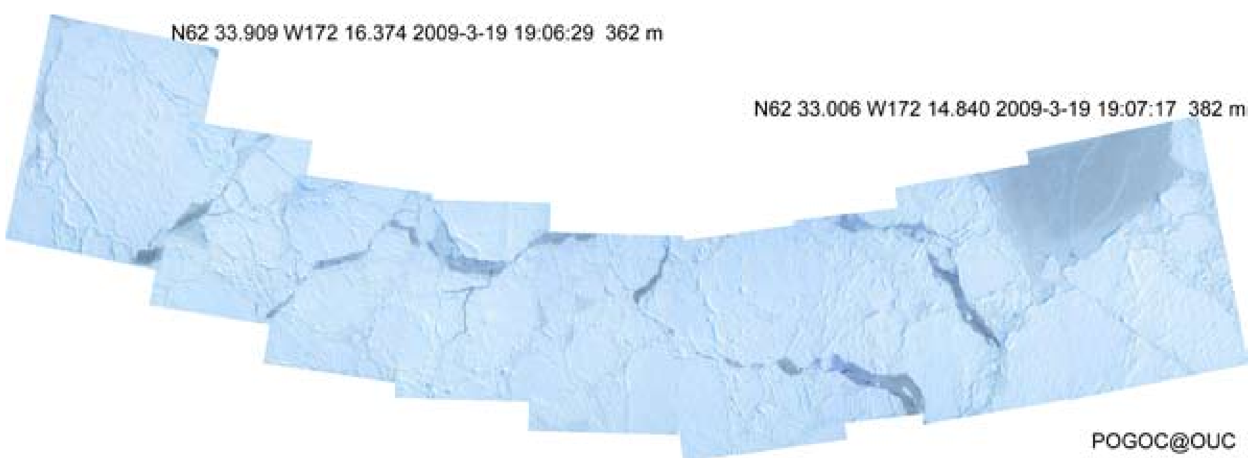


Figure 7 An example of merged pictures along flight track.

Deanna Wheeler Final Report

As a PolarTREC teacher, I was selected to participate in the Healy 09-01 cruise out of Kodiak, Alaska, from March 10-31, 2009. The selection process included an application review, interview, and matching lead scientists with teachers. P.I. Lee Cooper from University of Maryland Center for Environmental Sciences agreed to add this educational outreach opportunity to his research trip. This expedition is part of the Bering Sea Ecosystem Study (BEST) and the Bering Sea Integrated Ecosystem Research Program (BSEIRP).

Training for PolarTREC took place in Fairbanks from Feb 21-28. In the training, teachers learned how to manage communications in challenging geographical areas. Participating in the ongoing research is the primary goal of PolarTREC teachers with the secondary goal of public outreach.

Throughout the expedition, I was able to participate in the ongoing research either directly or indirectly as in the case of the walrus monitoring and some of the eider studies. Direct participation included work in the following areas: marine mammal observations, sea ice, benthos, plankton, optics, and eiders. The opportunity to spend extended amounts of time with each project area assists me with the secondary goal of public outreach.

Public outreach about the expedition started in February, 2009. Public outreach included email notifications with press releases to all environmental groups in Southern Maryland and Charles County area. The groups included area watershed groups, Sierra Club, The Nature Conservancy, Southern Maryland Audubon Society, and Maryland DNR. The Charles County Public Schools publicized the expedition in its newsletters with follow-up system-wide emails each week. The local paper, The Maryland Independent, has published three articles with a planned follow up after the expedition. ABC News scheduled a before trip interview which subsequently was cancelled. They interviewed and filmed me while aboard the ship. They plan a follow-up filming at J. C. Parks Elementary School after the completion of the trip. Other outreaches occurred with schools in Central Florida and Northeast Ohio, along with the schools of other PolarTREC teachers around the country. In addition, 13 classroom /workshop presentations were given.

The public outreach included the Charles County Commissioners who assisted in fostering a sister school/community relationship with the village of Savoonga on St. Lawrence Island. While on board, I was able to visit the school in Savoonga to meet with teachers and the principal to begin this exchange. After a presentation about the science on board of the Healy, we planned how to create this sister school exchange which included a visit to Maryland by the Savoonga principal.

On board the Healy, public outreach occurred via the Internet. The science aboard the ship was reported in journal form at www.polartrec.com. A similar version of the journals was posted on the ship's intranet. As of March 29, 2009, 25 journals are posted with include 192 photos and 10 videos. The PolarTREC website is visited by many people, schools, and Coast Guard families. On the website is an area where questions can be addressed. While aboard the ship, many students sent questions by email, also.

On March 25^{th} and 30^{th}, I participated in two Live at IPY events via the Internet. The first webinar included scientist from both Polar Regions. There were over 200 in attendance from schools all over the US. The second webinar was targeted for students in Charles County. Over 400 students attended. Scientists in the areas of ice, walrus, plankton, benthos, and eiders talked to the students along with Lead Scientist Dr. Cooper. They answered questions from the students for over 45 minutes.

Additional outreach programs scheduled for after the trip include visitations to schools and classrooms and two public presentations. Other opportunities to present will be scheduled in the future as well as collaborative events with J. C. Parks and Dr. Cooper.

A Summary of the LDEO Science Support Activities on HLY0801

Prepared by Tom Bolmer, Steve Roberts and Dale Chayes

Created: April 3, 2008

Updated: April 4, 2008

This is a brief summary of the performance of the Underway Science systems during the research cruise HLY0801 on the USCGC Healy, 03/13/08 – 03/26/08 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 HLY0801 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.

Knudsen 320BR Sub-Bottom Profiler

The Knudsen was run in the Low Frequency "CHIRP" (3.5 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.

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. The ping rate was slower than the ADCP 75 should optimally be run at due to the desire to not conflict 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")

Operated and monitored the EK60 for Alex De Robertis of NOAA. 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 behaviour 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.

Sea Water Flow Through data

Uncontaminated Sea Water

The Uncontaminated Sea Water was used on the Fantail to clean samples. It worked satisfactorily except for occasionally freezing in the hoses on deck.

Thermosalinographs

New primary and a spare TSGs were installed by SIO/ODF (Scott Hiller) was installed for this season in the Biochem Lab Only one system was run and recording data for this cruise. It appeared to operate satisfactorily.

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. The True directions were improperly calculated for most of the leg. These calculations were corrected on 03/22/08 at 10:12UTC.

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 were created and provided to the chief scientist.

Data QC

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

Terrascan

The Terrascan system was operated and available for science use on a separate laptop. Part way into the cruise the Air Force changed the broadcast of data from the DMSP satellite F17 from Encrypted to Unencrypted when inside the Fairbanks, Alaska station range circle. This now meant that all DMSP satellites had the same broadcast schedule. To improve coverage the Healy terascan system was reconfigured on March 23 from Encrypted to Unencrypted mode. Assisted Karen Frey with data processing and generation of sea ice imagery from this system.

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 form Aloft Conn was emailed to shore for use in a web site there.

Ice Observations

The same ice observations web form that was used for B.E.S.T 2007 was installed and configured to work with the new Healy underway sensors. This appeared to operate satisfactorily.

An-My Lê

March 30, 2009

Report

As a large format photographer who has been inspired by the early pioneering landscape photographers, I have long been interested in the role of the military in support of the quest for knowledge, exploration and discovery in the 19th century. The joint venture between NSF and the Coast Guard seems to be a contemporary version of this endeavor. I feel grateful to have been able to participate in 2 cruises aboard USCGC HEALY (the first one in July 2008 and this current one under the leadership of Lee Cooper).

During this spring cruise 2009, I photographed the ever-changing landscape of the Bering Sea, the many of the experiments performed on the ship and on the sea ice. Inspired by August Sander's portraiture project from the 1920s where Sander systematically photographed men and women from various professions and provided an extensive and captivating typology of individuals, I also launched into my own inventory of the HEALY crew and working scientists on board.

My project surveys the imperiled landscape and current predicament. It also provides a hopeful contemplation of the potential energizing role of the military as it joins forces with the scientific community and focuses on environmental crises.

I am looking forward to sharing the resulting photographs with everyone.

Thin Ice: An Exploration of the Bering Sea in the Age of Climate Change
An International Polar Year- 2007-2009 Education Project

PI: Thomas Litwin, Smith College Northampton, MA
Co-PI: Lawrence Hott, Florentine Films/Hott Productions
Collaborator: Tom Walker, photographer/writer, Denali Park, AK

Thin Ice is a multi-platform education project developed to engage and educate the public about the Bering Sea environment and its diverse cultures. With the Bering Sea as a natural laboratory, the project examines the broader implications of climate change for the region and its people. The regional and global implications of changing earth and ocean systems are overarching themes.

During the March 13-26, 2008 USCGC Healy 08-01 mission Litwin, Hott and cameraman David Lutz , filmed research and ship operations, and conducted interviews with researchers. In addition, the team filmed and interviewed subsistence hunters and community members in the Native villages of Gambell and Savoonga, St. Lawrence Island. The result is a four-part vodcast series, focuses on two connected Bering Sea stories – the Yupik people of St. Lawrence Island and the 2008-2009 USCGC Healy scientific expeditions in the Bering Sea. The vodcasts were premiered on the ship for the 2009 Healy 09-01 scientific party and USCGC crew. The series, *On Thin Ice in the Bering Sea,* is being hosted by WGBH Boston's *NOVA*, as part of their Extreme Ice programming and can be seen on line at http://www.pbs.org/wgbh/nova/extremeice/.

The focus of participation in the 2009 Healy mission was continued research for the Thin Ice book and web site, as well producing real-time materials for the IPY Polar Ocean Days. Polar Ocean Days, March 18-26, 2009, was an International Polar Year (IPY) global community education event focused on the role of polar oceans in the functioning of the earth's climate. *Thin Ice's* Polar Ocean Days contributions focused on the Healy mission, the Bering Sea ecosystem, and the researchers studying it. Seven units were produced and posted during the event, featuring 8 scientists who participated in the 2008 and 2009 missions. The units were: 1) *Rendezvous In Kodiak* (Mar 17, 2009), an introduction to the Healy mission, 2) *Into the Bering Sea, Into the Ice* (March 18, 2009), featuring Chief Scientists Lee Cooper and Jackie Grebmeier, 3) *On Station* (March 20, 2009) featuring NOAA researcher Sue Moore and bowhead whales, 4) *More Than Frozen Water* (March 22, 2009), featuring Karen Frey, Arctic System Scientist, 5) *Ice Deployment, Best Laid Plans* (March 23, 2009), featuring Rolf Gradinger, Polar Marine Ecologist, 6) *Contrasts, Helicopter Operations, and Eiders* (March 23, 2009), featuring Jim Lovvorn, Ecologist, and spectacled eider, and 7) *Two Worlds, One Walrus* (March 26, 2009), featuring walrus biologists Chad Jay and Tony Fischbach, and the people of Gambell, St. Lawrence island.

For the complete set of reports and profiles see: *www.ipy.org/index.php?/ipy/detail/on_thin_ice_in_the_bering_sea/*

We thank the Charles & Natalie Webster Trust, North Pacific Research Board, National Science Foundation, and U.S. Coast Guard for their support of the project. We also thank Andrew Trites, Tony Fischbach, Kathy Kuletz, and Erika Engelhaupt for contributing photographs. With special thanks to Lee Cooper for his deep commitment to science education and outreach.

Examples of other outreach and education efforts from the HLY 09-01 cruise follow

Healy Cruise 0901

March 10-31, 2009

March 30: Heading home

Tom Van Pelt, aboard Healy, near Unalaska Island

We finished work at the last of about 40 scientific stations on 27 March and turned south, breaking heavy ice and moving slowly. The scientists got busy packing away all of the equipment in the labs, clearing room for the next cruise (HLY0902) which follows this one.

By Sunday, we were abreast of St. Matthew Island (right) and had left the heaviest ice behind. See larger image

We were still breaking ice in an area that had been totally ice-free on our way north, three short weeks ago -- illustrating how dynamic the ice cover can be in the northern Bering Sea. But by dawn on Monday morning, we were moving through big patches of open water, and by midmorning we had left the ice entirely.

Open ocean felt delightfully liberating after 17 days of breaking ice. The silence of our movement, slipping through the water at a speedy 16 knots, was almost startling, and the southerly swell gave the ship an unfamiliar but gentle up-and-down motion beneath our feet.

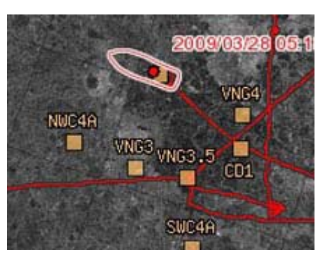
IMPORTANCE OF THE BENTHIC ZONE

In earlier logbook entries, I've mentioned the important work done by the scientists on board who are studying the seafloor, or the "benthic zone." Why is their work important?

First, think about the seafloor as the marine "bottom line." All of the abundant life in the sea eventually dies and falls to the seabed. Any organic material that isn't consumed on its way down winds up in the benthic zone. The shallow continental shelf of the Bering Sea, which is only around 60m deep, features an exceptionally rich benthic zone. But how does the benthic zone function? What are the linkages between the benthic zone, the water column above it, and the ice? How do changing ice conditions affect it?

Second, we know that the seafloor in our study area support populations of predators that are of great interest to Native Alaskans and others in the region. The Pacific walrus and the spectacled eider, described earlier, depend heavily on the benthic zone for feeding. But how does this dependence operate -- what biological characteristics combine to make good seafloor feeding habitat for walrus and eiders? How do changing ice conditions affect those characteristics?

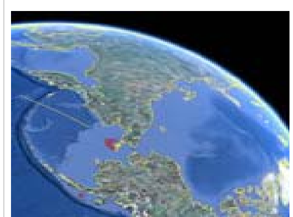
SEAFLOOR SCIENCE STATIONS



To tackle those important questions, the cruise has been organized around **a series of scientific "stations" (right)** where we collect samples. These stations are virtual points on the seafloor that **Lee Cooper, Jackie Grebmeier,** and others have been visiting in the context

EARLIER LOGBOOK ENTRIES

GOOGLE EARTH



Logbook entries from the March-April cruise are available for download into Google Earth. Fly to the Bering Sea to see where it all happened. Download the logbook file and open in Google Earth

YOUR CORRESPONDENTS

Tom Van Pelt, NPRB, was on board as a scientist and Bering Sea Project program manager. All photos by Tom Van Pelt unless noted otherwise.

Francis Wiese, NPRB, was on board 17-21 March as a scientist and media liaison.

Deanna Wheeler, PolarTREC teacher-on-board, blogged for her students.

of various research programs for more than two decades.

One of the challenges for biologists working on ecosystem-wide questions is the enormous spatial scale that's part of our work. **By visiting the same point on the seafloor in different years, using GPS to position the ship, we ensure that any changes we see in the ecology at that spot over time are real.**

TEAM BENTHOS

The benthic team is a 24/7 operation, led by **Lee Cooper** and also by **Jackie Grebmeier** while she was aboard the ship during the cruise's first ten days. The full team consists of:

- Linton Beaven, Maria Ceballos, Marisa Guarinello, Krista Hoff, and Regan Simpson (University of Maryland Center for Environmental Science)
- Cynthia Yeung (NOAA Alaska Fisheries Science Center)
- Laura Gemery (USGS)
- Nathalie Morata (University of Tromsø)
- The ship's team of USCG Marine Science Technicians, who work with the bridge crew to position the ship, operate the hydraulics, and oversee the whole operation.

OTHER DUTIES AS ASSIGNED

On Friday I pulled on an orange flotation suit, steel-toed boots and a hardhat, and assisted the benthic team. **The main tool for their work is the "van Veen grab" (below).** This is a clamshell-style shovel that is weighted with lead bricks and lowered to the seafloor with its jaws held open.

As the grab touches the seafloor, the lock holding it open releases. When the command is given to reel it in, the cable tightens and pulls the jaws together. The jaws dig down into the seafloor a foot or so before they snap shut and the grab pops free of the bottom. A minute or so later, the grab breaks the surface of the water and we swing it aboard (left).

MASKED AND MUDDY

Team Benthos is a tough bunch, dealing with seawater and mud day and night, with air temperatures in the single or minus digits and with often with a hard wind blowing that makes their working area on the aft deck feel much colder. Everyone wears facemasks against the biting cold. The van Veen grab swings overhead; waiting hands guide it down onto a wooden frame over a wide, galvanized bucket. We open the jaws, releasing the dense, rich mud of the seafloor (right).

Time for the big soup spoons (right) -- not for lunch, but to scoop out all the mud from the grab. We also rinse the grab, using cold seawater piped through a chronically-freezing hose. Errant seawater hits the deck, hardening into slippery ice within seconds.

Next two people join in to carry the bucket over to a rack of strainers. The fine mesh of the strainers retains all of the animals living in the mud. It’s a cold job rinsing all of the mud away.

Finally the mud is gone and we have a quantitative sample of the animals living in and on the seafloor (left).

Repeat this process six or seven times, add in deployment of a couple other sampling systems (HAPS corer, multi-HAPS, bongo nets, optics and UV sensors ...), and you have a full station's worth of science!

WHAT DOES IT ALL MEAN?

Healy 0901 has been a great success:

- > 40 benthic stations and > 7 ice stations completed
- 17 walrus tags deployed

- notable spectacled eider concentrations located and sampled
- > 1,400 km of transects surveyed for seabirds and marine mammals

This first cruise of the 2009 field season for the BEST-BSIERP Bering Sea Project aims to "connect the dots" between cruise components as I've described here. It also aims to connect with subsequent cruises and other pieces of the integrated Bering Sea Project, aiming to address the overarching question that shapes the Bering Sea Project: how does seasonal ice influence the ecology of the Bering Sea, and how will changes in sea ice affect the Bering Sea?

UP NEXT

When the Healy reaches Dutch Harbor, a new team will board the ship, ready for Healy cruise 0902, led by Chief Scientist **Carin Ashjian** and scheduled to start on 3 April**.** Healy 0902 will cover a broader study area, focused on the whole eastern Bering Sea shelf region, and will use a wide variety of tools to investigate the Bering Sea as it transitions from its winter ice-covered state to the spring phase, with no ice cover and with blooming phytoplankton populations.

Check out more about their work in **Carin's logbook** and at **WHOI Polar Discovery.**

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March 25: Strong winds and ice algae

Tom Van Pelt, aboard Healy, southeast of St. Lawrence Island

Yesterday the north winds kicked up even more, building to a steady 40 knots. Winds that exceed 30 knots or so ground the helicopter, so the walrus team had no chance to go to work today.

Chief Scientist **Lee Cooper** worked with the *Healy*'s officers to find a suitable ice floe for safe deployment of the on-ice team, led by **Rolf Gradinger**. Rolf and his colleagues, including **Katrin Iken** and **Bodil Bluhm,** together with graduate students Brenna McConnell and Jared Weeds, study ice algae and their relevance in the Bering Sea ecosystem.

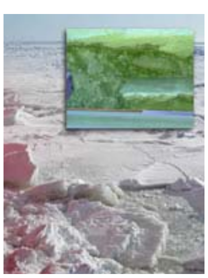
BACKING AND RAMMING

As we crunch and crash our way through the Bering Sea ice, from time to time our progress is halted by ice that is too strong for us to break. Sometimes we back up and change course in response, but most of the time we simply "back and ram." The ship backs up a length or two, then gathers speed through the broken channel to smash into the stubborn ice with tremendous momentum, driven by 20,000 horsepower accelerating hundreds of tons of steel forward. **Above (left):** Healy ramming sea ice *(Rolf Gradinger)*. **Above (right):** algae grows on the underside of sea ice. *(Francis Wiese)*

Healy ramming sea ice

One of the crew members compared Healy ramming ice at 8 knots to "1,600 Toyota Camrys hitting a wall at 60mph."

While we're backing up, the overturned ice chunks sometimes show a distinct brownish-green color, revealing ice algae. These algae are specialized phytoplankton adapted to grow within the spaces between ice crystals on the underside of sea ice.



AT HOME IN THE ICE

On first glance, this seems like one of the more minor but fascinating details of complex ecosystems. But in fact, **ice algae can be extremely important components of high-latitude marine ecology.**

Converting nutrients and sunlight into growth, phytoplankton forms the foundation of marine life. In ice-covered waters, little sunlight penetrates into the water column, making growth difficult for phytoplankton in the water. Yet the ice algae, as close to sunlight as possible in their protected homes underneath the ice, are able to flourish.

In the permanently ice-covered central Arctic Ocean, an estimated 50% of total plant growth, or

"primary productivity," comes from ice algae. **Left:** algae on the undersides of broken pieces of sea ice, with an inset closeup. *(Francis Wiese)* **See larger image**

So how important are ice algae in the seasonally ice-covered northern Bering Sea? That's the question Rolf and his team aim to answer.

IT TAKES A VILLAGE ... AND LADLES

Scenes from shipboard work, sea ice data collection, and walrus tagging in the Bering Sea. Photos by Andrew Trites, Tom Van Pelt, Francis Wiese, and others.

I've been helping out with the on-ice deployments, led by Rolf and graduate student Brenna McConnell, who direct a team of three or four volunteers like me.

After parking the ship against a strong, suitable ice floe, the deck crew cranes the steep, metal "brow" over the side -- our way onto the ice (right). Before we're allowed out, a Coast Guard swimmer and a gun-toting polar bear guard descend the brow and assess the ice safety. After getting the go-ahead, we send down several army-surplus toboggans filled with equipment. Down on the ice, we haul the toboggans a short distance away from the ship, looking for undisturbed ice.

As with a lot of biology fieldwork, the **on-ice deployments involve a funny mix of high-tech instruments and old-fashioned grunt work.** We use an ice auger -- basically a four-foot high giant drill bit a foot across, powered by a lawnmower engine with handles -- to drill several large holes in the often meter-thick ice.

Into one of the holes, we lower a "CTD," an instrument package that measures the temperature and salinity of the water column and gives us an oceanographic context to the ice work. It's kind of like taking temperature and windspeed measurements at a biological study site on land. With a price tag of $14,000, we make sure the knots securing the CTD are well tied. **Right:** Brenna with the very expensive CTD. **More about CTD casts from 2008**

TRAPPING SEDIMENT

Next, it's time for sediment traps. **Rolf wants to work out how much of the ice algae falls down to the seafloor, where it could become food** for the worms, snails, clams and other animals that live on and in the mud and sand. **The ice auger roars into action again,** this time to drill four side-by-side holes that create a long slot in the ice, smoothed out with a medieval-looking ice saw.

All of the drilling and sawing creates a lot of slush in the super-cold salt water; **I'm assigned to get rid of the slush, using a giant straining ladle like you might find in a big kitchen.** Kneeling there in my drysuit on this thin skin of ice capping 60 meters of the Bering Sea, with the Arctic wind whistling past a spot that is in constant motion and will soon melt away, gives me plenty to contemplate as I scoop slush over and over again. **Right:** Dorothy Childers contemplatively scoops slush.

SLUSHY SEAS

Ten minutes later I've scooped out most of the slush, and I'm rewarded by the sight of clear, dark water. It looks almost gelatinous, as though it can't decide whether to be a liquid or a solid. **In fact, it's super cold at one and half degrees below freezing -- salt water has a lower freezing point than fresh water.**

Kneeling next to the rectangular hole in the ice, Rolf and Ivan Kuletz prepare a metal frame equipped with two tall bottles. Rolf fills the bottles with filtered seawater, and we lower them to 20 meters into the water. We prepare another pair of bottles that we lower down to ten meters, then anchor the lines holding the bottles, and leave them to passively capture any material sinking down from the ice. **Left:** Rolf and Ivan filling sediment trap tubes, preparing to deploy.

Several hours later, we recover the sediment traps, and in the lab, Rolf and his colleagues will use the material to work out how much organic material is transferred from the ice to the seafloor.

CORING ICE

Next we break out the ice corer. This hollow, four-foot long tube is four inches across, tipped with razor-sharp bits. Yellow with an

orange spiral, it looks like an exotic candy cane. **Right:** Rolf and Ivan coring ice.

Fortunately, we repaired our heavy-duty drill to power the corer. When it broke at the last station, we had to drill some fifteen cores by hand, the old-fashioned way; which got a little old after a half-dozen or so. The electric drill makes short work of the ice. We fire up the generator and seconds later, we've punched a hole in the ice. Out comes the corer, we detach the drill, open the corer's top, and out slides a perfectly cylindrical core of ice.

The algae live at the bottom of the core. Why? We take a temperature profile of the first core to answer that question. The temperature at the bottom five centimeters or so of the core is very close to water temperature, but falls quickly with increasing distance from the water. Only 15 or 20 centimeters away from the water up the meter-long ice core, the ice temperature approaches the below-freezing air temperatures -- lethal for plant growth.

INCUBATING ALGAE

We also scrape off the algae zone from the bottom of the first core, putting it into bottles filled with a special solution. We attach those bottles to a weighted line, dropping them down into the water at different depths for an “incubation experiment.” Like the sediment traps, we leave those bottles for several hours before recovering them for later analysis in the lab, which will tell Rolf about the primary productivity of these algae.

We repeat the coring process a half-dozen times at one spot on the floe, cutting up the cores into sections for lab analyses; then move out 30 or 40 meters or so to two secondary spots, taking a couple more cores. We also measure both incident light and snow depth, so that Rolf can scale his results by how much light reaches the algae. **Above:** Brenna and Dorothy meaure core length and ice temperature profile. **Right:** Brenna holds a cross-section of an ice core.

SO WHAT?

At a range of sites across the northern Bering Sea, Rolf and Brenna have now completed seven ice deployments, capturing data on ice algae presence, productivity, and transfer to the seafloor. With these data, they should be able to describe how ice algae behave across a range of ice depths, snow cover, and seawater characteristics. Rolf and graduate student Jared Weems are also using isotopic tracers to work out how much ice algae benthic and pelagic animals rely on compared to other kinds of phytoplankton.

As the winter ice cover of the Bering Sea changes in response to climate change, ice algae will change right along with it; Rolf's work allows us to put numbers on those changes, filling in an important piece of the Bering Sea ecosystem puzzle and strengthening our ability to understand the consequences of changing ice.

At the same time, the benthic team is taking measurements of life on and in the seafloor. We're also learning about walrus, seaducks and other benthic predators and zooplankton that graze on phytoplankton on this cruise. All of this information, combined with data from other cruises as well as shore-based work, feeds into other pieces of the overall BEST-BSIERP study so we can build integrated, top-to-bottom models of this complex Bering Sea ecosystem. **More about sea ice from the 2008 cruise**

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March 24: Ice birds in the polynya

Tom Van Pelt, aboard Healy, off St. Lawrence Island

Steady northern winds over the past few days, blowing up to 35 knots, created a "polynya" -- an area of open water, surrounded by ice -- to the south of St. Lawrence Island. Having accomplished most of our work in the heavier ice to the east, yesterday Chief Scientist **Lee Cooper** decided to head into the polynya to run a series of transects and stations, allowing us to characterize the animal life, oceanography, and seafloor characteristics of this important type of habitat. **Above:** Polynya southeast of St. Lawrence Island. *(Craig Kasemodel/PolarTREC)*

More open water means more seabirds and marine mammals. The past few days we've been in relatively solid ice; aside from spotting the occasional walrus, and futilely scanning the horizon for polar bears, the observing team has mostly been documenting the unsurprising fact that **seabirds and marine mammals are rarely found in areas of thick, unbroken ice.** So with the prospect of crossing more open water, the shipboard observers led by U.S. Fish and Wildlife biologist **Kathy Kuletz,** assisted by her son Ivan and me, have swung into more intense action.

THE RARE ICE MURRELET

Kathy and Ivan's dedication to scrutinizing the ice and water quickly paid off when they spotted more than a dozen Kittlitz's murrelets (below) yesterday, and several more today.

This rare species, currently under consideration for "threatened" listing under the federal Endangered Species Act, is a very unusual seabird. The bulk of the 20,000 or so remaining Kittlitz's murrelets are found in regions with a lot of tidewater glaciers, like Prince William Sound. Scientists aren't sure why, but these small birds seem to prefer icy habitat.

They're also known to occur in smaller numbers in the Bering Sea and even farther north to the Chukchi Sea, but, of course, we have scant documentation of their presence in the ice, given how few vessels break into these icebound waters.

Seeing them here now, among the open water leads and with very few other birds around (with the notable exception of the spectacled eiders that **Jim Lovvorn** is studying on this cruise), gives us a sense of discovery and also of curiosity -- **what is it about this harsh habitat that attracts the little Kittlitz's murrelets?**

All of the measurements that are being taken at every station -- including the abundance of zooplankton, which are important prey for Kittlitz's murrelets, as well as the characteristics of the water column (temperature, nutrients, salinity, phytoplankton abundance) that drive zooplankton populations -- should help us work out some clues as to why the ice murrelet chooses to spend time in this polynya.

Soon we'll be back in the heavier ice, which will give **Rolf Gradinger** a chance to rally his team of ice corers and slush scoopers for a sixth "ice station" off the ship -- I'll describe his work in my next blog.

March 23: Walrus tag

Tom Van Pelt, aboard Healy, off St. Lawrence Island

We're now deep into the thick ice of the northern Bering Sea, about 64km south of St. Lawrence Island. A high-pressure weather system has been sitting in the region for days, giving us beautifully clear (and very cold) weather. Thin layers of scalloped and ridged snow cover the ice pack, stretching in unbroken whiteness from horizon to horizon. *(walrus photo by Joel Garlich-Miller)*

The ship's clocks are still set to Kodiak time; we've come far west since leaving Kodiak, so the sun rises late. Looking out this morning at 9:00 am, **the surrounding ice has a deep blue pastel shade,** meeting a horizon colored red and yellow as we rotate toward sunrise. *(ice photo by Francis Wiese)*

"Flight briefing on the bridge at oh-nine-thirty hours" is announced on the ships PA system -- the walrus team is preparing for lift-off. Up in the dawn's half-light on the bridge, a circle forms: USCG officers and crew, the walrus biologists **Chad Jay** and **Tony Fischbach**; Bill Springer, the helicopter pilot; and other support crew work through a checklist of pre-flight preparations. The operations chief, Commander Jeff Stewart, closes the briefing: "OK, let's fuel and traverse the helicopter at 1000, and pipe for flight quarters at 1015 for a 1030 launch."

WHERE, AND WHY, ARE THE WALRUS

Familiar around the world as a symbol of the mysterious Arctic, walrus are a particularly important cultural and subsistence resource for the Siberian Yu'pik peoples living on St. Lawrence Island and elsewhere along the Alaskan and Russian coasts surrounding the Bering Sea. **Despite their importance, we still don't know much about walrus.** One of our primary missions on this Healy cruise is to learn more about where walrus like to feed in the late winter, and then investigate what kind of food is available at their preferred areas compared to other areas.

Walrus eat clams, worms, and other animals living in and atop the seafloor mud and silt. A whole team of hard-working scientists is bringing up seafloor samples around the clock, working under brutally cold conditions on the aft deck to investigate the life living in and on the seafloor. **Go to the ice algae blog**

SCIENTIST TO WALRUS: TAG, YOU'RE IT

Wriggling into a tight-fitting drysuit and strapping on a pack filled with crossbow bolts and arctic survival gear is part of the unique daily routine that Chad and Tony follow on board the Healy. Since the ship has been in the ice, each day they load up and fly out in the helicopter, looking for small groups of walrus. When they find a group that offers a safe downwind approach with strong ice that will support the weight of the loaded helicopter, pilot Bill Springer brings the chopper down, and Chad and Tony hop out to gather their gear.

Right: Chad Jay and Tony Fischbach, dressed for another day at the office. *(Andrew Trites)*

Dressed in white from head to toe, the biologists carefully approach the walrus. They scramble over precarious ice floes, and crawl belly down across flat expanses of thin ice to sneak in close enough to deploy the satellite-relayed-radios by crossbow: for them "close enough" means 10 meters or less. When they are in position to target the flat upper back of an adult walrus they fire a special crossbow bolt, with a sharp end that is essentially **a tiny, razor-sharp harpoon, attached to a puck-shaped satellite transmitter.** The harpoon anchors the transmitter on the walrus, resulting in a satellite-tagged walrus with no need for sedation or capture of these enormous (up to one ton!) animals.

HAPPY CUSTOMERS

Last year, on Healy cruise 0801, Chad and Tony attached satellite tags to ten walrus, allowing them to put together detailed information on where and when walrus feed. This year, they want to increase their sample size by attaching more tags.

So far on the cruise, Chad and Tony have had good luck -- they have more than a dozen "happy customers," as Tony puts it -- walrus that will now transmit their daily secrets of feeding and resting locales. In the coming months, Chad and Tony will receive daily "diaries" of the feeding and resting habits from these walrus along with location data. Combined with the information on benthic habitat and other oceanographic characteristics that scientists on this and other cruises are collecting, Chad and Tony will deepen their understanding of these enigmatic beasts, and other parts of the integrated BEST-BSIERP Bering Sea Project will benefit as we seek to understand how the Bering Sea ecosystem responds to changing ice conditions. More about walrus from 2008 fieldwork

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March 19: Fifteen thousand eiders, ice cores, and extreme science

Francis Wiese, aboard Healy, off St. Lawrence Island

It is calm, warm (-13C) and stunningly, serenely beautiful, the sun just rising over this virgin seascape. Yesterday the media all went out on a reconnaissance flight with **Jim Lovvorn,** looking for spectacled eiders.

They found about 10,000, and later a flock of 5,000 flew by the ship just as the sun was setting -- such synchronized harmony in the air.

Right: Spectacled eiders in an open lead off St. Lawrence Island. *(Flock of eiders, Deanna Wheeler/PolarTREC; inset photo, Brendan Smith/NPRB)*

More about eiders from the 2008 cruise

ICE CORES THE OLD FASHIONED WAY

I just spent four hours on the ice about 96km south of St.Lawrence Island. It is an incredible place, you stand on one meter of ice and snow over 70m of ocean, you walk on snow never walked on before or ever again, a place shaped by winds and currents, a system for itself, responsible for much of the rich life that lives at the bottom of the ocean.

Today, the drill that helps **Rolf Gradinger** drill ice cores broke, so Ivan (a young guy assisting with

counting birds) and I drilled all the ice cores by hand, the good old fashioned way. It was good exercise and kept us nice and warm. The weather was perfect, hardly any wind, -13C, sunny ... We're now on our way to the next station to take more samples of plankton, water, and all the critters that live in the mud below. **Left:** taking ice cores. *(Francis Wiese)*

While Rolf and his team where on the ice, others went in search of eiders. So far, walrus biologists **Chad Jay** and **Tony Fishbach** have tagged thirteen animals. Once we head further east, they'll attempt to deploy the remaining six satellite tags. More about sea ice from the 2008 cruise

EXTREME SCIENCE

I've been on the ship now for 24 hours and just got done helping with the work we started at 3am today, taking samples from the bottom of the ocean. **It was cold (-20C) but absolutely clear. With no light in the way, the stars overhead were overwhelming.** Then back to grabbing mud from the bottom time after time. Around 5am, a male walrus suddenly appeared out of the darkness into the spotlight right behind the icebreaker. He was beautiful, puffed up, with big tusks. He hung out for about 15 minutes, played around with some ice floes and then disappeared.

It is an interesting group of people on board, from China, Norway, Chile, Germany, Canada, as well as the US. Breaking ice with a ship is rather amazing. It's loud against the hull, scraping like a metal junk yard crushing cars, **outside the ice and snow sounds like styrofoam being brushed and torn apart.** Everything on deck freezes and seizes, so we spend a lot of time staying warm and hosing down the equipment with warm water to keep it functioning when it goes into the water. Quite some insights into how this extreme science is and can be done -- like they say in the POLAR-PALOOZA climate change rap -- by polar adventurers! **Above:** Scientists collect sea ice data. *(Francis Wiese)*

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March 12: Rock the shafts

Tom Van Pelt, aboard Healy, heading north

Thirty-six hours ago, we departed Kodiak under low grey skies and cold drizzle. Over the ship's PA system came the terse warning: **"Prepare to rock the shafts!"** Before the ship's crew casts her lines loose, the officers on the bridge ask to see the massive propeller shafts in motion -- the engineers give the propellers a little bump, and on the bridge the watches observe the shaft rotation on a video monitor -- giving assurance that the ship will respond to commands after she's loosed from the pier. **Above:** Healy at the dock, pre-departure.

A few minutes later, lines were cast off, and with a little help from a tugboat, all 428 feet of the USCG icebreaker Healy slipped away from Kodiak and began to gather speed for the voyage around the Alaska Peninsula and through Unimak Pass, headed north to the Bering Sea ice.

This Healy cruise -- "Healy 0901" -- is the first of several major research cruises that form the backbone of the BEST-BSIERP Bering Sea Project. Led by Chief Scientist Lee Cooper, thirty-seven scientists are busy making preparations for the work ahead. This cruise has several linked objectives, all built around hypotheses related to the interaction between ice cover and the marine ecosystem.

Now at 0230 on March 12, we're passing through Unimak Pass, nosing into a gentle swell as we enter the Bering Sea. The ship steams northward, commanded by Captain Fred Sommer, leading seventy-seven officers and crew. To the west, the Krenitzin Islands are visible in the bright moonlight, marking the start of the Aleutian Chain. To the east, the navigational light at Cape Sarichef winks out its faint signal. All of the months of meetings, planning, packing ... all of the grunt work that lives behind the scenes of this research cruise, such as bringing 15,000 pounds of gear aboard. Now all of the preparation is behind us and we're reaching the short window of intense action that lies a day or so ahead, when we reach the Bering Sea ice-edge.

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Benthic Ecosystem Response to Changing Ice Cover in the Bering Sea

(Funded by the National Science Foundation)

Patch Dynamics

(Funded by the North Pacific Research Board)

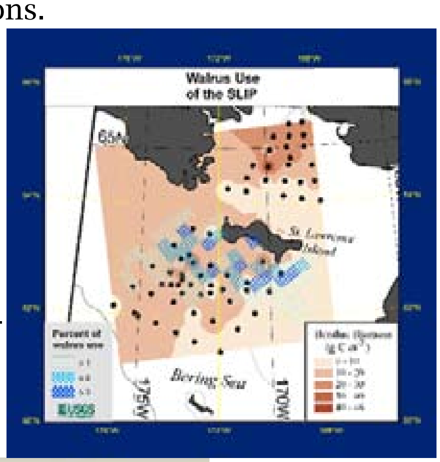
USCGC Healy (HLY0901), March 10–March 31, 2009

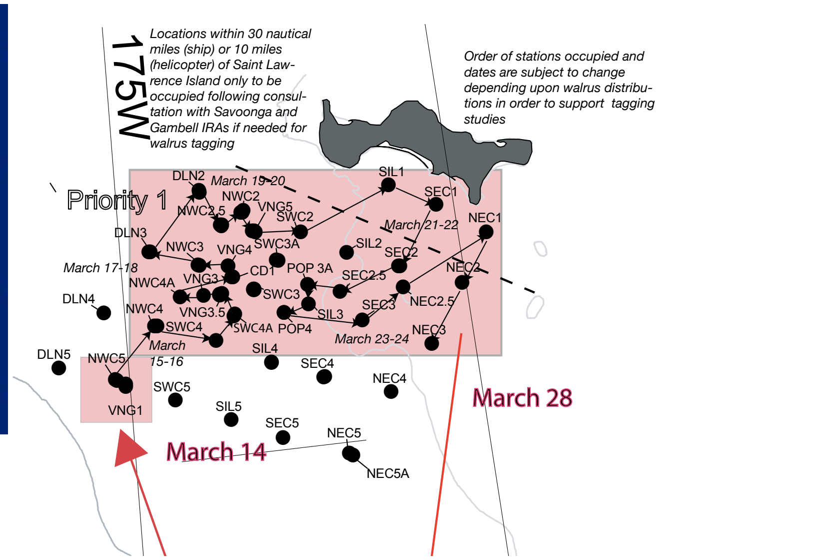
Lead scientists: Lee Cooper, cooper@cbl.umces.edu, phone: (410) 326-7359, and Jackie Grebmeier, jgrebmei@cbl.umces.edu (University of Maryland) phone: (410) 326-7334 and Chad Jay, cjay@usgs.gov, phone: (907) 786-7414 (Biological Resources Division, US Geological Survey)

The icebreaker Healy will be visiting waters near Saint Lawrence Island in March 2009. During this early season research cruise, we are continuing work on benthic (sediment-based) food webs, as well as documenting the distributions of walruses, other marine mammals and seabirds. Our past work has shown that the number and weight of organisms present in the sediments is in decline and the species present have also changed. One of the main scientific questions is whether this change is due to the recent shifts in sea ice cover and associated apparent climate warming, and how these changes in food supply will affect animals that dive to the bottom to feed, including walrus, bearded seals, and eiders. Of concern also are whether fish are becoming more critical competitors in the food web as water temperatures warm and fish become present in greater numbers. All of our work relates to these general questions and involves chemical and biological sampling. On this cruise, a research team will also be studying the distributions of walrus in relation to the food resources on the sea floor. Tagging of walrus for tracking by GPS will be done by walking out over the ice from a helicopter or the ship. We will also be surveying numbers of marine mammals and birds to better understand the distributions of the animals using the rich waters near Saint Lawrence Island. We are very much committed to sharing our research results with local communities well as receiving locally generated knowledge in return. A tentative ship track has been worked out (far right), but will probably be adjusted depending upon walrus distributions.

Walrus use of habitat relative to benthic (seafloor) biomass (right), April 2006

Walrus tracks following tagging, 2008 (below).





We will occupy many of the same areas sampled during previous cruises in 2006-2008, During our upcoming work, we expect to continue consulting with Gambell and Savoonga to insure that the ship operations have no significant impact on any subsistence hunting. The consultations will be through the community IRA Councils by electronic mail and satellite phone from the ship. In particular, we will consult if there are scientific needs to approach closer than 30 miles to Saint Lawrence Island.

Flyer mailed and personally brought prior to the cruise to the IRA Council (tribal governemt) Offices in Savoonga and Gambell for public posting

SUNDAY 04.12.2009 C baltimoresun.com / maryland closeup

MARYLAND closeup OPINION&COMMENTARY

Marylanders are on international team gathering climate change data

Polar mission

A polar bear guard (foreground) provided by the U.S. Coast Guard protects researchers working near the icebreaker Healy.

TIM WHEELER | *tim.wheeler@baltsun.com*

The Arctic is warming, and the sea ice is thinner than anyone has seen before. That could spell trouble for walruses, sea ducks and a host of other species — including humans — that depend on the North to sustain them.

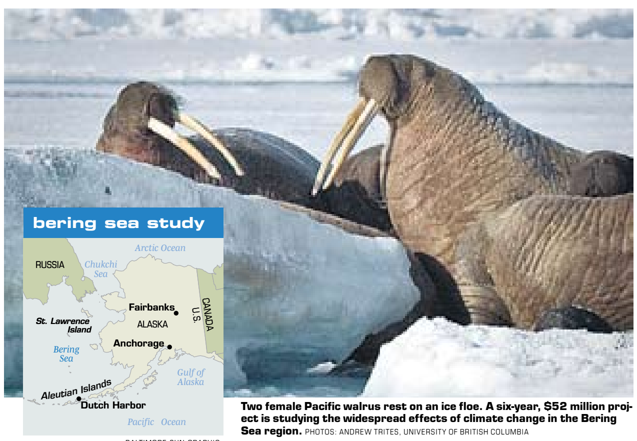
An international team of researchers, including some from Maryland, spent much of March aboard a Coast Guard icebreaker in the Bering Sea, gathering evidence that might help explain what's happening there. Enduring fierce winds and temperatures that dipped to minus 10 degrees Fahrenheit at times, they sampled the ice off the coast of Alaska, scooped up clams and other creatures from the sea bottom and scouted by helicopter across the vast white landscape to find and tag walruses.

"In some ways, it's like a three-ring circus," said Lee Cooper, chief scientist for the cruise and a research professor at the University of Maryland's Chesapeake Biological Laboratory. With nearly three dozen researchers from the United States, Canada and abroad, the icebreaker *Healy* was a hive of activity virtually around the clock.

The three-week cruise was part of a six-year, $52 million study of the changing climate's impact on a region whose importance stretches far beyond its shores. Besides offering early signs of an ecological upheaval that could sweep across a warming planet, the Bering Sea supplies half of the seafood eaten in the United States.

"Changes here affect the entire country and seafood markets abroad," said Francis Wiese, senior scientist for the North Pacific Research Board in Anchorage, which is coordinating the study in partnership with the National Science Foundation. Those changes also threaten the way of life and possibly the existence of remote native communities such as Savoonga on St. Lawrence Island. The Yup'ik people there have traditionally subsisted by hunting walruses and other prey across the frozen sea.

About a decade ago, scientists noticed that the ice covering much of the Bering Sea in winter was melting earlier and faster than before. Weak or vanishing ice means the long-tusked Pacific walruses that congregate in the shallow waters off Alaska's coast have fewer places to haul out of the frigid water.



BALTIMORE SUN GRAPHIC

Two female Pacific walrus rest on an ice floe. A six-year, $52 million project is studying the widespread effects of climate change in the Bering Sea region. PHOTOS: ANDREW TRITES, UNIVERSITY OF BRITISH COLUMBIA

The mammals feed mainly on clams, worms and other tiny creatures on the bottom, using their sensitive whiskers to locate prey amid the sand and muck. The ice provides the animals a floating platform on which to rest between foraging dives. The females also bear their young there.

As the ice begins to melt in April, the walruses begin moving north, passing through the Bering Strait to the Chukchi Sea by summer. The Chukchi sea ice also is melting more in summer, and scientists have noticed "some very dramatic responses" there, said Chad Jay, a scientist with the U.S. Geological Survey's Alaska Science Center in Anchorage.

With no ice left in their traditional shallow-water feeding grounds, many walruses have migrated to land along the coast.

"But we might be seeing some more subtle changes in the Bering as well," Jay said.

There, the husband-wife team of Cooper and Jacqueline Grebmeier, also a research professor at Maryland's Chesapeake lab, think the melting ice might be affecting more than the walruses' loafing habits. Sampling

See **BERING,** *page 4*

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For more on the Bering Sea mission, go to **/bayblog**

An eye on earmarks: There's something in them for everyone

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I think I've come up with the ultimate earmark: "BioAgroEco Infrastructure Improvements to 911 Communications, Chesapeake Oyster Protection and Endless Preparations for BRAC — Plus a Little Something for Girl Scouts, Easter Seals and Victims of Head Trauma."

Reading through the earmark wish lists that Maryland's congressional representatives have compiled, I thought of that old song about the ultimate country lyrics, covering all the bases beloved by that genre: *"Well, I was drunk the day my mama got out of prison, and I went to pick her up in the rain. But before I could get to the station in a pickup truck, she got runned over by a damned old train."*

So it is with the earmarks that Maryland's delegation are requesting — all the usual suspects on the state's checklist of the deserving get a nod, or five: the bay, the police, the children, the military, the medical research.

Thanks to the new transparency that Congress is now supposed to be operating under when it comes to the hot topic of earmarks, House members had to make public which projects they want funded in the 2010 budget. (Senators have a later deadline to do the same.)

Earmarks, of course, became a campaign issue last year, denounced as the ultimate in government waste and pork barrel spending. Never mind that a) they represent a tiny fraction, 1 percent or 2 percent, of total federal spending and b) their loudest critics often turned out to be the same ones who requested and accepted them for their states.

Still, earmarks remain the potato chip of politicians. They may be bad for you — some opponent is likely to find a mockable request you've made involving fruit flies or volcanoes — but they're ultimately irresistible.

For all the cheap and easy outrage you can generate by highlighting a project that seems trivial — some of the great advances in science, after all, have come from research involving fruit flies — surely earmarks have funded some worthy local projects that otherwise wouldn't have come to the attention of those who control the budget in Washington.

So the solution was not to outlaw earmarks but to make the process a more public one:

See **MARBELLA,** *page 5*

Icebreaker becomes hive of scientific activity

BERING, From page 1
conducted over the past 25 years by Grebmeier and others has shown declines in the population of bottom-dwelling creatures in the eastern Bering Sea , meaning a decrease in the food supply for walruses, Cooper said.

The researchers think the drop-off in clams and worms could also stem from the changing climate, by affecting the bottom-dwellers' food supply.

Algae, tiny plant-like organisms that are the base of the sea's food chain, grow on the underside of the ice. In spring, lengthening daylight and warming temperatures trigger massive "blooms" of algae in the water along the receding edge of the melting pack. The mollusks and crustaceans on the bottom feed on the fallout from that burst of life in the water.

"Because the ice is starting to disappear earlier," Cooper said, "there may not be as much food getting to the bottom anymore in such a big pulse."

The Maryland research team spent hours outside on the stern of the 420-foot icebreaker, dredging the bottom and then screening out the clams and other creatures in the muck so they could be identified and counted.

Meanwhile, other scientists disembarked from the ship to take ice cores for analysis. As they worked, armed Coast Guard crew members kept watch across the white plain for polar bears that might see the scientists as their next meal.

Jay and his team took off from the Healy in a helicopter to find walruses and tagged 17 of them — from a distance, given the animals' size. Using a crossbow, they fired transmitters with barbed heads into the animals' blubbery hides so scientists could track their movements by satellite.

Sea ice scientist Dr. Rolf Gradinger removes an ice core from an ice auger as part of a study of warming effects. PHOTO: ANDREW TRITES, UNIVERSITY OF BRITISH COLUMBIA

Still other researchers canvassed the open waters around St. Lawrence Island for flocks of spectacled eiders, large sea ducks that winter in the eastern Bering Sea. Their numbers have plummeted since the 1970s, and they're listed as threatened.

Suspected causes include hunting pressure, chemical contamination and changes in food supply. Like walruses, they dive to the bottom to feed on the mollusks and little crabs that have declined over that period.

Researchers aren't sure how many Pacific walruses there are in the Bering and Chukchi seas. A 1990 aerial survey estimated 200,000, but the tally is considered soft because the animals spend most of their time in the water, where it's hard to count them. A petition has been filed to classify them as endangered, however, because of the threats posed by changes in their icy habitat.

Their sampling done, the scientists returned to Dutch Harbor, Alaska, and flew home at the end of March, past erupting Mount Redoubt. Back in their labs, Cooper and the others now turn to analyzing, comparing and publishing findings from the data they collected in those few weeks — a process that will take months or years.

"Most of the work from this cruise is still ahead of us," Cooper said.

This year, scientists are nearing the midpoint in the six-year Bering Sea Project. Ultimately, they hope this cruise and the rest of the study will help them identify the pattern in changes they're seeing. They will use that knowledge to predict future conditions.

"It has huge implications, and it's very complicated to figure out," said Wiese, of the Pacific Research Board. "There's a lot of changes, and the changes are occurring quickly."

April 17, 2009

Environment

Battle Over Offshore Drilling In Arctic Dwarfs ANWR

by Elizabeth Arnold

Andrew Trites

Melting ice over the past few years has forced walruses onto small pieces of remnant ice. The Pacific walrus is under consideration for listing as a threatened or endangered species.

Andrew Trites

More than 30 scientists were aboard this 400-foot icebreaker, which is purposefully positioned in the ice so researchers can work. The scientists took samples of water and ice algae (which blooms in the spring on the underside of the ice) and put satellite tags on walruses.

Morning Edition, April 15, 2009 · Melting ice in the Arctic may not be good for species that live there, but it does mean those icy waters are much more accessible and cost-effective places to drill for oil and gas.

Interior Secretary Ken Salazar was in Alaska this week as part of an "information gathering" tour to help craft a new Outer Continental Shelf drilling policy. After two days of public testimony from those for and against offshore drilling, Salazar pronounced Alaskans passionate and divided.

Just over a year ago, the oil and gas industry bid $2.6 billion for drilling rights in the Chukchi Sea, located in the Arctic between Alaska and Russia. It's the largest oil and gas lease sale in history, and it's staggering when compared with the $7 million that the same leases went for in 1991.

Though rapidly retreating sea ice makes it easier and more cost-effective to drill in the Chukchi Sea, it also means the area is more fragile. Just about every marine mammal and seabird in the Chukchi Sea is already endangered or a candidate for listing. And, the opposition from native villages that rely on fish, walrus, seals and whales for subsistence dwarfs the fight over the Arctic National Wildlife Refuge.

Melting Ice Could Mean More Drilling, More Controversy

The biggest lease of the most recent sale went to Shell Gulf of Mexico, which spent $105 million for rights in the Chukchi Sea. Shell already had bought leases even further north and was ready with rigs when then-President George W. Bush lifted the ban on drilling along the Outer Continental Shelf.

"We are drill-bit ready to move in the Arctic right now, and this is stuff that can happen right now, and with a few things going our way, we will be ready to go in 2010," says Pete Slaiby, Shell's Alaska general manager.

But those few things are now largely in the hands of Salazar, who went to Alaska this week as part of the process of developing this administration's offshore energy plan. He has called a time out on new leasing, for more public input, and he got plenty Tuesday.

Whaling captain and mayor of the North Slope Borough Edward Itta advised slowing down: "Mr. Secretary, like all Alaskans, the people of the North Slope depend on the economic engine of oil and gas development. We have supported onshore for well over 30 years now. But, Mr. Secretary, offshore is a different matter."

Alaska Gov. Sarah Palin advised speeding up: "Delays or major restrictions in accessing our needed resources for environmentally responsible development

Andrew Trites

Scientists on deck lower instruments into open water for samples of the water column, mud from the bottom and everything in between.

are not in the nation's or our state's best interest."

Passionate Protests From Both Sides

From laborers in hard hats chanting "jobs, jobs, jobs" to environmentalists dressed as polar bears and puffins, division and emotion over offshore drilling was apparent.

Shell's Slaiby says the industry has learned from problems like the Exxon Valdez spill. Of the total volume of oil, less than 1 percent ends up in the oceans, he says. And, he says, more than 100 exploratory wells have been drilled in U.S. and Canadian Arctic waters without a single accident.

But concern over offshore drilling in Arctic waters doesn't just center on spills. The Interior Department is also responsible for endangered species. An increasing number of marine mammals and seabirds in the arctic are in decline, and the fear is that the impacts of a warming climate will be compounded by new development.

Species At Risk

Traveling on an icebreaker in the northern Bering Sea, University of Wyoming researcher Jim Lovvorn studies seabirds that breed in the Arctic, including the spectacled eider. On both hands, he counts off other species in danger: Steller's eiders, king eiders, common eiders, red-throated loons, yellow-billed loons, four species of ice seal, walruses and bowhead whales.

"You could not find a more sensitive habitat," Lovvorn says.

On the same ship, USGS research ecologist Chad Jay is tracking the Pacific walrus, which is also under consideration for listing as a threatened or endangered species. Reductions in the extent of ice over the past few years have forced walruses onto small pieces of remnant ice.

In 2007, there was no ice at all near the shelf.

"As a result of [ice shelf melting] we saw upwards of 6,000 walruses hauling out along the shore of northwest Alaska, which is the first ever," Jay says. "It means that a greater number of animals are using a smaller space to forage in and to haul out on — probably not a good thing."

But the very thing that is cause for concern with regard to walrus and other species in the Arctic is what's made drilling in these waters more attractive to industry: less sea ice.

Whether and how to balance development of a what is a fragile ecosystem — and what some believe is the next best answer to America's thirst for oil — poses a major policy decision for the new Department of Interior. Salazar says he doesn't expect to make everybody happy.

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  A Closer Look At Offshore Drilling

Bering Ecosystem Study: Early Spring Plankton and Benthos

- **Overview** (/early-spring-plankton-and-benthos)
- **Ms. Wheeler's Journal** (/early-spring-plankton-and-benthos/journals/deanna-wheeler)
- **Ask the Team** (/early-spring-plankton-and-benthos/ask-the-team)
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Bering Sea Ecosystem Study (BEST)-Bering Sea Integrated Ecosystem

March 8 - March 31, 2009 | USCGC Healy, Bering Sea

Teacher
Deanna Wheeler (/user/178)
J. C. Parks Elementary School
Indian Head, MD

Researcher
Lee Cooper (/user/138)
University of Maryland
Solomons, MD

The archive is now available from the 30 March 2009 Live from IPY! event held between Deanna Wheeler and students at J.C. Parks Elementary. Go to the archive... (/live-from-ipy/archive)

Who is on the expedition?

Passionate about land and water, Deanna Wheeler is inspired to make sure that 'no child is left inside'. Hands on, real science is her priority. From hatching, raising, and releasing yellow perch and horseshoe crabs to participating in a pilot sturgeon project, her students discover how connected they are to the world around them. Ms. Wheeler's love of learning and the outdoors meld together in her professional and personal life. She is dedicated as a teacher and as a citizen to better understand and protect the environment for positive impacts on individuals, the community, and the health of our environment. Ms. Wheeler cherishes time spent with her family, exploring, camping, kayaking, reading, and just having fun, and she looks forward to trading places with the tundra swans that winter near her house in Maryland to spend time in the Arctic on a PolarTREC expedition. Ms. Wheeler's particpation in PolarTREC is supported in part by the **North Pacific Research Board** (http://www.nprb.org/) .

Lee Cooper of the University of Maryland is the chief scientist on the first of two science cruises that will take place aboard the USCGC Healy in the Bering Sea in 2009. Dr. Cooper organizes the science mission and coordinates the work of approximately 35 other scientists studying sea ice, walrus distributions, sea floor processes, biological communities, water chemistry, and marine mammal and bird observations. Dr. Cooper works at the Chesapeake Biological Laboratory in Solomons, Maryland. His research specialty is **biogeochemistry** and he presently studies biological changes in the northern Bering Sea. Dr. Cooper is working with a PolarTREC teacher to share Bering Sea research with the public and K-12 classrooms.

What are they doing?

in the first of three research cruises this season in support of the **[Bering Sea Ecosystem Study (BEST) and the Bering Sea Integrated Ecosystem Research Program (](http://bsierp.nprb.org/)** (http://bsierp.nprb.org/) **BSIERP** (http://bsierp.nprb.org/) **)** (http://bsierp.nprb.org/) . Scientists onboard the ship will document late winter ocean conditions, study the biological communities found in sea ice, monitor the early spring **plankton** bloom, and investigate light penetration through open water and ice cover. Additionally, researchers will be examining the **benthic communities** living on the seafloor as well as observing an important benthic predator, the walrus. The region of the Bering Sea where the team is working is biologically rich and supports highly productive ecological communities of **bivalves**, **gastropods**, and **polychaetes**. These benthic communities have been changing over the past several decades, perhaps as a result of competing fish species moving north as the Bering Sea's waters warm.

Where are they?

The team will be travelling on the **icebreaker** **USCGC Healy** (/www.uscg.mil/pacarea/cgcHealy/) to a sampling area in the northern Bering Sea. The Bering Sea lies to the west of Alaska and to the east of Russia. The team will depart from Kodiak Island, Alaska, and return to the port of Dutch Harbor, Alaska, which is in the Aleutian Islands.

Project Vocabulary

(/vocabulary/benthic-communities)
Benthic Communities

Communities of organisms that live on or in the bottom sediments of a sea or lake.

(/vocabulary/biogeochemistry)
Biogeochemistry

The study of processes in the natural environmental using interdisciplinary tools from biology, chemistry and geology.

(/vocabulary/bivalves)
Bivalves

A group of mollusks, typically with two-part symmetrical shells.

(/vocabulary/gastropods)
Gastropods

A group of mollusks that travel on a single, muscular foot and often secrete a one-piece shell for protection. Snails, slugs, limpets and abalones are all gastropods.

(/vocabulary/icebreaker)
Icebreaker

An icebreaker is a special purpose ship or boat designed to move and navigate through ice-covered waters.

(/vocabulary/plankton)
Plankton

Plankton are small or microscopic organisms that float or drift in fresh or salt water, especially at or near the surface, and serve as food for fish and other larger organisms.

(/vocabulary/polychaetes)
Polychaetes

A large and diverse group of segmented marine worms. All possess an array of bristles on their many leg-like parapodia.

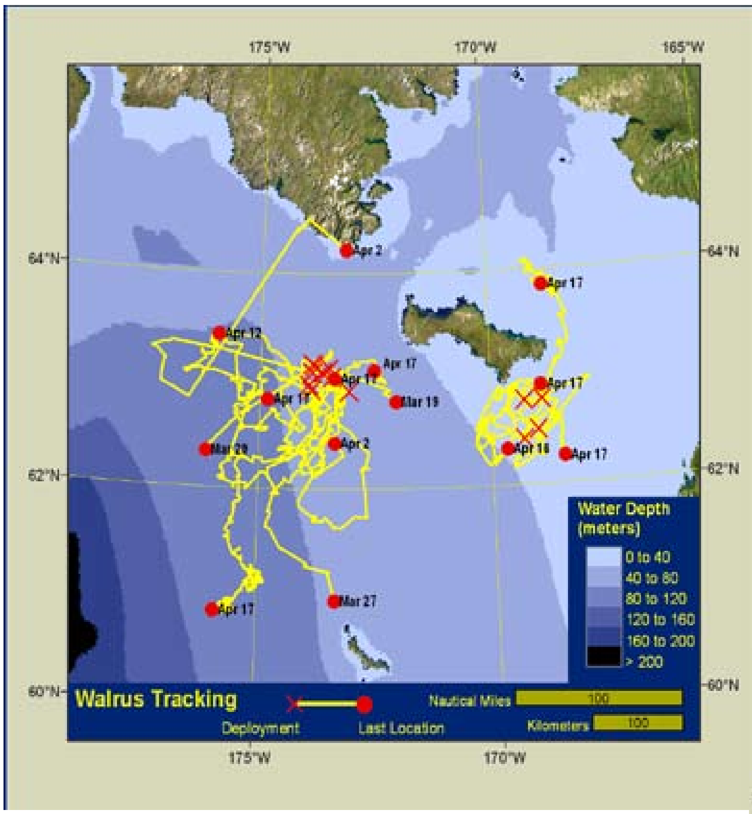
View all PolarTREC Vocabulary Terms (vocabulary)

Walrus Radio-Tagging 2009

USGS science for a changing world

In mid March of 2009 USGS attached satellite radio-tags to 17 walruses (9 males, 8 females) in the St. Lawrence Island polynya. The purpose of the tagging is to determine where walruses feed relative to the distribution of their prey and conditions of sea ice.

Over the next 6 to 8 weeks, the radio-tags will reveal walrus movements and detailed hourly feeding and haulout behaviors. An example of these data is mapped below from walruses radio-tagged in March of 2008. Feeding hot spots identified from these data will be analyzed with maps of walrus prey abundance and sea ice conditions to better understand walruses and their ecosystem.



Mapped above are the movements of walrus radio tagged in March of 2009. You can follow these walruses on-line (http://alaska.usgs.gov/science/biology/walrus/index.html).

If you harvest a radio tagged walrus,

please help us by returning the tag and providing information on the location and condition of the animal. If you have any questions, please contact

USGS Alaska Science Center
(907-786-7145)
or Fish and Wildlife Service
(800-362-5148)

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