Cruise Report:
USCGC Healy 08-01, March 13-26, 2008
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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USCGC Healy Cruise HLY0801
March 13-26, 2008

Summary:

Healy Cruise 08-01 departed Dutch Harbor, Alaska on March 13, 2008 and returned to Dutch Harbor on March 26, 2008. 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 the first jointly sponsored research cruise of 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 aboard Healy later in 2008, 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 both an independent film and writing team that undertook interviews during the scientific work and a British Broadcasting Corporation film team that obtained footage for use in future natural history documentaries. A professional photographer, Mr. Christian Morel, also documented the scientific research activities as part of an International Polar Year project that will freely make available high-definition images to increase public understanding of polar research issues. A middle school science teacher from Anchorage, Mr. Craig Kasemodel, participated in the scientific work and communicated results back to his classes through the PolarTREC (www.polartrec.com) program with both NSF and NPRB support. Finally, Ms. Nora Deans, BEST-BSIERP Outreach Manager participated in the scientific work and maintained a ship's log throughout the cruise that is posted on the BSIERP web page (www.bsierp.nprb.org).

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 experienced Marine Science Technician team aboard the ship which was invaluable in facilitating the research operations. Maritime Helicopters and the Aviation Management Directorate of the Department of the Interior also contributed significantly to completing successfully the science mission objectives. Lamont-Doherty Earth Observatory provided 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.

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 O4.62), 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

BSIERP Project: Epi-benthic survey (NPRB project)
PIs: Jackie Grebmeier, Lee Cooper

Impacts of Sea Ice Variability and Polynya Formation on Biological Productivity in the Northern Bering Sea (NSF ARC-0713939)
PI: Karen Frey

Climate-driven changes in impacts of benthic predators in the northern Bering Sea (NSF ARC-0454454)
PIs: Jim Lovvorn, Jackie Grebmeier, Lee Cooper

North Pacific Pelagic Seabird Observer Program (NPRB Project 637)
PIs: Kathy Kuletz, David Irons

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

National Marine Mammal Laboratory shipboard marine mammal observation program
PI: Sue Moore

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 PIs: Thomas Litwin and Larry Hott (film); Thomas Litwin (book)

“Frozen Planet”, British Broadcasting Corporation Natural History Unit documentary filming project,, Jeff Wilson, lead producer

“Our Polar Heritage” International Polar Year photography documentation, Christian Morel, onboard participant (IPY Expression Of Intent ID # 1134)

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24. Mr. Tom Bolmer, Woods Hole Oceanographic Institution (tbolmer@whoi.edu)
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29. Mr. Stephen De Vere, BBC Natural History Unit, Bristol, UK (route e-mail through Jeff Wilson)
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31. Mr. Scott Hiller, Scripps Institution of Oceanography (shiller@ucsd.edu)
32. Dr. Sue Moore, National Marine Mammals Lab, shipboard marine mammal observation program (Sue.Moore@noaa.gov)
33. Dr. Clarence Pautzke, North Pacific Research Board (cpautzke@nprb.org)
34. Ms. Nora Deans, North Pacific Research Board (nora.deans@nprb.org)

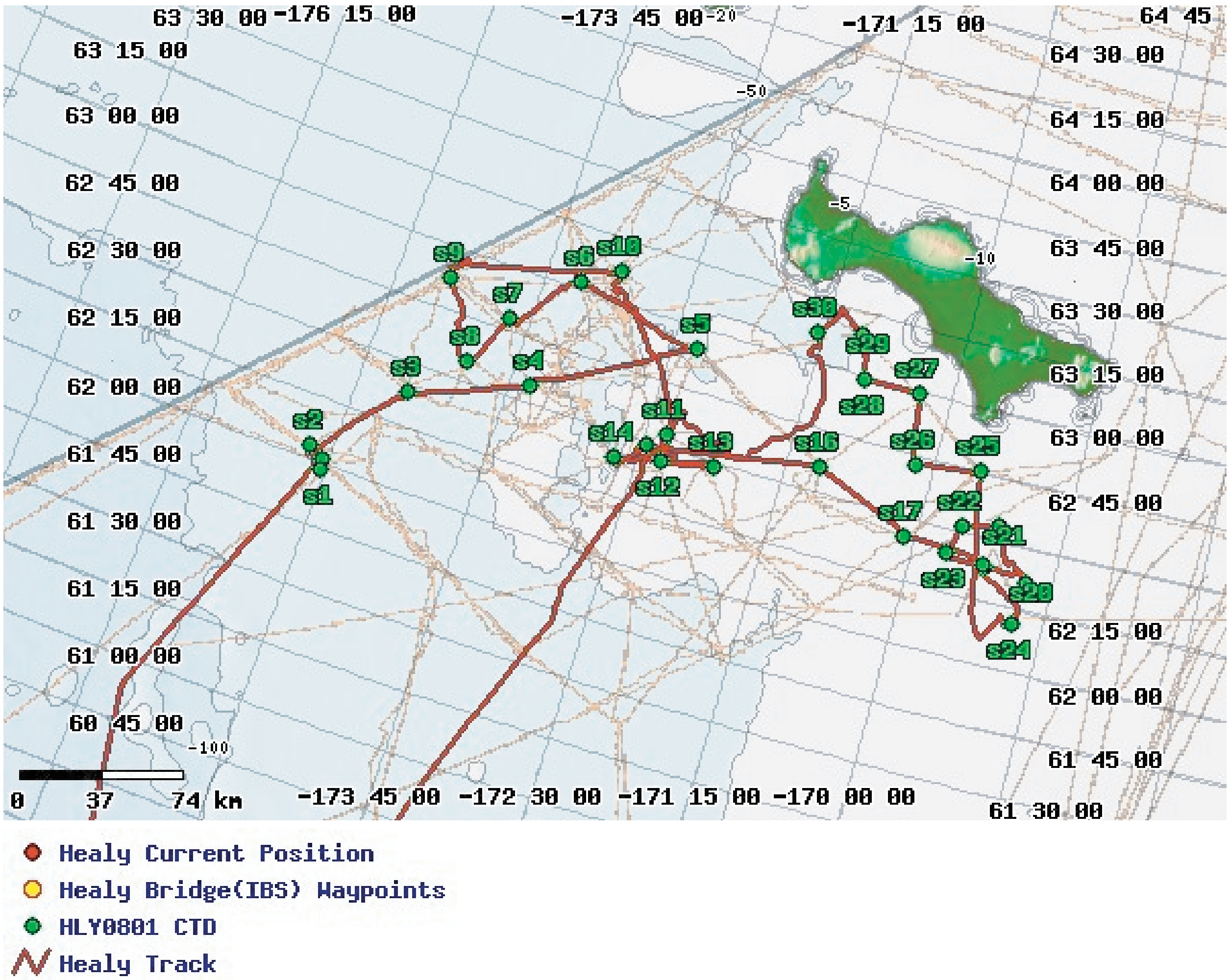

Figure 1. Ship track (from ship map server courtesy of Steve Roberts, UCAR). Station numbers correspond to coordinates in Table 1.

CTD and benthic station list (*=benthic camera deployed; †=van Veen grabs deployed; ‡ = HAPS corer deployed

Number	Station	DateUTC	Time	Latitude N	Longitude E	Depth
1	VNG1*†‡	3/16/2008	15:30:14	61.97353	-175.05	79
2	NWC5*†‡	3/16/2008	21:57:26	62.04846	-175.201	80
3	NWC4†‡	3/17/2008	5:23:09	62.38144	-174.567	72
4	VNG3.5†‡	3/17/2008	11:47:28	62.568	-173.579	68
5	SWC2†	3/17/2008	18:49:31	62.91514	-172.298	60
6	NWC2.5*†‡	3/18/2008	0:19:45	63.03312	-173.446	70
7	NWC3†	3/18/2008	13:28:43	62.79888	-173.929	70
8	NWC4a†	3/18/2008	17:26:06	62.5778	-174.165	70
9	DLN3†	3/19/2008	4:16:56	62.87874	-174.538	72
10	NWC2†	3/19/2008	18:16:39	63.11864	-173.122	71
11	POP3a†	3/20/2008	12:36:50	62.55039	-172.32	60
12	SIL3†	3/20/2008	15:33:29	62.43822	-172.3	60
13	SEC2.5†	3/20/2008	19:33:03	62.48322	-171.848	60
14	POP4*†	3/21/2008	0:19:10	62.40016	-172.705	60
15	FD1†	3/21/2008	6:20:03	62.48235	-172.464	55
16	SEC2†	3/21/2008	12:29:26	62.60104	-170.968	45
17	NEC2†	3/21/2008	17:35:27	62.4237	-170.113	39
18	WAL1*†	3/21/2008	22:46:52	62.38708	-169.362	33
19	WAL2*	3/22/2008	6:29:17	62.39355	-169.381	36
20	WAL3†	3/22/2008	10:57:13	62.3672	-168.976	36
21	WAL4	3/22/2008	13:39:50	62.56173	-169.318	34
22	WAL5	3/22/2008	15:03:35	62.52242	-169.635	30
23	WAL6	3/22/2008	16:31:06	62.4042	-169.72	34
24	MK10A*†	3/23/2008	1:39:50	62.19219	-169.01	36
25	NEC1*	3/23/2008	9:04:33	62.75434	-169.594	42
26	JGR1	3/23/2008	12:02:21	62.71074	-170.167	43
27	SEC1	3/23/2008	14:19:17	62.99242	-170.289	40
28	JGR2	3/23/2008	16:03:24	62.98769	-170.8	40
29	JGR3	3/23/2008	18:08:12	63.15769	-170.921	37
30	JGR4*	3/23/2008	20:22:17	63.11573	-171.301	46

Notes: Station 6, NWC2.5 is identified as NWC3.5 in some records
Station 13, SEC2.5 is identified as SIL2.5 in some records

Individual Project Reports

Cruise report HLY0801 – CTD data collection

13-26 March 2008
Markus Janout, University of Alaska Fairbanks

30 CTD stations were collected during HLY0801 (see station list). Ocean temperatures were homogenous and at the freezing point of seawater throughout the study region. Only the two southwestern most stations showed warmer (~-1C) water at the bottom, possibly as the result of on-shelf advection of deeper warmer water.
Salinity is the dominant physical parameter that determines horizontal density variations. Figure 1 shows the bottom salinity distribution throughout the region. A large part of the area on the central shelf was occupied by Bering Shelf water with intermediate salinity (32-32.4). Stations close to the south side of St Lawrence Island (SLI) showed salinities of ~33 which may be characteristic for waters advected with the southern branch of the Anadyr current that bifurcates on the west side of SLI. Saline water was found to the southeast of SLI. The high salinity values (~33.5-34) of these waters are likely caused by brine rejection events during ice formation.

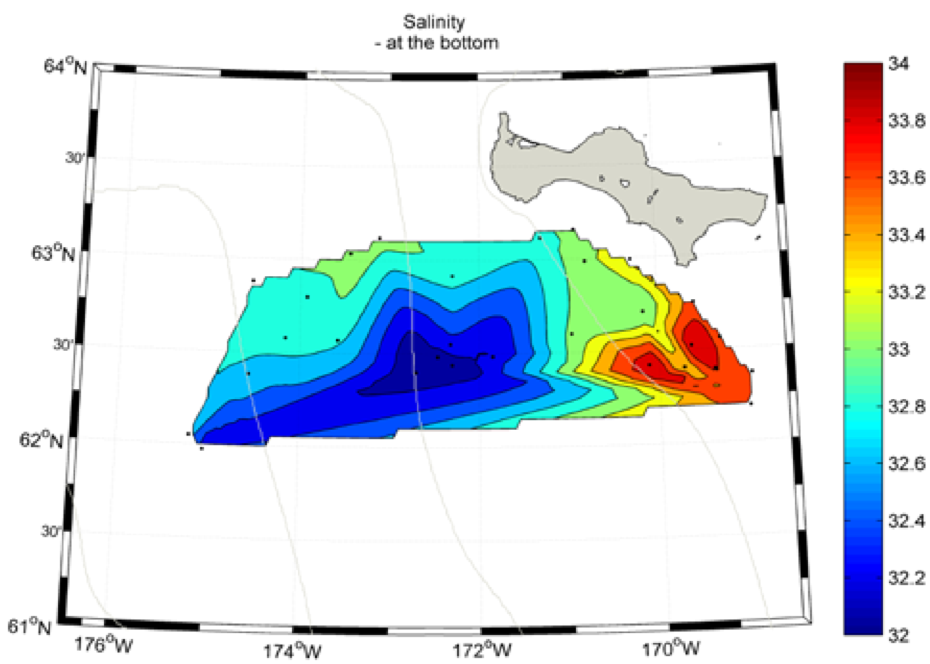

Figure 1. Bottom salinity (color) across stations (black dots) occupied during HLY0801.

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

BSIERP Project: Epi-benthic survey (NPRB project) PIs: Jackie Grebmeier, Lee Cooper

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

Coring was restricted to five stations that have the best time-series record for sediment respiration in this region of the Bering Sea. At these stations, duplicate undisturbed cores were collected and incubated for up to 24 hours in the dark at in-situ bottom water temperatures in the shipboard incubation facilities. Nutrient and alkalinity exchange between the bottom water and sediments, and oxygen utilization by the sediment biological community was measured in these cores shipboard. Biomass and species identification of macrofaunal organisms will proceed as with the community analysis in a shore laboratory over the next year.

The benthic camera system that was deployed is a new experimental system manufactured by A.G.O. Environmental Electronics, Ltd., Victoria, British Columbia. It consists of a weatherized sub-sea camera mounted in a stainless steel cage with two 33 watt green lasers to provide a size scale on the seafloor. The sub-sea camera was connected by a multi-conductor cable to the shipboard control system and a separate Canon GL1 video camera recording the bottom images on mini-DV tapes that will be transferred to computer storage for analysis of epibenthic communities on the sea floor using video imaging software. A video overlay box provides the capability for providing GPS coordinates, temperature and depth data on the videotape. Because of the late arrival of funds for acquisition of the system, we were fortunate to be able to even deploy the camera; it was delivered about 24 hours before the departure of the ship from Seattle and we thank Ms. Ramona Okumura of the University of Washington and Mr. Yutian Jiao of the Ocean University of China for transporting the system through U.S. Customs from the Victoria Clipper dock to the Coast Guard base, as well as the Coast Guard marine science technician team for insuring that the camera was brought aboard the ship.

The camera was deployed at a total of nine stations during the cruise, with steadily improving results and it is now being used on a daily basis during the Healy 08-02 cruise. One final tenth deployment was also made south of St. Matthew Island enroute back to Dutch Harbor during the final walrus helicopter deployment; no CTD deployment was made and no station number assigned for this location. Several challenges were overcome, including adjusting the sub-sea camera focus and the capabilities of the lasers to operate at near-freezing temperatures in seawater as well as being subjected to subfreezing temperatures during deployment from the deck. We thank Mr. Scott Hiller, the Scripps CTD technical support staff onboard for helping us work through these initial problems. Several different ways of deploying the camera were experimented with; an efficient procedure for deployment using the starboard SeaMac winch was eventually resolved. Ship drift at high winds continues to pose some challenges for good video quality and one laser was replaced by the manufacturer for the Healy 08-02 cruise.

Chlorophyll a measurements were made at most stations from the CTD rosette and are discussed in the section contributed by Karen Frey of Clark University. In addition we also collected water samples for determinations of $\delta^{18}O$ values at most stations from surface, bottom and a mid-depth rosette bottle.

Still-frame from epibenthic survey, south of St. Matthew Island

HLY08-01 Walrus Radio-tagging Summary

With support from the North Pacific Research Board and National Science Foundation, USGS sought to attach satellite radio-tags to 12 walruses to map walrus foraging locations within the St. Lawrence Island polynya. The radio-tags are capable of characterizing hourly walrus foraging and haulout status and tracking walrus movements for 6 to 8 weeks.

The USCG Healy reached the first sampling station on 16 March. The walrus team placed observers on reconnaissance flights on eight different days to locate walrus herds for tagging (Table 1, Fig. 1). Substantial walrus groups were encountered on only one day (21 March). Ten walruses (4 females, 5 males, and 1 unknown sex) were radio-tagged within the polynya. The Healy departed the ice on about 24 March in transit to Dutch Harbor.

Table 1. Summary of walrus and spectacled eider reconnaissance flights, March 2008.

Flight	Purpose	Region	Notes
2008-03-16A	Walrus and eider recon	Western SLIP	Few walrus groups.
2008-03-16B	Eider recon and BBC filming	Western SLIP	Afternoon flight. Two small walrus groups.
2008-03-17	Walrus recon / tagging	Western SLIP	Afternoon flight after Savoonga transit flight.
2008-03-18	Walrus recon / tagging	Western SLIP	Encountered walrus groups and **radio-tagged 4 walruses**
2008-03-19	Walrus recon / tagging	Western SLIP	Only one swimming walrus encountered.
2008-03-19B	Eider recon	Central SLIP	One walrus group encountered.
2008-03-20	Walrus recon / tagging	Western SLIP	No walruses encountered.
2008-03-21	Walrus recon / tagging	Eastern SLIP	Encountered substantial walrus groups and **radio-tagged 4 walruses**. Large walrus groups encountered east of station NEC2. Deployed tagging teams from the ship and **radio-tagged 1 walrus**.
2008-03-22	Walrus recon / tagging	Eastern SLIP	Encountered few walrus groups. **Radio-tagged 1 walrus**.
2008-03-24	Walrus recon / tagging	St. Matthew Island polynya	Encountered a dozen small walrus groups. Walruses were unusually sensitive to the aircraft and flushed prior.

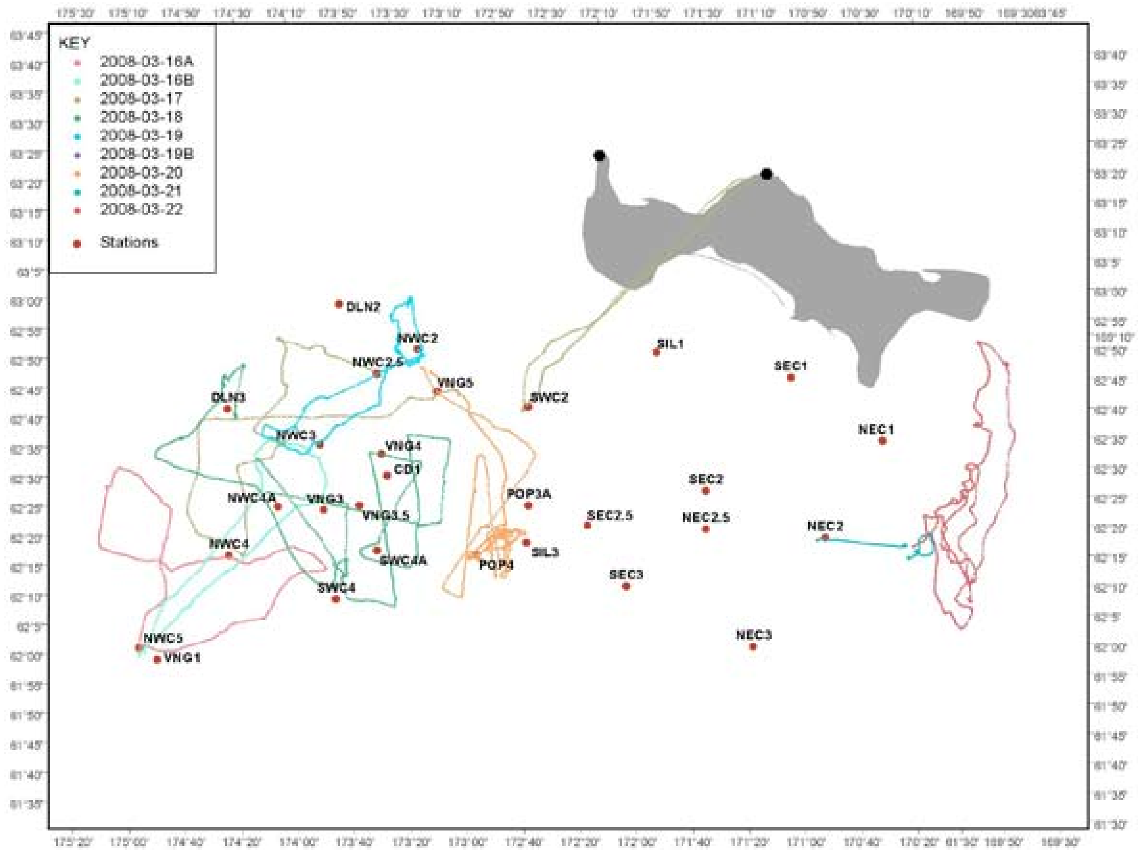

Figure 2. Walrus and spectacled eider reconnaissance flights within the St. Lawrence Island polynya, March 2008.

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

Our research project focuses on the quality and quantity of organic matter produced by ice algal communities and its relevance for pelagic and benthic herbivores. During Healy0801 we collected sea ice (five station), plankton (eight stations) and benthic (eight stations) samples (Table 1).

Overview of sampling events:

Date	Station	Sea ice samping	Under-ice CTD	Plankton	Benthos
3/16/08	VNG1			X	X
3/16/08	NWC5	X	X	X	X
3/17/08	NWC2.5			X	X
3/18/08	DLN3	X		X	X
3/19/08	NWC2ice	X	X	X (no CTD)	X
3/20/08	SEC2.5			X	X
3/21/08	WAL2	X	X	X	X
3/22/08	MK10-A	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 could be deployed at four stations- station time at DLN3 was too short (total of 30min because of daylight limitation) to include the CTD. The under-ice CTD measurements (Fig. 1) agree with the ship's CTD data showing a well mixed and homogenous water column structure with the exception of increased bottom water salinities, likely due to brine drainage from growing sea ice. T and S data could not be collected at station NWC5 due to freezing of the CTD pump system.

ESea ice sampling

Ice cores for algal pigment, species composition and stable isotope ratios were collected at five stations. Ice thickness varied between 45 and 80 cm. Ice cores were sectioned into 5 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.

In addition, snow depth transects (two transects, each 100m) were conducted at four stations (not at DLN3) with measurements every meter. At the four end points, snow samples were collected to determine salinity (on the ship) and d18O ratios (in home lab).

Plankton and Benthos sampling

Zooplankton samples were collected with a 250μm hand net at eight stations (Table 1). After collection, samples were sorted alive and tissue material from dominant taxa in plankton and benthos was frozen for later stable isotope analysis at UAF. Further, surface samples from sediment grabs were taken and seawater aliquots (500 to 750 ml) were filtered for Chl and POM analysis from three water depths.

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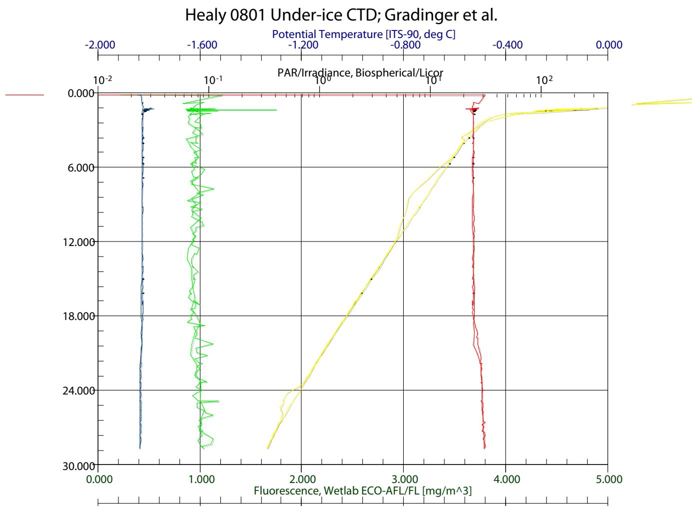

Example of profile from underice CTD sampling

Final cruise report for activities related to the NSF grant "Impacts of Sea Ice Variability and Polynya Formation on Biological Productivity in the northern Bering Sea"

A) Teleconference to Clark University: Worcester, Massachusetts

At 0800 on 24 March 2008, a one-hour teleconference was held by several Healy scientists and crew, who spoke with students enrolled in the *Arctic System Science* undergraduate course at Clark University. Karen Frey (an assistant professor in the Graduate School of Geography at Clark University) is the instructor for this interdisciplinary course, which focuses on the interfaces of systems in the Arctic including land-atmosphere-ocean-ice-human interactions, with special emphasis on impacts of climate change to these systems. The course has 31 undergraduate students enrolled, including freshmen through seniors. Those involved in the teleconference included Dr. Lee Cooper, Dr. Jim Lovvorn, Dr. Rolf Gradinger, Dr. Sue Moore, Mr. Tony Fischbach, Mr. Stephen Elliott, and Dr. Karen Frey. Each of these participants spoke for a few minutes about their individual projects and what they had found during the 0801 cruise to date. Clark University students then asked several questions related to the science and logistics of fieldwork onboard the Healy. It has been reported to Karen Frey (since returning to Clark University) that the teleconference was enthusiastically received by the students and that they learned a great deal about the marine environment of the northern Bering Sea.

B) Chlorophyll-*a* Measurements

Assistance was provided to measure chlorophyll-*a* from waters sampled from the CTD at 23 of the 30 science stations (see table below) using standard shipboard water column measurement methodologies. Water samples were collected at ~5 m intervals via a CTD-rosette system and the samples were filtered, chlorophyll-*a* extracted with acetone, and chlorophyll-*a* subsequently determined using a Turner flourometer. In the context of this project, these measurements will be used to interpret, validate, and calibrate our compiled remotely sensed datasets of chlorophyll-a (MODIS-Aqua, SeaWIFS, etc.).

Station Number	Station Name	Date	AD Time-Put in Water	AD Time-Out of Water	Bridge Depth (m)	Integrated Chl-*a* (ug/L)
1	VNG 1	3/16/2008	6:57	7:10	80	3.1576976
2	NWC 5	3/16/2008	13:58	14:18	80	37.644
3	NWC 4	3/16/2008	21:30	21:49	70	32.3982
4	VNG 3.5	3/17/2008	3:47	4:06	65	18.5136
5	SWC 2	3/17/2008	10:50	11:12	57	12.0538
6	NWC 2.5	3/17/2008	16:22	16:40	72	18.4906
7	NWC 3	3/18/2008	5:29	5:49	73	20.5666
8	NWC 4A	3/18/2008	9:46	9:46	70	32.4082
9	DLN 3	3/18/2008	20:23	20:51	78	24.97184
10	NWC 2	3/19/2008	10:16	10:35	70	20.36738
11	POP 3	3/20/2008	2:48	2:56	50	6.5808
12	SIL 3	3/20/2008	7:35	7:48	50	7.3326
13	SEC2.5	3/20/2008	11:12	11:24	48	7.4752
14	POP 4	3/20/2008	16:24	16:43	59	6.43485
15	FD 1	3/20/2008	22:22	22:38	52	2.8892
16	SEC 2	3/21/2008	4:29	4:45:00	44	3.16608
17	NEC 2	3/21/2008	9:36	9:53	38	7.0786
18	WAL 1	3/21/2008	14:48	15:02	33	2.365
19	WAL 2	3/21/2008	22:30	22:40	35	1.6056
20	WAL 3	3/22/2008	2:57	3:04	25	
21	WAL 4	3/22/2008	5:40	5:48	30	
22	WAL 5	3/22/2008	7:04	7:15	40	
23	WAL 6	3/22/2008	8:13	8:19	34	
24	MK 10A	3/22/2008	17:41	17:50	35	0.31728
25	NEC 1	3/23/2008	1:08	1:18	36	1.41338
26	JGR 1	3/23/2008	3:48	3:53	44	
27	SEC 1	3/23/2008	6:19	6:30	38	7.7782
28	JGR 2	3/23/2008	8:03	8:12	46	
29	JGR 3	3/23/2008	10:10	10:22	36	9.1338
30	HELO 1	3/23/2008	12:25	12:32	45	

C) Snow Depth Measurements

In collaboration with Rolf Gradinger, snow depth measurements were taken at five ice stations throughout the 0801 cruise. Snow depth measurements at each station were taken at two perpendicular 100m transects, spaced one meter apart (hence, 200 snow depth measurements were taken at each station). Snow depths were quite variable, particularly at stations where older ice and extensive rafting was present. Snow depth measurements will be utilized for interpretation and validation of satellite imagery, particularly with radar imagery where snow presence and depth can impact radar backscatter returns dramatically.

D) Sea Ice Observations

As of 26 March 2008 on HLY0801, sea ice observations have been made from the Healy bridge (05 deck) at 87 sites (Table 1) by Karen Frey and Rolf Gradinger. The bridge is ~60 ft above sea level and has a maximum of ~9.8 miles of visibility. Sea ice observations wee taken during daylight hours while the ship was in transit. Ideally, observations are taken once per hour, although while the ship is moving through dynamic ice conditions, more frequent observations have been made. The following general parameters (with further details within each category) were recorded at each site:

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

In addition, the following ship sensors were used for the above parameters:

- Wind Speed and Direction:Jack Staff Ultrasonic Anemometer (RM Young 85004, serial #00703)
- Air Temp: Jack Staff Temperature Sensor(Paroscientific MET3A, serial #101757)
- Air Press: Jack Staff Barometer Sensor(Paroscientific MET3A, serial #101757)
- SST: Remote Sea Temp (SeaBird SBE3S, serial #4063)
- Salinity: TSG (SeaBird SBE45, serial #0215)
- Ship Speed: POSMV (Model- MV V4, serial #2306)
- Ship Heading: POSMV (Model- MV V4, serial #2306)
- Ship Position: 3D GPS (Ashtech ADU5, serial #AD520033513)
- Depth: Multibeam Seabeam 2112 center beam

These observations have continued throughout the length of the cruise (from 3/14/2008 to 3/26/2008). To date, hundreds of digital photographs have been taken of ice conditions. The measured parameters and digital photographs will be used to understand sea ice dynamics, sediment transport, and algal blooms throughout the region as well as to validate satellite imagery (e.g., RadarSat, AVHRR, MODIS, etc.) of sea ice conditions and cover once onshore. As weather conditions have been variable throughout the cruise (i.e., cloud/fog conditions) it is clear that visible/near-infrared imagery will need to be supplemented with longer wavelength satellite data (e.g., passive microwave, scatterometer, synthetic aperture radar) that penetrate cloud coverage. Field-based ice observations and satellite imagery combined will additionally be useful for interpreting biological productivity and water mass identification/movement data (e.g.., interpreted through CTD profiles) collected onboard.

In addition, collections of real-time satellite imagery have been compiled through the Terascan system onboard Healy. Currently, the Terascan system is stripping data from three suites of satellites: AVHRR (1.1 km), DMSP (0.55 km), and CHRPT. The relatively high spatial resolution of the DMSP data makes them conducive to the tracking of sea ice variability and floe movement. Currently, 631 DMSP images have been compiled from 3/13/2008–3/26/2008. Sea ice type, concentration, thickness, etc. have been highly variable throughout the length of the cruise (both spatially and temporally), which is apparent in these DMSP images shown in Figure 3. Additionally, the high temporal resolution (up to ~12 viable images per day) allows for determination of sea ice floe velocities.

Table 1. Example parameters for sea ice observations at the 87 observation sites.

Start Time	Start Lat	Start Lon	Air	Total ice concentration (%)	Ice Field Type	Dominant ice type	Concentration of Primary Ice Type
3/14/2008 17:04	56:37.0	-170:17.53027	?	0	---		---
3/14/2008 18:04	56:50.4	-170:30.06994	?	0	---		---
3/14/2008 19:46	57:08.3	-171:02.39264	?	10	9 - first-year white ice	10	---
3/14/2008 20:09	57:11.4	-171:06.98886	?	80	6 - pancakes	50	3 - brash ice
3/14/2008 21:48	57:26.0	-171:26.69210	?	95%	9 - first-year white ice	90%	3 - brash ice
3/14/2008 22:17	57:29.9	-171:29.67365	?	100%	9 - first-year white ice	100%	---
3/15/2008 0:54	57:45.0	-171:40.89550	?	100%	9 - first-year white ice	100%	---
3/15/2008 20:05	59:22.7	-175:27.96596	-10.36	95	8 - young grey-white ice	95	---
3/15/2008 3:52	58:03.0	-172:19.47513	?	90	9 - first-year white ice	80	3 - brash ice
3/15/2008 5:16	58:10.5	-172:39.96695	?	100%	9 - first-year white ice	100%	---
3/15/2008 22:11	59:25.4	-175:32.13082	-10.35	100%	9 - first-year white ice	90%	8 - young grey-white ice
3/15/2008 18:33	59:14.9	-175:23.95747	-10.13	100%	9 - first-year white ice	100%	---
3/16/2008 0:19	59:40.1	-175:35.86299	-10.51	100	9 - first-year white ice	100	---
3/16/2008 1:33	59:49.2	-175:37.45597	-10.56	100	9 - first-year white ice	100	---
3/16/2008 2:58	00:03.1	-175:42.42470	-10.58	100%	9 - first-year white ice	100%	---
3/16/2008 5:03	00:23.7	-175:48.60242	-11.32	99	9 - first-year white ice	99	---
3/16/2008 5:58	00:32.9	-175:51.46086	-10.92	99	9 - first-year white ice	99	---
3/16/2008 18:50	01:58.9	-175:02.97601	-13.34	80	9 - first-year white ice	70	7 - young grey ice
3/16/2008 20:21	01:58.2	-175:04.62814	-13.06	70	9 - first-year white ice	50	4 - dark nilas
3/17/2008 2:27	02:02.4	-175:09.23201	-12.89	90%	9 - first-year white ice	80%	7 - young grey ice
3/17/2008 3:45	02:10.7	-174:55.75339	-12.81	65	9 - first-year white ice	40	2 - grease
3/17/2008 17:48	02:52.5	-172:27.62418	-13.38	95	7 - young grey ice	94	2 - grease
3/17/2008 20:24	02:54.3	-172:18.89767	-13.04	95	5 - light nilas	93	4 - dark nilas
3/17/2008 22:17	02:56.8	-172:43.55450	-12.24	95%	7 - young grey ice	75%	9 - first-year white ice
3/17/2008 23:25	02:59.9	-173:05.58612	-11.35	90	5 - light nilas	70	9 - first-year white ice
3/18/2008 0:48	03:02.1	-173:27.16661	-10.35	95	4 - dark nilas	90	5 - light nilas
3/18/2008 16:25	02:41.8	-174:01.49983	-15.49	95	9 - first-year white ice	70	9 - first-year white ice
3/18/2008 18:56	02:34.3	-174:09.32444	-15.64	90	7 - young grey ice	80%	9 - first-year white ice
3/18/2008 20:42	02:36.6	-174:16.39944	-15.94	99	5 - light nilas	90	8 - young grey-white ice
3/18/2008 22:04	02:43.0	-174:21.25524	-15.6	100%	9 - first-year white ice	50	7 - young grey ice
3/18/2008 22:34	02:45.4	-174:19.85625	-15.66	98	8 - young grey-white ice	90	9 - first-year white ice
3/19/2008 6:33	02:54.7	-174:33.84643	-13.21	100	9 - first-year white ice	100	---
3/19/2008 17:04	03:04.7	-173:24.20350	-15.24	98	5 - light nilas	98	---
3/19/2008 17:57	03:07.1	-173:07.06330	-16.76	99	5 - light nilas	99	---
3/19/2008 20:58	03:05.8	-173:05.98215	-16.26	100%	9 - first-year white ice	100%	---
3/20/2008 2:04	03:02.9	-173:06.23343	-15.93	100%	9 - first-year white ice	100%	---
3/20/2008 4:55	03:01.8	-173:01.44336	-16.73	100%	9 - first-year white ice	100%	---
3/20/2008 6:06	03:00.7	-173:00.55366	-16.73	100	9 - first-year white ice	89	5 - light nilas

3/20/2008 17:33	02:26.5	-172:15.05850	-19.37	90	5 - light nilas	70	2 - grease
3/20/2008 18:04	02:27.9	-172:05.55881	-19.12	99	5 - light nilas	99	---
3/20/2008 18:51	02:29.5	-171:51.87551	-18.73	99	5 - light nilas	99	---
3/20/2008 22:32	02:27.0	-172:09.41235	-16.82	95	5 - light nilas	90	2 - grease
3/20/2008 23:34	02:25.9	-172:28.14311	-16.57	95%	7 - young grey ice	95%	---
3/21/2008 1:37	02:24.0	-172:43.22952	-15.58	90	5 - light nilas	95	---
3/21/2008 4:30	02:23.0	-172:39.92552	-13.81	95	9 - first-year white ice	50	5 - light nilas
3/21/2008 15:20	02:30.2	-170:27.06535	-14.06	99	5 - light nilas	99	---
3/21/2008 18:04	02:25.2	-170:06.84218	-14.09	99	5 - light nilas	90	---
3/21/2008 20:21	02:25.6	-170:00.36289	-13.2	95	7 - young grey ice	95	---
3/21/2008 21:05	02:25.3	-169:44.39877	-13.19	90%	7 - young grey ice	90%	---
3/22/2008 17:29	02:23.2	-169:28.51443	-16.05	98	5 - light nilas	98	---
3/22/2008 18:46	02:22.2	-169:24.33774	-15.97	98	5 - light nilas	98	---
3/22/2008 19:23	02:19.4	-169:12.80399	-15.55	98	9 - first-year white ice	60	4 - dark nilas
3/23/2008 3:46	02:11.7	-169:06.51799	-13.56	95%	7 - young grey ice	70%	9 - first-year white ice
3/23/2008 4:34	02:12.1	-169:07.12007	-13.88	100	9 - first-year white ice	100	---
3/23/2008 5:59	02:13.4	-169:22.99963	-14.12	99	5 - light nilas	99	---
3/23/2008 14:54	02:59.5	-170:25.79723	-15.43	99	5 - light nilas	60	4 - dark nilas
3/23/2008 19:48	03:09.6	-171:13.88968	-15.57	98	4 - dark nilas	98	---
3/23/2008 21:52	03:05.5	-171:16.67317	-15.05	95%	7 - young grey ice	90%	9 - first-year white ice
3/24/2008 0:00	03:03.6	-171:18.26336	-14.65	98	9 - first-year white ice	60	5 - light nilas
3/24/2008 1:07	02:53.9	-171:07.05367	-12.37	98	5 - light nilas	98	---
3/24/2008 2:10	02:41.8	-171:16.63535	-12.7	50%	2 - grease	25%	9 - first-year white ice
3/24/2008 4:19	02:34.6	-171:53.00411	-13.16	98	4 - dark nilas	98	---
3/24/2008 5:02	02:36.6	-172:05.69888	-13	95%	7 - young grey ice	95%	---
3/24/2008 17:54	00:31.3	-173:36.29631	-12.78	95%	8 - young grey-white ice	95%	---
3/24/2008 18:08	00:29.0	-173:37.59463	-12.84	99	7 - young grey ice	99	---
3/24/2008 18:37	00:24.7	-173:34.04016	-12.34	99	7 - young grey ice	99	---
3/24/2008 19:46	00:17.9	-173:20.87643	-12.02	98	7 - young grey ice	98	---
3/24/2008 21:54	00:12.6	-173:08.85737	-11.68	90%	9 - first-year white ice	80%	7 - young grey ice
3/24/2008 23:07	00:10.3	-173:05.80193	-11.45	95	9 - first-year white ice	75	4 - dark nilas
3/25/2008 0:05	00:06.2	-173:05.00010	-11.27	90%	9 - first-year white ice	85%	7 - young grey ice
3/25/2008 3:38	59:24.5	-172:43.37329	-10.82	100%	7 - young grey ice	100%	---
3/25/2008 4:52	59:12.0	-172:41.08329	-10.7	99	4 - dark nilas	99	---
3/25/2008 5:33	59:03.8	-172:45.38516	-10.92	99%	7 - young grey ice	99%	---
3/25/2008 14:20	58:49.2	-172:52.70753	-12.06	100	5 - light nilas	100	---
3/25/2008 18:18	58:41.1	-173:36.74821	-13.67	100%	8 - young grey-white ice	100%	---
3/25/2008 19:02	58:34.3	-173:46.74873	-13.83	100%	8 - young grey-white ice	90%	9 - first-year white ice
3/25/2008 19:26	58:30.5	-173:46.46902	-13.03	99	9 - first-year white ice	50	5 - light nilas
3/25/2008 21:12	58:11.2	-173:38.31062	-11.86	80%	7 - young grey ice	70%	9 - first-year white ice
3/25/2008 21:55	58:04.7	-173:32.49760	-11.25	99	9 - first-year white ice	80	5 - light nilas
3/25/2008 23:24	57:51.7	-173:15.10715	-10.3	90%	9 - first-year white ice	80%	7 - young grey ice
3/25/2008 1:02	59:58.4	-172:55.19948	-11.38	95%	7 - young grey ice	95%	---
3/25/2008 1:42	59:48.9	-172:53.16959	-11.7	95	4 - dark nilas	50	5 - light nilas
3/25/2008 4:19	59:19.1	-172:42.12747	-10.8	99	5 - light nilas	99	---
3/26/2008 0:42	57:43.5	-173:12.62525	-10.01	50	9 - first-year white ice	45	2 - grease
3/26/2008 2:22	57:23.8	-173:20.69980	-8.77	75%	7 - young grey ice	75%	---
3/26/2008 4:10	57:01.3	-172:56.19469	-7.96	25%	9 - first-year white ice		---
3/26/2008 5:20	56:51.1	-172:46.02450	-7.97	10%	9 - first-year white ice	10%	---

Figure 1. Example ice observation photograph from the bridge (observed on 3/14/2008).

Figure 2. Example of snow cover, sea ice stratigraphy, and basal ice algal layer (above). These parameters are all noted during each sea ice observation.

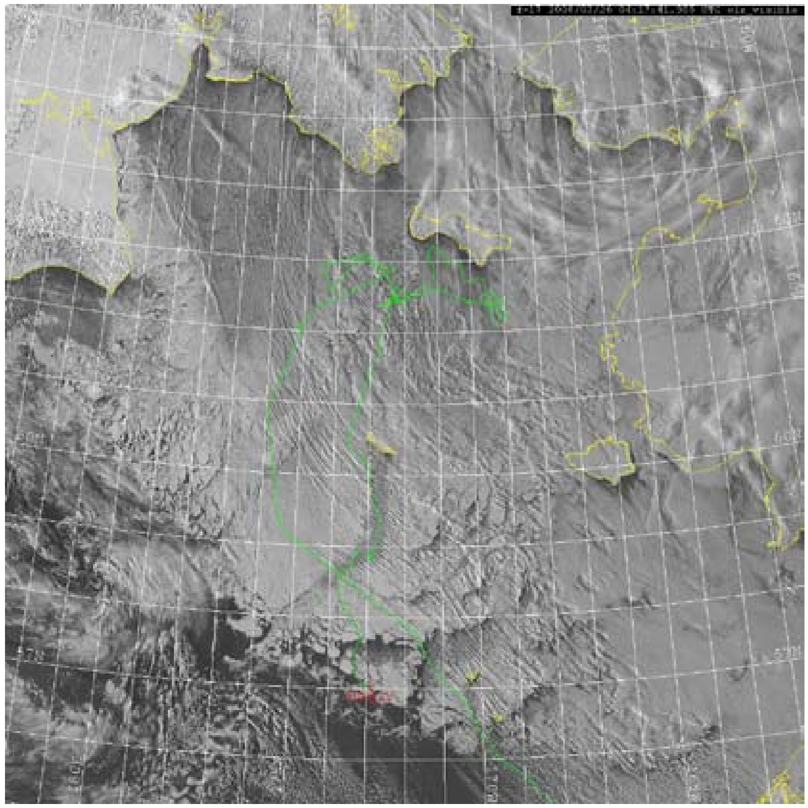

Figure 3. Defense Meteorological Satellites Program (DMSP) images stripped from the Terascan system onboard Healy. The image above was taken on 26 March 2008. Sea ice is still in high concentration and strong consistent northerly winds over the past weeks has kept all polynyas in the area active sites of sea ice formation.

Spectacled eider distribution surveys (Jim Lovvorn, University of Wyoming)

Helicopter surveys to locate Spectacled Eiders began as soon as the ship entered the study area on 16 March. The first two flights (each lasting 2 h) were east and south of the area where eiders have been found in the past. A thorough search (2.5 h) of their former concentration area was done on 18 March, when no eiders were seen. However, on 19 March, a large flock of about 8,000 eiders was located at 62° 62.5'N, –172° 28'W, east of their former concentration area. We were at the end of a 2-h flight near sunset and returned to the ship without further searching. The next day (20 March), the weather prevented flights until 5 pm, when we took off prepared to land on the ice and collect eiders. Although we immediately found many eiders, most were in a single very wide lead around which the ice appeared too thin to land. We aborted the collecting attempt and let the BBC crew go out to film the eiders before it got dark. We established a new benthic sampling station (FD1) at the eiders' location (62° 28.9' N, –172° 26.6' W), and sampled it that night.

The ship then went much farther east for several days to find ice more suitable for walruses. On our way out of the study area on 23 March, we returned to the area where eiders had been seen. At 6:15 pm we were still 25 miles away from FD1. If we had taken off from that location, it was possible that after finding the eiders and setting up on the ice, we would have had only an hour on the ice before having to head back to the ship. There was also the question of whether there would be adequate ice to land on. As the ship later proceeded into the area, we learned that the eiders were actually much closer and that there were a number of good places to land near them. However, at 6:15 pm we did not know this, and a decision was made to send the BBC crew out to film the eiders. They obtained excellent footage at a location around 62° 39.2' N, –172° 11.3' W. The ship later passed near the main concentration of eiders at about 62° 38.8'N, –172° 13.8'W.

The BBC has a movie camera system called a heligimbal, which stabilizes vibration from the helicopter and can thus use high-powered zoom lenses at altitudes of around 900 feet to film small groups of animals. Their films revealed previously unknown phenomena that could not have been seen from lower altitudes at which the birds are greatly disturbed by helicopters. Rather frequent predation attempts on eiders by walruses (7 observations in 1 hour of filming), and unique group courtship behaviors that to my knowledge do not resemble anything documented for sea ducks, were recorded on film. In initial viewing of the films no paired birds were apparent, suggesting that courtship was just starting in late March. Although one cannot rule out some disturbance from the helicopter, no birds were feeding, perhaps supporting our computer simulations that suggest the eiders spend a relatively small part of the day feeding. These films will be studied in detail to document eider behaviors that could not otherwise be investigated.

In March 2008, the eiders were far more concentrated than we had seen them to be in April 1999 and March-April 2001. Counting them under such circumstances is quite difficult, but it is possible that the entire world population of around 370,000 eiders were in a single concentration within a radius of only a few miles. The area they occupied in March 2008 was farther east than areas where they were located in earlier surveys (1996, 1997, 1998, 1999, 2001), and apparently east of areas with highest density of bivalve prey. The ice around the massive concentration in 2008 had very little fecal material on it, suggesting that the birds had not been there long and may be somewhat nomadic in some years.

Seabird and Marine Mammal Observations During HLY0801 Cruise, Onboard The USCGC Healy (March 14 - 26, 2008)

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As part of the HLY0801 Cruise we censused marine birds and mammals in conjunction with oceanographic and biological sampling conducted onboard the USCGC Healy. This survey (March 14 – 26, 2008) ranged from Dutch Harbor to St. Lawrence Island. These data will be archived in the North Pacific Pelagic Seabird Database and are a part of the BESIRP study funded by the North Pacific Research Board.

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

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

We surveyed a total of 1276 km of track-line over 13 days. We recorded a total of 1099 birds belonging to 10 species (Table 1.) The majority of unidentified birds (99%) were Murres (Uria spp.) which were difficult to identify to species (Common and Thick-billed) under certain conditions.

A preliminary review of the bird distribution data indicates bird numbers were low in the areas where heavy ice conditions were prevalent. The majority of transects on this survey were conducted in heavy ice coverage with few open leads. We encountered more birds (murres, northern fulmars and gull spp.) when transiting near the Pribilof Islands and south of St. Matthew Island, where there were more open leads in the ice or ice was not present.

A highlight of the cruise was encountering groups of Spectacled Eiders (SPEI) near St. Lawrence Island. We believe we observed the main over-wintering flock of SPEI on March 23, 2008 when we estimated that approximately 350,000 birds were dispersed among open leads at 62.643N - 172.260W. The total world population of SPEI is estimated to be approximately 360,000 birds, thus this aggregation likely comprised most of the population of this endangered species. SPEI were also observed in smaller groups on March 20, 2008. The ship avoided closely approaching the SPEI flocks, therefore all of the SPEI observations were beyond our standard 300m survey area.

On transect we observed 104 marine mammals of 8 identified marine species and one arctic fox (Table 2), with spotted seal being most frequently encountered mammal. Most of the mammal observations were "off transect" (> 300 m from the ship), and of these, Pacific walrus were the most abundant mammal observed. We documented two species of whales (3 Bowhead and 2 Minke) during the cruise. On two separate occasions we made the unusual observation of a large male Steller's Sea Lion hauled up on the edge of the pack ice, south of St. Matthew Island.

Table 1. Seabird observations during HLY0801 (March 14-26, 2008)

	On transect counts		
Species	**Total (n)**	**Proportion of Total (%)**	**Overall Abundance (# / 100km)**
Black Guillemot	5	0.5	0.4
Black-legged Kittiwake	19	1.7	1.5
Common Murre	78	7.1	6.1
Glaucous Gull	28	2.5	2.2
Glaucous-winged Gull	34	3.1	2.7
Herring Gull	1	0.1	0.1
Laysan Albatross	1	0.1	0.1
Long-tailed Duck	2	0.2	0.2
Northern Fulmar	38	3.5	3.0
Thick-billed Murre	333	30.3	26.1
Unid. Alcid	1	0.1	0.1
Unid. Guillemot	2	0.2	0.2
Unid. Gull	3	0.3	0.2
Unid. Kittiwake	1	0.1	0.1
Unid. Murre	553	50.3	43.3
Total Birds	1099	100.0	86.1

Table 2. Mammal observations during HLY0801 (March 14-26, 2008)

	On transect counts			Off transect (> 300 m)
Species	**Total (n)**	**Proportion of Total (%)**	**Overall Abundance (# / 100km)**	**Total (n)**
Arctic Fox	1	1.0	0.1	1
Bearded Seal	6	5.8	0.5	10
Bowhead Whale				3
Minke Whale	1	1.0	0.1	1
Pacific Walrus	33	31.7	2.6	678
Ribbon Seal				3
Ringed Seal				1
Spotted Seal	50	48.1	3.9	51
Steller's Sea Lion				1
Unid. Pinniped				3
Unid. Seal	13	12.5	1.0	13
Total Mammals	104	100.0	8.2	765

HEALY 0801

Cruise Report

for Optical Observation

(March 13 – March 26, 2008)

written by
Jinping Zhao and Yutian Jiao

Key Lab for Polar Oceanography and Global Ocean Change
Ocean University of China

2008-3-24

Contents

1. Introduction

This cruise is for the US-NSF project “Benthic Ecosystem Response to Changing Ice Cover in the Bering Sea (BEST)”. Chief scientist is Dr. Lee CooperDr, University of Maryland, USA.

Observations are focused on the northern shelf area of the Bering Sea, the south part of the St. Laurence Island. Healy, icebreaker of US Coast Guard Cutter is the carrier for this cruise.

Dr. Jinping Zhao, professor of physical oceanography, and Yutian Jiao, senior engineer from Ocean University of China are invited by chief scientist to participate the optical observation in this cruise.

Optical observation includes the units, PRR-800 for underwater profiling and PRR-810 for surface observation simultaneously. They are a multispectral system to measure the change of sunlight in sea water. Optical measurement is conducted in daytime.

During the cruise, about 14 optical profiles are conducted successfully with the help of marine science technicians of Healy. The data seems perfect and reflects the optical status in this region.

Eight other under ice measurements in four stations are implemented to measure the transmission of solar radiation.

The optical data is benefit to understand the solar heating in the upper layer of the ocean and correlated to the climate system. The optical data has also good linkage with biological activities. The signals of different wavelengths include the information from various biomasses. Some interesting message embodies the difference between them.

It is great appreciated to Lee, Jackie, Ted and all crew of the Healy.

2. Instruments

2.1 Optical Instruments

The instruments used for optical observation are high resolution Profiling Reflectance and Radiometer (PRR) made by Biospherical Instruments Inc. (BSI, USA). The system includes both an underwater profiler PRR800 and a surface unit PRR810, which collect signals simultaneously. Both instruments are all multispectral ones with very high resolution and sensitivity, enough to detect the light in deeper water. The parameters for the system are as follows.

PRR-800

Optical features:

Wavelenths:313,380,412,443,490,510,520,532,555,565,589,625,665,683,710,765,780 and 875nm

Bandwidth: 10nm FWHM

Sensors:

Upwelling radiance, downwelling irradiance, dual axis inclinometer, detector array temperature, PRT water temperature, and pressure/depth

Irradiance array

Typical Saturation: 10^{5} $\mu Wcm^{-2}nm^{-1}$

Noise Equivalent Irradiance: 10 $^{5}\mu Wcm^{-2}nm^{-1}$

Radiance array

Typical Saturation: 10^{-3} $Wcm^{-2}nm^{-1}$ sr^{-1}

Noise Equivalent Irradiance: 10^{-12} $Wcm^{-2}nm^{-1}$ sr^{-1}

PRR-810

Optical features:

Wavelenths:313,380,412,443,490,510,520,532,555,565,589,625,665,683,710,765,780 and 875nm

Bandwidth: 10nm FWHM

Sensors:

Downwelling irradiance and detector array temperature

PRR-800/810 is a cable linked system to collect data directly by a computer during the deployment. A unit is adopted to link PRR-800, PRR-810 and computer to control the data acquirement.

2.2 Deployment of underwater system

The underwater system is deployed by the winch on the starboard. The members of marine science technicians helped to operate the winch and kept the communication with the bridge.

The system was linked to the steel rope wrapped on the winch. The rope passed the A-frame to the water. The instrument system was deployed by the rope, while the cable linking the instrument and computer are deployed together with the underwater system. A-frame was also operated by MST members.

To increase the vertical stability of the underwater unit, some steel blocks are attached to the balance the system, which reduced the tilt less than 10 degree even in the worst sea condition.

The data collection unit and computer were put on a box to real-time monitor the depth of the underwater instruments and the data quality. When it was raining, the unit was moved under the flight deck.

A dark value was recorded for optical system before the deployment. When it reached bellow the sea surface, a half minutes stay was conducted to balance the temperature.

In the shallow water region, the underwater unit was deployed to the depth, which is 3-5 m from bottom.

The profiling of the system usually took 15 minutes with the deployment speed 0.3-0.4 m/s.

The sampling frequency of PRR800/810 is 5Hz, a record per 0.2 second. The sampling interval time for MCTD is 0.1second.

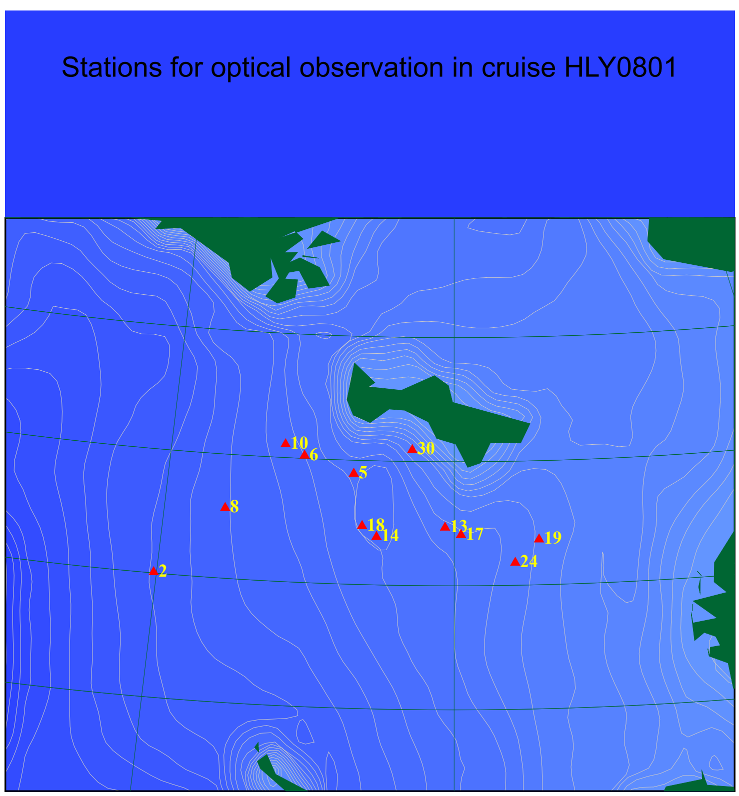
3. Measurements

3.1 Profiling

Deployment of optical unit was always immediately following the CTD cast. It is only deployed in daytime, from 9:30 to 21:30 in this cruise. Much lower radiation was measured in the early morning and midnight, as the solar height is low.

In the cloudy days, the sky became dark. The radiations in those days were quite low.

Sometimes the directions of light and wind were different, we have to choose to deploy in the shadow of the ship. In this case, the radiation was only 1/5 of the normal. Most ship-based profiling is shaded by the ship, as the wind is always to against the light.



The features of the observation environment, sea ice condition, and weather factors are recorded in the forms.

All the data we used is the original data, which file names as listed in Table 3.1, together with other information of each station. However, the original data is exported from Access files, which is recorded by the instrument system. The names of Access files for each station are listed in the record form.

Table 3.1 Station information for optical profiling

No	Stn	Depth	Level	Latitude	Longitude	File name
1	002	79	75	62°01.06'N	175°03.92'W	prof002.txt
2	005	60	55	62°54.19'N	172°18.01'W	prof005.txt
3	006	72	67	63°02.08'N	173°27.27'W	prof006.txt
4	008	75	65	62°34.66'N	174°09.92'W	prof008.txt
5	010	70	32	63°07.12'N	173°07.29'W	prof010.txt
6	Ice1	69	65	63°04.32'N	173°08.04'W	Prof100.txt
7	013	48	43	62°28.84'N	171°50.92'W	prof013.txt
8	014	60	50	62°23.91'N	172°42.50'W	prof014.txt
9	017	36	32	62°25.27'N	170°06.89'W	prof017.txt
10	018	32	31	62°29.00'N	172°27.85'W	prof018.txt
11	019ice	35	32	62°22.62'N	169°24.66'W	prof019.txt
12	Ice3	32	31	62°11.57'N	169°00.56'W	Prof101.txt
13	024	34	31	62°11.57'N	169°00.56'W	prof024.txt
14	030	45	43	63°06.24'N	171°17.18'W	prof030.txt

3.2 Under ice measurements

Working on ice, we measure both the profiling and under ice radiation. The profiling measurements from ice are listed on Table 3.1. Meanwhile, the under ice radiation measurements are listed on Table 3.2.

Under ice radiation are measured by both surface unit in the air and under water unit under sea ice. A hole through ice is necessary for each measurement. Dr. Rolf Gradinger drilled all holes for our measurements.

The surface unit was used to measure the downwelling radiation to the ice surface. It was also used to measure the reflection from the ice surface by up-side-down the unit. The unit was put on the ice by a tripod, which could be turn over easily.

The under water unit was linked to a balance frame, and then linked to a steel lever. The lever linked to a rotatable unit and another lever. After the deployment of the under water unit, the hole was shaded by a black rubber to eliminate the light through the hole. Then, rotate the worm wheel system to turn the instrument under sea ice by 90 degree.

Measurements for both downwelling radiation and reflection for ice surface are conducted separately by turn around the surface unit. Each measurement spent about 1 minutes.

Measurements are for both cases with snow and without snow. After the measurement with snow, the snow was swept in a large area to eliminate the shadow.

Table 3.2 Station information for under ice measurement

No	name	Ice thickness	Snow thickness	date	
1	002a	50	0.0	2008-3-16	Und002a.txt
2	002b	54	0.0	2008-3-16	Und002b.txt
3	100a	45	3.5	2008-3-19	Und100a.txt
4	100b	48	3.6	2008-3-19	Und100b.txt
5	019a	78	2.0	2008-3-21	Und019a.txt
6	019b	78	2.0	2008-3-21	Und019b.txt
7	101a	68	4.1	2008-3-22	Und101a.txt
8	**101b**	**68**	**4.1**	**2008-3-22**	Und101b.txt

4. Acknowledgements

We greatly appreciate the chief scientists of Healy0702, Dr. **Lee Cooper**, to provide us the opportunity to participate the cruise. During the cruise, he gave us much help and suggestion to our work, and he created lots of opportunity and convenience to us for in situ measurement.

We greatly appreciate Dr. **Rolf Gradinger** to provide us help working on ice. He helped us to drill all holes for our measurements.

We greatly appreciate the Captain of Healy, **Ted Lindstrom**, and his **crew** to provide in the maximum extent help to us.

We also appreciate the marine science technicians. They provided the winch operation, deployment, and ship manoeuvre to us in each station. Their diligent and responsible work impressed us deeply. We will forever remember the days working on the cold and windy deck with them.

We appreciate the **China IPY Office**, who offers us support to participate the cruise.

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BEST/BSIERP 'PATCH DYNAMICS CRUISE' 13-26 MARCH 2008
Marine Mammal Observations

BACKGROUND
Baleen whales, such as bowhead and gray whales, must find dense patches of prey to forage effectively. A shift in peak sighting rates of foraging gray whales from the northern Bering to the southern Chukchi Sea[1] and detection of gray whale calls over-winter 2003-04 in the western Beaufort Sea[2] suggest that this species may be changing its feeding and migratory habits in response to population growth, climate change, or both[3]. Bowhead whales over-winter along the ice front and in polynas in the northern Bering Sea, but their behavior and movements prior to the onset of the spring migration into the Chukchi Sea are poorly known[4]. In recent years, the regular occurrence of feeding bowheads near Barrow in late summer suggests that this species too may be changing foraging and migratory habits.

The use of passive acoustics to detect the distinctive calls of large whales in offshore Alaskan waters has become a reliable tool[5]. Currently, five autonomous recorders are deployed in the western Beaufort Sea to detect calls, as part of a study of bowhead whale feeding ecology near Barrow, Alaska[6]. While the lexicon of typical bowhead calls has been described, there are very few data to link whale behaviors to specific calls. Furthermore, recent recording of complex song from this species offshore from West Greenland[7] suggests that, if it occurs in the Bering Sea bowhead population, this type of acoustic display may be confined to a brief period in early spring. Documenting song for bowhead whales in the Bering Sea would be a significant gain in understanding the bio-acoustic behavior of these endangered whales.

METHODS
During the HEALY08-01 cruise, marine mammal observations were undertaken primarily via deployment of expendable sonobuoys to listen and record marine mammal calls, and secondarily by conducting a visual watch from the ship. Sonobuoys were deployed over the side of the ship during the final approach to hydrographic/benthic sampling stations and relayed underwater sounds back to the ship via radio link. Recordings were made over several hours while the ship maintained station roughly 1-2 km from the sonobuoy deployment site. Primary objectives of this sampling included: (1) identification of calls coincident with observed behaviors of bowhead whales; (2) detection of patterned calling, or song, in bowhead whales; (3) identification of calls of gray whales, or other temperate-water whale species (e.g., fin, humpback); (4) recording of walrus and ice seal calls, relative to numbers seen; (5) description of ambient noise levels in various classes of sea ice. Visual watches for whales and ice seals were conducted from the bridge, in partnership with USFWS seabird observations (E. Labunski).

RESULTS SUMMARY
Seventeen sonobuoys were deployed during the cruise, of which 13 were functional (Table 1). A dipping hydrophone was deployed at two on-ice stations, with recording at the second station stymied by temperatures too low for the equipment. Bowhead calls were recorded from eight of the 13 (62%) functional sonobuoys (Fig. 1). Best sampling was achieved near the polynyas south of St. Lawrence Island (SLI) and St. Matthews Island (SMI), and at stations along the western boundary of the study area. Patterned calling by bowheads was detected, consisting primarily of 'call doublets'; a variety of 'growls', 'trumpets' and 'moans' were also recorded. Calls of bearded seals (trills) and walrus (tapping) were the dominant signals on all recordings. Bearded seal calls were strongest near the polynya south of SMI, while walrus tapping was prevalent at deployment sites southeast of SLI.

Bowhead whales were seen twice (total = 3 whales; Table 2), both times near large flocks of spectacled eiders. Bowheads were observed only briefly, in small openings in 8-9/10ths ice cover, making extended behavioral observations impossible. The only other cetacean sighting was a group of 15-20 belugas, swimming actively in a small opening in 9/10 ice. This sighting took on an ethereal quality as it occurred during darkness and made possible by ship's lights.

Table 1. Sonobuoy and on ice (OI) hydrophone deployments; marine mammal species* detected.

DATE	SONOBUOY CH #	LATITUDE (N) LONGITUDE (W)	STATION NO.	SPECIES DETECTED
16 MAR	21	6221.1 175 10.2	NWC5	**BH**, BS WS
17 MAR	4	6254.3 17518.9	SWC2	**BH**, BS, WS
	24	6301.7 17325.2	NWC2.5	WS, BS
18 MAR	30	6234.7 17409.9	NWC4A	BE, BS, WS
	OI	6252.6 17432.2	DLN9	BS, WS
19 MAR	4	6306.5 17309.2	NWC2	**BH**, BE, BS, WS
	OI	6304.9 17305.9	(?)	H-phone FAILURE (-16C)
20 MAR	14	6229.6 17150.9	SEC2.5	**BH**, BS, WS
	30	6224.1 17241.9	POP4	SONOBUOY FAILURE
	1	6227.1 17231.9	FD1	RECORDER FAILURE
21 MAR	21	6225.4 17006.8	NEC2	BS, WS
	14	6223.9 16921.6	NNY	BS (faint), WS
22 MAR	4	6215.8 16900.5	(?)	BS (faint), WS
23 MAR	27	6258.9 17016.3	JGR1	SONOBUOY FAILURE
	24	6259.4 17046.8	JGR1 (SLI)	**BH**, BS, WS
	1	6307.5 17052.9	JGR3 (SLI)	PATCHY SB SIGNAL
	14	6309.6 17055.3	JGR3 (SLI)	**BH**, BS, WS
	4	6307.2 17118.3	JGR4 (SLI)	**BH**, BS. WS
24 MAR	24	6012.5 17307.8	St. Matt Is.	**BH**, BS, WS

*BH = bowhead; BE = beluga; BS = bearded seal; WS = walrus

Table 2. Summary of cetacean sightings.

DATE	SPECIES	LATITUDE (N) LONGITUDE (W)	NUMBER	COMMENT
15 MAR	Beluga	5857.1 17441.1	15-20	0545 sighting = dark beluga seen actively swimming in small hole from ship's lights
20 MAR	Bowhead	6227.2 17230.1	2	Bowheads seen among large flock (~ 8K) of spectacled eiders; 2 blows each whale & one head lunge; then dove under ice
23 MAR	Bowhead	6235.1 17158.9	1	Single whale surfaces twice in small hole in 0.9 new pan ice; shape of head (stack) and smooth-black skin are ID features

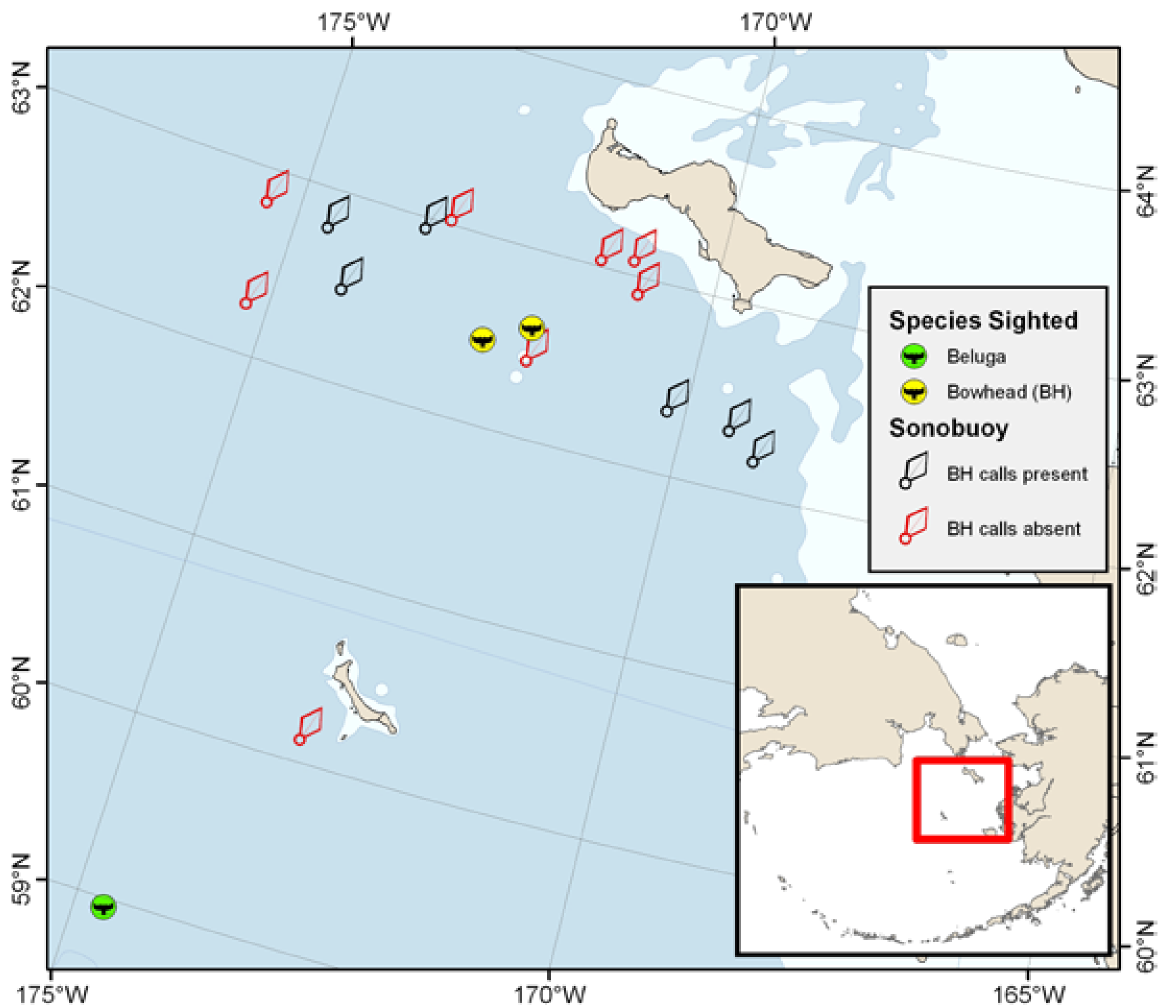


Figure 1. Locations of acoustic sampling for bowhead whale & other marine mammal calls.

References

1) Moore et al. 2003. Can. J. Zoo. 81: 734-742.
2) Stafford et al. 2007. Arctic 60(2): 167-172.
3) Grebmeier et al. 2006. Science 311 (5766): 1461-1464
4) Moore and Reeves 1993. The Bowhead Book, pp. 313-386, Allen Press, Inc.
5) Moore et al. 2006. BioScience, 56(1): 49-55.
6) Rugh et al. 2007. BOWFEST Study Plan
7) Stafford et al. review. J. Acoust. Soc. Am.

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.

Florentine Films/Hott Productions
Production Report
Filming on the USCG Healy, March 13 - 26, 2008

Florentine Films/Hott Productions, in collaboration with Smith College and Tom Litwin, Director of the Clark Science Center at Smith College. is producing “Thin Ice,” a two-hour film about climate change and the Bering Sea. The production has received partial funding from the NPRB. Lawrence Hott, producer and director, and David Litz, cinematographer were on board, along with Tom Litwin.

One theme of the film is the study of the impact of changing ice conditions on both the ecosystem and people of the northern Bering Sea. To that end, we accepted the gracious invitation of Lee Cooper, lead scientist on this expedition, to film the work of the science teams on board.

Our immediate goal was to gather sufficient material to edit five video podcasts for use on the web, probably through the NOVA website. We filmed material on the Healy for video podcasts and later use in the longer film about patch dynamics, satellite tagging of walrus, distribution and health of eiders, and sea ice ecology and microbrial networks.

We filmed extensive scenes of benthic grabs, CTD-Rosette collection and analysis, laboratory examination of infauna, and the use of benthic cameras. We participated in three ice deployments and filmed the ice teams headed by Rolf Gradinger, Jinping Zhao and Yutian Jiao, and Karen Frey.

We also did extensive interviews with Chad Jay and Tony Fishbach about walrus satellite tagging and its relationship to the other research being done on the Healy. We filmed the walrus tagging team preparing for their expeditions and their returns, gathering information about their processes and theory. We took the same approach with Jim Lovvorn and his survey of spectacled eiders.

We did our most extensive interviews with Lee Cooper and Jackie Grebmeier, both as stand alone interviews and while each scientist was working with the CTD, benthic camera, benthic grabs, or in the lab.

In order to portray of the complexity of work on the ship, we filmed ice deployment and flight briefings and interviews with the captain and crew. In addition to the filming effort, Tom Litwin wrote 10 blogs with pictures for the Boston Globe. The blogs were featured on their website, Boston.com, in the Lifestyle Section, in the Green Blogs feature. Litwin’s onboard efforts represented research for curricular materials and the book, Thin Ice: An Exploration of the Bering Sea at the Dawn of Global Warming. The film, book, podcasts, and instructional materials are products of a Smith College-Florentine Films/Hott Productions IPY education and outreach initiative.

On March 23 Larry Hott and Tom Litwin left the ship by helicopter and flew to St.

Lawrence Island. There they spent five days in Gambell and Savoonga meeting with community leaders, walrus hunters and other community members in order to prepare for filming on the island in late April and early May.

Respectfully submitted by,

Lawrence R. Hott

Frozen Planet

BBC Natural History Unit/Discovery
Production Report
Natural History Filming onboard USCG Healy March 2008.

Frozen Planet is a BBC Natural History Unit / Discovery co-production of 7 one hour high definition documentaries brought to you by the team that produced Planet Earth. The remit of the series is to produce the ultimate portrait of the Polar Regions, using the same combination of cinematography, ground breaking visual styles, revelatory wildlife stories and emotional narrative drives. Frozen Planet will profile the Arctic and the Antarctic and species which live in these disappearing environments in a way that has never been done before.

The BBC team of Jeff Wilson (Director), David Mackay (aerial cameraman) and Stephen De Vere (ground cameraman), joined the USCH Healy 08-01 cruise under the invitation of Lee Cooper, Jim Lovvorn and Chad Jay with the aim of trying to film Spectacled eider ducks (SPEI) and walrus both from the air and the ground. Frozen Planet aimed to try and profile those species who choose to over winter in the Bering Sea rather than migrate to avoid the obvious trappings of a polar winter, and to document what conditions conspire to allow them to do so.

In total we flew 4.9 hours using the Bell206L onboard with Pilot Bill Springer, Jeff Wilson and David Mackay on board. During this time we managed to film a total of 1.2 hours of High definition video . This will be broadcast on Discovery in the USA in 2011, as part of the series Frozen Planet.

The footage consisted of 370,000 SPEI , found by the BBC, from the air, in amongst which we filmed and observed display aggregations of 30+ ducks which have never been recorded in this species before. As well we documented several predation attempts by Walrus on the ducks. This was seen approximately 7 times on 2 separate occasions by different walrus. All footage is currently being laid down on DVD for Jim Lovvorn and Chad Jay for further analyses.

The BBC also filmed a number of approaches, rotations around and take offs from the USCH Healy on the request of the XO to be used by the USCG Healy for training operations in the future. The BBC also documented a number of sea ice formations which will be used in the final program.

Unfortunately due to ice conditions and limitations on personnel inside the helicopter, we did not manage to film from the ground.

The BBC will also be supplying Lee Cooper with a number of images to be used for future science talks on a non commercial basis.

We were humbled by the amount of co-operation and advice on the part of the science teams and the crew of the USCG Healy, and had an extremely good experience which we believe will translate to exposing the fragile ecosystem of the Bering Sea to millions of viewers worldwide in 2011.

Report from Christian Morel:

The Polar Planet Association and French photographer Christian Morel, want to give our best thanks to Dr Lee Cooper who provided the opportunity for participation on this Healy cruise. I am also very appreciative of the kind support of Dr Rolf Gradinger and his team (to whom I was depending on) and the positive reaction and assistance to my photographic work by all the other scientists onboard. During the cruise I made a very interesting set of photo views, documenting the different scientific work being done from the ship and on the ice.

At the end of the IPY, a selection of the most interesting images will be put together with other photos from additional trips I am making, in a traveling exhibition (from one city to another worldwide) whose goal will be to give to the general public, the decision-makers, and school children a wide view of the scientific research in polar areas. What is it, how is it made, by who, where, why and for what.

Before that the pictures will be soon displayed on the website www.ourpolarheritage.com and available for the publication and communication needs of the scientists from the cruise. I also have made very short videos interviews (2 min) from the researchers that will help some school children in France to have a better understanding of the importance of this research, and of a scientific cruise as this one on the Healy.

Appendix: Selected Examples of Public Outreach and Education Activities Conducted During Cruise. Other outrach efforts are available as discussed in the individual cruise report sections

Forum Of Alaska Marine Issues (FOAMI)

MARINE ADVISORY PROGRAM

CG icebreaker Healy research summaries!

When: ***7pm, Tuesday 11 March 2008***

Where: ***Museum of the Aleutians***

Who: ***Rolf Gradinger (UAF)***
Lee Cooper (Univ. of Maryland) and others

- Come and hear about research going on in the Northern Bering Sea!!!
- Researchers will talk about research being done on ***walrus, benthos, birds and sea ice***

Questions, contact: Reid B er (MAP) 581-4589

Flyer courtesy of Reid Brewer, Marine Advisory Program Agent in Unalaska for the University of Alaska Fairbanks

Photos courtesy of Craig Kasemodel, Central Middle School of Science, Anchorage

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)

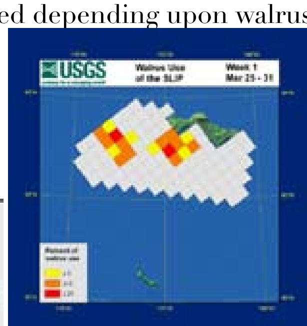
USCGC Healy (HLY0801), March 13-March 26, 2008

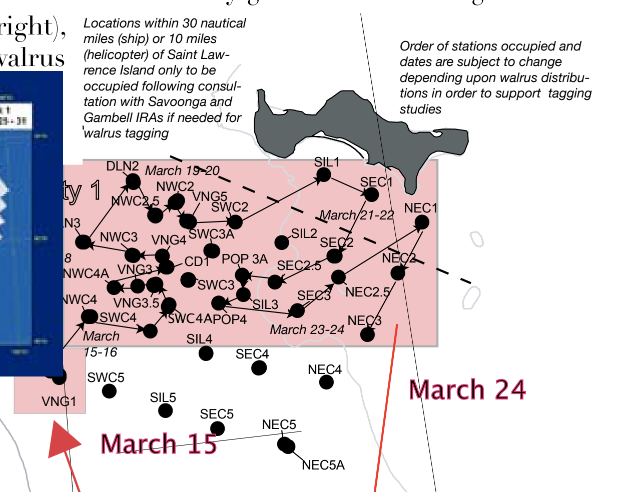
Lead scientists: Lee Cooper, cooper@cbl.umces.edu, phone: (410) 326-7359, University of Maryland) Jackie Grebmeier, jgrebmei@utk.edu, phone: (865) 974-2592 (University of Tennessee), and Chad Jay, cjay@usgs.gov, phone: (907) 786-7414 (Biological Resources Division, US Geological Survey)

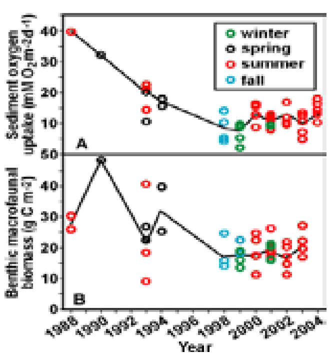
The icebreaker Healy will be visiting waters near Saint Lawrence Island three times in 2008. In this first short research cruise in March, we are continuing work on benthic (sediment-based) food webs. Our past work has shown that the number and weight of organisms present in the sediments is in decline 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. Mr. Perry Pungowiyi of Savoonga will participate in the cruise as part of the walrus tagging team and we hope to find some other ways to share information with both Savoonga and Gambell about what we learn as well as receive 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 in 2007 (right)







Benthic biomass and sediment metabolism declines during the last decade in the Bering Strait region. From a paper published in Science, March 10, 2006

We will occupy many of the same areas sampled during the Healy cruises in May 2006 amd 2007. 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 operations. The consultations with the villages will be through their IRA Councils by electronic mail and satellite phone from the ship. In particular we will consult if there are scientific needs for the ship to approach closer than 30 miles to Saint Lawrence Island.

Flyer sent prior to the cruise to the IRA Council (tribal governemt) Offices in Savoonga and Gambell for public posting click to print

PLENTY
IT'S EASY BEING GREEN

The walrus and the researcher

Tracking walruses and what they eat sheds light on the changing Bering Sea ecosystem

By Alisa Opar

From a helicopter swooping low over the Bering Sea, Chad Jay spotted walruses resting on an expanse of sea ice and decided to go after one of them. The pilot dropped off Jay and his companions a good distance away so they could approach their quarry undetected. Drawing near, they paused to unload their equipment and ready their crossbow, and then began the final approach. Suddenly, the large panel of ice the walrus was sitting on began to shift and drift away from the party.

“It started taking our walrus away from us,” recalls Jay. “He went right into the water."

That creature got away, but Jay’s team hit ten others on the two-week trip last month near St. Lawrence Island, located west of mainland Alaska in the Bering Sea. The group didn’t have malevolent intentions, however: They’re walrus researchers who use a crossbow to implant satellite radio tags that will track the animals for six to eight weeks (when the transmitters naturally fall off). Tagging walruses is the best way to track their movement because they spend about 80 percent of their time underwater, where they feed on benthic organisms like snails and clams that live on the seafloor.

With the transmitters, Jay and his colleagues will collect data on where the walruses are foraging and compare that information to the availability of benthic prey, which may become increasingly scarce if current warming trends continue. (Click here to go to the Alaska USGS webiste and see how the walruses are moving.)

The walrus research is just one of the dozens of projects taking place in the oceans during the International Polar Year. Other scientists are investigating sea ice reduction, how contaminants are affecting polar marine ecosystems, and ocean current systems.

Though the main focus of the cruise, a two-week research excursion in March on the 420-foot icebreaker, Healy, was studying walruses, the three dozen scientists onboard also aimed to gain a better understanding of the Bering Sea ecosystem and how it will be affected if global temperatures continue to rise. Recent studies have found that a major ecosystem shift is underway—the air and water temperatures are rising, and the makeup of marine organisms is changing.

“One of the concerns is that as sea ice retreats and water temperatures are warming, how will the food web change?” says Lee Cooper, a biogeochemist and the chief scientist for the recent cruise. “Already, there’s some evidence that the food supply for benthic feeding organisms like gray whales, bearded seals, and walrus, is declining.

Scientists don’t entirely understand why crabs and other critters that live on the ocean floor are disappearing, but walruses may soon face more competition for what food there is. In the northern Bering Sea at the continental shelf’s southern boundary lies an area called a cold pool, where cold, dense water effectively prevents fish, like salmon and pollack, from reproducing. That means walruses that forage on the shelf have little competition from fish.

“But lately that pool appears to be eroding away, and salmon and pollack that haven’t been seen as much in the northern Bering Sea are starting to be observed there,” says Cooper. “Fish probably eat a lot of the things on the bottom that walruses eat. It’s entirely likely that we’re seeing a shift in food web and we’re going to see a more fish-dominated web. That brings up concerns about trawling and what areas get opened up for fishing, which could potentially hurt benthic feeders like walruses."

Another concern is shrinking sea ice. Walruses use sea ice as a platform, resting on it between foraging trips into the relatively shallow waters over the shelf, where the water is only about 60 meters deep.

“When there’s no sea ice to take them out to forage, there’s much less of the shelf they can forage on, and with time they may deplete some of those near-shore resources. That may become a problem for them,” says Jay.

To the north of the Bering Sea, in the Chukchi Sea, researchers have already seen how walruses suffer when ice is reduced. The animals must choose between staying with the ice, which is retreating over deep waters where they can’t forage effectively, or coming to shore, where they’re at risk from people and polar bears.

“We’re not sure exactly what will happen, so we’re trying to gain a better understanding of how walruses respond to reduced sea ice conditions,” says Jay, “and that translates into management conditions."

The knowledge could be especially useful if walruses are listed as Endangered Species. On February 7, the Center for Biological Diversity filed a petition with the US Fish and Wildlife Service to protect the Pacific walrus under the federal Endangered Species Act, due to threats from global warming and growing oil and gas development throughout its range.

Posted on Apr 9, 2008 at 8:00 AM

An additional news feature was carried on the Alaska Public Radio Network, “Tagged walrus teaching scientists about Bering Sea” on April 9, and is available at http://aprn.org/2008/04/09/tagged-walrus-teaching-scientists-about-bering-sea/ or from the Apple I-tunes store as a free podcast (APRN: Alaska News, April 9. 2008)

Press release from Coast Guard; portions of the press release were featured in a number of media outlets, including the Seattle Times, Baltimore Sun, Anchorage Daily News and local television news in Seattle and elsewhere

U. S. DEPARTMENT OF HOMELAND SECURITY

U. S. Coast Guard

FOR IMMEDIATE RELEASE **March 4, 2008**

Contact: LTJG Stephen M. Elliott
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SEATTLE, WASHINGTON - The nation's largest icebreaker, USCGC HEALY, commanded by CAPT Ted Lindström, will depart her homeport of Seattle, WA on the 6th of March. HEALY's departure from Seattle will denote the beginning of the Arctic West Summer 2008 Deployment that will have the cutter in the northern polar regions for over six months. During the deployment HEALY will travel over 25,000 nautical miles and conduct over 2,000 individual science evolutions in the course of completing seven separate science missions. HEALY will spend six weeks between the second and third missions in Seattle conducting scheduled maintenance and training.

HEALY's two science missions this spring are part of the National Science Foundation's Bering Ecosystem Study (or BEST) and the North Pacific Research Board's Bering Sea Integrated Ecosystem Research Program. They are timed to study ecological processes as sea ice retreats through the Bering Sea. The recent decline in the extent and duration of arctic sea ice has stimulated scientific as well as public interest in how the productive Bering Sea ecosystem will change if current warming trends continue. HEALY scientists will launch a comprehensive suite of studies to provide insights about how marine microorganisms, plants and animals, including fish, marine mammals, and birds, as well as local human communities, will be affected by the on-going changes in the region. The two chief scientists coordinating the scientific missions explain that this work at the ice edge will use different sampling strategies, but focus on a common goal of improving ecological understanding of the Bering Sea.

HEALY will pick up the first team of scientists from Dutch Harbor, Alaska in mid March and proceed into the central Bering Sea. The mission will focus on determining how the dynamics of walrus movement relate to the supplies of small seafloor animals that walrus consume as food. According to chief scientist Lee Cooper of the University of Maryland, "Walruses are thought to become more vulnerable as the arctic sea ice disappears. The recent observations of stranded calves and the congregations of thousands of these animals along Arctic Ocean beaches last summer, when they historically used to feed from ice, seem consistent with that view." Declining sources of winter food on the sea floor in the Bering Sea were documented in a study published in 2006 in *Science* and may be a result of competing fish moving north. These concerns, among others, led to a recent petition to formally list walruses as threatened under the Endangered Species Act. According to Cooper, in addition to the walrus work, the cruise plan includes efforts to study other important arctic species as well as the chemical and physical conditions they live in.

The second research mission, which runs from early April to mid May, is arguably the most ambitious scientific deployment HEALY has ever undertaken, according to chief scientist Carin Ashjian of the Woods Hole Oceanographic Institution. “Scientific berth space is entirely spoken for by scientists from universities, institutions and agencies across the United States and the rest of the world. We are adding to the extensive lab space already on HEALY by seeking out temporary science vans that are essentially modified shipping containers for some of the scientists to work in.” The research program will focus on the entire Bering ecosystem and how it changes as the ice melts. Scientists will use sediment grabs, video plankton recorders, ice corers and a wide variety of other equipment to study everything from big seals and tiny plankton to the chemistry and physics of the Bering Sea. According to Ashjian, “I expect the overall study to pay great scientific dividends with all of the new scientific tools and approaches being used. We are also sharing and exchanging information with local residents of the Bering Sea region, who are dependent upon subsistence hunting and fishing and are greatly concerned about the prospects for climate change.” Also joining the mission is middle school teacher, Craig Kasemodel, who is participating in the mission through an International Polar Year research immersion program for teachers called PolarTREC. Students across the nation will participate in the research through conference calls and interactive blogs while HEALY is underway.

HEALY is the newest and largest of the nation’s three heavy icebreakers and the only one with extensive scientific capabilities. The 420-foot cutter was commissioned in 2000 and has a permanent crew of 80. Scientific support is her primary mission, but as a Coast Guard Cutter, HEALY is also a capable platform for supporting other potential missions in the Polar Regions, including logistics, search and rescue, ship escort, environmental protection, and the enforcement of laws and treaties. Many people have begun to speculate what will happen in the Arctic if the less ice leads to more shipping and human activity in the region. When speaking of the future, Admiral Thad Allen, the current Commandant of the Coast Guard, has said that “Icebreakers will have an important role to play.”

Caption for attached picture:

1. Scientists working on the ice-covered Bering Sea during HEALY’s BEST mission in 2007. US Coast Guard Photo/BM3 Andrew Yeckley

For more information about HEALY, please check:
http://www.uscg.mil/pacarea/healy
http://www.icefloe.net
Or contact the public affairs officer at:
stephen.m.elliott@healy.uscg.mil
(808) 434-4897 Ext. 0 after tone
For more information on BEST, please check:

http://www.arcus.org/bering/
http://bsierp.nprb.org/
For more information on PolarTrec, please check:
http://www.polartrec.com/
Dr. Lee Cooper, the chief scientist for the first mission, can be contacted at:
lcooper1@utk.edu
Dr. Carin Ashjian, the chief scientist for the second mission, can be contacted at :
cashjian@whoi.edu

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2008 Expeditions » **Current Expeditions**

Bering Ecosystem Change

Overview	**Mr. Kasemodel's Journal**	**Ask the team**	**Photo Gallery**

Bering Ecosystem Change

March 11 - 28, 2008 | Bering Sea

Teacher
Craig Kasemodel
Central Middle School of Science
Anchorage, AK

Researcher
Lee Cooper
University of Maryland
Solomons, MD

Senior Outreach Manager
Nora Deans
North Pacific Research Board

The Live from IPY! event on March 20, 2008, with PolarTREC teacher Craig Kasemodel and researchers aboard the USCGC Healy, in the Bering Sea is now archived. To access the archive, click here.

Who is on the expedition?

Craig Kasemodel is a science and technology teacher at the Central Middle School of Science in Anchorage, Alaska. Mr. Kasemodel attended the University of Wisconsin-Madison and Montana State University and holds degrees in Economics, International Relations, and Fish & Wildlife Management, and spent several years conducting wildlife biology research in rural Alaska and Montana. Mr. Kasemodel enjoys teaching other teachers how to incorporate technology in their classrooms and introducing students to science. He is active with the **ALISON** Project and recently developed a freshwater science class for students to conduct water quality and stream assessments. In his spare time, he enjoys building computers and websites, fly-fishing, hiking, skiing, and spending time outdoors with his wife and chocolate lab. He is excited to be part of PolarTREC and to join the crew on the *Healy* with the hope of increasing awareness of climate change and polar science. Learn more about Mr. Kasemodel at his classroom **website**.

Lee Cooper, of the University of Maryland, is the chief scientist on the first of several science cruises that will take place aboard the USCGC **Healy** in 2008. 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?

A diverse team of researchers will be participating in the first of three research cruises this spring and summer aboard the **USCGC Healy** in support of the **Bering Sea Ecosystem Study (BEST) and the Bering Sea Integrated Ecosystem Research Program (BSIERP)**. Check out the logbook at **http://bsierp.nprb.org/cruises/current.html**

Scientists onboard the ship will be documenting late winter ocean conditions, studying the biological communities found in sea ice, examining the early spring plankton bloom, and investigating light penetration through open water and ice cover. Additionally, researchers will be examining the **benthic** communities living on the seafloor as will as observing an important benthic predator, the walrus. The region of the Bering Sea where the team will be 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 waters warm.

Where are they?

The team will travel on the USCGC *Healy* to the 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 and return to the port of Dutch Harbor, Alaska, which is in the Aleutian Islands. During the cruise they will sample the biologically diverse waters as they move northward toward Saint Lawrence Island.

Project Vocabulary

Benthic:

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

Biogeochemistry:

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

Bivalves:

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

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.

Polychaetes:

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