Cruise Plan for Bering Ecosystem Study Project (BEST) on U.S.C.G. Cutter Healy (HLY0701); April 10 through May 12, 2007

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Introduction and Overview

The initial cruise of the NSF sponsored Bering Ecosystem Study (BEST) project will take place April 10 –May 12, 2007 aboard the USCG cutter Healy (hereafter HLY0701). Similar ice-breaker cruises are planned in the following years. BEST is part of a larger, multi-agency, integrated effort that addresses ecosystem research in the eastern Bering Sea. Further information on the broader scientific context can be found at http://www.arcus.org/bering/. The more specific major scientific goals of the BEST project and the general approach to their accomplishment can be found in the BEST Science Plan on-line at http://www.fish.washington.edu/research/best/. Briefly, BEST is concerned with understanding the ecosystem level responses to the changes in ice extent and seasonal distribution in the eastern Bering Sea, and in particular the impacts these changes may have on the fish, bird and marine mammal populations. The availability of an icebreaker with the capabilities of the Healy provides one of the first opportunities to sample extensively in the marginal ice zone (MIZ) of this biologically productive marine system.

Science and Outreach Missions on HLY0701

The science efforts aboard HLY0701 consist of several groups of researchers who will address various aspects of hydrography, nutrient chemistry, plankton production and distribution, marine mammal populations and bird surveys (Table 1).

Table 1. Science components and their major sampling activities during HLY0701.

Component - Principal Investigators	**Sampling activities**
1) Hydrography and circulation - Phyllis Stabeno; NOAA PMEL	CDT casts; drifter releases
2) Nutrient and oxygen fields - Cal Mordy; JISAO/Univ. of Wash.	Water sampling with Niskin bottles; ice sampling
3) Nitrogen productivity and budget – Ray Sambrotto; LDEO & Dan Sigman;	Water sampling with Niskin bottles, incubations, ice sampling

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4) Iron distribution – Jingfeng Wu; UAF	Water sampling with trace metal clean bottles, ice sampling.
5) Productivity, sediment fluxes and benthos – Al Devol; UW & David Shull; UWW	Water sampling with Niskin bottles, multicorer collections
6) Zooplankton & meroplankton – Jeff Napp; NOAA AFSC	Plankton net hauls and size fractionation
7) Ice Seals distribution and abundance – Michael Cameron, NOAA NMML	Bearded, spotted, ringed, and ribbon seals - aerial & shipboard surveys; satellite tagging
8) Marine bird distributions and abundance – Kathy Kuletz; Fish and Wildlife Service; K. David Hyrenback, UW	Observations from ship & ice
9) Walrus distributions and abundance – Carleton Ray; UVA	Aerial & shipboard surveys
10) Echo location and estimation of fish and krill – Chris Wilson & Alex De Robertis; NOAA	simrad EK60 scientific echosounders
11) CTD support and data management – Scott Hiller, Parisa Nahavandi, Scripps; Janet Scannell, NCAR/EOL	CTD/ Niskin sampling; computer databases
12) Underway bottom profile measurements and science support - Steve Roberts, UCAR; Tom Bolmar, WHOI.	Acoustic system; computer networking
13) Helicopter support – Maritime Helicopters	Surveys of ice field, transport of scientists & gear.
14) Education & outreach – Robyn Staup, Boonshoft Museum; Maggie Prevenas, Kalama Intermediate School	Blog from the ship; ask-a-teacher interactions with classrooms; follow up curriculum development.

Overall Cruise Track and Logistical Considerations

Some of the science components listed in Table 1 have specific requirements and incompatibilities that need to be considered in the cruise plan. These factors include the sensitivity of the iron sampling to contamination from the ship and other equipment as well as the need of the coring work for a soft-bottom community. The ice seal work is dependant on the appropriate ice environment. In addition, specific sampling requests were made for deep-basin and slope waters as well as for specific regions for zooplankton collection. These issues were considered at cruise planning meetings that were held in September 2006 in

Washington DC and December 2006 at the University of Washington. The latter planning also included meetings with the Coast Guard and a tour of the Healy. Based on these meetings and further communications within the science group, a sampling plan was developed that covers most of the non-Russian waters in the eastern Bering Sea (Fig. 1). The cruise track will begin and end in Dutch Harbor, Alaska for the 33-day period from April 10 to May 12, 2007. Fig. 1 depicts the four major cross-shelf lines: SL, MN, PN and CN. These lines are crossed by an extensive long-shelf section along the 70m isobath (the 70m line).

An important factor in the planning of HLY0701 is the contemporaneous sampling of the NOAA ship Miller Freeman in the region. This 2-ship sampling has been incorporated into the HLY0701 cruise plan and will impact upon it in two basic ways. We plan joint sampling of the Healy and Miller Freeman in the region of the residual southernmost MIZ front. This region will be identified from the Healy during the early part of HLY0701 and its location communicated to the Miller Freeman for joint sampling on April 29-30. The Miller Freeman has a UTOW instrument package that can provide a 3-dimensional map of surface water for salinity, temperature, oxygen, chlorophyll and other parameters. Also, we expect that the Miller Freeman can sample most of the CN line toward the end of its cruise, thus leaving the Healy more time in the MIZ. For planning purposes, the overall cruise plan has been sub-divided into 11 sequential phases. The goals and sampling of each of these phases is detailed in the following sections.

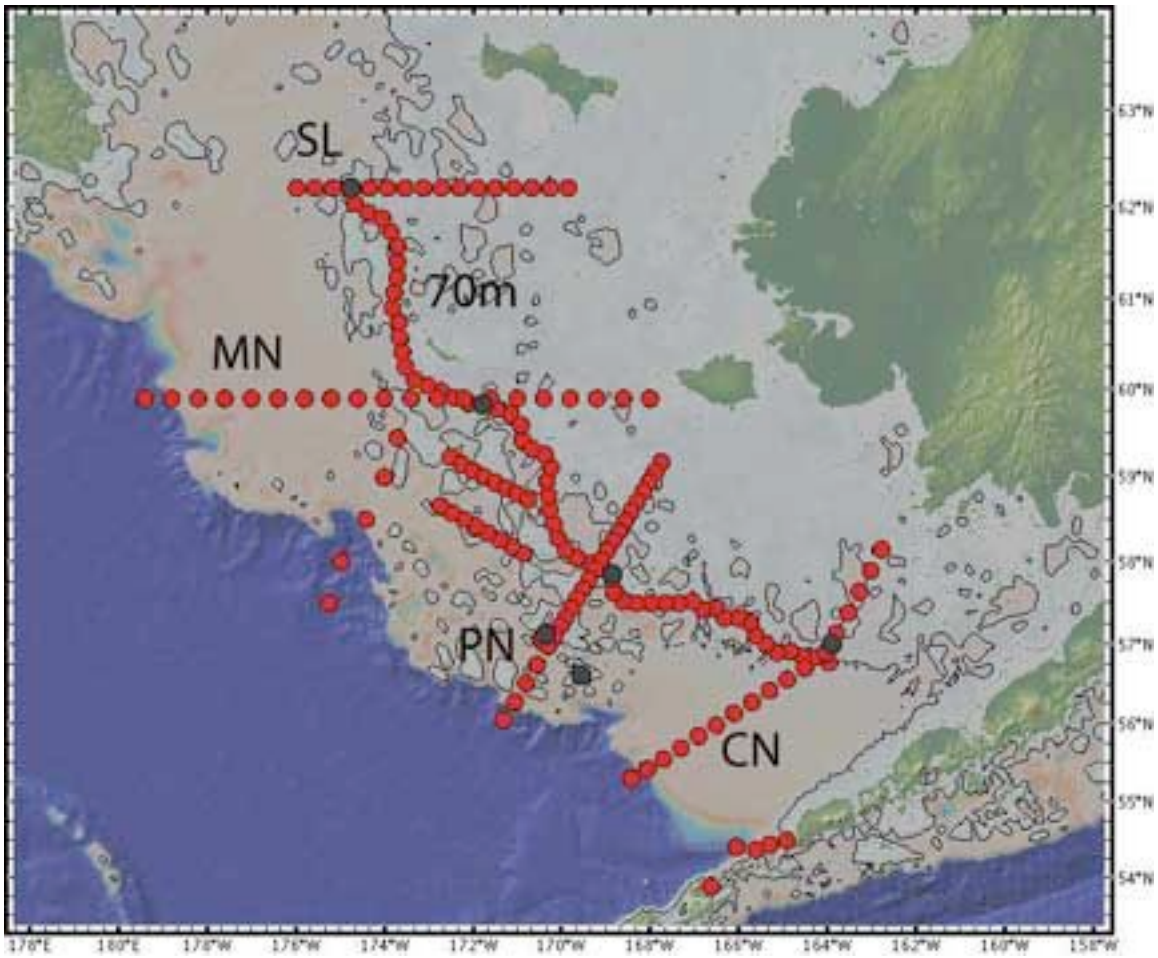
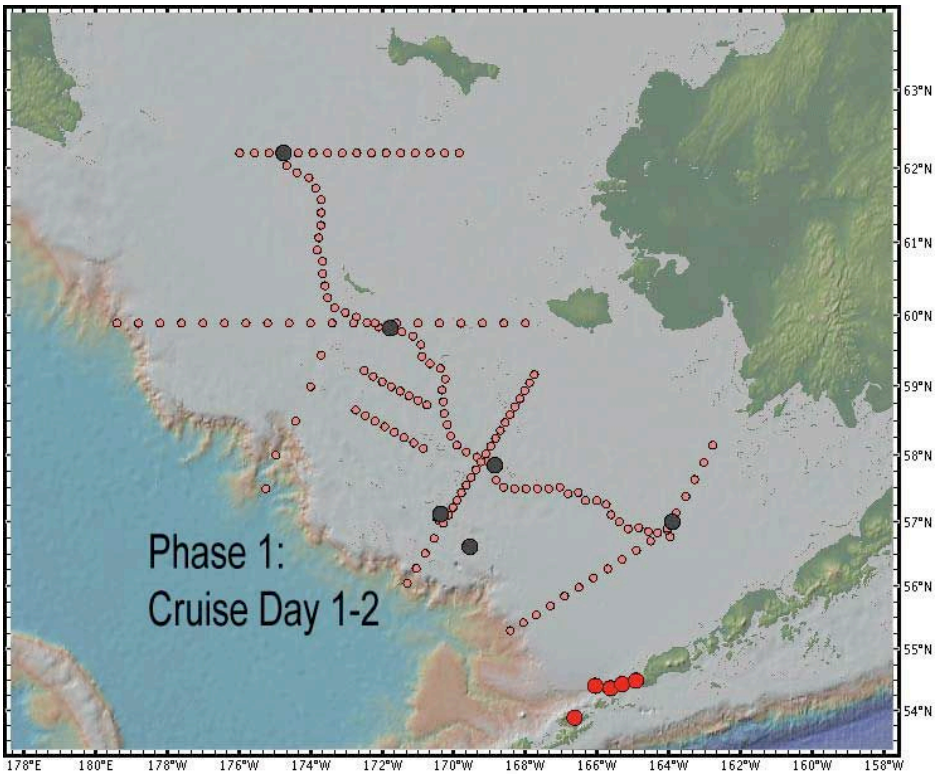


Fig. 1. Overview of planned station locations during HLY0701. The four major cross-shelf sections and 70m section are labeled.

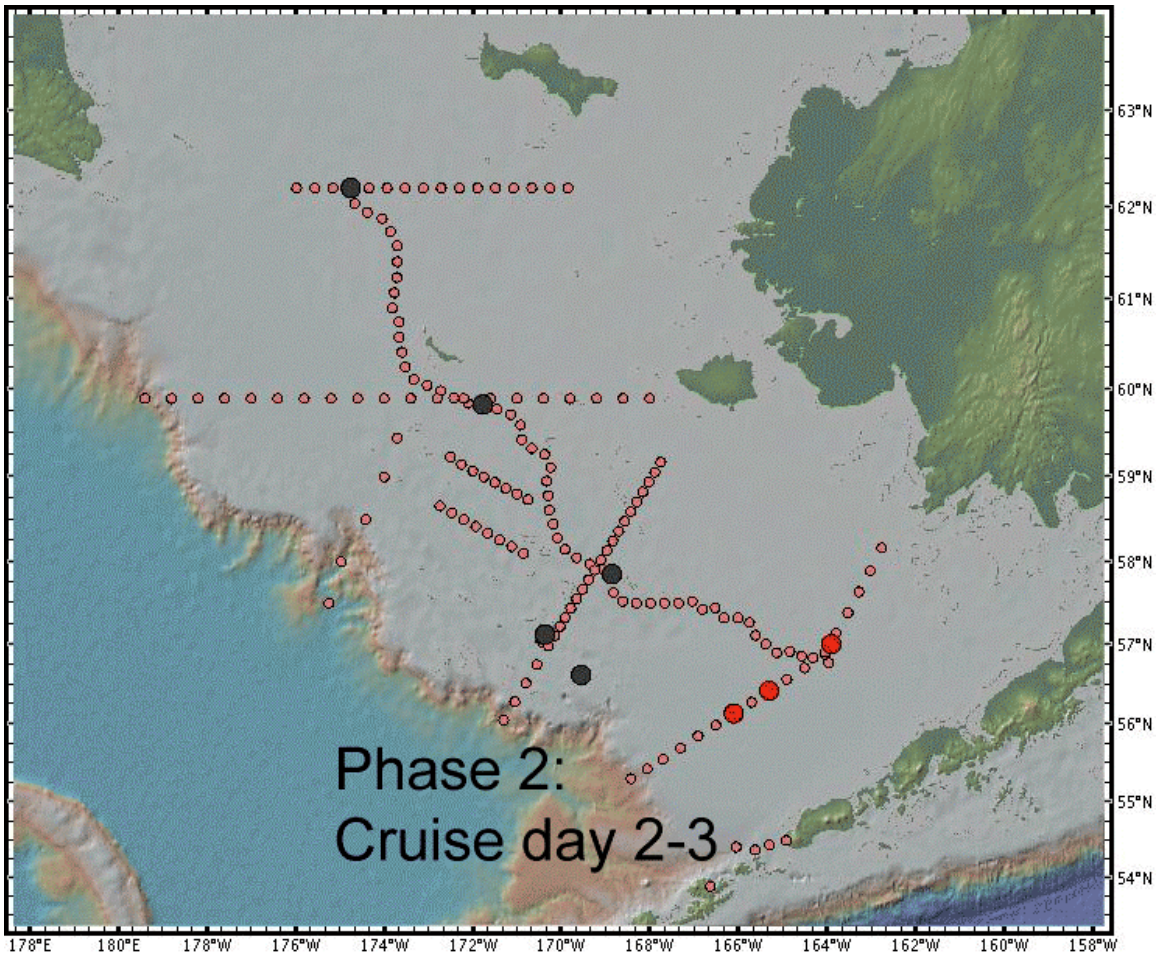
Phase 1 – Initial stations from Bering Canyon to Unimak Pass

Healy is scheduled to arrive in Dutch Harbor late on 4/8 or early on 4/9/07. The remaining loading and science preparations that were not done in Seattle will be done at this time. The Healy departs the dock on 4/10/07 at 12:00 or as early as possible thereafter. Four stations follow within the next 13 hrs. that are intended to sample various source waters for the eastern shelf including the slope water in the Bering Canyon, the North Aleutian Shelf Current (NASC), Unimak Pass and a station close to Unimak Island to sample the Alaskan Coastal Current (ACC).



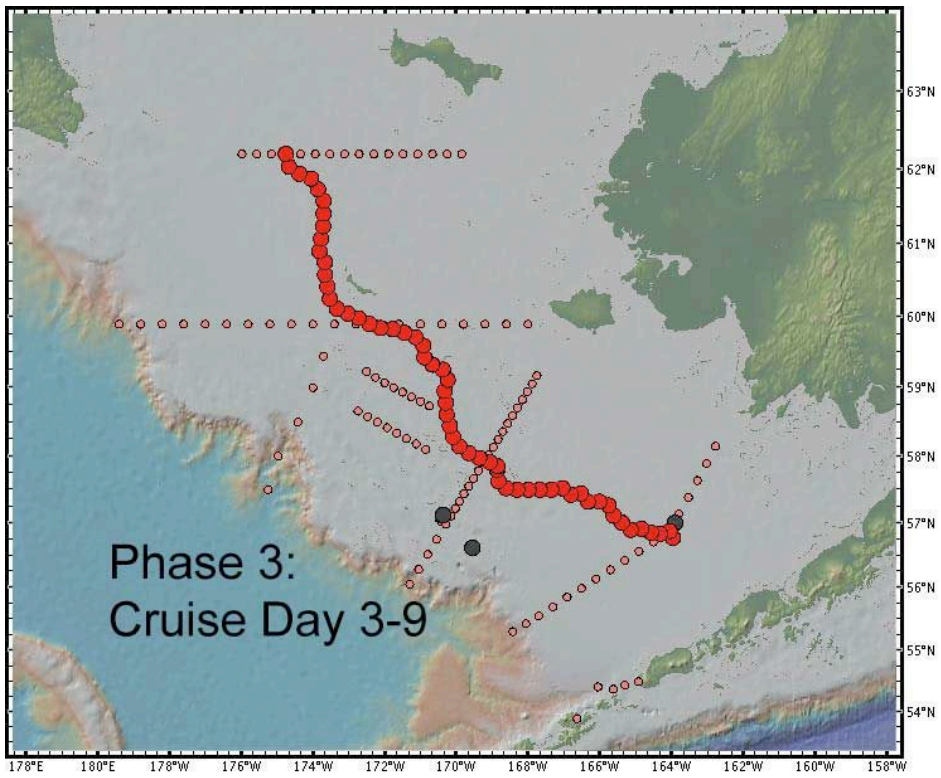
Phase 2 - Initial sampling of Bristol Bay

Four stations are planned along the CN line as the Healy progresses north. These stations will provide late winter conditions in the (likely) ice-free Bristol Bay region that can be compared to repeat sampling of this line in early May.



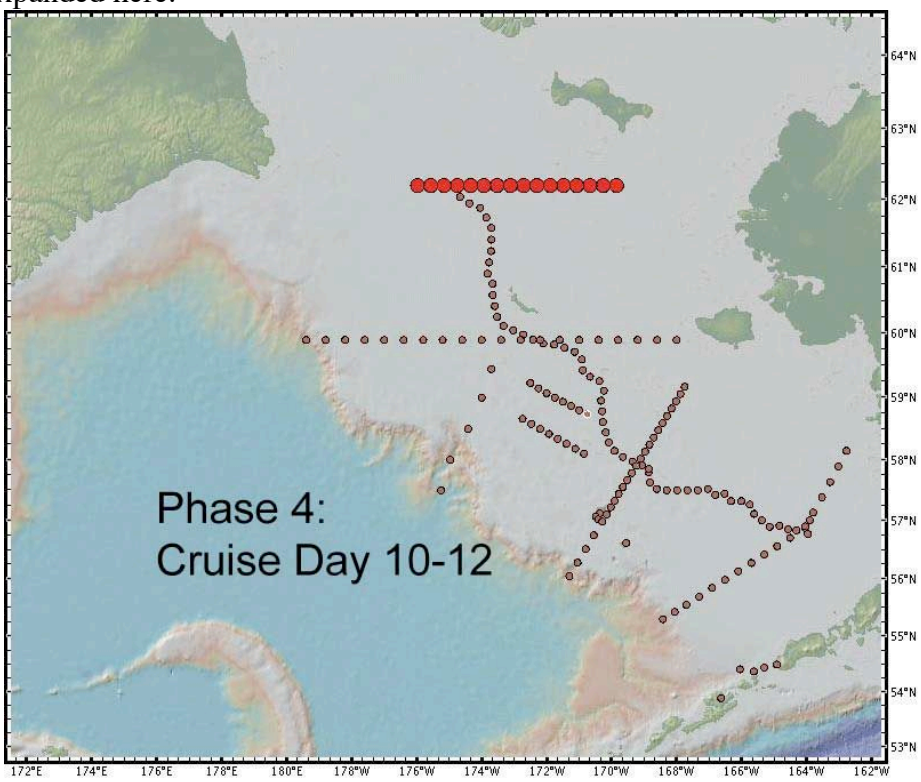
Phase 3 - Long shelf section along 70 m (expected 1st entry into ice)

The Healy will occupy a series of stations along the 70 m isobath that has been sampled by NOAA PMEL in prior years. The section will contrast the mid-shelf conditions in and out of the sea ice. The stations will be short and many will consist of a CTD/Niskin cast only. This should allow us to make rapid progress and reach the MIZ somewhere around 59˚N in a few days. Progress likely will slow in the ice north of St. Matthew.



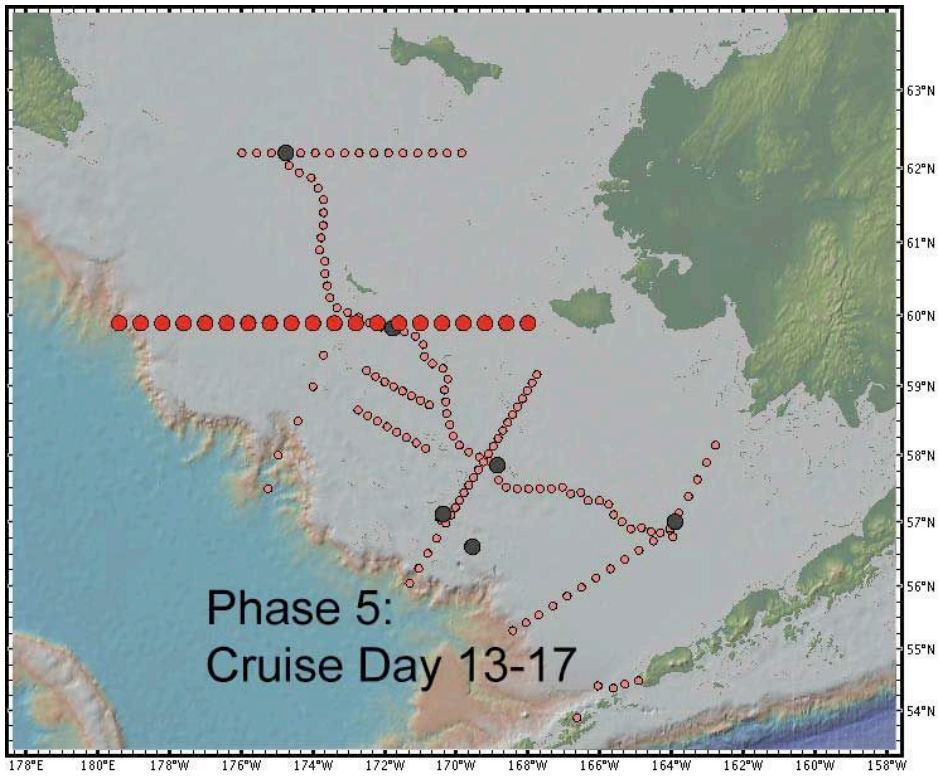
Phase 4 - Northern-most cross shelf section (SL)

The Healy will work from east to west along this line and will likely encounter the heaviest ice of the cruise. The line may cross the southern part of the St. Laurence polynya and provides the greatest contrast to Bristol Bay in terms of ice-impact. The region to the north will be sampled more extensively by the following Healy (SLIP) cruise. Ice sampling that began on the prior phase at the northern end of the 70 M line will be expanded here.



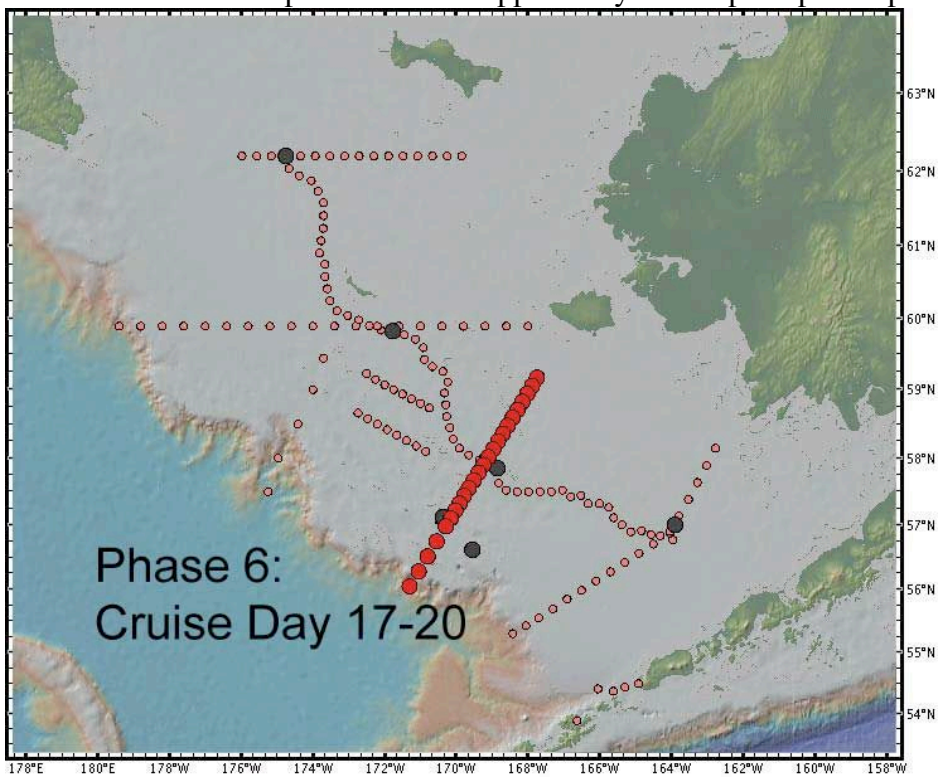
Phase 5 - St. Matthew – Nunivak cross shelf section (SN)

This long cross-shelf line will be sampled from west to east. The first stations of this line provide the second opportunity of the cruise to sample deep and slope waters. Sediment maps also indicate that there is a muddy bottom in the outer shelf part of this line that may facilitate coring. This line should also provide continued sampling opportunities in the broken pack ice although the ice near Nunivak Island may be difficult to make progress through.



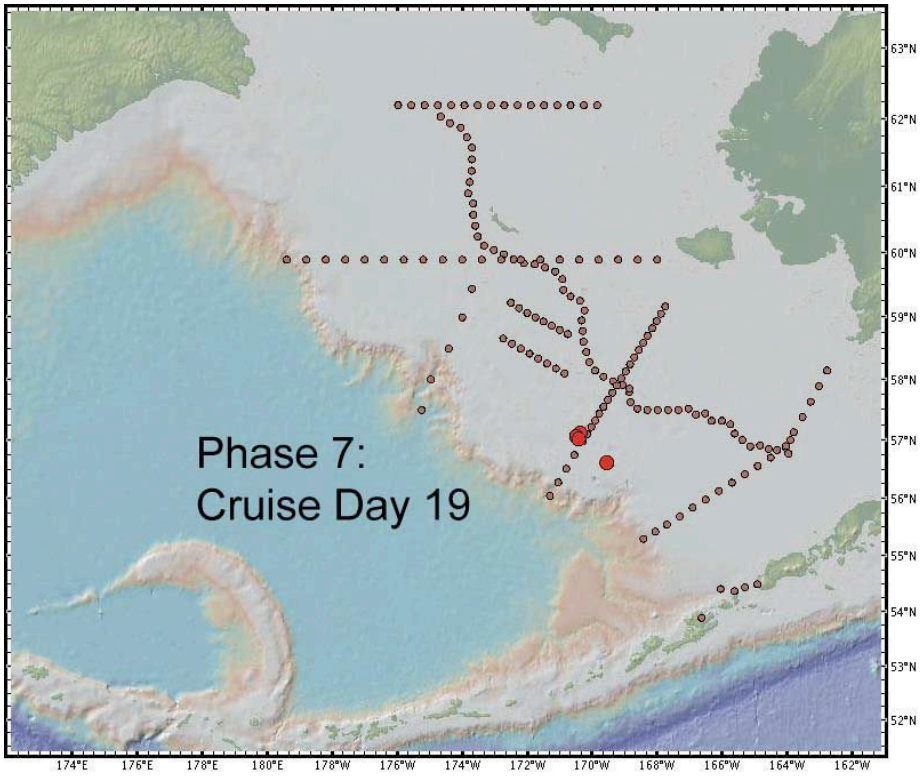
Phase 6 - Nunivak Pribilof line (2 parts)

This phase will be broken into two parts by the planned stop at the Pribilof Islands on April 27. The PN line will be occupied from east to west with greater station density in the on-shelf part of the line that may cross the residual region of maximum ice extent. This line also crosses a frontal region just northeast of St. Paul that supports high productivity throughout the summer and the line will provide early season sampling of this region. The outer stations provide a third opportunity for deep/ slope samples.



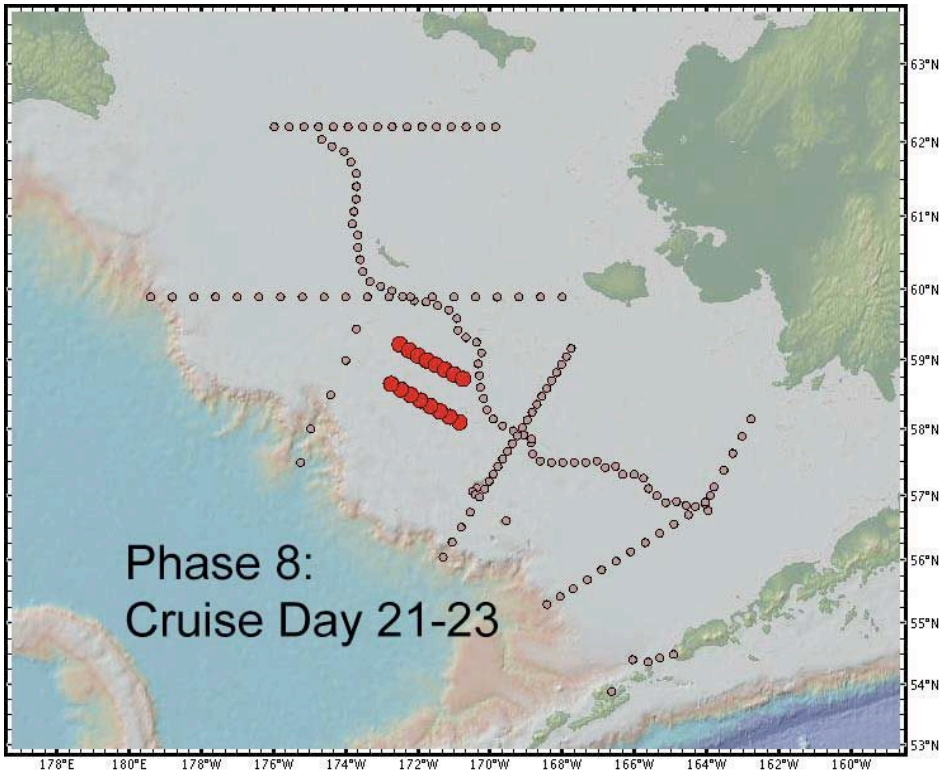
Phase 7 - Exchange of personnel and equipment on St. Paul and education & outreach activities in St. George

This stop marks the end of leg 1 of HLY0701. The Healy arrives at St. Paul on the late afternoon of April 27. The only thing scheduled for the remainder of the 27th is to transport personnel to/from St. Paul. There may be time for some net work by Jeff Napp's group around the Islands on the night of the 27/28. From 9-12 AM on Saturday April 28, groups of scientists will meet with leaders and educational groups on St. Paul and St. George (likely NOAA people on the former and NSF on the latter). The scientists will be collected in the early afternoon of April 28, and the cruise resumes.



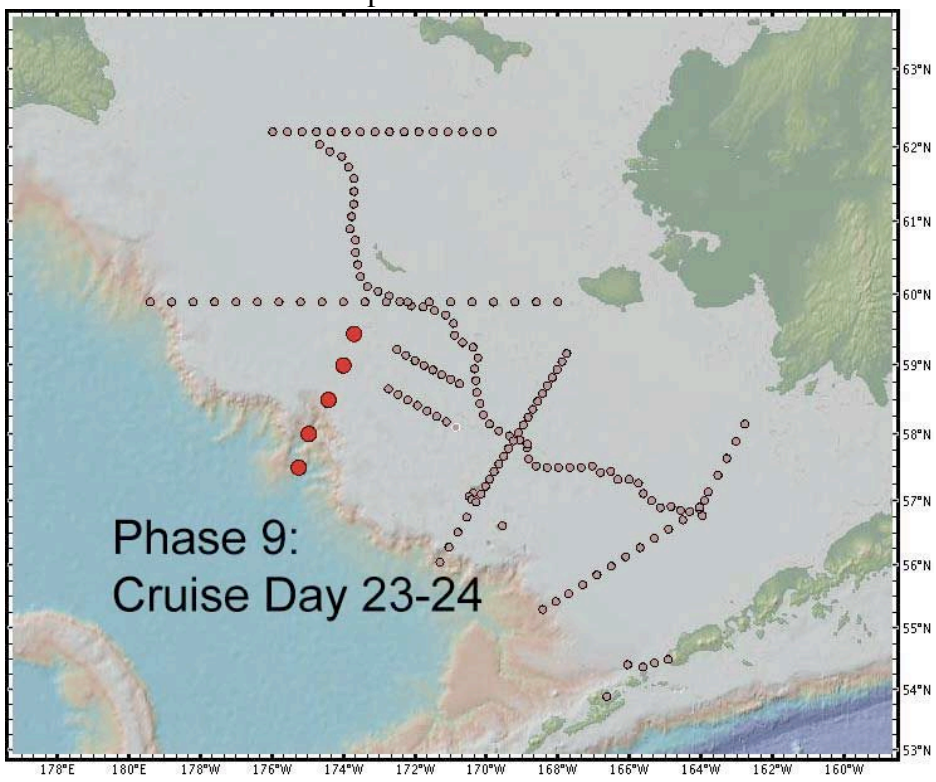
Phase 8 – Joint sampling with Miller Freeman

The collaboration between NSF and NOAA has made possible a joint sampling period that is planned for the days immediately following the PN line. The stations indicated on the map are meant only as placeholders for the actual sampling lines. These stations will be laid out after our initial sampling in the first leg establishes the maximum ice extent and permits us to identify the frontal structure separating the ice and non-ice regions. Additional considerations include the inability of the Miller Freeman to operate in the ice. However, the Miller Freeman will have a towed instrument package (UTOW) capable of continuous underway sampling. We plan to use this capability to map the frontal structure in detail while the Healy concentrates on more extended process studies of the features identified by the underway sampling.



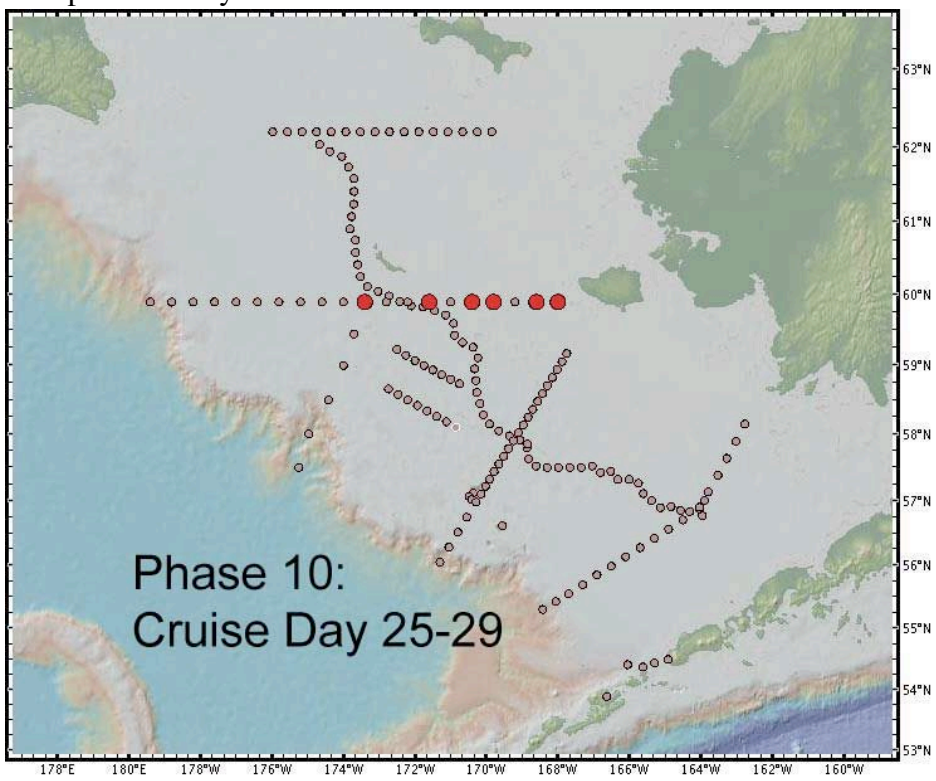
Phase 9 - Reoccupy WOCE P14 stations through Zemchung Canyon

This short line provides a fourth opportunity to sample deep/ slope water and reoccupies stations sampled at the northern end of the WOCE P14 section during July, 1993. The line returns the Healy into what may still be ice-impacted waters in early May. The on-shelf stations of this line also should provide access to soft-bottom communities.



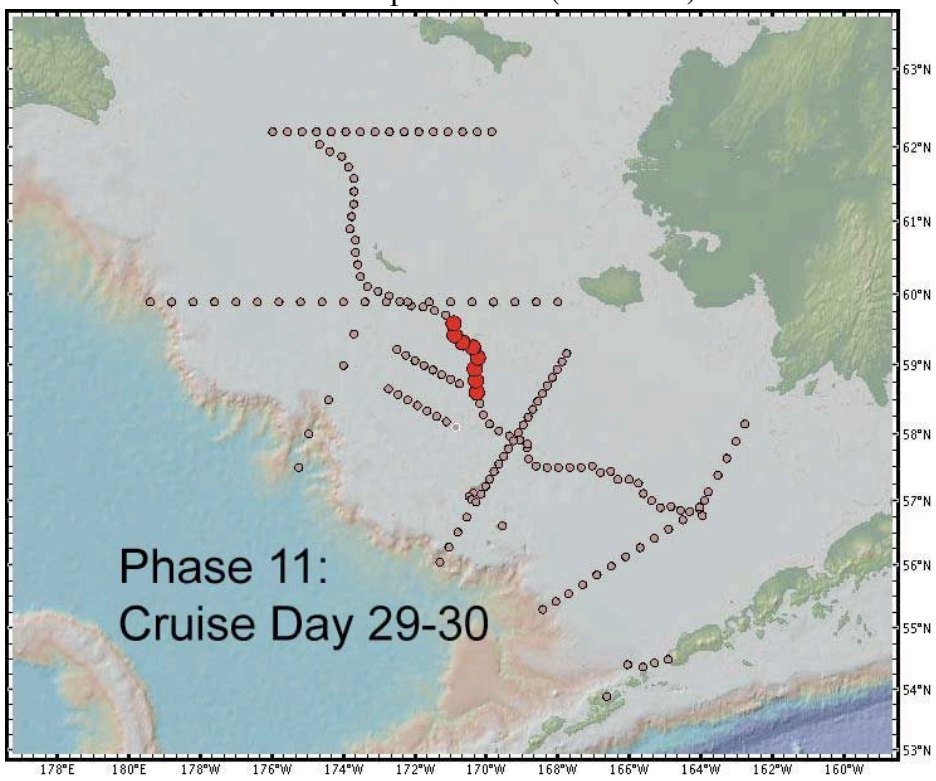
Phase 10 – Work in ice along St. Matthew – Nunivak cross shelf section (SN)

This phase provides continued ice-sampling opportunities as the Healy works its way toward the expected heavy ice near Nunivak Island.



Phase 11 – Work as north as time allows on 70 m line

The Healy will remain in the ice as long as possible and may have several more days near the MN line if the Miller Freeman samples the CN (see below).



Phase 12 - Southern-most cross shelf sampling along CN line

As the final cross-shelf line, the Healy will resample the CN line in Bristol Bay that should be at or near spring bloom conditions. It is possible that the Miller Freeman may be able to sample this line in early May. If so, this would free the Healy to remain in the ice-impacted region near 60˚N for additional time.