# Cruise Report for USCG Cutter Healy Cruise 0803 (HLY0803)

## July 3 - July 31, 2008, Dutch Harbor to Dutch Harbor, AK

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Healy Captain: Captain Frederick Sommer USCG

## Acknowledgements

USGC Healy cruise 0803 was a complex and ambitious undertaking. In addition to the large number of scientists and educators involved (55), the scientific goals were interdisciplinary and therefore logistically complex. The cruise included the deployment of moorings and sediment traps, over two hundred CTD casts, many net hauls and extensive on-deck work that took place around the clock. In the midst of all of this sampling work, there also were several educational outreach activities, both from the ship and in the form of visits by scientists and educators to St. George Island. The success of these many aspects of the cruise reflects the high level of expertise and cooperation of the officers and crew of the Healy. Although the science party gratefully acknowledges the help of all of the Coast Guard personnel on-board, the cooperation and expertise of Captain Fred Sommer and his officers was outstanding. The scientists were uniformly appreciative of the work of Executive Officer Dale Bateman, Operations Officer Jeff Stewart and Science Officer Silas Ayers. MSTC Mark Reig and his crew of marine science technicians (Chuck Bartlett, Rich Layman, Tom Kruger and Tiffany Wright) worked tirelessly during the cruise and made the scientific work possible. All science results from this cruise owe a large debt to this valued cooperation.

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## Cruise Summary

This report summarizes the cruise of the USCG cutter Healy from July 5 through July 31, 2008 (HLY0803). This was the third NSF funded, dedicated cruise for the Bering Ecosystem Study (BEST) project that focuses on the impact of sea ice on the marine ecology of the region. In particular it focused on pathways of nutrients and organic matter that lead to the abundant upper trophic levels and valuable fisheries on this extensive, high latitude continental shelf. The first two BEST cruises took place in April-May of 2007 and 2008 and focused on the conditions directly associated with the retreating ice edge. The HLY0803 cruise was the first BEST cruise to characterize summer conditions on the eastern shelf, including the seasonal evolution of the nutrient and phytoplankton fields, as well as the distribution and abundance of zooplankton and ichthyoplankton. The cruise covered most of the eastern Bering Sea shelf from the Aleutian Islands to St. Lawrence Island. A complex, multidisciplinary sampling plan was carried out that included continuous measurements of meteorological and surface water characteristics with autonomous sensors on the ship as well as bird and marine mammal observations along the over 4000 nautical miles of cruise track. In addition, 177 unique stations were occupied during the cruise. Sampling activities at these stations included 210 CTD casts, 52 bio-optics casts, 22 productivity casts, 59 MOCNESS tows, 83 CalVet tows, 25 bongo tows, 37 multicore drops, 3 sediment trap deployments and recoveries as well as the deployment of 11 long-term moorings. Some of these samples were processed on-board by the 17 research groups that participated in the cruise, although thousands more will be analyzed on-shore. Initial results include the characterization of the shelf cold pool, a feature that reflects the ice extent from earlier in the year and its relationship with the nutrient distributions on the shelf. The northern part of the cold pool was associated with an intense subsurface Chl *a* layer. Mesozooplankton distributions were patchy and few Euphausiids were found inshore of the 100 m isobath. Pollock larvae were found in greatest abundance along the Aleutian Peninsula and seaward of the Pribilof Islands. Education and outreach activities also were part of the cruise led by two teachers who reported to student and teacher groups on shore through webinars from the ship. They also organized community outreach at St. George Island during the cruise.

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# 1 Introduction

The Bering Ecosystem Study Project (BEST) focuses on the impact of seasonal sea ice on the environment of the eastern Bering Sea. More specifically, BEST seeks to clarify how sea ice influences the ecological pathways of nutrients and organic matter that lead to the abundant upper trophic levels and valuable fisheries on this extensive, high latitude continental shelf. More detailed background information can be found on the BEST home page (http://www.fish.washington.edu/research/best/). BEST also is part of a larger interagency effort to model the response of upper trophic levels to variations in climate forcing and more information on these collaborative efforts can be found on the web site of the Bering Sea Integrated Ecosystem Response Project (BSIERP; http://bsierp.nprb.org/index.htm). Science parties supported by both BEST and BSIERP participated in HLY0803.

The cruise described in this document is the third dedicated cruise for the BEST project. The first two took place in April-May of 2007 and 2008 and focused on the conditions directly associated with the retreating ice edge. HLY0803 examined the summer conditions on the eastern Bering Sea shelf. Although this region is ice-free in summer, the presence of ice earlier in the year influences the subsequent development of physical and biological conditions. The overall goal was to improve the understanding of these influences significantly during HLY0803. The cruise covered the entire shelf from the Aleutian Islands to St. Lawrence Island. A multidisciplinary sampling plan was carried out that included the deployment of moorings and physical oceanography, a hydrographic survey that collected discrete samples for a variety of chemical and biological analyses, zooplankton and ichthyoplankton net hauls, sediment sampling with a coring device, a variety of biological rate measurements that were done in on-board incubators on the bow, the deployment and retrieval of sediment traps that required small boat operations, as well as a variety of underway observations both from autonomous instruments sampling the sea chest water and visual observation of birds and marine mammals from the bridge.

There were several unique features of this initial summer cruise of the BEST/ BSIERP program. Although no sea ice was present in the study region during the cruise, the residual effects of sea ice were still obvious. These effects included the cold bottom water that roughly reflected the extent of the earlier ice, and low salinity surface water that still retained the signature of the ice melt from April and May. HLY0803 provided an opportunity to build on the spring observations already collected in the first two cruises. Importantly, in addition to the physical development of the shelf waters, HLY00803 focused on the biological populations during their early summer conditions. For example, extensive net hauls were done to determine how far on the shelf populations of large oceanic grazers, that are important prey items for juvenile fish, had moved since the spring sampling. An important addition in this respect from earlier cruises was the inclusion of a science component on the ichthyoplankton to determine where and to what extent some of the key fish populations such as pollock were spawning. Although the core hydrographic and primary productivity programs on HLY0803 were very similar in nature to those done on the spring cruises, the sampling approach differed in that the lack of ice favored a more standard survey approach in comparison to the featured based sampling associated with the productive ice edged of spring.

This report summarizes the sampling program carried out during HLY0803 along with a brief summary of the hydrographic conditions recorded. Many of the details on the science that will eventually result from this work are contained in the individual group reports that are included later in this report. Also, for more detailed information on the Healy data acquisition systems that continuously logged data from the many meteorological, sea water and other autonomous instruments used during the cruise, please refer to the Data Synopsis for HLY0803 prepared by: Tom Bolmer, David Forcucci, David Hassilev and Steve Roberts. One of the main goals of bringing together the many lines of information in the current report is to serve as a guide for researchers in identifying information relevant to their work that was collected during the HLY0803.

Final preparations for HLY0803 commenced on morning of July 2 when the Healy arrived at the Coast Guard dock at Dutch Harbor. Most of the science party arrived in town by the previously day and moved onto the ship during the mobilization day in Dutch Harbor (July 2). Cruise preparations proceeded quickly due to the fact that most of the science components had stored gear in Dutch Harbor after HLY0802. Cruise preparations also were aided by the development of a remarkably complete consumer environment in Dutch Harbor (rental trucks, hardware, and supplies of all kinds). Among the first priorities was a meeting among the senior scientists and officers of the Healy that would be interacting to implement cruise activities. Tom Weingartner from UAF agreed to act as co-chief scientist with R. Sambrotto on this ambitious and logistically complex cruise.

## 2 Science Groups & Participants

The major research components on HLY0803 and the associated participants were as follows:

*Long-term moorings* – Tom Weingartner, Jim Johnson, Dave Leech, Kevin Taylor. This group deployed 9 moorings during the cruise.

*Hydrography* – Cal Mordy, Bill Floering, Dean Stockwell, Sigrid Salo and Dave Kachel (Dylan Righi and Ned Cokelet replaced the later 2 for the second leg). This group analyzed salts, nutrients, oxygen and chlorophyll from the Niskin casts at each station as well as helped to manage cruise information.

*Carbon Productivity* - John Casey and Matt Tiahlo. This group carried out standard $^{14}C$ productivity experiments as well as size fractionated and cell sorted productivity.

*Nitrogen uptake and cycling* - Ray Sambrotto, Didier Burdloff and Kali McKee. This group carried out $^{15}N$ productivity experiments as well as urea and growth response experiments.

*Particle flux* – Roger Kelly, URI. Roger deployed a floating sediment trap on 2 occasions that collected particles for 24 hr. periods as well as measured Radium and Radon concentrations.

*Iron analyses* (leg 2 only) – Rob Rember, and Ana M Aguilar-Islas. This group collected samples for iron analyses on special casts from trace metal clean samplers.

*Euphausiid and macrozooplankton collections* - Alexei Pinchuk, UAF, and Tracy Shaw, OSU. Alexei collected macrozooplankton with a MOCNESS and CalVET net for quantitative distributions. Tracy collected live euphausiids with a Bongo net for rate measurements and organic tracer assays.

*Euphausiid rate measurements* - Megan Bernhardt, Tracy Shaw, Virginia Engel, UW (Lessard group) performed grazing, growth and reproduction experiments with euphausiids collected with Bongo nets using water collected on CTD casts.

*Organic tracers of trophic transfer/euphausiid population age structure* - Rachel Pleuthner, Karen Taylor, Charles Morgan, UMD (Harvey Group) extracted organic pools from zooplankton and their prey from net tows and water from CTD casts.

*Ichthyolplankton* – Nicola Hillgruber, Elizabeth Siddon and Ron Heintz. This group collected larval fish in collaboration with A. Pinchuk's net hauls.

*Microzooplankton grazing* – Diane Stoecker and Kristin Blattner, UMD. This group performed grazing experiments on water from the daily productivity cast.

*Benthic biological characterization and fluxes* - David Shull, and Greg Brusseau WWU. This group collected benthic samples with the multicorer and measured nutrient fluxes and Radon.

*Benthic biogeochemical fluxes* - Heather Whitney and Amy Cash. This group measured benthic fluxes of oxygen and nutrients on cores retrieved from the multicorer.

*Bird distribution and abundance* – Paul Suchanek and David Porter (leg 1) and Tom Van Pelt and Mark Rauzon (leg 2). FWS. They made observations from the bridge during the day.

*Marine mammal distribution and abundance* – Gary Friedrechsen, NOAA (guest investigator). Gary made observations from the bridge during the day.

*Bio-optical and nitrate variations* - Lisa Eisner, NMFS Auk Bay (guest investigator). Lisa added two instruments to the suite of instruments that analyze the science seawater – a WetLabs acs hyperspectral absorption instrument and a nitrate sensor. She also calibrated these instruments using samples from the Niskin rosette.

*Water column bio-optics* - Joaquim Goes, Eurico J. D'Sa, Puneeta Naik and Maria Fatima Helga do R. Gomes (guest investigators). This group measured profiles in the upper 100 m with their own bio-optical package that includes an FRRF. They also used an Advanced Laser Fluorescence System (ALFS) in both underway mode with the science seawater system as well as in discrete mode from samples from the Niskin rosette.

*CTD operations and support* - Scott Hiller and Sue Reynolds.

*Science support activities* - Steve Roberts and Tom Bolmer.

*Data support* - Janet Scannell (leg 1) and Scott Loehrer (leg 2)

*Educational component* - Teachers Jillian Worsssam (PolarTrek) and John Karavias (Armada) took part in the cruise. A trainee from the MATE program (Alex Nanez) also participated.

# 3 Sampling Operations

## 3.1 Bridge Observations

During daylight hours, quantitative observations for birds and marine mammals were made from the bridge by the bird and marine mammal group. Both groups recorded GPS coordinated observations on laptops on the bridge.

## 3.2 Autonomous measurements from the ship

Continuous and autonomous sensing was done from the ship's seawater system as well as from meteorological instruments and depth recorders. A complete listing of these measurements along with their data format and calibration is available in the data synopsis by Tom Bolmer et al., cited above. Briefly, surface seawater was pumped from 8 m to the science laboratory were several measurements were made. These include temperature and salinity from a thermosalinograph, oxygen from a membrane electrode and chlorophyll *a* from a fluorometer. In addition to the ship's instruments, Lisa Eisner installed a nitrate sensor as well as a WetLabs ac-s that measured hyperspectral adsorption. Joaquim Goes installed an Advanced Laser Fluorescence System (ALFS) for phytoplankton characterization for part of the cruise.

## 3.3 On Station, Over-the-side Operations

Most stations began with a CTD cast from the starboard A-frame that included water sampling from a rosette of 12 - 30 L Niskin bottles to within 5 m of the bottom. This provided water samples for nutrients and other hydrographic measurements such as chlorophyll *a*. A variety of additional discrete samples were taken that varied from station to station. The stations can most easily be grouped by length into short, intermediate and long stations as described below.

### 3.3.1 Short Stations

In addition to the CTD cast, a short station may include sampling activities that add not more than 30 minutes onto the length of the station. These additional sampling activities may include for example, a productivity cast, a CalVET Net tow or ring net tow from the 3/8" wire off of the stern and an optics cast from an ancillary winch.

For these operations, the ship was stationary. The optics casts were done only during daylight hours with the optimum time period being within several hours of local noon (~14:30 ship time that remained on Alaska Time). In addition, the side of the ship from which the optics package was deployed faced the sun. After the CTD, the order of order of operations for short stations was the optics cast and then the net hauls.

### 3.3.2 Intermediate Stations

These stations may include almost any of the activities that were performed on HLY0803 with the exception of the sediment trap deployments that have a 24 hr. requirement. The difference between the intermediate and long stations is based on the number of activities carried out and the total water depth. Some of the activities that can be done during an intermediate station in shallow water (multicorer or iron for example) required a long station over slope and basin regions. Intermediate stations provide time for a variety of process oriented and experimental work including - CalVET net tow from the stern A-frame, 3/8" wire (Pinchuk); Bongo Net tows (2-3) at night (Lessard group); MOCNESS net tow (1) from stern A-frame, 0.68" conducting wire (Pinchuk and Hillgruber). A number of MOCNESS only stations were done in the first phase of the cruise to provide adequate sampling for the ichthyoplankton.

The MOCNESS tow was conducted at a speed of 1-2 knots. The multicore casts were conducted with the ship stationary. Benthic sampling typically was done at the end of the station or at a location slightly offset from the station location in order to avoid washing sediment into the water column during sample sieving and processing and deck cleanup.

### 3.3.3 Long Stations

Several CTD casts were conducted at each long station to assess diurnal variation. For multi-day stations, CTD were done on the morning of each day with succeeding casts interspersed with activities occurring on the stern in order to maximize efficiency and minimize down time while the CTD bottles are being emptied. Diurnal sampling was also done for the zooplankton collections. The long stations also provided an opportunity for deep iron casts. Long stations also provided enough time for sediment trap deployments consisting of a trap line (5/8" dia poly-dac rope) that is 110m long with samples collected at 25 m, 40 m, 50 m, 60 m and 100 m. Stations were limited to shelf-slope locations with water depths greater than 300 m, and deployments lasted approximately 24 hours. The traps were deployed from the ship but were retrieved using a small boat. The ship typically continued to sample spatially during the trap deployments.

### 3.3.4 Mooring Deployments

The moorings deployed during the cruise held CTDs at multiple depths as well as ADCPs to assess water movement. These are described in more detail in the individual group report section on moorings.

# 4 Additional Logistical and Operational Considerations

## 4.1 Educational outreach visit to St. George on July 11

A visit to St. George Island by the Healy was made on July 11 to interact with a Ocean Science Camp that was directed by Michele Ridgeway. Twenty students from the Pribilof Islands between the $5^{th}$ and $12^{th}$ grades participated in the camp that ran from July 10 through 18. In addition to the teachers, several science personnel visited the camp. These visits coincided with sampling in the waters around the Pribilof Islands and the collection of ship supplies from the airport at St. Paul.

## 4.2 Personnel exchange at St. Paul on July 17

A mid-cruise exchange of personnel occurred at St. Paul Island, Alaska on July 17. These exchanges were facilitated by the NOAA facility on the island (206-526-6453).

## 4.3 Existing Moorings to Avoid

We worked near four NOAA moorings. The positions are listed below.

Bering Sea 2 (M2) 56.877°N, 164.057°W, 73m water depth. (There also were some other moorings within 1 nm).
Bering Sea 4 (M4) 57.853°N, 168.870, 71m water depth (Note – This mooring was inoperable was located during the cruise).
Bering Sea 5 (M5) 59.898°N, 171.711°W, 72m water depth
Bering Sea 8 (M8) 62.194°N, 174.668°W, 73m water depth

# 5 Cruise Track and Narrative on 4 Phases

The overall cruise track consisted of several cross shelf sections together with a long shelf (70m) section that re-occupied regions that were sampled in prior BEST cruises. An inshore line northwest of Nunivak Island and 9 additional stations were added on HLY0803 to accommodate the mooring deployments (Figure 1). In addition to the division of HLY0803 into 2 legs by the personnel exchange at St. Paul on July 17, the sampling activities were further organized into 4 phases of operation (2 phases before the St. Paul stop and 2 afterwards). The 4 phases and their respective major foci were as follows:

Phase 1 – July 3 – 8: *Sampling of the non-ice impacted region of southeastern Bering Sea and ichthyoplankton collection*. The southern region was the only one not impacted significantly by ice this year and provides a contrast to the heavily ice-impacted northern shelf. In addition, it is the main spawning region for pollock and other important commercial species and collections of ichthyoplankton were a top priority during this phase. Collection of larval fish by Nicola Hillgruber and Alexei Pinchuk reflected a variety of species including Pacific cod, arrowtooth flounder and walleye pollock. Hydrographic sampling began in Unimak Pass in the southern part of the eastern Bering shelf (line UP). Four stations were occupied across this pass to characterize the water entering the Bering Sea from the Gulf of Alaska, particularly the fresh Alaska Coastal Current (ACC) that continues along the inner shelf of the eastern Bering. We next sampled along a series of cross-shelf sections in the southeastern Bering Sea (lines UAP, CN and CNN). This phase included stations 1 to approximately 29.

Phase 2 - July 8-16: *Deployment of moorings in inner and middle shelf regions*. The initial deployment of moorings by Tom Weingartner's group began during this phase. The mooring group deployed three moorings along each of the NP, W and SL lines at 25m, 40m and 55m. Tom decided not to deploy a tenth mooring near the SL-55m mooring site. The mooring deployments are logistically complex when combined with the many simultaneous process studies on HLY0803. The requirement for daytime deployments for the moorings, and the avoidance of long work periods for the mooring crew meant that other work needed to be scheduled around the mooring efforts to accommodate its schedule. We received cooperation from the other research groups however, and were able to characterize summer physical and biological conditions in the inner shelf during summer in addition to deploying the moorings. We also completed most of the NP line. Unfortunately, a bio-optical sensor package brought on-board by Eurico D'Sa and Joaquim Goes was lost on July 8. A replacement system was obtained for the second leg of the cruise however, that contained a spectral radiometer, back-scatter meter, fluorometer and CTD and this new package restored most of the lost measurement capabilities. Pat Kelly did two drifting sediment trap deployments from Brad Moran's group in the slope region. Microplankton productivity was the concern of several groups on board including Ray Sambrotto's nitrogen productivity group, Mike Lomas's carbon productivity group and Diane Stoecker's microzooplankton group. These three groups coordinated their sampling activities on the daily productivity cast. Euphausiid rate measurements were done when enough animals were obtained by Evelyn Lessard's group and these conditions were found at several stations in the outer shelf. Roger Harvey's group collected samples for later organic analyses. David Shull has been able to collect a number of sediment cores with the multicore, and together with Al Devol's group worked on the sediment profiles and fluxes. Lisa Eisner calibrated her underway nitrate measurements against the on-board autoanalyzer system and the results from the continuous nitrate sensor appear useful. The CTD operations continued without major problems and the data support group has been able to utilize the existing resources to update and expand the BEST field catalog as we progress. The bird observers manned the bridge each day, although fog restricted observations. The two teachers on board have contributed daily journals of their activities and observations on the cruise. The educational outreach on St. George was done during this phase and it ended with the participant exchange at St. Paul.

Phase 3 - July 18-26: *Sampling of the northern, outer shelf region*. This region has been the most consistently impacted by the ice edge during the last decade. The region supported intense primary production in spring 2007 and scattered production in spring 2008. Sampling characterized the seasonal development of production in this region and will help to determine how the earlier ice cover influenced it. Of particular interest is the shelf break frontal region (at locations between approximately 100-200 m water depth). This region supports consistent summer production along the southern shelf and is associated with the physical mixing of deeper shelf waters to the surface. This phase included the occupation of section MN and the outer part of section SL. Together with the more inshore stations on SL occupied in phase 2, this completed the SL line. Additional moorings were also deployed in the inner shelf. This phase included stations 83 to approximately 121.

Phase 4 - July 26-31: *Mid-shelf sampling along 70 m isobath and characterization of the shelf cold pool*. This provided a mid-summer sampling of the middle shelf and contributed towards a better understanding of the seasonal evolution of the physics, chemistry and biological distributions on the shelf. In particular, it helped to define the extent of the shelf cold pool that is formed in winter in associated with ice production. This current occupation of the 70 m line, and the prior occupations done on previous BEST and NOAA cruises, has provided several years of seasonal observations on the changes in the middle shelf.

## 6 Meteorological Conditions

Sea state did not stop sampling activities at any time during the cruise even though winds exceeded 25 knots. several times during the cruise (Figure 2A). Winds were generally out of the north and west, with some southerly winds during phase 2. The northwesterly winds generally were associated with greater wind speeds. Wind was

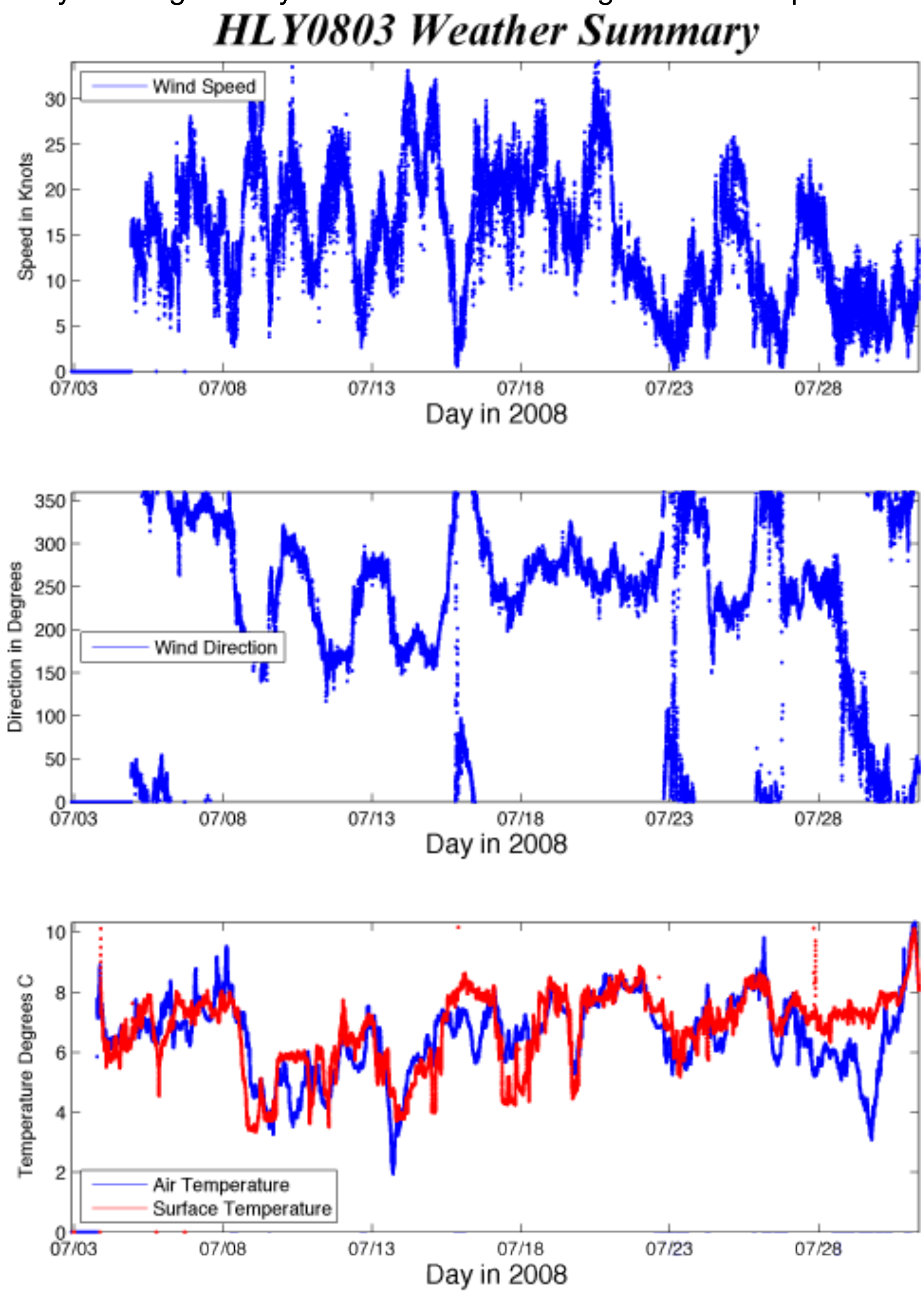
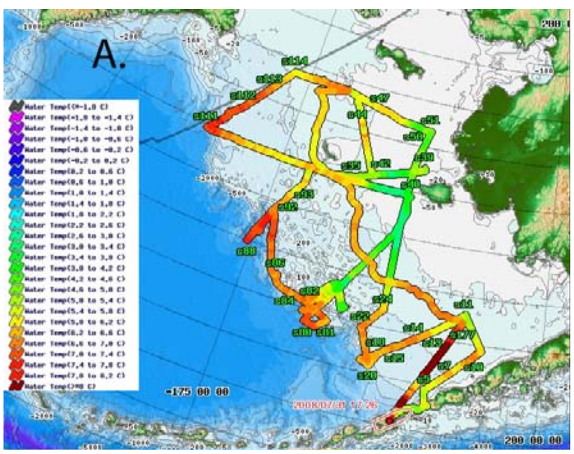


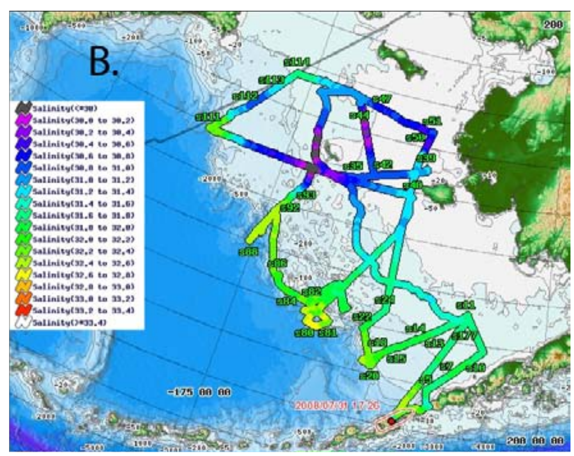

Figure 2. Meteorological conditions during HLY0803. Top – wind speed; middle – wind direction; 3 – surface water and air temperatures.

an issue with sea-keeping on station due to Healy's large freeboard area, and particular care was taken to keep the bow into the wind during casts. The major meteorological impediment to sampling was fog that was common over the cold waters of the inner and middle shelf. This required slower speeds and delayed progress along the planned station lines. Due to the lack of weather days caused by sea state and the faster than anticipated speeds made under clear conditions, however, the delays due to fog had no appreciable impact on overall sampling.

## 7 Underway and Remotely Sensed Data

The continuously measured properties from the ship's underway system provide a natural compliment to the remotely sensed features of surface waters. Some of the major parameters measured along the ship's track are shown in Figure 3. The ship recorded the coldest waters around Nunivak Island and these cold temperatures extended well offshore north of the Pribilof Islands. Water over the outer shelf and slope regions was generally the warmest, although surface waters of the southern shelf warmed appreciably between the beginning and end of the cruise. The pattern of surface salinity was different that that of temperature (Figure 3 B). Surface salinities were much lower in the middle shelf waters of the northern region



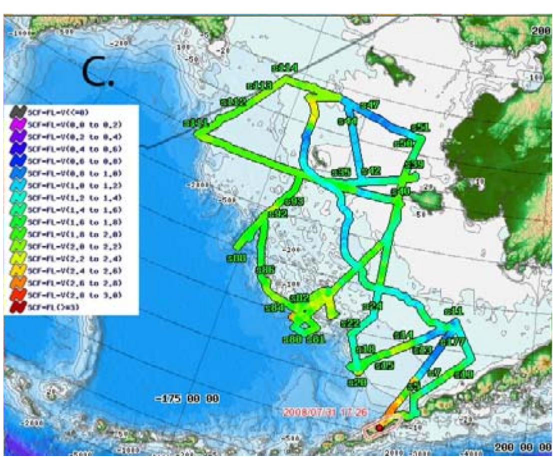




Figure 3. Data from ship's underway system. A. Temperature (˚C); B. Salinity; C. Chl *a* (ug/l).

than in the south. This pattern also was reflected in the surface Chl *a* levels (Figure 3 C) that were lower in the low salinity regions than in the south.

This is a good example of the link we hope to make between the earlier ice extent and the subsequent patterns of biological production. In this case, it appears that the regions of ice melt that caused the low salinity surface waters that persisted to July, also resulted in less surface Chl *a* in summer. This may be due to greater vertical stratification in the northern regions and the resulting lower supply of nutrients that reach the upper euphotic zone.

The remotely-sensed, sea surface temperature (SST) at the end of July 2008 was similar to the pattern shown by the ship measurements (Figure 4 A). Most obvious, was the cold surface water in the near shore region, with the lowest temperatures in the Nunivak Island region. In the MODIS Chl *a* distribution from early July (Figure 4 B), the region of low Chl *a* on the northern shelf as suggested by the later ship sampling is also apparent. The regions of elevated Chl a recorded in the southern shelf and near Unimak pass in the MODIS scene, also appear in the ship data a week or 2 later. Unfortunately, later weeks in the cruise did not provide an opportunity for another clear scene.

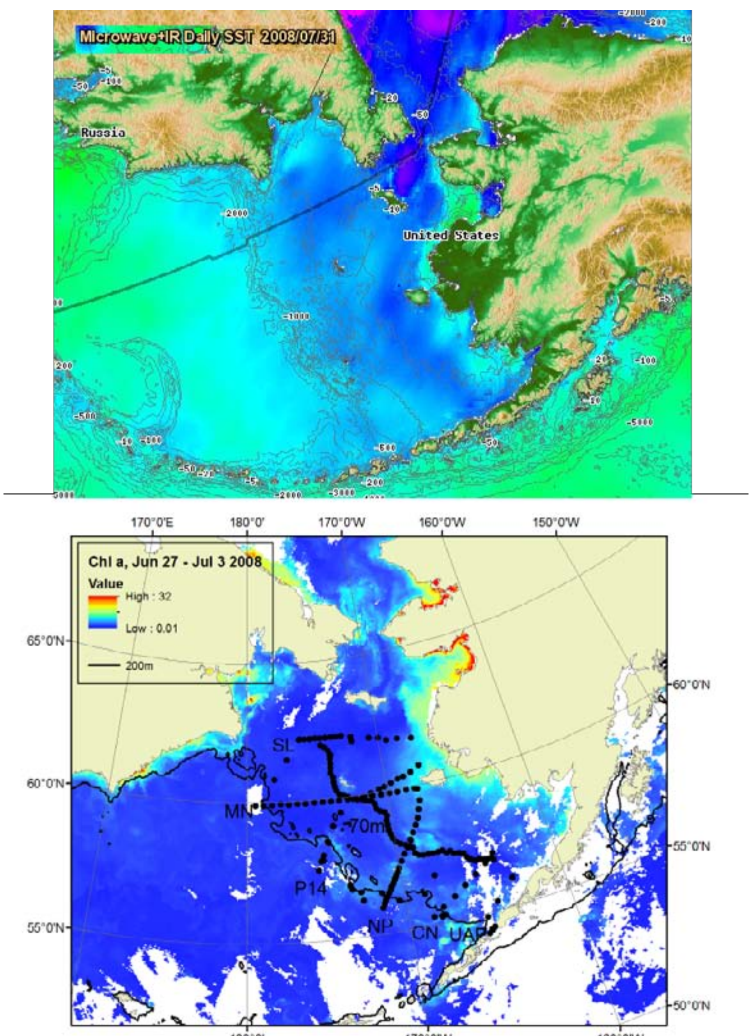



Figure 4. Remotely sensed data of the Bering Sea in and around the time of HLY0803. Top – Daily SST image from 7/31/08. Bottom – MODIS Terra Chl *a* image for the 8-day period from June 27-July 3, 2008.

## 8 Preliminary Hydrographic results

The salinity and temperature data were processed on the ship to remove spurious measurements and to calibrate the sensor values against the salinometer measurements that were made. The T-S plot for all of the CTD casts made on HLY0803 is shown in Figure 5. The plot clearly shows the high salinity 'tail' of deep basin and slope water mixing into the lower salinity shelf waters as denoted by the decrease in temperature as the water mixes below a salinity of 33.5. The plot indicates the mixing between these warmer waters and the cold pool waters. This mixing is largely at depth as reflected by the elevated AOU (~100 uM) along the mixing line. The warming of this mixture is associated with increases in oxygen as AOU falls to negative values. This is compatible with the mixing of this water into the surface where it ventilates and gains oxygen from photosynthesis.

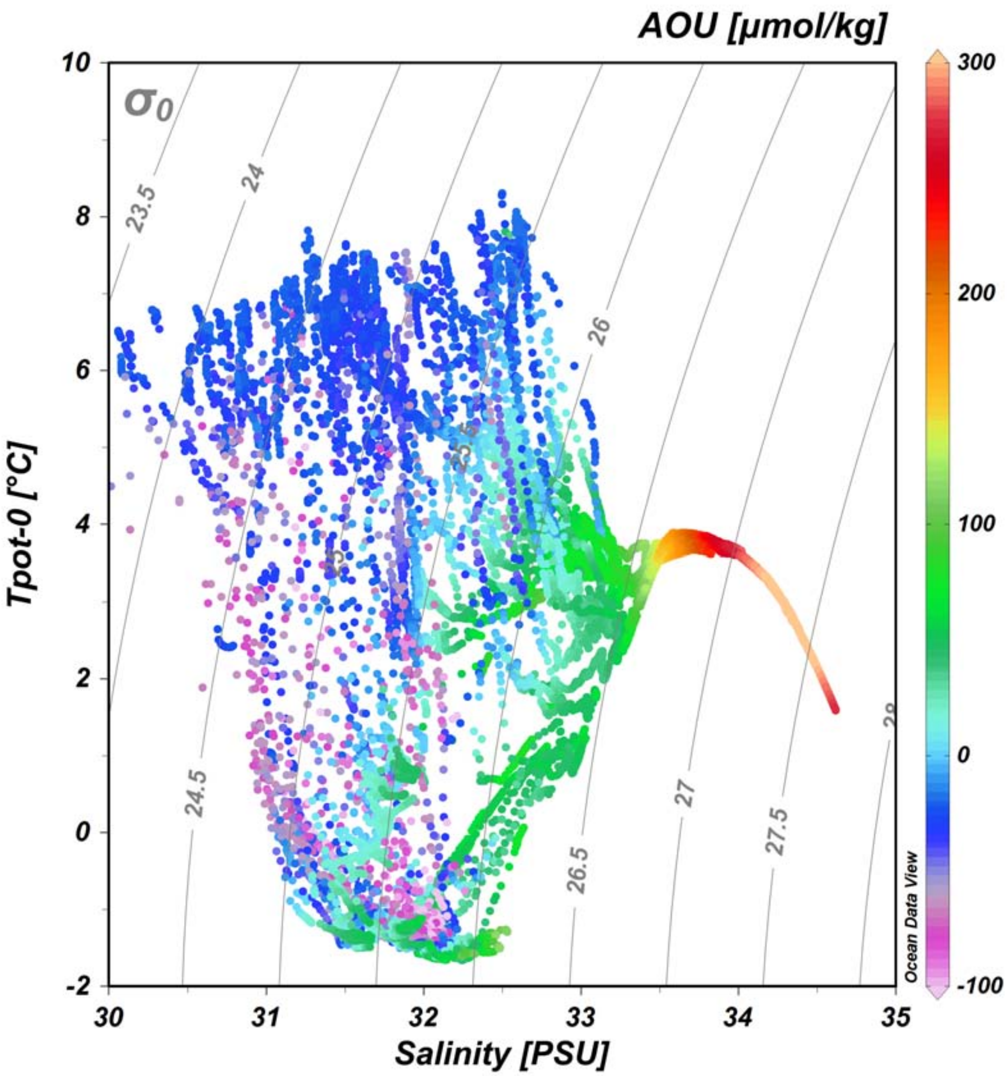



Figure 5. T-S diagram of all HLY0803 CTD data. Labeled isopleths are lines of constant density. Data have ben color coded to reflect the Apparent Oxygen Utilization (AOU, uM, defined as the difference between the saturation value of oxygen and its measured value).

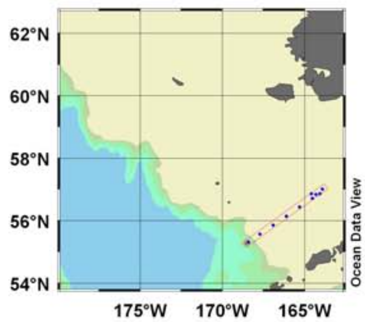
The nutrient data measured under the direction of Cal Mordy has not been finalized, but is suitable for developing sections for preliminary review of data from the cruise. For this report, 9 properties were plotted for each of the 5 major sections (CN, NP, MN, SL and 70m lines). The properties include salinity, temperature, the 5 nutrients (nitrate, nitrite, ammonium, phosphate and silicate), Chl *a* fluorescence and density. Even at this stage of processing, the property distributions are very interpretable and show little if any spurious data. It appears that the hydrographic data from HLY0803 will soon be ready to use and yield extensive information on the summer conditions on the eastern shelf.

Although it is not the purpose of this report to analyze the hydrography from the cruise in detail, a brief overview will serve to illustrate the robust nature of the data and some of the ways it can be used. For each of the sections, the 9 properties have been grouped into 5 sections, each with one property distribution colorized and another overlain as labeled isopleths. The five combinations are: temperature with salinity overlain; nitrate with density overlain; fluorescence with nitrate overlain; ammonium with nitrite overlain; phosphate with density overlain; and finally silicate with density overlain. Starting from the southern cross-shelf section CN (Figures 6 & 7), the salinity distributions shows the higher salinity slope water encroaching on the middle shelf at depth (Figure 6A). Colder (<1˚C) water persists at depth in the deeper middle shelf region. This is a pattern common to all cross shelf sections on the eastern shelf. It also manifests itself in the distribution of nutrients. The deep-water nutrients nitrate, phosphate and silicate, all show the same spatial distribution as salinity (Figures 6B & 7 top & bottom). Although Chl *a* levels are much lower than they were in spring (Figure 6C), there is still significant Chl *a* in the surface waters of the southern shelf. A major feature of the summer shelf is the intense regeneration signal associated with the middle shelf sediments, here illustrated by the elevated ammonium levels (Figure 6D). The ammonium distribution also displays another feature that is consistent on this shelf. This is the subsurface ammonium maximum that connects the high ammonium bottoms waters on the middle shelf to the surface waters of the shelf break front.

The distribution along the NP line is a useful contrast with the others because they show the large impact of the Pribilof Islands and the vertical mixing in the nearby water (Figures 8 & 9). This mixing is reflected by the elevated nutrient concentrations that have made their way well onto the shelf as the slope water mixes around the islands (Figures 8B & 9). The elevated ammonium levels at depth and their extension offshore between the 25.5 and 26 isopycnals are still obvious however (Figure 8D). The relationship between the deep water nutrients and the salinity distributions remain clear along the MN line (Figure 10 & 11). The MN line passes through a much colder region of the shelf cold pool and had lower surface salinity values than the more southerly sections, however (Figure 10A). The MN line also exhibits a more intense sub-surface Chl *a* layer and sub-surface ammonium layer than was present in the south (Figure 10C&D). The middle shelf ammonium maximum at depth is also present, but in the colder bottom water has a lower concentration than in the south.

The SL line terminates at the international boundary and does not include the slope region that the more southerly sections do (Figures 12 & 13). The relationship between the slope water and deep-water nutrients is still clear however. The sub-surface Chl a levels are more intense still than the more southerly lines (Figure 12C). The mid-shelf ammonium levels at depth along the SL line are as large as those along the CN line (Figure 12D).

The distributions along the 70 m line tie together many of the features seen in the cross shelf sections (Figure 14 & 15). For example, the 70 M line shows the disappearance of the sub-zero cold pool temperatures between 400 and 600 km (just off Nunivak Island). It also shows the long shelf extent of the low salinity surface waters that were first seen in the MN section. These low salinity surface values show a distinct pool, probably reflecting the residual melt water from the spring. The 70 M line also confirms that the subsurface Chl a layers are more intense in the north and that the bottom water ammonium more concentrated, in the south. Interestingly, the 70 m sections also show a distinct difference between the silicate and phosphate concentrations of shelf bottom waters (Figure 15 top & bottom). While the silicate levels drop over 50% in the region between Nunivak and Pribilof Islands, the phosphate levels decrease less than 30%. The smooth variations and interpretable nature of these sections is encouraging.



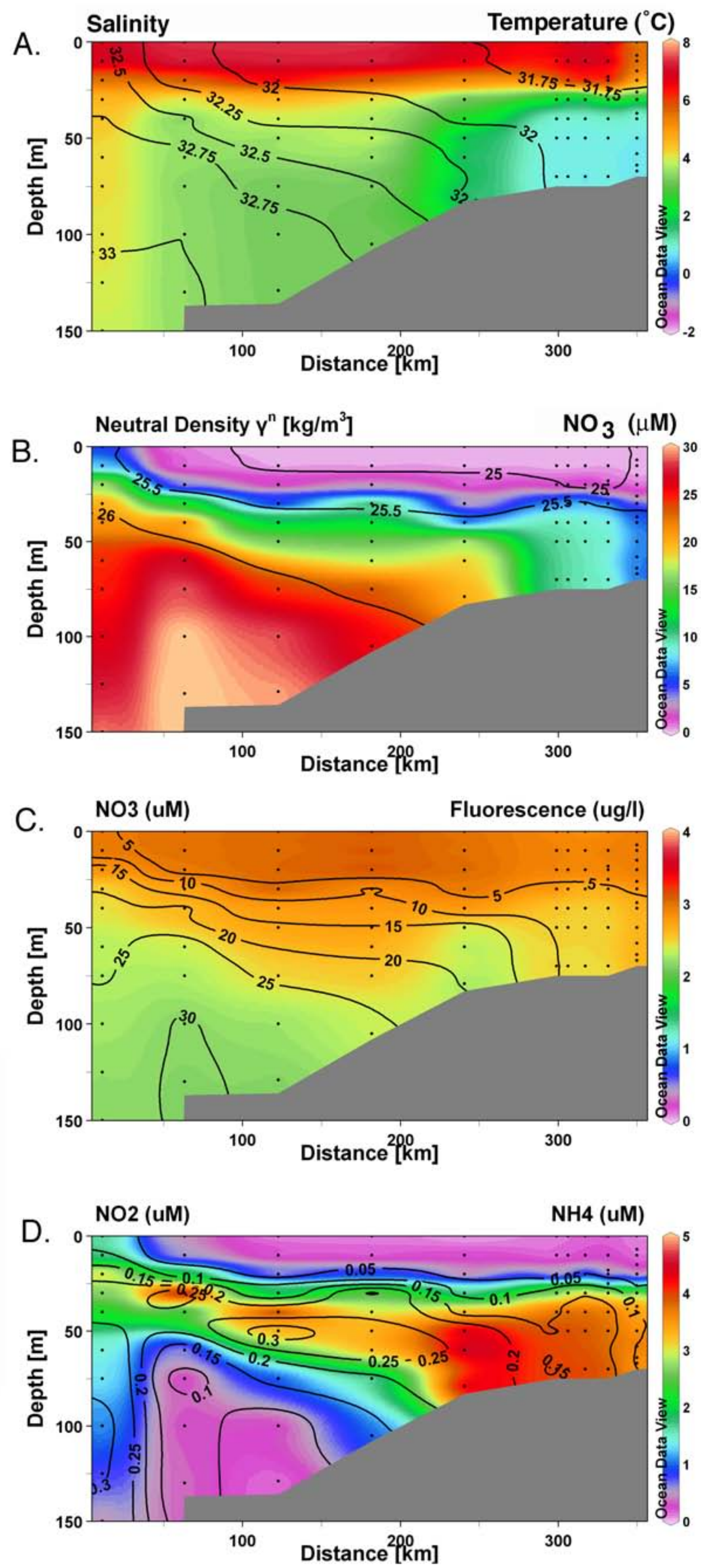
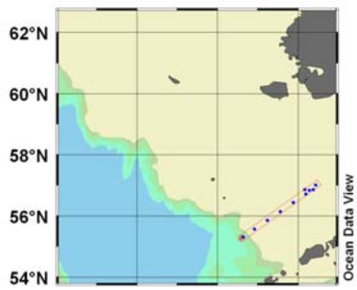
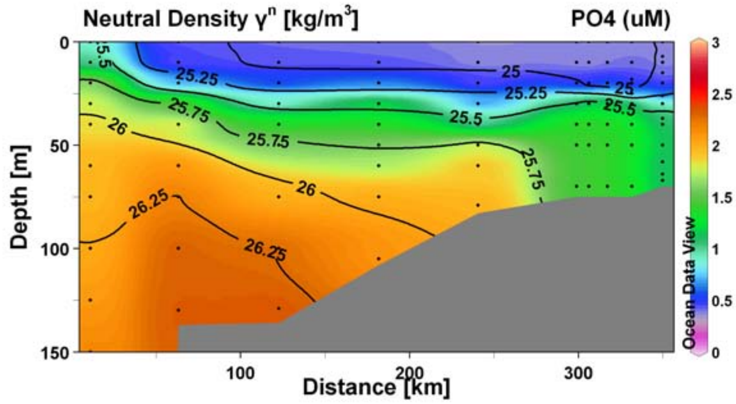




Figure 6. Sections from the CN line (Fig. 1 & inset above; distances are from northern end of line). A. Temperature (˚C; color bar) with salinity (labeled isopleths). B. Nitrate (μM; color bar) with neutral density (kg $m^{-3}$; labeled isopleths). C. Chl *a* fluorescence (ug $l^{-1}$; color bar) with nitrate (μM; labeled isopleths). D. Ammonium (μM; color bar) with nitrite (μM; labeled isopleths).



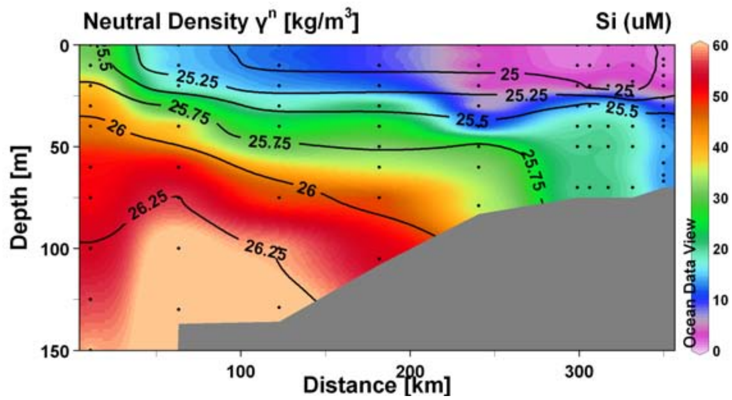
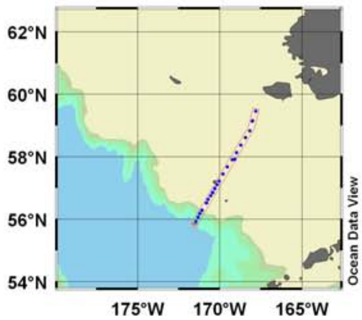




Figure 7. Sections from CN line, continued. Top. Phosphate (μM; color bar) with neutral density (kg $m^{-3}$; labeled isopleths). Bottom. Phosphate (μM; color bar) with neutral density (kg $m^{-3}$; labeled isopleths).



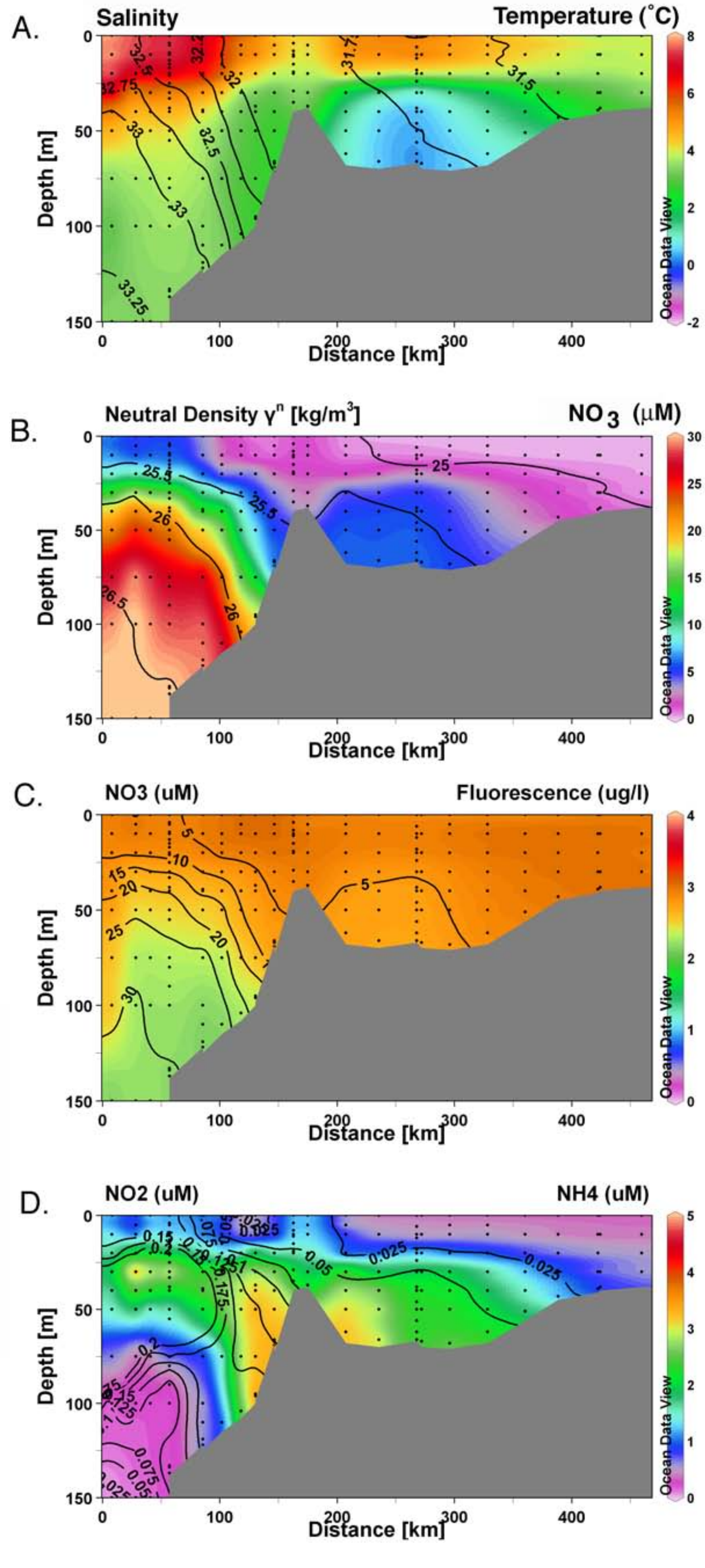
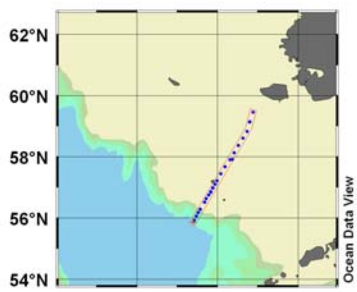




Figure 8. Sections from the NP line (Fig. 1 & inset above; distances are from northern end of line). A. Temperature (˚C; color bar) with salinity (labeled isopleths). B. Nitrate (μM; color bar) with neutral density (kg $m^{-3}$; labeled isopleths). C. Chl *a* fluorescence (ug $l^{-1}$; color bar) with nitrate (μM; labeled isopleths). D. Ammonium (μM; color bar) with nitrite (μM; labeled isopleths).



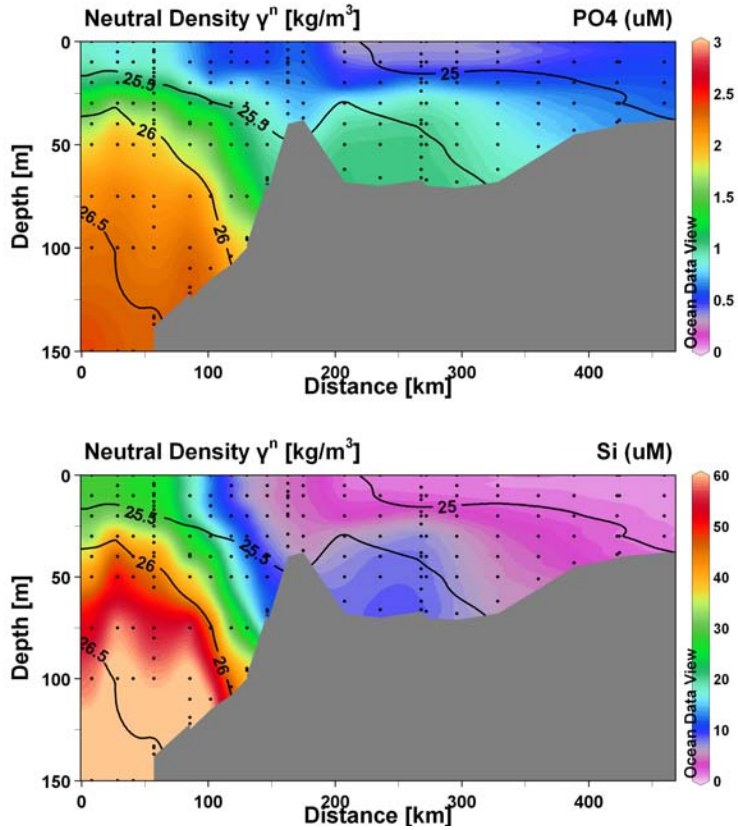
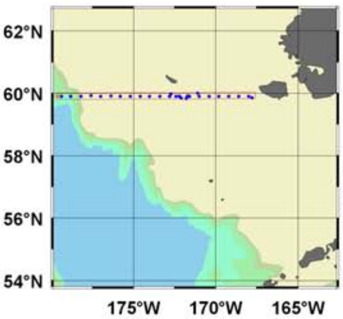




Figure 9. Sections from NP line, continued. Top. Phosphate (μM; color bar) with neutral density (kg m$^{-3}$; labeled isopleths). Bottom. Phosphate (μM; color bar) with neutral density (kg m$^{-3}$; labeled isopleths).



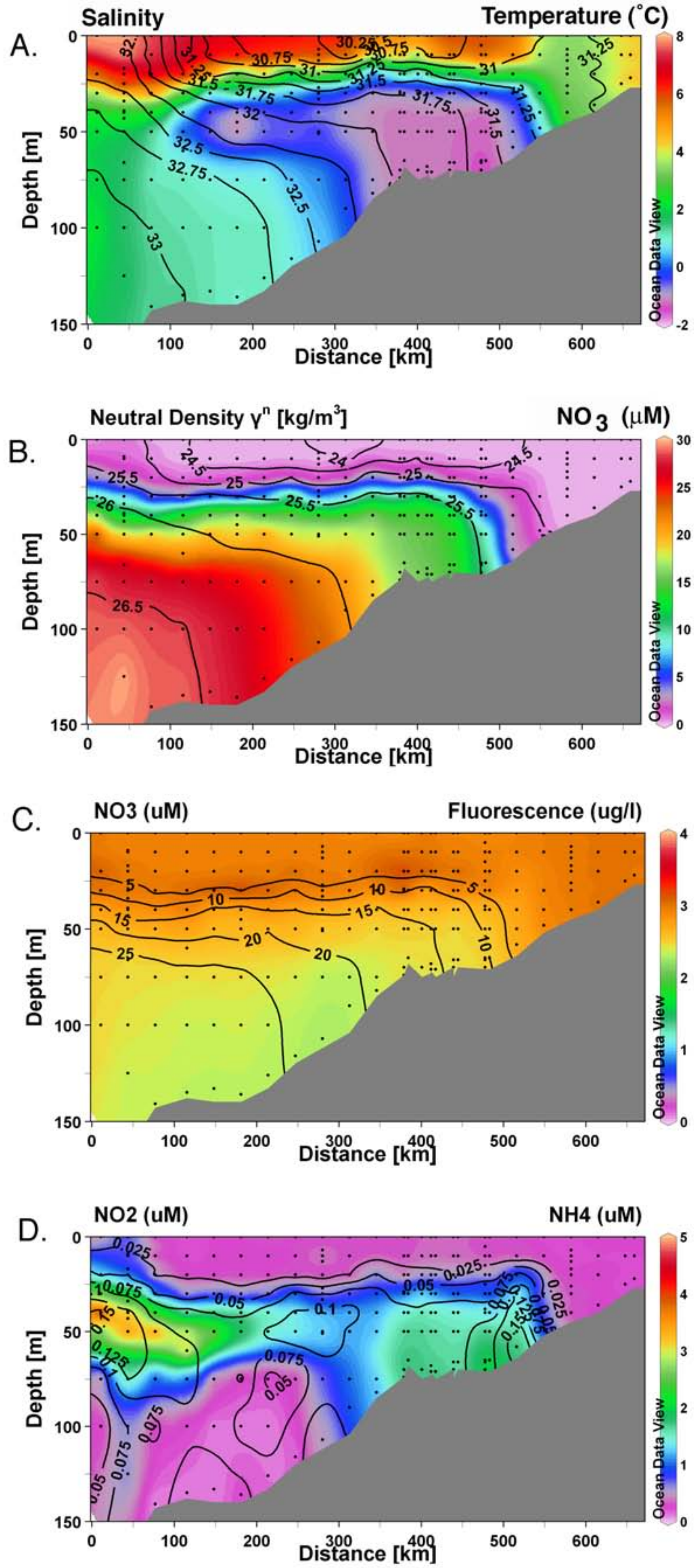
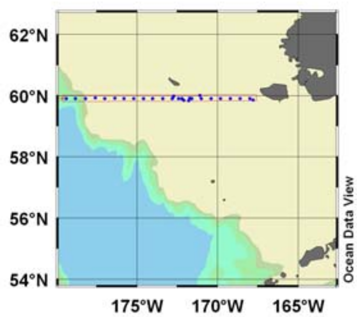




Figure 10. Sections from the MN line (Fig. 1 & inset above; distances are from northern end of line). A. Temperature (˚C; color bar) with salinity (labeled isopleths). B. Nitrate ($\mu$M; color bar) with neutral density (kg $m^{-3}$; labeled isopleths). C. Chl *a* fluorescence (ug $l^{-1}$; color bar) with nitrate ($\mu$M; labeled isopleths). D. Ammonium ($\mu$M; color bar) with nitrite ($\mu$M; labeled isopleths).



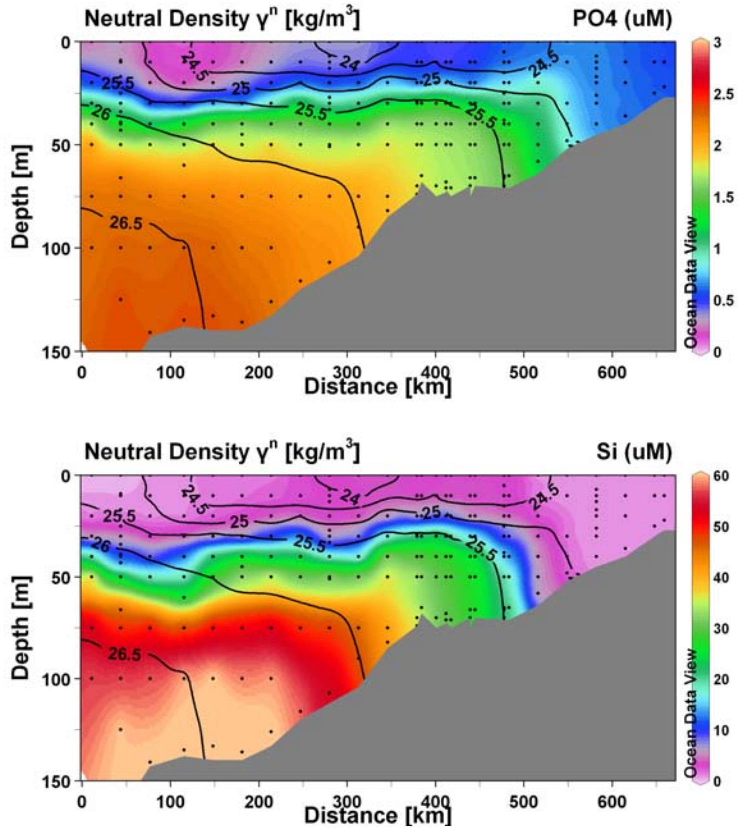
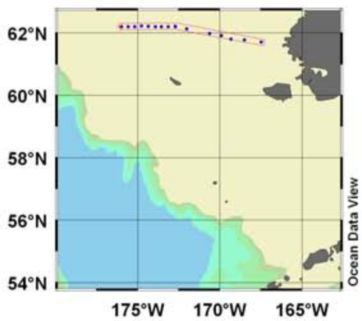




Figure 11. Sections from MN line, continued. Top. Phosphate (μM; color bar) with neutral density (kg m$^{-3}$; labeled isopleths). Bottom. Phosphate (μM; color bar) with neutral density (kg m$^{-3}$; labeled isopleths).



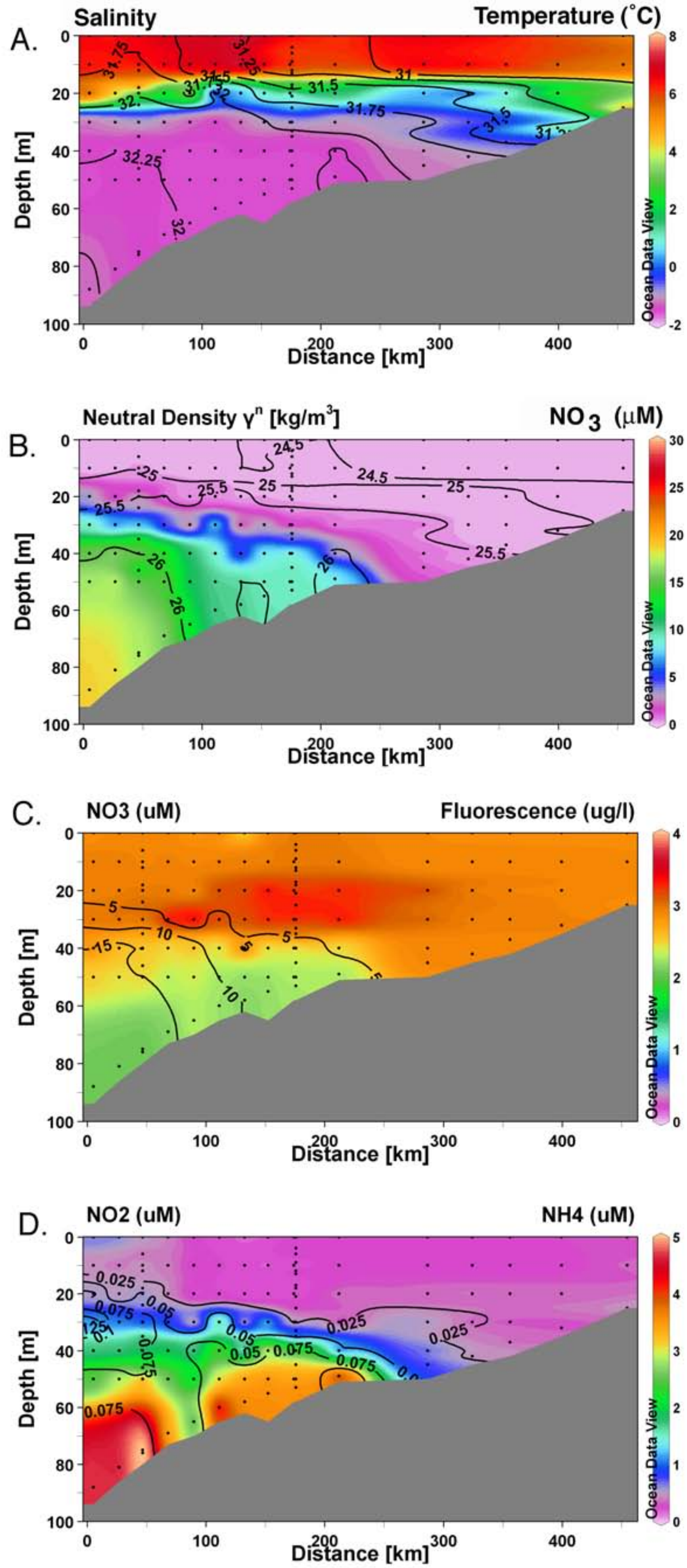
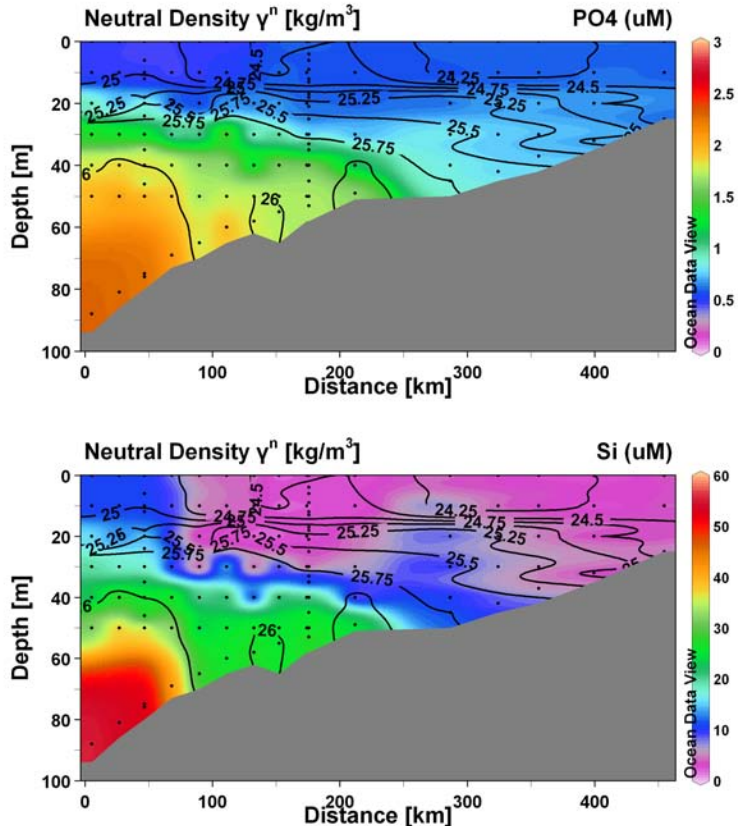




Figure 12. Sections from the SL line (Fig. 1 & inset above; distances are from northern end of line). A. Temperature (˚C; color bar) with salinity (labeled isopleths). B. Nitrate (μM; color bar) with neutral density (kg $m^{-3}$; labeled isopleths). C. Chl *a* fluorescence (ug $l^{-1}$; color bar) with nitrate (μM; labeled isopleths). D. Ammonium (μM; color bar) with nitrite (μM; labeled isopleths).





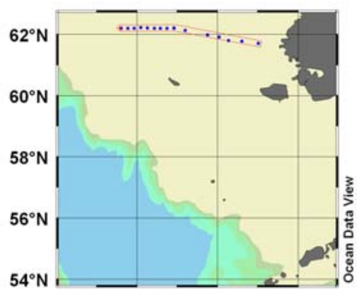




Figure 13. Sections from SL line, continued. Top. Phosphate (μM; color bar) with neutral density (kg $m^{-3}$; labeled isopleths). Bottom. Phosphate (μM; color bar) with neutral density (kg $m^{-3}$; labeled isopleths).

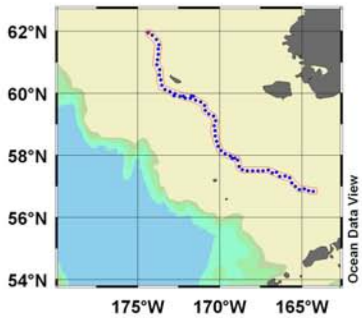
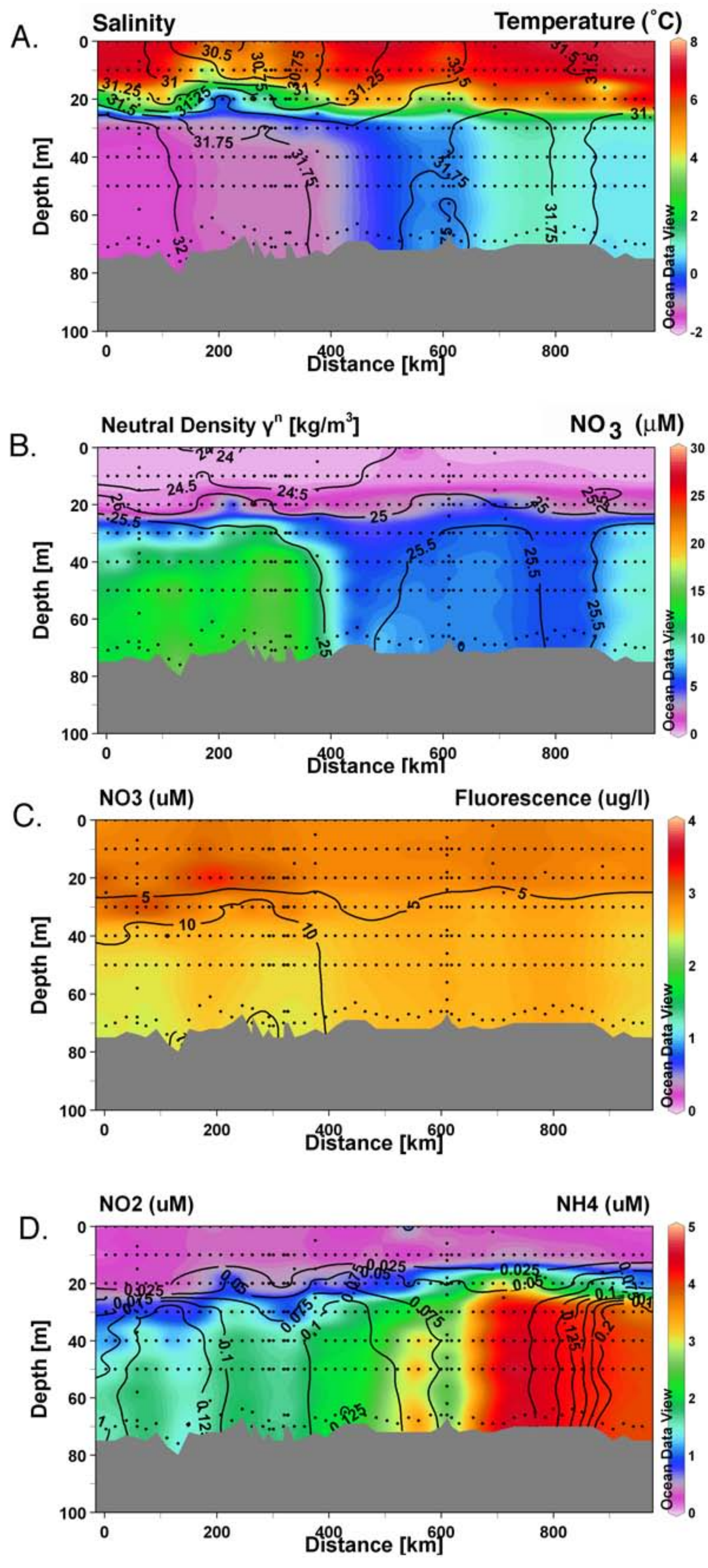
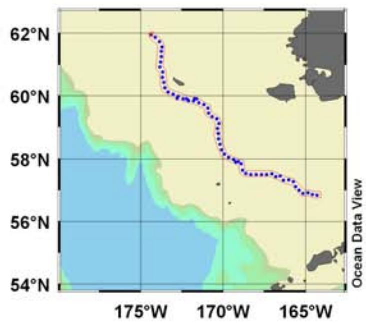



Figure 14. Sections from the 70 m line (Fig. 1 & inset above; distances are from northern end of line). A. Temperature (˚C; color bar) with salinity (labeled isopleths). B. Nitrate (μM; color bar) with neutral density (kg m$^{-3}$; labeled isopleths). C. Chl *a* fluorescence (ug l$^{-1}$; color bar) with nitrate (μM; labeled isopleths). D. Ammonium (μM; color bar) with nitrite (μM; labeled isopleths).





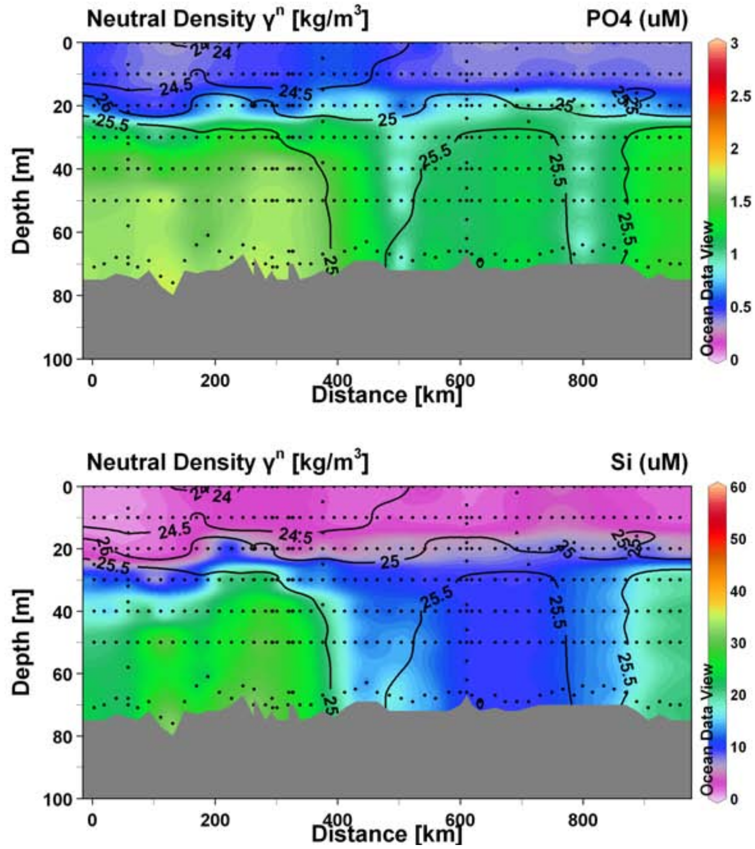




Figure 15. Sections from 70 m line, continued. Top. Phosphate (μM; color bar) with neutral density (kg m$^{-3}$; labeled isopleths). Bottom. Phosphate (μM; color bar) with neutral density (kg m$^{-3}$; labeled isopleths).

# 9 Individual Group Reports

## 9.1 Mooring group - Tom Weingartner

**Collaborative Research - Stratification on the Bering Shelf and its consequences for nutrients and the ecosystem: The effects of ice and coastal water advection (K. Aagaard and T. Weingartner)**

Our observational program is focused on how freshwater, either re-distributed by the shelf circulation or introduced from sea ice, modifies stratification and nutrient distributions over key portions of the central Bering shelf (between Nunivak and St. Lawrence islands). To achieve this goal we will:

1. describe the cross-shelf and vertical structure of selected physical properties in the coastal and mid-shelf domains, and examining how these vary seasonally and interannually.
2. identify the physical mechanisms controlling cross-shelf and vertical distributions of freshwater and nutrients, including the exchange processes between the coastal and mid-shelf domains; and
3. assess the relative roles of ice melt and meteoric waters (including runoff) in stratifying the shelf, and how changes in these freshwater sources can be expected to modify the shelf ecosystem.

Two principal hypotheses underlie these objectives. First, we propose that the central Bering shelf is significantly freshened by offshore transport of low-salinity coastal waters through most of the year. This cross-shelf freshwater flux influences not only the stratification on the shelf, but also the nutrient supply, since the coastal waters are typically deficient in macro-nutrients, even though they appear to be enhanced in iron. Second, we hypothesize that the effect on stratification of the cross-shelf flux of coastal waters varies seasonally, depending on the wind forcing and the strength of the coastal flow, the latter in turn being dependent on runoff. For example, in summer, when river discharge is high, we expect that the interaction of a vigorous buoyant coastal flow and relatively weak, but upwelling-favorable winds, with the change in coastline orientation north of Nunivak Island will result in along-shelf convergence and the offshore expulsion of coastal waters. Unless the inner shelf front is unstable, however, that front will remain intact, so that essentially the coastal domain expands seaward with little cross-frontal transport. On the other hand, in late summer and fall, strong upwelling-favorable winds and reduced runoff weakens the inner front so that the coastal and mid-shelf domains merge as the coastal waters move offshore. Both of these hypotheses involve interannual variability. In part this comes about because of interannual changes in runoff and winds, but in part also because of an intricate interplay between stratification, winds, and tides.

Our observational program includes shipboard CTD/rosette sampling that includes $\delta^{18}O$ measurements. We have collected ~300 $\delta^{18}O$ samples with measurements typically at the surface, 10 m and bottom on the shelf. We also deployed a nine-mooring array over the central shelf between the 55 and 25 m isobaths, which links to the NOAA-PMEL moorings deployed along the 70 m isobath (Figure 1).

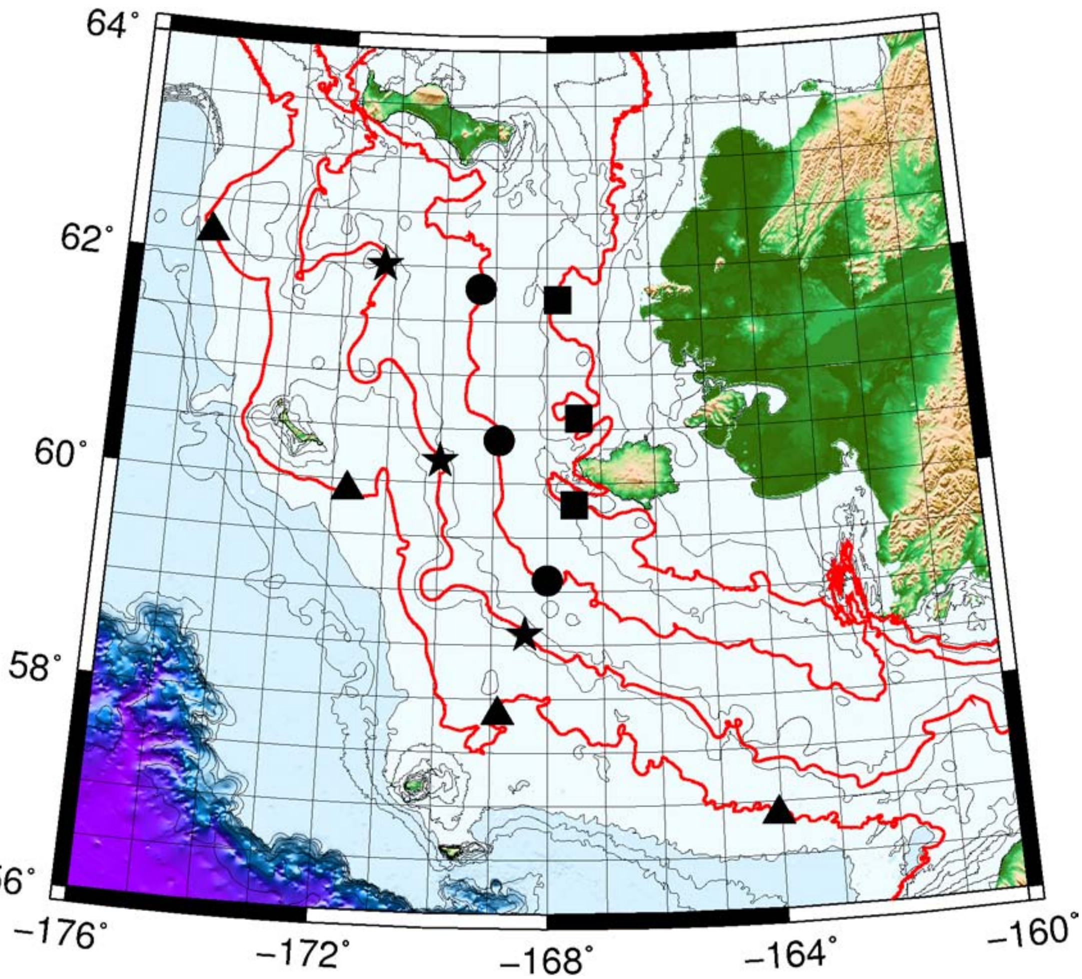



**Figure 1. Mooring location map:**
Triangles are the NOAA moorings M2, M4, M5 and M8 (on the 70 m isobath).
Stars are moorings S55, C55 and N55 (on the 55 m isobath)
Circles are moorings S40, C40 and N40 (on the 40 m isobath)
Squares are moorings S25, C25 and N25 (on the 25 m isobath)
Red contours: 25, 40, 55 and 70 m isobaths. Black contours: 10, 20, 30, 50, 60, 80, 90, 100, 150, 200, 250, 500, 1000, 2000 & 3000 m isobaths.

The mooring deployments are summarized in Table I. The instruments sample at half-hourly rates and store data internally. They will be recovered and replaced with fresh instruments in summer 2009, with the final recovery scheduled fro summer 2010. Table II lists the instruments on each mooring.

**Table I.** Healy 0803 BEST Mooring deployments

| Mooring | Date/time[1] (ADT) | Longitude (W) | Latitude (N) | Depth[2] (m) | Comments |
|---|---|---|---|---|---|
| N55 | 2131 July 11 | 171 58.488’ | 61 57.717 | 54.4 | 25 kts, rainy. Deployment smooth. 1454 m/s |
| N40 | 16:30 July 12 | 169 16.722’ | 61 48.328 | 40.3 | 12 kts, light seas, deployment smooth. 1450 m/s |
| N25 | 22:54 July 12 | 167 27.112 | 61 42.006 | 25.6 | 14 kts, light seas, smooth deploy. :1468 m/s |
| C55 | 1151 July 11 | 170 5.367’ | 60 10.316’ | 54.91 | Deployment smooth, 15 kts overcast. 1440m/s |
| C40 | 1534 July 10 | 169 1.266’W | 60 20.204’N | 40.5 | Deployment smooth calm and overcast |
| C25 | 2116 July 10 | 167 20.257’W | 60 40.959’N | 24.9 | Deployment smooth; calm and overcast. |
| S55 | 22:40 July 13 | 168 23.646 | 58 35.378 | 55.3 | 1457 m/s. foggy, 32 kts, deployment smooth |
| S40 | 1423 July 8 | 167 58.94 | 59 8.175’ | 42 | Deployment smooth; 20 -25 S and seass building. Rain |
| S25 | 2230 July 8 | -167 46.885 | 59 51.088’ | 26.2 | Deployment smooth 25 kts S and 7 – 8’ seas. About 10 miles NW of nominal position due to shoaling bottom. |

[1] GMT = ADT + 8 hours

[2]includes hull and sound speed correction based on CTD prior to deployment.

**Table 2. BEST MOORING PLAN (Aagaard, Danielson and Weingartner)**

| Mooring | Instrumentation |
|---|---|
| N55 | SBE 16/37 @ 20*, 50 m; Upward-looking 300Khz ADCP @ 49 m; T chain**; IceCat @ 10m |
| N40 | SBE 16/37 @ 20* & 35 m, Upward-looking 300Khz ADCP @ 34 m |
| N25 | 1-m Bottom Tripod SBE 37 Upward-looking 300Khz ADCP |
| C55 | SBE @ 20* & 50 m Upward-looking 300Khz ADCP @ 49 m; T chain**; IceCat @ 10 m |
| C40 | SBE 16/37 @ 20* & 35 m Upward-looking 300Khz ADCP @ 34 m |
| C25 | 1-m Bottom Tripod SBE 37 Upward-looking 300Khz ADCP |
| S55 | SBE 16/37 @ 20*, 50 m; Upward-looking 300Khz ADCP @ 49 m; T chain**; IceCat @ 10 m |
| S40 | SBE 16/37 @ 20* & 35 m, Upward-looking 300Khz ADCP @ 34 m |
| S25 | 1-m Bottom Tripod SBE 37 Upward-looking 300Khz ADCP |

* SBE @ 20 m on N40, C40, S40 and N55, C55, S55 include fluorometer

** T chain consists of 15 internally logging T recorders at 2.5 m intervals

## 9.2 Hydrography & PMEL group

Leg 1: Sigrid Salo[1], David Kachel[1], Calvin Mordy[2], William Floering[1]
Leg 2: Edward D. (Ned) Cokelet[1], Dylan Righi[3], Calvin Mordy[2], William Floering[1], Andrew Koehn[3]
[1]NOAA/Pacific Marine Environmental Laboratory
[2]GenWest Systems, Edmonds, WA
[3]University of Washington Joint Institute for the Study of Atmospheres and Oceans

The BEST Hydrography Group conducted 210 CTD casts at 177 oceanographic stations. The CTD was a Sea Bird Electronics SBE 911 plus with dual temperature and conductivity sensors. It carried an auxiliary SBE 35 temperature sensor, a

WETLabs optical transmissiometer, a Chelsea Aqua Tracker fluorometer, a Biospherical QSP2300 PAR sensor and a Benthos 916 altimeter. The group conducted CTD casts which included nutrient samples from up to 12 thirty-liter Niskin bottles, two or more Winkler oxygen samples for calibration of the CTD oxygen sensor, three $O^{18}$ samples for Tom Weingartner of the University of Alaska Fairbanks (UAF), and two to seven Dissolved Organic Carbon (DOC) and Dissolved Inorganic Carbon (DIC) samples for Jeremy Mathis of UAF. Table 1 summarizes the sampling. Scott Hiller and Sue Reynolds, Scripps Institution of Oceanography, operated the CTD console during the cruise and analyzed salinity samples for calibration.

**Nutrient** Measurements

Nutrient samples were collected from the Niskin bottles in acid-washed 35-ml polyethylene bottles after three complete seawater rinses and typically analyzed within 12 hours of sample collection. Nutrients were analyzed with a continuous flow analyzer (CFA) using the standard and analysis protocols for the WOCE hydrographic program as set forth in the manual by L.I. Gordon, et al (2000). Approximately 1900 samples were analyzed for phosphate ($PO_4^{3-}$), nitrate ($NO_3^-$), nitrite ($NO_2^-$), orthosilicic acid ($H_4SiO_4$), and ammonium ($NH_4^+$).

A mixed stock standard consisting of silicic acid, phosphate and nitrate was prepared at PMEL by dissolving high purity standard materials ($KNO_3$, $KH_2PO_4$ and $Na_2SiF_6$) in deionized water using a two step dilution for phosphate and nitrate. This standard was stored at room temperature. Nitrite and ammonium stock standards were prepared about every 10 days by dissolving in distilled water, and these standards were stored in the refrigerator. Working standards were freshly made at each day by diluting the stock solutions in low nutrient seawater. The low nutrient seawater used for the preparation of working standards, determination of blank, and wash between samples was filtered seawater obtained from low-nutrient Pacific surface waters.

A typical analytical run consisted of distilled water blanks, standard blanks, working standards, a standard from the previous run, samples, replicates, and working standards, and standard and distilled water blanks. Four replicates were usually measured on each run, plus any samples with questionable peaks, and the overall precision of the analysis was within 1% of full range.

Table 1. Sampling by Hydrographic Group, 3-31 July 2008

| | |
|---|---|
| **Hydrographic Stations** | 177 |
| CTD casts | 210 |
| Nutrient Samples Analyzed | 1770 |
| Winkler Oxygen Samples | 263 |
| DOC Samples | 311 |
| DIC Samples | 311 |
| $O^{18}$ Samples | 296 |
| **Underway Samples** | |
| Nutrient Samples | 121 |
| Winkler Oxygen Samples | 96 |
| Total Chlorophyll Samples | 93 |

**Oxygen Measurements**

Winkler titrations were conducted according to WOCE protocols. On each cast, the number of samples and the depths sampled were dependent on the oxygen profile from the CTD. In deep water, samples were typically collected at every depth below 100m. On the shelf, samples were usually collected in the upper layer, and in the bottom layer. End point determinations of the Winker titration were determined poteniometrically. Thiosulfate was standardized for each batch of sample titrations, and blanks were measured periodically during the cruise.

**DIC and DOC Sampling**

The sampling protocol for the DIC sampling was as follows: Samples were drawn into glass bottles immediately after oxygen sampling directly from the Niskin bottles using tubing to reduce the amount of bubbles entrained in the sample. The bottles were rinsed three times and then filled almost full. A little head space was allowed for gas expansion, but the level in the bottle was not below the white tape on the bottle neck. After the bottle was filled, it was injected with mercuric chloride. The lid was screwed on as tightly as possible, and the bottle shaken a little. Glass bottles were labeled with the station number, cast number and bottle number on each sample.

The sampling protocol for the DOC sampling was as follows: The plastic bottles were rinsed three times from the Niskin and then filled about 70% full. The caps were screwed on tight, labeled the same as the DIC samples and placed in a freezer for the duration of the cruise.

Ned Cokelet arranged for the underway seawater sampling system to be augmented for this cruise, and Scott Hiller set up the instruments. Additions included a WetLabs ac-9 optical absorption and attenuation meter and a Satlantic ISUS nitrate meter (both on loan from Lisa Eisner, NOAA Auke Bay Laboratory). Seawater samples were collected from the system and analyzed for dissolved oxygen, nitrate and chlorophyll concentration for calibration.

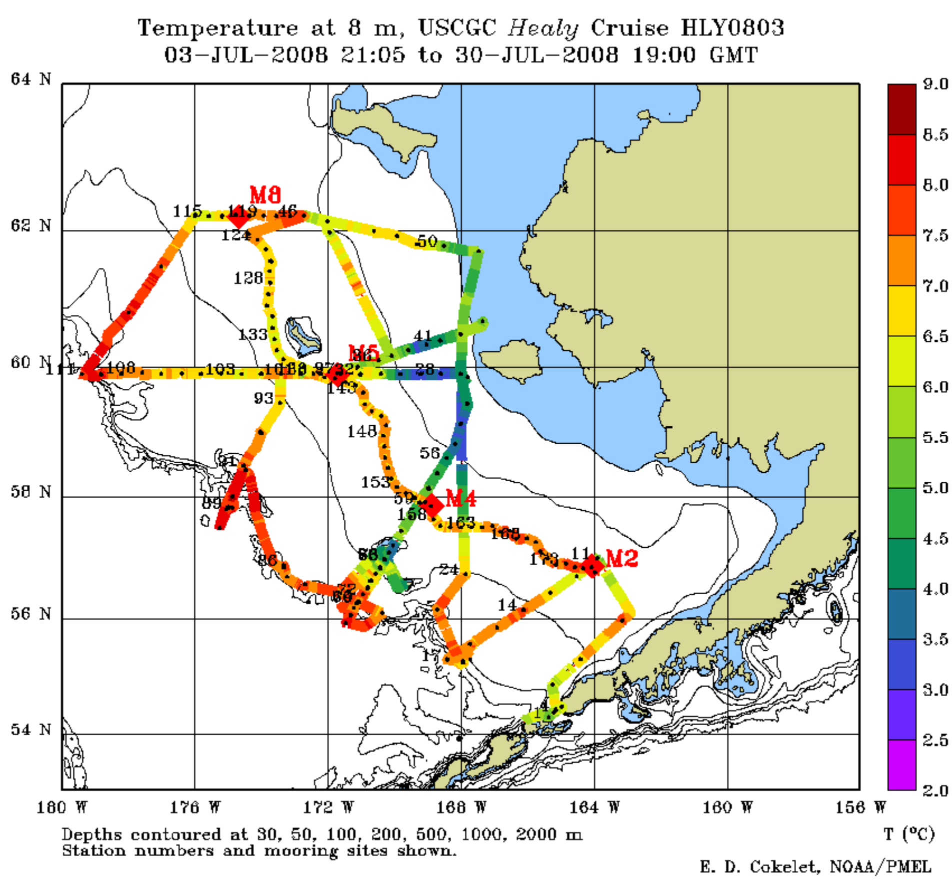
**Typical Results**

Figures 1-5 show the water temperature, salinity, nitrate, chlorophyll and oxygen concentrations as measured by the underway seawater sampling system. The underway nitrate and oxygen values were calibrated against discrete samples taken and analyzed during the cruise. These measurements are preliminary and may change after further analysis.

Figure 6 shows the locations of various CTD transects taken during the cruise.

Figures 7-13 show the water temperature, salinity, density (sigma-t), photosynthetically available radiation (PAR), optical beam attenuation, chlorophyll and oxygen concentrations for the MN transect (Figure 6). These measurements are preliminary and may change after further analysis.

Figure Hydro-1. Water temperature at 8 m depth measured by the underway seawater sampling system.



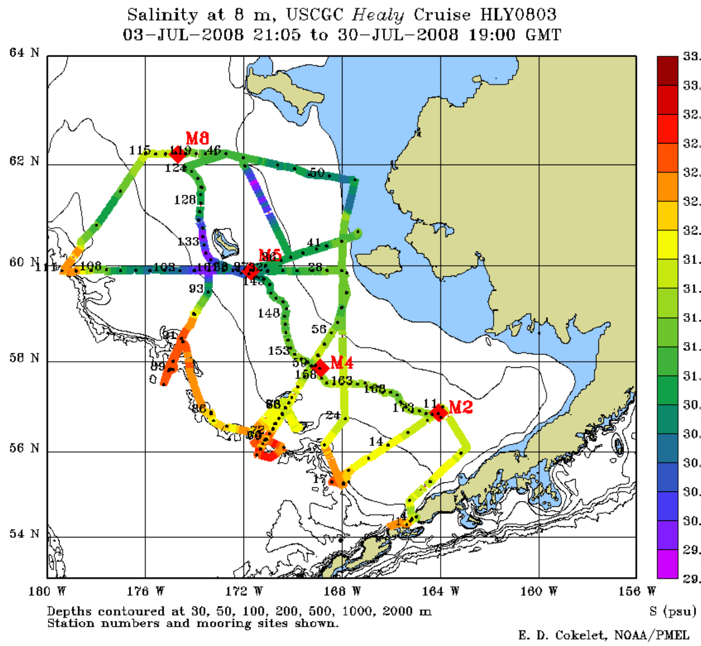



Figure 2. Salinity at 8 m depth measured by the underway seawater sampling system.

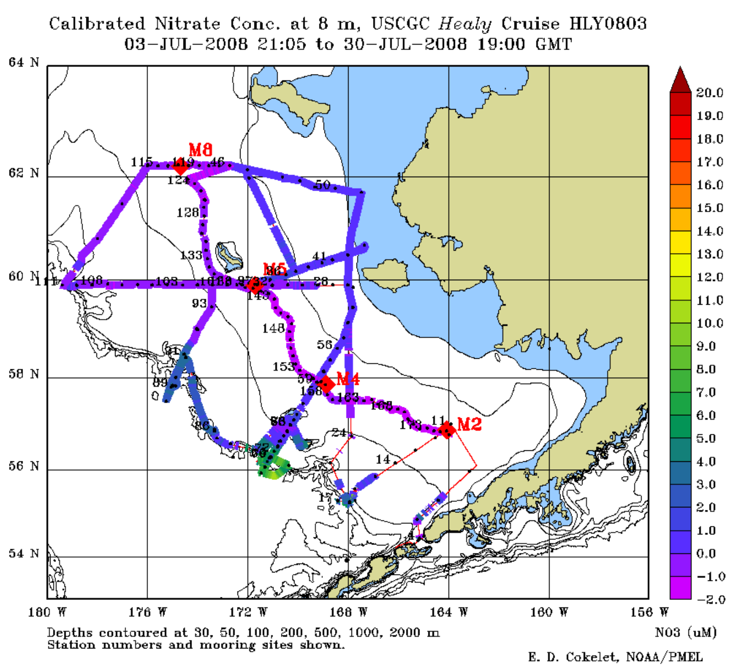



Figure Hydro-3. Calibrated dissolved nitrate concentration at 8 m depth measured by the underway seawater sampling system.

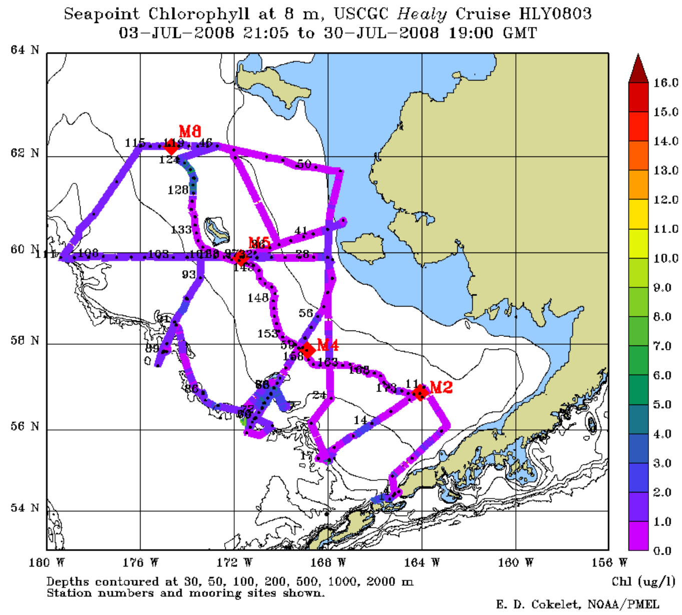
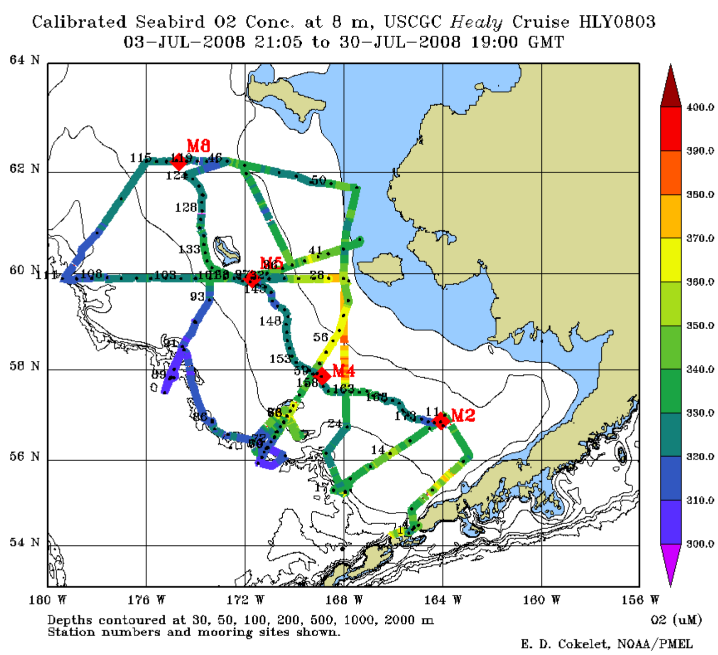



Figure Hydro-4. Chlorophyll concentration at 8 m depth measured by the underway seawater sampling system.

Figure Hydro-5. The calibrated dissolved oxygen concentration at 8 m depth measured by the underway seawater sampling system.



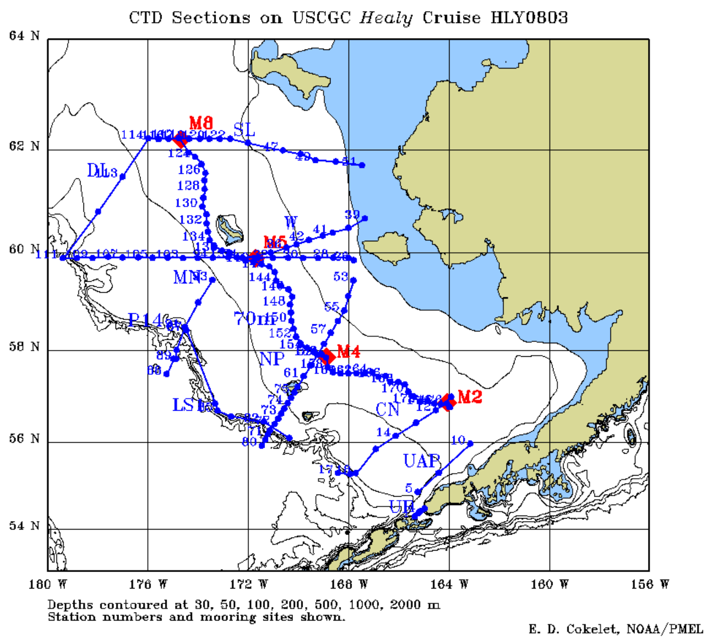



Figure Hydro-6. The locations of the SL, DL, 70-m, W, MN, P14, NP, LS1, NP, CN, UAP and UP CTD transects made during the cruise.

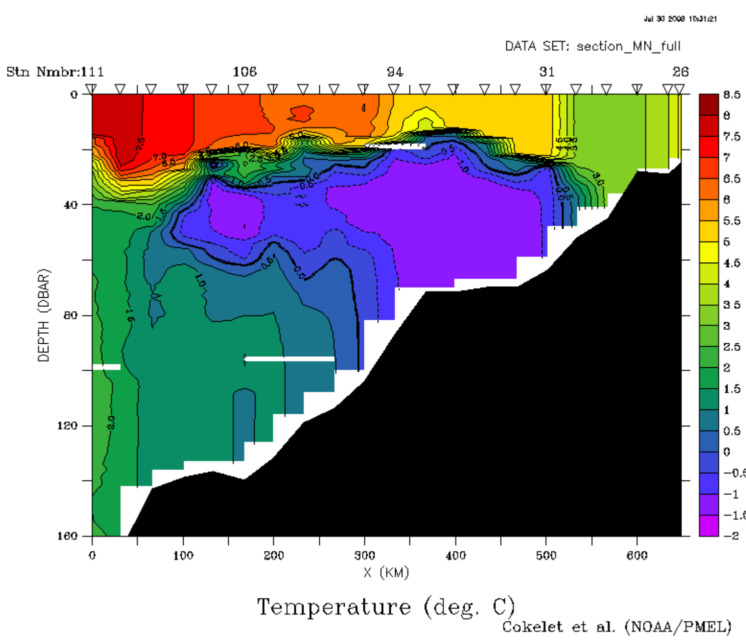



Figure Hydro-7. Water temperature along the MN transect.

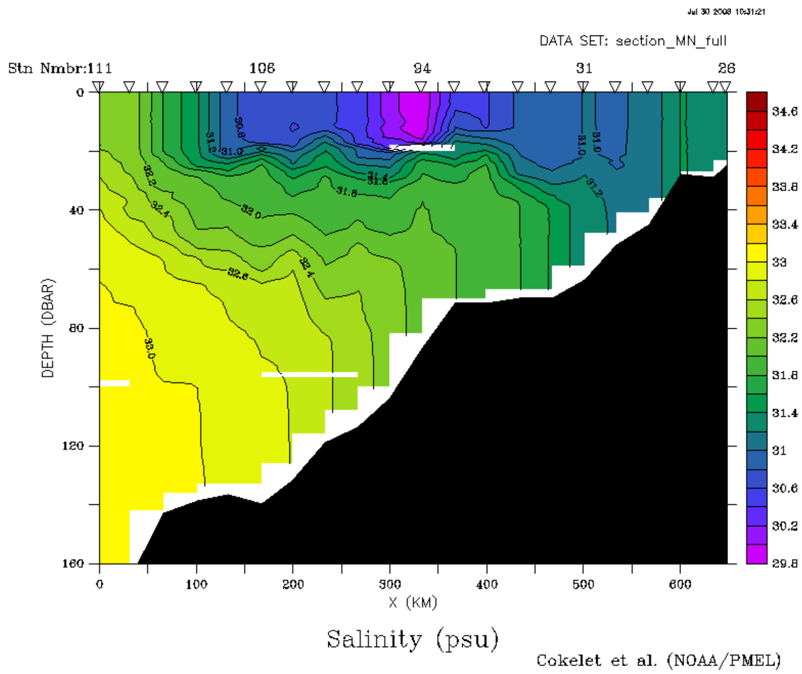



Figure Hydro-8. Salinity along the MN transect.

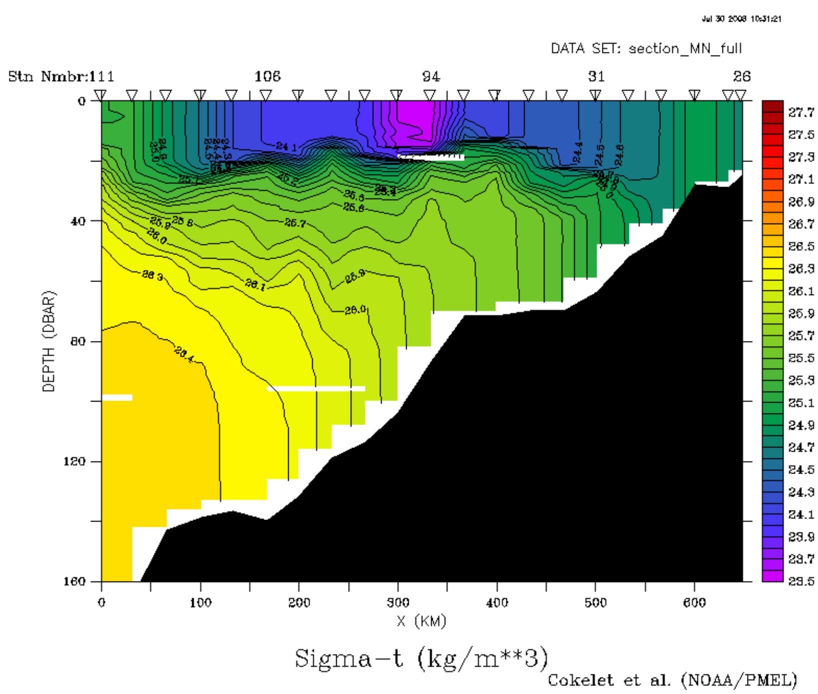



Figure Hydro-9. Sigma-t density along the MN transect.

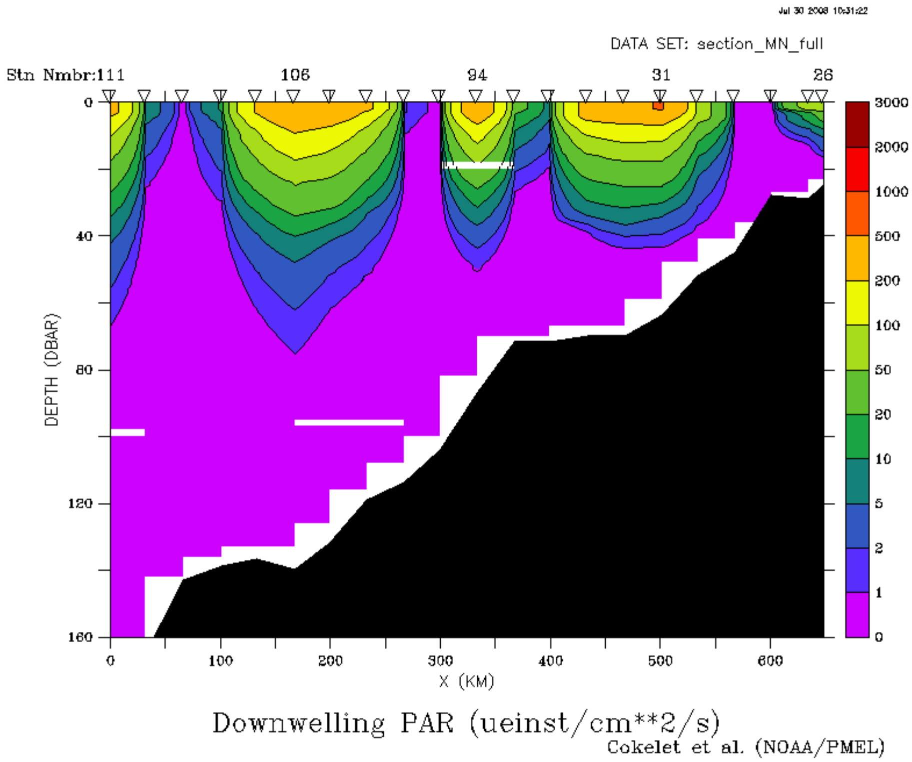



Figure Hydro-10. Photosynthetically Available Radiation (PAR) along the MN transect.

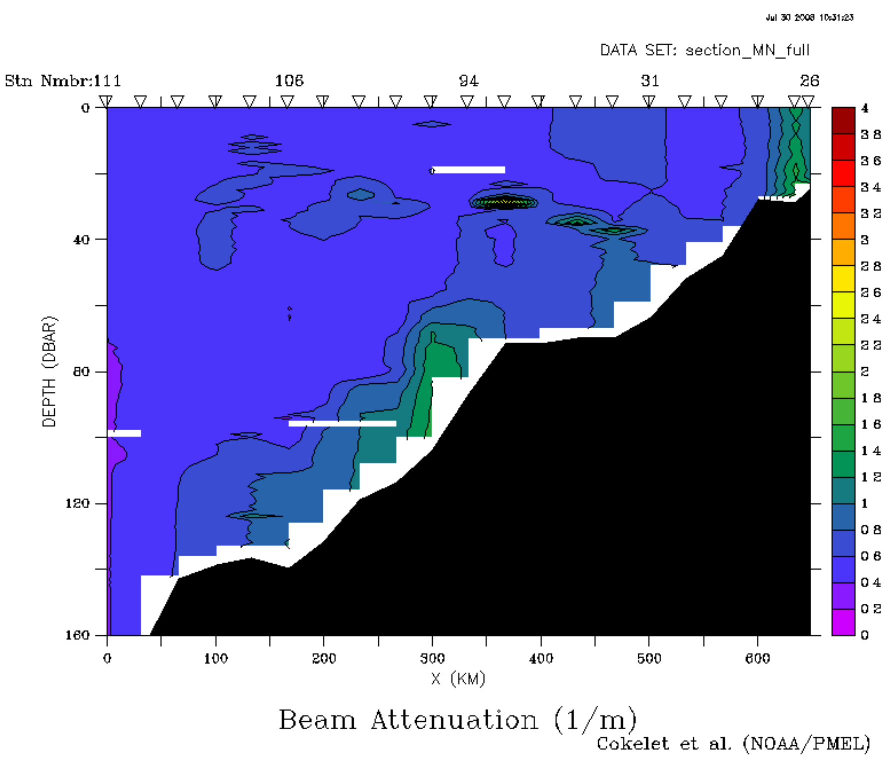



Figure Hydro-11. Optical beam attenuation along the MN transect.

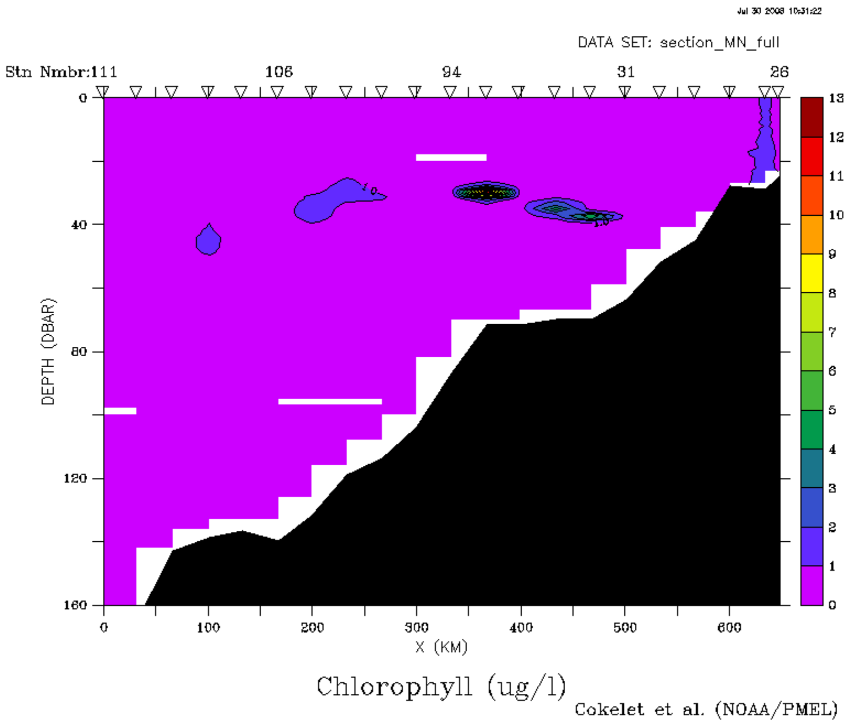



Figure Hydro-12. Chlorophyll concentration along the MN transect.

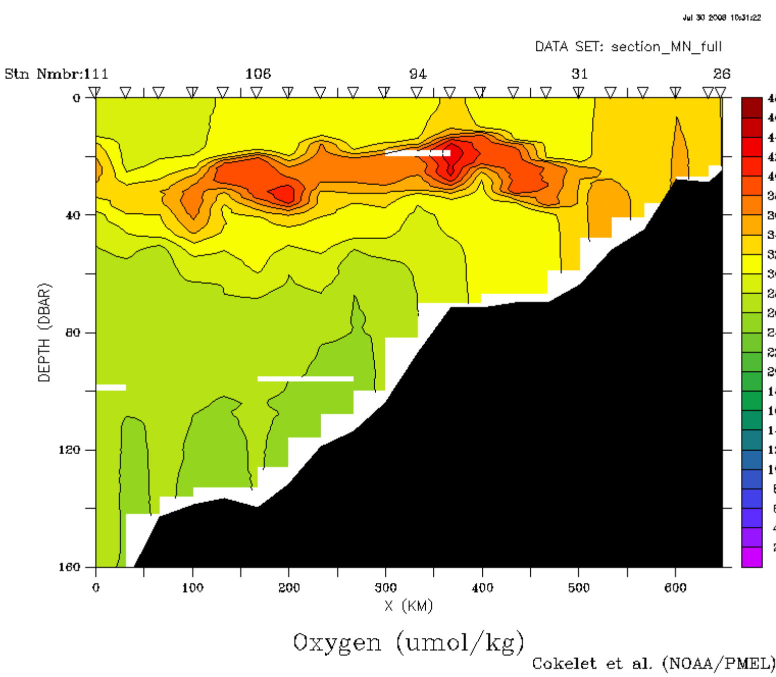



Figure Hydro-13. Dissolved oxygen concentration along the MN transect.

## 9.3 Carbon productivity – Lomas/ BIOS group

Component goals:

1. Quantify the magnitude and regional variability of gross primary production and net community production in MIZ and open-water blooms associated with seasonal and interannual changes in sea ice extent.
2. Quantify the main floristic patterns (using a diversity of chemotaxonomic methods) and autotrophic cell size distributions in MIZ and open-water blooms.
3. Quantify the export flux of organic carbon associated with MIZ and open-water blooms in deeper waters (outer-shelf/slope), and link carbon export to primary production and benthic oxygen utilization to assess the efficiency of pelagic-benthic coupling associated with seasonal and interannual changes in sea ice extent.

To achieve these objectives we have used the following methods:

- Obj 1. Net primary production was estimated by use of 14C incubations. Taxon-specific carbon turnover will be estimated from samples taken in collaboration with Ray Sambrotto that will be sorted on a flow cytometer after returning to BIOS.
- Obj 2. We are documenting phytoplankton community structure by several methods. Microplankton (>10um) are being quantified using traditional Utermohl setting chambers. We are estimating the C content of each cell (and after multiplying by cell abundance - Carbon in each population or functional group) using the Strathman equations and the Montagnes et al. equations using approximate geometric shapes for each species. Pico and Nano-plankton, and heterotrophic bacteria are being quantified using flow cytometry. Cell abundance is calculated based upon the volume analyzed method. Lastly, we are taking samples for HPLC analysis that will be converted to approximate taxonomic groups based upon the CHEMTAX algorithms.
- Obj 3. We are quantifying POC fluxes using surface-tethered traps and elemental analysis. We are also collecting samples for pigment analyses from the trap material to attempt to link phytoplankton community structure in the euphotic zone with the composition that is collected in the traps (with all appropriate caveats).

Expected Results are:

1. size-fractionated (whole and >5um) chla (fluorometry) and HPLC pigment concentrations, and size-fractionated rates of primary production.
2. estimates of Synechococcus abundance, pico- and nano-eukaryotes, and identification, abundances and carbon content of microphytoplankton.
3. Export flux estimates for POC and HPLC pigments.

Data availability:

1. Chla and HPLC pigments, and primary production will be available by the end of the calender year 2008.
2. Pico/nano-plankton analyses and a subset of the microplankton analyses will be completed by the end of 2008.

3. No samples for HLY0803 have been analyzed as yet, and therefore nothing to show at this time.

### 9.4 Nitrogen productivity & cycling – Sambrotto/ LDEO group

Project objectives:

1) Measure new (nitrate) and regenerated productivity during summer as a comparison to the spring measurements made on earlier BEST cruises.
2) Measure isotopic signatures of particulate carbon and nitrogen to determine their variations with production and regeneration.
3) Determine the seasonal development of the production in the regions that supported elevated levels of productivity during the earlier ice edge.

Nitrogen & carbon productivity rates measured:

| Station | cast | latitude [degrees north] | longitude [degrees east] | Date |
|---|---|---|---|---|
| 4 | 7 | 54.43817 | 194.8588 | 07/04/2008 |
| 11 | 12 | 57.00117 | 196.0948 | 07/05/2008 |
| 16 | 18 | 55.2805 | 192.0733 | 07/06/2008 |
| 21 | 24 | 55.25 | 192.0705 | 07/07/2008 |
| 29 | 33 | 59.89683 | 190.8008 | 07/09/2008 |
| 37 | 42 | 60.171 | 189.9333 | 07/10/2008 |
| 46 | 52 | 62.204 | 187.2988 | 07/12/2008 |
| 59 | 67 | 57.89867 | 190.7612 | 07/14/2008 |
| 66 | 76 | 56.28817 | 188.9352 | 07/15/2008 |
| 75 | 85 | 57.0925 | 189.8347 | 07/17/2008 |
| 79 | 90 | 56.27117 | 187.4248 | 07/18/2008 |
| 86 | 102 | 56.84867 | 186.6872 | 07/20/2008 |
| 89 | 107 | 57.82833 | 185.0075 | 07/21/2008 |
| 92 | 114 | 59.00667 | 185.9843 | 07/22/2008 |
| 98 | 122 | 59.89867 | 189.0002 | 07/23/2008 |
| 103 | 131 | 59.89367 | 185.4247 | 07/24/2008 |
| 110 | 140 | 59.89517 | 181.1935 | 07/25/2008 |
| 116 | 147 | 62.199 | 184.8383 | 07/26/2008 |
| 126 | 159 | 61.552 | 186.3098 | 07/27/2008 |
| 143 | 176 | 59.616 | 189.0673 | 07/28/2008 |

Expected results:

1) Spatial pattern of productivity.
2) Vertical pattern of productivity – Particularly the productivity associated with sub-surface Chl a layers.
3) Pattern of isotopic fractionation of marine particulate material and its relationship to productivity and regeneration.

## 9.5 Particle flux – URI group

**Project Objectives:**

1) Quantify the flux of particulate organic carbon (POC) from the surface water to the deep waters of the Bering Sea using $^{234}Th$ as a tracer of particle export.
2) Determine POC/$^{234}Th$ ratio and phytoplankton community values for particles collected in drifting sediment traps at five different depths (25, 40, 50, 60, and 100m).
3) Estimate particle export using measurements of total $^{234}Th$ – $^{238}U$ disequilibrium in the water column determined using small-volume thorium extractions with a manganese oxide precipitate.
4) Estimate gross primary production within the surface mixed layer using triple-oxygen isotope method.
5) Estimate cross-shelf exchange and self-break front isopycnal mixing using short-lived radium isotopes ($^{223, 224}Ra$).

**Samples Collected:**

Drifting sediment traps

| Station | Depths (m) | POC/$^{234}Th$ samples | Pigment samples |
|---|---|---|---|
| PIT 1 | 25,40,50,60,100 | 2 per depth | 2 per depth |
| PIT 2 | 25,40,50,60,100 | 2 per depth | 2 per depth |
| PIT 3 | 25,40,50,60,100 | 2 per depth | 2 per depth |

Small Volume $^{234}Th$

| Station | Depths (m) |
|---|---|
| 4-UP3 | 10, 20, 30, 40, M60, 75, 100, 131 |
| 16-PITD-1 | 6, 12, 19, 24, 30, 46, 70, 100, 150, 200 |
| 29-MN3 | 10, 20, 30, 40 |
| 46-SL8 | 6, 18, 25, 30, 35, 45, 50 |
| 59-NP7 | 10, 20, 30, 40, 50, 62 |
| 67-PITD-2 | 10, 25, 40, 50, 60, 80, 100, 125, 150, 175, 200, 215 |
| 83-NP11 | 10, 20, 30, 40, 50, 66 |
| 86-LS1-6 | 10, 20, 30, 40, 50, 75, 100, 125, 161 |
| 87-PITD-3 | 10, 25, 40, 50, 60, 75, 100, 150, 170 |
| 92-P14-3 | 10, 20, 30, 40, 50, 75, 100, 120 |
| 103-MN12 | 10, 20, 30, 40, 50, 75, 107 |
| 111-MN20 | 10, 20, 30, 40, 50, 75, 100, 200, 300, 400, 500 |
| 116-SL14 | 10, 20, 30, 40, 50, 76 |
| 143-70M36 | 10, 20, 30, 38, 50, 67 |

Triple-oxygen isotopes

| Date | Station | Depth (m) |
|---|---|---|
| 7/4/08 13:07 | 4-UP3 | 10 |
| 7/5/08 11:47 | 10-UAP3 | 20 |
| 7/6/08 1:53 | 17-CN18 | 18 |
| 7/8/08 9:43 | 24-CNN6 | 32 |

| | | |
|---|---|---|
| 7/9/08 20:09 | 31-MN5 | 20 |
| 7/10/08 13:15 | 35-W7 | 10 |
| 7/11/08 10:10 | 41-W3 | 20 |
| 7/12/08 10:06 | 46-SL8 | 12 |
| 7/12/08 10:06 | 46-SL8 | 35 |
| 7/13/08 6:37 | 51-N25 | 10 |
| 7/14/08 14:14 | 59-NP7 | 15 |
| 7/15/08 6:19 | 64-NP12 | 10 |
| 7/16/08 1:06 | 68-NP15 | 16 |
| 7/18/08 11:58 | 78-NP12.5 | 10 |
| 7/19/08 4:29 | 81-LS1-1 | 10 |
| 7/20/08 5:56 | 84-LS1-4 | 10 |
| 7/20/08 8:52 | 85-LS1-5 | 10 |
| 7/20/08 11:08 | 86-LS1-6 | 12 |
| 7/21/08 16:24 | 89-P14-4 | 15 |
| 7/22/08 11:32 | 92-P14-3 | 10 |
| 7/23/08 10:16 | 96-MN8 | 10 |
| 7/24/08 9:42 | 102-MN11 | 10 |
| 7/25/08 8:09 | 108-MN17 | 10 |
| 7/25/08 13:18 | 110-MN19 | 10 |
| 7/25/08 21:04 | 111-MN20 | 10 |
| 7/26/04 12:10 | 114-SL16 | 10 |
| 7/26/08 23:09 | 118-SL12 | 10 |
| 7/27/08 12:50 | 124-70M55 | 10 |
| 7/28/08 4:17 | 133-70M46 | 10 |
| 7/28/08 13:45 | 141-70M48 | 15 |
| 7/29/08 5:09 | 153-70M26 | 10 |
| 7/29/08 9:17 | 156-70M23 | 10 |
| 7/29/08 16:01 | 159-70M19 | 15 |
| 7/29/08 22:40 | 164-70M14 | 15 |
| 7/30/08 0:44 | 165-70M13 | 6 |
| 7/30/08 5:59 | 169-70M09 | 15 |
| 7/30/08 9:59 | 172-70M06 | 10 |
| 7/30/08 16:20 | 177-70M01 | 15 |

Short-lived Radium isotope samples

| Station | Depth (m) |
|---|---|
| S-25 | 8 |
| C-25 | 8 |
| 72-NP13.5 | 20 |
| 73-NP12.5 | 39 |
| 74-NP11.5 | 36 |
| 76-NP11 | 69 |
| LS1-4 | 8 |

| | |
|---|---|
| LS1-5 | 8 |
| LS1-6 | 8 |
| 92-P14-2 | 26 |
| 93-P14-1 | 25 |
| 96-MN8 | 20 |
| 101-MN9B | 28 |
| 101-MN9B | 74 |

**Data Summary**

Trap Results:

Measurable quantities of $^{234}Th$ have been collected in the sediment traps, though further comment is unwarranted due to incomplete analysis. CHN and pigment analysis will be completed upon return to URI-GSO. Samples archived for pigment analysis may also be analyzed for $\partial^{13}C$ and $\partial^{15}N$ by Dr. Sambrotto, as well as organic biomarkers by Dr. Goes.

Small Volume Results:

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

Triple Oxygen Productivity Results:

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

Short Lived Radium Results:

Analysis of only sample collected up to this point revealed low activities of $^{223}Ra$ and $^{224}Ra$, typical of open ocean values. Near shore, shallow water column samples had highest activities (~2 dpm/100L for $^{224}Ra$, and 0.15 dpm/100L for $^{223}Ra$). Near-bottom samples collected where the 25.5 $\sigma_t$ isopycnal was in contact with the sediments had the next highest activities (0.7-0.8 dpm/100 L for $^{224}Ra$, and 0.05 dpm/100 L for $^{223}Ra$). Lowest radium activities were found where the 25.5 $\sigma_t$ isopycnal shoaled (0.14-0.19 dpm/100L for $^{224}Ra$ and 0.007 dpm/100L for $^{223}Ra$). These values are not corrected for supported values, which will be made after the cruise in the lab. However, these results indicate some advection of radium from the sediments along the 25.5 $\sigma_t$ isopycnal. Values for longer-lived $^{228}Ra$ and $^{226}Ra$ will be determined at URI-GSO.

## 9.6 Iron Analysis - UAF group

PI: Jingfeng Wu
Participants: Ana Aguilar-Islas and Robert Rember

**Cruise goals**

The "Green Belt", a band of high and sustained spring and summer productivity, is located along the shelf break in the transition zone between the iron-limited HNLC surface waters of the deep basin, and the iron-replete, but nitrate-limited surface shelf waters. Mesoscale eddies and the shelf break front have been suggested as mechanisms that can promote mixing of outer shelf and slope waters, and lead to the input of nutrients into Green Belt waters. During the summer this additional input of nitrate can only be fully assimilated when enough iron is also available. In summer, surface outer shelf waters contain low (picomolar) surface dissolved iron concentrations, thus external sources of iron are needed to support the high and sustained productivity of the Green Belt. A possible mechanism for the introduction of iron into Green Belt waters is the outcropping of higher iron bottom shelf water via frontal processes.

To test our hypothesis that the shelf break front provides a mechanism for the input of iron into the Green Belt, we collected vertical profiles along this front. Three cross-shelf transects were selected (NP, P-14, and MN lines) to cover southern and northern portions of the shelf break. Our sampling was focused within isopycnals originating on bottom shelf waters and surfacing within the photic zone of the Green Belt.

**Methods**

Collection of seawater samples was focused from the outer shelf to offshore waters along the NP, P14, and MN lines. Trace metal-clean vertical profiles were collected using our UAF/ATE vane samplers at 15 stations (5 stations at each line). To avoid contamination from the ship, samples were filtered in a class 100 laminar flow hood using trace metal clean procedures. Samples were filtered through 0.4 μm PCTE filters, collecting triplicate 30 ml samples for total dissolved Fe measurements. The remaining unfiltered sample will be used for the analysis of total acid dissolvable Fe (pH 2). Samples will be acidified to pH 2 with the equivalent of 1 ml of 12 M hydrochloric acid (Optima grade, Fisher Scientific Inc.) per liter of sample. Acidified samples will be stored at room temperature for 1 month prior to Fe analysis using $Mg(OH)_2$ co-precipitation isotope dilution ICPMS . This method has a detection limit of ~0.03 nM and a precision of ~3% at 0.3 nM Fe level.

**Expected results**

A well developed shelf break front, with isopycnals originating in the bottom layer of the outer shelf (near the 80 m isobath) and surfacing in the photic zone of the shelf break, was apparent at the NP, P-14, and MN lines. We expect the bottom waters of the outer shelf to be high in iron due to their proximity to sediment. This high iron water could serve as an iron reservoir throughout the summer. An inshore-offshore gradient in both total dissolved iron and total dissolvable iron (which includes labile particulate iron) is expected along the sampled isopycnals.

The vertical profiles taken along the NP, P-14, and MN lines provided high resolution samples along the isopycnals of interest. Concentrations of the two sampled iron species together with information from short and long lived Radium isotopes (samples collected and measured by the Moran lab) will provide data for quantifying the flux of iron to the Green Belt via the shelf break front. Nutrient and chlorophyll, and species composition data (historical and from this cruise) could then be used to estimate the biological iron requirement for maintaining a phytoplankton bloom in the Green Belt. The importance of the shelf break front as a mechanism for the delivery of additional iron to Green Belt waters can then be evaluated.

Total dissolved iron, and total dissolvable iron data will be available during the winter of 2008.

**Sample Station Data Table**

| Station Name | Sample Depth (m) | Sigma t (Kg $m^{-3}$) | Total Dissolved Iron (nM) | Total Dissolvable Iron (nM) |
|---|---|---|---|---|
| P14-4 | 15 m | 25.45 | | |
| | 20 m | 25.57 | | |
| | 25 m | 25.88 | | |
| | 30 m | 26.08 | | |
| | 40 m | 26.17 | | |
| | 55 m | 26.25 | | |

## 9.7 Euphausiid and macrozooplankton collections – UAF & OSU group

### Meso-Zooplankton Distribution and Abundance (A. Pinchuk)

The primary task of the zooplankton component was to assess the abundance, biomass and species composition of the mesozooplankton and micronecton on the shelf-break/outer, middle and inner shelf domains of the southeastern Bering Sea. The data from these samples will aid in determining the fate of new and recycled production on the shelf. A total of 58 MOCNESS tows were taken in shelf-break and outer shelf regime and in the middle and inner domains. We obtained 81 CalVET samples at all CTD stations along NP, MN, SL and W transect lines and at selected locations along 70M line.

The large mesozooplankton component was sampled using a 1-m MOCNESS (Multiple Opening Closing Net and Environmental Sensing System), equipped with 0.5 mm mesh nets. The MOCNESS was equipped with salinity, temperature and fluorescence sensors to provide depth profiles of physical oceanographic data during the tows. Samples were consistently taken in 20 m depth increments from 100 m or the bottom to the surface.

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

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

Casual observation of the samples indicates that oceanic zooplankton species were common in the shelf-break and outer shelf region, but large copepods were rare or absent from the middle and inner domains stations. It appears that the mesozooplankton community was dominated by medium-sized and small copepods, gelatinous zooplankton and, at some stations, euphausiids and hyperiids. Oceanic Neocalanus spp., Eucalanus bungii and Thysanoessa longipes were abundant on the offshore ends of NP and MN transects indicating advection of oceanic water on the outer shelf (up to ~100 m isobath). Calanus marschallae and

Thysanoessa raschii comprised bulk of zooplankton on the middle shelf, while Sagitta elegans and small copepod Pseudocalanus spp. were especially abundant in the inner domains. Cold water hyperiids Parathemisto libellula were common on the northern part of the shelf. Large numbers of juvenile scyphozoan Chrysaora melanaster (bell diameter <15 cm) were observed on the southern middle shelf. A detailed assessment of zooplankton abundance, biomass and distribution will be made after the samples have been processed.

Appendix 1 Summary of zooplankton survey during HLY0803

| STATION | GEAR | LATITUDE | LONGITUDE | DEPTH(m) |
|---|---|---|---|---|
| UP1 | MOCNESS | 54.3166 | 165.3790 | 60 |
| UP2 | MOCNESS | 54.3942 | 165.1927 | 100 |
| UP4 | MOCNESS | 54.4803 | 164.9563 | 70 |
| UP3 | MOCNESS | 54.4315 | 165.1535 | 100 |
| UAP8 | MOCNESS | 54.8728 | 165.2534 | 100 |
| UAP7 | MOCNESS | 55.0818 | 164.8218 | 90 |
| UAP6 | MOCNESS | 55.3016 | 164.3954 | 80 |
| UAP5 | MOCNESS | 55.5296 | 163.9713 | 75 |
| UAP4 | MOCNESS | 55.7538 | 163.5531 | 80 |
| UAP3 | MOCNESS | 55.9769 | 163.1440 | 70 |
| CN6 | MOCNESS | 56.9994 | 163.8889 | 55 |
| CN6 | CalVET | 56.9971 | 163.9112 | 68 |
| CN8 | CalVET | 56.6967 | 164.5303 | 70 |
| CN8 | MOCNESS | 56.6984 | 164.5296 | 55 |
| CN10 | CalVET | 56.4313 | 165.2817 | 84 |
| CN12 | CalVET | 56.1380 | 166.1061 | 100 |
| CN14 | CalVET | 55.8476 | 166.9038 | 100 |
| CN14 | MOCNESS | 55.8376 | 166.9099 | 100 |
| CN18 | CalVET | 55.2916 | 168.3838 | 100 |
| CN18 | MOCNESS | 55.3115 | 168.4010 | 100 |
| CN16 | MOCNESS | 55.5479 | 167.7002 | 100 |
| CN16 | MOCNESS | 55.5639 | 167.7036 | 100 |
| CN16 | CalVET | 55.5611 | 167.7042 | 100 |
| X-1 | MOCNESS | 55.3855 | 167.8542 | 100 |
| X-2 | MOCNESS | 55.2482 | 167.9574 | 100 |
| CNN8 | CalVET | 56.1424 | 168.7432 | 100 |
| CNN8 | MOCNESS | 56.1540 | 168.7139 | 100 |
| CNN7 | MOCNESS | 56.4949 | 168.2223 | 100 |
| CNN6 | CalVET | 56.7338 | 167.8441 | 98 |
| CNN6 | MOCNESS | 56.7602 | 167.8578 | 98 |
| MN1 | CalVET | 59.8976 | 167.9899 | 28 |
| MN1 | MOCNESS | 59.8936 | 167.9904 | 15 |
| MN2 | CalVET | 59.9025 | 168.5884 | 38 |
| MN2 | MOCNESS | 59.8822 | 168.5699 | 25 |
| MN3 | CalVET | 59.8963 | 169.1956 | 44 |
| MN3 | MOCNESS | 59.8871 | 169.1806 | 44 |
| MN4 | CalVET | 59.8917 | 169.8089 | 54 |
| MN4 | MOCNESS | 59.8839 | 169.8142 | 40 |
| MN5 | CalVET | 59.9067 | 170.3914 | 60 |

| | | | | |
|---|---|---|---|---|
| MN5 | MOCNESS | 59.8947 | 170.4189 | 50 |
| MN6 | CalVET | 59.8965 | 170.9852 | 69 |
| MN6 | MOCNESS | 59.9006 | 170.9917 | 55 |
| MN7 | CalVET | 59.9001 | 171.6130 | 74 |
| MN7 | MOCNESS | 59.9021 | 171.6191 | 55 |
| MN8 | CalVET | 59.8981 | 172.2310 | 72 |
| MN8 | MOCNESS | 59.8919 | 172.2408 | 60 |
| W7 | CalVET | 59.9920 | 171.1072 | 65 |
| W6 | CalVET | 60.1014 | 170.4563 | 60 |
| W3 | CalVET | 60.4003 | 168.6142 | 36 |
| W4b | CalVET | 60.2550 | 169.5659 | 47 |
| SL6b | CalVET | 61.9697 | 171.9436 | 54 |
| SL7b | CalVET | 62.1230 | 171.9957 | 51 |
| SL8b | CalVET | 62.2093 | 172.7101 | 54 |
| SL5b | CalVET | 61.9820 | 170.6009 | 48 |
| SL5b | MOCNESS | 61.9804 | 170.5979 | 48 |
| SL4b | CalVET | 61.9154 | 169.9003 | 49 |
| SL3b | CalVET | 61.7970 | 169.3037 | 41 |
| SL3b | MOCNESS | 61.8065 | 169.2862 | 41 |
| SL2b | CalVET | 61.7717 | 168.4877 | 33 |
| NP1 | CalVET | 59.4453 | 167.7933 | 38 |
| NP1 | MOCNESS | 59.4420 | 167.7869 | 38 |
| NP2 | CalVET | 59.1272 | 168.0030 | 44 |
| NP3 | CalVET | 58.8297 | 168.1597 | 47 |
| NP3 | MOCNESS | 58.8304 | 168.1456 | 43 |
| NP4 | CalVET | 58.6029 | 168.4110 | 55 |
| NP5 | CalVET | 58.3596 | 168.6845 | 65 |
| NP6 | CalVET | 58.1274 | 168.9586 | 70 |
| NP7 | CalVET | 57.8982 | 169.2236 | 70 |
| NP7 | MOCNESS | 57.8910 | 169.2132 | 70 |
| NP8 | CalVET | 57.6729 | 169.5173 | 70 |
| NP9 | CalVET | 57.4448 | 169.7786 | 64 |
| NP9 | MOCNESS | 57.4431 | 169.7757 | 50 |
| NP10 | CalVET | 57.2056 | 170.0244 | 41 |
| NP10 | MOCNESS | 57.2030 | 170.0151 | 30 |
| NP11 | CalVET | 56.9732 | 170.2705 | 72 |
| NP11 | MOCNESS | 56.9668 | 170.2677 | 72 |
| NP12 | CalVET | 56.7386 | 170.5473 | 100 |
| NP12 | MOCNESS | 56.7343 | 170.5479 | 100 |
| NP13 | CalVET | 56.5140 | 170.7914 | 100 |
| NP13 | MOCNESS | 56.5017 | 170.7977 | 100 |
| NP14 | CalVET | 56.2876 | 171.0606 | 100 |
| NP14 | MOCNESS | 56.2813 | 171.0665 | 100 |
| NP15-B | CalVET | 56.0535 | 171.3025 | 100 |
| NP 12.5 | MOCNESS | 56.6226 | 170.6794 | 100 |
| NP 11.5 | MOCNESS | 56.8537 | 170.4136 | 85 |
| NP10.5 | MOCNESS | 57.0871 | 170.1698 | 25 |
| NP12.5 | CalVET | 56.6267 | 170.7015 | 100 |

| | | | | |
|---|---|---|---|---|
| NP12.5 | MOCNESS | 56.6222 | 170.7347 | 100 |
| LS3 | CalVET | 56.4464 | 171.3597 | 100 |
| LS3 | MOCNESS | 56.4429 | 171.3662 | 100 |
| LS1-6 | CalVET | 56.8826 | 173.3031 | 100 |
| LS1-6 | MOCNESS | 56.8715 | 173.3306 | 100 |
| PI-4-4.5 | CalVET | 57.8023 | 175.0217 | 100 |
| PI-4-4.5 | MOCNESS | 57.8076 | 175.0254 | 100 |
| PI4-2 | CalVET | 58.9893 | 173.9856 | 100 |
| PI4-2 | MOCNESS | 58.9997 | 174.0014 | 100 |
| MN10 | CalVET | 59.9076 | 173.4077 | 84 |
| MN9 | CalVET | 59.9094 | 172.7834 | 70 |
| MN8 | CalVET | 59.8962 | 172.1926 | 70 |
| MN7 | CalVET | 59.8935 | 171.5962 | 71 |
| MN6 | CalVET | 59.8962 | 171.0020 | 70 |
| MN5 | CalVET | 59.9008 | 170.4057 | 62 |
| MN11 | CalVET | 59.8975 | 174.0033 | 100 |
| MN11 | MOCNESS | 59.8994 | 173.9972 | 85 |
| MN12 | CalVET | 59.8938 | 174.5808 | 100 |
| MN13 | CalVET | 59.9012 | 175.1943 | 100 |
| MN14 | CalVET | 59.8955 | 175.7924 | 100 |
| MN15 | CalVET | 59.9088 | 176.3594 | 100 |
| MN16 | CalVET | 59.9036 | 176.9836 | 100 |
| MN17 | CalVET | 59.9230 | 177.5628 | 100 |
| MN18 | CalVET | 59.8974 | 178.1806 | 100 |
| MN19 | MOCNESS | 59.8858 | 178.8088 | 100 |
| MN19 | CalVET | 59.8926 | 178.8108 | 100 |
| MN20 | CalVET | 59.8940 | 179.3797 | 100 |
| SL16 | CalVET | 62.1996 | 175.9632 | 93 |
| SL15 | CalVET | 62.1920 | 175.5612 | 86 |
| SL14 | CalVET | 62.1953 | 175.1642 | 80 |
| SL13 | CalVET | 62.2132 | 174.7502 | 71 |
| SL12 | CalVET | 62.2028 | 174.3359 | 68 |
| SL11 | CalVET | 62.1971 | 173.9059 | 62 |
| SL10 | CalVET | 62.1952 | 173.5242 | 61 |
| SL9 | CalVET | 62.1958 | 173.1153 | 64 |
| SL8 | CalVET | 62.1967 | 172.7046 | 55 |
| 70m-56 | CalVET | 61.9413 | 174.3645 | 69 |
| 70m-53 | CalVET | 61.5568 | 173.7013 | 69 |
| 70m-50 | CalVET | 61.0766 | 173.7683 | 78 |
| 70m-47 | CalVET | 60.5824 | 173.6563 | 69 |
| 70m-44 | CalVET | 60.1121 | 173.3207 | 69 |
| 70m-23 | MOCNESS | 57.9083 | 169.0708 | 55 |
| 70m-22 | MOCNESS | 57.8451 | 168.8898 | 55 |
| 70m-20 | MOCNESS | 57.6334 | 168.8104 | 55 |
| 70m-6 | MOCNESS | 56.9823 | 165.0145 | 55 |
| 70m-5 | MOCNESS | 56.9118 | 164.8361 | 55 |
| 70m-4 | MOCNESS | 56.8542 | 164.5716 | 55 |
| 70m-3 | CalVET | 56.8321 | 164.3117 | 73 |

| | | | | |
|---|---|---|---|---|
| 70m-2 | CalVET | 56.8493 | 164.0662 | 69 |
| 70m-1 | CalVET | 56.7649 | 163.9609 | 69 |

## 9.8 Euphausiid rate measurements – Lessard/ Harvey/UW group

**The Trophic Role of Euphausiids in the eastern Bering Sea: Ecosystem Responses to Changing Sea-Ice Conditions (Lessard and Harvey)**
Lessard field team: Tracy Shaw, Megan Bernhardt and Gigi Engel
Harvey field team: Rachel Pluethner, Karen Taylor and Charlie Morgan

The goal of our project is to understand how climatically-driven changes in sea-ice conditions may affect the ecology and population dynamics of euphausiids in the eastern Bering Sea. Our primary hypothesis is that seasonal and interannual variation in the timing and coverage of sea-ice and associated food resources will lead to differences in age structure, diet history, and nutritional condition for euphausiids, which ultimately translate into differences in production rates and availability as prey to higher trophic levels. To determine diet, nutritional condition, and feeding rates, we are performing shipboard krill feeding experiments to measure ingestion rates of specific prey taxa (phytoplankton, heterotrophic protists, copepods) and we are determining the lipid profiles of both euphausiids and prey field. We are also isolating and culturing specific prey species to identify prey biomarkers. Identifying the lipid profiles and specific biomarkers for different prey taxa (particularly the poorly known heterotrophic protists) will enable us to infer diets from lipid profiles of field-caught euphausiids. We are also measuring euphausiid growth and egg production rates and estimating euphausiid age using the lipofuscin method. Our colleague, Alexei Pinchuk, will conduct laboratory rearing to allow calibration of the lipofuscin aging method when eggs can be collected in the field.

<u>Bongo net tows</u>

We performed 25 Bongo tows (Table 1) to capture live euphausiids for feeding and growth experiments and for lipid, carbon and lipofuscin analyses. The nets were towed obliquely.

<u>Feeding experiments</u>

We performed seventeen feeding experiments (Table 2, Figure 1) across the Bering Sea shelf and slope. For the feeding experiments, we captured live euphausiids with a Bongo net and added known numbers and species to bottles filled with seawater and incubated, along with control bottles without animals, for 24 hours on a rotating wheel in a flowing seawater incubator. The prey for each experiment were unaltered seawater plankton or seawater supplemented with concentrated seawater targeting the addition of protists. Shipboard, herbivorous feeding was assessed by measuring changes in size-fractionated chlorophyll. Samples were also fixed for microscopic counts of phytoplankton and heterotrophic protists to be analyzed back in the laboratory.

Growth experiments

We performed eight growth experiments, assessing instantaneous growth rates on 392 euphausiids (Table 3). Euphausiids were captured with a Bongo net and one euphausiid was added to a sideflask filled with 200um filtered seawater captured from the CTD. The euphausiids were checked twice a day for molts for two days. We provided >700 euphausiids with species and size determinations, from the feeding and growth experiments, to Harvey for lipid profiles, carbon and lipofuscin content (an index of age).

Starvation experiment

We performed one starvation experiment to assess what lipids are stored or changed within euphausiids over time without the presence of food. Two 10L carboys were filled with filtered seawater and twenty krill were put into each 10L carboy. An additional 10 krill were retained initially for analysis. Carboys were incubated in the dark in a climate control chamber. Each week for two weeks, 5 krill were taken from each carboy. Experiment was to run for 4 weeks but a failed incubator ended the experiment prematurely.

Preliminary findings

Feeding and growth experiments were done under varying conditions, from inner shelf to slope, low and high chlorophyll and varying euphausiid species and sizes. As expected, the dominant euphausiid species on the mid to inner shelf was *Thysanoessa raschii*, with *Thysanoessa inermis* dominating on the outer shelf. Chlorophyll was typically low (<1.5ug/L) throughout our feeding experiments and dominated by small (< 5 μm) pico- and nanoplankton (cyanobacteria, picoeukaryotes, small flagellates), with heterotrophic protists (dinoflagellates and ciliates) present in modest numbers. Based on chlorophyll readings, herbivorous feeding by euphausiids was not always detectable with low initial chlorophyll. When initial chlorophyll was higher (>2ug/L), herbivorous feeding was detected. Experiments conducted with the high initial chlorophyll were mostly diatom dominant communities. Detection of feeding by euphausiids was most evident in the >5ug/L chlorophyll fraction despite total chlorophyll concentration. Final euphausiid feeding rates will be determined with the counting of the fixed samples in the laboratory. This process will take a significant amount of time as each individual organism, both phytoplankton and microzooplankton, will be enumerated and a sized for biomass.

| Station # | Station Name | Cast # | Latitude (decimal) | Longitude (decimal) | Date (local) | Time (local) | Station Depth | Calculated tow depth | Surface temp (ºC) | Surface chl (µg/l) | Salinity | Air temp (ºC) | Feeding expt | IGR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | UP3 | 1 | 54.4225 | 165.1481 | 7/4/08 | 0254 | 137 | 85 | 5.5 | 0.6 | 31.98 | 6.5 | | |
| 10 | UAP3 | 2 | 55.9673 | 163.1394 | 7/5/08 | 0400 | 88 | 57 | 7.6 | 0.6 | 31.78 | 6.98 | | |
| 14 | CN12 | 3 | 56.1390 | 166.1075 | 7/6/08 | 0250 | 110 | 64 | 7.72 | 2 | 31.86 | 6.9 | 1 | |
| 18 | CN16 | 4 | 55.5626 | 167.7029 | 7/7/08 | 0310 | 136 | 71 | 7.51 | 0.8 | 32.06 | 7.1 | 2 | 11 |
| 24 | CNN6 | 5 | 56.7344 | 167.8446 | 7/8/08 | 0220 | 100 | 78 | 6.9 | 0.4 | 31.7 | 7.2 | | |
| 28 | MN2 | 6 | 59.9025 | 168.5882 | 7/9/08 | 0230 | 41 | 32 | 3.4 | 0.6 | 31.38 | 4.1 | 3 | |
| 35 | W7 | 7 | 60.0033 | 171.0919 | 7/10/08 | 0540 | 70 | 60 | 5.6 | 0.6 | 30.86 | 4.2 | 4 | 12 |
| 40 | W2 | 8 | 60.4936 | 168.0000 | 7/11/08 | 0005 | 30 | 21 | 5.9 | 1.8 | 31.21 | 4.5 | | |
| 41 | W3 | 9 | 60.4001 | 168.6204 | 7/11/08 | 0232 | 35 | 28 | 4.3 | 0.7 | 30.92 | 4.2 | 5 | 13 |
| 46 | SL8 | 10 | 62.2098 | 172.7108 | 7/12/08 | 0245 | 58 | 43 | 5.9 | 0.2 | 31.15 | 5.5 | | |
| 52 | EL2 | 11 | 61.0475 | 167.7863 | 7/13/08 | 0200 | 26 | 21 | 5.7 | 0.8 | 31.25 | | | |
| 58 | NP6 | 12 | 58.1306 | 168.9698 | 7/14/08 | 0410 | 70 | 39 | 5.2 | 0.9 | 31.58 | 5.8 | 6 | 14 |
| 65 | NP13 | 13 | 56.5145 | 170.7919 | 7/15/08 | 0215 | 122 | 71 | 7 | 1.8 | 32.15 | 7.3 | 7 | |
| 69 | EL3 | 14 | 56.2783 | 170.7919 | 7/16/08 | 0445 | 142 | 85 | 7.7 | 1 | 32.38 | 5.7 | | |
| 75 | NP10.5 | 15 | 57.0929 | 170.1545 | 7/17/08 | 0220 | 39 | 30 | 3.9 | 2 | 31.8 | 5.8 | | |
| 78 | NP12.5 | 16 | 56.6268 | 170.7006 | 7/18/08 | 0430 | 116 | 85 | 6.24 | 3.27 | 31.84 | 6.75 | 8 | 15 |
| 82 | LS1-3 | 17 | 56.4526 | 171.3680 | 7/19/08 | 0330 | 152 | 85 | 7.7 | 1.35 | 32.33 | 7.4 | 9 | |
| 86 | LS1-6 | 18 | 56.8822 | 173.3032 | 7/20/08 | 0300 | 160 | 92 | 7.74 | 1.87 | 32.09 | 7.6 | 10 | |
| 89 | P14-4 | 19 | 57.8024 | 175.0218 | 7/21/08 | 0315 | 2665 | 92 | 7.9 | 1.26 | 32.56 | 8.16 | 11 | 16 |
| 92 | P14-2 | 20 | 58.9893 | 173.9856 | 7/22/08 | 0407 | 126 | 89 | 7.1 | 1.6 | 31.88 | 7.69 | 12 | |
| 96 | MN8 | 21 | 59.8965 | 172.1976 | 7/23/08 | 0249 | 73 | 57 | 6.27 | 1.45 | 30.25 | 5.8 | 13 | 17 |
| 102 | MN11 | 22 | 59.8982 | 174.0092 | 7/24/08 | 0308 | 101 | 85 | 7.3 | 1.51 | 29.97 | 6.9 | 14 | |
| 110 | MN19 | 23 | 59.8975 | 178.8003 | 7/25/08 | 0457 | 157 | 85 | 8.01 | 1.92 | 32.29 | 8.3 | 15 | 18 |
| 114 | SL16 | 24 | 62.2005 | 175.9653 | 7/26/08 | 0434 | 94 | 78 | 6.48 | 1.84 | 31.69 | 5.8 | 16 | |
| 123 | 70m56 | 25 | 61.9402 | 174.3643 | 7/27/08 | 0330 | 74 | 60 | 7.06 | 2.04 | 31.12 | 7.06 | 17 | |

Table Zoopl.-1

| Station # | Station Name | Cast # | Latitude (decimal) | Longitude (decimal) | Date (local) | Time (local) | Station Depth | Calculated tow depth | Surface temp (ºC) | Surface chl (µg/l) | Salinity | Air temp (ºC) | Feeding expt | IGR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | UP3 | 1 | 54.4225 | 165.1481 | 7/4/08 | 0254 | 137 | 85 | 5.5 | 0.6 | 31.98 | 6.5 | | |
| 10 | UAP3 | 2 | 55.9673 | 163.1394 | 7/5/08 | 0400 | 88 | 57 | 7.6 | 0.6 | 31.78 | 6.98 | | |
| 14 | CN12 | 3 | 56.1390 | 166.1075 | 7/6/08 | 0250 | 110 | 64 | 7.72 | 2 | 31.86 | 6.9 | 1 | |
| 18 | CN16 | 4 | 55.5626 | 167.7029 | 7/7/08 | 0310 | 136 | 71 | 7.51 | 0.8 | 32.06 | 7.1 | 2 | 11 |
| 24 | CNN6 | 5 | 56.7344 | 167.8446 | 7/8/08 | 0220 | 100 | 78 | 6.9 | 0.4 | 31.7 | 7.2 | | |
| 28 | MN2 | 6 | 59.9025 | 168.5882 | 7/9/08 | 0230 | 41 | 32 | 3.4 | 0.6 | 31.38 | 4.1 | 3 | |
| 35 | W7 | 7 | 60.0033 | 171.0919 | 7/10/08 | 0540 | 70 | 60 | 5.6 | 0.6 | 30.86 | 4.2 | 4 | 12 |
| 40 | W2 | 8 | 60.4936 | 168.0000 | 7/11/08 | 0005 | 30 | 21 | 5.9 | 1.8 | 31.21 | 4.5 | | |
| 41 | W3 | 9 | 60.4001 | 168.6204 | 7/11/08 | 0232 | 35 | 28 | 4.3 | 0.7 | 30.92 | 4.2 | 5 | 13 |
| 46 | SL8 | 10 | 62.2098 | 172.7108 | 7/12/08 | 0245 | 58 | 43 | 5.9 | 0.2 | 31.15 | 5.5 | | |
| 52 | EL2 | 11 | 61.0475 | 167.7863 | 7/13/08 | 0200 | 26 | 21 | 5.7 | 0.8 | 31.25 | | | |
| 58 | NP6 | 12 | 58.1306 | 168.9698 | 7/14/08 | 0410 | 70 | 39 | 5.2 | 0.9 | 31.58 | 5.8 | 6 | 14 |
| 65 | NP13 | 13 | 56.5145 | 170.7919 | 7/15/08 | 0215 | 122 | 71 | 7 | 1.8 | 32.15 | 7.3 | 7 | |
| 69 | EL3 | 14 | 56.2783 | 170.7919 | 7/16/08 | 0445 | 142 | 85 | 7.7 | 1 | 32.38 | 5.7 | | |
| 75 | NP10.5 | 15 | 57.0929 | 170.1545 | 7/17/08 | 0220 | 39 | 30 | 3.9 | 2 | 31.8 | 5.8 | | |
| 78 | NP12.5 | 16 | 56.6268 | 170.7006 | 7/18/08 | 0430 | 116 | 85 | 6.24 | 3.27 | 31.84 | 6.75 | 8 | 15 |
| 82 | LS1-3 | 17 | 56.4526 | 171.3680 | 7/19/08 | 0330 | 152 | 85 | 7.7 | 1.35 | 32.33 | 7.4 | 9 | |
| 86 | LS1-6 | 18 | 56.8822 | 173.3032 | 7/20/08 | 0300 | 160 | 92 | 7.74 | 1.87 | 32.09 | 7.6 | 10 | |
| 89 | P14-4 | 19 | 57.8024 | 175.0218 | 7/21/08 | 0315 | 2665 | 92 | 7.9 | 1.26 | 32.56 | 8.16 | 11 | 16 |
| 92 | P14-2 | 20 | 58.9893 | 173.9856 | 7/22/08 | 0407 | 126 | 89 | 7.1 | 1.6 | 31.88 | 7.69 | 12 | |
| 96 | MN8 | 21 | 59.8965 | 172.1976 | 7/23/08 | 0249 | 73 | 57 | 6.27 | 1.45 | 30.25 | 5.8 | 13 | 17 |
| 102 | MN11 | 22 | 59.8982 | 174.0092 | 7/24/08 | 0308 | 101 | 85 | 7.3 | 1.51 | 29.97 | 6.9 | 14 | |
| 110 | MN19 | 23 | 59.8975 | 178.8003 | 7/25/08 | 0457 | 157 | 85 | 8.01 | 1.92 | 32.29 | 8.3 | 15 | 18 |
| 114 | SL16 | 24 | 62.2005 | 175.9653 | 7/26/08 | 0434 | 94 | 78 | 6.48 | 1.84 | 31.69 | 5.8 | 16 | |
| 123 | 70m56 | 25 | 61.9402 | 174.3643 | 7/27/08 | 0330 | 74 | 60 | 7.06 | 2.04 | 31.12 | 7.06 | 17 | |

Table Zoopl.-2

| Expt # | Station Number | Station Name | Start Date | Species | Stages | # days incubated | # animals | # molts | Surface Chl (µg/L) | Surface Temp (°C) | Depth (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 18 | CN16 | 7/7/08 | *T. spinifera & T. inermis* | adults | 2 | 45 | 10 | 0.80 | 7.51 | 136 |
| 12 | 35 | W7 | 7/10/08 | *T. raschii* | adults | 2 | 50 | 10 | 0.60 | 5.60 | 70 |
| 13 | 41 | W3 | 7/11/08 | *T. raschii* | adults | 2 | 50 | 11 | 0.70 | 4.30 | 35 |
| 14 | 58 | NP6 | 7/14/08 | *T. raschii* | adults | 2.5 | 50 | 5 | 0.90 | 5.20 | 70 |
| 15 | 78 | NP12.5 | 7/18/08 | *T. inermis* | adults | 2.5 | 49 | 7 | 3.27 | 6.24 | 116 |
| 16 | 89 | P14-4 | 7/21/08 | *T. inermis* | adults | 3 | 50 | 4 | 1.26 | 7.90 | 2665 |
| 17 | 96 | MN8 | 7/23/08 | *T. raschii* | adults | 2.5 | 50 | 34 | 1.45 | 6.27 | 73 |
| 18 | 110 | MN19 | 7/25/08 | *T. inermis* | adults | 2.5 | 48 | 12 | 1.92 | 8.01 | 157 |

Table Zoopl.-3

## 9.9 Organic tracers of trophics/ euphausiid age structure – Harvey/ UMD group

Karen Taylor, Charlie Morgan, and Rachel Pleuthner, University of Maryland, Chesapeake Biological Labs,MOGEL Lab

- KRILL GRAZING AND AGING EXPERIMENTS
- **Water Column Particles and Krill Collection**
- Grazing Experiments for Determination of Euphausiid Grazing Rates and Food Source Preferences

Grazing experimental setup is detailed in the report from Lessard. For characterization of food resources and tracking of consumption, euphausiids were collected and incubated over a 24-hour period in CTD water from the same station. Water from designated Niskin bottles was filtered at $T_0$ through combusted GF/F filters for carbon and detailed lipid analysis to characterize the algal and detrital food available to krill (Table 1). At the conclusion of each of the seventeen grazing experiment conducted by the Lessard group, water from the four bottles containing animals was combined and filtered onto particulate filters for lipid analysis to compare food amounts and potential for selective grazing. Water from each of the control bottles was treated likewise.

Three different grazing experiments aimed to investigate food source preference through the addition of a volume of concentrated protists. Refer to Table 2 for sample inventory.

At the beginning of each grazing experiment, ten animals -with the exception of Experiment #16 which only has 5 animals - were collected from the bongo tow and individually frozen in the -80ºC to serve as $T_0$ samples.  Euphausiids incubated for 24 hours were also individually frozen ($T_{final}$ animals). The frozen samples will be taken back to the lab for lipid analysis using a Gas Chromatograph coupled with Mass Spectrometry. The results will illustrate the types and quantities of organisms that euphausiids utilize for food

**Lipid Storage and Metabolism Via Starvation Experiments**

Long term lipid storage and metabolism will be examined by means of a starvation experiment initiated at the beginning of this cruise. Animals were collected at the beginning of the cruise with the intention of running a long-term incubation in filtered sea water. Ten animals were taken at $T_0$ and ten sub-sampled weekly to observe the gradual change in euphausiid lipid content. An environmental refrigerator malfunction, coincidentally at the Week 2 time point, increased the temperature to 68 ºF. Since the animals had survived the temperature increase, the experiment was moved into the refrigerators in the aft staging area. At the Week 3 time point, that refrigerator's temperature had jumped to 50ºC. None of the animals survived; hence, the experiment ended prematurely.

The frozen samples will be taken back to the lab for lipid analysis using a Gas Chromatograph coupled with Mass Spectrometry.

**Total Energy Content**

Animals of a wide range of body lengths were frozen, 95 in total, to measure total carbon content using calorimetry.

**Determination of Age in Euphausiids Found in the Bering Sea**

Eight growth experiments were performed over the course of the cruise; the animals from these experiments were also used for lipofuscin measurements. These experiments have included animals of a large size range to provide a first estimate of lipofuscin indices in field animals of differing ages. Alexei Pinchuk will conduct growth experiments, when euphausiid eggs are made available, that will span a minimum of two years in order to allow age calibration of the field specimens that have been analyzed.

At the conclusion of the first growth experiment, the experiment animals were sacrificed. The eyes and eye stalks were removed; both the lipofuscin (Part A) and protein content (Part B) in each pair of eyes was extracted and quantified via flow-through fluorescence using an Agilent 1100 HPLC. This preliminary analysis of the first growth experiment could not be completed due to the malfunction of the fluorescence flow cell, for which there was no replacement. Euphausiids from subsequent experiments were frozen in the -80ºC chest freezer for future lipofuscin analysis.

**Lipofuscin Sample Analysis**

High Performance Liquid Chromatography for the Identification and Quantification of Lipofuscin - Part A

Toward the beginning of the HLY0802 cruise, the optimal excitation and emission wavelengths for lipofuscin - an oxidation product that accumulates in euphausiid neural tissue - from *Thysanoessa inermis* was determined by running a three-dimensional fluorescent scan of the extracted product present in a composite of samples of krill neural tissue (see Figure 1). That scan allowed a qualitative identification of lipofuscin for that species, and was used to measure lipofuscin content in euphausiids for the duration of the cruise. A calibration curve using quinine sulfate allowed quantitative measurements of fluorescence intensity to be performed for each run.

Part B

For protein analysis of krill neural tissues, tryptophan fluorescence – a proxy for protein quantification – was measured using known excitation and emission wavelengths. Bovine Serum Albumin (BSA) was used to generate a calibration curve, which acted as a means to quantify protein in the eye tissues.

During protein analysis (Part B) for Growth Experiment 11 (a continuation of the numbering system from HLY0802), the HPLC fluorescence flow cell began to leak. Timing did not allow for the shipment of a replacement, preventing sample runs for the remainder of the cruise. Consequently, all animals used for lipofuscin analysis were frozen.
Using the age calibration established from Alexei's animals, the euphausiid age population can be examined both seasonally (winter and spring) and interannually (2008-2009). This information will bring insight into the condition of the krill population.

## ORGANIC TRACERS

### **Water Column Particles and Sediment Collection**

Investigating the input and preservation of bacterial derived organic matter
Sediment cores were collected as detailed in the report from David Shull. Surface sediment (0-2 cm) and downcore samples (sliced in 1 cm increments) were obtained from thirteen stations (Table 4) and frozen in I-Chem jars for the characterization of bacterial derived organic matter using intact bacteriohopanepolyols (BHPs). Intact BHPs are recalcitrant membrane lipids and thus considered ideal biomarkers for tracing microbial sources of organic carbon, and potentially bacterial populations and processes within marine environments. To trace the remnants of the spring bloom and also compare recent inputs and preservation of intact BHPs in the Bering Sea, water sampled below the chlorophyll maximum was taken from Niskin bottles and filtered through combusted GF/F filters for carbon and lipid analysis. Reversed-phase high-performance liquid chromatography-atmospheric pressure chemical ionization tandem mass spectrometry (RP-HPLC-APCI-MSn) will be applied for the analysis of intact BHPs, and all work will be completed at the University of Maryland Center for Environmental Science Chesapeake Biological Laboratory.

## **FIGURES AND TABLES**

Table 1: Water Column Sample Collection for Experiments. This table lists the $T_0$ and $T_f$ water collection in conjunction with the grazing experiments

| Grazing Experiment | Station, No. | $T_0$ filter date | $T_f$ filter date | Added Nutrition |
|---|---|---|---|---|
| 1 | CN-14, #12 | 7/6/2008 | 7/7/2008 | None |
| 2 | CN-16, #18 | 7/7/2008 | 7/8/2008 | None |
| 3 | MN-2, #28 | 7/9/2008 | 7/10/2008 | None |
| 4 | W-7, #35 | 7/10/2008 | 7/11/2008 | None |
| 5 | W-3, #41 | 7/11/2008 | 7/12/2008 | None |
| 6 | NP-6, #58 | 7/14/2008 | 7/15/2008 | Protists |
| 7 | NP-13, #65 | 7/15/2008 | 7/16/2008 | None |
| 8 | NP-12.5, #78 | 7/18/2008 | 7/19/2008 | None |
| 9 | LS-3, #82 | 7/19/2008 | 7/20/2008 | None |
| 10 | LS1-6, #86 | 7/20/2008 | 7/21/2008 | Protists |
| 11 | P14-4, #89 | 7/21/2008 | 7/22/2008 | None |
| 12 | P14-2, #92 | 7/22/2008 | 7/23/2008 | None |

| | | | | |
|---|---|---|---|---|
| 13 | MN-8, #96 | 7/23/2008 | 7/24/2008 | None |
| 14 | MN-11, #102 | 7/24/2008 | 7/25/2008 | Protists |
| 15 | MN-19, #110 | 7/25/2008 | 7/26/2008 | None |
| 16 | SL-16, #114 | 7/26/2008 | 7/27/2008 | None |
| 17 | 70m-56, #123 | 7/27/2008 | 7/28/2008 | None |

*All filters frozen in the -80 immediately after particle collection

Table 2: Grazing Experiment Animal Log
This table lists all animals collected in grazing experiments, barring $T_0$ animals.

| **Experiment No.** | **No. Animals in the Incubation** | ***Dominant Species*** | **Storage date** |
|---|---|---|---|
| Grazing Experiment #1 | 17 | *T. inermis* | 7/7/2008 |
| Grazing Experiment #2 | 16 | *T. spinifera* | 7/8/2008 |
| Grazing Experiment #3 | 16 | *T. raschii* | 7/10/2008 |
| Grazing Experiment #4 | 32 | *T. raschii* | 7/11/2008 |
| Grazing Experiment #5 | 31 | *T. raschii* | 7/12/2008 |
| Grazing Experiment #6 | 24 | *T. raschii* | 7/15/2008 |
| Grazing Experiment #7 | 16 | *T. inermis* | 7/16/2008 |
| Grazing Experiment #8 | 16 | *T. inermis* | 7/19/2008 |
| Grazing Experiment #9 | 16 | *E. pacifica* | 7/20/2008 |
| Grazing Experiment #10 | 16 | *E. pacifica* | 7/21/2008 |
| Grazing Experiment #11 | 16 | *T. inermis* | 7/22/2008 |
| Grazing Experiment #12 | 16 | *T. raschii* | 7/23/2008 |
| Grazing Experiment #13 | 16 | *T. raschii* | 7/24/2008 |
| Grazing Experiment #14 | 16 | *T. raschii* | 7/25/2008 |
| Grazing Experiment #15 | 16 | *T. inermis* | 7/26/2008 |
| Grazing Experiment #16 | 16 | *T. raschii* | 7/27/2008 |
| Grazing Experiment #17 | 16 | *T. raschii* | 7/28/2008 |

Table 3: HPLC Sample Run Log
This table lists the full set of HPLC sample runs performed throughout the entire cruise, barring calibration curves. A leaking HPLC flow cell prevented full analysis of Growth Experiment #11 and any experiment thereafter. Refer to Lessard report for the corresponding stations.

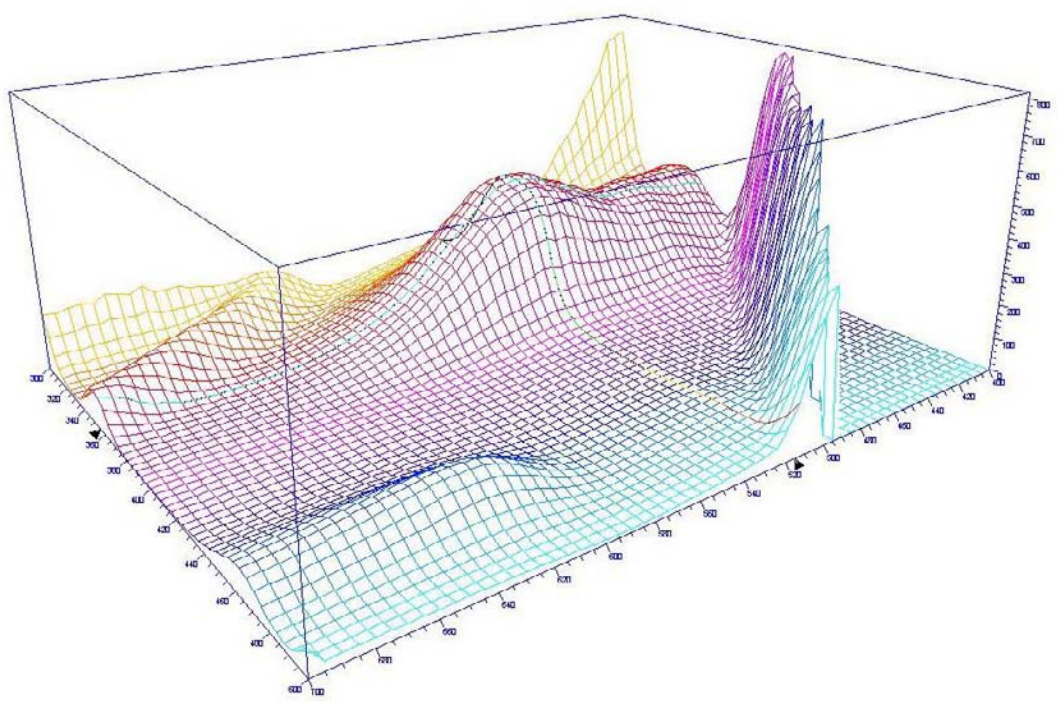
| **Experiment No.** | **No. Animals in the Experiment** | ***Dominant Species*** | **Krill Eye Lipofuscin Analysis** | **Krill Eye Protein Analysis** | **Whole Samples Frozen** | **Total Whole Frozen** | **Storage date** |
|---|---|---|---|---|---|---|---|
| Growth Experiment #11 | 45 | *T. inermis* | 7/9/08 | 7/10/2008 | No | 0 | 7/9/08 |
| Growth Experiment #12 | 50 | *T. raschii* | N/A | N/A | Yes | 50 | 7/12/08 |
| Growth Experiment #13 | 50 | *T. raschii* | N/A | N/A | Yes | 50 | 7/13/08 |
| Growth Experiment #14 | 50 | *T. raschii* | N/A | N/A | Yes | 50 | 7/16/08 |
| Growth Experiment #15 | 49 | *T. inermis* | N/A | N/A | Yes | 49 | 7/21/08 |
| Growth Experiment #16 | 50 | *T. inermis* | N/A | N/A | Yes | 50 | 7/24/08 |
| Growth Experiment #17 | 50 | *T. raschii* | N/A | N/A | Yes | 50 | 7/25/08 |
| Growth Experiment #18 | 48 | *T. inermis* | N/A | N/A | Yes | 48 | 7/28/08 |
| | | | | | | | |

Table 4: Sediment and particle sample collection for intact BHP analysis

| Station Name | Bottom Depth (m) | Depth of sediment (cm) | Vol. water filtered (L) |
|---|---|---|---|
| UAP-3 | 88 | 0 - 2 | 0 |
| CN-10 | 84 | 0 - 2 | 24.2 |
| CN-18 | 1665 | 0 - 17 | 34.2 |
| MN-5 | 62 | 0 - 10 | 22.0 |
| SL-8 | 58 | 0 - 2 | 23.0 |
| NP-7 | 66 | 0 - 2 | 24.0 |
| NP-15 | 2755 | 0 - 2 | 24.0 |
| NP-14 | 140 | 0 - 2 | 20.0 |
| LS16 | 188 | 0 - 2 | 24.0 |
| P14-2 | 126 | 0 - 2 | 24.0 |
| MN-5 (revisit) | 62 | 0 - 2 | 0 |
| MN-15 | 145 | 0 - 10 | 19.5 |
| SL-14 | 80 | 0 - 2 | 23.0 |

*All sediment and filters frozen in -80ºC immediately following collection and filtration, respectivel

Figure 1: Three-dimensional scan of lipofuscin in *Thysanoessa inermis* neural tissues from HLY0802.



## 9.10 Ichthyolplankton – UAF group

**The effect of environmental factors on distribution, abundance, and energy density of late larval and early juvenile stages of walleye pollock (*Theragra chalcogramma*), Pacific cod (*Gadus macrocephalus*), and arrowtooth flounder (*Atheresthes stomias*)**

Participating Scientists
Nicola Hillgruber, Ron Heintz, Elizabeth Siddon

Statement of objectives
Our main objectives were to (1) characterize the larval/early juvenile summer fish assemblages in the eastern Bering Sea, (2) determine the effect of environmental factors on the abundance, distribution, and composition of ichthyoplankton, and (3) examine the energy density of larval and early juvenile stages of three target species, namely walleye pollock (*Theragra chalcogramma*), Pacific cod (*Gadus macrocephalus*), and arrowtooth flounder (*Atheresthes stomias*). Our participation on this research cruise was supported by the North Pacific Research Board's Bering Sea Integrated Ecosystem Research Program (BSIERP) and the National Science Foundation's Bering Ecosystem Studies (BEST). Our data will contribute to the collaborative effort of improving the understanding of the effects of climate variability on spatial and temporal variability in abundance, distribution, and condition of the early life stages of these three target fish species in the eastern Bering Sea. Ultimately, these data will allow for the better prediction of transport pathways of early life stages and of production of the three target taxa under changing climatic conditions in the eastern Bering Sea.

Field Methods
Sampling was conducted in collaboration with Alexei Pinchuk. We sampled ichthyoplankton using a 1 $m^2$ MOCNESS (Multiple Opening Closing Net and Environmental Sensing System) equipped with nine 500 μm mesh nets. In addition, the MOCNESS was equipped with sensors for conductivity, temperature, and fluorescence, thus recording data to characterize the sampled water column. Sampling was conducted obliquely in 20-m increments from 100 m depth (or 15 m above the bottom) to the surface. After retrieval of the gear, all net bags were carefully rinsed down, codends were detached, and samples were preserved in 10% formalin seawater. Samples will be brought to the lab for further processing. In addition, the contents of the drogue net of the MOCNESS were examined on board and all larval and early juvenile fishes were removed for identification. Early life stages of target taxa were counted and frozen at -80 ºC for further analysis of energy density in the lab.

During the first leg of HLY0803, a total of 45 stations on 7 transects were sampled (Table 1). While not all scheduled stations could be sampled due to time constraints, the realized sampling effort still provides a large spatial coverage of data on ichthyoplankton assemblages from the eastern Bering Sea. In addition, MOCNESS sampling is continuing on leg 2 of HLY0803 and stations collected as part of that effort will further increase the spatial extent of the ichthyoplankton data.

The examination of the drogue net of the MOCNESS resulted in the collection of early life stages of all three target taxa. Overall, a total of 440 *T. chalcogramma*, 24 *G. macrocephalus*, and 9 *Atheresthes* spp. were frozen for future analysis of energy density. Highest abundances of *T. chalcogramma* were observed in the vicinity of St. Paul Island; at all other stations, numbers of *T. chalcogramma* were substantially lower. Future lab analysis will provide data on the horizontal and vertical distribution, size, and condition of early life stages of the target fish taxa.

MOCNESS sampling benefitted greatly from the generous help provided by the participating PolarTrec teacher-at-sea, Ms. Jillian Worssam.

Table 1. Summary of MOCNESS samples collected during leg 1 of HLY0803 and number of specimens frozen for further analysis

| Station ID | MOCNESS # | # Samples | *Theragra chalcogramma* | *Gadus macrocephalus* | *Atheresthes stomias* |
|---|---|---|---|---|---|
| UP 1 | MOC 1 | 4 | 0 | 0 | 0 |
| UP 2 | MOC 2 | 5 | 0 | 0 | 0 |
| UP 4 | MOC 3 | 4 | 0 | 3 | 0 |
| UP 3 | MOC 4 | 5 | 2 | 9 | 0 |
| UAP 8 | MOC 5 | 5 | 0 | 0 | 0 |
| UAP 7 | MOC 6 | 5 | 0 | 0 | 0 |
| UAP 6 | MOC 7 | 4 | 0 | 0 | 1 |
| UAP 5 | MOC 8 | 4 | 0 | 0 | 0 |
| UAP 4 | MOC 9 | 4 | 0 | 3 | 0 |
| UAP 3 | MOC 10 | 4 | 0 | 1 | 0 |
| CN 6 | MOC 11 | 3 | 0 | 2 | 0 |
| CN 8 | MOC 12 | 3 | 0 | 0 | 0 |
| CN 14 | MOC 13 | 5 | 0 | 0 | 3 |
| CN 18 | MOC 14 | 5 | 0 | 0 | 0 |
| CN 16 | MOC 15 | 5 | 0 | 0 | 1 |
| X 1 | MOC 16 | 5 | 0 | 0 | 2 |
| X 2 | MOC 17 | 5 | 0 | 0 | 0 |
| CNN 8 | MOC 18 | 5 | 0 | 0 | 1 |
| CNN 7 | MOC 19 | 5 | 0 | 2 | 0 |
| CNN 6 | MOC 20 | 4 | 0 | 0 | 0 |
| MN 1 | MOC 21 | 1 | 0 | 0 | 0 |
| MN 2 | MOC 22 | 2 | 0 | 0 | 0 |
| MN 3 | MOC 23 | 2 | 0 | 0 | 0 |
| MN 4 | MOC 24 | 2 | 0 | 0 | 0 |
| MN 5 | MOC 25 | 3 | 0 | 0 | 0 |
| MN 6 | MOC 26 | 3 | 0 | 0 | 0 |
| MN 7 | MOC 27 | 3 | 0 | 0 | 0 |
| MN 8 | MOC 28 | 3 | 0 | 1 | 0 |
| SL 7B | MOC 29 | 2 | 0 | 1 | 0 |
| SL 5B | MOC 30 | 2 | 0 | 1 | 0 |
| SL 3B | MOC 31 | 2 | 0 | 0 | 0 |
| NP 1 | MOC 32 | 1 | 3 | 0 | 0 |
| NP 3 | MOC 33 | 2 | 2 | 0 | 0 |
| NP 5 | MOC 34 | 3 | 0 | 1 | 1 |
| NP 7 | MOC 35 | 3 | 34 | 0 | 0 |
| NP 9 | MOC 36 | 3 | 34 | 0 | 0 |
| NP 10 | MOC 37 | 2 | 66 | 0 | 0 |
| NP 11 | MOC 38 | 3 | 155 | 0 | 0 |
| NP 12 | MOC 39 | 4 | 47 | 0 | 0 |
| NP 13 | MOC 40 | 5 | 1 | 0 | 0 |
| NP 14 | MOC 41 | 5 | 0 | 0 | 0 |
| NP 15 | MOC 42 | 5 | 0 | 0 | 0 |
| NP 12.5 | MOC 43 | 5 | 0 | 0 | 0 |
| NP 11.5 | MOC 44 | 4 | 78 | 0 | 0 |
| NP 10.5 | MOC 45 | 2 | 18 | 0 | 0 |

## 9.11 Microzooplankton grazing – UMD group

Project: Microzooplankton abundance, biomass and grazing impact on phytoplankton during summer in the eastern Bering Sea (funded by BSIERP)
PI: Diane Stoecker; Research Assistant: Kristen Blattner

Science Goals for Cruise:
1. Obtain samples for determination of microzooplankton (MZ) abundance, biomass and composition in the mixed layer and chlorophyll maximum layer.
2. Estimate the grazing impact of microzooplankton on phytoplankton in the mixed layer.

Methods:
Water samples were collected on "Prod" and some regular CTD casts from the mixed layer and chlorophyll maximum layer, if present, and preserved with 10% acid Lugol's solution. These samples will be shipped to HPL for enumeration of the larger microzooplankton (>20 micron microzooplankton). In addition, 20 ml samples were preserved with alternative fixatives including Basic Lugol's solution, acid Lugol's solution and 1 % glutaraldehyde. These smaller samples were observed onboard to characterize the phytoplankton and microzooplankton communities used in the dilution experiments and to make note of the presence or absence of plastids and fluorescence of the larger protists. This information will be useful in identifying and characterizing microzooplankton when the samples are counted in the laboratory. It has also been useful in understanding optical signals, particularly orange fluorescence, detected by in situ sensors (Dr. Goes and colleagues). Water samples for microzooplankton enumeration were collected in association with the dilution experiments and at additional selected stations (refer to tables).
Two point dilution grazing experiments (with and without the addition of N) were conducted to estimate grazing rates of microzooplankton assemblages on phytoplankton. Water for the experiments was collected from the mixed layer. Grazing on total chlorophyll and chlorophyll in the >20 micron size was determined from 24 h incubations conducted in a flowing seawater on deck incubator screened to achieve an irradiance of ~50% Io. Experiments were conducted at 21 stations (refer to table). In conjunction with these experiments, Dr. Goes has been measuring variable fluorescence (an indicator of phytoplankton health and potential productivity) in control and N enriched treatments. Treatments from the experiments are being analyzed by Dr. Sambrotto to investigate the role of microzooplankton razing in urea production. These collaborative efforts should provide some data on nutrient regeneration by microzooplankton and phytoplankton physiology in the Being Sea during summer.

Expected Results:
We will have data on the abundance, biomass, and taxonomic composition of microzooplankton (primarily ciliates and dinoflagellates) from different regimes. We observed and sampled a diversity of phytoplankton and microzooplankton communities, some containing unusual organisms. In low nutrient waters, the phytoplankton was dominated by very small cells and microzooplankton (primarily

ciliates), not phytoplankton, were the dominant microplankton (20-200 micron fraction). At many stations, the phytoplankton were N limited and their growth was stimulated by the addition of nitrate: at other stations, although the phytoplankton appeared to be nutrient limited, they did not grow in response to added nitrate in the incubations. Nutrient regeneration by microzooplankton appeared to be important to phytoplankton growth in many experiments. Cryptophytes, single cell *Phaeocystis* and other small flagellates were usually the dominant phytoplankton in low chlorophyll waters. These small cells made up the chlorophyll maximum at some stations at the edge of the shelf.

Twenty-one dilution grazing experiments were conducted. Microzooplankton grazing was a large source of mortality to phytoplankton at most stations (see example of data from experiment 18). Photosynthetic mixotrophic ciliates appeared to be the dominant large micrograzers in low chlorophyll waters. Large non- thecate dinoflagelates were important grazers in chlorophyll maximum layers dominated by diatom chains. They were a source of fecal particles containing diatom frustules. At the stations centered around SL12, we found a interesting diverse assemblage containing some unexpected organisms, including large cyanobacteria chains (see micrographs below).

Abundance and biomass data, expected availability: June 2009. Estimates of microzooplankton grazing on phytoplankton, expected availability: October-November 2008.

List of Microzooplankton Grazing Experiments Conducted, Summer 2008

| Experiment# | Date | Station | Sample Depth (m) * |
|---|---|---|---|
| 1 | 4-July | UP-3 | 5 |
| 2 | 5-July | CN-6 | 7 |
| 3 | 6-July | Pit 1 | 6 |
| 4 | 7-July | Sta 21 | 5 |
| 5 | 9-July | MN-3 | 3 |
| 6 | 10-July | C-55 | 4 |
| 7 | 11-July | W-4b | 4 |
| 8 | 12-July | SL8 | 4 |
| 9 | 14-July | NP-7 | 7 |
| 10 | 15-July | NP-14 | 4 |
| 11 | 18-July | NP-14 | 5 |
| 12 | 19-July | NP-11 | 3 |
| 13 | 20-July | LS1-6 | 5 |
| 14 | 21-July | P14.4.5 | 7 |
| 15 | 22-July | P14.2 | 7 |
| 16 | 23-July | MN-6 | 5 |
| 17 | 24-July | MN-12 | 7 |
| 18 | 25-July | MN-19 | 9 |

| | | | |
|---|---|---|---|
| 19 | 26-July | SL-14 | 6 |
| 20 | 27-July | 70m-53 | 7 |
| 21 | 28-July | 70m-36 | 5 |
| | | | |
| *Correponds to 55% Io, in mixed layer. | | | |

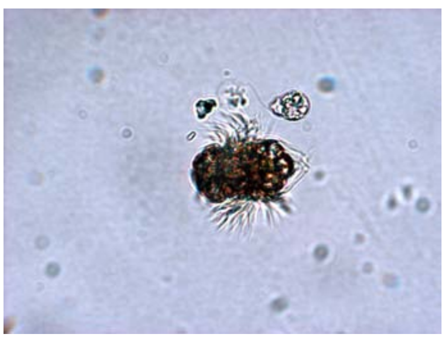
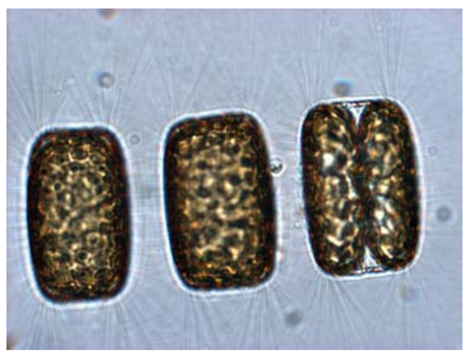
List of Microzooplankton Samples Collected, Summer 2008

| Date | Station | Mixed layer sample depth (m) | Chl. Max Sample Depth (m) |
|---|---|---|---|
| 4-July | UP-3 | 5 | 10 |
| 5-July | CN-6 | 7 | 29 |
| 6-July | Pit 1 | 6 | 19 |
| 7-July | Sta 21 | 5 | NA |
| 9-July | MN-3 | 3 | NA |
| | MN-6 | 10 | 39 |
| 10-July | C-55 | 4 | NA |
| 11-July | W-4b | 4 | NA |
| | N-55 | 20 | 40 |
| 12-July | SL8 | 4 | 34 |
| 13-July | NP-1 | 5 | NA |
| | NP-2 | 5 | NA |
| | NP-3 | 5 | NA |
| | NP-4 | 5 | 28 |
| 14-July | NP-5 | 5 | 20 |
| | NP-6 | 5 | NA |
| | NP-7 | 7 | NA |
| | NP-8 | 5 | NA |
| | NP-9 | 5 | 30 |
| | NP-10 | 5 | NA |
| | NP-11 | 5 | NA |
| | NP-12 | 5 | NA |
| | NP-13 | 5 | 20 |
| 15-July | NP-14 | 4 | NA |
| | NP-15 | 5 | NA |
| 18-July | NP-14 | 5 | 15 |
| 19-July | NP-11 | 3 | 17 |
| 20-July | LS1-6 | 5 | NA |
| 21-July | P14.4.5 | 7 | NA |
| 22-July | P14.2 | 7 | 27 |
| 23-July | MN-6 | 5 | NA |
| | MN-9 | 10 | 29 |
| 24-July | MN-12 | 7 | 33 |
| 25-July | MN-19 | 9 | 34, 39, 43 |

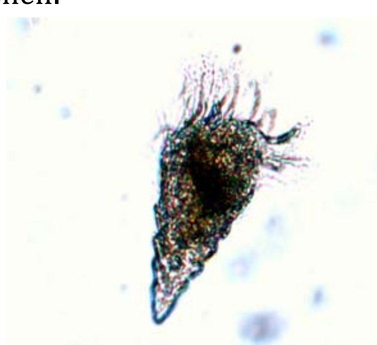
| | | | |
|---|---|---|---|
| 26-July | SL-14 | 6, 10 | 30, 30 |
| | SL13 | NA | 30 |
| | SL-12 | NA | 30 |
| 27-July | 70m-53 | 7 | 32 |
| | 70m-50 | 10 | 20, 30,40,50 |
| | 70m-47 | NA | 20,30 |
| 28-July | 70m-36 | 5 | 25 |
| | 70m-27 | 10 | 30 |
| 29-July | 70m-17 | 10 | 25 |
| | 70m-13 | 6 | 14 |
| | | | |
| NA=Not Applicable, no strong Chl. Max or sample not available | | | |
| | | | |

**Sample results (photomicrographs taken by DS and John Casey):**

In the chlorophyll maximum layer on the mid-shelf, often the ciliate *Myrionecta rubra* and small phytoflagellates, particularly cryptophytes, were common along with large chain forming diatoms (example, station N-55, midshelf south of St Matthews Island). This mixture of diatoms, phytoflagellates and microzooplankton may be important as a concentrated source of food for macrozooplankton.

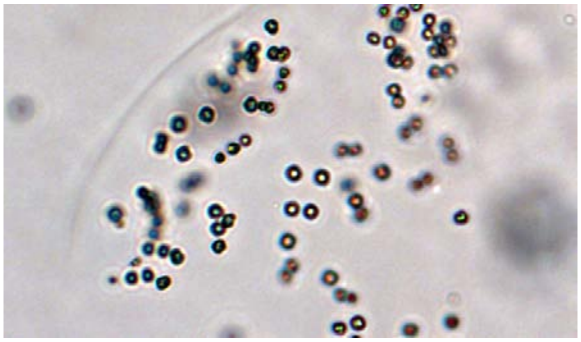



At many shelf stations, chlorophyll values were low and most of the phytoplankton were small (>90% of chl in < 20 micron size class). At these stations, ciliates were very abundant and large photosynthetic ciliates were very common in the mixed layer. Ciliates may be important prey for macozooplankton and as well as important as photosynthetic microplankton in low chlorophyll waters. For example, *Laboea strobila (a mixotrphic ciliate)* and heterotrophic ciliates were common in the mixed layer at station NP-2 located on the mid shelf.

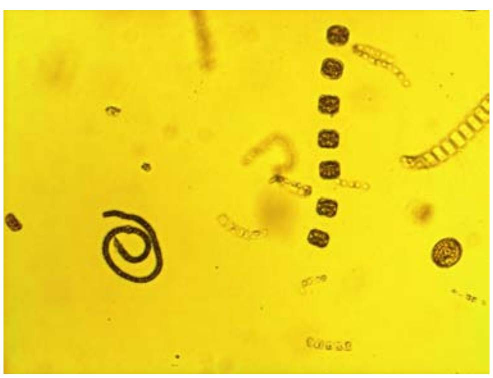



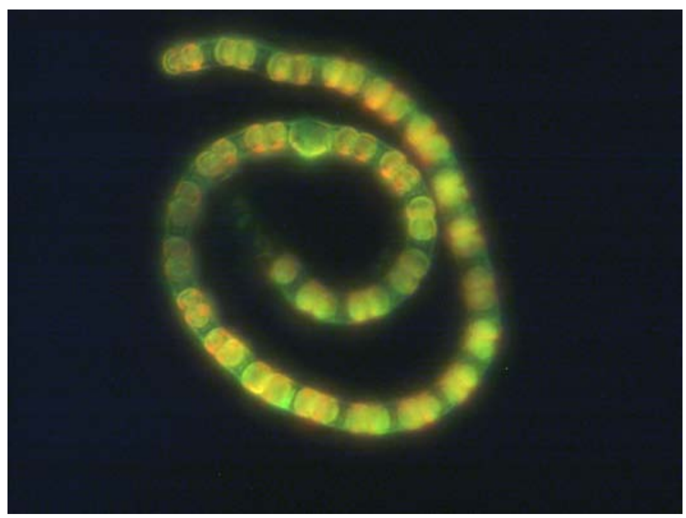
.

At some stations, the mixed layer was dominated by *Phaeocystis* and small diatoms. At these stations a rich mixture of ciliate and dinoflagellate grazers was observed (examples stations NP-14 & 15 near the shelf edge).

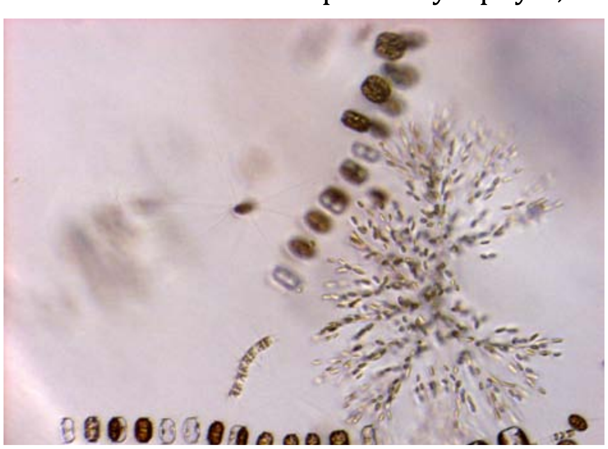


At midshelf stations SL-12 and SL-13,
located in the cold pool area southwest of St. Matthews Island, cyanobacterial chains with hetereocysts (tentatively identified as *Anabaena* sp.) were present in the chl. max. layer. The chains appeared to be healthy. This observation is very surprising. Do they survive year round in Bering Sea waters or are they seeded by river discharge? Are they fixing N?

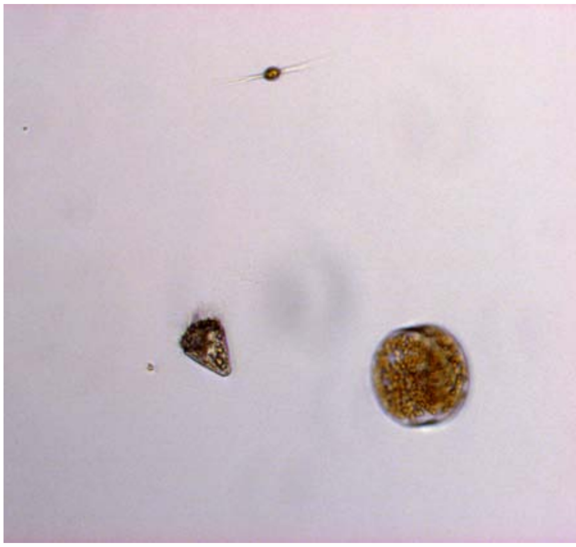


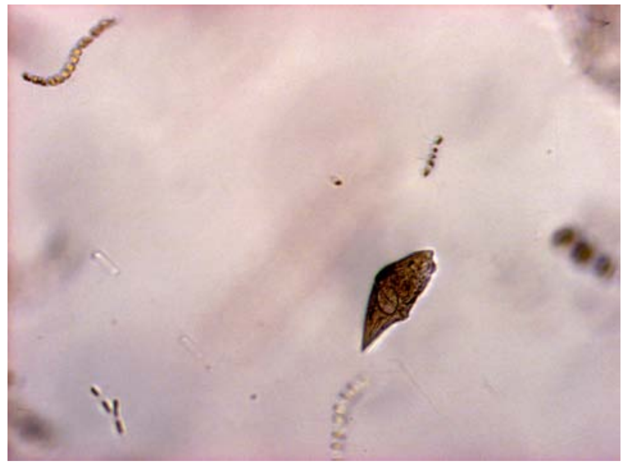


The phytoplankton at SL-12 and S-13 was rich mixture of diatoms and flagellates. Colonies of the mixotrophic chrysophyte, *Dinobryon*, were common.

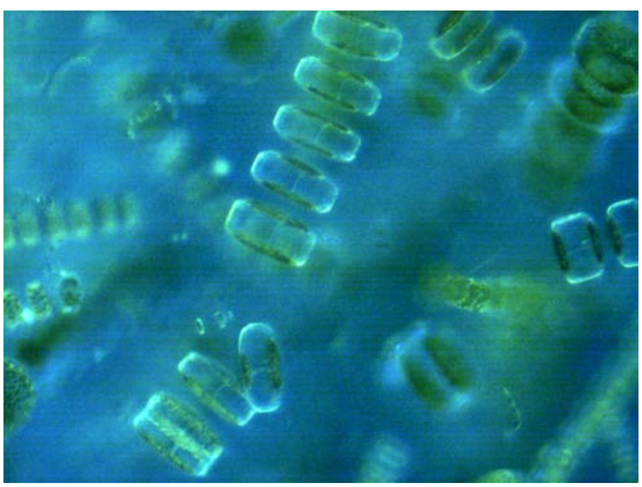


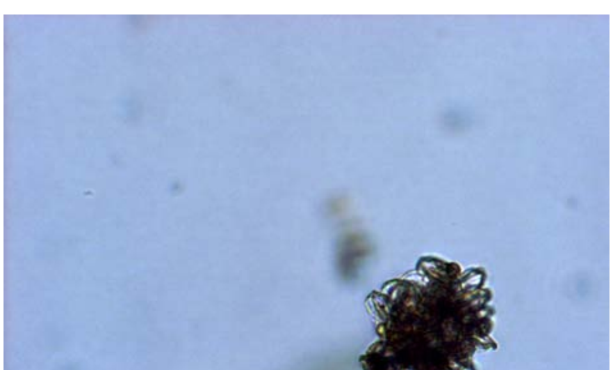
Microzooplankton were abundant and included photosynthetic and non-photosynthetic ciliates and small and large heterotrophc dinoflagellates. This was a rich and diverse assemblage of microplankton.





At some mid shelf stations, a chlorophyll max dominated by large diatom chains was present. Large non-thecate heterotrophic dinoflagellates were grazing on the diatoms and producing fecal pellets. An example is mid shelf station 70m-47.





Example of data from a dilution experiment, these results are preliminary. The data have not undergone statistical analyses.

Experiment #18 25-Jul-08 Sta110 MN-19 9m Preliminary data

Pt=final chl
Po= initial chl
K=net growth rate
μ= intrinsic growth rate
g=grazing rate

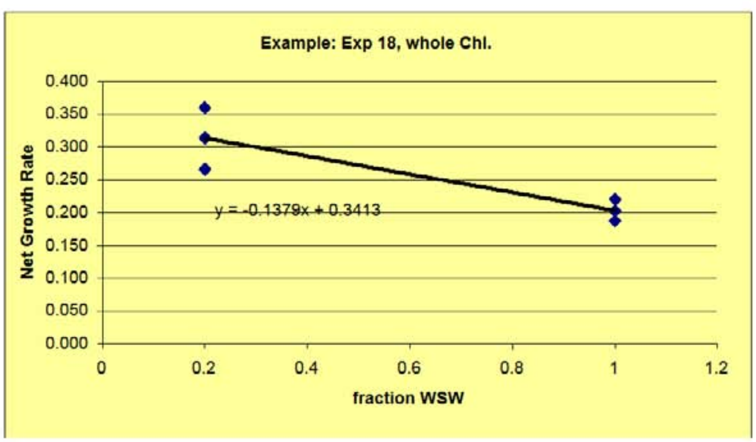
Control
Plus N

Whole Chl's

| Treatment | Pt (t=24) | Po (t=0) | K (y) | x | μ | g | g/u |
|---|---|---|---|---|---|---|---|
| WSW | 0.463 | 0.371 | 0.220 | 1 | 0.341 | -0.138 | 0.40 |
| | 0.448 | 0.371 | 0.187 | 1 | | | |
| | 0.455 | 0.371 | 0.202 | 1 | | | |
| 20% WSW | 0.107 | 0.075 | 0.360 | 0.2 | | | |
| | 0.102 | 0.075 | 0.314 | 0.2 | | | |
| | 0.098 | 0.075 | 0.266 | 0.2 | | | |
| WSW + N | 0.449 | 0.371 | 0.190 | 1 | 0.243 | -0.063 | 0.26 |
| | 0.453 | 0.371 | 0.199 | 1 | | | |
| | 0.431 | 0.371 | 0.150 | 1 | | | |
| 20% WSW + N | 0.091 | 0.075 | 0.201 | 0.2 | | | |
| | 0.095 | 0.075 | 0.238 | 0.2 | | | |
| | 0.096 | 0.075 | 0.252 | 0.2 | | | |

<20 μm chl's

| Treatment | Pt (t=24) | Po (t=0) | K (y) | x | μ | g | |
|---|---|---|---|---|---|---|---|
| WSW | 0.429 | 0.359 | 0.178 | 1 | 0.316 | -0.127 | 0.40 |
| | 0.440 | 0.359 | 0.204 | 1 | | | |
| | 0.431 | 0.359 | 0.185 | 1 | | | |
| 20%WSW | 0.098 | 0.074 | 0.281 | 0.2 | | | |
| | 0.101 | 0.074 | 0.316 | 0.2 | | | |
| | 0.097 | 0.074 | 0.274 | 0.2 | | | |
| WSW + N | 0.474 | 0.359 | 0.279 | 1 | 0.288 | -0.012 | 0.04 |
| | 0.466 | 0.359 | 0.261 | 1 | | | |
| | 0.478 | 0.359 | 0.288 | 1 | | | |
| 20% WSW + N | 0.100 | 0.074 | 0.302 | 0.2 | | | |
| | 0.098 | 0.074 | 0.288 | 0.2 | | | |
| | 0.096 | 0.074 | 0.267 | 0.2 | | | |




The results of this experiment indicate several things. At this station, most of the chlorophyll is < 20 micron phytoplankton. The growth rate of the phytoplankton (u), was not stimulated the addition of nitrate; the phytoplankton do not appear to be N limited. In the treatments without added nutrients, the grazing coefficient was 0.34 $d^{-1}$

and about 40% of the daily phytoplankton production was grazed by microzooplankton. For some unknown reason, the addition of nitrate appeared to inhibit grazing. It will be interesting to see if the variable fluorescence is consistent with the phytoplankton responses observed. It will also be interesting to determine if the phytoplankton growth rates correlate with measurements of primary productivity conducted simultaneously on the cruise and whether the microzooplankton grazing rates correlate with urea production.

The results from this grazing experiment will be compared to those from the other 20 stations to determine if grazing coefficients or % of production or standing stock grazed per day are related to phytoplankton or microzooplankton community composition, nutrient availability or domain.

## 9.12 Benthic biological characterization and fluxes – WWU group

**Shull/Devol Cruise report**

The primary goal of the benthic biogeochemistry group is to measure rates of sedimentary organic carbon remineralization, benthic denitrification rates, nutrient fluxes, and sediment bioirrigation rates and to evaluate the role of the benthos in the nitrogen cycle of the Bering Sea. A secondary goal is to determine gas exchange rates for calculating water column primary productivity along with measurements of the triple isotopes of dissolved oxygen.

**Core samples**

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

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

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

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

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

2-3 cores sieved over 0.5-mm sieve and preserved in 10% formalin for later enumeration of benthic infauna

## Water-column sampling

At nine stations vertical profiles of $^{222}Rn/^{226}Ra$ were measured. The $^{222}Rn/^{226}Ra$ measurements will be used for determining gas exchange rates and, combined with oxygen isotope data, rates of net primary production.

## Multicore locations

| Stn | Name | Date | Latitude | | Longitude | | Depth (m) | [O2]pw | Flux | [Nut]pw | 222Rn | Benthos |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Station data** | | | | | | | | **Measurements** | | | |
| 4 | UP-3 | 7/4/2008 | 54º 25.3' | N | 165º 8.4' W | | 133 | X | X | X | X | X |
| 9 | UAP-4 | 7/5/2008 | 55º 45.7' | N | 169º 31.6'W | | 94 | X | X | X | X | X |
| 17 | CN-18 | 7/6/2008 | 55º 18.4' | N | 168º 23.5'W | | 1615 | X | X | X | X | X |
| 24 | CNN6 | 7/8/2008 X | 56º 45.68' | N | 167º 51.77' | | W | 100 | X | X | X | X |
| 31 | MN-5 | 7/9/2008 | 59º 54' | N | 170º 23.8'W | | 63 | X | X | X | X | X |
| 46 | SL-8 | 7/12/2008 X | X | 62º 12.1' | N | 172º 42.83 | | W | 59 | X | X | X |
| 59 | NP-7 | 7/14/2008 X | | 57º 53.6' | N | 169º 13.8'W | | 66 | X | X | X | X |
| 68 | NP-15 | 715/2008 | 56º 3.5' | N | 171º 18.6'W | | 2766 | X | X | X | X | X |
| 79 | NP-14 | 7/18/2008 X | | 56º 17.21' | N | 171º 2.85'W | | 136 | X | X | X | X |
| 86 | LS1-6 | 7/20/2008 | | 56º 50.0' | N | 173º 18.9'W | | 160 | | X | | |
| 92 | P-14-2 | 7/22/2008 X | X | 59º 00.6' | N | 174º 00.52' | | W | 123 | X | X | X |
| 99 | MN-5 | 7/23/2008 X | | 59º 54.1' | N | 170º 23.6'W | | 64 | X | X | X | X |
| 102 | MN-11 | 7/24/2008 X | | 59º 54.0' | N | 173º 59.9'W | | 101 | X | X | X | X |
| 106 | MN-15 | 7/25/2008 X | | 59º 54.3' | N | 176º 23.3'W | | 139 | X | X | X | X |
| 116 | SL-14 | 7/26/2008 X | | 62º 11.5' | N | 175º 10.7'W | | 80 | X | X | X | X |

## Expected results

Our measurements of oxygen and nitrogen changes in flux cores will enable us to determine the rate of organic matter supply to the benthos and the rate of denitrification. Nutrient measurements in flux cores will enable us to calculate rates of nutrient cycling between sediments and overlying water. We will calculate rates of sediment bioirrigation from the pore water profiles of Rn-222. Profiles of dissolved oxygen and nutrients will enable us to infer the biogeochemical processes leading to the observed nutrient and gas fluxes. Samples preserved for identification and enumeration of benthic organisms along with CT scans of flux core burrow distributions will enable us to examine how benthic organisms influence nutrient cycling in Bering Shelf sediments.

Many of these measurements will not be completed until after the Healy returns to port in October. At that time, we will be able to offload samples and equipment necessary to complete this work. I expect that most data will be available by July 2009.

## Example of data from flux core experiments and sediment profiles, Stn 24

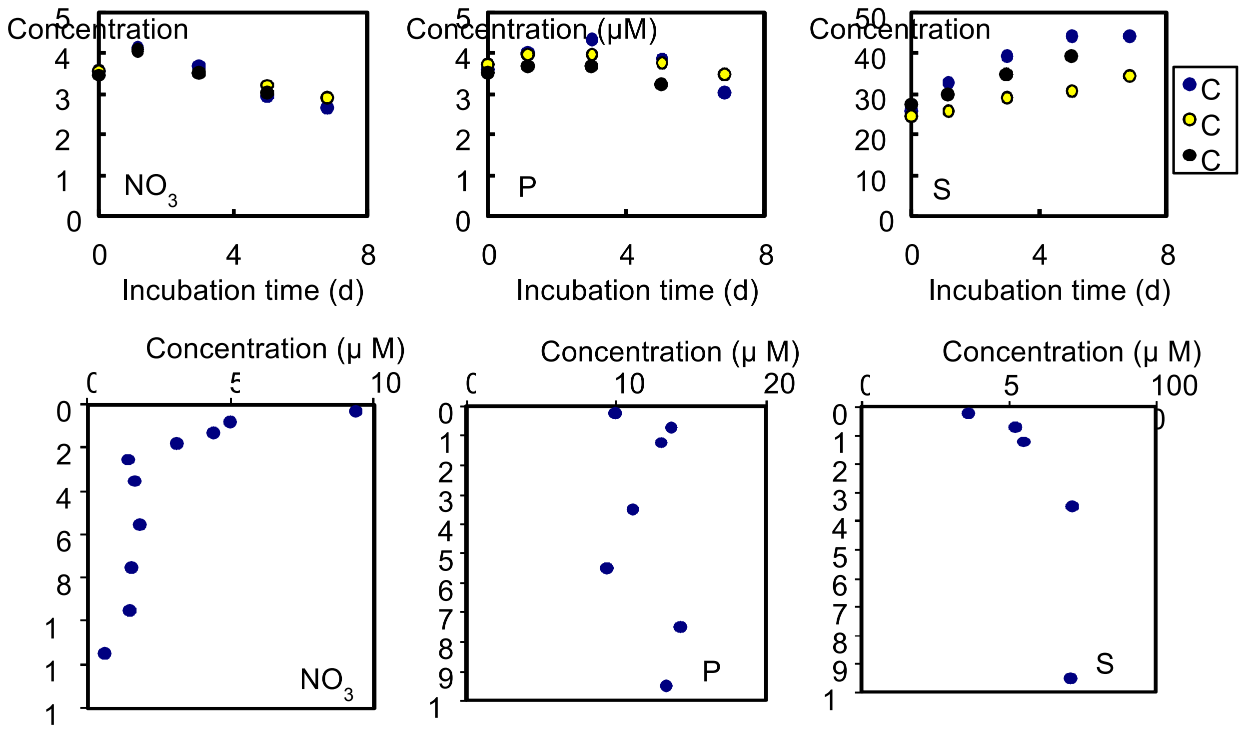



**Figure 9-12.1.** Changes in concentration of nitrate, phosphate and silicate in flux-core experiments (top row) and corresponding profiles in sediment from the same station (bottom row). Station 24, 100 m water depth.

**9.13 Bird distribution and abundance – US Fish & Wildlife group**
**Seabird and Marine Mammal Surveys aboard HLY0803**

Kathy J. Kuletz and Elizabeth A. Labunski
U.S. Fish and Wildlife Service, Migratory Bird Management, MS-201, 1011 E. Tudor Rd., Anchorage, Alaska 99507

**Project:**
As part of the HLY0803 cruise we surveyed marine birds and mammals in conjunction with the National Science Foundation 2008 BEST cruise onboard the USCGC Healy July 3 - 31, 2008. The seabird and marine mammal data will be archived in the North Pacific Pelagic Seabird Database (U.S. Fish and Wildlife Service, Anchorage, Alaska) and are part of the Bering Sea Ecosystem Integrated Research Program funded by the North Pacific Research Board (Anchorage, Alaska).

**Methods:**
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. Birds on the water or foraging were counted continuously. Flying birds were counted during 'snapshots' at intervals that varied with ship speed, typically about once every minute. We recorded the animal's behavior as flying, on water, on scan, or actively foraging. 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 used the DLOG2 data entry program (Ford Ecological Consultants, Inc.) to record observations directly into a laptop computer interfaced with the Healy's global positioning system. Every entry by the observer was recorded with location, date, and time stamps, along with associated environmental and observer variables. Location data were also automatically written to the data file 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.

**Preliminary Results and Discussion:**
From July 3 - 31, we surveyed 115 transects totaling 3,515 km. During this time we recorded a total of 24,184 birds, of which 95 % were identified to species for a total of 29 species (Table 1). The majority of birds observed were Short-tailed Shearwaters (*Puffinus tenuirostris* and Northern Fulmars (*Fulmarus glacialis*) which were 77 % of the on-transect bird observations. Six species of seabirds comprised 92 % of the identified birds; these were Short-tailed Shearwaters, Northern Fulmar, Fork-tailed Storm-petrel, Thick-billed Murre, Common Murre, and Black-legged Kittiwake (Table 1).

A preliminary examination of the distribution of the two prevalent species of marine birds (short-tailed shearwater and northern fulmars) illustrate that Short-tailed Shearwaters were concentrated near Unimak Pass, while Northern Fulmars were the most ubiquitous of the prevalent seabird species throughout the survey region (Figure 1). Planktivorous Fork-tailed Storm-petrels were the third most prevalent seabird observed during the survey. The majority of these surface feeding Storm-petrels were observed along the Bering Sea shelf edge and southern Bering Sea, while piscivourous Murre spp. (Common & Tick-billed) were more commonly observed on the shelf (Figure 2). Other marine bird observations of interest included 3 species of albatross (Black-footed, Laysan and Short-tailed), Mottled Petrels, and Red-legged Kittiwakes.

**Marine Mammals**: We recorded 230 marine mammals of 7 identified species (Table 2). Of those, 117 were 'on transect'. Dall's Porpoise were the most common and widely distributed marine mammal encountered, followed by Northern Fur Seals (Figure 3). We also observed 4 whale species: Fin, Minke, Humpback, and Killer Whales. Humpback whales were observed in the southern Bering Sea north of Unimak Pass, while observations of Fin, Minke and Killer whales extended into the central and north Bering Sea (Figure 3).

Table 1. Marine bird observations during the BEST cruise on the USCGC Healy, July 3 - 31, 2008

| **Species** | **Total Count (n)** | **Proportion of Total (%)** | **Overall Abundance (# / 100km)** |
|---|---|---|---|
| Ancient Murrelet | 52 | 0.22 | 1.48 |
| Arctic Tern | 5 | 0.02 | 0.14 |
| Barn Swallow | 1 | 0.00 | 0.03 |
| Black-footed Albatross | 1 | 0.00 | 0.03 |
| Black-legged Kittiwake | 332 | 1.37 | 9.45 |
| Cassin's Auklet | 3 | 0.01 | 0.09 |
| Common Murre | 878 | 3.63 | 24.98 |
| Crested Auklet | 42 | 0.17 | 1.19 |
| Fork-tailed Storm-petrel | 1372 | 5.67 | 39.03 |
| Glaucous Gull | 3 | 0.01 | 0.09 |
| Glaucous-winged Gull | 1 | 0.00 | 0.03 |
| Harlequin Duck | 5 | 0.02 | 0.14 |
| Herring Gull | 5 | 0.02 | 0.14 |
| Horned Puffin | 97 | 0.40 | 2.76 |
| Laysan Albatross | 4 | 0.02 | 0.11 |
| Least Auklet | 111 | 0.46 | 3.16 |
| Leach's Storm-petrel | 1 | 0.00 | 0.03 |
| Mottled Petrel | 6 | 0.02 | 0.17 |
| Northern Fulmar | 5046 | 20.87 | 143.56 |
| Parakeet Auklet | 65 | 0.27 | 1.85 |
| Parasitic Jaeger | 2 | 0.01 | 0.06 |
| Pigeon Guillemot | 3 | 0.01 | 0.09 |
| Pomarine Jaeger | 19 | 0.08 | 0.54 |
| Red Phalarope | 25 | 0.10 | 0.71 |
| Red-legged Kittiwake | 63 | 0.26 | 1.79 |
| Short-tailed Albatross | 2 | 0.01 | 0.06 |
| Short-tailed Shearwater | 13599 | 56.23 | 386.88 |
| Thick-billed Murre | 1131 | 4.68 | 32.18 |
| Tufted Puffin | 109 | 0.45 | 3.10 |
| Unid. Alcid | 21 | 0.09 | 0.60 |
| Unid. Dark Shearwater | 987 | 4.08 | 28.08 |
| Unid. Gull | 1 | 0.00 | 0.03 |
| Unid. Kittiwake | 6 | 0.02 | 0.17 |
| Unid. Murre | 181 | 0.75 | 5.15 |
| Unid. Shearwater | 1 | 0.00 | 0.03 |
| Unid. Small Dark Alcid | 4 | 0.02 | 0.11 |
| Total | 24184 | 100.00 | 688.02 |

Table 2. Marine mammal observations during the BEST cruise on the USCGC Healy, July 3- 31, 2008. Off transect counts were observations > 300 m from the ship's center line.

| | On transect counts | | | Off transect (> 300 m) |
|---|---|---|---|---|
| Species | Total Count (n) | Proportion of Total (%) | Overall Abundance (# / 100km) | Total Count (n) |
| Dall's Porpoise | 61 | 52.14 | 1.74 | 61 |
| Fin Whale | 3 | 2.56 | 0.09 | 14 |
| Humpback Whale | 2 | 1.71 | 0.06 | 6 |
| Killer Whale | 0 | 0.00 | 0.00 | 12 |
| Minke Whale | 2 | 1.71 | 0.06 | 7 |
| Northern Fur Seal | 45 | 38.46 | 1.28 | 11 |
| Pacific Walrus | 0 | 0.00 | 0.00 | 1 |
| Unid. Seal | 1 | 0.85 | 0.03 | 0 |
| Unid. Whale | 1 | 0.85 | 0.03 | 1 |
| Unid. Pinniped | 2 | 1.71 | 0.06 | 0 |
| Total | 117 | 100 | 3.33 | 113 |

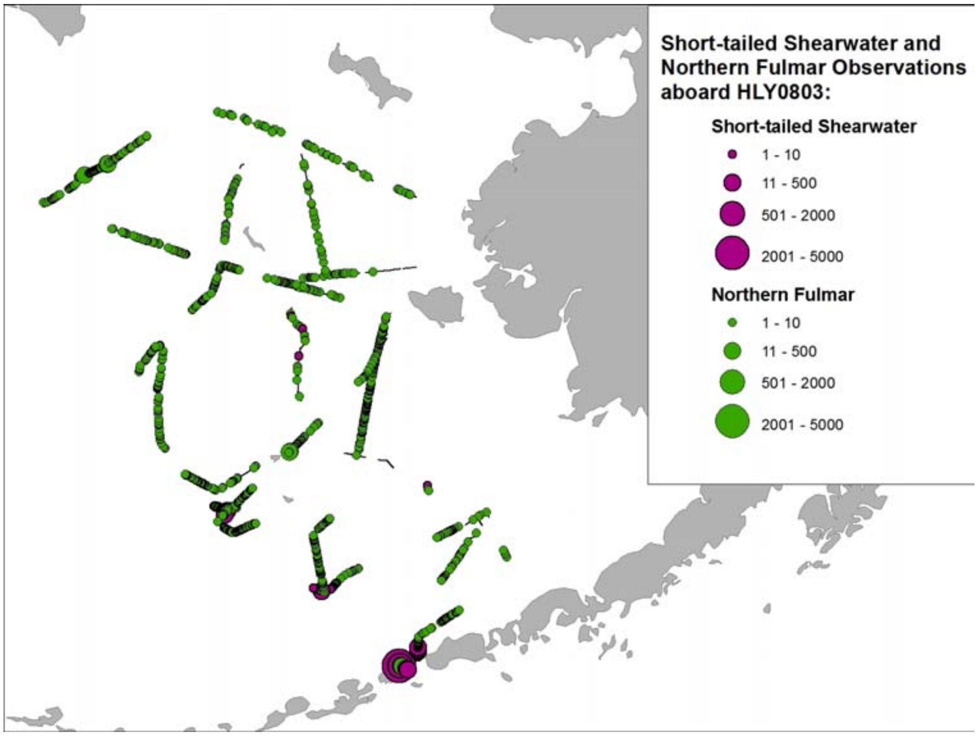



Figure 9-13.1. Short-tailed Shearwater and Northern Fulmar observations during surveys from the Healy, 3 – 31 July, 2008. Black lines indicate survey track lines.

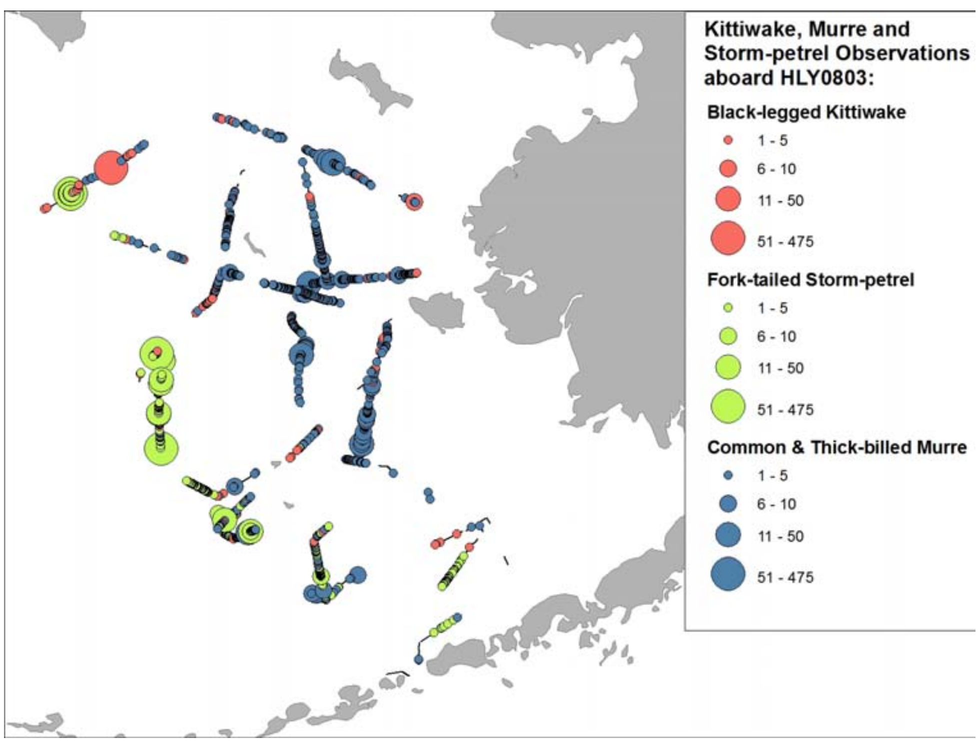


Figure 9-13.2. Black-legged Kittiwake, Fork-tailed Storm-petrel and Common & Thick-billed Murre observations during surveys from the Healy, 3 – 31 July, 2008. Black lines indicate survey track lines.

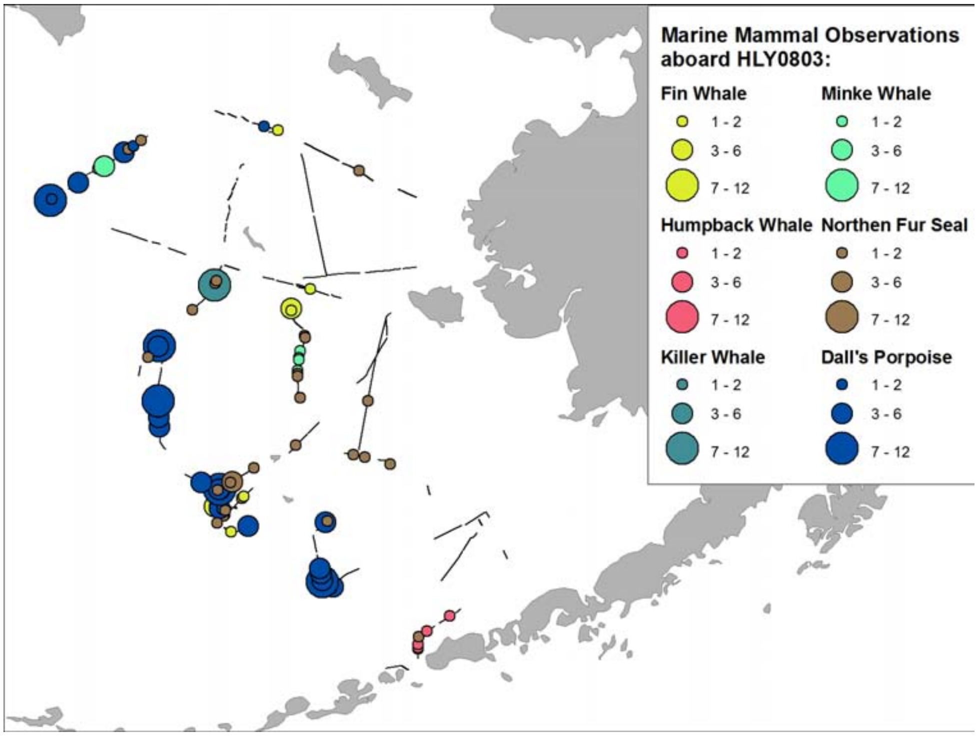



Figure 9-13.3. Marine Mammal observations during surveys from the Healy, 3 – 31 July, 2008. Black lines indicate survey track lines.

## 9.14 Marine mammal distribution and abundance – NOAA group

**Overall goal**

This 2008 survey is part of the North Pacific Right Whale Tagging and Foraging Ecology Study and was conducted aboard the USCGC Healy along pre-determined transect lines. Photographic and sighting data were collected on a “not-to-interfere basis” with the oceanographic survey. Right whales were the priority species for this survey but all cetaceans and pinnipeds were of interest and all sightings save fur seals (Callorhinus ursinus) near the Pribilof Islands were included in the effort. The primary objective of this portion of the right whale ecology study was to aid in the location of right whales prior to the departure of the R/V “Ocean Olympic” at the beginning of August. This latter cruise will focus on areas of past sightings and carry out a dedicated program of radio tagging, photogrametery, acoustic monitoring, and biopsy of these animals to further understand their biology and the present state of the health of this remaining stock in the eastern portion of the whales range.

**Procedures**

The visual data was collected by a researcher positioned in the ship’s Aloft Conning Tower (“aloft con”) with a height of eye of 33 meters using hand held 10 power Zeiss binoculars. Sightings were recorded on WinCruz software during daylight transit periods between stations. Effort was halted whenever viewing conditions dropped below one nautical mile of visibility generally due to fog or fog and rain. The ship traveled at between 11 and 15 nautical miles per hour and ocean conditions were generally favorable.

Digital photos taken of marine mammals and seabirds were taken by a Canon EOS 30D with a Canon 100-400 image stabilized zoom lens.

All sightings recorded during transit were input into WinCruz which accepts relative angle and distance (reticule or estimated in nautical miles).

Communication between the bird observers working a similar schedule was made possible via thee ships VHF radios.

## Results and Data Distribution

Daily summaries will accompany the WinCruz data files and be made available to the Chief Scientist of the HLY0803 Cruise as well as members of the NMFS- Northwest Marine Mammal Laboratory in Seattle.

Sample Summary:

**July 04**- Began survey after morning station and continued throughout day in between stations, working two hours on and ~ one hour off.
16 sightings:
11 of M. novaeangliae, (24 individuals)
1 of P. dalli porpoise (5 individuals)
1 of B. physalus (12 individuals)
2 of unidentified large whales (3 individuals)
Two fur seals were seen by the birders.

Much of the day was spent on a good ocean (Beaufort 2-3) with some fog and rain. The rain became more of a problem later in the day as visibility decreased. After the third station (1900) fog descended and no further effort was possible although just as we arrived at the 2130 station the fog lifted to reveal 8 more fin whales (included in count above).

Sample Win Cruz readout for same day:

```
022*.092405 070408 N54:33.95 W165:10.03
023*.092605 070408 N54:34.36 W165:10.14
024S.092702 070408 N54:34.55 W165:10.19  001  001    2    1  280      8.00  076
025A.092702 070408 N54:34.55 W165:10.19  001         N    N  070
  1                            OBS BEST HIGH  LOW  %S1  %S2  %S3
026*.092805 070408 N54:34.76 W165:10.25
027C.092941 070408 N54:35.09 W165:10.34 Large whale breaching near horizon
028*.093005 070408 N54:35.17 W165:10.35
029S.093125 070408 N54:35.44 W165:10.40  002  001    6    2  270      2.00  076
030A.093125 070408 N54:35.44 W165:10.40  002         N    N  076
  1                            OBS BEST HIGH  LOW  %S1  %S2  %S3
031*.093205 070408 N54:35.58 W165:10.42
032C.093236 070408 N54:35.69 W165:10.43 3 humpback, one cow/calf
033*.093405 070408 N54:35.98 W165:10.48
034S.093418 070408 N54:36.02 W165:10.49  003  001    6    2  270      1.40  076
035A.093418 070408 N54:36.02 W165:10.49  003         N    N  076
  1                            OBS BEST HIGH  LOW  %S1  %S2  %S3
```

036C.093537 070408 N54:36.29 W165:10.54 4 M. novaeangliae traveling slowly in one direction
037*.093605 070408 N54:36.38 W165:10.55
038S.093650 070408 N54:36.53 W165:10.59 004 001 3 1 273 0.90 076
039A.093650 070408 N54:36.53 W165:10.59 004 N N 076
1 OBS BEST HIGH LOW %S1 %S2 %S3
040C.093802 070408 N54:36.77 W165:10.64 2 M. novaeangliae slow travel towards stern
041*.093805 070408 N54:36.79 W165:10.64
042C.093927 070408 N54:37.07 W165:10.71 Increased bird activity

**Photographs:**
All pictures of cetaceans will be placed on the "shared site" on the public drive and be available there as well as files that will accompany the data and summaries going to NMML.

**Comments on Operations**
The USCGC Healy is an outstanding platform for numerous oceanographic observations and experiments. These comments will be restricted to this past survey and future possible marine mammal sighting surveys.
Aloft-Con:
This area of the ship, which is used as a steering station when the ship is transiting ice, is an extremely good area for marine mammal sighting. Protected from the environment and with near 360 degree viewing at the commanding height of 99 feet makes it a natural for line transect or behavioral work. Suggestions to improvement:

1) Purchase two pairs of Zeiss 20X48 Image Stabilized binoculars and mount them in the front windows using a sling made of shock cord suspended from the overhead to a small board. This would provide flexibility to move from front to side windows and remove some of the possible vibration encountered at some shaft RPM.
2) It would be nice to get the heater working!

Flying Bridge:
This vessel is very stable and the height of the flying bridge would lend itself for "big eye" type line-transect work as well. The ship has two, port and starboard, mounting platforms for pedestals and the 75X150 Fujinon binoculars used on other ships for this type of work. A major draw back would be the environment this ship generally works. Mounting the binoculars and stands would be relatively easy due to the afore mentioned mounts but to make observing from this area feasible some sort of protection from the elements would be required. Room for a structure to enclose the binoculars is restricted by two items on both port and starboard. An antennae/receiver and spotlight surround the present pedestal mounts and would present difficulties to positioning the standard big-eyes and/or a weather housing. Communication would need to be provided with VOX style headsets between port and starboard and a recorder (most likely stationed in the "aloft-con").

## 9.15 Water column bio-optics – Bigelow Lab. Group

**Cruise Report for HLY0803**

Project: Spatial and Temporal Variability in phytoplankton biomass and primary production in the Bering Sea linked to Climate Change (funded by NASA, IPY)

Team Members:
Joaquim I. Goes and Helga Gomes (Bigelow Laboratory for Ocean Sciences)
Eurico.D'Sa and Puneeta Naik (Louisiana State University)

Science Goals for the Cruise:

Our major goal in this study was to collect bio-optical data in conjunction with measurements of chlorophyll, rates of primary productivity, CDOM, suspended matter, coccolithophore counts and calcium carbonate in support of NASA's efforts to develop robust empirical and semi-analytic algorithms for ocean color products of the Bering Sea. This effort is part of longer strategic objective of understanding the impacts of changing climate on biological oceanographic processes in the Bering Sea using ocean color satellite data.

An additional goal was to investigate the distribution of major phytoplankton groups and their physiological status in relation to nitrate and iron availability in the water column.

Methods and Approach:

Data required to meet our project goals was acquired from three different streams: 1) Profiling with a bio-optical package 2) Underway measurements with a prototype Automatic Laser Fluorometer and 3) Laboratory based analysis of samples obtained from discrete depths in the water column.

*1) Bio-optical Profiling:*

A bio-optical package put together prior to this cruise was used to attain some of the core measurements required to meet our project objectives. This bio-optical profiling package comprised of the following instruments: i) **CTD**, ii) **ECO-Triplet** (WETLABS chlorophyll, CDOM fluorometer with scattering sensor), iii) **ac-s** (WETLABS hyperspectral absorption-attenuation meter), iv) **Hyper OCI** (Satlantic hyperspectral downwelling irradiance sensor) , v) **Hyper OCR** (Satlantic hyperspectral upwelling radiance sensor, vi) **VSF-3** (WETLABS three-angle, three wavelength volume scattering function meter) and a **Fast**

Figure 1: Bio-optical package before deployment at a station in the Bering Sea during USCG Healy cruise 0803.

**Repetition Rate Fluorometer** (FRRF, JAPAN, for estimating quantum efficiencies (variable fluorescence) of ambient phytoplankton populations, rates of photosynthesis, and parameters ($\alpha$ and $P^B{}_{max}$) of the photosynthesis versus light response curve required for modeling of water column primary production (Fig.1). Preliminary results obtained with the bio-optical package and processed are given in Figs. 2 to 4; This data can be used to model column primary production. Our plan is to test model derived measurements of primary production with those made using standard deck-based incubation methods (Fig. 1).

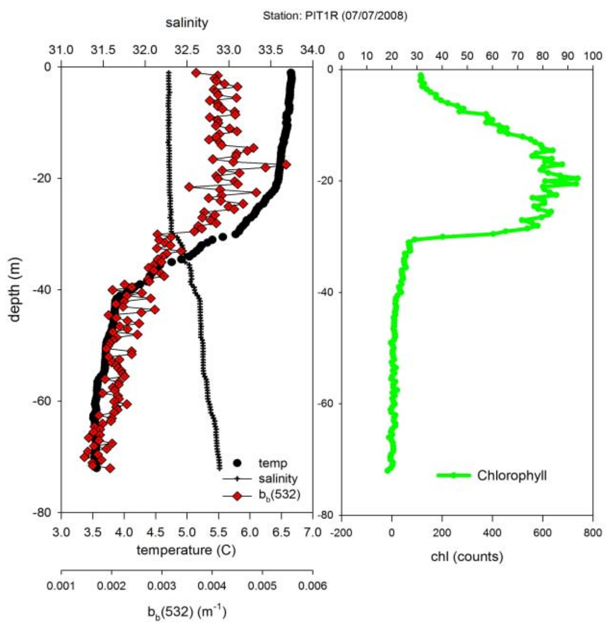



Figure 2. Vertical profiles of water column properties obtained from the optical profiler at station PIT1R

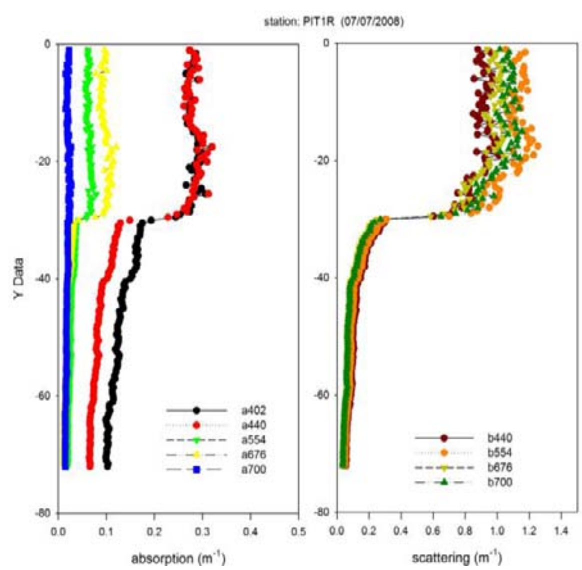



Figure 3. Vertical profiles of spectral absorption and scattering estimated at station PIT1R

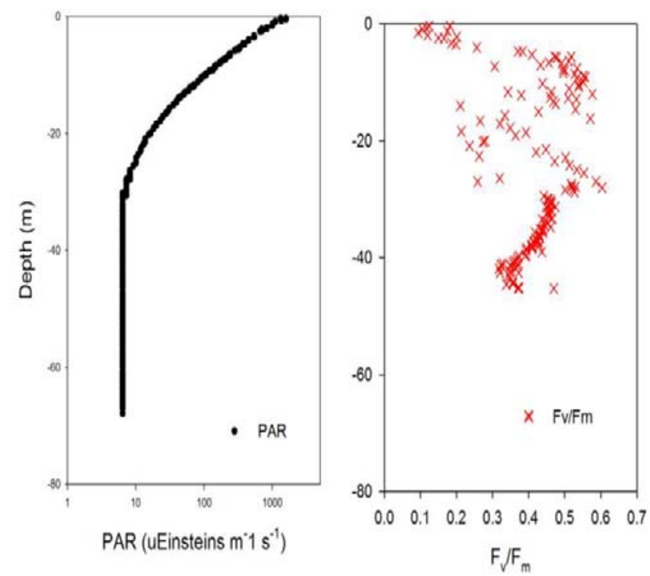



Figure 4. PAR and phytoplankton physiological response Fv/Fm measured by the Fast Repetition Rate Fluorometer (FRRF) on the optical profiler at station PIT1R

On July 8th 2008, during normal shipside operations at station NP2 to the southeast of Nunivak Island the bio-optical package was lost after we had acquired data at 10 stations. By the 19th of July 2008,

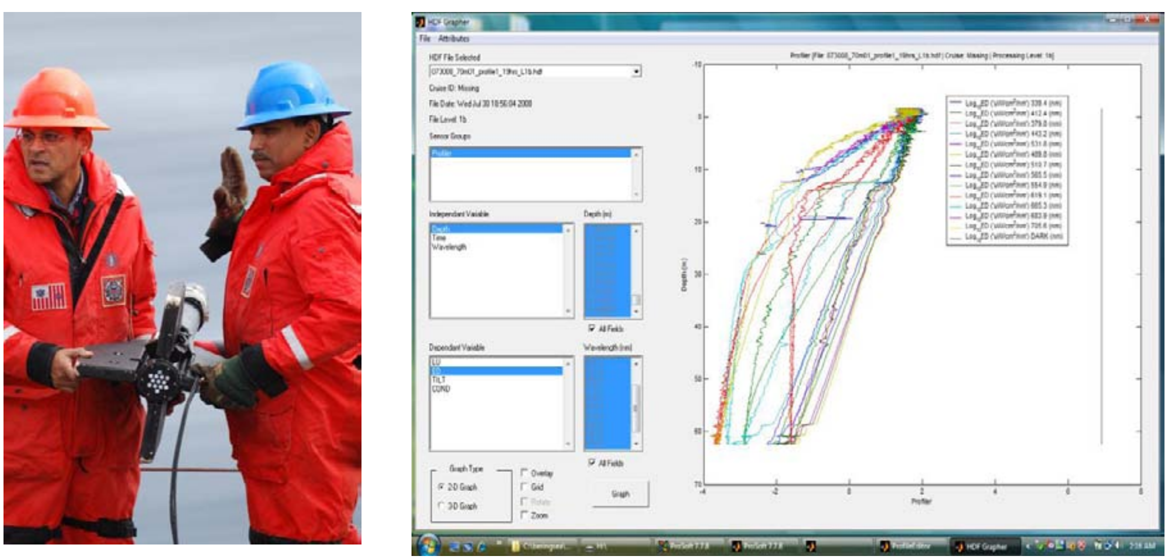


Figure 7. Hand-deployment of Satlantic 14 channel radiometer for measurements of downwelling irradiance and upwelling radiance. Screen capture of the radiometer data is also shown.

with the exception of the profiling FRRF, we were able to obtain replacement instruments to continue our measurements. Following the loss of the bio-optical package, replacement equipment were sent to St. Paul when both new scientific crew and USCG member were picked up in the island. Dr. Ian Walsh from Wetlabs put together and rushed a basic optical package to St. Paul. Dr. Ajit Subramaniam from LDEO shipped the Satlantic Profiling and surface reference multi-channel radiometers (Figure 6). These equipments were instrumental in our group being able to continue making optical measurements in the Bering Sea from 22 July till the end of the cruise. Over the period of the cruise we carried out around 46 optical deployments.

Operations with the replacement instruments commenced on 20th of July, St. LS1 onwards and continued until the 30th of July 2008. In addition to water column profiles of underwater light, one of the instruments that was part of the replacement was able to provide us with on-deck measurement of incoming solar irradiance at 14 different wavelengths.

*2) Underway measurements:*

A dual automated blue and green laser induction fluorometer (ALF) being developed at Lamont Doherty Earth Observatory by Dr. A. Chekalyuk, was serially interfaced with several other instruments fitted to the ship's underway system to obtain measurements of phytoplankton chlorophyll, a measure of major phytoplankton groups (diatoms, dinoflagellates, cryptophytes, cyanobacteria etc. based on specific pigment fluorescence signatures of each group) and variable fluorescence as the ship transected through different water types in the Bering Sea. The instrument also provided trends in Colored Dissolved Organic Matter (CDOM) along the cruise track when it was operated in underway mode. An illustration of data sets along the 70m-isobath is shown in Figure 6.

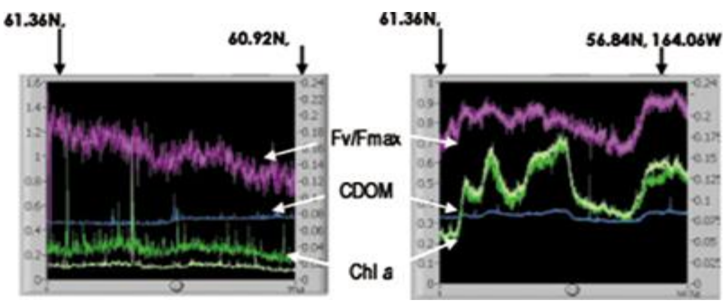



Figure 6. Screen capture of data generated by the ALF in underway mode along the 70m isobath line.

At a few select stations, the ALF was operated in discrete mode for quantifying the quantum efficiencies for photosynthesis of phytoplankton populations with depth in the water column. Figure 7 is an illustration dataset for Station SL14. These datasets will be processed further for identification of the major phytoplankton groups. At a few stations these data will be compared with HPLC pigment analysis and phytoplankton absorption spectra determined spectrophotometrically.

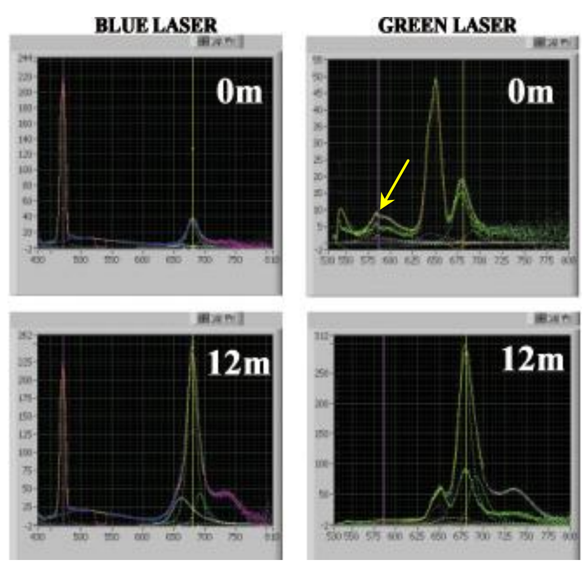



Figure7. Screen capture of data generated by the ALF for samples obtained at discrete depths at Station SL14. The arrow indicates the presence of phycoerythrin containing pigmented organisms in surface waters.

*3) Discrete stations:*

At select survey stations, water samples were collected for the following measurements: 1) Spectral absorption of CDOM using a shipboard hyperspectral waveguide capillary system 2) spectral absorbance by phytoplankton and detrital particles, 3) coccolithophore counts and calcium carbonate concentrations in separate aliquots of seawater samples filtered onto 0.4µm polycarbonate filters using microscopy and the inductively-coupled optical emission spectrometric technique respectively, 4) Pigment analysis by HPLC 5) suspended matter and POC estimates of material collected on pre-weighed GF/F filters (see Fig. 8 for sample data).

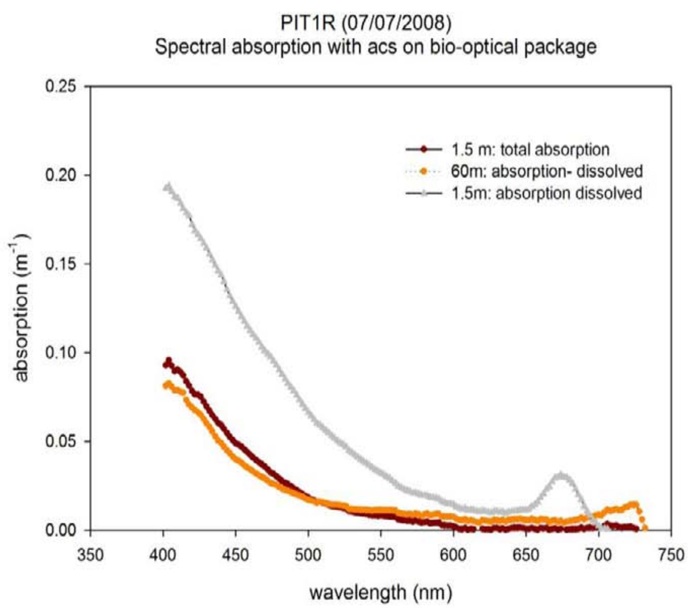



Figure 8. Absorption spectra of total particulate and CDOM measured by the ac-s at 1.5 and 60 m depths.

Anticipated outcome::

1) Development of more robust algorithms for estimating chlorophyll, primary productivity, CDOM, total suspended matter in the Bering Sea from satellite fields of ocean color data.

2) Maps showing the distribution of major summer-time phytoplankton communities and their physiological status.

### 9.16 *Science support activities* - Steve Roberts and Tom Bolmer

This is a brief summary of the performance of the Underway Science systems during the research cruise HLY0803 on the USCGC Healy, 07/03/08 – 07/31/08 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 HLY0803 has additional information.

**Acoustic Data**

***SeaBeam 2112 Multibeam Sonar***

The SeaBeam worked well for this leg. Frequent CTD's allowed us to keep the sound velocity profile valid. 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. Similar to an event in HLY0802 a brief power outage appears to have corrupted the Magneto Optical(MO) disk and the system was down for a couple of hours to identify the problem and replace the disk. These failures should serve as a reminder as to how fragile this system has become and the need for it to be replaced.

***Knudsen 320BR Sub-Bottom Profiler***

The Knudsen was run in the Low Frequency “CHIRP” (3 - 6 KHz) mode for most of the cruise. These data look good. The system was run briefly in 12KHz “CHIRP” mode to aide in the search for the lost optics package but in the few passes over the search area no indications of the package were observed. 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..

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

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

***ADCP 75***

Due to the cruise being primarily in shallow water and issue with both ADCP's interfering with each other the ADCP 75 was not operated for this leg.

***ADCP150***

The ADCP 150 was operated for the whole leg.

**Navigation**

***POS/MV-320***

The POSMV recorded the ship's position, heading, pitch and roll with no know issues during the cruise. It was noted that DGPS was utilized by the POS/MV for most of the cruise except for the extreme Northwest region.

***Ashtech ADU5***

The ADU5 operated well except for an occasional drop outs which are mostly logged in the ELOG. There were also events where the receiver stopped producing heading and attitude data even though the data streams remained active. Partway into the cruise antenna cabling problems caused the system to stop generating output for a short period of time. Be sure to check the ELOG entries if you are using this data.

***Sperry Gyro compasses***

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

**Sea Water Flow Through data**

***Uncontaminated Sea Water***

This seemed to work satisfactorily for HLY0803.

***Thermosalinographs***

New primary and a spare TSGs were installed by SIO/ODF (Scott Hiller) was installed for this season in the Biochem Lab. These appeared to operate satisfactorily. Be sure to look in the ELOG for ties when the Salinity values were adjusted.

***Dissolved Oxygen, Flurometer, and Flowmeter***

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

**Meteorological Sensors**

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

**Mapserver**

A web-based real-time GIS system (Mapserver) was actively maintained and kept up-to-date with the most current science cruise data and information. Included in this activity was the monitoring, downloading and processing of near real-time MODIS chlorophyll imagery.

**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 USB disk containing all the underway data along with various documentation was created and provided to the chief scientist.

***Data QC***

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

***Terrascan***

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

***Web Cameras***

Web cameras were operated in Aloft Con, Aft Con and the Board of Lies. Images from the cameras were logged on LDS. In addition once an hour an image from Aloft Con was emailed to shore for use in a web site there. The Aloft Con web camera was replaced with a wider angled lens camera mid way through the cruise. This replacement is working satisfactorily

## 9.17 Educational Activities

The two teachers on board, Jillian Worsssam (a high school teacher from Arizona supported by PolarTrek) and John Karavias (a high school science teacher from New York supported by Armada) managed several educational activities. By 'joining' various research groups, they familiarized themselves with science questions and methods. They then developed educational activities around these experiences. Some of these educational materials will require further development after the cruise. Some were shared with teachers on-shore via webinars originated from the ship.  The teachers also directed the outreach activities on St. George Island on July 11.  The arrangements were made beforehand with Michele Ridgeway, a marine geophysicists who has developed a summer Ocean Science Camp on the island (see letter in Appendix). The teachers and several scientists from the Healy took part in presentations and discussions with the students during a several hour visit.

# 10 Appendix – Event Log; Niskin water budget; Sample depths; Letter from Michele Ridgeway

| Stn.# | Station Name | Event Type | Cast# | CTD Type | Time in Water (UTC) | Time on Deck (UTC) | Start Lat. | Start Long. | End Lat. | End Long. | Start Depth (m) | End Depth (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | UP1 | CTD | 1 | Standard | 7/4/08 2:08 | 7/4/08 2:21 | 54.30889 | 165.3536 | 54.31361 | 165.3634 | 80 | 78 | Unimak Pass 1/start; end |
| 1 | UP1 | BIO-OPTICS | | | 7/4/08 2:50 | 7/4/08 3:05 | 54.3087 | 165.3533 | 54.3075 | 165.3538 | 78 | 76 | |
| 1 | UP1 | MOC | | | 7/4/08 3:22 | 7/4/08 3:56 | 54.3166 | 165.379 | 54.3082 | 165.3549 | 60 | 60 | |
| 2 | UP2 | CTD | 2 | Standard | 7/4/08 6:18 | 7/4/08 6:41 | 54.38532 | 165.1988 | 54.39121 | 165.1966 | 174 | 174 | UP2 (Unimak Pass); Unimak Pass |
| 2 | UP2 | MOC | | | 7/4/08 6:55 | 7/4/08 7:33 | 54.3942 | 165.1927 | 54.4095 | 165.177 | 100 | 100 | |
| 3 | UP4 | CTD | 3 | Standard | 7/4/08 8:40 | 7/4/08 8:50 | 54.48513 | 164.9593 | 54.48359 | 164.9572 | 86 | 76 | start; end |
| 3 | UP4 | MOC | | | 7/4/08 9:02 | 7/4/08 9:33 | 54.4803 | 164.9563 | 54.4679 | 164.972 | 70 | 70 | |
| 4 | UP3 | CTD | 4 | Standard | 7/4/08 10:20 | 7/4/08 10:35 | 54.41903 | 165.139 | 54.4216 | 165.1465 | 135 | 135 | start intermediate station; end |
| 4 | UP3 | BONGO | 1 | | 7/4/08 10:54 | 7/4/08 11:04 | 54.4225 | 165.1481 | 54.4225 | 165.1481 | 137 | 137 | Dark. Oblique tow. |
| 4 | UP3 | CTD | 5 | Zoop | 7/4/08 11:14 | 7/4/08 11:22 | 54.42841 | 165.1503 | 54.43097 | 165.156 | 135 | 135 | Zooplankton; end |
| 4 | UP3 | MOC | | | 7/4/08 11:38 | 7/4/08 12:20 | 54.4315 | 165.1535 | 54.4261 | 165.1534 | 100 | 100 | |
| 4 | UP3 | CTD | 6 | Radon | 7/4/08 13:07 | 7/4/08 13:24 | 54.42849 | 165.1432 | 54.44013 | 165.1576 | 130 | 133 | sta 4:start radon cast; end |
| 4 | UP3 | MCORE | 1 | | 7/4/08 14:15 | 7/4/08 14:25 | 54.4217 | 165.1387 | 54.4216 | 165.1394 | 132 | 133 | Eight tubes rigged.... very coarse sandy sediment... some shell hash...20m/min up and down. Time on Deck / End Position = Time / Position of core on bottom ! |
| 4 | UP3 | MCORE | 2 | | 7/4/08 14:52 | 7/4/08 15:00 | 54.4219 | 165.1406 | 54.4217 | 165.1412 | 133 | 133 | Four tubes rigged.. very coarse sandy sediment..some shell hash..20m/min up and down..~20cms sed .. 3.5 Knot current. Time on Deck / End Position = Time / Position of core on bottom ! |
| 4 | UP3 | CTD | 7 | Prod | 7/4/08 15:36 | 7/4/08 15:54 | 54.43815 | 165.1411 | 54.44498 | 165.143 | 123 | 122 | start; end |
| 4 | UP3 | BIO-OPTICS | | | 7/4/08 16:50 | 7/4/08 17:10 | 54.352 | 165.138 | 54.3517 | 165.1375 | 138 | 135 | |
| 5 | UAP8 | CTD | 8 | Standard | 7/4/08 19:05 | 7/4/08 19:25 | 54.86988 | 165.2357 | 54.87356 | 165.2335 | 124 | 125 | start; end nsta 05 |
| 5 | UAP8 | BIO-OPTICS | | | 7/4/08 19:29 | 7/4/08 19:50 | 54.8759 | 165.232 | 54.876 | 165.2477 | 124 | 125 | |
| 5 | UAP8 | MOC | | | 7/4/08 20:25 | 7/4/08 20:56 | 54.8728 | 165.2534 | 54.8608 | 165.244 | 100 | 100 | |
| 6 | UAP7 | MOC | | | 7/4/08 23:13 | 7/4/08 23:42 | 55.0818 | 164.8218 | 55.0894 | 164.8065 | 90 | 90 | |
| 7 | UAP6 | CTD | 9 | Standard | 7/5/08 1:35 | 7/5/08 1:47 | 55.30527 | 164.3981 | 55.30404 | 164.3975 | 100 | 100 | start nsta 07 no ctd at uap7 |
| 7 | UAP6 | BIO-OPTICS | | | 7/5/08 1:55 | 7/5/08 2:20 | 55.3008 | 164.3963 | 55.2993 | 164.3958 | 100 | 102 | |
| 7 | UAP6 | MOC | | | 7/5/08 2:31 | 7/5/08 3:05 | 55.3016 | 164.3954 | 55.3138 | 164.363 | 80 | 80 | |
| 8 | UAP5 | MOC | | | 7/5/08 5:19 | 7/5/08 5:48 | 55.5296 | 163.9713 | 55.5491 | 163.9496 | 75 | 75 | |
| 9 | UAP4 | MOC | | | 7/5/08 7:37 | 7/5/08 8:08 | 55.7538 | 163.5531 | 55.773 | 163.5388 | 80 | 80 | |
| 9 | UAP4 | MCORE | 1 | | 7/5/08 8:39 | 7/5/08 8:43 | 55.7617 | 163.5311 | 55.7617 | 163.5312 | 92 | 92 | 8 good cores ... ~20cm penetration..well sorted fine grained silty sand...SOG=0.2kts...2900lb pullout at 20m/min in and out. Time on Deck / End Position = Time / Position of core on bottom ! |
| 9 | UAP4 | MCORE | 2 | | 7/5/08 9:24 | 7/5/08 9:29 | 55.7592 | 163.5263 | 55.7592 | 163.5264 | 93 | 93 | 8 good cores ... ~20cm penetration..well sorted fine grained silty sand...SOG=0.2kts...4109lb pullout at 20m/min in and out. Time on Deck / End Position = Time / Position of core on bottom ! |
| 10 | UAP3 | CTD | 10 | Standard | 7/5/08 11:38 | 7/5/08 11:52 | 55.96388 | 163.1384 | 55.96687 | 163.139 | 87 | 87 | Standard cast Station 10; end sta 10 |
| 10 | UAP3 | BONGO | 2 | | 7/5/08 12:00 | 7/5/08 12:10 | 55.9673 | 163.1394 | 55.9673 | 163.1394 | 88 | 88 | Oblique tow. Dark but with visible horizon. |
| 10 | UAP3 | MOC | | | 7/5/08 12:27 | 7/5/08 12:59 | 55.9769 | 163.144 | 55.9933 | 163.1484 | 70 | 70 | |
| 11 | CN6 | CTD | 11 | Standard | 7/5/08 19:30 | 7/5/08 19:41 | 57.00016 | 163.8993 | 57.00043 | 163.9005 | 70 | 70 | start sta 12; end |
| 11 | CN6 | BIO-OPTICS | | | 7/5/08 19:55 | 7/5/08 20:20 | 57.001 | 163.9025 | 56.9991 | 163.904 | 69 | 70 | |
| 11 | CN6 | MOC | | | 7/5/08 20:28 | 7/5/08 20:55 | 56.9994 | 163.8889 | 57.0135 | 163.8901 | 55 | 55 | |
| 11 | CN6 | CTD | 12 | Prod | 7/5/08 21:18 | 7/5/08 21:32 | 57.00125 | 163.9052 | 57.00023 | 163.9107 | 70 | 70 | Start Prod cast; the real end for ctd12 |
| 11 | CN6 | CALVET | | | 7/5/08 21:53 | 7/5/08 21:54 | 56.9971 | 163.9112 | 56.9972 | 163.9113 | 68 | 68 | |
| 12 | CN8 | CTD | 13 | Standard | 7/6/08 0:16 | 7/6/08 0:27 | 56.70394 | 164.511 | 56.70218 | 164.5149 | 70 | 70 | Start station 12;ctd13; end ctd 13 |
| 12 | CN8 | BIO-OPTICS | 2 | | 7/6/08 0:35 | 7/6/08 1:00 | 56.7021 | 164.5152 | 56.6968 | 164.53 | 75 | 80 | |
| 12 | CN8 | CALVET | | | 7/6/08 1:19 | 7/6/08 1:20 | 56.69666 | 164.5303 | 56.69695 | 164.5302 | 70 | 70 | |
| 12 | CN8 | MOC | | | 7/6/08 1:22 | 7/6/08 1:50 | 56.69845 | 164.5296 | 56.71634 | 164.5288 | 55 | 55 | |
| 13 | CN10 | CTD | 14 | Standard | 7/6/08 5:02 | 7/6/08 5:17 | 56.43049 | 165.3034 | 56.43142 | 165.3025 | 85 | 85 | start ctd14; end ctd 14 |
| 13 | CN10 | BIO-OPTICS | | | 7/6/08 5:25 | 7/6/08 5:50 | 56.4301 | 165.3011 | 56.4323 | 165.294 | 85 | 83 | |
| 13 | CN10 | CALVET | | | 7/6/08 6:07 | 7/6/08 6:12 | 56.43129 | 165.2817 | 56.43156 | 165.2809 | 84 | 84 | |
| 13 | CN10 | MCORE | 1 | | 7/6/08 6:41 | 7/6/08 6:44 | 56.4301 | 165.2765 | 56.4301 | 165.2766 | 84 | 84 | 8 tubes rigged - no useable samples... disturbed and uneven core penetration (max=~12cms).. possible hard pan / dense clay layer beneath. Time on Deck / End Position = Time / Position of core on bottom ! |
| 13 | CN10 | MCORE | 2 | | 7/6/08 7:08 | 7/6/08 7:12 | 56.4297 | 165.2767 | 56.4297 | 165.2767 | 83 | 83 | 8 tubes rigged - no useable samples... disturbed and uneven core penetration (max=~12cms).. possible hard pan / dense clay layer beneath.. this time in at 20m/min and slower pullout at 10m/min with low 1263 lb pullout tension ! MC hydraulics tested OK. Time on Deck / End Position = Time / Position of core on bottom ! |
| 14 | CN12 | CTD | 15 | Standard | 7/6/08 9:56 | 7/6/08 10:13 | 56.13798 | 166.1061 | 56.13811 | 166.106 | 109 | 109 | start sta014; end sta014 |
| 14 | CN12 | BONGO | 3 | | 7/6/08 10:50 | 7/6/08 11:00 | 56.1389 | 166.1075 | 56.1389 | 166.1075 | 110 | 110 | Dark with visible horizon |
| 14 | CN12 | CTD | 16 | Zoop | 7/6/08 10:59 | 7/6/08 11:04 | 56.145667 | 166.1115 | 56.145667 | 166.1115 | 136 | 136 | start/log overwritten; from ctd file; end/log overwritten; from ctd file |
| 14 | CN12 | CALVET | | | 7/6/08 11:10 | 7/6/08 11:20 | 56.13798 | 166.1061 | 56.13798 | 166.1061 | 100 | 100 | |
| 15 | CN14 | CTD | 17 | Standard | 7/6/08 13:33 | 7/6/08 13:53 | 55.84761 | 166.9038 | 55.84165 | 166.9062 | 136 | 136 | start sta015; end sta 015 |
| 15 | CN14 | CALVET | | | 7/6/08 13:55 | 7/6/08 14:05 | 55.84761 | 166.9038 | 55.84761 | 166.9038 | 100 | 100 | |
| 15 | CN14 | MOC | | | 7/6/08 14:17 | 7/6/08 14:53 | 55.8376 | 166.9099 | 55.8552 | 166.9353 | 100 | 100 | |
| 16 | PIT1D | SEDTRAPS | | | 7/6/08 19:24 | 7/7/08 19:20 | 55.2878 | 167.9415 | 55.2213 | 168.0373 | 330 | 877 | First PIT deployment |
| 16 | PIT1D | CTD | 18 | Prod | 7/6/08 19:48 | 7/6/08 20:17 | 55.28054 | 167.9276 | 55.26851 | 167.9217 | 368 | 368 | start ctd18 prod at PIT1; end |
| 16 | PIT1D | BIO-OPTICS | | | 7/6/08 20:30 | 7/6/08 21:00 | 55.2627 | 167.9188 | 55.2472 | 167.9097 | 370 | 375 | |
| 17 | CN18 | CTD | 19 | Standard | 7/6/08 23:06 | 7/7/08 0:42 | 55.30736 | 168.4149 | 55.3037 | 168.4242 | 1665 | 1665 | First deep cast; end ctd 19 |
| 17 | CN18 | BIO-OPTICS | | | 7/7/08 1:20 | 7/7/08 1:50 | 55.3013 | 168.4012 | 55.3017 | 168.383 | 1658 | 1655 | |
| 17 | CN18 | CTD | 20 | Radon | 7/7/08 1:53 | 7/7/08 2:09 | 55.29724 | 168.3904 | 55.29489 | 168.3832 | 1602 | 1602 | Start radon; end ctd 20 radon |
| 17 | CN18 | CTD | 20 | Radon | 7/7/08 1:53 | 7/7/08 2:09 | 55.298 | 168.3918 | 55.298 | 168.3918 | 1614 | 1614 | Radon and O2 isotopes. Cast to 70m (10 bottles for Rn; 1 for O2; one other) |
| 17 | CN18 | CALVET | | | 7/7/08 2:22 | 7/7/08 2:26 | 55.29159 | 168.3838 | 55.29067 | 168.3862 | 100 | 100 | |
| 17 | CN18 | CTD | 21 | Standard | 7/7/08 2:52 | 7/7/08 3:07 | 55.2979 | 168.3954 | 55.29782 | 168.3953 | 1602 | 1602 | start shallow part of standard cast; end shallow part CN18 |

| Stn.# | Station Name | Event Type | Cast# | CTD Type | Time in Water (UTC) | Time on Deck (UTC) | Start Lat. | Start Long. | End Lat. | End Long. | Start Depth (m) | End Depth (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | CN18 | MCORE | 1 | | 7/7/08 3:25 | 7/7/08 4:15 | 55.3047 | 168.3974 | 55.3061 | 168.3922 | 1625 | 1622 | Eight tubes rigged.... eight good samples... approx. 25-30 cms penetration. Time on Deck / End Position = Time / Position of core on bottom ! |
| 17 | CN18 | MCORE | 2 | | 7/7/08 5:12 | 7/7/08 5:58 | 55.3058 | 168.3984 | 55.3075 | 168.3973 | 1634 | 1630 | Eight good samples... approx. 25-30 cms penetration. Wire out at core trip = 1680 meters. Time on Deck / End Position = Time / Position of core on bottom ! |
| 17 | CN18 | MOC | | | 7/7/08 7:07 | 7/7/08 7:26 | 55.3115 | 168.401 | 55.32093 | 168.4038 | 100 | 100 | |
| 18 | CN16 | MOC | | | 7/7/08 10:05 | 7/7/08 10:42 | 55.5479 | 167.7002 | 55.56395 | 167.7036 | 100 | 100 | |
| 18 | CN16 | CTD | 22 | Standard | 7/7/08 10:46 | 7/7/08 11:04 | 55.56375 | 167.7035 | 55.5622 | 167.7029 | 137 | 137 | start; end |
| 18 | CN16 | BONGO | 4 | | 7/7/08 11:10 | 7/7/08 11:20 | 55.5626 | 167.7023 | 55.5626 | 167.7029 | 136 | 136 | Dark with visible horizon |
| 18 | CN16 | CALVET | | | 7/7/08 11:19 | 7/7/08 11:24 | 55.5614 | 167.7037 | 55.56114 | 167.7042 | 100 | 100 | |
| 18 | CN16 | CTD | 23 | Zoop | 7/7/08 11:44 | 7/7/08 11:50 | 55.56882 | 167.7133 | 55.56878 | 167.7142 | 138 | 137 | start; end |
| 19 | X1 | MOC | | | 7/7/08 13:17 | 7/7/08 13:47 | 55.36894 | 167.8376 | 55.38552 | 167.8542 | 100 | 100 | |
| 20 | X2 | MOC | | | 7/7/08 15:06 | 7/7/08 15:34 | 55.23441 | 167.9428 | 55.24823 | 167.9574 | 100 | 100 | |
| 20 | X2 | CTD | 24 | Prod | 7/7/08 15:48 | 7/7/08 16:30 | 55.25 | 167.9295 | 55.24462 | 167.9624 | 502 | 511 | start; end |
| 21 | PIT1R | BIO-OPTICS | | | 7/7/08 19:55 | 7/7/08 20:15 | 55.2226 | 168.0087 | 55.2213 | 167.9895 | 740 | 668 | |
| 21 | PIT1R | BIO-OPTICS | | | 7/7/08 20:25 | 7/7/08 20:44 | 55.2226 | 168.0087 | 55.2213 | 167.9895 | 740 | 668 | |
| 22 | CNN8 | CTD | 25 | Standard | 7/8/08 1:38 | 7/8/08 2:23 | 56.1495 | 168.70367 | 56.1495 | 168.70367 | 457 | 457 | start; end |
| 22 | CNN8 | BIO-OPTICS | | | 7/8/08 2:31 | 7/8/08 3:20 | 56.1435 | 168.7227 | 56.1412 | 168.7408 | 484 | 501 | |
| 22 | CNN8 | BIO-OPTICS | | | 7/8/08 3:00 | 7/8/08 3:20 | 56.1435 | 168.7227 | 56.1411 | 168.7408 | 484 | 501 | |
| 22 | CNN8 | CALVET | | | 7/8/08 3:33 | 7/8/08 3:39 | 56.14161 | 168.7432 | 56.14241 | 168.7432 | 100 | 100 | |
| 22 | CNN8 | MOC | | | 7/8/08 3:50 | 7/8/08 4:24 | 56.14563 | 168.7358 | 56.15405 | 168.7139 | 100 | 100 | |
| 23 | CNN7 | MOC | | | 7/8/08 6:44 | 7/8/08 7:33 | 56.4523 | 168.2826 | 56.49494 | 168.2223 | 100 | 100 | |
| 24 | CNN6 | CTD | 26 | Standard | 7/8/08 9:43 | 7/8/08 9:57 | 56.73652 | 167.8463 | 56.7351 | 167.8456 | 95 | 95 | start standard cast; end |
| 24 | CNN6 | CALVET | | | 7/8/08 10:04 | 7/8/08 10:08 | 56.73436 | 167.8446 | 56.73382 | 167.8441 | 98 | 98 | |
| 24 | CNN6 | BONGO | 5 | | 7/8/08 10:20 | 7/8/08 10:30 | 56.7344 | 167.8446 | 56.7344 | 167.8446 | 100 | 100 | Time of tow close to local midnight. Light level more like twilight. |
| 24 | CNN6 | MOC | | | 7/8/08 10:51 | 7/8/08 11:06 | 56.75302 | 167.855 | 56.76021 | 167.8578 | 98 | 98 | |
| 24 | CNN6 | MCORE | 1 | | 7/8/08 11:28 | 7/8/08 11:32 | 56.7623 | 167.8619 | 56.7618 | 167.8619 | 99 | 99 | Six tubes rigged.... six good samples... approx. 25-30 cms penetration. 1465 lb pullout. End time/position = time / position of core on the bottom. |
| 24 | CNN6 | MCORE | 2 | | 7/8/08 11:45 | 7/8/08 11:48 | 56.7613 | 167.8627 | 56.7613 | 167.8628 | 100 | 100 | Six tubes rigged.... six good samples... approx. 25-30 cms penetration. 2087 lb pullout. End time/position = time / position of core on the bottom. |
| 25 | NP2/S40 | CTD | 27 | Standard | 7/8/08 22:01 | 7/8/08 22:07 | 59.13982 | 167.9795 | 59.13965 | 167.9794 | 41 | 41 | start ctd27 mooring S40; end ctd27 |
| 25 | NP2/S40 | MOORING | 27 | Standard | 7/8/08 22:23 | 7/8/08 22:23 | 59.1363 | 167.9823 | 59.1363 | 167.9823 | 42 | 42 | Mooring Deployment; recover in 2009 |
| 26 | S25 | CTD | 28 | Standard | 7/9/08 6:17 | 7/9/08 6:21 | 59.85111 | 167.7826 | 59.85105 | 167.7823 | 27 | 27 | start ctd 28 mooring 25; end ctd 28 |
| 26 | S25 | MOORING | | | 7/9/08 6:30 | 7/9/08 6:30 | 59.8515 | 167.7814 | 59.8515 | 167.7814 | 26 | 26 | Recover in 2009 |
| 27 | MN1 | CTD | 29 | Standard | 7/9/08 7:28 | 7/9/08 7:33 | 59.89789 | 167.9956 | 59.89762 | 167.9937 | 29 | 29 | start ctd29; end ctd 29 |
| 27 | MN1 | CALVET | | | 7/9/08 7:39 | 7/9/08 7:43 | 59.89764 | 167.9911 | 59.89763 | 167.9899 | 28 | 28 | |
| 27 | MN1 | MOC | | | 7/9/08 7:53 | 7/9/08 8:04 | 59.89611 | 167.99 | 59.89355 | 167.9904 | 15 | 15 | |
| 28 | MN2 | CTD | 30 | Standard | 7/9/08 10:08 | 7/9/08 10:14 | 59.90182 | 168.5977 | 59.90231 | 168.5934 | 39 | 39 | start ctd 30; end ctd 030 |
| 28 | MN2 | CALVET | | | 7/9/08 10:20 | 7/9/08 10:23 | 59.90252 | 168.5898 | 59.9025 | 168.5884 | 38 | 38 | |
| 28 | MN2 | BONGO | 6 | | 7/9/08 10:30 | 7/9/08 10:40 | 59.9025 | 168.5882 | 59.9025 | 168.5882 | 41 | 41 | Close to local midnight; but horizon easily visible. |
| 28 | MN2 | CTD | 31 | Zoop | 7/9/08 10:47 | 7/9/08 10:51 | 59.89662 | 168.582 | 59.89631 | 168.5806 | 40 | 40 | Start zoop cast; end zoop cast |
| 28 | MN2 | MOC | | | 7/9/08 10:59 | 7/9/08 11:19 | 59.8951 | 168.579 | 59.88216 | 168.5699 | 25 | 25 | |
| 29 | MN3 | CTD | 32 | Standard | 7/9/08 13:33 | 7/9/08 13:41 | 59.89606 | 169.2007 | 59.8961 | 169.1987 | 45 | 45 | start: ctd032; end ctd032 |
| 29 | MN3 | CALVET | | | 7/9/08 13:51 | 7/9/08 13:55 | 59.89625 | 169.1964 | 59.8963 | 169.1956 | 44 | 44 | |
| 29 | MN3 | MOC | | | 7/9/08 14:09 | 7/9/08 14:20 | 59.89219 | 169.1879 | 59.88707 | 169.1806 | 44 | 44 | |
| 29 | MN3 | CTD | 33 | Prod | 7/9/08 14:57 | 7/9/08 15:08 | 59.89681 | 169.1991 | 59.89642 | 169.1982 | 45 | 45 | start ctd033; end ctd033 |
| 30 | MN4 | CTD | 34 | Standard | 7/9/08 17:06 | 7/9/08 17:14 | 59.89571 | 169.8055 | 59.89319 | 169.8073 | 52 | 52 | start ctd 34; end ctd 034 |
| 30 | MN4 | CALVET | | | 7/9/08 17:25 | 7/9/08 17:35 | 59.89245 | 169.8086 | 59.89167 | 169.8089 | 54 | 54 | |
| 30 | MN4 | MOC | | | 7/9/08 17:43 | 7/9/08 17:59 | 59.8923 | 169.8087 | 59.88385 | 169.8142 | 40 | 40 | |
| 31 | MN5 | CTD | 35 | Radon | 7/9/08 20:09 | 7/9/08 20:21 | 59.90223 | 170.3931 | 59.90411 | 170.3922 | 64 | 64 | Start radon cast; end ctd 34 radon |
| 31 | MN5 | CALVET | | | 7/9/08 20:27 | 7/9/08 20:31 | 59.90531 | 170.3923 | 59.90674 | 170.3914 | 60 | 60 | |
| 31 | MN5 | MCORE | 1 | | 7/9/08 20:59 | 7/9/08 21:01 | 59.8992 | 170.3979 | 59.8999 | 170.3971 | 62 | 63 | 6 tubes rigged.. 5 samples recovered.. one empty...SOG>1.6kts during cast...core probably tipped over during pullout with wire angle to starboard. 1918 lb pullout .. ~25cm uneven penetration. Time / pos'n on deck = time / pos'n of core on bottom. |
| 31 | MN5 | MCORE | 2 | | 7/9/08 21:20 | 7/9/08 21:24 | 59.9017 | 170.3946 | 59.9025 | 170.3945 | 62 | 63 | 8 tubes rigged.. 8 samples recovered.SOG=0.4kts during cast...good wire angle 2157 lb pullout .. 28cm penetration into soft mud / clay. Time / pos'n on deck = time / pos'n of core on bottom. |
| 31 | MN5 | MOC | | | 7/9/08 22:05 | 7/9/08 22:17 | 59.89476 | 170.4081 | 59.89469 | 170.4189 | 50 | 50 | |
| 32 | MN6 | CTD | 36 | Standard | 7/10/08 0:28 | 7/10/08 0:37 | 59.89837 | 170.9988 | 59.89635 | 170.9931 | 71 | 71 | Start ctd36; end cast 36 |
| 32 | MN6 | CALVET | | | 7/10/08 0:45 | 7/10/08 0:56 | 59.89633 | 170.9883 | 59.8965 | 170.9852 | 69 | 69 | |
| 32 | MN6 | MOC | | | 7/10/08 1:21 | 7/10/08 1:39 | 59.90061 | 170.9917 | 59.90846 | 171.0057 | 55 | 55 | |
| 33 | MN7 | CTD | 37 | Standard | 7/10/08 4:05 | 7/10/08 4:16 | 59.90108 | 171.6033 | 59.89986 | 171.6068 | 70 | 70 | start ctd37; end ctd 37 |
| 33 | MN7 | CALVET | | | 7/10/08 4:31 | 7/10/08 4:37 | 59.90009 | 171.613 | 59.90077 | 171.6138 | 74 | 68 | |
| 33 | MN7 | MOC | | | 7/10/08 4:47 | 7/10/08 5:09 | 59.90214 | 171.6191 | 59.90751 | 171.6445 | 55 | 55 | |
| 34 | MN8 | CTD | 38 | Standard | 7/10/08 8:36 | 7/10/08 8:48 | 59.90001 | 172.2239 | 59.89899 | 172.2275 | 72 | 72 | start CTD38; end ctd 038 |
| 34 | MN8 | CALVET | | | 7/10/08 8:58 | 7/10/08 9:04 | 59.89809 | 172.231 | 59.89725 | 172.2303 | 72 | 72 | |
| 34 | MN8 | MOC | | | 7/10/08 9:15 | 7/10/08 9:39 | 59.89194 | 172.2408 | 59.88066 | 172.2545 | 60 | 60 | |
| 35 | W7 | CTD | 39 | Standard | 7/10/08 13:15 | 7/10/08 13:26 | 60.0043 | 171.0909 | 60.0018 | 171.093 | 71 | 71 | start ctd 039; end ctd 039 |
| 35 | W7 | BONGO | 7 | | 7/10/08 13:40 | 7/10/08 13:50 | 60 | 171.0919 | 60.0033 | 171.0919 | 70 | 70 | Pretty light out. |
| 35 | W7 | CALVET | | | 7/10/08 13:55 | 7/10/08 14:02 | 59.99196 | 171.1072 | 59.99191 | 171.1074 | 65 | 65 | |
| 35 | W7 | CTD | 40 | Zoop | 7/10/08 14:05 | 7/10/08 14:13 | 59.99116 | 171.1085 | 59.98862 | 171.1096 | 71 | 71 | start ctd 040; end ctd 40 |
| 36 | W6 | CTD | 41 | Standard | 7/10/08 16:35 | 7/10/08 16:46 | 60.10216 | 170.4615 | 60.10133 | 170.4579 | 62 | 62 | start ctd 41; end ctd 41 |
| 36 | W6 | CALVET | | | 7/10/08 16:52 | 7/10/08 17:04 | 60.10144 | 170.4563 | 60.10144 | 170.4563 | 60 | 60 | |
| 37 | W5/C55 | CTD | 42 | Prod | 7/10/08 18:29 | 7/10/08 18:39 | 60.17075 | 170.0675 | 60.17102 | 170.0667 | 56 | 56 | start ctd 042; end ctd 042 |
| 37 | W5/C55 | MOORING | | | 7/10/08 19:23 | 7/10/08 19:23 | 60.1723 | 170.0885 | 60.1723 | 170.0885 | 55 | 55 | Mooring was recovered and re-deployed as station 43. Use those data for actual position |
| 38 | W4/C40 | CTD | 43 | Standard | 7/10/08 23:16 | 7/10/08 23:21 | 60.33943 | 169.0222 | 60.33942 | 169.0213 | 40 | 40 | start ctd43 mooring; end c-40 ctd |

| Stn.# | Station Name | Event Type | Cast# | CTD Type | Time in Water (UTC) | Time on Deck (UTC) | Start Lat. | Start Long. | End Lat. | End Long. | Start Depth (m) | End Depth (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 38 | W4/C40 | MOORING | 43 | Standard | 7/10/08 23:34 | 7/10/08 23:34 | 60.3367 | 169.0211 | 60.3367 | 169.0211 | 40.5 | 40.5 | Deployment; recover in 2009 |
| 39 | W1/C25 | CTD | 44 | Standard | 7/11/08 5:04 | 7/11/08 5:08 | 60.68194 | 167.336 | 60.68235 | 167.3368 | 26 | 26 | start ctd44 mooring c25; end ctd44 m c25 |
| 39 | W1/C25 | MOORING | 44 | Standard | 7/11/08 5:16 | 7/11/08 5:16 | 60.6827 | 167.3376 | 60.6827 | 167.3376 | 25 | 25 | Mooring Deployment; recover in 2009 |
| 40 | W2 | CTD | 45 | Standard | 7/11/08 7:46 | 7/11/08 7:52 | 60.49339 | 168 | 60.49289 | 167.9998 | 30 | 30 | start ctd45; end ctd45 |
| 40 | W2 | BONGO | 8 | | 7/11/08 8:05 | 7/11/08 8:15 | 60.4936 | 168 | 60.4936 | 168 | 30 | 30 | Essentially daylight |
| 41 | W3 | CTD | 46 | Standard | 7/11/08 10:10 | 7/11/08 10:16 | 60.40015 | 168.6195 | 60.40018 | 168.6174 | 36 | 36 | start ctd 46; end ctd 46 |
| 41 | W3 | CALVET | | | 7/11/08 10:24 | 7/11/08 10:29 | 60.40029 | 168.6142 | 60.39956 | 168.6119 | 36 | 36 | |
| 41 | W3 | BONGO | 9 | | 7/11/08 10:32 | 7/11/08 10:42 | 60.4001 | 168.6204 | 60.4001 | 168.6204 | 35 | 35 | Dark |
| 41 | W3 | CTD | 47 | Zoop | 7/11/08 10:50 | 7/11/08 10:54 | 60.39548 | 168.6011 | 60.39529 | 168.5996 | 36 | 36 | start zoops cast (46); end zoops cast |
| 42 | W4.5 | CTD | 48 | Prod | 7/11/08 14:07 | 7/11/08 14:17 | 60.25412 | 169.5699 | 60.25451 | 169.5684 | 48 | 48 | start ctd 48/prod also; end ctd 48 |
| 42 | W4.5 | CALVET | | | 7/11/08 14:29 | 7/11/08 14:35 | 60.25502 | 169.5659 | 60.25751 | 169.564 | 47 | 47 | |
| 43 | C55 | MOORING | | | 7/11/08 19:51 | 7/11/08 19:51 | 60.1719 | 170.0895 | 60.1719 | 170.0895 | 55 | 55 | Mooring will be recovered in 2009 |
| 44 | SL6.5/N5 | CTD | 49 | Standard | 7/12/08 4:32 | 7/12/08 4:40 | 61.96651 | 171.9437 | 61.96926 | 171.9417 | 55 | 55 | start ctd49(moor n55); end ctd49 |
| 44 | SL6.5/N5 | CALVET | | | 7/12/08 4:48 | 7/12/08 4:52 | 61.96975 | 171.9436 | 61.96989 | 171.9429 | 54 | 54 | |
| 44 | SL6.5/N5 | MOORING | 49 | Standard | 7/12/08 5:31 | 7/12/08 5:31 | 61.9619 | 171.9748 | 61.9619 | 171.9748 | 54 | 54 | Mooring Deployment; recover in 2009 |
| 45 | SL7.5 | CTD | 50 | Standard | 7/12/08 7:02 | 7/12/08 7:10 | 62.12497 | 172.0001 | 62.12396 | 171.9976 | 52 | 53 | start: ctd50/sta 45; end |
| 45 | SL7.5 | CALVET | | | 7/12/08 7:16 | 7/12/08 7:19 | 62.12297 | 171.9957 | 62.12254 | 171.9939 | 51 | 51 | |
| 45 | SL7.5 | MOC | | | 7/12/08 7:34 | 7/12/08 7:53 | 62.11471 | 171.9844 | 62.10329 | 171.9797 | 51 | 51 | |
| 46 | SL8 | CTD | 51 | Standard | 7/12/08 10:06 | 7/12/08 10:19 | 62.20331 | 172.7012 | 62.20625 | 172.7052 | 58 | 58 | start ctd 51; end ctd 51/sta 46 |
| 46 | SL8 | CTD | 51 | Radon | 7/12/08 10:08 | 7/12/08 10:08 | 61.2033 | 172.7012 | 61.2033 | 172.7012 | 58 | 58 | Radon and triple O2 isotopes collected during standard cast |
| 46 | SL8 | CALVET | | | 7/12/08 10:33 | 7/12/08 10:40 | 62.20931 | 172.7101 | 62.20932 | 172.7101 | 54 | 54 | |
| 46 | SL8 | BONGO | 10 | | 7/12/08 10:45 | 7/12/08 10:55 | 62.2098 | 172.7108 | 62.2098 | 172.7108 | 58 | 58 | Basically twlight |
| 46 | SL8 | MCORE | 1 | | 7/12/08 11:15 | 7/12/08 11:19 | 62.2018 | 172.7127 | 62.2088 | 172.7138 | 58 | 58 | Eight tubes rigged... extremely erratic pullout wire angle to starboard.. 7 knot wind on starboard beam. all eight samples disturbed -- discarded eight samples for re-try.End time/pos'n = time/position of core on bottom. |
| 46 | SL8 | MCORE | 2 | | 7/12/08 11:41 | 7/12/08 11:44 | 62.2033 | 172.7133 | 62.2038 | 172.7136 | 58 | 58 | Eight tubes rigged. very slight pullout wire angle to starboard. 7 knot wind on starboard beam. One minute bottom time with 6 of 8 suitable samples. 1684lb pullout - 1 min on bottom. 25 -30 cms penetration. End time/pos'n = time/pos'n of core on bottom. |
| 46 | SL8 | MCORE | 3 | | 7/12/08 12:00 | 7/12/08 12:03 | 62.205 | 172.7096 | 62.2054 | 172.7088 | 58 | 58 | Eight tubes rigged. very slight pullout wire angle to starboard. 7 knot wind on starboard beam. One minute bottom time with 6 of 8 suitable samples. 2297 lb pullout - 1 min on bottom. 25 -30 cms penetration. End time/pos'n = time/pos'n of core on bottom. |
| 46 | SL8 | CTD | 52 | Prod | 7/12/08 12:19 | 7/12/08 12:34 | 62.20405 | 172.701 | 62.20543 | 172.6964 | 58 | 58 | start ctd 52/sta 46; end: ctd 52/sta 46 |
| 47 | SL5.5 | CTD | 53 | Standard | 7/12/08 18:19 | 7/12/08 18:27 | 61.98258 | 170.6022 | 61.98217 | 170.6015 | 49 | 49 | start ctd 053/sta 47; end ctd 53 |
| 47 | SL5.5 | CALVET | | | 7/12/08 18:34 | 7/12/08 18:38 | 61.98202 | 170.6009 | 61.98222 | 170.6006 | 48 | 48 | |
| 47 | SL5.5 | MOC | | | 7/12/08 18:50 | 7/12/08 19:07 | 61.98039 | 170.5979 | 61.97137 | 170.5923 | 48 | 48 | |
| 48 | SL4.5 | CTD | 54 | Standard | 7/12/08 21:12 | 7/12/08 21:19 | 61.91449 | 169.9004 | 61.91449 | 169.9004 | 46 | 46 | start ctd54; end ctd54 |
| 48 | SL4.5 | CALVET | | | 7/12/08 21:23 | 7/12/08 21:27 | 61.91539 | 169.9003 | 61.91568 | 169.9003 | 49 | 49 | |
| 49 | SL3.5/N4 | CTD | 55 | Standard | 7/12/08 23:44 | 7/12/08 23:50 | 61.79715 | 169.3074 | 61.79716 | 169.3057 | 42 | 42 | start ctd55 moor n-40; end ctd 55 |
| 49 | SL3.5/N4 | CALVET | | | 7/12/08 23:57 | 7/13/08 0:00 | 61.79704 | 169.3037 | 61.79707 | 169.3027 | 41 | 41 | |
| 49 | SL3.5/N4 | MOORING | 44 | Standard | 7/13/08 0:30 | 7/13/08 0:30 | 61.8055 | 169.2787 | 61.8055 | 169.2787 | 40 | 40 | Mooring Deployment; recover in 2009 |
| 49 | SL3.5/N4 | MOC | | | 7/13/08 0:37 | 7/13/08 0:53 | 61.8065 | 169.2862 | 61.80906 | 169.3031 | 41 | 41 | |
| 50 | SL2.5 | CTD | 56 | Standard | 7/13/08 3:12 | 7/13/08 3:17 | 61.77159 | 168.4956 | 61.77159 | 168.4956 | 36 | 36 | start ctd 56; end ctd 56 |
| 50 | SL2.5 | CALVET | | | 7/13/08 3:23 | 7/13/08 3:26 | 61.7717 | 168.4877 | 61.77182 | 168.4853 | 33 | 33 | |
| 51 | SL1.5/N2 | CTD | 57 | Standard | 7/13/08 6:38 | 7/13/08 6:42 | 61.699833 | 167.45617 | 61.699833 | 167.45617 | 30 | 30 | start ctd 57; end ctd 57 |
| 51 | SL1.5/N2 | MOORING | | | 7/13/08 6:54 | 7/13/08 6:54 | 61.7001 | 167.4519 | 61.7001 | 167.4519 | 25.6 | 25.6 | Mooring will be recovered in 2009 |
| 52 | B1 | BONGO | 11 | | 7/13/08 10:00 | 7/13/08 10:10 | 61.0475 | 167.7863 | 61.0475 | 167.7863 | 26 | 26 | Dark as it's getting. No other events at this station. |
| 53 | NP1 | CTD | 58 | Standard | 7/13/08 17:12 | 7/13/08 17:18 | 59.44604 | 167.7969 | 59.44578 | 167.7949 | 37 | 37 | start ctd058; end ctd 58 |
| 53 | NP1 | CALVET | | | 7/13/08 17:23 | 7/13/08 17:26 | 59.44534 | 167.7933 | 59.44505 | 167.7923 | 38 | 38 | |
| 53 | NP1 | MOC | | | 7/13/08 17:37 | 7/13/08 17:48 | 59.44201 | 167.7869 | 59.43741 | 167.7799 | 38 | 38 | |
| 54 | NP2/S40 | CTD | 59 | Standard | 7/13/08 20:52 | 7/13/08 20:57 | 59.12659 | 168.0044 | 59.12701 | 168.0039 | 41 | 41 | start ctd 59; end ctd 59 |
| 54 | NP2/S40 | CALVET | | | 7/13/08 21:07 | 7/13/08 21:13 | 59.12724 | 168.003 | 59.1269 | 168.0025 | 44 | 44 | |
| 55 | NP3 | CTD | 60 | Standard | 7/14/08 2:50 | 7/14/08 2:56 | 58.8278 | 168.1587 | 58.82911 | 168.1591 | 46 | 46 | start ctd 60; end ctd 60 |
| 55 | NP3 | CALVET | | | 7/14/08 3:01 | 7/14/08 3:05 | 58.8297 | 168.1597 | 58.83028 | 168.1597 | 47 | 47 | |
| 55 | NP3 | MOC | | | 7/14/08 3:18 | 7/14/08 3:30 | 58.83043 | 168.1456 | 58.82474 | 168.1388 | 43 | 43 | |
| 56 | NP4/S55 | CTD | 61 | Standard | 7/14/08 5:48 | 7/14/08 5:57 | 58.60581 | 168.4185 | 58.60447 | 168.4135 | 55 | 55 | start ctd 61 moor s55; end ctd 61 |
| 56 | NP4/S55 | CALVET | | | 7/14/08 6:03 | 7/14/08 6:08 | 58.60288 | 168.411 | 58.60157 | 168.4092 | 55 | 55 | |
| 56 | NP4/S55 | MOORING | | | 7/14/08 6:40 | 7/14/08 6:40 | 58.5896 | 168.3941 | 58.5896 | 168.3941 | 55.3 | 55.3 | Mooring will be recovered in 2009 |
| 57 | NP5 | CTD | 62 | Standard | 7/14/08 8:34 | 7/14/08 8:46 | 58.36314 | 168.6973 | 58.36138 | 168.6916 | 68 | 68 | start ctd 62; end ctd 62 |
| 57 | NP5 | CALVET | | | 7/14/08 8:58 | 7/14/08 8:58 | 58.35956 | 168.6845 | 58.35954 | 168.6845 | 65 | 65 | |
| 57 | NP5 | MOC | | | 7/14/08 9:06 | 7/14/08 9:30 | 58.35503 | 168.6835 | 58.34164 | 168.6791 | 50 | 50 | |
| 58 | NP6 | CTD | 63 | Standard | 7/14/08 11:29 | 7/14/08 11:39 | 58.12969 | 168.968 | 58.1284 | 168.9622 | 68 | 68 | start ctd63; end ctd 63 |
| 58 | NP6 | CALVET | | | 7/14/08 11:47 | 7/14/08 11:51 | 58.12744 | 168.9586 | 58.12629 | 168.9561 | 70 | 70 | |
| 58 | NP6 | BONGO | 12 | | 7/14/08 12:10 | 7/14/08 12:20 | 58.1306 | 168.9698 | 58.1306 | 168.9698 | 70 | 70 | Dark & foggy |
| 58 | NP6 | CTD | 64 | Zoop | 7/14/08 12:14 | 7/14/08 12:20 | 58.11594 | 168.9456 | 58.11538 | 168.942 | 70 | 70 | start ctd 64; end ctd 64 |
| 59 | NP7 | CTD | 65 | Radon | 7/14/08 14:12 | 7/14/08 14:26 | 57.90056 | 169.2341 | 57.89914 | 169.2269 | 70 | 70 | start ctd 65; end ctd 65 |
| 59 | NP7 | CTD | 65 | Radon | 7/14/08 14:12 | 7/14/08 14:28 | 57.9003 | 169.2318 | 57.9003 | 169.2318 | 66 | 66 | 10 bottles for radon; one bottle for triple O2 isotopes (15m); one bottle for Karen (50m) |
| 59 | NP7 | CALVET | | | 7/14/08 14:32 | 7/14/08 14:36 | 57.8982 | 169.2236 | 57.89782 | 169.2216 | 70 | 70 | |
| 59 | NP7 | CTD | 66 | Standard | 7/14/08 15:00 | 7/14/08 15:09 | 57.89304 | 169.2106 | 57.89104 | 169.2072 | 70 | 70 | start ctd66; end ctd66 |
| 59 | NP7 | MOC | | | 7/14/08 15:23 | 7/14/08 15:45 | 57.891 | 169.2132 | 57.89988 | 169.2323 | 70 | 70 | |
| 59 | NP7 | CTD | 67 | Prod | 7/14/08 16:05 | 7/14/08 16:17 | 57.89865 | 169.2389 | 57.89625 | 169.2357 | 66 | 68 | start prod cast; end ctd 67 |
| 59 | NP7 | MCORE | 1 | | 7/14/08 16:38 | 7/14/08 16:43 | 57.8941 | 169.2317 | 57.8939 | 169.231 | 66 | 66 | 8 tubes rigged.. 1 suitable sample recovered.SOG=0.7kts during cast...port wire angle with 1242 lb pullout . <10cms penetration into clayey silt. Time / pos'n on deck = time / pos'n of core on bottom. |

| Stn.# | Station Name | Event Type | Cast# | CTD Type | Time in Water (UTC) | Time on Deck (UTC) | Start Lat. | Start Long. | End Lat. | End Long. | Start Depth (m) | End Depth (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 59 | NP7 | MCORE | 2 | | 7/14/08 17:15 | 7/14/08 17:19 | 57.8924 | 169.2304 | 57.8924 | 169.2303 | 66 | 66 | 6 tubes rigged.. 5 suitable samples recovered.SOG=0.2kts during cast...good wire angle with 2711 lb pullout . ~18cms penetration into clayey silt. 1.5 min bottom time. Time / pos'n on deck = time / pos'n of core on bottom. |
| 59 | NP7 | MCORE | 3 | | 7/14/08 17:36 | 7/14/08 17:39 | 57.8931 | 169.2316 | 57.8933 | 169.2321 | 66 | 66 | 6 tubes rigged.. 5 suitable samples recovered.SOG=0.2kts first then 0.9kts at windy pullout... port wire angle with 4041 lb pullout ! .. ~18cms penetration into clayey silt. 1.5 min bottom time. Time / pos'n on deck = time / pos'n of core on bottom. |
| 60 | NP8 | CTD | 68 | Standard | 7/14/08 19:40 | 7/14/08 19:50 | 57.67154 | 169.5188 | 57.67255 | 169.5182 | 71 | 71 | start ctd68; end ctd 68 |
| 60 | NP8 | CALVET | | | 7/14/08 19:57 | 7/14/08 20:02 | 57.67292 | 169.5173 | 57.67295 | 169.5168 | 70 | 70 | |
| 61 | NP9 | CTD | 69 | Standard | 7/14/08 22:07 | 7/14/08 22:16 | 57.44349 | 169.7836 | 57.44464 | 169.7806 | 66 | 67 | start ctd 69; end ctd 69 |
| 61 | NP9 | CALVET | | | 7/14/08 22:23 | 7/14/08 22:28 | 57.44478 | 169.7786 | 57.44516 | 169.777 | 64 | 64 | |
| 61 | NP9 | MOC | | | 7/14/08 22:36 | 7/14/08 22:52 | 57.44315 | 169.7757 | 57.43768 | 169.7737 | 50 | 55 | |
| 62 | NP10 | CTD | 70 | Standard | 7/15/08 0:56 | 7/15/08 1:01 | 57.20703 | 170.0329 | 57.20631 | 170.0299 | 39 | 39 | start ctd 70; end ctd 70 |
| 62 | NP10 | CALVET | | | 7/15/08 1:10 | 7/15/08 1:12 | 57.20555 | 170.0244 | 57.20535 | 170.0226 | 41 | 41 | |
| 62 | NP10 | MOC | | | 7/15/08 1:23 | 7/15/08 1:35 | 57.20297 | 170.0151 | 57.20026 | 170.0079 | 30 | 30 | |
| 63 | NP11 | CTD | 71 | Standard | 7/15/08 3:37 | 7/15/08 3:48 | 56.9757 | 170.2814 | 56.97448 | 170.2733 | 72 | 72 | start ctd 71; end ctd 71 |
| 63 | NP11 | CALVET | | | 7/15/08 3:55 | 7/15/08 3:59 | 56.97318 | 170.2705 | 56.97198 | 170.2701 | 72 | 72 | |
| 63 | NP11 | MOC | | | 7/15/08 4:10 | 7/15/08 4:26 | 56.96676 | 170.2677 | 56.9593 | 170.2645 | 72 | 72 | |
| 64 | NP12 | CTD | 72 | Standard | 7/15/08 6:19 | 7/15/08 6:32 | 56.74408 | 170.5502 | 56.74024 | 170.5478 | 110 | 110 | start ctd72; end ctd 72 |
| 64 | NP12 | CALVET | | | 7/15/08 6:38 | 7/15/08 6:44 | 56.73859 | 170.5473 | 56.73786 | 170.5479 | 100 | 100 | |
| 64 | NP12 | MOC | | | 7/15/08 6:51 | 7/15/08 7:24 | 56.73428 | 170.5479 | 56.71418 | 170.5385 | 100 | 100 | |
| 65 | NP13 | CTD | 73 | Standard | 7/15/08 9:48 | 7/15/08 10:02 | 56.51832 | 170.793 | 56.51553 | 170.7924 | 121 | 121 | start ctd73; end ctd 73 |
| 65 | NP13 | CALVET | | | 7/15/08 10:12 | 7/15/08 10:18 | 56.51398 | 170.7914 | 56.51004 | 170.7934 | 100 | 100 | |
| 65 | NP13 | BONGO | 13 | | 7/15/08 10:15 | 7/16/08 10:25 | 56.5145 | 170.7919 | 56.5145 | 170.7918 | 122 | 122 | |
| 65 | NP13 | CTD | 74 | Zoop | 7/15/08 10:38 | 7/15/08 10:43 | 56.50388 | 170.7974 | 56.50303 | 170.7971 | 122 | 122 | start zoops cast; end ctd 074 |
| 65 | NP13 | MOC | | | 7/15/08 10:47 | 7/15/08 11:33 | 56.50172 | 170.7977 | 56.47804 | 170.8188 | 100 | 100 | |
| 66 | NP14 | CTD | 75 | Standard | 7/15/08 13:40 | 7/15/08 13:58 | 56.28513 | 171.0565 | 56.28712 | 171.0589 | 136 | 136 | start ctd75; end ctd75 |
| 66 | NP14 | CALVET | | | 7/15/08 14:05 | 7/15/08 14:11 | 56.28756 | 171.0606 | 56.28807 | 171.0618 | 100 | 100 | |
| 66 | NP14 | CTD | 76 | Prod | 7/15/08 14:27 | 7/15/08 14:51 | 56.28816 | 171.0648 | 56.28502 | 171.0713 | 136 | 136 | start prod cast; end prodcast |
| 66 | NP14 | MOC | | | 7/15/08 15:01 | 7/15/08 15:33 | 56.28132 | 171.0665 | 56.27402 | 171.0399 | 100 | 100 | |
| 67 | PIT 2 | SEDTRAPS | | | 7/15/08 17:35 | 7/16/08 17:52 | 56.244 | 171.1084 | 56.2755 | 171.2362 | 300 | 140 | Second Sediment Trap deployment |
| 67 | PIT2D | CTD | 77 | Standard | 7/15/08 17:59 | 7/15/08 18:24 | 56.25576 | 171.1246 | 56.25936 | 171.129 | 235 | 215 | start ctd after Pat's Sediment Trap; end PITD1 |
| 68 | NP15 | CTD | 78 | Standard | 7/15/08 20:10 | 7/15/08 21:20 | 56.0551 | 171.3073 | 56.06511 | 171.3189 | 2755 | 2755 | start ctd 78; end ctd 78 |
| 68 | NP15 | MOC | | | 7/15/08 22:27 | 7/15/08 22:55 | 56.12275 | 171.3723 | 56.13996 | 171.3754 | 100 | 100 | |
| 68 | NP15 | CALVET | | | 7/15/08 22:58 | 7/15/08 23:06 | 56.14155 | 171.3758 | 56.14485 | 171.3773 | 100 | 100 | |
| 68 | NP15 | CALVET | | | 7/15/08 23:21 | 7/15/08 23:22 | 56.14909 | 171.3813 | 56.14929 | 171.3814 | 100 | 100 | |
| 68 | NP15-B | CALVET | | | 7/16/08 0:43 | 7/16/08 0:48 | 56.05348 | 171.3025 | 56.05376 | 171.3028 | 100 | 100 | |
| 68 | NP15 | CTD | 79 | Radon | 7/16/08 1:06 | 7/16/08 1:20 | 56.0556 | 171.3025 | 56.05777 | 171.302 | 2751 | 2751 | start radon cast; end radon cast |
| 68 | NP15 | MCORE | 1 | | 7/16/08 1:34 | 7/16/08 3:03 | 56.0573 | 171.3028 | 56.0587 | 171.3121 | 2749 | 2768 | 8 tubes rigged. 7 suitable samples recovered. Tube 4 missing at recovery (bellyband / failed glue) SOG=0.2kts. good wire angle with 3550 lb pullout ! . 46cms penetration into clay. 1.5 min bottom time. Time / pos'n on deck = time / pos'n of core on bottom. |
| 68 | NP15 | MCORE | 2 | | 7/16/08 4:52 | 7/16/08 6:10 | 56.0575 | 171.301 | 56.0653 | 171.3047 | 2742 | 2745 | 8 tubes rigged. 8 suitable samples recovered. SOG=0.4kts. Good wire angle w/ 3328 lb pullout ! Delayed recovery - wire jumped sheave at 186m wire out. 46cms penetration into clay. 1.5 mins bottom time. Time / pos'n on deck = time / pos'n of core on bottom. |
| 69 | EL3 | BONGO | 14 | | 7/16/08 12:45 | 7/16/08 12:55 | 56.2783 | 171.1634 | 56.2783 | 171.1634 | 142 | 142 | Bongo only at this station |
| 71 | NP14.5 | CTD | 80 | Standard | 7/16/08 23:24 | 7/16/08 23:56 | 56.173667 | 171.20867 | 56.173667 | 171.23233 | 2130 | 2130 | start ctd 80; end ctd 80 |
| 72 | NP13.5 | CTD | 81 | Standard | 7/17/08 1:51 | 7/17/08 2:11 | 56.403 | 170.92667 | 56.40284 | 170.9264 | 126 | 126 | late start ctd081; end ctd81 |
| 73 | NP12.5 | CTD | 82 | Standard | 7/17/08 3:58 | 7/17/08 4:16 | 56.62959 | 170.6742 | 56.62567 | 170.6732 | 114 | 114 | start ctd82; end ctd 82 |
| 73 | NP12.5 | MOC | | | 7/17/08 4:26 | 7/17/08 4:54 | 56.62262 | 170.6794 | 56.61428 | 170.6999 | 100 | 100 | |
| 74 | NP11.5 | CTD | 83 | Radium | 7/17/08 6:43 | 7/17/08 6:58 | 56.86089 | 170.4196 | 56.85623 | 170.413 | 100 | 100 | start Radium cast 3; end ctd 83 radium |
| 74 | NP11.5 | MOC | | | 7/17/08 7:05 | 7/17/08 7:35 | 56.8537 | 170.4136 | 56.84085 | 170.4281 | 85 | 85 | |
| 75 | NP10.5 | CTD | 84 | Radium | 7/17/08 9:33 | 7/17/08 9:41 | 57.09328 | 170.1561 | 57.09285 | 170.1538 | 41 | 41 | start ctd84 radium; end ctd84 no radium |
| 75 | NP10.5 | CTD | 84 | Zoop | 7/17/08 9:54 | 7/17/08 10:03 | 57.09249 | 170.15 | 57.0933 | 170.1486 | 41 | 41 | combined std and zoops cast; end ctd 85 |
| 75 | NP10.5 | BONGO | 15 | | 7/17/08 10:20 | 7/17/08 10:30 | 57.0929 | 170.1545 | 57.0929 | 170.1545 | 39 | 39 | |
| 75 | NP10.5 | MOC | | | 7/17/08 10:34 | 7/17/08 10:49 | 57.0871 | 170.1698 | 57.08587 | 170.1838 | 25 | 25 | |
| 75 | NP10.5 | CTD | 85 | Prod | 7/17/08 11:14 | 7/17/08 11:18 | 57.09255 | 170.1642 | 57.09291 | 170.1634 | 41 | 41 | prod cast; 3 AM; end prod cast |
| 76 | NP11 | CTD | 86 | Standard | 7/18/08 6:23 | 7/18/08 6:35 | 56.97878 | 170.2791 | 56.97728 | 170.2768 | 73 | 73 | start ctd86; end ctd 86 |
| 77 | NP11.5 | CTD | 87 | Fe | 7/18/08 7:40 | 7/18/08 8:45 | 56.85 | 170.4167 | 56.85 | 170.4167 | 102 | 102 | Done in conjunction with CTD 87 |
| 77 | NP11.5 | CTD | 87 | Standard a | 7/18/08 9:00 | 7/18/08 9:10 | 56.83773 | 170.411 | 56.83773 | 170.411 | 100 | 100 | start ctd 87; end ctd 87 |
| 78 | NP12.5 | CTD | 88 | Fe | 7/18/08 10:50 | 7/18/08 11:40 | 56.6333 | 170.6667 | 56.6333 | 170.6833 | 114 | 116 | Done in conjunction with CTD88 |
| 78 | NP12.5 | CTD | 88 | Standard a | 7/18/08 11:58 | 7/18/08 12:12 | 56.63053 | 170.6937 | 56.62717 | 170.6976 | 115 | 115 | start ctd 88; end ctd 88 |
| 78 | NP12.5 | CALVET | | | 7/18/08 12:20 | 7/18/08 12:25 | 56.62665 | 170.7015 | 56.62665 | 170.7015 | 100 | 100 | |
| 78 | NP12.5 | BONGO | 16 | | 7/18/08 12:30 | 7/18/08 12:40 | 56.6267 | 170.7006 | 56.6267 | 170.7006 | 116 | 116 | |
| 78 | NP12.5 | CTD | 89 | Zoop | 7/18/08 12:53 | 7/18/08 12:59 | 56.62286 | 170.7256 | 56.62237 | 170.7268 | 115 | 115 | start ctd 89; end ctd 89 |
| 78 | NP12.5 | MOC | | | 7/18/08 13:08 | 7/18/08 13:30 | 56.62223 | 170.7347 | 56.6178 | 170.7569 | 100 | 100 | |
| 79 | NP 14 | CTD | 90 | Fe | 7/18/08 15:45 | 7/18/08 16:40 | 56.2833 | 171.0667 | 56.2833 | 171.0667 | 138 | 138 | In conjuction with CTD 90 |
| 79 | NP14 | CTD | 90 | Prod | 7/18/08 17:00 | 7/18/08 17:22 | 56.27102 | 171.0751 | 56.26771 | 171.0803 | 140 | 140 | start ctd 90; end; ctd 90 |
| 79 | NP14 | CTD | 91 | Standard | 7/18/08 18:16 | 7/18/08 18:34 | 56.27932 | 171.0497 | 56.27402 | 171.0535 | 137 | 137 | start; ctd 91; end; ctd 91 |
| 79 | NP14 | MCORE | 1 | | 7/18/08 19:07 | 7/18/08 19:13 | 56.287 | 171.0472 | 56.2868 | 171.0477 | 140 | 140 | 6 tubes rigged. 6 suitable samples recovered. SOG=0.3kts. Good wire angle w/ 4240 lb pullout ! 25cms penetration into clay. 1.5 mins bottom time. Time / pos'n on deck = time / pos'n of core on bottom. |

| Stn.# | Station Name | Event Type | Cast# | CTD Type | Time in Water (UTC) | Time on Deck (UTC) | Start Lat. | Start Long. | End Lat. | End Long. | Start Depth (m) | End Depth (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 79 | NP14 | MCORE | 2 | | 7/18/08 19:31 | 7/18/08 19:38 | 56.2877 | 171.0479 | 56.2872 | 171.0471 | 137 | 139 | 8 tubes rigged. 8 suitable samples recovered. SOG=0.4kts. Good wire angle w/ 4595 lb pullout ! 15 cms penetration into clay. 1.5 mins bottom time. Time / pos'n on deck = time / pos'n of core on bottom. |
| 80 | NP15.5 | CTD | 92 | Fe | 7/18/08 22:30 | 7/18/08 23:35 | 55.9167 | 171.45 | 55.9167 | 171.45 | 3032 | 3032 | In conjuction with CTD 92 |
| 80 | NP15.5 | CTD | 92 | Standard | 7/18/08 23:51 | 7/19/08 0:25 | 55.92019 | 171.4473 | 55.9241 | 171.4391 | 3031 | 3031 | start ctd 92; end ctd 92 |
| 81 | LS1_1 | CTD | 93 | Standard | 7/19/08 4:29 | 7/19/08 4:49 | 56.09095 | 170.3484 | 56.08728 | 170.3541 | 150 | 146 | start; end |
| 82 | LS1_3 | CTD | 94 | Standard | 7/19/08 10:46 | 7/19/08 10:56 | 56.45 | 171.3622 | 56.45 | 171.3622 | 152 | 152 | start; ctd94; end; ctd94 |
| 82 | LS1_3 | CALVET | | | 7/19/08 11:10 | 7/19/08 11:15 | 56.44639 | 171.3597 | 56.44642 | 171.3598 | 100 | 100 | |
| 82 | LS1_3 | BONGO | 17 | | 7/19/08 11:30 | 7/20/08 11:40 | 56.4526 | 171.368 | 56.4513 | 171.368 | 152 | 152 | |
| 82 | LS1_3 | CTD | 95 | Zoop | 7/19/08 11:43 | 7/19/08 11:50 | 56.44761 | 171.3636 | 56.44521 | 171.3625 | 154 | 154 | start; ctd 95; end; ctd 95 |
| 82 | LS1_3 | MOC | | | 7/19/08 12:01 | 7/19/08 12:27 | 56.4429 | 171.3662 | 56.4433 | 171.3904 | 100 | 100 | |
| 83 | NP11 | CTD | 96 | Prod | 7/19/08 17:23 | 7/19/08 17:37 | 56.9795 | 170.2918 | 56.9808 | 170.2915 | 70 | 70 | start; ctd 96; end; ctd 96 |
| 83 | NP11 | CTD | 97 | Standard | 7/19/08 18:35 | 7/19/08 18:46 | 56.98674 | 170.2901 | 56.9881 | 170.2899 | 67 | 67 | start; ctd 97; end |
| 84 | LS1_4 | CTD | 98 | Standard | 7/20/08 5:50 | 7/20/08 5:50 | 56.569 | 172.675 | 56.569 | 172.675 | 153 | 153 | start; end |
| 85 | LS1_5 | CTD | 99 | Standard | 7/20/08 9:01 | 7/20/08 9:01 | 56.697 | 173.213 | 56.697 | 173.213 | 155 | 155 | start; end |
| 86 | LS1_6 | CALVET | | | 7/20/08 10:35 | 7/20/08 10:42 | 56.88256 | 173.3031 | 56.87917 | 173.3048 | 100 | 100 | |
| 86 | LS1_6 | BONGO | 18 | | 7/20/08 11:00 | 7/20/08 11:10 | 56.8822 | 173.3032 | 56.8822 | 173.3032 | 160 | 160 | |
| 86 | LS1_6 | CTD | 100 | Zoop | 7/20/08 11:08 | 7/20/08 11:08 | 56.875 | 173.324 | 56.875 | 173.324 | 175 | 175 | start; end |
| 86 | LS1_6 | MOC | | | 7/20/08 11:20 | 7/20/08 11:44 | 56.87146 | 173.3306 | 56.86508 | 173.3544 | 100 | 100 | |
| 86 | LS1_6 | CTD | 101 | Standard | 7/20/08 12:24 | 7/20/08 12:24 | 56.884 | 173.307 | 56.884 | 173.307 | 163 | 163 | start; end |
| 86 | LS1_6 | CTD | 102 | Fe | 7/20/08 13:13 | 7/20/08 14:10 | 56.865 | 173.315 | 56.865 | 173.315 | 188 | 188 | In conjuction with CTD 102 |
| 86 | LS1_6 | CTD | 102 | Prod | 7/20/08 14:36 | 7/20/08 14:36 | 56.852 | 173.314 | 56.852 | 173.314 | 174 | 174 | start; end |
| 86 | LS1_6 | BIO-OPTICS | | | 7/20/08 15:23 | 7/20/08 15:43 | 56.8835 | 173.3008 | 56.8858 | 173.302 | 178 | 175 | |
| 86 | LS1_6 | BIO-OPTICS | | | 7/20/08 15:50 | 7/20/08 16:14 | 56.8742 | 173.2983 | 56.8745 | 173.2985 | 157 | 159 | |
| 86 | LS1_6 | MCORE | 1 | | 7/20/08 17:00 | 7/20/08 17:08 | 56.8419 | 173.3095 | 56.8417 | 173.3093 | 163 | 163 | 6 tubes rigged..SOG >1.7kts at pullout with sudden jerk to 4000lbs. Only one suitable sample .. five disturbed samples. Time / pos'n at end = time / pos/n of core on bottom |
| 86 | LS1_6 | MCORE | 2 | | 7/20/08 17:45 | 7/20/08 17:49 | 56.8336 | 173.3156 | 56.833 | 173.3156 | 163 | 163 | 8 tubes rigged..SOG=0.5kts with low 2850 lb pullout at 10m/min wire speed. At least six disturbed samples. Very shallow uneven core penetration. Time / pos'n at end = time / pos/n of core on bottom |
| 87 | PIT3 | SEDTRAPS | | | 7/21/08 3:01 | 7/22/08 20:00 | 58.42 | 174.4686 | 58.465 | 174.565 | 210 | 200 | Third trap deployment |
| 87 | PIT3D | CTD | 103 | Standard | 7/21/08 3:17 | 7/21/08 3:17 | 58.417 | 174.453 | 58.417 | 174.453 | 176 | 176 | start; end |
| 88 | P14_5 | CTD | 104 | Standard | 7/21/08 8:19 | 7/21/08 8:19 | 57.494 | 175.243 | 57.494 | 175.243 | 3493 | 3493 | start; end |
| 89 | P14_4.5 | CALVET | | | 7/21/08 11:05 | 7/21/08 11:15 | 57.80229 | 175.0217 | 57.80024 | 175.0257 | 100 | 100 | |
| 89 | P14_4.5 | BONGO | 19 | | 7/21/08 11:15 | 7/21/08 11:25 | 57.8024 | 175.0218 | 57.8024 | 175.0218 | 2665 | 2665 | |
| 89 | P14_4.5 | CTD | 105 | Zoop | 7/21/08 11:44 | 7/21/08 11:44 | 57.797 | 175.043 | 57.797 | 175.043 | 2568 | 2568 | start; end |
| 89 | P14_4.5 | MOC | | | 7/21/08 12:00 | 7/21/08 12:29 | 57.80764 | 175.0254 | 57.80767 | 175.0254 | 100 | 100 | |
| 89 | P14_4.5 | CTD | 106 | Fe | 7/21/08 12:43 | 7/21/08 13:38 | 57.81 | 175 | 57.81 | 175 | 2371 | 2371 | Prior to CTD 106 |
| 89 | P14_4.5 | CTD | 106 | Standard | 7/21/08 14:06 | 7/21/08 14:06 | 57.812 | 174.983 | 57.812 | 174.983 | 2327 | 2327 | start; end |
| 89 | P14_4.5 | CTD | 107 | Prod | 7/21/08 15:07 | 7/21/08 15:07 | 57.828 | 174.994 | 57.828 | 174.994 | 2250 | 2250 | start; end |
| 89 | P14_4.5 | CTD | 108 | Radon | 7/21/08 16:25 | 7/21/08 16:45 | 57.8253 | 174.9427 | 57.8253 | 174.9427 | 2195 | 2195 | Radon and triple O2 isotopes collected |
| 89 | P14_4.5 | CTD | 108 | Radon | 7/21/08 16:32 | 7/21/08 16:32 | 57.825 | 174.944 | 57.825 | 174.944 | 2194 | 2194 | start; end |
| 89 | P14_4.5 | BIO-OPTICS | | | 7/21/08 16:55 | 7/21/08 17:12 | 57.788 | 174.9088 | 57.818 | 174.8943 | 2210 | 2271 | |
| 89 | P14_4.5 | BIO-OPTICS | | | 7/21/08 17:21 | 7/21/08 17:46 | 57.8217 | 174.9088 | 57.822 | 174.9095 | 2191 | 2196 | |
| 89 | P14_4.5 | CTD | 109 | Standard | 7/21/08 18:44 | 7/21/08 18:44 | 57.817 | 174.892 | 57.817 | 174.892 | 2450 | 2450 | start; end |
| 90 | P14_4 | CTD | 110 | Standard | 7/21/08 21:41 | 7/21/08 21:41 | 57.999 | 174.851 | 57.999 | 174.851 | 3005 | 3005 | start; end |
| 90 | P14_4 | MCORE | 1 | | 7/21/08 23:05 | 7/22/08 0:15 | 58.007 | 174.873 | 57.9963 | 174.8524 | 3008 | 3010 | 8 tubes rigged..SOG=0.9kts with 4487 lb pullout at 20m/min after 2 min settling at 60 meters off bottom. Added four 75lb CTD weights to multicore frame for 50m/min descent. All eight tubes overpenetrated. Time/pos'n at end = time / pos/n of core on bottom |
| 91 | P14_3 | CTD | 111 | Fe | 7/22/08 5:12 | 7/22/08 6:08 | 58.4867 | 174.5417 | 58.4867 | 174.5417 | 236 | 236 | In conjunction with CTD 111 |
| 91 | P14_3 | CTD | 111 | Standard | 7/22/08 6:22 | 7/22/08 6:22 | 58.485 | 174.518 | 58.485 | 174.518 | 200 | 200 | start; end |
| 92 | P14_2 | CTD | 112 | Fe | 7/22/08 10:30 | 7/22/08 11:15 | 58.9983 | 173.99 | 58.9983 | 173.99 | 126 | 126 | In conjunction with CTD 112 |
| 92 | P14_2 | CTD | 112 | Standard | 7/22/08 11:29 | 7/22/08 11:40 | 58.99261 | 173.9858 | 58.99074 | 173.9855 | 126 | 126 | start; ctd 112; end; ctd 112 |
| 92 | P14_2 | CALVET | | | 7/22/08 11:48 | 7/22/08 11:54 | 58.98932 | 173.9856 | 58.98786 | 173.9861 | 100 | 100 | |
| 92 | P14_2 | BONGO | 20 | | 7/22/08 12:07 | 7/22/08 12:17 | 58.9893 | 173.9856 | 58.9893 | 173.9856 | 126 | 126 | |
| 92 | P14_2 | MOC | | | 7/22/08 12:26 | 7/22/08 12:56 | 58.99967 | 174.0014 | 59.01491 | 174.0112 | 100 | 100 | |
| 92 | P14_2 | CTD | 113 | Zoop | 7/22/08 13:24 | 7/22/08 13:30 | 59.01328 | 174.0076 | 59.01243 | 174.0078 | 123 | 123 | start; ctd 113; end; ctd 113 |
| 92 | P14_2 | MCORE | 1 | | 7/22/08 13:45 | 7/22/08 13:50 | 59.0108 | 174.0083 | 59.0103 | 174.0086 | 123 | 123 | 6 tubes rigged. 4 suitable samples. SOG=0.4kts with good 2069 lb pullout and 10cms penetration into dense clay. Time/pos'n end = time/pos'n of core on the bottom. |
| 92 | P14_2 | MCORE | 2 | | 7/22/08 14:08 | 7/22/08 14:14 | 59.0092 | 174.0098 | 59.0089 | 174.0103 | 125 | 125 | 6 tubes rigged. 4 suitable samples. SOG=0.4kts with good 1579 lb pullout and 10cms penetration into dense clay. Time/pos'n end = time/pos'n of core on the bottom. |
| 92 | P14_2 | MCORE | 3 | | 7/22/08 14:35 | 7/22/08 14:41 | 59.0075 | 174.0124 | 59.0076 | 174.0126 | 125 | 125 | 4 tubes rigged. 4 suitable samples. SOG=0.4kts with good 2028 lb pullout and 15cms penetration into dense clay. Time/pos'n end = time/pos'n of core on the bottom. |
| 92 | P14_2 | MCORE | 4 | | 7/22/08 15:00 | 7/22/08 15:06 | 59.007 | 174.0139 | 59.0068 | 174.0143 | 124 | 124 | 4 tubes rigged. 4 suitable samples. SOG=0.3kts with good 2287 lb pullout and 15cms penetration into dense clay. Time/pos'n end = time/pos'n of core on the bottom. |
| 92 | P14_2 | CTD | 114 | Prod | 7/22/08 15:21 | 7/22/08 16:14 | 59.00651 | 174.0148 | 59.00709 | 174.0154 | 124 | 124 | start; ctd 114; end; ctd 114 |
| 92 | P14_2 | BIO-OPTICS | | | 7/22/08 17:11 | 7/22/08 17:20 | 59.0083 | 174.011 | 59.0048 | 174.0098 | 120 | 122 | |
| 92 | P14_2 | BIO-OPTICS | | | 7/22/08 17:25 | 7/22/08 17:45 | 59.0053 | 174.0117 | 59.0048 | 174.0098 | 120 | 23 | |
| 92 | P14_2 | CTD | 115 | Radium | 7/22/08 17:53 | 7/22/08 18:02 | 59.00492 | 174.0093 | 59.00481 | 174.0081 | 124 | 124 | start; ctd 115; end; ctd 115 |
| 93 | P14_1 | CTD | 116 | Fe | 7/22/08 21:50 | 7/22/08 22:50 | 59.4533 | 173.4167 | 59.4533 | 173.4167 | 103 | 103 | Done in conjunction with CTD 116 |

| Stn.# | Station Name | Event Type | Cast# | CTD Type | Time in Water (UTC) | Time on Deck (UTC) | Start Lat. | Start Long. | End Lat. | End Long. | Start Depth (m) | End Depth (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 93 | P14_1 | CTD | 116 | Standard | 7/22/08 23:06 | 7/22/08 23:19 | 59.4562 | 173.4191 | 59.45715 | 173.4196 | 104 | 104 | start; end |
| 93 | P14_1 | BIO-OPTICS | | | 7/22/08 23:30 | 7/22/08 23:45 | 59.4578 | 173.4212 | 59.4593 | 173.4267 | 102 | 106 | |
| 93 | P14_1 | BIO-OPTICS | | | 7/22/08 23:50 | 7/23/08 0:15 | 59.4578 | 173.4245 | 59.4613 | 173.0433 | 103 | 102 | |
| 94 | MN10 | CTD | 117 | Standard | 7/23/08 3:08 | 7/23/08 3:20 | 59.90043 | 173.4002 | 59.90061 | 173.4013 | 87 | 87 | start; end |
| 94 | MN10 | BIO-OPTICS | | | 7/23/08 3:26 | 7/23/08 3:35 | 59.9007 | 173.4015 | 59.9032 | 173.4043 | 86 | 87 | |
| 94 | MN10 | BIO-OPTICS | | | 7/23/08 3:44 | 7/23/08 4:02 | 59.9035 | 173.4032 | 59.905 | 173.4042 | 85 | 87 | |
| 94 | MN10 | CALVET | | | 7/23/08 4:25 | 7/23/08 4:31 | 59.90755 | 173.4077 | 59.90826 | 173.4078 | 84 | 84 | |
| 95 | MN9 | CTD | 118 | Fe | 7/23/08 6:54 | 7/23/08 6:54 | 59.9117 | 172.795 | 59.9067 | 172.795 | 74 | 72 | Done in Conjuction with CTD 118 |
| 95 | MN9 | CTD | 118 | Standard | 7/23/08 7:41 | 7/23/08 7:51 | 59.90901 | 172.7864 | 59.90939 | 172.7845 | 75 | 75 | start ctd 118; end ctd |
| 95 | MN9 | CALVET | | | 7/23/08 7:58 | 7/23/08 8:02 | 59.90937 | 172.7834 | 59.90923 | 172.7829 | 70 | 70 | |
| 95 | MN9 | BIO-OPTICS | | | 7/23/08 8:10 | 7/23/08 8:30 | 59.9095 | 172.7837 | 59.925 | 172.7517 | 72 | 73 | |
| 96 | MN8 | CTD | 119 | Standard | 7/23/08 10:16 | 7/23/08 10:26 | 59.89646 | 172.1972 | 59.89622 | 172.1943 | 73 | 73 | start; ctd 119; end; ctd 119 |
| 96 | MN8 | CALVET | | | 7/23/08 10:32 | 7/23/08 10:39 | 59.89624 | 172.1926 | 59.89584 | 172.1918 | 70 | 70 | |
| 96 | MN8 | BONGO | 21 | | 7/23/08 10:49 | 7/23/08 10:59 | 59.8965 | 172.1976 | 59.8965 | 172.1976 | 73 | 73 | |
| 96 | MN8 | CTD | 120 | Zoop | 7/23/08 11:11 | 7/23/08 11:18 | 59.90215 | 172.211 | 59.90155 | 172.2099 | 73 | 73 | start; ctd 120; end; ctd 120 |
| 96 | MN8 | MOC | | | 7/23/08 11:24 | 7/23/08 11:34 | 59.90124 | 172.209 | 59.90124 | 172.209 | 55 | 56 | |
| 97 | MN7 | CTD | 121 | Standard | 7/23/08 13:32 | 7/23/08 13:43 | 59.89647 | 171.5962 | 59.89456 | 171.5959 | 70 | 70 | start; ctd 121; end; ctd 121 |
| 97 | MN7 | CALVET | | | 7/23/08 13:53 | 7/23/08 13:57 | 59.89348 | 171.5962 | 59.89301 | 171.5965 | 71 | 71 | |
| 98 | MN6 | CTD | 122 | Prod | 7/23/08 15:57 | 7/23/08 16:10 | 59.89937 | 170.9994 | 59.89737 | 171.0011 | 69 | 69 | start; ctd 122; end; ctd 122 |
| 98 | MN6 | CALVET | | | 7/23/08 16:19 | 7/23/08 16:26 | 59.89616 | 171.002 | 59.89511 | 171.0024 | 70 | 70 | |
| 98 | MN6 | BIO-OPTICS | | | 7/23/08 16:28 | 7/23/08 16:45 | 59.8922 | 171.0045 | 59.8923 | 171.0042 | 69 | 68 | |
| 98 | MN6 | BIO-OPTICS | | | 7/23/08 16:50 | 7/23/08 17:12 | 59.8925 | 171.0042 | 59.8922 | 171.0045 | 69 | 70 | |
| 98 | MN6 | BIO-OPTICS | | | 7/23/08 17:20 | 7/23/08 17:41 | 59.889 | 171.0098 | 59.8892 | 171.0099 | 70 | 71 | |
| 98 | MN6 | CTD | 123 | Standard | 7/23/08 17:30 | 7/23/08 17:40 | 59.888 | 171.0115 | 59.88724 | 171.0143 | 69 | 69 | start; ctd 123; end; ctd 123 |
| 99 | MN5 | CTD | 124 | Standard | 7/23/08 19:45 | 7/23/08 19:53 | 59.89987 | 170.4004 | 59.89919 | 170.4019 | 62 | 62 | start; end |
| 99 | MN5 | CALVET | | | 7/23/08 20:08 | 7/23/08 20:15 | 59.90083 | 170.4057 | 59.90084 | 170.4057 | 62 | 62 | |
| 99 | MN5 | BIO-OPTICS | | | 7/23/08 20:30 | 7/23/08 20:45 | 59.9037 | 170.3932 | 59.9033 | 170.392 | 62 | 61 | |
| 99 | MN5 | BIO-OPTICS | | | 7/23/08 20:50 | 7/23/08 21:06 | 59.9033 | 170.392 | 59.9035 | 170.3913 | 60 | 61 | |
| 99 | MN5 | BIO-OPTICS | | | 7/23/08 21:10 | 7/23/08 21:23 | 59.903 | 170.3918 | 59.9022 | 170.3923 | 63 | 64 | |
| 99 | MN5 | MCORE | 1 | | 7/23/08 21:38 | 7/23/08 21:41 | 59.9012 | 170.3945 | 59.9012 | 170.394 | 64 | 64 | 6 tubes rigged. 6 suitable samples. SOG=0.2kts with good 1654 lb pullout and 30cms penetration into soft clay/mud. Time/pos'n end = time/pos'n of core on the bottom. |
| 99 | MN5 | MCORE | 2 | | 7/23/08 22:03 | 7/23/08 22:06 | 59.9018 | 170.3958 | 59.9017 | 170.3958 | 64 | 64 | 8 tubes rigged. 8 suitable samples. SOG=0.2kts with good 2569 lb pullout and 38cms penetration into soft clay/mud. Time/pos'n end = time/pos'n of core on the bottom. |
| 100 | 70M39 | MOORING | 125 | Standard | 7/24/08 2:29 | 7/24/08 5:53 | 59.9077 | 171.7074 | 59.9077 | 171.7074 | 71 | 71 | O8-BSV-5A |
| 100 | 70M39 | CTD | 125 | Standard | 7/24/08 2:40 | 7/24/08 2:50 | 59.909 | 171.7147 | 59.90718 | 171.7174 | 70 | 70 | start CTD @ Mooring M5; end CTD |
| 101 | MN9 | CTD | 126 | Standard | 7/24/08 5:52 | 7/24/08 6:04 | 59.89777 | 172.8112 | 59.89769 | 172.8111 | 74 | 74 | start; end |
| 101 | MN9 | CTD | 127 | Standard | 7/24/08 6:40 | 7/24/08 6:52 | 59.8982 | 172.8089 | 59.89868 | 172.8082 | 75 | 75 | start; end |
| 102 | MN11 | CTD | 128 | Standard | 7/24/08 9:42 | 7/24/08 9:52 | 59.89822 | 174.0084 | 59.89781 | 174.0056 | 104 | 104 | start; ctd 128; end; ctd 128 |
| 102 | MN11 | CALVET | | | 7/24/08 9:59 | 7/24/08 10:06 | 59.89755 | 174.0033 | 59.89749 | 174.0003 | 100 | 100 | |
| 102 | MN11 | BONGO | 22 | | 7/24/08 10:08 | 7/24/08 10:18 | 59.8982 | 174.0092 | 59.8982 | 174.0092 | 101 | 101 | Lots of Chrysaeora |
| 102 | MN11 | CTD | 129 | Zoop | 7/24/08 10:28 | 7/24/08 10:34 | 59.89873 | 173.9766 | 59.89849 | 173.9752 | 103 | 103 | start; ctd 129; end; ctd 129 |
| 102 | MN11 | MOC | | | 7/24/08 10:45 | 7/24/08 11:04 | 59.89944 | 173.9972 | 59.89946 | 173.9975 | 85 | 85 | |
| 102 | MN11 | MCORE | 1 | | 7/24/08 11:30 | 7/24/08 11:05 | 59.8994 | 173.9981 | 59.8996 | 173.9981 | 104 | 104 | 6 tubes rigged. 4 suitable samples. SOG=0.1kts with good 1857 lb pullout and 20cms penetration into silty clay. Time/pos'n end = time/pos'n of core on the bottom. |
| 102 | MN11 | MCORE | 2 | | 7/24/08 11:53 | 7/24/08 11:58 | 59.9005 | 173.9984 | 59.9006 | 173.9983 | 102 | 102 | 6 tubes rigged. 6 suitable samples. SOG=0.2kts with good 1963 lb pullout and 25cms penetration into silty clay. Time/pos'n end = time/pos'n of core on the bottom. |
| 103 | MN12 | CTD | 131 | Fe | 7/24/08 14:00 | 7/24/08 14:50 | 59.8967 | 174.5933 | 59.8967 | 174.5933 | 109 | 111 | Done in conjuntion with CTD 131 |
| 103 | MN12 | CTD | 130 | Standard | 7/24/08 15:06 | 7/24/08 15:21 | 59.89434 | 174.5836 | 59.89403 | 174.5818 | 114 | 114 | start; ctd 130; end; ctd 130 |
| 103 | MN12 | CALVET | | | 7/24/08 15:29 | 7/24/08 15:35 | 59.89378 | 174.5808 | 59.89346 | 174.5785 | 100 | 100 | |
| 103 | MN12 | CTD | 131 | Prod | 7/24/08 15:59 | 7/24/08 16:11 | 59.89378 | 174.5751 | 59.89433 | 174.5736 | 110 | 110 | start; ctd 131; end; ctd 131 |
| 103 | MN12 | BIO-OPTICS | | | 7/24/08 16:15 | 7/24/08 16:28 | 59.8938 | 174.5725 | 59.8943 | 174.5723 | 110 | 108 | |
| 103 | MN12 | BIO-OPTICS | | | 7/24/08 16:36 | 7/24/08 16:55 | 59.8935 | 174.5685 | 59.8942 | 174.5687 | 107 | 108 | |
| 104 | MN13 | CTD | 132 | Standard | 7/24/08 18:37 | 7/24/08 18:53 | 59.90152 | 175.1928 | 59.9012 | 175.194 | 120 | 120 | start; ctd 132; end; ctd 133 |
| 104 | MN13 | CALVET | | | 7/24/08 19:00 | 7/24/08 19:08 | 59.90122 | 175.1943 | 59.90088 | 175.194 | 100 | 100 | |
| 105 | MN14 | CTD | 133 | Standard | 7/24/08 20:51 | 7/24/08 21:09 | 59.89901 | 175.7969 | 59.89659 | 175.7932 | 132 | 132 | start; end |
| 105 | MN14 | CALVET | | | 7/24/08 21:17 | 7/24/08 21:25 | 59.89553 | 175.7924 | 59.8956 | 175.7925 | 100 | 100 | |
| 106 | MN15 | CTD | 134 | Fe | 7/24/08 23:15 | 7/25/08 0:10 | 59.9033 | 176.3917 | 59.9033 | 176.3917 | 145 | 141 | Done in conjunction with CTD 134 |
| 106 | MN15 | CTD | 134 | Standard | 7/25/08 0:08 | 7/25/08 0:28 | 59.90678 | 176.3715 | 59.90822 | 176.363 | 140 | 140 | start; end |
| 106 | MN15 | CALVET | | | 7/25/08 0:36 | 7/25/08 0:44 | 59.90879 | 176.3594 | 59.90919 | 176.3561 | 100 | 100 | |
| 106 | MN15 | BIO-OPTICS | | | 7/25/08 0:50 | 7/25/08 1:04 | 59.9092 | 176.3558 | 59.9113 | 176.3463 | 140 | 142 | |
| 106 | MN15 | BIO-OPTICS | | | 7/25/08 1:10 | 7/25/08 1:25 | 59.9098 | 176.343 | 59.9108 | 176.3362 | 139 | 143 | |
| 106 | MN15 | BIO-OPTICS | | | 7/25/08 1:30 | 7/25/08 1:45 | 59.911 | 176.3358 | 59.9113 | 176.3367 | 142 | 140 | |
| 106 | MN15 | MCORE | 1 | | 7/25/08 2:15 | 7/25/08 2:23 | 59.9028 | 176.3931 | 59.9027 | 176.3928 | 141 | 141 | 6 tubes rigged. 5 suitable samples. SOG=0.2kts with a starboard angle 2366 lb pullout and 25cms penetration into silty clay. Time/pos'n end = time/pos'n of core on the bottom. |
| 106 | MN15 | MCORE | 2 | | 7/25/08 2:42 | 7/25/08 2:55 | 59.9025 | 176.3889 | 59.9057 | 176.3881 | 140 | 140 | 8 tubes rigged. 8 suitable samples. SOG=0.2kts with a vertical 2814 lb pullout and 21cms penetration into silty clay. Let core settle out 40 mab for 2 minutes. Time/pos'n end = time/pos'n of core on the bottom. |
| 107 | MN16 | CTD | 135 | Standard | 7/25/08 4:47 | 7/25/08 5:05 | 59.90092 | 176.9963 | 59.90294 | 176.9872 | 137 | 137 | start; end |
| 107 | MN16 | CALVET | | | 7/25/08 5:12 | 7/25/08 5:16 | 59.90362 | 176.9836 | 59.90407 | 176.9807 | 100 | 100 | |
| 108 | MN17 | CTD | 136 | Fe | 7/25/08 7:00 | 7/25/08 8:00 | 59.9117 | 177.58 | 59.9117 | 177.58 | 137 | 138 | Done in conjunction with CTD 136 |
| 108 | MN17 | CTD | 136 | Standard | 7/25/08 8:09 | 7/25/08 8:24 | 59.91773 | 177.5716 | 59.92162 | 177.565 | 138 | 138 | start; ctd 136; end; ctd 136 |
| 108 | MN17 | CALVET | | | 7/25/08 8:29 | 7/25/08 8:34 | 59.92303 | 177.5628 | 59.92444 | 177.5606 | 100 | 100 | |
| 109 | MN18 | CTD | 137 | Standard | 7/25/08 10:24 | 7/25/08 10:41 | 59.89869 | 178.1952 | 59.89771 | 178.1844 | 143 | 143 | start; ctd 137; end; ctd 137 |
| 109 | MN18 | CALVET | | | 7/25/08 10:47 | 7/25/08 10:52 | 59.89739 | 178.1806 | 59.89726 | 178.1773 | 100 | 100 | |
| 110 | MN19 | BONGO | 23 | | 7/25/08 12:57 | 7/25/08 13:07 | 59.8975 | 178.8003 | 59.8975 | 178.8003 | 157 | 157 | |
| 110 | MN19 | MOC | | | 7/25/08 13:08 | 7/25/08 13:58 | 59.8858 | 178.8088 | 59.87362 | 178.8344 | 100 | 100 | |

| Stn.# | Station Name | Event Type | Cast# | CTD Type | Time in Water (UTC) | Time on Deck (UTC) | Start Lat. | Start Long. | End Lat. | End Long. | Start Depth (m) | End Depth (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 110 | MN19 | CTD | 138 | Zoop | 7/25/08 13:18 | 7/25/08 15:43 | 59.88924 | 178.805 | 59.89476 | 178.8097 | 171 | 171 | start; ctd 138; end; ctd 138 |
| 110 | MN19 | CTD | 139 | Fe | 7/25/08 14:15 | 7/25/08 15:15 | 59.895 | 178.81 | 59.895 | 178.81 | 167 | 169 | in conjunction with CTD 139 |
| 110 | MN19 | CALVET | | | 7/25/08 15:50 | 7/25/08 15:56 | 59.89262 | 178.8108 | 59.89261 | 178.8107 | 100 | 100 | |
| 110 | MN19 | CTD | 139 | Standard | 7/25/08 16:16 | 7/25/08 16:20 | 59.89387 | 178.807 | | | 167 | 167 | start; ctd 139; end |
| 110 | MN19 | CTD | 140 | Prod | 7/25/08 16:23 | 7/25/08 16:33 | 59.894 | 178.807 | 59.894 | 178.807 | 165 | 165 | start; end |
| 110 | MN19 | BIO-OPTICS | | | 7/25/08 16:45 | 7/25/08 16:52 | 59.8995 | 178.8062 | 59.8993 | 178.8063 | 161 | 159 | |
| 111 | MN20 | CTD | 141 | Fe | 7/25/08 20:00 | 7/25/08 20:59 | 59.8967 | 179.3933 | 59.8967 | 179.3933 | 2705 | 2705 | Done in conjunction with CTD 141 |
| 111 | MN20 | CTD | 141 | Standard | 7/25/08 21:04 | 7/25/08 21:44 | 59.89454 | 179.3884 | 59.89402 | 179.3803 | 2718 | 2718 | start; end |
| 111 | MN20 | CALVET | | | 7/25/08 21:58 | 7/25/08 22:09 | 59.89402 | 179.3797 | 59.90501 | 179.3471 | 100 | 100 | |
| 112 | DL1 | CTD | 142 | Standard | 7/26/08 3:33 | 7/26/08 3:52 | 60.80879 | 177.9759 | 60.80934 | 177.9734 | 154 | 154 | start; end |
| 112 | DL1 | BIO-OPTICS | | | 7/26/08 4:00 | 7/26/08 4:15 | 60.812 | 177.9687 | 60.8117 | 177.9692 | 151 | 149 | |
| 112 | DL1 | BIO-OPTICS | | | 7/26/08 4:20 | 7/26/08 4:42 | 60.8115 | 177.9677 | 60.81 | 177.9683 | 149 | 147 | |
| 113 | DL2 | CTD | 143 | Standard | 7/26/08 8:14 | 7/26/08 8:25 | 61.4853 | 176.998 | 61.48532 | 176.9958 | 120 | 120 | start; ctd 143; end; ctd 143 |
| 114 | SL16 | CTD | 144 | Standard | 7/26/08 12:10 | 7/26/08 12:20 | 62.20081 | 175.9662 | 62.2001 | 175.9643 | 94 | 94 | start; ctd 144; end; ctd 144 |
| 114 | SL16 | CALVET | | | 7/26/08 12:26 | 7/26/08 12:30 | 62.19962 | 175.9632 | 62.19919 | 175.9628 | 93 | 93 | |
| 114 | SL16 | BONGO | 24 | | 7/26/08 12:34 | 7/27/08 12:44 | 62.2005 | 175.9653 | 62.2005 | 175.9655 | 94 | 94 | |
| 114 | SL16 | CTD | 145 | Zoop | 7/26/08 12:53 | 7/26/08 12:58 | 62.19515 | 175.9815 | 62.19468 | 175.9816 | 94 | 94 | start; ctd 145; end; ctd 145 |
| 115 | SL15 | CTD | 146 | Standard | 7/26/08 14:17 | 7/26/08 14:29 | 62.19558 | 175.5603 | 62.19342 | 175.5609 | 85 | 85 | start; ctd 146; end; ctd 146 |
| 115 | SL15 | CALVET | | | 7/26/08 14:36 | 7/26/08 14:41 | 62.19202 | 175.5612 | 62.19105 | 175.5618 | 86 | 86 | |
| 116 | SL14 | CTD | 147 | Prod | 7/26/08 16:02 | 7/26/08 16:18 | 62.19967 | 175.1612 | 62.19651 | 175.1633 | 80 | 80 | start; ctd 147; end; ctd 147 |
| 116 | SL14 | CALVET | | | 7/26/08 16:25 | 7/26/08 16:31 | 62.19534 | 175.1642 | 62.19312 | 175.1663 | 80 | 80 | |
| 116 | SL14 | BIO-OPTICS | | | 7/26/08 16:45 | 7/26/08 17:00 | 62.186 | 175.1808 | 62.1932 | 175.1815 | 79 | 80 | |
| 116 | SL14 | CTD | 148 | Standard | 7/26/08 17:28 | 7/26/08 17:40 | 62.18567 | 175.1743 | 62.18447 | 175.1761 | 80 | 80 | start; ctd 148; end; ctd 148 |
| 116 | SL14 | MCORE | 1 | | 7/26/08 18:06 | 7/26/08 18:10 | 62.1928 | 175.1763 | 62.1927 | 175.177 | 80 | 80 | 8 tubes rigged. 8 suitable samples. SOG=0.2kts with a vertical 1432 lb pullout and 2 dm (20cm) penetration into silty clay / mud. Time/pos'n end = time/pos'n of core on the bottom. |
| 116 | SL14 | MCORE | 2 | | 7/26/08 18:24 | 7/26/08 18:28 | 62.1918 | 175.1792 | 62.1916 | 175.1797 | 80 | 80 | 8 tubes rigged. 8 suitable samples. SOG=0.2kts with a vertical 1789 lb pullout and 2 dm (20cm) penetration into silty clay / mud. Time/pos'n end = time/pos'n of core on the bottom. |
| 117 | SL13 | MOORING | 149 | Standard | 7/26/08 20:39 | 7/26/08 20:39 | 62.2009 | 174.749 | 62.2009 | 174.749 | 70 | 70 | 08-BSV-8A |
| 117 | SL13 | BIO-OPTICS | | | 7/26/08 20:55 | 7/26/08 21:05 | 62.2058 | 174.7468 | 62.2062 | 174.7465 | 70 | 71 | |
| 117 | SL13 | BIO-OPTICS | | | 7/26/08 21:10 | 7/26/08 21:21 | 66.1968 | 173.8998 | 66.1972 | 173.8992 | 63 | 65 | |
| 117 | SL13 | CALVET | | | 7/26/08 21:25 | 7/26/08 21:32 | 62.21323 | 174.7502 | 62.21486 | 174.7512 | 71 | 71 | |
| 117 | SL13 | CTD | 149 | Standard | 7/26/08 21:37 | 7/26/08 21:47 | 62.21583 | 174.7517 | 62.21814 | 174.7526 | 74 | 74 | start; end |
| 118 | SL12 | CTD | 150 | Standard | 7/26/08 23:09 | 7/26/08 23:18 | 62.20105 | 174.343 | 62.20195 | 174.3391 | 69 | 69 | start; end |
| 118 | SL12 | CALVET | | | 7/26/08 23:27 | 7/26/08 23:33 | 62.20284 | 174.3359 | 62.20335 | 174.3334 | 68 | 68 | |
| 119 | SL11 | CTD | 151 | Standard | 7/27/08 1:09 | 7/27/08 1:18 | 62.19695 | 173.918 | 62.19715 | 173.9109 | 64 | 64 | start; end |
| 119 | SL11 | CALVET | | | 7/27/08 1:24 | 7/27/08 1:31 | 62.19713 | 173.9059 | 62.19701 | 173.9008 | 62 | 62 | |
| 119 | SL11 | BIO-OPTICS | | | 7/27/08 1:35 | 7/27/08 1:45 | 62.1969 | 173.8998 | 62.1969 | 173.8992 | 64 | 64 | |
| 119 | SL11 | BIO-OPTICS | | | 7/27/08 1:50 | 7/27/08 2:00 | 62.1962 | 173.8865 | 62.1963 | 173.8912 | 64 | 64 | |
| 120 | SL10 | CTD | 152 | Standard | 7/27/08 3:02 | 7/27/08 3:11 | 62.19728 | 173.5332 | 62.19587 | 173.5271 | 63 | 63 | start; end |
| 120 | SL10 | CALVET | | | 7/27/08 3:15 | 7/27/08 3:20 | 62.19522 | 173.5242 | 62.19451 | 173.5206 | 61 | 61 | |
| 121 | SL9 | CTD | 153 | Standard | 7/27/08 4:32 | 7/27/08 4:40 | 62.19741 | 173.1182 | 62.19642 | 173.116 | 60 | 60 | start; end |
| 121 | SL9 | CALVET | | | 7/27/08 4:45 | 7/27/08 4:49 | 62.19582 | 173.1153 | 62.19562 | 173.113 | 64 | 64 | |
| 122 | SL8 | CTD | 154 | Standard | 7/27/08 6:04 | 7/27/08 6:13 | 62.19905 | 172.7058 | 62.19783 | 172.7044 | 60 | 60 | start; end |
| 122 | SL8 | CALVET | | | 7/27/08 6:18 | 7/27/08 6:22 | 62.19667 | 172.7046 | 62.19605 | 172.7047 | 55 | 55 | |
| 123 | 70M56 | CTD | 155 | Standard | 7/27/08 11:00 | 7/27/08 11:12 | 61.94021 | 174.3643 | 61.94088 | 174.3644 | 74 | 74 | start; ctd 155; end; ctd 155 |
| 123 | 70M56 | CALVET | | | 7/27/08 11:18 | 7/27/08 11:22 | 61.94129 | 174.3645 | 61.9416 | 174.3638 | 69 | 69 | |
| 123 | 70M56 | BONGO | 25 | | 7/27/08 11:40 | 7/27/08 11:50 | 61.9402 | 538.3 | 61.9402 | 174.3643 | 74 | 74 | Cast time is approximate |
| 124 | 70M55 | CTD | 156 | Standard | 7/27/08 12:50 | 7/27/08 12:55 | 61.85906 | 174.102 | 61.85889 | 174.0978 | 75 | 75 | start; ctd 156; end; ctd 156 |
| 125 | 70M54 | CTD | 157 | Standard | 7/27/08 14:13 | 7/27/08 14:22 | 61.72559 | 173.8498 | 61.72404 | 173.8432 | 72 | 72 | start; ctd 157; end; ctd 157 |
| 126 | 70M53 | CTD | 158 | Standard | 7/27/08 15:34 | 7/27/08 15:44 | 61.56097 | 173.7108 | 61.55877 | 173.7053 | 73 | 73 | start; ctd 158; end; ctd 158 |
| 126 | 70M53 | CALVET | | | 7/27/08 15:51 | 7/27/08 15:56 | 61.55682 | 173.7013 | 61.55564 | 173.6989 | 69 | 69 | |
| 126 | 70M53 | CTD | 159 | Prod | 7/27/08 16:07 | 7/27/08 16:24 | 61.55305 | 173.6927 | 61.54904 | 173.6833 | 73 | 73 | start; ctd 159; end; ctd 159 |
| 126 | 70M53 | BIO-OPTICS | | | 7/27/08 16:32 | 7/27/08 16:48 | 61.5468 | 173.679 | 61.547 | 173.6792 | 73 | 73 | from ship log |
| 127 | 70M52 | CTD | 160 | Standard | 7/27/08 18:07 | 7/27/08 18:10 | 61.41036 | 173.7372 | 61.41018 | 173.7371 | 73 | 73 | start; ctd 160; end; ctd 160 |
| 128 | 70M51 | CTD | 161 | Standard | 7/27/08 19:37 | 7/27/08 19:45 | 61.24712 | 173.726 | 61.24595 | 173.7231 | 73 | 73 | start; ctd 161; end; ctd 161 |
| 129 | 70M50 | CTD | 162 | Standard | 7/27/08 20:59 | 7/27/08 21:12 | 61.07976 | 173.7745 | 61.07772 | 173.7703 | 77 | 77 | start; end |
| 129 | 70M50 | CALVET | | | 7/27/08 21:19 | 7/27/08 21:25 | 61.07663 | 173.7683 | 61.07548 | 173.7657 | 78 | 78 | |
| 129 | 70M50 | BIO-OPTICS | | | 7/27/08 21:34 | 7/27/08 21:54 | 61.0742 | 173.7627 | 61.0733 | 173.7623 | 70 | 70 | |
| 130 | 70M49 | CTD | 163 | Standard | 7/27/08 23:20 | 7/27/08 23:32 | 60.91139 | 173.8208 | 60.91329 | 173.8144 | 80 | 80 | start; end |
| 131 | 70M48 | CTD | 164 | Standard | 7/28/08 1:04 | 7/28/08 1:14 | 60.75782 | 173.6543 | 60.75747 | 173.6462 | 72 | 72 | start; end |
| 132 | 70M47 | CTD | 165 | Standard | 7/28/08 2:47 | 7/28/08 2:57 | 60.58242 | 173.6637 | 60.58261 | 173.6591 | 70 | 70 | start; end |
| 132 | 70M47 | CALVET | | | 7/28/08 3:03 | 7/28/08 3:15 | 60.58236 | 173.6563 | 60.58158 | 173.65 | 69 | 69 | |
| 133 | 70M46 | CTD | 166 | Standard | 7/28/08 4:17 | 7/28/08 4:26 | 60.41767 | 173.5925 | 60.41653 | 173.5863 | 64 | 64 | start; end |
| 134 | 70M45 | CTD | 167 | Standard | 7/28/08 5:26 | 7/28/08 5:36 | 60.25488 | 173.523 | 60.25357 | 173.5175 | 69 | 69 | start; end |
| 135 | 70M44 | CTD | 168 | Standard | 7/28/08 6:38 | 7/28/08 6:48 | 60.11542 | 173.3251 | 60.11288 | 173.323 | 70 | 70 | start; end |
| 135 | 70M44 | CALVET | | | 7/28/08 6:54 | 7/28/08 6:58 | 60.11214 | 173.3207 | 60.11181 | 173.3197 | 69 | 69 | |
| 136 | 70M43 | CTD | 169 | Standard | 7/28/08 8:04 | 7/28/08 8:11 | 60.0461 | 173.026 | 60.04477 | 173.0245 | 67 | 67 | start; ctd 169; end; ctd 169 |
| 137 | 70M42 | CTD | 170 | Standard | 7/28/08 9:08 | 7/28/08 9:15 | 59.98245 | 172.7199 | 59.98161 | 172.7179 | 68 | 68 | start; ctd 170; end; ctd 170 |
| 138 | 70M41 | CTD | 171 | Standard | 7/28/08 10:26 | 7/28/08 10:34 | 59.90173 | 172.4213 | 59.90153 | 172.4197 | 74 | 74 | start; ctd 171; end; ctd 171 |
| 139 | 70M40 | CTD | 172 | Standard | 7/28/08 11:45 | 7/28/08 11:53 | 59.84523 | 172.0934 | 59.84521 | 172.0904 | 75 | 75 | start; ctd 172; end; ctd 172 |
| 140 | 70M39 | CTD | 173 | Standard | 7/28/08 12:44 | 7/28/08 12:52 | 59.83067 | 171.7743 | 59.82996 | 171.7713 | 74 | 74 | start; ctd 173; end; ctd 173 |
| 141 | 70M38 | CTD | 174 | Standard | 7/28/08 13:45 | 7/28/08 13:54 | 59.77457 | 171.457 | 59.77396 | 171.4541 | 73 | 73 | start; ctd 174; end; ctd 174 |
| 142 | 70M37 | CTD | 175 | Standard | 7/28/08 14:46 | 7/28/08 14:54 | 59.71879 | 171.1457 | 59.71807 | 171.1441 | 72 | 72 | start; ctd 175; end; ctd 175 |
| 143 | 70M36 | CTD | 176 | Prod | 7/28/08 15:46 | 7/28/08 16:03 | 59.59962 | 170.9162 | 59.59779 | 170.9144 | 70 | 70 | start; ctd 176; end; ctd 176 |
| 143 | 70M36 | BIO-OPTICS | | | 7/28/08 16:12 | 7/28/08 16:32 | 59.5948 | 170.913 | 59.5948 | 170.913 | 70 | 70 | |
| 144 | 70M35 | CTD | 177 | Standard | 7/28/08 17:19 | 7/28/08 17:29 | 59.43689 | 170.8788 | 59.43597 | 170.8798 | 72 | 72 | start; ctd 177; end; ctd 177 |
| 145 | 70M34 | CTD | 178 | Standard | 7/28/08 18:18 | 7/28/08 18:27 | 59.33101 | 170.666 | 59.33177 | 170.667 | 70 | 70 | start; ctd 178; end; ctd 178 |
| 146 | 70M33 | CTD | 179 | Standard | 7/28/08 19:21 | 7/28/08 19:29 | 59.25999 | 170.3815 | 59.26033 | 170.3812 | 69 | 69 | start; ctd 179; end; ctd 179 |
| 147 | 70M32 | CTD | 180 | Standard | 7/28/08 20:27 | 7/28/08 20:35 | 59.11232 | 170.237 | 59.11232 | 170.237 | 66 | 66 | start; end |
| 148 | 70M31 | CTD | 181 | Standard | 7/28/08 21:40 | 7/28/08 21:50 | 58.9517 | 170.3234 | 58.95328 | 170.3214 | 70 | 70 | start; end |
| 149 | 70M30 | CTD | 182 | Standard | 7/28/08 22:56 | 7/28/08 23:05 | 58.7849 | 170.289 | 58.78682 | 170.2891 | 70 | 70 | start; end |
| 149 | 70M30 | BIO-OPTICS | | | 7/28/08 23:08 | 7/28/08 23:18 | 58.7928 | 170.287 | 58.7928 | 170.2873 | 71 | 71 | |
| 149 | 70M30 | BIO-OPTICS | | | 7/28/08 23:20 | 7/28/08 23:32 | 58.7927 | 170.2872 | 58.7935 | 170.2873 | 71 | 71 | |
| 150 | 70M29 | CTD | 183 | Standard | 7/29/08 0:51 | 7/29/08 1:00 | 58.61178 | 170.2672 | 58.61256 | 170.2659 | 70 | 70 | start; end |
| 151 | 70M28 | CTD | 184 | Standard | 7/29/08 2:10 | 7/29/08 2:23 | 58.44913 | 170.1795 | 58.44978 | 170.1772 | 73 | 73 | start; end |
| 152 | 70M27 | CTD | 185 | Standard | 7/29/08 3:44 | 7/29/08 3:56 | 58.2804 | 170.0828 | 58.27989 | 170.0819 | 72 | 72 | start; end |
| 153 | 70M26 | CTD | 186 | Standard | 7/29/08 5:09 | 7/29/08 5:24 | 58.14606 | 169.9081 | 58.14544 | 169.91 | 72 | 72 | start; end |

| Stn.# | Station Name | Event Type | Cast# | CTD Type | Time in Water (UTC) | Time on Deck (UTC) | Start Lat. | Start Long. | End Lat. | End Long. | Start Depth (m) | End Depth (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 153 | 70M26 | CTD | 186 | Radon | 7/29/08 5:10 | 7/29/08 5:25 | 58.146 | 169.9082 | 58.146 | 169.9082 | 72 | 72 | Radon; standard cast; Plus triple O2 isotopes |
| 154 | 70M25 | CTD | 187 | Standard | 7/29/08 6:39 | 7/29/08 6:46 | 58.04802 | 169.6468 | 58.04792 | 169.648 | 70 | 70 | start; end |
| 155 | 70M24 | CTD | 188 | Standard | 7/29/08 7:57 | 7/29/08 8:05 | 57.97522 | 169.3615 | 57.97466 | 169.3627 | 70 | 70 | start; ctd 188; end; ctd 188 |
| 156 | 70M23 | CTD | 189 | Standard | 7/29/08 9:17 | 7/29/08 9:24 | 57.9102 | 169.0641 | 57.91053 | 169.0667 | 68 | 68 | start; ctd 189; end; ctd 189 |
| 156 | 70M23 | MOC | | | 7/29/08 9:30 | 7/29/08 10:02 | 57.9083 | 169.0708 | 57.8996 | 169.0443 | 55 | 55 | |
| 157 | 70M22 | CTD | 190 | Standard | 7/29/08 10:48 | 7/29/08 10:56 | 57.84367 | 168.893 | 57.84394 | 168.893 | 71 | 71 | start; ctd 190; end; ctd 190 |
| 157 | 70M22 | MOC | | | 7/29/08 11:01 | 7/29/08 11:28 | 57.84508 | 168.8898 | 57.83142 | 168.8834 | 55 | 55 | |
| 158 | 70M20 | CTD | 191 | Standard | 7/29/08 12:49 | 7/29/08 12:58 | 57.63033 | 168.8139 | 57.63144 | 168.8129 | 70 | 70 | start; ctd 191; end; ctd 191 |
| 158 | 70M20 | MOC | | | 7/29/08 13:03 | 7/29/08 13:34 | 57.63339 | 168.8104 | 57.63374 | 168.7745 | 55 | 55 | |
| 159 | 70M19 | CTD | 192 | Standard | 7/29/08 14:38 | 7/29/08 14:47 | 57.52684 | 168.6108 | 57.52511 | 168.6078 | 71 | 71 | start; ctd 192; end; ctd 192 |
| 160 | 70M18 | CTD | 193 | Standard | 7/29/08 16:02 | 7/29/08 16:12 | 57.49959 | 168.3034 | 57.49854 | 168.3043 | 70 | 70 | start; ctd 193; end; ctd 193 |
| 161 | 70M17 | CTD | 194 | Standard | 7/29/08 17:59 | 7/29/08 18:11 | 57.49982 | 167.988 | 57.49904 | 167.9941 | 71 | 71 | start; ctd 194; end; ctd 194 |
| 162 | 70M16 | CTD | 195 | Standard | 7/29/08 19:37 | 7/29/08 19:50 | 57.50119 | 167.6708 | 57.50057 | 167.6765 | 71 | 71 | start; end |
| 163 | 70M15 | CTD | 196 | Standard | 7/29/08 21:11 | 7/29/08 21:22 | 57.50159 | 167.3508 | 57.50148 | 167.3549 | 70 | 70 | start; end |
| 164 | 70M14 | CTD | 197 | Standard | 7/29/08 22:40 | 7/29/08 22:53 | 57.52459 | 167.0425 | 57.5258 | 167.045 | 70 | 70 | start; end |
| 164 | 70M14 | BIO-OPTICS | | | 7/29/08 23:00 | 7/29/08 23:25 | 57.5263 | 167.0462 | 57.5265 | 167.0453 | 69 | 69 | |
| 165 | 70M13 | CTD | 198 | Radon | 7/30/08 0:44 | 7/30/08 0:55 | 57.4279 | 166.8021 | 57.4279 | 166.8021 | 70 | 70 | Radon and triple O2 isotopes collected from standard cast bottles |
| 165 | 70M13 | CTD | 198 | Standard | 7/30/08 0:44 | 7/30/08 0:59 | 57.42788 | 166.8021 | 57.42966 | 166.8037 | 70 | 70 | start; end |
| 166 | 70M12 | CTD | 199 | Standard | 7/30/08 2:03 | 7/30/08 2:14 | 57.44466 | 166.5239 | 57.4444 | 166.5234 | 69 | 69 | start; end |
| 167 | 70M11 | CTD | 200 | Standard | 7/30/08 3:25 | 7/30/08 3:34 | 57.31634 | 166.3303 | 57.31593 | 166.3306 | 71 | 71 | start; end |
| 168 | 70M10 | CTD | 201 | Standard | 7/30/08 4:47 | 7/30/08 4:57 | 57.32066 | 166.0056 | 57.31907 | 166.004 | 71 | 71 | start; end |
| 169 | 70M9 | CTD | 202 | Standard | 7/30/08 5:59 | 7/30/08 6:09 | 57.26294 | 165.7405 | 57.26116 | 165.7394 | 70 | 70 | start; end |
| 170 | 70M8 | CTD | 203 | Standard | 7/30/08 7:12 | 7/30/08 7:21 | 57.11079 | 165.6044 | 57.11013 | 165.6041 | 70 | 70 | start; end |
| 171 | 70M7 | CTD | 204 | Standard | 7/30/08 8:34 | 7/30/08 8:42 | 56.99666 | 165.3775 | 56.9958 | 165.3773 | 72 | 72 | start; ctd 204; end; ctd 204 |
| 172 | 70M6 | CTD | 205 | Standard | 7/30/08 9:59 | 7/30/08 10:09 | 56.89339 | 165.1366 | 56.89239 | 165.1362 | 72 | 72 | start; ctd 205; end; ctd 205 |
| 172 | 70M6 | MOC | | | 7/30/08 10:44 | 7/30/08 10:44 | | | 56.89852 | 165.1084 | 55 | 55 | |
| 173 | 70M5 | CTD | 206 | Standard | 7/30/08 11:43 | 7/30/08 11:52 | 56.91044 | 164.8363 | 56.91124 | 164.8363 | 73 | 73 | start; ctd 206; end; ctd 206 |
| 173 | 70M5 | MOC | | | 7/30/08 11:56 | 7/30/08 12:15 | 56.9118 | 164.8361 | 56.90996 | 164.8185 | 55 | 55 | |
| 174 | 70M4 | CTD | 207 | Standard | 7/30/08 13:17 | 7/30/08 13:25 | 56.85241 | 164.5709 | 56.85302 | 164.5712 | 73 | 73 | start; ctd 207; end; ctd 207 |
| 174 | 70M4 | MOC | | | 7/30/08 13:29 | 7/30/08 13:53 | 56.85418 | 164.5716 | 56.85155 | 164.5482 | 55 | 55 | |
| 175 | 70M3 | CTD | 208 | Standard | 7/30/08 14:47 | 7/30/08 14:56 | 56.83136 | 164.3087 | 56.83221 | 164.3108 | 73 | 73 | start; ctd 208; end; ctd 208 |
| 175 | 70M3 | CALVET | | | 7/30/08 15:08 | 7/30/08 15:12 | 56.8321 | 164.3117 | 56.83198 | 164.3118 | 73 | 73 | |
| 176 | 70M2 | CTD | 209 | Standard | 7/30/08 16:10 | 7/30/08 16:20 | 56.85189 | 164.0647 | 56.85079 | 164.0653 | 74 | 74 | start; ctd 209; end; ctd 209 |
| 176 | 70M2 | CALVET | | | 7/30/08 16:28 | 7/30/08 16:35 | 56.84925 | 164.0662 | 56.84925 | 164.0662 | 69 | 69 | |
| 176 | 70M2 | BIO-OPTICS | | | 7/30/08 16:40 | 7/30/08 16:55 | 57.42 | 164.1 | 57.4183 | 164.0833 | 69 | 69 | |
| 177 | 70M1 | CTD | 210 | Standard | 7/30/08 17:54 | 7/30/08 18:00 | 56.76693 | 163.9595 | 56.76677 | 163.9596 | 74 | 74 | start; ctd 210; end; ctd 210 |
| 177 | 70M1 | CALVET | | | 7/30/08 18:08 | 7/30/08 18:18 | 56.76489 | 163.9609 | 56.76489 | 163.9609 | 69 | 69 | |
| 177 | 70M1 | BIO-OPTICS | | | 7/30/08 18:20 | 7/30/08 18:40 | 56.7568 | 163.9723 | 56.7572 | 163.9733 | 73 | 73 | |

Appendix 2 – Details for sampling and deployment procedures

## CTD Rosette water budget.

Priority/Order for CTD Rosette Water Sampling – HLY0803. Circulate clockwise around the rosette, beginning at the deepest Niskin bottle (No. 1).

| Priority/ Order | Sampling | Sampler(s) | Sample Vol. /Niskin | Depths | How Often? | Notes |
|---|---|---|---|---|---|---|
| 1 | Radon | Shull/ Brusseau | 20 L | A few | | Separate casts |
| 1 | Triple oxygen Isotopes | Moran | 0.5 L | A few | | |
| 2 | $O_2$ (Winkler) | Calvin Mordy (NOAA/PMEL) | 0.7 L (1.4L total for dup. | | Every station | Dup. At 2 depths |
| 2 | DIC & Alkalinity | PMEL | 1.5 L | 6 depths | ~1/3 of stations | |
| 2.5 | $\delta^{18}O$ | Weingartner, and Others | 50ml | 3 | Selected-all | |
| 3 | N Production | Sambrotto/ Burdloff | 5-8 L | 7 | daily | Prod. casts |
| | C production | Casey/ Tiahlo | 1-2 L | 7 | daily | Prod. casts |
| | Micro-zooplankton | Stoecker | 5 L | 10 | Half of stns.? | Prod. casts et al. |
| 3 | Particulates/ DON/ | Sambrotto/ Burdloff | 4 L | 10 | ~1/3 of stations | |
| 3 | zooplankton | Taylor/ Pleuthner | 30L | Chl Max | Every station | Separate casts |
| 3 | Phyto. fluorescent properties/ ALFS | Goes and others | 0.5 | | | |
| 3 | Total Chl | PMEL | 1.5L | 6 | Every station | |
| 3 | Fractionated Chl | PMEL | 1.5L | 6 | ~1/3 station | |
| 4 | $\delta^{15}N-NO_3$ | Sambrotto/ Burdloff | 0.125 L | All | ~12 stns | |
| 4 | $\delta^{15}N$-DON | Sambrotto/ Burdloff | 0.125 L | All | ~12 stns | |
| 4 | Nutrients | Calvin Mordy (NOAA/PMEL) | 0.1 L | All | All | |
| 4 | Salinity | SIO | 0.6 L | selected | All | |

Niskin bottle positions in various water depths

| Niskin Bottle no. | Niskin depth | Niskin depth | Niskin depth |
|---|---|---|---|
| 1 | 0 | 0 | 0 |
| 2 | 10 | 10 | 10 |
| 3 | 20 | 20 | 20 |
| 4 | 30 | 30 | 30 |
| 5 | 40 | 40 | 40 |
| 6 | 50 or 60 | 50 or 60 | 50 or 60 |
| 7 | bottom | 75 | 75 |
| 8 | chl max | 100 | 100 |
| 9 | | 125 | 150 |
| 10 | | 150 | 200 |
| 11 | | bottom | bottom |
| 12 | | chl max | chl max |

**Invitation for educational outreach at Marine Science Camp on St. George Island**

1.1.1.1.1 PO Box 211470
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***"Serving Coastal Alaska Since 1988"***

Ray Sambrotto, Chief Scientist 13 June 2008
BEST/BSIERP July 2008 Cruise
By e-mail: sambrott@ldeo.columbia.edu

Dear Ray:
It's great to hear that R/V Healy will be working in the vicinity of the Pribilof Islands this summer. As we discussed, I will be conducting an intensive marine science camp on St. George Island in July for students from both islands. This is an outgrowth of a short Ocean Science Days program I led with Tribal government and school leaders in April 2008. Students were very inspired and so enthusiastic to pursue marine science studies that their communities, school district and tribal entities pooled resources to hold a science camp this summer. A brief description of the program is attached at the end of this memo.

The students have exhibited deep interest in exploring marine species and ecosystems in the Bering Sea broadly and near their islands. They are also intrigued by research technology being used to examine the marine ecosystem, which they know from an island perspective.

If there is an opportunity for these students to join researchers on the R/V Healy during even a brief working cruise in July, it would be tremendously valuable for them in many ways: exposure to technology, engagement in discussion of ongoing research with scientists from outside, collection of data and or specimens from deeper waters further offshore from the near shore realm in which we will be working during camp.

Please contact me at any time if you wish to discuss a student mini research expedition aboard the R/V Healy. The students will be thrilled to have such an experience, so we will remain open to any means to make this happen for them.

Michelle Ridgway, Director

Pribilof Marine Science Camp

# Pribilof Island Marine Science Camp ~

# Discovering Wonders of the Bering Sea Ecosystem

From July 8-18, 2008, twenty Aleut students from the Pribilof School District will work together in an intensive marine science camp program. Half of the team will travel from St. Paul Island to join the St. George Island students for field and laboratory research focused entirely on the sea surrounding their island homes. Research projects will build upon king crab ecology, plankton and oceanographic studies initiated in the spring Ocean Science Days program.

Highlights of the summer program include these research topics: marine fish foodwebs; king crab ecology II, oceanographic processes around the Pribilof Islands and nearby shelfbreak, plankton communities, effects of shore ice on intertidal communities, nearshore benthic habitat suitability for king crab.

Students will use GPS to map marine habitats, an ROV to investigate nearshore subtidal habitats, CTD for nearshore pelagic habitat characterization, crab larvae catchment units, plankton nets, van veen grabs, pots and a trawl sampling net to examine species and habitats of interest.