Cruise Report
Bering Ecosystem Study-Bering Sea Integrated Research Program
R/V Thomas G. Thompson TN249
May 9 – June 14, 2010

Prepared by Carin Ashjian, Chief Scientist, and the TN249 Science Team

Photo by Terry Anderson

Funded by the National Science Foundation and the North Pacific Research Board

Acknowledgements

The Captain and crew of the Thompson have been extremely accommodating and welcoming. We greatly appreciate their assistance and their support of our science. It has been a pleasure to work with them. Our marine technicians Rob Hagg and Steve Jalickee, together with marine technician interns Evan Johnson and Russell Rejda, assisted us with routine deck operations, ship underway data collection, CTD data acquisition, and computer networking as well as with the usual unforeseen breakdowns in equipment. Their assistance has been invaluable; we cannot speak highly enough of them. Jessica Cross took on the task of maintaining the "autonomous" underway sensor systems that were installed by scientists outside of the program; many thanks to Jessica for her hard work. The North Pacific Research Board posted the Chief Scientist's blog on their web site; many thanks to Carolyn, Michael, Tom, and Nora at the NPRB for their work on this. Dave Forcucci assisted in acquiring the ice imagery from the National Ice Center (NIC). We are grateful to the NIC for providing satellite ice imagery daily or twice daily and thank everyone at the NIC who participated in that effort.

Note: All data and summaries in this report are preliminary unpublished data subject to revision or correction with intellectual property reserved to the scientist contributing to the report. Please contact the individual scientist responsible for each section (see Appendix 1 for contact information) for additional information.

Overview

The overall objective of this cruise was to describe the lower trophic levels of the Bering Sea ecosystem under varying environmental conditions, including proximity to sea ice and cross-shelf location, in order to better understand ecosystem response to ongoing changes in climate, ice cover (extent of ice cover and timing of ice formation and retreat), and accompanying oceanographic conditions. Sampling was planned along four established cross-shelf transects (CN, NP, MN, and SL lines) and longitudinally along the 70 m isobath between the CN line in the south and the SL line in the north. Additional opportunistic or event driven sampling was envisioned. Eleven projects were supported on cruise TN249 on board the *R/V Thomas G. Thompson* in the Bering Sea during the period of May 9 – June 14, 2010. Thirty-five science party members were on board, including two marine science technicians and two marine science technician interns who assist all scientists with the on-deck sampling.

Seasonally persistent ice cover prevented our access to the inner shelf along three of four of the cross-shelf transects during the first half of the cruise. Even in late-May and early June, we could not access the inner end of the MN line (MN1 – MN6) or the innermost station on the NP line (NP1) because of sea ice cover. Scientifically, it had been hoped to complete cross-shelf transects earlier in the cruise than was possible. Sampling was completed along the 70 m line (with one station skipped because of ice), the MN line deeper than ~65 m, almost all of the NP line (the inner station could not be sampled because of ice), and the CN line (although we sampled ever other station along that line because of time constraints) (Fig. 1). During the first portion of the cruise, when much of the shelf was still inaccessible, sampling was conducted along ad-hoc transects established in ice free or light ice regions, with some extending from the shelf break inshore as far as the ice, or time, would permit (ZN, A, KP), some zigzagging along the ice edge and one on the shelf across Zemchung Canyon (ZC). Our inability to sample across the shelf in its entirety, and particularly during the first portion of the cruise, compromised the achievement of our cruise objectives.

One hundred and ninety five stations were occupied during the cruise. A Conductivity-Temperature-Depth (CTD) with rosette cast was done at every station except one and Video Plankton Recorder casts and CalVET net tows were done at some locations. More intensive sampling was conducted every other day at nine "Process" stations, where a fuller suite of sampling and experimentation was conducted to measure phytoplankton, microzooplankton, mesozooplankton (copepods, krill), and benthic composition and selected rates (e.g., grazing, reproduction, nutrient regeneration, production) and every night during the "Krill Suite" of sampling to collect krill. Other sampling (e.g., benthic grabs, plankton tows, benthic cores) also was conducted several times per day at selected locations. Altogether we conducted 246 CTD casts, 104 vertical ring net tows, 27 horizontal ring net tows, 72 VPR casts, 66 CalVet net tows, 28 MOCNESS tows, 18 vertical Bongo tows, 20 towed Bongo tows, 4 drifter deployments, multiple deployments of the Multicore at 34 stations, and Van-Veen grab series (3 grabs) at 18 stations. Floating sediment traps were deployed 5 times; unfortunately the traps were lost during recovery after the first deployment so that only 4 recoveries were successful using the spare traps. A set of Bongo nets was lost during the second deployment; a spare was shipped to St. Paul and picked up during a personnel transfer on May 27.

Underway sampling of the surface water for temperature, salinity, and fluorescence, water velocity, and seafloor topography from Multibeam and underway observations of marine mammal and bird distributions and sea ice extent and type also have been conducted. We had on board four additional underway sampling sensors; a flow cytometer, a pCO2 sampler with an ISUS nitrate sensor, and a MIMS sensor system (please see report from hydographic group below). Although these sensors should ultimately provide valuable data, they were not as autonomous as advertised and required substantial attention by Jessica Cross, who is not affiliated with the sensor owners. Furthermore, the data collected have not been available yet to the project, with the exception of ISUS data that was not available in real time and thus was less useful than it had been on previous cruises when the data were automatically entered into the MapServer.

John Allison and Dennis Flanigan from EOL set up and maintained the Mapserver and Field Catalog on board. The field catalog is well populated with the event log, preliminary CTD data, station sheets, and plots of underway data. The Mapserver was fully operational, with satellite images available to view relative to the cruise track, historic Multibeam data, underway temperature, salinity, fluorescence, and ISUS nitrate data, planned and accomplished stations, and the full set of query tools. We were delighted to have this capability on board. Portions of the cruise catalog were mirrored at http://catalog.eol.ucar.edu/best_tn249/. The Mapserver was used by the Captain and crew as well as by the science party. We also instituted an event board ("Board of Lies") similar to that is used on the Healy for this cruise on Thompson and installed a web cam so that the schedule of events is available via the ship web page throughout the ship.

A mid-cruise personnel transfer at St. Paul Island, AK was conducted on May 27. Five people disembarked and five people embarked; four each members of the science party and one each crewmember. Personnel embarking arrived at St. Paul by Tuesday May 25 with target dates of May 26-28 for the exchange. Unfortunately, several important cargo items (computer for the marine technicians, replacement bongo nets) had not arrived in St. Paul by May 25. After locating the items, it was decided to delay the personnel transfer until the evening of May 27 so that the missing cargo could arrive on the 1800 cargo flight.

Ice imagery was slow in arriving but eventually was available to the ship regularly from the National Ice Center. Several different types of images are posted to the ftp site daily or twice daily, including Radarsat2, Radarsat1, MODIS, Envisat, and ALOS. The imagery was a great help when it covered the region in which we were operating. Radarsat1, because of its' larger footprint, more often covers the region than Radarsat2 that has a gap between swaths that unfortunately coincided with the location of our 70m isobath transect. The MODIS images also were quite helpful when cloud free because of their large footprint.

We had on board four laboratory vans and three storage vans. The storage vans enabled us to keep all of the cargo for both BEST cruises on board rather than storing cargo needed for the summer cruise only or empty shipping crates in Dutch Harbor. Two of the laboratory vans belonged to the University of Washington and two were part of the UNOLS van pool, with one of the latter two being the OPP Arctic General Purpose Van. The heater in the OPP Arctic Van failed about a week into the cruise. Chief Engineer Terry Anderson assessed the situation and consulted with the manufacturer of the van and determined that the fault was likely a fuse deep

within the A/C Unit. Two space heaters that belong to Thompson crew members were pressed into service in that van and the temperature inside is satisfactory. Therefore we elected not to excavate the fuse out of the van A/C Unit at this time. Although it has been suggested that the A/C units on these vans are not designed for use in the extreme cold experienced in the Arctic during winter/spring, it appears that the A/C units might not be suitable for winter conditions even in temperate regions since the temperatures experienced on this cruise (~0 °C or 32 °F) were consistent with what would be experienced on Georges Bank in winter (for instance). Two heaters were sent to St. Paul from the UNOLS West Coast Van Pool (thanks Pete Zerr and Don Hilliard), however the heaters were lost in transit and did not make it to St. Paul. New heaters were then sent to Dutch Harbor for use in this van on the summer cruise. The heater and the liquid scintillation counter in the radioactive isotope van failed as well. A portable liquid scintillation counter was borrowed from the University of Rhode Island and brought aboard at St. Paul during the personnel transfer. The Lomas group, users of the radioactive isotope van, had on board a heater used during the Healy cruise of spring 2009 when the heater in a different radioactive van also failed; this heater is providing sufficient heat. The radiation van also leaks in at least three locations (around one door and two locations that seem to be in the roof with water leaking into the van at the bottom of the wall) when showered with sea spray during rough sea conditions.

We had five water baths on deck plumbed with ambient seawater and furnished with electricity. Providing the seawater required fabrication of two manifolds for distribution of the seawater stream; this was done by the Thompson engineering department prior to sailing from Seattle. The seawater flow to the water baths was excellent and we experienced no problems with the seawater supply or with temperatures in the water baths not being maintained at ambient temperatures. Furthermore, because of the more benevolent temperatures (relative to the 2009 and 2009 spring cruises), we did not experience freezing of the water bath drain hoses.

Chief Scientist Carin Ashjian maintained a cruise “blog” that was posted at the NPRB web site (bsierp.nprb.org).

Overall, the cruise was very successful with all groups obtaining plentiful samples and data and conducting numerous experiments. Because of our inability to access the inner shelf, our original objectives could not be met completely. This was wholly due to the unusually persistent sea ice cover.

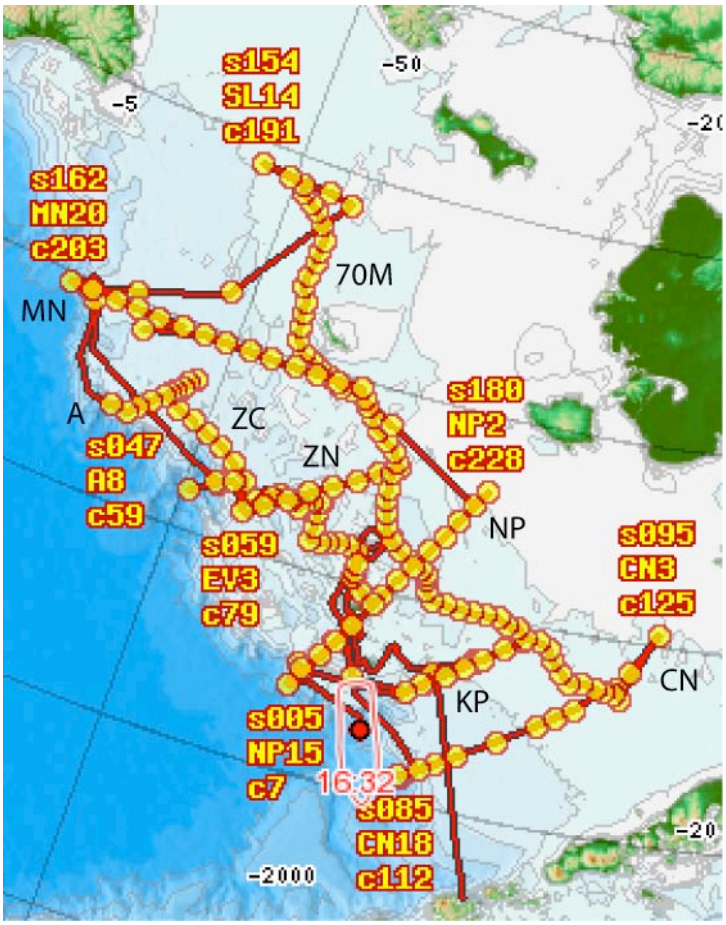


Figure 1. Cruise track and sampling locations. The four BEST cross-shelf transects (CN, NP, MN, and SL) are noted as well as the BEST 70 m isobath line (70M). Other ad-hoc transects also noted (KP, ZN, A, ZC).

INDIVIDUAL PROJECT REPORTS

Note that tables and figures are numbered sequentially within each project but not within the document.

A Service Proposal to Examine Impacts of Sea-ice on The Hydrographic Structure and Nutrients Over the Eastern Bering Sea Shelf

PIs: Terry Whitledge (UAF), Rolf Sonnerup (UW), Phyllis Stabeno (NOAA)

A Service Proposal to Examine Impacts of Sea-Ice on the Distribution of Chlorophyll-a over the Eastern Bering Sea Shelf

PIs: Terry Whitledge (UAF), Dean Stockwell (UAF), Rolf Sonnerup (UW)

On-board team members: Nancy Kachel, David Kachel, Peter Proctor, Scott McKeever, Daniel Naber, Jessica Cross

The BEST Hydrographic Group conducted CTD casts and hydrographic sampling, coordinated the water collection activities of the other PI groups, and maintained and took calibration samples for several underway sampling systems attached to the ship's flow-through seawater system.

1. CTD Measurements and Sampling

By the end of the cruise (14 June 2010), the hydrographic group had completed 246 CTD casts at 195 oceanographic stations. The CTD was a Sea Bird Electronics SBE 911 plus with dual temperature and conductivity sensors. It carried dual SBE 43 oxygen sensors, a Chelsea/SeaTech/WetLabs CStar optical transmissometer, a WetLabs ECO-AFL/FL fluorometer, a Biospherical/LICOR PAR sensor and a Benthos 916 altimeter. Standard CTD casts included nutrient samples from up to 12 thirty-liter Niskin bottles, one or more Winkler oxygen samples for calibration of the oxygen sensors, three or more O^{18} samples on major transects for Tom Weingartner of the University of Alaska Fairbanks (UAF), and three to ten Total Alkalinity/Dissolved Inorganic Carbon (TA/DIC) and Dissolved Organic Carbon (DOC) samples. Total chlorophyll samples were taken from bottles at the surface, 10m, 20m, 30m, 40m and 50m. At approximately one-third of the stations samples were taken out of the same Niskin bottles for fractionated analysis. Extra nutrient samples were analyzed from bottles used for biological experiments at the request of scientists on the cruise. At deep stations, samples for Winkler oxygen, DIC/Alkalinity, nutrients and O18 analyses were taken at each depth sampled below 100m. Table 1 summarizes the sampling. Scott McKeever, using the ship's AutoSal, analyzed salinity samples for calibration. Dan Naber titrated the oxygen samples using the Winkler method. Peter Proctor analyzed nutrient samples.

Table 1. Sampling by Hydrographic Group

Hydrographic Stations	195
CTD casts	246
Salinity Samples Analyzed	167
Nutrient Samples Analyzed	1740
Winkler Oxygen Samples	225
DOC Samples	150
TA/DIC Samples	320
O^{18} Samples	349
Total Chlorophyll Samples	1082
Fractionated Chlorophyll Samples	360
Underway Samples	
Nutrient Samples	49
Total Chlorophyll Samples	46
Salinity Samples Analyzed	50

a. Total and Fractionated Chlorophyll

We collected samples from 6 depths at each station, filtered them through GFF filters and froze them at –80°C for analysis ashore. At approximately one-third of the stations, another set of samples of the same volume was collected from the same Niskins. These were filtered through 5micron membrane filters, then the GFF filters. Both fractions were then frozen at –80°C for chlorophyll analysis ashore after the cruise.

b. 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 analysis protocols for the WOCE hydrographic program as set forth in the manual by L.I. Gordon, et al (2000). Approximately 1740 samples from CTD casts were analyzed for phosphate (PO4-), nitrate (NO3-), nitrite (NO2-), orthosilicic acid (H4SiO4), and ammonium (NH4+).

A mixed stock standard consisting of silicic acid, phosphate and nitrate was prepared at PMEL by dissolving high purity standard materials (KNO3, KH2PO4 and Na2SiF6) 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 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. The overall precision of the analysis was within 1% of full range.

c. 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, or in the bottom mixed layer. End point determinations of the Winkler titration were determined poteniometrically. Thiosulfate was standardized for each batch of sample titrations, and blanks were measured periodically during the cruise.

d. TA/DIC and TOC Sampling

The sampling protocol for the TA/DIC sampling was as follows: Samples were drawn into pre-combusted, acid-washed borosilicate 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. Approximately one cm of head space was allowed for gas expansion. After the bottle was filled, it was injected with 200 µl of saturated aqueous mercuric chloride to stop biological activity in the sample. The lid was screwed on as tightly as possible, and the bottle shaken to mix in the mercuric chloride solution. Sample bottles were labeled with the station number, cast number and Niskin bottle number.

The sampling protocol for the TOC sampling was as follows: The plastic bottles were rinsed three times from the Niskin and then filled about 90% full. The caps were screwed on tight, labeled the same as the DIC samples and placed in a -20o C freezer for the duration of the cruise. Both TA/DIC and TOC samples will be transported to the University of Alaska, Fairbanks for analysis following the cruise.

e. O^{18} Sampling

The sampling protocol for O18 was as follows: 10 ml glass vials were triple rinsed from the Niskin bottle, using tubing. When the bottle was full, the tubing was slowly pulled out and pinched off to not introduce air bubbles into the vial and to leave a meniscus on the top. The vial was capped and checked to ensure no air was in the vial when sealed. After the water in the vial reached room temperature the cap was checked for looseness, tightened, and then wrapped with parafilm.

2. Underway Seawater System

The ship's underway seawater flow-through analysis system collects temperature, salinity, and fluorescence through a typical TSG system. Calibration samples were taken 1-2 times daily from the flow-through seawater line and analyzed for chlorophyll concentration and salinity. Ned Cokelet from PMEL arranged for the underway seawater sampling system to be augmented for this cruise by adding a Satlantic ISUS nitrate meter (on loan from Lisa Eisner, NOAA Auke Bay Laboratory). This system gives one new nitrate value every five minutes based

on spectrophotometric analysis. Calibrations were periodically performed by sampling the underway seawater line to analyze nitrate.

Laurie Juranek from NOAA/PMEL arranged for Richard Feely's technicians to install an underway pCO2system for both TN249 and TN250, and for Paul Quay's group at the School of Oceanography at University of Washington to keep a MIMS (mini mass spectrometer) aboard for TN249. The GO 8050 Underway pCO2 system collects real time pCO2 measurements from seawater and air. This system was periodically calibrated by the measurement of gas standards. The membrane-inlet mass spectrometer (MIMS) system samples ion currents of dissolved nitrogen, oxygen, argon, and CO2, providing real-time O2 : Ar, N2 : Ar and CO2 calibration data. These ratios can then be later analyzed in order to estimate net community production and pCO2. Calibration samples for the MIMS were taken via the ONAR sampling method according to the protocol provided in Best Practices for Ocean CO2 Measurements (Dickson, 1990).

In addition, Ginger Armbrust's technicians installed a SeaFlow flow-cytometer in the underway seawater system, hopefully as a permanent installation on the Thompson. In concept, the SeaFlow system will provide oceanographers with a real-time display of the evolution of phytoplankton populations. This evolution occurs both over time, as most phytoplankton exhibit a diurnal cycle, and space due to either ship movement or water currents. Future development of the SeaFlow processing code will include automated population tracking and a real-time display of concentration.

Jessica Cross, a UAF graduate student and member of the Hydro Team, tended all four of the underway installations throughout the cruise, completing daily and advanced maintenance as well as collecting calibration samples.

To our knowledge, continuous flow-through pCO2 data has never been collected on the Bering shelf, and these cruises provide an opportunity to establish baseline measurements over a broad area of this shelf. By taking continuous surface samples, transitions between areas of productivity, species differentiations and varying percentages of ice cover can all be continuously mapped. Furthermore, development of a permanent flow-through installation on the R/V Thompson provides a unique opportunity in data collection and management for the University of Washington and the BEST program.

3. Drifters

Four satellite-tracked ARGOS drifters, drogued at 40m with ''holey sock'' drogues, were deployed (Table 2) to examine ocean circulation over the shelf. Locations of hypothesized cross-shelf exchange were targeted.

Drifter Number	Date Deployed	Latitude deployed	Longitude deployed
72428	**17 May 2010**	**59.3253°N**	**174.3834°W**
91992	**19 May 2010**	**59.8997°N**	**177.7940°W**
51975	**2 June 2010**	**57.9056°N**	**168.9355°W**

Drifter Number	Date Deployed	Latitude deployed	Longitude deployed
51973	**3 June 2010**	**59.8467°N**	**170.1504°W**

4. Problems

The new 30 liter Niskin bottles leaked throughout the cruise. Sometimes they leaked as they were pulled out of the water and sometimes they leaked only after cracking the pressure valve. About halfway through the cruise, we realized that if we hit the bottom lid upwards, just after recovering the cage, it would set the lid in place and leaking was minimized. New O-rings have been ordered and will be installed in Dutch Harbor before the next cruise.

During stations on the MN transect (~8 June), the two temperature sensors and the salinity sensors were diverging from each other as they passed through the pycnocline. The sensors were moved down the cage farther from the Niskin bottles and that appeared to fix the problem.

Typical Results

Figure 1. Map of stations completed through 12 June 2010.

Figures 2-6. Water temperature, salinity, chlorophyll and oxygen concentrations for the partial transects completed during the first half of the cruise. These measurements are preliminary and may change after further analysis.

Figure 7. Water temperature, salinity, chlorophyll and oxygen concentrations along the 70m transect. These measurements are preliminary and may change after further analysis.

Figure 8. Water temperature, salinity, chlorophyll and oxygen concentrations along the MN transect. These measurements are preliminary and may change after further analysis.

Figure 9. Water temperature, salinity, chlorophyll and oxygen concentrations along the NP transect. These measurements are preliminary and may change after further analysis.

Figures

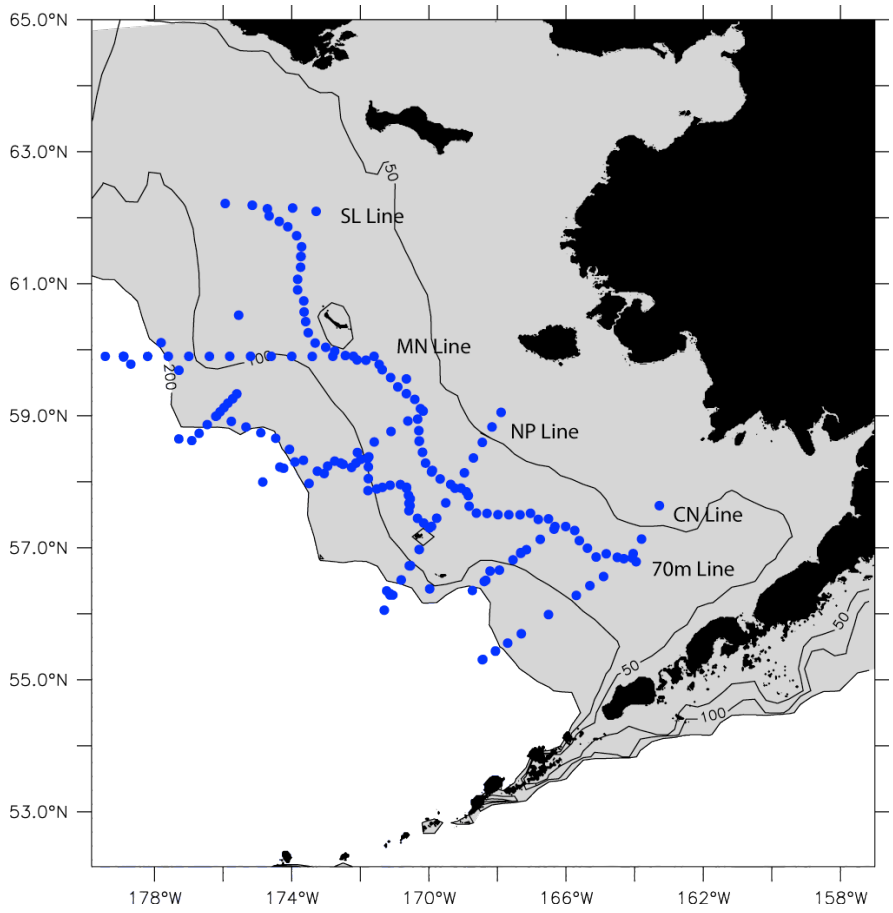


Fig. 1 Map of CTD casts completed during TN249 (9 May – 13 June 2010).

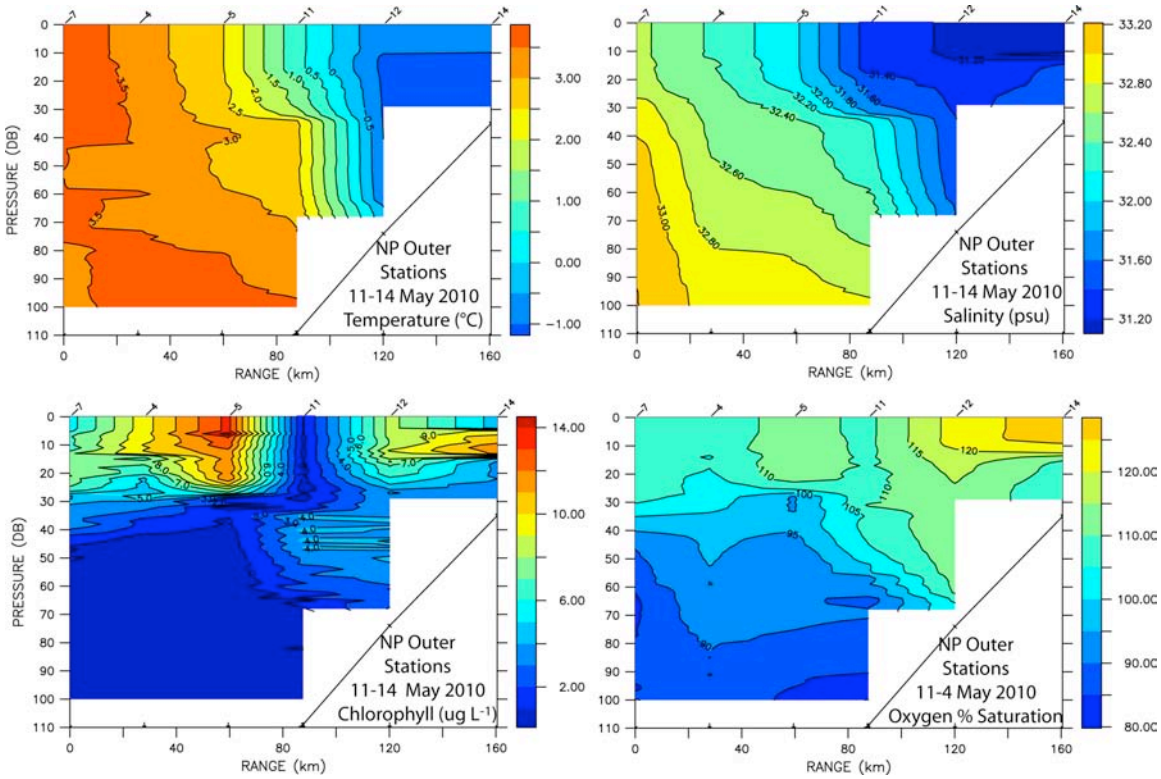


Figure 2. Water properties along the outer NP line 11-14 May 2010. Note stations were not occupied consecutively.

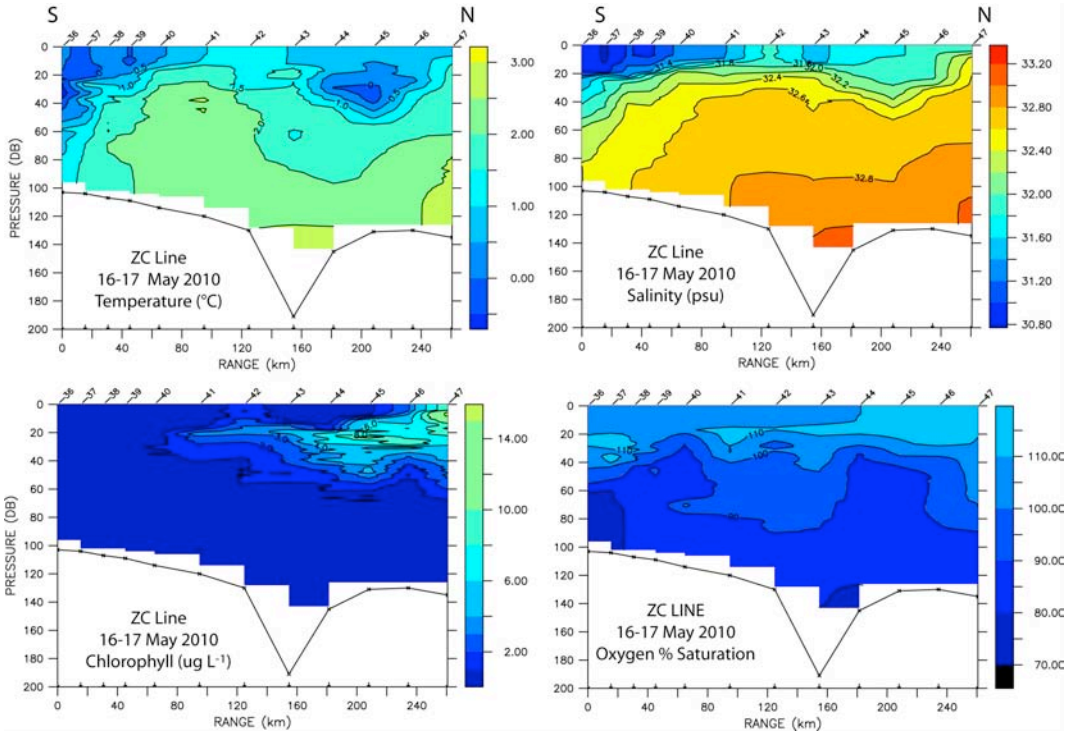


Figure 3. Water properties along the Zemchung Canyon line, 16-17 May 2010.

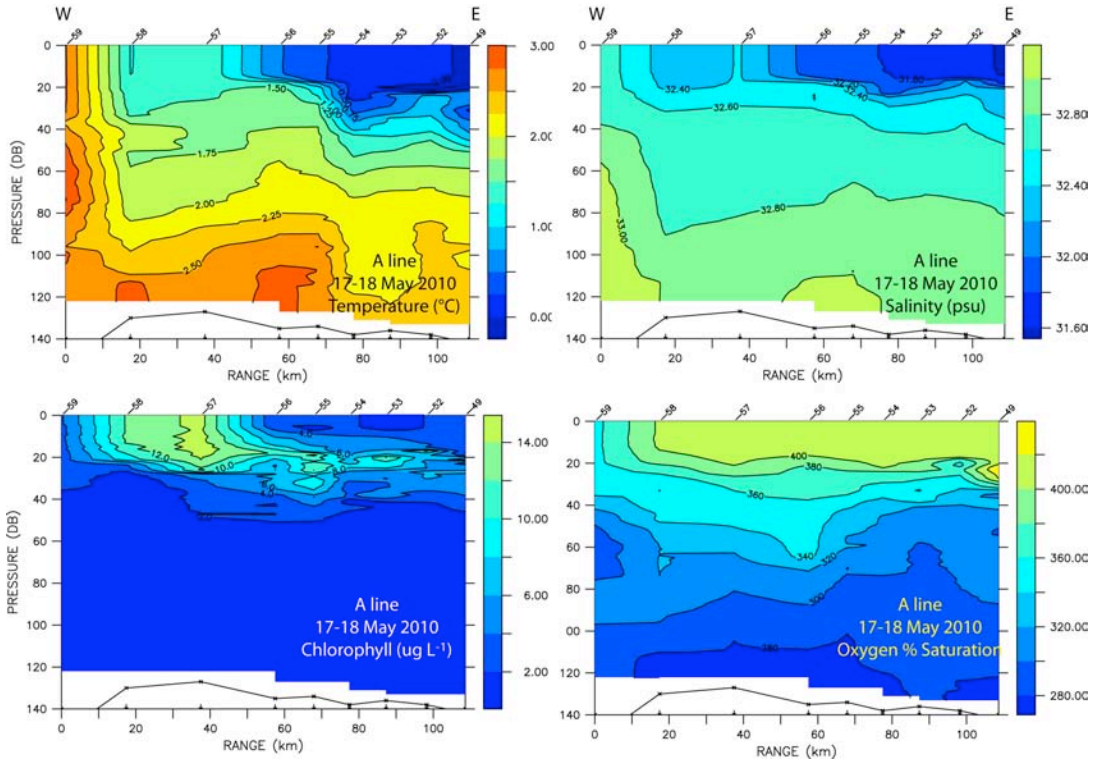


Figure 4. Water properties along the A transect on 17-18 May 2010.

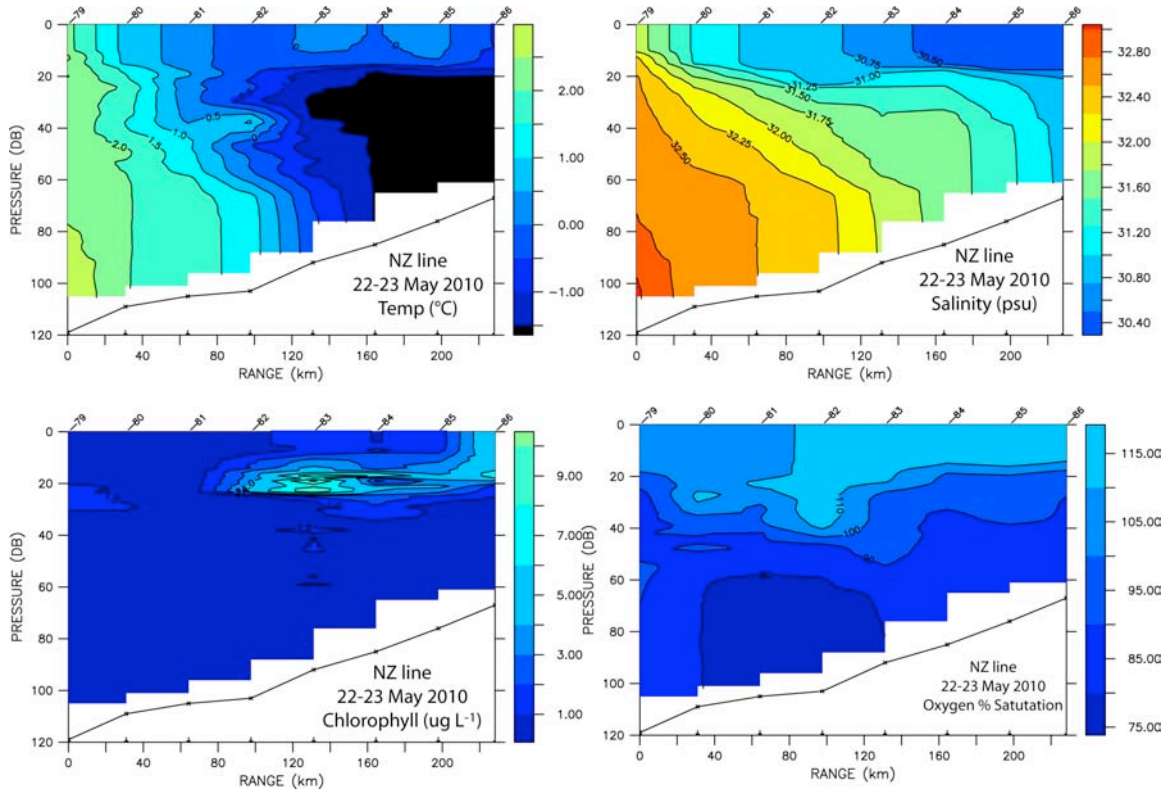


Figure 5. Water properties along the NZ transect 22-23 May 2010.

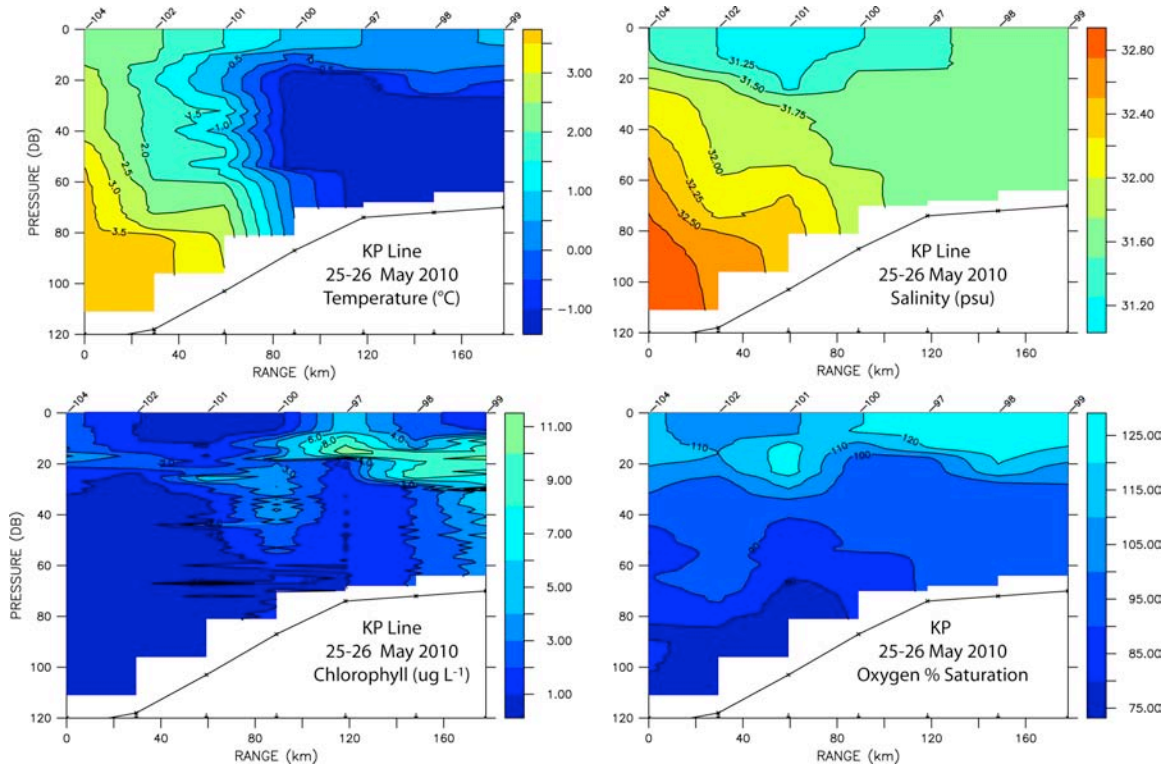


Figure 6. Water properties along the KP transect on 25-26 May 2010.

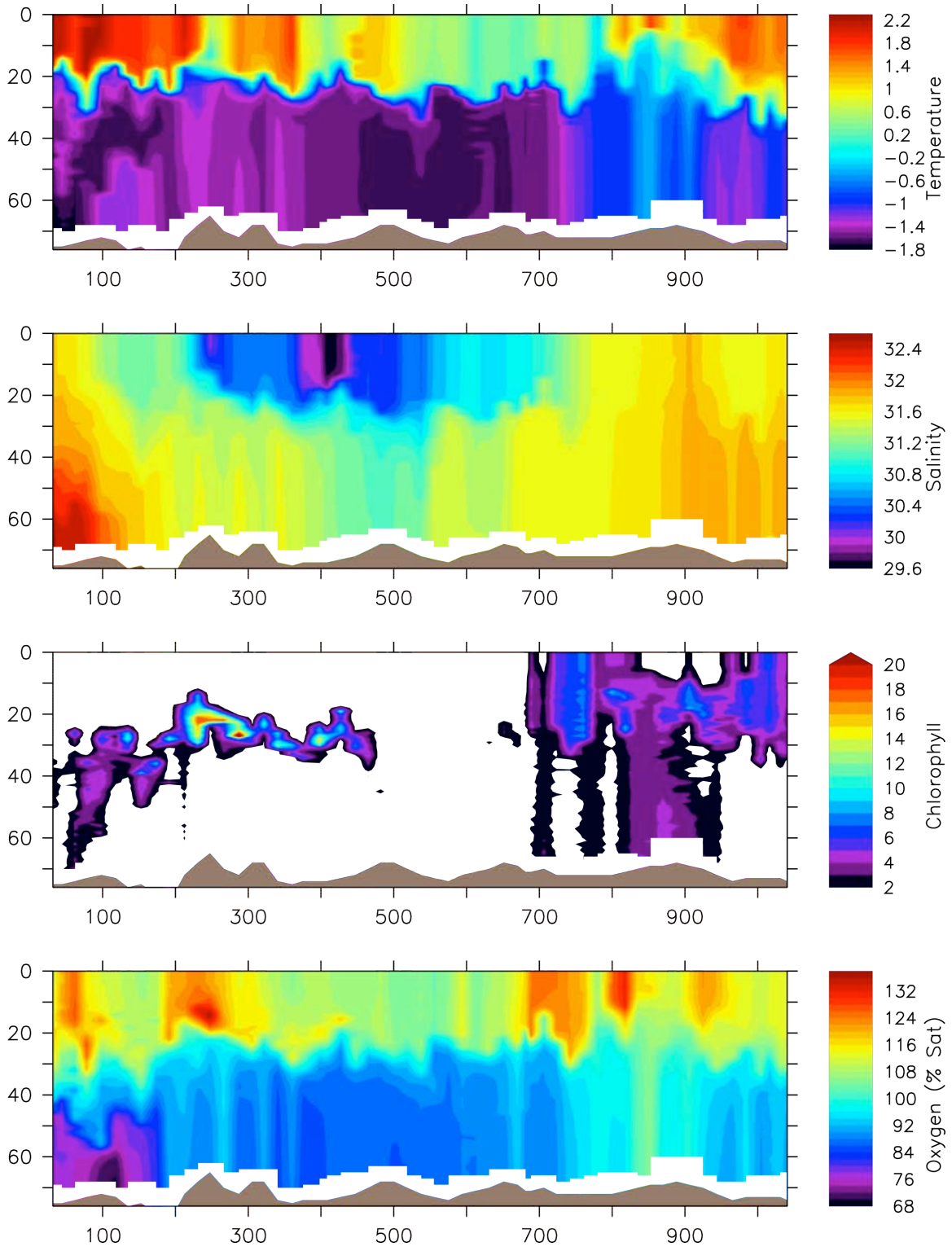


Figure 7. Water properties along the 70m transect on 31 May – 5 June 2010 (plotted from north on the left to south on the right).

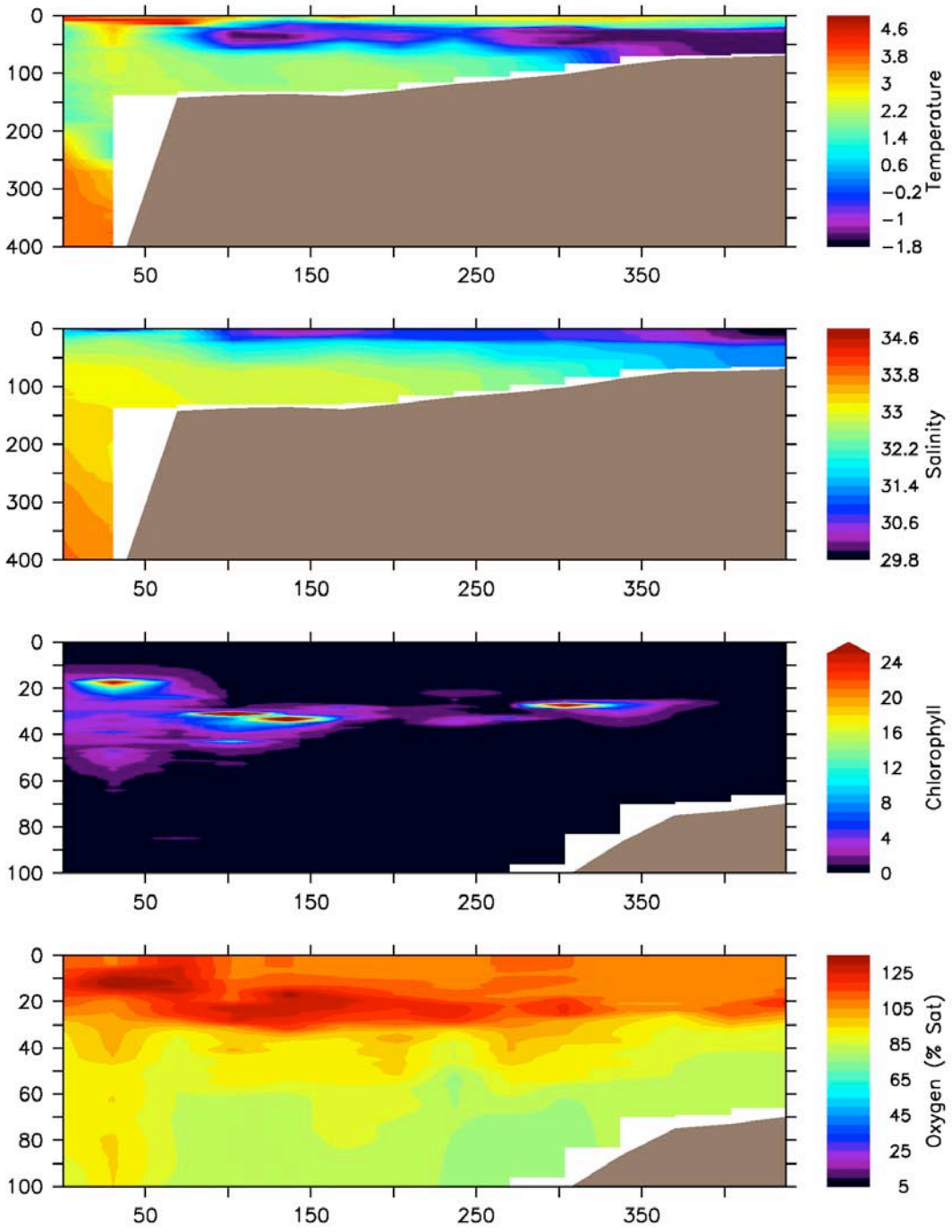


Figure 8. Water properties along the MN transect on 7 – 9 June 2010.

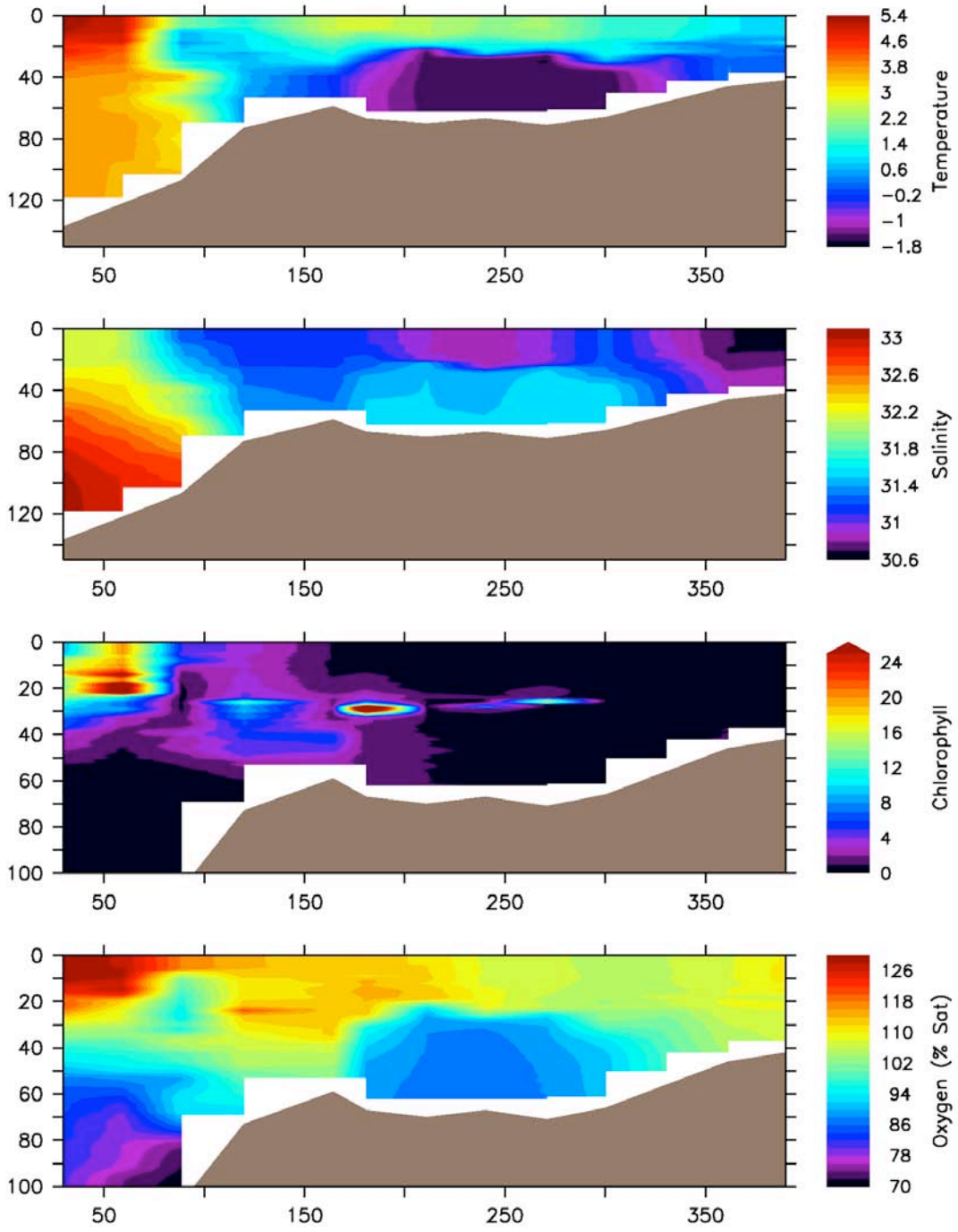


Figure 9. Water properties along the NP transect on 10 – 13 June 2010.

The Impact of Changes in Sea Ice on Primary Production, Phytoplankton Community Structure, and Export in the Eastern Bering Sea

PI's: Brad Moran (URI) and Mike Lomas (BIO)
On-Board Team: Mike Lomas (leg 1, TN249), Roger P. Kelly (leg 2, TN249), Matt Baumannm and Doug Bell

This project, part of a collaborative effort between BIOS and URI, addresses the question of whether climate-driven interannual variability in sea ice extent alters the magnitude of gross and net primary production, its autotrophic community structure, and subsequently the partitioning of primary production carbon between carbon export to the benthos and DOC within the water column. The broader project objectives are to:

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.*

A. Moran Component:

The primary goals of this project are to quantify and characterize the material sinking through the water column and its accumulation in the sediments of the Bering Sea. The sinking particulate flux will be evaluated using ^{234}Th, a tracer of particle export, and analysis of material collected in sediment traps. Thorium-234 samples are collected from the CTD-rosette at the standard depths determined by the hydro team. These 4L samples are treated with reagents (25% ammonium hydroxide, 0.2 M potassium permanganate, 1.0 M manganese chloride) to produce a manganese dioxide precipitate, which quantitatively scavenges thorium. This precipitate is collected on a filter, which is analyzed at sea for ^{234}Th using a RISO GM-25-5 beta counter. Water column samples of U-238 analysis are also being collected to evaluate the U-Salinity relationship.

This year only surface tethered sediment traps will be used to collect sinking particles from the water column. As of 6/13/10, we have conducted 6 deployments and 5 successful recoveries. In addition to ^{234}Th, trap samples will be analyzed for organic and inorganic CHN, particulate biogenic silica and phosphorus and pigments (where sufficient sample mass is collected).

Samples for suspended POC have been collected at most stations with corresponding water column Th-234 measurements. This has been done in an effort to establish a relationship between sinking material (trap POC) and suspended material. In addition to POC, these samples will be analyzed for stable C and N ratios.

In addition to water column ^{234}Th, sediment ^{234}Th is being measured at sea on samples collected by the Devol/Shull group. These measurements will be used to quantify the accumulation of ^{234}Th as well as bioturbation rates in marine sediment. In an effort to create a ^{234}Th budget, water column ^{234}Th profiles have been collected in places where sediment samples have been collected.

The table below summarizes the samples collected between May 10 and June 12, 2010, on TN249.

Station	WC Th-234	WC POC/Stable Carbon	WC U-238	Sediment Th-234	Drifting Sed. Traps
2-NP14	X	X			X*
6-NP13				X	
7-NP12	X	X			
15-Z6	X	X		X	
24-Z15	X	X		X	
35-ZC8	X			X	
39-IE1	X	X		X	
49-MN19	X	X		X	X
52-MN20	X				
54-AL1				X	
55-NZ11.5	X	X		X	X
56-P14-3	X				
57-NZ11.5	X				
66-NZ4.5	X	X		X	
69-70M26		X			
71-HBR1	X	X		X	
81-70M26	X	X		X	
84-CN17	X	X			X
85-CN18	X		X		
87-CN17	X	X		X	
99-70M4	X	X	X	X	
121-70M26	X	X			
124-70M29	X	X	X	X	
147-70M52	X	X	X	X	
156-SL12	X	X		X	
161-MN19	X	X			X
162-MN20	X		X		
163-MN19	X			X	
169-MN14	X		X	X	
175-MN8	X	X	X		

178-AL4				X	
179-NP3	X	X	X		
190-NP14	X	X			X
194-TR6				X	
195-NP15	X		X		
* Traps not successfully recovered					

Results to date:

Although ^{234}Th is being measured at sea, it is necessary to count the samples monthly over the life-time of ^{234}Th (140 days) before a precise value is known for any sample. As of this time it is impossible to evaluate any results from this component of the study.

B. Lomas component:

The primary goal of this project is quantify rates of primary production and who are the primary producers. We are collecting samples from a full light profile (7 depths), and using ^{14}C to quantify primary production in on-deck incubators. At each of these process stations we also collect samples for a detailed analysis of phytoplankton community composition. This is done in several ways. Samples are collected for flow cytometric analysis to quantify the pico- (<2µm) and nano-(<20µm) sized phytoplankton as well as heterotrophic bacteria. These groups are dominated by marine *Synechococcus* (pico-) and cryptophytes (nano-), although there are at least 2-3 other eukaryotic populations of nano-phytoplankton present. Samples are also collected microscopic analysis of micro-phytoplankton. These direct counts (by flow cytometry and microscopy) of specific phytoplankton groups are ultimately converted to carbon/population values. This information is critical for both the other biologists (e.g., M-MFW gang) on the cruise as well as modelers as we try to understand carbon flow in the first few ecosystem trophic levels. Samples from all depths are collected for size-fractionated (whole and >5µm) chlorophyll a and HPLC pigment analysis. HPLC pigment profiles will be processed to assess the relative abundance of pico-, nano- and micro-phytoplankton abundances for comparison with other analyses. Lastly, we have been collecting samples for suspended biogenic silica which is a proxy for diatoms and another means to assess phytoplankton composition.

At the non-process stations we are also collecting samples for pico- and nano-phytoplankton analyses to survey the abundance of these organisms underneath the ice in the eastern Bering Sea. Information on sea ice micro-phytoplankton (primarily diatoms) is abundant in the literature and also collected by the Gradinger and Iken group on this cruise. However, little is known about the abundance of pico- and nano-phytoplankton underneath the ice. Data from HLY0802 suggest they are in general abundant ($>10^3$ cells ml^{-1}) but have the highest abundance under the ice (compared to at the ice edge) where *in situ* light is lowest.

In addition to the above we are also collecting samples for suspended particulate organic carbon, nitrogen and phosphorus to help understand variability in environmental stoichiometry.

The table below summarizes the samples collected between May 10th and June13th 2010, on TN249. Samples collected are listed as yes (Y) or no (N) and the number of depths sampled in parentheses.

Station No.	Station Name	s-f Chla	s-f HPLC pigments	Pico-/Nano-plankton	Micro-plankton	Primary Production	Biogenic Silica
2	NP14	Y(7)	Y(4)	Y(7)	Y(4)	Y(7)	Y(4)
3	NP13	Y(4)	N	Y(4)	N	N	N
4	NP15	Y(4)	N	Y(4)	N	N	Y(4)
7	NP12	Y(7)	Y(4)	Y(7)	Y(4)	Y(7)	Y(7)
8	NP11	Y(4)	N	Y(4)	N	N	N
15	Z6	Y(4)	N	Y(4)	N	N	Y(4)
17	Z8	Y(4)	N	Y(4)	N	N	N
19	Z10	Y(3)	N	Y(3)	N	N	Y(4)
21	Z12	Y(4)	N	Y(4)	N	N	Y(4)
24	Z15	Y(4)	Y(4)	Y(4)	Y(4)	Y(7)	Y(4)
26	Z17	Y(4)	N	Y(4)	N	N	Y(4)
28	ZC1	Y(4)	N	Y(4)	N	N	Y(4)
32	ZC5	Y(4)	N	Y(4)	N	N	Y(4)
34	ZC7	Y(4)	N	Y(4)	N	N	Y(4)
35	ZC8	Y(4)	N	Y(4)	N	N	Y(4)
37	ZC10	Y(4)	N	Y(4)	N	N	Y(4)
39	IE1	Y(7)	Y(4)	Y(7)	Y(4)	Y(7)	Y(7)
45	A6	Y(4)	N	Y(4)	N	N	Y(4)
49	MN19	Y(7)	Y(4)	Y(7)	Y(4)	Y(7)	Y(7)
52	MN20	Y(4)	N	Y(4)	N	N	Y(4)
55	NZ11.5	Y(7)	Y(4)	Y(7)	Y(4)	Y(7)	Y(7)
	NZ9	Y(4)	N	Y(4)	N	N	Y(4)
63	NZ7	Y(4)	N	Y(4)	N	N	Y(4)
65	NZ5	Y(4)	N	Y(4)	N	N	Y(4)
66	NZ4.5	Y(7)	Y(4)	Y(7)	Y(4)	Y(7)	Y(7)
67	70M30	Y(4)	N	Y(4)	N	N	Y(4)
68	70M28	Y(4)	N	Y(4)	N	N	Y(4)
69	70M26	Y(4)	N	Y(4)	N	N	Y(4)
71	HBR1	Y(7)	Y(4)	Y(7)	Y(4)	Y(7)	Y(7)
81	70M26	Y(7)	Y(4)	Y(7)	Y(4)	Y(7)	Y(7)
82	BOB1	Y(4)	N	Y(4)	N	N	Y(4)
84	CN17	Y(7)	N	Y(7)	N	N	Y(7)
87	CN17	Y(7)	Y(4)	Y(7)	Y(4)	Y(7)	Y(7)
89	CN13	Y(4)	N	Y(4)	N	N	Y(4)
95	CN3	Y(4)	N	Y(4)	N	N	Y(4)
99	70M4	Y(7)	Y(7)	Y(7)	Y(4)	Y(7)	Y(7)
105	70M10	Y(4)	N	Y(4)	N	N	N
124	70M29	Y(7)	Y(7)	Y(7)	Y(4)	Y(7)	Y(7)

Station No.	Station Name	s-f Chla	s-f HPLC pigments	Pico-/Nano-plankton	Micro-plankton	Primary Production	Biogenic Silica
148	70M52	Y(7)	Y(7)	Y(7)	Y(4)	Y(7)	Y(7)
156	SL12	Y(7)	Y(7)	Y(7)	Y(4)	Y(7)	Y(7)
158	SL9	N	N	Y(4)	N	N	N
161	MN19	Y(7)	N	Y(4)	N	N	N
163	MN19	Y(7)	Y(7)	Y(7)	Y(4)	Y(7)	Y(7)
165	MN17	Y(4)	N	Y(4)	N	N	Y(4)
170	MN13	Y(4)	N	Y(4)	N	N	Y(4)
175	MN8	Y(7)	Y(7)	Y(7)	Y(4)	Y(7)	Y(7)
179	NP3	Y(7)	Y(7)	Y(7)	Y(4)	Y(7)	Y(7)
182	NP5	Y(4)	N	Y(4)	N	N	Y(4)
189	NP12	Y(4)	N	Y(4)	N	N	Y(4)
190	NP14	Y(7)	N	Y(7)	N	N	Y(7)

Results to date:

To date, we have run only 1 primary production profile due to failure of the scintillation counter. We have run all of the collected Chl a samples to date but have not yet crunched the numbers. The remaining samples will be processed and analyzed post-cruise.

Sea Ice Algae, a Major Food Source for Herbivorous Plankton and Benthos in the Eastern Bering Sea

PIs: Rolf Gradinger, Bodil Bluhm, Katrin Iken (UAF)
On board team member: Katrin Iken

Primary Objectives

Our research focused on quantifying the fate of phytoplankton and possibly ice algal production (if still available during then time of the cruise) and their transfer to the pelagic and benthic consumers of the Bering Sea. This sampling augmented previous sampling done this spring aboard the Polar Sea and sampling during 2008 and 2009 for temporal resolution. Our sampling design remained consistent with our previous cruises, in that phytoplankton, pelagic, and benthic organism samples were taken at each station in order to trace primary production using stable isotope techniques.

Methods

Phytoplankton samples were taken from the CTD Rosette at the chlorophyll max layer, filtered onto pre-combusted GF/F filters, and stored frozen. Pelagic fauna were taken with a 333 μm ring net, sorted to species, and stored frozen. Benthic fauna were collected using a van Veen grab, sorted to species, dissected for organic tissue, and stored frozen. Surface sediment samples were taken for particulate organic matter isotope content and for chlorophyll content analysis. Most samples were taken in three replicates for bulk isotopic analysis. Additional samples were

taken for isotope composition of fatty acid methyl esters (FAME). Voucher samples were prepared for organism identification back in Fairbanks.

Table 1. Sampling station summary during the 2010 Thompson BEST cruise (TN249). Numbers represent samples (incl. replicates) collected within each category

St. name	#	Lat (N)	Long (W)	Date	Depth (m)	water POM	Zoop	Benthos	sed Chl	sed POM	FAME
NP14	2	56 16.99	171 03.07	11-May-10	141	3	8	18	3	3	19
NP12	7	56 43.63	179 54.37	13-May-10	104	3	12	34	3	3	31
Z15	24	58 21.14	171 47.72	15-May-10	102	3	13	49	3	3	53
IE1	39	59 19.72	175 36.39	17-May-10	138	3	14	34	3	3	39
MN19	49	59 53.99	178 56.71	19-May-10	489	3	23	1	3	3	36
NZ4.5	66	59 04.31	170 10.26	23-May-10	67	3	7	26	3	3	45
HBR1	71	56 55.00	167 19.00	25-May-10	78	3	10	22	3	3	34
70m26	81	58 10.29	169 53.86	27-May-10	72	3	9	24	3	3	28
CN17	87	55 25.92	168 03.66	29-May-10	203	3	25	16	3	3	36
CN5	94	57 07.87	163 47.91	30-May-10	67	3	3	37	3	3	27
70m4	99	56 51.18	164 30.25	31-May-10	70	–	5	–	–	–	12
70m29	124	58 36.71	170 17.09	2-Jun-10	72	3	10	32	3	3	39
70m39	134	59 50.44	171 50.15	3-Jun-10	74	3	6	24	3	3	30
70m52	147	61 24.66	173 44.10	4-Jun-10	74	3	12	25	3	3	35
SL12	156	62 11.34	175 09.18	5-Jun-10	79	3	3	38	3	3	35
SL9	158	62 05.76	173 17.27	5-Jun-10	61	3	3	27	3	3	29
MN19/2	163	59 53.61	178 53.90	7-Jun-10	656	3	–	–	–	–	3
MN13	170	59 54.02	175 12.06	8-Jun-10	119	3	11	16	3	3	23
NP3	179	58 49.80	168 09.53	10-Jun-10	46	3	6	17	3	3	21
NP7	184	57 54.10	169 14.48	10-Jun-10	67	3	4	30	3	3	23
					TOTAL	**51**	**184**	**470**	**48**	**48**	**598**

Samples

During the first part of the cruise, remaining sea ice cover prevented progress along the established BEST transect lines. Sampling of repeat stations from previous years, therefore, occurred during the latter part of the cruise. A sample summary is given in Table 1. Samples will be further processed back at the University of Alaska, Fairbanks. Pelagic samples collected were mostly of copepods and euphausiids; benthic samples collected were mostly of polychaetes, bivalves and amphipods (see Figure 1 for examples).

Figure 1
(left to right, top): benthic sample at St Z15 with large *Macoma calcarea* and many polychates; Neptunea sp (St 70m39); *Thysanoessa rashii* (many stations); *Calanus marshallae/glacialis* (many stations);
(bottom): *Lumbrineris* sp (many stations); Maldanidae (most stations); cf *Eupentacta* (Holothuroidea, station HBR1)

Mesozooplankton-microbial food web interactions in a climatically changing sea ice environment

PIs: Evelyn Sherr and Barry Sherr (OSU), Robert Campbell (URI), Carin Ashjian (WHOI)

A) Sherr Component: Microzooplankton Grazing on Phytoplankton and Herbivorous Protists as Food for Mesozooplankton

On-board team members: Celia Ross, Julie Arrington

The overall objective of our research was to evaluate the rates and impact of microzooplankton grazing on algae suspended in the upper water column and to describe the microzooplankton community composition and abundance under varying conditions of late spring. We also assessed the importance of microzooplankton as a food resource for key copepod and krill species in conjunction with Carin Ashjian and Bob Campbell.

We completed eighteen microzooplankton grazing experiments in the open water and along the ice edge. We compared the rates of algal growth in whole water and in 10% whole

water diluted with particle-free filtered seawater over a 24 hour day-night cycle at light levels of about 10% of ambient. We incubated all but one of our 10% diluted water samples on the Ashjian/Campbell plankton wheel (Figure 1). Experiment 3 used our incubator (Figure 2). Nutrients were added to twelve experiments where the [NO3] was less than 10 umole/liter.

Growth rates of algae were determined by change in chlorophyll-a concentrations from the initial to final times of the incubations. The results (Table 1) suggest grazing mortality in fourteen experiments with significant grazing in five of those experiments. Phytoplankton growth rates in the 10% diluted water treatments varied from negligible to 0.384 day^{-1}.

Preliminary microscopic examination by epifluorescence of several experiments found evidence of grazing by both dinoflagellates and ciliates.

We took samples from each experiment at initial and final times for microzooplankton abundance. Sampling techniques used include acid Lugols which yields biovolume and carbon/cell. Epifluorescence will be used to verify whether the microzooplankton are heterotrophic. Flow cytometry determines abundances of small sized phytoplankton and potential changes in cell-specific fluorescence of larger algae, which would affect chlorophyll values.

We also collected profile samples for additional analysis by flow cytometry, acid Lugols and epifluorescence from seventeen primary productivity casts. These casts took place at the same stations as our dilution experiments and will be used to put our experiments in context with the overall distribution of microzooplankton in the water.

Four growth incubations were undertaken to study the succession of community structure over time using the Sherr incubator.

Table 1. Results of dilution experiments.
Microzooplankton grazing rate was calculated as the difference between the 10% diluted whole water (10%WW) growth rate and the whole water growth rate. Negative values (in bold) for micro-zooplankton grazing rate indicate microzooplankton grazing losses for algae in the water. Values close to 0 or positive indicate net growth of algae and no apparent microzooplankton grazing. Highlighted values indicate significant grazing. There was an indication of significant microzooplankton grazing at five out of the eighteen stations sampled.

Exp #	**Date**	**Station And Site**	**Depth (m)**	**Initial whole water [chlor] (ug/L)**	**10% WW Growth day^{-1} average**	**10% WW Growth Day^{-1} Std dev**	**Whole water growth day^{-1} average**	**Whole water Growth day^{-1} Std dev**	**Micro-Zooplankton Grazing Day-1**	**Nutrients added?**
1	5/11	2 (NP-14)	15	14.80	0.191	0.030	0.129	0.043	**-0.062**	no
2	5/13	7 (NP-12)	40	8.08	0.125	0.020	0.054	0.004	**-0.071**	no
3	5/15	24 (Z-15)	18	11.02	0.076	0.012	0.083	0.034	**-0.021**	yes
4	5/17	39 (IE-1)	27.5	10.504	0.289	0.034	0.025	0.032	**-0.264**	no
5	5/19	49 (MN-10)	5	24.326	0.107	0.011	-0.001	0.034	**-0.109**	yes
6	5/21	55 (NZ11.5)	24	1.17	0.123	0.015	0.150	0.031	0.027	no
Exp #	**Date**	**Station And Site**	**Depth (m)**	**Initial whole water**	**10% WW Growth day^{-1}**	**10% WW Growth**	**Whole water growth**	**Whole water Growt**	**Micro-Zooplankton Grazing**	**Nutrients added?**

				[chlor] (ug/L)	average	Day $^{-1}$ Std dev	day^{-1} average	h day^{-1} Std dev	Day-1	
7	5/23	66 (NZ4.5)	19	11.14	0.074	0.015	0.025	0.004	**-0.049**	yes
8	5/25	71 (HBR-1)	22	31.59	0.015	0.044	0.033	0.025	0.018	yes
9	5/27	81 (70m26)	28.5	5.575	0.065	0.035	-0.055	0.041	**-0.120**	yes
10	5/29	87 (CN-17)	12	7.784	0.357	0.017	0.359	0.023	0.003	no
11	5/30	94 (CN-5)	25	3.497	0.052	0.035	0.039	0.030	**-0.013**	yes
12	5/31	99 (70m4)	15	6.623	0.126	0.067	0.109	0.156	**-0.017**	yes
13	6/2	124 (70m29)	15	0.525	0.384	0.011	0.248	0.022	**-0.136**	yes
14	6/4	147 (70m52)	25	14.891	0.069	0.073	0.020	0.040	**-0.050**	yes
15	6/5	156 (SL-12)	27	1.982	-0.128	0.029	-0.056	0.019	0.072	yes
16	6/7	163, MN-19	17	7.885	0.128	0.016	0.090	0.034	**-0.038**	no
17	6/9	175, MN-8	25	0.379	0.208	0.020	0.114	0.130	**-0.094**	yes
18	6/10	179, NP-3	35	1.194	0.021	0.062	-0.143	0.023	**-0.164**	yes

Figure 1. Ashjian/Campbell plankton wheel incubator, showing incubation bottles wrapped to simulate 10% in situ light level being placed on the plankton wheel. Bottles are slowly rotated for a 24 hour period while being immersed in flowing water at near surface seawater temperatures.

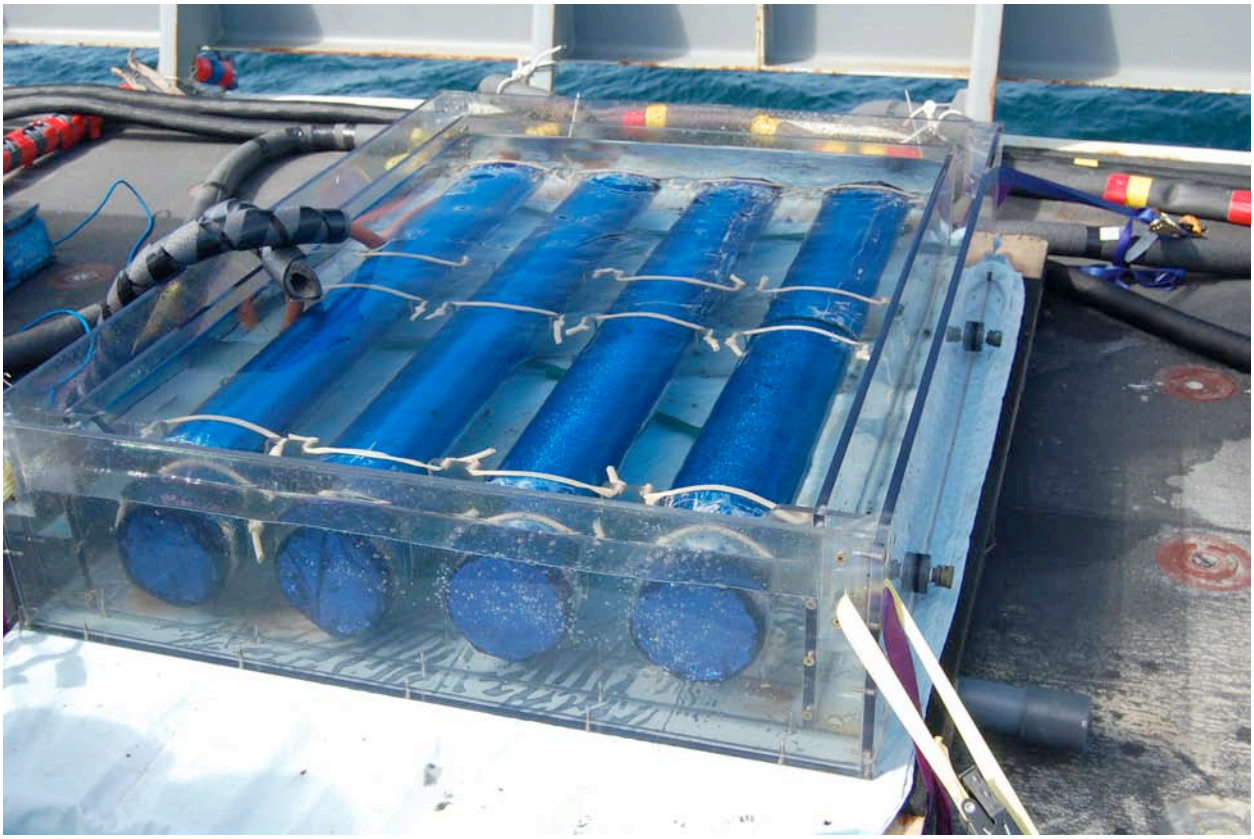


Figure 2. Sherr incubator with tubes wrapped to simulate 10% light. Bottles are placed inside the tubes. Flowing seawater keeps the temperature near that of surface seawater.

B. Campbell/Ashjian Component: Mesozooplankton Feeding and Reproduction

On-board team members: Robert Campbell, Carin Ashjian, Philip Alatalo, Celia Gelfman, Donna Van Keuren

The purpose of this project is to determine the feeding characteristics (rates, preferences) of dominant zooplankton (copepods, krill), zooplankton community grazing impacts, and egg production rates of copepods at locations characterized by a range of environmental (ice, hydrography, chlorophyll) conditions. This will be used together with the Sherr et al. project to better understand trophic linkages in the microzooplankton-mesozooplankton food web. Feeding experiments using the dominant mesozooplankton taxa were conducted every other day. An on-deck plankton wheel/incubator was used to maintain the animals under *in situ* temperature and light conditions during the experiments. Feeding rates were assessed on board using changes in chlorophyll concentration in the bottles during the experiment. Samples were taken to estimate feeding on microzooplankton and phytoplankton/ice algae that will be analyzed in the laboratory post-cruise. Quantitative samples for zooplankton abundance were collected with a Bongo net for estimates of zooplankton grazing impacts. Egg production experiments were conducted with ovigerous females of the dominant copepod species at selected stations.

A total of 18 feeding experiments using the dominant zooplankton species/taxa at the process stations have been conducted to date. Outer shelf copepod species (*Neocalanus cristatus* and *N. plumchrus/flemingeri, Eucalanus bungii bungii)* have been present much further inshore than we observed in previous years. *Calanus glacialis/marshallae* has been dominant on the middle shelf. Early in the cruise young stages of *Calanus* from the G1 generation up to stages C3/C4 were abundant across the shelf and by the end of the cruise stages to C5 were observed.. *Pseudocalanus* spp. and *Acartia longiremis* were abundant from the inner to middle shelf. *Metridia pacifica* were present from the middle to outer shelf, but rarely dominant. Krill have been present, with *Thysanoessa raschii* dominant inshore and *T. longipes* and *T. inermis* more important offshore. The grazing experiments have been comprised of a number of stages of 7 different copepod species (*Calanus marshallae/glacialis*, *E. bungii bungii, N. cristatus, N. plumchrus/flemingeri, Pseudocalanus* spp., *M. pacifica, and A. longa*) and several euphausiid (*Thysanoessa* spp.) species. Chlorophyll concentrations have been substantial >10 µg chl a/l) for most experiments with concomitant high grazing on chlorophyll at those stations. At several stations near the end of the cruise, experiments were conducted in low chlorophyll, low nutrient waters and grazing on chlorophyll was substantially lower there.

Egg production rates (EPR) have been determined for *C. marshallae/glacialis, E. bungii bungii, M. pacifica*, *Acartia longirermis*, and *Pseudocalanus* spp. We conducted a total of 65 egg production experiments in which we incubated almost 2000 females with a total reproductive output of over 50,000 eggs. EPR was high for *C. marshallae/glacialis* and *E. bungii bungii*. For both species, the EPR averaged 35 to 40 eggs/female/day. Reproductive output was much lower for *Acartia* and *Metridia*, and was on the order of 10 to 15 eggs/female/day. Reproduction of *Pseudocalanus* spp. was similar to previous spring cruises with an average of 11% of the population producing a new clutch each day. Egg hatching success was consistently greater than 90% for *Calanus*, while for the other species it was much lower and more variable.

Samples have also been collected for morphometrics, carbon and nitrogen, RNA/DNA, and genetic analyses.

Table 1. Summary of zooplankton experiments and measurements by station. Locations of egg production experiments (EPR) for each species, CHN=Animals picked for carbon and nitrogen content determination, RNA/DNA = animals picked for the ratio of RNA to DNA, a measure of metabolic activity, samples for genetic analysis, grazing experiments and quantitative Bongo net hauls. All animals used in these experiments were photographed for morphometric measurements. (Cal=Calanus; Pcal=Pseudocalanus; Met=Metridia; Euc=Eucalanus; Acr=Acartia; Gen.=Genetics; Grz.=Grazing0

Sta. Name	Sta. #	Date	Cal EPR	Pcal EPR	Met EPR	Euc EPR	Acr EPR	CHN	RNA/DNA	Gen.	Grz.	Bongo
Test	1	5/10/10	x						x	x		
NP14	2	5/12/10				x		x		x	GE1	x
NP15	5	5/12/10				x		x	x	x		
NP12	7	5/13/10				x		x		x	GE2	x

Sta. Name	Sta. #	Date	Cal EPR	Pcal EPR	Met EPR	Euc EPR	Acr EPR	CHN	RNA/DNA	Gen.	Grz.	Bongo
NP10	9	5/13/10	x	x					x			
Z6	15	5/14/10	x	x					x	x		
Z15	24	5/15/10						x		x	GE3	x
ZC8	35	5/16/10		x						x		
IE1	39	5/17/10						x			GE4	x
A2	41	5/17/10		x					x			
MN19	49	5/18/10			x	x			x	x		
MN19	49	5/19/10						x		x	GE5	x
AL1	54	5/20/10		x		x				x		
NZ11.5	55	5/21/10		x	x			x	x	x	GE6	x
NZ8	62	5/22/10	x	x	x				x	x		
NZ4.5	66	5/23/10	x	x				x	x		GE7	x
70M28	68	5/23/10	x						x			
HBR1	71	5/25/10	x					x	x	x	GE8	x
KP1	74	5/25/10	x						x	x		
70M26	81	5/27/10	x	x				x	x	x	GE9	x
BOB1	82	5/27/10	x				x	x	x			
CN17	87	5/29/10			x	x		x	x	x	GE10	x
CN13	89	5/29/10	x	x					x			
CN5	94	5/30/10	x					x	x	x	GE11	x
70M4	99	5/31/10	x					x	x	x	GE12	x
70M22	117	6/1/10	x	x					x	x		
70M29	124	6/2/10	x	x			x	x	x		GE13	x
70M32	127	6/2/10	x	x					x			
70M45	140	6/3/10	x	x					x	x		
70M52	147	6/4/10	x	x				x	x	x	GE14	x
70M55	150	6/4/10	x	x					x			
SL12	156	6/5/10	x					x	x	x	GE15	x
SL9	158	6/5/10	x	x			x		x	x		
AL3	160	6/6/10		x						x		
MN19	163	6/7/10			x	x		x	x	x	GE16	x
MN12	171	6/8/10		x								
MN8	175	6/9/10	x	x			x	x	x	x	GE17	x
BOB2	177	6/9/10	x	x			x		x	x		
NP3	179	6/10/10		x			x	x			GE18	x
NP5	182	6/10/10	x				x		x			
NP11	188	6/11/10						x		x		
TOT.	41		24	22	5	7	7	1326	1296	24	15	15

C. Fine Scale Vertical Distribution of Plankton and Particles from a Video Plankton Recorder

On-board team members: Carin Ashjian and Philip Alatalo

The fine scale vertical distribution of plankton and particles in association with hydrographic features and water column structure is being described using a self-contained Video Plankton Recorder (see Ashjian et al., 2004 for more information on the instrument). This year we are using a newer VPR that has better camera resolution. Casts have been conducted on cross-shelf transects and at locations where grazing experiments were done. Seventy-two casts

have been conducted. Image identification is ongoing. Complete analysis will be conducted in the laboratory following the cruise.

Table 1. Stations, dates, and maximum depths for VPR casts.

Station Name	Station Number	VPR Number	Date Local	Tow Depth (m)
TEST	1	1	5/10/10	6
NP14	2	2	5/11/10	135
NP13	3	3	5/11/10	125
NP14	5	4	5/12/10	300
NP12	7	5	5/12/10	95
NP11	8	6	5/13/10	70
NP10	9	7	5/13/10	30
Z15	24	8	5/15/10	95
IE1	39	9	5/17/10	130
A1	40	10	5/17/10	130
A2	41	11	5/17/10	100
A3	42	12	5/17/10	130
A4	43	13	5/17/10	130
A5	44	14	5/17/10	130
MN19	49	15	5/19/10	300
NZ11.5	55	16	5/21/10	300
NZ11	58	17	5/21/10	120
NZ10	60	18	5/22/10	95
NZ9	61	19	5/22/10	95
NZ8	62	20	5/22/10	95
NZ7	63	21	5/22/10	90
NZ6	64	22	5/22/10	75
NZ5	65	23	5/22/10	75
NZ4.5	66	24	5/23/10	60
70M30	67	25	5/23/10	65
70M28	68	26	5/23/10	73
70M26	69	27	5/23/10	65
HBR1	71	28	5/25/10	66
KP3	72	29	5/25/10	69
KP2	73	30	5/25/10	67
kP1	74	31	5/25/10	65
KP4	75	32	5/25/10	81
KP5	76	33	5/25/10	95
70M26	81	34	5/27/10	67
CN18	85	35	5/28/10	300

Station Name	Station Number	VPR Number	Date Local	Tow Depth (m)
CN16	86	36	5/28/10	132
CN17	87	37	5/29/10	190
CN15	88	38	5/29/10	130
CN13	89	39	5/29/10	125
CN11	90	40	5/29/10	87
CN9	92	41	5/30/10	75
CN5	94	42	5/30/10	65
CN3	95	43	5/30/10	42
70M4	99	44	5/31/10	67
70M29	124	45	6/2/10	67
70M52	147	46	6/4/10	72
70M57.5/SL11	153	47	6/4/10	70
SL14	154	48	6/4/10	85
SL13	155	49	6/5/10	80
SL12	156	50	6/5/10	72
SL10	157	51	6/5/10	60
SL9	158	52	6/5/10	55
MN20	161	53	6/6/10	300
MN19	163	54	6/7/10	300
MN18	164	55	6/7/10	140
MN17	165	56	6/7/10	134
MN16	166	57	6/7/10	131
MN15	167	58	6/7/10	135
MN14	169	59	6/8/10	125
MN13	170	60	6/8/10	115
MN12	171	61	6/8/10	106
MN11	172	62	6/8/10	
MN10	173	63	6/8/10	82
MN9	174	64	6/8/10	68
MN8	175	65	6/9/10	70
MN7	176	66	6/9/10	66
NP3	179	67	6/10/10	42
NP2	180	68	6/10/10	40
NP4	181	69	6/10/10	51
NP5	182	70	6/10/10	61
NP6	183	71	6/10/10	66
NP7	184	72	6/10/10	62

Figure 1. Philip Alatalo recovers the Video Plankton Recorder.

Figure 2. Copepod "in the wild". An image of a *Calanus* spp. copepod taken in-situ with the Video Plankton Recorder.

Assessment of mesozooplankton population and biomass in the eastern Bering Sea for spring and summer of 2008, 2009 and 2010.

PIs: Ken Coyle and Alexei Pinchuk (UAF)
On-board team member: Alexei Pinchuk

The primary task of the mesozooplankton component was to assess the abundance, biomass and species composition of the mesozooplankton on the shelf-break, middle and inner shelf 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 65 CalVET samples were taken at

all CTD stations along all transect lines across the shelf covering all domains. Heavy ice conditions allowed for 28 stratified MOCNESS tows in ice-free waters.

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.

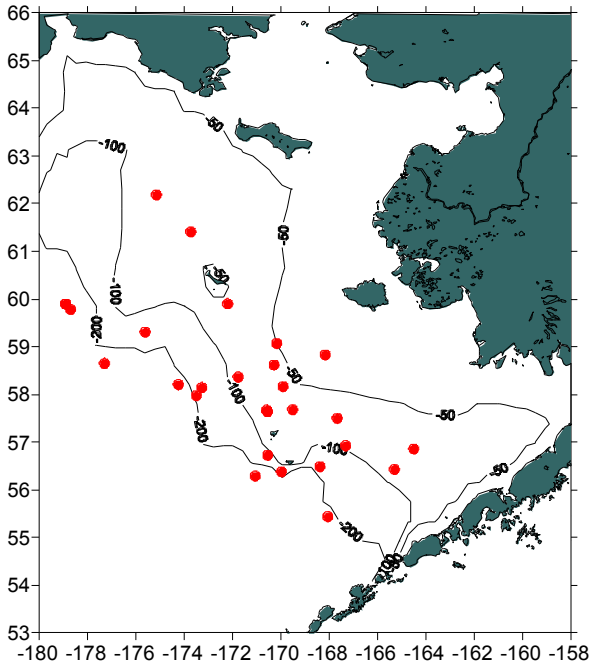
The large mesozooplankton component was intended to be sampled with a 1-m MOCNESS (Multiple Opening Closing Net and Environmental Sensing System), equipped with 0.5 mm mesh nets. The MOCNESS was equipped with salinity, temperature and fluorescence sensors to provide depth profiles of physical oceanographic data during the tows. Samples were planned to be consistently taken in 20 m depth increments from the bottom to the surface.
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 substantial amount of oceanic zooplankton species were common in the shelf-break and outer shelf region, but large copepods were rare or absent from the middle domains stations. It appears that the mesozooplankton community was dominated by medium-sized and small copepods, chaetognats, gelatinous zooplankton and euphausiids. Oceanic *Neocalanus* spp. and *Eucalanus bungii* were observed on the deep water stations (>200m) and over medium depths (200-100 m), indicating substantial advection of oceanic water onto the shelf. *Calanus marschallae*, *Metridia pacifica* and *Thysanoessa raschii* were common on the middle shelf. Large numbers of scyphozoan jellyfish (*Chrysaora melanaster*) were observed on the middle shelf over 100 m – 50 m depth range. A detailed assessment of zooplankton abundance, biomass and distribution will be made after the samples have been processed.

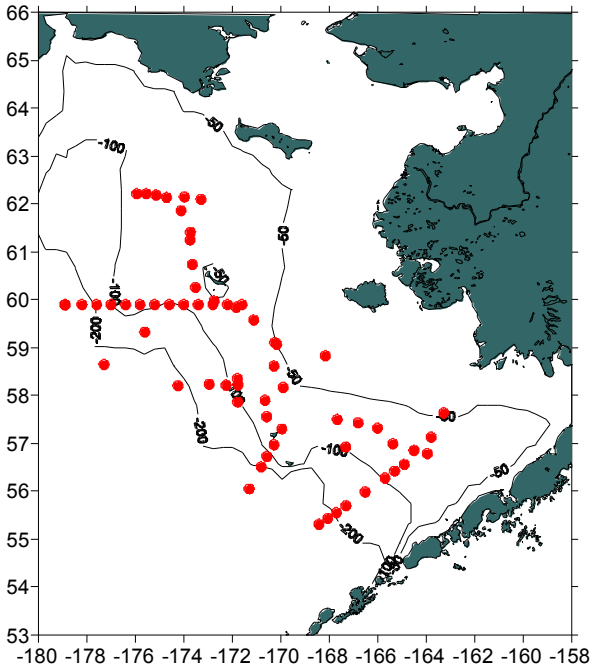
The primary task of the krill egg production and rearing component was to assess reproductive status of krill population, timing of reproduction, number of eggs released, hatching success under laboratory conditions, and to establish a krill culture of known age to aid work on the biology and ageing of euphausiids performed by Harvey/Lessard.

Visual assessment of live krill catches done by Lessard/Harvey group revealed that *Thysanoessa raschii* have just started their reproduction in ice free waters over 200-100 m depth. In contrast, only few spawning *Thysanoessa inermis* were collected on the outer end of MN line. Total of 15 gravid females of *T. raschii* and 2 of *T. inermis* were incubated at ambient temperature over two days and produced eggs.. Hatching success was generally high (~80%). The hatched nauplii were set for rearing at 10^{o}C.

MOCNESS Stations; TN249



CalVET Station Map; TN249



The Trophic Role of Euphausiids in the eastern Bering Sea: Ecosystem Responses to Changing Sea-Ice Conditions

PIs: Rodger Harvey (UMaryland) and Evelyn Lessard (UW)
On-Board Team Members: Rodger Harvey, Evelyn Lessard, Megan Bernhardt Schatz, Tracy Shaw, and Rachel Pleuthner

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 euphausiid diet history, prey selection, ingestion rates and nutritional condition 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 the 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.

A) Krill collections, feeding and growth experiments and microplankton prey distributions

Evelyn Lessard, Tracy Shaw and Megan Bernhardt

Euphausiid collections: Net tows

We performed 37 net tows (Table 1) to capture live euphausiids for the feeding and growth experiments (Lessard) and for lipid, carbon and lipofuscin analyses (Harvey). The Bongo frame and nets were lost on the first deployment when the ship rode over and cut the tow wire. For subsequent tows on the first leg, we used a 1m ring net (333 μm mesh net). On the second leg, we used a Bongo frame kindly sent to us by Ted Durbin, and picked up at the personnel exchange in St. Paul. The nets were towed obliquely when ice conditions permitted.

Euphausiid grazing experiments – grazing rates and preferences for phytoplankton and microzooplankton taxa

We performed 22 feeding experiments (Table 2) under mostly ice-free or light ice conditions. For the feeding experiments, we captured live euphausiids with an obliquely towed ring net (333 um) and added known numbers and species to bottles filled with seawater and incubated them for 24h on a rotating wheel in a flowing seawater incubator under ambient temperature and light conditions. When availability permitted, krill from the net tows were preserved for ambient gut content analysis. The prey suite for each grazing experiment was

unaltered seawater plankton. A subset of krill were also incubated in 0.2 µm filtered seawater to allow gut clearing and provide animals without ambient food in their guts for lipid analysis (see Harvey, below). At To and Tf (24h), samples were taken for size-fractionated chlorophyll, nutrients, glutaraldehyde and Lugol's preserved samples for enumerating and identifiying phytoplankton and microzooplankton. At the end of the incubation period, krill were removed from the bottles, identified, sized and immediately frozen at -80C for lipid analyses. Shipboard, an index of herbivorous feeding was assessed by measuring changes in size-fractionated chlorophyll and by live plankton cell counting and identification using an automated imaging flow-cytometer (FlowCAM). Phytoplankton and microzooplankton cell counts from the preserved samples will be analyzed back in the laboratory with transmitted and epifluorescence microscopy for taxa and carbon-specific grazing rates and prey selection.

Euphausiid Growth experiments

We performed 7 growth experiments, for a total of 40 on all the BEST cruises so far, assessing instantaneous growth rates on 344 euphausiids (Table 3). We provided >600 animals with species and size determinations, from the feeding and growth experiments, to Harvey for lipid profiles and lipofuscin content (below).

Culturing Phagotrophic and Phototrophic Protists

A large number of enrichment and isolation cultures of heterotrophic protists (dinoflagellates and ciliates) were made and will be brought back to the lab after the summer cruise. Successful isolates will augment the species that were isolated by grad student Gigi Engel on BEST3. We have several phototrophic protists (diatoms and cryptophytes) isolated on previous cruises which we used as prey to grow phagotrophic isolates from the enrichments and water samples. Other phototrophic prey were also isolated from water samples to serve as potential prey. Lipid profiles will be determined on the heterotrophic protist cultures to identify biomarkers that can be used to trace ingestion.

Preliminary observations:

Over the course of the cruise, the euphausiid prey field changed as spring conditions transitioned into summer.. In early May, the spring bloom was underway in ice free waters. From regular FlowCAM sampling, we observed that the bloom was initially dominated by *Thalassiosira* species, and ice-derived pennate chain diatoms (e.g *Fragilariopsis, Nitzschia frigida*), indicating a relatively early stage of the spring bloom. As bloom progressed, *Chaetoceros* species, particularly *C. socialis* dominated. After the diatom blooms declined, dense blooms of *Phaeocystis* developed on the southern shelf. In response to these blooms, heterotrophic protists (ciliates and heterotrophic dinoflagellates) increased in abundance and availability.

We performed grazing and growth experiments with several euphausiid species and a wide range of sizes. As expected, *Thysanoessa raschii* was most common euphausiid on the middle shelf, but was also dominant on the outer shelf this year. *T. inermis*, typically found on the outer shelf (ca 125- 200m depth) was found at relatively deep depths (145-570m) this year. It

will be interesting to determine what role the very late and extensive ice cover may have played in their distributions. We did one grazing experiment with *T. longipes,* a more oceanic species. Unlike the other two species, *T. longipes* was not herbivorous, even in the presence of very high phytoplankton biomass.

T, raschii had started spawning in ice free waters over the outer shelf at the start of the cruise in early May, and gravid females were observed until sampling on June 11. Gravid *T. raschii* females were rather ravenous feeders, ingesting 2-5 times more than male and non-gravid *T. raschii*. *T. inermis* appears to spawn later, and only a few gravid females were found in off-shelf waters in mid-May and in early June.

Table 1. Location of net tows for euphausiid collections for experiments, lipid and carbon analyses

Station #	Station Name	Net type	Cast #	Latitude (decimal deg. N)	Longitude (decimal deg. W)	Date (local)	Time (local)	Station Depth (m)	Calculated tow depth (m)	Surface temp (ºC)	Surface chl (v)	Salinity	Air temp (ºC)	Feeding expt	IGR
1	Test	Bongo, 70cm	1	56.6633	168.2144	5/10/10	1915	110	57	1.13	0.19	31.28	-1.5		
4	NP14	Bongo, 70cm	2	56.2817	171.0540	5/12/10	0150	141	NA	3.13	0.659	32.19	-0.8		
7	NP12	Ring net, 1m	1	56.7270	170.5372	5/13/10	0308	109	32	0.92	0.212	31.32	-0.6	1	
13	Z4	Ring net, 1m	2	57.6767	170.5844	5/14/10	0240	77	32	-0.58	0.305	30.84	-0.6	2	34
24	Z15	Ring net, 1m	3	58.3792	171.7526	5/15/10	0104	99	32	-0.806	0.337	30.82	-1.2	3	
31	ZC4	Ring net, 1m	4	58.1597	173.2525	5/16/10	0240	114	43	0.5	0.173	31.1	-1.5	4	
39	IE1	Ring net, 1m	5	59.3279	175.6071	5/17/10	0155	142	60	0.116	0.258	31.54	-1.1	5	
48	EV1	Ring net, 1m	6	58.6488	177.2716	5/18/10	0210	168	92	2.795	0.342	32.76	-0.3		
49	MN19	Ring net, 1m	7	59.9001	178.8960	5/19/10	0245	570	106	0.155	0.817	31.68	0	6	
53	EV2	Ring net, 1m	8	59.7818	178.6930	5/20/10	0245	286	71	0.06	0.709	31.32	-0.5	7	
55	NZ11.5	Ring net, 1m	9	58.2058	175.2472	5/21/10	0240	439	53	1.8	NR	31.14	0.9	8	35
59	EV3	Ring net, 1m	10	57.9687	173.4895	5/22/10	0230	122	53	2.38	0.203	31.72	-1.8		
66	NZ4.5	Ring net, 1m	11	59.0725	170.1838	5/23/10	0220	68	46	0.102	0.357	29.99	-2.6	9	36
70	EV4	Ring net, 1m	12	57.6361	170.5595	5/24/10	0232	79	53	-0.014	0.37	30.67	0.1	10	37
71	HBR1	Ring net, 1m	13	56.9218	167.3255	5/25/10	0240	78	50	0.808	0.535	30.98	-2.8	11	
78	KP6.5	Ring net, 1m	14	56.4844	168.3942	5/25/10	0240	118	53	2.19	0.233	30.86	1.6		
81	70m26	Ring net, 1m	15	58.1689	169.9028	5/27/10	0250	72	46	-0.45	0.243	30.38	0.9	12	
83	EV5	Bongo, 60cm	1	56.3750	169.9777	5/28/10	0251	106	75	3.087	0.397	30.97	1.9	13	
87	CN17	Bongo, 60cm	2	55.4335	168.0611	5/29/10	0233	200	142	4.296	0.433	32.01	3.9	14	
91	CN10	Bongo, 60cm	3	56.4239	165.3040	5/30/10	0220	85	60	2.028	0.272	31.22	3.2		38
99	70M4	Bongo, 60cm	4	56.8548	164.5042	5/31/10	0306	73	52	1.714	0.381	31.44	3	15	
111	70M16	Bongo, 60cm	5	57.5001	167.6651	6/1/10	0319	72	51	0.089	0.288	31.33	-0.6		
124	70M29	Bongo, 60cm	6	58.6170	170.2786	6/2/10	0210	73	52	0.761	0.221	30.48	-1.3	16	39
134	70M39	Bongo, 60cm	7	59.8421	171.8388	6/3/10	0310	74	52	1.036	0.2	29.56	-0.9		
147	70M52	Bongo, 60cm	8	61.4129	173.7277	6/4/10	0220	73	52	1.967	0.173	30.86	0.4	17	
156	SL12	Bongo, 60cm	9	62.1880	175.1469	6/5/10	0205	79	56	2.16	0.193	31.28	1.5	18	
159	EV6	Bongo, 60cm	10	60.5232	175.5473	6/6/10	0250	111	79	2.141	0.179	30.9	1.6		
163	MN19	Bongo, 60cm	11	59.8933	178.8984	6/7/10	0245	659	467	4.072	0.2	30.8	3.9	19	
167	MN15	Bongo, 60cm	12	59.8940	176.4215	6/8/10	0020	140	99	2.643	0.19	30.32	3		
(none)	(none)	Bongo, 60cm	13	59.7359	177.0987	6/8/10	0230	143	101	2.052	0.192	30.14	3.8		
168	EV7	Bongo, 60cm	14	59.6867	177.2954	6/8/10	0338	185	131	3.127	0.193	30.04	4	20	40

Station #	Station Name	Net type	Cast #	Latitude (decimal deg. N)	Longitude (decimal deg. W)	Date (local)	Time (local)	Station Depth (m)	Calculated tow depth (m)	Surface temp (ºC)	Surface chl (v)	Salinity	Air temp (ºC)	Feeding expt	IGR
175	MN8	Bongo, 60cm	15	59.9018	172.2040	6/9/10	0238	73	52	2.461	0.193	29.76	1.9	21	
179	NP3	Bongo, 60cm	16	58.8297	168.1626	6/10/10	0240	45.7	32	1.491	0.193	30.35	0.8		
185	NP8	Bongo, 60cm	17	57.6796	169.5083	6/11/10	0205	69.8	50	2.636	0.197	30.65	2.4		
193	EV8a	Bongo, 60cm	18	56.2508	171.2507	6/12/10	0200	450	319	5.36	0.795	32.21	4.8		
193	EV8b	Bongo, 60cm	19	56.2694	171.2440	6/12/10	0225	160	113	5.419	0.985	32.09	4.8		
193	EV8c	Bongo, 60cm	20	56.3441	171.2294	6/12/10	0318	141.5	100	5.453	0.836	32.02	4.5	22	

Table 2. Euphausiid feeding experiments: collection location, local time, initial chlorophyll levels, and species.

Expt #	Date	Time	CTD	Station	Latitude	Longitude	Depth	Water Temp	Salinity	Total Chl	>5 Chl	<5 Chl	% >5	Krill Species
1	05/13/10	0345	8	NP12	56 43.48N	170 32.63W	36m	2.7	32.2	9.80	9.69	0.12	99	T. raschii
2	05/14/10	0303	18	Z4	57 40.92N	170 34.89W	5m	-0.8	30.9	6.31	6.21	0.10	98	T. raschii
3	05/15/10	0221	30	Z15	58 22.47N	171 45.72W	15m	-1.2	31	18.95	18.61	0.34	98	T. raschii
4	05/16/10	0230	40	ZC4	58 09.58N	173 15.15W	30m	2.07	32.4	0.70	0.27	0.43	39	T. raschii
5	05/17/10	0220	48	IE1	59 19.66N	175 36.05W	24m	0.3	32.08	9.81	9.70	0.11	99	T. raschii
6	05/19/10	0200	63	MN19	59 54.03N	178 53.77W	3.7m	0	31.8	24.99	24.89	0.10	99.6	T. inermis
7	05/20/10	0220	70	EV2	59 46.90N	178 41.60W	14m	0.1	32.07	23.71	23.34	0.37	98	T. inermis
8	05/21/10	0200	72	NZ11.5	58 12.27N	174 14.09W	9m	3	32.5	1.00	0.55	0.45	55	T. inermis
9	05/23/10	0330	87	NZ4.5	59 04.19N	170 10.03W	12m	-0.68	30.3	11.86	11.54	0.32	97	T. raschii
10	05/24/10	0310	93	EV4	57 38.23N	170 32.91W	6m	-0.18	30.95	9.65	9.50	0.15	98	T. raschii
11	05/25/10	0323	94	HBR1	56 55.58N	167 19.30W	12m	0.5	31.4	3.43	3.23	0.20	94	T. raschii
12	05/27/10	0336	105	70M26	58 10.01N	169 54.76W	10m	-0.7	30.7	2.63	2.48	0.15	94	T. raschii
13	05/28/10	0310	109	EV5	56 22.61N	169 58.64W	14m	2.8	32.04	9.27	8.89	0.38	96	T. inermis
14	05/29/10	0300	114	CN17	55 26.16N	168 03.70W	6m	4.04	32.36	10.96	10.47	0.49	96	T. inermis / T. longipes
15	05/31/10	0330	129	70M4	56 51.37N	164 30.29W	12m	1.45	31.57	9.15	8.75	0.41	96	T. raschii
16	06/02/10	0230	156	70M29	58 37.06N	170 17.01W	13m	0.48	30.6	0.65	0.45	0.20	69	T. raschii
17	06/04/10	0250	182	70M52	61 24.78N	173 43.61W	28m	-1.59	31.47	24.76	24.42	0.34	99	T. raschii
18	06/05/10	0239	193	SL12	62 11.28N	175 08.81W	27m	-1.2	31.8	8.66	8.52	0.14	98	T. raschii
19	06/07/10	0314	205	MN19	59 52.60N	178 53.90W	13m	3.2	32.6	11.57	7.48	4.09	65	T. longipes
20	06/08/10	0430	213	EV7	59 41.29N	177 17.35W	23m	0.1	32.2	4.41	4.28	0.13	97	T. inermis
21	06/09/10	0310	220	MN8	59 54.05N	172 12.00W	12m	1.9	30	0.34	0.12	0.22	35	T. raschii
22	06/12/10	0415	242	EV8	56 20.83N	171 13.89W	9m	5.2	32.1	7.70	6.02	1.68	78	T. inermis

Table 3. Instantaneous growth rate experiments (IGR)

Expt #	Station Number	Station Name	Start Date	Species	Stages	# days incubated	# animals	# molts	Surface Chl (v)	Surface Temp (°C)	Depth (m)
34	13	Z4	14-May-10	*T. raschii*	juv/adult	2	48	4	0.305	-0.58	77
35	55	NZ11.5	21-May-10	*mixed*	juv/adult	2.5	48	6	NR	1.80	439
36	66	NZ4.5	23-May-10	*T. raschii*	juv/adult	2	48	10	0.357	0.10	68
37	70	EV4	24-May-10	*T. raschii*	adult	2	48	1	0.37	-0.01	79
38	91	CN10	30-May-10	*T. raschii*	adult	2	48	3	0.272	2.028	85
39	124	70M29	2-Jun-10	*T. raschii*	juv/adult	2	48	4	0.221	0.761	73
40	168	EV7	8-Jun-10	*T. inermis*	adult	2	48	12	0.193	3.127	185

B) Lipid composition of water column particles

Rodger Harvey and Rachel Pleuthner

Grazing Experiments - Determination of Euphausiid Diet History and Food Source Preferences from Lipids

A central goal of this project is to link grazing rates for euphausiids on natural and amended food sources with detailed lipid analysis of animals and their diets. The grazing experiment setup is detailed in the report from Lessard and provides animals for analysis. For lipid characterization of food resources and tracking of consumption, water is taken from designated Niskin bottles at the beginning of each grazing experiment (T_0) and filtered through combusted GF/F filters for carbon and lipid biomarkers to characterize the algal and detrital food available to krill. (Refer to Table 1 for grazing experiment water column samples.) Krill used for grazing experiments are transferred (T_0) directly from the bongo cast into either ambient seawater or 0.2µm filtered sea water. The subsets of animals are placed in filtered seawater for 24 hours allow gut clearing of any prior consumption before analysis and comparison with fed animals. At the end of the incubation, the krill are removed from the bottles, sorted by species and sized, and then immediately frozen in the -80 °C freezer. (Refer to the Lessard report for a complete report on experimental set up for grazing.) Frozen samples will be returned to the laboratory for detailed lipid analysis via GC-FID and GC-MS. (Refer to Table 1 for euphausiid collection logs).

One extended starvation experiment, scheduled to run throughout TN249 and TN250, has been initiated and two time points have been taken. The animals collected from NZ 11.5 (#55) are currently incubating in filtered sea water and will be sub-sampled at various times until the conclusion of the TN250 cruise. The T_0 time point originated from Grazing Experiment 8, which was started at the same station.

A second extended experiment with animals given a pulsed food regime began with euphausiids collected from 70M16, #111. These zooplankton were incubated in 0.2µm filtered sea water for just over a week. The day the krill were to be transferred to water from station EV-7, #168, it was discovered that over half of the experimental animals had expired; one day prior, the experimental animals looked fine. The remaining sixteen were transferred and incubated for a few days, another sub-sample removed, and the rest of the krill were transferred back into filtered sea water for the remainder of the experiment.

Individual euphausiids of multiple species were also collected for lipid, calorie, carbon and nitrogen analysis. Excess krill from a net tow were separated by species and placed into 2mm length increments. The composite samples were frozen in cryogenic vials in the -70 freezer for later lab analysis (Table 2).

Growth Experiments for the Determination of Euphausiid Age

Seven growth experiments have been completed and provided animals for age analysis shipboard. Preliminary lipofuscin analysis has been completed for the all seven. These growth experiments include animals of a range of sizes and native species, with a focus on *Thysanoessa inermis* and *Thysanoessa raschii*, to provide estimates of lipofuscin indices for field animals of differing ages. After the collection of eggs, Alexei Pinchuk will conduct spawning experiments to provide larval animals of known age. These animals will be used in long term rearing experiments to calibrate ages for the field specimen that have been analyzed.

At the conclusion of each growth experiment, the eyes are removed extracted for lipofuscin first (Part A) and then protein content (Part B). Quantification was done via flow-through fluorescence using an Agilent 1100 HPLC system following extraction. The bodies were composited for storage at -80ºC, potentially for future lipid analysis. (Refer to Table 2 for dates of animal processing.)

<u>High Performance Liquid Chromatography for the Identification and Quantification of Lipofuscin</u>

<u>Part A</u>

During initial study cruises, the optimal excitation and emission wavelengths for lipofuscin – an oxidation product of aerobic metabolism that accumulates in euphausiid neural tissue –was determined from a composite of *Thysanoessa inermis* by three dimensional fluorescence scan of the extracted products present in eye and neural tissues. That scan allowed for a qualitative identification of lipofuscin, or age "pigment," and was used to measure lipofuscin content in euphausiids for subsequent work. The total lipofuscin concentration is determined with quinine sulfate as a metric for lipofuscin and conversion of fluorescence intensity into concentration present for each sample.

<u>Part B</u>

Protein quantification is used to normalize the amount of lipofuscin in each pair of euphausiid eyes. The fluorescent properties of tryptophan allow a calibration curve utilizing bovine serum albumin (BSA) to serve as the basis to determine extracted protein concentrations in each sample.

Analysis is performed for growth experiment euphausiids and extra krill from the nets with the primary source being growth experiments. (Refer to Table 3) Figure 1 displays the range of body lengths covered for all of the euphausiids analyzed for lipofuscin during the TN249/BEST #5 cruise.

Organic Biomarkers in Particles verses Trap Material and Surface Sediments

To compare the suite of organic markers in suspended verses sinking material, aliquots from Moran group sediment traps were filtered onto 25mm combusted GF/Fs and 47mm polycarbonate filters. Trap samples were samples in parallel with corresponding depths by CTD for particles and sediment from the same station when possible. (Refer to Tables 4 and 5 for

sample location and designation). Surface sediments were obtained from extra multicore samples collected by the Devol group.

Cyanobacteria Detection and Lipid Biomarkers (BHPs)

At various stations, samples of water initially pre-filtered at the 3μm level, are pulled through 0.4 μm polycarbonate filters and stored for initial attempts to examine cyanobacterial cells and provide samples for genomic analysis. For some samples, corresponding water samples were taken to analyze for BHPs (bacterial hopanoid polyols) to search for specialized bacterial cellular markers.

Table 1: Water Collections and Euphausiid Sample Collection for Grazing Experiments as of 6/13/10

Experiment Type and No.	Station, #	T_0 filter date	CTD Cast	Niskins	# krill composited	Dominant species
Grazing Experiment 1	NP-12, #7	5/13/2010	8	9, 11, 12	26	*T. raschii*
Grazing Experiment 2	Z-4, #13	5/14/2010	18	11	41	*T. raschii*
Grazing Experiment 3	Z-15, #24	5/15/2010	30	10,11	37	*T. raschii*
Grazing Experiment 4	ZC-4, #31	5/16/2010	40	5	37	*T. raschii*
Grazing Experiment 5	IE-1, #39	5/17/2010	48	4	9	*T. raschii*
Grazing Experiment 6	MN-19, #49	5/18/2010	63	1	16	*T. inermis*
Grazing Experiment 7	EV-2, #53	5/20/2010	70	5	22	*T. inermis*
Grazing Experiment 8	NZ 11.5, #55	5/21/2010	72	6	21	*T. inermis*
Grazing Experiment 9	NZ 4.5, #66	5/23/2010	86	6	49	*T. raschii*
Grazing Experiment 10	EV-4, #70	5/24/2010	93	11	34	*T. raschii*
Grazing Experiment 11	HBR-1, #71	5/25/2010	94	10	22	*T. raschii*
Grazing Experiment 12	70M26, #81	5/27/2010	105	10	22	*T. raschii*
Grazing Experiment 13	EV-5, #84	5/28/2010	109	11	62	*T. raschii*
Grazing Experiment 14	CN-17, #87	5/29/2010	114	2	38	*T. longipes*
Grazing Experiment 15	70M-4, #99	5/31/2010	129	10	22	*T. raschii*
Grazing Experiment 16	70M-29, #124	6/2/2010	156	10	18	*T. raschii*
Grazing Experiment 17	70M-52, #147	6/4/2010	182	6	14	*T. raschii*
Grazing Experiment 18	SL-12, # 156	6/5/2010	193	10	18	*T. raschii*
Grazing Experiment 19	MN-19, #163	6/7/2010	205	8	19	*T. longipes*
Grazing Experiment 20	EV-7, #168	6/8/2010	213	9,10	18	*T. inermis*
Grazing Experiment 21	MN-8, #175	6/9/2010	220	10	49	*T. raschii*
Grazing Experiment 22	EV-8, #193	6/12/2010	243	3,4	22	*T. inermis*
Long term starvation #1	NZ 11.5, #55	5/21/2010	72	6	continuous	*T. inermis*
Long term starvation #2	70M-16, #111	6/1/2010	143	7	continuous	*T. raschii*
All filters frozen in the -80ºC freezer immediately after collection						

Table 2: Euphausiid Sample Log of animals for Analysis as of 6/13/10

Sample Type	Total # krill stored	Length range for species collected - TL (mm)	Station, #	Species	Date Stored
Carbon/Calorie/Lipid	1	26-28mm	Z4, 13	*T. raschii*	5/14/10
Carbon/Calorie/Lipid	4	18-20mm	Z15, 24	*T. raschii*	5/15/10
Carbon/Calorie/Lipid	1	20-22mm	Z15, 24	*T. raschii*	5/15/10
Carbon/Calorie/Lipid	1	22-24mm	Z15, 24	*T. raschii*	5/15/10
Carbon/Calorie/Lipid	1	24-26mm	Z15, 24	*T. raschii*	5/15/10
Carbon/Calorie/Lipid	2	12-14mm	ZC4, 31	*T. inermis*	5/16/10
Carbon/Calorie/Lipid	2	14-16mm	ZC4, 31	*T. inermis*	5/16/10
Carbon/Calorie/Lipid	3	16-18mm	ZC4, 31	*T. inermis*	5/16/10
Carbon/Calorie/Lipid	2	20-22mm	ZC4, 31	*T. raschii*	5/16/10
Carbon/Calorie/Lipid	3	22-24mm	ZC4, 31	*T. raschii*	5/16/10
Carbon/Calorie/Lipid	4	24-26mm	ZC4, 31	*T. raschii*	5/16/10
Carbon/Calorie/Lipid	1	16-18mm	IE4, 39	*T. raschii*	5/17/10
Carbon/Calorie/Lipid	2	20-22mm	IE4, 39	*T. raschii*	5/17/10
Carbon/Calorie/Lipid	1	22-24mm	IE4, 39	*T. raschii*	5/17/10
Carbon/Calorie/Lipid	1	10-12mm	MN19, #49	*T. longipes*	5/19/10
Carbon/Calorie/Lipid	3	12-14mm	MN19, #49	*T. longipes*	5/19/10
Carbon/Calorie/Lipid	1	12-14mm, females w/eggs	MN19, #49	*T. longipes*	5/19/10
Carbon/Calorie/Lipid	1	12-14mm, females w/eggs	MN19, #49	*T. longipes*	5/19/10
Carbon/Calorie/Lipid	1	12-14mm, females w/eggs	MN19, #49	*T. longipes*	5/19/10
Carbon/Calorie/Lipid	1	14-16mm, females w/eggs	MN19, #49	*T. longipes*	5/19/10
Carbon/Calorie/Lipid	1	14-16mm, females w/eggs	MN19, #49	*T. longipes*	5/19/10
Carbon/Calorie/Lipid	1	14-16mm, females w/eggs	MN19, #49	*T. longipes*	5/19/10
Carbon/Calorie/Lipid	1	14-16mm	MN19, #49	*T. inermis*	5/19/10
Carbon/Calorie/Lipid	3	14-16mm	EV2, #53	*T. inermis*	5/20/10
Carbon/Calorie/Lipid	4	16-18mm	EV2, #53	*T. inermis*	5/20/10
Carbon/Calorie/Lipid	1	18-20mm	EV2, #53	*T. inermis*	5/20/10
Carbon/Calorie/Lipid	1	20-22mm	EV2, #53	*T. inermis*	5/20/10
Carbon/Calorie/Lipid	1	22-24mm	EV2, #53	*T. inermis*	5/20/10
Carbon/Calorie/Lipid	7	12-14mm	EV2, #53	*T. longipes*	5/20/10
Carbon/Calorie/Lipid	6	14-16mm	EV2, #53	*T. longipes*	5/20/10
Carbon/Calorie/Lipid	2	16-18mm	EV2, #53	*T. longipes*	5/20/10
Carbon/Calorie/Lipid	1	20-22mm	EV2, #53	*T. longipes*	5/20/10
Carbon/Calorie/Lipid	20	14-16mm	EV2, #53	*T. inermis*	5/21/10
Carbon/Calorie/Lipid	26	16-18mm	EV2, #53	*T. inermis*	5/21/10
Carbon/Calorie/Lipid	3	18-20mm	EV2, #53	*T. inermis*	5/21/10

Carbon/Calorie/Lipid	2	18-20mm	EV2, #53	*T. longipes*	5/21/10
Carbon/Calorie/Lipid	1	20-22mm	EV2, #53	*T. longipes*	5/21/10
Carbon/Calorie/Lipid	1	22-24mm	EV2, #53	*T. longipes*	5/21/10
Carbon/Calorie/Lipid	50	10-12mm	NZ4.5, #66	*T. raschii*	5/23/10
Carbon/Calorie/Lipid	50	12-14mm	NZ4.5, #66	*T. raschii*	5/23/10
Carbon/Calorie/Lipid	20	14-16mm	HBR1, #71	*T. raschii*	5/25/10
Carbon/Calorie/Lipid	20	16-18mm	HBR1, #71	*T. raschii*	5/25/10
Carbon/Calorie/Lipid	20	18-20mm	HBR1, #71	*T. raschii*	5/25/10
Carbon/Calorie/Lipid	2	18-20mm	SL-12, 156	*T. raschii*	6/5/2010
Carbon/Calorie/Lipid	3	20-22mm	SL-12, 156	*T. raschii*	6/5/2010
Carbon/Calorie/Lipid	3	22-24mm	SL-12, 156	*T. raschii*	6/5/2010
Carbon/Calorie/Lipid	4	24-26mm	SL-12, 156	*T. raschii*	6/5/2010
Carbon/Calorie/Lipid	1	26-28mm	SL-12, 156	*T. raschii*	6/5/2010
Carbon/Calorie/Lipid	2	16-18mm	SL-12, 156	*T. raschii*	6/5/2010
Carbon/Calorie/Lipid	5	18-20mm	SL-12, 156	*T. raschii*	6/5/2010
Carbon/Calorie/Lipid	9	20-22mm	SL-12, 156	*T. raschii*	6/5/2010
Carbon/Calorie/Lipid	2	22-24mm	SL-12, 156	*T. raschii*	6/5/2010
Carbon/Calorie/Lipid	12	12-14mm	MN19, #163	*T. longipes*	6/7/2010
Carbon/Calorie/Lipid	9	14-16mm	MN19, #163	*T. longipes*	6/7/2010
Carbon/Calorie/Lipid	7	16-18mm	MN19, #163	*T. longipes*	6/7/2010
Carbon/Calorie/Lipid	10	14-16mm	EV-7, #168	*T. inermis*	6/8/2010
Carbon/Calorie/Lipid	10	18-20mm	EV-7, #168	*T. inermis*	6/8/2010
Carbon/Calorie/Lipid	2	22-24mm	EV-7, #168	*T. inermis*	6/8/2010
Carbon/Calorie/Lipid	14	12-14mm	EV-8, #193	*T. longipes*	6/12/2010
Carbon/Calorie/Lipid	12	14-16mm	EV-8, #193	*T. longipes*	6/12/2010
Carbon/Calorie/Lipid	16	16-18mm	EV-8, #193	*T. longipes*	6/12/2010
Carbon/Calorie/Lipid	5	18-20mm	EV-8, #193	*T. longipes*	6/12/2010
Carbon/Calorie/Lipid	6	20-22mm	EV-8, #193	*T. longipes*	6/12/2010
Carbon/Calorie/Lipid	2	22-24mm	EV-8, #193	*T. longipes*	6/12/2010

Table 3: HPLC Lipofuscin Run Log as of 6/13/10

Experiment/ Station	No. krill in experiment	No. krill analyzed	Dominant species	Krill Eye LF Analysis	Krill Eye protein Analysis	Storage Date
IGR 34	48	47	*T. raschii*	5/17/2010	5/17/2010	5/14/2010
IGR 35	48	47	*E. pacifica*	5/24/2010	5/24/2010	5/24/2010
IGR 36	48	48	*T. raschii*	5/26/2010	5/27/2010	5/26/2010
IGR 37	48	48	*T. raschii*	5/28/2010	5/29/2010	5/27/2010
IGR 38	48	47	*T. raschii*	6/2/2010	6/3/2010	6/1/2010
IGR 39	48	48	*T. raschii*	6/6/2010	6/6/2010	6/4/2010
IGR 40	48	48	*T. inermis*	6/11/2010	6/12/2010	6/11/2010
MN-19 krill	N/A	11	*T. longipes*	5/24/2010	5/24/2010	5/24/2010
EV-3 krill	N/A	15	*T. inermis*	5/24/2010	5/24/2010	5/24/2010
CN-17 krill	N/A	29	*T. longipes*	6/2/2010	6/3/2010	6/1/2010
70M-4 krill	N/A	5	*T. raschii*	6/2/2010	6/3/2010	6/1/2010
70M-16 krill	N/A	29	*T. raschii*	6/2/2010	6/3/2010	6/1/2010

Experiment/ Station	No. krill in experiment	No. krill analyzed	Dominant species	Krill Eye LF Analysis	Krill Eye protein Analysis	Storage Date
SL-12 krill	N/A	11	*T. raschii*	6/11/2010	6/12/2010	6/10/2010
MN-19A krill	N/A	3	*T. inermis*	6/11/2010	6/12/2010	6/10/2010
EV-6 krill	N/A	4	*T. inermis*	6/11/2010	6/12/2010	6/10/2010
MN-8GF krill	N/A	4	*T. raschii*	6/11/2010	6/12/2010	6/10/2010

Table 4: Sediment Trap and CTD Collection Log as of 6/13/10

Sample Type	Date	Station	Experimental Details
Water Colum for sediment traps	5/18/2010	MN-19, #49	250m sampling depth, cast 62, Niskins 1&2
			100m sampling depths, cast 62, Niskins 3&4
			50m sampling depth, cast 62, Niskins 5&6
			40m sampling depth, cast 62, Niskins 7&8
			20m sampling depth, cast 62, Niskin 9
Sediment trap samples - recovery	5/19/2010	MN-19, #51	Sediment trap @ 25m
			Sediment trap @ 40m
			Sediment trap @ 50m
			Sediment trap @ 60m
			Sediment trap @ 100m
Water Colum for sediment traps	5/21/2010	NZ 11.5, #55	20m sampling depth, cast 72, Niskin 5
			50m sampling depth, cast 72, Niskin 2
			100m sampling depth, cast 72, Niskin 1
Sediment trap samples - recovery	5/21/2010	NZ 11.5, #57	Sediment trap @ 25m
			Sediment trap @ 40m
			Sediment trap @ 50m
			Sediment trap @ 60m
			Sediment trap @ 100m
Sediment trap samples - recovery	5/29/2010	Deployed at	Sediment trap @ 25m
		CN-17, #84	Sediment trap @ 40m
			Sediment trap @ 50m
			Sediment trap @ 60m
			Sediment trap @ 100m
Water Colum for sediment traps	6/7/2010	MN-19, #163	100m sampling depth, cast 204, Niskin 5
			200m sampling depth, cast 204, Niskin 4
			400m sampling depth, cast 204, Niskin 2
	6/7/2010	MN-19, #163	40m sampling depth, cast 205, Niskin 3
			60m sampling depth, cast 205, Niskin 1
Sediment trap samples - recovery	6/7/2010	MN-19, 163	Sediment trap @ 25m
			Sediment trap @ 40m
			Sediment trap @ 50m
			Sediment trap @ 60m
			Sediment trap @ 100m
Water Colum for sediment traps	6/12/2010	TR-6, #194	100m sampling depth, cast 243, Niskin 1
			60m sampling depth, cast 243, Niskin 2
			40m sampling depth, cast 243, Niskin 3

Sample Type	Date	Station	Experimental Details
Sediment trap samples - recovery	6/12/2010	TR-6, #194	Sediment trap @ 25m
			Sediment trap @ 40m
			Sediment trap @ 50m
			Sediment trap @ 60m
			Sediment trap @ 100m

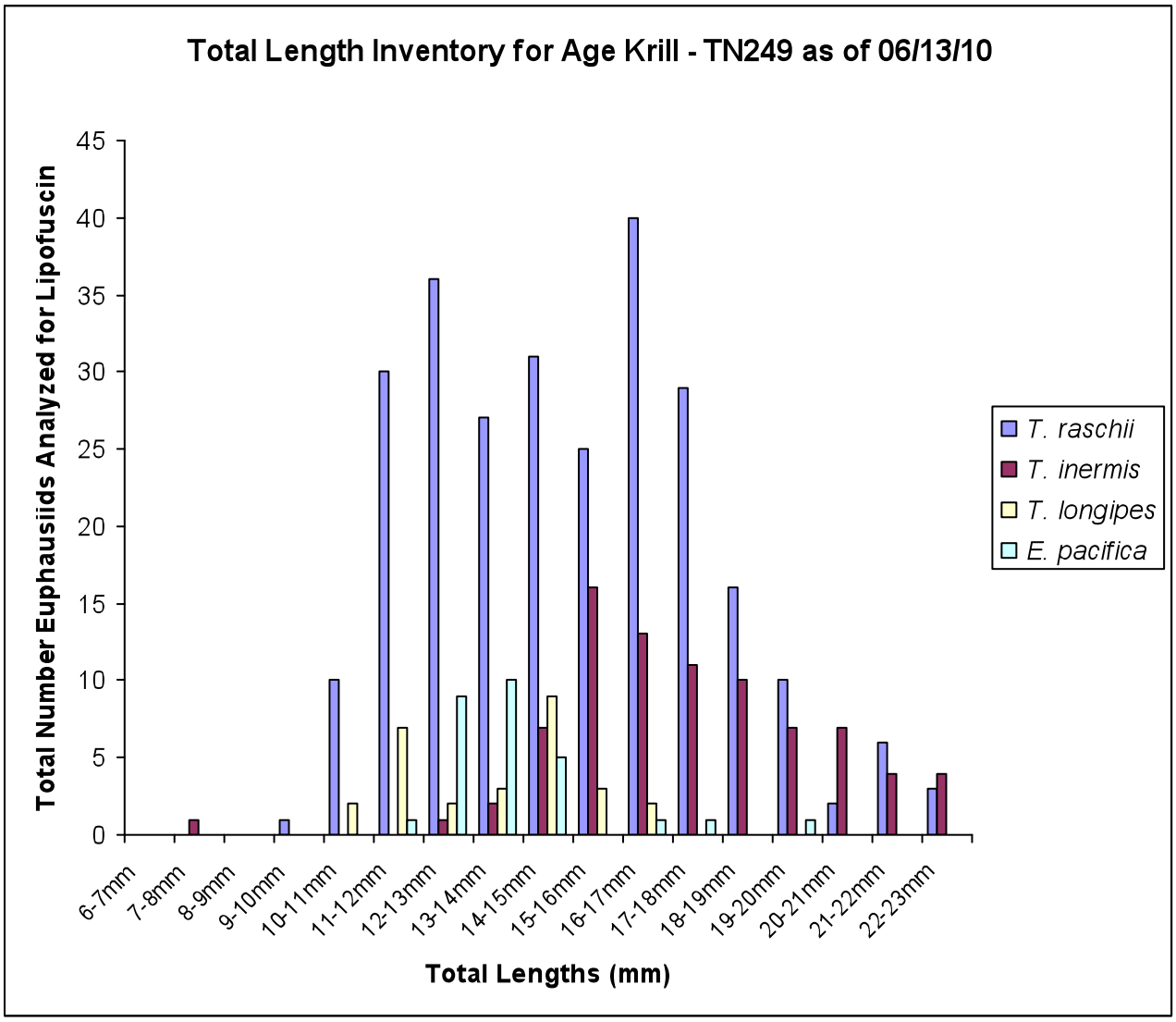
Note: All filter samples were frozen at -80ºC after collection

Table 5: Sediment Collection Log as of 6/13/10

Date	Station	Stn #	# Cores	Surface/Down Core/Whole Core	Increments (cm)	Range (cm)
5/13/2010	NP-13	6	2	Surface	1	0-2
5/15/2010	Z-15	24	3	Surface	1	0-2
5/16/2010	ZC-8	35	2	Surface	1	0-2
5/21/2010	NZ-11.5	55	1-3	Whole/Down Core	1	0-22
5/23/2010	NZ4.5	66	2	Surface	1	0-2
6/2/2010	70M-29	124	2	Surface	1	0-2
6/4/2010	70M-52	147	2	Surface	1	0-2
6/5/2010	SL-12	156	2	Surface	1	0-2
6/5/2010	SL-9	158	2	Surface	1	0-2
6/7/2010	MN-19		1	Surface	1	0-1
6/8/2010	MN-14	169	2	Whole/Down Core	1	0-16
6/8/2010	MN-14	169	1	Whole/Down Core	2	16-34
6/9/2010	AL-4	178	1	Surface	1	0-1
6/12/2010	TR-6	194	2	Surface	1	0-2

Note: All sediment samples were frozen at -80ºC after collection.

Figure 1: Inventory of euphausiids analyzed as total length for lipofuscin index during TN249



A novel molecular approach to measuring In situ feeding rates of copepods in the South Eastern Bering Sea.

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The purpose of this research is to investigate the *in situ* prey items and ingestion rates of copepods in the Eastern Bering Sea using genetic techniques. This new method of investigating trophic interactions should provide a good picture of the variety of prey items consumed by the dominant copepod species of the Eastern Bering Sea including microzooplankton in addition to

phytoplankton. To approach this area of research, sampling was conducted at 24 stations (Table 1).

Table 1: A summary of station activities indicating the deployment of a night tow, day tow, and CTD.

Date	Station	Latitude	Longitude	Night	Day	CTD
05/11/10	2, NP14	56 16.996 N	171 3.066 W		x	x
05/12/10	5, NP15	56 03.2382 N	171 18.1108 W		x	x
05/13/10	7, NP12	56 43.6348 N	170 34.374 W		x	x
05/14/10	15, Z6	57 54.0404 N	170 39.1729 W		x	
05/15/10	24, Z15	58 21.0649 N	171 47.6119 W	x		x
05/15/10	39, IE1	59 19.7376 N	175 36.3658 W	x	x	x
05/19/10	49, NP15	59 53.9933 N	178 53.7614 W	x	x	x
05/21/10	55, NZ11.5	58 12.2571 N	174 14.1445 W	x	x	x
05/23/10	66, NZ4.5	59 04.3167 N	170 10.2659 W	x	x	x
05/25/10	71, HBR1	56 55.0630 N	167 19.2205 W	x	x	x
05/27/10	81, 70M26	58 10.1226 N	169 53.5109 W	x	x	x
05/29/10	87, CN17	55 25.8870 N	168 03.6494 W	x	x	x
05/30/10	94, CN5	57 07.8926 N	163 47.9057 W		x	
05/31/10	99, 70MN4	56 51.217 N	164 30.336 W	x	x	x
06/01/10	117, 70MN22	57 50.8413 N	168 54.5458 W		x	
06/02/10	124, 70MN29	58 37.0198 N	170 16.5333 W	x	x	x
06/04/10	147, 70MN52	61 24.6592 N	173 44.1666 W	x	x	x
06/05/10	156, SL12	62 11.3394 N	175 09.1240 W	x	x	x
06/06/10	160, AL3	60 06.3678 N	177 48.5454W		x	
06/07/10	163, MN19	59 53.6040 N	178 53.8975 W	x	x	x
06/08/10	170, MN13	60 06.3678 N	177 48.5454W		x	
06/09/10	175, MN8	59 54.0190 N	172 12.0000 W	x	x	x
06/10/10	179, NP3	58 49.805 N	168 09.534 W	x	x	x
06/11/10	188, NP11	56 58.3599 N	170 16.8131W		x	

Zooplankton Sampling

At each station, a 333 μm mesh ring net was deployed to a depth of 60 meters (or bottom depth) at a rate of 15-20 m/minute (Figure 1). Half of the collected sample was concentrated over a 150 μm screen and immediately fixed in 95% Ethyl Alcohol for later genetic analysis at the University of Rhode Island. The other half of the sample was used for additional data including gut pigment analysis, fecal pellet collection and specimen collection for species DNA analysis. Fixed ethanol samples were taken at all stations, but additional data collection was variable depending on species collected and time of sampling (Table 2). At 14 of the 24 stations, both a night and day tow were conducted. The night tows corresponded with the Ashjian/Campbell collection for incubation feeding experiments (around 0530). Day tows were taken between 0800 and 1400 in full daylight. At 10 of the stations, either a day or night sample was taken. The focus of these stations was to increase the area sampled for later DNA analysis.

Picture credit: Julie Arrington

Figure 1: Retrieving the net after deployment.

Table 2: A summary of zooplankton sampling, dominant species and additional sampling.

Station	Fixed	Gut Pigments	Fecal Pellets	Dominant Copepods
2, NP14	x			*Eucalanus* sp., *Neocalanus* spp., *Pseudocalanus* spp.
5, NP15	x			*Eucalanus* sp., *Neocalanus* spp., *Pseudocalanus* spp.
7, NP12	x			*Eucalanus* sp., *Neocalanus* spp., *Pseudocalanus* spp.
15, Z6	x			*Eucalanus* sp., *Neocalanus* spp., *Pseudocalanus* spp.
24, Z15	x	x		*Neocalanus* spp., *Pseudocalanus* spp.
39, IE1	x	x		*Neocalanus* spp., *Pseudocalanus* spp.
49, NP15	x	x		*Neocalanus* spp., *Pseudocalanus* spp.
55, NZ11.5	x	x		*Neocalanus* spp., *Pseudocalanus* spp.
66, NZ4.5	x	x		*Neocalanus* spp., *Pseudocalanus* spp.
71, HBR1	x			*Psuedocalanus* spp., *Acartia* sp.
81, 70M26	x	x		*Psuedocalanus* spp., *Acartia* sp., *Calanus* sp.
87, CN17	x	x		*Eucalanus* sp., *Neocalanus* spp., *Pseudocalanus* spp.
94, CN5	x			*Calanus sp.* (developmental stages: C 1-3)
99, 70MN4	x	x		*Calanus sp.*
117, 70MN22				*Psuedocalanus spp.*
124, 70MN29	x	x		*Psuedocalanus spp., Acartia sp., Calanus sp.*
147, 70MN52	x	x		*Psuedocalanus spp., Acartia sp., Calanus sp.*
156, SL12	x	x		*Psuedocalanus spp., Calanus sp.*
160, AL3	x		x	*Psuedocalanus spp., Neocalanus spp.*
163, MN19	x	x	x	*Psuedocalanus spp., Metridia sp., Eucalanus sp.*
170, MN13	x	x	x	*Psuedocalanus spp., Neocalanus spp.*
175, MN8	x	x		*Psuedocalanus spp., Acartia sp.*
179, NP3	x	x		*Psuedocalanus spp., Acartia sp.*
188, NP11	x		x	*Calanus sp.*

Gut pigment analysis allows for the fullness of the copepod guts to be recorded and may provide information as to the presence or absence of diel feeding behavior and rates of digestion when measured at a day and night end point. Dominant female and C5 stage copepod species were collected in groups of 5-20 (dependent on size of species) on A/E glass fiber filters. Species used to date include *Neocalanus cristatus, N. plumchrus, Pseudocalanus* spp., *Acartia longiremis,* and *Calanus marshallae/glacialis, Eucalanus* sp., and *Metridia* sp. Filters were placed in 6ml of acetone for 24 hours in a freezer. The following day, chlorophyll a and phaeo pigments were measured. No trend has yet to be identified in the chlorophyll a and phaeophytin a measurements. Further analysis of the data will be conducted at the University of Rhode Island.

At Station 117 (70MN22), multiple species of *Pseudocalanus* were observed in the collected sample. Individuals were picked for at least two different species and preserved in the -80°C freezer. These individuals will later be used for genetic comparison between species. Additional specimen were collected from multiple stations by the Ashjian/Campbell group for the same purpose. Information collected from this work will provide a better understanding of *Pseudocalanus* species distribution and dominance in the Eastern Bering Sea.

Fecal pellet samples were collected from four stations at the end of the cruise. Copepod species including *Neocalanus cristatus, N. plumchrus, Eucalanus* sp., and *Calanus marshallae/glacialis* were placed into separate containers fresh seawater for approximately three hours after the initial ring net collection. Fecal pellets released into the fresh seawater were collected, placed on 5 μm filters and stored in the -80°C freezer for later DNA analysis. Prey DNA collected from the fecal pellets will provide further information on *in situ* copepod feeding and may help in analyzing differences in digestion of a variety of prey items. High copepod mortality prevented collection of fecal pellets earlier in the cruise.

CTD Water Sampling

The phytoplankton community also was sampled for comparative DNA samples and analysis of food web dynamics. Up to 4L of water was collected from 10 sampling stations at both the surface and chlorophyll maximum (Table 4). One liter of this water was concentrated over a 10 μm screen into 20 ml and then fixed with 2% Lugol's solution for phytoplankton community composition and potential further DNA extraction. An additional 300-500 ml of water was filtered over 0.8 μm filters in replicates of 3 and stored in the -80°C freezer for later DNA extraction. This filtration and concentration was performed for both the surface and chlorophyll maximum samples.

Table 4: A summary of CTD dates, ship file names and depths where chlorophyll maximum sample was taken. **Station 124 had no chlorophyll maximum and 30 meters was chosen as an arbitrary depth before the pycnocline.

Date	Station	Ship CTD File Number	Chlorophyll Maximum Depth (m)
05/11/10	2	24900201	15
05/12/10	5	24900501	40
05/13/10	7	24900702	40
05/15/10	24	24902405	20
05/17/10	39	24903903	27
05/19/10	49	24904905	18
05/21/10	55	24905504	22
05/23/10	66	24906604	22
05/25/10	71	24907104	27
05/27/10	81	24908103	22
05/29/10	87	24908704	17
05/31/10	99	24909903	33
06/02/10	124	24912403	30**
06/04/10	147	24914704	26
06/05/10	156	24915604	40
06/07/10	163	24916305	15
06/09/10	175	24917503	37
06/10/10	179	24917903	29

At nine of the stations (39, 49, 71, 87, 124, 156, 163, 175, 179), additional water was concentrated over a 10 μm screen and individual phytoplankton cells or chains were isolated for culturing. Cultures were stored in a low light, low temperature (1°C) environment for optimal growth. A total of 25 culture tubes were filled for each station. These cultures may provide useful information in determining the identity of the DNA retrieved from the copepod guts and may also provide useful information about the distribution and abundant types of phytoplankton in the water column in both near ice and open water environments.

A detailed report of significant findings for copepod stomach content DNA, fecal pellet gut pigments and phytoplankton community will be made after samples have been processed at the University of Rhode Island. Information obtained from this analysis will provide a good picture of the *in situ* predation by a variety of species of copepods in the Eastern Bering Sea under a variety of environmental conditions. This will be useful in gaining further detail of present trophic interactions of a key group of species in the Bering Sea and may provide useful insight for future work concerning inter-annual and inter-spatial variations.

Denitrification and Global Change in Bering Sea shelf sediments

PIs: Allan Devol (UW and David Shull (WWU)
On-board team members: Allan Devol, Wendi Ruef, Greg Brusseau

The benthic group made sediment chemical flux and pore-water measurements. Sediment samples were collected using a MultiCore that collects up to 8 individual cores per deployment. During the later two thirds of the cruise we usually only deployed the instrument with four core tubes in order to increase the length of the cores.

In total we sampled at 34 locations and successfully collect usable sediment samples at 27 of them. At each station we subsampled for whole core incubation in the cold van (usually 4 incubation cores). Incubation cores were sampled periodically over a 2-3 day interval and measurements were made of dissolve oxygen concentration (oxygen optode) and N:Ar ratio was determined onboard by membrane inlet mass spectrometry. Samples also were collected from incubation cores for dissolved nutrient concentration and frozen for later analysis. On selected incubation cores initial and final time point samples were collected for determination of N:Ar by isotope ratio mass spectrometry on shore in the University of Washington Stable Isotope Facility. Another core was subsampled for determination of pore-water O_2 profile, which was determined with a Clark-type microelectrode. A separate core was used for whole core squeezing. During squeezing, dissolved O2 was measured and samples were taken for nutrient concentration (also frozen for later analysis). The Squeeze core technique yields pore-water profiles at sub-millimeter scale resolution. At almost all stations, two additional cores were collected for sectioning and pore waters were extracted via centrifugation for determination of pore-water nutrient profiles (samples frozen for later analysis). Core sectioning results in coarser scale pore-water profile resolution than squeezing but allows for much deeper sampling, tens of centimeters, than squeezing, tens of millimeters. Another core was sectioned for analysis of thorium, a short lived radionuclide. These samples were counted on board and counting will continue on during the next cruise of the BEST program. From the thorium results we will be able to calculate the rate of sediment reworking (mixing) by macrofaunal animals. Thorium results will also be analyzed in conjunction with the water-column thorium analyses being done by Dr. B. Moran and thorium budgets for the different stations will be constructed and used in constructing an overall carbon budget for that station.

A table listing sampling locations and major analyses is appended. All of our analyses are in different stages of completion at this time, but none have been worked up to the stage of preliminary numbers as yet. Nutrient analysis of frozen samples will be initiated on the second BEST cruise (TN250; Dr. D. Shull). Final flux results will be calculated from both incubation cores and pore-water profiles after porosity measurement at the University of Washington. Overall we feel we have had a very successful cruise and either met or exceed our sampling goals.

Date	Station #	Alt. Name	Depth (m)	Location		flux core	section	squeeze	Thorium
				N	W				
11-May-10	1	Test	133	56.647	168.135	4	2	1	1
13-May-10	6	NP 13	122	56.512	170.804	4	2	0	1
14-May-10	15	Z6	79.6	57	170.653	4	2	1	1

Date	Station #	Alt. Name	Depth (m)	Location		flux core	section	squeeze	Thorium
15-May-10	24	Z15	98.5	58.352	171.795	4	2	1	1
16-May-10	35	ZC8	145.6	58.741	174.902	4	2	1	1
17-May-10	39	IE1	138	59.325	177.611	4	1	1	1
18-May-10	49	MN19	488.6	59.902	177.912	4	2	1	1
20-May-10	54	AL1	126.1	58.857	176.855	4	2	1	1
21-May-10	55	NZ11.8	381.2	58.205	174.236	4	2	1	1
23-May-10	66	NZ4.5	66.7	59.073	170.169	4	2	1	1
25-May-10	71	HBR1	78.1	56.915	167.323	4	2	1	1
26-May-10	80	AL2	85	57.18	170.871	4	2	1	1
27-May-10	81	70M26	72.3	58.169	169.01	4	2	1	1
29-May-10	87	CN17	204.2	55.431	168.061	4	2	1	1
30-May-10	94	CN5	66.8	57.132	163.799	4	2	0	1
30-May-10	95	CN3	46.8	57.637	163.278	4	2	1	1
31-May-10	99	70M4	72.9	56.854	164.501	3	2	1	1
2-Jun-10	124	70M29	72.4	58.618	170.276	4	2	1	1
4-Jun-10	147	70M52	75.3	61.411	173.736	4	2	1	1
5-Jun-10	156	SL12	79.1	62.189	175.152	4	2	1	1
5-Jun-10	158	SL9	60.4	62.096	173.288	4	2	0	1
6-Jun-10	160	AL3	141	60.107	177.805	4	2	0	1
7-Jun-10	163	MN19	656.3	59.893	178.898	4	2	0	1
8-Jun-10	169	MN14	130	59.9	175.809	4	2	0	1
9-Jun-10	178	AL4	67.7	59.52	172.5	4	0	0	1
10-Jun-10	179	NP3	460	58.83	168.16	4	1	0	1
10-Jun-10	184	NP7	67.2	57.9	169.24	4	2	0	1

North Pacific Pelagic Seabird Observer Program

PIs: Kathy Kuletz and David Irons (USFWS)
On-board team members: Nate Jones and Marty Reedy

This report summarizes the effort of two US Fish and Wildlife (USFWS) observers during May 10-June 11, 2010 on board the University of Washington *R/V Thomas G Thompson*.

During that time there has been:

- 33 days at sea
- 299 transects
- 29262 animals observed within transect
- 7 marine mammal and 45 avian species noted

Methodology

All survey methodology was achieved using the North Pacific Pelagic Seabird Database protocols. All birds were identified within 99% certainty as to genus and species, unless otherwise noted.

All available daylight hours were used to survey, when possible.

Whenever the ship arrived on station, the bird observations would stop and a new transect begun after the ship left for a new station.

Zeiss or Swarovski 10X42 binoculars were used when necessary for bird identification.

A Panasonic W7 computer was used on the bridge to record data concerning behavior, distance from the ship, species and their numbers. Dlog3 software was used for data collection and was integrated with a handheld Garmin GPSmap 60CSx navigation system. The ship's position was recorded every 20 seconds.

A Leica Rangefinder 1200 and a "coffee stick bin calculator" were used to verify observer distance estimates. Scans of the survey area were done out to 300 meters in a 90 degree arc from the midline of the ship to the port side

Bins were established at:

Bin 1: 0-100m parallel and forward of the ship

Bin 2: 101-200m

Bin 3: 201-300m

Bin 9: 301m beyond the ship.

Incidental Observations/Highlights:

There were some notable sightings that are not listed in the summary tables below as the animals were observed outside the survey area or while during stations, or "off-effort." Typically, the animals were brought to the attention of the observers by other members of the scientific party or the ship's crew members.

There was a single Brambling (*Fringilla montifringilla*) that was seen on the ship for a number of hours. This bird is a common vagrant to the western Aleutian Islands, but occurring rarely off of the Pribilof Islands.

Also noted was at least one McKay's Bunting (*Plectrophenax hyperboreus*). This bird breeds off of St. Matthew and Hall islands. It is occasionally seen off of the Pribilof Islands. This particular sighting placed this individual at 150 miles from St. Paul in pelagic water.

A number of Dovekies (*Alle alle*) were seen and recorded on this survey. A mostly Atlantic Ocean range species, we were pleased when both observers were able to concur on the presence of this hard-to-identify bird in the Bering Sea. Of particular note was its tendency to fly with flocks of Least Auklets (*Aethia pusilla*).

A number of Black Guillemots (*Cepphus grille*) were seen. Thirty six were seen both within and outside of the 300 meter range (25 within 300 meters). Of these 36 guillemots, 15 were in molt, or in some instances, still in winter plumage (12 within 300 meters).

Other animals of interest seen were:

- Lapland Longspur (*Calcarius lapponicus*)
- Least Sandpiper (*Calidrus minutilla*)
- Ribbon Seal (*Phoca fasciata*)
- Spotted or Largha Seal (*Phoca largha*)
- Long-tailed Duck - formerly "Old Squaw" (*Clangula hyemalis*)
- Northern Pintail (*Anas acuta*)
- Wandering Tattler (*Heteroscelus incanus*)
- Dunlin (*Calidris alpine*)

- Semipalmated Sandpiper (*Calidris pusilla*)
- Short-tailed Albatross (*Phoebastria immutabilis*)

Of special interest is the above mentioned Short-tailed Albatross. The bird approached the ship while we were on station near the "Donut Hole" at N 59 54.008/W 179 26.245. It was a sub-adult and photos were taken (see below).

A report on this federally endangered species will be sent to Greg Balogh and associates with the USFWS in Anchorage, Alaska.

Table 1. Observations of all animals within 300 meters of ship

SPP ALPHA CODE	0-100M	101-200M	201-300M	Grand Total	SPP Common Name	% OF ALL ANIMALS
Survey	*through*	*06 11 2010*				
UNMU	2129	4296	5410	11835	Unidentified Murre	40.45
LEAU	1475	1390	1665	4530	Least Auklet	15.48
TBMU	1123	1281	1039	3443	Thick-billed Murre	11.77
NOFU	692	806	634	2132	Northern Fulmar	7.29
USDA	464	448	890	1802	Unidentified Small Dark Alcid	6.16
COMU	729	607	312	1648	Common Murre	5.63
BLKI	353	318	220	891	Black-legged Kittiwake	3.05
REPH	246	254	290	790	Red Phalarope	2.7
CRAU	96	194	110	400	Crested Auklet	1.37
FTSP	136	123	109	368	Fork-tailed Storm-Petrel	1.26
PAAU	115	102	73	290	Parakeet Auklet	0.99
TUPU	111	84	66	261	Tufted Puffin	0.89
RLKI	62	108	43	213	Red-legged Kittiwake	0.73
GLGU	73	62	55	190	Glaucous Gull	0.65
HOPU	43	37	19	99	Horned Puffin	0.34
HEGU	27	5	1	33	Herring Gull	0.11
UNAL	9	13	8	30	Unidentified Alcid	0.1
GWGU	11	10	5	26	Glaucous-winged Gull	0.09
BLGU	16	5	3	24	Black Guillemot	0.08
UNGU	11	5	7	23	Unidentified Gull	0.08
HARD	13	6	2	21	Harlequin Duck	0.07
LAAL	6	4	7	17	Laysan Albatross	0.06
SPSE	1	8	7	16	Spotted Seal	0.05
SBGU	9	7		16	Slaty-backed Gull	0.05
UNDS	3	5	6	14	Unidentified Dark Shearwater	0.05
UNKI	2	7	4	13	Unidentified Kittiwake	0.04
PECO	9		3	12	Pelagic Cormorant	0.04
DAPO	9		2	11	Dall's Porpoise	0.04
RFCO	4	5	1	10	Red-faced Cormorant	0.03
ZZZZ	5	4		9	Unidentified Animal	0.03
PASS	3	3	2	8	Passerine	0.03

SPP ALPHA CODE	0-100M	101-200M	201-300M	Grand Total	SPP Common Name	% OF ALL ANIMALS
PIGU	2	5		7	Pigeon Guillemot	0.02
NOFS	5		2	7	Northern Fur Seal	0.02
SOSH	4		1	5	Sooty Shearwater	0.02
FIWH	1	2	2	5	Fin Whale	0.02
ARTE	2		3	5	Arctic Tern	0.02
ANMU	5			5	Ancient Murrelet	0.02
UNSC			4	4	Unidentified Scoter	0.01
POJA	1	2	1	4	Pomarine Jaeger	0.01
MIWH	2	1	1	4	Minke Whale	0.01
LTJA	1	2	1	4	Long-tailed Jaeger	0.01
DOVE		2	2	4	Dovekie	0.01
UNPU	2		1	3	Unidentified Puffin	0.01
HBWH		1	2	3	Humpback Whale	0.01
UNWH	1	1		2	Unidentified Whale	0.01
UNSB	2			2	Unidentified Shorebird	0.01
UNPR			2	2	Unidentified Procellariiformes	0.01
UNBU	2			2	Unidentified Bunting	0.01
UNBI	2	0	0	2	Unidentified BIrd	0.01
RISE	1		1	2	Ringed Seal	0.01
LALO	2			2	Lapland Longspur	0.01
DUNL	2			2	Dunlin	0.01
UNSP	1			1	Unidentified Sandpiper	0
UNSE		1		1	Unidentified Seal	0
UNJA			1	1	Unidentified Jaeger	0
UNAU			1	1	Unidentified Auklet	0
SPSP	1			1	Semipalmated Sandpiper	0
PRCO			1	1	Pelagic/Red-faced Cormorant	0
NOPI		1		1	Northern Pintail	0
LTDU	1			1	Long-tailed Duck	0
Grand Total	**8025**	**10215**	**11019**	**29259**		**100**

Short-tailed Albatross

Table 2. Observations of all birds within 300 meters of ship

SPP ALPHA CODE	0-100M	101-200M	201-300M	Grand Total	SPP Common Name	% OF ALL BIRDS
Survey through 06 11 2010						
UNMU	2129	4296	5410	11835	Unidentified Murre	40.45
LEAU	1475	1390	1665	4530	Least Auklet	15.48
TBMU	1123	1281	1039	3443	Thick-billed Murre	11.77
NOFU	692	806	634	2132	Northern Fulmar	7.29
USDA	464	448	890	1802	Unidentified Small Dark Alcid	6.16
COMU	729	607	312	1648	Common Murre	5.63
BLKI	353	318	220	891	Black-legged Kittiwake	3.05
REPH	246	254	290	790	Red Phalarope	2.7
CRAU	96	194	110	400	Crested Auklet	1.37
FTSP	136	123	109	368	Fork-tailed Storm-Petrel	1.26
PAAU	115	102	73	290	Parakeet Auklet	0.99
TUPU	111	84	66	261	Tufted Puffin	0.89
RLKI	62	108	43	213	Red-legged Kittiwake	0.73
GLGU	73	62	55	190	Glaucous Gull	0.65
HOPU	43	37	19	99	Horned Puffin	0.34
HEGU	27	5	1	33	Herring Gull	0.11

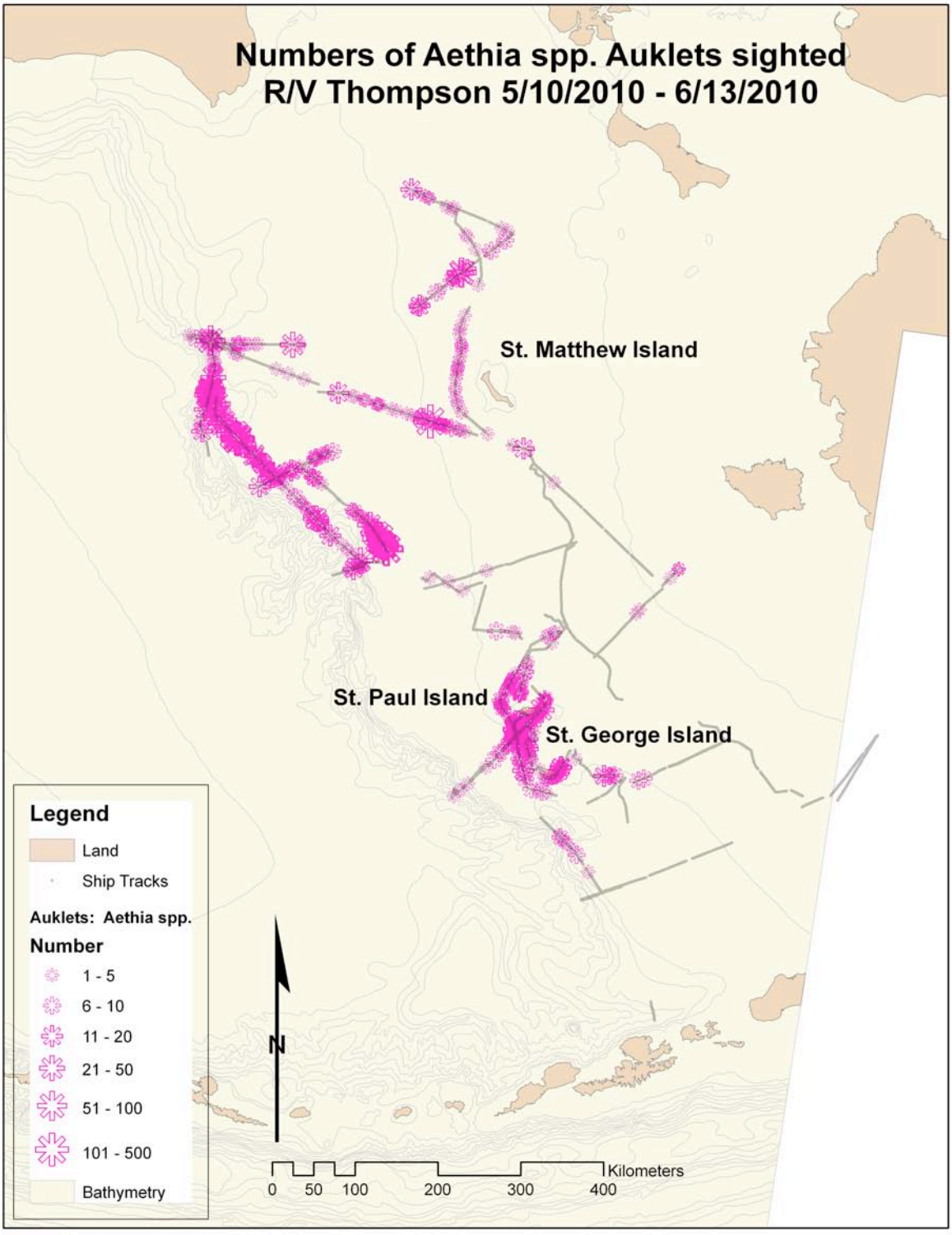
SPP ALPHA CODE	0-100M	101-200M	201-300M	Grand Total	SPP Common Name	% OF ALL BIRDS
UNAL	9	13	8	30	Unidentified Alcid	0.1
GWGU	11	10	5	26	Glaucous-winged Gull	0.09
BLGU	16	5	3	24	Black Guillemot	0.08
UNGU	11	5	7	23	Unidentified Gull	0.08
HARD	13	6	2	21	Harlequin Duck	0.07
LAAL	6	4	7	17	Laysan Albatross	0.06
SBGU	9	7		16	Slaty-backed Gull	0.05
UNDS	3	5	6	14	Unidentified Dark Shearwater	0.05
UNKI	2	7	4	13	Unidentified Kittiwake	0.04
PECO	9		3	12	Pelagic Cormorant	0.04
RFCO	4	5	1	10	Red-faced Cormorant	0.03
ZZZZ	5	4		9	Unidentified Animal	0.03
PASS	3	3	2	8	Passerine	0.03
PIGU	2	5		7	Pigeon Guillemot	0.02
SOSH	4		1	5	Sooty Shearwater	0.02
ARTE	2		3	5	Arctic Tern	0.02
ANMU	5			5	Ancient Murrelet	0.02
UNSC			4	4	Unidentified Scoter	0.01
POJA	1	2	1	4	Pomarine Jaeger	0.01
LTJA	1	2	1	4	Long-tailed Jaeger	0.01
DOVE		2	2	4	Dovekie	0.01
UNPU	2		1	3	Unidentified Puffin	0.01
UNSB	2			2	Unidentified Shorebird	0.01
UNPR			2	2	Unidentified Procellariiformes	0.01
UNBU	2			2	Unidentified Bunting	0.01
UNBI	2	0	0	2	Unidentified BIrd	0.01
LALO	2			2	Lapland Longspur	0.01
DUNL	2			2	Dunlin	0.01
UNSP	1			1	Unidentified Sandpiper	0
UNJA			1	1	Unidentified Jaeger	0
UNAU			1	1	Unidentified Auklet	0
SPSP	1			1	Semipalmated Sandpiper	0
PRCO			1	1	Pelagic/Red-faced Cormorant	0
NOPI		1		1	Northern Pintail	0
LTDU	1			1	Long-tailed Duck	0
Grand Total	**8005**	**10201**	**11002**	**29208**		**100**

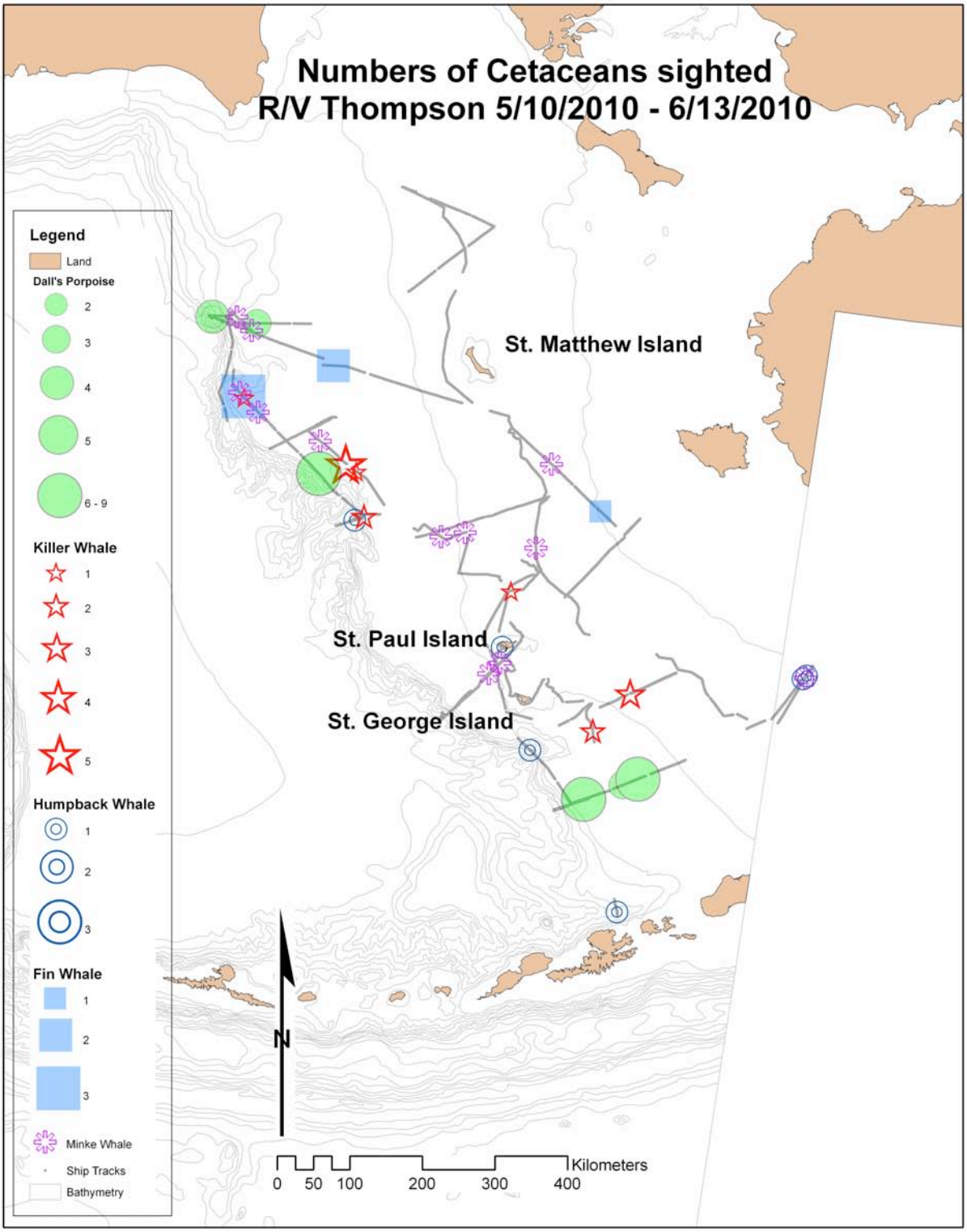
Black Guillemots with different plumages

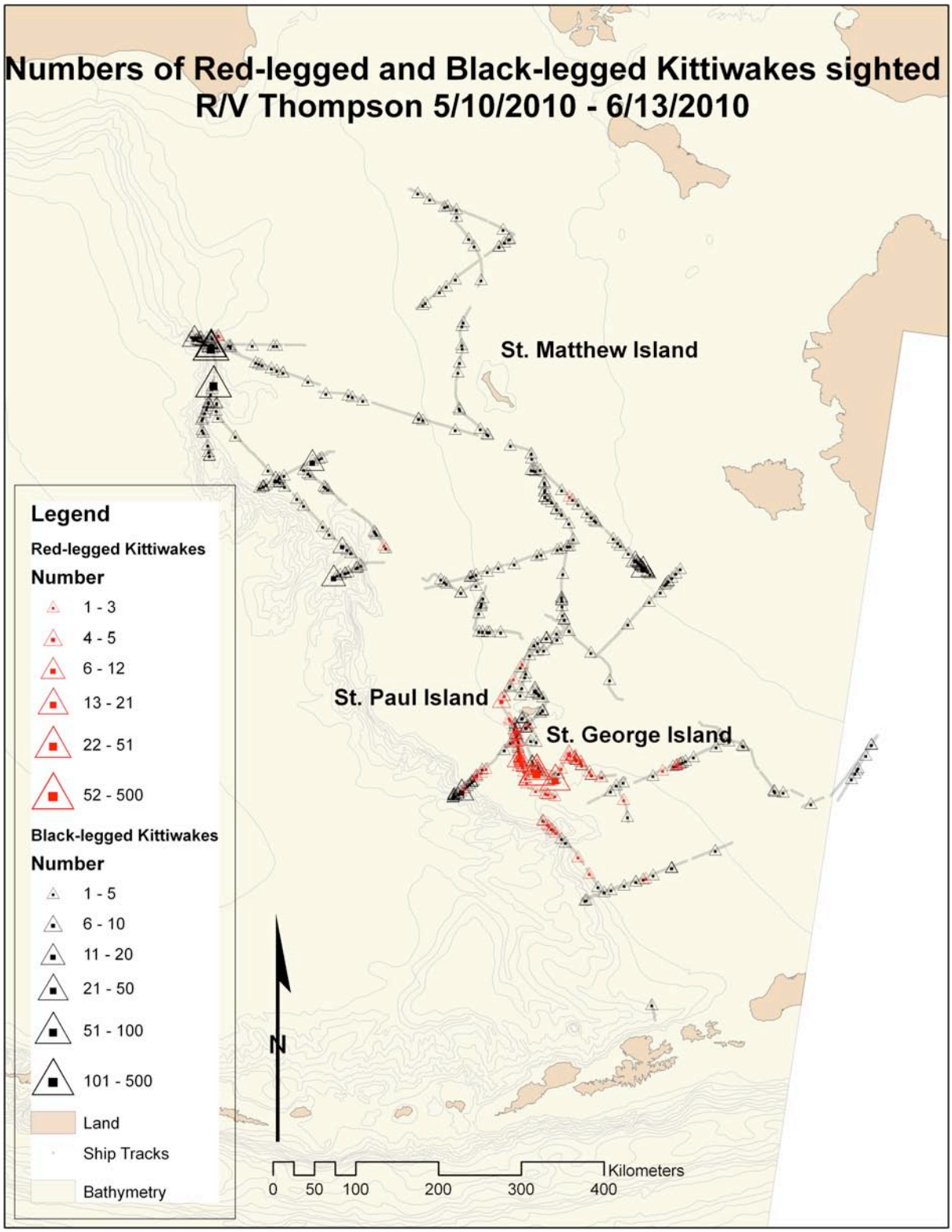
Table 3. Observations of all marine mammals within 300 meters of ship

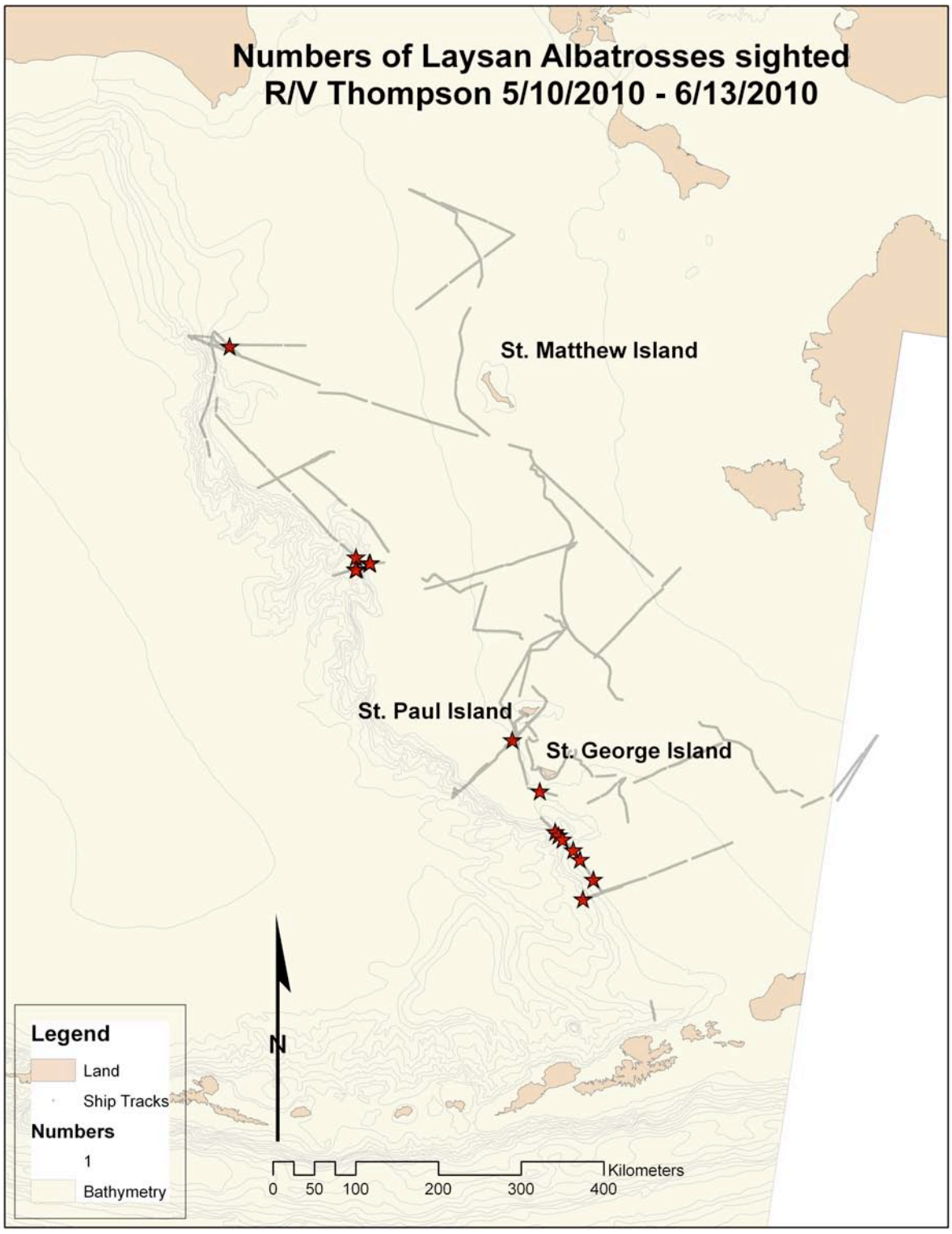
SPP ALPHA CODE	0-100M	101-200M	201-300M	Grand Total	SPP Common Name	% OF ALL Marine Mammals
Survey through 06 11 2010						
SPSE	1	8	7	16	Spotted Seal	31.37
DAPO	9		2	11	Dall's Porpoise	21.57
NOFS	5		2	7	Northern Fur Seal	13.73
FIWH	1	2	2	5	Fin Whale	9.80
MIWH	2	1	1	4	Minke Whale	7.84
HBWH		1	2	3	Humpback Whale	5.88
RISE	1		1	2	Ringed Seal	3.92
UNWH	1	1		2	Unidentified Whale	3.92
UNSE		1		1	Unidentified Seal	1.96
Grand Total	**20**	**14**	**17**	**51**		**100**

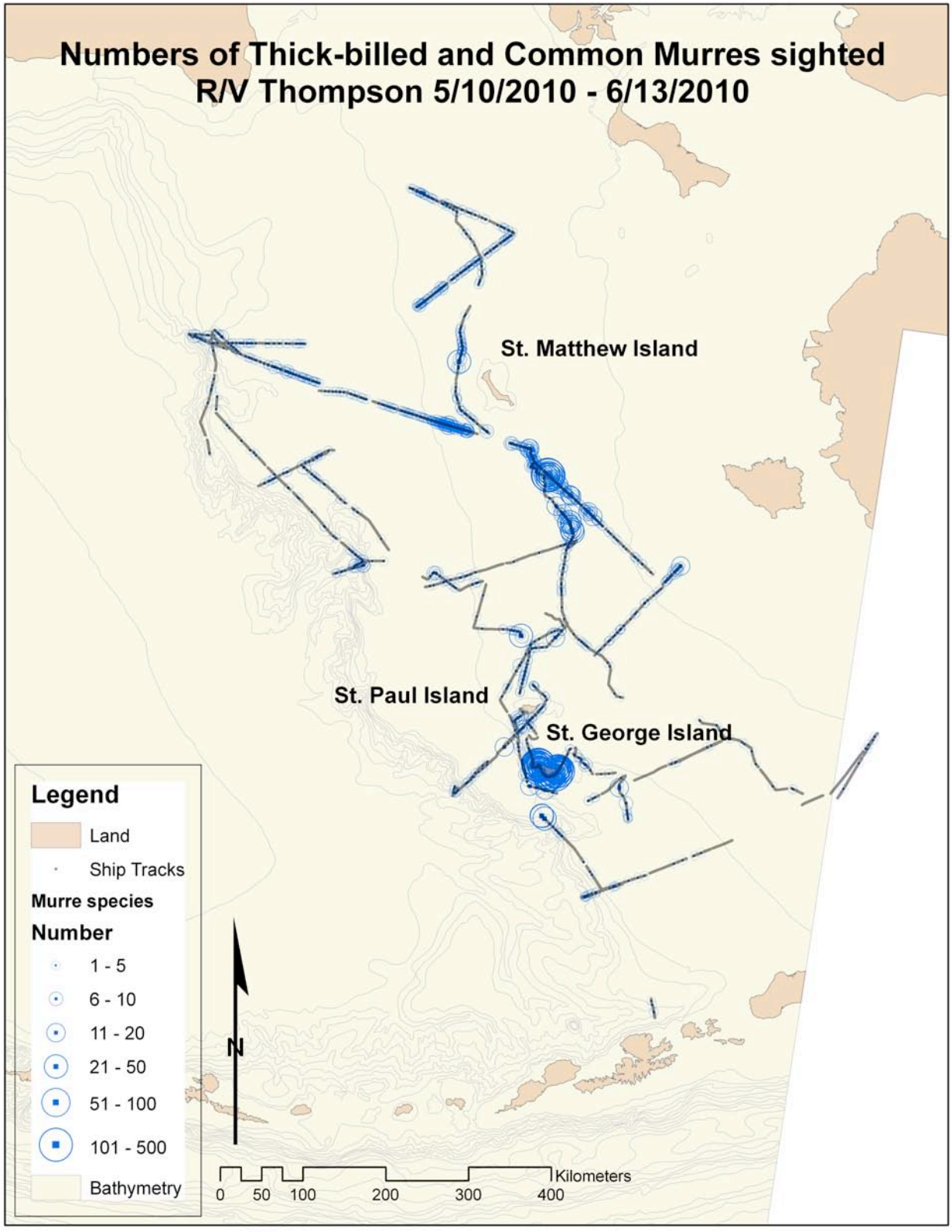
A Brambling, a Eurasian vagrant, on the deck of the R/V Thomas G Thompson

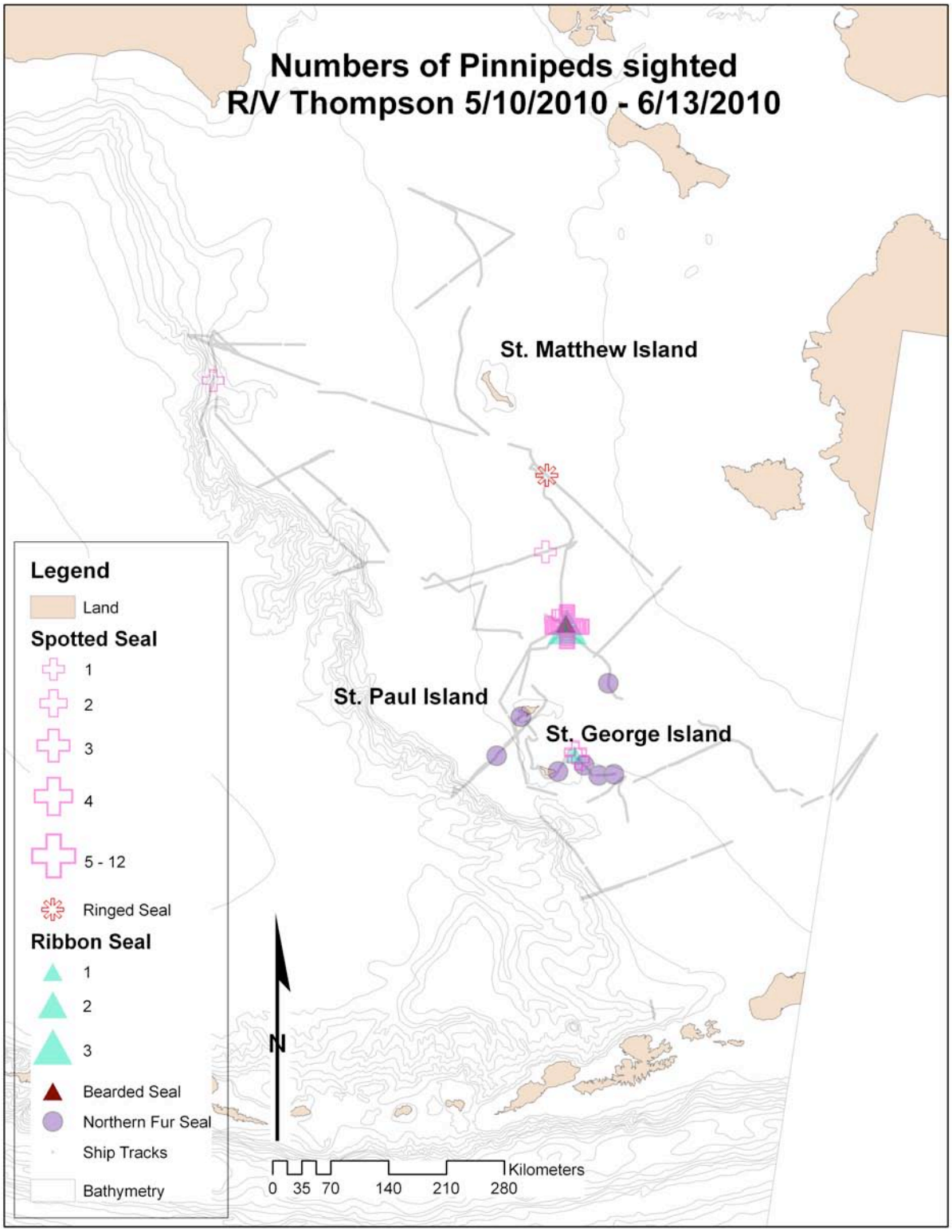

Numbers of Aethia spp. Auklets sighted
R/V Thompson 5/10/2010 - 6/13/2010
St. Matthew Island
St. Paul Island
St. George Island
Legend
Land
Ship Tracks
Auklets: Aethia spp.
Number
1 - 5
6 - 10
11 - 20
21 - 50
51 - 100
101 - 500
Bathymetry
N
0 50 100 200 300 400
Kilometers


Numbers of Cetaceans sighted
R/V Thompson 5/10/2010 - 6/13/2010
Legend
Land
Dall's Porpoise
2
3
4
5
6 - 9
Killer Whale
1
2
3
4
5
Humpback Whale
1
2
3
Fin Whale
1
2
3
Minke Whale
Ship Tracks
Bathymetry
St. Matthew Island
St. Paul Island
St. George Island
N
0 50 100 200 300 400
Kilometers


Numbers of Red-legged and Black-legged Kittiwakes sighted
R/V Thompson 5/10/2010 - 6/13/2010
St. Matthew Island
St. Paul Island
St. George Island
Legend
Red-legged Kittiwakes
Number
1 - 3
4 - 5
6 - 12
13 - 21
22 - 51
52 - 500
Black-legged Kittiwakes
Number
1 - 5
6 - 10
11 - 20
21 - 50
51 - 100
101 - 500
Land
Ship Tracks
Bathymetry
N
0 50 100 200 300 400
Kilometers


Numbers of Laysan Albatrosses sighted
R/V Thompson 5/10/2010 - 6/13/2010
St. Matthew Island
St. Paul Island
St. George Island
Legend
Land
Ship Tracks
Numbers
1
Bathymetry
N
0 50 100 200 300 400
Kilometers


Numbers of Thick-billed and Common Murres sighted
R/V Thompson 5/10/2010 - 6/13/2010
St. Matthew Island
St. Paul Island
St. George Island
Legend
Land
Ship Tracks
Murre species
Number
1 - 5
6 - 10
11 - 20
21 - 50
51 - 100
101 - 500
Bathymetry
N
0 50 100 200 300 400
Kilometers


Numbers of Pinnipeds sighted
R/V Thompson 5/10/2010 - 6/13/2010
St. Matthew Island
St. Paul Island
St. George Island
Legend
Land
Spotted Seal
1
2
3
4
5 - 12
Ringed Seal
Ribbon Seal
1
2
3
Bearded Seal
Northern Fur Seal
Ship Tracks
Bathymetry
N
0 35 70 140 210 280
Kilometers

Bering Ecosystem Study Data Management Support

PIs: Jim Moore, Greg Stossmeister, Steve Williams (NCAR/EOL)
On-board team members: John Allison (first leg), Dennis Flanigan (second leg)

The online field catalog and Mapserver were installed and run aboard ship, accessible via the internal ship network. Archives of previous BEST cruises were available for easy reference and station/track comparison. Both systems were built for continued operations during TN250. The catalog included the event log, reports and plans, underway plots from ship data and preliminary CTD transect plots from PMEL personnel, CTD data files and logsheets from the ship and PMEL, and data downloaded from the Internet including satellite images and ice and weather forecasts. The event log contains a record of all science events during the cruise.

New for TN249 was the ability for scientists to edit their event records, and full sorting and subsetting of the event log display. The mapserver displayed real-time ship data, including the track, fluorescence, sea surface temperature, and salinity.

Other regularly updated ship track data included nitrate data from PMEL and bird/animal observations from USFWS. Satellite products from the National/Naval Ice Center (visible and radar images), AMSR-E (ice analysis), and Aqua-MODIS (chlorophyll) were updated daily. Ice analysis from the NWS Anchorage office were updated when available (three times per week). Mid-way though the cruise drifter and sediment trap tracking plots were added. During the cruise a subset of the field catalog and mapserver plots were transmitted back to NCAR/EOL and hosted on their website.

The full catalog will be hosted at NCAR/EOL: http://catalog.eol.ucar.edu/best_tn249

NCAR/EOL will also host the full suite of mapserver plots:
http://mapserver.eol.ucar.edu/bestcruises

Appendix A. Science Party

Both Legs

Name	Institution	E-Mail Address
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Second Leg Only

Name	Institution	E-Mail Address
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Carol Ladd	NOAA	Carol.Ladd@noaa.gov
Peggy Sullivan	University of Washington	Peggy.Sullivan@noaa.gov

Appendix B. Ship's Crew

Both Legs

Name	Title
Al McClenaghan	Master
J Stephens	Chief Mate
Steven Haugland	2nd Mate
Chris Sheridan	3rd Mate
Pam Blusk	AB
Mike Hansen	AB
Zeke Machado	AB
Rob Worrad	AB
Terry Anderson	Chief Engineer
Mark Johnson	1st Asst. Engineer
John Hubner	2nd Asst. Engineer
Nic Ridgway	3rd Asst. Engineer
Victoria Simms	Oiler
Mike Koch	Oiler
Jim Phillips	Oiler
Larry Nelson	Wiper
Dan McBriar	Ch. Steward
Steve Sniezak	2nd Cook
Christy Christoferson	Mess Attd.

First Leg

Name	Title
Carlos Oliveira	AB (Cadet)

Second Leg

Name	Title
Mat Ursin	AB