CRUISE REPORT

ALPHA HELIX CRUISE 288

26 July 2004 to 20 August 2004

Project Title: Cross-shelf Transport and Post-Bloom New Production near the Pribilof Islands

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I. Scientific Purpose: This study tested the hypothesis that on-shelf flow of nutrient- and zooplankton-rich slope water influences post-bloom new production and zooplankton populations in the vicinity of the Pribilof Islands, thereby enhancing the ability of the region to support juvenile fish and planktivorous seabirds. We hypothesized that on-shelf transport of slope water supplies nutrients that enhance new primary production in summer, a season when the availability of new production on the shelf is limited by stratification. We predicted that this new production would be dominated by diatoms rather than by flagellates, and that the transfer of energy from diatoms to zooplankton would result in zooplankton with a greater lipid content than zooplankton that have fed on flagellates. These energy-rich zooplankton would be expected to be of greater value to juvenile fish and planktivorous seabirds than those that had fed upon less lipid-rich phytoplankton. During this cruise we compared production and its fate on the middle shelf where there is little cross-shelf advection (area of mooring and at the Pribilof Islands where there is both on-shelf transport and tidal mixing of nutrients into the upper mixed layer. We measured along- and across-shelf flows with CTD casts, moorings, and drifters drogued at 40 m (Stabeno, PMEL), nutrient concentrations (Mordy, PMEL), standing stocks of phytoplankton (Zeeman, U. New England), new production (Zeeman, Sambrotto, Lamont-Doherty), the grazing rates of micro-zooplankton in relation to phytoplankton standing stocks and production (Strom, Western Washington U.), zooplankton biomass and composition (Coyle, U. Alaska, Fairbanks), lipid content, fatty-acid composition, and stable isotope signatures of zooplankton, juvenile fish and seabirds (J. Napp, NMFS), growth rates of euphausiids (Pinchuk, U. Alaska, Fairbanks), and the foraging distributions and food habits of marine birds (Jahncke and Hunt, U. California, Irvine). Simultaneously, collaborators on the Pribilof Is. determined the numbers of breeding seabirds, their production of young, and the types of prey brought to chicks (Byrd, USFWS). Additionally, Dr. Watanuki of Hokkaido University instrumented murres at St. George Is. to determine the depth and hydrographic structure of the water column where they foraged.

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II. Personnel

George Hunt	U. California, Irvine	USA	Ornithology
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III. Cruise Schedule

DATE	ACTIVITY
23 July	Depart Seward
23-25July	In transit
26 July	13:30: Depart Dutch on route to Pribilofs. Bird observations along route during daylight. Night: 3 MOCNESS tows at SES 1, 2 and 3. Weather: Overcast with light winds.
27 July	Day: Ran SES line from about 600 m isobath to 100 m isobath with CTDs and CalVETs. Bird observations between stations. Microzooplankton and C^{14} Productivity experiments at SES-1 (600m isobath). Released drifters at 200 (SES1-2) and 100 m (SES8) isobaths. Night: One MOCNESS around SES-8. Weather: Overcast with light winds.
28 July	Day: Out on G-C south from St George Is. to shelf edge (600 m isobath) with CTDs and CalVETs. Conducted C^{14} production and microzooplankton experiments at shelf edge (near 600 m isobath GC 13).

	Released drifter at 100m isobath (GC-3) and GC-7 (100m head of west arm of Pribilof Canyon). Night: MOCNESS tows at GC-13, 10, 8 and 5. Weather: Overcast with light winds; fog near island.
29 July	Day: Out on G-B southeast from St George across eastern arm of Pribilof Canyon with CTDs and CalVETs. Bird observations between stations. Microzooplankton experiment at GB-9 in about 600 m of water. Released drifter at GB-9 at head of east arm of Pribilof Canyon. Night: MOCNESS at GB-9, and 11. Weather: Overcast with light winds.
30 July	Day: Bird observations along line between SES-1 and SES-8. C^{14}, N^{15} and microzooplankton experiments at SES-1 and C^{14} experiments at SES-8. Night: MOCNESS tows at GB-6, 3 and 2. Weather: Overcast with light winds.
31 July	Day: Out on G-D, with CTDs and CalVETs. Bird observations between stations. C^{14}, N^{15} experiments at GD-5 Released drifter at GD-5, 100 m isobath. Night: MOCNESS tows at GD-12, 9, 7, 5. Weather: Overcast with fog near island, calm winds.
1 August.	Day: NW on PG with CTDs and CalVETs. Bird observations between stations. C^{14}, N^{15} and microzooplankton experiments at PG-5 in green patch observed on satellite images from mid and late July. Into St Paul to pick up shotguns. Night: MOCNESS canceled due to rough weather. Weather: During day, calm and partly sunny; night, winds to 25 knots.
2 August	Day: AM: At anchor in St Paul, because of weather. PM: CTDs at PG-1, 3, 5, 6 and 7. Bird observations between stations and along line down to St. George. Night: MOCNESS at PG-11, 8 and 5. Weather: Overcast with light winds.
3 August	Day: Out CW line SW from center with CTDs and CalVETs. Bird observations between stations. C^{14}, N^{15} and microzooplankton experiments at CW-6 (100 m isobath).

Night: MOCNESS tows at CW-15, 12, and 9.
Weather: Overcast, light winds.

4 August — Day: Out CE line with CTDs and CalVETs.
Bird observations between stations.
C^{14}, N^{15} and microzooplankton experiments at CE-3, in green patch.
Night: MOCNESS tows at CW-6, CE3, CE-7 and CE-9
Weather: Overcast and light winds

5 August — Day: South on SL with CTDs and CalVETs.
Bird observations between stations.
C^{14}, N^{15} experiments at SL-9 in green patch.
Released drifter at SL-9
Night: MOCNESS tows at CE-13 and CE-11.
Weather: Overcast and calm

6 August — Day: Out on GA, with CTDs and CalVets, then continued toward M-2.
Bird observations between stations, and then until dark.
C^{14}, N^{15} and microzooplankton experiments at GA-8 and GA-100, both on 100 m isobath (8 west of east arm of Pribilof Canyon, GA-100 was east of and upstream of the canyon, near SES-8).
Night: MOCNESS tows at M2C-5.
Weather: Overcast, light winds.

7 August — Day: CTD and CalVET survey on M2C line from M2C-5 to M2C-21.
Bird observations between stations.
C^{14}, N^{15} *In Situ* experiments at M2C-9, the location of Mooring 2.
Night: MOCNESS tows at M2C-21, 17, 13.
Weather: Overcast and light winds.

8 August — Day: No surveys due to sea conditions.
C^{14}, N^{15} and microzooplankton experiments at M2C-9
Night: MOCNESS tows at M2W5, M2W-9 and M2W-13
Weather: Overcast, moderate winds but quite lumpy.

9 August — Day: Survey M2E and M2W lines with CTDs and CalVETs.
Bird observations between stations.
C^{14}, N^{15} and Microzooplankton experiments at M2C-9
Night: MOCNESS tows at M2E-5, 9 and 13.
Weather: Patches of sun, with light winds.

10 August — Day: C^{14}, N^{15} and microzooplankton experiments at M2C-9 to complete the series of three experiments at Mooring 2.
Then, underway for GA line with bird observations.

Night: MOCNESS Tows at GA-11, GA-8, GA-5 and GA-2.
Collected "blue" water for S. Strom at GA-8.
Weather: Overcast, light winds/calm.

11 August
Day: Run PG line from St. George to St. Paul with CTDs and CalVETs.
Bird observations between stations.
C^{14}, N^{15}, and microzooplankton experiments at PG5, as before, to examine effects of storm.
Collected birds near Otter Island.
Night: MOCNESS tows at PB-5, 9 and 11.
Weather: Overcast, light winds.

12 August
Day: Run in on PB line from PB13. Did CTDs at 13, 12, 11, 10, 9 and 8 with CalVETs at 13, 11, and 9.
CalVET at 7 aborted and CTDs cancelled due to rising seas.
Bird observations between stations and along line back to St. Paul where we tied up.
Weather: Overcast and rainy with winds rising to 25 knots. Lost about 2/3 day.

13 August
At dock in St Paul. Winds to 25-30 knots.

14 August
At dock in St Paul. Winds to 25-30 knots.

15 August
Day: Attempted CTD survey down PG line, and did two stations before having to call off CTD casts due to high and mixed seas.
Conducted bird observations along line to St George;
Returned up line toward St. Paul with CTDs.
Did daylight MOCNESS at PG-7.
Night: MOCNESS tows at PC-3, 6 and 9.
Weather: Partly sunny with light winds

16 August
Day: Started from outer end of PC line with CTDs and CalVETs to PC-3 then over to PD-3 and out that line in PM with CTDs and CalVETs.
Bird observations between stations.
Released a drifter at PC-4.
C^{14}, N^{15} and microzooplankton experiments at PC-10;
C^{14}, N^{15} experiments at PD-6; microzooplankton experiments at PD-12.
Night: MOCNESS tows at PD-12, and PD-4
Weather: Partly sunny with calm.

17 August
Day: Out on the PB line to PB-13 with CTDs and CalVETs.
Bird observations between stations.
C^{14}, N^{15} experiments at PB-9; microzooplankton experiments at PB-13.

	Night: MOCNESS on south end of PB line to obtain Food web Tracer samples Weather: Overcast, some rain and moderate winds.
18 August	Day: Ran CTDs on the SES line from SES10 to SES5.5, Bird observations between stations and before and after working the line. Night: Underway to Unimak Pass. Weather: Partly sunny with moderate winds to 20 knots.
19 August	AM: Work lines in Unimak Pass with acoustics, CTDs and bird observations. PM: Underway to Dock
20 August	Depart Ship at 09:00

IV. Overview of Results

The objective of this research was to test the hypothesis that cross-shelf transport of nutrients and oceanic copepods would enrich the marine ecosystem in the vicinity of the Pribilof Islands, thereby leading to enhanced post-spring-bloom primary and secondary production, as compared to the middle domain where such advection was absent.

We found evidence for advection to the Pribilof Islands region, both from the outer shelf southeast of Pribilof Canyon, and through advection of water from Pribilof Canyon onto the shelf. Drifter trajectories showed that water from both sources moved to retention areas between the Pribilof Islands. There was unexpected evidence of advection in the vicinity of Mooring 2, with subtle changes in salinity, and nutrient content of sub-pycnocline water. These results, reported on the ship, but not obvious in the profiles in the Cruise Report, need to be checked carefully, as lack of advection in the vicinity of M2 was a basic assumption behind our hypothesis.

Outer Shelf

Water being advected along the outer shelf south of the Pribilof Islands was rich in nitrate (> 28 μml^{-1}) and ammonium (>4 μml^{-1}) below the pycnocline, with appreciable amounts of both nutrients entering the surface mixed layer over the shelf break and over the arms of Pribilof Canyon. Concentrations of nitrate below the pycnocline decreased with distance from the shelf break and concentrations of ammonium increased at the near-island ends of transects. Microplankton grazing experiments showed that the shelf edge and Pribilof Canyon plankton communities were dominated by large algal cells (> 20 µm). These large phytoplankton cells showed moderate growth without the addition of nutrients and very strong growth with the addition of nitrate or ammonium to the growth chambers. They were biologically active and not nutrient limited.

Experiments from along the 100 m isobath were consistent with a successional sequence involving a community responding to nutrient input in the vicinity of Pribilof Canyon. Water from stations upstream of the canyon supported a low total biomass of phytoplankton that was dominated by small cells (< 5 μm), with moderate growth rates and low to moderate microzooplankton grazing. In water just downstream from the canyon, phytoplankton biomass was much higher and both small and large cells were major components. Growth rates, especially of the large cells, were high, and there was no evidence for nutrient limitation. Microzooplankton grazing rates remained low. However, farther downstream, the phytoplankton biomass, although high and dominated by large cells, was nutrient limited. Here, microzooplankton grazing on both small and large cells was elevated as compared with the previous station.

Preliminary examination of zooplankton samples also showed a progression from a oceanic community just downstream of Pribilof Canyon to a predominately shelf community in the waters between the Pribilof Islands. Zooplankton from stations in Pribilof Canyon and immediately downstream of the canyon consisted of primarily oceanic species, whereas communities more distant from the canyon, though still on the outer shelf, had a mixture of shelf and oceanic species, including the relatively large neritic *Calanus marshallae*.

Region Between the Pribilof Islands

In the region between the Pribilof Islands, waters below the pycnocline had substantial amounts of ammonium (4-6 μml^{-1}), and nitrate (8-10 μml^{-1}). Neither was plentiful in the upper mixed layer, although subsequent to storm-mixing, nitrate (4 μml^{-1}) and ammonium (4-5 μml^{-1}) were present in the upper mixed layer near the shore south of St Paul Island and over the sill between the islands. These enhanced surface concentrations of nutrients occurred near where we found elevated concentrations of chlorophyll (1.1 to 2.8 μgl^{-1}) in the water. However, much to our surprise, initial examination of primary production experiments from this region of high chlorophyll concentrations showed some of the lowest levels of P_{max} that we measured. The region was dominated by >20 μm^{-1} phytoplankton cells, and showed evidence of nutrient depletion despite the advection of nutrients to the region and their mixing into the upper mixed layer. Four microzooplankton experiments were conducted on water collected from the phytoplankton patch between St. Paul and St. George Islands that had been identified from satellite remote sensing. Phytoplankton growth rates were low to moderate and showed evidence of varying degrees of nutrient limitation. As in the outer shelf region, microzooplankton grazing rates were low. The zooplankton tows from between the islands were dominated by shelf species, though in one tow from north of St. Paul Island copepods of oceanic origin were found.

Middle Shelf Stations

In the middle domain near Mooring 2, nitrate (8-10 μml^{-1}) and ammonia (6 μml^{-1}) levels beneath the pycnocline were about the same as the concentrations at depth between the islands, but in the Middle Domain, these nutrients were isolated from the upper mixed layer by a strong thermocline of about 9° C. An exception was that, in the vicinity of the inner front, there was some evidence of vertical mixing, and offshore of the front there were of low concentrations (~ 1 μml^{-1}) of nitrate at the surface.

The microplankton community at Mooring-2 differed strikingly from those found between the islands or in the outer domain/shelf-edge regions. The community was dominated by small-celled species and had a low biomass (~ 0.3 μgl^{-1}). Although P_{max} values at M2 were some of the highest recorded on the cruise, phytoplankton growth and grazing rates were low. Phytoplankton growth rates showed a modest response to added nutrients; this was the only station at which algal cell growth responded more strongly to ammonium than to nitrate, suggesting a community that had had many generations to adapt to growth on regenerated nitrogen. With both algal growth rates and microzooplankton grazing rates low, the profile of this community was not consistent with the picture of a community sustaining high growth rates and high grazing rates through a rapid recycling of regenerated nutrients.

The net zooplankton sampled in the middle shelf domain showed striking differences from north and northeast of St. Paul Island to Mooring-2, southeast of St. George Island. Thus, the middle domain stations could be divided into three groups, northern, central and southern (Mooring-2) groups. There was an apparent gradation in the ages of the euphausiids present, with adults and older juveniles present in the north and central stations, but only furcilla and early juveniles present in the south. The copepod community in the north included the large C. marshallae, in addition to many other species, but C. marshallae were largely absent from the central and southern stations, where small species of zooplankton predominated. Copepod predators (chaetognaths and hydromedusae) were noticeably abundant in the vicinity of Mooring-2, as were chaetognaths at the northern stations.

Age-0 pollock were found throughout the study area, but were noticeably more abundant in the vicinity of Mooring-2. The age-0 pollock caught at Mooring-2 were larger and less variable in size than those caught between the islands or on the outer shelf. There was a gradient in the size of age-0 pollock within the middle domain, with smaller fish being caught at the northern stations than in the vicinity of Mooring-2.

The distributions of marine bird species were much as had been expected, although numbers seemed low, and very few feeding aggregations were observed. Most planktivorous auklets were concentrated between the islands. One unexpected finding was that fulmars and red-legged kittiwakes, species normally associated with the outer domain and shelf slope region, were fairly common in the region between the islands. Ornithologists working on the islands reported that auklets bred earlier than usual, but that at the end of their breeding period in late july, there was a rapid decline in their numbers and in the condition of remaining young. Additionally, there were reports of a die-off of puffins in July and a general breeding failure for thick-billed murres. These events suggest that 2004 was not a typical year for marine birds breeding on the Pribilof Islands.

In summary, we found advection of water from both the outer domain and from the basin via Pribilof Canyon to the vicinity of the Pribilof Islands, where drifters showed that there was an area of retention between the islands. Nutrient levels at depth between the islands remained substantial, despite evidence for mixing into the upper mixed layers, where a large-celled community of phytoplankton predominated that was equally able to utilize nitrate and ammonium. In the middle domain, nutrients were isolated from the upper mixed layer by a strong thermocline, chlorophyll was concentrated in the pycnocline, and the phytoplankton was dominated by small cells adapted to growth on regenerated nitrogen. Preliminary examination of zooplankton samples suggested that some oceanic forms were advected from the outer domain to the waters around the Pribilofs, and that there were considerable differences in the zooplankton communities in the waters between the islands and in the middle domain, particularly near Mooring-2. Data on seabirds from the colonies and at sea suggested that 2004 was quite different from what has been found in recent years.

V. Results by Discipline

A. Physical Oceanography (S. Salo and P. Stabeno)

The physical oceanography component of the cruise described the physical environment of the study area: the temperature and salinity of the water, and its currents. To do this, we deployed moorings during an earlier cruise at 8 locations around the Pribilof Islands. In addition, prior to the commencement of our field work, a number of satellite-tracked drifters, drogued at 40m were released in the study area and "upstream" of the study area along the shelf break, the 100m isobath and in the Gulf of Alaska.

During HX288, we set out 9 satellite-tracked drifters drogued at 40m to monitor currents at that depth, and occupied two grids of CTD stations with a total of 289 CTD casts completed (Fig. 1; Appendix A). One grid was near a long-term mooring, PMEL's Mooring 2, which is in 70m of water near 57° N, 164° W in the middle domain of the southeastern Bering Sea shelf (Fig. 2). The other grid consisted of transects radiating out from the two Pribilof Islands. Some of these transects (PC, PD, and SL) crossed from the near-island region into the middle domain north of the islands (Fig. 3, 4). Transects GA east of St. George Island and PA and PB west of St. Paul Island sampled shelf water to depths slightly greater than 100m (Fig. 5). Transects GC and GD south of the St George Island crossed the shelf and the shelf-break; GC and GB southeast of St. George Island also passed over Pribilof Canyon (Fig. 5). Transect PG, which we occupied three and a half times, connected the two islands, and passed through a zone of high chlorophyll we had seen in a composite MODIS chlorophyll image from 11-18 July (Figure 6). A long transect perpendicular to transect PG (CECW) measured conditions from the middle domain through the zone of high chlorophyll to the shelf break (Fig. 5). Large-scale currents in this area generally flow along isobaths toward the northwest. Thus we also occupied transect SES which crossed the shelf upstream (southeast) of the Pribilofs (Fig. 7).

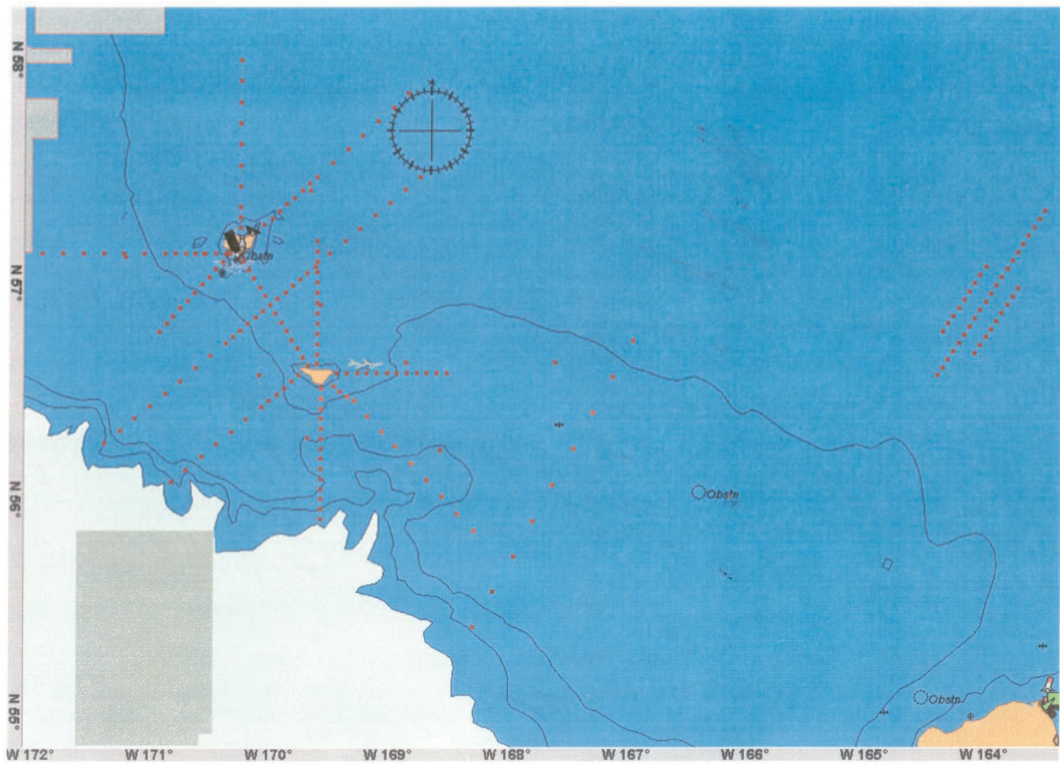


Figure 1. Map of SE Bering Sea showing distribution of CTD stations.

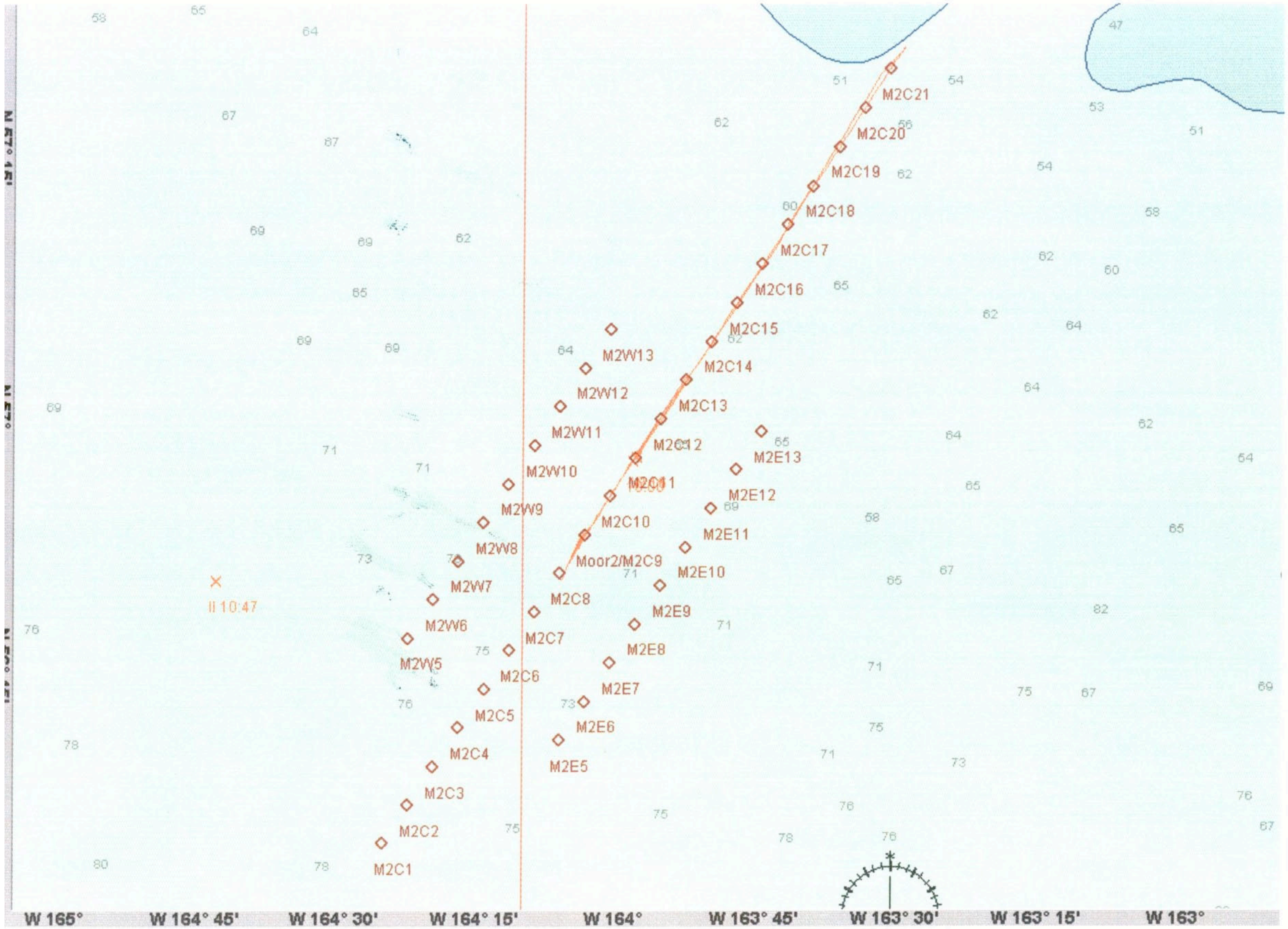


Figure 2. CTD Stations in the Middle Domain near NOAA Mooring 2.

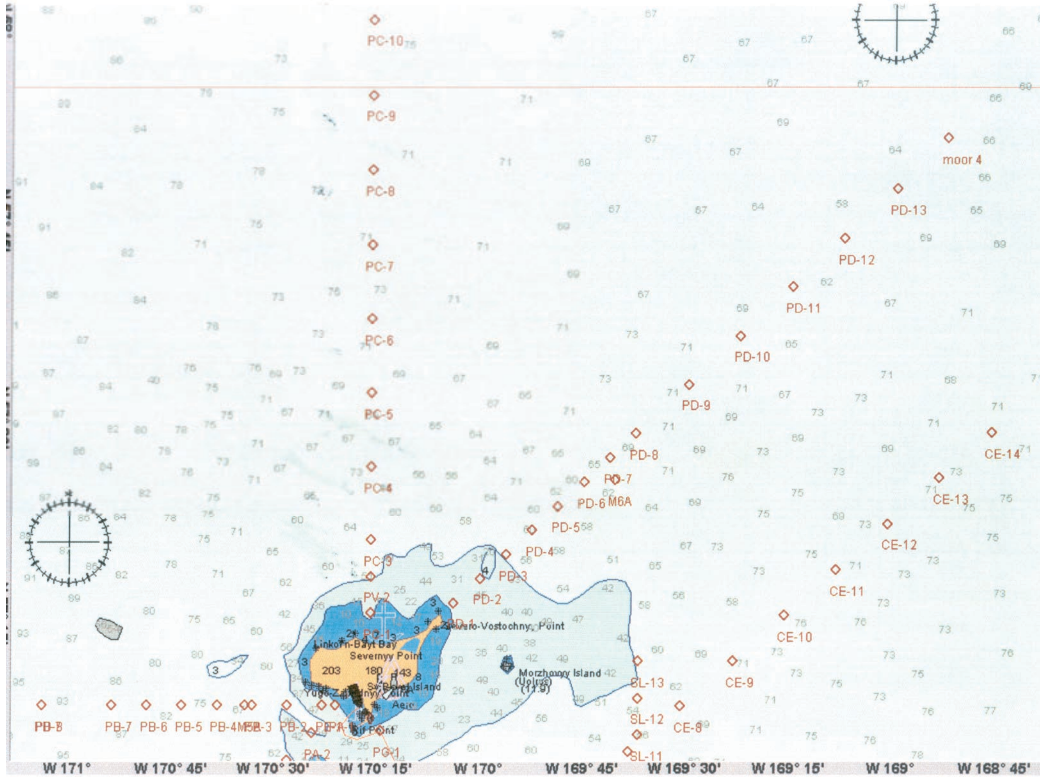


Figure 3. Transects and CTD stations north of St. Paul Island.

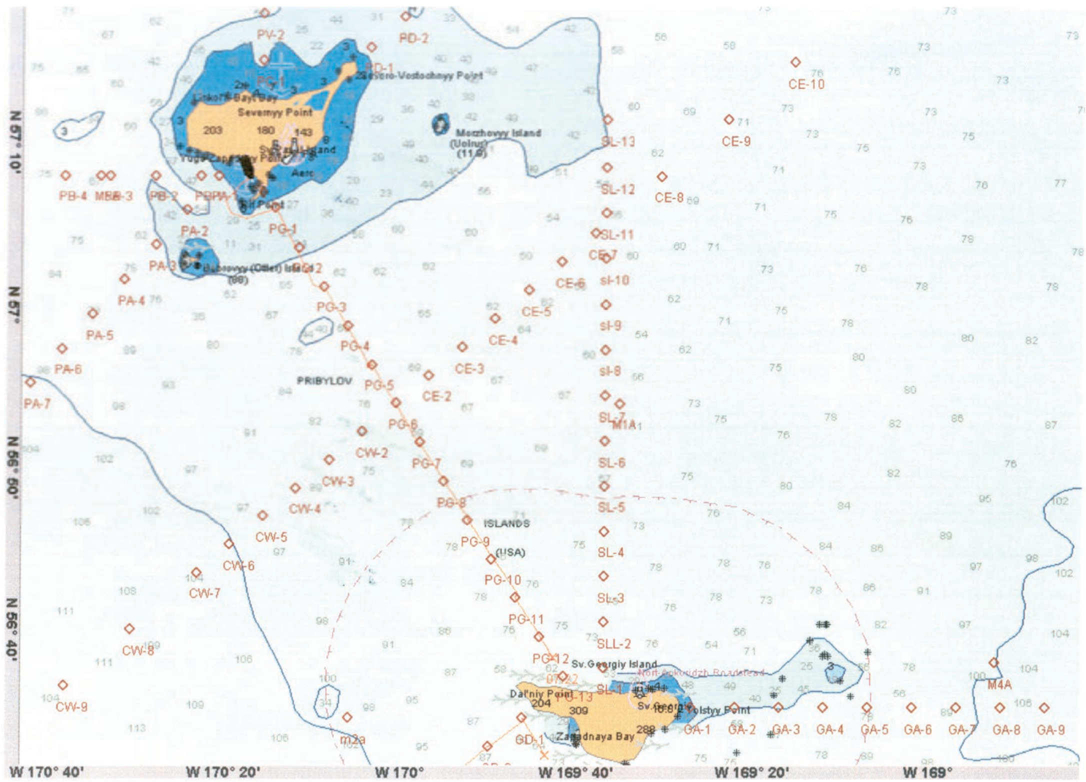


Figure 4. Transects and CTD stations in the region between the islands.

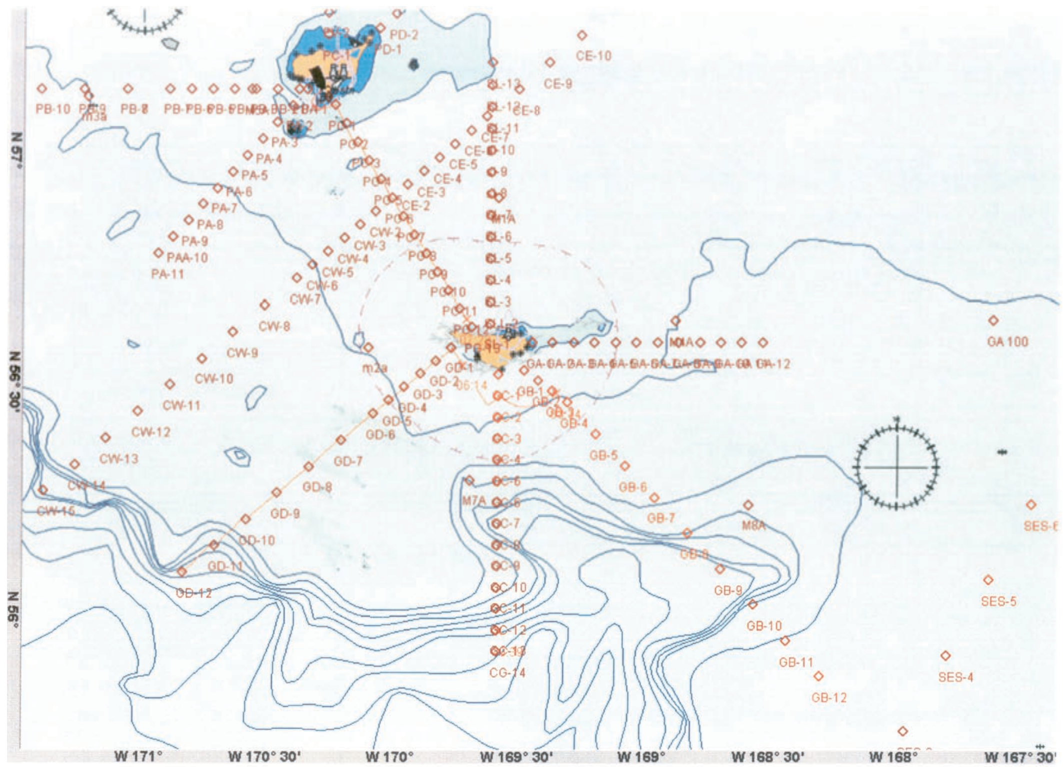


Figure 5. Transects and CTD stations in the vicinity of St. George Island.

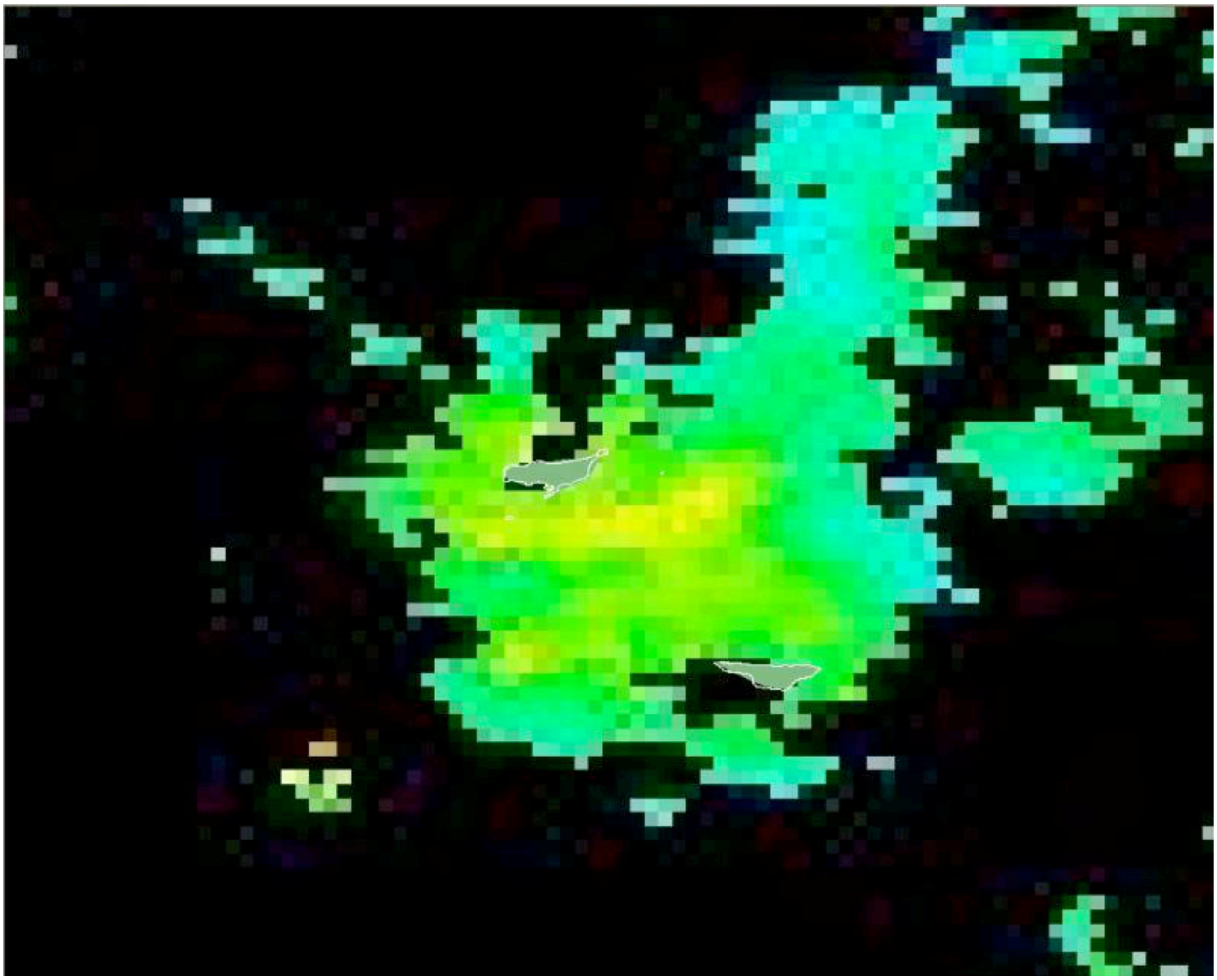


Fig 6. MODIS composite image of Chlorophyll-a near the Pribilof Islands, 11-18 July 2004.

Drifters

The mean current at and near the Bering Sea shelf slope (Bering Slope Current) flows to the northwest south of the Pribilof Islands. In previous years, drifter studies have shown that water from the shelf shallower than about 100m south of the Pribilof Islands at times turns northward just west of St. Paul Island. Some drifters have circled the islands, and others have remained north of the islands.

During the cruise, we deployed 9 drifters in the vicinity of the Pribilof Islands (Fig. 8, Appendix B). In addition, prior to our cruise, six drifters were already in the region of the Pribilof Islands (Fig. 8). One (# 43711) was deployed southeast of St. George

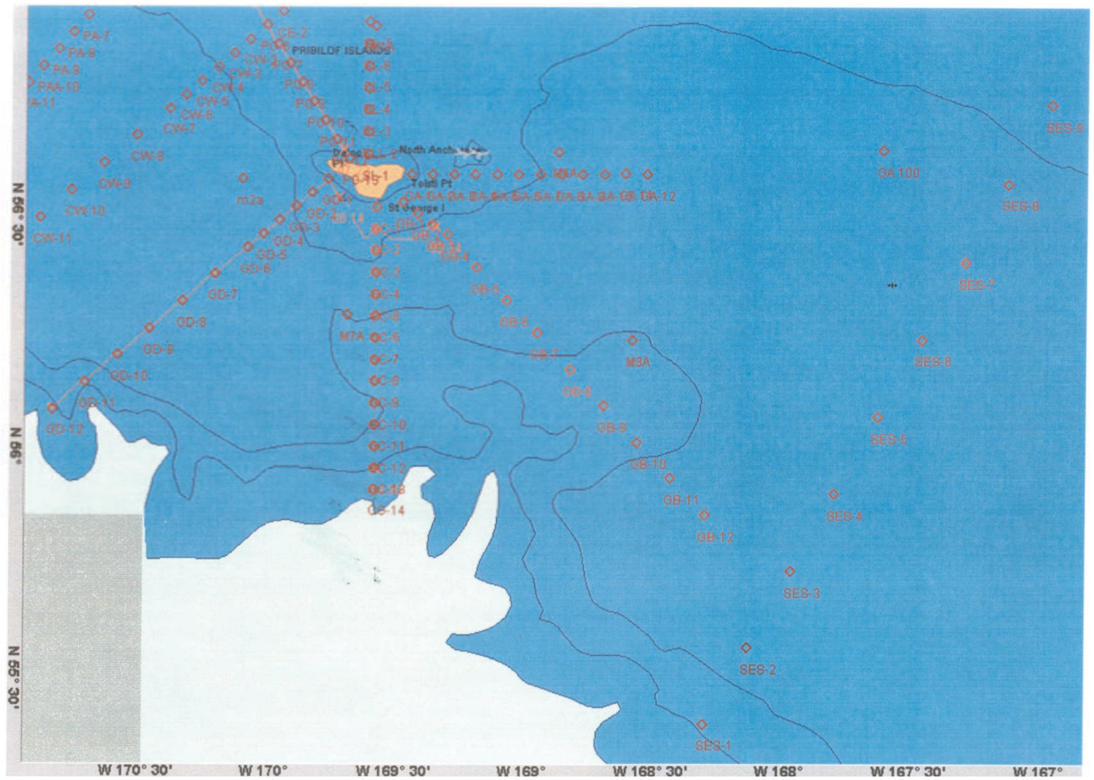


Figure 7. Transect and CTD stations southeast of Pribilof Canyon

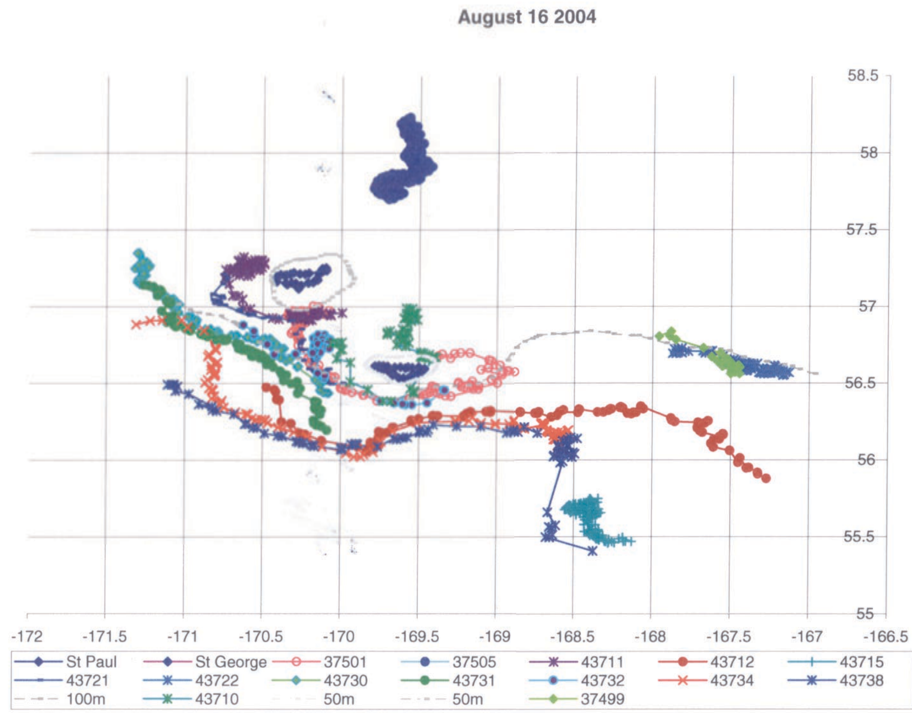


Figure 8. Drifter Tracks from 23 July to 16 August 2004 near the Pribilof Is.

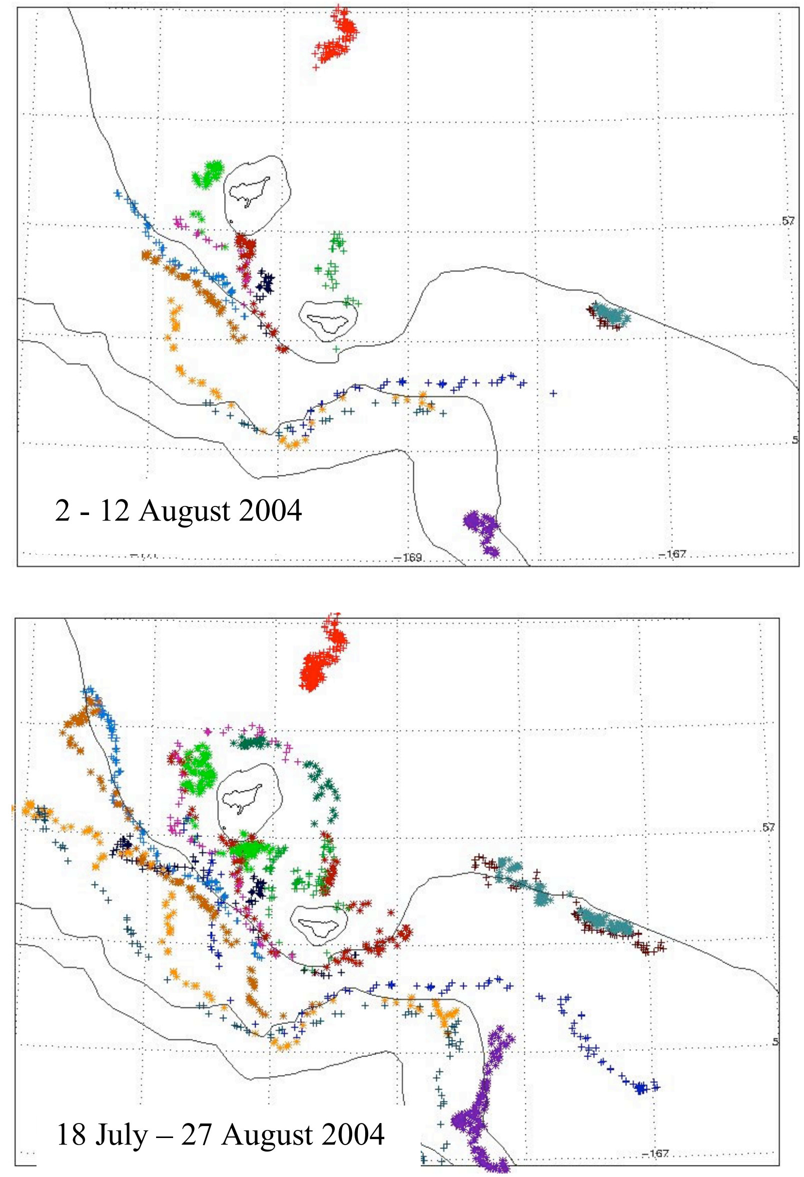


Figure 9. Drifter tracks near the Pribilof Islands, July-August 2004.

Island in May 2004. Others shown on the plot of drifter tracks (Fig. 8) were set out in the Gulf of Alaska in 2003 and near Unimak Pass in May 2004. Although these drifters had been advected long distances to arrive near the Pribilofs, Phyllis Stabeno reported that circulation near the islands was sluggish just prior to the cruise.

We deployed drifters # 43715 and # 43722 on line SES upstream of the Pribilofs. Drifter # 43722, deployed at 100m, moved slowly but steadily to the northwest along the 100m isobath, while advection of drifter # 43715, deployed at 200m, was slower and less linear (Fig. 8, 9).

Three drifters, # 43721, # 43730 and # 43732, were deployed south of the Pribilofs in water 100m deep (Fig.8, 9). One of these drifters (43730) has continued along the 100m isobath past St. Paul Island. The drifter deployed at 100m southeast of St. George Island (43732) first stalled in the chlorophyll patch (shallower than 100m) southeast of St. Paul Island and then continued to the northwest along the 100m isobath. The third drifter (43721) turned northward west of St. Paul. Other evidence of circulation around the islands is offered by drifters # 43711, # 43712, and # 43710, all of which followed clockwise paths at least partway around islands. A feature to note is that many of the drifters stalled in the area south or southeast of St. Paul Island during their circulation.

A drifter was deployed in each lobe of Pribilof Canyon (43731 in the west; 43734 in the east) to see whether this canyon contributes water to the shelf (Fig. 8, 9). Both of these drifters moved onshore from their original depths. One has continued northwestward at its new depth, the other has moved partway offshore again. Many of the drifters from deeper water moved into shallower water. These episodes followed a probable spin-up of currents after storms.

B. Nutrient Chemistry (C. Mordy)

To map the distribution and abundance of nutrients, water samples were obtained from a suite of depths at most CTD stations. During the cruise, 220 stations and 1651 samples were analyzed for nutrients. In addition, nutrients were measured on 220 samples provided by biologists conducting incubation experiments, and productivity casts were immediately analyzed for nitrate and ammonia.

Nutrient samples were analyzed for dissolved phosphate, silicic acid, nitrate, nitrite and ammonium using protocols of Gordon et al. (1993). Samples were collected in 50 ml high-density polyethylene bottles that were rinsed with 10% HCl prior to each station, and rinsed at least three times with sample before filling. Samples were usually refrigerated for 3-12 hours prior to analysis. Silicic acid, nitrate and nitrite were analyzed using a Perstorp autoanalyzer modified with Alpkem RFA 300 mixing coils. Phosphate and ammonium were analyzed using a Technicon II Autoanalyzer; however, during the second half of the cruise the Technicon detectors failed and they were replaced with Perstorp detectors The following analytical methods were employed:

HPO_4 was converted to phosphomolybdic acid and reduced with hydrazine to form phosphomolybdous acid in a reaction stream heated to 55°C (Bernhardt and Wilhelms, 1967).

$Si(OH)_4$ was converted to silicomolybdic acid and reduced with stannous chloride to form silicomolybdous acid or molybdenum blue (Armstrong, 1967).

NO_2 was diazotized with sulfanilamide and coupled with NEDA to form a red azo dye. ($NO_3 + NO_2$) was measured by first reducing nitrate to nitrite in a copperized cadmium coil, and then analyzing for nitrite. NO_3 was determined from the difference of ($NO_3 + NO_2$) and NO_2 (Armstrong, 1967).

NH_4 reacts with hypochlorite and phenol in an alkaline solution to form the dye indophenol blue, and this reaction was catalyzed by addition of nitroprusside. The reaction stream was complexed with sodium citrate and heated to 70°C (Koroleff, 1983).

C. Primary Production, New Production and Chlorophyll (S. Zeeman, M. Fijolek, and N. Metheny)

The primary goals of the primary production studies were to obtain a series of measurements that would allow us to compare rates of primary production in the various water masses in the study area, and to determine whether this production was dependent on regenerated nutrients or new nitrogen. To this end, the primary production group conducted ^{14}C and ^{15}N (NO_3 and NH_4) uptake experiments at 20 stations.

At each CTD station, chlorophyll extractions were done on water collected at 3 or 6 depths, from 0-60 m, for a total of almost 1250 samples. Chlorophyll measurements averaged 1.66 mg Chl m^{-3}, with high values of up to 18 mg Chl m^{-3}. Size fractionation of chlorophyll into > 20 micrometer and < 20 micrometer fractions was performed on the GA and PG lines. On the GA line the larger fraction dominated near the islands, while the smaller size class became dominant further away from the island. Samples of phytoplankton were collected for enumeration of species composition in the laboratory.

Satellite imagery was obtained for the study period (e.g., Fig. 6, 10). Image libraries are being examined for cloud-free areas, and if suitable images are located, they will be examined for evidence of frontal zones and other oceanographic phenomena. Interpretation of remote sensing images will rely on *in situ* optical measurements, CTD data, and CDOM determined by spectrofluorometry.

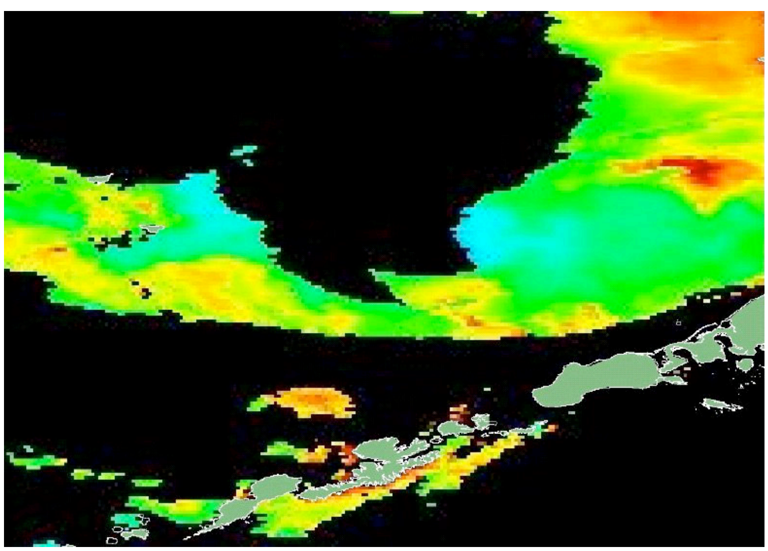


Figure 10 MODIS composite image of SE Bering Sea Chl-a, 3-10 July 2004

The ^{14}C uptake measurements were conducted to measure P-I curves at 8 light intensities from 750 to 0 micro mol photons m^{-2} s^{-1}, while ^{15}N uptake was measured at 8 light depths (0, 55, 30, 17, 9, 5, 3, and 1%). Water from the ^{15}N experiments was collected after filtration and frozen for later determination of dissolved organic matter content. An on-deck PAR sensor recorded mean light levels at 15 minute intervals for the duration of the cruise. The PI curves showed photoinhibition at almost all stations. P_{max} values averaged about 1.5 mg C (mg Chl)$^{-1}$ m^{-3} hr^{-1} (Fig. 11).

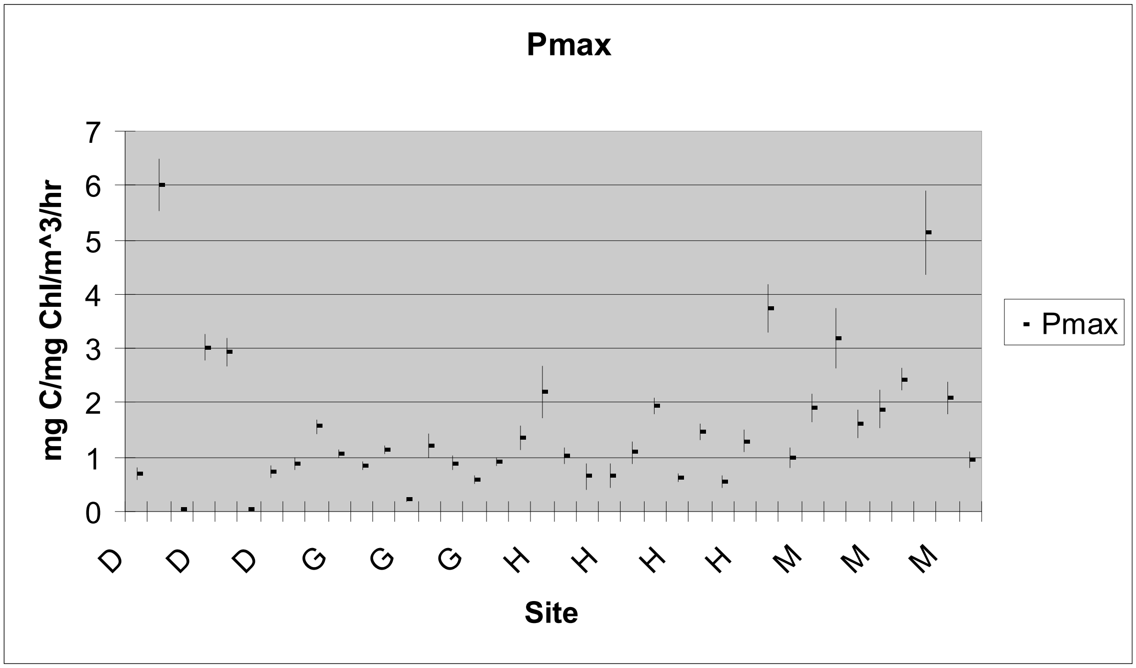


Figure 11. P_{max} values and 95% confidence interval. D=slope water, G=zone between the islands, H= hundred meter isobath, and M= middle domain

The highest P_{max} values were found at stations over the shelf slope, and also in the middle domain at Mooring-2 (Fig. 11). The areas of high chlorophyll between the two islands consistently had the lowest P_{max} values. From repeat measurements at some stations, it could be seen that production increased after strong winds, probably due to mixing of nutrients into the upper water column.

D. Microplankton Processes (S. Strom and K. Fredrickson)

The primary goal of the microplankton component of the study was to determine the importance of food webs dependent on microzooplankton that feed on flagellates and those that feed on the larger components of the plankton. We wanted to evaluate the importance of micro-zooplankton as transfer agents, and the basis of the food webs on which they depend. To this end, a series of dilution experiments were conducted using samples of water from each of the major water masses in the study area.

The microplankton group conducted a total of 19 seawater dilution experiments during the cruise. All experiments were conducted with water from the depth corresponding to 50% surface irradiance (typically 3 to 7 m, depending on water clarity). Each experiment yielded the following rate information for three different phytoplankton size classes (<5 µm, 5 to 20 µm, >20 µm) based on changes in chlorophyll concentration in the three different size fractions during 24-hr incubations:

1. Rates of phytoplankton growth (these are intrinsic growth rates, i.e. rates in the absence of grazing losses).
2. Degree of phytoplankton growth rate response to added ammonium + phosphate, and to added nitrate + phosphate (i.e. the degree of nutrient limitation of phytoplankton intrinsic growth).
3. Rates of microzooplankton grazing on phytoplankton.

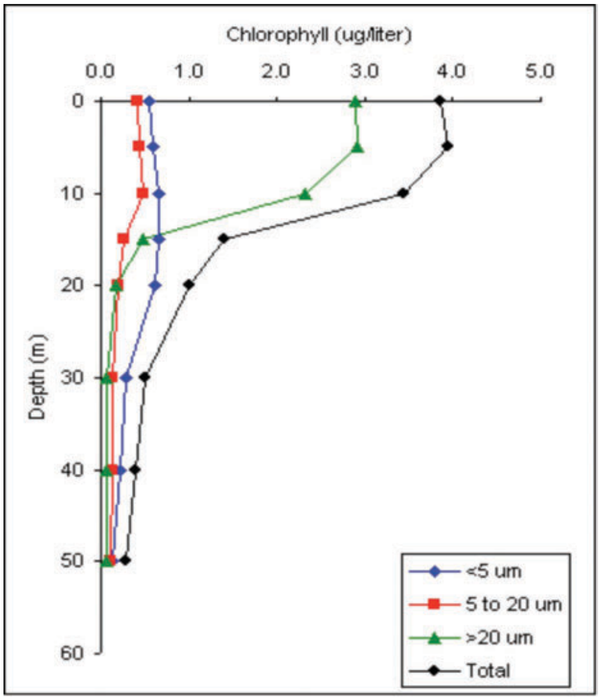
Additional samples taken during each experiment included:

1. Initial microplankton community composition, abundance and biomass (two samples types taken, one for inverted microscopy and one for epifluorescence microscopy, to be analyzed at shore laboratory).
2. Initial and final macronutrient (nitrate, ammonium, silicate, phosphate) concentrations (analyzed on board by C. Mordy).
3. Initial and final samples for Pulse Amplitude-Modulated (PAM) fluorometry (analyzed on board; 6 of 19 experiments).
4. A vertical profile (8 discrete depths) of chlorophyll concentration (3 size classes) was obtained for each station at which a dilution experiment was conducted (19 total).
5. A continuous record of incident photosynthetically active radiation (hourly integrated values) was also obtained for the duration of the cruise.

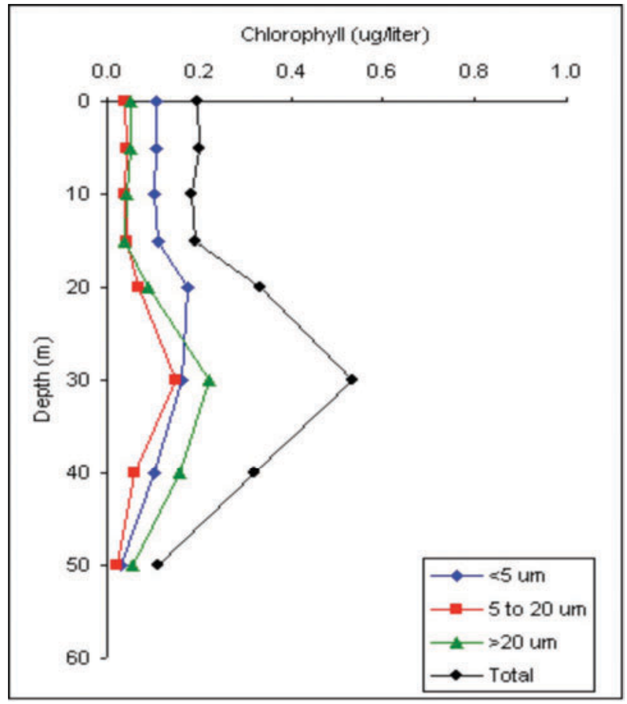
Additional experimental work was aimed at testing a possible inhibitory effect of diatoms on the growth of small phytoplankton.

Although phytoplankton communities differed in overall biomass and in size composition (Fig. 12), rates of microplankton activity throughout the studied shelf region were relatively low. Phytoplankton growth rates in unenriched bottles generally ranged between 0.0 and 0.4 d^{-1} (equivalent to 0.0 to 0.6 doublings d^{-1}). Nutrient (N+P) limitation was widespread throughout the study region, although there was considerable variation among experiments in the magnitude of the growth rate response to added nutrients. This variation may have been related to phytoplankton physiological state, species composition, light availability, and other factors. Rates of microzooplankton grazing were also low throughout the study region, typically ranging between 0.0 and 0.3 d^{-1}. For the two smallest phytoplankton size fractions (<5 µm, 5 to 20 µm), microzooplankton grazing rates were, in general, roughly equal to phytoplankton intrinsic growth rates.

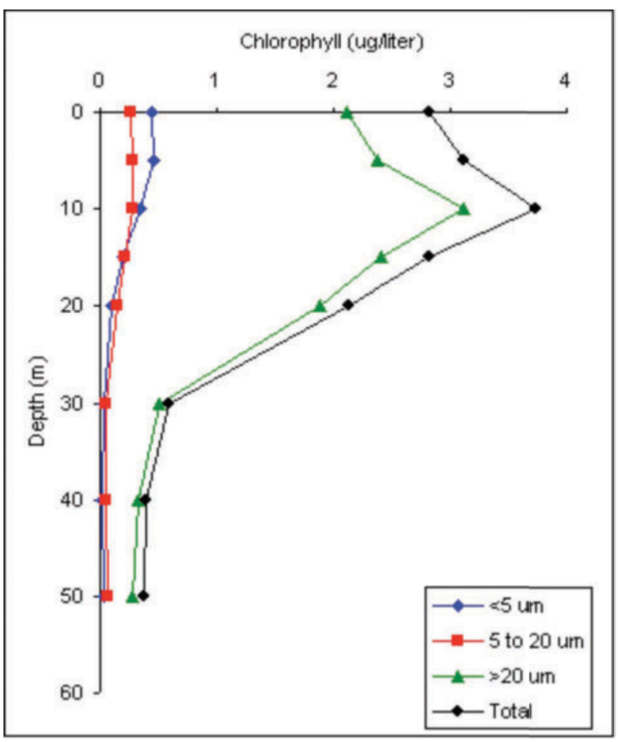
Station: GC-13 **Date:** 07/28/04
CTD cast: 24



Station: GA-100 **Date:** 08/06/04
CTD cast: 152



Station: PG-5 **Date:** 08/11/04
CTD cast: 203



Station: M2 **Date:** 08/09/04
CTD cast: 176

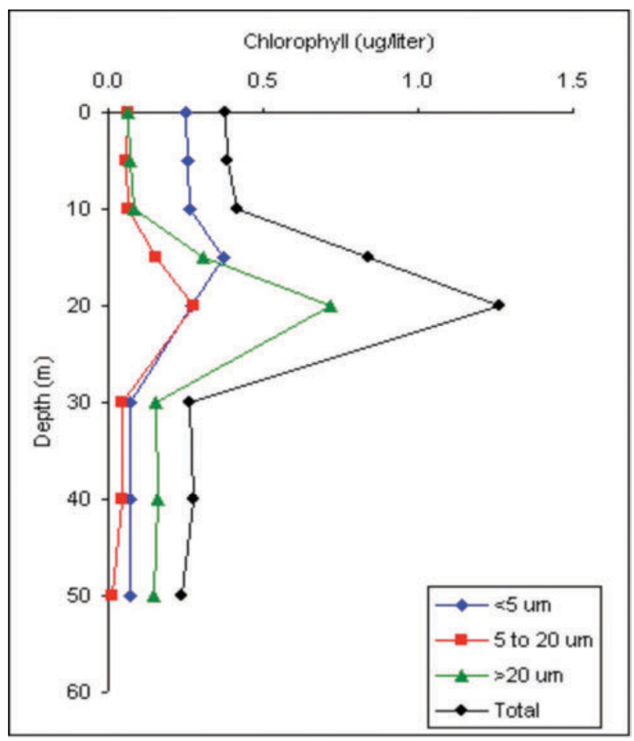


Figure 12. Vertical distribution of chlorophyll (size-fractionated) by study area.

E. Meso-Zooplankton Distribution and Abundance (K. O. Coyle and A. Pinchuk)

The primary task of the mesozooplankton component was to assess the abundance, biomass and species composition of the mesozooplankton in the shelf-break, Pribilof-Island and Middle-Domain regions of the southeastern Bering Sea. The data from these samples will aid in determining the fate of new and recycled production in these three regions. A total of 54 MOCNESS tows were completed (Appendix C): 10 tows were taken in the Middle Domain near M2, 18 were taken on transects in the shelf break regime (either south of St. George or on transects running south from St. George), and the remainder were taken in middle domain water around the islands. We obtained 118 CalVET samples at alternating CTD stations along all transect lines (Appendix D).

The large mesozooplankton component was sampled using a 1-m MOCNESS (Multiple Opening Closing Net and Environmental Sensing System), equipped with 0.5 mm mesh nets. The MOCNESS was equipped with salinity, temperature and fluorescence sensors to provide depth profiles of physical oceanographic data during the tows. Samples were taken to depths of 600 m or to within about 10 m of the bottom at shallower locations. At depths of 100 m or less, samples were consistently taken in 20 m depth increments from the bottom to the surface. Samples from depths below 100 m were taken in 50 to 100 m depth increments.

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 flowmeters to monitor volume filtered. The CTD sample number was recorded with each net to facilitate comparison of CalVET samples with physical oceanographic data.

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

Casual observation of the samples indicates that oceanic zooplankton species were common in the shelf-break region, but large copepods were rare or absent from the middle domain stations. Age-0 pollock were common in both the Pribilof region and the M2 region, but M2 specimens were considerably larger than those from the Pribilofs. It appears that the mesozooplankton community was dominated by small copepods, gelatinous zooplankton and, at some stations, euphausiids. A detailed assessment of zooplankton abundance, biomass and distribution will be made after the samples have been processed.

F. Euphausiid Growth Rates (A. Pinchuk)

Euphausiids are major components in marine food webs in the Bering Sea. They are a major prey for many of the commercially harvested fishes in the Bering Sea, including all species of salmon (Paul, 1982), pollock (Clausen, 1983), as well as seabirds and baleen whales (Mauchline, 1980). These grazers and predators of microzooplankton are, therefore, important elements in the transfer of energy from the lower trophic levels upwards. Growth dynamics of euphausiids and factors influencing growth are crucial for understanding and quantifying the role of euphausiids in ecosystem production cycles and energy transfer to apex predators. Among others, a problem to be addressed is: how do mesoscale transport processes affect the recruitment, vital rates, and other measures of population dynamics of euphausiids in the Bering Sea?

As the first step to achieve the above goals, individual growth rates of euphausiids from areas with different oceanographic conditions (shelf break, Pribilof Islands vicinity, middle shelf around Mooring-2) were determined. Since a cohort analysis would require repetitive sampling of the same population over an extended period of time, we used an instantaneous growth rate measurement technique (Quentin and Ross, 1991).

To collect live animals for experiments, the location and depth of euphausiid aggregations were identified with an HTI acoustic system operating at 42, 120, 240 and 420 kHz during a nighttime acoustic survey. Detected aggregations were fished using the MOCNESS with 100 μm mesh nets. Euphausiids were gently removed from the catch and placed in individual 750 ml tissue flasks filled with seawater collected simultaneously at the site. The animals were maintained for 48 hours at the ambient mixed layer water temperature (8^{o}C and 10^{o}C) in the dark, and were checked every 12-24 hours for molts and egg production. If an animal molted, the exuviae was removed and preserved simultaneously with the animal. At the end of each experiment, all remaining animals were preserved. The length of uropods will be measured on all molts, and body length, carapace length, uropod length, and eye diameter will be measured on preserved animals using a digitized measuring system.

A total of 9 experiments, each consisting of ~160 individuals, were conducted during the cruise. Two experiments were conducted in the deep area over the shelf break (stations GC-8 and GB-9). The majority of the animals were oceanic *Euphausia pacifica* and *Thysanoessa longipes,* indicating the influence of the Aleutian North Slope Current and the Bering Slope Current. Many of the *E. pacifica* females had spermatophores attached and 5 females produced viable eggs.

Seven experiments were conducted in the vicinity of Pribilof Islands. The euphausiids that we found in this area were small (probably 0+) juveniles of *T. longipes* and *T. inermis.* In addition, we also encountered dense, irregular aggregations of adult *T. raschii*, a shelf species. The majority of *T. raschii* females had spermatophores attached and many produced viable eggs.

We were unable to conduct any experiments in the middle shelf area due to a lack of euphausiids. While we observed some late furcilid stages, there were virtually no older specimens found, suggesting unfavorable conditions such as a lack of food or strong predation.

G. Marine Ornithology (J. Jahncke and G. Hunt)

To determine the relationships between the foraging areas chosen by seabirds and the source of a water mass and its zooplankton fauna, bird observations were made when the ship is underway at speeds of 5 knots or greater. During the cruise, we surveyed a total of 2,411 kilometers: 1,227 km in the outer domain, 628 km in the inter-Island region, and 556 km in the middle domain. We counted a total of 50,330 seabirds: 35,351 in the outer domain, 10,030 on the inter-island region, and 4,949 in the middle domain (Table 1, Fig. 13). Seabird abundance was greatest (28.8 birds/km²) in the outer domain, with densities in the inter-island region (16 birds/km²) intermediate between those in the outer domain and those in the middle domain (8.9 birds/km²).

All birds within an arc of 90^{o} from the bow to the side with the best visibility were counted from the bridge and were recorded on a laptop computer for later analysis. Behaviors were recorded, with particular attention being paid to the small alcids and to whether shearwaters were feeding at the surface by hydroplaning or by deep diving.

Few birds were collected as we encountered very few foraging aggregations that presented opportunities for collection. We obtained only 3 short-tailed shearwaters and 2 common murres between Otter Island and St Paul Island. The shearwaters had been eating sand lance and euphausiids. Stomach contents were removed from birds within 1 hour of collection and were stored in 80% ETOH. Samples of tissue were obtained for stable isotope analyses and for fatty acid signatures.

The most abundant species of seabirds were northern fulmars *Fulmarus glacialis* (16,889 individuals, 37% of all birds observed flying, feeding and on the water), short-tailed shearwaters *Puffinus tenuirostris* (9,615 individuals, 19% of birds flying, feeding and on the water) and fork-tailed storm petrels *Oceanodroma furcata* (6,430 individuals, 13% of birds flying, feeding and on the water). Northern fulmars and short-tailed shearwaters occurred in relatively large numbers in all parts of our study area (Fig. 13). However, foraging birds were observed in large aggregations in few locations. One large group of foraging fulmars was observed east of Saint George just offshore of the 100-m isobath. Two large flocks of foraging shearwaters were observed: the first one north of Saint Paul Island near the 50-m isobath, a second one west of Saint Paul Island in the vicinity of the 100-m isobath. Fork-tailed storm-petrels were far more common in the offshore waters of the outer domain than in the middle domain (Fig. 13).

Table 1. Numbers of seabirds and northern fur seals by species and region

Common Name	Scientific Name	Alpha Code	Outer Domain	Between Islands	Middle Domain	Total
Sampling Effort (km)			1,227	628	556	2,411
Short-tailed Shearwater	*Puffinus tenuirostris*	DKSH	6,511	788	2,326	9,615
Northern Fulmar	*Fulmarus glacialis*	NOFU	14,675	1,743	471	16,889
Fork-tailed Storm-Petrel	*Oceanodroma furcata*	FTSP	5,658	127	645	6,430
Black-legged Kittiwake	*Rissa tridactyla*	BLKI	862	706	594	2,162
Red-legged Kittiwake	*Rissa brevirostris*	RLKI	497	575	25	1,097
Unidentified Kittiwake	*Rissa spp.*	UNKI	82	4	7	93
Common Murre	*Uria algae*	COMU	684	1,016	162	1,862
Thick-billed Murre	*Uria lomvia*	TBMU	2,139	1,629	223	3,991
Unidentified Murre	*Uria spp.*	UNMU	3,508	2,030	58	5,596
Ancient Murrelet	*Synthliboramphus antiquum*	ANMU	39	1	152	192
Least Auklet	*Aethia pusilla*	LEAU	34	184	88	306
Crested Auklet	*Aethia cristatella*	CRAU	6	560	8	574
Parakeet Auklet	*Cyclorrhynchus psittacula*	PAAU	117	160	26	303
Horned Puffin	*Fratercula corniculata*	HOPU	262	317	10	589
Tufted Puffin	*Fratercula cirrhata*	TUPU	275	317	154	629
Northern Fur Seal	*Callorhinus ursinus*	FUSE	27	43	35	105
			35,351	10,030	4,949	50,330

Murres as a group constituted 23% of all birds counted (Table 1). On our transects, thick-billed murres *Uria lomvia* were twice as numerous as Common murres *Uria algae.* Small auklets (least auklets *Aethia pusilla*, crested auklets *Aethia cristatella* and parakeet auklets *Cyclorrhynchus psittacula*) were nearly absent from the study area and represented only 2.4% of the birds flying, feeding and on the water (Table 1, Fig. 13). Both murres and small auklets were relatively more common in the inter-island region than in the middle or outer domains.

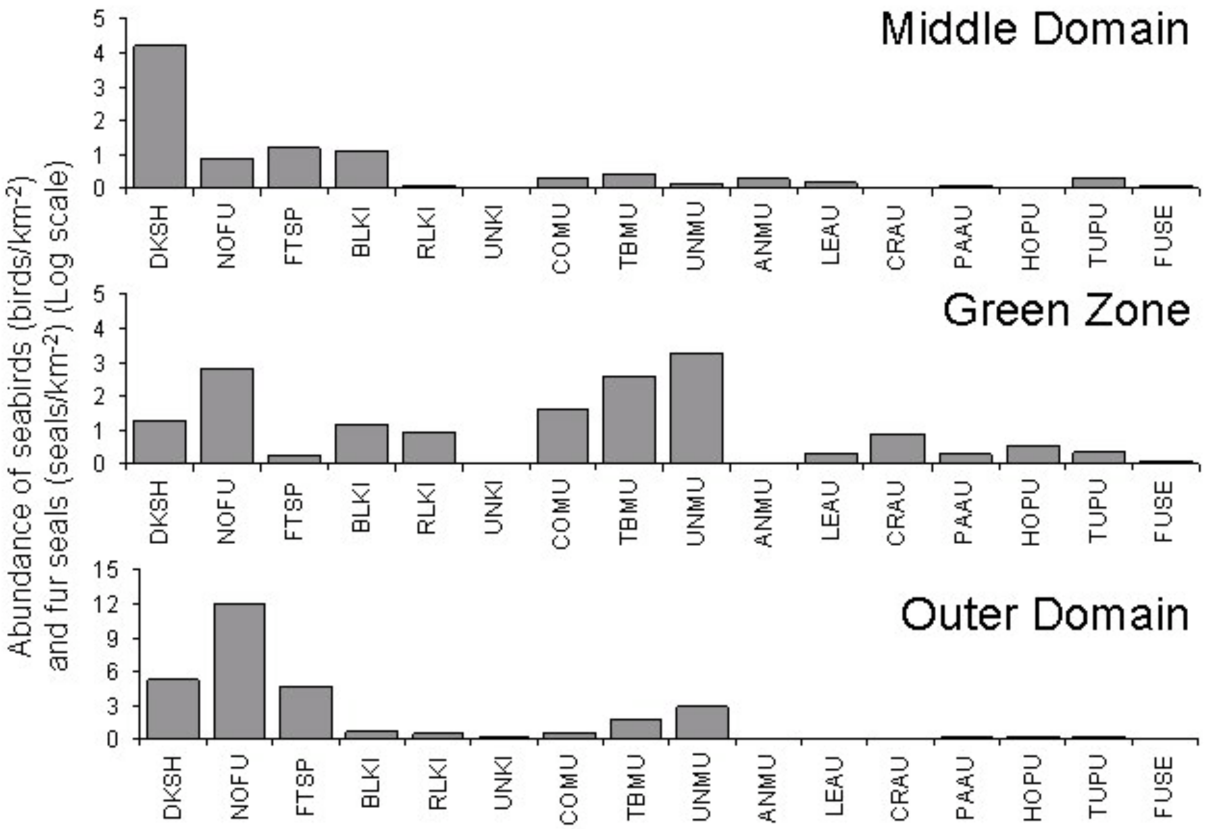


Figure 13. Abundance of marine bird species by region.

H. Food Web Tracers (J. Napp)

Samples of particulate organic matter, zooplankton, fish, and bird tissue were collected to analyze for chemical tracers of food webs (stable isotopes and fatty acids). These samples will be invaluable for corroborating results from other program components to resolve which source of nitrogen is fueling the food web and whether the food chain is long or short. More than 180 individual samples were collected for fatty acid analysis and more than 300 were collected for stable isotopes.

Sample collection used several different methods. Particulate organic matter (POM) was collected by filtering water sampled with the CTD rosette. Zooplankton was collected from a fine-mesh net during the night MOCNESS tows and was later sorted to species (and sometimes stage). Sorted plankters were either dried at 60 °C for 24 hr and stored in a dessicator (stable isotope analyses) or placed in cryovials and frozen in liquid nitrogen (fatty acids). Whenever possible, replicated samples were taken for each analysis. Age-0 pollock (which are planktivorous) were often obtained as "by-catch" from the MOCNESS and frozen at –20°C for later analyses. Tissues from planktivorous and piscivorous seabirds (breast muscle and liver), as well as fat, were obtained from birds shot from the small boat on one dedicated collecting trip. Sample locations are shown in Fig. 1 and Appendix A lists which samples were collected at each station.

As a by product of sorting zooplankton from the MOCNESS for food web tracers, we obtained qualitative information on the composition of the meso- and macrozooplankton communities at the various stations. These observations are presented under the appropriate regional discussions below.

VI. Results by Region

A. Shelf Edge and Outer Shelf Domain

Physical Oceanography- Offshore Domain

We made two crossings of the Outer Shelf Domain "upstream" of Pribilof Canyon and the Pribilof Islands (Transect SES, Fig. 14). We also crossed north of the canyon, east of St. George Island to detect north-south water movements in or out of the canyon (Transect GA, Fig. 15). On the first crossing of the outer shelf domain southeast of the canyon on 27 July, we surveyed the line from the shelf edge to the 100m isobath (Fig. 14). The sloping isopycnals over the shelf indicate that there was water movement to the northwest, along the shelf, over much of the outer domain. On the 18 August survey that covered only the inner 90 km of the line, we again found evidence for along-shelf movement of water.

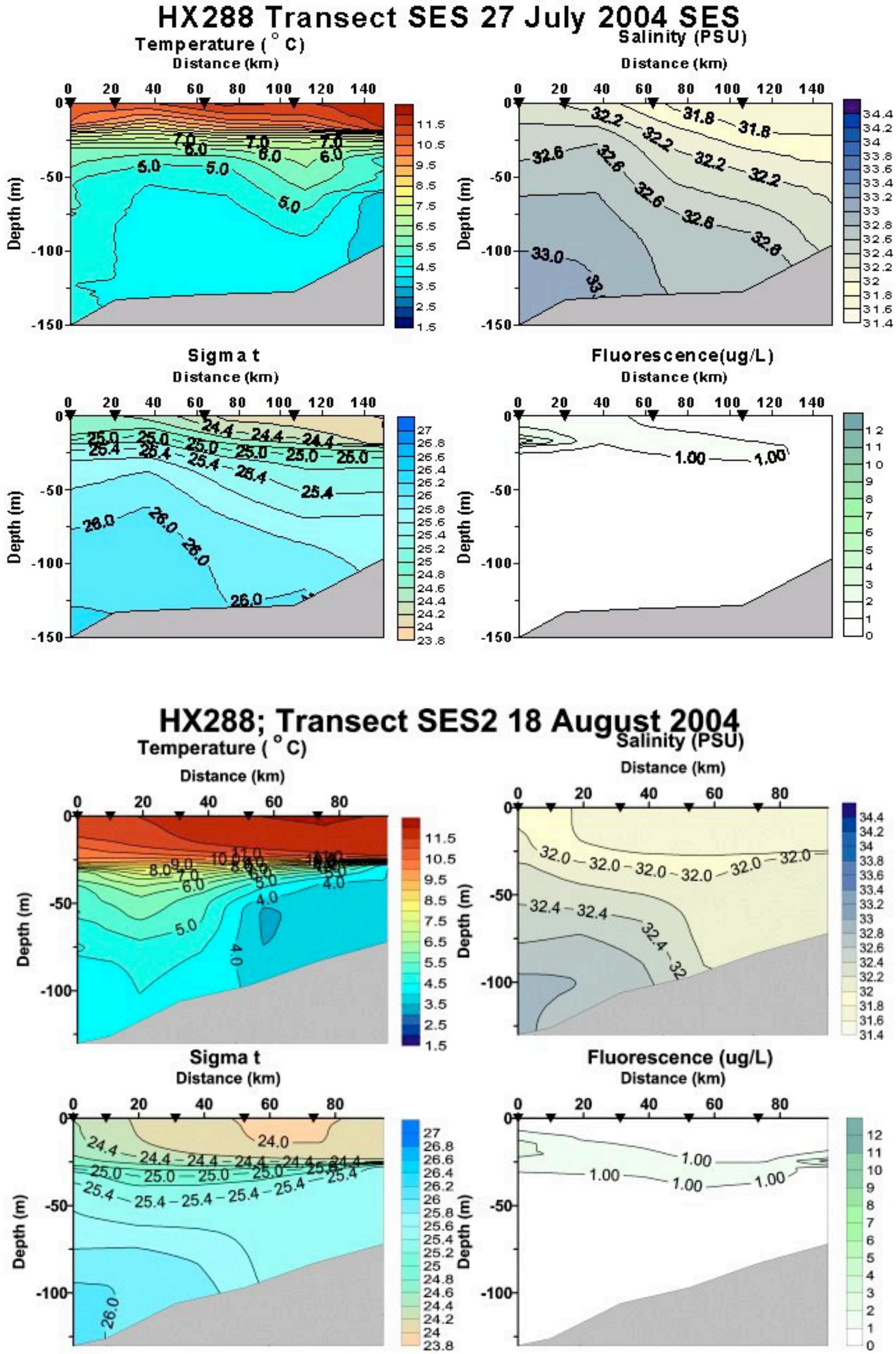


Figure 14. CTD profiles, SES transect across outer domain SE of Pribilof Canyon.

Transect GA went due east from St. George Island north of Pribilof Canyon, and crossed the 100 m isobath about half way along its length (Fig. 5, 15). Usually, currents flow from the north here, and this line would be expected to be “upstream” of the canyon. However, earlier in the summer, drifter tracks showed water east of St. George Island flowing to the north. Thus, we did not know what to expect when we surveyed this line. By the time of our survey, a major storm in July had apparently “reorganized” the system, and east of St. George Island, southward flows had been restored. Waters near St. George Island tend to be stirred by the strong tides there, and the isopycnals were quite loose. For the eastern end of the line, over waters deeper than 60 m, there was a strong pycnocline at about 20 m depth, with a warm, somewhat reduced-salinity upper mixed layer.

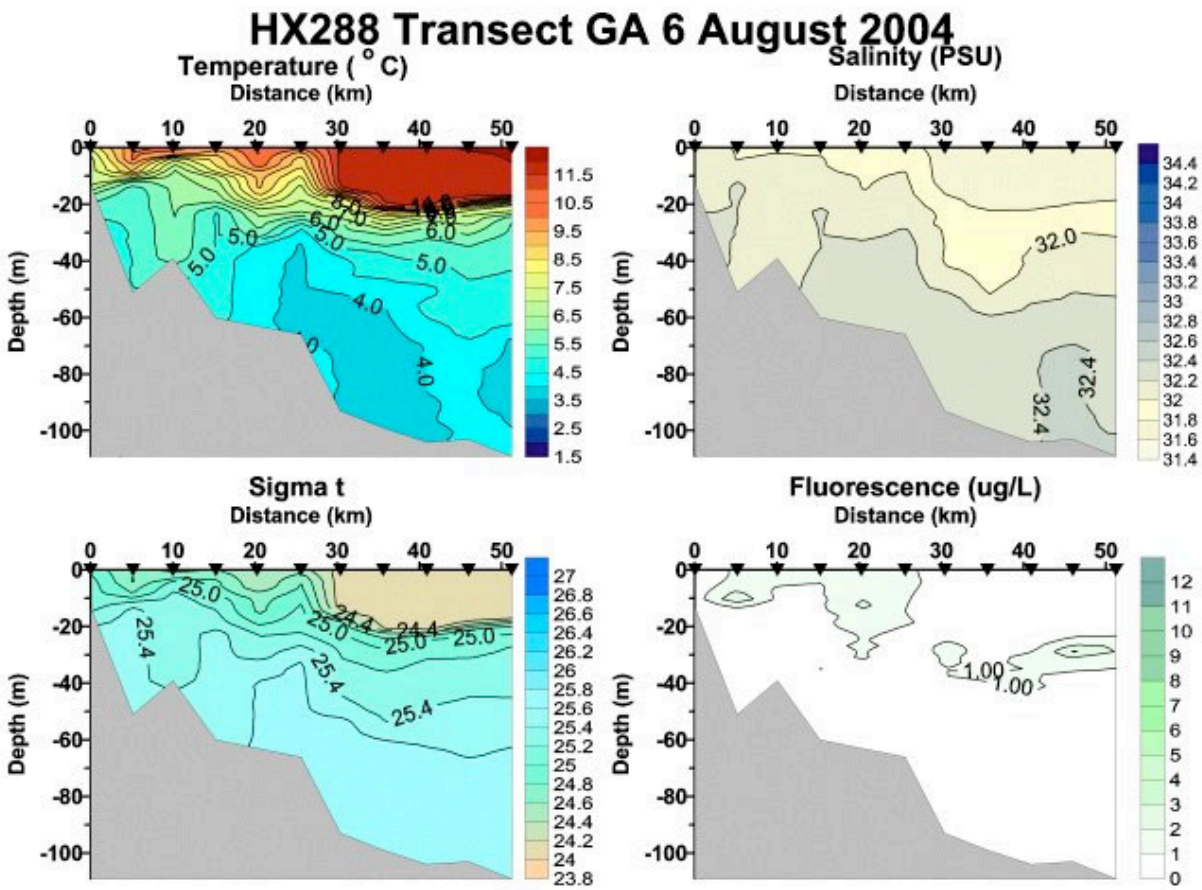


Figure 15. CTD profiles, GA transect east of St. George Island

On transects GC, GD, and CW, that crossed the shelf edge, we found evidence of the Bering Slope Current (Fig. 16, 17, 18). The isopycnals, which sloped downward toward the shore, indicate flow toward the northwest. We also could see strongly downward sloping isopycnals in shallow water (about 100 m depth), presumably evidence of enhanced flow of Outer Domain waters to the northwest along the 100 m isobath.

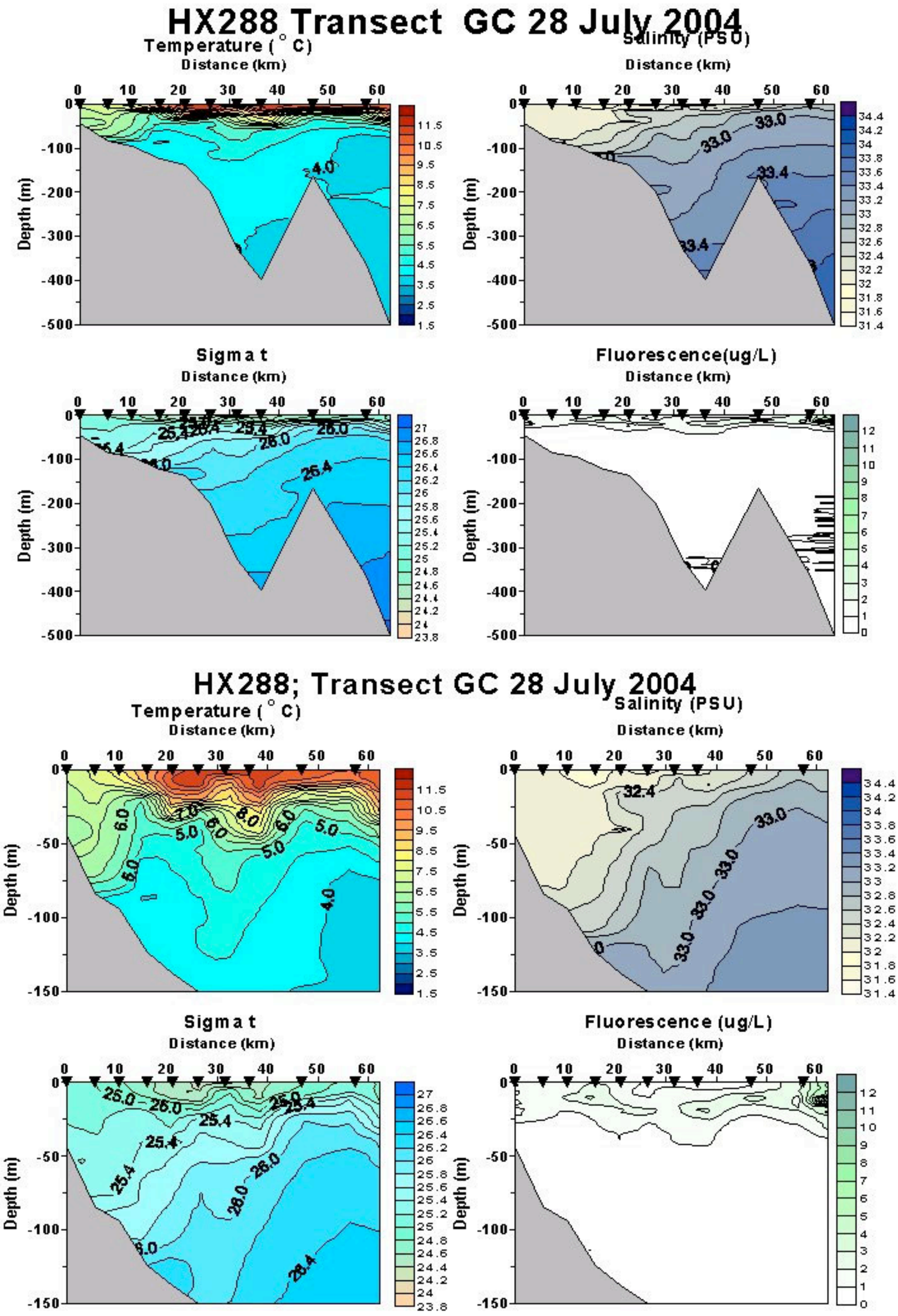
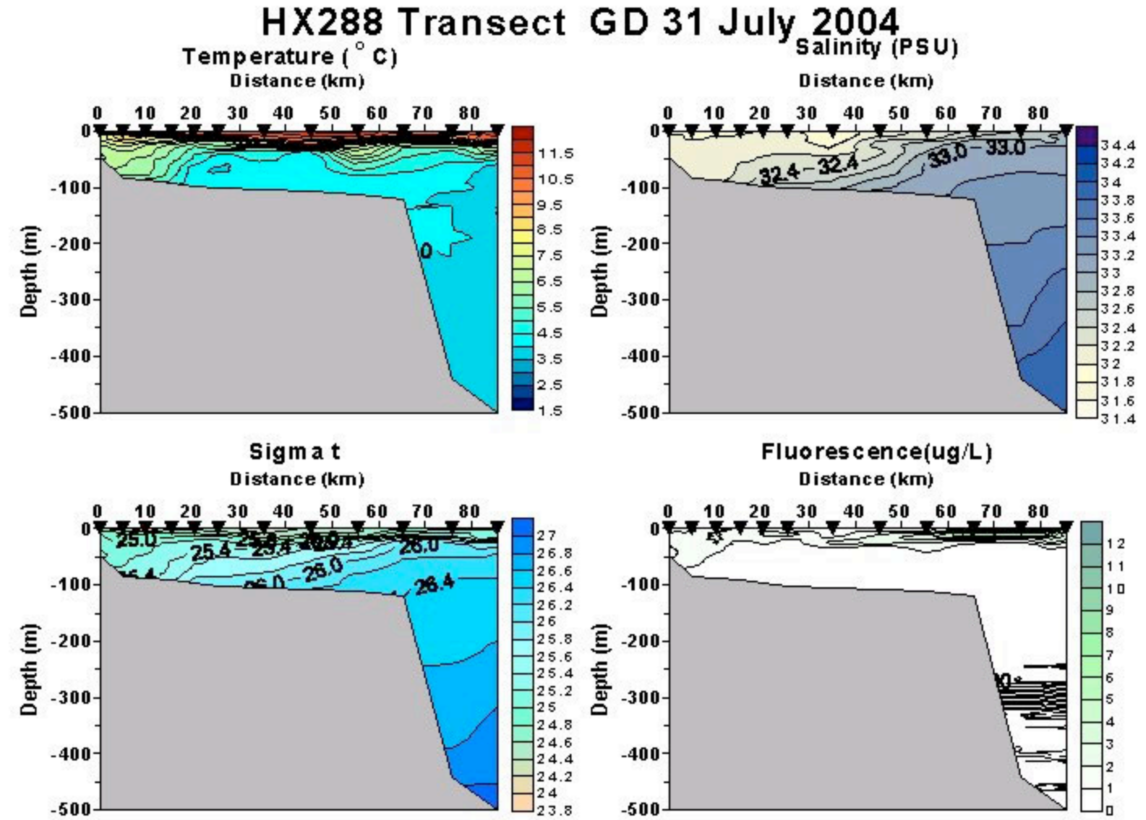


Figure 16. CTD profiles, GC transect, south from St. George Is. across the west arm of Pribilof Canyon.



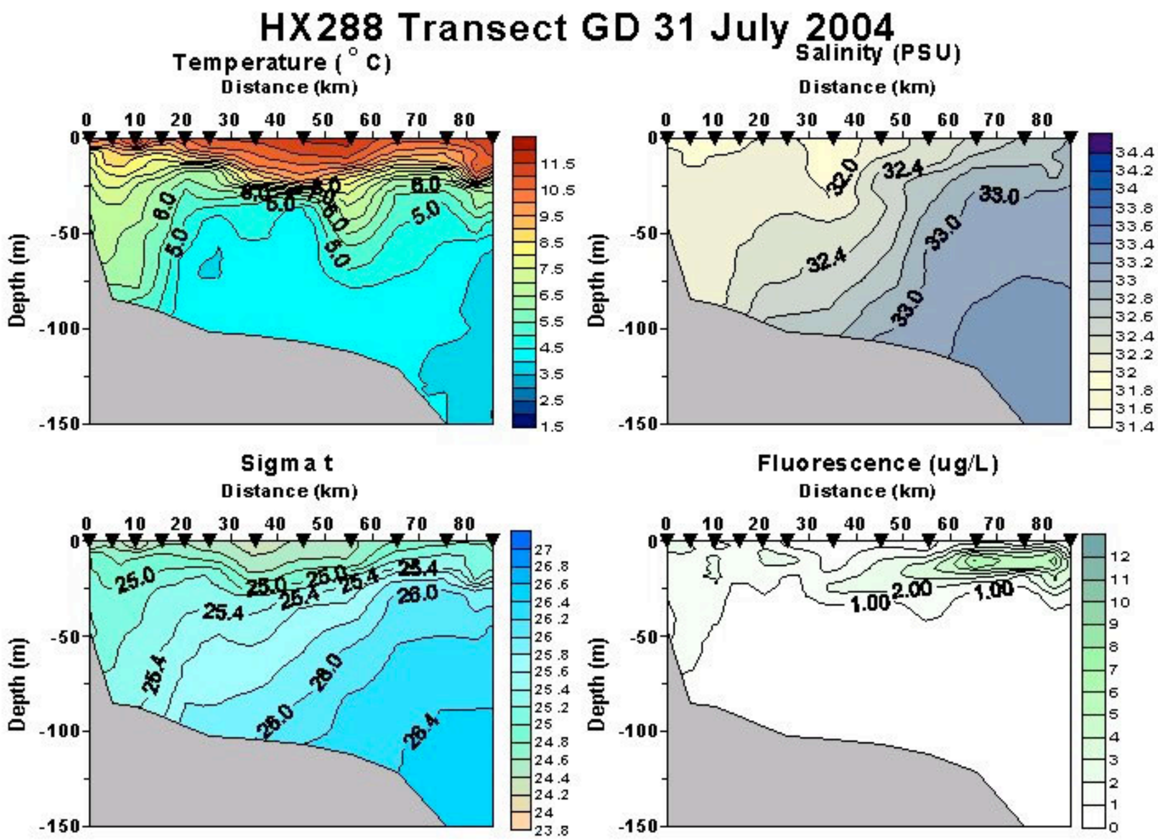


Figure 17. CTD profiles, GD transect, southwest from St. George Is.

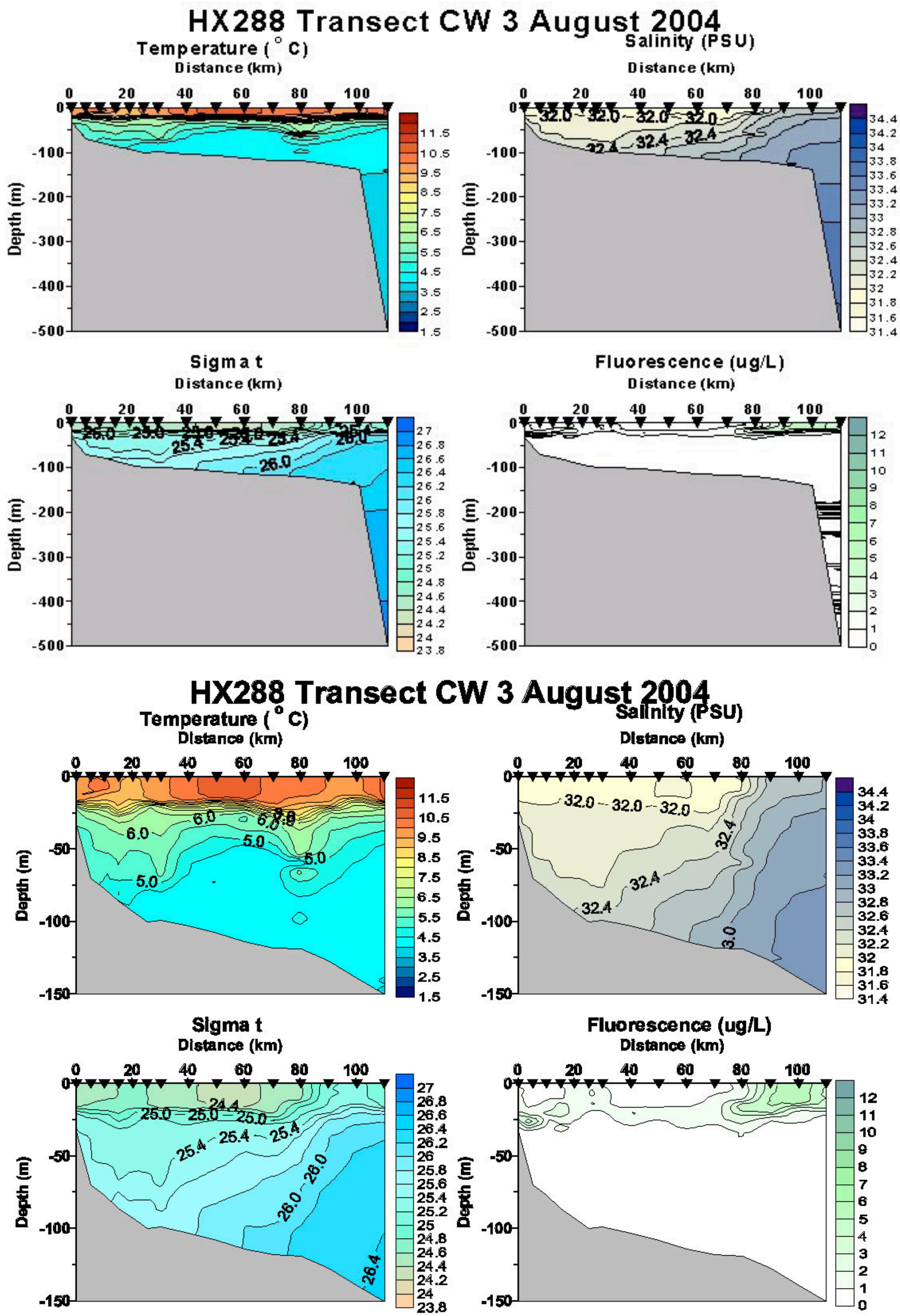


Figure 18. CTD profiles, CW transect, southwest from the region between the Pribilof Islands.

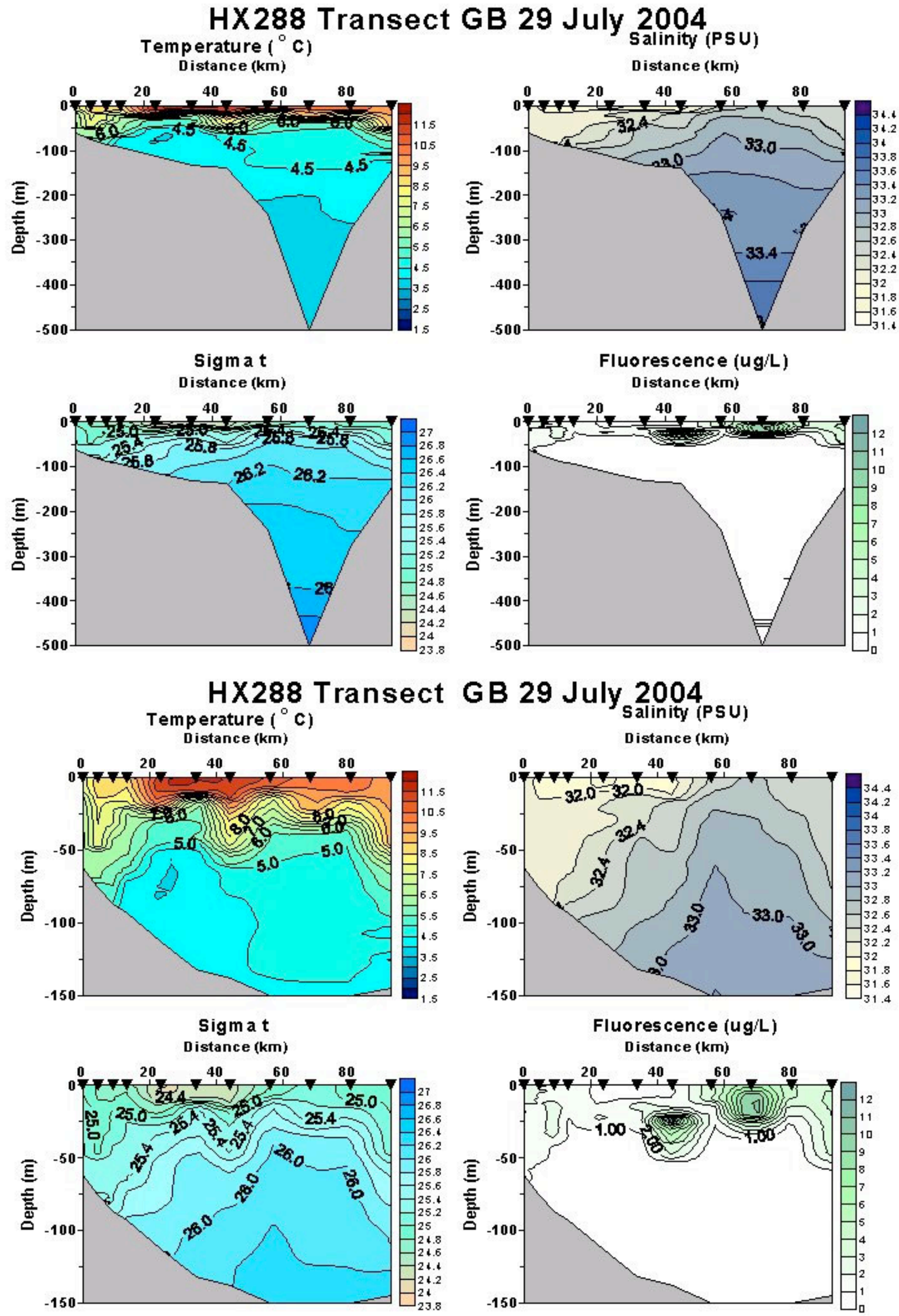


Figure 19. CTD profiles, GB transect, SE from St. George Island across the east arm of Pribilof Canyon.

Transect GB projected SE from St. George Island, and crossed the eastern horn of Pribilof Canyon (Fig. 5 and 19). At GB, flow was northeast on the southeastern side of the canyon and northwestward on the western side of the canyon. The effect of the canyon on flow is also seen in the slope of the outer isopycnals of line GC (Fig. 16). The slopes of the isopycnals were steeper at depth than near the surface. However, we did not calculate dynamic height or geostrophic flow.

Maximum surface temperatures were generally near 10°C, in a band about 20 km offshore (Fig. 16, bottom). Bottom temperatures on the shelf were near 4 - 4.5°C. Once beyond the near-shore zone, salinity resembled that in the middle domain in that it was generally 31.8 - 32 psu at the surface and 32 - 32.2 psu at depth. Similar salinities, with surface values near 31.8 - 32 psu and bottom values 32-32.2 psu were also measured "upstream" at line SES at depths less than 100m.

Line PB, to the west of St. Paul, also passed into deeper water (Fig. 20). Because of a storm on 12 August, we were only able to sample the outer end of the transect that day. At that time, its surface salinity fell into the 31.8 - 32.0 psu range, like the signature waters mentioned above. However, on 17 August, the salinity of much of the transect had increased in the surface layer, and conditions were more patchy (Fig 20). The thermocline had not broken down, so the increase was not primarily due to mixing in place. Remember that drifter 43711 moved northward through the area and then began to oscillate in place at about this time (Fig. 8, 9), indicating that advection followed by disorganized flow played a role in forming this hydrographic structure.

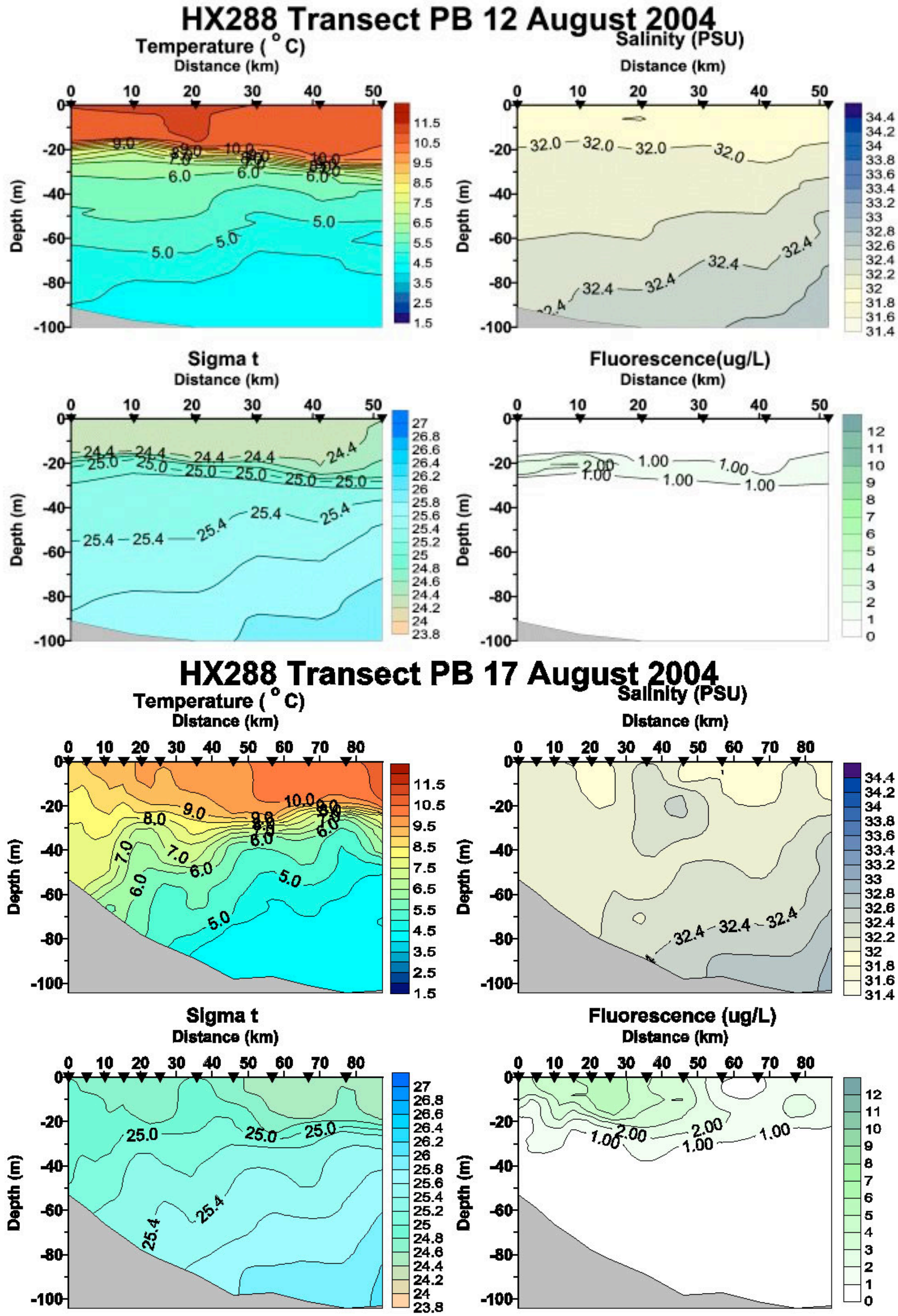


Figure 20. CTD profiles, PB transect, west from St. Paul Is.

Nutrients- Outer Shelf Domain

Hydrographic lines (SES) across the Outer Domain southeast of the Pribilof Islands and "upstream" of Pribilof Canyon showed low levels of nitrate in the upper mixed layer, and high levels of ammonia below the pycnocline, particularly at the inner end of the transect near the 100 m isobath (Fig. 21). Hydrographic sections extending southeast (GB, Fig. 22) and south of St. George Island (GC and GD, Fig 23 and 24), and across the outer shelf west of the Pribilofs (CW and PB, Fig. 25 and 26), also showed an intense concentration of ammonia below the pycnocline near and inshore of the 100 m isobath.

Hydrographic lines that extended beyond the 200m isobath (GB, GC, GD, and CW) showed a generalized pattern of mixing near shore, increased stratification and lower nutrient concentrations seaward of the 100m isobath, and rising isopycnals and higher nutrient concentrations at the slope break (Fig. 22, 23). Chlorophyll distributions generally reflected nutrient availability with higher concentrations inshore and near the slope break. While the concentration of major nutrients increased offshore, ammonium concentrations were highest inshore with shoaling of the subsurface ammonium maximum seaward. Nevertheless, the subsurface ammonium maximum remained below the pycnocline. Several exceptions were observed along the GB line. A large subsurface chlorophyll maximum was observed in the center of the section and was associated with flow at the head of Pribilof Canyon. Also, about 30 km along the transect, near-surface nutrient concentrations (including ammonium) were high in well-stratified region with little chlorophyll.

Transect PB extended west from St. Paul across a broad expanse of outer domain (Fig. 20). On our first visit on 12 August, just as a major storm was developing, we found the outer end of the line well stratified. We returned on 17 August after a three-day storm with winds in excess of 30 knots (Fig. 20, bottom). At this time, concentrations of nitrate at the bottom in < 100m of water were > 20 μml (Fig. 26, top). Ammonium concentrations were 3-4 μml at and below the pycnocline, with concentrations of 1.5 μml reaching the surface where the water shoaled to < 60 m between the islands near where the patch of high concentrations of chlorophyll had been observed earlier in the cruise.

Nutrient concentrations transect GA, east of St. George Island, were typical of the outer shelf upstream of Pribilof Canyon (bottom nitrate concentrations of 24 μml^{-1}), but had the elevated concentrations of ammonium (3-3.5 μml^{-1}) near the island that was seen for all of the outer domain lines extending out from the island. Thus, there was little evidence of advection of nutrients out of Pribilof Canon to the east of St. George Island by the time we sampled the region.

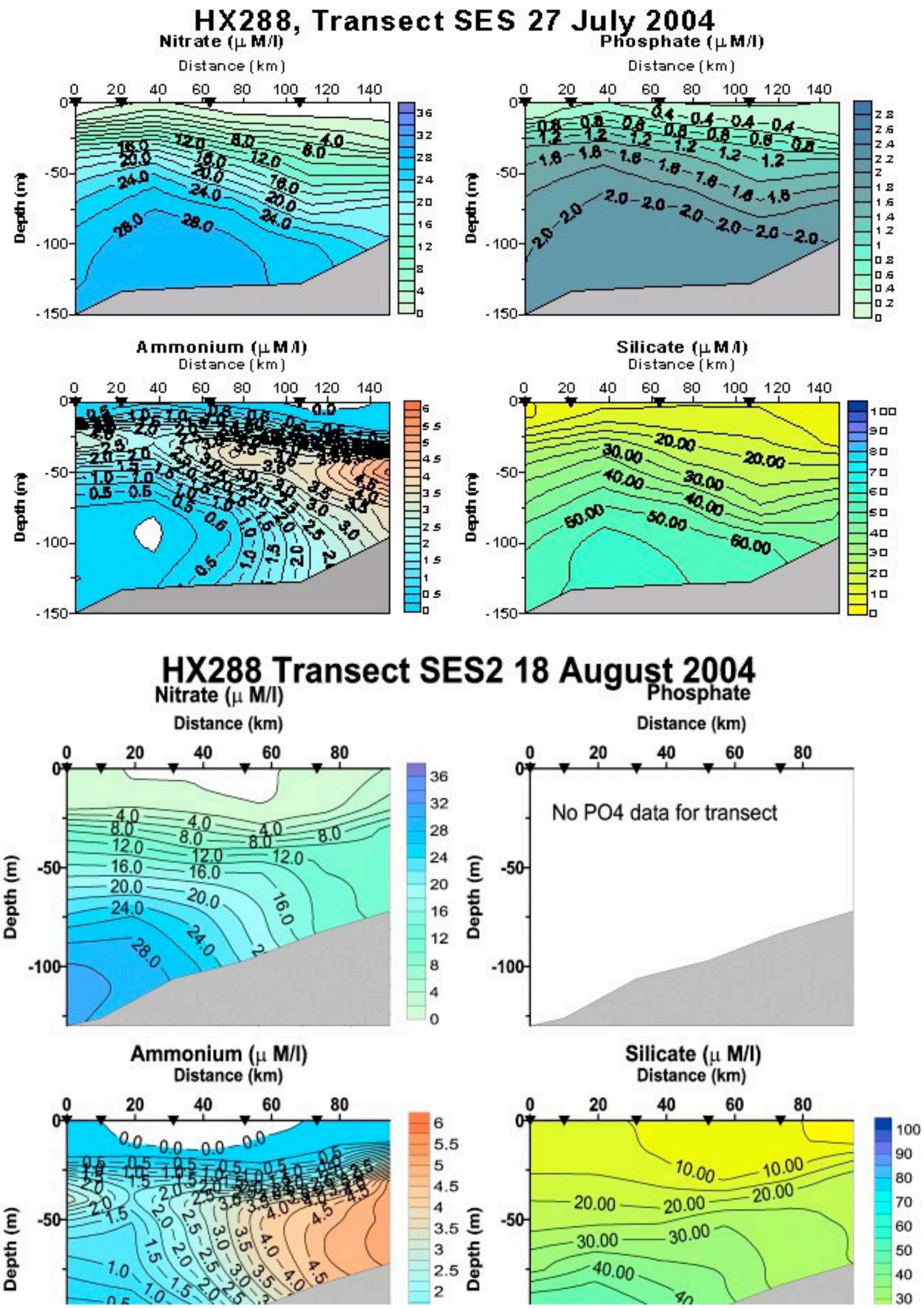


Figure 21. Nutrient profiles, SES transect, across the outer domain SE of Pribilof Canyon.

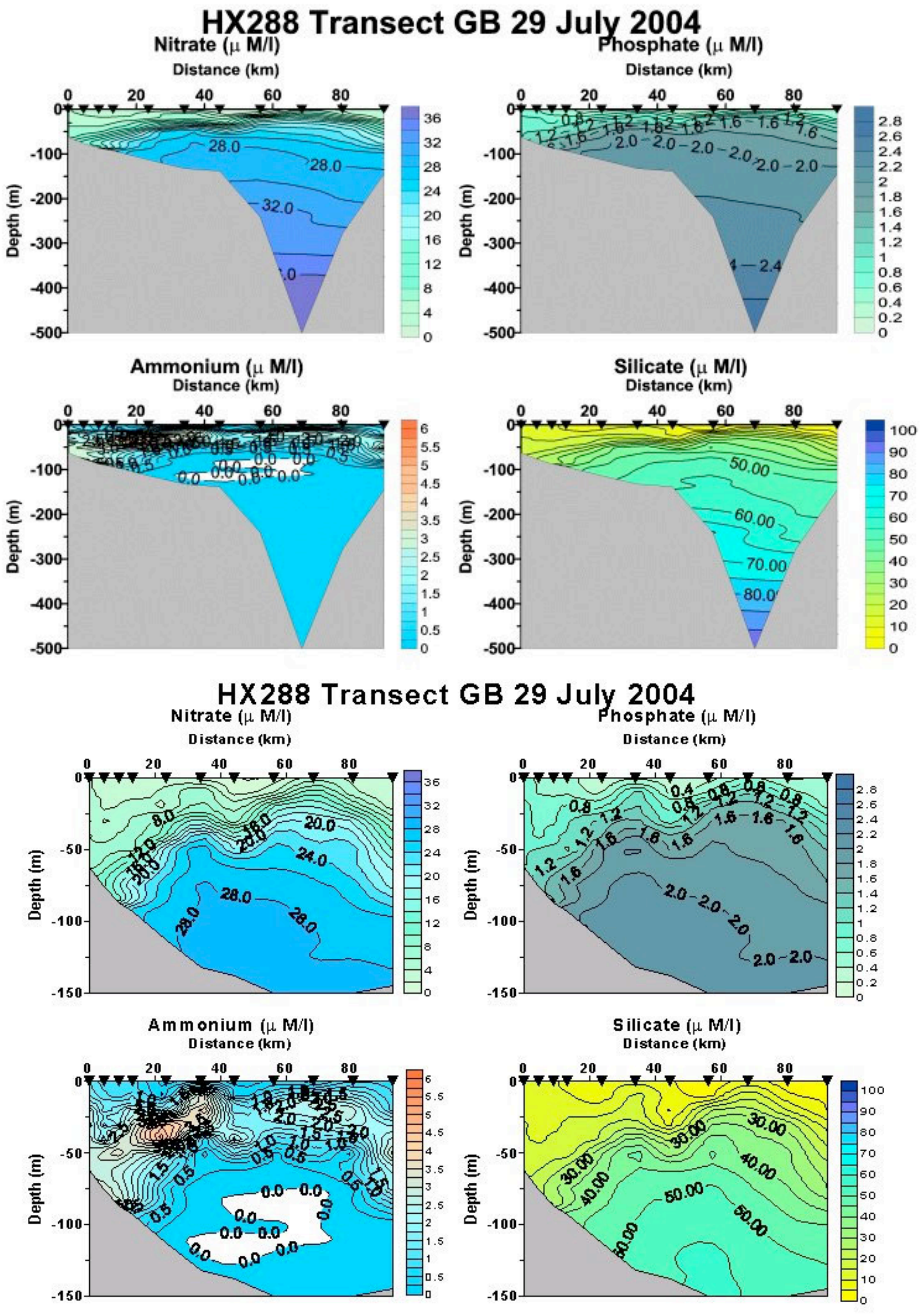


Figure 22. Nutrient profiles, GB transect, SE from St. George Is. across the east arm of Pribilof Canyon.

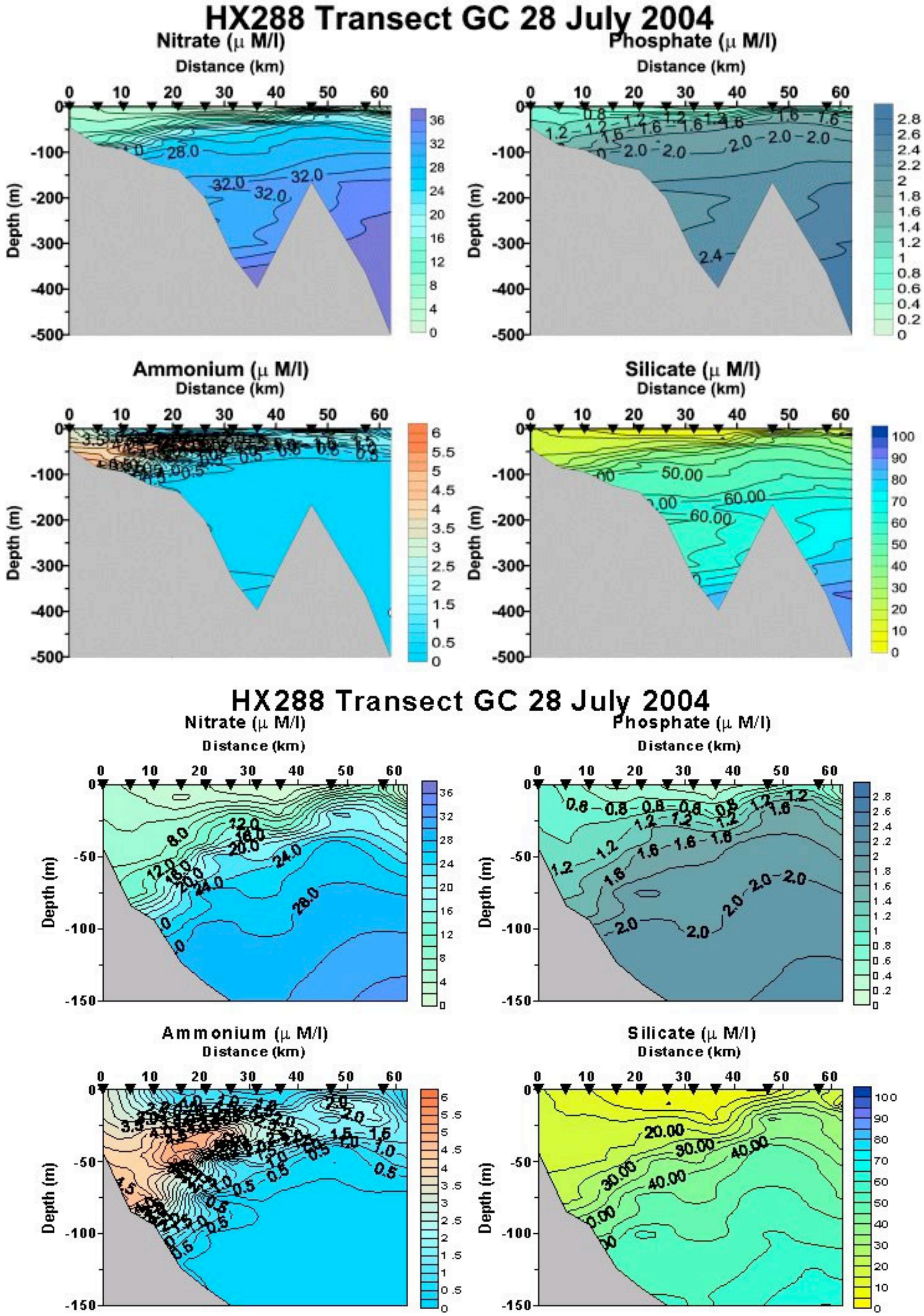


Figure 23. Nutrient profiles, GC transect, south from St. George Is. across the west arm of Pribilof Canyon.

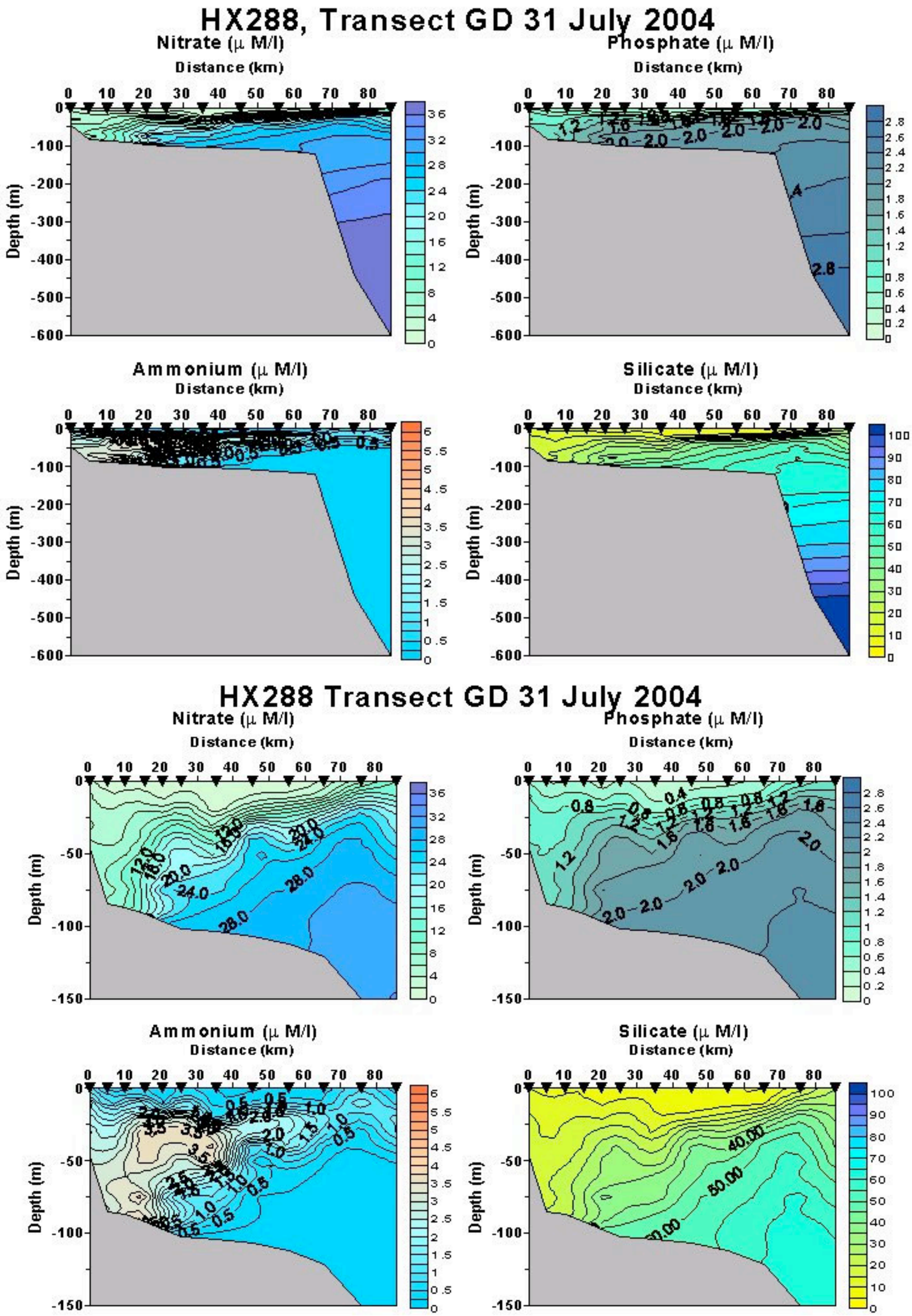


Figure 24. Nutrient profiles, GD transect, southwest from St. George Is.

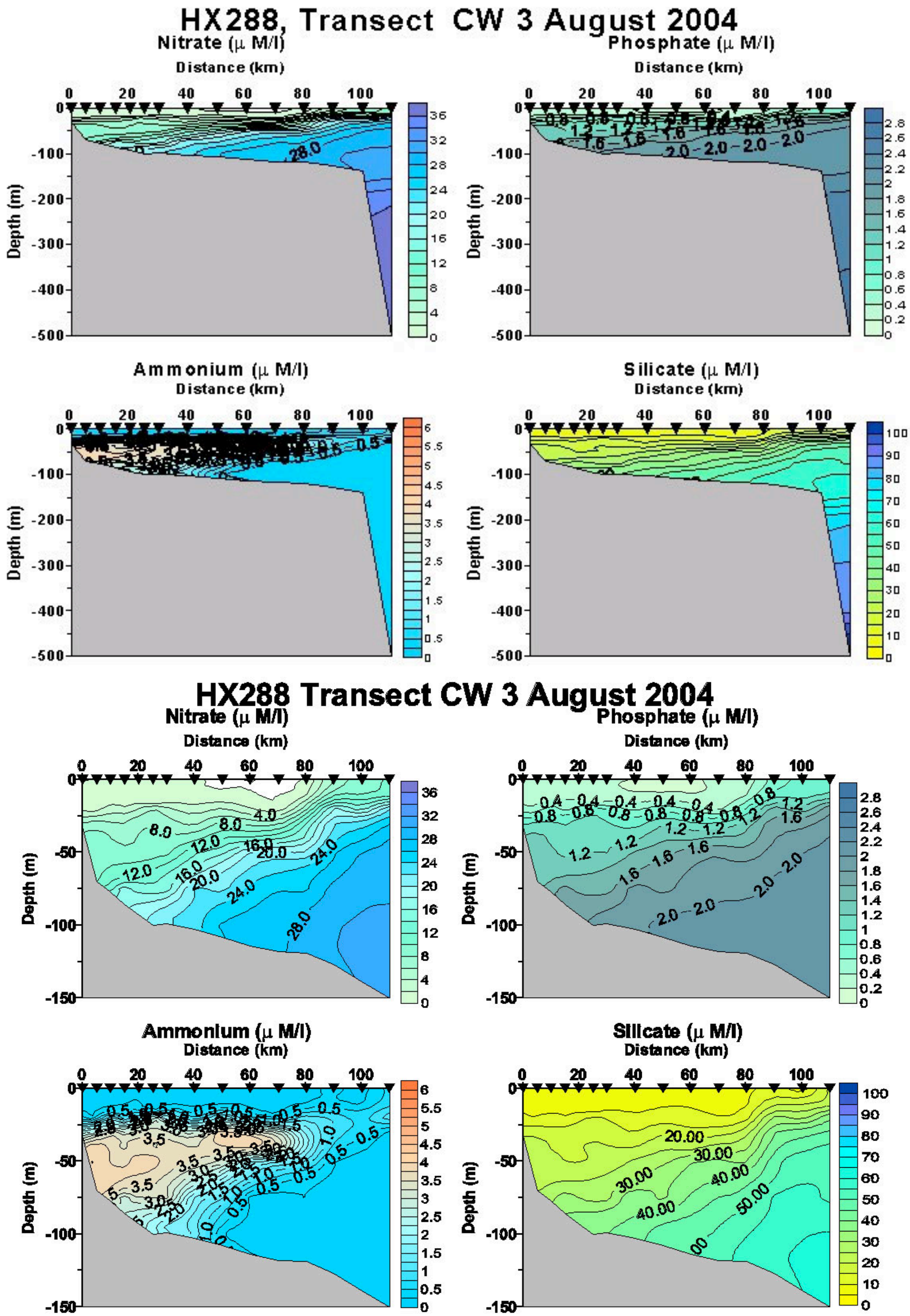


Figure 25. Nutrient profiles, CW transect, SW from the region between the Pribilof Is.

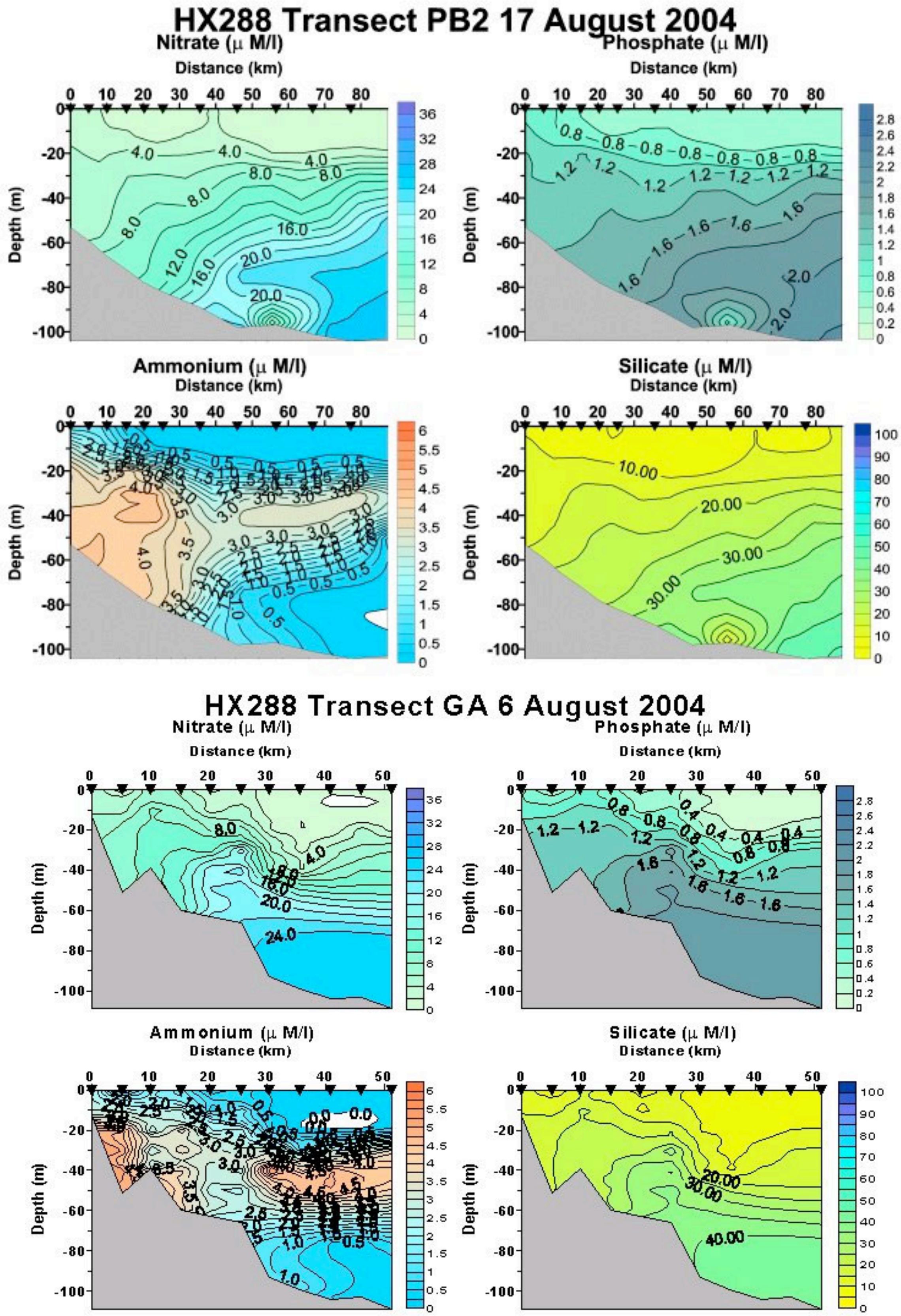


Figure 26. Nutrient profiles, PB transect, west from St. Paul Is.

Microplankton-Outer Shelf Domain

Four microzooplankton dilution experiments were conducted in slope waters (2 at SES-1; and one each at GB-9, and GC-13). Chlorophyll levels were moderate (1.2 to 3.3 $\mu g l^{-1}$) in these experiments, and communities, with one exception, were dominated by >20 µm phytoplankton cells. These experiments yielded the highest growth rate measurements of any during the cruise, indicating that the slope microplankton community was biologically more active than that on the shelf. Large phytoplankton cells showed moderate-to-high unenriched growth rates (ca. 1 doubling d^{-1}) and remarkably high growth rates in response to nutrient addition. Water collected at the head of Pribilof Canyon (GB-9) contained high levels of macronutrients: these phytoplankton cells were not nutrient-limited and exhibited high rates of growth (Fig. 27).

Four dilution experiments were conducted along the 100 m isobath east, south, and west of the Pribilof Islands (one each at GA-100, GA-8, GD-5 and CW-6). In addition, one experiment was conducted to the west of St. Paul Island in the middle of the outer domain at PB-13. Experiments conducted at these stations are consistent with a successional sequence involving a community response to nutrient input in the vicinity of Pribilof Canyon. Stations GA-100 and GA-8, "upstream" of the canyon (as indicated by drifter tracks during the cruise), had low total phytoplankton biomass (0.2 to 0.3 µg/liter), communities dominated by <5 µm phytoplankton cells, moderate rates of phytoplankton growth (ca. 0.4 d^{-1}) and low to moderate microzooplankton grazing. While GA-100 waters showed nutrient limitation, GA-8 waters did not. In GD-5 waters just downstream from the canyon, phytoplankton biomass was much higher (1.3 µg chl l^{-1}) and both small (< 5 µm) and large (>20 µm) phytoplankton were major contributors to this. Growth rates were high, especially for the largest phytoplankton cells, and there was no evidence of nutrient limitation. Microzooplankton grazing rates remained low at 0.1 to 0.2 d^{-1}. At station CW-6, further downstream, phytoplankton biomass remained high and was dominated by >20 µm cells, but unenriched growth rates were near zero and there was a strong growth rate response to added N+P (Fig. 28). Microzooplankton grazing rates had increased to 0.3 to 0.4 d^{-1} on all phytoplankton size classes.

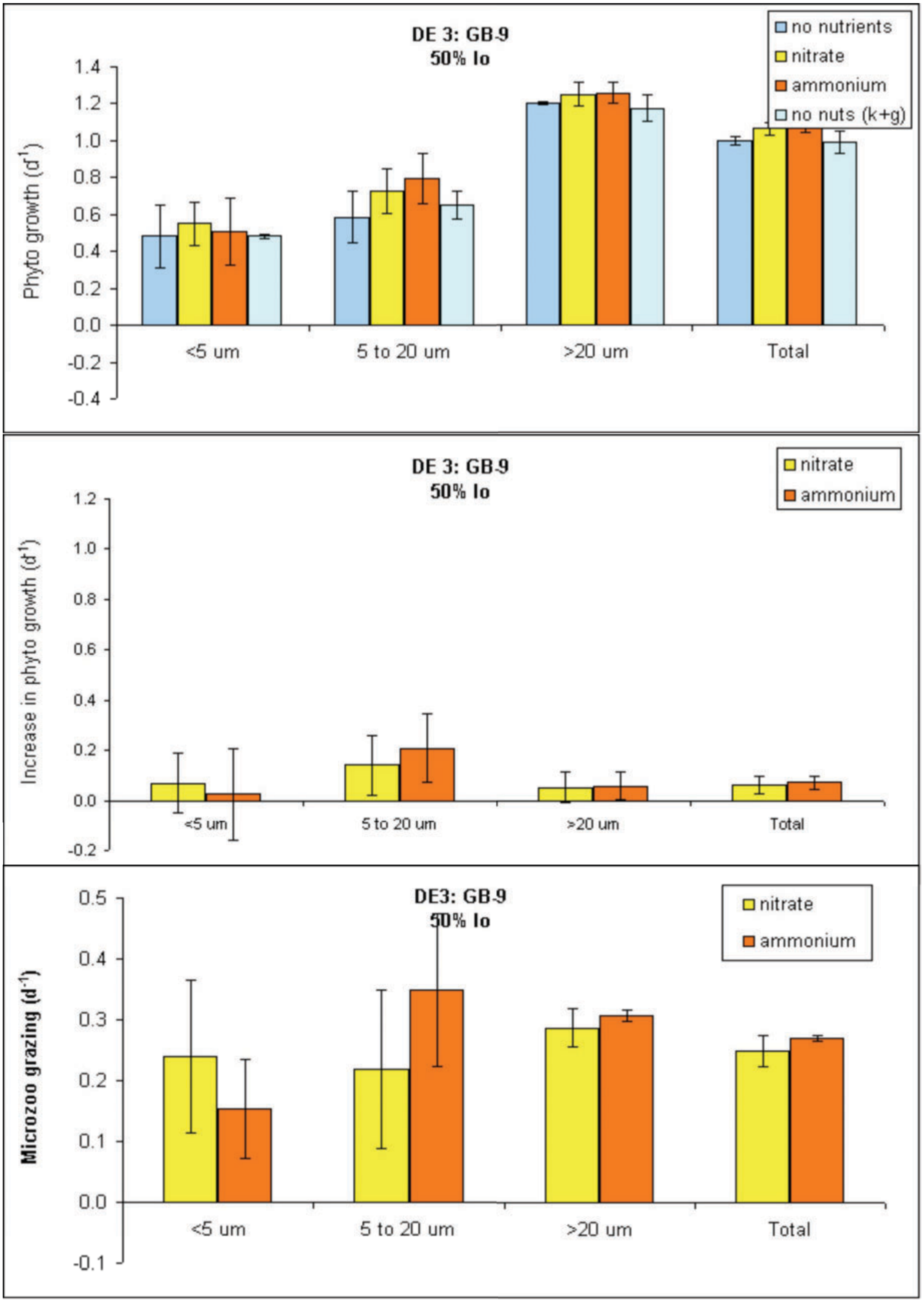


Figure 27. Results of the microzooplankton grazing experiment at station GB-9, on the shelf slope in the eastern arm of Pribilof Canyon.

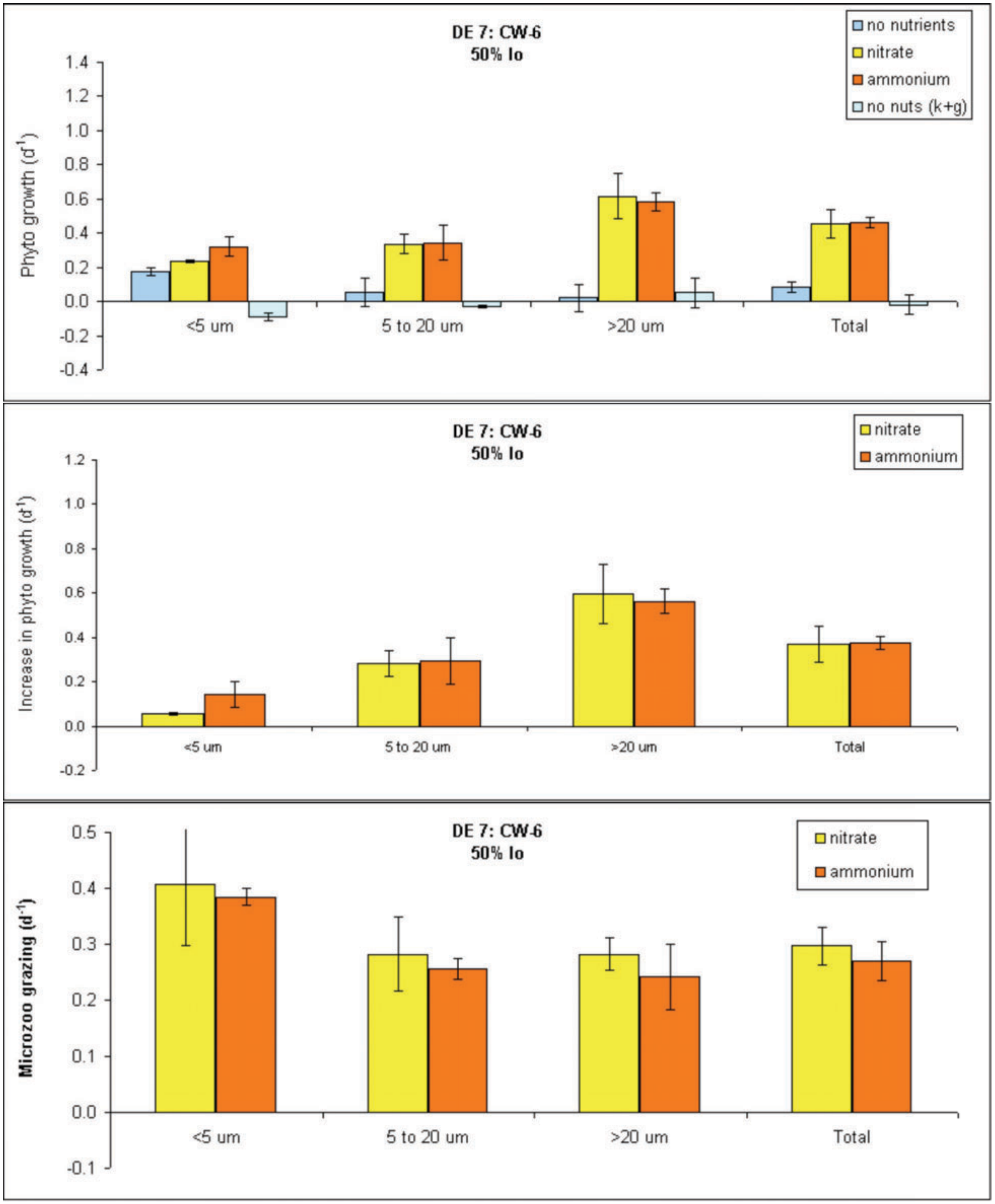


Figure 28. Results of the microzooplankton grazing experiment at station CW-6, along the 100 m isobath southwest of ST. Paul Island.

Zooplankton- Outer Shelf Domain

Net samples for sorting specimens for stable isotope and fatty acid signatures were obtained from the outer shelf domain from 2 stations in Pribilof Canyon (GB-9 and GC-8), and 6 stations along the 100 m isobath (GB3, GC3, GD5, CW6, GA8, PB9).

Preliminary examination of net tows from the two canyon sites showed that the zooplankton community at these stations resembled an oceanic or shelf break community. Abundant euphausiids (juvenile and adult *Thysanoessa longipes and T. spinifera*) were found over the eastern horn of canyon, as well as a few furcilia. *Neocalanus cristatus* C5 and *Metridia pacifica* C6F were abundant. *Calanus marshallae* C6F and *Neocalanus* spp. C5 were present in smaller quantities. *Eucalanus bungii* (all stages) were common.

At the 100 m isobath stations, phytoplankton (diatoms) was very common in the fine-meshed MOCNESS net. South of St. George Island (GB-3 and GD-5) the zooplankton community looked somewhat oceanic, whereas further "downstream" at stations west of St Paul (CW-6 and PB-9) the community had a stronger shelf component. For example, furcilia, juveniles and adults of the euphausiids *T. inermis* and *T. spinifera* were present in net tows at GB-3 and GD-5. However, at station PB-9, mostly furcilia and juveniles of *Thysanoessa raschii,* a shelf species, were obtained. At station CW-6, smaller furcilia and juveniles (all < 8 mm) of this species were collected. South of St. George (GB-3 and GD-5), the copepod component of the zooplankton community looked oceanic with *N. cristatus* and *Neocalanus* spp. present. *M. pacifica* and *E. bungii* were also found at CW-6, but *Neocalanus* were not present there. Few or no individuals of these taxa were found east of St. George (GA-8). Few *C. marshallae* C5, a shelf species, were found at GD-5, CW-5 or GA-8. Interestingly, the *C. marshallae* at GA-8 (east of St. George) appeared to be much smaller, and were observed to contain smaller and more variable lipid sacs than the *C. marshallae* C5 at Mooring-2. in the middle domain. Decapod larvae (zoea stage 1 & 2 and megalopae) were common at each station. Shelled and naked molluscs were found at many stations.

We collected a few age-0 *Theragra chalcogramma* at each of the outer domain stations. Sizes were variable, but standard lengths tended to be small (≤ 40 mm).

Marine Birds- Outer Shelf Domain

Over the outer shelf domain and basin, we surveyed 1,227 km and counted 35,351 seabirds flying, feeding and sitting on the water. Northern fulmars were most abundant accounting for 42% of all seabirds in this region. Short-tailed shearwaters and fork-tailed storm-petrels were also abundant representing 18% and 16% of all seabirds, respectively. Red-legged kittiwakes were seen mostly close to St. George Island, an artifact of our starting transects from the islands in the morning when these birds were retuning from nocturnal foraging near the shelf edge (Fig. 29). The decrease in sightings of thick-billed murres as we went away from the islands is evidence that much of their foraging occurs in fairly inshore waters.

Dr. Takahashi of Professor Watanuki's group conducted studies of the foraging ecology of thick-billed murres that were nesting on St. George Island. They examined the diving behavior of 12 chick-rearing thick-billed murres in relation to sea surface temperature and thermocline depth, data that were recorded by ventrally-attached depth-temperature-acceleration data loggers (16g). Their initial results showed that murres utilized various water masses, ranging from well-mixed water (SST 7-9 C, near the island) to well-stratified water (SST 9-12 C, relatively far from the island). Murres dived deeper (c. 80m) in the mixed water mass, whereas dives were shallower (ca. 20-30 m) and to just below the thermocline depth in the stratified water mass. In the stratified water mass, murres dived deeper, to below the thermocline, during the last dive bout in a foraging trip, when they were presumably foraging for a chick meal rather than foraging for themselves. Thus, the thermocline is important in shaping depth utilization of thick-billed murres, possibly through its effect on the vertical distribution of both zooplankton and fish prey.

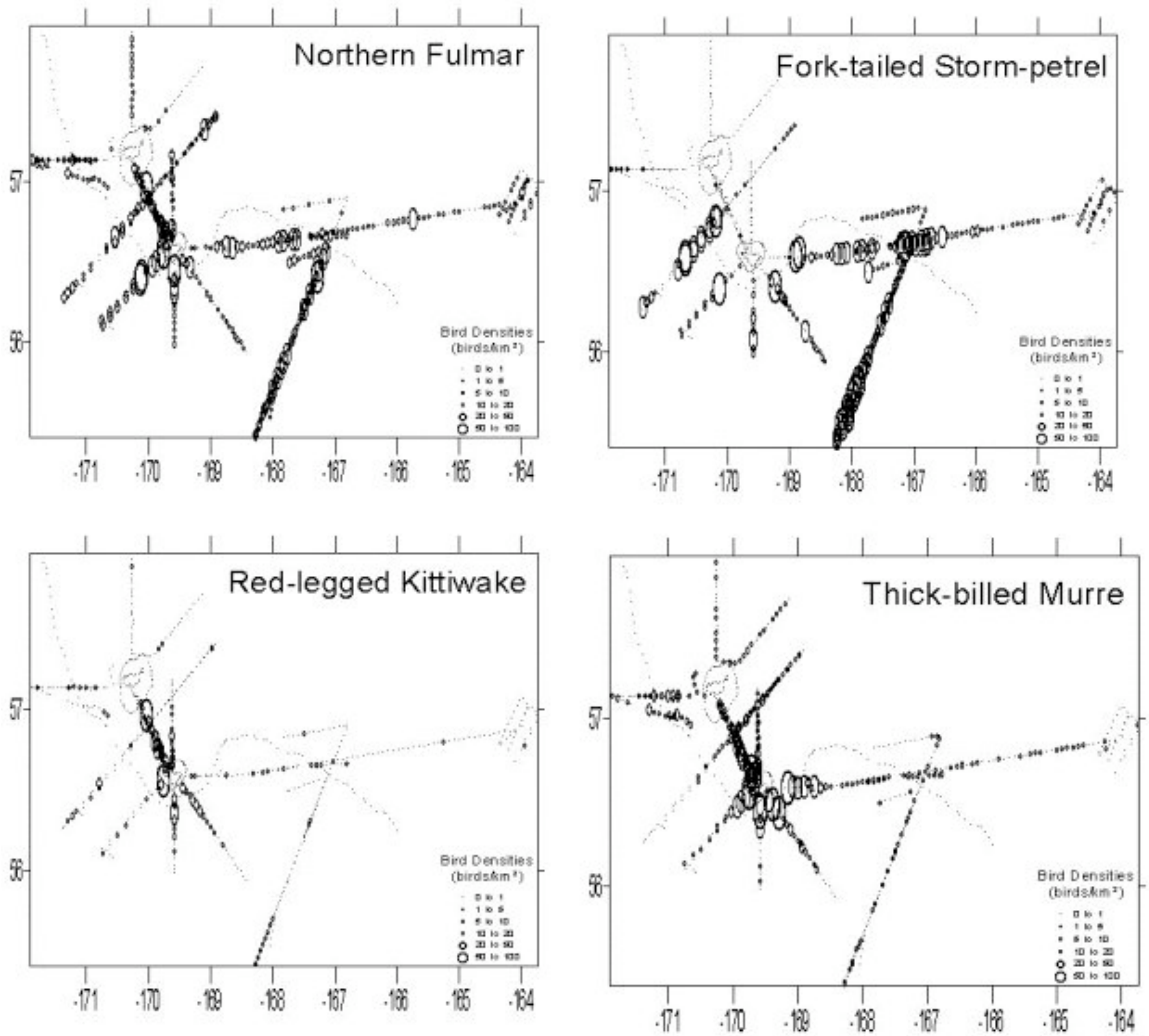


Figure 29. Distribution of four species of marine that typically use offshore waters.

B. Inter-Island Region

Physical Oceanography Interisland Region

Two transects (CECW and PG) passed through the area between the two islands where we had observed an area of high concentration of chlorophyll on satellite remote sensing images (Fig. 6, 10). A third transect (SL) went north from St. George Island just east of the chlorophyll patch. Transect CECW passed between the islands, from the shelf slope southwest of the islands to the middle domain northeast of them (Fig. 3, 5 and 30). We occupied transect PG four times. The first occupation was after a calm period with winds less than 15 knots (Fig. 31, top), the second was just after a storm with winds above 20-25 knots (Fig. 31, bottom), the third was after moderate winds (Fig. 32, top), and the fourth followed a storm with winds above 30 knots (Fig. 32 bottom). All four shared the signature surface salinity range of 31.8-32.0 psu, and similar temperatures- 9-11 °C at the surface and 5-6 °C below the pycnocline. The depth limit of the 31.8-32.0 psu water had deepened on the last occupation, and the surface temperature cooled, showing the effect of mixing by the storm that had just ended.

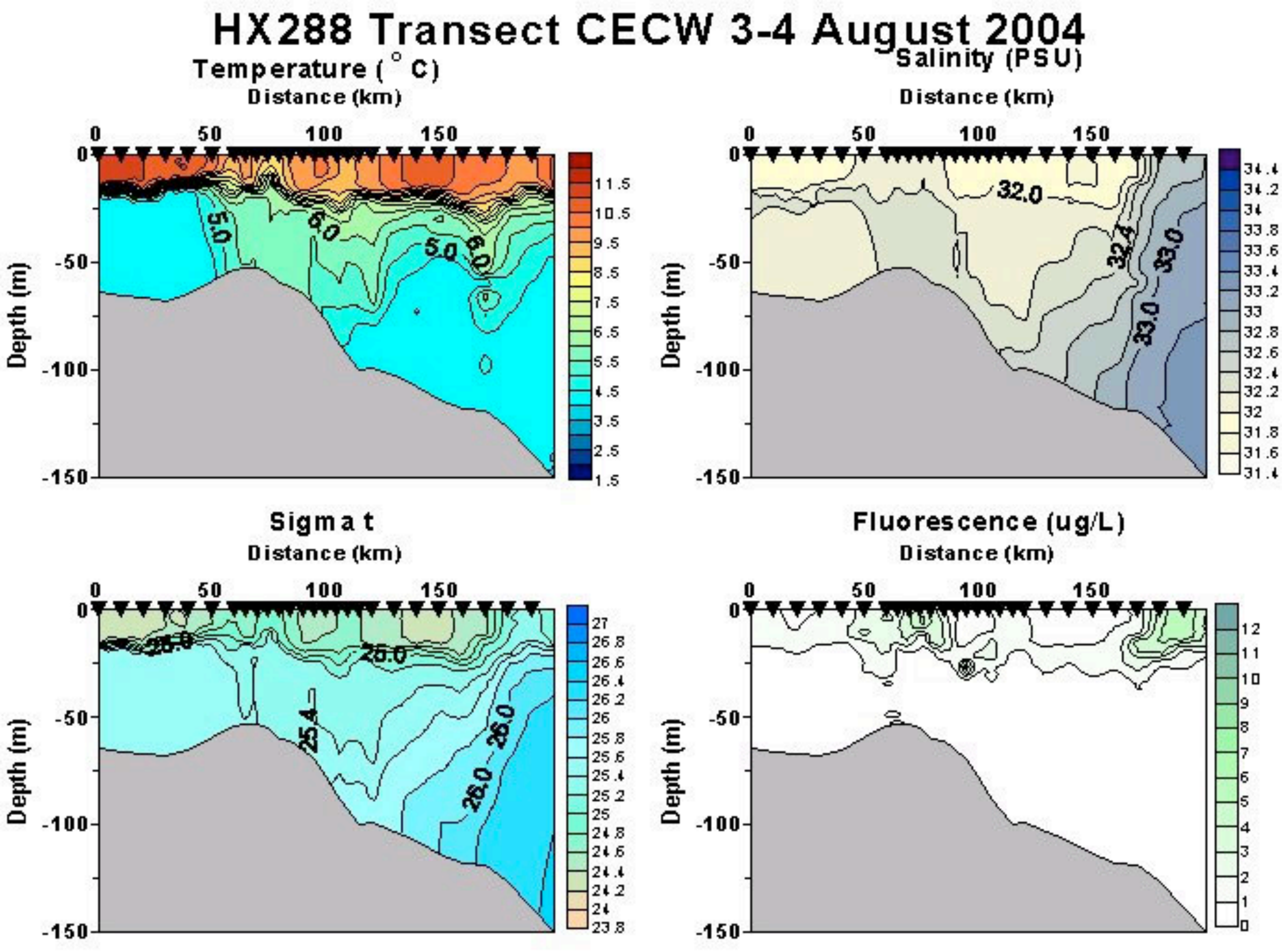


Figure 30. CTD profiles, CECW transects, NE-SW between the Pribilof Islands, from the shelf edge to the middle domain.

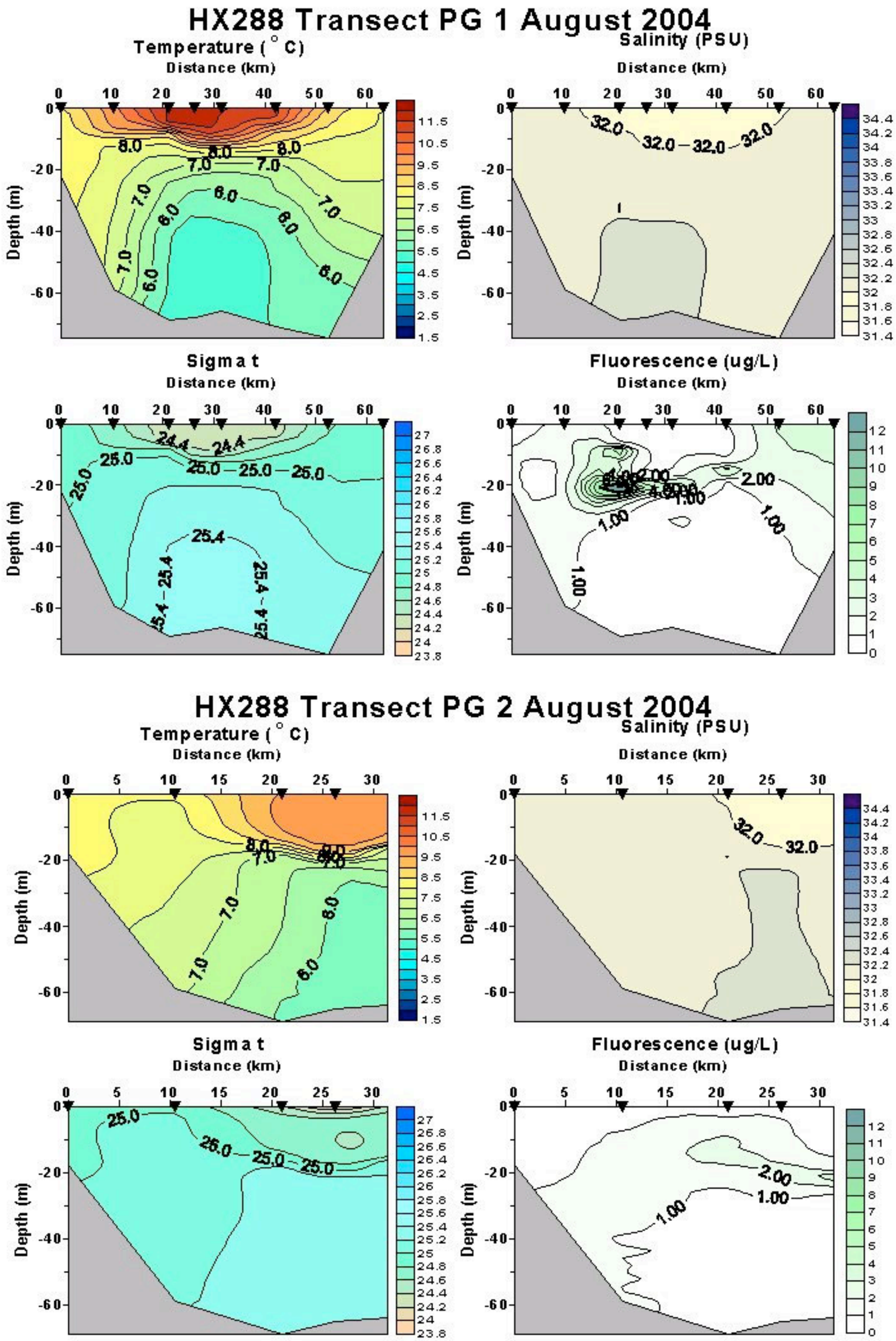


Figure 31. CTD profiles, PG transect, between St. Paul and St. George Is, 1, 2 August 2004. St. Paul Is. is to the left.

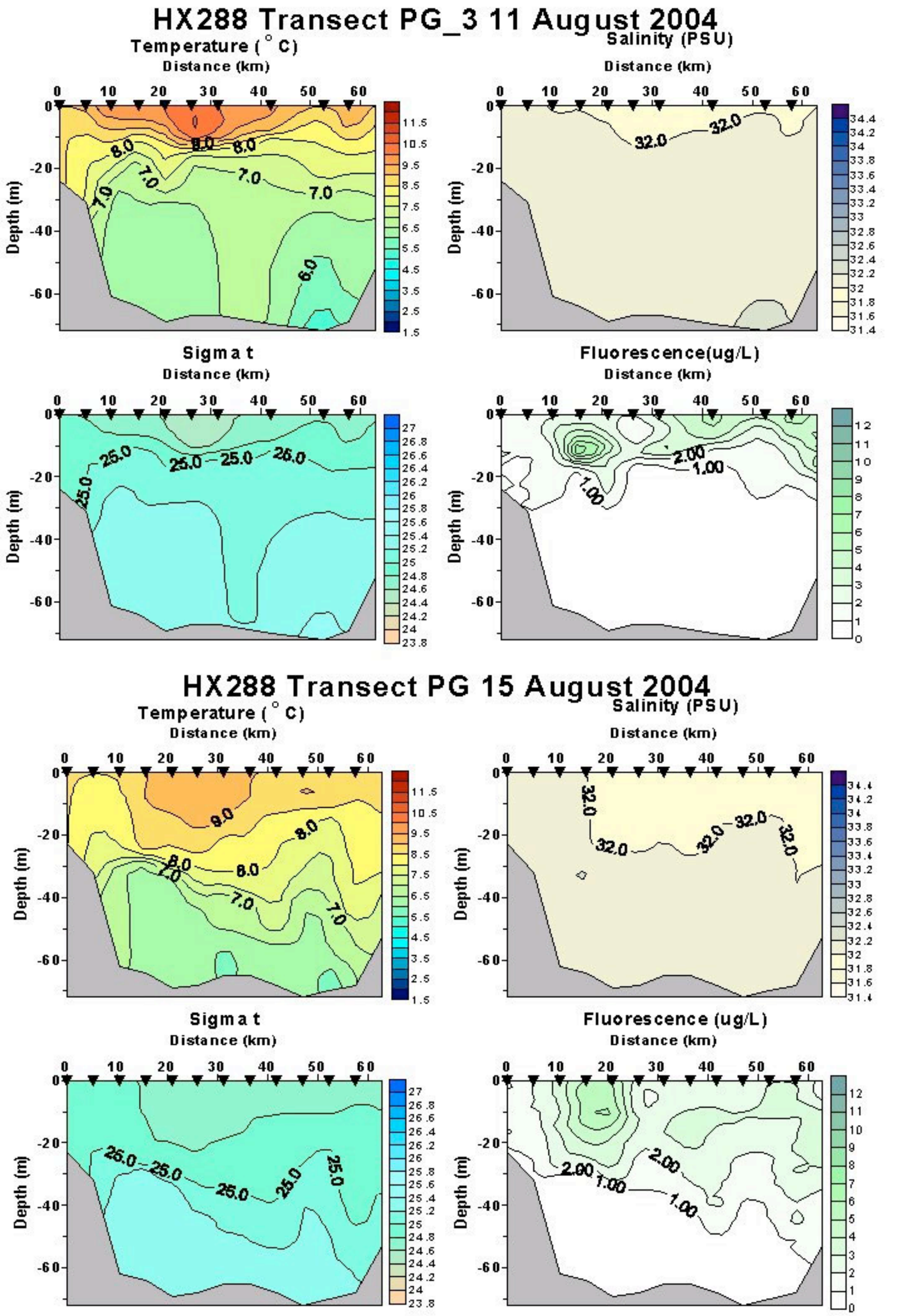


Figure 32. CTD profiles, PG transect, between islands, 11, 15 August 2005. St Paul Is. is to the left.

The SL line went from shallow water next to St. George Island northward across a long sloping area to a plateau east of St. Paul Island (Fig. 4, 33). As the sloping rise shoaled to 50 - 60 m, a weak front formed where the effects of mixing have been reported in the past (Kinder et al. 1983). We measured bottom temperatures near 5.5 °C offshore on line SL, associated with salinities of 32.2 psu. Drifter trajectories indicated that this colder, saltier water might be coming around the north side of St. Paul Island from the outer shelf.

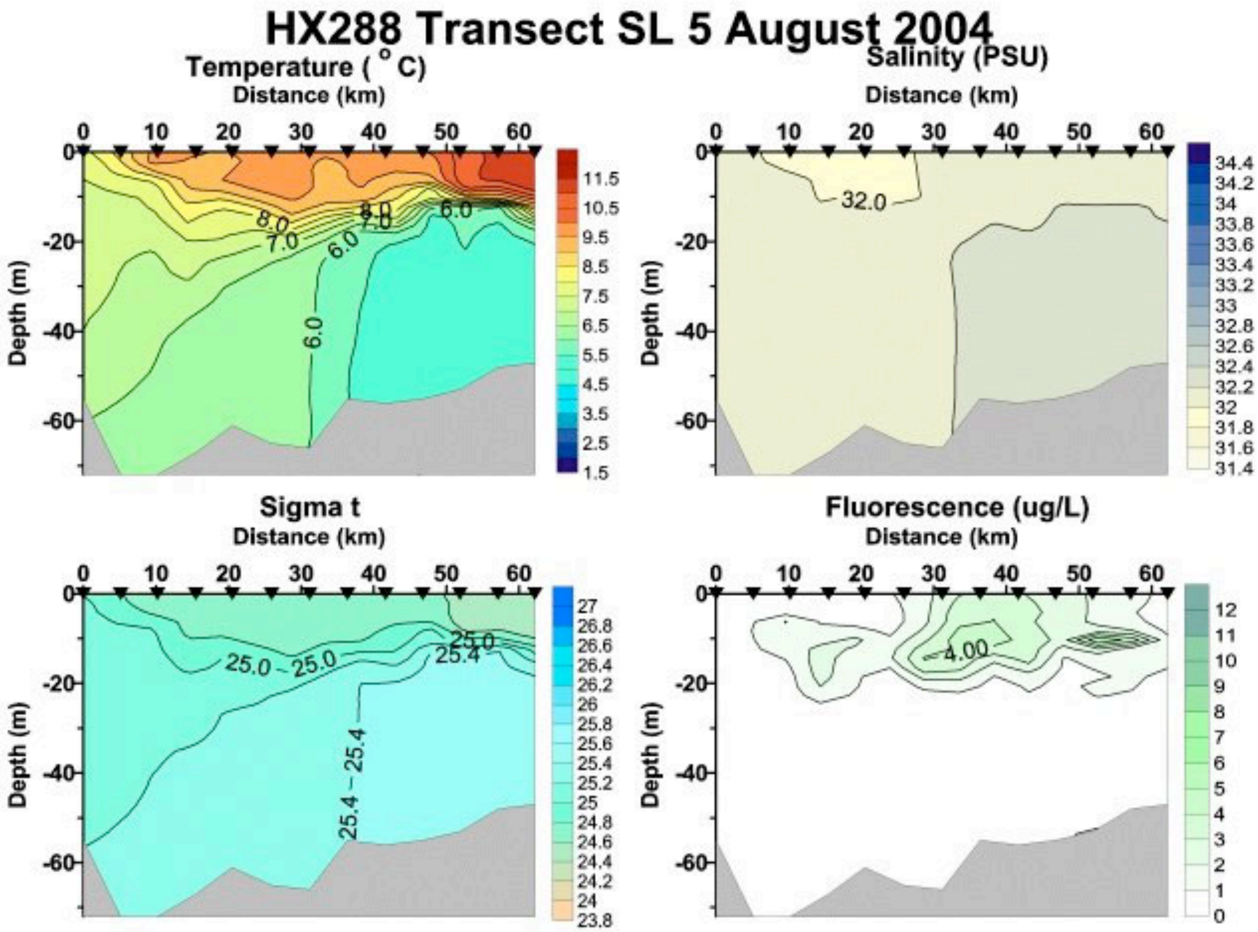


Figure 33. CTD profiles, SL transect, north from St. George Island.

Nutrients- Interisland Region

In the middle of the CE-CW line, there was a strong front in ammonium that was weakly reflected in the other nutrient sections (Fig. 34). Along the PG line, mixing near the islands resulted in elevated concentrations of all nutrients in surface waters. Surface concentrations of nutrients were generally low in the more stratified waters between the islands. In general, ammonium concentrations below the pycnocline were < 4 µM in the southern portion of the PG line and > 4 µM in the northern portion of the line. During the first occupation of the PG line, ammonium concentrations of > 6 µM were found several meters below the most intense chlorophyll patch observed during the expedition. The chlorophyll patch was observed on subsequent occupations and ammonium concentrations below the patch remained high.

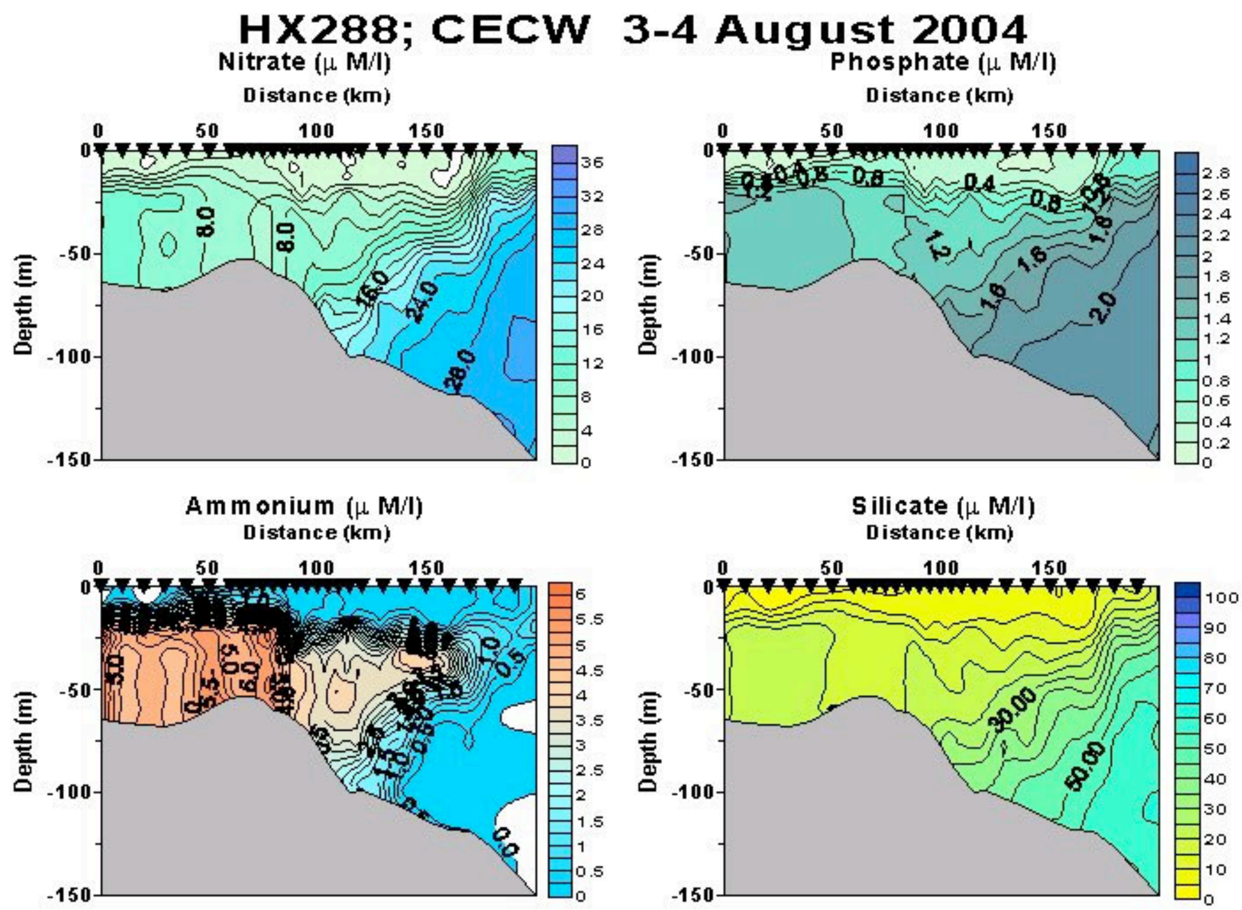


Figure 34. Nutrient profiles, CECW transect, NE-SW between islands. Tides interacting with the shallow area in the middle create an region of mixed water that sometimes reaches the surface.

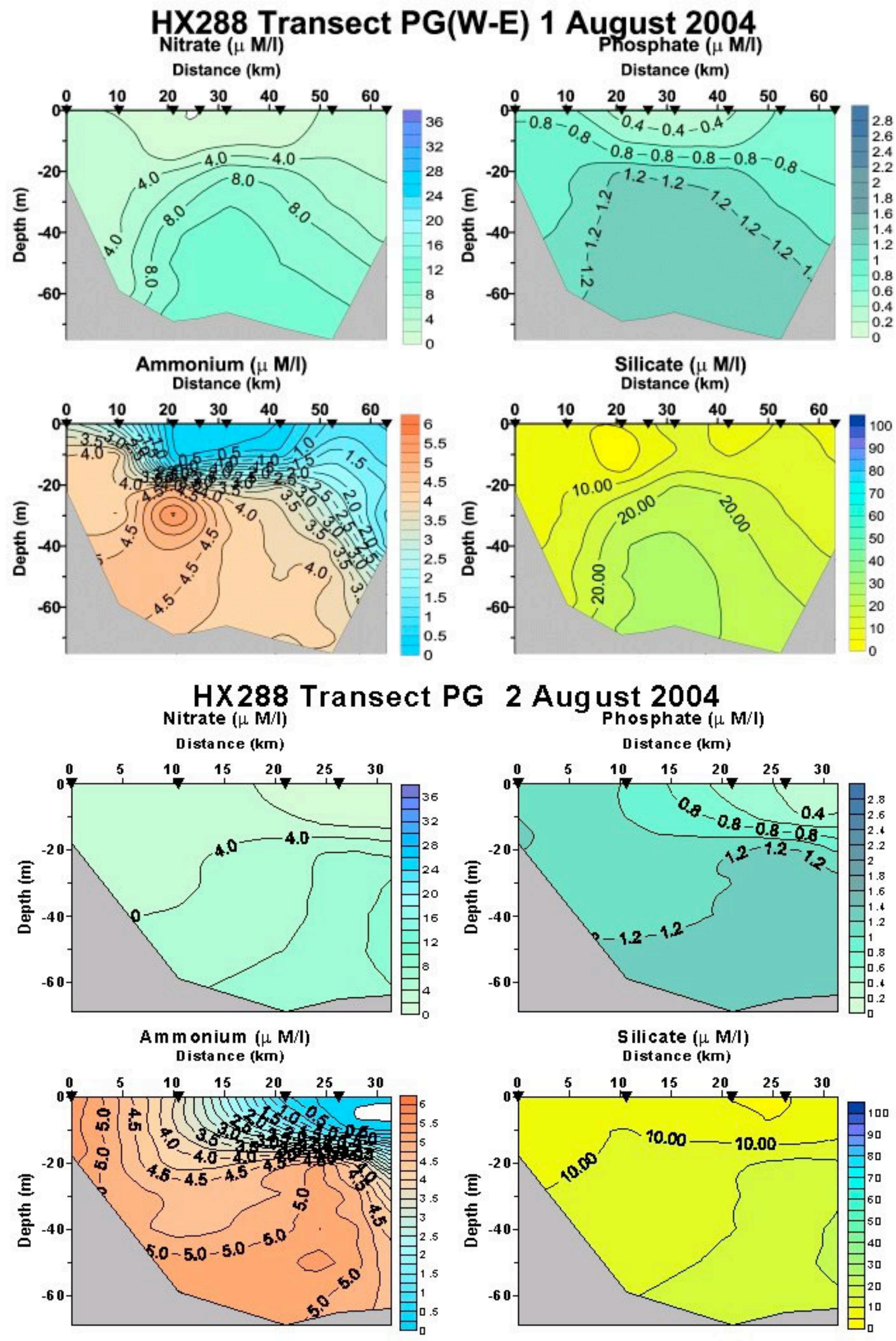


Figure 35 Nutrient profiles, PG transect between islands, 1, 2 August 2004. St. Paul Is. is to the left.

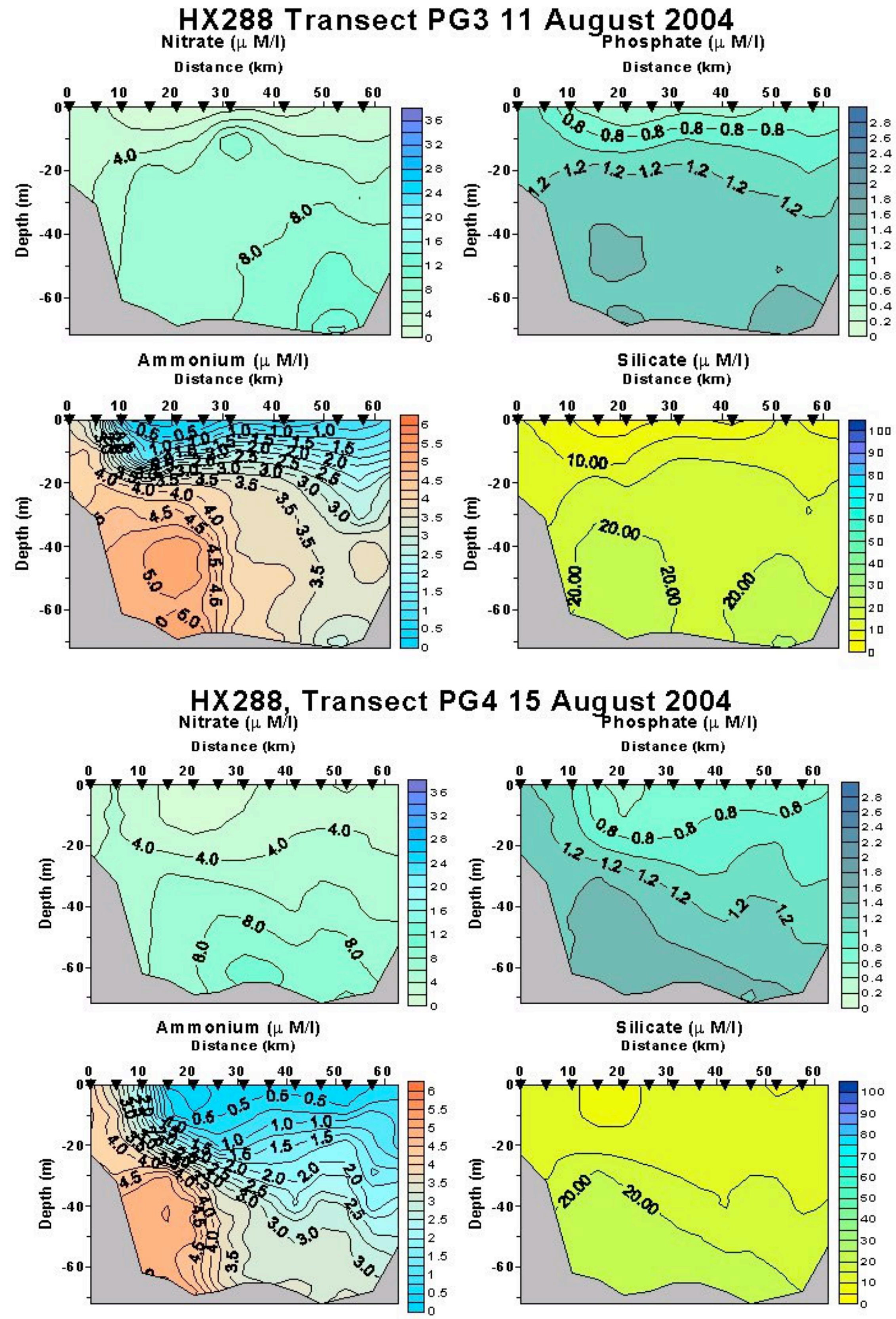


Figure 36 Nutrient profiles, PG transect between islands, 11, 15 August 2004. St. Paul Is. is to the left.

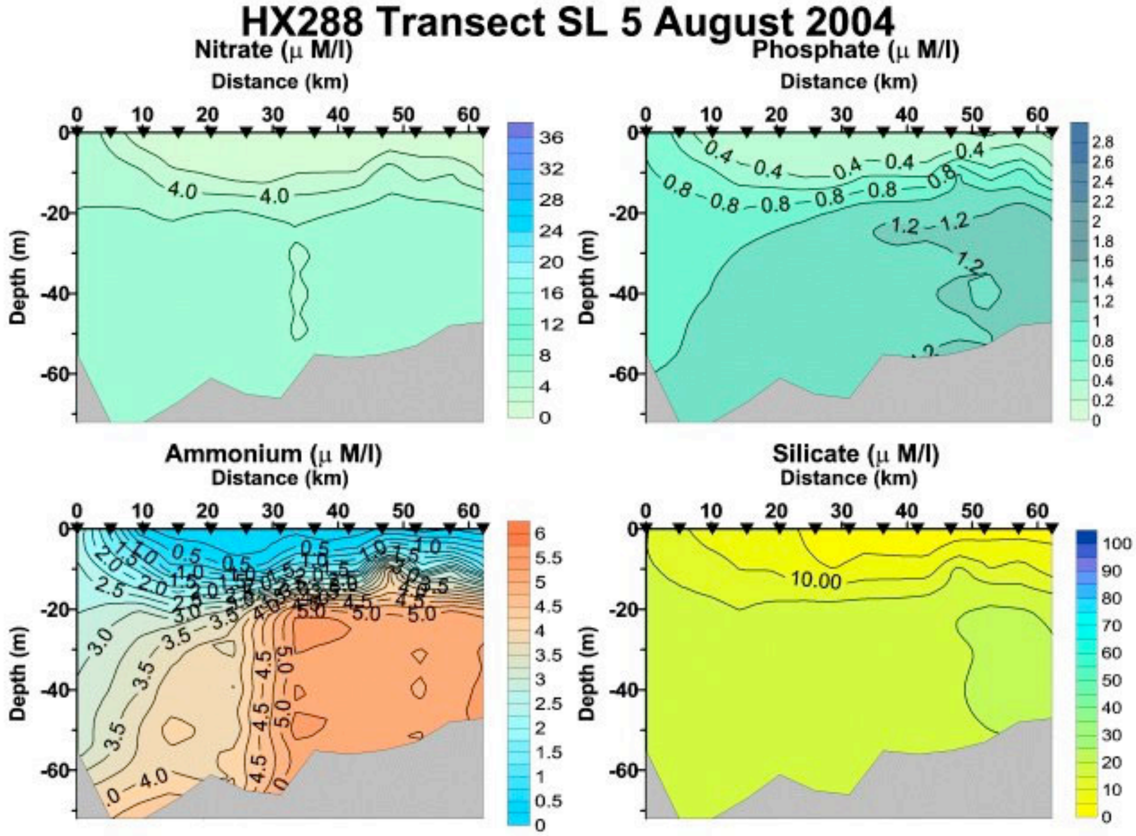


Figure 37. Nutrient profiles, SL transect, north from St. George Is.

Microplankton- Interisland Region

Four dilution experiments were conducted in "green patch" between St. George and St. Paul Islands (two experiments at PG-5, and one each at CE-3 and SL-9). Chlorophyll levels in the green patch were moderate (1.1 - 2.8 μgl^{-1}) and, as on the slope, phytoplankton communities were dominated by cells larger than 20 μm. Phytoplankton growth rates were low to moderate, and moderately-growing communities showed evidence of nutrient depletion and cessation of growth during the 24-hr incubation. Thus these communities appeared to fall on a trajectory ranging from early (incipient) to late (profound) nutrient limitation (Fig. 38). Rates of microzooplankton grazing ranged from 0.1 to 0.3 d^{-1}.

Zooplankton- Interisland Region

Net samples for sorting specimens for stable isotope and fatty acid signatures were obtained from between the islands at three stations (PG-5, PG-7, and PG-10). Preliminary examination of these net tows showed that very high concentrations of net phytoplankton were present. Night tows yielded adult euphausiids (*T. raschii*) and the one daytime tow had high concentrations of furcilia and early-stage juvenile euphausiids. Some *Calanus marshallae* copepidid-5s were available to sort at these stations. Decapod larvae (zoea and megalopae) were very abundant. Both shelled and naked mollusks were present. When the fine-mesh net was used, we observed high concentrations of small (< 1 mm) shelled mollusks. Pollock age-0 larvae were small (< 40 mm).

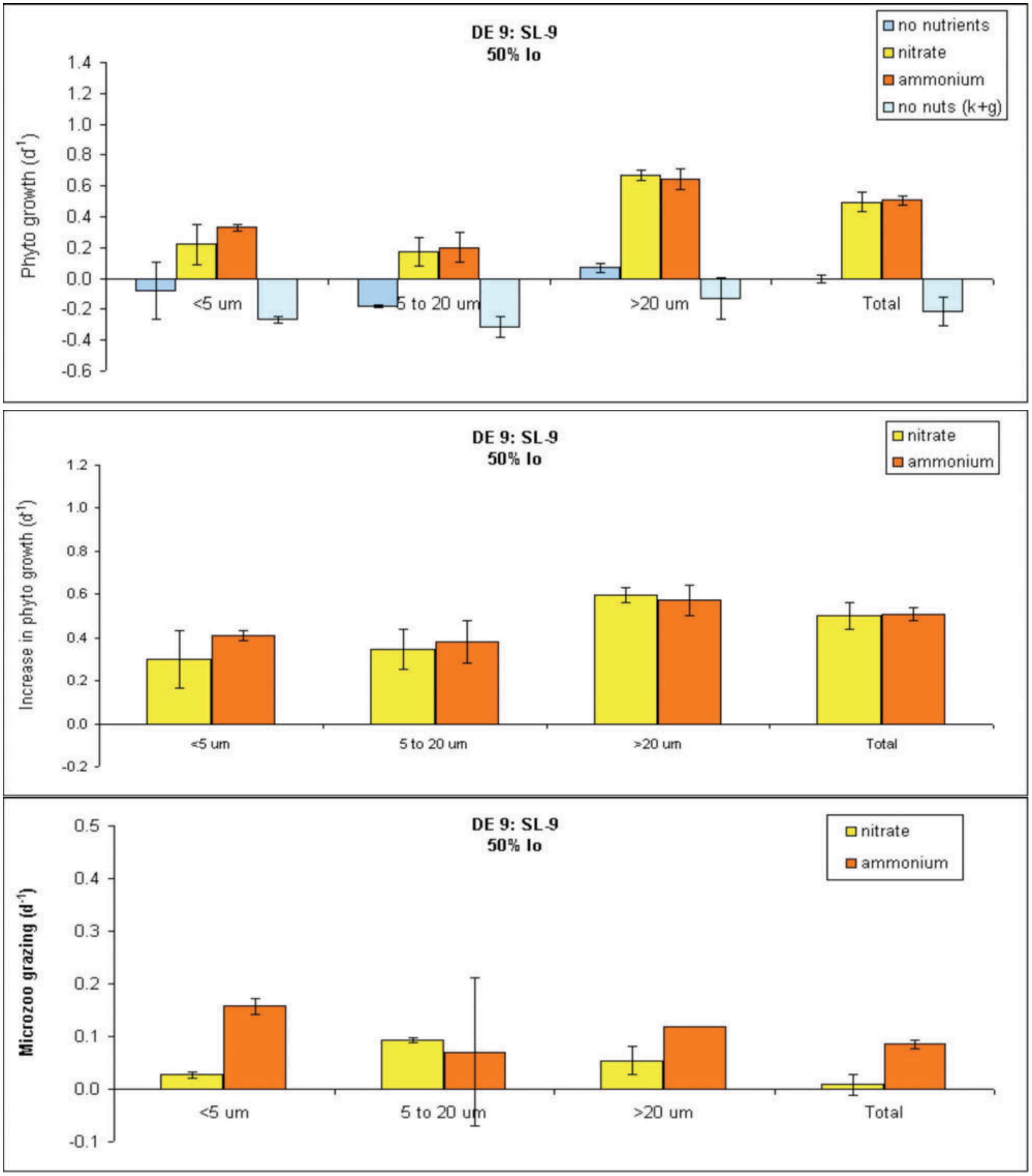


Figure 38. Results microzooplankton grazing experiment at SL-9, between the Pribilof Islands.

Marine Birds- Interisland Region

We surveyed 628 km and counted 10,030 seabirds flying, feeding and sitting on the water. Murres were most abundant in this region representing 47% of all seabirds in this region. Northern fulmars were also abundant accounting for 17% of all seabirds. Piscivorous common murres appeared to concentrate their foraging in the area between the islands, as did the planktivorous auklets (Fig. 39). This suggests that this region was somewhat richer in large copepods and euphausiids, the prey of the auklets, than other waters equidistant from the islands. It is also of note that fur seal sightings were concentrated in the region between the islands, suggesting that they might be foraging there, as well a at known foraging locations in Pribilof canyon and near the inner front.

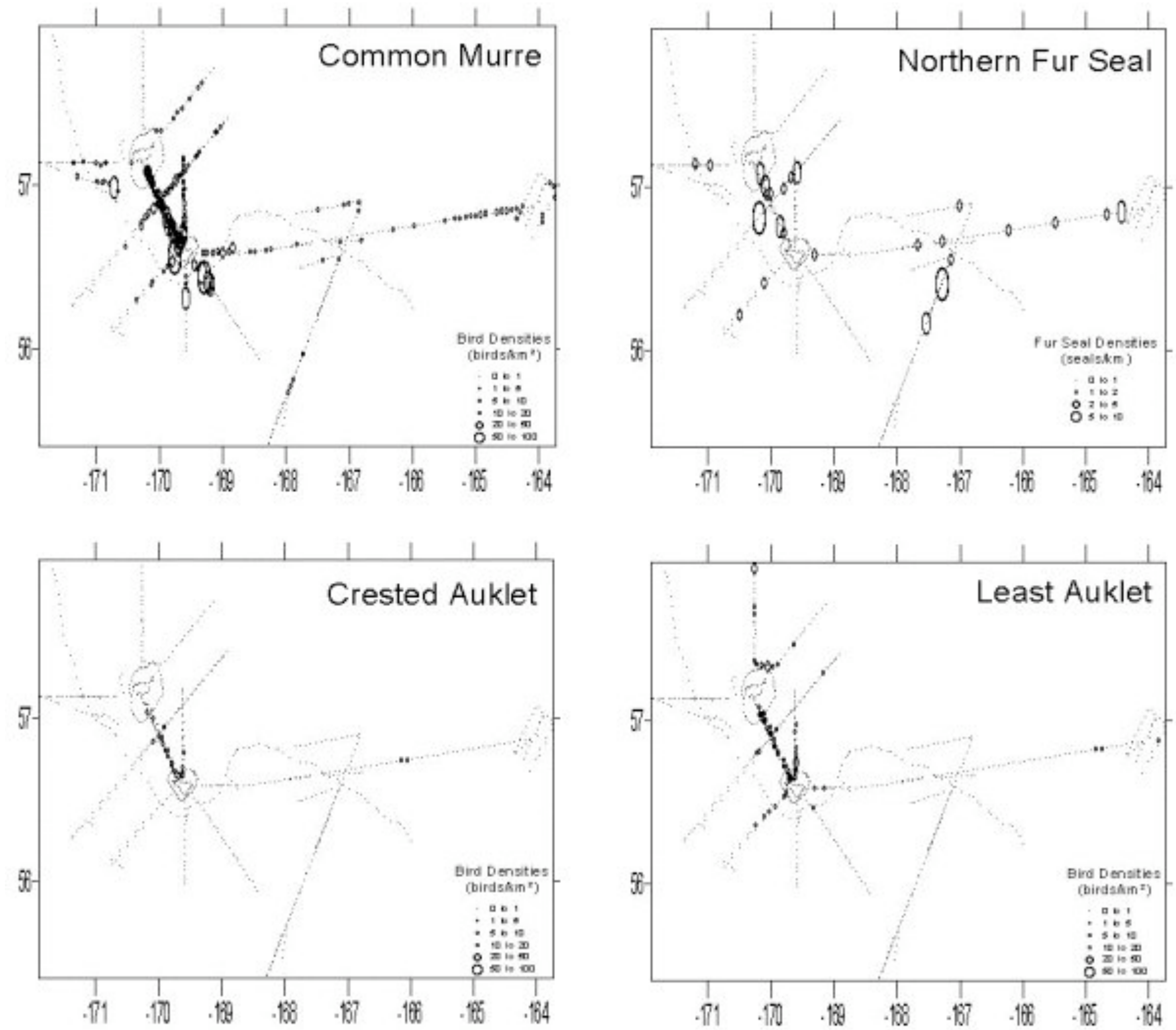


Figure 39 Fur seal and marine bird distributions. Past work has shown that these auklets often forage close to the Pribilof Islands where they nest.

C. Middle Domain and Mooring 2

Physical Oceanography- Middle Domain

The middle domain was strongly stratified in temperature, but not in salinity. Near Mooring-2, surface temperature was greater than 12 °C and the bottom temperature was near 4 °C (Fig. 40, 41). Salinity was between 31.8 -32.0 psu at the surface, with "blobs" of water with a salinity of 32-32.2 psu at the bottom. North of the

Pribilof Islands on line PC, the stratification in temperature was weaker and the pycnocline had a very slight slope (Fig. 42, top). On line CE, the bottom temperature was 4.5 °C, with a bottom salinity near 32 psu in the north, but 32.2 psu over a rise slightly farther south (Fig. 43). We saw the coldest bottom temperatures, 2 °C, at the northernmost stations of line PC. There as elsewhere, salinity was 31.8-32 psu in the surface layer and 32-32.2 psu in the bottom layer. However, the zone where surface salinity was less than 32 psu extended throughout line PC, but was limited to the near-shore region of lines SL, PD, and CE, and SL (Fig. 33; 42, bottom; .43).

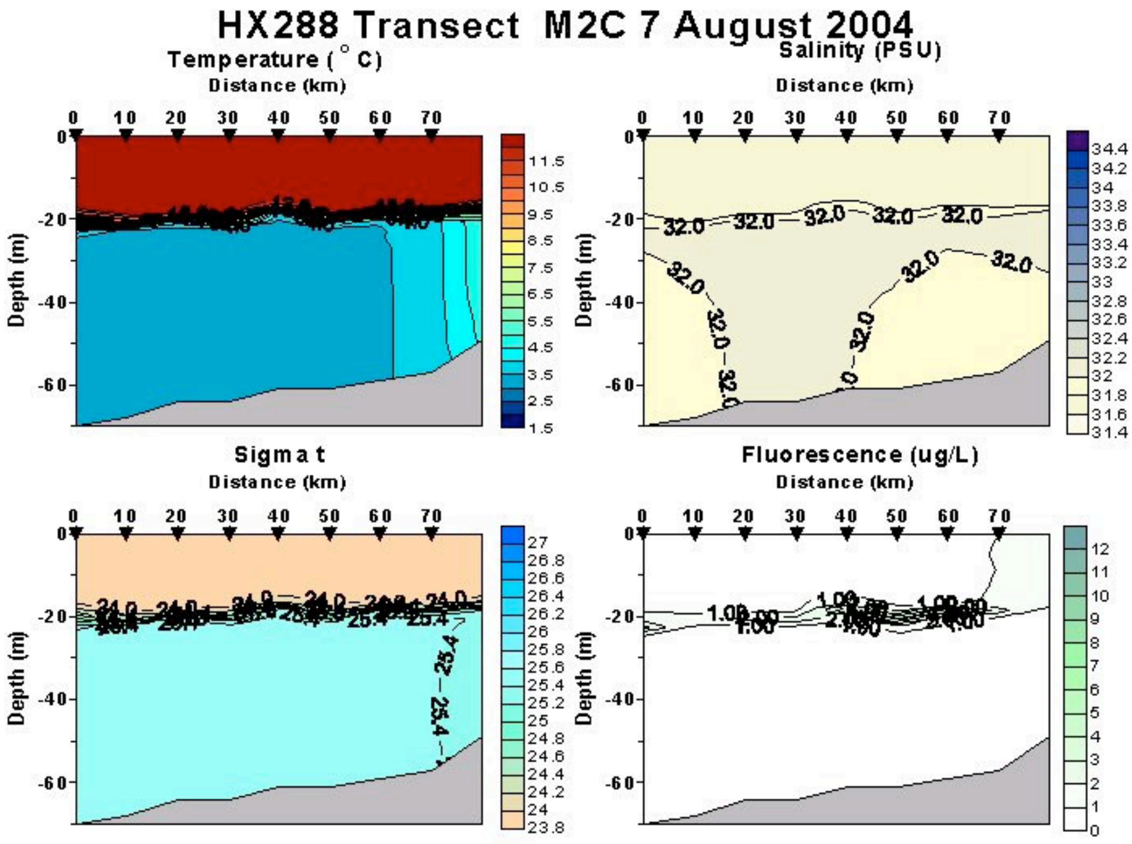


Figure 40. CTD profiles, transect M2-C, Mooring 2, middle domain, 7 August 2004.

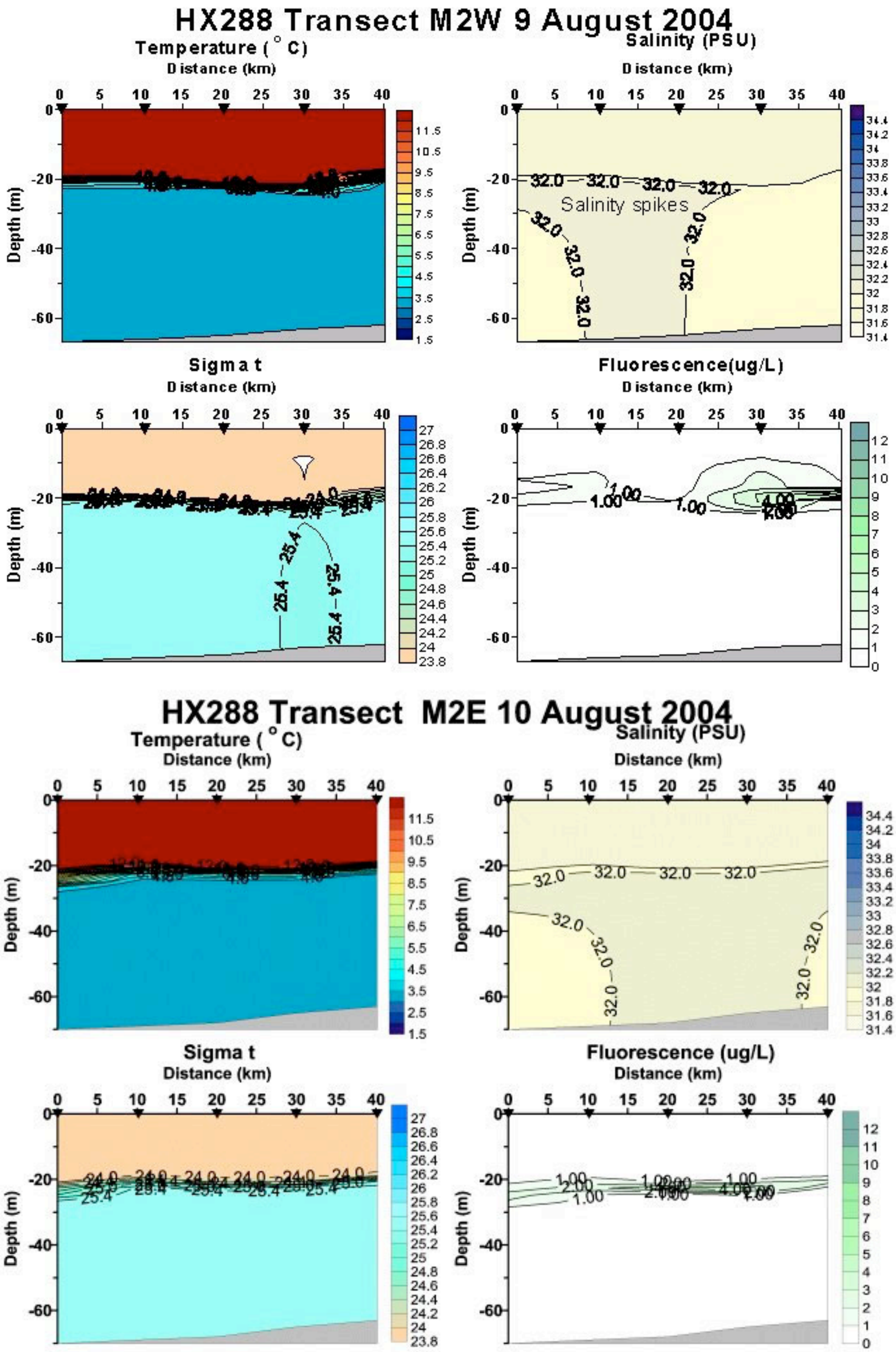


Figure 41. CTD profiles, transects M2-W and M2-E, Mooring 2, 9, 10 August 2004.

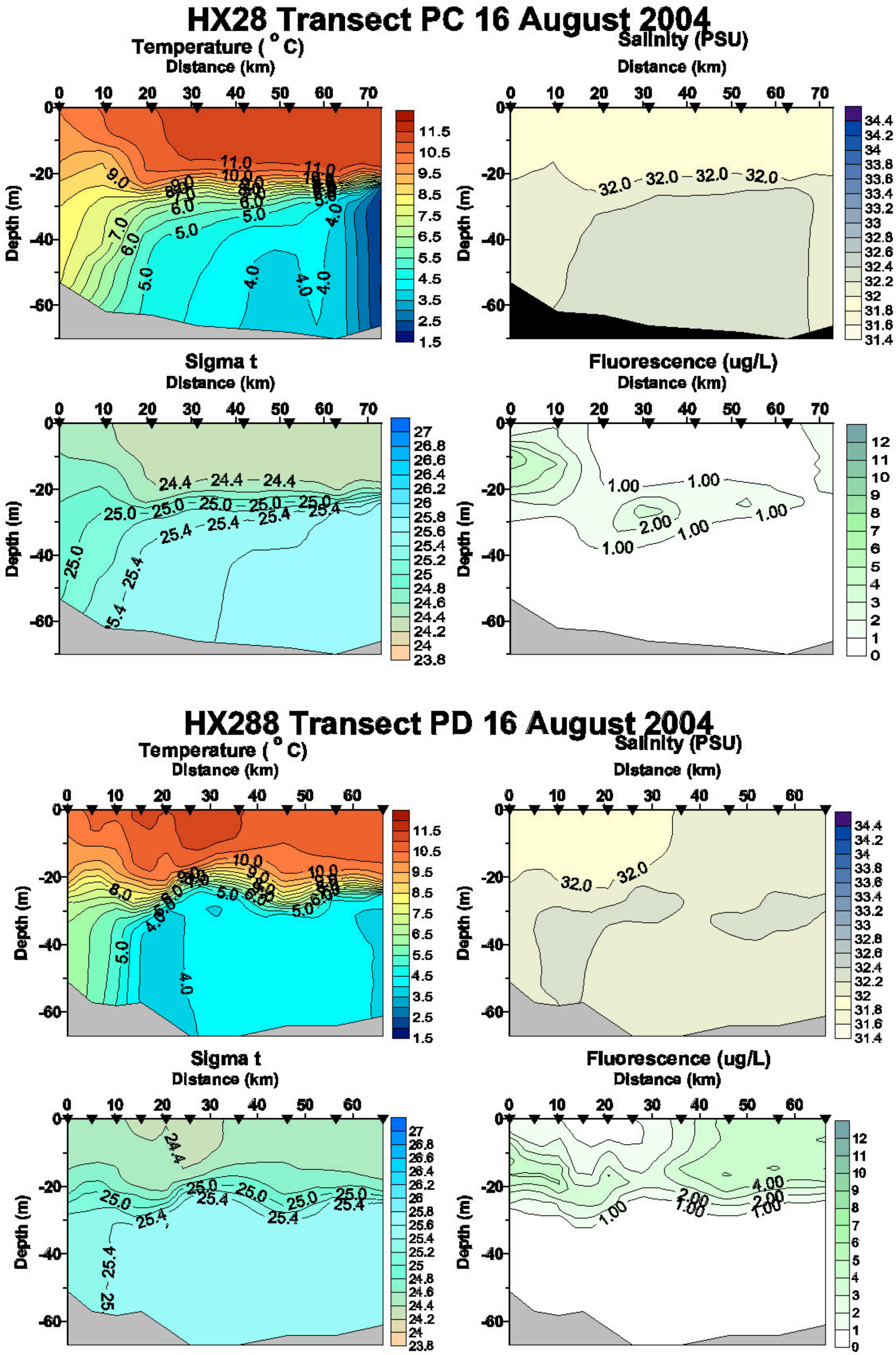


Figure 42. CTD profiles, transects PC and PD, N and NE from St. Paul Is.

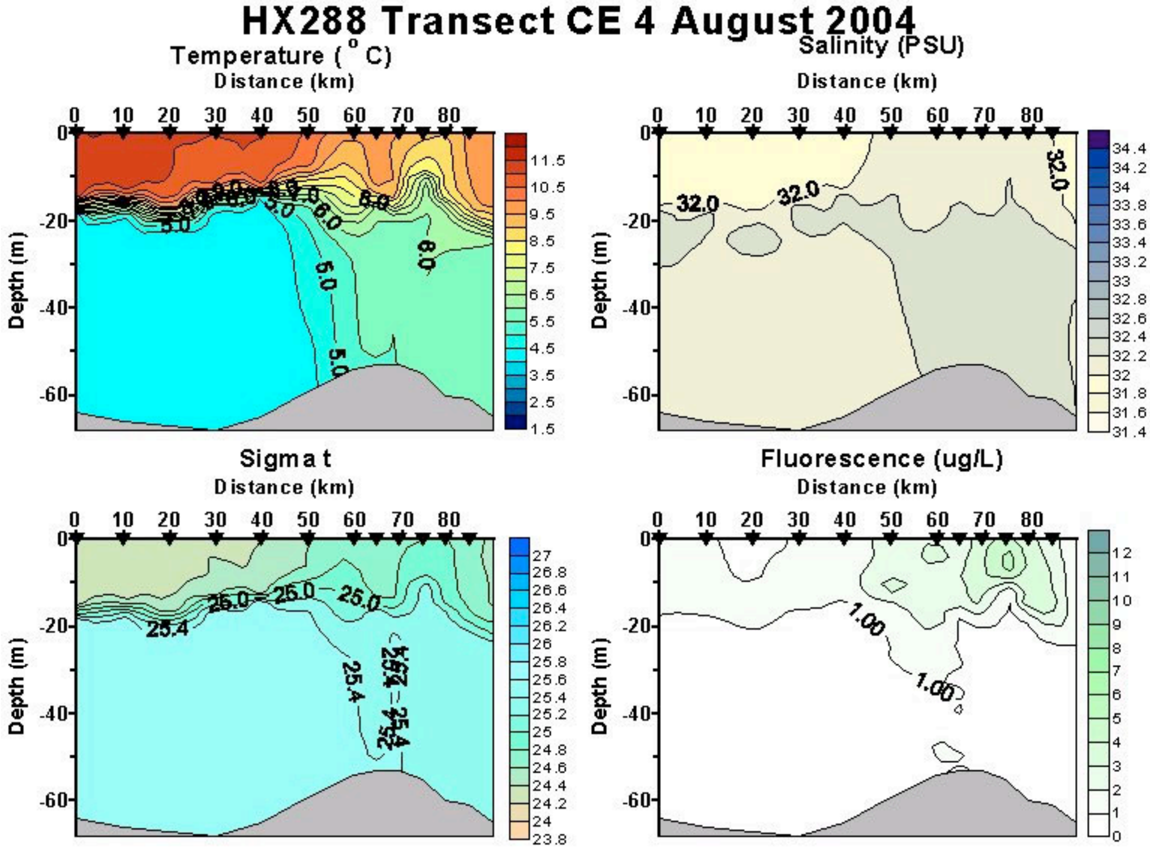


Figure 43. CTD profiles, CE transect, NE from between islands into the middle domain..

Nutrients-Middle Domain

Over the middle domain, the strong two-layer system was evident in all of the nutrient fields. Nutrient concentrations were low and often depleted in the surface with moderate concentrations below the pycnocline. Most notable was the absence of a strong subsurface chlorophyll maximum (Fig. 40, 41). In the vicinity of Mooring-2, the nutricline was broader (10-15 m thick) than the very intense pycnocline there (~5 m thick) (Fig. 44, 45). As a result, along the M2C line, although nitrate and ammonium were depleted at the surface, up to 8 μM l^{-1} nitrate and 3 μM l^{-1} ammonium were observed at the top of the pycnocline. Despite elevated nutrients, chlorophyll concentrations above the pycnocline remained low. Instead, along the M2C line, the subsurface chlorophyll maximum was confined to the narrow depth range of the pycnocline. Near the northern end of the CE line, there was a slight enrichment of nutrients above the pycnocline and chlorophyll concentrations of 1-2 μg l^{-1} were observed from the surface to the pycnocline (Fig. 34). Nitrate levels at depth were somewhat elevated 30- 60 km north of St. Paul on the PC line, possibly indicating the results of advection from the outer shelf domain. The northern end of this line entered the cold pool (Fig. 42, top) which was depleted of nitrate at depth (Fig. 46, top). Line PD, to the northeast of St. Paul Island, showed a two layer system for nutrients once away from the effects of the inshore front around the island (Fig. 46, bottom).

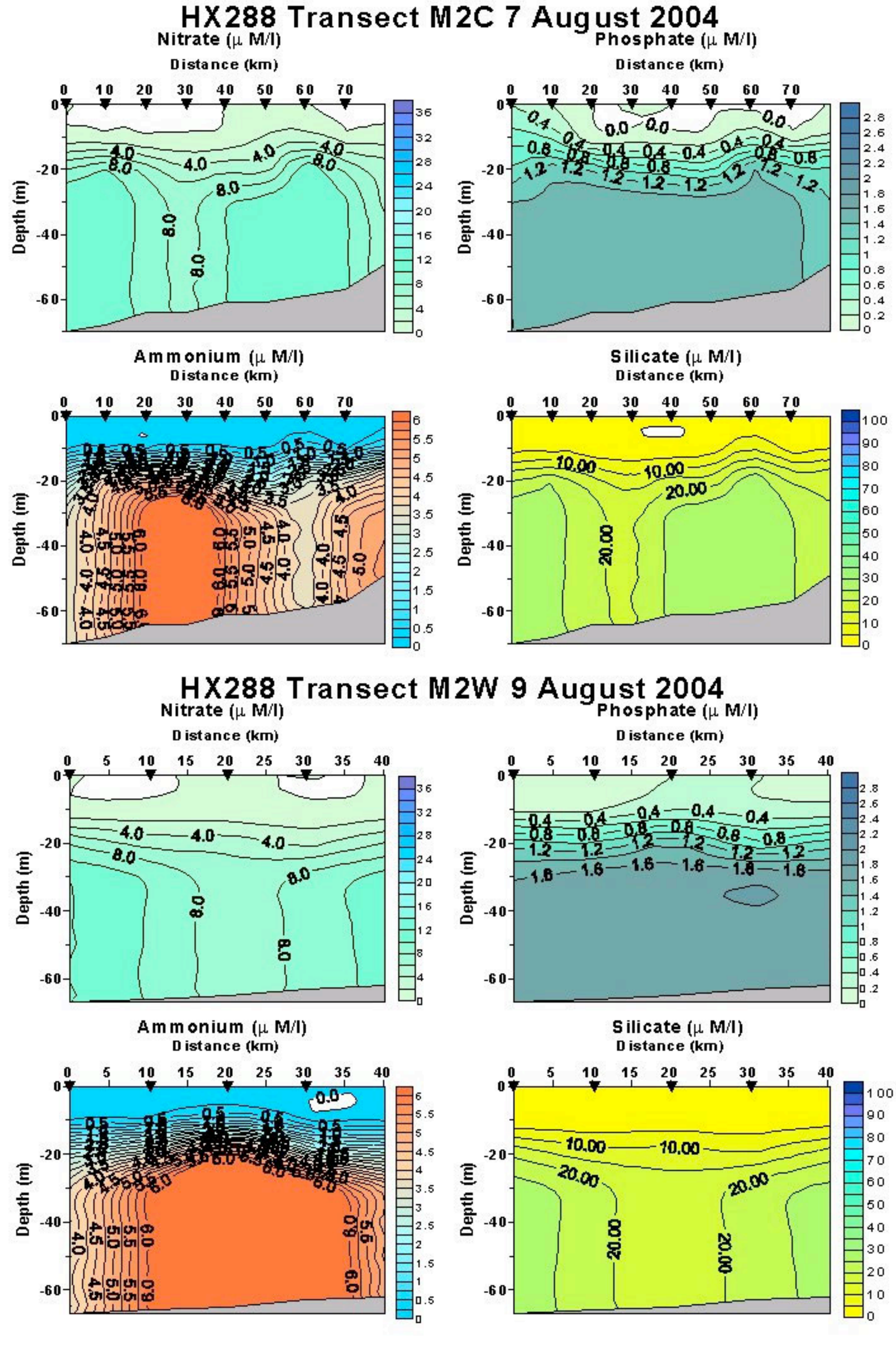


Figure 44. Nutrient profiles, M2-C and M2-W, Mooring-2, middle domain, 7, 9 August.

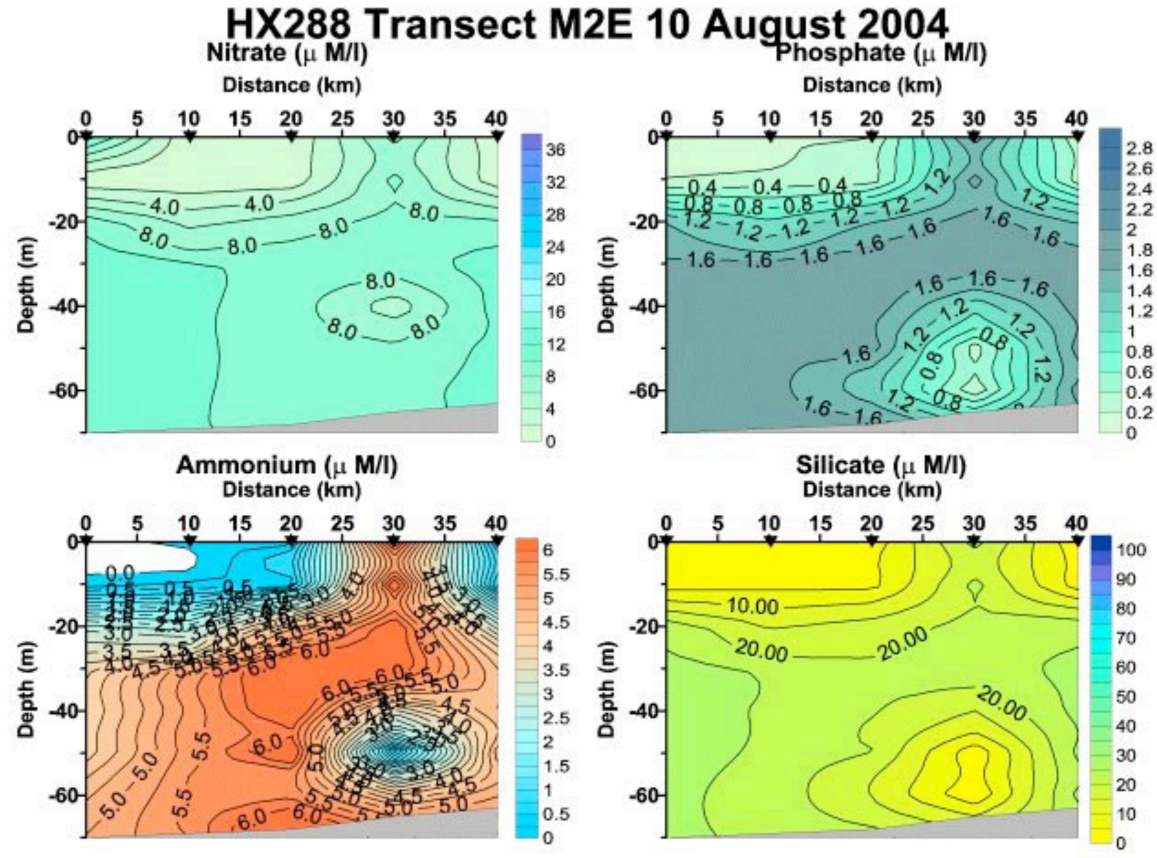


Figure 45. Nutrient profiles, M2E, Mooring-2, 10 August 2004.

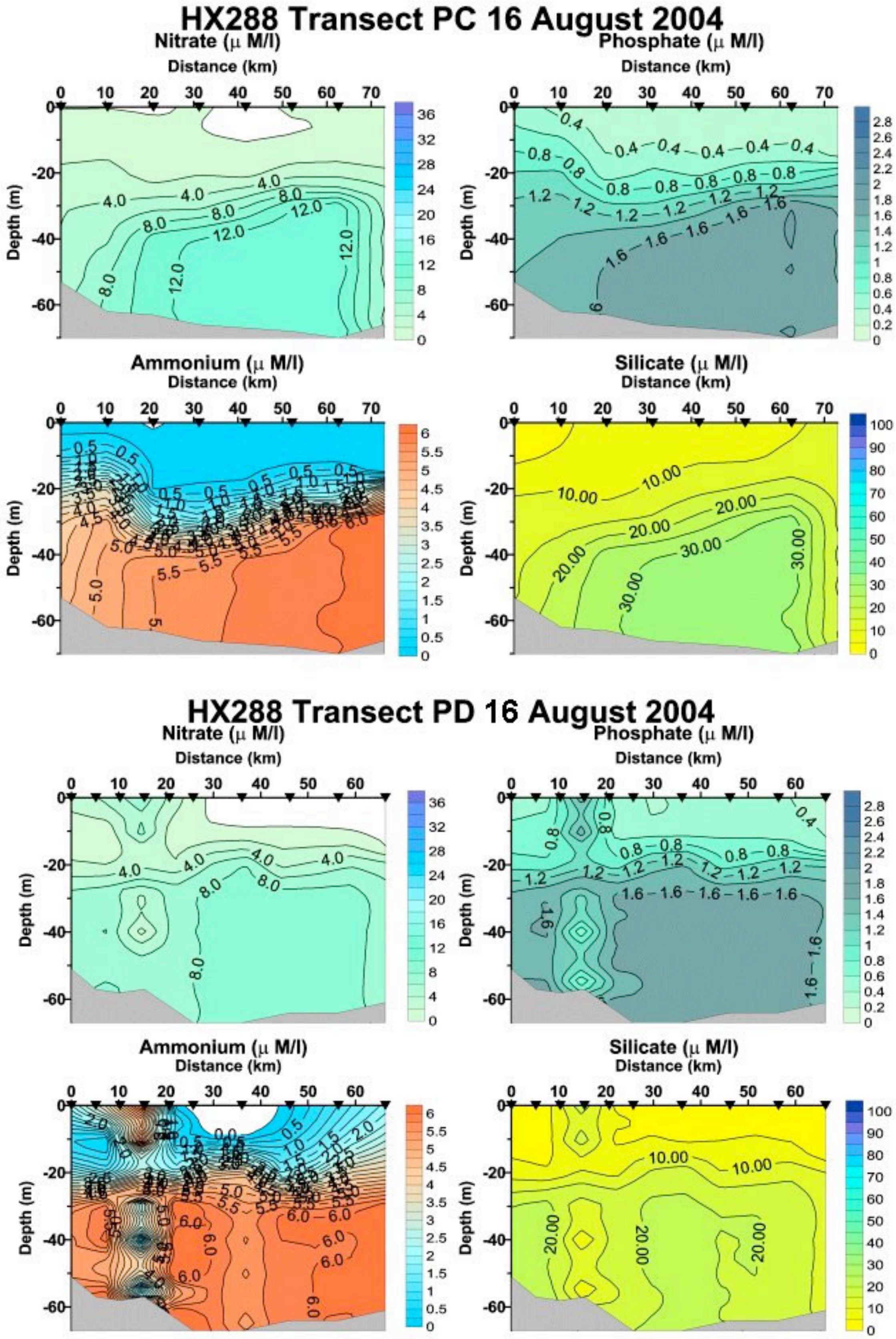


Figure 46. CTD profiles, CE transect, NE from between islands.

Microplankton- Middle Domain

A total of five microplankton dilution experiments were conducted in middle domain waters (3 at Mooring-2, and one each at PC-10, and PD-12). Station PC-12 was at the northern end of the PC line that extended northward from St. paul island to the southern edge of the cold pool. The PD line extended to the northeast of St. Paul Island and terminated in the middle domain.

The location of Mooring-2 provided our southeastern middle shelf domain site with which we hoped to contrast the waters between the Pribilof Islands. The highly stratified waters at station M-2 (a.k.a. M2C-9) hosted a small-cell-dominated phytoplankton community with low total biomass (chlorophyll levels ca. 0.3 μg l^{-1}). Both phytoplankton growth and microzooplankton grazing rates were low (0.0 to 0.2 d^{-1}), and were inconsistent with a community sustaining high growth and grazing rates through a rapid supply of regenerated nutrients (i.e. the "spinning wheel" model of oligotrophic oceanic communities). Phytoplankton growth rate response to added macronutrients was modest (Fig. 47). This was the only station at which a difference in response to ammonium versus nitrate was observed: small (< 5 μm) phytoplankton showed a greater increase in growth in response to added ammonium than to added nitrate. This indicates a community that has had many generations to adapt to growth on regenerated nitrogen.

Zooplankton- Middle Domain

The net zooplankton sampled in the middle shelf domain for the purpose of obtaining specimens for stable isotope and fatty acid analyses showed striking differences from north and northeast of St. Paul Island to Mooring-2, southeast of St. George Island. Thus, the middle domain stations could be divided into three groups, northern, central and southern (Mooring-2) groups.

North Middle Shelf Domain (PC-6 and PD-12) -- These samples had very little phytoplankton in them. The sample at PC-6 contained late juvenile and adult *T. raschii*, a shelf species, while the sample at PD-12 contained predominantly furcilia and early juvenile euphausiids. The sample from PC-6 contained more *C.alanus marshallae* C5, a large neritic copepod, than did the sample from PD-12. In addition, the sample from PC-6 contained *E. bungii* of various stages indicating an offshore or slope source for the water. We found many crab larvae at both stations, and there were large numbers of very small shelled mollusks (< 1 mm) found at PC-6. Both stations had many chaetognaths, but there were few of the hydromedusae predators that were present at Mooring-2. . Both samples contained small age-0 pollock (< 50 mm)

Central Middle Shelf Domain (CE11) – We found no small euphausiids (furcilia), here, but some larger juveniles and adults of *T. raschii* were present. The catch was also void of any of the medium to large copepods (*Calanus* and *Pseudocalanus*). There were many small copepods (*Oithona*), echinoderm (bipinnaria) and decapod (zoea and bipinnaria) larvae.

South Middle Shelf Domain (Mooring-2, M2C-13, M2W-9, M2E-9) -- Large euphausiids and copepods were lacking at all three stations. All euphausiids captured were furcilia or early juveniles. Likewise, we were only able to collect a few *C. marshallae* each station. Instead, the small calanoids, *Oithona*, *Pseudocalanus*, and *Acartia,* dominated the catch except at M2E9. Copepod predators were noticeably abundant here, with chaetognaths and several types of hydromedusae abundant. Echinoderm (bipinnaria) and decapod larvae were common. Age 0 pollock appeared to be larger and less variable in size than at other stations in the study area.

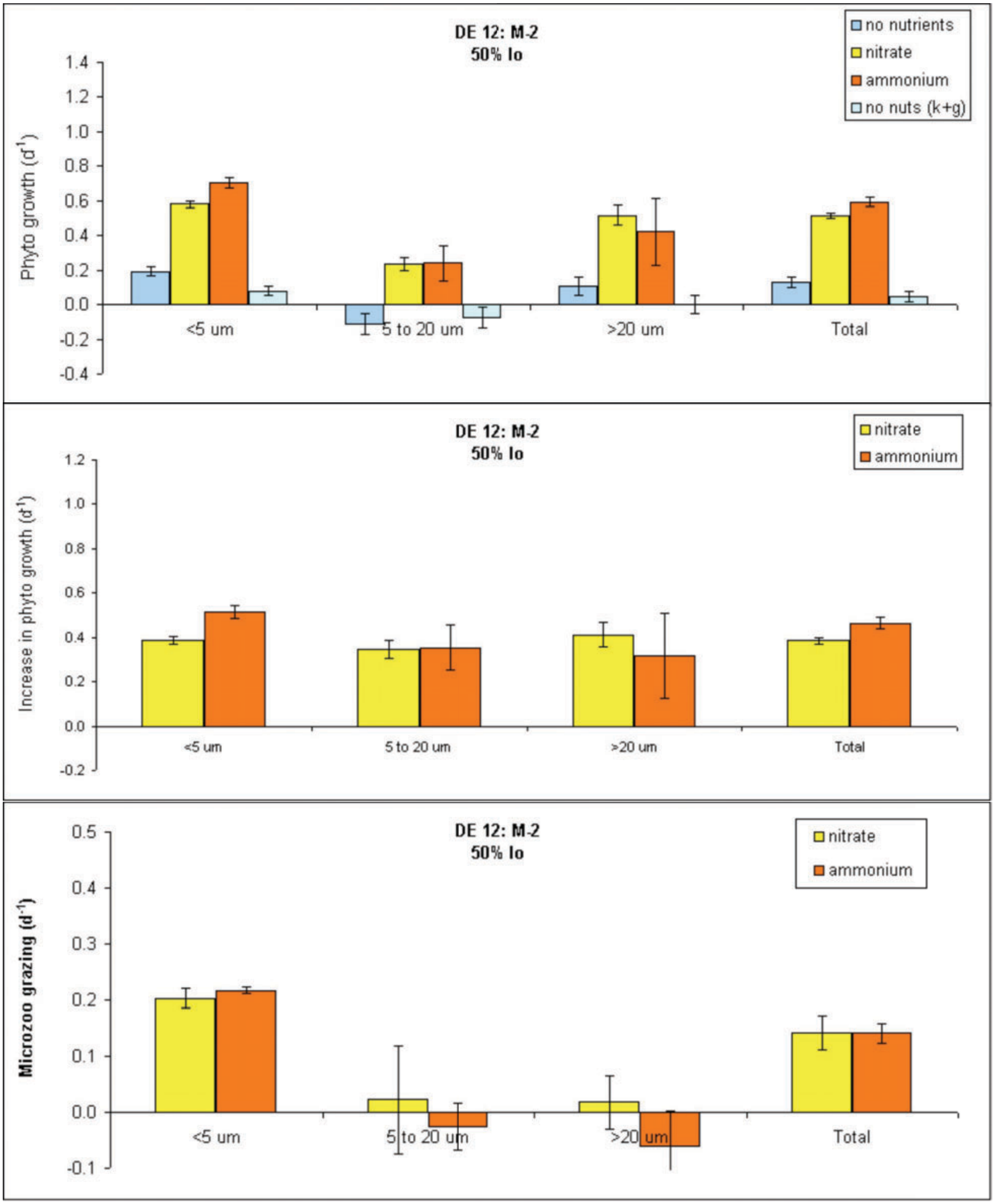


Figure 47. Results microzooplankton grazing expt. at M2-C9, Mooring 2, middle domain.

Marine Birds- Middle Domain

We surveyed 556 km and counted 4,949 seabirds flying, feeding and sitting on the water. Short-tailed shearwaters were most abundant representing 47% of all seabirds in this region, though they were more abundant in the vicinity of the 100 m isobath (Fig. 48). Fork-tailed storm-petrels and black-legged kittiwakes *Rissa tridactyla* were also abundant accounting for 13% and 12% of all seabirds, respectively (Table 1, Fig. 29). Ancient murrelets were found almost exclusively in middle domain waters (Fig. 48). Overall, marine bird densities in the middle domain were low, and the species composition was dominated by pursuit-diving piscivors and surface-foraging birds.

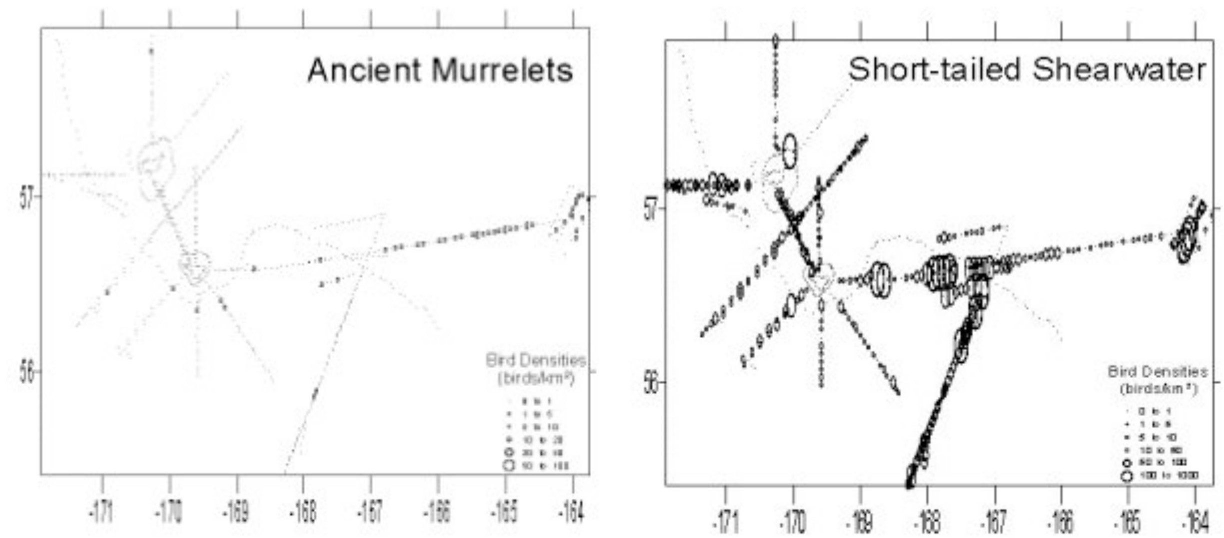


Figure 48. Marine bird distributions, species of the middle shelf.

VII. References Cited

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Appendix A. Event log of AHX-288, 26 July- 19 August 2004

Description	Station	Date	GMT	Latitude	Longitude	Depth	Comments	Scientist
CTD1-Start	Cocco-1	7/26/04	22:31	53.96287	166.493	120	outside white patch	Hunt
CTD1-End	Cocco	7/26/04	22:39	53.96108	166.4915	120		Hunt
CTD2-Start	Cocco-2	7/26/04	22:50	53.95968	166.4972	117	In bloom	Hunt
CTD2-End	Cocco-2	7/26/04	22:57	53.95878	166.4964	117		Hunt
MOCNESS-Start	SES1	7/27/04	9:48	55.39423	168.3112	719		coyle
MOCNESS-end	SES1	7/27/04	11:51	55.39734	168.3007	719		coyle
MOCNESS-Start	SES1	7/27/04	11:53	55.39657	168.3024	719		coyle
MOCNESS-End	SES1	7/27/04	12:24	55.37831	168.3235	719		coyle
MOCNESS-Start	SES2	7/27/04	13:50	55.56353	168.1338	138		coyle
MOCNESS-End	SES2	7/27/04	14:24	55.5389	168.1554	138		coyle
MOCNESS-Start	SES3	7/27/04	16:06	55.73032	167.9748	130	flowmeter failed, restart	coyle
MOCNESS-Start	SES3	7/27/04	16:25	55.71793	167.9955	130		coyle
MOCNESS-End	SES3	7/27/04	17:03	55.6944	168.0346	130		coyle
MOCNESS-End	SES3	7/27/04	17:18	55.68928	168.0422	130		coyle
CTD3-Start	SES3a	7/27/04	17:18	55.68927	168.0422	130	extra water collection	strom
CTD3-End	SES3a	7/27/04	17:26	55.6896	168.0423	130		strom
CalVET Net Start	SES1	7/27/04	19:26	55.40048	168.3018	625	Transect SES start	napp
CalVET Net End	SES1	7/27/04	19:36	55.39963	168.302	625	Problem with meter, depth uncertain	napp
CTD4-Start	SES1	7/27/04	19:42	55.40003	168.3024	625	Deep nuts	stabeno
CTD4-End	SES1	7/27/04	20:13	55.40375	168.3061	625	deep cast, 1 of 2 or 3	stabeno
CalVET Net Start	SES1	7/27/04	20:20	55.40052	168.2993	625	1 min late	napp
CalVET Net End	SES1	7/27/04	20:25	55.40105	168.2995	625		napp
CTD5-Start	SES1	7/27/04	20:36	55.4002	168.3009	632	nuts, chl, s-f chl, cell count	Strom
CTD6-start	SES1	7/27/04	21:11	55.4014	168.3002	632	Cast for 15m, 3m water (start not logged)	Strom
CTD7-Start	SES1	7/27/04	21:33	55.4003	168.2999	632	n15, whole water DE1FSW	Strom
CTD7-End	SES1	7/27/04	21:44	55.40199	168.3022	632		Strom
ARGOS drifter-Start	SES1-2	7/27/04	22:18	55.4858	168.2162	200	43715	Hunt
CalVET Net Start	SES2	7/27/04	23:00	55.5676	168.129	139	Estimated Position	napp
CTD8-Start	SES2	7/27/04	23:09	55.5676	168.129	139		stabeno
CalvVETNet Start	SES4	7/28/04	1:35	55.9	167.8	133	Entered by hand	Napp
CalVET Netend	SES4	7/28/2004	1:42	55.899	167.799	133		Napp
CTD9-Start	SES4	7/28/2004	1:44	55.899	167.799	133	Entered by hand	Zeeman
CalVET Net-Start	SES6	7/28/04	4:10	56.23373	167.467	132		napp
CalVET Net End	SES6	7/28/04	4:15	56.23355	167.4666	135		napp
CTD10-Start	SES6	7/28/04	4:21	56.2324	167.4666	134		Hunt
CTD10-End	SES6	7/28/04	4:29	56.23242	167.4666	134		Hunt

Ring Net-Start	SES6	7/28/04	4:39	56.23372	167.4656	134	middle	napp
Ring Net-End	SES6	7/28/04	4:41	56.23407	167.4657	134		napp
CalVET Net Start	SES8	7/28/04	6:58	56.56737	167.1335	103		napp
CalVET Net-End	SES8	7/28/04	7:02	56.56737	167.1329	103		napp
CTD11-Start	SES8	7/28/04	7:09	56.56748	167.1312	103		Hunt
CTD11-End	SES8	7/28/04	7:15	56.56763	167.1311	103		Hunt
MOCNESS-Start	SES8	7/28/04	7:26	56.56437	167.1365	103		coyle
MOCNESS-End	SES8	7/28/04	7:58	56.55102	167.17	103		coyle
Drifter	SES8	7/28/04	8:03	56.54907	167.1735	103	43722	Hunt
CalVET Net Start	GC1	7/28/04	15:56	56.516	169.586	50		coyle
CalVET Net End	GC1	7/28/04	15:58	56.5164	169.588	50		coyle
CTD12-Start	GC1	7/28/04	16:03	56.51607	169.5898	50		Hunt
CTD12-End	GC1	7/28/04	16:08	56.51598	169.5917	50		Hunt
MOCNESS-Start	sg13	7/29/04	7:33	55.96407	169.5758	1169		coyle
CalVET Net End	GC2	7/28/04	16:33	56.46778	169.5878	89		napp
CTD13-Start	GC2	7/28/04	16:37	56.46718	169.589	89		Stabeno
CTD13-End	GC2	7/28/200 4	16:43	56.467	169.588	89		Stabeno
CTD14-Start	GC3	7/28/04	17:22	56.42255	169.5851	101		Hunt
CTD14-End	GC3	7/28/04	17:30	56.42143	169.5893	101		stebano
CalVET Net Start	GC3	7/28/04	17:36	56.42258	169.5846	101		napp
CalVET Net-End	GC3	7/28/04	17:41	56.42128	169.5866	101		napp
Drifter-Start	GC3	7/28/04	17:47	56.41751	169.5888	101	43721	
CalVET Net Start	GC4	7/28/04	18:04	56.37548	169.5819	127		
CalVET Net-End	GC4	7/28/04	18:08	56.37398	169.583	127		
CTD15-Start	GC4	7/28/04	18:12	56.3731	169.5836	127		
CTD15-End	GC4	7/28/04	18:21	56.37145	169.5855	127		stebano
CalVET Net Start	GC5	7/28/04	18:41	56.32862	169.5825	145		napp
CalVET Net End	GC5	7/28/04	18:45	56.3274	169.584	145		napp
CTD16-Start	GC5	7/28/04	18:57	56.32645	169.5887	145		stebano
CTD16-End	GC5	7/28/04	19:00	56.32608	169.5889	145		stebano
CalVET Net-Start	GC6	7/28/04	19:18	56.28218	169.5828	214		stebano
CalVET Net-End	GC6	7/28/04	19:23	56.28102	169.5844	214		stebano
CTD17-Start	GC6	7/28/04	19:28	56.28002	169.5854	205		stebano
CTD17-End	GC6	7/28/04	19:40	56.28	169.585	205	late	stebano
CalVET Net-Start	GC7	7/28/04	20:04	56.23627	169.5829	332		napp
CalVET Net-End	GC7	7/28/04	20:09	56.23507	169.5843	332		napp
CTD18-Start	GC7	7/28/04	20:14	56.23403	169.5855	332	nuts, chl, cell counts	stebano
CTD18-End	GC7	7/28/04	20:33	56.2292	169.5948	332		stebano
Drifter-Start	GC7	7/28/04	20:47	56.22578	169.6055	364	Drifter #43731	stebano
CalVET Net-Start	GC8	7/28/04	21:02	56.18965	169.5824	408		napp
CalVET Net-End	GC8	7/28/04	21:07	56.18895	169.5839	408		napp
CTD19-Start	GC8	7/28/04	21:12	56.1889	169.5841	408	nuts, chl	stebano
CTD19-End	GC8	7/28/04	21:45	56.18852	169.5846	408		stebano
CalVET Net-Start	GC10	7/28/04	22:21	56.09652	169.5823	169		napp
CalVET Net End	GC10	7/28/04	22:26	56.09562	169.5824	169		napp
CTD20-Start	GC10	7/28/04	22:30	56.09538	169.5821	169	nuts, chl cell count	stebano

CTD20-End	GC10	7/28/04	22:44	56.09505	169.5785	169		stebano
CalVET Net Start	GC12	7/28/04	23:21	56.003	169.5821	360		napp
CalVET Net End	GC12	7/28/04	23:25	56.00232	169.5821	366		napp
CTD15-Start	GC12	7/28/04	23:29	56.00178	169.5821	366	nuts, chl,	stebano
CTD15-End	GC12	7/28/04	23:53	56.00146	169.5837	366		stebano
CTD22-Start	GC13	7/29/04	0:22	55.95705	169.5818	1071	just a look	stebano
CTD22-End	GC13	7/29/04	1:10	55.9601	169.5773	1071		stebano
CTD23-Start	GC13	7/29/04					N15 expt water	zeeman
CTD23-End	GC13	7/29/04						
CalVET Net-Start	GC13	7/29/04	2:02	55.95515	169.5884	1071		napp
CalVET Net-End	GC13	7/29/04	2:06	55.95548	169.5874	1071		napp
CTD24-Start	GC13	7/29/04	2:16	55.95583	169.5874	1079	nuts, chl, s-f chl, cell count	stebano
CTD25-Start	GC13	7/29/04	2:39	55.95483	169.5818	1079	DE2 fsw, prim prod	Strom
Ring Net-Start	GC13	7/29/04	2:55	55.95575	169.5833	1079		napp
Ring Net-End	GC13	7/29/04	2:56	55.95572	169.5829	1079		napp
Ring Net-Start	GC13	7/29/04	2:59	55.95558	169.5823	1079		napp
Ring Net-End	GC13	7/29/04	3:10	55.95448	169.58	1079		napp
CTD26-Start	GC13	7/29/04	3:24	55.95755	169.5872	977	DE2 wsw	Strom
CTD to 20 m	GC13	7/29/04					Named ctd288alexei	Pinchuk
MOCNESS-Start	GC13	7/29/04	5:12	55.95963	169.5719	1169	Flow meter failed	coyle
MOCNESS-End	sg13	7/29/04	6:04	55.92928	169.6104	1169		coyle
MOCNESS-Start	sg13	7/29/04	8:14	55.93715	169.6138	1169		coyle
MOCNESS-Start	sg10	7/29/04	9:22	56.09632	169.5771	160		coyle
MOCNESS-End	sg10	7/29/04	10:09	56.10965	169.5307	160		coyle
MOCNESS-Start	sg8	7/29/04	10:48	56.18453	169.5873	400		coyle
MOCNESS-End	sg8	7/29/04	11:45	56.19553	169.5244	400		coyle
MOCNESS-Start	sg8	7/29/04	12:11	56.19562	169.5445	400		coyle
MOCNESS-End	sg8	7/29/04	12:48	56.18987	169.5974	400		coyle
MOCNESS-Start	sg5	7/29/04	13:48	56.33033	169.5882	145		coyle
MOCNESS-End	sg5	7/29/04	14:23	56.3266	169.6232	145		coyle
CalVET Net-Start	GB1	7/29/04	15:55	56.52663	169.4835	72		napp
CalVET Net-End	GB1	7/29/04	15:58	56.5262	169.4831	72		napp
CTD28-Start	GB1	7/29/04	16:04	56.52542	169.4828	72		stabeno
CTD28-end	GB1					72		
CalVET Net-Start	GB2	7/29/04	16:27	56.50352	169.4236	81		napp
CalVET Net-End	GB2	7/29/04	16:30	56.50295	169.4234	81		napp
CTD29	GB2	7/29/04	16:39	56.501	169.422	81	at depth	Stabeno
CalVET Net Start	GB3	7/29/04	17:01	56.4789	169.3652	94		napp
CalVET Net End	GB3	7/29/04	17:05	56.47713	169.3656	94		napp
CTD30-Start	GB3	7/29/04	17:08	56.47578	169.366	94		stabeno
CTD30-End	GB3	7/29/04	17:16	56.476	169.367	94		stabeno
CalVET Net Start	GB4	7/29/04	17:39	56.45645	169.3101	102		napp
CalVET Net-End	GB4	7/29/04	17:43	56.4554	169.3114	102		napp
CTD31-Start	GB4	7/29/04	17:48	56.45412	169.3128	102		stabeno
CTD31-End	GB4	7/29/04	17:55	56.45242	169.3152	102		stabeno
CalVET Net-Start	GB5	7/29/04	18:34	56.38592	169.192	117		napp

CalVET Net End	GB5	7/29/04	18:39	56.38485	169.1941	117		napp
CTD32-Start	GB5	7/29/04	18:44	56.3844	169.1954	117		stabeno
CTD32-End	GB5	7/29/04	18:52	56.38355	169.2002	117		stabeno
CalVET Net Start	GB6	7/29/04	19:33	56.3171	169.0761	136		napp
CalVET Net End	GB6	7/29/04	19:38	56.31605	169.0781	136		napp
CTD33-Start	GB6	7/29/04	19:43	56.31452	169.0817	136		stabeno
CTD33-End	GB6	7/29/04	19:55	56.3145	169.083	136		stabeno
CalVET Net Start	GB7	7/29/04	20:37	56.24792	168.9595	142		napp
CalVET Net End	GB7	7/29/04	20:42	56.2475	168.9623	142		napp
CTD34-Start	GB7	7/29/04	20:48	56.24805	168.9657	142		stabeno
CalVET Net-Start	GB8	7/29/04	21:48	56.16936	168.8268	256		napp
CalVET Net-End	GB8	7/29/04	21:53	56.17038	168.8278	256		napp
CTD35-Start	GB8	7/29/04	22:10	56.17318	168.8349	256		stabeno
CalVET Net Start	GB9	7/29/04	23:01	56.09108	168.6938	700		napp
CalVET Net End	GB9	7/29/04	23:06	56.0921	168.6922	700		napp
CTD36-Start	GB9	7/29/04	23:11	56.09305	168.6914	670	deep nuts	stabeno
CTD36-End	GB9	7/29/04	23:44	56.09935	168.6825	670		stabeno
CTD37-Start	GB9	7/29/04	23:56	56.08988	168.6943	709	nuts, chl, cell cts, s-f chl	Strom
CTD37-End	GB9	7/30/04	0:05	56.09107	168.6925	709		Strom
CTD38-Start	GB9	7/30/04	0:20	56.09097	168.693	692	DE3 fsw	Strom
CTD38-End	GB9	7/30/04	0:25	56.0914	168.6929	692		Strom
CTD39-Start	GB9	7/30/04	1:10	56.09005	168.6939	692	de3 wsw	Strom
Drifter-Start	GB9	7/30/04	1:21	56.09052	168.6866	692	43734	Stabeno
CalVET Net Start	GB10	7/30/04	2:00	56.01235	168.566	281		napp
CalVET Net Tow-End	GB10	7/30/04	2:05	56.01365	168.564	281		napp
CTD40-Start	GB10	7/30/04	2:11	56.01492	168.5629	281		stabeno
CTD40-End	GB10	7/30/04	2:32	56.01995	168.5524	281		stabeno
CalVET Net Start	GB11	7/30/04	3:13	55.93265	168.4347	151		napp
CalVET Net End	GB11	7/30/04	3:18	55.93247	168.4336	151		napp
CTD28-Start	GB11	7/30/04	3:23	55.9324	168.4315	151		Hunt
CTD28-End	GB11	7/30/04	3:33	55.93067	168.4284	151		Hunt
MOCNESS-Start	GB9	7/30/04	4:57	56.0877	168.7023	775	deep cast, 1 of 2 or 3	coyle
MOCNESS-End	GB9	7/30/04	6:14	56.04762	168.7565	775		coyle
MOCNESS-Start	GB9	7/30/04	8:03	56.10485	168.6746	775		coyle
MOCNESS-End	GB9	7/30/04	8:47	56.08255	168.7191	775		coyle
MOCNESS-Start	GB11	7/30/04	10:18	55.93103	168.4384	150		coyle
MOCNESS-End	GB11	7/30/04	10:49	55.91985	168.4753	150		coyle
CTD42-Start	SES1	7/30/04	14:32	55.4016	168.2982	617	nuts, chl, cell cts, sf chl	stabeno
CTD43-Start	SES1	7/30/04	15:02	55.39998	168.3002	617	prim prod, DE4 fsw	Strom
CTD44-Start	SES1	7/30/04	15:28	55.3993	168.2993	617	N15	Zee
CTD44-End	SES1	7/30/04	15:33	55.39942	168.299	617		Zee
CTD45-Start	SES1	7/30/04	15:57	55.40032	168.3006	633	DE4 wsw	Strom
CTD45-End	SES1	7/30/04	16:02	55.40112	168.3008	633		Strom
CTD46-Start	SES8	7/30/04	23:53	56.56852	167.1328	102	nuts, chl, cell count	Zee

CTD46-Start	SES8	7/31/04	0:14	56.56682	167.1315	102	prods	Zee
Ring Net-Start	SES8	7/31/04	0:24	56.56925	167.1288	102		napp
Ring Net-End	SES8	7/31/04	0:40	56.57403	167.1276	102		napp
CTD29-Start	SES8	7/31/04	0:50	56.56675	167.1318	102	N15	Zee
CTD29-End	SES8	7/31/04	0:58	56.56875	167.1305	102		Zee
CTD29-Start	SES8	7/31/04	1:47	56.56807	167.1292	102	N15	Zee
CTD29-End	SES8	7/31/04	1:48	56.56828	167.1289	102	start was 5 min late	Zee
MOCNESS-Start	GB6	7/31/04	10:14	56.3137	169.0734	138		coyle
MOCNESS-End	GB6	7/31/04	10:43	56.29862	169.111	138		coyle
Drifter-Start		7/31/04	12:00	56.46087	169.3355	100	43732	stabeno
	Lost weather pack	7/31/04	12:08	56.47638	169.3516	100		Dan
MOCNESS-Start	GB3	7/31/04	12:16	56.47778	169.3709	95		coyle
MOCNESS-End	GB3	7/31/04	12:52	56.45357	169.4199	100		coyle
MOCNESS-Start	GC2	7/31/04	13:35	56.46778	169.5873	90		coyle
MOCNESS-End	GC2	7/31/04	13:58	56.4573	169.6095	90		coyle
CalVET Net Start	GD1	7/31/04	15:06	56.57692	169.7699	55		napp
CalVET Net End	GD1	7/31/04	15:09	56.57658	169.7693	55		napp
CTD50-Start	GD1	7/31/04	15:14	56.57573	169.7677	55	nuuts, chl, cell counts	stabeno
CTD50-End	GD1	7/31/04	15:18	56.57495	169.7657	55		stabeno
CalVET Net Start	GD2	7/31/04	15:40	56.54772	169.8325	87		napp
CalVET Net End	GD2	7/31/04	15:44	56.54793	169.8325	87	net hung up - redone	napp
CalVET Net Start	GD2	7/31/04	15:50	56.54825	169.8323	87		napp
CalVET Net End	GD2	7/31/04	15:53	56.54845	169.8321	87		napp
CTD51-Start	GD2	7/31/04	15:57	56.54867	169.8319	87		stabeno
CTD51-End	GD2	7/31/04	16:08	56.54732	169.8347	87	late	stabeno
CalVET Net Start	GD3	7/31/04	16:26	56.5186	169.8946	91		napp
CalVET Net End	GD3	7/31/04	16:30	56.51905	169.8945	91		napp
CTD52-Start	GD3	7/31/04	16:34	56.51965	169.8943	91	nuts, chl,	stabeno
CTD52-End	GD3	7/31/04	16:43	56.51983	169.8948	91		stabeno
CalVET Net Start	GD4	7/31/04	17:16	56.4887	169.9582	96		napp
CalVET Net End	GD4	7/31/04	17:20	56.48875	169.9574	96		napp
CTD53-Start	GD4	7/31/04	17:24	56.48825	169.9568	96		stabeno
CTD53-End	GD4	7/31/04	17:31	56.48707	169.9568	96	nuts, chl	stabeno
CalVET Net-Start	GD5	7/31/04	17:53	56.46018	170.0214	102		napp
CalVET Net-End	GD5	7/31/04	17:58	56.46038	170.0221	102		napp
CTD54-Start	GD5	7/31/04	18:00	56.46027	170.0222	102	nuts, chl, cell counts, s-f chl	stabeno
CTD54-End	GD5	7/31/04	18:10	56.45972	170.0243	102		stabeno
CTD55-Start	GD5	7/31/04	18:23	56.46041	170.02	102	prim prod, de5 fsw	Zee, Strom
CTD55-End	GD5	7/31/04	18:29	56.45958	170.0209	102		Zee, Strom
CTD56-End	GD5	7/31/04	18:50	56.46088	170.0207	102	N15	Zee
CTD56-End	GD5	7/31/04	18:57	56.46115	170.0213	102		Zee
CTD57-Start	GD5	7/31/04	19:17	56.45895	170.0228	102	DE5WSW	Strom
Drifter-Start	GD5	7/31/04	19:32	56.44777	170.0478	102	43730	stabeno
CalVET Net Start	GD6	7/31/04	19:43	56.43078	170.0842	106		napp
CalVET Net End	GD6	7/31/04	19:47	56.43013	170.0853	106		napp

CTD58-Start	GD6	7/31/04	19:55	56.42995	170.0874	106		stabeno
CalVET Net-Start	GD7	7/31/04	20:34	56.37355	170.2085	110		napp
CalVET Net-End	GD7	7/31/04	20:38	56.37432	170.2096	110		napp
CTD59-Start	GD7	7/31/04	20:42	56.37468	170.2108	110		stabeno
CTD59-End	GD7	7/31/04	20:51	56.37593	170.2143	110		stabeno
CalVET Net-Start	GD8	7/31/04	21:26	56.31503	170.3346	113		napp
CalVET Net-End	GD8	7/31/04	21:31	56.31503	170.3361	113		napp
CTD60-Start	GD8	7/31/04	21:34	56.31492	170.3375	113		stabeno
CalVET Net Start	GD9	7/31/04	22:15	56.257	170.4597	116		napp
CalVET Net-End	GD9	7/31/04	22:20	56.25703	170.4602	116		napp
CTD61-Start	GD9	7/31/04	22:24	56.25694	170.461	116		stabeno
CalVET Net Start	GD10	7/31/04	23:08	56.19923	170.5858	125		napp
CalVET Net End	GD10	7/31/04	23:12	56.20002	170.5876	125		napp
CTD62-Start	GD10	7/31/04	23:15	56.2005	170.5886	125		stabeno
CTD62-End	GD10	7/31/04	23:25	56.20315	170.5921	125		stabeno
CalVET Net Start	GD11	8/1/04	0:01	56.14103	170.7115	638		napp
CalVET Net End	GD11	8/1/04	0:06	56.14167	170.712	638		napp
CTD63-Start	GD11	8/1/04	0:09	56.1424	170.7129	570		stabeno
CTD63-End	GD11	8/1/04	0:34	56.14807	170.7189	570		stabeno
CalVET Net Start	GD12	8/1/04	1:11	56.084	170.8357	1128		napp
CalVET Net End	GD12	8/1/04	1:16	56.08495	170.8371	1128		napp
ctd 64-Start	GD12	8/1/04	1:20	56.08627	170.8386	1417		stabeno
ctd 64-End	GD12	8/1/04	2:06	56.09225	170.8512	1884		stabeno
ctd 65-Start	GD12	8/1/04	2:19	56.08633	170.837	1438	Prods	Zee
ctd 65-End	GD12	8/1/04	2:23	56.0873	170.838	1438		Zee
MOCNESS-Start	GD12	8/1/04	3:58	56.09347	170.8371	1647		coyle
MOCNESS-End	GD12	8/1/04	5:15	56.05087	170.808	1647		coyle
MOCNESS-Start	GD12	8/1/04	7:32	56.09235	170.8357	1774		coyle
MOCNESS-End	GD12	8/1/04	8:03	56.08412	170.8072	1774		coyle
MOCNESS-Start	GD9	8/1/04	9:40	56.25667	170.4537	117		coyle
MOCNESS-End	GD9	8/1/04	10:11	56.25617	170.4159	117		coyle
MOCNESS-Start	GD7	8/1/04	11:14	56.37365	170.2016	110		coyle
MOCNESS-End	GD7	8/1/04	11:53	56.36788	170.1492	110		coyle
MOCNESS-Start	GD5	8/1/04	12:39	56.46013	170.0161	103		coyle
MOCNESS-End	GD5	8/1/04	13:18	56.45392	169.9677	103		coyle
CalVET Net Start	PG13	8/1/04	15:34	56.61917	169.6918	43		napp
CalVET Net End	PG13	8/1/04	15:36	56.61917	169.6913	43		napp
CTD66-Start	PG13	8/1/04	15:41	56.61977	169.6918	43		stabeno
CTD66-End	PG13	8/1/04	15:46	56.62	169.692	43		stabeno
CalVET Net Start	PG11	8/1/04	16:25	56.70172	169.7848	77		napp
CalVET Net End	PG11	8/1/04	16:29	56.70213	169.7839	77		napp
CTD67-Start	PG11	8/1/04	16:31	56.7029	169.7826	77		stabeno
CTD67-End	PG11	8/1/04	16:38	56.70418	169.7805	77		stabeno
CalVET Net Start	PG9	8/1/04	17:14	56.78008	169.8757	74		napp
CalVET Net End	PG9	8/1/04	17:17	56.78027	169.8749	74		napp
CTD68-Start	PG9	8/1/04	17:21	56.78047	169.874	74		stabeno
CTD68-End	PG9	8/1/04	17:27	56.78082	169.8731	74		stabeno

CalVET Net Start	PG7	8/1/04	18:05	56.85985	169.9686	70		napp
CalVET Net End	PG7	8/1/04	18:08	56.86002	169.9689	70		napp
CTD69-Start	PG7	8/1/04	18:12	56.85982	169.9694	70		stabeno
CTD70-Start	PG6	8/1/04	18:41	56.9006	170.0138	71		stabeno
CalVET Net Start	PG5	8/1/04	19:06	56.94017	170.0597	72		Napp
CalVET Net End	PG5	8/1/04	19:10	56.94022	170.0603	72		napp
CTD71-Start	PG5	8/1/04	19:14	56.93992	170.0615	72		stabeno
CTD72-Start	PG5	8/1/04	19:39	56.94015	170.0593	72	prim prod, DE6 fsw	Strom, Zee
CTD72-End	PG5	8/1/04	19:44	56.9395	170.0612	72		Strom, Zee
CTD73-Start	PG5	8/1/04	20:06	56.94068	170.0596	72	N15	Strom, Zee
CTD73-End	PG5	8/1/04	20:12	56.9399	170.0631	72		Zee
CTD74-Start	PG5	8/1/04	20:30	56.94078	170.0589	72	DE6 wsw	Strom
CTD74-End	PG5	8/1/04	20:37	56.94045	170.0635	72		Strom
CalVET Net Start	PG3	8/1/04	21:14	57.02018	170.1535	63		napp
CalVET Net End	PG3	8/1/04	21:16	57.02013	170.1555	63		napp
CTD75-Start	PG3	8/1/04	21:21	57.0197	170.1599	63		stabeno
CalVET Net Start	PG1	8/1/04	22:03	57.09938	170.2461	26		napp
CalVET Net End	PG1	8/1/04	22:04	57.09905	170.2471	26		napp
CTD76-Start	PG1	8/1/04	22:09	57.09768	170.2526	26		stabeno
CTD77-Start	PG1	8/2/04	23:13	57.09963	170.2474	26	nuts, chl, cell counts	stabeno
CTD77-End	PG1	8/2/04	23:16	57.09938	170.2493	26		stabeno
CTD78-Start	PG3	8/3/04	0:08	57.02013	170.1536	64	nuts, chl, cell counts	stabeno
CTD78-End	PG3	8/3/04	0:13	57.02025	170.1578	64		stabeno
CTD79-Start	PG5	8/3/04	1:09	56.94153	170.058	72		stabeno
CTD79-End	PG5	8/3/04	1:15	56.94265	170.062	72		stabeno
CTD80-Start	PG6	8/3/04	2:30	56.90218	170.0116	71		stabeno
CTD80-End	PG6	8/3/04	2:35	56.90412	170.012	71		stabeno
CTD81-Start	PG7	8/3/04	3:10	56.86397	169.965	69		stabeno
CTD81-End	PG7	8/3/04	3:15	56.86607	169.9637	69		stabeno
MOCNESS-Start	PG11	8/3/04	8:33	56.69745	169.7822	76		coyle
MOCNESS-End	PG11	8/3/04	9:04	56.6932	169.8069	76		coyle
MOCNESS-Start	PG8	8/3/04	10:08	56.8178	169.928	73		coyle
MOCNESS-End	PG8	8/3/04	10:28	56.81285	169.9561	73		coyle
MOCNESS-Start	PG5	8/3/04	11:42	56.9392	170.0643	73		coyle
MOCNESS-End	PG5	8/3/04	12:12	56.93559	170.118	73		coyle
CTD72-Start	PG4	8/3/04	12:57	56.93893	170.0587	72		napp
CalVET Net Start	PG6/CW1	8/3/04	16:05	56.9008	170.0119	71		napp
CalVET Net End	PG6/CW1	8/3/04	16:08	56.9014	170.0112	71		napp
CTD83-Start	PG6/CW1	8/3/04	16:18	56.90342	170.0096	71		stabeno
CTD84-Start	CW2	8/3/04	16:44	56.87088	170.0722	76		stabeno
CalVET Net Start	CW3	8/3/04	17:16	56.84353	170.1372	82		napp
CalVET Net End	CW3	8/3/04	17:20	56.84348	170.1364	82		napp
CTD85-Start	CW3	8/3/04	17:24	56.84387	170.1349	82		stabeno
CTD86-Start	CW4	8/3/04	18:01	56.81385	170.1996	91		stabeno
CalVET Net Start	CW5	8/3/04	18:35	56.78477	170.2625	96		napp
CalVET Net End	CW5	8/3/04	18:39	56.78445	170.2612	96		napp

CTD87-Start	CW5	8/3/04	18:43	56.7844	170.2602	96		stabeno
CTD87-End	CW5	8/3/04	18:50	56.78493	170.2589	96		stabeno
CalVET Net Start	CW6	8/3/04	19:14	56.75577	170.3248	100		napp
CalVET Net End	CW6	8/3/04	19:20	56.75563	170.3218	100		napp
CTD88-Start	CW6	8/3/04	19:24	56.75578	170.3201	100	nuts , chl, sfchl, cell counts	stabeno
CTD88-End	CW6	8/3/04	19:27	56.75605	170.3194	100		stabeno
CTD89-Start	CW6	8/3/04	19:37	56.75392	170.324	101	redo of 88	stabeno
CTD89-End	CW6	8/3/04	19:48	56.75443	170.3205	101		stabeno
CTD90-Start	CW6	8/3/04	20:05	56.75412	170.3246	101	prim prod, DE7 fsw	Strom, Zee
CTD90-End	CW6	8/3/04	20:12	56.7543	170.3232	101		Strom, Zee
CTD91-Start	CW6	8/3/04	20:32	56.75395	170.3244	101	N15	Zee
CTD91-End	CW6	8/3/04	20:38	56.75397	170.3237	101		Zee
CTD92-Start	CW6	8/3/04	20:59	56.75375	170.3241	101	DE7WSW	Strom
CTD92-End	CW6	8/3/04	21:04	56.7536	170.3234	101		Strom
CalVET Net Start	CW7	8/3/04	21:28	56.72635	170.3877	103		napp
CalVET Net End	CW7	8/3/04	21:32	56.72587	170.3865	103		napp
CTD93-Start	CW7	8/3/04	21:40	56.72569	170.3851	103		stabeno
MOCNESS-Start	cw6	8/5/04	7:43	56.75955	170.3167	100		coyle
MOCNESS-Start	cw6	8/5/04	7:44	56.75945	170.3172	100		coyle
CalVET Net End	CW9	8/3/04	23:17	56.61043	170.6393	113		napp
CTD96-Start	CW10	8/4/04	0:09	56.55152	170.7624	118		stabeno
CTD96-End	CW10	8/4/04	0:18	56.55235	170.7647	118		stabeno
CalVET Net Start	CW11	8/4/04	0:55	56.49417	170.8902	122		napp
CalVET Net End	CW11	8/4/04	1:00	56.49367	170.8908	122		napp
CTD97-Start	CW11	8/4/04	1:38	56.4942	170.8882	122	Replaced 2ary T,Con	stabeno
CTD98-Start	CW12	8/4/04	3:05	56.43568	171.0133	126	Back to original sensors	stabeno
CTD98-End	CW12	8/4/04	3:14	56.43692	171.0142	126		stabeno
CalVET Net-Start	CW13	8/4/04	4:02	56.37965	171.1382	134		napp
CalVET Net-End	CW13	8/4/04	4:07	56.38005	171.1373	134		napp
CTD99-Start	CW13	8/4/04	4:14	56.3808	171.1384	134	Back to new 2ary sensors	stabeno
CTD100-Start	CW14	8/4/04	5:09	56.31937	171.2619	144		stabeno
CTD100-End	CW14	8/4/04	5:20	56.32078	171.2603	144		stabeno
CalVET Net-Start	CW15	8/4/04	6:01	56.26248	171.3896	398		napp
CalVET Net End	CW15	8/4/04	6:06	56.26322	171.3895	398		napp
CTD101-Start	CW15	8/4/04	6:15	56.26538	171.3915	463		stabeno
CTD101-End	CW15	8/4/04	6:49	56.27493	171.3911	463		stabeno
MOCNESS-Start	CW15	8/4/04	7:24	56.27042	171.3955	463		coyle
MOCNESS-End	CW15	8/4/04	8:11	56.25772	171.4538	463		coyle
MOCNESS-Start	CW12	8/4/04	10:10	56.43267	171.0175	126		coyle
MOCNESS-End	CW12	8/4/04	10:46	56.41507	171.0639	126		coyle
MOCNESS-Start	CW9	8/4/04	12:49	56.61032	170.6428	114		coyle
MOCNESS-End	CW9	8/4/04	13:21	56.60095	170.6956	114		coyle
CalVET Net Start	CE1/PG6	8/4/04	16:34	56.90063	170.0135	71		napp
CalVet Net end	CE1/PG6	8/4/04	16:37	56.90071	170.0131	71		napp

CTD102-Start	CE1/PG6	8/4/04	16:43	56.9017	170.0129	71		stabeno
CTD103-Start	CE2	8/4/04	17:09	56.93022	169.9476	67	nuts, chl	stabeno
CTD103-End	CE2	8/4/04	17:14	56.9316	169.9467	67		stabeno
CalVET Net Start	CE3	8/4/04	17:32	56.95887	169.8868	65		napp
CalVET Net End	CE3	8/4/04	17:35	56.9598	169.8857	65		napp
CTD104-Start	CE3	8/4/04	17:38	56.9606	169.8846	65		stabeno
CTD104-End	CE3	8/4/04	17:44	56.96237	169.883	65		stabeno
CTD105-Start	CE3	8/4/04	17:58	56.95783	169.8855	65	prim prod, DE8 fsw	Strom, Zee
CTD106-Start	CE3	8/4/04	18:27	56.95803	169.8862	65	N15	Zee
CTD106-End	CE3	8/4/04	18:36	56.96015	169.8816	65		Zee
CTD107-Start	CE3	8/4/04	18:56	56.95773	169.8855	65	DE8 wsw	Strom
CTD107-End	CE3	8/4/04	19:02	56.95903	169.8816	65		Strom
CTD108-Start	CE4	8/4/04	19:21	56.9876	169.8221	62		stabeno
CalVET Net Start	CE5	8/4/04	19:47	57.01783	169.7593	60		napp
CalVET Net End	CE5	8/4/04	19:50	57.0184	169.7577	60		napp
CTD109-Start	CE5	8/4/04	19:53	57.01895	169.7558	60		stabeno
CTD110-Start	CE6	8/4/04	20:16	57.04633	169.6989	58		stabeno
CalVET Net Start	CE7	8/4/04	20:42	57.0749	169.6347	58		napp
CalVET Net End	CE7	8/4/04	20:44	57.0753	169.6338	58		napp
CTD111-Start	CE7	8/4/04	20:48	57.07522	169.6334	58		stabeno
CTD112-Start	CE8	8/4/04	21:28	57.13272	169.51	65		stabeno
CalVET Net Start	CE9	8/4/04	22:10	57.1905	169.3853	69		napp
CalVET Net End	CE9	8/4/04	22:13	57.19045	169.3846	69		napp
CTD113-Start	CE9	8/4/04	22:17	57.19085	169.3842	70		stabeno
CTD114-Start	CE10	8/4/04	22:58	57.24782	169.2606	73		stabeno
CalVET Net Start	CE11	8/4/04	23:42	57.30637	169.1374	71		napp
CalVET Net End	CE11	8/4/04	23:45	57.30577	169.137	71		napp
CTD115-Start	CE11	8/4/04	23:48	57.30562	169.1369	71		stabeno
CTD115-End	CE11	8/4/04	23:55	57.3055	169.1368	71		stabeno
CTD116-Start	CE12	8/5/04	0:32	57.36398	169.0113	71		stabeno
CalVET Net Start	CE13	8/5/04	1:20	57.42288	168.8872	70		napp
CalVET Net End	CE13	8/5/04	1:23	57.42223	168.8874	70		napp
CTD117-Start	CE13	8/5/04	1:26	57.42202	168.8881	70		stabeno
MOCNESS-Start	cw6	8/5/04	7:51	56.75778	170.325	100		coyle
MOCNESS-End	cw6	8/5/04	8:15	56.75125	170.3529	100		coyle
CTD118-Start	cw6	8/5/04	8:47	56.78498	170.2788	100		coyle
MOCNESS-Start	ce3	8/5/04	10:26	56.95897	169.8888	65		coyle
MOCNESS-End	ce3	8/5/04	10:48	56.96075	169.9131	65		coyle
MOCNESS-Start	critter	8/5/04	11:16	56.99233	169.851	65	Critter Tow	coyle
MOCNESS-End	critter	8/5/04	11:23	56.99233	169.8588	65		coyle
MOCNESS-Start	ce7	8/5/04	12:24	57.07483	169.6421	57		coyle
MOCNESS-End	ce7	8/5/04	12:39	57.07833	169.6626	57		coyle
MOCNESS-Start	ce11	8/5/04	14:04	57.19048	169.397	71		coyle
MOCNESS-End	ce11	8/5/04	14:24	57.19	169.4249	71		coyle
CalVET Net Start	SL13	8/5/04	16:05	57.18852	169.6182	53		napp
CalVET Net End	SL13	8/5/04	16:08	57.18825	169.6188	53		napp
CTD119-Start	SL13	8/5/04	16:11	57.18745	169.6191	52		stabeno

CTD119-End	SL13	8/5/04	16:17	57.1869	169.6208	52		stabeno
CTD120-Start	SL12	8/5/04	16:40	57.14137	169.6193	53		stabeno
CalVET Net Start	SL11	8/5/04	17:05	57.09465	169.6161	54		napp
CalVET Net End	SL11	8/5/04	17:07	57.09448	169.6171	54		napp
CTD121-Start	SL11	8/5/04	17:10	57.09422	169.6174	54		stabeno
CTD122-Start	SL10	8/5/04	17:37	57.04795	169.618	59		stabeno
CTD122-End	SL10	8/5/04	17:42	57.04783	169.6187	59		stabeno
CalVET Net Start	SL9	8/5/04	18:03	57.00191	169.6154	59	Tow Failed	napp
CalVET Net End	SL9	8/5/04	18:06	57.00215	169.6146	59		napp
CTD123-Start	SL9	8/5/04	18:11	57.00233	169.6122	59	nuts. chl, cell counts, sf chl	stabeno
CTD123-End	SL9	8/5/04	18:17	57.00277	169.6098	59		stabeno
CTD124-Start	SL9	8/5/04	18:25	57.0017	169.6169	59	redo 123, nuts, chl, sf chl, cell counts	stabeno
CTD124-End	SL9	8/5/04	18:30	57.0016	169.6155	59		stabeno
CalVET Net-Start	SL9	8/5/04	18:37	57.00122	169.6134	59	redo	napp
CalVET Net End	SL9	8/5/04	18:40	57.00125	169.6125	59		napp
CTD125-Start	SL9	8/5/04	18:47	57.0017	169.6167	59	prim prod, DE9 fsw	Strom, Zee
CTD125-End	SL9	8/5/04	18:51	57.00172	169.6156	59		Strom, Zee
CTD126-Start	SL9	8/5/04	19:11	57.00103	169.6169	60	N15	Zee
CTD126-End	SL9	8/5/04	19:17	57.00112	169.6148	60		Zee
CTD127-Start	SL9	8/5/04	19:37	57.00146	169.617	60	DE9 wsw	Strom
CTD127-End	SL9	8/5/04	19:42	57.00125	169.6158	60		Strom
Drifter-Start	SL9	8/5/04	19:46	56.99882	169.6149	60	43710	stabeno
CTD128-Start	SL8	8/5/04	20:06	56.95473	169.617	58		stabeno
CalVET Net-Start	SL7	8/5/04	20:35	56.90832	169.6131	69		napp
CalVET Net End	SL7	8/5/04	20:38	56.90816	169.6114	69		napp
CTD129-Start	SL7	8/5/04	20:42	56.90783	169.6089	69		stabeno
CTD130-Start	SL6	8/5/04	21:09	56.86075	169.6166	69		stabeno
CalVET Net-Start	SL5	8/5/04	21:35	56.81396	169.6144	66		napp
CalVET Net End	SL5	8/5/04	21:38	56.81339	169.6133	66		napp
CTD131-Start	SL5	8/5/04	21:41	56.81227	169.6113	66		stabeno
CTD132-Start	SL4	8/5/04	22:05	56.7673	169.6158	71		stabeno
CalVET Net Start	SL3	8/5/04	22:32	56.72062	169.6149	78	Tow Failed	napp
CalVET Net-End	SL3	8/5/04	22:35	56.71987	169.6146	78		napp
CTD133-Start	SL3	8/5/04	22:38	56.7195	169.6148	78		stabeno
CalVET Net Start	SL3	8/5/04	22:54	56.72222	169.6154	77	Redo of event 434	napp
CalVET Net End	SL3	8/5/04	22:57	56.7217	169.6147	77		napp
CTD134-Start	SL2	8/5/04	23:17	56.67383	169.6174	76		stabeno
CTD135-Start	SL1	8/5/04	23:45	56.62805	169.6144	60		stabeno
CTD135-End	SL1	8/5/04	23:51	56.62777	169.6138	60		stabeno
CalVET Net Start	SL1	8/5/04	23:54	56.62713	169.6134	59		napp
CalVET Net End	SL1	8/5/04	23:57	56.6268	169.6133	59		napp
MOCNESS-Start	ce13	8/6/04	7:48	57.42713	168.8842	71		coyle
MOCNESS-End	ce13	8/6/04	8:08	57.44517	168.8757	71		coyle
MOCNESS-Start	ce11	8/6/04	9:33	57.3053	169.1375	73		coyle
MOCNESS-End	ce11	8/6/04	10:00	57.29038	169.1604	73		coyle
CTD136-Start	ce11	8/6/04	10:25	57.28437	169.1595	73		napp

MOCNESS-Start	ce11	8/6/04	10:33	57.28217	169.1569	73		napp
MOCNESS-End	ce11	8/6/04	10:45	57.27515	169.1673	73		napp
CalVET Net Start	GA1	8/6/04	15:02	56.58538	169.4494	16		napp
CalVET Net End	GA1	8/6/04	15:03	56.5852	169.4493	16		napp
CTD137-Start	GA1	8/6/04	15:06	56.5845	169.4493	16		stabeno
CTD138-Start	GA2	8/6/04	15:29	56.58555	169.3656	54		stabeno
CalVET Net Start	GA3	8/6/04	15:56	56.58715	169.2838	43		napp
CalVET Net End	GA3	8/6/04	15:58	56.58693	169.2844	43		napp
CTD139-Start	GA3	8/6/04	16:01	56.58707	169.2857	43		stabeno
CTD140-Start	GA4	8/6/04	16:29	56.58647	169.2	70		stabeno
CalVET Net-Start	GA5	8/6/04	16:58	56.58743	169.1169	69		napp
CalVET Net End	GA5	8/6/04	17:01	56.58747	169.1178	69		napp
CTD141-Start	GA5	8/6/04	17:06	56.58832	169.1192	69		stabeno
CTD141-End	GA5	8/6/04	17:10	56.58905	169.1209	69		stabeno
CTD142-Start	GA6	8/6/04	17:34	56.58677	169.0322	69		stabeno
CTD142-End	GA6	8/6/04	17:39	56.58758	169.0318	69		stabeno
CalVET Net Start	GA7	8/6/04	18:01	56.58838	168.9516	95		napp
CalVET Net-End	GA7	8/6/04	18:05	56.58963	168.9527	95		napp
CTD143-End	GA7	8/6/04	18:08	56.59068	168.9533	95		stabeno
CalVET Net Start	GA8	8/6/04	18:37	56.58782	168.8667	105		napp
CalVET Net End	GA8	8/6/04	18:41	56.58885	168.8672	105		napp
CTD144-Start	GA8	8/6/04	18:46	56.59032	168.8682	105		stabeno
CTD144-End	GA8	8/6/04	18:56	56.59308	168.8701	105		stabeno
CTD145-Start	GA8	8/6/04	19:13	56.58738	168.8667	105	prim prod, DE10 fsw	Strom, Zee
CTD145-End	GA8	8/6/04	19:18	56.58887	168.8673	105		Strom, Zee
CTD146-Start	GA8	8/6/04	19:42	56.5881	168.8654	105	redo surface Prod	Zee
CTD146-End	GA8	8/6/04	19:52	56.59145	168.8655	105	redo Prods, 15N	Zee
CTD147-Start	GA8	8/6/04	20:17	56.58742	168.8661	105	DE10 wsw	Strom
CTD148-Start	Moor4A	8/6/04	20:41	56.63152	168.8756	102		stabeno
CalVET Net Start	GA9	8/6/04	21:19	56.58652	168.784	109		napp
CalVET Net End	GA9	8/6/04	21:24	56.58785	168.7834	109		napp
CTD149-Start	GA9	8/6/04	21:27	56.58922	168.783	109		stabeno
CTD150-Start	GA10	8/6/04	21:57	56.587	168.6988	110		stabeno
CTD150-End	GA10	8/6/04	22:06	56.58878	168.6958	110	Big bird flock feeding	stabeno
CalVET Net Start	GA11	8/6/04	22:26	56.58602	168.6162	111		napp
CalVET Net End	GA11	8/6/04	22:30	56.5863	168.6143	111		napp
CTD151-Start	GA11	8/6/04	22:33	56.58703	168.6133	112		stabeno
CalVET Net Start	GA100	8/7/04	1:55	56.63777	167.6205	106		napp
CalVET Net End	GA100	8/7/04	1:59	56.63788	167.6204	106		napp
CTD152-Start	GA100	8/7/04	2:03	56.6372	167.6207	106		stabeno
CTD152-End	GA100	8/7/04	2:13	56.63758	167.6205	106		stabeno
CTD153-Start	GA100	8/7/04	2:25	56.6383	167.6195	106	prim prod, DE11 fsw	Strom, Zee
CTD153-End	GA100	8/7/04	2:29	56.63835	167.6194	106		Strom, Zee
CTD154-Start	GA100	8/7/04	2:47	56.6361	167.6195	106	15N	Zee
CTD154-End	GA100	8/7/04	2:53	56.6364	167.6195	106		Zee

CTD155-Start	GA100	8/7/04	3:12	56.63762	167.6213	106	De11wsw	Strom
MOCNESS-Start	M2C5	8/7/04	13:29	56.72161	164.267	72		coyle
MOCNESS-End	M2C5	8/7/04	13:57	56.70193	164.2961	72		coyle
CTD156-Start	M2C5	8/7/04	14:37	56.6754	164.34	72	Water for Napp experiments	napp
Ring Net-Start	M2C5	8/7/04	15:36	56.72577	164.2326	72		napp
Ring Net-End	M2C5	8/7/04	15:53	56.72672	164.2337	72		napp
CTD157-Start	M2C5	8/7/04	16:04	56.72797	164.2344	72		stabeno
CalVET Net Start	M2C5	8/7/04	16:15	56.729	164.2363	72		napp
CalVET Net-End	M2C5	8/7/04	16:18	56.729	164.2364	72		napp
CalVET Net Start	M2C7	8/7/04	16:59	56.80145	164.1464	71		napp
CalVET Net End	M2C7	8/7/04	17:02	56.8017	164.1467	71		napp
CTD158-Start	M2C7	8/7/04	17:06	56.80276	164.1478	71		stabeno
CalVET Net Start	M2C9/M-2	8/7/04	17:49	56.8768	164.0546	71		napp
CalVET Net End	M2C9/M-2	8/7/04	17:52	56.8771	164.0548	71		napp
CTD159-Start	M2C9/M-2	8/7/04	17:55	56.87805	164.0553	71		stabeno
CalVET Net Start	M2C11	8/7/04	18:38	56.95147	163.9659	68		napp
CalVET Net End	M2C11	8/7/04	18:41	56.95185	163.9657	68		napp
CTD160-Start	M2C11	8/7/04	18:44	56.95296	163.9661	68		stabeno
CTD161-Start	M2C13	8/7/04	19:27	57.02623	163.8768	66		stabeno
CTD161-End	M2C13	8/7/04	19:33	57.02737	163.877	66		stabeno
CalVET Net Start	M2C13	8/7/04	19:36	57.02818	163.8761	66		napp
CalVET Net-End	M2C13	8/7/04	19:39	57.0285	163.8757	66		napp
CTD162-Start	M2C9/M-	8/7/04	20:49	56.87725	164.0519	66	In Situ	Zee
CTD162-End	M2C9/M-2	8/7/04	20:57	56.8791	164.0502	66		Zee
In Situ Prods-Start	M2C9/M-2	8/7/04	22:23	56.8782	164.0517	70	Launch In Situ Buoy	Zee
CTD163-Start	M2C11	8/8/04	2:45	56.94997	163.9644	68		stabeno
CTD164-Start	M2C13	8/8/04	3:27	57.0255	163.8748	66		stabeno
CTD165-Start	M2C15	8/8/04	4:08	57.09998	163.7849	65		stabeno
CTD166-Start	M2C17	8/8/04	4:48	57.1754	163.6953	63		stabeno
CTD167-Start	M2C19	8/8/04	5:31	57.24995	163.6049	60		stabeno
CTD168-Start	M2C21	8/8/04	6:12	57.32408	163.5156	54		stabeno
MOCNESS-Start	M2C21	8/8/04	8:08	57.33993	163.4973	54		coyle
MOCNESS-End	M2C21	8/8/04	8:37	57.32387	163.5245	54		coyle
MOCNESS-Start	M2C17	8/8/04	10:03	57.17375	163.6974	64		coyle
MOCNESS-End	M2C17	8/8/04	10:30	57.15703	163.7144	64		coyle
MOCNESS-Start	M2C13	8/8/04	11:46	57.02482	163.8764	66		coyle
MOCNESS-End	M2C13	8/8/04	12:15	57.00808	163.9	66		coyle
CTD169-Start	M2C12	8/8/04	12:49	56.99125	163.9207	66		coyle
CTD170-Start	M2C9	8/8/04	16:09	56.877	164.0565	70	nuts, chl, cell counts, sf chl	stabeno
CTD170-End	M2C9	8/8/04	16:16	56.87713	164.0591	70		stabeno
CTD171-Start	M2C9	8/8/04	16:33	56.87612	164.0588	70	prim prod, DE12 fsw	Strom, Zee
CTD171-End	M2C9	8/8/04	16:37	56.87602	164.0603	70		Strom, Zee
CTD172-Start	M2C9	8/8/04	16:47	56.87512	164.0587	70	re-do 171	Strom, Zee
CTD172-End	M2C9	8/8/04	16:52	56.87527	164.0609	70		Strom, Zee

CTD173-Start	M2C9	8/8/04	17:16	56.875	164.0582	70	n15	Zee
CTD173-End	M2C9	8/8/04	17:25	56.8753	164.0624	70		Zee
CTD174-Start	M2C9	8/8/04	17:54	56.87485	164.06	70	DE12 wsw, Surface n15	Strom
CTD174-End	M2C9	8/8/04	17:59	56.8751	164.0628	70		Strom
MOCNESS-Start	M2W5	8/9/04	8:03	56.78458	164.3593	72		coyle
MOCNESS-End	M2W5	8/9/04	8:23	56.76995	164.3662	72		coyle
MOCNESS-Start	M2W9	8/9/04	9:38	56.9227	164.1894	69		coyle
MOCNESS-End	M2W9	8/9/04	10:05	56.90508	164.199	69		coyle
CTD175-Start	M2W9	8/9/04	10:20	56.90855	164.1937	69		napp
MOCNESS-Start	M2W13	8/9/04	11:34	57.07188	164.0091	67		coyle
MOCNESS-End	M2W13	8/9/04	11:54	57.05793	164.0146	67		coyle
CTD176-Start	M2C9	8/9/04	16:07	56.87723	164.0531	67	nuts. chl, sf chl	stabeno
CTD176-End	M2C9	8/9/04	16:13	56.87702	164.0535	67		stabeno
CTD177-Start	M2C9	8/9/04	16:23	56.87562	164.0575	69	prim prod, DE13 fsw	Strom, Zee
CTD177-End	M2C9	8/9/04	16:29	56.87551	164.0578	69		Strom, Zee
CTD178-Start	M2C9	8/9/04	16:37	56.87505	164.0597	69	redo of 177	Strom, Zee
CTD178-End	M2C9	8/9/04	16:43	56.8747	164.061	69		Strom, Zee
CTD179-Start	M2C9	8/9/04	17:00	56.87495	164.0574	69	N15	Zee
CTD179-End	M2C9	8/9/04	17:08	56.87463	164.0581	69		Zee
CTD180-Start	M2C9	8/9/04	17:25	56.87495	164.0572	69	DE13 wsw	Strom
CalVET Net Start	M2W5	8/9/04	18:47	56.77487	164.3741	71		napp
CalVET Net End	M2W5	8/9/04	18:51	56.77457	164.3747	71		napp
CTD181-Start	M2W5	8/9/04	18:54	56.77488	164.3756	71		stabeno
CalVET Net Start	M2W7	8/9/04	19:39	56.85105	164.2814	69		napp
CalVET Net End	M2W7	8/9/04	19:42	56.8512	164.2818	69		napp
CTD182-Start	M2W7	8/9/04	19:45	56.85175	164.2827	69		stabeno
CalVET Net Start	M2W9	8/9/04	20:26	56.92567	164.1919	68		napp
CalVET Net End	M2W9	8/9/04	20:29	56.92613	164.1926	68		napp
CTD183-Start	M2W9	8/9/04	20:32	56.92688	164.1936	68		stabeno
CalVET Net Start	M2W11	8/9/04	21:14	57.00057	164.1017	66		napp
CalVET Net End	M2W11	8/9/04	21:17	57.00075	164.1016	66		napp
CTD184-Start	M2W11	8/9/04	21:22	57.00167	164.1022	66		stabeno
CalVET Net Start	M2W13	8/9/04	22:01	57.0755	164.0119	65		napp
CalVET Net End	M2W13	8/9/04	22:04	57.07588	164.0114	65		napp
CTD185-Start	M2W13	8/9/04	22:07	57.07658	164.0116	65		stabeno
CalVET Net Start	M2E13	8/9/04	23:23	56.97673	163.7395	66		napp
CalVET Net End	M2E13	8/9/04	23:25	56.97721	163.7392	66		napp
CTD186-Start	M2E13	8/9/04	23:29	56.97775	163.7386	66		stabeno
CTD186-End	M2E13	8/9/04	23:35	56.97852	163.7379	66		stabeno
CalVET Net Start	M2E11	8/10/04	0:13	56.9013	163.8319	69		napp
CalVET Net End	M2E11	8/10/04	0:16	56.90135	163.8311	69		napp
CTD187-Start	M2E11	8/10/04	0:20	56.90137	163.8295	69		stabeno
CTD187-End	M2E11	8/10/04	0:25	56.90123	163.8277	69		stabeno
CalVET Net Start	M2E9	8/10/04	1:02	56.82597	163.9218	70		napp
CalVET Net End	M2E9	8/10/04	1:05	56.82622	163.9206	70		napp
CTD188-Start	M2E9	8/10/04	1:09	56.82632	163.9188	70		stabeno

CalVET Net Start	M2E7	8/10/04	1:54	56.75165	164.0112	72		napp
CalVET Net-End	M2E7	8/10/04	1:57	56.75191	164.0103	72		napp
CTD189-Start	M2E7	8/10/04	1:59	56.7522	164.009	72		stabeno
CalVET Net Start	M2E5	8/10/04	2:58	56.6761	164.1016	74		napp
CalVET Net End	M2E5	8/10/04	3:02	56.67579	164.1007	74		napp
CTD190-Start	M2E5	8/10/04	3:05	56.67567	164.0997	74		stabeno
MOCNESS-Start	M2E5	8/10/04	8:02	56.6659	164.0942	74		coyle
MOCNESS-End	M2E5	8/10/04	8:23	56.68163	164.0843	74		coyle
MOCNESS-Start	M2E9	8/10/04	9:31	56.82877	163.9221	71		coyle
MOCNESS-End	M2E9	8/10/04	9:59	56.85202	163.917	71		coyle
CTD191-Start	M2E9	8/10/04	10:07	56.85682	163.9173	71		napp
MOCNESS-Start	M2E13	8/10/04	11:10	56.97913	163.7407	67		coyle
MOCNESS-End	M2E13	8/10/04	11:29	56.9945	163.7392	67		coyle
CTD192-Start	M2C9/M-2	8/10/04	16:04	56.87563	164.053	70		Strom,Zee
CTD193-Start	M2C9/M-2	8/10/04	16:21	56.87373	164.0553	70	prim prod, DE14 fsw	Strom,Zee
CTD193-End	M2C9/M-2	8/10/04	16:26	56.8733	164.0564	70		Strom,Zee
CTD194-Start	M2C9/M-2	8/10/04	16:47	56.87449	164.0569	70		Zee
CTD194-End	M2C9/M-2	8/10/04	16:53	56.87358	164.0579	70	N15	Zee
CTD195-Start	M2C9/M-2	8/10/04	17:13	56.87442	164.0573	70	DE14 wsw	Strom
CTD195-End	M2C9/M-2	8/10/04	17:18	56.87385	164.0573	70		Strom
MOCNESS-Start	GA11	8/11/04	7:56	56.58155	168.6194	111		coyle
MOCNESS-End	GA11	8/11/04	8:29	56.5566	168.6295	111		coyle
CTD196-Start	GA8	8/11/04	9:26	56.58618	168.8661	111	DE15 water	Strom
MOCNESS-Start	GA8	8/11/04	9:35	56.58572	168.866	106		coyle
MOCNESS-End	GA8	8/11/04	10:09	56.55938	168.8755	106		coyle
MOCNESS-Start	GA5	8/11/04	11:14	56.58445	169.119	73		coyle
MOCNESS-End	GA5	8/11/04	11:44	56.5619	169.1373	73		coyle
MOCNESS-Start	GA2	8/11/04	12:47	56.5836	169.3687	50		coyle
MOCNESS-End	GA2	8/11/04	13:13	56.55993	169.3794	50		coyle
CalVET Net Start	PG13	8/11/04	16:00	56.6203	169.6942	49		napp
CalVET Net End	PG13	8/11/04	16:02	56.62027	169.6959	49		napp
CTD197-Start	PG13	8/11/04	16:06	56.62083	169.6983	49		stabeno
CTD198-Start	PG12	8/11/04	16:32	56.66087	169.7385	73		stabeno
CalVET Net Start	PG11	8/11/04	16:57	56.70055	169.7842	76		napp
CalVET Net End	PG11	8/11/04	17:01	56.70057	169.7841	76		napp
CTD199-Start	PG11	8/11/04	17:03	56.7005	169.7838	76		stabeno
CalVET Net Start	PG9	8/11/04	17:49	56.78043	169.8748	73		napp
CalVET Net-End	PG9	8/11/04	17:52	56.78033	169.8754	73		napp
CTD200-Start	PG9	8/11/04	17:54	56.78035	169.8757	73		stabeno
CalVET Net Start	PG7	8/11/04	18:38	56.85945	169.9691	69		napp
CalVET Net-End	PG7	8/11/04	18:41	56.85917	169.9706	69		napp
CTD201-Start	PG7	8/11/04	18:45	56.85893	169.9726	70		stabeno
CTD202-Start	PG6	8/11/04	19:13	56.89995	170.0162	70		stabeno
CalVET Net Start	PG5	8/11/04	19:39	56.94005	170.0602	72		napp
CalVET Net End	PG5	8/11/04	19:43	56.93992	170.0605	72		napp
CTD203-Start	PG5	8/11/04	19:45	56.93925	170.0609	72		Strom,Zee

CTD203-End	PG5	8/11/04	19:54	56.9393	170.0618	72		Strom,Zee
CTD204-Start	PG5	8/11/04	20:05	56.9397	170.0597	72		Strom,Zee
CTD204-End	PG5	8/11/04	20:12	56.93938	170.0607	72	prim prod, DE15 fsw	Strom,Zee
CTD205-Start	PG5	8/11/04	20:29	56.94007	170.06	72	n15	Zee
CTD205-End	PG5	8/11/04	20:36	56.94047	170.0611	72		Zee
CTD206-Start	PG5	8/11/04	22:02	56.94077	170.0585	72	DE16 fsw	Strom
CTD207-Start	PG5	8/11/04	22:48	56.94035	170.0576	72	DE16 wsw	Strom
CTD207-End	PG5	8/11/04	22:52	56.9414	170.0585	72		Strom
CTD208-Start	PG4	8/11/04	23:16	56.98188	170.1055	67		stabeno
CalVET Net Start	PG3	8/11/04	23:42	57.02063	170.1518	64		napp
CalVET Net End	PG3	8/11/04	23:45	57.02147	170.1525	64		napp
CTD209-Start	PG3	8/11/04	23:48	57.0226	170.1537	64		stabeno
CTD210-Start	PG2	8/12/04	0:15	57.06167	170.1949	35		stabeno
CalVET Net Start	PG1	8/12/04	0:38	57.10007	170.2434	27		napp
CalVET Net End	PG1	8/12/04	0:40	57.1004	170.243	27		napp
CTD211-Start	PG1	8/12/04	0:43	57.10168	170.2427	27		stabeno
Small Boat Ops	St. Paul	8/12/04	1:40	57.0488	170.3823	18	Bird Collection By Otter Island	Hunt
MOCNESS-Start	pb5	8/12/04	8:03	57.13943	170.7382	80		coyle
MOCNESS-End	pb5	8/12/04	8:34	57.11887	170.7141	80		coyle
MOCNESS-Start	PB9	8/12/04	10:21	57.14692	171.1915	100		coyle
MOCNESS-End	PB9	8/12/04	10:56	57.12487	171.167	100		coyle
CTD212-Start	PB9	8/12/04	11:27	57.11323	171.1507	100		napp
CTD212-End	PB9	8/12/04	11:29	57.11368	171.151	100		napp
MOCNESS-Start	PB11	8/12/04	12:57	57.12987	171.5727	105		coyle
MOCNESS-End	PB11	8/12/04	13:31	57.10755	171.5455	105		coyle
CalVET Net Start	PB13	8/12/04	15:31	57.13391	171.9158	112		napp
CalVET Net-End	PB13	8/12/04	15:36	57.13477	171.9163	112		napp
CTD213-Start	PB13	8/12/04	15:39	57.1352	171.9165	112		stabeno
CTD214-Start	PB12	8/12/04	16:34	57.1348	171.7448	107		stabeno
CTD214-End	PB12	8/12/04	16:41	57.13477	171.7463	107		stabeno
CalVET Net Start	PB11	8/12/04	17:20	57.13472	171.5745	113		napp
CalVET Net End	PB11	8/12/04	17:25	57.13537	171.5744	113		napp
CTD215-Start	PB11	8/12/04	17:28	57.13577	171.5748	113		stabeno
CTD216-Start	PB10	8/12/04	18:17	57.13475	171.4053	103		stabeno
CalVET Net Start	PB9	8/12/04	19:07	57.13448	171.2342	100		napp
CalVET Net End	PB9	8/12/04	19:12	57.13522	171.2347	100		napp
CTD217-Start	PB9	8/12/04	19:16	57.1359	171.2363	100	Mooring M3A	stabeno
CTD218-Start	PB8	8/12/04	20:16	57.13557	171.0648	95		stabeno
CalVET Net-Start	PB7	8/12/04	21:12	57.13467	170.8935	87	aborted	napp
CalVET Net End	PB7	8/12/04	21:14	57.13507	170.8925	87	too rough	napp
CTD219-Start	PG2	8/15/04	17:19	57.06043	170.195	35		stabeno
CTD219-End	PG2	8/15/04	17:28	57.05898	170.1944	35		stabeno
CTD220-Start	PG4	8/15/04	18:18	56.98068	170.1028	67		stabeno
CTD221-Start	PG13	8/15/04	21:34	56.6206	169.6931	51		stabeno
CTD221-End	PG13	8/15/04	21:40	56.62162	169.6961	51		stabeno
CTD222-Start	PG12	8/15/04	22:01	56.66113	169.7372	72	nuts, chlo	stabeno

CTD222-End	PG12	8/15/04	22:06	56.66218	169.7386	72	stabeno
CTD223-Start	PG11	8/15/04	22:27	56.70148	169.7824	77 nuts, chlo	stabeno
CTD223-End	PG11	8/15/04	22:33	56.70265	169.7838	77	stabeno
CTD224-Start	PG10	8/15/04	22:54	56.74112	169.8281	76 nuts, chlo	stabeno
CTD224-End	PG10	8/15/04	23:00	56.74198	169.8286	76	stabeno
CTD225-Start	PG09	8/15/04	23:21	56.7816	169.8748	73 nust, chlo	stabeno
CTD225-End	PG09	8/15/04	23:27	56.78327	169.8764	73	stabeno
CTD226-Start	PG08	8/15/200				71 nuts, chlo	stabeno
CTD227-Start	PG7	8/16/04	0:15	56.86183	169.965	70 nuts, chl	stabeno
CTD227-End	PG7	8/16/04	0:21	56.8636	169.9635	70	stabeno
MOCNESS-Start	PG7	8/16/04	0:34	56.86357	169.9707	70	napp
CTD228-Start	PG6	8/16/04	1:46	56.90113	170.01	71 nuts, chlo	stabeno
CTD228-End	PG6	8/16/04	1:52	56.9021	170.0089	71	stabeno
CTD229-Start	PG5	8/16/04	2:19	56.94097	170.0546	71	stabeno
CTD229-End	PG5	8/16/04	2:26	56.94167	170.0535	71	stabeno
CTD230-Start	PG5	8/16/04	2:36	56.94265	170.0519	72 DE17 water	Strom
CTD230-End	PG5	8/16/04	2:41	56.94308	170.0507	72	Strom
CTD231-Start	PG4	8/16/04	3:08	56.98107	170.1012	68 nuts, chlo	stabeno
CTD231-End	PG4	8/16/04	3:13	56.98147	170.1	68	stabeno
CTD232-Start	PG3	8/16/04	3:36	57.02103	170.1468	64 nuts, chlo	stabeno
CTD232-End	PG3	8/16/04	3:42	57.02142	170.1454	64	stabeno
CTD233-Start	PG2	8/16/04	4:06	57.0593	170.197	35 nuts, chlo	stabeno
CTD233-End	PG2	8/16/04	4:08	57.05976	170.1965	35	stabeno
CTD234-Start	PG1	8/16/04	4:34	57.09968	170.2404	28 nuts, chlo	stabeno
CTD234-End	PG1	8/16/04	4:36	57.10005	170.239	28	stabeno
MOCNESS-Start	PC3	8/16/04	8:01	57.34428	170.2717	58	coyle
MOCNESS-End	PC3	8/16/04	8:29	57.33277	170.2267	58	coyle
MOCNESS-Start	PC6	8/16/04	10:27	57.62365	170.258	71	coyle
MOCNESS-End	PC6	8/16/04	10:56	57.6149	170.2197	71	coyle
CTD235-Start	PC6	8/16/04	11:10	57.61485	170.2104	71	coyle
CTD235-End	PC6	8/16/04	11:14	57.61492	170.2104	71	coyle
MOCNESS-Start	PC9	8/16/04	13:01	57.90605	170.2724	73	coyle
MOCNESS-End	PC9	8/16/04	13:29	57.90292	170.3101	73	coyle
CalVET Net Start	PC10	8/16/04	15:37	58.00089	170.2645	73	napp
CalVET Net End	PC10	8/16/04	15:40	58.00035	170.2634	73 redo - cable jammed	napp
CTD236-Start	PC10	8/16/04	15:48	57.99952	170.2629	73	stabeno
CalVET Net Start	PC10	8/16/04	16:03	58.00108	170.266	73	napp
CalVET Net End	PC10	8/16/04	16:07	58.0011	170.2635	73	napp
CTD237-Start	PC10	8/16/04	16:15	58.00137	170.261	73 prim prod, DE 17 fsw	Strom
CTD237-End	PC10	8/16/04	16:19	58.00152	170.2597	73	Strom
CTD238-Start	PC10	8/16/04	16:20	58.00158	170.2599	73 re-do cast 237	Strom, Zee
CTD238-End	PC10	8/16/04	16:25	58.00172	170.2586	73	Strom, Zee
CTD239-Start	PC10	8/16/04	16:44	57.99872	170.265	73 N15	Zee
CTD239-End	PC10	8/16/04	16:51	57.9988	170.2637	73	Zee
CTD240-Start	PC10	8/16/04	17:16	58.00082	170.2644	73 DE17 wsw	Strom
CTD240-End	PC10	8/16/04	17:20	58.00128	170.2641	73	Strom

CTD241-Start	PC9	8/16/04	18:01	57.9057	170.2641	72		stabeno
CalVET Net Start	PC8	8/16/04	18:47	57.8118	170.2649	71		napp
CalVET Net End	PC8	8/16/04	18:51	57.8115	170.2648	71		napp
CTD242-Start	PC8	8/16/04	18:54	57.81175	170.2652	71		stabeno
CTD243-Start	PC7	8/16/04	19:36	57.71817	170.2655	71		stabeno
CalVET Net Start	PC6	8/16/04	20:21	57.62127	170.2669	71		napp
CalVET Net End	PC6	8/16/04	20:24	57.62062	170.2682	71		napp
CTD244-Start	PC6	8/16/04	20:29	57.62398	170.2678	71		stabeno
CTD245-Start	PC5	8/16/04	21:13	57.53102	170.2666	68		stabeno
CalVET Net Start	PC4	8/16/04	21:57	57.4375	170.2666	68		napp
CalVET Net End	PC4	8/16/04	22:00	57.4378	170.2684	68		napp
CTD246-Start	PC4	8/16/04	22:04	57.43828	170.2704	68		stabeno
Drifter-Start	PC4	8/16/04	22:17	57.43828	170.275	68	43709	stabeno
CTD247-Start	PC3	8/16/04	22:54	57.34365	170.2666	56		stabeno
CTD247-End	PC3	8/16/04	22:58	57.34423	170.2678	56		stabeno
CalVET Net Start	PD3	8/17/04	0:13	57.3256	169.9386	55		napp
CalVET Net End	PD3	8/17/04	0:15	57.32653	169.9399	55		napp
CTD248-Start	PD3	8/17/04	0:19	57.32777	169.9415	55		stabeno
CTD249-Start	PD4	8/17/04	0:44	57.3566	169.8746	60		stabeno
CTD249-End	PD4	8/17/04	0:50	57.3587	169.8768	60		stabeno
CalVET Net Start	PD5	8/17/04	1:14	57.38825	169.8124	60		napp
CalVET Net End	PD5	8/17/04	1:16	57.38903	169.8131	60		napp
CTD250-Start	PD5	8/17/04	1:23	57.38905	169.8129	60		stabeno
CTD250-End	PD5	8/17/04	1:29	57.39042	169.814	60	chl,nuts	stabeno
CTD251-Start	PD6	8/17/04	1:56	57.41947	169.7489	63		stabeno
CTD251-End	PD6	8/17/04	2:04	57.42313	169.7505	63	chl, nuts, prim prod	stabeno
CTD252-Start	PD6	8/17/04	2:20	57.42752	169.7518	63	N15	Zee
CTD252-End	PD6	8/17/04	2:27	57.42975	169.7528	63		Zee
CalVET Net Start	PD7	8/17/04	2:46	57.44872	169.6848	67		napp
CalVET Net End	PD7	8/17/04	2:50	57.44975	169.685	67		napp
CTD253-Start	PD7	8/17/04	2:54	57.45158	169.6852	67		stabeno
CTD253-End	PD7	8/17/04	3:00	57.45323	169.6855	67		stabeno
CTD254-End	PD8	8/17/04	3:24	57.48314	169.6211	67		stabeno
CalVET Net Start	PD9	8/17/04	3:56	57.54085	169.4943	70		napp
CalVET Net End	PD9	8/17/04	3:59	57.5416	169.4932	70		napp
CTD255-Start	PD9	8/17/04	4:04	57.54323	169.4918	70		stabeno
CTD255-End	PD9	8/17/04	4:08	57.5444	169.4907	70		stabeno
CTD256-Start	PD10	8/17/04	4:38	57.60565	169.3663	69		stabeno
CalVET Net Start	PD11	8/17/04	5:17	57.66392	169.2417	66		napp
CalVET Net end	PD11	8/17/04	5:20	57.6644	169.2403	66		napp
CTD258-Start	PD12	8/17/04	6:03	57.727	169.1155	65	chl, sf chl	stabeno
CTD259-Start	PD12	8/17/04	6:18	57.72662	169.1167	65	DE18 fsw	Strom
CTD260-Start	PD12	8/17/04	7:03	57.72517	169.1128	65	DE18 wsw	Strom
CTD260-End	PD12	8/17/04	7:08	57.725	169.1107	65		Strom
CTD261-Start	PD12	8/17/04	8:00	57.72243	169.1119	65		coyle
MOCNESS-Start	PD12	8/17/04	8:10	57.71985	169.115	65		coyle
MOCNESS-End	PD12	8/17/04	8:37	57.7166	169.1468	65		coyle

MOCNESS-Start	PD4	8/17/04	11:42	57.35355	169.8834	61		coyle
MOCNESS-End	PD4	8/17/04	12:02	57.34808	169.9159	61		coyle
CalVET Net Start	PB2	8/17/04	15:34	57.13422	170.471	54		coyle
CalVET Net End	PB2	8/17/04	15:36	57.13488	170.4716	54		coyle
CTD262-Start	PB2	8/17/04	15:46	57.13818	170.4732	54		stabeno
CTD263-Start	PB3	8/17/04	16:07	57.13502	170.555	62		stabeno
CalVET Net Start	PB4	8/17/04	16:34	57.1374	170.6432	71		napp
CalVET Net End	PB4	8/17/04	16:37	57.13823	170.6433	71		napp
CTD264-Start	PB4	8/17/04	16:43	57.13465	170.6378	71		stabeno
CTD265-Start	PB5	8/17/04	17:12	57.13483	170.7256	79		stabeno
CalVET Net Start	PB6	8/17/04	17:42	57.1343	170.8095	83		napp
CalVET Net End	PB6	8/17/04	17:45	57.13519	170.8085	83		napp
CTD266-Start	PB6	8/17/04	17:49	57.13623	170.8085	85	nuts, chlo	stabeno
CTD266-End	PB6	8/17/04	17:55	57.13782	170.8074	85		stabeno
CTD267-Start	PB7	8/17/04	18:19	57.13486	170.8938	88	nuts, chlo	stabeno
CTD267-End	PB7	8/17/04	18:25	57.1362	170.8929	88		stabeno
CalVET Net-Start	PB8	8/17/04	19:04	57.13415	171.0643	95		napp
CalVET Net-End	PB8	8/17/04	19:08	57.13512	171.0637	95		napp
CTD268-Start	PB8	8/17/04	19:12	57.13583	171.063	96	nuts, chlo	stabeno
CTD268-End	PB8	8/17/04	19:18	57.13715	171.062	96		stabeno
CTD269-Start	PB9	8/17/04	19:59	57.13422	171.2342	100		stabeno
CTD269-End	PB9	8/17/04	20:05	57.13427	171.2342	100		stabeno
CTD270-Start	PB9	8/17/04	20:17	57.13512	171.2333	100	prods	Zee
CTD270-End	PB9	8/17/04	20:22	57.1354	171.233	100		Zee
CTD271-Start	PB9	8/17/04	20:34	57.1359	171.2326	100	N15	Zee
CTD271-End	PB9	8/17/04	20:41	57.13607	171.2328	100		Zee
CalVET Net Start	PB10	8/17/04	21:21	57.13407	171.4075	104		napp
CalVET Net End	PB10	8/17/04	21:26	57.13391	171.4084	104		napp
CTD272-Start	PB10	8/17/04	21:29	57.1338	171.4091	104		stabeno
CTD273-Start	PB11	8/17/04	22:13	57.13402	171.5753	105		stabeno
CalVET Net Start	PB12	8/17/04	22:57	57.13422	171.7467	109		napp
CalVET Net End	PB12	8/17/04	23:02	57.13486	171.749	109		napp
CTD274-Start	PB12	8/17/04	23:04	57.13533	171.75	109		stabeno
CTD275-Start	PB13	8/17/04	23:47	57.1368	171.918	111	chl, s-f chl	stabeno
CTD276-Start	PB13	8/18/04	0:18	57.13477	171.9162	111	DE19 fsw, wsw	Strom
MOCNESS-Start	PG10	8/18/04	8:56	56.73653	169.827	77	Live Animal Tow	napp
MOCNESS-End	PG10	8/18/04	9:43	56.6883	169.7953	77		napp
CTD277-Start	SES10	8/18/04	19:23	56.90068	166.7999	74		stabeno
CTD278-Start	SES9	8/18/04	20:42	56.73326	166.9688	88		stabeno
CTD279-Start	SES8	8/18/04	22:02	56.56728	167.1364	102		stabeno
CTD280-Start	SES7	8/18/04	23:23	56.4009	167.3029	114		stabeno
CTD281-Start	SES6	8/19/04	0:47	56.23413	167.4685	130		stabeno
CTD282-Start	SES5.5	8/19/04	1:35	56.16102	167.5616	134		stabeno
CTD283-Start	kry09	8/19/04	13:24	54.47115	165.729	356		Hunt
CTD283-End	kry09	8/19/04	13:40	54.47185	165.724	356		Hunt
CTD284-Start	kry06	8/19/04	14:10	54.42783	165.6376	120		Hunt
CTD285-Start	kry05	8/19/04	14:30	54.41405	165.6098	103		Hunt

CTD286-Start	kry04	8/19/04	14:52	54.39953	165.5804	86		Hunt
CTD287-Start	kry03	8/19/04	15:13	54.38147	165.5475	139		Hunt
CTD288-Start	kry02	8/19/04	15:34	54.36973	165.5215	118		Hunt
CTD289-Start	kry01	8/19/04	15:54	54.35587	165.4938	143		Hunt
HTI Transect-Strt	kry01	8/19/04	16:13	54.35513	165.4948	143		coyle
MOCNESS-Start	kry01	8/19/04	18:15	54.40828	165.5995	143		coyle
MOCNESS-End	kry01	8/19/04	18:46	54.38472	165.5547	143		coyle

Appendix B. Positions at which satellite-tracked drifters were released.

Drifter ID	Station	Date	Time (GMT)	Position		Depth (m)
43715	SES1-2	27 July 04	22:18	55.486N	168.216W	200
43722	SES8	28 July 04	08:03	56.549N	167.174W	103
43721	GC3	28 July 04	17:47	56.418N	169.589W	101
43731	GC7	28 July 04	20:47	56.226N	169.606W	364
43734	GB9	30 July 04	01:21	56:091N	168.687W	692
43732	GB3-4	31 July 04	12:00	56.461N	169.336W	100
43730	GD5	31 July 04	19:32	56.448N	170.048W	102
43710	SL9	5 Aug. 04	19:46	56.999N	169.615W	60
43709	PC4	16 Aug. 04	21:17	57.438N	170.275W	68

Appendix C. Log of MOCNESS tows and station numbers.

MOCNESS Tow No	Station Name	MOCNESS Tow No	Station Name
1	SES1 600-100 m	29	CE3
2	SES1 100 - 0	30	CE7
3	SES2	31	CE9
4	SES3	32	CE13
5	SES8	33	CE11
6	SG13	34	M2C5
7	SG10	35	M2C21
8	SG8 400-100 m	36	M2C17
9	SG8 100-surface	37	M2C13
10	SG5	38	M2W5
11	GB9 600-100 m	39	M2W9
12	GB9 100-surface	40	M2W13
13	GB11	41	M2E5
14	GB6	42	M2E9
15	GB3	43	M2E13
16	GC2	44	GA11
17	GD12 600-400 m	45	GA8
18	GD12 100-surface	46	GA5
19	GD9	47	GA2
20	GD7	48	PB5
21	GD5	49	PB9
22	GP11	50	PB11
23	GP8	52	PC3
24	GP5	53	PC6
25	CW15	54	PC9
26	CW12	55	PD12
27	CW9	56	PD4
28	CW5		

Appendix D. Log of CalVET tows and Station Numbers.

CalVET Number	Station Name	CalVET Number	Station Name
1	SES1	60	CE9
2	SES2	61	CE11
3	SES4	62	CE13
4	SES6	63	SL13
5	SES8	64	SL11
6	GC1	65	SL9
7	GC2	66	SL7
8	GC3	67	SL5
9	GC4	68	SL3
10	GC5	69	SL1
11	GC6	70	GA1
12	GC7	71	GA3
13	GC8	72	GA5
14	GC10	73	GA7
15	GC12	74	GA8
16	GC13	75	GA9
17	GB1	76	GA11
18	GB2	77	GA100
19	GB3	78	M2C5
20	GB4	79	M2C7
21	GB5	80	M2C9
22	GB6	81	M2C11
23	GB7	82	M2C13
24	GB8	83	M2W5
25	GB9	84	M2W7
26	GB10	85	M2W9
27	GB11	86	M2W11
28	GD1	87	M2W13
29	GD2	88	M2E13
30	GD3	89	M2E11
31	GD4	90	M2E9
32	GD5	91	M2E7
33	GD6	92	M2E5
34	GD7	93	PG13
35	GD8	94	PG11
36	GD9	95	PG9
37	GD10	96	PG7
38	GD11	97	PG5
39	GD12	98	PG3
40	PG13	99	PG1
41	PG11	100	PB13
42	PG9	101	PB11
43	PG7	102	PB9
44	PG5	104	PC10

45	PG3	105	PC8
46	PG1	106	PC6
47	CW1	107	PC4
48	CW3	108	PD3
49	CW5	109	PD5
50	CW6	110	PD7
51	CW7	111	PD9
52	CW9	112	PD11
53	CW11	113	PB2
54	CW13	114	PB4
55	CW15	115	PB6
56	CE1	116	PB8
57	CE3	117	PB10
58	CE5	118	PB12
59	CE7		

Appendix E. Summary of samples collected for food web analysis.

	Lipids			Stable Isotopes			
Station	**Zoopl.**	**Fish**	**Birds**	**POM**	**Zoopl.**	**Fish**	**Birds**
GC13	Y				Y		
GC8	Y				Y		
SES1	Y			Y	Y		
GB9	Y				Y		
GB3	Y	Y			Y	Y	
GD5	Y			Y	Y		
PG5	Y	Y		Y	Y	Y	
CW6	Y	Y		Y	Y	Y	
CE11	Y	Y		Y	Y	Y	
M2C5	Y	Y			Y	Y	
M2C13	Y	Y		Y	Y	Y	
M2W9	Y	Y		Y	Y	Y	
M2E9	Y	Y		Y	Y	Y	
GA8	Y	Y		Y	Y	Y	
St. Paul	Y		Y		Y		Y
PB9	Y	Y		Y	Y	Y	
PG7	Y			Y	Y		
PC6	Y	Y		Y	Y	Y	
PD12	Y	Y		Y	Y	Y	
PG10	Y	Y			Y	Y	

Appendix F. Wind speed, as recorded on the ship.