CRUISE SUMMARY REPORT

FOR COLLATING CENTRE USE

Centre: .... Ref. No: ....

Is data exchange restricted? ☐ Yes ☐ In part ☐ No

SHIP enter the full name and international radio call sign of the ship from which the data were collected, and indicate the type of ship, for example, research ship; ship of opportunity, naval survey vessel; etc.

Name: R/V Alpha Helix   Call Sign:

Type of ship: research

CRUISE NO./NAME AX-196   enter the unique number, name or acronym assigned to the cruise (or cruise leg, if appropriate).

CRUISE PERIOD start (set sail) 21 | 05 | 1997 (day month year) to 29 | 06 | 1997 (day month year) end (return to port)

PORT OF DEPARTURE (enter name and country) Seward AK USA

PORT OF RETURN (enter name and country) Dutch Harbor AK USA

RESPONSIBLE LABORATORY enter name and address of the laboratory responsible for coordinating the scientific planning of the cruise.

Name: George Hunt

Address: Dept Ecol/Evol Biology, Univ. California, Irvine CA 92697   Country: USA

CHIEF SCIENTIST(S) enter name and laboratory of the person(s) in charge of the scientific work (chief of mission) during the cruise.

George Hunt, Dept Ecol/Evol Biology, U. California, Irvine CA 92697

OBJECTIVES AND BRIEF NARRATIVE OF CRUISE enter sufficient information about the purpose and nature of the cruise so as to provide the context in which the reported data were collected.

It was hypothesized that elevated primary production at the inner front of the southeastern Bering Sea continues longer than in the upper mixed layer of non-frontal waters, and that this production provides an energy source throughout the summer for a food web that supports shearwaters, salmon, and their zooplankton prey. To test this hypothesis, we collected observations of physical and biological features in the vicinity of the inner front to determine: 1) the availability of nutrients in the euphotic zone, 2) the physical processes responsible for enhanced vertical flux of nutrients, 3) primary production, 4) the distribution, abundance and trophic ecology of near-surface swarms of euphausiids and other zooplankton, and 5) the distribution, abundance, and foraging ecology of shearwaters, and 6) by stable isotope enrichment, trophic pathways from phytoplankton to shearwaters at and away from the front. This cruise was the first of four planned for the next two years to obtain the required data.

PROJECT (IF APPLICABLE) if the cruise is designated as part of a larger scale cooperative project (or expedition or programme), then enter the name of the project, and of the organisation responsible for coordinating the project.

Project name:

Coordinating body:

PRINCIPAL INVESTIGATORS: Enter the name and address of the Principal Investigators responsible for the data collected on the and who may be contacted for further information about the data. (The letter assigned below against each Principal Investigator is used on pa and 3, under the column heading 'PI', to identify the data sets for which he/she is responsible)

A. George Hunt, Dept. Ecol/Evol Biol, U. Calif, Irvine, CA 92697 USA

B. Ken Coyle, Inst. Marine Science, U. Alaska, Fairbanks, Fairbanks AK

C. T. Whitledge, Marine Science Institute, U. Texas, Port Aransas TX 78373

D. J. Schumacher/P. Stabeno, Pacific Marine Environmental Lab. NOAA, Seattle WA.

E. S. Zeeman, University of New England, 11 Hills Beach Rd Biddeford ME 04005

F.

MOORINGS, BOTTOM MOUNTED GEAR AND DRIFTING SYSTEMS

This section should be used for reporting moorings, bottom mounted gear and drifting systems (both surface and deep) deployed and/or recovered during the cruise. Separate entries should be made for each location (only deployment positions need be given for drifting systems). This section may also be used to report data collected at fixed locations which are returned to routinely in order to construct 'long time series'.

PI see top of page.	APPROXIMATE POSITION LATITUDE deg	min	N/S	LONGITUDE deg	min	E/W	DATA TYPE enter code(s) from list on cover page.	DESCRIPTION Identify, as appropriate, the nature of the instrumentation, the parameters (to be) measured, the number of instruments and their depths, whether deployed and/or recovered, dates of deployment and/or recovery, and any identifiers given to the site.

Please continue on separate sheet if necessary.

SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN

Except for the data already described on page 2 under 'Moorings, Bottom Mounted Gear and Drifting Systems', this section should include a summary of all data collected on the cruise, whether they be measurements (e.g. temperature, salinity values) or samples (e.g. cores, net hauls).

Separate entries should be made for each distinct and coherent set of measurements or samples. Different modes of data collection (e.g. vertical profiles as opposed to underway measurements) should be clearly distinguished, as should measurement/sampling techniques that imply distinctly different accuracies or spatial/temporal resolutions. Thus, for example, separate entries would be created for i) BT drops, ii) water bottle stations, iii) CTD casts, iv) towed CTD, v) towed undulating CTD profiler, vi) surface water intake measurements, etc.

Each data set entry should start on a new line - it's description may extend over several lines if necessary.

NO, UNITS : for each data set, enter the estimated amount of data collected expressed in terms of the number of: 'stations'; 'miles' of track; 'days' of recording; 'cores' taken; net 'hauls'; balloon 'ascents'; or whatever unit is most appropriate to the data. The amount should be entered under 'NO' and the counting unit should be identified in plain text under 'UNITS'.

PI see page 2	NO see above	UNITS see above	DATA TYPE enter code(s) from list on cover page.	DESCRIPTION Identify, as appropriate, the nature of the data and of the instrumentation/sampling gear and list the parameters measured. Include any supplementary information that may be appropriate, e.g. vertical or horizontal profiles, depth horizons, continuous recording or discrete samples, etc. For samples taken for later analysis on shore, an indication should be given of the type of analysis planned, i.e. the purpose for which the samples were taken.
A	3,992	km	B25	survey of bird numbers, behaviour -
A	45	birds	B25	collected for stomach contents, stable isotopes + fatty acids
B	39	tows	B09	MOCNESS tows - with 9 nets opened/tow
B	67	tows	B09	CalVET nets - vertical tows
B	1200	km	B28	acoustic survey - zooplankton 100 + 43 kHz
C	900	samples	H22, H24 H25, H76 H26	Nutrient samples for analysis of nitrate, nitrite ammonium, silicate, phosphates
C	700	samples	B02	chlorophyll
C	100	samples	B02	HPLC analysis
C	7	experiments	B01	primary productivity - N^{15}
C	10	experiments	B01	nutrient amendments
D	298	casts	H10	CTD casts - T, S, ~~sigma~~ PAR, O_2 transmissometer, fluorescence
E	31	experiments	B01	Deck Productivity - C^{14}
E	8	experiments	B01	In situ productivity - C^{14}
E	6	experiments	B01	Deck Productivity N^{15}

Please continue on separate sheet if necessary.

K CHART: You are strongly encouraged to submit, with the completed report, an annotated track chart illustrating the route followed and the points where measurements were taken.

Insert a tick (✓) in this box if a track chart is supplied. ☐

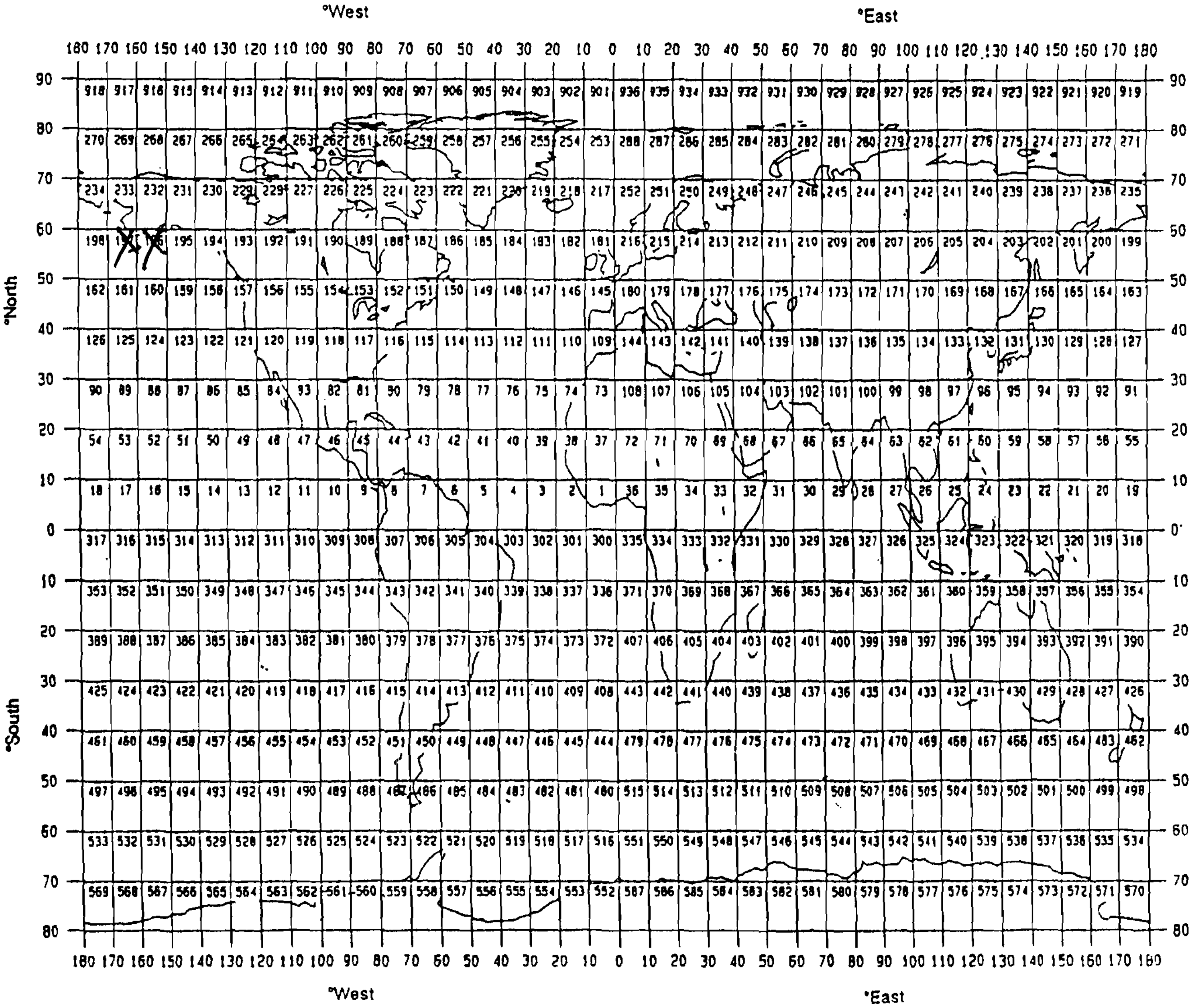
GENERAL OCEAN AREA(S): Enter the names of the oceans and/or seas in which data were collected during the cruise - please use commonly recognised names (see, for example, International Hydrographic Bureau Special Publication No. 23, 'Limits of Oceans and Seas').

southeastern Bering Sea

SPECIFIC AREAS: If the cruise activities were concentrated in a specific area(s) of an ocean or sea, then enter a description of the area(s). Such descriptions may include references to local geographic areas, to sea floor features, or to geographic coordinates.

southeastern Bering Sea, including Bristol Bay, inshore waters near Nunivak Island, inshore waters of the Pribilof Islands, shelf edge between Pribilof Islands and Unimak Pass

GEOGRAPHIC COVERAGE - INSERT 'X' IN EACH SQUARE IN WHICH DATA WERE COLLECTED



THANK YOU FOR YOUR COOPERATION

Please send your completed report without delay to the collating centre indicated on the cover page

http:// www.census.gov/geo/www/tiger-index.html
www.geo.ed.ac.uk/home/ded.html

CRUISE REPORT

ALPHA HELIX CRUISE 196

29 May 1997 to 28 June 1997

www.ngdc.noaa.gov/mgg/global/seltopo.html

I. Project Title: Collaborative Research: Prolonged production and trophic transfer to predators: Processes at the Inner Front of the Southeastern Bering Sea

Principal Investigator: George L. Hunt, Jr.
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Support: NSF OPP-9617287

II. Scientific Purpose:

Each year millions of short-tailed shearwaters (*Puffinus tenuirostris*) migrate from Australia to the Bering Sea to forage over the inner shelf. The evolution of this annual trans-equatorial migration implies that extraordinary amounts of prey must be readily available to these birds in the Bering Sea. We hypothesized that elevated primary production at the inner front continues longer than in the upper mixed layer of non-frontal waters, and that this production provides an energy source throughout the summer for a food web that supports shearwaters, salmon, and their zooplankton prey. To test this hypothesis, we collected observations on physical and biological features in the vicinity of the inner front to determine: 1) the availability of nutrients in the euphotic zone (T. Whitledge, U. Texas), 2) the physical processes responsible for enhanced vertical flux of nutrients (J. Schumacher and P. Stabeno, NOAA/PMEL), 3) primary production (S. Zeeman, U. New England), 4) the distribution, abundance and trophic ecology of near-surface swarms of euphausiids and other zooplankton (K. Coyle, U. Alaska, Fairbanks), and 5) the distribution, abundance, and foraging ecology of shearwaters (G. Hunt, U. California, Irvine, lead investigator), and 6) by stable isotope enrichment, trophic pathways from phytoplankton to shearwaters at and away from the front (K. Coyle, T. Whitledge and S. Zeeman). This cruise was the first of four planned for the next two years.

III. Personnel

George Hunt	Chief Sci.	UCI	USA	Ornithology
Ken O. Coyle	Co-PI	U. AK Fairbanks	USA	Zooplankton
Terry Whitledge	Co-PI	U. Texas	USA	Nutrients
Steve Zeeman	Co-PI	U. New England	USA	Primary Production
Dean Stockwell	Res. Assoc.	U. Texas	USA	Nutrients
Sigrid Salo	Res. Assoc.	PMEL	USA	Physical Oceanog.
Cheryl Baduini	Student	UCI	USA	Ornithology
Nina Karnovsky	Student	UCI	USA	Ornithology
Gregory Savage	Technician	UCI	USA	Ornithology
Milissa Jump	Technician	U. New England	USA	Primary Production
Alexey Pinchuk	Technician	U. AK Fairbanks	Russian	Zooplankton

IV. Cruise Schedule

DATE	ACTIVITY
May 29	Depart Seward 09:00
May 29 - 31	In Transit
June 1 - 6	Work in Slime Bank Grid
June 7 - 8	Med Evac run to Dillingham
June 9 - 11	Work in Port Moller Grid
June 12 - 15	Work in Cape Newenham Grid
June 16 - 21	Nunivak Island Grid
June 22 - 23	Comparative frontal studies at Pribilof Islands
June 24 - 27	Comparative studies at Outer Front
June 28	To Dutch Harbor
June 29	Depart vessel 08:00

V. Results:

Overview:

The spring of 1997 was marked by what has been reported as unusually mild weather; June was exceptionally calm, with winds generally below 15 knots throughout the cruise. As a result, work on the ship went more efficiently than expected, and we completed the planned work at our four study sites, Slime Bank and Port Moller along the south side of Bristol Bay, and Cape Newenham and Nunivak Island, on the north side of Bristol Bay (Figures 1, 2 ,3, 4a, 4b, 5a, 5b) in 21 days. We used the remaining time to conduct additional observations at stations across the middle domain (Figure 6), in the vicinity of the fronts surrounding the Pribilof Islands (Figure 7, 8), and across the shelf edge region between St. George Island and Unimak Pass (Figure 9). Thus *in toto*, we obtained a detailed examination of processes in the inner shelf domain, in the corresponding nearshore domain at the Pribilof Islands, and at the shelf edge, where processes were expected to contrast with those at the inner front.

The calm weather resulted in a lack of wind mixing of the upper ocean. Thus, instead of unstratified water occurring inshore of the 50 m isobath as is usually the case in late spring, stratified water occurred in water as shallow as 20 m in June 1997. Possibly as a result of the calm weather, there was a marked separation between the thermal signature of the inner front and the nutrient front at the Cape Newenham and Nunivak Island sites. In contrast, nutrients were present at and inshore of the inner or structural front at the Slime Bank and Port Moller study sites. The Slime Bank, and to a lesser extent, the Port Moller grid were expected to have higher nutrient levels as a result of advection from cross-shelf circulation, and elucidation of the origin of these nutrients will be a prime focus of the physical oceanography component of the project.

Physical Oceanography (Sigrid Salo):

To document the hydrographic structure and flow patterns, at both the Slime Bank and Nunivak Island grids we conducted a detailed CTD survey of five lines, followed by an XBT survey through the center of the grid (Figures 2, 5a,b). At the two additional sites, Port Moller and Cape Newenham, we conducted an abbreviated CTD survey that covered three of the five lines surveyed in the two primary grids (Figures 3, 4a,b). At all four of the grids we extended our planned coverage onshore to locate well mixed water which was only found inshore of the 50 m isobath. Additionally, at Cape Newenham and Nunivak Island, we extended the grids well offshore into the middle domain to locate the nutrient pool, a feature which normally extends close to the 50 m isobath, but in this year was widely separated from the normal location of the inner front. Additional CTD surveys were made in the vicinity of the inner fronts at St. Paul Island and St. George Island to sample the structural fronts, and across the outer shelf between St. George Island and Unimak Pass. In total we made 298 CTD casts. On each cast, temperature, conductivity, PAR, fluorescence and O2 values were recorded, and water was collected at the bottom for salinity analysis. Additionally, on most casts, water was taken from selected depths for sampling nutrients, chlorophyll, and/or for analysis of pigments by HPLC. Appendix 1 provides the positions at which CTDs were taken.

Conditions on the shelf during this cruise were affected by last winter's ice, which covered the Nunivak Island and Cape Newenham grids, but did not cover the two lower sites at Port Moller and Slime Bank. Ice retreated north of Nunivak little more than a month before we arrived there. Since that time, the surface has been warmed by the air, but this spring has been less windy than usual, so that the winds have been less effective in mixing the shelf from the top. Therefore, the inner front, which occurs where the bottom tidal mixing and the surface wind mixing can together mix the entire water column, was weaker or shallower than has been reported in previous studies.

Temperature was the most useful indicator of vertical mixing and the position of the inner front, and most of this preliminary discussion of the results of the physical oceanographic data set will concern temperature. There was little variation in salinity at the Nunivak Island or Cape Newenham sites. Although there was more salinity stratification and horizontal variation in salinity at the two southern sites, Port Moller and Slime Bank, even there the difference between the surface and bottom salinity was less than 0.2 PSU.

Slime Bank and Port Moller:

Water temperature patterns at Slime Bank (Figure 10) and Port Moller (Figure 11) were similar. Offshore, surface temperatures were higher than 7 °C and bottom temperatures lower than 3 °C. As we progressed inshore, bottom temperature increased above 3 °C, and often at roughly the same isobath, the surface temperature decreased below 7 °C. At Slime Bank (Figure 10), this diminution of temperature range occurred at between the 60 m and 70 m isobaths. When water depths decreased to 50 m, bottom water exceeded 4 °C and surface temperature dropped below 6 °C. As of the 30-35 m isobath, the water column was essentially well-mixed. Surface temperature was more variable at Port Moller (Figure 11). The near bottom temperature change occurred at roughly 50 m, but the near surface water remained stratified well inshore of this depth. We never reached well-mixed water at this site, although we sampled depths of less than 20 m. At Port Moller, the modest stratification (0.2 PSU) inshore of the 50 m isobath would have tended to restrict mixing.

Cape Newenham:

The Cape Newenham transect (Figure 12) was over a wide part of the shelf where the depth difference between two consecutive stations was often only 2 m. This transect was stratified, with surface temperatures greater than 6 °C and bottom temperature near 2 °C at depths greater than about 45m. Near this isobath, bottom temperature increased above 3 °C. Surface temperature was patchy, but tended to be lower here than farther offshore. This suggests that the upper and lower layers were undergoing some mixing within themselves and that the thermocline was being eroded, although it had not been destroyed. Only on line C, which we extended all the way in to Cape Newenham, did we observe well-mixed water. On that transect, the water became nearly isothermal at a depth near 30 m. The distance between the well-mixed site and the beginning of the erosion of the thermocline was about 100 km.

Nunivak Island:

The temperature structure at the Nunivak Island grid was two-layered all the way in to near the 40 m isobath, although there was a transition from somewhat strongly stratified (3-5 °C temperature difference) offshore to weakly stratified (1.5 °C) inshore (Figure 13). The outer edge of this transition zone, the location where the 1 °C isotherm touched bottom, was located in 55-60 m of water. Its inner edge, marked by the presence of bottom water greater than 2 °C, was at 50-55 m. This zone was about 10-15 km wide. Surface temperatures were greater offshore (4.1-4.6 °C) than inshore (3.5-3.9 °C) of this transition zone, indicating that surface waters were being cooled by some mixing inshore of the zone. Bottom water temperatures shoreward of the 50-55 m isobath remained between 2-3 °C all the way to near-shore, when they climbed above 3 °C. At line E (but not line C), stratification increased again in the region where the depth was between 35-42 m because of a warmer surface layer. This would appear to suggest less vertical mixing in this region, although there is no obvious explanation for the decrease, since there was no salinity stratification.

St. Paul Island, Pribilof Islands:

At the structural front north of St. Paul Island (Figure 14), water was stratified in both temperature and salinity; with salinity differences between the surface and the bottom up to 0.5 PSU and temperature differences of 3-4 °C offshore. The halocline was slightly deeper than the thermocline, since it was established first by the melting of sea ice and then restricted mixing, thereby allowing a thermocline to develop during spring warming. The first decrease in the strength of the pycnocline occurred near the 60 m isobath; water at the station near the 40 m isobath was well-mixed.

St. George Island, Pribilof Islands:

South of St. George Island, water was well-mixed within 5-10 km seaward from our shallowest station, at water depths of up to 90 m (Figures 15, 16). Beyond that depth, water was stratified, with a fairly broad thermocline 10-35 m thick where temperature decreased from 7 °C to 5 °C. There was no halocline, but between the two deepest stations of SG5 line (Figure 15), which was taken just at the western lobe of Pribilof Canyon over depths of 397 and 1673 m, there was a salinity front where surface salinity changed by 0.4 PSU, and salinity at 200 m changed by 0.2 PSU over that distance. A second line SG4, was run SE from St. George Island and crossed the top of the Pribilof Canyon (Figure 16).

Outer Shelf Region:

A salinity front, similar to that present at the shelf edge south of St George Island, was seen at the shelf break on the outer shelf transect (Figure 17). There the surface salinity changed by 0.6 PSU between the station at 139 m and the one at 208 m. There is a slight possibility that there was an eddy beyond this front, since the isohalines and isopycnals dome. At the final site, over a broader shelf break southeast of the first outer shelf transect, there was also a broader salinity front in water deeper than 1000 m, where salinity changed by 0.3 over several stations.

Productivity and Nutrient Studies:

a) **Nutrient, Phytoplankton Pigments and Nitrogen Productivity** (Terry Whitledge and Dean Stockwell):

The task of this group was to provide information on the coupling of the physical transport and circulation of water masses to the productivity of the waters through nutrient enrichment and regeneration. A special emphasis was placed on the frontal areas between the middle and inner shelf areas where many higher trophic level organisms forage and reproduce. The four regions of study provided comparisons of areas that are all known to support significant concentrations of foraging organisms, but probably have varying influences of advective and riverine inputs.

To assess the coupling of physical processes associated with the inner shelf and the frontal region between the inner and middle shelf regions, we conducted surveys and detailed process studies of nutrient distributions, phytoplankton biomass, general phytoplankton composition and phytoplankton nutrient uptake measurements in four study regions: Slime Bank, Port Moller, Cape Newenham and Nunivak Island. In total more than 200 stations were sampled for the above parameters in the four study areas. In addition, stations along transects crossing the fronts north of St. Paul Island and south of St. George Island were sampled, as were the fronts of the outer shelf region.

Nutrient samples for nitrate, nitrite, ammonium, phosphate and silicate were analyzed on shipboard with an Alpkem RFA 300. Typically, all depths of the CTD/rosette hydrocasts were analyzed. Special efforts were made to sample unusual phytoplankton maxima as indicated by the *in situ* profiling fluorometer. Nutrient samples were analyzed from nitrogen productivity stations to determine gross changes during the incubations and for comparison with N-15 uptake experiments. Samples were also frozen for later analyses of urea and dissolved organic nitrogen (DON) concentrations.

Phytoplankton pigments were sampled intensively to determine phytoplankton biomass for comparison with nutrient abundance and distributions and phytoplankton productivity studies. Samples for high performance liquid chromatography (HPLC) analysis of pigments were also collected to provide information on the general phytoplankton groups in the plankton community.

Uptake of N-15 nitrogen isotopes of ammonium, nitrate and urea were conducted at all of the study sites. Both 10 percent and saturated additions of the isotopes were used to estimate the rate of phytoplankton utilization of nitrogen under low and high concentrations. Some nitrogen isotope studies were accompanied with amendment studies to assess the potentially limiting substance(s). Additional nutrient and trace metal amendment studies were undertaken with several different combinations of nutrients and other possibly important limiting substances.

Slime Bank:

At the Slime Bank grid, three transects were sampled for nutrients and pigments in coordination with CTD stations. More than 200 nutrient and 180 chlorophyll samples were analyzed across the shelf. HPLC samples were collected for phytoplankton composition with 67 samples. Four N-15 nutrient uptake experiments were collected at the inner, middle and outer regions of the inner front with nitrate, ammonium and urea isotopes. Three nutrient amendment studies were accomplished across the inner shelf. The nutrient studies showed a generally low concentration of nutrients in the upper euphotic zone, although there was still an area rich in nutrients below the pycnocline (Figures 20 and 21). It was apparent at this point of the cruise that the unusual weather patterns over the prior several weeks had not produced the typical wind mixing that periodically enriches the euphotic zone for a few days.

Port Moller:

At the Port Moller grid, we collected about 200 nutrient and almost 150 chlorophyll samples in three cross shelf transects. Nine HPLC samples were collected from the surface and at depth at the corners of the study area. Two N-15 uptake studies and two nutrient amendment studies were accomplished in this interesting area of Bristol Bay. Nitrate distributions were low in concentration in the upper water column, and the lower layer contained smaller concentrations of nitrate compared to Slime Bank (Figs 3 and 4). However, at Port Moller there were larger quantities of ammonium in the lower layers of than at Slime Bank, indicating smaller advective inputs and larger contribution from regeneration. The comparison between the Slime Bank and the Port Moller grids also indicated that the thermal stratification in 1997 was unusually large and was probably inhibiting renourishment of the upper layers that might have occurred by wind mixing.

Cape Newenham:

In the Cape Newenham grid, we collected about 200 nutrient and 160 chlorophyll samples over the three main lines of the sampling grid. N-15 uptake studies were performed in the inner and outer parts of the grid and 11 HPLC samples were collected at locations of chlorophyll gradients. One nutrient amendment experiment was completed in the inshore area where there were very low nitrate concentrations and small concentrations of ammonium (Figures 22 and 23). Preliminary results of amendment additions indicated that additions other than nitrogen or phosphorus increased biomass most rapidly. This study area increased the concern that normal rates of primary production may not be occurring in 1997 due to the unusually calm and warm weather; the very strong thermocline probably inhibited normal enrichment processes.

Nunivak Island:

In the Nunivak Island grid, we collected more than 200 nutrient and 140 chlorophyll samples on the three transects. Five HPLC samples were collected, three N-15 uptake experiments were performed and one amendment study was completed. Concentrations of both nitrate and ammonium were lower than in previous areas (Figures 24 and 25). A strong indication of trace metal limitation was observed in the amendment studies and was later confirmed in a special N-15 study. Nutrient analyses of N-15 studies also confirmed that ammonium uptake was much greater than that of nitrate.

Other Sampling:

Additional sampling investigated the extent of depletion of shelf waters between Nunivak Island and the Pribilof Islands, north of St. Paul Island, south of St. George Island, and across the outer shelf between St. George Island and Unimak Pass from the apparently unusual weather. While the effect was noticeable across the shelf, the inner regions contained the areas of most severe nutrient depletion. Likewise the preliminary estimate of biomass of chlorophyll was much lower than expected from previous data collected in the area. Sampling later in the summer season during the upcoming August-September 1997 cruise will possibly show the effects of this apparently unusual year.

b) Productivity (Stephan I. Zeeman and Melissa Jump):

Primary productivity was measured on this cruise by ^{14}C uptake and ^{15}N uptake. Comparisons were made of *in situ* production and that measured in a deck incubator using fluorescent light. The *in situ* measurements were made both with bottles filled at the surface with water collected at depth, and chambers which would fill at depth. Comparisons were also made between ^{14}C uptake and ^{15}N in the incubators. Table 1 lists the stations where experiments were conducted, and shows their location relative to the fronts.

Uptake rates in the incubators will be used to model water column production. The P-I curves will be used to calculate production rates at meter intervals from the surface to the bottom (or as deep as light penetration allowed). We will then employ a numerical model that uses the P-I curves, chlorophyll profiles (from the CTD fluorometer), light extinction (from the PAR sensor on the CTD), and irradiance from 10-minute averages of surface PAR collected with a deck sensor to estimate total production. Before the model can be run, the production data require further processing of the uptake rates, and the CTD fluorometer requires calibration with chlorophyll samples that will be extracted at the University of Texas, Port Aransas.. Likewise, the ^{15}N uptake rates will be calculated after processing on the mass spectrometer at University of Texas, Port Aransas.

Along one line in each grid, water samples were collected from several depths to be analyzed on a spectrofluorometer for dissolved organic matter (DOM). Then, as part of a NASA funded study, the DOM spectra will be used to look for a DOM signal in remotely sensed data from SeaWiFS.

Initial impressions from the counting of productivity samples at sea are that the Slime Bank grid had the highest productivity rates, with raw counts here being on the order of 3000-6000 dpm (disintegrations per minute). There were some locations within the Port Moller grid with indications of elevated production, but most sites in the three study grids other than Slime bank had raw counts of 1000 or less.

The Outer Shelf transect showed an interesting phenomenon in that the counts at station OS-5 were around 3000 dpm, while at the other stations counts were around 600 dpm. The chlorophyll concentration however was greatest at OS-2 with 1.6 Volts on the fluorometer versus 0.5 Volts at the other two sites. Station OS-5 was at the shelf-break front, and the higher production is more than likely caused by a favorable nutrient regime there. This region was also highly dynamic, with major chlorophyll features moving distances greater than 20 km in a 24 hr period.

Zooplankton (Ken Coyle and Alexey Pinchuk):

The goals of the zooplankton component of the inner shelf process study were the following:

a) Determine the depth distribution and abundance of adult and juvenile euphausiids relative to the position and intensity of the inner front.

b) Determine any consistent differences in the cross-shelf species composition of zooplankton that may be related to the location and intensity of the inner front.

c) Determine the stable isotope ratio of zooplankton from the inner and middle domains and the inner front to document potential differences in the trophic position of zooplankton relative to the frontal region.

Euphausiids were particularly emphasized in this study because they are a major food of short-tailed shearwaters, and shearwaters were identified as an important indicator of conditions promoting rapid transfer of production from phytoplankton to apex predators. Due to net avoidance, euphausiids cannot be reliably assessed with nets alone. Therefore, the sampling design incorporated both acoustic and net assessments at night to document the depth distribution and density of potential euphausiid layers. As large fish are a major component of the shelf ecosystem in the Bering Sea, target strength data were gathered to identify layers composed of fish rather than zooplankton. The acoustic equipment included an HTI model 244 split beam echosounder using 43 and 120 kHz. Net sampling was done using a MOCNESS system with 0.5 mm mesh to assess macrozooplankton and micronekton densities and species composition. In addition, a CalVET net with 0.149 mm mesh was used to assess the smaller zooplankton taxa not retained by the MOCNESS.

Nine transects with bird and acoustic sampling were completed through the inner domain, inner front and into the middle domain in the four study sites: two at the Slime Bank, Port Moller and Cape Newenham and three at the Nunivak Island site. In addition, a long transect was done over the shelf break and outer shelf between the Pribilof Islands and Unimak Pass.

Thirty eight MOCNESS tows were completed during the cruise. Most were done at night to insure optimal conditions for assessment of euphausiids. Euphausiids on the inner shelf consisted primarily of *Thysanoessa raschii*. Adult females were observed in the samples at the Slime Bank and Cape Newenham. Samples from the Nunivak Island region seemed to consist primarily of juveniles. Some samples from the middle domain included almost exclusively furcilid stages. Preliminary observation of the acoustic and MOCNESS data suggest that euphausiids in the Inner Domain and Inner Front area did not occur as dense layers but as small aggregates, both above and below the pycnocline. The MOCNESS tows at Slime Bank and Port Moller were dominated by large specimens of the schyphozoan *Chrysaora melanaster*. Tows in the Cape Newenham region were dominated by *Calanus marshallae*. Samples from the outer shelf and Aleutian Basin were dominated by *Thysanoessa longipes, Neocalanus cristatus* and *Neocalanus plumchrus/flemingeri*. Shallow samples from all regions included juvenile fish, potential sources of elevated sound scattering.

Sixty seven CalVET samples were obtained at CTD stations across the various study sites from the inner to outer stations. In addition, specimens of species from a variety of trophic levels were sorted from samples at the inner, outer and frontal regions of the various sites and dried at 40 ^{o}C for stable isotope analysis. Table 2 lists the locations of the MOCNESS tows, Table 3, the locations of the CalVET tows, and Table 4, the times and locations of acoustic surveys.

Marine Ornithology (George Hunt, Cheryl Baduini, Nina Karnovsky and Gregg Savage):

Bird observations were made when the ship was underway at speeds of 5 knots or greater. 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 of all birds were recorded, with particular attention being paid to whether shearwaters were feeding at the surface by hydroplaning or were diving deeply.

Forty-two short-tailed shearwaters , two common murres (*Uria aalge*) and one thick-billed murre (*U. lomvia*) were collected in the study areas. When possible, shearwaters that were actively feeding were selected, or when necessary, birds that were resting on the surface. Both morning and evening collections were made at Slime Bank and Cape Newenham. Stomach contents were removed from birds within 1 hour of collection, and stored in 80% ETOH for processing in the laboratory. In addition to stomach contents, samples of brain, pectoral muscle, intestine and liver were obtained from 17 short-tailed shearwaters, 2 common murres and one thick-billed murre were taken for stable isotope analysis. We also sampled fatty tissues from 30 shearwaters for analysis of fatty acid composition as a means of determining overall dietary composition.

Slime Bank:

At the Slime Bank grid, foraging and resting short-tailed shearwaters were abundant inshore of a distinct inner front. Relatively few birds were seen resting or foraging at or offshore of the inner front. Except for one evening collection, when one of five shearwaters had fish remains in its gut, shearwaters collected both in the morning and the evening had eaten euphausiids exclusively. In two instances, large flocks of feeding shearwaters were in the vicinity of schools of small fish that boiled at the surface. In these flocks, some of the shearwaters were hydroplaning. The fish may have been capelin (10-15 cm, with reddish purple sides), and the shearwaters were apparently not feeding on the fish. Ken reported that adult euphausiids were abundant in his MOCNESS tows inside the front at the Slime Bank grid, and Terry reported that both chlorophyll and nutrients were present inshore of the front.

Port Moller:

At Port Moller, shearwaters were less numerous than at Slime Bank, and most foraging and resting birds were at, or seaward of, the weak inner front. Birds collected in the morning had eaten euphausiids. Some of those collected had nearly empty to half-full stomachs, suggesting that little foraging had occurred during the night. At Port Moller, Ken reported few or no adult euphausiids inshore of the inner front, and Terry indicated that both nutrients and chlorophyll were scarce inshore of about the 50 m isobath.

Cape Newenham:

Shearwaters at Cape Newenham were found resting and foraging primarily inshore of the temperature front, which was widely separated from the offshore nutrient front. Birds were observed foraging from 06:00 to about 20:00, suggesting no diel cycle to their foraging; shearwaters collected both in the morning and in the afternoon were eating exclusively euphausiids. Most foraging flocks moved swiftly, with birds in the front diving and birds behind flying beyond those under water to dive in front of them. Dives were mostly short, between 10 and 15 sec. in duration. Ken reported small scatted patches of biomass (probably euphausiids) 10 to 15 m below foraging birds. In one case, stronger targets, presumably fish, were present beneath the near-surface patches believed to be euphausiids.

Nunivak Island:

At Nunivak Island, we observed few shearwaters on the water and no foraging groups. Ken reported that although euphausiids were abundant inshore of the 50 m isobath, most were small immatures, and therefore possibly not good shearwater food. It is possible that growing conditions for euphausiids at this, the most northern grid, are such that the maturation of euphausiids is delayed.

Other Observations:

Work at both the Pribilof Islands and at the shelf-edge revealed few shearwaters until our last days at the shelf-edge when several flocks were encountered. These areas did, however, yield new information on the foraging of murres and red-legged kittiwakes (*Rissa brevirostris*)from St. George Island, which were seen south over deep water toward Unimak Pass. Flight directions and time of day indicated that an origin at Bogoslof Island was unlikely. These observations suggest that events far from the colonies may be important in determining food availability to the red-legs. It will be useful to repeat these observations another year, when oceanographic conditions are more "normal," as 1997 seemed quite atypical. We also obtained a very strong signal from fork-tailed storm-petrels (*Oceanodroma furcata*)that were aggregated at the strong salinity front near the shelf edge.

Acknowledgments

We thank the Captain, William Rook, and the crew of the R/V Alpha Helix for their support and professionalism during our cruise. We especially appreciate their flexibility in adjusting work loads and job categories so that we lost minimal time from our research when they had to work short-handed. The positive, helpful attitude of the crew deserves high praise and recognition by UNOLS. We would also like to single out the efforts of Marine Technician, Steve Hartz, whose dedication and skill were instrumental in correcting problems with materials or instruments brought by the scientific party. Over the years, Steve's efforts at developing and upgrading the acquisition and processing of electronic data on the ship have greatly improved the capacity of the R/V Alpha Helix as a research platform. Steve also deserves recognition and praise from UNOLS for going well beyond the ordinary in ensuring that the cruises on the R/V Alpha Helix are successful.

Table 1- Spatial distribution of locations of *In Situ* and deck productivity experiments.

	Inside			Front		Outside
Slime Bank		SBD2		SBB4		SBB8
					(*In situ*)	
	SBC1		SBC4		SBC11	
	(^{15}N, *in situ*)		(*in situ*)		(*in situ*)	
Port Moller		PMA2		PMA4		PMA11
					(^{15}N)	
	PMC1				PMC11	
	(*in situ*)				(*In situ*)	
Cape Newenham		CNCX11		CNEX6		CNE11
(no real front)		(*In situ*)				CNC14
	CNEX10		CNEX8		(^{15}N)	
Nunivak Isl.		NICX16		NIA7		NIC12
					(^{15}N)	
	NICX6	NIC1				
	(*In situ*)					
St. Paul	SPI2				SPI5	
		SPI3		SPI4		
		(^{15}N)		(^{15}N)		
St. George		SG4_1				SG4_3
Outer Shelf		OS7		OS5		OS2

Table 2- Times and locations of MOCNESS sampling

Sample #	Local Time	GMT	Latitude	Longitude
MOC1	06-03 1705	06-04 0105	55 19.10	163 55.90
MOC2	06-03 2018	06-04 0418	55 08.39	163 40.77
MOC3	06-03 2214	06-04 0614	55 12.49	163 44.49
MOC4	06-03 2353	06-04 0753	55 17.20	163 48.25
MOC5	06-04 0212	06-04 1012	55 15.54	164 00.21
MOC6	06-04 0439	06-04 1239	55 08.02	163 53.57
MOC7	06-04 2052	06-05 0452	55 30.16	163 58.52
MOC8	06-05 2016	06-06 0416	55 12.12	163 55.87
MOC9	06-05 2156	06-06 0556	55 15.51	163 52.92
MOC11	06-06 0303	06-06 1103	55 25.93	164 07.92
MOC12	06-09 0037	06-09 0837	55 38.83	159 55.30
MOC13	06-09 0313	06-09 1113	56 37.71	160 02.36
MOC14	06-09 2343	06-10 0743	56 47.31	160 39.15
MOC15	06-10 0154	06-10 0954	56 48.11	160 24.98
MOC16	06-10 1857	06-11 0257	56 51.89	160 30.82
MOC17	06-10 2105	06-11 0505	56 45.92	160 21.31
MOC18	06-11 0039	06-11 0839	56 34.25	160 03.89
MOC19	06-11 0211	06-11 1011	56 38.07	160 09.37
MOC20	06-14 1459	06-14 2259	58 08.24	162 34.86
MOC21	06-14 1706	06-15 0106	58 04.17	162 39.71
MOC22	06-15 0128	06-15 0928	58 01.57	162 32.30
MOC23	06-15 0413	06-15 1213	58 04.12	162 35.99
MOC24	06-15 1308	06-15 2108	58 20.66	162 12.62
MOC25	06-16 0027	06-16 0827	57 24.21	163 12.11
MOC26	06-16 0150	06-16 0950	57 20.72	163 15.83
MOC27	06-18 0112	06-18 0912	58 15.13	169 00.65
MOC28	06-18 0354	06-18 1154	58 25.03	168 49.86
MOC29	06-19 0112	06-19 0912	59 34.02	167 18.44
MOC30	06-19 0227	06-19 1027	59 35.47	167 20.40
MOC31	06-20 0046	06-20 0846	58 34.19	168 27.29
MOC32	06-20 0301	06-20 1101	58 38.10	168 29.97
MOC33	06-21 0111	06-21 0911	59 22.90	167 30.98
MOC34	06-21 0308	06-21 1108	59 17.61	167 37.10

MOC35	06-23 0242	06-23 1042	55 53.90	169 47.39
MOC36	06-24 0133	06-24 0933	56 13.08	168 26.51
MOC37	06-25 0256	06-25 1056	55 21.90	168 11.67
MOC38	06-26 0045	06-26 0845	55 50.83	167 00.35
MOC39	06-27 0247	06-27 1047	55 11.40	168 03.62

Table 3- Times and locations of CalVET net samples

Sample #	Local Time		GMT		Latitude	Longitude	Tow Depth	Bottom Depth
#1	06-03	1430	06-03	2230	55 14.48	163 52.23	50 m	52 m
#2	06-04	1323	06-04	2123	55 05.50	163 56.17	26 m	27 m
#3	06-05	1337	06-05	2137	55 29.68	164 12.30	90 m	96 m
#4	06-05	1555	06-05	2355	55 22.82	164 05.39	86 m	92 m
#5	06-05	1658	06-06	0058	55 18.07	164 01.35	70 m	74 m
#6	06-05	1736	06-06	0136	55 15.50	163 59.26	50 m	55 m
#7	06-05	1802	06-06	0202	55 13.11	163 71.00	46 m	51 m
#8	06-05	1829	06-06	0229	55 10.67	163 55.13	41 m	42 m
#9	06-05	1856	06-06	0256	55 02.23	163 53.16	29 m	30 m
#10	06-09	1143	06-09	1943	56 52.17	160 31.25	65 m	68 m
#11	06-09	1220	06-09	2020	56 50.11	160 27.94	59 m	60 m
#12	06-09	1303	06-09	2103	56 48.09	160 24.74	66 m	67 m
#13	06-09	1349	06-06	2149	56 45.98	160 21.57	60 m	63 m
#14	06-09	1431	06-09	22.31	56 43.98	160 18.40	60 m	61 m
#15	06-09	1510	06-09	2310	56 41.88	160 15.26	60 m	61 m
#16	06-09	1549	06-09	2349	56 39.80	160 12.10	50 m	52 m
#17	06-09	1628	06-10	0028	56 37.81	160 08.99	46 m	48 m
#18	06-09	1705	06-10	0105	56 35.72	160 05.86	42 m	44 m
#19	06-09	1741	06-10	0141	56 33.67	160 02.86	28 m	30 m
#20	06-09	1813	06-10	0213	56 31.54	159 59.61	20 m	22 m
#21	06-12	1902	06-13	0302	57 59.79	162 47.44	38 m	39 m
#22	06-12	1949	06-13	0349	57 55.47	162 52.57	41 m	43 m
#23	06-12	2034	06-13	0434	57 50.78	162 57.63	40 m	42 m
#24	06-12	2125	06-13	0525	57 46.21	163 02.57	41 m	45 m
#25	06-12	2220	06-13	0620	57 41.56	163 07.61	41 m	43 m
#26	06-12	2307	06-13	0707	57 36.92	163 12.56	43 m	45 m
#27	06-12	2354	06-13	0754	57 32.20	163 17.61	45 m	47 m
#28	06-13	0045	06-13	0845	57 27.52	163 22.72	48 m	50 m
#29	06-13	0139	06-13	0939	57 22.93	163 27.68	49 m	51 m
#30	06-13	0234	06-13	1034	57 18.20	163 32.77	55 m	57 m
#31	06-13	0339	06-13	1139	57 11.33	163 40.03	61 m	63 m
#32	06-13	0450	06-13	1250	57 06.69	163 44.92	65 m	68 m

#33	06-14	0024	06-14	0824	58 37.35	162 07.39	32 m	35 m
#34	06-14	0112	06-14	0912	58 32.77	162 12.37	39 m	40 m
#35	06-14	0202	06-14	1002	58 28.09	162 17.58	43 m	44 m
#36	06-14	0248	06-14	1048	58 23.44	162 22.47	33 m	34 m
#37	06-14	0335	06-14	1135	58 18.86	162 27.43	30 m	31 m
#38	06-14	0420	06-14	1220	58 14.16	162 32.41	34 m	36 m
#39	06-14	0510	06-14	1310	58. 09.38	162 37.30	36 m	38 m
#40	06-14	0550	06-14	1350	58 04.82	162 42.52	36 m	38 m
#41	06-19	0620	06-19	1420	59 43.06	167 08.85	30 m	32 m
#42	06-19	0741	06-19	1541	59 33.73	167 19.23	29 m	31 m
#43	06-19	0827	06-19	1627	59 29.04	167 24.35	29 m	31 m
#44	06-19	0912	06-19	1712	59 24.35	167 29.54	31 m	33 m
#45	06-19	0958	06-19	1758	59 19.69	167 34.70	35 m	37 m
#46	06-19	1043	06-19	1843	59 15.07	167 39.91	38 m	40 m
#47	06-19	1127	06-19	1927	59 10.40	167 45.14	39 m	41 m
#48	06-19	1203	06-19	2003	59 05.71	167 50.34	36 m	38 m
#49	06-19	1422	06-19	2222	59 01.07	167 55.55	38 m	41 m
#50	06-19	1516	06-19	2316	58 56.37	168 00.75	40 m	42 m
#51	06-19	1601	06-20	0001	58 51.70	168 05.87	42 m	44 m
#52	06-19	1647	06-20	0047	58 47.03	168 11.13	45 m	47 m
#53	06-19	1735	06-20	0135	58 42.42	168 16.22	47 m	50 m
#54	06-19	1833	06-20	0233	58 37.75	168 21.40	50 m	53 m
#55	06-19	1925	06-20	0325	58 33.09	168 26.57	57 m	59 m
#56	06-19	2013	06-20	0413	58 28.43	168 31.76	60 m	63 m
#57	06-19	2115	06-20	0515	58 21.40	168 39.59	65 m	67 m
#58	06-19	2215	06-20	0615	58 16.73	168 44.70	67 m	69 m
#59	06-24	0912	06-24	1712	55 38.97	167 30.07	50 m	136 m
#60	06-24	1039	06-24	1839	55 33.01	167 45.99	50 m	139 m
#61	06-24	1210	06-24	2010	55 25.99	168 04.09	50 m	207 m
#62	06-24	1305	06-24	2105	55 22.98	168 09.98	50 m	430 m
#63	06-24	1410	06-24	2210	55 19.98	168 15.04	50 m	1468 m
#64	06-24	1650	06-25	0050	55 06.97	168 28.94	50 m	1744 m
#65	06-24	1900	06-25	0300	54 57.98	168 45.02	50 m	2000 m
#66	06-25	2100	06-26	0500	55 53.97	166 54.07	50 m	134 m
#67	06-25	2230	06-26	0630	55 46.02	167 10.01	50 m	138 m

Table 4- Times and location of acoustic surveys.

File Name		Local Time		GMT		Latitude	Longitude
Test file: SBE2-4a	Start	06-04	1640	06-05	0040	55 08.03	164 06.19
	End	06-04	1855	06-05	0255	55 20.20	164 15.78
SBC1-11	Start	06-05	0712	06-05	1512	55 06.29	163 51.84
	End	06-05	1148	06-05	1748	55 30.30	164 11.59
SBA 1--0	Start	06-06	1707	06-07	0107	55 30.39	163 59.24
	End	06-06	2153	06-07	0553	55 06.07	163 39.09
PMC1-10	Start	06-10	1414	06-10	2214	56 31.58	159 59.60
	End	06-10	1846	06-11	0246	56 52.23	160 31.19
PMA1-11	Start	06-11	0712	06-11	1512	56 35.71	159 50.66
	End	06-11	1146	06-11	1946	56 56.26	160 21.98
CNC11-1	Start	06-13	0727	06-13	1527	57 18.15	163 32.48
	End	06-13	1511	06-13	2311	57 53.36	162 54.78
CNC11-1A	Start	06-13	1533	06-13	2333	57 56.31	162 52.68
	End	06-13	2057	06-14	0457	58 31.87	162 23.23
CNC11-1B	Start	06-13	2057	06-14	0457	58 31.87	162 23.23
	End	06-14	0001	06-14	0801	58 37.24	162 07.55
FLOCK1	Start	06-14	1840	06-15	0240	58 03.70	162 37.73
	End	06-14	1944	06-15	0344	58 00.74	162 33.53
CNEX14-2	Start	06-15	1444	06-15	2244	58 20.26	162 11.98
	End	06-15	1815	06-16	0215	58 00.19	162 33.60
CNEX14A	Start	06-15	1819	06-16	0219	57 59.79	162 34.00
	End	06-15	2209	06-16	0609	57 42.93	162 52.02

NIA14-X	Start	06-18	0704	06-18	1504	58	19.92	168	55.39
	End	06-18	1108	06-18	1908	58	39.45	168	33.74
NIA14-X3	Start	06-18	1108	06-18	1908	58.	39.45	168	33.74
	End	06-18	1741	06-19	0141	59	10.24	167	59.67
NIA14-X4	Start	06-18	1742	06-19	0142	59	10.24	167	59.67
	End	06-18	2144	06-19	0544	59	31.63	167	35.89
NIA14-X5	Start	06-18	2144	06-19	0544	59	31.63	167	35.89
	End	06-18	2345	06-19	0745	59	40.73	167	25.83
NIC14-2	Start	06-20	0721	06-20	1521	58	16.85	168	44.49
	End	06-20	1144	06-20	2044	58	38.84	168	20.12
NIC14-3	Start	06-20	1147	06-20	2047	58	39.11	168	19.82
	End	06-20	1431	06-20	2231	58	51.77	168	05.94
NIC14-4	Start	06-20	1500	06-20	2300	58	52.00	168	05.70
	End	06-20	2238	06-21	0638	59	32.91	167	20.05
NIEX14-1	Start	06-21	0704	06-21	1504	59	30.50	167	08.51
	End	06-21	1130	06-21	1930	59	09.53	167	31.70
NIEX14-2	Start	06-21	1133	06-21	1133	59	09.30	167	31.95
	End	06-21	1753	06-22	0153	58	36.01	168	08.91
NIEX14-3	Start	06-21	1755	06-22	0155	58	35.85	168	09.17
	End	06-21	2147	06-22	0547	58	18.18	168	28.68
PC1-2	Start	06-24	0027	06-24	0827	56	15.02	168	00.01
	End	06-24	0126	06-24	0926	56	12.98	168	26.77
OS1	Start	06-24	1917	06-25	0317	54	58.15	168	44.70
	End	06-25	0107	06-25	0907	55	25.24	168	05.49

OS2	Start	06-25	0113	06-25	0913	55	25.24	168	05.49
	End	06-25	0134	06-25	0934	55	26/47	168	02.91
OS3	Start	06-25	0736	06-25	1536	55	07.54	168	28.26
	End	06-25	1215	06-25	2015	55	27.85	167	59.25
OS5	Start	06-25	1625	06-26	0025	55	40.55	167	25.61
	End	06-25	2032	06-26	0432	55	54.02	166	53.31
OS6	Start	06-25	2342	06-26	0742	55	51.16	166	59.72
	End	06-25	2359	06-26	0759	55	51.80	166	58.51
OS7	Start	06-26	0006	06-26	0806	55	51.85	166	58.28
	End	06-26	0036	06-26	0836	55	51.02	167	00.00

Appendix 1

Positions of CTD Stations

Positions of Slime Bank CTD Stations

Station Name	Lat	Long	Lat		Long		Comment
SBC-1	55.0965	163.8570	55	05.79	163	51.42	(too shallow?)
SBC-2	55.1371	163.8903	55	08.23	163	53.42	
SBC-3	55.1777	163.9236	55	10.66	163	55.42	
SBC-4	55.2184	163.9568	55	13.10	163	57.41	
SBC-5	55.2591	163.9901	55	15.55	163	59.41	
SBC-6	55.2998	164.0234	55	17.99	164	01.40	
SBC-7	55.3405	164.0567	55	20.43	164	03.40	
SBC-8	55.3811	164.0900	55	22.87	164	05.40	
SBC-9	55.4218	164.1233	55	25.31	164	07.40	
SBC-10	55.4625	164.1566	55	27.75	164	09.40	
SBC-11	55.5032	164.1899	55	30.19	164	11.39	
SBC-12	55.5844	164.2565	55	35.06	164	15.39	12-19 are
SBC-13	55.6656	164.3231	55	39.94	164	19.38	extensions to
SBC-14	55.7468	164.3897	55	44.81	164	23.38	line C. We
SBC-15	55.8280	164.4563	55	49.68	164	27.38	probably will
SBC-16	55.9092	164.5228	55	54.55	164	31.37	not get to all
SBC-17	55.9904	164.5894	55	59.42	164	35.37	of them.
SBC-18	56.0716	164.6560	56	04.30	164	39.36	
SBC-19	56.1528	164.7226	56	09.17	164	43.36	
SBE-10	55.4170	164.3279	55	25.02	164	19.67	
SBE-8	55.3356	164.2613	55	20.14	164	15.68	
SBE-6	55.2543	164.1947	55	15.26	164	11.68	
SBE-5	55.2136	164.1615	55	12.81	164	09.69	
SBE-4	55.1729	164.1282	55	10.37	164	07.69	
SBE-2	55.0915	164.0616	55	05.49	164	03.70	
SBE-1	55.0508	164.0283	55	03.05	164	01.70	(newly added)
SBD-1	55.0736	163.9426	55	04.42	163	56.56	
SBD-2	55.1143	163.9759	55	06.86	163	58.56	
SBD-4	55.1957	164.0425	55	11.74	164	02.55	
SBD-5	55.2363	164.0758	55	14.18	164	04.55	
SBD-6	55.2770	164.1091	55	16.62	164	06.55	
SBD-7			55	19.06	164	08.54	
SBD-8	55.3584	164.1757	55	21.50	164	10.54	
SBD-10	55.4397	164.2422	55	26.38	164	14.53	

SBB-10	55.4853	164.0709	55 29.12	164 04.26
SBB-8	55.4039	164.0043	55 24.23	164 00.26
SBB-7			55..21.92	163 58.38
SBB-6	55.3225	163.9378	55 19.35	163 56.27
SBB-5	55.2819	163.9045	55 16.91	163 54.27
SBB-4	55.2412	163.8712	55 14.47	163 52.27
SBB-3			55 12.03	163 50.28
SBB-2	55.1598	163.8046	55 09.59	163 48.28
SBB-1	55.1191	163.7713	55 07.15	163 46.28
SBA-1	55.1419	163.6856	55 08.51	163 41.14
SBA-2	55.1826	163.7189	55 10.96	163 43.14
SBA-4	55.2640	163.7855	55 15.84	163 47.13
SBA-5	55.3046	163.8188	55 18.28	163 49.13
SBA-6	55.3453	163.8521	55 20.72	163 51.13
SBA-8	55.4267	163.9187	55 25.60	163 55.12
SBA-10	55.5080	163.9853	55 30.48	163 59.12

Positions of Port Moller CTD Stations

Station	Lat.	Long.	Lat.	Long.
PMA-12	56.9725	160.4212	56 58.347	160 25.272
PMA-11	56.9381	160.3687	56 56.286	160 22.120
PMA-10	56.9038	160.3161	56 54.225	160 18.968
PMA-09	56.8694	160.2636	56 52.164	160 15.815
PMA-08	56.8351	160.2110	56 50.103	160 12.662
PMA-07	56.8007	160.1585	56 48.042	160 09.510
PMA-06	56.7664	160.1060	56 45.984	160 06.360
PMA-05	56.7320	160.0534	56 43.920	160 03.204
PMA-04	56.6976	160.0009	56 41.859	160 00.051
PMA-03	56.6633	159.9483	56 39.798	159 56.899
PMA-02	56.6289	159.8958	56 37.737	159 53.747
PMA-01	56.5946	159.8432	56 35.676	159 50.594
PMB-12	56.9379	160.4965	56 56.272	160 29.788
PMB-11	56.9035	160.4439	56 54.210	160 26.635
PMB-10	56.8692	160.3914	56 52.149	160 23.481
PMB-09	56.8348	160.3388	56 50.088	160 20.328
PMB-08	56.8005	160.2863	56 48.027	160 17.175
PMB-07	56.7661	160.2337	56 45.966	160 14.022
PMB-06	56.7317	160.1811	56 43.902	160 10.866
PMB-05	56.6974	160.1286	56 41.844	160 07.716
PMB-04	56.6630	160.0760	56 39.783	160 04.563

PMB-03	56.6287	160.0235	56	37.722	160	01.410
PMB-02	56.5943	159.9709	56	35.661	159	58.257
PMB-01	56.5600	159.9184	56	33.600	159	55.104
PMC-12	56.9035	160.5716	56	54.210	160	34.294
PMC-11	56.8691	160.5190	56	52.146	160	31.141
PMC-10	56.8347	160.4665	56	50.082	160	27.988
PMC-09	56.8003	160.4139	56	48.018	160	24.835
PMC-08	56.7659	160.3614	56	45.954	160	21.682
PMC-07	56.7315	160.3088	56	43.890	160	18.528
PMC-06	56.6971	160.2563	56	41.826	160	15.378
PMC-05	56.6627	160.2037	56	39.762	160	12.222
PMC-04	56.6283	160.1512	56	37.698	160	09.069
PMC-03	56.5939	160.0986	56	35.634	160	05.916
PMC-02	56.5595	160.0461	56	33.570	160	02.763
PMC-01	56.5251	159.9935	56	31.506	159	59.610
PMD-12	56.8689	160.6468	56	52.134	160	38.806
PMD-11	56.8345	160.5942	56	50.070	160	35.652
PMD-10	56.8001	160.5417	56	48.006	160	32.499
PMD-09	56.7657	160.4891	56	45.942	160	29.346
PMD-08	56.7313	160.4366	56	43.878	160	26.193
PMD-07	56.6969	160.3840	56	41.814	160	23.040
PMD-06	56.6625	160.3314	56	39.750	160	19.884
PMD-05	56.6281	160.2789	56	37.686	160	16.734
PMD-04	56.5937	160.2263	56	35.622	160	13.581
PMD-03	56.5593	160.1738	56	33.558	160	10.428
PMD-02	56.5249	160.1212	56	31.494	160	07.275
PMD-01	56.4905	160.0687	56	29.430	160	04.122
PME-12	56.8343	160.7219	56	50.058	160	43.312
PME-11	56.7999	160.6693	56	47.994	160	40.159
PME-10	56.7655	160.6168	56	45.930	160	37.006
PME-09	56.7311	160.5642	56	43.866	160	33.853
PME-08	56.6967	160.5117	56	41.802	160	30.699
PME-07	56.6623	160.4591	56	39.738	160	27.546
PME-06	56.6279	160.4066	56	37.674	160	24.396
PME-05	56.5935	160.3540	56	35.610	160	21.240
PME-04	56.5591	160.3015	56	33.546	160	18.087
PME-03	56.5247	160.2489	56	31.482	160	14.934
PME-02	56.4903	160.1964	56	29.418	160	11.781
PME-01	56.4559	160.1438	56	27.354	160	08.628

Positions of Cape Newenham CTD Stations

Station	Lat.	Long.	Lat.	Long.
CNA-12	57.3182	163.7572	57 19.092	163 45.432
CNA-11	57.3571	163.7154	57 21.426	163 42.924
CNA-10	57.3960	163.6736	57 23.760	163 40.417
CNA-09	57.4349	163.6318	57 26.094	163 37.908
CNA-08	57.4738	163.5900	57 28.428	163 35.400
CNA-07	57.5127	163.5482	57 30.762	163 32.892
CNA-06	57.5516	163.5064	57 33.096	163 30.384
CNA-05	57.5905	163.4646	57 35.430	163 27.876
CNA-04	57.6294	163.4228	57 37.764	163 25.367
CNA-03	57.6683	163.3810	57 40.098	163 22.860
CNA-02	57.7072	163.3392	57 42.432	163 20.352
CNA-01	57.7461	163.2974	57 44.766	163 17.844
CNB-12	57.2913	163.6700	57 17.479	163 40.203
CNB-11	57.3302	163.6283	57 19.812	163 37.698
CNB-10	57.3691	163.5865	57 22.146	163 35.193
CNB-09	57.4080	163.5448	57 24.480	163 32.688
CNB-08	57.4469	163.5031	57 26.814	163 30.183
CNB-07	57.4858	163.4613	57 29.148	163 27.678
CNB-06	57.5247	163.4196	57 31.482	163 25.176
CNB-05	57.5636	163.3778	57 33.816	163 22.668
CNB-04	57.6025	163.3361	57 36.150	163 20.164
CNB-03	57.6414	163.2943	57 38.484	163 17.659
CNB-02	57.6803	163.2526	57 40.818	163 15.154
CNB-01	57.7192	163.2108	57 43.152	163 12.649
CNC-20	56.6439	164.2504	56 38.63	164 15.03
CNC-19	56.7215	164.1670	56 43.29	164 10.02
CNC-18	56.7991	164.0836	56 47.95	164 05.02
CNC-17	56.8767	164.0002	56 52.60	164 00.01
CNC-16	56.9543	163.9168	56 57.26	163 55.01
CNC-15	57.0319	163.8334	57 01.91	163 50.01
CNC-14	57.1095	163.7500	57 06.57	163 45.00
CNC-13	57.1871	163.6666	57 11.23	163 40.00
CNC-12	57.2647	163.5832	57 15.88	163 34.99
CNC-11	57.3035	163.5415	57 18.21	163 32.49
CNC-10	57.3424	163.4997	57 20.54	163 29.98
CNC-09	57.3812	163.4580	57 22.87	163 27.48
CNC-08	57.4201	163.4162	57 25.21	163 24.97
CNC-07	57.4589	163.3745	57 27.53	163 22.47
CNC-06	57.4978	163.3328	57 29.87	163 19.97
CNC-05	57.5366	163.2910	57 32.20	163 17.46

CNC-04	57.5754	163.2493	57	34.52	163	14.96	
CNC-03	57.6143	163.2075	57	36.86	163	12.45	
CNC-02	57.6531	163.1658	57	39.19	163	09.95	
CNC-01	57.6920	163.1240	57	41.52	163	07.44	
CNCX-02	57.7696	163.0406	57	46.18	163	02.44	(CNC1 (CNCX2,4,6,
CNCX-04	57.8472	162.9572	57	50.83	162	57.43	8 were first called
CNCX-06	57.9248	162.8738	57	55.49	162	52.43	1,2,3,4 but their
CNCX-08	58.0024	162.7904	58	00.14	162	47.42	names were changed
CNCX-10	58.0800	162.7070	58	04.80	162	42.42	when we went to 5
CNCX-11	58.1576	162.6236	58	09.46	162	37.41	km spacing at the
CNCX-12	58.2352	162.5402	58	14.11	162	32.41	first part of the line)
CNCX-13	58.3128	162.4568	58	18.77	162	27.41	
CNCX-14	58.3904	162.3734	58	23.42	162	22.40	
CNCX-15	58.4680	162.2899	58	28.08	162	17.40	
CNCX-16	58.5456	162.2065	58	32.74	162	12.39	
CNCX-17	58.6232	162.1231	58	37.39	162	07.39	

CND-12	57.2377	163.4965	57	14.265	163	29.789
CND-11	57.2766	163.4547	57	16.596	163	27.284
CND-10	57.3154	163.4130	57	18.927	163	24.778
CND-09	57.3543	163.3712	57	21.258	163	22.273
CND-08	57.3932	163.3295	57	23.589	163	19.768
CND-07	57.4320	163.2877	57	25.920	163	17.262
CND-06	57.4708	163.2460	57	28.248	163	14.760
CND-05	57.5097	163.2042	57	30.582	163	12.252
CND-04	57.5486	163.1624	57	32.913	163	09.747
CND-03	57.5874	163.1207	57	35.244	163	07.241
CND-02	57.6263	163.0789	57	37.575	163	04.735
CND-01	57.6651	163.0372	57	39.906	163	02.230

CNE-12	57.2105	163.4096	57	12.63	163	24.58
CNE-11	57.2494	163.3679	57	14.96	163	22.07
CNE-10	57.2883	163.3261	57	17.30	163	19.57
CNE-09	57.3272	163.2844	57	19.63	163	17.06
CNE-08	57.3661	163.2426	57	21.97	163	14.56
CNE-07	57.4050	163.2009	57	24.30	163	12.05
CNE-06	57.4439	163.1591	57	26.63	163	09.55
CNE-05	57.4828	163.1174	57	28.97	163	07.04
CNE-04	57.5217	163.0757	57	31.30	163	04.54
CNE-03	57.5606	163.0339	57	33.64	163	02.03
CNE-02	57.5995	162.9922	57	35.97	162	59.53
CNE-01	57.6384	162.9504	57	38.30	162	57.02
CNEX-02	57.7162	162.8670	57	42.97	162	52.02
CNEX-04	57.7940	162.7836	57	47.64	162	47.02
CNEX-05	57.8329	162.7419	57	49.97	162	44.52

CNEX-06	57.8718	162.7002	57	52.31	162	42.01
CNEX-07	57.9107	162.6585	57	54.64	162	39.51
CNEX-08	57.9496	162.6168	57	56.98	162	37.01
CNEX-09	57.9885	162.5751	57	59.32	162	34.51
CNEX-10	58.0274	162.5334	58	01.65	162	32.00
CNEX-11	58.1052	162.4500	58	06.31	162	27.00
CNEX-12	58.1830	162.3666	58	10.98	162	21.99
CNEX-13	58.2608	162.2832	58	15.65	162	16.99
CNEX-14	58.3386	162.1998	58	20.32	162	11.99
CNEX-15	58.4164	162.1163	58	24.99	162	06.98
CNEX-16	58.4943	162.0329	58	29.66	162	01.98
CNEX-17	58.5721	161.9495	58	34.32	161	56.97

Positions of Nunivak Island CTD Stations

station name	Lat.	Long.	Lat.		Long.	
A-Line, Outer extension						
NIA-24	57.5546	169.7850	57	33.28	169	47.10
NIA-23	57.6324	169.6988	57	37.95	169	41.93
NIA-22	57.7102	169.6126	57	42.61	169	36.76
NIA-21	57.7880	169.5264	57	47.28	169	31.59
NIA-20	57.8658	169.4402	57	51.95	169	26.41
NIA-19	57.9436	169.3541	57	56.62	169	21.24
NIA-18	58.0214	169.2679	58	01.29	169	16.07
NIA-17	58.0992	169.1817	58	05.95	169	10.90
NIA-16	58.1770	169.0955	58	10.62	169	05.73
NIA-15	58.2548	169.0093	58	15.29	169	00.56
NIA-14	58.3326	168.9232	58	19.96	168	55.39
NIA-13	58.4104	168.8370	58	24.62	168	50.22
A-Line Core Grid						
NIA-12	58.4882	168.7508	58	29.292	168	45.049
NIA-11	58.5271	168.7077	58	31.626	168	42.460
NIA-10	58.5660	168.6645	58	33.960	168	39.871
NIA-09	58.6049	168.6214	58	36.294	168	37.283
NIA-08	58.6438	168.5782	58	38.628	168	34.695
NIA-07	58.6827	168.5351	58	40.962	168	32.106
NIA-06	58.7216	168.4919	58	43.296	168	29.514
NIA-05	58.7605	168.4488	58	45.630	168	26.928
NIA-04	58.7994	168.4057	58	47.964	168	24.340
NIA-03	58.8383	168.3625	58	50.298	168	21.751
NIA-02	58.8772	168.3194	58	52.632	168	19.162
NIA-01	58.9161	168.2762	58	54.966	168	16.574

A-Line Inner Extension

NIA-X2	58.9939	168.1900	58	59.63	168	11.40
NIA-X4	59.0717	168.1038	59	04.30	168	06.23
NIA-X6	59.1495	168.0177	59	08.97	168	01.06
NIA-X8	59.2273	167.9315	59	13.64	167	55.89
NIA-X10	59.3051	167.8453	59	18.31	167	50.72
NIA-X11	59.3829	167.7591	59	22.97	167	45.55
NIA-X12	59.4607	167.6729	59	27.64	167	40.38
NIA-X13	59.5385	167.5867	59	32.31	167	35.20
NIA-X14	59.6163	167.5006	59	36.98	167	30.03
NIA-X15	59.6941	167.4144	59	41.64	167	24.86
NIA-X16	59.7719	167.3282	59	46.31	167	19.69
NIA-X17	59.8497	167.2420	59	50.98	167	14.52

B-Line, Core Grid

NIB-12	58.4613	168.6612	58	27.678	168	39.670
NIB-11	58.5002	168.6180	58	30.012	168	37.081
NIB-10	58.5391	168.5749	58	32.346	168	34.492
NIB-09	58.5780	168.5317	58	34.680	168	31.902
NIB-08	58.6169	168.4886	58	37.014	168	29.313
NIB-07	58.6558	168.4454	58	39.348	168	26.724
NIB-06	58.6947	168.4022	58	41.682	168	24.132
NIB-05	58.7336	168.3591	58	44.016	168	21.546
NIB-04	58.7725	168.3159	58	46.350	168	18.957
NIB-03	58.8114	168.2728	58	48.684	168	16.368
NIB-02	58.8503	168.2296	58	51.018	168	13.779
NIB-01	58.8892	168.1865	58	53.352	168	11.190

C-Line, Outer Extension

NIC-24	57.5010	169.6082	57	30.06	169	36.49
NIC-23	57.5788	169.5219	57	34.73	169	31.31
NIC-22	57.6566	169.4355	57	39.40	169	26.13
NIC-21	57.7344	169.3491	57	44.07	169	20.94
NIC-20	57.8122	169.2627	57	48.73	169	15.76
NIC-19	57.8900	169.1763	57	53.40	169	10.58
NIC-18	57.9678	169.0899	57	58.07	169	05.39
NIC-17	58.0456	169.0035	58	02.74	169	00.21
NIC-16	58.1234	168.9171	58	07.40	168	55.03
NIC-15	58.2012	168.8307	58	12.07	168	49.84
NIC-14	58.2790	168.7443	58	16.74	168	44.66
NIC-13	58.3568	168.6579	58	21.41	168	39.47

C-Line, Core Grid

NIC-12	58.4346	168.5715	58	26.079	168	34.287
NIC-11	58.4735	168.5283	58	28.410	168	31.698
NIC-10	58.5123	168.4852	58	30.741	168	29.109
NIC-09	58,5512	168.4420	58	33.072	168	26.520
NIC-08	58.5900	168.3988	58	35.403	168	23.931
NIC-07	58.6289	168.3557	58	37.734	168	21.342
NIC-06	58.6678	168.3125	58	40.068	168	18.750
NIC-05	58.7066	168.2694	58	42.396	168	16.164
NIC-04	58.7455	168.2262	58	44.727	168	13.575
NIC-03	58.7843	168.1831	58	47.058	168	10.985
NIC-02	58.8232	168.1399	58	49.389	168	08.396
NIC-01	58.8620	168.0968	58	51.720	168	05.807

C-Line, Inner Extension

NIC-X2	58.9398	168.0104	58	56.39	168	00.62
NIC-X4	59.0176	167.9240	59	01.06	167	55.44
NIC-X6	59.0954	167.8376	59	05.72	167	50.26
NIC-X8	59.1732	167.7512	59	10.39	167	45.07
NIC-X10	59.2510	167.6648	59	15.06	167	39.89
NIC-X11	59.3288	167.5784	59	19.73	167	34.71
NIC-X12	59.4066	167.4920	59	24.39	167	29.52
NIC-X13	59.4844	167.4056	59	29.06	167	24.34
NIC-X14	59.5622	167.3192	59	33.73	167	19.15
NIC-X15	59.6400	167.2328	59	38.40	167	13.97
NIC-X16	59.7178	167.1465	59	43.07	167	08.79
NIC-X17	59.7956	167.0601	59	47.73	167	03.60

D-Line, Core Grid

NID-12	58.4078	168.4818	58	24.465	168	28.906
NID-11	58.4466	168.4386	58	26.796	168	26.317
NID-10	58.4855	168.3955	58	29.127	168	23.728
NID-09	58.5243	168.3523	58	31.458	168	21.139
NID-08	58.5632	168.3092	58	33.789	168	18.549
NID-07	58.6020	168.2660	58	36.120	168	15.960
NID-06	58.6408	168.2228	58	38.448	168	13.368
NID-05	58.6797	168.1797	58	40.782	168	10.782
NID-04	58.7185	168.1366	58	43.113	168	08.193
NID-03	58.7574	168.0934	58	45.444	168	05.604
NID-02	58.7962	168.0502	58	47.775	168	03.015
NID-01	58.8351	168.0071	58	50.106	168	00.426

E-line, Outer Extension

NIE-24	57.4469	169.4288	57	26.82	169	25.73
NIE-23	57.5247	169.3425	57	31.48	169	20.55
NIE-22	57.6025	169.2561	57	36.15	169	15.36
NIE-21	57,6803	169.1697	57	40.82	169	10.18
NIE-20	57.7581	169.0833	57	45.49	169	05.00
NIE-19	57.8359	168.9969	57	50.16	168	59.81
NIE-18	57.9137	168.9105	57	54.82	168	54.63
NIE-17	57.9915	168.8241	57	59.49	168	49.44
NIE-16	58.0693	168.7377	58	04.16	168	44.26
NIE-15	58.1471	168.6513	58	08.83	168	39.08
NIE-14	58.2249	168.5649	58	13.49	168	33.89
NIE-13	58.3027	168.4785	58	18.16	168	28.71

E-line, Core Grid

NIE-12	58.3805	168.3921	58	22.830	168	23.524
NIE-11	58.4194	168.3489	58	25.164	168	20.934
NIE-10	58.4583	168.3058	58	27.498	168	18.345
NIE-09	58.4972	168.2626	58	29.832	168	15.756
NIE-08	58.5361	168.2195	58	32.166	168	13.167
NIE-07	58.5750	168.1763	58	34.500	168	10.578
NIE-06	58.6139	168.1331	58	36.834	168	07.986
NIE-05	58.6528	168.0900	58	39.168	168	05.400
NIE-04	58.6917	168.0468	58	41.502	168	02.811
NIE-03	58.7306	168.0037	58	43.836	168	00.222
NIE-02	58.7695	167.9605	58	46.170	167	57.632
NIE-01	58.8084	167.9174	58	48.504	167	55.043

E-Line, Inner Extension

NIE-X2	58.8862	167.8310	58	53.17	167	49.86
NIE-X4	58.9640	167.7446	58	57.84	167	44.68
NIE-X6	59.0418	167.6582	59	02.51	167	39.49
NIE-X8	59.1196	167.5718	59	07.18	167	34.31
NIE-X10	59.1974	167.4854	59	11.84	167	29.13
NIE-X11	59.2752	167.3990	59	16.51	167	23.94
NIE-X12	59.3530	167.3126	59	21.18	167	18.76
NIE-X13	59.4308	167.2262	59	25.85	167	13.57
NIE-X14	59.5086	167.1398	59	30.51	167	08.39
NIE-X15	59.5864	167.0535	59	35.18	167	03.21
NIE-X16	59.6642	166.9671	59	39.85	166	58.02
NIE-X17	59.7420	166.8807	59	44.52	166	52.84

Positions of CTDs at the Pribilof Islands

St. Paul Island:

station name	Latitude		Longitude	
SP1_01	57	14.00	170	16.0
SPX1	57	15.35	170	16.0
SP1_02	57	16.69	170	16.0
SPX2	57	18.04	170	16.0
SP1_03	57	19.39	170	16.0
SPX3	57	20.73	170	16.0
SP1_04	57	22.08	170	16.0
SPX4	57	23.43	170	16.0
SP1_05	57	24.77	170	16.0
SPX5	57	26.12	170	16.0
SP1_06	57	27.46	170	16.0
SPX6	57	28.82	170	16.0
SP1_07	57	30.16	170	16.0
SPX7	57	31.50	170	16.0
SP1_08	57	32.85	170	16.0
SPX_8	57	35.54	170	16.0
SP1_09	57	38.24	170	16.0
SP1_10	57	43.62	170	16.0
SP1_11	57	49.01	170	16.0

St. George Island:

SG4_01	56	31.60	169	32.4
SG4_02	56	29.70	169	28.96
SG4_03	56	27.79	169	25.52
SG4_04	56	25.89	169	22.08
SG4_05	56	23.98	169	18.64
SG4_06	56	22.08	169	15.19
SG4_07	56	20.18	169	11.75
SG4_08	56	18.27	169	08.31
SG4_09	56	16.37	169	04.87
SG4_10	56	14.46	169	01.43

SG4_11	56	12.56	168	57.99
SG4_12	56	10.66	168	54.55
SG4_13	56	08.75	168	51.11
SG4_14	56,	06.85	168	47.67
SG4_15	56	04.95	168	44.23

SG5_01	56	26.90	169	35.0
SG5_02	56	24.21	169	35.0
SG5_03	56	21.51	169	35.0
SG5_04	56	18.82	169	35.0
SG5_05	56	16.13	169	35.0
SG5_06	56	13.44	169	35.0
SG5_07	56	10.74	169	35.0
SG5_08	56	08.05	169	35.0
SG5_09	56	05.36	169	35.0
SG5_10	56	02.66	169	35.0
SG5_11	55	59.97	169	35.0
SG5_12	55	57.28	169	35.0
SG5_13	55	54.58	169	35.0
SG5_14	55	51.89	169	35.0
SG5_15	55	49.20	169	35.0

Pribilof Canyon:

PC-01	56	15.59	168	22.11
PC-02	56	12.05	168	29.02
PC-03	56	09.05	168	36.65

Positions of CTDs in the Outer Shelf Region

Outer Shelf Line 1:

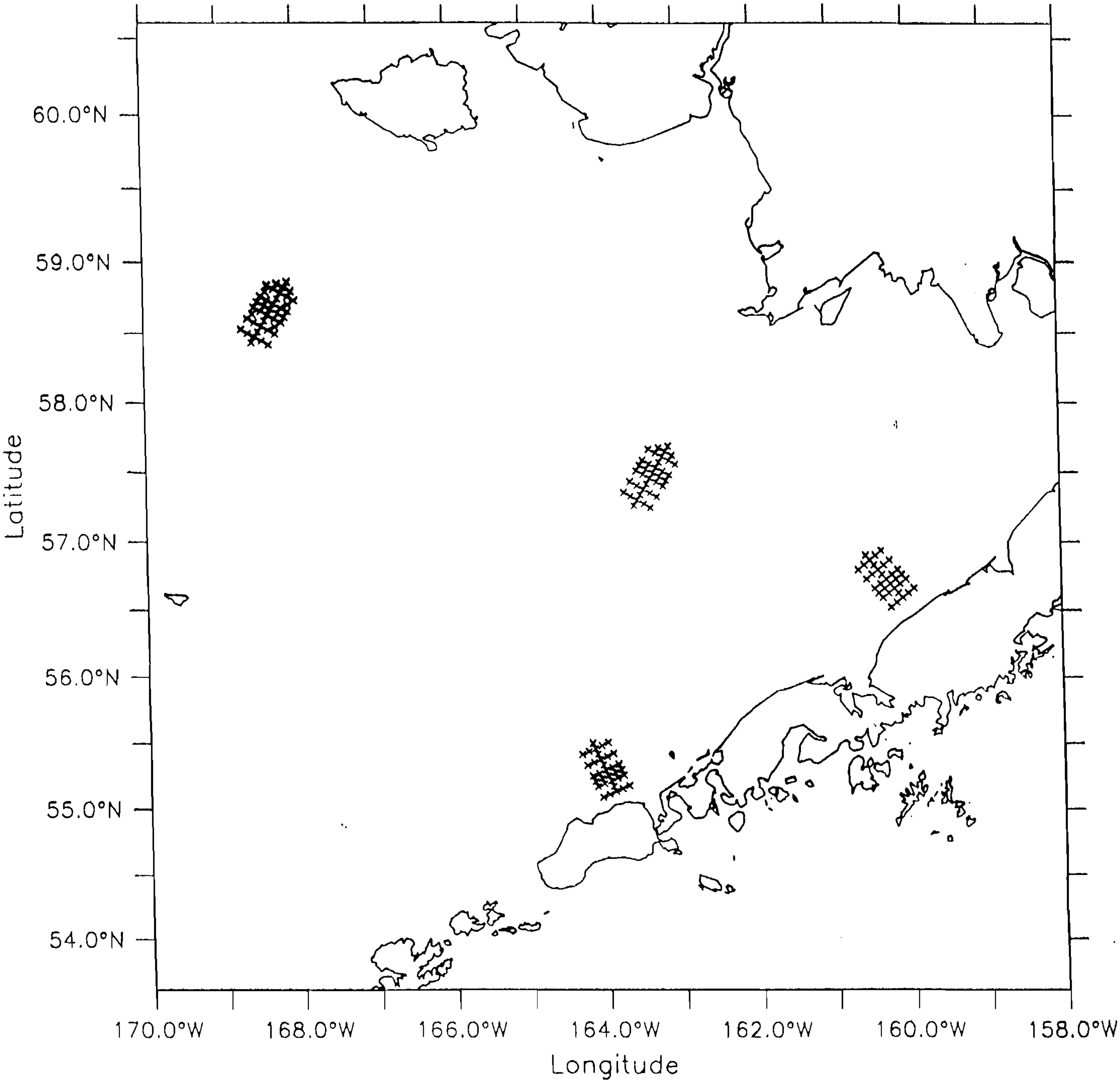
station name	Latitude	Longitude
OS-01	54 58.0	168 45.0
OS-02	55 07.0	168 29.0
OS-03	55 20.0	168 15.0
OS-04	55 23.0	168 10.0
OS-05	55 26.0	168 4.0
OS-06	55 33.0	167 46.0
OS-07	55 39.0	167 30.0
OS-08	55 46.0	167 10.0
OS-09	55 54.0	166 54.0

Outer Shelf, Line 2:

OS2-01	54 08.02	168 35.85
OS2-02	54 14.32	168 22.41
OS2-03	54 20.37	168 09.04
OS2-04	54 26.58	167 55.59
OS2-05	54 32.65	167 42.14
OS2-06	54 38.87	167 28.53
OS2-07	54 44.93	167 14.95
OS2-08	54 51.12	167 01.18
OS2-09	54 57.33	166 47.62
OS2-10	55 03.50	166 33.99

Eddy Line:

ED-01	55 27.38	168 26.98
ED-02	55 .12.68	168 02.96



Mooring and CTD positions, Alpha Helix June 1997

Fig. 1

06/27/97 SeaPlot - (untitled) 15:39:52

Scale: 31.3NM 1:223000 Chart: NOAA/16520A

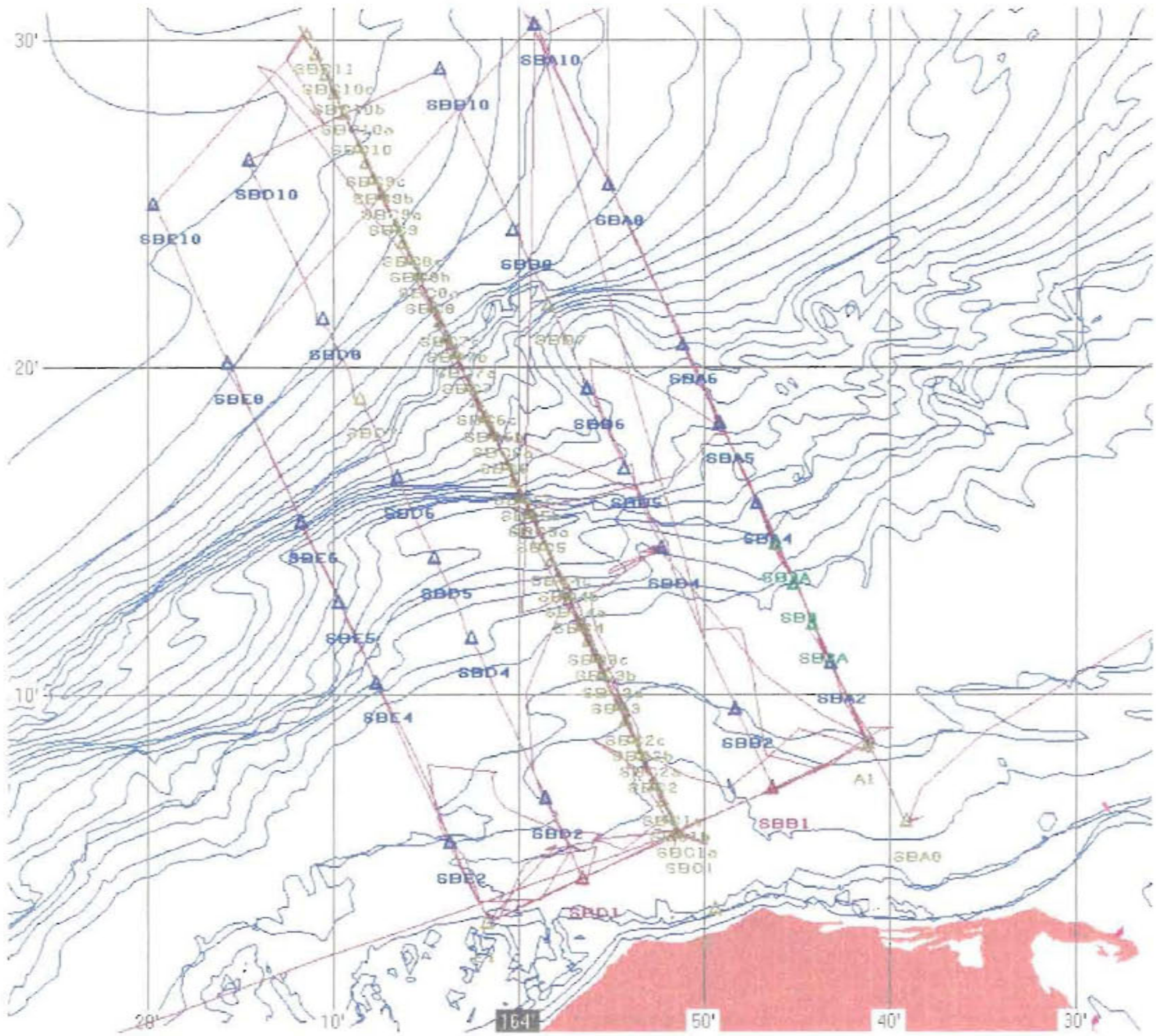


Fig. 2 Slime Bank Grid

06/27/97 SeaPlot - (untitled) 15:48:31

Scale: 35.9NM 1:256000 Chart: NOAA/16011

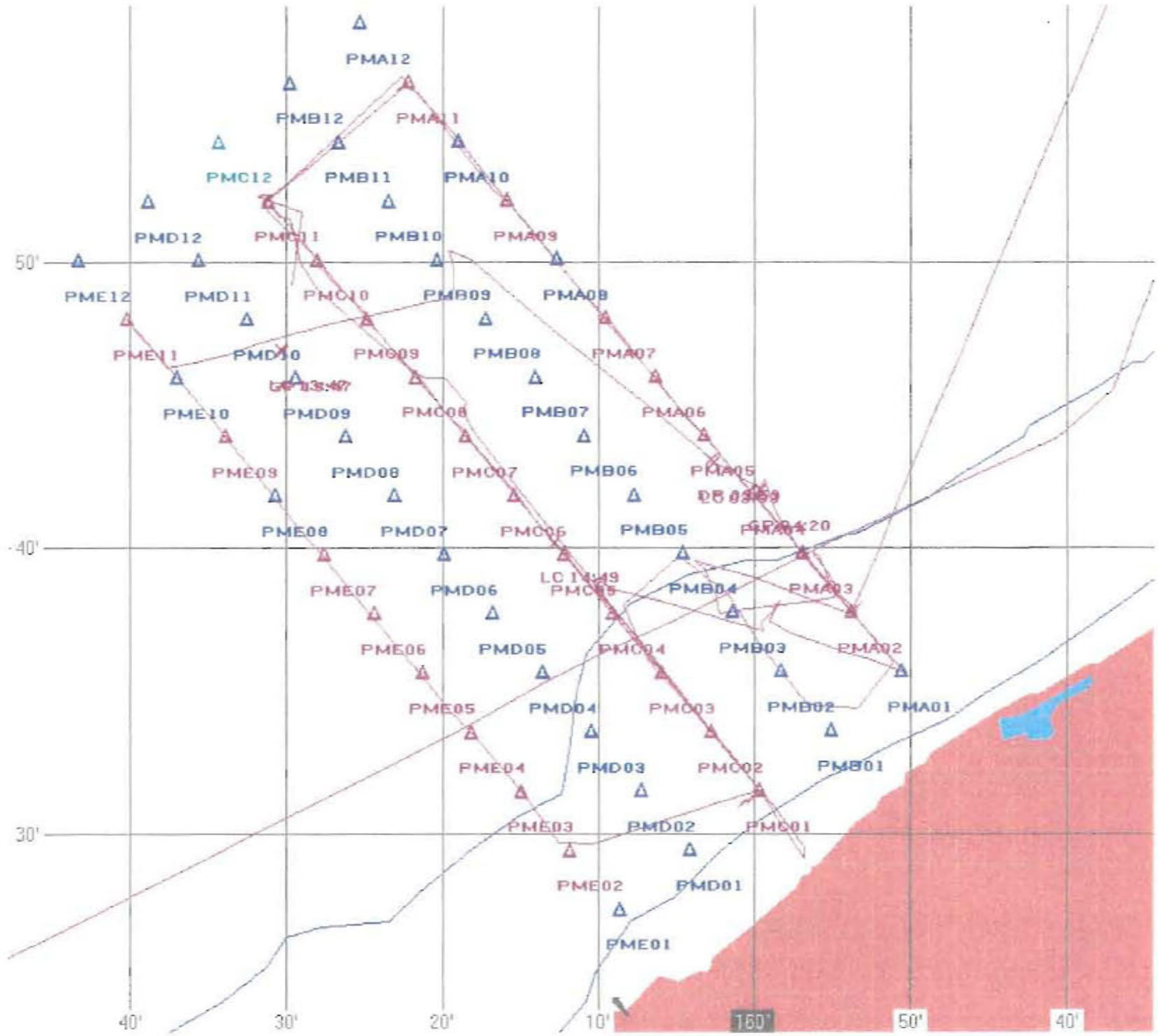


Fig. 3 Port Moller Grid

06/27/97 SeaPlot - (untitled) 15:26:53

Scale: 85.0NM 1:705000 Chart: NOAA/16011

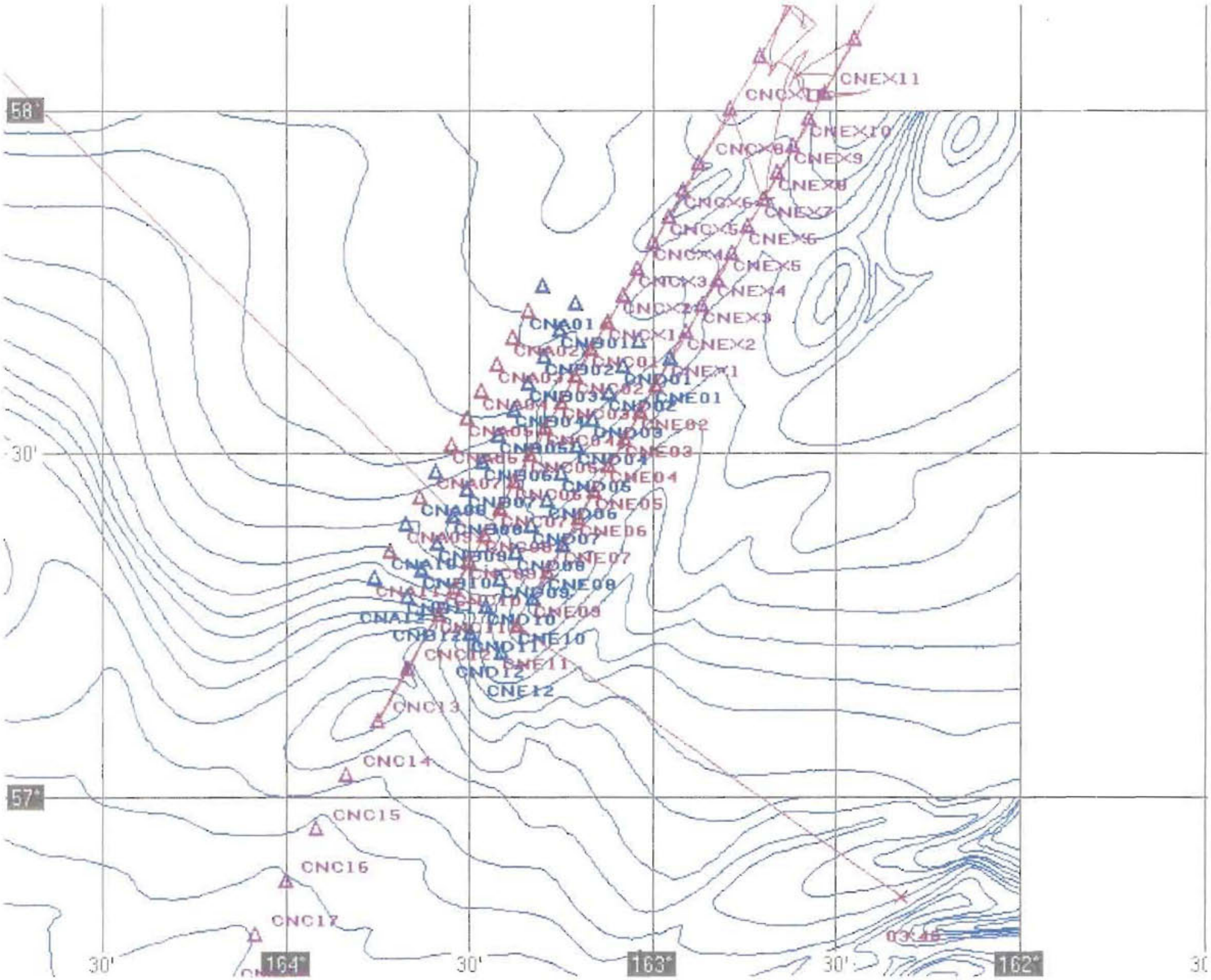


Fig. 4a Cape Newenham Grid - outer

06/27/97 SeaPlot - (untitled) 15:33:55

Scale: 71.2NM 1:590000 Chart: NOAA/513A

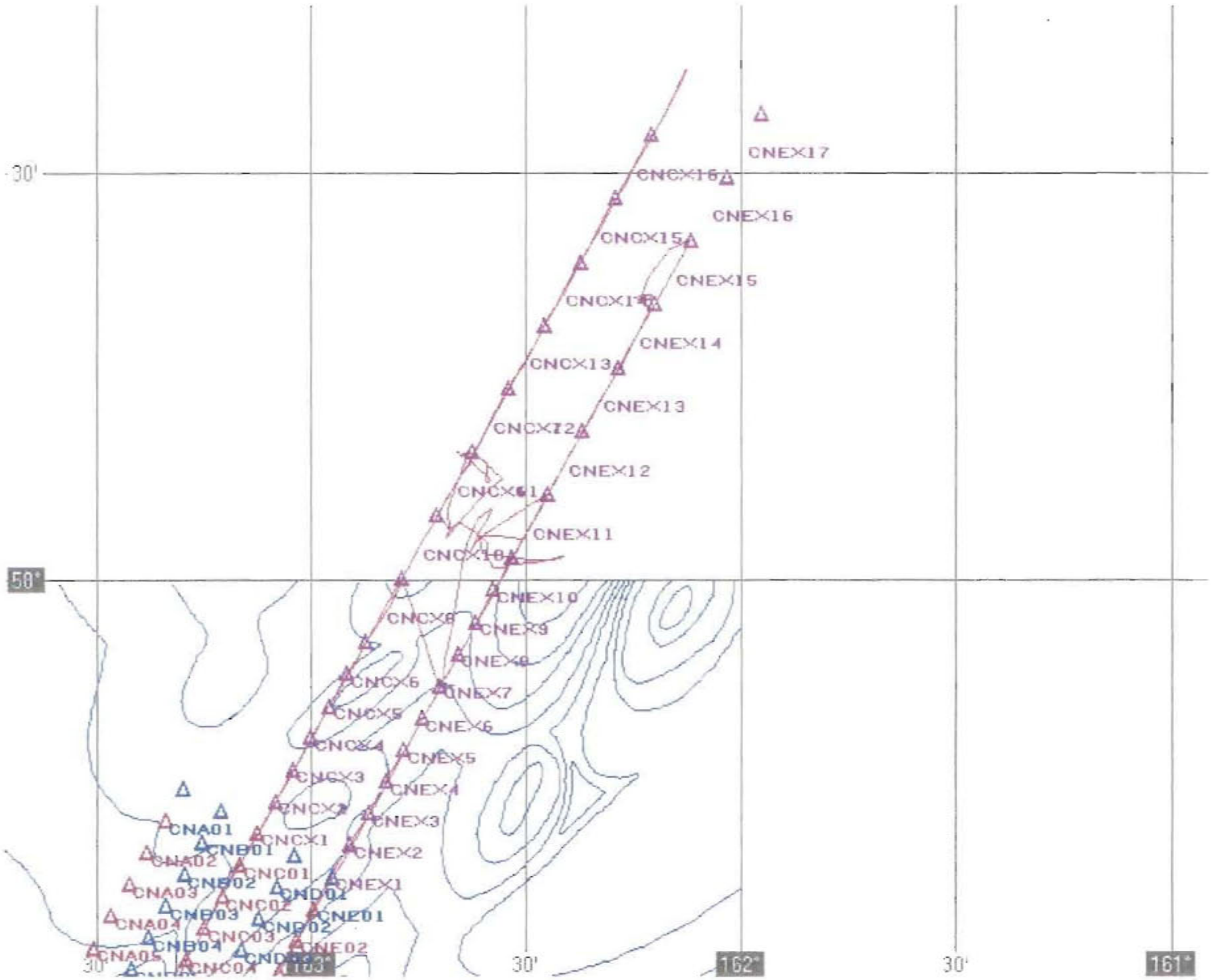


Fig. 4b Cape Newenham Grid - inner

06/27/97 SeaPlot - (untitled) 15:08:21

Scale: 176NM 1:1253000 Chart: NOAA/513A

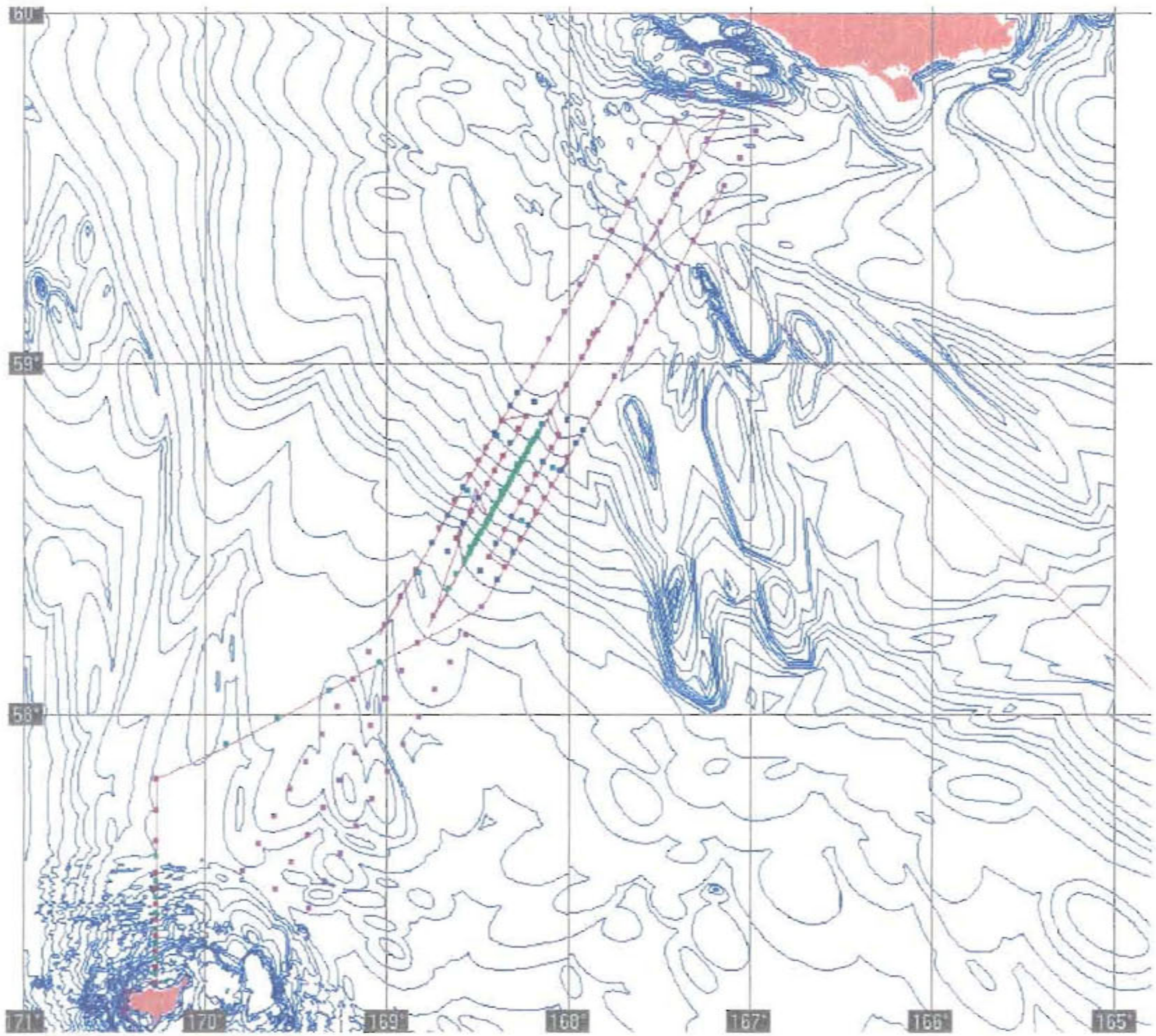


Fig. 5a Nunivak Island Grid

06/27/97 SeaPlot - (untitled) 15:13:40

Scale: 28.3NM 1:202000 Chart: NOAA/513A

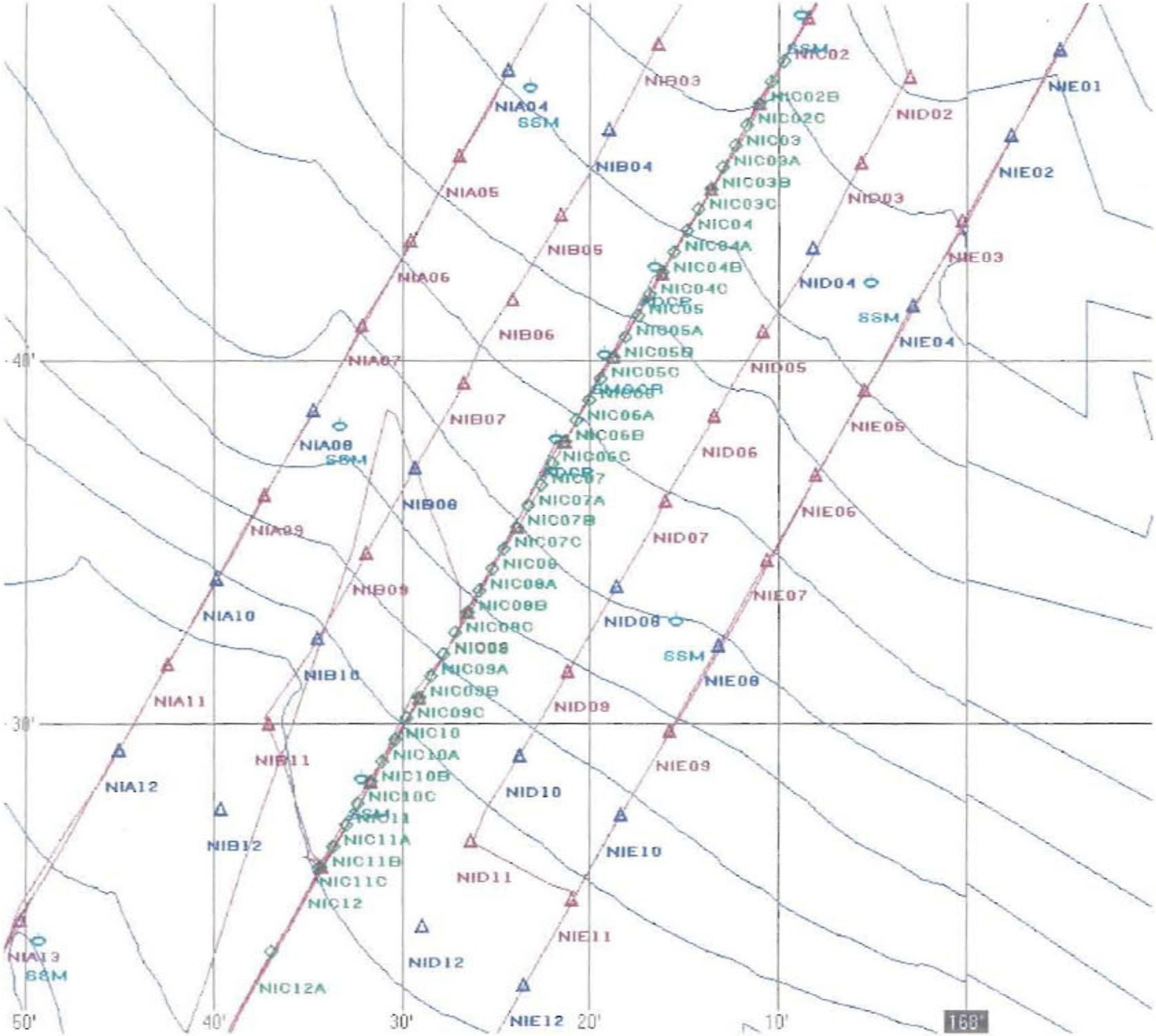


Fig. 5b Nunivak Island - Mooring Grid

06/27/97 SeaPlot - (untitled) 15:03:32

Scale: 54.4NM 1:388000 Chart: NOAA/513A

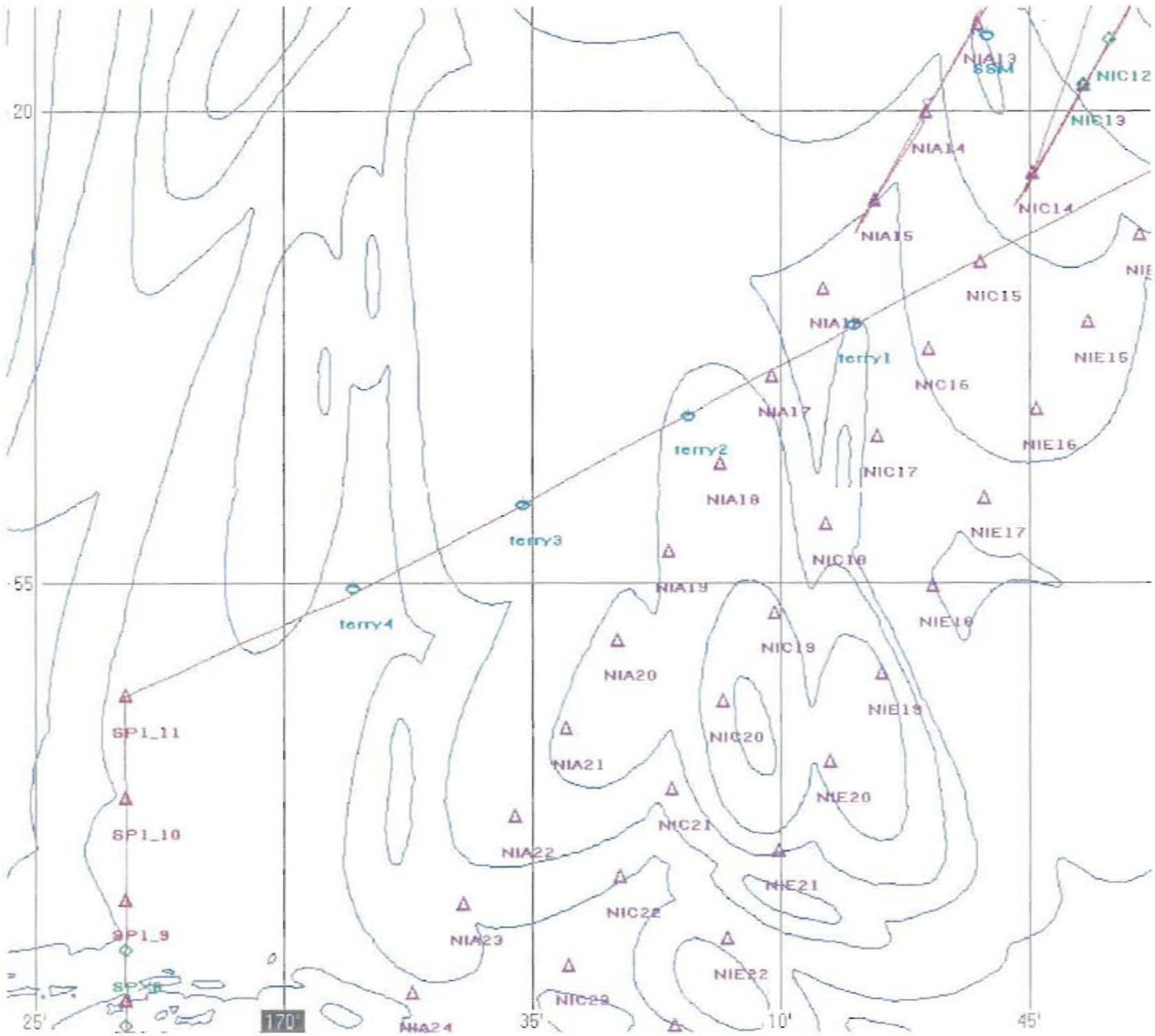


Fig. 6 Line from Nunivak Grid to St. Paul Island

06/27/97 SeaPlot - (untitled) 15:01:22

Scale: 48.3NM 1:344000 Chart: NOAA/16380

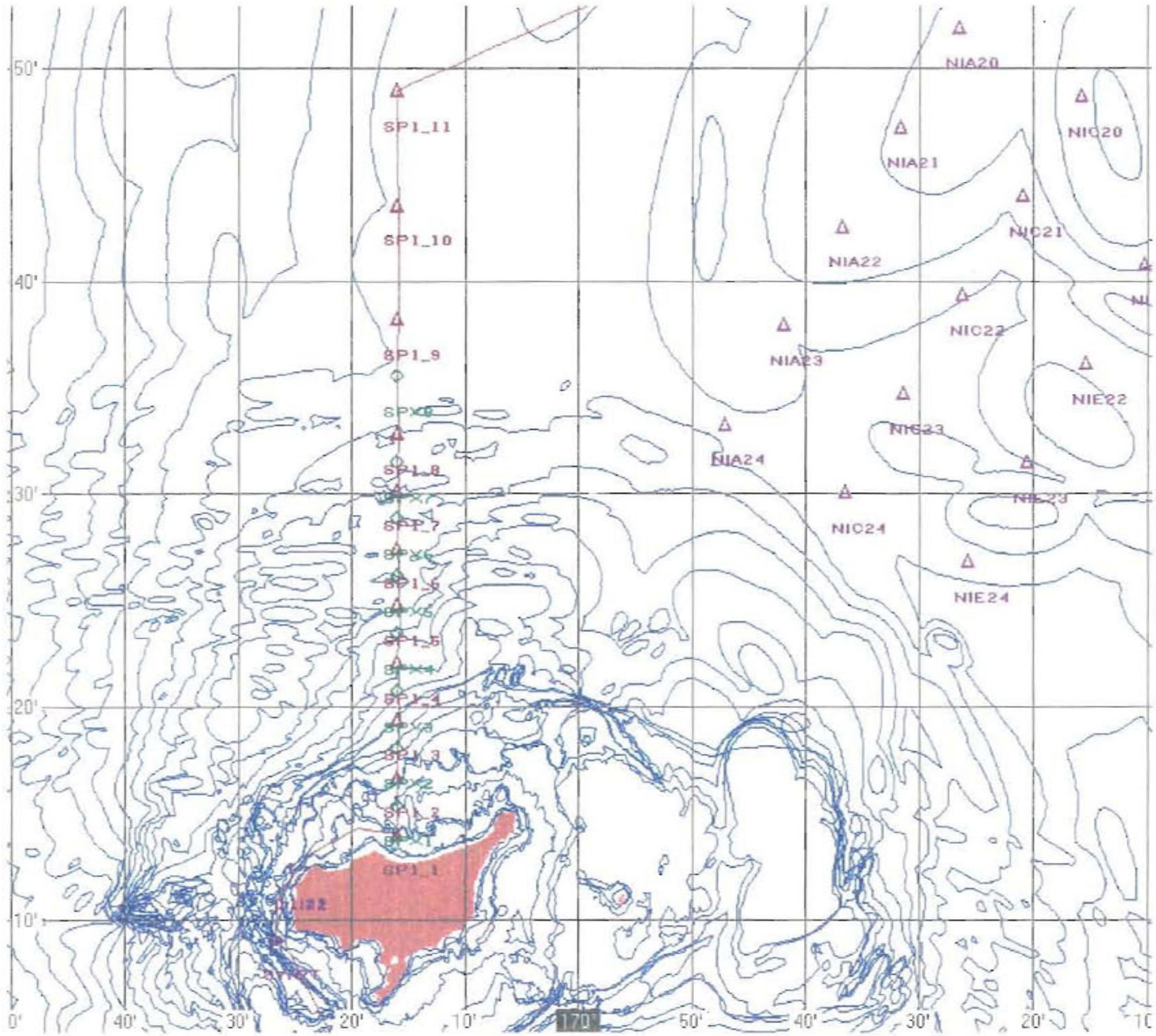


Fig. 7 St. Paul Island Line 1

06/27/97 SeaPlot - (untitled) 14:46:38

Scale: 65.3NM 1:466000 Chart: NOAA/16380

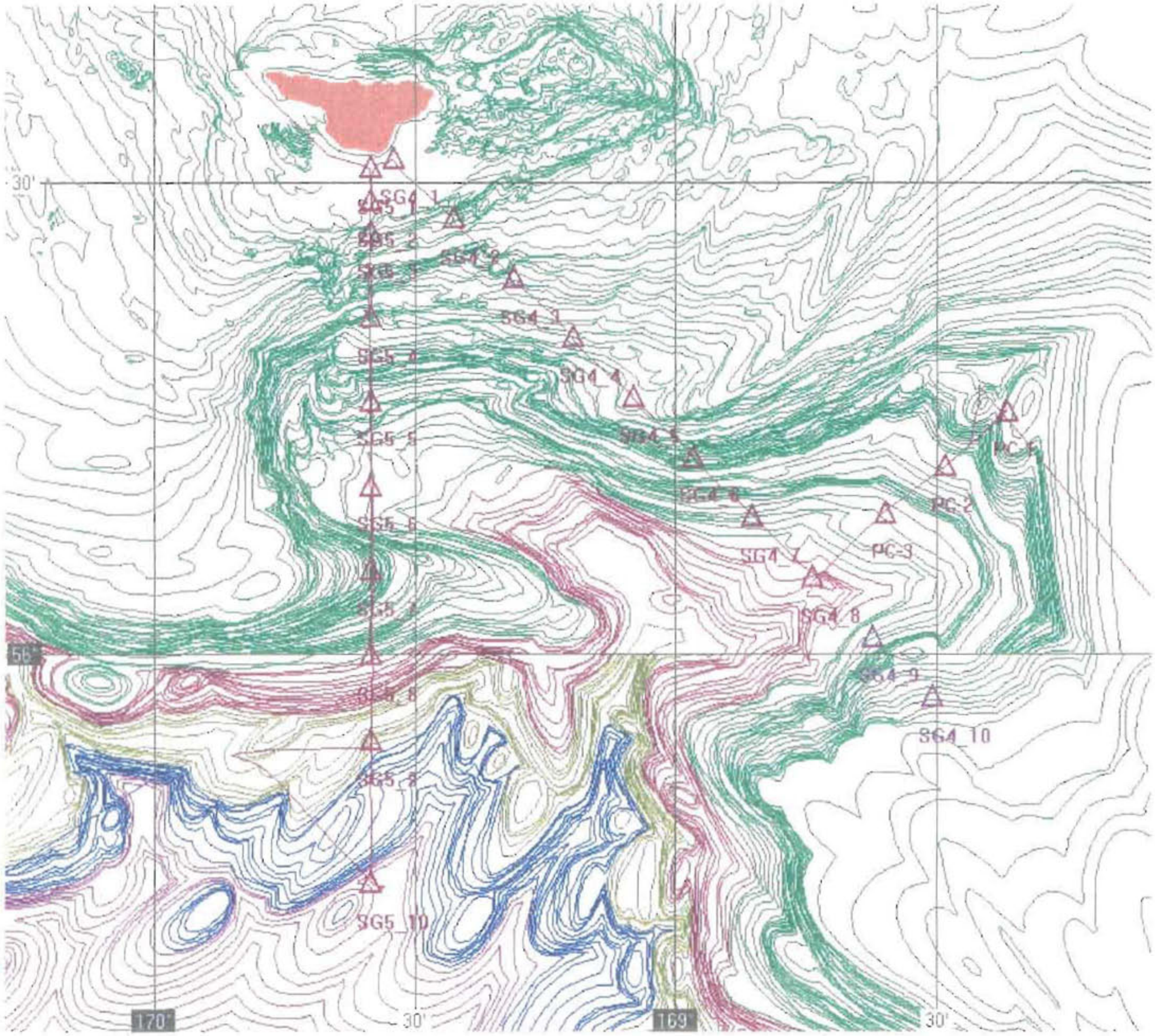


Fig. 8 St. George Island Lines 4 and 5

06/27/97   SeaPlot - (untitled)   14:43:12

Scale: 65.3NM 1:466000   Chart: NOAA/513A

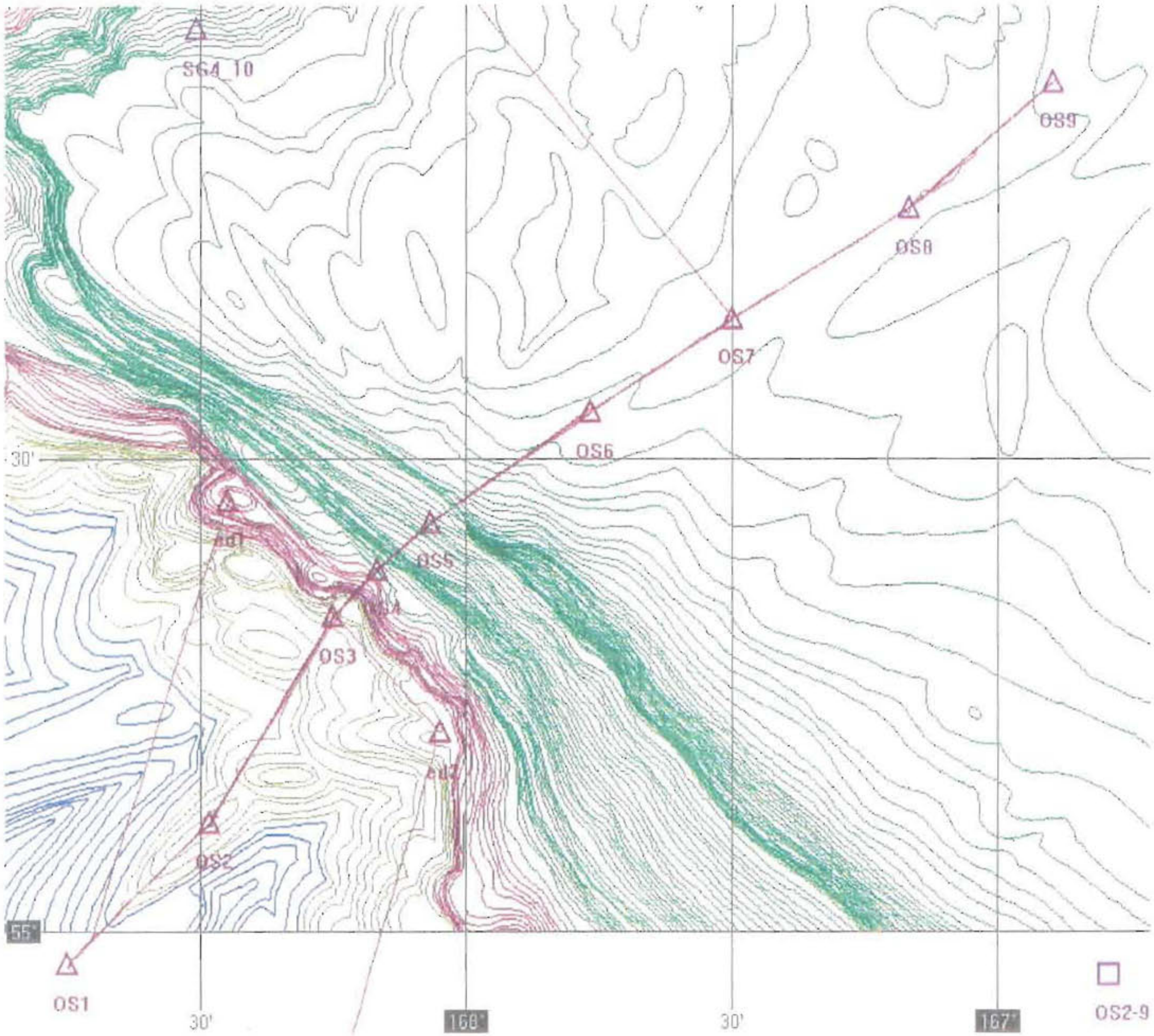


Fig. 9   Out Shelf Line 1

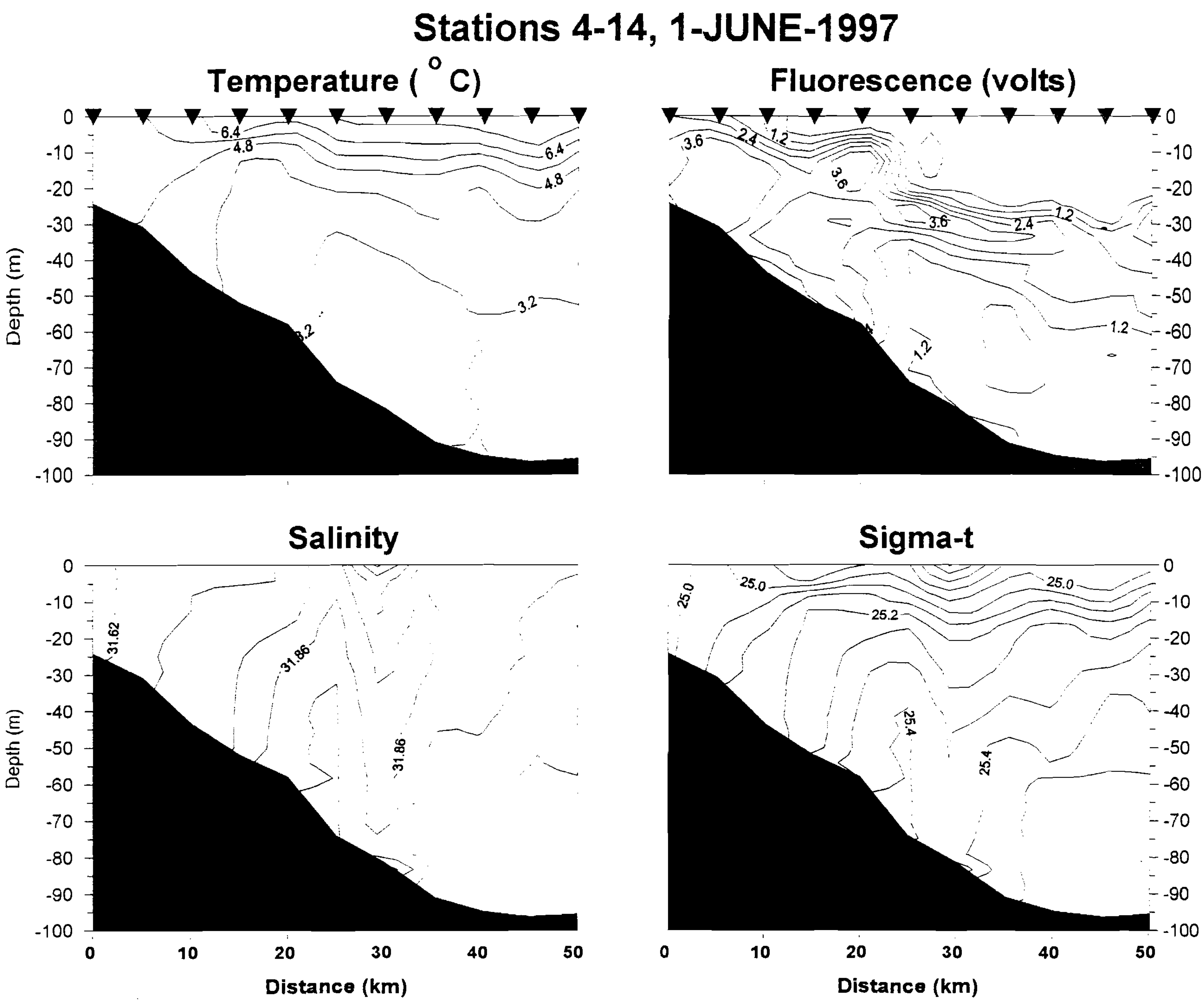


Fig. 10 Slime Bank C-line profile

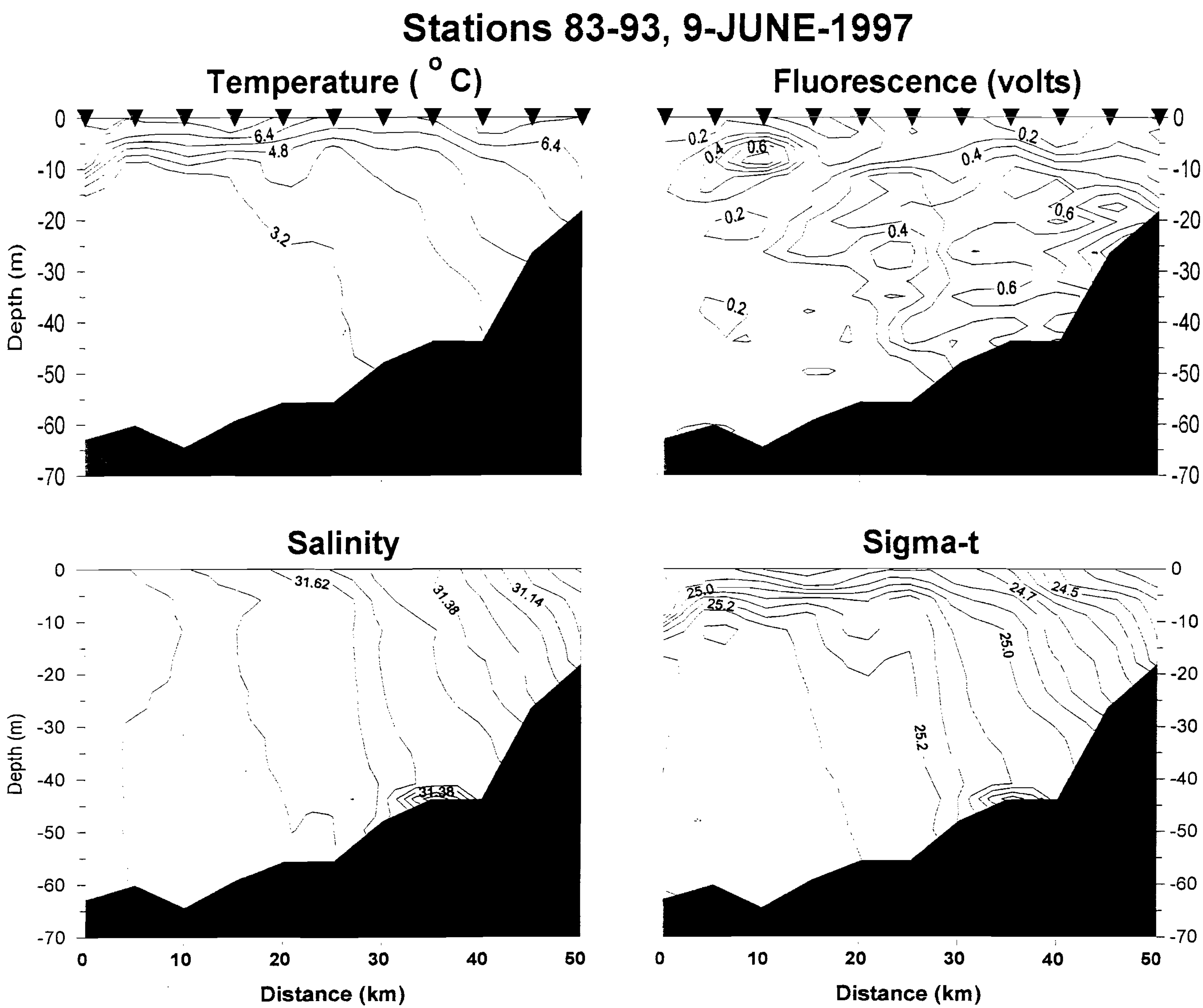


Fig. 11 Port Moller C-line profile

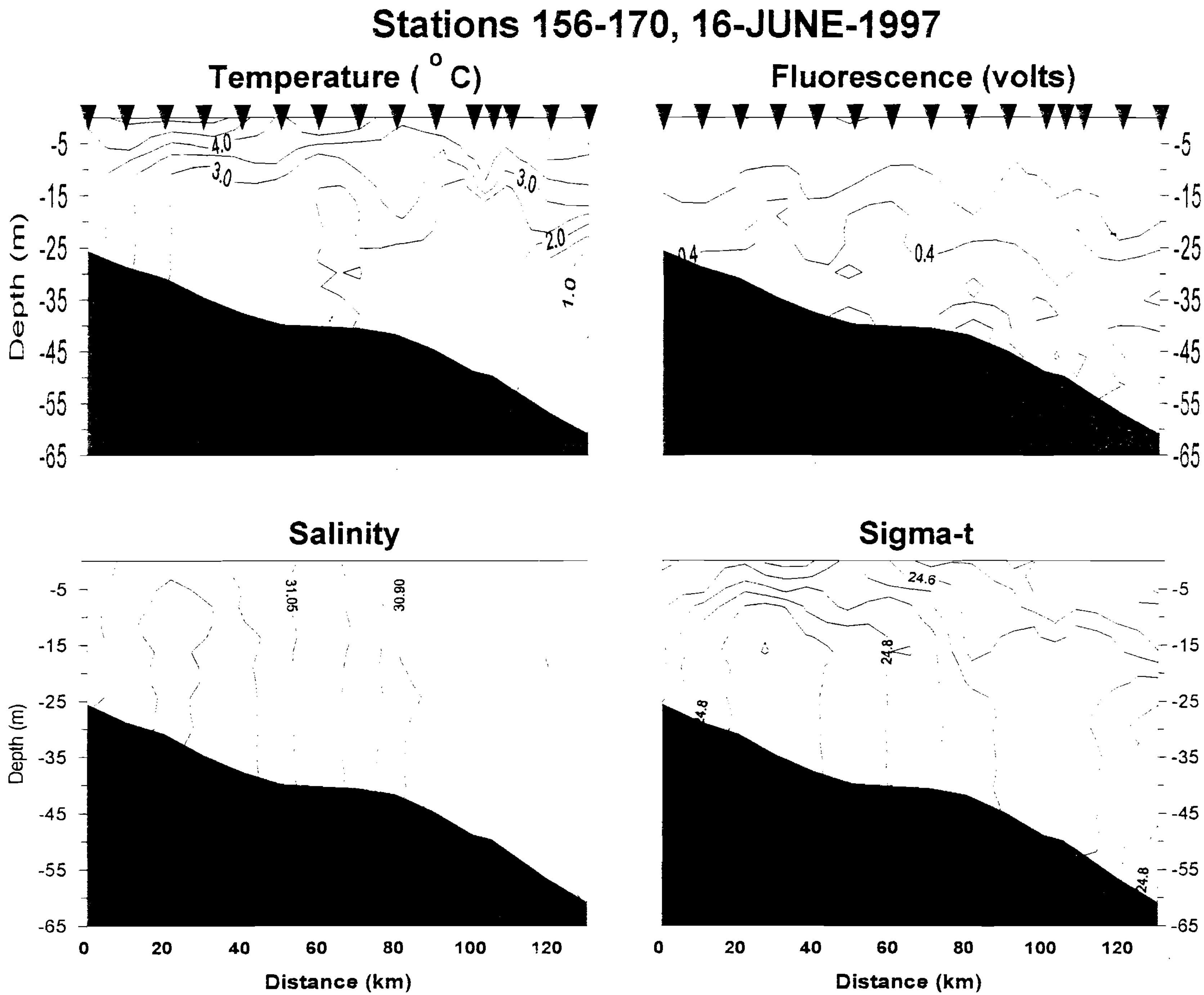


Fig. 12 Cape Newenham C-line profile

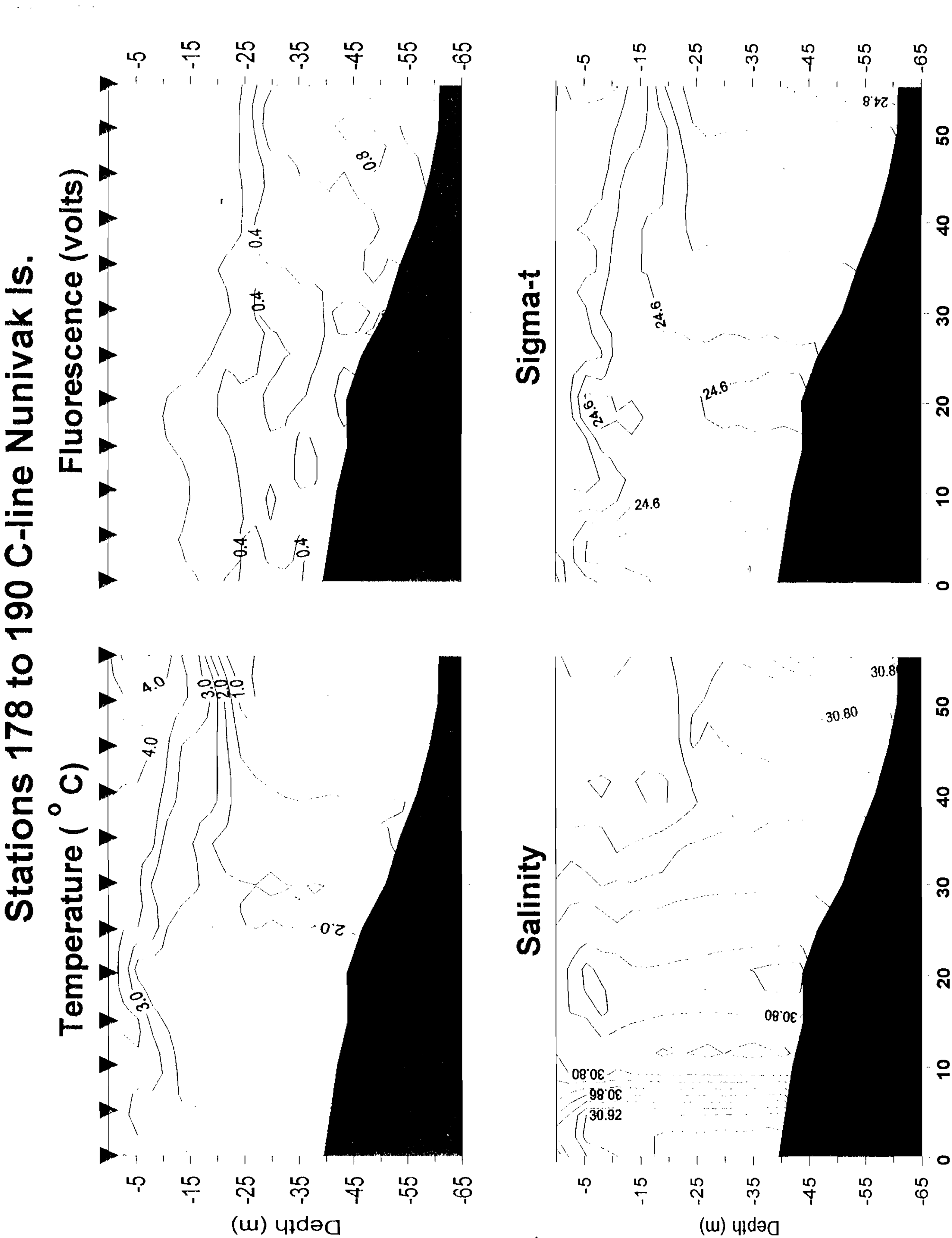


Fig. 13 Nunivak Island C-line profile

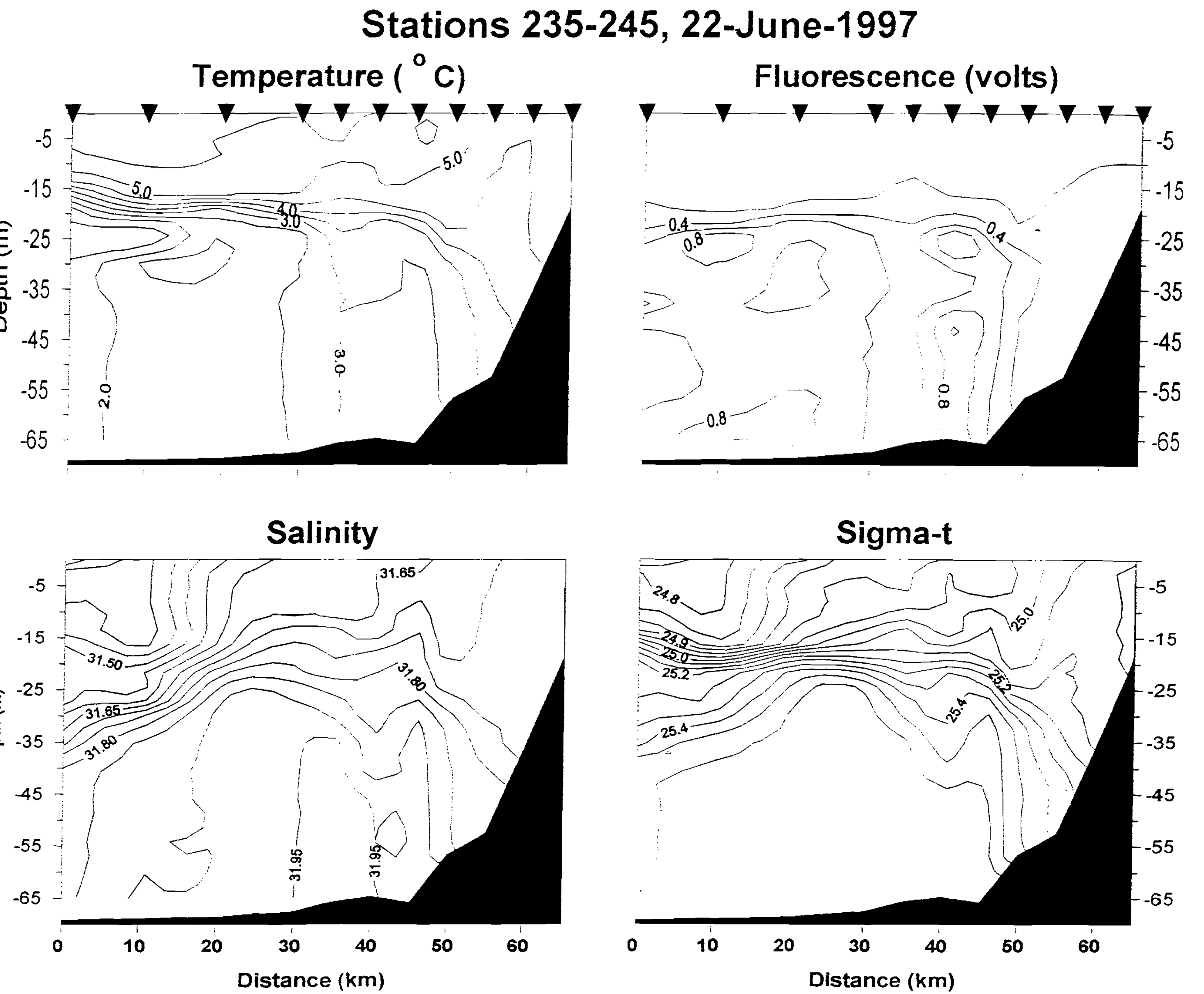


Fig. 14 St. Paul Island line 1 profile

SG5 Stations 247-255, 22-June-1997

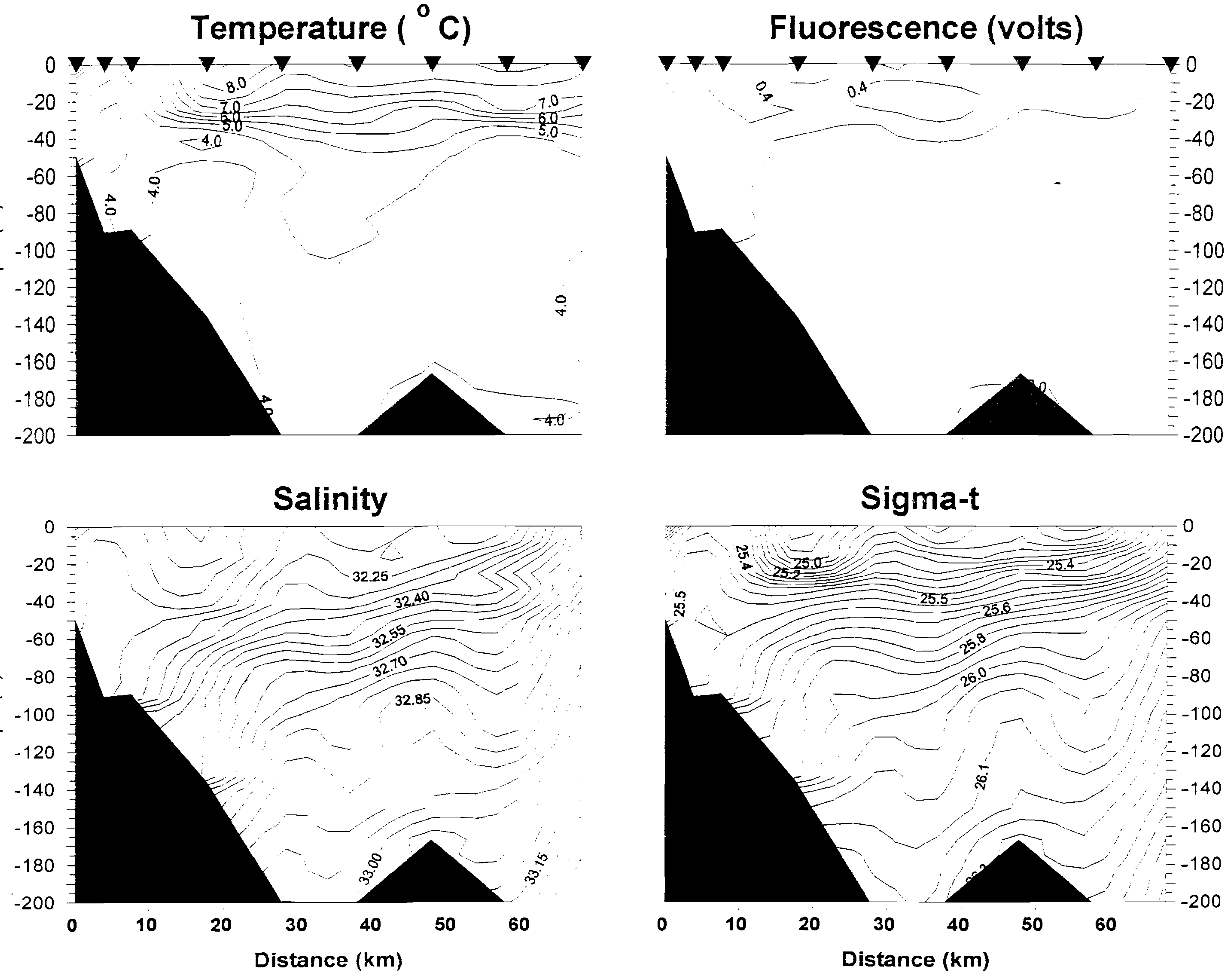


Fig. 15 St. George Island - South line

SG4 Stations 256-263, 22-June-1997

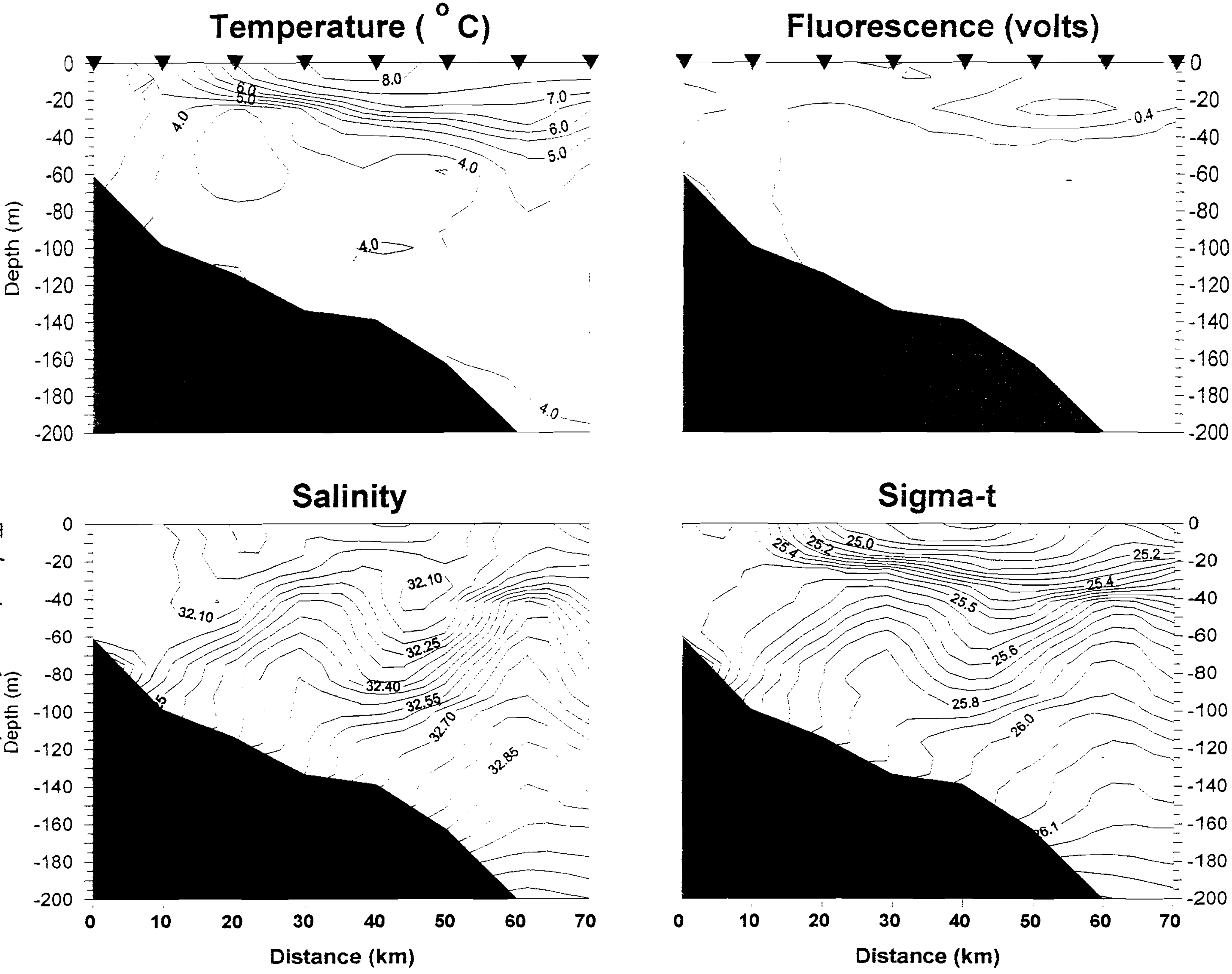


Fig. 16 St. George Island - SE line

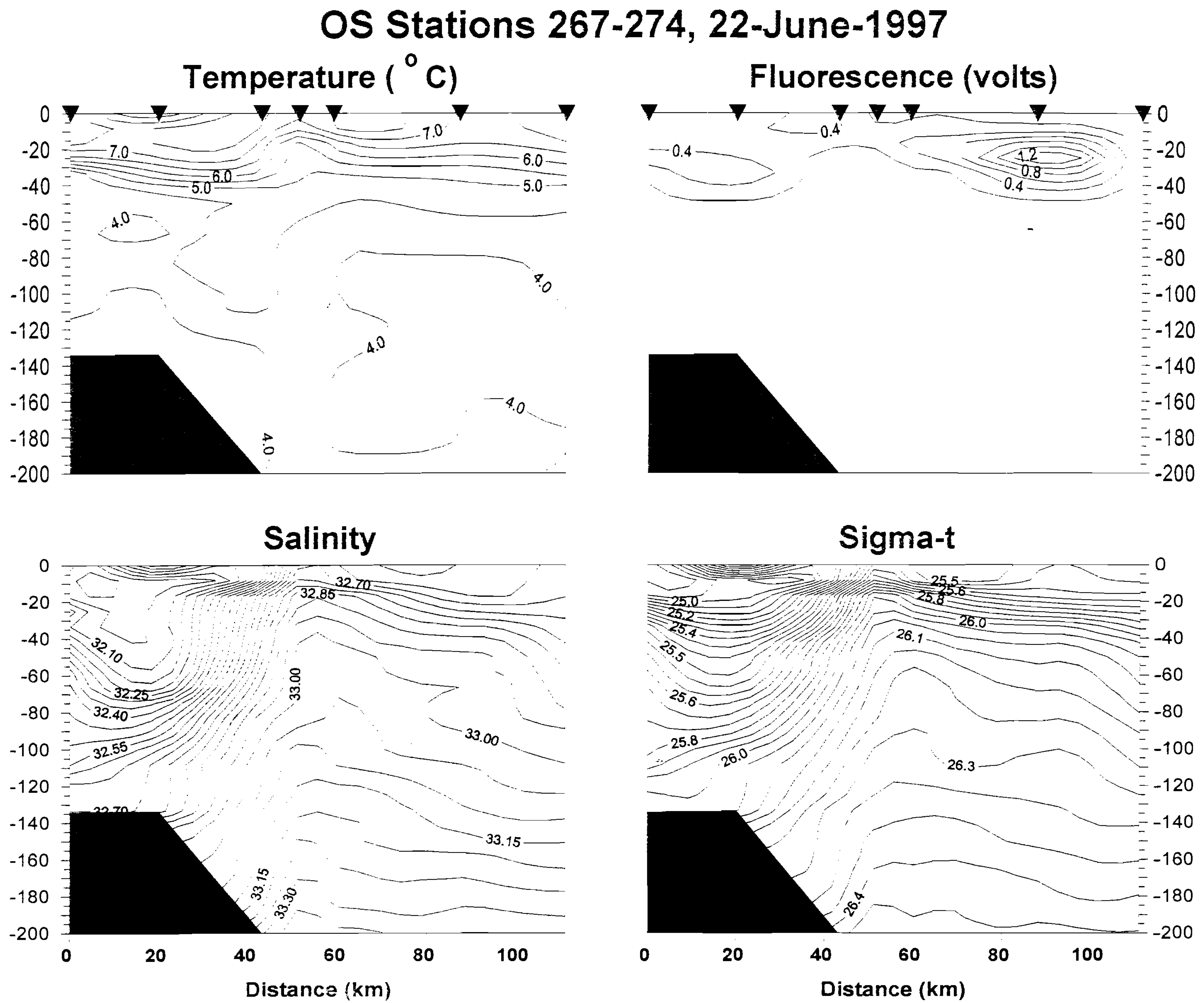


Fig. 17 Outer Shelf Transect 1

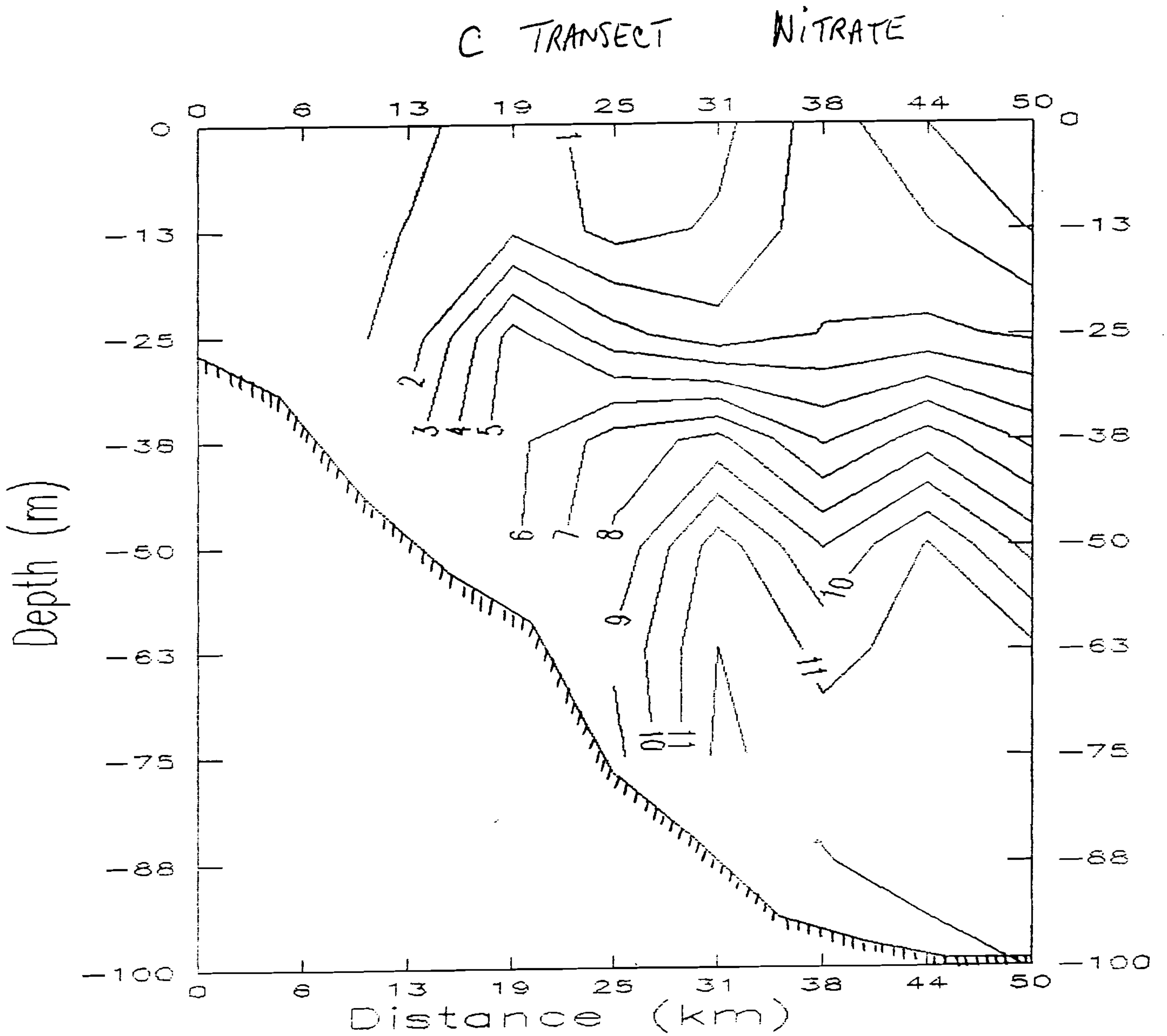


Fig. 18 Slime Bank C line Nitrate Profile

C TRANSECT AMMONIUM

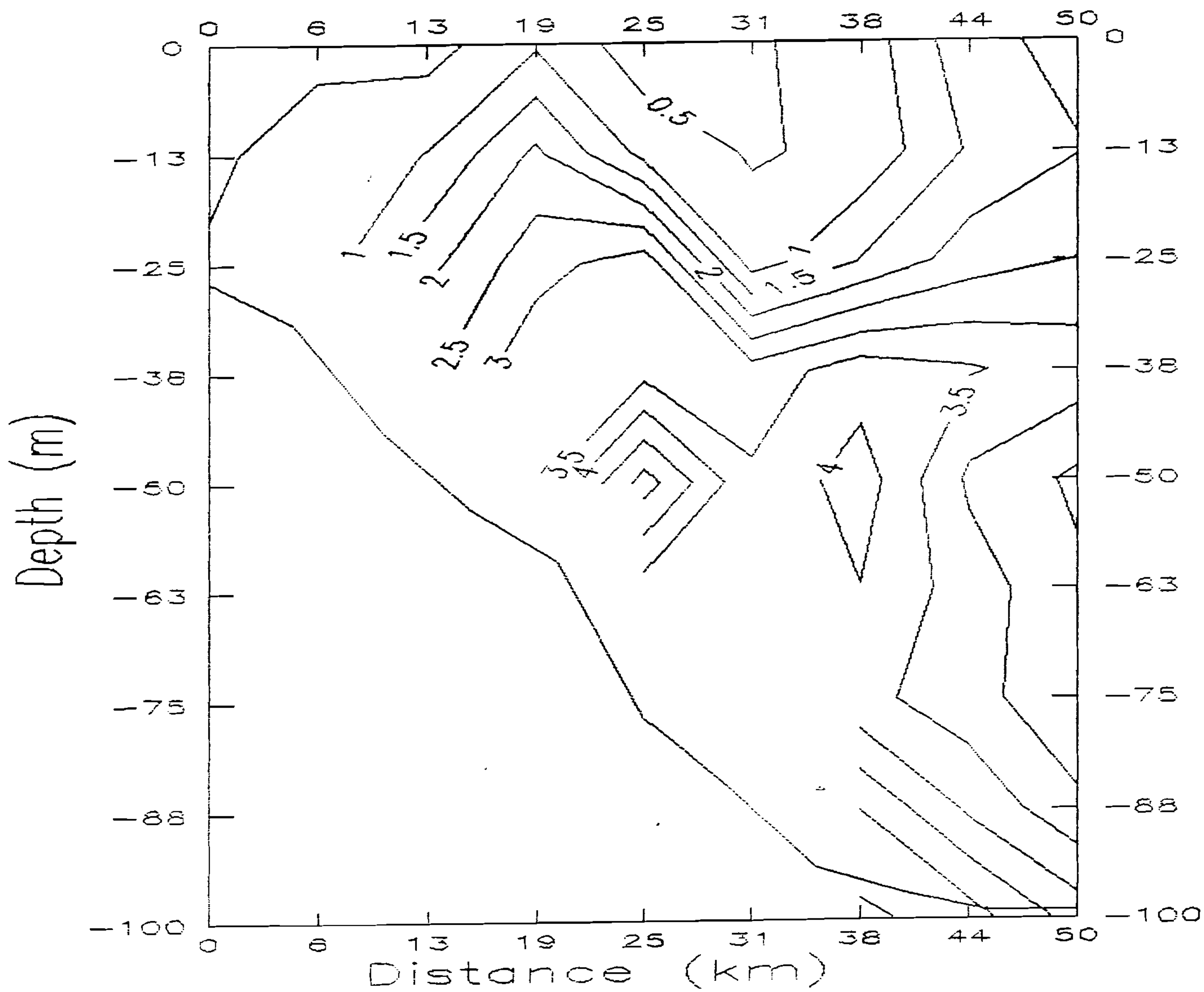


Fig. 19 Slime Bank C-line Ammonium Profile

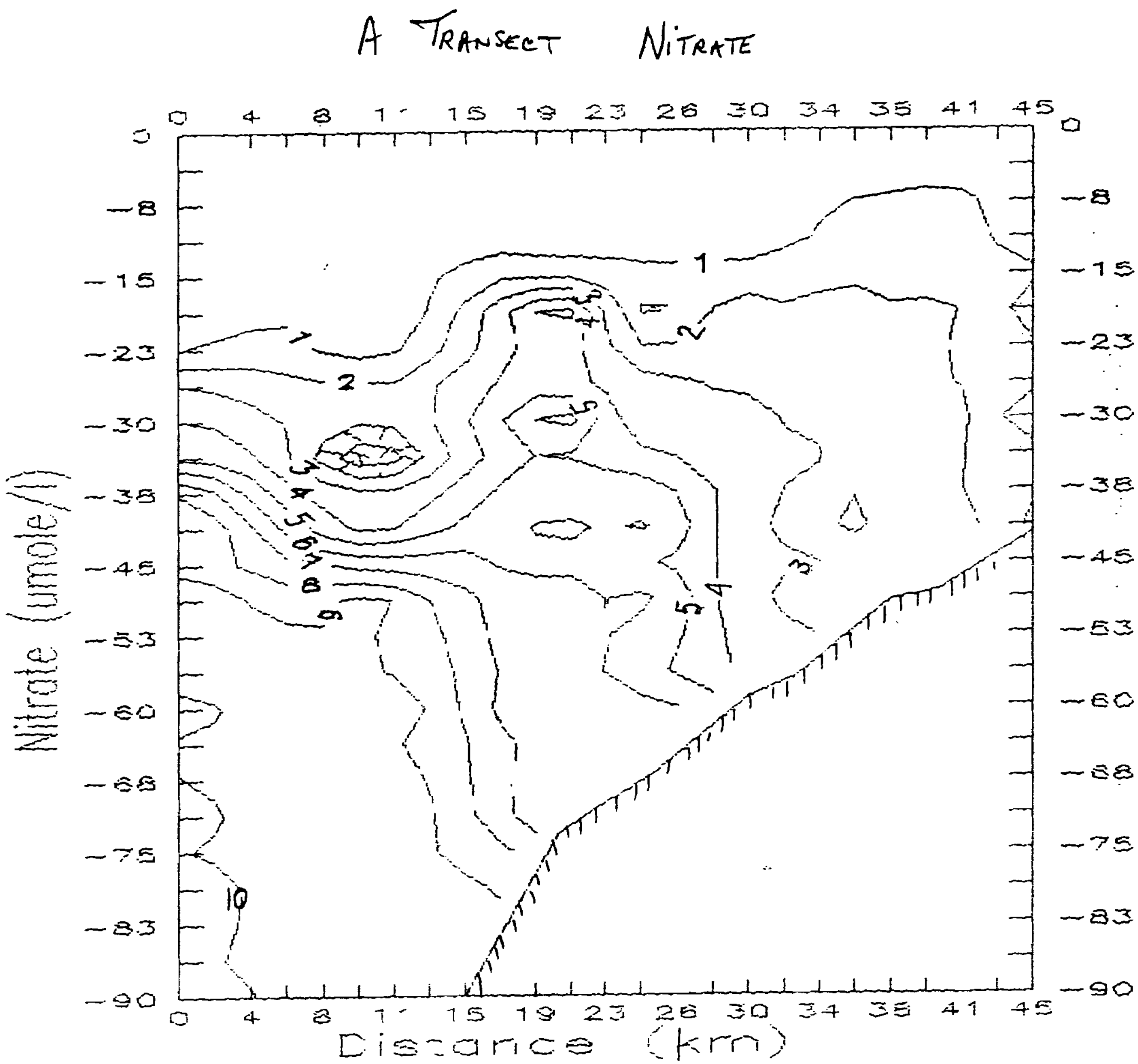


Fig. 20 Port Moller A-line Nitrate Profile

Fig. 4 Port Moller

A TRANSECT AMMONIUM

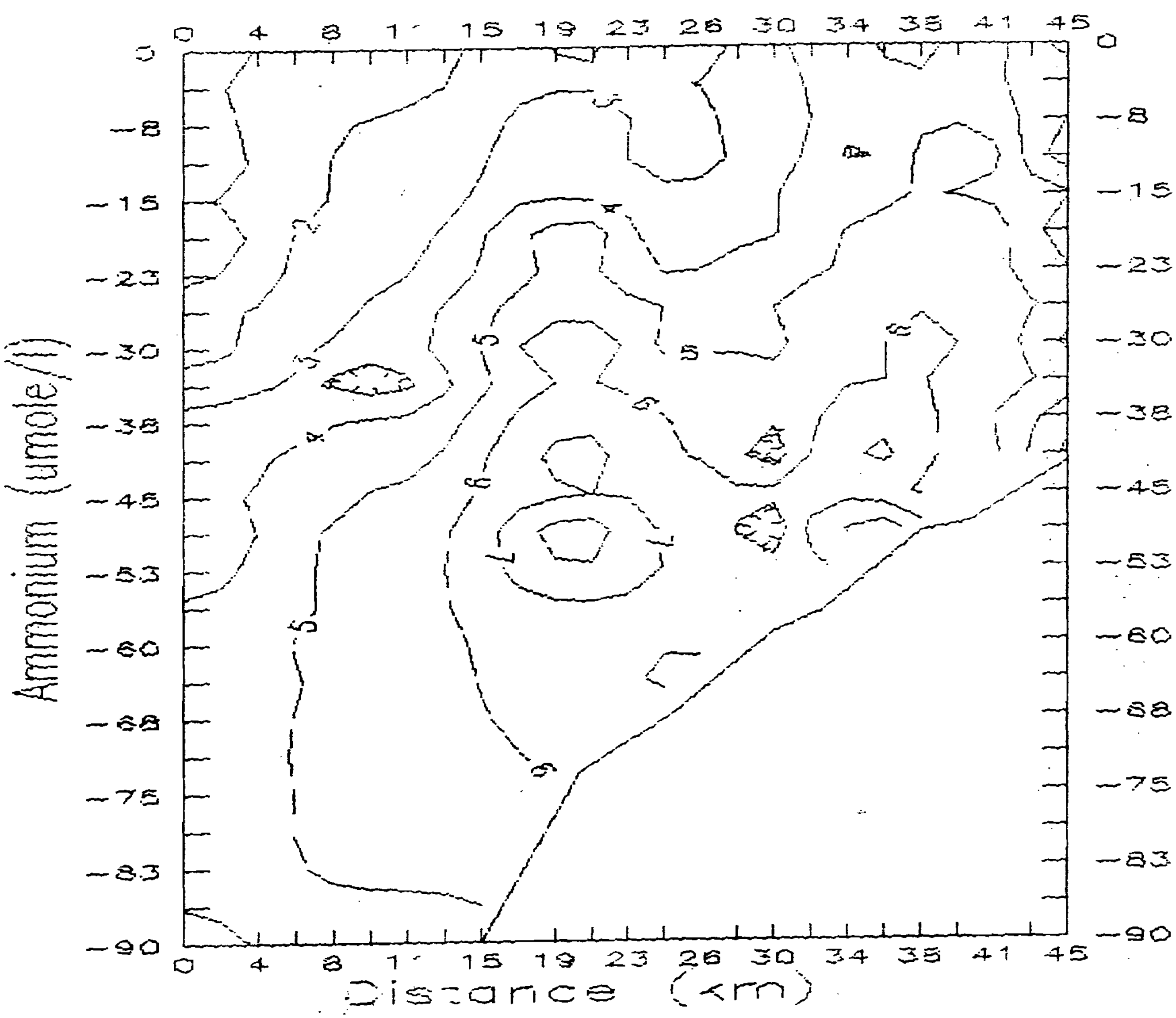


Fig. 21 Port Moller A-line Ammonium Profile

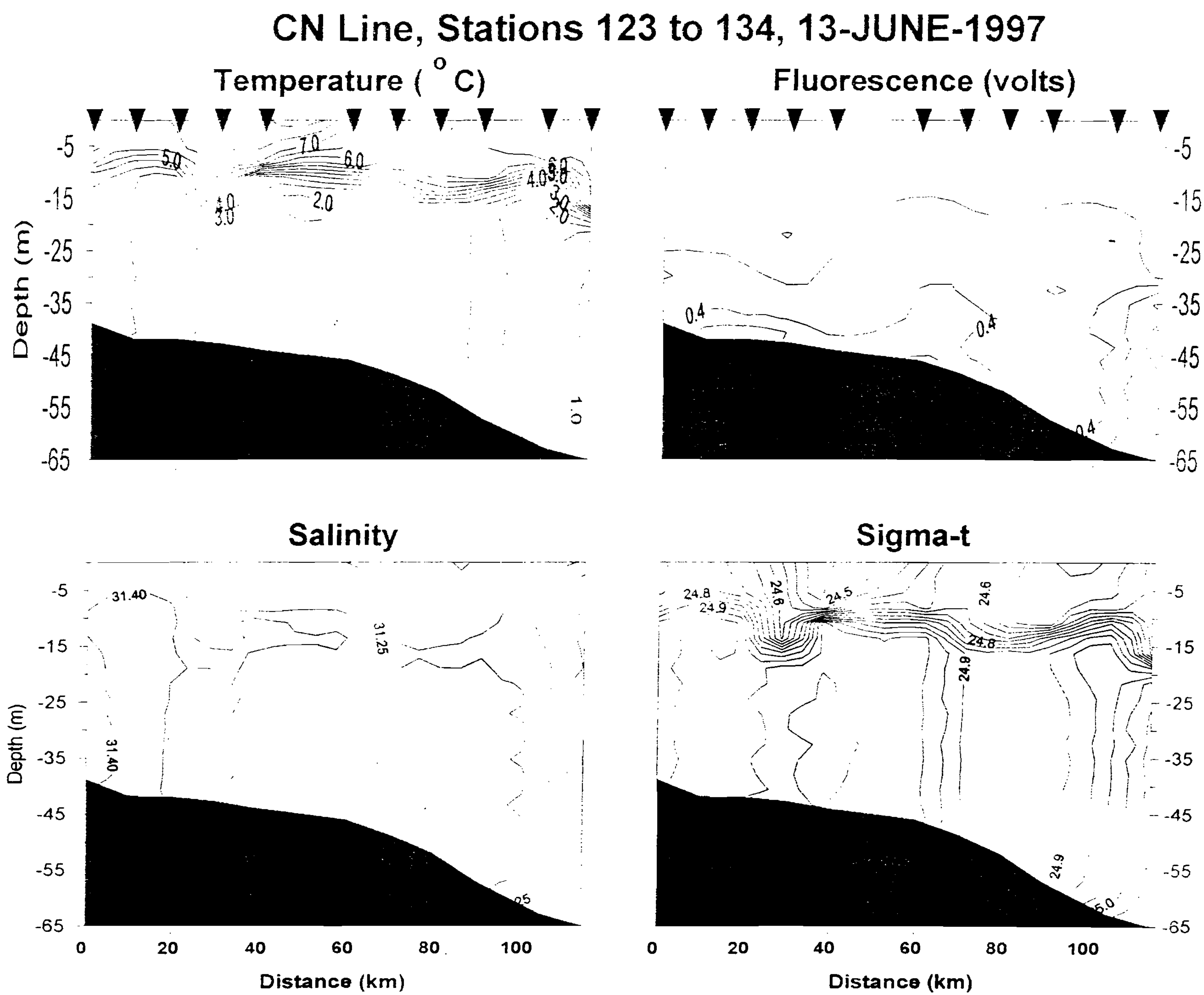


Fig. 22 Cape Newenham C-line profile

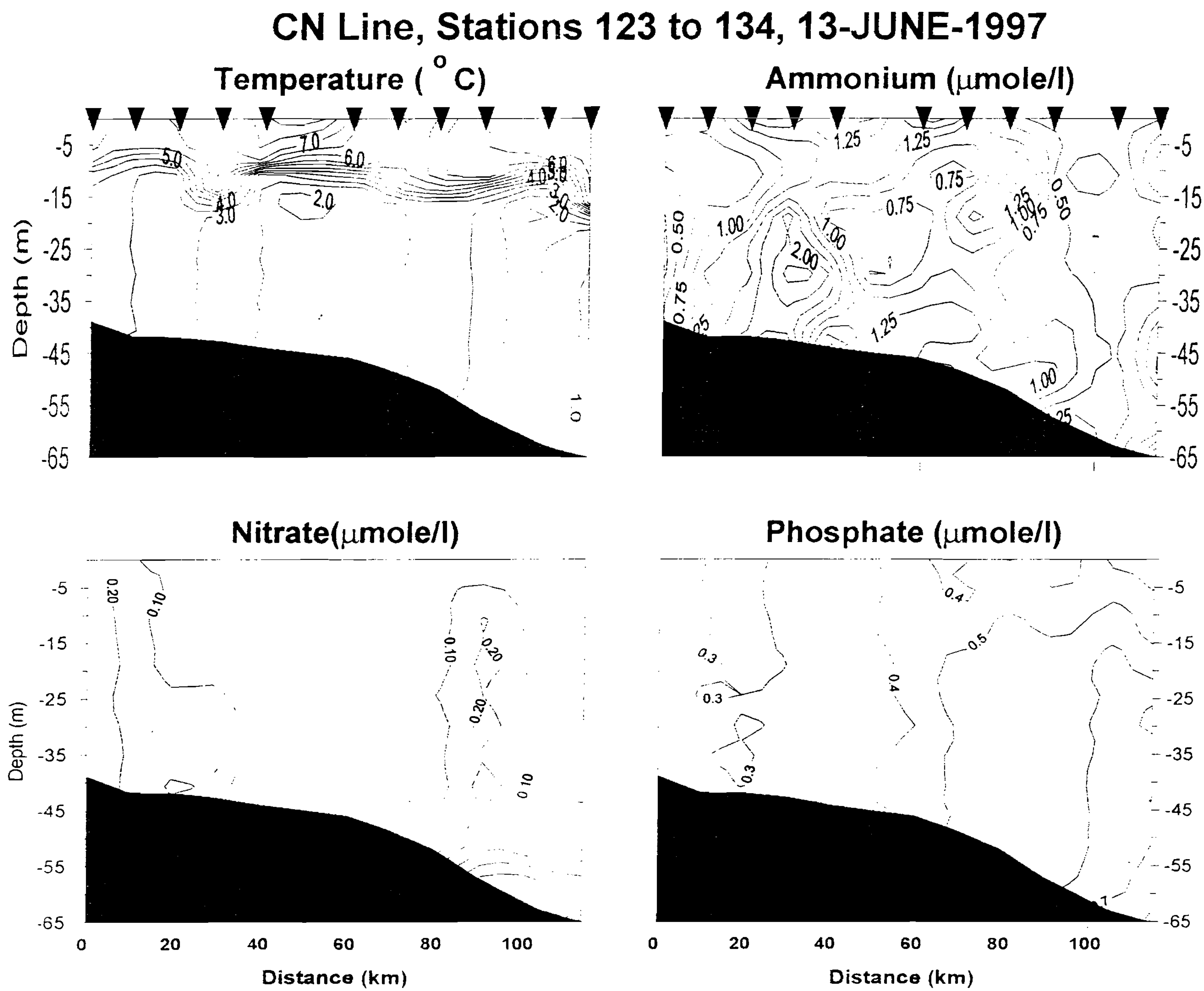


Fig. 23 Cape Newenham C-line Nutrient Profile

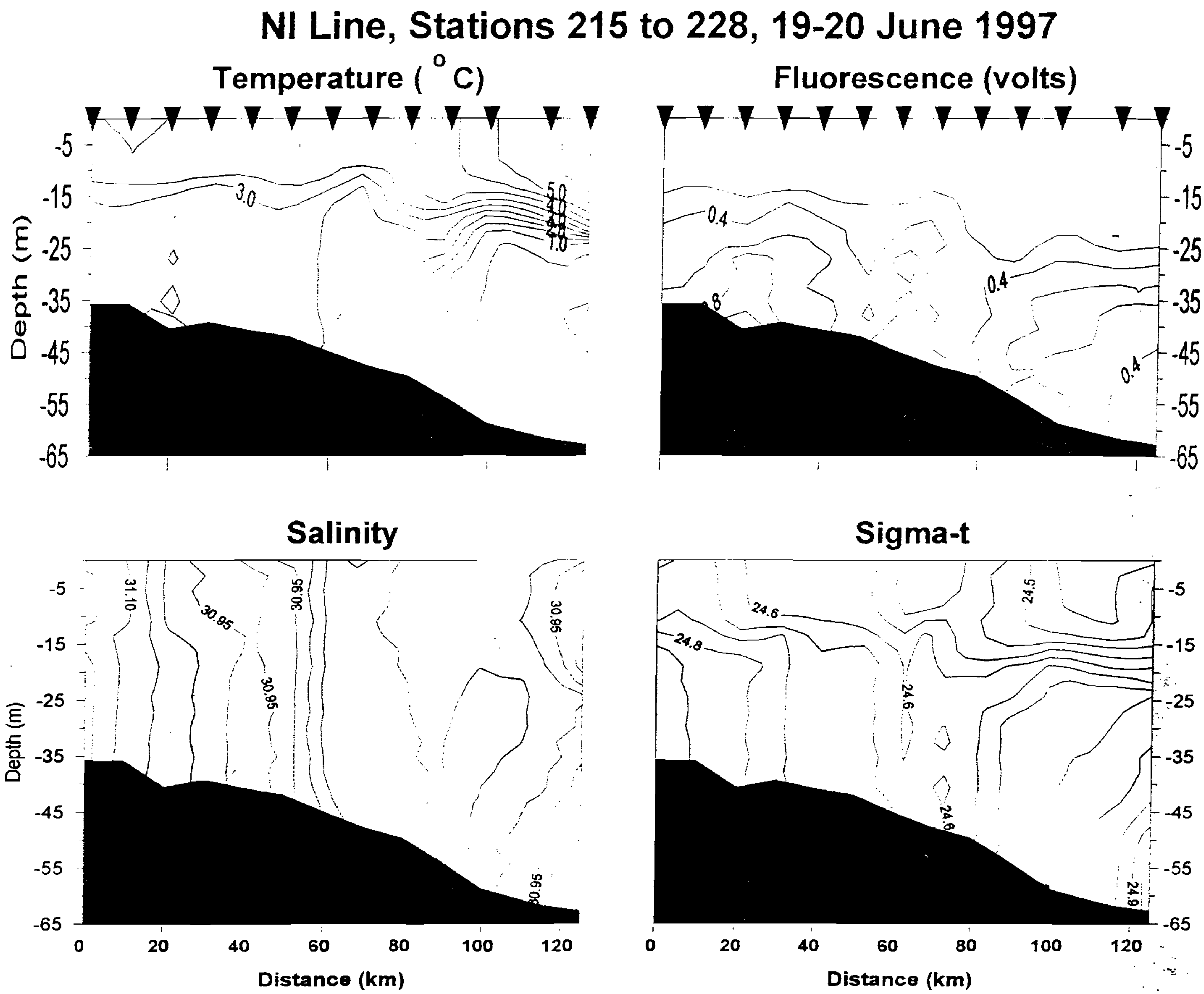


Fig. 24 Nunivak Island C-line profile

NI Line, Stations 215 to 228, 19-20 June 1997

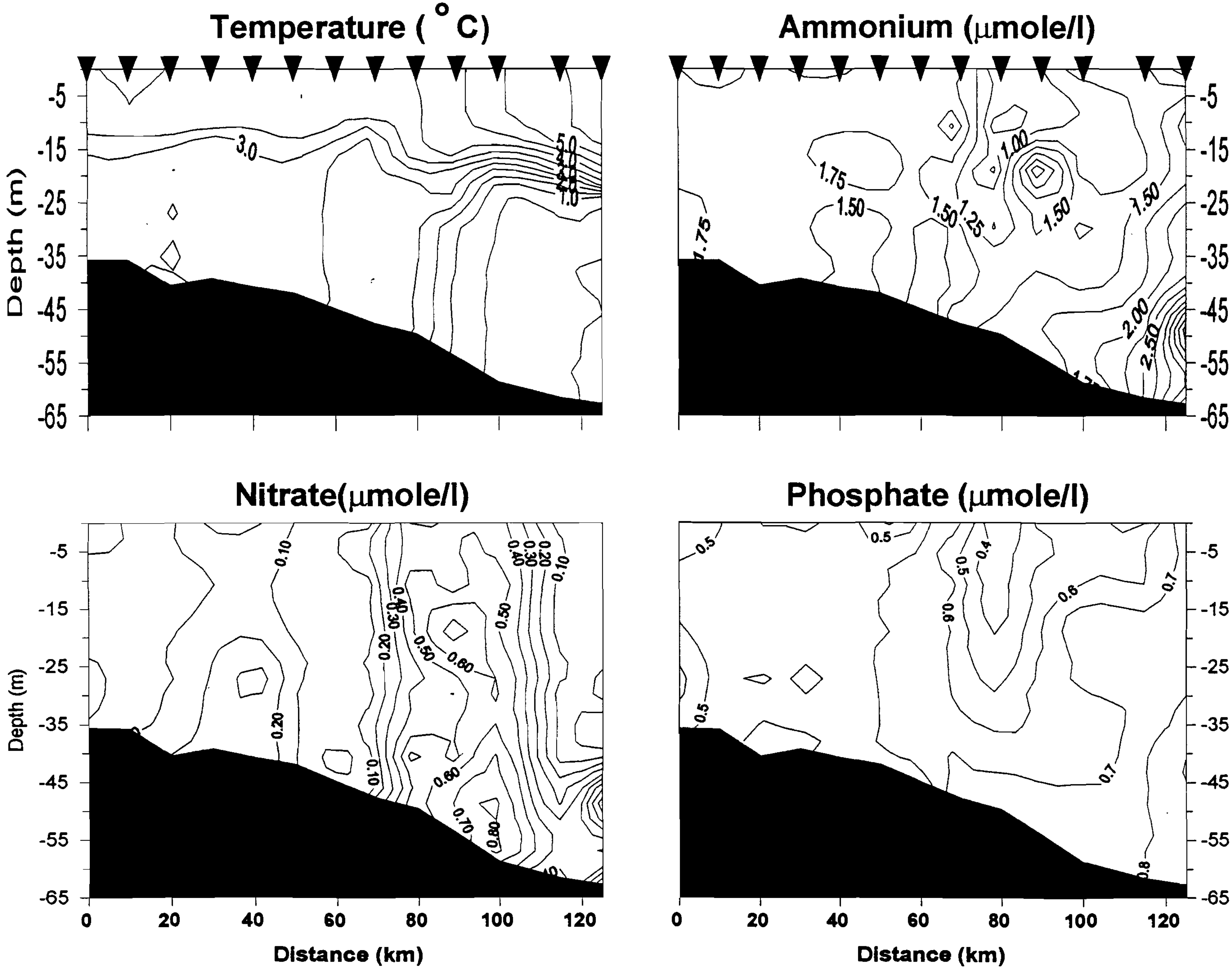


Fig. 25 Nunivak Island C-line Nutrient profile

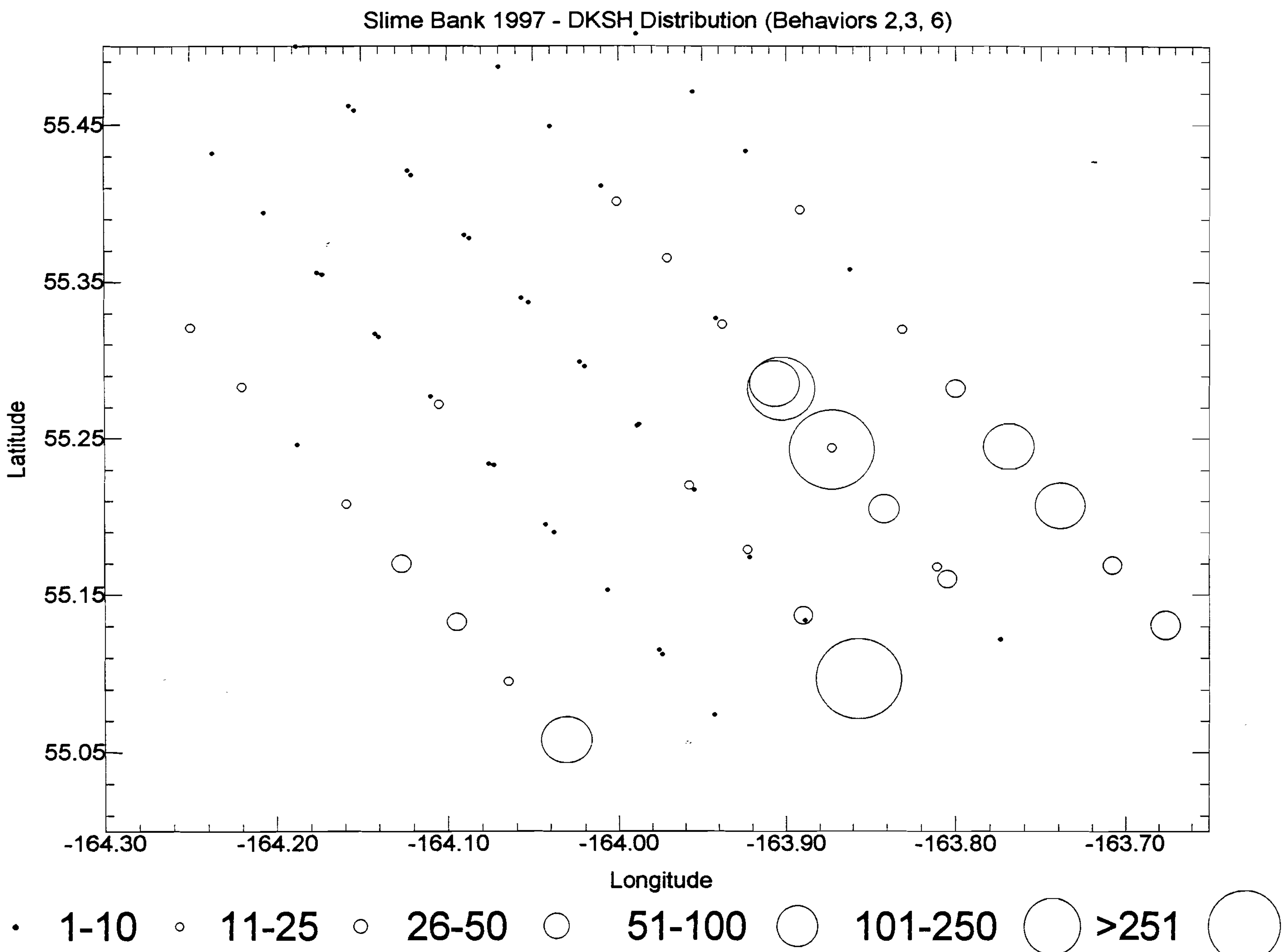


Fig. 26 Slime Bank - Distribution of foraging and sitting shearwaters

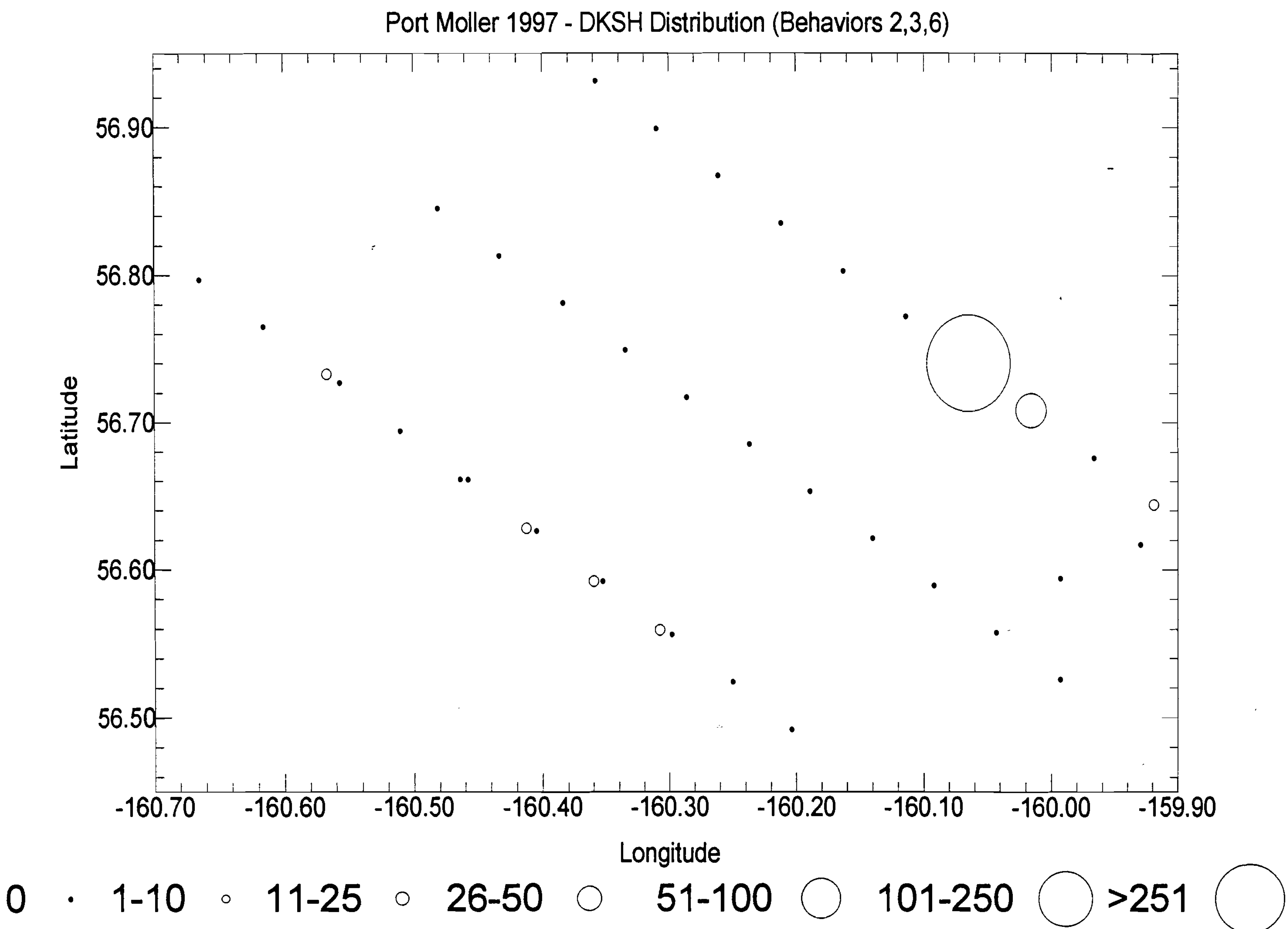


Fig. 27 Port Moller - Distribution of foraging and sitting shearwaters

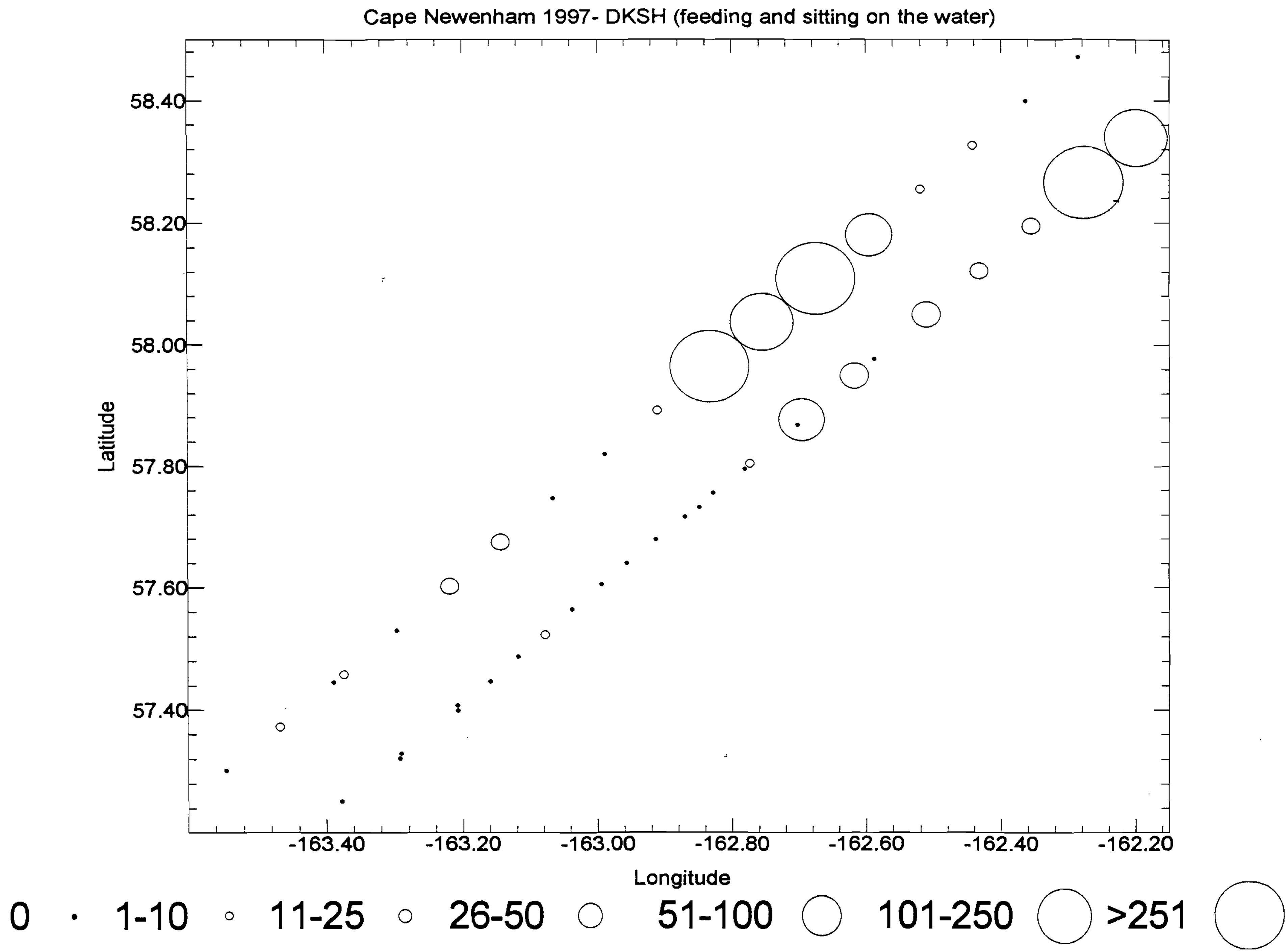


Fig. 28 Cape Newenham - Distribution of foraging and sitting shearwaters

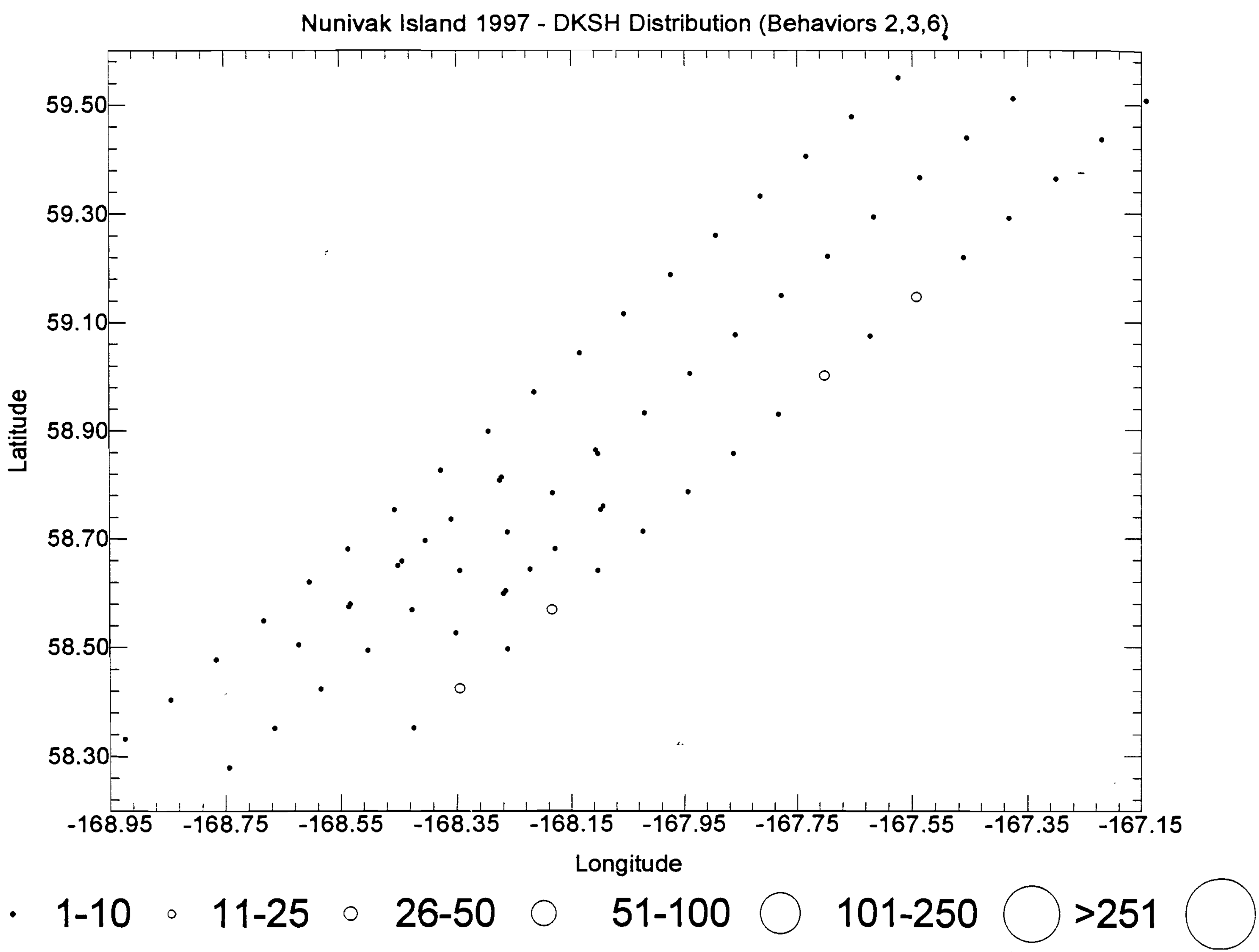


Fig. 29 Nunivak Island - Distribution of foraging and sitting shearwaters