Semi-annual water column monitoring report: August-December 1995

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Semi-Annual Water Column Monitoring Report
August - December, 1995

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SEMI-ANNUAL REPORT 1995, 95-02

EXECUTIVE SUMMARY

Water quality monitoring data presented in this report were collected during the second half of the 1995 Massachusetts Water Resources Authority (MWRA) Harbor and Outfall Monitoring (HOM) Program in the Massachusetts Bay system. The scope of the semi-annual report includes a synthesis of water column data, and a brief analysis of integrated physical and biological results. The horizontal and vertical distribution of water column parameters in the farfield and nearfield from the second eight surveys of 1995 are presented. Finally, key biological events that occurred during the semi-annual period both regionally and within the nearfield are discussed.

Baseline data have been collected to support the HOM Program mission to assess the potential environmental effects of effluent discharge into Massachusetts Bay. The data were collected to establish water quality conditions, and include physical water properties, nutrients, biological respiration and productivity, and plankton measurements. In the second half of 1995, two types of surveys were performed: eight nearfield surveys with stations located in the area over the future outfall site, and two comprehensive combined nearfield/farfield surveys that included stations in Boston Harbor, Massachusetts Bay, and Cape Cod Bay.

Results from the second semi-annual period are provided in summary tables, then discussed for each parameter measured. The horizontal distribution of physical parameters is presented through regional contour plots, and the vertical distribution through both time-series plots of averaged surface and bottom water column parameters, and along depth transects in the survey area. The timing of water column vertical stratification and the fall turnover influences the timing and impact of critical events such as dissolved oxygen depletion in bottom water. Results are summarized, therefore, for the pre-turnover surveys in August-September (W9510-13) and post-turnover surveys in October-December (W9514-17).

The pre-turnover period was characterized by a vertically stratified water column, due primarily to a strong temperature differential between surface and bottom water. Nutrients in the surface water were low, except for in Boston Harbor, which remained mixed and had the highest surface water concentrations of all nutrients measured during both farfield surveys. Nearfield dissolved oxygen in bottom water reached minimum concentrations during the final pre-turnover survey in late September.

Many physical and biological parameters clearly indicated a late summer bloom in late August and early September, primarily concentrated in and near Boston Harbor. During the first farfield survey in late August (W9511), maximum chlorophyll *a* concentrations were measured in Boston Harbor (14.2 µg/L), the inner nearfield (15 µg/L), and along the coast (11.8 µg/L). Peak annual production (7,584 $mgCm^{-2}d^{-1}$)

was measured during this survey at station F23, located outside of Boston Harbor. Boston Harbor had the highest phytoplankton densities of all farfield regions, with slightly lower abundances in the nearfield, coastal, and offshore regions. The late summer bloom was dominated by microflagellates and centric diatoms, including *Skeletonema costatum* and *Rhizosolenia fragilissima*.

The fall turnover was in progress by mid-October (W9514), with the water column remaining vertically stratified in the offshore and boundary regions, while remaining slightly stratified ($\Delta\sigma_t$ ranged from 0 to -1.0) in Boston Harbor, Cape Cod Bay, and the coastal regions. A mixing event, documented by continuous monitoring data collected at the USGS buoy in the nearfield, resulted in a reduction of the water column temperature gradient and a gradual breakdown of vertical stratification. The relative increase of surface water nutrient concentrations provided a catalyst for the nearfield fall bloom.

In October, results from the second combined nearfield/farfield survey showed that production of chlorophyll was focused in the outer nearfield, with maximum concentrations of 4-6 µg/L in the upper 10 m, and semi-annual maximum areal production among the nearfield stations measured at station N16 (2,793 $mgCm^{-2}d^{-1}$). Regionally, the nearfield had the highest surface water phytoplankton abundance during this survey.

The early November survey was conducted during the height of the fall bloom, with the highest semi-annual chlorophyll concentrations measured, reaching 18 µg/L in the central nearfield around station N21. The fall bloom was dominated by pennate diatoms (*Asterionellopsis glacialis*). During this and the following two final nearfield surveys, all physical and biological parameters indicated that the nearfield water column was well mixed.

1.0 INTRODUCTION

1.1 Program Overview

The Massachusetts Water Resources Authority (MWRA) has implemented a long-term Harbor and Outfall Monitoring (HOM) Program in the Massachusetts Bay system. The objective of the HOM Program is to verify compliance with the discharge permit, and to assess the potential environmental effects of the relocated effluent discharge into Massachusetts Bay. To establish baseline water quality conditions with respect to nutrients, water properties, phytoplankton and zooplankton, and water-column respiration and productivity, ENSR is conducting water quality surveys in the nearfield and farfield region of Massachusetts and Cape Cod Bays.

This report summarizes results from water quality monitoring conducted during the second half of the 1995 monitoring year. Water column monitoring results for the second 8 of 17 surveys conducted in 1995 are included in this report (Table 1-1). There were two types of surveys performed: eight nearfield surveys with stations located in the area over the future outfall site, and two more comprehensive nearfield/farfield combined surveys that included stations in Boston Harbor, Massachusetts Bay, and Cape Cod Bay (Figures 1-1 and 1-2). The stations in these surveys are further separated into regional groupings according to geographic location. The nearfield survey W9516 included a Stellwagen Basin survey at station F12 to monitor late fall dissolved oxygen levels in the basin. The final winter survey, conducted in mid-December (W9517), included a winter nutrients objective to characterize winter nutrient levels in Massachusetts Bay. Due to inclement weather, only three nearfield stations were sampled during this survey.

This report presents summarized data from the second semi-annual period. A summary of the raw data, along with specific field information, is available in individual survey reports, submitted immediately following each survey. Data reports, including final processed data and regression information, are submitted five times annually. The available data reports are the nutrient data reports (including sensor and water chemistry data), phytoplankton data reports, and the productivity and respiration data reports.

1.2 Organization of the Semi-Annual Report

The scope of the semi-annual report is focused primarily towards providing a synthesis of all of the water column data collected during the reporting period. Secondarily, integrated physical and biological results are discussed for key water column events. The report first provides a summary of the survey and laboratory methods (Section 2.0). The bulk of the report, as discussed in further detail below, presents results of water column data from the second eight surveys of 1995 (Sections 3.0-5.0). Finally, the major findings of the semi-annual period, including integrated physical and biological water column results during water column events are synthesized in Section 6.0.

In the results sections, data are first provided in summary tables (Section 3.0). The data summary tables include the major results of water column surveys in the semi-annual period. A description of data selection, integration information, and statistical analyses conducted are included with that section.

Each of the summary results sections (Section 4.0, 5.0) includes presentation of the horizontal and vertical distribution of water column parameters in both the farfield and nearfield. The horizontal distribution of physical parameters is presented through regional contour plots. The vertical distribution of water column parameters is presented using both time-series plots of averaged surface and bottom water column parameters, and along three transects in the survey area (Figure 1-3). The time-series plots utilize average values of the surface water sample (the "A" depth, as described in Section 3.0), and the bottom water sample (the "E" depth). Examining data trends along the three farfield transects, Boston-Nearfield, Cohassett, and Marshfield, and one nearfield transect (N10 to N04, Figure 1-3), allows three-dimensional analysis of water column conditions during each survey.

Results of water column physical data, including water properties, nutrients, chlorophyll, and dissolved oxygen, are provided in Section 4.0. Survey results were organized according to the physical characteristics of the water column during the semi-annual period. For the second semi-annual period, the timing of the fall water column turnover is the key event that, to a large degree, determines ecological water quality parameters that are a major focus in assessing effects of the outfall. Because of the importance of this dynamic, this report describes the horizontal and vertical characterization of the water column during the pre-turnover stage (W9510-W9513), and then further delineates processes occurring during and following the fall turnover (W9514-W9517). Time-series data are commonly provided for the entire semi-annual period for clarity of data presentation.

Productivity, respiration, and plankton measurements, along with corresponding discussion of chlorophyll and dissolved oxygen results, are provided in Section 5.0. Discussion of the biological processes and trends during the semi-annual period are included in this section. A summary of the major water column events of the semi-annual period is presented in Section 6.0, and finally, references are provided in Section 7.0.

TABLE 1-1

Second Semi-Annual 1995 Schedule of Survey Events

Event Number	Type of Survey	Date
W9510	Nearfield	August 8-10
W9511	Nearfield/Farfield	August 21-26
W9512	Nearfield/Plume	September 6-14
W9513	Nearfield/Plume	September 25-29
W9514	Nearfield/Farfield	October 9-13
W9515	Nearfield	November 1-4
W9516	Nearfield/Stellwagen	November 27 & December 5
W9517	Nearfield/Winter Nutrients	December 17-19

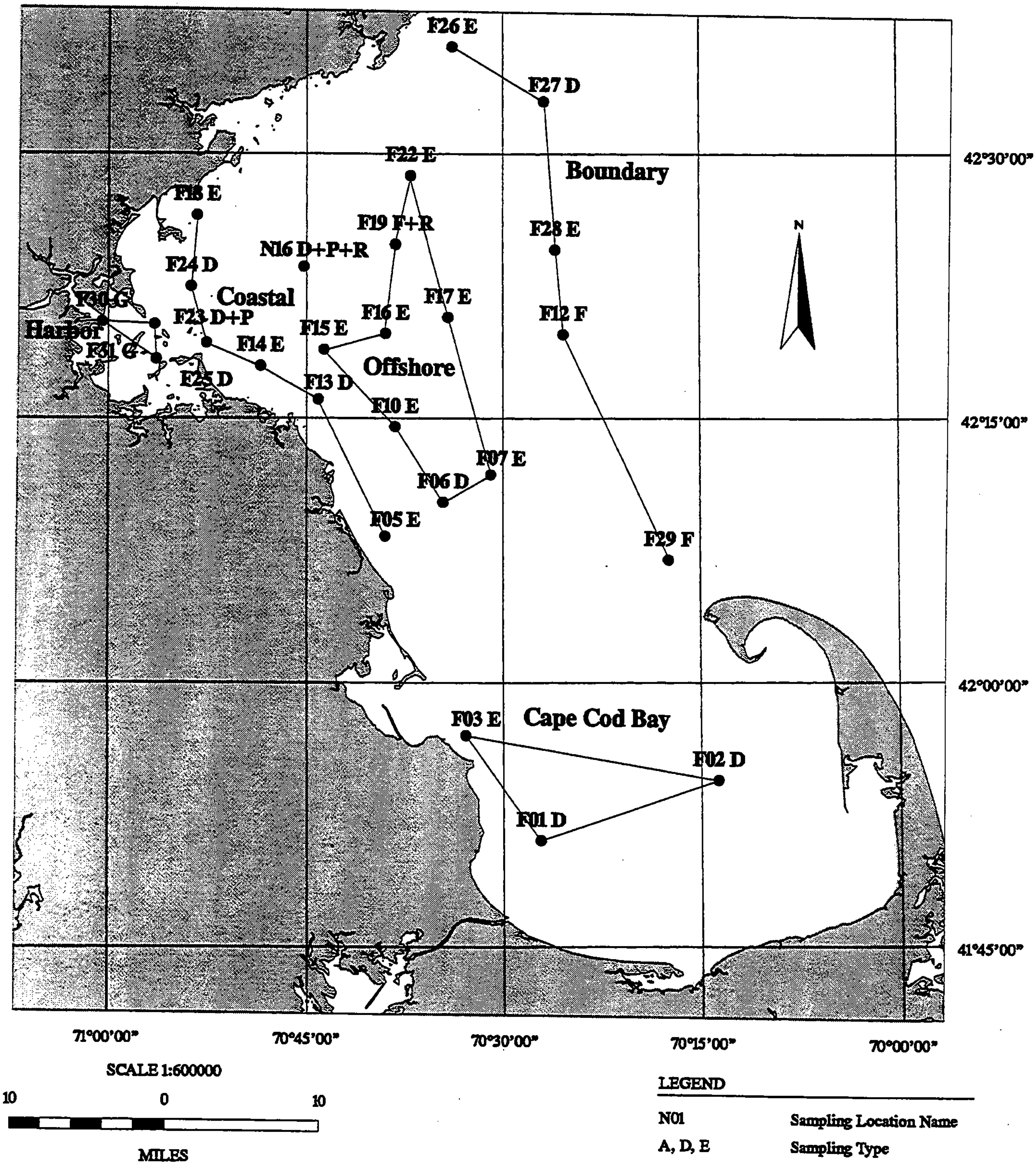


FIGURE 1-1
Location of Farfield Stations Showing
Regional Geographic Classifications

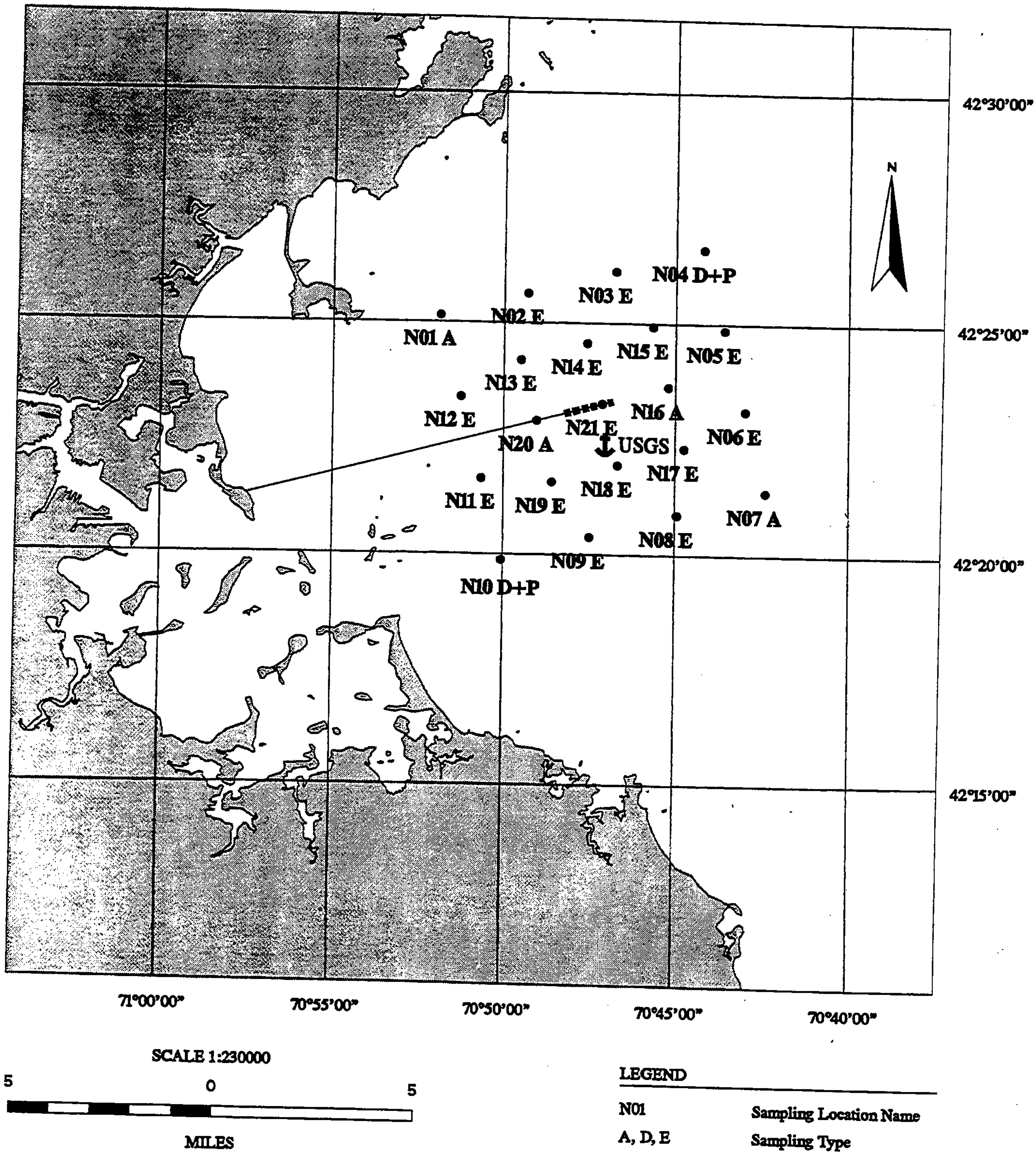


FIGURE 1-2
Location of Nearfield Stations

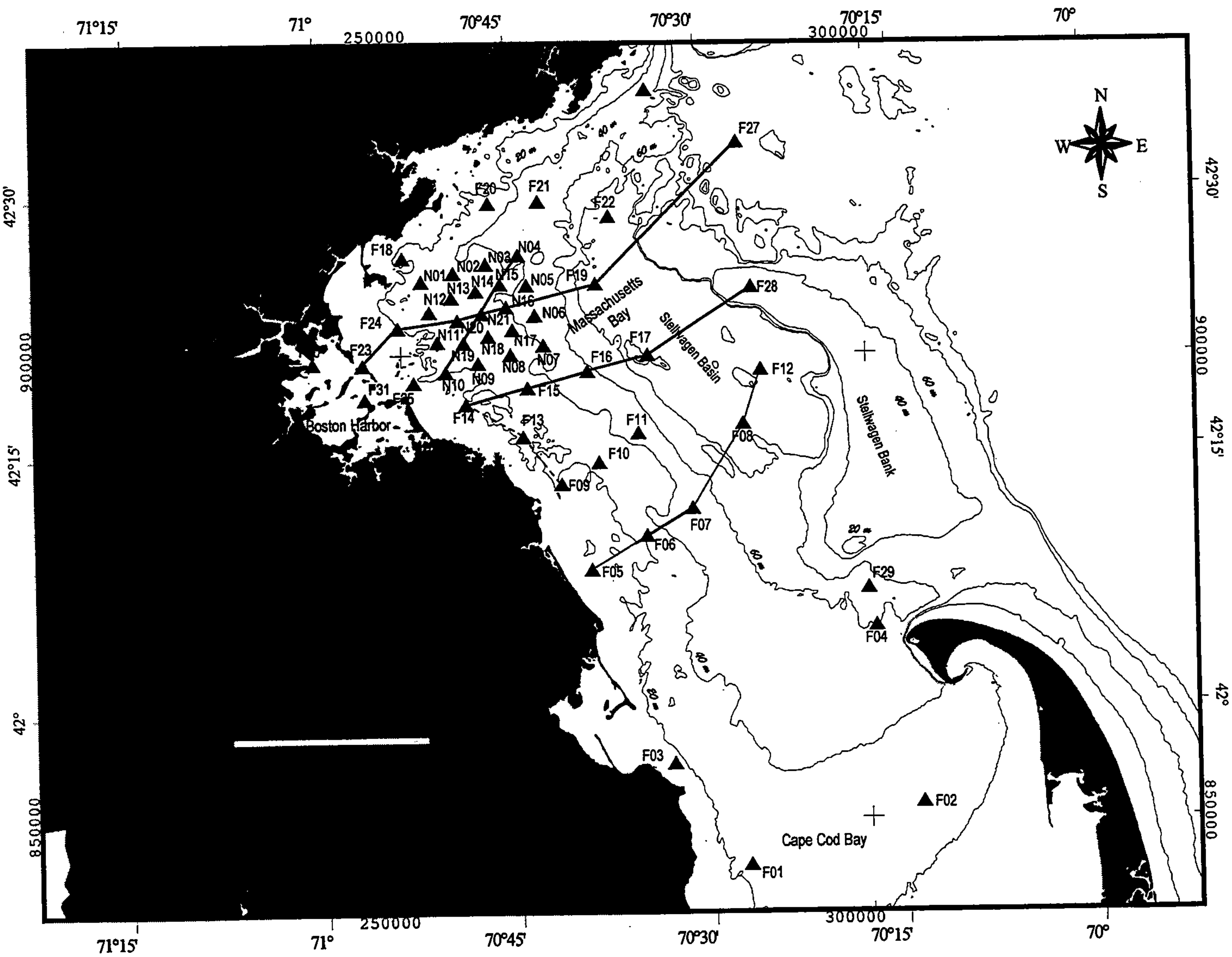


FIGURE 1-3
Location of Stations Selected for Vertical Transect Graphics

2.0 METHODS

Water quality data for this report were collected from the sampling platforms *R/V Christopher Andrew* and *R/V Isabelle S.* Continuous vertical profiles of the water column and discrete water samples for analysis are collected using a CTD/Niskin Bottle Rosette system. Hydrographic measurements of the water column include conductivity/salinity, temperature, depth, dissolved oxygen, transmissometry, irradiance, and relative fluorescence.

Water samples were collected at five depths: bottom, mid-bottom, middle, mid-surface, and surface; in general, the middle water column depth was selected at or near the chlorophyll maximum. All samples were analyzed for dissolved inorganic nutrients (DINuts), including nitrate (NO_3), nitrite (NO_2), phosphate (PO_4), silicate (SiO_4) and ammonium (NH_4). Additional analyses carried out for differing subsets of stations and depths include dissolved organic carbon, total dissolved nitrogen and phosphorous, particulate organic carbon, nitrogen, and phosphorous, biogenic silica, chlorophyll *a*, and phaeopigments, total suspended solids, dissolved oxygen, urea, estimates of plankton productivity and respiration rates, and plankton taxonomy and enumeration.

The sampling schema are outlined in Table 2-1. Further details on field sampling and analytical procedures, laboratory sample processing and analysis, sample handling and custody, calibration and preventive maintenance, documentation, data evaluation, and data quality procedures are discussed in the Water Quality Monitoring Combined Work/Quality Assurance Project Plan (CW/QAPP; Bowen *et al.*, 1997).

Principal deviations from the CW/QAPP plan for each survey are described below. For additional information about a specific survey, the individual survey reports may be consulted.

Deviations from the CW/QAPP for the nearfield survey in early August (W9510):

- Only 18 out of 21 nearfield stations were sampled due to time limitations.
- Analysis groups for mid-surface and middle depths were switched based on chlorophyll maximum for Station N01.
- Only 90 out of 105 planned samples for Dissolved Inorganic Nutrients (DINuts) were collected due to the decreased number of sampling stations.

Deviations from the CW/QAPP for the combined farfield/nearfield survey in mid August (W9511):

- One farfield station (F17) could not be sampled due to time limitations resulting from an equipment failure.

- Only 121 out of 126 planned samples for DINuts were collected due to the inability to sample the last farfield station.

- The trigger mechanism failed to release for the bottom bottle at the nearfield station N05, therefore no sample was collected for DINuts at the bottom depth for this station.

- The BOD bottle from the bottom depth at station N01 broke during repacking of a sample cooler. Therefore, no sample was analyzed for dissolved oxygen at the bottom depth for this station.

Deviations from the CW/QAPP for the combined nearfield/plume tracking survey in early September (W9512):

- Only 16 out of 19 nearfield stations were sampled due to time limitations.

- Only 80 out of 95 planned samples for DINuts were collected due to the decreased number of sampling stations.

- At station N01, uncalibrated fluorescence readings exceeded the full scale setting of 10.0 µg/l. The full scale setting had to be reset internally to read greater chlorophyll values present at station N01. Analysis groups were switched to mid-surface level based on chlorophyll maximum.

Plume tracking:

- The rosette triggering system failed during the plume tracking survey. As a result, CTD casts only were performed at NOAA waypoints 017 and 031. Manual triggering of Niskin bottles was implemented in order to collect samples at station 004. After station 004, the rosette triggering problem was solved.

- The mid-depth bottle misfired at station 005 and no water sample was collected at that depth.

- Bottles fired in the incorrect order at Station 011 resulting in some uncertainty about the samples.

Deviations from the CW/QAPP for the combined nearfield/plume tracking survey in late September (W9513):

- Only 18 out of 19 nearfield stations were sampled due to time limitations and rough seas. The station that was dropped was station N08.

- Only 90 out of 95 planned samples for DINuts were collected due to the decreased number of sampling stations.

Plume tracking:

- Weather problems caused the cancellation of the ebb tide survey on Thursday September 28, 1995.

- At station 007 of the flood tide plume tracking survey, the programmed rosette triggering sequence of 1,4,6,9,11 was executed by the onboard electronics unit. Instead a sequence of 1,4,6,7,9 was executed. Position 7, which did not have a loaded Niskin, was fired at the mid-surface depth. Bottle 9 was fired at the surface instead of the mid-surface, and bottle 11 was never fired during the upcast.

- Due to the technical problems at station 007, a sample from the mid-surface depth was not collected for DINuts analysis.

- Station 011, designated as an experiment to test two sample collection protocols, was not sampled due to time constraints. Station 022 was not sampled due to proximity of the station site to a seawall and time constraints.

Deviations from the CW/QAPP for the combined farfield/nearfield survey in early October (W9514):

- Observation that zooplankton tow count seemed low at Station F06. Possibility that the impeller of the flowmeter caught on the net because lead lines were too long and therefore, the flowmeter lead lines were tightened.

- Two BOD bottles with DO samples broke during transport to the lab (F29, bottom duplicate; F12, bottom sample).

Deviations from the CW/QAPP for the nearfield survey in early November (W9515):

- Only 17 out of 19 nearfield stations were sampled due to time limitations caused by rough sea conditions. The stations that were dropped were stations N08 and N09.

- Only 85 out of 95 planned samples for DINuts were collected due to the decreased number of sampling stations.

- The cast at Station N05 was performed without navigation input due to faulty connection between the deck unit and the rosettes. Position information for Station N05 was noted in the survey log directly from the GPS unit.

- During preservation of DO samples at Station N07, it was noticed that the bottom depth BOD bottle was cracked (sample W95F1N07ES). The bottle was taped in compression to help hold it together.

Deviations from the CW/QAPP for the nearfield survey/Stellwagen Basin station in early December (W9516):

- At station N04, the CTD's real-time data acquisition process failed due to a problem linking with the navigation data. CTD data and navigation data were recorded separately from the GPS for the remainder of the survey.

Deviations from the CW/QAPP for the nearfield survey in mid December (W9517):

- Samples were collected at only three of the six planned stations (N10, N16, and N04) due to weather conditions.

TABLE 2-1

Station Types and Analyses

Analysis	A	D	E	F	G	P	R
Dissolved Inorganic Nutrients (NH_4, NO_3, NO_2, PO_4, SiO_4)	X	X	X	X	X		
Other Nutrients (DOC, TDN, TDP, PC, PN, PP, Biogenic Si)	X	X			X		
Chlorophyll	X	X			X		
Total Suspended Solids	X	X			X		
Dissolved Oxygen		X		X	X		
Phytoplankton and Urea		X			X		
Zooplankton		X			X		
Respiration							X
Productivity						X	

3.0 DATA SUMMARY PRESENTATION

Data from each survey were compiled from the complete HOM 1995 database and organized to facilitate regional comparisons between surveys, and to allow a quick evaluation of results for contingency planning purposes (Tables 3-1 through 3-8). Each table provides summary data from one survey; the survey dates are provided at the top of each table. A discussion of which parameters were selected, how the data were grouped and integrated, and the assumptions behind the calculation of statistical values (average, minimum, and maximum), are provided below. All raw data summarized in this report are available from MWRA either in hardcopy or electronic formats.

The spatial pattern of data summary follows the sample design over major geographic areas of interest in Massachusetts Bay, Cape Cod Bay, and Boston Harbor (Section 3.1). Compilation of data both horizontally by region and vertically over the entire water column was conducted in order to provide an efficient way of assessing the status of the regions during a particular survey. Maximum and minimum values are provided because of the need to assess extremes of pre-outfall conditions relative to criteria being developed for contingency planning purposes (MWRA, 1997).

Prior to regional compilation of data, individual replicate data points were averaged first, followed by replicate datasets (i.e., CTD casts). Significant figures for average values were selected based on the precision of the specific dataset. Detailed considerations for individual datasets are provided in the sections below.

3.1 Defined Geographic Areas

The primary partitioning of data is between the nearfield and farfield stations (Figures 1-1 and 1-2). Farfield data from surveys W9511 and W9514 were additionally segmented into five geographic areas: three stations in Boston Harbor (F23, F30, and F31), six coastal stations (F05, F13, F14, F18, F24, F25), eight offshore stations (F06, F07, F10, F15, F16, F17, F19, and F22), five boundary region stations (F12, F26, F27, F28, F29), and three Cape Cod Bay stations (F01, F02, and F03). Results from one boundary station (Stellwagen Basin, F12) are presented in the summary data from W9516. Geographic regions are shown in Figure 1-1.

The data summary tables include data that are derived from all of the station data collected in each region. Average, maximum, and minimum values are reported from the cumulative horizontal and vertical dataset as described for each data type below.

3.2 Sensor Data

Six CTD profile parameters provided in the data summary tables include: temperature, salinity, density (σ_t), fluorescence (chlorophyll *a*), transmissivity, and dissolved oxygen (DO) concentration. Statistical parameters (maximum, minimum, and average) were calculated from the five upcast sensor readings collected at five depths through the water column (defined as A-E). The five depth values, rather than the entire set of profile data, were selected in order to reduce the statistical weighing of deep water data at the offshore and boundary stations. Generally, the samples were collected in an even depth-distributed pattern. One of the mid-depth samples (B, C, or D) was typically located at the fluorescence (chlorophyll) peak in the water column, depending on the relative depth of the chlorophyll maximum. Details of the collection, calibration, and processing of CTD data are provided in the Water Column Monitoring CW/QAPP (Bowen *et al.*, 1997).

Fluorescence data were calibrated to the amount of chlorophyll *a* in discrete water samples collected at the depth of the sensor reading. The calibrated chlorophyll sensor values were used for all discussions of chlorophyll in this report. The other derived parameter from the chlorophyll calibration is phaeopigments, included in the summary data tables as part of the nutrient parameters discussed below.

In addition to DO concentration, the derived percent saturation, calculated from the potential saturation value of the water (a function of the physical properties of the water), was also provided. Finally, the derived beam attenuation coefficient from the transmissometer ("transmissivity") was provided on the summary tables. Beam attenuation is calculated from the ratio of light transmission relative to the initial light incidence, over a particular distance in the water column, and is provided in units of m^{-1}.

3.3 Nutrients

Analytical results for nutrient concentrations were extracted from the HOM database, and include: ammonium (NH_4), nitrite (NO_2), nitrite + nitrate (NO_2 + NO_3), phosphate (PO_4), and silicate (SiO_4). Nutrients were measured in water samples collected at each of the A-E depths during the CTD casts. The concentration of phaeopigments in the water samples was also measured during chlorophyll processing. Information on the collection, processing, and analysis of nutrient samples can be found in the CW/QAPP (Bowen *et al.*, 1997).

3.4 Biological Water Column Parameters

Three productivity parameters were selected for inclusion in the data summary tables. Areal production, which is determined by integrating the measured productivity over the photic zone, is included for the productivity stations (F23 representing the harbor, and N04, N10, and N16, representing the nearfield). Because areal production is already depth-integrated, averages were calculated only among productivity stations for the two regions sampled. The derived parameters α ($gC[gChla]^{-1}h^{-1}[\mu Em^{-2}s^{-1}]^{-1}$) and Pmax ($gC[gChla]^{-1}h^{-1}$) were also included (Appendix A).

A suite of other water column biological parameters were summarized on the data tables. Respiration rates were averaged over the respiration stations (the same harbor and nearfield stations as productivity, and additionally one offshore station [F19]), and over the three water column depths sampled (upper, mid-, and lower water column). The water column depths of the respiration samples typically coincided with the water depths of the productivity measurements.

Dissolved and particulate organic parameters were also summarized for the tables, including: biogenic silica (BIOSI), dissolved and particulate organic carbon (DOC and POC), particulate and total dissolved phosphate (PART P, TDP), particulate organic and total dissolved nitrogen (PON and TDN), and urea. Total suspended solids (TSS) data are provided as a baseline for total particulate matter in the water column. Dissolved and particulate constituents were measured from water samples collected from each of the five (A-E) depths during CTD casts. Detailed methods of sample collection, processing, and analysis are available in the CW/QAPP (Bowen *et al.*, 1997).

3.5 Plankton

Plankton results were extracted from the HOM database and include whole water phytoplankton, screened phytoplankton, and zooplankton. Phytoplankton measurements included whole-water collections at the surface (depth A) and at the water column chlorophyll *a* maximum (depth C) during the water column casts. Additional samples were taken at these two depths and screened through 20μm Nitex mesh to retain and concentrate larger dinoflagellate species. Zooplankton measurements were collected through oblique tows at all stations. Detailed methods of sample collection, processing, and analysis are available in the CW/QAPP (Bowen *et al.*, 1997).

Final plankton values were derived for each cast by first averaging analytical replicates, then averaging station visits. Values were calculated from the data for the following parameters: nuisance algae (*Alexandrium tamarense, Phaeocystits pouchetii, and Pseudo-nitzschia pungens*), total phytoplankton, total zooplankton, and total centric diatoms. Only the maximum of each plankton parameter is presented in the summary tables.

3.6 Other Data Sources

Two other data sources were utilized in the preliminary interpretation of semi-annual water column data. Satellite images collected near survey dates were interpreted for surface water events including intrusions of surface water masses from the Gulf of Maine and upwelling (Table 3-9). The image date, interpretation, and file name are provided. In addition, continuous monitoring data from the USGS buoy

(Figure 1-2), located between nearfield stations N21 and N18, were collected and processed. Hourly temperature (Figure 3-1) and salinity (Figure 3-2) data from the surface (upper 5 m) and bottom (20-30 m) were averaged over each day, and plotted with HOM survey data. Selected monitoring data from the HOM database included surface (A bottle) and bottom (E bottle) water samples, averaged over four outer nearfield stations (N04, N07, N16, and N20). The discrete data were plotted with the continuous data for comparison. The discrepancy between the HOM data and the moored salinity values may be due to problems with the USGS bottom water salinity sensor.

TABLE 3-1
Semi-Annual Data Summary Table
Event W9510 (8/08/95 - 8/10/95)
Nearfield Survey

Region		Nearfield		
Parameter	Unit	Min	Max	Avg
Physical				
Chlorophyll a	µg/L	0.07	2.10	0.74
Salinity	psu	30.9	32.0	31.4
Sigma_T		21.4	25.1	23.1
Temperature	°C	6.4	21.5	15.0
Transmissivity	m-1	0.26	0.97	0.48
Nutrients				
NH_4	µM	0.45	4.66	1.36
NO_2	µM	0.03	0.41	0.13
$NO_2 + NO_3$	µM	0.0	7.6	1.0
PO_4	µM	0.10	1.22	0.46
SIO_4	µM	1.6	12.6	4.1
Phaeopigment	µg/L	0.14	1.40	0.68
DO				
Concentration	mg/l	7.2	9.4	8.4
Saturation	%	79	118	101
Productivity				
Alpha	see text	0.00	0.07	0.04
Areal Production	mgC/m²/d	1116.9	1587.4	1352.1
Pmax	see text	0.3	9.1	5.5
Respiration	µmol/h	0.01	0.19	0.07
Water Column				
BIOSI	µM	0.2	3.0	1.1
DOC	mg/L	1.0	3.0	1.5
PART P	µM	0.18	0.46	0.29
POC	µM	9.3	36.3	22.0
PON	µM	0.66	4.94	2.72
TDN	µM	9.2	17.8	11.3
TDP	µM	0.22	0.96	0.48
TSS	mg/L	0.0	14.0	5.1
Urea	µM	0.29	0.73	0.41
Plankton (Surface samples only)				
Total Phytoplankton	Mcell/L		7.0	
Centric diatoms	Mcell/L		0.11	
Alexandrium tamarense	Mcell/L		NP	
Phaeocystis pouchetti	Mcell/L		NP	
Pseudo-nitzschia sp	Mcell/L		1.40E-06	
Total Zooplankton	#/m3		106851	

TABLE 3-2
Semi-Annual Data Summary Table
Event W9511 (8/21/95 - 8/26/95)
Combined Nearfield/Farfield Survey

		Nearfield			Farfield														
Region					Harbor			Coastal			Offshore			Boundary			Cape Cod Bay		
Parameter	Unit	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Physical																			
Chlorophyll a	µM	0.0	15.0	1.4	1.8	14.2	7.2	0.1	11.8	4.5	0.0	7.2	1.0	0.0	4.5	0.9	0.0	3.7	1.1
Salinity	psu	31.4	32.1	31.7	31.0	31.4	31.2	31.3	31.8	31.5	31.3	32.2	31.7	31.1	32.2	31.8	31.3	31.8	31.5
Sigma_T		22.2	25.1	23.5	21.2	22.8	22.1	21.7	24.4	22.7	21.7	25.4	23.7	21.5	25.4	23.9	21.7	24.7	22.9
Temperature	°C	7.3	19.7	14.2	16.6	22.0	19.3	9.9	20.9	17.1	5.6	20.8	12.8	5.4	21.1	12.4	8.9	21.0	16.3
Transmissivity	m-1	0.26	1.13	0.46	0.68	1.62	1.06	0.42	1.18	0.73	0.24	0.78	0.43	0.25	0.93	0.43	0.25	1.20	0.45
Nutrients																			
NH_4	µM	0.06	6.45	0.89	4.00	16.20	7.87	0.26	7.26	1.94	0.00	5.29	1.45	0.00	5.24	0.47	0.10	2.82	0.89
NO_2	µM	-0.002	0.46	0.13	0.20	0.43	0.29	0.01	0.49	0.17	0.00	0.46	0.13	0.00	0.36	0.08	0.00	0.33	0.06
$NO_2 + NO_3$	µM	0.0	8.3	1.6	0.9	2.2	1.7	0.0	4.8	1.3	0.0	11.6	2.5	0.0	11.0	3.9	0.1	1.6	0.5
PO_4	µM	0.15	1.03	0.48	0.87	1.71	1.17	0.13	1.13	0.56	0.12	1.28	0.60	0.10	1.20	0.59	0.27	0.93	0.49
SIO_4	µM	0.9	12.2	4.3	3.4	5.9	4.2	1.3	13.2	4.3	1.9	19.8	5.6	0.0	13.5	4.8	1.6	11.6	4.7
Phaeopigment	µg/L	0.27	4.68	1.35	2.05	6.44	4.18	0.34	4.70	2.17	0.45	2.09	1.26	0.11	1.17	0.54	0.07	0.92	0.47
DO																			
Concentration	mg/l	6.9	10.2	8.1	6.3	7.3	6.8	6.3	8.8	7.7	7.2	9.8	8.1	7.8	11.8	8.6	7.6	9.5	8.1
Saturation	%	75	116	96	78	98	89	71	116	97	71	119	94	76	139	98	83	114	100
Productivity																			
Alpha	see text	0.02	0.07	0.04	0.18	2.86	0.83												
Areal Production	mgC/m²/d	973.9	1897.3	1401.9	7583.5	7583.5	7583.5												
Pmax	see text	1.3	16.8	8.1	30.8	212.8	130.3												
Respiration	µmol/h	0.02	0.28	0.14	0.12	0.48	0.35				0.02	0.14	0.07						
Water Column																			
BIOSI	µM	0.30	4.03	1.36	2.85	5.47	4.40	0.43	4.86	2.32	0.68	1.45	1.07	0.06	0.39	0.23	0.17	1.07	0.65
DOC	mg/L	1.0	3.0	2.1	2.0	3.0	2.2	2.0	2.0	2.0	2.0	2.0	2.0	0.0	1.0	0.5	2.0	2.0	2.0
PART P	µM	0.13	0.54	0.25	0.39	1.08	0.73	0.18	0.64	0.37	0.20	0.29	0.25	0.12	0.12	0.12	0.08	0.28	0.15
POC	µM	6.9	68.9	26.3	29.0	98.7	57.7	18.9	57.2	36.0	14.1	26.4	25.1	12.0	12.9	12.4	13.9	19.6	16.6
PON	µM	0.61	8.78	3.38	3.81	14.87	8.57	1.64	7.79	4.21	2.35	3.59	2.91	1.11	1.23	1.17	1.27	2.17	1.68
TDN	µM	7.4	16.0	10.5	7.1	46.4	25.7	10.3	16.4	13.2	10.3	13.9	12.2	8.8	12.6	10.7	9.9	11.4	10.8
TDP	µM	0.23	0.83	0.48	1.02	2.22	1.56	0.31	1.03	0.65	0.38	0.72	0.56	0.20	0.73	0.47	0.46	0.78	0.61
TSS	mg/L	0.0	17.0	4.6	0.0	18.0	7.0	0.0	15.0	7.4	0.0	0.0	0.0	6.0	7.0	6.5	0.0	0.0	0.0
Urea	µM	0.67	2.95	1.23	1.14	2.48	1.77	1.19	1.77	1.37	0.73	0.93	0.83	1.25	1.39	1.32	0.76	1.43	1.15
Plankton (Surface samples only)																			
Total Phytoplankton	Mcell/L		14.0			33.7			17.5			3.4			1.5			3.9	
Centric diatoms	Mcell/L		2.14			6.55			1.29			0.07			0.01			0.10	
Alexandrium tamarense	Mcell/L		NP			NP			NP			NP			NP			NP	
Phaeocystis pouchetti	Mcell/L		NP			NP			NP			NP			NP			NP	
Pseudo-nitzschia sp	Mcell/L		3.00E-03			1.45E-02			2.00E-03			1.00E-03			NP			4.00E-03	
Total Zooplankton	#/m3		130657			215969			159029			94353			23766			27463	

TABLE 3-3
Semi-Annual Data Summary Table
Event W9512 (9/11/95 - 9/14/95)
Nearfield Survey

Region		Nearfield		
Parameter	Unit	Min	Max	Avg
Physical				
Chlorophyll a	µg/L	0.00	11.84	2.52
Salinity	psu	31.5	32.1	31.8
Sigma_T		22.5	25.0	23.7
Temperature	°C	7.4	18.8	13.5
Transmissivity	m-1	0.26	1.77	0.70
Nutrients				
NH_4	µM	0.00	1.51	0.35
NO_2	µM	-0.004	0.55	0.14
$NO_2 + NO_3$	µM	0.0	9.5	2.2
PO_4	µM	0.23	1.12	0.61
SIO_4	µM	-0.003	14.7	4.5
Phaeopigment	µg/L	0.20	3.00	0.94
DO				
Concentration	mg/l	6.7	11.1	8.3
Saturation	%	73	143	98
Productivity				
Alpha	see text	0.01	0.30	0.07
Areal Production	$mgC/m^2/d$	1525.7	2378.4	1952.1
Pmax	see text	0.7	32.4	10.8
Respiration	µmol/h	0.01	0.31	0.17
Water Column				
BIOSI	µM	1.5	6.1	3.0
DOC	mg/L	2.0	3.0	2.2
PART P	µM	0.13	0.54	0.27
POC	µM	7.9	81.8	35.3
PON	µM	0.85	10.65	4.12
TDN	µM	4.6	23.1	12.3
TDP	µM	0.42	1.27	0.73
TSS	mg/L	0.0	11.0	4.7
Urea	µM	1.02	3.70	1.83
Plankton (Surface samples only)				
Total Phytoplankton	Mcell/L		7.5	
Centric diatoms	Mcell/L		4.1	
Alexandrium tamarense	Mcell/L		NP	
Phaeocystis pouchetti	Mcell/L		NP	
Pseudo-nitzschia sp	Mcell/L		2.33E-04	
Total Zooplankton	#/m3		75344	

TABLE 3-4
Semi-Annual Data Summary Table
Event W9513 (9/25/95 - 9/29/95)
Nearfield Survey

Region		Nearfield		
Parameter	Unit	Min	Max	Avg
Physical				
Chlorophyll a	µg/L	0.17	6.29	1.32
Salinity	psu	31.3	32.3	31.8
Sigma_T		23.1	25.0	23.8
Temperature	°C	8.7	15.6	13.6
Transmissivity	m-1	0.29	1.13	0.44
Nutrients				
NH_4	µM	0.02	9.80	1.66
NO_2	µM	0.01	0.51	0.19
$NO_2 + NO_3$	µM	0.0	9.8	2.3
PO_4	µM	0.27	1.39	0.70
SIO_4	µM	0.0	14.2	3.8
Phaeopigment	µg/L	0.15	1.94	0.98
DO				
Concentration	mg/l	5.7	9.5	7.6
Saturation	%	64	115	89
Productivity				
Alpha	see text	0.04	0.09	0.08
Areal Production	$mgC/m^2/d$	923.1	1107.5	1015.3
Pmax	see text	5.3	22.2	16.0
Respiration	µmol/h	0.03	0.23	0.17
Water Column				
BIOSI	µM	0.9	2.9	1.8
DOC	mg/L	2.0	2.0	2.0
PART P	µM	0.16	0.37	0.26
POC	µM	9.5	24.9	19.3
PON	µM	1.03	4.31	2.81
TDN	µM	5.7	30.7	15.0
TDP	µM	0.42	1.67	0.82
TSS	mg/L	0.0	4.0	1.6
Urea	µM	1.21	4.65	2.69
Plankton (Surface samples only)				
Total Phytoplankton	Mcell/L		4.7	
Centric diatoms	Mcell/L		0.65	
Alexandrium tamarense	Mcell/L		NP	
Phaeocystis pouchetti	Mcell/L		NP	
Pseudo-nitzschia sp	Mcell/L		0.0065	
Total Zooplankton	#/m3		39353	

TABLE 3-5
Semi-Annual Data Summary Table
Event W9514 (10/09/95 - 10/13/95)
Combined Nearfield/Farfield Survey

		Nearfield			Farfield														
Region					Harbor			Coastal			Offshore			Boundary			Cape Cod Bay		
Parameter	Unit	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Physical																			
Chlorophyll a	μM	0.0	5.6	1.7	0.3	1.2	0.6	0.2	2.6	1.0	0.0	3.7	1.1	0.0	2.6	0.7	0.3	3.1	1.7
Salinity	psu	31.2	32.2	31.8	30.5	31.5	31.1	31.1	31.9	31.5	31.4	32.3	31.9	31.7	32.4	32.0	31.6	31.8	31.6
Sigma_T		22.9	24.7	23.8	22.4	23.5	23.0	22.9	24.0	23.4	23.3	25.1	24.0	23.4	25.2	24.3	23.2	24.0	23.4
Temperature	°C	10.2	16.0	13.8	14.2	15.4	14.8	12.8	15.4	14.3	8.6	14.5	13.0	7.9	15.2	11.9	12.6	15.8	14.9
Transmissivity	m-1	0.27	0.92	0.48	0.56	1.12	0.77	0.34	0.64	0.50	0.26	0.66	0.41	0.25	0.95	0.43	0.42	0.64	0.54
Nutrients																			
NH_4	μM	0.00	6.85	0.78	6.29	15.03	11.71	0.55	11.02	6.17	-0.003	5.18	0.59	0.00	0.77	0.26	0.06	1.27	0.39
NO_2	μM	0.00	0.55	0.15	0.46	0.86	0.67	0.10	0.63	0.46	0.03	0.43	0.15	0.01	0.32	0.12	0.02	0.23	0.07
$NO_2 + NO_3$	μM	0.0	7.7	1.1	3.0	5.3	4.2	0.4	4.3	3.2	0.0	10.8	2.3	0.0	11.0	4.0	0.0	4.0	0.4
PO_4	μM	0.35	1.20	0.54	1.05	1.70	1.47	0.43	1.40	1.07	0.38	1.18	0.59	0.35	1.12	0.70	0.46	0.87	0.53
SIO_4	μM	0.5	12.0	3.3	5.9	7.4	6.7	1.7	8.9	5.3	1.6	17.8	4.2	1.5	15.2	6.5	1.8	9.3	3.0
Phaeopigment	μg/L	0.22	5.00	1.25	0.55	1.14	0.81	0.32	2.23	0.75	0.52	1.08	0.89	0.08	1.31	0.95	0.54	1.89	1.24
DO																			
Concentration	mg/l	6.4	9.7	8.2	6.4	7.1	6.7	6.4	8.4	7.3	6.6	9.1	7.8	6.7	8.8	7.7	5.6	8.3	7.7
Saturation	%	72	119	97	76	85	80	75	101	87	69	108	91	71	103	88	64	100	92
Productivity																			
Alpha	see text	0.03	0.14	0.08	0.03	0.03	0.03												
Areal Production	$mgC/m^2/d$	1511.8	2792.3	2021.8	641.0	641.0	641.0												
Pmax	see text	3.8	34.7	17.3	4.4	9.6	8.3												
Respiration	μmol/h	0.04	0.19	0.11	0.08	0.17	0.14				0.04	0.19	0.09						
Water Column																			
BIOSI	μM	0.77	1.78	1.05	2.21	4.62	2.86	1.21	2.09	1.53	1.08	1.12	1.10	1.09	1.25	1.17	2.04	2.53	2.29
DOC	mg/L	1.0	2.0	1.3	1.0	2.0	1.7	1.0	2.0	1.8	1.0	1.0	1.0	1.0	2.0	1.5	1.0	2.0	1.7
PART P	μM	0.19	0.36	0.26	0.30	0.54	0.41	0.21	0.43	0.31	0.20	0.24	0.23	0.20	0.30	0.25	0.26	0.31	0.28
POC	μM	8.7	39.6	22.8	15.3	26.7	21.9	14.4	24.5	18.2	9.3	28.9	16.5	19.2	24.5	21.7	23.7	32.3	27.1
PON	μM	1.20	5.17	3.03	1.76	4.15	3.19	1.75	3.28	2.44	1.08	3.65	1.77	2.63	4.23	3.40	3.08	4.63	3.92
TDN	μM	2.0	25.2	9.5	13.6	35.0	29.7	21.4	29.6	24.7	10.5	25.5	17.7	7.2	20.5	13.6	5.8	21.6	15.8
TDP	μM	0.45	1.49	0.65	1.64	2.03	1.84	1.27	1.62	1.43	0.56	0.58	0.57	0.61	0.64	0.62	0.61	0.70	0.65
TSS	mg/L	0.5	4.0	2.2	1.5	5.0	3.6	0.5	3.0	2.1	1.5	2.0	1.8	3.0	3.0	3.0	1.5	4.0	3.0
Urea	μM	0.11	0.31	0.20	0.55	0.95	0.75	0.42	0.67	0.54	0.35	1.98	1.13	0.14	0.20	0.17	0.35	0.84	0.52
Plankton (Surface samples only)																			
Total Phytoplankton	Mcell/L		9.7			4.4			4.4			1.2			2.7			5.5	
Centric diatoms	Mcell/L		0.26			0.10			0.17			0.26			0.01			0.14	
Alexandrium tamarense	Mcell/L		NP			NP			NP			NP			NP			NP	
Phaeocystis pouchetti	Mcell/L		NP			NP			NP			NP			NP			NP	
Pseudo-nitzschia sp	Mcell/L		7.67E-03			2.50E-03			6.50E-03			8.00E-03			1.00E-03			1.95E-02	
Total Zooplankton	#/m3		91816			42133			65022			55080			39385			175972	

TABLE 3-6
Semi-Annual Data Summary Table
Event W9515 (11/01/95 - 11/04/95)
Nearfield Survey

Region		Nearfield		
Parameter	Unit	Min	Max	Avg
Physical				
Chlorophyll a	µg/L	0.00	18.06	6.30
Salinity	psu	31.7	32.5	32.1
Sigma_T		24.3	25.0	24.6
Temperature	°C	9.7	11.4	10.5
Transmissivity	m-1	0.29	1.02	0.57
Nutrients				
NH_4	µM	0.01	5.49	0.76
NO_2	µM	0.09	0.65	0.34
$NO_2 + NO_3$	µM	1.4	10.2	5.9
PO_4	µM	0.56	1.39	0.86
SIO_4	µM	1.9	13.3	5.9
Phaeopigment	µg/L	0.41	4.84	2.54
DO				
Concentration	mg/l	6.4	9.4	8.0
Saturation	%	70	104	88
Productivity				
Alpha	see text	0.08	0.38	0.25
Areal Production	$mgC/m^2/d$	932.2	1459.2	1195.7
Pmax	see text	13.9	110.0	58.4
Respiration	µmol/h	0.03	0.15	0.09
Water Column				
BIOSI	µM	3.4	9.5	5.6
DOC	mg/L	1.0	2.0	1.1
PART P	µM	0.24	0.45	0.35
POC	µM	8.6	43.8	27.5
PON	µM	1.86	7.56	4.29
TDN	µM	12.5	35.3	21.1
TDP	µM	0.64	1.48	0.90
TSS	mg/L	2.0	7.0	4.1
Urea	µM	0.43	1.52	0.81
Plankton (Surface samples only)				
Total Phytoplankton	Mcell/L		4.1	
Centric diatoms	Mcell/L		0.43	
Alexandrium tamarense	Mcell/L		NP	
Phaeocystis pouchetti	Mcell/L		NP	
Pseudo-nitzschia sp	Mcell/L		0.071	
Total Zooplankton	#/m3		60991	

TABLE 3-7
Semi-Annual Data Summary Table
Event W9516 (11/27/95 - 12/05/95)
Nearfield Survey

Region		Nearfield			Boundary				
Parameter	Unit	Min	Max	Avg	Min	Depth	Max	Depth	Avg
Physical									
Chlorophyll a	µg/L	0.21	2.42	1.65	0.83	89.19	1.51		1.20
Salinity	psu	31.2	32.2	31.9	32.0	44.6	32.1	89.19	32.0
Sigma_T		24.6	24.9	24.8	24.9	2.6	24.9	89.19	24.9
Temperature	°C	5.9	9.0	7.8	8.3	89.2	8.4		8.4
Transmissivity	m-1	0.36	0.61	0.42	0.37	66.12	0.41		0.38
Nutrients									
NH_4	µM	**0.00**	8.90	1.22	0.00		0.30	44.58	0.105
NO_2	µM	0.09	0.62	0.25	0.08		0.12	89.19	0.098
$NO_2 + NO_3$	µM	7.2	9.5	7.7	7.1		9.5	66.12	7.89
PO_4	µM	0.83	1.38	0.94	0.80		1.17	66.12	0.92
SIO_4	µM	5.5	11.1	7.4	6.3		7.9	89.19	7.0
Phaeopigment	µg/L	0.19	0.99	0.76					
DO									
Concentration	mg/l	8.0	9.1	8.9	8.6	22.06	8.7	89.19	8.7
Saturation	%	85	93	91	90		92		91
Productivity									
Alpha	see text	0.04	0.07	0.05					
Areal Production	$mgC/m^2/d$	502.3	515.1	508.7					
Pmax	see text	5.2	8.4	6.9					
Respiration	µmol/h	0.02	0.04	0.03					
Water Column									
BIOSI	µM	0.7	3.8	3.0					
DOC	mg/L	1.0	1.0	1.0					
PART P	µM	0.12	0.33	0.20					
POC	µM	8.9	26.0	18.4					
PON	µM	1.31	3.87	2.47					
TDN	µM	11.7	26.4	17.1					
TDP	µM	0.84	1.49	0.97					
TSS	mg/L	0.5	6.0	1.7					
Urea	µM	0.32	0.70	0.55					
Plankton (Surface samples only)									
Total Phytoplankton	Mcell/L		0.74						
Centric diatoms	Mcell/L		0.04						
Alexandrium tamarense	Mcell/L		NP						
Phaeocystis pouchetti	Mcell/L		NP						
Pseudo-nitzschia sp	Mcell/L		0.003						
Total Zooplankton	#/m3		37602						

TABLE 3-8
Semi-Annual Data Summary Table
Event W9517 (12/17/95 - 12/19/95)
Nearfield Survey

Region		Nearfield		
Parameter	Unit	Min	Max	Avg
Physical				
Chlorophyll a	µg/L	0.27	0.55	0.49
Salinity	psu	32.0	32.1	32.0
Sigma_T		25.2	25.2	25.2
Temperature	°C	6.0	6.7	6.2
Transmissivity	m-1	0.31	0.39	0.35
Nutrients				
NH_4	µM	0.08	0.25	0.14
NO_2	µM	0.11	0.16	0.14
$NO_2 + NO_3$	µM	8.1	8.6	8.4
PO_4	µM	0.88	0.96	0.92
SIO_4	µM	7.7	10.4	9.4
Phaeopigment	µg/L	0.39	0.57	0.49
DO				
Concentration	mg/l	9.2	9.5	9.4
Saturation	%	93	94	93
Productivity				
Alpha	see text	0.02	0.02	0.02
Areal Production	$mgC/m^2/d$	87.8	95.4	91.6
Pmax	see text	2.4	2.9	2.8
Respiration	µmol/h	0.01	0.03	0.02
Water Column				
BIOSI	µM	1.3	2.0	1.6
DOC	mg/L	1.0	2.0	1.4
PART P	µM	0.11	0.14	0.12
POC	µM	7.7	14.0	10.1
PON	µM	0.55	2.14	1.48
TDN	µM	5.0	12.1	6.5
TDP	µM	0.68	0.77	0.73
TSS	mg/L	0.0	5.0	1.6
Urea	µM	0.76	1.14	0.94
Plankton (Surface samples only)				
Total Phytoplankton	Mcell/L		0.27	
Centric diatoms	Mcell/L		0.009	
Alexandrium tamarense	Mcell/L		NP	
Phaeocystis pouchetti	Mcell/L		NP	
Pseudo-nitzschia sp	Mcell/L		2.10E-03	
Total Zooplankton	#/m3		33476	

TABLE 3-9

Summary of Second Semi-Annual 1995 Satellite Imagery for Massachusetts and Cape Cod Bays

Month	Date	Image Numbers	Upwelling	G.O.M.[1] Intrusion	Location
August	8/1/95	E9521312.MD7		X	Stellwagen Basin
	8/7/95	E9521917.MD7		X	Stellwagen Basin
	8/13/95	E9522517.MD7			
	8/22/95	E9523417.MD7		X	Cape Ann and Stellwagen Basin
	8/28/95	E9524012.MD7		X	Cape Ann and Stellwagen Basin
September	9/3/95	E9524617.MD7			
	9/11/95	E9525417.MD7		X	Eastern Mass Bay
	9/12/95	E9525517.MD7			
	9/30/95	E9527317.MD7			
October	10/9/95	E9528212.MD7			
	10/12/95	E9528517.MD7		X	Northern Mass Bay and Boston Harbor
	10/19/95	E9529211.MD7		X	Northern Mass Bay and Boston Harbor
	10/23/95	E9529612.MD7			
	10/24/95	E9529711.MD7		X	Northern Mass Bay and Boston Harbor
	10/29/95	E9530211.MD7			
November	11/5/95	E9530912.MD7			
	11/6/95	E9531012.MD7			
	11/17/95	E9532117.MD7			
	11/22/95	E9532617.MD7			
December	12/2/95	E9533617.MD7			
	12/5/95	E9533907.MS7			
	12/8/95	E9534223.MS7			
	12/10/95	E9534417.MD7			
	12/17/95	E9535123.MS7			
	12/29/95	E9536306.MS7			

[1]G.O.M. = Gulf of Maine

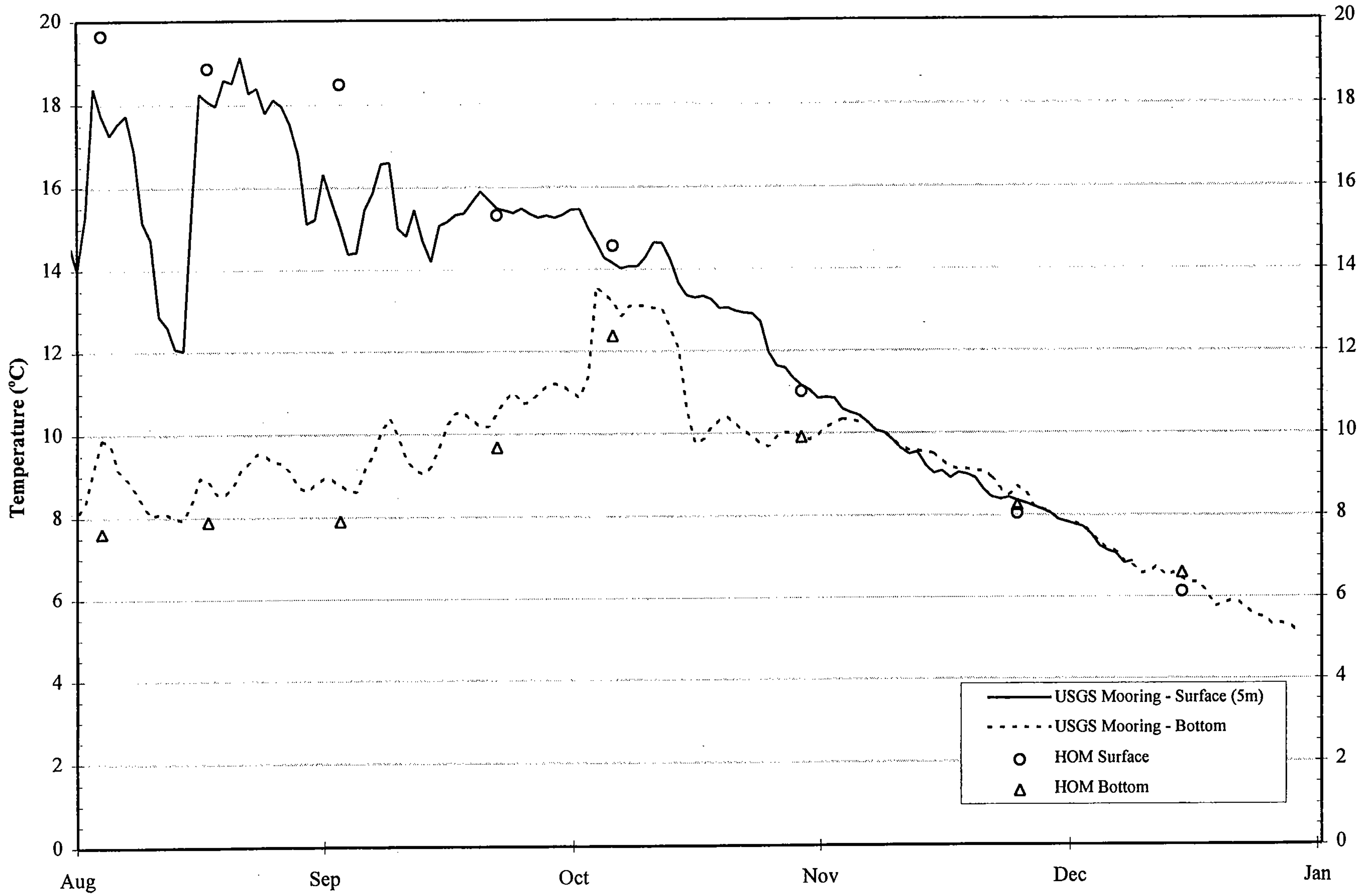


FIGURE 3-1
Moored Temperature Sensor Data
August-December 1995

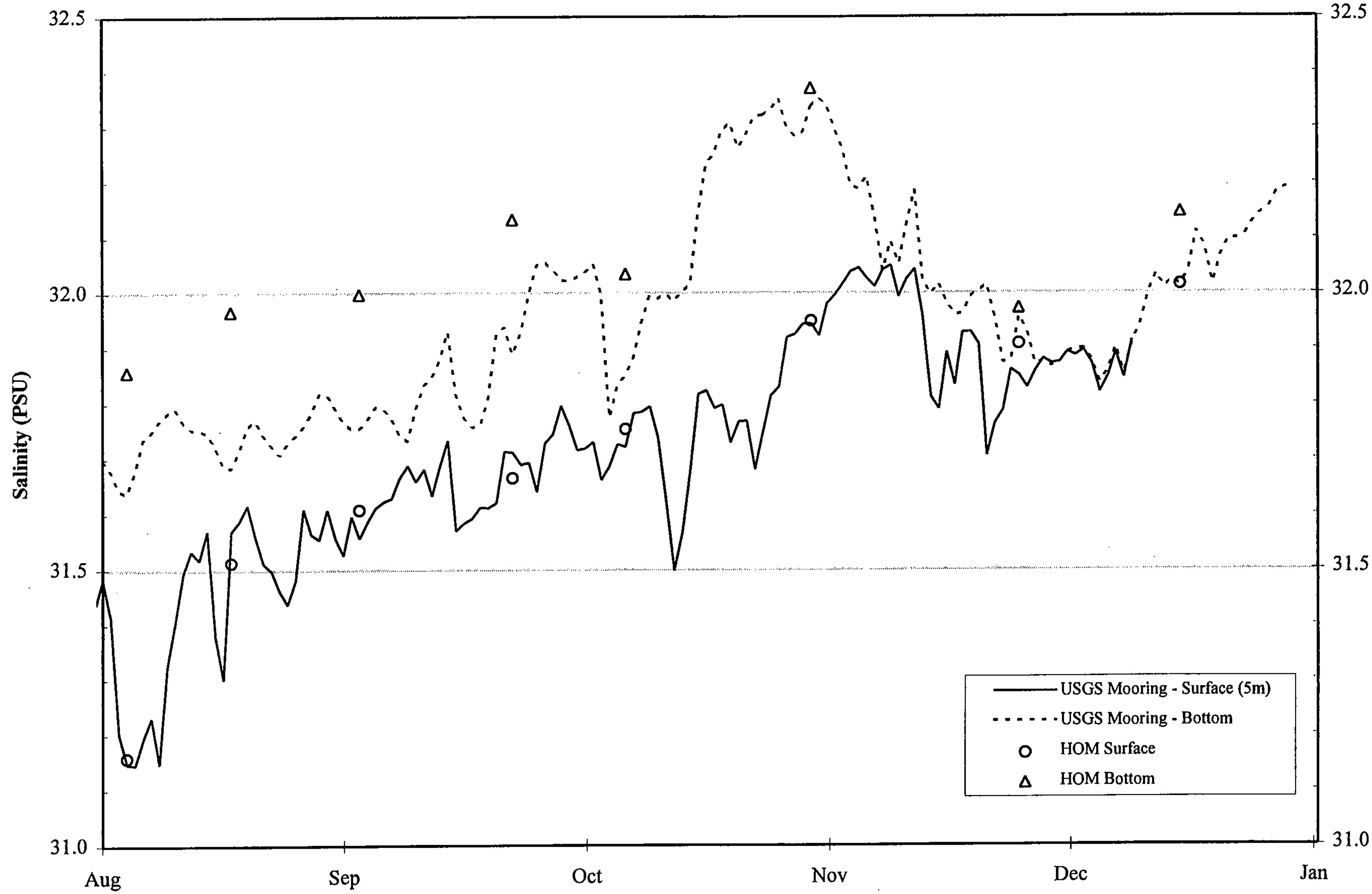


FIGURE 3-2
Moored Salinity Sensor Data
August-December 1995

4.0 RESULTS OF WATER COLUMN MEASUREMENTS

Data from the two farfield surveys conducted during the semi-annual monitoring period (W9511, W9514) were evaluated for trends in regional water masses throughout Boston Harbor, Massachusetts Bay, and Cape Cod Bay. The variation of regional surface water properties is presented using contour plots of surface water parameters, derived from the A (surface water) sample. Classifying data by region allowed comparison of the horizontal distribution of water mass properties over the farfield area.

The regional vertical distribution of water column parameters is presented in the following sections along three transects in the farfield survey area (Figure 1-3). Examining data trends along the three transects, Boston-Nearfield, Cohassett, and Marshfield, provides a three-dimensional perspective of water column conditions during each survey.

Eight nearfield surveys were conducted during the second semi-annual period (W9510-W9517). Nearfield surveys were conducted more frequently than farfield surveys, allowing better temporal resolution of the changes in water column parameters during the summer stratified period and the fall turnover. Variability in the nearfield is presented by comparing surface and bottom water concentrations (A and E depths), along a depth transect through the nearfield (Figure 1-3), and by plotting individual parameters with depth in the water column.

4.1 Physical Characteristics

4.1.1 Horizontal Distribution

During the first combined nearfield/farfield survey in late August (W9511), regional surface water temperatures were very warm (>19°C) except for an area of cooler surface water (17-19°C) at the northern end of the offshore/nearfield area (Figure 4-1). The cooler surface water may have been related to the intrusion of Gulf of Maine water into Massachusetts Bay documented by satellite images collected in late August (Table 3-1). A drop of almost 6°C in surface water temperature also was measured immediately prior to the late August survey by the outer nearfield USGS buoy (Figure 3-1).

Salinities ranged in the surface water from 30.9 to 31.7 PSU during this survey, with the lowest salinity value at F23 near the entrance to Boston Harbor. Salinity values of <31.5 PSU were concentrated in the harbor, Cape Cod Bay, and coastal areas, while salinities of >31.5 PSU were concentrated farther offshore. A complete set of surface contour maps of water properties during the farfield surveys is provided in Appendix B.

By W9514 in October, surface water temperatures had decreased to 14-16°C, with the warmest water (>15°C) in Boston Harbor, Cape Cod Bay, and in the nearfield. The salinity range and inshore-offshore gradient was similar to the W9511 survey.

4.1.2 Vertical Distribution

Farfield. Transects from west to east (Figure 1-3) in Massachusetts Bay show the gradient of physical characteristics within the water column from surface to bottom water in all regions. Vertical stratification of the water column varies by parameter and through time with incursions of different water masses. The value of vertical stratification was calculated from the density difference ($\Delta\sigma_t$) of the bottom water σ_t from the surface water value. For the purposes of this report, vertical stratification will be defined by the presence of a pycnocline with a $\Delta\sigma_t$ between the upper and lower water column of less than -1.0.

Regionally, all the water masses in the survey area were vertically stratified ($\Delta\sigma_t$ <-1.0) in late August (W9511) except the harbor, which remained relatively well-mixed throughout the semi-annual period. Vertical transects of σ_t show strong vertical stratification, ranging from 21.7 regionally in surface water, to >25 in the deeper offshore bottom water (Figure 4-2). A complete set of transect plots for water properties is provided in Appendix C.

The summer vertical density stratification was primarily a function of water temperature, which ranged from 5°C in bottom water to 19°C in surface water along the farfield transects, resulting in a maximum ΔT of 14°C. Salinity was less variable, with a stronger inshore-offshore gradient ranging from 31 PSU in the harbor surface water, to >32 PSU in the bottom water of the offshore-boundary regions (Figure 4-3).

The Boston-Nearfield transects show a patch of cooler, less saline water at the surface at Station F19. The pattern of anomalous surface water at the transect station F19 is repeated for many physical characteristics, indicating that the location of F19 near the northern end of the offshore region was influenced by the Gulf of Maine intrusion documented by satellite images (Table 3-1).

In the early fall (W9514, mid-October), the range of σ_t was smaller in the farfield (~23 to 25; Figure 4-4). The water column remained vertically stratified ($\Delta\sigma_t$ > -1.0) in the offshore and boundary regions, but $\Delta\sigma_t$ ranged from 0 to -1.0 in Boston Harbor, Cape Cod Bay, and the coastal regions. The data suggest that the fall turnover was in progress during this survey. The timing and catalyst of the fall turnover is discussed further below using more frequent nearfield data.

A reduction in the surface-bottom water temperature gradient was primarily responsible for the breakdown of the summer pycnocline. Regionally, surface water cooled from a maximum of 19°C in August to a maximum of 15°C in October. At the same time, deeper water was still warming up, from approximately 5°C in August to 8°C in October, resulting in a maximum ΔT of 7°C. The vertical structure of salinity was very similar between the two farfield surveys, except for an increased horizontal gradient, especially apparent in the nearfield surface water (Figure 4-5).

Nearfield. More frequent sampling of nearfield stations allowed more detailed analysis of the variability within the nearfield water column during the second 1995 semi-annual period. A series of transect plots along the line from the inshore nearfield station N10, through the diffuser station N21, to the offshore station N04 (Figure 1-3) is presented. Discussion of the variability within the nearfield includes summary of bottom (E) and surface (A) water samples from the inner and outer nearfield. For the purposes of data presentation, the inner and outer nearfield regions have been plotted separately because of the differences in physical characteristics between the two areas. In time-series plots discussed below, the inner nearfield is represented by stations N10 and N11, while the outer nearfield is represented by the stations N04, N07, N16, and N20, unless otherwise stated.

The relative degree of vertical stratification ($\Delta\sigma_t$) was < -1.0 in both the inner and outer nearfield during the first three nearfield surveys from early August through early September (W9510-W9512; Figure 4-6). In the shallower inner nearfield, $\Delta\sigma_t$ remained steady at approximately -2.0 during the first three surveys, while the density increased in both the surface and bottom water. Average density of the deeper bottom water of the outer nearfield, however, remained relatively constant during the first three nearfield surveys, so that $\Delta\sigma_t$ decreased as the surface density increased (Figure 4-7).

Without a fresh water perturbation (precipitation, water mass incursions), the overall density increase in nearfield surface water throughout the late summer and fall is a result of both falling surface water temperatures and increasing salinity from evaporation. The surface water density increase between the late August (W9510) and early September (W9511) surveys was not related to temperature, which remained relatively constant (Figure 4-8), but rather an increase of salinity. The early August (W9510) was conducted during the minimum semi-annual measured surface salinity (Figure 3-2). The nearfield surface water salinity increased from early to late August from approximately 31 PSU in the upper 20 m to >31.5 PSU, except at N10 which was slightly less saline (Figure 4-9).

Beginning in late September (W9513), salinity and temperature fluctuations in surface and bottom water in the nearfield caused an overall differentiation between the density structure and timing of the fall turnover between the inner and outer nearfield regions. Inner/outer nearfield trends of salinity and temperature were delineated using temperature-salinity (TS) plots of all nearfield data during the fall period of seasonal transition (W9512-W9514; Figure 4-10). In the TS scatter plots, inner nearfield stations include: N01, N02, N09, N10, N11, N12, N13, N19, and N20, and outer nearfield stations include: N03, N04, N05, N06, N07, N08, N15, N16, N17. Mid-nearfield stations N14, N18, and N21 were not included in the plots.

The density of inner nearfield bottom water dropped by almost 1.0 in late September (W9513; Figure 4-6) due to an influx of less saline water to the inner nearfield (primarily stations N10, N12), and an overall increase of bottom water temperatures (approximately 2°C; Figure 4-10). The nearfield salinity transect from survey W9513 shows the lens of this less saline water originating from the direction of Boston Harbor (Figure 4-9). Salinity also decreased in the surface water of a majority of the inner nearfield stations.

During this same period, salinity in the outer nearfield, however, increased between early (W9512) and late (W9513) September (Figure 3-2), resulting in a clear salinity division between the inner and outer nearfield that continued through the October survey (W9514; Figure 4-10). The resultant vertical density structure of the nearfield during W9513 (Figure 4-7) shows interlayering of water bodies of different densities in the transitional area around station N21.

The water column remained vertically stratified throughout September in the outer nearfield until the fall turnover, when $\Delta\sigma_t$ exceeded -1.0 in the October survey (W9514; Figure 4-6). A decrease in bottom water density during this survey resulted in a breakdown of vertical stratification which continued throughout the rest of the semi-annual period (Figure 4-11). The density decrease was due to a mixing event that resulted in rapid warming of bottom waters of the outer nearfield, documented most clearly in continuous moored temperature data (Figure 3-1).

During the October survey (W9514) in the inner nearfield, surface water physical characteristics were influenced more by harbor water than the mixing indicated in the outer nearfield (Figures 4-12, 4-13). A density gradient was present in the inner nearfield so that $\Delta\sigma_t$ remained slightly > -1.0 until the subsequent survey in November (W9515; Figure 4-6).

During the final three nearfield surveys of the second semi-annual period of 1995 (W9515-W9517), vertical stratification of all of the nearfield had ceased (Figure 4-11). Water temperature (Figure 4-12) and salinity (Figure 4-13) values were relatively uniform throughout the nearfield water column during early November (W9515; 9.6-11°C, 31.7-32.1 PSU). During the late November-December surveys, $\Delta\sigma_t$ was essentially zero resulting in a well-mixed water column (Figure 4-6). An inshore-offshore temperature and salinity gradient was well established by the end of November (W9516.

4.2 Nutrients

4.2.1 Horizontal Distribution

During both farfield surveys conducted in the semi-annual period, nutrients were depleted in the surface water, especially outside of Boston Harbor. The spatial distribution of nutrient concentrations in the surface water (A depth) indicated that Boston Harbor consistently had the highest concentration of all nutrients measured during both semi-annual farfield surveys. A complete set of farfield surface water contour maps of all water property data is available in Appendix B.

In late August (W9511), surface water nitrate (NO_3) concentrations within and near Boston Harbor (within tidal flushing zone) ranged from 0.7-1.7 µM (Figure 4-14), silicate (SiO_4) ranged from 3-5 µM, and phosphate (PO_4) ranged from 1.5-1.7 µM. Outside of the harbor, surface water NO_3 concentrations were <1.0 µM. Minimum surface water SiO_4 concentrations were measured in the nearfield (1-2 µM), then increased again to 2-3 µM in the offshore/boundary regions and 1.7-2.3 µM in Cape Cod Bay. Outside of Boston Harbor, PO_4 was <0.2 µM, except for slightly higher coastal (0.3-0.5 µM) and Cape Cod Bay (0.3 µM) concentrations.

During the final farfield survey of 1995 in mid-October (W9514), the water column was still vertically stratified with respect to nutrients, resulting in relatively low surface water concentrations. Boston Harbor had higher nitrate/silicate concentrations relative to the prior August survey, and again regionally the highest surface water nutrient concentrations (NO_3: 3.0-4.4 µM, Figure 4-15; SiO_4: 6.4-7.4 µM; PO_4: 1.4-1.7 µM). Concentrations in the inner nearfield were also elevated relative to the previous farfield survey (NO_3: 2-4 µM; SiO_4: 4-6 µM, PO_4: 1.2-1.4 µM). Densely spaced contours through the nearfield show the surface water gradient. Nitrate was strongly depleted regionally offshore of the gradient (commonly undetected [0.0 µM]), with all measured concentrations <0.4 µM (Figure 4-15). Silicate was less depleted regionally, with concentrations similar to the August farfield survey (2-3 µM). Consistently low PO_4 concentrations were also common outside of the central nearfield gradient (0.3-0.5 µM).

Overall, regional waters were depleted in nitrogen relative to phosphorus compared to the Redfield ratio of 16:1, especially in the surface water during the summer (Appendix D). The two main forms of nitrogen nutrients, nitrate and ammonium, had different distributions in Boston Harbor and along the coast relative to the more offshore stations. The NO_3:PO_4 ratio of harbor/coastal stations during the October survey was approximately 4:1, whereas the nearfield/boundary/offshore ratios were closer to 16:1. In contrast, the NH_4:PO_4 ratio of harbor/coastal stations was approximately 16:1, whereas the nearfield/boundary/offshore ratios were closer to 4:1. The higher NH_4:PO4 ratio in the harbor/coastal regions is due to the influence of the existing effluent plume and coastal upwelling.

4.2.2 Vertical Distribution

Farfield. Regionally, nutrient concentrations were depleted in surface water and increased with depth below the pycnocline during both farfield surveys (Figure 4-16). Surface water concentrations were slightly higher in Boston Harbor and along the coast, especially during the second October farfield survey (W9514). The overall increase of surface water nutrients measured in the harbor, coast, and nearfield during the October survey was evidence for the ongoing fall turnover, providing a catalyst for the fall bloom documented in the subsequent nearfield survey in early November (W9515). Transect plots of nutrient concentrations demonstrate the vertical stratification of nutrient concentrations, and the gradients throughout the water column between the harbor/inner nearfield and outer nearfield. A complete set of transect plots is provided in Appendix C.

In general, maximum surface water nutrient depletion in the late August survey (W9511) was in the upper 20 m outside of Boston Harbor, except for slightly elevated concentrations in the surface water at station F19 of the Boston-Nearfield transect (Figure 4-17 and Appendix C). The location of this elevated nutrient water mass was spatially coincident with the physical characteristics that indicated the presence of Gulf of Maine (GOM) water in the offshore region (Section 4-1). Inshore-offshore nutrient gradients between the harbor and nearfield region were apparent in the Boston-Nearfield transects, especially for PO_4 and dissolved inorganic nitrogen (DIN, consisting of nitrate, nitrite, and ammonium, Figure 4-18), both of which are influenced by the harbor effluent (PO_4, NH_4). The range of nutrient concentrations between the surface and bottom water during the August farfield survey were: 0-11 µM (NO_3); 0-17 µM (SiO_4), 0-1.7 µM (PO_4), and 0-17 µM (DIN).

During the mid-October farfield survey (W9514), maximum surface water nutrient depletion was concentrated in the outer nearfield/offshore regions for all nutrients measured (Figures 4-19, 4-20, Appendix C). Surface to bottom water gradients were slightly lower than during the August survey: 0-10 µM (NO_3); 0-15 µM (SiO_4), 0-1.4 µM (PO_4), and 0-16 µM (DIN). Reduced nutrient stratification was due to the nearfield mixing event documented by physical data, providing a catalyst for the fall turnover. Boston Harbor continued to provide a source of PO_4 and DIN (Figure 4-20).

Nearfield. Bottom water nutrient concentrations of nitrate, nitrite, and silicate increased from early August (W9510) to late September (W9513), with maximum NO_3+NO_2 concentrations increasing from 7.6 to 9.8 µM over that period of time (Figure 4-21), and maximum SiO_4 increasing from 12.6 to 14.2 µM. The harbor-influenced nutrients PO_4 and NH_4 showed more scatter with depth during these surveys (Appendix D), with the maximum PO_4 remaining steady at approximately 1.2 µM in bottom water, and NH_4 reaching minimum semi-annual concentrations in early September (W9512).

The onset of the fall turnover in the inner nearfield was apparent during the October survey (W9514), when the maximum concentrations of NO_3+NO_2 (Figure 4-22) and SiO_4 decreased by approximately 2 µM. During this early November survey, vertical stratification of nutrients had decreased with respect to nutrients, and were relatively uniform in the inner nearfield (Figure 4-22). Outer nearfield surface water remained nutrient-depleted. Although the subsequent nearfield survey in early November (W9515) was conducted during the late stages of the fall bloom (Section 5.0), surface water nutrient concentrations had increased and the highest semi-annual concentrations were measured in bottom water (NO_3+NO_2: 10.2µM; SiO_4: 13.3µM).

Nutrient concentrations measured during late November through December (W9516-17) were reduced overall primarily due to mixing of nutrient-depleted surface water with nutrient-enriched bottom water. The final semi-annual nearfield/winter nutrients survey in mid-December resulted in a very low range of nutrient concentrations throughout the well-mixed water column (8.1-8.6 μM, NO_3+NO_2; 7.7-10.4 μM, SiO_4; 0.9-1.0 μM, PO_4).

4.3 Chlorophyll *a*

4.3.1 Horizontal Distribution

During the first farfield survey in August (W9511), measured chlorophyll *a* concentrations were <1 μg/L in all farfield regions except Boston Harbor, the inner nearfield, along the coast, and at station F19 (2 μg/L; Figure 4-23). A late summer bloom, focused in the harbor, resulted in chlorophyll concentrations of >14 μg/L. The pattern of surface water chlorophyll suggests that the GOM water mass intrusion indicated at the northern area of the offshore region by physical data was relatively more productive than the surrounding water. The maximum surface water chlorophyll value was measured at station F31 (14.2 μg/L) in Boston Harbor.

The concentration range of chlorophyll was smaller during the October (W9514) farfield survey (0.3 to 4.7 μg/L), but concentrations were higher everywhere except in the harbor and along coast (Figure 4-24). There was no apparent regional chlorophyll pattern. The maximum concentration was measured at nearfield station N01 (4.7 μg/L).

4.3.2 Vertical Distribution

Farfield. The late summer bloom in August (W9511) resulted in maximum chlorophyll *a* concentrations (>10 μg/L) in Boston Harbor and along the coast. Chlorophyll was concentrated in the surface water of the coastal stations in the three regional transects (Figure 4-25). Farther offshore, maximum chlorophyll values of 4-5 μg/L were concentrated in the mid-water column, at approximately 20 m water depth.

Overall, chlorophyll concentrations measured during the October (W9514) survey in the farfield were reduced relative to those measured in August. Maximum chlorophyll values of >3 μg/L along the survey area transects were located at the outer nearfield stations (Boston-Nearfield transect), and at the center stations (F15, F16) of the Cohassett transect in the central offshore region (Figure 4-26). Chlorophyll production during this survey was concentrated in the surface water of the nearfield/offshore, with reduced growth in the harbor, potentially due to light limitation. Light attenuation was greatest during this time of year, reflecting heavy particulate load in the water column, especially in the harbor. The mixing event occurring at the beginning of the fall turnover suggested by continuous monitoring data collected in the outer nearfield (Section 4-1) was the likely cause of the localized nearfield/offshore bloom.

Nearfield. Chlorophyll *a* production during the first survey of the semi-annual period in early August (W9510) was limited, with a maximum of 2 μg/L concentrated in the inner nearfield (Figure 4-27). Consistently low mid-water chlorophyll (>1.2 μg/L) was present throughout the nearfield at approximately 10-20 m water depth.

The following combined nearfield/farfield survey in late August (W9511) resulted in chlorophyll concentrations of up to 15 μg/L in the nearfield. The late summer bloom was concentrated in the inner nearfield and in Boston Harbor (Figure 4-23). Maximum chlorophyll production was in the top 10 m. Farther offshore in the outer nearfield, chlorophyll concentrations of up to 4 μg/L were concentrated along isoclines in the water column at 10 and 20 m (compare Figure 4-27 and Figure 4-7).

The late summer bloom continued but was waning during the following nearfield survey in early September (W9512), with chlorophyll concentrations reaching a maximum of 12 μg/L, again concentrated in the inner nearfield (Figure 4-27). Outer nearfield concentrations had increased relative to the late August survey, however, to >6 μg/L along the 20 m isocline.

By late September (W9513), chlorophyll concentrations had decreased to <2 μg/L throughout the nearfield water column (Figure 4-28), except for the northwest region of the nearfield grid, where concentrations reached 6.3 μg/L in the surface water at nearfield station N12. The nearfield transect shows a relatively even distribution of chlorophyll in the upper 20 m, except for a gradient of reduced chlorophyll towards inner nearfield station N10.

Spurred by the onset of fall water column mixing, production of chlorophyll started to increase again in October (W9514), with maximum concentrations of 4-6 μg/L in the upper 10 m in the center of the nearfield (Figure 4-28). By the following survey in early November (W9515), the fall bloom was in full swing, with chlorophyll concentrations reaching 18 μg/L in the central nearfield around station N21. The highest semi-annual chlorophyll concentration was measured during this survey. Unlike the late summer-early fall bloom that was focused in the harbor and inner nearfield, chlorophyll production during the fall bloom was concentrated in the nearfield (Figure 4-29).

Following the fall bloom, chlorophyll production in the nearfield slowly petered out. The maximum concentration measured in late November (W9516) was 2.4 μg/L, and decreased to 0.6 μg/L by the last semi-annual survey in December.

4.4 Dissolved Oxygen

4.4.1 Regional Distribution

Dissolved oxygen (DO) was measured regionally during the two combined farfield/nearfield surveys in August and October, and at the Stellwagen Basin station (F12) during the late November survey (W9516). The reduction of bottom water DO through the stratified period is a primary issue for the HOM Program due to the importance of DO as an ecological indicator. In this section, results from the first two regional surveys will be discussed, and then the annual pattern of DO depletion in Stellwagen Basin bottom water will be presented.

The concentration of DO in the surface water in August (W9511) ranged from 7.3 mg/L in the harbor to 11.9 mg/l in the boundary region, and was oversaturated (>100% saturation) in the surface water of all regions except the harbor (98%; Figure 4-30). The vertically stratified water column resulted in lower DO concentrations below the pycnocline, ranging from 6.3 mg/L in the harbor and coastal regions, to 7.8 mg/L in the boundary region. DO was undersaturated in all bottom water, with percent saturation ranging from 71% (coastal, offshore) to 83% (Cape Cod Bay). Saturation in the deeper waters of the boundary region reached a minimum of 76%.

The range of DO concentration in the upper water column during the second farfield/nearfield survey in October (W9514) was smaller, from 7.1 mg/L in the harbor to 9.1 mg/l in the offshore region. Dissolved oxygen in the surface water was still oversaturated in all regions, again except in the harbor, that had a lower maximum DO saturation of 85% (Figure 4-31). During this survey, the distribution of maximum DO saturation (Figure 4-31) was similar to that of chlorophyll (Figure 4-26), indicating that the distribution DO was influenced by production in the upper water column.

In October, there was still a vertical gradient of DO in the water column, and overall bottom water DO concentrations were lower than in August, ranging from 5.6 mg/L in Cape Cod Bay to 6.7 mg/L in the boundary region. The Cape Cod Bay bottom water value was the minimum annual bottom water DO concentration, and was measured at station F02 during this survey. This value is less than the state standard value of 6 mg/L. The saturation of DO was slightly lower than the prior survey in August, ranging from 64% (Cape Cod Bay) to 76% (harbor). Saturation in the deeper waters of the boundary region reached a minimum of 71%.

To further delineate the annual cycle of DO depletion, the annual average DO data from the four deep Stellwagen Basin stations (F12, F17, F19, and F22) were plotted for surface (A) and bottom (E) water samples (Figure 4-32). The concentration and saturation of DO reached a minimum value in the bottom water of Stellwagen Basin during the October (W9514) farfield/nearfield survey (6.7, 71%), and increased to surface water levels during the late November survey (W9516), indicating a well-mixed winter water column with respect to DO. Trends in the variation of DO concentration in bottom water throughout 1995 were similar to DO saturation. Surface water DO, although decreasing throughout the spring and summer, was oversaturated from June-October. Both the surface and bottom water during the final Stellwagen Basin survey in late November, following the fall turnover, showed that DO was slightly undersaturated (91%).

4.4.2 Nearfield Distribution

Average nearfield DO concentrations in nearfield surface water generally ranged from 8-9 mg/L throughout the semi-annual period, with the minimum semi-annual concentration measured in late August (8 mg/L; W9511). The highest average concentration of >9 mg/L was measured in early September (W9512) and during the final semi-annual survey in December. Bottom water average DO concentrations declined from >8 mg/L measured during the first nearfield survey in early August (W9510) to 6.5 mg/L in late September (W9513). Bottom water average DO then began to increase to >7 mg/L in October, to surface water concentrations in late November-December after the fall turnover.

The trends of average DO saturation generally followed those of DO concentration. Dissolved oxygen in the surface water of the nearfield was saturated throughout the late summer and fall, reaching a peak average saturation value of approximately 120% in early September (W9512). Surface water DO remained oversaturated until the early November survey (W9515), and was undersaturated (90-100%) through the end of the semi-annual period. Bottom water was undersaturated during the whole semi-annual period, displaying the same decreasing trend as DO concentration through W9513 in late September, and then increasing to the end of the monitoring period.

The distribution of DO saturation in the water column commonly followed trends of maximum chlorophyll production. During the late summer/early fall bloom (W9511) documented by high chlorophyll concentrations in the harbor and inner nearfield (Figure 4-27), areas of maximum DO saturation (Figure 4-33) were located at areas of maximum chlorophyll production in the surface water of the inner nearfield, and in mid-water of the central and outer nearfield. As chlorophyll production moved farther offshore into the central and outer nearfield during the next survey in early September (W9512), DO saturation reached levels of >110% in outer nearfield surface water. The next period of fall production in October (W9514) and early November (W9515), both chlorophyll and DO saturation reached maximums in the surface waters of the central nearfield (Figures 4-28, 4-34).

4.5 Summary of Water Column Results

Physical Characteristics

- Regional surface water temperatures were very warm (>19°C) in late August (W9511), with an area of cooler surface water (17-19°C) at the northern end of the offshore/nearfield area, related to an intrusion of Gulf of Maine water;
- Water column stratification during late August primarily was due to water temperature, which ranged from 5°C in bottom water to 19°C in surface water;
- Transect data from late August show a patch of cooler, less saline water at the surface at Station F19, indicating influence from the Gulf of Maine intrusion;
- The density of inner nearfield bottom water dropped by almost 1.0 in late September (W9513) due to a lens of less saline water originating from Boston Harbor;
- Salinity increased in the outer nearfield, however, between early (W9512) and late (W9513) September, resulting in a salinity transition through the middle of the nearfield and a resultant complex vertical density structure;
- The fall turnover was in progress by the early fall (W9514, mid-October), with the water column remaining vertically stratified in the offshore and boundary regions, while $\Delta\sigma_t$ ranged from 0 to -1.0 in Boston Harbor, Cape Cod Bay, and the coastal regions;
- A reduction in the surface-bottom water temperature gradient was primarily responsible for the breakdown of the summer pycnocline;
- A mixing event that resulted in rapid warming of bottom waters of the outer nearfield documented by continuous monitoring data resulted in a breakdown of vertical stratification in mid-October (W9514) in the outer nearfield;

Nutrients

- During both combined nearfield/farfield surveys conducted in the semi-annual period, nutrients in the surface water were low, especially outside of Boston Harbor, which had the highest surface water concentrations of all nutrients measured;

- Elevated surface water nutrients were associated with the GOM water mass in the northern offshore region indicated by physical data;

- The inshore-offshore nutrient gradient of PO_4 and DIN (NH_4) between the harbor and nearfield region was due to influence of harbor effluent;

- Nearfield bottom water nutrient concentrations increased from early August (W9510) to late September (W9513);

- The relative increase of surface water nutrient concentrations measured in the harbor, coast, and inner nearfield during the October (9514) survey evidenced the ongoing fall turnover, providing a catalyst for the fall bloom documented in the subsequent nearfield survey in early November (W9515);

Chlorophyll

- The late summer bloom measured during the August combined nearfield/farfield survey (W9511) resulted in maximum chlorophyll *a* concentrations in the upper water column of Boston Harbor (14.2 µg/L), the inner nearfield (15 µg/L), and along the coast (11.8 µg/L);

- Farther offshore in the outer nearfield in late August (W9511), chlorophyll concentrations of up to 4 µg/L were concentrated along isoclines in the water column at 10 and 20 m;

- The subsequent nearfield survey in early September (W9512) showed that the late summer bloom was waning in the inner nearfield, but outer nearfield chlorophyll had increased to >6 µg/L along the 20 m isocline;

- With the onset of the fall turnover in October (W9514), production of chlorophyll was focused in the outer nearfield, with maximum concentrations of 4-6 µg/L in the upper 10 m in the center of the nearfield;

- The following nearfield survey in early November (W9515) was conducted during the height of the fall bloom, with the highest semi-annual chlorophyll concentrations measured, reaching 18 µg/L in the central nearfield around station N21;

Dissolved Oxygen

- The lowest regional DO concentrations were measured during the combined nearfield/farfield survey in October (W9514), ranging from 5.6 mg/L in Cape Cod Bay to 6.7 mg/L in the boundary region;

- The minimum annual value of 5.6 mg/L was measured at station F02, which was less than the state standard value of 6 mg/L;

- Average Stellwagen Basin concentration and saturation values reached bottom water minima during October (W9514), and increased to surface water levels during the late November survey (W9516);

- In the nearfield, average bottom water DO concentrations declined from >8 mg/L in early August (W9510) to 6.5 mg/L in late September (W9513), and then began to increase to >7 mg/L in October (W9514), to surface water concentrations after the fall turnover;

- The distribution of DO saturation in the water column commonly followed trends of maximum chlorophyll production.

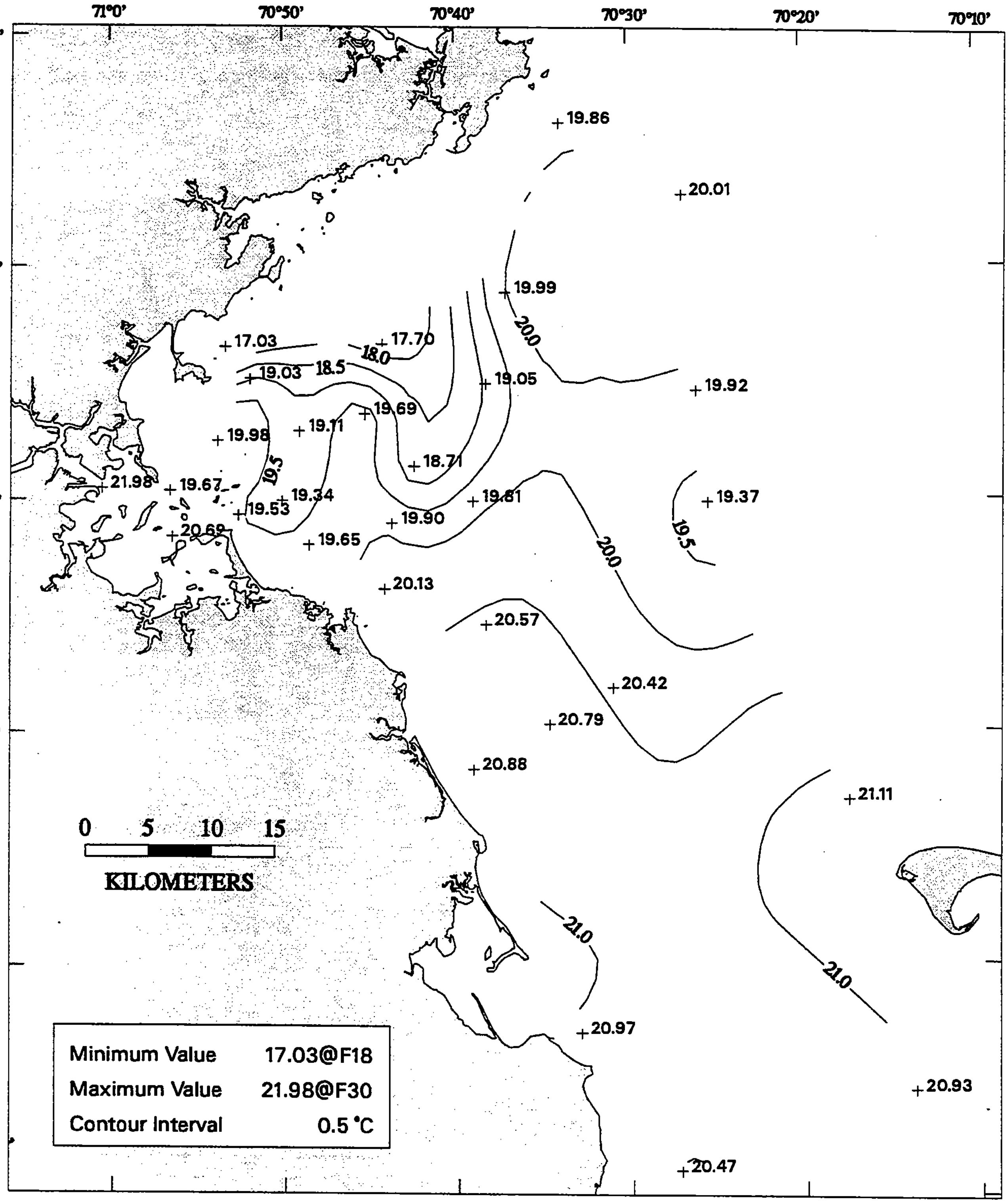


FIGURE 4-1
Surface Water Contour Plot of Temperature (°C) in Late August (W9511)

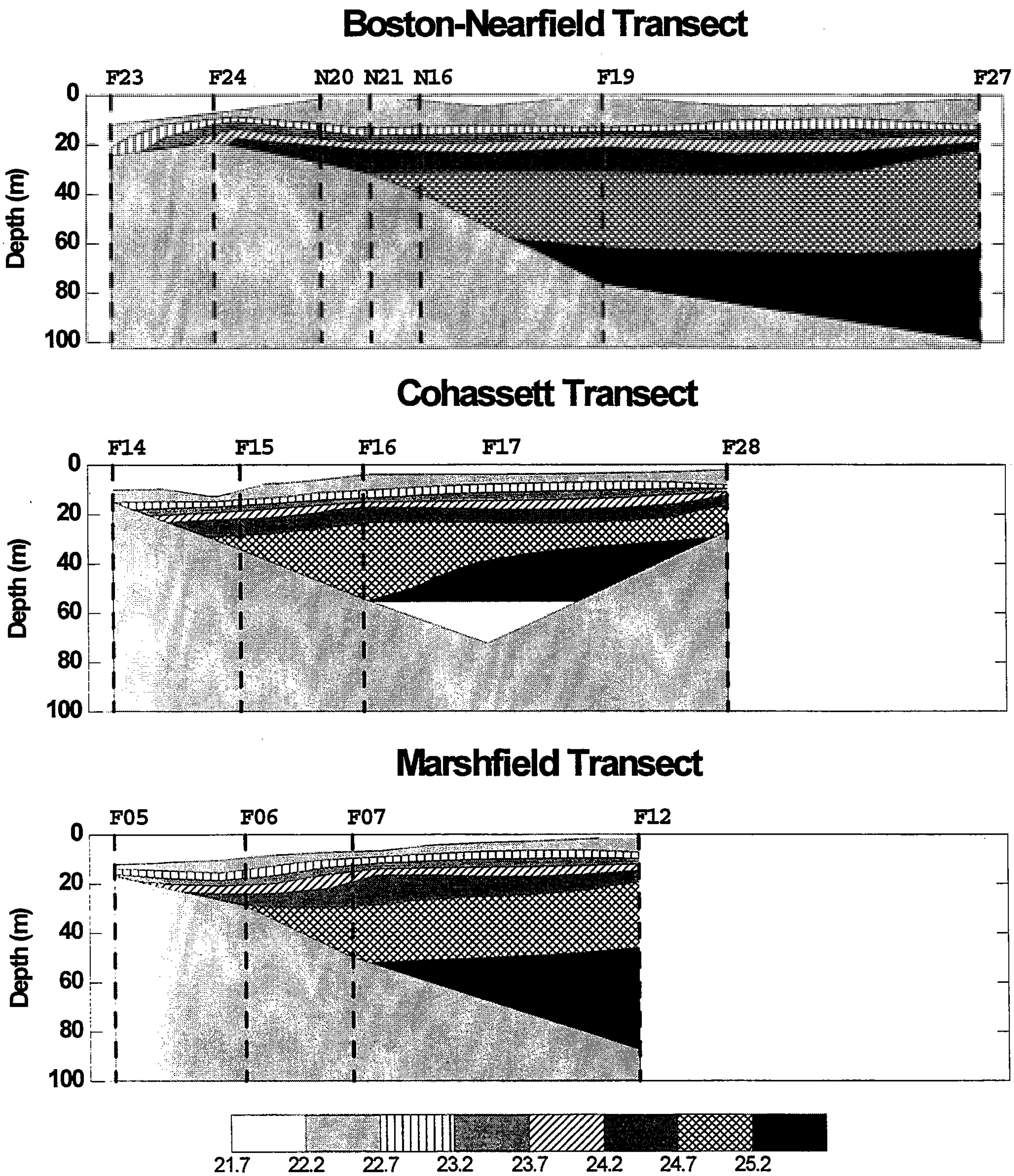


FIGURE 4-2
Density (σ_t) Contours Along Three Farfield Transects in Late August (W9511)

Sigma-T 9511

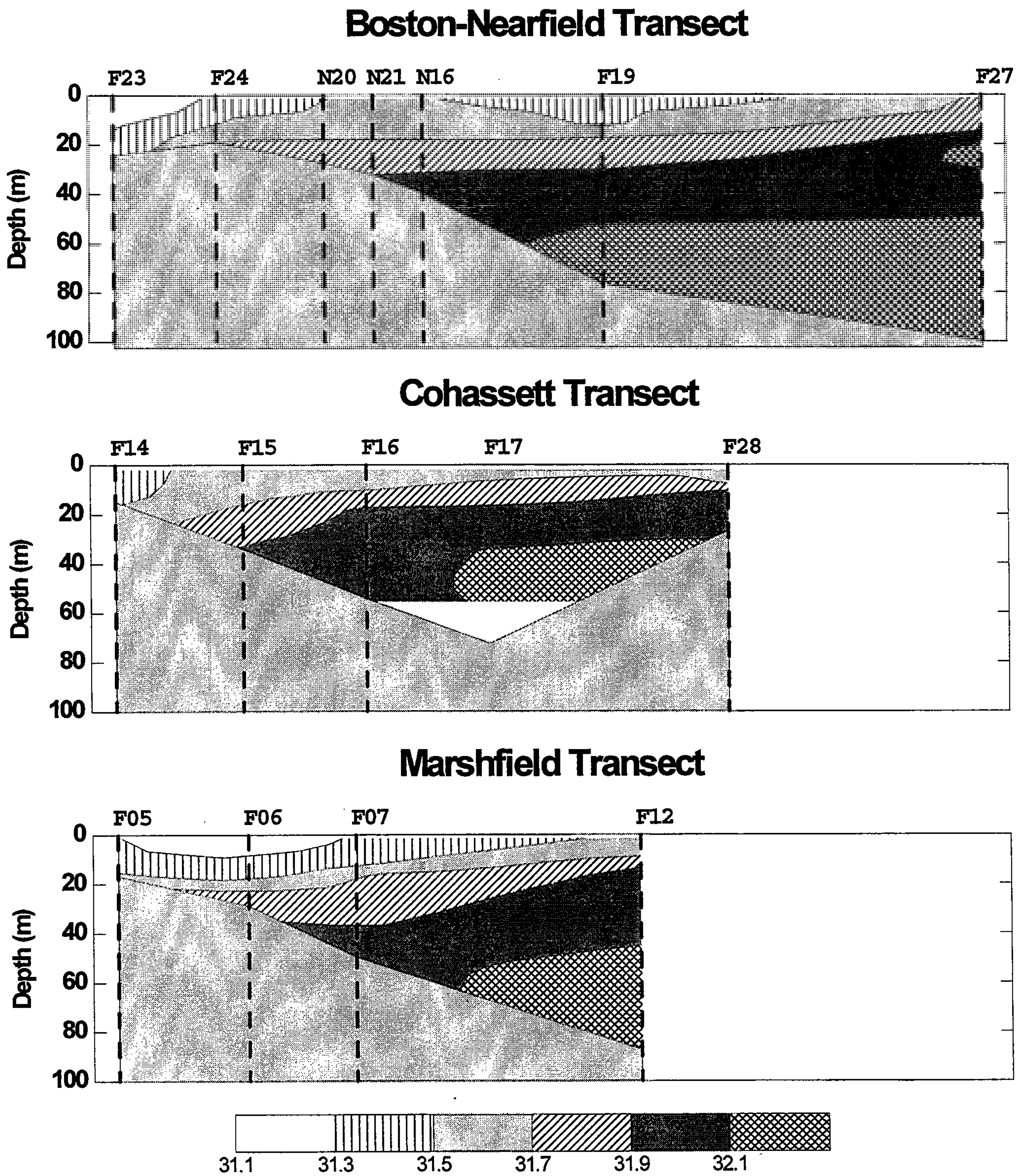


FIGURE 4-3
Salinity (PSU) Contours Along Three Farfield Transects in Late August (W9511)

Salinity 9511

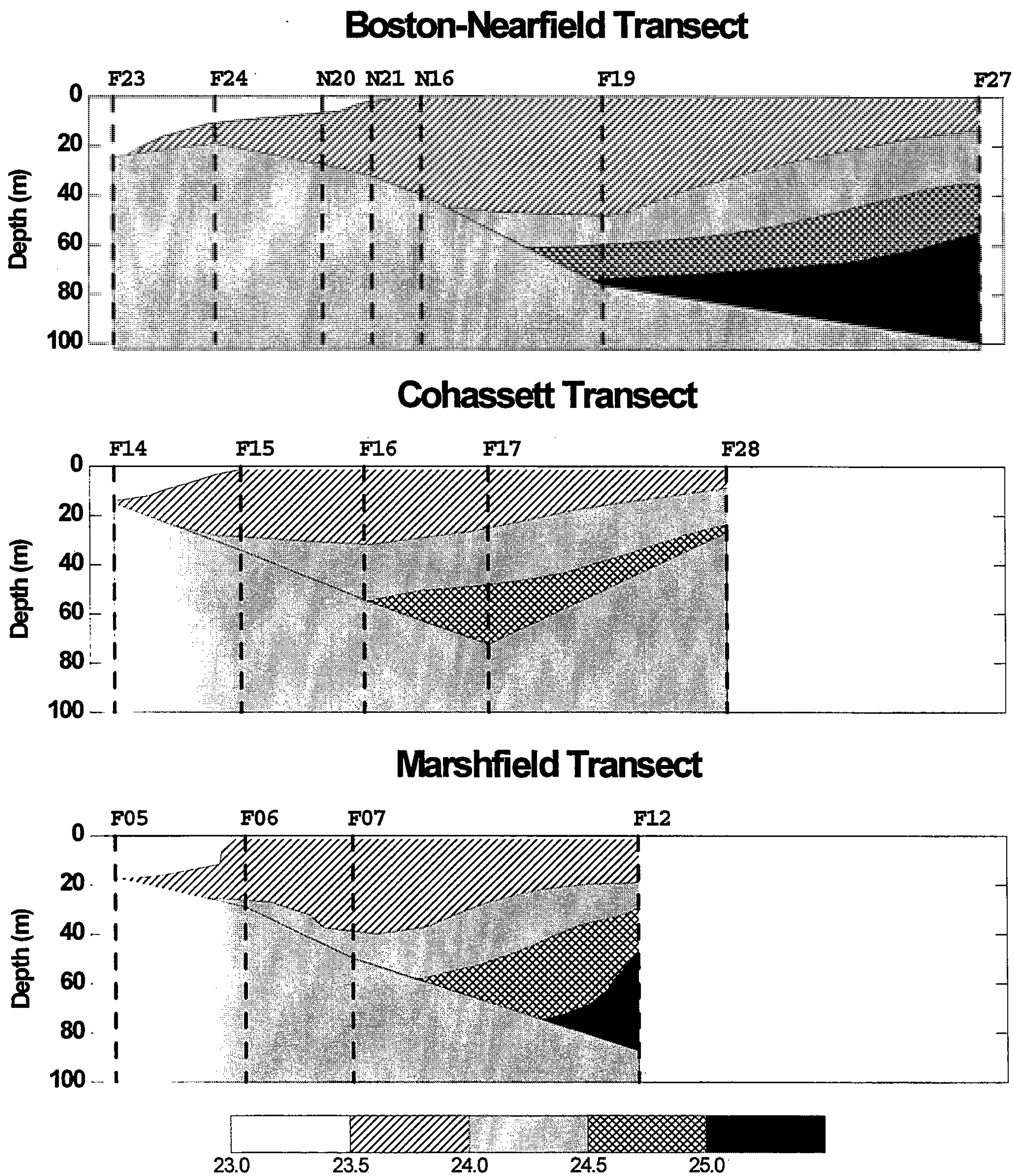


FIGURE 4-4
Density (σ_t) Contours Along Three Farfield Transects in October (W9514)

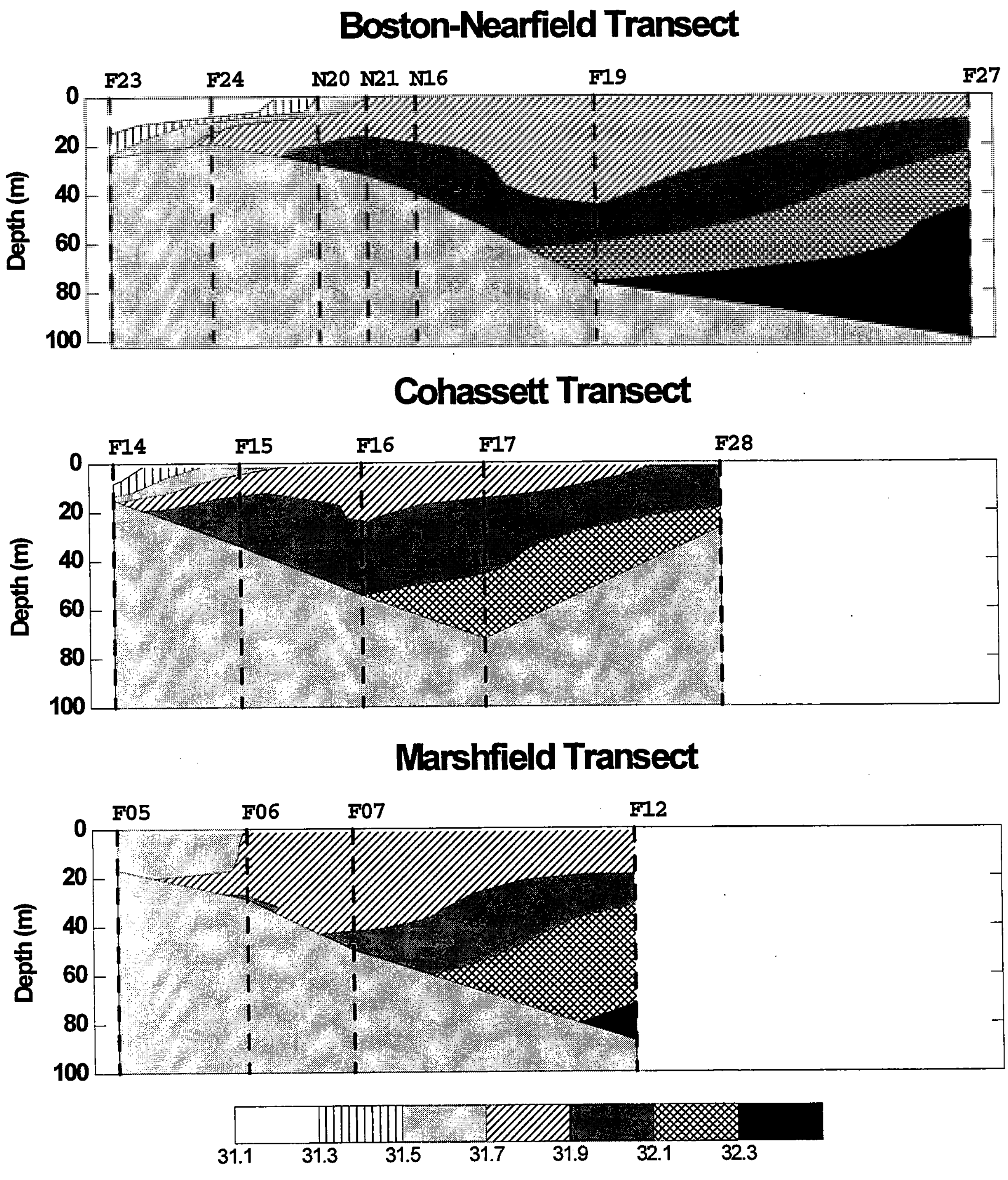
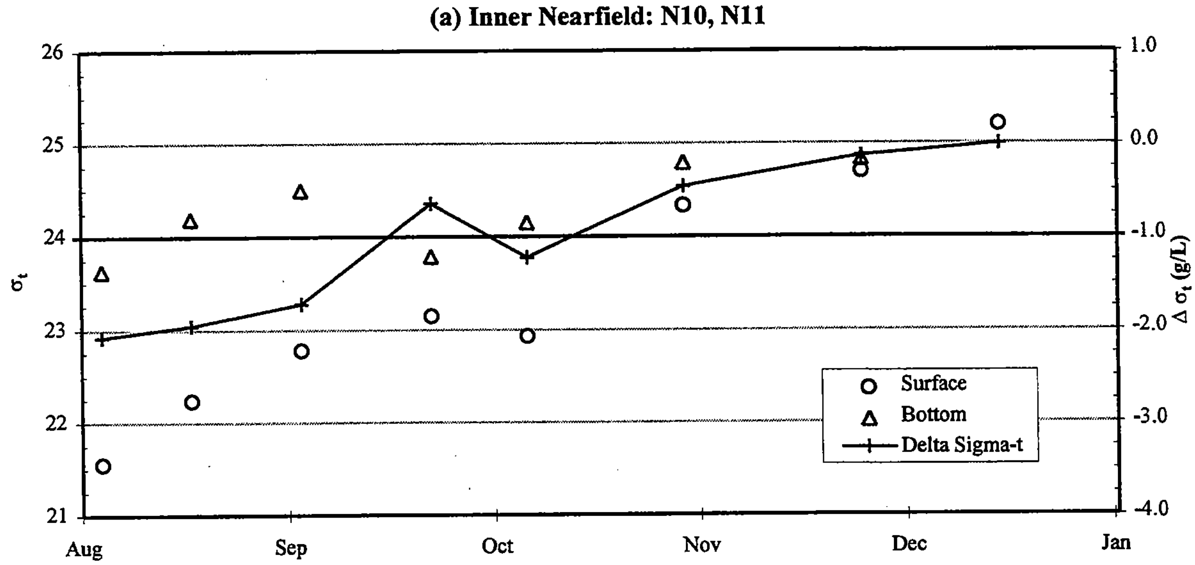


FIGURE 4-5
Salinity (PSU) Contours Along Three Farfield Transects in October (W9514)



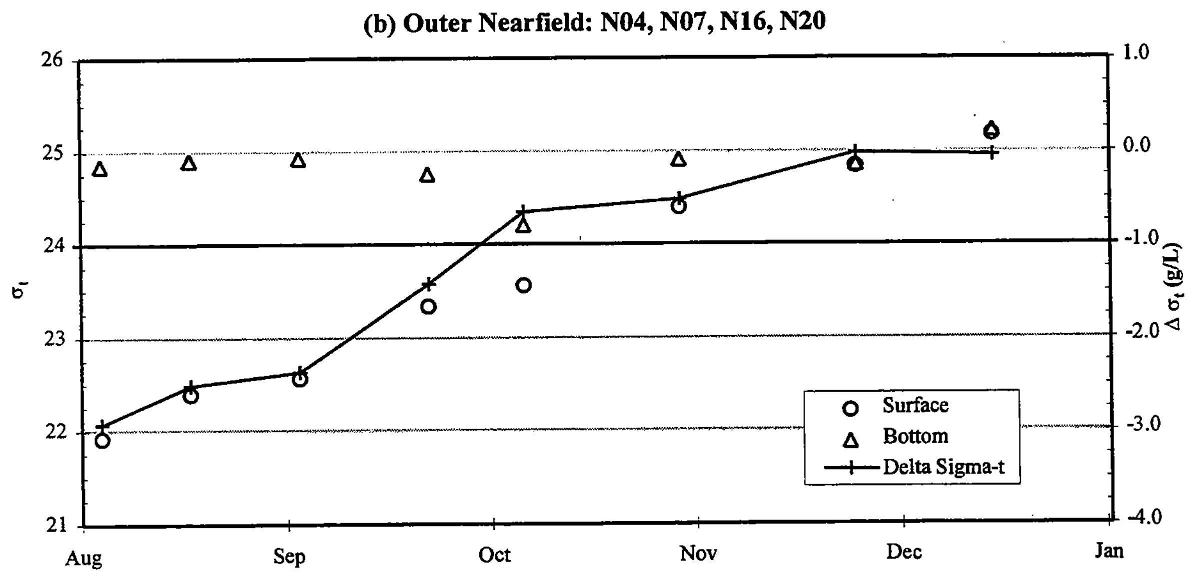


FIGURE 4-6
Time-Series of Average Surface and Bottom Water Density (σ_t) and $\Delta\sigma_t$ in the (a) Inner and (b) Outer Nearfield

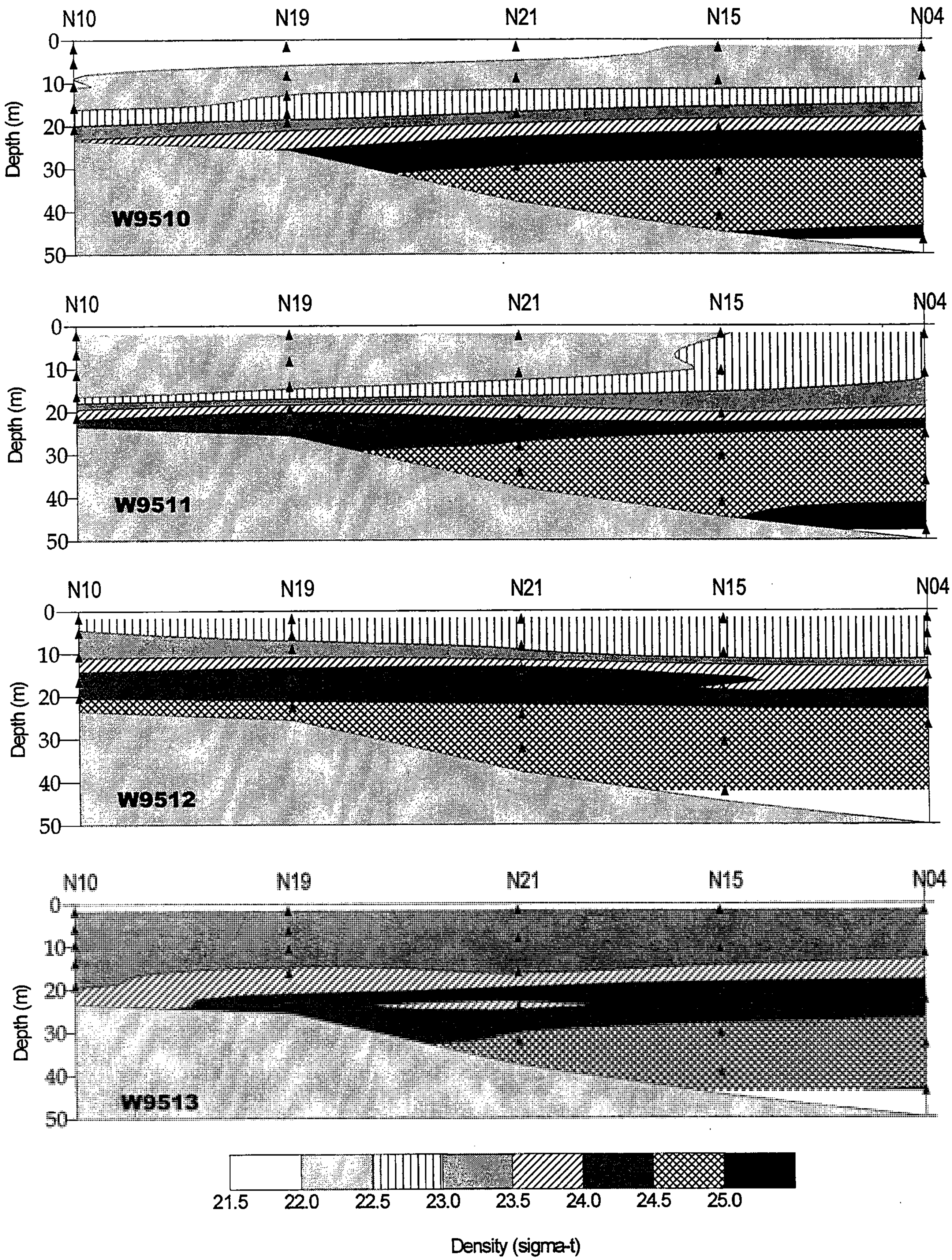


FIGURE 4-7
Density (σ_t) Contours Along Nearfield Transect During
the First Four Nearfield Surveys

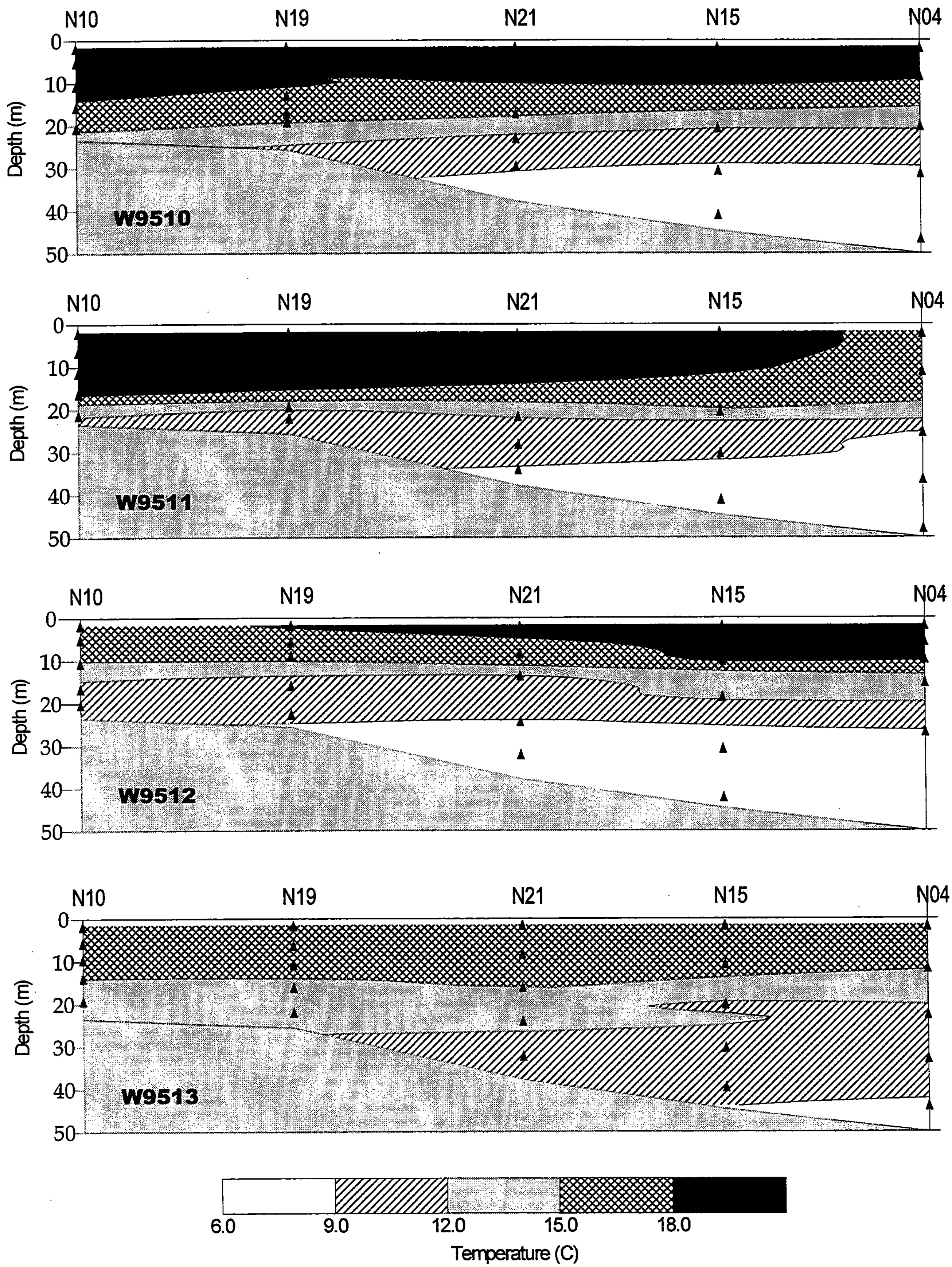


FIGURE 4-8
Temperature (°C) Contours Along Nearfield Transect During
the First Four Nearfield Surveys

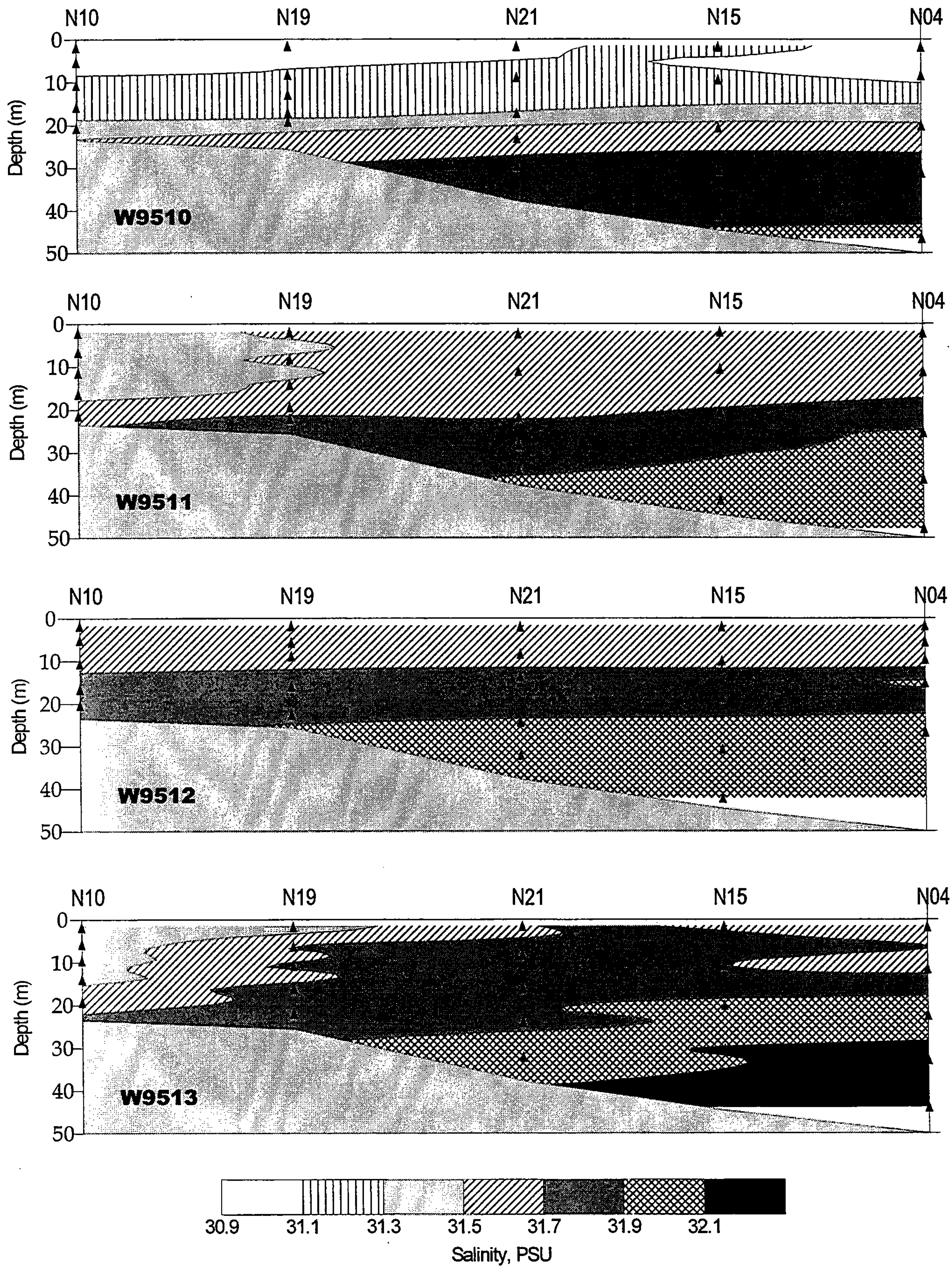
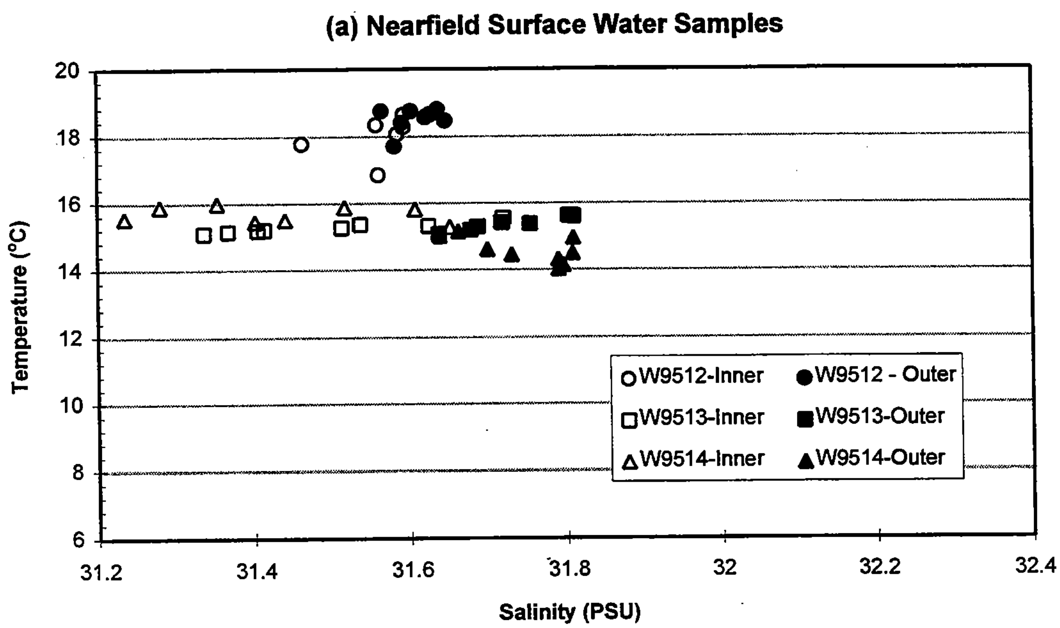


FIGURE 4-9
Salinity (PSU) Contours Along Nearfield Transect During the First Four Nearfield Surveys



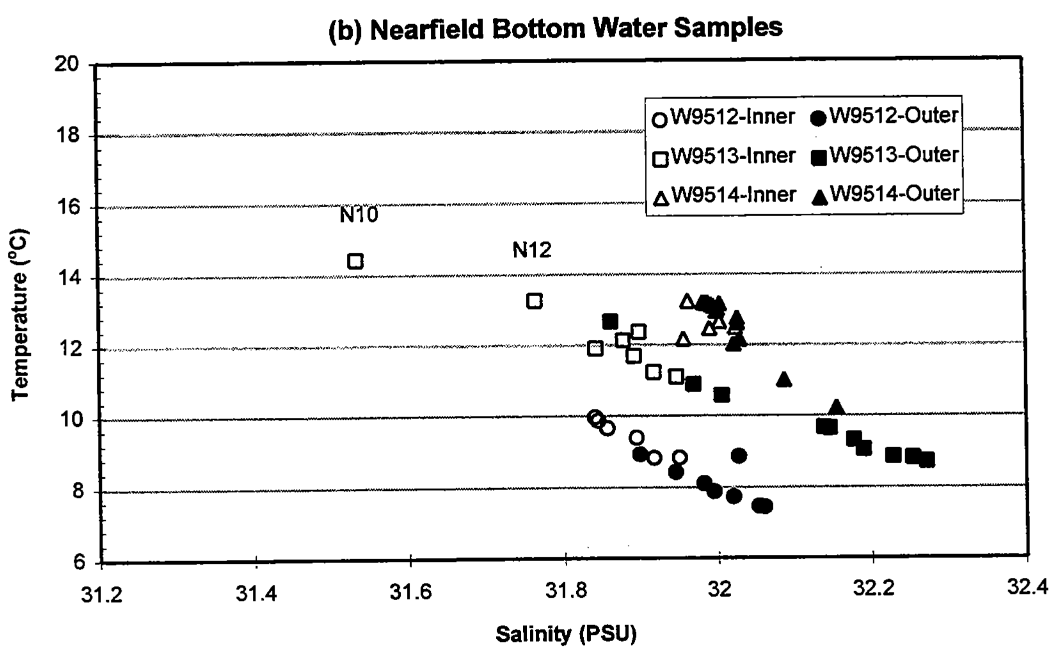


FIGURE 4-10
Nearfield Temperature/Salinity Data for (a) Surface and (b) Bottom Water During September (W9512-13) and October (W9514)

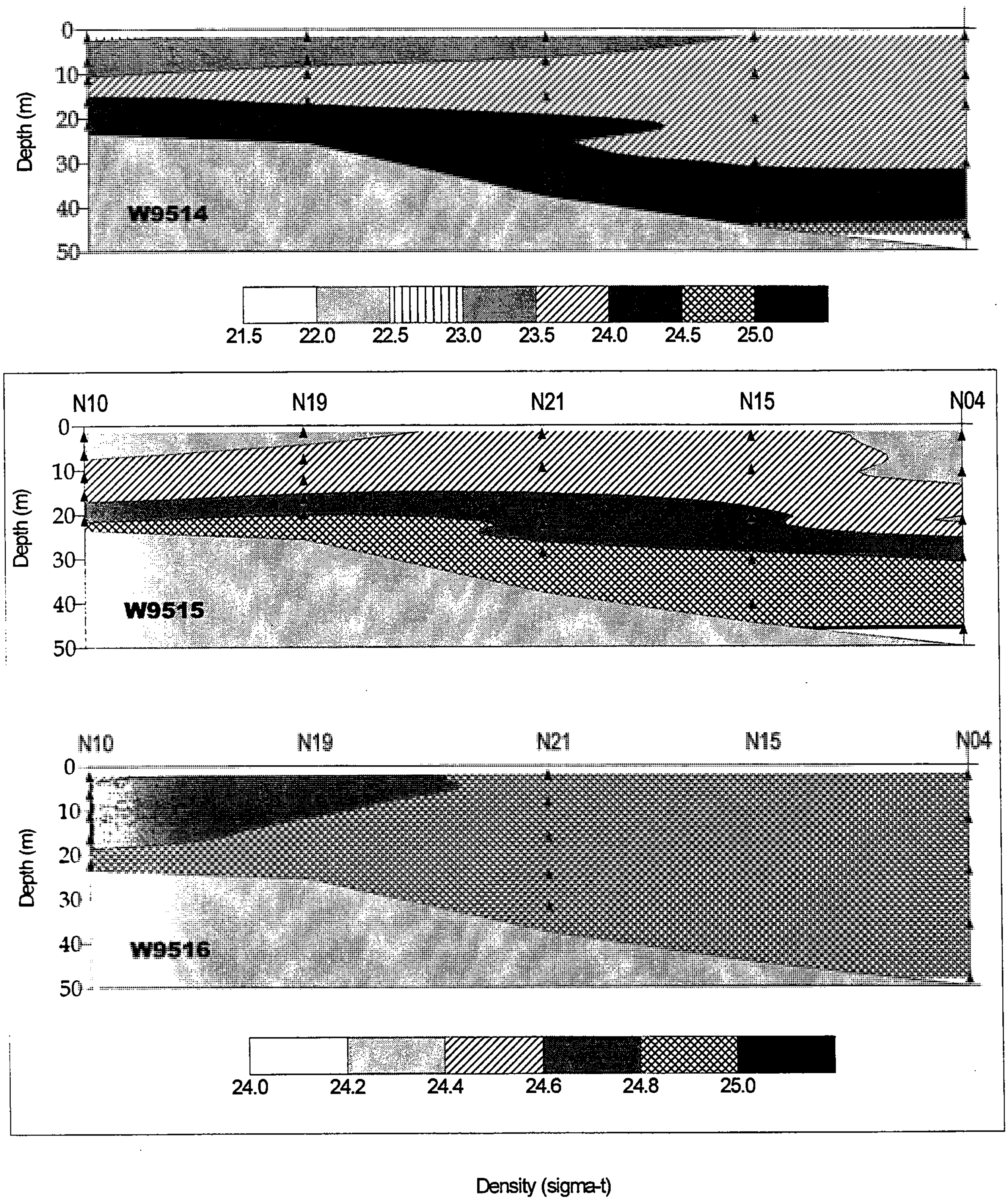


FIGURE 4-11
Density (σ_t) Contours Along Nearfield Transect After the Fall Turnover

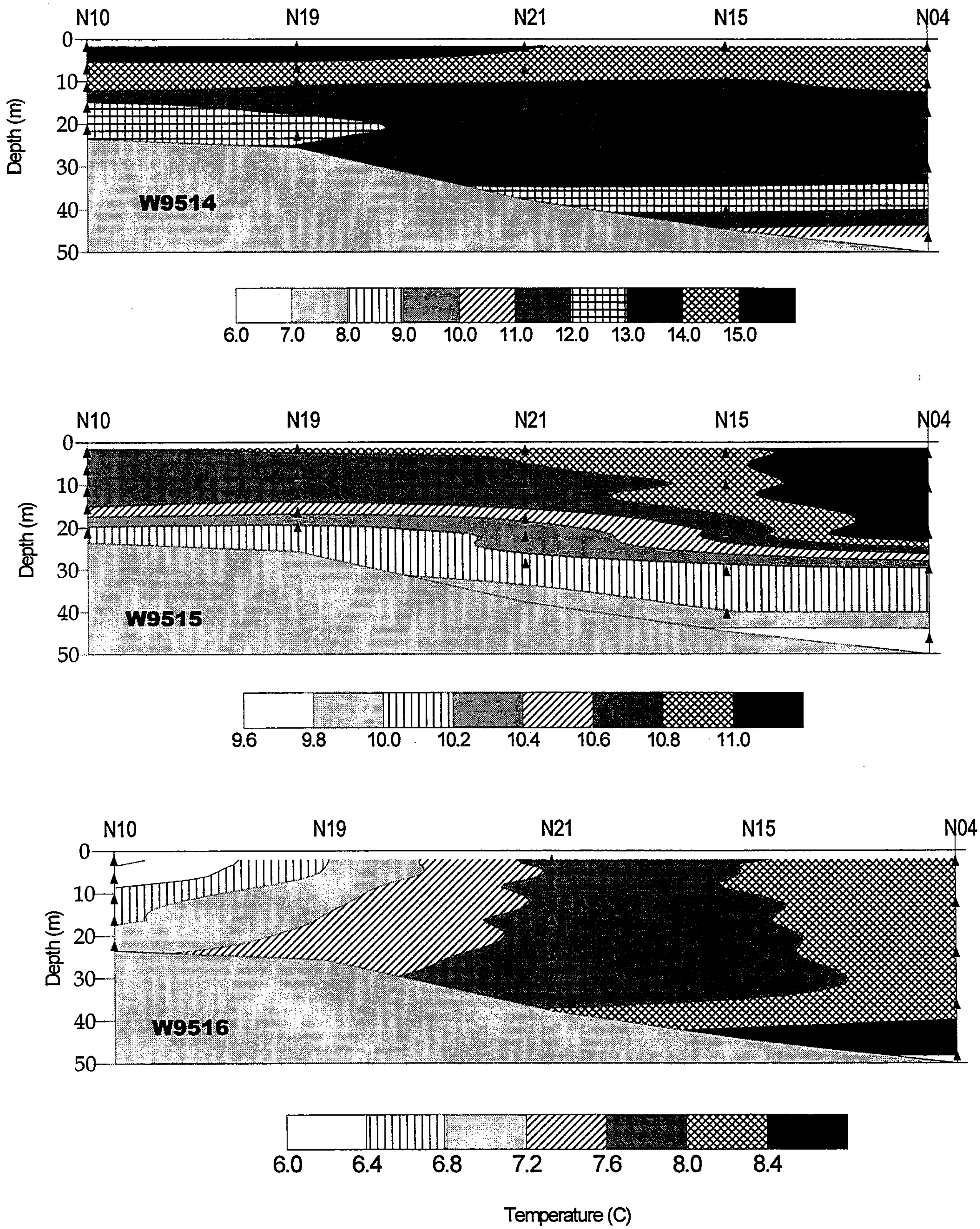


FIGURE 4-12
Temperature (°C) Contours Along Nearfield Transect After the Fall Turnover

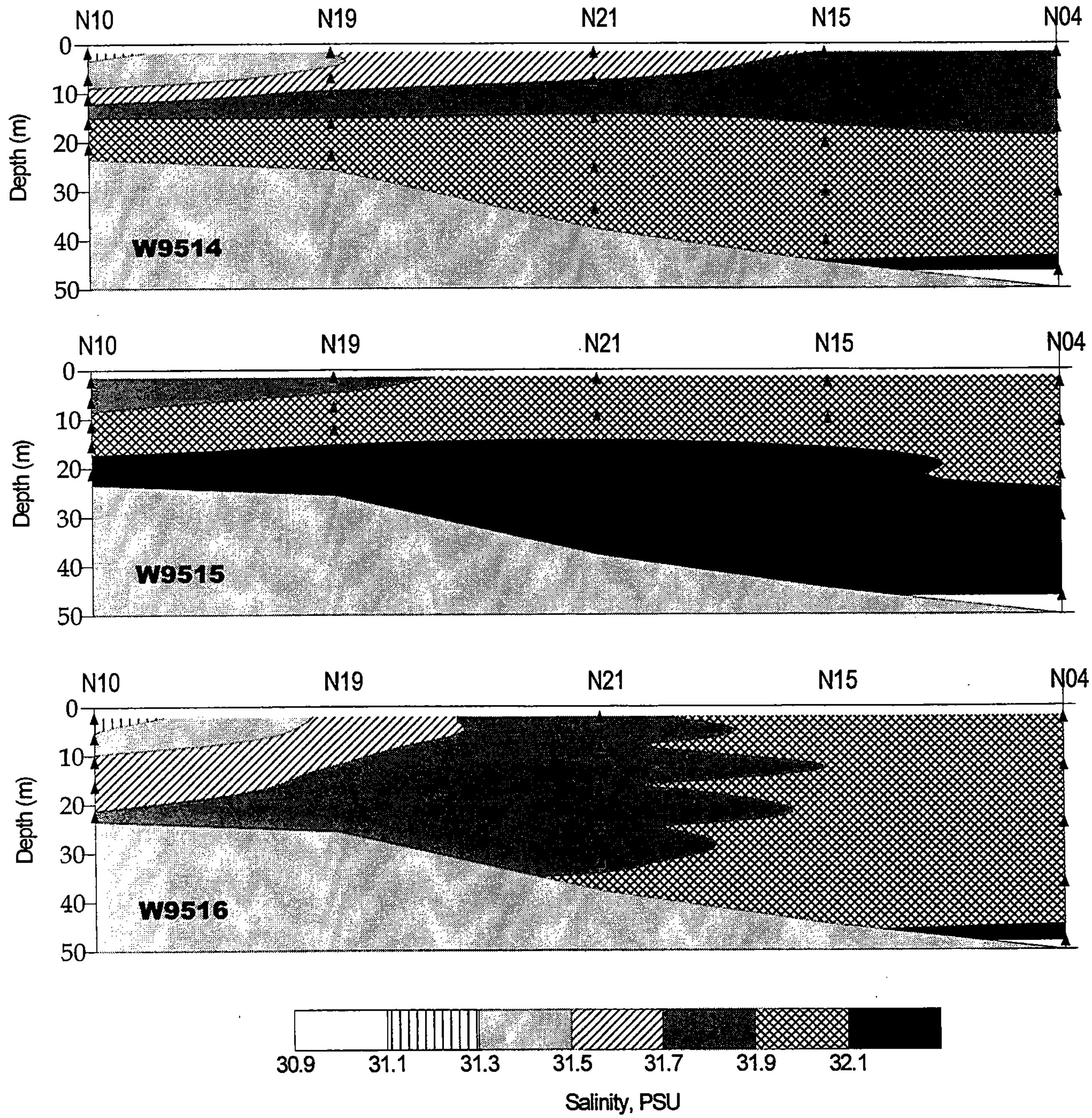


FIGURE 4-13
Salinity (PSU) Contours Along Nearfield Transect After the Fall Turnover

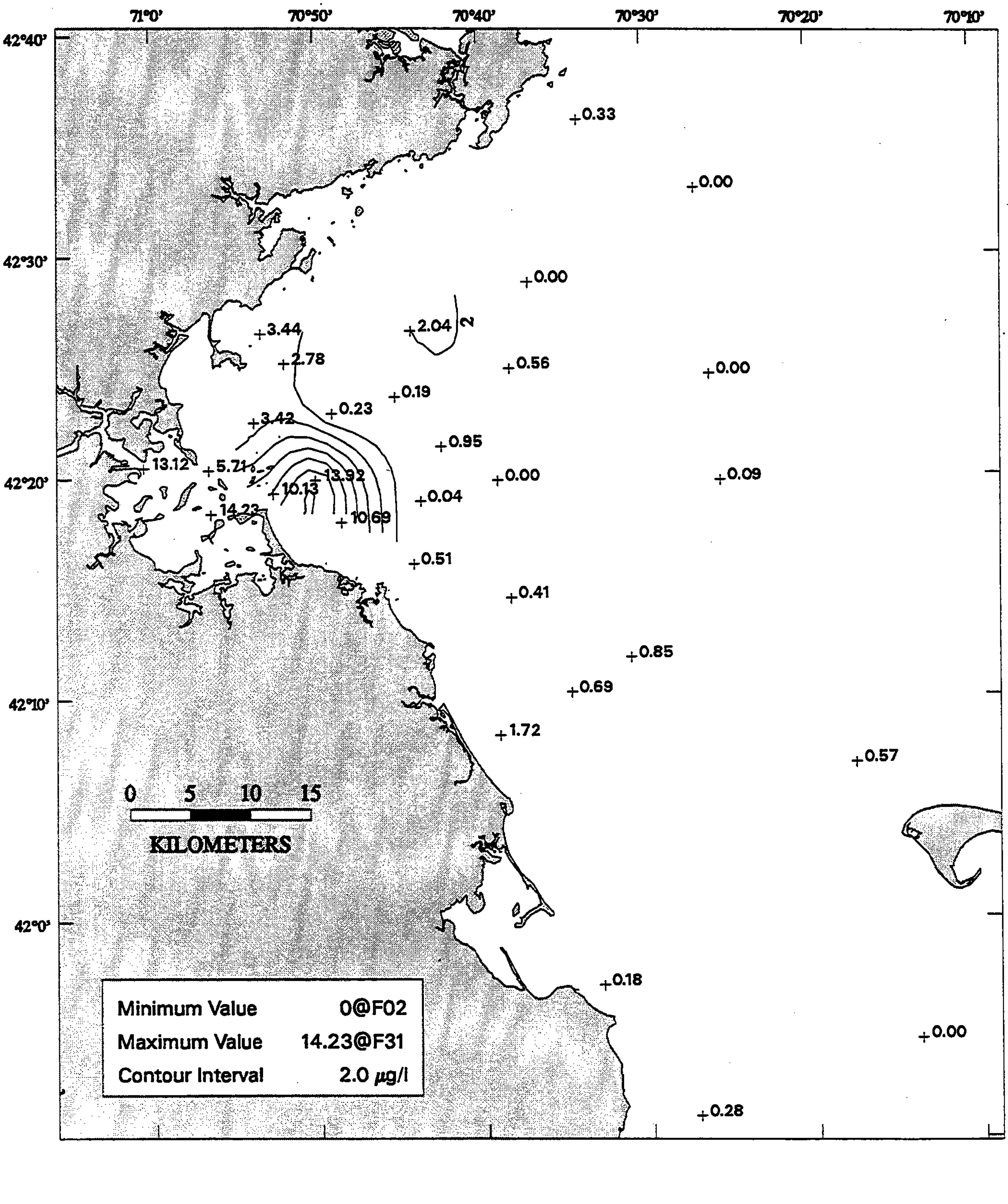


FIGURE 4-14
Surface Water Contour Plot of Nitrate (μM) in Late August (W9511)

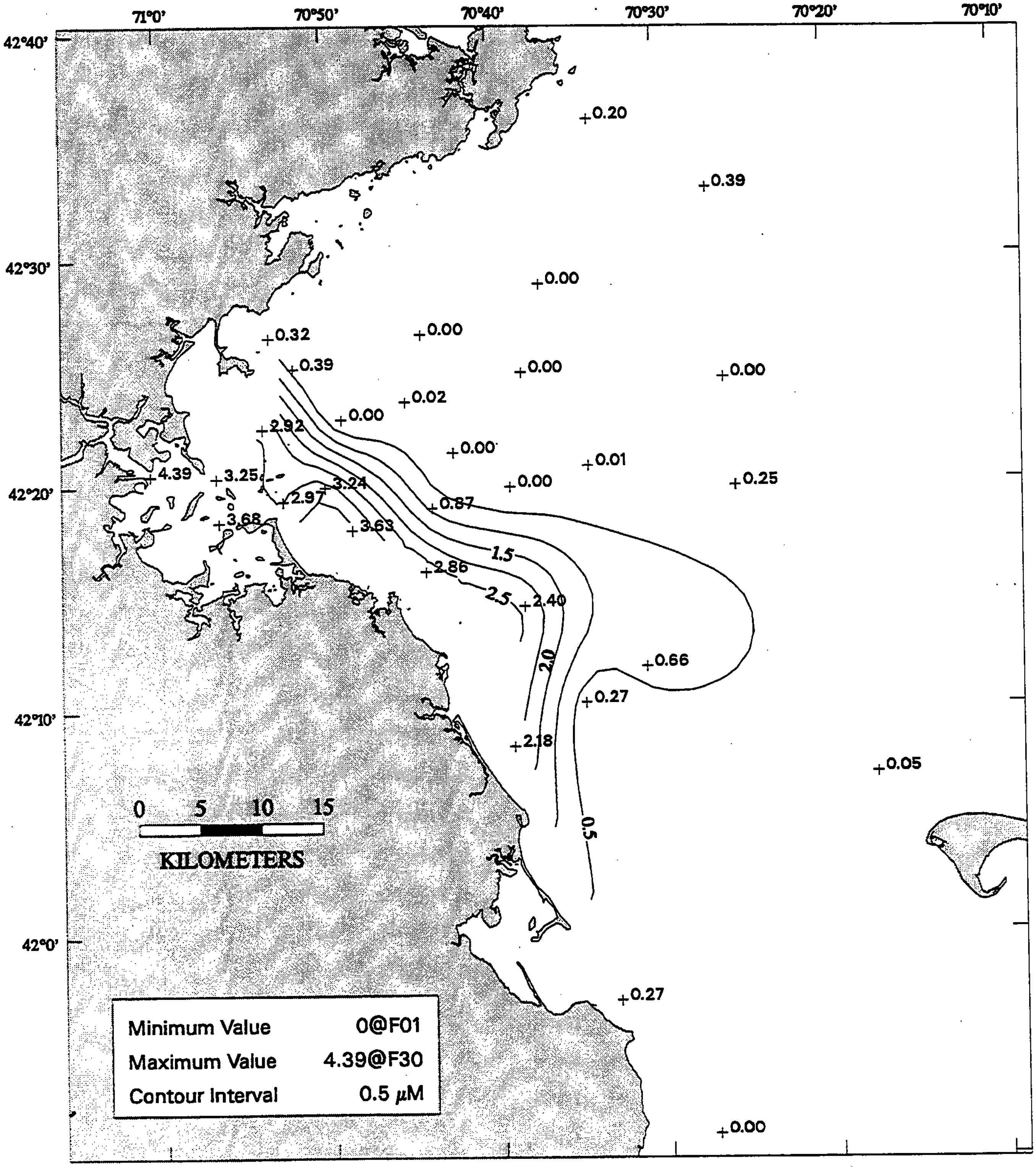
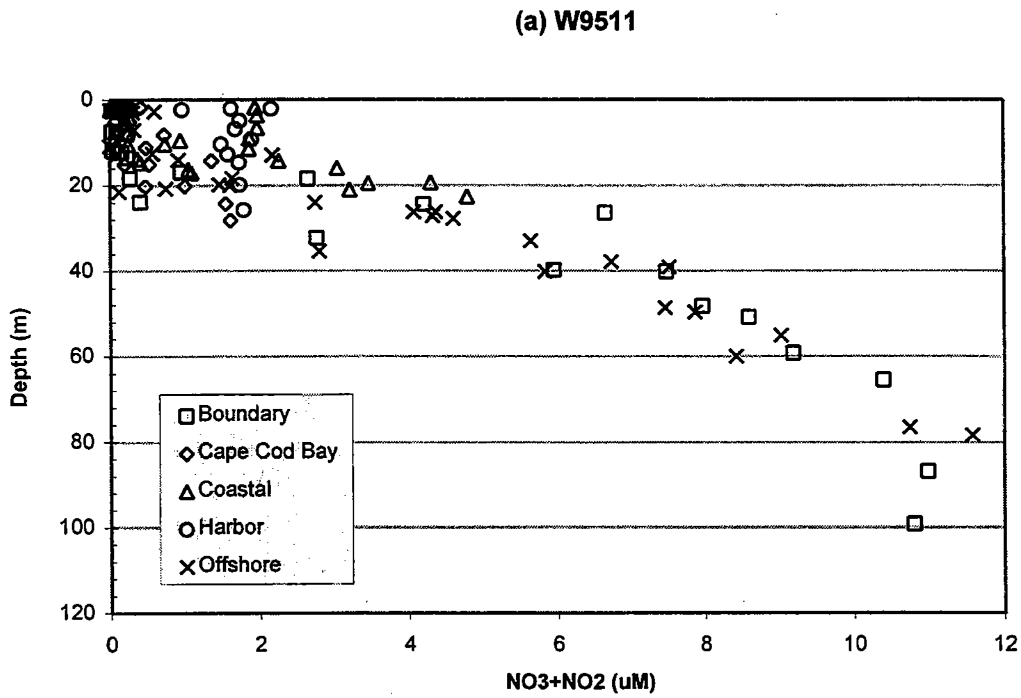


FIGURE 4-15
Surface Water Contour Plot of Nitrate (µM) in October (W9514)



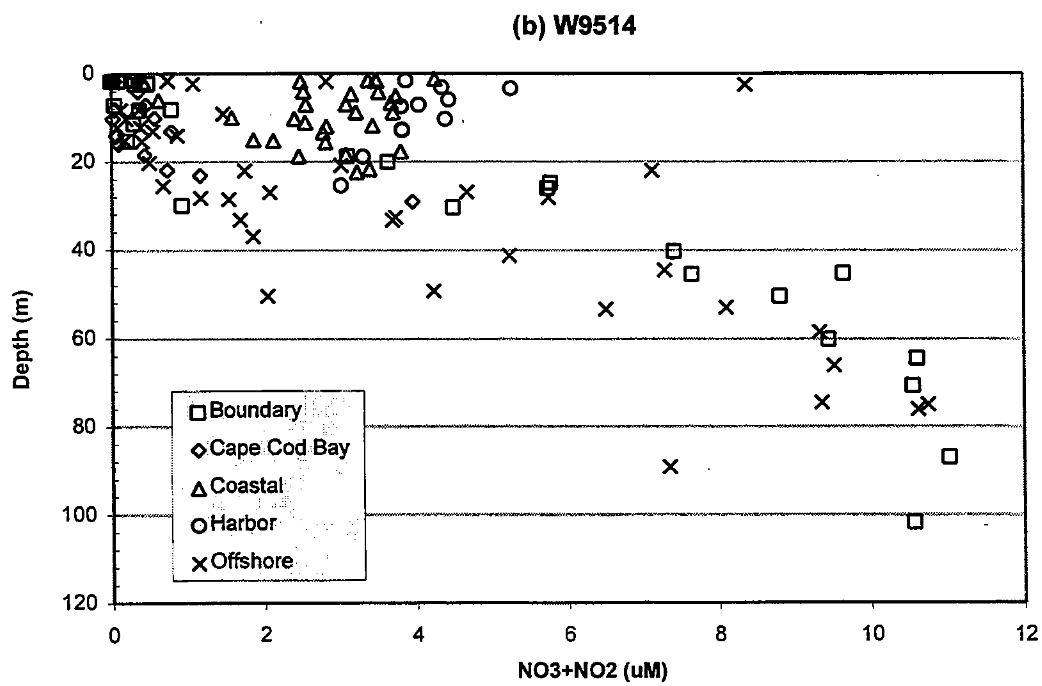


FIGURE 4-16
Nitrate+Nitrite (µM) Concentrations With Depth in
(a) Late August (W9511) and (b) October (W9514)

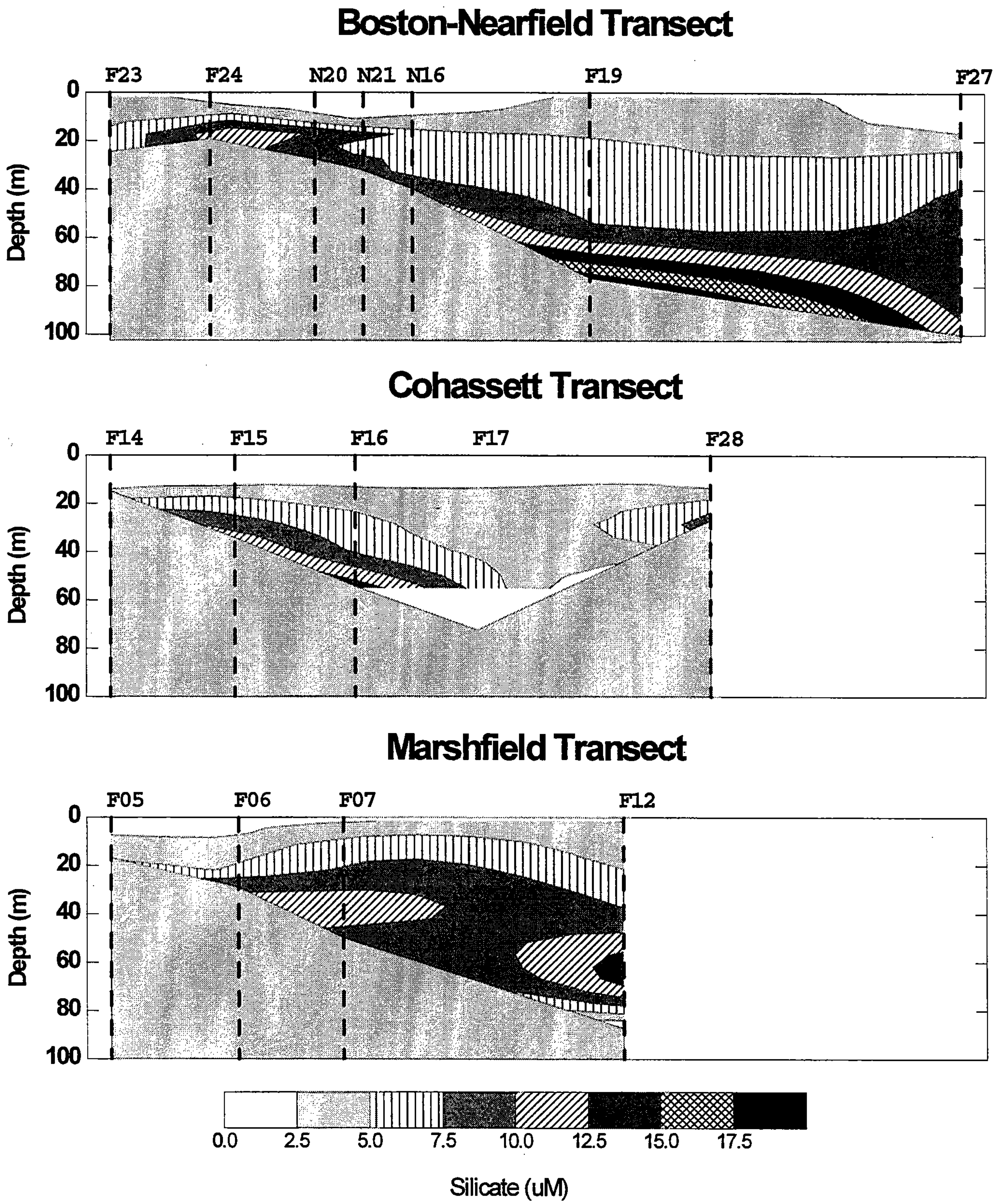


FIGURE 4-17
Silicate Concentration (µM) Contours Along Three Farfield Transects in Late August (W9511)

SIO4 9511

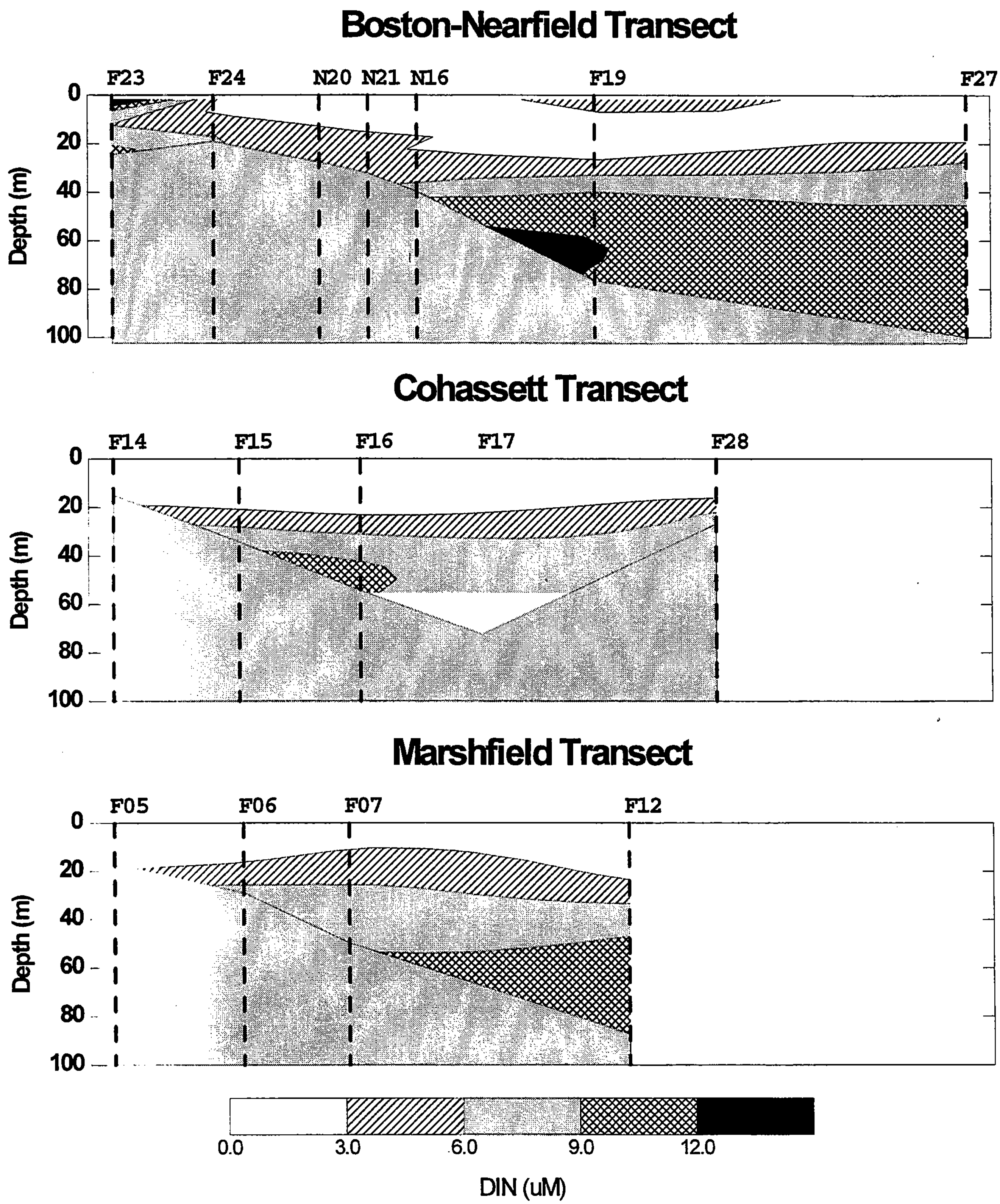


FIGURE 4-18
Dissolved Inorganic Nitrogen (DIN, µM) Contours Along
Three Farfield Transects in Late August (W9511)

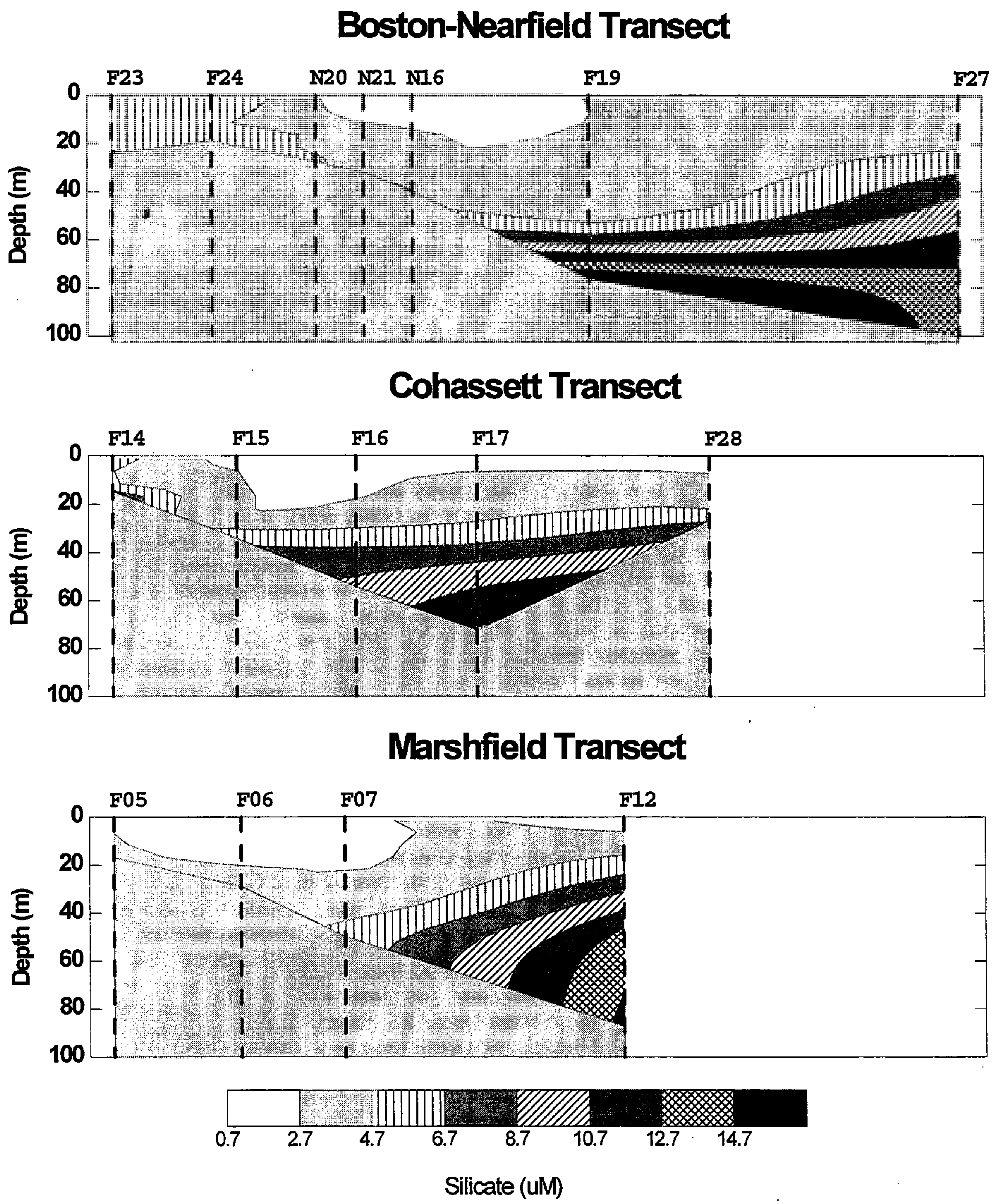


FIGURE 4-19
Silicate Concentration (μM) Contours Along
Three Farfield Transects in October (W9514)

SIO4 9514

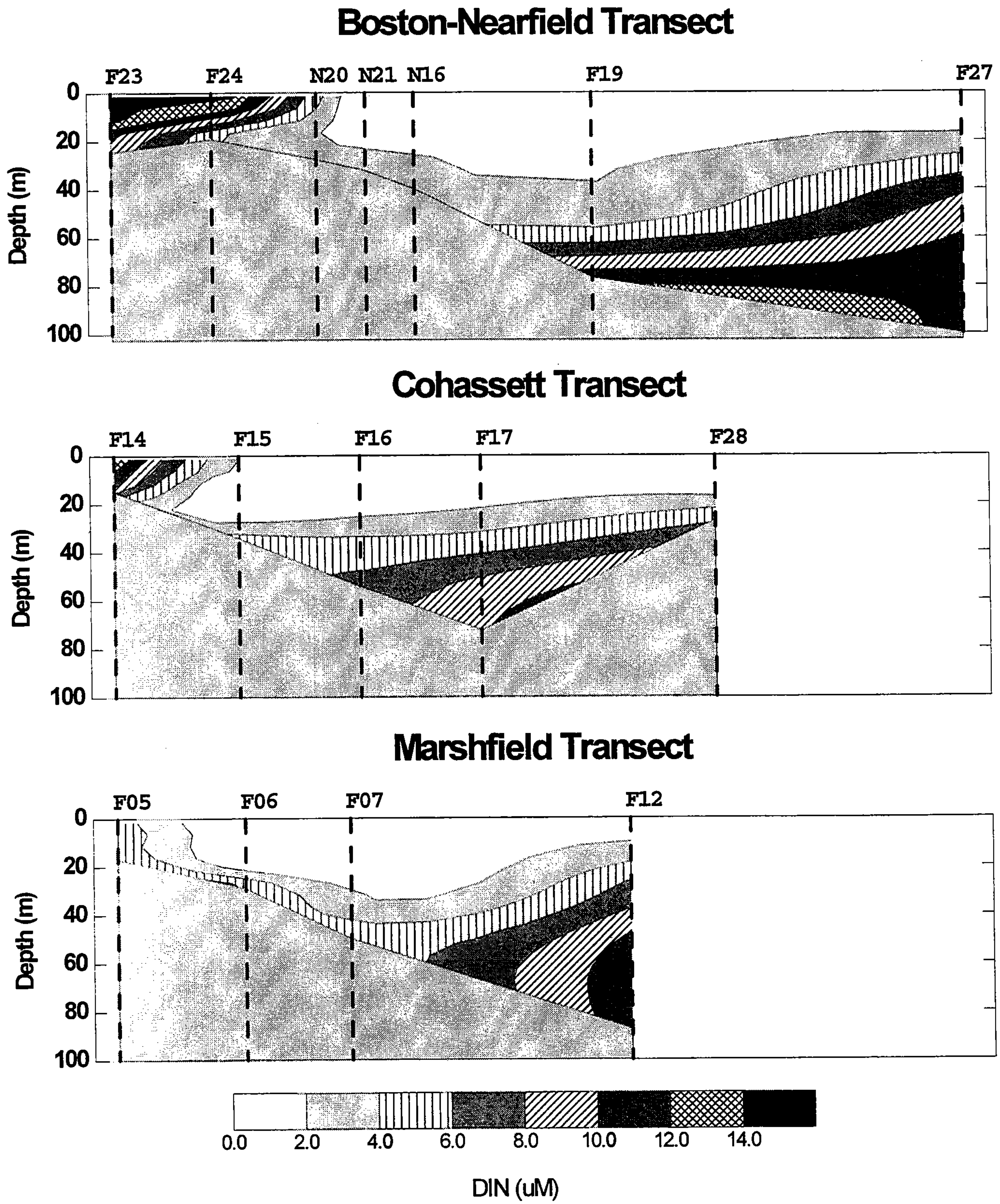


FIGURE 4-20
Dissolved Inorganic Nitrogen (DIN, µM) Contours Along
Three Farfield Transects in October (W9514)

DI Nitro 9514

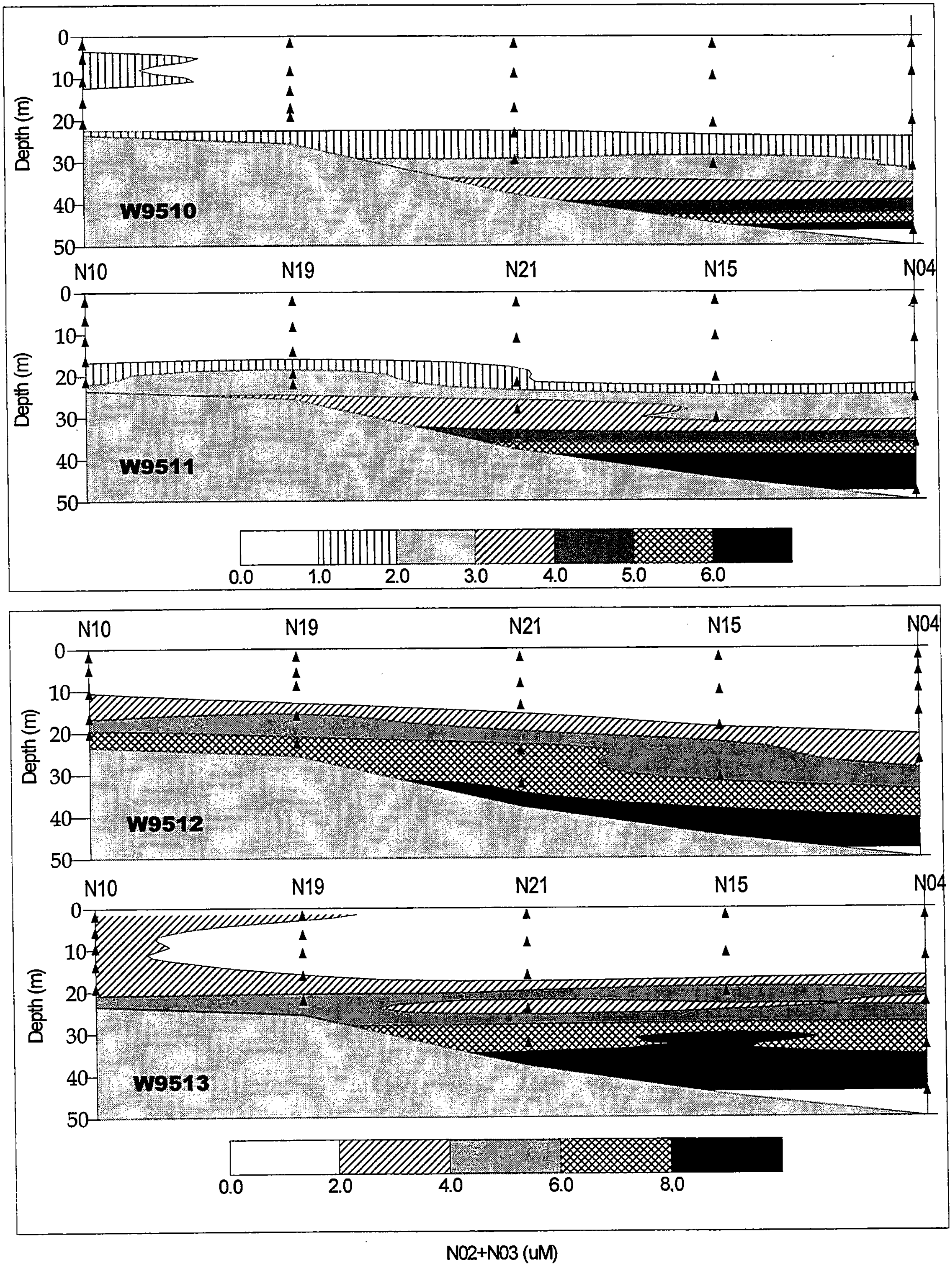


FIGURE 4-21
Nitrate+Nitrite Concentrations (μM) Along Nearfield Transect
During the First Four Nearfield Surveys

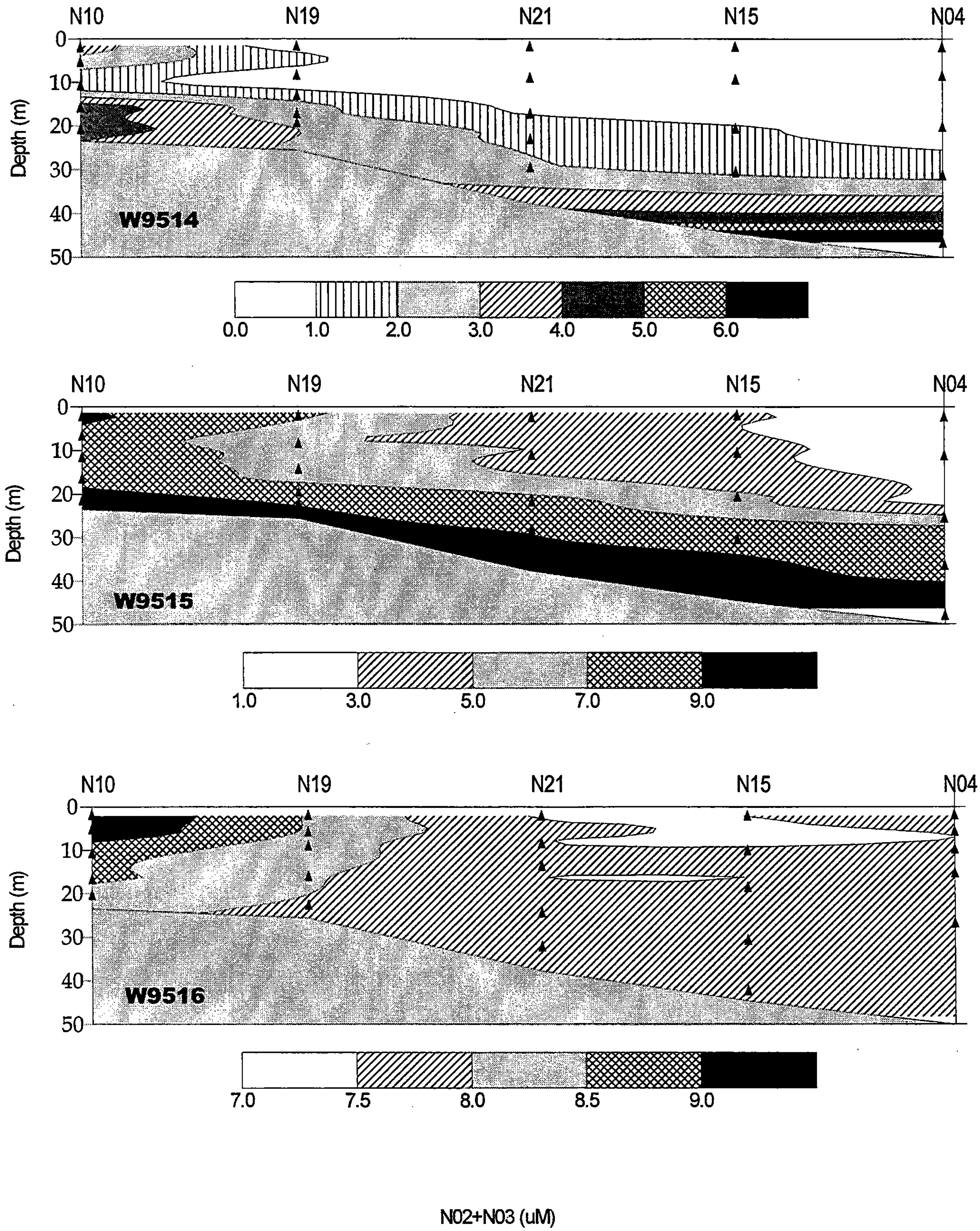


FIGURE 4-22
Nitrate+Nitrite Concentrations (μM) Along Nearfield Transect
After the Fall Turnover

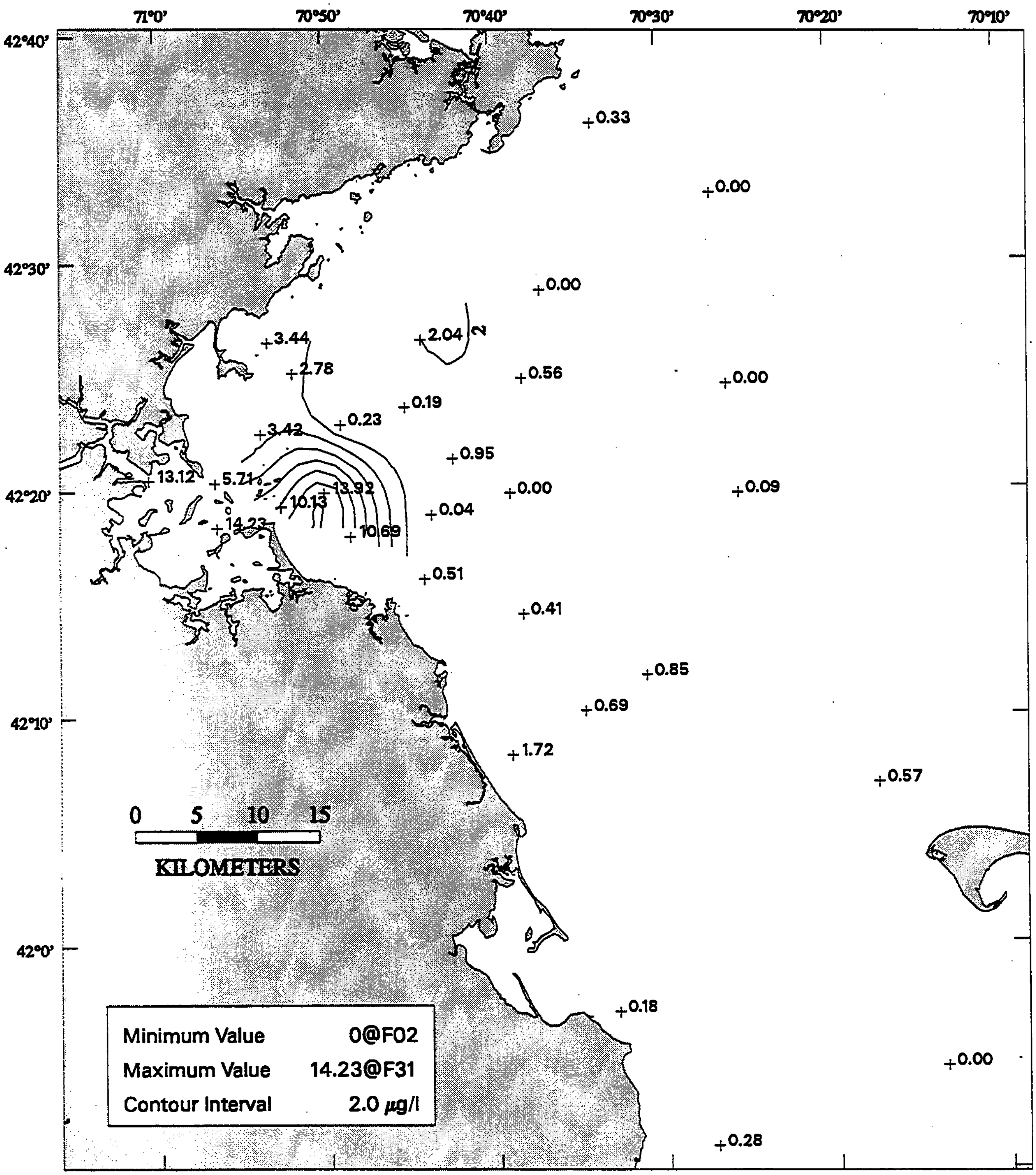


FIGURE 4-23
Surface Water Contour Plot of Chlorophyll *a* (µg/L) in Late August (W9511)

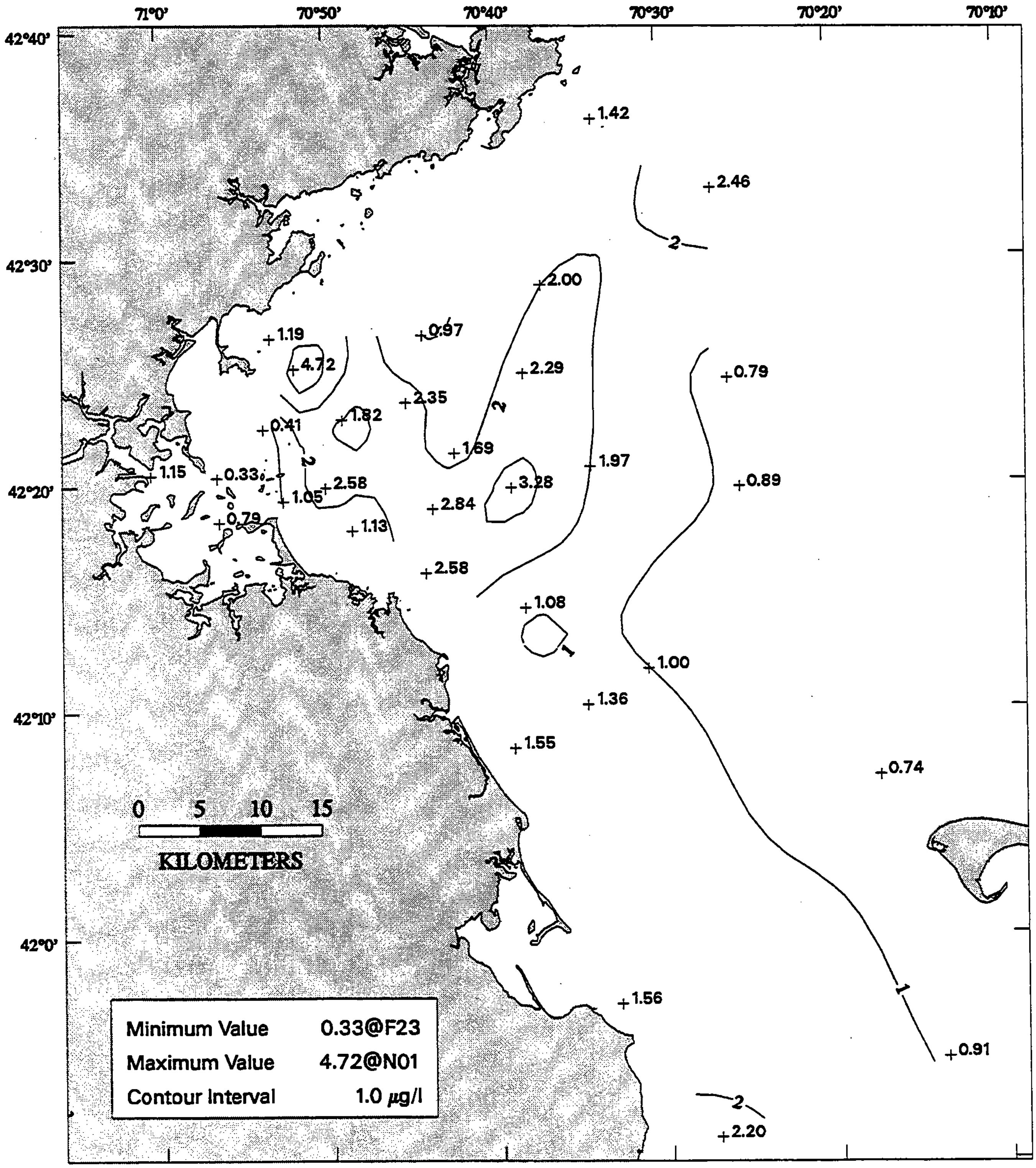


FIGURE 4-24
Surface Water Contour Plot of Chlorophyll *a* (µg/L) in October (W9514)

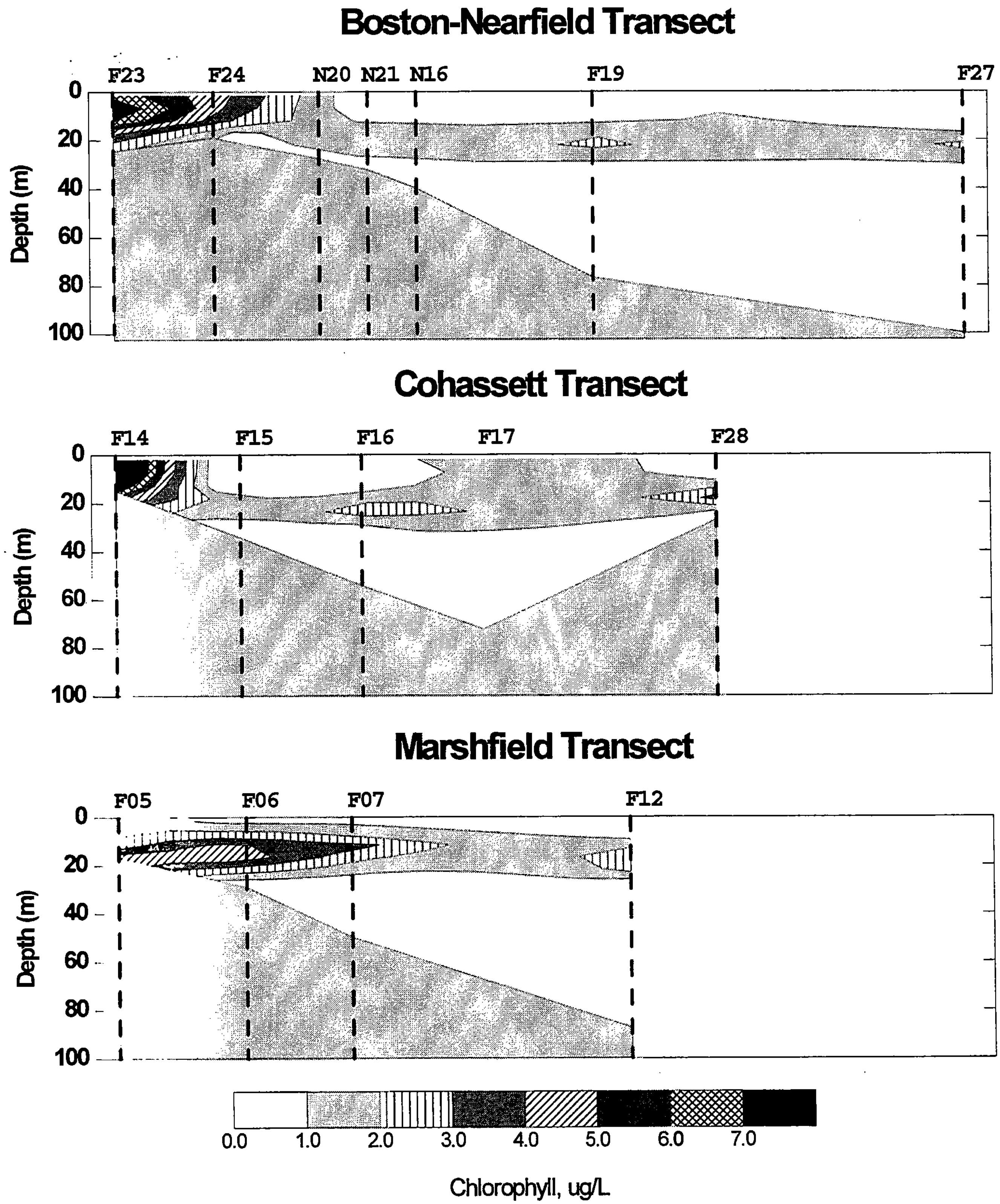


FIGURE 4-25
Chlorophyll *a* (μg/L) Contours Along Three Farfield Transects in Late August (W9511)

Fluorescence 9511

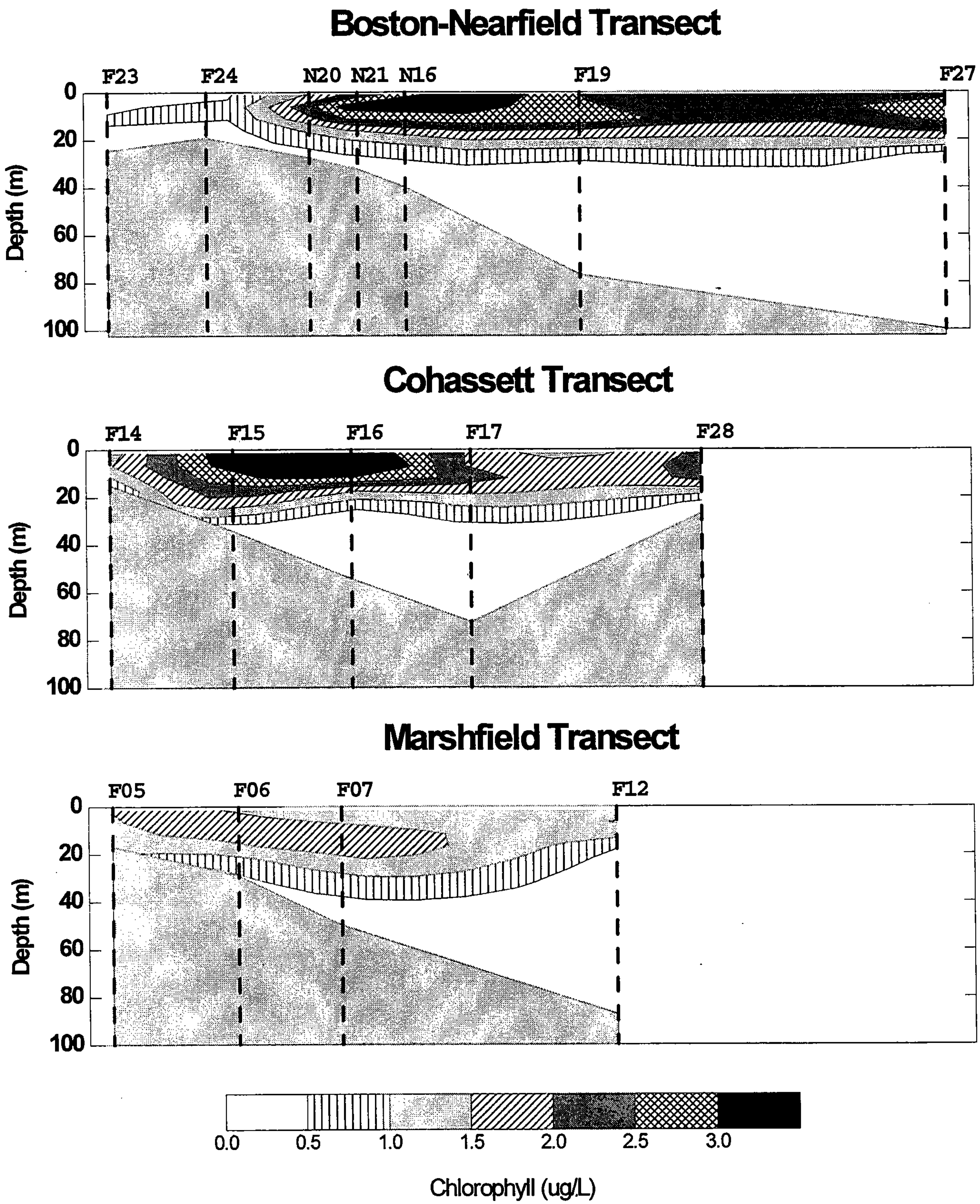


FIGURE 4-26
Chlorophyll *a* (µg/L) Contours Along Three Farfield Transects in October (W9514)

Fluorescence 9514

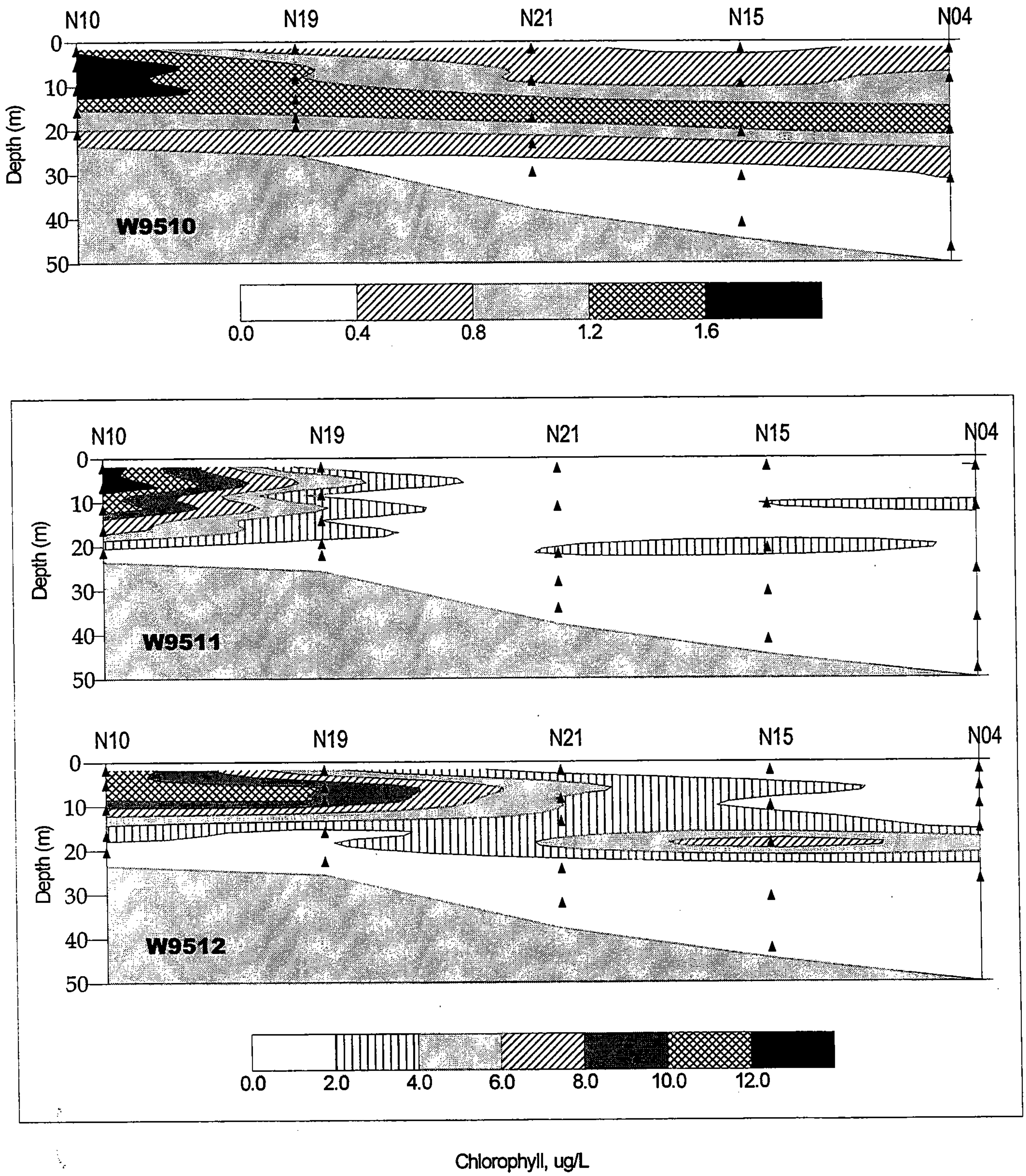


FIGURE 4-27

Chlorophyll *a* (μg/L) Contours Along Nearfield Transect During Surveys W9510-W9512

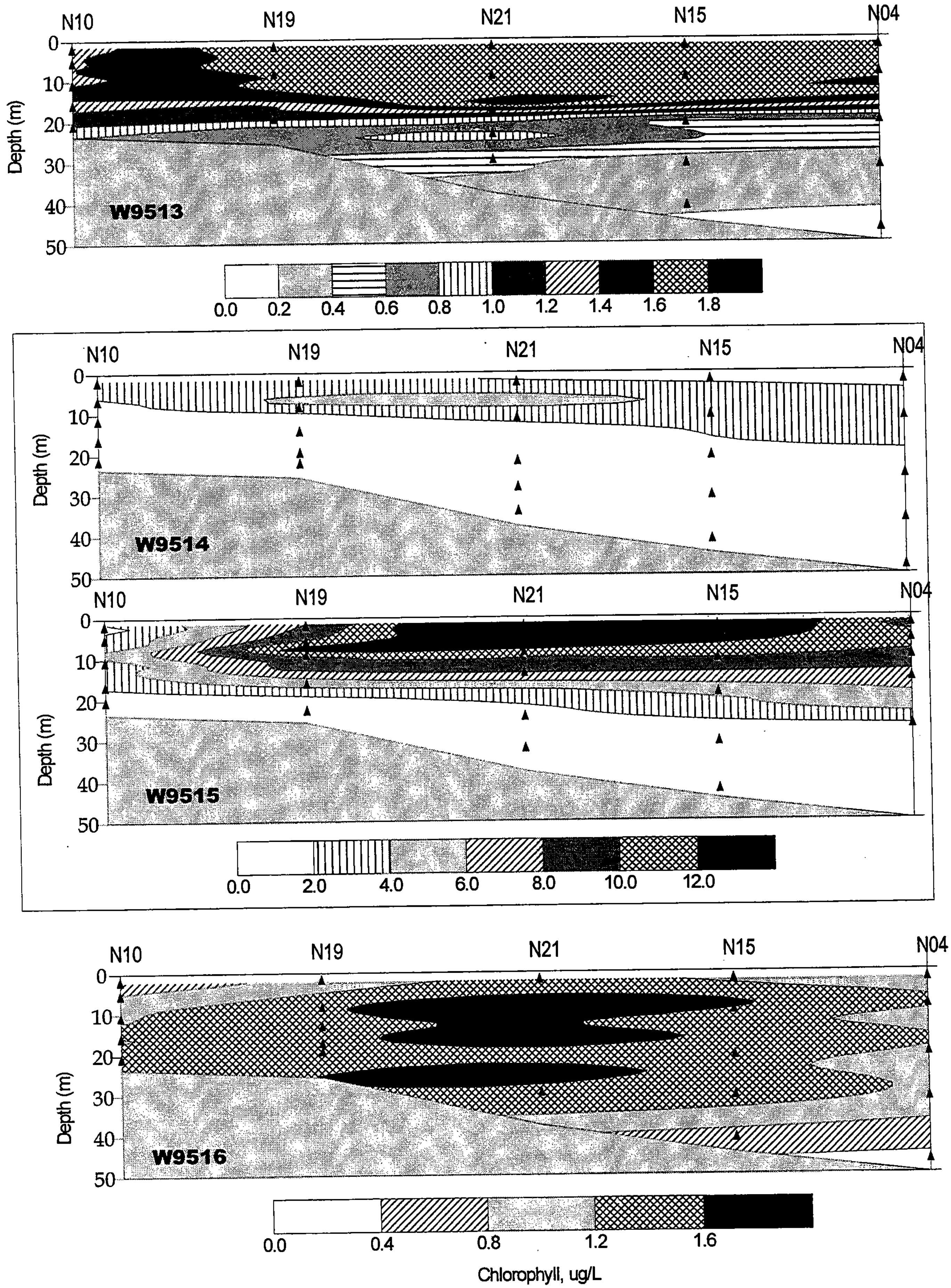


FIGURE 4-28
Chlorophyll *a* (μg/L) Contours Along Nearfield Transect, W9513-W9516

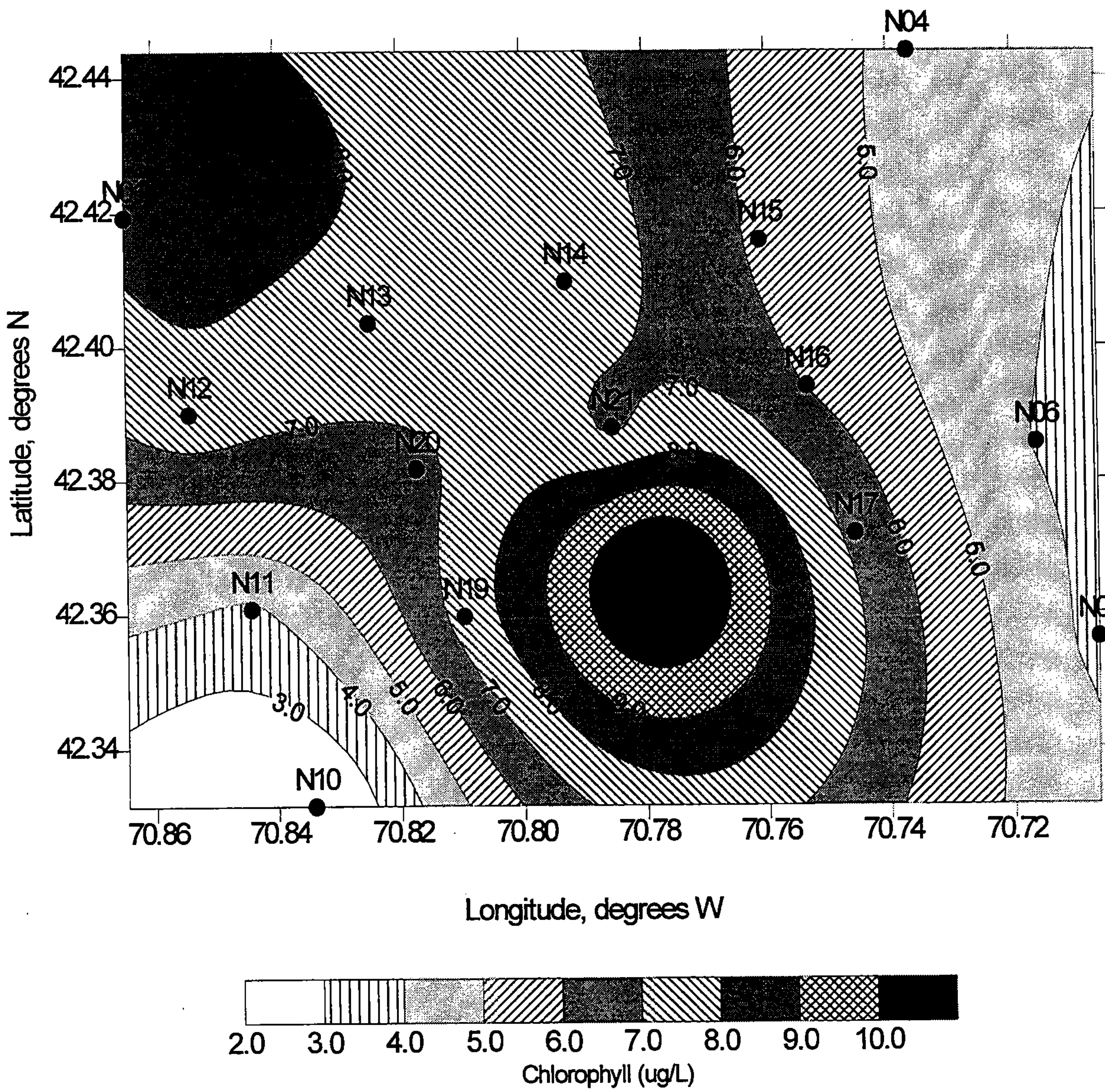


FIGURE 4-29
Distribution of Average Water Column Chlorophyll *a* in the Nearfield During the Fall Bloom in November (W9515)

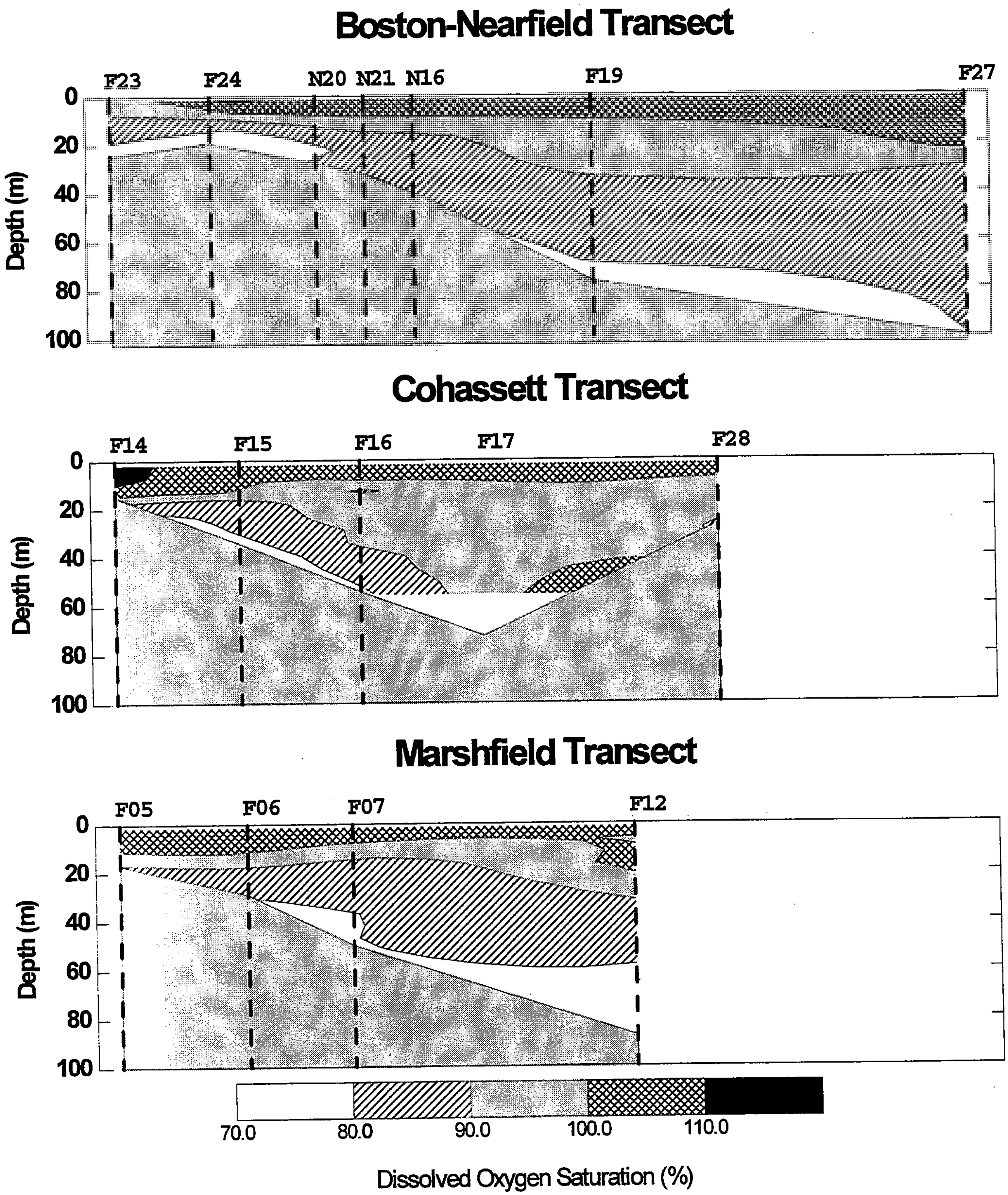


FIGURE 4-30
Dissolved Oxygen Saturation (%) Contours Along Three Farfield Transects in Late August (W9511)

DO % Saturation 9511

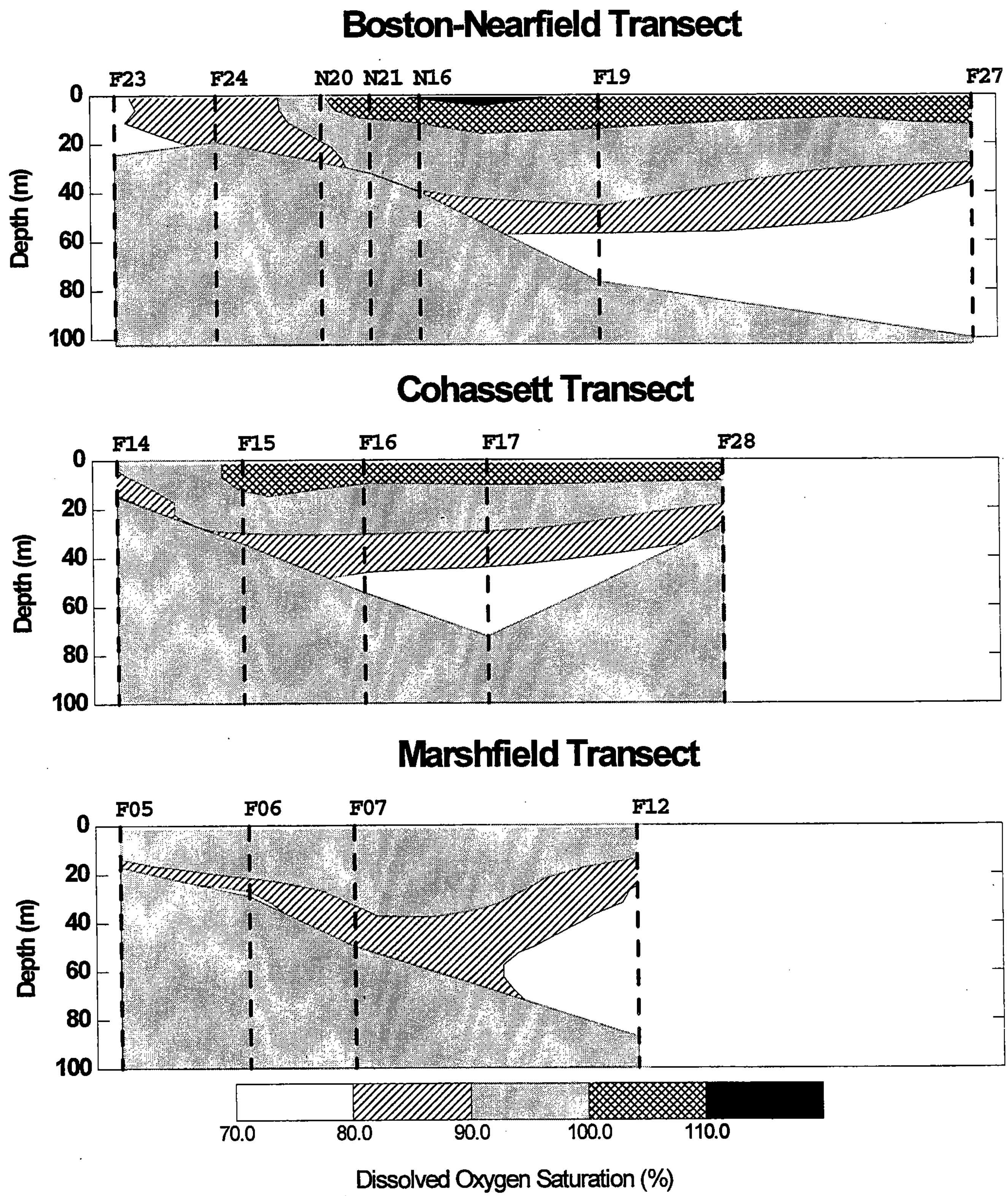


FIGURE 4-31
Dissolved Oxygen Saturation (%) Contours Along Three Farfield Transects in October (W9514)

DO % Saturation 9514

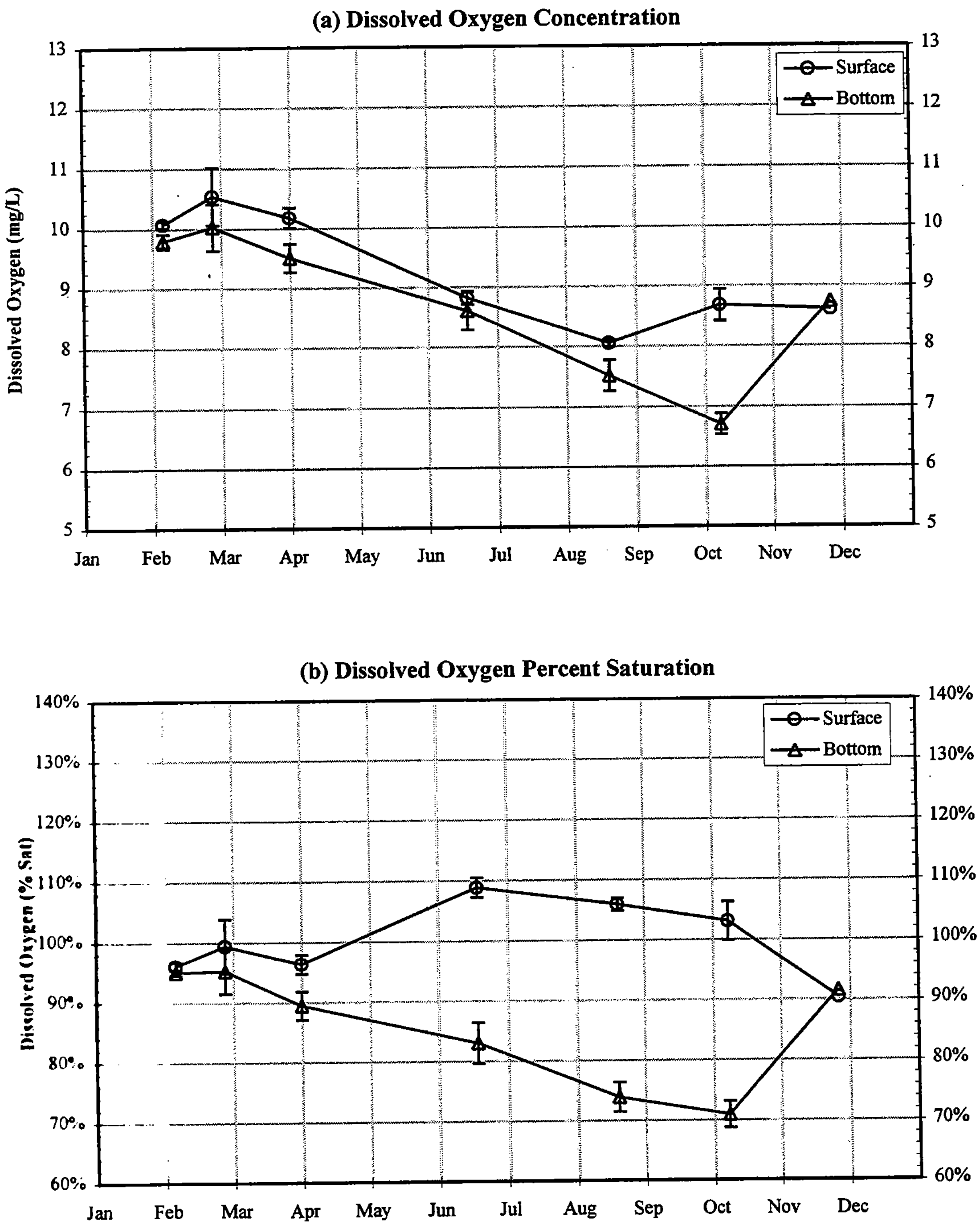


FIGURE 4-32

Time-Series of Average Surface and Bottom Water Dissolved Oxygen (a) Concentration (mg/L) and (b) Saturation (%) Among Four Stellwagen Basin Stations

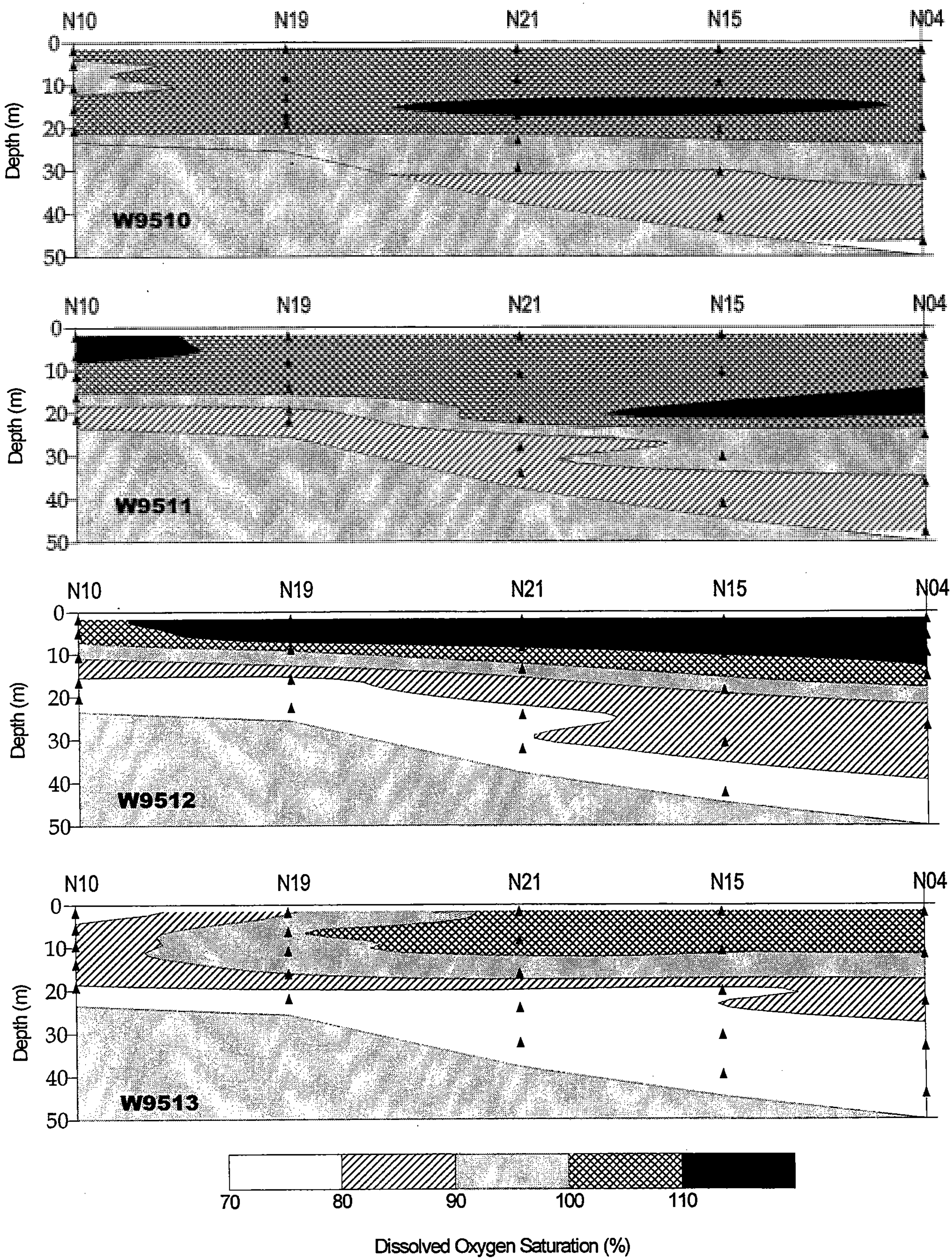


FIGURE 4-33
Dissolved Oxygen Saturation (%) Contours Along Nearfieled Transect During Surveys W9510-W9513

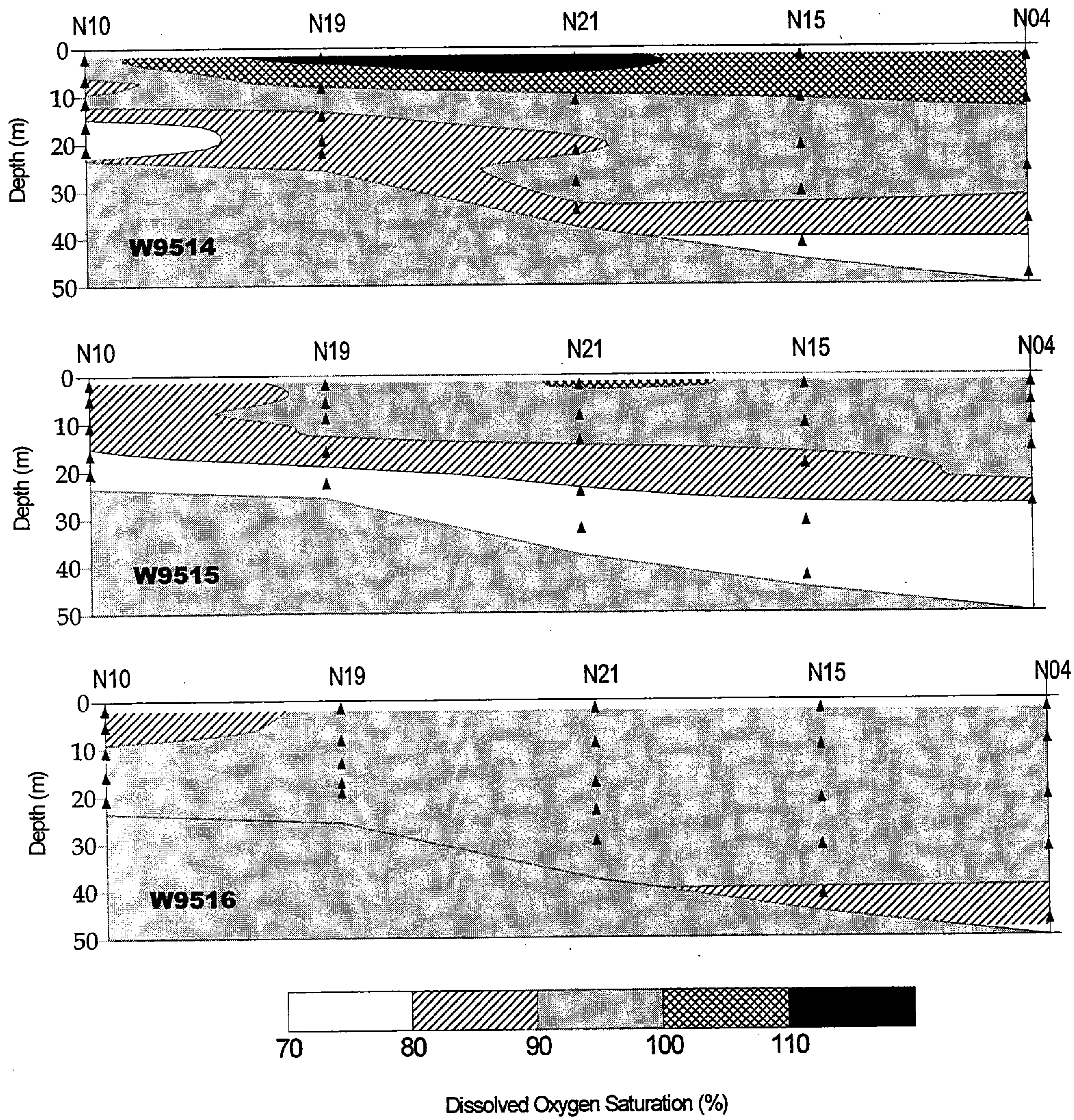


FIGURE 4-34
Dissolved Oxygen Saturation (%) Contours Along Nearfield
Transect After the Fall Turnover

5.0 PRODUCTIVITY, RESPIRATION, AND PLANKTON RESULTS

5.1 Productivity

Production measurements were taken at three nearfield stations (N04, N07, N16) and one farfield station (F23), at the entrance to Boston Harbor. All stations were sampled during the two farfield surveys conducted during this semi-annual reporting period; additionally, N04 and N16 were sampled during all eight nearfield surveys during the period. Samples were collected at five depths throughout the euphotic zone. Production was determined by measuring ^{14}C at varying light intensities as summarized below and in Appendix A.

In addition to samples collected from the water column, productivity calculations also utilized light attenuation data from a CTD-mounted 4π sensor, and incident light time-series data from an on-deck 2π irradiance sensor. After collection of the productivity samples, they were incubated in a temperature-controlled incubator. The resulting photosynthesis versus light intensity (P-I) curves (Figure 5-1 and comprehensively in Appendix E), were used, in combination with light attenuation and incident light information, to determine hourly production at intervals throughout the day for each sampling depth.

For this semi-annual report, areal production ($mgCm^{-2}d^{-1}$) is presented, determined by integrating the measured productivity over the depth interval. In addition, calibrated chlorophyll *a* sensor data were used to normalize productivity for calculation of chlorophyll-specific production, a measurement of the efficiency of production.

5.1.1 Areal Production

Areal production among the nearfield stations was >900 $mgCm^{-2}d^{-1}$ throughout the summer and fall (W9510-W9515), then decreased through the winter to 500 $mgCm^{-2}d^{-1}$ in early November (W9516), to minimum annual levels in December of <100 $mgCm^{-2}d^{-1}$ (Figure 5-2). Maximum productivity among the nearfield stations (>2,000 $mgCm^{-2}d^{-1}$) was measured at station N16 in early September (W9512, 2,378 $mgCm^{-2}d^{-1}$), corresponding with the late summer bloom indicated by chlorophyll data, and during the onset of the fall turnover in early October (W9514, 2,793 $mgCm^{-2}d^{-1}$).

At the Boston Harbor productivity/respiration station (F23), the highest production rate of the annual monitoring period of 7,584 $mgCm^{-2}d^{-1}$ was measured during the late August survey (W9511). This maximum value was twice the next highest bloom production rates measured in the spring in the nearfield (3,847 $mgCm^{-2}d^{-1}$). The production data are in agreement with the chlorophyll data, which indicated that the peak of the late summer bloom, which was concentrated in the harbor and coastal areas, was during the late August survey (Section 4.3). Station F23, near the entrance of Boston Harbor, remained poorly stratified so was replete with nutrients throughout the year, promoting phytoplankton growth.

5.1.2 Chlorophyll-Specific Production

In order to compare production with chlorophyll concentrations, chlorophyll-specific production (daily production normalized to average chlorophyll concentrations over the water column) values were calculated. Chlorophyll-specific production can be used as an indicator of the optimal conditions necessary for photosynthesis. The spatial and temporal distribution of production and chlorophyll-specific production on a volumetric basis was summarized by showing contoured production through the second half of 1995 (Figures 5-3 and 5-4).

Daily production was concentrated in the upper 10 m of the water column during all of the surveys except the early September survey (W9512), when a subsurface (10-20 m) productivity maximum was measured (Figure 5-3). At the two nearfield stations, the highest daily production was measured during the late summer bloom at N04, and during the fall bloom at station N16.

Chlorophyll-specific production at N10 overall was similar to production, indicating no anomalous discrepancies between production and chlorophyll throughout the semi-annual period (Figure 5-4). At station N16, higher chlorophyll-specific production during the early August surveys suggested that the efficiency of photosynthesis was high but not reflected in the amount of biomass present, as measured by total chlorophyll *a*. The highest semi-annual zooplankton abundance was measured at station N16 during the late August survey (W9511; Section 5.3.2), indicating that the chlorophyll produced during this period was rapidly scavenged, resulting in high chlorophyll-specific production values.

In contrast to the late summer bloom, the fall bloom in October-November in the outer nearfield suggested by chlorophyll data resulted in very low chlorophyll-specific production in early November (W9515). The bloom period was not reflected in productivity data, probably because of cloudiness on the day of sampling.

5.2 Respiration

Respiration was measured at the same three nearfield stations (N04, N07, N16) and one farfield station (F23) as productivity, as well as at farfield station F19, in the offshore region (Figure 1-1). All stations were sampled during the four farfield surveys; additionally, N04 and N16 were sampled during all nearfield surveys during the second semi-annual period of 1995. Measurements were made on samples collected at three depths (surface, mid-water, and bottom). Samples were incubated without light and at *in situ* temperatures. Detailed method information for respiration analyses is available in Appendix A.

Both respiration (in units of μMO_2/hr) and carbon-specific respiration ($\mu MO_2/\mu MC$/hr) rates at the three sampled depths are presented here. Carbon-specific respiration was calculated by normalizing respiration rates to the total measured particulate organic carbon (POC) in the water column. Carbon-specific respiration provides an indicator of how efficiently the POC substrate material is oxidized during respiration.

5.2.1 Water Column Respiration

Respiration is controlled by water temperature and the availability of labile organic matter. During the pre-turnover stratified period, surface water respiration rates were higher than bottom water for all stations except during the first survey at N16 (Figure 5-5). Higher surface rates are due to both a surface-bottom water temperature gradient (Section 4.1), and generally higher surface water POC levels (Figure 5-6).

Surface water respiration rates increased from early August (W9510), reaching peak rates in September (W9512-13; Figure 5-5). This increase was closely related to the availability of organic matter, as surface water temperatures were actually decreasing over this period (Section 4-1). The minimum summer surface water rate was measured during survey W9510 at station N16 (0.05 μMO_2/hr), and gradually increased at both nearfield stations to reach a maximum of 0.3 μMO_2/hr during W9512 at station N04. Respiration in surface water then started a gradual decline at station N04; this decline did not start until after the late September survey (W9513) at station N16.

The overall pattern of respiration decline through the fall and winter in surface water was due to decreasing surface water temperatures, with POC concentrations having only a secondary influence. The discrepancies between POC availability and respiration rates are further delineated by examining carbon-specific respiration below (Section 5.2.2).

The maximum semi-annual respiration rate was measured at F23, one of the stations measured only during the farfield surveys. A rate of 0.48 μMO_2/hr was measured in the surface water of F23 during W9511 in late August. This high rate corresponded with high productivity (Section 5.1) during the late summer bloom in Boston Harbor and the inner nearfield. The rate at F23 during the second semi-annual farfield survey in October (W9514) was considerably smaller (0.15 μMO_2/hr). The highest surface respiration rates (~0.2 μMO_2/hr) during this farfield survey were measured at nearfield station N16 and offshore station F19.

Surface water respiration rates were generally lower during the late fall and winter with the decrease of chlorophyll production. The production of POC was highest at station N16 during the fall bloom surveys (W9514-15), although respiration continued to decline. By late fall-early winter (W9516-17), surface water respiration rates at both nearfield stations measured had fallen to levels similar to bottom water rates (<0.05 μMO_2/hr), indicating a well-mixed water column.

Bottom water respiration rates measured during all stations during the semi-annual period were relatively low (<0.05 μMO_2/hr), except for slightly higher rates at F23 (~0.1 μMO_2/hr). The single exception was the bottom water rate at N16 during survey W9513 in late September; the semi-annual maximum of bottom water respiration (0.15 μMO_2/hr) was measured at this station. The source of organic material for respiration during this survey was probably related to the late summer bloom (dominated by diatoms, Section 5.3) during the prior to surveys in late August (W9511) and early September (W9512). Although the water column was still stratified during this survey, the high respiration rate suggests either rapid settling of coalesced mats of senescent material to bottom water, or zooplankton facilitated vertical transport through fecal pellet formation. The relationship between the measured POC concentration and respiration during this survey is discussed further below (Section 5.2.2).

5.2.2 Carbon-Specific Respiration

Discrepancies between respiration and carbon-specific respiration at each station can be attributed to the differences in the character of the source POC contributing to respiration. Sources of organic carbon which are more easily oxidized (i.e., recently produced plankton) will result in higher carbon-specific respiration. By comparing respiration rates relative to the source material, the availability (pathways) of fresh plankton can be inferred.

Overall, carbon-specific respiration rates in the surface water of the two nearfield stations were higher prior to the fall turnover, and became similarly low as bottom water rates following the fall turnover (Figure 5-7). By normalizing to the influence of POC, the data show the importance of the decrease of surface water temperature with the onset of the winter season initiated by the nearfield mixing event (Section 4-1).

Surface water chlorophyll-specific respiration rates increased steadily prior to the fall turnover at station N16. This pattern suggests that the POC available for respiration increased in quality through the late summer and early fall. Carbon-specific respiration peaked during the late September survey (W9513) in both the bottom and surface water of station N16. The data confirm that surface and bottom water respiration following the late summer bloom event was high. The abundance of organic carbon, however, was not unusually elevated (Figure 5-6), indicating that the available material was easily oxidized, typical of very recently produced plankton.

5.3 Plankton Results

The HOM Program includes collection and analysis of the plankton community, including phytoplankton (Section 5.3.1) and zooplankton (Section 5.3.2). In the second semi-annual period of 1995, two stations (N10, N16) were sampled during the eight nearfield surveys, while an additional ten locations were sampled during the two combined events (Figure 5-8). In this report, the second half of the 1995 plankton record is presented (surveys W9510 to W9517), including two of the six annual combined sampling events (W9511 and W9514). Comprehensive tabulations of results are available in periodic Plankton Data Reports.

Whole-water and screened phytoplankton samples were collected at the surface and at mid-depth, with the latter often selected to coincide with the presence of a sub-surface chlorophyll maximum (as determined by *in vivo* fluorometry). Zooplankton samples were collected at each station by oblique tow. Details regarding sampling and analysis can be found in the CW/QAPP for water column monitoring (Bowen *et al.*, 1997). Quantitative taxonomic analyses were performed during 1995, continuing the monitoring record begun in 1992. Starting in 1995, carbon equivalence estimates were made for the plankton communities using species-specific carbon data from the literature.

In this section, the plankton data are presented through an assessment of their seasonal and regional characteristics. Total abundance, relative abundance of major groups, and estimated carbon equivalence are presented for each plankton community. Appendix F-1 tabulates dominant phytoplankton species (>5% of total abundance) for whole water surface samples, along with the associated cell densities and percent abundance. Appendix F-2 provides similar information for the mid-depth samples. Appendix G-1 and G-2 includes information for screened phytoplankton results, while Appendix H summarizes zooplankton results.

5.3.1 Phytoplankton

5.3.1.1 Seasonal Trends in Total Phytoplankton Abundance

Total phytoplankton abundance results from the whole water surface samples taken in the nearfield showed peaks during the late August bloom (W9511), and again in early October (W9514) following the fall turnover (Figure 5-9). The mid-depth chlorophyll *a* maximum samples also showed a nearfield peak during the August survey, but decreased steadily after that survey to the end of the semi-annual period.

During the first combined nearfield/farfield survey in late August before the fall turnover (W9511), Boston Harbor had the highest phytoplankton densities of all the regions in both surface and mid-water samples. These results are consistent with the chlorophyll and production data indicating bloom conditions in the harbor, and secondarily in the coastal and nearfield regions. During this survey, surface and mid-water abundances were similar between nearfield, coastal, and offshore stations, and lower in the boundary region and Cape Cod Bay (<1 million cells/L).

The nearfield region had the highest phytoplankton densities in both the surface and mid-water in October (W9514) with the onset of the fall turnover. Mid-water samples from the boundary region had similar densities as the nearfield during this survey. Cape Cod Bay in October again had the lowest mid-water abundance (<1 million cells/L).

5.3.1.2 Nearfield Phytoplankton Community Structure

Phytoplankton abundance and community composition at the two nearfield stations are depicted in Figure 5-10. Overall abundances were much higher in both surface and mid-water samples at N10 prior to the fall turnover. The high abundances were due to the proximity of station N10 to Boston Harbor, the central location of the late summer bloom (Section 4-3). At station N16, abundances were similar before and after the turnover until the last two winter surveys. Overall abundances at the two depths were generally similar at each station.

In both surface and mid-depth samples at each nearfield station, microflagellates were the numerically dominant plankton group in most samples (up to 90% of total density; Appendix F-1 and F-2). Centric diatoms were co-dominant before the fall turnover, especially during the peak of the late summer bloom in early September (W9512). Pennate diatoms were co-dominant during the survey conducted at the peak of the fall bloom in early November (W9515; Appendix F-1). The dominant pennate diatom was *Asterionellopsis glacialis* during the bloom associated with the fall turnover.

Centric diatoms in early season samples (e.g., W9511) largely consisted of *Skeletonema costatum* and *Rhizosolenia fragilissima* before the fall turnover event (Figure 5-11). A small (<20μm) *Gymnodinium* species and a small (<30μm) *Protoperidinium* species dominated the dinoflagellate group. After the fall turnover event, *Rhizosolenia fragilissima* and a small (<10μm) centric diatom were prevalent, with *Rhizosolenia fragilissima* reaching densities of 6.2 million cells/L. *Ceratium tripos* and *Gymnodinium* species were the dominant dinoflagellates, with *Ceratium tripos* reaching densities of around 720 cells/L in October (Appendix G-2).

In terms of estimated carbon equivalence, phytoplankton carbon was dominated by centric diatoms at station N10 during the late summer bloom, and was relatively low overall following the fall turnover (Figure 5-12). Centric diatoms also dominated carbon equivalence values at station N16, with microflagellates and dinoflagellates providing a consistent contribution throughout the year (Figure 5-13). Early season carbon dominants included centric diatoms, *Ceratium tripos*, and the small *Gymnodinium* (Figure 5-14). Following the fall turnover, the dominant carbon contributors were microflagellates, *Ceratium tripos*, and *Prorocentrum micans*. Pennate and centric diatoms contributed the bulk of the total carbon during the fall bloom survey in early November.

5.3.1.3 Regional Phytoplankton Assemblages

The community composition of surface and mid-water samples were similar among farfield regions sampled (Figure 5-15). The harbor assemblage (stations F23, F30, and F31) during the first regional survey in late August (W9511) yielded a relatively high number of microflagellates and centric diatoms produced during the late summer bloom (Figure 5-15; Appendix F-1). The presence of centric diatoms in the harbor were comprised largely of *Rhizosolenia fragilissima* and *Skeletonema costatum*. Cape Cod Bay stations F01 and F02, as well as other stations outside of the bloom area, had a more concentrated composition of microflagellated species.

By the October combined survey (W9514, Figure 5-16), small flagellates dominated most regions, although many areas (i.e., stations F24, F25, and N10) had modest densities of small (<10μm) centric diatoms including *Cyclotella*. There also appeared to be a localized bloom (720 cells/L) of the dinoflagellate *Ceratium tripos* in the surface sample from station N16 (Appendix F-2).

5.3.2 Zooplankton

5.3.2.1 Seasonal Trends in Total Zooplankton Abundance

Zooplankton densities in the nearfield generally decreased throughout the reporting period at station N10, following the trend observed in phytoplankton abundance (Figure 5-17). Zooplankton densities in the nearfield at Station N16 showed a peak during late August (W9511), and in early October following the fall turnover which coincided with an increase in phytoplankton. Total zooplankton abundance decreased from a maximum of 62,000/m^3 in early August to a minimum of 10,000/m^3 (late November) at station N10, and approximately 78,000/m^3 at station N16 (late August) to a decline of 20,000/m^3 in December.

5.3.2.2 Nearfield Zooplankton Community Structure

Zooplankton abundance was evenly distributed among copepod adults and copepod nauplii (Figure 5-18). These two groups comprised both peaks reported at stations N10 and N16 during the late summer (W9511) and fall (W9514) blooms.

The numerically dominant species among the copepods during the reporting period was *Oithona similis*, with initial high densities in August of around 16,800/m^3 (N10) and 12,153/m^3 (N16; Appendix G). Another early dominant copepod included *Pseudocalanus newmani*, before the fall turnover event. After the fall turnover event, *Oithona similis* remained a dominant species with the emergence of *Centropages typicus* as a co-dominant.

In terms of estimated biomass, *Calanus finmarchicus* was by far the dominant species, with adults comprising an estimated $2x10^5$ µgC/m^3. The next most important contributor of zooplankton biomass was *Centropages typicus*, with an estimated carbon contribution of around $1x10^5$ µgC/m^3.

5.3.2.3 Regional Zooplankton Assemblages

Regional data for the first combined nearfield/farfield survey (W9511) showed highest zooplankton densities (around 124,000/m^3) outside of the harbor at station F24, again numerically dominated by copepod adults and other zooplankton, specifically bivalve species (Figure 5-19). Other stations were generally less than 100,000/m^3. The numerical dominance by copepods was comprised primarily of *Oithona similis* in most regions, with *Pseudocalanus newmani* most pronounced in the nearfield stations and *Acartia tonsa* and *Acartia hudsonica* at the two harbor stations (F30 and F31; Appendix G).

During the October combined survey (W9514), numerical dominance by the copepods *Oithona similits* and *Centropages typicus* was evident (Figure 5-20). Densities of bivalve species and copepod species peaked in Cape Cod Bay during this period, with densities exceeding 36,000/m^3. Maximum densities were measured in Cape Cod Bay, followed by the nearfield.

5.4 Summary of Water Column Biological Events

- Semi-annual maximum areal production among the nearfield stations was measured at station N16 during the bloom in early September (W9512, 2,378 mgCm^{-2}d^{-1}), and during the onset of the fall turnover in early October (W9514, 2,793 mgCm^{-2}d^{-1});

- Peak annual production (7,584 mgCm^{-2}d^{-1}) was measured in August (W9511) at station F23, during the late summer bloom in the harbor and coastal regions, a rate which was twice the next highest rate measured during the spring bloom;

- Productivity was potentially underestimated during the fall bloom, due to cloudy conditions during sampling;

- Chlorophyll-specific production during the August surveys at nearfield station N16 indicated that potential production of chlorophyll was rapidly scavenged because of the high abundances of zooplankton present;

- Surface water respiration rates increased from early August to September, due to the availability of organic matter;

- The overall decline of surface water respiration through the late fall and winter was primarily due to decreasing surface water temperatures;

- The semi-annual maximum rate of bottom water respiration (0.15 μMO_2/hr) was measured at station N16 in late September following the late summer bloom (W9513), due to either rapid settling of coalesced mats of senescent material, or facilitated by zooplankton grazing;

- The pattern of increasing surface water chlorophyll-specific respiration prior to the fall turnover, especially at station N16, suggested that the available POC was easily oxidized, typical of very recently produced plankton associated with the late summer bloom;

- Nearfield surface water carbon-specific respiration was higher prior to the fall turnover, and decreased to bottom water rates with the onset of winter mixing and decreasing water temperature;

- Nearfield phytoplankton abundance showed peaks during the late summer bloom (W9511), and again in early October (W9514) following the fall turnover;

- Boston Harbor had the highest phytoplankton densities of all farfield regions in late August associated with the late summer bloom (W9511), with lower abundances in the nearfield, coastal, and offshore stations, to minimum values in the boundary region and Cape Cod Bay;

- With the onset of the fall turnover in October (W9514), the nearfield had the highest surface water phytoplankton abundance, while mid-water samples from both the nearfield and the boundary region had the highest densities;

- Microflagellates were the numerically dominant plankton group during the semi-annual period, with co-dominance by centric diatoms (*Skeletonema costatum* and *Rhizosolenia fragilissima*) during the late summer bloom, and by pennate diatoms (*Asterionellopsis glacialis*) during the peak fall bloom survey in early November (W9515);

- Estimated phytoplankton carbon equivalence was dominated by centric diatoms during the late summer and fall, pennate and centric diatoms during the fall bloom survey in early November, with microflagellates and dinoflagellates providing a consistent carbon contribution throughout the year;

- Prior to the fall turnover, carbon dominants included centric diatoms, *Ceratium tripos*, and the small *Gymnodinium*, while after the turnover, the dominant carbon contributors were microflagellates, *Ceratium tripos*, and *Prorocentrum micans*;

- Nearfield zooplankton densities showed peaks at station N16 during late August (78,000/m^3) and in early October (>60,000/m^3), coinciding with an increase in phytoplankton, and decreased to a minimum of 10,000/m^3 (N10) in late November;

- *Calanus finmarchicus* was by far the dominant species in terms of estimated biomass, with adults comprising an estimated $2x10^5$ μgC/m^3;

- Regionally, station F24 data outside of the harbor showed the highest zooplankton densities (around 124,000/m^3) during late August, numerically dominated by copepod adults and bivalve species;

- During October, densities of bivalve and copepod species peaked in Cape Cod Bay during this period, with densities exceeding 36,000/m^3 and numerical dominance by the copepods *Oithona similits* and *Centropages typicus*.

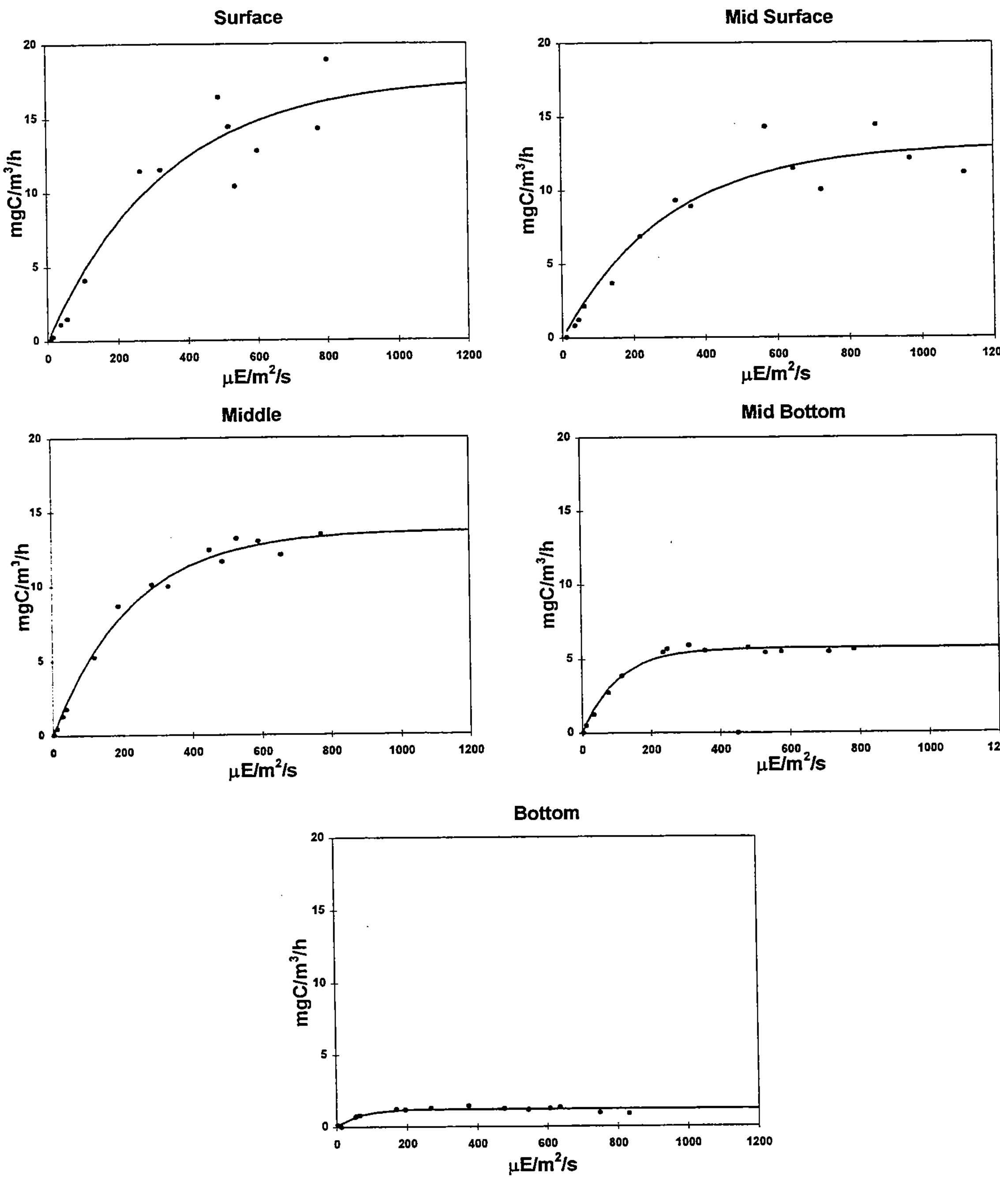


FIGURE 5-1
An Example Photosynthesis-Irradiance Curve

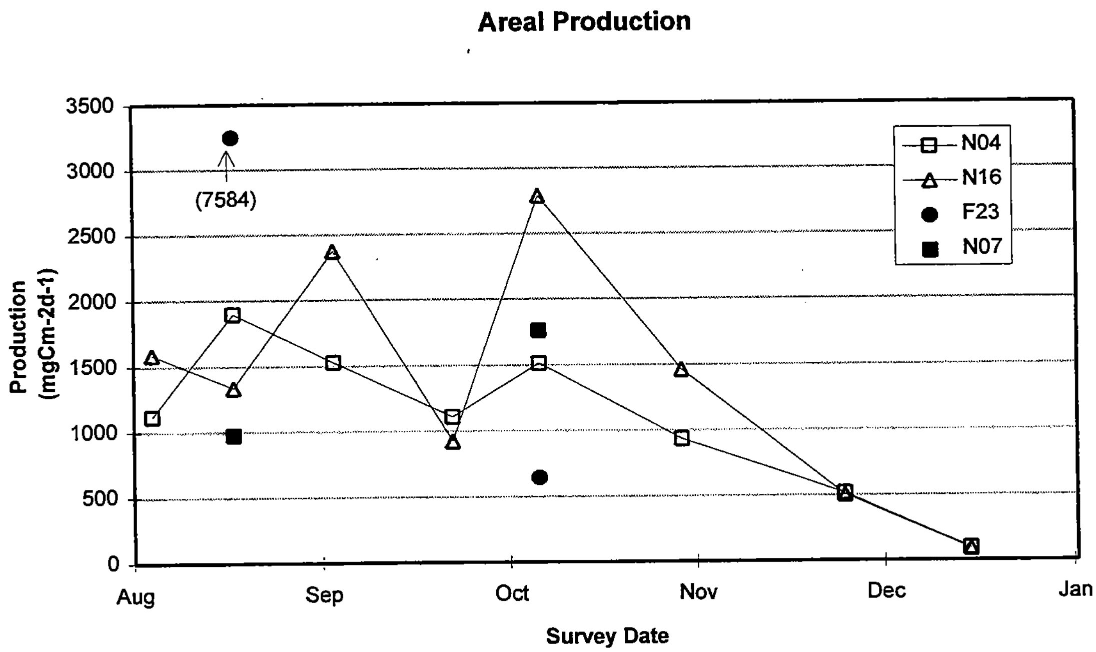


FIGURE 5-2
Time-Series of Areal Production (mgC/m^2/d) for Productivity Stations

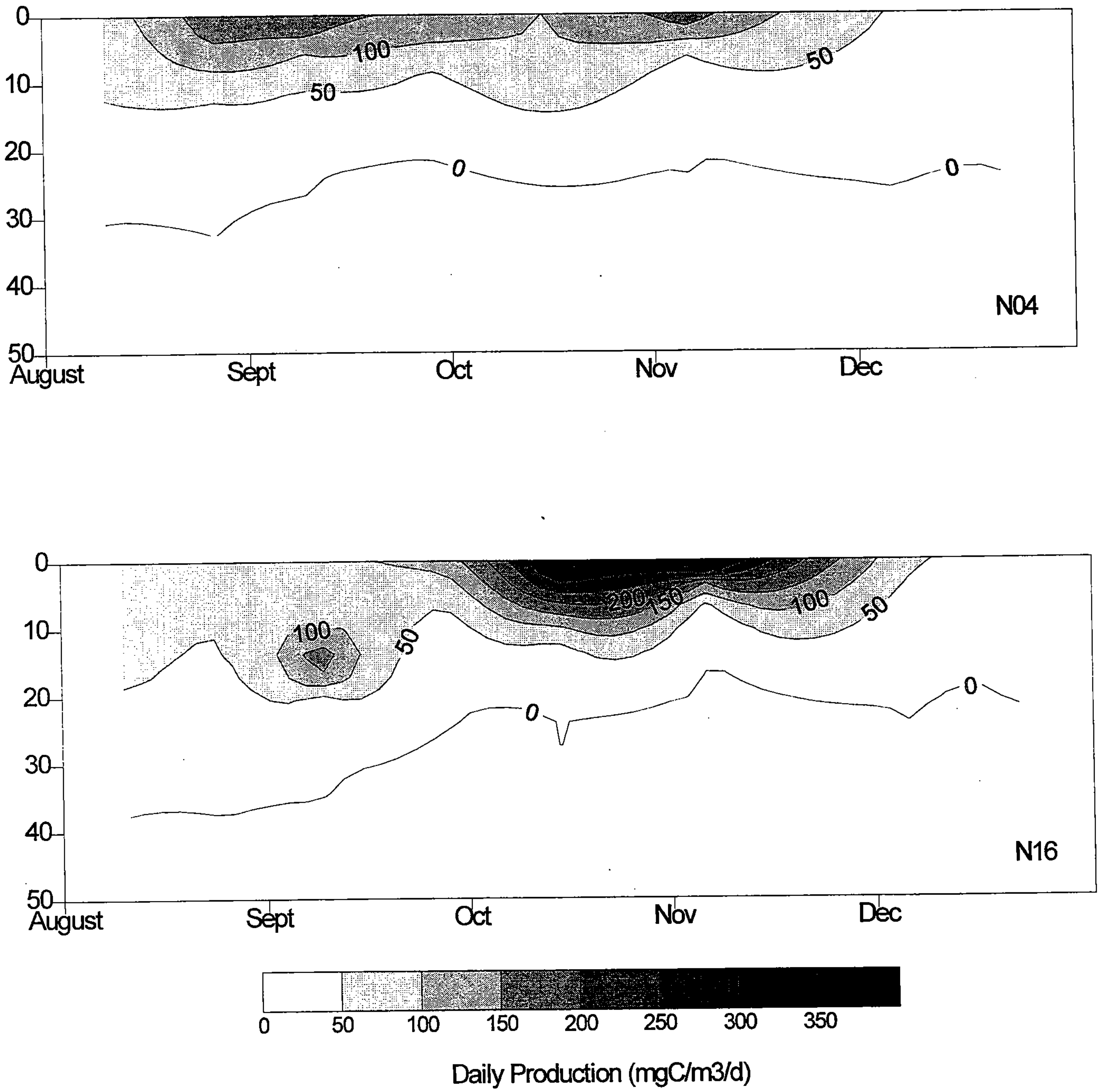


FIGURE 5-3
Time-Series of Contoured Daily Production (mgC/m^3/d)
Over Water Depth at N04 and N16

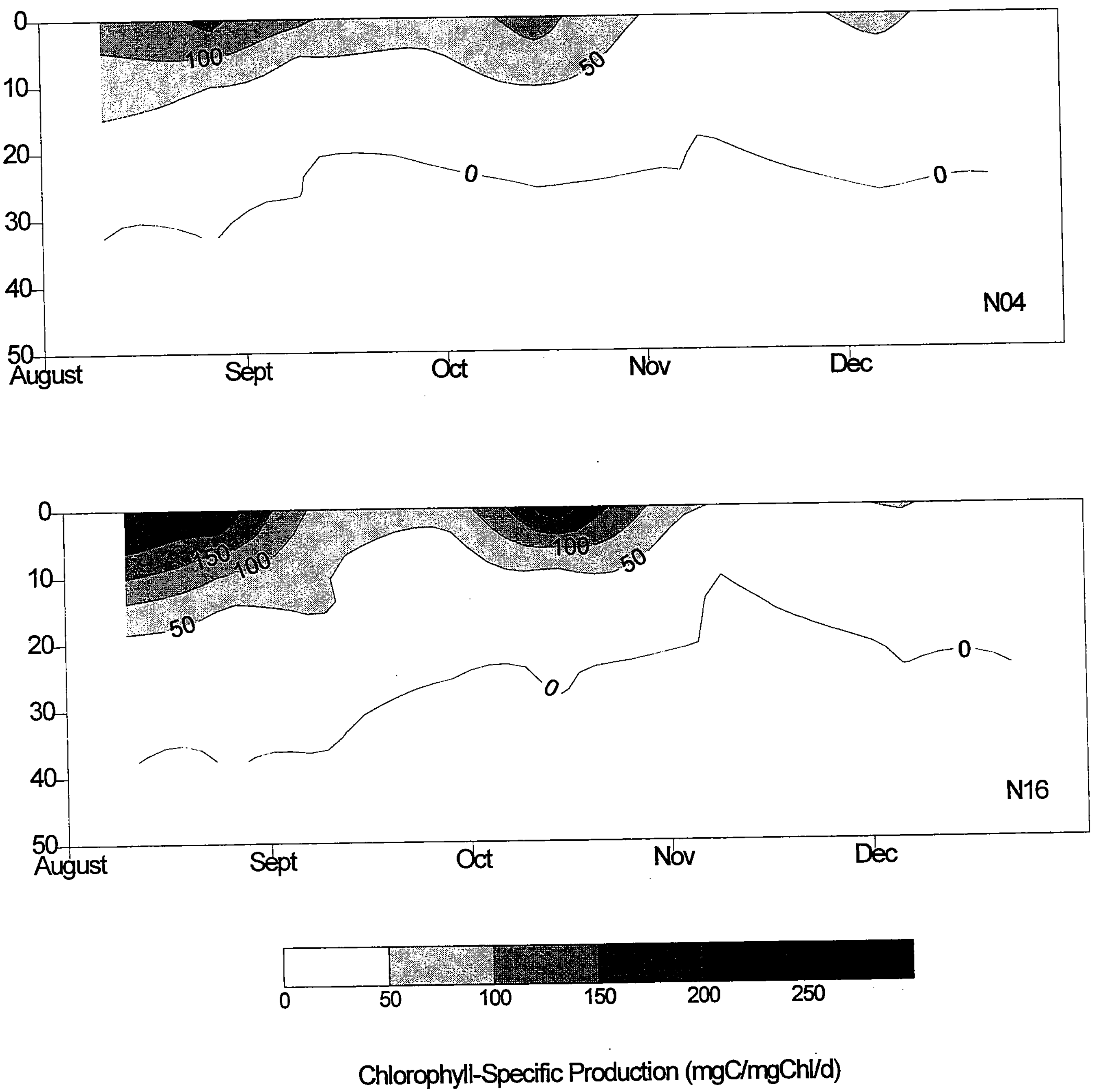


FIGURE 5-4
Time-Series of Contoured Chlorophyll-Specific Production (mgC/mgChl/d)
Over Water Depth at N04 and N16

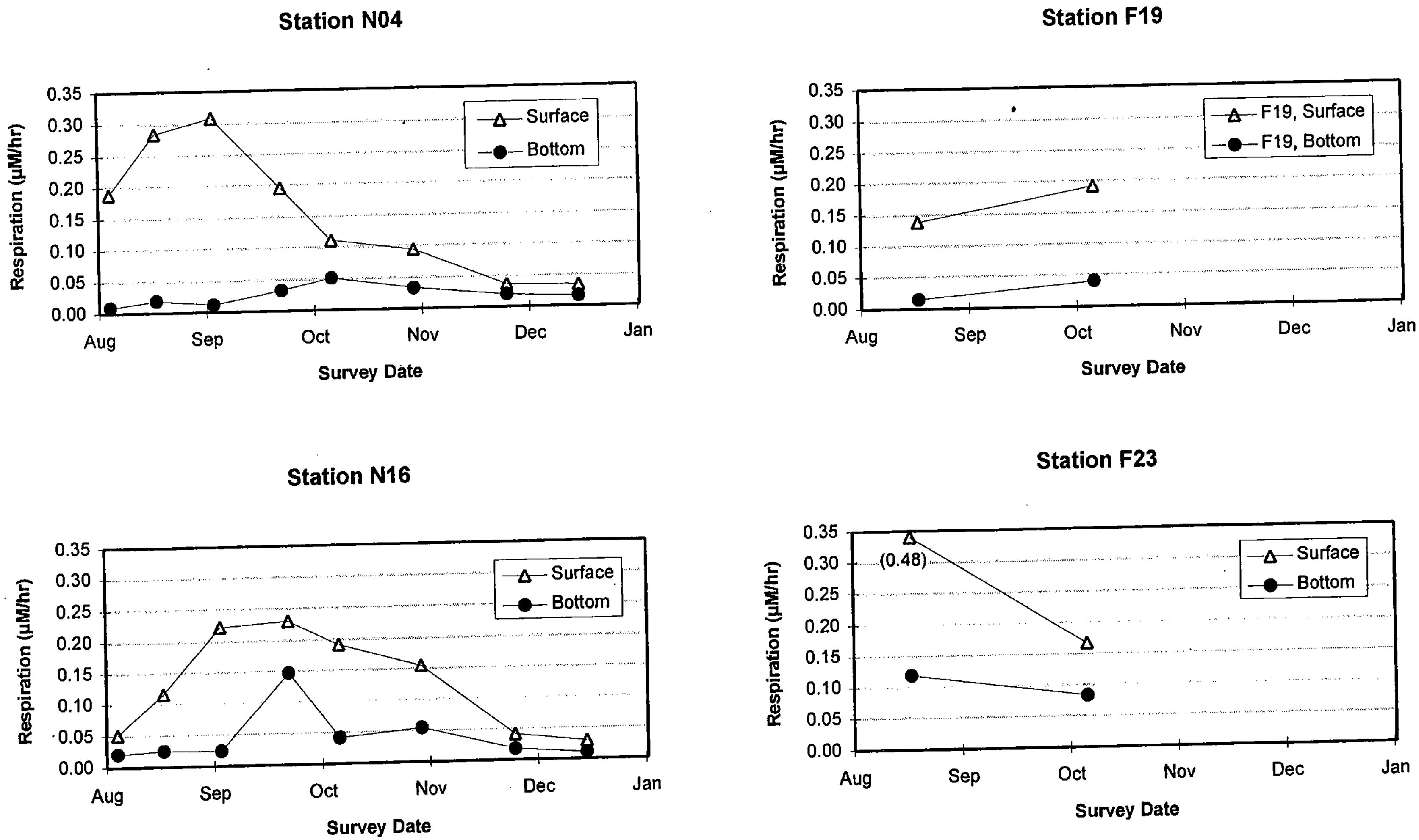


FIGURE 5-5
Time-Series of Water Column Respiration (µM/hr) at Stations N04, N16, F19, and F23

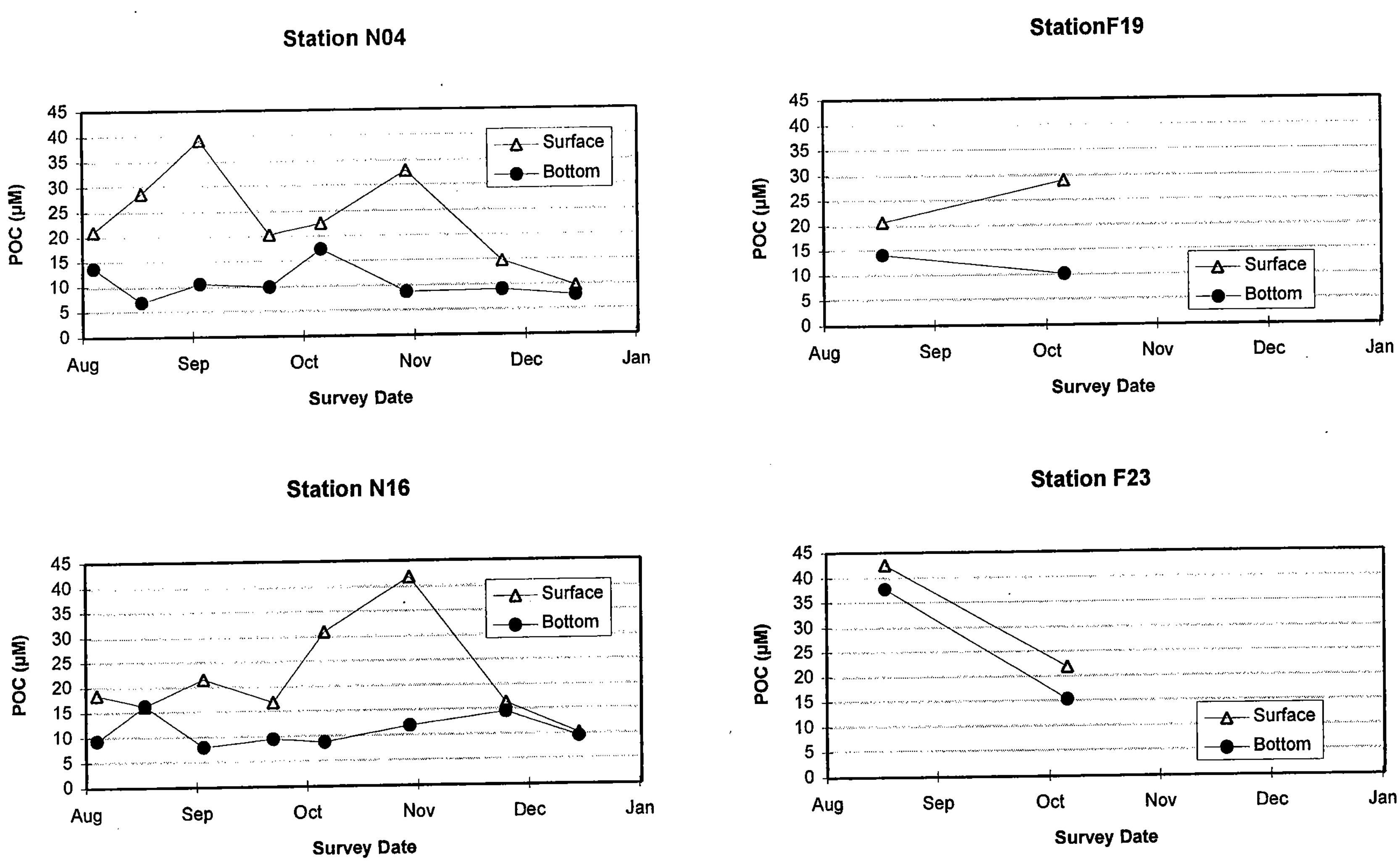


FIGURE 5-6
Time-Series of Particulate Organic Carbon (POC, µM) at
Stations N04, N16, F19, and F23

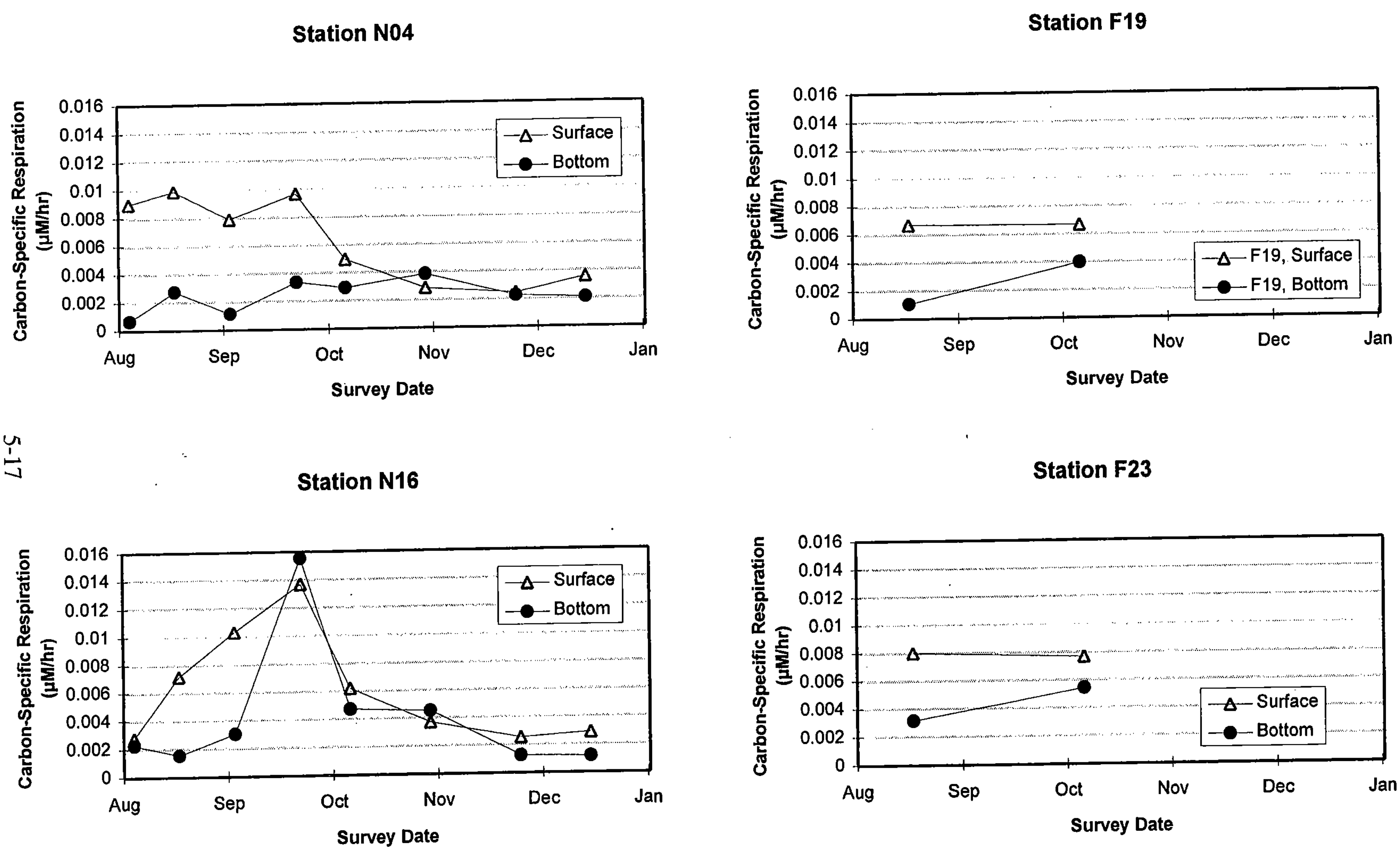


FIGURE 5-7
Time-Series of Carbon-Specific Respiration (µM/hr) at
Stations N04, N16, F19, and F23

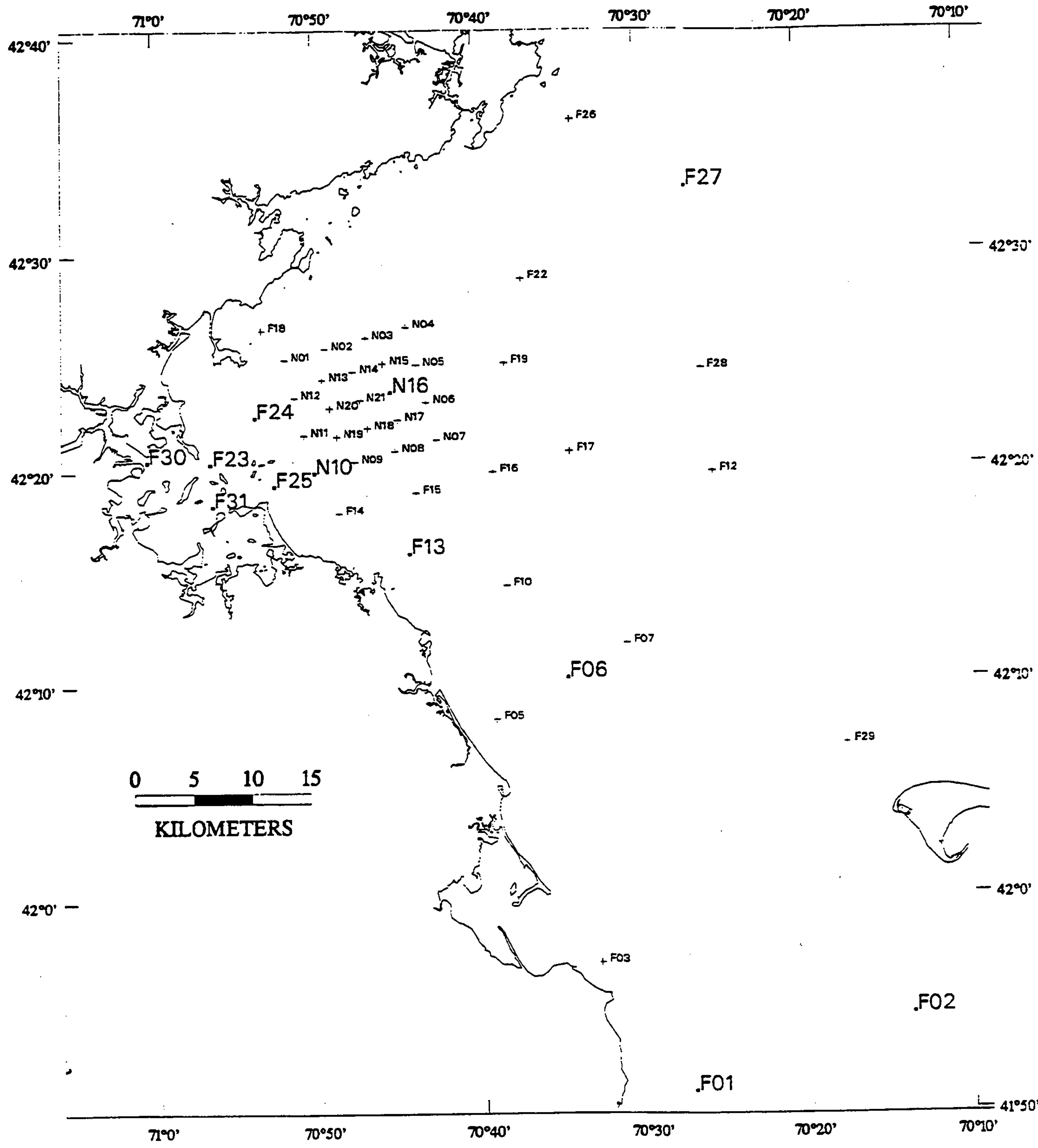
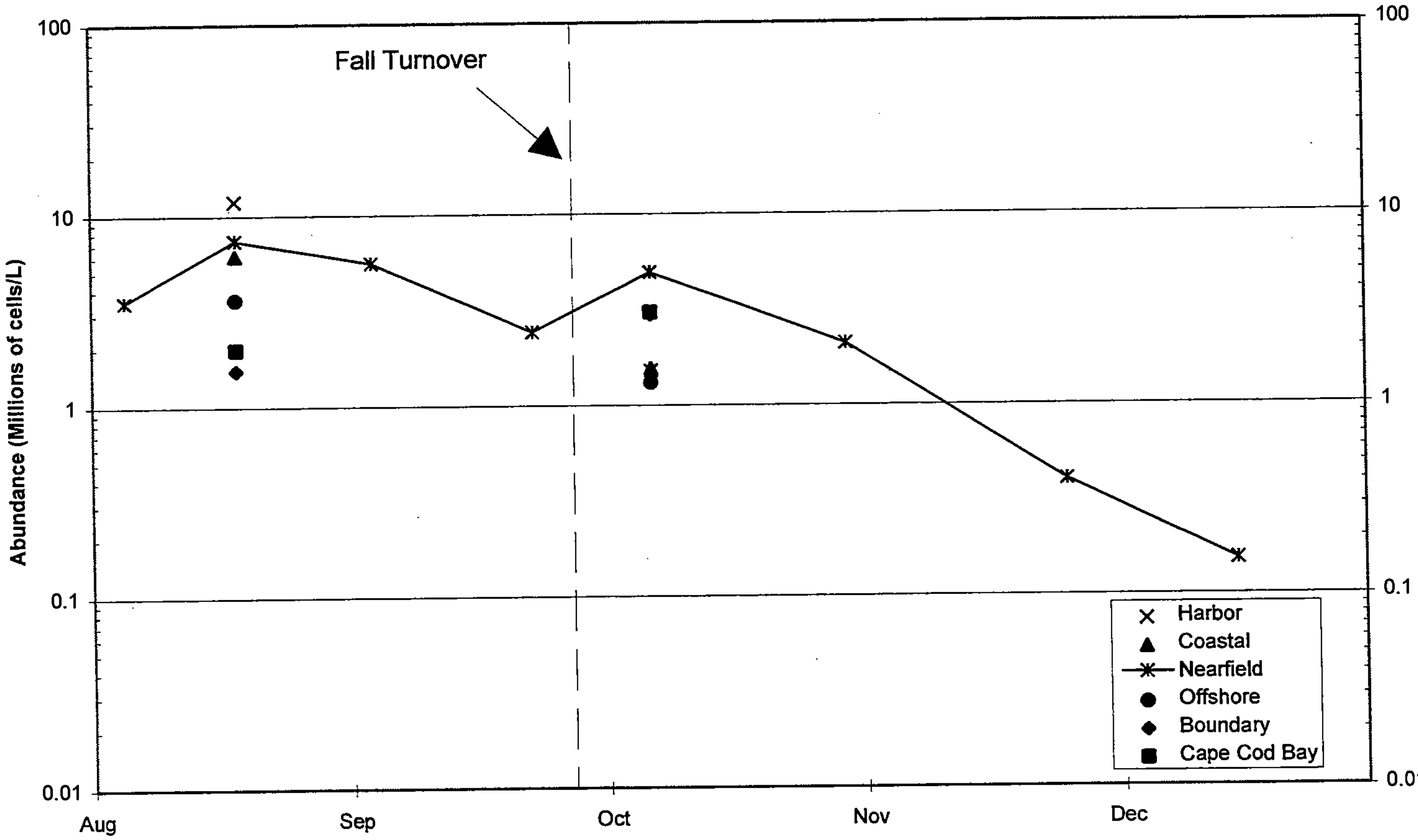


FIGURE 5-8
1995 HOM Plankton Stations Locations
(shown in enlarged text)



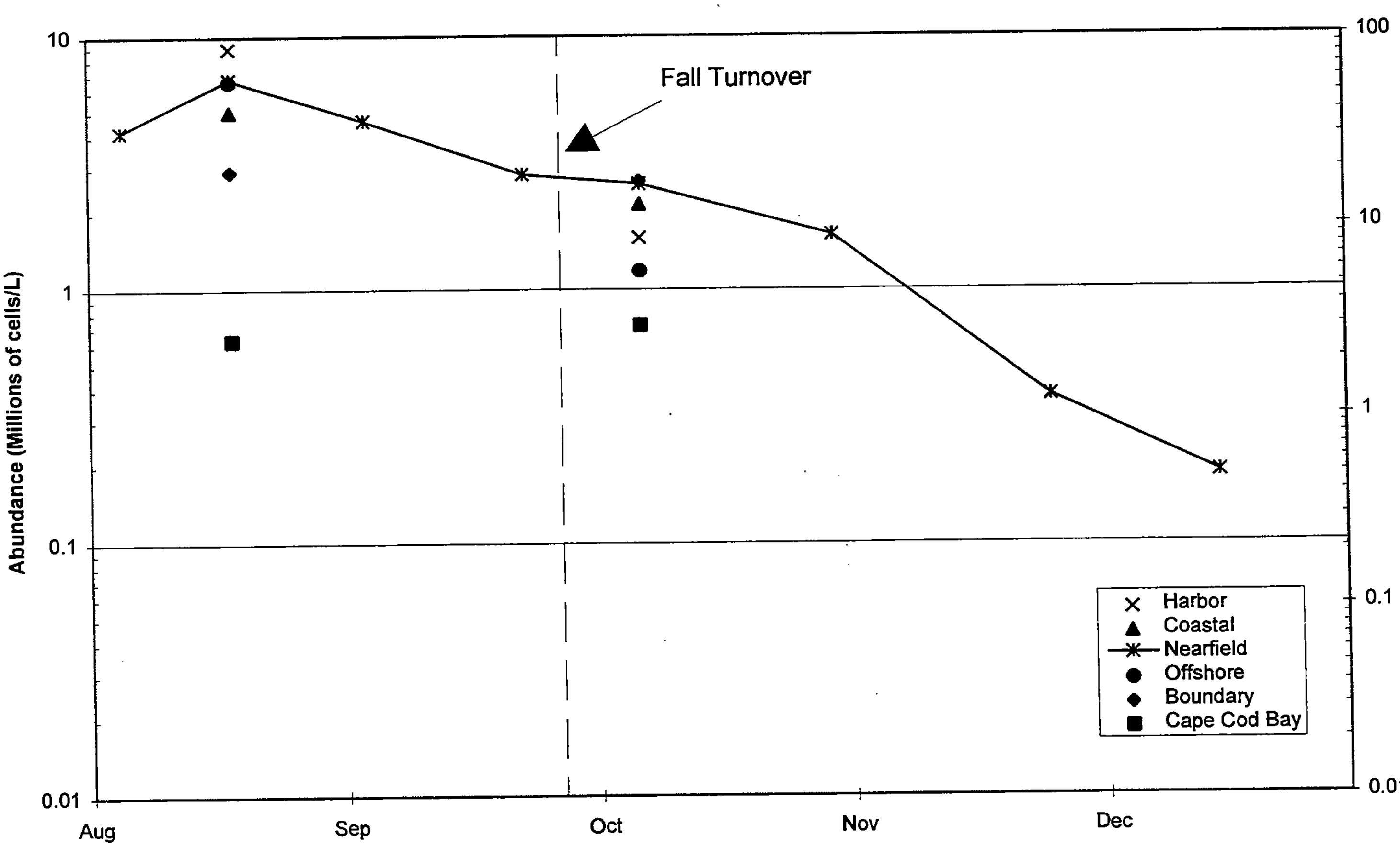


FIGURE 5-9
1995 Regional Total Phytoplankton Abundance
Top: Surface Data, Bottom: Chlorophyll *a* Maximum Data

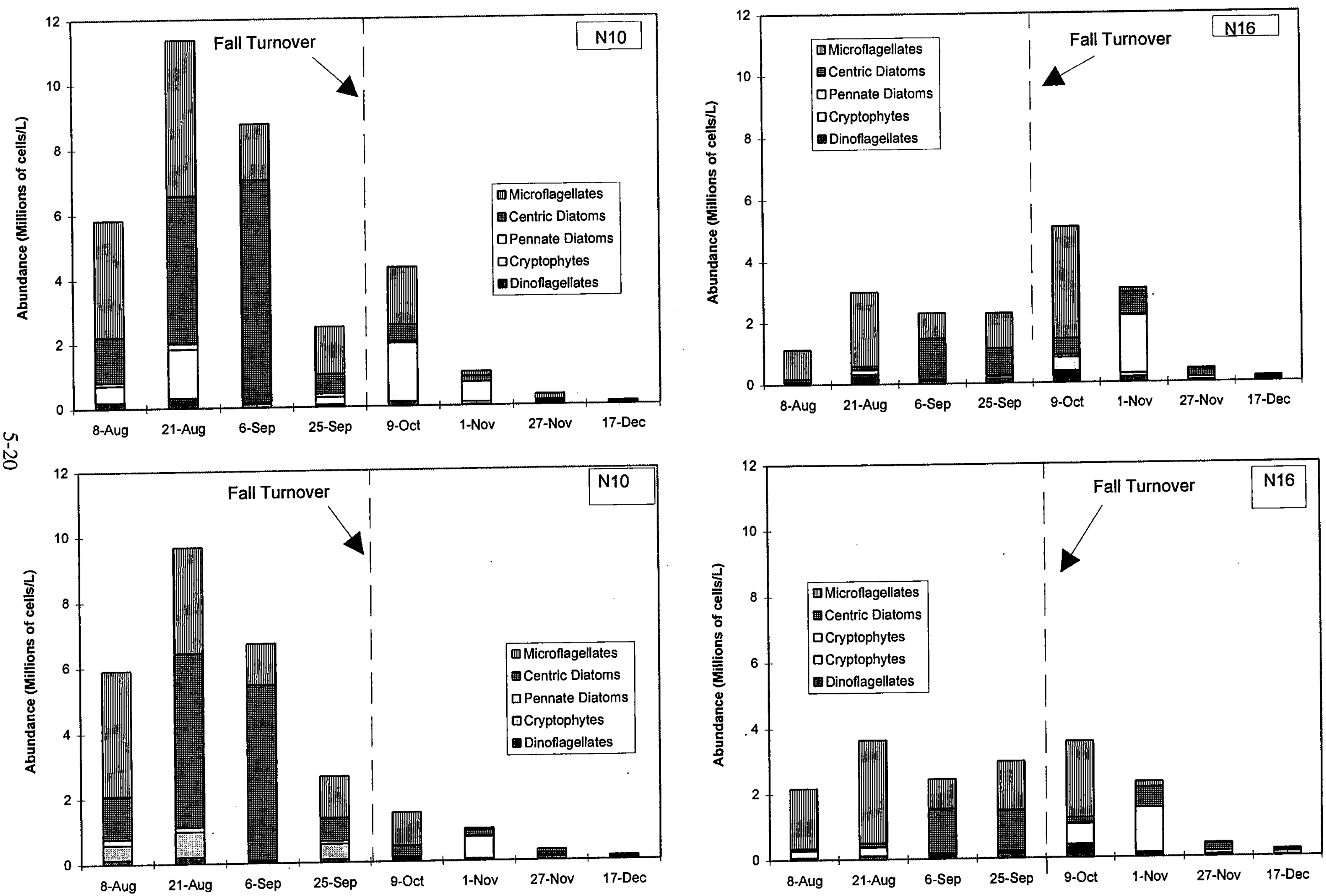


FIGURE 5-10
Distribution of Major Taxonomic Groups at Nearfield Stations N10 and N16
Top: Surface Data, Bottom: Chlorophyll *a* Maximum Data

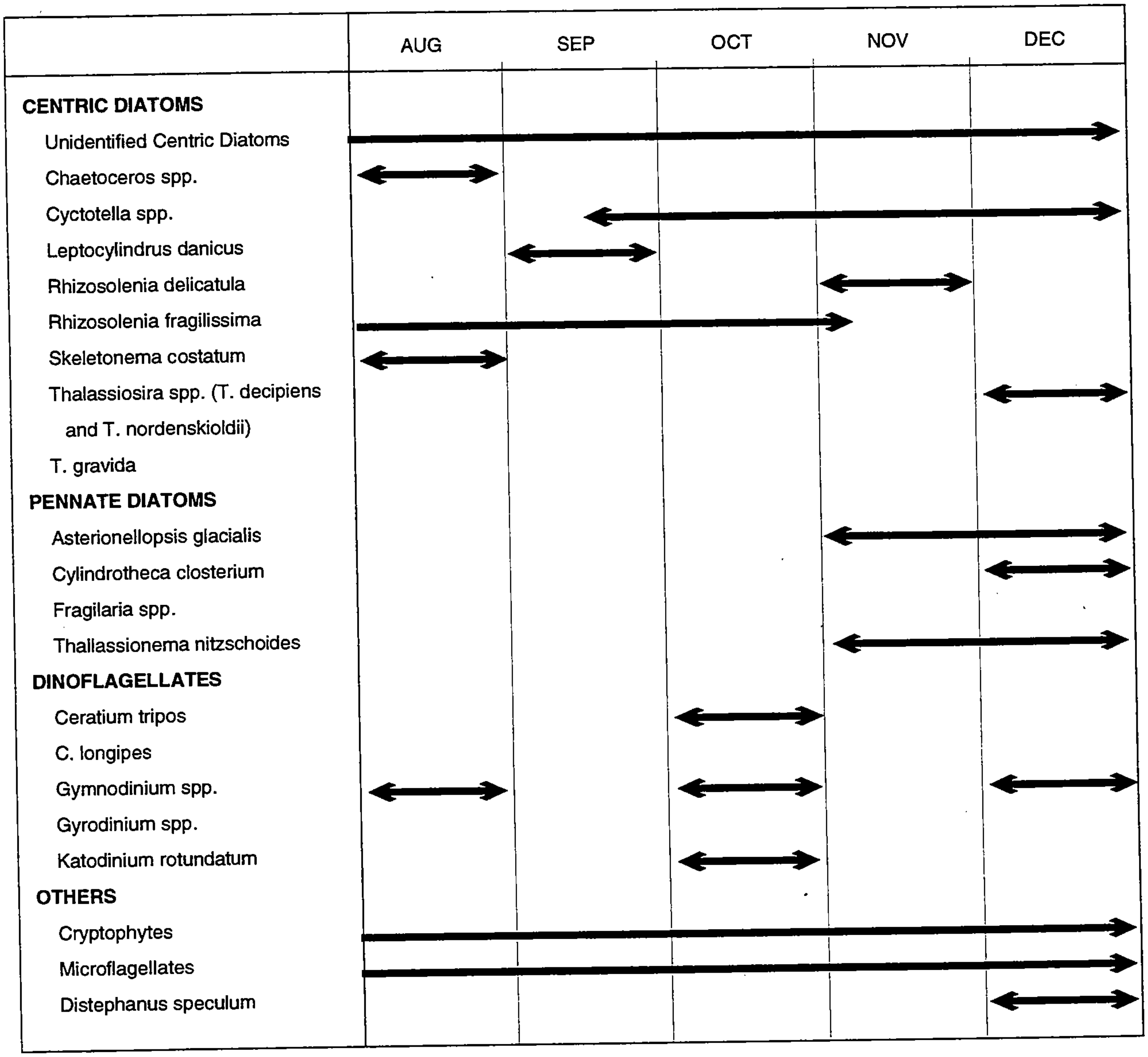


FIGURE 5-11
Dominant Phytoplankton Species by Abundance in Nearfield

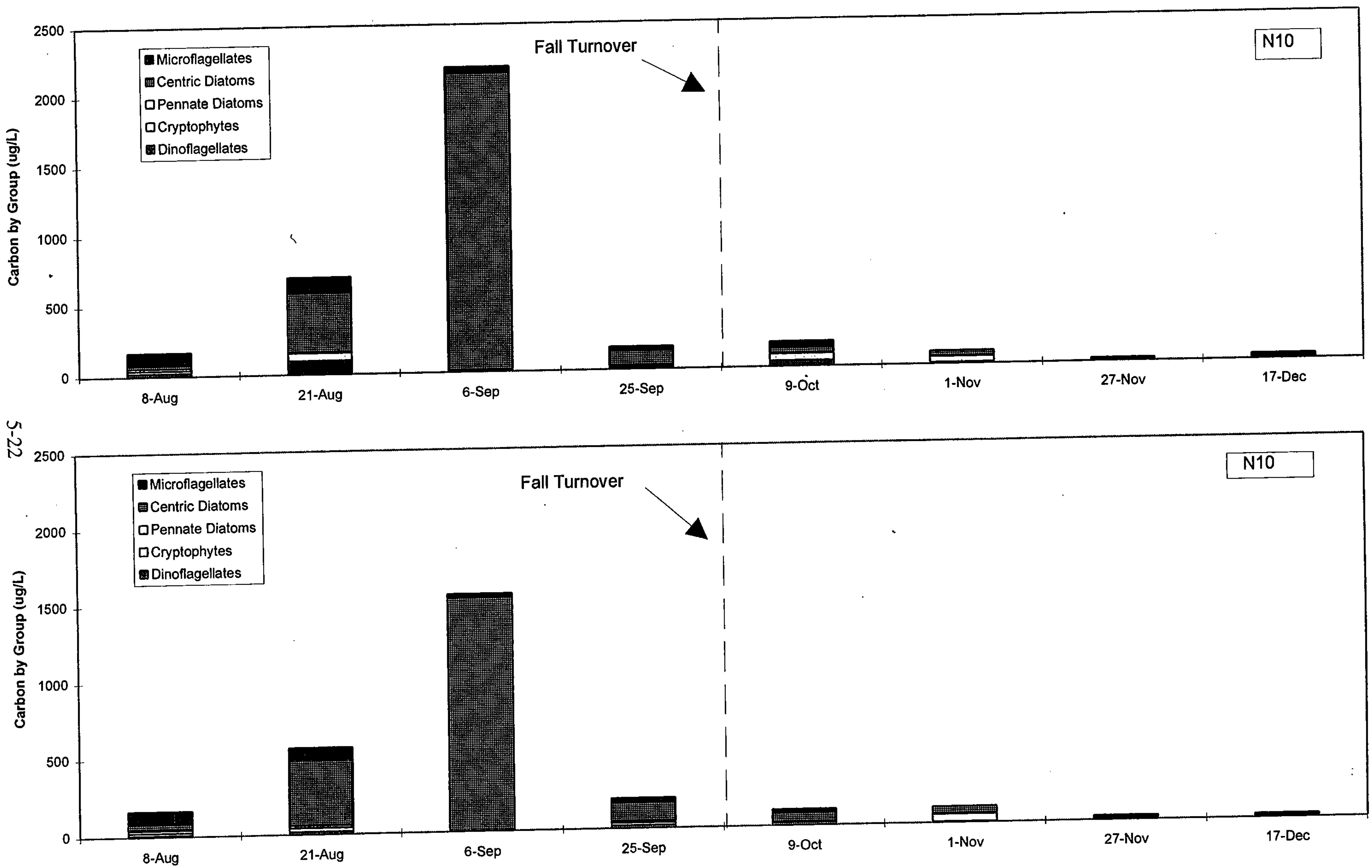


FIGURE 5-12
Distribution of Carbon (µg/L) by Major Taxonomic Groups
Top: Surface Data, Bottom: Chlorophyll *a* Maximum Data

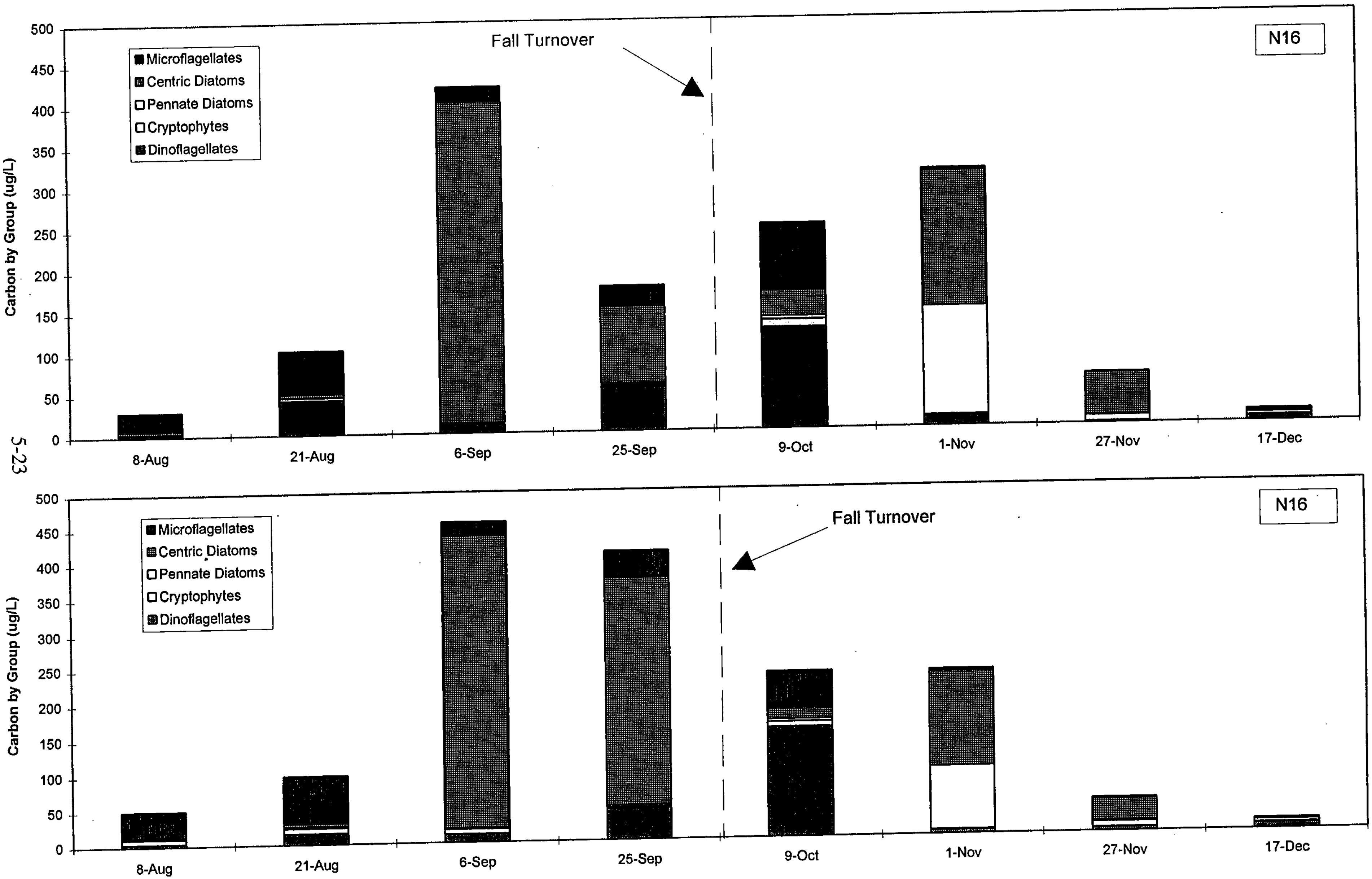


FIGURE 5-13
Distribution of Carbon (µg/L) by Major Taxonomic Groups
Top: Surface Data, Bottom: Chlorophyll *a* Maximum Data

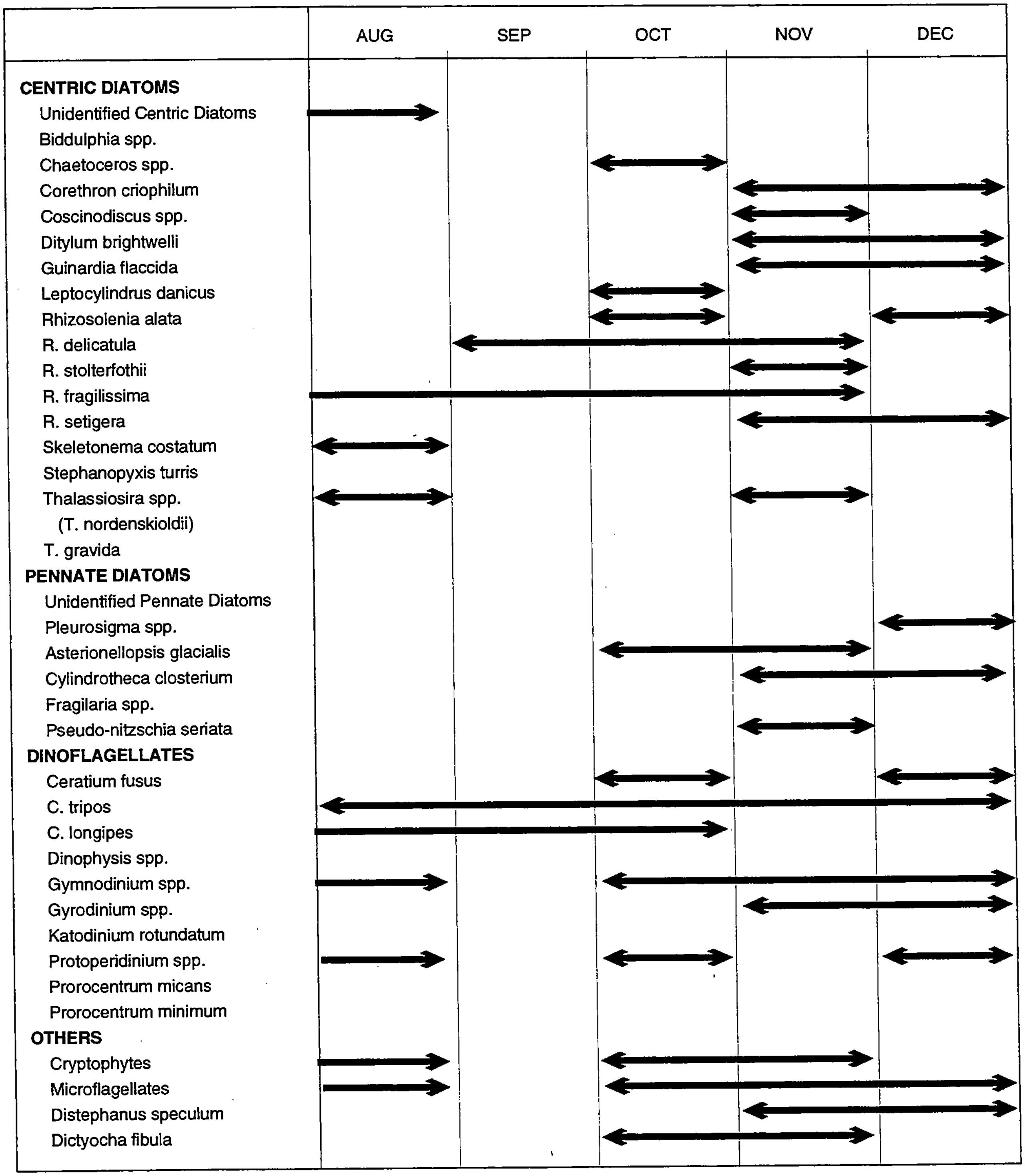
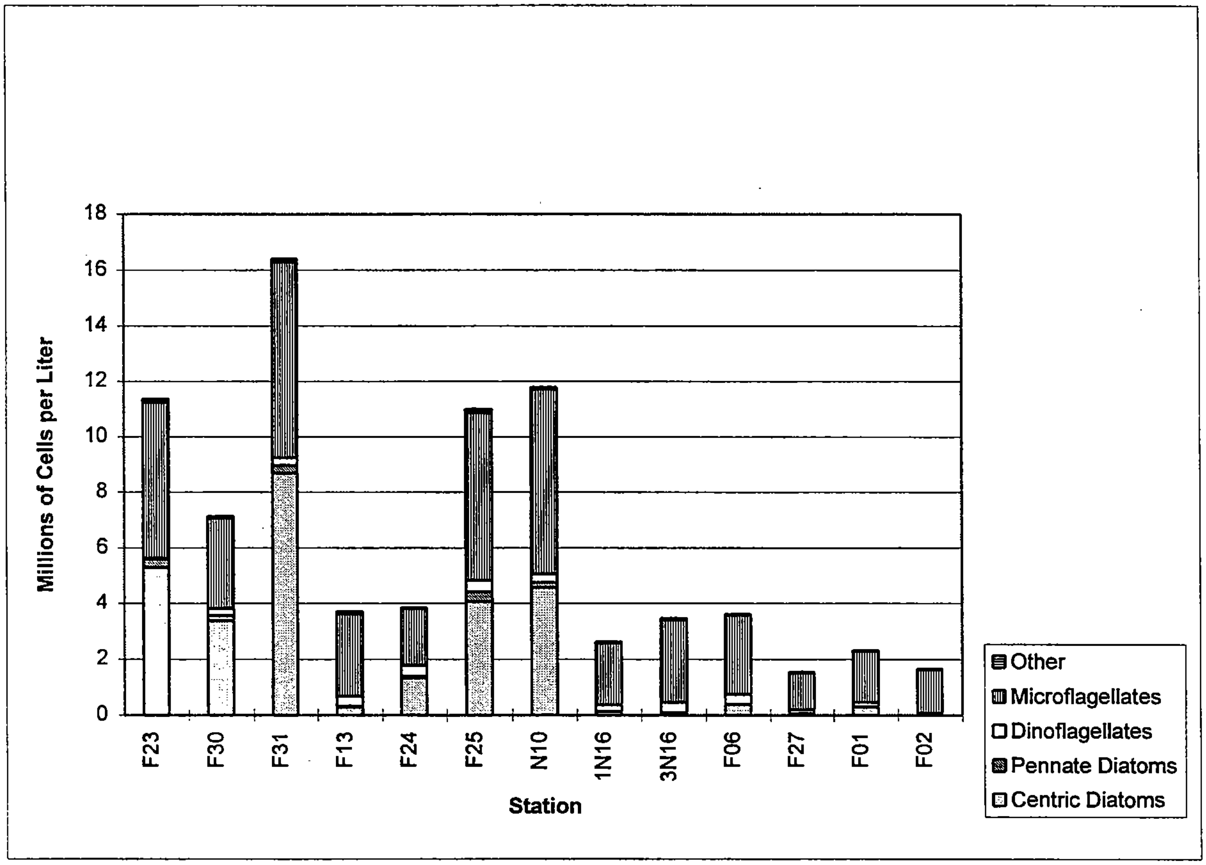


FIGURE 5-14
Dominant Phytoplankton Species by Carbon in Nearfield



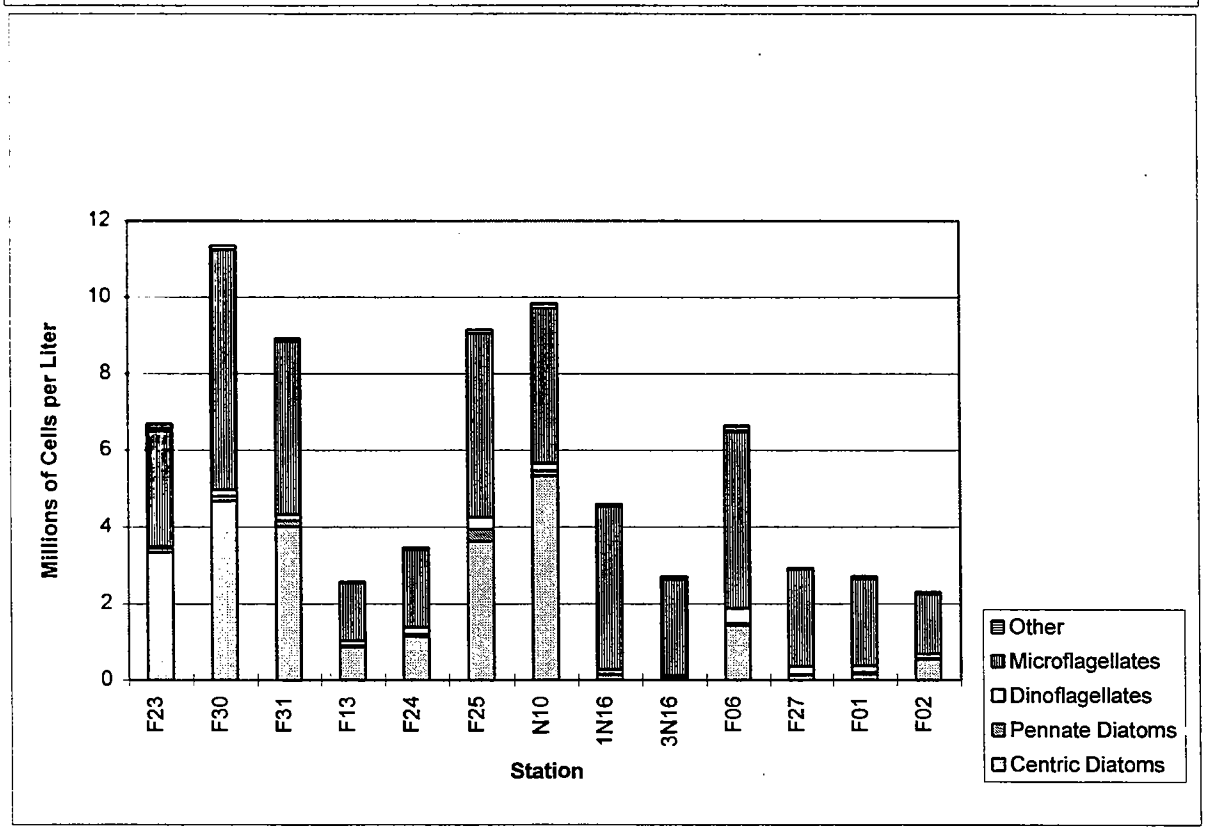
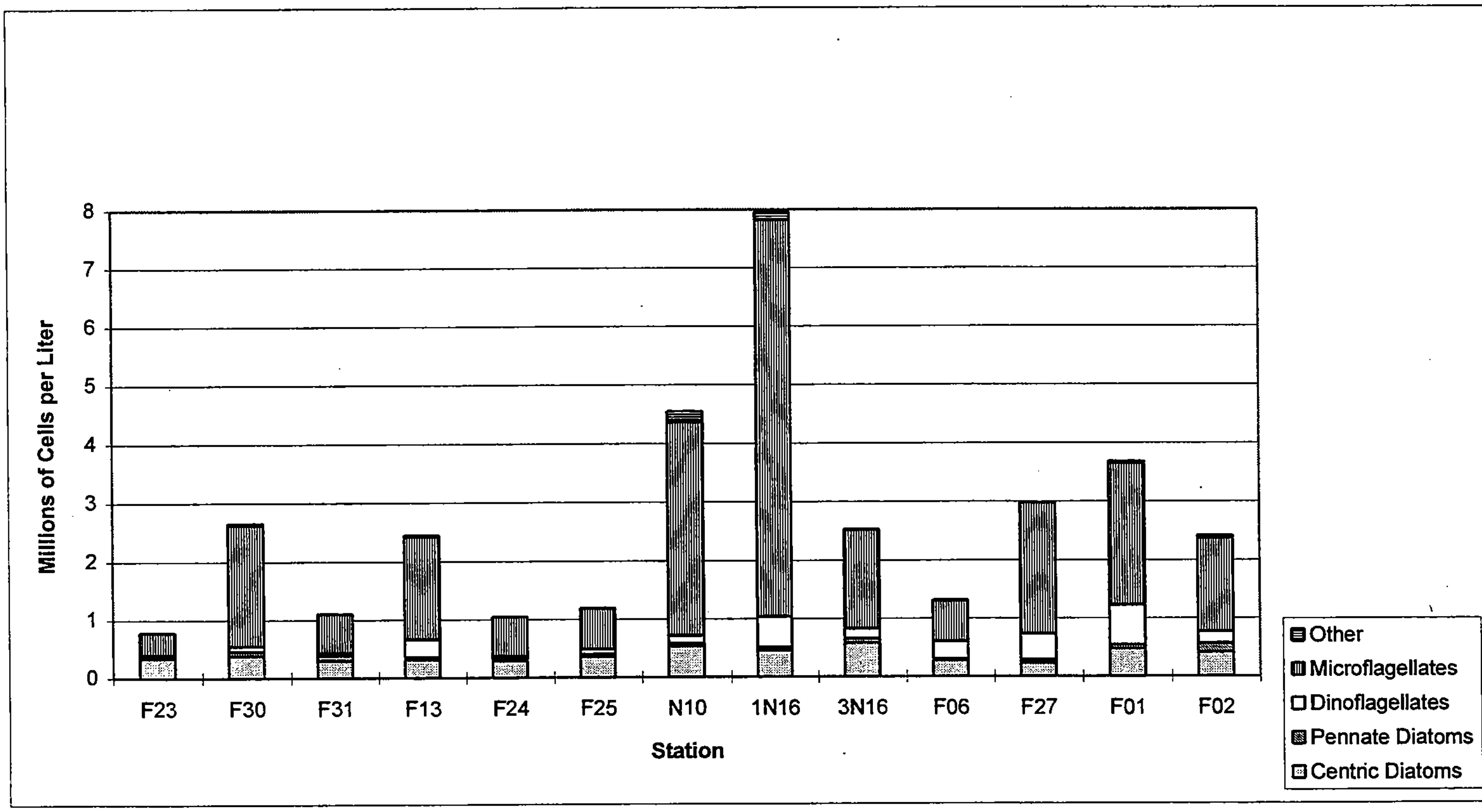


FIGURE 5-15
Total Phytoplankton Abundance by Taxonomic Group Collected in Late August (W9511)
Top: Surface Data, Bottom: Chlorophyll *a* Maximum Data



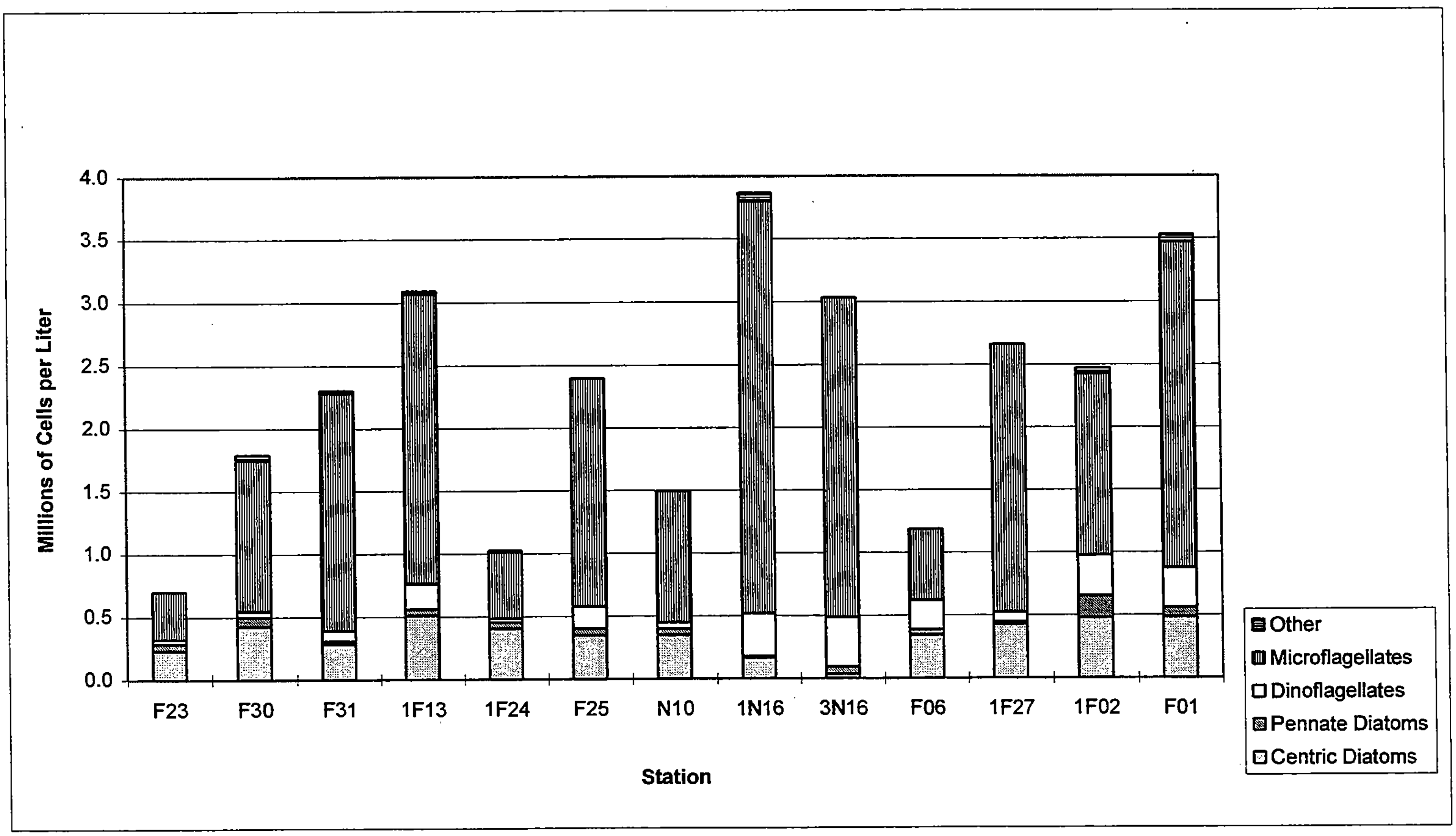
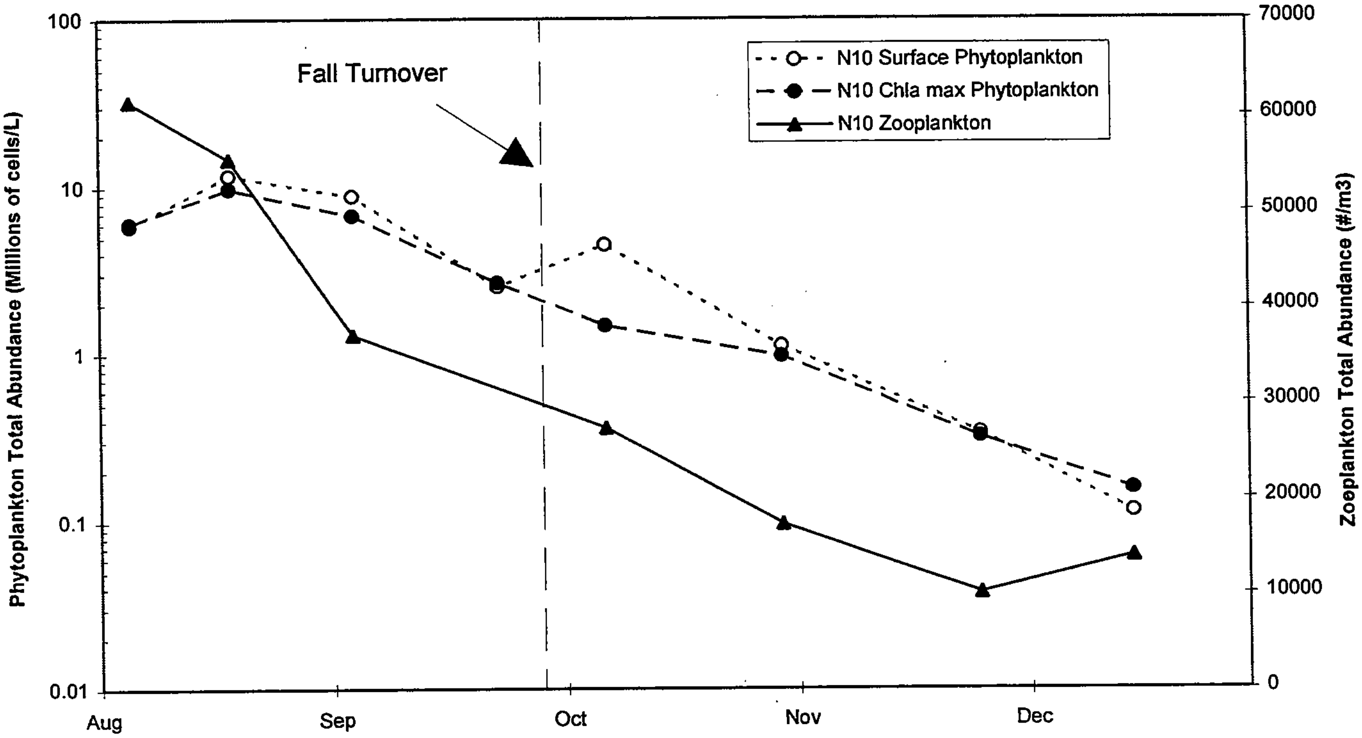


FIGURE 5-16
Total Phytoplankton Abundance by Taxonomic Group Collected in October (W9514)
Top: Surface Data, Bottom: Chlorophyll *a* Maximum Data



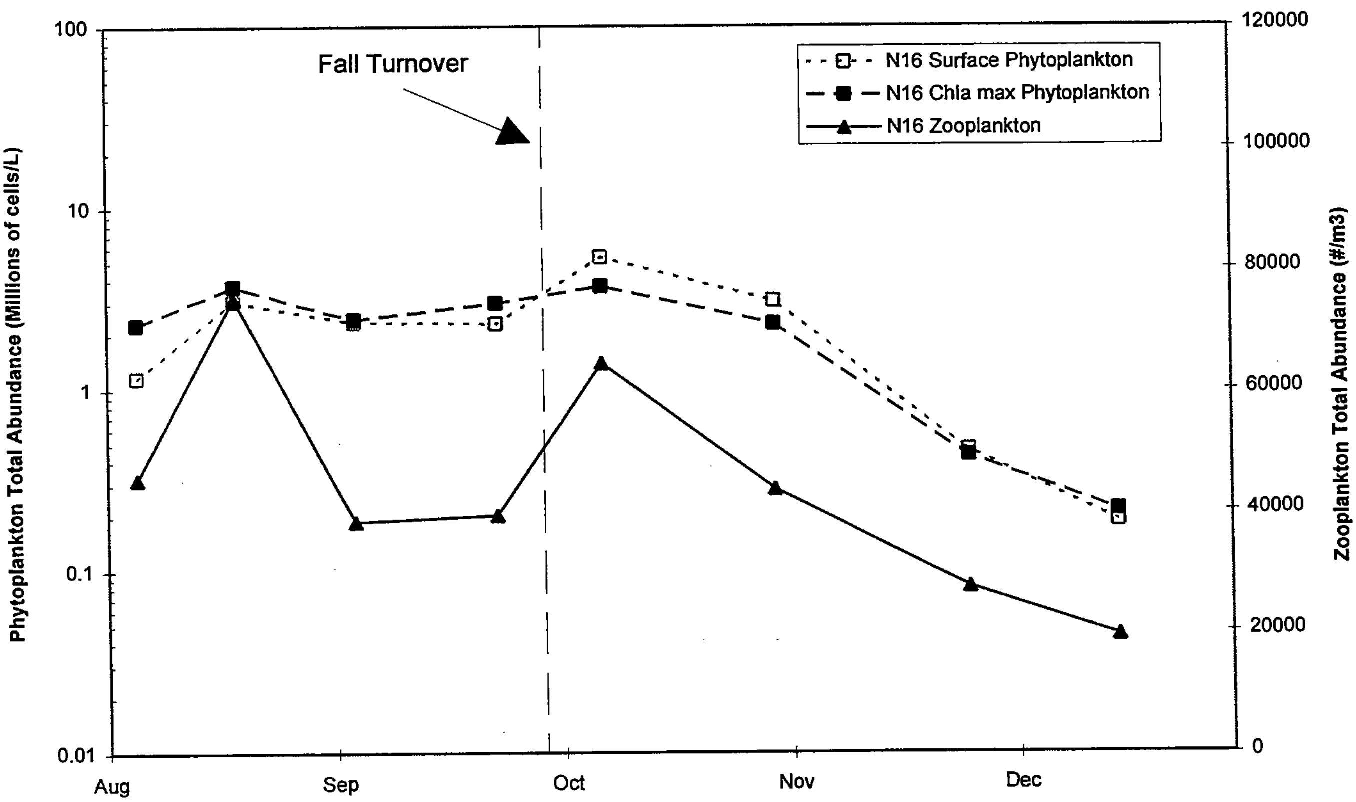


FIGURE 5-17
Total Abundance of Phytoplankton and Zooplankton
Top: Station N10, Bottom: Station N16

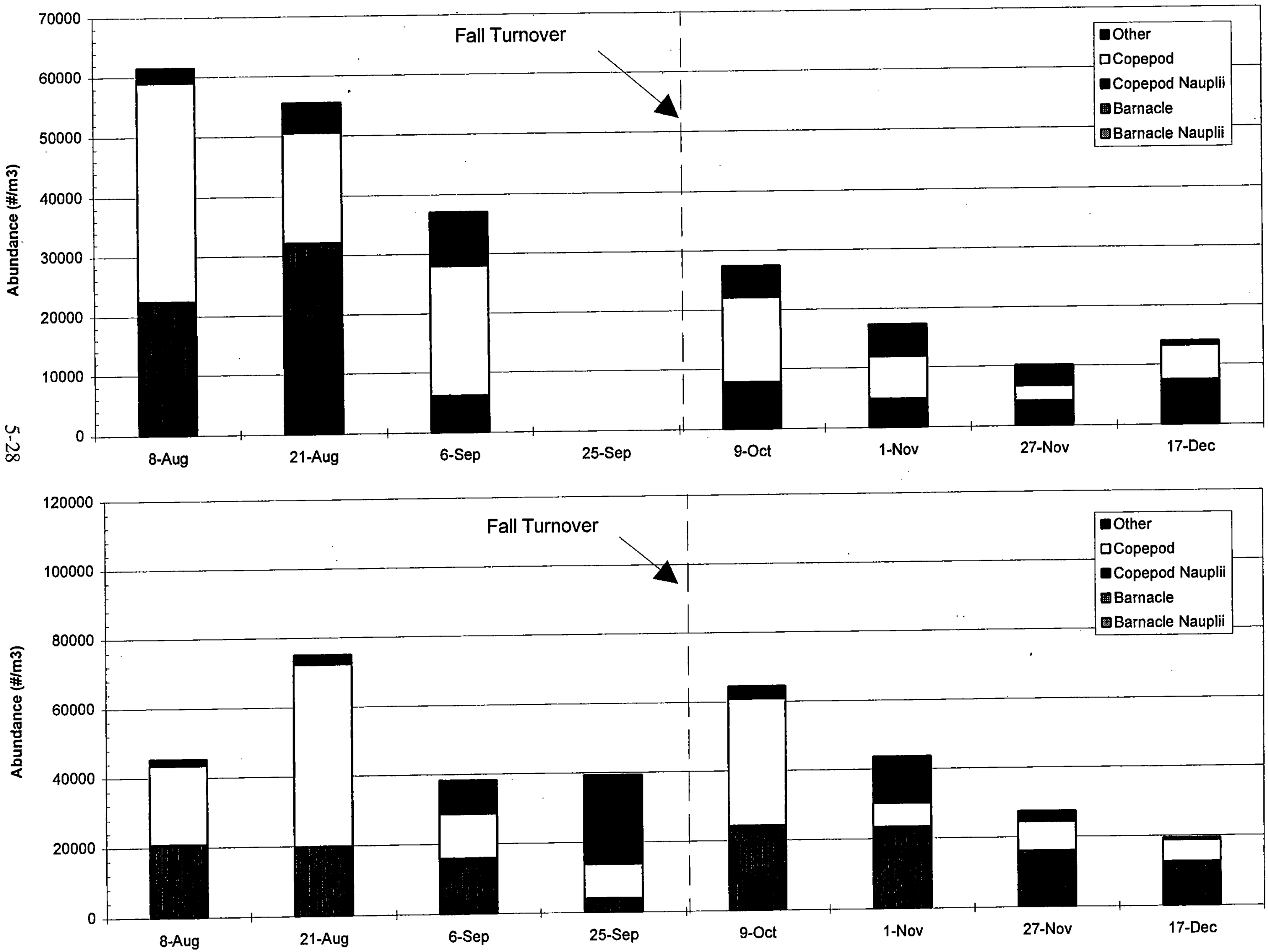


FIGURE 5-18
Total Zooplankton Abundance by Group in Surface Water
Top: Station N10, Bottom: Station N16

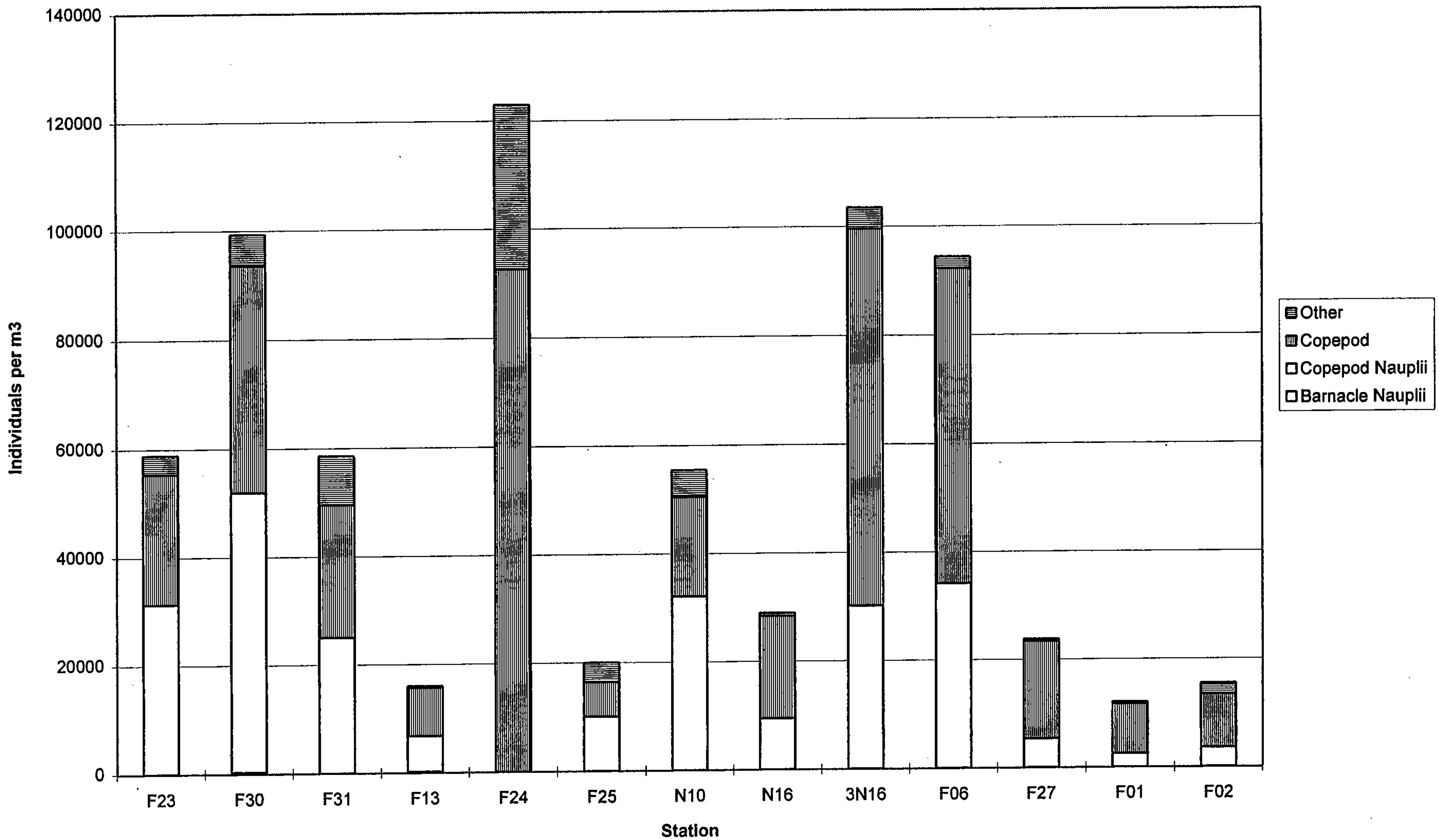


FIGURE 5-19
Zooplankton Abundance by Group Collected in Late August (W9511)

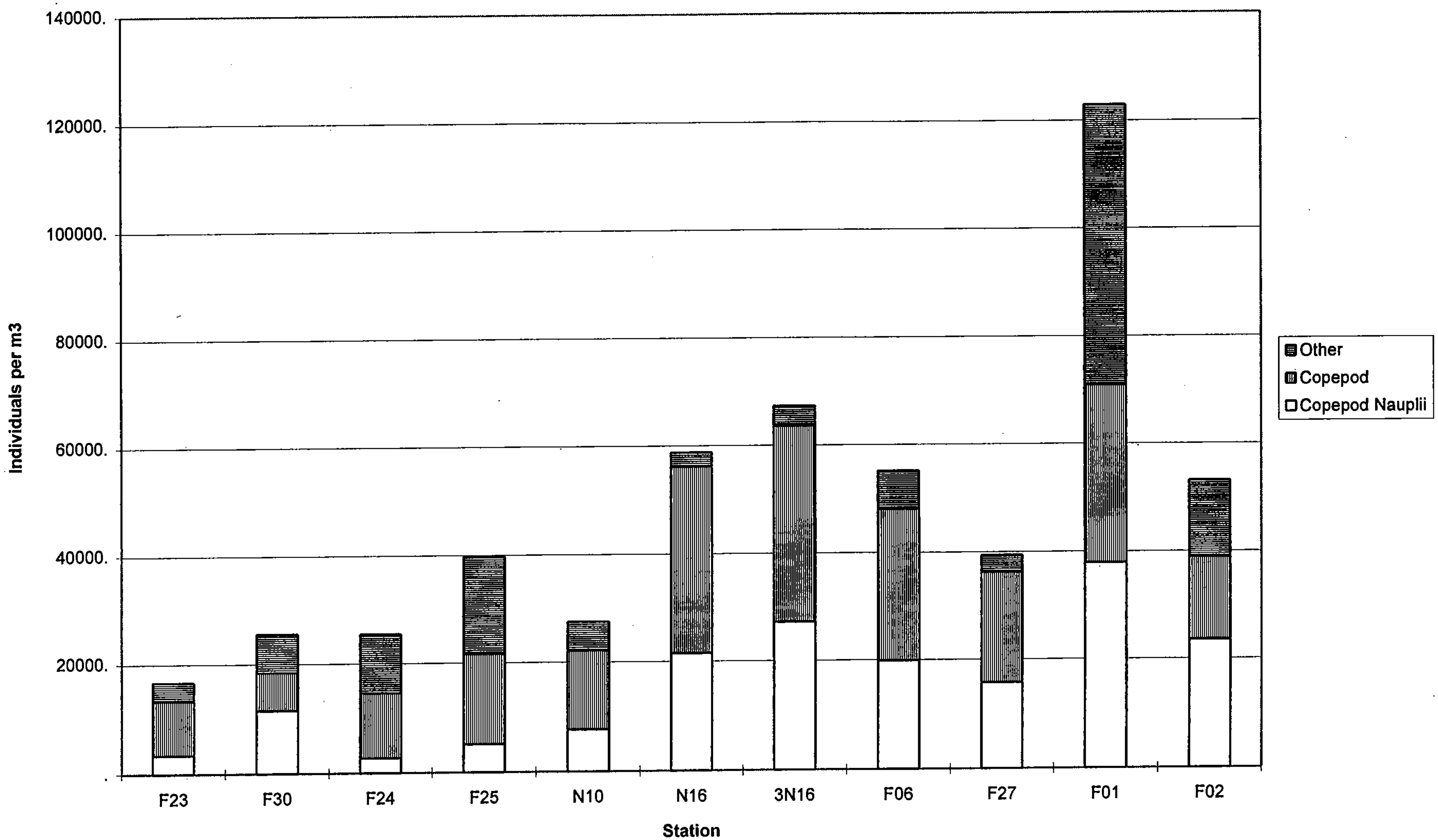


FIGURE 5-20
Zooplankton Abundance by Group Collected in October (W9514)

6.0 A SUMMARY OF MAJOR WATER COLUMN EVENTS

The purpose of this section is to provide a brief synthesis of some of the regional events supported by both the physical and biological trends in the data. Although a rigorous analysis of the datasets from the first semi-annual period is out of the scope of this data synthesis, several events, both regionally and within the nearfield, were evidenced by a variety of data.

The pre-turnover period (W9510-13) was characterized by a vertically stratified water column. Water column stratification was due primarily to a surface/bottom water temperature gradient. Nutrients in the surface water were low, except for in Boston Harbor, which remained mixed and had the highest surface water concentrations of all nutrients measured during both farfield surveys. Overall, through the pre-turnover period, nearfield bottom water nutrient concentrations increased from early August (W9510) to late September (W9513). An inshore-offshore nutrient gradient of PO_4 and DIN (NH_4) between the harbor and nearfield region was due to influence of harbor effluent.

Dissolved oxygen in the bottom water reached minimum concentrations during the final pre-turnover survey in late September (W9513). Nearfield average bottom water DO concentrations declined from >8 mg/L in early August (W9510) to 6.5 mg/L in late September (W9513), and then began to increase to >7 mg/L in October (W9514). Surface water respiration also increased from early August to September, due to the availability and quality of organic carbon production.

During the first regional farfield survey in late August (W9511), surface water temperatures were very warm (>19°C), but a patch of cooler surface water (17-19°C) at the northern end of the offshore/nearfield area was due to an intrusion of Gulf of Maine water as indicated by satellite data. Farfield transects showed a patch of cooler, less saline water at the surface at Station F19. Elevated surface water nutrients in the northern offshore region were associated with the GOM water mass.

A late summer bloom began in late August, clearly documented in many of the physical and biological parameters. Maximum chlorophyll *a* concentrations were measured in the upper water column of Boston Harbor (14.2 μg/L), the inner nearfield (15 μg/L), and along the coast (11.8 μg/L). Peak annual production (7,584 $mgCm^{-2}d^{-1}$) was measured during this survey at station F23, located outside of Boston Harbor, a rate which was twice the next highest rate measured during the spring bloom. Boston Harbor had the highest phytoplankton densities of all farfield region, with slightly lower abundances in the nearfield, coastal, and offshore regions. The late summer bloom was dominated by microflagellates and centric diatoms, including *Skeletonema costatum* and *Rhizosolenia fragilissima*. Estimated phytoplankton carbon equivalence also was dominated by centric diatoms.

Farther offshore in the outer nearfield, chlorophyll concentrations of up to 4 μg/L were concentrated along isoclines in the water column at 10 and 20 m. Chlorophyll-specific production data indicated that the outer nearfield was also experiencing conditions conducive to photosynthesis, but produced chlorophyll was probably rapidly scavenged because of the high abundances of zooplankton present. The peak of nearfield zooplankton abundance was at station N16 during late August (78,000/m^3). Regionally, station F24 data outside of the harbor showed the highest zooplankton densities (around 124,000/m^3) during late August, numerically dominated by copepod adults and bivalve species.

The subsequent nearfield survey in early September (W9512) showed that the late summer bloom was waning in the inner nearfield, but outer nearfield chlorophyll had increased to >6 μg/L along the 20 m isocline. Daily production data were consistent with a subsurface (10-20 m) productivity maximum. Semi-annual maximum areal production among the nearfield stations was measured at station N16 (2,378 $mgCm^{-2}d^{-1}$). As chlorophyll production moved farther offshore into the central and outer nearfield, DO saturation reached maximum levels of >110% in outer nearfield surface water. Respiration reached a maximum of 0.3 μMO_2/hr in surface water at station N04.

The density of inner nearfield bottom water dropped by almost 1.0 in late September (**W9513**) due to a lens of less saline water originating from the direction of Boston Harbor. Salinity increased in the outer nearfield, however, between early (W9512) and late September, resulting in a salinity transition through the middle of the nearfield and a resultant complex vertical density structure;

Chlorophyll concentrations had decreased to <2 μg/L throughout the nearfield water column, except for the northwest region of the nearfield grid, where concentrations reached 6.3 μg/L in the surface water at nearfield station N12. Despite the lack of chlorophyll in the water column, the semi-annual maximum rate of bottom water respiration (0.15 μMO_2/hr) was measured at station N16. The pattern of increasing chlorophyll-specific respiration prior to the fall turnover, especially at station N16, suggested that the available POC was easily oxidized. Recently produced plankton associated with the late summer bloom apparently had a mechanism for reaching bottom water during this survey, due to either rapid settling of coalesced mats of senescent material, or facilitated by zooplankton grazing.

The fall turnover was in progress by mid-October (W9514), with the water column remaining vertically stratified in the offshore and boundary regions, while $\Delta\sigma_t$ ranged from 0 to -1.0 in Boston Harbor, Cape Cod Bay, and the coastal regions. The nearfield mixing event, documented by continuous monitoring data, resulted in a reduction of the water column temperature gradient and a breakdown of vertical stratification.

The relative increase of surface water nutrient concentrations measured in the harbor, coast, and inner nearfield in October provided a catalyst for the nearfield fall bloom documented in early November. With the onset of the fall turnover, production of chlorophyll was focused in the outer nearfield, with maximum concentrations of 4-6 μg/L in the upper 10 m in the center of the nearfield measured during the October survey. Semi-annual maximum areal production among the nearfield stations was measured at station N16 (2,793 $mgCm^{-2}d^{-1}$). Regionally, the nearfield had the highest surface water phytoplankton abundance during this survey, while nearfield zooplankton abundance was high at station N16 (>60,000/m^3).

Cape Cod Bay in October had the lowest mid-water phytoplankton abundance (<1 million cells/L). This may be due to grazing, as zooplankton densities of bivalve and copepod species peaked in Cape Cod Bay during this period, with densities exceeding 36,000/m^3, with numerical dominance by the copepods *Oithona similits* and *Centropages typicus*.

During the final three nearfield surveys of the second semi-annual period of 1995 (W9515-W9517), all physical and biological parameters indicated that the nearfield water column was well mixed. The early November survey (W9515) was conducted during the height of the fall bloom, with the highest semi-annual chlorophyll concentrations measured, reaching 18 µg/L in the central nearfield around station N21. Production measurements were potentially underestimated during the bloom, due to cloudy conditions during sampling. The fall bloom was dominated by pennate diatoms (*Asterionellopsis glacialis*) as well as microflagellates.

7.0 REFERENCES

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Massachusetts Water Resources Authority (MWRA), 1997. Contingency Plan. MWRA, Boston, MA. 41pp.

APPENDIX A

Productivity Methods

Methods

Production Analyses by ^{14}C - Field Procedures.

From each of the 5 productivity depths at each productivity station, samples were obtained by filtration through 300 mm Nitex screen (to remove zooplankton) from the Niskin bottles into opaque 1 gal polyethylene bottles. Under subdued green light, sub-samples were transferred by siphon into individual 75 ml acid cleaned polycarbonate bottles. Each bottle was flushed with approximately 250 ml of sample. A total of 16 bottles (14 light bottles, 2 dark bottles) were filled for each depth and incubated in a light and temperature controlled incubator. Light bottles from each depth are incubated at 14 light intensities (250 W tungsten-halogen lamps attenuated with Rosco neutral density filters) and all bottles incubated within 2° C of the *in situ* temperature at each depth for 4-6 hr (actual time was recorded). Single bottles of sample collected from each depth was assayed for background (time-zero) activity.

The 75 ml samples were incubated with 5-10 µCi ^{14}C-bicarbonate (higher activity during winter and spring season) and biological activity terminated by filtration of the entire contents of the bottles through 2.5 cm diameter Whatman GF/F glass fiber filters and immediate contact of the filters with 0.2 ml of a 20% aqueous solution of acetic acid contained in pre-prepared 20 ml glass scintillation vials (vials immediately recapped). For specific activity determination 0.1 ml aliquots of sample were placed in pre-prepared 20 ml scintillation vials containing 0.2 ml of benzethonium hydroxide (approximately 1.0 M solution in methanol; Sigma Chemical Company) to covalently sequester the ^{14}C inorganic carbon (vials immediately recapped). Specific activity was determined from the measured activity and measurements of DIC.

Samples for DIC analysis were collected from the Niskin bottles into 300 ml BOD bottles, following collection procedures used for oxygen analyses. Within 6 hr. of BOD sample collection, duplicate 10 ml samples were injected into 20 ml crimp-sealed serum bottles containing 0.5 ml of a 2N aqueous solution of sulfuric acid for subsequent I.R. analysis (Beckman IR-315 infrared analyzer) of the gaseous phase (5 - 150 ml samples) at the W.H.O.I. laboratory.

During summer months 1995 some of the ^{14}C incubations (W9508-W9513) were incubated on shore in the MWRA laboratory at Deer Island. Samples were collected in opaque bottles and maintained at *in situ* temperature until transport to the lab. The ^{14}C incubations were begun approximately 2 - 3 hr from sample collection and should compare favorably with samples that are incubated aboard the ship.

Production Analyses by ^{14}C - Laboratory Procedures.

Sample processing. Upon arrival to the W.H.O.I. laboratory scintillation cocktail (10 ml Scintiverse II) were added to the scintillation vials containing the specific activity samples and analyzed using a Packard Tricarb 4000 liquid scintillation counter which possesses automated routines for quench correction. Vials containing acidified filters were opened and placed in a

ventilator in the hood for overnight to allow the filters to dry and excess ^{14}C carbon dioxide dissipate. The vials containing the filters were analyzed by scintillation spectroscopy as described above.

Calculation of Primary production. Volume specific primary production was calculated using equations similar to that of Strickland and Parsons (1972) as follows:

$$P(i) = \frac{1.05(DPM(i)-DPM(blk))}{V_s A_{sp} T}$$

$$P(d) = \frac{1.05(DPM(d)-DPM(blk))}{V_s A_{sp} T}$$

$$A_{sp} = \frac{DPM(sa)-DPM(back)}{V_{sa} DIC}$$

where:

P(i) = primary production rate at light intensity i, (μgC $l^{-1}h^{-1}$ or mgC $m^{-3}h^{-1}$)
P(d) = dark production, (μgC $l^{-1}h^{-1}$ or mgC $m^{-3}h^{-1}$)
A_{sp} = specific activity (DPM/μgC)
DPM(i) = dpm in sample incubated at light intensity i
DPM(blk) = dpm in zero time blank (sample filtered immediately after addition of tracer)
DPM(d) = dpm in dark incubated sample
DPM(back) = background dpm in vial containing only scintillation cocktail
V_s = volume of incubated sample (l)
T = incubation time (h)
V_{sa} = volume counted of specific activity sample (ml)
DIC = concentration of dissolved inorganic carbon (μg/ml)

P-I curves. For each of the 5 depths for each photosynthesis station a P-I curve was obtained from the data P(I) = P(i)-P(d) vs. the irradiance (I, μE $m^{-2}s^{-1}$) that the incubating sample is exposed. The P-I curves were fit via one of two possible models, depending upon whether or not significant photoinhibition occurs. In cases where photoinhibition is evident the model of Platt et al. (1980) was fit (SAAM II, 1994) to obtain the theoretical maximum production, and terms for light-dependent rise in production and degree of photoinhibition:

$$P(I) = P_{sb}''(1-e^{-a})e^{-b}$$

$$P\max'' = P_{sb}''[\alpha''/(\alpha''+\beta'')][\beta''/(\alpha''+\beta'')]^{\beta''/\alpha''}$$ (Lohrenz et al., 1994)

where:

P(I) = primary production at irradiance I, corrected for dark fixation (P(i)-P(d))
P_{sb}" = theoretical maximum production without photoinhibition
a = α"I/Psb", and α"is the initial slope the light-dependent rise in production

$b = \beta$"I/Psb", and β"is a term relaying the degree of photoinhibition
P_{max}"= light saturated maximum production

If it is not possible to converge upon a solution the model of Webb et al. (1974) was similarly fit to obtain the maximum production and the term for light-dependent rise in production:

$$P(I) = P_{max}"\left(1 - e^{-a'}\right)$$

where:

P(I) = primary production at irradiance I corrected for dark fixation (P(i)-P(d))
P_{max}"= light saturated maximum production
a' = α"I/Pmax", and α"is the initial slope the light-dependent rise in production

Nearly all P-I curves obtained did not show evidence of photoinhibition and were fit according to the Webb model.

Light vs. depth profiles. To obtain a numerical representation of the light field throughout the water column bin averaged CTD light profiles (0.5 m intervals) was fit (SAAM II, 1994) to an empirical sum of exponentials equation of the form:

$$I_Z = A_1 e^{-a_1 Z} + A_2 e^{-a_2 Z}$$

which is an expansion of the standard irradiance vs. depth equation:

$$I_Z = I_0 e^{-kZ}$$

where:

I_Z = light irradiance at depth Z
I_0 = incident irradiance (Z=0)
k = extinction coefficient
A_1, A_2 = factors relating to incident irradiance ($I_0 = A_1+A_2$)
a_1, a_2 = coefficients relating to the extinction coefficient ($k = a_1+a_2$)

The expanded equation was used as pigment absorption and other factors usually resulted in significant deviation from the idealized standard irradiance vs. depth equation. The best fit profiles were used to compute percent light attenuation for each of the sampling depths.

Daily incident light field. During normal CTD hydrocasts the incident light field was routinely measured via a deck light sensor at high temporal resolution. The average incident light intensity was determined for each of the CTD casts to provide, over the course of the photoperiod (12 hr period centered upon solar noon), a reasonably well resolved irradiance time series consisting of 12-17 data points. A 48 point time series (every 15 min.) of incident was obtained from these data by linear interpolation.

Calculation of daily primary production. Given the best fit parameters (Pmax", α", β") of the P-I curves obtained for each of the 5 sampling depths, percent *in situ* light attenuation at each depth determined from the sum of exponential fits of the *in situ* light field, and the photoperiod incident light (I_0) time series it was possible to compute daily volumetric production for each depth. To do this at a given depth, hourly production was determined for the *in situ* light intensity computed for each 15 min. interval of the photoperiod, using the appropriate P-I parameters and *in situ* irradiance computed from the percent attenuation and incident irradiance. Daily production (μgC $l^{-1}d^{-1}$) was obtained by integration of the determined activity throughout the 12 hr photoperiod. An advantage of this approach is that seasonal changes in photoperiod length are automatically incorporated into the integral computation. For example, during winter months computed early morning and late afternoon production contributes minimally to whole day production, whereas during summer months the relative contribution during these hours is more significant. The investigator does not have to decide which factor to employ when converting hourly production to daily production. The primary assumption for the approach is that the P-I relationship obtained at the time of sample procurement (towards the middle of the photoperiod) is representative of the majority of production occurring during the photoperiod.

Calculation of daily areal production. Areal production (mgC $m^{-2}d^{-1}$) was obtained by trapezoidal integration of daily volumetric production vs. depth from the sea surface down to the 0.5% light level. The P-I factors from the uppermost sampling depth (approximately 1.2 - 2.7 m, depending upon weather state) were used to compute the contribution of the portion of the water column between the sea surface interface and uppermost sampling depth to areal production (rather than to assume that the activity in the uppermost sample is representative of that section of the water column, which is not always the case).

Calculation of chlorophyll-specific parameters. Chlorophyll-specific measures of the various parameters were determined by dividing by the appropriate chlorophyll term obtained from independent measurements:

$$\alpha = \frac{\alpha''}{[chla]}$$

$$P\max = \frac{P\max''}{[chla]}$$

where:

α = chlorophyll-a-specific initial slope of light-dependent production [(gC(gchla)$^{-1}$h^{-1}(μEm^{-2}s^{-1})$^{-1}$]

Pmax = light saturated chlorophyll-specific production [gC(gchla)$^{-1}$h^{-1}]

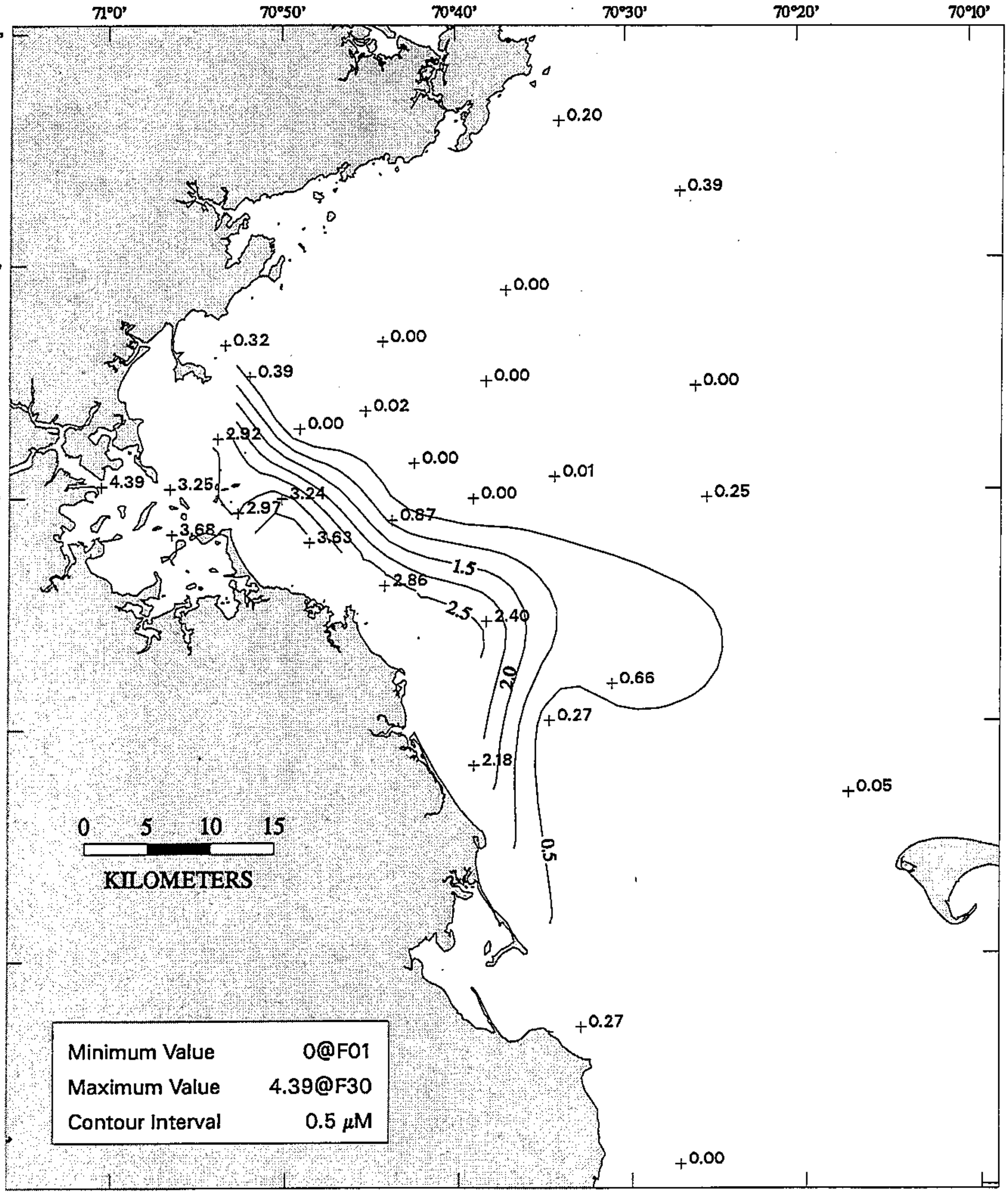
APPENDIX B
Surface Contour Plots - Farfield Surveys

All contour plots were created using data from the surface bottle sample (A). Each plot is labelled on the bottom right with the survey number ("9511"), and parameter as listed below. The minimum and maximum value, and the station where the value was measured, is provided for each plot, as well as the contour interval and parameter units.

Appendix B: Table of Contents

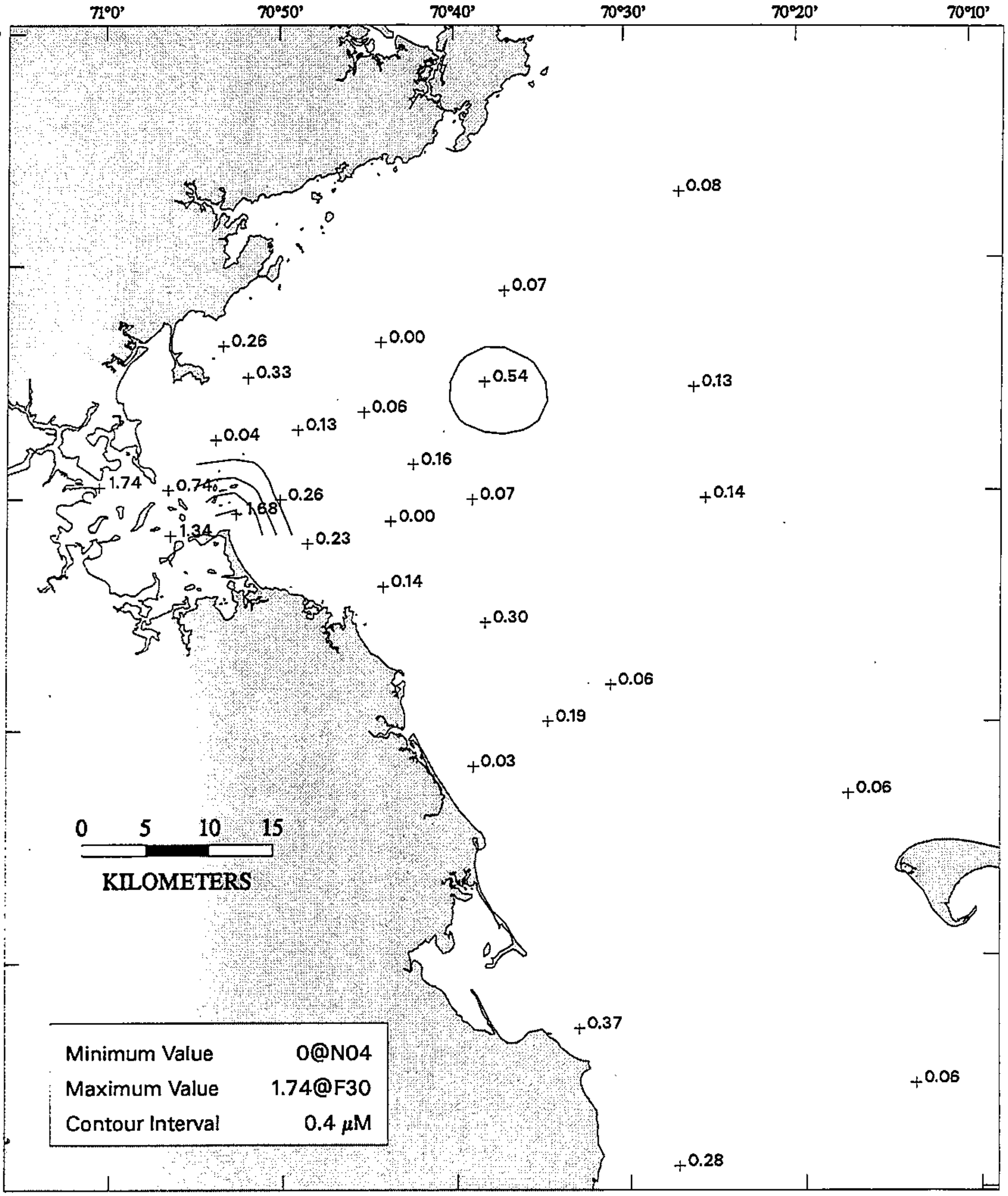
Parameter Name	Map Parameter Name	Units
Temperature	temp_lin	°C
Salinity	sal_lin	SU
Transmissivity (beam attenuation)	tran_lin	/m
Nitrate (NO_3)	no3_lin	µM
Phosphate (PO_4)	po4_lin	µM
Silicate (SiO_4)	sio4_lin	µM
Dissolved Inorganic Nitrogen (DIN*)	din_lin	µM
Chlorophyll *a*	fluo_lin	µg/L

*$NO_3 + NO_2 + NH_4$

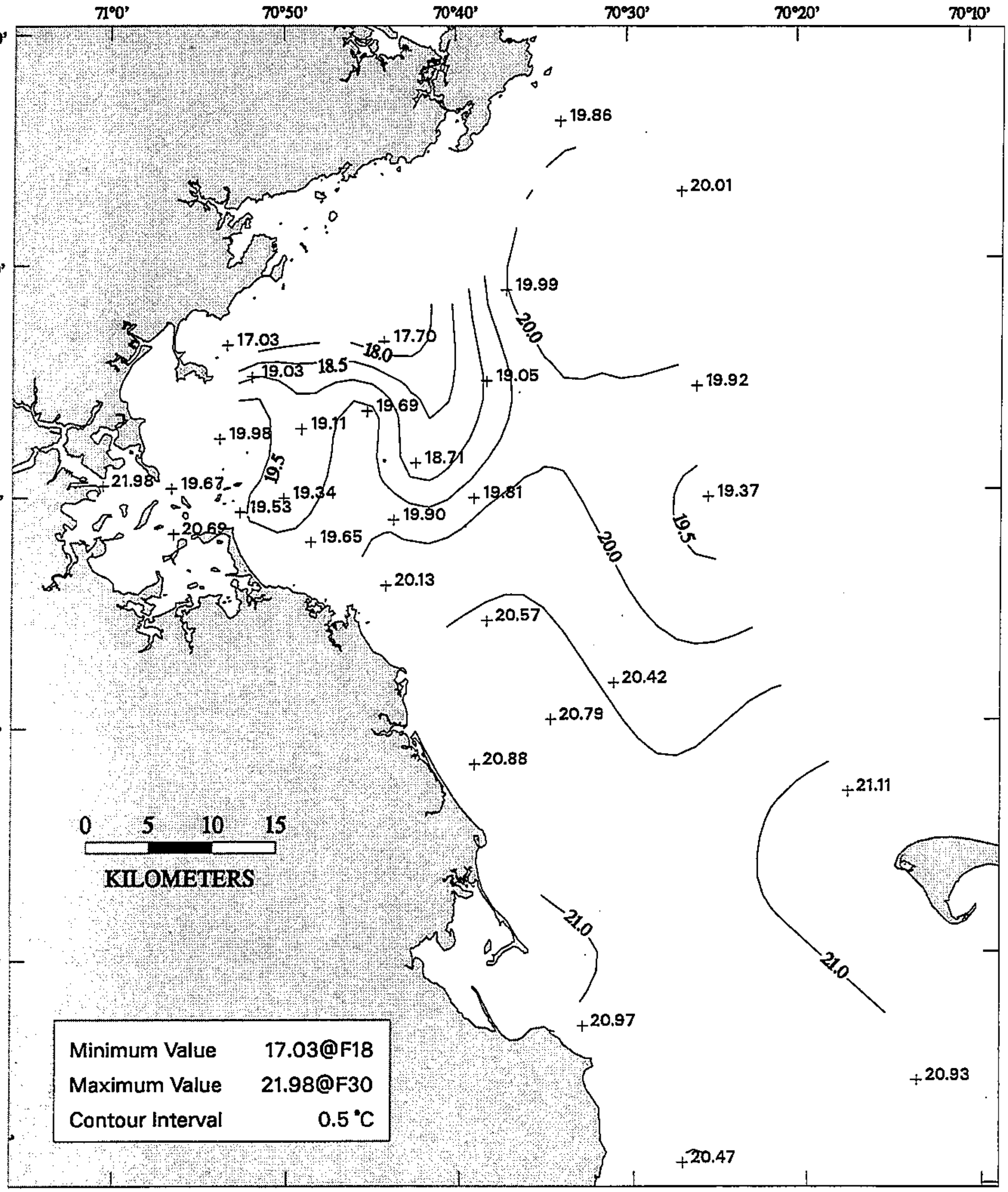


9514no3_lin

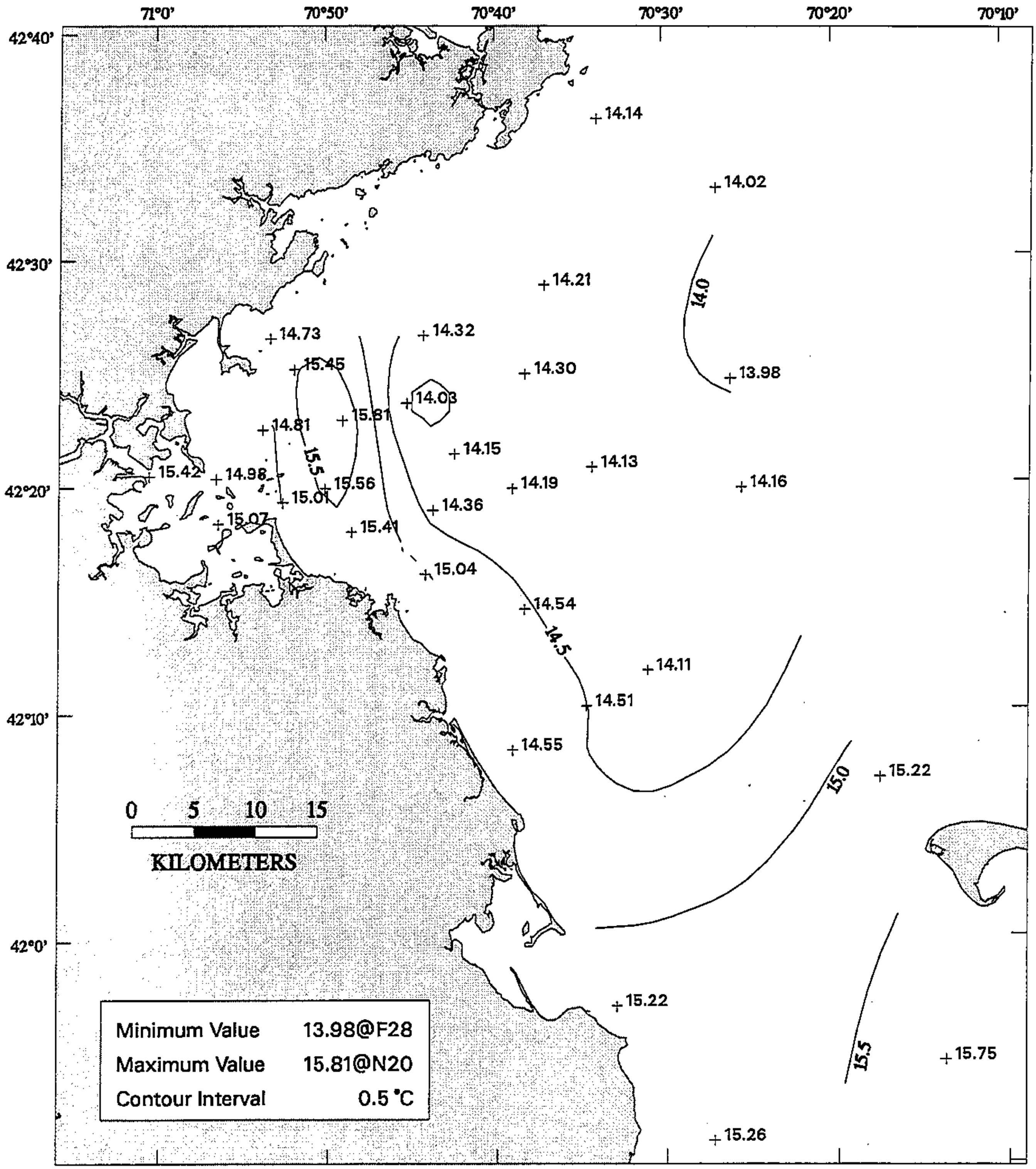
NO3



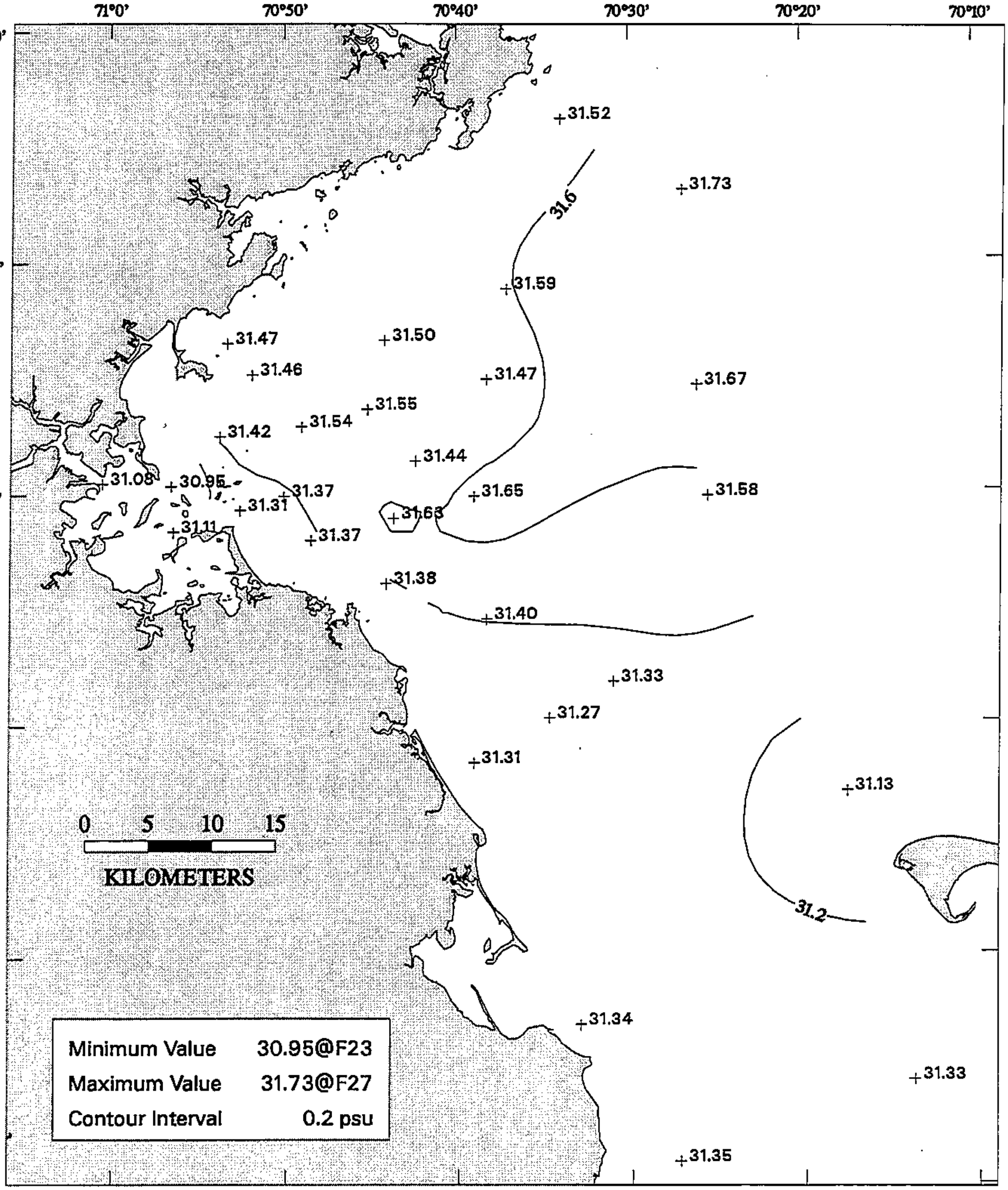
9511no3_lin
NO3



9511temp_lin
FLUO

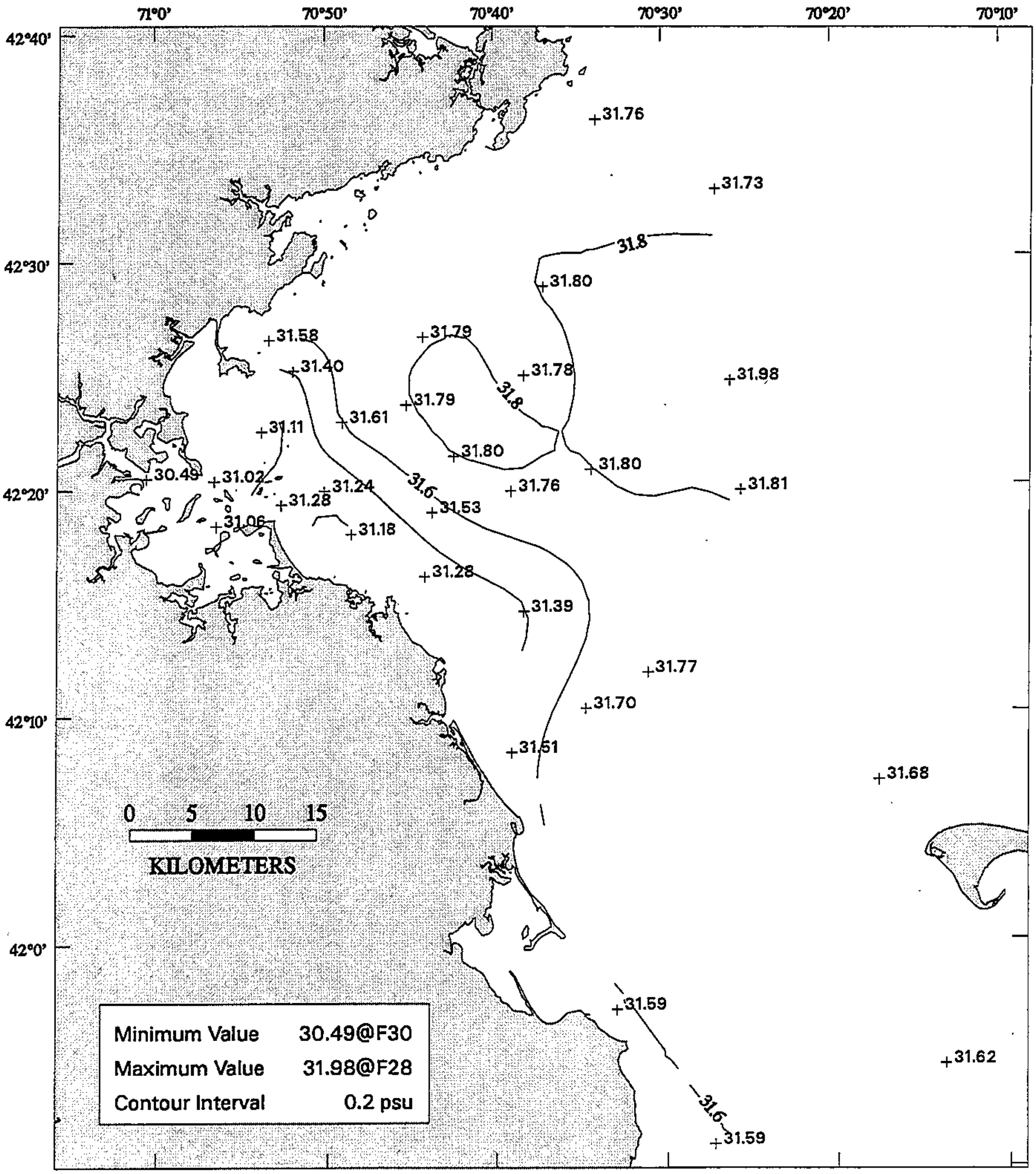


9514temp_lin
FLUO

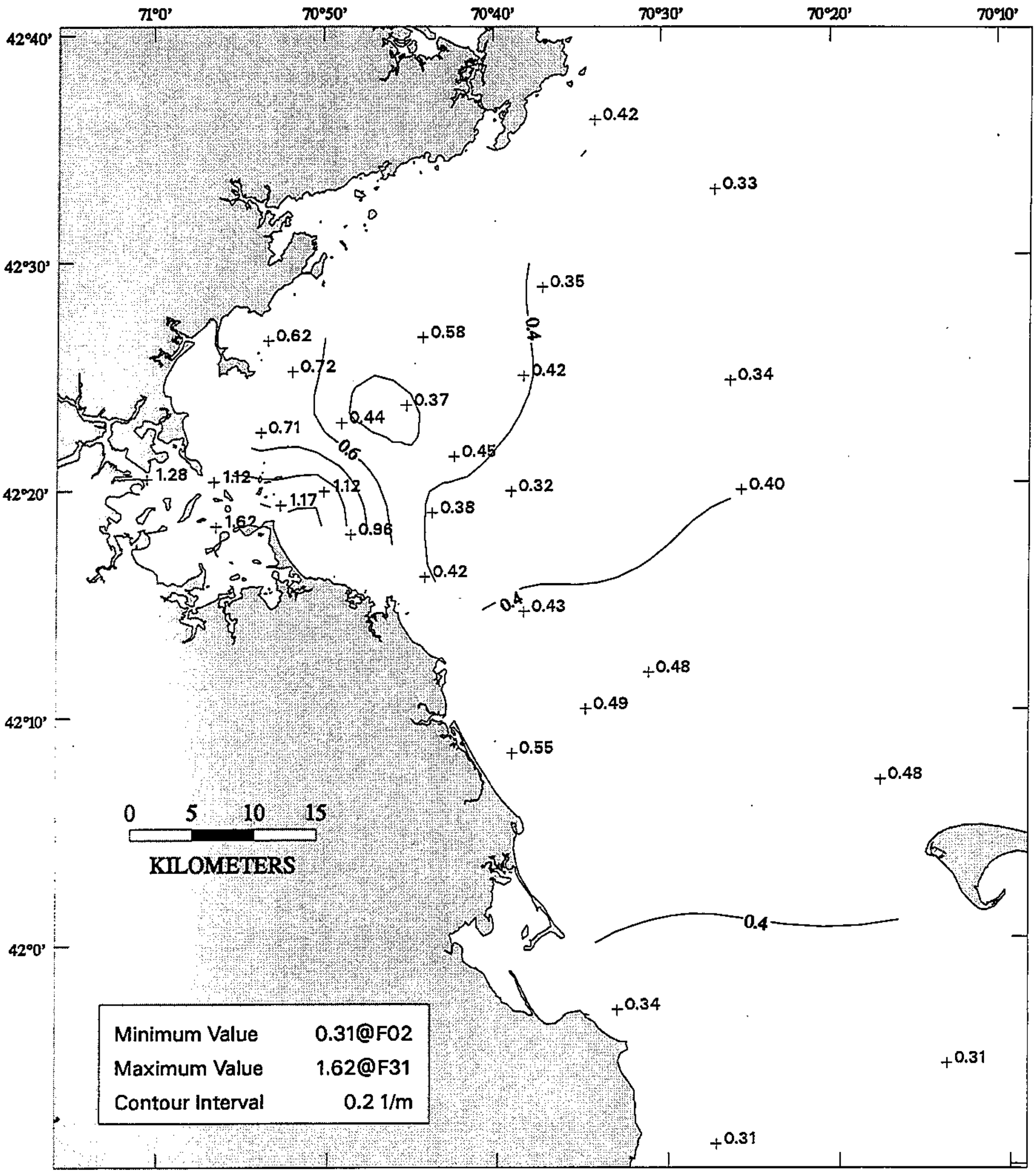


Minimum Value	30.95@F23
Maximum Value	31.73@F27
Contour Interval	0.2 psu

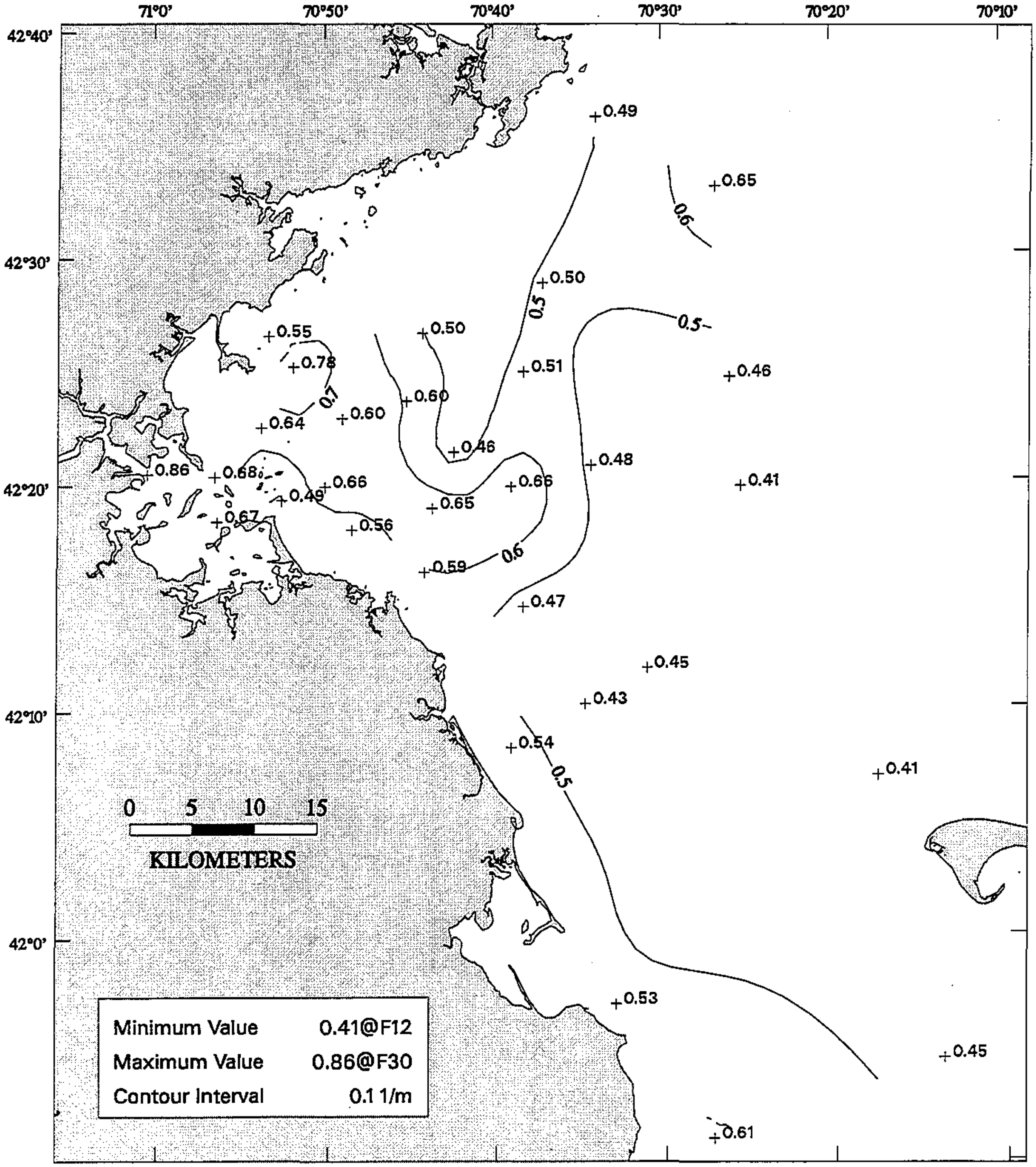
9511sal_lin
FLUO



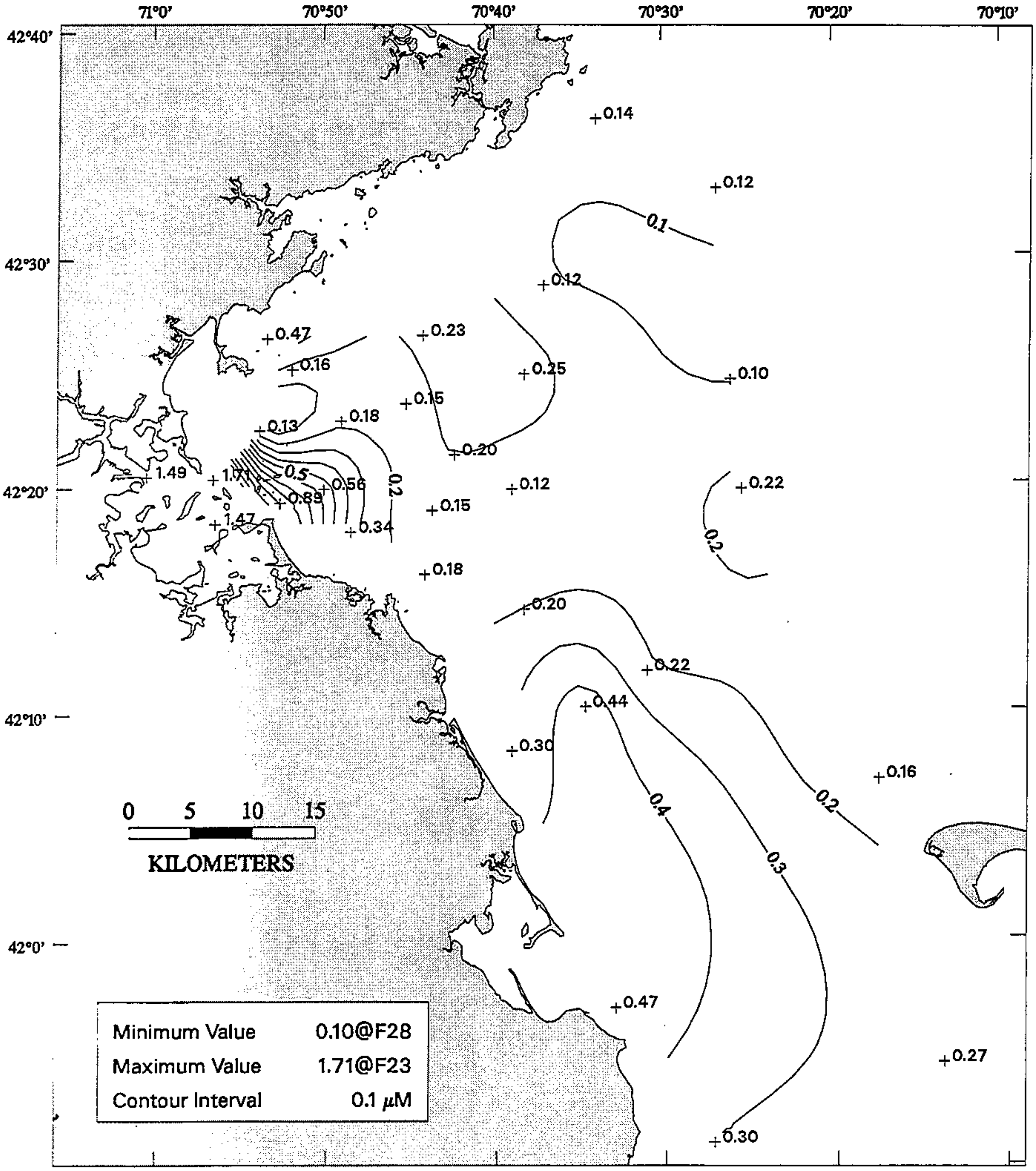
9514sal_lin
FLUO



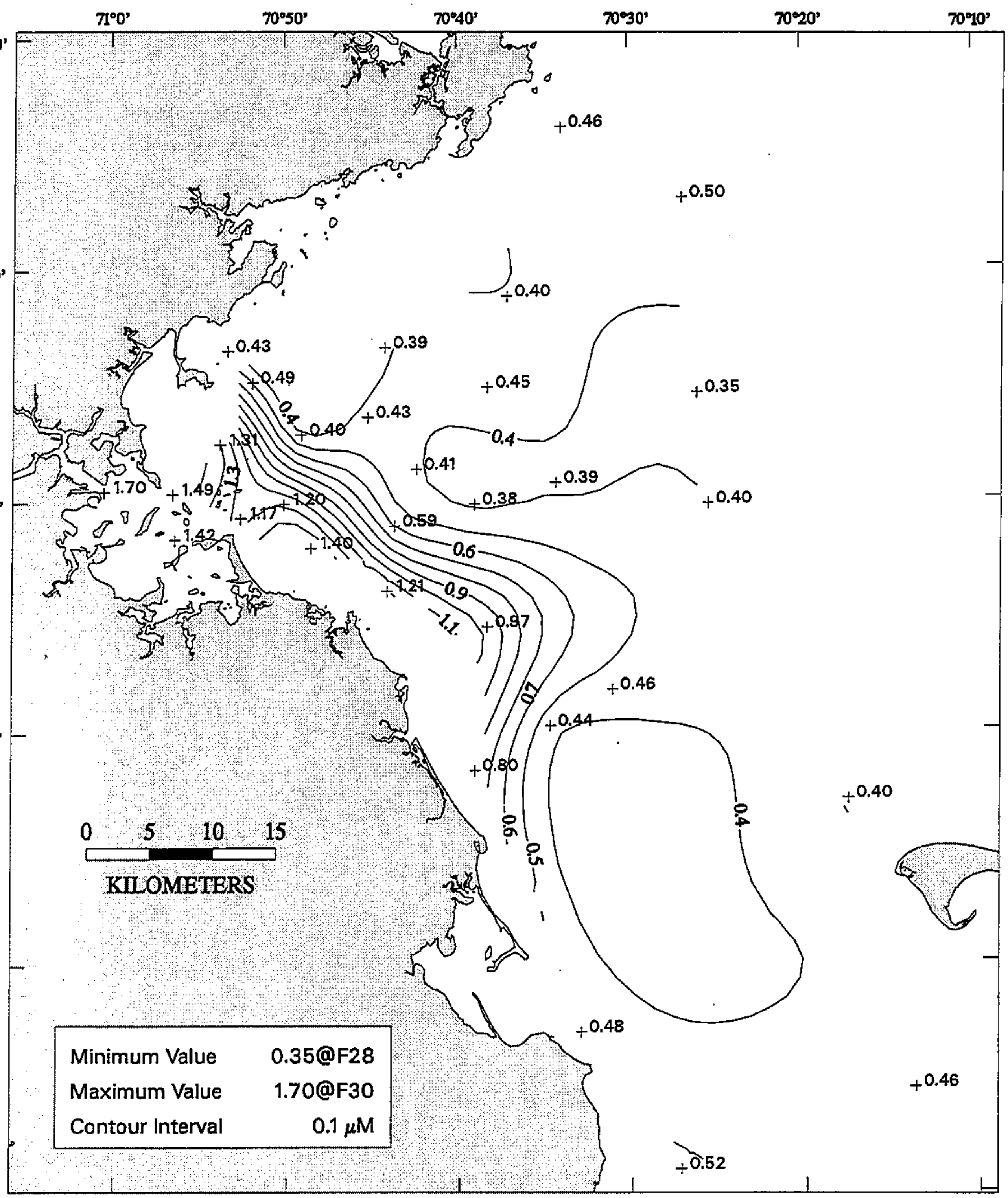
9511tran_lin
FLUO



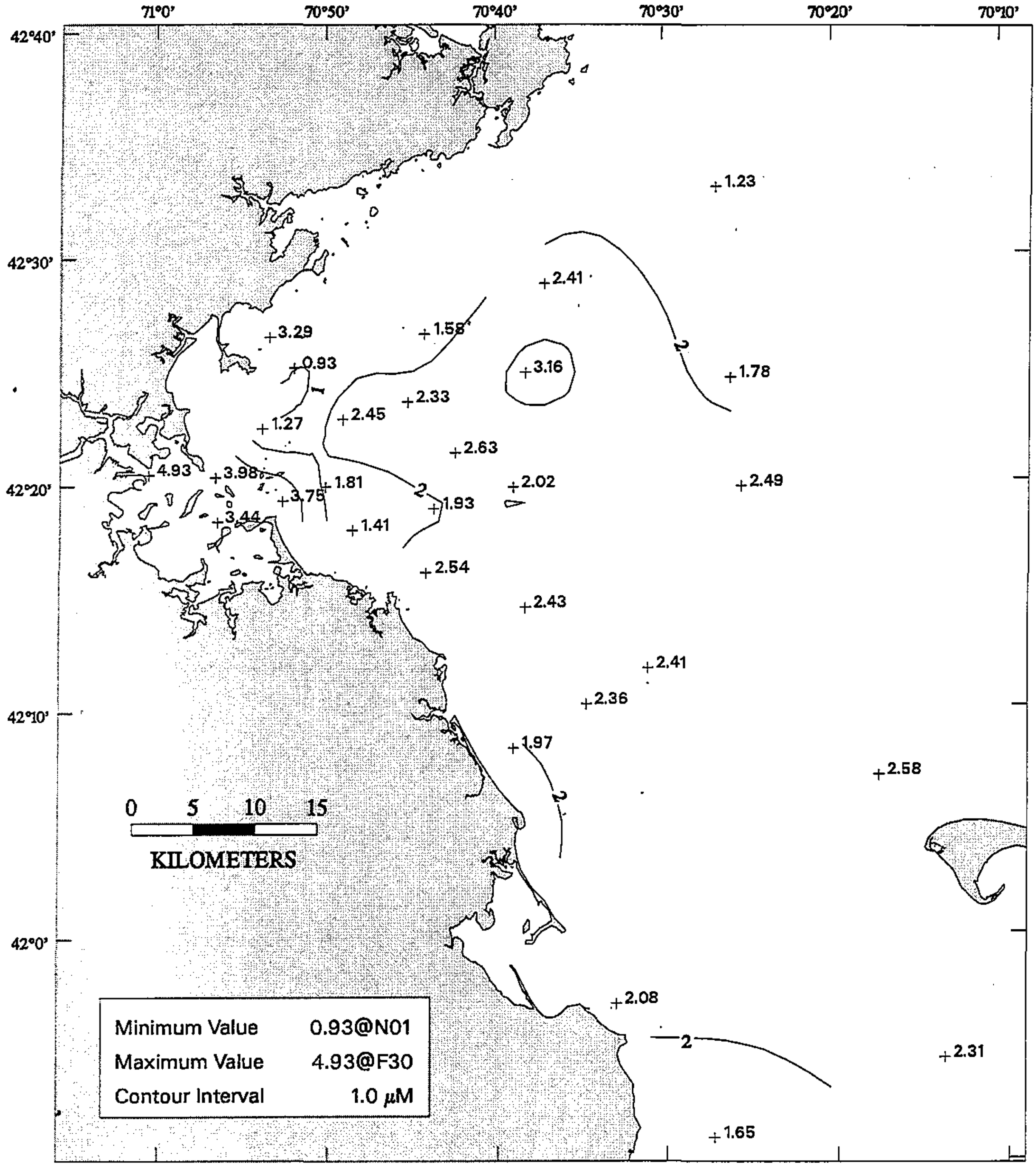
9514tran_lin
FLUO



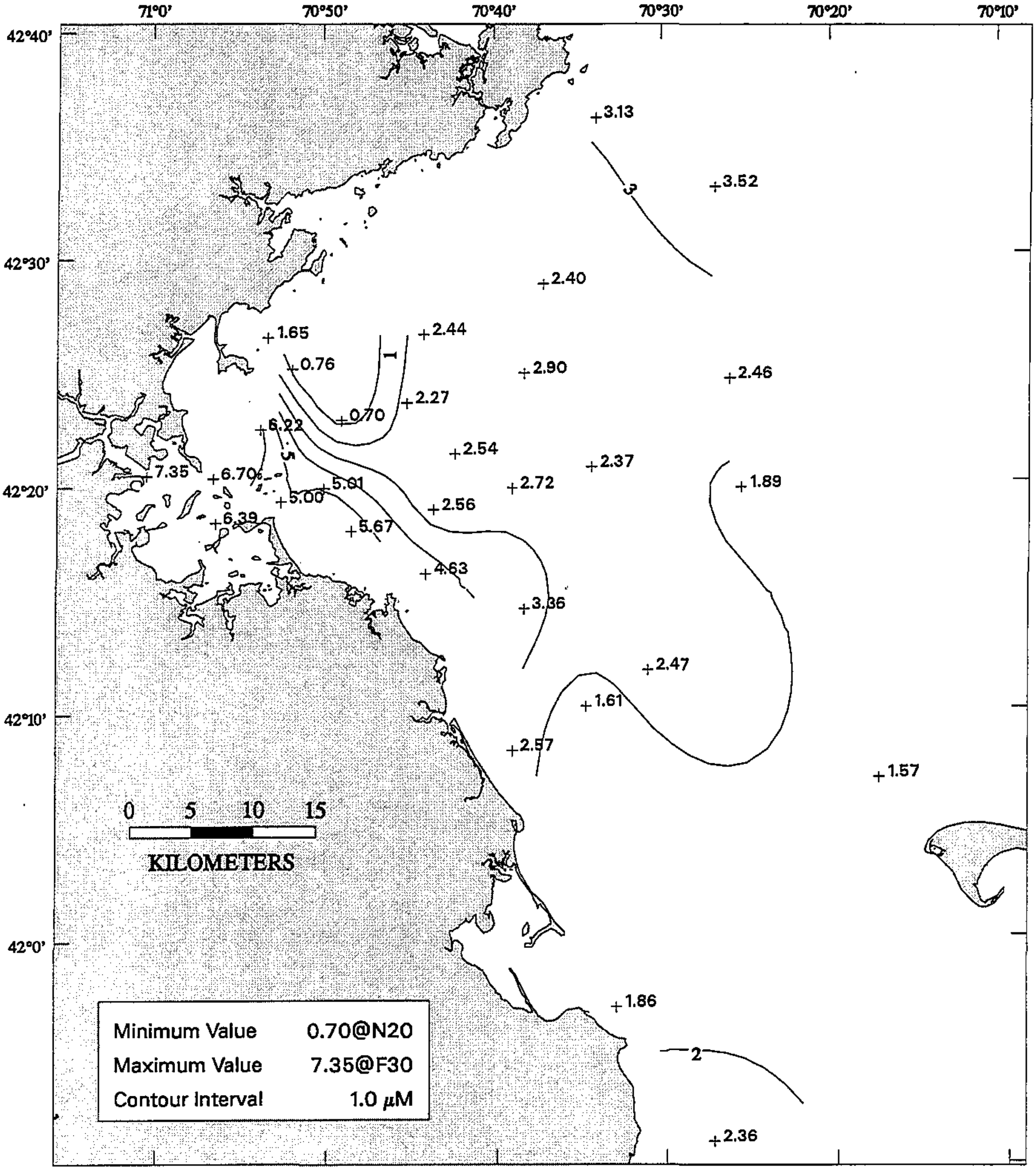
9511po4_lin
PO4



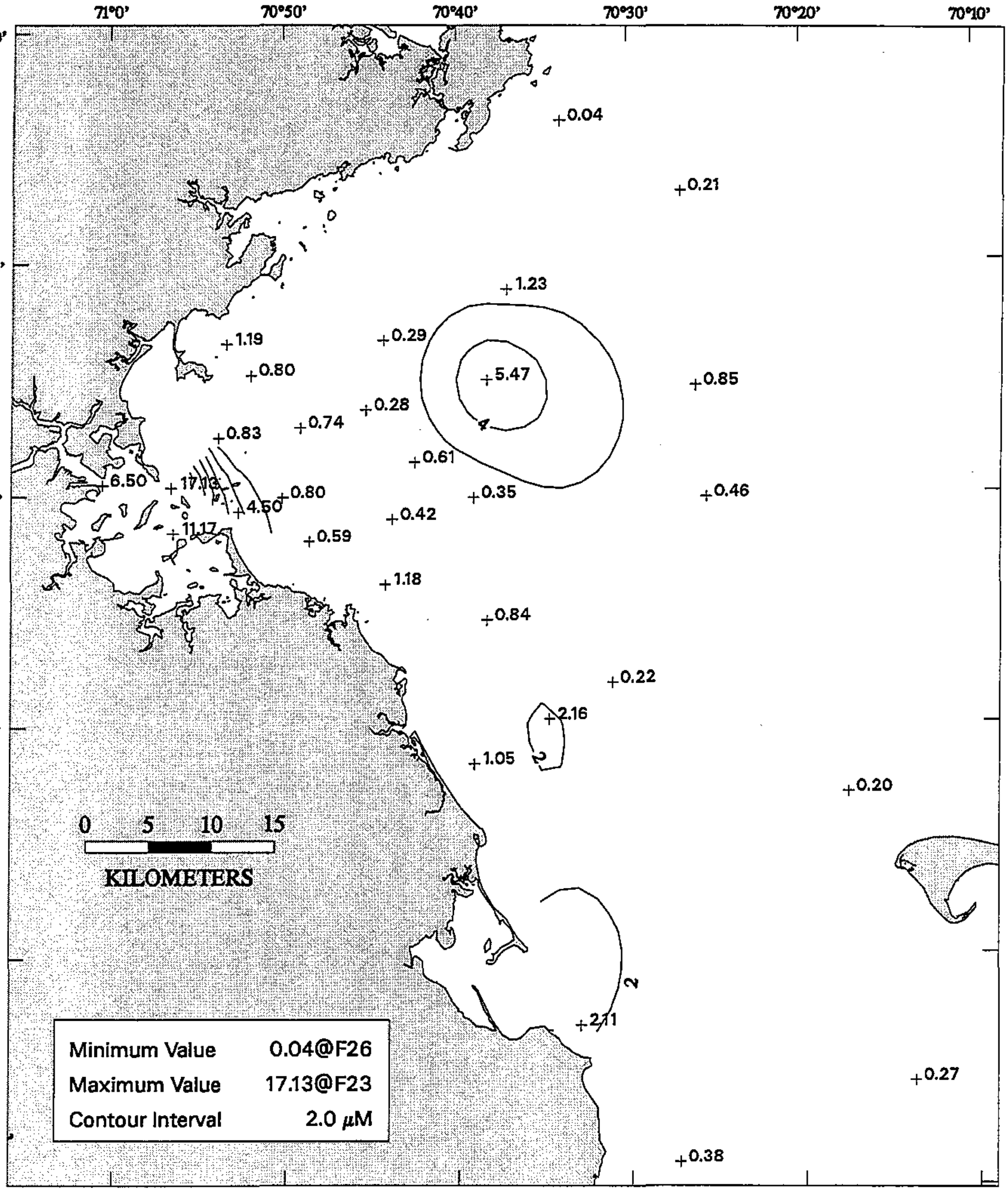
9514po4_lin
PO4



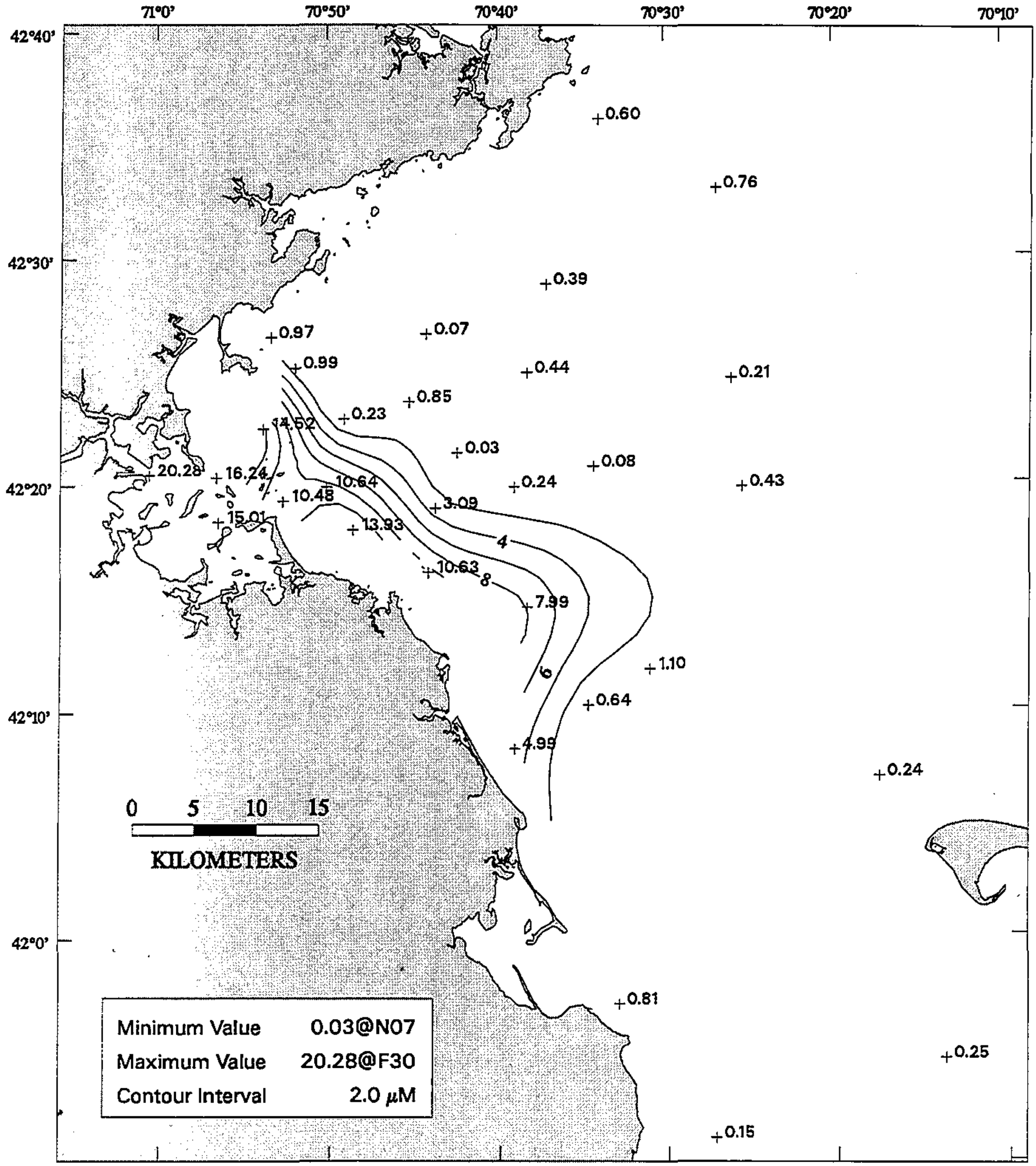
9511sio4_lin
SIO4



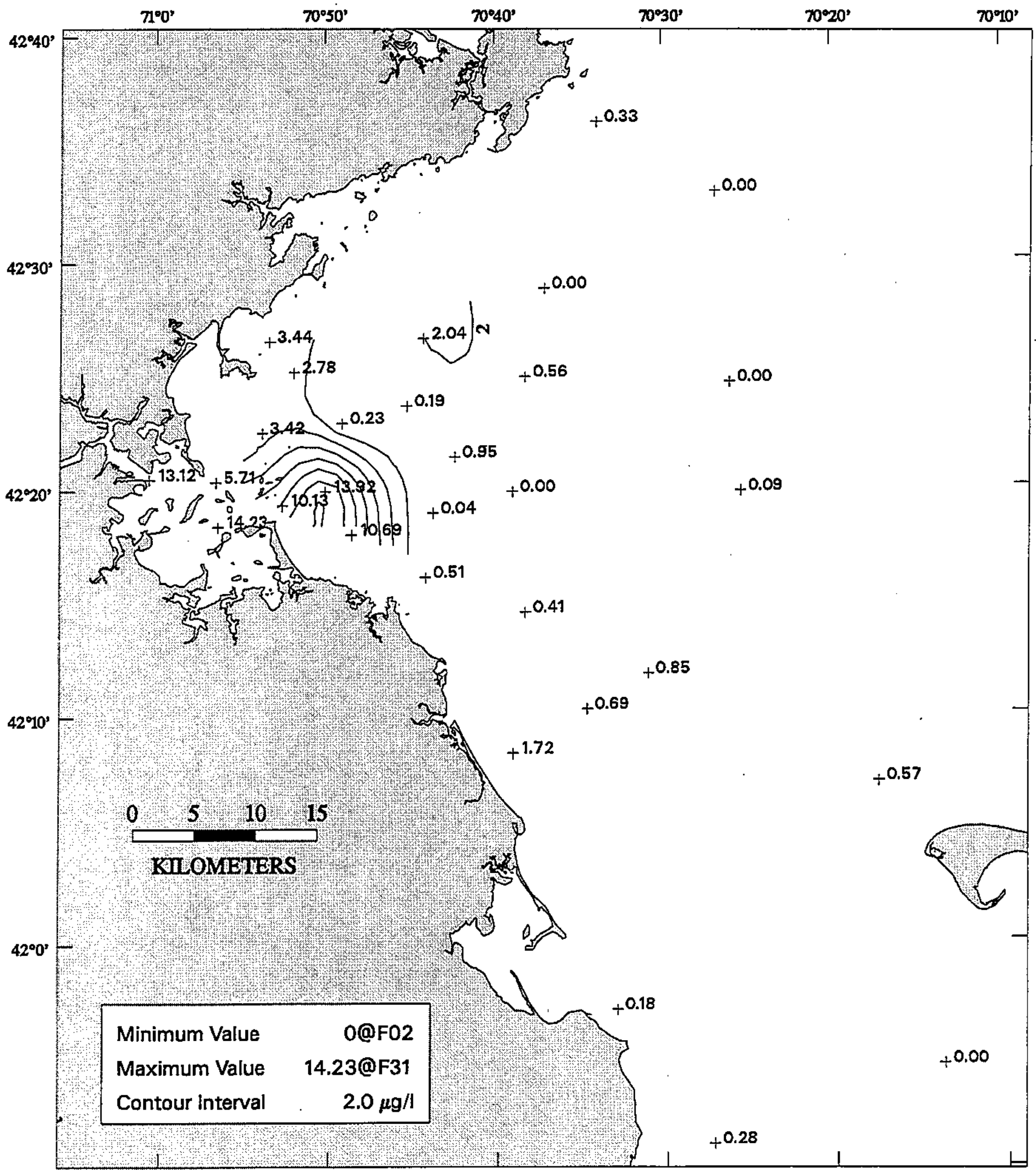
9514sio4_lin
SIO4



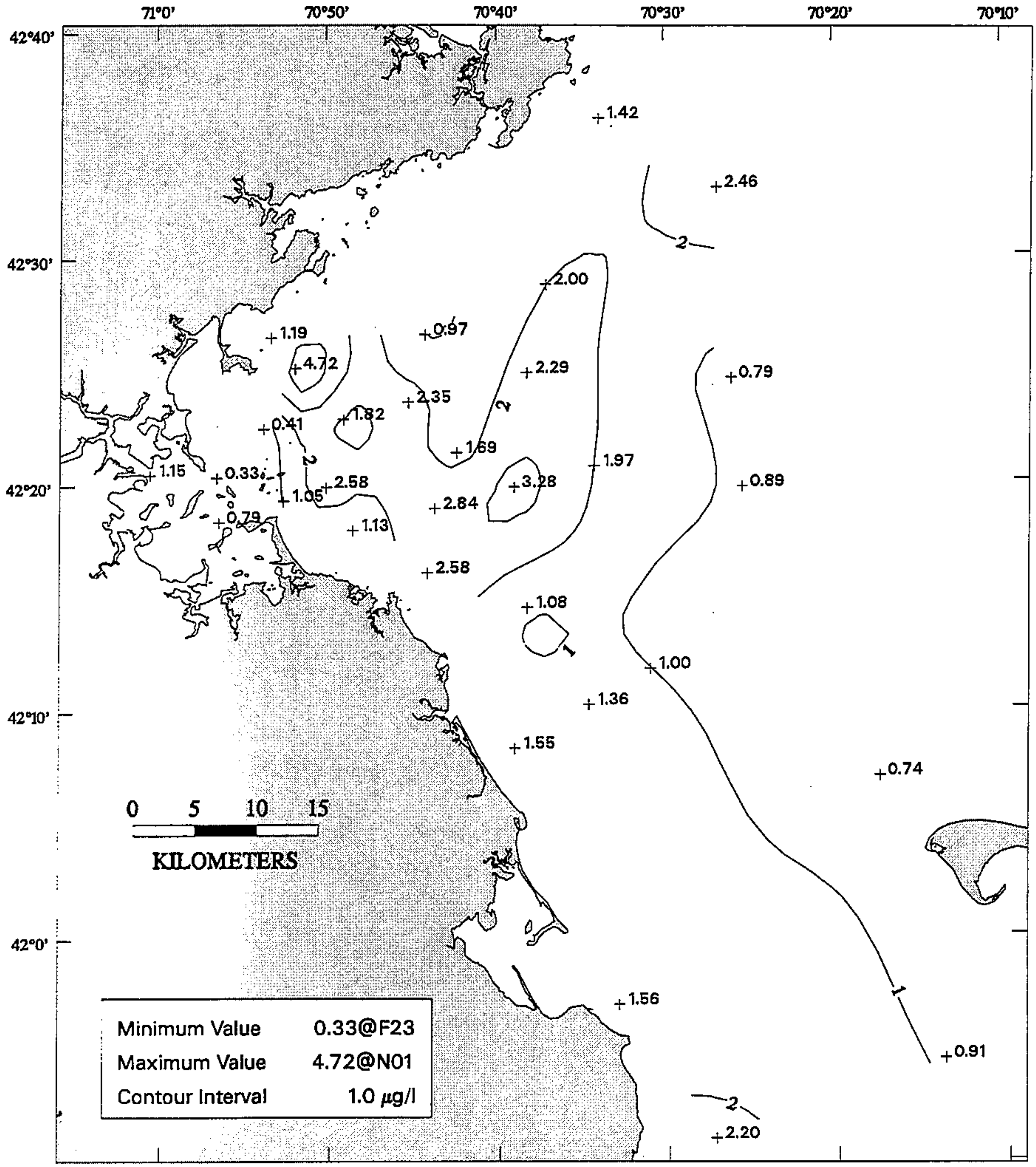
9511din_lin
DIN



9514din_lin
DIN



9511fluo_lin
FLUO



9514fluo_lin
FLUO

APPENDIX C

Transect Plots

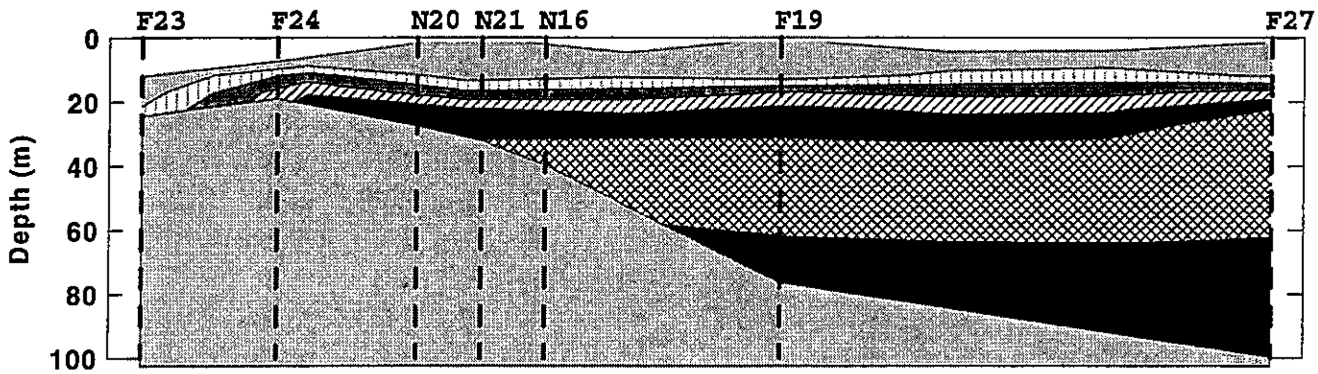
Data were contoured relative to water depth and distance between stations as shown on the transects (Figure 1-3, text). Relative distances between stations and water depth at each station is shown on the transect. Water depth is labelled with negative values in meters, with zero depth at the sea surface, and shaded with slanted lines. Three transects (Boston-Nearfield, Cohasset, and Marshfield) are provided on each plot, as well as shaded contour levels on the scale bar at the bottom of the plot. Contour units are as noted on the table below. Each plot is labelled on the bottom right with the parameter as listed below, and the survey number ("9511").

Appendix C: Table of Contents

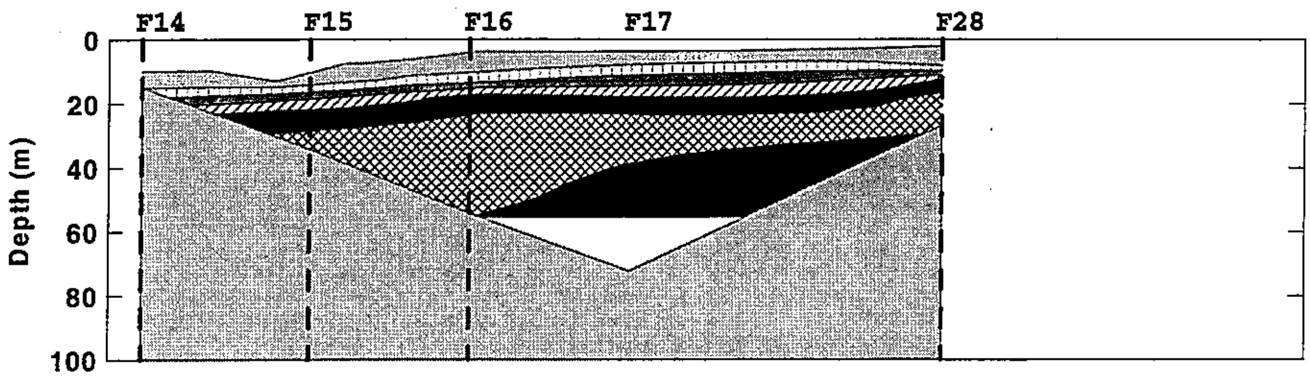
Parameter Name	Map Parameter Name	Units
Sigma-T (σ_t)	Sigma-T	n/a
Temperature	Temperature	°C
Salinity	Salinity	PSU
Transmissivity (beam attenuation)	Trans	/m
Nitrate (NO_3)	NO3	µM
Phosphate (PO_4)	PO4	µM
Silicate (SiO_4)	SiO4	µM
Dissolved Inorganic Nitrogen (DIN*)	DI Nitro	µM
Chlorophyll *a*	Fluorescence	µg/L
DO Saturation	DO % Saturation	%

*$NO_3 + NO_2 + NH_4$

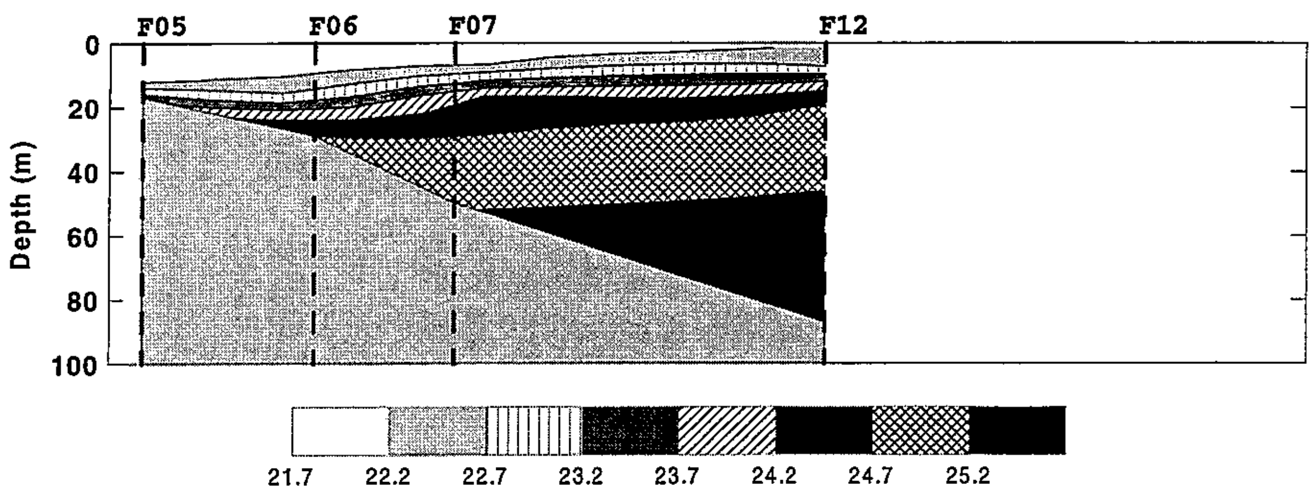
Boston-Nearfield Transect

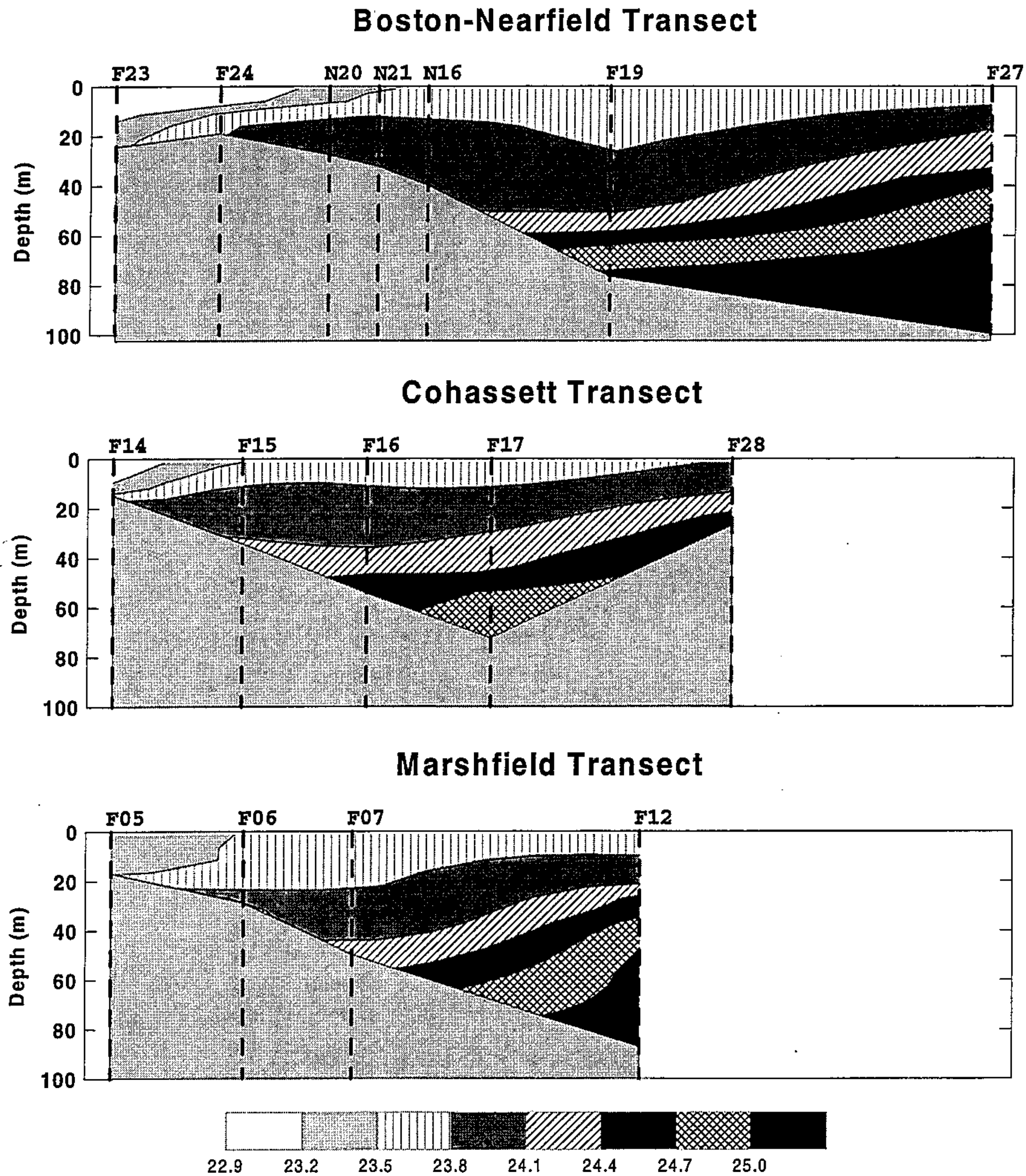


Cohassett Transect

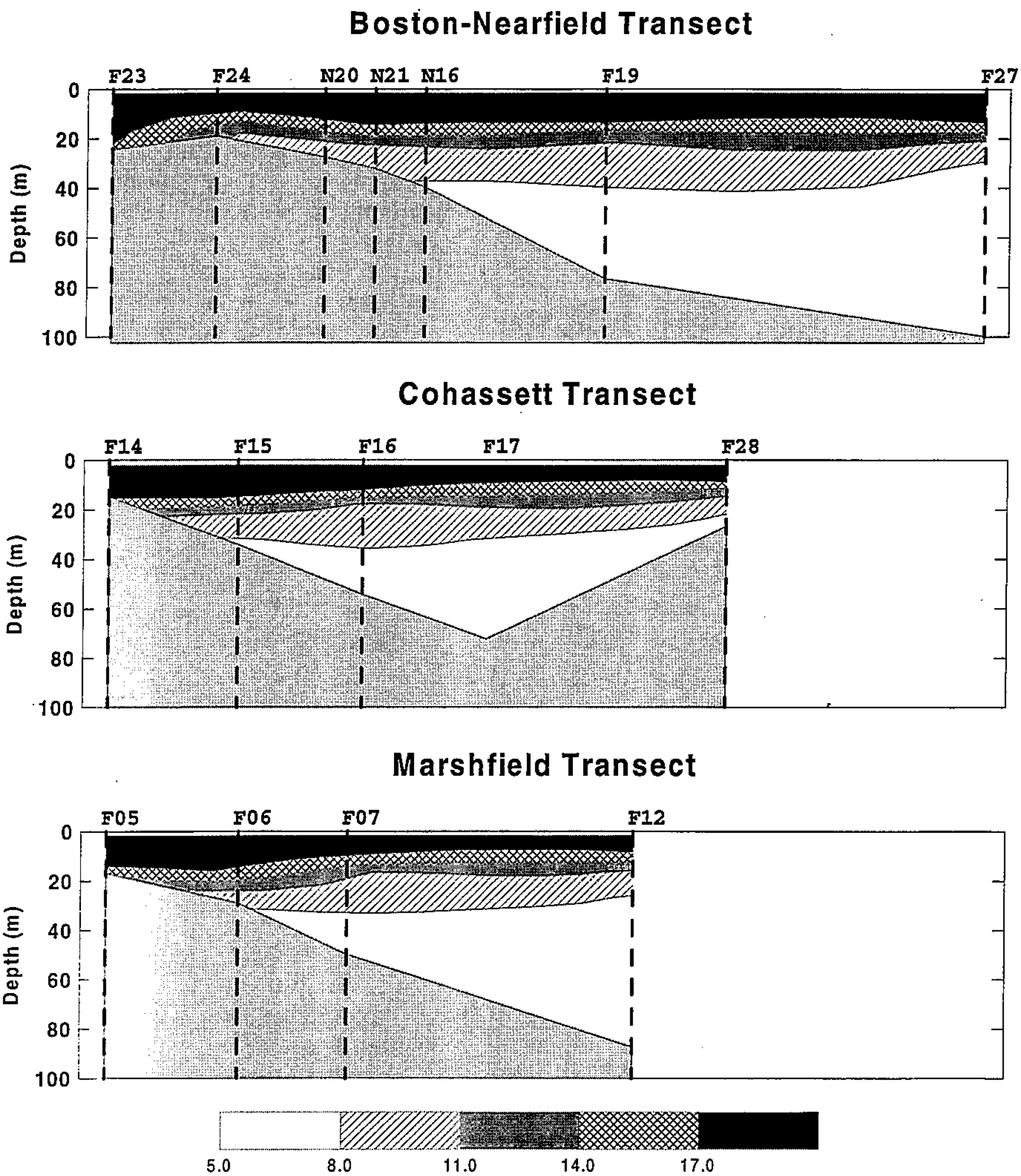


Marshfield Transect

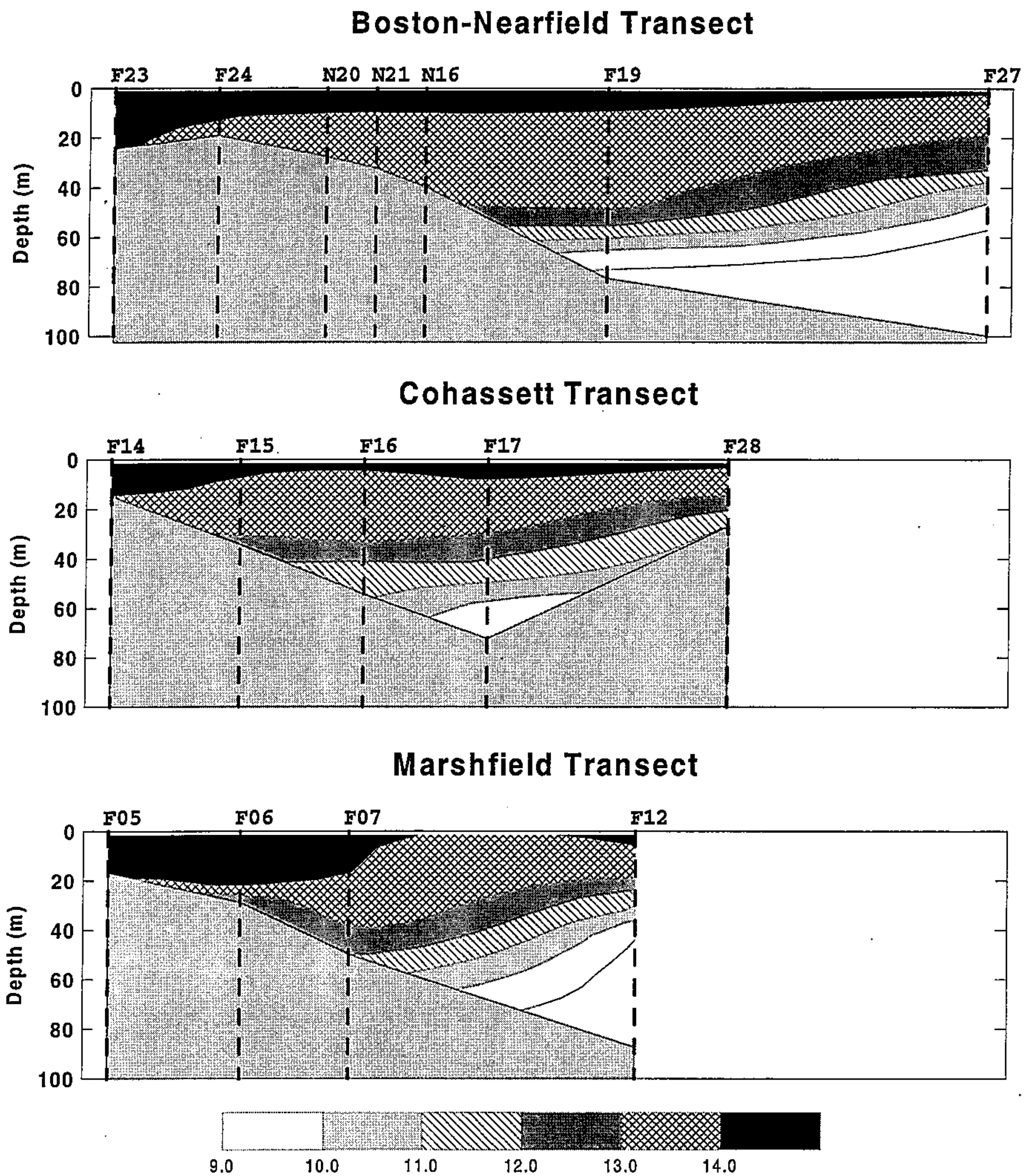



Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
22.9
23.2
23.5
23.8
24.1
24.4
24.7
25.0

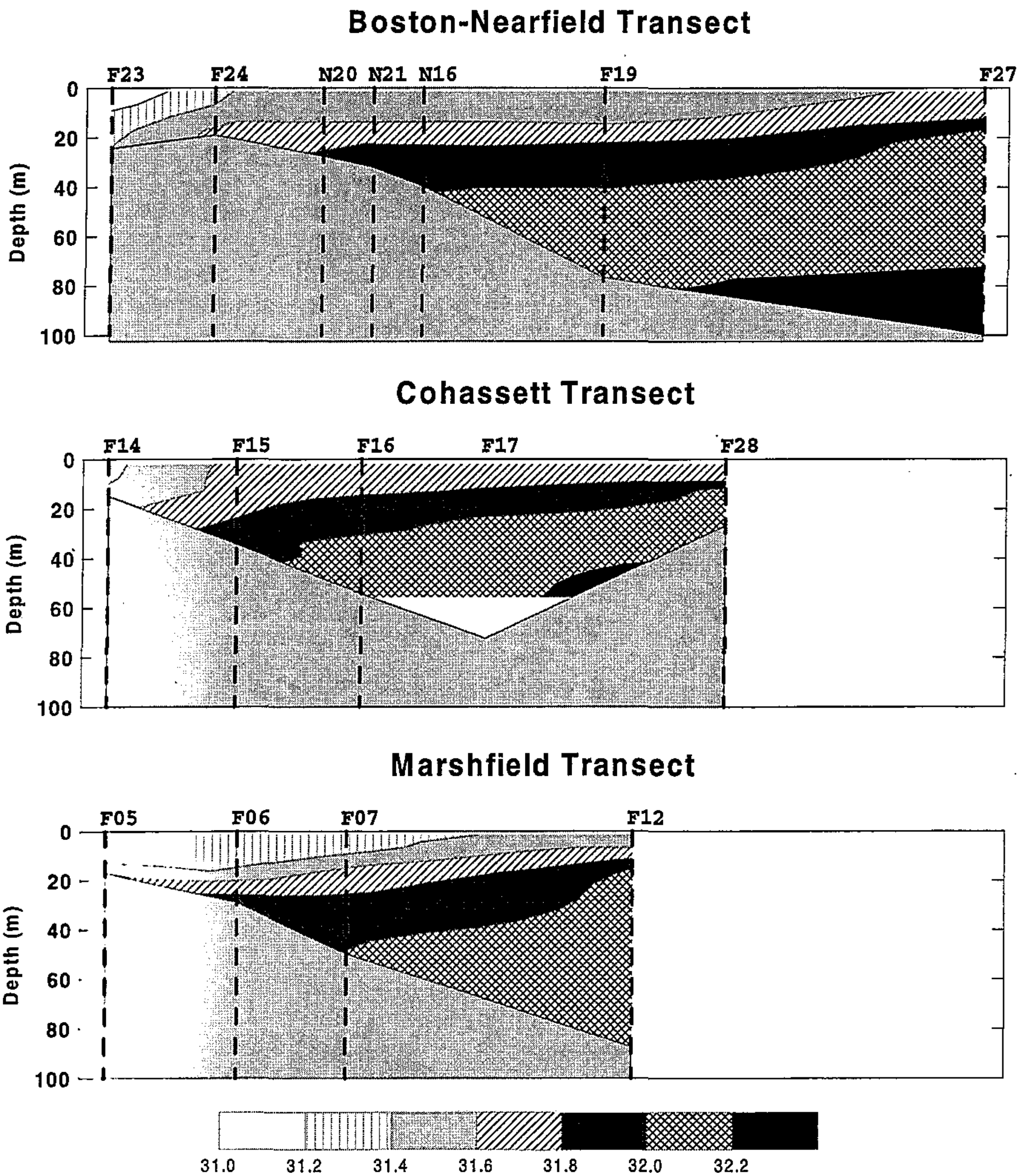
Sigma-T 9514



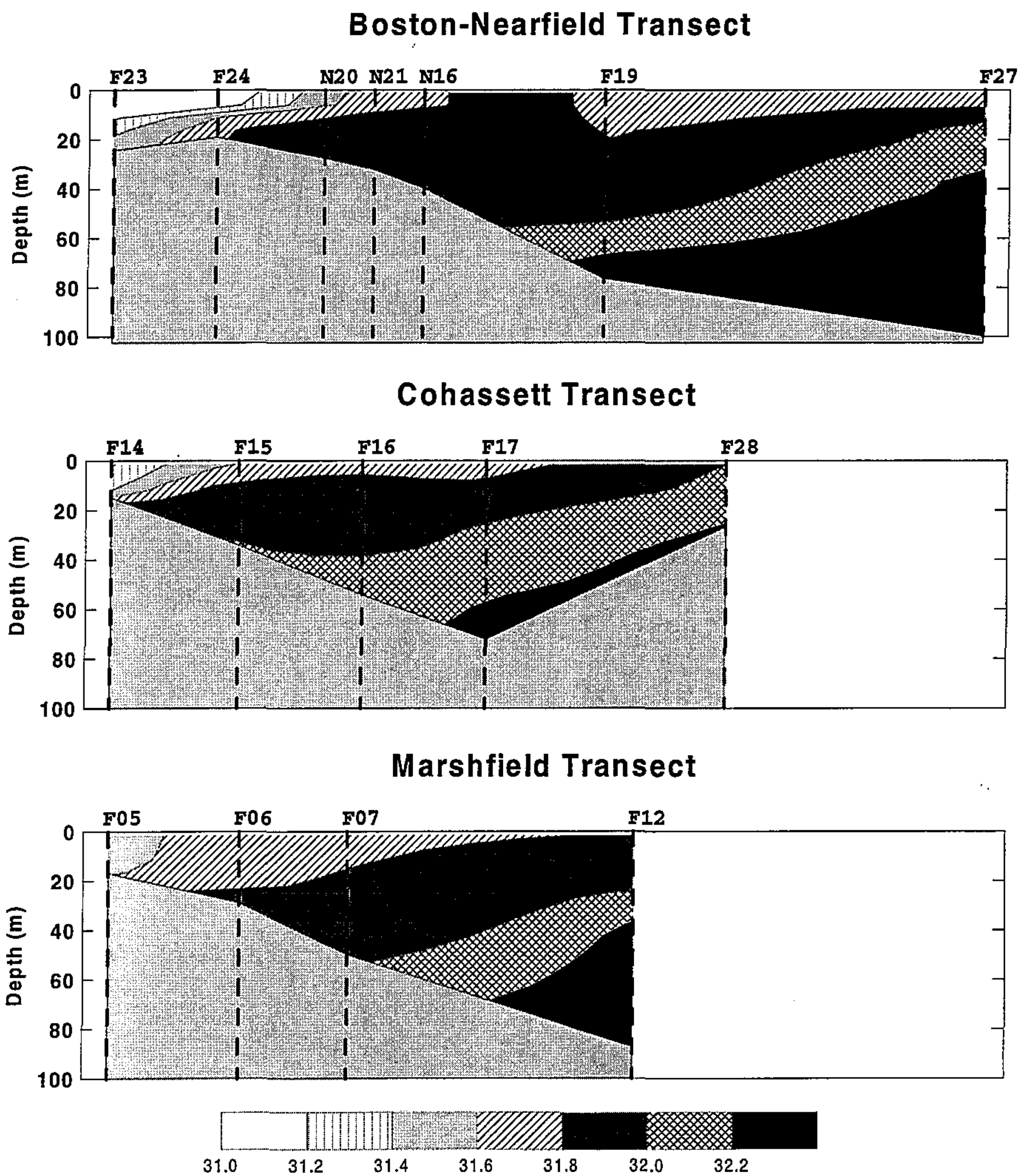
Temperature 9511



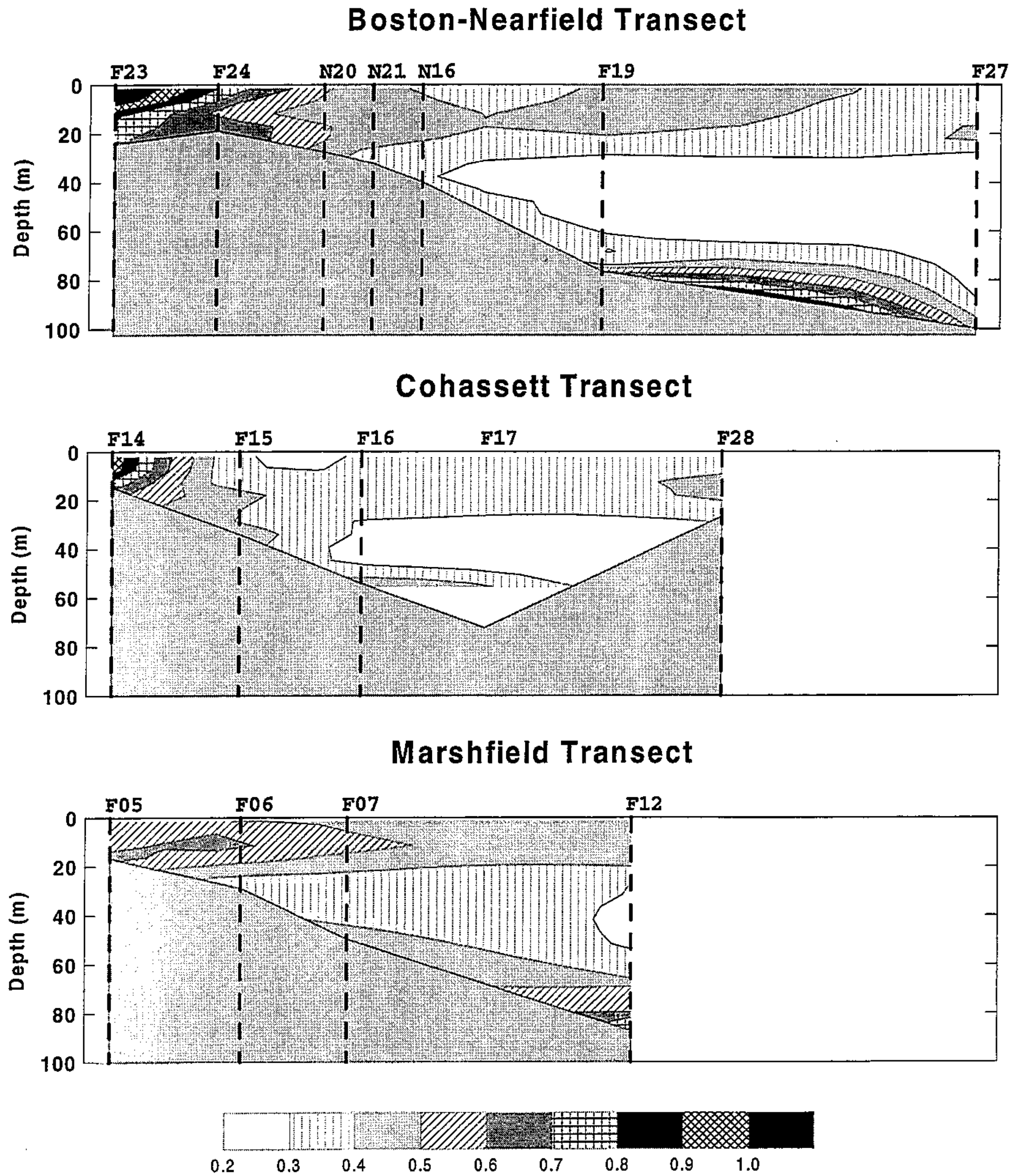
Temperature 9514



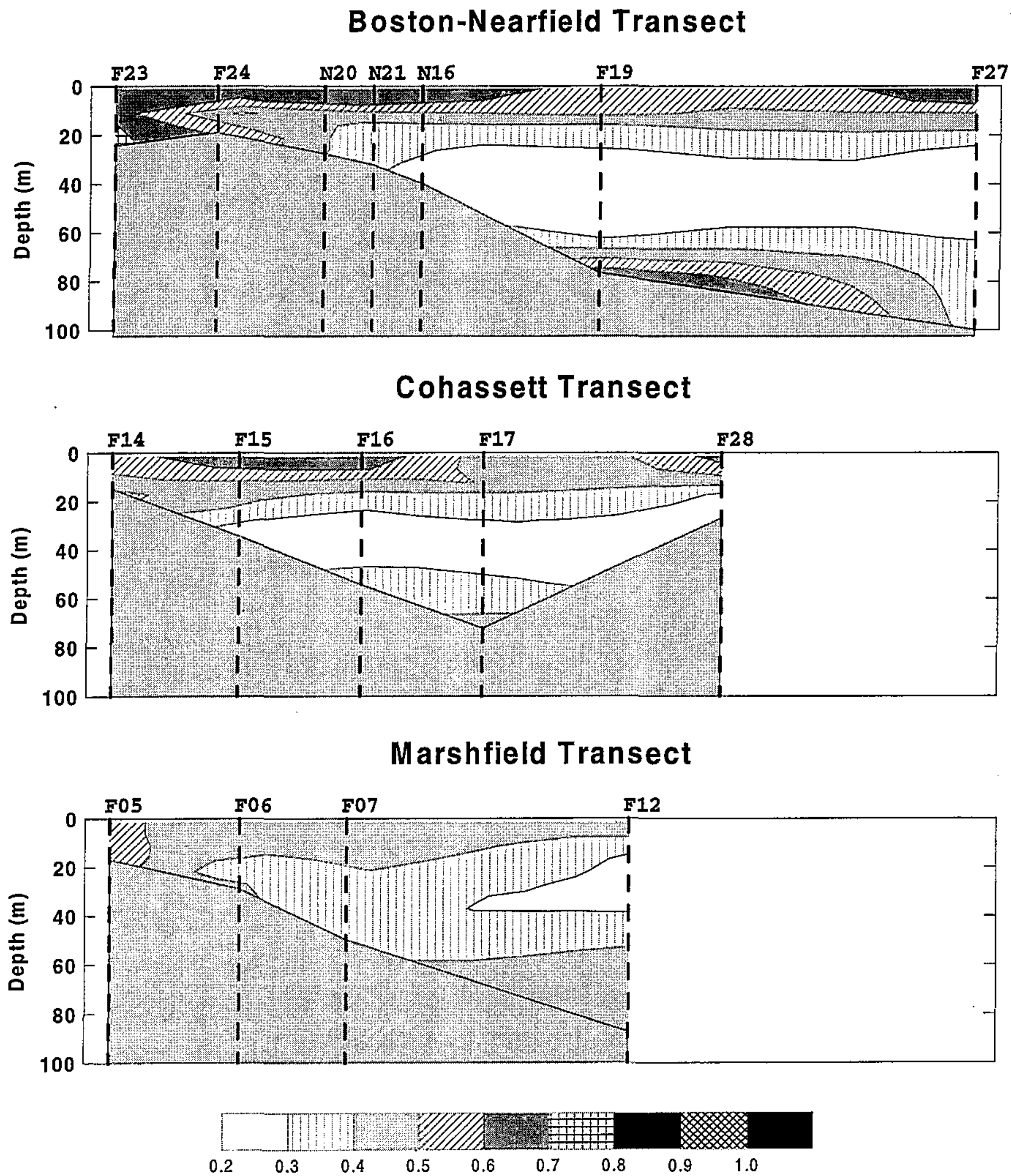
Salinity 9511

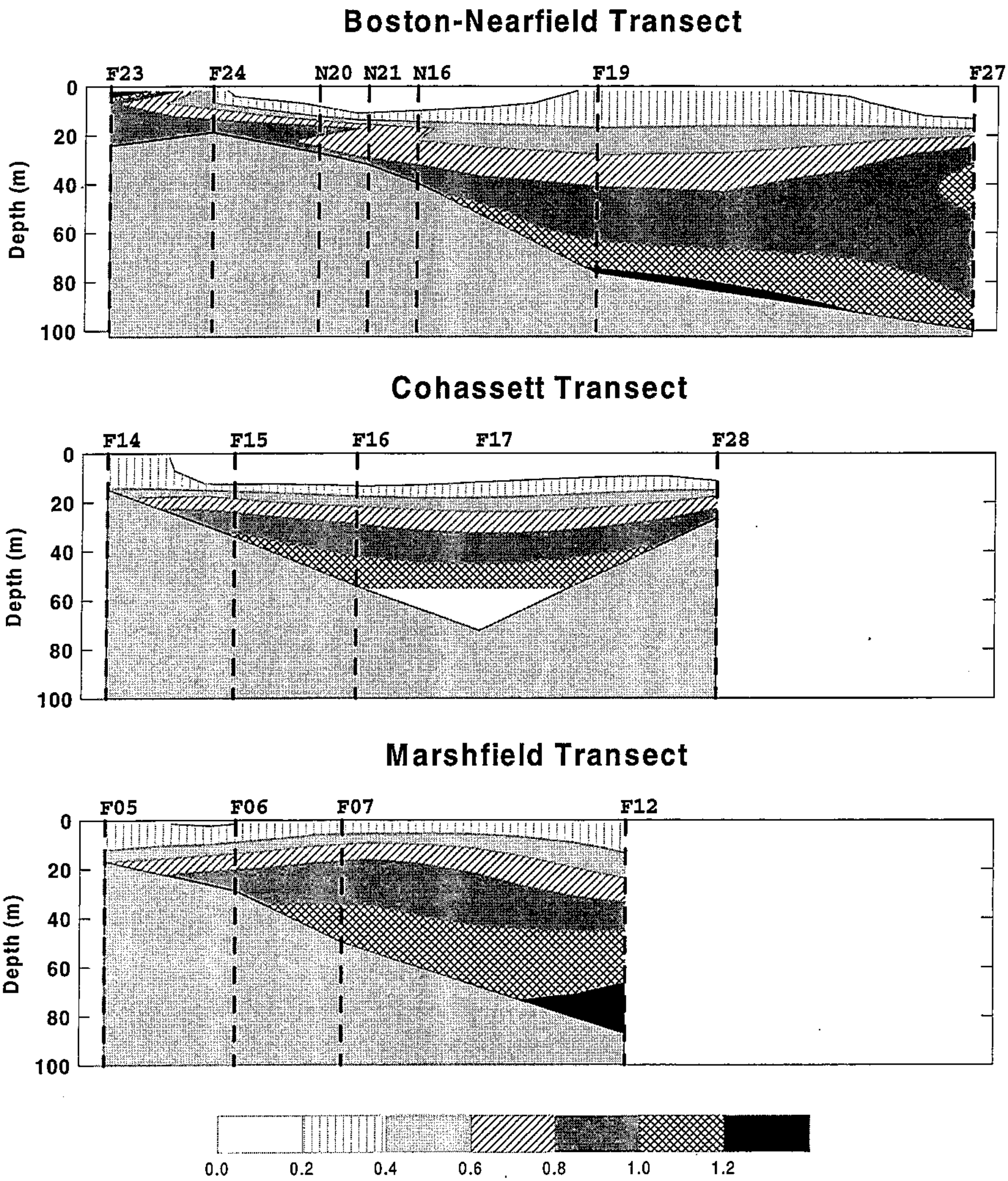


Salinity 9514

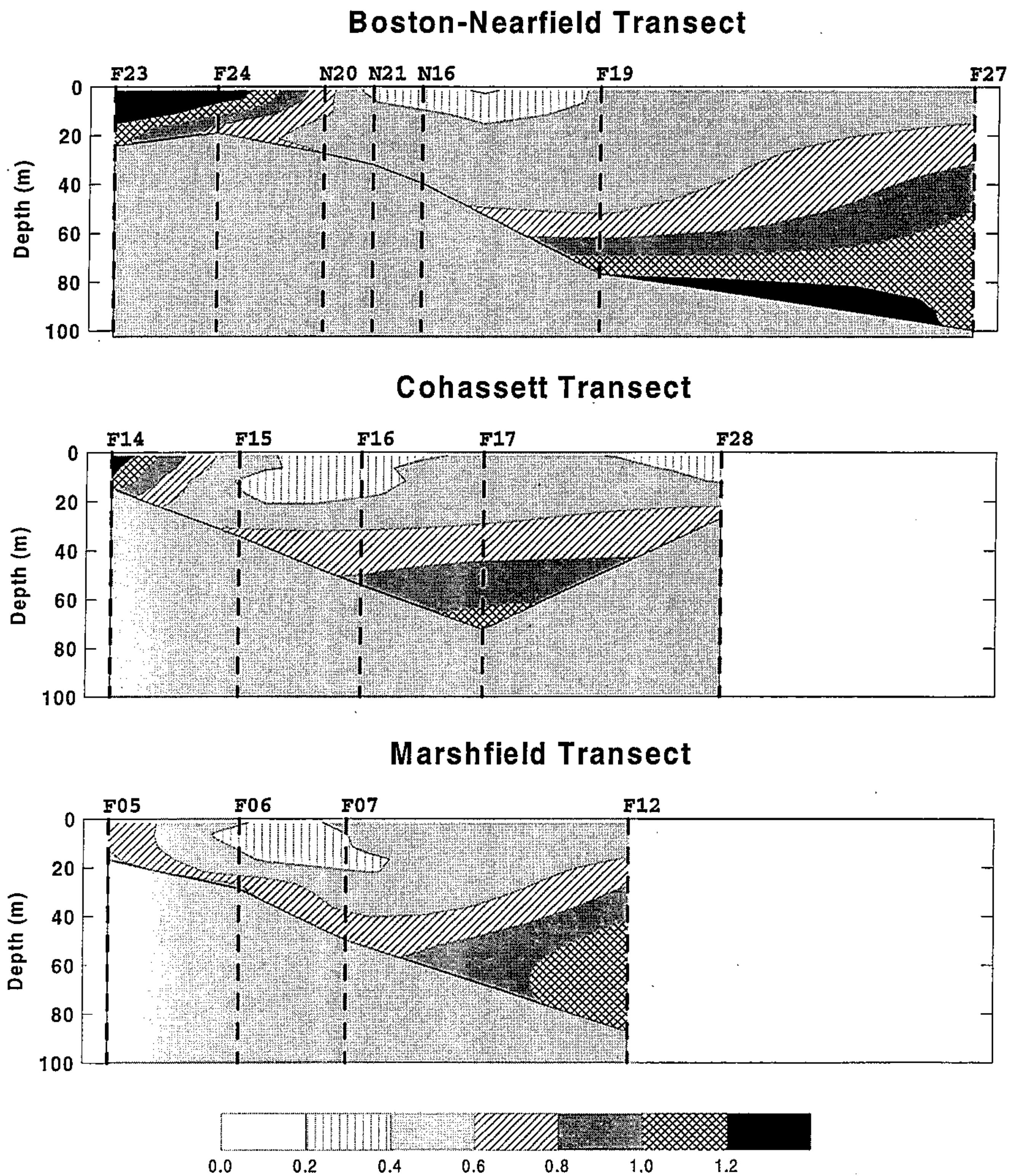

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

Trans 9511

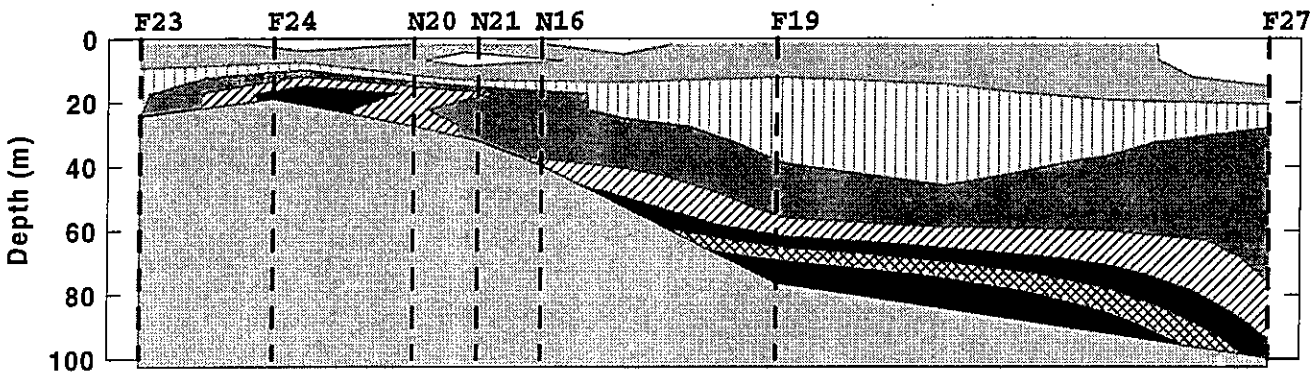

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0



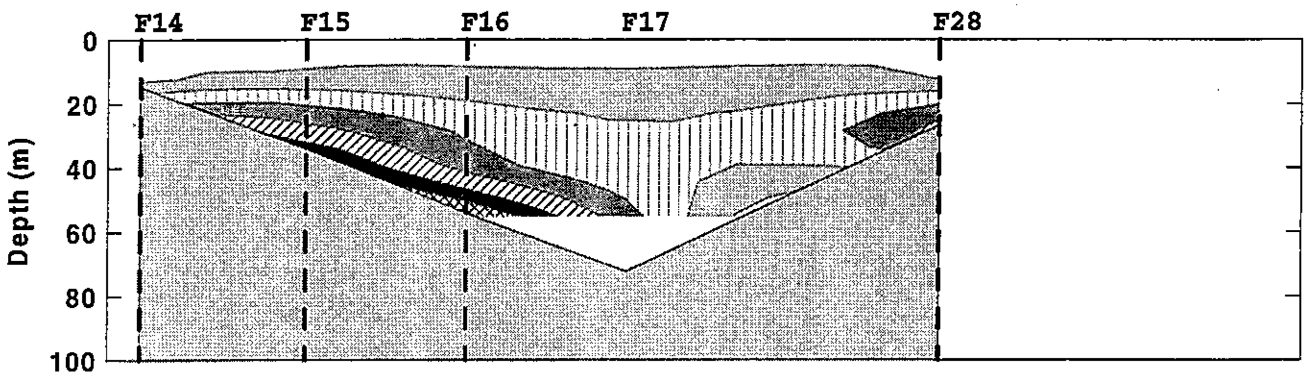
Boston-Nearfield Transect
F23 F24 N20 N21 N16 F19 F27
Depth (m)
0 20 40 60 80 100
Cohassett Transect
F14 F15 F16 F17 F28
Depth (m)
0 20 40 60 80 100
Marshfield Transect
F05 F06 F07 F12
Depth (m)
0 20 40 60 80 100
0.0 0.2 0.4 0.6 0.8 1.0 1.2


Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0
1.2

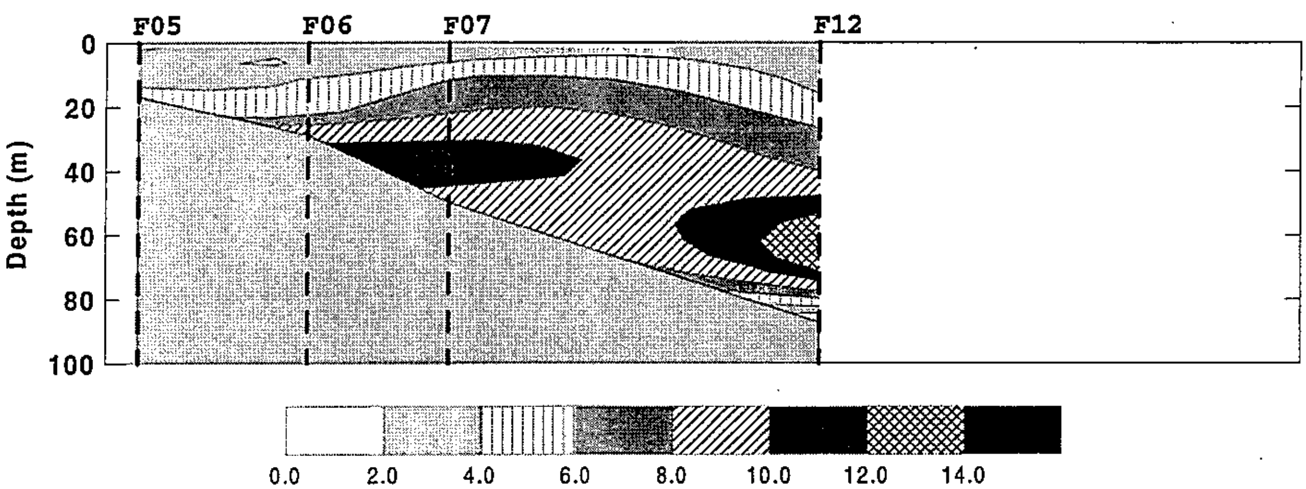
Boston-Nearfield Transect

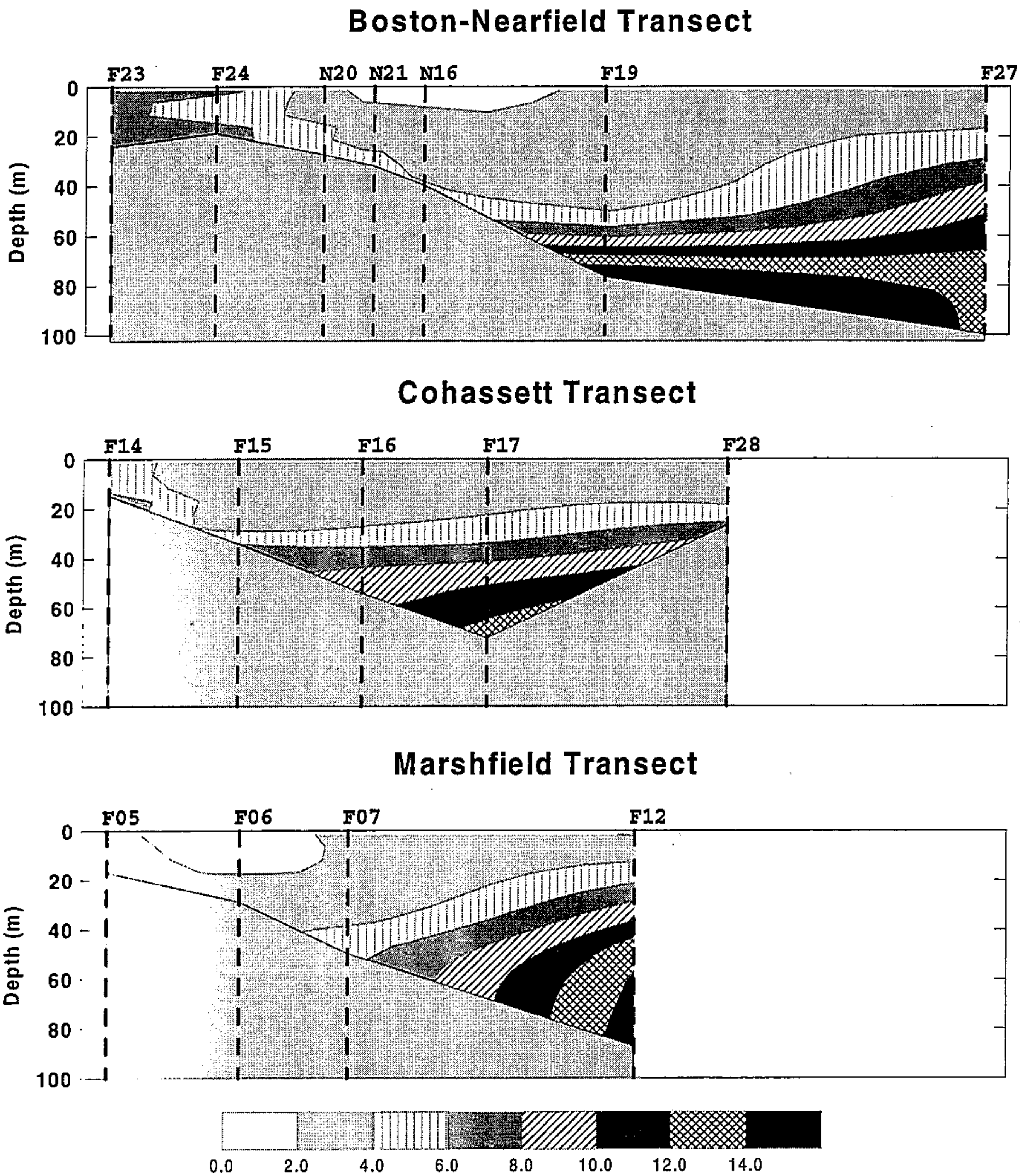


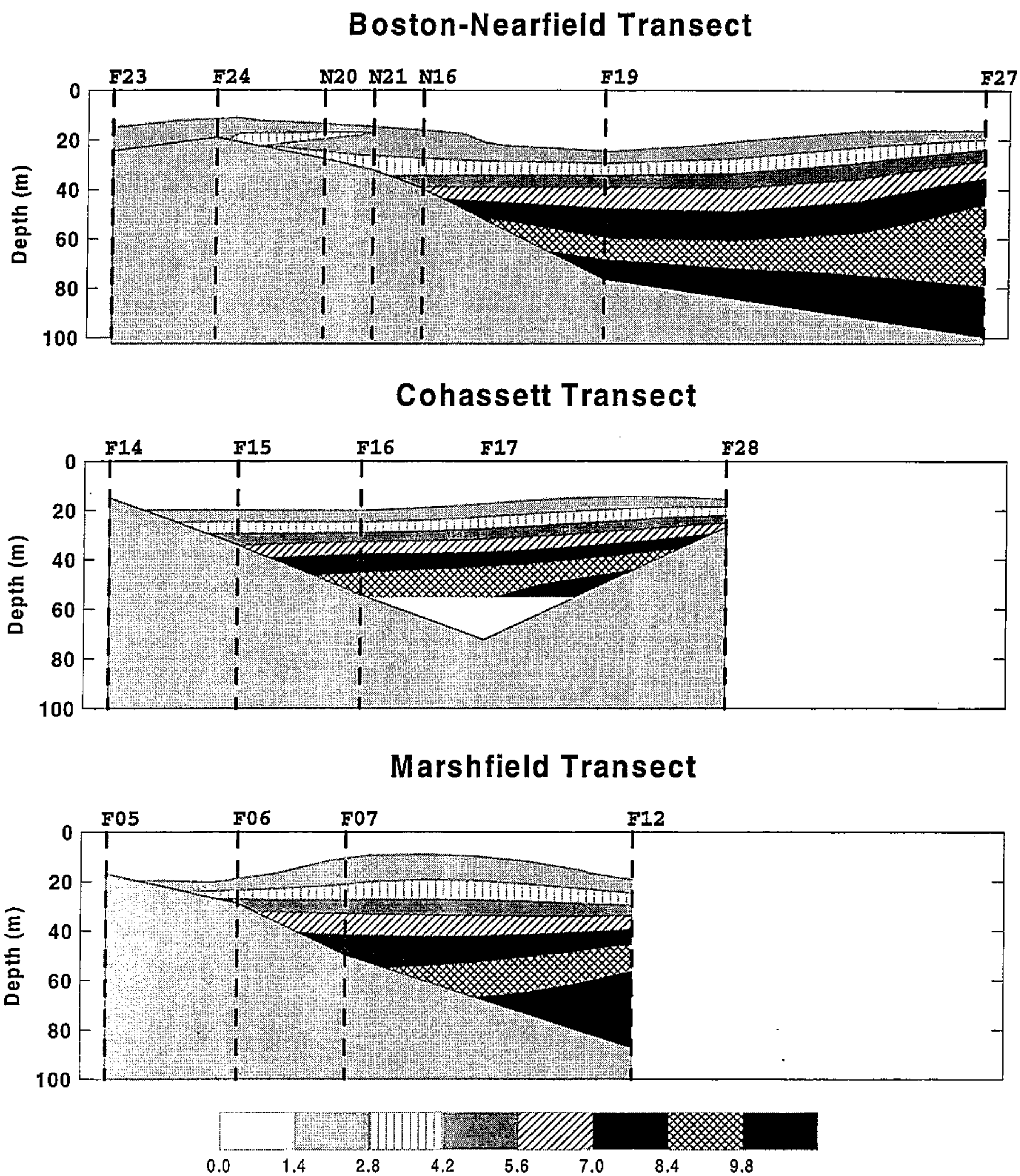
Cohassett Transect



Marshfield Transect

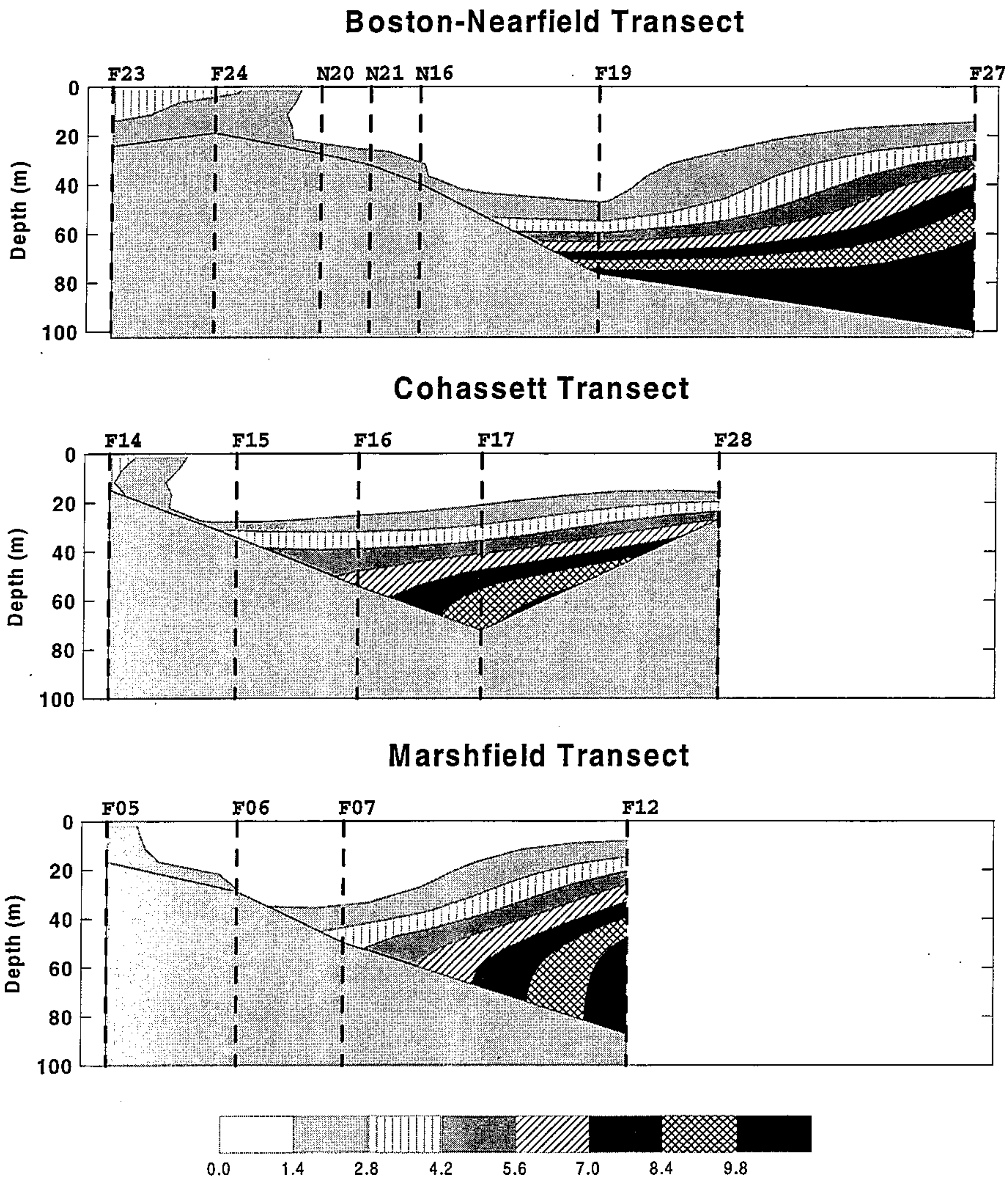



Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0



Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Marshfield Transect
F05
F06
F07
F12
0.0
1.4
2.8
4.2
5.6
7.0
8.4
9.8

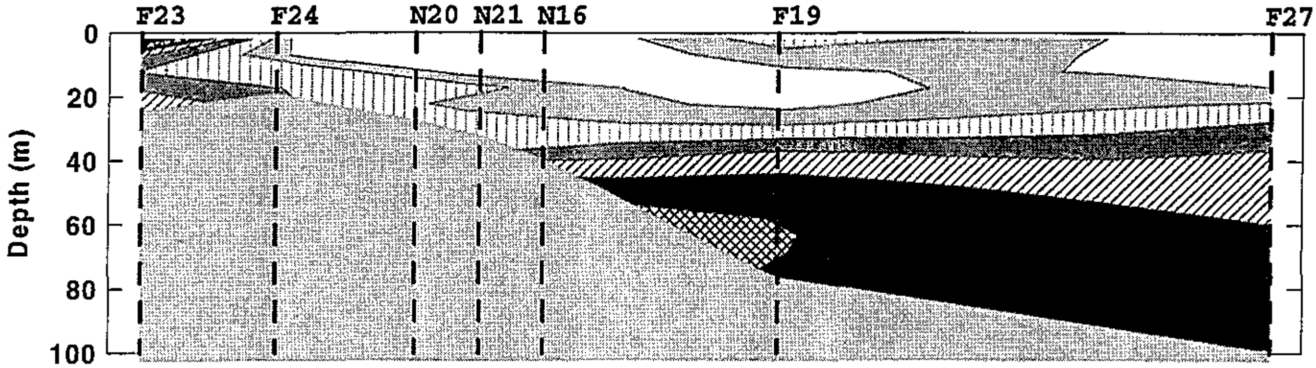
NO3 9511



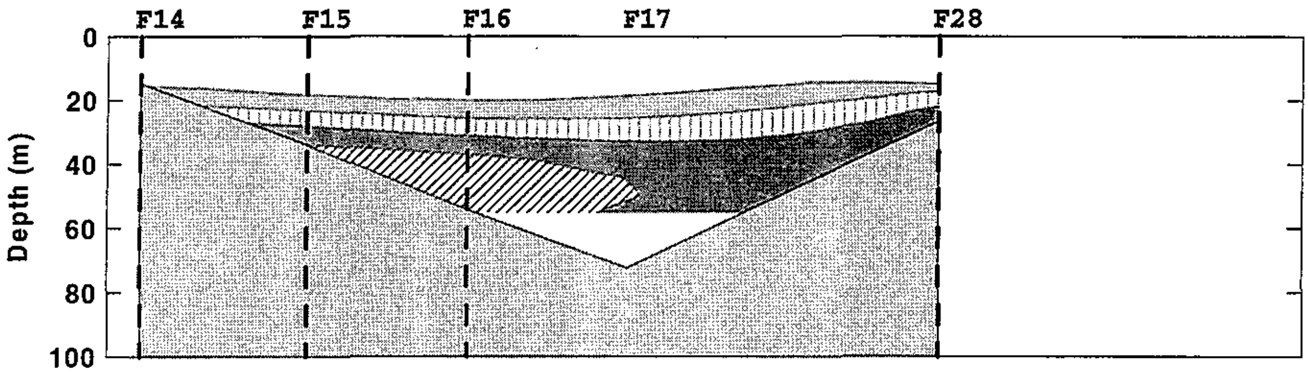
Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.0
1.4
2.8
4.2
5.6
7.0
8.4
9.8

NO3 9514

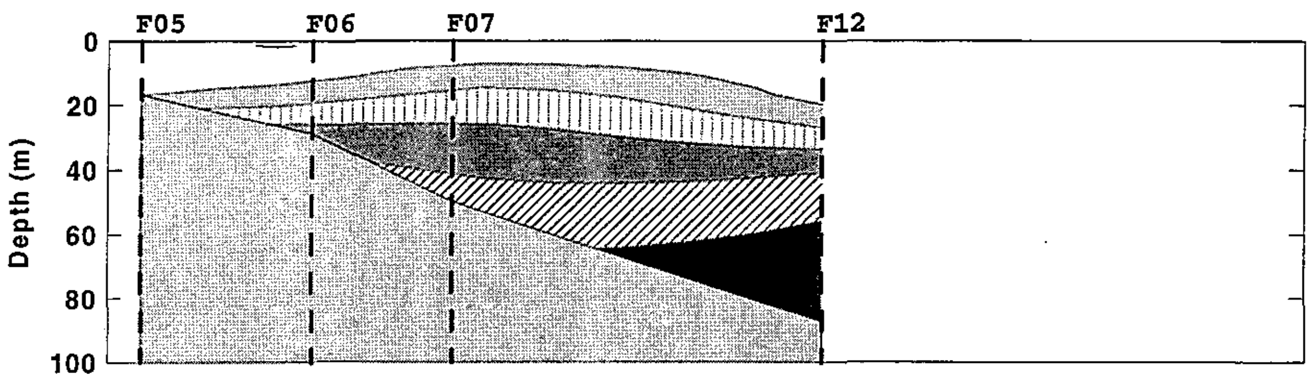
Boston-Nearfield Transect

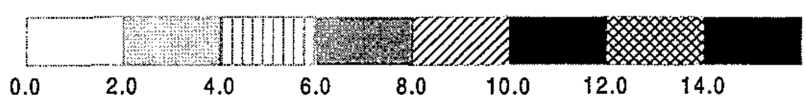


Cohassett Transect

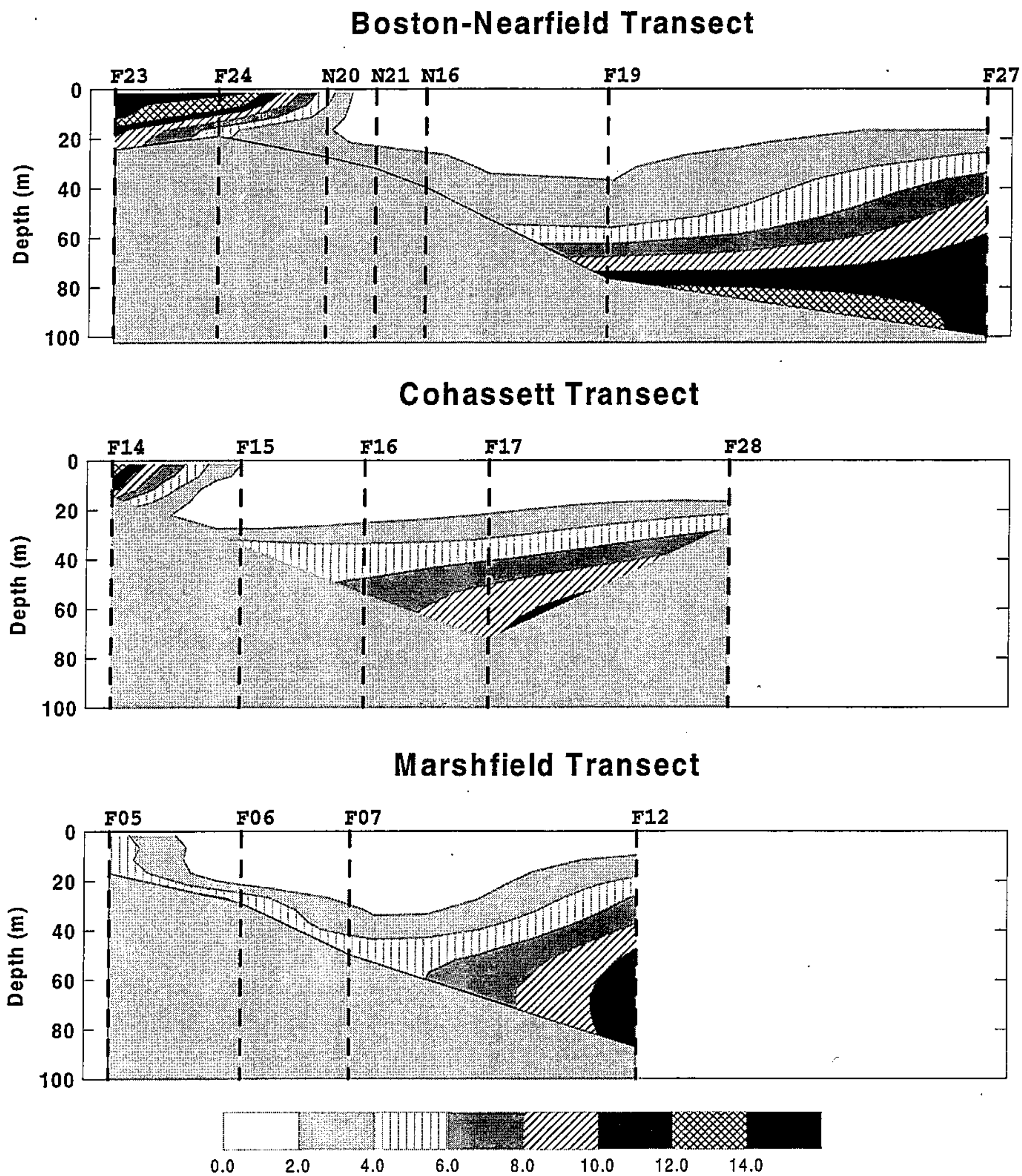


Marshfield Transect

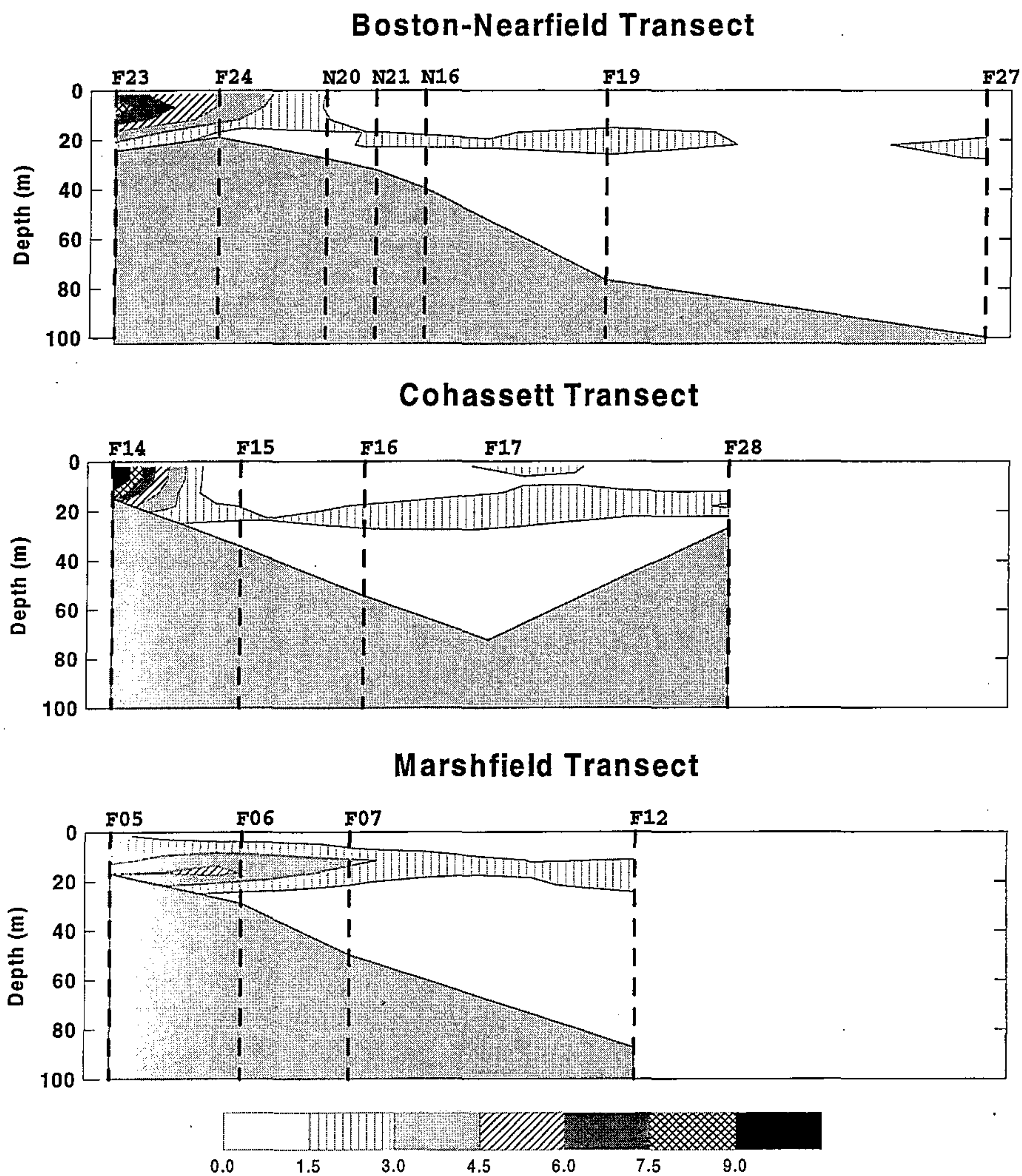




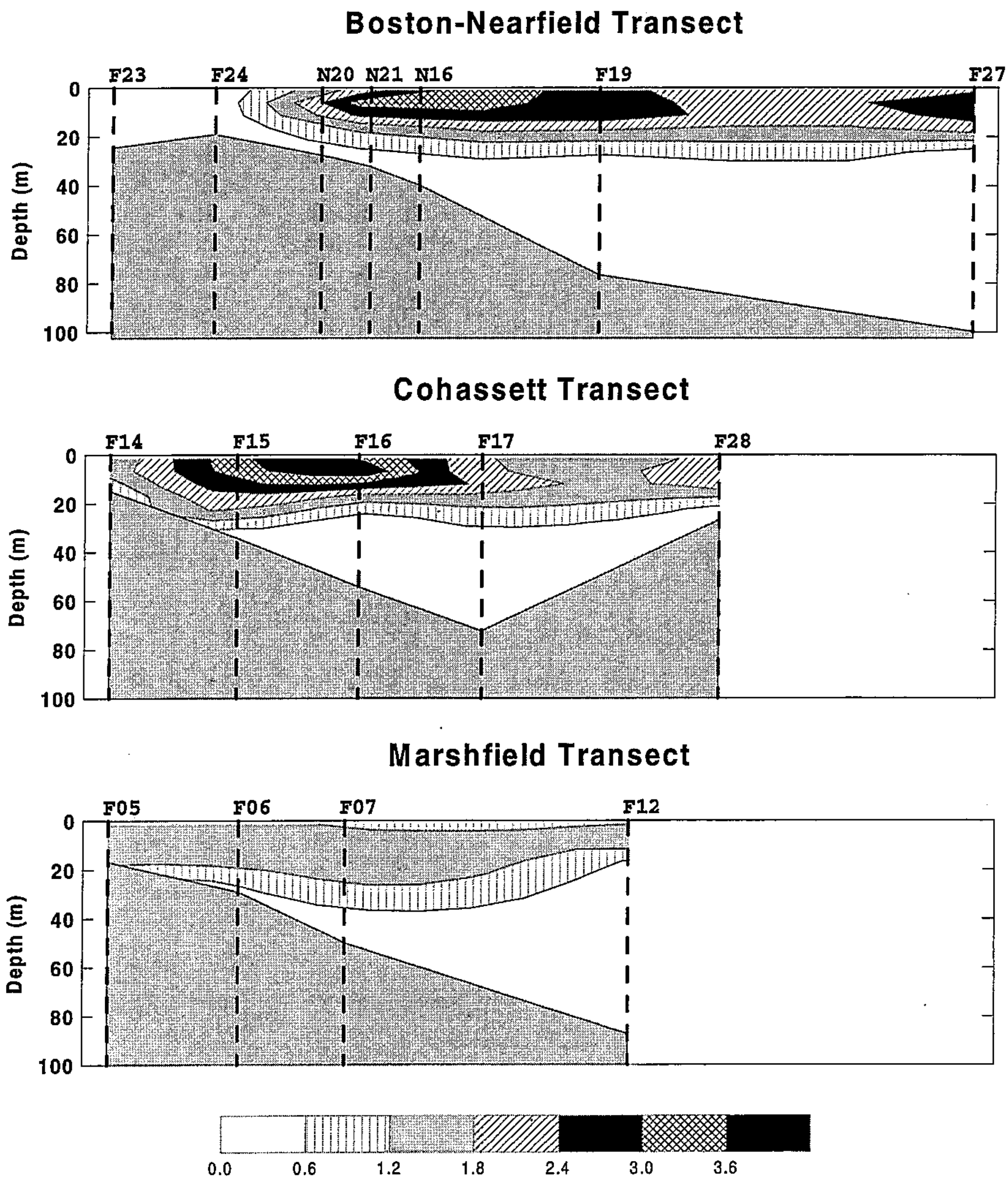
DI Nitro 9511



DI Nitro 9514

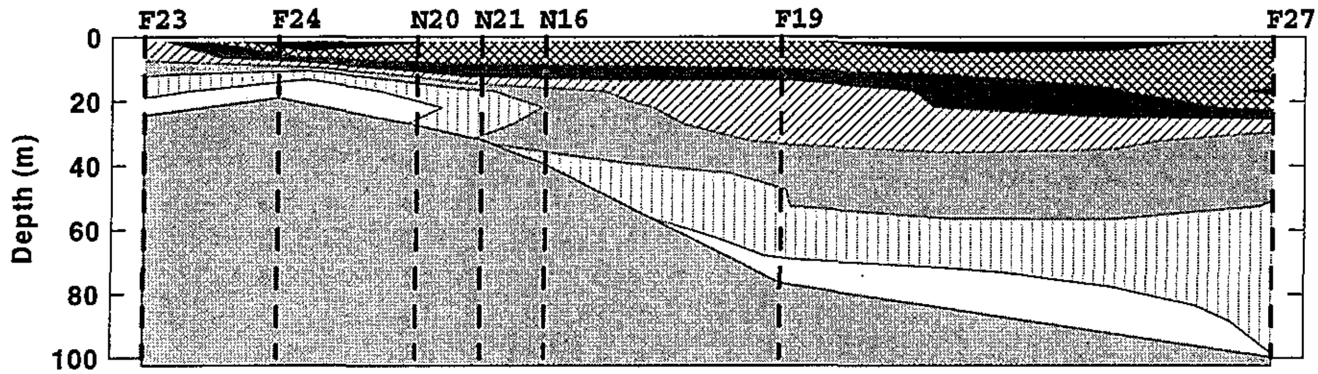


Fluorescence 9511

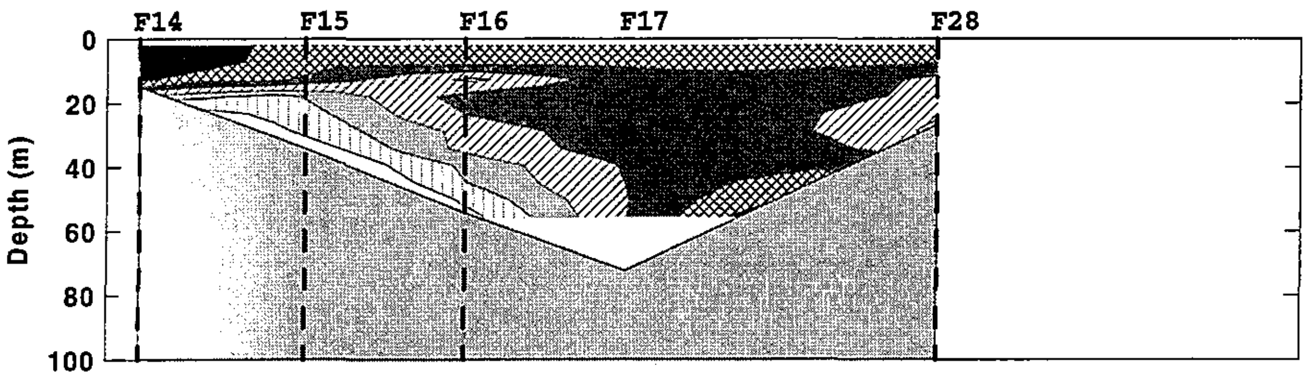


Fluorescence 9514

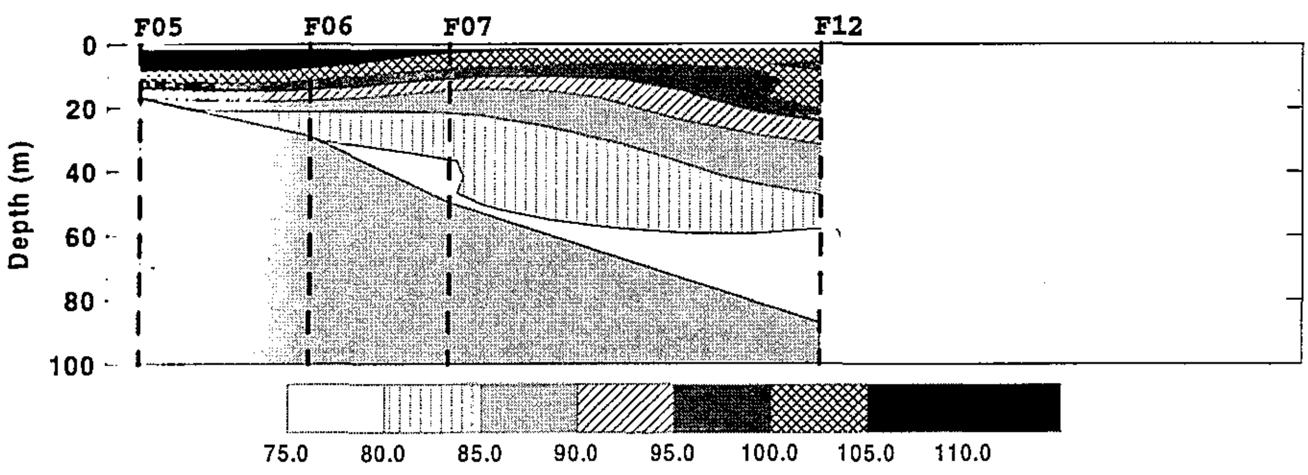
Boston-Nearfield Transect



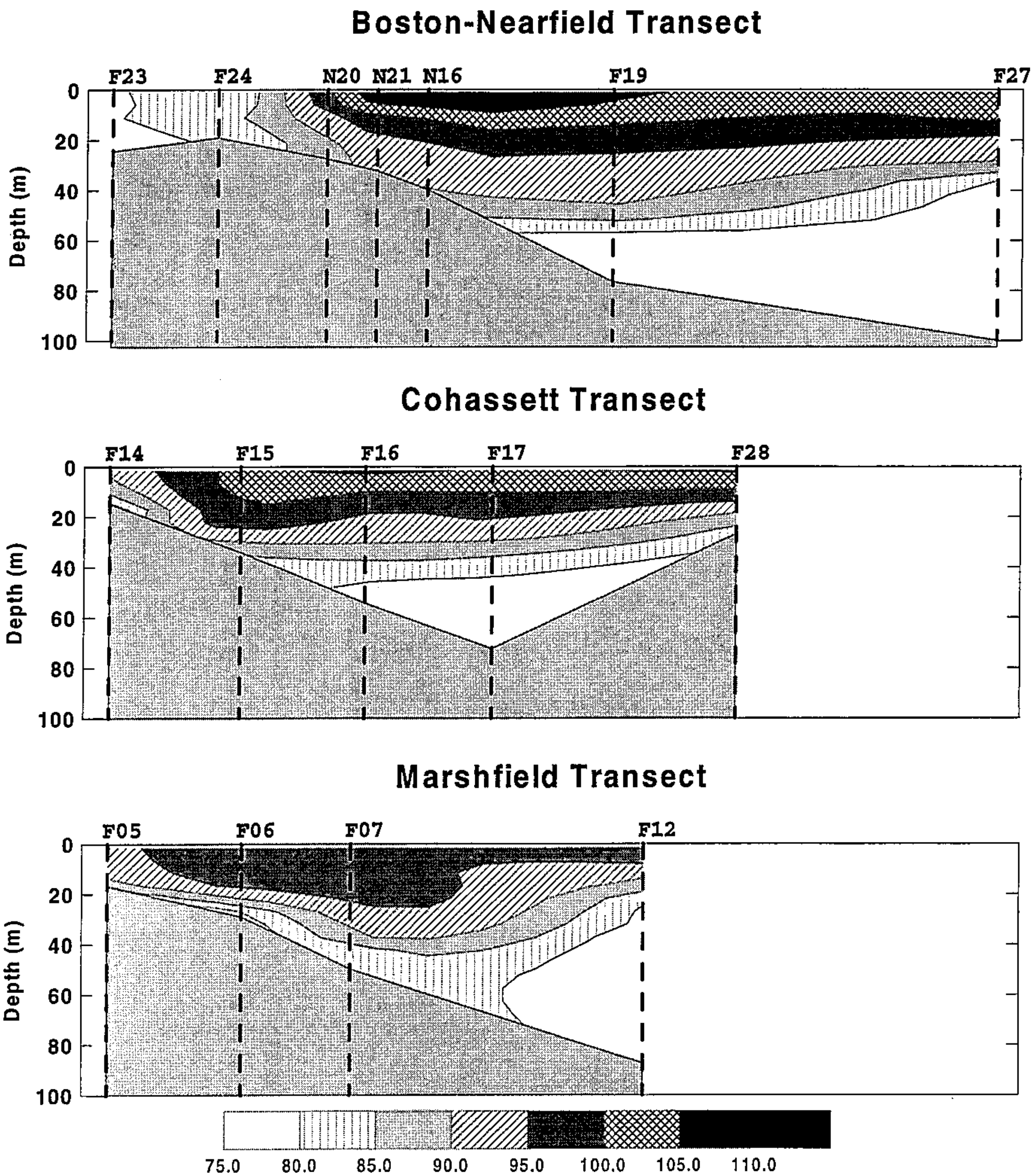
Cohassett Transect



Marshfield Transect



DO % Saturation 9511



DO % Saturation 9514

APPENDIX D

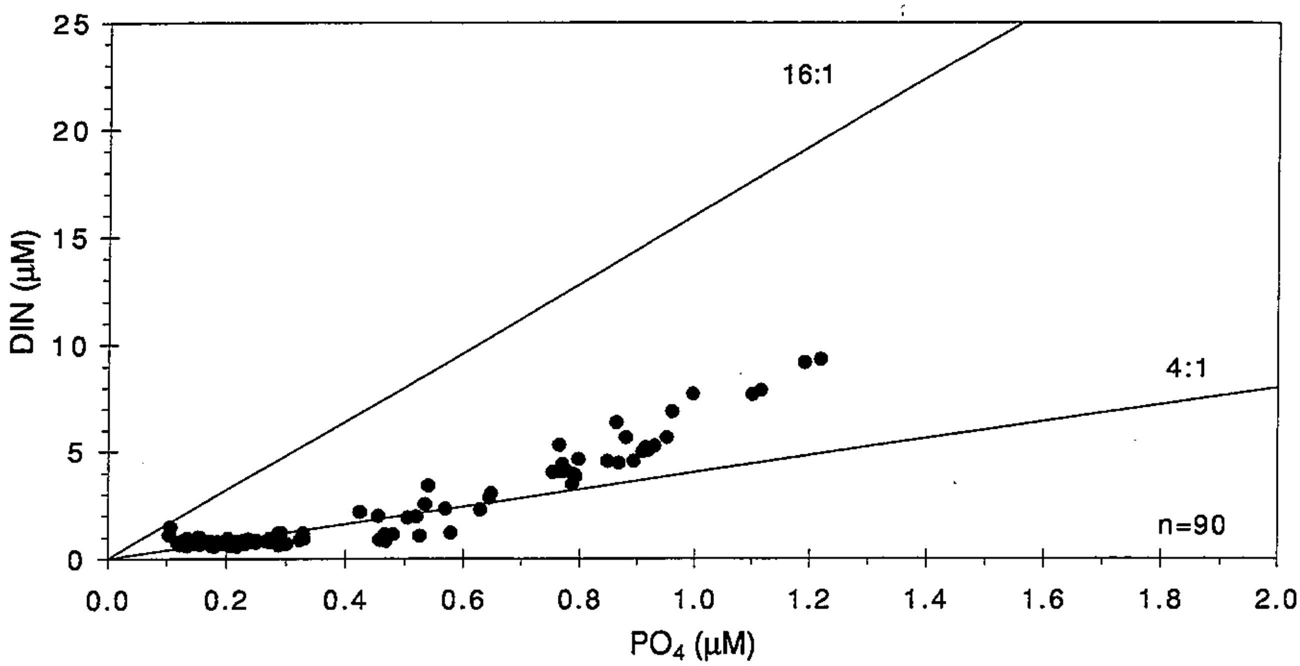
Nutrient Scatter Plots

Scatter plots are included for every survey conducted during the semi-annual period. Each plot includes all stations and all depths unless otherwise noted. The plots are organized by type of plot, and then by survey. Combined nearfield/farfield surveys show the regions with different symbols, including boundary (BOU), Cape Cod Bay (CCB), coastal (COA), Boston Harbor (BH), nearfield (NEA), and offshore (OFF). Available plots, in the order they appear in the appendix, are summarized in the table below.

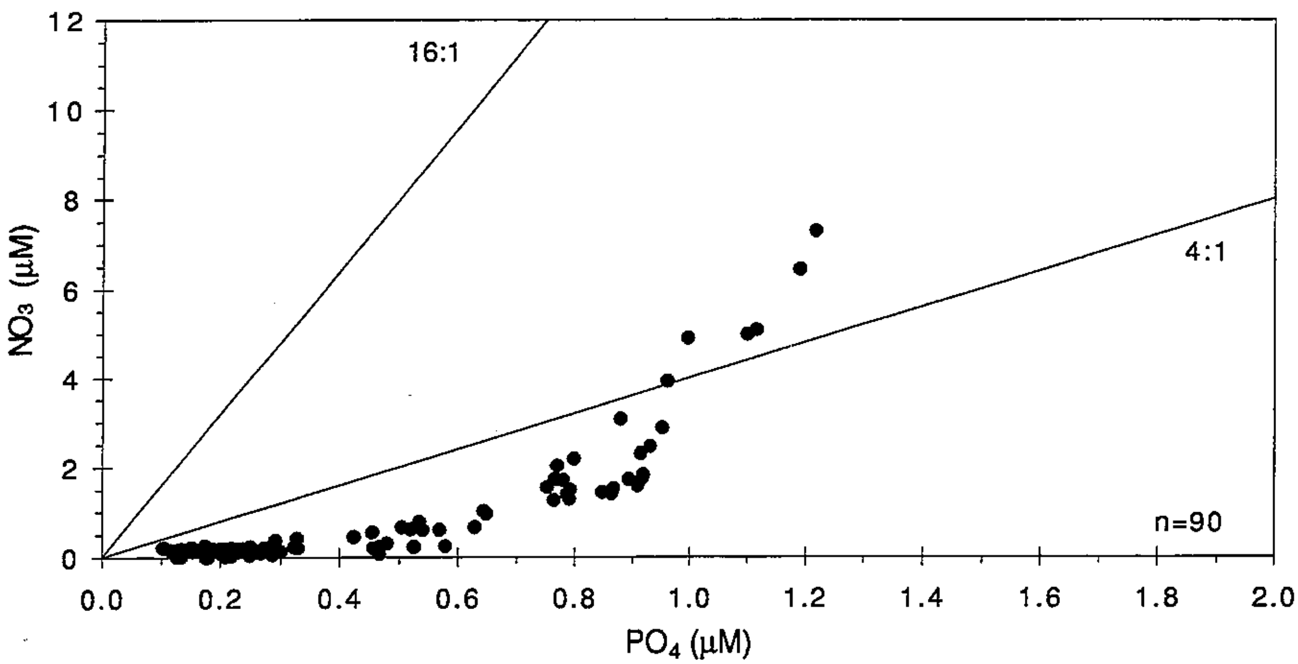
Type of Plot	Surveys	Comments
PO_4:DIN; PO_4:NO_3	W9511-17	Lines of nitrogen:phosphate
PO_4:NH_4; SiO_4:NH_4	W9511-17	
SiO_4:DIN; SiO_4:NO_3	W9511-17	Lines of nitrogen:silicate
Salinity:DIN	W9511-17	Stations types A,D,F,G
Salinity:NH_4 and NO_3	W9511-17	
Salinity:PO_4 and SiO_4	W9511-17	
Salinity:TN and DIN+PON	W9511-17	Station types A,D,F,G
Depth:DIN	W9511-17	
Depth:NH_4 and NO_3	W9511-17	
Depth:PO_4 and SiO_4	W9511-17	

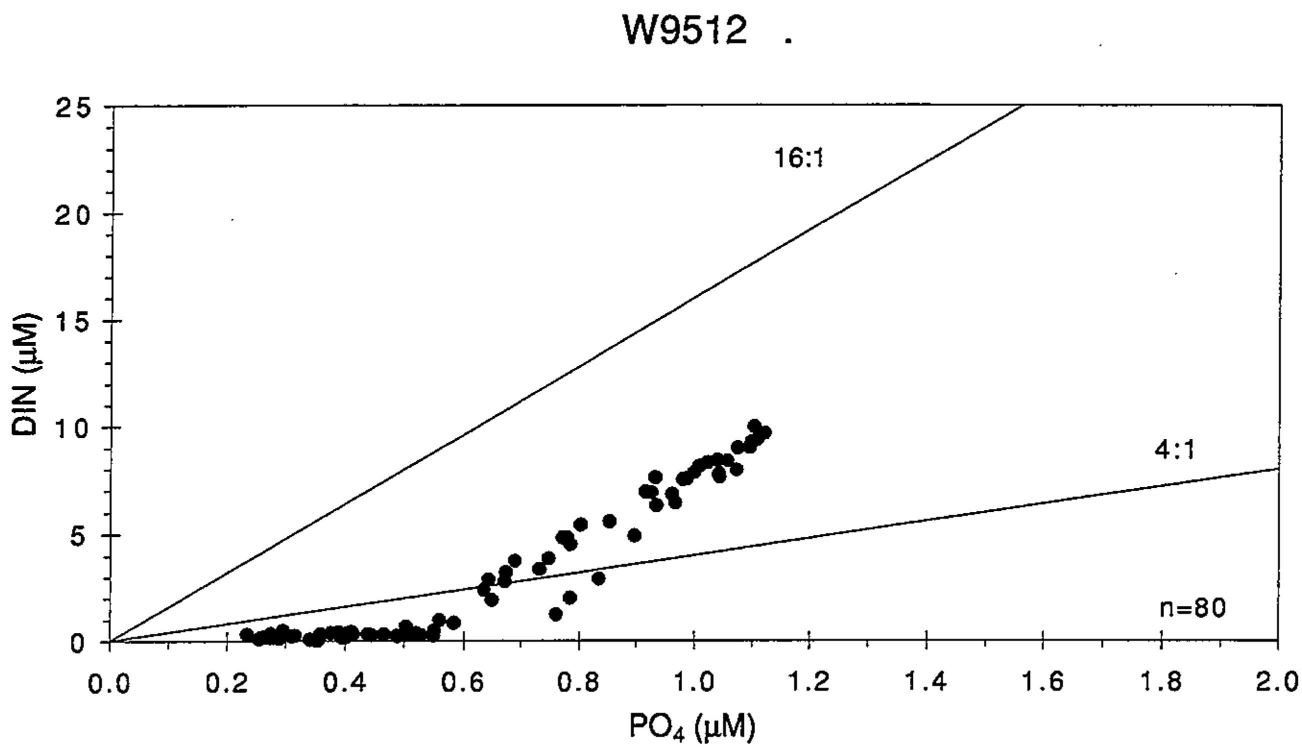
Acronyms:
DIN = dissolved inorganic nitrogen
PON = particulate organic nitrogen
TN = total dissolved nitrogen + PON

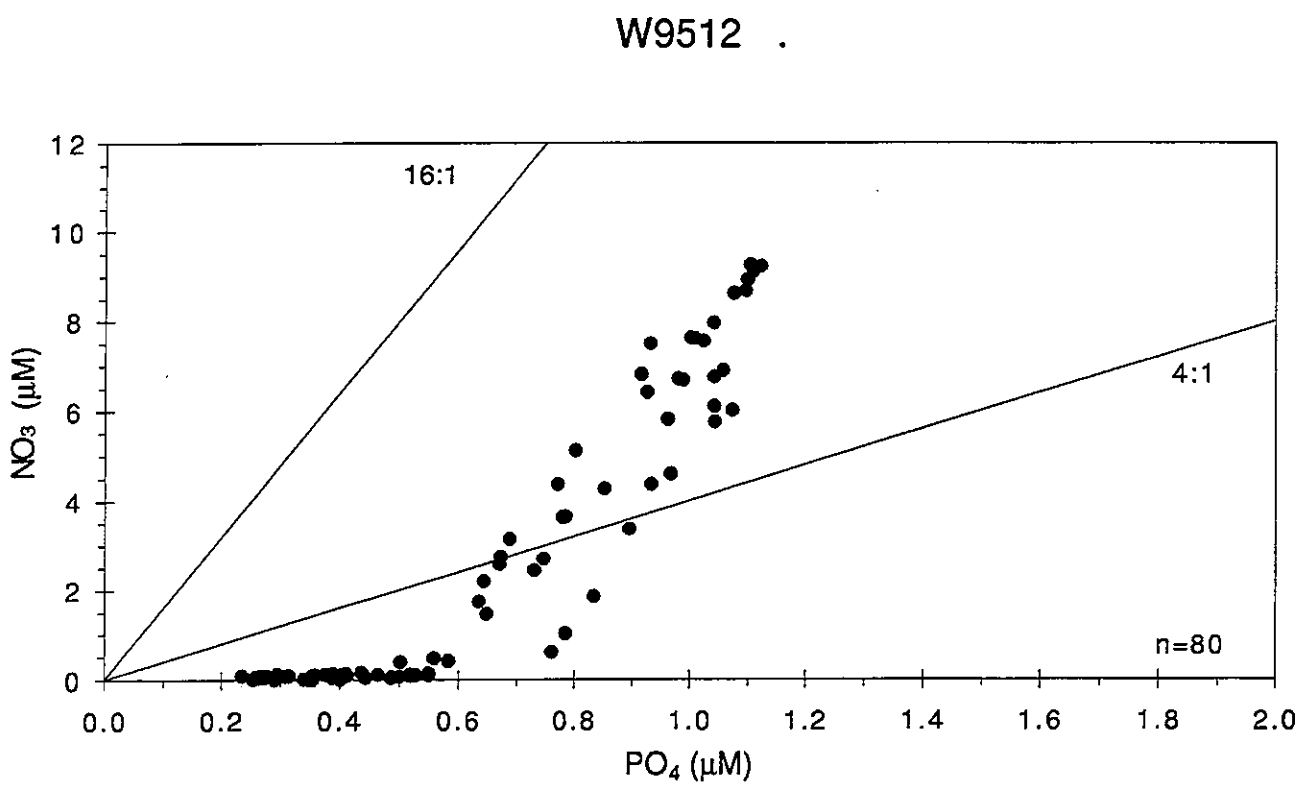
W9510 .

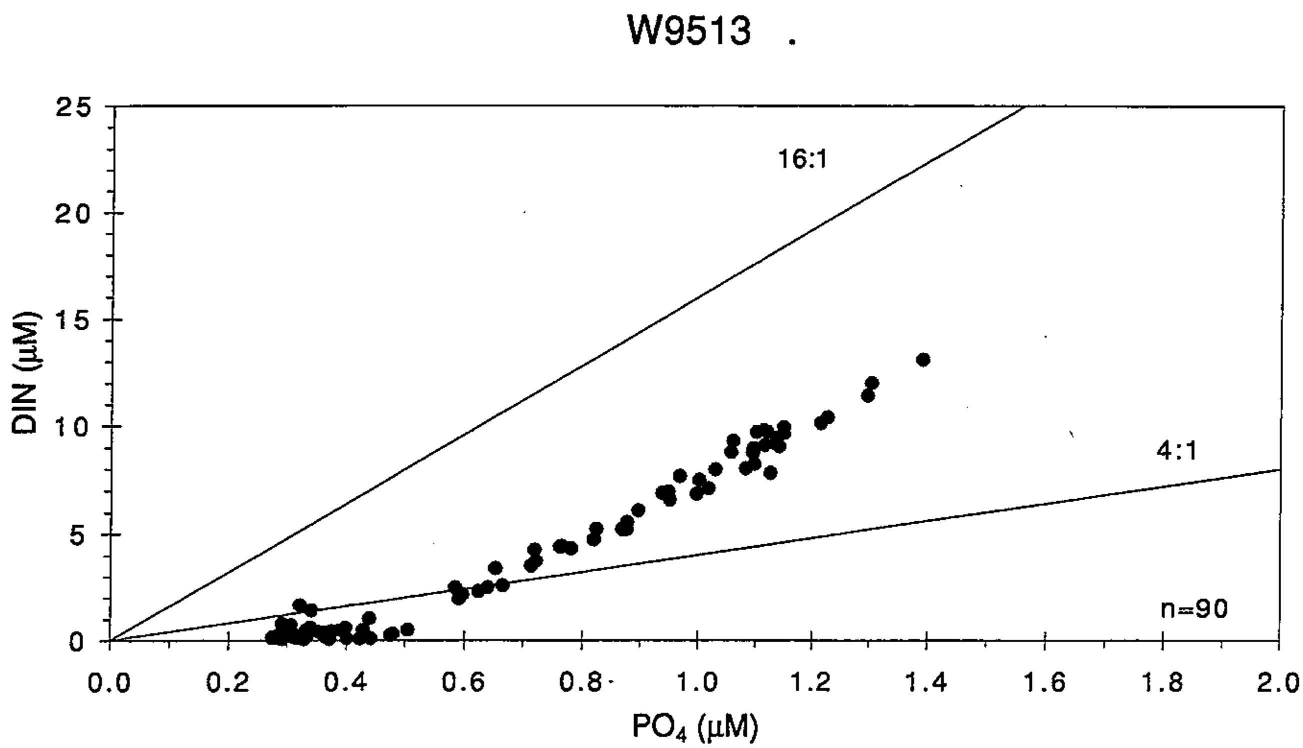

16:1
4:1
n=90
DIN (µM)
PO4 (µM)
0
5
10
15
20
25
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0

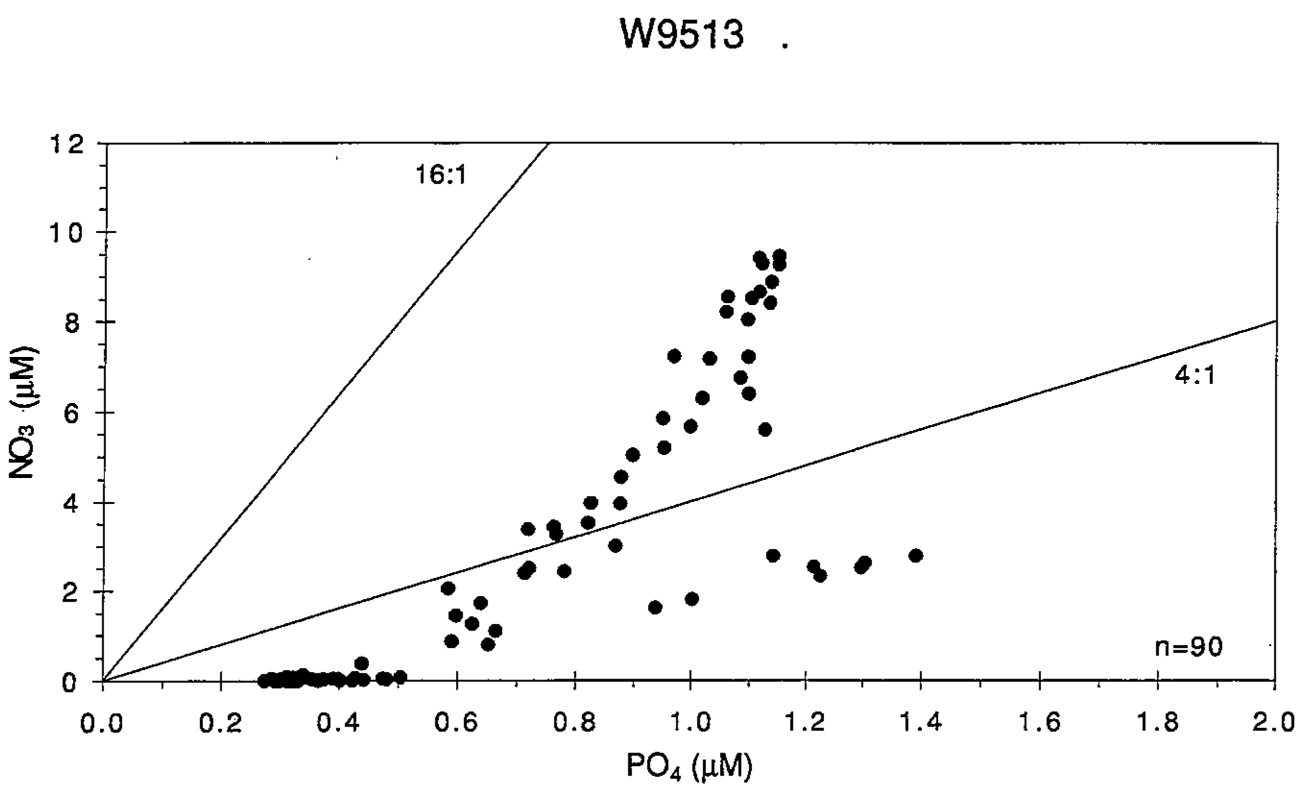
W9510 .


16:1
4:1
n=90
NO3 (µM)
PO4 (µM)
0
2
4
6
8
10
12
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0

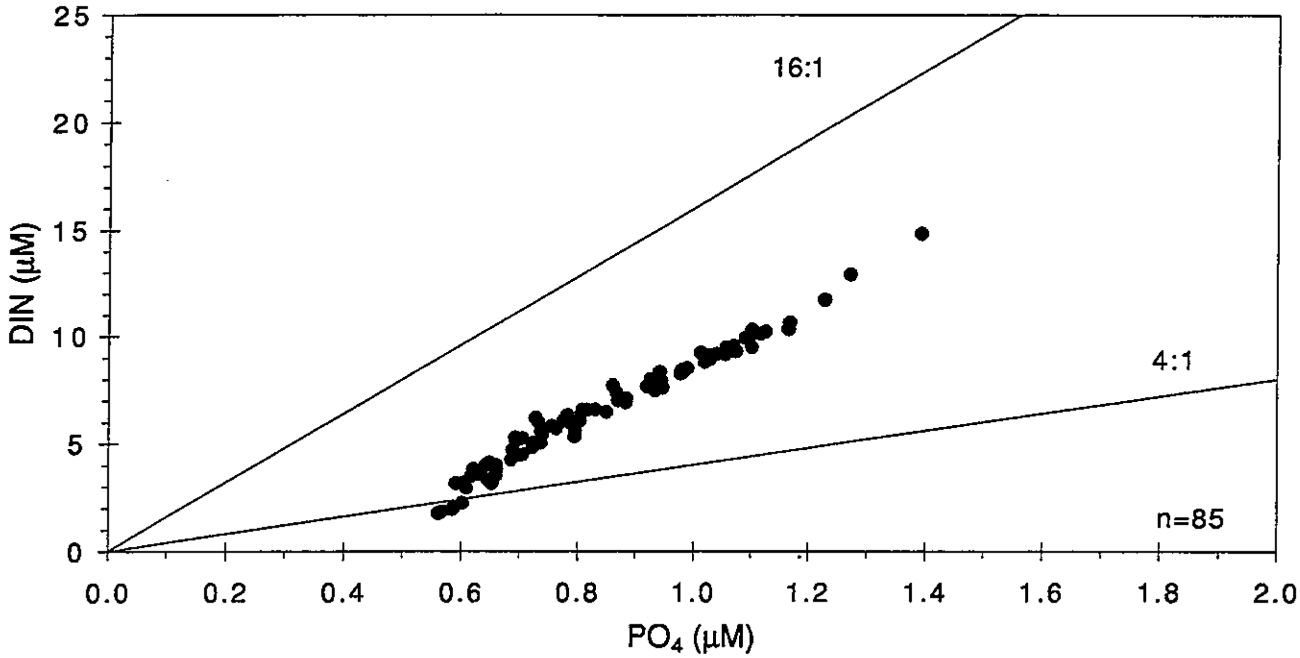

W9512 .
16:1
4:1
n=80
DIN (µM)
PO4 (µM)
0
5
10
15
20
25
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0


W9512 .
16:1
4:1
n=80
NO3 (µM)
PO4 (µM)
0
2
4
6
8
10
12
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0


W9513
DIN (µM)
25
20
15
10
5
0
16:1
4:1
n=90
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

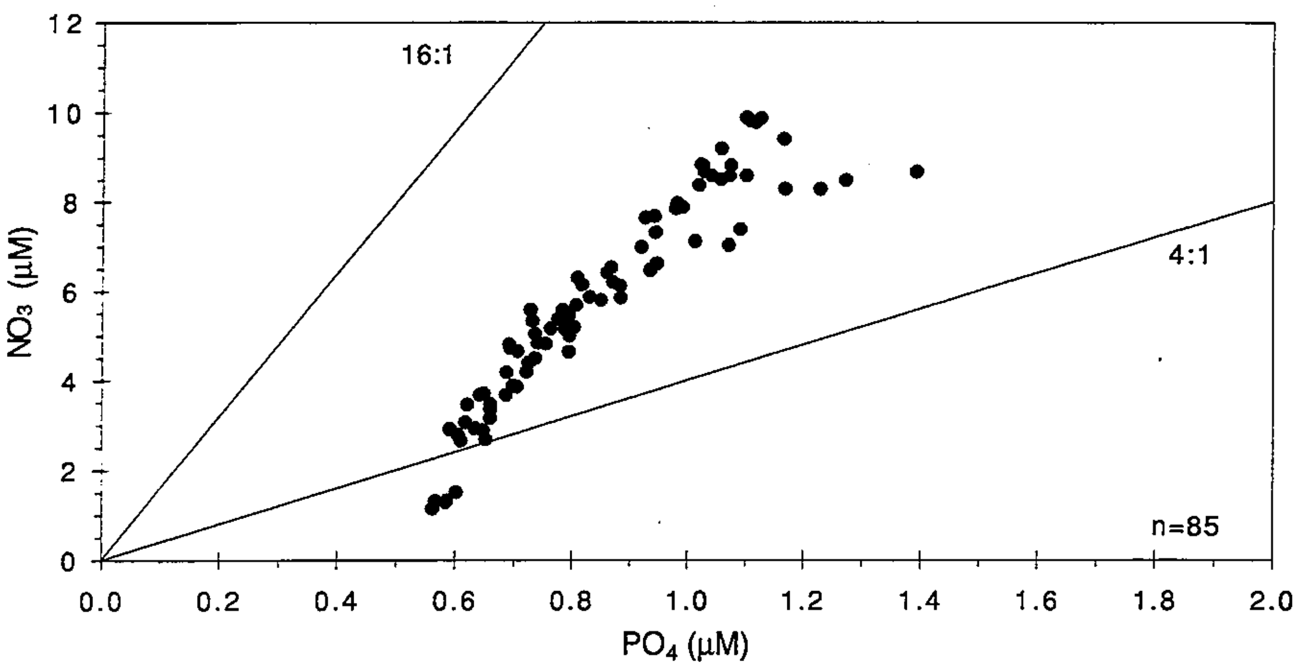

W9513
NO3 (µM)
12
10
8
6
4
2
0
16:1
4:1
n=90
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

W9515 .



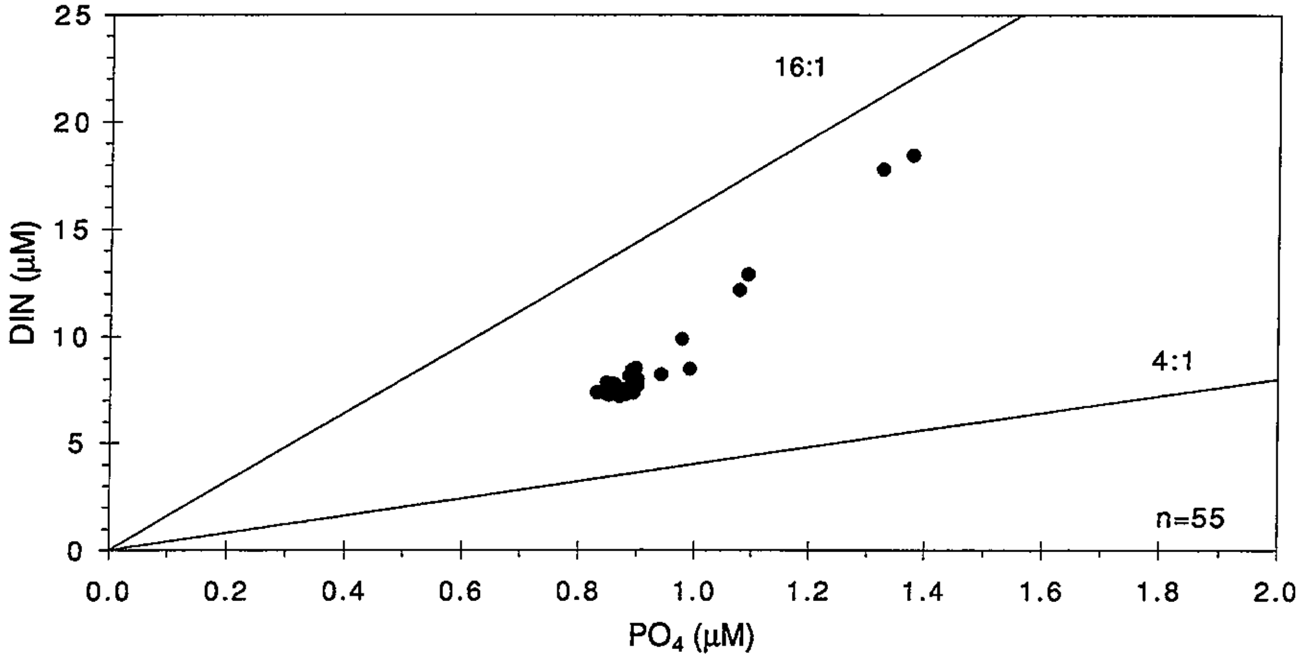
25
20
15
10
5
0
DIN (µM)
16:1
4:1
n=85
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

W9515 .

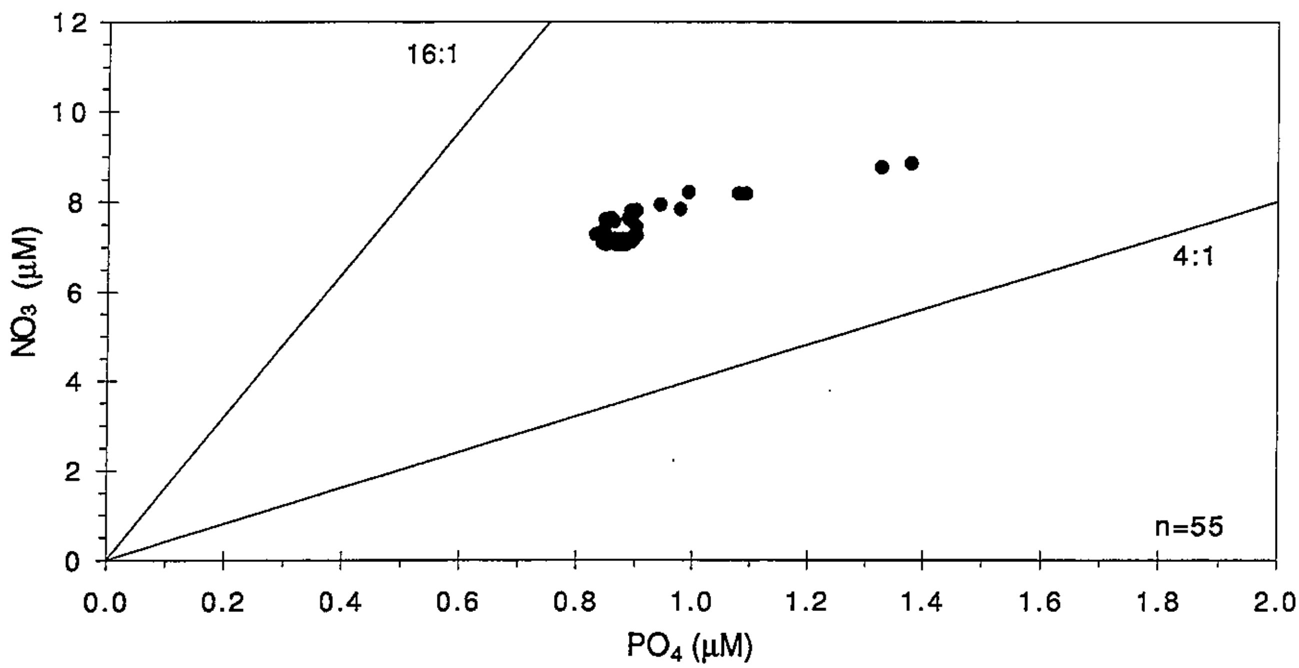


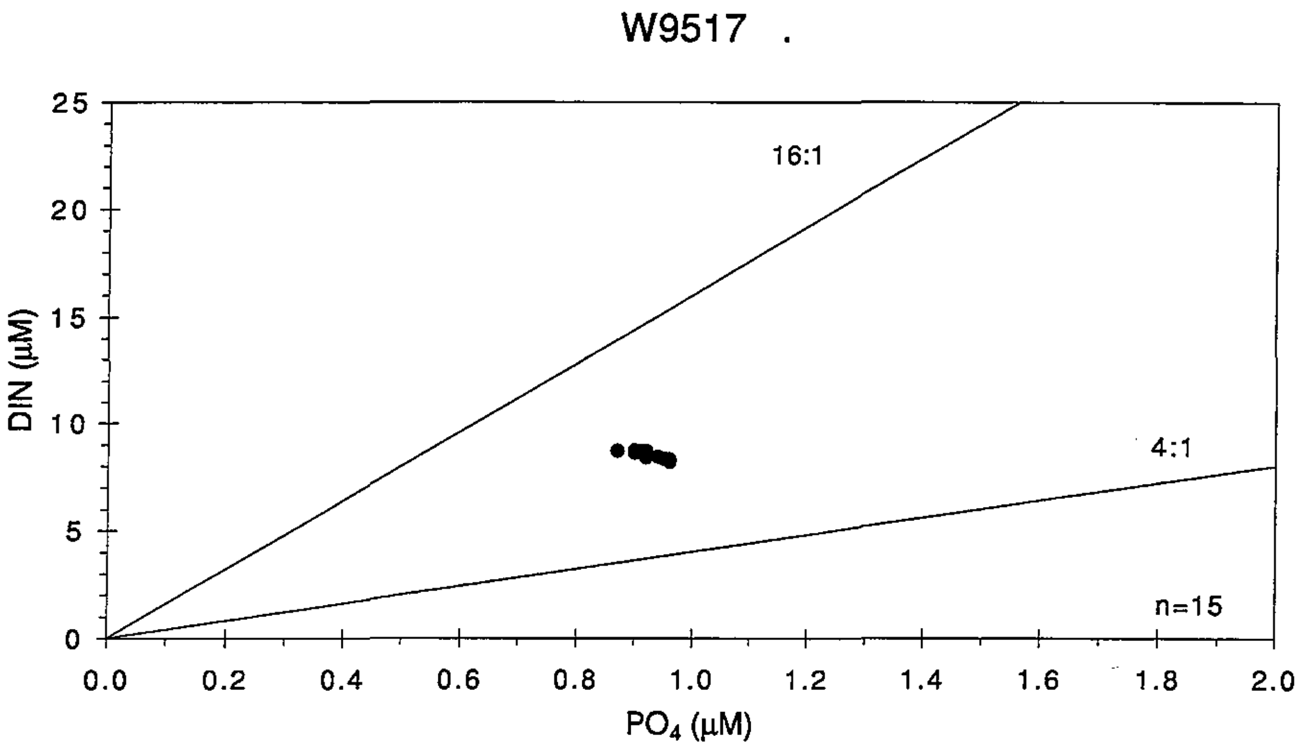
12
10
8
6
4
2
0
NO3 (µM)
16:1
4:1
n=85
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

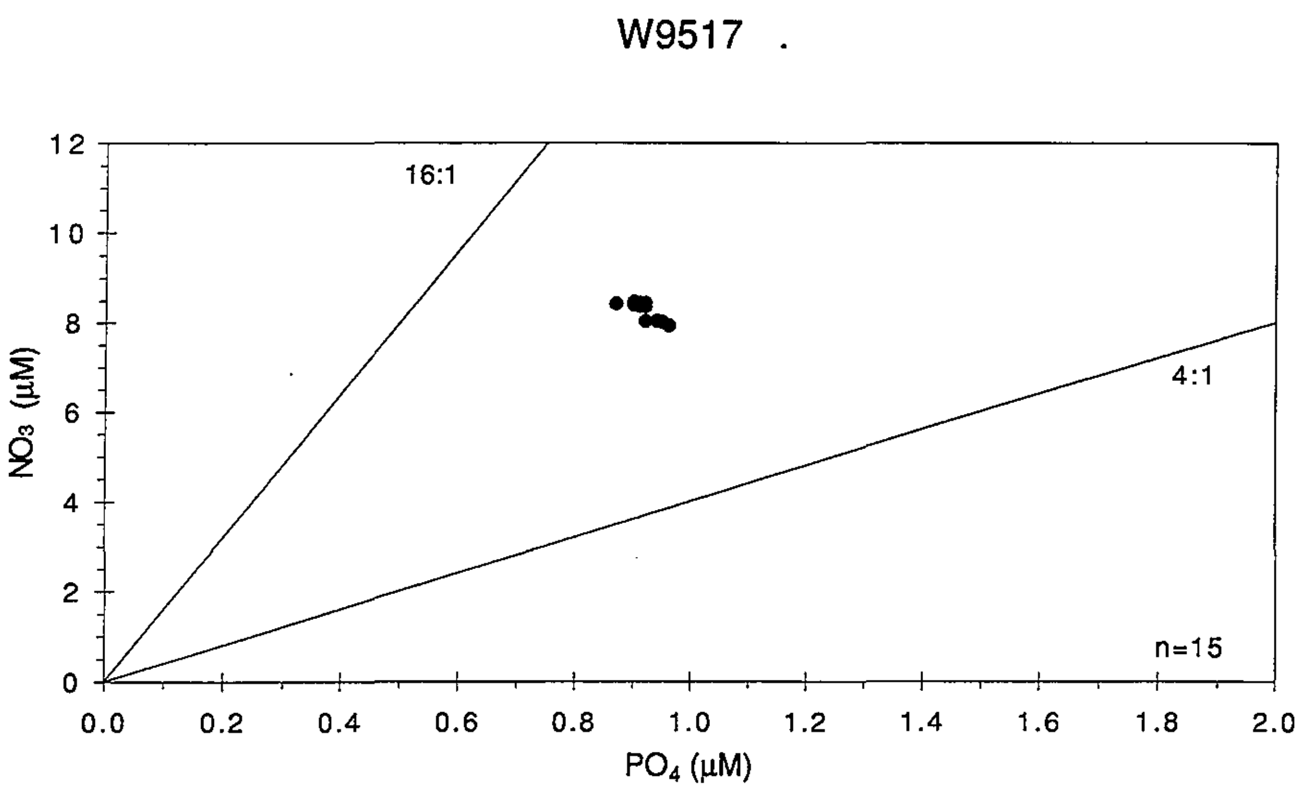
W9516 .



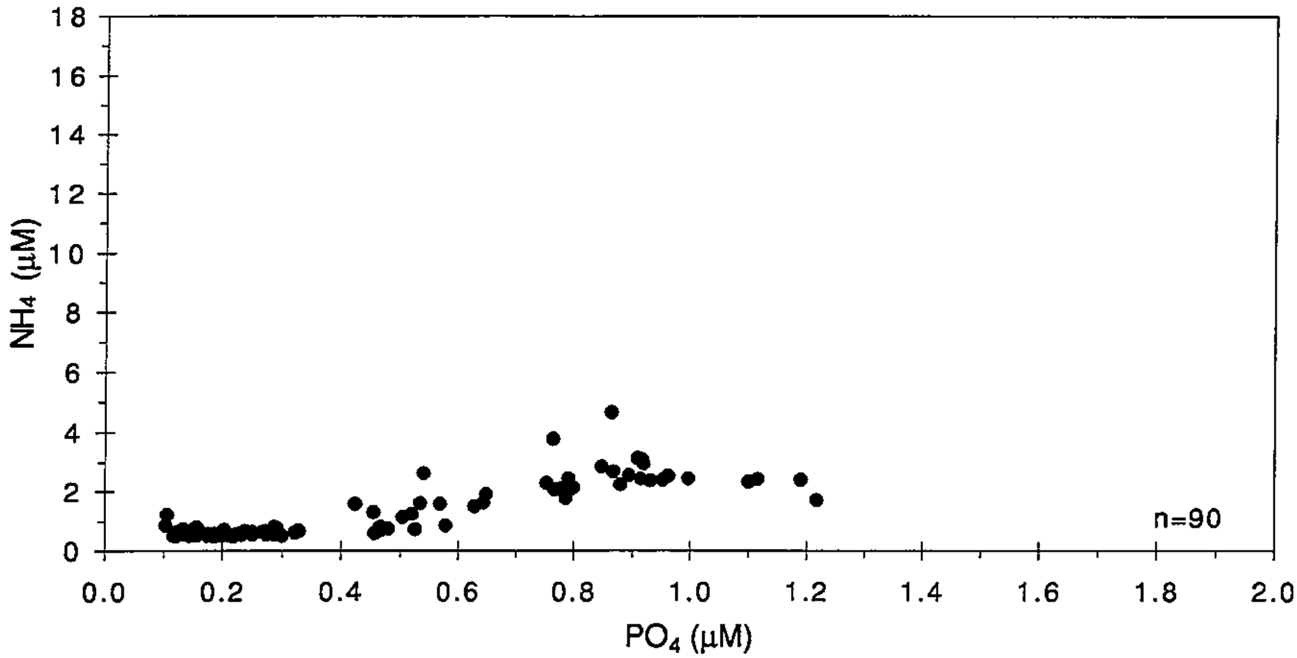
W9516 .




W9517 .
DIN (µM)
PO4 (µM)
16:1
4:1
n=15
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
0
5
10
15
20
25

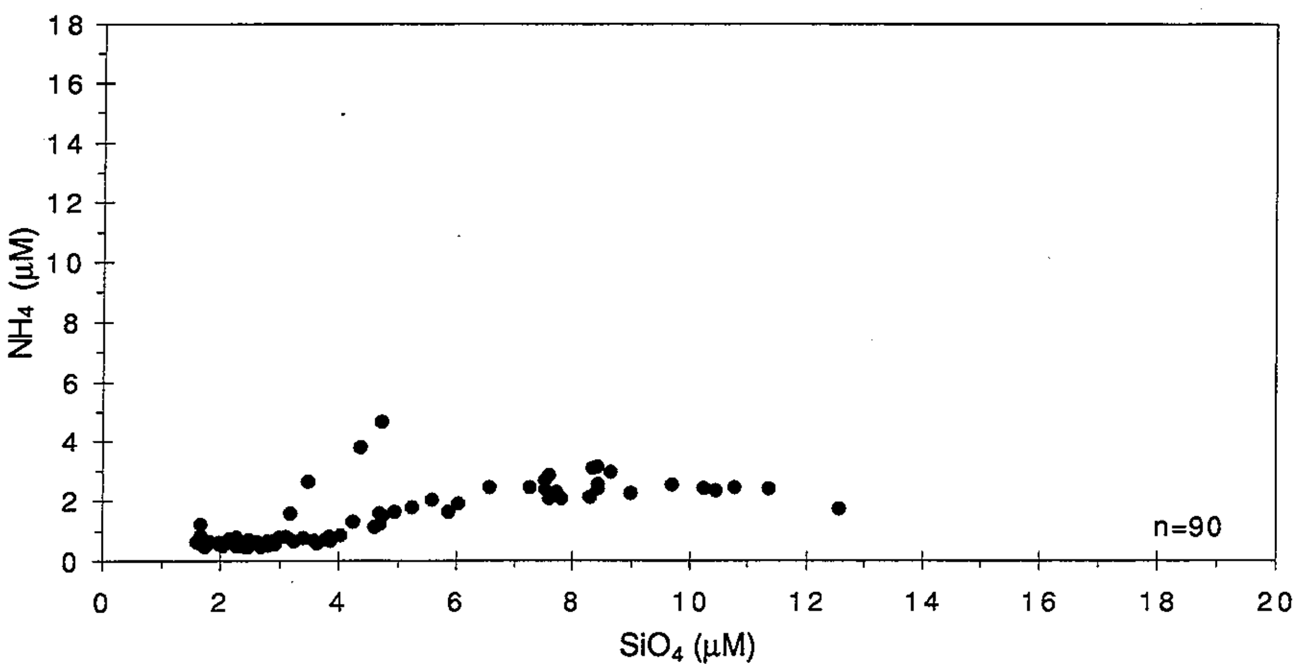

W9517 .
NO3 (µM)
PO4 (µM)
16:1
4:1
n=15
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
0
2
4
6
8
10
12

W9510 .

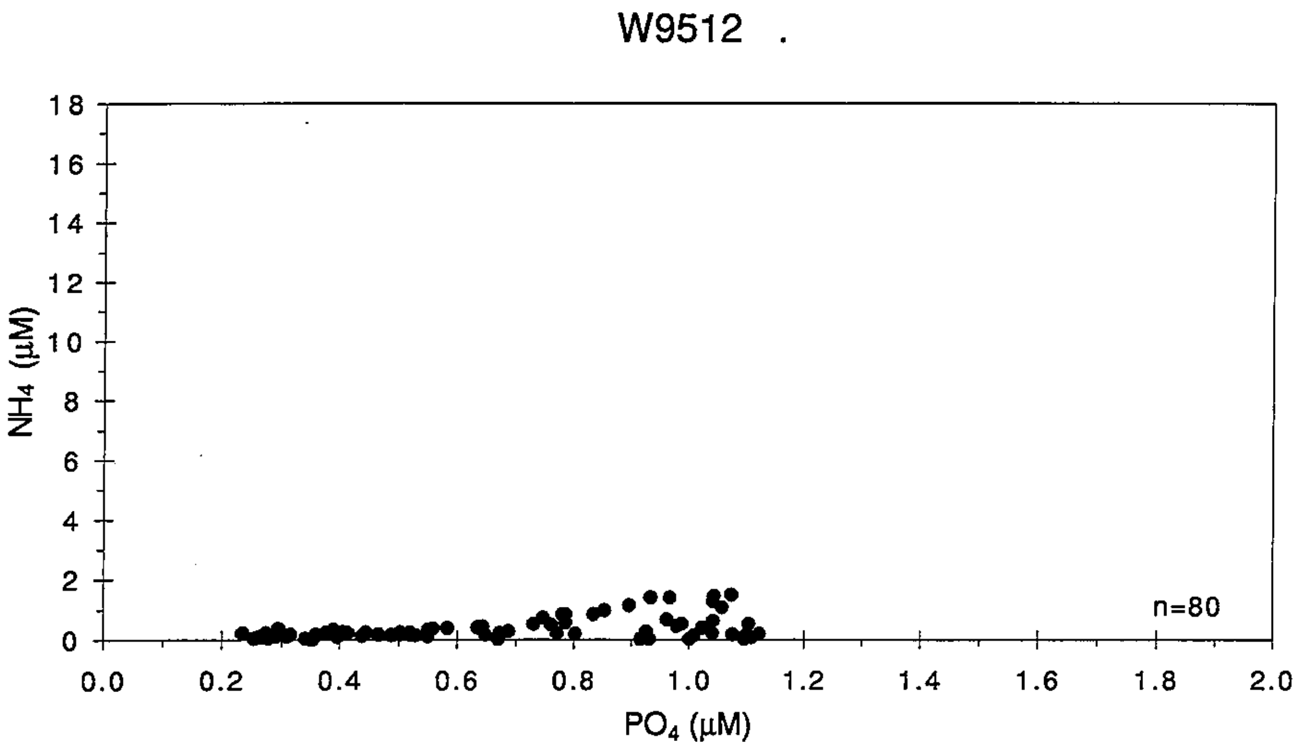


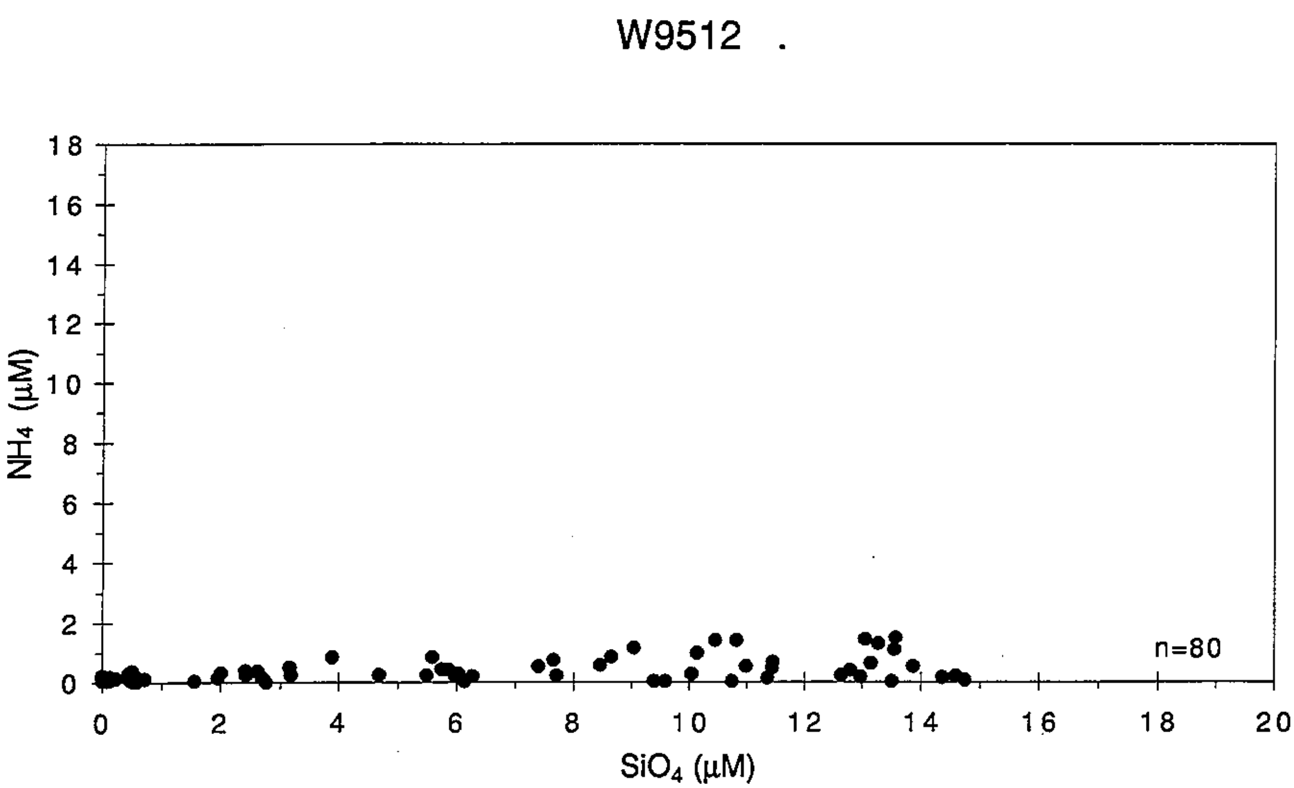
NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=90
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

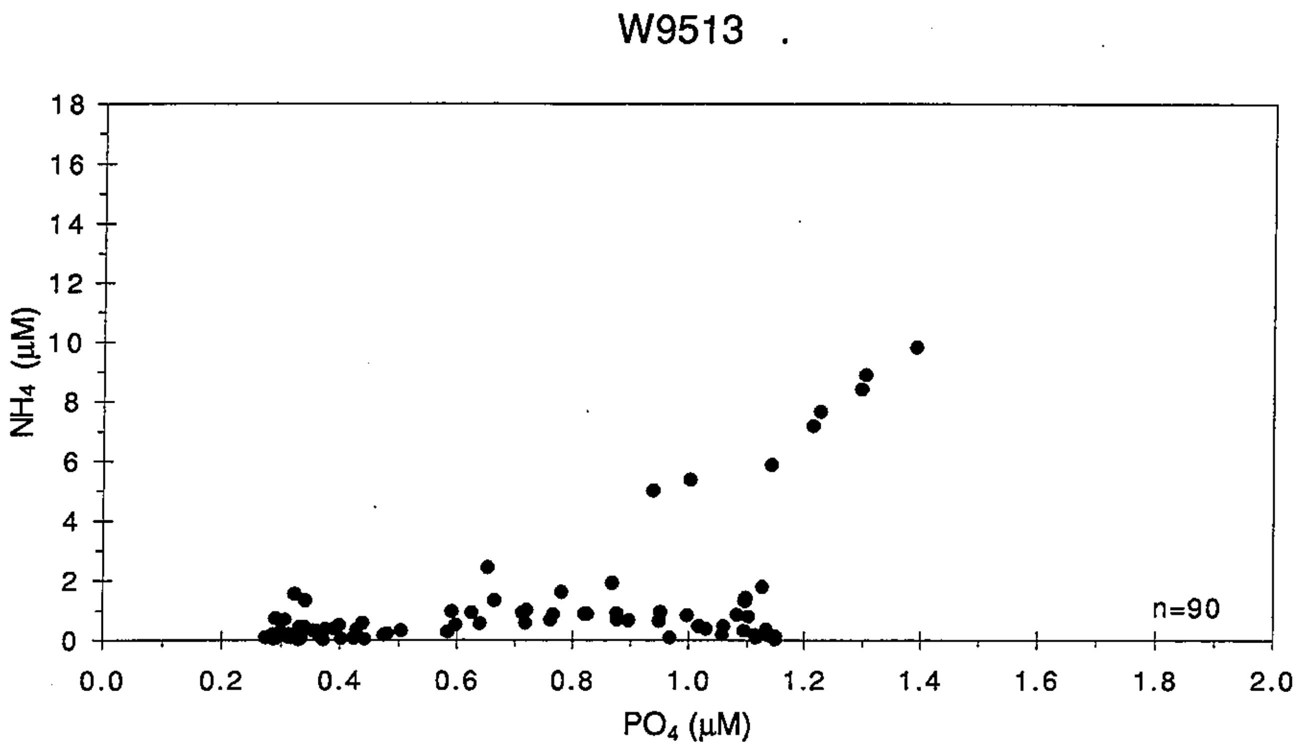
W9510 .

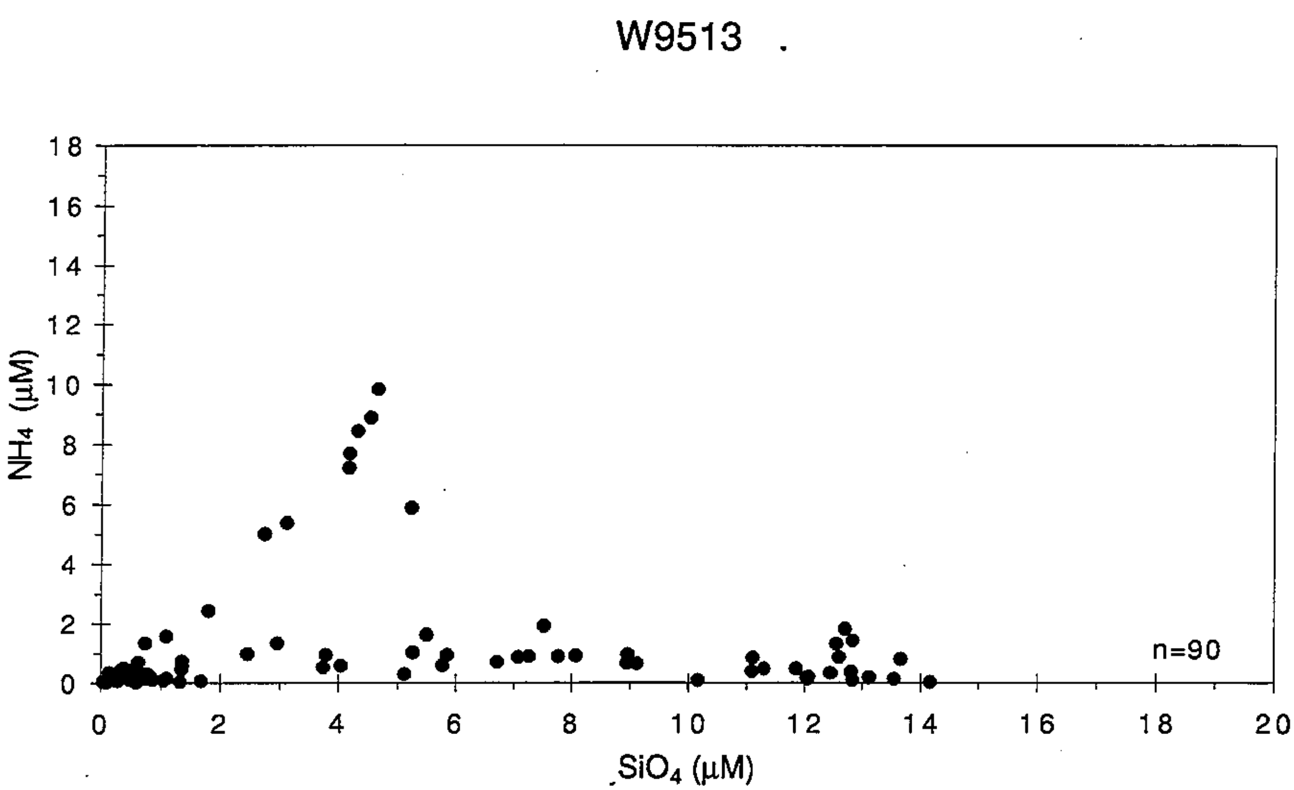


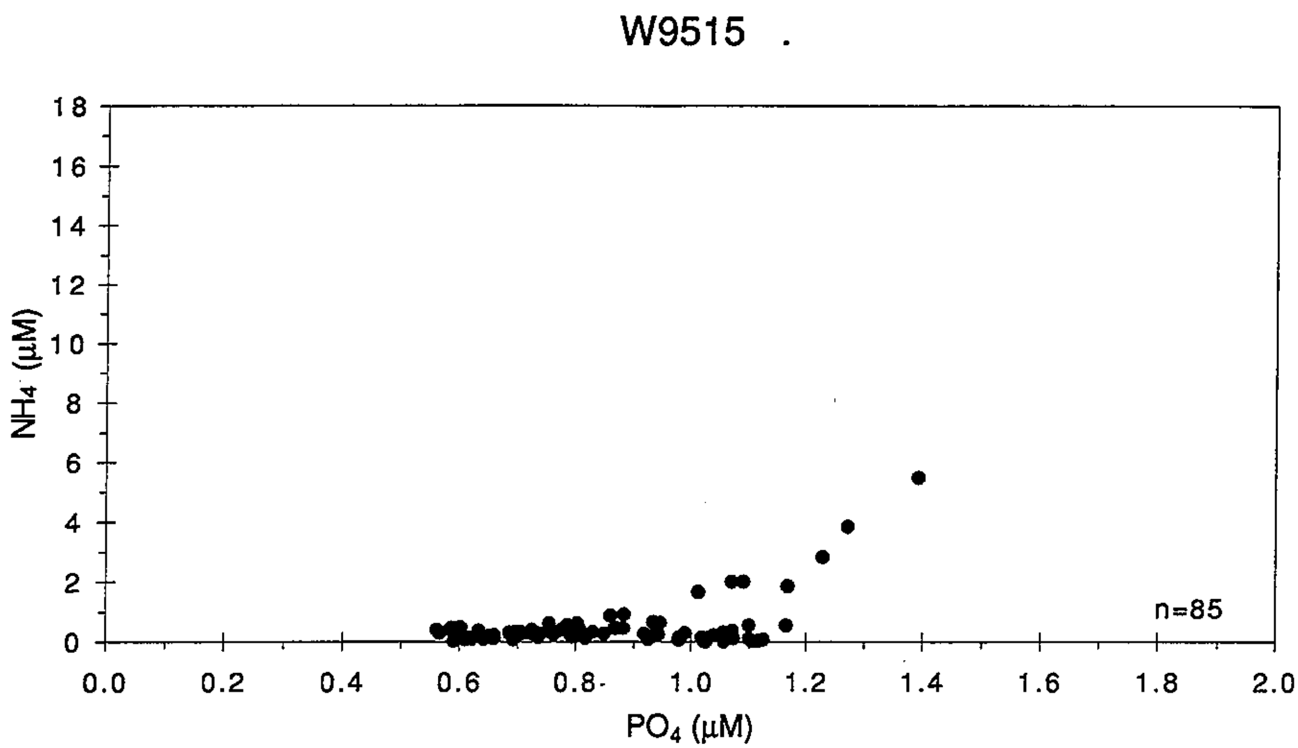
NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=90
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)

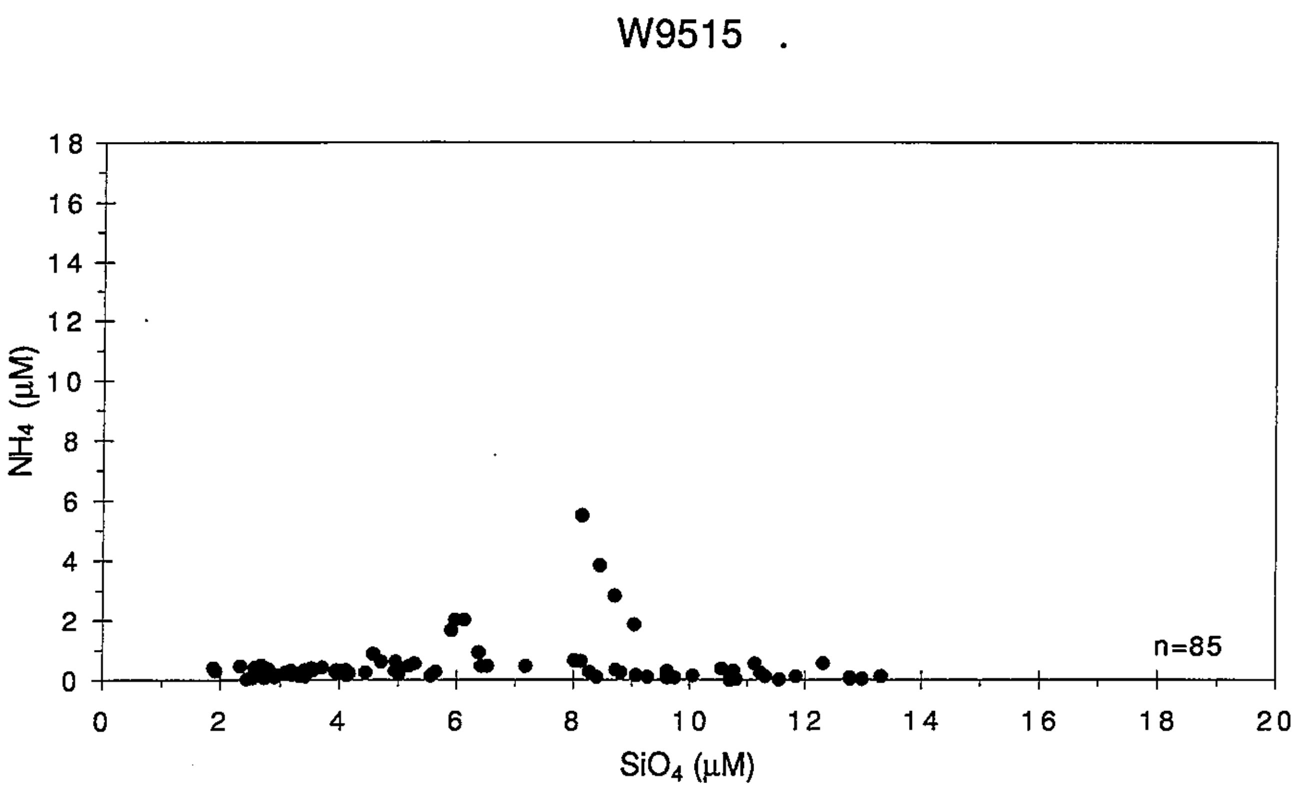

W9512 .
NH4 (µM)
PO4 (µM)
n=80


W9512 .
NH4 (µM)
SiO4 (µM)
n=80

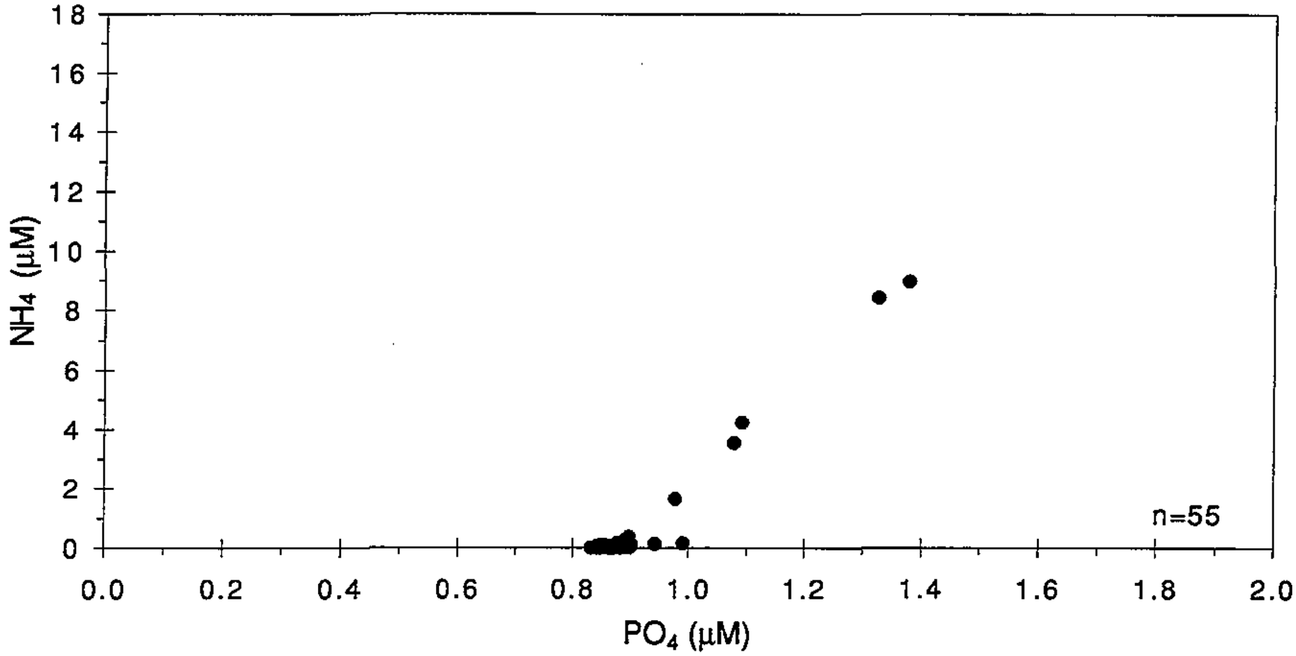

W9513
NH4 (µM)
PO4 (µM)
n=90


W9513
NH4 (µM)
SiO4 (µM)
n=90


W9515 .
NH4 (μM)
PO4 (μM)
n=85
0
2
4
6
8
10
12
14
16
18
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0

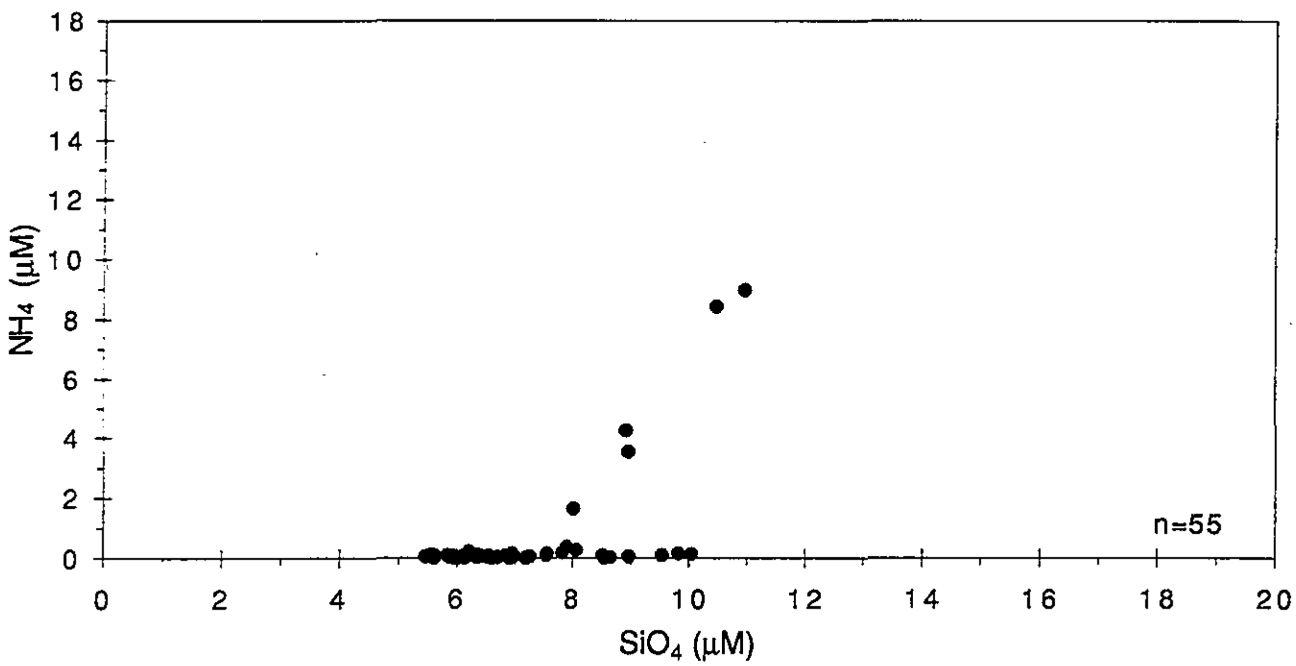

W9515 .
NH4 (μM)
SiO4 (μM)
n=85
0
2
4
6
8
10
12
14
16
18
0
2
4
6
8
10
12
14
16
18
20

W9516 .



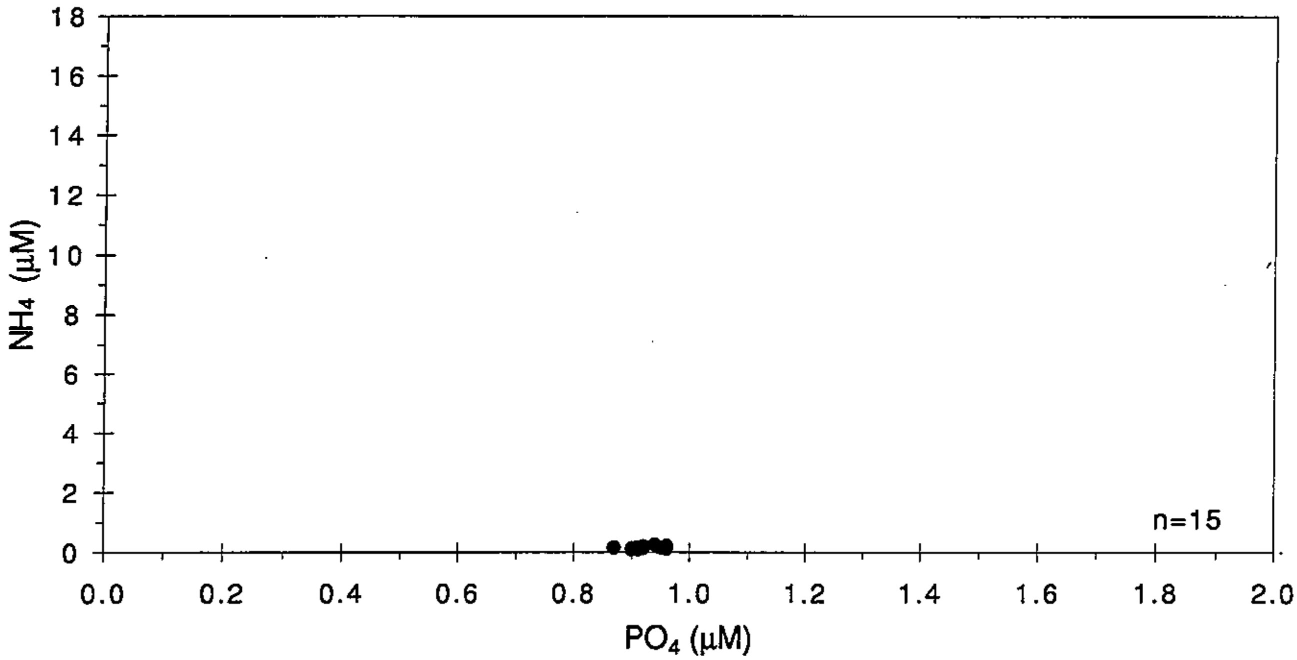
NH4 (µM)
PO4 (µM)
n=55
0
2
4
6
8
10
12
14
16
18
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0

W9516 .



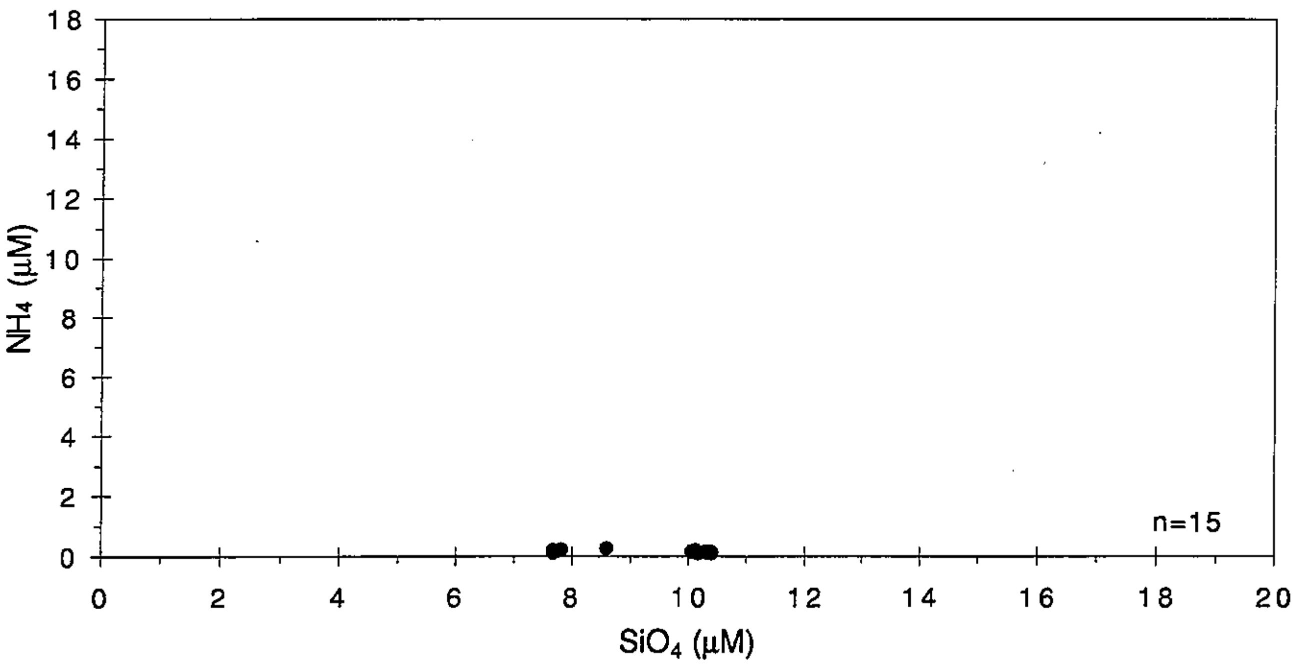
NH4 (µM)
SiO4 (µM)
n=55
0
2
4
6
8
10
12
14
16
18
20

W9517 .



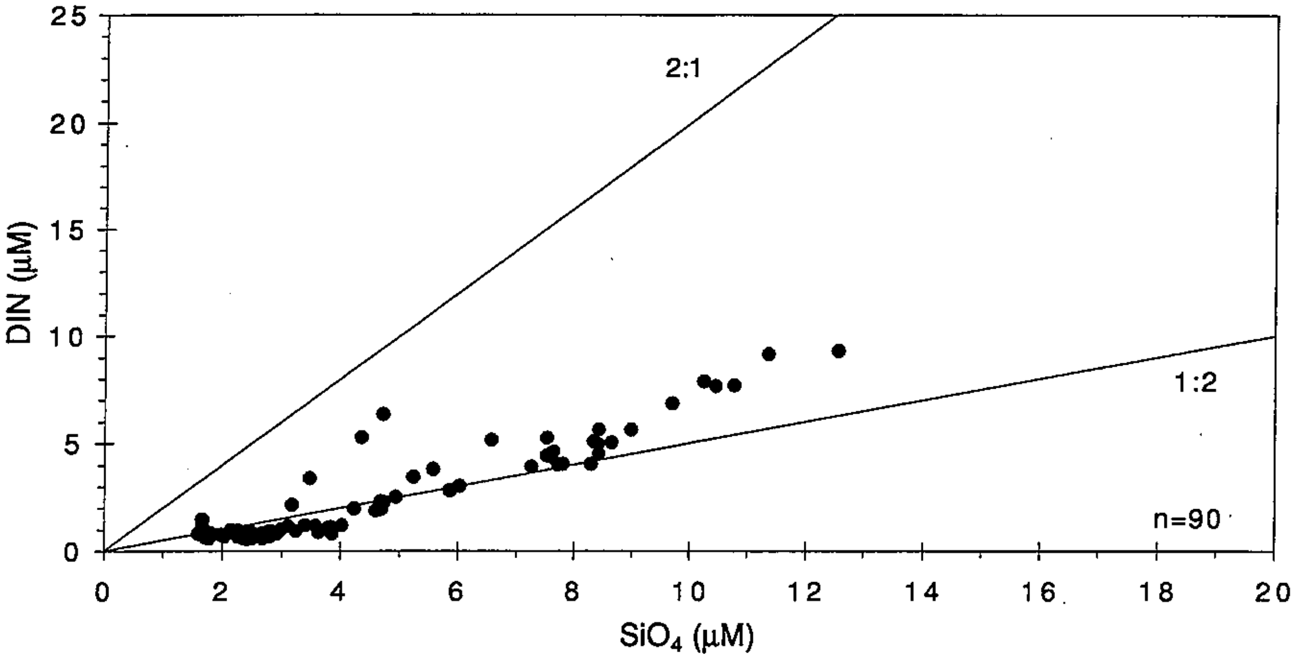
NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=15
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

W9517 .

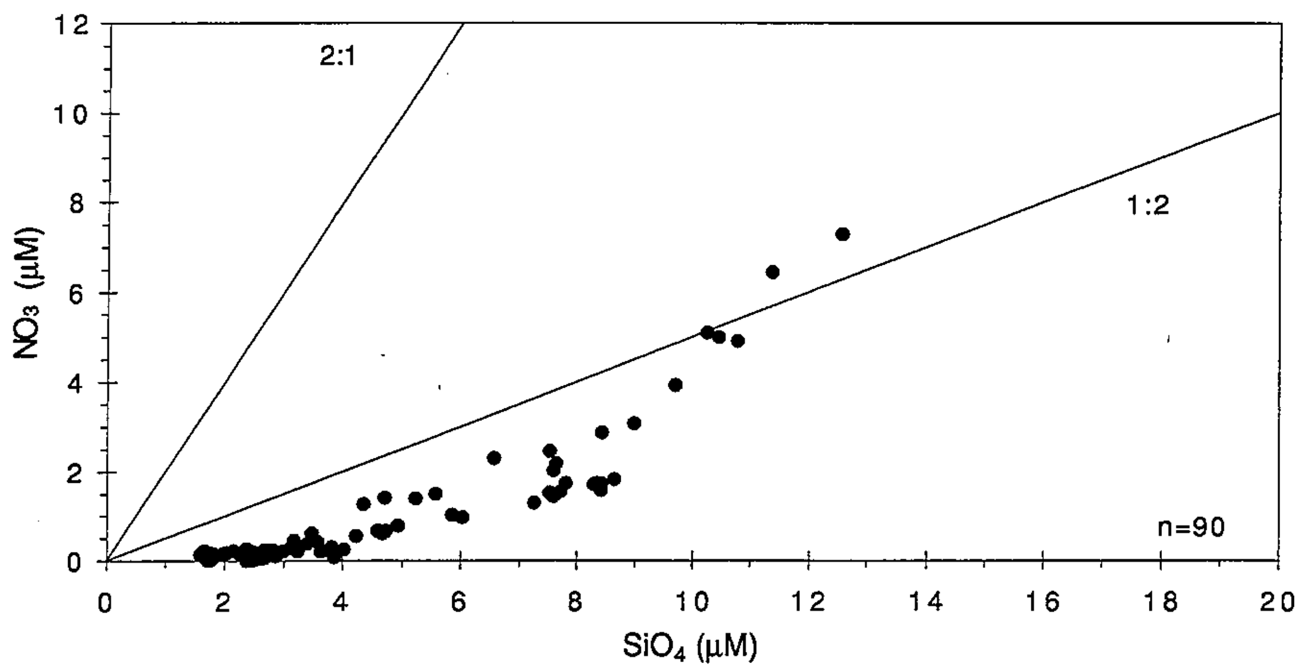


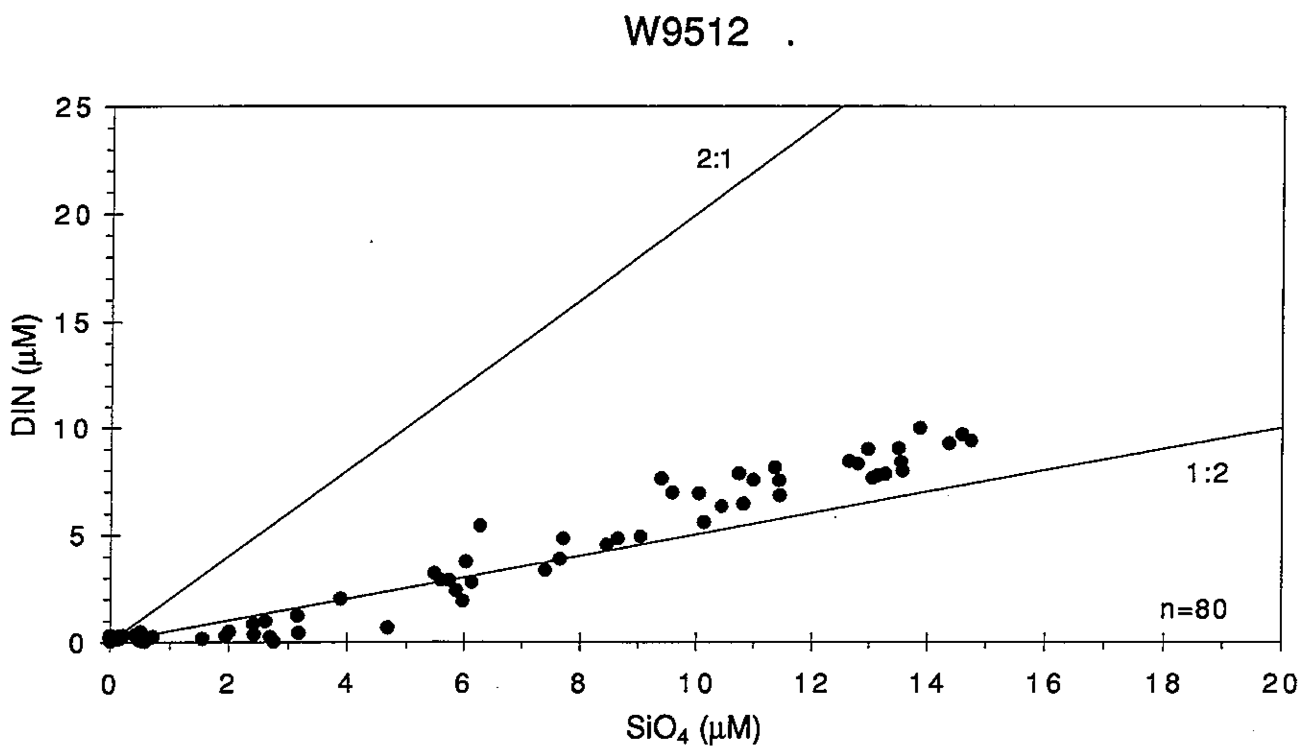
NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=15
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)

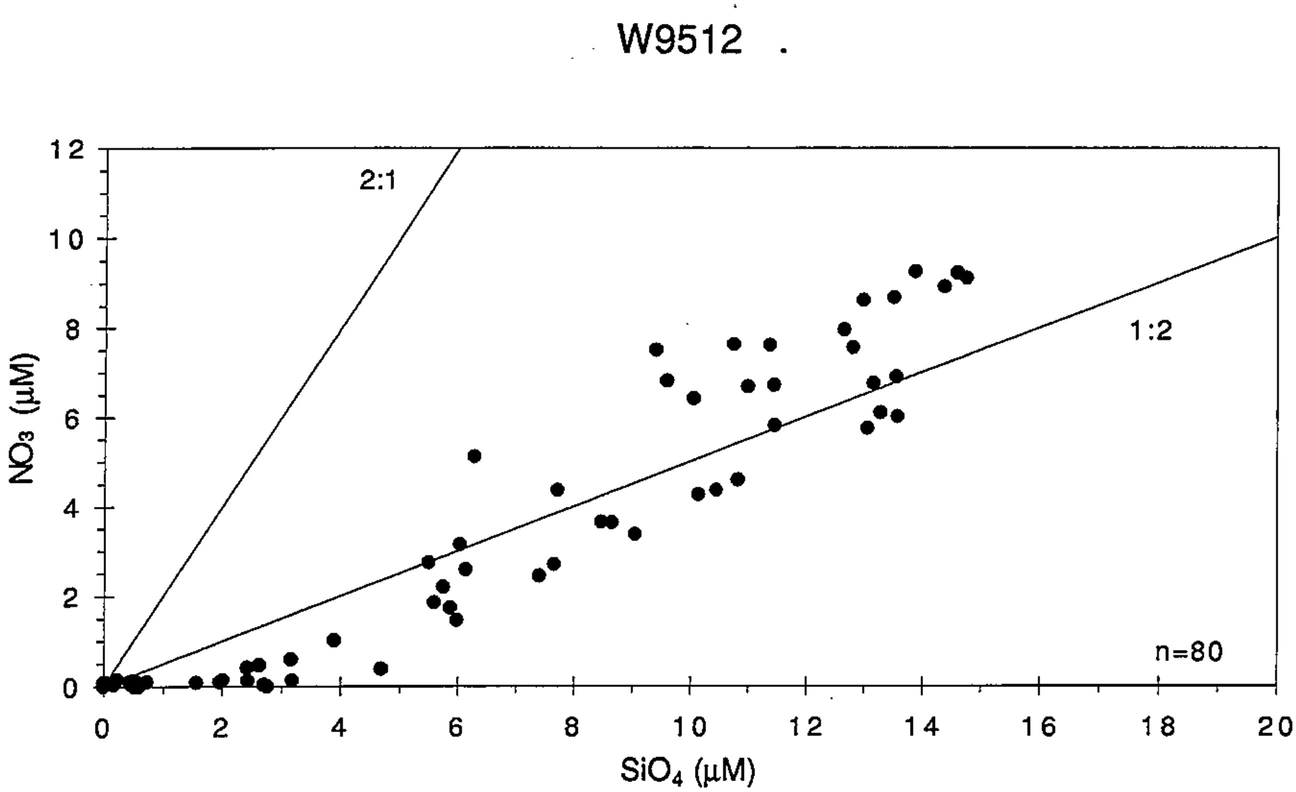
W9510



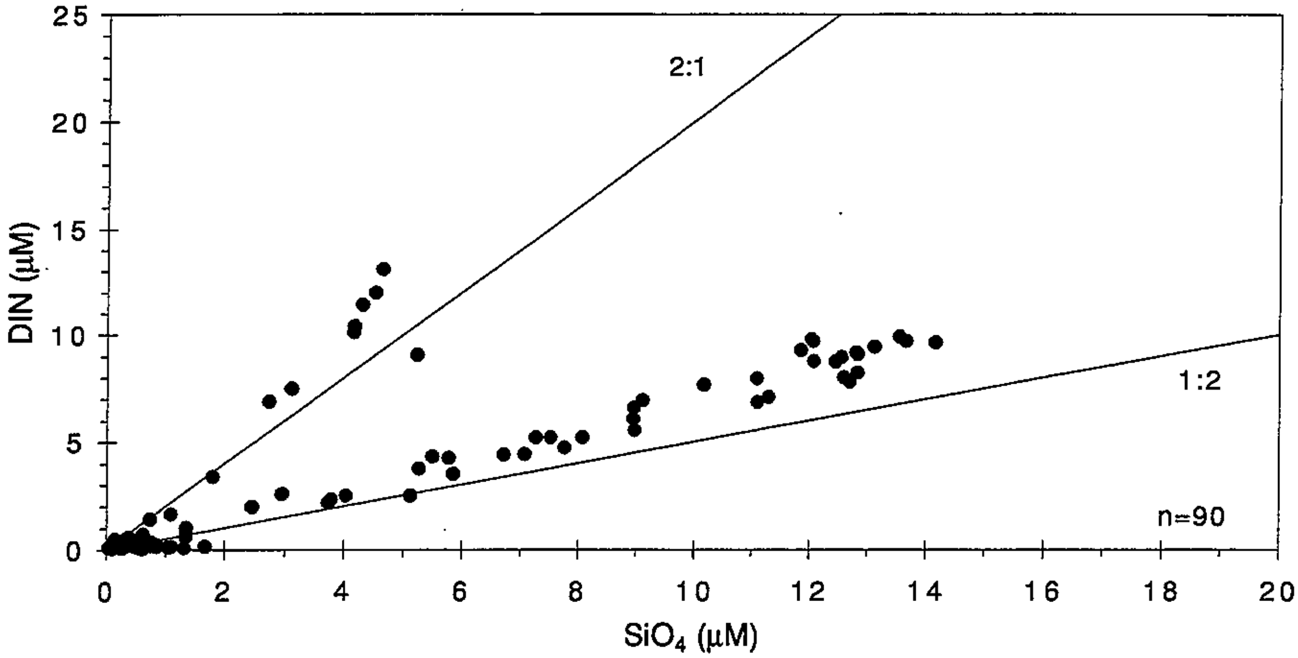
W9510



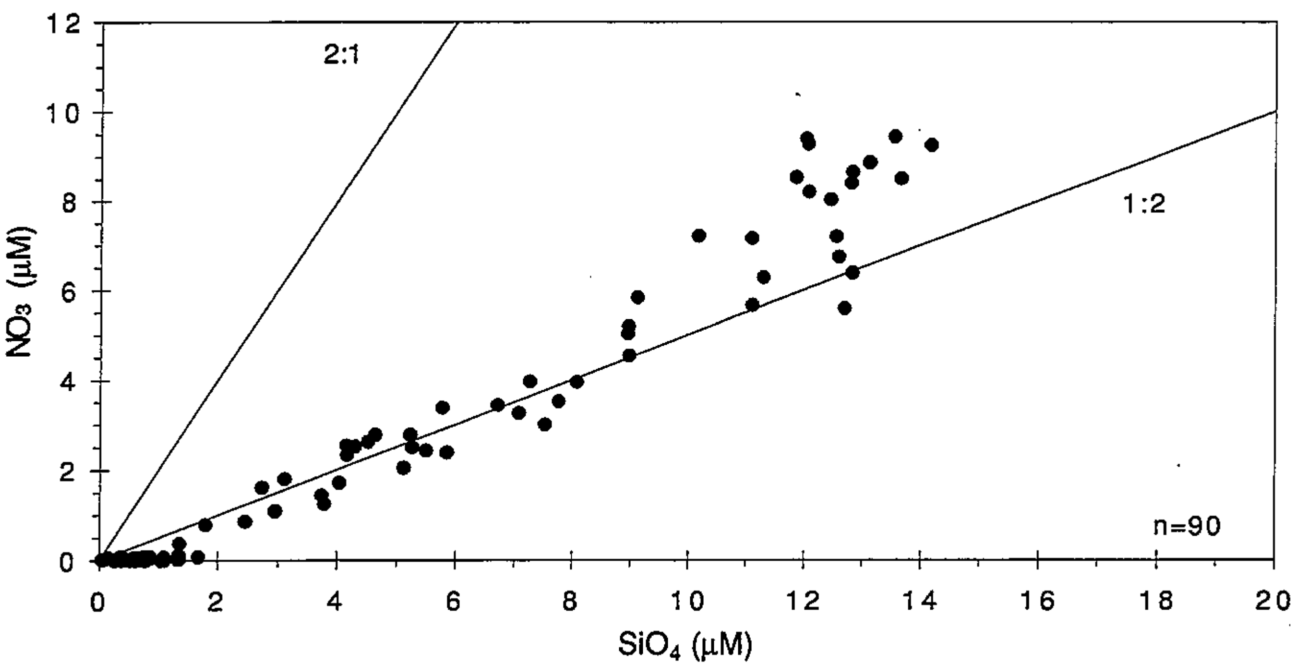

W9512 .
25
20
15
10
5
0
DIN (μM)
2:1
1:2
n=80
0
2
4
6
8
10
12
14
16
18
20
SiO4 (μM)


W9512 .
12
10
8
6
4
2
0
NO3 (μM)
2:1
1:2
n=80
0
2
4
6
8
10
12
14
16
18
20
SiO4 (μM)

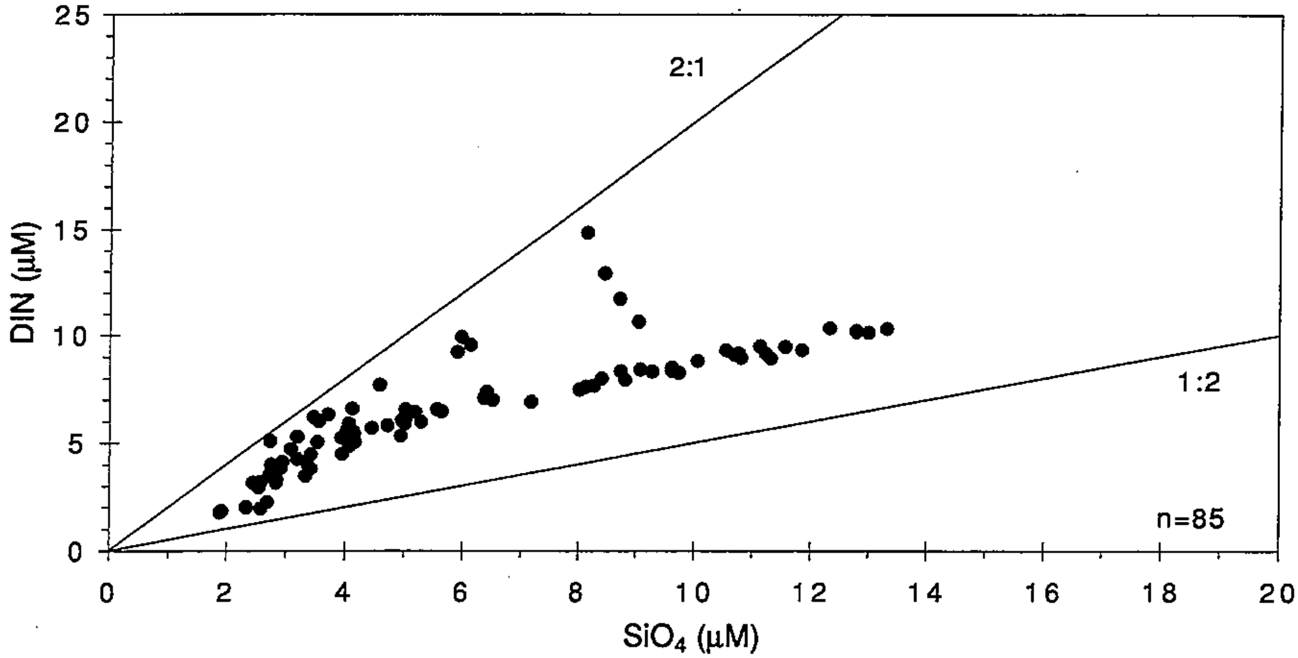
W9513


2:1
1:2
n=90
DIN (μM)
SiO4 (μM)
0
5
10
15
20
25
0
2
4
6
8
10
12
14
16
18
20

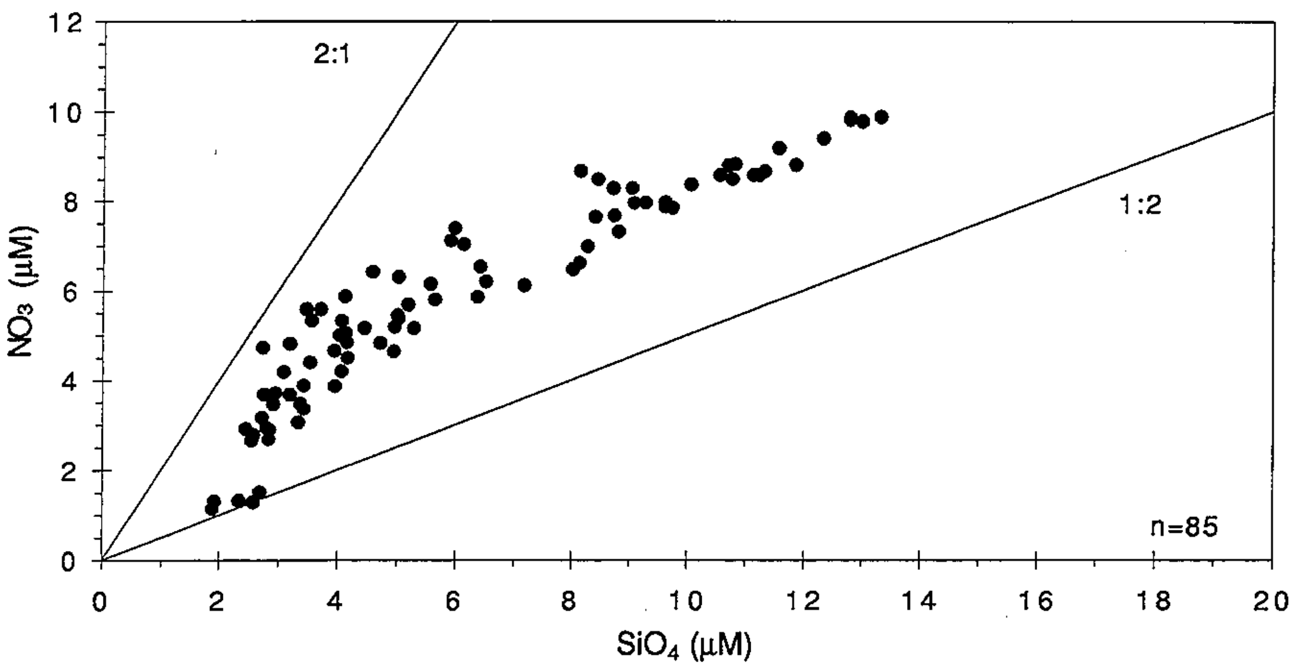
W9513


2:1
1:2
n=90
NO3 (μM)
SiO4 (μM)
0
2
4
6
8
10
12
0
2
4
6
8
10
12
14
16
18
20

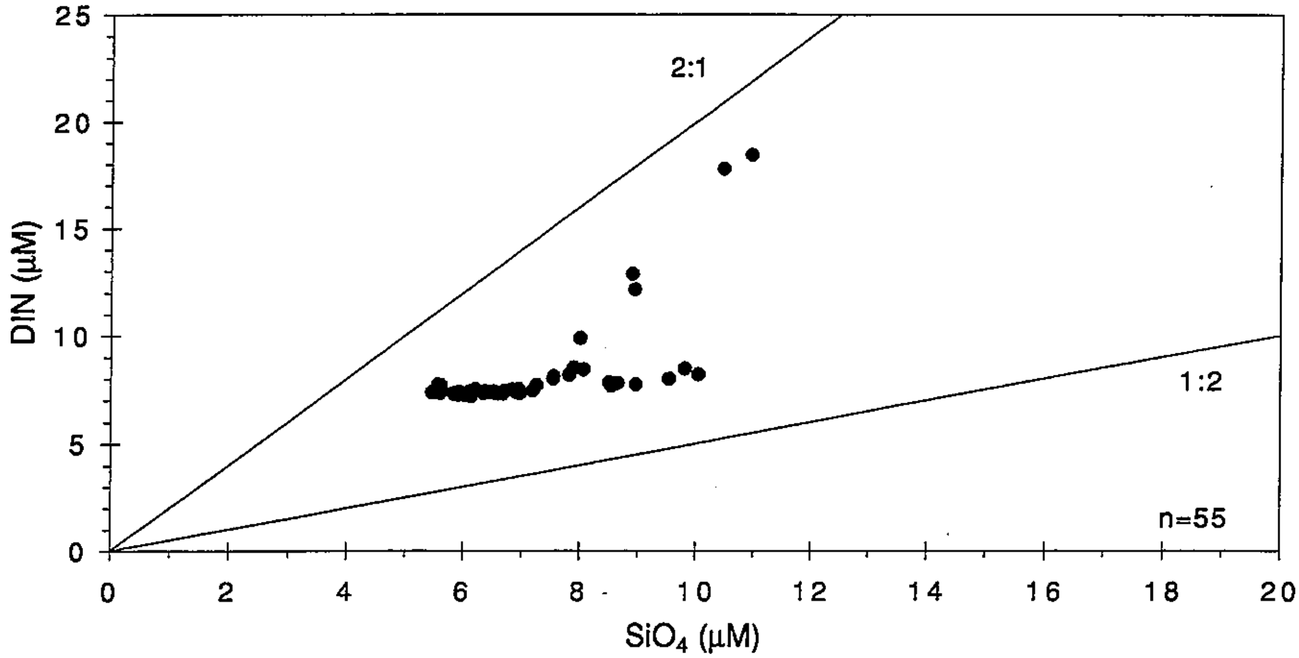
W9515 .


25
20
15
10
5
0
DIN (µM)
2:1
1:2
n=85
0 2 4 6 8 10 12 14 16 18 20
SiO4 (µM)

W9515 .

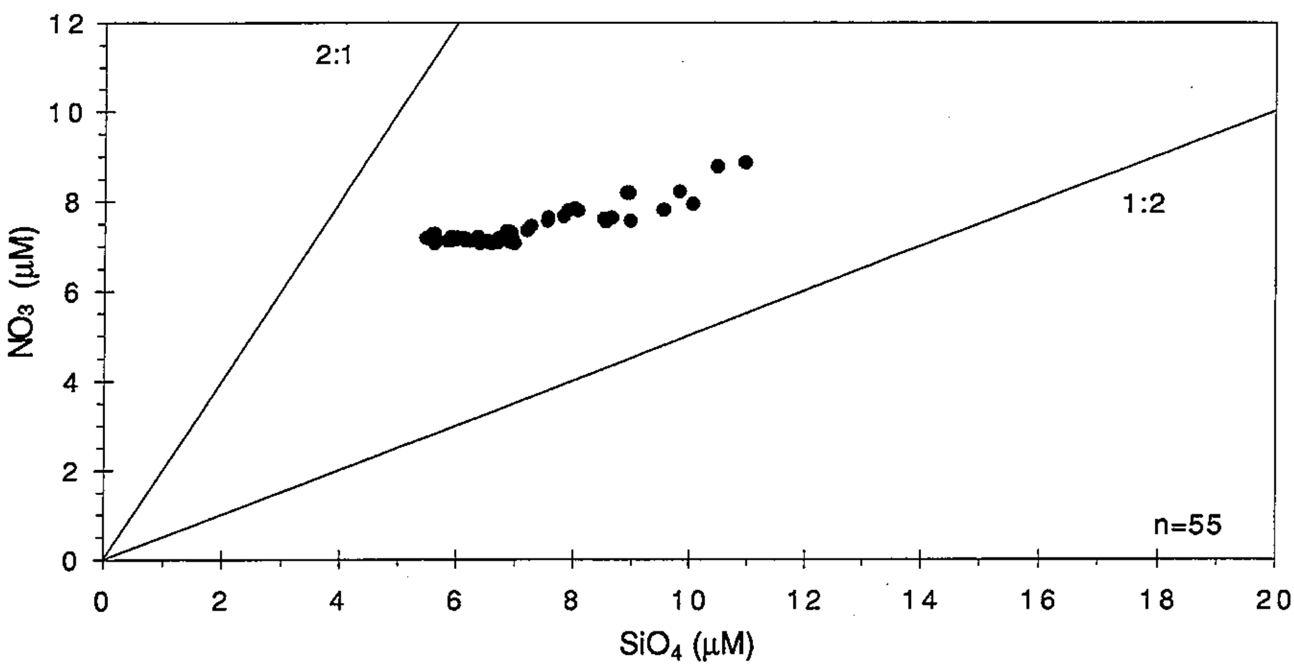

12
10
8
6
4
2
0
NO3 (µM)
2:1
1:2
n=85
0 2 4 6 8 10 12 14 16 18 20
SiO4 (µM)

W9516

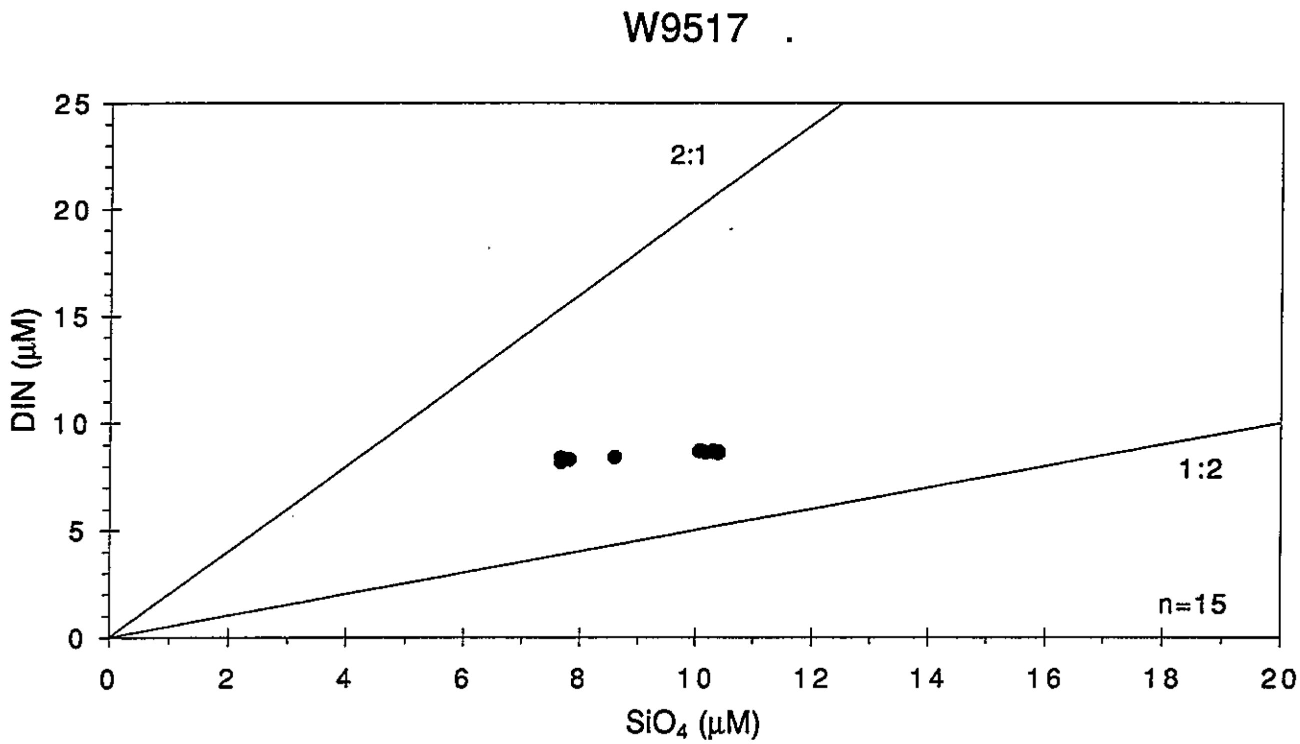


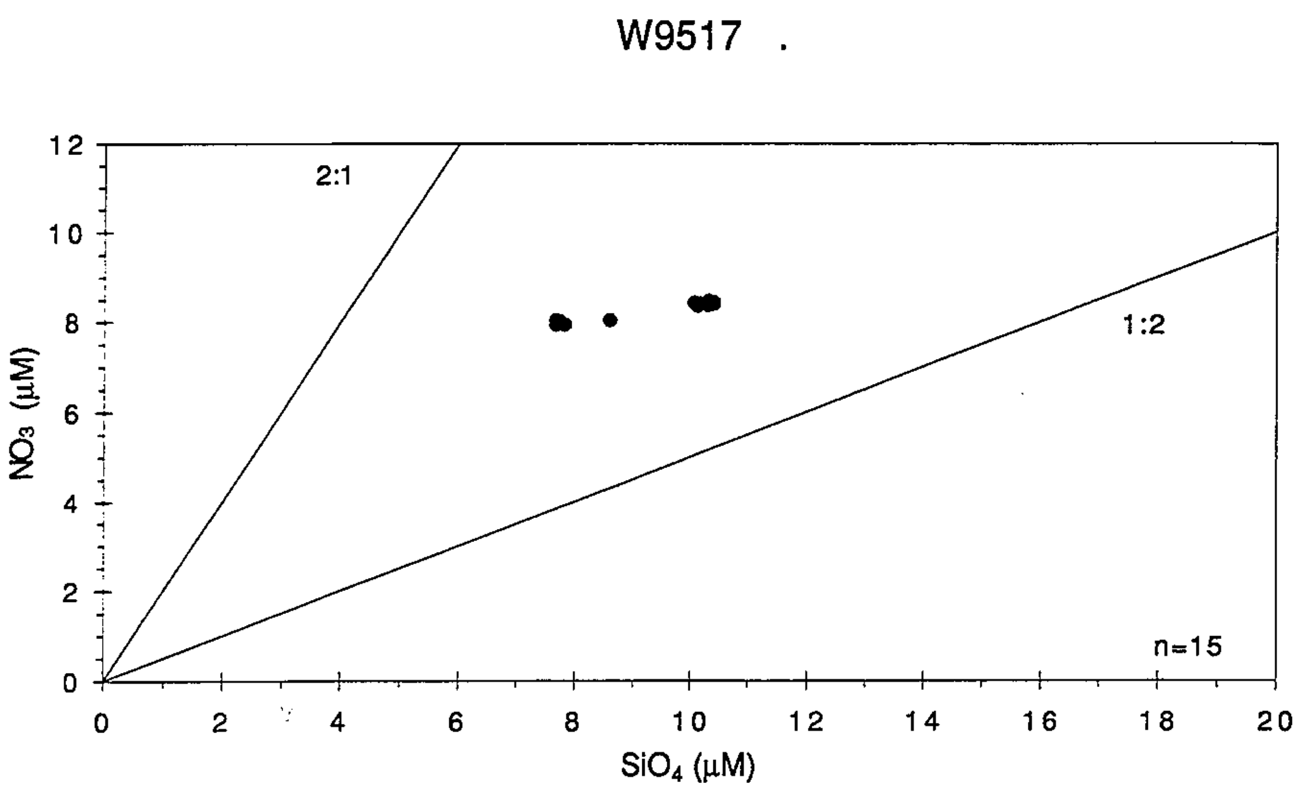
25
20
15
10
5
0
DIN (μM)
0
2
4
6
8
10
12
14
16
18
20
SiO4 (μM)
2:1
1:2
n=55

W9516

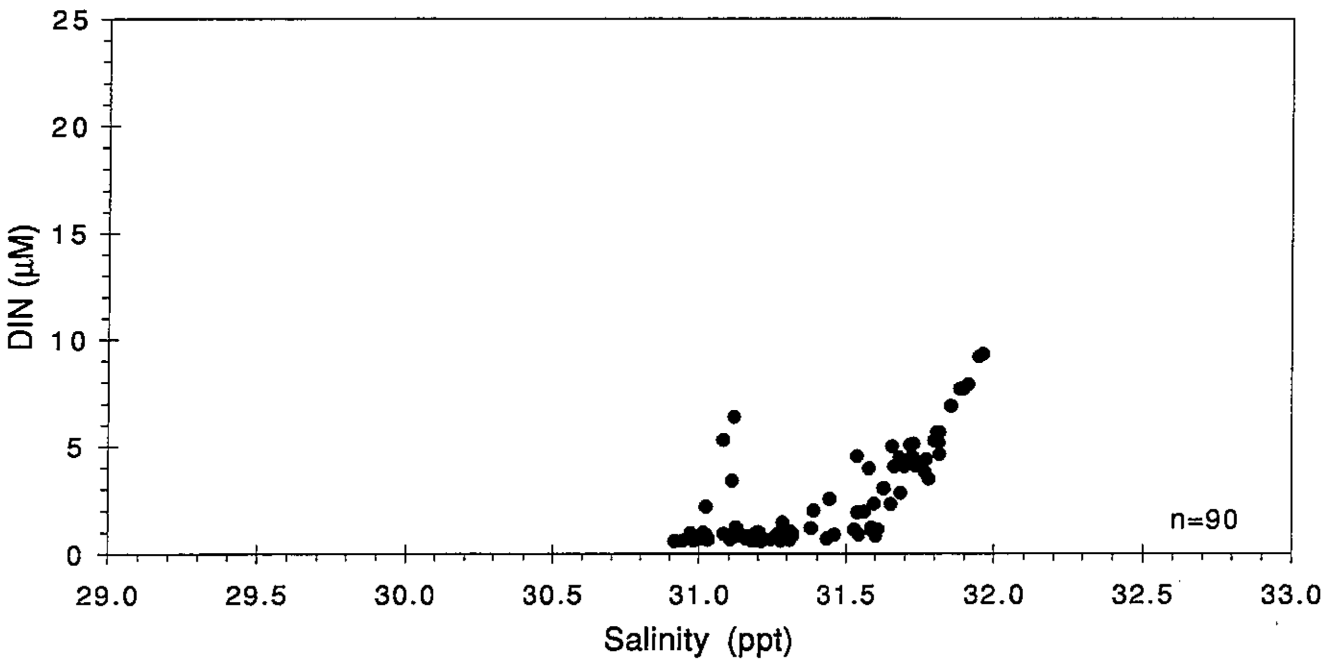


12
10
8
6
4
2
0
NO3 (μM)
0
2
4
6
8
10
12
14
16
18
20
SiO4 (μM)
2:1
1:2
n=55


W9517 .
25
20
15
10
5
0
DIN (μM)
2:1
1:2
n=15
0
2
4
6
8
10
12
14
16
18
20
SiO4 (μM)

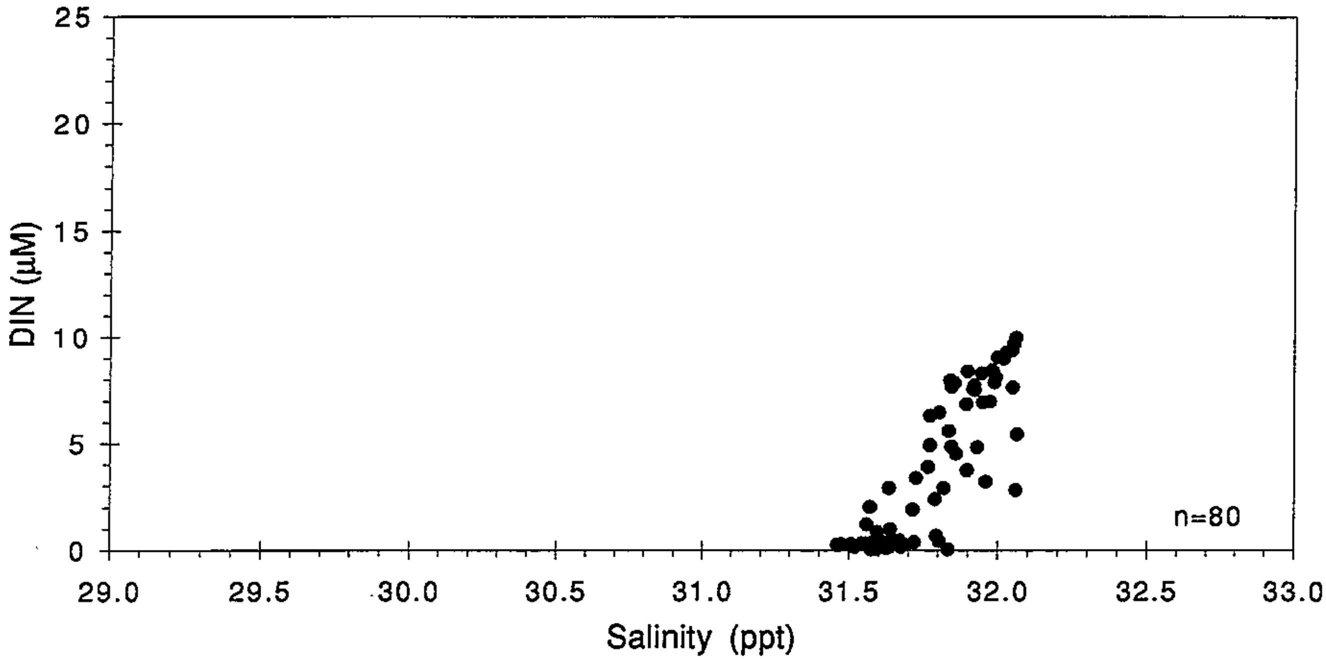

W9517 .
12
10
8
6
4
2
0
NO3 (μM)
2:1
1:2
n=15
0
2
4
6
8
10
12
14
16
18
20
SiO4 (μM)

W9510



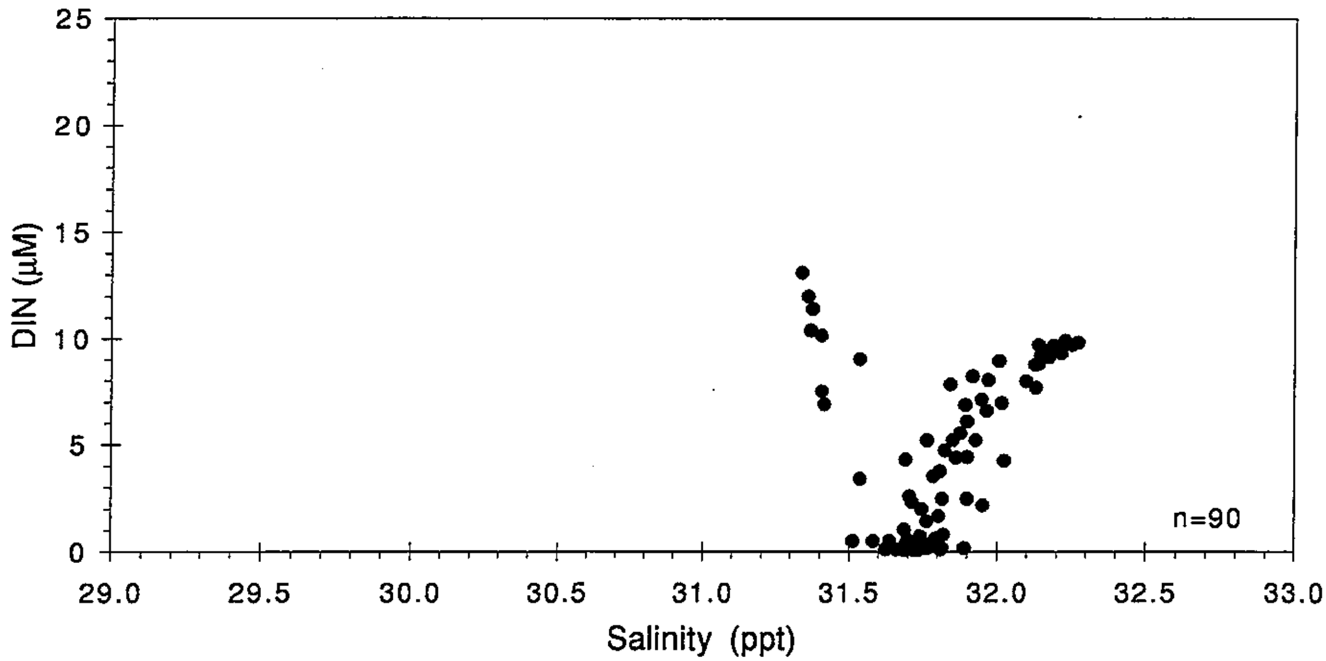
25
20
15
10
5
0
DIN (μM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9512 .



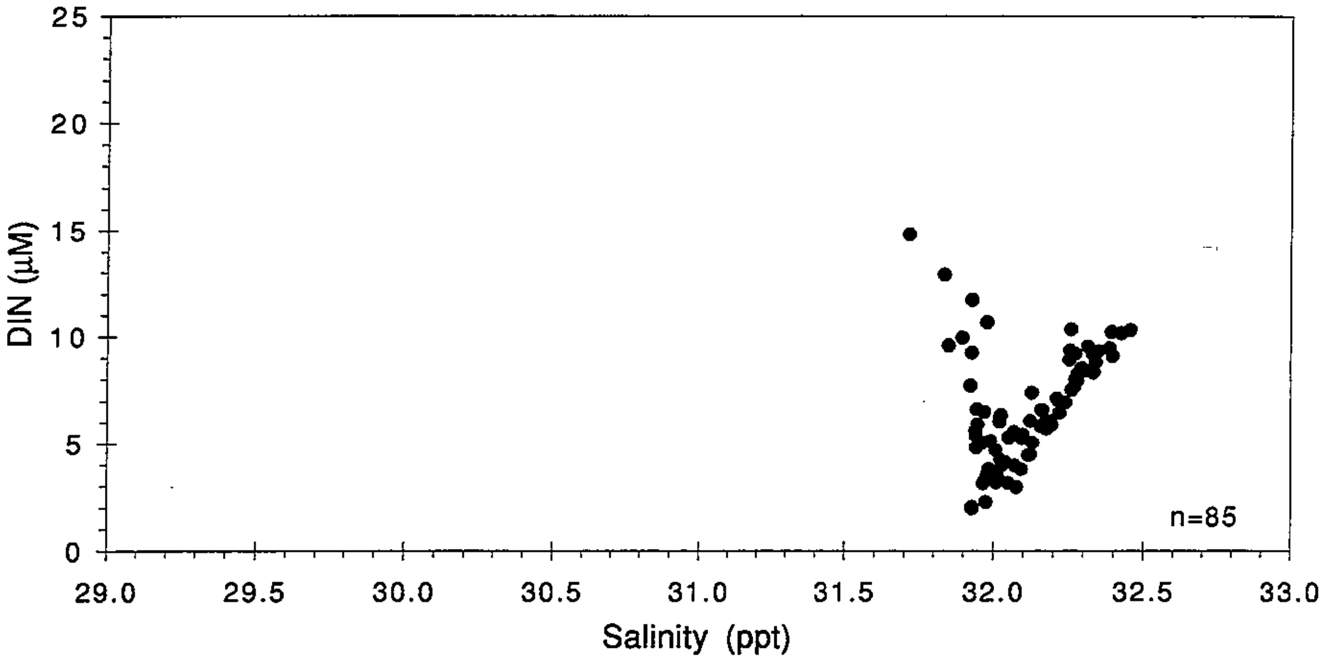
25
20
15
10
5
0
DIN (μM)
n=80
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9513



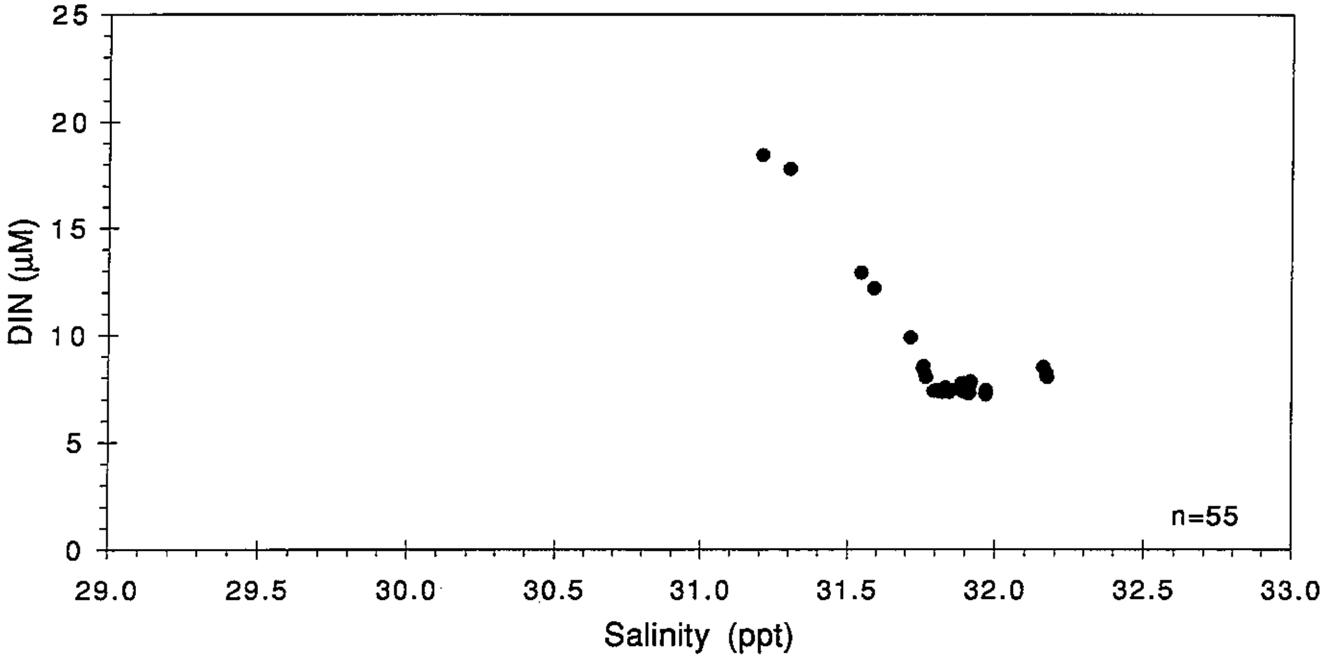
DIN (µM)
25
20
15
10
5
0
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=90

W9515



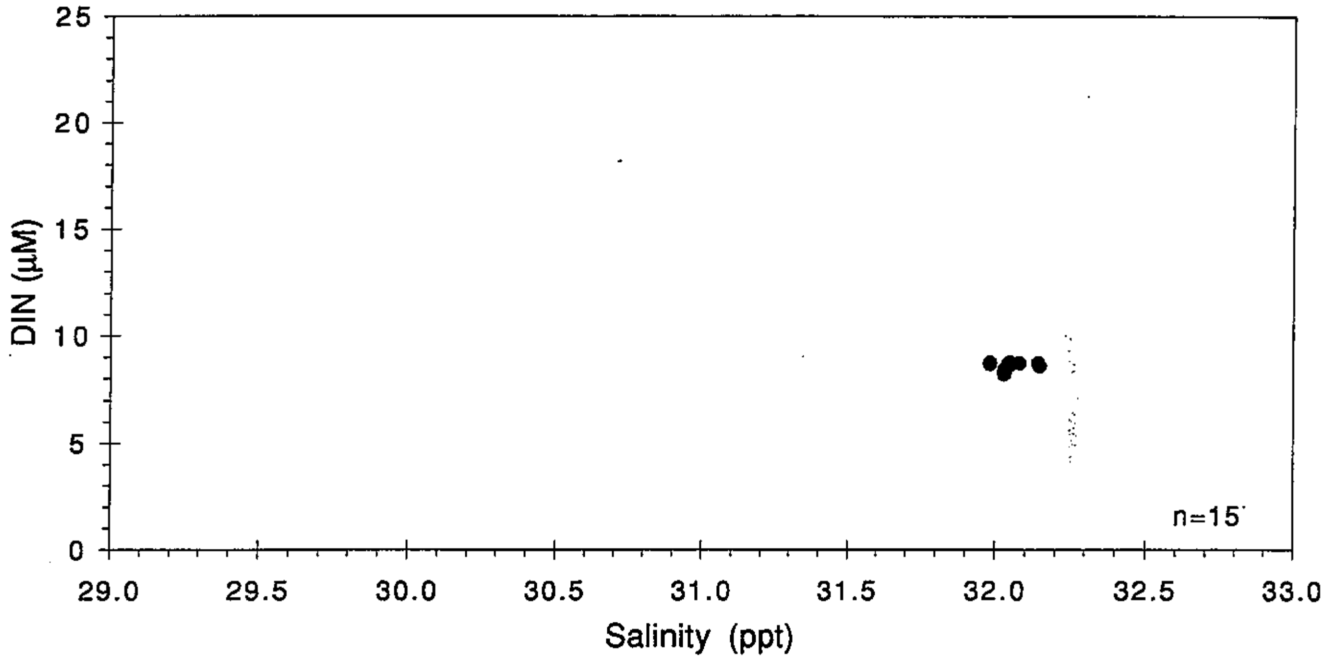
25
20
15
10
5
0
DIN (µM)
n=85
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

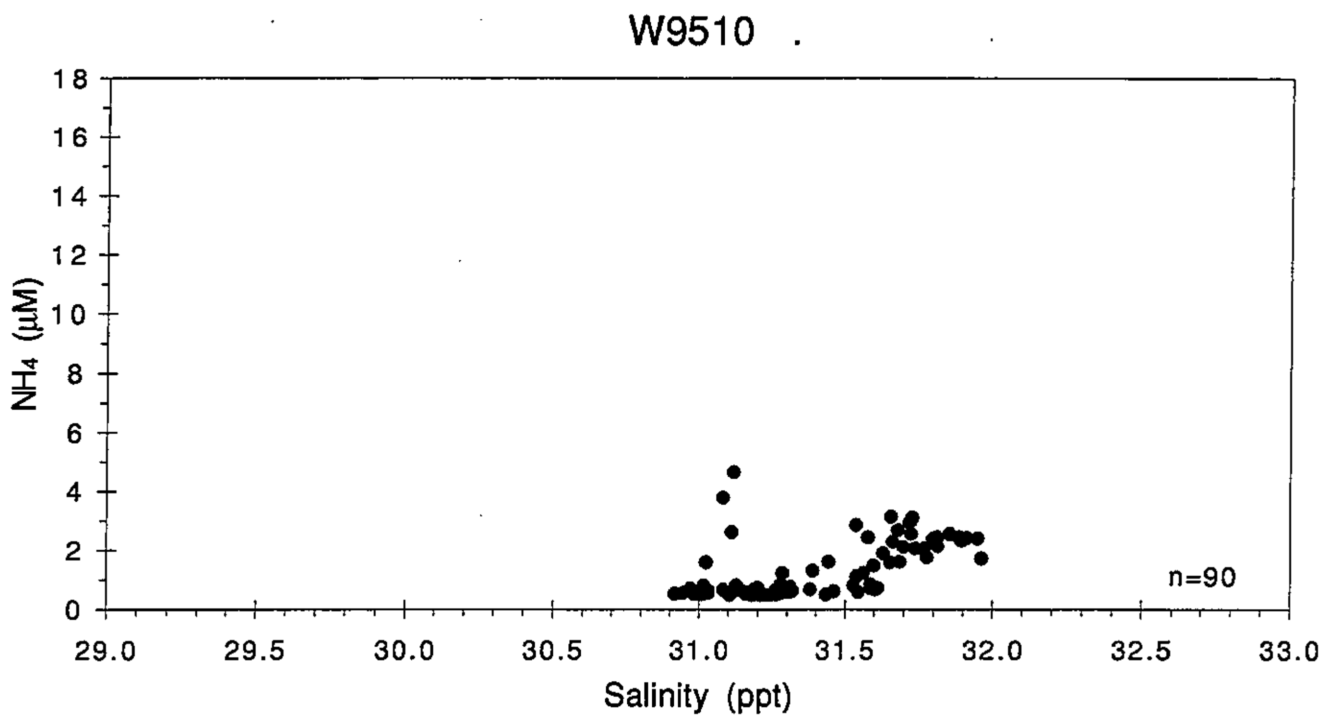
W9516

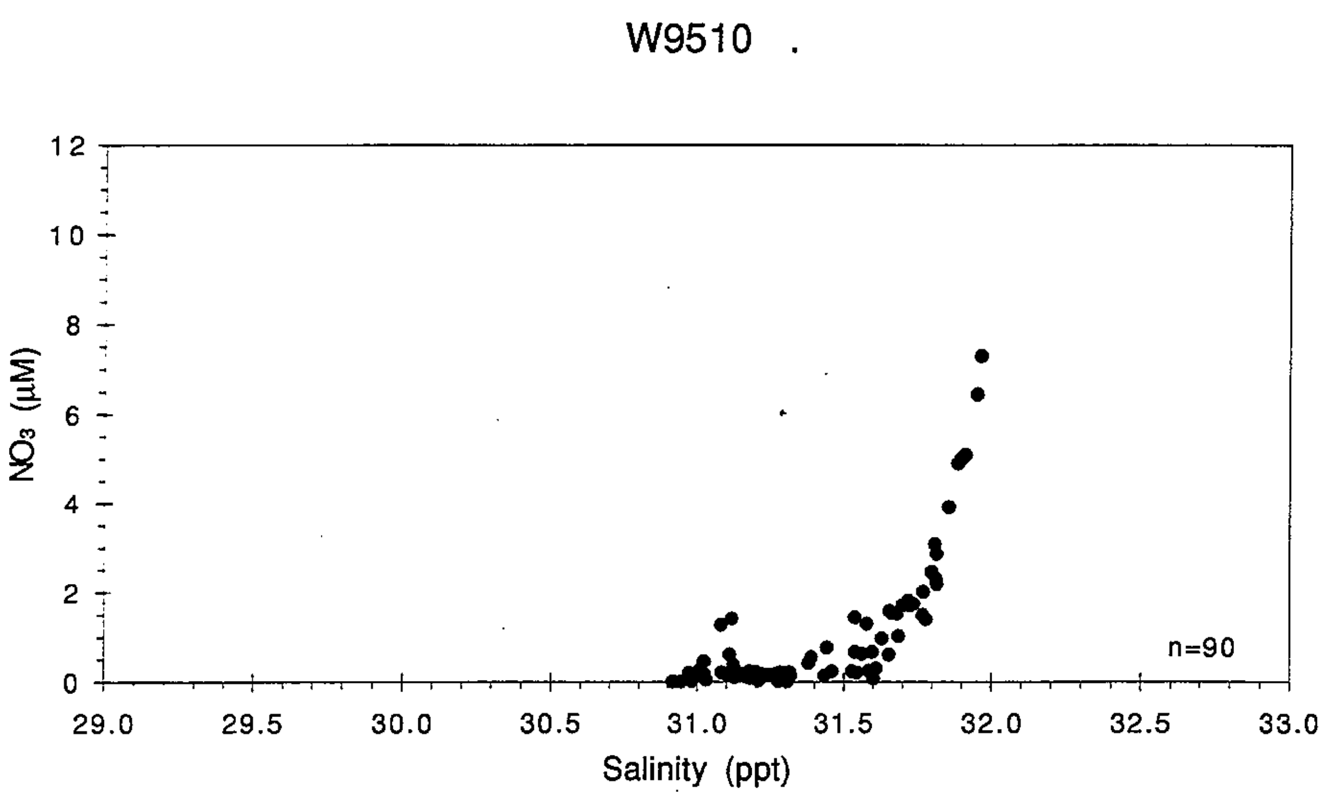


25
20
15
10
5
0
DIN (µM)
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=55

W9517 .


25
20
15
10
5
0
DIN (μM)
n=15
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9510
NH4 (µM)
n=90
Salinity (ppt)
0
2
4
6
8
10
12
14
16
18
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0


W9510
NO3 (µM)
n=90
Salinity (ppt)
0
2
4
6
8
10
12
29.0
29.5
30.0
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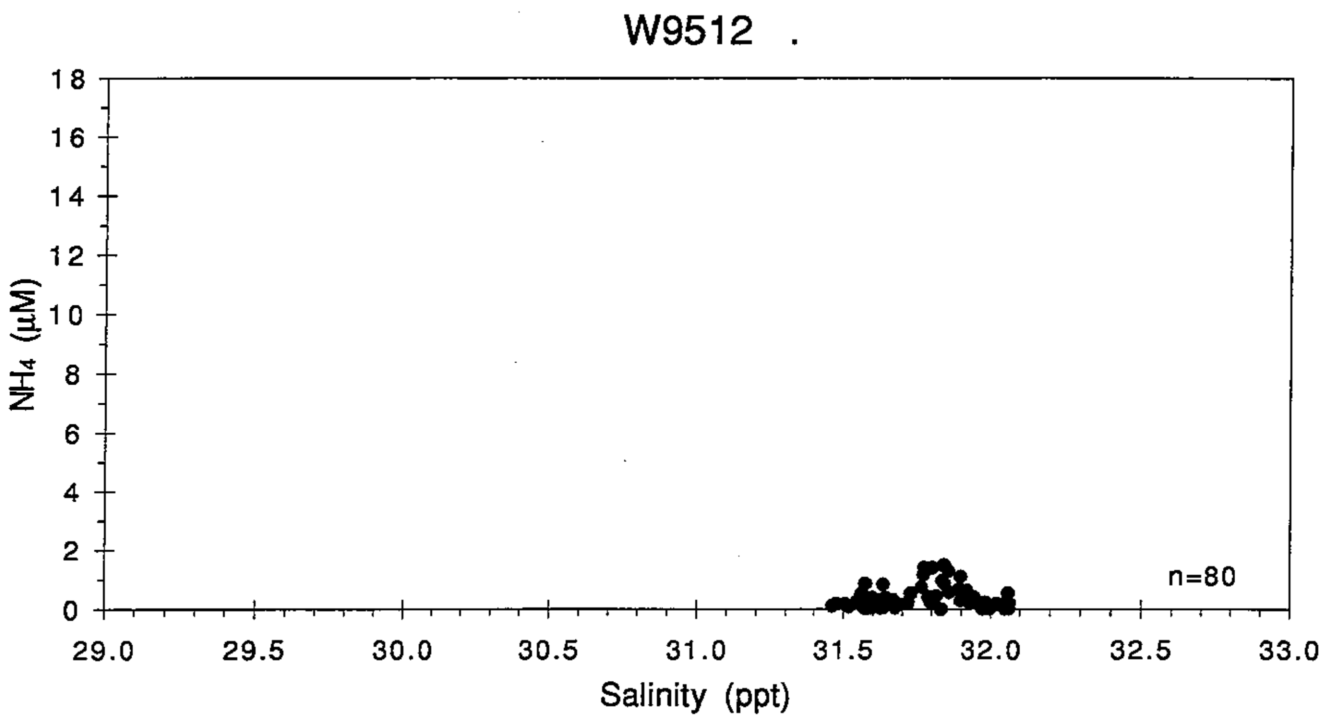
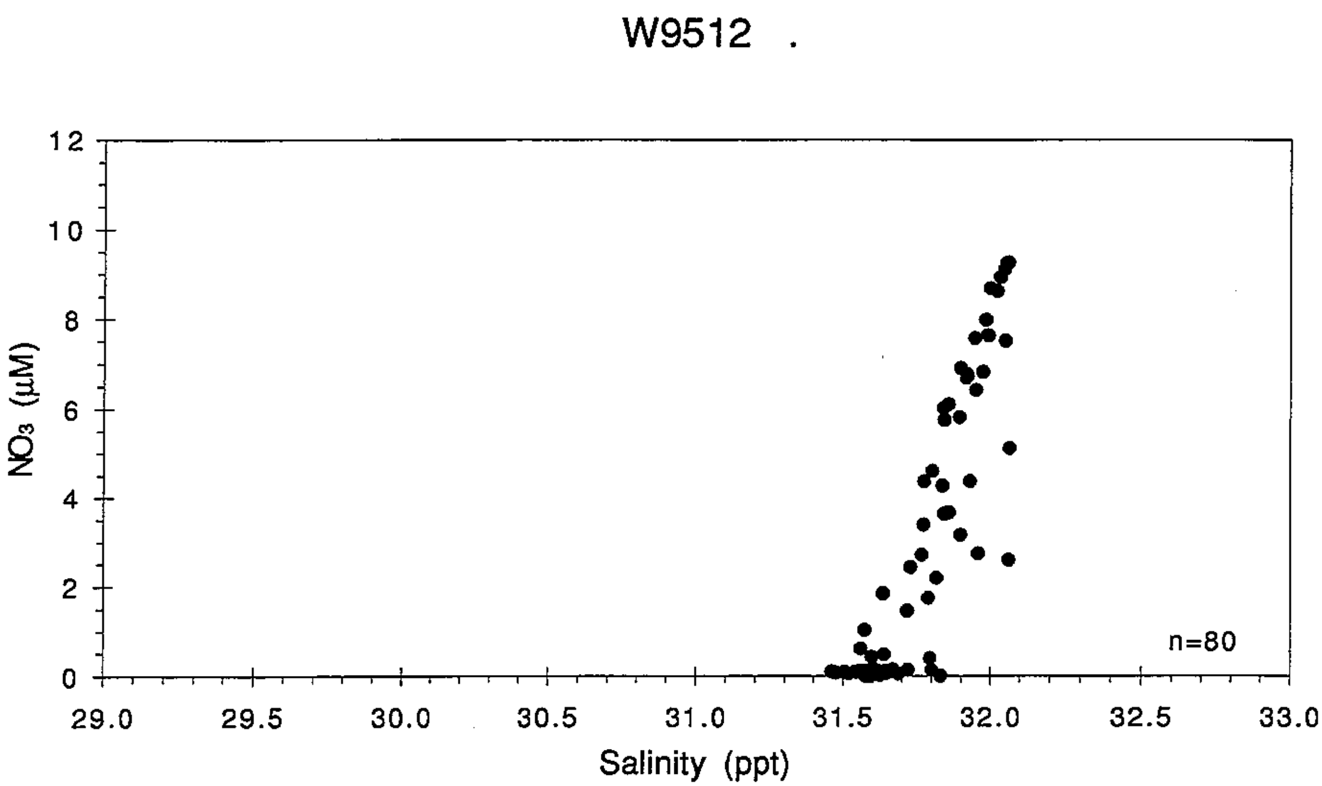
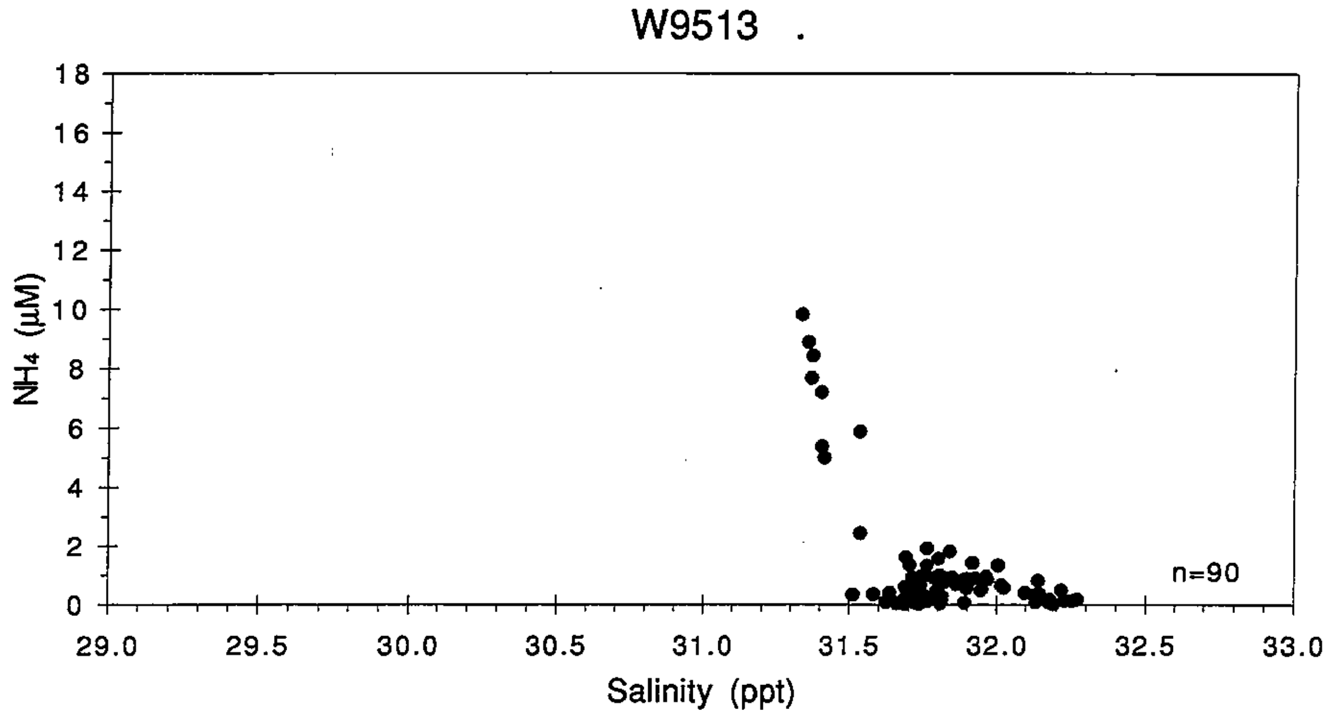
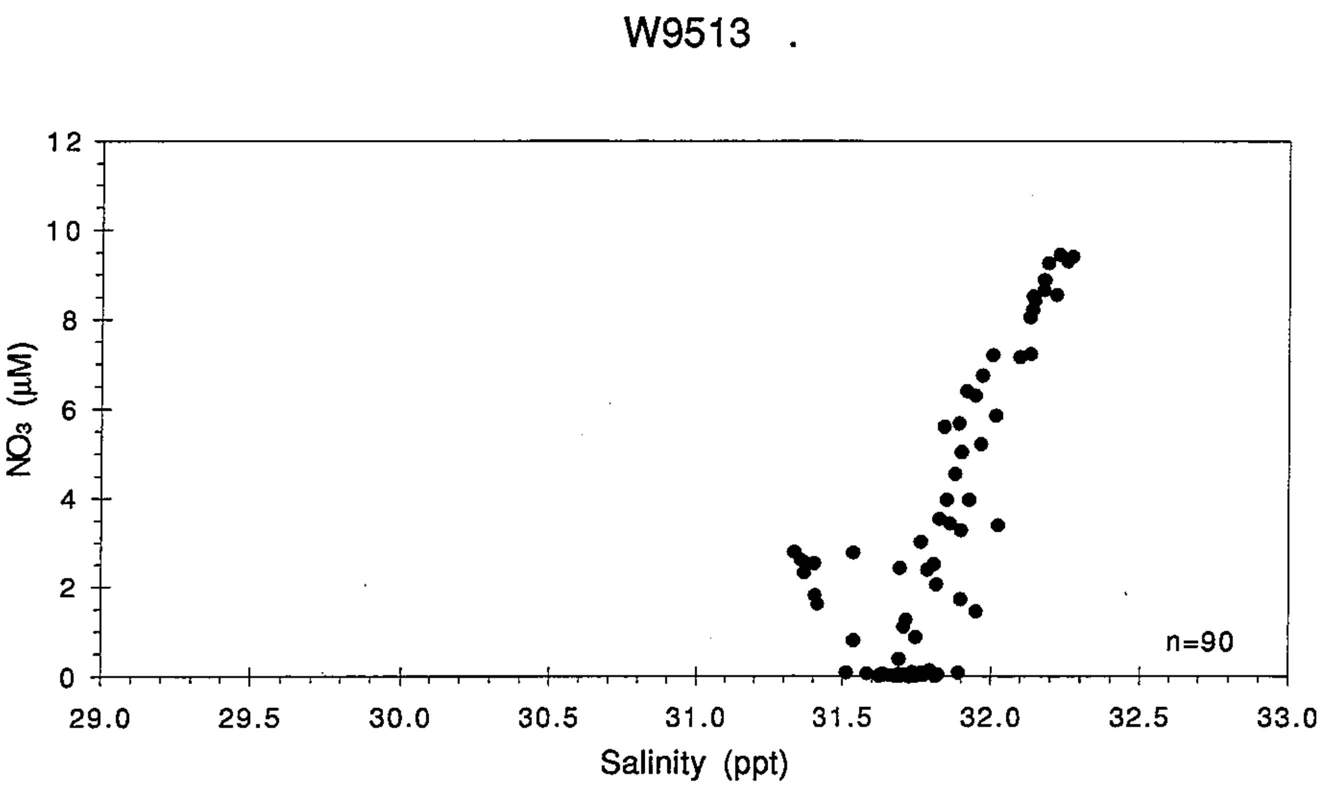
31.0
31.5
32.0
32.5
33.0

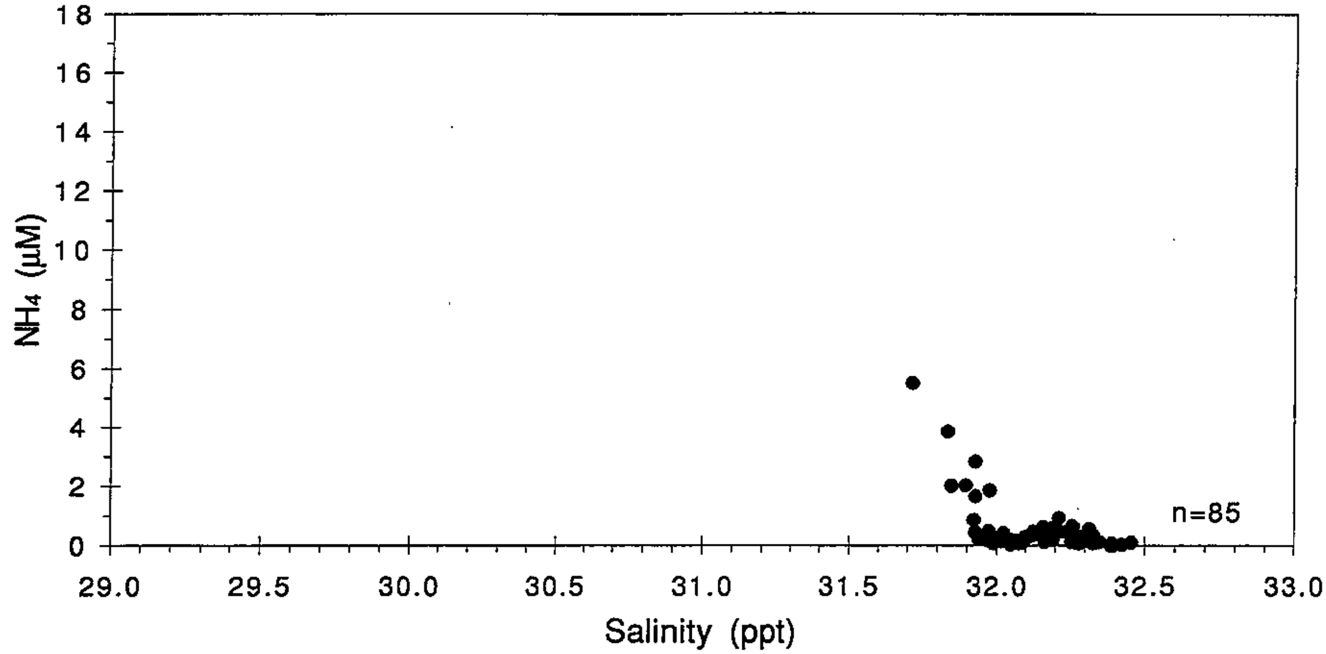

W9512 .
18
16
14
12
10
8
6
4
2
0
NH4 (µM)
n=80
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9512 .
12
10
8
6
4
2
0
NO3 (µM)
n=80
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9513 .
18
16
14
12
10
8
6
4
2
0
NH4 (µM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

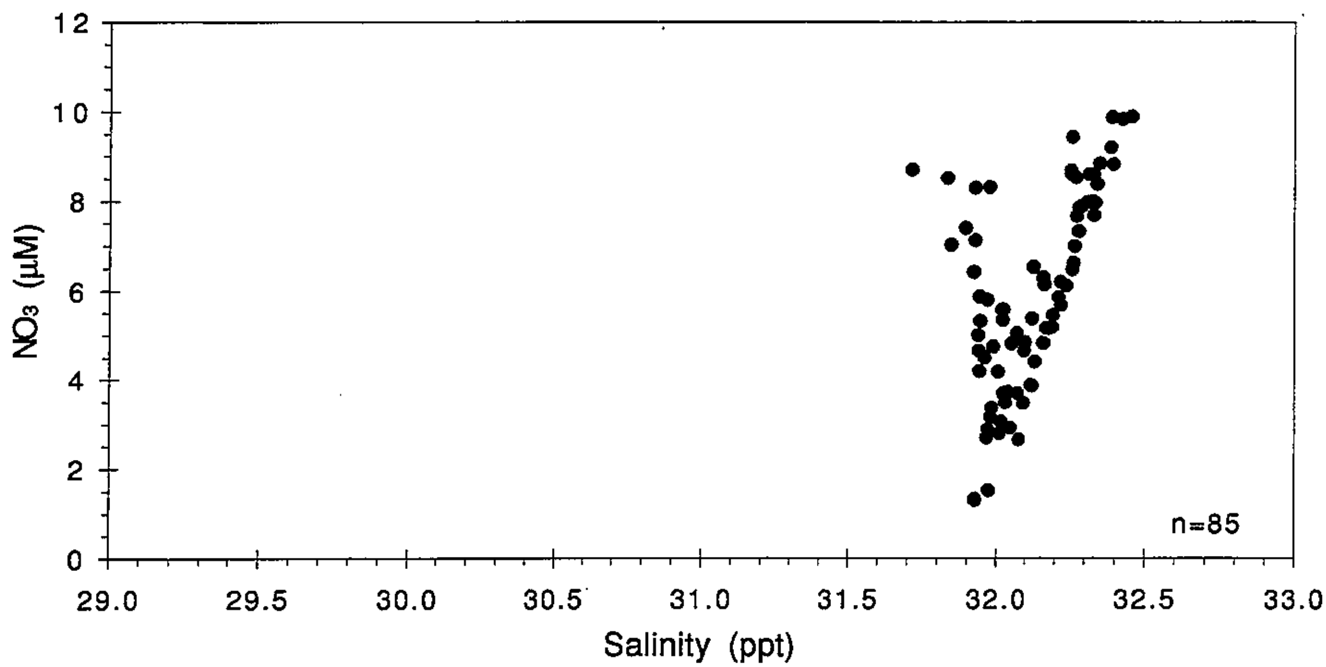

W9513 .
12
10
8
6
4
2
0
NO3 (µM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9515 .

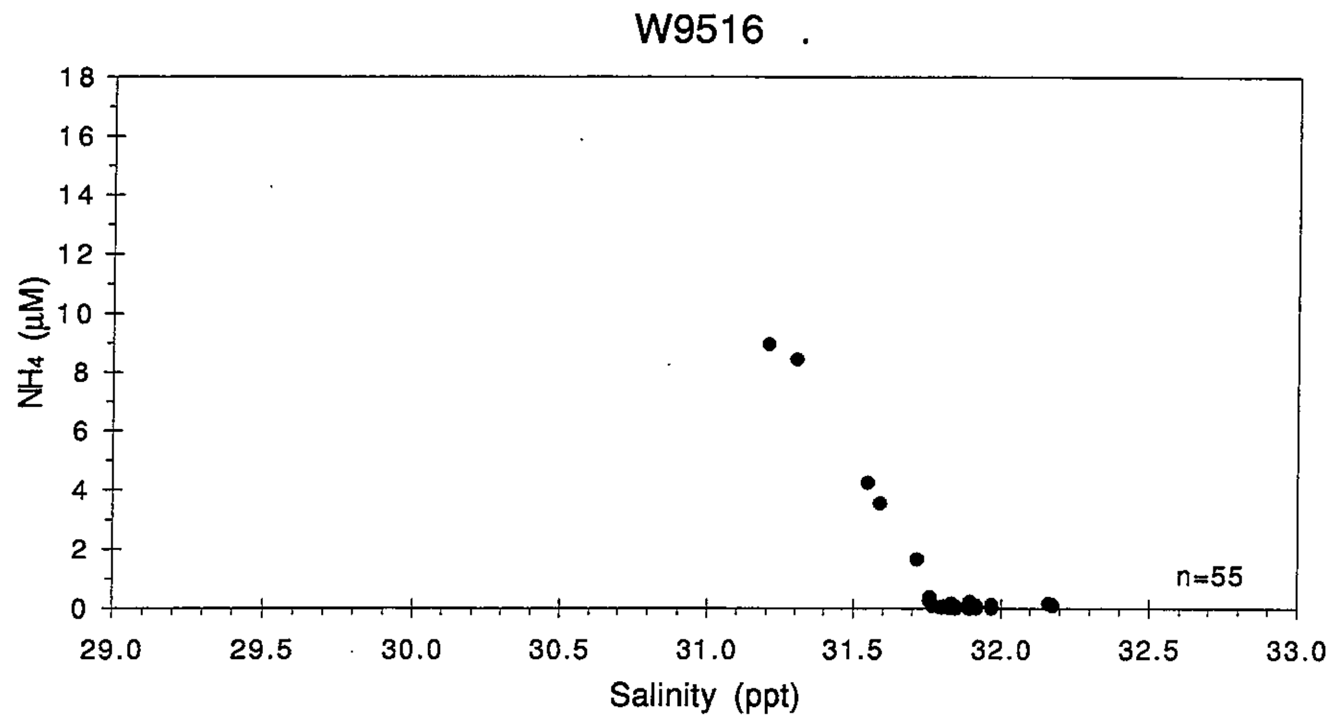


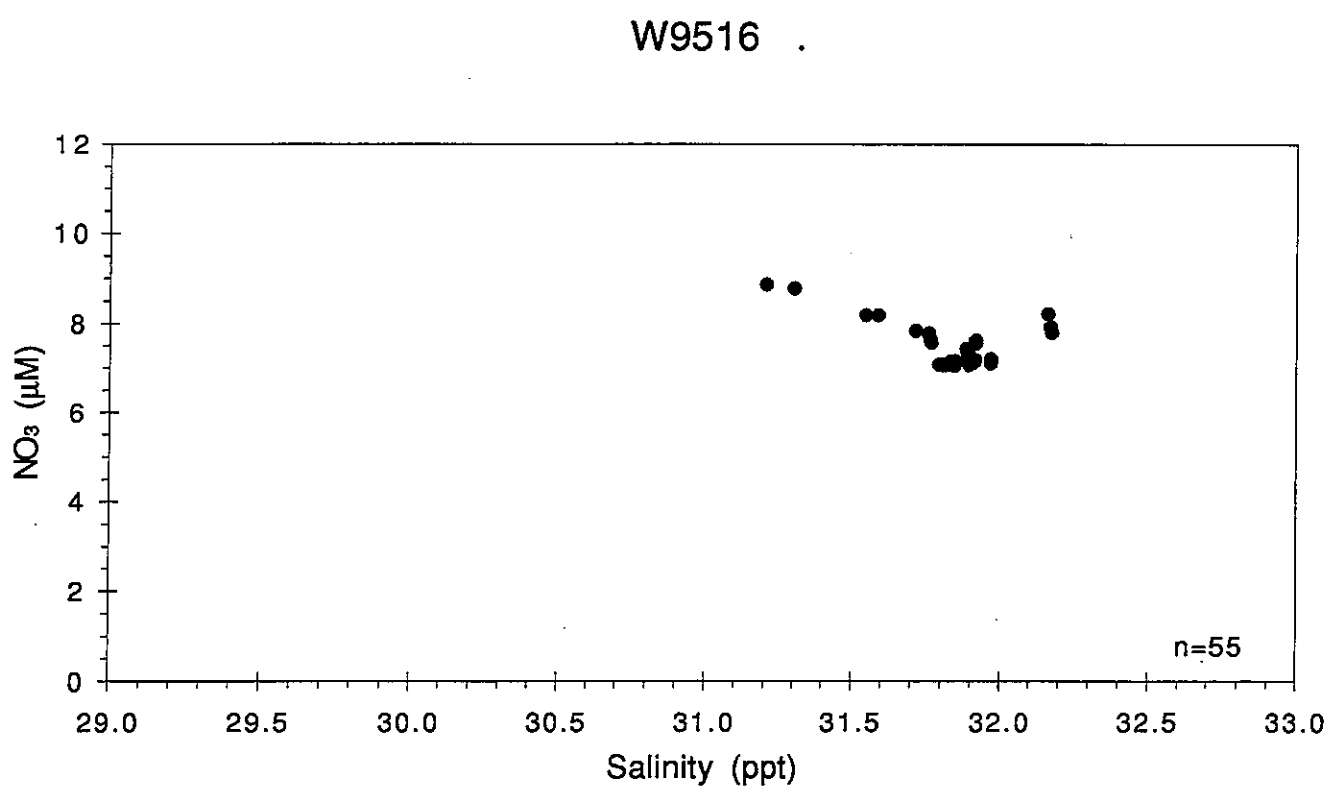
18
16
14
12
10
8
6
4
2
0
NH4 (μM)
n=85
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

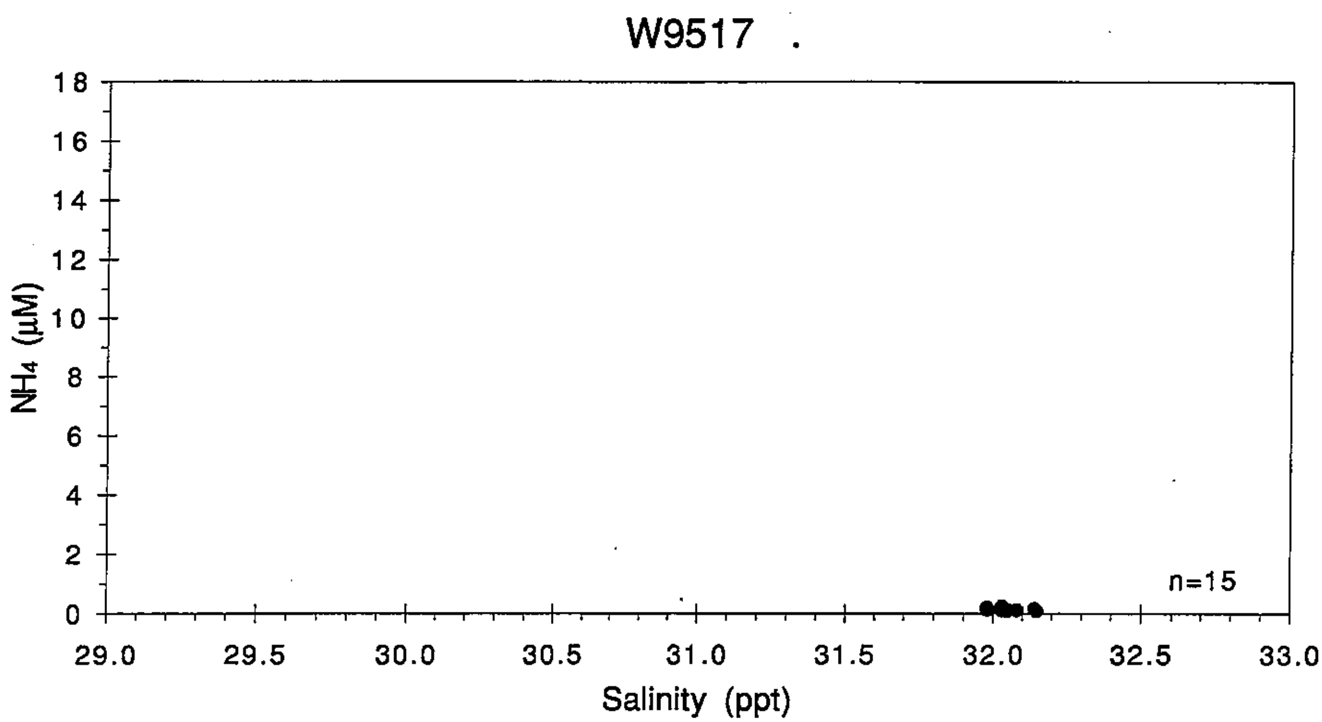
W9515 .

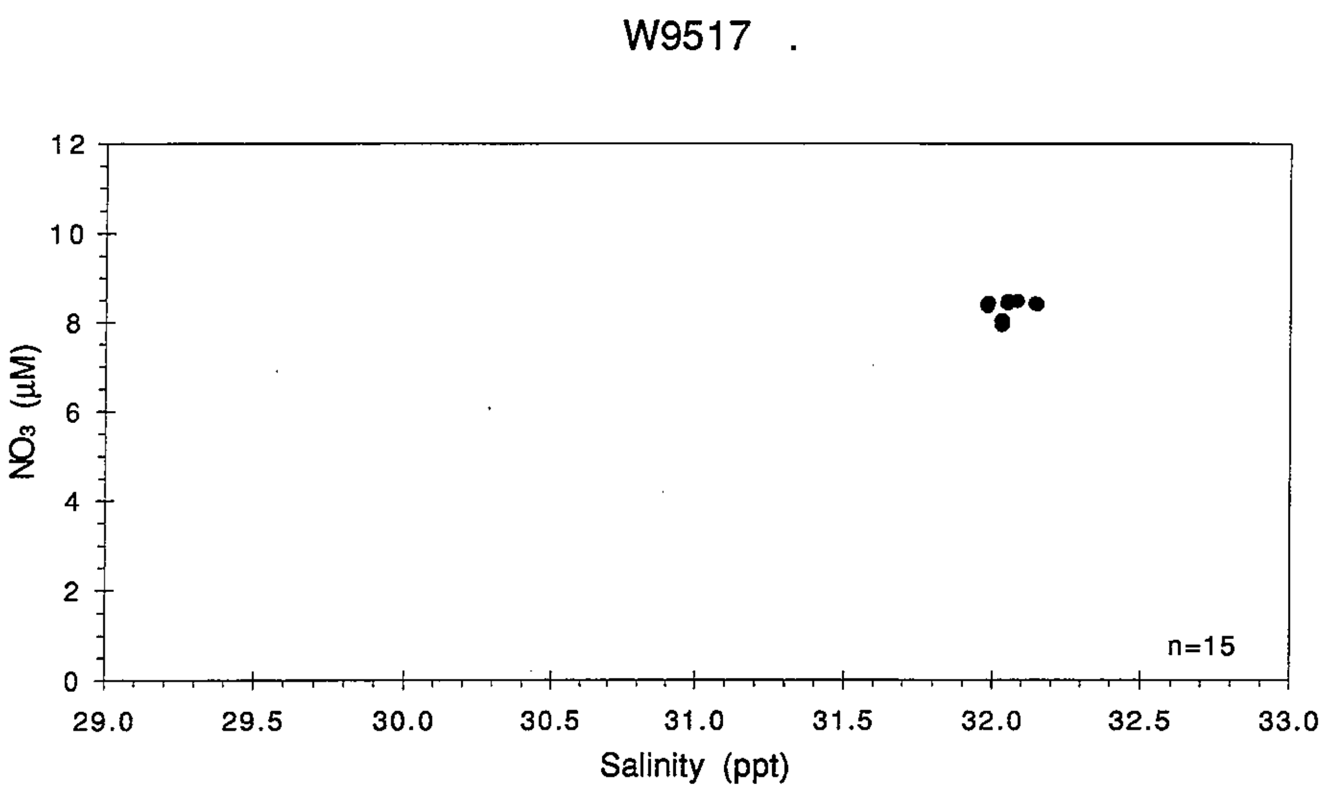


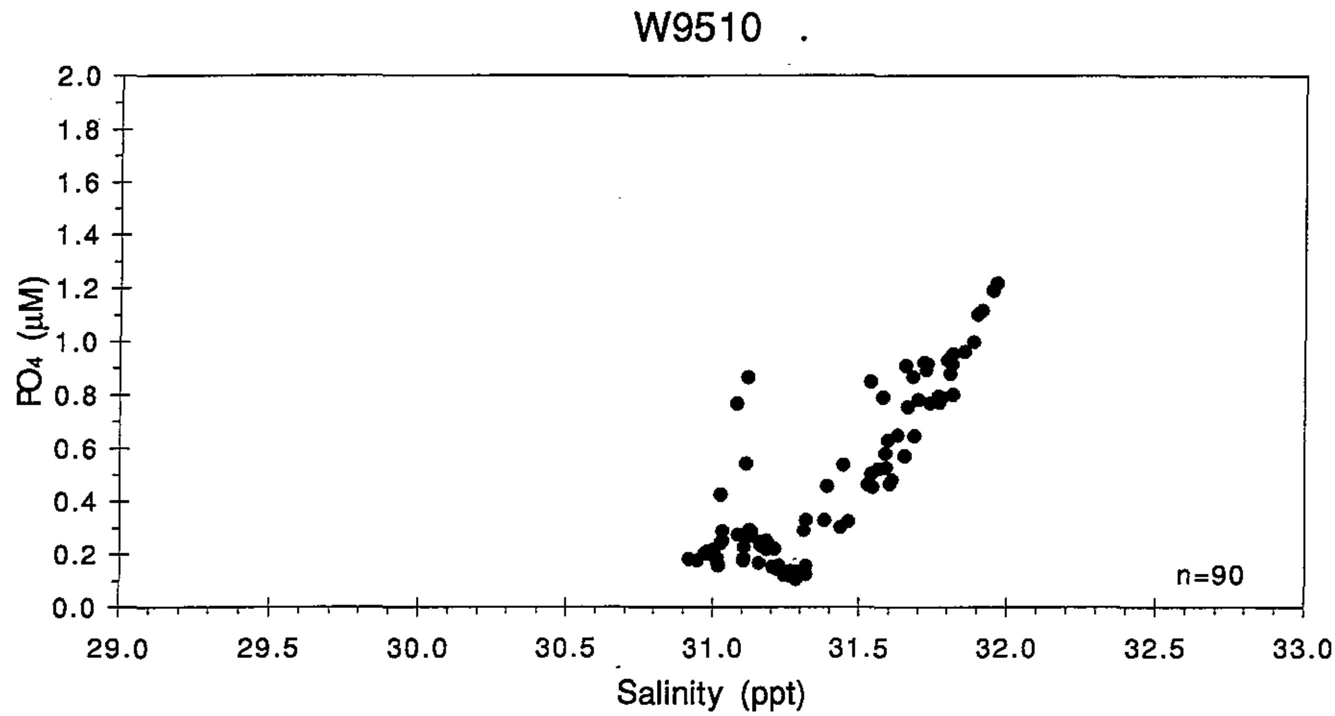
12
10
8
6
4
2
0
NO3 (μM)
n=85
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9516
NH4 (μM)
18
16
14
12
10
8
6
4
2
0
n=55
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

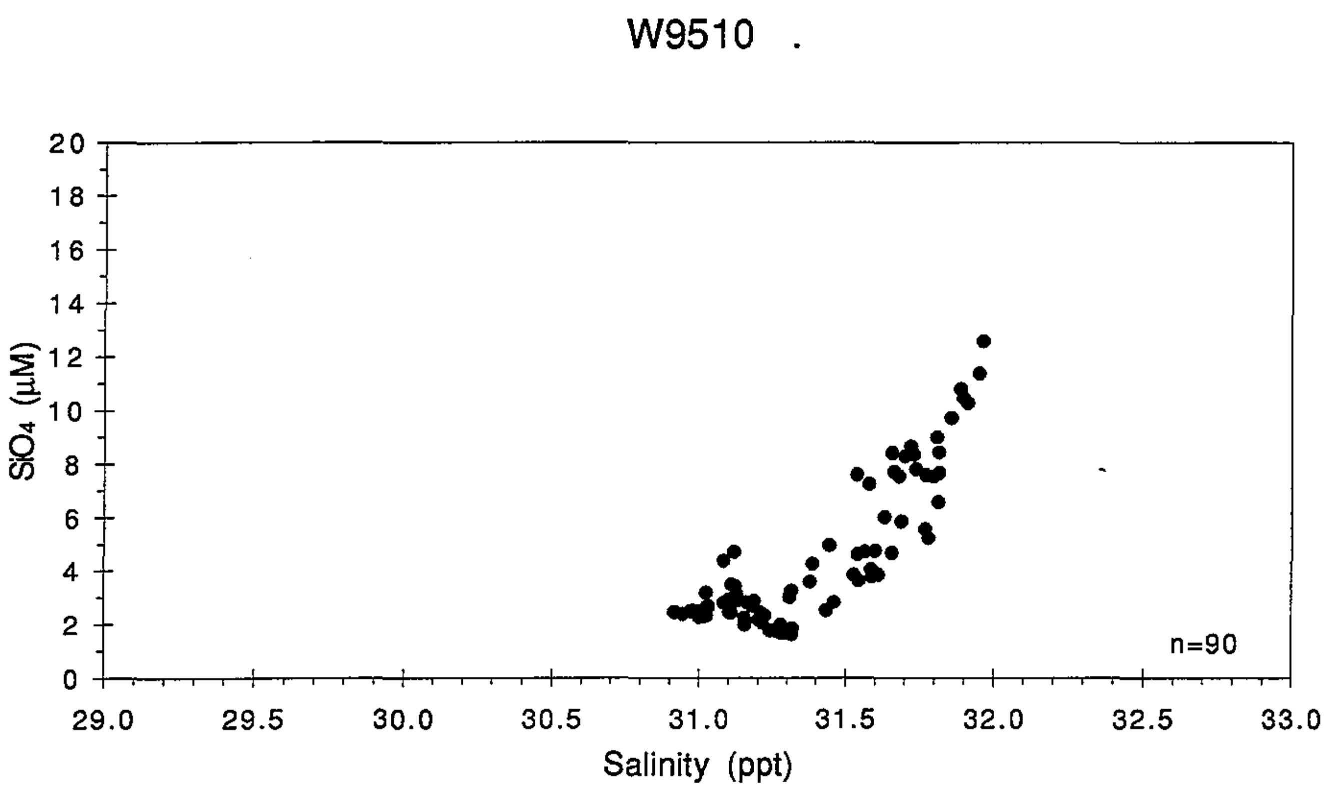

W9516
NO3 (μM)
12
10
8
6
4
2
0
n=55
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9517 .
NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=15
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

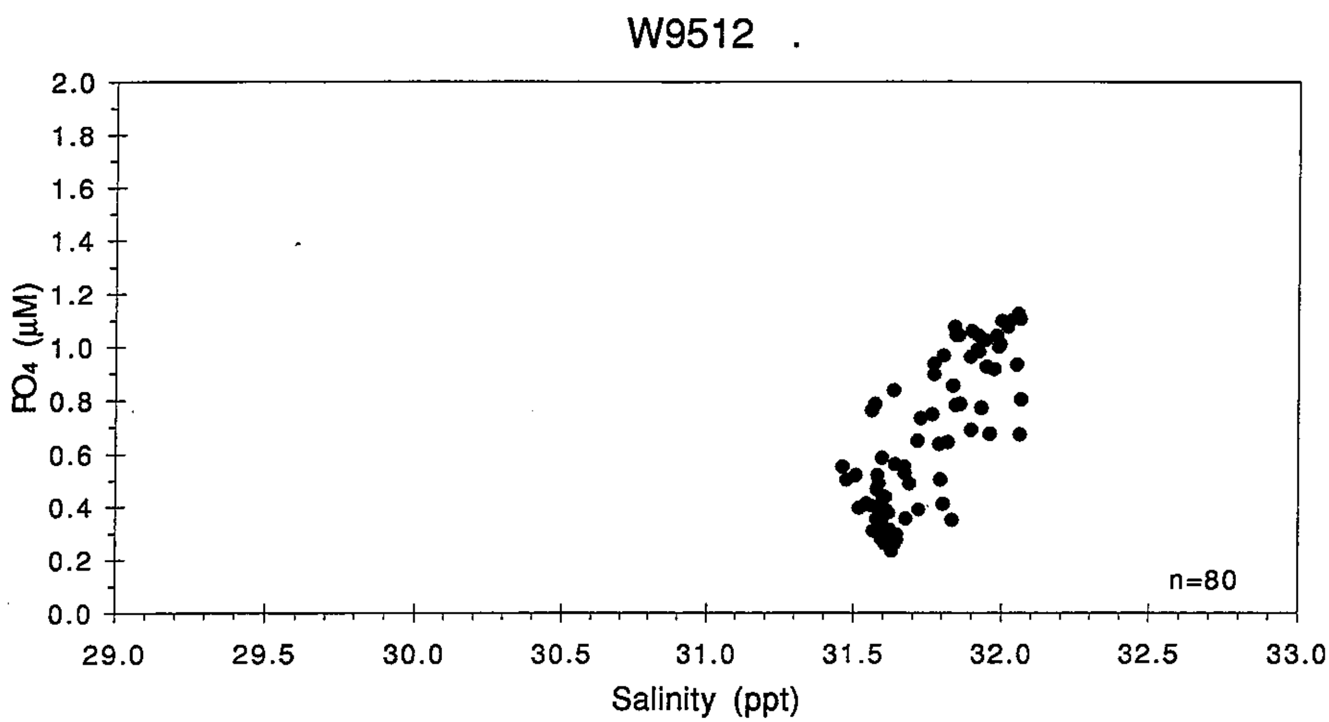

W9517 .
NO3 (µM)
12
10
8
6
4
2
0
n=15
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

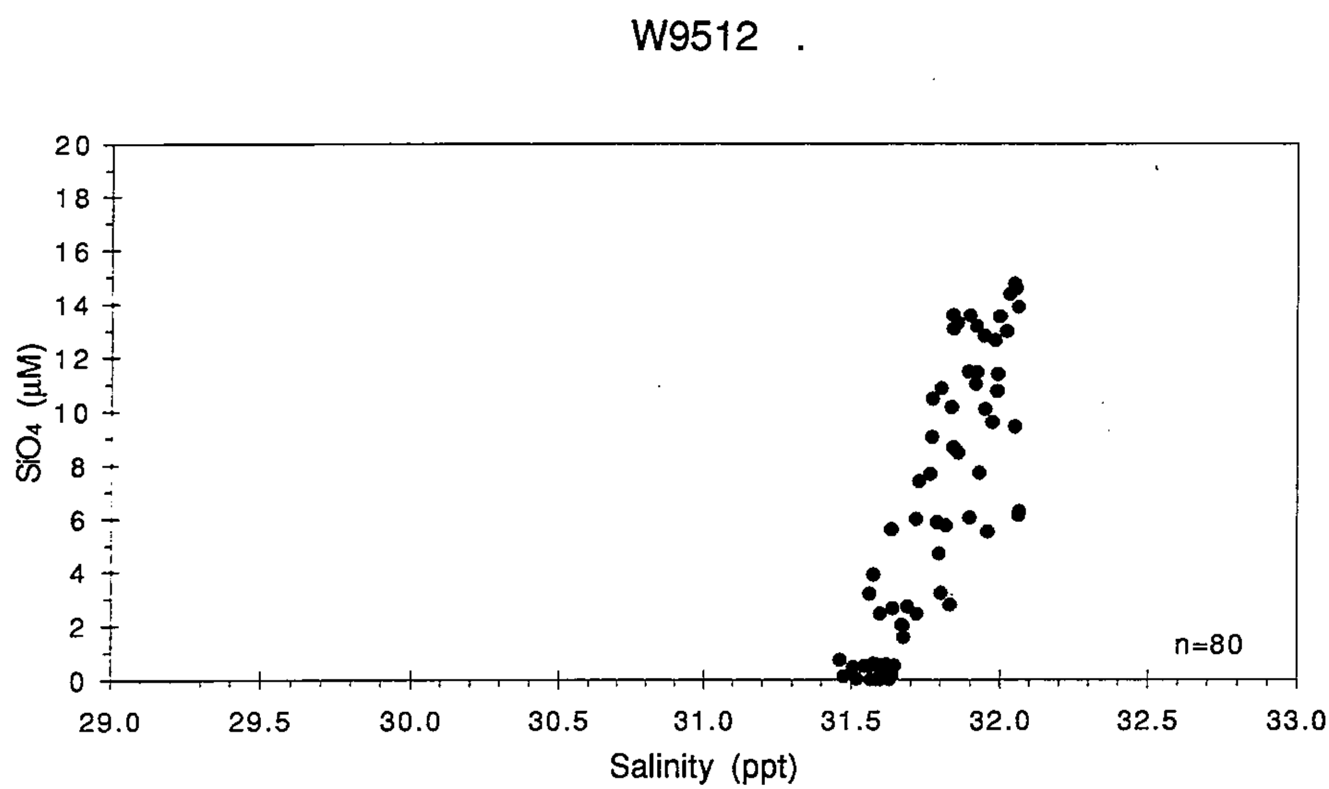


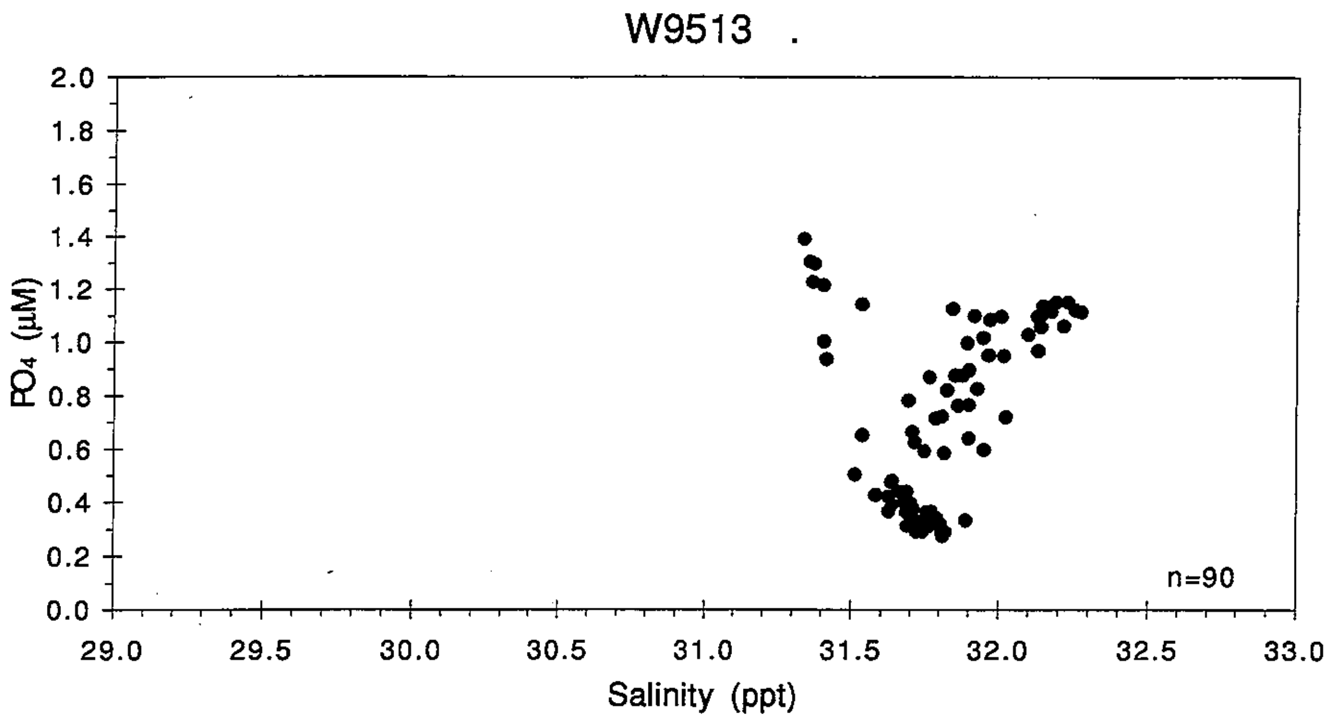
W9510 .
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (μM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)



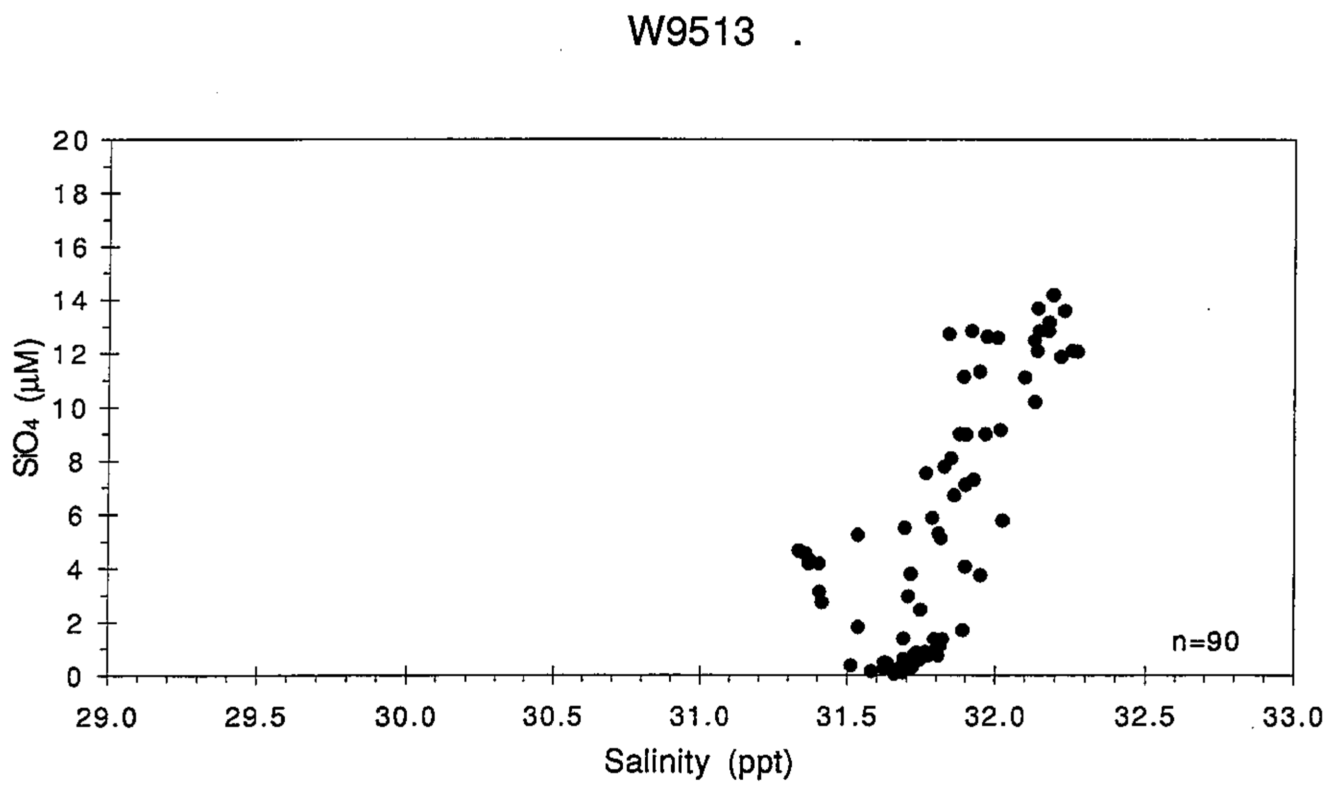
W9510 .
20
18
16
14
12
10
8
6
4
2
0
SiO4 (μM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9512 .
PO4 (µM)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
n=80
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9512 .
SiO4 (µM)
20
18
16
14
12
10
8
6
4
2
0
n=80
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

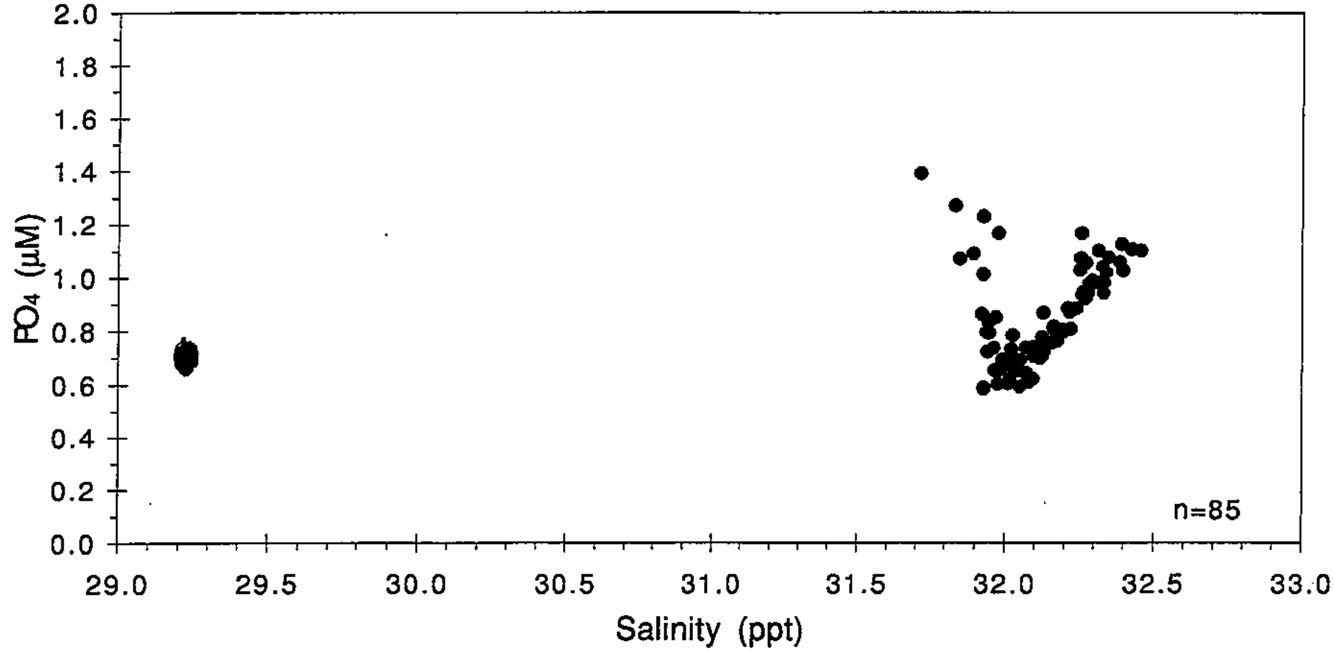


W9513
PO4 (µM)
n=90
Salinity (ppt)



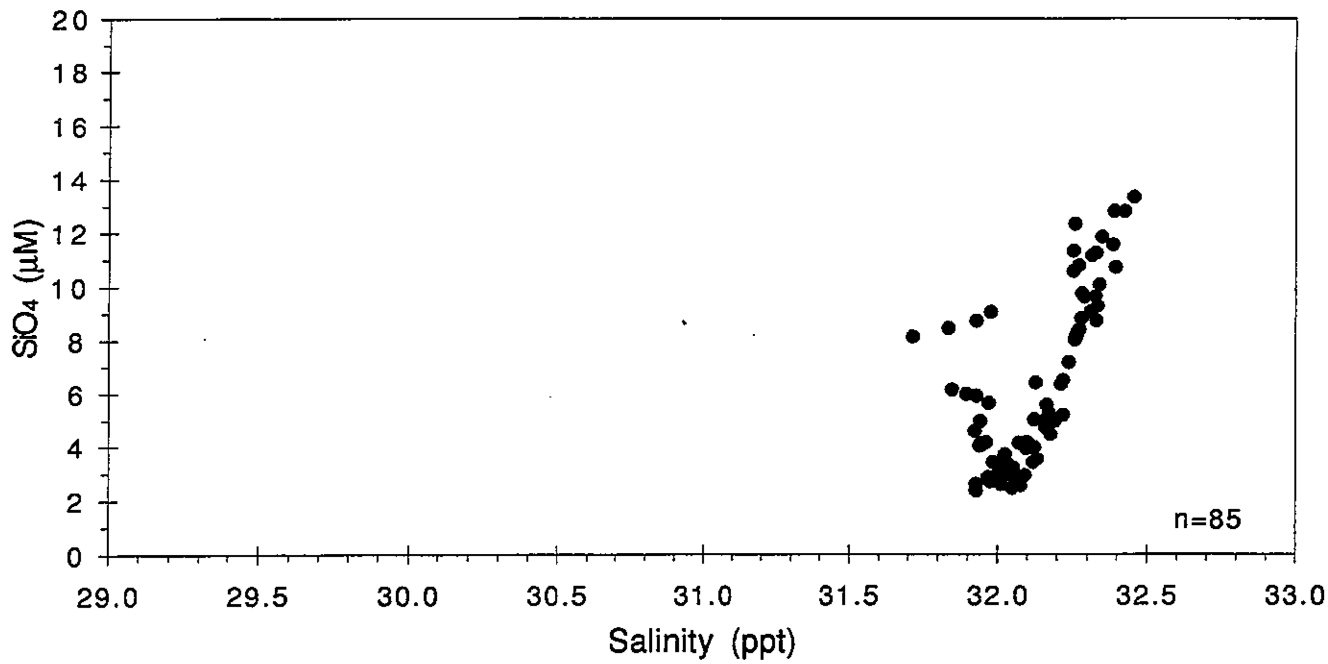
W9513
SiO4 (µM)
n=90
Salinity (ppt)

W9515 .

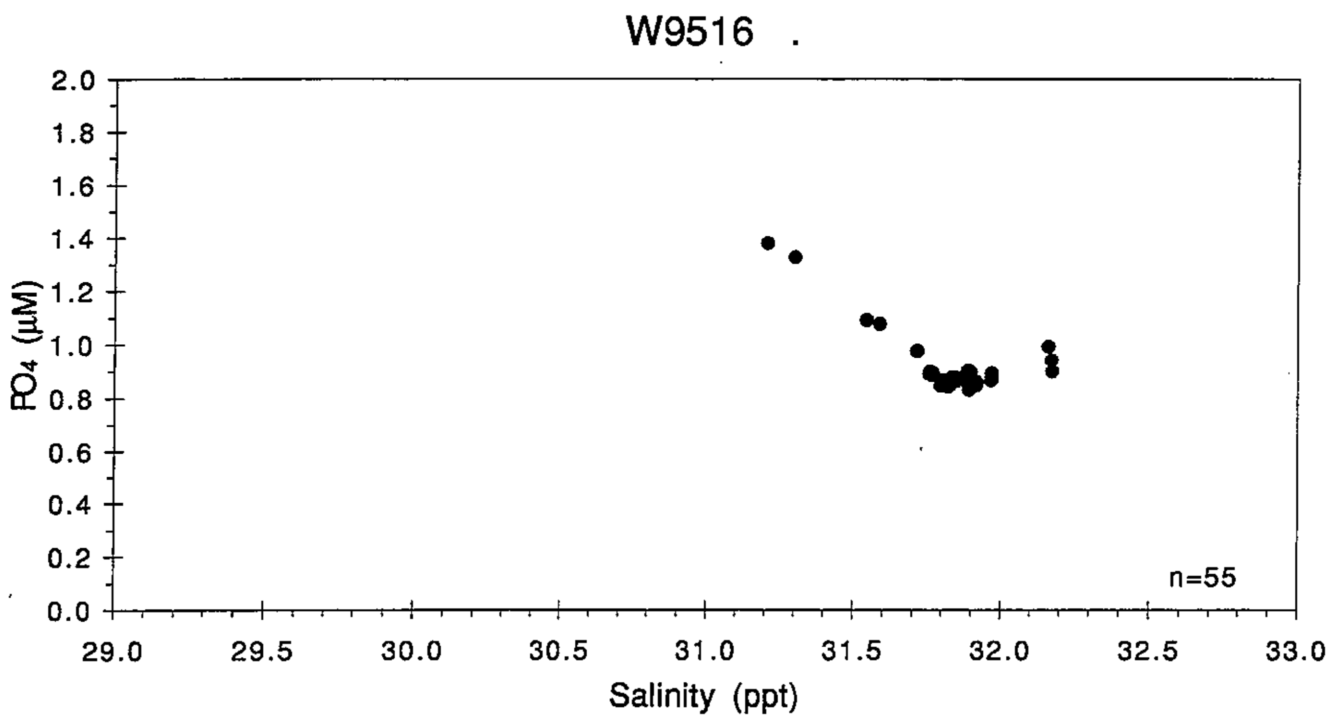


2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO_4 (µM)
n=85
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

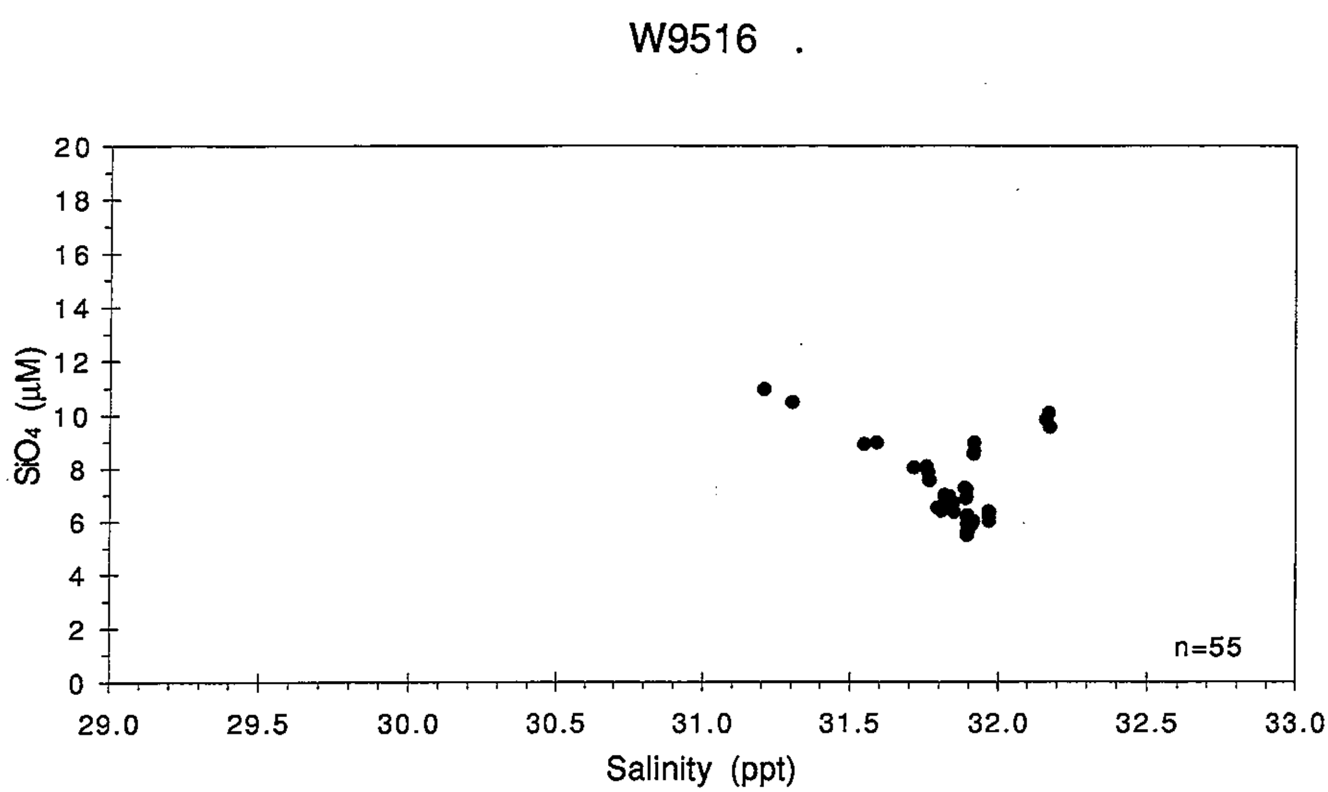
W9515 .



20
18
16
14
12
10
8
6
4
2
0
SiO_4 (µM)
n=85
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

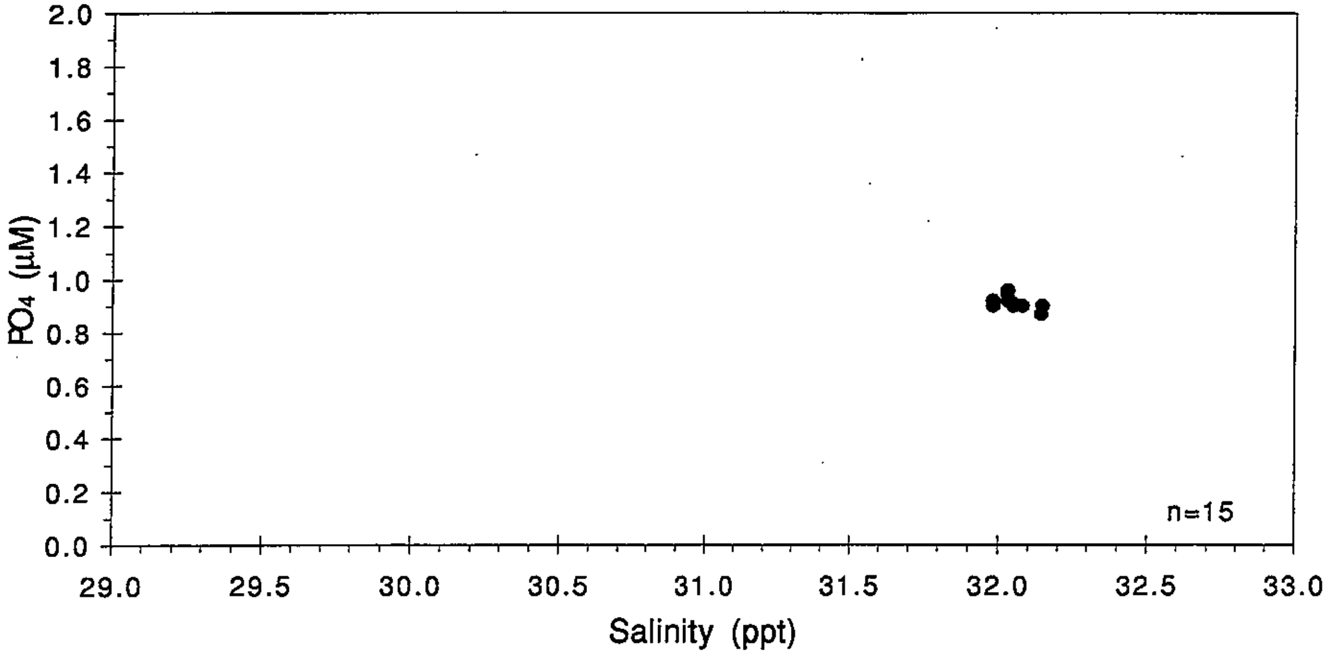


W9516 .
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (µM)
n=55
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

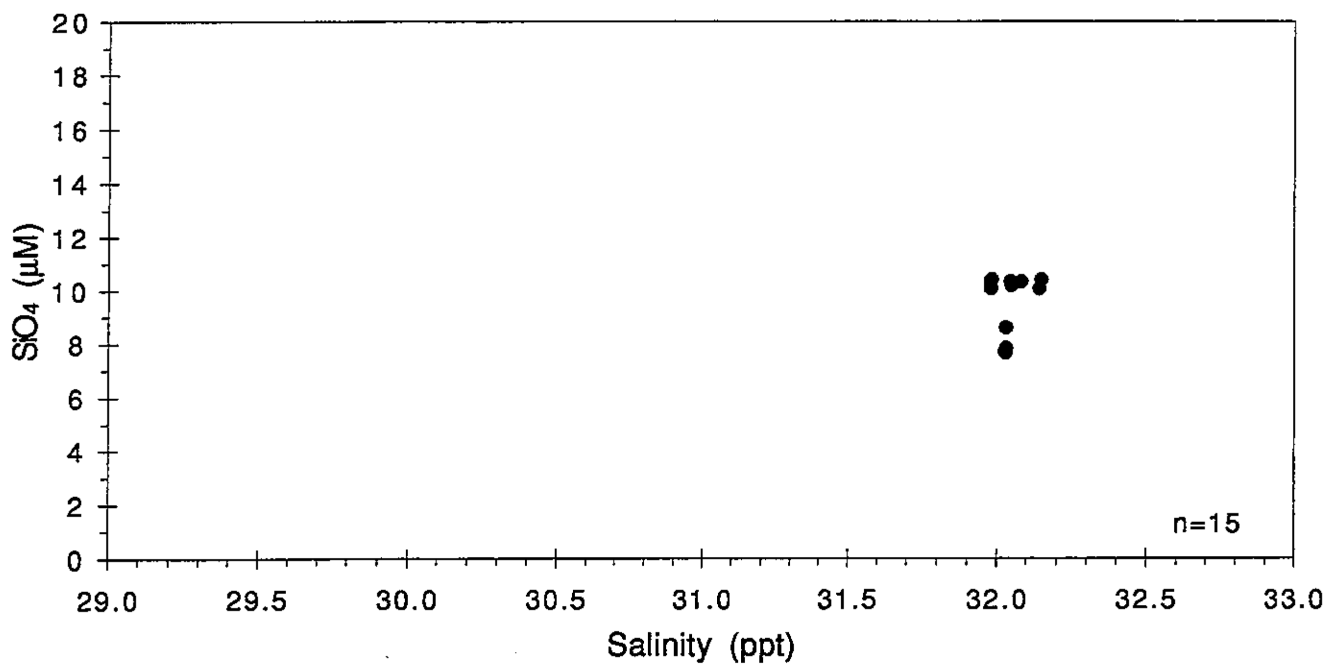


W9516 .
20
18
16
14
12
10
8
6
4
2
0
SiO4 (µM)
n=55
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

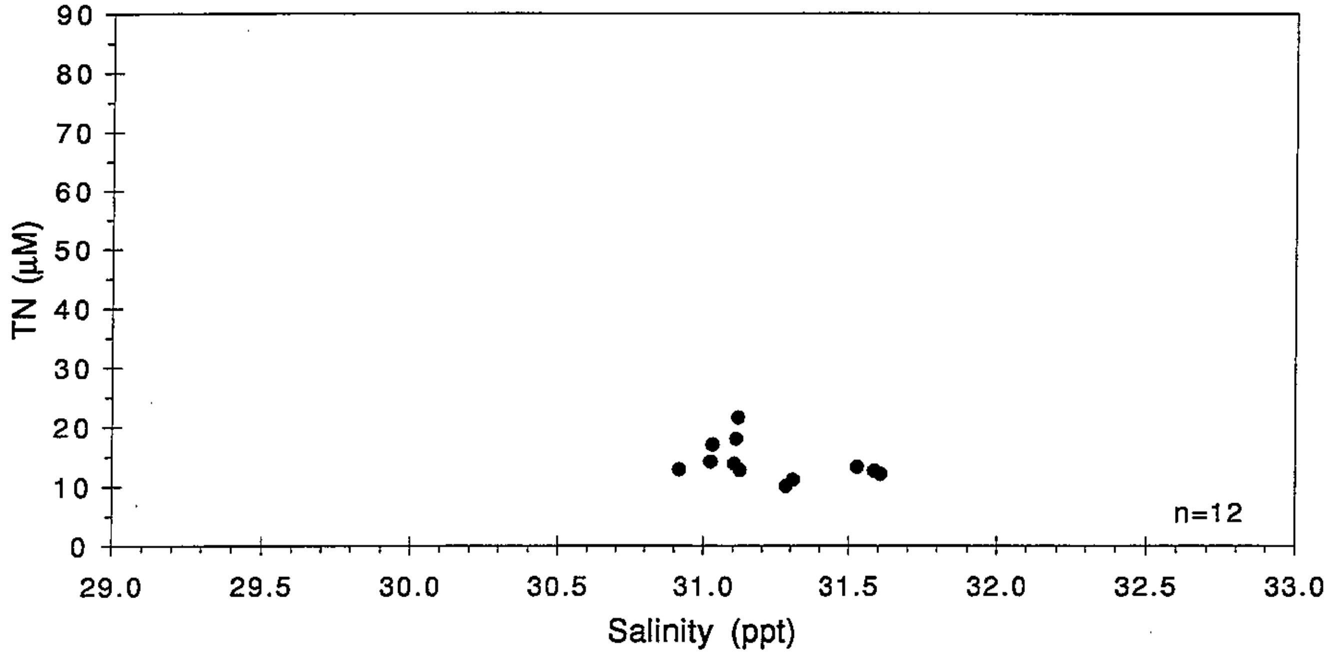
W9517 .


2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (µM)
n=15
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9517 .

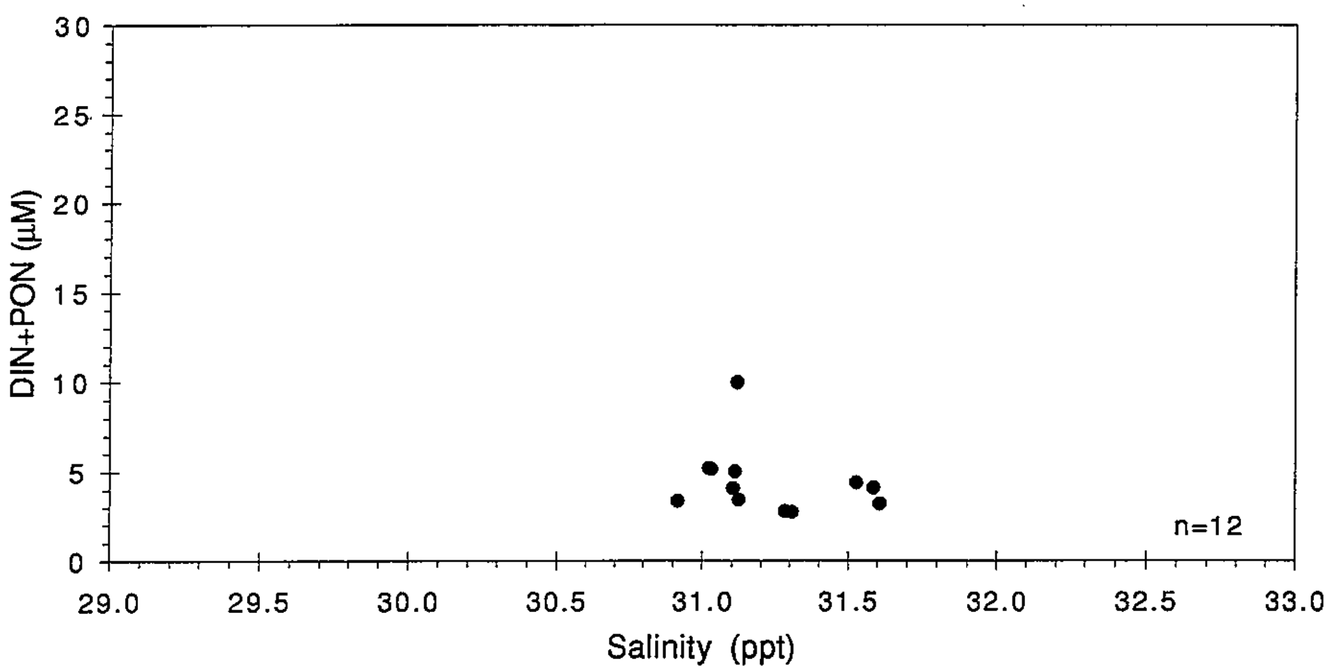

20
18
16
14
12
10
8
6
4
2
0
SiO4 (µM)
n=15
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9510 .

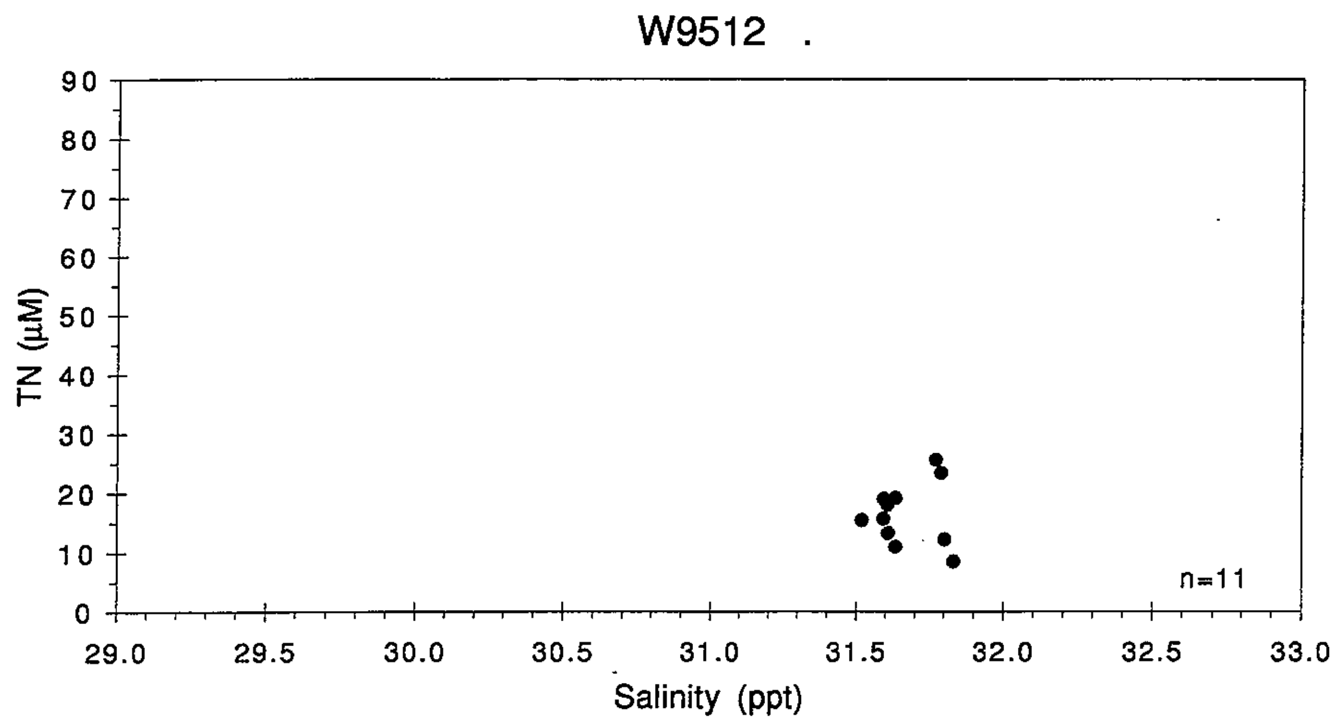


TN (µM)
90
80
70
60
50
40
30
20
10
0
n=12
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9510 .



DIN+PON (µM)
30
25
20
15
10
5
0
n=12
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)



W9512 .
TN (µM)
90
80
70
60
50
40
30
20
10
0
n=11
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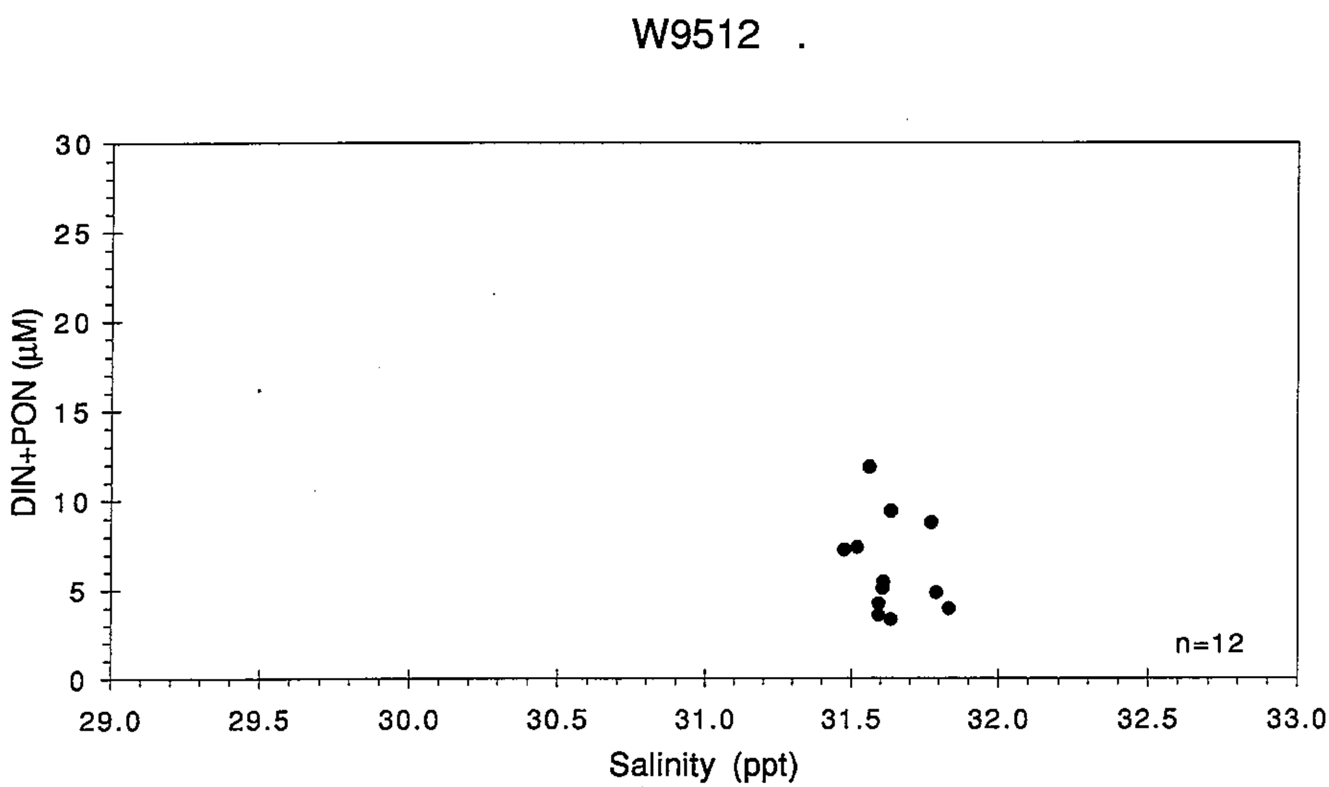
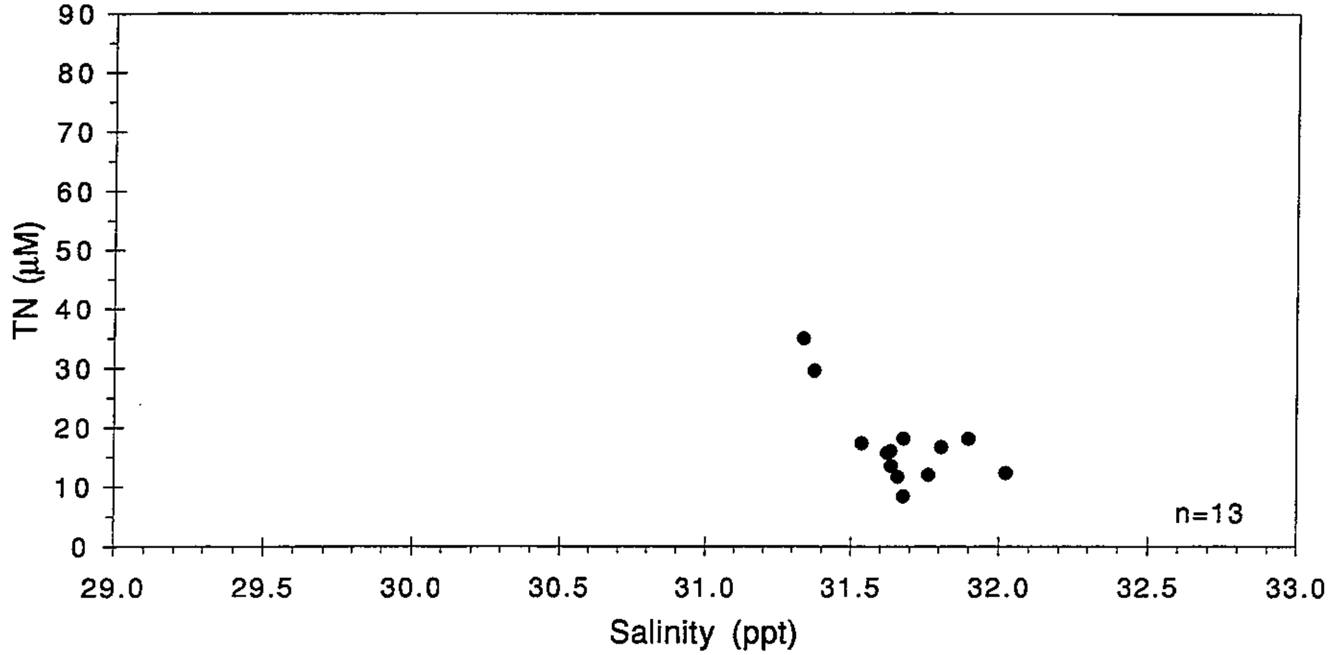
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)



W9512 .
DIN+PON (µM)
30
25
20
15
10
5
0
n=12
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9513 .



90
80
70
60
50
40
30
20
10
0
TN (µM)
n=13
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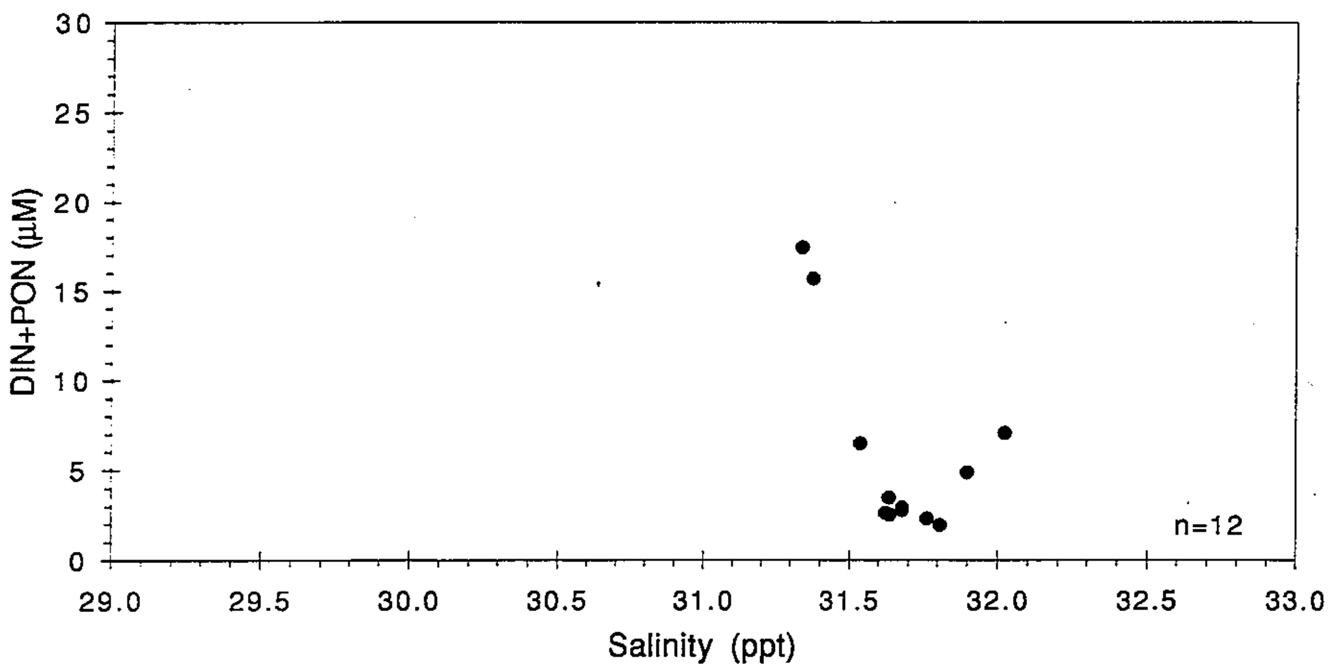
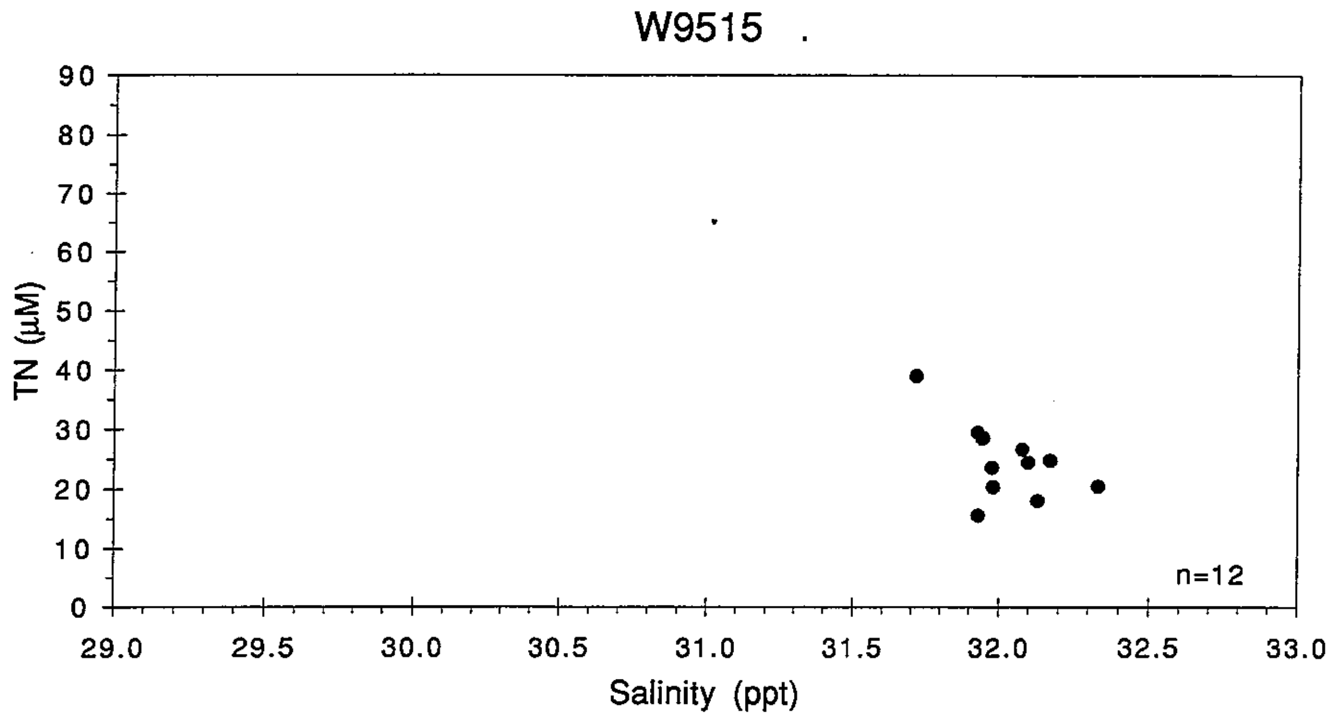
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

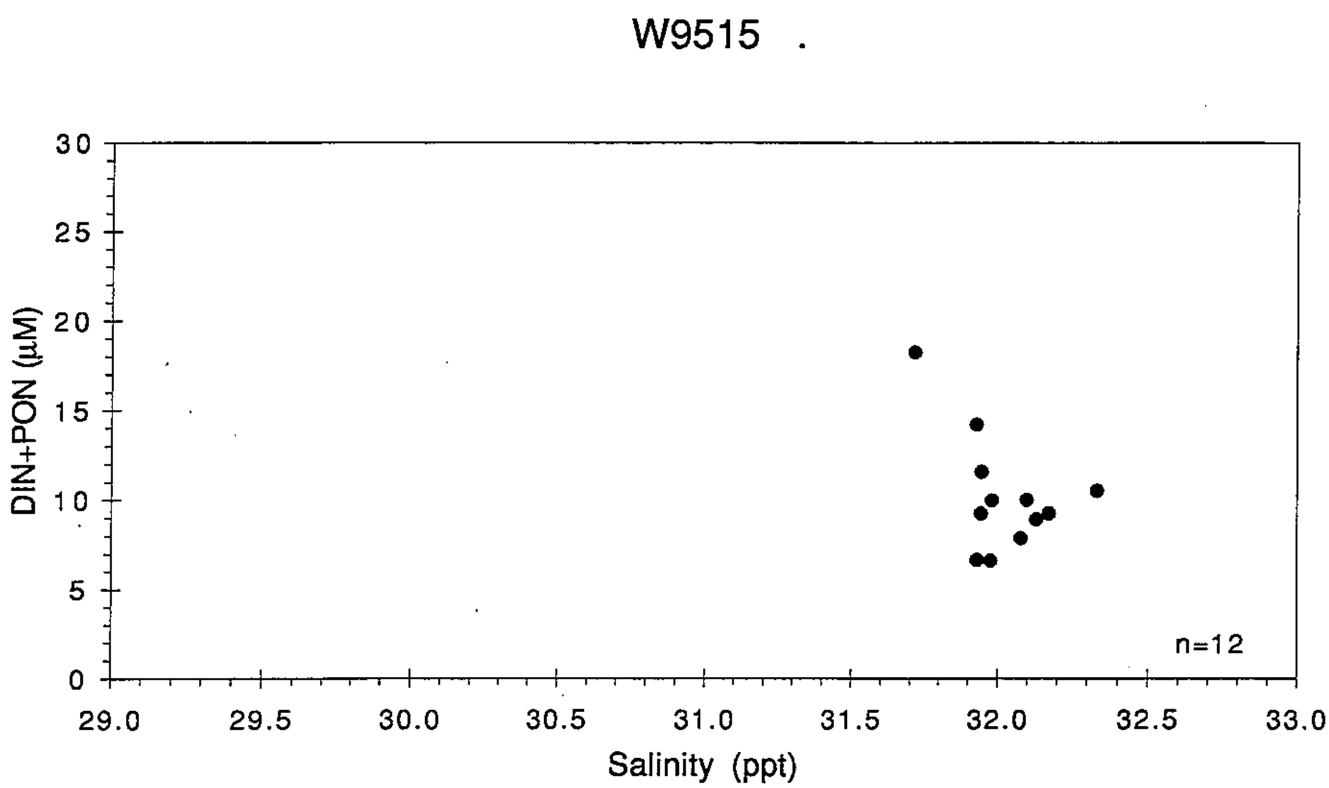
W9513 .



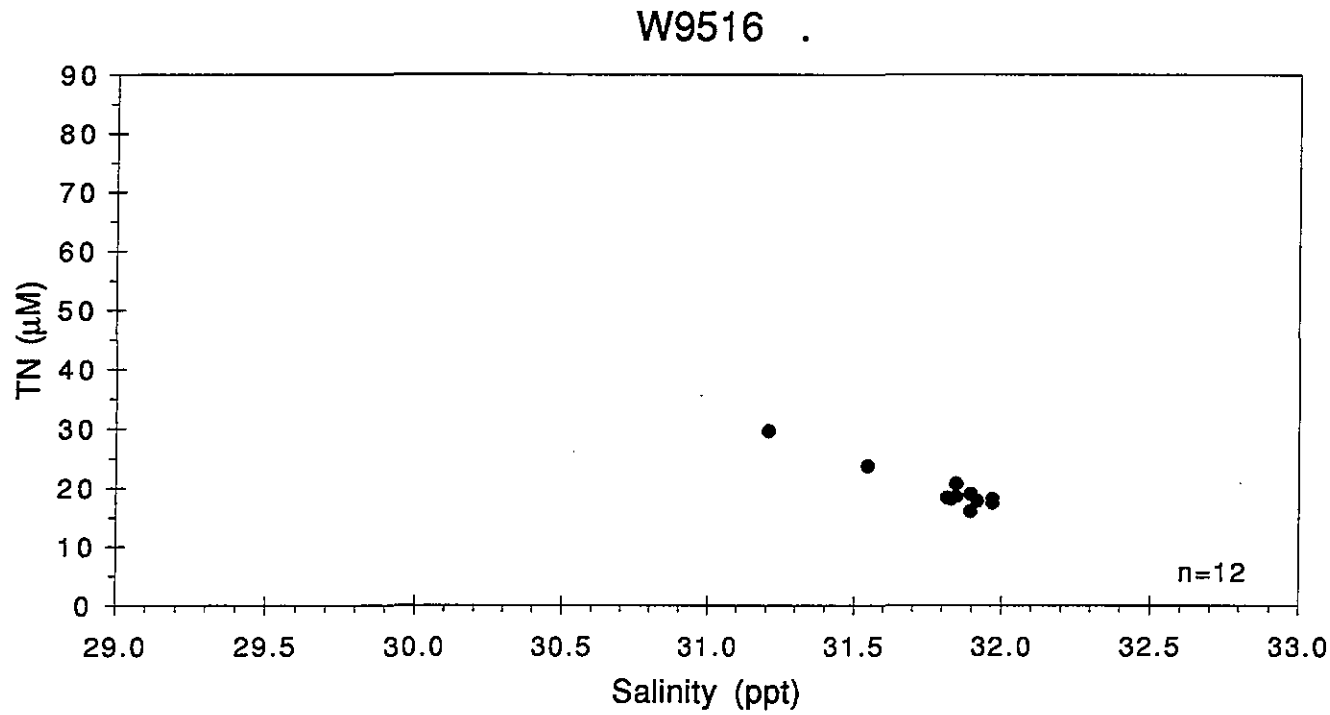
30
25
20
15
10
5
0
DIN+PON (µM)
n=12
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

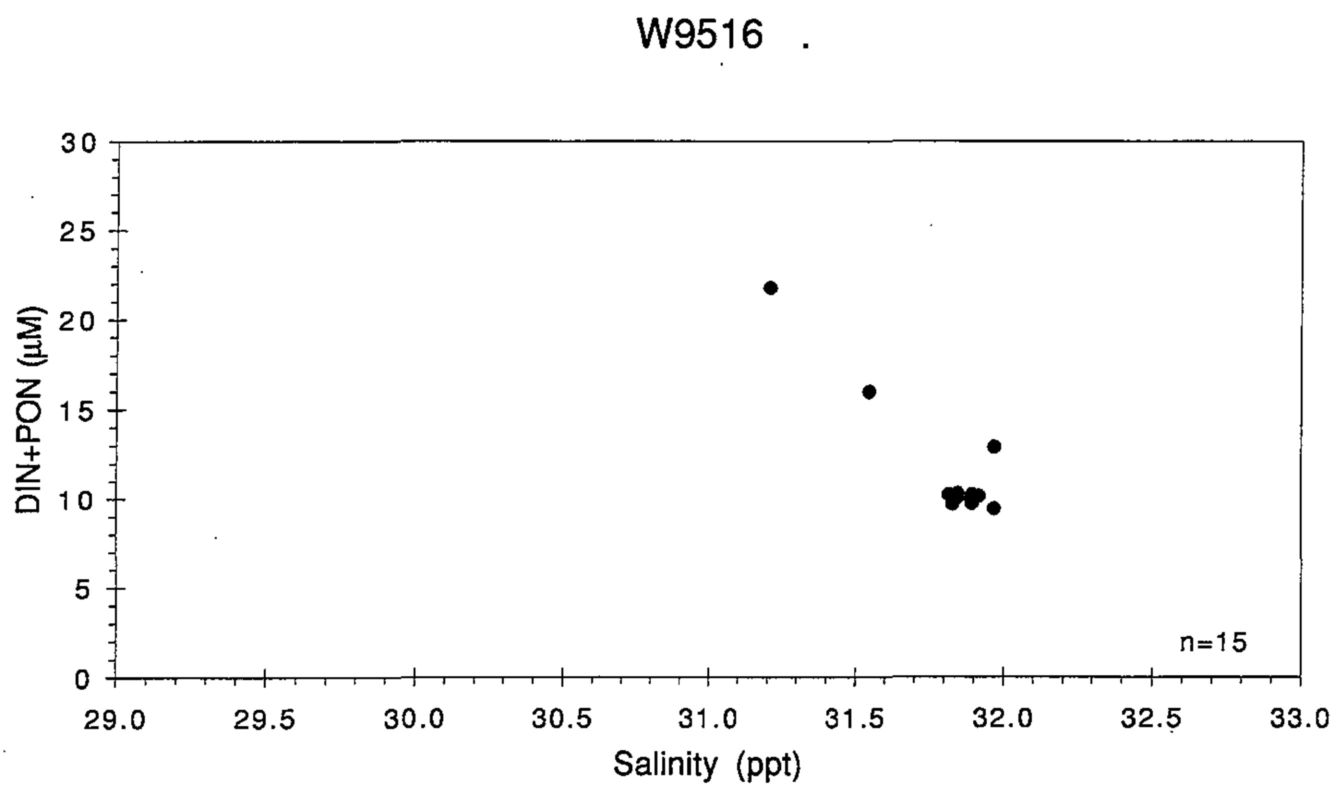


W9515
TN (µM)
90
80
70
60
50
40
30
20
10
0
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=12

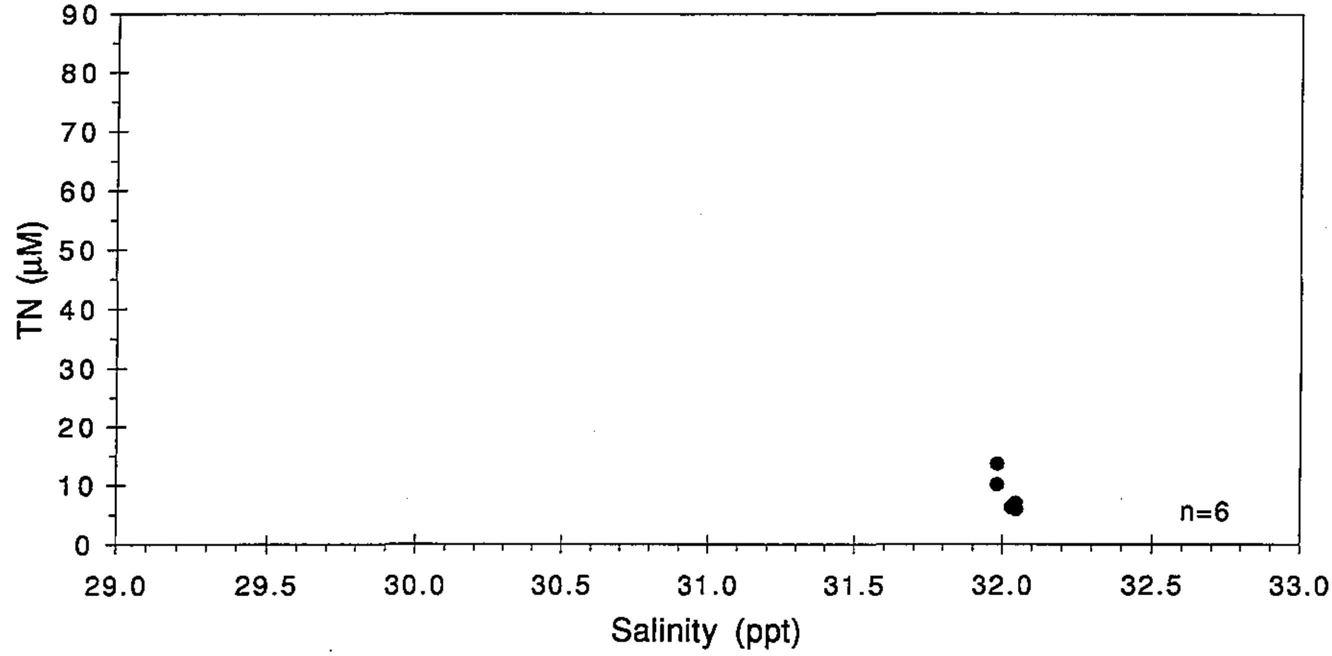


W9515
DIN+PON (µM)
30
25
20
15
10
5
0
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=12


W9516 .
TN (µM)
90
80
70
60
50
40
30
20
10
0
n=12
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

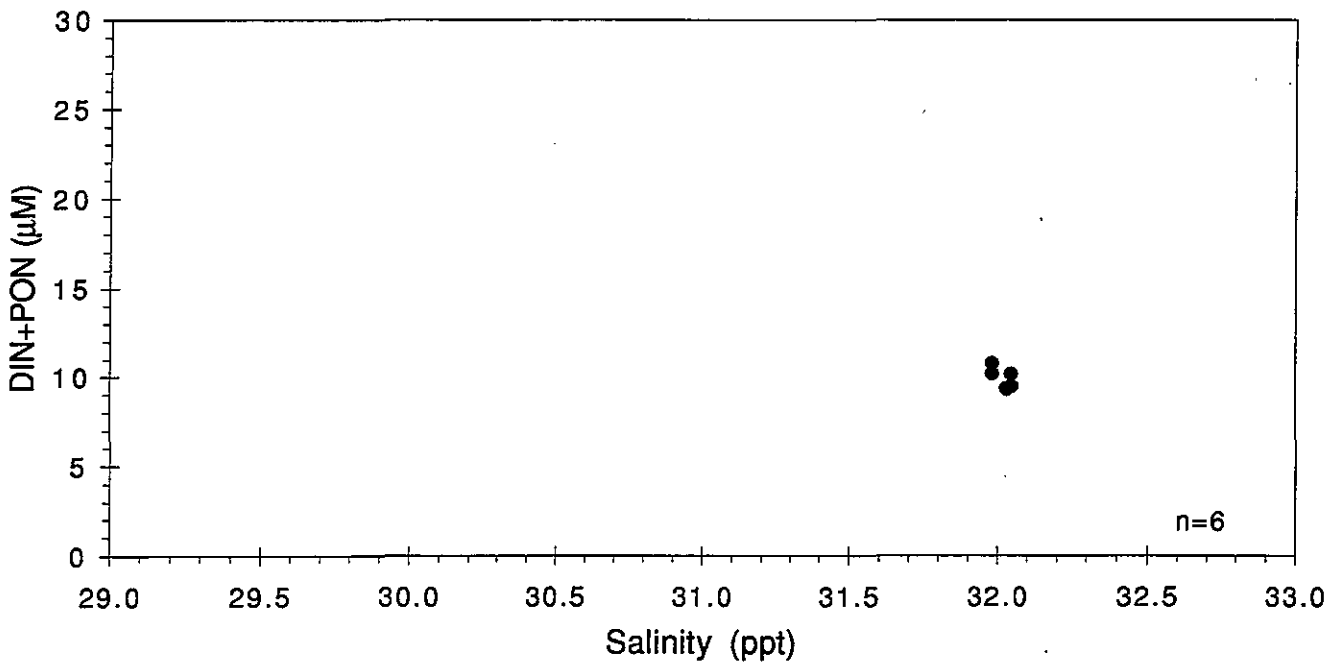

W9516 .
DIN+PON (µM)
30
25
20
15
10
5
0
n=15
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9517 .

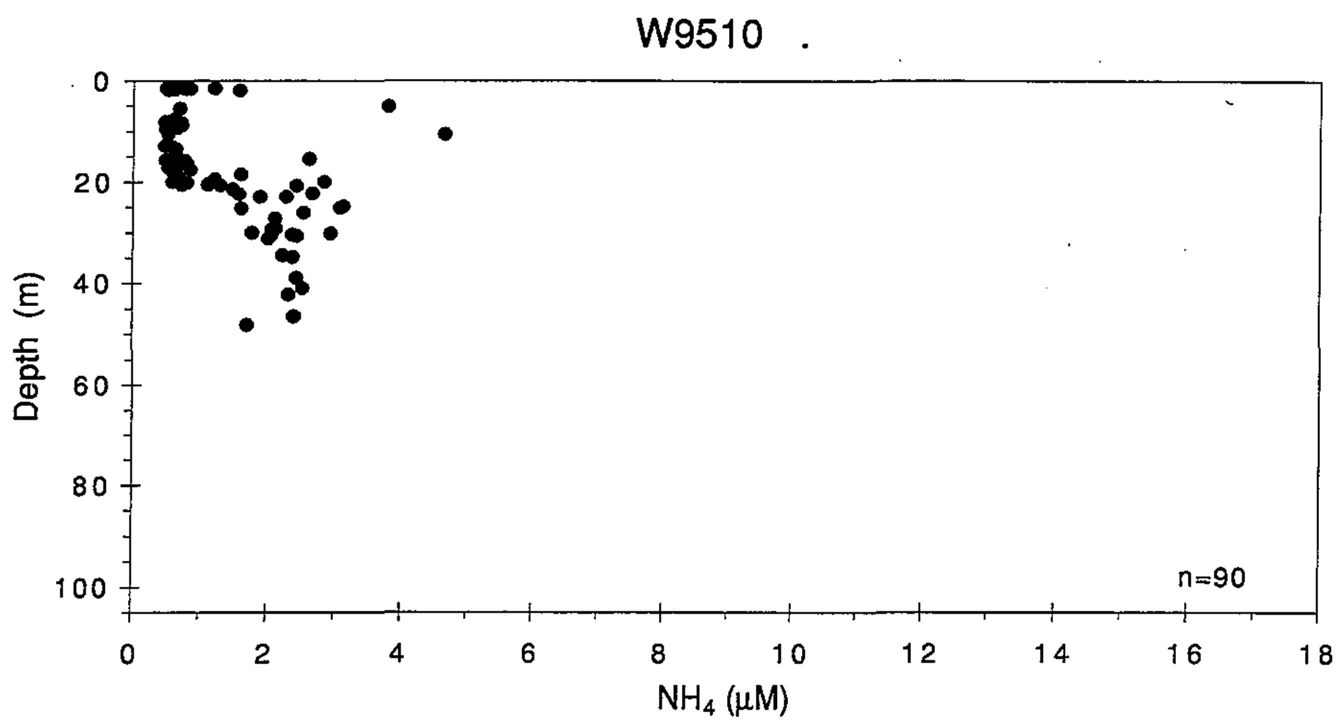


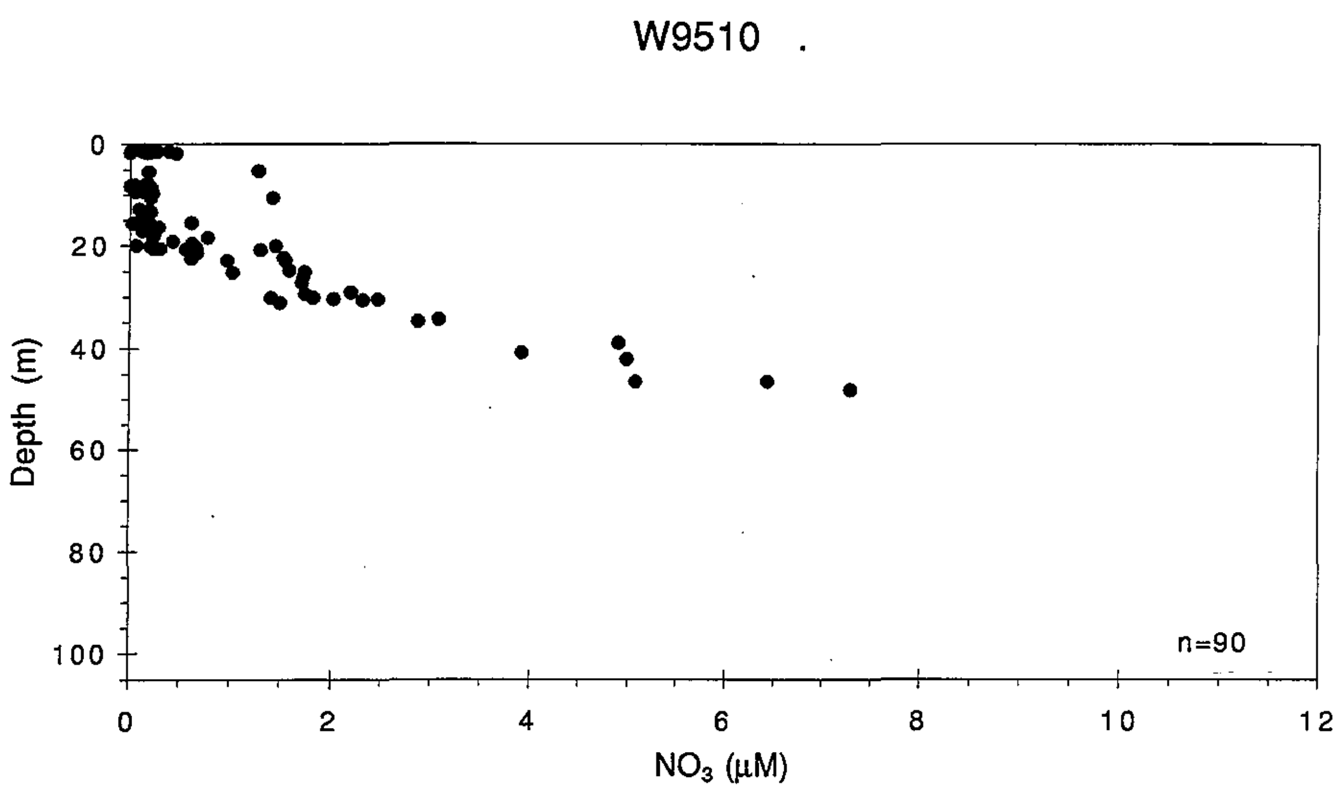
TN (µM)
90
80
70
60
50
40
30
20
10
0
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=6

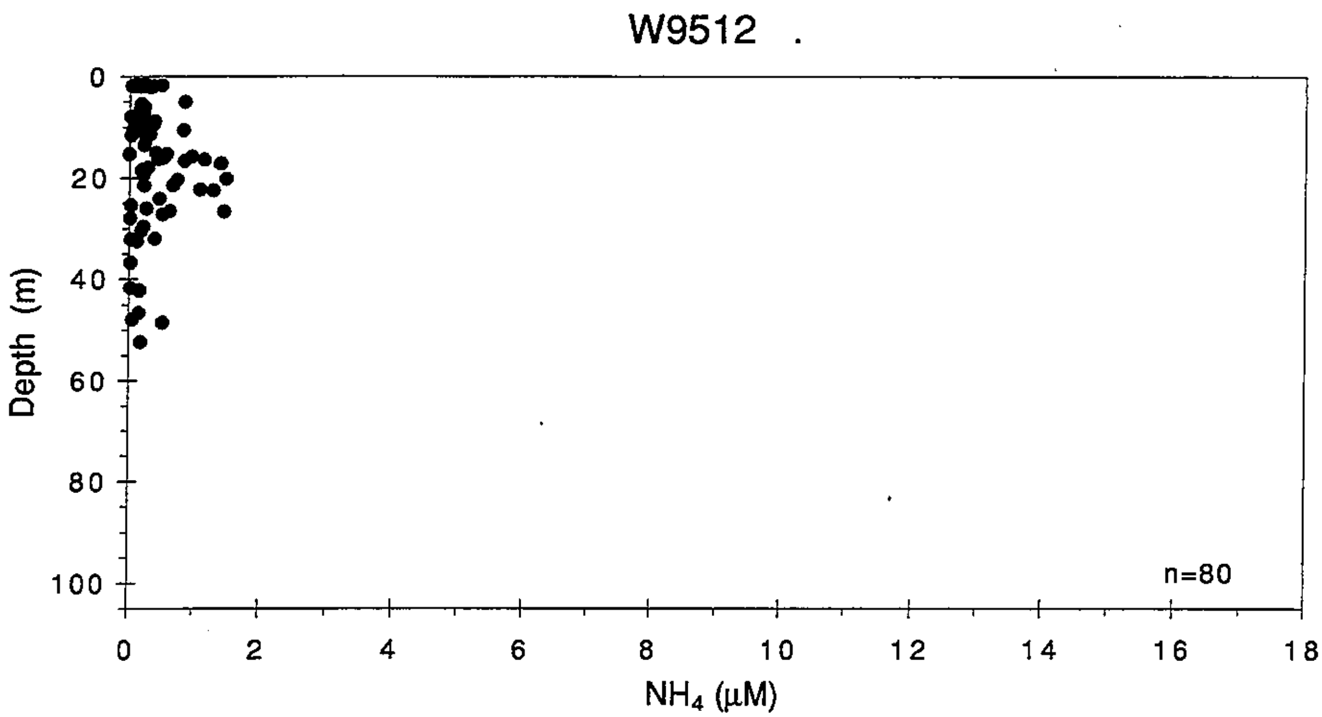
W9517 .

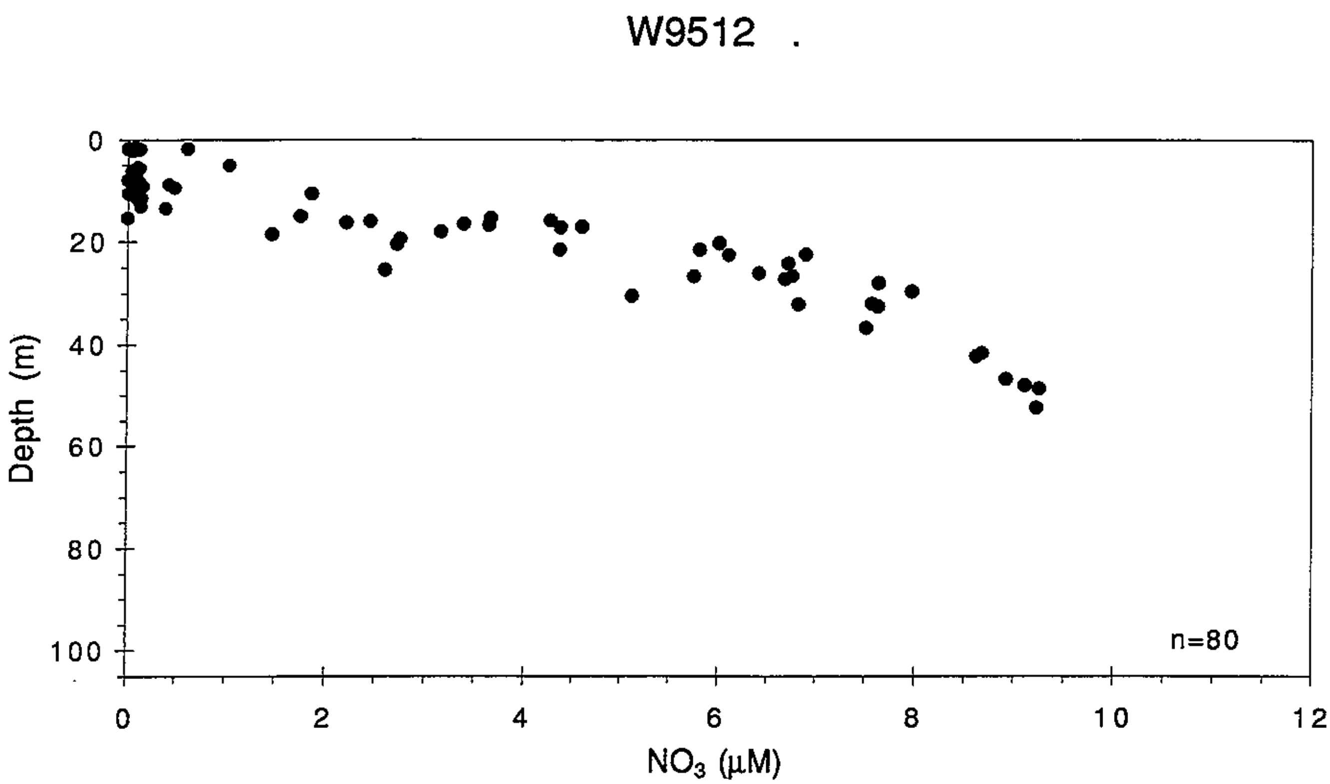


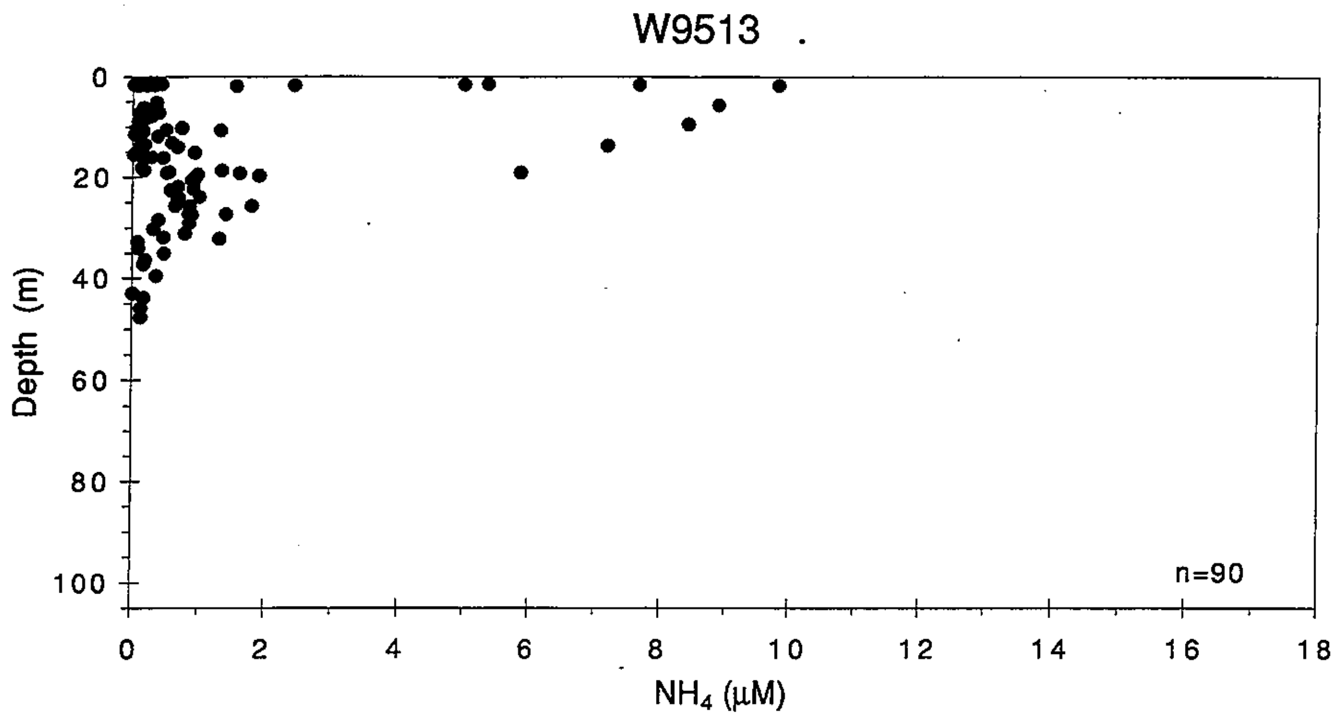
DIN+PON (µM)
30
25
20
15
10
5
0
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=6


W9510 .
Depth (m)
0
20
40
60
80
100
n=90
0
2
4
6
8
10
12
14
16
18
NH_4 (µM)

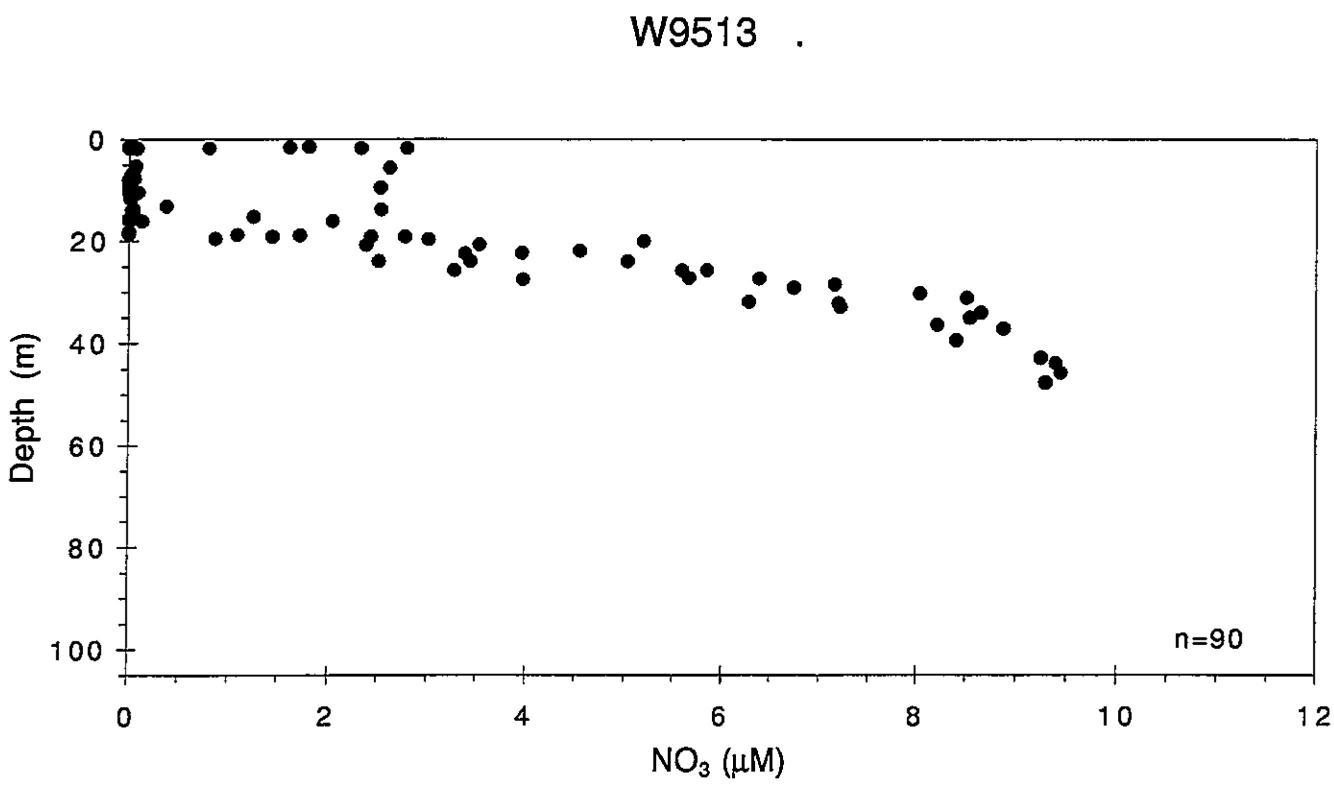

W9510 .
Depth (m)
0
20
40
60
80
100
n=90
0
2
4
6
8
10
12
NO_3 (µM)


W9512
Depth (m)
0
20
40
60
80
100
n=80
0
2
4
6
8
10
12
14
16
18
NH4 (µM)

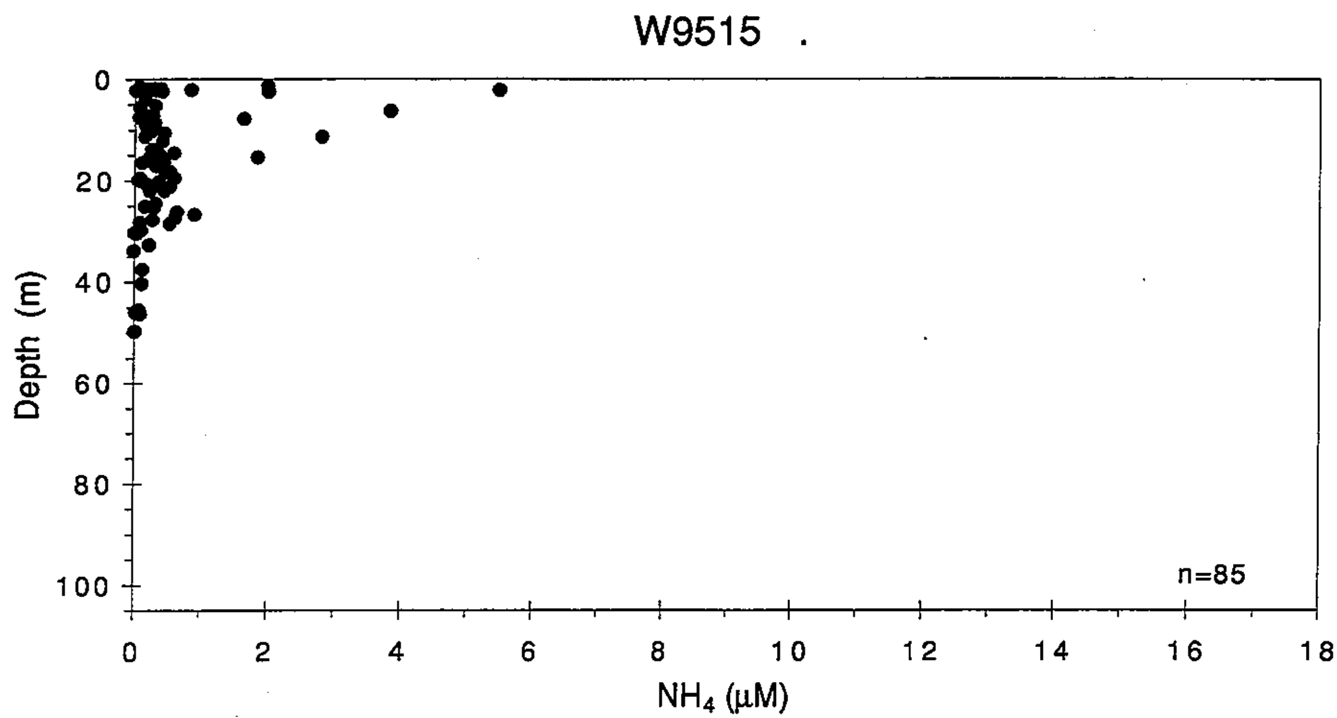

W9512
Depth (m)
0
20
40
60
80
100
n=80
0
2
4
6
8
10
12
NO3 (µM)

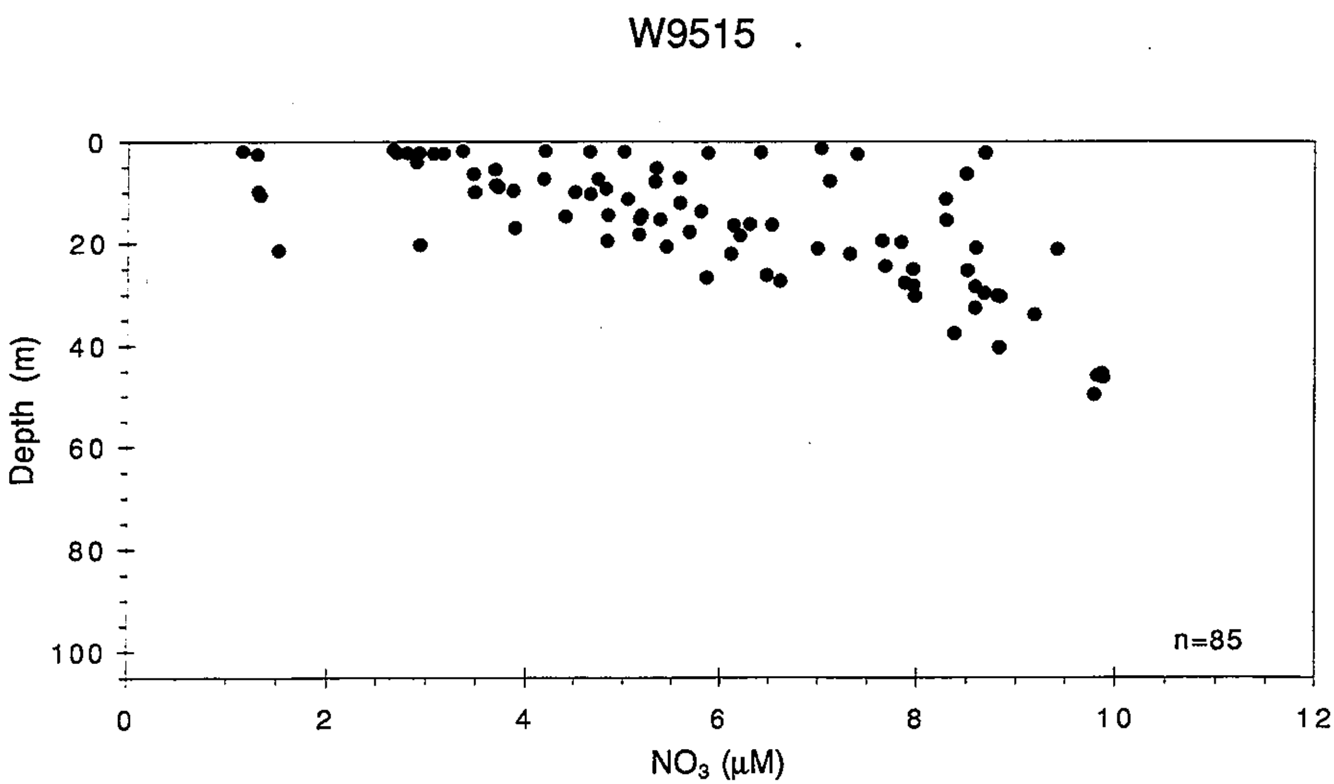


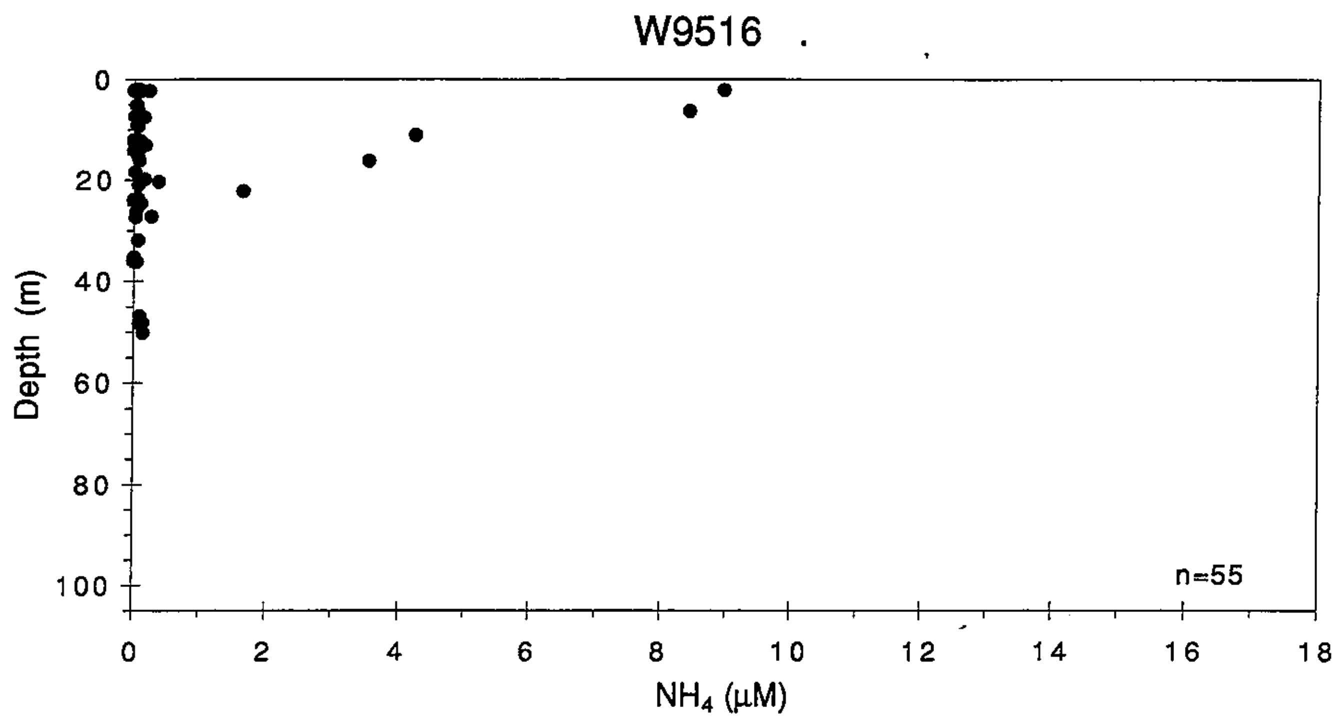
W9513
Depth (m)
NH4 (μM)
n=90

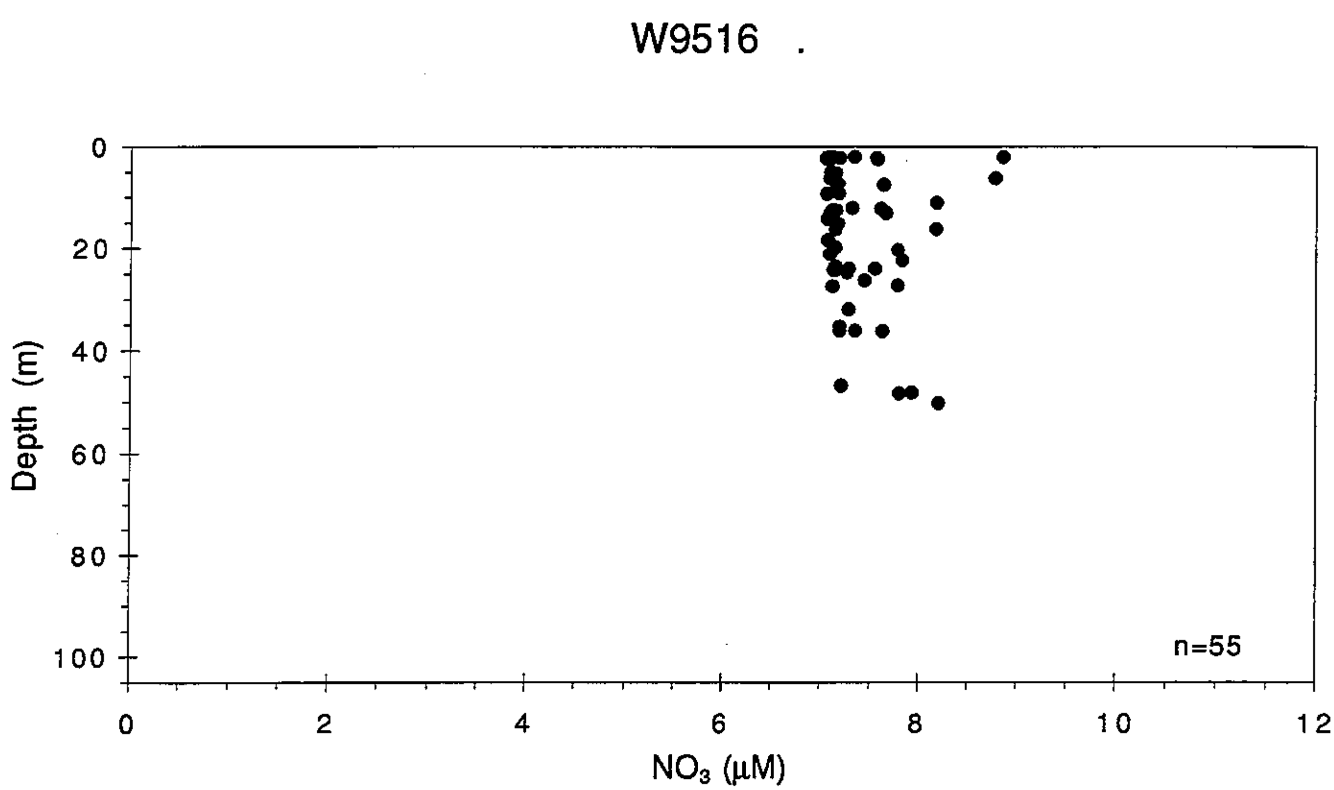


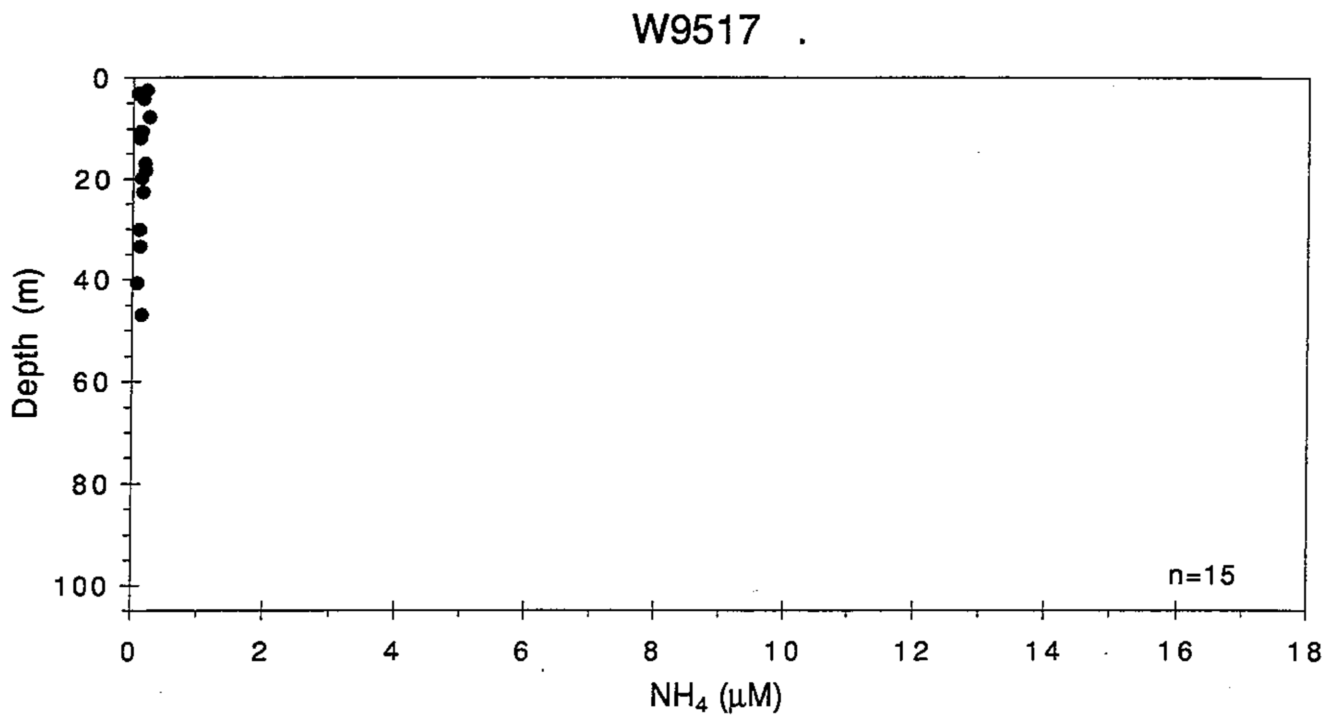
W9513
Depth (m)
NO3 (μM)
n=90

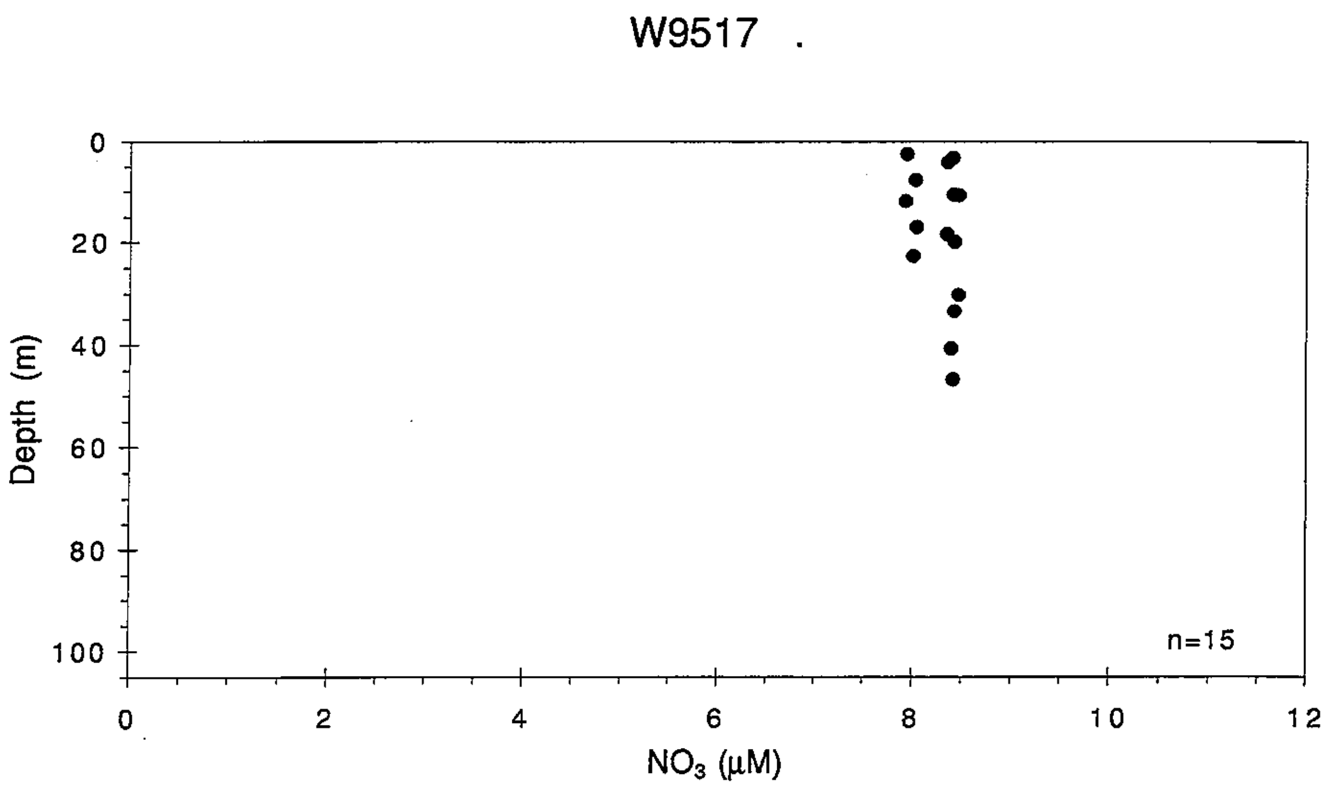

W9515
Depth (m)
0
20
40
60
80
100
n=85
0
2
4
6
8
10
12
14
16
18
NH4 (µM)

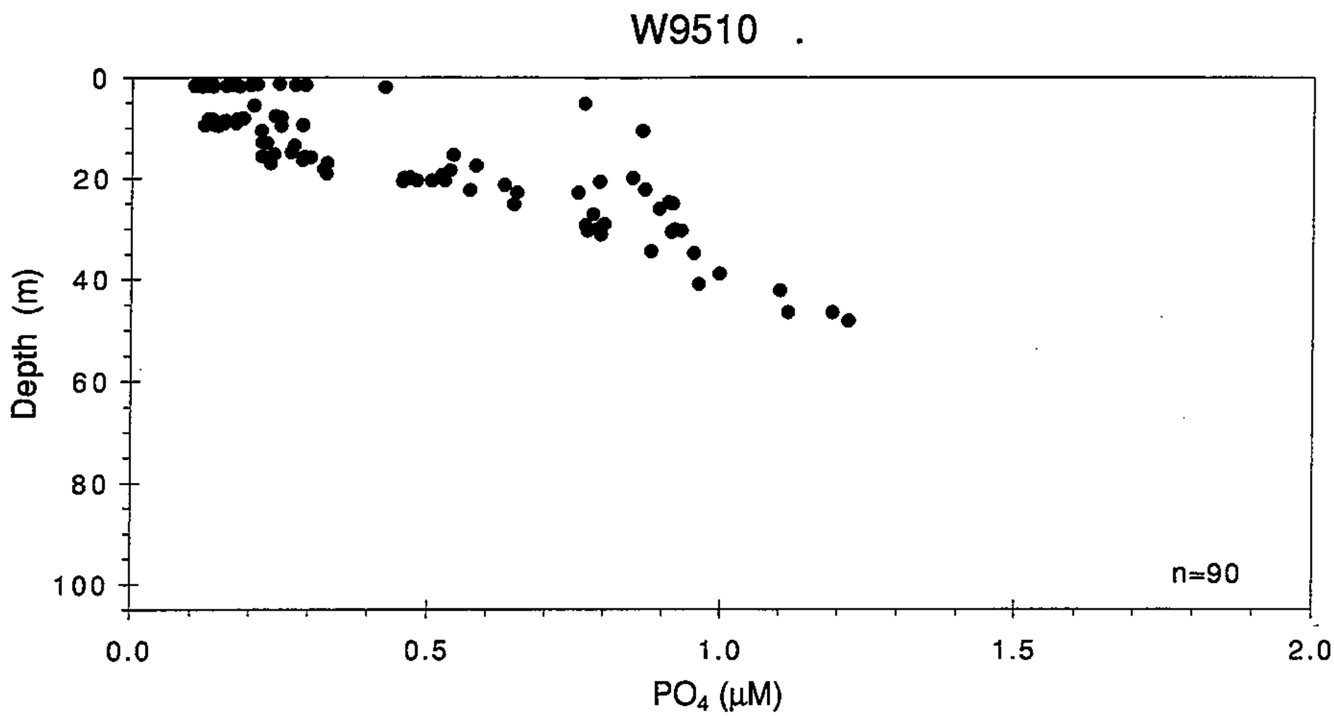

W9515
Depth (m)
0
20
40
60
80
100
n=85
0
2
4
6
8
10
12
NO3 (µM)


W9516
Depth (m)
0
20
40
60
80
100
0
2
4
6
8
10
12
14
16
18
NH_4 (μM)
n=55

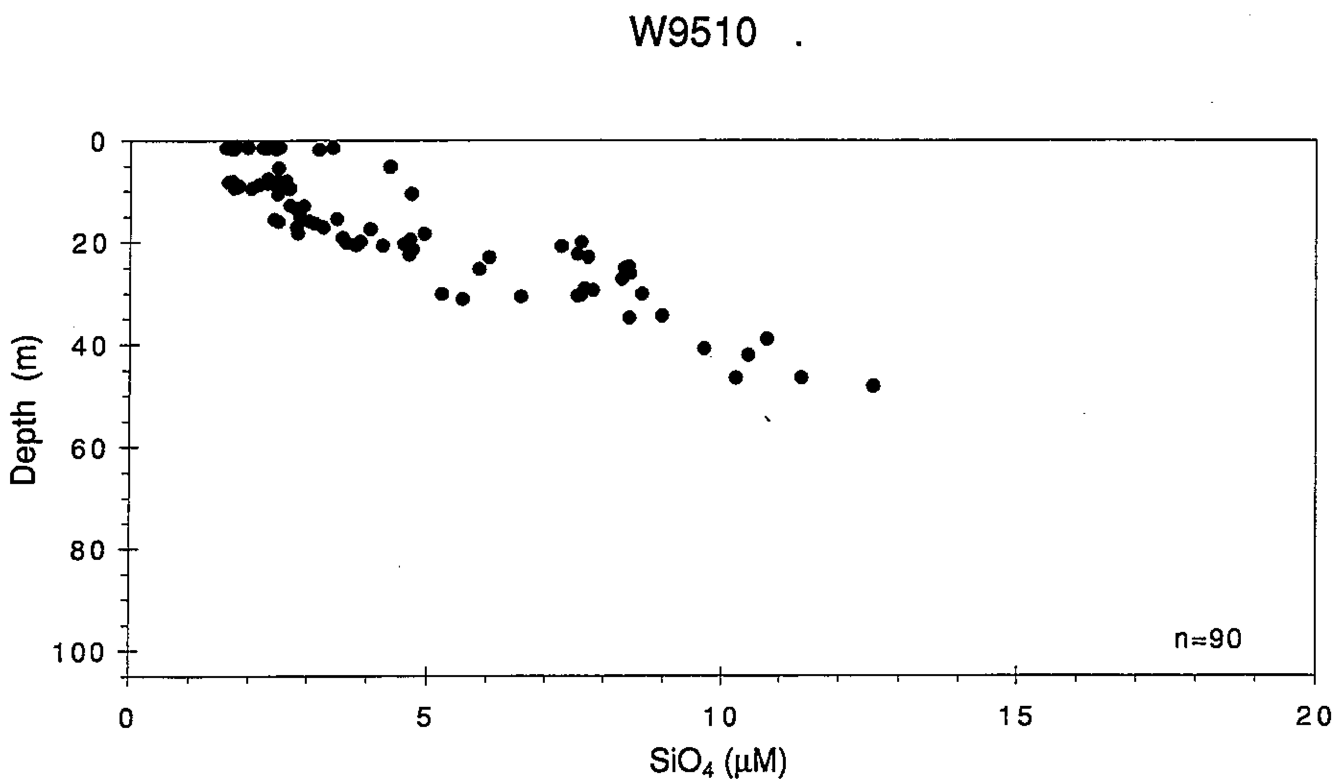

W9516
Depth (m)
0
20
40
60
80
100
0
2
4
6
8
10
12
NO_3 (μM)
n=55


W9517 .
0
20
40
60
80
100
Depth (m)
n=15
0
2
4
6
8
10
12
14
16
18
NH4 (µM)


W9517 .
0
20
40
60
80
100
Depth (m)
n=15
0
2
4
6
8
10
12
NO3 (µM)

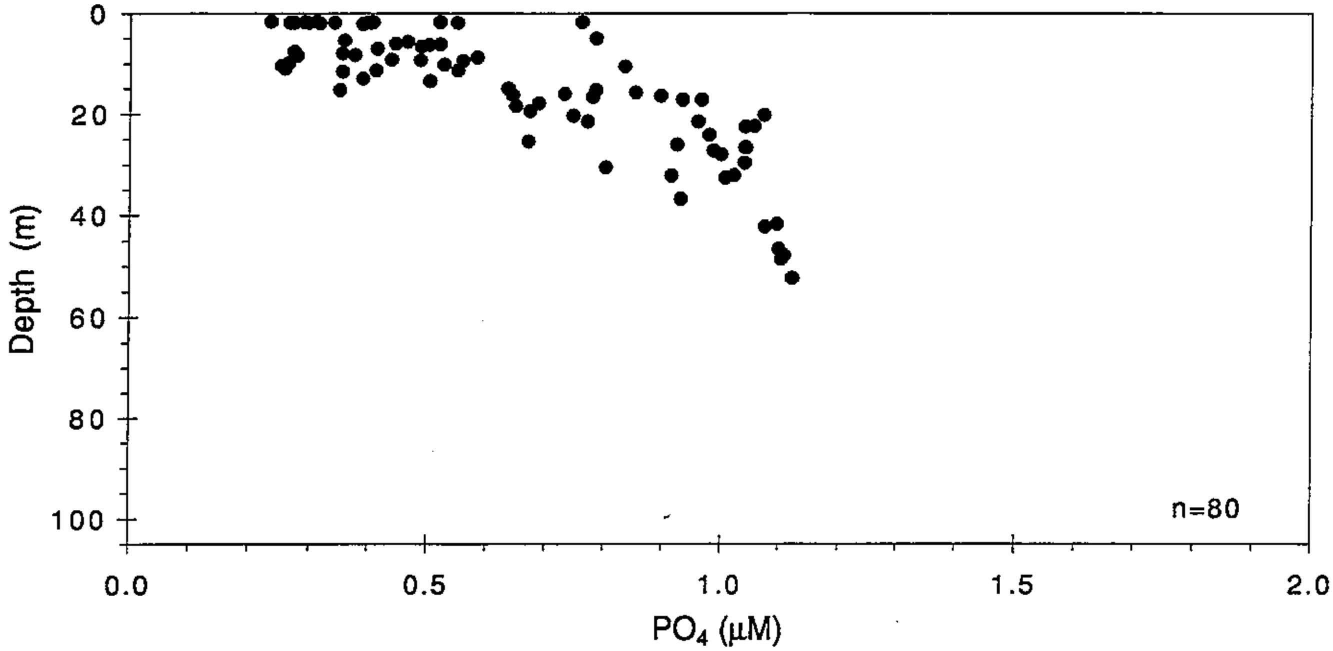


W9510 .
0
20
40
60
80
100
Depth (m)
n=90
0.0
0.5
1.0
1.5
2.0
PO4 (µM)



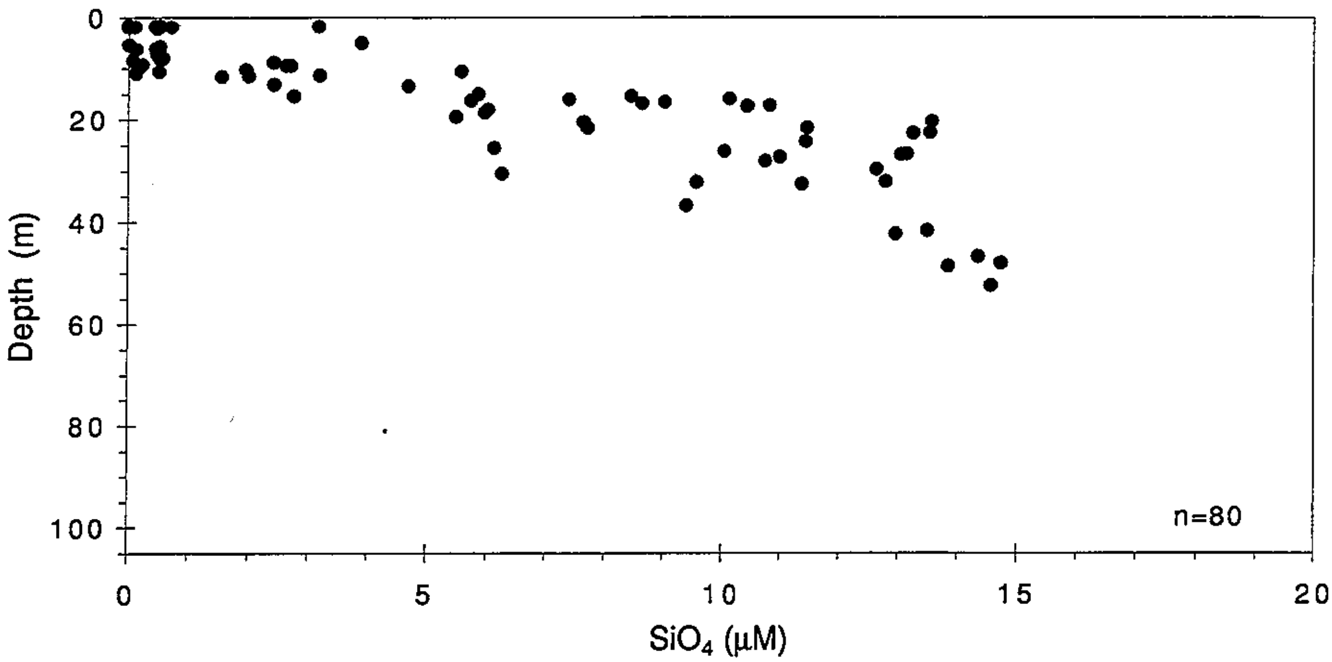
W9510 .
0
20
40
60
80
100
Depth (m)
n=90
0
5
10
15
20
SiO4 (µM)

W9512 .

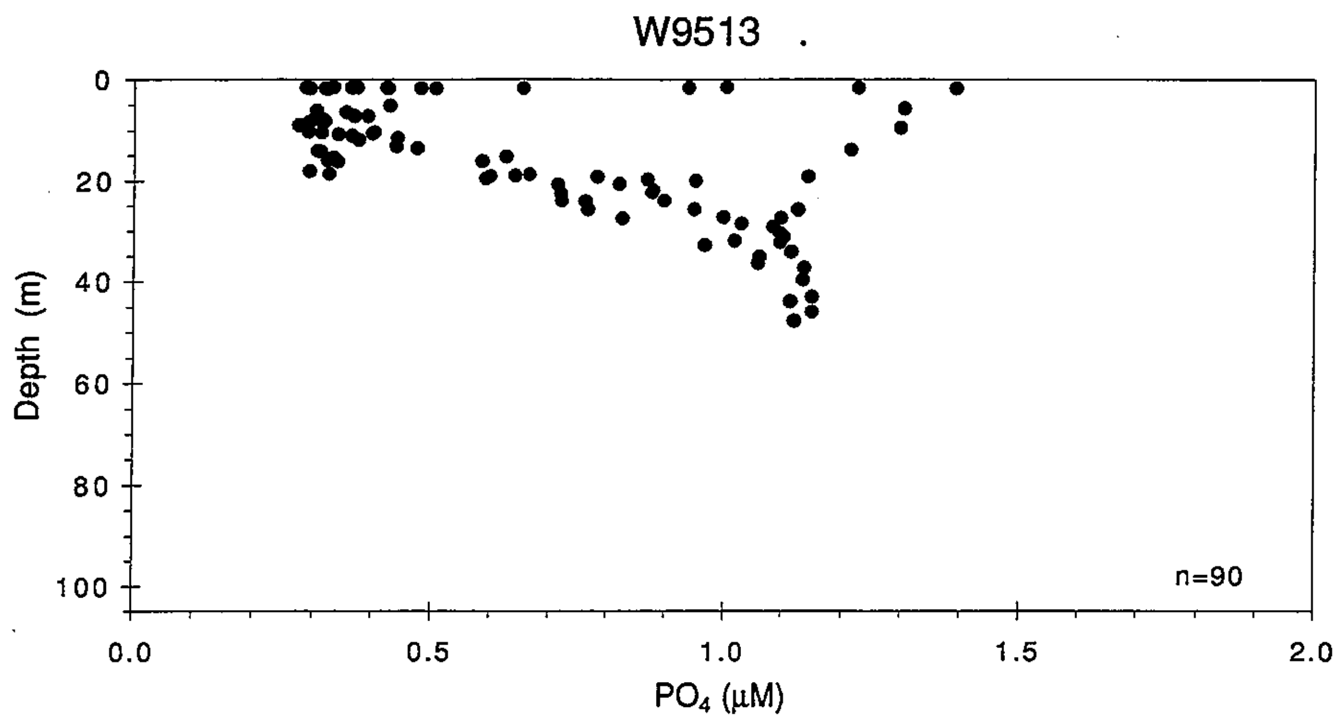


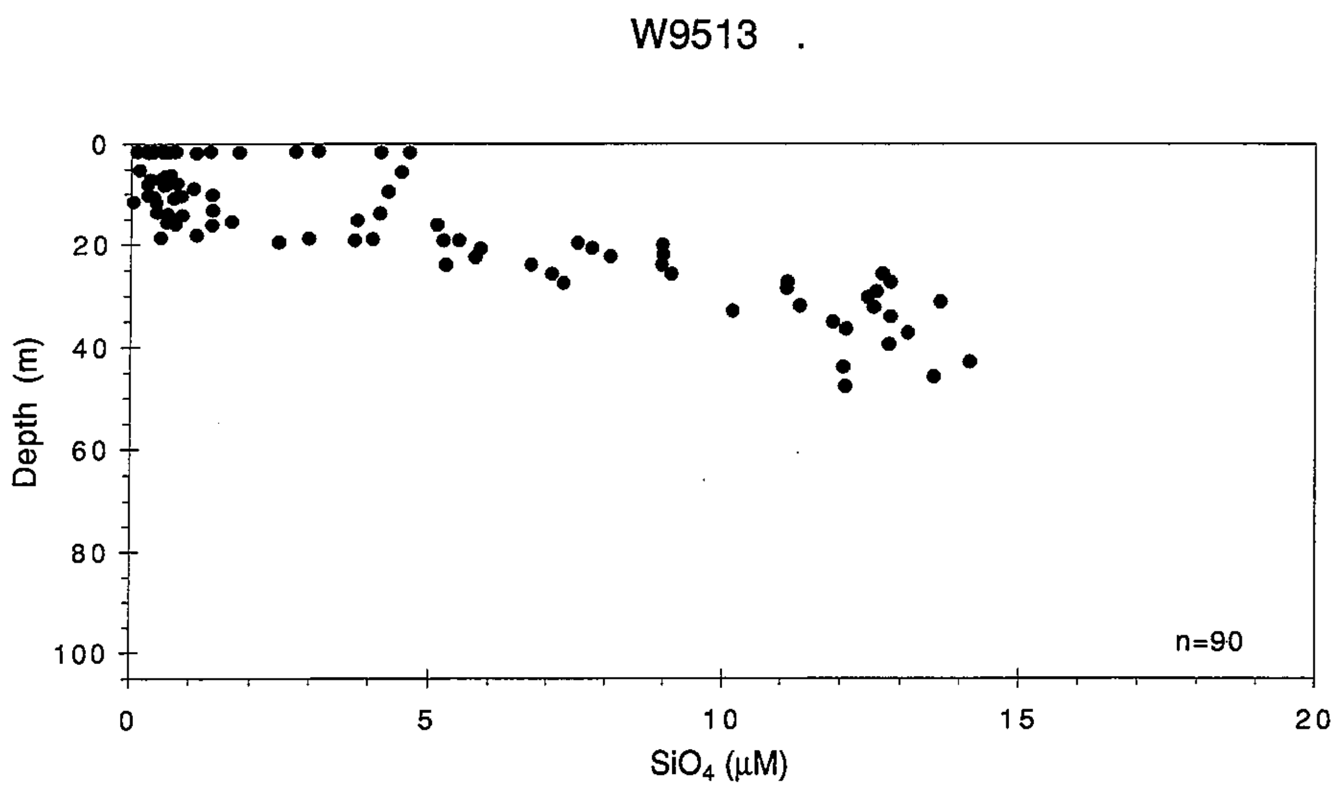
0
20
40
60
80
100
Depth (m)
n=80
0.0
0.5
1.0
1.5
2.0
PO4 (µM)

W9512 .

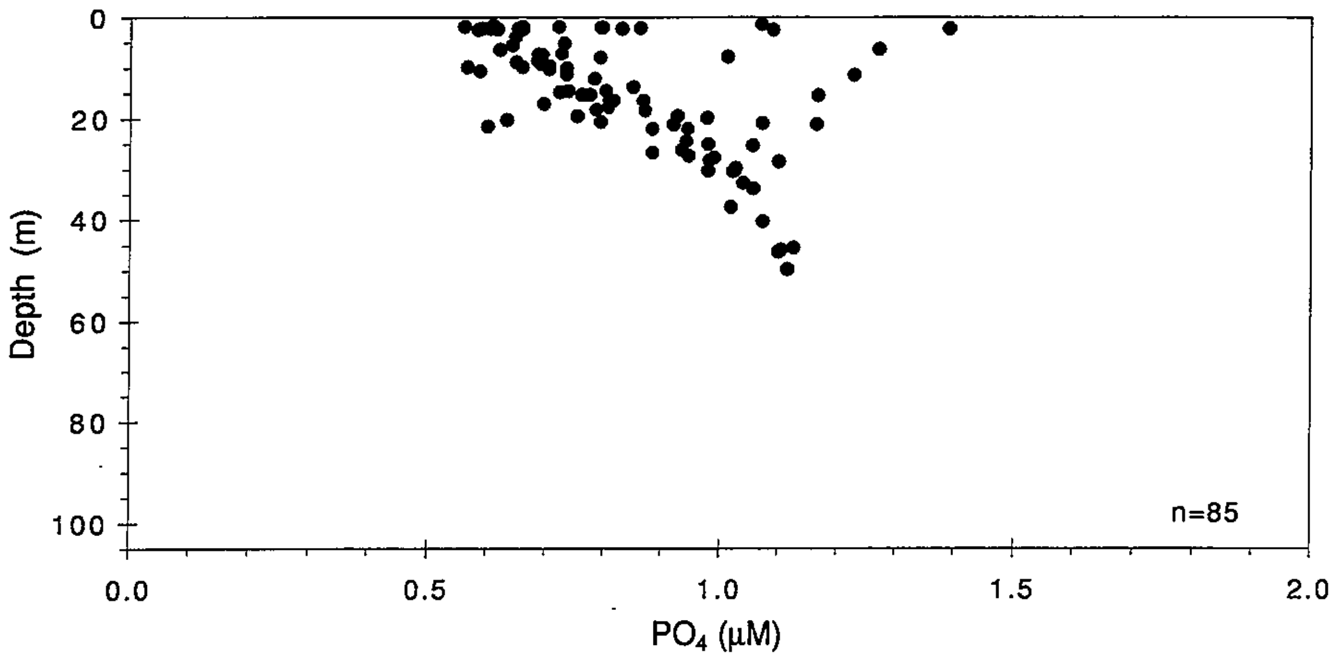


0
20
40
60
80
100
Depth (m)
n=80
0
5
10
15
20
SiO4 (µM)

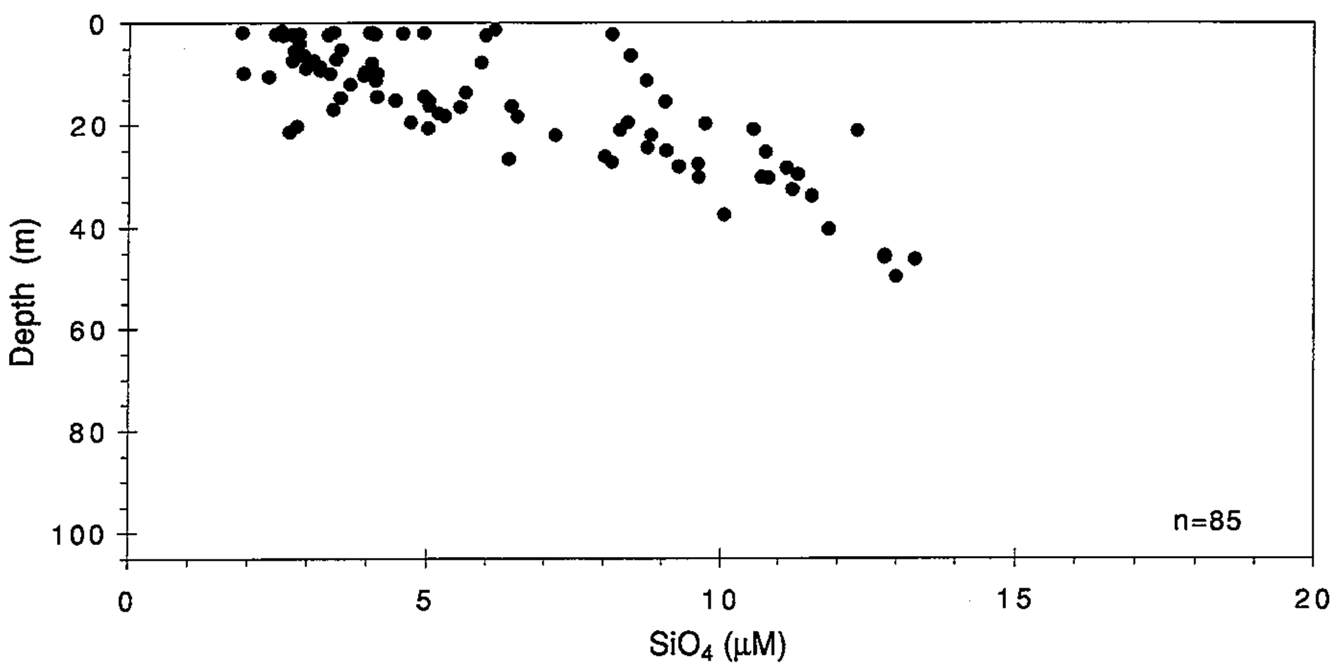

W9513
Depth (m)
0
20
40
60
80
100
n=90
0.0
0.5
1.0
1.5
2.0
PO4 (μM)

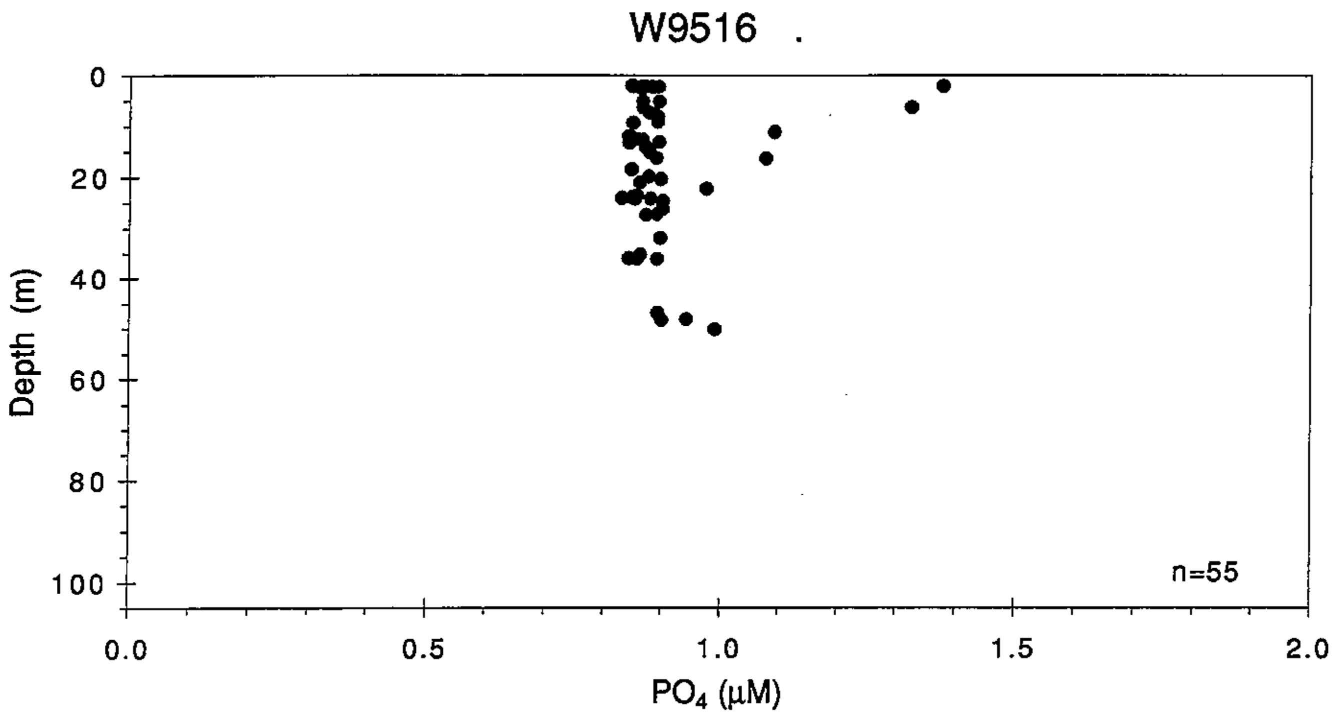

W9513
Depth (m)
0
20
40
60
80
100
n=90
0
5
10
15
20
SiO4 (μM)

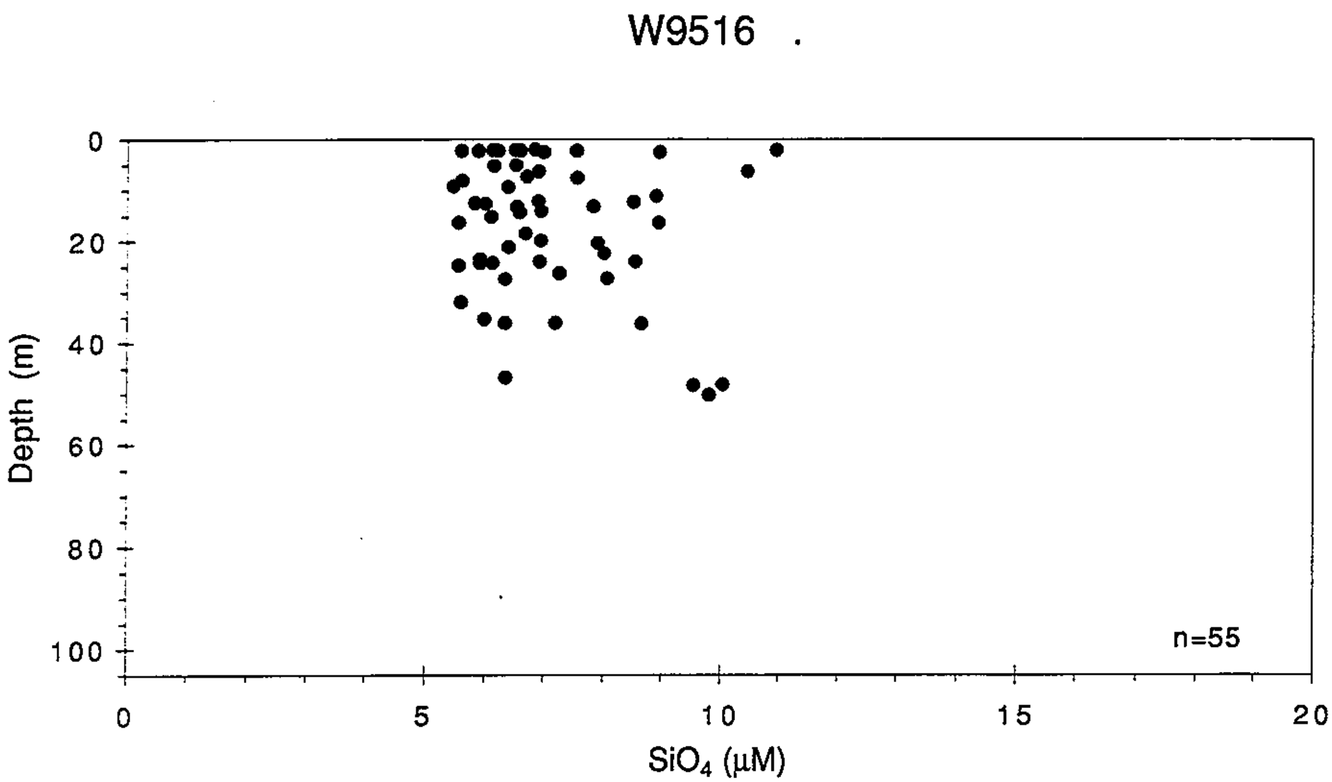
W9515 .

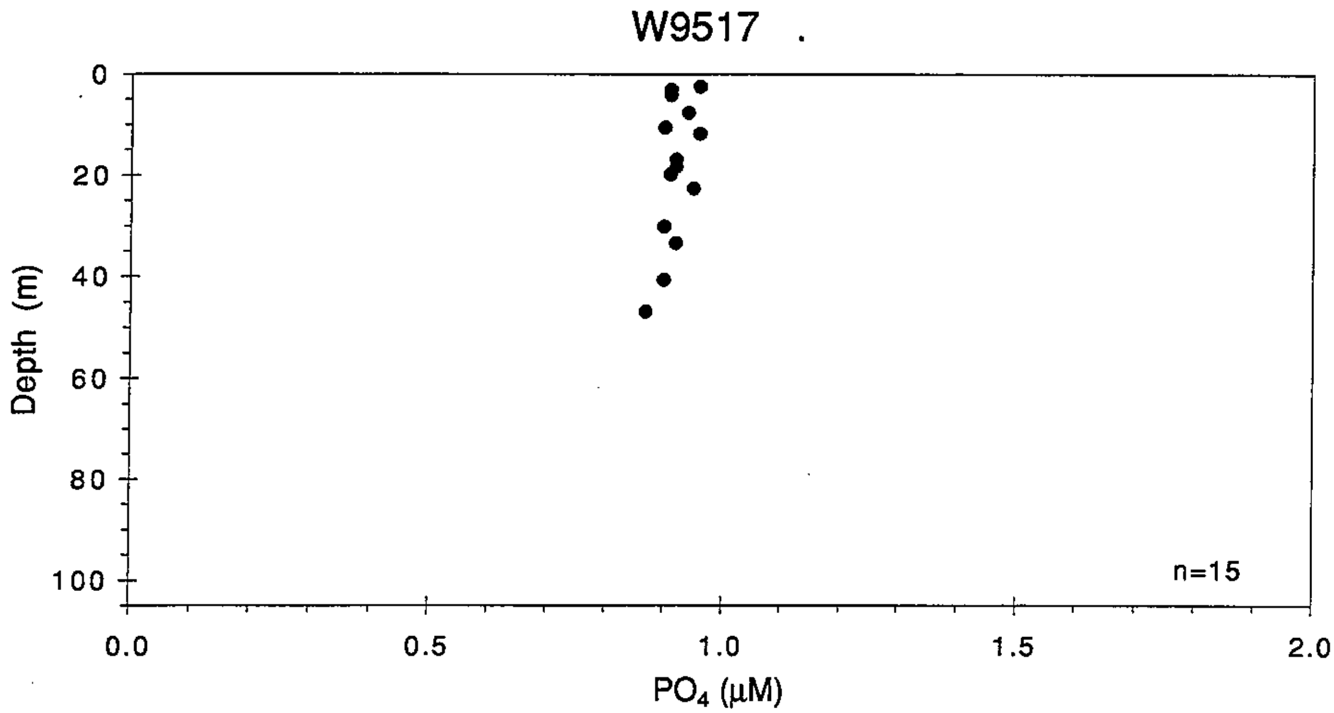

0
20
40
60
80
100
Depth (m)
n=85
0.0
0.5
1.0
1.5
2.0
PO4 (μM)

W9515 .

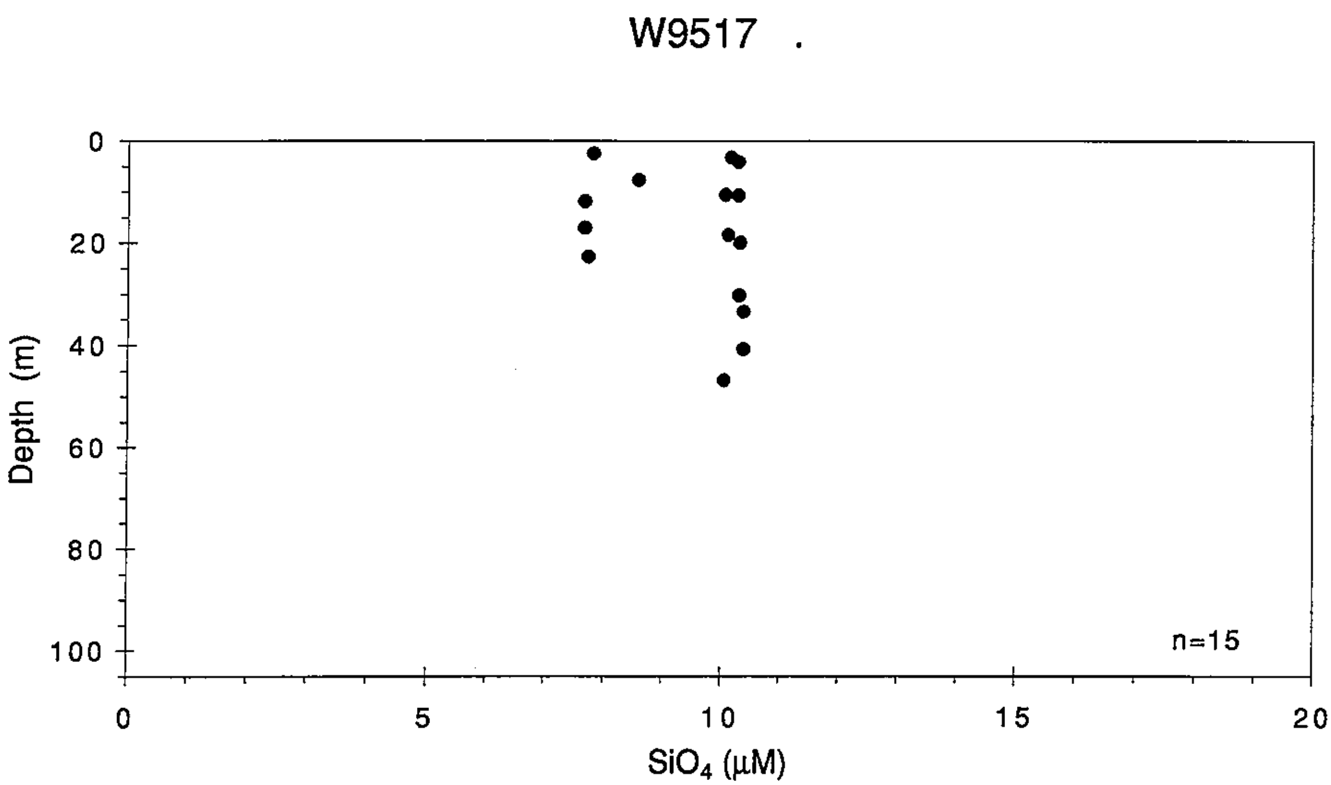

0
20
40
60
80
100
Depth (m)
n=85
0
5
10
15
20
SiO4 (μM)


W9516
Depth (m)
0
20
40
60
80
100
n=55
0.0
0.5
1.0
1.5
2.0
PO4 (µM)

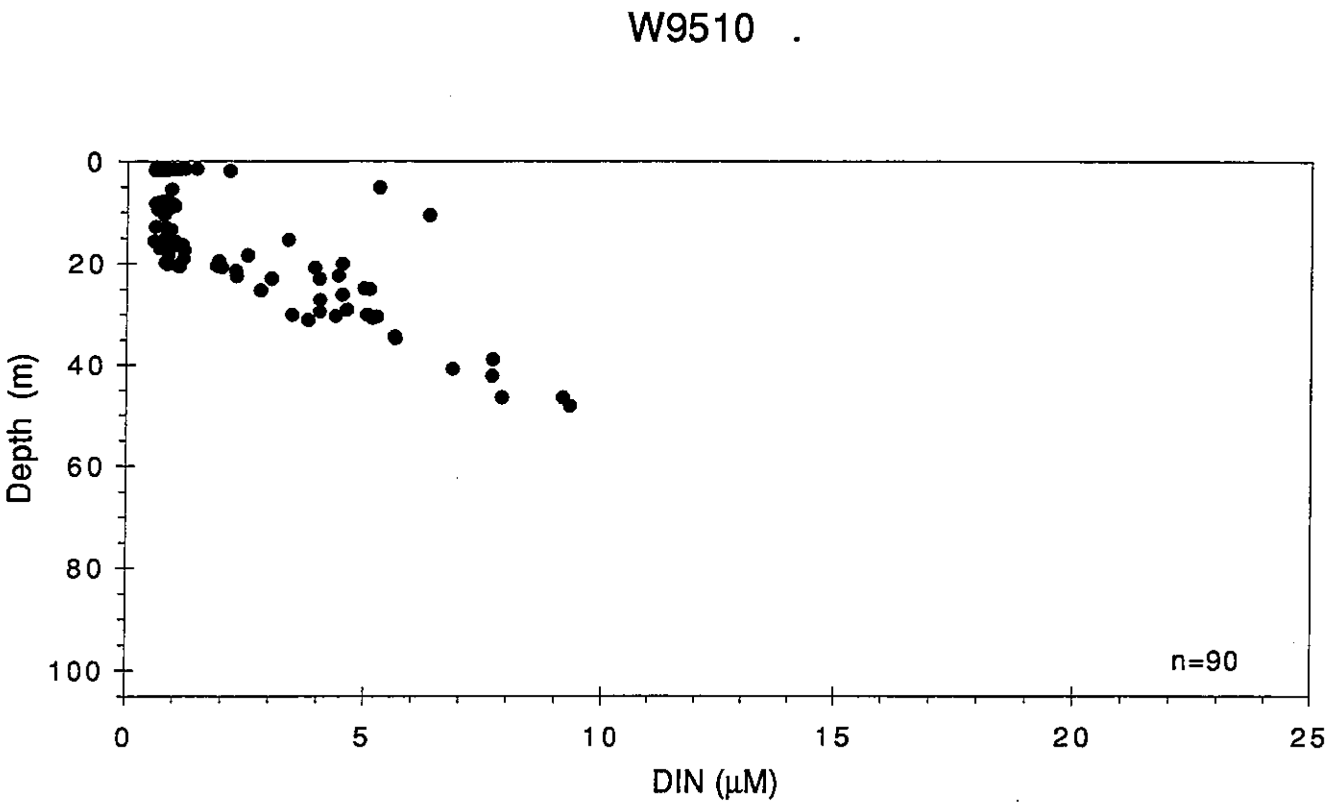

W9516
Depth (m)
0
20
40
60
80
100
n=55
0
5
10
15
20
SiO4 (µM)



W9517
Depth (m)
0
20
40
60
80
100
n=15
0.0
0.5
1.0
1.5
2.0
PO4 (μM)

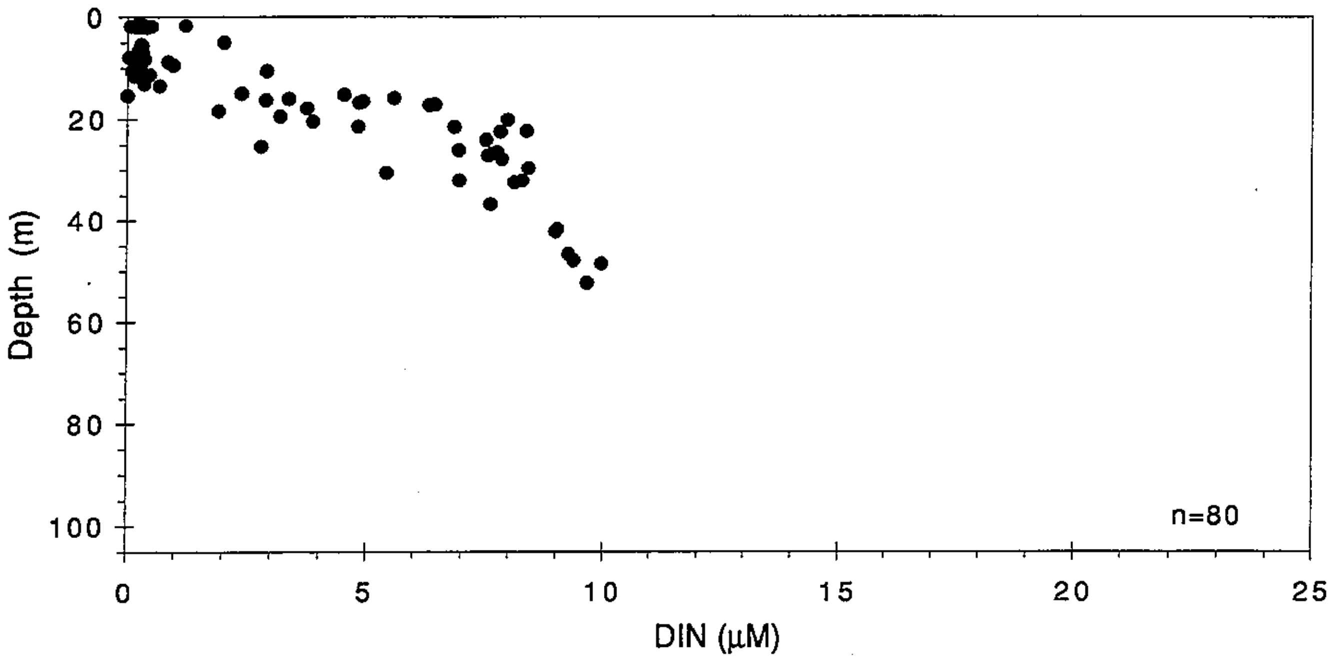


W9517
Depth (m)
0
20
40
60
80
100
n=15
0
5
10
15
20
SiO4 (μM)

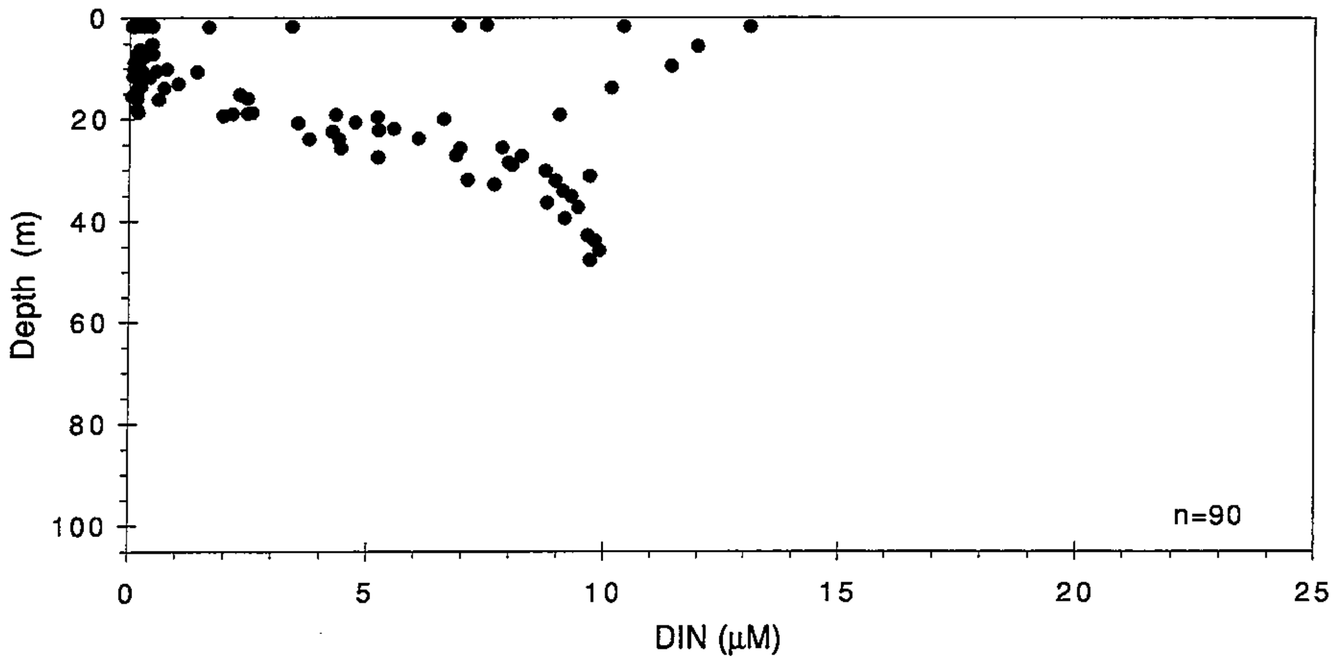


W9510
Depth (m)
0
20
40
60
80
100
n=90
0
5
10
15
20
25
DIN (µM)

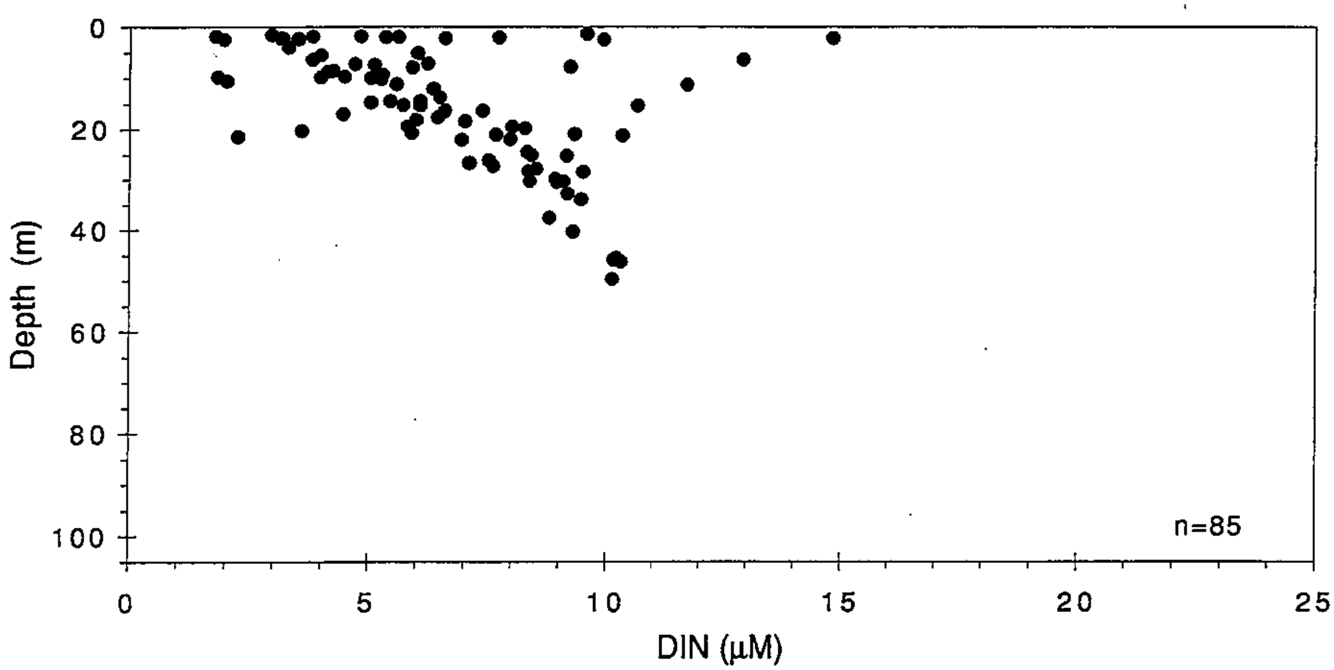
W9512



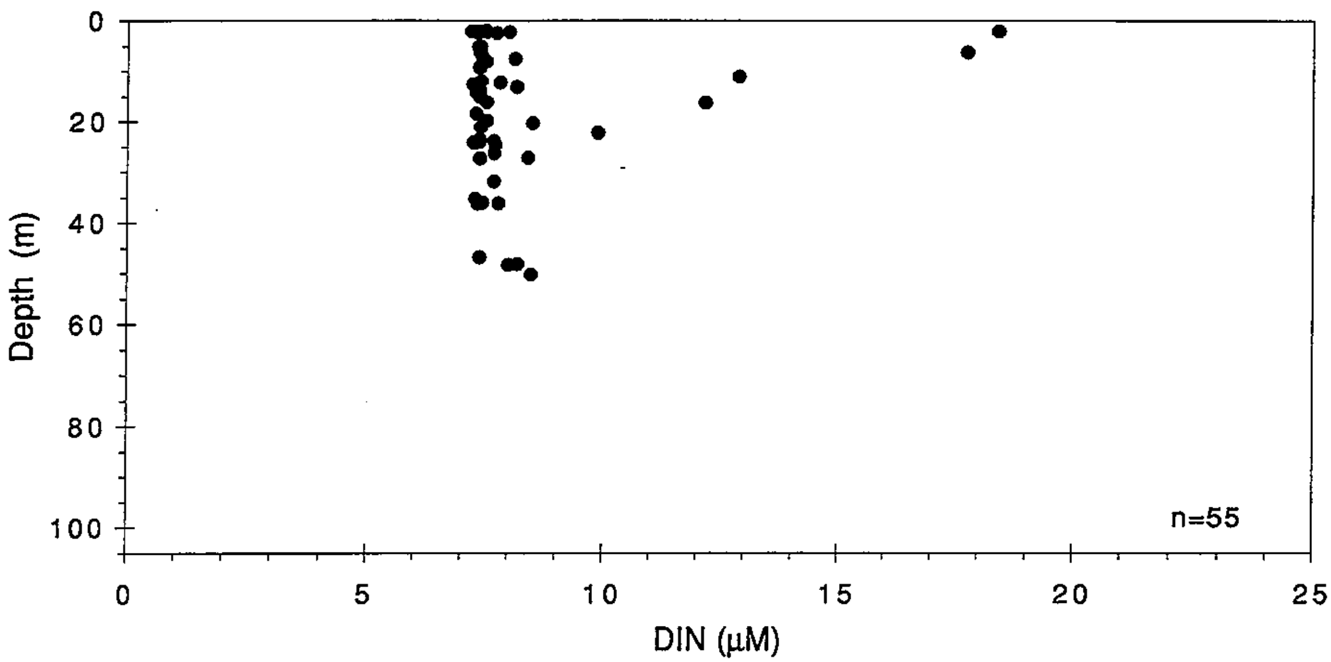
W9513



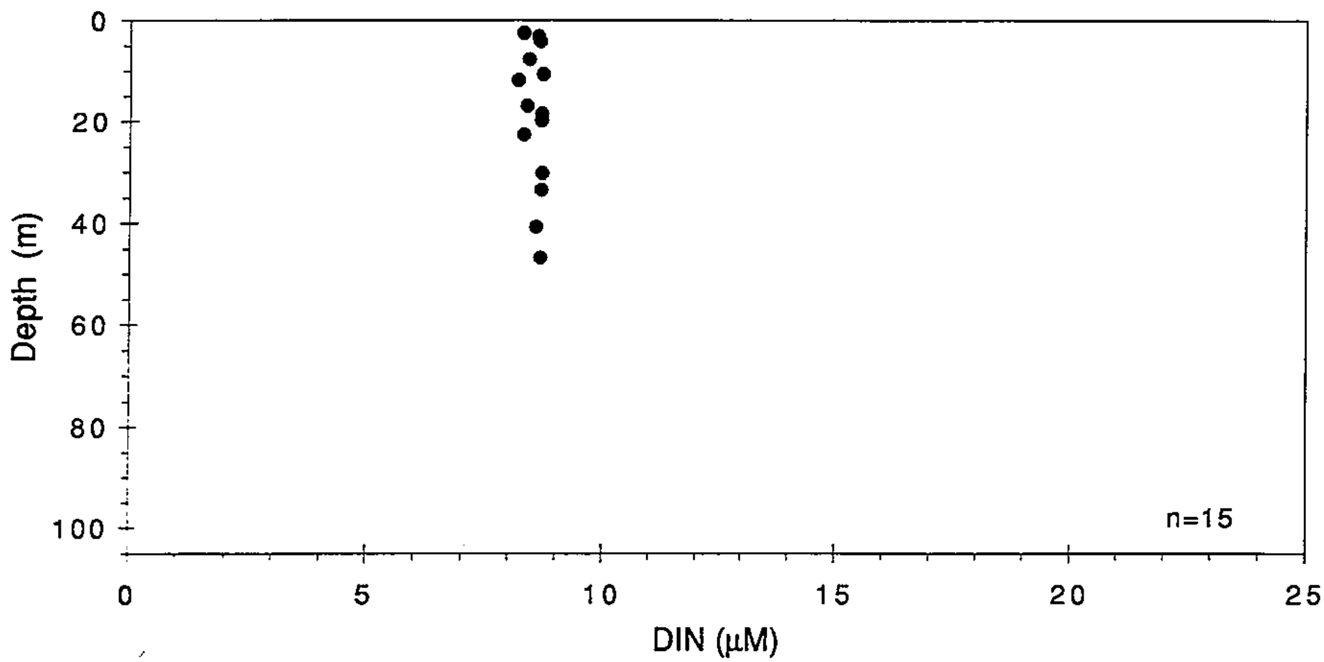
W9515 .



W9516



W9517 .

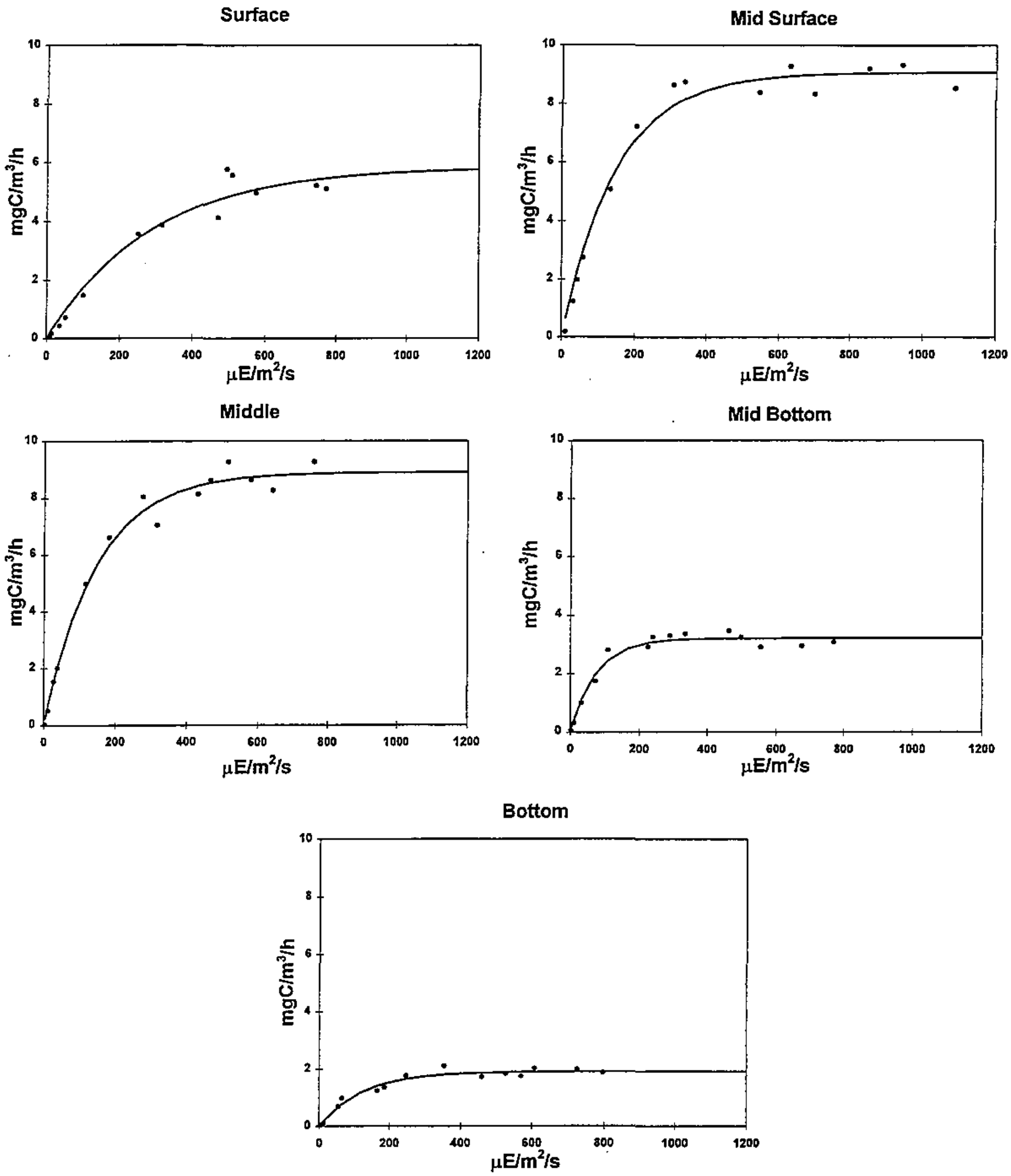


APPENDIX E

Photosynthesis-Irradiance (P-I) Curves

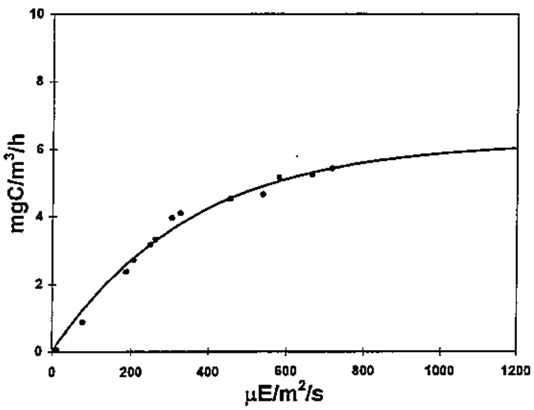
Productivity calculations (Appendix A) utilized light attenuation data from a CTD-mounted 4π sensor and incident light time-series data from an on-deck 2π irradiance sensor. After collection of the productivity samples, they were incubated in a temperature-controlled incubator. The resulting photosynthesis (mgC/m^3/h) versus light irradiance (μE/m^2/s, P-I) curves are comprehensively presented in this appendix. These data were used to determine hourly production at intervals throughout the day for each sampling depth.

W9510 Station N04

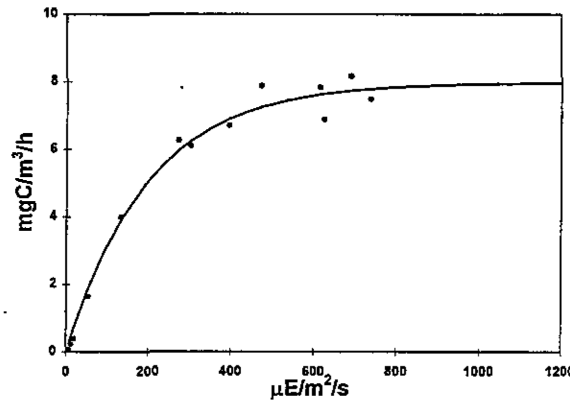


W9510 Station N16

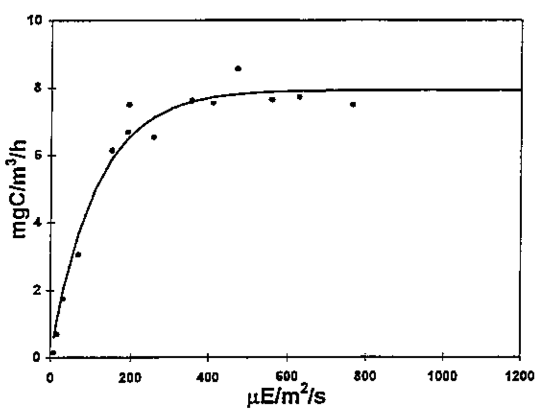
Surface



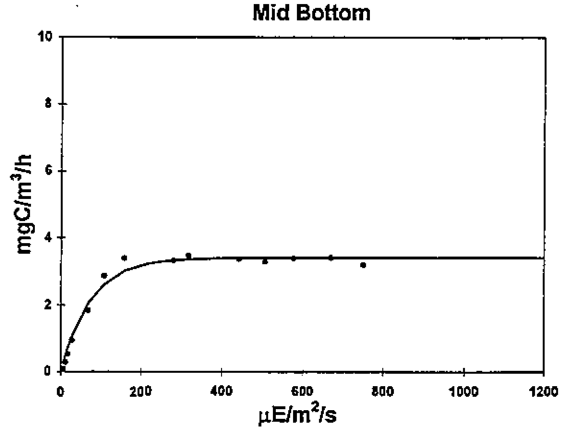
Mid Surface



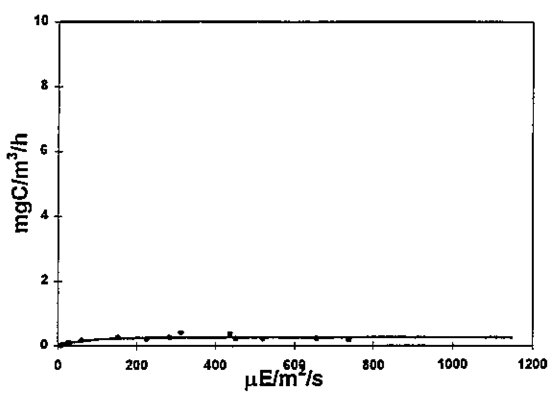
Middle



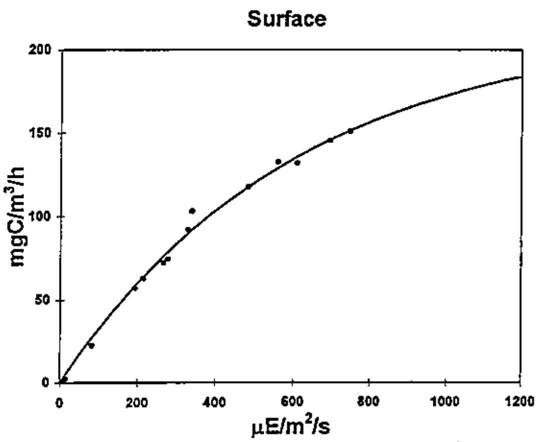
Mid Bottom

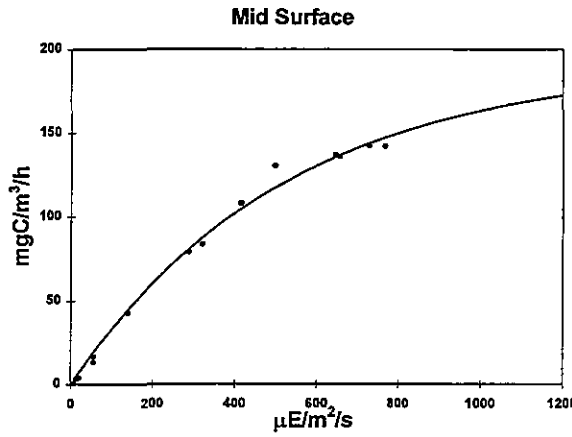


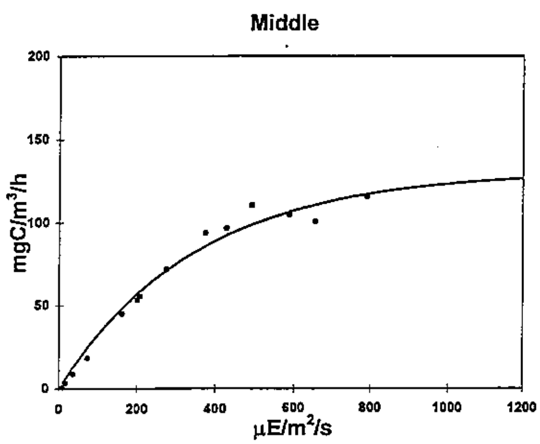
Bottom

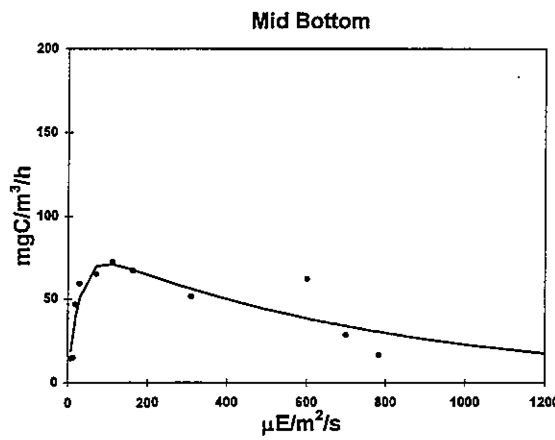


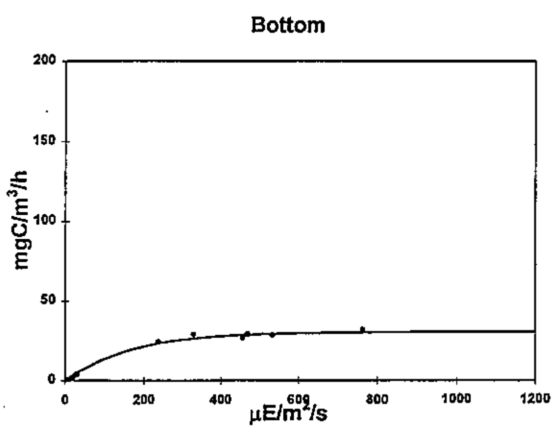
W9511 Station F23





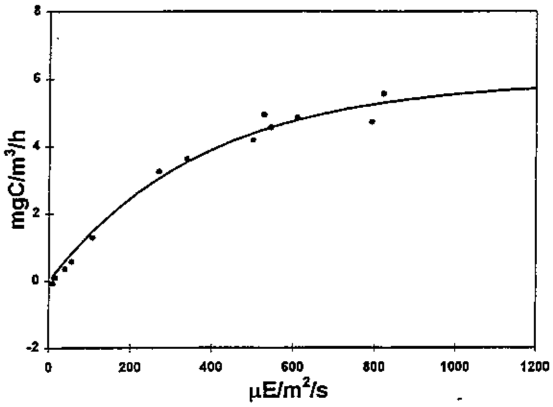




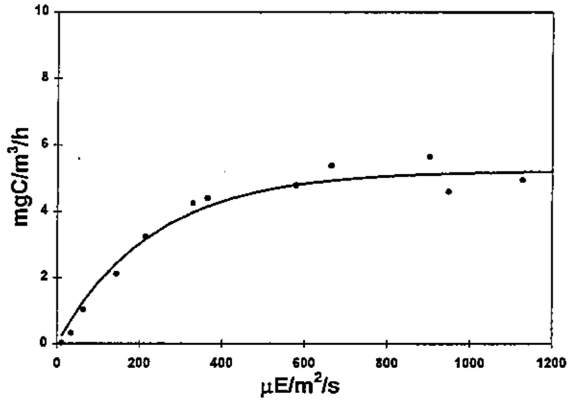


W9511 Station N16

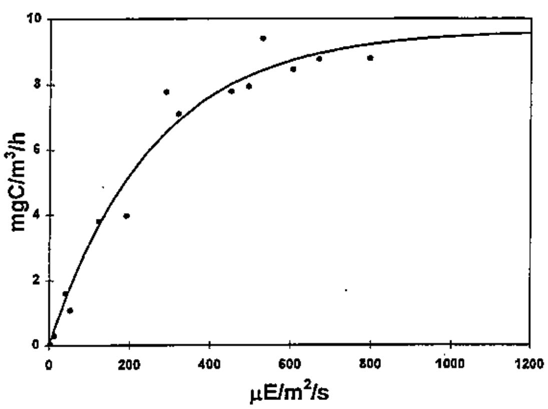
Surface



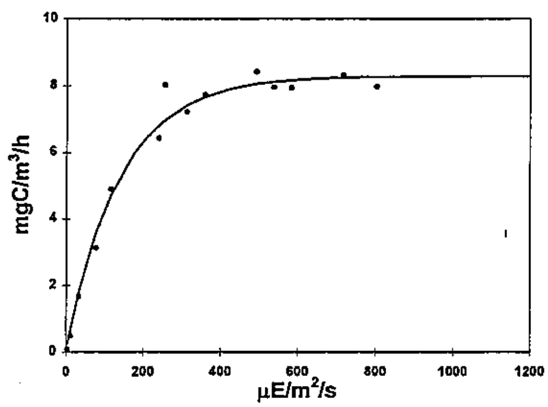
Mid Surface



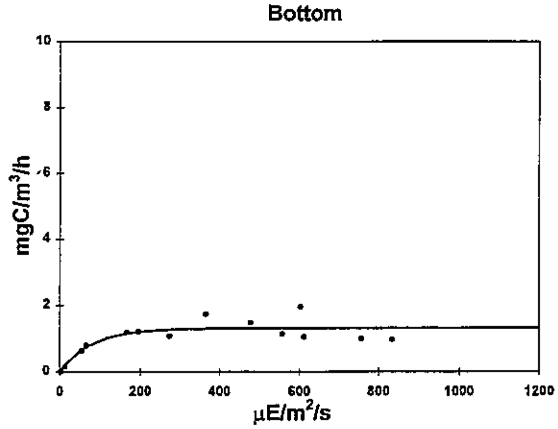
Middle



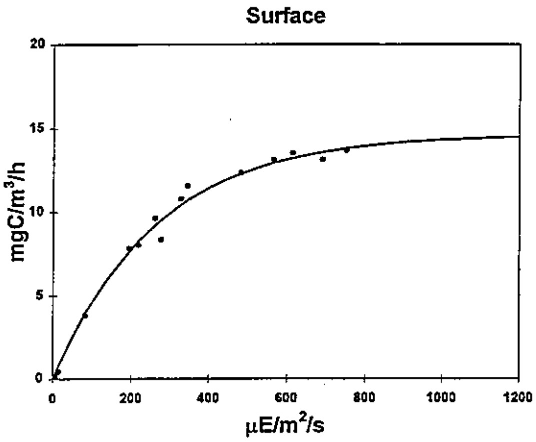
Mid Bottom

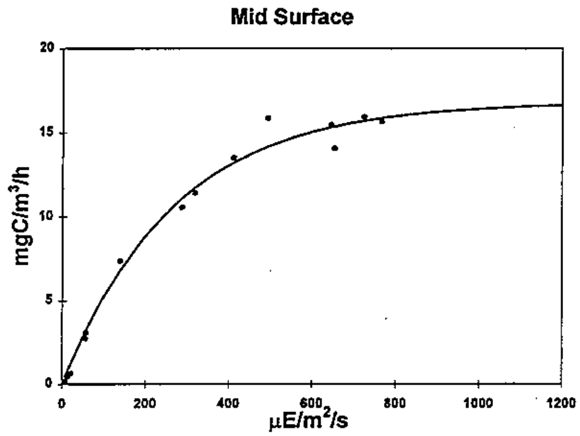


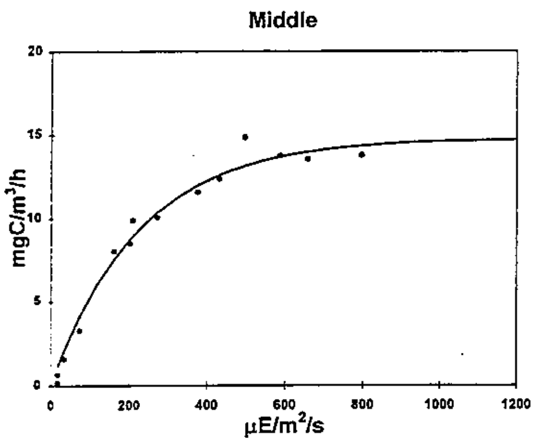
Bottom

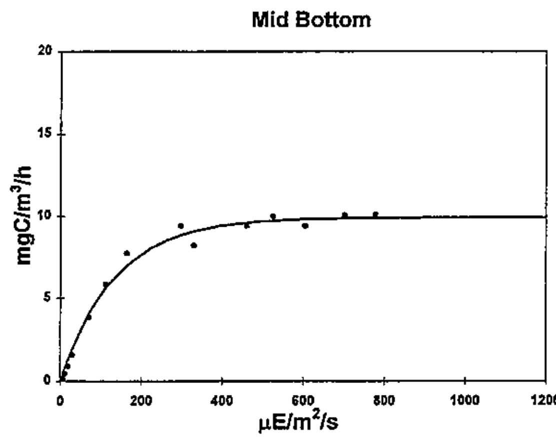


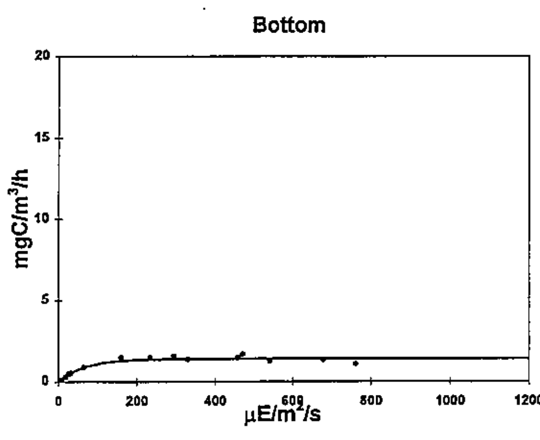
W9511 Station N04





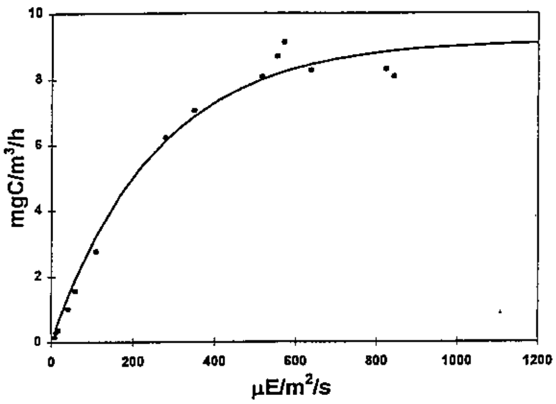




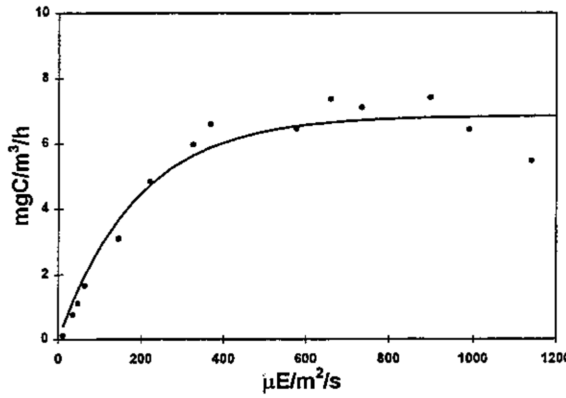


W9511 Station N07

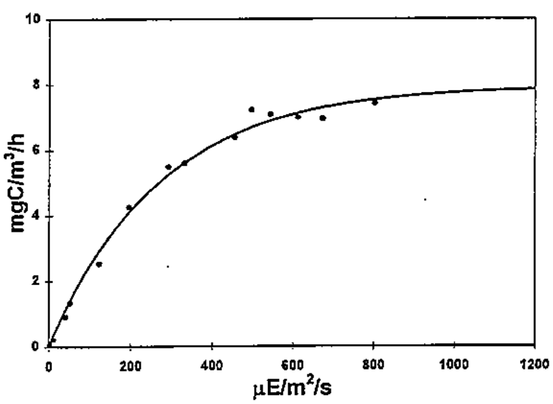
Surface



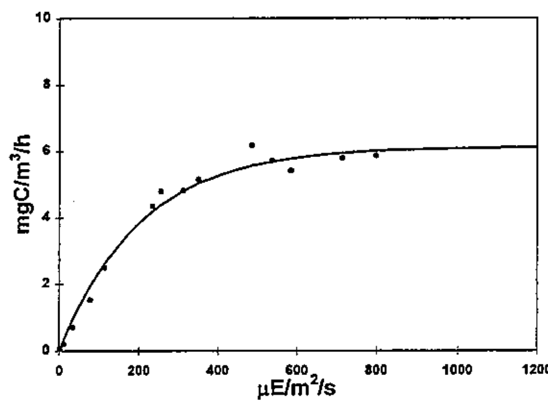
Mid Surface



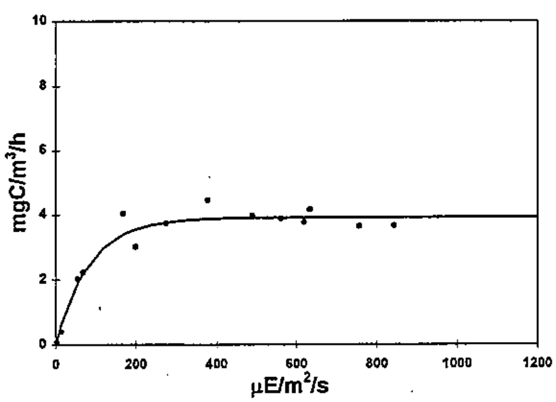
Middle



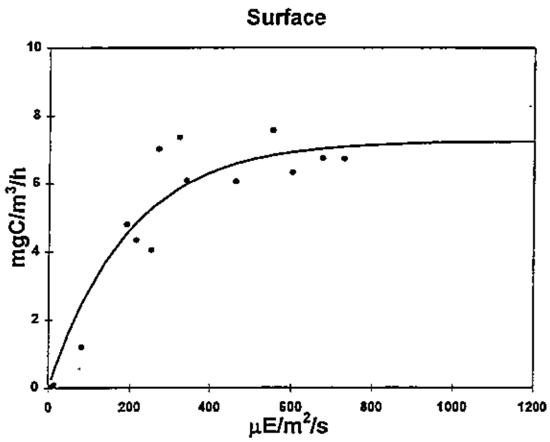
Mid Bottom

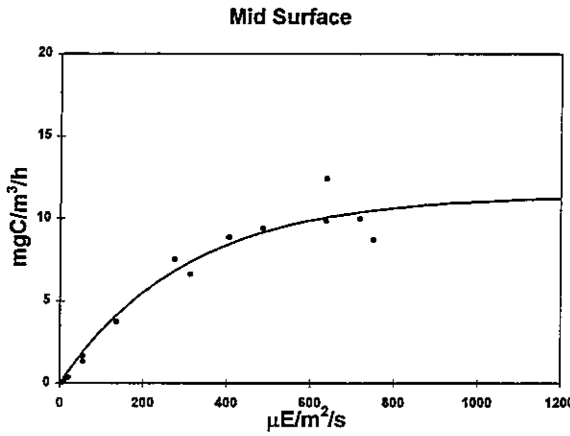


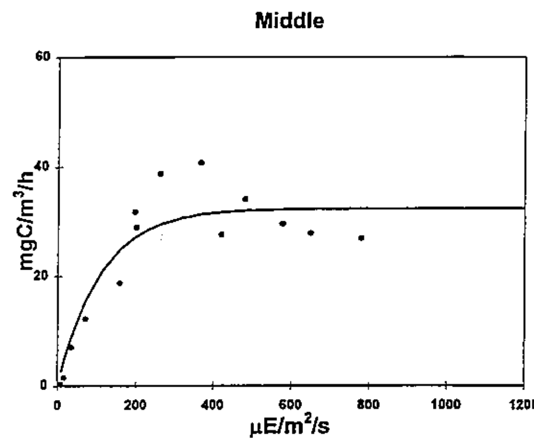
Bottom

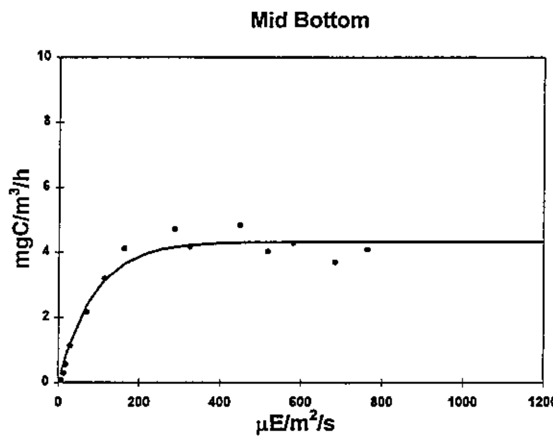


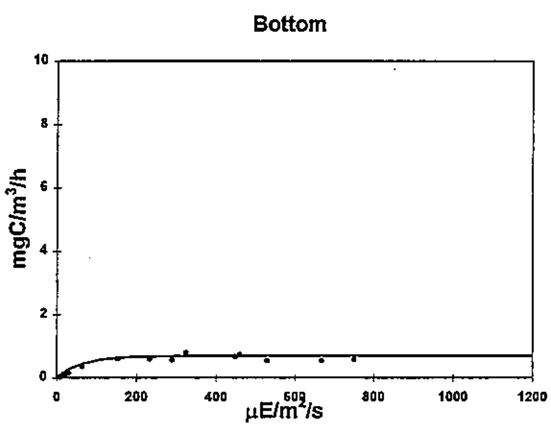
W9512 Station N16











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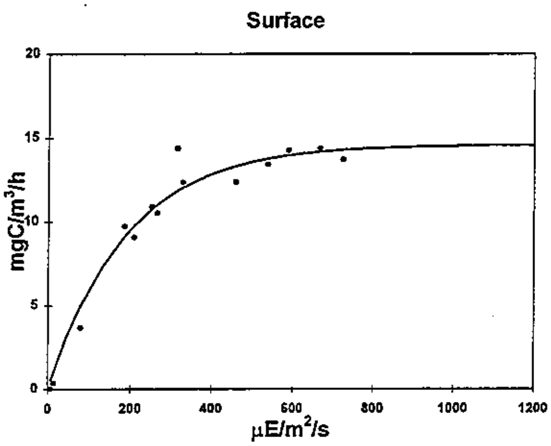

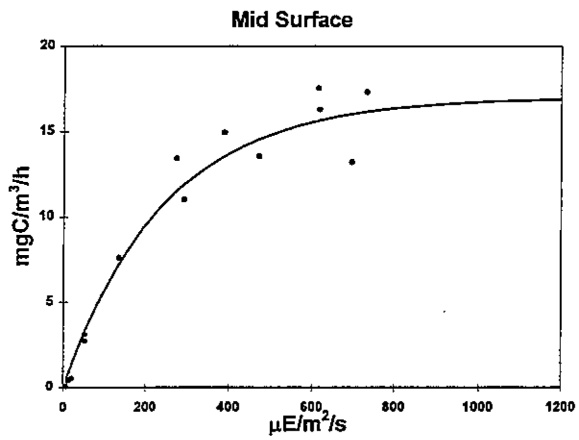

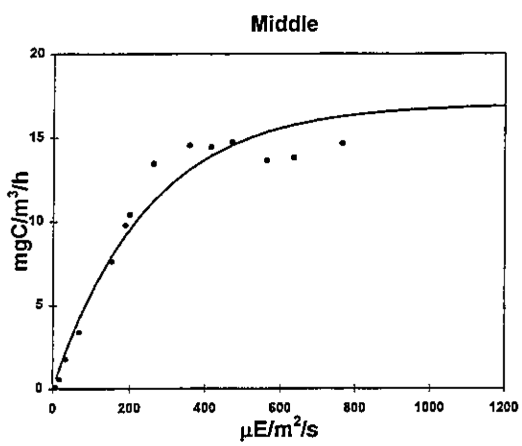

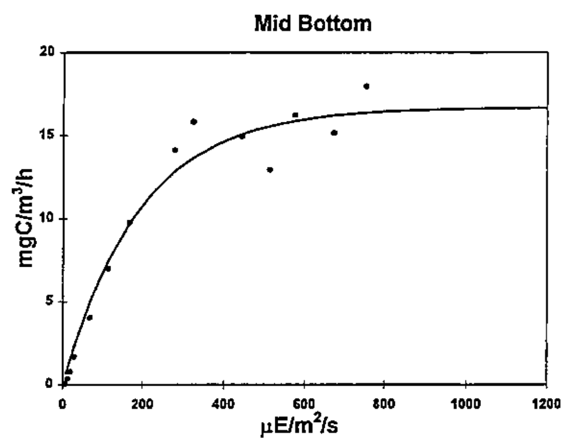

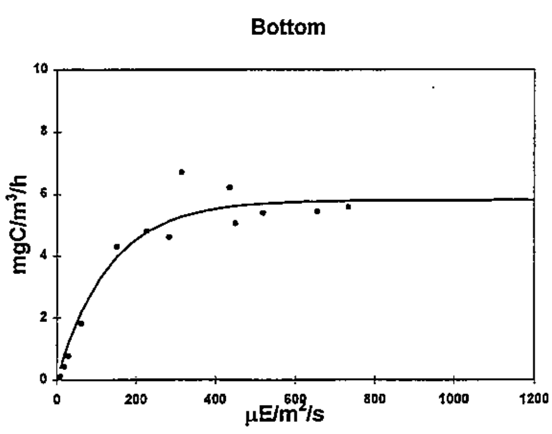

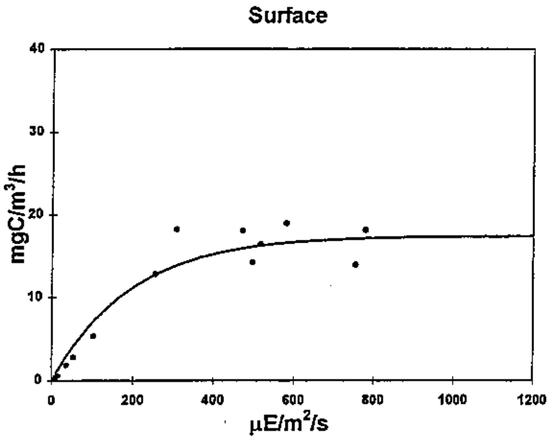
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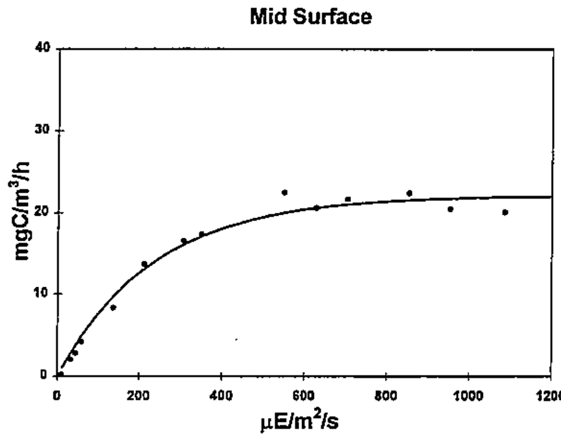
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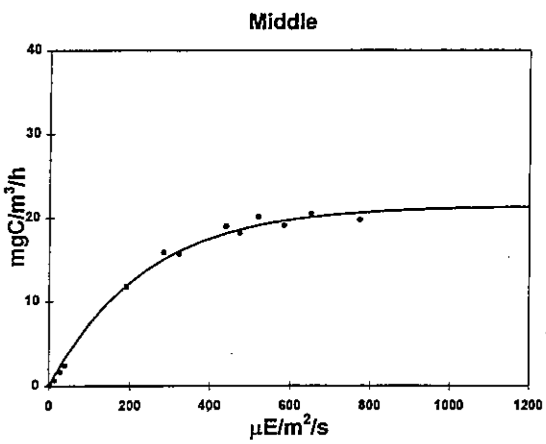
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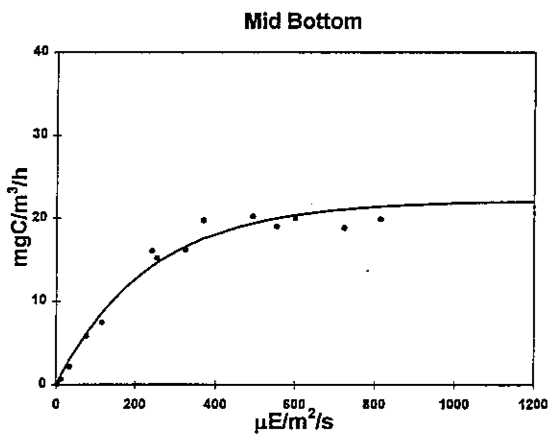
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µE/m2/s
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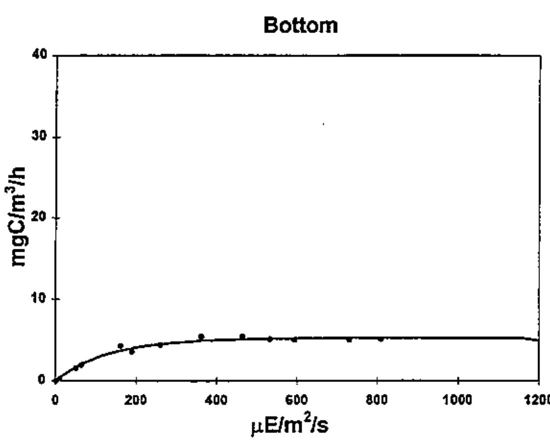
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µE/m2/s
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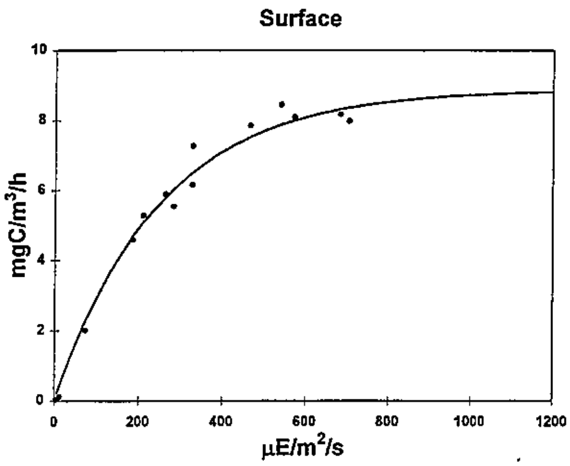
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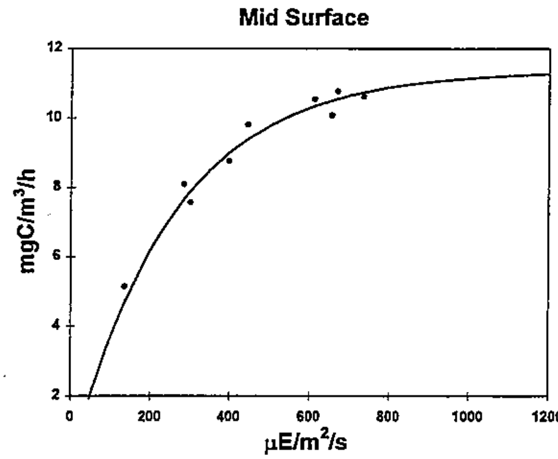
μE/m2/s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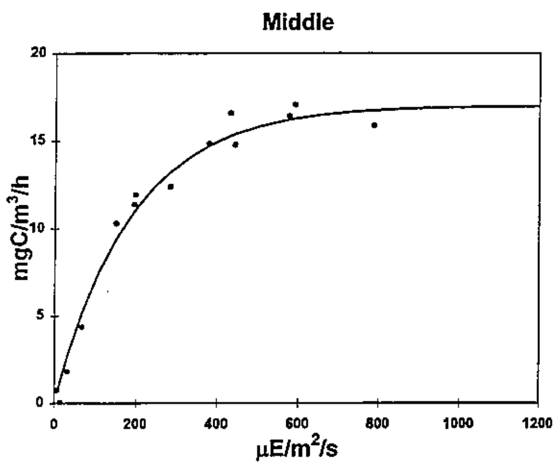
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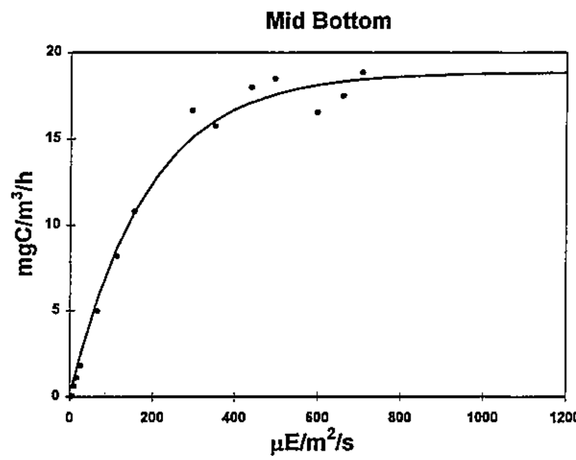
μE/m2/s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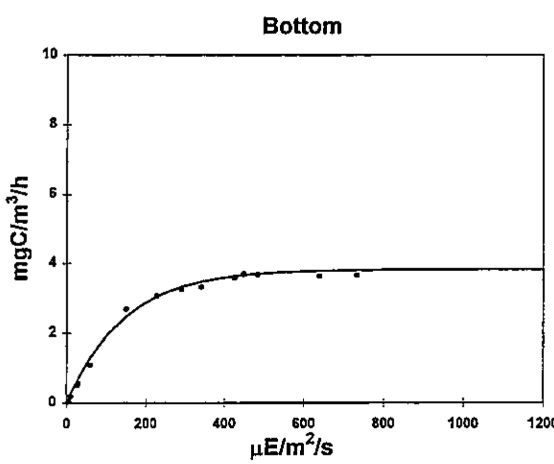
μE/m2/s


Bottom
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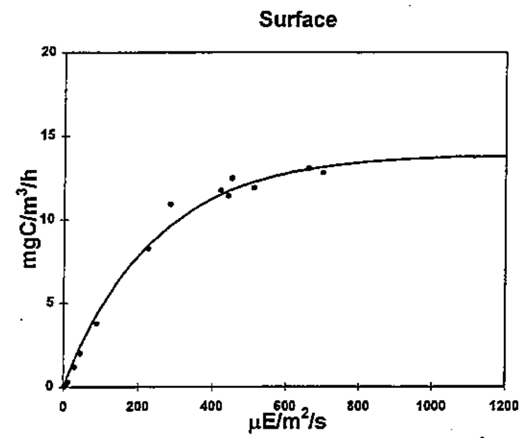
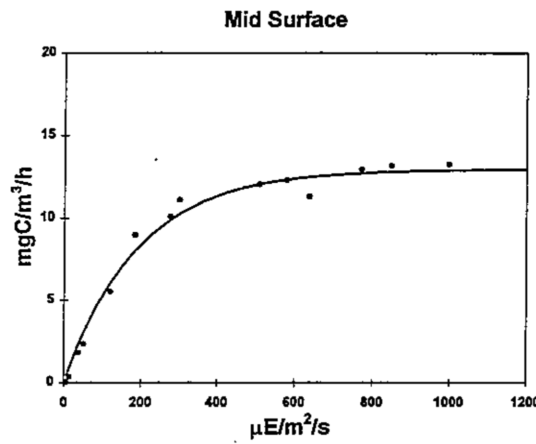
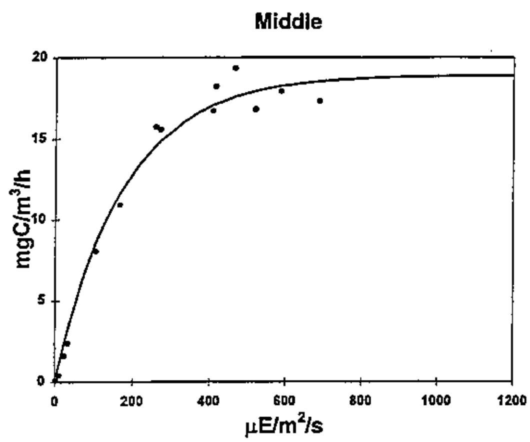
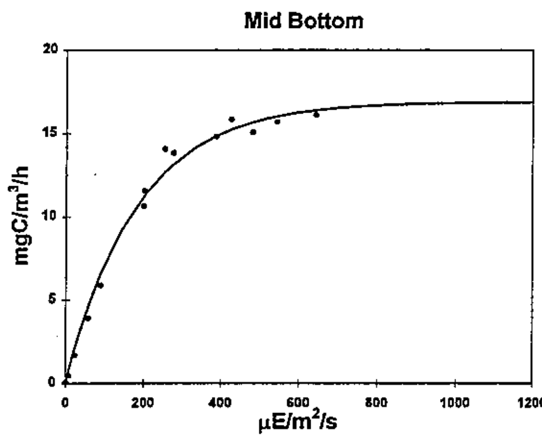
μE/m2/s

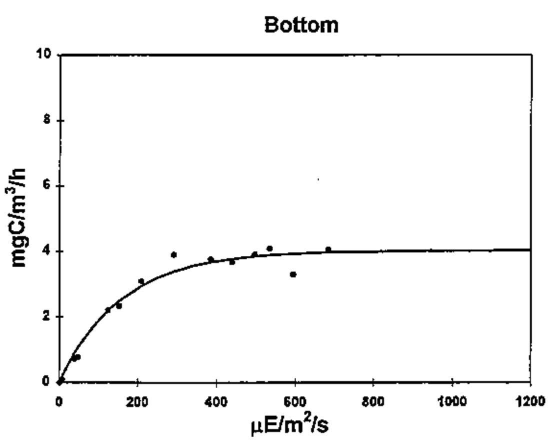
W9514 Station N07





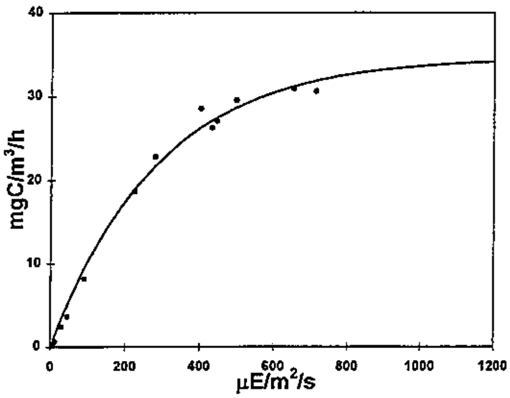






W9514 Station N16

Surface



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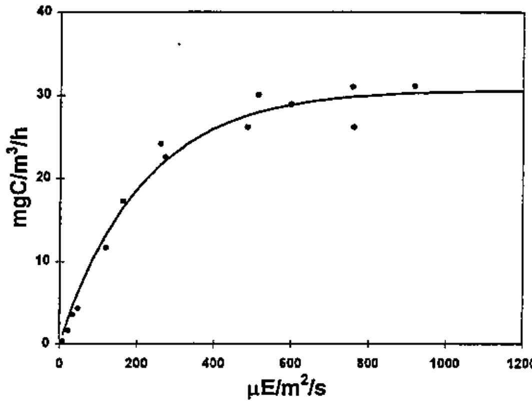
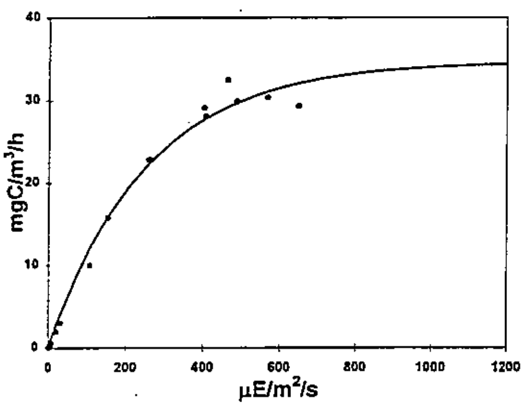
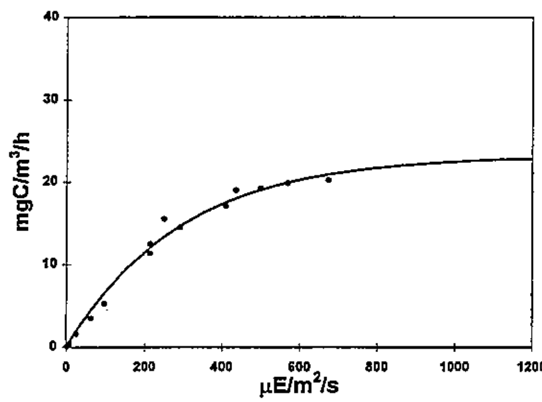


Middle



Mid Bottom



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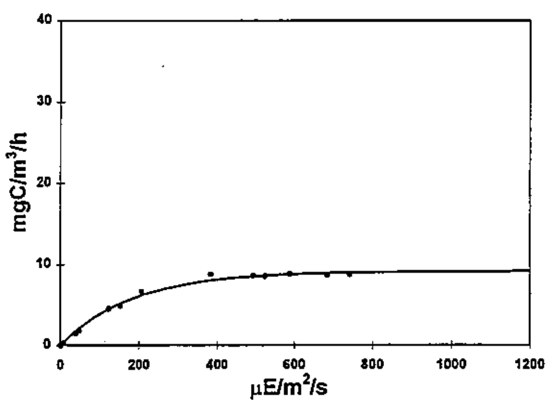
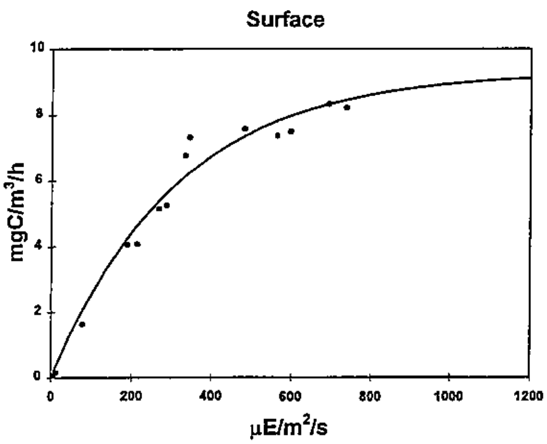
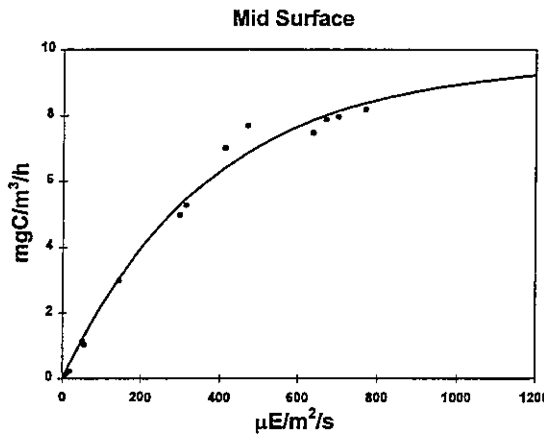
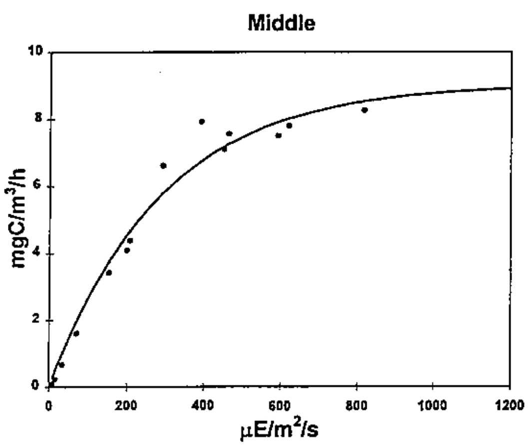
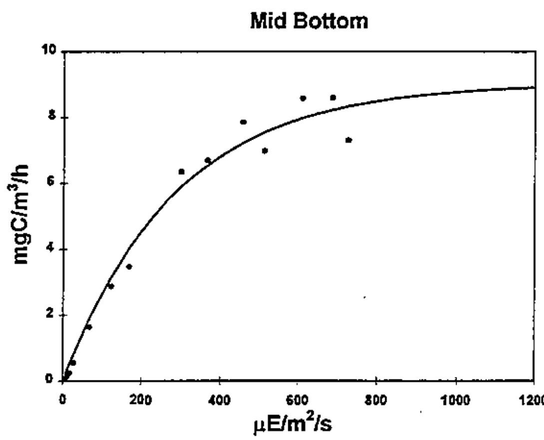


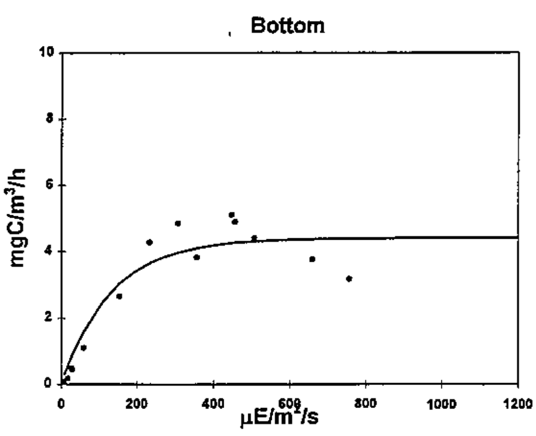
W9514 Station F23



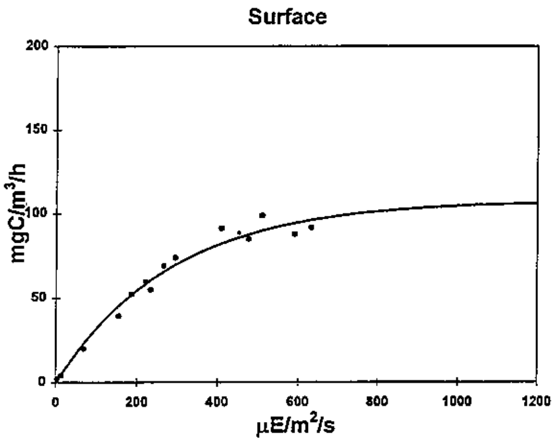


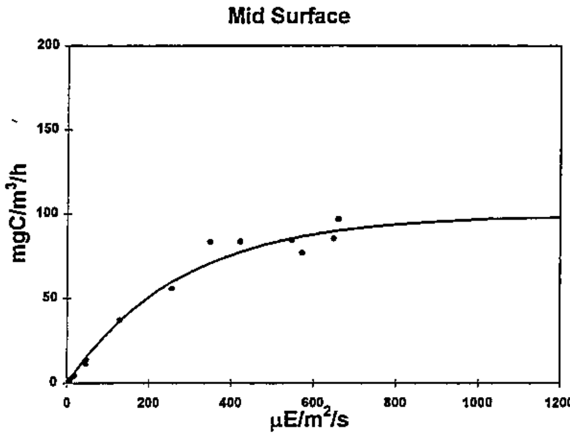


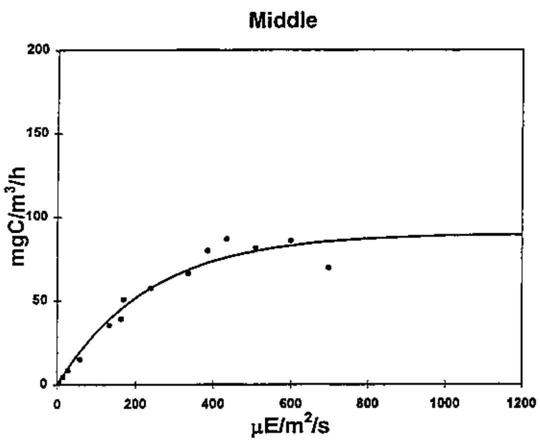


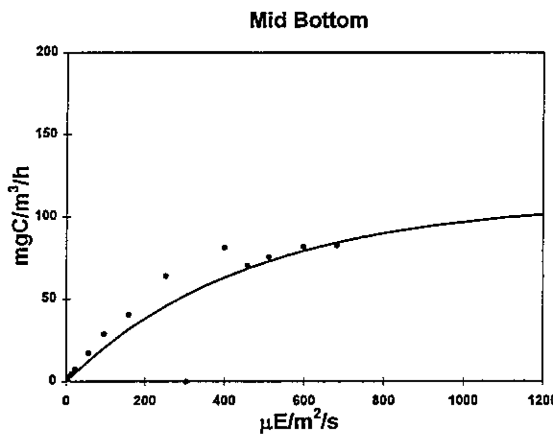


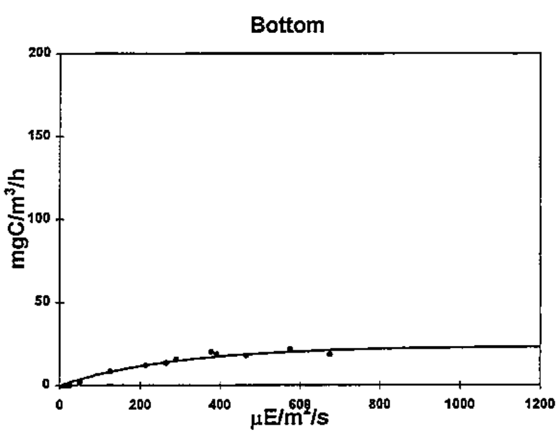
W9515 Station N16











W9515 Station N04

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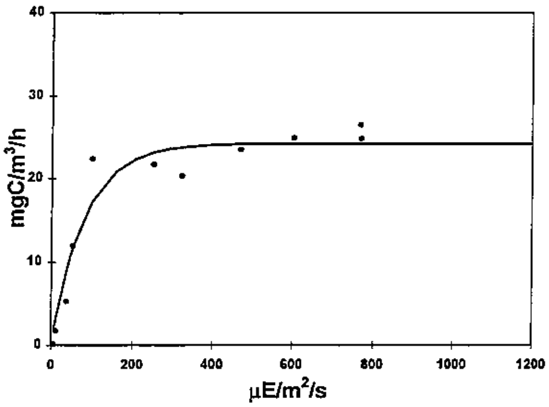

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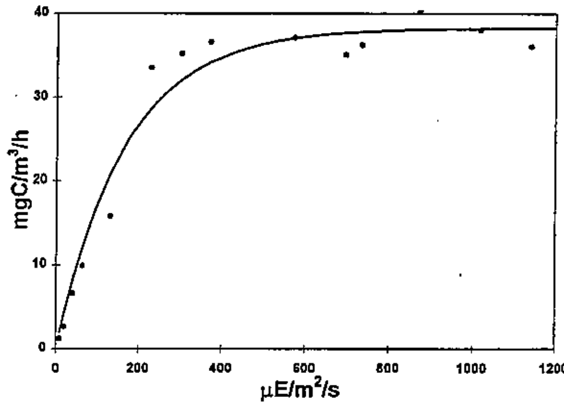

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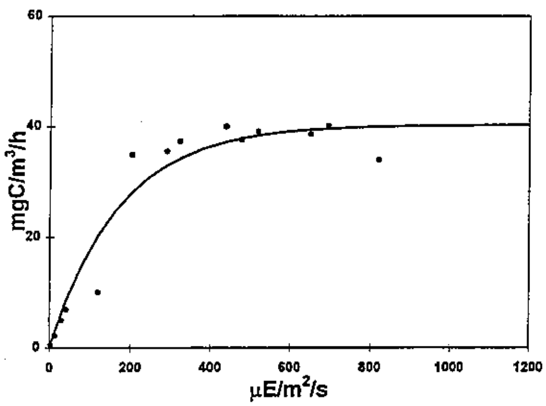

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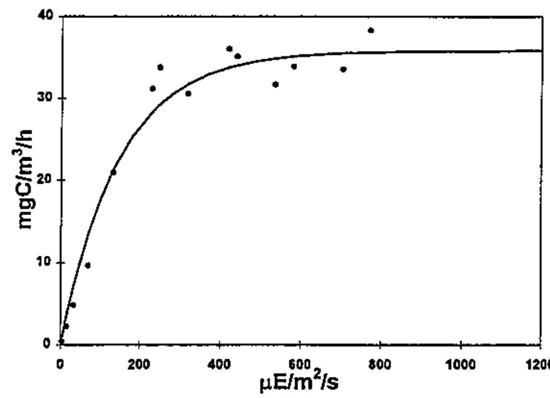

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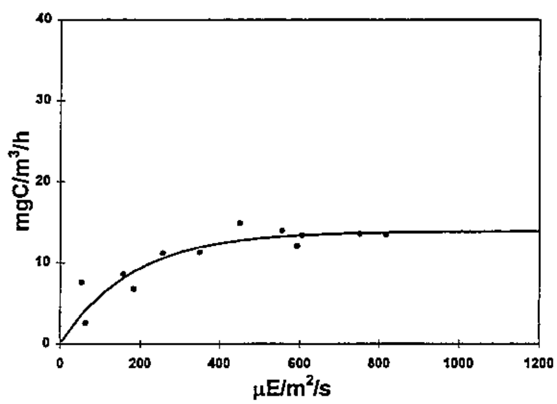

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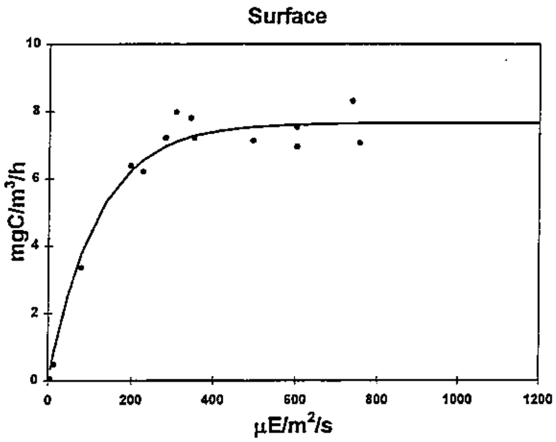
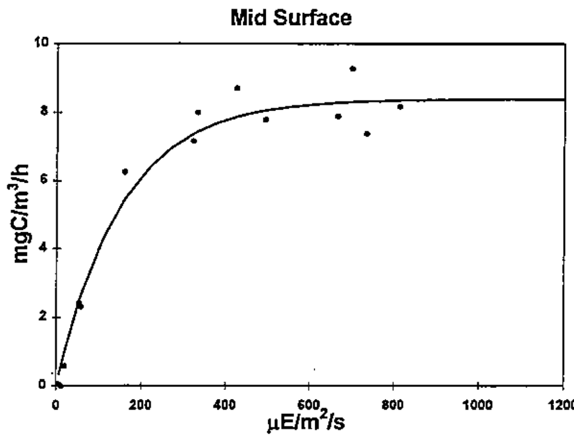
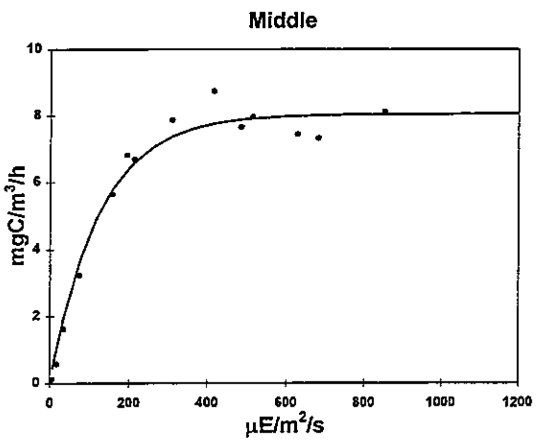
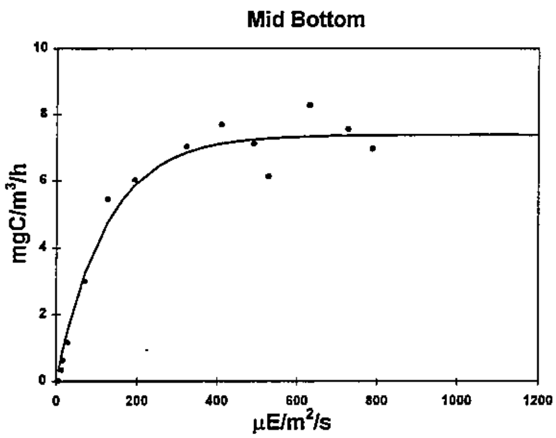
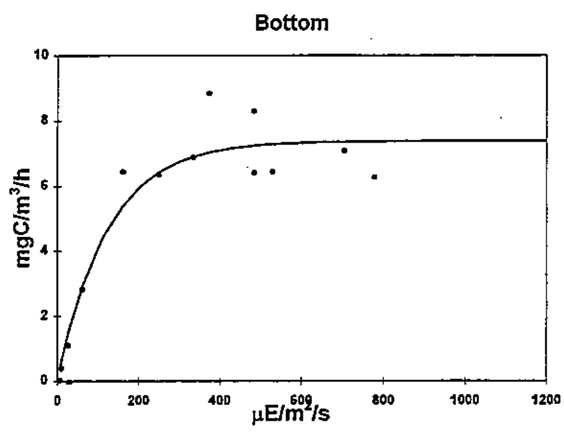


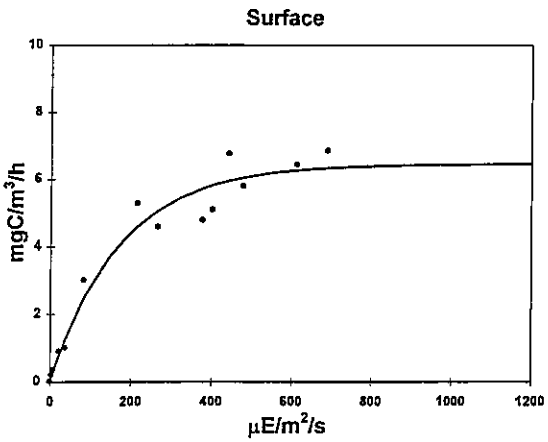


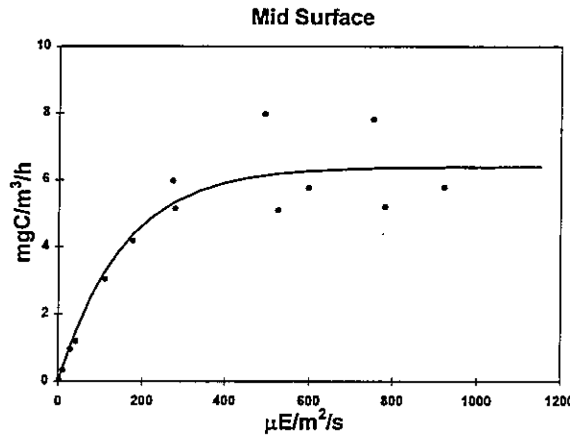


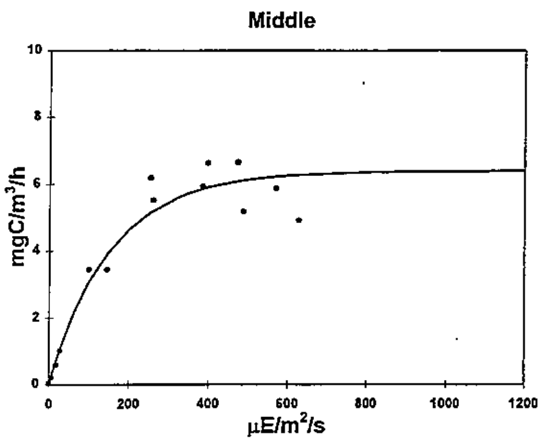


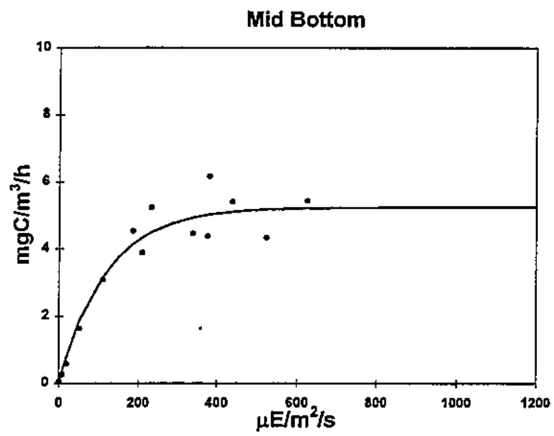


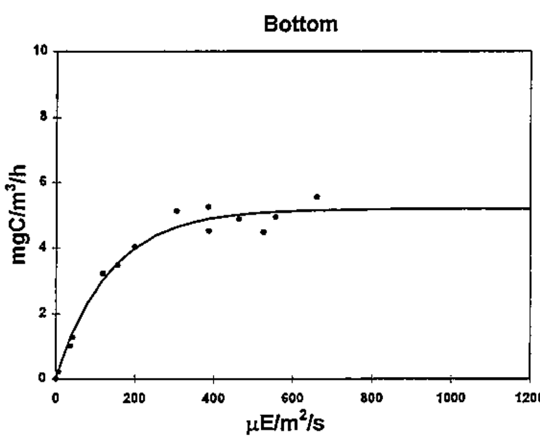
W9516 Station N04



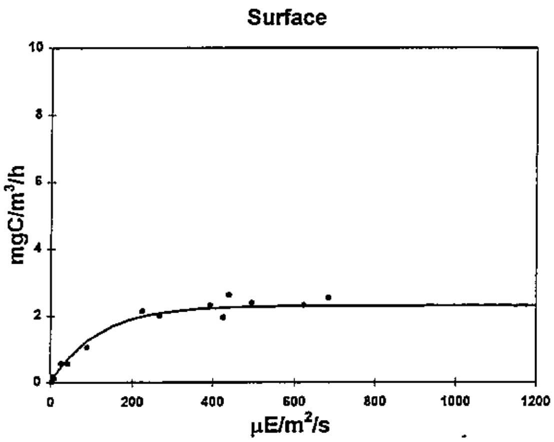


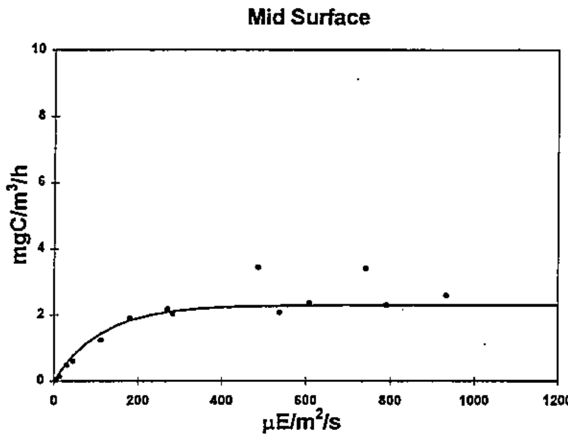


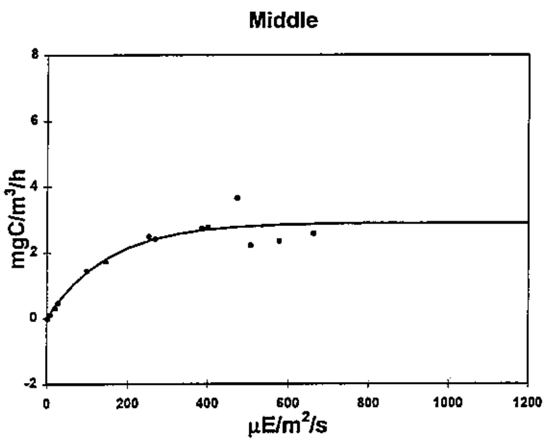


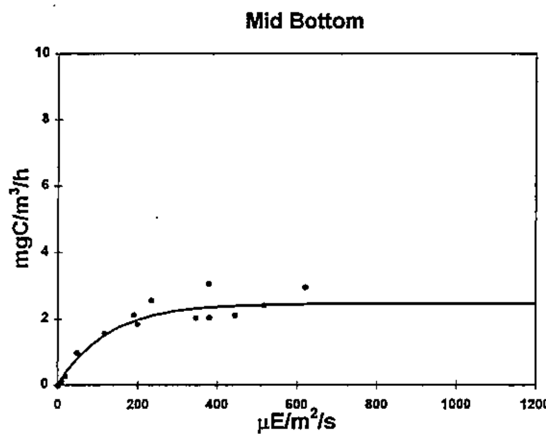


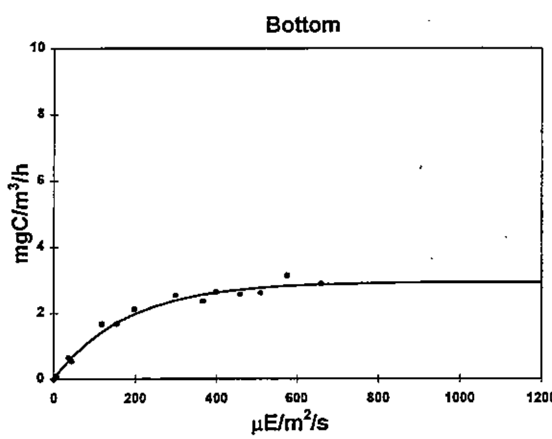
W9517 Station N16





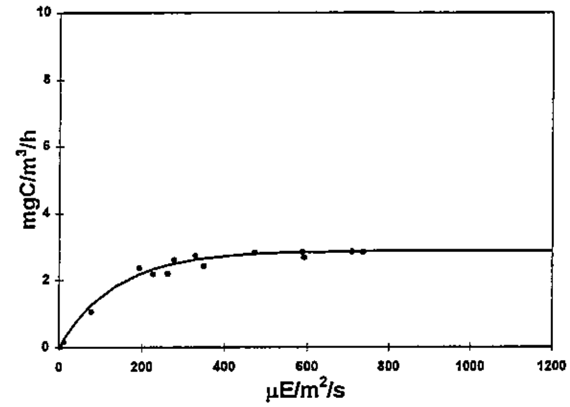




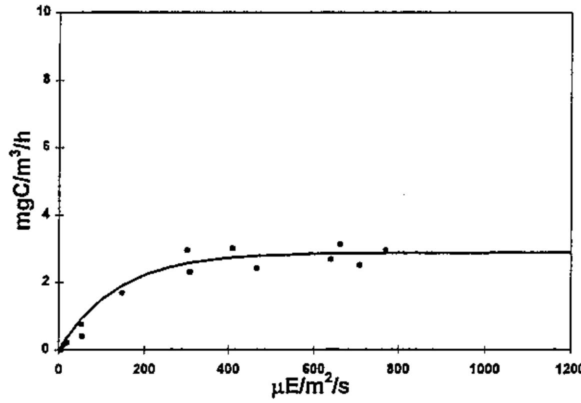


W9517 Station N04

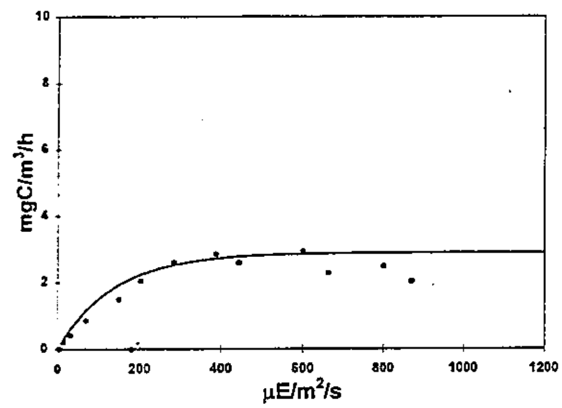
Surface



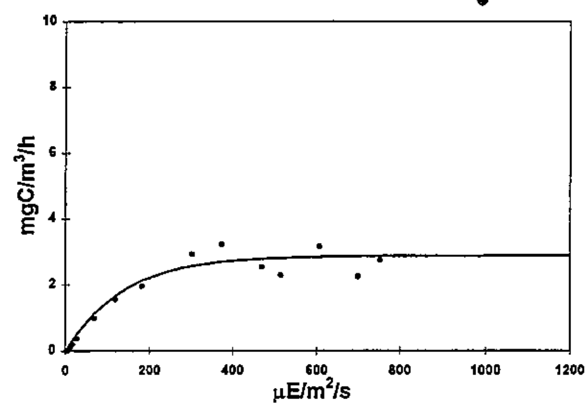
Mid Surface



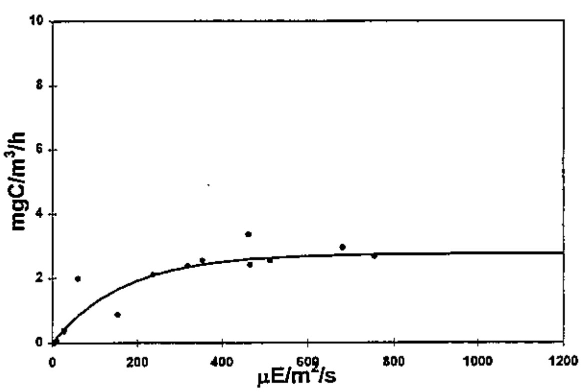
Middle



Mid Bottom



Bottom



APPENDIX F-1

ABUNDANCE OF PREVALENT SPECIES IN SURFACE SAMPLE

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, August 8, 1995 - August 10, 1995 (W9510)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.479	
		%	8	
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	1.249	0.128
		%	21	11
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	3.456	0.981
		%	58	81

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5 % Total Count) in Surface Sample Whole Water Phytoplankton, August 21, 1995 - August 26, 1995 (W9511)

			Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
Species	Group	Parameter	1F23	1F30	1F31	1F13	1F24	1F25	1N10	1N16	3N16	1F06	1F27	1F01	1F02
CHAETOCEROS SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L			2.409			0.915							
		%			15			8							
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L		0.579			0.213	0.610	1.338						
		%		8			6	6	11						
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L			0.976										
		%			6										
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L				0.329	0.366			0.244	0.360	0.335	0.111	0.155	
		%				9	9			9	10	9	7	7	
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L		1.403										0.133	
		%		20										6	
SKELETONEMA COSTATUM	CD	10^6 Cells/L	2.328		1.220		0.476	0.584	1.684						
		%	20		7		12	5	14						
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.998	0.793	2.714		0.427	1.245	1.103			0.232			
		%	9	11	17		11	11	9			6			
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	5.211	2.363	5.366	2.836	1.732	4.878	4.646	2.147	2.647	2.659	1.246	1.780	1.604
		%	46	33	33	76	45	44	39	81	76	73	81	77	90

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample
Whole Water Phytoplankton, September 6, 1995 - September 8, 1995 and September 11, 1995 - September 14, 1995
(W9512)

Species	Group	Parameter	Nearfield Stations	
			1N10	2N16
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L	6.174	1.142
		%	69	49
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.139
		%		6
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	1.677	0.826
		%	19	35

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, September 25, 1995 - September 29, 1995 (W9513)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.177	
		%	7	
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L		0.122
		%		5
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L	0.201	0.177
		%	8	8
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.316
		%		14
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	1.451	1.142
		%	57	49

Group Definitions:		
	CD	Centric Diatom
	DF	Dinoflagellate
	MF	Microflagellate
	O	Other
	PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, October 9 - October 13, 1995 (W9514)

			Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
Species	Group	Parameter	1F23	1F30	1F31	1F13	1F24	1F25	1N10	1N16	3N16	1F06	1F27	1F01	1F02
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.119	0.152	0.151		0.084	0.158	0.672		0.307		0.601		
		%	15	6	14		8	13	15		12		20		
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.066	0.482	0.081	0.316		0.167	1.146					0.336	
		%	7	18	7	13		14	25					9	
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L	0.090		0.059		0.082	0.100							0.122
		%	11		5		8	8							5
GYMNODINIUM SP #1 5-20UM W 10-20UM L	DF	10^6 Cells/L				0.166						0.071	0.209	0.567	0.139
		%				7						5	7	15	6
KATODINIUM ROTUNDATUM	DF	10^6 Cells/L										0.213	0.233		
		%										16	8		
LEPTOCYLINDRUS DANICUS	CD	10^6 Cells/L													
		%													
PYRAMIMONAS SP.	MF	10^6 Cells/L			0.073								0.153		
		%			7								5		
RHIZOSOLENIA DELICATULA	CD	10^6 Cells/L										0.136			
		%										10			
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L										0.078			
		%										6			
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.203		0.196		0.137	0.199	0.260		0.477				
		%	26		18		13	17	6		19				
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.200	1.37205	0.33877	1.303	0.516	0.357173	1.7522	6.02177	1.1606	0.633	1.37482	1.988	1.486
		%	26	51.66746	30.64118	53	49	29.84561	38.53119	75.647431	45.869276	48	46.11219604	54	61

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, November 1 - November 4, 1995 (W9515)

Species	Group	Parameter	Nearfield Stations 1N10	Nearfield Stations 1N16
ASTERIONELLA GLACIALIS	PD	10^6 Cells/L	0.538	1.594
		%	48	52
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.058	
		%	5	
PANDORINA SP.	O	10^6 Cells/L	0.082	
		%	7	
RHIZOSOLENIA DELICATULA	CD	10^6 Cells/L		0.191
		%		6
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.224
		%		7
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.104	
		%	9	

Group Definitions:

	CD	Centric Diatom
	DF	Dinoflagellate
	MF	Microflagellate
	O	Other
	PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, November 27, 1995 - December 5, 1995 (W9516)

Species	Group	Parameter	Nearfield Stations 1N10	Nearfield Stations 1N16
ASTERIONELLA GLACIALIS	PD	10^6 Cells/L	0.018	0.041
		%	5	9
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L		0.027
		%		6
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.036	
		%	10	
THALASSIONEMA NITZSCHIOIDES	PD	10^6 Cells/L		0.039
		%		8
THALASSIOSIRA SP#1 DIAM <20 MICRONS	CD	10^6 Cells/L	0.018	0.136
		%	5	29
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.044
		%		9
UNID. CHOANOFLAGELLATE	MF	10^6 Cells/L	0.031	
		%	9	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.142	0.026
		%	42	5

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, December 17, 1995 - December 19, 1995 (W9517)

Species	Group	Parameter	Nearfield Stations 1N10	Nearfield Stations 2N16
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.021	0.041
		%	21	22
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L		0.013
		%		7
CYLINDROTHECA CLOSTERIUM	PD	10^6 Cells/L	0.019	
		%	19	
DISTEPHANUS SPECULUM	O	10^6 Cells/L	0.006	
		%	6	
GYMNODINIUM SP #1 5-20UM W 10-20UM L	DF	10^6 Cells/L	0.006	0.011
		%	5	6
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.011	
		%	11	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.011	0.063
		%	10	33

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

APPENDIX F-2

ABUNDANCE OF PREVALENT SPECIES IN CHLOROPHYLL *a* MAXIMUM SAMPLE

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample Whole Water Phytoplankton, August 8, 1995 - August 10, 1995 (W9510)

Species	Group	Parameter	Nearfield Stations 1N10	Nearfield Stations 1N16
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.407	0.154
		%	7	7
UNID. BLUE GREEN SINGLE SPHERE	O	10^6 Cells/L		0.117
		%		5
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	1.045	
		%	17	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	3.760	1.819
		%	61	80

Group Definitions:

- CD Centric Diatom
- DF Dinoflagellate
- MF Microflagellate
- O Other
- PD Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll a Maxiumum Sample Whole Water Phytoplankton, August 21, 1995 - August 26, 1995 (W9511)

			Harbor Stations			Coastal Stations			Nearfield Stations			Offshore	Boundary	Cape Cod Bay Station	
Species	Group	Parameter	1F23	1F30	1F31	1F13	1F24	1F25	1N10	1N16	3N16	1F06	1F27	1F01	1F02
CHAETOCEROS SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L	0.488	0.716	1.082			1.357	0.686						
		%	7	6	12			15	7						
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L		0.610	0.640				0.579		0.177				
		%		5	7				6		7				
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L													
		%													
GYMNODINIUM SP#1 5-20UM W 10-20UM L	DF	10^6 Cells/L					0.177					0.335	0.195		
		%					5					5	7		
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L		1.008					0.671						0.405
		%		9					7						18
SKELETONEMA COSTATUM	CD	10^6 Cells/L	1.585	1.167	0.579	0.256	0.470		2.256						
		%	24	10	6	10	14		23						
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.656	0.822	1.281	0.213	0.250	0.595	0.838			0.701			
		%	10	7	14	8	7	6	9			11			
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	2.866	5.276	3.644	1.317	1.762	4.025	3.156	3.965	2.177	4.223	2.336	2.195	1.513
		%	43	46	41	51	51	44	32	87	80	64	80	81	66

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll a Maximum Sample Whole Water Phytoplankton, September 6, 1995 - September 8, 1995 and September 11, 1995 - September 14, 1995 (W9512)

Species	Group	Parameter	Nearfield Stations	
			1N10	2N16
LEPTOCYLINDRUS DANICUS	CD	10^6 Cells/L	0.869	
		%	13	
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L	4.025	1.162
		%	59	48
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	1.250	0.889
		%	18	36

Group Definitions:		
	CD	Centric Diatom
	DF	Dinoflagellate
	MF	Microflagellate
	O	Other
	PD	Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample Whole Water Phytoplankton, September 25, 1995 - September 29, 1995 (W9513)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L		0.890
		%		30
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.213
		%		7
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L		1.427
		%		48
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.390	
		%	15	
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L	0.183	
		%	7	
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.140	
		%	5	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	1.250	
		%	47	

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll a Maximum Sample Whole Water Phytoplankton, October 9 - October 13, 1995 (W9514)

Species	Group	Parameter	Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
			1F23	1F30	1F31	1F13	1F24	1F25	1N10	1N16	3N18	1F06	1F27	1F01	1F02
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.055		0.116		0.066	0.842			0.957	0.106	0.224		
		%	8		5		6	35			32	9	8		
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L		0.159	0.255	0.335								0.482	
		%		9	11	11								14	
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L	0.098	0.179			0.105	0.170					0.224		
		%	14	10			10	7					8		
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L								0.213				0.244	0.232
		%								6				7	9
KATODINIUM ROTUNDATUM	DF	10^6 Cells/L									0.221	0.163			
		%									7	14			
LEPTOCYLINDRUS DANICUS	CD	10^6 Cells/L	0.080				0.076								
		%	11				7								
PYRAMIMONAS SP.	MF	10^6 Cells/L													
		%													
RHIZOSOLENIA DELICATULA	CD	10^6 Cells/L										0.103			
		%										9			
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L							0.139			0.160			
		%							9			13			
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.098			0.187		0.113				0.191	0.195	
		%		5			18		8				7	6	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.307	0.955353	1.4358	1.707	0.408406	0.847573	1.00638	3.0429	1.49757	0.451	1.79172	2.043	1.359
		%	44	53.35121	62.34954	55	39.8167	35.36686	67.277674	78.65868	49.375921	38	67.36502125	58	55

Group Definitions:

- CD Centric Diatom
- DF Dinoflagellate
- MF Microflagellate
- O Other
- PD Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample Whole Water Phytoplankton, November 1 - November 4, 1995 (W9515)

Species	Group	Parameter	Nearfield Stations 1N10	Nearfield Stations 1N16
ASTERIONELLA GLACIALIS	PD	10^6 Cells/L	0.616	1.067
		%	63	46
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L		0.128
		%		6
THALASSIONEMA NITZSCHIOIDES	PD	10^6 Cells/L		0.208
		%		9
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.055	0.229
		%	6	10
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.053	0.155
		%	5	7

Group Definitions:

- CD Centric Diatom
- DF Dinoflagellate
- MF Microflagellate
- O Other
- PD Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample Whole Water Phytoplankton, November 27, 1995 - December 5, 1995 (W9516)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
ASTERIONELLA GLACIALIS	PD	10^6 Cells/L		0.036
		%		8
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.033	0.038
		%	10	9
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.042	
		%	13	
THALASSIONEMA NITZSCHIOIDES	PD	10^6 Cells/L		0.033
		%		8
THALASSIOSIRA SP#1 DIAM <20 MICRONS	CD	10^6 Cells/L	0.029	0.162
		%	9	37
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.022	
		%	7	
UNID. CHOANOFLAGELLATE	MF	10^6 Cells/L	0.023	
		%	7	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.073	0.027
		%	23	6

Group Definitions:

CD Centric Diatom
DF Dinoflagellate
MF Microflagellate
O Other
PD Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample Whole Water Phytoplankton, December 17, 1995 - December 19, 1995 (W9517)

Species	Group	Parameter	Nearfield Stations 1N10	Nearfield Stations 2N16
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.064	0.085
		%	40	39
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L	0.008	0.012
		%	5	6
CYLINDROTHECA CLOSTERIUM	PD	10^6 Cells/L	0.011	
		%	7	
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L		0.014
		%		6
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.019	0.046
		%	12	21

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

APPENDIX G-1

ABUNDANCE OF ALL IDENTIFIED TAXA IN SCREENED SAMPLES NEAR THE SURFACE

Table 3-2a. Abundance of all identified taxa in screened samples near the surface August 8 - 10, 1995 (W9510)

Species	Group	Nearfield Stations	
		1N10A	1N16A
CERATIUM FUSUS	DF	0.001	0.005
CERATIUM LONGIPES	DF	0.009	0.003
CERATIUM SP.	DF	0.002	
CERATIUM TRIPOS	DF	0.004	0.005
DINOPHYSIS ACUMINATA	DF		
DINOPHYSIS NORVEGICA	DF		0.001
DINOPHYSIS PUNCTATA	DF	0.001	
DIPLOPSALIS SP.	DF		0.001
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF	0.001	
KATODINIUM ROTUNDATUM	DF		
PROTOPERIDINIUM DEPRESSUM	DF		0.001
SCRIPPSIELLA TROCHOIDEA	DF	0.001	
PYRAMIMONAS SP.	MF		
UNID. SILICOFLAGELLATE	MF		
UNID. BLUE GREEN TRICHOME	O	0.044	
UNID. BLUE GREEN TRICHOME (CELL)	O		0.256

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface August 21 - 26, 1995 (W9511)

Species	Group	Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
		1F23A	1F30A	1F31A	1F13A	1F24A	1F25A	1N10A	1N16A	3N16A	1F06A	1F27A	1F01A	1F02A
CERATIUM FUSUS	DF	0.001	0.003	0.001	0.002	0.019	0.001	0.012	0.028	0.023		0.013		
CERATIUM LONGIPES	DF	0.008	0.012	0.004	0.007	0.022	0.003	0.024	0.004	0.035	0.011	0.028		
CERATIUM MACROCEROS	DF													
CERATIUM SP.	DF	0.001												
CERATIUM TRIPOS	DF	0.005	0.003	0.002	0.003	0.005	0.001	0.016	0.009	0.029	0.008	0.038	0.007	0.004
DINOPHYSIS ACUMINATA	DF					0.001					0.001	0.001		
DINOPHYSIS NORVEGICA	DF													0.003
DINOPHYSIS OVUM	DF		0.002											
DINOPHYSIS PUNCTATA	DF													
DIPLOPSALIS LENTICULA	DF		0.009											
DIPLOPSALIS SP.	DF	0.001	0.028	0.018				0.005		0.001				0.001
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.190	0.077		0.035		0.214	0.103		0.233	0.100		
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF	0.004	0.011	0.268	0.001		0.149	0.001			0.003		0.002	
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF		0.005	0.001										
HETEROCAPSA TRIQUETRA	DF		0.006											
KATODINIUM ROTUNDATUM	DF											0.033		
PROROCENTRUM BALTICUM	DF		0.066											
PROROCENTRUM MAXIMUM	DF													0.003
PROROCENTRUM MICANS	DF													
PROROCENTRUM MINIMUM	DF		0.002	0.077			0.001		0.052	0.001				
PROROCENTRUM TRIESTINUM	DF													
PROTOPERIDINIUM DEPRESSUM	DF	0.001			0.001					0.001				
PROTOPERIDINIUM DIVERGENS	DF													0.002
PROTOPERIDINIUM GRANII	DF													
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF	0.073	0.379	0.001			0.149	0.393						0.001
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.020	0.095	0.023				0.004		0.001			0.002	0.001
PROTOPERIDINIUM SP.#3 76-150W 81-150L	DF													
SCRIPPSIELLA TROCHOIDEA	DF	0.007	0.190	0.011				0.178			0.013		0.002	
UNID. DINOFLAGELLATE	DF		0.003											
UNID. DINOFLAGELLATE CYST	DF													
EUGLENA SP.	MF													
EUTREPTIA LANOWII	MF			0.077										
PYRAMIMONAS SP.	MF									0.070				
UNID. CHOANOFLAGELLATE	MF								0.052	0.106		0.017		
UNID. SILICOFLAGELLATE	MF													
ACANTHOICA SP.	O													
DICTYOCHA FIBULA	O													
DISTEPHANUS SPECULUM	O													
EBRIA TRIPARTITA	O													
RHABDOSPHAERA HISPIDA	O					0.104		0.001						
UNID. BLUE GREEN TRICHOME	O		0.003											
UNID. BLUE GREEN TRICHOME (CELL)	O			0.383										

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all screened taxa near the surface September 6 - 8, 1995 and September 11 - 14, 1995 (W9512)

Species	Group	Nearfield Stations	
		1N10A	2N16A
CERATIUM FUSUS	DF	0.013	0.020
CERATIUM LONGIPES	DF	0.017	0.004
CERATIUM MACROCEROS	DF		
CERATIUM TRIPOS	DF	0.019	0.060
DINOPHYSIS NORVEGICA	DF		
DIPLOPSALIS SP.	DF	0.036	0.018
GONYAULAX POLYGRAMMA	DF		0.002
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	0.117	0.103
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF		
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF		
PROROCENTRUM MICANS	DF		
PROTOPERIDINIUM DEPRESSUM	DF		0.002
PROTOPERIDINIUM GRANII	DF		0.002
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.002
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.027	
SCRIPPSIELLA TROCHOIDEA	DF	0.004	0.034
EUTREPTIA SP.	MF		
DICTYOCHA FIBULA	O		
EBRIA TRIPARTITA	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface September 25 - 29, 1995 (W9513)

Species	Group	Nearfield Stations 1N10A	1N16A
CERATIUM FUSUS	DF	0.049	0.274
CERATIUM LINEATUM	DF		0.007
CERATIUM LONGIPES	DF	0.023	0.064
CERATIUM MACROCEROS	DF		0.104
CERATIUM TRIPOS	DF	0.061	0.333
DINOPHYSIS ACUMINATA	DF		0.009
DINOPHYSIS NORVEGICA	DF		0.002
DINOPHYSIS SP.	DF		0.002
DIPLOPSALIS SP.	DF	0.003	0.002
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.287
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF		0.002
HETEROCAPSA TRIQUETRA	DF		
PROROCENTRUM BALTICUM	DF		
PROROCENTRUM MAXIMUM	DF		0.014
PROROCENTRUM MICANS	DF		
PROROCENTRUM MINIMUM	DF		0.014
PROTOPERIDINIUM DEPRESSUM	DF		0.005
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.005
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.005	0.005
SCRIPPSIELLA TROCHOIDEA	DF		
UNID. SILICOFLAGELLATE	MF		
EBRIA TRIPARTITA	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface October 9 - 13, 1995 (W9514)

Species	Group	Harbor Stations			Coastal Stations			Nearfield Stations				Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
		1F23A	1F30A	1F31A	1F13A	1F24A	1F25A	1N10A	1N16A	2N16A	3N16A	1F06A	1F27A	1F01A	1F02A
AMPHIDINIUM SPHENOIDES	DF														
CERATIUM FUSUS	DF	0.020	0.063	0.042	0.470	0.042	0.173	0.132	0.127		0.066	0.221	0.084	0.563	0.322
CERATIUM LINEATUM	DF	0.001	0.002	0.003	0.010	0.007	0.011	0.001	0.011		0.005	0.009	0.004	0.010	
CERATIUM LONGIPES	DF	0.009	0.003	0.001	0.050	0.049	0.007	0.048	0.052		0.013	0.011	0.038	0.012	0.107
CERATIUM MACROCEROS	DF														
CERATIUM SP.	DF	0.006										0.009			
CERATIUM TRIPOS	DF	0.025	0.049	0.115	0.651	0.131	0.263	0.217	0.716		0.428	0.600	0.383	0.517	0.392
DINOPHYSIS ACUMINATA	DF	0.001	0.001	0.004	0.011		0.003	0.003	0.005		0.001	0.010		0.005	
DINOPHYSIS CAUDATA	DF														
DINOPHYSIS NORVEGICA	DF	0.001	0.001	0.011	0.011	0.016	0.017	0.003	0.011		0.008	0.008	0.010		
DINOPHYSIS OVUM	DF														
DINOPHYSIS PUNCTATA	DF										0.003				
DINOPHYSIS SP.	DF					0.005	0.001								
DIPLOPSALIS SP.	DF		0.008		0.006	0.012	0.007		0.002		0.001		0.001		
GONYAULAX DIGITALIS	DF														
GONYAULAX POLYGRAMMA	DF			0.001			0.294				0.003				
GONYAULAX SP.	DF				0.005										
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	0.001	0.079	0.001	0.389	0.284		0.181			0.112		0.152	0.121	0.583
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF														
HETEROCAPSA TRIQUETRA	DF														
KATODINIUM ROTUNDATUM	DF	0.425	0.592	0.277	2.235	0.426		0.362				0.536	0.114	0.162	0.097
OXYTOXUM SP.	DF												0.038		
PROROCENTRUM BALTICUM	DF				0.002			0.121							0.097
PROROCENTRUM COMPRESSUM	DF			0.001	0.003		0.001				0.004	0.015	0.014	0.009	
PROROCENTRUM MAXIMUM	DF			0.009	0.069		0.024		0.016		0.012	0.015	0.009	0.547	0.194
PROROCENTRUM MICANS	DF	0.004	0.010	0.007	0.008	0.002	0.010	0.060				0.026	0.004	0.162	0.389
PROROCENTRUM MINIMUM	DF	0.003										0.003			
PROROCENTRUM TRIESTINUM	DF		0.005		0.011		0.001	0.001			0.001	0.016		0.003	
PROTOPERIDINIUM DEPRESSUM	DF	0.001	0.001	0.001	0.002		0.003	0.001	0.005		0.001		0.003	0.002	
PROTOPERIDINIUM DIABOLUM	DF														
PROTOPERIDINIUM PELLUCIDUM	DF														
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF			0.001							0.056			0.003	
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.001	0.003			0.002								0.001	
PROTOPERIDINIUM SP.#3 76-150W 81-150L	DF		0.001												
SCRIPPSIELLA TROCHOIDEA	DF		0.079	0.092	0.097	0.142							0.001		0.902
UNID. DINOFLAGELLATE CYST	DF						0.001								
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF														
PYRAMIMONAS SP.	MF										0.056				
UNID. CHOANOFLAGELLATE	MF														
UNID. MICRO-PHYTOFLAG LENGTH >10 MICRONS	MF														
CALCIOSOLENIA SP.	O				0.292						0.056	0.306		1.336	
CALYCOMONAS WULFII	O														
DICTYOCHA FIBULA	O			0.370	1.069		0.784	0.845	1.247		1.065	1.684	0.379	0.023	
DISTEPHANUS SPECULUM	O	0.128	0.079	0.185		0.284	0.098		0.002			0.077	0.076		
EBRIA TRIPARTITA	O														
EMILIANIA HUXLEYI	O						0.098								
OSCILLATORIA SP. (TRICHOME)	O														
PEDIASTRUM DUPLEX	O														
PEDIASTRUM DUPLEX V. CLATHRATUM	O		0.042												
PSEUDOPEDINELLA PYRIFORME	O		0.039												
RHABDOSPHAERA HISPIDA	O														
SCENEDESMUS QUADRICAUDA	O														
SCENEDESMUS SP.	O	0.006	0.158												
UNID. BLUE GREEN SINGLE SPHERE	O							1.448				3.903		9.051	10.302
UNID. BLUE GREEN TRICHOME	O		0.039												

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface November 1 - 4, 1995 (W9515)

Species	Group	Nearfield Stations 1N10A	1N16A
CERATIUM FUSUS	DF	0.005	0.080
CERATIUM LONGIPES	DF	0.005	0.035
CERATIUM TRIPOS	DF	0.047	0.270
DINOPHYSIS ACUMINATA	DF	0.002	0.002
DINOPHYSIS NORVEGICA	DF	0.002	0.002
DIPLOPSALIS SP.	DF		0.006
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		
PROROCENTRUM COMPRESSUM	DF		0.113
PROROCENTRUM MAXIMUM	DF	0.004	0.113
PROROCENTRUM MICANS	DF		0.113
PROROCENTRUM TRIESTINUM	DF		
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.004
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.002	0.004
DICTYOCHA FIBULA	O	0.126	3.955
DISTEPHANUS SPECULUM	O	0.126	2.034
EMILIANIA HUXLEYI	O	0.126	
SCENEDESMUS QUADRICAUDA	O	0.007	

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface November 27 - December 5, 1995 (W9516)

Species	Group	Nearfield Stations 1N10A	Nearfield Stations 1N16A
CERATIUM FUSUS	DF	0.042	0.081
CERATIUM LINEATUM	DF	0.003	0.001
CERATIUM LONGIPES	DF	0.009	0.006
CERATIUM TRIPOS	DF	0.249	0.178
DINOPHYSIS ACUMINATA	DF	0.002	0.004
DINOPHYSIS NORVEGICA	DF	0.033	0.003
DINOPHYSIS SP.	DF		
PROROCENTRUM COMPRESSUM	DF	0.002	0.005
PROROCENTRUM MAXIMUM	DF	0.003	0.009
PROROCENTRUM TRIESTINUM	DF		0.001
PROTOPERIDINIUM DEPRESSUM	DF	0.002	0.006
PROTOPERIDINIUM PALLIDUM	DF		
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF	0.002	
UNID. DINOFLAGELLATE CYST	DF		
UNID. CHOANOFLAGELLATE	MF	0.084	
DICTYOCHA FIBULA	O	0.293	3.110
DISTEPHANUS SPECULUM	O	0.481	1.788

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface December 17 - 19, 1995 (W9517)

Species	Group	Nearfield Stations 1N10A	Nearfield Stations 2N16A
CERATIUM FUSUS	DF	0.006	0.025
CERATIUM LINEATUM	DF		0.012
CERATIUM LONGIPES	DF	0.001	0.005
CERATIUM SP.	DF	0.002	0.002
CERATIUM TRIPOS	DF	0.038	0.083
DINOPHYSIS ACUMINATA	DF		0.007
DINOPHYSIS CAUDATA	DF		0.001
DINOPHYSIS NORVEGICA	DF		0.004
PROROCENTRUM COMPRESSUM	DF	0.001	0.001
PROROCENTRUM MAXIMUM	DF		0.001
PROROCENTRUM MICANS	DF		0.015
PROROCENTRUM TRIESTINUM	DF	0.002	0.003
PROTOPERIDINIUM DEPRESSUM	DF	0.002	0.004
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.001
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		0.002
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF		
DICTYOCHA FIBULA	O		0.046
DISTEPHANUS SPECULUM	O	0.032	0.334
EBRIA TRIPARTITA	O		0.015
UNID. COCCOLITHOPHORE	O	0.032	

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

APPENDIX G-2

ABUNDANCE OF ALL IDENTIFIED TAXA IN SCREENED SAMPLES NEAR THE CHLOROPHYLL MAXIMUM

Table 3-2b. Abundance of all identified taxa in screened samples near the Chlorophyll maximum August 8 - 10, 1995 (W9510)

Species	Group	Nearfiled Stations 1N10C	Nearfiled Stations 1N16C
CERATIUM FUSUS	DF	0.003	0.010
CERATIUM LONGIPES	DF	0.034	0.155
CERATIUM SP.	DF		
CERATIUM TRIPOS	DF	0.010	0.016
DINOPHYSIS ACUMINATA	DF		0.001
DINOPHYSIS NORVEGICA	DF		0.001
DINOPHYSIS PUNCTATA	DF	0.001	
DIPLOPSALIS SP.	DF		
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.019
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF		
KATODINIUM ROTUNDATUM	DF		0.038
PROTOPERIDINIUM DEPRESSUM	DF		0.001
SCRIPPSIELLA TROCHOIDEA	DF		
PYRAMIMONAS SP.	MF	0.028	
UNID. SILICOFLAGELLATE	MF		0.395
UNID. BLUE GREEN TRICHOME	O	0.001	
UNID. BLUE GREEN TRICHOME (CELL)	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near the Chlorophyll maximum August 21 - 26, 1995 (W9511)

Species	Group	Harbor Stations			Coastal Stations			Nearfield Stations				Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
		1F23C	1F30C	1F31C	1F13C	1F24C	1F25C	1N10C	1N16C	2N16C	3N16C	1F06C	1F27C	1F01C	1F02C
CERATIUM FUSUS	DF	0.002	0.002	0.001	0.006	0.012	0.005	0.007	0.011		0.017	0.001	0.002	0.003	0.003
CERATIUM LONGIPES	DF	0.006	0.014	0.012	0.007	0.024	0.055	0.006	0.185		0.129	0.034	0.314	0.021	0.021
CERATIUM MACROCEROS	DF								0.017						
CERATIUM SP.	DF				0.002	0.003									
CERATIUM TRIPOS	DF	0.009		0.002	0.008	0.044	0.014	0.017	0.018		0.031	0.010	0.126	0.007	0.003
DINOPHYSIS ACUMINATA	DF						0.008		0.001		0.007		0.001		
DINOPHYSIS NORVEGICA	DF							0.001			0.004				
DINOPHYSIS OVUM	DF														
DINOPHYSIS PUNCTATA	DF											0.001	0.001		
DIPLOPSALIS LENTICULA	DF														
DIPLOPSALIS SP.	DF		0.025	0.009			0.006	0.034			0.001		0.001		
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.474						0.334			0.041	0.180	0.087	
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF			0.131										0.044	
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF													0.001	
HETEROCAPSA TRIQUETRA	DF														
KATODINIUM ROTUNDATUM	DF														
PROROCENTRUM BALTICUM	DF														
PROROCENTRUM MAXIMUM	DF										0.001				
PROROCENTRUM MICANS	DF		0.002											0.001	
PROROCENTRUM MINIMUM	DF		0.190	0.098					0.001						
PROROCENTRUM TRIESTINUM	DF		0.095												
PROTOPERIDINIUM DEPRESSUM	DF	0.001		0.002	0.001		0.001	0.001			0.003	0.013	0.001		
PROTOPERIDINIUM DIVERGENS	DF														
PROTOPERIDINIUM GRANII	DF							0.034							
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF	0.001	1.137			0.001		0.662			0.045			0.001	
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		0.009	0.024			0.015				0.004	0.007			
PROTOPERIDINIUM SP.#3 76-150W 81-150L	DF										0.001				
SCRIPPSIELLA TROCHOIDEA	DF		0.095	0.163		0.001	0.070	0.001			0.001	0.007			0.001
UNID. DINOFLAGELLATE	DF														0.001
UNID. DINOFLAGELLATE CYST	DF					0.002		0.001							
EUGLENA SP.	MF			0.098											
EUTREPTIA LANOWII	MF						0.070								
PYRAMIMONAS SP.	MF														
UNID. CHOANOFLAGELLATE	MF								0.030				0.045		
UNID. SILICOFLAGELLATE	MF										0.045				
ACANTHOICA SP.	O												0.022		
DICTYOCHA FIBULA	O							0.034							
DISTEPHANUS SPECULUM	O					0.001							0.045		
EBRIA TRIPARTITA	O			0.001			0.001							0.001	
RHABDOSPHAERA HISPIDA	O					0.001									
UNID. BLUE GREEN TRICHOME	O				0.001	0.001									
UNID. BLUE GREEN TRICHOME (CELL)	O														

Group Definitions:

DF Dinoflagellate
MF Microflagellate
O Other

Table 3-2b. Abundance of all identified taxa in screened samples near the Chlorophyll maximum September 6 - 8, 1995 and September 11 - 14, 1995 (W9512)

Species	Group	Nearfiled Stations	
		1N10C	2N16C
CERATIUM FUSUS	DF	0.013	0.011
CERATIUM LONGIPES	DF	0.014	0.047
CERATIUM MACROCEROS	DF	0.009	0.002
CERATIUM TRIPOS	DF	0.009	0.018
DINOPHYSIS NORVEGICA	DF	0.002	
DIPLOPSALIS SP.	DF	0.007	0.002
GONYAULAX POLYGRAMMA	DF		
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.136
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF		0.011
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF		0.002
PROROCENTRUM MICANS	DF	0.002	
PROTOPERIDINIUM DEPRESSUM	DF	0.002	0.004
PROTOPERIDINIUM GRANII	DF		
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.002
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.011	0.022
SCRIPPSIELLA TROCHOIDEA	DF	0.002	0.007
EUTREPTIA SP.	MF		0.136
DICTYOCHA FIBULA	O		0.007
EBRIA TRIPARTITA	O		0.002

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near Chlorophyll maximum September 25 - 29, 1995 (W9513)

Species	Group	Nearfiled Stations 1N10C	1N16 B
CERATIUM FUSUS	DF	0.050	0.209
CERATIUM LINEATUM	DF		0.007
CERATIUM LONGIPES	DF	0.009	0.109
CERATIUM MACROCEROS	DF		0.075
CERATIUM TRIPOS	DF	0.074	0.273
DINOPHYSIS ACUMINATA	DF		0.002
DINOPHYSIS NORVEGICA	DF		0.002
DINOPHYSIS SP.	DF		
DIPLOPSALIS SP.	DF	0.006	
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF		
HETEROCAPSA TRIQUETRA	DF	0.004	
PROROCENTRUM BALTICUM	DF	0.002	0.011
PROROCENTRUM MAXIMUM	DF	0.226	
PROROCENTRUM MICANS	DF		0.004
PROROCENTRUM MINIMUM	DF	0.006	0.016
PROTOPERIDINIUM DEPRESSUM	DF		0.002
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		0.002
SCRIPPSIELLA TROCHOIDEA	DF		0.002
UNID. SILICOFLAGELLATE	MF		0.539
EBRIA TRIPARTITA	O	0.002	

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near Chlorophyll maximum October 9 - 13, 1995 (W9514)

Species	Group	Harbor Stations	Coastal Stations		Nearfield Stations	Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
		1F23C	1F13B	1F24B	1N18B	1F06C	1F27B	1F01C	1F02B
AMPHIDINIUM SPHENOIDES	DF								0.097
CERATIUM FUSUS	DF	0.027	0.358	0.054	0.038	0.230	0.015	0.558	0.531
CERATIUM LINEATUM	DF		0.113	0.008		0.008		0.008	0.003
CERATIUM LONGIPES	DF	0.002	0.080	0.008	0.048	0.062	0.002	0.009	0.069
CERATIUM MACROCEROS	DF		0.021						
CERATIUM SP.	DF					0.054			0.019
CERATIUM TRIPOS	DF	0.090	0.453	0.186	0.372	0.565	0.061	0.606	0.586
DINOPHYSIS ACUMINATA	DF			0.002	0.004	0.004		0.006	0.097
DINOPHYSIS CAUDATA	DF		0.001						
DINOPHYSIS NORVEGICA	DF		0.007	0.019	0.008	0.006	0.001	0.002	
DINOPHYSIS OVUM	DF		0.024						
DINOPHYSIS PUNCTATA	DF								
DINOPHYSIS SP.	DF				0.004				
DIPLOPSALIS SP.	DF		0.002			0.001			0.003
GONYAULAX DIGITALIS	DF							0.001	
GONYAULAX POLYGRAMMA	DF							0.003	
GONYAULAX SP.	DF								
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.565		1.021	0.467	0.034	0.078	0.389
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF		0.001						
HETEROCAPSA TRIQUETRA	DF		0.038						
KATODINIUM ROTUNDATUM	DF		1.017	0.630	2.211	0.176		0.076	0.389
OXYTOXUM SP.	DF			0.265	0.085				
PROROCENTRUM BALTICUM	DF								
PROROCENTRUM COMPRESSUM	DF			0.012	0.002	0.009	0.001	0.029	0.010
PROROCENTRUM MAXIMUM	DF	0.002	0.058	0.017		0.233	0.006	0.245	0.194
PROROCENTRUM MICANS	DF		0.006	0.010	0.006	0.058		0.013	0.027
PROROCENTRUM MINIMUM	DF								
PROROCENTRUM TRIESTINUM	DF		0.010						0.013
PROTOPERIDINIUM DEPRESSUM	DF	0.002	0.003	0.006		0.003	0.001	0.001	
PROTOPERIDINIUM DIABOLUM	DF							0.001	
PROTOPERIDINIUM PELLUCIDUM	DF						0.001		
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.038			0.001	0.001	0.001	0.006
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		0.002			0.001			0.003
PROTOPERIDINIUM SP.#3 76-150W 81-150L	DF								
SCRIPPSIELLA TROCHOIDEA	DF		0.076		0.085			0.076	0.002
UNID. DINOFLAGELLATE CYST	DF	0.003					0.001		
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF								
PYRAMIMONAS SP.	MF								
UNID. CHOANOFLAGELLATE	MF						0.034		
UNID. MICRO-PHYTOFLAG LENGTH >10 MICRONS	MF						0.034		
CALCIOSOLENIA SP.	O					0.408		1.366	1.361
CALYCOMONAS WULFII	O				0.255	0.117			
DICTYOCHA FIBULA	O	0.323		0.265	1.106	0.700	0.006	0.152	0.389
DISTEPHANUS SPECULUM	O	0.108	0.753	0.008		0.058	0.001	0.001	
EBRIA TRIPARTITA	O								
EMILIANIA HUXLEYI	O			0.002					
OSCILLATORIA SP. (TRICHOME)	O								
PEDIASTRUM DUPLEX	O								
PEDIASTRUM DUPLEX V. CLATHRATUM	O								
PSEUDOPEDINELLA PYRIFORME	O								
RHABDOSPHAERA HISPIDA	O						0.001		
SCENEDESMUS QUADRICAUDA	O			0.008					
SCENEDESMUS SP.	O								
UNID. BLUE GREEN SINGLE SPHERE	O		1.243		6.273	3.441			7.873
UNID. BLUE GREEN TRICHOME	O								

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near Chlorophyll maximum November 1 - 4, 1995 (W9515)

Species	Group	Nearfield Stations	
		1N10C	1N16C
CERATIUM FUSUS	DF	0.005	0.004
CERATIUM LONGIPES	DF	0.002	0.004
CERATIUM TRIPOS	DF	0.027	0.111
DINOPHYSIS ACUMINATA	DF		
DINOPHYSIS NORVEGICA	DF		
DIPLOPSALIS SP.	DF		
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	0.092	
PROROCENTRUM COMPRESSUM	DF		0.001
PROROCENTRUM MAXIMUM	DF	0.008	0.010
PROROCENTRUM MICANS	DF		
PROROCENTRUM TRIESTINUM	DF	0.002	
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		
DICTYOCHA FIBULA	O	0.092	0.099
DISTEPHANUS SPECULUM	O	0.165	0.013
EMILIANIA HUXLEYI	O		
SCENEDESMUS QUADRICAUDA	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near the Chlorophyll Maximum November 27 - December 5, 1995 (W9516)

Species	Group	Nearfield Stations	
		1N10C	1N16C
CERATIUM FUSUS	DF	0.031	0.071
CERATIUM LINEATUM	DF	0.003	0.006
CERATIUM LONGIPES	DF	0.017	0.010
CERATIUM TRIPOS	DF	0.273	0.325
DINOPHYSIS ACUMINATA	DF	0.001	0.004
DINOPHYSIS NORVEGICA	DF	0.004	0.006
DINOPHYSIS SP.	DF	0.001	
PROROCENTRUM COMPRESSUM	DF	0.001	0.012
PROROCENTRUM MAXIMUM	DF	0.007	0.022
PROROCENTRUM TRIESTINUM	DF		0.004
PROTOPERIDINIUM DEPRESSUM	DF		0.001
PROTOPERIDINIUM PALLIDUM	DF	0.001	
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		
UNID. DINOFLAGELLATE CYST	DF	0.003	
UNID. CHOANOFLAGELLATE	MF		
DICTYOCHA FIBULA	O	0.702	1.524
DISTEPHANUS SPECULUM	O	1.794	1.524

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near the Chlorophyll maximum December 17 - 19, 1995 (W9517)

Species	Group	Nearfield Stations 1N10C	Nearfield Stations 2N16C
CERATIUM FUSUS	DF	0.007	0.016
CERATIUM LINEATUM	DF		0.003
CERATIUM LONGIPES	DF	0.001	0.001
CERATIUM SP.	DF	0.001	
CERATIUM TRIPOS	DF	0.042	0.056
DINOPHYSIS ACUMINATA	DF	0.002	0.004
DINOPHYSIS CAUDATA	DF	0.001	
DINOPHYSIS NORVEGICA	DF	0.008	0.002
PROROCENTRUM COMPRESSUM	DF		
PROROCENTRUM MAXIMUM	DF	0.003	0.001
PROROCENTRUM MICANS	DF	0.001	
PROROCENTRUM TRIESTINUM	DF		
PROTOPERIDINIUM DEPRESSUM	DF	0.001	0.001
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		0.001
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF		0.022
DICTYOCHA FIBULA	O	0.173	
DISTEPHANUS SPECULUM	O	0.069	0.197
EBRIA TRIPARTITA	O		
UNID. COCCOLITHOPHORE	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

APPENDIX H

ZOOPLANKTON SPECIES DATA

TABLE A3
Zooplankton Species Data (ind/m^3)
W9510 - W9517

Event	Species		Life Stage	Group	Station Cast														
					1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9510	ACARTIA TONSA		C	C											686				
W9510	ACARTIA TONSA		F	C											171				
W9510	BIVALVIA SPP.		L	O											1714	1585			
W9510	CENTROPAGES TYPICUS		C	C											343	528			
W9510	CENTROPAGES TYPICUS		M	C											343	132			
W9510	COPEPOD SPP.		-	C											171				
W9510	COPEPOD SPP.		C	C											171	132			
W9510	COPEPOD SPP.		N	C											22457	20739			
W9510	CRUSTACEA:UNIDED CRUSTACEAN		-	O												132			
W9510	EURYTEMORA HERDMANI		C	C											1371				
W9510	EURYTEMORA HERDMANI		F	C											514				
W9510	EURYTEMORA HERDMANI		M	C											171				
W9510	METRIDIA LUCENS		C	C												132			
W9510	METRIDIA LUCENS		F	C											171				
W9510	MICROSETELLA NORVEGICA		-	C											171	264			
W9510	OITHONA SIMILIS	CLAUS	C	C											16800	12153			
W9510	OITHONA SIMILIS	CLAUS	F	C											4629	2246			
W9510	OITHONA SIMILIS	CLAUS	M	C											514	528			
W9510	PODON SPP.		-	O											343				
W9510	POLYCHAETE SPP.		-	O											343				
W9510	POLYCHAETE SPP.		T	O											171				
W9510	PSEUDOCALANUS NEWMANI		C	C											5486	2774			
W9510	PSEUDOCALANUS NEWMANI		F	C											1200	2246			
W9510	PSEUDOCALANUS NEWMANI		M	C											171	396			
W9510	TEMORA LONGICORNIS		C	C											1886	396			
W9510	TEMORA LONGICORNIS		F	C											514	132			
W9510	TEMORA LONGICORNIS		M	C											1029	396			
W9510	UNIDENTIFIED LARVAE		L	O												132			
W9511	ACARTIA HUDSONICA		C	C				62	4819		449		4800	1621	2651				
W9511	ACARTIA HUDSONICA		F	C					912				300		442				
W9511	ACARTIA HUDSONICA		M	C				62	521		128		1500	232	442				
W9511	ACARTIA TONSA		C	C	359	176	1176	744	3256	1943	1155	242	22500	10189	4713				
W9511	ACARTIA TONSA		F	C	135	59		62	1563	648	128		900	1853	442				
W9511	ACARTIA TONSA		M	C	359	351		124	521		64		1800	1621	442	116			
W9511	BIVALVIA SPP.		L	O	90	234	1176	62	1953	24615	3081	181	2100	6252	3829	463			2435
W9511	BRYOZOA SPP.		-	O			471				64			695	442				
W9511	CALANUS FINMARCHICUS		C	C	45	59										116			
W9511	CALANUS FINMARCHICUS		F	C	45														
W9511	CALANUS FINMARCHICUS		M	C		176	235									232			

TABLE A3

Zooplankton Species Data (ind/m^3)

W9510 - W9517

Event	Species	Life Stage	Group	Station Cast 1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9511	CENTROPAGES TYPICUS	C	C	224	1404	471	1178		648		1391			1031	463			913
W9511	CENTROPAGES TYPICUS	F	C			235	434				181				347			913
W9511	CENTROPAGES TYPICUS	M	C		117	235	496				786			295	116			609
W9511	CIRRIPEDE SPP.	N	B				186					300						
W9511	COPEPOD SPP.	-	C	90	59	235		521	1296			300						3044
W9511	COPEPOD SPP.	C	C	45		3294			12955	385	847							4262
W9511	COPEPOD SPP.	N	C	2467	3569	34118	6509	31256		10012	5322	51600	25009	32105	9379			30139
W9511	CRUSTACEA:UNIDED CRUSTACEAN	-	O			235		130	648									
W9511	EURYTEMORA HERDMANI	C	C								60							
W9511	GASTROPODA;MOLLUSCA	L	O		117			521	648		121	600	695	295	116			304
W9511	HARPACTICOIDA SPP.	-	C					130				300						
W9511	METRIDIA LUCENS	C	C												232			913
W9511	MICROSETELLA NORVEGICA	-	C	404	117	235		260	5830	64	726	300			232			609
W9511	OIKOPLEURA DIOICA	-	O	224	936	235												
W9511	OITHONA ATLANTICA	-	C			706												
W9511	OITHONA SIMILIS CLAUS	-	C	179	59	235												
W9511	OITHONA SIMILIS CLAUS	C	C	2511	3861	24471	2913	2474	40161	1797	7015	2700	2084	4565	9842			27703
W9511	OITHONA SIMILIS CLAUS	F	C	404	1404	12471	992	260	6478	642	3870	600	463	1325	2895			17353
W9511	OITHONA SIMILIS CLAUS	M	C		59	2353	186		3239	257	181	300	463	442	695			1827
W9511	PARACALANUS PARVUS	C	C		59		992				1149		463	442				3653
W9511	PARACALANUS PARVUS	F	C				124				242		232					2131
W9511	PARACALANUS PARVUS	M	C		59		248			64	121		232	147				1522
W9511	PODON POLYPHEMOIDES	-	O					130										
W9511	PODON SPP.	-	O				186					1500						
W9511	POLYCHAETE SPP.	L	O		761			781		449		1200	695	295				
W9511	PSEUDOCALANUS NEWMANI	C	C	2825	1229	1412	186	1172	9716	385	605	1200			3011			609
W9511	PSEUDOCALANUS NEWMANI	F	C	897	234	1176		1042	5182	128	60				232			609
W9511	PSEUDOCALANUS NEWMANI	M	C		59			391	1296	64	242		232		116			304
W9511	TEMORA LONGICORNIS	C	C	179	234	3059	62	260	1943	193	181	300	695	295				1218
W9511	TEMORA LONGICORNIS	F	C		59	1176		391			60				232			609
W9511	TEMORA LONGICORNIS	M	C	45		3059		260	1296						116			304
W9511	UNIDENTIFIED LARVAE	L	O	45					4534	64	121	300	695	147				1218
W9512	ACARTIA HUDSONICA	M	C											104				
W9512	ACARTIA TONSA	C	C											5415			2021	
W9512	ACARTIA TONSA	F	C											2812			713	
W9512	ACARTIA TONSA	M	C											3020			832	
W9512	BIVALVIA SPP.	L	O											2708			1189	
W9512	BRYOZOA SPP.	-	O											312			238	
W9512	CENTROPAGES TYPICUS	C	C														951	

TABLE A3

Zooplankton Species Data (ind/m^3)

W9510 - W9517

Event	Species	Life Stage	Group	Station Cast 1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9512	CENTROPAGES TYPICUS	F	C														238	
W9512	CENTROPAGES TYPICUS	M	C														119	
W9512	COPEPOD SPP.	-	C											417				
W9512	COPEPOD SPP.	C	C											417			951	
W9512	COPEPOD SPP.	N	C											6144			15808	
W9512	CRUSTACEA:UNIDED CRUSTACEAN	-	O											312				
W9512	ECHINODERM PLUTEI	-	O														119	
W9512	EURYTEMORA HERDMANI	C	C														119	
W9512	GASTROPODA;MOLLUSCA	L	O											1041				
W9512	HARPACTICOIDA SPP.	-	C											104				
W9512	MEDUSA	-	O											208			119	
W9512	METRIDIA LUCENS	-	C											208				
W9512	MICROSETELLA NORVEGICA	-	C											833			238	
W9512	OIKOPLEURA DIOICA	-	O											3645			7607	
W9512	OITHONA SIMILIS CLAUS	-	C														238	
W9512	OITHONA SIMILIS CLAUS	C	C											3020			2734	
W9512	OITHONA SIMILIS CLAUS	F	C											1250			951	
W9512	OITHONA SIMILIS CLAUS	M	C											312			594	
W9512	PARACALANUS PARVUS	C	C														951	
W9512	PARACALANUS PARVUS	F	C											104			119	
W9512	PARACALANUS PARVUS	M	C														119	
W9512	PODON SPP.	-	O											208				
W9512	POLYCHAETE SPP.	L	O											521				
W9512	POLYCHAETE SPP.	T	O											104				
W9512	PSEUDOCALANUS NEWMANI	C	C											521			119	
W9512	PSEUDOCALANUS NEWMANI	F	C											729				
W9512	TEMORA LONGICORNIS	C	C											208				
W9512	TEMORA LONGICORNIS	F	C											104				
W9512	UNIDENTIFIED LARVAE	L	O											104			357	
W9513	ACARTIA TONSA	C	C												746			
W9513	ACARTIA TONSA	M	C												166			
W9513	BIVALVIA SPP.	-	O												22204			
W9513	BRYOZOA SPP.	-	O												249			
W9513	CALANUS FINMARCHICUS	C	C												83			
W9513	CENTROPAGES TYPICUS	C	C												911			
W9513	COPEPOD SPP.	-	C												83			
W9513	COPEPOD SPP.	C	C												414			
W9513	COPEPOD SPP.	N	C												4060			
W9513	ECHINODERM PLUTEI	-	O												166			

TABLE A3

Zooplankton Species Data (ind/m^3)

W9510 - W9517

Event	Species		Life Stage	Group	Station Cast 1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9513	EURYTEMORA HERDMANI		C	C												249			
W9513	GASTROPODA;MOLLUSCA		L	O												249			
W9513	MICROSETELLA NORVEGICA		-	C												580			
W9513	OIKOPLEURA DIOICA		-	O												2154			
W9513	OITHONA ATLANTICA		-	C												166			
W9513	OITHONA SIMILIS	CLAUS	C	C												4391			
W9513	OITHONA SIMILIS	CLAUS	F	C												663			
W9513	OITHONA SIMILIS	CLAUS	M	C												331			
W9513	PARACALANUS PARVUS		C	C												331			
W9513	PARACALANUS PARVUS		M	C												83			
W9513	PSEUDOCALANUS NEWMANI		C	C												83			
W9513	PSEUDOCALANUS NEWMANI		F	C												83			
W9513	PSEUDOCALANUS NEWMANI		M	C												83			
W9513	TEMORA LONGICORNIS		C	C												166			
W9513	UNIDENTIFIED LARVAE		L	O												663			
W9514	ACARTIA HUDSONICA		C	C					251	186									
W9514	ACARTIA HUDSONICA		F	C					125										
W9514	ACARTIA HUDSONICA		M	C												140			
W9514	ACARTIA TONSA		C	C	492	384	216		2824	931	2962	188	3583		563	701			301
W9514	ACARTIA TONSA		F	C		128	216		816	466	987		156		282	280			
W9514	ACARTIA TONSA		M	C	1476	256	216		627	1025	889	188	260		1056				151
W9514	ALTEUTHA DEPRESSA		-	C									52						
W9514	ASCIDIAN SPP.		L	O									52						
W9514	BIVALVIA SPP.		-	O	36402														
W9514	BIVALVIA SPP.		L	O		11904	4104		1192	8476	14414	2638	2025		3731	1402			3013
W9514	BRYOZOA SPP.		-	O	984		216				197	188	104		70	280			301
W9514	CALANUS FINMARCHICUS		C	C								283				140			151
W9514	CALANUS FINMARCHICUS		M	C								94							
W9514	CENTROPAGES TYPICUS		C	C	6887	1920	5400		1380	2794	1678	4900	156		4224	12200			17477
W9514	CENTROPAGES TYPICUS		F	C	492	640	432		188	186	99	283			634	280			301
W9514	CENTROPAGES TYPICUS		M	C	984	512	864		251	466	494				774	140			603
W9514	COPEPOD SPP.		-	C	492	128	432		251	186	395	471	52		282	140			151
W9514	COPEPOD SPP.		C	C	492	896	864		314	466	494	565	52		493				452
W9514	COPEPOD SPP.		N	C	37878	23424	19872		3388	2701	5134	15735	11527		7744	21454			27120
W9514	CRUSTACEA:UNIDED CRUSTACEAN		-	O		256	648				99					140			
W9514	ECHINODERM PLUTEI		-	O	492					93									
W9514	EURYTEMORA HERDMANI		C	C					188				260						
W9514	EURYTEMORA HERDMANI		F	C								94							
W9514	EURYTEMORA HERDMANI		M	C												140			

TABLE A3

Zooplankton Species Data (ind/m^3)

W9510 - W9517

Event	Species		Life Stage	Group	Station Cast 1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9514	EVADNE SPP.		-	O	5411		216		502	1118	1283	94	675		1126				
W9514	GASTROPODA;MOLLUSCA		L	O		256			627		987	283	727		70	280			
W9514	HARPACTICOIDA SPP.		-	C		128	648		188	186			104						
W9514	MEDUSA		-	O		512	216			93	99		52		70				151
W9514	MICROSETELLA NORVEGICA		-	C	984	512	1080		125	279	494	848			282	140			
W9514	OIKOPLEURA DIOICA		-	O	492	768	864		125	373	99		104		70	140			
W9514	OITHONA ATLANTICA		-	C	492							188	52						
W9514	OITHONA ATLANTICA		C	C												140			
W9514	OITHONA SIMILIS	CLAUS	-	C												280			151
W9514	OITHONA SIMILIS	CLAUS	C	C	11806	5120	9936		753	2049	3060	7632	779		2323	14724			11752
W9514	OITHONA SIMILIS	CLAUS	F	C	3935	1280	4968		565	931	1283	1696	363		1197	3365			2712
W9514	OITHONA SIMILIS	CLAUS	M	C		256	1080		125	93	691	283	104		141	421			151
W9514	PARACALANUS PARVUS		C	C	1476	1408	864				99	377			282	421			603
W9514	PARACALANUS PARVUS		F	C	984	128			63	93	494	1131			70				151
W9514	PARACALANUS PARVUS		M	C	984	128	432			93		94			141	140			301
W9514	PENILIA AVIROSTRIS		-	O	4919						99		52		70				
W9514	PODON SPP.		-	O					63				467						
W9514	POLYCHAETE SPP.		L	O	2952	384	216		627		395		2337						
W9514	PSEUDOCALANUS NEWMANI		C	C		128			63	93		94				701			151
W9514	PSEUDOCALANUS NEWMANI		F	C						93		754			70	140			452
W9514	TEMORA LONGICORNIS		C	C		128	216			186	494	94	260						
W9514	TEMORA LONGICORNIS		F	C							99				70				301
W9514	TEMORA LONGICORNIS		M	C		128					99	94			211				
W9514	UNIDENTIFIED LARVAE		L	O	492		648		188	559	395		415		70	421			151
W9515	ACARTIA HUDSONICA		M	C											52				
W9515	ACARTIA TONSA		C	C											208	279			
W9515	ACARTIA TONSA		F	C											156				
W9515	ACARTIA TONSA		M	C											208				
W9515	BIVALVIA SPP.		L	O											3436	11517			
W9515	BRYOZOA SPP.		-	O											104				
W9515	CENTROPAGES TYPICUS		C	C											625	650			
W9515	CENTROPAGES TYPICUS		F	C												93			
W9515	COPEPOD SPP.		-	C											364				
W9515	COPEPOD SPP.		C	C											469	464			
W9515	COPEPOD SPP.		N	C											4738	23405			
W9515	EURYTEMORA HERDMANI		C	C											52				
W9515	EVADNE SPP.		-	O											625	464			
W9515	GASTROPODA;MOLLUSCA		L	O											729	93			
W9515	HARPACTICOIDA SPP.		-	C											208				

TABLE A3

Zooplankton Species Data (ind/m^3)

W9510 - W9517

Event	Species		Life Stage	Group	Station Cast 1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9515	HYDROZOA SPP.		-	O											52				
W9515	MICROSETELLA NORVEGICA		-	C											521	743			
W9515	OIKOPLEURA DIOICA		-	O											104	1300			
W9515	OITHONA ATLANTICA		F	C												93			
W9515	OITHONA SIMILIS	CLAUS	C	C											1614	2972			
W9515	OITHONA SIMILIS	CLAUS	F	C											573	557			
W9515	OITHONA SIMILIS	CLAUS	M	C											52	186			
W9515	POLYCHAETE SPP.		-	O											52				
W9515	POLYCHAETE SPP.		L	O											312				
W9515	PSEUDOCALANUS NEWMANI		C	C											417				
W9515	PSEUDOCALANUS NEWMANI		F	C											156				
W9515	PSEUDOCALANUS NEWMANI		M	C											260				
W9515	TEMORA LONGICORNIS		C	C											312				
W9515	TEMORA LONGICORNIS		M	C											52				
W9515	UNIDENTIFIED LARVAE		L	O											52	93			
W9516	ACARTIA TONSA		C	C											26			83	
W9516	ACARTIA TONSA		F	C											52				
W9516	ACARTIA TONSA		M	C											26				
W9516	BIVALVIA SPP.		L	O											3185			2241	
W9516	BRYOZOA SPP.		-	O											26			83	
W9516	CENTROPAGES TYPICUS		C	C											209			1494	
W9516	CENTROPAGES TYPICUS		F	C											26				
W9516	COPEPOD SPP.		-	C											52			166	
W9516	COPEPOD SPP.		C	C											157			664	
W9516	COPEPOD SPP.		N	C											4125			15936	
W9516	ECHINODERM PLUTEI		-	O														83	
W9516	GASTROPODA;MOLLUSCA		L	O											183			664	
W9516	HARPACTICOIDA SPP.		-	C														83	
W9516	MICROSETELLA NORVEGICA		-	C											78			830	
W9516	OITHONA ATLANTICA		-	C														83	
W9516	OITHONA SIMILIS	CLAUS	C	C											1018			3071	
W9516	OITHONA SIMILIS	CLAUS	F	C											470			1079	
W9516	OITHONA SIMILIS	CLAUS	M	C											52			83	
W9516	PARACALANUS PARVUS		F	C											26			166	
W9516	PARACALANUS PARVUS		M	C											26				
W9516	POLYCHAETE SPP.		L	O											104				
W9516	PSEUDOCALANUS NEWMANI		C	C														166	
W9516	PSEUDOCALANUS NEWMANI		F	C														332	
W9516	PSEUDOCALANUS NEWMANI		M	C														83	

TABLE A3
Zooplankton Species Data (ind/m^3)
W9510 - W9517

		Life		Station Cast														
Event	Species	Stage	Group	1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9516	TEMORA LONGICORNIS	C	C											26				
W9516	TEMORA LONGICORNIS	F	C														83	
W9516	TEMORA LONGICORNIS	M	C											26				
W9517	ACARTIA TONSA	C	C														63	
W9517	BIVALVIA SPP.	L	O											576			251	
W9517	BRYOZOA SPP.	-	O											58			63	
W9517	CENTROPAGES TYPICUS	C	C											461			502	
W9517	CENTROPAGES TYPICUS	F	C											144			63	
W9517	CENTROPAGES TYPICUS	M	C											115				
W9517	COPEPOD SPP.	-	C											58			63	
W9517	COPEPOD SPP.	C	C											173			126	
W9517	COPEPOD SPP.	N	C											7436			12497	
W9517	GASTROPODA;MOLLUSCA	L	O														63	
W9517	HARPACTICOIDA SPP.	-	C											29				
W9517	MICROSETELLA NORVEGICA	-	C											404			188	
W9517	OIKOPLEURA DIOICA	-	O														314	
W9517	OITHONA ATLANTICA	-	C														63	
W9517	OITHONA SIMILIS CLAUS	C	C											2853			4208	
W9517	OITHONA SIMILIS CLAUS	F	C											951			754	
W9517	OITHONA SIMILIS CLAUS	M	C											115				
W9517	PARACALANUS PARVUS	C	C											86			126	
W9517	PARACALANUS PARVUS	F	C														63	
W9517	POLYCHAETE SPP.	L	O											29				
W9517	PSEUDOCALANUS NEWMANI	C	C											115				
W9517	PSEUDOCALANUS NEWMANI	F	C											58				
W9517	PSEUDOCALANUS NEWMANI	M	C											58				
W9517	TEMORA LONGICORNIS	C	C											29				
W9517	UNIDENTIFIED LARVAE	L	O											86			63	

Life Stage Definitions:

- C Copepodite stages I-V
- F Copepoda adult female
- L Larva
- M Copepoda adult male
- N Nauplii
- T Trochophore (larval stage of polychaete
- Y Cypris Larva of Barnacle

Group Definitions:

- B Barnacle
- C Copepod
- OZ Other Zooplankton

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APPENDIX A

Productivity Methods

Methods

Production Analyses by ^{14}C - Field Procedures.

From each of the 5 productivity depths at each productivity station, samples were obtained by filtration through 300 mm Nitex screen (to remove zooplankton) from the Niskin bottles into opaque 1 gal polyethylene bottles. Under subdued green light, sub-samples were transferred by siphon into individual 75 ml acid cleaned polycarbonate bottles. Each bottle was flushed with approximately 250 ml of sample. A total of 16 bottles (14 light bottles, 2 dark bottles) were filled for each depth and incubated in a light and temperature controlled incubator. Light bottles from each depth are incubated at 14 light intensities (250 W tungsten-halogen lamps attenuated with Rosco neutral density filters) and all bottles incubated within 2° C of the *in situ* temperature at each depth for 4-6 hr (actual time was recorded). Single bottles of sample collected from each depth was assayed for background (time-zero) activity.

The 75 ml samples were incubated with 5-10 µCi ^{14}C-bicarbonate (higher activity during winter and spring season) and biological activity terminated by filtration of the entire contents of the bottles through 2.5 cm diameter Whatman GF/F glass fiber filters and immediate contact of the filters with 0.2 ml of a 20% aqueous solution of acetic acid contained in pre-prepared 20 ml glass scintillation vials (vials immediately recapped). For specific activity determination 0.1 ml aliquots of sample were placed in pre-prepared 20 ml scintillation vials containing 0.2 ml of benzethonium hydroxide (approximately 1.0 M solution in methanol; Sigma Chemical Company) to covalently sequester the ^{14}C inorganic carbon (vials immediately recapped). Specific activity was determined from the measured activity and measurements of DIC.

Samples for DIC analysis were collected from the Niskin bottles into 300 ml BOD bottles, following collection procedures used for oxygen analyses. Within 6 hr. of BOD sample collection, duplicate 10 ml samples were injected into 20 ml crimp-sealed serum bottles containing 0.5 ml of a 2N aqueous solution of sulfuric acid for subsequent I.R. analysis (Beckman IR-315 infrared analyzer) of the gaseous phase (5 - 150 ml samples) at the W.H.O.I. laboratory.

During summer months 1995 some of the ^{14}C incubations (W9508-W9513) were incubated on shore in the MWRA laboratory at Deer Island. Samples were collected in opaque bottles and maintained at *in situ* temperature until transport to the lab. The ^{14}C incubations were begun approximately 2 - 3 hr from sample collection and should compare favorably with samples that are incubated aboard the ship.

Production Analyses by ^{14}C - Laboratory Procedures.

Sample processing. Upon arrival to the W.H.O.I. laboratory scintillation cocktail (10 ml Scintiverse II) were added to the scintillation vials containing the specific activity samples and analyzed using a Packard Tricarb 4000 liquid scintillation counter which possesses automated routines for quench correction. Vials containing acidified filters were opened and placed in a

ventilator in the hood for overnight to allow the filters to dry and excess ^{14}C carbon dioxide dissipate. The vials containing the filters were analyzed by scintillation spectroscopy as described above.

Calculation of Primary production. Volume specific primary production was calculated using equations similar to that of Strickland and Parsons (1972) as follows:

$$P(i) = \frac{1.05(DPM(i)-DPM(blk))}{V_s A_{sp} T}$$

$$P(d) = \frac{1.05(DPM(d)-DPM(blk))}{V_s A_{sp} T}$$

$$A_{sp} = \frac{DPM(sa)-DPM(back)}{V_{sa} DIC}$$

where:

P(i) = primary production rate at light intensity i, (µgC $l^{-1}h^{-1}$ or mgC $m^{-3}h^{-1}$)
P(d) = dark production, (µgC $l^{-1}h^{-1}$ or mgC $m^{-3}h^{-1}$)
A_{sp} = specific activity (DPM/µgC)
DPM(i) = dpm in sample incubated at light intensity i
DPM(blk) = dpm in zero time blank (sample filtered immediately after addition of tracer)
DPM(d) = dpm in dark incubated sample
DPM(back) = background dpm in vial containing only scintillation cocktail
V_s = volume of incubated sample (l)
T = incubation time (h)
V_{sa} = volume counted of specific activity sample (ml)
DIC = concentration of dissolved inorganic carbon (µg/ml)

P-I curves. For each of the 5 depths for each photosynthesis station a P-I curve was obtained from the data P(I) = P(i)-P(d) vs. the irradiance (I, µE $m^{-2}s^{-1}$) that the incubating sample is exposed. The P-I curves were fit via one of two possible models, depending upon whether or not significant photoinhibition occurs. In cases where photoinhibition is evident the model of Platt et al. (1980) was fit (SAAM II, 1994) to obtain the theoretical maximum production, and terms for light-dependent rise in production and degree of photoinhibition:

$$P(I) = P_{sb}''(1-e^{-a})e^{-b}$$

$$P\max'' = P_{sb}''[\alpha''/(\alpha''+\beta'')][\beta''/(\alpha''+\beta'')]^{\beta''/\alpha''}$$ (Lohrenz et al., 1994)

where:

P(I) = primary production at irradiance I, corrected for dark fixation (P(i)-P(d))
P_{sb}"= theoretical maximum production without photoinhibition
a = α"I/Psb", and α"is the initial slope the light-dependent rise in production

$b = \beta\text{"}I/Psb\text{"}$, and β"is a term relaying the degree of photoinhibition
P_{max}"= light saturated maximum production

If it is not possible to converge upon a solution the model of Webb et al. (1974) was similarly fit to obtain the maximum production and the term for light-dependent rise in production:

$$P(I) = P_{max}\text{"}\left(1 - e^{-a'}\right)$$

where:

$P(I)$ = primary production at irradiance I corrected for dark fixation (P(i)-P(d))
P_{max}"= light saturated maximum production
$a' = \alpha\text{"}I/Pmax\text{"}$, and α"is the initial slope the light-dependent rise in production

Nearly all P-I curves obtained did not show evidence of photoinhibition and were fit according to the Webb model.

Light vs. depth profiles. To obtain a numerical representation of the light field throughout the water column bin averaged CTD light profiles (0.5 m intervals) was fit (SAAM II, 1994) to an empirical sum of exponentials equation of the form:

$$I_Z = A_1 e^{-a_1 Z} + A_2 e^{-a_2 Z}$$

which is an expansion of the standard irradiance vs. depth equation:

$$I_Z = I_0 e^{-kZ}$$

where:

I_Z = light irradiance at depth Z
I_0 = incident irradiance (Z=0)
k = extinction coefficient
A_1, A_2 = factors relating to incident irradiance ($I_0 = A_1+A_2$)
a_1, a_2 = coefficients relating to the extinction coefficient ($k = a_1+a_2$)

The expanded equation was used as pigment absorption and other factors usually resulted in significant deviation from the idealized standard irradiance vs. depth equation. The best fit profiles were used to compute percent light attenuation for each of the sampling depths.

Daily incident light field. During normal CTD hydrocasts the incident light field was routinely measured via a deck light sensor at high temporal resolution. The average incident light intensity was determined for each of the CTD casts to provide, over the course of the photoperiod (12 hr period centered upon solar noon), a reasonably well resolved irradiance time series consisting of 12-17 data points. A 48 point time series (every 15 min.) of incident was obtained from these data by linear interpolation.

Calculation of daily primary production. Given the best fit parameters (Pmax", α", β") of the P-I curves obtained for each of the 5 sampling depths, percent *in situ* light attenuation at each depth determined from the sum of exponential fits of the *in situ* light field, and the photoperiod incident light (I_0) time series it was possible to compute daily volumetric production for each depth. To do this at a given depth, hourly production was determined for the *in situ* light intensity computed for each 15 min. interval of the photoperiod, using the appropriate P-I parameters and *in situ* irradiance computed from the percent attenuation and incident irradiance. Daily production ($\mu gC\ l^{-1}d^{-1}$) was obtained by integration of the determined activity throughout the 12 hr photoperiod. An advantage of this approach is that seasonal changes in photoperiod length are automatically incorporated into the integral computation. For example, during winter months computed early morning and late afternoon production contributes minimally to whole day production, whereas during summer months the relative contribution during these hours is more significant. The investigator does not have to decide which factor to employ when converting hourly production to daily production. The primary assumption for the approach is that the P-I relationship obtained at the time of sample procurement (towards the middle of the photoperiod) is representative of the majority of production occurring during the photoperiod.

Calculation of daily areal production. Areal production ($mgC\ m^{-2}d^{-1}$) was obtained by trapezoidal integration of daily volumetric production vs. depth from the sea surface down to the 0.5% light level. The P-I factors from the uppermost sampling depth (approximately 1.2 - 2.7 m, depending upon weather state) were used to compute the contribution of the portion of the water column between the sea surface interface and uppermost sampling depth to areal production (rather than to assume that the activity in the uppermost sample is representative of that section of the water column, which is not always the case).

Calculation of chlorophyll-specific parameters. Chlorophyll-specific measures of the various parameters were determined by dividing by the appropriate chlorophyll term obtained from independent measurements:

$$a = \frac{a''}{[chla]}$$

$$P\max = \frac{P\max''}{[chla]}$$

where:

α = chlorophyll-a-specific initial slope of light-dependent production $[(gC(gchla)^{-1}h^{-1}(\mu Em^{-2}s^{-1})^{-1}]$

Pmax = light saturated chlorophyll-specific production $[gC(gchla)^{-1}h^{-1}]$

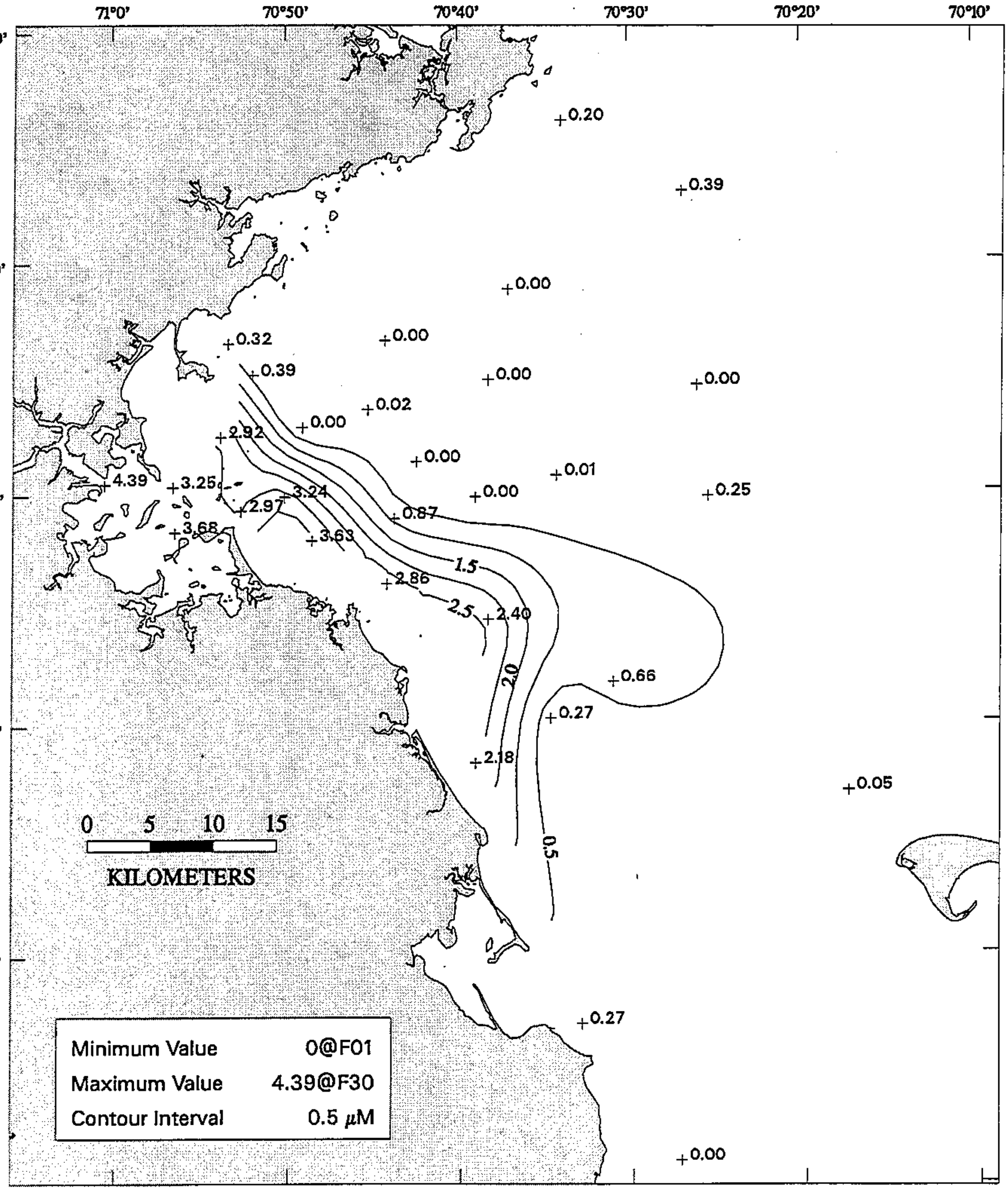
APPENDIX B
Surface Contour Plots - Farfield Surveys

All contour plots were created using data from the surface bottle sample (A). Each plot is labelled on the bottom right with the survey number ("9511"), and parameter as listed below. The minimum and maximum value, and the station where the value was measured, is provided for each plot, as well as the contour interval and parameter units.

Appendix B: Table of Contents

Parameter Name	Map Parameter Name	Units
Temperature	temp_lin	°C
Salinity	sal_lin	SU
Transmissivity (beam attenuation)	tran_lin	/m
Nitrate (NO_3)	no3_lin	µM
Phosphate (PO_4)	po4_lin	µM
Silicate (SiO_4)	sio4_lin	µM
Dissolved Inorganic Nitrogen (DIN*)	din_lin	µM
Chlorophyll *a*	fluo_lin	µg/L

*$NO_3 + NO_2 + NH_4$



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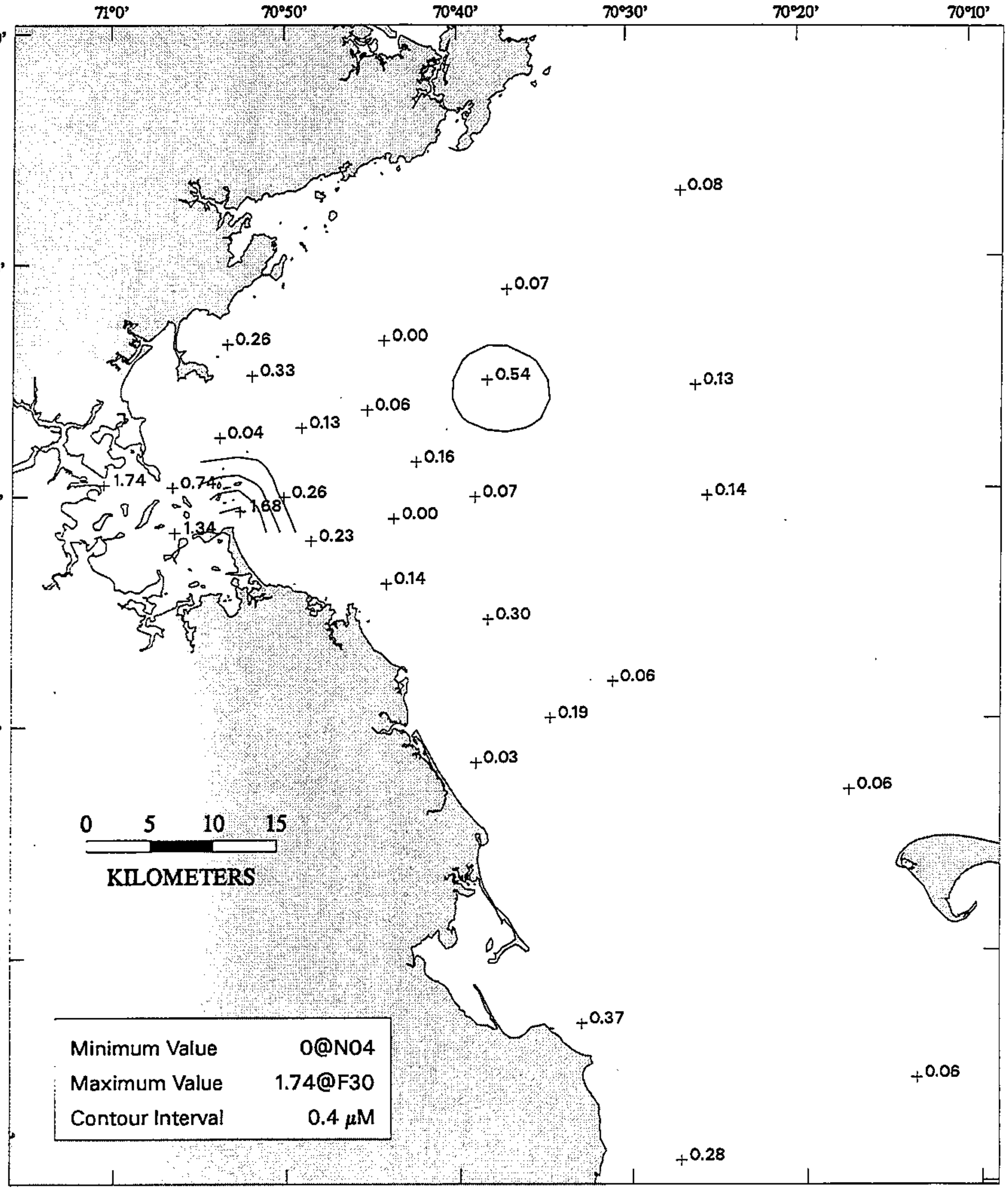
NO3



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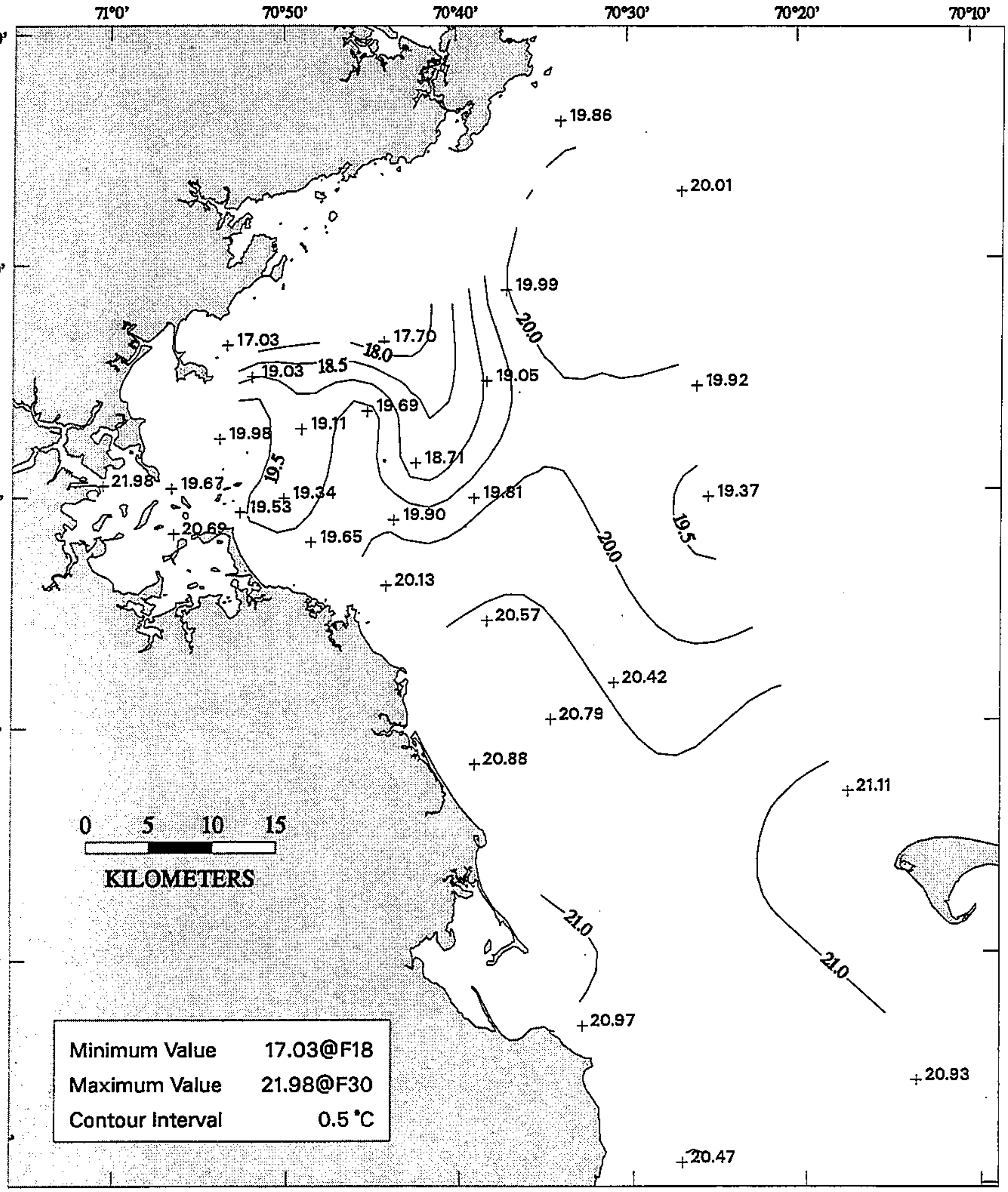
NO3



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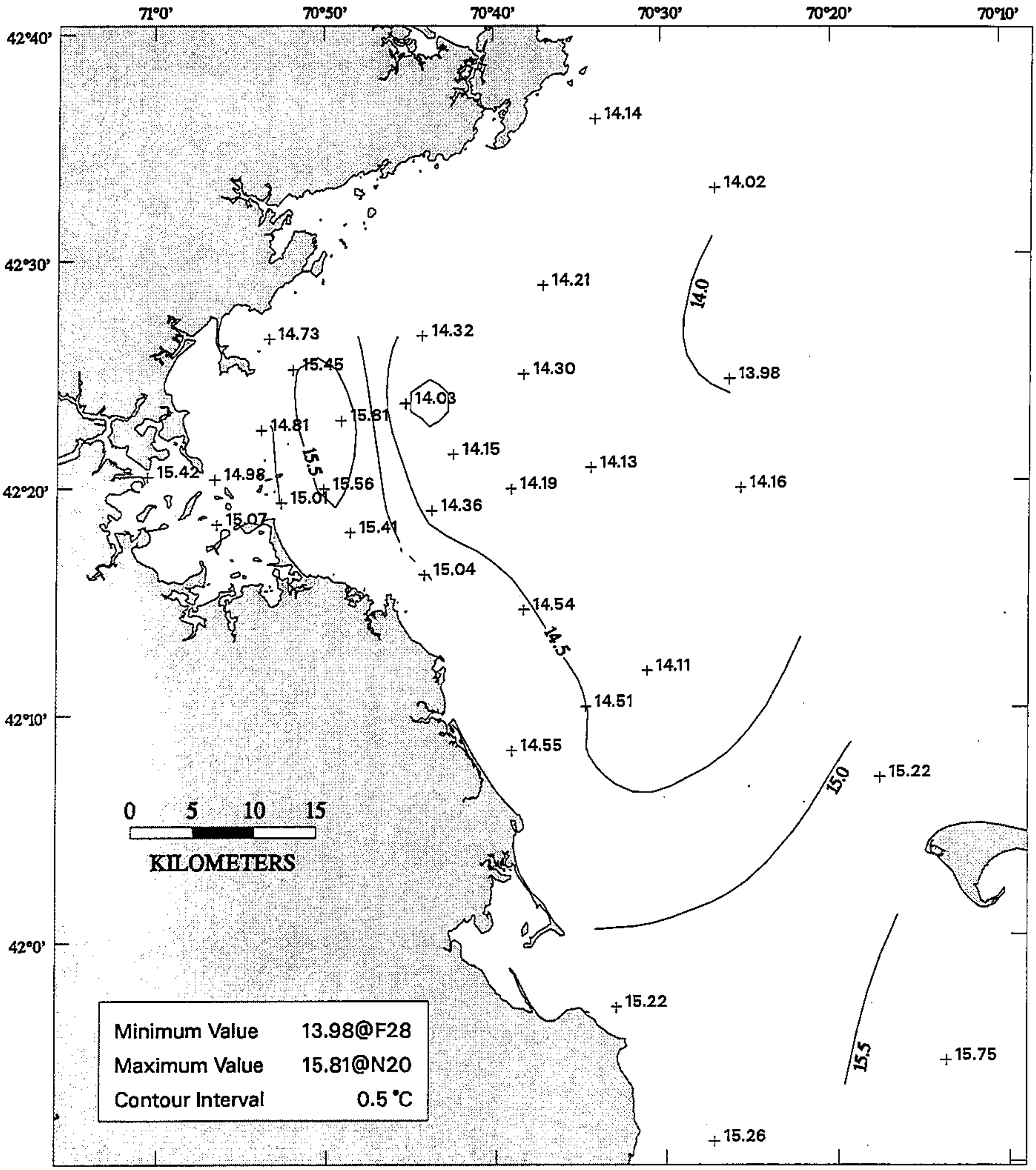
FLUO



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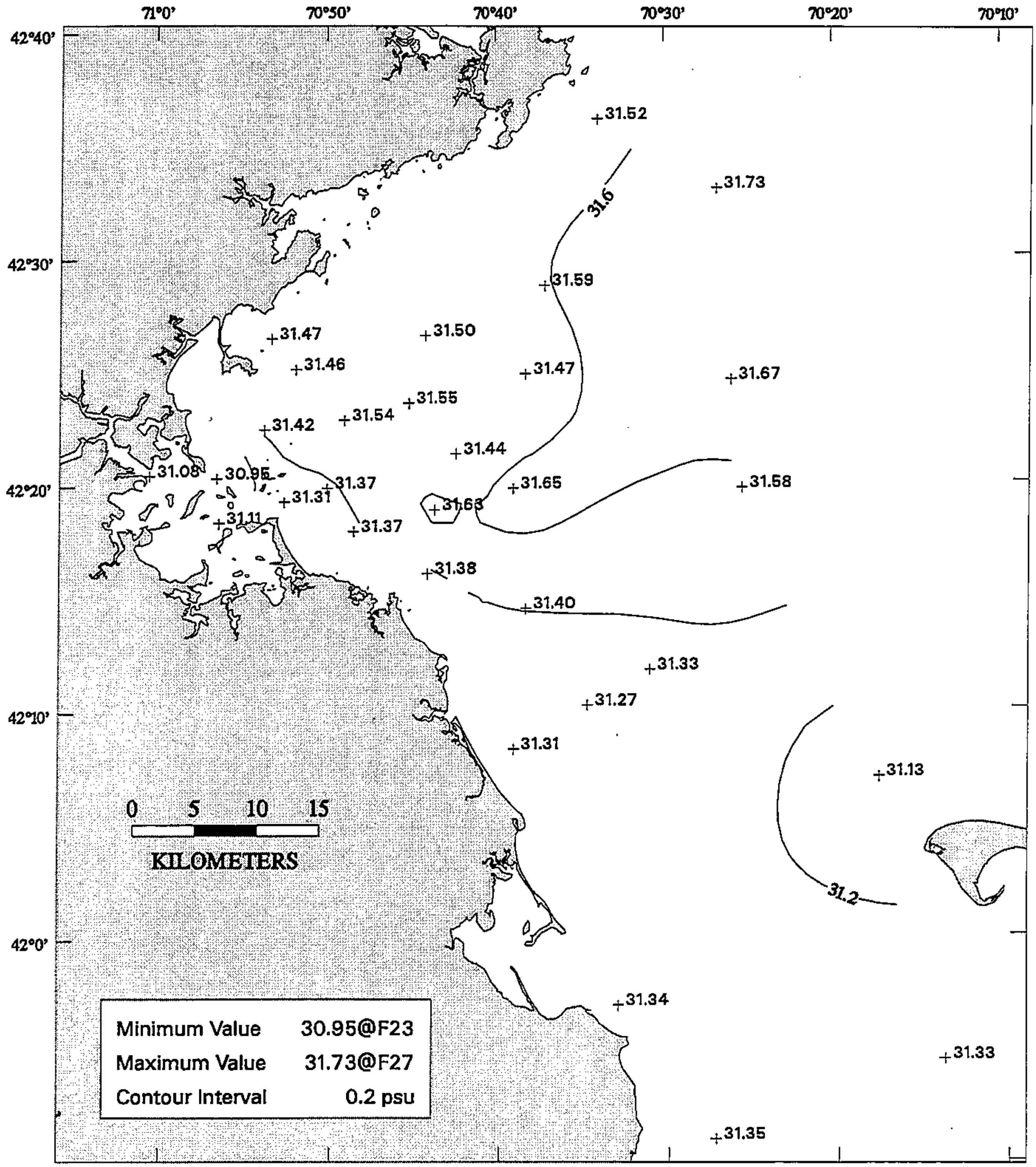

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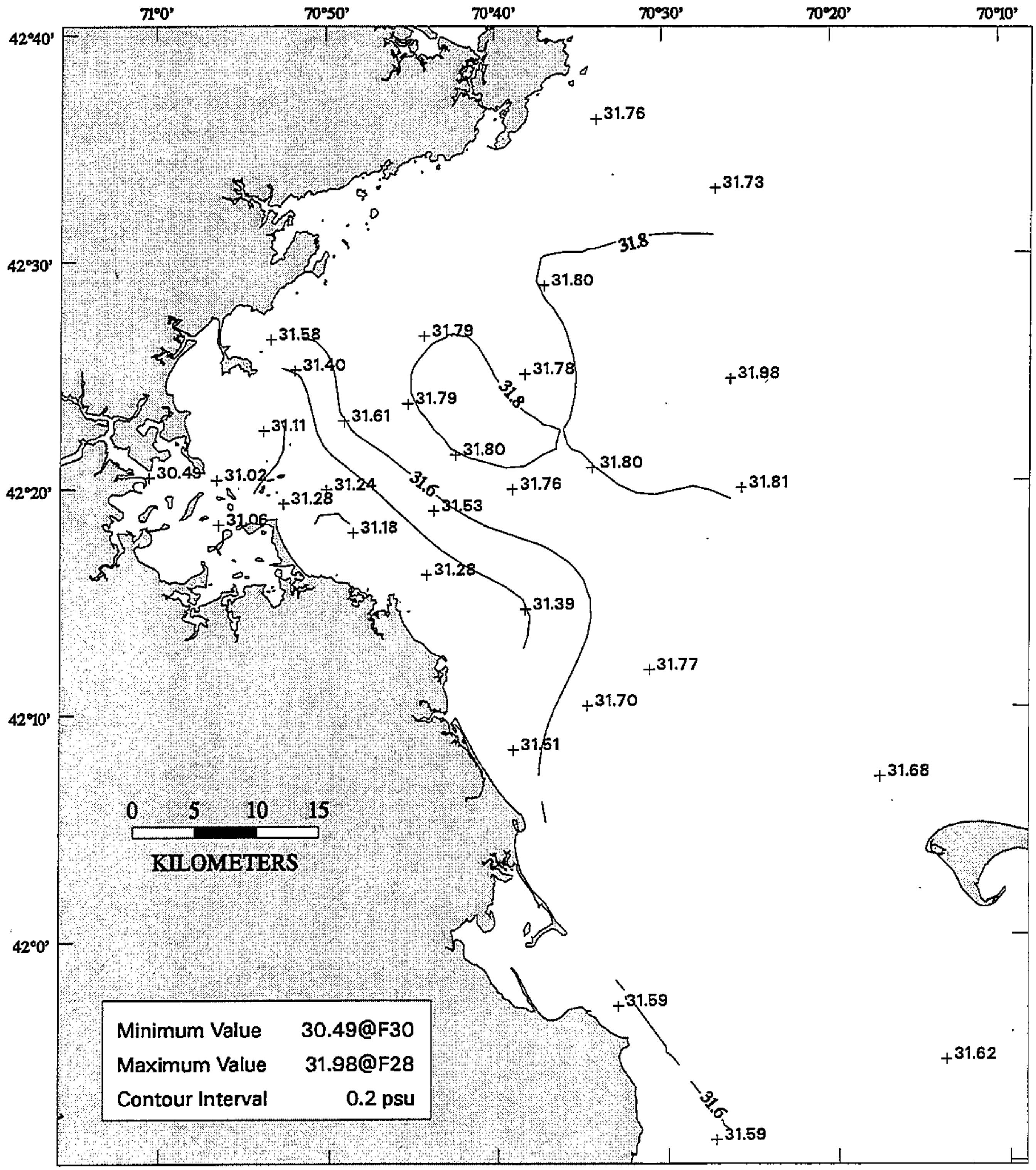

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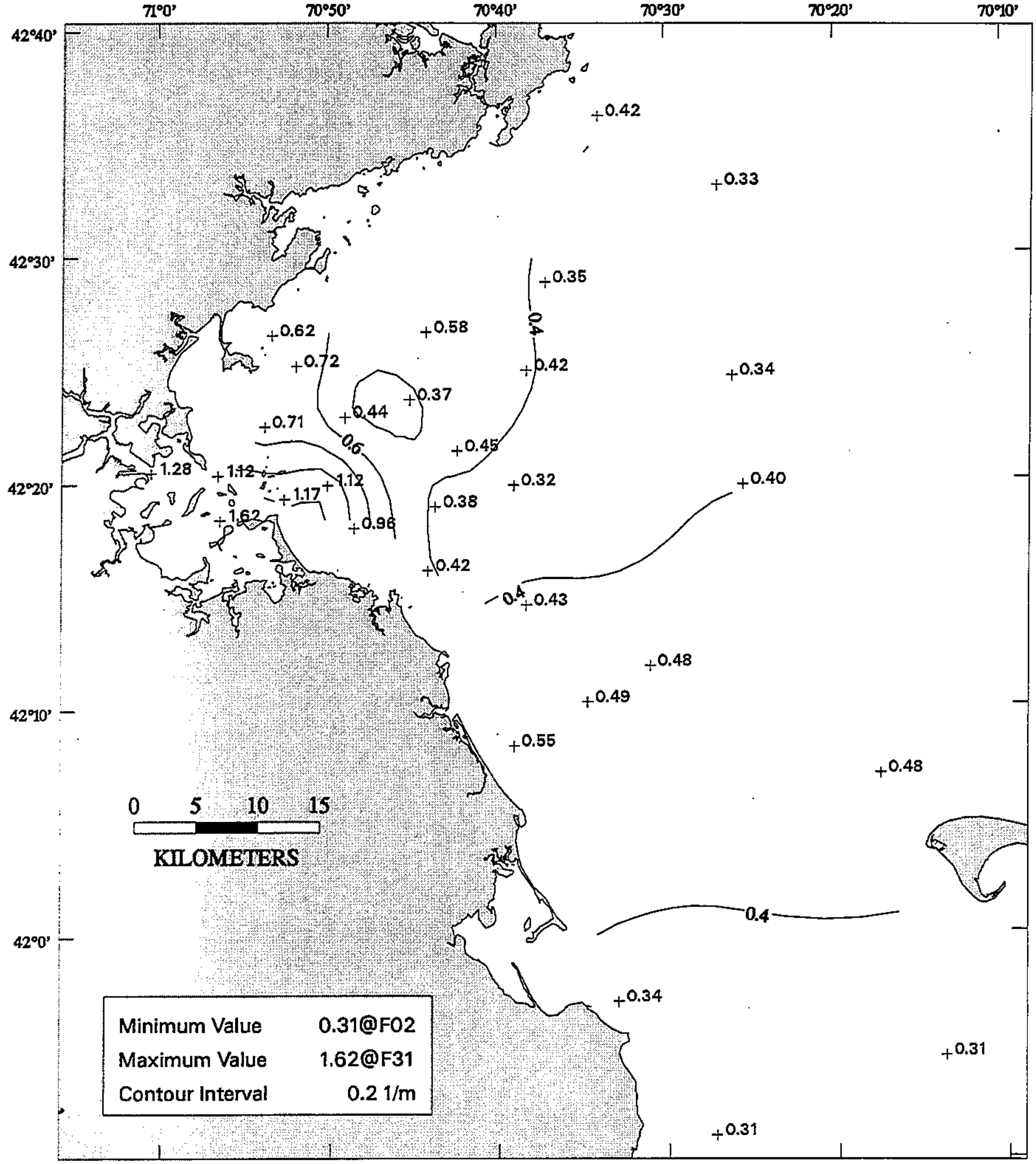

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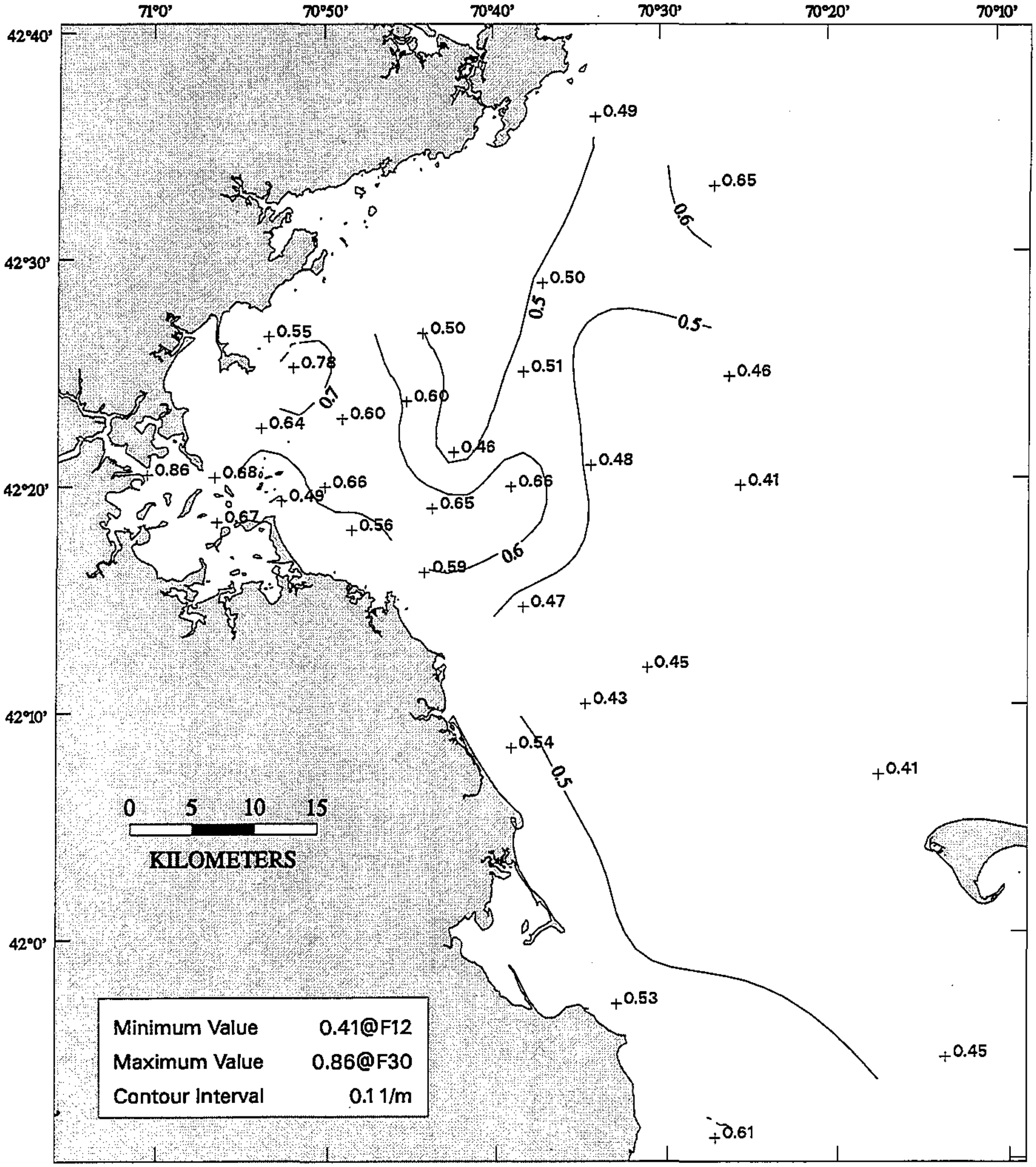

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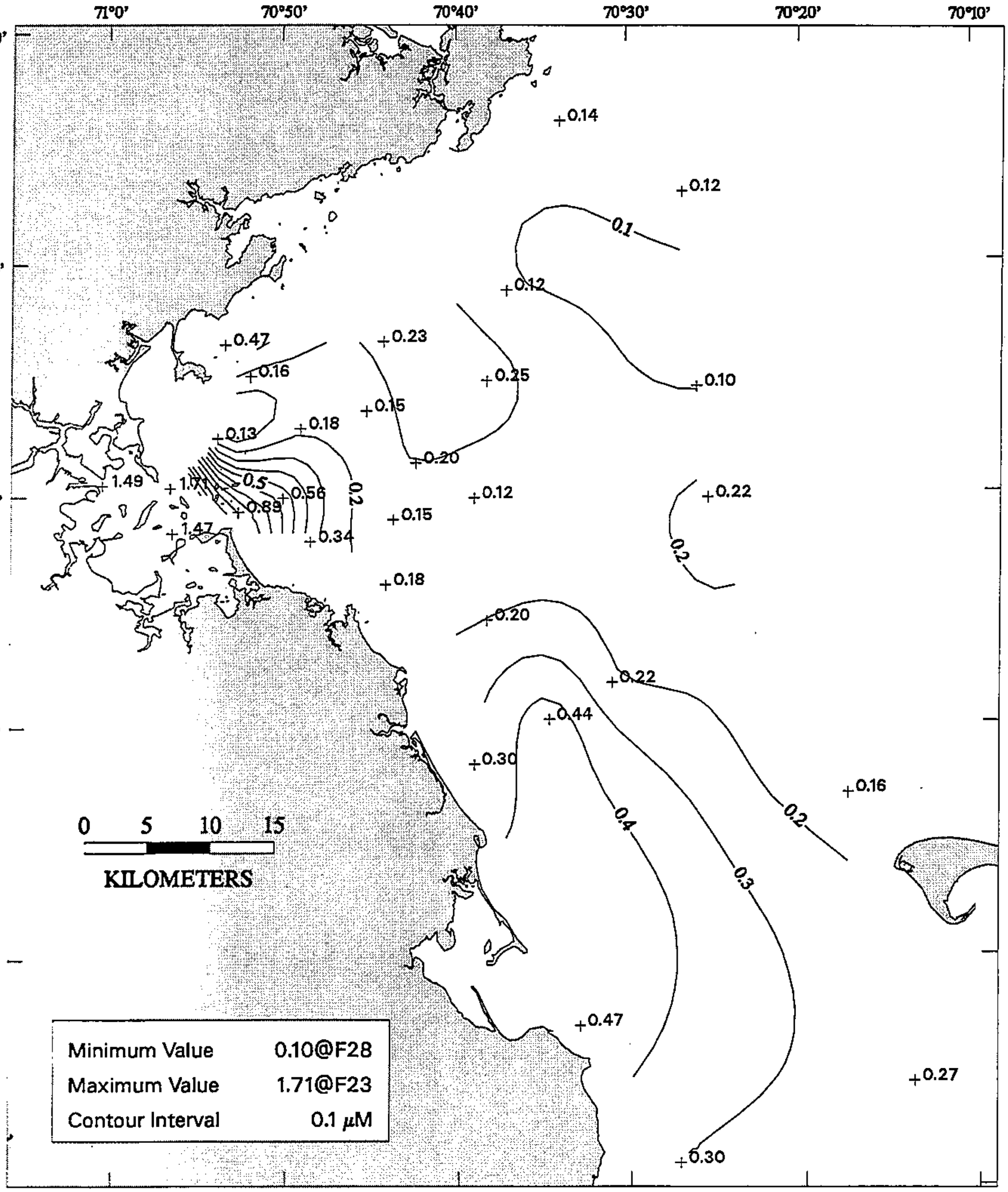

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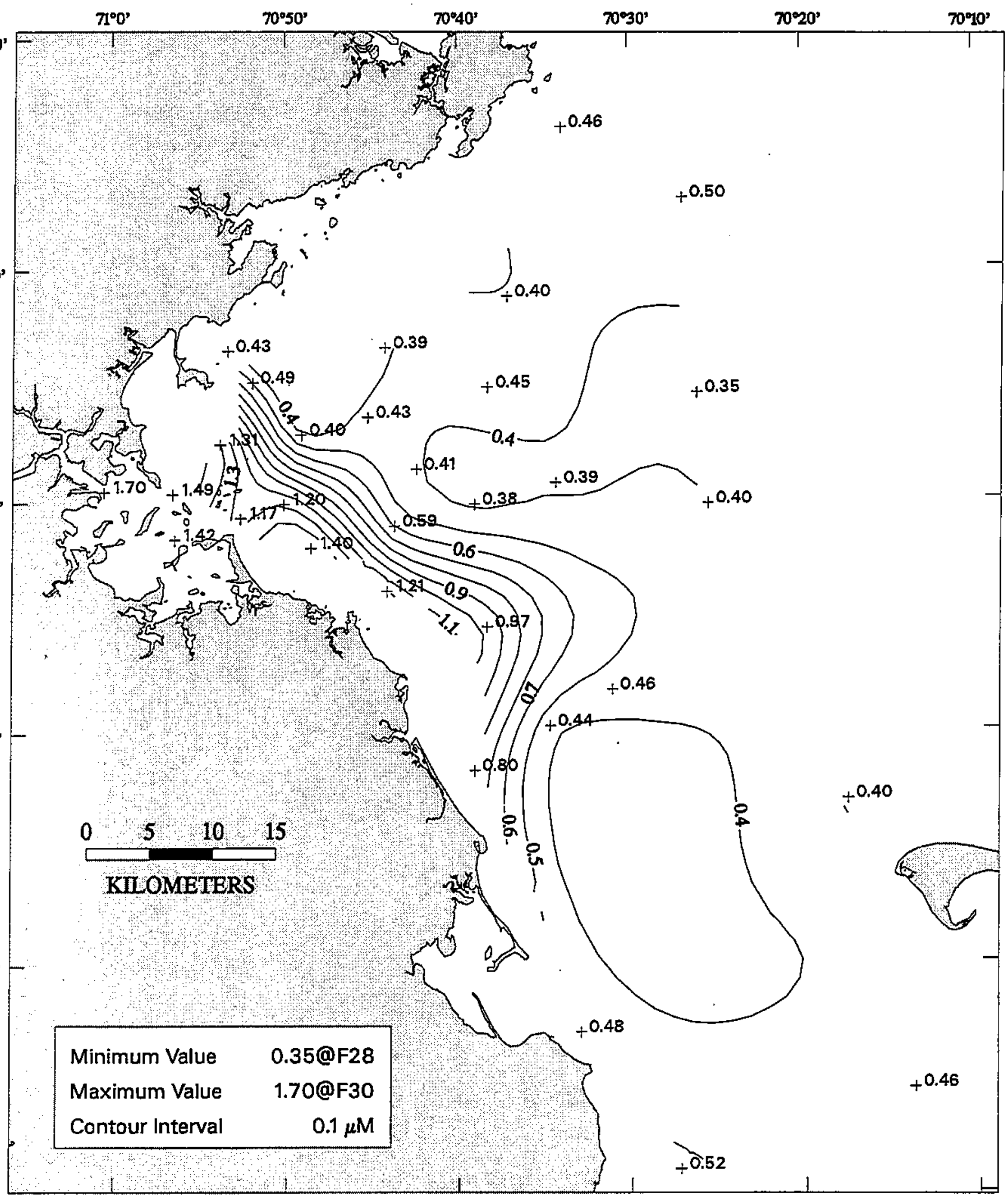
PO4



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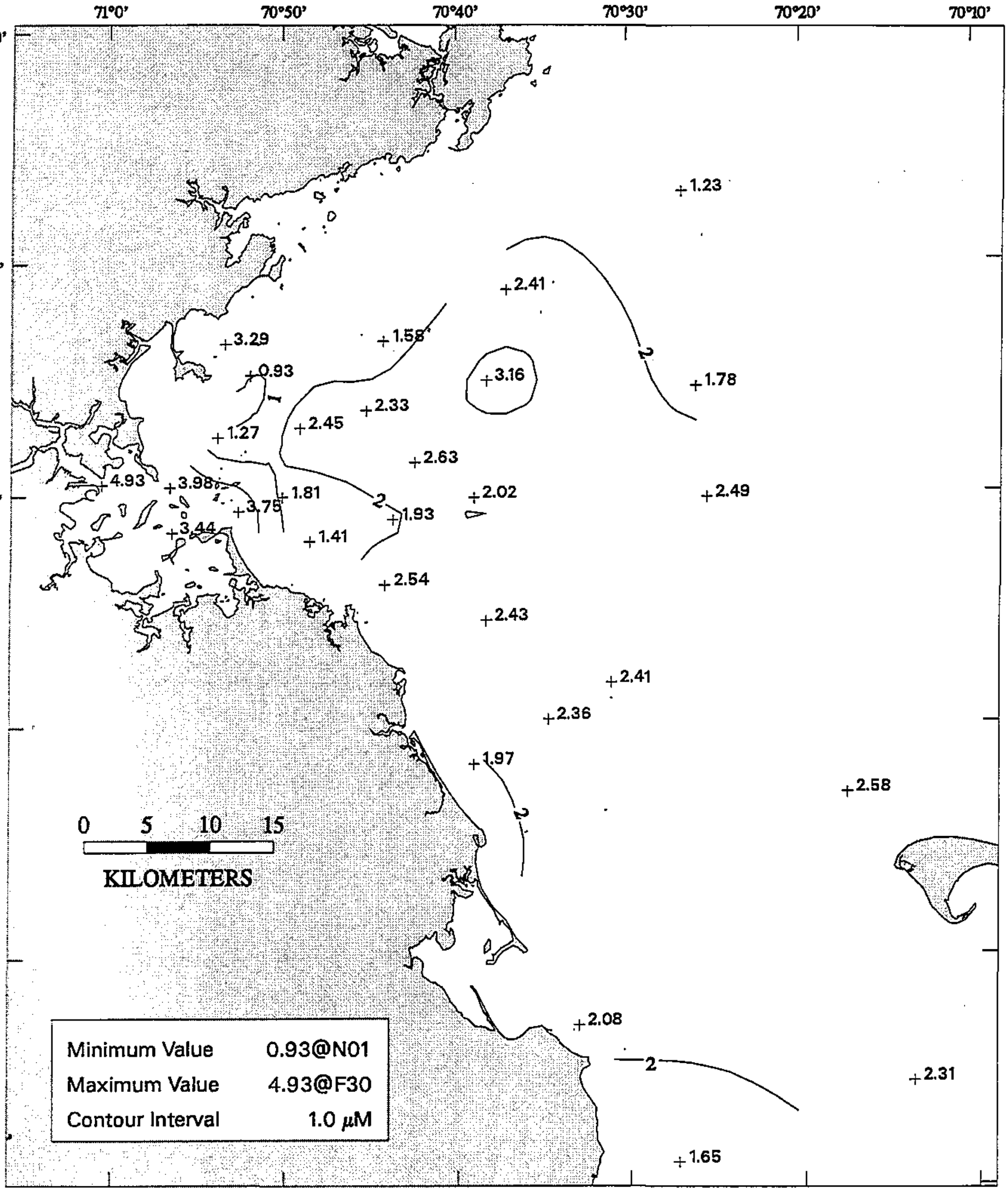
PO4



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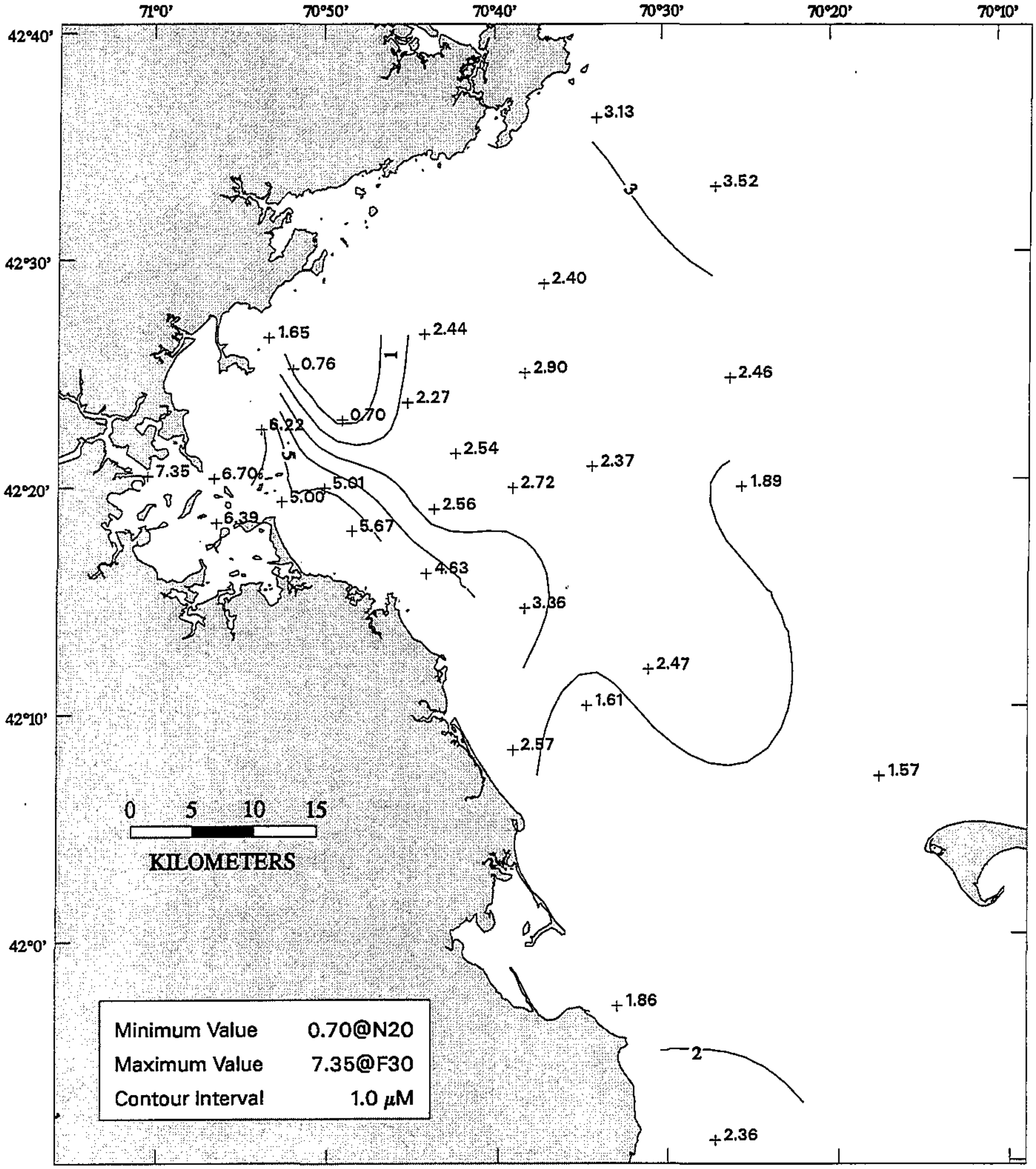
SIO4



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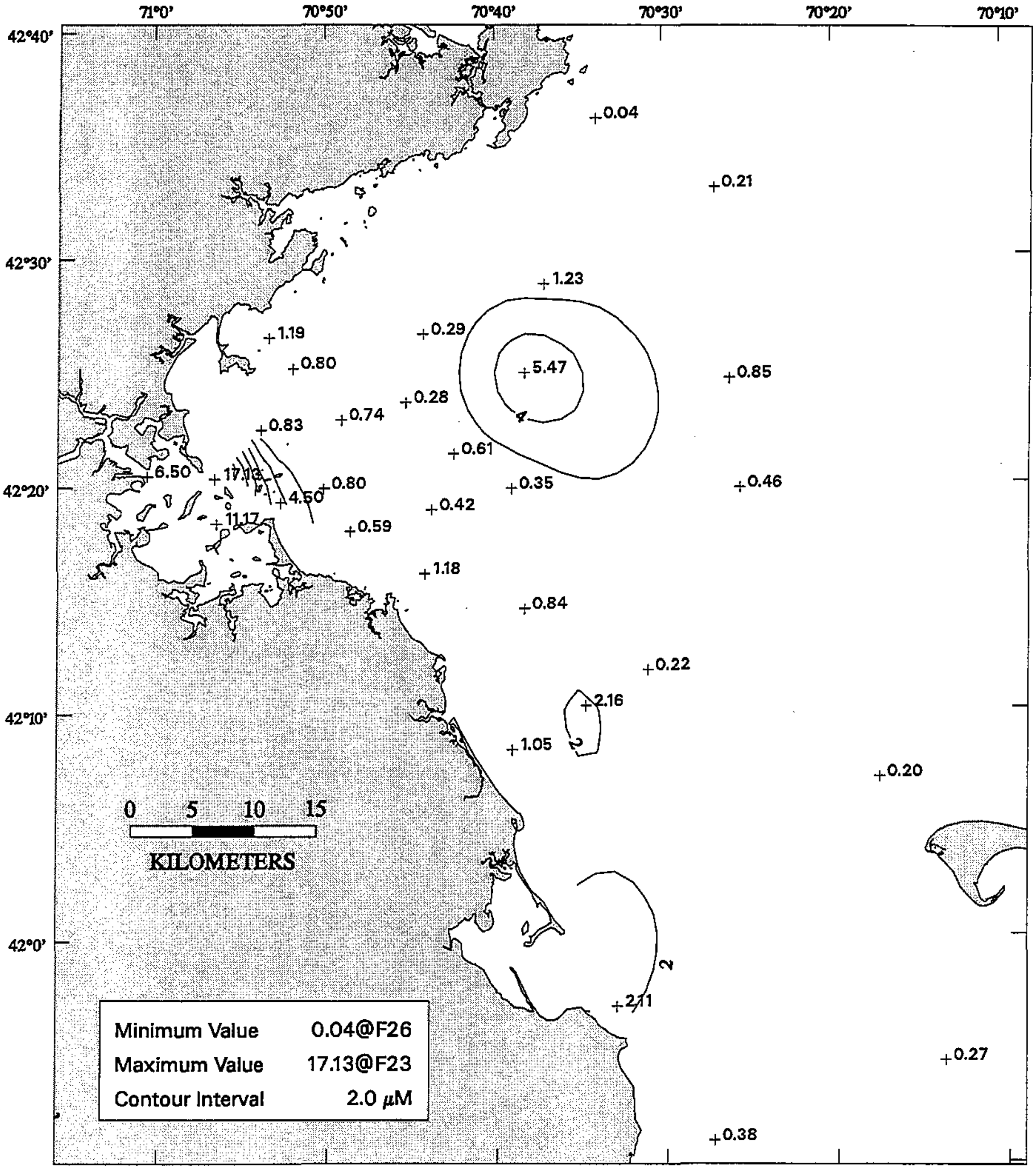
SIO4



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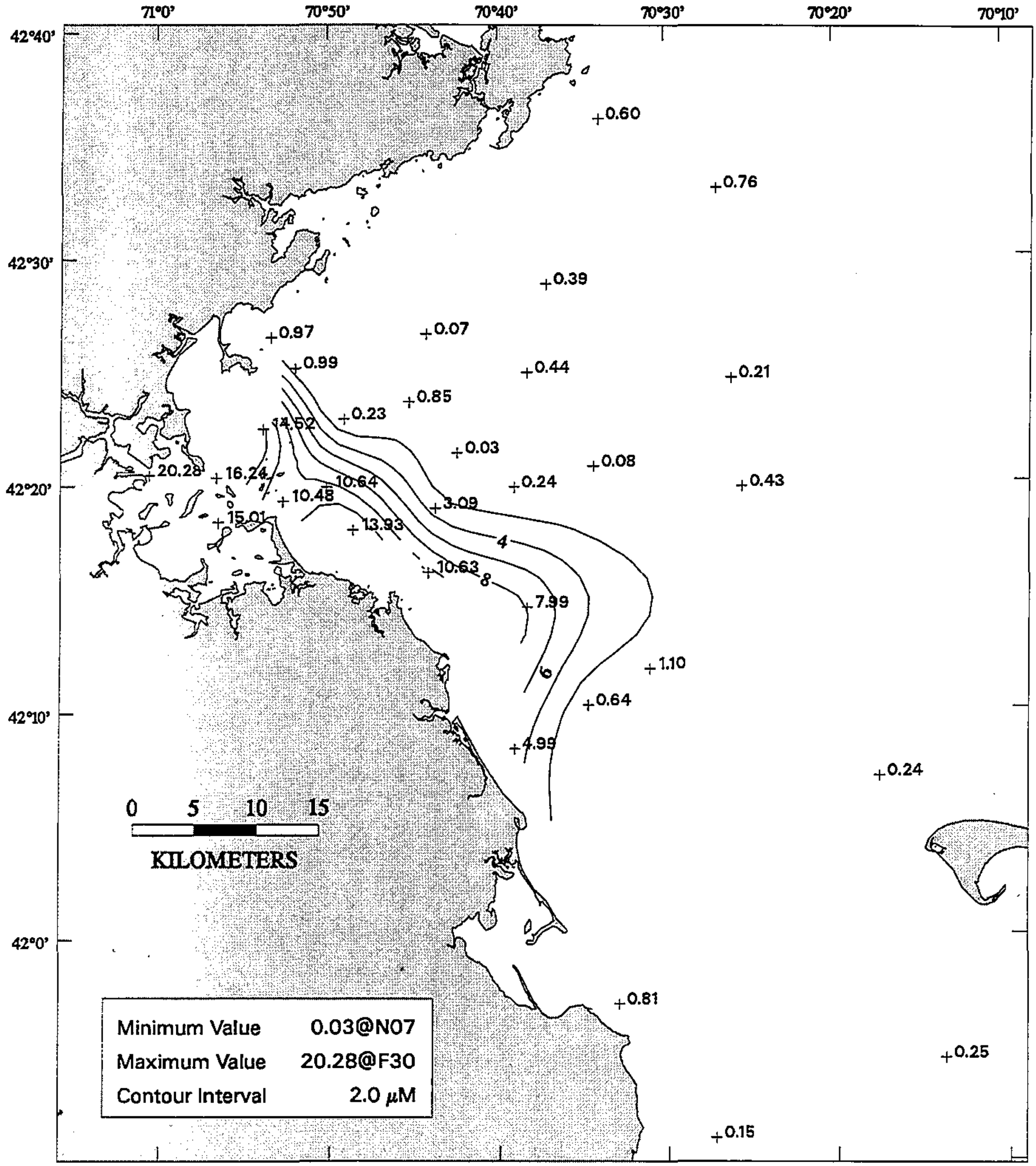
DIN



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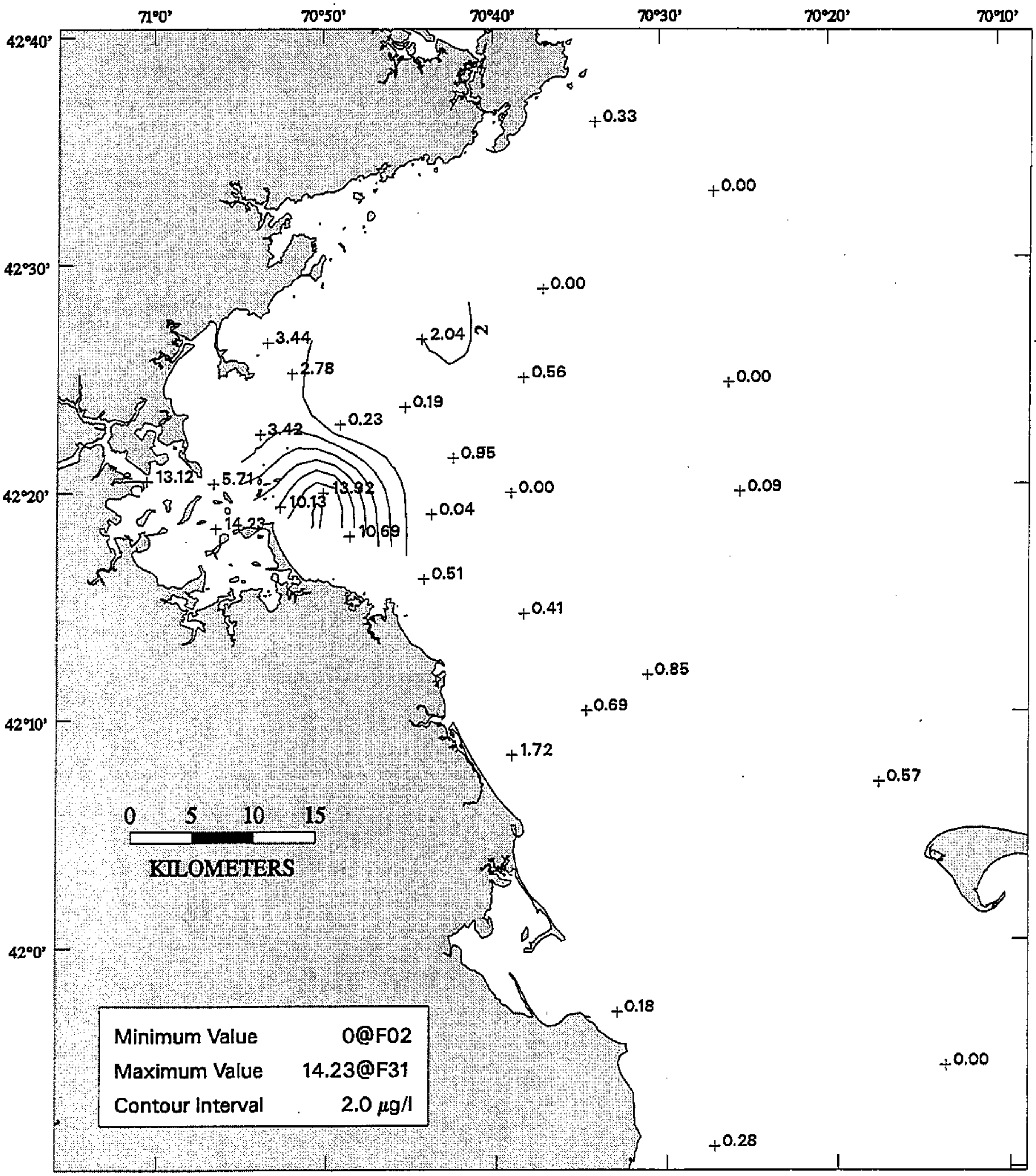
DIN



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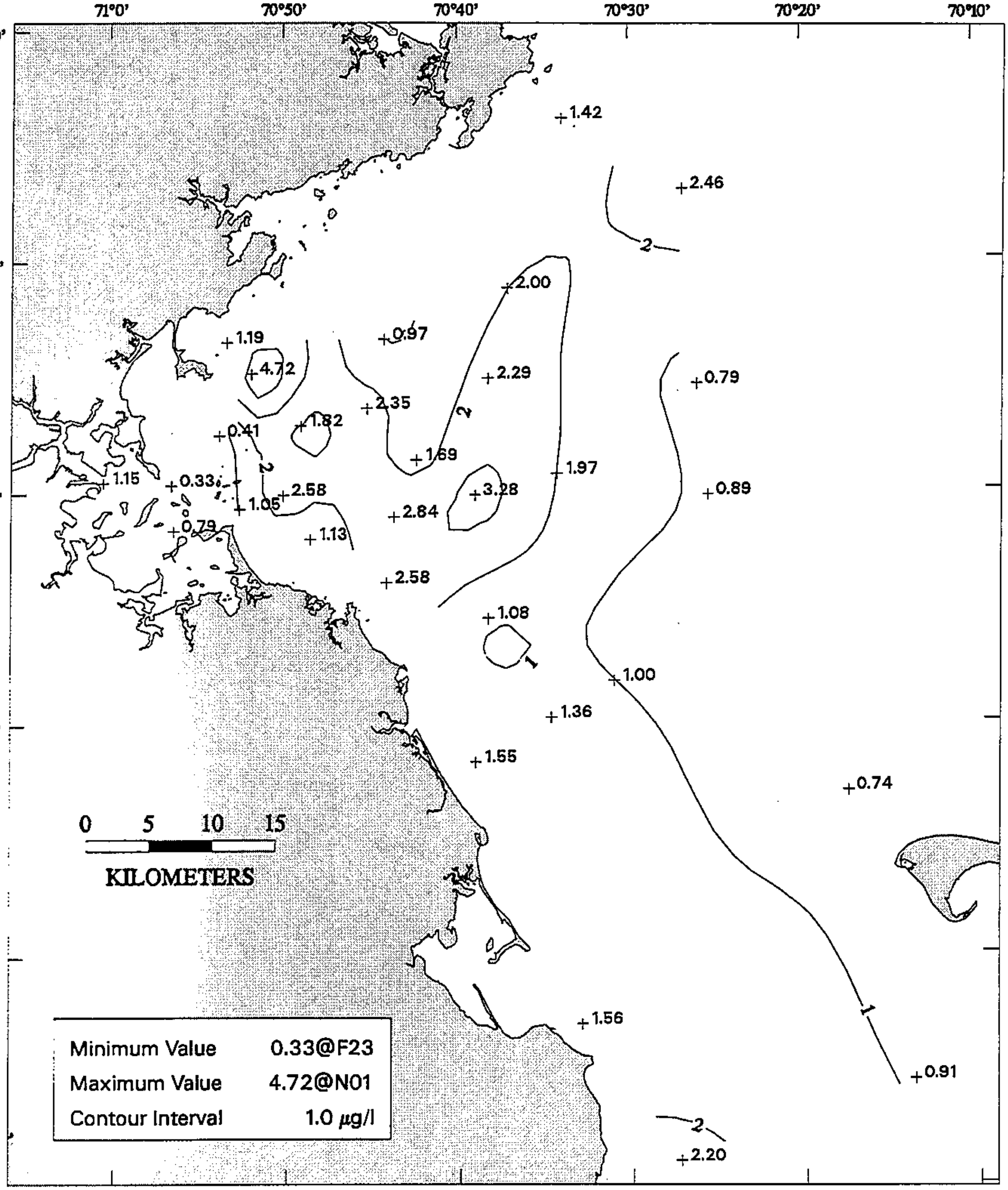
FLUO



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FLUO

APPENDIX C

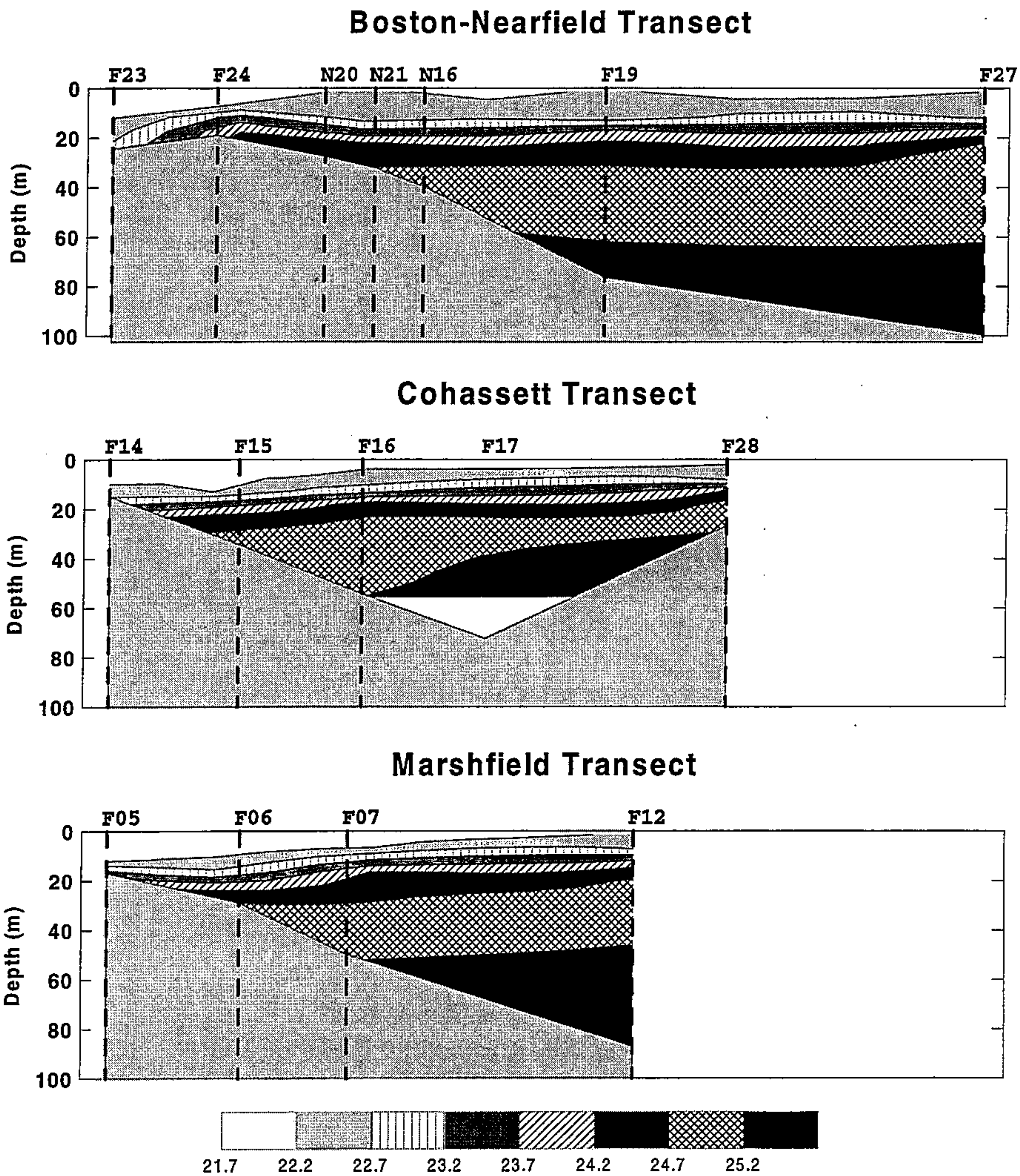
Transect Plots

Data were contoured relative to water depth and distance between stations as shown on the transects (Figure 1-3, text). Relative distances between stations and water depth at each station is shown on the transect. Water depth is labelled with negative values in meters, with zero depth at the sea surface, and shaded with slanted lines. Three transects (Boston-Nearfield, Cohasset, and Marshfield) are provided on each plot, as well as shaded contour levels on the scale bar at the bottom of the plot. Contour units are as noted on the table below. Each plot is labelled on the bottom right with the parameter as listed below, and the survey number ("9511").

Appendix C: Table of Contents

Parameter Name	Map Parameter Name	Units
Sigma-T (σ_t)	Sigma-T	n/a
Temperature	Temperature	°C
Salinity	Salinity	PSU
Transmissivity (beam attenuation)	Trans	/m
Nitrate (NO_3)	NO3	µM
Phosphate (PO_4)	PO4	µM
Silicate (SiO_4)	SiO4	µM
Dissolved Inorganic Nitrogen (DIN*)	DI Nitro	µM
Chlorophyll *a*	Fluorescence	µg/L
DO Saturation	DO % Saturation	%

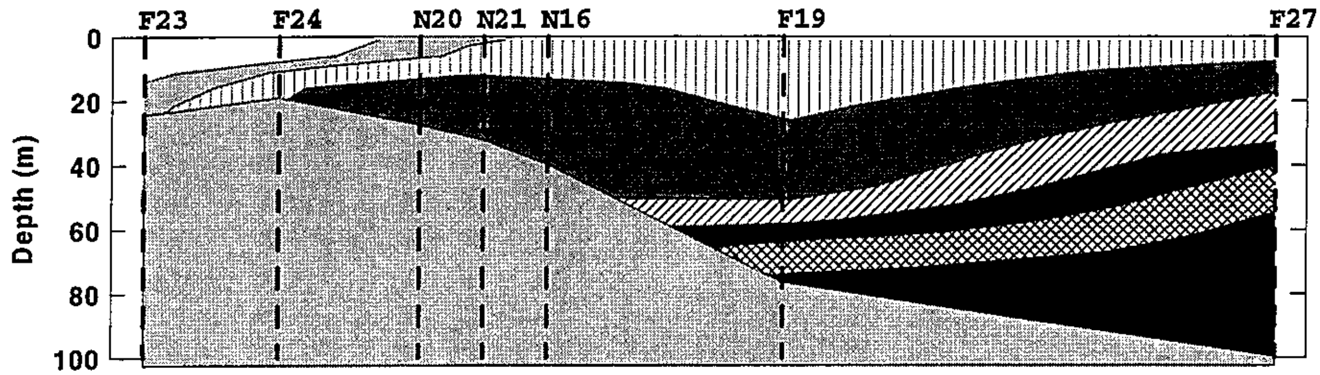
*$NO_3 + NO_2 + NH_4$



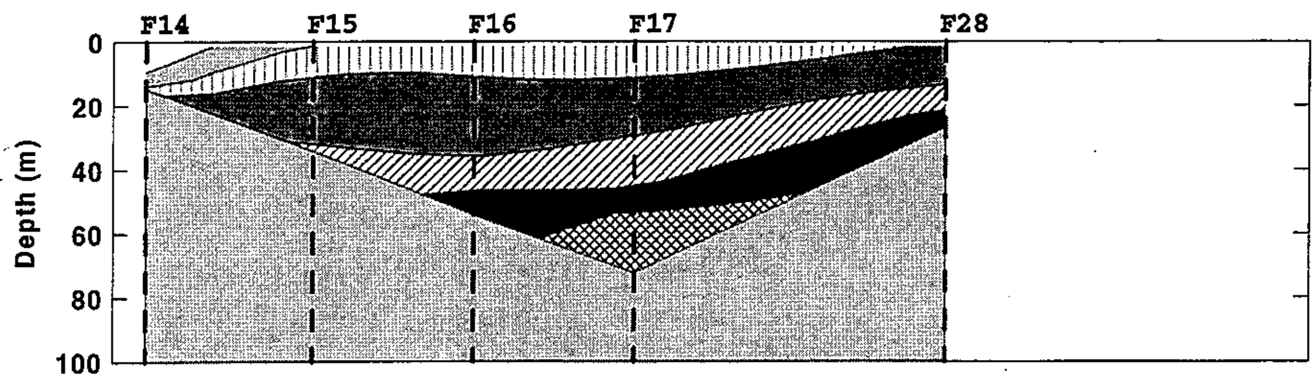
Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
21.7
22.2
22.7
23.2
23.7
24.2
24.7
25.2

Sigma-T 9511

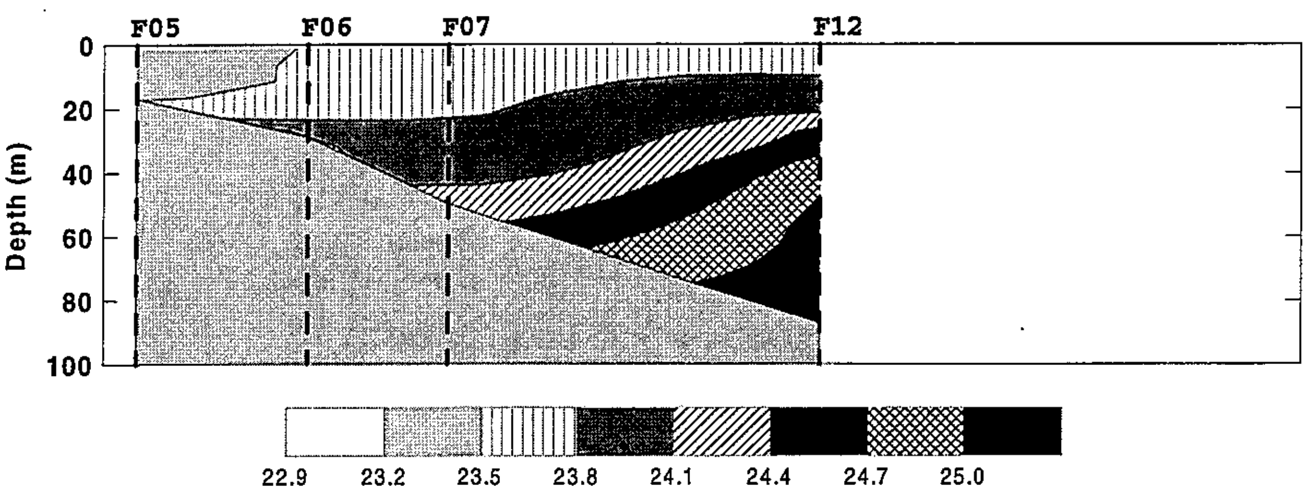
Boston-Nearfield Transect



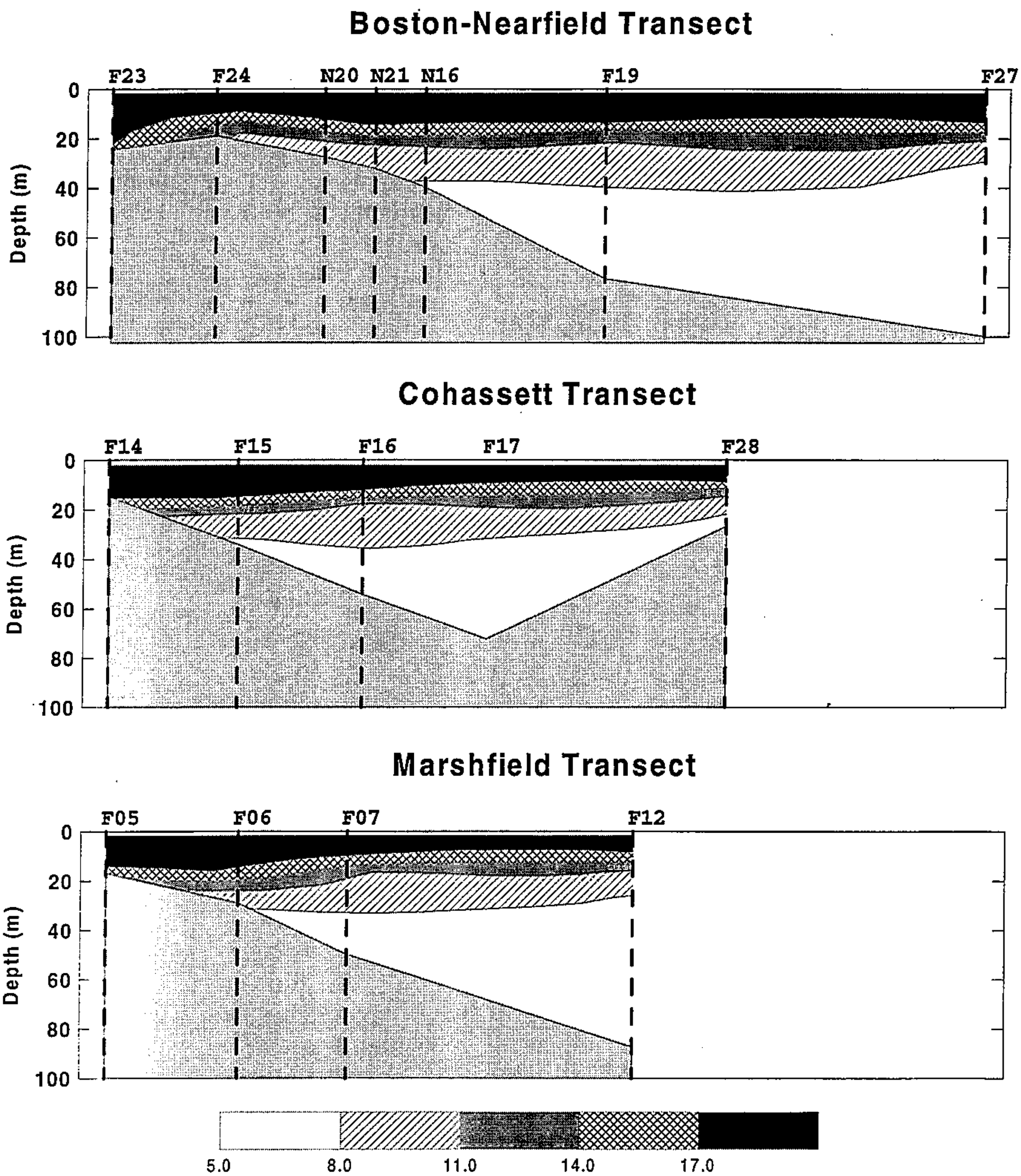
Cohassett Transect

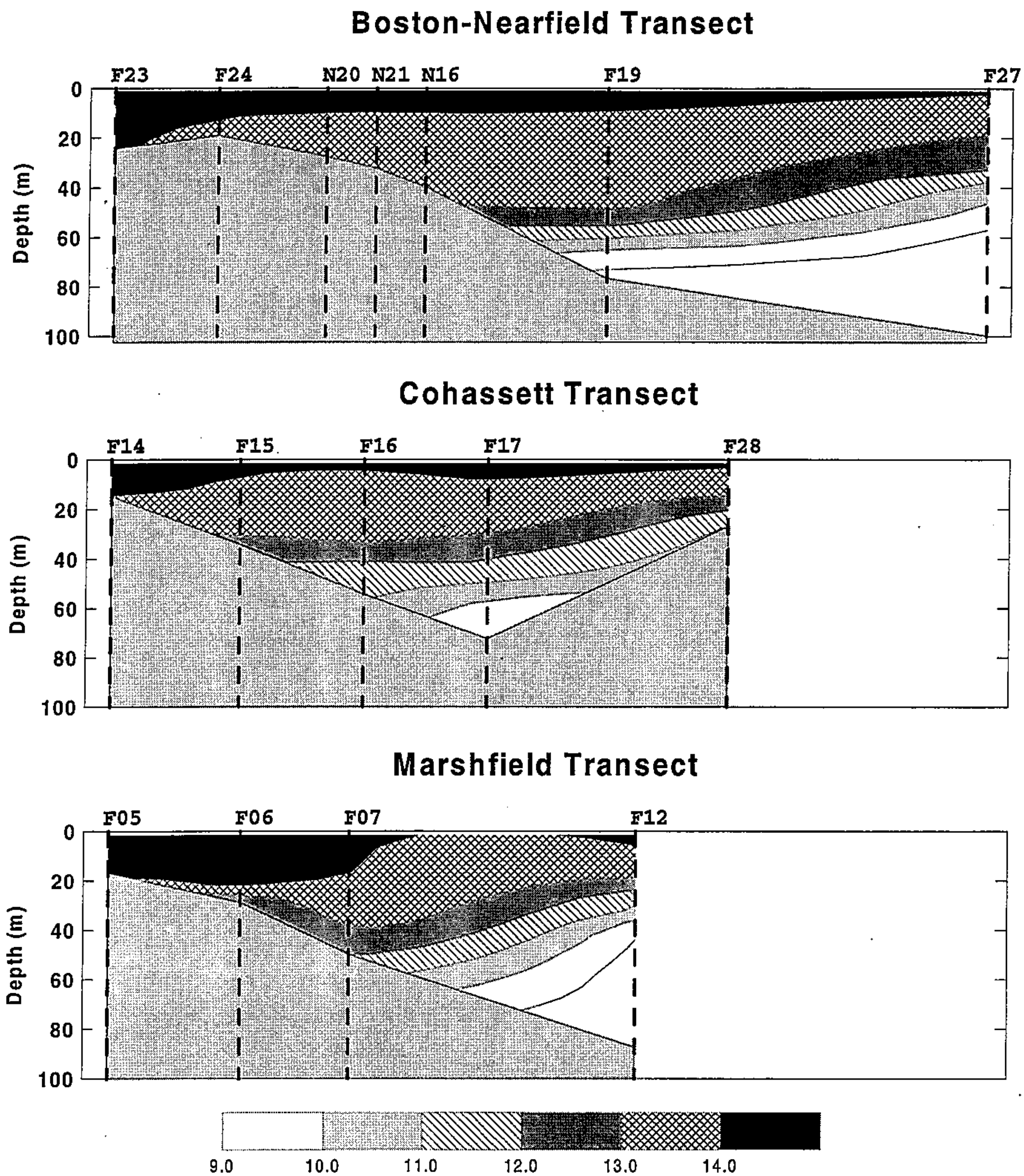


Marshfield Transect

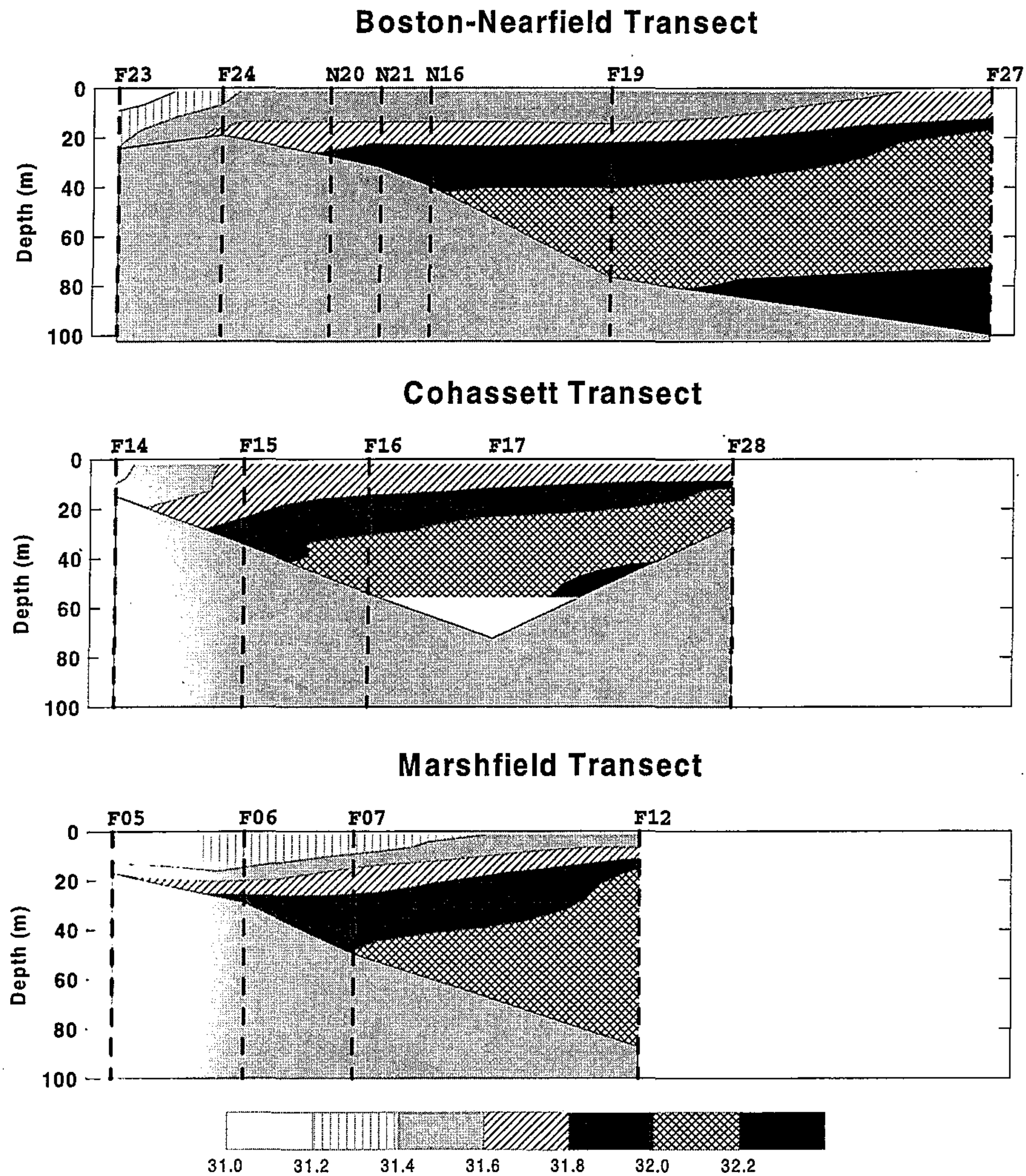


Sigma-T 9514

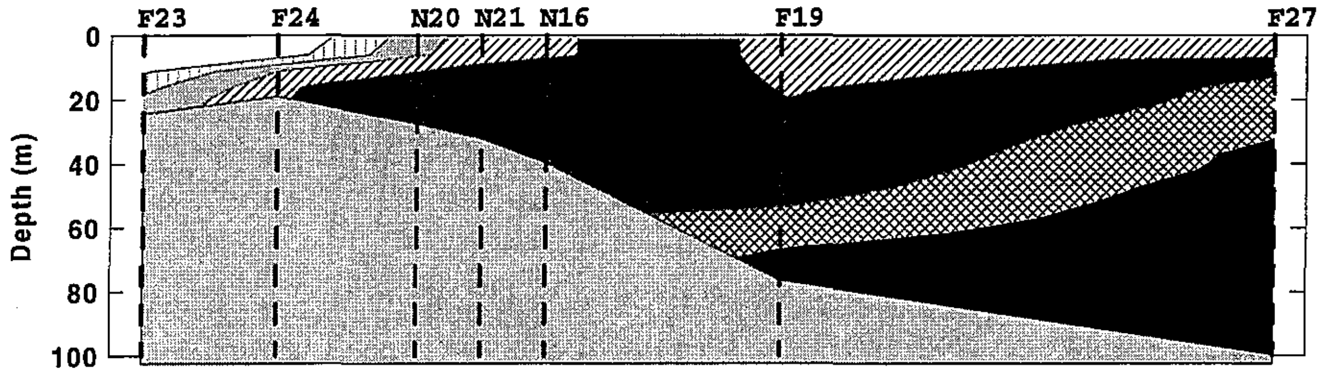

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
5.0
8.0
11.0
14.0
17.0



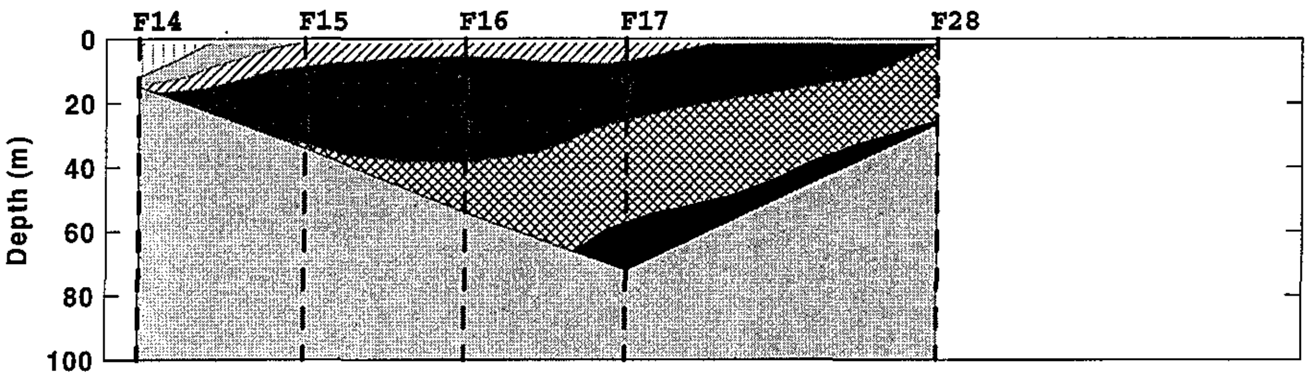
Temperature 9514


Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
31.0
31.2
31.4
31.6
31.8
32.0
32.2

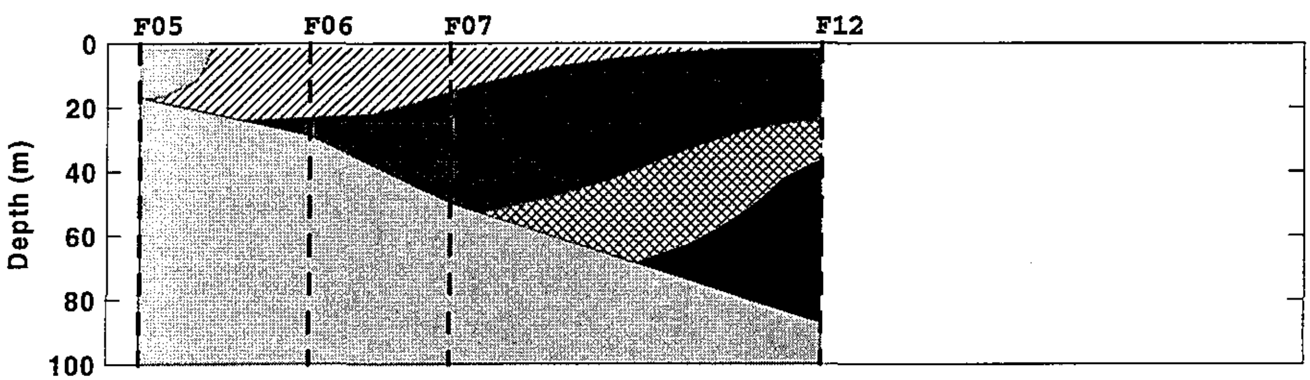
Boston-Nearfield Transect

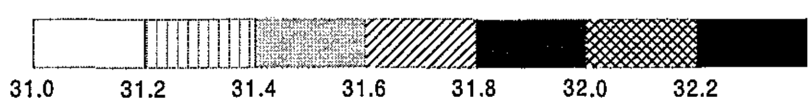


Cohassett Transect

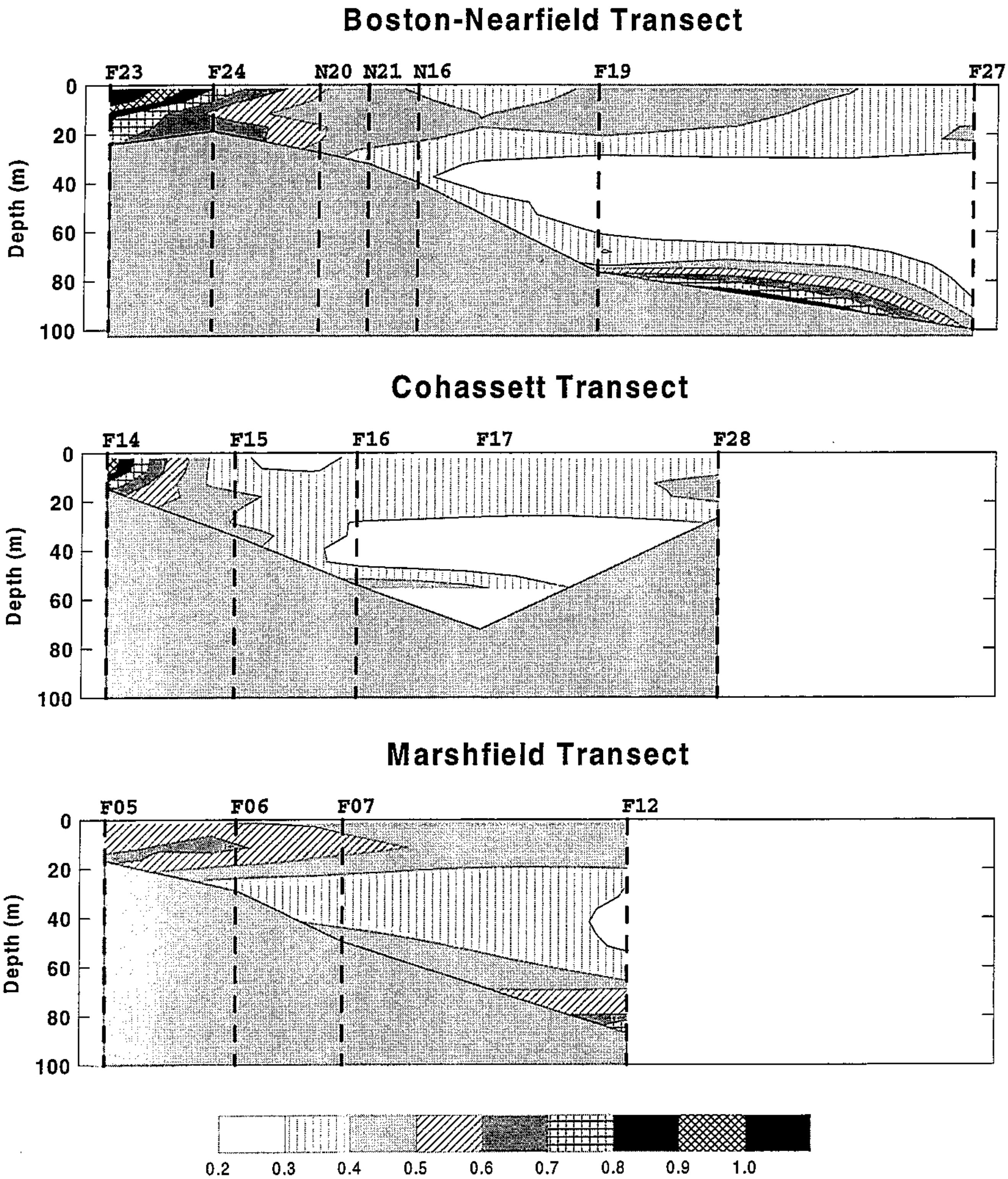


Marshfield Transect

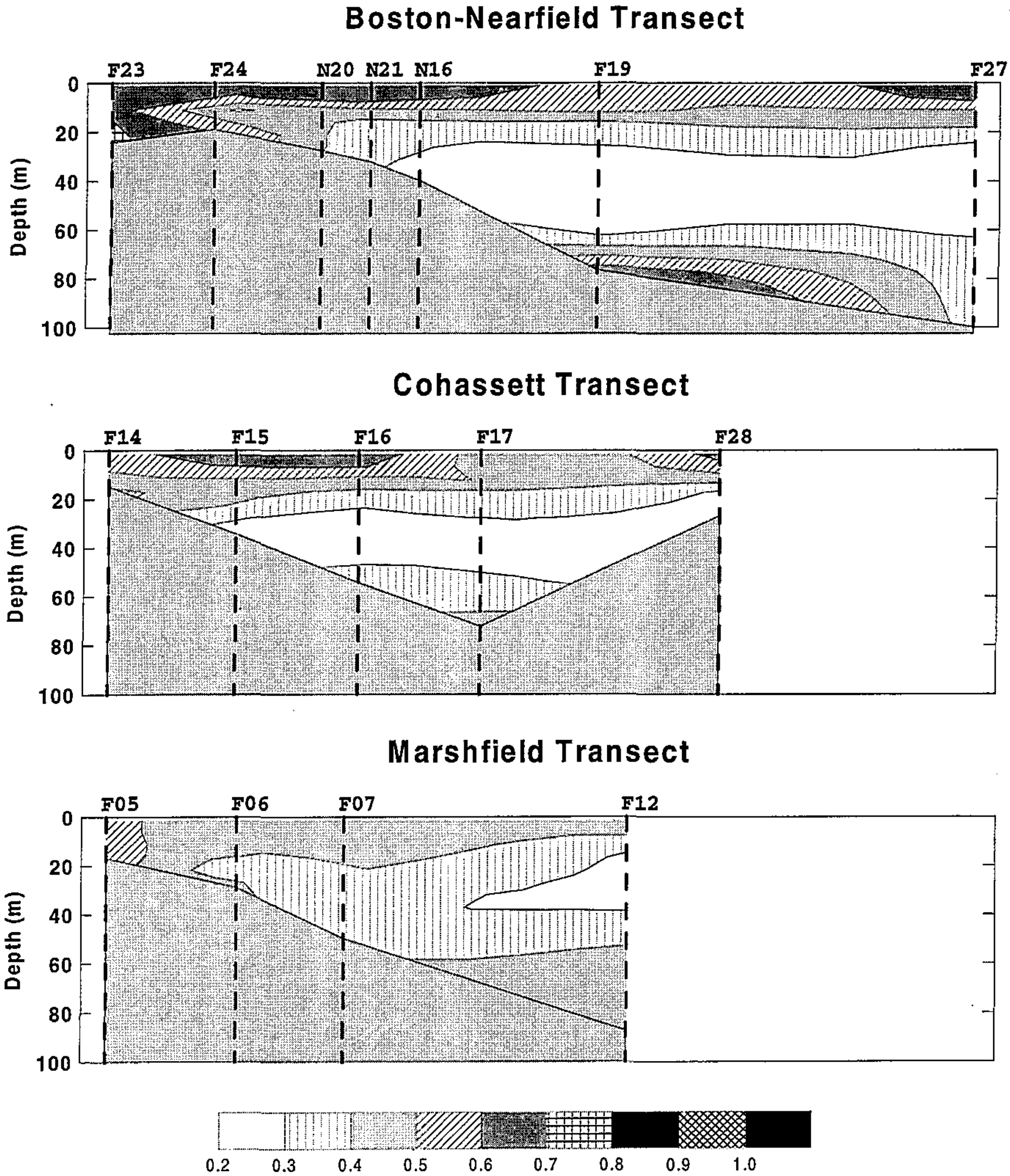




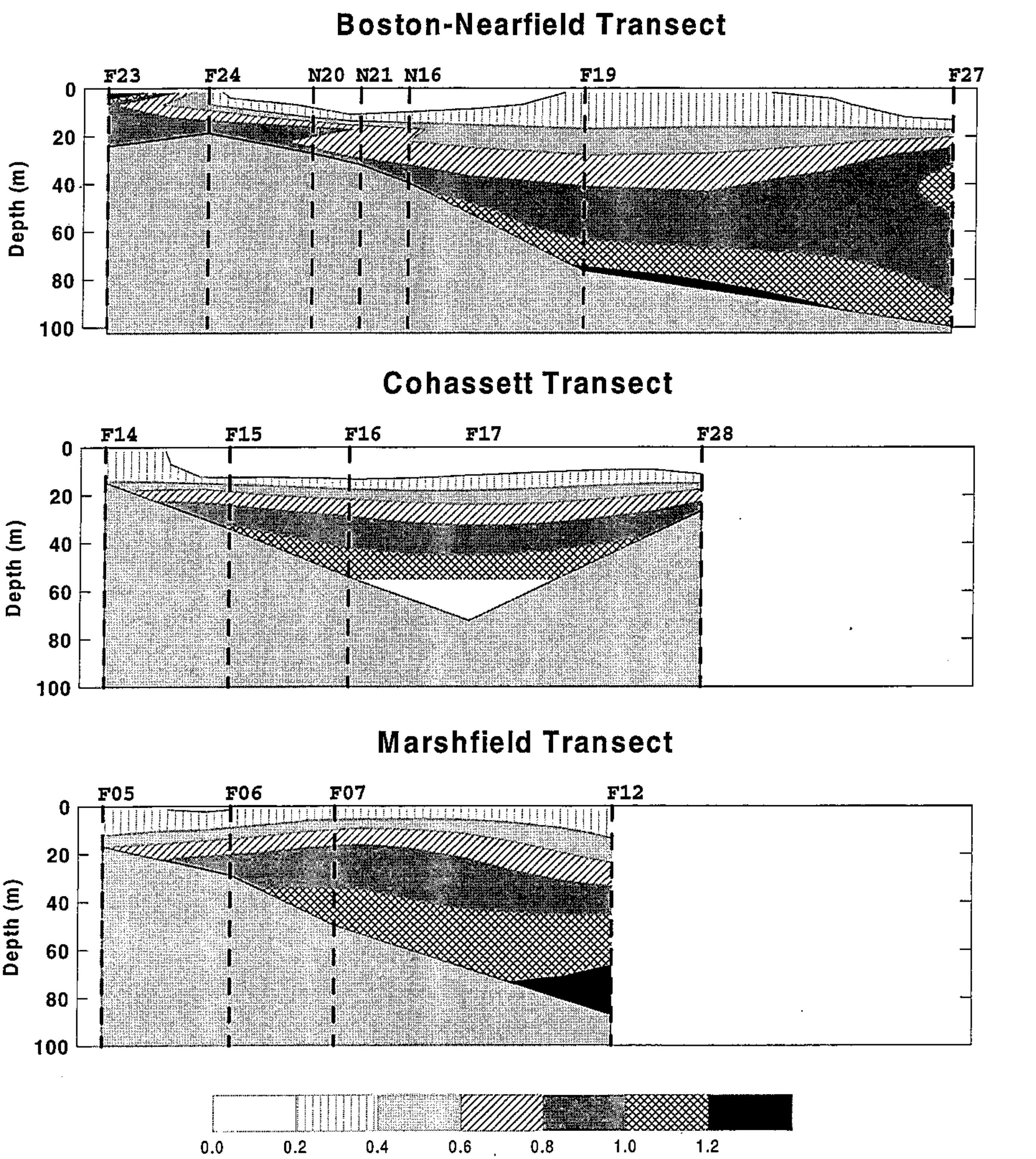
Salinity 9514

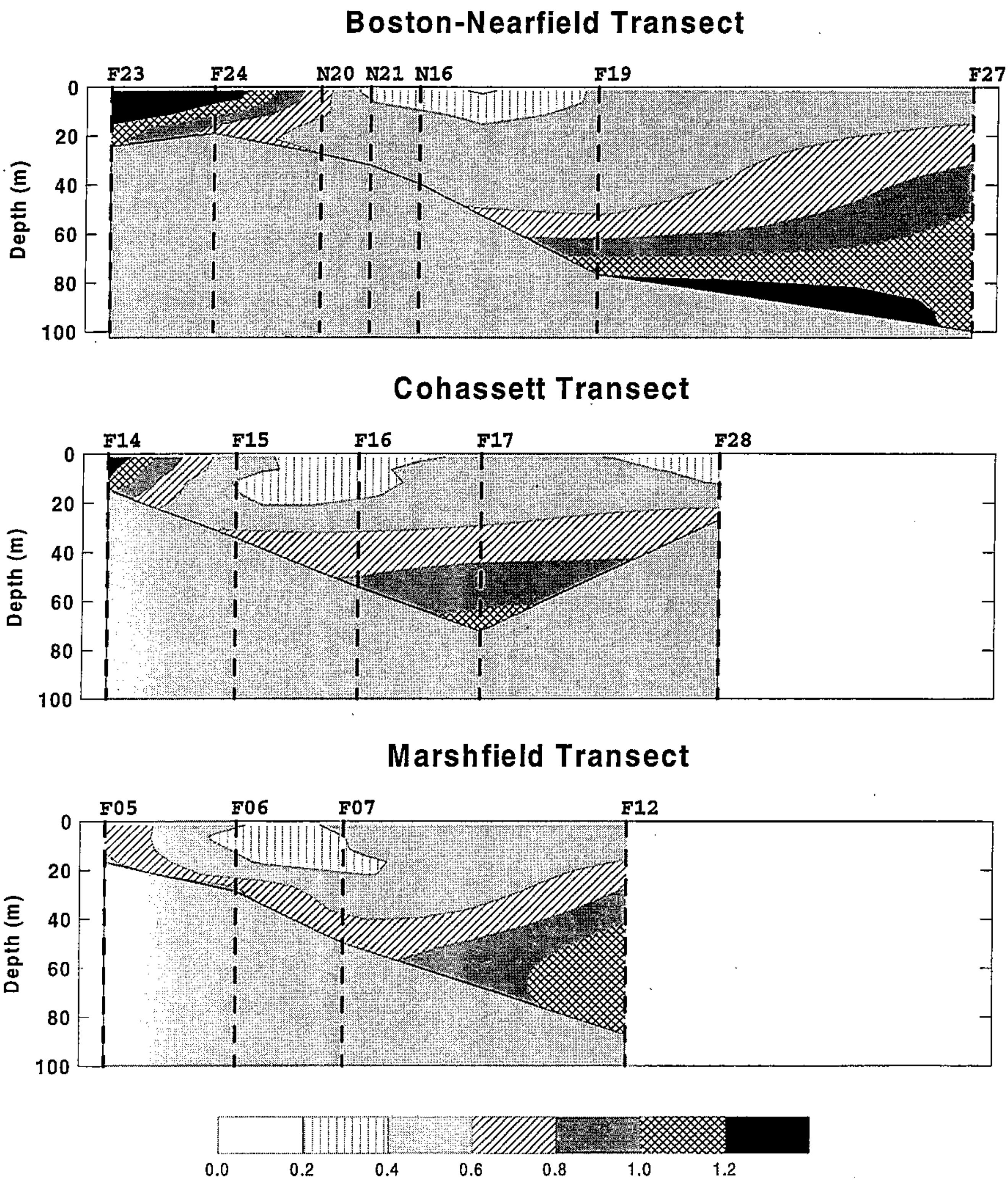


Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

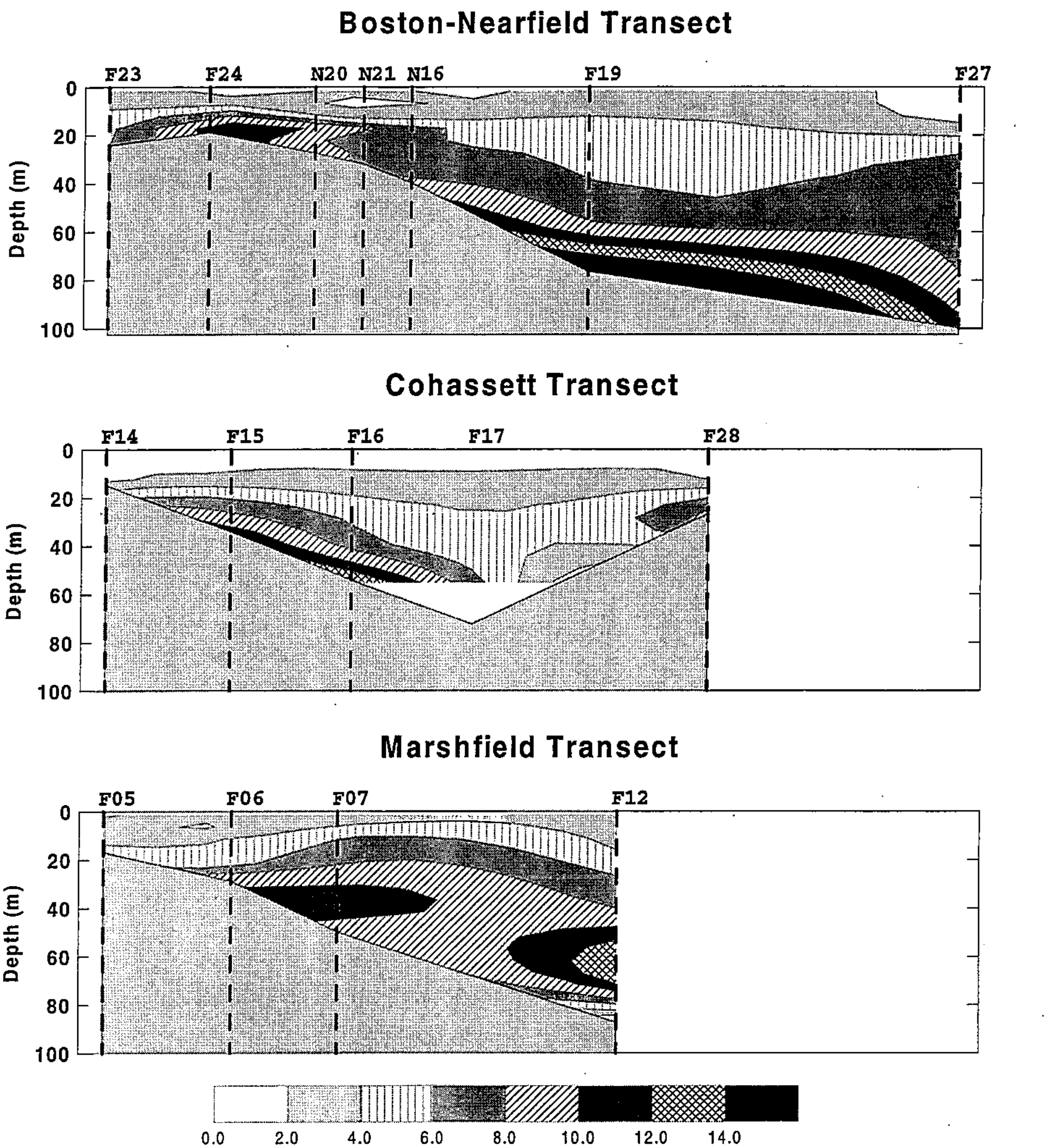

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

Trans 9514

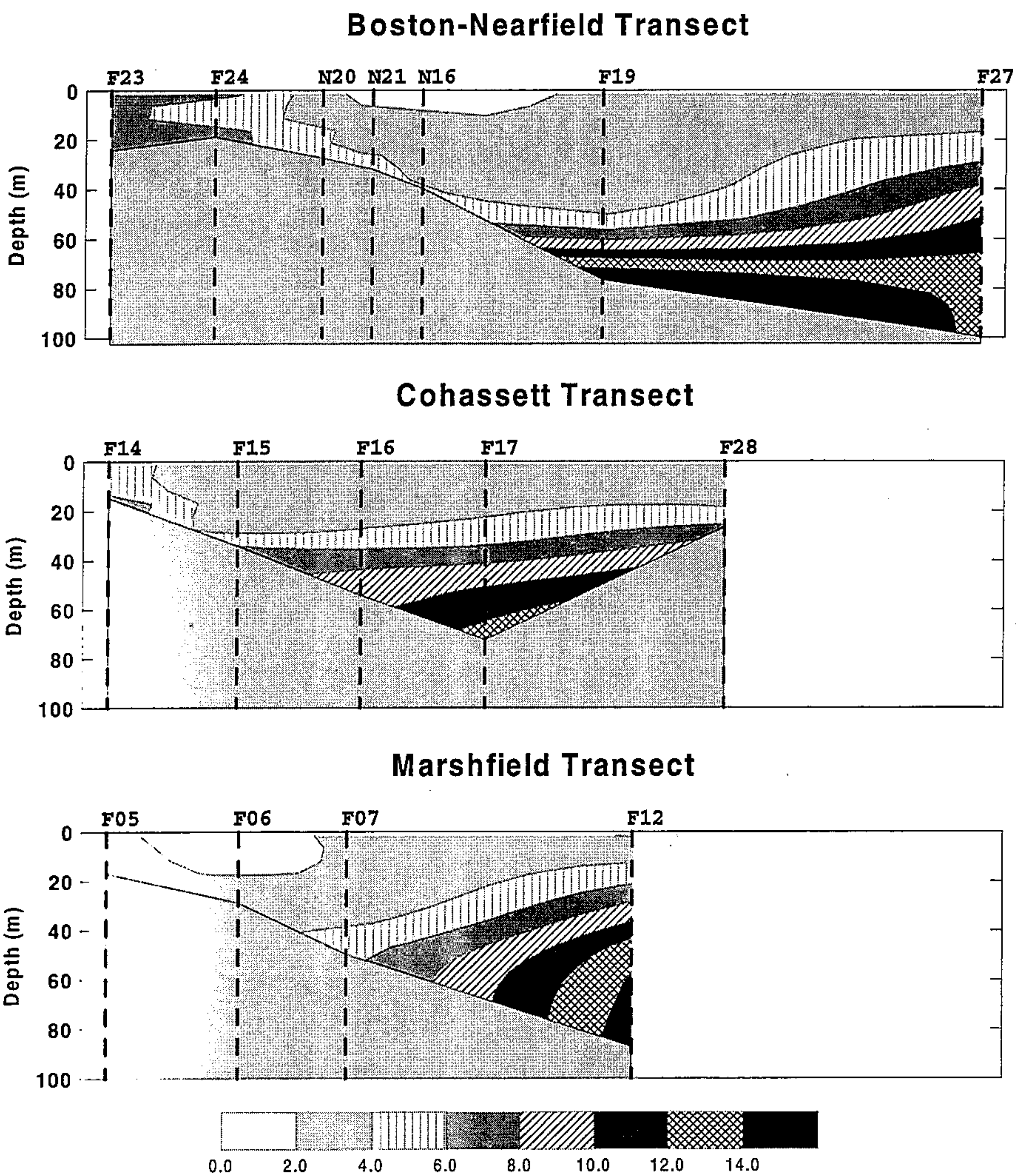

Boston-Nearfield Transect
F23 F24 N20 N21 N16 F19 F27
Depth (m)
0 20 40 60 80 100
Cohassett Transect
F14 F15 F16 F17 F28
Depth (m)
0 20 40 60 80 100
Marshfield Transect
F05 F06 F07 F12
Depth (m)
0 20 40 60 80 100
0.0 0.2 0.4 0.6 0.8 1.0 1.2



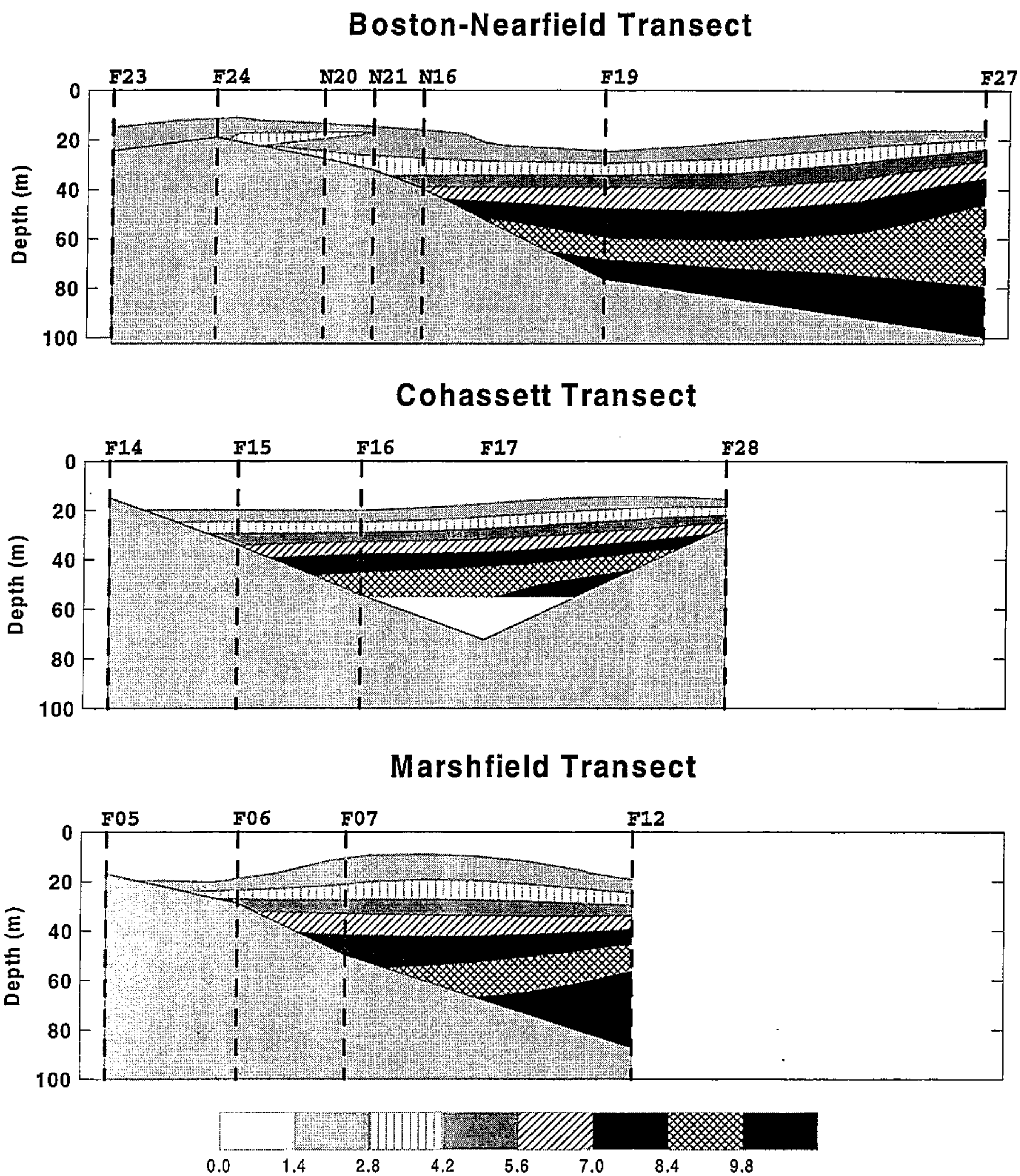
Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0
1.2



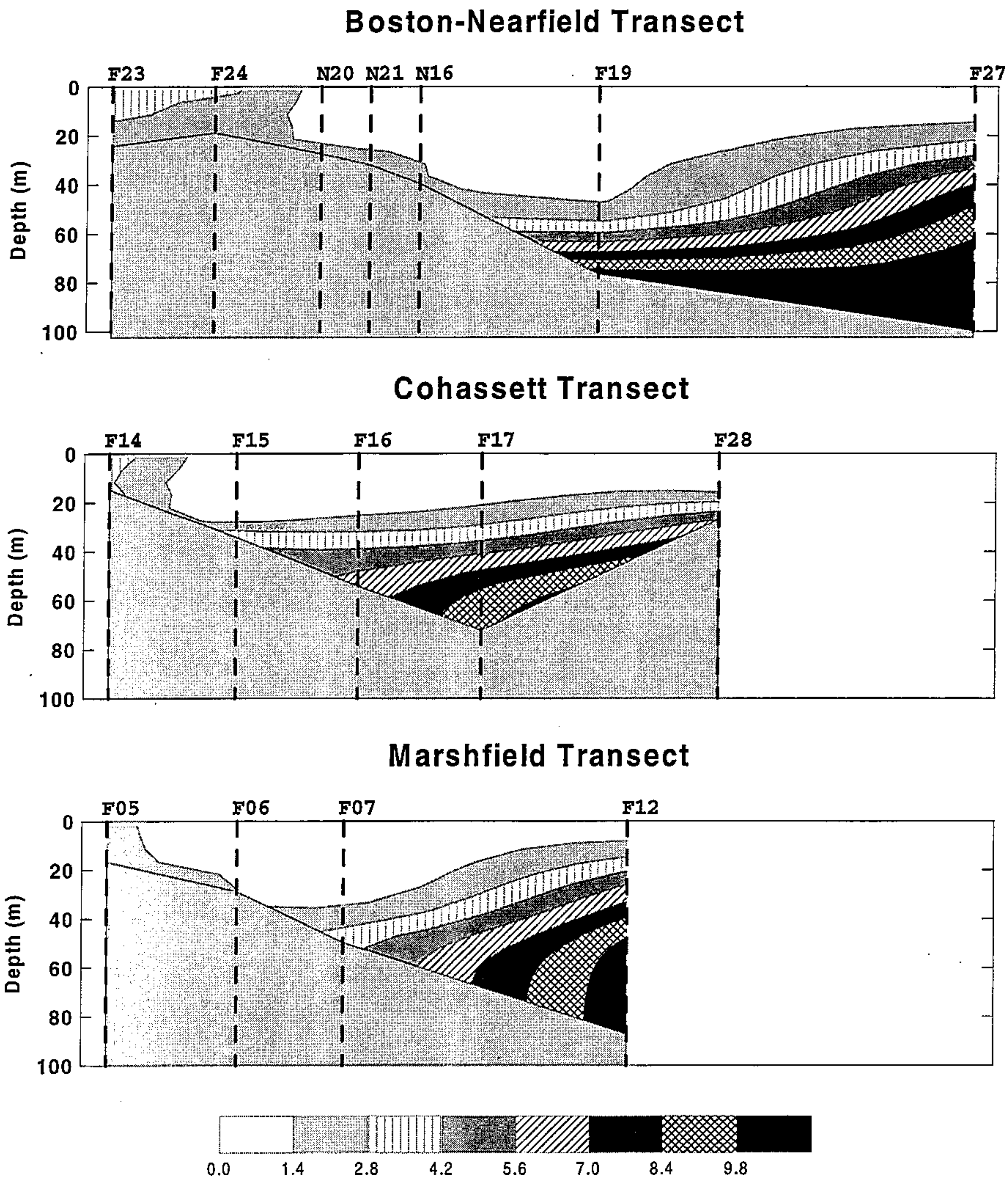
Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Marshfield Transect
F05
F06
F07
F12
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0


Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0

SIO4 9514

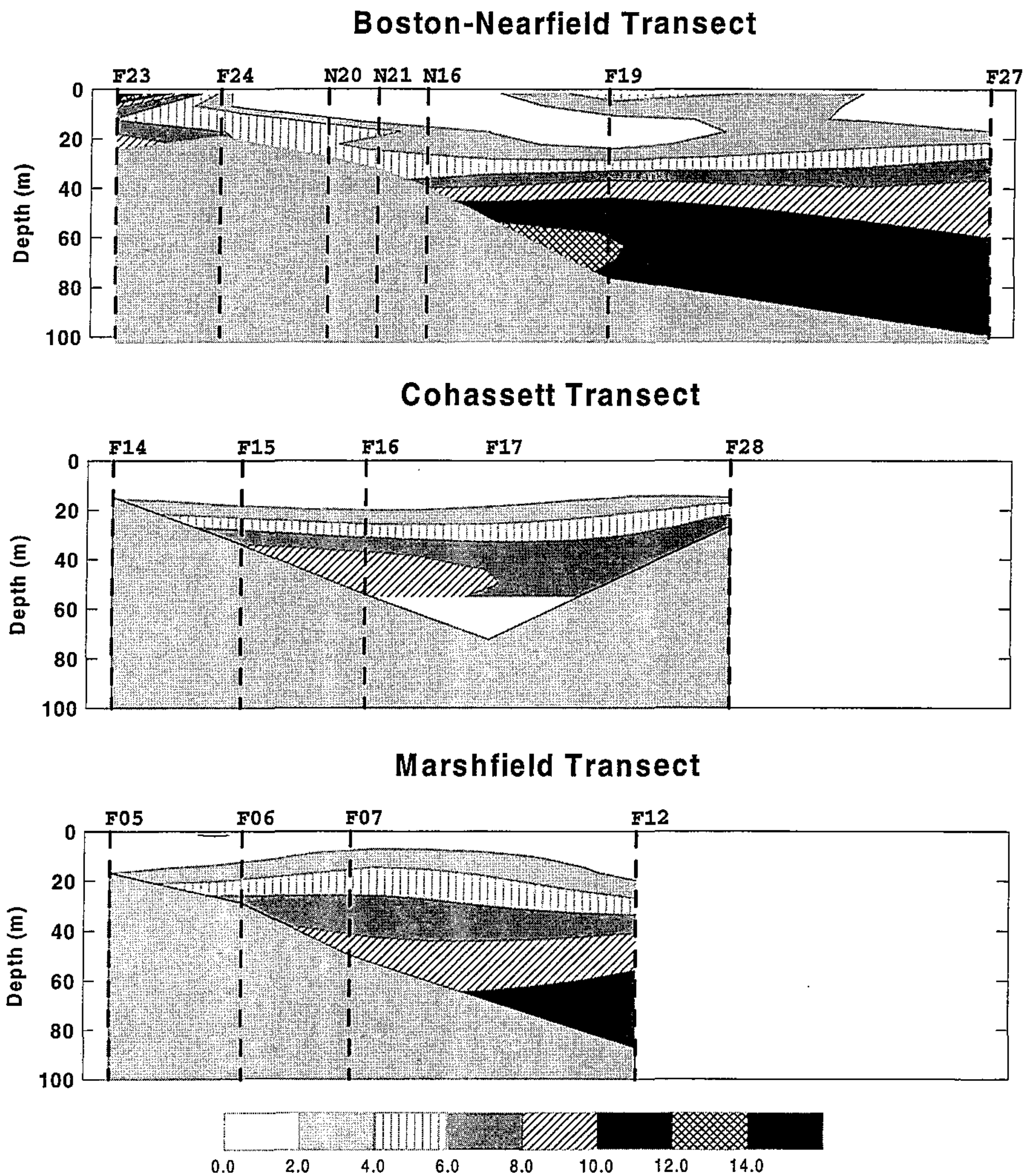

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.0
1.4
2.8
4.2
5.6
7.0
8.4
9.8

NO3 9511

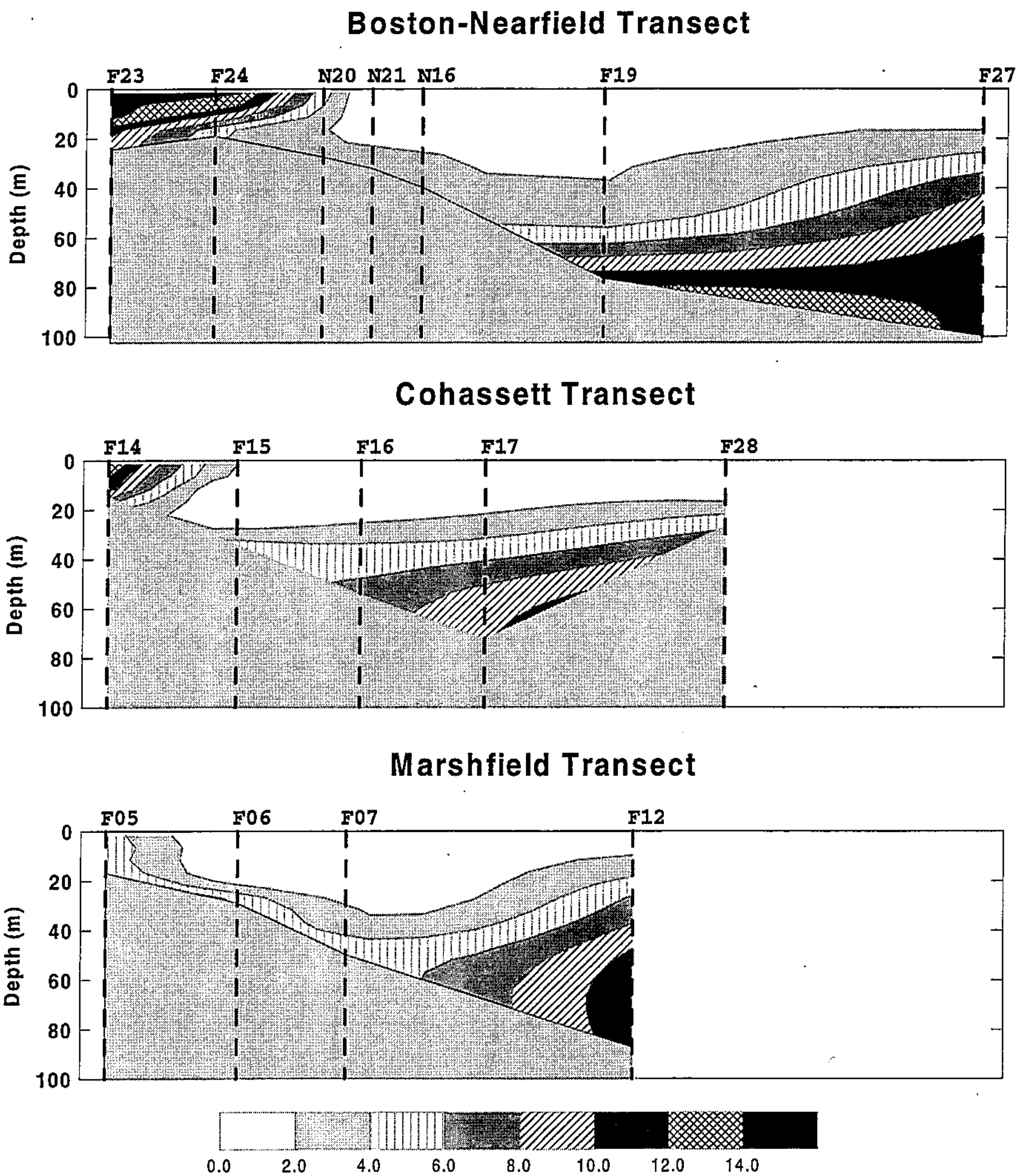


Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.0
1.4
2.8
4.2
5.6
7.0
8.4
9.8

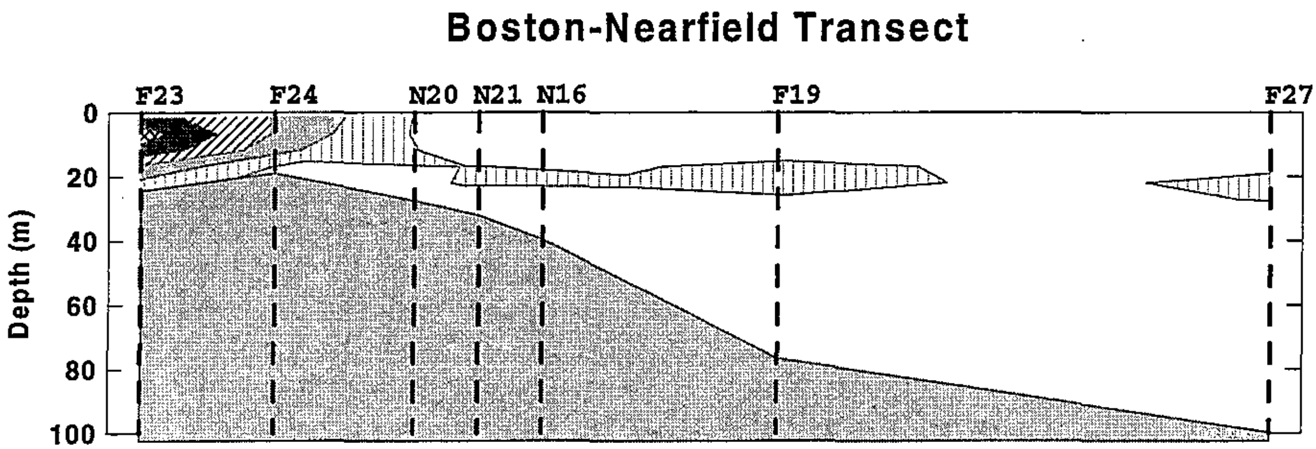
NO3 9514

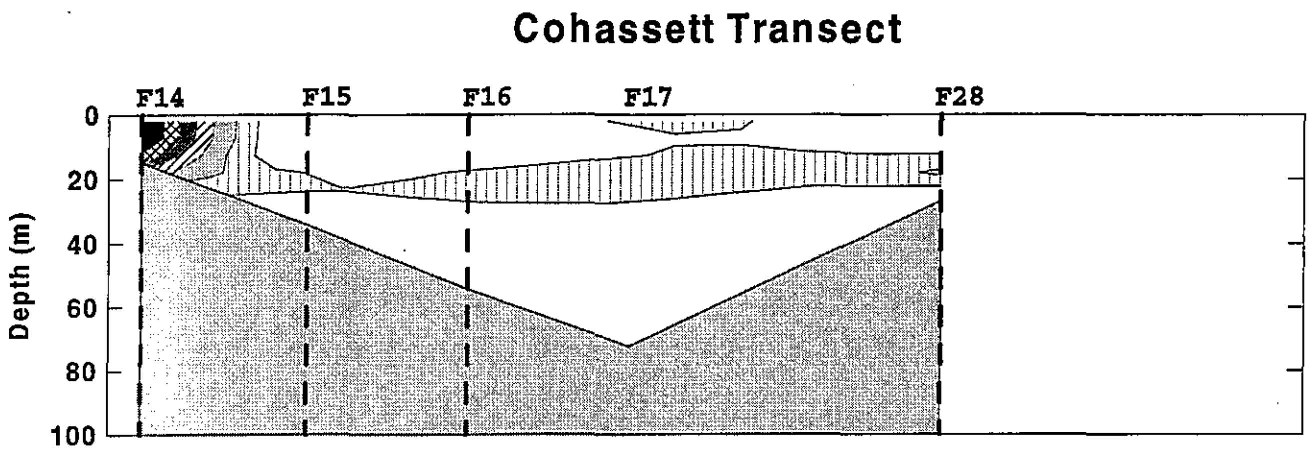


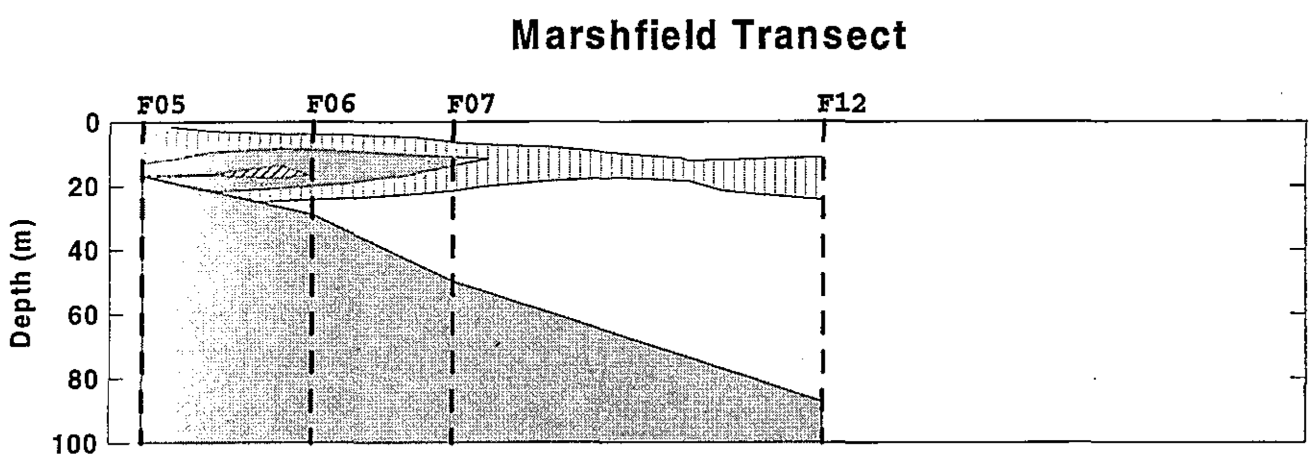
DI Nitro 9511

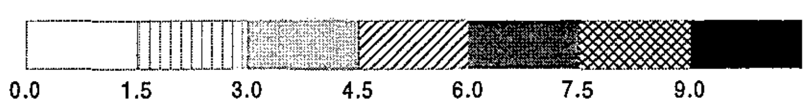


DI Nitro 9514

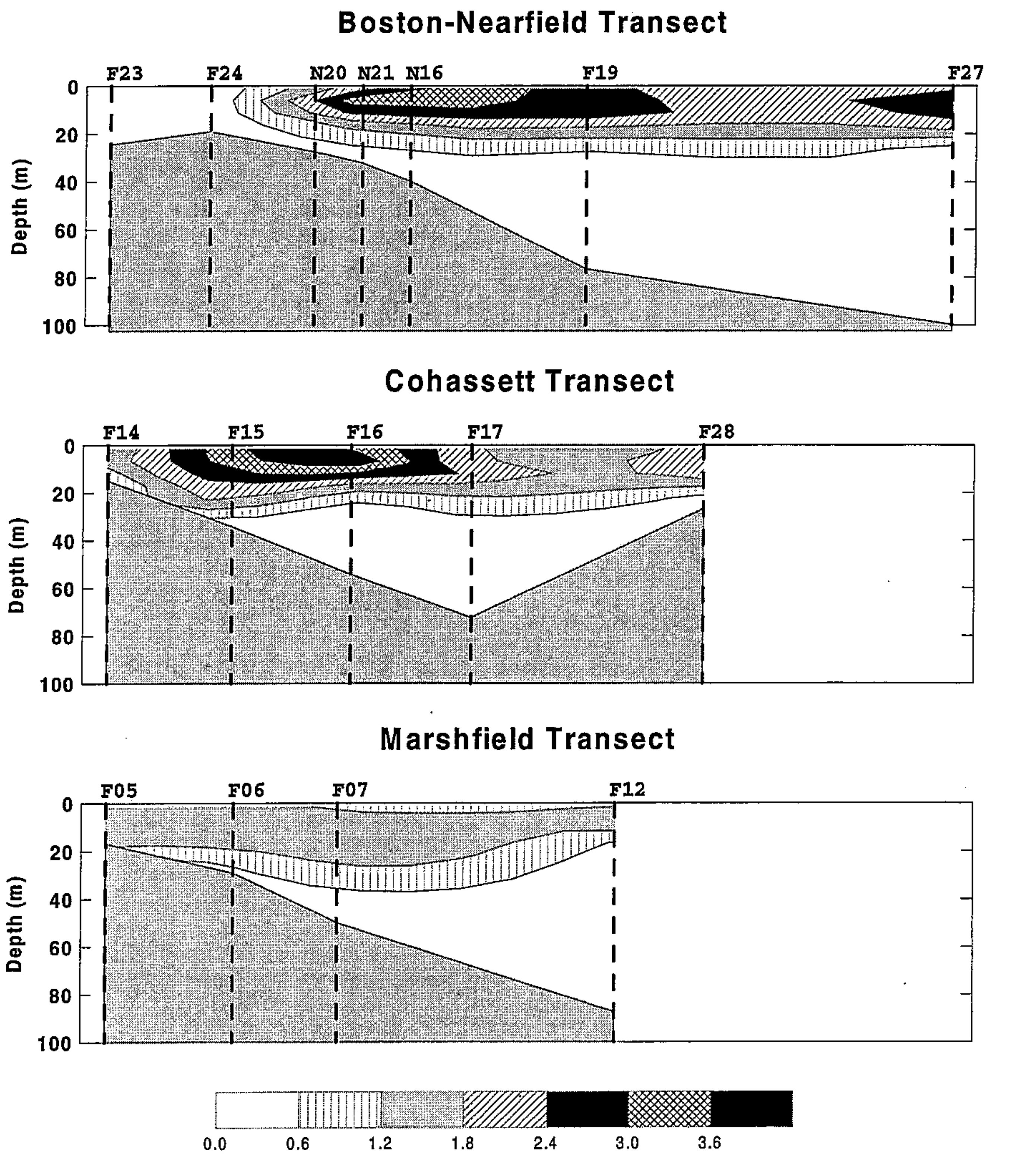








Fluorescence 9511

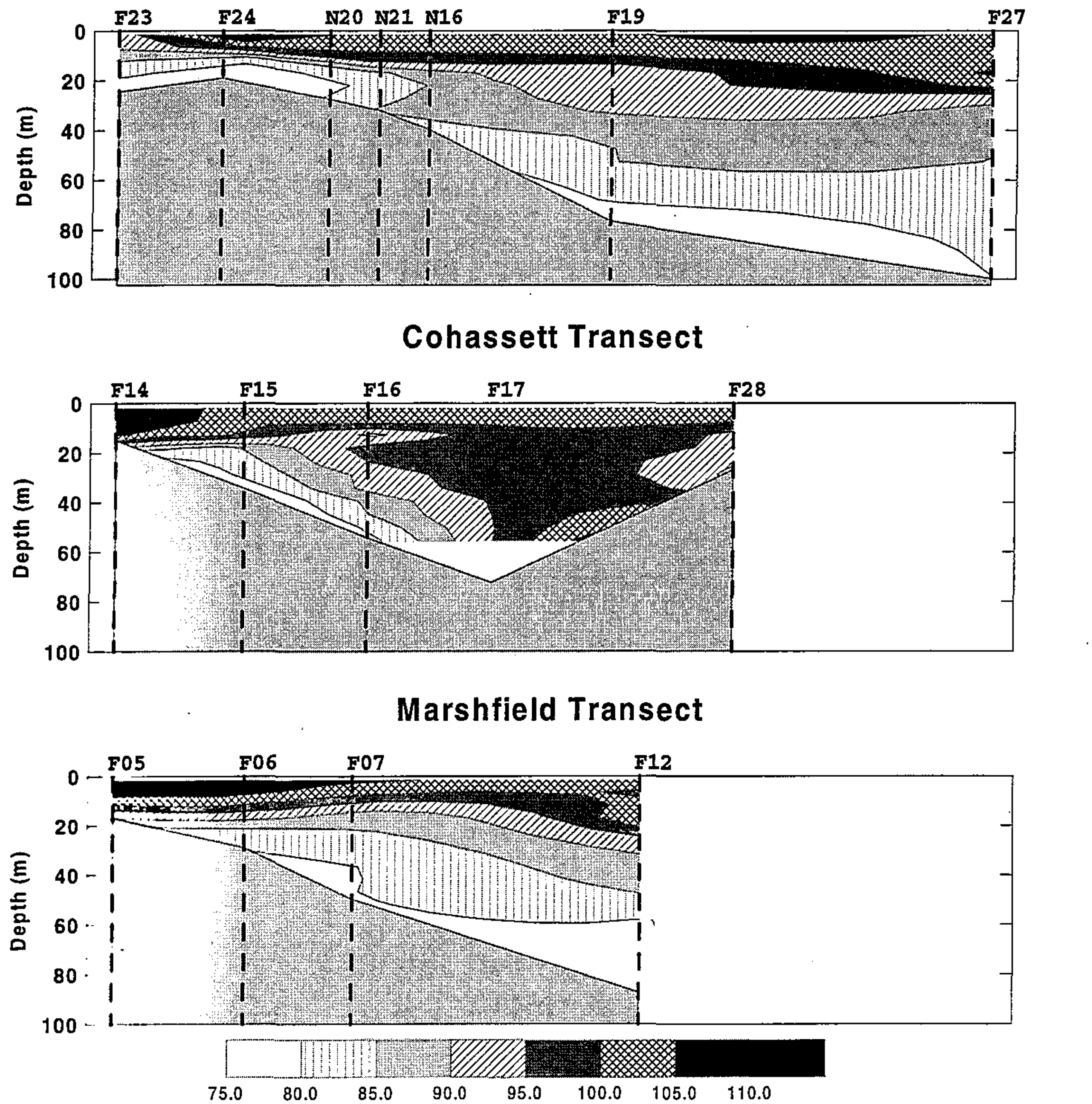


Fluorescence 9514

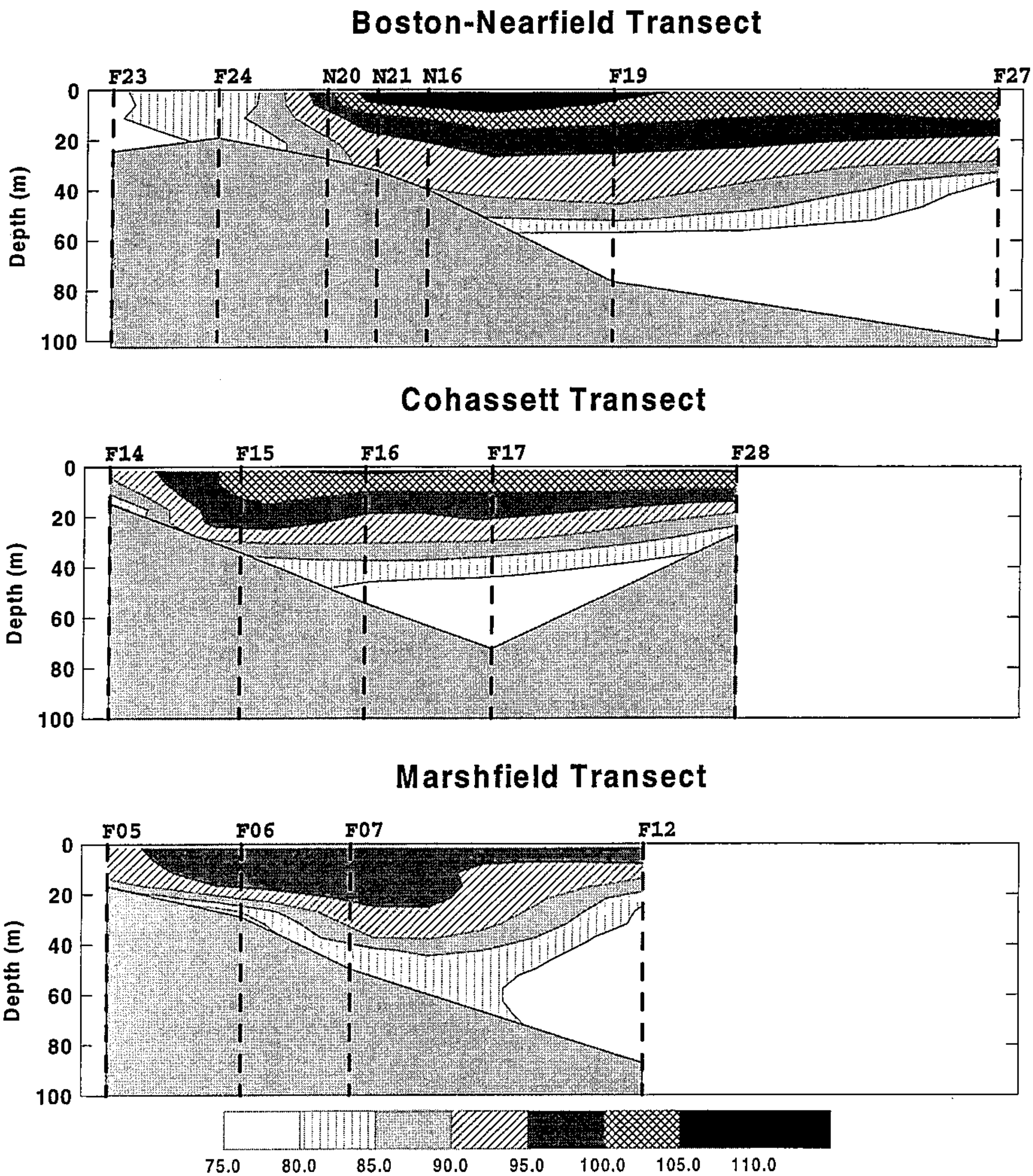
Boston-Nearfield Transect

Cohassett Transect

Marshfield Transect



DO % Saturation 9511



DO % Saturation 9514

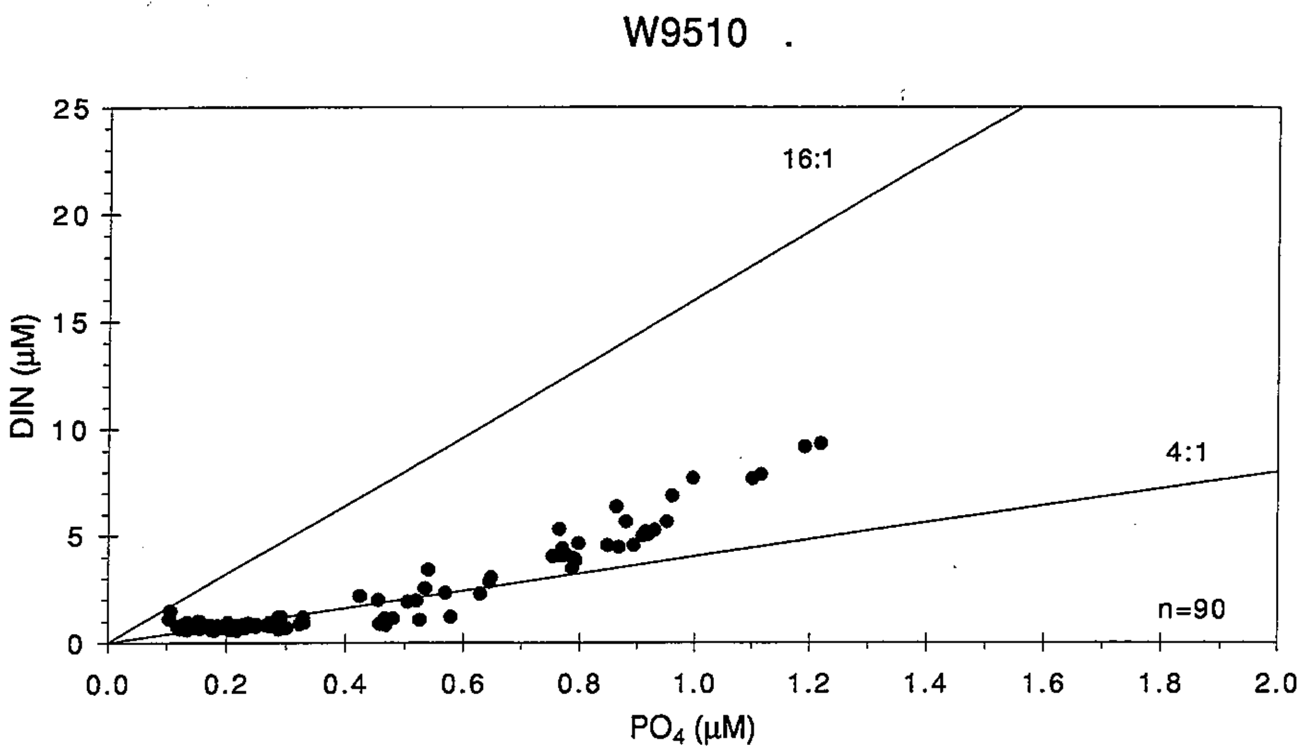
APPENDIX D

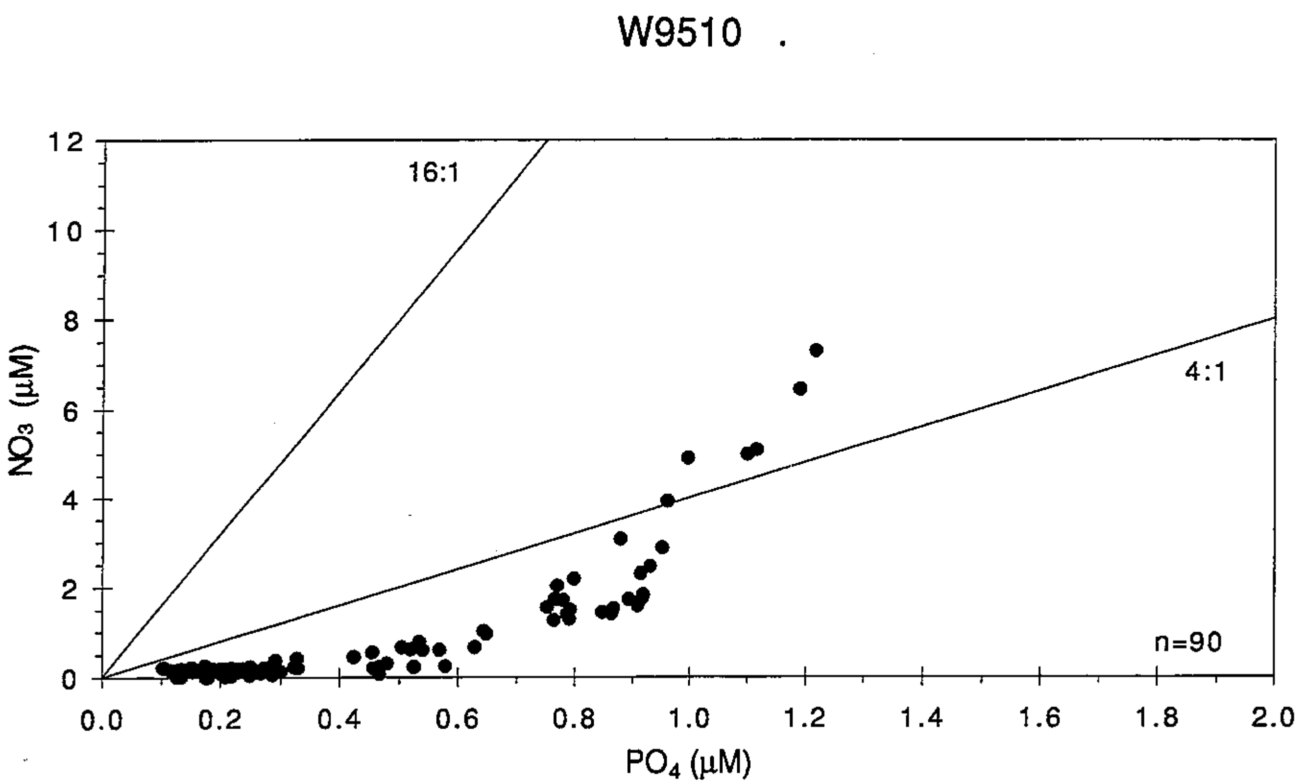
Nutrient Scatter Plots

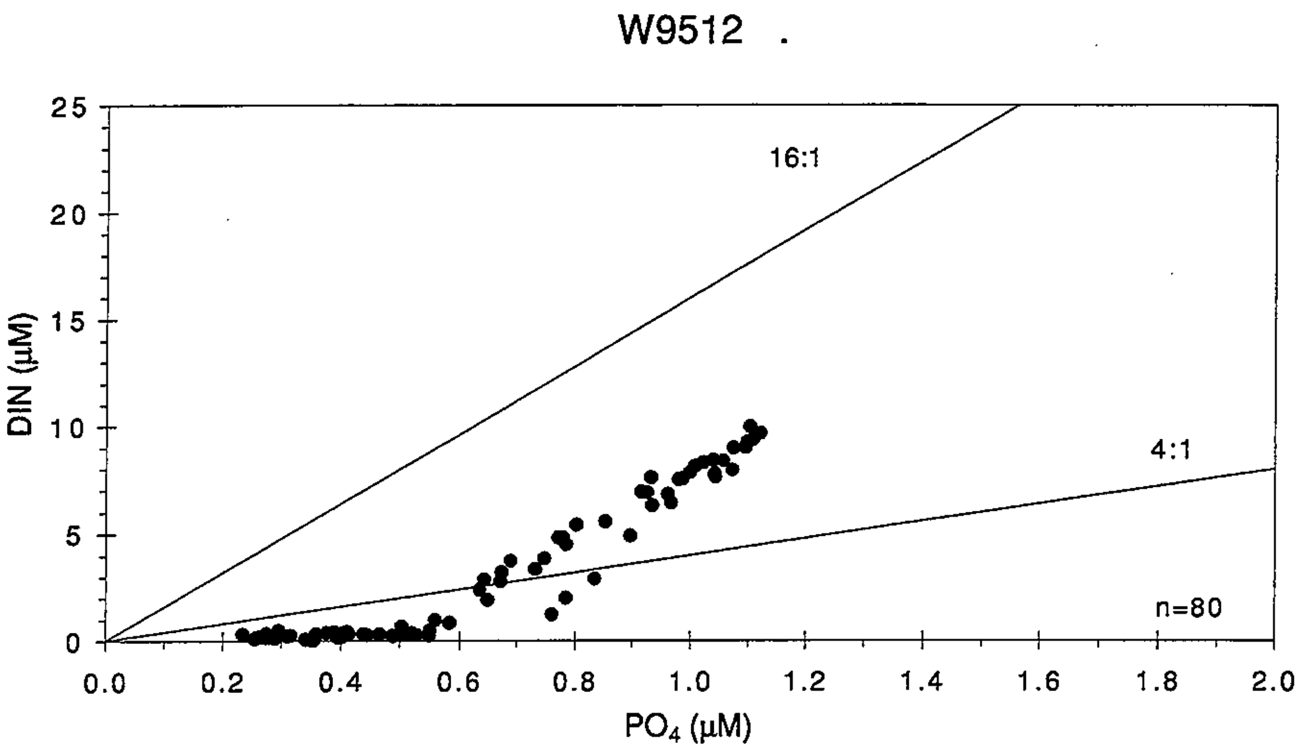
Scatter plots are included for every survey conducted during the semi-annual period. Each plot includes all stations and all depths unless otherwise noted. The plots are organized by type of plot, and then by survey. Combined nearfield/farfield surveys show the regions with different symbols, including boundary (BOU), Cape Cod Bay (CCB), coastal (COA), Boston Harbor (BH), nearfield (NEA), and offshore (OFF). Available plots, in the order they appear in the appendix, are summarized in the table below.

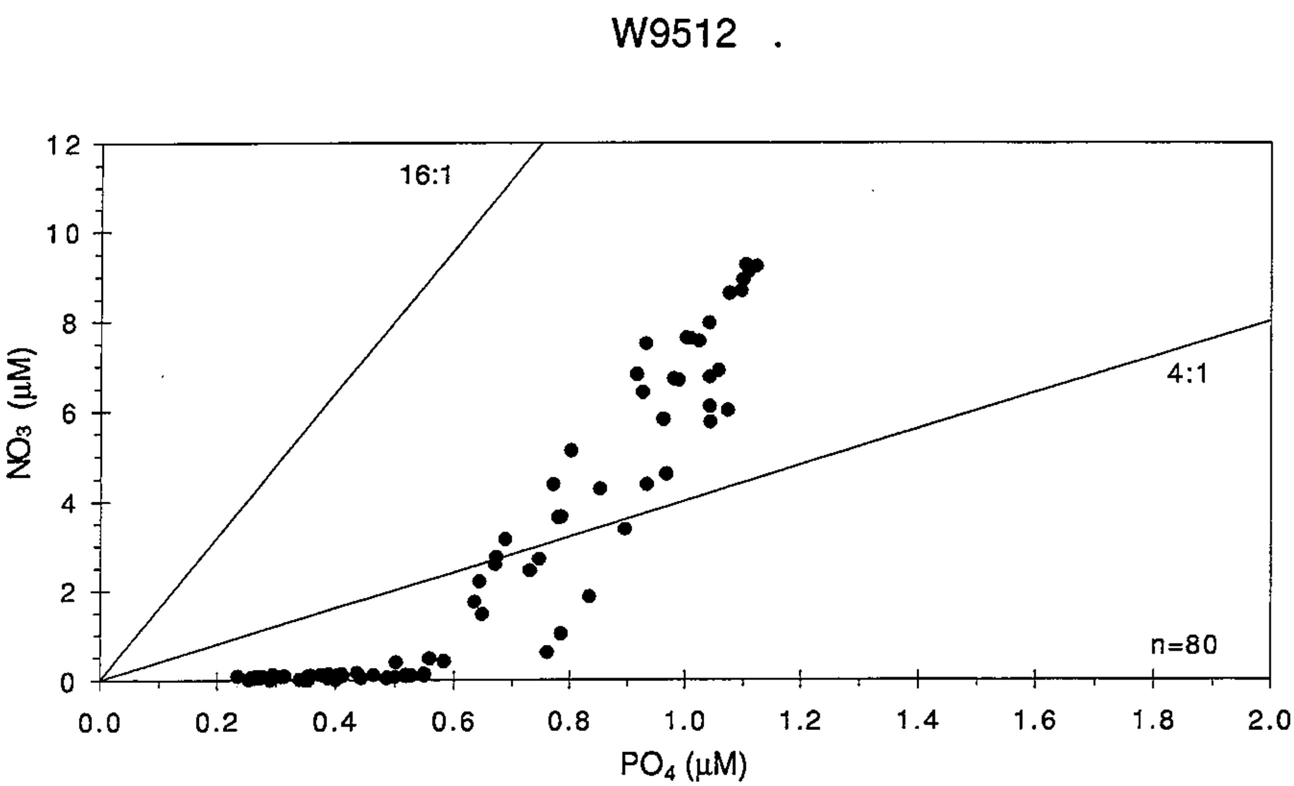
Type of Plot	Surveys	Comments
PO_4:DIN; PO_4:NO_3	W9511-17	Lines of nitrogen:phosphate
PO_4:NH_4; SiO_4:NH_4	W9511-17	
SiO_4:DIN; SiO_4:NO_3	W9511-17	Lines of nitrogen:silicate
Salinity:DIN	W9511-17	Stations types A,D,F,G
Salinity:NH_4 and NO_3	W9511-17	
Salinity:PO_4 and SiO_4	W9511-17	
Salinity:TN and DIN+PON	W9511-17	Station types A,D,F,G
Depth:DIN	W9511-17	
Depth:NH_4 and NO_3	W9511-17	
Depth:PO_4 and SiO_4	W9511-17	

Acronyms:
DIN = dissolved inorganic nitrogen
PON = particulate organic nitrogen
TN = total dissolved nitrogen + PON

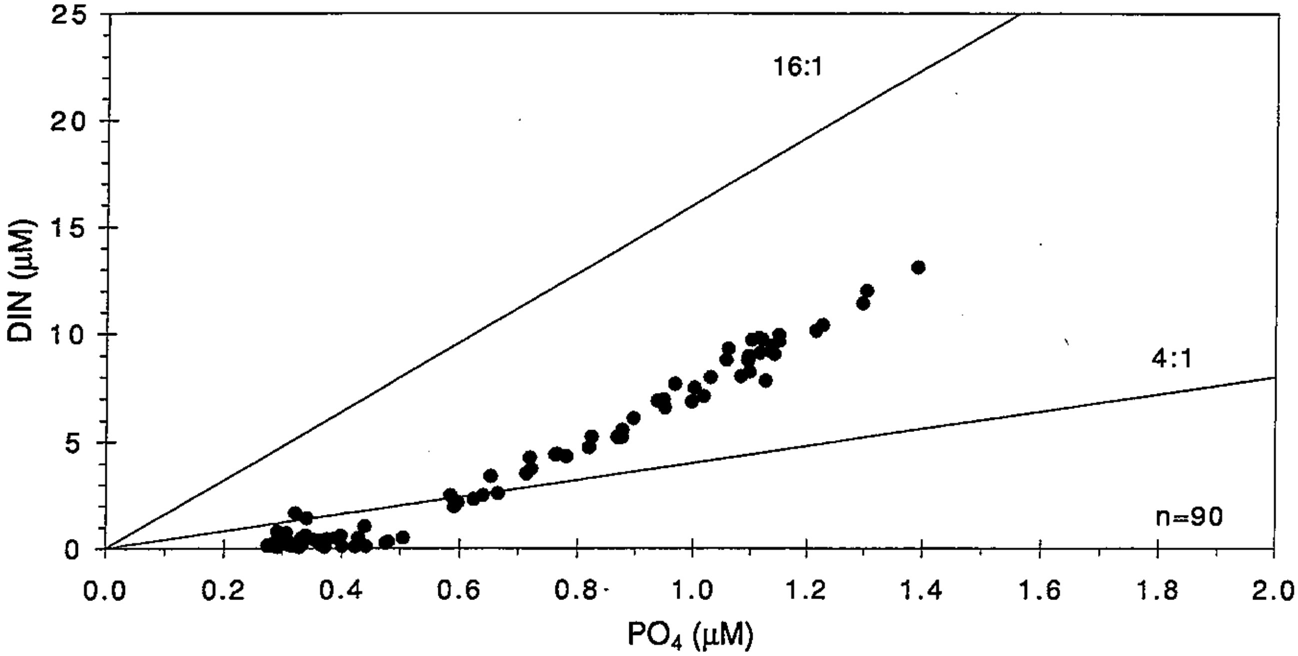

W9510 .
16:1
4:1
n=90
DIN (µM)
PO4 (µM)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
0
5
10
15
20
25


W9510 .
16:1
4:1
n=90
NO3 (µM)
PO4 (µM)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
0
2
4
6
8
10
12

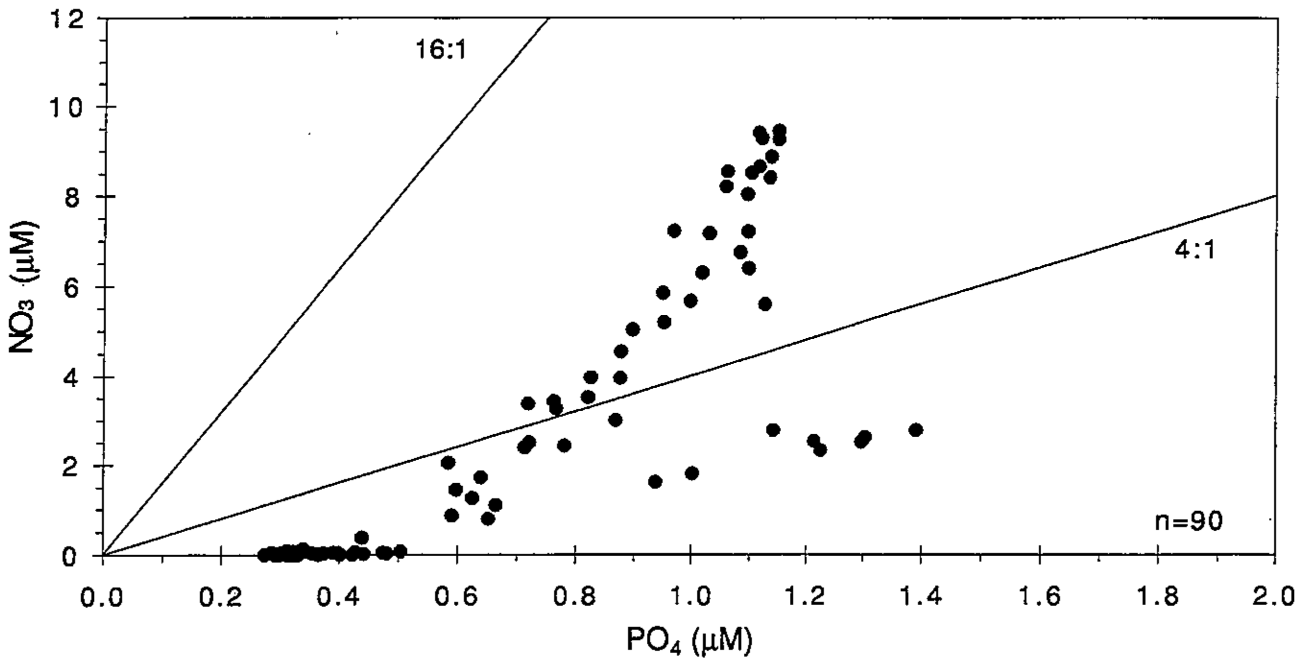

W9512 .
DIN (µM)
PO4 (µM)
16:1
4:1
n=80

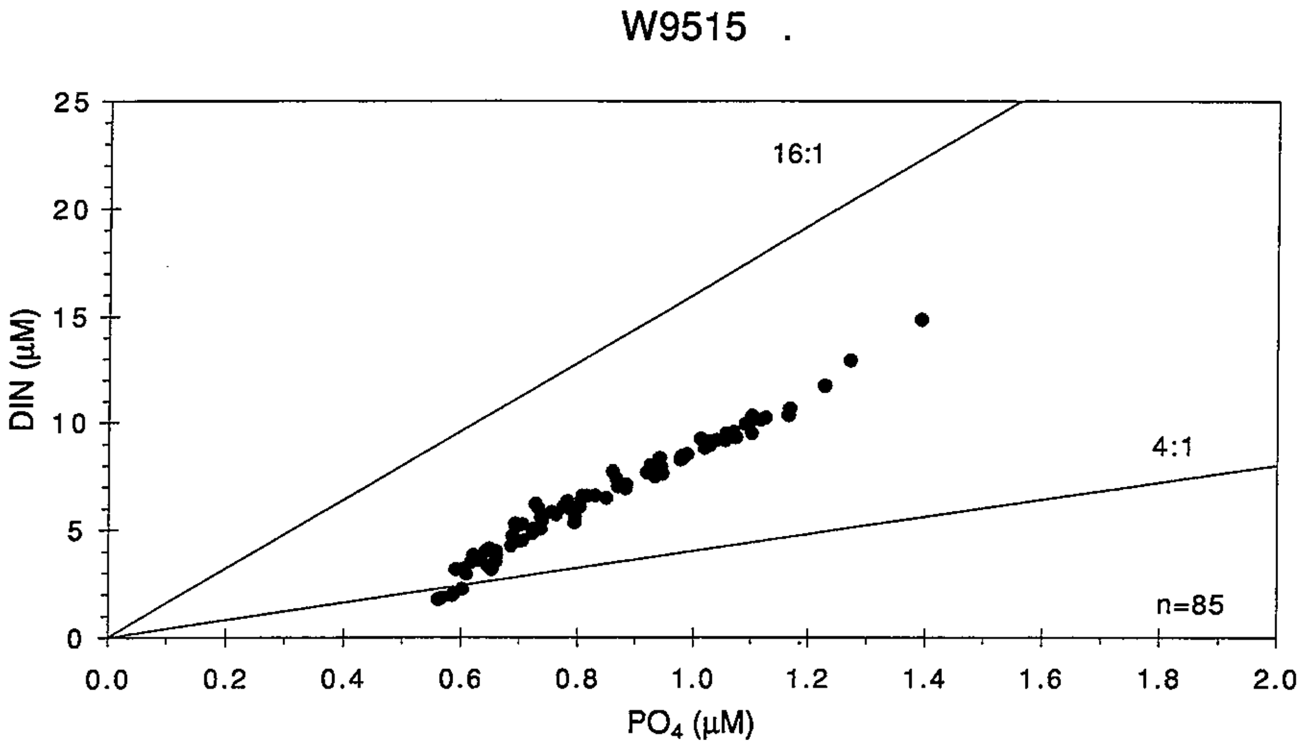

W9512 .
NO3 (µM)
PO4 (µM)
16:1
4:1
n=80

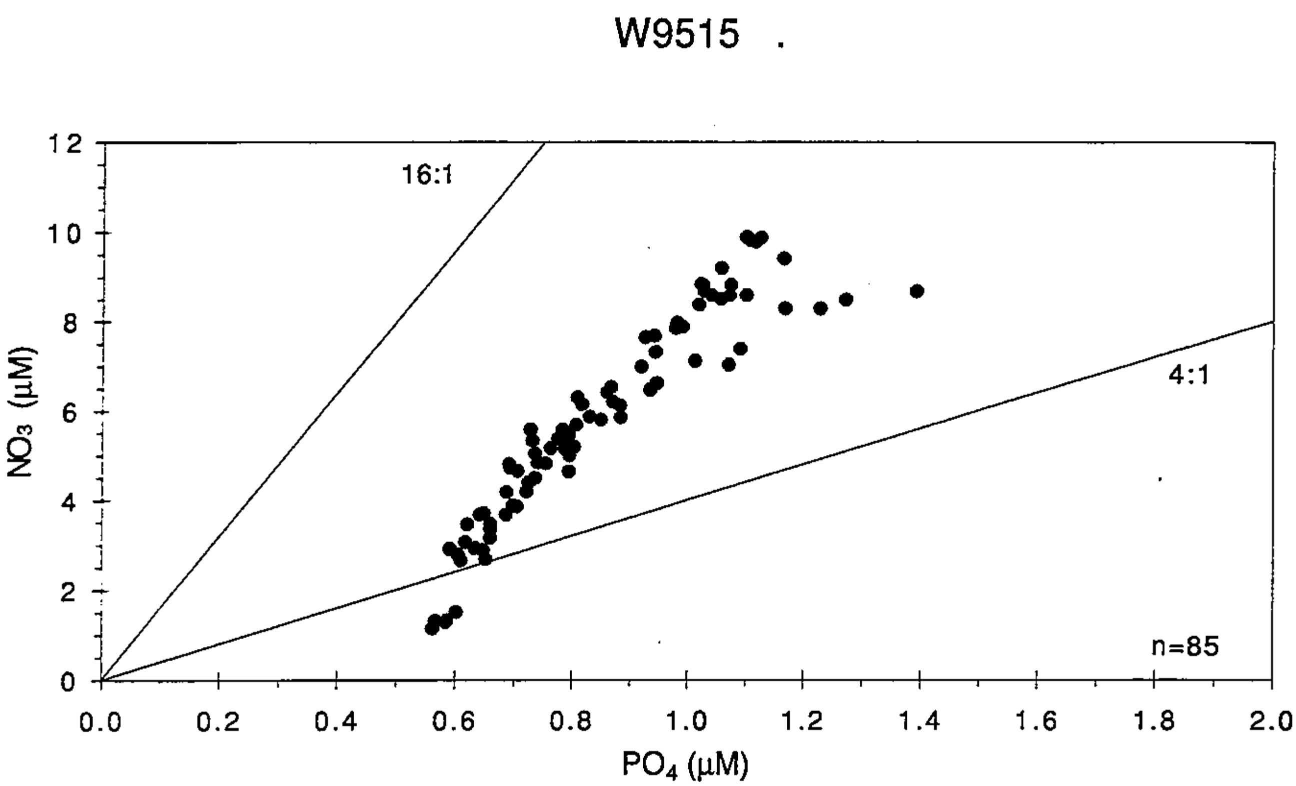
W9513 .


16:1
4:1
n=90
DIN (µM)
PO4 (µM)
0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0
0 5 10 15 20 25

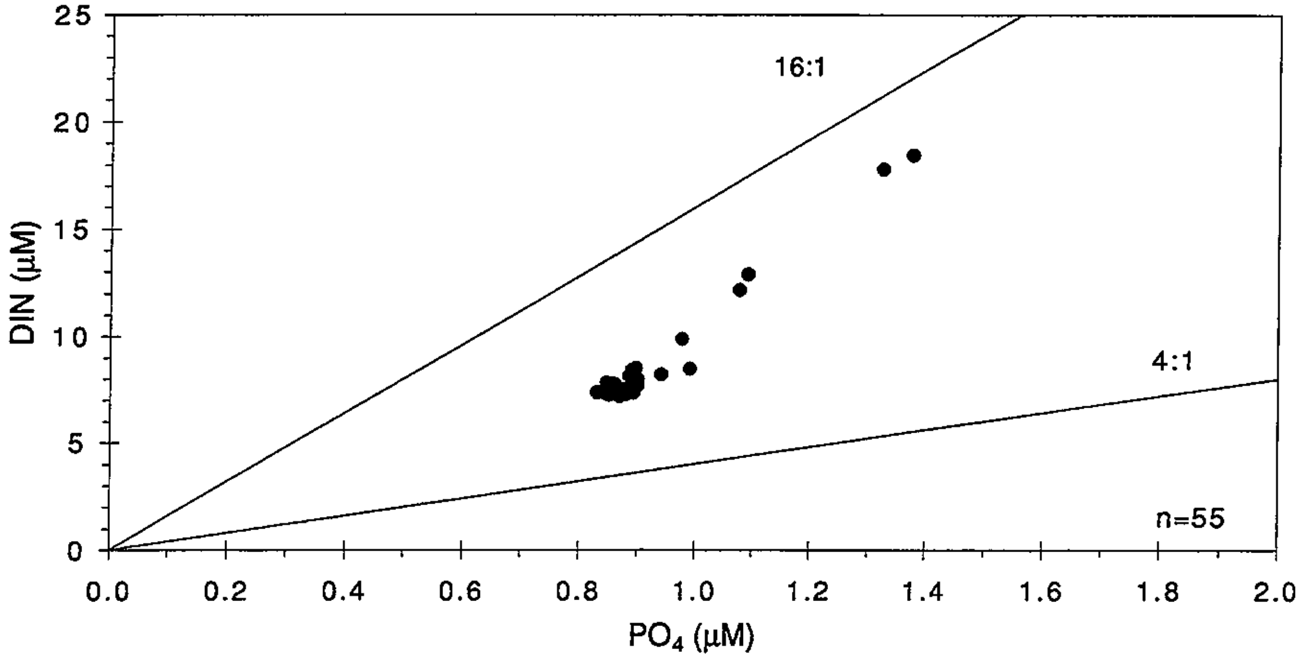
W9513 .


16:1
4:1
n=90
NO3 (µM)
PO4 (µM)
0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0
0 2 4 6 8 10 12

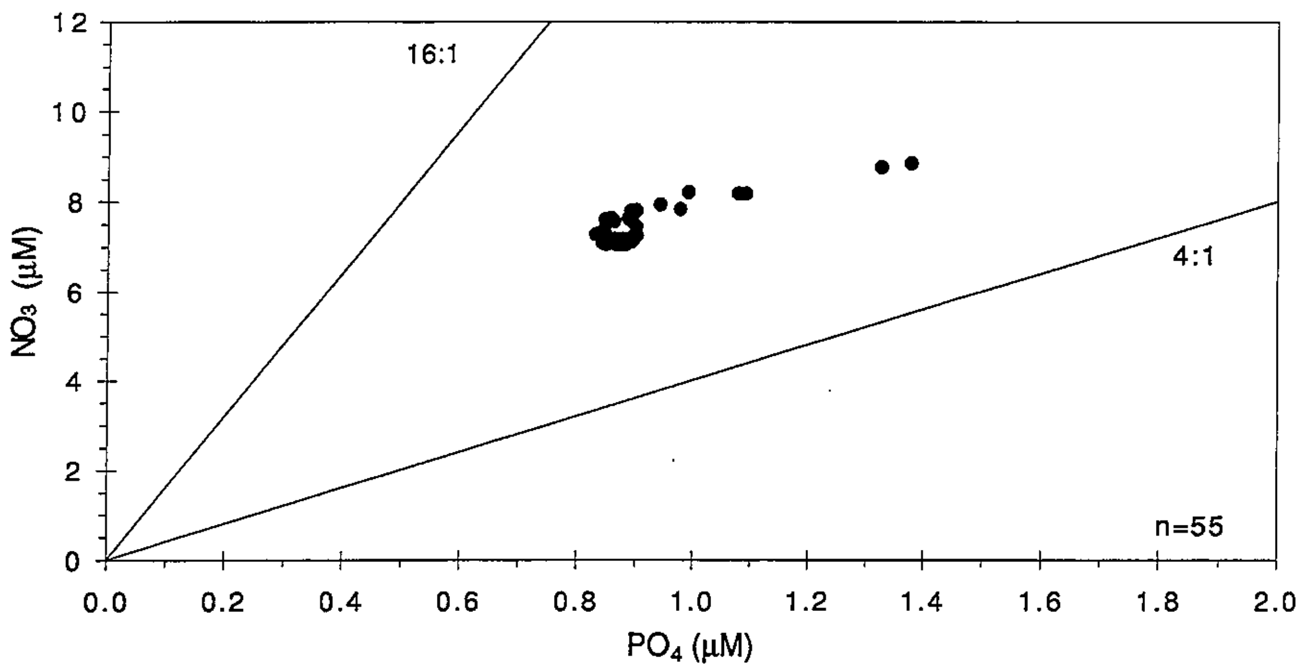

W9515 .
16:1
4:1
n=85
DIN (µM)
PO4 (µM)
25
20
15
10
5
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0


W9515 .
16:1
4:1
n=85
NO3 (µM)
PO4 (µM)
12
10
8
6
4
2
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0

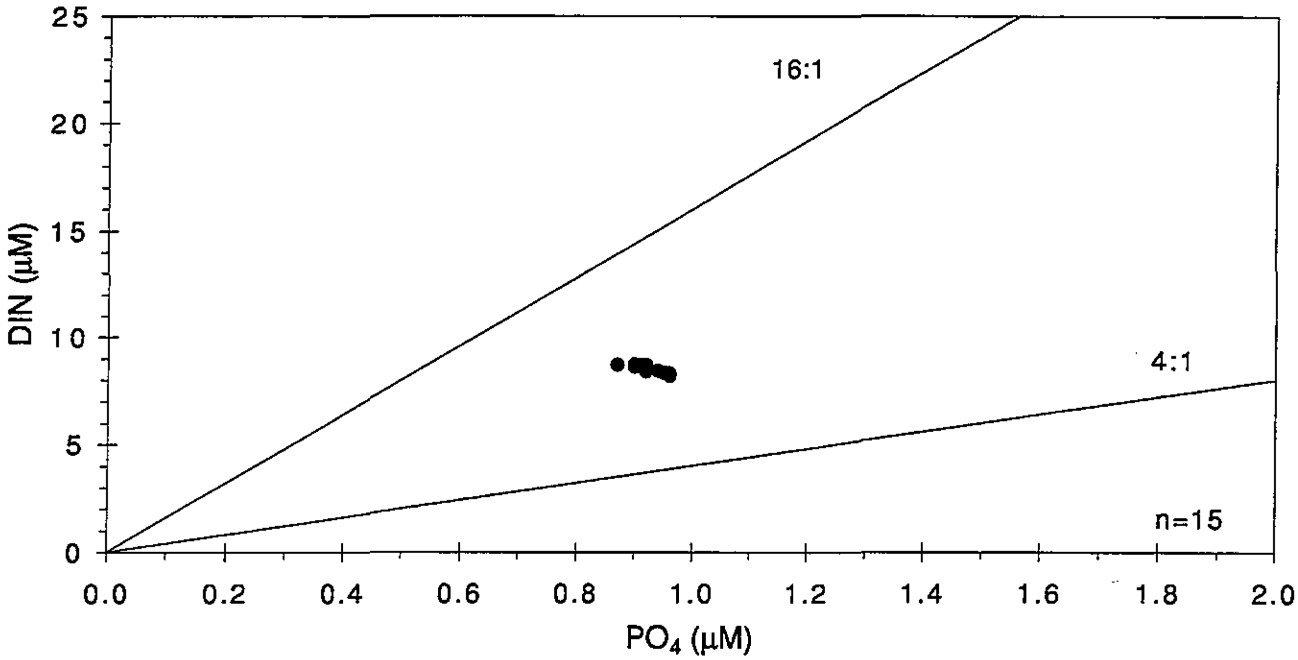
W9516 .



W9516 .

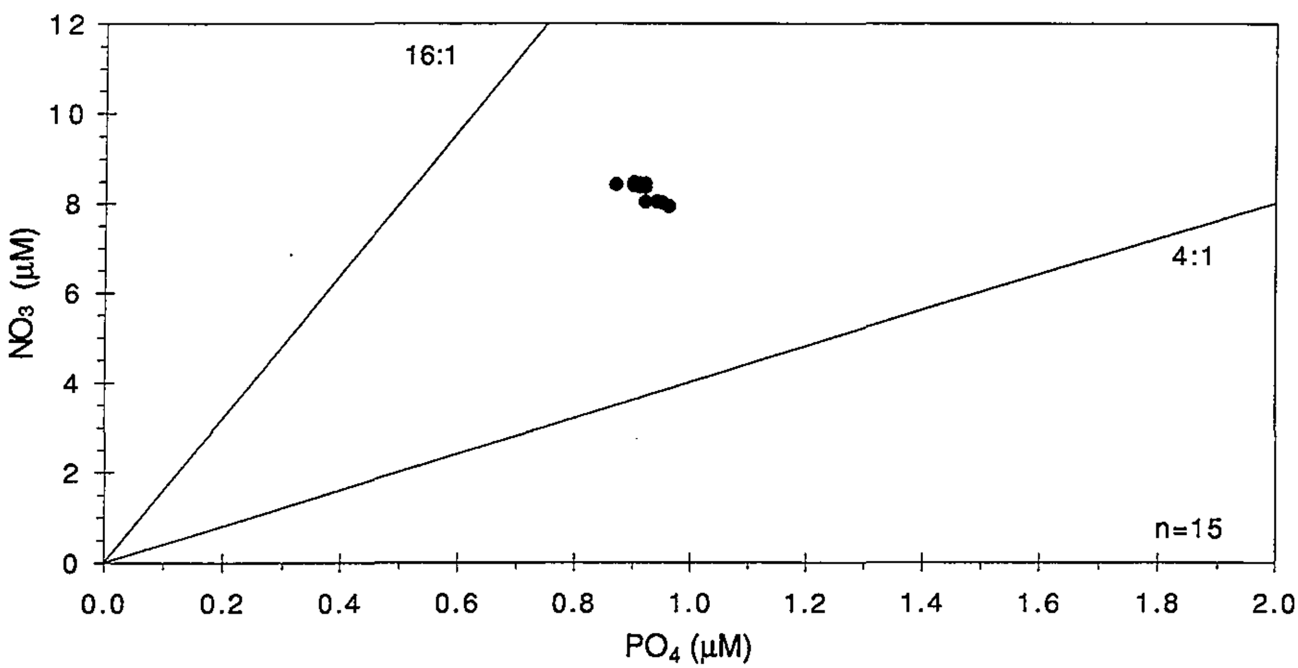


W9517 .



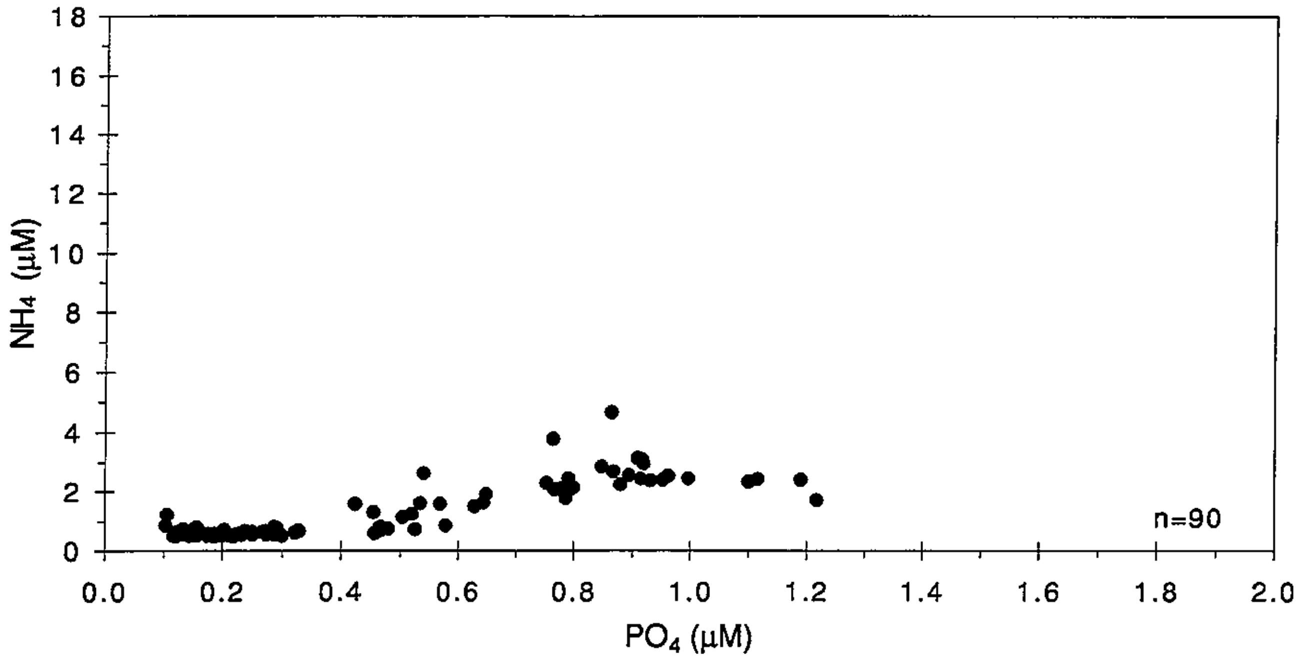
16:1
4:1
n=15
DIN (µM)
PO4 (µM)
0
5
10
15
20
25
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0

W9517 .

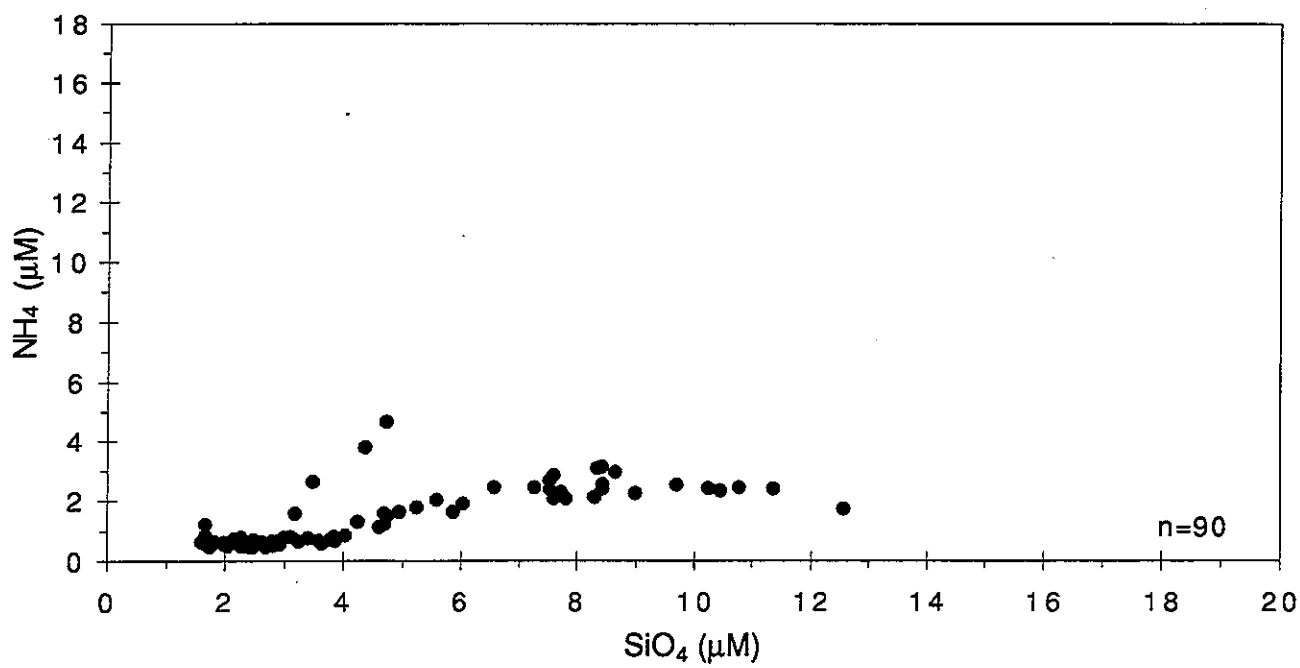


16:1
4:1
n=15
NO3 (µM)
PO4 (µM)
0
2
4
6
8
10
12
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0

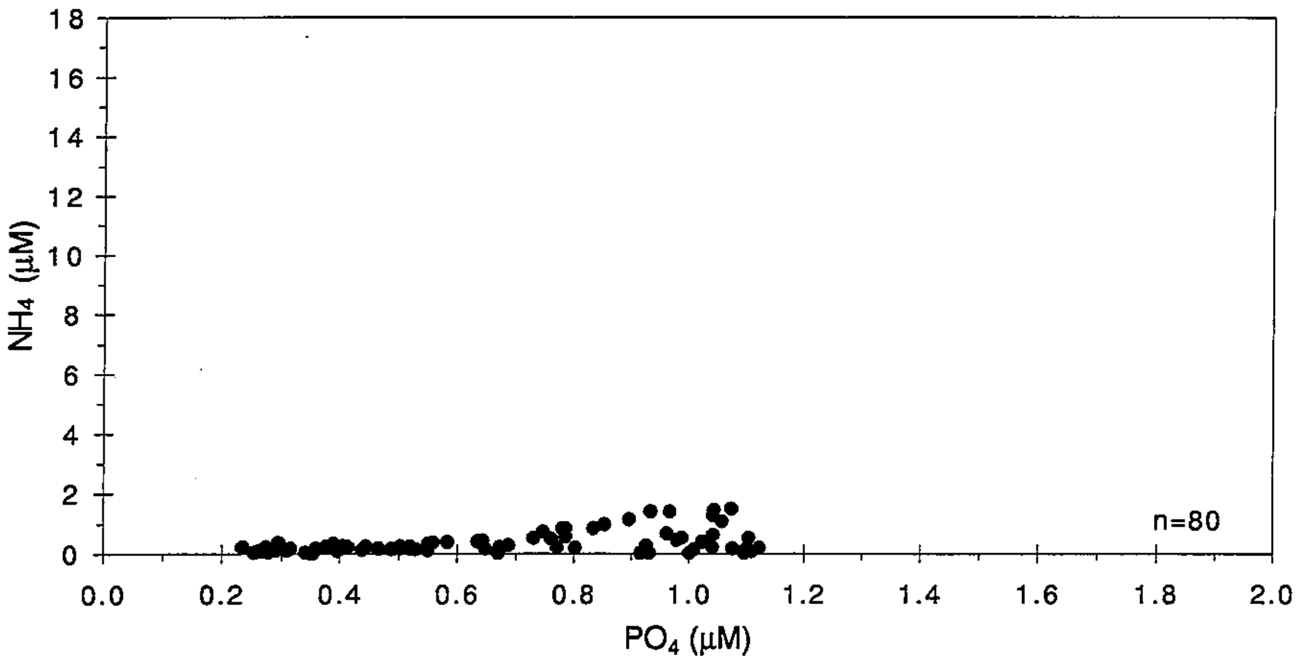
W9510 .



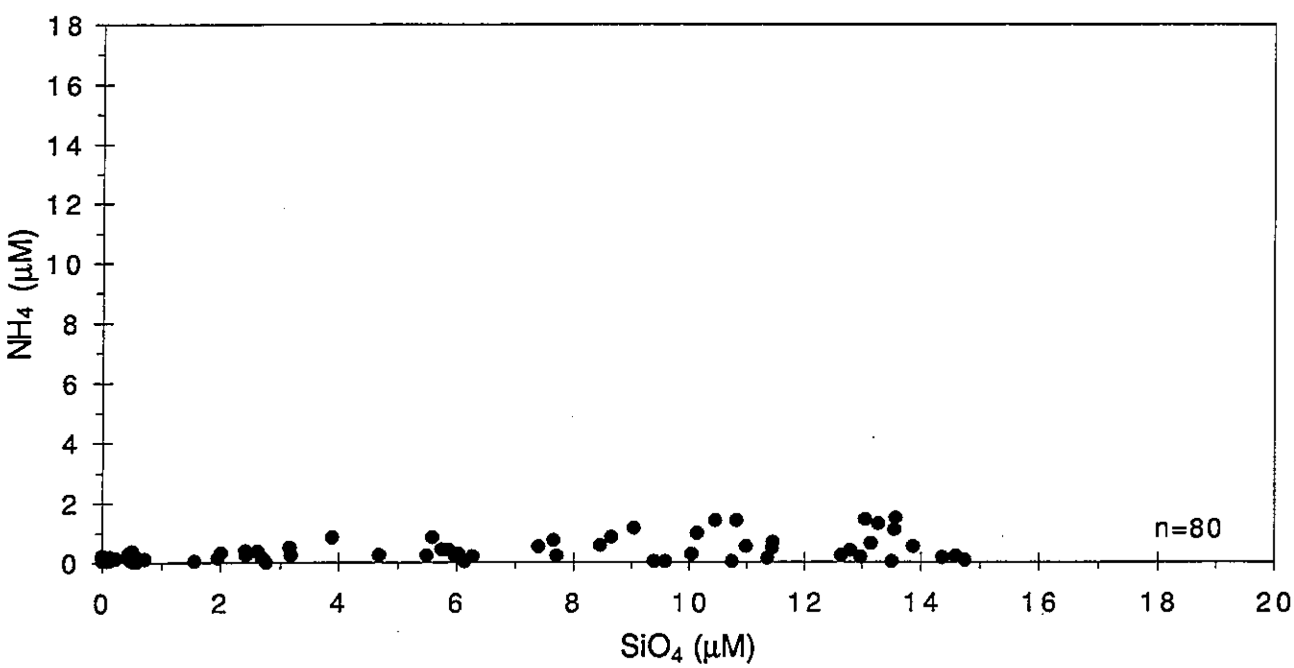
W9510 .

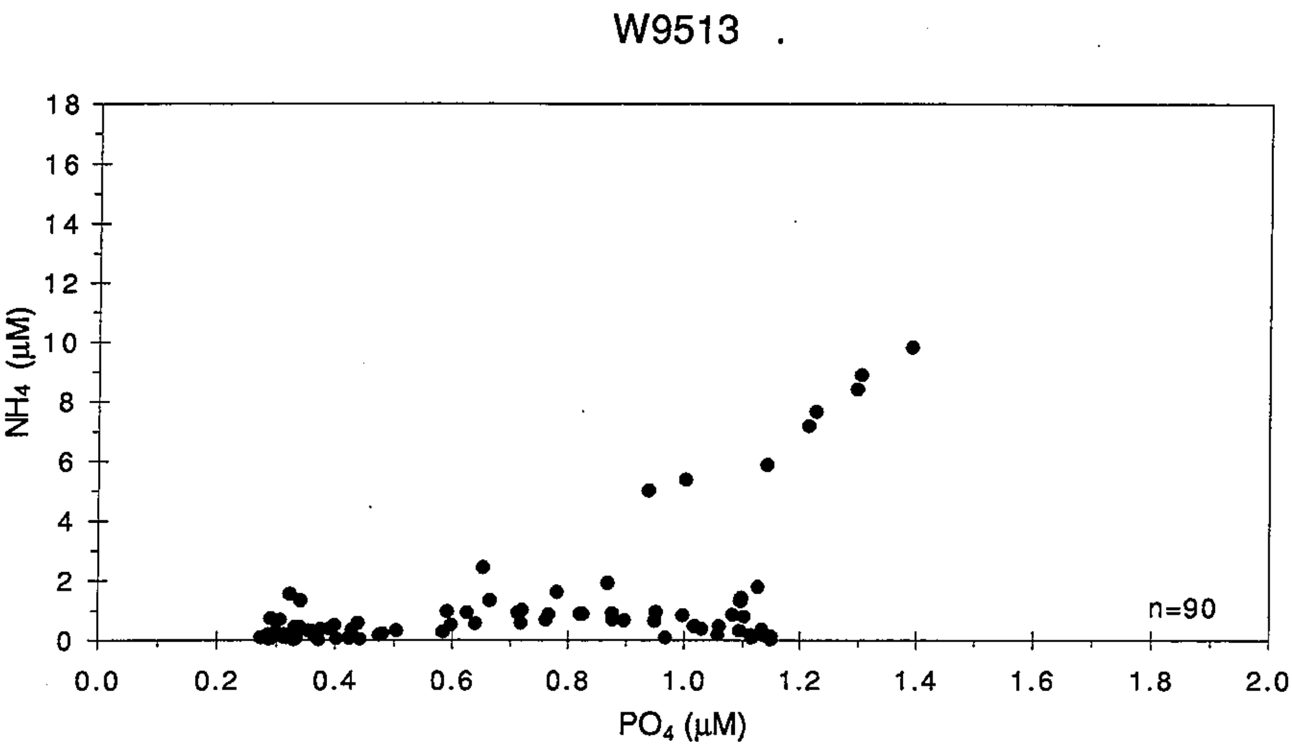


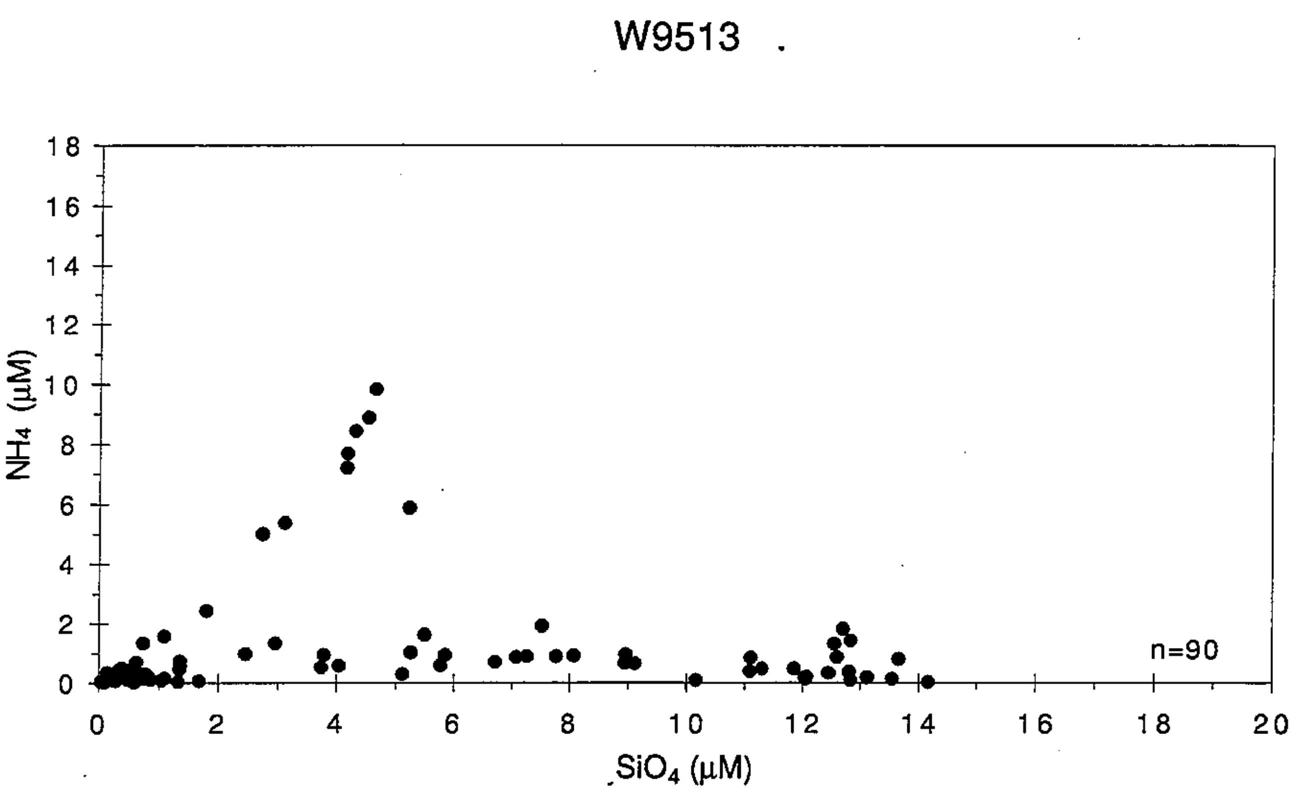
W9512 .



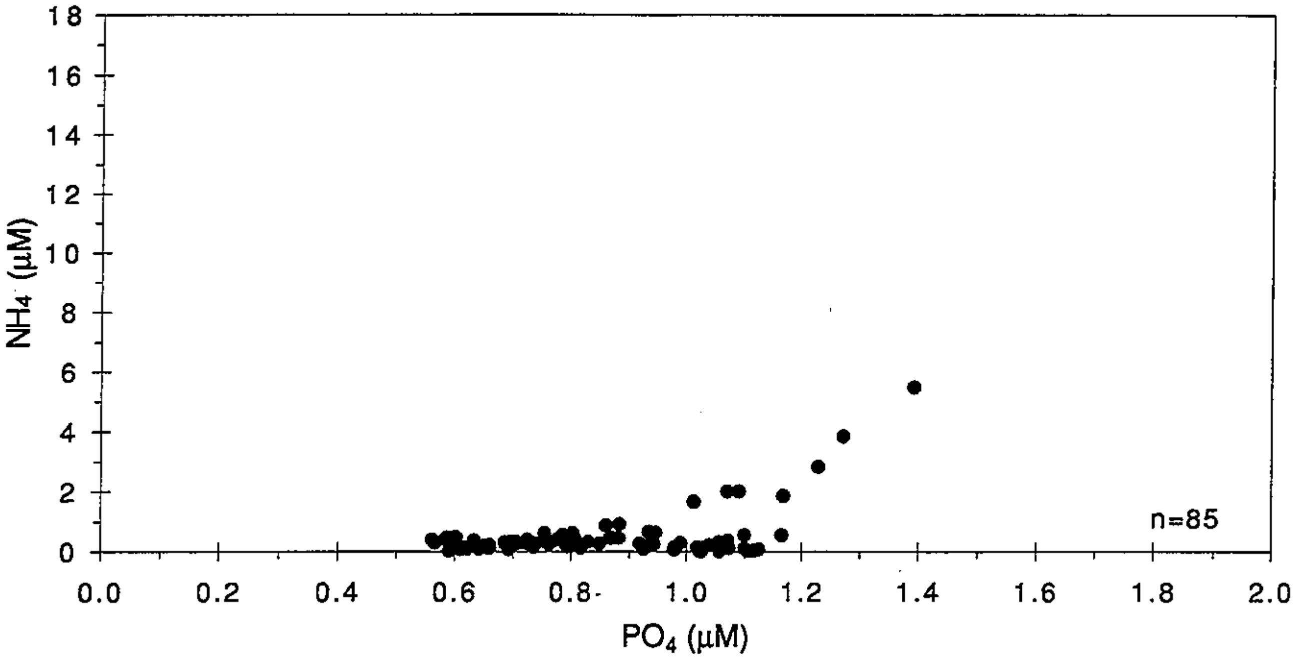
W9512 .




W9513
NH4 (µM)
PO4 (µM)
n=90

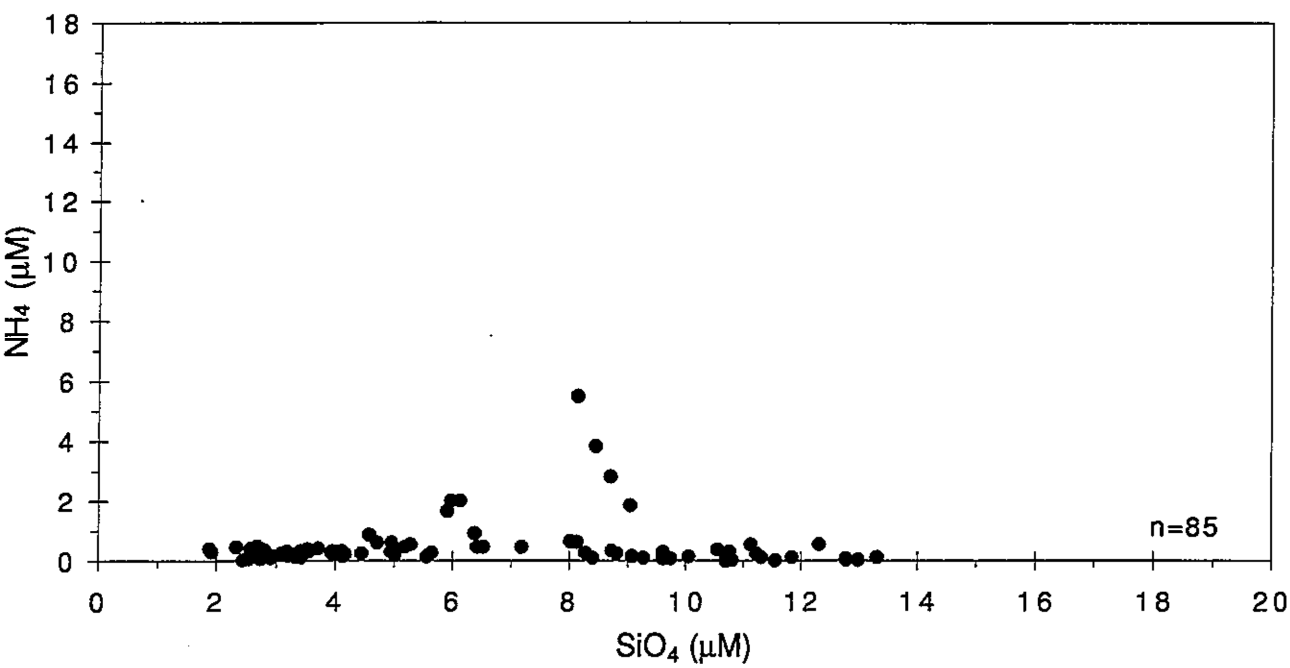

W9513
NH4 (µM)
SiO4 (µM)
n=90

W9515 .



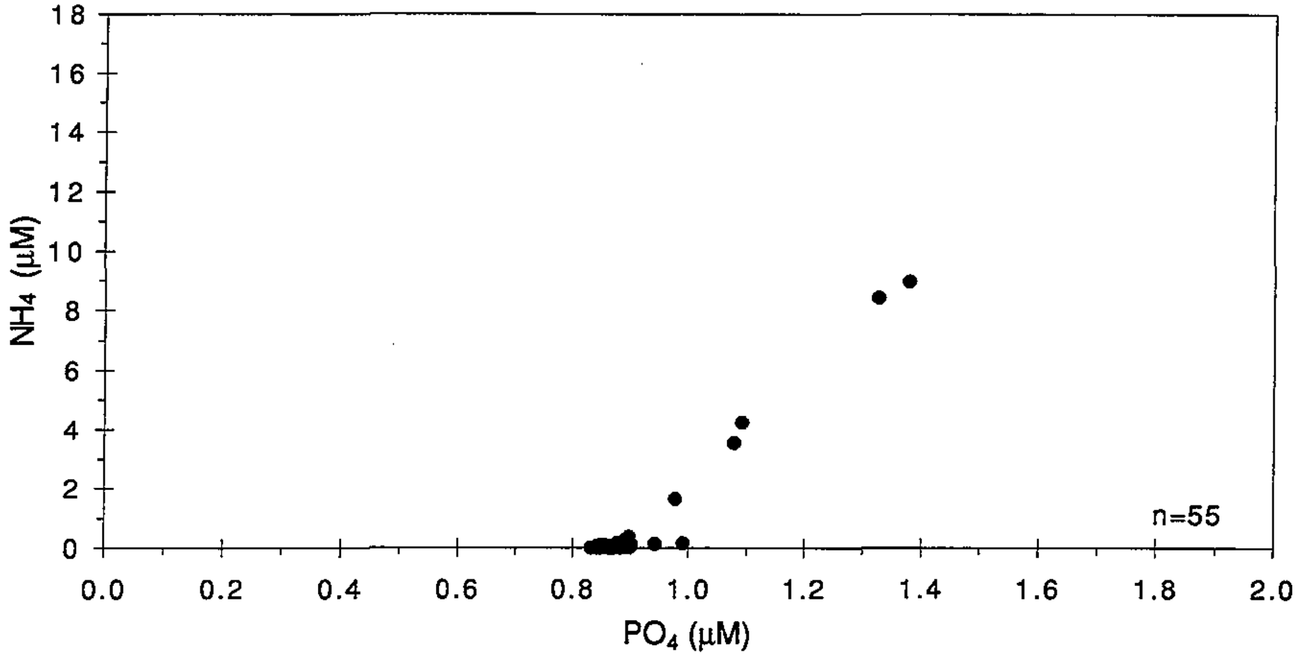
18
16
14
12
10
8
6
4
2
0
NH4 (µM)
n=85
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

W9515 .



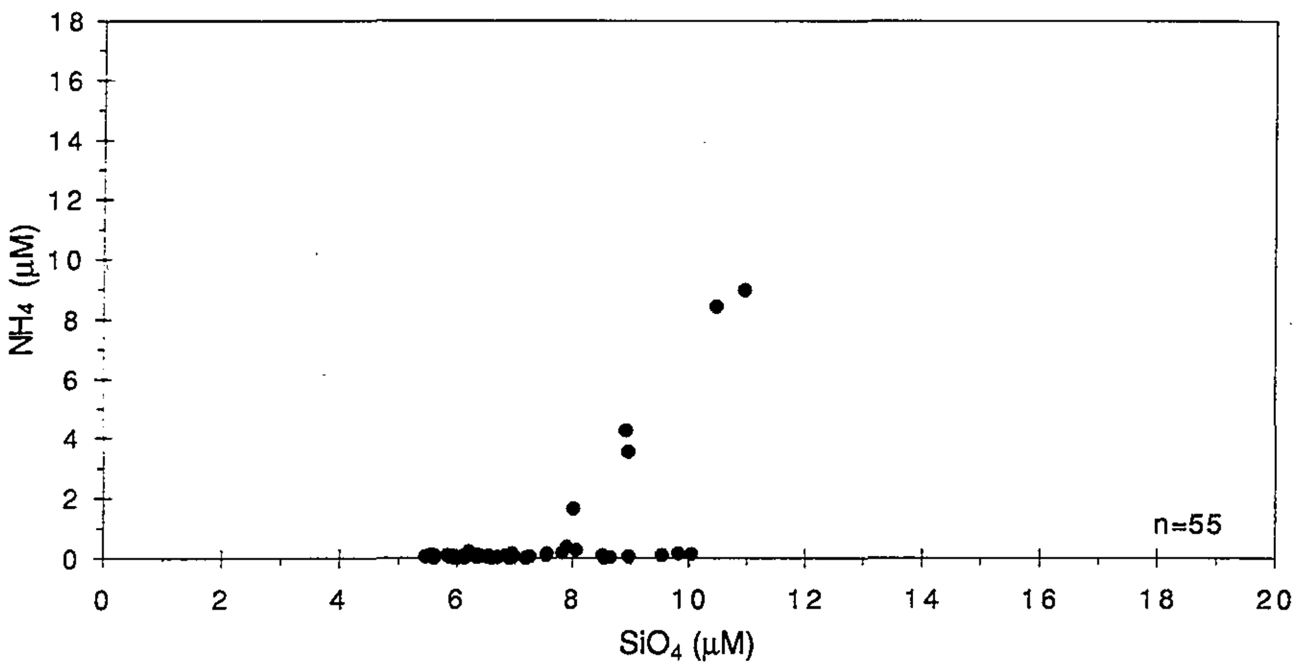
18
16
14
12
10
8
6
4
2
0
NH4 (µM)
n=85
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)

W9516 .

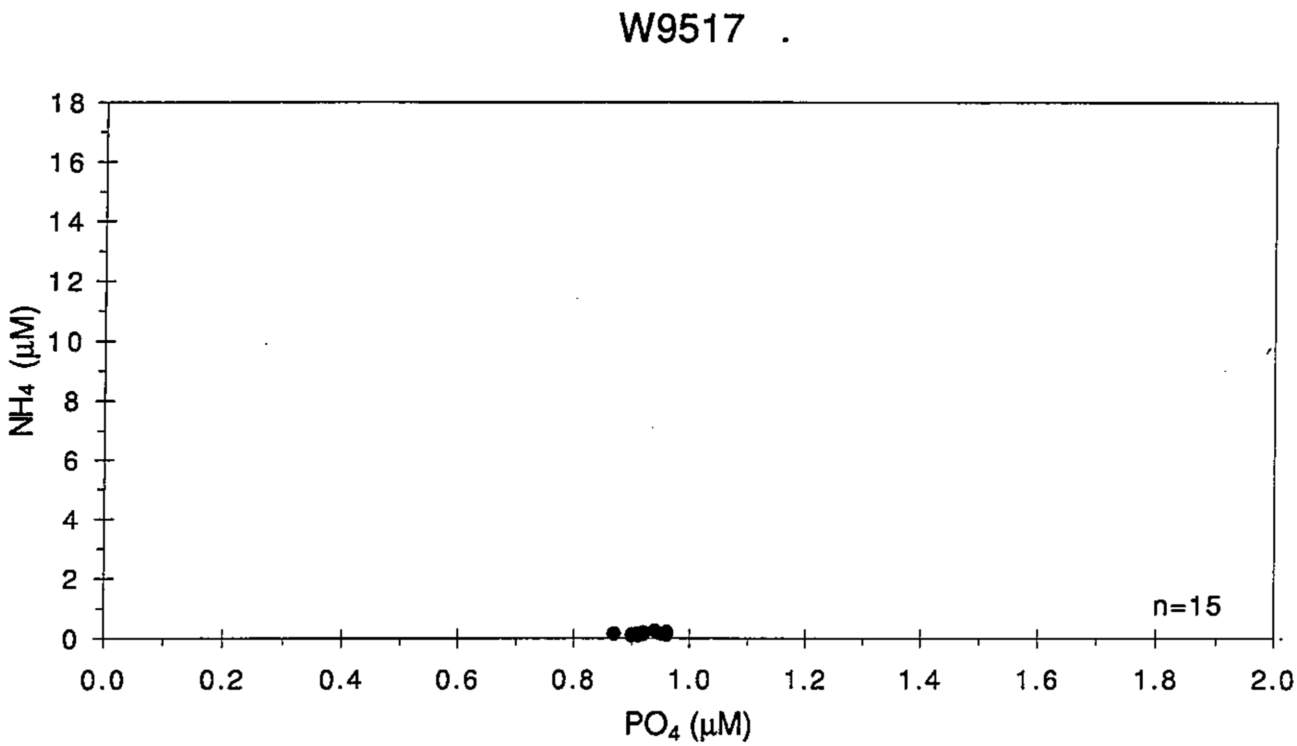


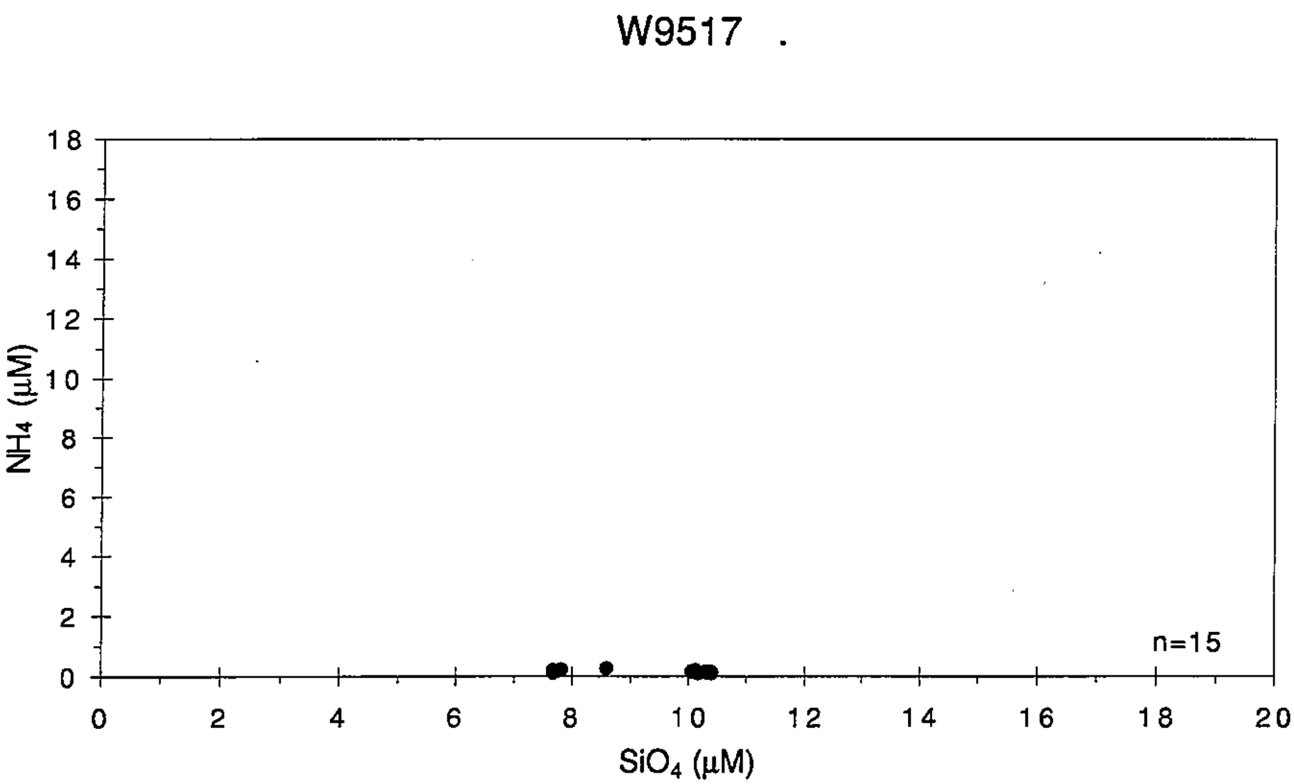
NH4 (µM)
18
16
14
12
10
8
6
4
2
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)
n=55

W9516 .

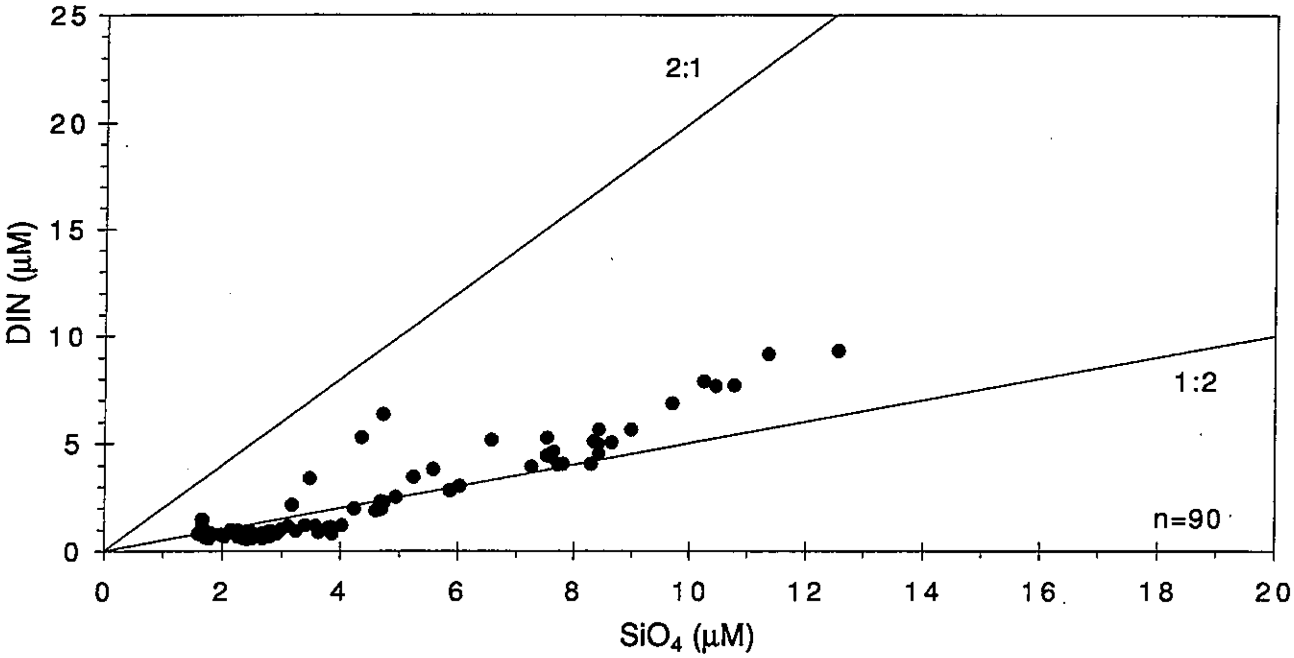


NH4 (µM)
18
16
14
12
10
8
6
4
2
0
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)
n=55

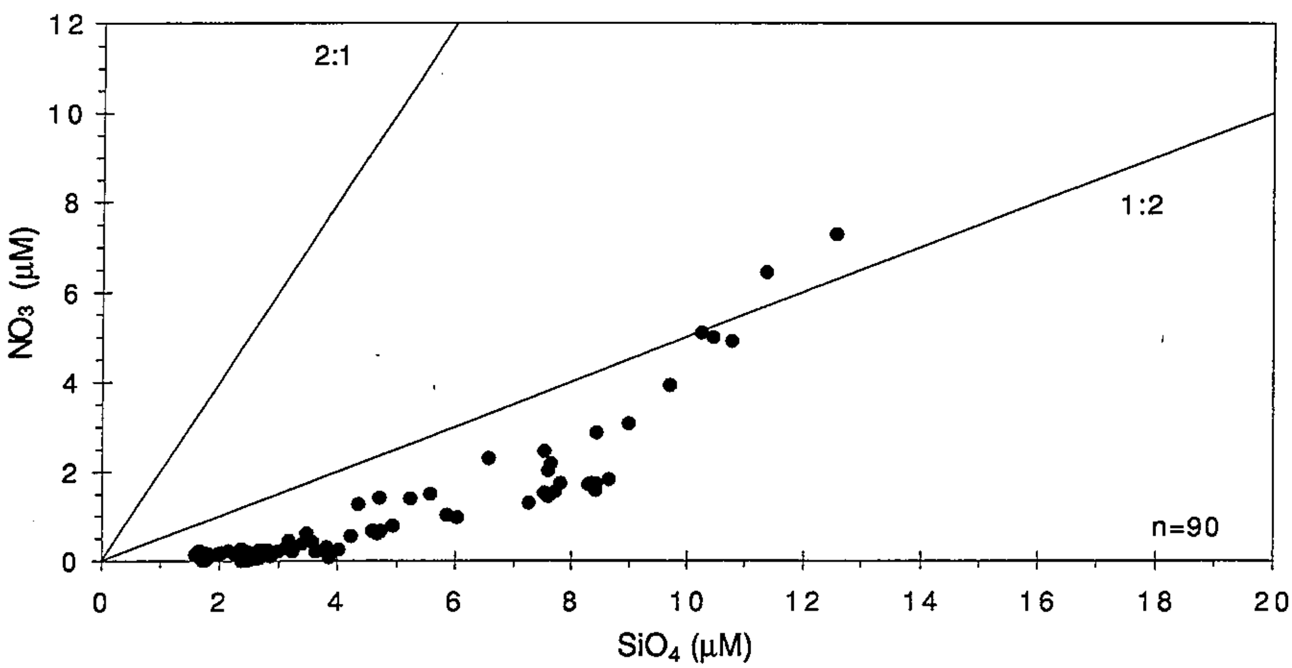

W9517 .
18
16
14
12
10
8
6
4
2
0
NH4 (µM)
n=15
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)


W9517 .
18
16
14
12
10
8
6
4
2
0
NH4 (µM)
n=15
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)

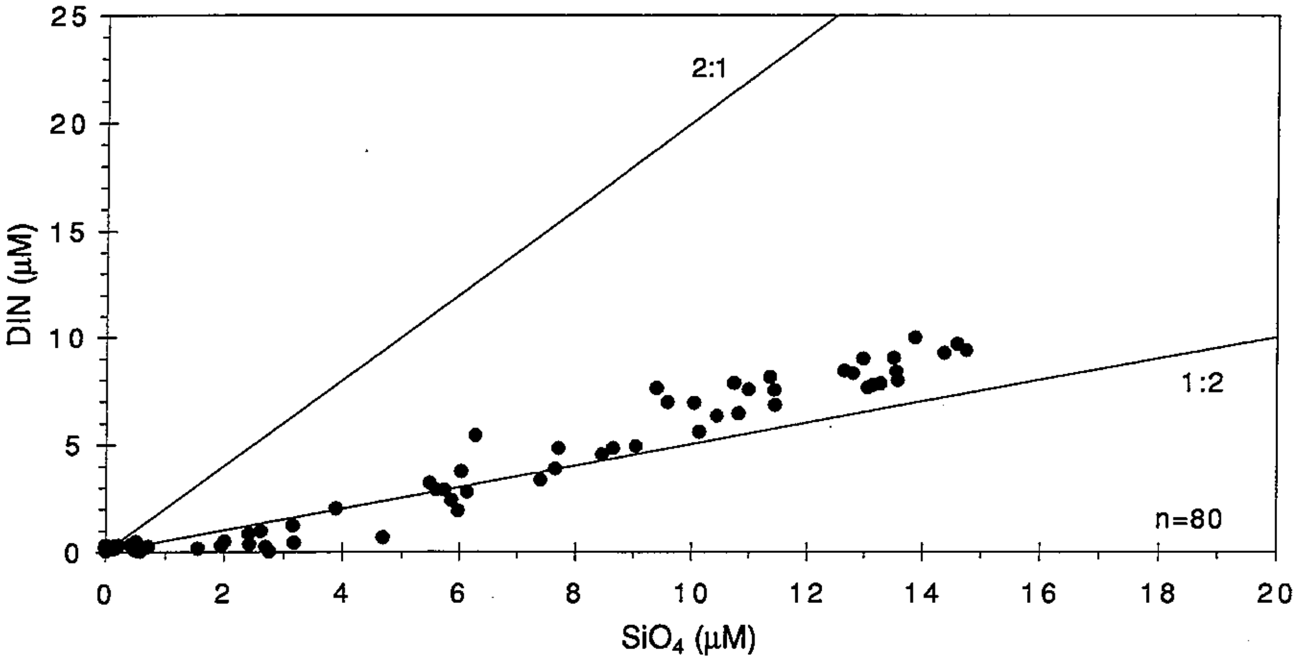
W9510


2:1
1:2
n=90
DIN (µM)
SiO$_4$ (µM)
0
5
10
15
20
25
0
2
4
6
8
10
12
14
16
18
20

W9510

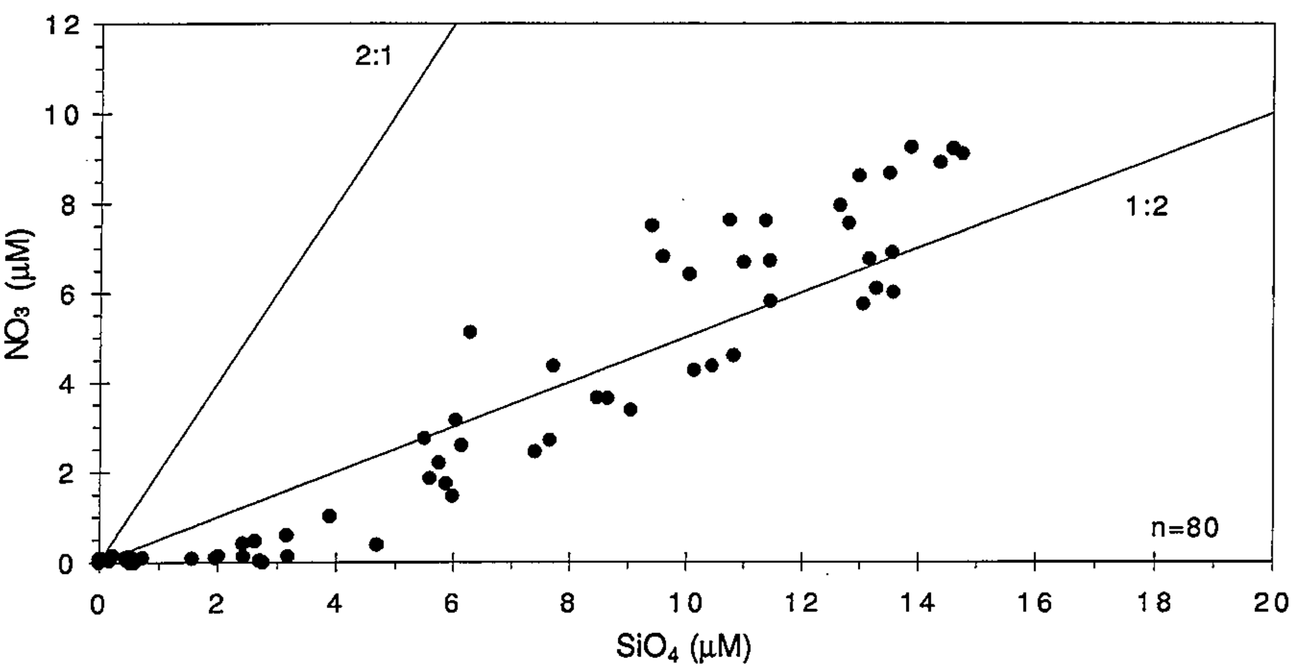

2:1
1:2
n=90
NO$_3$ (µM)
SiO$_4$ (µM)
0
2
4
6
8
10
12
0
2
4
6
8
10
12
14
16
18
20

W9512 .



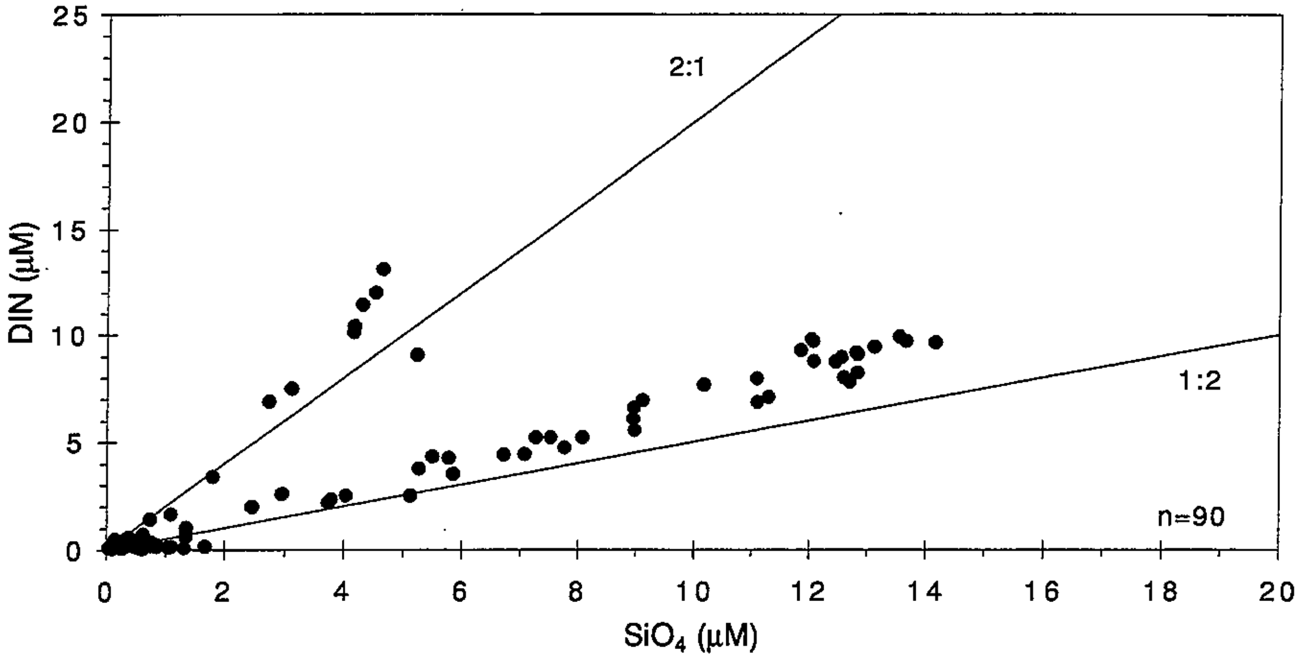
2:1
1:2
n=80
DIN (μM)
SiO4 (μM)
25
20
15
10
5
0
0
2
4
6
8
10
12
14
16
18
20

W9512 .



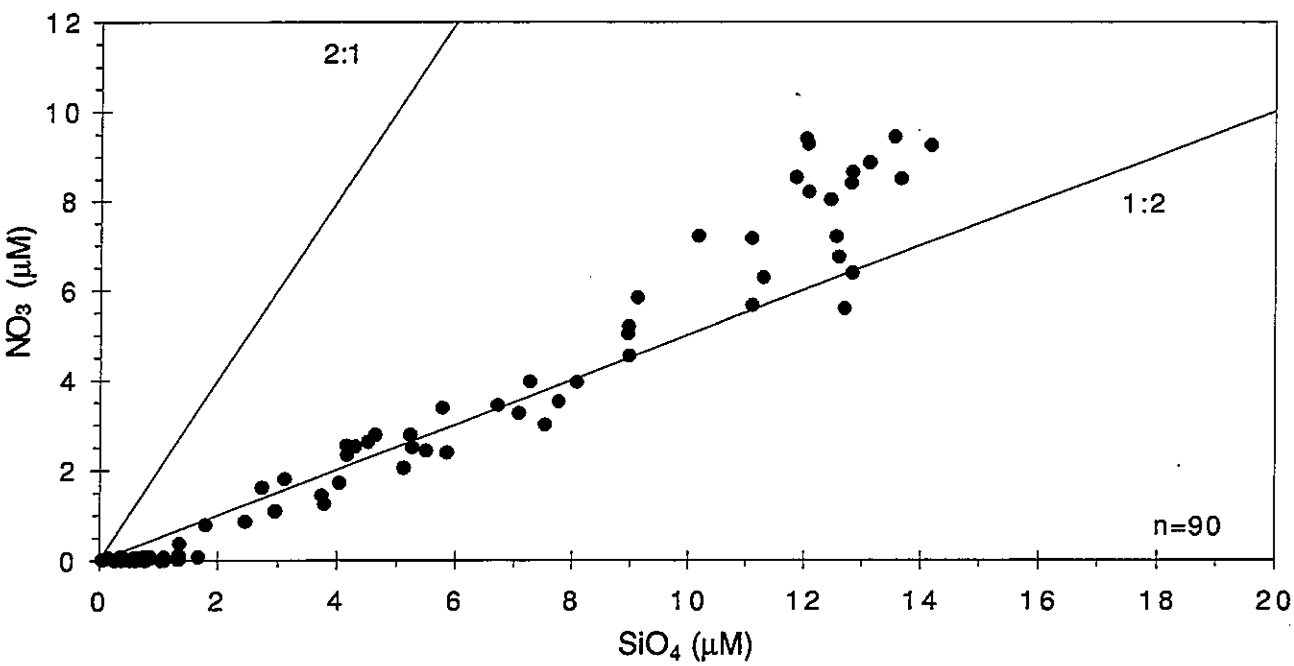
2:1
1:2
n=80
NO3 (μM)
SiO4 (μM)
12
10
8
6
4
2
0
0
2
4
6
8
10
12
14
16
18
20

W9513 .

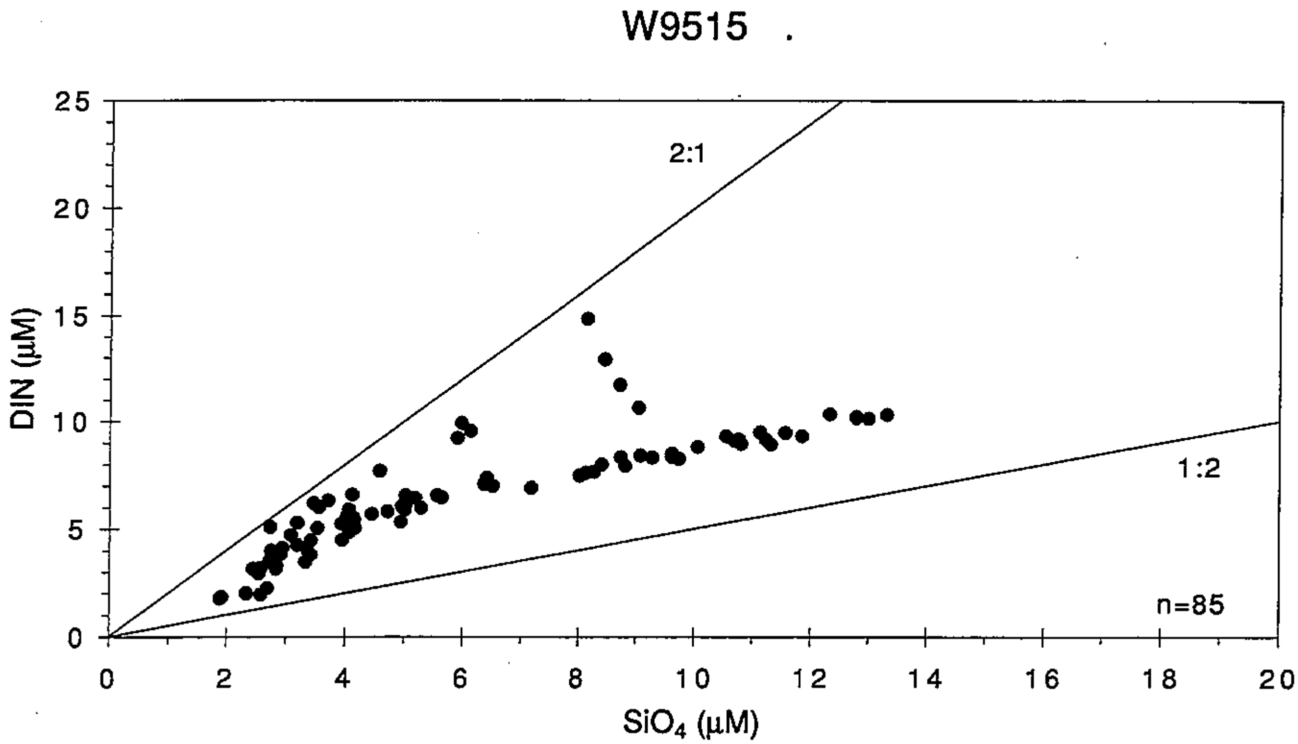


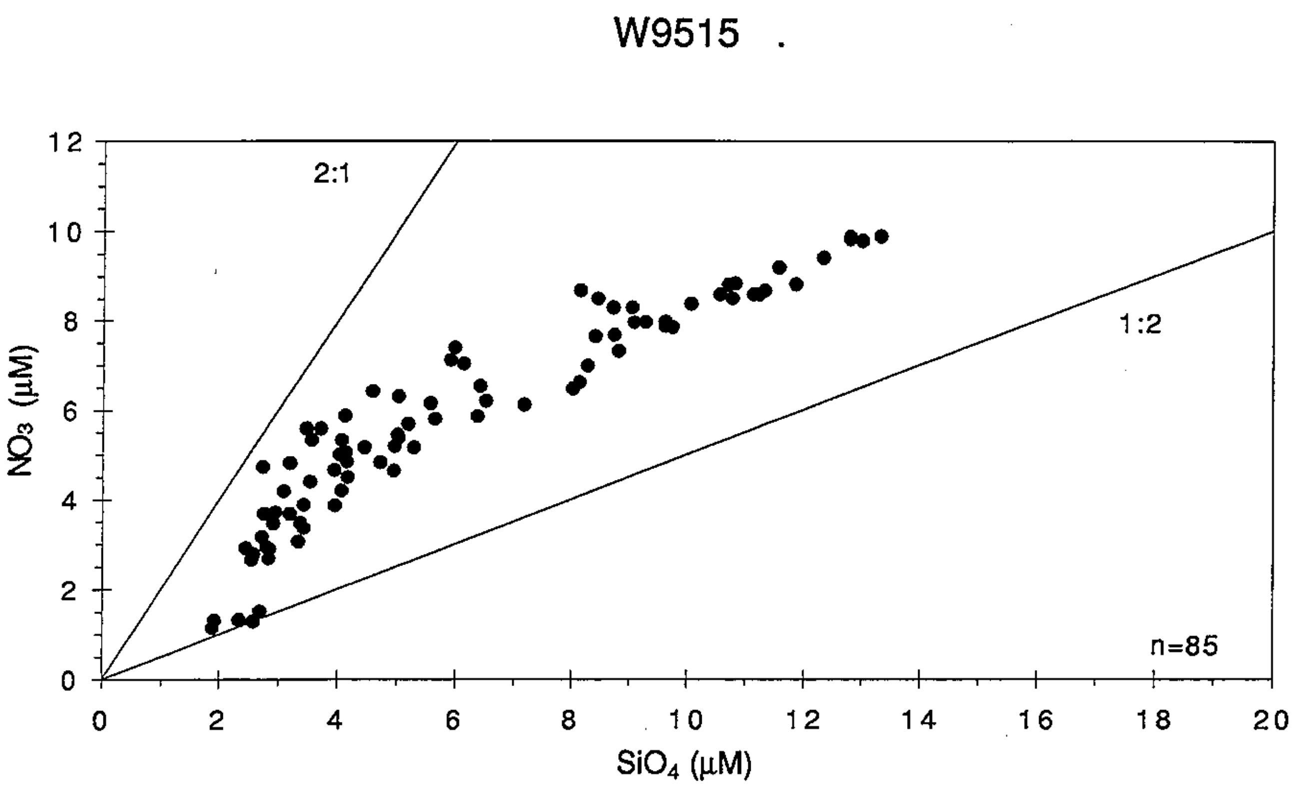
2:1
1:2
n=90
DIN (μM)
SiO4 (μM)
0
5
10
15
20
25
0
2
4
6
8
10
12
14
16
18
20

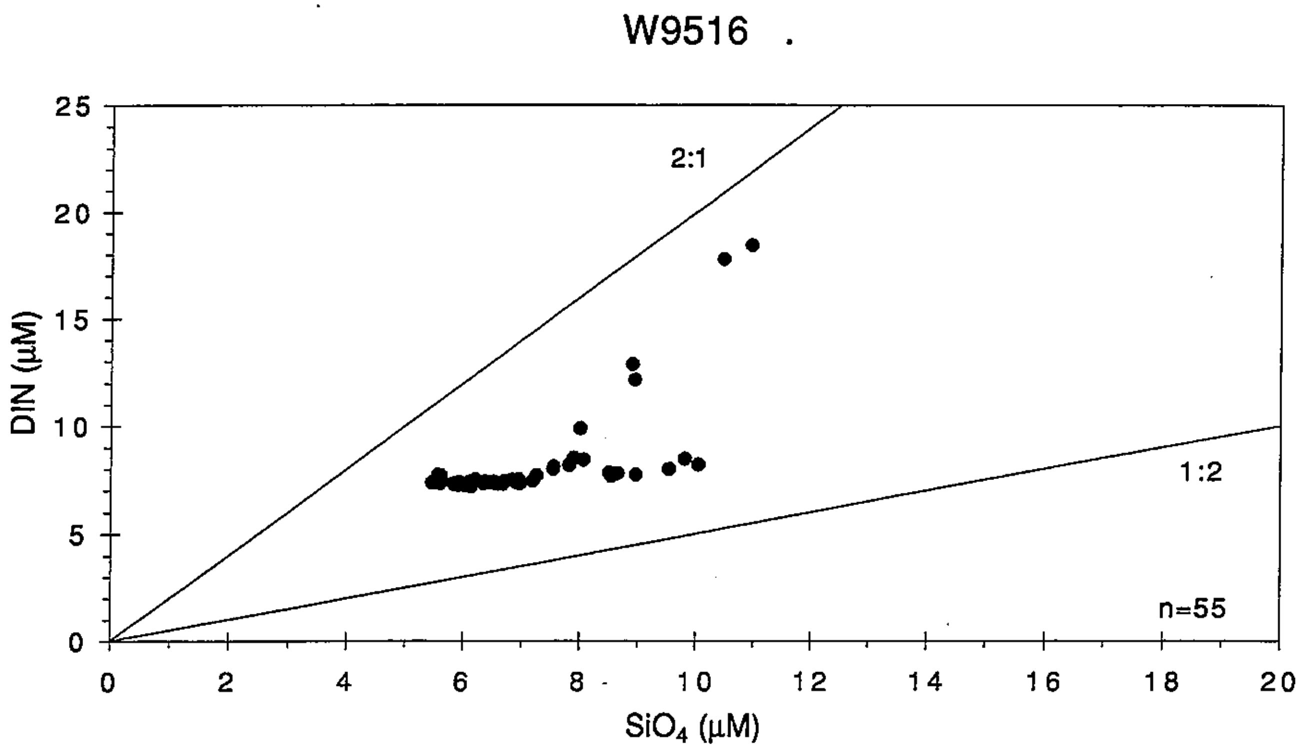
W9513 .

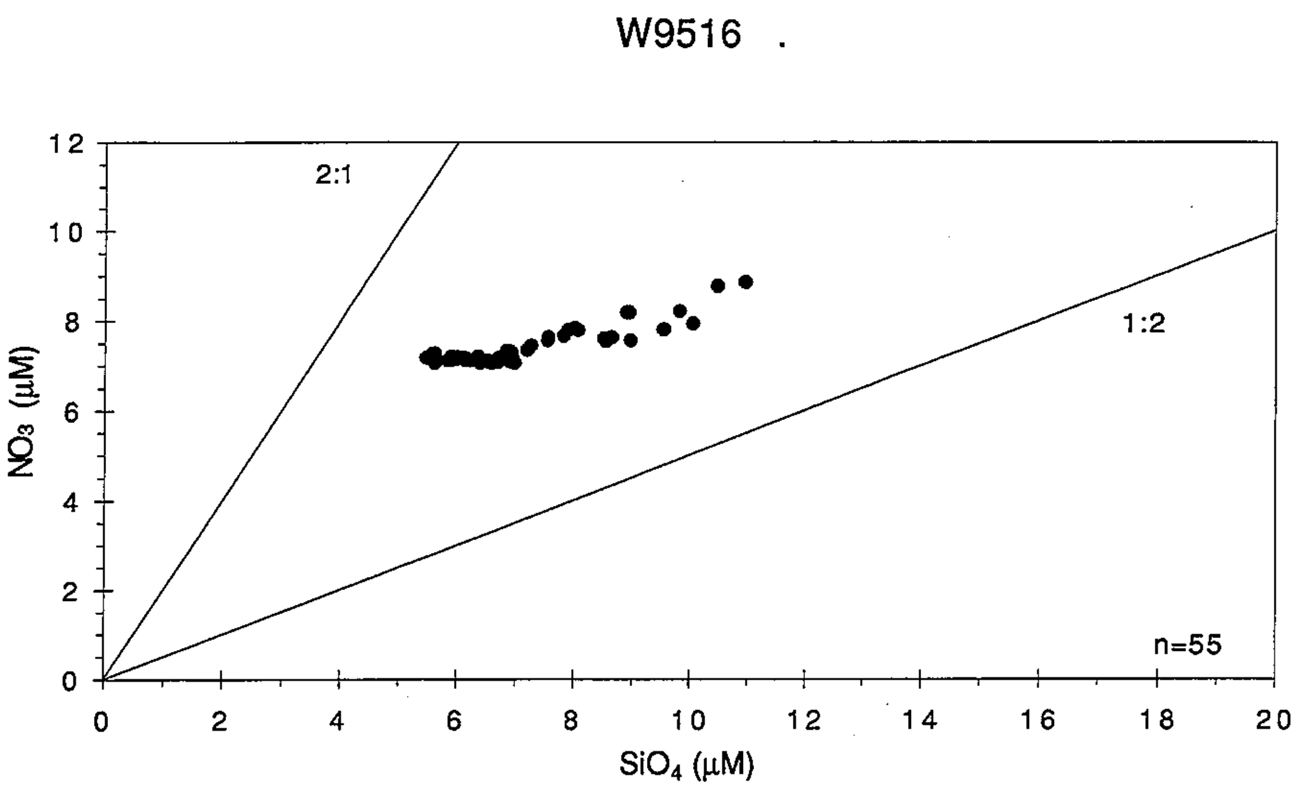


2:1
1:2
n=90
NO3 (μM)
SiO4 (μM)
0
2
4
6
8
10
12
0
2
4
6
8
10
12
14
16
18
20

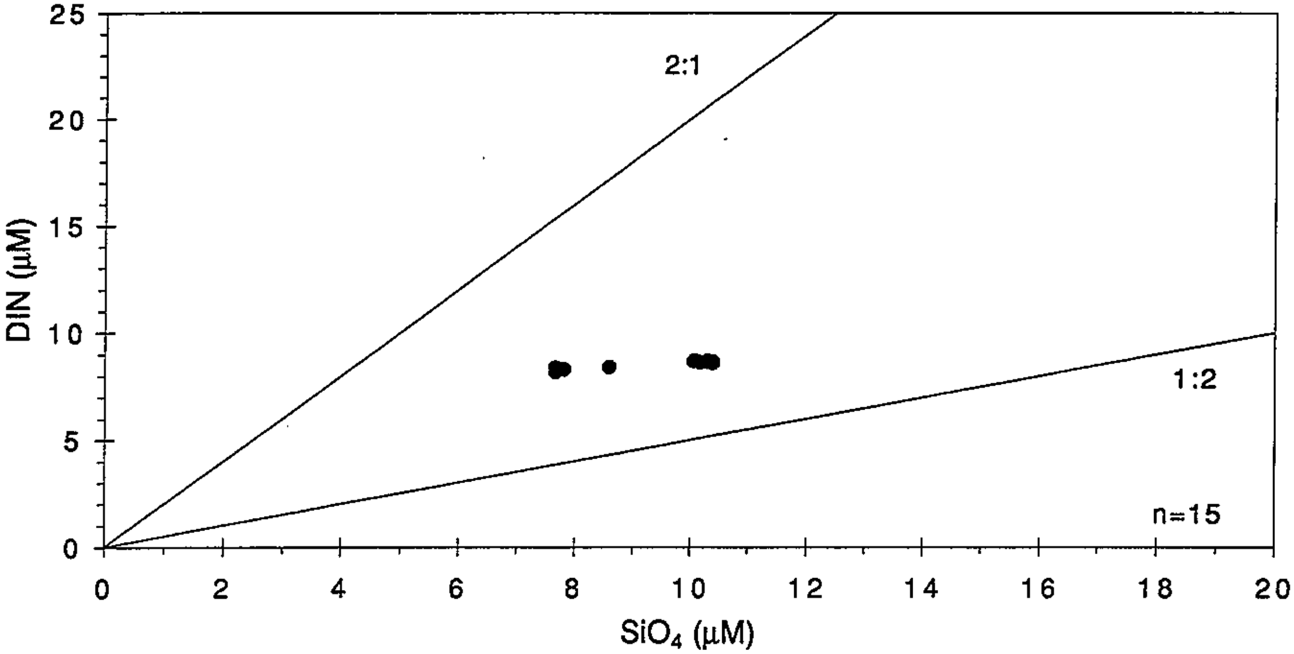

W9515 .
2:1
1:2
n=85
DIN (µM)
SiO4 (µM)
0
5
10
15
20
25
0
2
4
6
8
10
12
14
16
18
20


W9515 .
2:1
1:2
n=85
NO3 (µM)
SiO4 (µM)
0
2
4
6
8
10
12
0
2
4
6
8
10
12
14
16
18
20


W9516
2:1
1:2
n=55
DIN (µM)
SiO4 (µM)
0
5
10
15
20
25
0
2
4
6
8
10
12
14
16
18
20

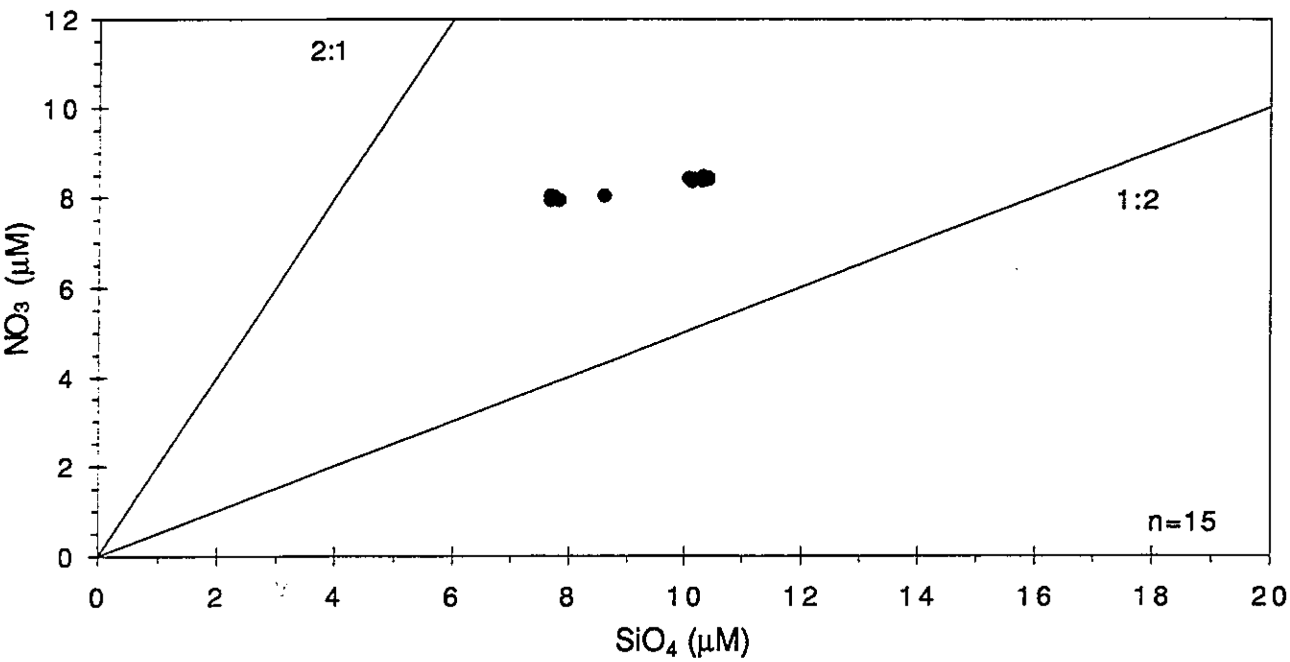

W9516
2:1
1:2
n=55
NO3 (µM)
SiO4 (µM)
0
2
4
6
8
10
12
0
2
4
6
8
10
12
14
16
18
20

W9517 .



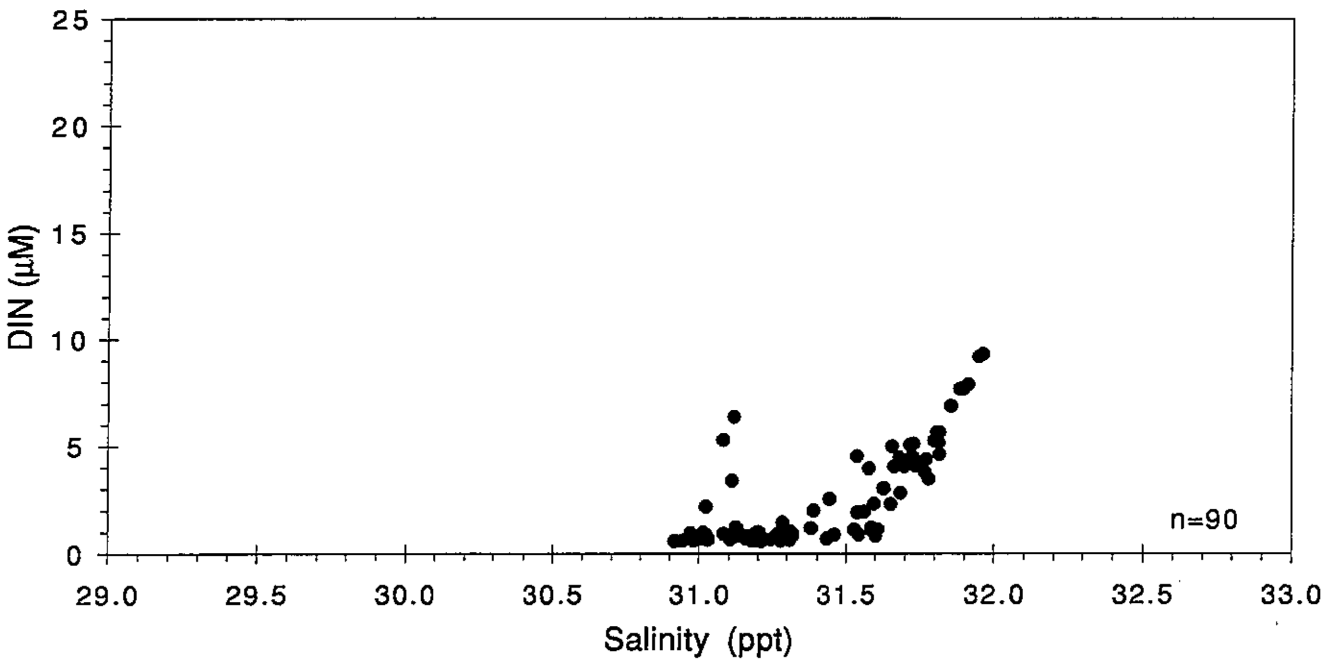
25
20
15
10
5
0
DIN (µM)
2:1
1:2
n=15
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)

W9517 .



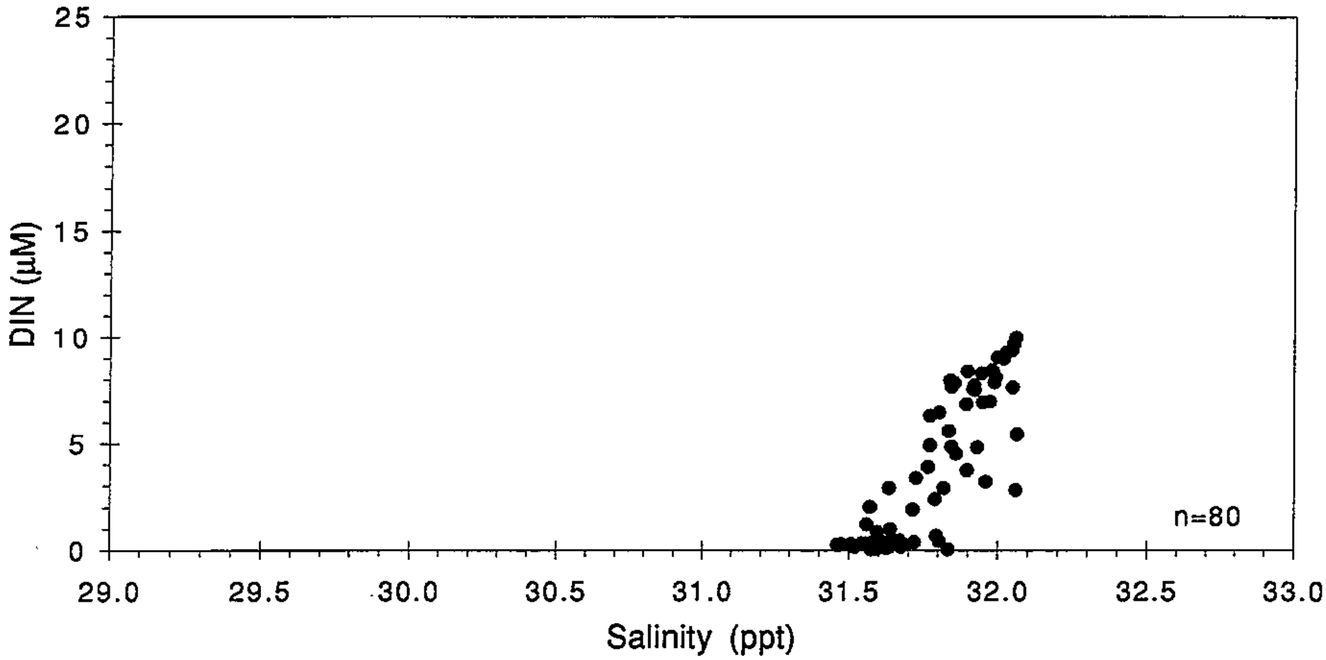
12
10
8
6
4
2
0
NO3 (µM)
2:1
1:2
n=15
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)

W9510



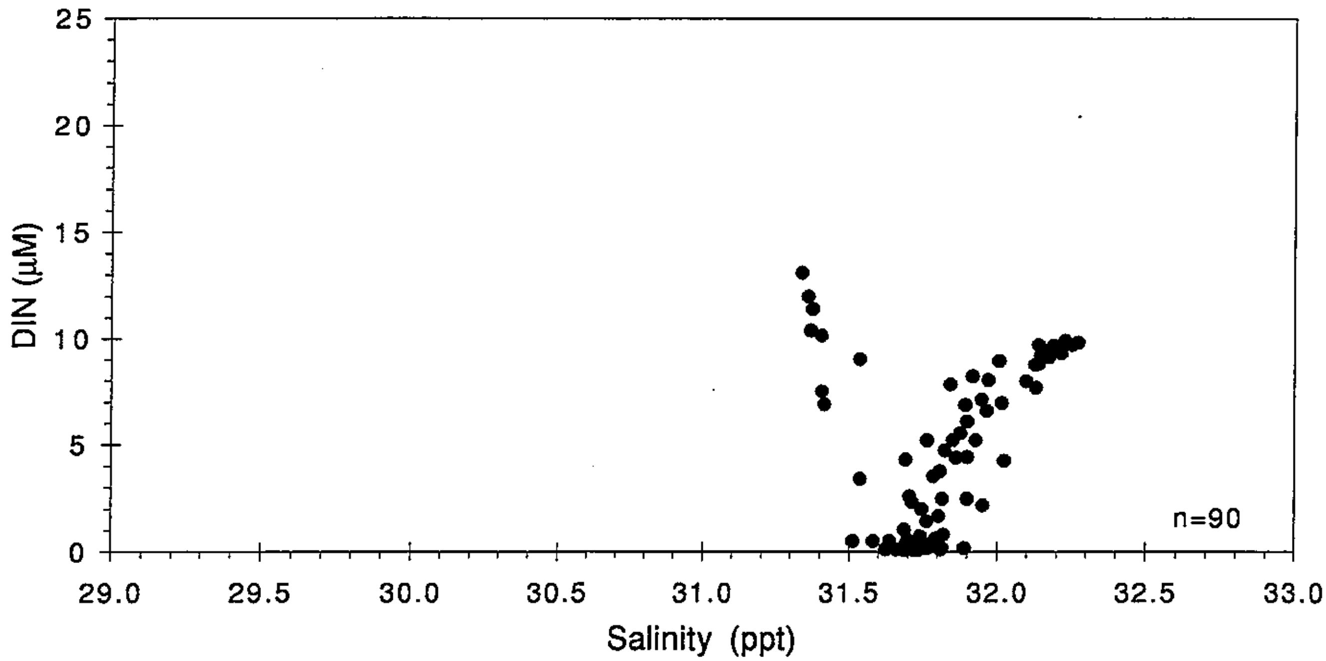
25
20
15
10
5
0
DIN (µM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9512



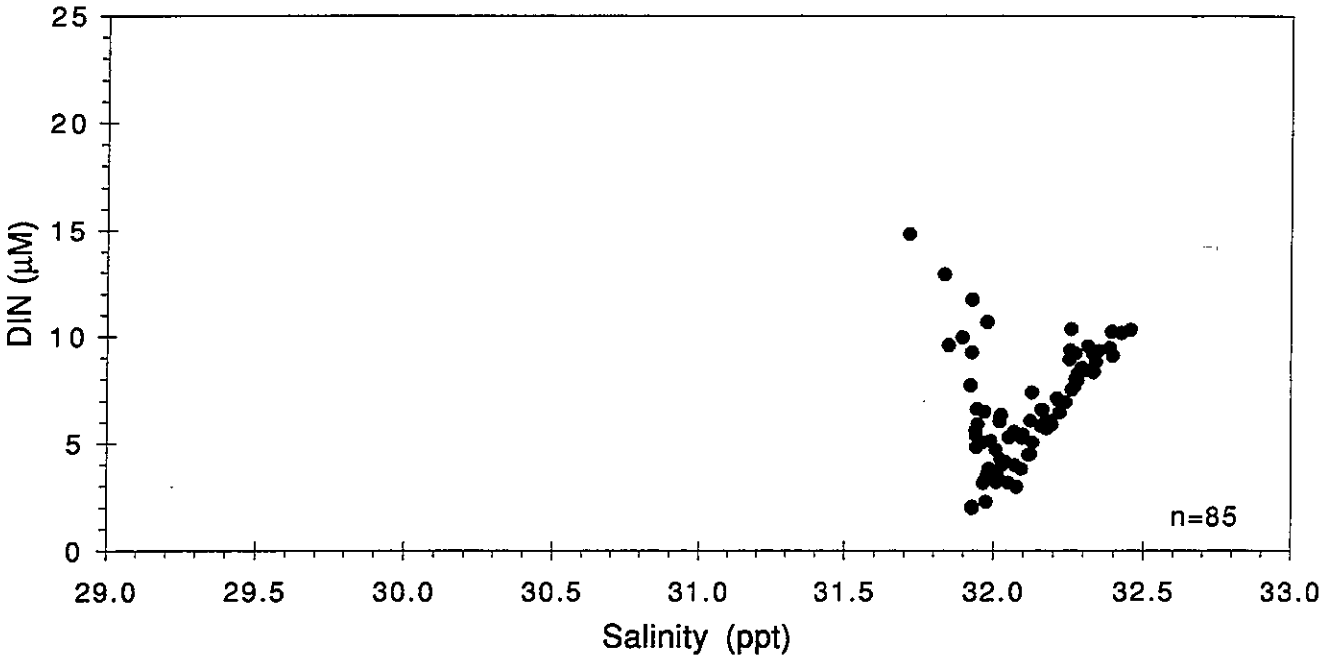
25
20
15
10
5
0
DIN (µM)
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=80

W9513



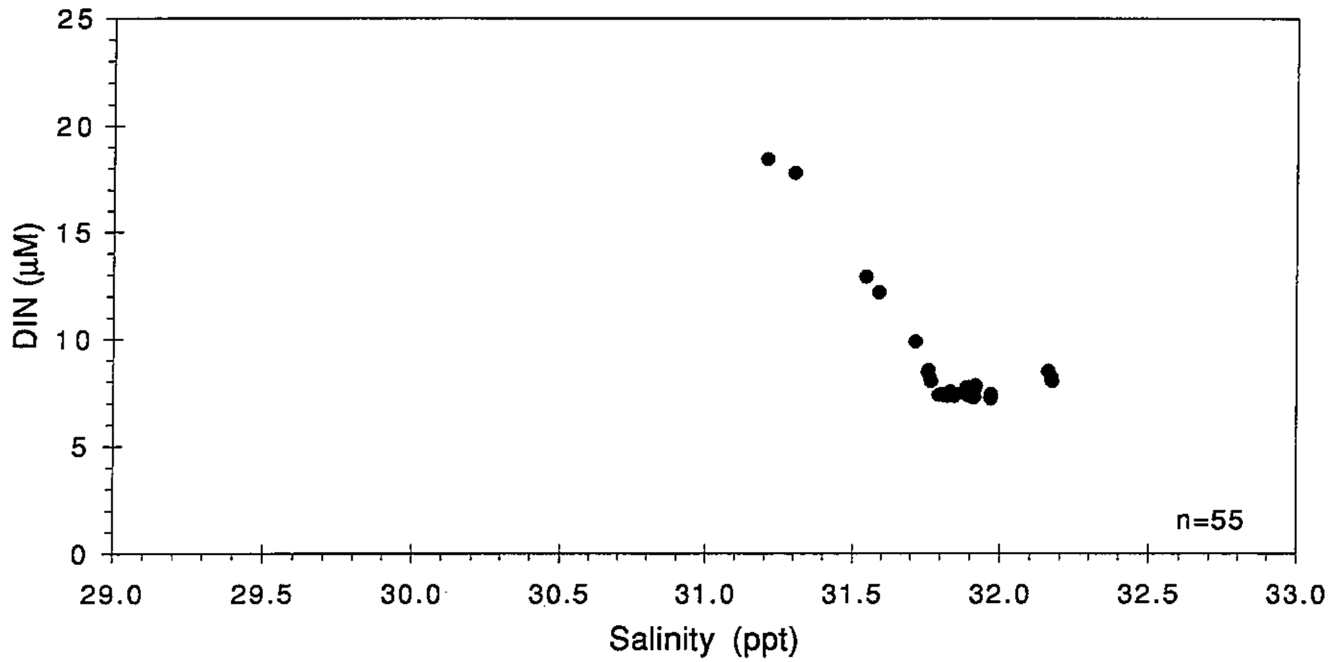
25
20
15
10
5
0
DIN (μM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9515 .

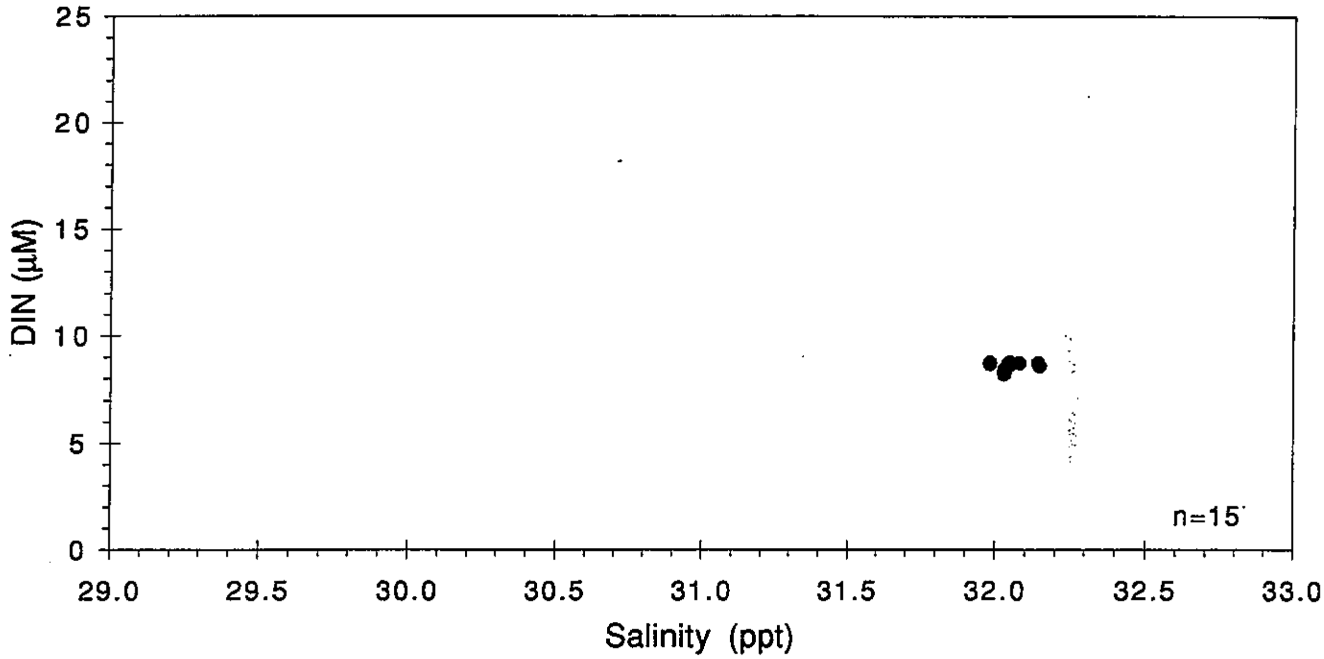


25
20
15
10
5
0
DIN (µM)
n=85
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

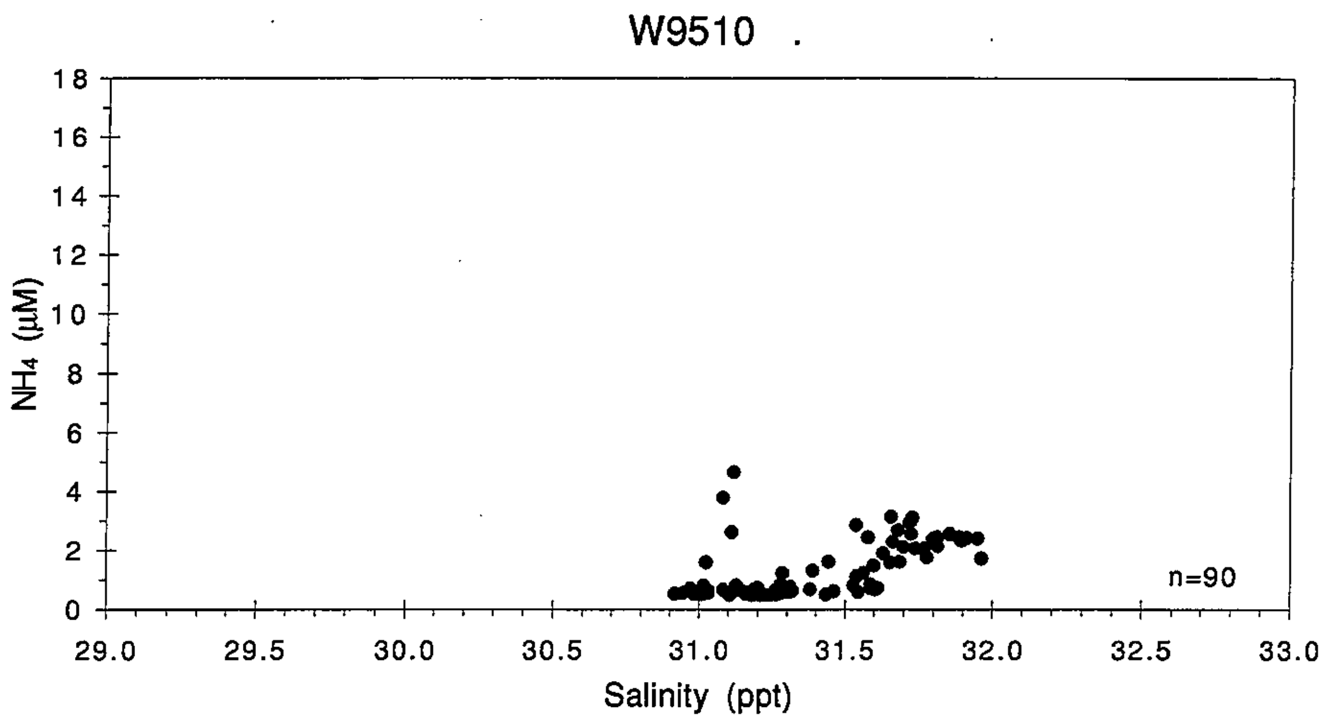
W9516


25
20
15
10
5
0
DIN (µM)
n=55
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

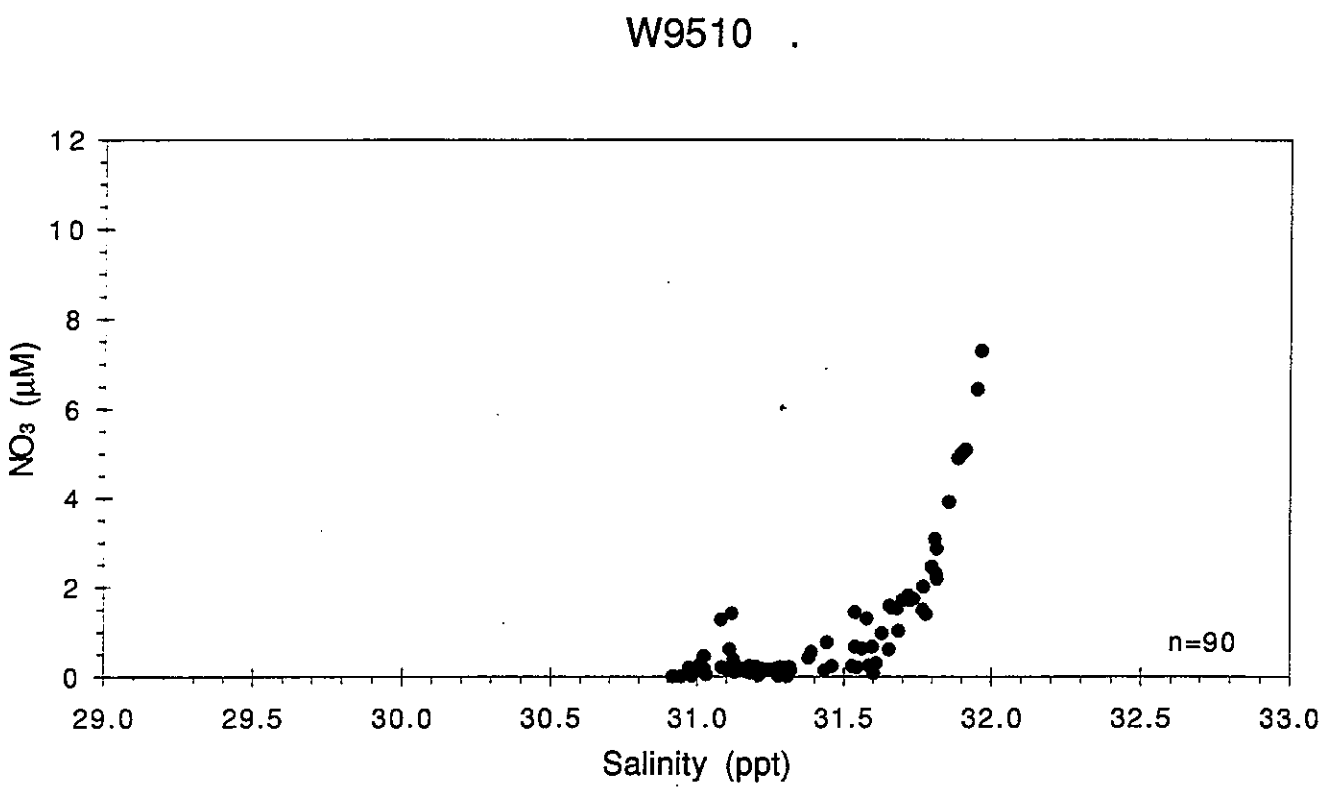
W9517



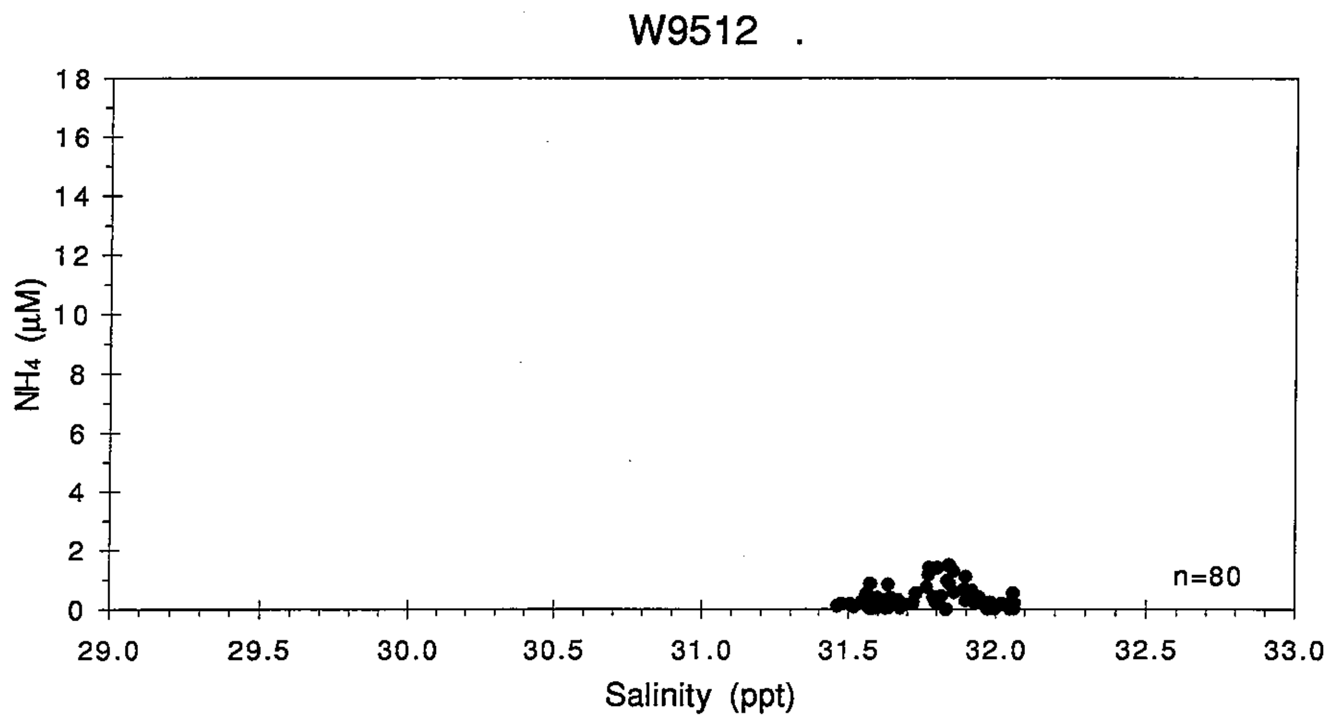
25
20
15
10
5
0
DIN (μM)
n=15
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)



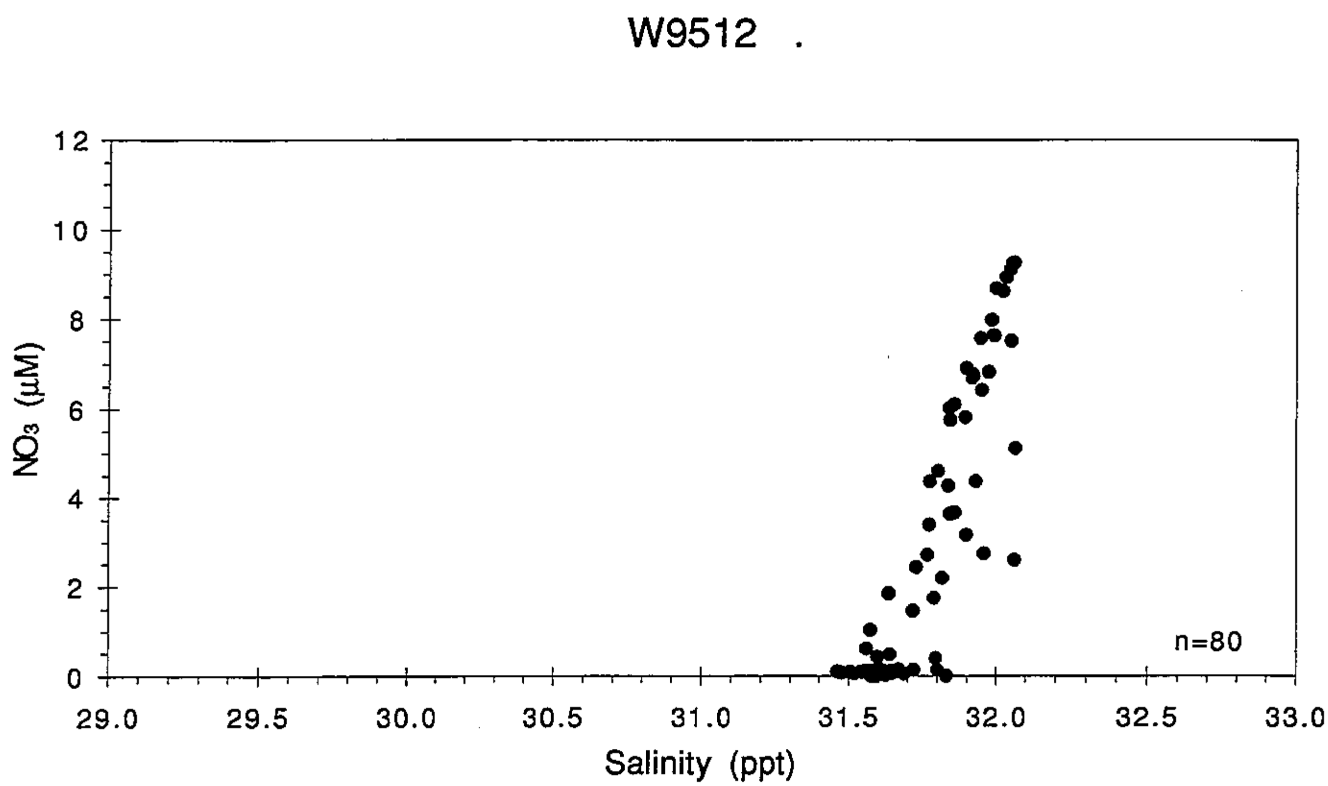
W9510 .
18
16
14
12
10
8
6
4
2
0
NH4 (µM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)



W9510 .
12
10
8
6
4
2
0
NO3 (µM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

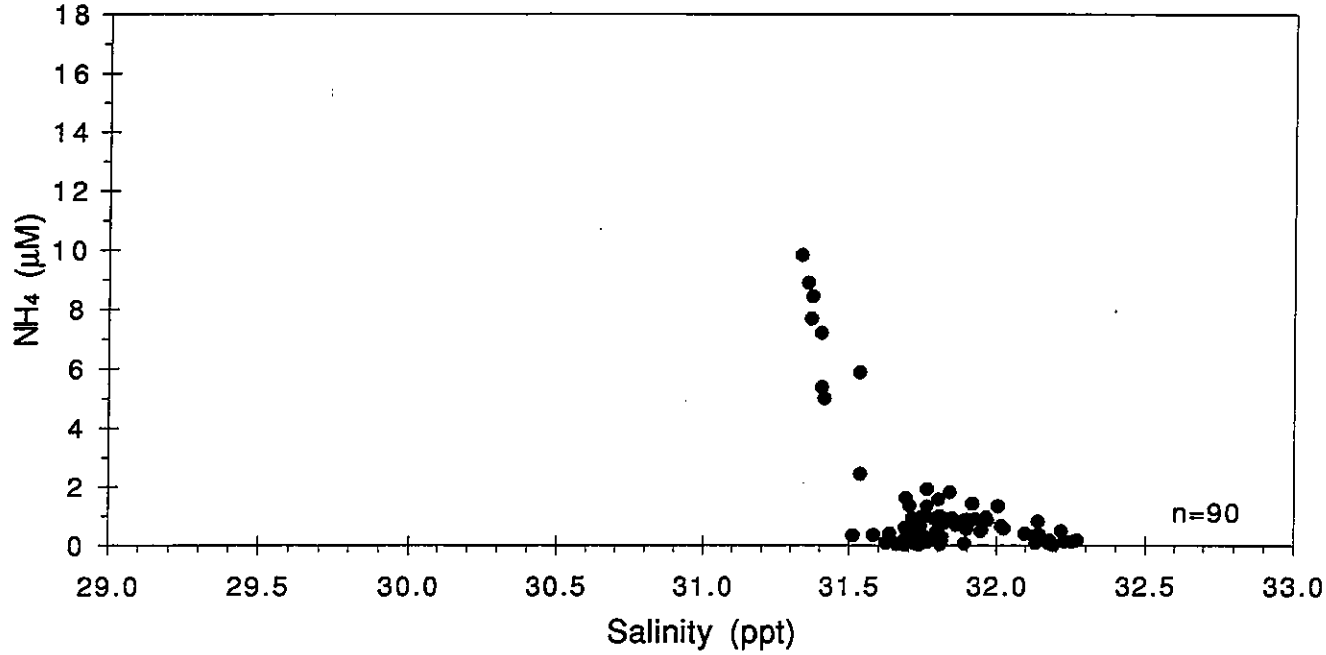


W9512
18
16
14
12
10
8
6
4
2
0
NH_4 (µM)
n=80
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)



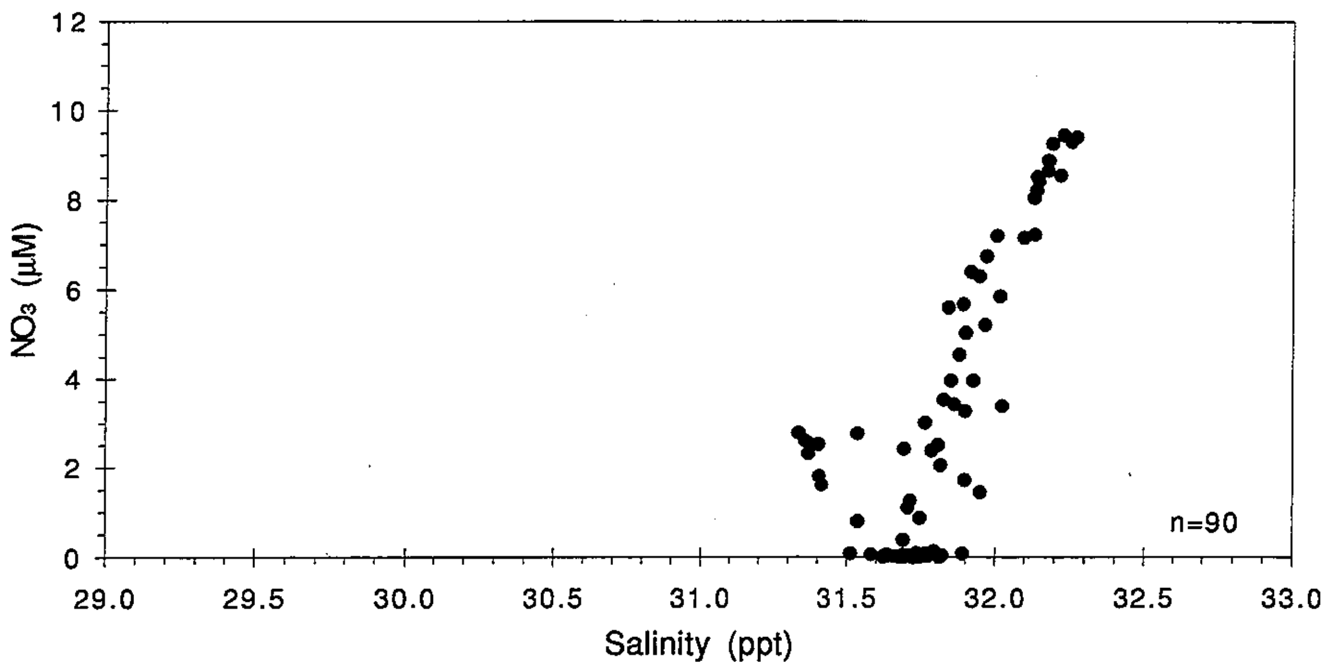
W9512
12
10
8
6
4
2
0
NO_3 (µM)
n=80
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9513 .

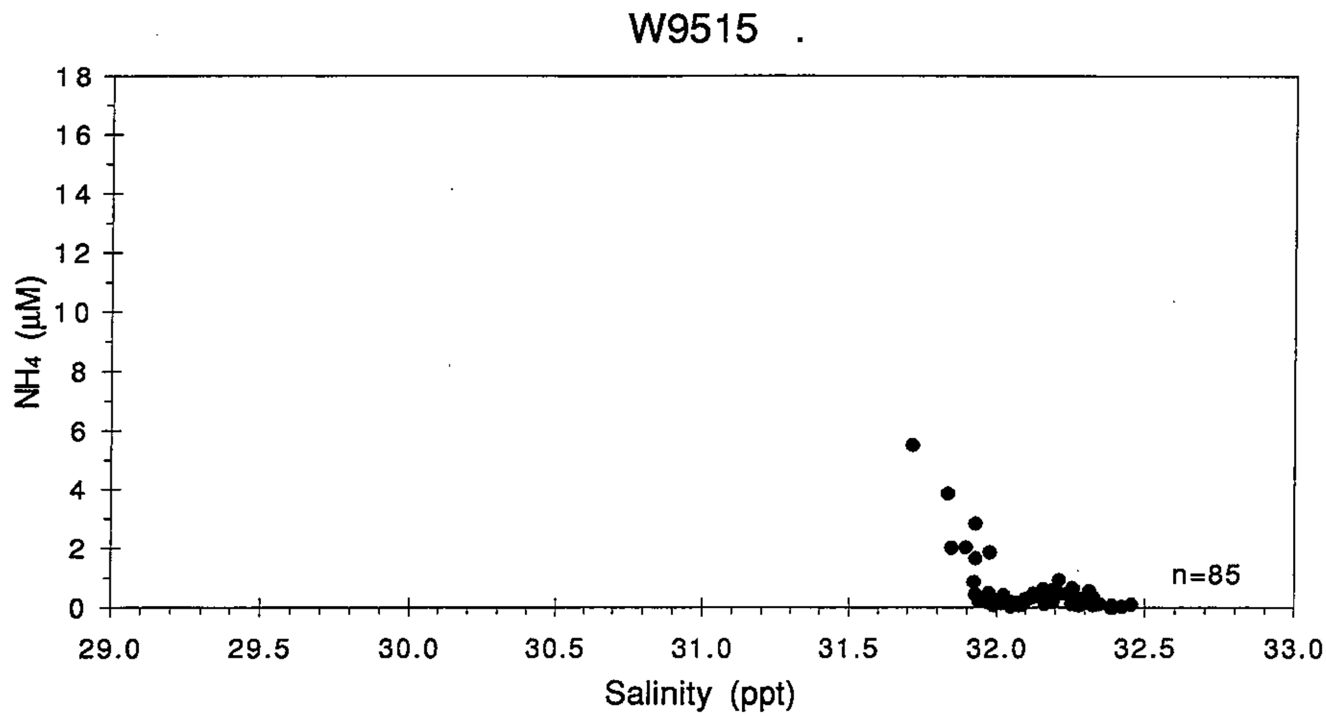


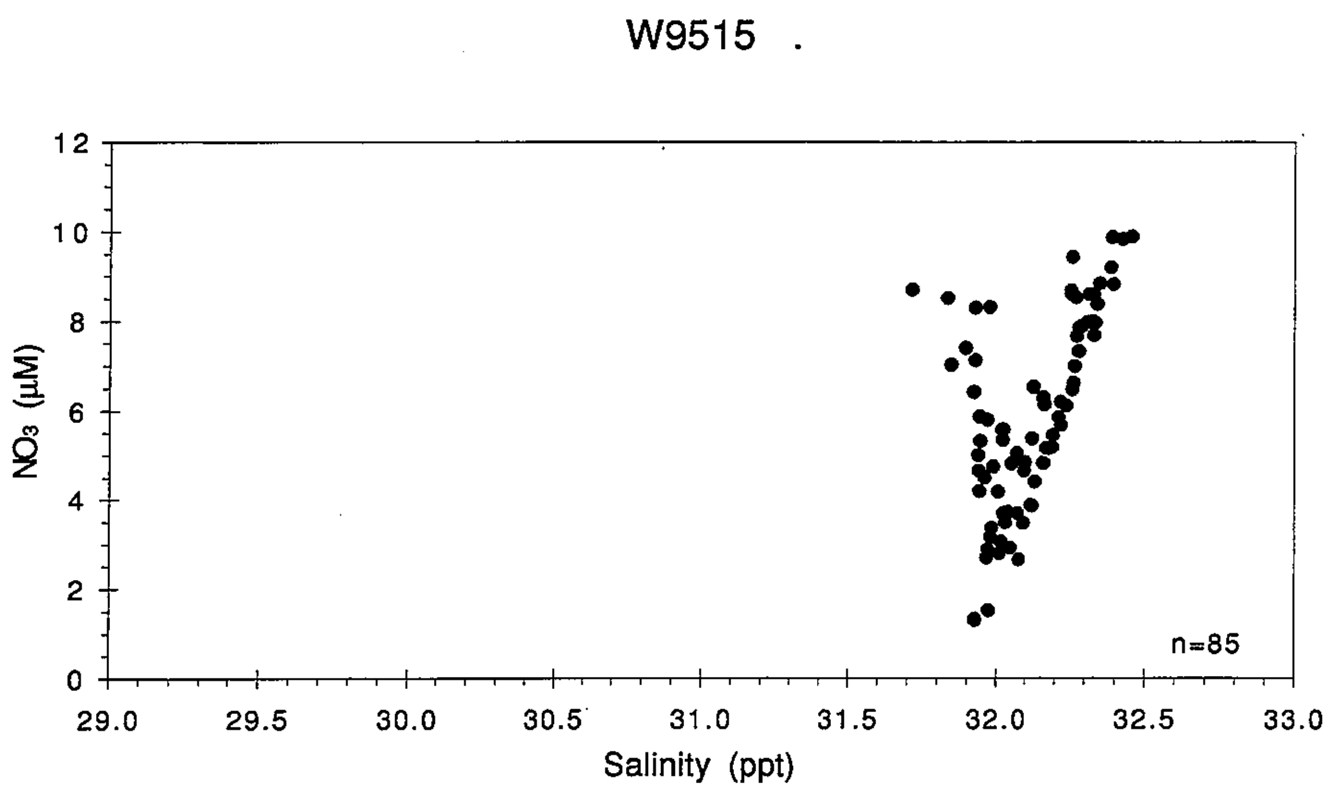
18
16
14
12
10
8
6
4
2
0
NH_4 (µM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

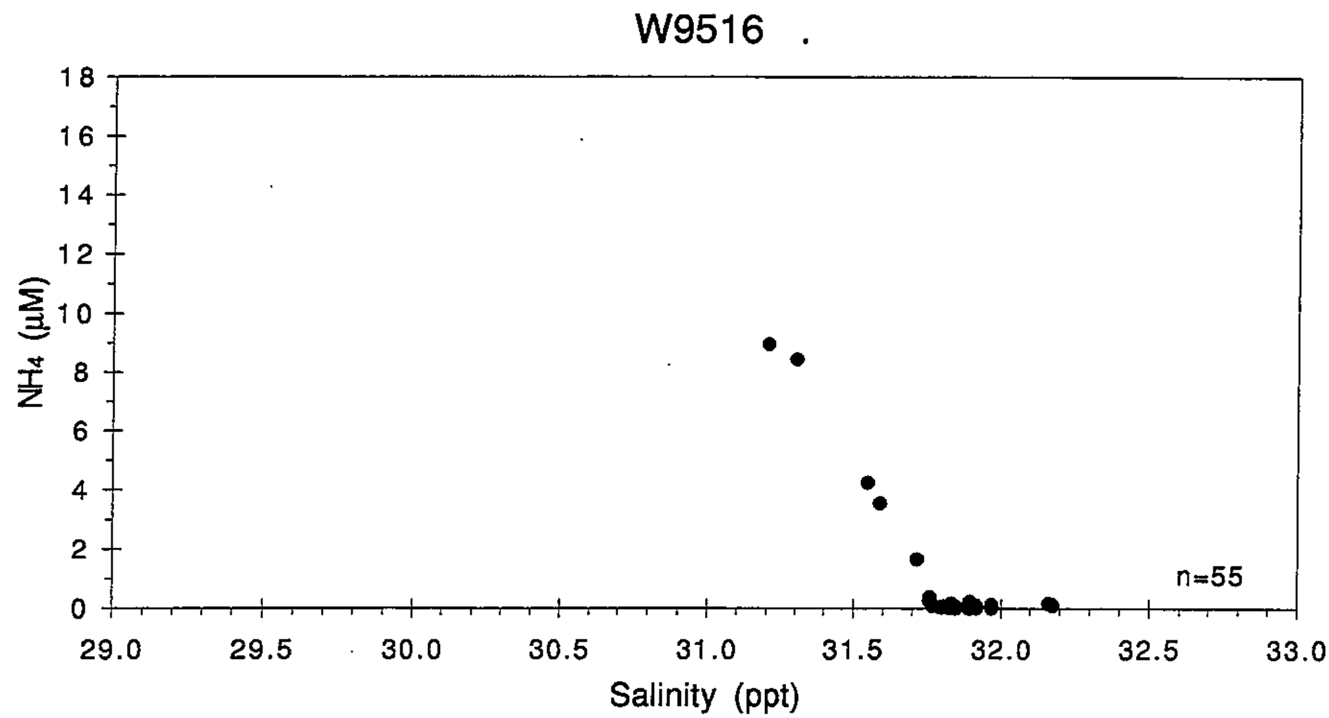
W9513 .

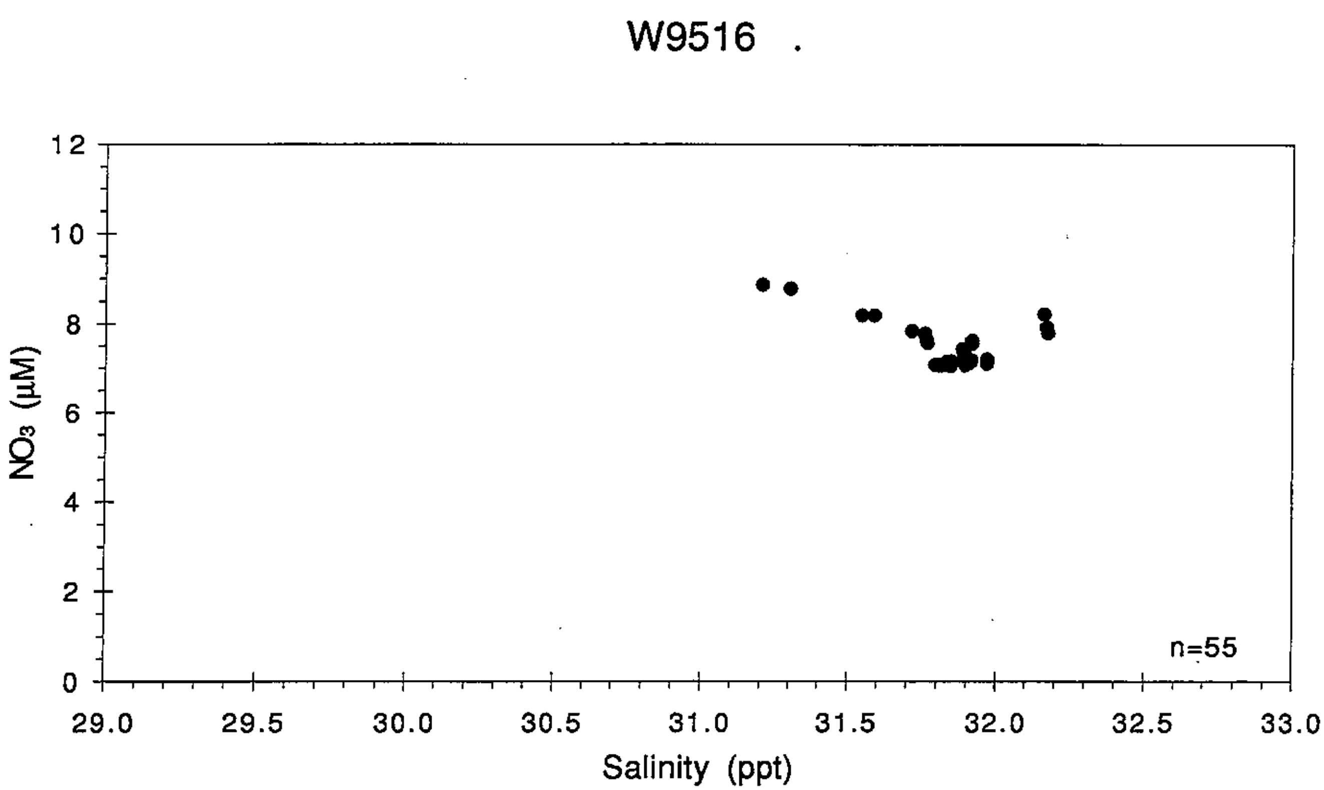


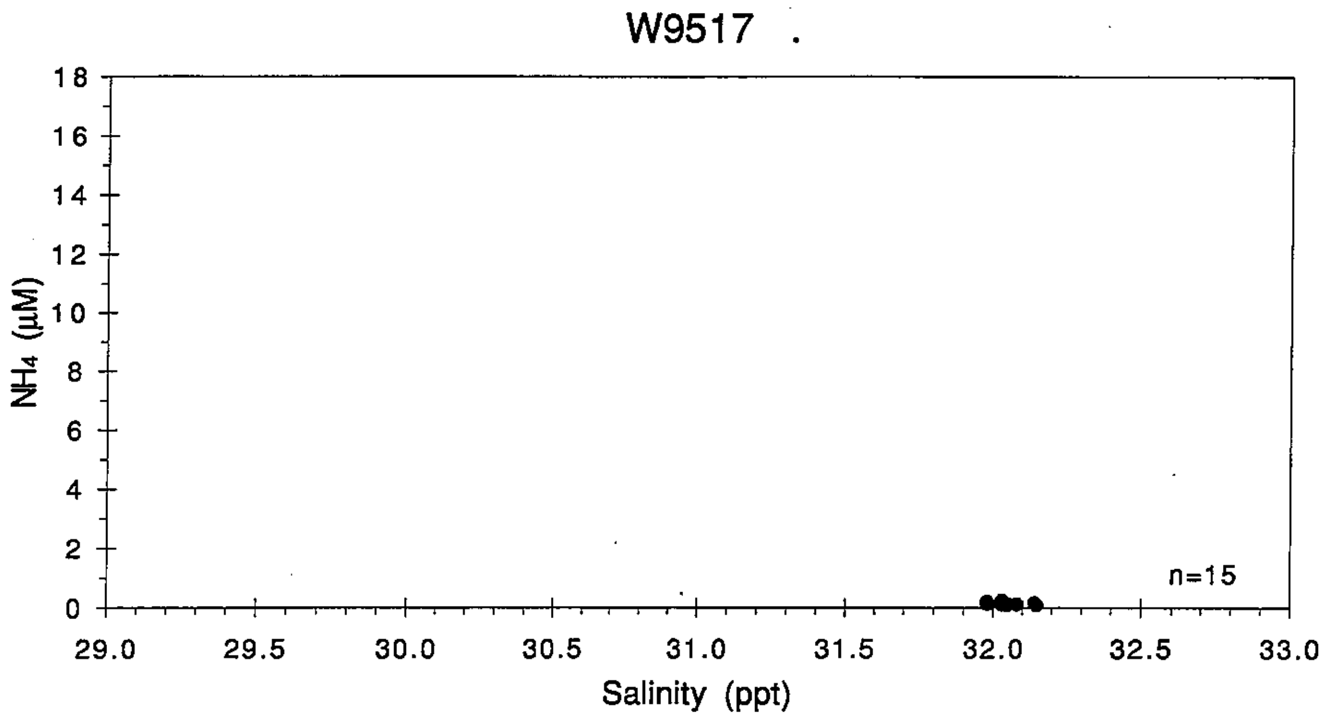
12
10
8
6
4
2
0
NO_3 (µM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

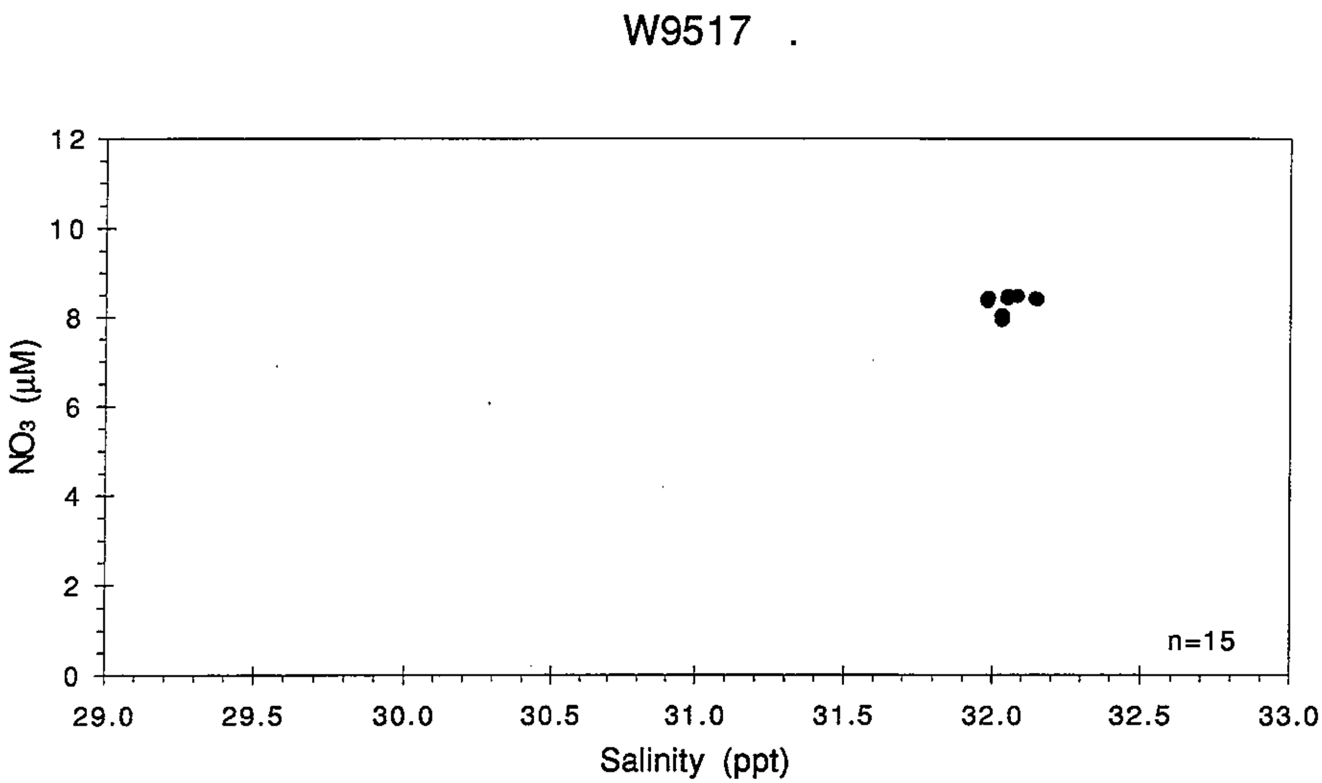

W9515 .
NH4 (µM)
n=85
Salinity (ppt)

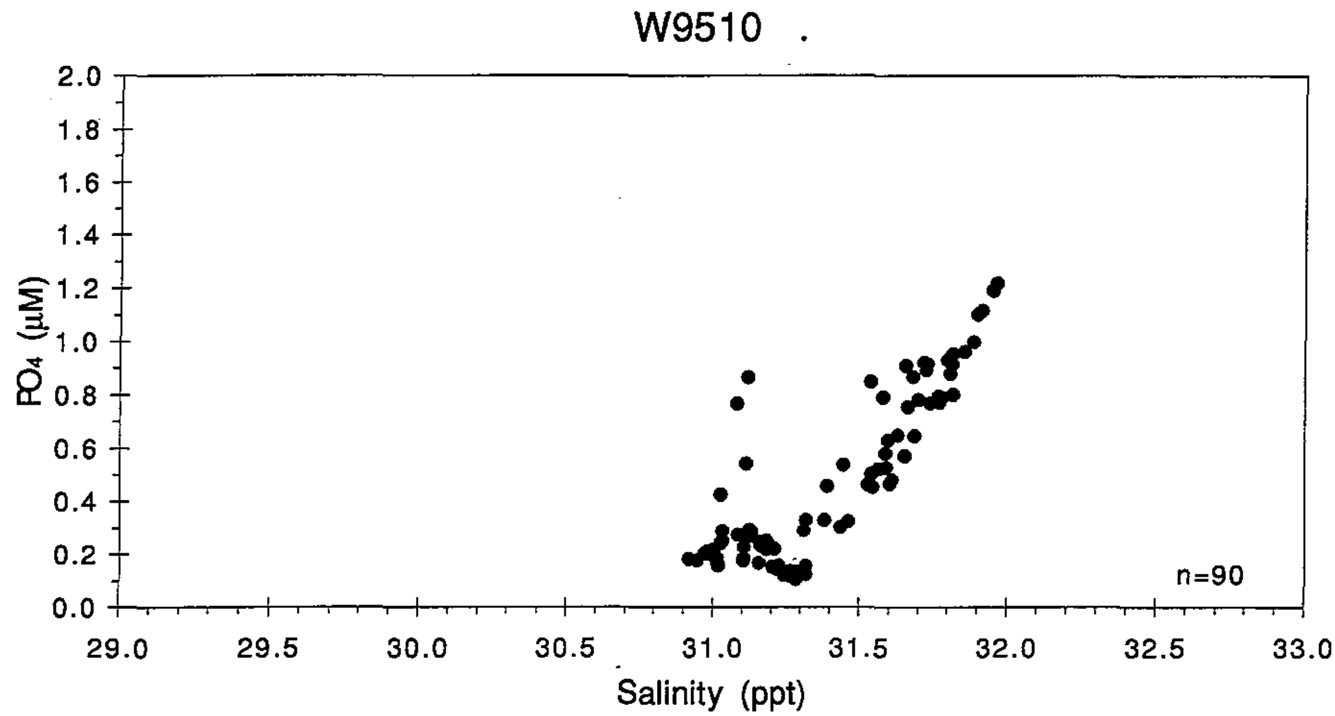

W9515 .
NO3 (µM)
n=85
Salinity (ppt)


W9516
NH4 (µM)
n=55
Salinity (ppt)

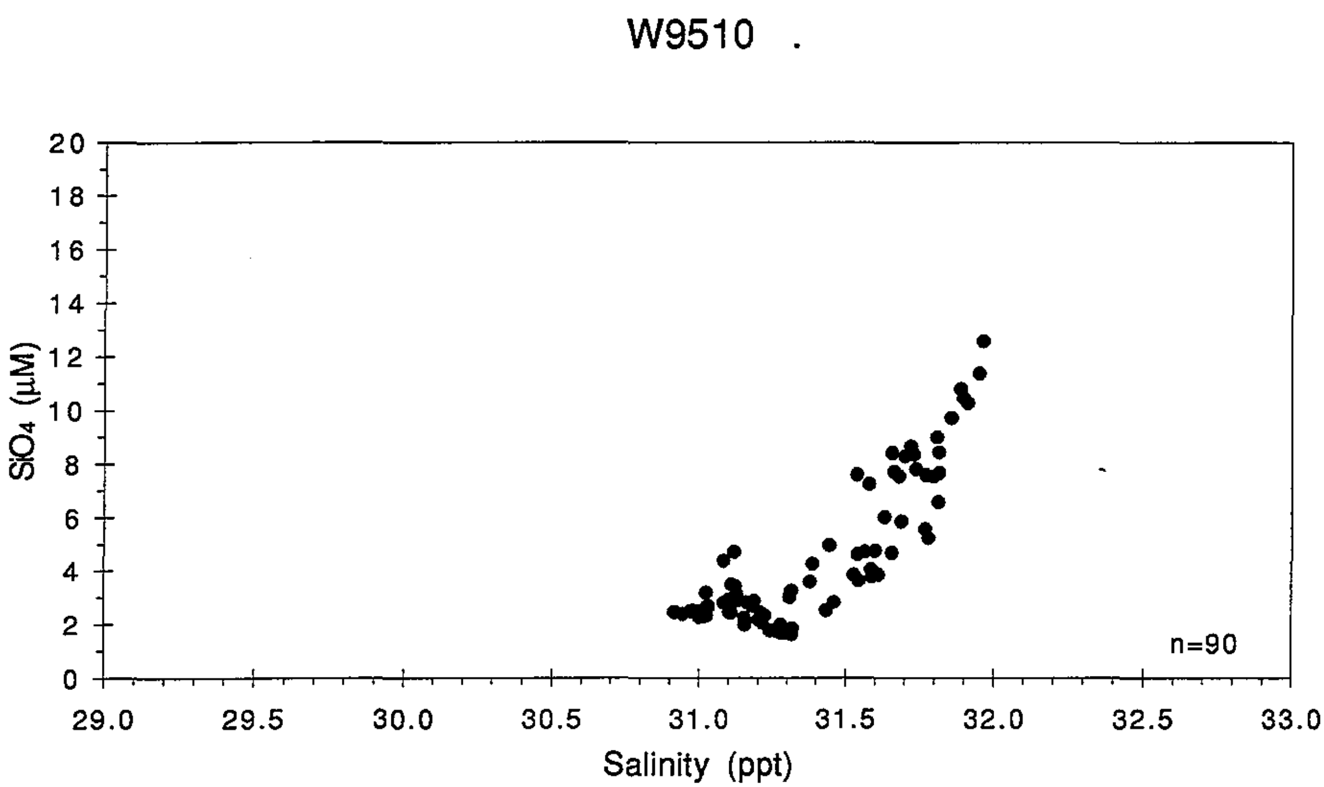

W9516
NO3 (µM)
n=55
Salinity (ppt)


W9517 .
18
16
14
12
10
8
6
4
2
0
NH4 (µM)
n=15
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

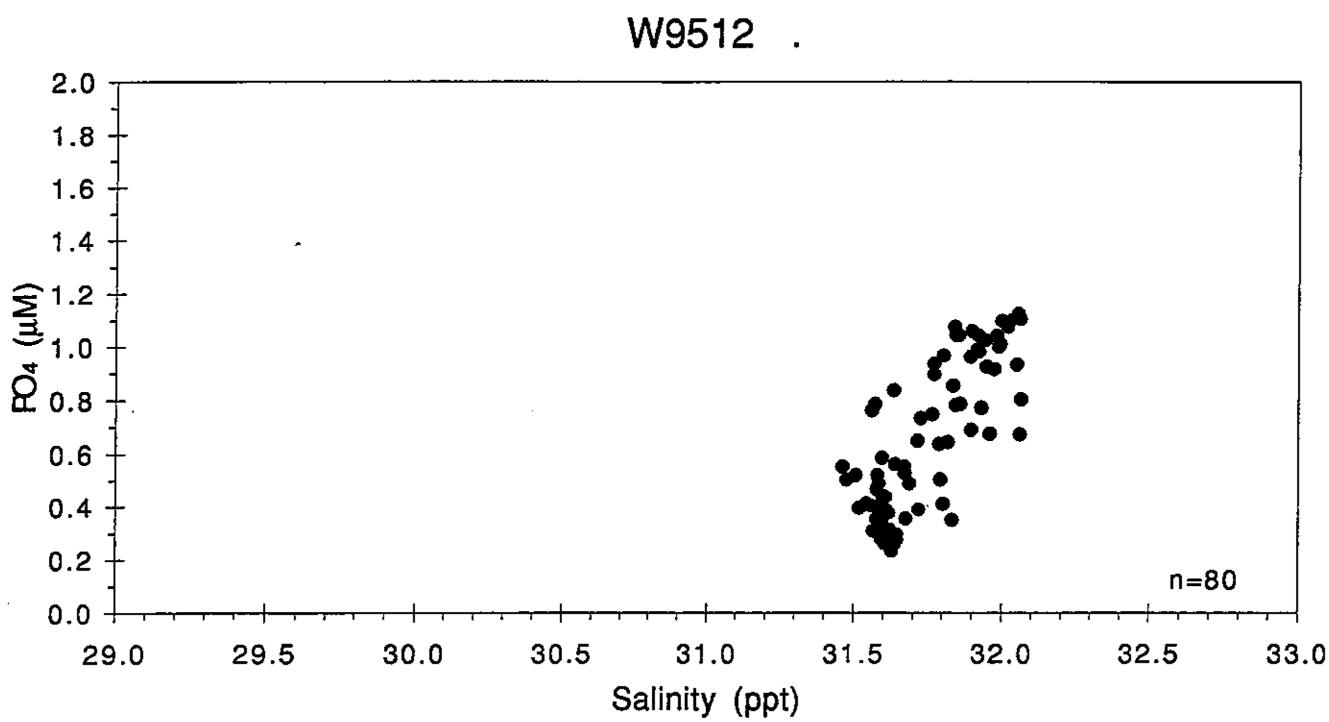

W9517 .
12
10
8
6
4
2
0
NO3 (µM)
n=15
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

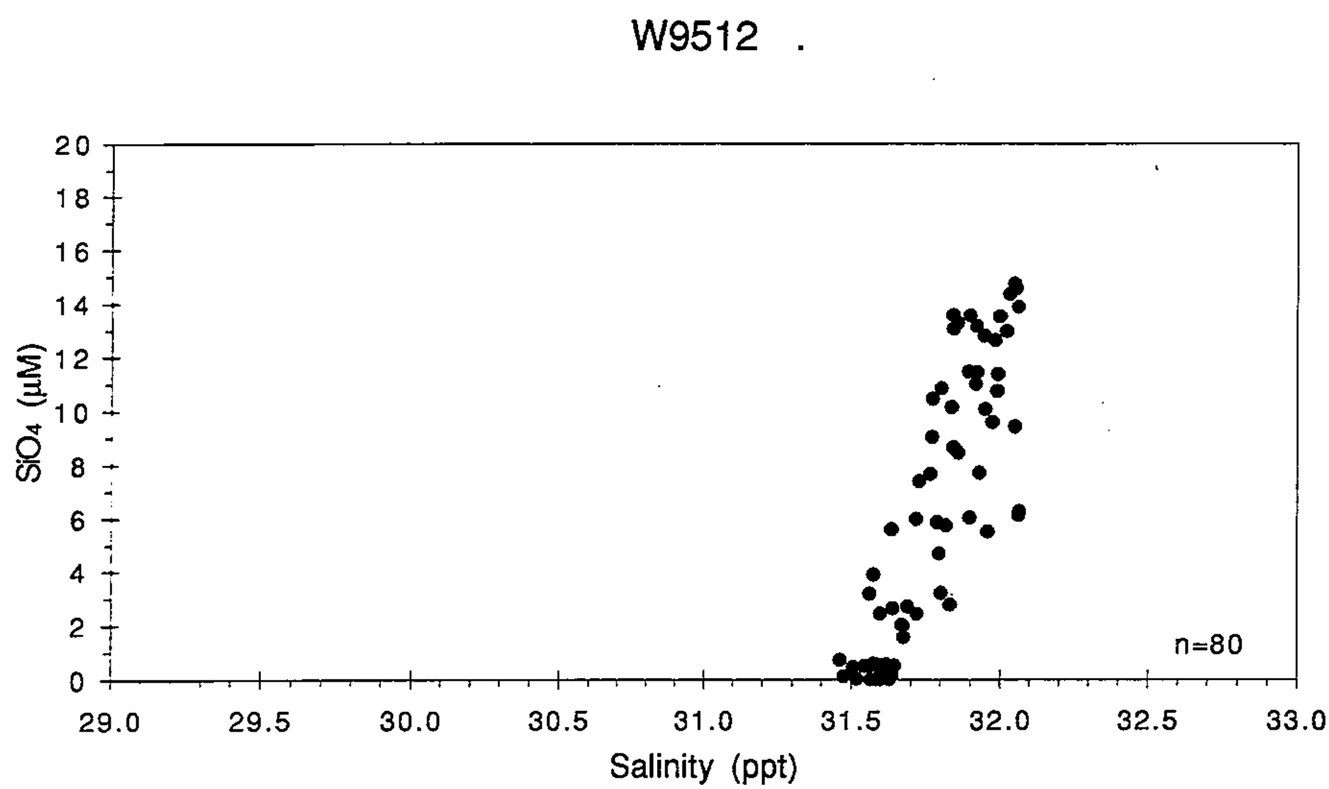


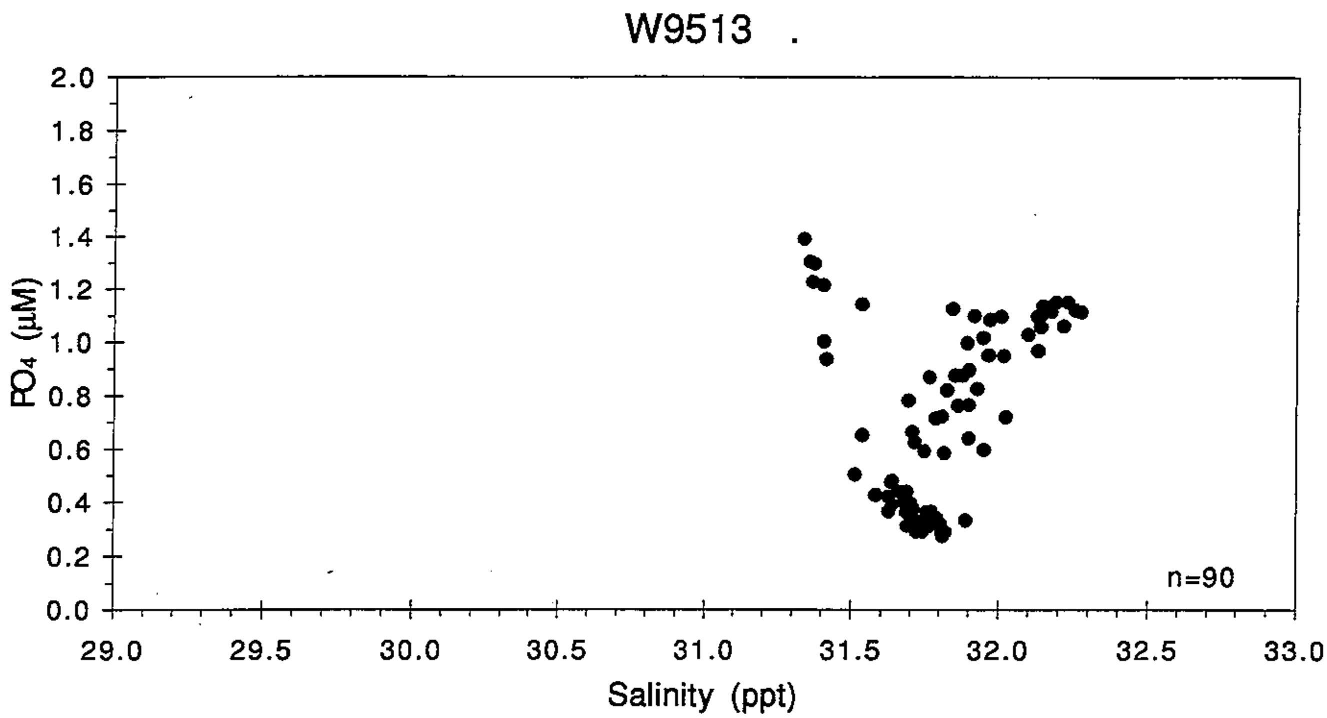
W9510
PO4 (µM)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

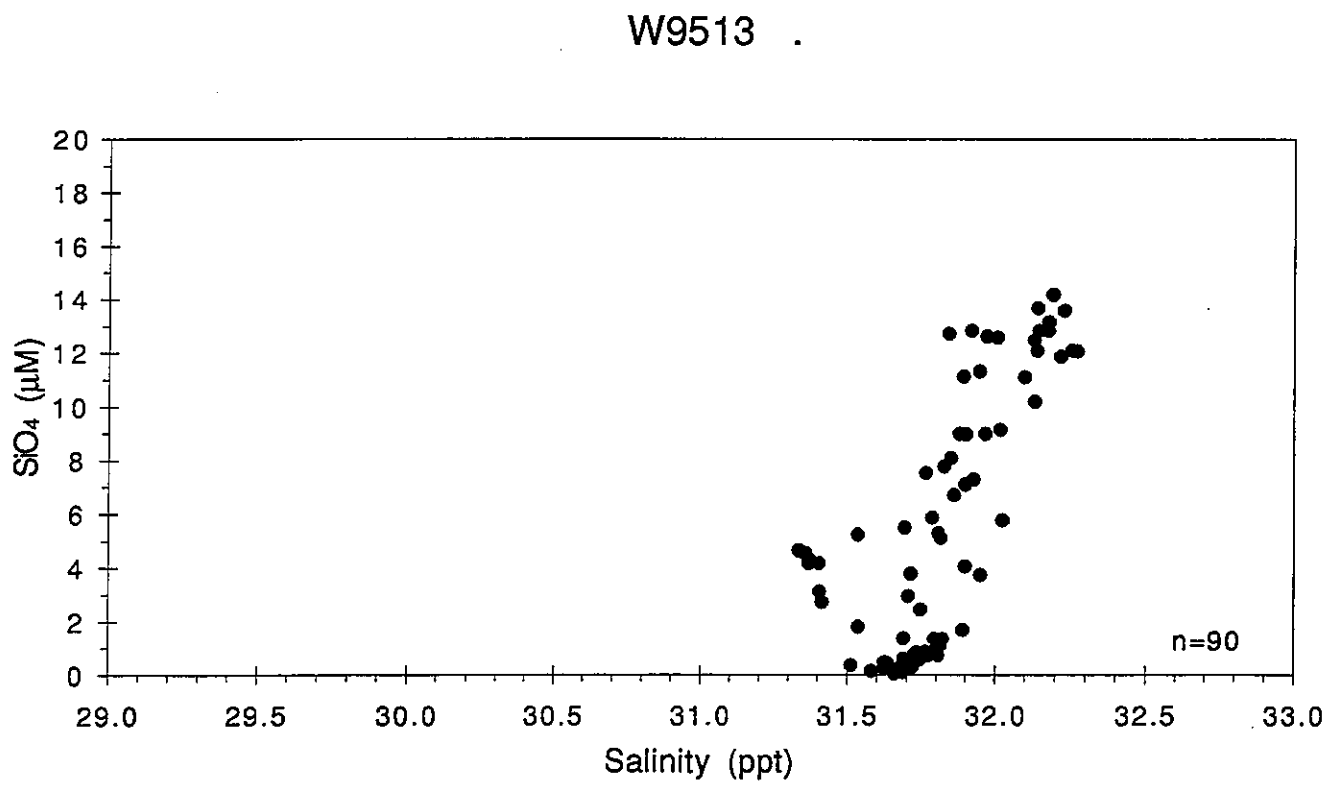


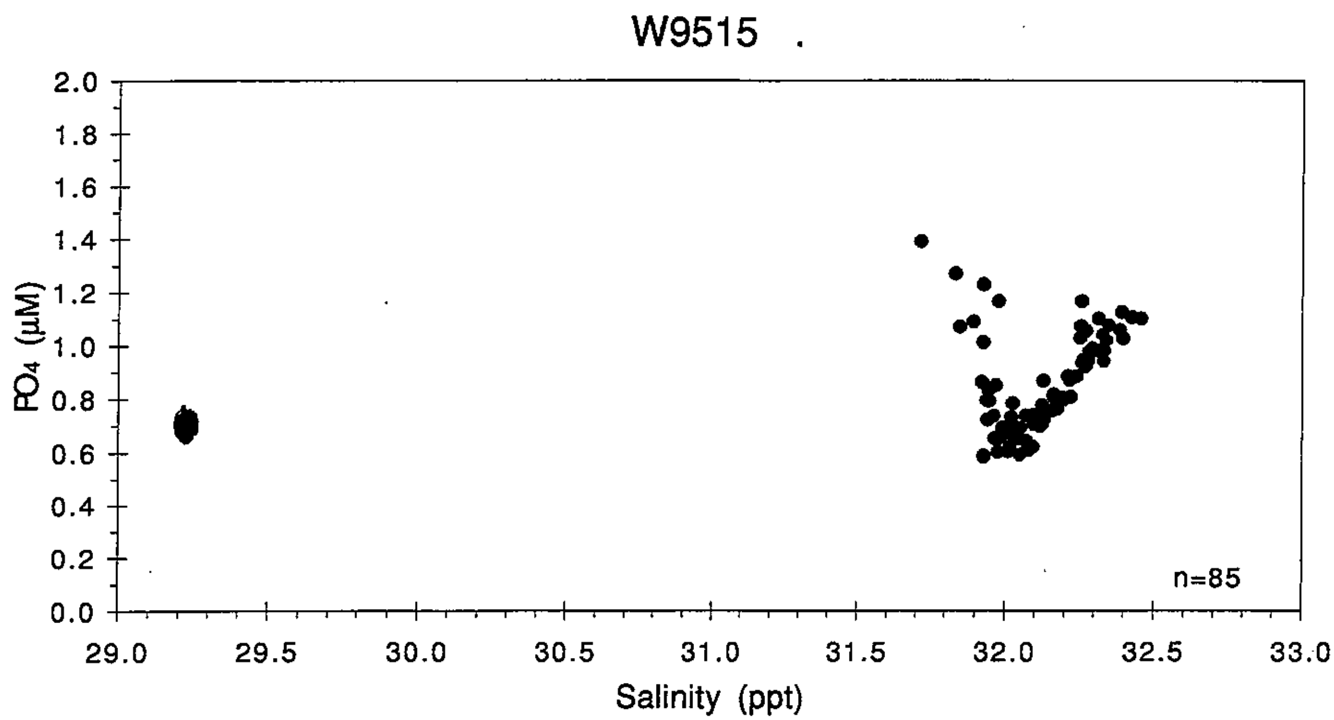
W9510
SiO4 (µM)
20
18
16
14
12
10
8
6
4
2
0
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

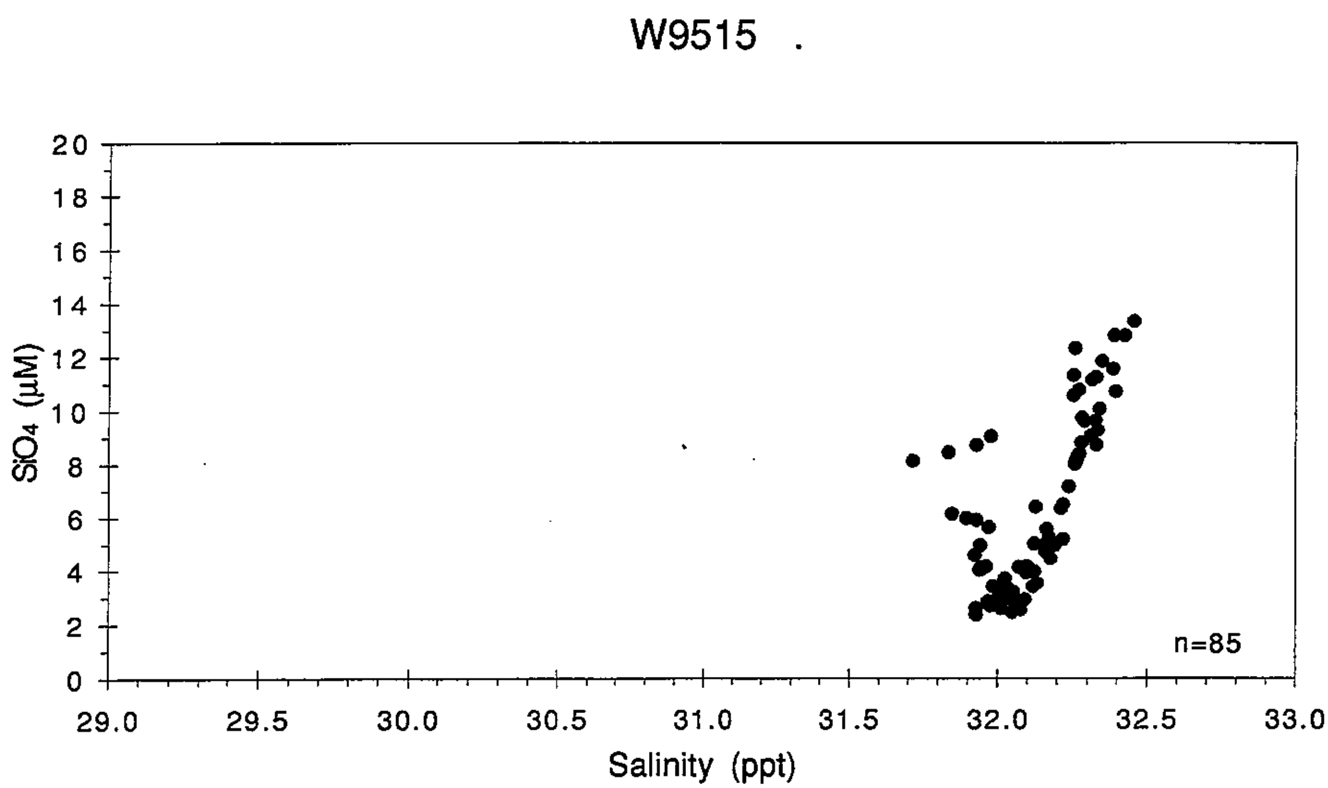

W9512 .
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO_4 (µM)
n=80
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

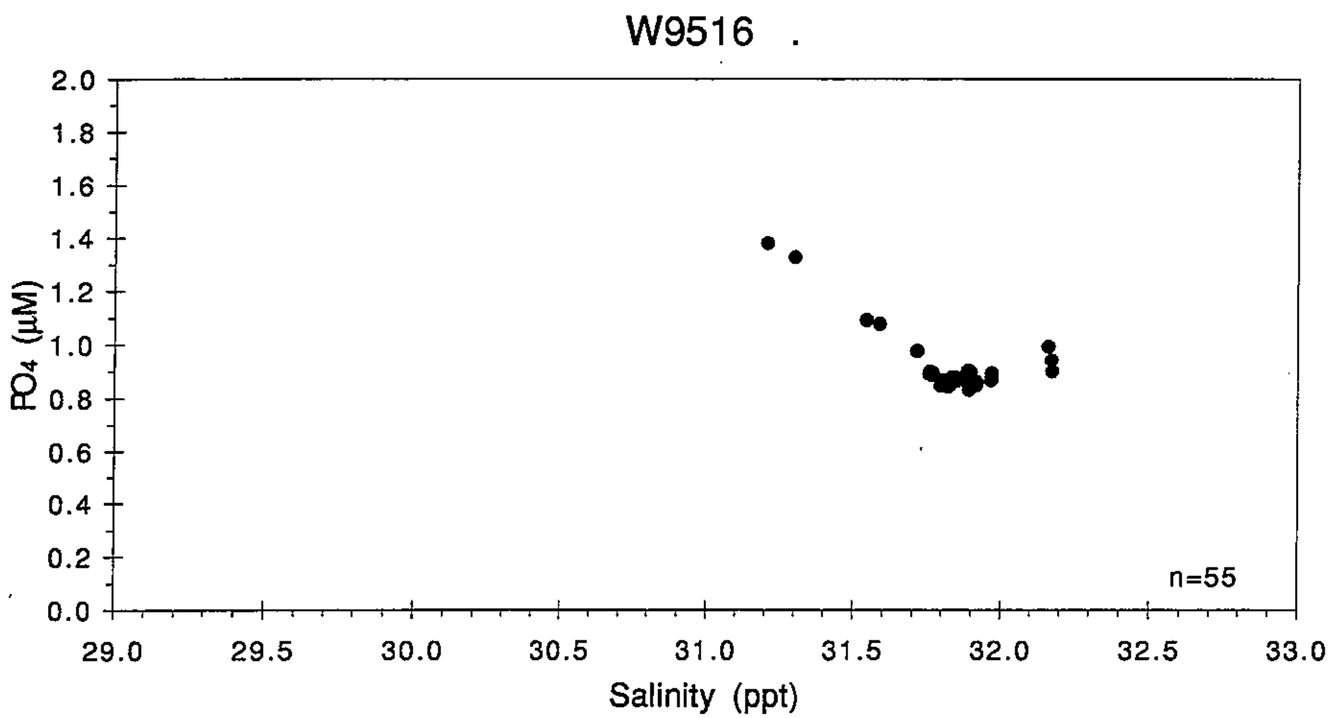

W9512 .
20
18
16
14
12
10
8
6
4
2
0
SiO_4 (µM)
n=80
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

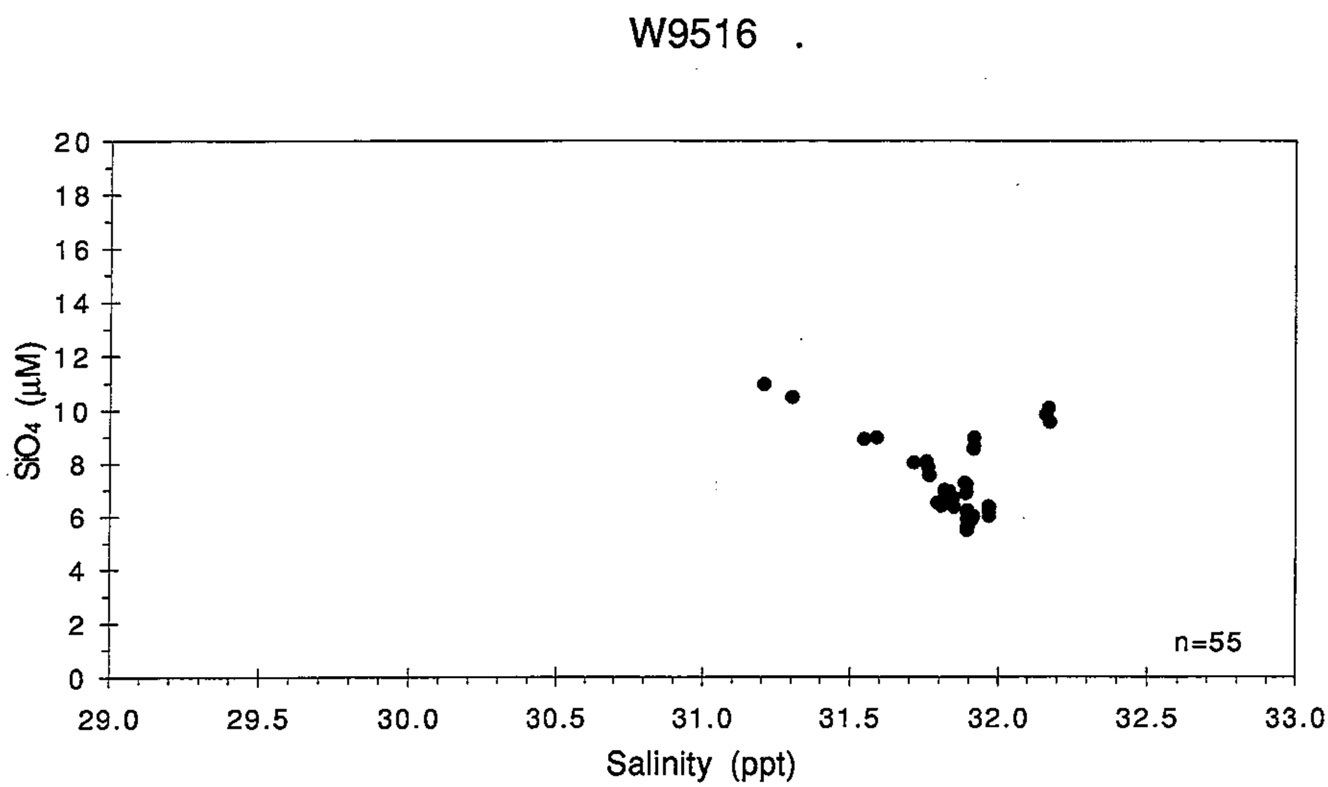

W9513 .
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (µM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9513 .
20
18
16
14
12
10
8
6
4
2
0
SiO4 (µM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

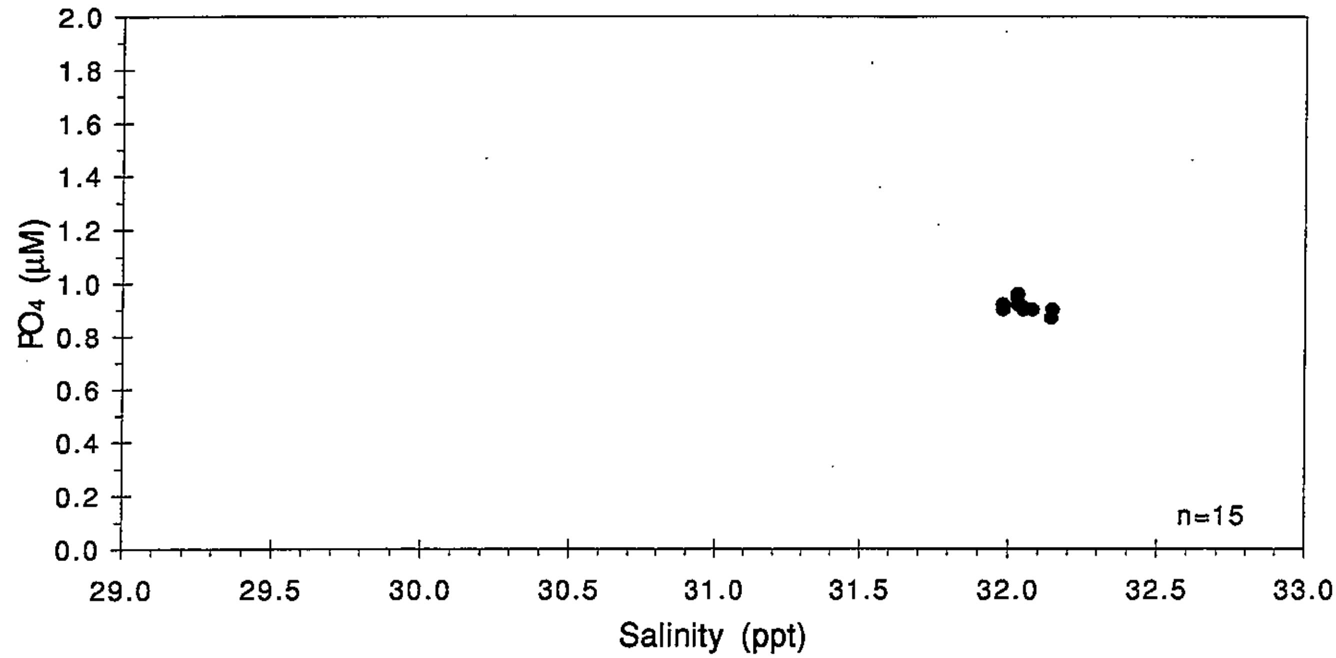

W9515
PO4 (µM)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=85


W9515
SiO4 (µM)
20
18
16
14
12
10
8
6
4
2
0
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=85

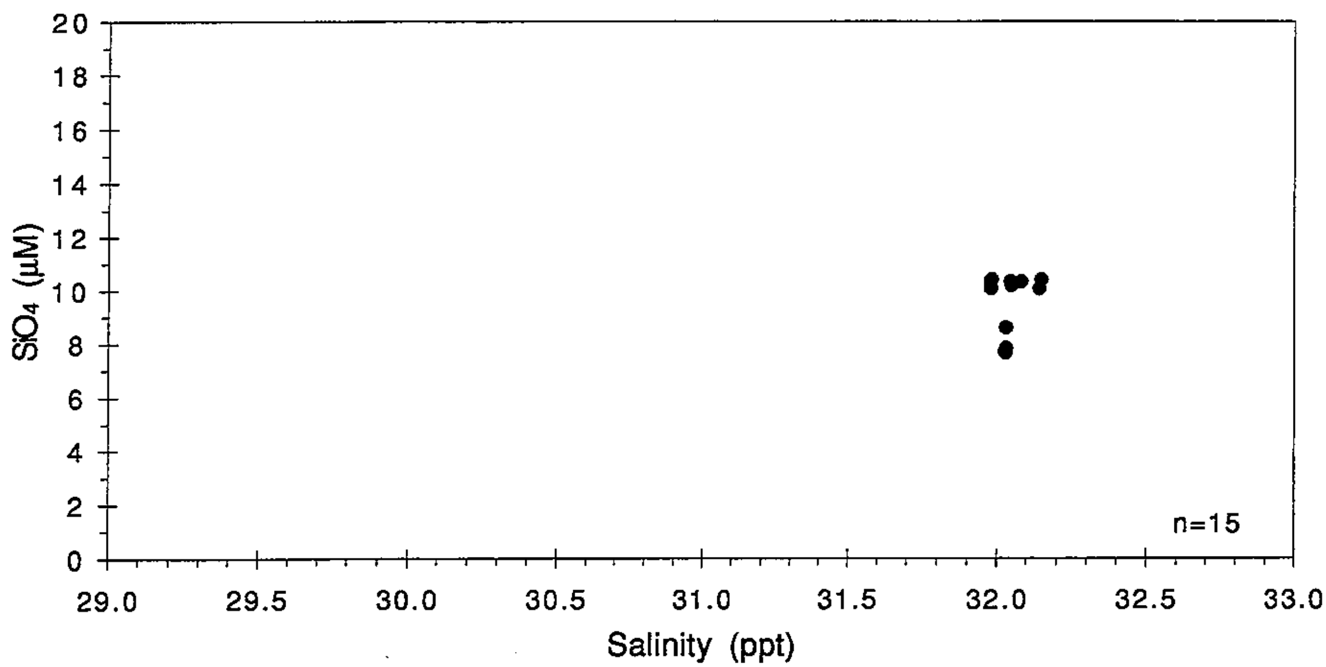

W9516 .
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (µM)
n=55
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

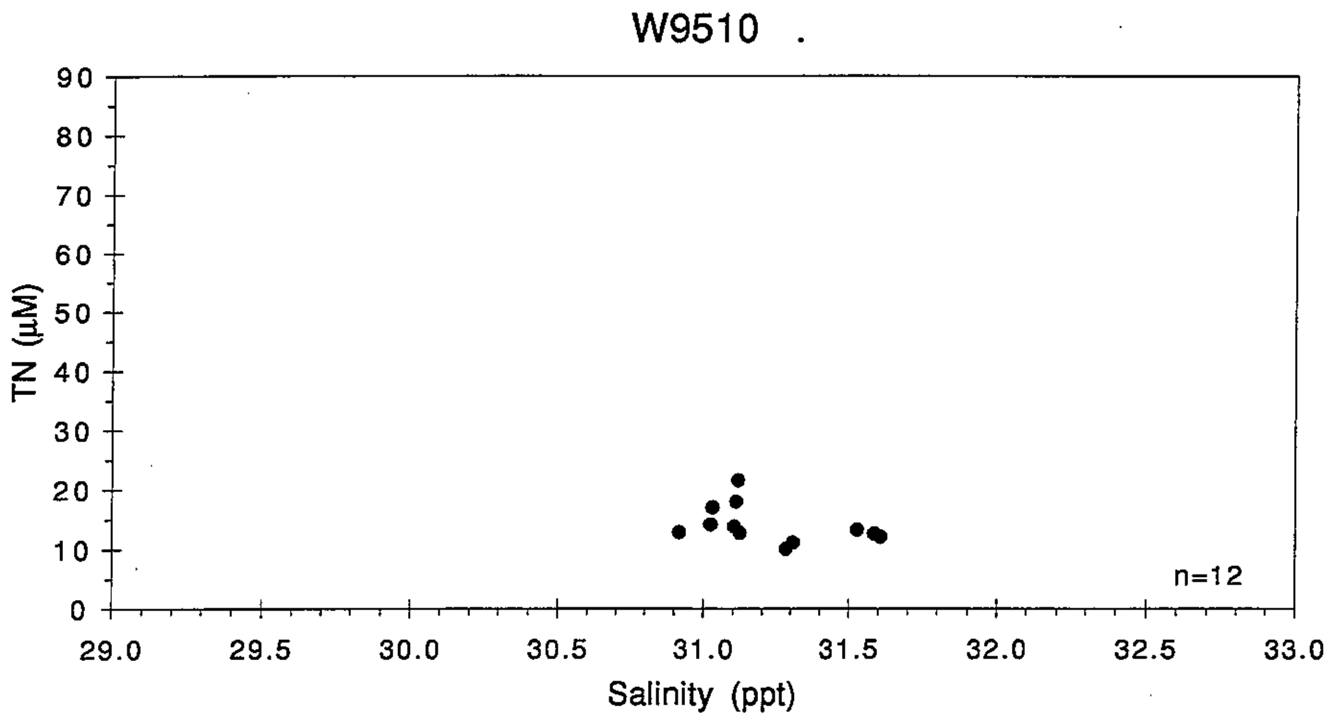

W9516 .
20
18
16
14
12
10
8
6
4
2
0
SiO4 (µM)
n=55
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

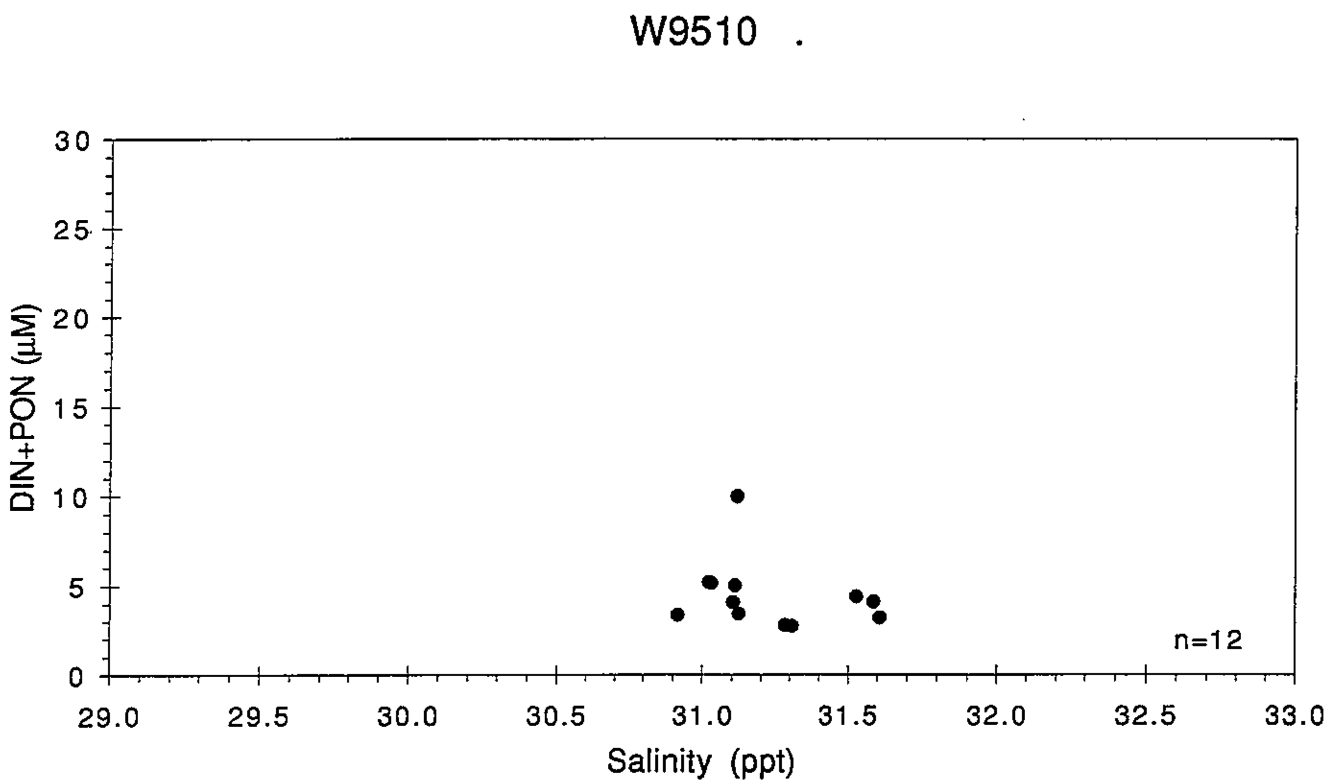
W9517 .


2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (µM)
n=15
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

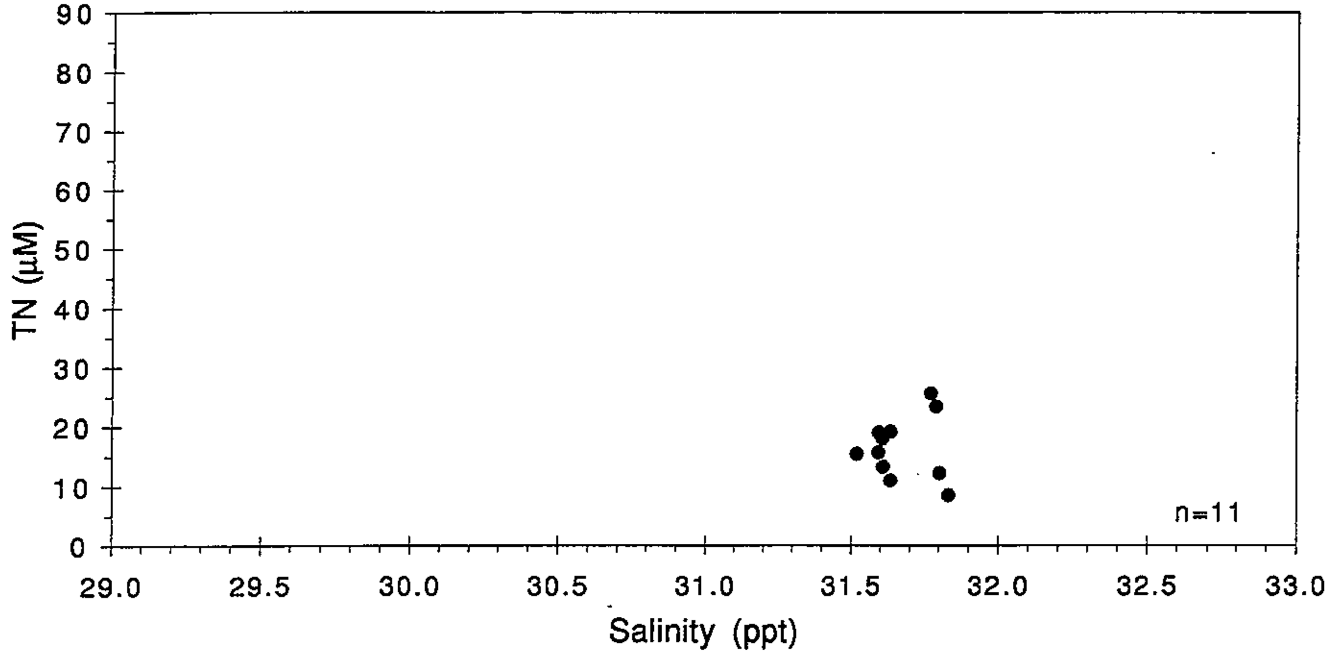
W9517 .


20
18
16
14
12
10
8
6
4
2
0
SiO4 (µM)
n=15
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

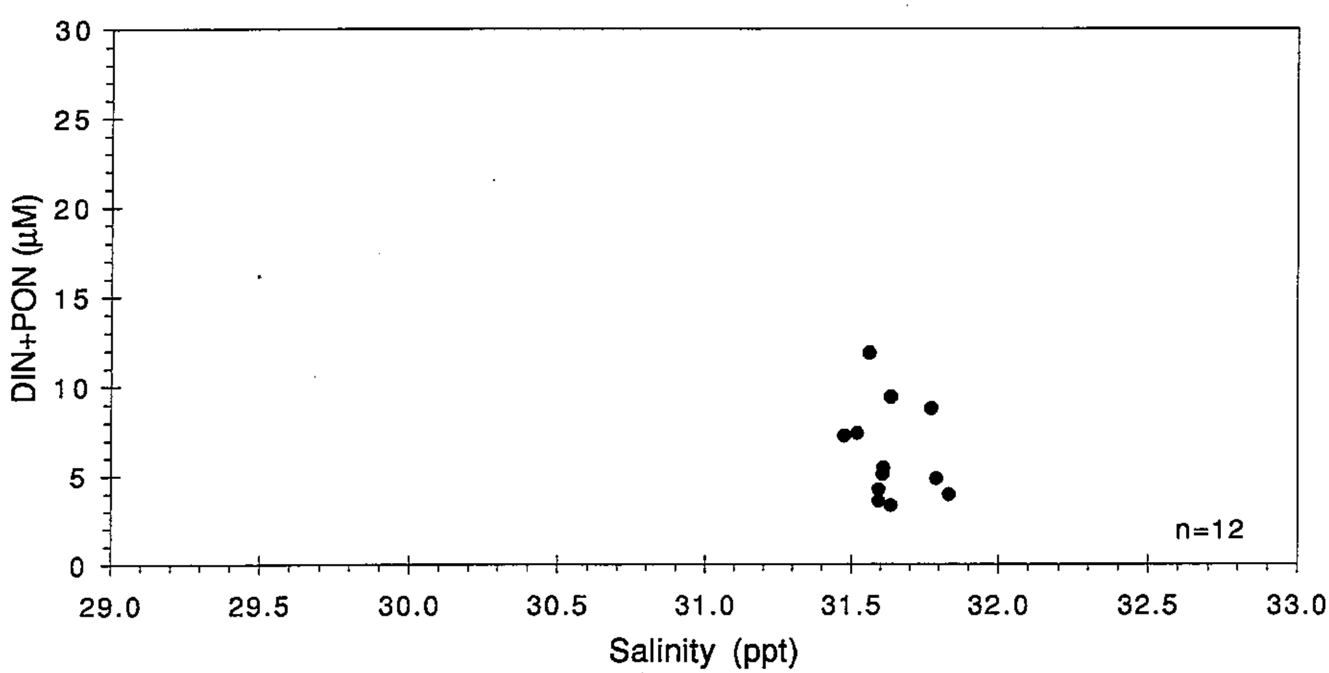

W9510 .
TN (µM)
90
80
70
60
50
40
30
20
10
0
n=12
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

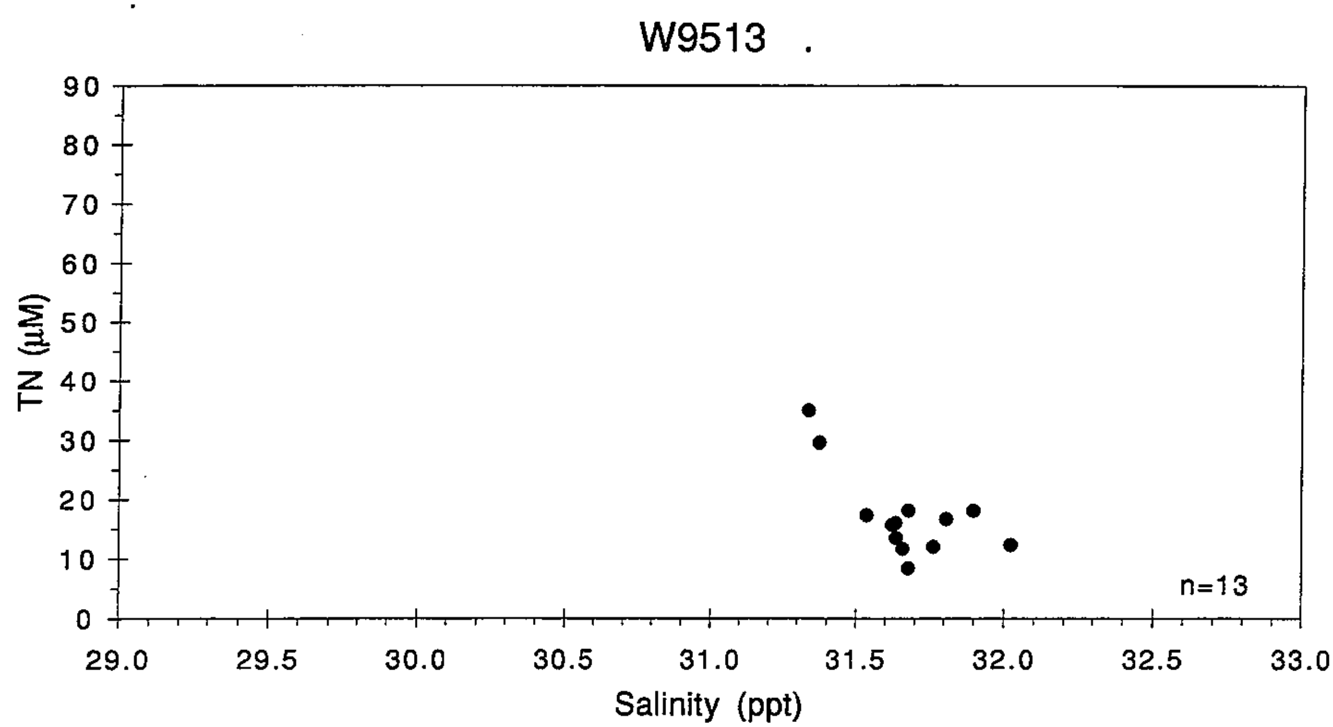

W9510 .
DIN+PON (µM)
30
25
20
15
10
5
0
n=12
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

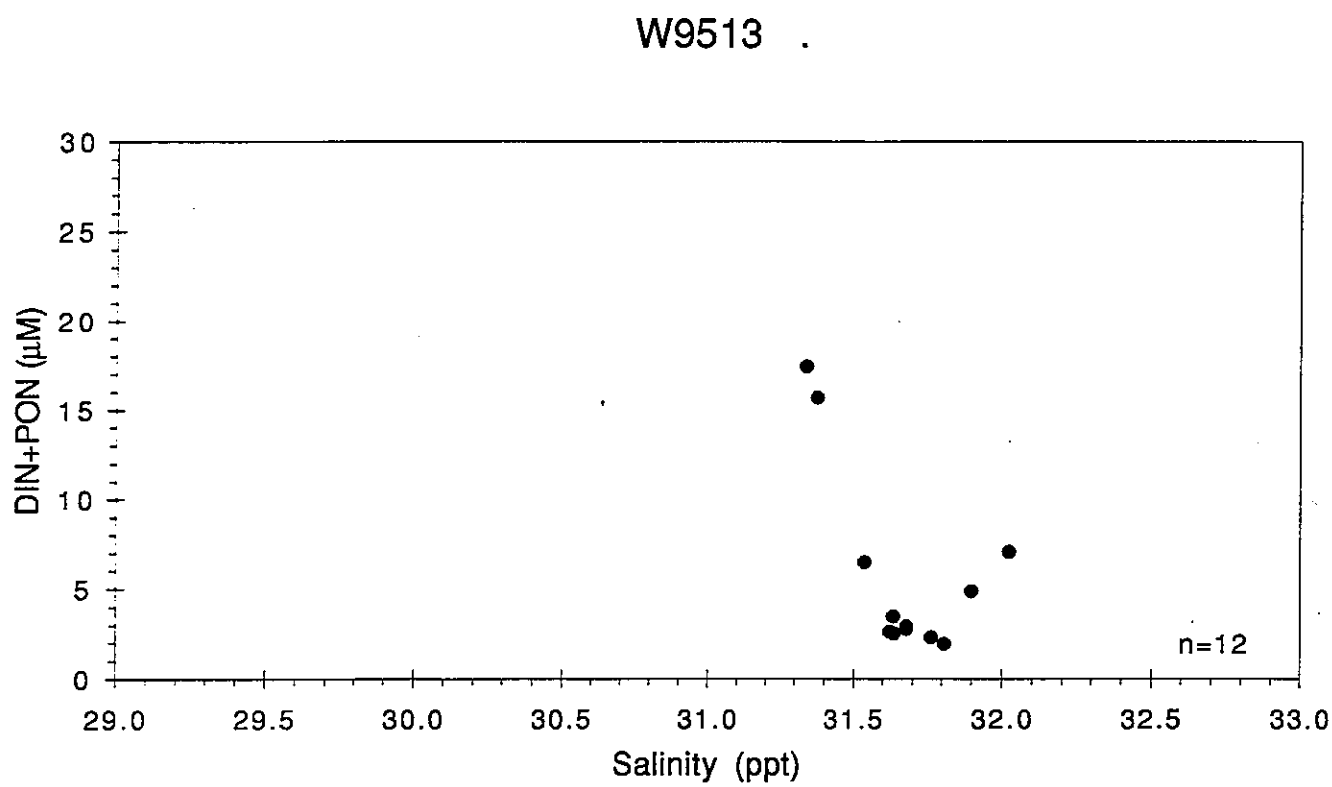
W9512 .

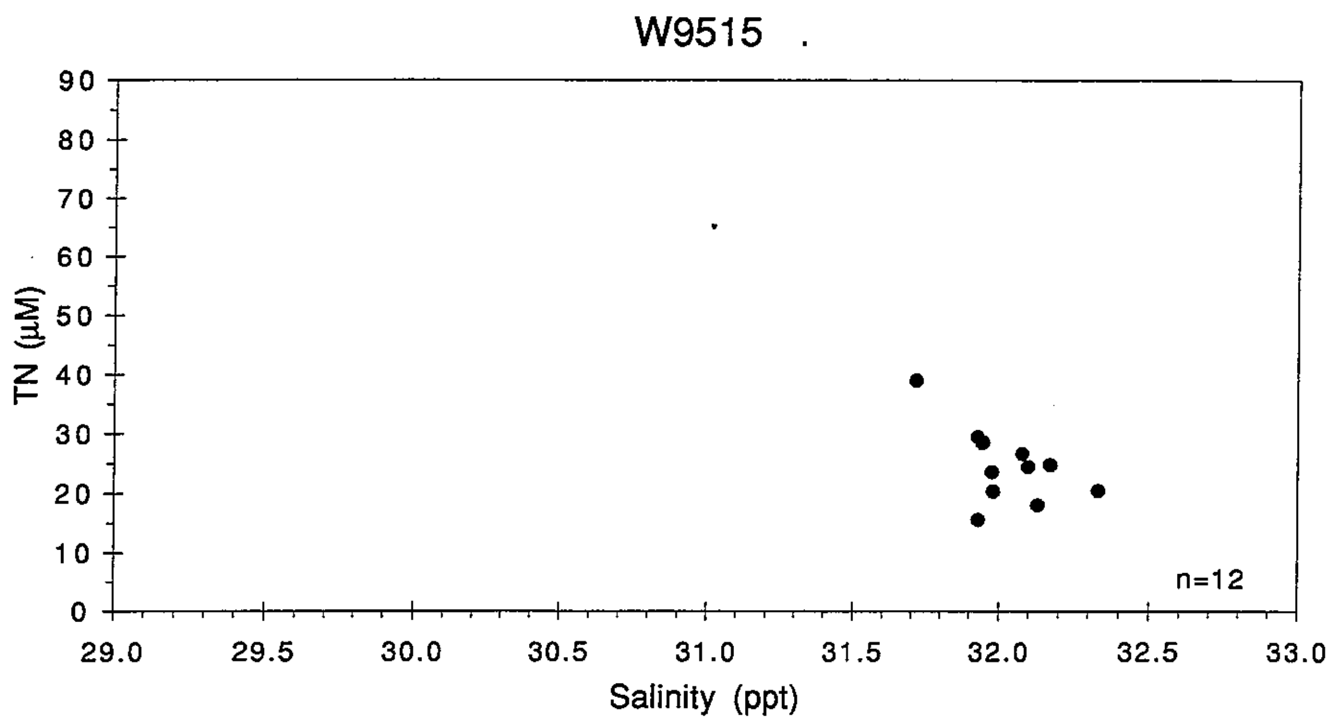

90
80
70
60
50
40
30
20
10
0
TN (µM)
n=11
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

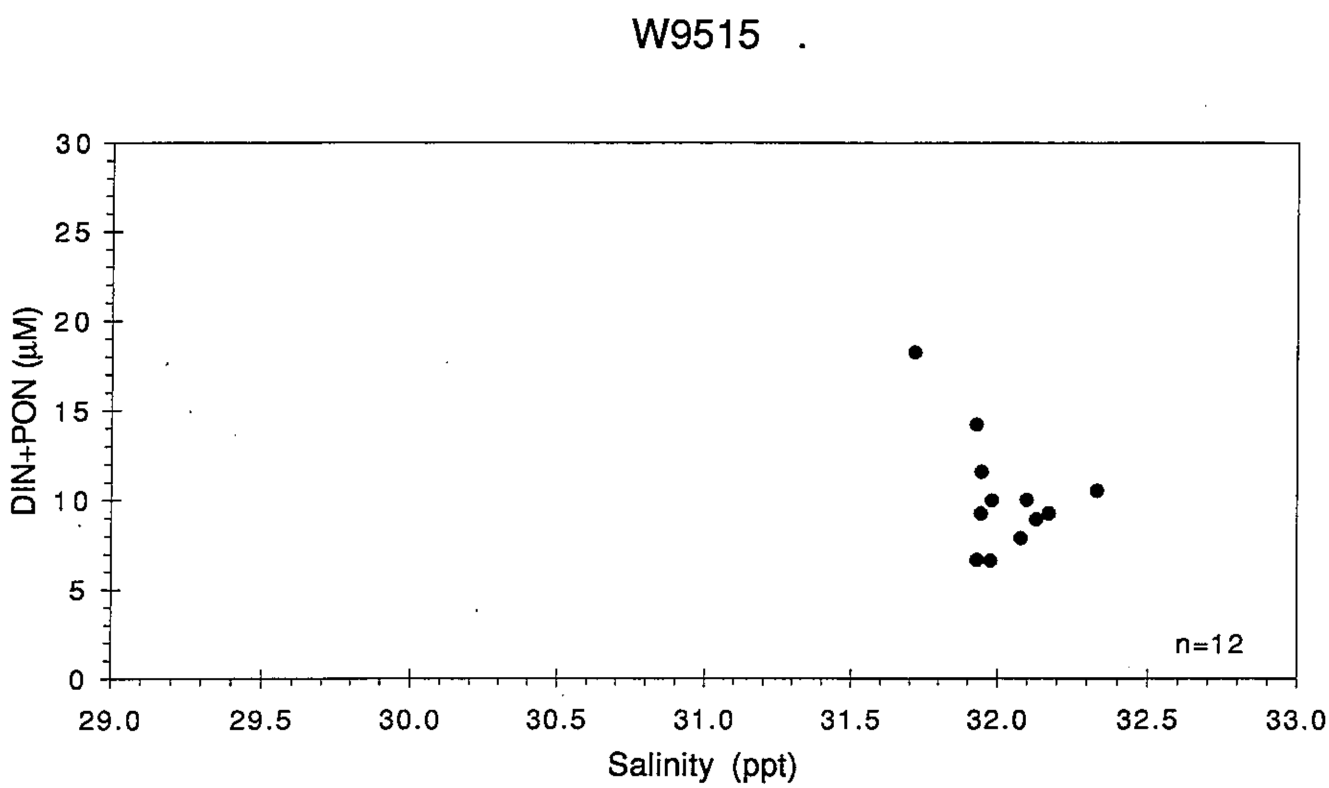
W9512 .

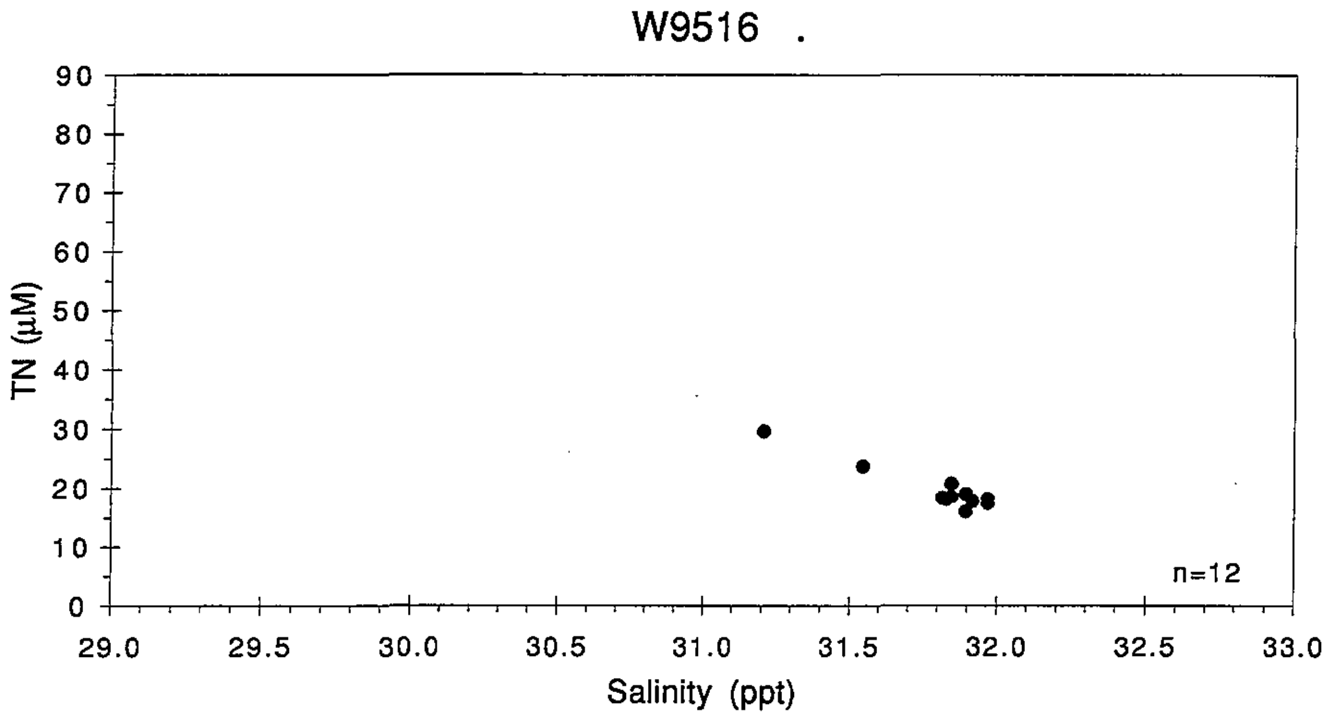

30
25
20
15
10
5
0
DIN+PON (µM)
n=12
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

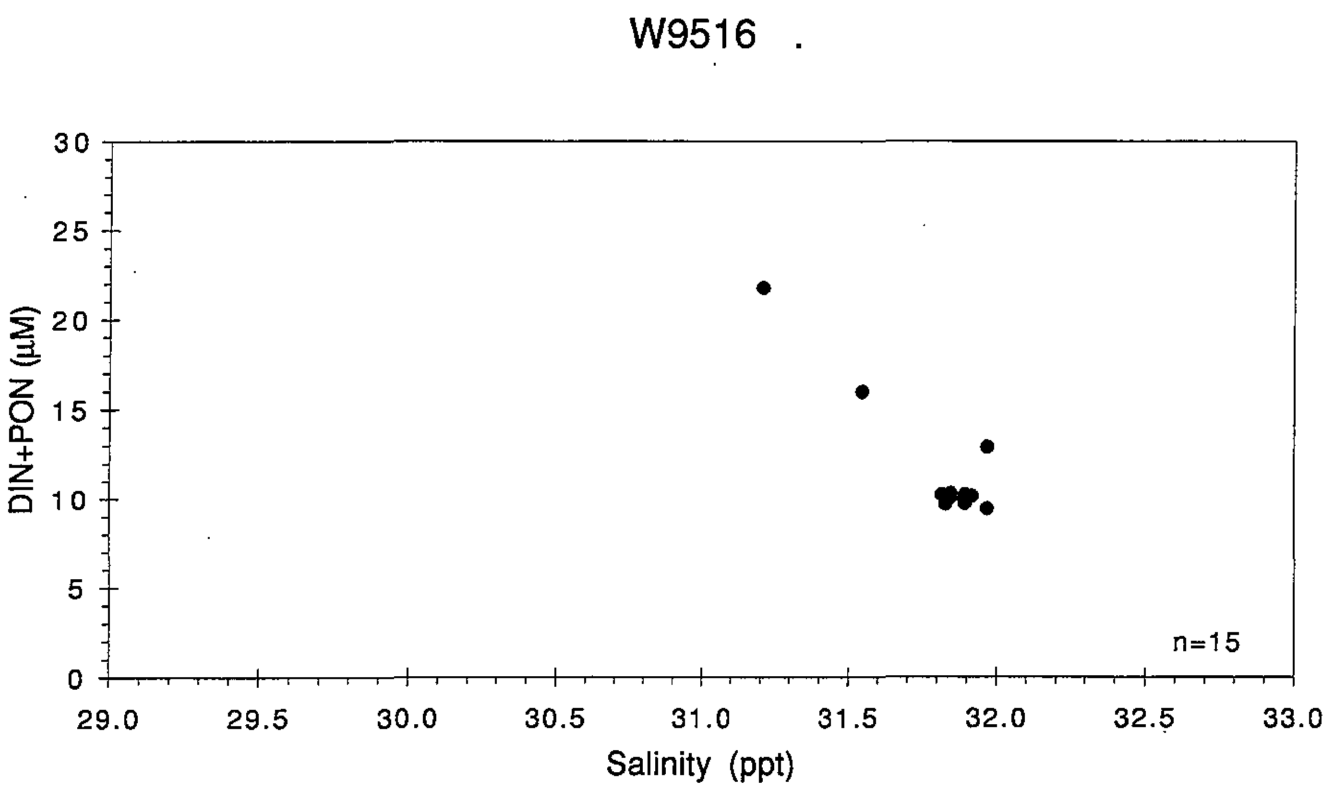

W9513 .
TN (µM)
90
80
70
60
50
40
30
20
10
0
n=13
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9513 .
DIN+PON (µM)
30
25
20
15
10
5
0
n=12
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

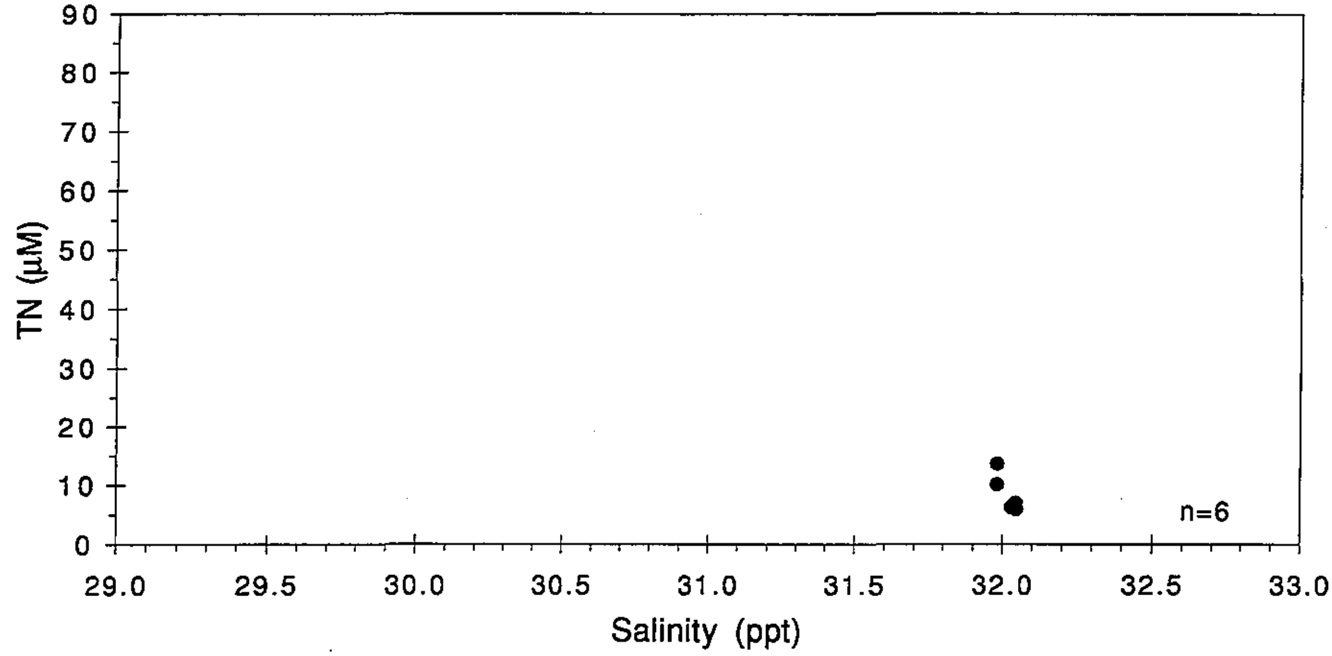

W9515
TN (µM)
0
10
20
30
40
50
60
70
80
90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=12


W9515
DIN+PON (µM)
0
5
10
15
20
25
30
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=12


W9516
TN (µM)
0
10
20
30
40
50
60
70
80
90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=12

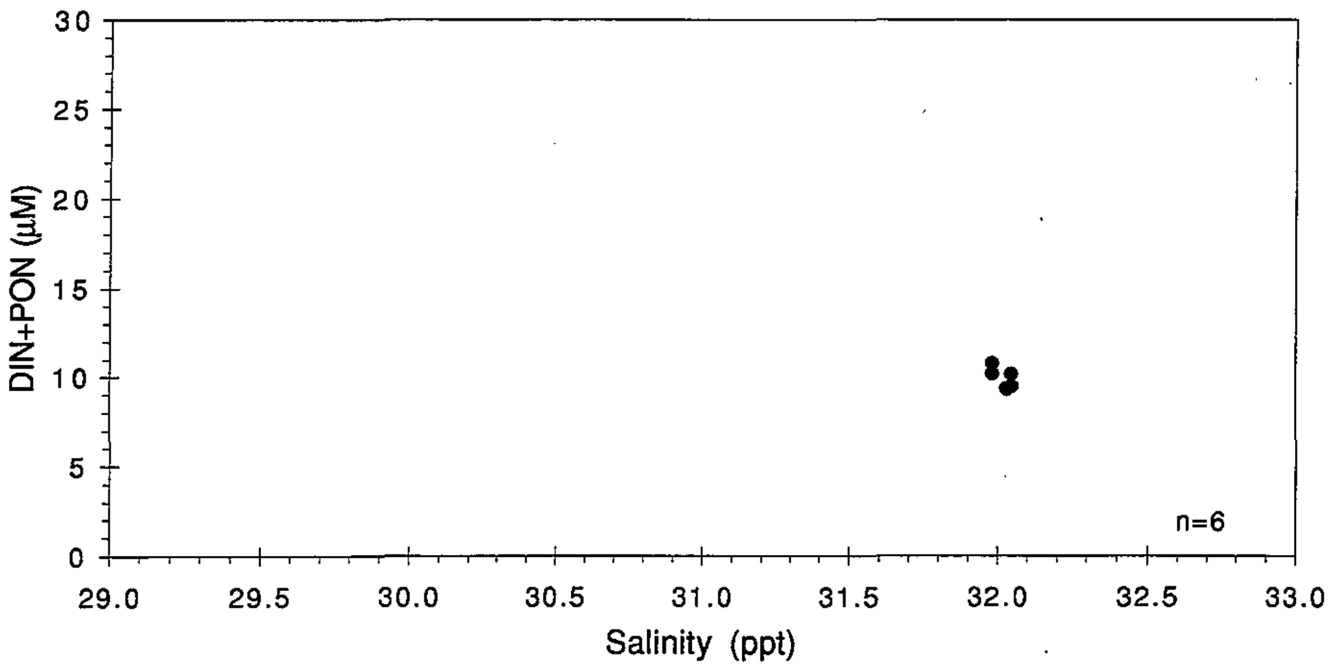

W9516
DIN+PON (µM)
0
5
10
15
20
25
30
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=15

W9517 .

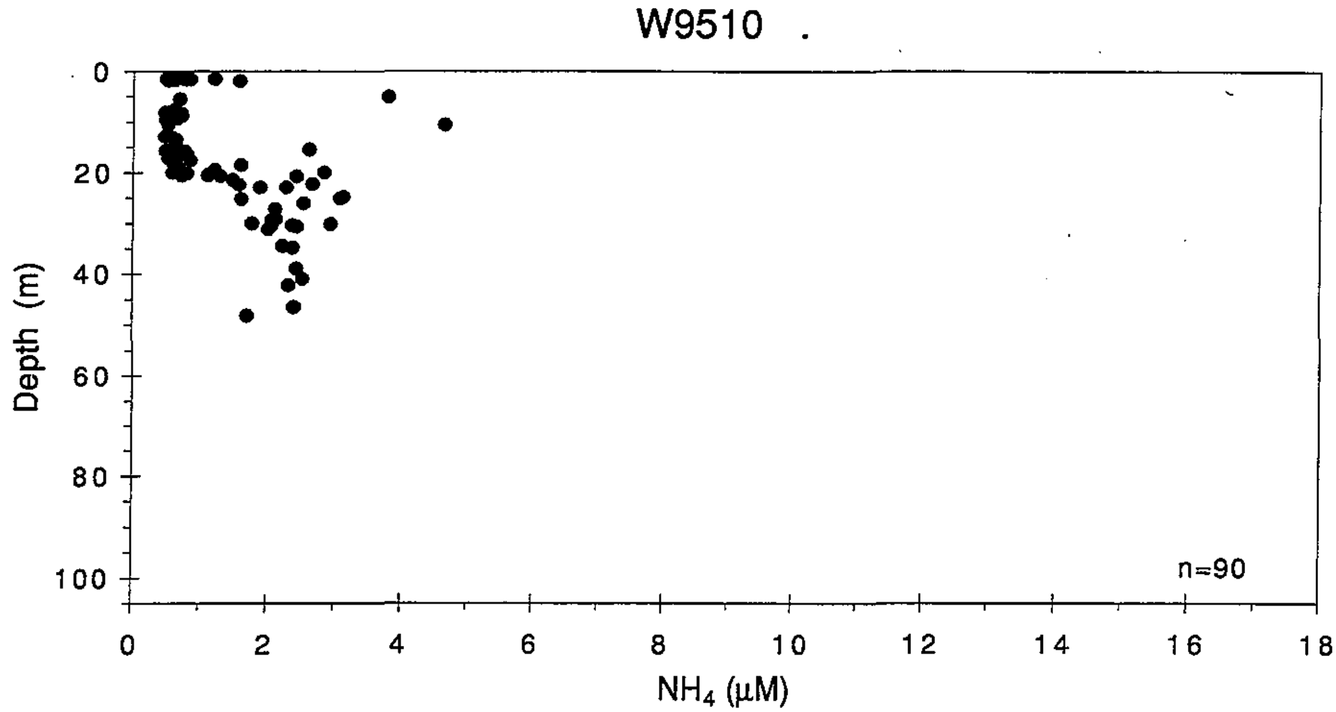


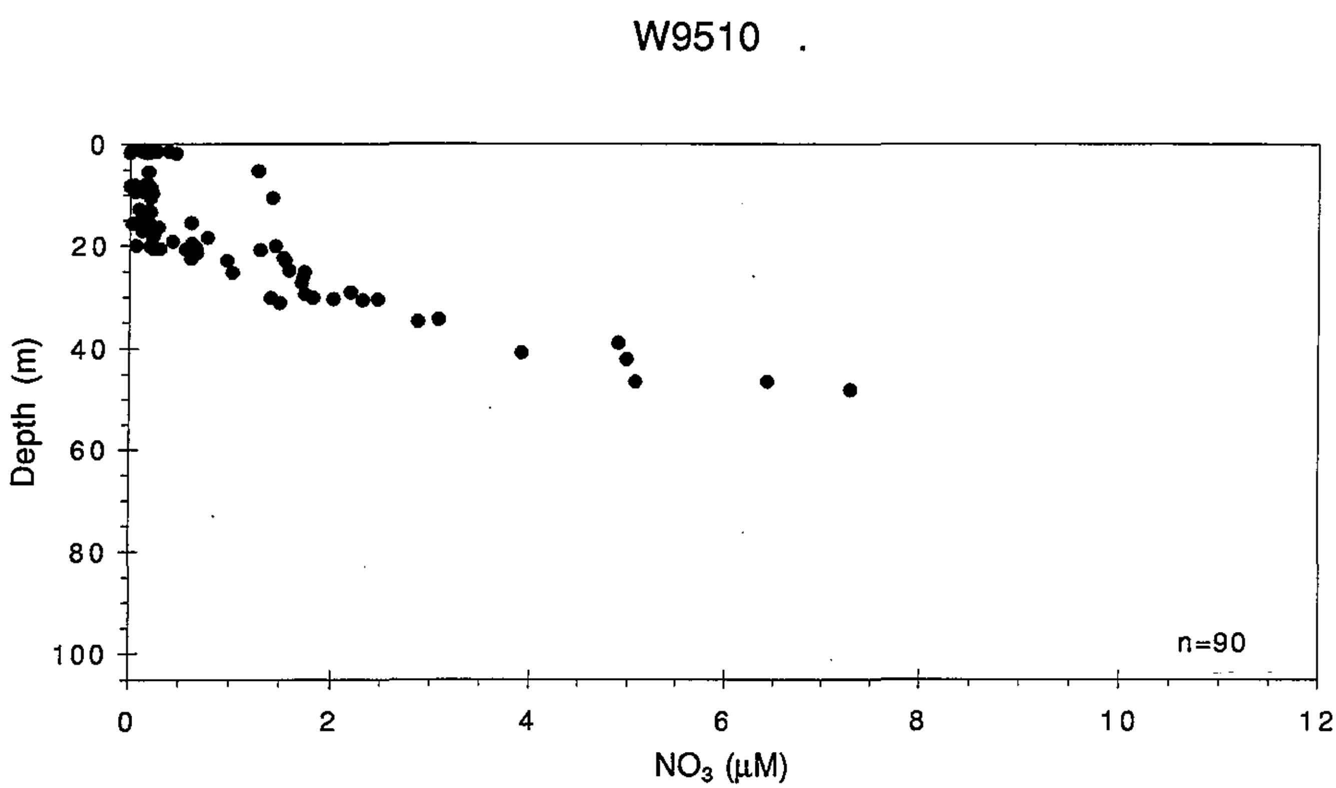
TN (µM)
90
80
70
60
50
40
30
20
10
0
n=6
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

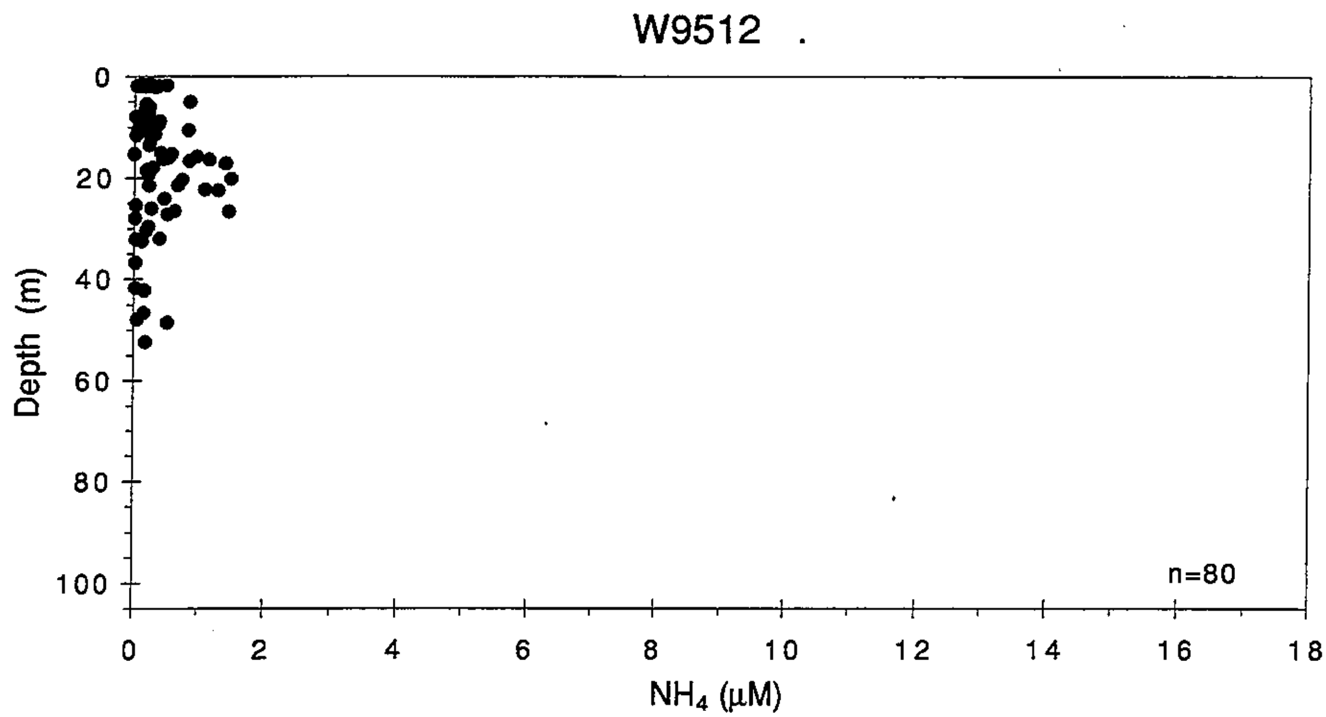
W9517 .

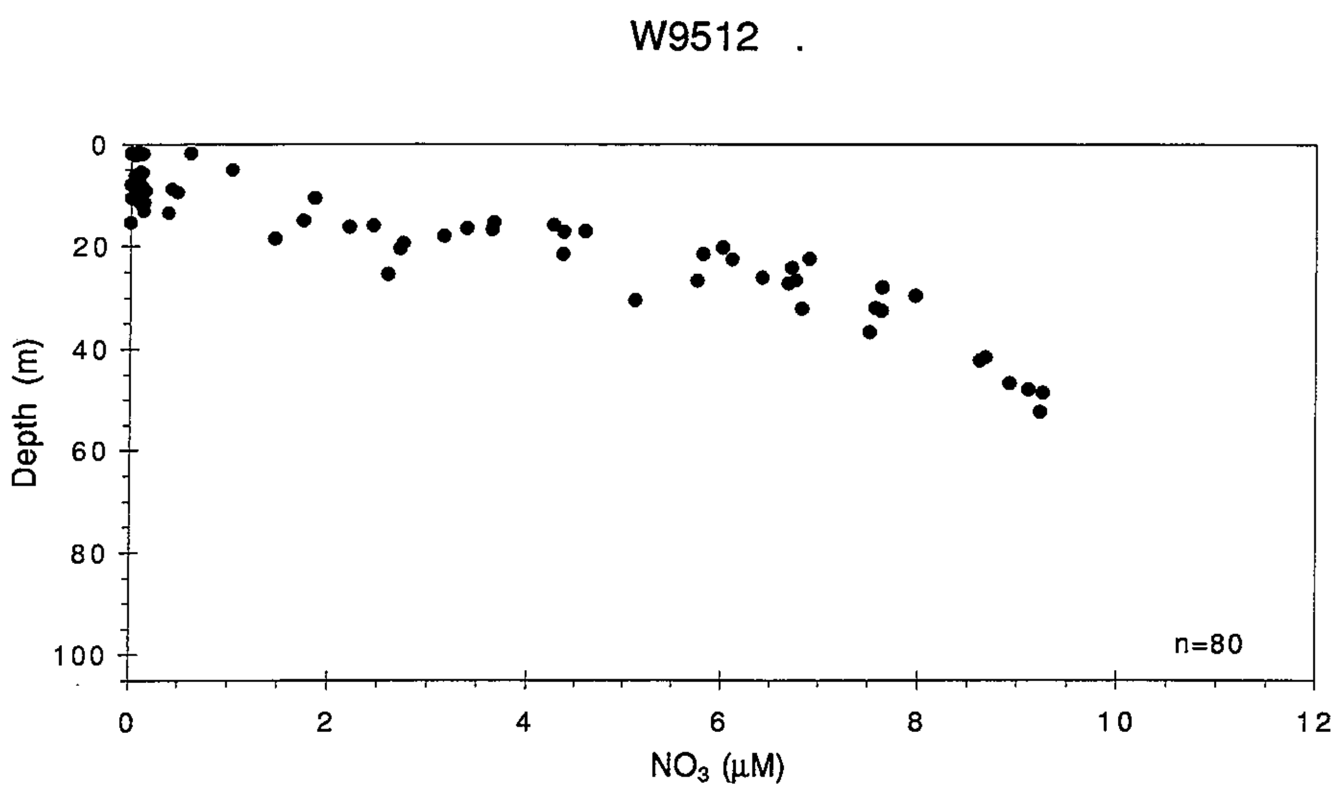


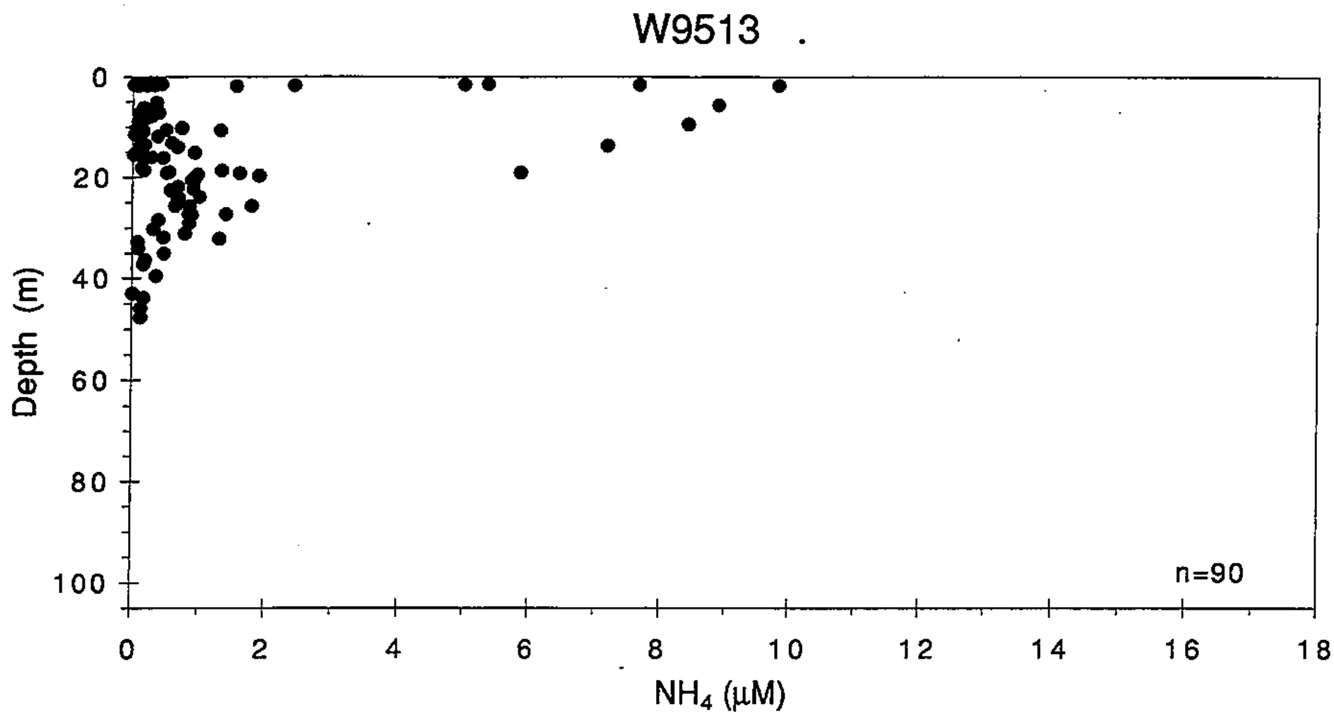
DIN+PON (µM)
30
25
20
15
10
5
0
n=6
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9510
Depth (m)
n=90
NH4 (μM)
0
20
40
60
80
100
0
2
4
6
8
10
12
14
16
18

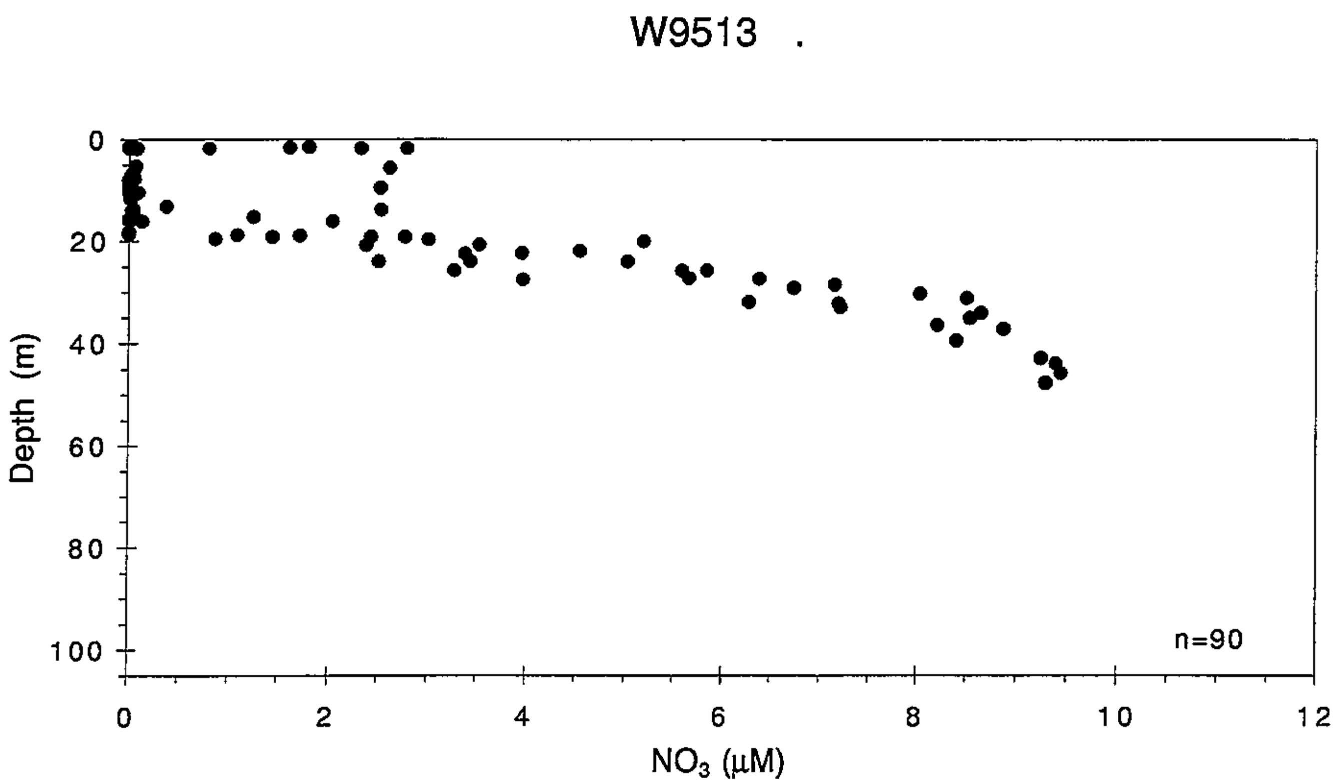

W9510
Depth (m)
n=90
NO3 (μM)
0
20
40
60
80
100
0
2
4
6
8
10
12


W9512 .
0
20
40
60
80
100
Depth (m)
n=80
0 2 4 6 8 10 12 14 16 18
NH4 (µM)

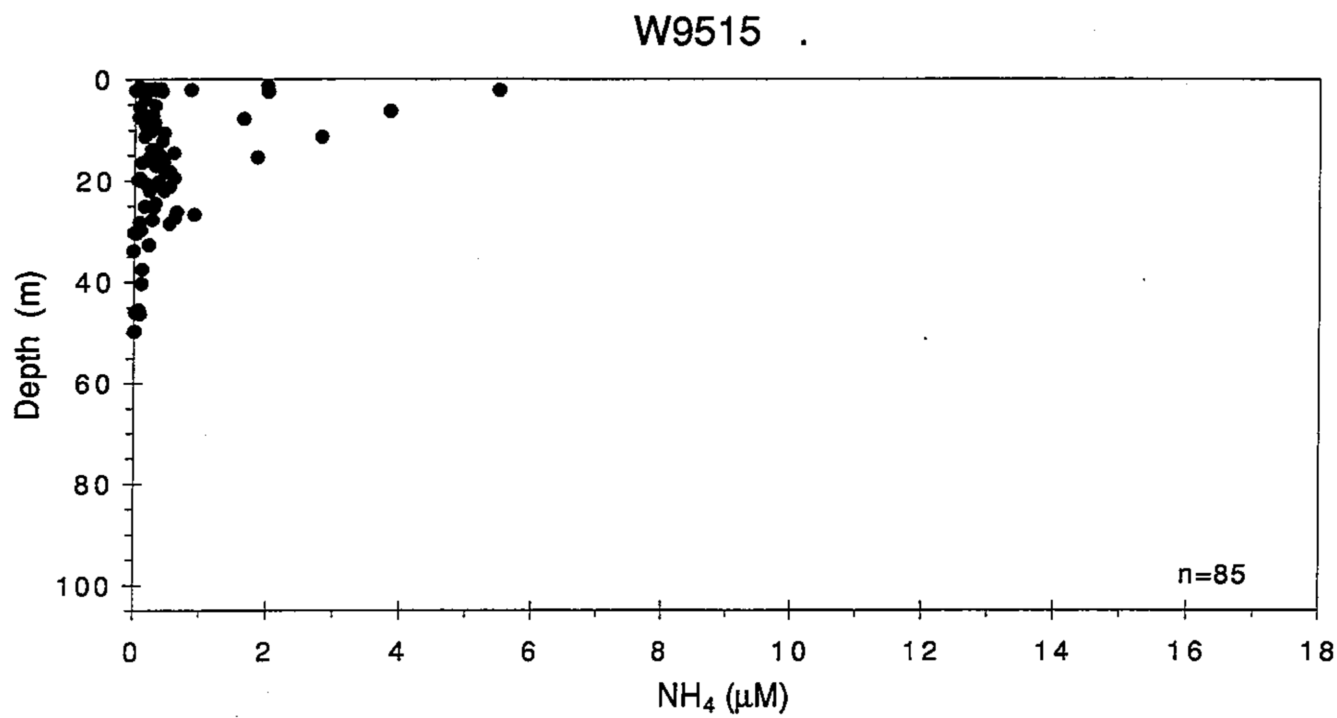

W9512 .
0
20
40
60
80
100
Depth (m)
n=80
0 2 4 6 8 10 12
NO3 (µM)

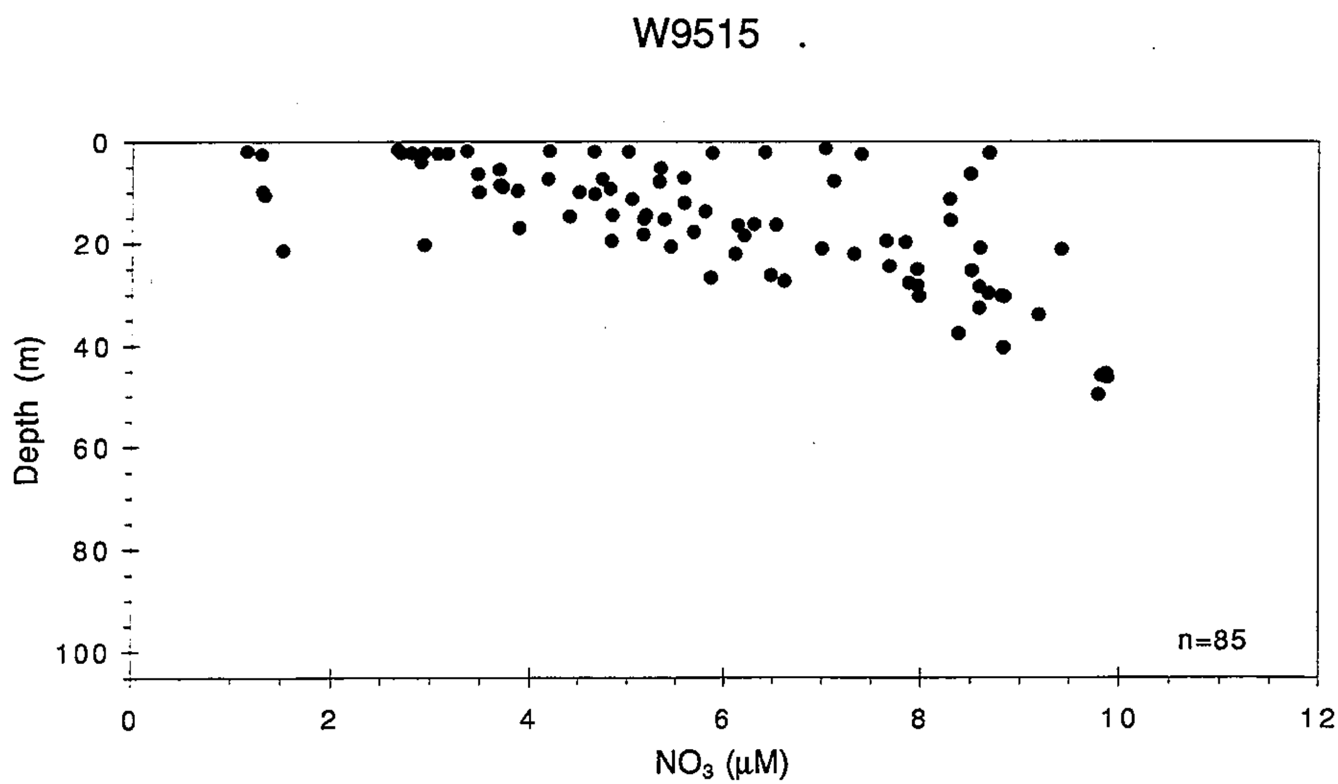


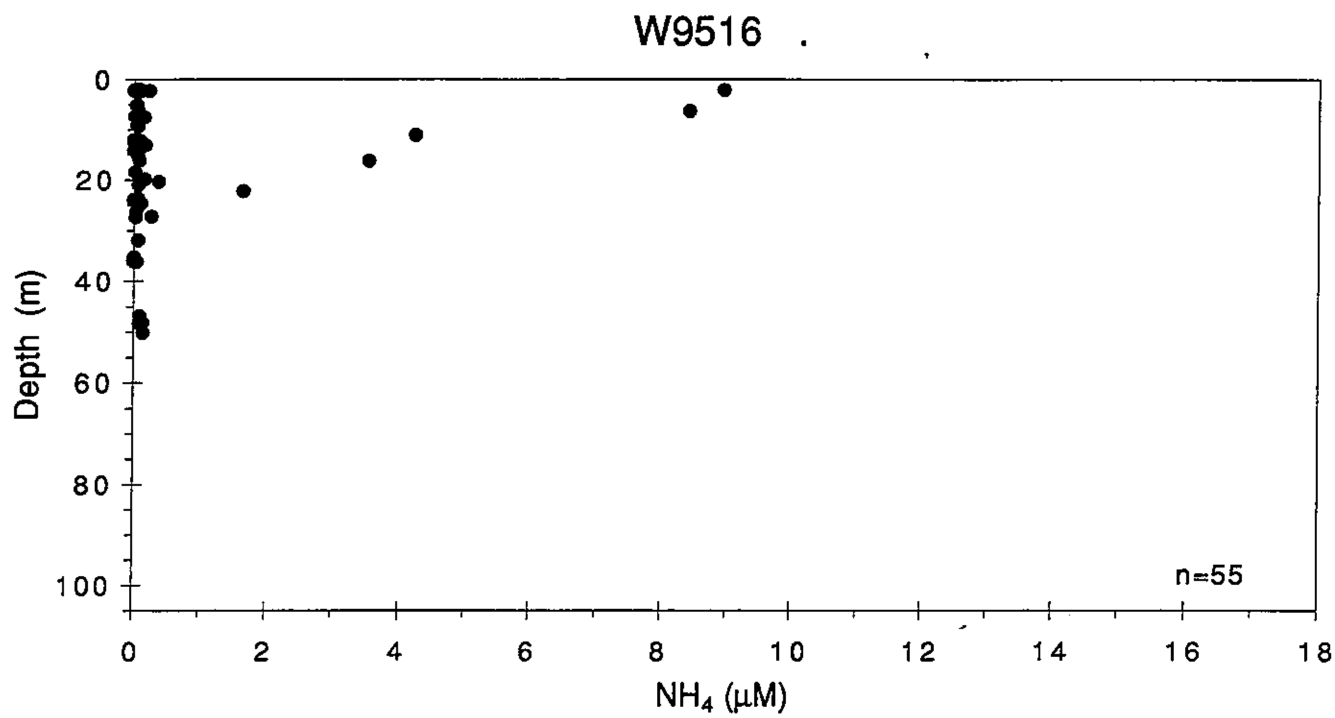
W9513 .
0
20
40
60
80
100
Depth (m)
n=90
0
2
4
6
8
10
12
14
16
18
NH4 (μM)

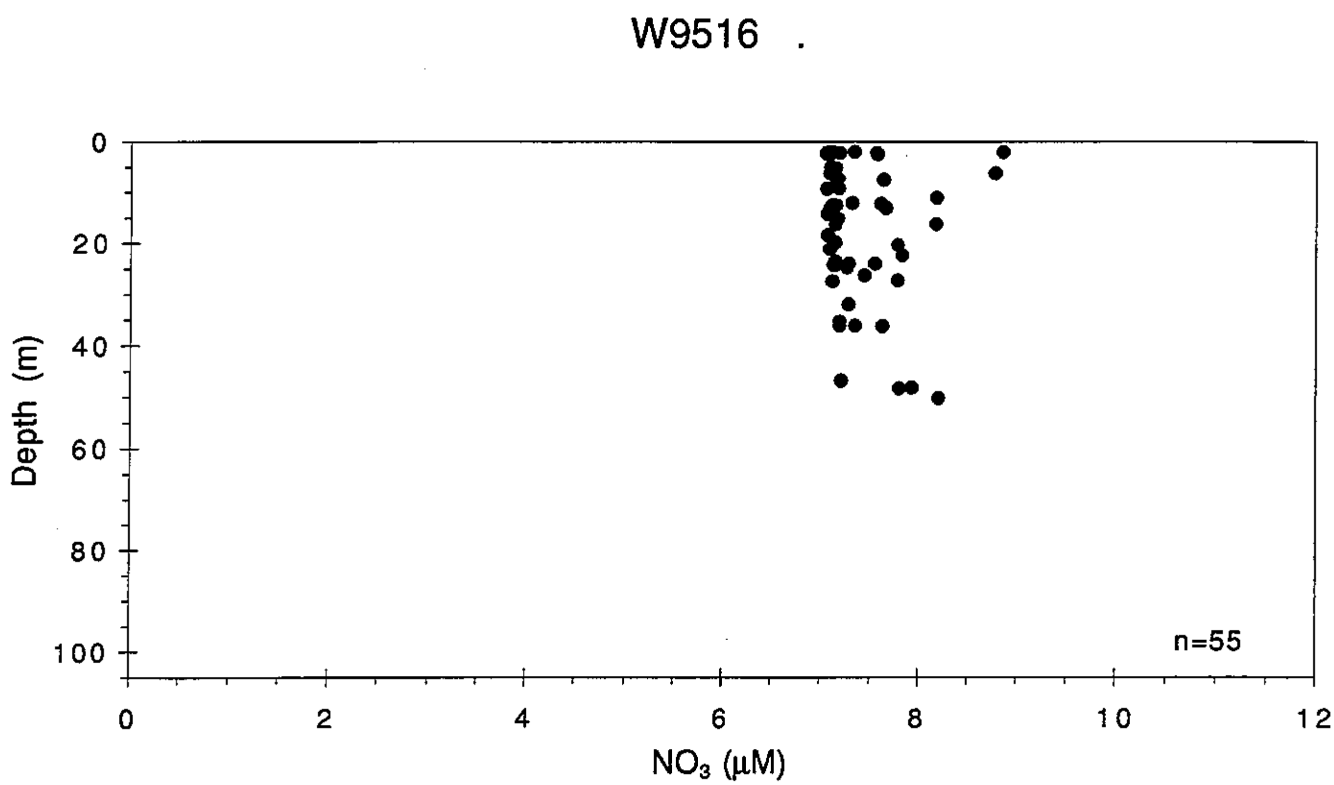


W9513 .
0
20
40
60
80
100
Depth (m)
n=90
0
2
4
6
8
10
12
NO3 (μM)

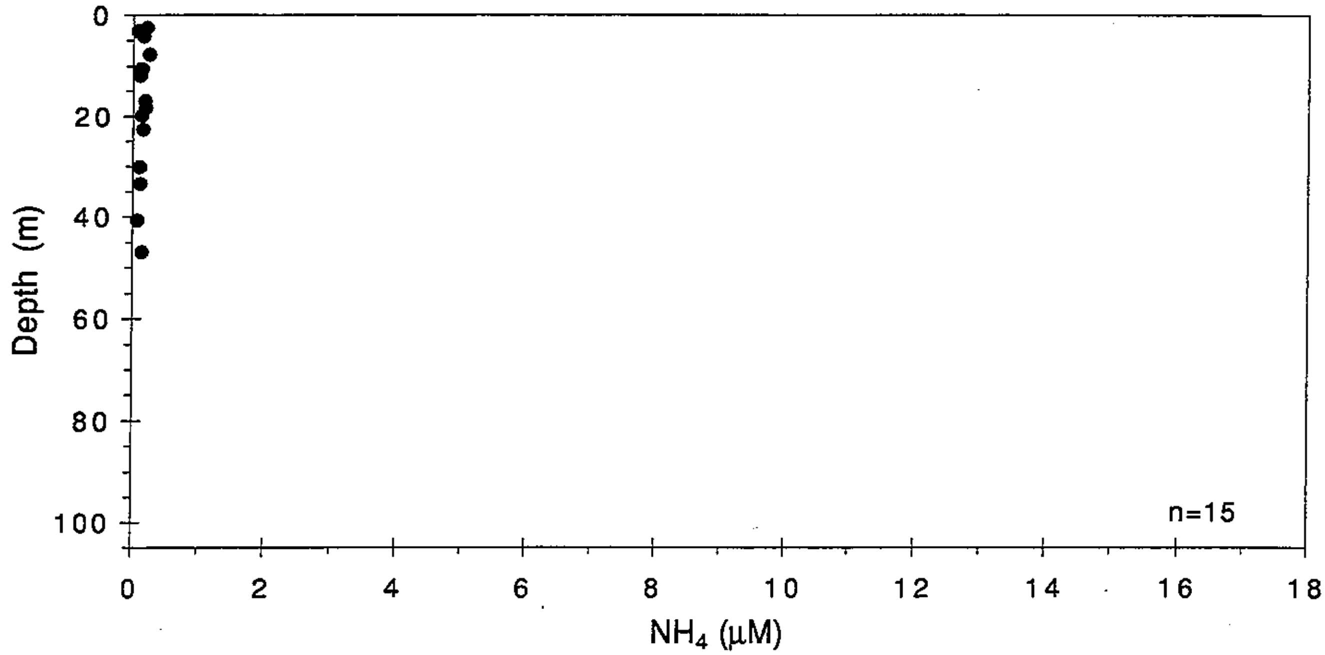

W9515
Depth (m)
0
20
40
60
80
100
n=85
0
2
4
6
8
10
12
14
16
18
NH4 (μM)


W9515
Depth (m)
0
20
40
60
80
100
n=85
0
2
4
6
8
10
12
NO3 (μM)


W9516
Depth (m)
0
20
40
60
80
100
n=55
0
2
4
6
8
10
12
14
16
18
NH4 (µM)

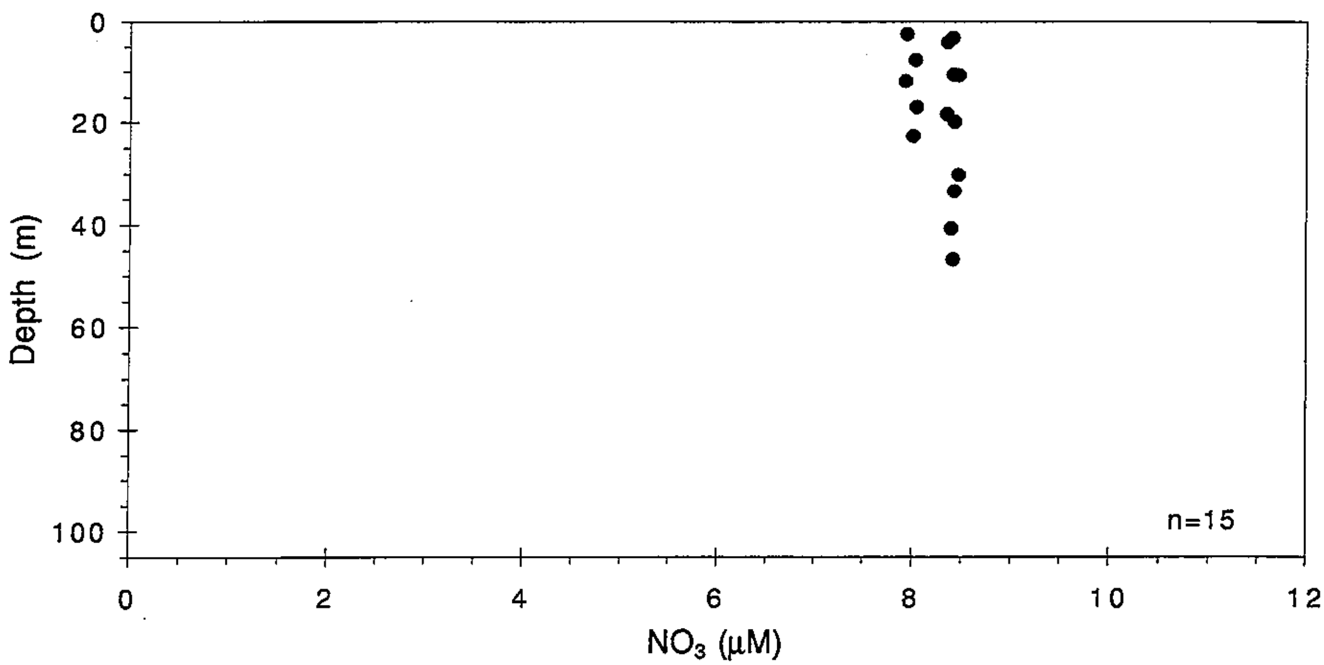

W9516
Depth (m)
0
20
40
60
80
100
n=55
0
2
4
6
8
10
12
NO3 (µM)

W9517 .

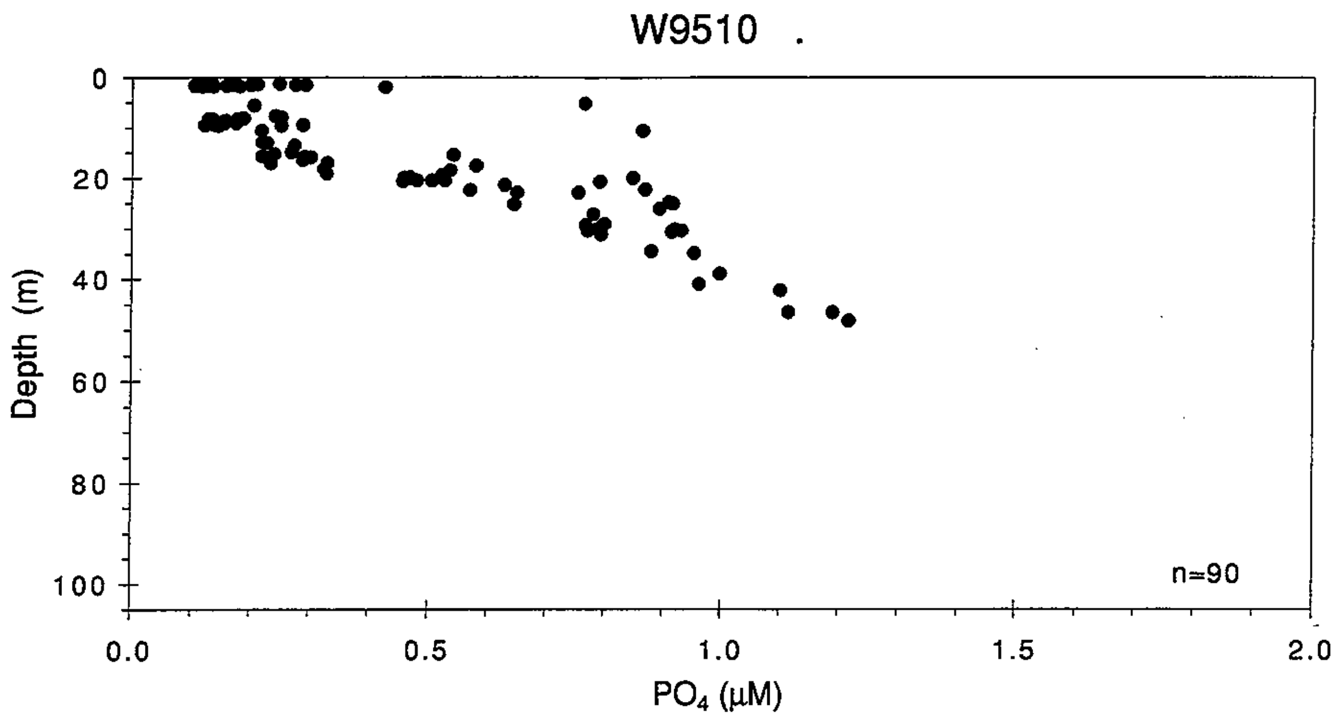


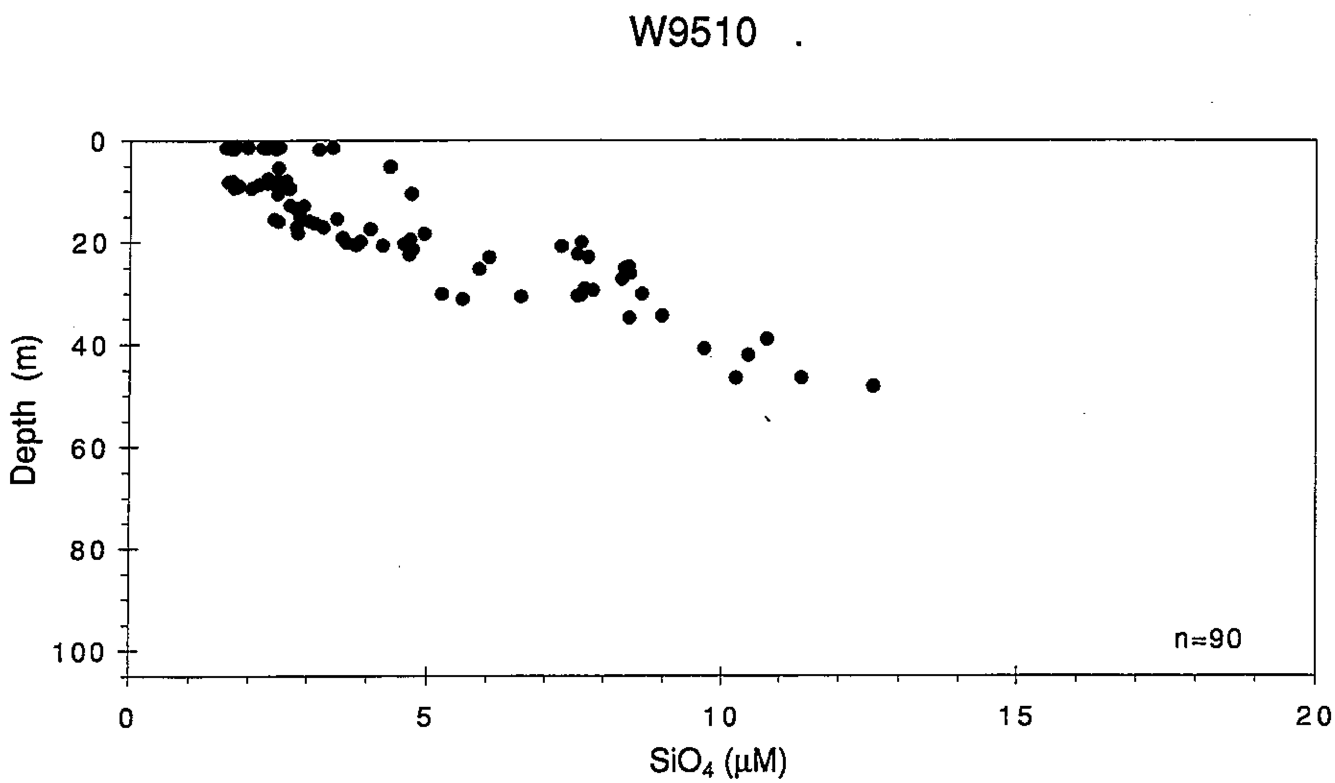
Depth (m)
0
20
40
60
80
100
n=15
0
2
4
6
8
10
12
14
16
18
NH4 (µM)

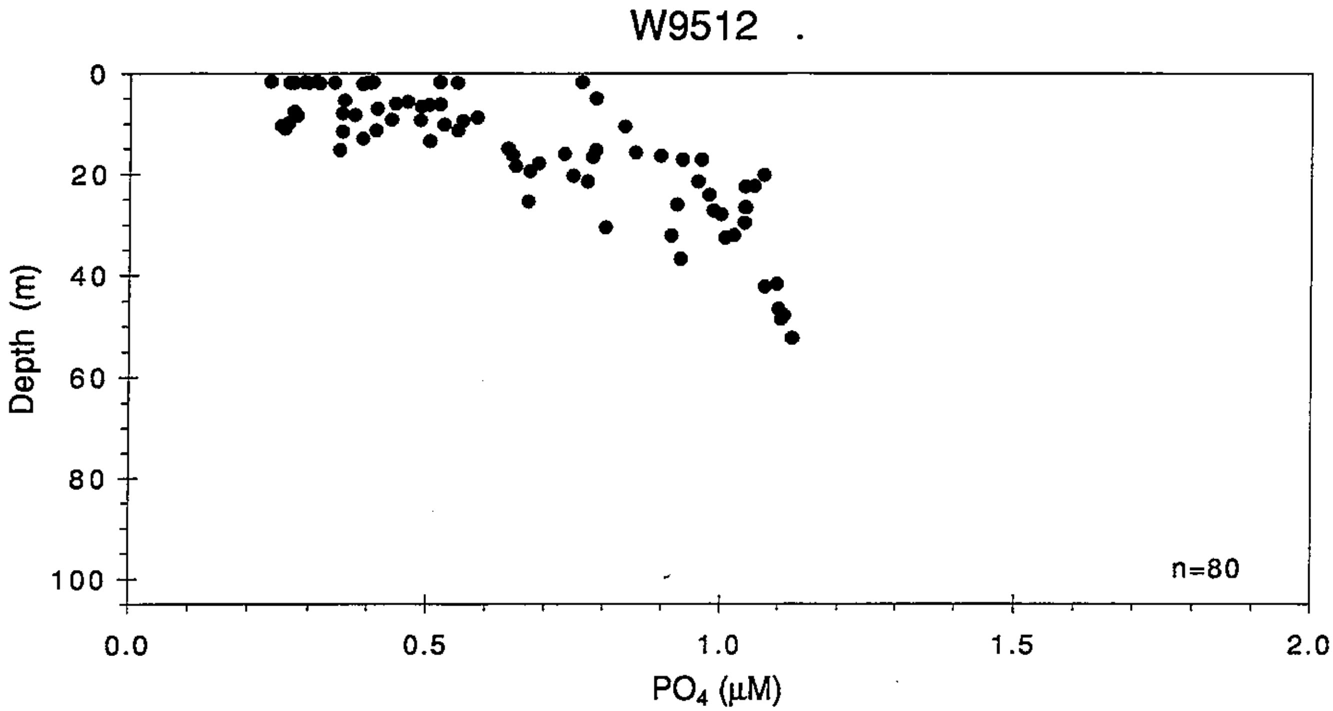
W9517 .

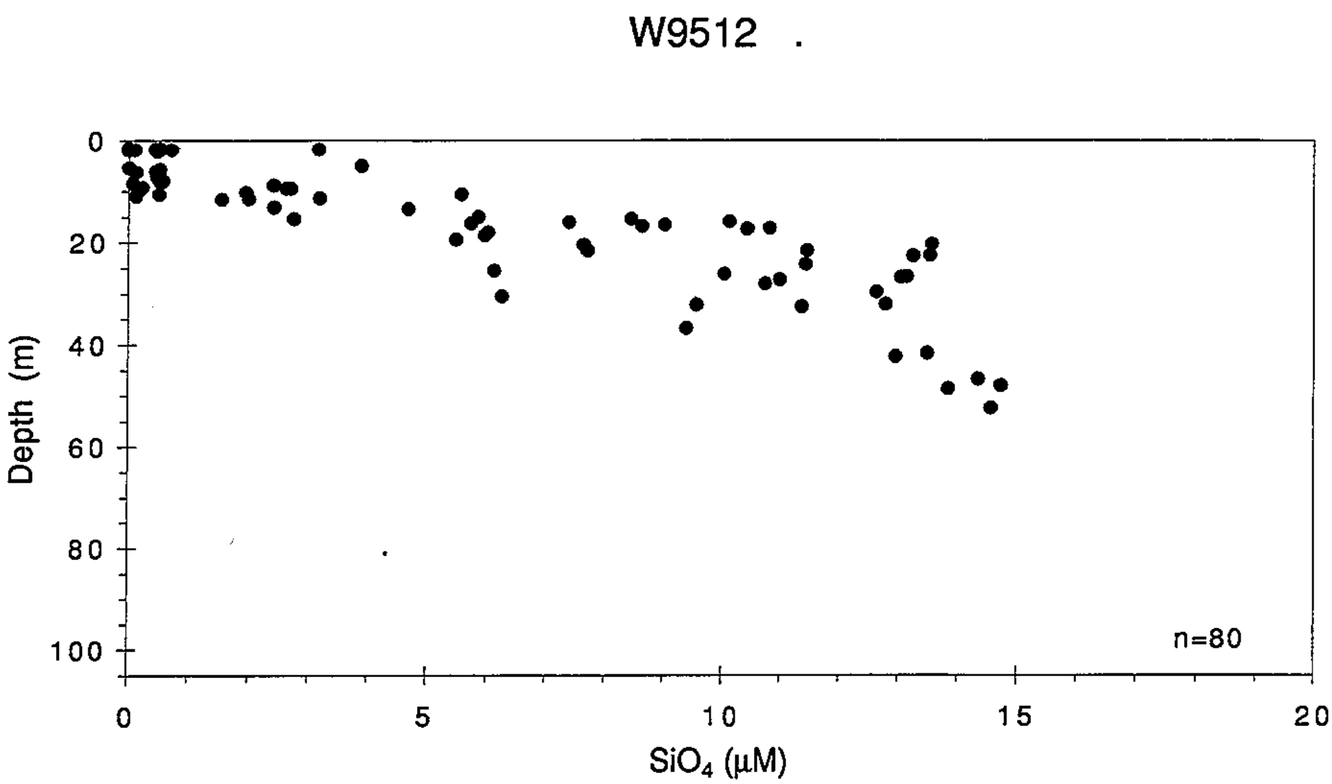


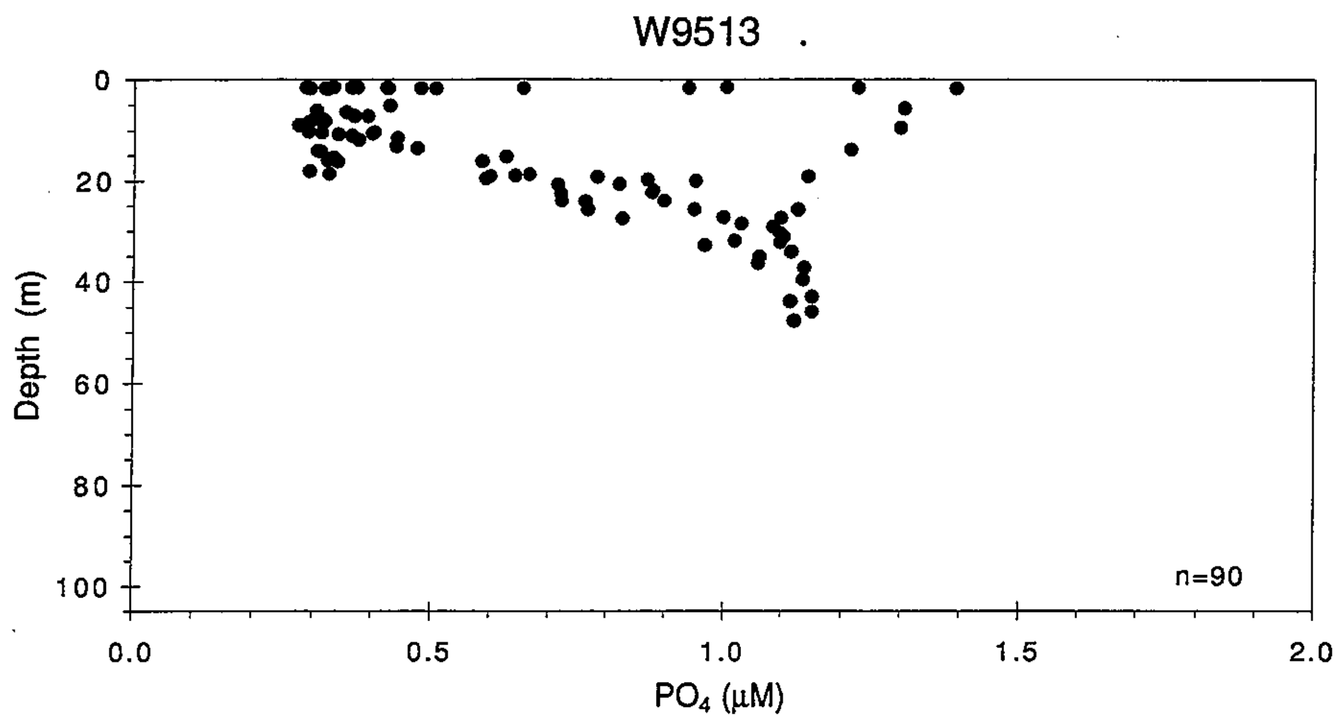
Depth (m)
0
20
40
60
80
100
n=15
0
2
4
6
8
10
12
NO3 (µM)

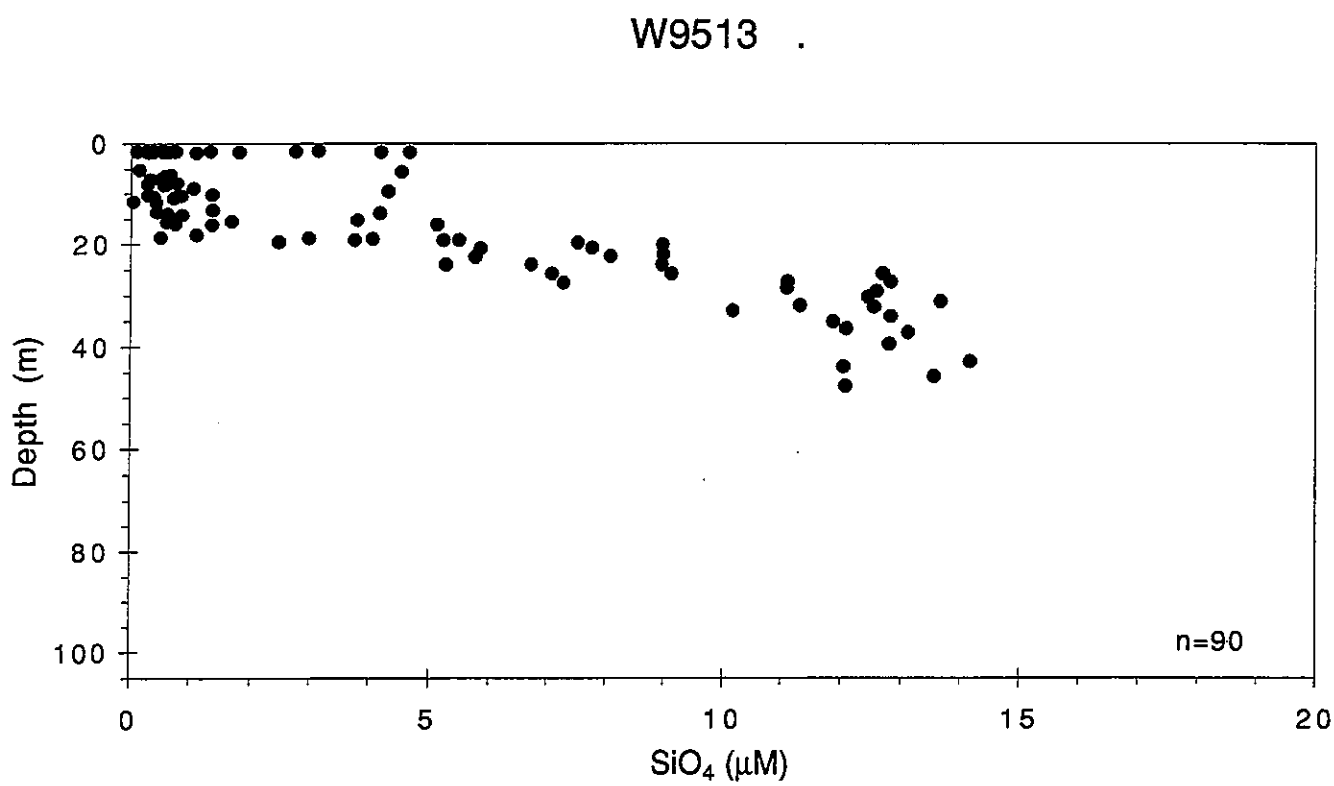

W9510
Depth (m)
0
20
40
60
80
100
0.0
0.5
1.0
1.5
2.0
PO4 (µM)
n=90

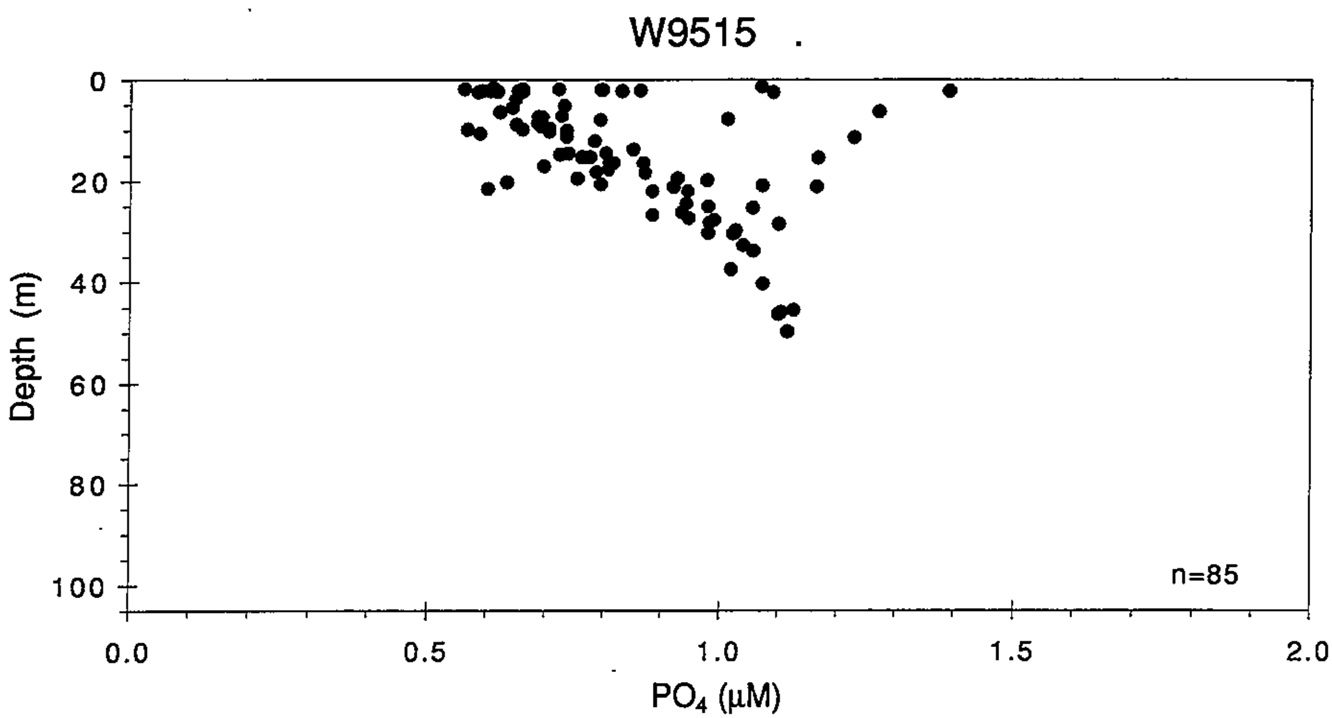

W9510
Depth (m)
0
20
40
60
80
100
0
5
10
15
20
SiO4 (µM)
n=90

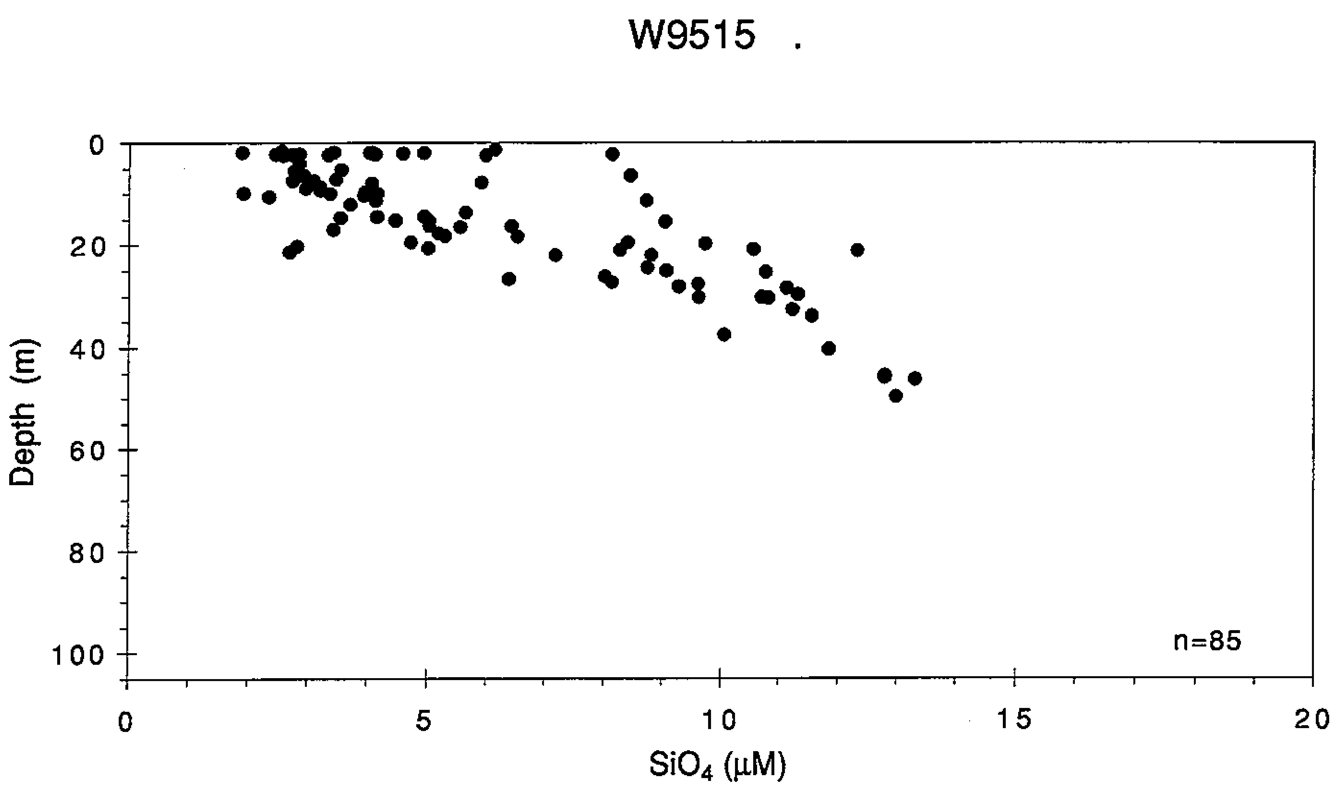

W9512
Depth (m)
n=80
PO_4 (μM)
0
20
40
60
80
100
0.0
0.5
1.0
1.5
2.0

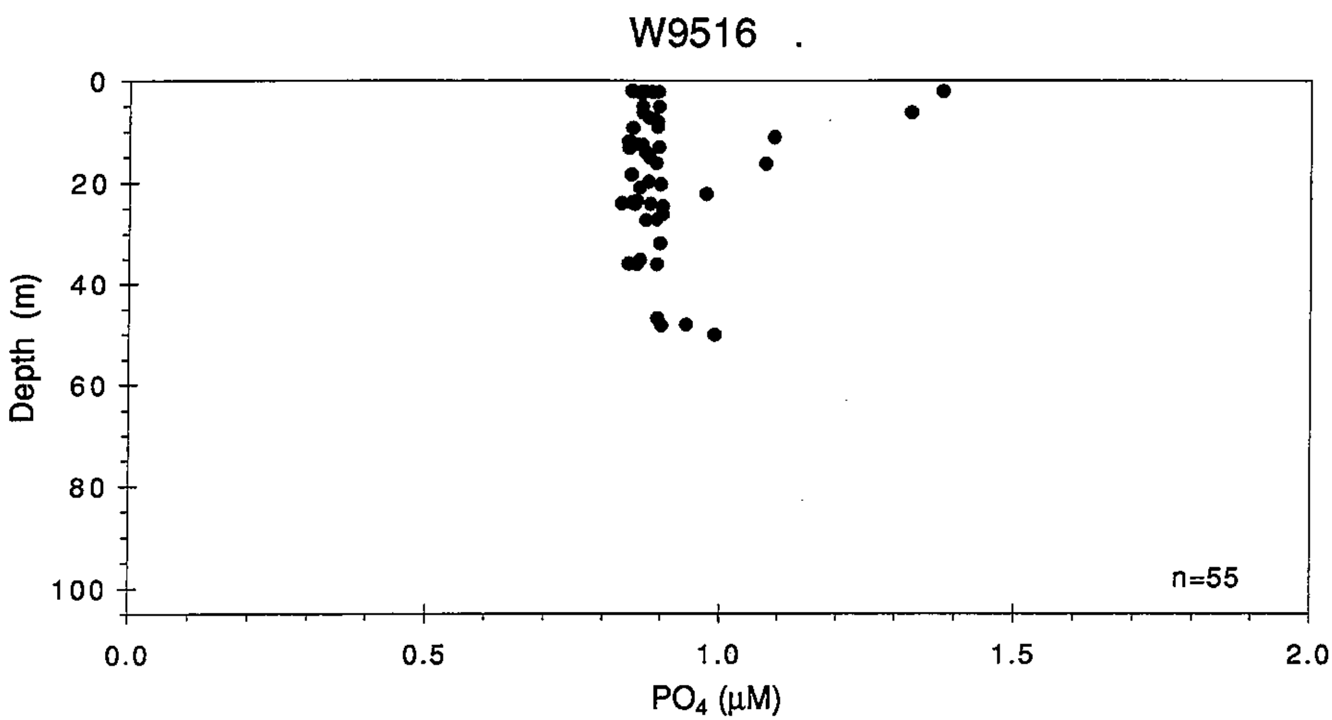

W9512
Depth (m)
n=80
SiO_4 (μM)
0
20
40
60
80
100
0
5
10
15
20

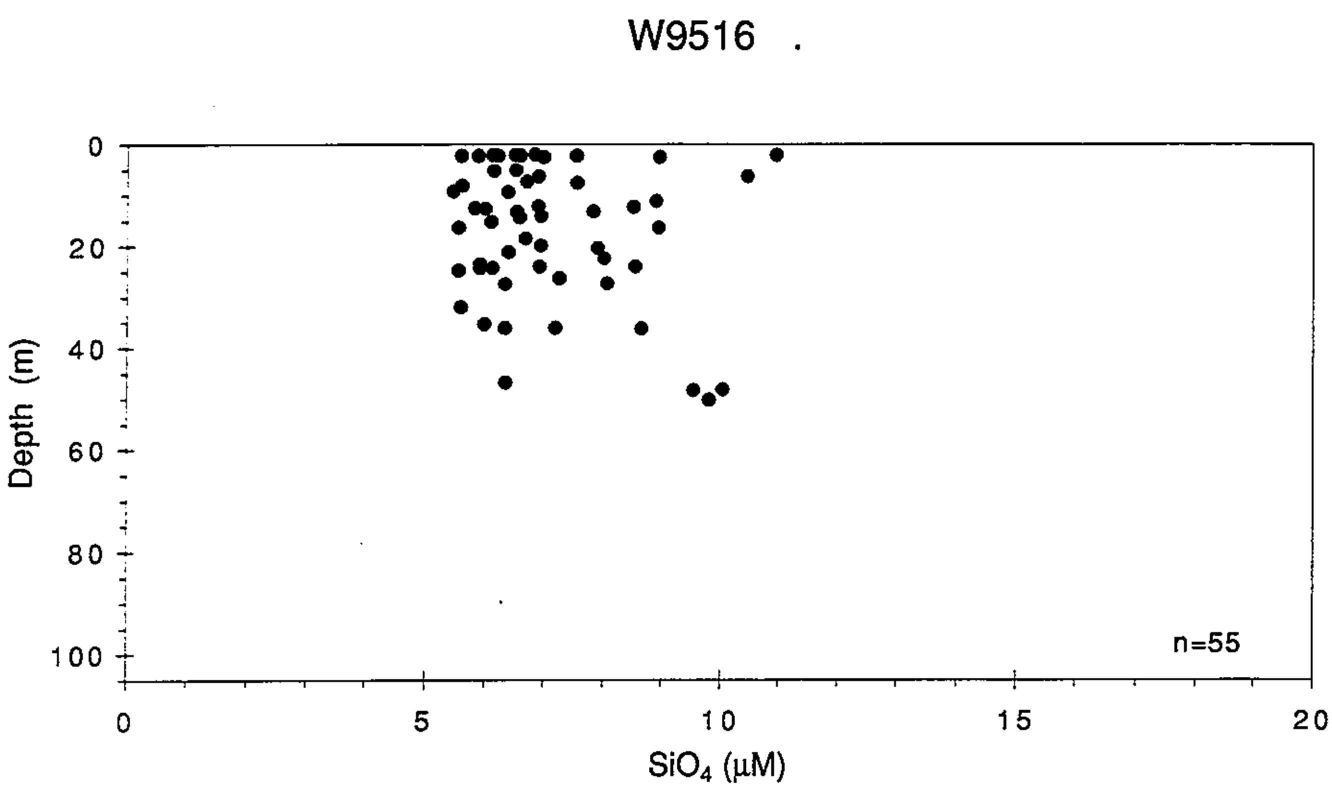

W9513
Depth (m)
0
20
40
60
80
100
n=90
0.0
0.5
1.0
1.5
2.0
PO4 (μM)

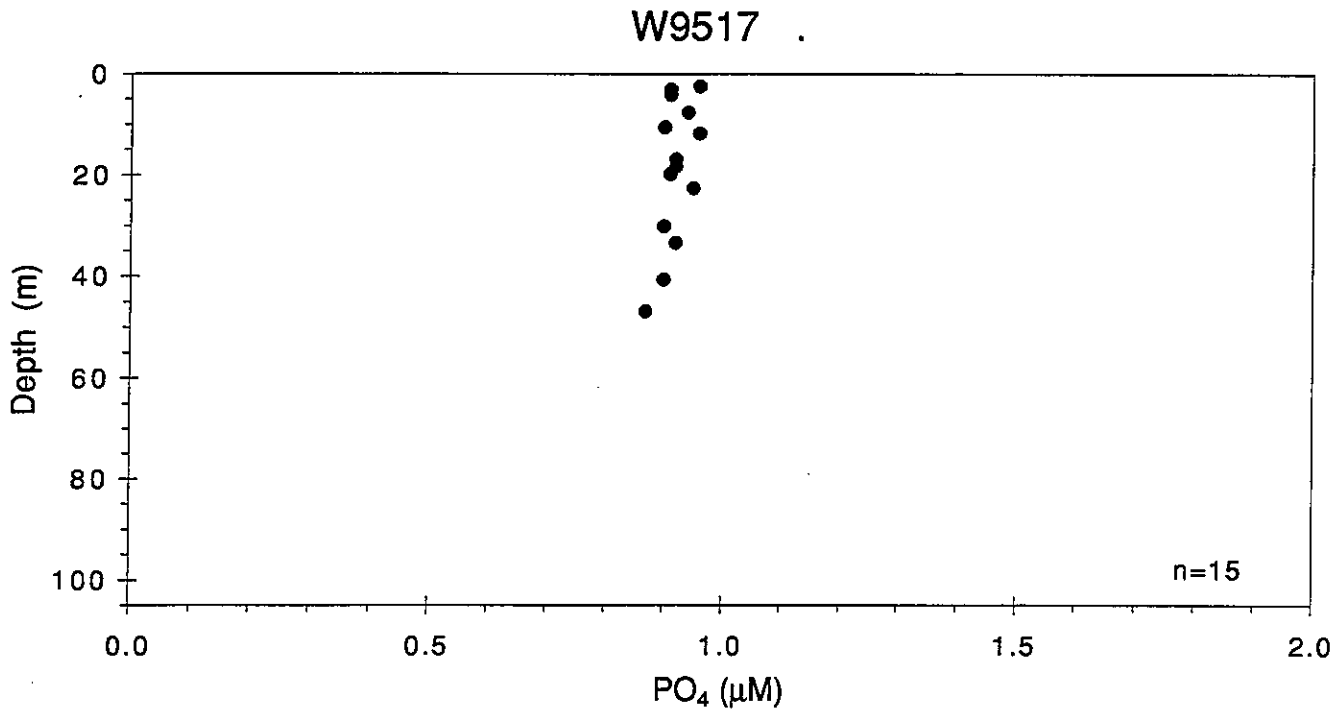

W9513
Depth (m)
0
20
40
60
80
100
n=90
0
5
10
15
20
SiO4 (μM)

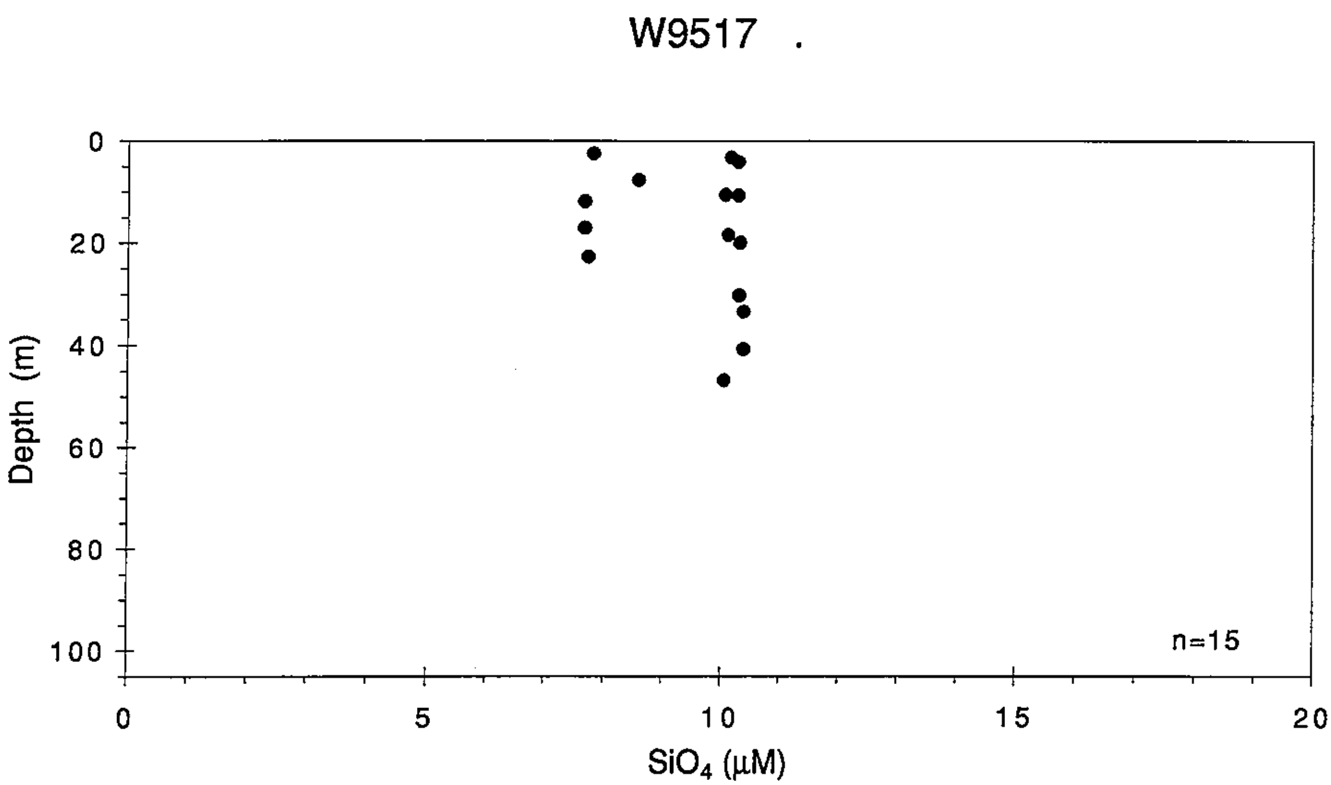

W9515 .
Depth (m)
0
20
40
60
80
100
n=85
0.0
0.5
1.0
1.5
2.0
PO_4 (μM)


W9515 .
Depth (m)
0
20
40
60
80
100
n=85
0
5
10
15
20
SiO_4 (μM)

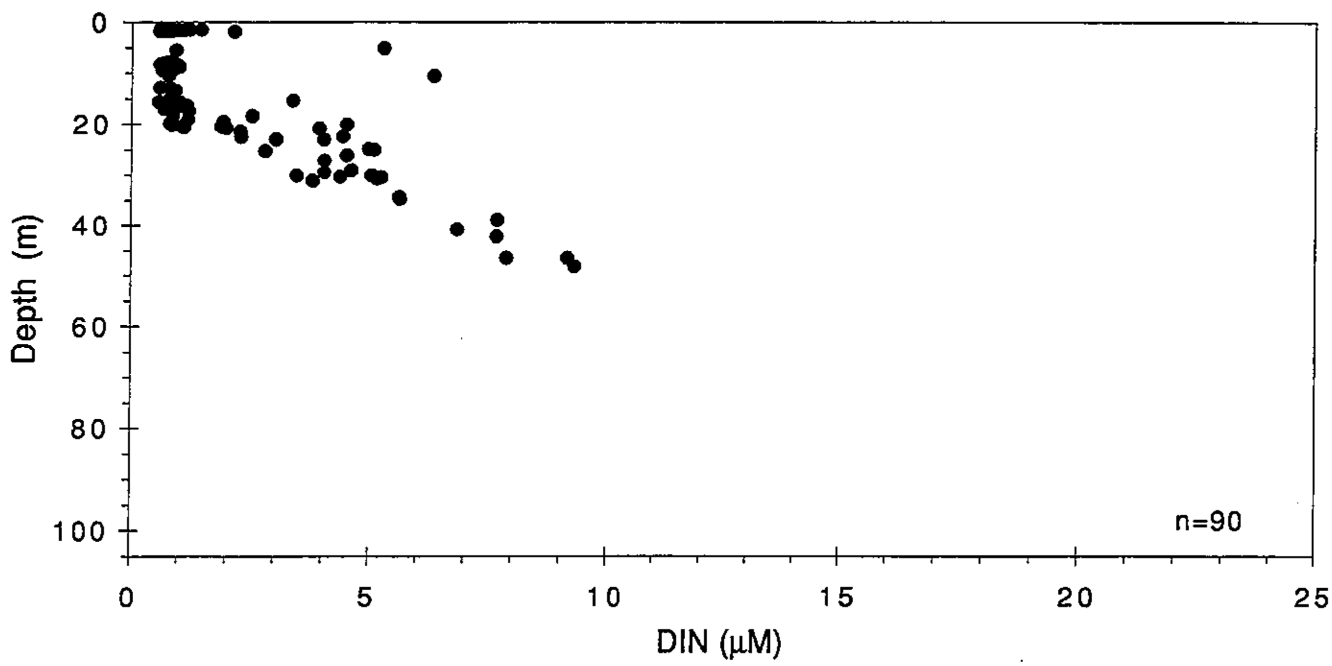

W9516
Depth (m)
0
20
40
60
80
100
n=55
0.0
0.5
1.0
1.5
2.0
PO4 (µM)


W9516
Depth (m)
0
20
40
60
80
100
n=55
0
5
10
15
20
SiO4 (µM)

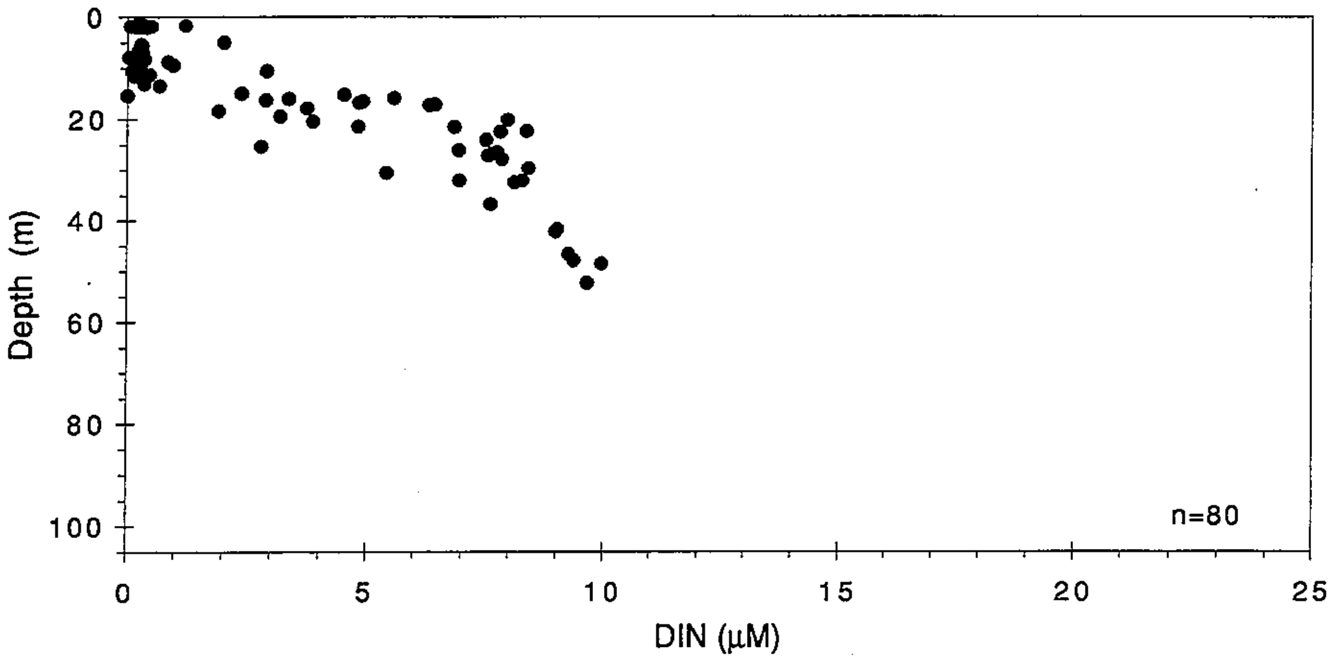

W9517 .
Depth (m)
0
20
40
60
80
100
n=15
0.0
0.5
1.0
1.5
2.0
PO4 (μM)


W9517 .
Depth (m)
0
20
40
60
80
100
n=15
0
5
10
15
20
SiO4 (μM)

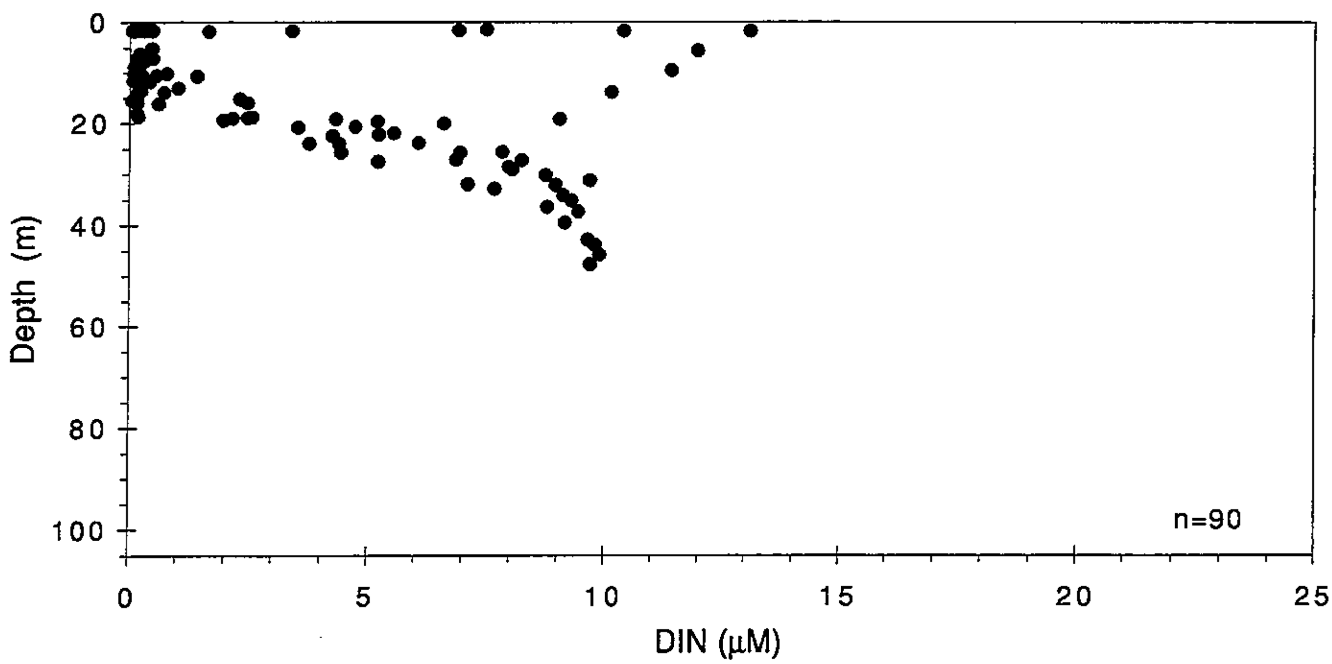
W9510



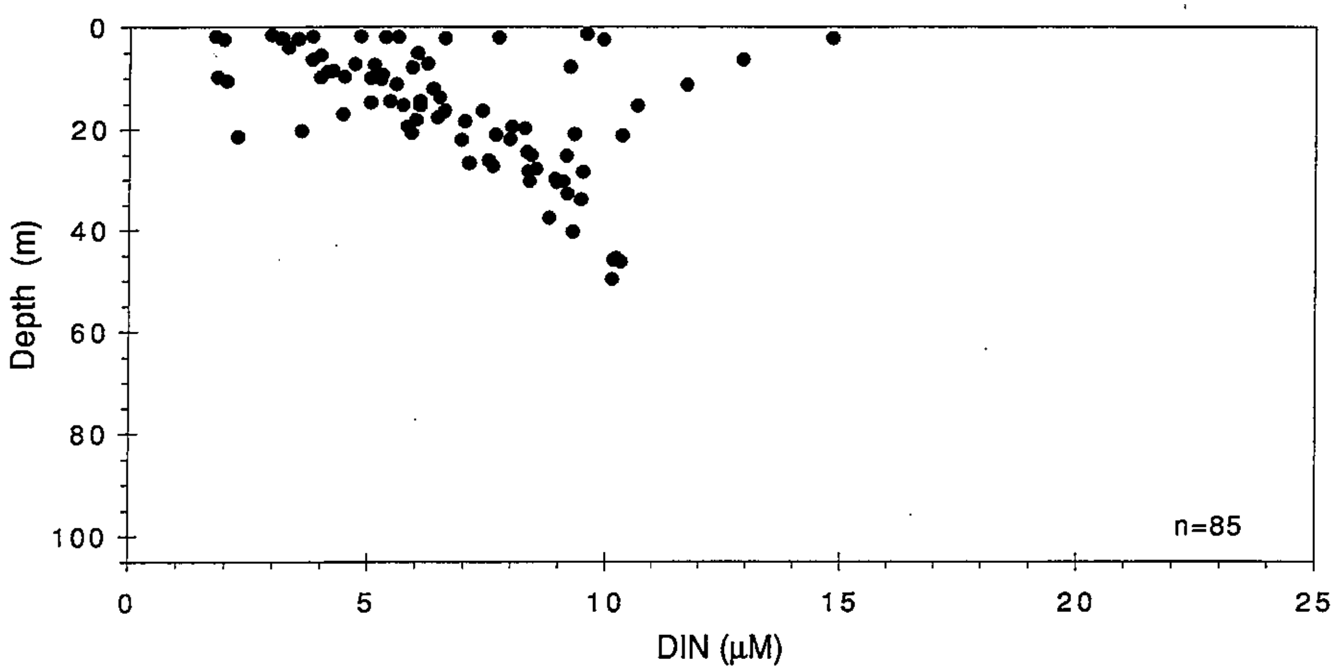
W9512

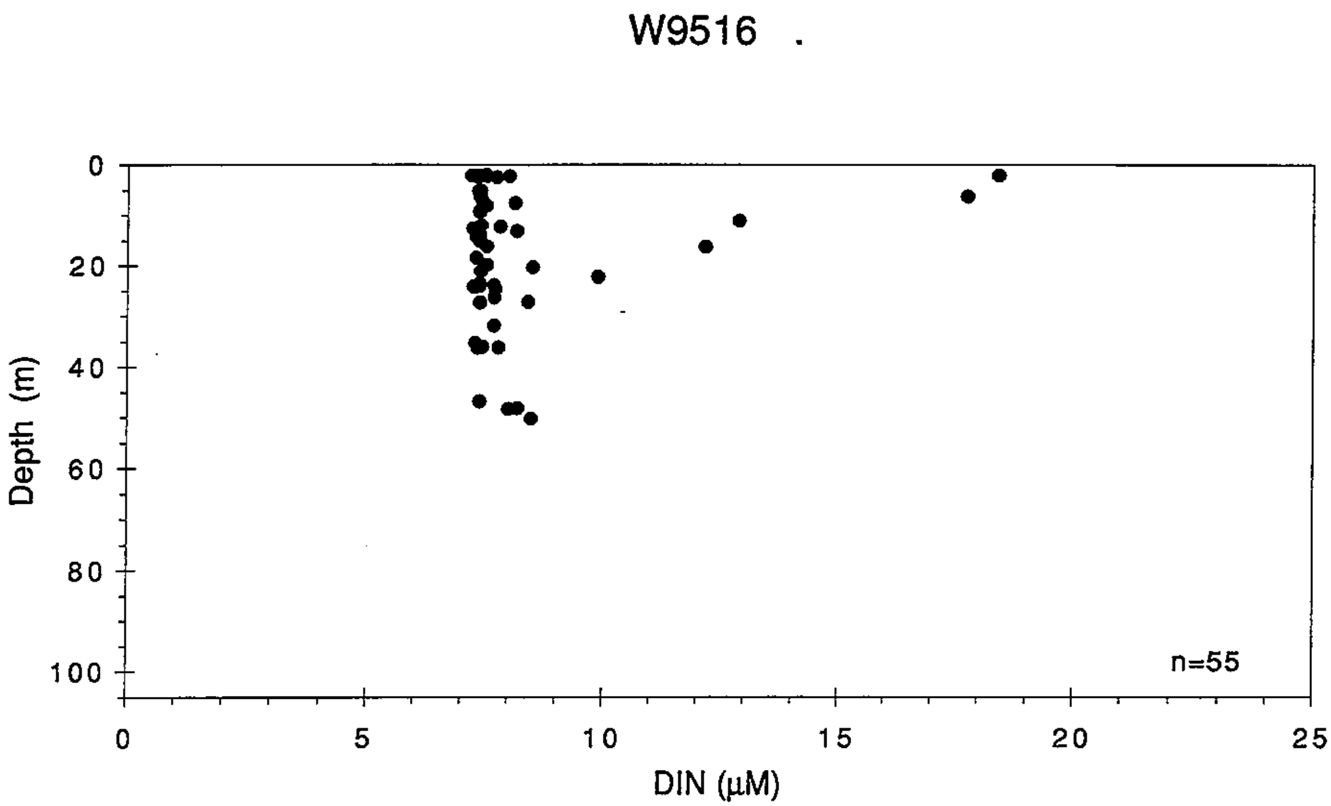


W9513

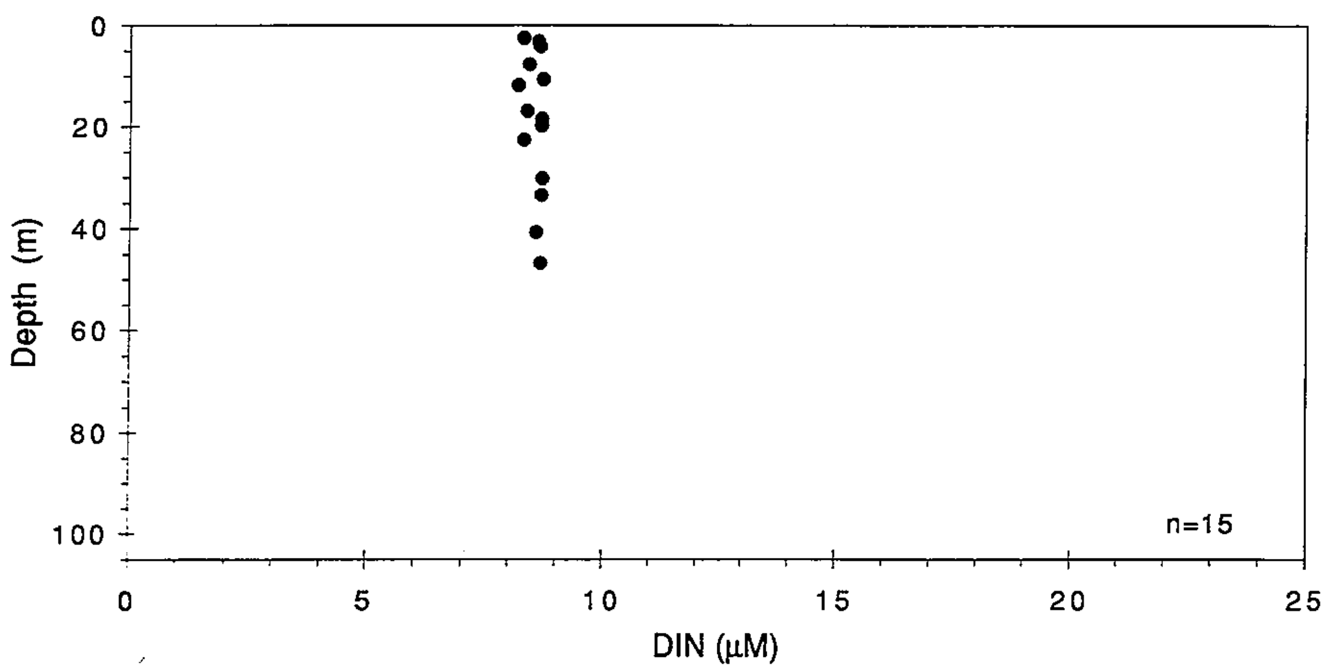


W9515




W9516
Depth (m)
0
20
40
60
80
100
0
5
10
15
20
25
DIN (µM)
n=55

W9517 .

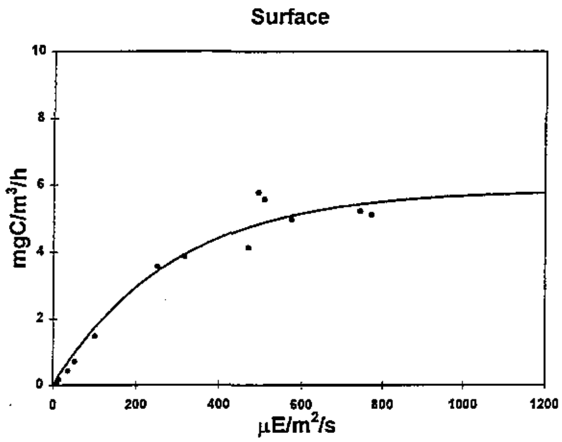


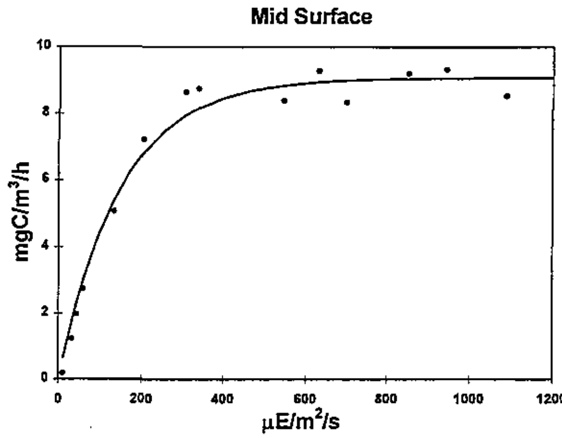
APPENDIX E

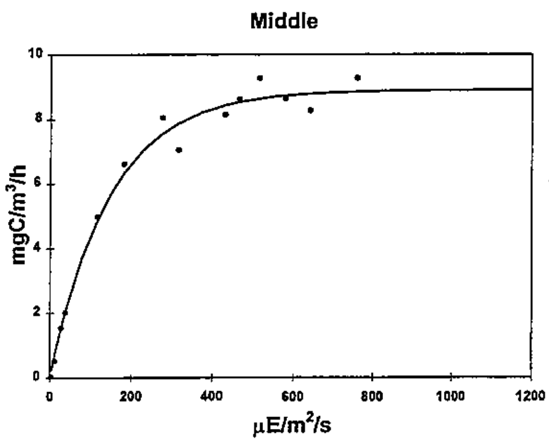
Photosynthesis-Irradiance (P-I) Curves

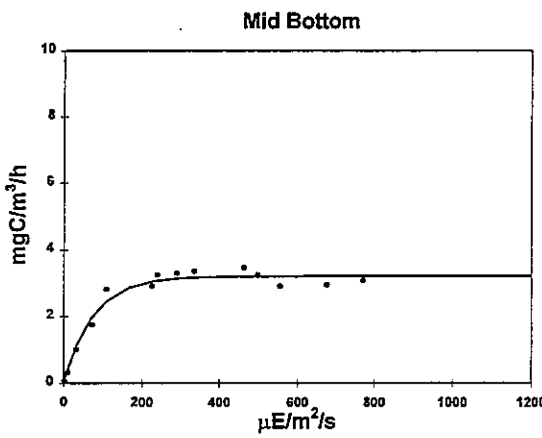
Productivity calculations (Appendix A) utilized light attenuation data from a CTD-mounted 4π sensor and incident light time-series data from an on-deck 2π irradiance sensor. After collection of the productivity samples, they were incubated in a temperature-controlled incubator. The resulting photosynthesis ($mgC/m^3/h$) versus light irradiance ($\mu E/m^2/s$, P-I) curves are comprehensively presented in this appendix. These data were used to determine hourly production at intervals throughout the day for each sampling depth.

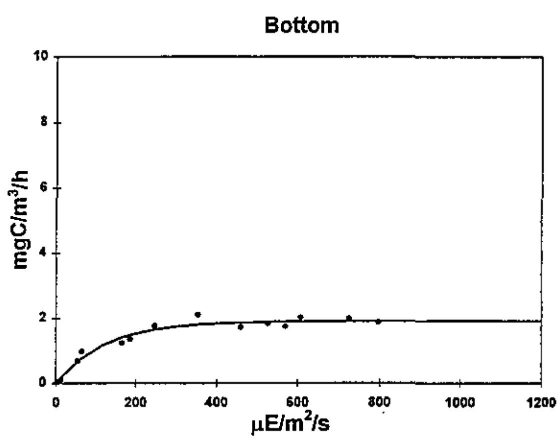
W9510 Station N04





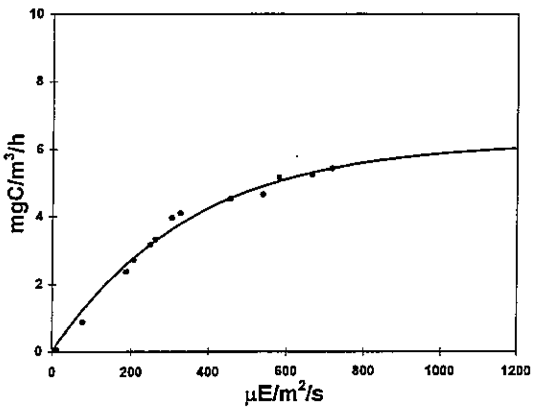




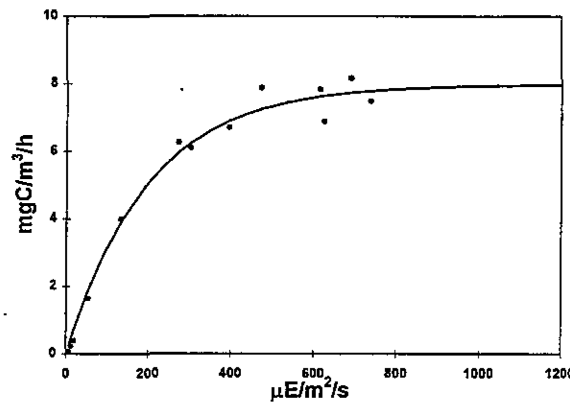


W9510 Station N16

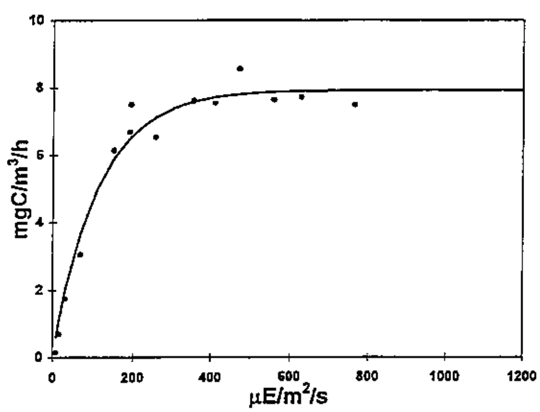
Surface



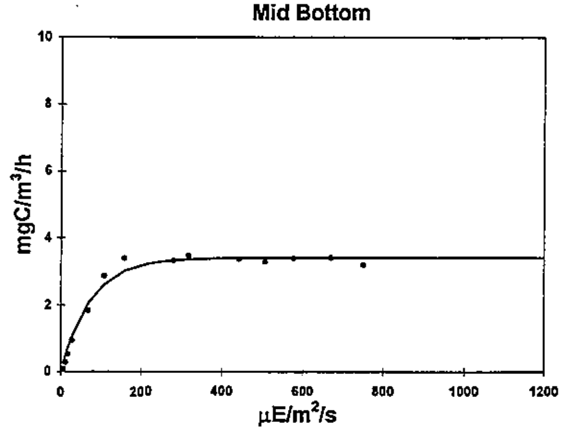
Mid Surface



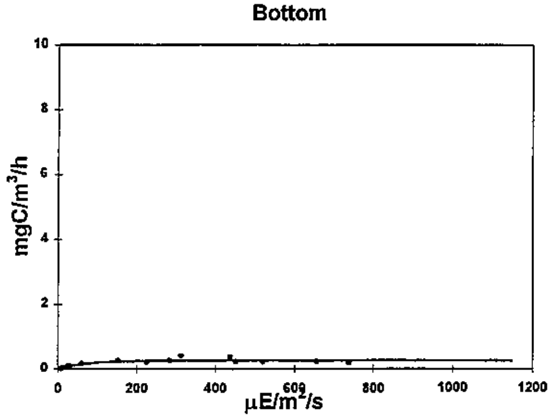
Middle



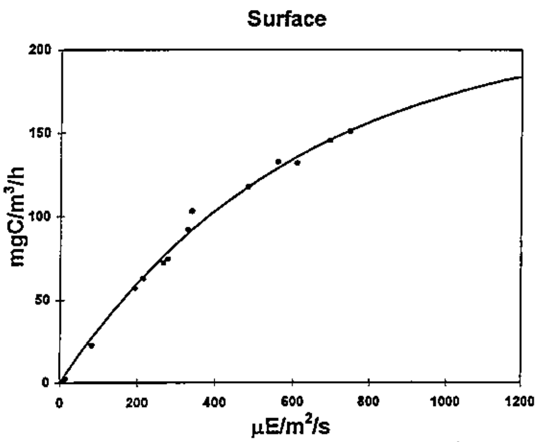
Mid Bottom

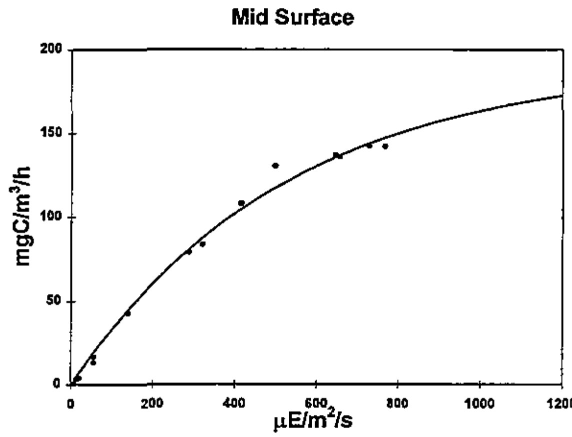


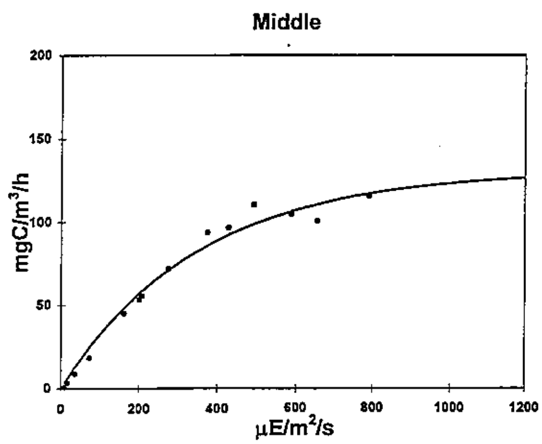
Bottom

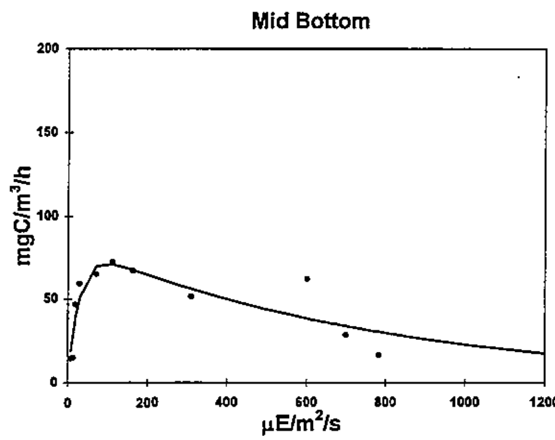


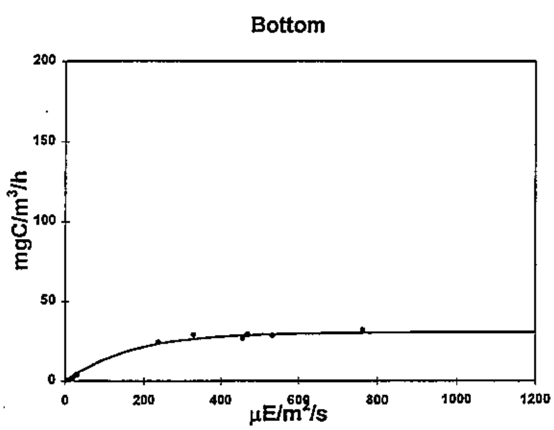
W9511 Station F23



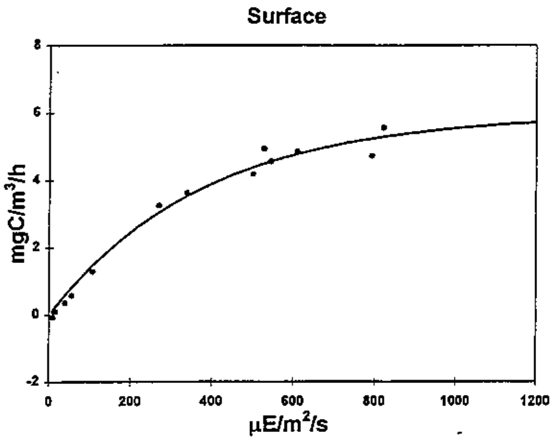


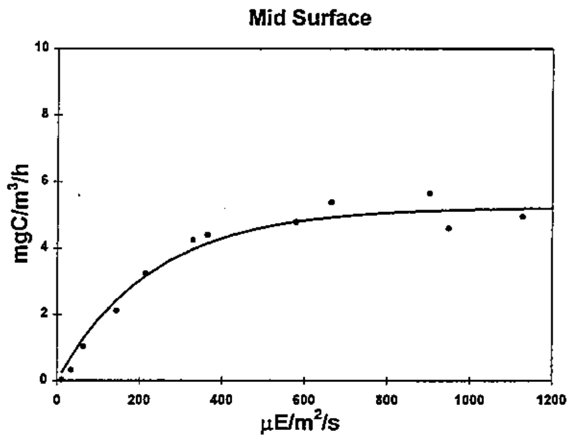


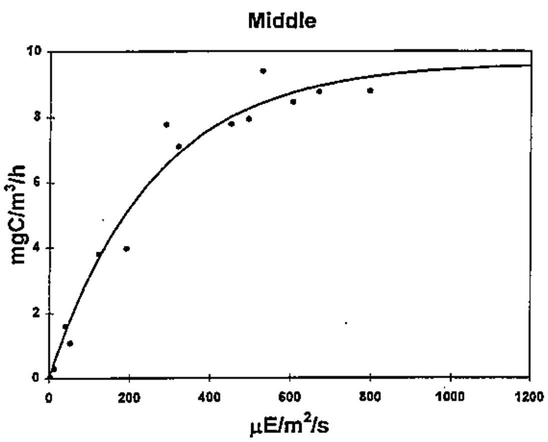


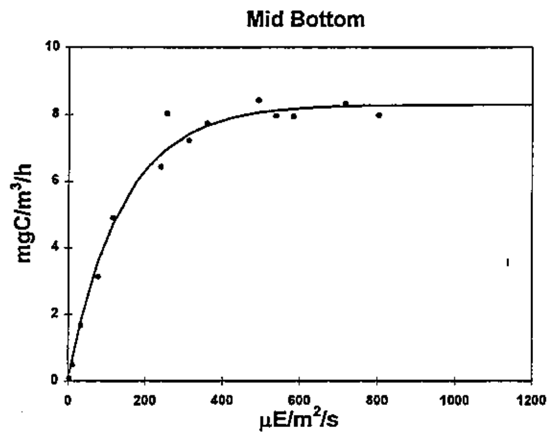


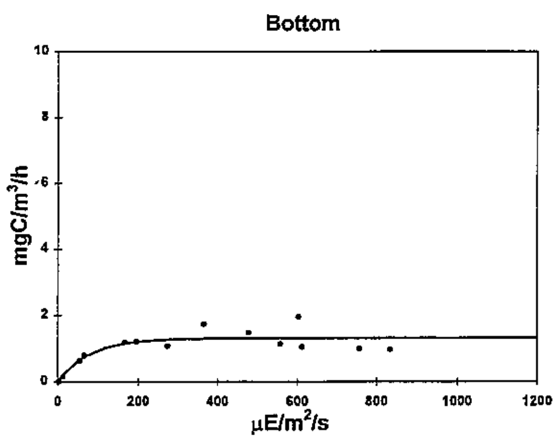
W9511 Station N16



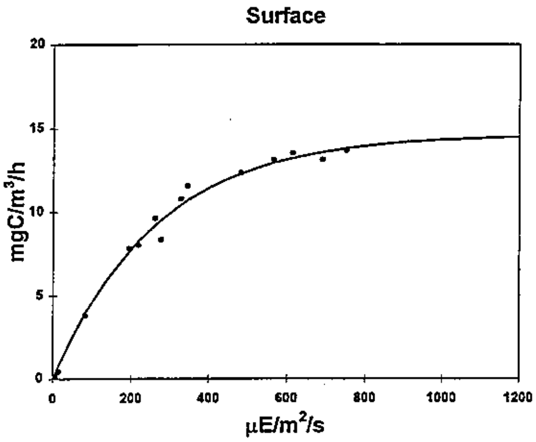


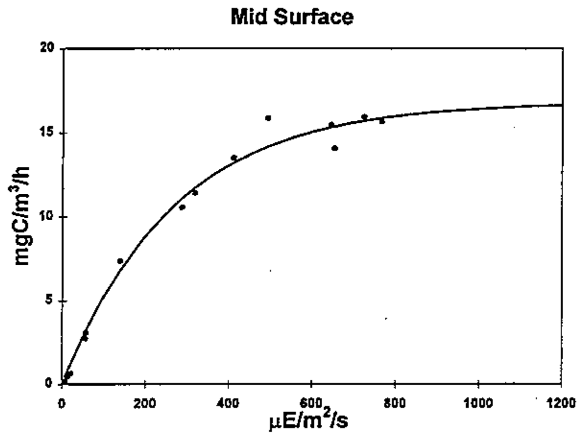


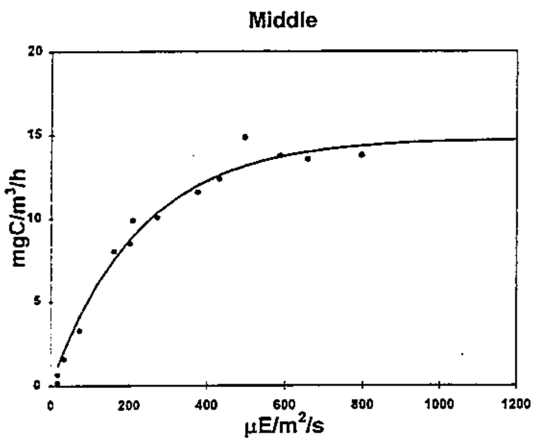


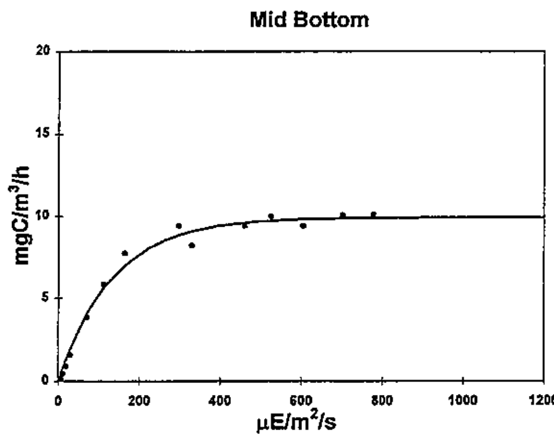


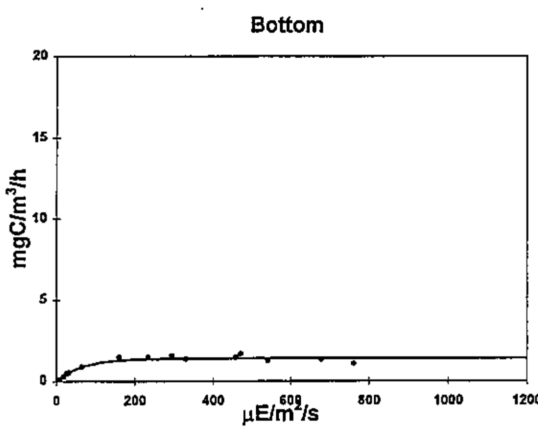
W9511 Station N04



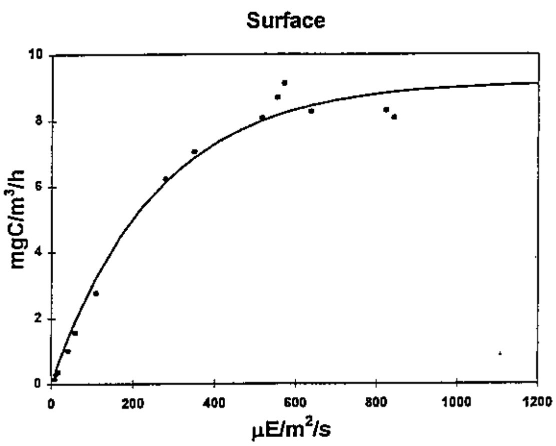


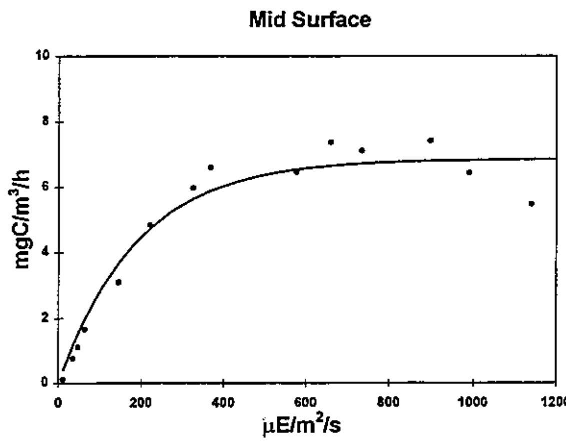


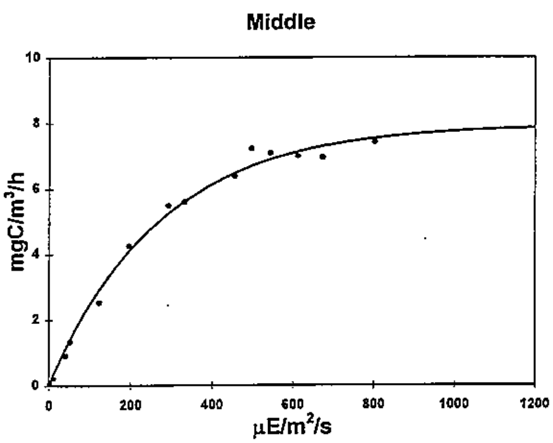


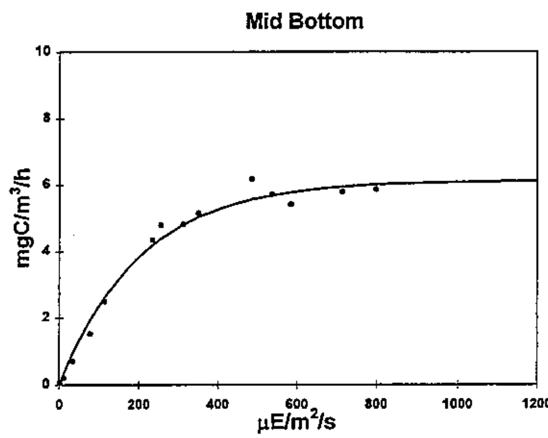


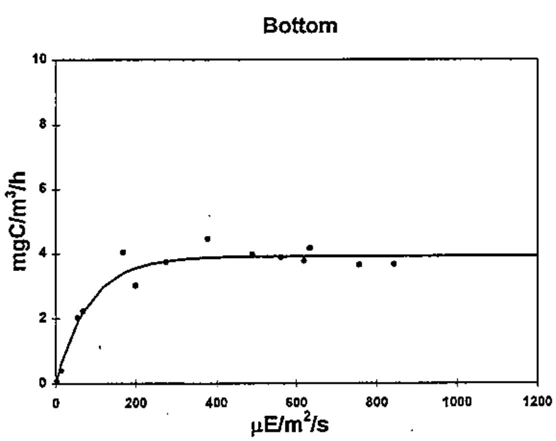
W9511 Station N07





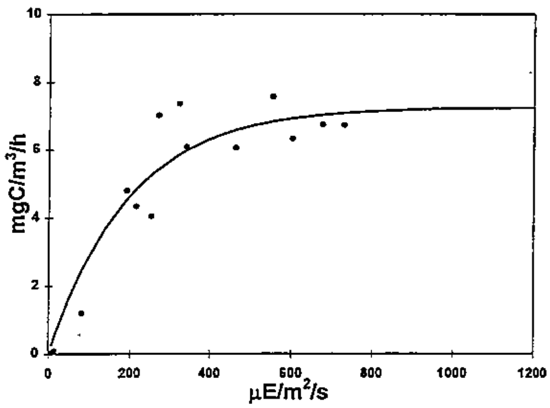




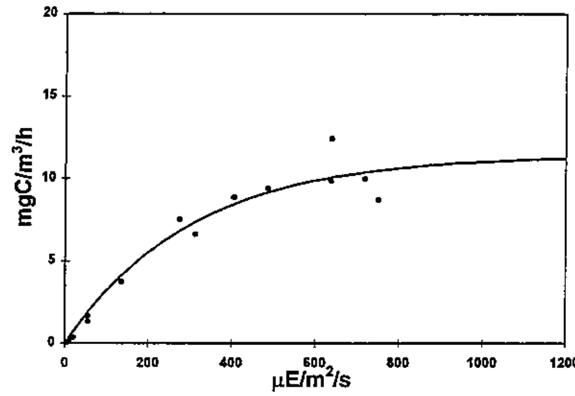


W9512 Station N16

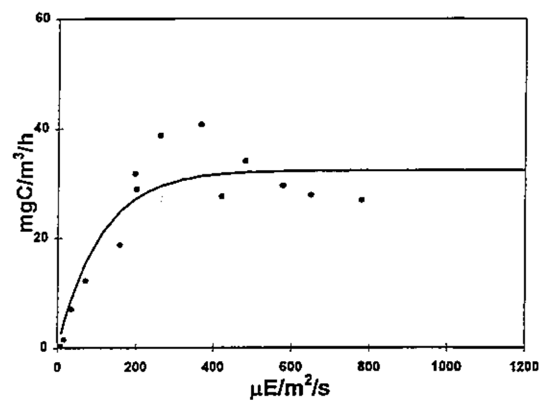
Surface



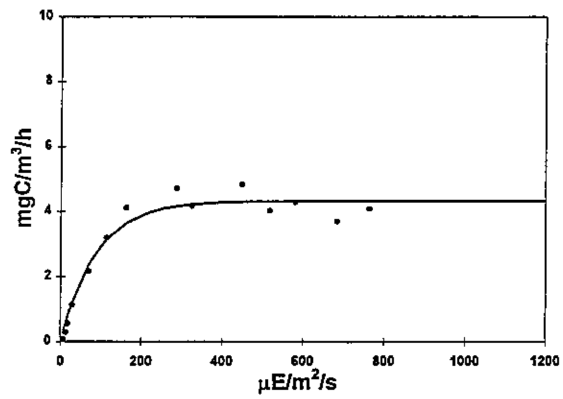
Mid Surface



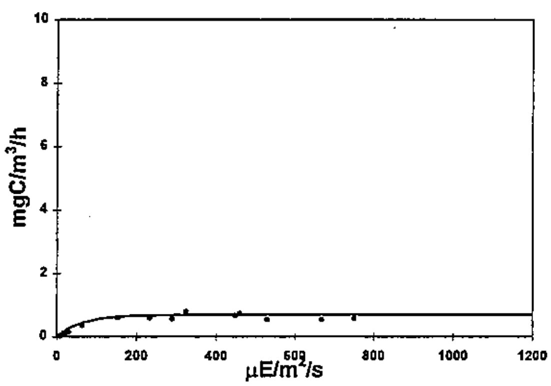
Middle



Mid Bottom



Bottom



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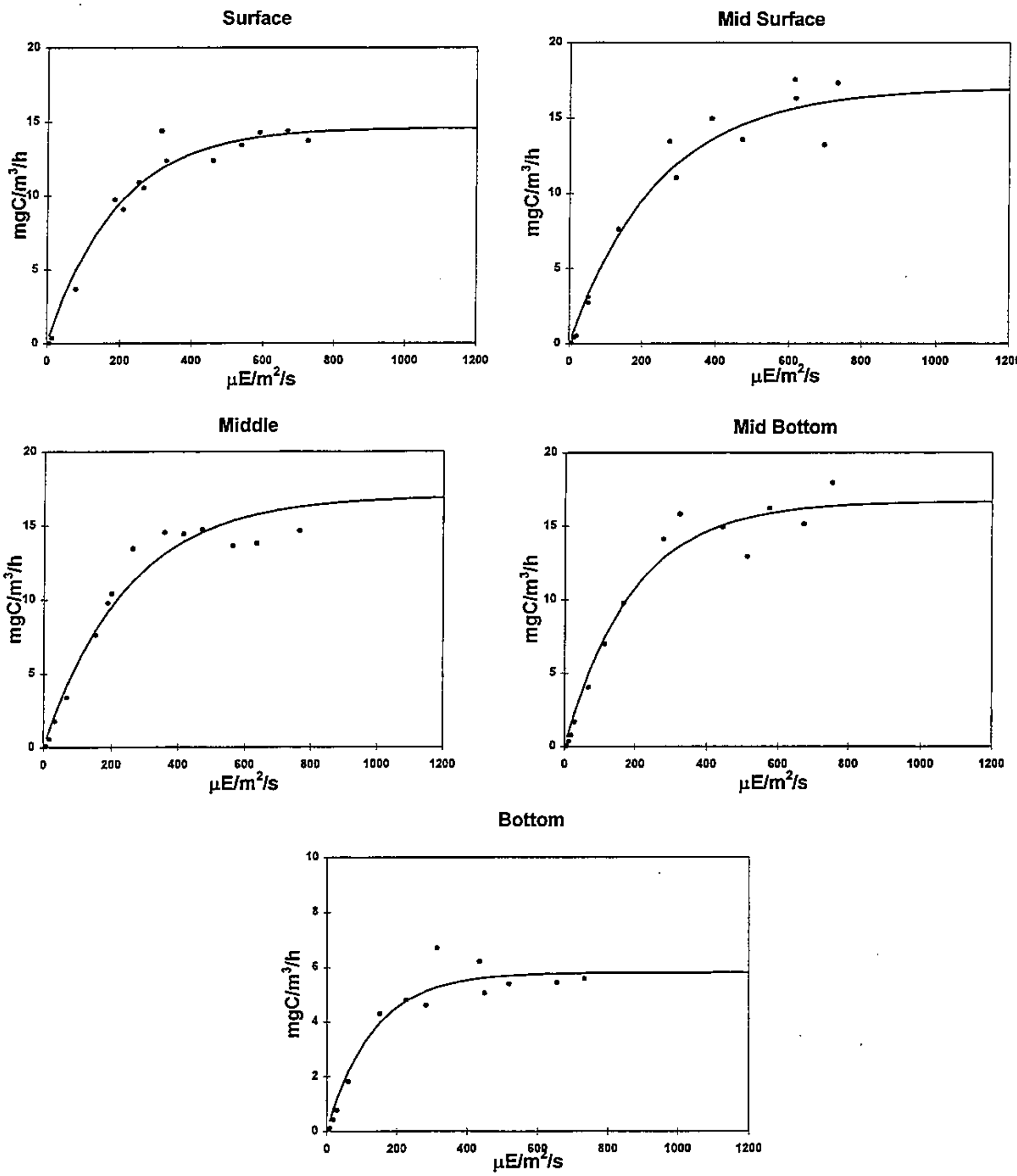
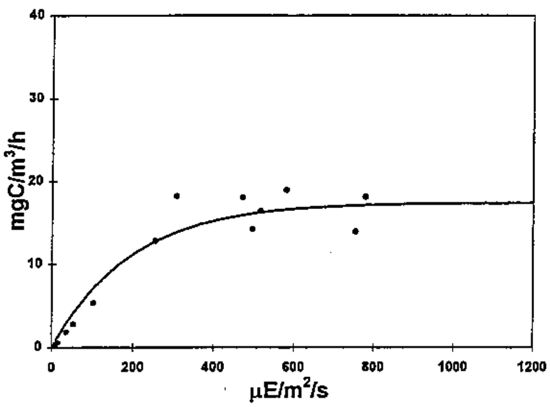
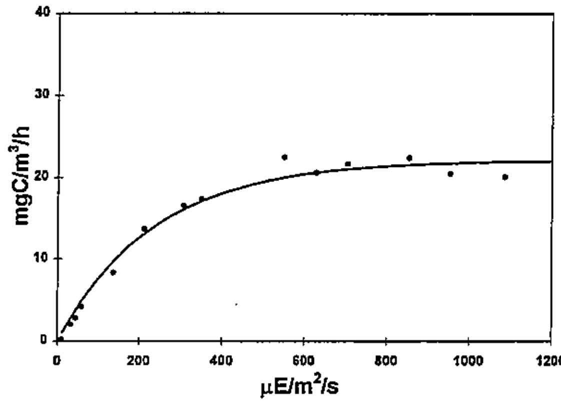


W9513 Station N04

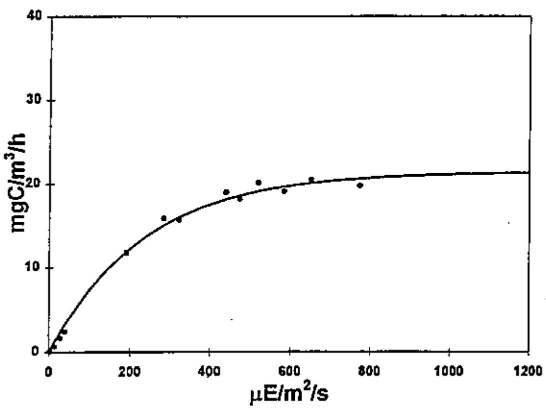
Surface



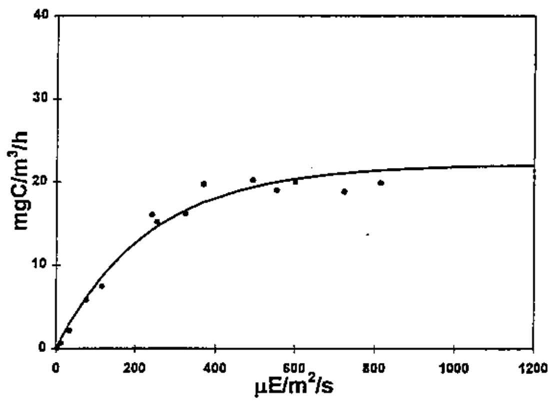
Mid Surface



Middle



Mid Bottom



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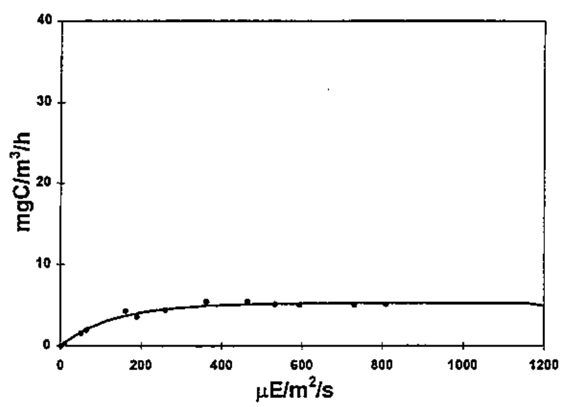
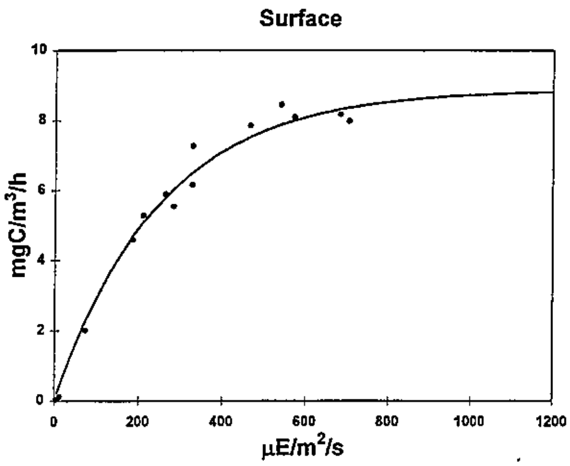
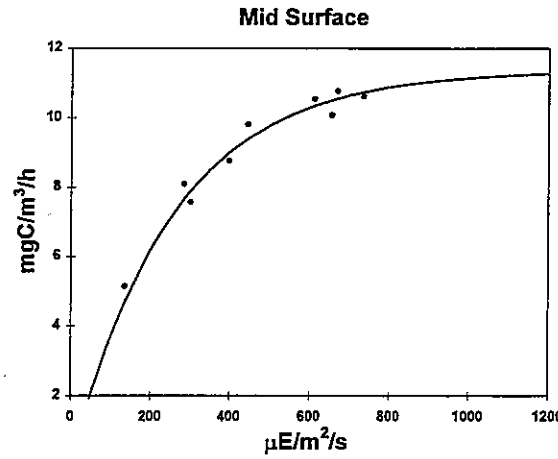



Surface
mgC/m3/h
μE/m2/s
0
2
4
6
8
10
0
200
400
600
800
1000
1200


Mid Surface
mgC/m3/h
μE/m2/s
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4
6
8
10
12
0
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600
800
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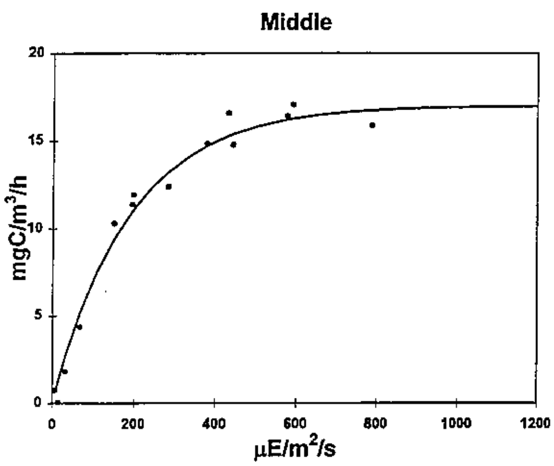
1200


Middle
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μE/m2/s
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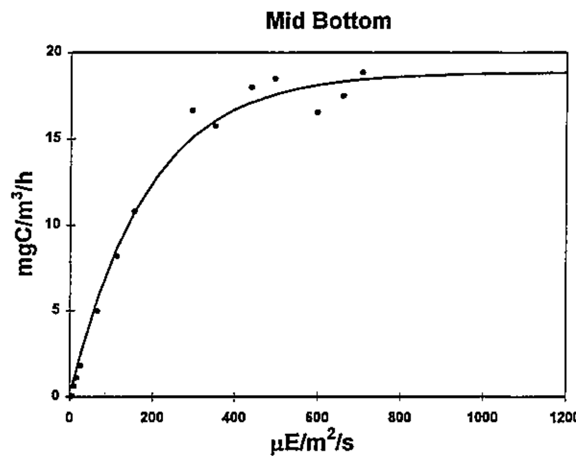
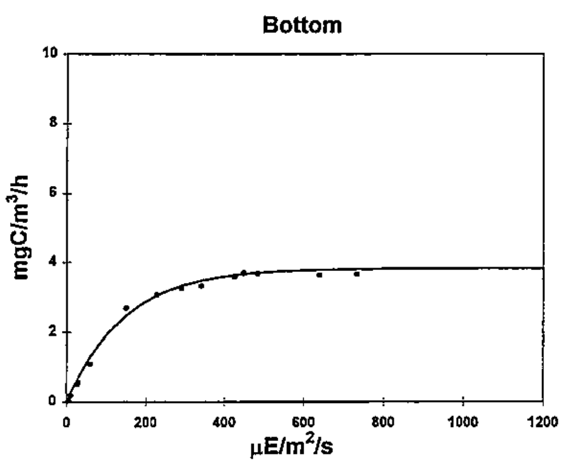
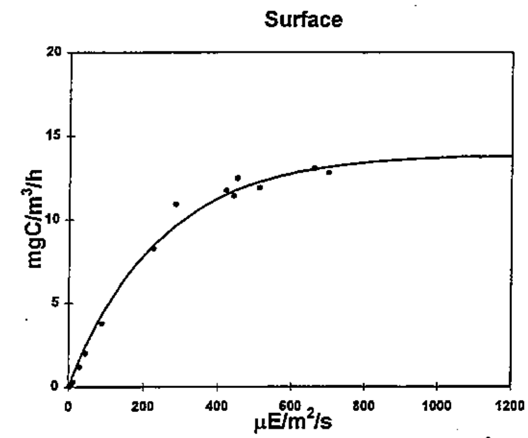
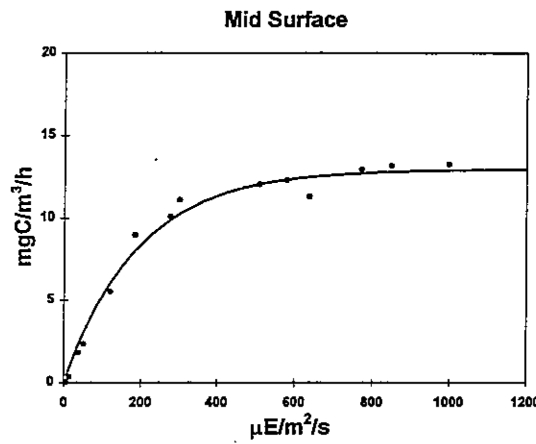
5
10
15
20
0
200
400
600
800
1000
1200

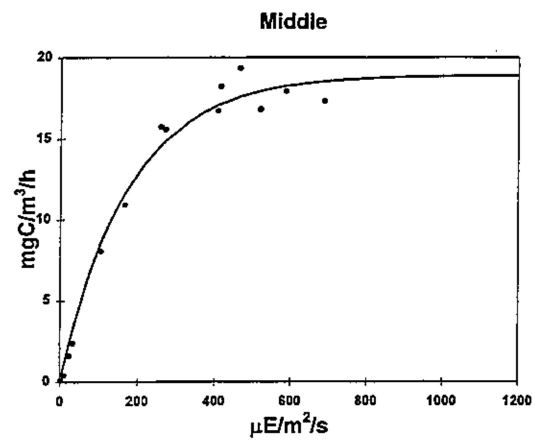

Mid Bottom
mgC/m3/h
μE/m2/s
0
5
10
15
20
0
200
400
600
800
1000
1200

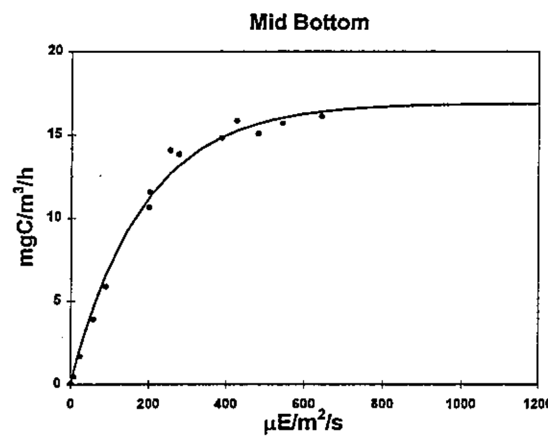

Bottom
mgC/m3/h
μE/m2/s
0
2
4
6
8
10
0
200
400
600
800
1000
1200

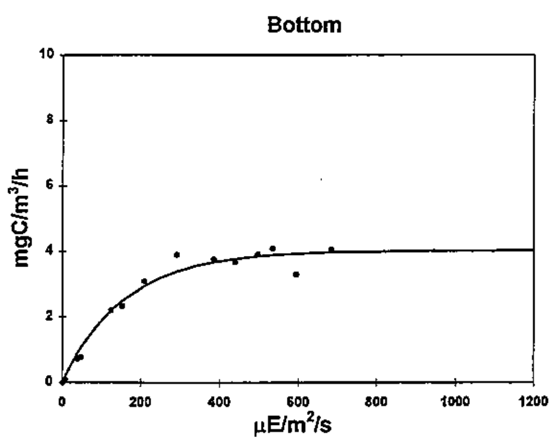
W9514 Station N07



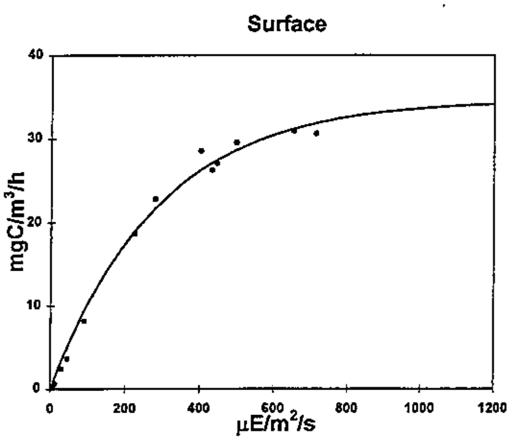


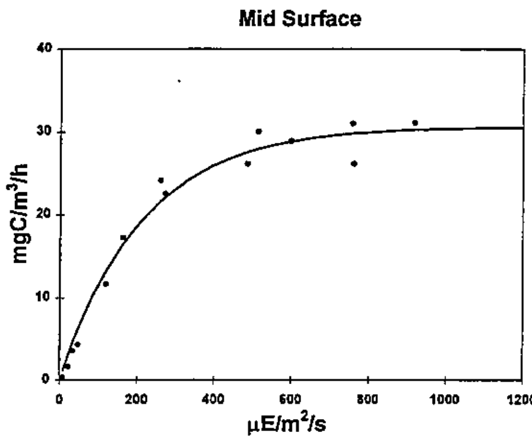


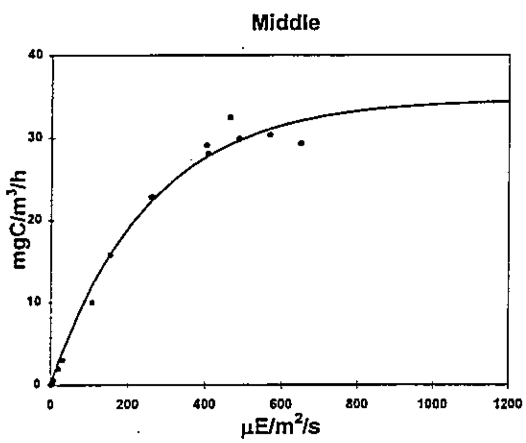


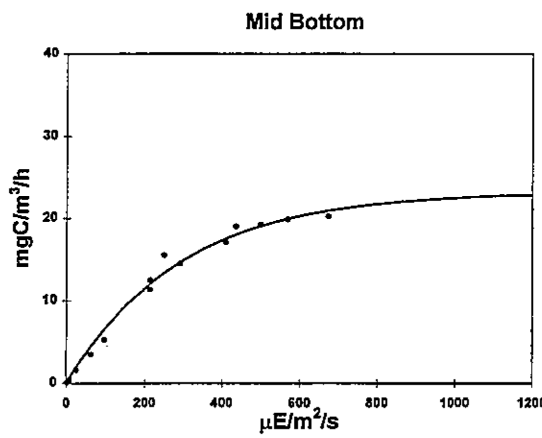


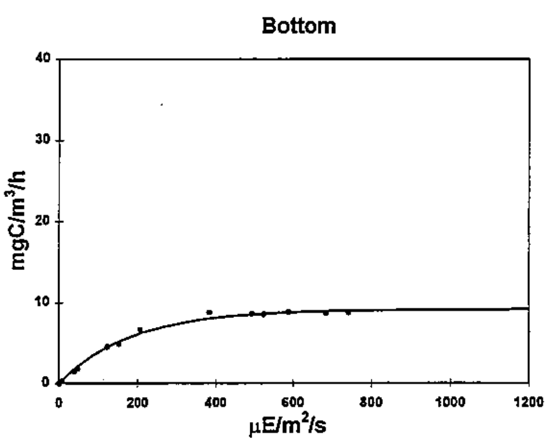
W9514 Station N16



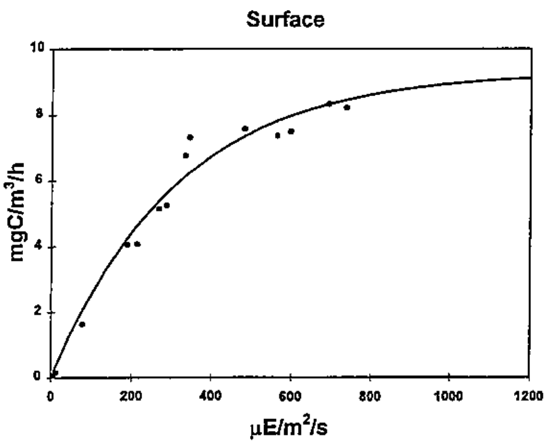


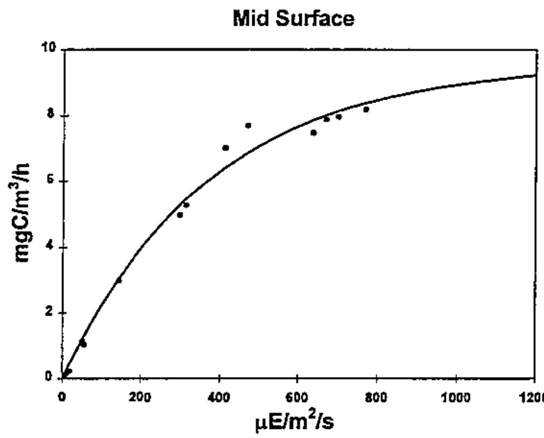


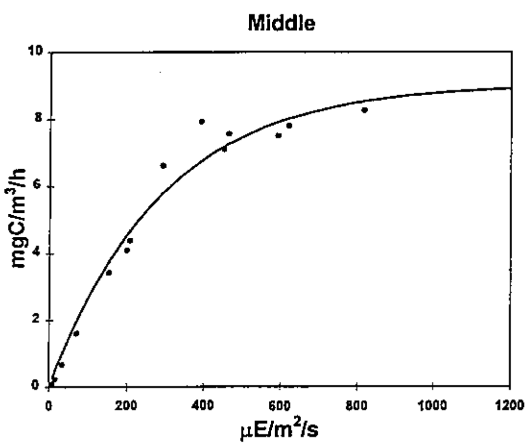


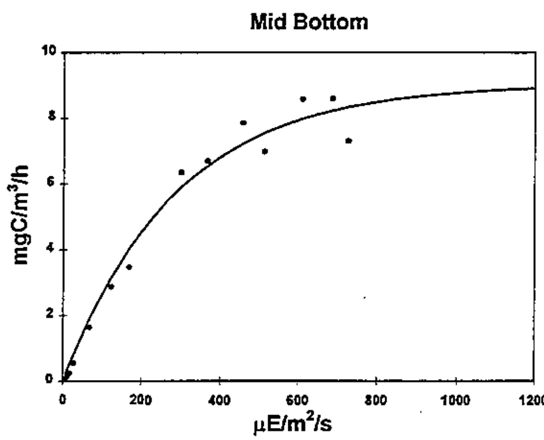


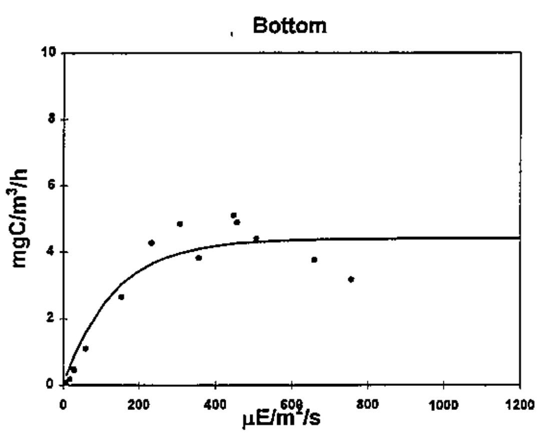
W9514 Station F23



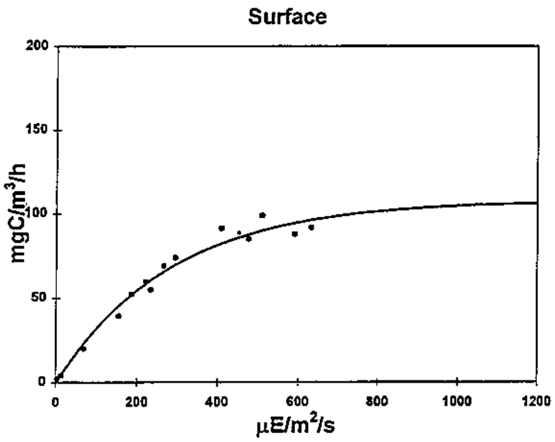


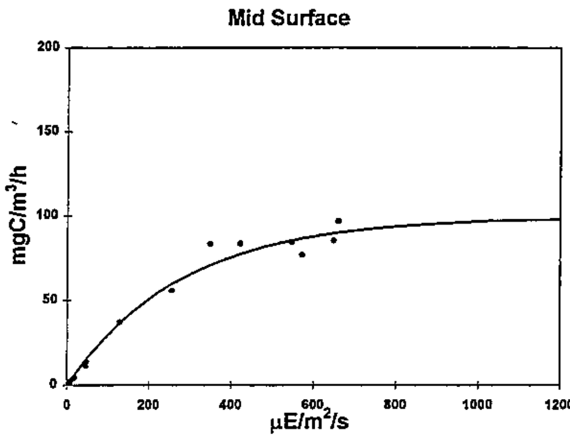


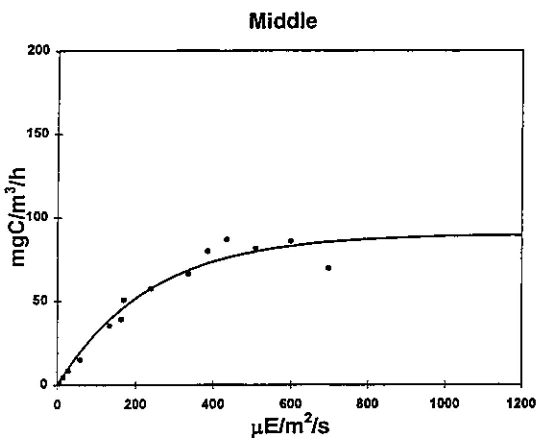


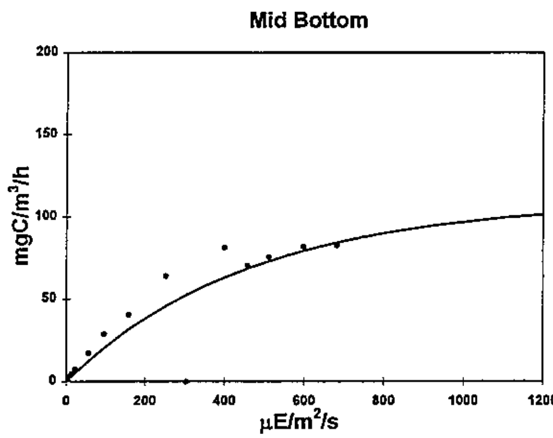


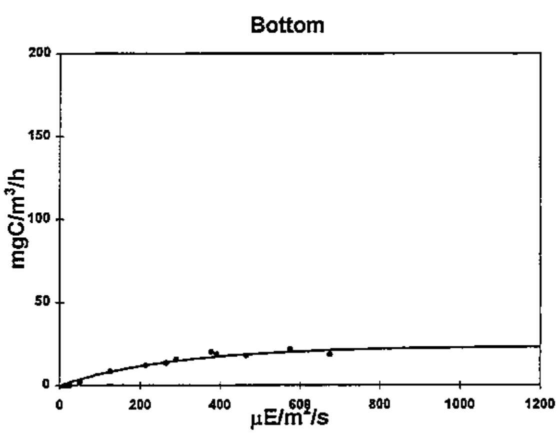
W9515 Station N16











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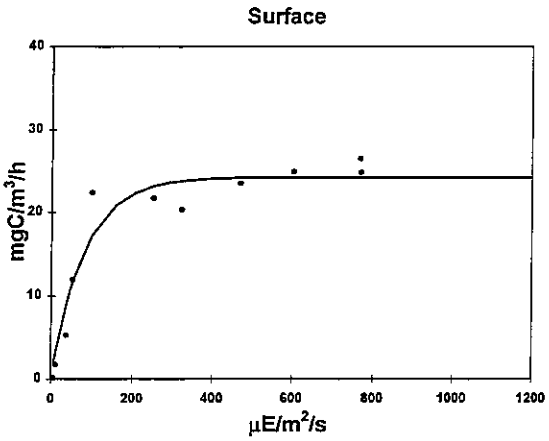

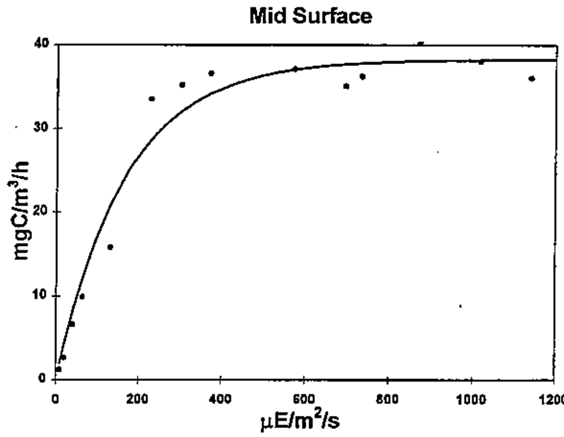

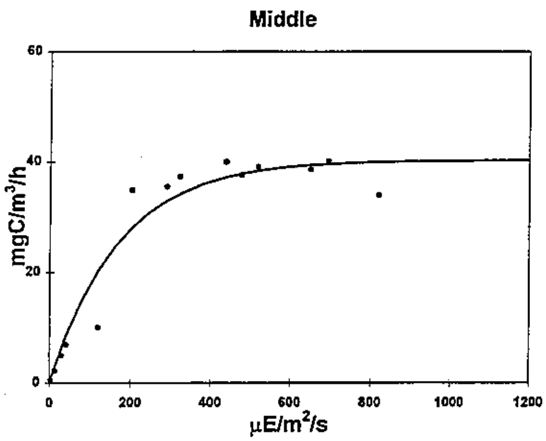

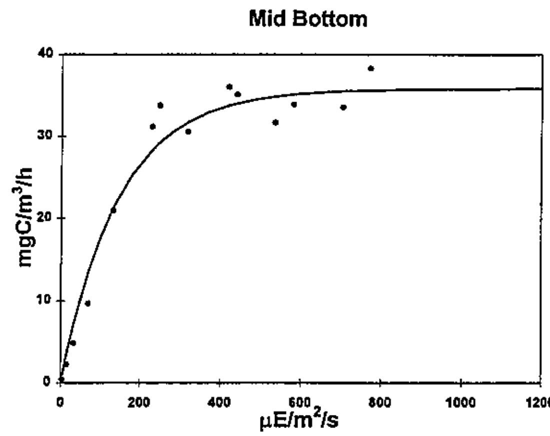

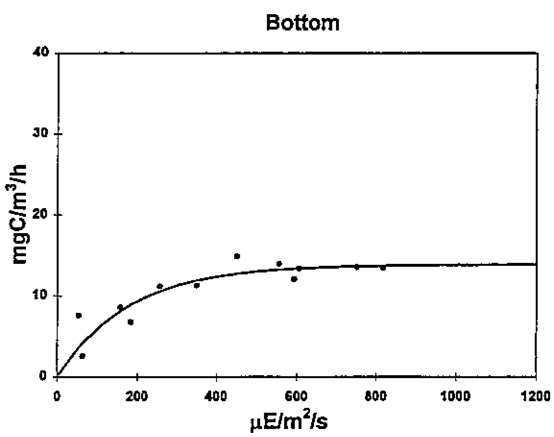

W9516 Station N16

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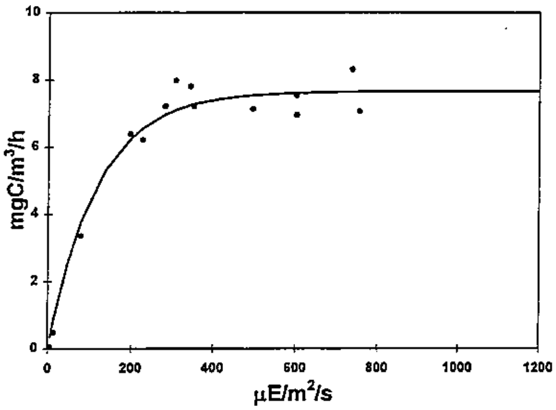

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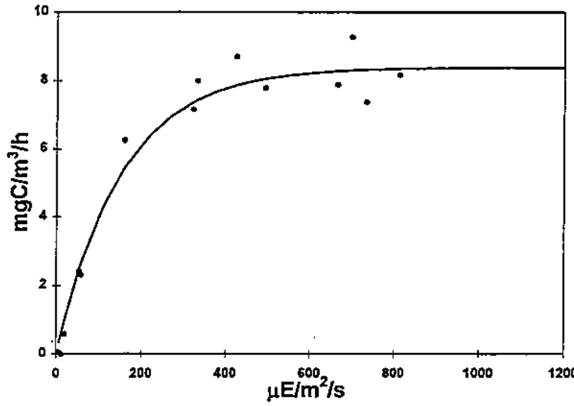

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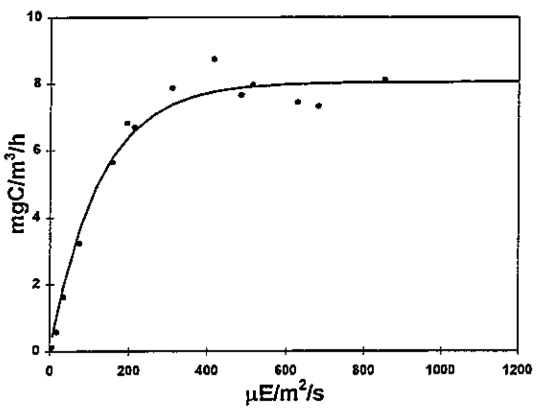

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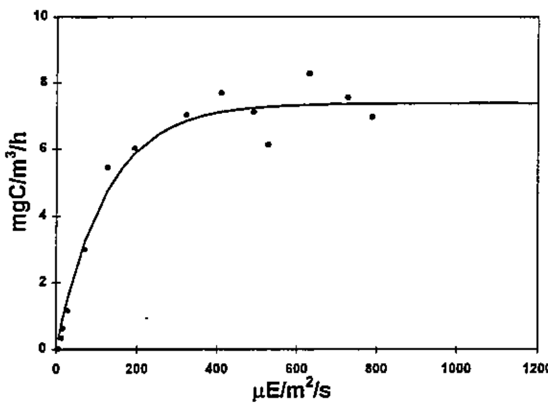

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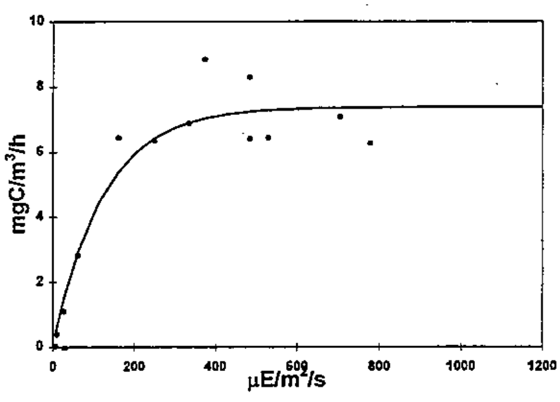
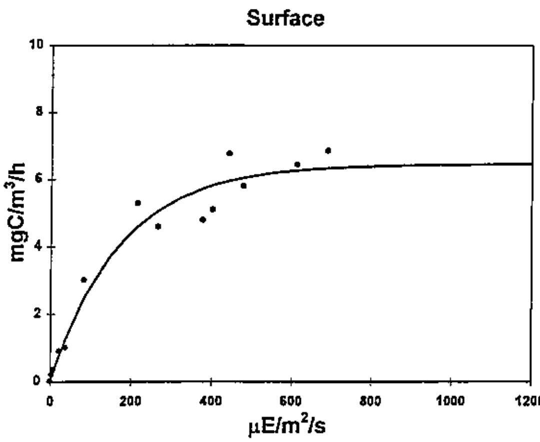
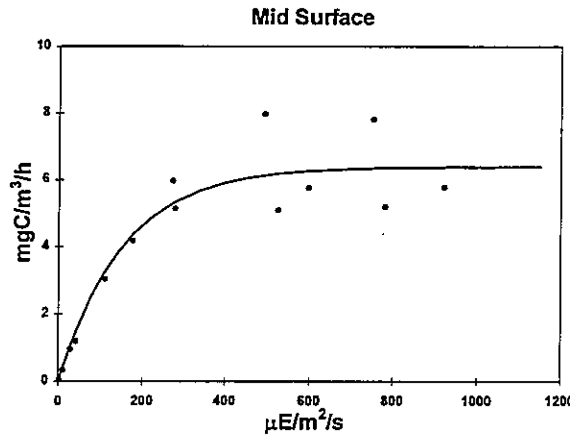
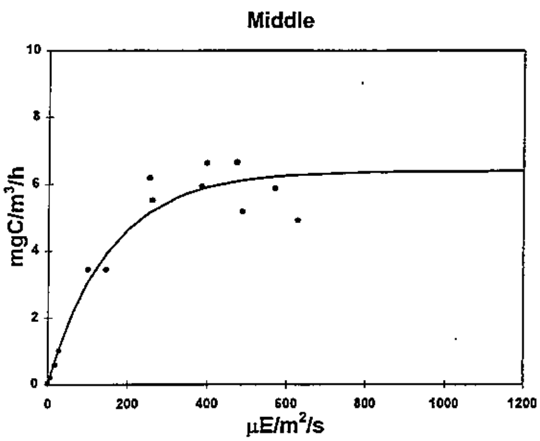
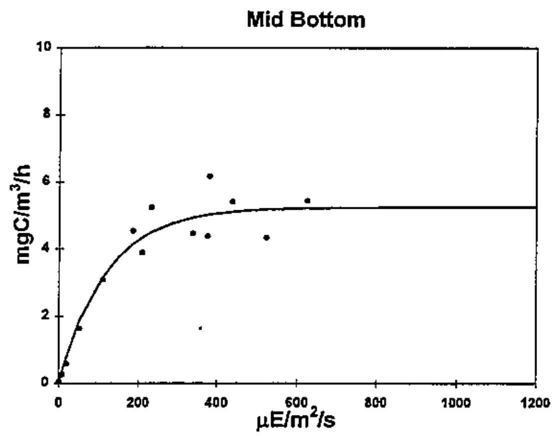


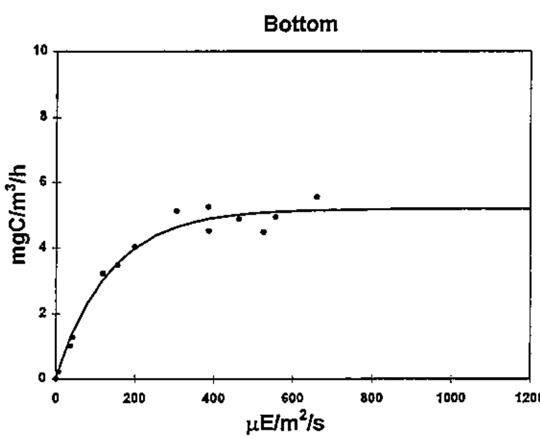
W9516 Station N04





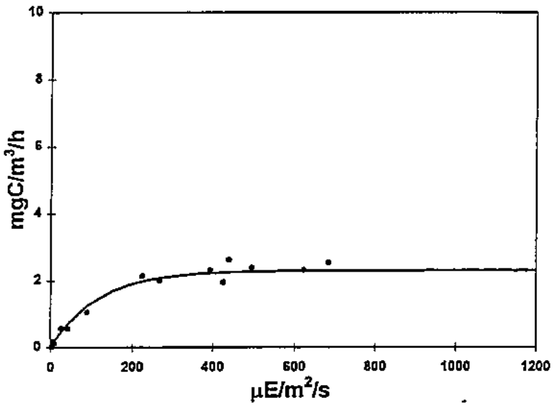




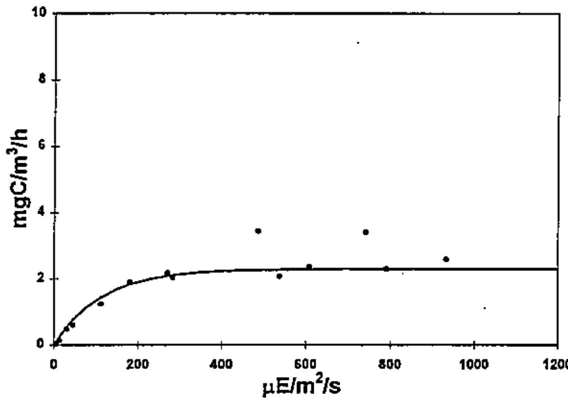


W9517 Station N16

Surface



Mid Surface



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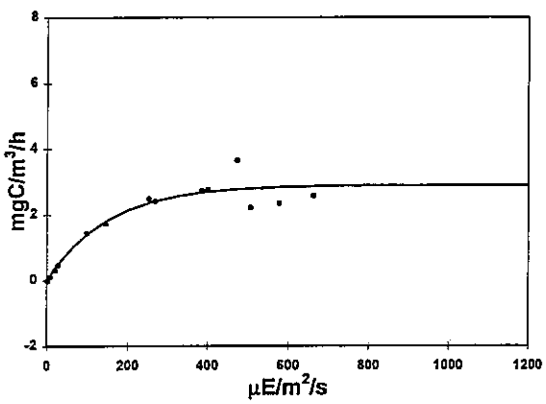
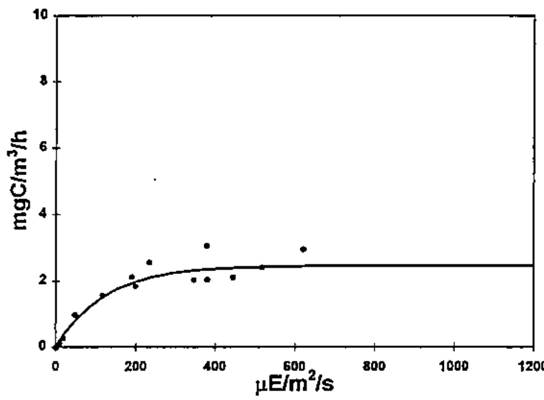


Mid Bottom



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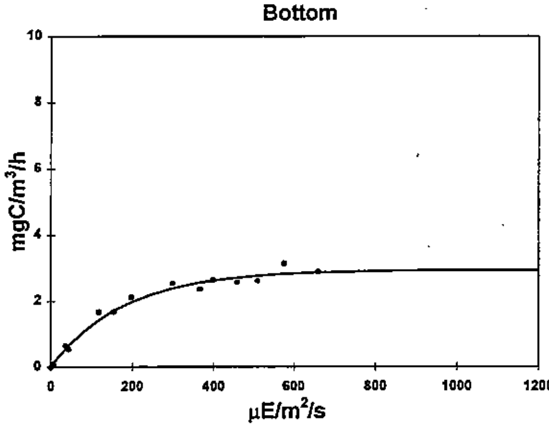
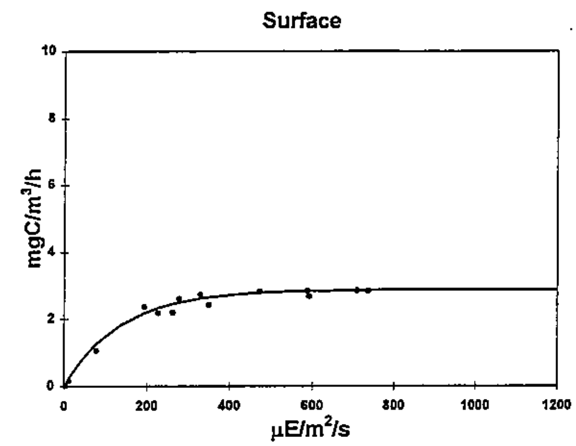
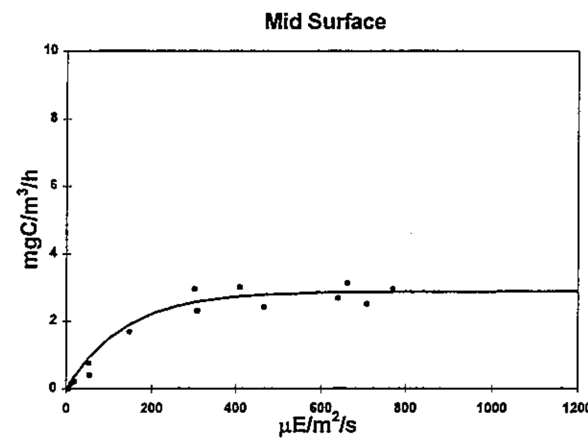
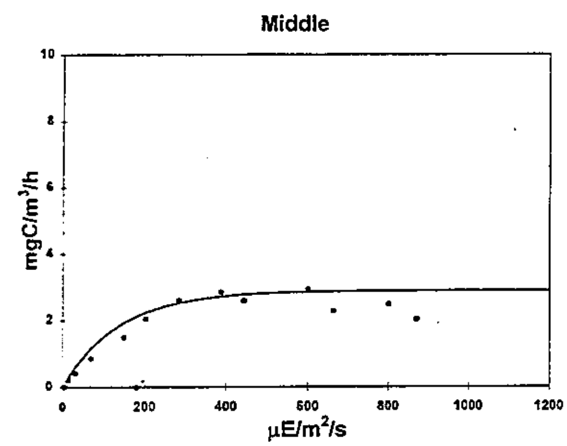
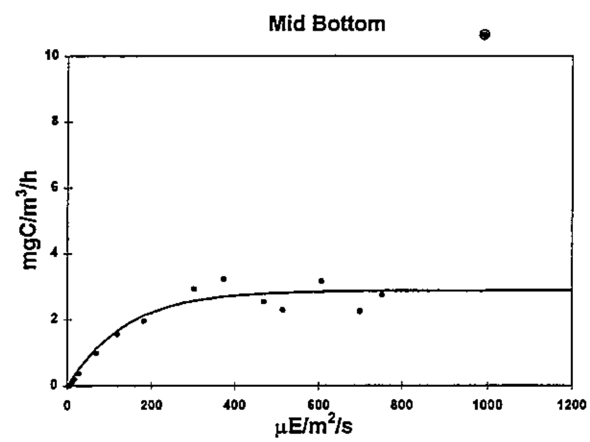


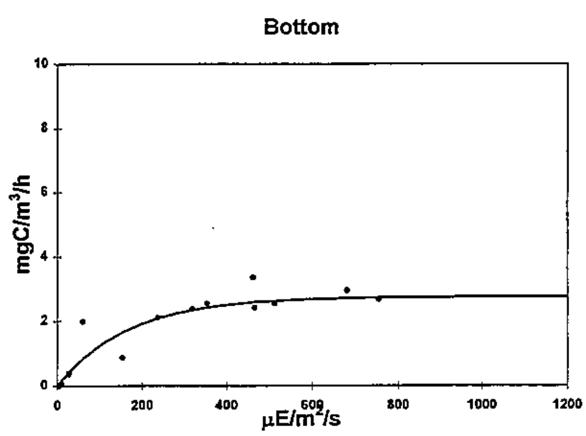
W9517 Station N04











APPENDIX F-1

ABUNDANCE OF PREVALENT SPECIES IN SURFACE SAMPLE

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, August 8, 1995 - August 10, 1995 (W9510)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.479	
		%	8	
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	1.249	0.128
		%	21	11
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	3.456	0.981
		%	58	81

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5 % Total Count) in Surface Sample
Whole Water Phytoplankton, August 21, 1995 - August 26, 1995 (W9511)

			Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
Species	**Group**	**Parameter**	**1F23**	**1F30**	**1F31**	**1F13**	**1F24**	**1F25**	**1N10**	**1N16**	**3N16**	**1F06**	**1F27**	**1F01**	**1F02**
CHAETOCEROS SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L			2.409			0.915							
		%			15			8							
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L		0.579			0.213	0.610	1.338						
		%		8			6	6	11						
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L			0.976										
		%			6										
GYMNODINIUM SP#1 5-20UM W 10-20UM L	DF	10^6 Cells/L				0.329	0.366			0.244	0.360	0.335	0.111	0.155	
		%				9	9			9	10	9	7	7	
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L		1.403										0.133	
		%		20										6	
SKELETONEMA COSTATUM	CD	10^6 Cells/L	2.328		1.220		0.476	0.584	1.684						
		%	20		7		12	5	14						
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.998	0.793	2.714		0.427	1.245	1.103			0.232			
		%	9	11	17		11	11	9			6			
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	5.211	2.363	5.366	2.836	1.732	4.878	4.646	2.147	2.647	2.659	1.248	1.780	1.604
		%	46	33	33	76	45	44	39	81	76	73	81	77	90

Group Definitions:
- CD Centric Diatom
- DF Dinoflagellate
- MF Microflagellate
- O Other
- PD Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, September 6, 1995 - September 8, 1995 and September 11, 1995 - September 14, 1995 (W9512)

Species	Group	Parameter	Nearfield Stations	
			1N10	2N16
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L	6.174	1.142
		%	69	49
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.139
		%		6
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	1.677	0.826
		%	19	35

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, September 25, 1995 - September 29, 1995 (W9513)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.177	
		%	7	
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L		0.122
		%		5
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L	0.201	0.177
		%	8	8
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.316
		%		14
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	1.451	1.142
		%	57	49

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, October 9 - October 13, 1995 (W9514)

			Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
Species	Group	Parameter	1F23	1F30	1F31	1F13	1F24	1F25	1N10	1N16	3N16	1F06	1F27	1F01	1F02
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.119	0.152	0.151		0.084	0.158	0.672		0.307		0.601		
		%	15	6	14		8	13	15		12		20		
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.055	0.482	0.081	0.316		0.167	1.146					0.335	
		%	7	18	7	13		14	25					9	
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L	0.090		0.059		0.082	0.100							0.122
		%	11		5		8	8							5
GYMNODINIUM SP #1 5-20UM W 10-20UM L	DF	10^6 Cells/L				0.166						0.071	0.209	0.567	0.139
		%				7						5	7	15	6
KATODINIUM ROTUNDATUM	DF	10^6 Cells/L										0.213	0.233		
		%										16	8		
LEPTOCYLINDRUS DANICUS	CD	10^6 Cells/L													
		%													
PYRAMIMONAS SP.	MF	10^6 Cells/L			0.073								0.153		
		%			7								5		
RHIZOSOLENIA DELICATULA	CD	10^6 Cells/L										0.136			
		%										10			
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L										0.078			
		%										6			
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.203		0.196		0.137	0.199	0.260		0.477				
		%	26		18		13	17	6		19				
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.200	1.37205	0.33877	1.303	0.516	0.357173	1.7522	6.02177	1.1606	0.633	1.37482	1.988	1.486
		%	26	51.66746	30.64116	53	49	29.84561	38.53119	75.647431	45.869276	48	46.11219604	54	61

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, November 1 - November 4, 1995 (W9515)

Species	Group	Parameter	Nearfield Stations 1N10	Nearfield Stations 1N16
ASTERIONELLA GLACIALIS	PD	10^6 Cells/L	0.538	1.594
		%	48	52
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.058	
		%	5	
PANDORINA SP.	O	10^6 Cells/L	0.082	
		%	7	
RHIZOSOLENIA DELICATULA	CD	10^6 Cells/L		0.191
		%		6
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.224
		%		7
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.104	
		%	9	

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, November 27, 1995 - December 5, 1995 (W9516)

Species	Group	Parameter	Nearfield Stations 1N10	Nearfield Stations 1N16
ASTERIONELLA GLACIALIS	PD	10^6 Cells/L	0.018	0.041
		%	5	9
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L		0.027
		%		6
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.036	
		%	10	
THALASSIONEMA NITZSCHIOIDES	PD	10^6 Cells/L		0.039
		%		8
THALASSIOSIRA SP#1 DIAM <20 MICRONS	CD	10^6 Cells/L	0.018	0.136
		%	5	29
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.044
		%		9
UNID. CHOANOFLAGELLATE	MF	10^6 Cells/L	0.031	
		%	9	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.142	0.026
		%	42	5

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, December 17, 1995 - December 19, 1995 (W9517)

Species	Group	Parameter	Nearfield Stations	
			1N10	2N16
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.021	0.041
		%	21	22
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L		0.013
		%		7
CYLINDROTHECA CLOSTERIUM	PD	10^6 Cells/L	0.019	
		%	19	
DISTEPHANUS SPECULUM	O	10^6 Cells/L	0.006	
		%	6	
GYMNODINIUM SP #1 5-20UM W 10-20UM L	DF	10^6 Cells/L	0.006	0.011
		%	5	6
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.011	
		%	11	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.011	0.063
		%	10	33

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

APPENDIX F-2

ABUNDANCE OF PREVALENT SPECIES IN CHLOROPHYLL *a* MAXIMUM SAMPLE

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample Whole Water Phytoplankton, August 8, 1995 - August 10, 1995 (W9510)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.407	0.154
		%	7	7
UNID. BLUE GREEN SINGLE SPHERE	O	10^6 Cells/L		0.117
		%		5
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	1.045	
		%	17	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	3.760	1.819
		%	61	80

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll a Maxiumum Sample Whole Water Phytoplankton, August 21, 1995 - August 26, 1995 (W9511)

			Harbor Stations			Coastal Stations			Nearfield Stations			Offshore	Boundary	ape Cod Bay Station	
Species	Group	Parameter	1F23	1F30	1F31	1F13	1F24	1F25	1N10	1N16	3N16	1F06	1F27	1F01	1F02
CHAETOCEROS SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L	0.488	0.716	1.082			1.357	0.686						
		%	7	6	12			15	7						
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L		0.610	0.640				0.579		0.177				
		%		5	7				6		7				
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L													
		%													
GYMNODINIUM SP #1 5-20UM W 10-20UM L	DF	10^6 Cells/L					0.177					0.335	0.195		
		%					5					5	7		
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L		1.008					0.671						0.405
		%		9					7						18
SKELETONEMA COSTATUM	CD	10^6 Cells/L	1.585	1.167	0.579	0.256	0.470		2.256						
		%	24	10	6	10	14		23						
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.656	0.822	1.281	0.213	0.250	0.595	0.838			0.701			
		%	10	7	14	8	7	6	9			11			
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	2.666	5.276	3.644	1.317	1.762	4.025	3.156	3.965	2.177	4.223	2.336	2.195	1.513
		%	43	46	41	51	51	44	32	87	80	64	80	81	66

Group Definitions:

CD Centric Diatom
DF Dinoflagellate
MF Microflagellate
O Other
PD Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll a Maximum Sample Whole Water Phytoplankton, September 6, 1995 - September 8, 1995 and September 11, 1995 - September 14, 1995 (W9512)

Species	Group	Parameter	Nearfield Stations 1N10	2N16
LEPTOCYLINDRUS DANICUS	CD	10^6 Cells/L	0.869	
		%	13	
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L	4.025	1.162
		%	59	48
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	1.250	0.869
		%	18	36

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample Whole Water Phytoplankton, September 25, 1995 - September 29, 1995 (W9513)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L		0.890
		%		30
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.213
		%		7
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L		1.427
		%		48
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.390	
		%	15	
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L	0.183	
		%	7	
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.140	
		%	5	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	1.250	
		%	47	

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll a Maximum Sample Whole Water Phytoplankton, October 9 - October 13, 1995 (W9514)

			Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
Species	Group	Parameter	1F23	1F30	1F31	1F13	1F24	1F25	1N10	1N16	3N16	1F06	1F27	1F01	1F02
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.055		0.116		0.066	0.842			0.957	0.106	0.224		
		%	8		5		6	35			32	9	8		
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L		0.159	0.255	0.335								0.482	
		%		9	11	11								14	
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L	0.098	0.179			0.105	0.170					0.224		
		%	14	10			10	7					8		
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L								0.213				0.244	0.232
		%								6				7	9
KATODINIUM ROTUNDATUM	DF	10^6 Cells/L									0.221	0.163			
		%									7	14			
LEPTOCYLINDRUS DANICUS	CD	10^6 Cells/L	0.080				0.076								
		%	11				7								
PYRAMIMONAS SP.	MF	10^6 Cells/L													
		%													
RHIZOSOLENIA DELICATULA	CD	10^6 Cells/L										0.103			
		%										9			
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L							0.139			0.160			
		%							9			13			
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.098			0.187		0.113				0.191	0.195	
		%		5			18		8				7	6	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.307	0.955353	1.4358	1.707	0.408406	0.847573	1.00638	3.0429	1.49757	0.451	1.79172	2.043	1.359
		%	44	53.35121	62.34954	55	39.8167	35.36686	67.277674	78.65668	49.375921	38	67.36502125	58	55

Group Definitions:

- CD Centric Diatom
- DF Dinoflagellate
- MF Microflagellate
- O Other
- PD Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample Whole Water Phytoplankton, November 1 - November 4, 1995 (W9515)

Species	Group	Parameter	Nearfield Stations 1N10	Nearfield Stations 1N16
ASTERIONELLA GLACIALIS	PD	10^6 Cells/L	0.616	1.067
		%	63	46
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L		0.128
		%		6
THALASSIONEMA NITZSCHIOIDES	PD	10^6 Cells/L		0.208
		%		9
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.055	0.229
		%	6	10
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.053	0.155
		%	5	7

Group Definitions:		
	CD	Centric Diatom
	DF	Dinoflagellate
	MF	Microflagellate
	O	Other
	PD	Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample Whole Water Phytoplankton, November 27, 1995 - December 5, 1995 (W9516)

Species	Group	Parameter	Nearfield Stations 1N10	Nearfield Stations 1N16
ASTERIONELLA GLACIALIS	PD	10^6 Cells/L		0.036
		%		8
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.033	0.038
		%	10	9
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.042	
		%	13	
THALASSIONEMA NITZSCHIOIDES	PD	10^6 Cells/L		0.033
		%		8
THALASSIOSIRA SP#1 DIAM <20 MICRONS	CD	10^6 Cells/L	0.029	0.162
		%	9	37
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.022	
		%	7	
UNID. CHOANOFLAGELLATE	MF	10^6 Cells/L	0.023	
		%	7	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.073	0.027
		%	23	6

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample Whole Water Phytoplankton, December 17, 1995 - December 19, 1995 (W9517)

Species	Group	Parameter	Nearfield Stations	
			1N10	2N16
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.064	0.085
		%	40	39
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L	0.008	0.012
		%	5	6
CYLINDROTHECA CLOSTERIUM	PD	10^6 Cells/L	0.011	
		%	7	
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L		0.014
		%		6
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.019	0.046
		%	12	21

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

APPENDIX G-1

ABUNDANCE OF ALL IDENTIFIED TAXA IN SCREENED SAMPLES NEAR THE SURFACE

Table 3-2a. Abundance of all identified taxa in screened samples near the surface August 8 - 10, 1995 (W9510)

Species	Group	Nearfield Stations 1N10A	Nearfield Stations 1N16A
CERATIUM FUSUS	DF	0.001	0.005
CERATIUM LONGIPES	DF	0.009	0.003
CERATIUM SP.	DF	0.002	
CERATIUM TRIPOS	DF	0.004	0.005
DINOPHYSIS ACUMINATA	DF		
DINOPHYSIS NORVEGICA	DF		0.001
DINOPHYSIS PUNCTATA	DF	0.001	
DIPLOPSALIS SP.	DF		0.001
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF	0.001	
KATODINIUM ROTUNDATUM	DF		
PROTOPERIDINIUM DEPRESSUM	DF		0.001
SCRIPPSIELLA TROCHOIDEA	DF	0.001	
PYRAMIMONAS SP.	MF		
UNID. SILICOFLAGELLATE	MF		
UNID. BLUE GREEN TRICHOME	O	0.044	
UNID. BLUE GREEN TRICHOME (CELL)	O		0.256

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface August 21 - 26, 1995 (W9511)

Species	Group	Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
		1F23A	1F30A	1F31A	1F13A	1F24A	1F25A	1N10A	1N16A	3N16A	1F06A	1F27A	1F01A	1F02A
CERATIUM FUSUS	DF	0.001	0.003	0.001	0.002	0.019	0.001	0.012	0.028	0.023		0.013		
CERATIUM LONGIPES	DF	0.008	0.012	0.004	0.007	0.022	0.003	0.024	0.004	0.035	0.011	0.028		
CERATIUM MACROCEROS	DF													
CERATIUM SP.	DF	0.001												
CERATIUM TRIPOS	DF	0.005	0.003	0.002	0.003	0.005	0.001	0.016	0.009	0.029	0.008	0.038	0.007	0.004
DINOPHYSIS ACUMINATA	DF					0.001					0.001	0.001		
DINOPHYSIS NORVEGICA	DF													0.003
DINOPHYSIS OVUM	DF		0.002											
DINOPHYSIS PUNCTATA	DF													
DIPLOPSALIS LENTICULA	DF		0.009											
DIPLOPSALIS SP.	DF	0.001	0.028	0.018				0.005		0.001				0.001
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.190	0.077		0.035		0.214	0.103		0.233	0.100		
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF	0.004	0.011	0.268	0.001		0.149	0.001			0.003		0.002	
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF		0.005	0.001										
HETEROCAPSA TRIQUETRA	DF		0.008											
KATODINIUM ROTUNDATUM	DF											0.033		
PROROCENTRUM BALTICUM	DF		0.066											
PROROCENTRUM MAXIMUM	DF													0.003
PROROCENTRUM MICANS	DF													
PROROCENTRUM MINIMUM	DF		0.002	0.077			0.001		0.052	0.001				
PROROCENTRUM TRIESTINUM	DF													
PROTOPERIDINIUM DEPRESSUM	DF	0.001			0.001					0.001				
PROTOPERIDINIUM DIVERGENS	DF													0.002
PROTOPERIDINIUM GRANII	DF													
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF	0.073	0.379	0.001			0.149	0.393						0.001
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.020	0.095	0.023				0.004		0.001			0.002	0.001
PROTOPERIDINIUM SP.#3 76-150W 81-150L	DF													
SCRIPPSIELLA TROCHOIDEA	DF	0.007	0.190	0.011				0.178			0.013		0.002	
UNID. DINOFLAGELLATE	DF		0.003											
UNID. DINOFLAGELLATE CYST	DF													
EUGLENA SP.	MF													
EUTREPTIA LANOWII	MF			0.077										
PYRAMIMONAS SP.	MF									0.070				
UNID. CHOANOFLAGELLATE	MF								0.052	0.106		0.017		
UNID. SILICOFLAGELLATE	MF													
ACANTHOICA SP.	O													
DICTYOCHA FIBULA	O													
DISTEPHANUS SPECULUM	O													
EBRIA TRIPARTITA	O													
RHABDOSPHAERA HISPIDA	O					0.104		0.001						
UNID. BLUE GREEN TRICHOME	O		0.003											
UNID. BLUE GREEN TRICHOME (CELL)	O			0.383										

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all screened taxa near the surface September 6 - 8, 1995 and September 11 - 14, 1995 (W9512)

Species	Group	Nearfield Stations 1N10A	Nearfield Stations 2N16A
CERATIUM FUSUS	DF	0.013	0.020
CERATIUM LONGIPES	DF	0.017	0.004
CERATIUM MACROCEROS	DF		
CERATIUM TRIPOS	DF	0.019	0.060
DINOPHYSIS NORVEGICA	DF		
DIPLOPSALIS SP.	DF	0.038	0.018
GONYAULAX POLYGRAMMA	DF		0.002
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	0.117	0.103
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF		
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF		
PROROCENTRUM MICANS	DF		
PROTOPERIDINIUM DEPRESSUM	DF		0.002
PROTOPERIDINIUM GRANII	DF		0.002
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.002
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.027	
SCRIPPSIELLA TROCHOIDEA	DF	0.004	0.034
EUTREPTIA SP.	MF		
DICTYOCHA FIBULA	O		
EBRIA TRIPARTITA	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface September 25 - 29, 1995 (W9513)

Species	Group	Nearfield Stations	
		1N10A	1N16A
CERATIUM FUSUS	DF	0.049	0.274
CERATIUM LINEATUM	DF		0.007
CERATIUM LONGIPES	DF	0.023	0.064
CERATIUM MACROCEROS	DF		0.104
CERATIUM TRIPOS	DF	0.061	0.333
DINOPHYSIS ACUMINATA	DF		0.009
DINOPHYSIS NORVEGICA	DF		0.002
DINOPHYSIS SP.	DF		0.002
DIPLOPSALIS SP.	DF	0.003	0.002
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.287
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF		0.002
HETEROCAPSA TRIQUETRA	DF		
PROROCENTRUM BALTICUM	DF		
PROROCENTRUM MAXIMUM	DF		0.014
PROROCENTRUM MICANS	DF		
PROROCENTRUM MINIMUM	DF		0.014
PROTOPERIDINIUM DEPRESSUM	DF		0.005
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.005
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.005	0.005
SCRIPPSIELLA TROCHOIDEA	DF		
UNID. SILICOFLAGELLATE	MF		
EBRIA TRIPARTITA	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface October 9 - 13, 1995 (W9514)

Species	Group	Harbor Stations			Coastal Stations			Nearfield Stations				Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
		1F23A	1F30A	1F31A	1F13A	1F24A	1F25A	1N10A	1N16A	2N16A	3N16A	1F06A	1F27A	1F01A	1F02A
AMPHIDINIUM SPHENOIDES	DF														
CERATIUM FUSUS	DF	0.020	0.063	0.042	0.470	0.042	0.173	0.132	0.127		0.066	0.221	0.084	0.563	0.322
CERATIUM LINEATUM	DF	0.001	0.002	0.003	0.010	0.007	0.011	0.001	0.011		0.005	0.009	0.004	0.010	
CERATIUM LONGIPES	DF	0.009	0.003	0.001	0.050	0.049	0.007	0.048	0.052		0.013	0.011	0.038	0.012	0.107
CERATIUM MACROCEROS	DF														
CERATIUM SP.	DF	0.006										0.009			
CERATIUM TRIPOS	DF	0.025	0.049	0.115	0.651	0.131	0.263	0.217	0.716		0.428	0.600	0.383	0.517	0.392
DINOPHYSIS ACUMINATA	DF	0.001	0.001	0.004	0.011		0.003	0.003	0.005		0.001	0.010		0.005	
DINOPHYSIS CAUDATA	DF														
DINOPHYSIS NORVEGICA	DF	0.001	0.001	0.011	0.011	0.016	0.017	0.003	0.011		0.008	0.008	0.010		
DINOPHYSIS OVUM	DF														
DINOPHYSIS PUNCTATA	DF										0.003				
DINOPHYSIS SP.	DF					0.005	0.001								
DIPLOPSALIS SP.	DF		0.008		0.006	0.012	0.007		0.002		0.001		0.001		
GONYAULAX DIGITALIS	DF														
GONYAULAX POLYGRAMMA	DF			0.001			0.294				0.003				
GONYAULAX SP.	DF				0.005										
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	0.001	0.079	0.001	0.389	0.284		0.181			0.112		0.152	0.121	0.583
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF														
HETEROCAPSA TRIQUETRA	DF														
KATODINIUM ROTUNDATUM	DF	0.425	0.592	0.277	2.235	0.426		0.362				0.536	0.114	0.162	0.097
OXYTOXUM SP.	DF												0.038		
PROROCENTRUM BALTICUM	DF				0.002			0.121							0.097
PROROCENTRUM COMPRESSUM	DF			0.001	0.003		0.001				0.004	0.015	0.014	0.009	
PROROCENTRUM MAXIMUM	DF			0.009	0.069		0.024		0.016		0.012	0.015	0.009	0.547	0.194
PROROCENTRUM MICANS	DF	0.004	0.010	0.007	0.008	0.002	0.010	0.060				0.026	0.004	0.162	0.389
PROROCENTRUM MINIMUM	DF	0.003										0.003			
PROROCENTRUM TRIESTINUM	DF		0.005		0.011		0.001	0.001			0.001	0.016		0.003	
PROTOPERIDINIUM DEPRESSUM	DF	0.001	0.001	0.001	0.002		0.003	0.001	0.005		0.001		0.003	0.002	
PROTOPERIDINIUM DIABOLUM	DF														
PROTOPERIDINIUM PELLUCIDUM	DF														
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF			0.001							0.056			0.003	
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.001	0.003			0.002								0.001	
PROTOPERIDINIUM SP.#3 76-150W 81-150L	DF		0.001												
SCRIPPSIELLA TROCHOIDEA	DF		0.079	0.092	0.097	0.142							0.001		0.902
UNID. DINOFLAGELLATE CYST	DF						0.001								
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF														
PYRAMIMONAS SP.	MF										0.056				
UNID. CHOANOFLAGELLATE	MF														
UNID. MICRO-PHYTOFLAG LENGTH >10 MICRONS	MF														
CALCIOSOLENIA SP.	O				0.292						0.056	0.306		1.336	
CALYCOMONAS WULFII	O														
DICTYOCHA FIBULA	O			0.370	1.069		0.784	0.845	1.247		1.065	1.684	0.379	0.023	
DISTEPHANUS SPECULUM	O	0.128	0.079	0.185		0.284	0.098		0.002			0.077	0.076		
EBRIA TRIPARTITA	O														
EMILIANIA HUXLEYI	O						0.098								
OSCILLATORIA SP. (TRICHOME)	O														
PEDIASTRUM DUPLEX	O														
PEDIASTRUM DUPLEX V. CLATHRATUM	O		0.042												
PSEUDOPEDINELLA PYRIFORME	O		0.039												
RHABDOSPHAERA HISPIDA	O														
SCENEDESMUS QUADRICAUDA	O														
SCENEDESMUS SP.	O	0.006	0.158												
UNID. BLUE GREEN SINGLE SPHERE	O							1.448				3.903		9.051	10.302
UNID. BLUE GREEN TRICHOME	O		0.039												

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface November 1 - 4, 1995 (W9515)

		Nearfield Stations	
		1N10A	1N16A
Species	**Group**		
CERATIUM FUSUS	DF	0.005	0.080
CERATIUM LONGIPES	DF	0.005	0.035
CERATIUM TRIPOS	DF	0.047	0.270
DINOPHYSIS ACUMINATA	DF	0.002	0.002
DINOPHYSIS NORVEGICA	DF	0.002	0.002
DIPLOPSALIS SP.	DF		0.006
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		
PROROCENTRUM COMPRESSUM	DF		0.113
PROROCENTRUM MAXIMUM	DF	0.004	0.113
PROROCENTRUM MICANS	DF		0.113
PROROCENTRUM TRIESTINUM	DF		
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.004
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.002	0.004
DICTYOCHA FIBULA	O	0.126	3.955
DISTEPHANUS SPECULUM	O	0.126	2.034
EMILIANIA HUXLEYI	O	0.126	
SCENEDESMUS QUADRICAUDA	O	0.007	

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface November 27 - December 5, 1995 (W9516)

Species	Group	Nearfield Stations 1N10A	Nearfield Stations 1N16A
CERATIUM FUSUS	DF	0.042	0.081
CERATIUM LINEATUM	DF	0.003	0.001
CERATIUM LONGIPES	DF	0.009	0.006
CERATIUM TRIPOS	DF	0.249	0.178
DINOPHYSIS ACUMINATA	DF	0.002	0.004
DINOPHYSIS NORVEGICA	DF	0.033	0.003
DINOPHYSIS SP.	DF		
PROROCENTRUM COMPRESSUM	DF	0.002	0.005
PROROCENTRUM MAXIMUM	DF	0.003	0.009
PROROCENTRUM TRIESTINUM	DF		0.001
PROTOPERIDINIUM DEPRESSUM	DF	0.002	0.006
PROTOPERIDINIUM PALLIDUM	DF		
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF	0.002	
UNID. DINOFLAGELLATE CYST	DF		
UNID. CHOANOFLAGELLATE	MF	0.084	
DICTYOCHA FIBULA	O	0.293	3.110
DISTEPHANUS SPECULUM	O	0.481	1.788

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface December 17 - 19, 1995 (W9517)

Species	Group	Nearfield Stations 1N10A	Nearfield Stations 2N16A
CERATIUM FUSUS	DF	0.006	0.025
CERATIUM LINEATUM	DF		0.012
CERATIUM LONGIPES	DF	0.001	0.005
CERATIUM SP.	DF	0.002	0.002
CERATIUM TRIPOS	DF	0.038	0.083
DINOPHYSIS ACUMINATA	DF		0.007
DINOPHYSIS CAUDATA	DF		0.001
DINOPHYSIS NORVEGICA	DF		0.004
PROROCENTRUM COMPRESSUM	DF	0.001	0.001
PROROCENTRUM MAXIMUM	DF		0.001
PROROCENTRUM MICANS	DF		0.015
PROROCENTRUM TRIESTINUM	DF	0.002	0.003
PROTOPERIDINIUM DEPRESSUM	DF	0.002	0.004
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.001
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		0.002
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF		
DICTYOCHA FIBULA	O		0.046
DISTEPHANUS SPECULUM	O	0.032	0.334
EBRIA TRIPARTITA	O		0.015
UNID. COCCOLITHOPHORE	O	0.032	

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

APPENDIX G-2

ABUNDANCE OF ALL IDENTIFIED TAXA IN SCREENED SAMPLES NEAR THE CHLOROPHYLL MAXIMUM

Table 3-2b. Abundance of all identified taxa in screened samples near the Chlorophyll maximum August 8 - 10, 1995 (W9510)

Species	Group	Nearfiled Stations	
		1N10C	1N16C
CERATIUM FUSUS	DF	0.003	0.010
CERATIUM LONGIPES	DF	0.034	0.155
CERATIUM SP.	DF		
CERATIUM TRIPOS	DF	0.010	0.016
DINOPHYSIS ACUMINATA	DF		0.001
DINOPHYSIS NORVEGICA	DF		0.001
DINOPHYSIS PUNCTATA	DF	0.001	
DIPLOPSALIS SP.	DF		
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.019
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF		
KATODINIUM ROTUNDATUM	DF		0.038
PROTOPERIDINIUM DEPRESSUM	DF		0.001
SCRIPPSIELLA TROCHOIDEA	DF		
PYRAMIMONAS SP.	MF	0.028	
UNID. SILICOFLAGELLATE	MF		0.395
UNID. BLUE GREEN TRICHOME	O	0.001	
UNID. BLUE GREEN TRICHOME (CELL)	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near the Chlorophyll maximum August 21 - 26, 1995 (W9511)

Species	Group	Harbor Stations			Coastal Stations			Nearfield Stations				Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
		1F23C	1F30C	1F31C	1F13C	1F24C	1F25C	1N10C	1N16C	2N16C	3N16C	1F06C	1F27C	1F01C	1F02C
CERATIUM FUSUS	DF	0.002	0.002	0.001	0.006	0.012	0.005	0.007	0.011		0.017	0.001	0.002	0.003	0.003
CERATIUM LONGIPES	DF	0.006	0.014	0.012	0.007	0.024	0.055	0.006	0.185		0.129	0.034	0.314	0.021	0.021
CERATIUM MACROCEROS	DF								0.017						
CERATIUM SP.	DF				0.002	0.003									
CERATIUM TRIPOS	DF	0.009		0.002	0.008	0.044	0.014	0.017	0.018		0.031	0.010	0.126	0.007	0.003
DINOPHYSIS ACUMINATA	DF						0.008		0.001		0.007		0.001		
DINOPHYSIS NORVEGICA	DF							0.001			0.004				
DINOPHYSIS OVUM	DF														
DINOPHYSIS PUNCTATA	DF											0.001	0.001		
DIPLOPSALIS LENTICULA	DF														
DIPLOPSALIS SP.	DF		0.025	0.009			0.006	0.034			0.001		0.001		
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.474						0.334			0.041	0.180	0.087	
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF			0.131										0.044	
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF													0.001	
HETEROCAPSA TRIQUETRA	DF														
KATODINIUM ROTUNDATUM	DF														
PROROCENTRUM BALTICUM	DF														
PROROCENTRUM MAXIMUM	DF										0.001				
PROROCENTRUM MICANS	DF		0.002											0.001	
PROROCENTRUM MINIMUM	DF		0.190	0.098					0.001						
PROROCENTRUM TRIESTINUM	DF		0.095												
PROTOPERIDINIUM DEPRESSUM	DF	0.001		0.002	0.001		0.001	0.001			0.003	0.013	0.001		
PROTOPERIDINIUM DIVERGENS	DF														
PROTOPERIDINIUM GRANII	DF							0.034							
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF	0.001	1.137			0.001		0.662			0.045			0.001	
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		0.009	0.024			0.015				0.004	0.007			
PROTOPERIDINIUM SP.#3 76-150W 81-150L	DF										0.001				
SCRIPPSIELLA TROCHOIDEA	DF		0.095	0.163		0.001	0.070	0.001			0.001	0.007			0.001
UNID. DINOFLAGELLATE	DF														0.001
UNID. DINOFLAGELLATE CYST	DF					0.002		0.001							
EUGLENA SP.	MF			0.098											
EUTREPTIA LANOWII	MF						0.070								
PYRAMIMONAS SP.	MF														
UNID. CHOANOFLAGELLATE	MF								0.030				0.045		
UNID. SILICOFLAGELLATE	MF										0.045				
ACANTHOICA SP.	O												0.022		
DICTYOCHA FIBULA	O							0.034							
DISTEPHANUS SPECULUM	O					0.001							0.045		
EBRIA TRIPARTITA	O			0.001			0.001							0.001	
RHABDOSPHAERA HISPIDA	O					0.001									
UNID. BLUE GREEN TRICHOME	O				0.001	0.001									
UNID. BLUE GREEN TRICHOME (CELL)	O														

Group Definitions:

DF Dinoflagellate
MF Microflagellate
O Other

Table 3-2b. Abundance of all identified taxa in screened samples near the Chlorophyll maximum September 6 - 8, 1995 and September 11 - 14, 1995 (W9512)

Species	Group	Nearfiled Stations	
		1N10C	2N16C
CERATIUM FUSUS	DF	0.013	0.011
CERATIUM LONGIPES	DF	0.014	0.047
CERATIUM MACROCEROS	DF	0.009	0.002
CERATIUM TRIPOS	DF	0.009	0.018
DINOPHYSIS NORVEGICA	DF	0.002	
DIPLOPSALIS SP.	DF	0.007	0.002
GONYAULAX POLYGRAMMA	DF		
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.136
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF		0.011
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF		0.002
PROROCENTRUM MICANS	DF	0.002	
PROTOPERIDINIUM DEPRESSUM	DF	0.002	0.004
PROTOPERIDINIUM GRANII	DF		
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.002
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.011	0.022
SCRIPPSIELLA TROCHOIDEA	DF	0.002	0.007
EUTREPTIA SP.	MF		0.136
DICTYOCHA FIBULA	O		0.007
EBRIA TRIPARTITA	O		0.002

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near Chlorophyll maximum September 25 - 29, 1995 (W9513)

Species	Group	Nearfiled Stations 1N10C	Nearfiled Stations 1N16 B
CERATIUM FUSUS	DF	0.050	0.209
CERATIUM LINEATUM	DF		0.007
CERATIUM LONGIPES	DF	0.009	0.109
CERATIUM MACROCEROS	DF		0.075
CERATIUM TRIPOS	DF	0.074	0.273
DINOPHYSIS ACUMINATA	DF		0.002
DINOPHYSIS NORVEGICA	DF		0.002
DINOPHYSIS SP.	DF		
DIPLOPSALIS SP.	DF	0.006	
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF		
HETEROCAPSA TRIQUETRA	DF	0.004	
PROROCENTRUM BALTICUM	DF	0.002	0.011
PROROCENTRUM MAXIMUM	DF	0.226	
PROROCENTRUM MICANS	DF		0.004
PROROCENTRUM MINIMUM	DF	0.006	0.016
PROTOPERIDINIUM DEPRESSUM	DF		0.002
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		0.002
SCRIPPSIELLA TROCHOIDEA	DF		0.002
UNID. SILICOFLAGELLATE	MF		0.539
EBRIA TRIPARTITA	O	0.002	

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near Chlorophyll maximum October 9 - 13, 1995 (W9514)

Species	Group	Harbor Stations 1F23C	Coastal Stations 1F13B	Coastal Stations 1F24B	Nearfield Stations 1N18B	Offshore Stations 1F06C	Boundary Stations 1F27B	Cape Cod Bay Stations 1F01C	Cape Cod Bay Stations 1F02B
AMPHIDINIUM SPHENOIDES	DF								0.097
CERATIUM FUSUS	DF	0.027	0.358	0.054	0.038	0.230	0.015	0.558	0.531
CERATIUM LINEATUM	DF		0.113	0.008		0.008		0.008	0.003
CERATIUM LONGIPES	DF	0.002	0.080	0.008	0.048	0.062	0.002	0.009	0.069
CERATIUM MACROCEROS	DF		0.021						
CERATIUM SP.	DF					0.054			0.019
CERATIUM TRIPOS	DF	0.090	0.453	0.166	0.372	0.565	0.061	0.606	0.586
DINOPHYSIS ACUMINATA	DF			0.002	0.004	0.004		0.006	0.097
DINOPHYSIS CAUDATA	DF		0.001						
DINOPHYSIS NORVEGICA	DF		0.007	0.019	0.008	0.006	0.001	0.002	
DINOPHYSIS OVUM	DF		0.024						
DINOPHYSIS PUNCTATA	DF								
DINOPHYSIS SP.	DF				0.004				
DIPLOPSALIS SP.	DF		0.002			0.001			0.003
GONYAULAX DIGITALIS	DF							0.001	
GONYAULAX POLYGRAMMA	DF							0.003	
GONYAULAX SP.	DF								
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.565		1.021	0.467	0.034	0.078	0.389
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF		0.001						
HETEROCAPSA TRIQUETRA	DF		0.038						
KATODINIUM ROTUNDATUM	DF		1.017	0.630	2.211	0.175		0.076	0.389
OXYTOXUM SP.	DF			0.265	0.085				
PROROCENTRUM BALTICUM	DF								
PROROCENTRUM COMPRESSUM	DF			0.012	0.002	0.009	0.001	0.029	0.010
PROROCENTRUM MAXIMUM	DF	0.002	0.058	0.017		0.233	0.006	0.245	0.194
PROROCENTRUM MICANS	DF		0.006	0.010	0.006	0.058		0.013	0.027
PROROCENTRUM MINIMUM	DF								
PROROCENTRUM TRIESTINUM	DF		0.010						0.013
PROTOPERIDINIUM DEPRESSUM	DF	0.002	0.003	0.006		0.003	0.001	0.001	
PROTOPERIDINIUM DIABOLUM	DF							0.001	
PROTOPERIDINIUM PELLUCIDUM	DF						0.001		
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.038			0.001	0.001	0.001	0.006
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		0.002			0.001			0.003
PROTOPERIDINIUM SP.#3 76-150W 81-150L	DF								
SCRIPPSIELLA TROCHOIDEA	DF		0.076		0.085			0.078	0.002
UNID. DINOFLAGELLATE CYST	DF	0.003					0.001		
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF								
PYRAMIMONAS SP.	MF								
UNID. CHOANOFLAGELLATE	MF						0.034		
UNID. MICRO-PHYTOFLAG LENGTH >10 MICRONS	MF						0.034		
CALCIOSOLENIA SP.	O					0.408		1.366	1.361
CALYCOMONAS WULFII	O				0.255	0.117			
DICTYOCHA FIBULA	O	0.323		0.265	1.106	0.700	0.006	0.152	0.389
DISTEPHANUS SPECULUM	O	0.108	0.753	0.008		0.058	0.001	0.001	
EBRIA TRIPARTITA	O								
EMILIANIA HUXLEYI	O			0.002					
OSCILLATORIA SP. (TRICHOME)	O								
PEDIASTRUM DUPLEX	O								
PEDIASTRUM DUPLEX V. CLATHRATUM	O								
PSEUDOPEDINELLA PYRIFORME	O								
RHABDOSPHAERA HISPIDA	O						0.001		
SCENEDESMUS QUADRICAUDA	O			0.008					
SCENEDESMUS SP.	O								
UNID. BLUE GREEN SINGLE SPHERE	O		1.243		6.273	3.441			7.873
UNID. BLUE GREEN TRICHOME	O								

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near Chlorophyll maximum November 1 - 4, 1995 (W9515)

Species	Group	Nearfield Stations 1N10C	Nearfield Stations 1N16C
CERATIUM FUSUS	DF	0.005	0.004
CERATIUM LONGIPES	DF	0.002	0.004
CERATIUM TRIPOS	DF	0.027	0.111
DINOPHYSIS ACUMINATA	DF		
DINOPHYSIS NORVEGICA	DF		
DIPLOPSALIS SP.	DF		
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	0.092	
PROROCENTRUM COMPRESSUM	DF		0.001
PROROCENTRUM MAXIMUM	DF	0.008	0.010
PROROCENTRUM MICANS	DF		
PROROCENTRUM TRIESTINUM	DF	0.002	
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		
DICTYOCHA FIBULA	O	0.092	0.099
DISTEPHANUS SPECULUM	O	0.165	0.013
EMILIANIA HUXLEYI	O		
SCENEDESMUS QUADRICAUDA	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near the Chlorophyll Maximum November 27 - December 5, 1995 (W9516)

Species	Group	Nearfield Stations 1N10C	1N16C
CERATIUM FUSUS	DF	0.031	0.071
CERATIUM LINEATUM	DF	0.003	0.006
CERATIUM LONGIPES	DF	0.017	0.010
CERATIUM TRIPOS	DF	0.273	0.325
DINOPHYSIS ACUMINATA	DF	0.001	0.004
DINOPHYSIS NORVEGICA	DF	0.004	0.006
DINOPHYSIS SP.	DF	0.001	
PROROCENTRUM COMPRESSUM	DF	0.001	0.012
PROROCENTRUM MAXIMUM	DF	0.007	0.022
PROROCENTRUM TRIESTINUM	DF		0.004
PROTOPERIDINIUM DEPRESSUM	DF		0.001
PROTOPERIDINIUM PALLIDUM	DF	0.001	
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		
UNID. DINOFLAGELLATE CYST	DF	0.003	
UNID. CHOANOFLAGELLATE	MF		
DICTYOCHA FIBULA	O	0.702	1.524
DISTEPHANUS SPECULUM	O	1.794	1.524

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near the Chlorophyll maximum December 17 - 19, 1995 (W9517)

Species	Group	Nearfield Stations 1N10C	2N16C
CERATIUM FUSUS	DF	0.007	0.016
CERATIUM LINEATUM	DF		0.003
CERATIUM LONGIPES	DF	0.001	0.001
CERATIUM SP.	DF	0.001	
CERATIUM TRIPOS	DF	0.042	0.056
DINOPHYSIS ACUMINATA	DF	0.002	0.004
DINOPHYSIS CAUDATA	DF	0.001	
DINOPHYSIS NORVEGICA	DF	0.008	0.002
PROROCENTRUM COMPRESSUM	DF		
PROROCENTRUM MAXIMUM	DF	0.003	0.001
PROROCENTRUM MICANS	DF	0.001	
PROROCENTRUM TRIESTINUM	DF		
PROTOPERIDINIUM DEPRESSUM	DF	0.001	0.001
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		0.001
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF		0.022
DICTYOCHA FIBULA	O	0.173	
DISTEPHANUS SPECULUM	O	0.069	0.197
EBRIA TRIPARTITA	O		
UNID. COCCOLITHOPHORE	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

APPENDIX H

ZOOPLANKTON SPECIES DATA

TABLE A3
Zooplankton Species Data (ind/m^3)
W9510 - W9517

Event	Species		Life Stage	Group	Station Cast														
					1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9510	ACARTIA TONSA		C	C											686				
W9510	ACARTIA TONSA		F	C											171				
W9510	BIVALVIA SPP.		L	O											1714	1585			
W9510	CENTROPAGES TYPICUS		C	C											343	528			
W9510	CENTROPAGES TYPICUS		M	C											343	132			
W9510	COPEPOD SPP.		-	C											171				
W9510	COPEPOD SPP.		C	C											171	132			
W9510	COPEPOD SPP.		N	C											22457	20739			
W9510	CRUSTACEA:UNIDED CRUSTACEAN		-	O												132			
W9510	EURYTEMORA HERDMANI		C	C											1371				
W9510	EURYTEMORA HERDMANI		F	C											514				
W9510	EURYTEMORA HERDMANI		M	C											171				
W9510	METRIDIA LUCENS		C	C												132			
W9510	METRIDIA LUCENS		F	C											171				
W9510	MICROSETELLA NORVEGICA		-	C											171	264			
W9510	OITHONA SIMILIS	CLAUS	C	C											16800	12153			
W9510	OITHONA SIMILIS	CLAUS	F	C											4629	2246			
W9510	OITHONA SIMILIS	CLAUS	M	C											514	528			
W9510	PODON SPP.		-	O											343				
W9510	POLYCHAETE SPP.		-	O											343				
W9510	POLYCHAETE SPP.		T	O											171				
W9510	PSEUDOCALANUS NEWMANI		C	C											5486	2774			
W9510	PSEUDOCALANUS NEWMANI		F	C											1200	2246			
W9510	PSEUDOCALANUS NEWMANI		M	C											171	396			
W9510	TEMORA LONGICORNIS		C	C											1886	396			
W9510	TEMORA LONGICORNIS		F	C											514	132			
W9510	TEMORA LONGICORNIS		M	C											1029	396			
W9510	UNIDENTIFIED LARVAE		L	O												132			
W9511	ACARTIA HUDSONICA		C	C				62	4819		449		4800	1621	2651				
W9511	ACARTIA HUDSONICA		F	C					912				300		442				
W9511	ACARTIA HUDSONICA		M	C				62	521		128		1500	232	442				
W9511	ACARTIA TONSA		C	C	359	176	1176	744	3256	1943	1155	242	22500	10189	4713				
W9511	ACARTIA TONSA		F	C	135	59		62	1563	648	128		900	1853	442				
W9511	ACARTIA TONSA		M	C	359	351		124	521		64		1800	1621	442	116			
W9511	BIVALVIA SPP.		L	O	90	234	1176	62	1953	24615	3081	181	2100	6252	3829	463			2435
W9511	BRYOZOA SPP.		-	O			471				64			695	442				
W9511	CALANUS FINMARCHICUS		C	C	45	59										116			
W9511	CALANUS FINMARCHICUS		F	C	45														
W9511	CALANUS FINMARCHICUS		M	C		176	235									232			

TABLE A3

Zooplankton Species Data (ind/m^3)

W9510 - W9517

Event	Species	Life Stage	Group	1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
				Station Cast														
W9511	CENTROPAGES TYPICUS	C	C	224	1404	471	1178		648		1391			1031	463			913
W9511	CENTROPAGES TYPICUS	F	C			235	434				181				347			913
W9511	CENTROPAGES TYPICUS	M	C		117	235	496				786			295	116			609
W9511	CIRRIPEDE SPP.	N	B				186					300						
W9511	COPEPOD SPP.	-	C	90	59	235		521	1296			300						3044
W9511	COPEPOD SPP.	C	C	45		3294			12955	385	847							4262
W9511	COPEPOD SPP.	N	C	2467	3569	34118	6509	31256		10012	5322	51600	25009	32105	9379			30139
W9511	CRUSTACEA:UNIDED CRUSTACEAN	-	O			235		130	648									
W9511	EURYTEMORA HERDMANI	C	C								60							
W9511	GASTROPODA;MOLLUSCA	L	O		117			521	648		121	600	695	295	116			304
W9511	HARPACTICOIDA SPP.	-	C					130				300						
W9511	METRIDIA LUCENS	C	C												232			913
W9511	MICROSETELLA NORVEGICA	-	C	404	117	235		260	5830	64	726	300			232			609
W9511	OIKOPLEURA DIOICA	-	O	224	936	235												
W9511	OITHONA ATLANTICA	-	C			706												
W9511	OITHONA SIMILIS CLAUS	-	C	179	59	235												
W9511	OITHONA SIMILIS CLAUS	C	C	2511	3861	24471	2913	2474	40161	1797	7015	2700	2084	4565	9842			27703
W9511	OITHONA SIMILIS CLAUS	F	C	404	1404	12471	992	260	6478	642	3870	600	463	1325	2895			17353
W9511	OITHONA SIMILIS CLAUS	M	C		59	2353	186		3239	257	181	300	463	442	695			1827
W9511	PARACALANUS PARVUS	C	C		59		992				1149		463	442				3653
W9511	PARACALANUS PARVUS	F	C				124				242		232					2131
W9511	PARACALANUS PARVUS	M	C		59		248			64	121		232	147				1522
W9511	PODON POLYPHEMOIDES	-	O					130										
W9511	PODON SPP.	-	O				186					1500						
W9511	POLYCHAETE SPP.	L	O		761			781		449		1200	695	295				
W9511	PSEUDOCALANUS NEWMANI	C	C	2825	1229	1412	186	1172	9716	385	605	1200			3011			609
W9511	PSEUDOCALANUS NEWMANI	F	C	897	234	1176		1042	5182	128	60				232			609
W9511	PSEUDOCALANUS NEWMANI	M	C		59			391	1296	64	242		232		116			304
W9511	TEMORA LONGICORNIS	C	C	179	234	3059	62	260	1943	193	181	300	695	295				1218
W9511	TEMORA LONGICORNIS	F	C		59	1176		391			60				232			609
W9511	TEMORA LONGICORNIS	M	C	45		3059		260	1296						116			304
W9511	UNIDENTIFIED LARVAE	L	O	45					4534	64	121	300	695	147				1218
W9512	ACARTIA HUDSONICA	M	C											104				
W9512	ACARTIA TONSA	C	C											5415			2021	
W9512	ACARTIA TONSA	F	C											2812			713	
W9512	ACARTIA TONSA	M	C											3020			832	
W9512	BIVALVIA SPP.	L	O											2708			1189	
W9512	BRYOZOA SPP.	-	O											312			238	
W9512	CENTROPAGES TYPICUS	C	C														951	

TABLE A3

Zooplankton Species Data (ind/m^3)

W9510 - W9517

Event	Species	Life Stage	Group	Station Cast														
				1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9512	CENTROPAGES TYPICUS	F	C														238	
W9512	CENTROPAGES TYPICUS	M	C														119	
W9512	COPEPOD SPP.	-	C											417				
W9512	COPEPOD SPP.	C	C											417			951	
W9512	COPEPOD SPP.	N	C											6144			15808	
W9512	CRUSTACEA:UNIDED CRUSTACEAN	-	O											312				
W9512	ECHINODERM PLUTEI	-	O														119	
W9512	EURYTEMORA HERDMANI	C	C														119	
W9512	GASTROPODA;MOLLUSCA	L	O											1041				
W9512	HARPACTICOIDA SPP.	-	C											104				
W9512	MEDUSA	-	O											208			119	
W9512	METRIDIA LUCENS	-	C											208				
W9512	MICROSETELLA NORVEGICA	-	C											833			238	
W9512	OIKOPLEURA DIOICA	-	O											3645			7607	
W9512	OITHONA SIMILIS CLAUS	-	C														238	
W9512	OITHONA SIMILIS CLAUS	C	C											3020			2734	
W9512	OITHONA SIMILIS CLAUS	F	C											1250			951	
W9512	OITHONA SIMILIS CLAUS	M	C											312			594	
W9512	PARACALANUS PARVUS	C	C														951	
W9512	PARACALANUS PARVUS	F	C											104			119	
W9512	PARACALANUS PARVUS	M	C														119	
W9512	PODON SPP.	-	O											208				
W9512	POLYCHAETE SPP.	L	O											521				
W9512	POLYCHAETE SPP.	T	O											104				
W9512	PSEUDOCALANUS NEWMANI	C	C											521			119	
W9512	PSEUDOCALANUS NEWMANI	F	C											729				
W9512	TEMORA LONGICORNIS	C	C											208				
W9512	TEMORA LONGICORNIS	F	C											104				
W9512	UNIDENTIFIED LARVAE	L	O											104			357	
W9513	ACARTIA TONSA	C	C												746			
W9513	ACARTIA TONSA	M	C												166			
W9513	BIVALVIA SPP.	-	O												22204			
W9513	BRYOZOA SPP.	-	O												249			
W9513	CALANUS FINMARCHICUS	C	C												83			
W9513	CENTROPAGES TYPICUS	C	C												911			
W9513	COPEPOD SPP.	-	C												83			
W9513	COPEPOD SPP.	C	C												414			
W9513	COPEPOD SPP.	N	C												4060			
W9513	ECHINODERM PLUTEI	-	O												166			

TABLE A3

Zooplankton Species Data (ind/m^3)

W9510 - W9517

Event	Species		Life Stage	Group	1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
					Station Cast														
W9513	EURYTEMORA HERDMANI		C	C												249			
W9513	GASTROPODA;MOLLUSCA		L	O												249			
W9513	MICROSETELLA NORVEGICA		-	C												580			
W9513	OIKOPLEURA DIOICA		-	O												2154			
W9513	OITHONA ATLANTICA		-	C												166			
W9513	OITHONA SIMILIS	CLAUS	C	C												4391			
W9513	OITHONA SIMILIS	CLAUS	F	C												663			
W9513	OITHONA SIMILIS	CLAUS	M	C												331			
W9513	PARACALANUS PARVUS		C	C												331			
W9513	PARACALANUS PARVUS		M	C												83			
W9513	PSEUDOCALANUS NEWMANI		C	C												83			
W9513	PSEUDOCALANUS NEWMANI		F	C												83			
W9513	PSEUDOCALANUS NEWMANI		M	C												83			
W9513	TEMORA LONGICORNIS		C	C												166			
W9513	UNIDENTIFIED LARVAE		L	O												663			
W9514	ACARTIA HUDSONICA		C	C					251	186									
W9514	ACARTIA HUDSONICA		F	C					125										
W9514	ACARTIA HUDSONICA		M	C												140			
W9514	ACARTIA TONSA		C	C	492	384	216		2824	931	2962	188	3583		563	701			301
W9514	ACARTIA TONSA		F	C		128	216		816	466	987		156		282	280			
W9514	ACARTIA TONSA		M	C	1476	256	216		627	1025	889	188	260		1056				151
W9514	ALTEUTHA DEPRESSA		-	C									52						
W9514	ASCIDIAN SPP.		L	O									52						
W9514	BIVALVIA SPP.		-	O	36402														
W9514	BIVALVIA SPP.		L	O		11904	4104		1192	8476	14414	2638	2025		3731	1402			3013
W9514	BRYOZOA SPP.		-	O	984		216				197	188	104		70	280			301
W9514	CALANUS FINMARCHICUS		C	C								283				140			151
W9514	CALANUS FINMARCHICUS		M	C								94							
W9514	CENTROPAGES TYPICUS		C	C	6887	1920	5400		1380	2794	1678	4900	156		4224	12200			17477
W9514	CENTROPAGES TYPICUS		F	C	492	640	432		188	186	99	283			634	280			301
W9514	CENTROPAGES TYPICUS		M	C	984	512	864		251	466	494				774	140			603
W9514	COPEPOD SPP.		-	C	492	128	432		251	186	395	471	52		282	140			151
W9514	COPEPOD SPP.		C	C	492	896	864		314	466	494	565	52		493				452
W9514	COPEPOD SPP.		N	C	37878	23424	19872		3388	2701	5134	15735	11527		7744	21454			27120
W9514	CRUSTACEA:UNIDED CRUSTACEAN		-	O		256	648				99					140			
W9514	ECHINODERM PLUTEI		-	O	492					93									
W9514	EURYTEMORA HERDMANI		C	C					188				260						
W9514	EURYTEMORA HERDMANI		F	C								94							
W9514	EURYTEMORA HERDMANI		M	C												140			

TABLE A3

Zooplankton Species Data (ind/m^3)

W9510 - W9517

Event	Species		Life Stage	Group	1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
					Station Cast														
W9514	EVADNE SPP.		-	O	5411		216		502	1118	1283	94	675		1126				
W9514	GASTROPODA;MOLLUSCA		L	O		256			627		987	283	727		70	280			
W9514	HARPACTICOIDA SPP.		-	C		128	648		188	186			104						
W9514	MEDUSA		-	O		512	216			93	99		52		70				151
W9514	MICROSETELLA NORVEGICA		-	C	984	512	1080		125	279	494	848			282	140			
W9514	OIKOPLEURA DIOICA		-	O	492	768	864		125	373	99		104		70	140			
W9514	OITHONA ATLANTICA		-	C	492							188	52						
W9514	OITHONA ATLANTICA		C	C												140			
W9514	OITHONA SIMILIS	CLAUS	-	C												280			151
W9514	OITHONA SIMILIS	CLAUS	C	C	11806	5120	9936		753	2049	3060	7632	779		2323	14724			11752
W9514	OITHONA SIMILIS	CLAUS	F	C	3935	1280	4968		565	931	1283	1696	363		1197	3365			2712
W9514	OITHONA SIMILIS	CLAUS	M	C		256	1080		125	93	691	283	104		141	421			151
W9514	PARACALANUS PARVUS		C	C	1476	1408	864				99	377			282	421			603
W9514	PARACALANUS PARVUS		F	C	984	128			63	93	494	1131			70				151
W9514	PARACALANUS PARVUS		M	C	984	128	432			93		94			141	140			301
W9514	PENILIA AVIROSTRIS		-	O	4919						99		52		70				
W9514	PODON SPP.		-	O					63				467						
W9514	POLYCHAETE SPP.		L	O	2952	384	216		627		395		2337						151
W9514	PSEUDOCALANUS NEWMANI		C	C		128			63	93		94				701			301
W9514	PSEUDOCALANUS NEWMANI		F	C						93		754			70	140			452
W9514	TEMORA LONGICORNIS		C	C		128	216			186	494	94	260						
W9514	TEMORA LONGICORNIS		F	C							99				70				301
W9514	TEMORA LONGICORNIS		M	C		128					99	94			211				
W9514	UNIDENTIFIED LARVAE		L	O	492		648		188	559	395		415		70	421			151
W9515	ACARTIA HUDSONICA		M	C											52				
W9515	ACARTIA TONSA		C	C											208	279			
W9515	ACARTIA TONSA		F	C											156				
W9515	ACARTIA TONSA		M	C											208				
W9515	BIVALVIA SPP.		L	O											3436	11517			
W9515	BRYOZOA SPP.		-	O											104				
W9515	CENTROPAGES TYPICUS		C	C											625	650			
W9515	CENTROPAGES TYPICUS		F	C												93			
W9515	COPEPOD SPP.		-	C											364				
W9515	COPEPOD SPP.		C	C											469	464			
W9515	COPEPOD SPP.		N	C											4738	23405			
W9515	EURYTEMORA HERDMANI		C	C											52				
W9515	EVADNE SPP.		-	O											625	464			
W9515	GASTROPODA;MOLLUSCA		L	O											729	93			
W9515	HARPACTICOIDA SPP.		-	C											208				

TABLE A3

Zooplankton Species Data (ind/m^3)

W9510 - W9517

Event	Species		Life Stage	Group	Station Cast 1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9515	HYDROZOA SPP.		-	O											52				
W9515	MICROSETELLA NORVEGICA		-	C											521	743			
W9515	OIKOPLEURA DIOICA		-	O											104	1300			
W9515	OITHONA ATLANTICA		F	C												93			
W9515	OITHONA SIMILIS	CLAUS	C	C											1614	2972			
W9515	OITHONA SIMILIS	CLAUS	F	C											573	557			
W9515	OITHONA SIMILIS	CLAUS	M	C											52	186			
W9515	POLYCHAETE SPP.		-	O											52				
W9515	POLYCHAETE SPP.		L	O											312				
W9515	PSEUDOCALANUS NEWMANI		C	C											417				
W9515	PSEUDOCALANUS NEWMANI		F	C											156				
W9515	PSEUDOCALANUS NEWMANI		M	C											260				
W9515	TEMORA LONGICORNIS		C	C											312				
W9515	TEMORA LONGICORNIS		M	C											52				
W9515	UNIDENTIFIED LARVAE		L	O											52	93			
W9516	ACARTIA TONSA		C	C											26			83	
W9516	ACARTIA TONSA		F	C											52				
W9516	ACARTIA TONSA		M	C											26				
W9516	BIVALVIA SPP.		L	O											3185			2241	
W9516	BRYOZOA SPP.		-	O											26			83	
W9516	CENTROPAGES TYPICUS		C	C											209			1494	
W9516	CENTROPAGES TYPICUS		F	C											26				
W9516	COPEPOD SPP.		-	C											52			166	
W9516	COPEPOD SPP.		C	C											157			664	
W9516	COPEPOD SPP.		N	C											4125			15936	
W9516	ECHINODERM PLUTEI		-	O														83	
W9516	GASTROPODA;MOLLUSCA		L	O											183			664	
W9516	HARPACTICOIDA SPP.		-	C														83	
W9516	MICROSETELLA NORVEGICA		-	C											78			830	
W9516	OITHONA ATLANTICA		-	C														83	
W9516	OITHONA SIMILIS	CLAUS	C	C											1018			3071	
W9516	OITHONA SIMILIS	CLAUS	F	C											470			1079	
W9516	OITHONA SIMILIS	CLAUS	M	C											52			83	
W9516	PARACALANUS PARVUS		F	C											26			166	
W9516	PARACALANUS PARVUS		M	C											26				
W9516	POLYCHAETE SPP.		L	O											104				
W9516	PSEUDOCALANUS NEWMANI		C	C														166	
W9516	PSEUDOCALANUS NEWMANI		F	C														332	
W9516	PSEUDOCALANUS NEWMANI		M	C														83	

TABLE A3

Zooplankton Species Data (ind/m^3)

W9510 - W9517

Event	Species	Life Stage	Group	1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
				Station Cast														
W9516	TEMORA LONGICORNIS	C	C											26				
W9516	TEMORA LONGICORNIS	F	C														83	
W9516	TEMORA LONGICORNIS	M	C											26				
W9517	ACARTIA TONSA	C	C														63	
W9517	BIVALVIA SPP.	L	O											576			251	
W9517	BRYOZOA SPP.	-	O											58			63	
W9517	CENTROPAGES TYPICUS	C	C											461			502	
W9517	CENTROPAGES TYPICUS	F	C											144			63	
W9517	CENTROPAGES TYPICUS	M	C											115				
W9517	COPEPOD SPP.	-	C											58			63	
W9517	COPEPOD SPP.	C	C											173			126	
W9517	COPEPOD SPP.	N	C											7436			12497	
W9517	GASTROPODA;MOLLUSCA	L	O														63	
W9517	HARPACTICOIDA SPP.	-	C											29				
W9517	MICROSETELLA NORVEGICA	-	C											404			188	
W9517	OIKOPLEURA DIOICA	-	O														314	
W9517	OITHONA ATLANTICA	-	C														63	
W9517	OITHONA SIMILIS CLAUS	C	C											2853			4208	
W9517	OITHONA SIMILIS CLAUS	F	C											951			754	
W9517	OITHONA SIMILIS CLAUS	M	C											115				
W9517	PARACALANUS PARVUS	C	C											86			126	
W9517	PARACALANUS PARVUS	F	C														63	
W9517	POLYCHAETE SPP.	L	O											29				
W9517	PSEUDOCALANUS NEWMANI	C	C											115				
W9517	PSEUDOCALANUS NEWMANI	F	C											58				
W9517	PSEUDOCALANUS NEWMANI	M	C											58				
W9517	TEMORA LONGICORNIS	C	C											29				
W9517	UNIDENTIFIED LARVAE	L	O											86			63	

Life Stage Definitions:

- C Copepodite stages I-V
- F Copepoda adult female
- L Larva
- M Copepoda adult male
- N Nauplii
- T Trochophore (larval stage of polychaete
- Y Cypris Larva of Barnacle

Group Definitions:

- B Barnacle
- C Copepod
- OZ Other Zooplankton

Semi-annual water column monitoring report: August-December 1995

Massachusetts Water Resources Authority

Environmental Quality Department

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August - December, 1995

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SEMI-ANNUAL REPORT 1995, 95-02

EXECUTIVE SUMMARY

Water quality monitoring data presented in this report were collected during the second half of the 1995 Massachusetts Water Resources Authority (MWRA) Harbor and Outfall Monitoring (HOM) Program in the Massachusetts Bay system. The scope of the semi-annual report includes a synthesis of water column data, and a brief analysis of integrated physical and biological results. The horizontal and vertical distribution of water column parameters in the farfield and nearfield from the second eight surveys of 1995 are presented. Finally, key biological events that occurred during the semi-annual period both regionally and within the nearfield are discussed.

Baseline data have been collected to support the HOM Program mission to assess the potential environmental effects of effluent discharge into Massachusetts Bay. The data were collected to establish water quality conditions, and include physical water properties, nutrients, biological respiration and productivity, and plankton measurements. In the second half of 1995, two types of surveys were performed: eight nearfield surveys with stations located in the area over the future outfall site, and two comprehensive combined nearfield/farfield surveys that included stations in Boston Harbor, Massachusetts Bay, and Cape Cod Bay.

Results from the second semi-annual period are provided in summary tables, then discussed for each parameter measured. The horizontal distribution of physical parameters is presented through regional contour plots, and the vertical distribution through both time-series plots of averaged surface and bottom water column parameters, and along depth transects in the survey area. The timing of water column vertical stratification and the fall turnover influences the timing and impact of critical events such as dissolved oxygen depletion in bottom water. Results are summarized, therefore, for the pre-turnover surveys in August-September (W9510-13) and post-turnover surveys in October-December (W9514-17).

The pre-turnover period was characterized by a vertically stratified water column, due primarily to a strong temperature differential between surface and bottom water. Nutrients in the surface water were low, except for in Boston Harbor, which remained mixed and had the highest surface water concentrations of all nutrients measured during both farfield surveys. Nearfield dissolved oxygen in bottom water reached minimum concentrations during the final pre-turnover survey in late September.

Many physical and biological parameters clearly indicated a late summer bloom in late August and early September, primarily concentrated in and near Boston Harbor. During the first farfield survey in late August (W9511), maximum chlorophyll *a* concentrations were measured in Boston Harbor (14.2 μg/L), the inner nearfield (15 μg/L), and along the coast (11.8 μg/L). Peak annual production (7,584 $mgCm^{-2}d^{-1}$)

was measured during this survey at station F23, located outside of Boston Harbor. Boston Harbor had the highest phytoplankton densities of all farfield regions, with slightly lower abundances in the nearfield, coastal, and offshore regions. The late summer bloom was dominated by microflagellates and centric diatoms, including *Skeletonema costatum* and *Rhizosolenia fragilissima*.

The fall turnover was in progress by mid-October (W9514), with the water column remaining vertically stratified in the offshore and boundary regions, while remaining slightly stratified ($\Delta\sigma_t$ ranged from 0 to -1.0) in Boston Harbor, Cape Cod Bay, and the coastal regions. A mixing event, documented by continuous monitoring data collected at the USGS buoy in the nearfield, resulted in a reduction of the water column temperature gradient and a gradual breakdown of vertical stratification. The relative increase of surface water nutrient concentrations provided a catalyst for the nearfield fall bloom.

In October, results from the second combined nearfield/farfield survey showed that production of chlorophyll was focused in the outer nearfield, with maximum concentrations of 4-6 µg/L in the upper 10 m, and semi-annual maximum areal production among the nearfield stations measured at station N16 (2,793 $mgCm^{-2}d^{-1}$). Regionally, the nearfield had the highest surface water phytoplankton abundance during this survey.

The early November survey was conducted during the height of the fall bloom, with the highest semi-annual chlorophyll concentrations measured, reaching 18 µg/L in the central nearfield around station N21. The fall bloom was dominated by pennate diatoms (*Asterionellopsis glacialis*). During this and the following two final nearfield surveys, all physical and biological parameters indicated that the nearfield water column was well mixed.

1.0 INTRODUCTION

1.1 Program Overview

The Massachusetts Water Resources Authority (MWRA) has implemented a long-term Harbor and Outfall Monitoring (HOM) Program in the Massachusetts Bay system. The objective of the HOM Program is to verify compliance with the discharge permit, and to assess the potential environmental effects of the relocated effluent discharge into Massachusetts Bay. To establish baseline water quality conditions with respect to nutrients, water properties, phytoplankton and zooplankton, and water-column respiration and productivity, ENSR is conducting water quality surveys in the nearfield and farfield region of Massachusetts and Cape Cod Bays.

This report summarizes results from water quality monitoring conducted during the second half of the 1995 monitoring year. Water column monitoring results for the second 8 of 17 surveys conducted in 1995 are included in this report (Table 1-1). There were two types of surveys performed: eight nearfield surveys with stations located in the area over the future outfall site, and two more comprehensive nearfield/farfield combined surveys that included stations in Boston Harbor, Massachusetts Bay, and Cape Cod Bay (Figures 1-1 and 1-2). The stations in these surveys are further separated into regional groupings according to geographic location. The nearfield survey W9516 included a Stellwagen Basin survey at station F12 to monitor late fall dissolved oxygen levels in the basin. The final winter survey, conducted in mid-December (W9517), included a winter nutrients objective to characterize winter nutrient levels in Massachusetts Bay. Due to inclement weather, only three nearfield stations were sampled during this survey.

This report presents summarized data from the second semi-annual period. A summary of the raw data, along with specific field information, is available in individual survey reports, submitted immediately following each survey. Data reports, including final processed data and regression information, are submitted five times annually. The available data reports are the nutrient data reports (including sensor and water chemistry data), phytoplankton data reports, and the productivity and respiration data reports.

1.2 Organization of the Semi-Annual Report

The scope of the semi-annual report is focused primarily towards providing a synthesis of all of the water column data collected during the reporting period. Secondarily, integrated physical and biological results are discussed for key water column events. The report first provides a summary of the survey and laboratory methods (Section 2.0). The bulk of the report, as discussed in further detail below, presents results of water column data from the second eight surveys of 1995 (Sections 3.0-5.0). Finally, the major findings of the semi-annual period, including integrated physical and biological water column results during water column events are synthesized in Section 6.0.

In the results sections, data are first provided in summary tables (Section 3.0). The data summary tables include the major results of water column surveys in the semi-annual period. A description of data selection, integration information, and statistical analyses conducted are included with that section.

Each of the summary results sections (Section 4.0, 5.0) includes presentation of the horizontal and vertical distribution of water column parameters in both the farfield and nearfield. The horizontal distribution of physical parameters is presented through regional contour plots. The vertical distribution of water column parameters is presented using both time-series plots of averaged surface and bottom water column parameters, and along three transects in the survey area (Figure 1-3). The time-series plots utilize average values of the surface water sample (the "A" depth, as described in Section 3.0), and the bottom water sample (the "E" depth). Examining data trends along the three farfield transects, Boston-Nearfield, Cohassett, and Marshfield, and one nearfield transect (N10 to N04, Figure 1-3), allows three-dimensional analysis of water column conditions during each survey.

Results of water column physical data, including water properties, nutrients, chlorophyll, and dissolved oxygen, are provided in Section 4.0. Survey results were organized according to the physical characteristics of the water column during the semi-annual period. For the second semi-annual period, the timing of the fall water column turnover is the key event that, to a large degree, determines ecological water quality parameters that are a major focus in assessing effects of the outfall. Because of the importance of this dynamic, this report describes the horizontal and vertical characterization of the water column during the pre-turnover stage (W9510-W9513), and then further delineates processes occurring during and following the fall turnover (W9514-W9517). Time-series data are commonly provided for the entire semi-annual period for clarity of data presentation.

Productivity, respiration, and plankton measurements, along with corresponding discussion of chlorophyll and dissolved oxygen results, are provided in Section 5.0. Discussion of the biological processes and trends during the semi-annual period are included in this section. A summary of the major water column events of the semi-annual period is presented in Section 6.0, and finally, references are provided in Section 7.0.

TABLE 1-1

Second Semi-Annual 1995 Schedule of Survey Events

Event Number	Type of Survey	Date
W9510	Nearfield	August 8-10
W9511	Nearfield/Farfield	August 21-26
W9512	Nearfield/Plume	September 6-14
W9513	Nearfield/Plume	September 25-29
W9514	Nearfield/Farfield	October 9-13
W9515	Nearfield	November 1-4
W9516	Nearfield/Stellwagen	November 27 & December 5
W9517	Nearfield/Winter Nutrients	December 17-19

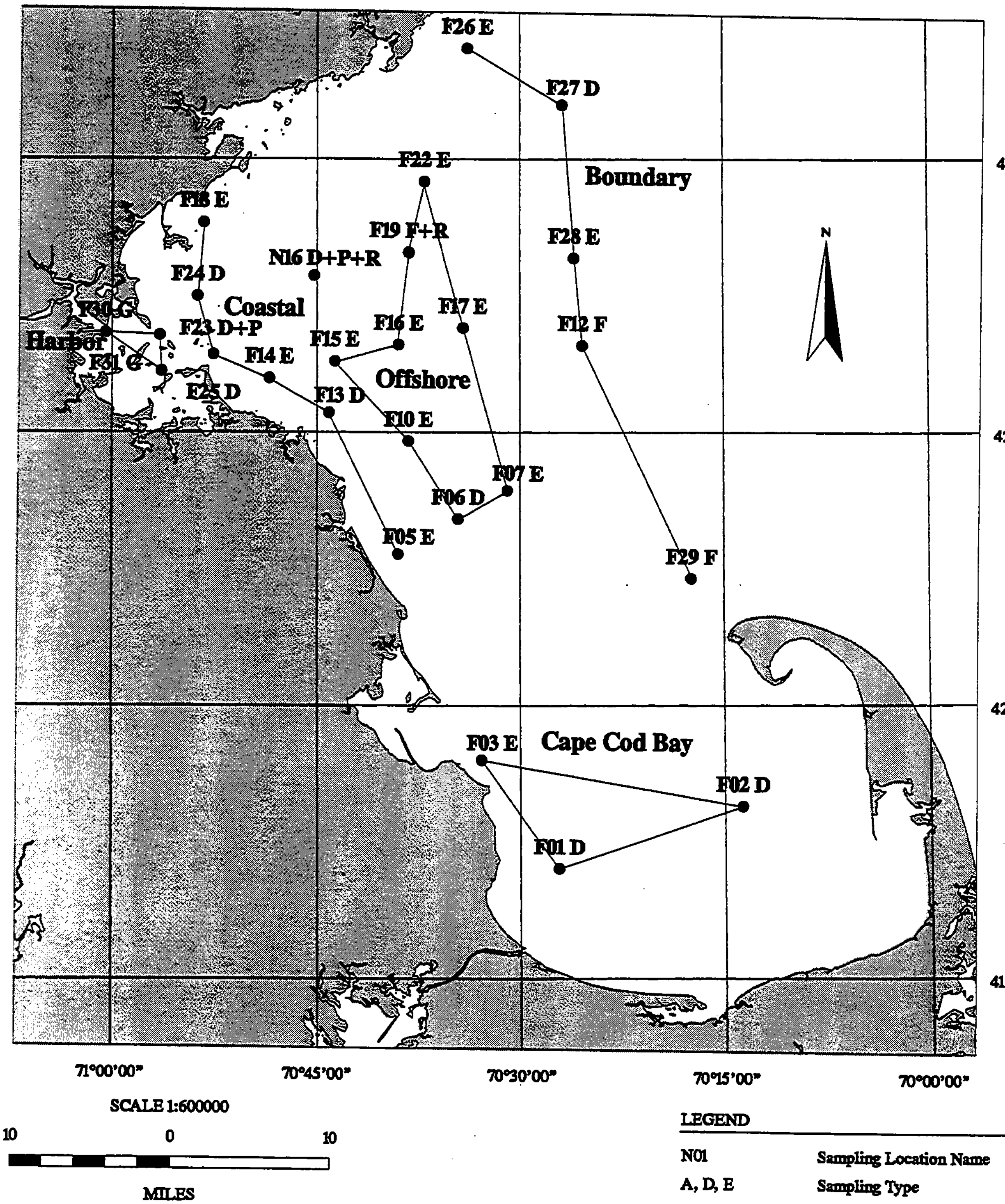


FIGURE 1-1
Location of Farfield Stations Showing
Regional Geographic Classifications

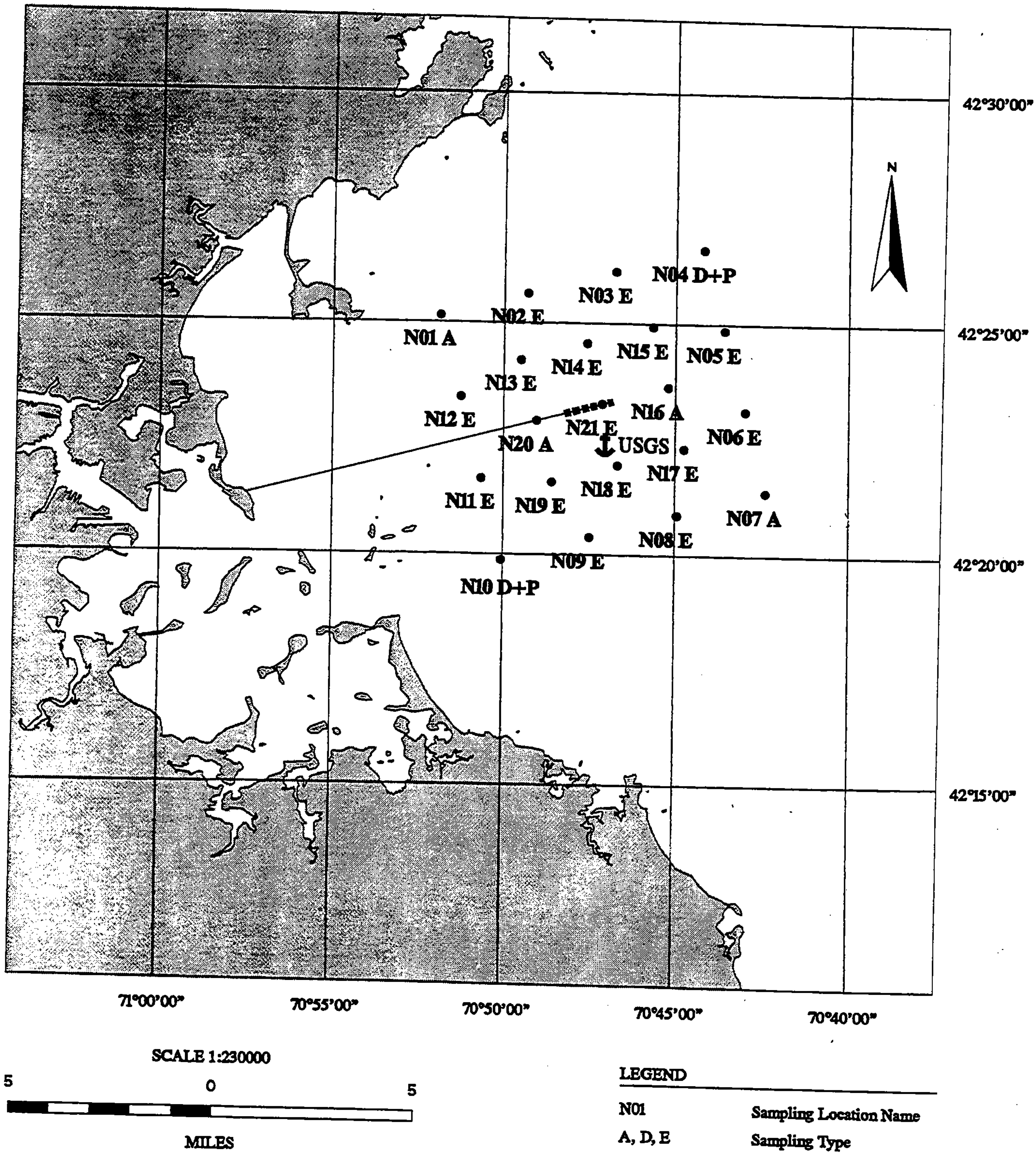


FIGURE 1-2
Location of Nearfield Stations

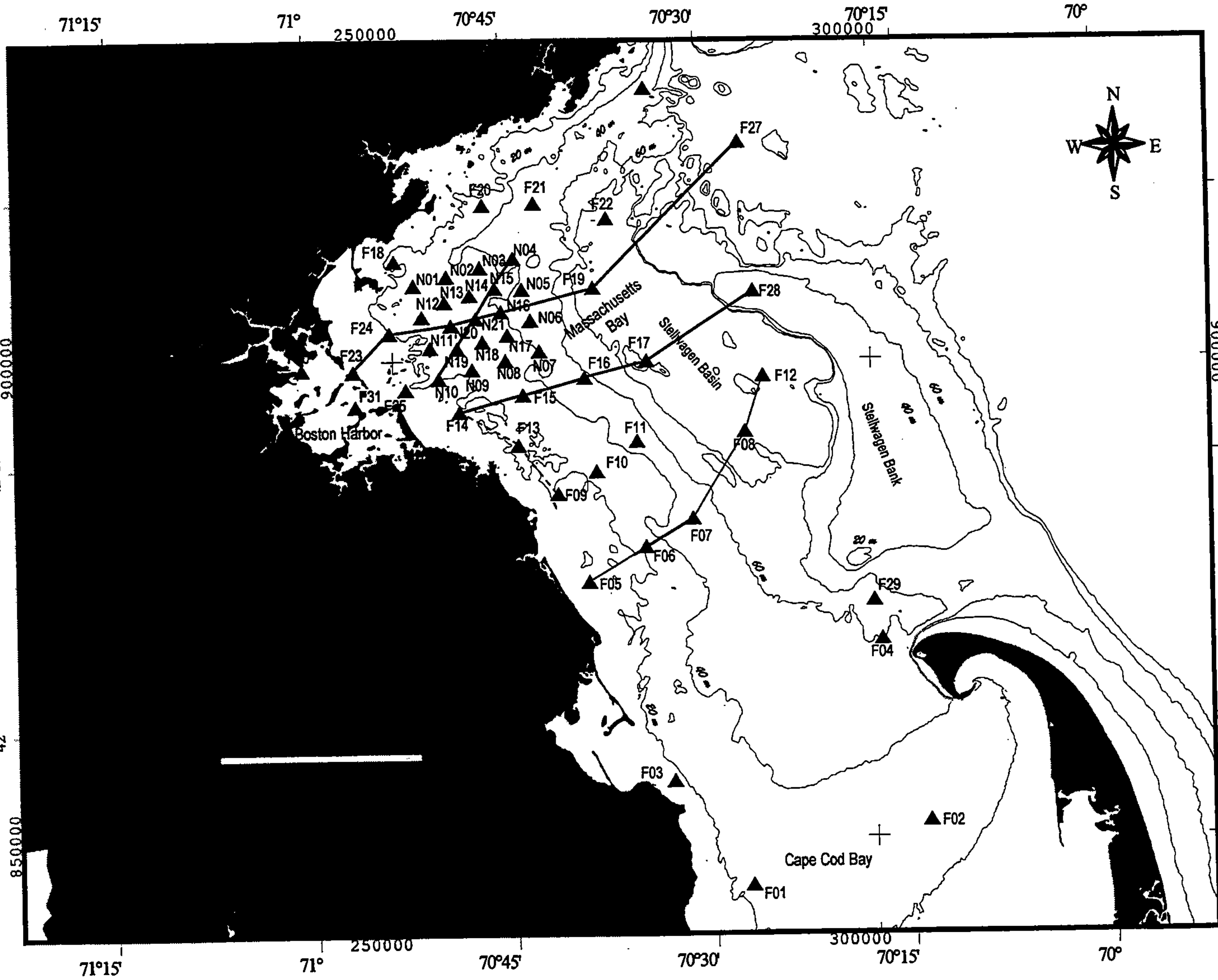


FIGURE 1-3
Location of Stations Selected for Vertical Transect Graphics

2.0 METHODS

Water quality data for this report were collected from the sampling platforms *R/V Christopher Andrew* and *R/V Isabelle S.* Continuous vertical profiles of the water column and discrete water samples for analysis are collected using a CTD/Niskin Bottle Rosette system. Hydrographic measurements of the water column include conductivity/salinity, temperature, depth, dissolved oxygen, transmissometry, irradiance, and relative fluorescence.

Water samples were collected at five depths: bottom, mid-bottom, middle, mid-surface, and surface; in general, the middle water column depth was selected at or near the chlorophyll maximum. All samples were analyzed for dissolved inorganic nutrients (DINuts), including nitrate (NO_3), nitrite (NO_2), phosphate (PO_4), silicate (SiO_4) and ammonium (NH_4). Additional analyses carried out for differing subsets of stations and depths include dissolved organic carbon, total dissolved nitrogen and phosphorous, particulate organic carbon, nitrogen, and phosphorous, biogenic silica, chlorophyll *a*, and phaeopigments, total suspended solids, dissolved oxygen, urea, estimates of plankton productivity and respiration rates, and plankton taxonomy and enumeration.

The sampling schema are outlined in Table 2-1. Further details on field sampling and analytical procedures, laboratory sample processing and analysis, sample handling and custody, calibration and preventive maintenance, documentation, data evaluation, and data quality procedures are discussed in the Water Quality Monitoring Combined Work/Quality Assurance Project Plan (CW/QAPP; Bowen *et al.*, 1997).

Principal deviations from the CW/QAPP plan for each survey are described below. For additional information about a specific survey, the individual survey reports may be consulted.

Deviations from the CW/QAPP for the nearfield survey in early August (W9510):

- Only 18 out of 21 nearfield stations were sampled due to time limitations.
- Analysis groups for mid-surface and middle depths were switched based on chlorophyll maximum for Station N01.
- Only 90 out of 105 planned samples for Dissolved Inorganic Nutrients (DINuts) were collected due to the decreased number of sampling stations.

Deviations from the CW/QAPP for the combined farfield/nearfield survey in mid August (W9511):

- One farfield station (F17) could not be sampled due to time limitations resulting from an equipment failure.

- Only 121 out of 126 planned samples for DINuts were collected due to the inability to sample the last farfield station.

- The trigger mechanism failed to release for the bottom bottle at the nearfield station N05, therefore no sample was collected for DINuts at the bottom depth for this station.

- The BOD bottle from the bottom depth at station N01 broke during repacking of a sample cooler. Therefore, no sample was analyzed for dissolved oxygen at the bottom depth for this station.

Deviations from the CW/QAPP for the combined nearfield/plume tracking survey in early September (W9512):

- Only 16 out of 19 nearfield stations were sampled due to time limitations.

- Only 80 out of 95 planned samples for DINuts were collected due to the decreased number of sampling stations.

- At station N01, uncalibrated fluorescence readings exceeded the full scale setting of 10.0 µg/l. The full scale setting had to be reset internally to read greater chlorophyll values present at station N01. Analysis groups were switched to mid-surface level based on chlorophyll maximum.

Plume tracking:

- The rosette triggering system failed during the plume tracking survey. As a result, CTD casts only were performed at NOAA waypoints 017 and 031. Manual triggering of Niskin bottles was implemented in order to collect samples at station 004. After station 004, the rosette triggering problem was solved.

- The mid-depth bottle misfired at station 005 and no water sample was collected at that depth.

- Bottles fired in the incorrect order at Station 011 resulting in some uncertainty about the samples.

Deviations from the CW/QAPP for the combined nearfield/plume tracking survey in late September (W9513):

- Only 18 out of 19 nearfield stations were sampled due to time limitations and rough seas. The station that was dropped was station N08.

- Only 90 out of 95 planned samples for DINuts were collected due to the decreased number of sampling stations.

Plume tracking:

- Weather problems caused the cancellation of the ebb tide survey on Thursday September 28, 1995.

- At station 007 of the flood tide plume tracking survey, the programmed rosette triggering sequence of 1,4,6,9,11 was executed by the onboard electronics unit. Instead a sequence of 1,4,6,7,9 was executed. Position 7, which did not have a loaded Niskin, was fired at the mid-surface depth. Bottle 9 was fired at the surface instead of the mid-surface, and bottle 11 was never fired during the upcast.

- Due to the technical problems at station 007, a sample from the mid-surface depth was not collected for DINuts analysis.

- Station 011, designated as an experiment to test two sample collection protocols, was not sampled due to time constraints. Station 022 was not sampled due to proximity of the station site to a seawall and time constraints.

Deviations from the CW/QAPP for the combined farfield/nearfield survey in early October (W9514):

- Observation that zooplankton tow count seemed low at Station F06. Possibility that the impeller of the flowmeter caught on the net because lead lines were too long and therefore, the flowmeter lead lines were tightened.

- Two BOD bottles with DO samples broke during transport to the lab (F29, bottom duplicate; F12, bottom sample).

Deviations from the CW/QAPP for the nearfield survey in early November (W9515):

- Only 17 out of 19 nearfield stations were sampled due to time limitations caused by rough sea conditions. The stations that were dropped were stations N08 and N09.

- Only 85 out of 95 planned samples for DINuts were collected due to the decreased number of sampling stations.

- The cast at Station N05 was performed without navigation input due to faulty connection between the deck unit and the rosettes. Position information for Station N05 was noted in the survey log directly from the GPS unit.

- During preservation of DO samples at Station N07, it was noticed that the bottom depth BOD bottle was cracked (sample W95F1N07ES). The bottle was taped in compression to help hold it together.

Deviations from the CW/QAPP for the nearfield survey/Stellwagen Basin station in early December (W9516):

- At station N04, the CTD's real-time data acquisition process failed due to a problem linking with the navigation data. CTD data and navigation data were recorded separately from the GPS for the remainder of the survey.

Deviations from the CW/QAPP for the nearfield survey in mid December (W9517):

- Samples were collected at only three of the six planned stations (N10, N16, and N04) due to weather conditions.

TABLE 2-1

Station Types and Analyses

Analysis	A	D	E	F	G	P	R
Dissolved Inorganic Nutrients (NH_4, NO_3, NO_2, PO_4, SiO_4)	X	X	X	X	X		
Other Nutrients (DOC, TDN, TDP, PC, PN, PP, Biogenic Si)	X	X			X		
Chlorophyll	X	X			X		
Total Suspended Solids	X	X			X		
Dissolved Oxygen		X		X	X		
Phytoplankton and Urea		X			X		
Zooplankton		X			X		
Respiration							X
Productivity						X	

3.0 DATA SUMMARY PRESENTATION

Data from each survey were compiled from the complete HOM 1995 database and organized to facilitate regional comparisons between surveys, and to allow a quick evaluation of results for contingency planning purposes (Tables 3-1 through 3-8). Each table provides summary data from one survey; the survey dates are provided at the top of each table. A discussion of which parameters were selected, how the data were grouped and integrated, and the assumptions behind the calculation of statistical values (average, minimum, and maximum), are provided below. All raw data summarized in this report are available from MWRA either in hardcopy or electronic formats.

The spatial pattern of data summary follows the sample design over major geographic areas of interest in Massachusetts Bay, Cape Cod Bay, and Boston Harbor (Section 3.1). Compilation of data both horizontally by region and vertically over the entire water column was conducted in order to provide an efficient way of assessing the status of the regions during a particular survey. Maximum and minimum values are provided because of the need to assess extremes of pre-outfall conditions relative to criteria being developed for contingency planning purposes (MWRA, 1997).

Prior to regional compilation of data, individual replicate data points were averaged first, followed by replicate datasets (i.e., CTD casts). Significant figures for average values were selected based on the precision of the specific dataset. Detailed considerations for individual datasets are provided in the sections below.

3.1 Defined Geographic Areas

The primary partitioning of data is between the nearfield and farfield stations (Figures 1-1 and 1-2). Farfield data from surveys W9511 and W9514 were additionally segmented into five geographic areas: three stations in Boston Harbor (F23, F30, and F31), six coastal stations (F05, F13, F14, F18, F24, F25), eight offshore stations (F06, F07, F10, F15, F16, F17, F19, and F22), five boundary region stations (F12, F26, F27, F28, F29), and three Cape Cod Bay stations (F01, F02, and F03). Results from one boundary station (Stellwagen Basin, F12) are presented in the summary data from W9516. Geographic regions are shown in Figure 1-1.

The data summary tables include data that are derived from all of the station data collected in each region. Average, maximum, and minimum values are reported from the cumulative horizontal and vertical dataset as described for each data type below.

3.2 Sensor Data

Six CTD profile parameters provided in the data summary tables include: temperature, salinity, density (σ_t), fluorescence (chlorophyll *a*), transmissivity, and dissolved oxygen (DO) concentration. Statistical parameters (maximum, minimum, and average) were calculated from the five upcast sensor readings collected at five depths through the water column (defined as A-E). The five depth values, rather than the entire set of profile data, were selected in order to reduce the statistical weighing of deep water data at the offshore and boundary stations. Generally, the samples were collected in an even depth-distributed pattern. One of the mid-depth samples (B, C, or D) was typically located at the fluorescence (chlorophyll) peak in the water column, depending on the relative depth of the chlorophyll maximum. Details of the collection, calibration, and processing of CTD data are provided in the Water Column Monitoring CW/QAPP (Bowen *et al.*, 1997).

Fluorescence data were calibrated to the amount of chlorophyll *a* in discrete water samples collected at the depth of the sensor reading. The calibrated chlorophyll sensor values were used for all discussions of chlorophyll in this report. The other derived parameter from the chlorophyll calibration is phaeopigments, included in the summary data tables as part of the nutrient parameters discussed below.

In addition to DO concentration, the derived percent saturation, calculated from the potential saturation value of the water (a function of the physical properties of the water), was also provided. Finally, the derived beam attenuation coefficient from the transmissometer ("transmissivity") was provided on the summary tables. Beam attenuation is calculated from the ratio of light transmission relative to the initial light incidence, over a particular distance in the water column, and is provided in units of m^{-1}.

3.3 Nutrients

Analytical results for nutrient concentrations were extracted from the HOM database, and include: ammonium (NH_4), nitrite (NO_2), nitrite + nitrate (NO_2 + NO_3), phosphate (PO_4), and silicate (SiO_4). Nutrients were measured in water samples collected at each of the A-E depths during the CTD casts. The concentration of phaeopigments in the water samples was also measured during chlorophyll processing. Information on the collection, processing, and analysis of nutrient samples can be found in the CW/QAPP (Bowen *et al.*, 1997).

3.4 Biological Water Column Parameters

Three productivity parameters were selected for inclusion in the data summary tables. Areal production, which is determined by integrating the measured productivity over the photic zone, is included for the productivity stations (F23 representing the harbor, and N04, N10, and N16, representing the nearfield). Because areal production is already depth-integrated, averages were calculated only among productivity stations for the two regions sampled. The derived parameters α ($gC[gChla]^{-1}h^{-1}[\mu Em^{-2}s^{-1}]^{-1}$) and Pmax ($gC[gChla]^{-1}h^{-1}$) were also included (Appendix A).

A suite of other water column biological parameters were summarized on the data tables. Respiration rates were averaged over the respiration stations (the same harbor and nearfield stations as productivity, and additionally one offshore station [F19]), and over the three water column depths sampled (upper, mid-, and lower water column). The water column depths of the respiration samples typically coincided with the water depths of the productivity measurements.

Dissolved and particulate organic parameters were also summarized for the tables, including: biogenic silica (BIOSI), dissolved and particulate organic carbon (DOC and POC), particulate and total dissolved phosphate (PART P, TDP), particulate organic and total dissolved nitrogen (PON and TDN), and urea. Total suspended solids (TSS) data are provided as a baseline for total particulate matter in the water column. Dissolved and particulate constituents were measured from water samples collected from each of the five (A-E) depths during CTD casts. Detailed methods of sample collection, processing, and analysis are available in the CW/QAPP (Bowen *et al.*, 1997).

3.5 Plankton

Plankton results were extracted from the HOM database and include whole water phytoplankton, screened phytoplankton, and zooplankton. Phytoplankton measurements included whole-water collections at the surface (depth A) and at the water column chlorophyll *a* maximum (depth C) during the water column casts. Additional samples were taken at these two depths and screened through 20μm Nitex mesh to retain and concentrate larger dinoflagellate species. Zooplankton measurements were collected through oblique tows at all stations. Detailed methods of sample collection, processing, and analysis are available in the CW/QAPP (Bowen *et al.*, 1997).

Final plankton values were derived for each cast by first averaging analytical replicates, then averaging station visits. Values were calculated from the data for the following parameters: nuisance algae (*Alexandrium tamarense, Phaeocystits pouchetii, and Pseudo-nitzschia pungens*), total phytoplankton, total zooplankton, and total centric diatoms. Only the maximum of each plankton parameter is presented in the summary tables.

3.6 Other Data Sources

Two other data sources were utilized in the preliminary interpretation of semi-annual water column data. Satellite images collected near survey dates were interpreted for surface water events including intrusions of surface water masses from the Gulf of Maine and upwelling (Table 3-9). The image date, interpretation, and file name are provided. In addition, continuous monitoring data from the USGS buoy

(Figure 1-2), located between nearfield stations N21 and N18, were collected and processed. Hourly temperature (Figure 3-1) and salinity (Figure 3-2) data from the surface (upper 5 m) and bottom (20-30 m) were averaged over each day, and plotted with HOM survey data. Selected monitoring data from the HOM database included surface (A bottle) and bottom (E bottle) water samples, averaged over four outer nearfield stations (N04, N07, N16, and N20). The discrete data were plotted with the continuous data for comparison. The discrepancy between the HOM data and the moored salinity values may be due to problems with the USGS bottom water salinity sensor.

TABLE 3-1
Semi-Annual Data Summary Table
Event W9510 (8/08/95 - 8/10/95)
Nearfield Survey

		Nearfield		
Region				
Parameter	Unit	Min	Max	Avg
Physical				
Chlorophyll a	µg/L	0.07	2.10	0.74
Salinity	psu	30.9	32.0	31.4
Sigma_T		21.4	25.1	23.1
Temperature	°C	6.4	21.5	15.0
Transmissivity	m-1	0.26	0.97	0.48
Nutrients				
NH_4	µM	0.45	4.66	1.36
NO_2	µM	0.03	0.41	0.13
$NO_2 + NO_3$	µM	0.0	7.6	1.0
PO_4	µM	0.10	1.22	0.46
SIO_4	µM	1.6	12.6	4.1
Phaeopigment	µg/L	0.14	1.40	0.68
DO				
Concentration	mg/l	7.2	9.4	8.4
Saturation	%	79	118	101
Productivity				
Alpha	see text	0.00	0.07	0.04
Areal Production	$mgC/m^2/d$	1116.9	1587.4	1352.1
Pmax	see text	0.3	9.1	5.5
Respiration	µmol/h	0.01	0.19	0.07
Water Column				
BIOSI	µM	0.2	3.0	1.1
DOC	mg/L	1.0	3.0	1.5
PART P	µM	0.18	0.46	0.29
POC	µM	9.3	36.3	22.0
PON	µM	0.66	4.94	2.72
TDN	µM	9.2	17.8	11.3
TDP	µM	0.22	0.96	0.48
TSS	mg/L	0.0	14.0	5.1
Urea	µM	0.29	0.73	0.41
Plankton (Surface samples only)				
Total Phytoplankton	Mcell/L		7.0	
Centric diatoms	Mcell/L		0.11	
Alexandrium tamarense	Mcell/L		NP	
Phaeocystis pouchetti	Mcell/L		NP	
Pseudo-nitzschia sp	Mcell/L		1.40E-06	
Total Zooplankton	#/m3		106851	

TABLE 3-2
Semi-Annual Data Summary Table
Event W9511 (8/21/95 - 8/26/95)
Combined Nearfield/Farfield Survey

Parameter	Unit	Nearfield Min	Nearfield Max	Nearfield Avg	Farfield Harbor Min	Harbor Max	Harbor Avg	Coastal Min	Coastal Max	Coastal Avg	Offshore Min	Offshore Max	Offshore Avg	Boundary Min	Boundary Max	Boundary Avg	Cape Cod Bay Min	Cape Cod Bay Max	Cape Cod Bay Avg
Physical																			
Chlorophyll a	µM	0.0	15.0	1.4	1.8	14.2	7.2	0.1	11.8	4.5	0.0	7.2	1.0	0.0	4.5	0.9	0.0	3.7	1.1
Salinity	psu	31.4	32.1	31.7	31.0	31.4	31.2	31.3	31.8	31.5	31.3	32.2	31.7	31.1	32.2	31.8	31.3	31.8	31.5
Sigma_T		22.2	25.1	23.5	21.2	22.8	22.1	21.7	24.4	22.7	21.7	25.4	23.7	21.5	25.4	23.9	21.7	24.7	22.9
Temperature	°C	7.3	19.7	14.2	16.6	22.0	19.3	9.9	20.9	17.1	5.6	20.8	12.8	5.4	21.1	12.4	8.9	21.0	16.3
Transmissivity	m-1	0.26	1.13	0.46	0.68	1.62	1.06	0.42	1.18	0.73	0.24	0.78	0.43	0.25	0.93	0.43	0.25	1.20	0.45
Nutrients																			
NH_4	µM	0.06	6.45	0.89	4.00	16.20	7.87	0.26	7.26	1.94	0.00	5.29	1.45	0.00	5.24	0.47	0.10	2.82	0.89
NO_2	µM	-0.002	0.46	0.13	0.20	0.43	0.29	0.01	0.49	0.17	0.00	0.46	0.13	0.00	0.36	0.08	0.00	0.33	0.06
$NO_2 + NO_3$	µM	0.0	8.3	1.6	0.9	2.2	1.7	0.0	4.8	1.3	0.0	11.6	2.5	0.0	11.0	3.9	0.1	1.6	0.5
PO_4	µM	0.15	1.03	0.48	0.87	1.71	1.17	0.13	1.13	0.56	0.12	1.28	0.60	0.10	1.20	0.59	0.27	0.93	0.49
SIO_4	µM	0.9	12.2	4.3	3.4	5.9	4.2	1.3	13.2	4.3	1.9	19.8	5.6	0.0	13.5	4.8	1.6	11.6	4.7
Phaeopigment	µg/L	0.27	4.68	1.35	2.05	6.44	4.18	0.34	4.70	2.17	0.45	2.09	1.26	0.11	1.17	0.54	0.07	0.92	0.47
DO																			
Concentration	mg/l	6.9	10.2	8.1	6.3	7.3	6.8	6.3	8.8	7.7	7.2	9.8	8.1	7.8	11.8	8.6	7.6	9.5	8.1
Saturation	%	75	116	96	78	98	89	71	116	97	71	119	94	76	139	98	83	114	100
Productivity																			
Alpha	see text	0.02	0.07	0.04	0.18	2.86	0.83												
Areal Production	$mgC/m^2/d$	973.9	1897.3	1401.9	7583.5	7583.5	7583.5												
Pmax	see text	1.3	16.8	8.1	30.8	212.8	130.3												
Respiration	µmol/h	0.02	0.28	0.14	0.12	0.48	0.35				0.02	0.14	0.07						
Water Column																			
BIOSI	µM	0.30	4.03	1.36	2.85	5.47	4.40	0.43	4.86	2.32	0.68	1.45	1.07	0.06	0.39	0.23	0.17	1.07	0.65
DOC	mg/L	1.0	3.0	2.1	2.0	3.0	2.2	2.0	2.0	2.0	2.0	2.0	2.0	0.0	1.0	0.5	2.0	2.0	2.0
PART P	µM	0.13	0.54	0.25	0.39	1.08	0.73	0.18	0.64	0.37	0.20	0.29	0.25	0.12	0.12	0.12	0.08	0.28	0.15
POC	µM	6.9	68.9	26.3	29.0	98.7	57.7	18.9	57.2	36.0	14.1	26.4	25.1	12.0	12.9	12.4	13.9	19.6	16.6
PON	µM	0.61	8.78	3.38	3.81	14.87	8.57	1.64	7.79	4.21	2.35	3.59	2.91	1.11	1.23	1.17	1.27	2.17	1.68
TDN	µM	7.4	16.0	10.5	7.1	46.4	25.7	10.3	16.4	13.2	10.3	13.9	12.2	8.8	12.6	10.7	9.9	11.4	10.8
TDP	µM	0.23	0.83	0.48	1.02	2.22	1.56	0.31	1.03	0.65	0.38	0.72	0.56	0.20	0.73	0.47	0.46	0.78	0.61
TSS	mg/L	0.0	17.0	4.6	0.0	18.0	7.0	0.0	15.0	7.4	0.0	0.0	0.0	6.0	7.0	6.5	0.0	0.0	0.0
Urea	µM	0.67	2.95	1.23	1.14	2.48	1.77	1.19	1.77	1.37	0.73	0.93	0.83	1.25	1.39	1.32	0.76	1.43	1.15
Plankton (Surface samples only)																			
Total Phytoplankton	Mcell/L		14.0			33.7			17.5			3.4			1.5			3.9	
Centric diatoms	Mcell/L		2.14			6.55			1.29			0.07			0.01			0.10	
Alexandrium tamarense	Mcell/L		NP			NP			NP			NP			NP			NP	
Phaeocystis pouchetti	Mcell/L		NP			NP			NP			NP			NP			NP	
Pseudo-nitzschia sp	Mcell/L		3.00E-03			1.45E-02			2.00E-03			1.00E-03			NP			4.00E-03	
Total Zooplankton	#/m3		130657			215969			159029			94353			23766			27463	

TABLE 3-3
Semi-Annual Data Summary Table
Event W9512 (9/11/95 - 9/14/95)
Nearfield Survey

Region		Nearfield		
Parameter	Unit	Min	Max	Avg
Physical				
Chlorophyll a	µg/L	0.00	11.84	2.52
Salinity	psu	31.5	32.1	31.8
Sigma_T		22.5	25.0	23.7
Temperature	°C	7.4	18.8	13.5
Transmissivity	m-1	0.26	1.77	0.70
Nutrients				
NH_4	µM	0.00	1.51	0.35
NO_2	µM	-0.004	0.55	0.14
$NO_2 + NO_3$	µM	0.0	9.5	2.2
PO_4	µM	0.23	1.12	0.61
SIO_4	µM	-0.003	14.7	4.5
Phaeopigment	µg/L	0.20	3.00	0.94
DO				
Concentration	mg/l	6.7	11.1	8.3
Saturation	%	73	143	98
Productivity				
Alpha	see text	0.01	0.30	0.07
Areal Production	$mgC/m^2/d$	1525.7	2378.4	1952.1
Pmax	see text	0.7	32.4	10.8
Respiration	µmol/h	0.01	0.31	0.17
Water Column				
BIOSI	µM	1.5	6.1	3.0
DOC	mg/L	2.0	3.0	2.2
PART P	µM	0.13	0.54	0.27
POC	µM	7.9	81.8	35.3
PON	µM	0.85	10.65	4.12
TDN	µM	4.6	23.1	12.3
TDP	µM	0.42	1.27	0.73
TSS	mg/L	0.0	11.0	4.7
Urea	µM	1.02	3.70	1.83
Plankton (Surface samples only)				
Total Phytoplankton	Mcell/L		7.5	
Centric diatoms	Mcell/L		4.1	
Alexandrium tamarense	Mcell/L		NP	
Phaeocystis pouchetti	Mcell/L		NP	
Pseudo-nitzschia sp	Mcell/L		2.33E-04	
Total Zooplankton	#/m3		75344	

TABLE 3-4
Semi-Annual Data Summary Table
Event W9513 (9/25/95 - 9/29/95)
Nearfield Survey

Region		Nearfield		
Parameter	Unit	Min	Max	Avg
Physical				
Chlorophyll a	µg/L	0.17	6.29	1.32
Salinity	psu	31.3	32.3	31.8
Sigma_T		23.1	25.0	23.8
Temperature	°C	8.7	15.6	13.6
Transmissivity	m-1	0.29	1.13	0.44
Nutrients				
NH_4	µM	0.02	9.80	1.66
NO_2	µM	0.01	0.51	0.19
$NO_2 + NO_3$	µM	0.0	9.8	2.3
PO_4	µM	0.27	1.39	0.70
SIO_4	µM	0.0	14.2	3.8
Phaeopigment	µg/L	0.15	1.94	0.98
DO				
Concentration	mg/l	5.7	9.5	7.6
Saturation	%	64	115	89
Productivity				
Alpha	see text	0.04	0.09	0.08
Areal Production	$mgC/m^2/d$	923.1	1107.5	1015.3
Pmax	see text	5.3	22.2	16.0
Respiration	µmol/h	0.03	0.23	0.17
Water Column				
BIOSI	µM	0.9	2.9	1.8
DOC	mg/L	2.0	2.0	2.0
PART P	µM	0.16	0.37	0.26
POC	µM	9.5	24.9	19.3
PON	µM	1.03	4.31	2.81
TDN	µM	5.7	30.7	15.0
TDP	µM	0.42	1.67	0.82
TSS	mg/L	0.0	4.0	1.6
Urea	µM	1.21	4.65	2.69
Plankton (Surface samples only)				
Total Phytoplankton	Mcell/L		4.7	
Centric diatoms	Mcell/L		0.65	
Alexandrium tamarense	Mcell/L		NP	
Phaeocystis pouchetti	Mcell/L		NP	
Pseudo-nitzschia sp	Mcell/L		0.0065	
Total Zooplankton	#/m3		39353	

TABLE 3-5
Semi-Annual Data Summary Table
Event W9514 (10/09/95 - 10/13/95)
Combined Nearfield/Farfield Survey

		Nearfield			Farfield														
Region					Harbor			Coastal			Offshore			Boundary			Cape Cod Bay		
Parameter	Unit	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Physical																			
Chlorophyll a	µM	0.0	5.6	1.7	0.3	1.2	0.6	0.2	2.6	1.0	0.0	3.7	1.1	0.0	2.6	0.7	0.3	3.1	1.7
Salinity	psu	31.2	32.2	31.8	30.5	31.5	31.1	31.1	31.9	31.5	31.4	32.3	31.9	31.7	32.4	32.0	31.6	31.8	31.6
Sigma_T		22.9	24.7	23.8	22.4	23.5	23.0	22.9	24.0	23.4	23.3	25.1	24.0	23.4	25.2	24.3	23.2	24.0	23.4
Temperature	°C	10.2	16.0	13.8	14.2	15.4	14.8	12.8	15.4	14.3	8.6	14.5	13.0	7.9	15.2	11.9	12.6	15.8	14.9
Transmissivity	m-1	0.27	0.92	0.48	0.56	1.12	0.77	0.34	0.64	0.50	0.26	0.66	0.41	0.25	0.95	0.43	0.42	0.64	0.54
Nutrients																			
NH_4	µM	0.00	6.85	0.78	6.29	15.03	11.71	0.55	11.02	6.17	-0.003	5.18	0.59	0.00	0.77	0.26	0.06	1.27	0.39
NO_2	µM	0.00	0.55	0.15	0.46	0.86	0.67	0.10	0.63	0.46	0.03	0.43	0.15	0.01	0.32	0.12	0.02	0.23	0.07
$NO_2 + NO_3$	µM	0.0	7.7	1.1	3.0	5.3	4.2	0.4	4.3	3.2	0.0	10.8	2.3	0.0	11.0	4.0	0.0	4.0	0.4
PO_4	µM	0.35	1.20	0.54	1.05	1.70	1.47	0.43	1.40	1.07	0.38	1.18	0.59	0.35	1.12	0.70	0.46	0.87	0.53
SIO_4	µM	0.5	12.0	3.3	5.9	7.4	6.7	1.7	8.9	5.3	1.6	17.8	4.2	1.5	15.2	6.5	1.8	9.3	3.0
Phaeopigment	µg/L	0.22	5.00	1.25	0.55	1.14	0.81	0.32	2.23	0.75	0.52	1.08	0.89	0.08	1.31	0.95	0.54	1.89	1.24
DO																			
Concentration	mg/l	6.4	9.7	8.2	6.4	7.1	6.7	6.4	8.4	7.3	6.6	9.1	7.8	6.7	8.8	7.7	5.6	8.3	7.7
Saturation	%	72	119	97	76	85	80	75	101	87	69	108	91	71	103	88	64	100	92
Productivity																			
Alpha	see text	0.03	0.14	0.08	0.03	0.03	0.03												
Areal Production	$mgC/m^2/d$	1511.8	2792.3	2021.8	641.0	641.0	641.0												
Pmax	see text	3.8	34.7	17.3	4.4	9.6	8.3												
Respiration	µmol/h	0.04	0.19	0.11	0.08	0.17	0.14				0.04	0.19	0.09						
Water Column																			
BIOSI	µM	0.77	1.78	1.05	2.21	4.62	2.86	1.21	2.09	1.53	1.08	1.12	1.10	1.09	1.25	1.17	2.04	2.53	2.29
DOC	mg/L	1.0	2.0	1.3	1.0	2.0	1.7	1.0	2.0	1.8	1.0	1.0	1.0	1.0	2.0	1.5	1.0	2.0	1.7
PART P	µM	0.19	0.36	0.26	0.30	0.54	0.41	0.21	0.43	0.31	0.20	0.24	0.23	0.20	0.30	0.25	0.26	0.31	0.28
POC	µM	8.7	39.6	22.8	15.3	26.7	21.9	14.4	24.5	18.2	9.3	28.9	16.5	19.2	24.5	21.7	23.7	32.3	27.1
PON	µM	1.20	5.17	3.03	1.76	4.15	3.19	1.75	3.28	2.44	1.08	3.65	1.77	2.63	4.23	3.40	3.08	4.63	3.92
TDN	µM	2.0	25.2	9.5	13.6	35.0	29.7	21.4	29.6	24.7	10.5	25.5	17.7	7.2	20.5	13.6	5.8	21.6	15.8
TDP	µM	0.45	1.49	0.65	1.64	2.03	1.84	1.27	1.62	1.43	0.56	0.58	0.57	0.61	0.64	0.62	0.61	0.70	0.65
TSS	mg/L	0.5	4.0	2.2	1.5	5.0	3.6	0.5	3.0	2.1	1.5	2.0	1.8	3.0	3.0	3.0	1.5	4.0	3.0
Urea	µM	0.11	0.31	0.20	0.55	0.95	0.75	0.42	0.67	0.54	0.35	1.98	1.13	0.14	0.20	0.17	0.35	0.84	0.52
Plankton (Surface samples only)																			
Total Phytoplankton	Mcell/L		9.7			4.4			4.4			1.2			2.7			5.5	
Centric diatoms	Mcell/L		0.26			0.10			0.17			0.26			0.01			0.14	
Alexandrium tamarense	Mcell/L		NP			NP			NP			NP			NP			NP	
Phaeocystis pouchetti	Mcell/L		NP			NP			NP			NP			NP			NP	
Pseudo-nitzschia sp	Mcell/L		7.67E-03			2.50E-03			6.50E-03			8.00E-03			1.00E-03			1.95E-02	
Total Zooplankton	#/m3		91816			42133			65022			55080			39385			175972	

TABLE 3-6
Semi-Annual Data Summary Table
Event W9515 (11/01/95 - 11/04/95)
Nearfield Survey

Region		Nearfield		
Parameter	Unit	Min	Max	Avg
Physical				
Chlorophyll a	µg/L	0.00	18.06	6.30
Salinity	psu	31.7	32.5	32.1
Sigma_T		24.3	25.0	24.6
Temperature	°C	9.7	11.4	10.5
Transmissivity	m-1	0.29	1.02	0.57
Nutrients				
NH_4	µM	0.01	5.49	0.76
NO_2	µM	0.09	0.65	0.34
$NO_2 + NO_3$	µM	1.4	10.2	5.9
PO_4	µM	0.56	1.39	0.86
SIO_4	µM	1.9	13.3	5.9
Phaeopigment	µg/L	0.41	4.84	2.54
DO				
Concentration	mg/l	6.4	9.4	8.0
Saturation	%	70	104	88
Productivity				
Alpha	see text	0.08	0.38	0.25
Areal Production	$mgC/m^2/d$	932.2	1459.2	1195.7
Pmax	see text	13.9	110.0	58.4
Respiration	µmol/h	0.03	0.15	0.09
Water Column				
BIOSI	µM	3.4	9.5	5.6
DOC	mg/L	1.0	2.0	1.1
PART P	µM	0.24	0.45	0.35
POC	µM	8.6	43.8	27.5
PON	µM	1.86	7.56	4.29
TDN	µM	12.5	35.3	21.1
TDP	µM	0.64	1.48	0.90
TSS	mg/L	2.0	7.0	4.1
Urea	µM	0.43	1.52	0.81
Plankton (Surface samples only)				
Total Phytoplankton	Mcell/L		4.1	
Centric diatoms	Mcell/L		0.43	
Alexandrium tamarense	Mcell/L		NP	
Phaeocystis pouchetti	Mcell/L		NP	
Pseudo-nitzschia sp	Mcell/L		0.071	
Total Zooplankton	#/m3		60991	

TABLE 3-7
Semi-Annual Data Summary Table
Event W9516 (11/27/95 - 12/05/95)
Nearfield Survey

Region		Nearfield			Boundary				
Parameter	Unit	Min	Max	Avg	Min	Depth	Max	Depth	Avg
Physical									
Chlorophyll a	µg/L	0.21	2.42	1.65	0.83	89.19	1.51		1.20
Salinity	psu	31.2	32.2	31.9	32.0	44.6	32.1	89.19	32.0
Sigma_T		24.6	24.9	24.8	24.9	2.6	24.9	89.19	24.9
Temperature	°C	5.9	9.0	7.8	8.3	89.2	8.4		8.4
Transmissivity	m-1	0.36	0.61	0.42	0.37	66.12	0.41		0.38
Nutrients									
NH_4	µM	**0.00**	8.90	1.22	0.00		0.30	44.58	0.105
NO_2	µM	0.09	0.62	0.25	0.08		0.12	89.19	0.098
$NO_2 + NO_3$	µM	7.2	9.5	7.7	7.1		9.5	66.12	7.89
PO_4	µM	0.83	1.38	0.94	0.80		1.17	66.12	0.92
SIO_4	µM	5.5	11.1	7.4	6.3		7.9	89.19	7.0
Phaeopigment	µg/L	0.19	0.99	0.76					
DO									
Concentration	mg/l	8.0	9.1	8.9	8.6	22.06	8.7	89.19	8.7
Saturation	%	85	93	91	90		92		91
Productivity									
Alpha	see text	0.04	0.07	0.05					
Areal Production	$mgC/m^2/d$	502.3	515.1	508.7					
Pmax	see text	5.2	8.4	6.9					
Respiration	µmol/h	0.02	0.04	0.03					
Water Column									
BIOSI	µM	0.7	3.8	3.0					
DOC	mg/L	1.0	1.0	1.0					
PART P	µM	0.12	0.33	0.20					
POC	µM	8.9	26.0	18.4					
PON	µM	1.31	3.87	2.47					
TDN	µM	11.7	26.4	17.1					
TDP	µM	0.84	1.49	0.97					
TSS	mg/L	0.5	6.0	1.7					
Urea	µM	0.32	0.70	0.55					
Plankton (Surface samples only)									
Total Phytoplankton	Mcell/L		0.74						
Centric diatoms	Mcell/L		0.04						
Alexandrium tamarense	Mcell/L		NP						
Phaeocystis pouchetti	Mcell/L		NP						
Pseudo-nitzschia sp	Mcell/L		0.003						
Total Zooplankton	#/m3		37602						

TABLE 3-8
Semi-Annual Data Summary Table
Event W9517 (12/17/95 - 12/19/95)
Nearfield Survey

		Nearfield		
Region				
Parameter	Unit	Min	Max	Avg
Physical				
Chlorophyll a	μg/L	0.27	0.55	0.49
Salinity	psu	32.0	32.1	32.0
Sigma_T		25.2	25.2	25.2
Temperature	°C	6.0	6.7	6.2
Transmissivity	m-1	0.31	0.39	0.35
Nutrients				
NH_4	μM	0.08	0.25	0.14
NO_2	μM	0.11	0.16	0.14
$NO_2 + NO_3$	μM	8.1	8.6	8.4
PO_4	μM	0.88	0.96	0.92
SIO_4	μM	7.7	10.4	9.4
Phaeopigment	μg/L	0.39	0.57	0.49
DO				
Concentration	mg/l	9.2	9.5	9.4
Saturation	%	93	94	93
Productivity				
Alpha	see text	0.02	0.02	0.02
Areal Production	$mgC/m^2/d$	87.8	95.4	91.6
Pmax	see text	2.4	2.9	2.8
Respiration	μmol/h	0.01	0.03	0.02
Water Column				
BIOSI	μM	1.3	2.0	1.6
DOC	mg/L	1.0	2.0	1.4
PART P	μM	0.11	0.14	0.12
POC	μM	7.7	14.0	10.1
PON	μM	0.55	2.14	1.48
TDN	μM	5.0	12.1	6.5
TDP	μM	0.68	0.77	0.73
TSS	mg/L	0.0	5.0	1.6
Urea	μM	0.76	1.14	0.94
Plankton (Surface samples only)				
Total Phytoplankton	Mcell/L		0.27	
Centric diatoms	Mcell/L		0.009	
Alexandrium tamarense	Mcell/L		NP	
Phaeocystis pouchetti	Mcell/L		NP	
Pseudo-nitzschia sp	Mcell/L		2.10E-03	
Total Zooplankton	#/m3		33476	

TABLE 3-9

Summary of Second Semi-Annual 1995 Satellite Imagery for Massachusetts and Cape Cod Bays

Month	Date	Image Numbers	Upwelling	G.O.M.[1] Intrusion	Location
August	8/1/95	E9521312.MD7		X	Stellwagen Basin
	8/7/95	E9521917.MD7		X	Stellwagen Basin
	8/13/95	E9522517.MD7			
	8/22/95	E9523417.MD7		X	Cape Ann and Stellwagen Basin
	8/28/95	E9524012.MD7		X	Cape Ann and Stellwagen Basin
September	9/3/95	E9524617.MD7			
	9/11/95	E9525417.MD7		X	Eastern Mass Bay
	9/12/95	E9525517.MD7			
	9/30/95	E9527317.MD7			
October	10/9/95	E9528212.MD7			
	10/12/95	E9528517.MD7		X	Northern Mass Bay and Boston Harbor
	10/19/95	E9529211.MD7		X	Northern Mass Bay and Boston Harbor
	10/23/95	E9529612.MD7			
	10/24/95	E9529711.MD7		X	Northern Mass Bay and Boston Harbor
	10/29/95	E9530211.MD7			
November	11/5/95	E9530912.MD7			
	11/6/95	E9531012.MD7			
	11/17/95	E9532117.MD7			
	11/22/95	E9532617.MD7			
December	12/2/95	E9533617.MD7			
	12/5/95	E9533907.MS7			
	12/8/95	E9534223.MS7			
	12/10/95	E9534417.MD7			
	12/17/95	E9535123.MS7			
	12/29/95	E9536306.MS7			

[1]G.O.M. = Gulf of Maine

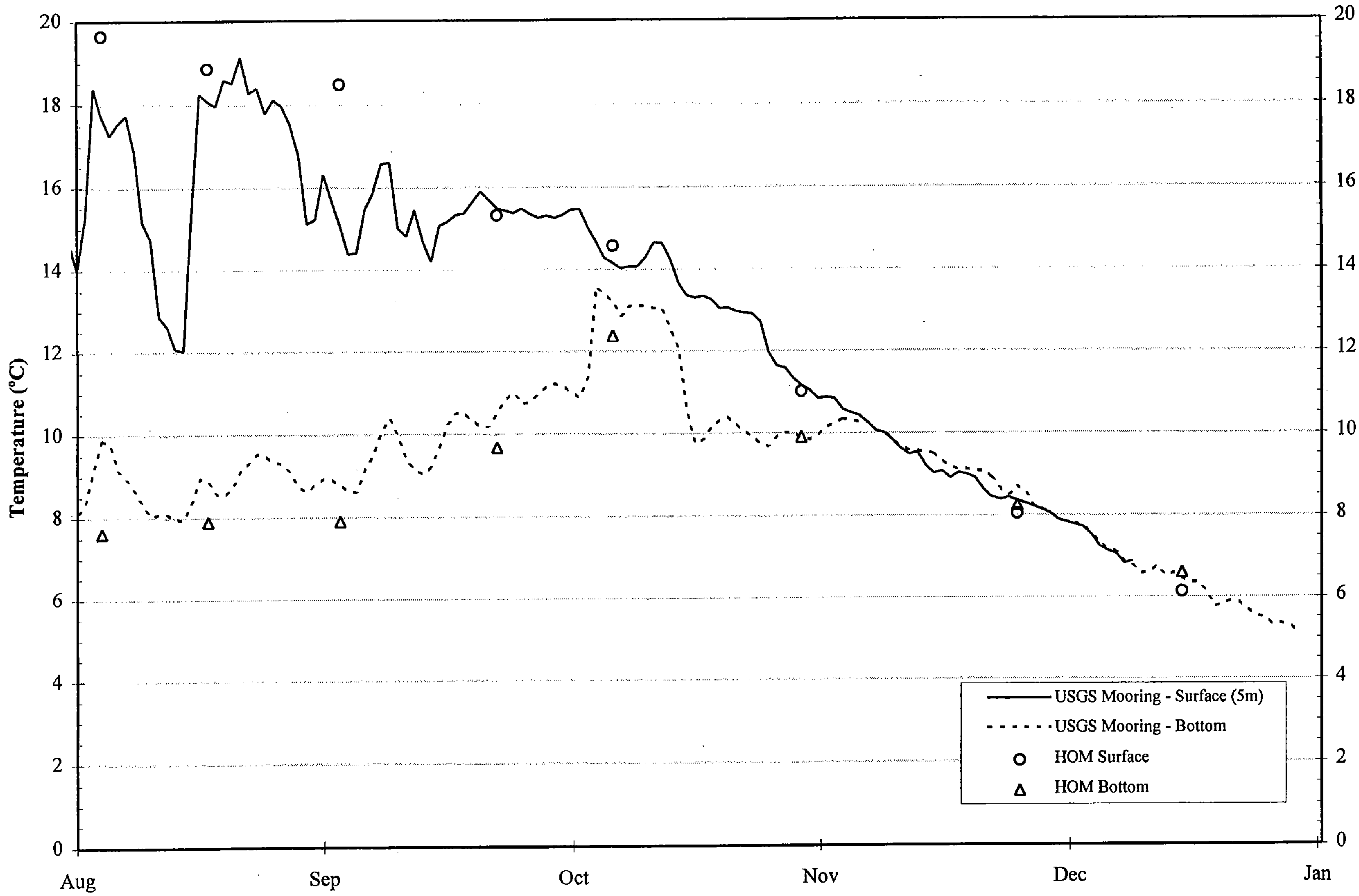


FIGURE 3-1
Moored Temperature Sensor Data
August-December 1995

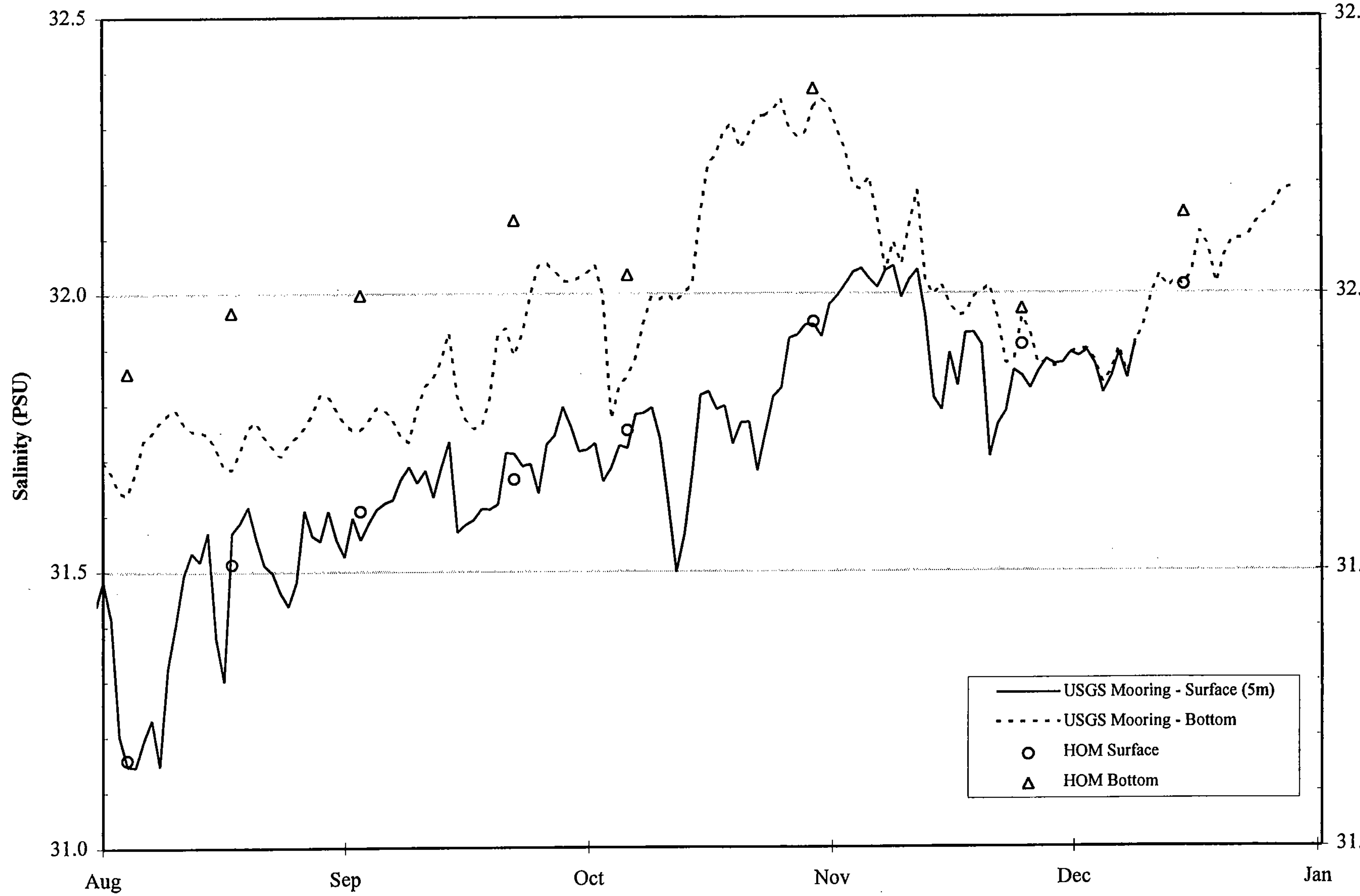


FIGURE 3-2
Moored Salinity Sensor Data
August-December 1995

4.0 RESULTS OF WATER COLUMN MEASUREMENTS

Data from the two farfield surveys conducted during the semi-annual monitoring period (W9511, W9514) were evaluated for trends in regional water masses throughout Boston Harbor, Massachusetts Bay, and Cape Cod Bay. The variation of regional surface water properties is presented using contour plots of surface water parameters, derived from the A (surface water) sample. Classifying data by region allowed comparison of the horizontal distribution of water mass properties over the farfield area.

The regional vertical distribution of water column parameters is presented in the following sections along three transects in the farfield survey area (Figure 1-3). Examining data trends along the three transects, Boston-Nearfield, Cohassett, and Marshfield, provides a three-dimensional perspective of water column conditions during each survey.

Eight nearfield surveys were conducted during the second semi-annual period (W9510-W9517). Nearfield surveys were conducted more frequently than farfield surveys, allowing better temporal resolution of the changes in water column parameters during the summer stratified period and the fall turnover. Variability in the nearfield is presented by comparing surface and bottom water concentrations (A and E depths), along a depth transect through the nearfield (Figure 1-3), and by plotting individual parameters with depth in the water column.

4.1 Physical Characteristics

4.1.1 Horizontal Distribution

During the first combined nearfield/farfield survey in late August (W9511), regional surface water temperatures were very warm (>19°C) except for an area of cooler surface water (17-19°C) at the northern end of the offshore/nearfield area (Figure 4-1). The cooler surface water may have been related to the intrusion of Gulf of Maine water into Massachusetts Bay documented by satellite images collected in late August (Table 3-1). A drop of almost 6°C in surface water temperature also was measured immediately prior to the late August survey by the outer nearfield USGS buoy (Figure 3-1).

Salinities ranged in the surface water from 30.9 to 31.7 PSU during this survey, with the lowest salinity value at F23 near the entrance to Boston Harbor. Salinity values of <31.5 PSU were concentrated in the harbor, Cape Cod Bay, and coastal areas, while salinities of >31.5 PSU were concentrated farther offshore. A complete set of surface contour maps of water properties during the farfield surveys is provided in Appendix B.

By W9514 in October, surface water temperatures had decreased to 14-16°C, with the warmest water (>15°C) in Boston Harbor, Cape Cod Bay, and in the nearfield. The salinity range and inshore-offshore gradient was similar to the W9511 survey.

4.1.2 Vertical Distribution

Farfield. Transects from west to east (Figure 1-3) in Massachusetts Bay show the gradient of physical characteristics within the water column from surface to bottom water in all regions. Vertical stratification of the water column varies by parameter and through time with incursions of different water masses. The value of vertical stratification was calculated from the density difference ($\Delta\sigma_t$) of the bottom water σ_t from the surface water value. For the purposes of this report, vertical stratification will be defined by the presence of a pycnocline with a $\Delta\sigma_t$ between the upper and lower water column of less than -1.0.

Regionally, all the water masses in the survey area were vertically stratified ($\Delta\sigma_t$ <-1.0) in late August (W9511) except the harbor, which remained relatively well-mixed throughout the semi-annual period. Vertical transects of σ_t show strong vertical stratification, ranging from 21.7 regionally in surface water, to >25 in the deeper offshore bottom water (Figure 4-2). A complete set of transect plots for water properties is provided in Appendix C.

The summer vertical density stratification was primarily a function of water temperature, which ranged from 5°C in bottom water to 19°C in surface water along the farfield transects, resulting in a maximum ΔT of 14°C. Salinity was less variable, with a stronger inshore-offshore gradient ranging from 31 PSU in the harbor surface water, to >32 PSU in the bottom water of the offshore-boundary regions (Figure 4-3).

The Boston-Nearfield transects show a patch of cooler, less saline water at the surface at Station F19. The pattern of anomalous surface water at the transect station F19 is repeated for many physical characteristics, indicating that the location of F19 near the northern end of the offshore region was influenced by the Gulf of Maine intrusion documented by satellite images (Table 3-1).

In the early fall (W9514, mid-October), the range of σ_t was smaller in the farfield (~23 to 25; Figure 4-4). The water column remained vertically stratified ($\Delta\sigma_t$ > -1.0) in the offshore and boundary regions, but $\Delta\sigma_t$ ranged from 0 to -1.0 in Boston Harbor, Cape Cod Bay, and the coastal regions. The data suggest that the fall turnover was in progress during this survey. The timing and catalyst of the fall turnover is discussed further below using more frequent nearfield data.

A reduction in the surface-bottom water temperature gradient was primarily responsible for the breakdown of the summer pycnocline. Regionally, surface water cooled from a maximum of 19°C in August to a maximum of 15°C in October. At the same time, deeper water was still warming up, from approximately 5°C in August to 8°C in October, resulting in a maximum ΔT of 7°C. The vertical structure of salinity was very similar between the two farfield surveys, except for an increased horizontal gradient, especially apparent in the nearfield surface water (Figure 4-5).

Nearfield. More frequent sampling of nearfield stations allowed more detailed analysis of the variability within the nearfield water column during the second 1995 semi-annual period. A series of transect plots along the line from the inshore nearfield station N10, through the diffuser station N21, to the offshore station N04 (Figure 1-3) is presented. Discussion of the variability within the nearfield includes summary of bottom (E) and surface (A) water samples from the inner and outer nearfield. For the purposes of data presentation, the inner and outer nearfield regions have been plotted separately because of the differences in physical characteristics between the two areas. In time-series plots discussed below, the inner nearfield is represented by stations N10 and N11, while the outer nearfield is represented by the stations N04, N07, N16, and N20, unless otherwise stated.

The relative degree of vertical stratification ($\Delta\sigma_t$) was < -1.0 in both the inner and outer nearfield during the first three nearfield surveys from early August through early September (W9510-W9512; Figure 4-6). In the shallower inner nearfield, $\Delta\sigma_t$ remained steady at approximately -2.0 during the first three surveys, while the density increased in both the surface and bottom water. Average density of the deeper bottom water of the outer nearfield, however, remained relatively constant during the first three nearfield surveys, so that $\Delta\sigma_t$ decreased as the surface density increased (Figure 4-7).

Without a fresh water perturbation (precipitation, water mass incursions), the overall density increase in nearfield surface water throughout the late summer and fall is a result of both falling surface water temperatures and increasing salinity from evaporation. The surface water density increase between the late August (W9510) and early September (W9511) surveys was not related to temperature, which remained relatively constant (Figure 4-8), but rather an increase of salinity. The early August (W9510) was conducted during the minimum semi-annual measured surface salinity (Figure 3-2). The nearfield surface water salinity increased from early to late August from approximately 31 PSU in the upper 20 m to >31.5 PSU, except at N10 which was slightly less saline (Figure 4-9).

Beginning in late September (W9513), salinity and temperature fluctuations in surface and bottom water in the nearfield caused an overall differentiation between the density structure and timing of the fall turnover between the inner and outer nearfield regions. Inner/outer nearfield trends of salinity and temperature were delineated using temperature-salinity (TS) plots of all nearfield data during the fall period of seasonal transition (W9512-W9514; Figure 4-10). In the TS scatter plots, inner nearfield stations include: N01, N02, N09, N10, N11, N12, N13, N19, and N20, and outer nearfield stations include: N03, N04, N05, N06, N07, N08, N15, N16, N17. Mid-nearfield stations N14, N18, and N21 were not included in the plots.

The density of inner nearfield bottom water dropped by almost 1.0 in late September (W9513; Figure 4-6) due to an influx of less saline water to the inner nearfield (primarily stations N10, N12), and an overall increase of bottom water temperatures (approximately 2°C; Figure 4-10). The nearfield salinity transect from survey W9513 shows the lens of this less saline water originating from the direction of Boston Harbor (Figure 4-9). Salinity also decreased in the surface water of a majority of the inner nearfield stations.

During this same period, salinity in the outer nearfield, however, increased between early (W9512) and late (W9513) September (Figure 3-2), resulting in a clear salinity division between the inner and outer nearfield that continued through the October survey (W9514; Figure 4-10). The resultant vertical density structure of the nearfield during W9513 (Figure 4-7) shows interlayering of water bodies of different densities in the transitional area around station N21.

The water column remained vertically stratified throughout September in the outer nearfield until the fall turnover, when $\Delta\sigma_t$ exceeded -1.0 in the October survey (W9514; Figure 4-6). A decrease in bottom water density during this survey resulted in a breakdown of vertical stratification which continued throughout the rest of the semi-annual period (Figure 4-11). The density decrease was due to a mixing event that resulted in rapid warming of bottom waters of the outer nearfield, documented most clearly in continuous moored temperature data (Figure 3-1).

During the October survey (W9514) in the inner nearfield, surface water physical characteristics were influenced more by harbor water than the mixing indicated in the outer nearfield (Figures 4-12, 4-13). A density gradient was present in the inner nearfield so that $\Delta\sigma_t$ remained slightly > -1.0 until the subsequent survey in November (W9515; Figure 4-6).

During the final three nearfield surveys of the second semi-annual period of 1995 (W9515-W9517), vertical stratification of all of the nearfield had ceased (Figure 4-11). Water temperature (Figure 4-12) and salinity (Figure 4-13) values were relatively uniform throughout the nearfield water column during early November (W9515; 9.6-11°C, 31.7-32.1 PSU). During the late November-December surveys, $\Delta\sigma_t$ was essentially zero resulting in a well-mixed water column (Figure 4-6). An inshore-offshore temperature and salinity gradient was well established by the end of November (W9516.

4.2 Nutrients

4.2.1 Horizontal Distribution

During both farfield surveys conducted in the semi-annual period, nutrients were depleted in the surface water, especially outside of Boston Harbor. The spatial distribution of nutrient concentrations in the surface water (A depth) indicated that Boston Harbor consistently had the highest concentration of all nutrients measured during both semi-annual farfield surveys. A complete set of farfield surface water contour maps of all water property data is available in Appendix B.

In late August (W9511), surface water nitrate (NO_3) concentrations within and near Boston Harbor (within tidal flushing zone) ranged from 0.7-1.7 µM (Figure 4-14), silicate (SiO_4) ranged from 3-5 µM, and phosphate (PO_4) ranged from 1.5-1.7 µM. Outside of the harbor, surface water NO_3 concentrations were <1.0 µM. Minimum surface water SiO_4 concentrations were measured in the nearfield (1-2 µM), then increased again to 2-3 µM in the offshore/boundary regions and 1.7-2.3 µM in Cape Cod Bay. Outside of Boston Harbor, PO_4 was <0.2 µM, except for slightly higher coastal (0.3-0.5 µM) and Cape Cod Bay (0.3 µM) concentrations.

During the final farfield survey of 1995 in mid-October (W9514), the water column was still vertically stratified with respect to nutrients, resulting in relatively low surface water concentrations. Boston Harbor had higher nitrate/silicate concentrations relative to the prior August survey, and again regionally the highest surface water nutrient concentrations (NO_3: 3.0-4.4 µM, Figure 4-15; SiO_4: 6.4-7.4 µM; PO_4: 1.4-1.7 µM). Concentrations in the inner nearfield were also elevated relative to the previous farfield survey (NO_3: 2-4 µM; SiO_4: 4-6 µM, PO_4: 1.2-1.4 µM). Densely spaced contours through the nearfield show the surface water gradient. Nitrate was strongly depleted regionally offshore of the gradient (commonly undetected [0.0 µM]), with all measured concentrations <0.4 µM (Figure 4-15). Silicate was less depleted regionally, with concentrations similar to the August farfield survey (2-3 µM). Consistently low PO_4 concentrations were also common outside of the central nearfield gradient (0.3-0.5 µM).

Overall, regional waters were depleted in nitrogen relative to phosphorus compared to the Redfield ratio of 16:1, especially in the surface water during the summer (Appendix D). The two main forms of nitrogen nutrients, nitrate and ammonium, had different distributions in Boston Harbor and along the coast relative to the more offshore stations. The NO_3:PO_4 ratio of harbor/coastal stations during the October survey was approximately 4:1, whereas the nearfield/boundary/offshore ratios were closer to 16:1. In contrast, the NH_4:PO_4 ratio of harbor/coastal stations was approximately 16:1, whereas the nearfield/boundary/offshore ratios were closer to 4:1. The higher NH_4:PO4 ratio in the harbor/coastal regions is due to the influence of the existing effluent plume and coastal upwelling.

4.2.2 Vertical Distribution

Farfield. Regionally, nutrient concentrations were depleted in surface water and increased with depth below the pycnocline during both farfield surveys (Figure 4-16). Surface water concentrations were slightly higher in Boston Harbor and along the coast, especially during the second October farfield survey (W9514). The overall increase of surface water nutrients measured in the harbor, coast, and nearfield during the October survey was evidence for the ongoing fall turnover, providing a catalyst for the fall bloom documented in the subsequent nearfield survey in early November (W9515). Transect plots of nutrient concentrations demonstrate the vertical stratification of nutrient concentrations, and the gradients throughout the water column between the harbor/inner nearfield and outer nearfield. A complete set of transect plots is provided in Appendix C.

In general, maximum surface water nutrient depletion in the late August survey (W9511) was in the upper 20 m outside of Boston Harbor, except for slightly elevated concentrations in the surface water at station F19 of the Boston-Nearfield transect (Figure 4-17 and Appendix C). The location of this elevated nutrient water mass was spatially coincident with the physical characteristics that indicated the presence of Gulf of Maine (GOM) water in the offshore region (Section 4-1). Inshore-offshore nutrient gradients between the harbor and nearfield region were apparent in the Boston-Nearfield transects, especially for PO_4 and dissolved inorganic nitrogen (DIN, consisting of nitrate, nitrite, and ammonium, Figure 4-18), both of which are influenced by the harbor effluent (PO_4, NH_4). The range of nutrient concentrations between the surface and bottom water during the August farfield survey were: 0-11 μM (NO_3); 0-17 μM (SiO_4), 0-1.7 μM (PO_4), and 0-17 μM (DIN).

During the mid-October farfield survey (W9514), maximum surface water nutrient depletion was concentrated in the outer nearfield/offshore regions for all nutrients measured (Figures 4-19, 4-20, Appendix C). Surface to bottom water gradients were slightly lower than during the August survey: 0-10 μM (NO_3); 0-15 μM (SiO_4), 0-1.4 μM (PO_4), and 0-16 μM (DIN). Reduced nutrient stratification was due to the nearfield mixing event documented by physical data, providing a catalyst for the fall turnover. Boston Harbor continued to provide a source of PO_4 and DIN (Figure 4-20).

Nearfield. Bottom water nutrient concentrations of nitrate, nitrite, and silicate increased from early August (W9510) to late September (W9513), with maximum NO_3+NO_2 concentrations increasing from 7.6 to 9.8 μM over that period of time (Figure 4-21), and maximum SiO_4 increasing from 12.6 to 14.2 μM. The harbor-influenced nutrients PO_4 and NH_4 showed more scatter with depth during these surveys (Appendix D), with the maximum PO_4 remaining steady at approximately 1.2 μM in bottom water, and NH_4 reaching minimum semi-annual concentrations in early September (W9512).

The onset of the fall turnover in the inner nearfield was apparent during the October survey (W9514), when the maximum concentrations of NO_3+NO_2 (Figure 4-22) and SiO_4 decreased by approximately 2 μM. During this early November survey, vertical stratification of nutrients had decreased with respect to nutrients, and were relatively uniform in the inner nearfield (Figure 4-22). Outer nearfield surface water remained nutrient-depleted. Although the subsequent nearfield survey in early November (W9515) was conducted during the late stages of the fall bloom (Section 5.0), surface water nutrient concentrations had increased and the highest semi-annual concentrations were measured in bottom water (NO_3+NO_2: 10.2μM; SiO_4: 13.3μM).

Nutrient concentrations measured during late November through December (W9516-17) were reduced overall primarily due to mixing of nutrient-depleted surface water with nutrient-enriched bottom water. The final semi-annual nearfield/winter nutrients survey in mid-December resulted in a very low range of nutrient concentrations throughout the well-mixed water column (8.1-8.6 µM, NO_3+NO_2; 7.7-10.4 µM, SiO_4; 0.9-1.0 µM, PO_4).

4.3 Chlorophyll *a*

4.3.1 Horizontal Distribution

During the first farfield survey in August (W9511), measured chlorophyll *a* concentrations were <1 µg/L in all farfield regions except Boston Harbor, the inner nearfield, along the coast, and at station F19 (2 µg/L; Figure 4-23). A late summer bloom, focused in the harbor, resulted in chlorophyll concentrations of >14 µg/L. The pattern of surface water chlorophyll suggests that the GOM water mass intrusion indicated at the northern area of the offshore region by physical data was relatively more productive than the surrounding water. The maximum surface water chlorophyll value was measured at station F31 (14.2 µg/L) in Boston Harbor.

The concentration range of chlorophyll was smaller during the October (W9514) farfield survey (0.3 to 4.7 µg/L), but concentrations were higher everywhere except in the harbor and along coast (Figure 4-24). There was no apparent regional chlorophyll pattern. The maximum concentration was measured at nearfield station N01 (4.7 µg/L).

4.3.2 Vertical Distribution

Farfield. The late summer bloom in August (W9511) resulted in maximum chlorophyll *a* concentrations (>10 µg/L) in Boston Harbor and along the coast. Chlorophyll was concentrated in the surface water of the coastal stations in the three regional transects (Figure 4-25). Farther offshore, maximum chlorophyll values of 4-5 µg/L were concentrated in the mid-water column, at approximately 20 m water depth.

Overall, chlorophyll concentrations measured during the October (W9514) survey in the farfield were reduced relative to those measured in August. Maximum chlorophyll values of >3 µg/L along the survey area transects were located at the outer nearfield stations (Boston-Nearfield transect), and at the center stations (F15, F16) of the Cohassett transect in the central offshore region (Figure 4-26). Chlorophyll production during this survey was concentrated in the surface water of the nearfield/offshore, with reduced growth in the harbor, potentially due to light limitation. Light attenuation was greatest during this time of year, reflecting heavy particulate load in the water column, especially in the harbor. The mixing event occurring at the beginning of the fall turnover suggested by continuous monitoring data collected in the outer nearfield (Section 4-1) was the likely cause of the localized nearfield/offshore bloom.

Nearfield. Chlorophyll *a* production during the first survey of the semi-annual period in early August (W9510) was limited, with a maximum of 2 μg/L concentrated in the inner nearfield (Figure 4-27). Consistently low mid-water chlorophyll (>1.2 μg/L) was present throughout the nearfield at approximately 10-20 m water depth.

The following combined nearfield/farfield survey in late August (W9511) resulted in chlorophyll concentrations of up to 15 μg/L in the nearfield. The late summer bloom was concentrated in the inner nearfield and in Boston Harbor (Figure 4-23). Maximum chlorophyll production was in the top 10 m. Farther offshore in the outer nearfield, chlorophyll concentrations of up to 4 μg/L were concentrated along isoclines in the water column at 10 and 20 m (compare Figure 4-27 and Figure 4-7).

The late summer bloom continued but was waning during the following nearfield survey in early September (W9512), with chlorophyll concentrations reaching a maximum of 12 μg/L, again concentrated in the inner nearfield (Figure 4-27). Outer nearfield concentrations had increased relative to the late August survey, however, to >6 μg/L along the 20 m isocline.

By late September (W9513), chlorophyll concentrations had decreased to <2 μg/L throughout the nearfield water column (Figure 4-28), except for the northwest region of the nearfield grid, where concentrations reached 6.3 μg/L in the surface water at nearfield station N12. The nearfield transect shows a relatively even distribution of chlorophyll in the upper 20 m, except for a gradient of reduced chlorophyll towards inner nearfield station N10.

Spurred by the onset of fall water column mixing, production of chlorophyll started to increase again in October (W9514), with maximum concentrations of 4-6 μg/L in the upper 10 m in the center of the nearfield (Figure 4-28). By the following survey in early November (W9515), the fall bloom was in full swing, with chlorophyll concentrations reaching 18 μg/L in the central nearfield around station N21. The highest semi-annual chlorophyll concentration was measured during this survey. Unlike the late summer-early fall bloom that was focused in the harbor and inner nearfield, chlorophyll production during the fall bloom was concentrated in the nearfield (Figure 4-29).

Following the fall bloom, chlorophyll production in the nearfield slowly petered out. The maximum concentration measured in late November (W9516) was 2.4 μg/L, and decreased to 0.6 μg/L by the last semi-annual survey in December.

4.4 Dissolved Oxygen

4.4.1 Regional Distribution

Dissolved oxygen (DO) was measured regionally during the two combined farfield/nearfield surveys in August and October, and at the Stellwagen Basin station (F12) during the late November survey (W9516). The reduction of bottom water DO through the stratified period is a primary issue for the HOM Program due to the importance of DO as an ecological indicator. In this section, results from the first two regional surveys will be discussed, and then the annual pattern of DO depletion in Stellwagen Basin bottom water will be presented.

The concentration of DO in the surface water in August (W9511) ranged from 7.3 mg/L in the harbor to 11.9 mg/l in the boundary region, and was oversaturated (>100% saturation) in the surface water of all regions except the harbor (98%; Figure 4-30). The vertically stratified water column resulted in lower DO concentrations below the pycnocline, ranging from 6.3 mg/L in the harbor and coastal regions, to 7.8 mg/L in the boundary region. DO was undersaturated in all bottom water, with percent saturation ranging from 71% (coastal, offshore) to 83% (Cape Cod Bay). Saturation in the deeper waters of the boundary region reached a minimum of 76%.

The range of DO concentration in the upper water column during the second farfield/nearfield survey in October (W9514) was smaller, from 7.1 mg/L in the harbor to 9.1 mg/l in the offshore region. Dissolved oxygen in the surface water was still oversaturated in all regions, again except in the harbor, that had a lower maximum DO saturation of 85% (Figure 4-31). During this survey, the distribution of maximum DO saturation (Figure 4-31) was similar to that of chlorophyll (Figure 4-26), indicating that the distribution DO was influenced by production in the upper water column.

In October, there was still a vertical gradient of DO in the water column, and overall bottom water DO concentrations were lower than in August, ranging from 5.6 mg/L in Cape Cod Bay to 6.7 mg/L in the boundary region. The Cape Cod Bay bottom water value was the minimum annual bottom water DO concentration, and was measured at station F02 during this survey. This value is less than the state standard value of 6 mg/L. The saturation of DO was slightly lower than the prior survey in August, ranging from 64% (Cape Cod Bay) to 76% (harbor). Saturation in the deeper waters of the boundary region reached a minimum of 71%.

To further delineate the annual cycle of DO depletion, the annual average DO data from the four deep Stellwagen Basin stations (F12, F17, F19, and F22) were plotted for surface (A) and bottom (E) water samples (Figure 4-32). The concentration and saturation of DO reached a minimum value in the bottom water of Stellwagen Basin during the October (W9514) farfield/nearfield survey (6.7, 71%), and increased to surface water levels during the late November survey (W9516), indicating a well-mixed winter water column with respect to DO. Trends in the variation of DO concentration in bottom water throughout 1995 were similar to DO saturation. Surface water DO, although decreasing throughout the spring and summer, was oversaturated from June-October. Both the surface and bottom water during the final Stellwagen Basin survey in late November, following the fall turnover, showed that DO was slightly undersaturated (91%).

4.4.2 Nearfield Distribution

Average nearfield DO concentrations in nearfield surface water generally ranged from 8-9 mg/L throughout the semi-annual period, with the minimum semi-annual concentration measured in late August (8 mg/L; W9511). The highest average concentration of >9 mg/L was measured in early September (W9512) and during the final semi-annual survey in December. Bottom water average DO concentrations declined from >8 mg/L measured during the first nearfield survey in early August (W9510) to 6.5 mg/L in late September (W9513). Bottom water average DO then began to increase to >7 mg/L in October, to surface water concentrations in late November-December after the fall turnover.

The trends of average DO saturation generally followed those of DO concentration. Dissolved oxygen in the surface water of the nearfield was saturated throughout the late summer and fall, reaching a peak average saturation value of approximately 120% in early September (W9512). Surface water DO remained oversaturated until the early November survey (W9515), and was undersaturated (90-100%) through the end of the semi-annual period. Bottom water was undersaturated during the whole semi-annual period, displaying the same decreasing trend as DO concentration through W9513 in late September, and then increasing to the end of the monitoring period.

The distribution of DO saturation in the water column commonly followed trends of maximum chlorophyll production. During the late summer/early fall bloom (W9511) documented by high chlorophyll concentrations in the harbor and inner nearfield (Figure 4-27), areas of maximum DO saturation (Figure 4-33) were located at areas of maximum chlorophyll production in the surface water of the inner nearfield, and in mid-water of the central and outer nearfield. As chlorophyll production moved farther offshore into the central and outer nearfield during the next survey in early September (W9512), DO saturation reached levels of >110% in outer nearfield surface water. The next period of fall production in October (W9514) and early November (W9515), both chlorophyll and DO saturation reached maximums in the surface waters of the central nearfield (Figures 4-28, 4-34).

4.5 Summary of Water Column Results

Physical Characteristics

- Regional surface water temperatures were very warm (>19°C) in late August (W9511), with an area of cooler surface water (17-19°C) at the northern end of the offshore/nearfield area, related to an intrusion of Gulf of Maine water;

- Water column stratification during late August primarily was due to water temperature, which ranged from 5°C in bottom water to 19°C in surface water;

- Transect data from late August show a patch of cooler, less saline water at the surface at Station F19, indicating influence from the Gulf of Maine intrusion;

- The density of inner nearfield bottom water dropped by almost 1.0 in late September (W9513) due to a lens of less saline water originating from Boston Harbor;

- Salinity increased in the outer nearfield, however, between early (W9512) and late (W9513) September, resulting in a salinity transition through the middle of the nearfield and a resultant complex vertical density structure;

- The fall turnover was in progress by the early fall (W9514, mid-October), with the water column remaining vertically stratified in the offshore and boundary regions, while $\Delta\sigma_t$ ranged from 0 to -1.0 in Boston Harbor, Cape Cod Bay, and the coastal regions;

- A reduction in the surface-bottom water temperature gradient was primarily responsible for the breakdown of the summer pycnocline;

- A mixing event that resulted in rapid warming of bottom waters of the outer nearfield documented by continuous monitoring data resulted in a breakdown of vertical stratification in mid-October (W9514) in the outer nearfield;

Nutrients

- During both combined nearfield/farfield surveys conducted in the semi-annual period, nutrients in the surface water were low, especially outside of Boston Harbor, which had the highest surface water concentrations of all nutrients measured;

- Elevated surface water nutrients were associated with the GOM water mass in the northern offshore region indicated by physical data;

- The inshore-offshore nutrient gradient of PO_4 and DIN (NH_4) between the harbor and nearfield region was due to influence of harbor effluent;

- Nearfield bottom water nutrient concentrations increased from early August (W9510) to late September (W9513);

- The relative increase of surface water nutrient concentrations measured in the harbor, coast, and inner nearfield during the October (9514) survey evidenced the ongoing fall turnover, providing a catalyst for the fall bloom documented in the subsequent nearfield survey in early November (W9515);

Chlorophyll

- The late summer bloom measured during the August combined nearfield/farfield survey (W9511) resulted in maximum chlorophyll *a* concentrations in the upper water column of Boston Harbor (14.2 µg/L), the inner nearfield (15 µg/L), and along the coast (11.8 µg/L);

- Farther offshore in the outer nearfield in late August (W9511), chlorophyll concentrations of up to 4 µg/L were concentrated along isoclines in the water column at 10 and 20 m;

- The subsequent nearfield survey in early September (W9512) showed that the late summer bloom was waning in the inner nearfield, but outer nearfield chlorophyll had increased to >6 µg/L along the 20 m isocline;

- With the onset of the fall turnover in October (W9514), production of chlorophyll was focused in the outer nearfield, with maximum concentrations of 4-6 µg/L in the upper 10 m in the center of the nearfield;

- The following nearfield survey in early November (W9515) was conducted during the height of the fall bloom, with the highest semi-annual chlorophyll concentrations measured, reaching 18 µg/L in the central nearfield around station N21;

Dissolved Oxygen

- The lowest regional DO concentrations were measured during the combined nearfield/farfield survey in October (W9514), ranging from 5.6 mg/L in Cape Cod Bay to 6.7 mg/L in the boundary region;

- The minimum annual value of 5.6 mg/L was measured at station F02, which was less than the state standard value of 6 mg/L;

- Average Stellwagen Basin concentration and saturation values reached bottom water minima during October (W9514), and increased to surface water levels during the late November survey (W9516);

- In the nearfield, average bottom water DO concentrations declined from >8 mg/L in early August (W9510) to 6.5 mg/L in late September (W9513), and then began to increase to >7 mg/L in October (W9514), to surface water concentrations after the fall turnover;

- The distribution of DO saturation in the water column commonly followed trends of maximum chlorophyll production.

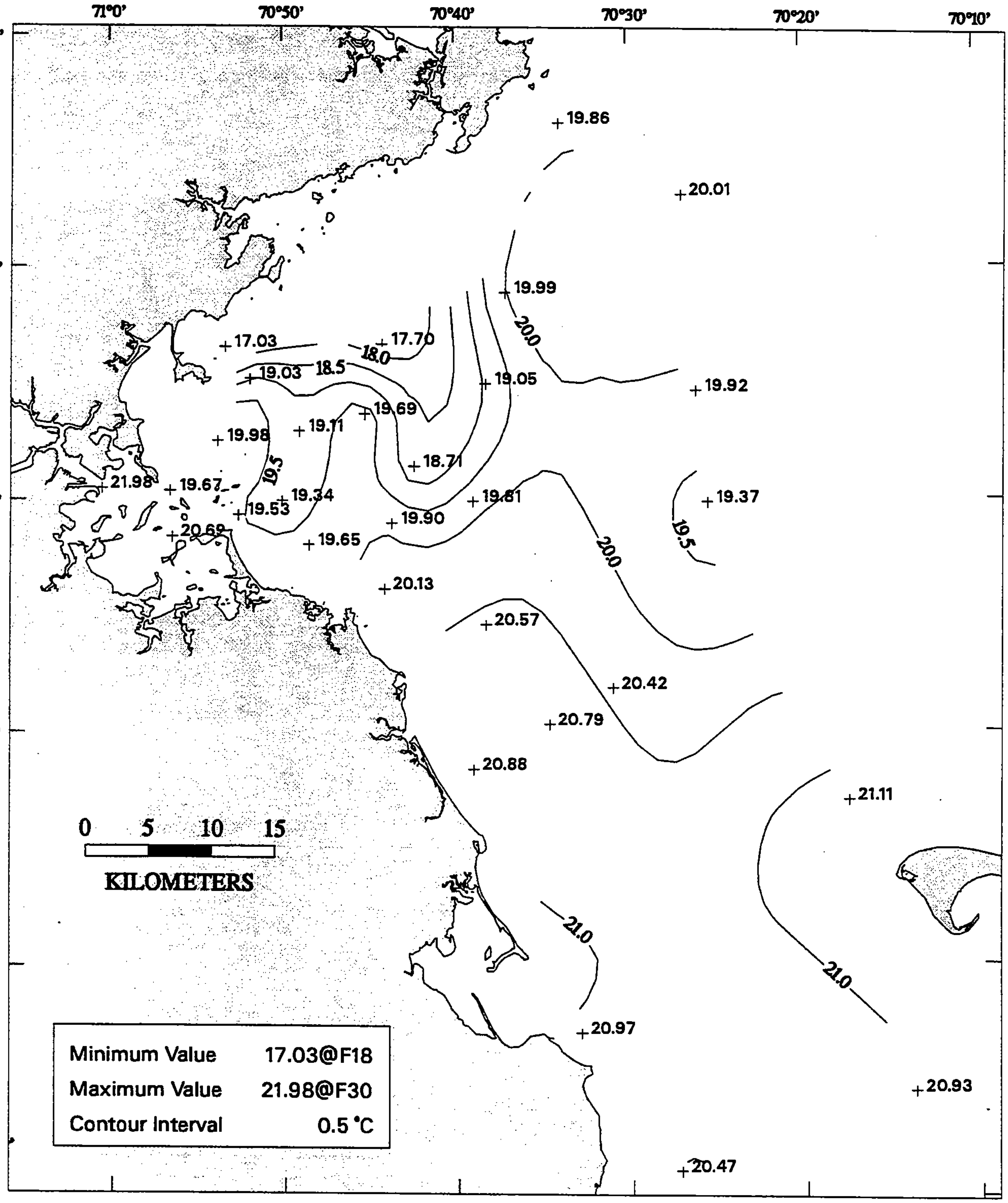


FIGURE 4-1
Surface Water Contour Plot of Temperature (°C) in Late August (W9511)

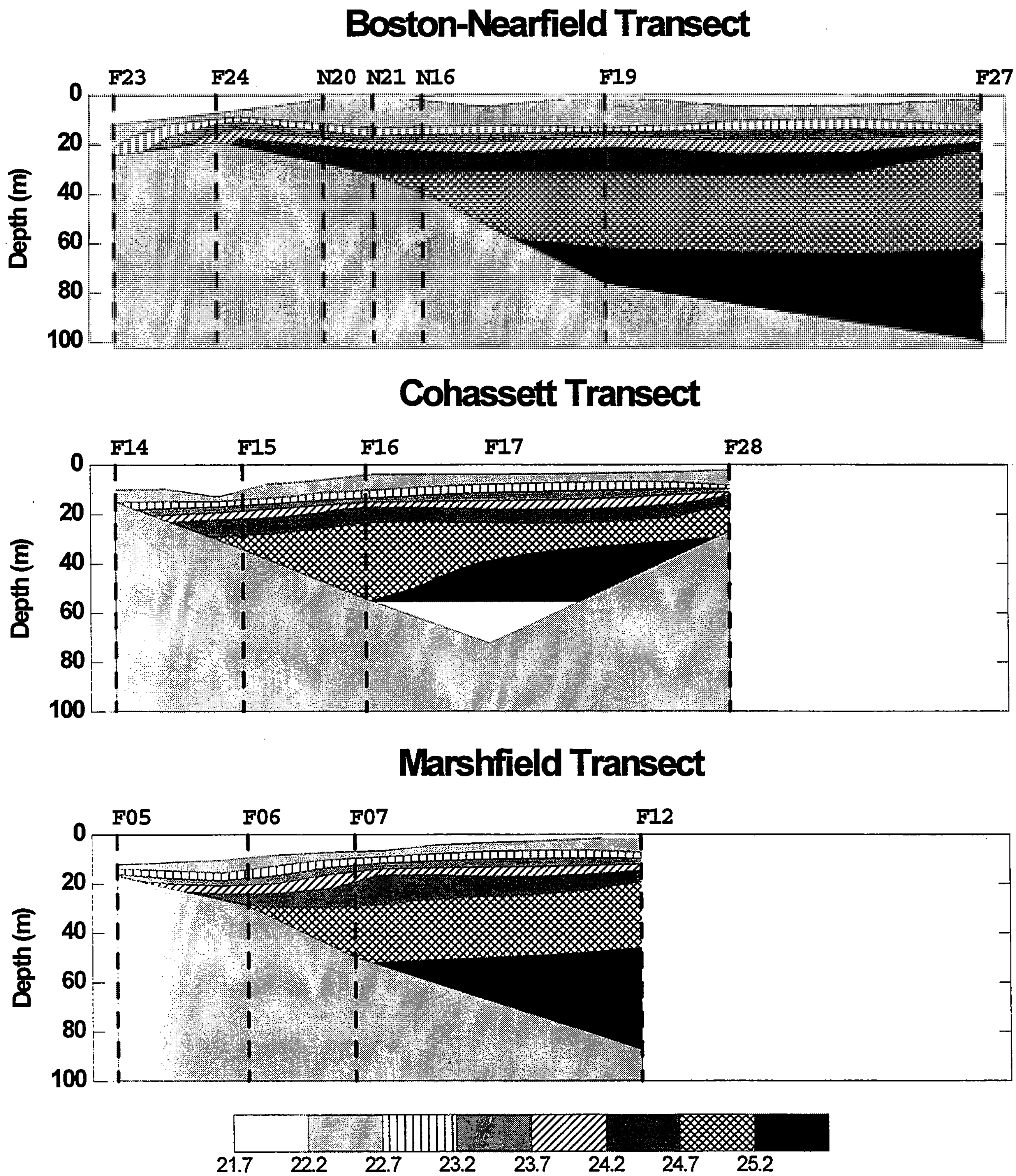


FIGURE 4-2
Density (σ_t) Contours Along Three Farfield Transects in Late August (W9511)

Sigma-T 9511

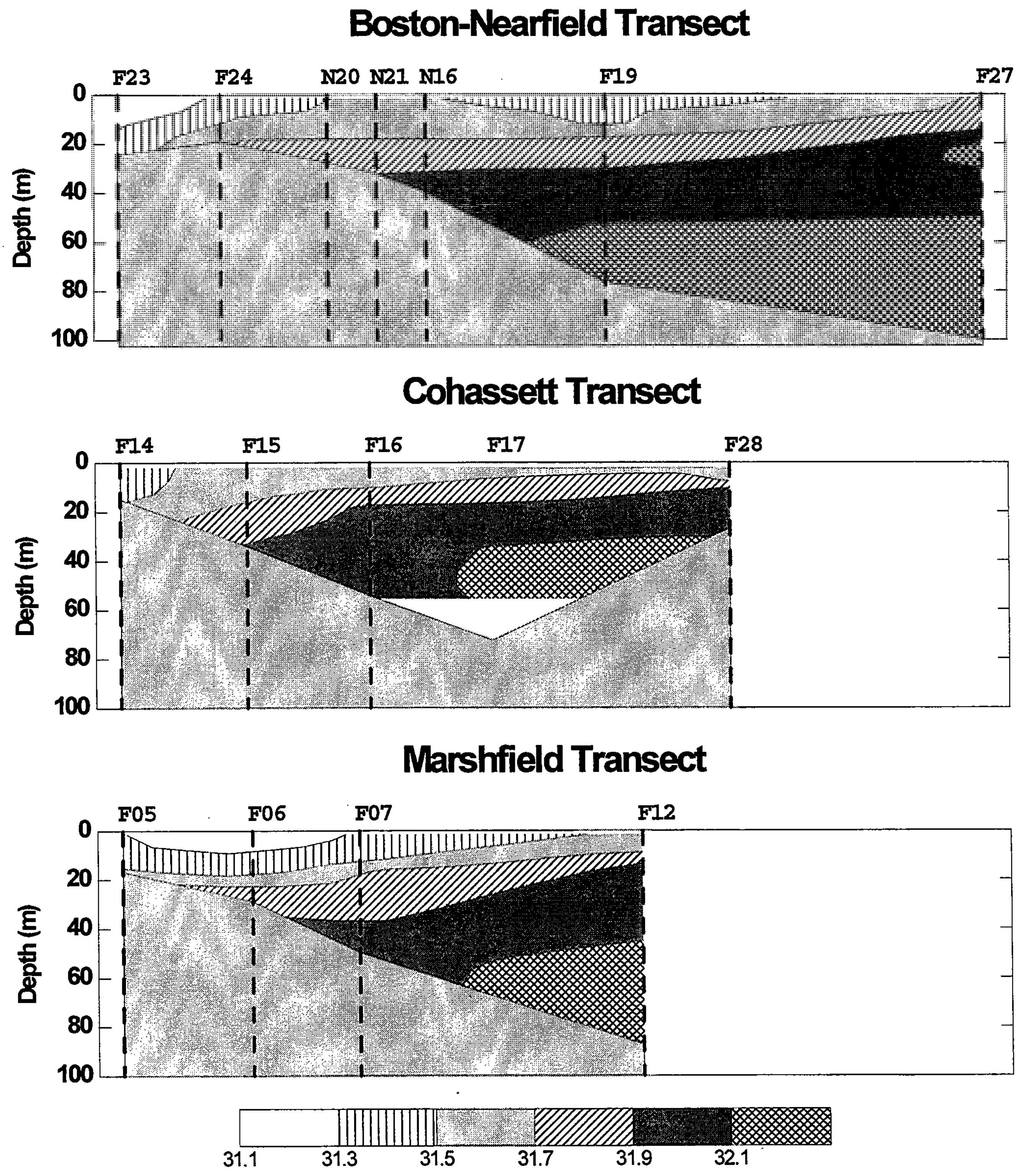


FIGURE 4-3
Salinity (PSU) Contours Along Three Farfield Transects in Late August (W9511)

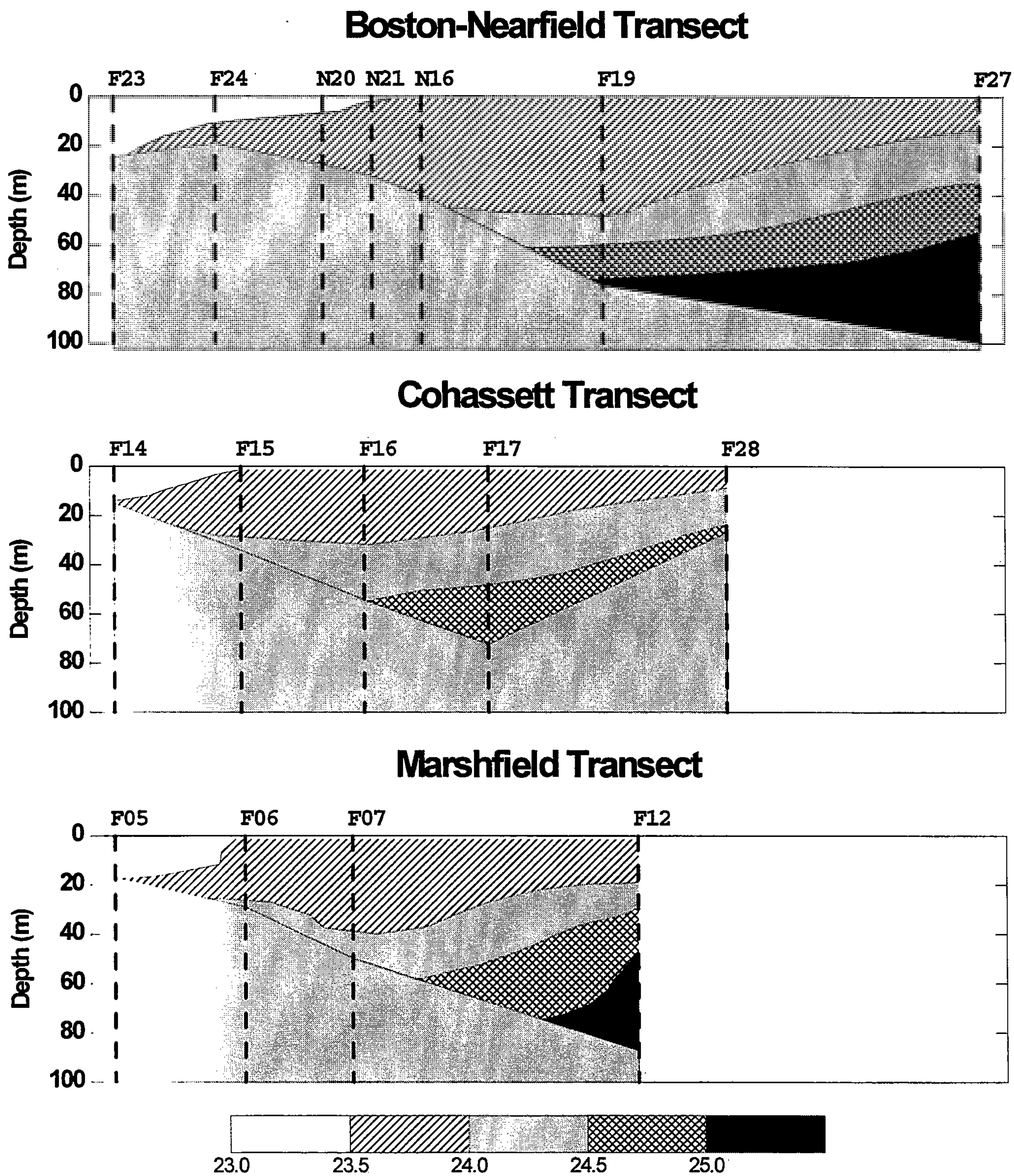


FIGURE 4-4
Density (σ_t) Contours Along Three Farfield Transects in October (W9514)

Sigma-T 9514

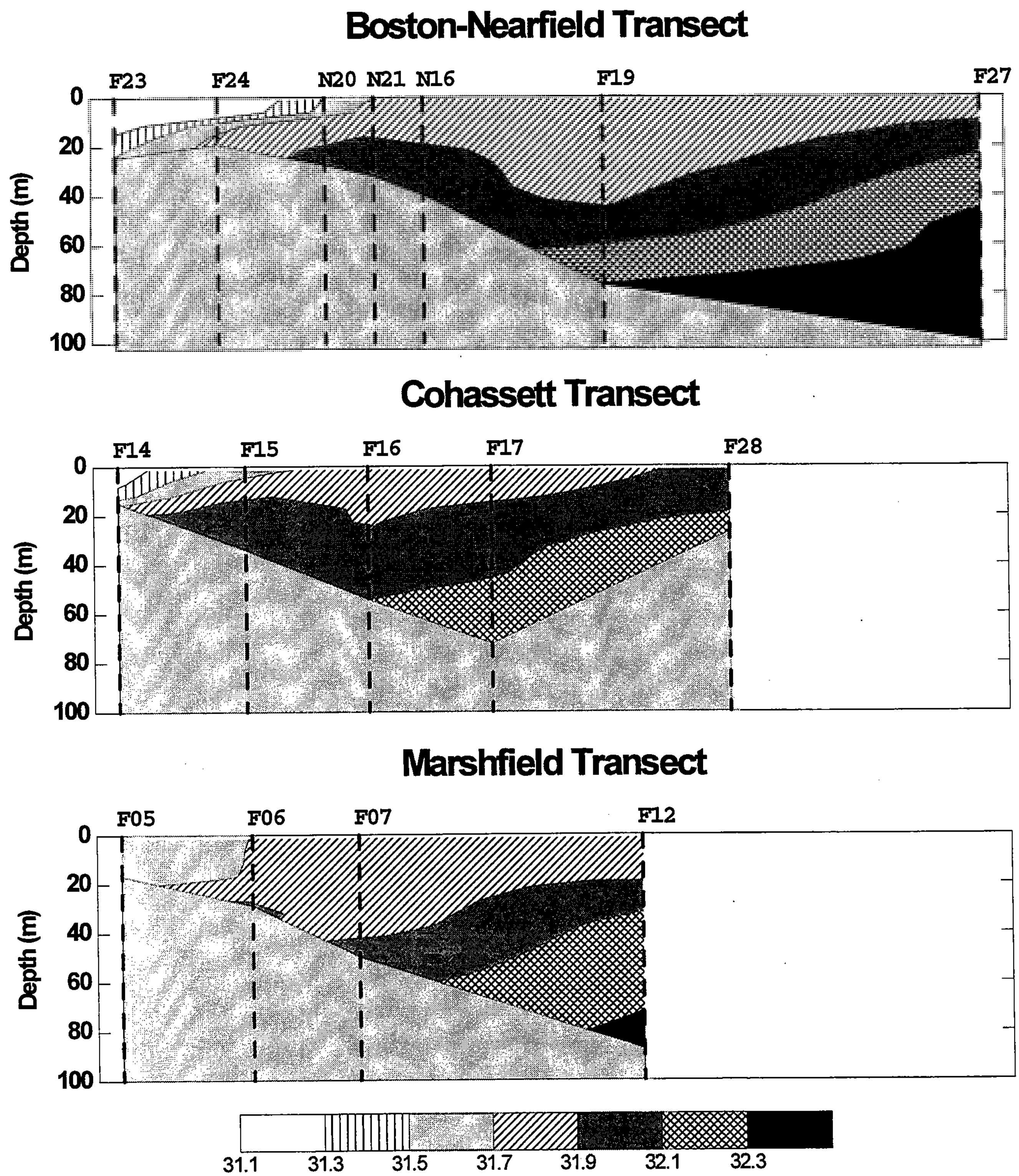
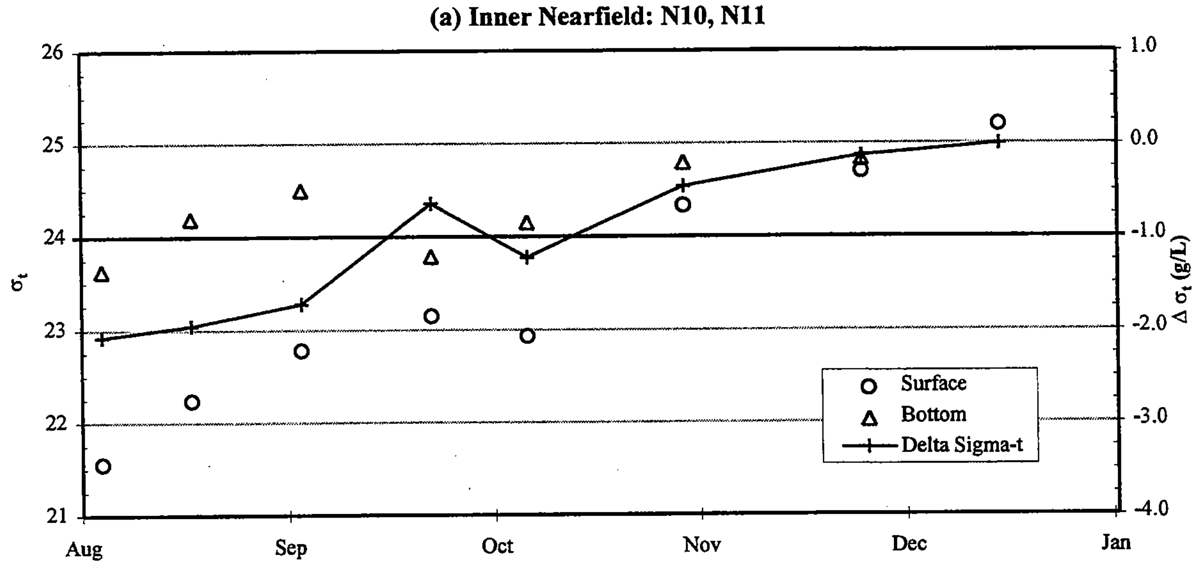


FIGURE 4-5
Salinity (PSU) Contours Along Three Farfield Transects in October (W9514)



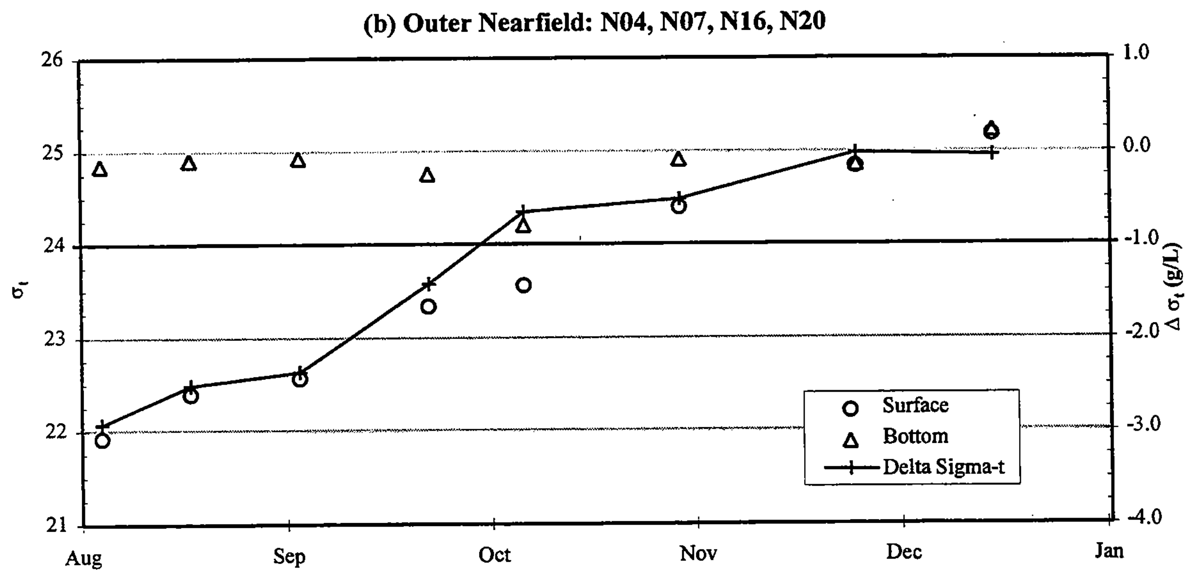


FIGURE 4-6

Time-Series of Average Surface and Bottom Water Density (σ_t) and $\Delta\sigma_t$ in the (a) Inner and (b) Outer Nearfield

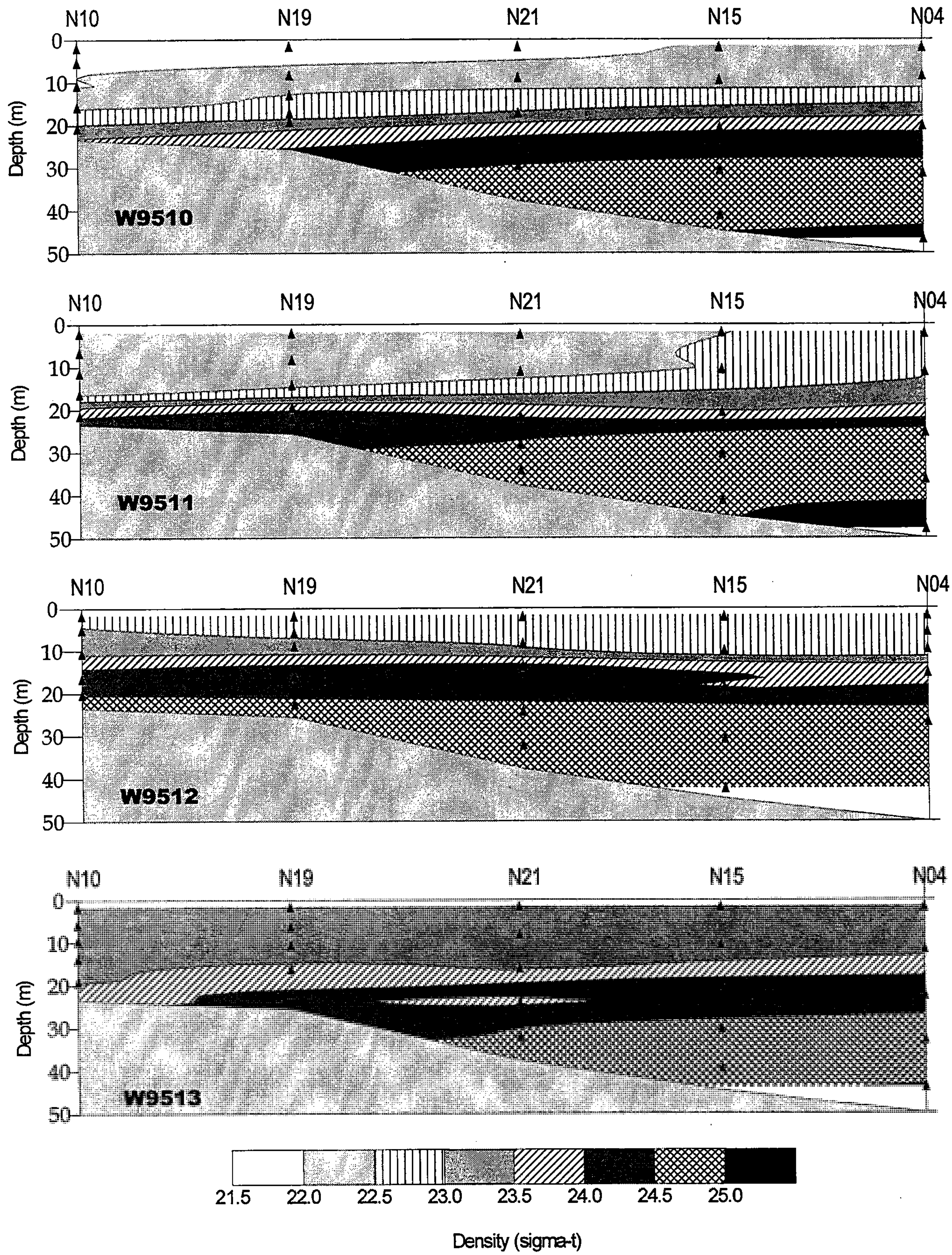


FIGURE 4-7
Density (σ_t) Contours Along Nearfield Transect During the First Four Nearfield Surveys

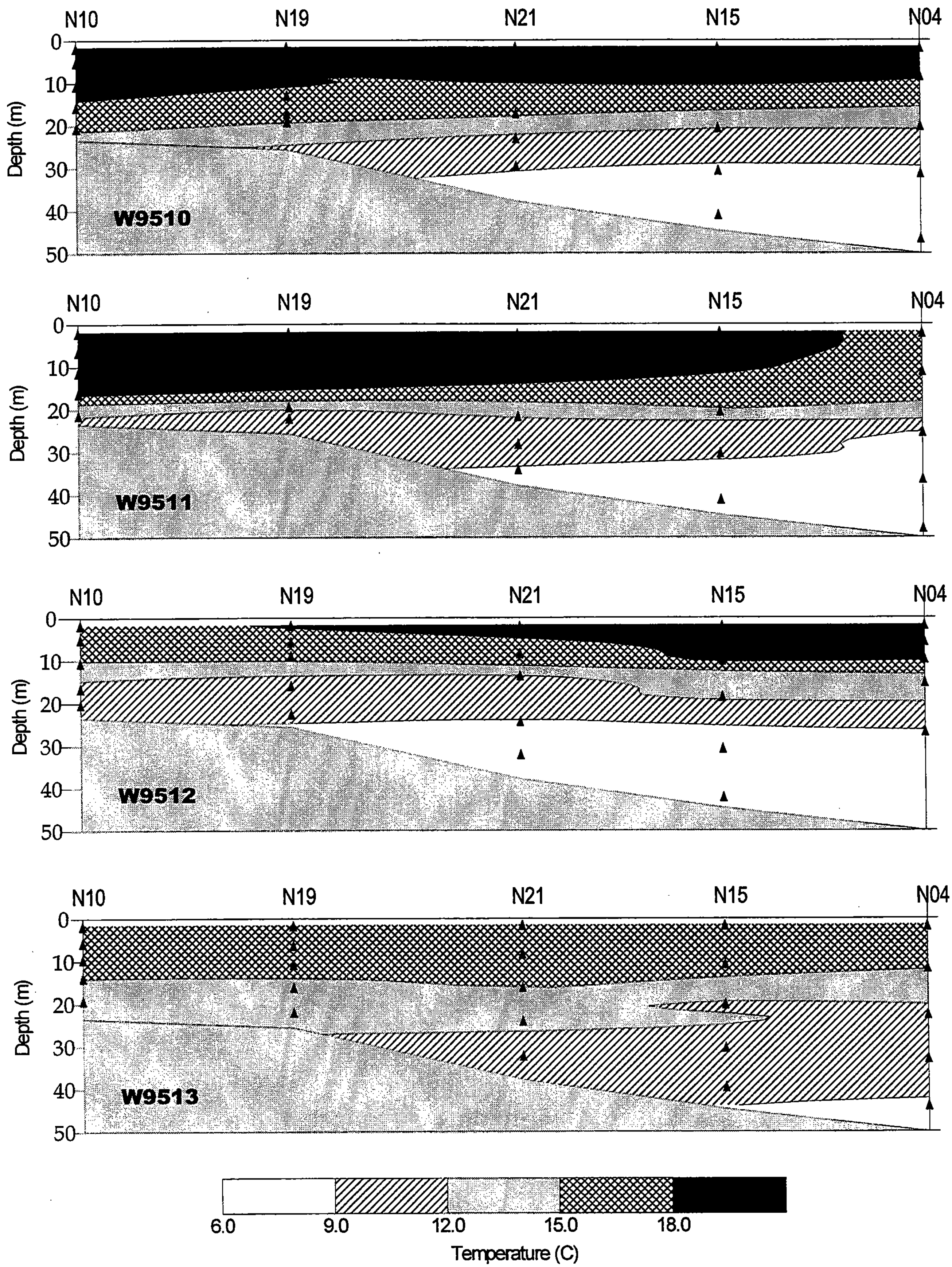


FIGURE 4-8
Temperature (°C) Contours Along Nearfield Transect During the First Four Nearfield Surveys

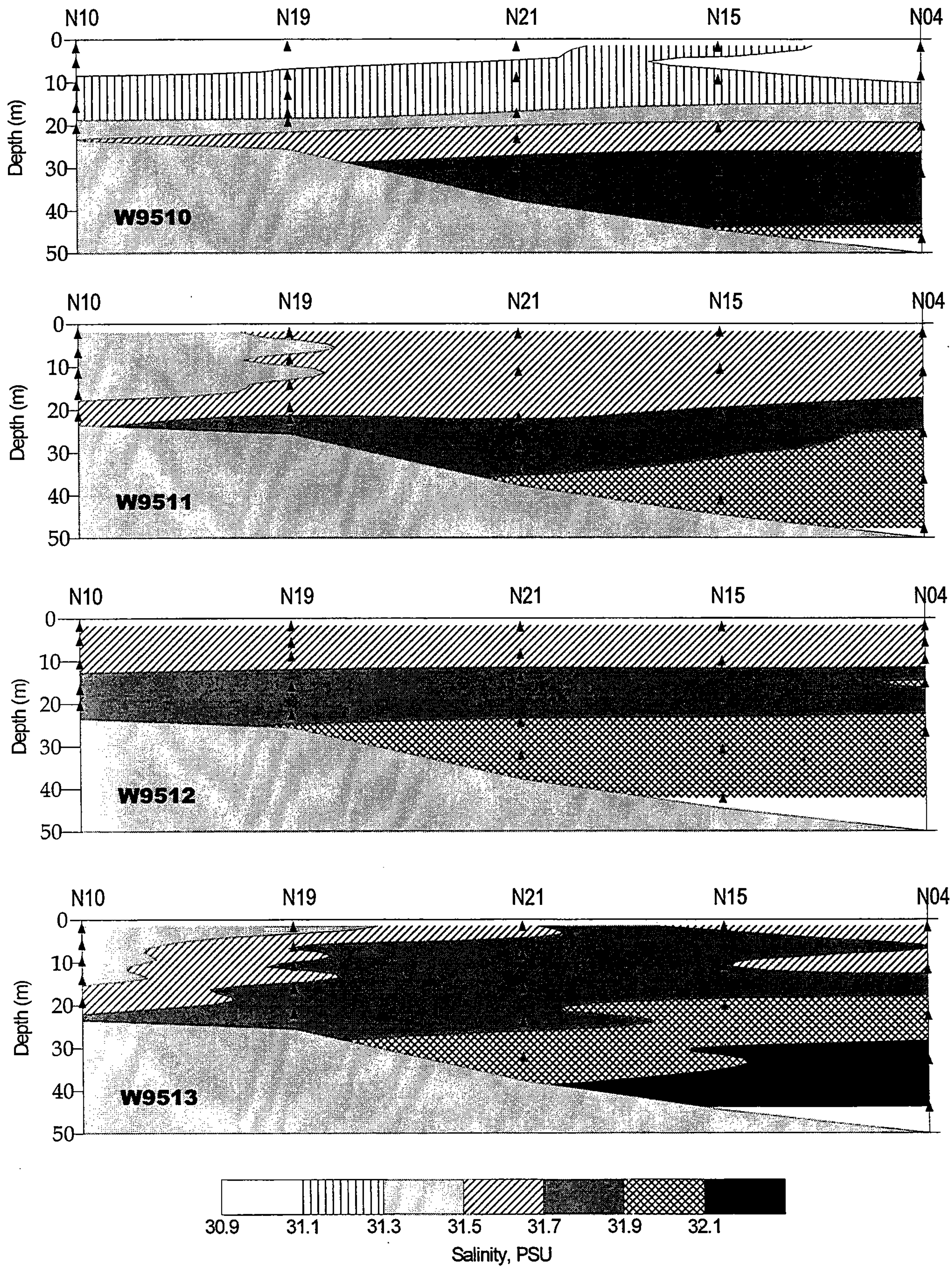


FIGURE 4-9
Salinity (PSU) Contours Along Nearfield Transect During the First Four Nearfield Surveys

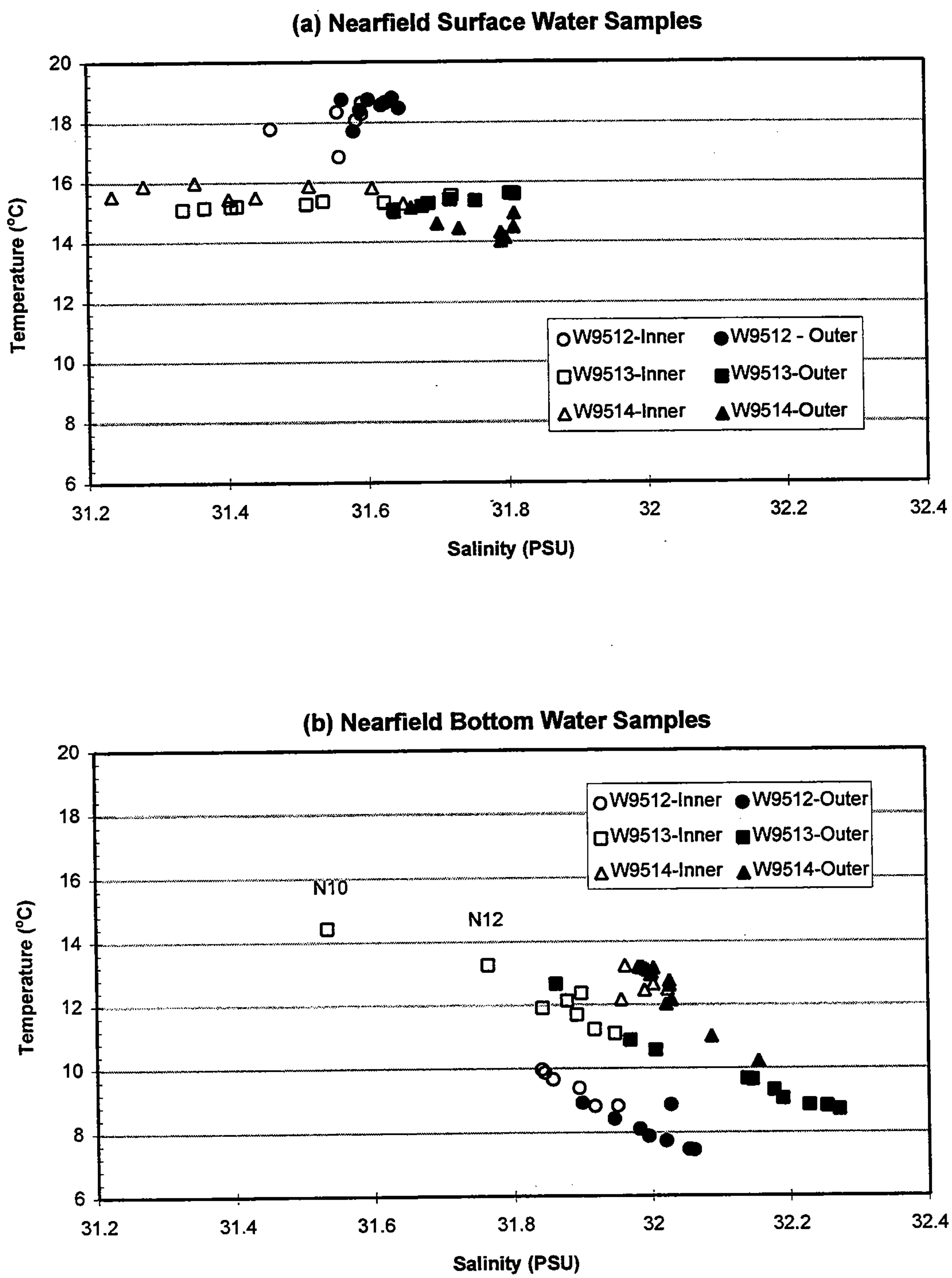


FIGURE 4-10

Nearfield Temperature/Salinity Data for (a) Surface and (b) Bottom Water During September (W9512-13) and October (W9514)

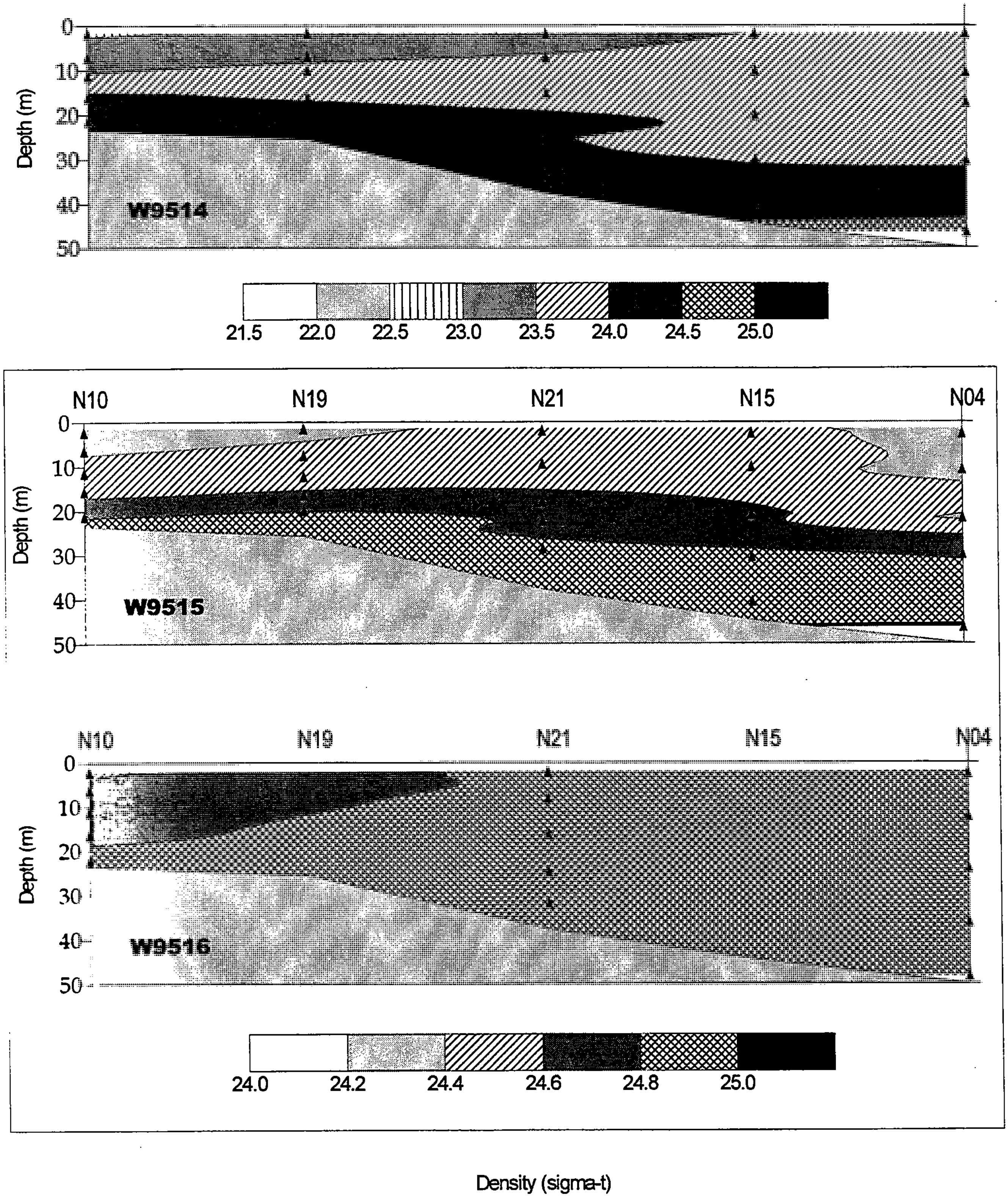


FIGURE 4-11
Density (σ_t) Contours Along Nearfield Transect After the Fall Turnover

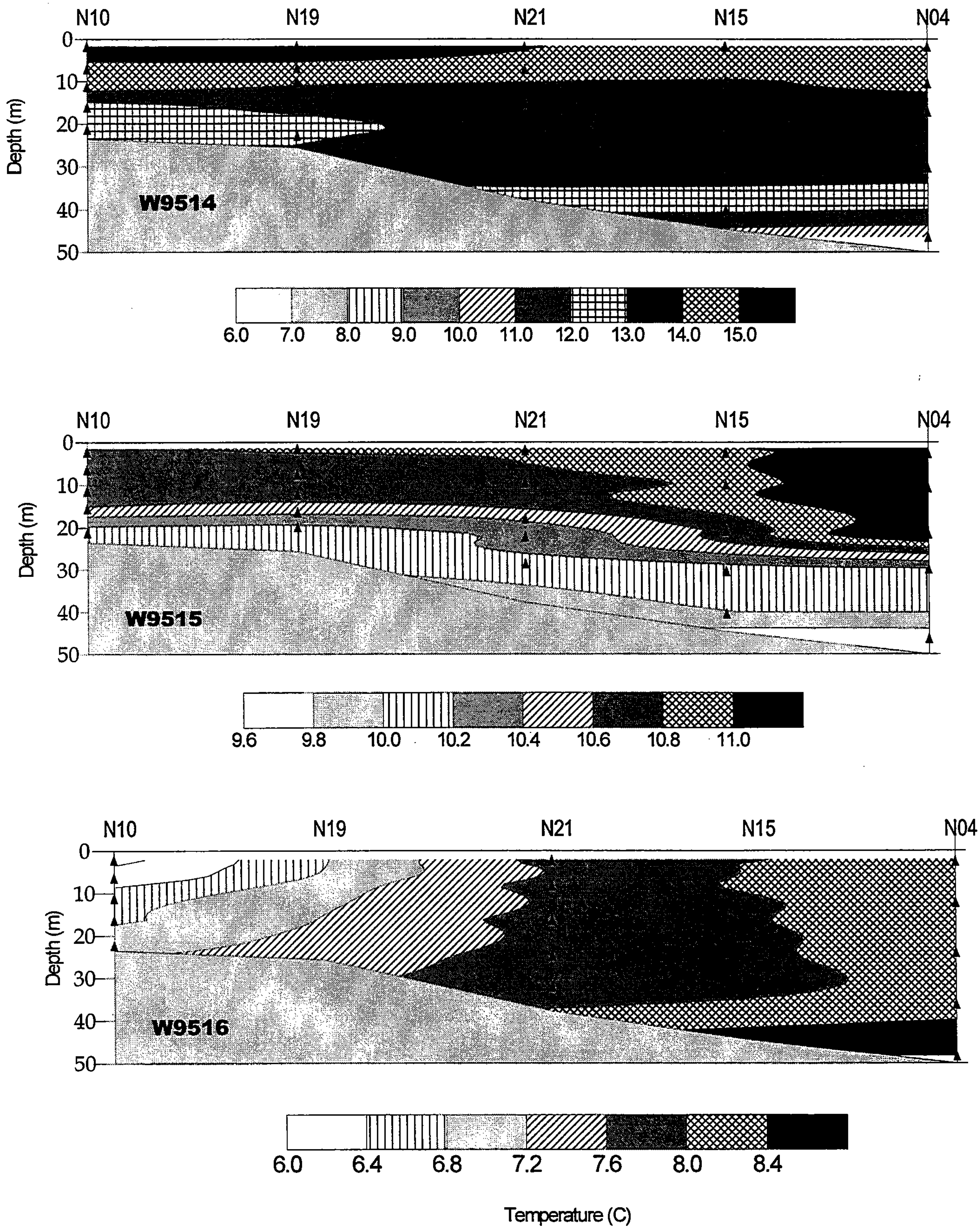


FIGURE 4-12
Temperature (°C) Contours Along Nearfield Transect After the Fall Turnover

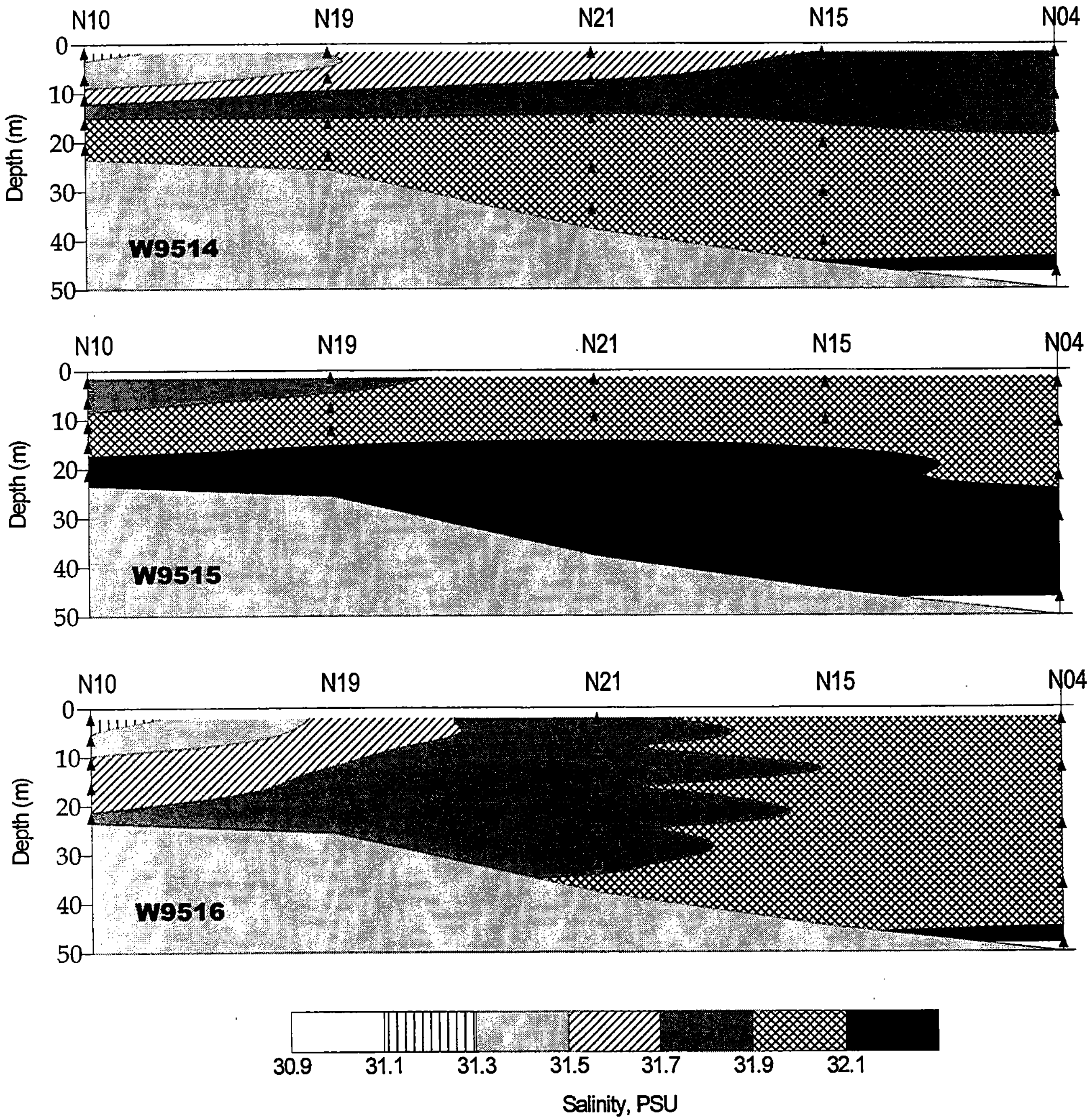


FIGURE 4-13
Salinity (PSU) Contours Along Nearfield Transect After the Fall Turnover

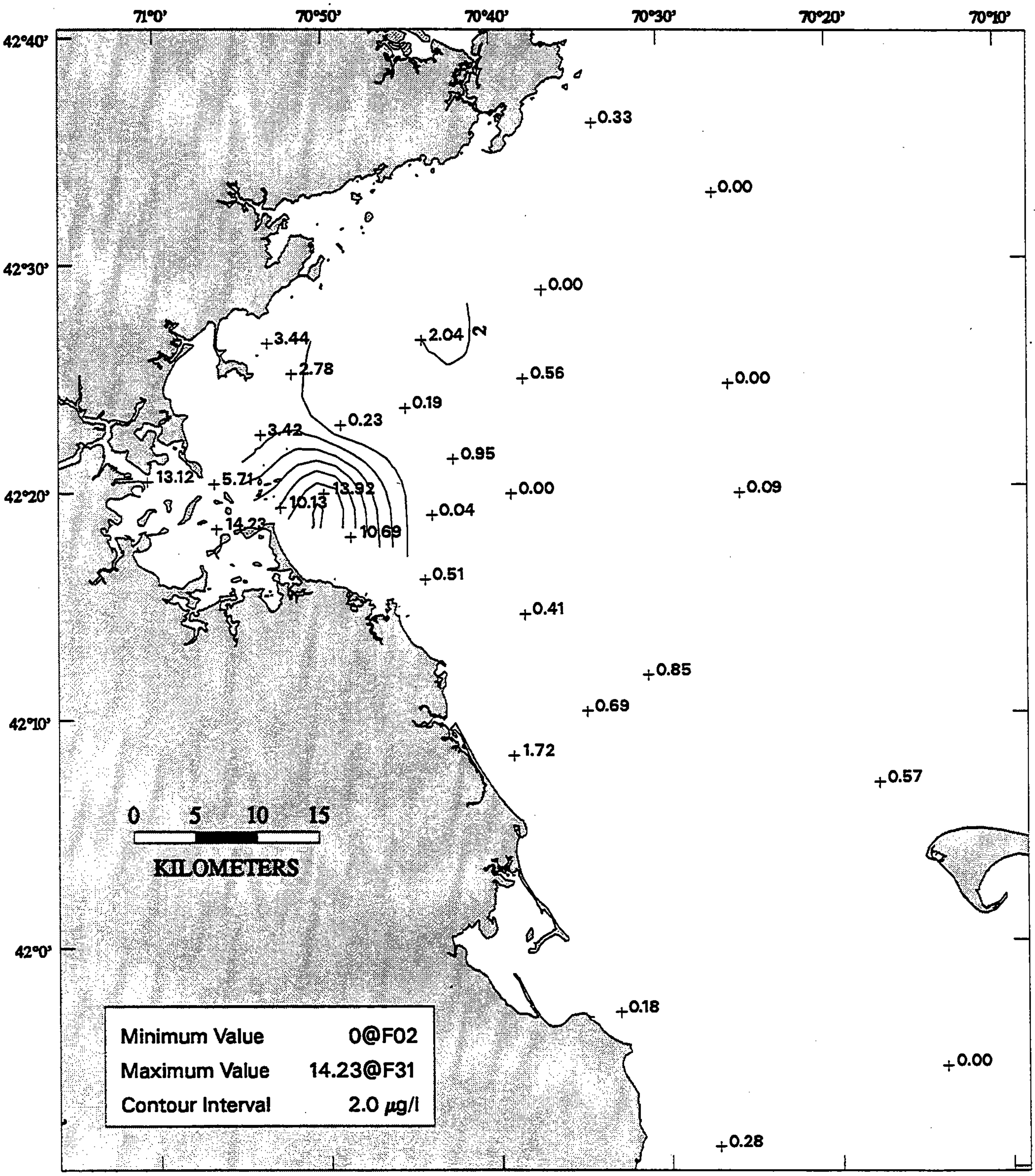


FIGURE 4-14
Surface Water Contour Plot of Nitrate (μM) in Late August (W9511)

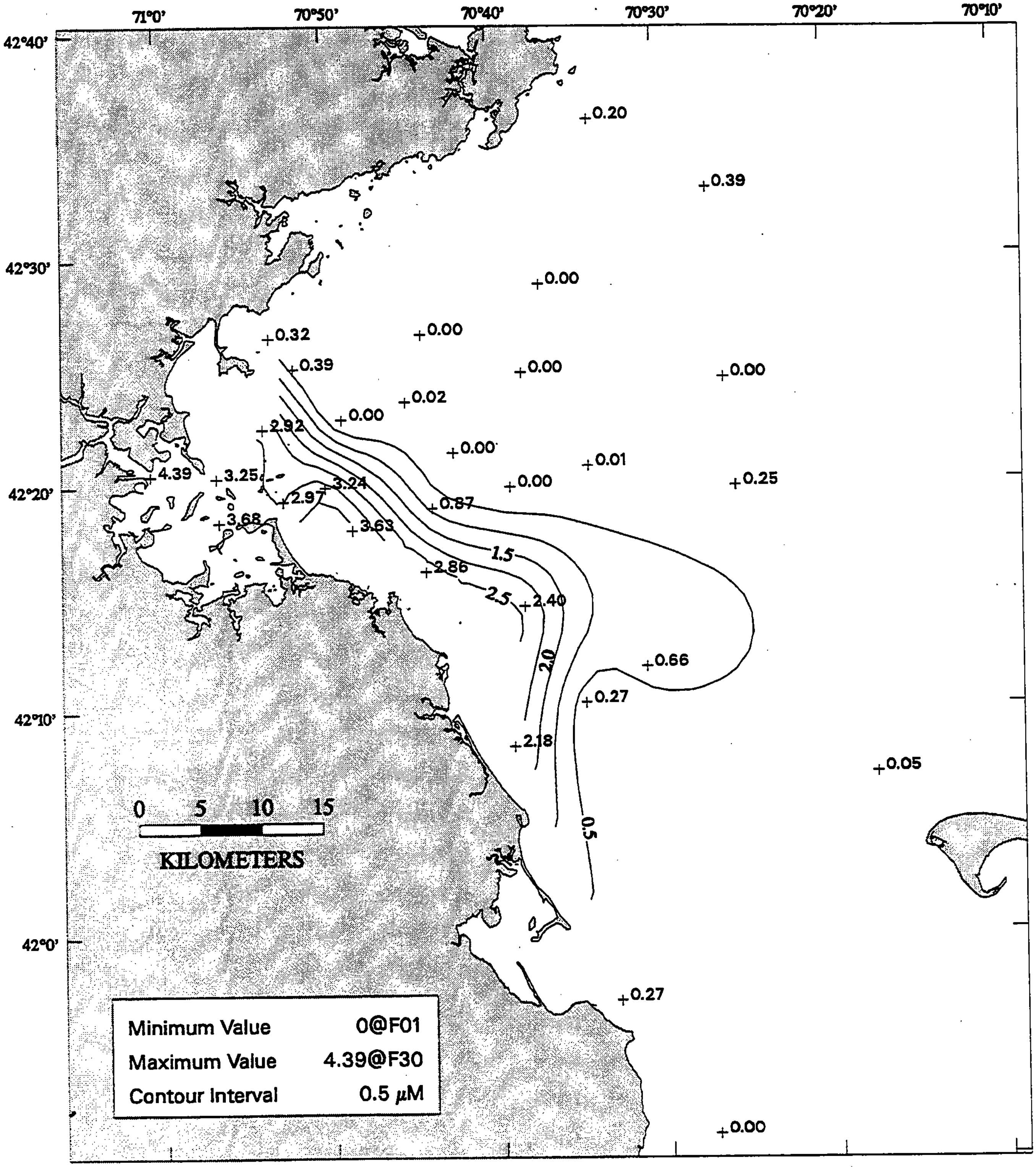
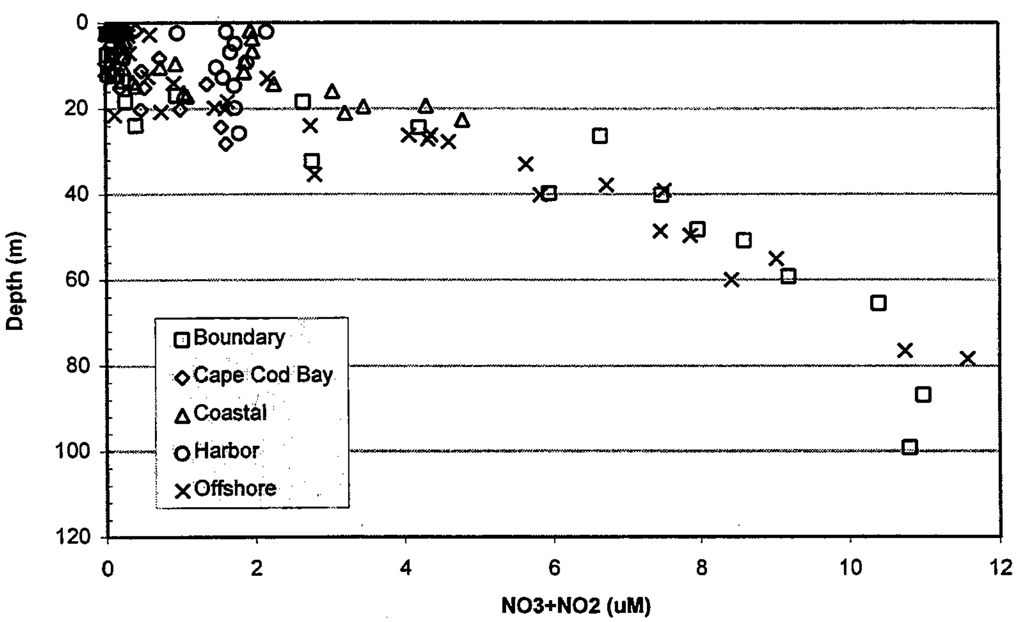


FIGURE 4-15
Surface Water Contour Plot of Nitrate (µM) in October (W9514)

(a) W9511



(b) W9514

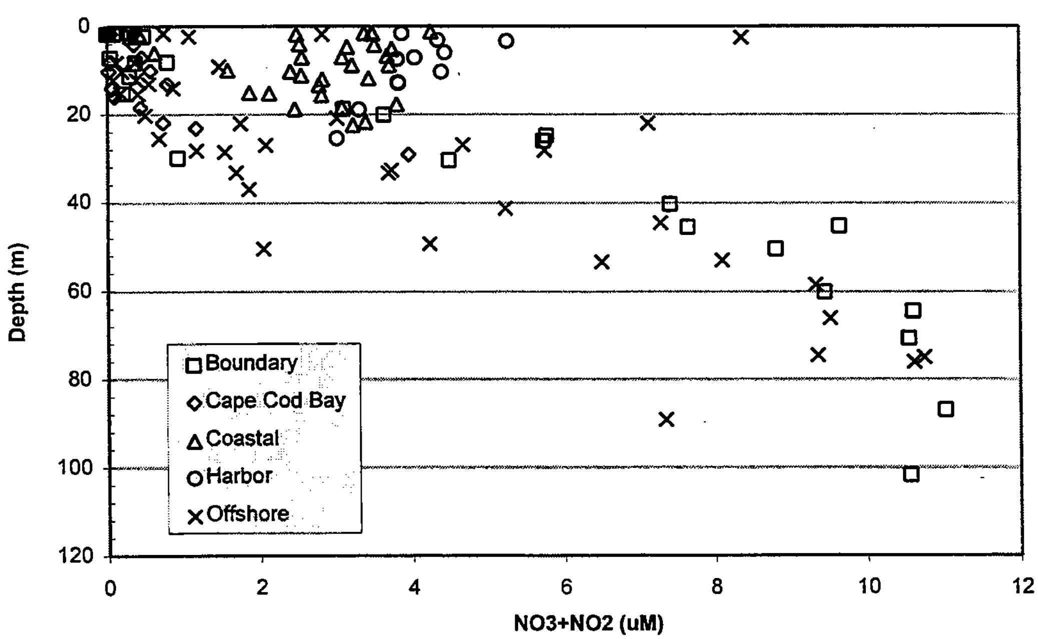


FIGURE 4-16
Nitrate+Nitrite (μM) Concentrations With Depth in
(a) Late August (W9511) and (b) October (W9514)

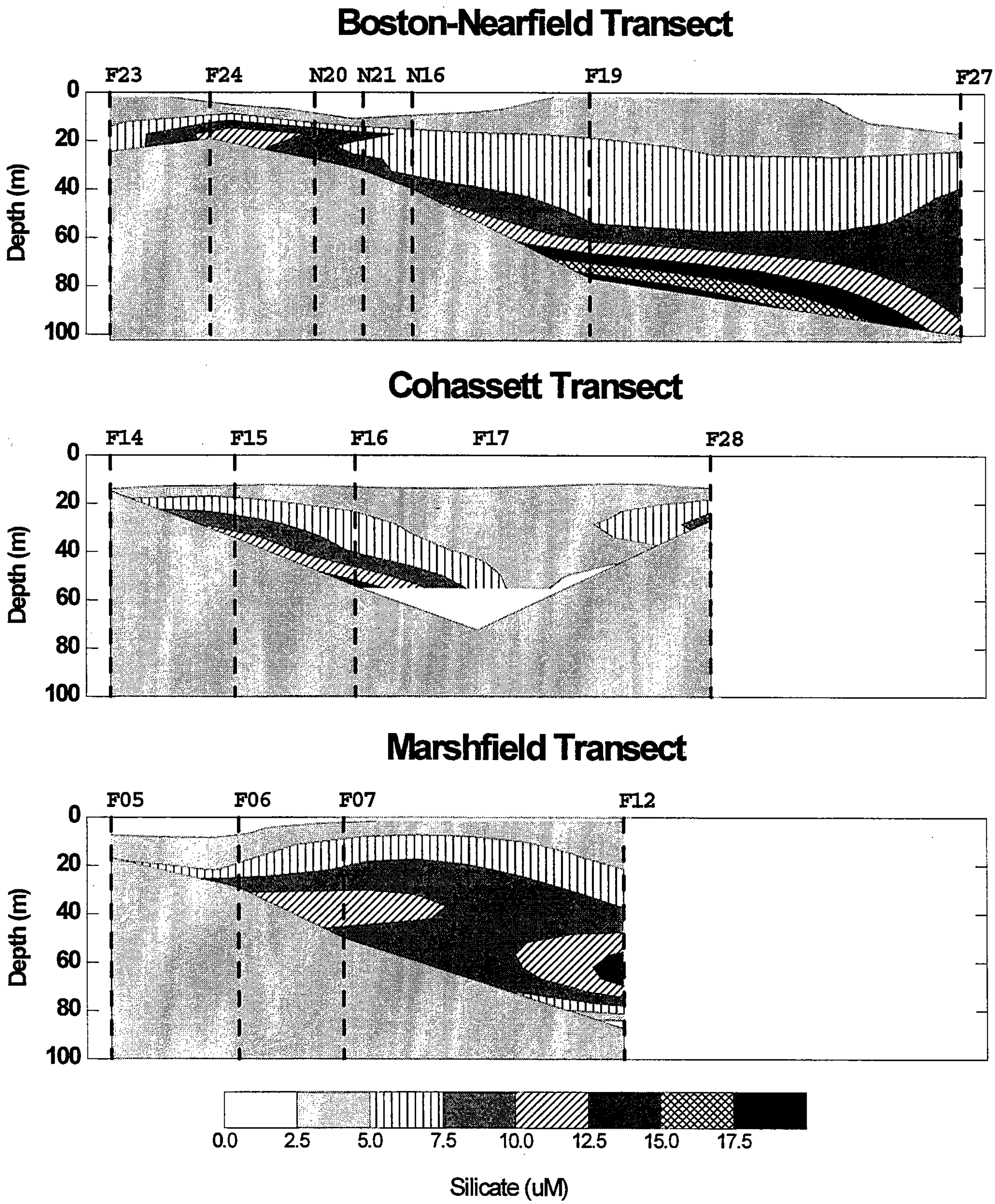


FIGURE 4-17
Silicate Concentration (μM) Contours Along Three Farfield Transects in Late August (W9511)

SIO4 9511

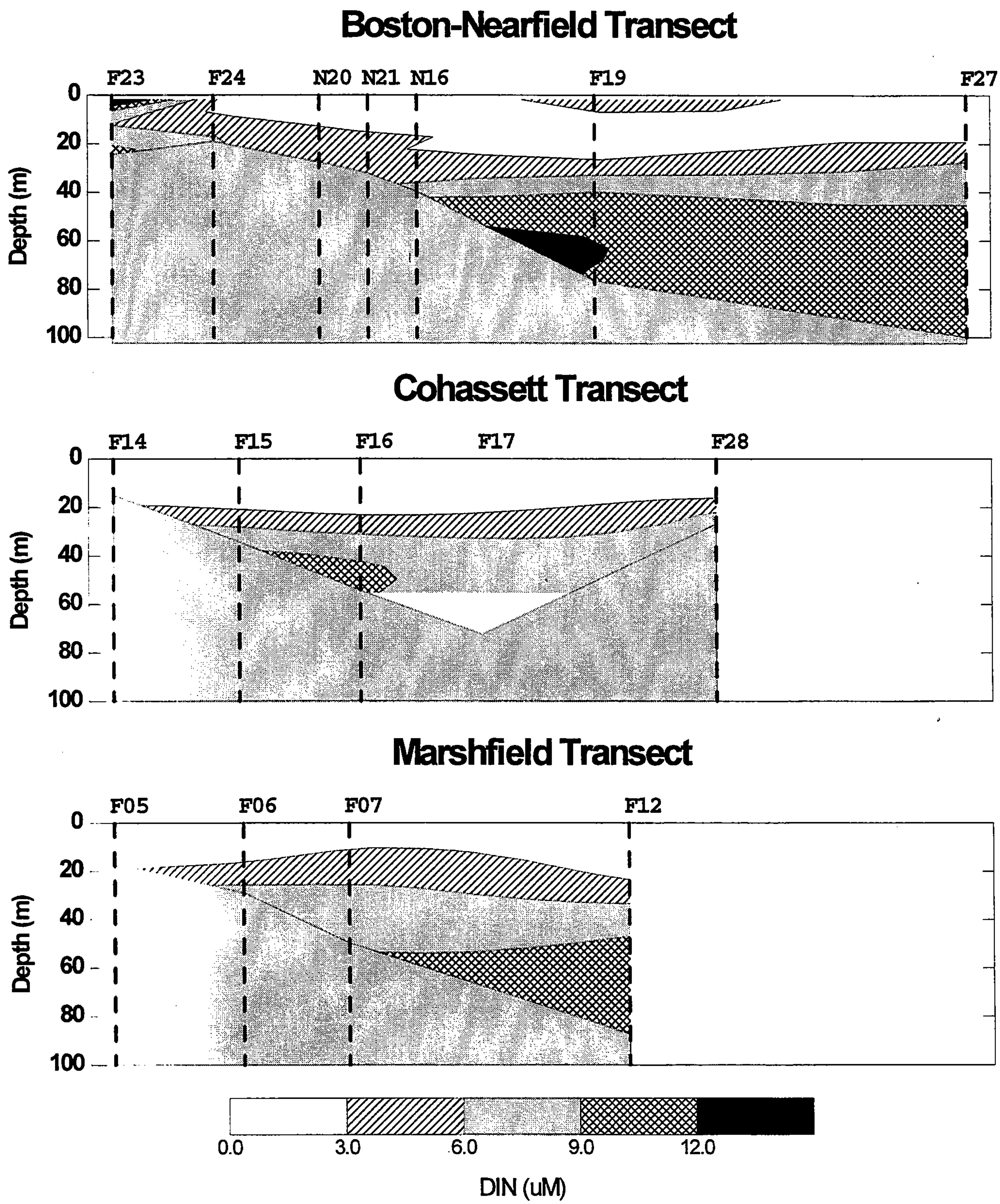


FIGURE 4-18
Dissolved Inorganic Nitrogen (DIN, μM) Contours Along
Three Farfield Transects in Late August (W9511)

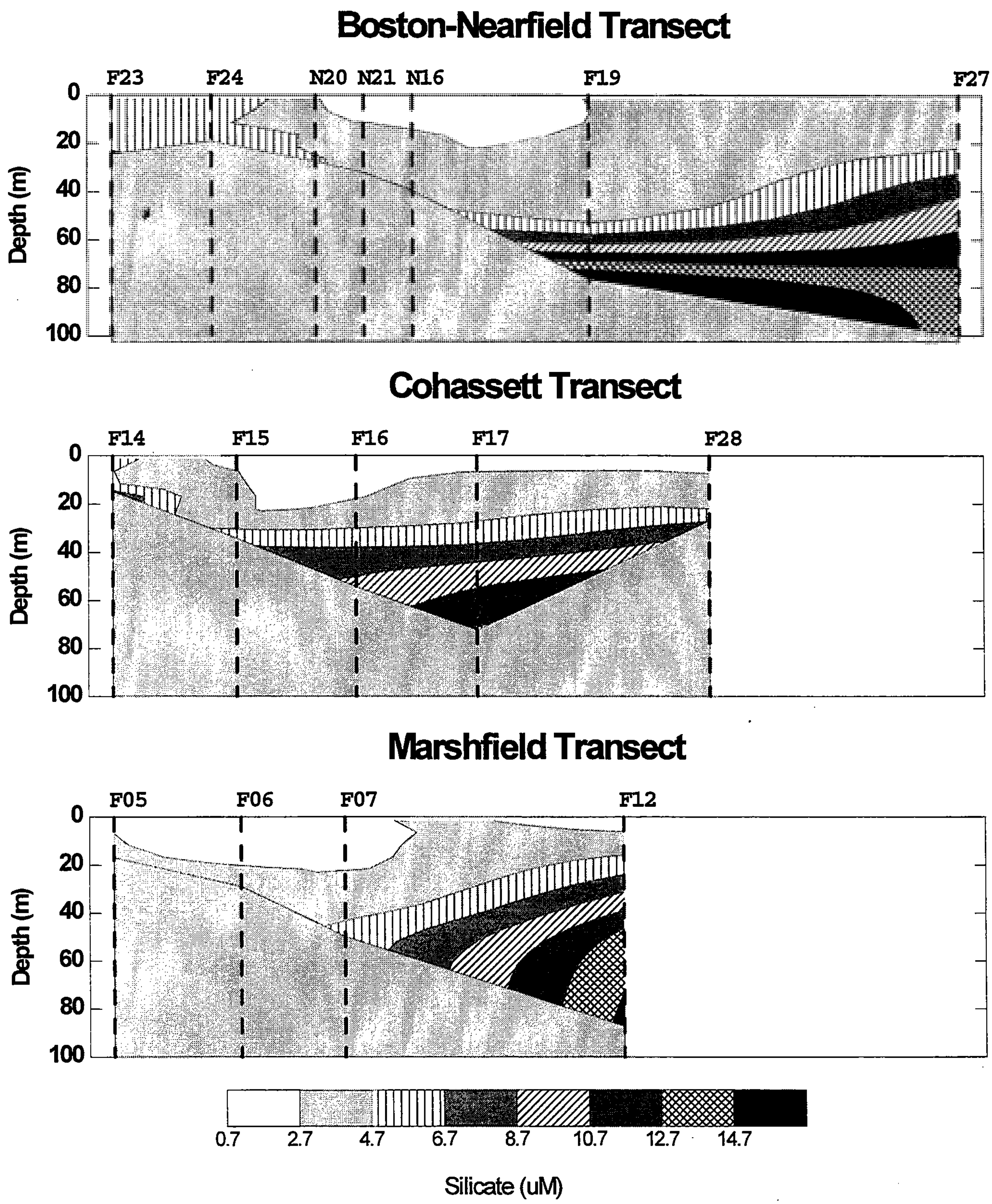


FIGURE 4-19
Silicate Concentration (µM) Contours Along
Three Farfield Transects in October (W9514)

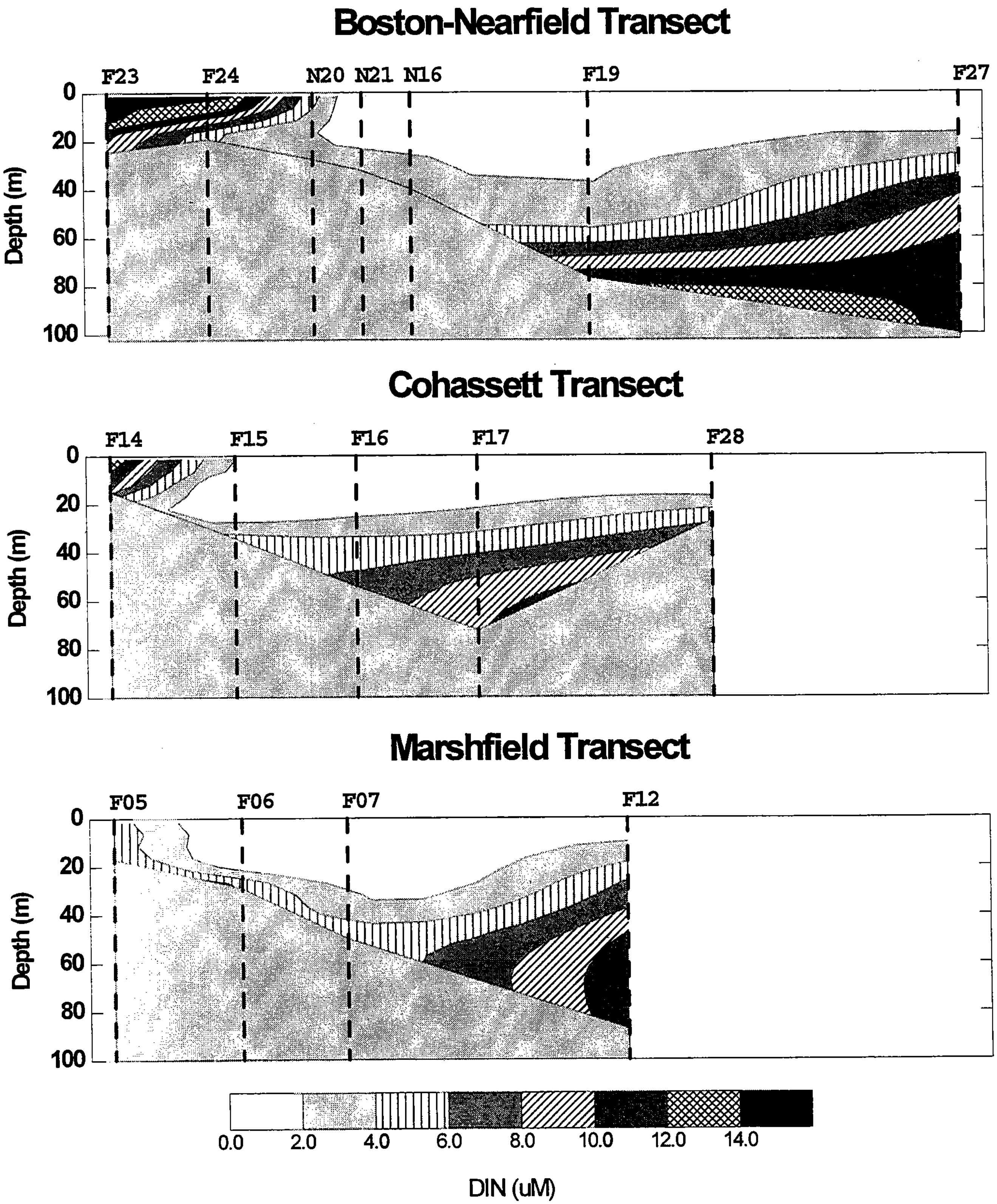


FIGURE 4-20
Dissolved Inorganic Nitrogen (DIN, µM) Contours Along Three Farfield Transects in October (W9514)

DI Nitro 9514

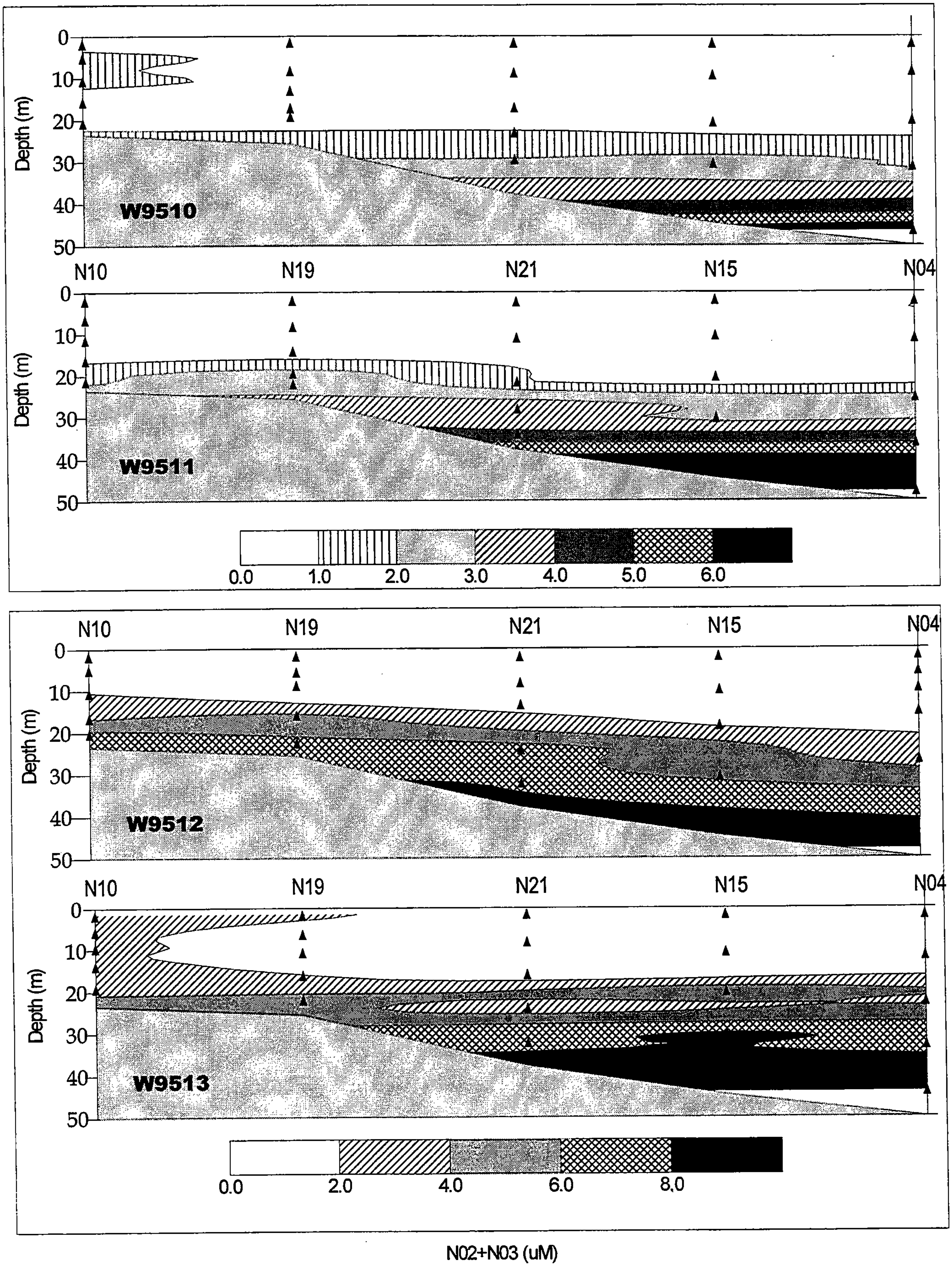


FIGURE 4-21
Nitrate+Nitrite Concentrations (μM) Along Nearfield Transect
During the First Four Nearfield Surveys

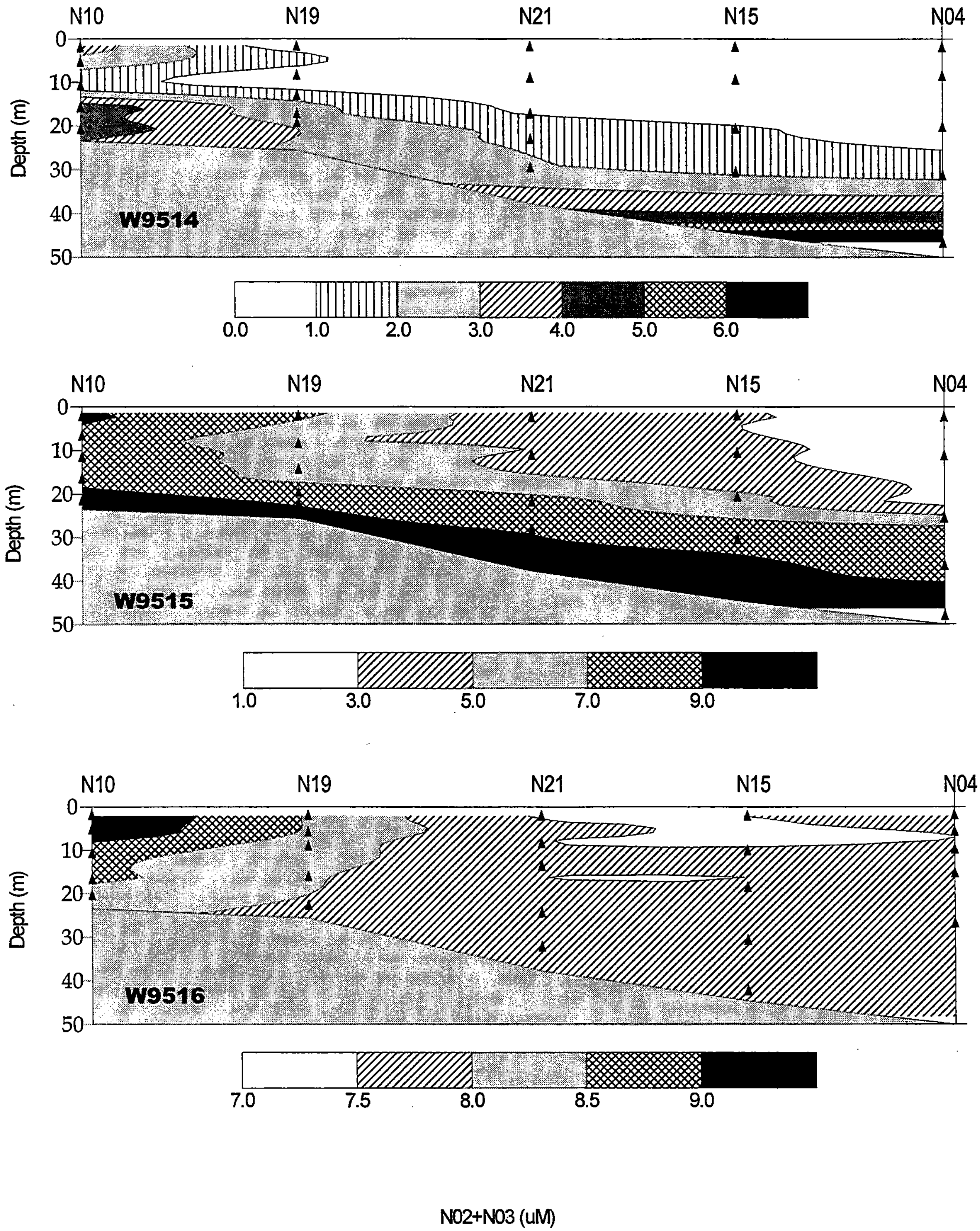


FIGURE 4-22
Nitrate+Nitrite Concentrations (μM) Along Nearfield Transect
After the Fall Turnover

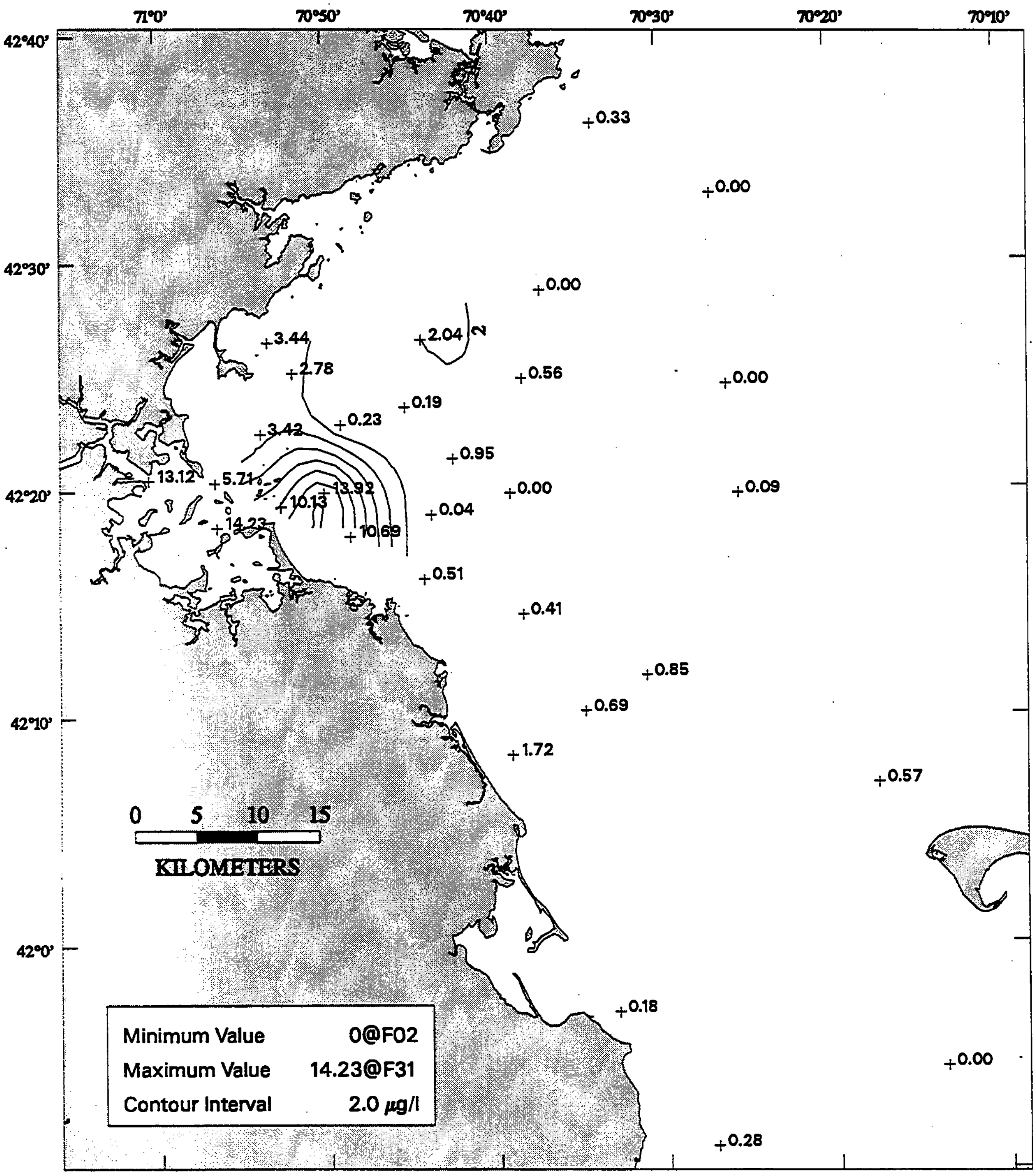


FIGURE 4-23
Surface Water Contour Plot of Chlorophyll *a* (µg/L) in Late August (W9511)

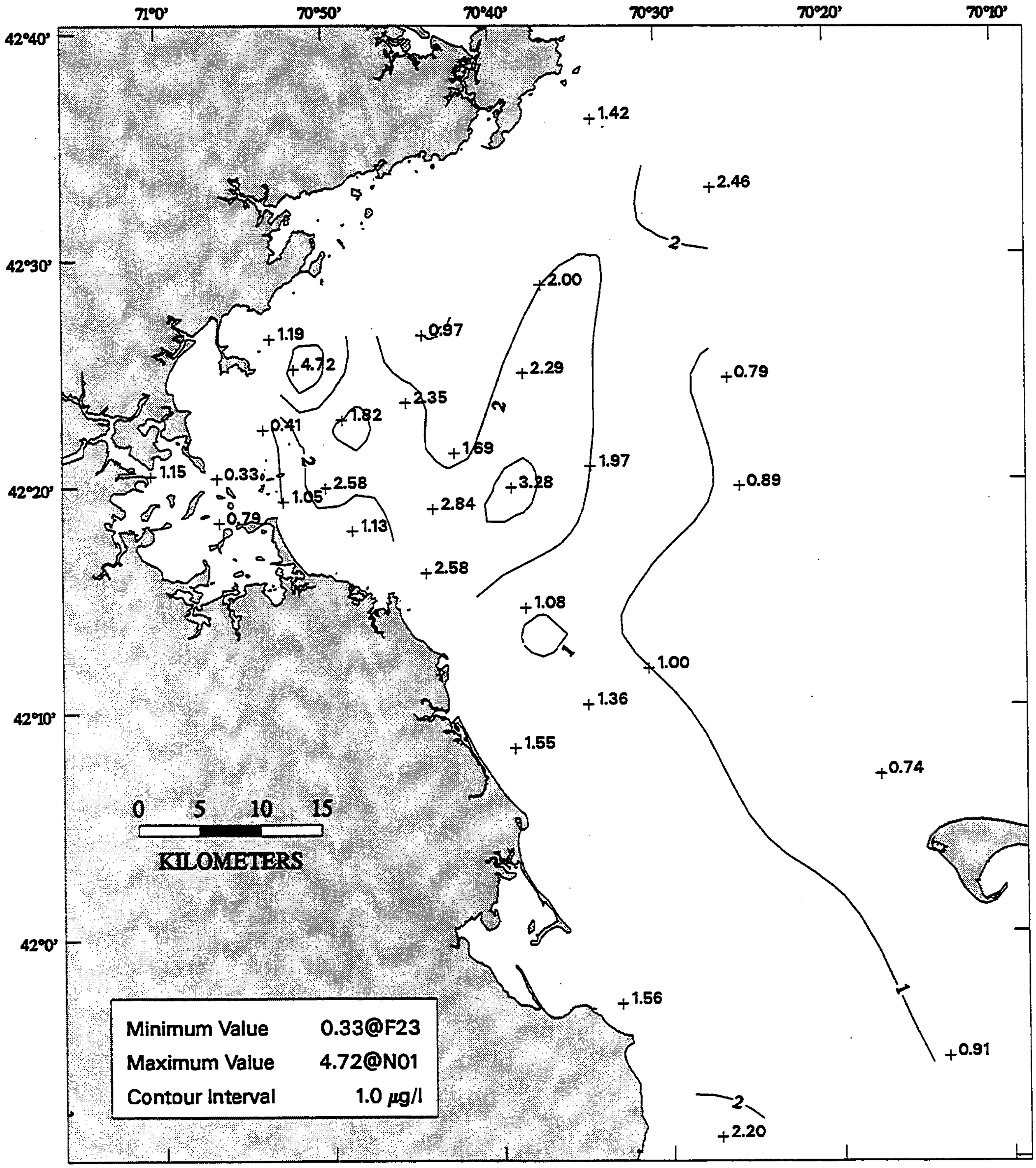


FIGURE 4-24
Surface Water Contour Plot of Chlorophyll *a* (µg/L) in October (W9514)

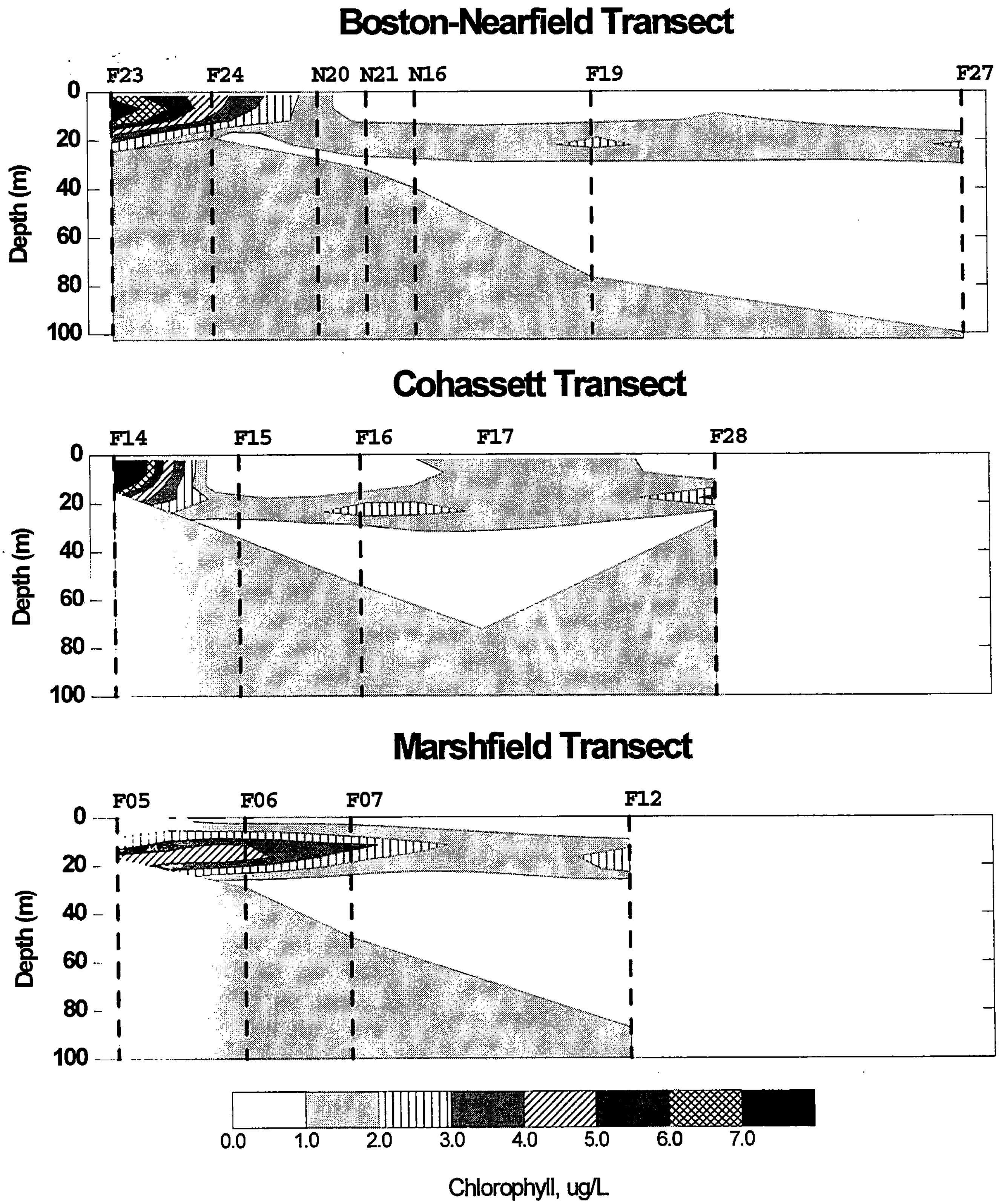


FIGURE 4-25
Chlorophyll *a* (μg/L) Contours Along Three Farfield Transects in Late August (W9511)

Fluorescence 9511

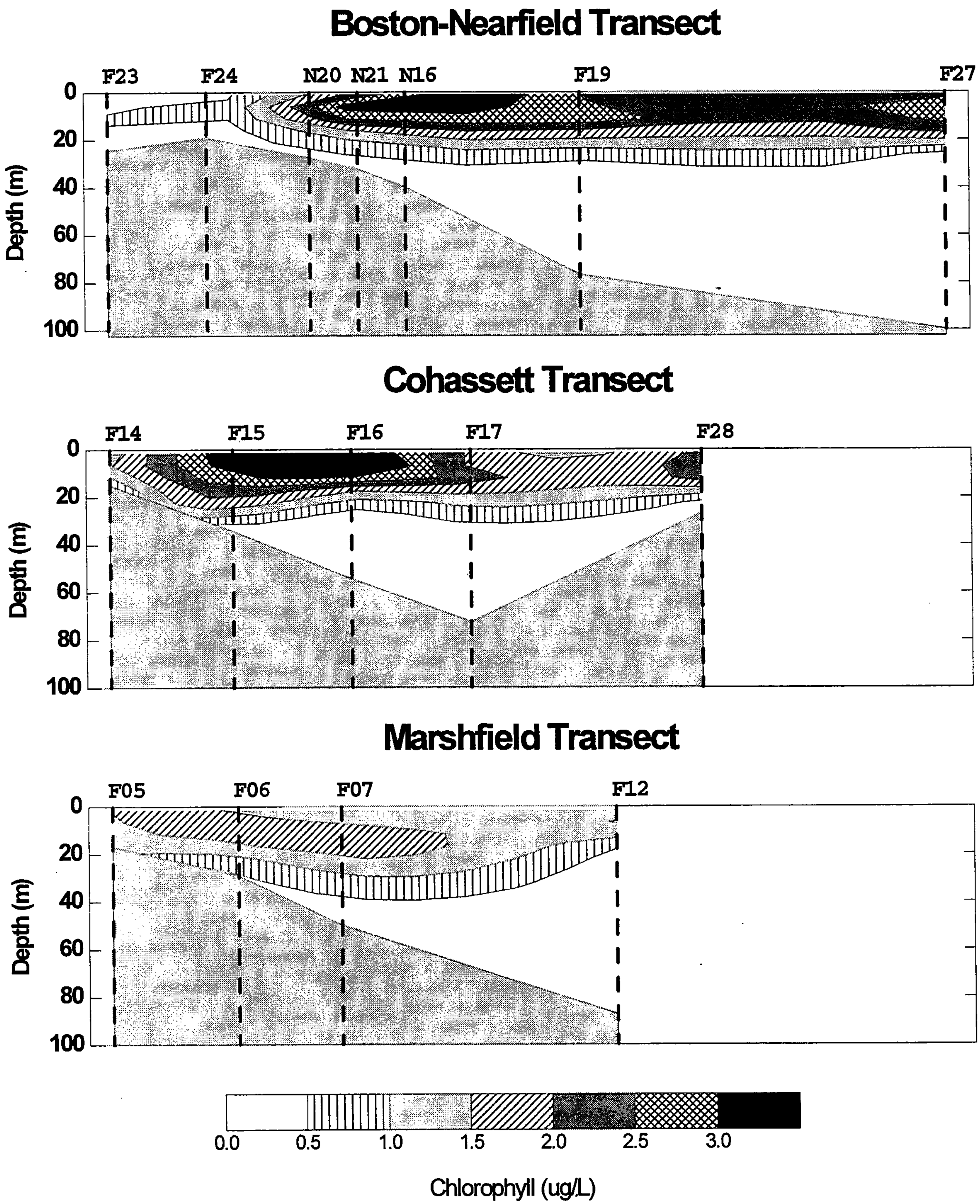


FIGURE 4-26
Chlorophyll *a* (µg/L) Contours Along Three Farfield Transects in October (W9514)

Fluorescence 9514

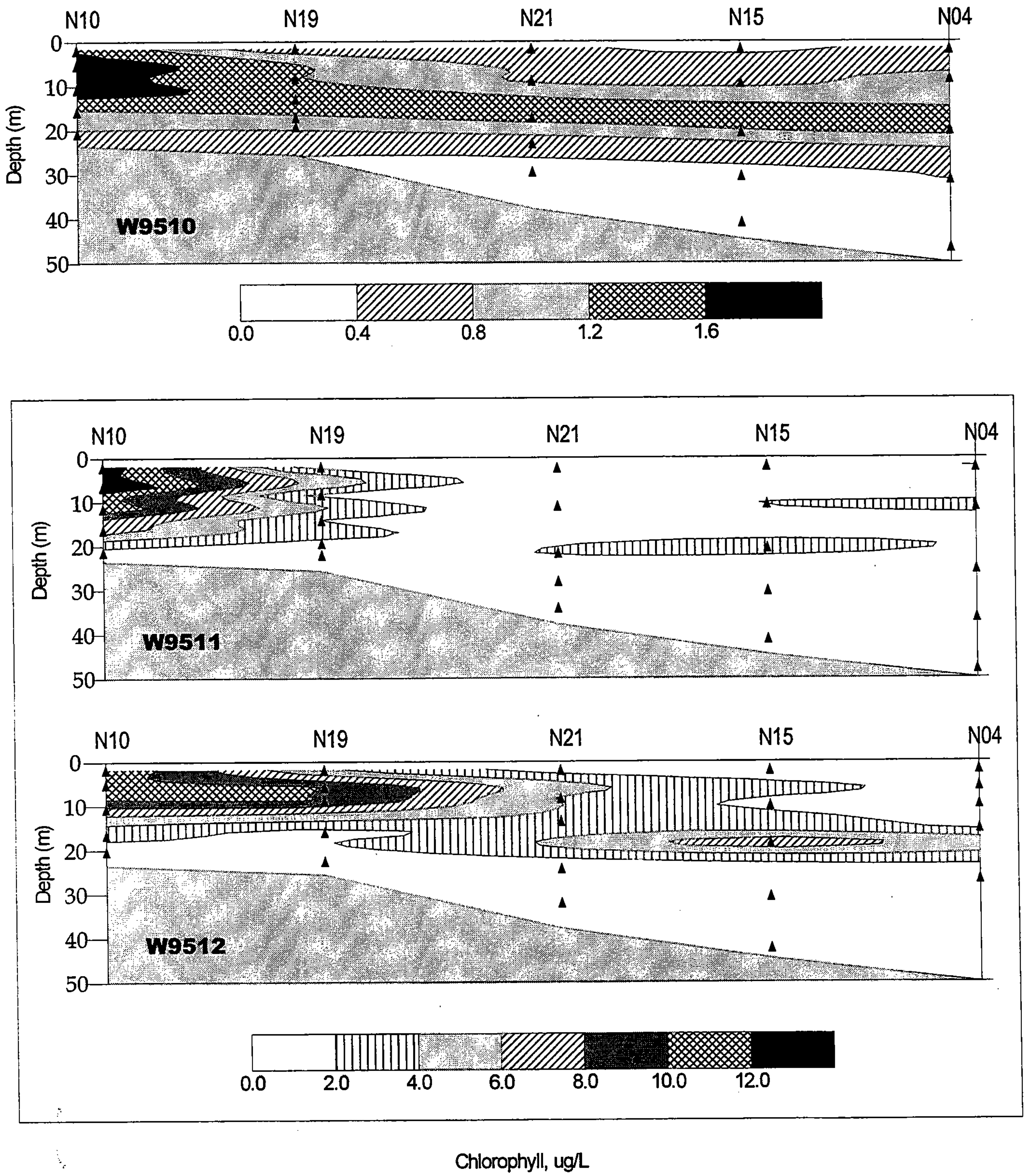


FIGURE 4-27

Chlorophyll *a* (μg/L) Contours Along Nearfield Transect During Surveys W9510-W9512

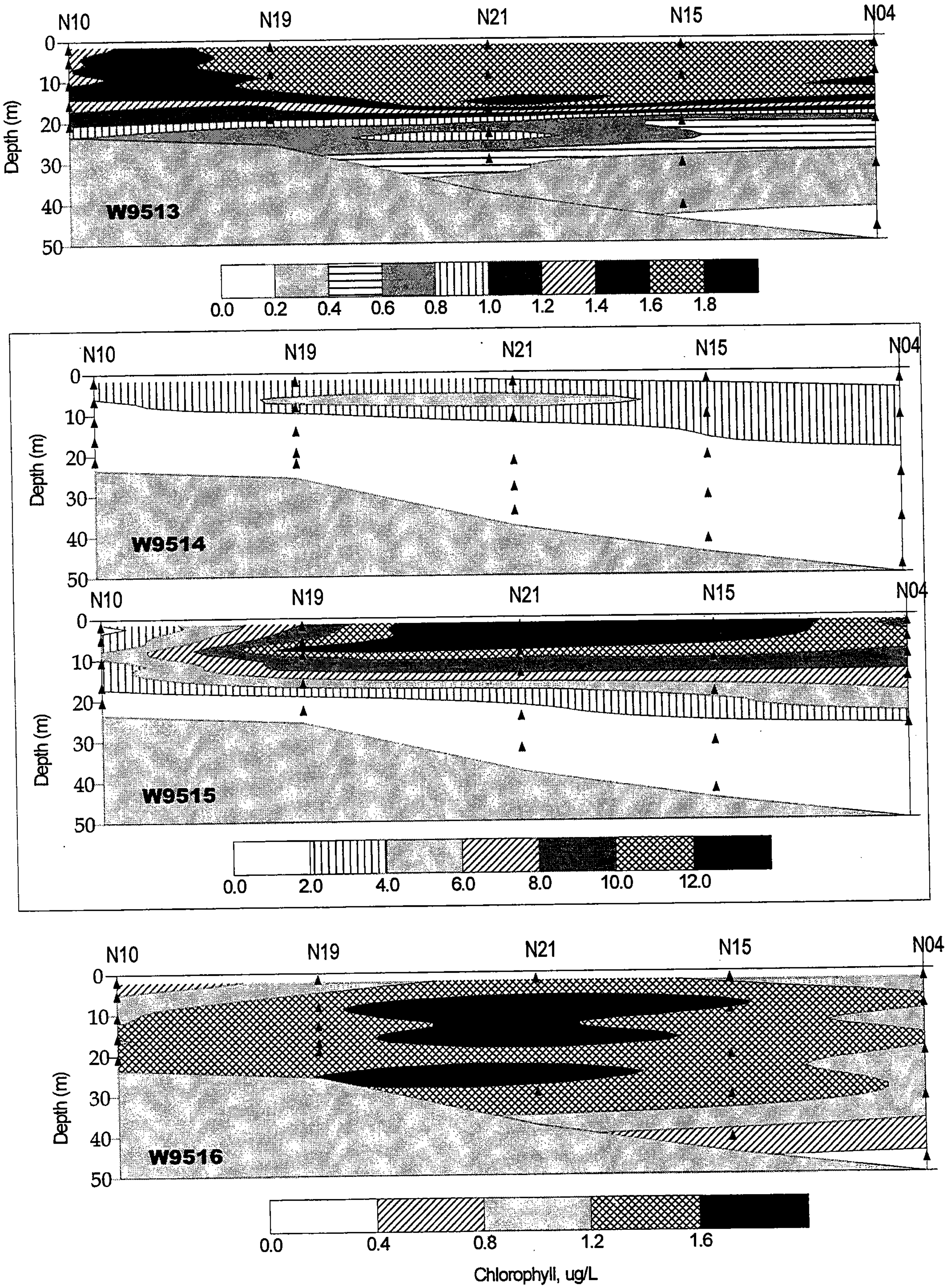


FIGURE 4-28
Chlorophyll *a* (μg/L) Contours Along Nearfield Transect, W9513-W9516

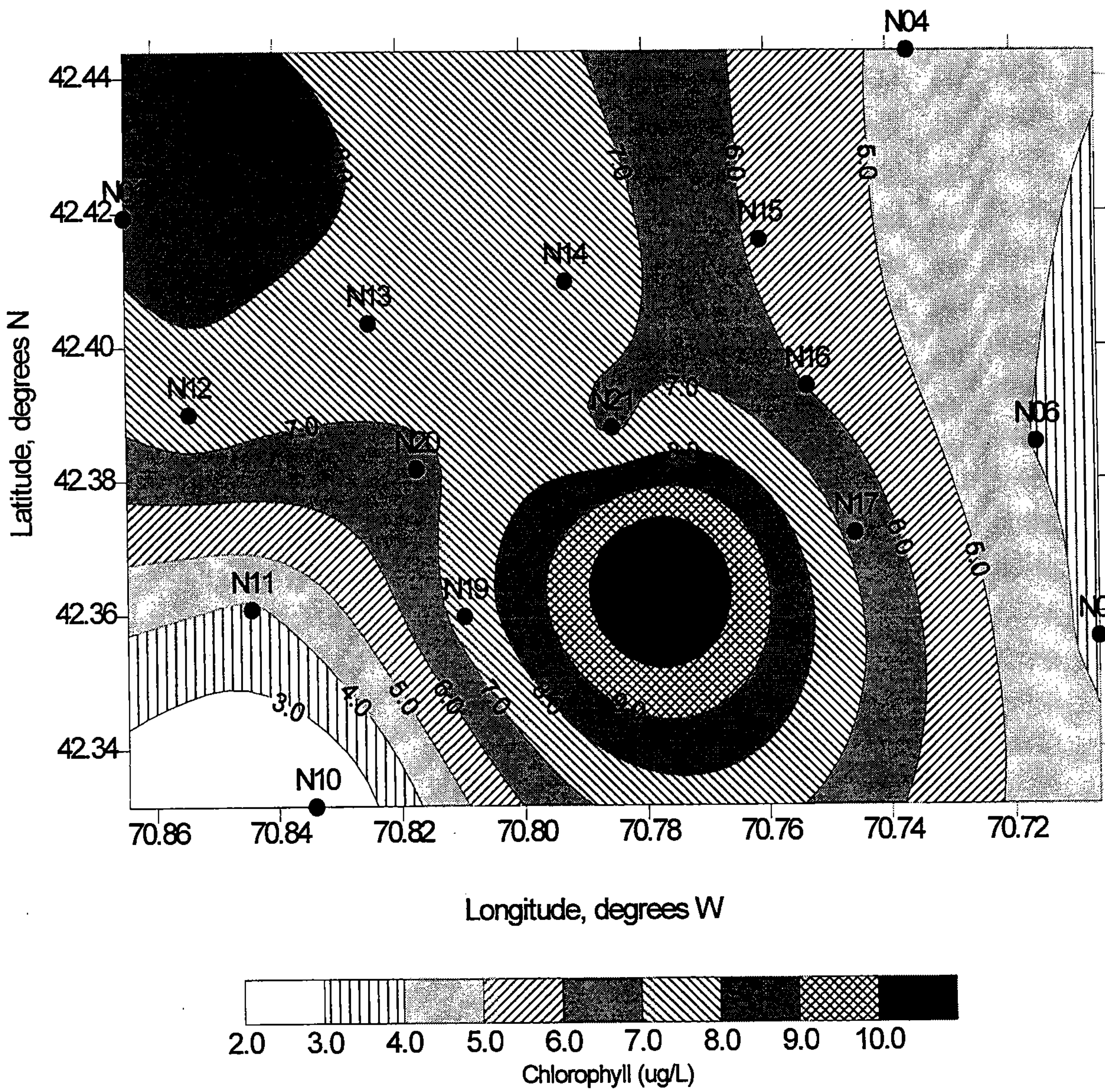


FIGURE 4-29
Distribution of Average Water Column Chlorophyll *a* in the Nearfield
During the Fall Bloom in November (W9515)

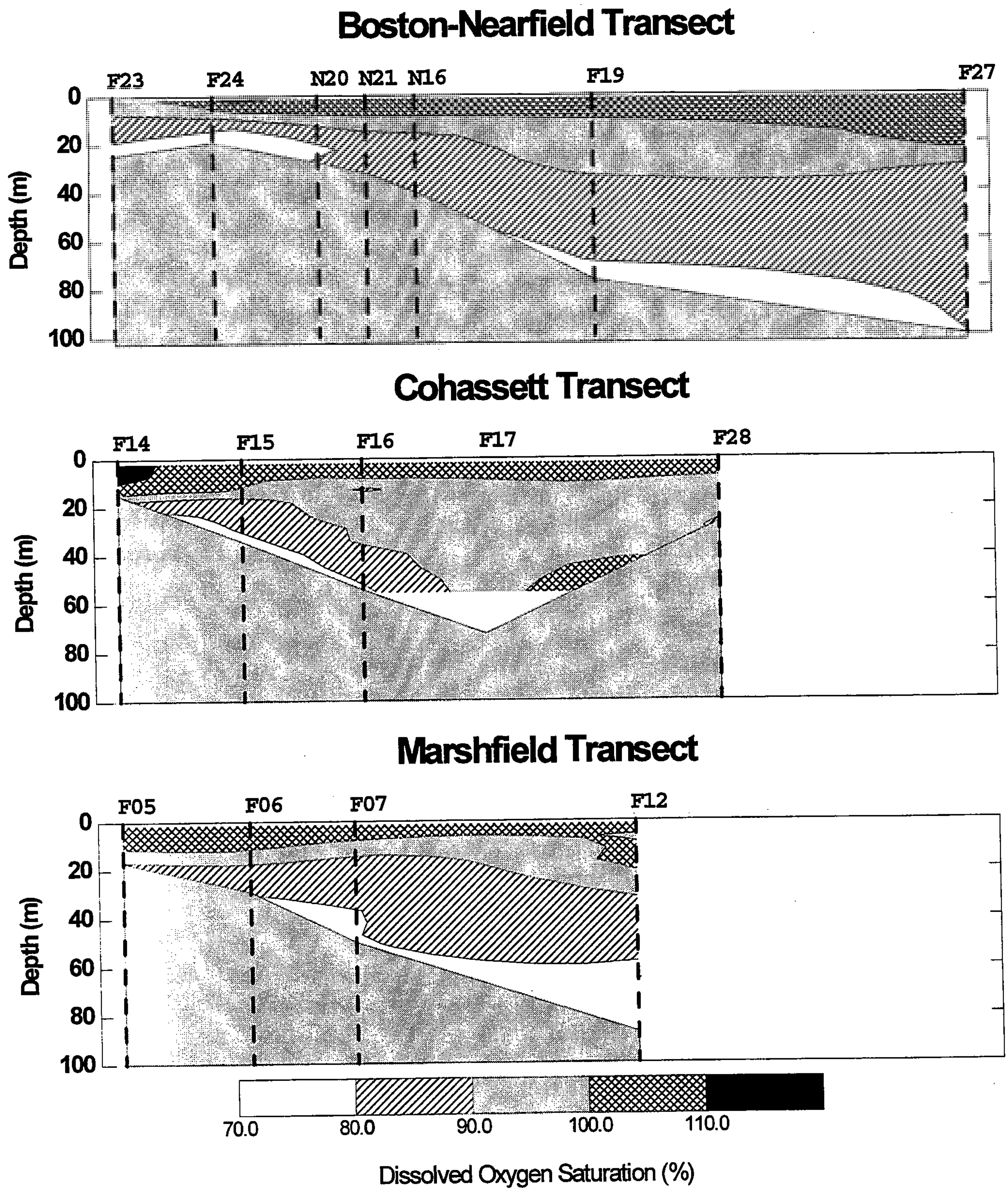


FIGURE 4-30
Dissolved Oxygen Saturation (%) Contours Along Three Farfield Transects in Late August (W9511)

DO % Saturation 9511

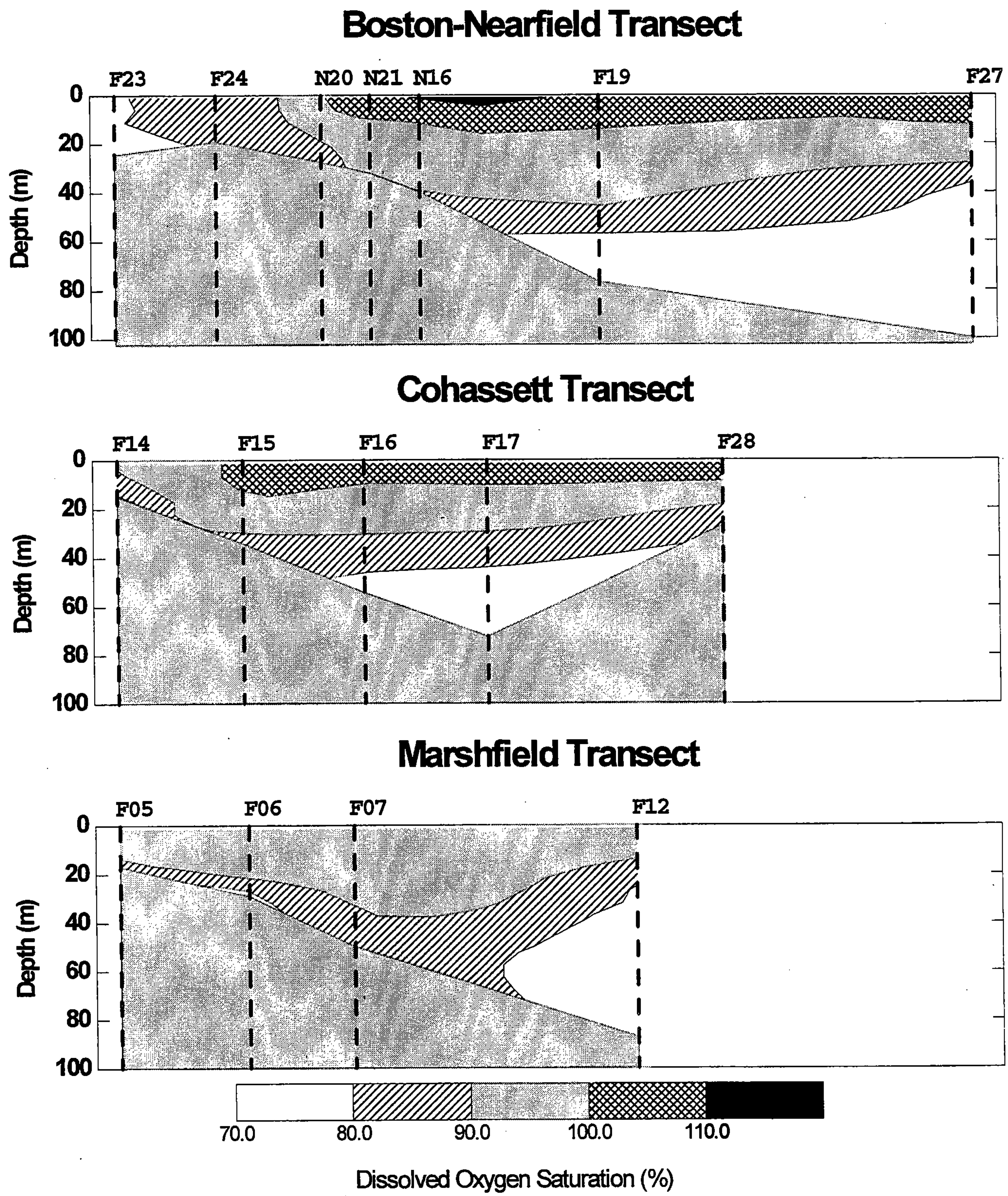
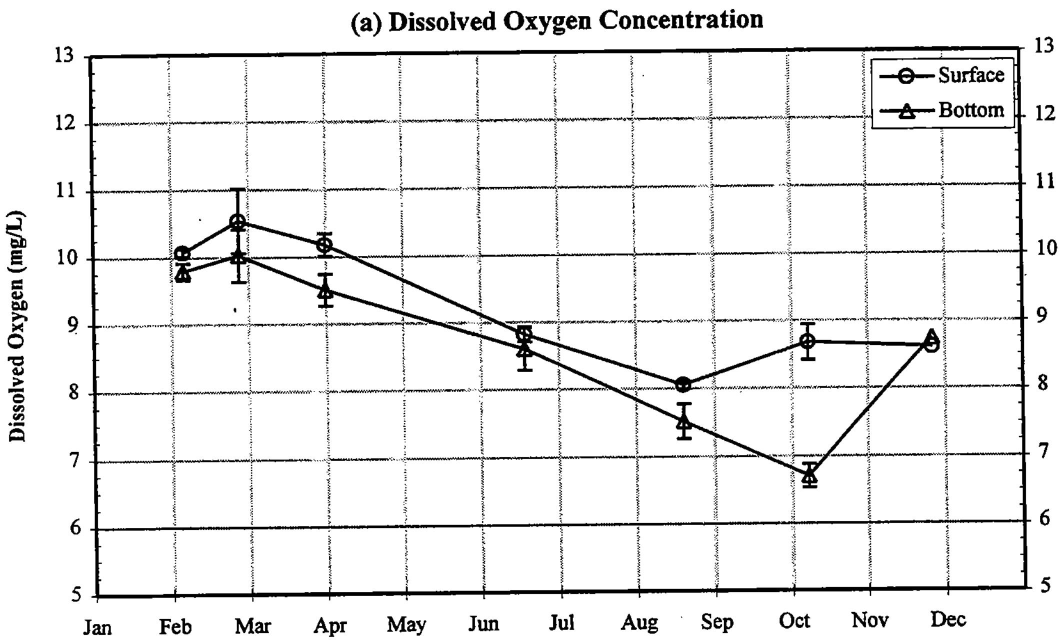


FIGURE 4-31
Dissolved Oxygen Saturation (%) Contours Along Three Farfield Transects in October (W9514)

DO % Saturation 9514



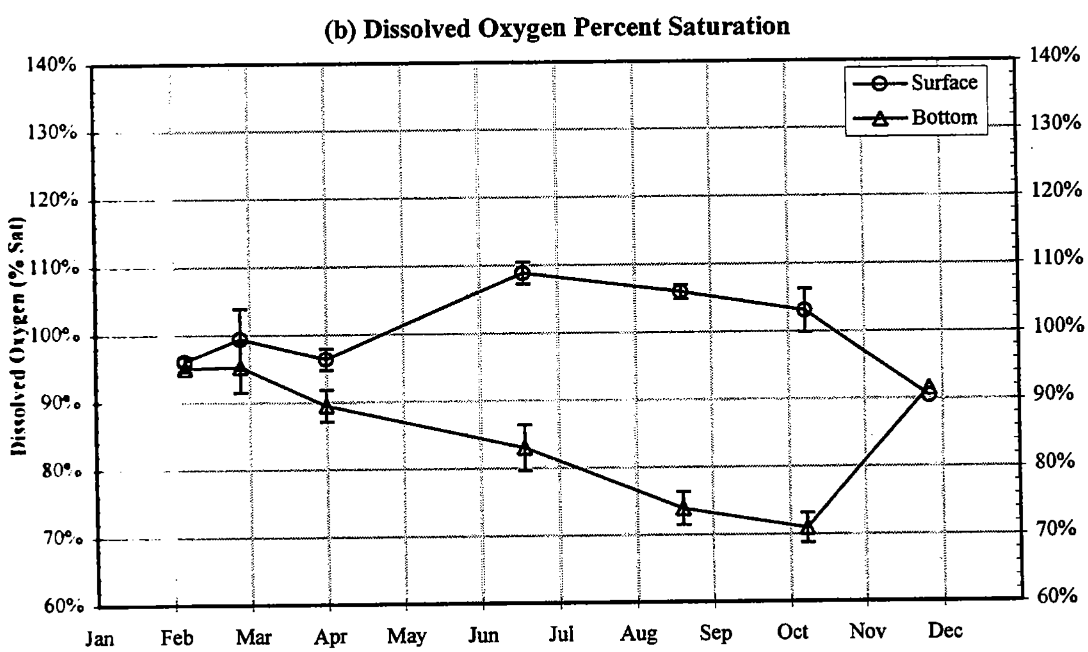


FIGURE 4-32

Time-Series of Average Surface and Bottom Water Dissolved Oxygen (a) Concentration (mg/L) and (b) Saturation (%) Among Four Stellwagen Basin Stations

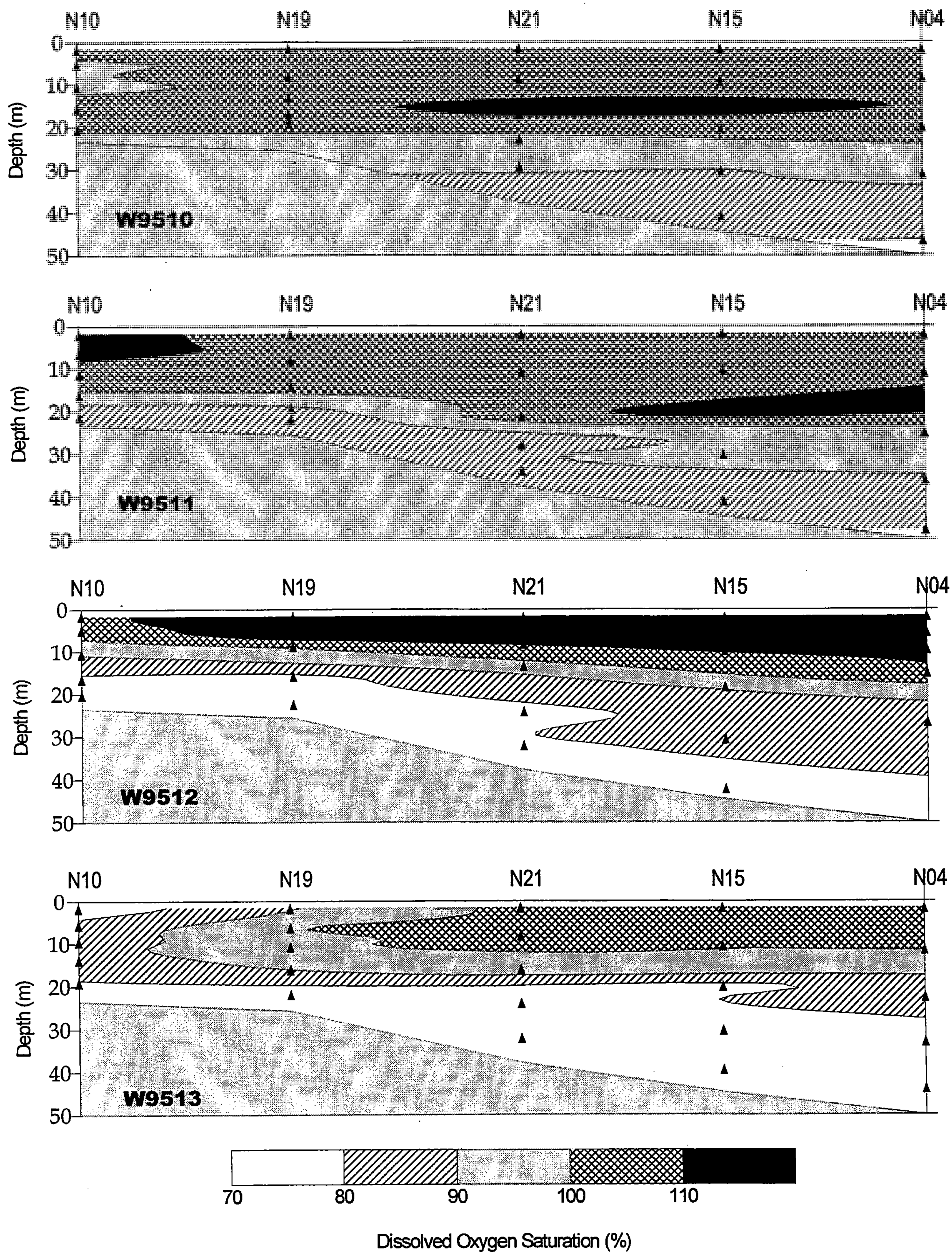


FIGURE 4-33
Dissolved Oxygen Saturation (%) Contours Along
Nearfieled Transect During Surveys W9510-W9513

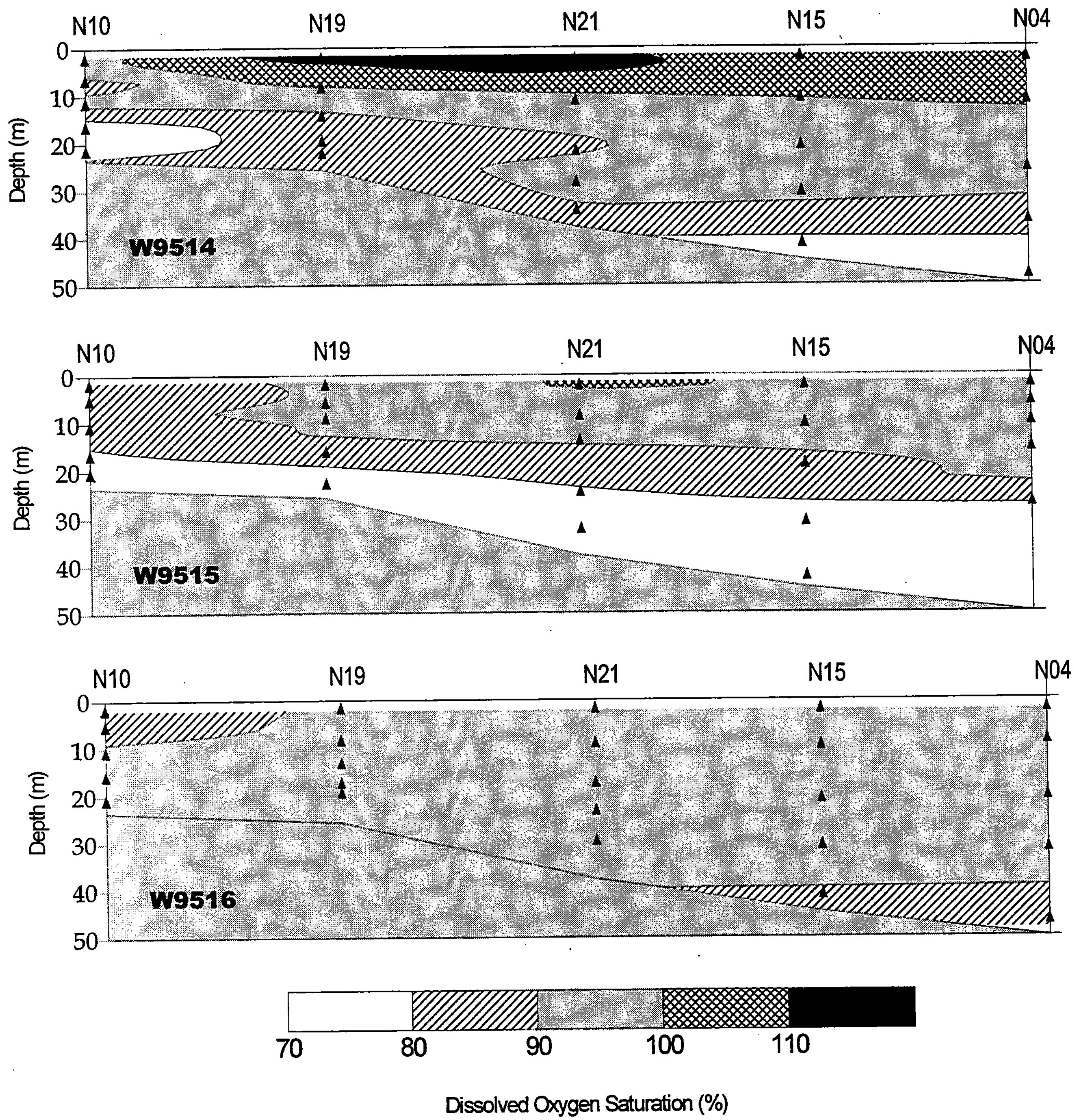


FIGURE 4-34
Dissolved Oxygen Saturation (%) Contours Along Nearfield Transect After the Fall Turnover

5.0 PRODUCTIVITY, RESPIRATION, AND PLANKTON RESULTS

5.1 Productivity

Production measurements were taken at three nearfield stations (N04, N07, N16) and one farfield station (F23), at the entrance to Boston Harbor. All stations were sampled during the two farfield surveys conducted during this semi-annual reporting period; additionally, N04 and N16 were sampled during all eight nearfield surveys during the period. Samples were collected at five depths throughout the euphotic zone. Production was determined by measuring ^{14}C at varying light intensities as summarized below and in Appendix A.

In addition to samples collected from the water column, productivity calculations also utilized light attenuation data from a CTD-mounted 4π sensor, and incident light time-series data from an on-deck 2π irradiance sensor. After collection of the productivity samples, they were incubated in a temperature-controlled incubator. The resulting photosynthesis versus light intensity (P-I) curves (Figure 5-1 and comprehensively in Appendix E), were used, in combination with light attenuation and incident light information, to determine hourly production at intervals throughout the day for each sampling depth.

For this semi-annual report, areal production ($mgCm^{-2}d^{-1}$) is presented, determined by integrating the measured productivity over the depth interval. In addition, calibrated chlorophyll *a* sensor data were used to normalize productivity for calculation of chlorophyll-specific production, a measurement of the efficiency of production.

5.1.1 Areal Production

Areal production among the nearfield stations was >900 $mgCm^{-2}d^{-1}$ throughout the summer and fall (W9510-W9515), then decreased through the winter to 500 $mgCm^{-2}d^{-1}$ in early November (W9516), to minimum annual levels in December of <100 $mgCm^{-2}d^{-1}$ (Figure 5-2). Maximum productivity among the nearfield stations (>2,000 $mgCm^{-2}d^{-1}$) was measured at station N16 in early September (W9512, 2,378 $mgCm^{-2}d^{-1}$), corresponding with the late summer bloom indicated by chlorophyll data, and during the onset of the fall turnover in early October (W9514, 2,793 $mgCm^{-2}d^{-1}$).

At the Boston Harbor productivity/respiration station (F23), the highest production rate of the annual monitoring period of 7,584 $mgCm^{-2}d^{-1}$ was measured during the late August survey (W9511). This maximum value was twice the next highest bloom production rates measured in the spring in the nearfield (3,847 $mgCm^{-2}d^{-1}$). The production data are in agreement with the chlorophyll data, which indicated that the peak of the late summer bloom, which was concentrated in the harbor and coastal areas, was during the late August survey (Section 4.3). Station F23, near the entrance of Boston Harbor, remained poorly stratified so was replete with nutrients throughout the year, promoting phytoplankton growth.

5.1.2 Chlorophyll-Specific Production

In order to compare production with chlorophyll concentrations, chlorophyll-specific production (daily production normalized to average chlorophyll concentrations over the water column) values were calculated. Chlorophyll-specific production can be used as an indicator of the optimal conditions necessary for photosynthesis. The spatial and temporal distribution of production and chlorophyll-specific production on a volumetric basis was summarized by showing contoured production through the second half of 1995 (Figures 5-3 and 5-4).

Daily production was concentrated in the upper 10 m of the water column during all of the surveys except the early September survey (W9512), when a subsurface (10-20 m) productivity maximum was measured (Figure 5-3). At the two nearfield stations, the highest daily production was measured during the late summer bloom at N04, and during the fall bloom at station N16.

Chlorophyll-specific production at N10 overall was similar to production, indicating no anomalous discrepancies between production and chlorophyll throughout the semi-annual period (Figure 5-4). At station N16, higher chlorophyll-specific production during the early August surveys suggested that the efficiency of photosynthesis was high but not reflected in the amount of biomass present, as measured by total chlorophyll *a*. The highest semi-annual zooplankton abundance was measured at station N16 during the late August survey (W9511; Section 5.3.2), indicating that the chlorophyll produced during this period was rapidly scavenged, resulting in high chlorophyll-specific production values.

In contrast to the late summer bloom, the fall bloom in October-November in the outer nearfield suggested by chlorophyll data resulted in very low chlorophyll-specific production in early November (W9515). The bloom period was not reflected in productivity data, probably because of cloudiness on the day of sampling.

5.2 Respiration

Respiration was measured at the same three nearfield stations (N04, N07, N16) and one farfield station (F23) as productivity, as well as at farfield station F19, in the offshore region (Figure 1-1). All stations were sampled during the four farfield surveys; additionally, N04 and N16 were sampled during all nearfield surveys during the second semi-annual period of 1995. Measurements were made on samples collected at three depths (surface, mid-water, and bottom). Samples were incubated without light and at *in situ* temperatures. Detailed method information for respiration analyses is available in Appendix A.

Both respiration (in units of μMO_2/hr) and carbon-specific respiration ($\mu MO_2/\mu MC$/hr) rates at the three sampled depths are presented here. Carbon-specific respiration was calculated by normalizing respiration rates to the total measured particulate organic carbon (POC) in the water column. Carbon-specific respiration provides an indicator of how efficiently the POC substrate material is oxidized during respiration.

5.2.1 Water Column Respiration

Respiration is controlled by water temperature and the availability of labile organic matter. During the pre-turnover stratified period, surface water respiration rates were higher than bottom water for all stations except during the first survey at N16 (Figure 5-5). Higher surface rates are due to both a surface-bottom water temperature gradient (Section 4.1), and generally higher surface water POC levels (Figure 5-6).

Surface water respiration rates increased from early August (W9510), reaching peak rates in September (W9512-13; Figure 5-5). This increase was closely related to the availability of organic matter, as surface water temperatures were actually decreasing over this period (Section 4-1). The minimum summer surface water rate was measured during survey W9510 at station N16 (0.05 μMO_2/hr), and gradually increased at both nearfield stations to reach a maximum of 0.3 μMO_2/hr during W9512 at station N04. Respiration in surface water then started a gradual decline at station N04; this decline did not start until after the late September survey (W9513) at station N16.

The overall pattern of respiration decline through the fall and winter in surface water was due to decreasing surface water temperatures, with POC concentrations having only a secondary influence. The discrepancies between POC availability and respiration rates are further delineated by examining carbon-specific respiration below (Section 5.2.2).

The maximum semi-annual respiration rate was measured at F23, one of the stations measured only during the farfield surveys. A rate of 0.48 μMO_2/hr was measured in the surface water of F23 during W9511 in late August. This high rate corresponded with high productivity (Section 5.1) during the late summer bloom in Boston Harbor and the inner nearfield. The rate at F23 during the second semi-annual farfield survey in October (W9514) was considerably smaller (0.15 μMO_2/hr). The highest surface respiration rates (~0.2 μMO_2/hr) during this farfield survey were measured at nearfield station N16 and offshore station F19.

Surface water respiration rates were generally lower during the late fall and winter with the decrease of chlorophyll production. The production of POC was highest at station N16 during the fall bloom surveys (W9514-15), although respiration continued to decline. By late fall-early winter (W9516-17), surface water respiration rates at both nearfield stations measured had fallen to levels similar to bottom water rates (<0.05 μMO_2/hr), indicating a well-mixed water column.

Bottom water respiration rates measured during all stations during the semi-annual period were relatively low (<0.05 μMO_2/hr), except for slightly higher rates at F23 (~0.1 μMO_2/hr). The single exception was the bottom water rate at N16 during survey W9513 in late September; the semi-annual maximum of bottom water respiration (0.15 μMO_2/hr) was measured at this station. The source of organic material for respiration during this survey was probably related to the late summer bloom (dominated by diatoms, Section 5.3) during the prior to surveys in late August (W9511) and early September (W9512). Although the water column was still stratified during this survey, the high respiration rate suggests either rapid settling of coalesced mats of senescent material to bottom water, or zooplankton facilitated vertical transport through fecal pellet formation. The relationship between the measured POC concentration and respiration during this survey is discussed further below (Section 5.2.2).

5.2.2 Carbon-Specific Respiration

Discrepancies between respiration and carbon-specific respiration at each station can be attributed to the differences in the character of the source POC contributing to respiration. Sources of organic carbon which are more easily oxidized (i.e., recently produced plankton) will result in higher carbon-specific respiration. By comparing respiration rates relative to the source material, the availability (pathways) of fresh plankton can be inferred.

Overall, carbon-specific respiration rates in the surface water of the two nearfield stations were higher prior to the fall turnover, and became similarly low as bottom water rates following the fall turnover (Figure 5-7). By normalizing to the influence of POC, the data show the importance of the decrease of surface water temperature with the onset of the winter season initiated by the nearfield mixing event (Section 4-1).

Surface water chlorophyll-specific respiration rates increased steadily prior to the fall turnover at station N16. This pattern suggests that the POC available for respiration increased in quality through the late summer and early fall. Carbon-specific respiration peaked during the late September survey (W9513) in both the bottom and surface water of station N16. The data confirm that surface and bottom water respiration following the late summer bloom event was high. The abundance of organic carbon, however, was not unusually elevated (Figure 5-6), indicating that the available material was easily oxidized, typical of very recently produced plankton.

5.3 Plankton Results

The HOM Program includes collection and analysis of the plankton community, including phytoplankton (Section 5.3.1) and zooplankton (Section 5.3.2). In the second semi-annual period of 1995, two stations (N10, N16) were sampled during the eight nearfield surveys, while an additional ten locations were sampled during the two combined events (Figure 5-8). In this report, the second half of the 1995 plankton record is presented (surveys W9510 to W9517), including two of the six annual combined sampling events (W9511 and W9514). Comprehensive tabulations of results are available in periodic Plankton Data Reports.

Whole-water and screened phytoplankton samples were collected at the surface and at mid-depth, with the latter often selected to coincide with the presence of a sub-surface chlorophyll maximum (as determined by *in vivo* fluorometry). Zooplankton samples were collected at each station by oblique tow. Details regarding sampling and analysis can be found in the CW/QAPP for water column monitoring (Bowen *et al.*, 1997). Quantitative taxonomic analyses were performed during 1995, continuing the monitoring record begun in 1992. Starting in 1995, carbon equivalence estimates were made for the plankton communities using species-specific carbon data from the literature.

In this section, the plankton data are presented through an assessment of their seasonal and regional characteristics. Total abundance, relative abundance of major groups, and estimated carbon equivalence are presented for each plankton community. Appendix F-1 tabulates dominant phytoplankton species (>5% of total abundance) for whole water surface samples, along with the associated cell densities and percent abundance. Appendix F-2 provides similar information for the mid-depth samples. Appendix G-1 and G-2 includes information for screened phytoplankton results, while Appendix H summarizes zooplankton results.

5.3.1 Phytoplankton

5.3.1.1 Seasonal Trends in Total Phytoplankton Abundance

Total phytoplankton abundance results from the whole water surface samples taken in the nearfield showed peaks during the late August bloom (W9511), and again in early October (W9514) following the fall turnover (Figure 5-9). The mid-depth chlorophyll *a* maximum samples also showed a nearfield peak during the August survey, but decreased steadily after that survey to the end of the semi-annual period.

During the first combined nearfield/farfield survey in late August before the fall turnover (W9511), Boston Harbor had the highest phytoplankton densities of all the regions in both surface and mid-water samples. These results are consistent with the chlorophyll and production data indicating bloom conditions in the harbor, and secondarily in the coastal and nearfield regions. During this survey, surface and mid-water abundances were similar between nearfield, coastal, and offshore stations, and lower in the boundary region and Cape Cod Bay (<1 million cells/L).

The nearfield region had the highest phytoplankton densities in both the surface and mid-water in October (W9514) with the onset of the fall turnover. Mid-water samples from the boundary region had similar densities as the nearfield during this survey. Cape Cod Bay in October again had the lowest mid-water abundance (<1 million cells/L).

5.3.1.2 Nearfield Phytoplankton Community Structure

Phytoplankton abundance and community composition at the two nearfield stations are depicted in Figure 5-10. Overall abundances were much higher in both surface and mid-water samples at N10 prior to the fall turnover. The high abundances were due to the proximity of station N10 to Boston Harbor, the central location of the late summer bloom (Section 4-3). At station N16, abundances were similar before and after the turnover until the last two winter surveys. Overall abundances at the two depths were generally similar at each station.

In both surface and mid-depth samples at each nearfield station, microflagellates were the numerically dominant plankton group in most samples (up to 90% of total density; Appendix F-1 and F-2). Centric diatoms were co-dominant before the fall turnover, especially during the peak of the late summer bloom in early September (W9512). Pennate diatoms were co-dominant during the survey conducted at the peak of the fall bloom in early November (W9515; Appendix F-1). The dominant pennate diatom was *Asterionellopsis glacialis* during the bloom associated with the fall turnover.

Centric diatoms in early season samples (e.g., W9511) largely consisted of *Skeletonema costatum* and *Rhizosolenia fragilissima* before the fall turnover event (Figure 5-11). A small (<20μm) *Gymnodinium* species and a small (<30μm) *Protoperidinium* species dominated the dinoflagellate group. After the fall turnover event, *Rhizosolenia fragilissima* and a small (<10μm) centric diatom were prevalent, with *Rhizosolenia fragilissima* reaching densities of 6.2 million cells/L. *Ceratium tripos* and *Gymnodinium* species were the dominant dinoflagellates, with *Ceratium tripos* reaching densities of around 720 cells/L in October (Appendix G-2).

In terms of estimated carbon equivalence, phytoplankton carbon was dominated by centric diatoms at station N10 during the late summer bloom, and was relatively low overall following the fall turnover (Figure 5-12). Centric diatoms also dominated carbon equivalence values at station N16, with microflagellates and dinoflagellates providing a consistent contribution throughout the year (Figure 5-13). Early season carbon dominants included centric diatoms, *Ceratium tripos*, and the small *Gymnodinium* (Figure 5-14). Following the fall turnover, the dominant carbon contributors were microflagellates, *Ceratium tripos*, and *Prorocentrum micans*. Pennate and centric diatoms contributed the bulk of the total carbon during the fall bloom survey in early November.

5.3.1.3 Regional Phytoplankton Assemblages

The community composition of surface and mid-water samples were similar among farfield regions sampled (Figure 5-15). The harbor assemblage (stations F23, F30, and F31) during the first regional survey in late August (W9511) yielded a relatively high number of microflagellates and centric diatoms produced during the late summer bloom (Figure 5-15; Appendix F-1). The presence of centric diatoms in the harbor were comprised largely of *Rhizosolenia fragilissima* and *Skeletonema costatum*. Cape Cod Bay stations F01 and F02, as well as other stations outside of the bloom area, had a more concentrated composition of microflagellated species.

By the October combined survey (W9514, Figure 5-16), small flagellates dominated most regions, although many areas (i.e., stations F24, F25, and N10) had modest densities of small (<10μm) centric diatoms including *Cyclotella*. There also appeared to be a localized bloom (720 cells/L) of the dinoflagellate *Ceratium tripos* in the surface sample from station N16 (Appendix F-2).

5.3.2 Zooplankton

5.3.2.1 Seasonal Trends in Total Zooplankton Abundance

Zooplankton densities in the nearfield generally decreased throughout the reporting period at station N10, following the trend observed in phytoplankton abundance (Figure 5-17). Zooplankton densities in the nearfield at Station N16 showed a peak during late August (W9511), and in early October following the fall turnover which coincided with an increase in phytoplankton. Total zooplankton abundance decreased from a maximum of 62,000/m^3 in early August to a minimum of 10,000/m^3 (late November) at station N10, and approximately 78,000/m^3 at station N16 (late August) to a decline of 20,000/m^3 in December.

5.3.2.2 Nearfield Zooplankton Community Structure

Zooplankton abundance was evenly distributed among copepod adults and copepod nauplii (Figure 5-18). These two groups comprised both peaks reported at stations N10 and N16 during the late summer (W9511) and fall (W9514) blooms.

The numerically dominant species among the copepods during the reporting period was *Oithona similis*, with initial high densities in August of around 16,800/m^3 (N10) and 12,153/m^3 (N16; Appendix G). Another early dominant copepod included *Pseudocalanus newmani*, before the fall turnover event. After the fall turnover event, *Oithona similis* remained a dominant species with the emergence of *Centropages typicus* as a co-dominant.

In terms of estimated biomass, *Calanus finmarchicus* was by far the dominant species, with adults comprising an estimated $2x10^5$ µgC/m^3. The next most important contributor of zooplankton biomass was *Centropages typicus*, with an estimated carbon contribution of around $1x10^5$ µgC/m^3.

5.3.2.3 Regional Zooplankton Assemblages

Regional data for the first combined nearfield/farfield survey (W9511) showed highest zooplankton densities (around 124,000/m^3) outside of the harbor at station F24, again numerically dominated by copepod adults and other zooplankton, specifically bivalve species (Figure 5-19). Other stations were generally less than 100,000/m^3. The numerical dominance by copepods was comprised primarily of *Oithona similis* in most regions, with *Pseudocalanus newmani* most pronounced in the nearfield stations and *Acartia tonsa* and *Acartia hudsonica* at the two harbor stations (F30 and F31; Appendix G).

During the October combined survey (W9514), numerical dominance by the copepods *Oithona similits* and *Centropages typicus* was evident (Figure 5-20). Densities of bivalve species and copepod species peaked in Cape Cod Bay during this period, with densities exceeding 36,000/m^3. Maximum densities were measured in Cape Cod Bay, followed by the nearfield.

5.4 Summary of Water Column Biological Events

- Semi-annual maximum areal production among the nearfield stations was measured at station N16 during the bloom in early September (W9512, 2,378 $mgCm^{-2}d^{-1}$), and during the onset of the fall turnover in early October (W9514, 2,793 $mgCm^{-2}d^{-1}$);

- Peak annual production (7,584 $mgCm^{-2}d^{-1}$) was measured in August (W9511) at station F23, during the late summer bloom in the harbor and coastal regions, a rate which was twice the next highest rate measured during the spring bloom;

- Productivity was potentially underestimated during the fall bloom, due to cloudy conditions during sampling;

- Chlorophyll-specific production during the August surveys at nearfield station N16 indicated that potential production of chlorophyll was rapidly scavenged because of the high abundances of zooplankton present;

- Surface water respiration rates increased from early August to September, due to the availability of organic matter;

- The overall decline of surface water respiration through the late fall and winter was primarily due to decreasing surface water temperatures;

- The semi-annual maximum rate of bottom water respiration (0.15 $\mu MO_2/hr$) was measured at station N16 in late September following the late summer bloom (W9513), due to either rapid settling of coalesced mats of senescent material, or facilitated by zooplankton grazing;

- The pattern of increasing surface water chlorophyll-specific respiration prior to the fall turnover, especially at station N16, suggested that the available POC was easily oxidized, typical of very recently produced plankton associated with the late summer bloom;

- Nearfield surface water carbon-specific respiration was higher prior to the fall turnover, and decreased to bottom water rates with the onset of winter mixing and decreasing water temperature;

- Nearfield phytoplankton abundance showed peaks during the late summer bloom (W9511), and again in early October (W9514) following the fall turnover;

- Boston Harbor had the highest phytoplankton densities of all farfield regions in late August associated with the late summer bloom (W9511), with lower abundances in the nearfield, coastal, and offshore stations, to minimum values in the boundary region and Cape Cod Bay;

- With the onset of the fall turnover in October (W9514), the nearfield had the highest surface water phytoplankton abundance, while mid-water samples from both the nearfield and the boundary region had the highest densities;

- Microflagellates were the numerically dominant plankton group during the semi-annual period, with co-dominance by centric diatoms (*Skeletonema costatum* and *Rhizosolenia fragilissima*) during the late summer bloom, and by pennate diatoms (*Asterionellopsis glacialis*) during the peak fall bloom survey in early November (W9515);

- Estimated phytoplankton carbon equivalence was dominated by centric diatoms during the late summer and fall, pennate and centric diatoms during the fall bloom survey in early November, with microflagellates and dinoflagellates providing a consistent carbon contribution throughout the year;

- Prior to the fall turnover, carbon dominants included centric diatoms, *Ceratium tripos*, and the small *Gymnodinium*, while after the turnover, the dominant carbon contributors were microflagellates, *Ceratium tripos*, and *Prorocentrum micans*;

- Nearfield zooplankton densities showed peaks at station N16 during late August (78,000/m^3) and in early October (>60,000/m^3), coinciding with an increase in phytoplankton, and decreased to a minimum of 10,000/m^3 (N10) in late November;

- *Calanus finmarchicus* was by far the dominant species in terms of estimated biomass, with adults comprising an estimated $2x10^5$ µgC/m^3;

- Regionally, station F24 data outside of the harbor showed the highest zooplankton densities (around 124,000/m^3) during late August, numerically dominated by copepod adults and bivalve species;

- During October, densities of bivalve and copepod species peaked in Cape Cod Bay during this period, with densities exceeding 36,000/m^3 and numerical dominance by the copepods *Oithona similits* and *Centropages typicus*.

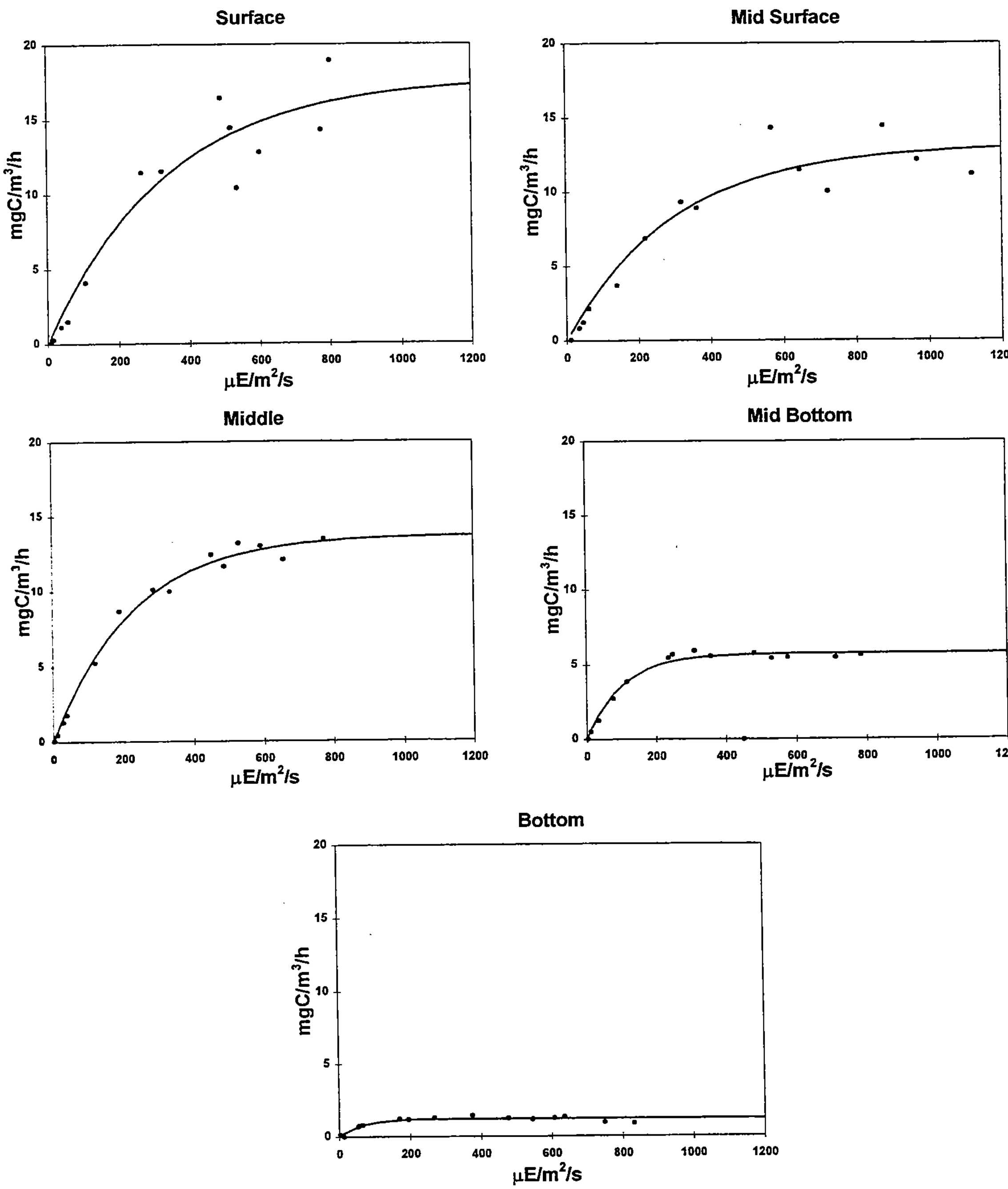


FIGURE 5-1
An Example Photosynthesis-Irradiance Curve

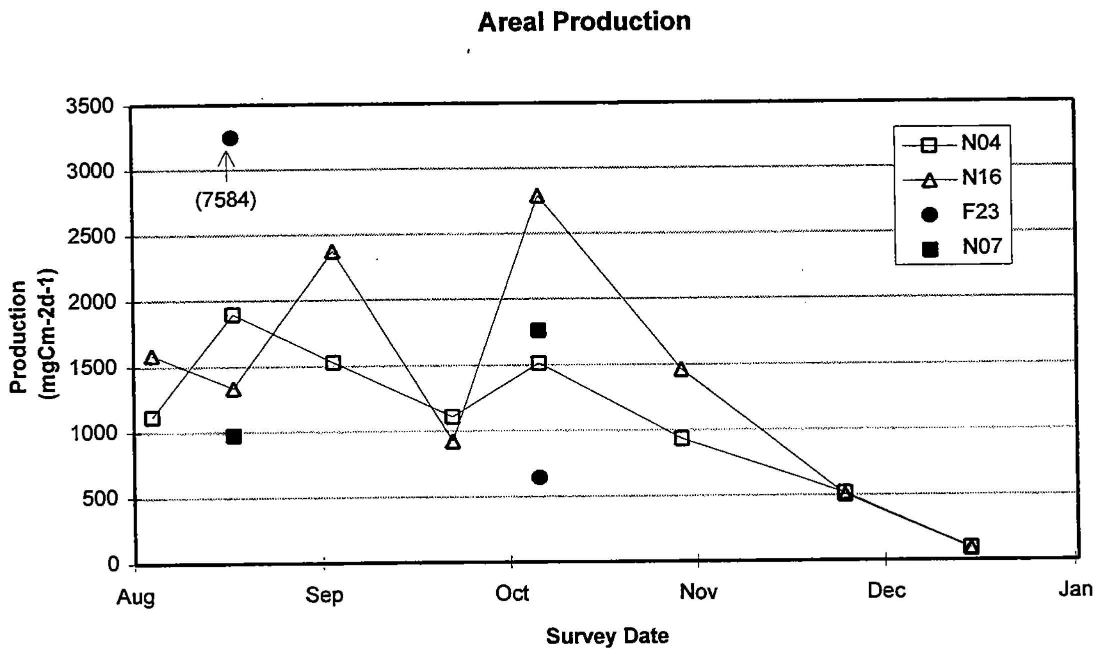


FIGURE 5-2
Time-Series of Areal Production (mgC/m^2/d) for Productivity Stations

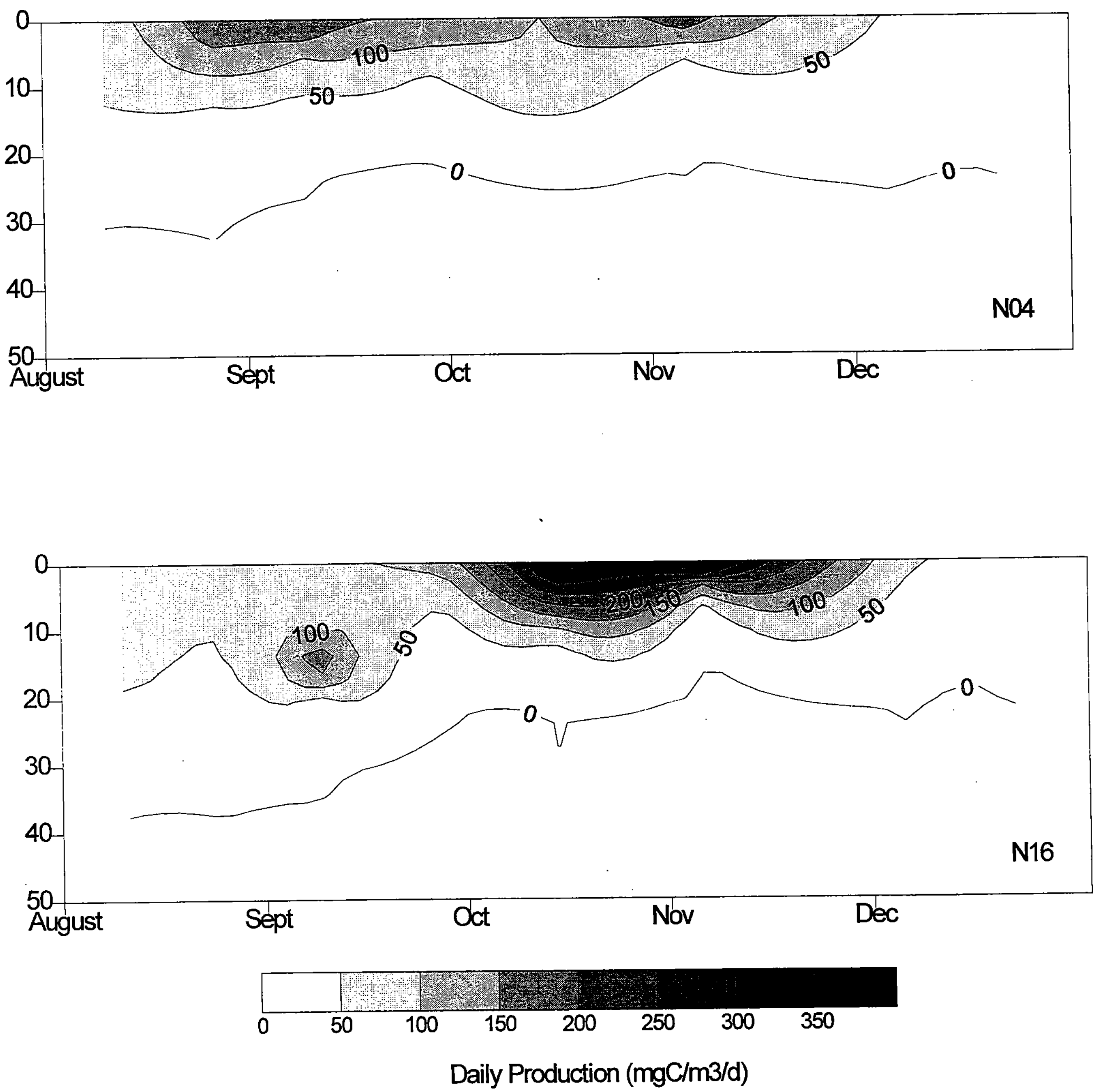


FIGURE 5-3
Time-Series of Contoured Daily Production (mgC/m^3/d)
Over Water Depth at N04 and N16

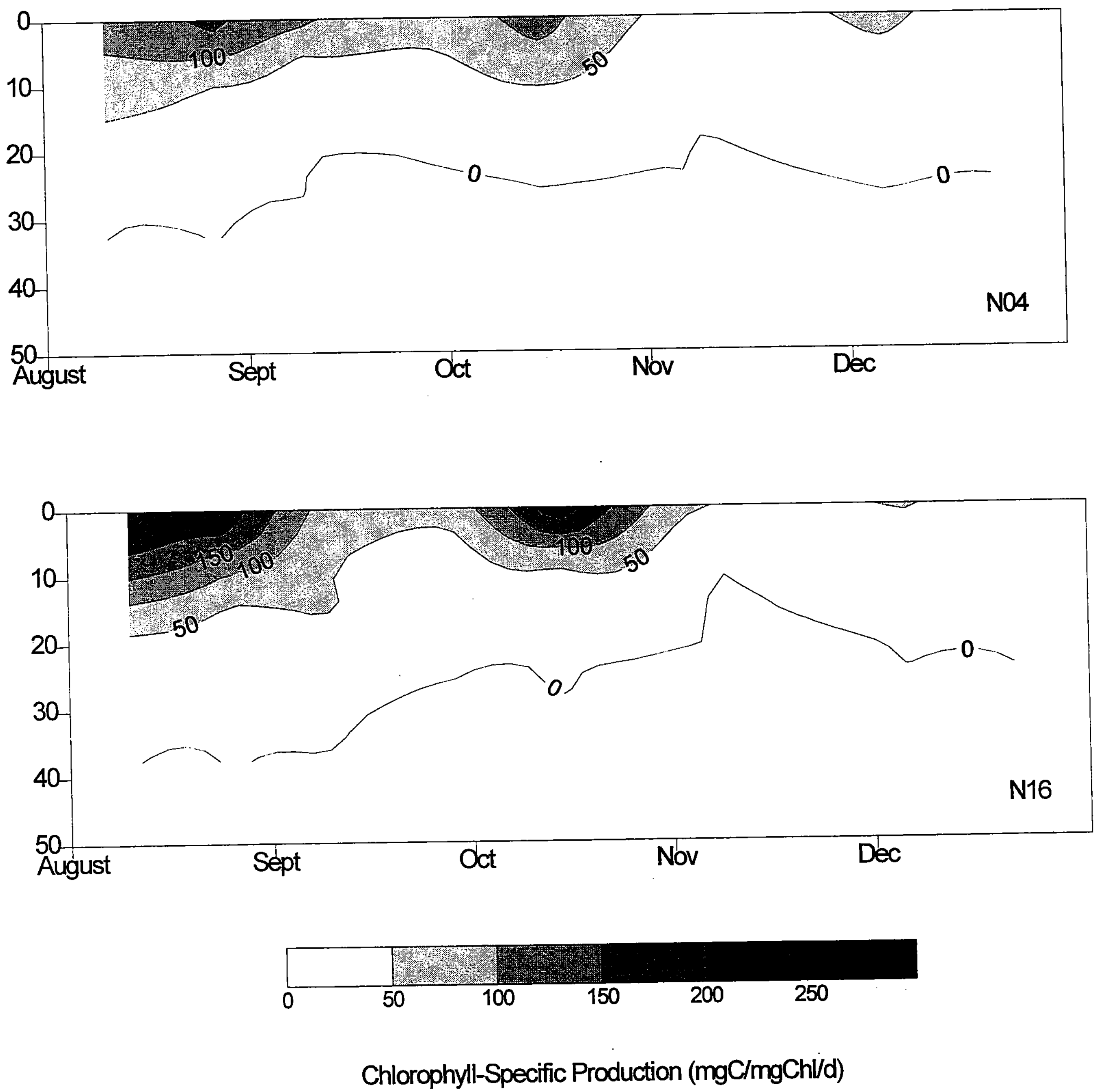


FIGURE 5-4
Time-Series of Contoured Chlorophyll-Specific Production (mgC/mgChl/d)
Over Water Depth at N04 and N16

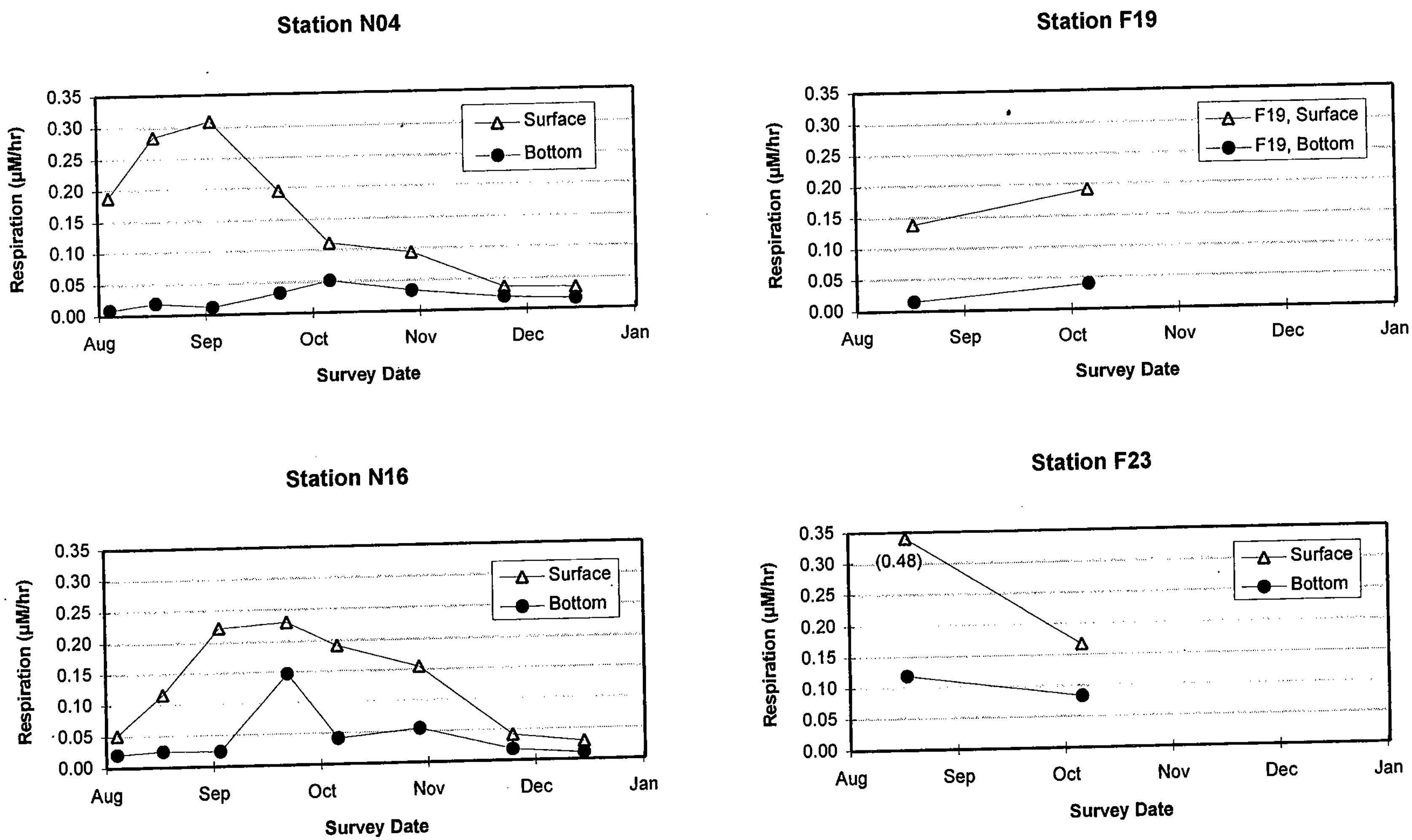


FIGURE 5-5
Time-Series of Water Column Respiration (µM/hr) at
Stations N04, N16, F19, and F23

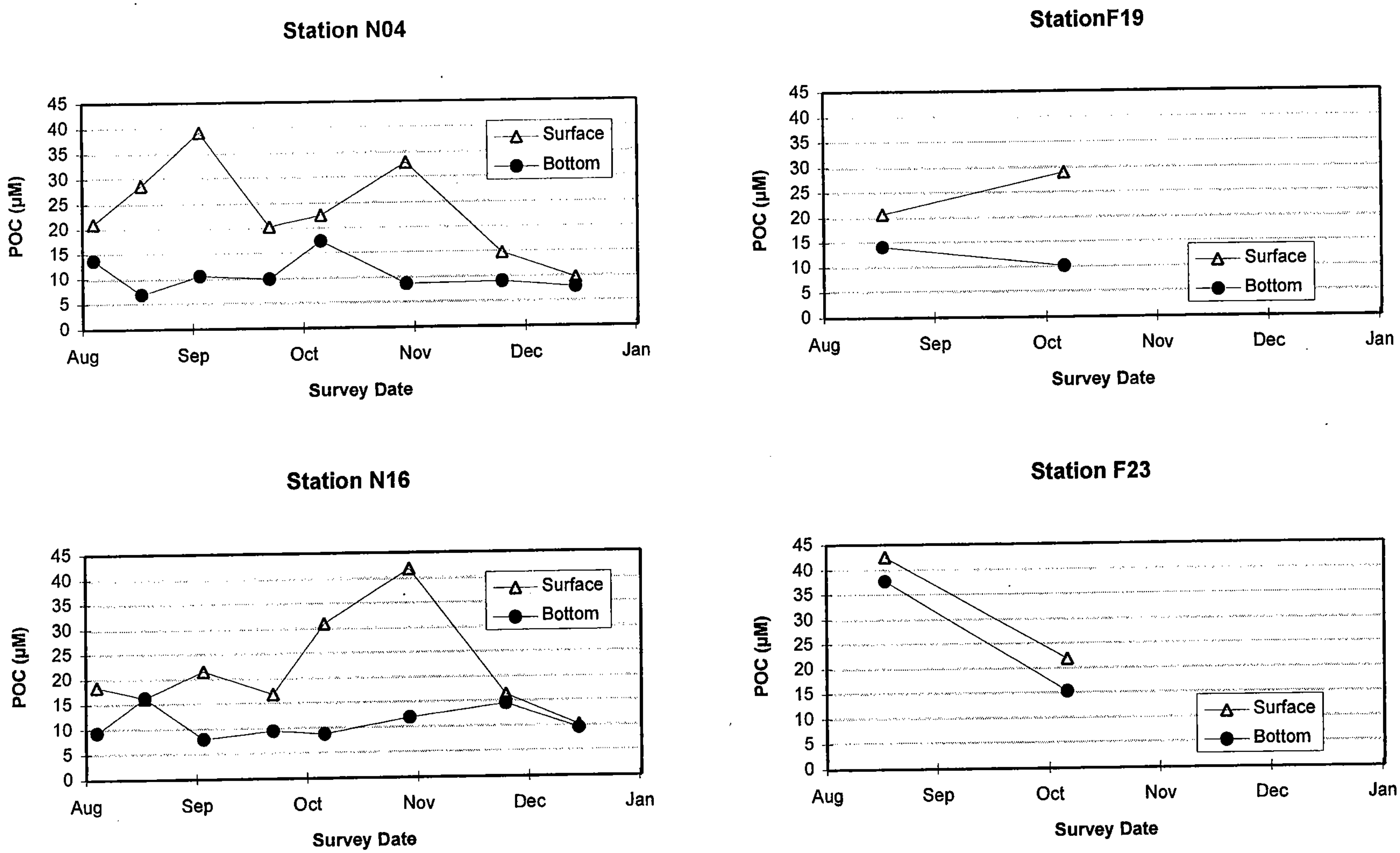


FIGURE 5-6
Time-Series of Particulate Organic Carbon (POC, µM) at
Stations N04, N16, F19, and F23

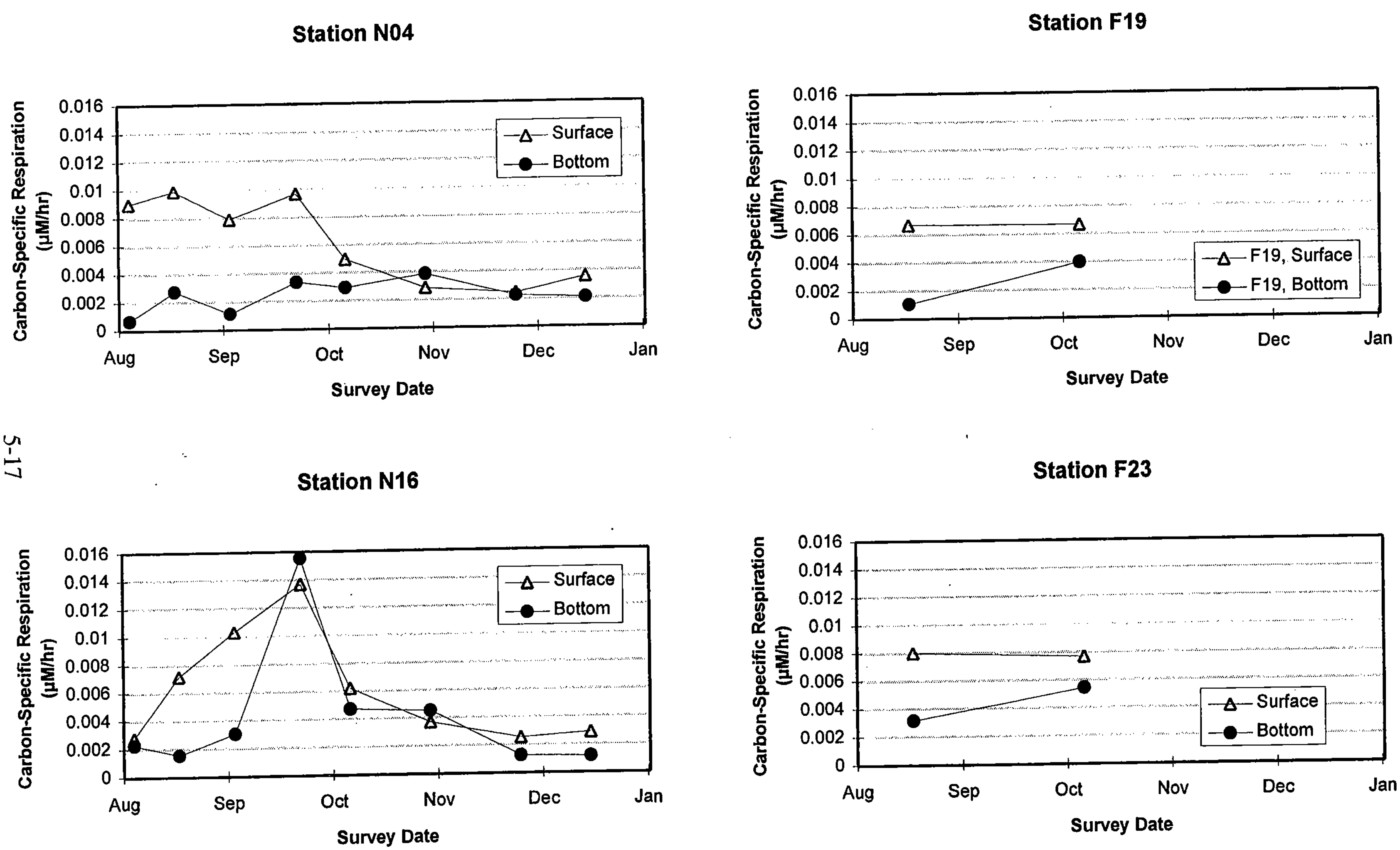


FIGURE 5-7
Time-Series of Carbon-Specific Respiration (µM/hr) at
Stations N04, N16, F19, and F23

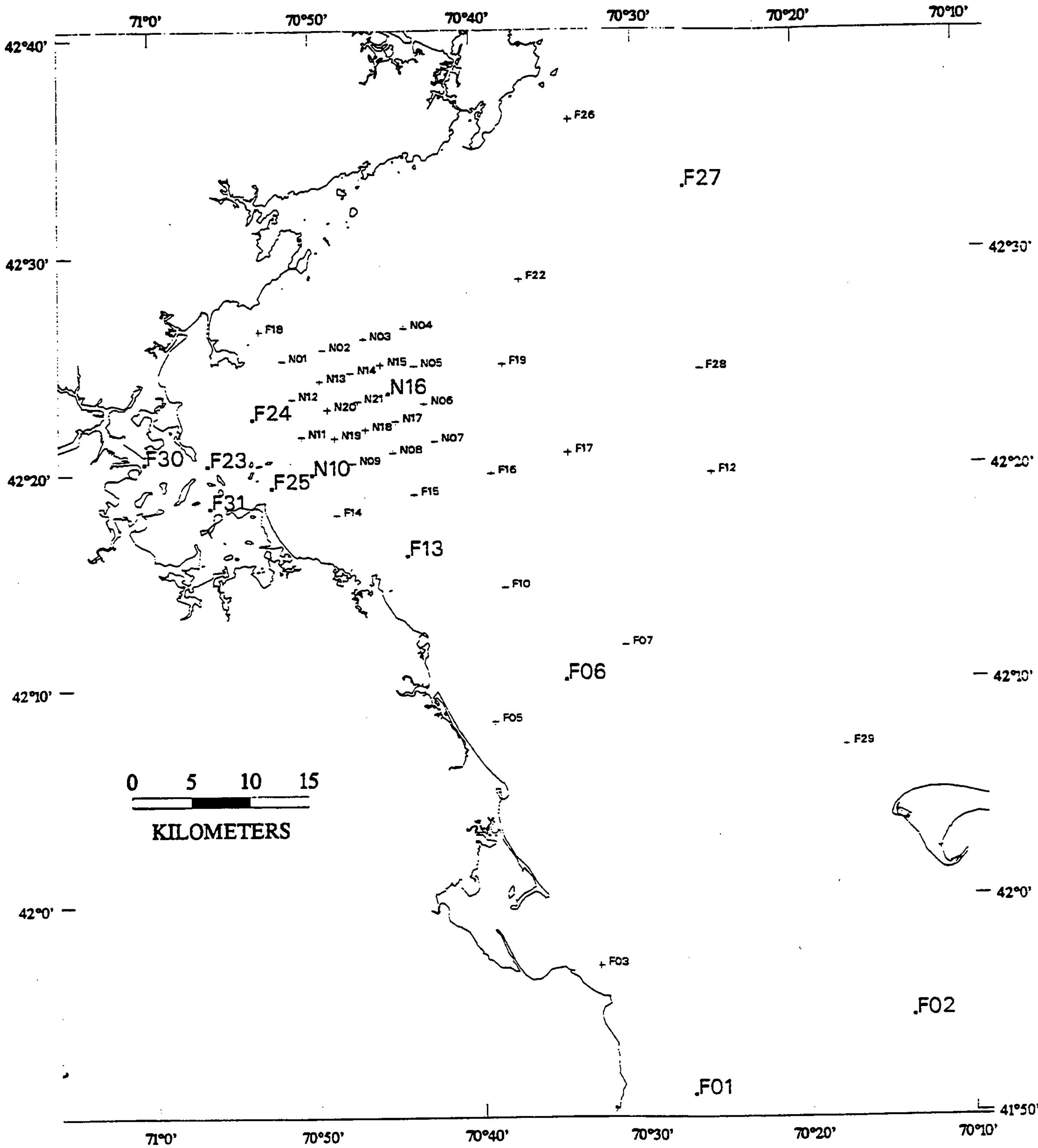


FIGURE 5-8
1995 HOM Plankton Stations Locations
(shown in enlarged text)

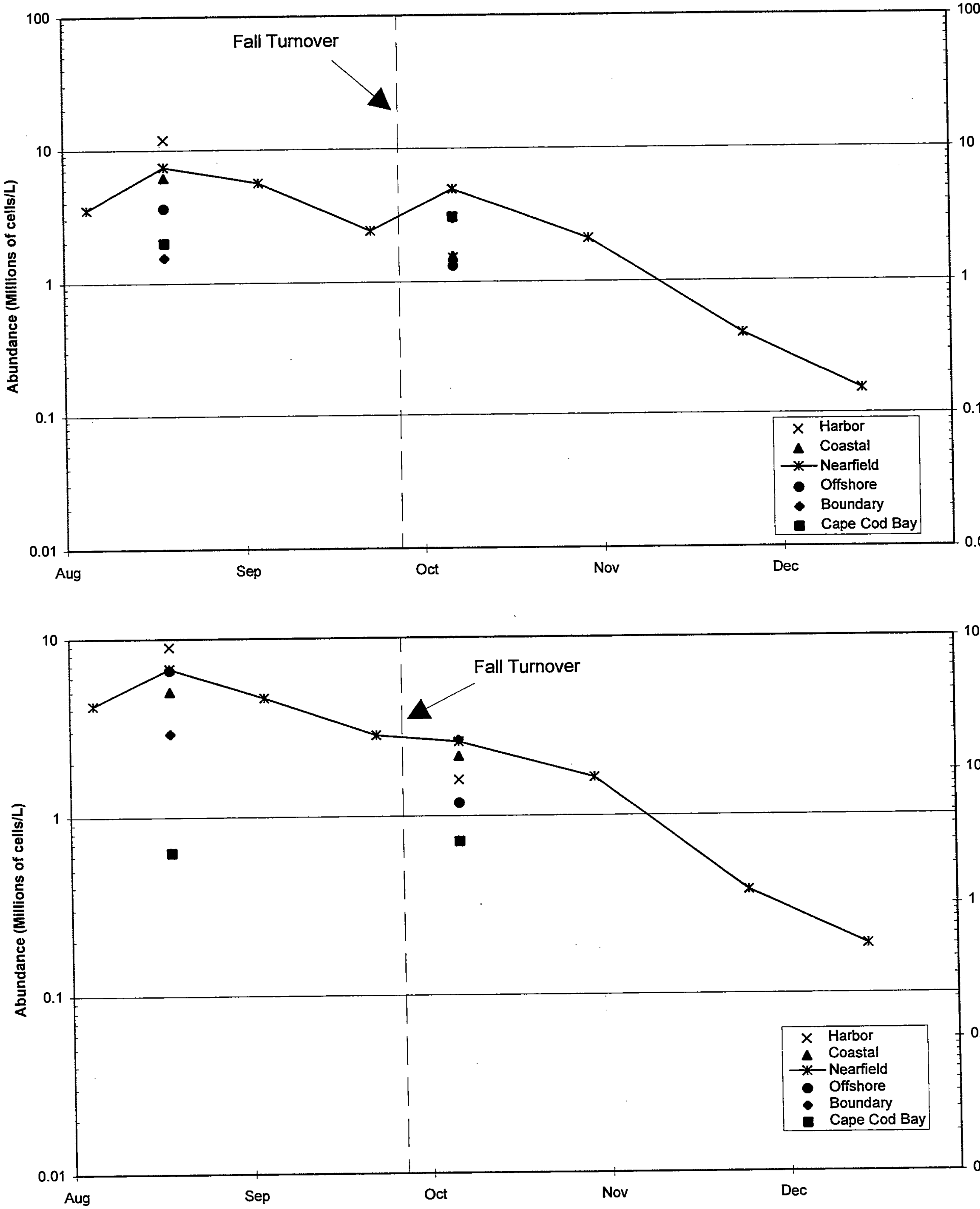


FIGURE 5-9
1995 Regional Total Phytoplankton Abundance
Top: Surface Data, Bottom: Chlorophyll *a* Maximum Data

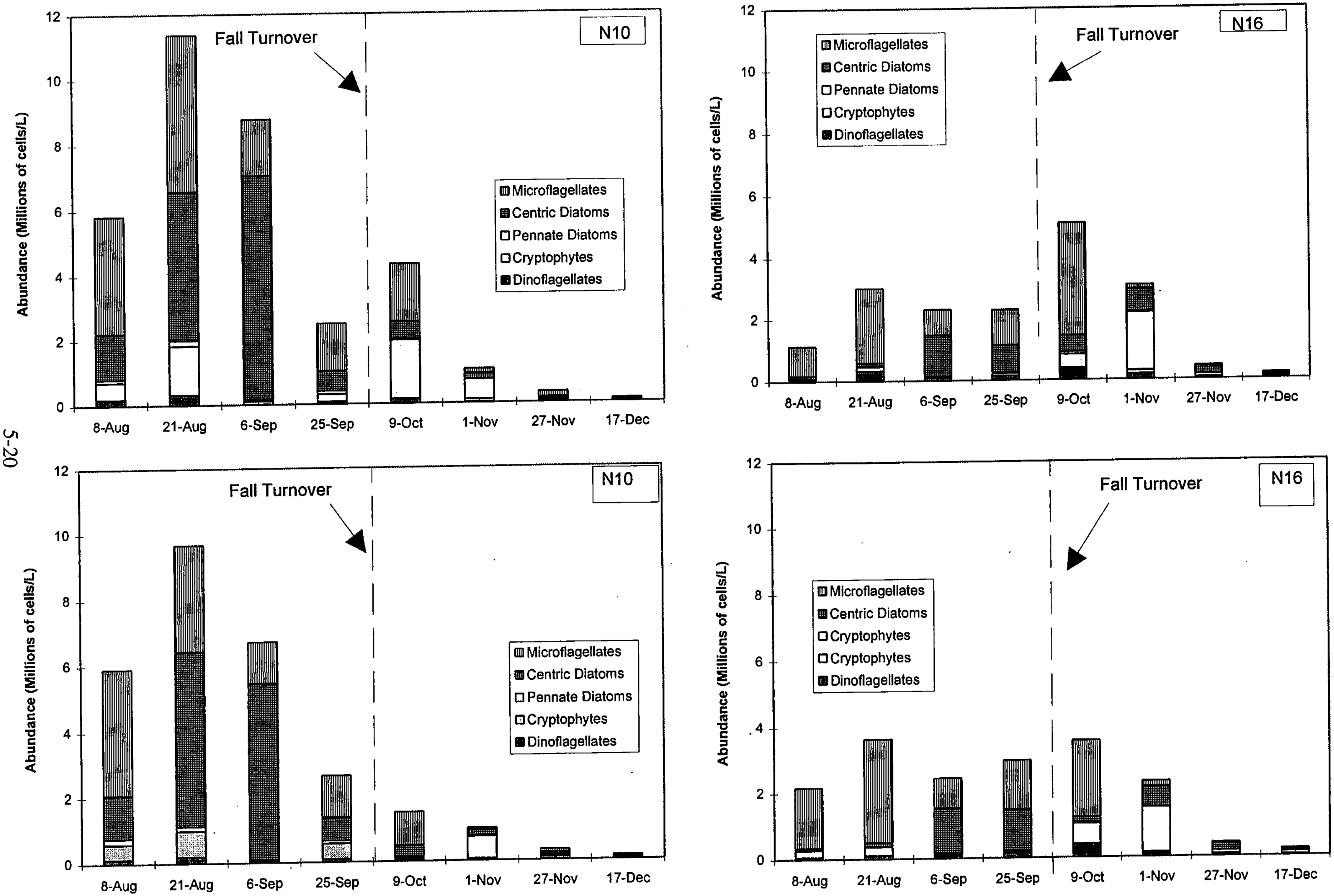


FIGURE 5-10
Distribution of Major Taxonomic Groups at Nearfield Stations N10 and N16
Top: Surface Data, Bottom: Chlorophyll *a* Maximum Data

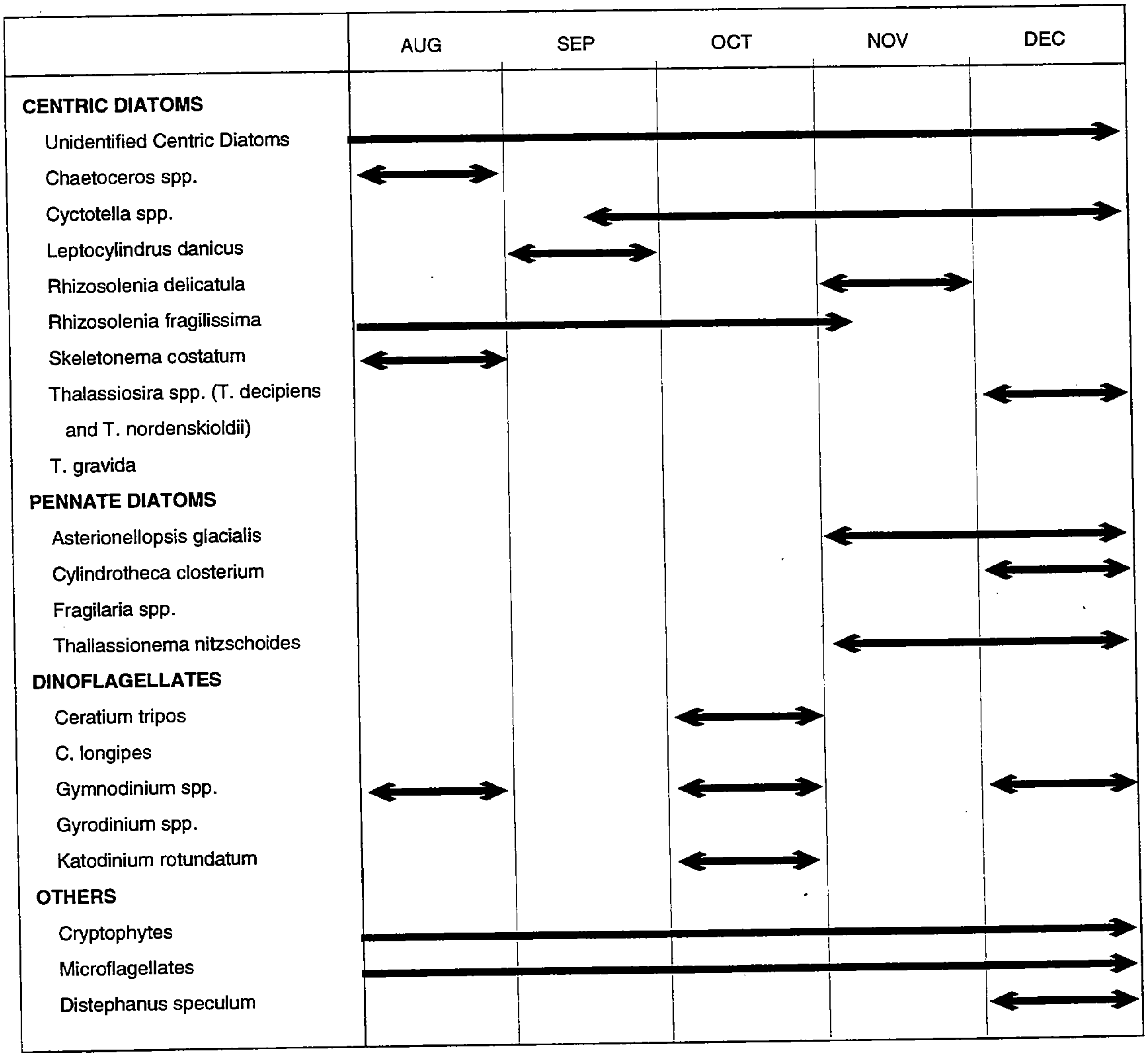
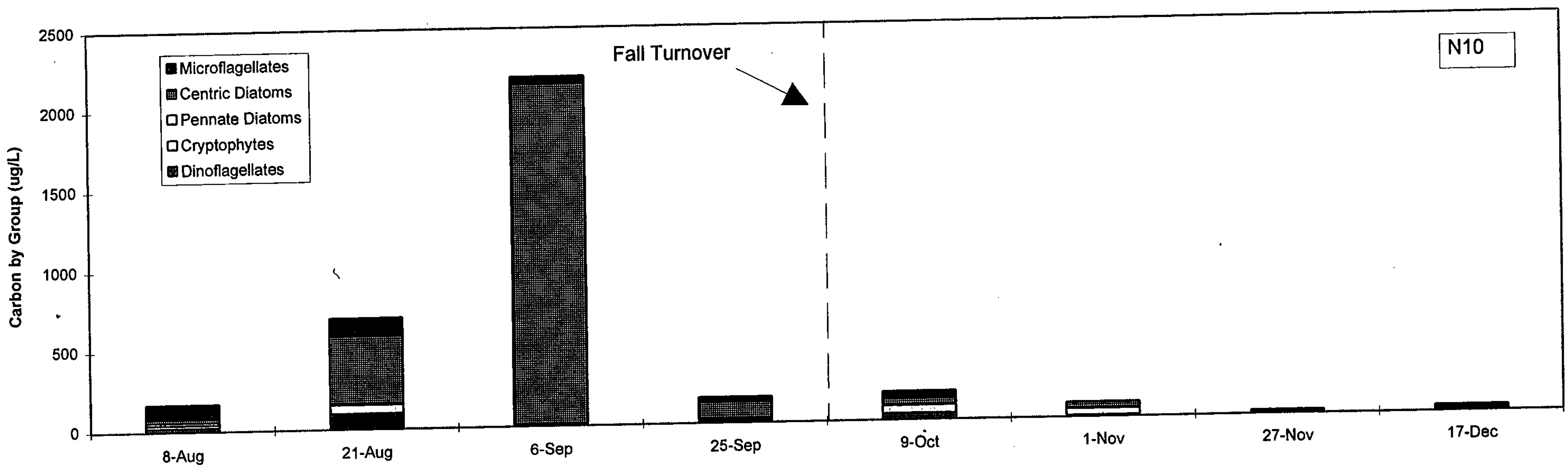


FIGURE 5-11
Dominant Phytoplankton Species by Abundance in Nearfield



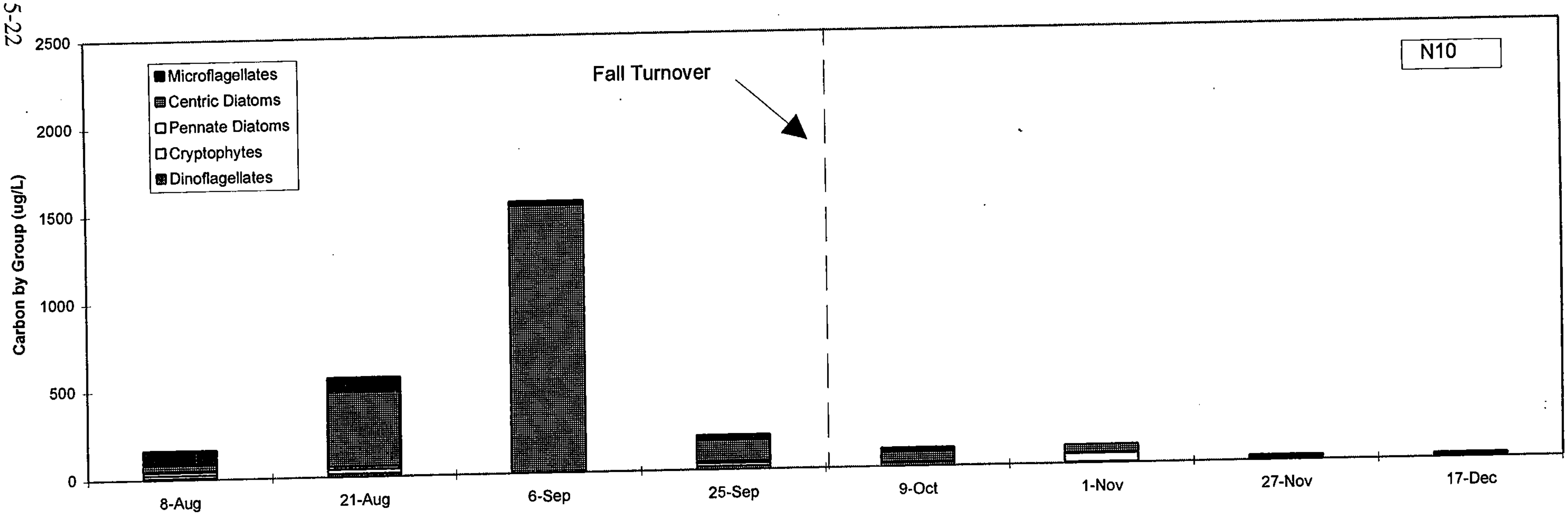


FIGURE 5-12
Distribution of Carbon (μg/L) by Major Taxonomic Groups
Top: Surface Data, Bottom: Chlorophyll *a* Maximum Data

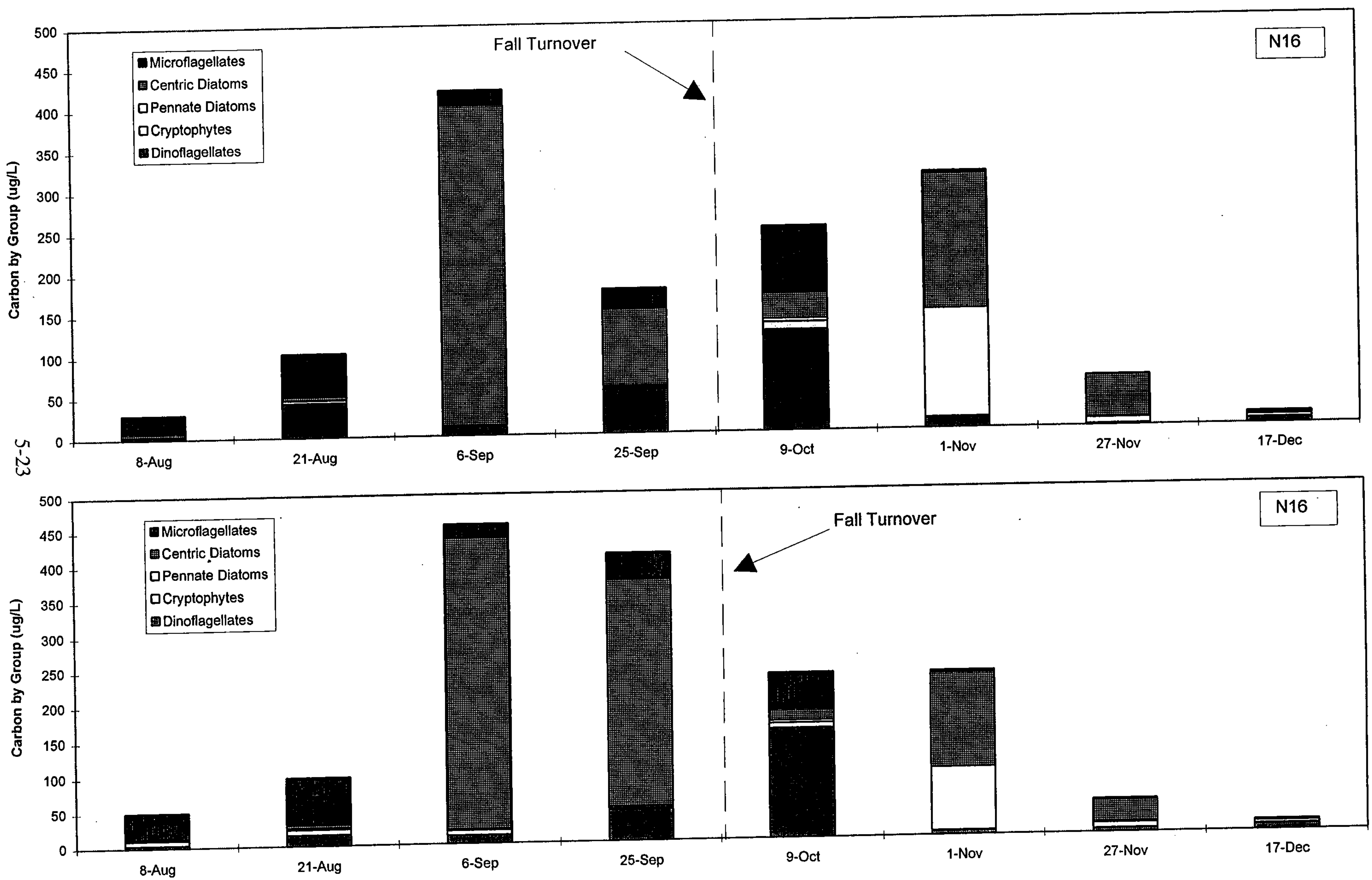


FIGURE 5-13
Distribution of Carbon (μg/L) by Major Taxonomic Groups
Top: Surface Data, Bottom: Chlorophyll *a* Maximum Data

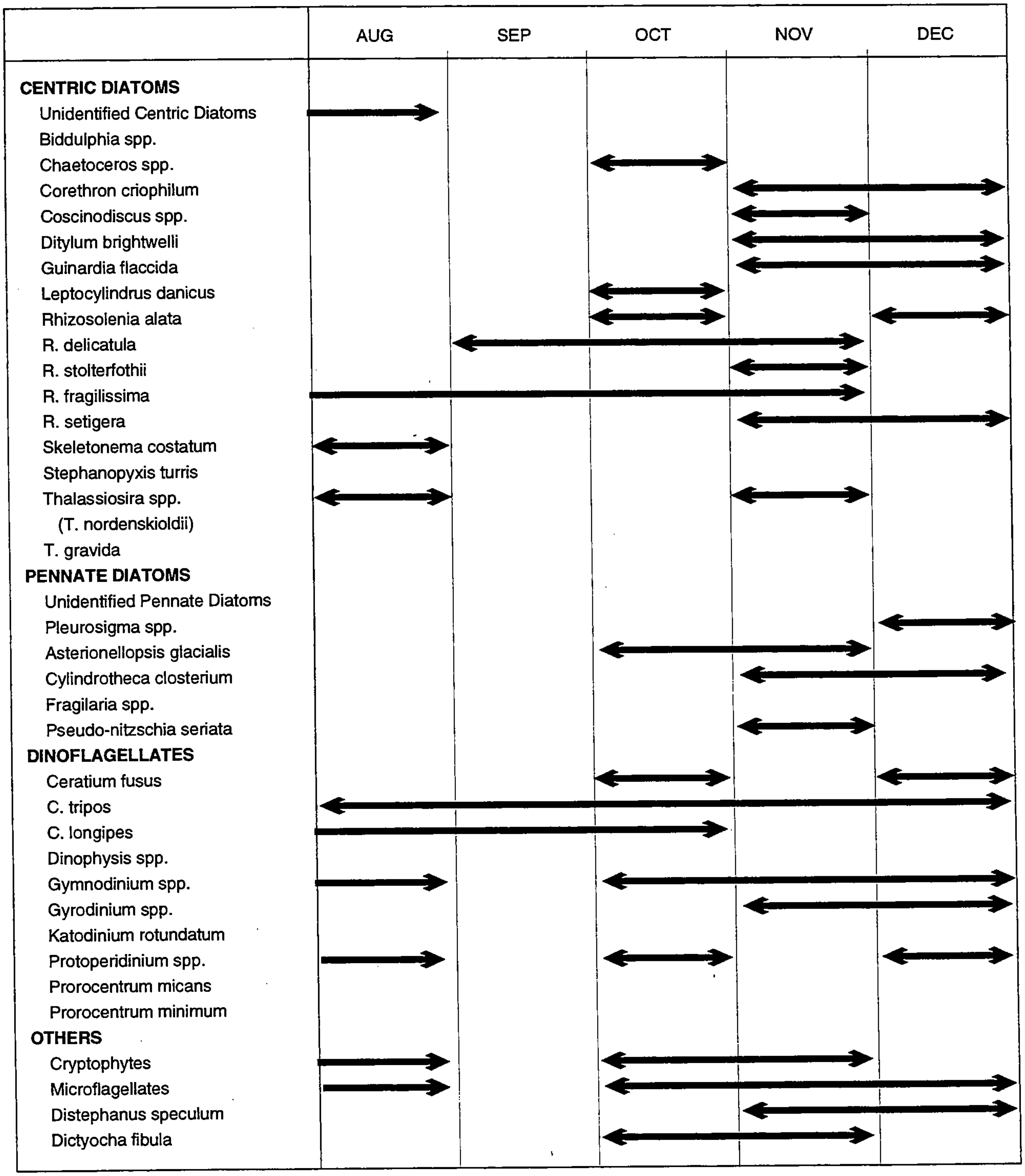
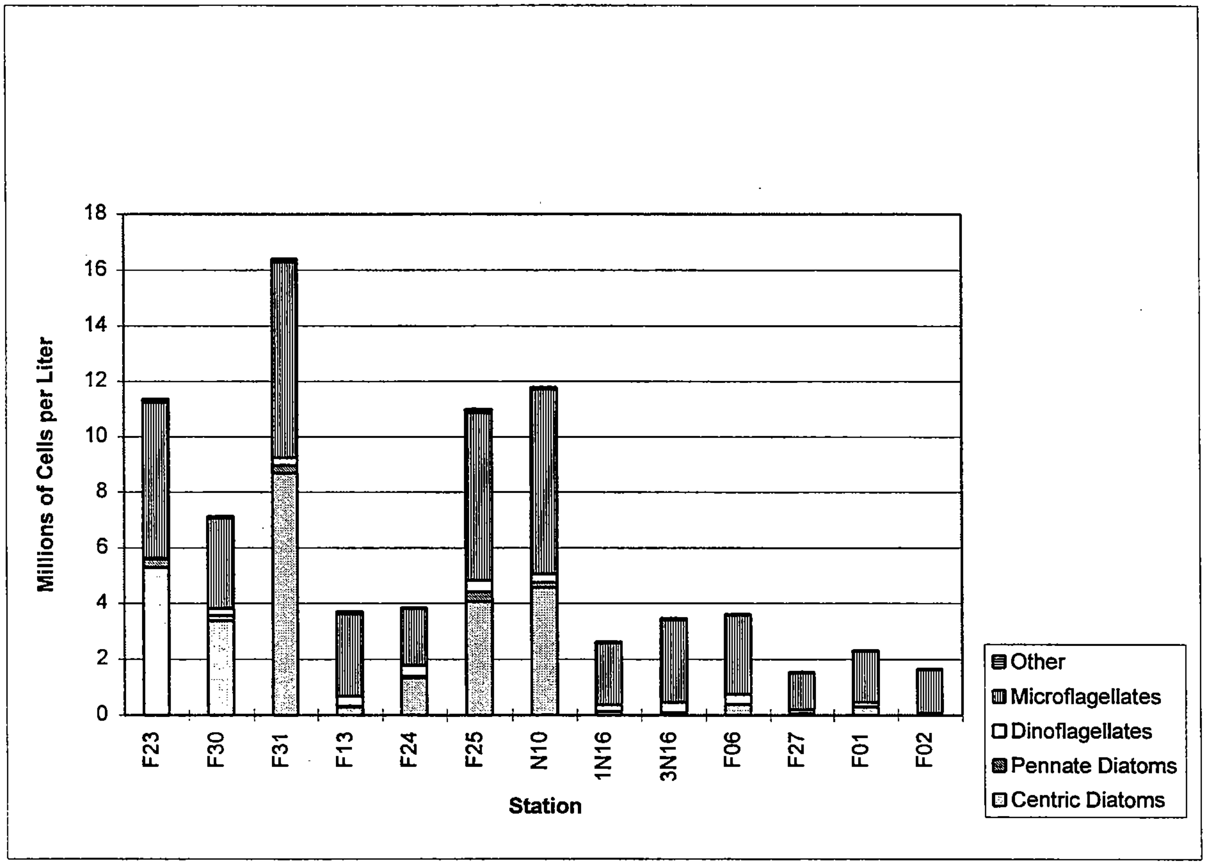


FIGURE 5-14
Dominant Phytoplankton Species by Carbon in Nearfield



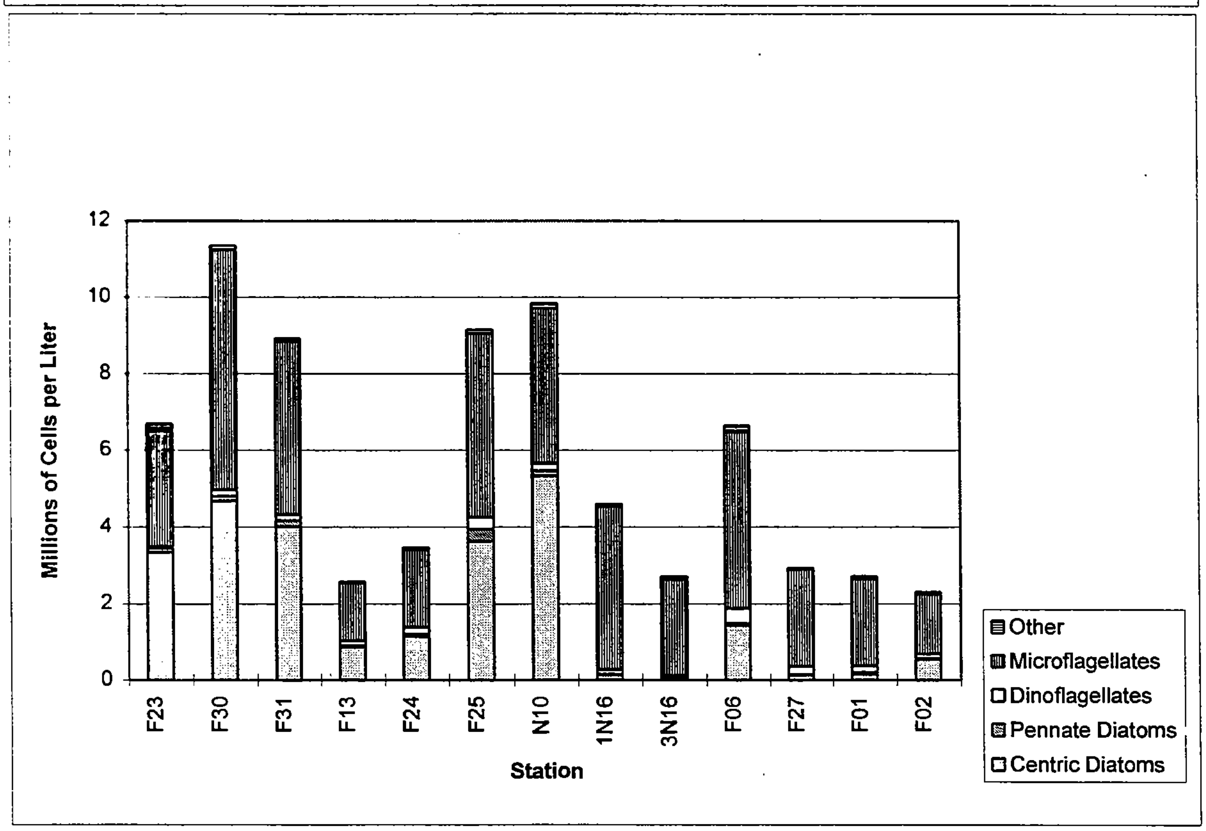
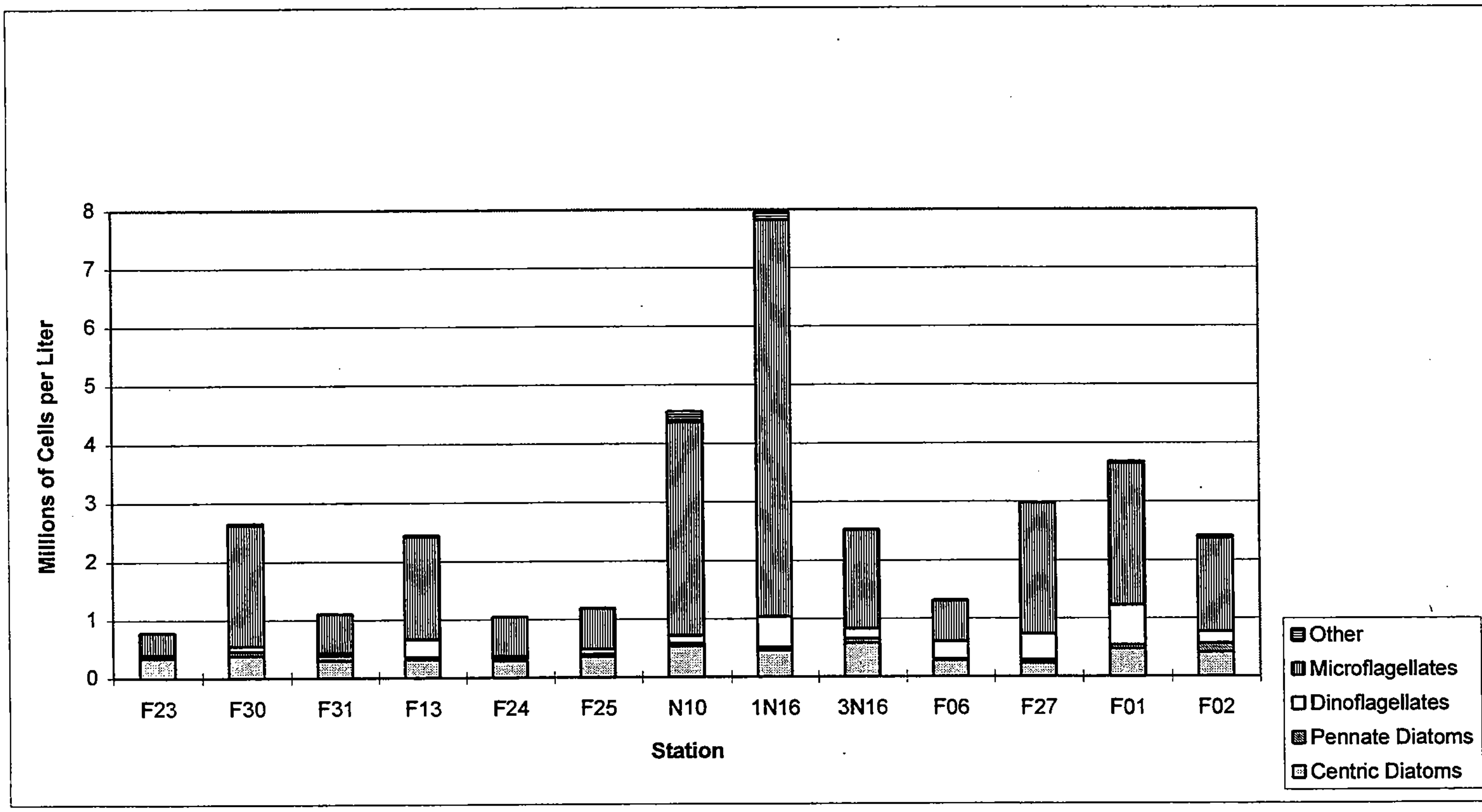


FIGURE 5-15

Total Phytoplankton Abundance by Taxonomic Group Collected in Late August (W9511)

Top: Surface Data, Bottom: Chlorophyll *a* Maximum Data



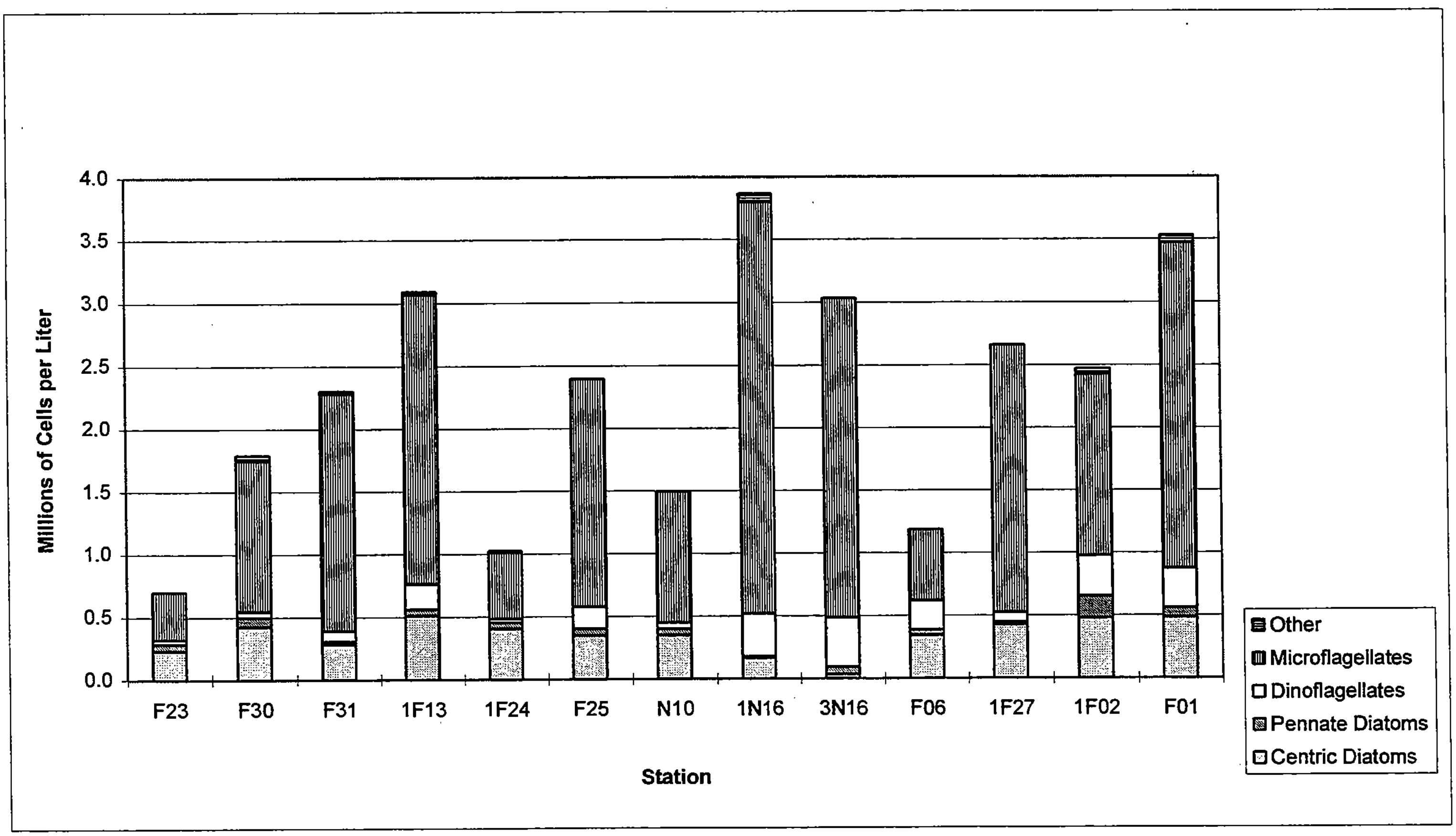
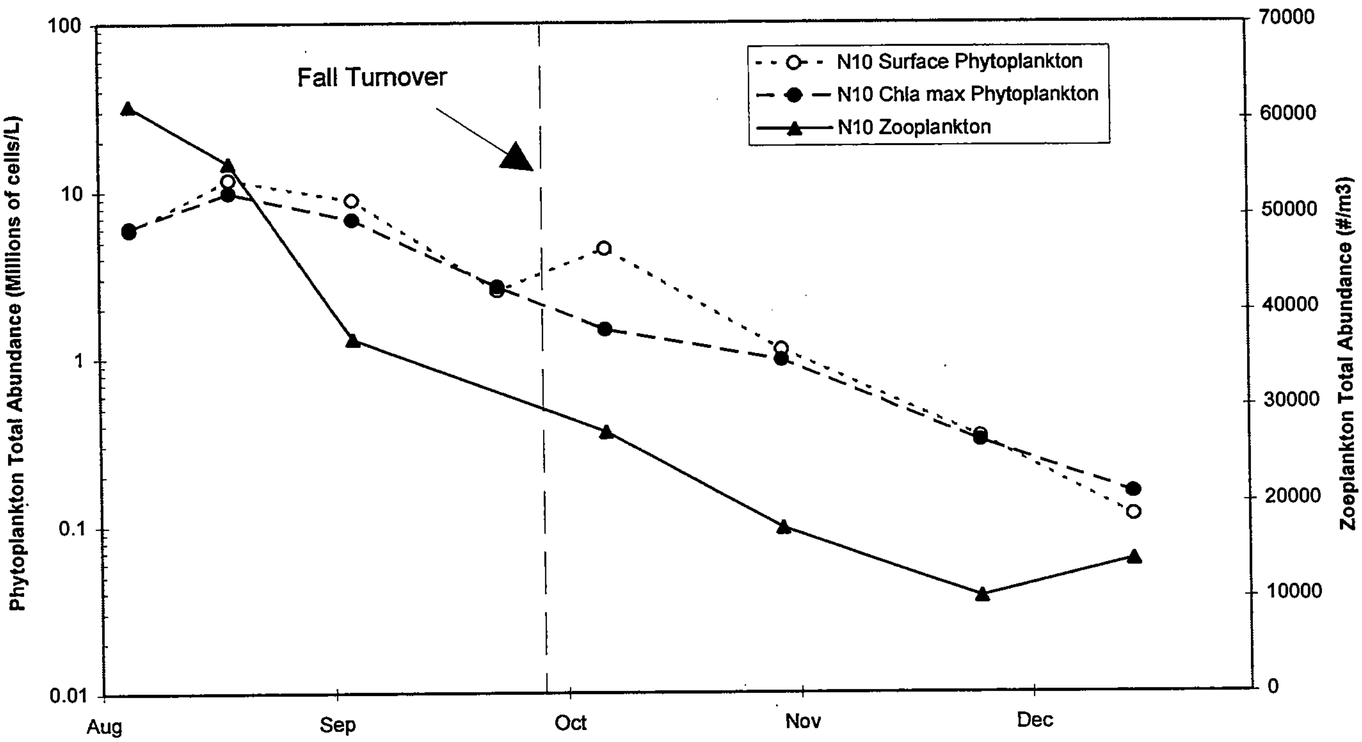


FIGURE 5-16

Total Phytoplankton Abundance by Taxonomic Group Collected in October (W9514)
Top: Surface Data, Bottom: Chlorophyll *a* Maximum Data



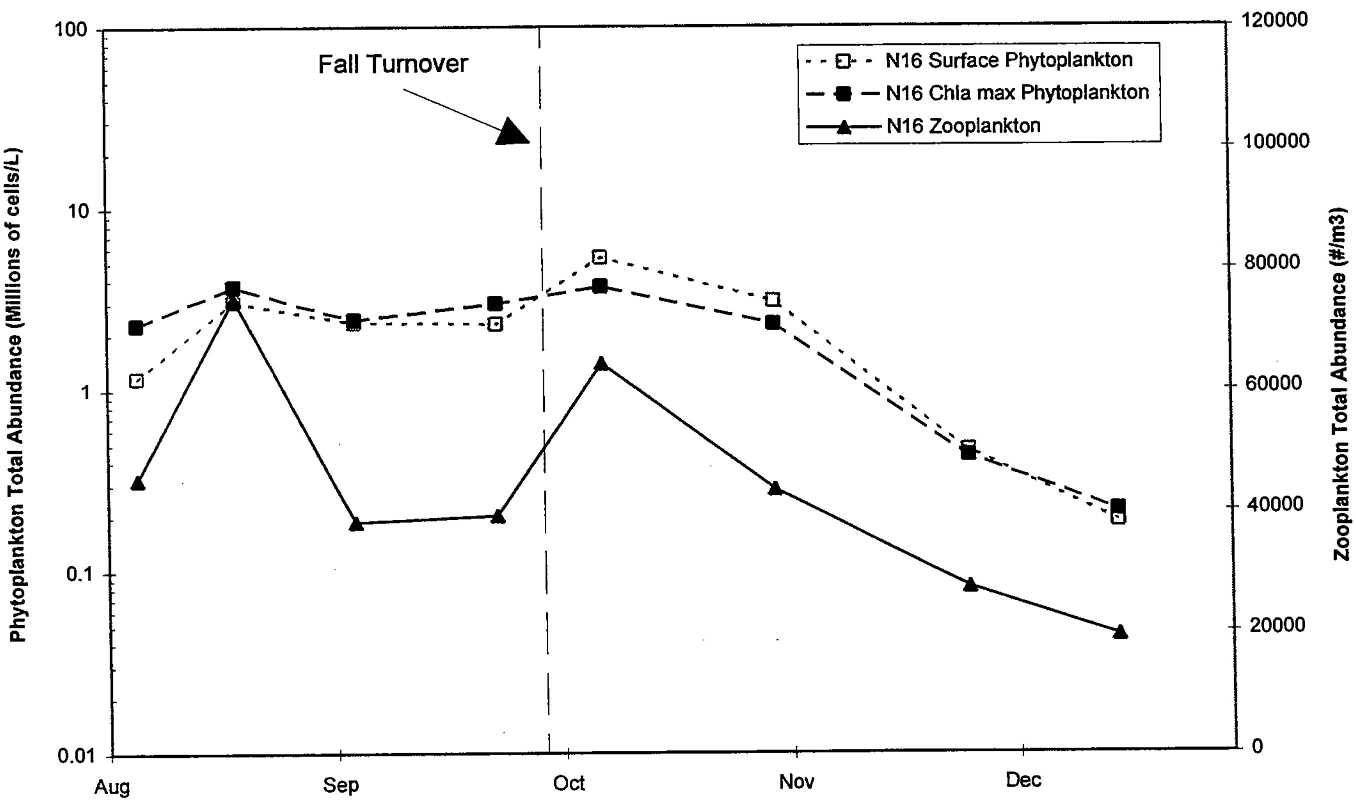


FIGURE 5-17
Total Abundance of Phytoplankton and Zooplankton
Top: Station N10, Bottom: Station N16

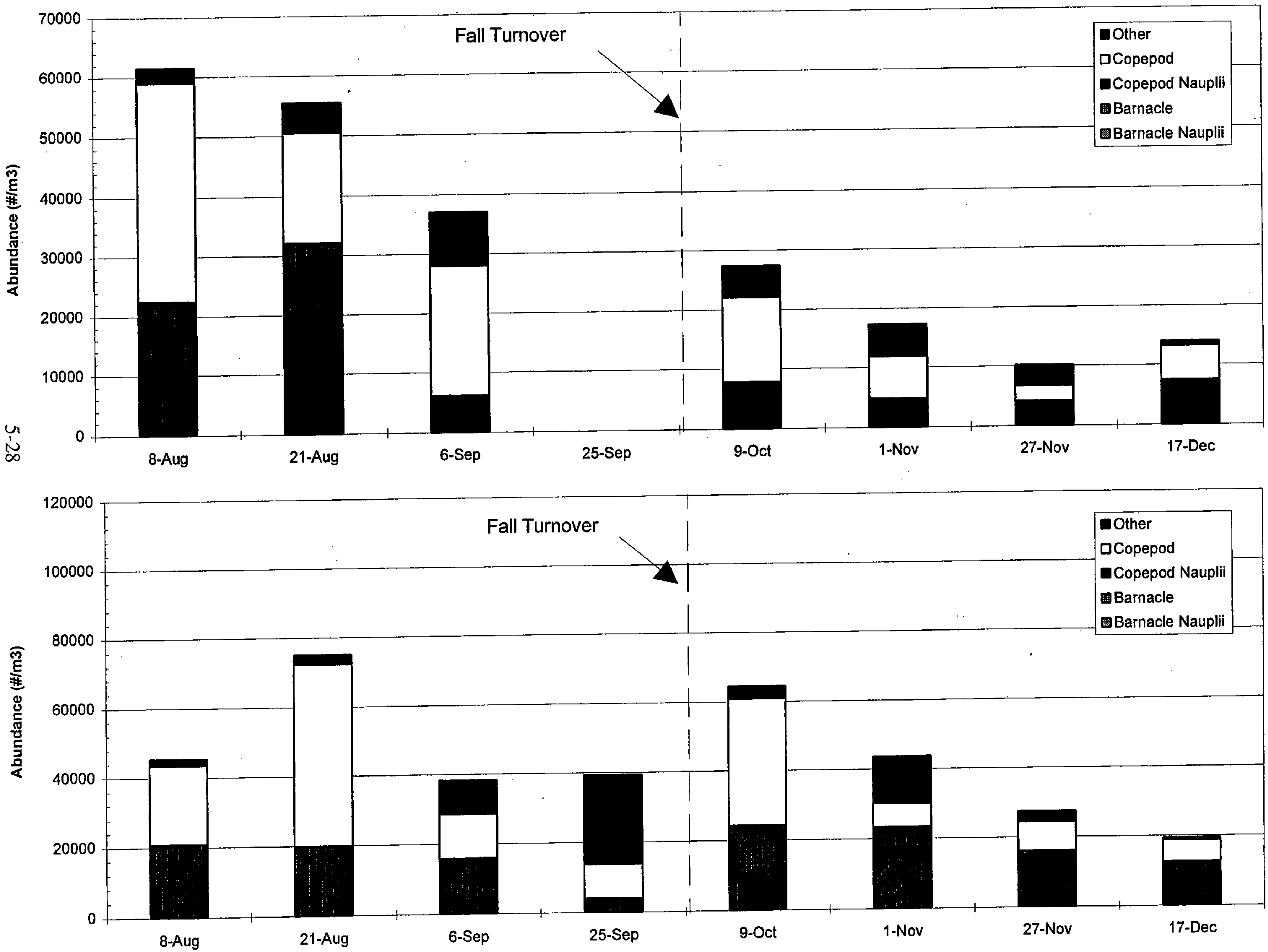


FIGURE 5-18
Total Zooplankton Abundance by Group in Surface Water
Top: Station N10, Bottom: Station N16

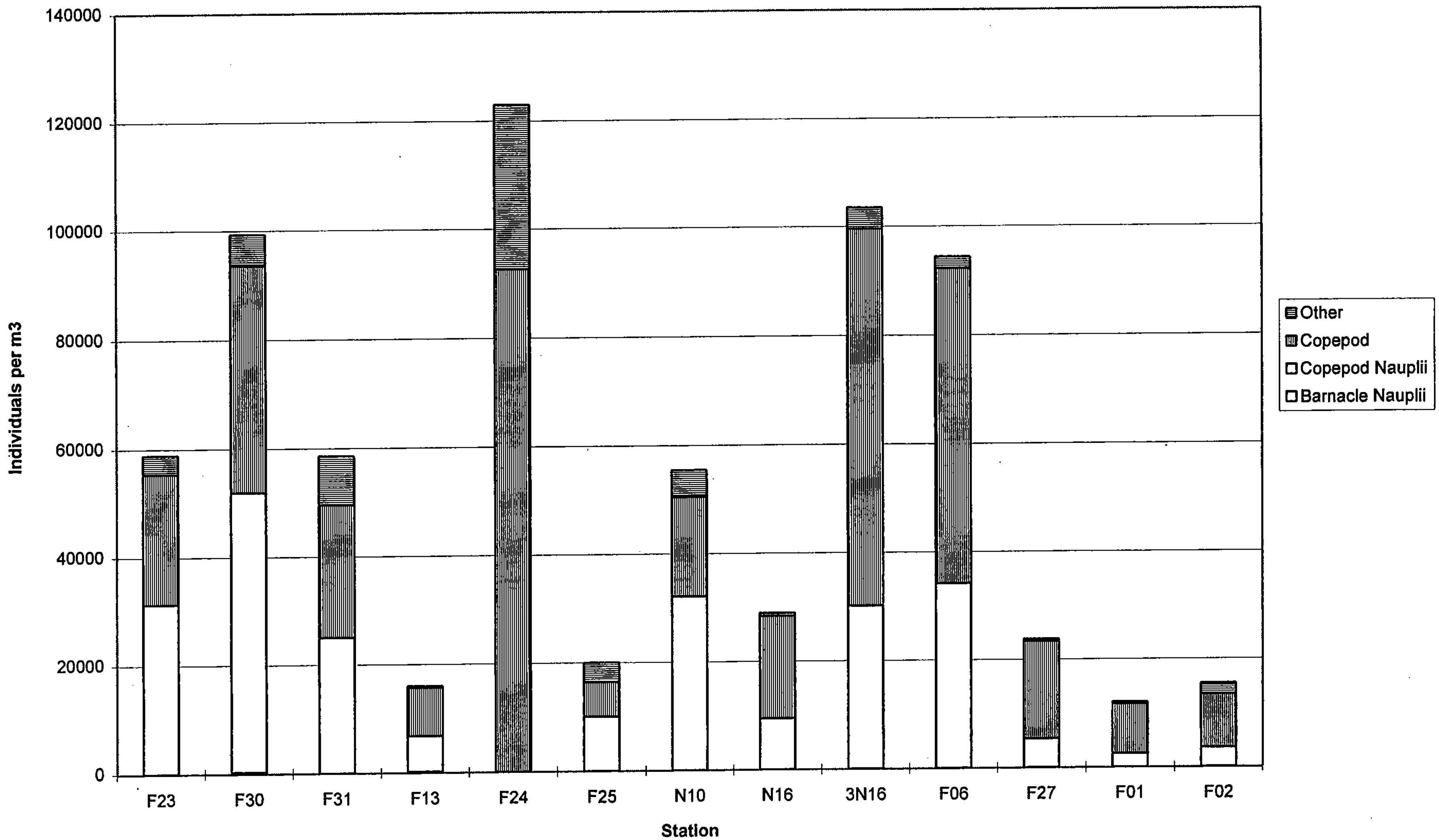


FIGURE 5-19
Zooplankton Abundance by Group Collected in Late August (W9511)

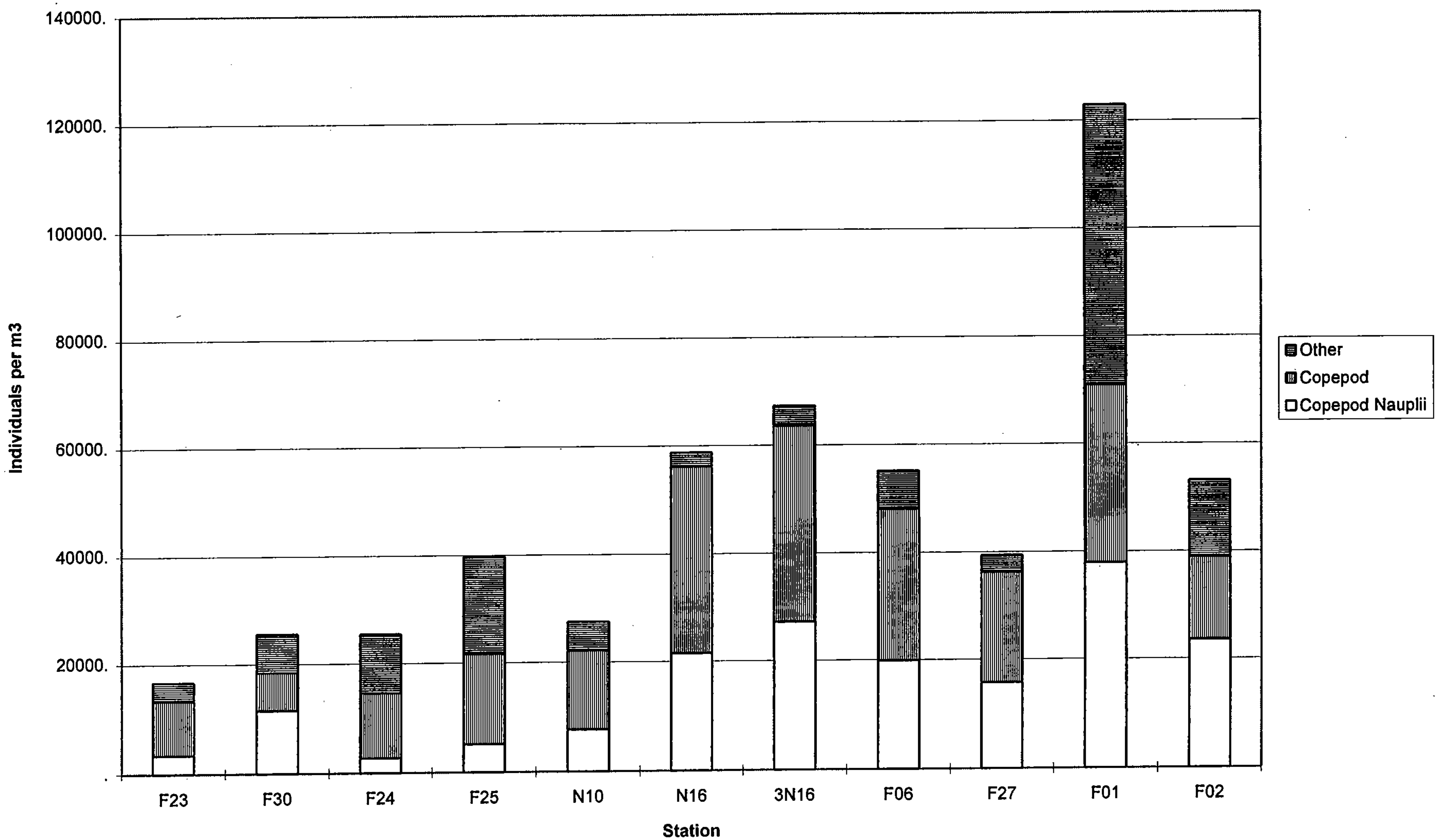


FIGURE 5-20
Zooplankton Abundance by Group Collected in October (W9514)

6.0 A SUMMARY OF MAJOR WATER COLUMN EVENTS

The purpose of this section is to provide a brief synthesis of some of the regional events supported by both the physical and biological trends in the data. Although a rigorous analysis of the datasets from the first semi-annual period is out of the scope of this data synthesis, several events, both regionally and within the nearfield, were evidenced by a variety of data.

The pre-turnover period (W9510-13) was characterized by a vertically stratified water column. Water column stratification was due primarily to a surface/bottom water temperature gradient. Nutrients in the surface water were low, except for in Boston Harbor, which remained mixed and had the highest surface water concentrations of all nutrients measured during both farfield surveys. Overall, through the pre-turnover period, nearfield bottom water nutrient concentrations increased from early August (W9510) to late September (W9513). An inshore-offshore nutrient gradient of PO_4 and DIN (NH_4) between the harbor and nearfield region was due to influence of harbor effluent.

Dissolved oxygen in the bottom water reached minimum concentrations during the final pre-turnover survey in late September (W9513). Nearfield average bottom water DO concentrations declined from >8 mg/L in early August (W9510) to 6.5 mg/L in late September (W9513), and then began to increase to >7 mg/L in October (W9514). Surface water respiration also increased from early August to September, due to the availability and quality of organic carbon production.

During the first regional farfield survey in late August (W9511), surface water temperatures were very warm (>19°C), but a patch of cooler surface water (17-19°C) at the northern end of the offshore/nearfield area was due to an intrusion of Gulf of Maine water as indicated by satellite data. Farfield transects showed a patch of cooler, less saline water at the surface at Station F19. Elevated surface water nutrients in the northern offshore region were associated with the GOM water mass.

A late summer bloom began in late August, clearly documented in many of the physical and biological parameters. Maximum chlorophyll *a* concentrations were measured in the upper water column of Boston Harbor (14.2 µg/L), the inner nearfield (15 µg/L), and along the coast (11.8 µg/L). Peak annual production (7,584 $mgCm^{-2}d^{-1}$) was measured during this survey at station F23, located outside of Boston Harbor, a rate which was twice the next highest rate measured during the spring bloom. Boston Harbor had the highest phytoplankton densities of all farfield region, with slightly lower abundances in the nearfield, coastal, and offshore regions. The late summer bloom was dominated by microflagellates and centric diatoms, including *Skeletonema costatum* and *Rhizosolenia fragilissima*. Estimated phytoplankton carbon equivalence also was dominated by centric diatoms.

Farther offshore in the outer nearfield, chlorophyll concentrations of up to 4 µg/L were concentrated along isoclines in the water column at 10 and 20 m. Chlorophyll-specific production data indicated that the outer nearfield was also experiencing conditions conducive to photosynthesis, but produced chlorophyll was probably rapidly scavenged because of the high abundances of zooplankton present. The peak of nearfield zooplankton abundance was at station N16 during late August (78,000/m^3). Regionally, station F24 data outside of the harbor showed the highest zooplankton densities (around 124,000/m^3) during late August, numerically dominated by copepod adults and bivalve species.

The subsequent nearfield survey in early September (W9512) showed that the late summer bloom was waning in the inner nearfield, but outer nearfield chlorophyll had increased to >6 µg/L along the 20 m isocline. Daily production data were consistent with a subsurface (10-20 m) productivity maximum. Semi-annual maximum areal production among the nearfield stations was measured at station N16 (2,378 $mgCm^{-2}d^{-1}$). As chlorophyll production moved farther offshore into the central and outer nearfield, DO saturation reached maximum levels of >110% in outer nearfield surface water. Respiration reached a maximum of 0.3 μMO_2/hr in surface water at station N04.

The density of inner nearfield bottom water dropped by almost 1.0 in late September (**W9513**) due to a lens of less saline water originating from the direction of Boston Harbor. Salinity increased in the outer nearfield, however, between early (W9512) and late September, resulting in a salinity transition through the middle of the nearfield and a resultant complex vertical density structure;

Chlorophyll concentrations had decreased to <2 µg/L throughout the nearfield water column, except for the northwest region of the nearfield grid, where concentrations reached 6.3 µg/L in the surface water at nearfield station N12. Despite the lack of chlorophyll in the water column, the semi-annual maximum rate of bottom water respiration (0.15 μMO_2/hr) was measured at station N16. The pattern of increasing chlorophyll-specific respiration prior to the fall turnover, especially at station N16, suggested that the available POC was easily oxidized. Recently produced plankton associated with the late summer bloom apparently had a mechanism for reaching bottom water during this survey, due to either rapid settling of coalesced mats of senescent material, or facilitated by zooplankton grazing.

The fall turnover was in progress by mid-October (W9514), with the water column remaining vertically stratified in the offshore and boundary regions, while $\Delta\sigma_t$ ranged from 0 to -1.0 in Boston Harbor, Cape Cod Bay, and the coastal regions. The nearfield mixing event, documented by continuous monitoring data, resulted in a reduction of the water column temperature gradient and a breakdown of vertical stratification.

The relative increase of surface water nutrient concentrations measured in the harbor, coast, and inner nearfield in October provided a catalyst for the nearfield fall bloom documented in early November. With the onset of the fall turnover, production of chlorophyll was focused in the outer nearfield, with maximum concentrations of 4-6 µg/L in the upper 10 m in the center of the nearfield measured during the October survey. Semi-annual maximum areal production among the nearfield stations was measured at station N16 (2,793 $mgCm^{-2}d^{-1}$). Regionally, the nearfield had the highest surface water phytoplankton abundance during this survey, while nearfield zooplankton abundance was high at station N16 (>60,000/m^3).

Cape Cod Bay in October had the lowest mid-water phytoplankton abundance (<1 million cells/L). This may be due to grazing, as zooplankton densities of bivalve and copepod species peaked in Cape Cod Bay during this period, with densities exceeding 36,000/m^3, with numerical dominance by the copepods *Oithona similits* and *Centropages typicus*.

During the final three nearfield surveys of the second semi-annual period of 1995 (W9515-W9517), all physical and biological parameters indicated that the nearfield water column was well mixed. The early November survey (W9515) was conducted during the height of the fall bloom, with the highest semi-annual chlorophyll concentrations measured, reaching 18 µg/L in the central nearfield around station N21. Production measurements were potentially underestimated during the bloom, due to cloudy conditions during sampling. The fall bloom was dominated by pennate diatoms (*Asterionellopsis glacialis*) as well as microflagellates.

7.0 REFERENCES

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Massachusetts Water Resources Authority (MWRA), 1997. Contingency Plan. MWRA, Boston, MA. 41pp.

APPENDIX A

Productivity Methods

Methods

Production Analyses by ^{14}C - Field Procedures.

From each of the 5 productivity depths at each productivity station, samples were obtained by filtration through 300 mm Nitex screen (to remove zooplankton) from the Niskin bottles into opaque 1 gal polyethylene bottles. Under subdued green light, sub-samples were transferred by siphon into individual 75 ml acid cleaned polycarbonate bottles. Each bottle was flushed with approximately 250 ml of sample. A total of 16 bottles (14 light bottles, 2 dark bottles) were filled for each depth and incubated in a light and temperature controlled incubator. Light bottles from each depth are incubated at 14 light intensities (250 W tungsten-halogen lamps attenuated with Rosco neutral density filters) and all bottles incubated within 2° C of the *in situ* temperature at each depth for 4-6 hr (actual time was recorded). Single bottles of sample collected from each depth was assayed for background (time-zero) activity.

The 75 ml samples were incubated with 5-10 µCi ^{14}C-bicarbonate (higher activity during winter and spring season) and biological activity terminated by filtration of the entire contents of the bottles through 2.5 cm diameter Whatman GF/F glass fiber filters and immediate contact of the filters with 0.2 ml of a 20% aqueous solution of acetic acid contained in pre-prepared 20 ml glass scintillation vials (vials immediately recapped). For specific activity determination 0.1 ml aliquots of sample were placed in pre-prepared 20 ml scintillation vials containing 0.2 ml of benzethonium hydroxide (approximately 1.0 M solution in methanol; Sigma Chemical Company) to covalently sequester the ^{14}C inorganic carbon (vials immediately recapped). Specific activity was determined from the measured activity and measurements of DIC.

Samples for DIC analysis were collected from the Niskin bottles into 300 ml BOD bottles, following collection procedures used for oxygen analyses. Within 6 hr. of BOD sample collection, duplicate 10 ml samples were injected into 20 ml crimp-sealed serum bottles containing 0.5 ml of a 2N aqueous solution of sulfuric acid for subsequent I.R. analysis (Beckman IR-315 infrared analyzer) of the gaseous phase (5 - 150 ml samples) at the W.H.O.I. laboratory.

During summer months 1995 some of the ^{14}C incubations (W9508-W9513) were incubated on shore in the MWRA laboratory at Deer Island. Samples were collected in opaque bottles and maintained at *in situ* temperature until transport to the lab. The ^{14}C incubations were begun approximately 2 - 3 hr from sample collection and should compare favorably with samples that are incubated aboard the ship.

Production Analyses by ^{14}C - Laboratory Procedures.

Sample processing. Upon arrival to the W.H.O.I. laboratory scintillation cocktail (10 ml Scintiverse II) were added to the scintillation vials containing the specific activity samples and analyzed using a Packard Tricarb 4000 liquid scintillation counter which possesses automated routines for quench correction. Vials containing acidified filters were opened and placed in a

ventilator in the hood for overnight to allow the filters to dry and excess ^{14}C carbon dioxide dissipate. The vials containing the filters were analyzed by scintillation spectroscopy as described above.

Calculation of Primary production. Volume specific primary production was calculated using equations similar to that of Strickland and Parsons (1972) as follows:

$$P(i) = \frac{1.05(DPM(i) - DPM(blk))}{V_s A_{sp} T}$$

$$P(d) = \frac{1.05(DPM(d) - DPM(blk))}{V_s A_{sp} T}$$

$$A_{sp} = \frac{DPM(sa) - DPM(back)}{V_{sa} DIC}$$

where:

P(i) = primary production rate at light intensity i, (µgC $l^{-1}h^{-1}$ or mgC $m^{-3}h^{-1}$)
P(d) = dark production, (µgC $l^{-1}h^{-1}$ or mgC $m^{-3}h^{-1}$)
A_{sp} = specific activity (DPM/µgC)
DPM(i) = dpm in sample incubated at light intensity i
DPM(blk) = dpm in zero time blank (sample filtered immediately after addition of tracer)
DPM(d) = dpm in dark incubated sample
DPM(back) = background dpm in vial containing only scintillation cocktail
V_s = volume of incubated sample (l)
T = incubation time (h)
V_{sa} = volume counted of specific activity sample (ml)
DIC = concentration of dissolved inorganic carbon (µg/ml)

P-I curves. For each of the 5 depths for each photosynthesis station a P-I curve was obtained from the data P(I) = P(i)-P(d) vs. the irradiance (I, µE $m^{-2}s^{-1}$) that the incubating sample is exposed. The P-I curves were fit via one of two possible models, depending upon whether or not significant photoinhibition occurs. In cases where photoinhibition is evident the model of Platt et al. (1980) was fit (SAAM II, 1994) to obtain the theoretical maximum production, and terms for light-dependent rise in production and degree of photoinhibition:

$$P(I) = P_{sb}''(1 - e^{-a})e^{-b}$$

$$P\max'' = P_{sb}''[\alpha''/(\alpha'' + \beta'')][\beta''/(\alpha'' + \beta'')]^{\beta''/\alpha''} \text{ (Lohrenz et al., 1994)}$$

where:

P(I) = primary production at irradiance I, corrected for dark fixation (P(i)-P(d))
P_{sb}"= theoretical maximum production without photoinhibition
a = α"I/Psb", and α"is the initial slope the light-dependent rise in production

$b = \beta\text{"}I/Psb\text{"}$, and β"is a term relaying the degree of photoinhibition
P_{max}"= light saturated maximum production

If it is not possible to converge upon a solution the model of Webb et al. (1974) was similarly fit to obtain the maximum production and the term for light-dependent rise in production:

$$P(I) = P_{max}\text{"}\left(1 - e^{-a'}\right)$$

where:

$P(I)$ = primary production at irradiance I corrected for dark fixation (P(i)-P(d))
P_{max}"= light saturated maximum production
$a' = \alpha\text{"}I/Pmax\text{"}$, and α"is the initial slope the light-dependent rise in production

Nearly all P-I curves obtained did not show evidence of photoinhibition and were fit according to the Webb model.

Light vs. depth profiles. To obtain a numerical representation of the light field throughout the water column bin averaged CTD light profiles (0.5 m intervals) was fit (SAAM II, 1994) to an empirical sum of exponentials equation of the form:

$$I_Z = A_1 e^{-a_1 Z} + A_2 e^{-a_2 Z}$$

which is an expansion of the standard irradiance vs. depth equation:

$$I_Z = I_0 e^{-kZ}$$

where:

I_Z = light irradiance at depth Z
I_0 = incident irradiance (Z=0)
k = extinction coefficient
A_1, A_2 = factors relating to incident irradiance ($I_0 = A_1 + A_2$)
a_1, a_2 = coefficients relating to the extinction coefficient ($k = a_1 + a_2$)

The expanded equation was used as pigment absorption and other factors usually resulted in significant deviation from the idealized standard irradiance vs. depth equation. The best fit profiles were used to compute percent light attenuation for each of the sampling depths.

Daily incident light field. During normal CTD hydrocasts the incident light field was routinely measured via a deck light sensor at high temporal resolution. The average incident light intensity was determined for each of the CTD casts to provide, over the course of the photoperiod (12 hr period centered upon solar noon), a reasonably well resolved irradiance time series consisting of 12-17 data points. A 48 point time series (every 15 min.) of incident was obtained from these data by linear interpolation.

Calculation of daily primary production. Given the best fit parameters (Pmax", α", β") of the P-I curves obtained for each of the 5 sampling depths, percent *in situ* light attenuation at each depth determined from the sum of exponential fits of the *in situ* light field, and the photoperiod incident light (I_0) time series it was possible to compute daily volumetric production for each depth. To do this at a given depth, hourly production was determined for the *in situ* light intensity computed for each 15 min. interval of the photoperiod, using the appropriate P-I parameters and *in situ* irradiance computed from the percent attenuation and incident irradiance. Daily production ($\mu gC\ l^{-1}d^{-1}$) was obtained by integration of the determined activity throughout the 12 hr photoperiod. An advantage of this approach is that seasonal changes in photoperiod length are automatically incorporated into the integral computation. For example, during winter months computed early morning and late afternoon production contributes minimally to whole day production, whereas during summer months the relative contribution during these hours is more significant. The investigator does not have to decide which factor to employ when converting hourly production to daily production. The primary assumption for the approach is that the P-I relationship obtained at the time of sample procurement (towards the middle of the photoperiod) is representative of the majority of production occurring during the photoperiod.

Calculation of daily areal production. Areal production ($mgC\ m^{-2}d^{-1}$) was obtained by trapezoidal integration of daily volumetric production vs. depth from the sea surface down to the 0.5% light level. The P-I factors from the uppermost sampling depth (approximately 1.2 - 2.7 m, depending upon weather state) were used to compute the contribution of the portion of the water column between the sea surface interface and uppermost sampling depth to areal production (rather than to assume that the activity in the uppermost sample is representative of that section of the water column, which is not always the case).

Calculation of chlorophyll-specific parameters. Chlorophyll-specific measures of the various parameters were determined by dividing by the appropriate chlorophyll term obtained from independent measurements:

$$a = \frac{a''}{[chla]}$$

$$P\max = \frac{P\max''}{[chla]}$$

where:

α = chlorophyll-a-specific initial slope of light-dependent production $[(gC(gchla)^{-1}h^{-1}(\mu Em^{-2}s^{-1})^{-1}]$

Pmax = light saturated chlorophyll-specific production $[gC(gchla)^{-1}h^{-1}]$

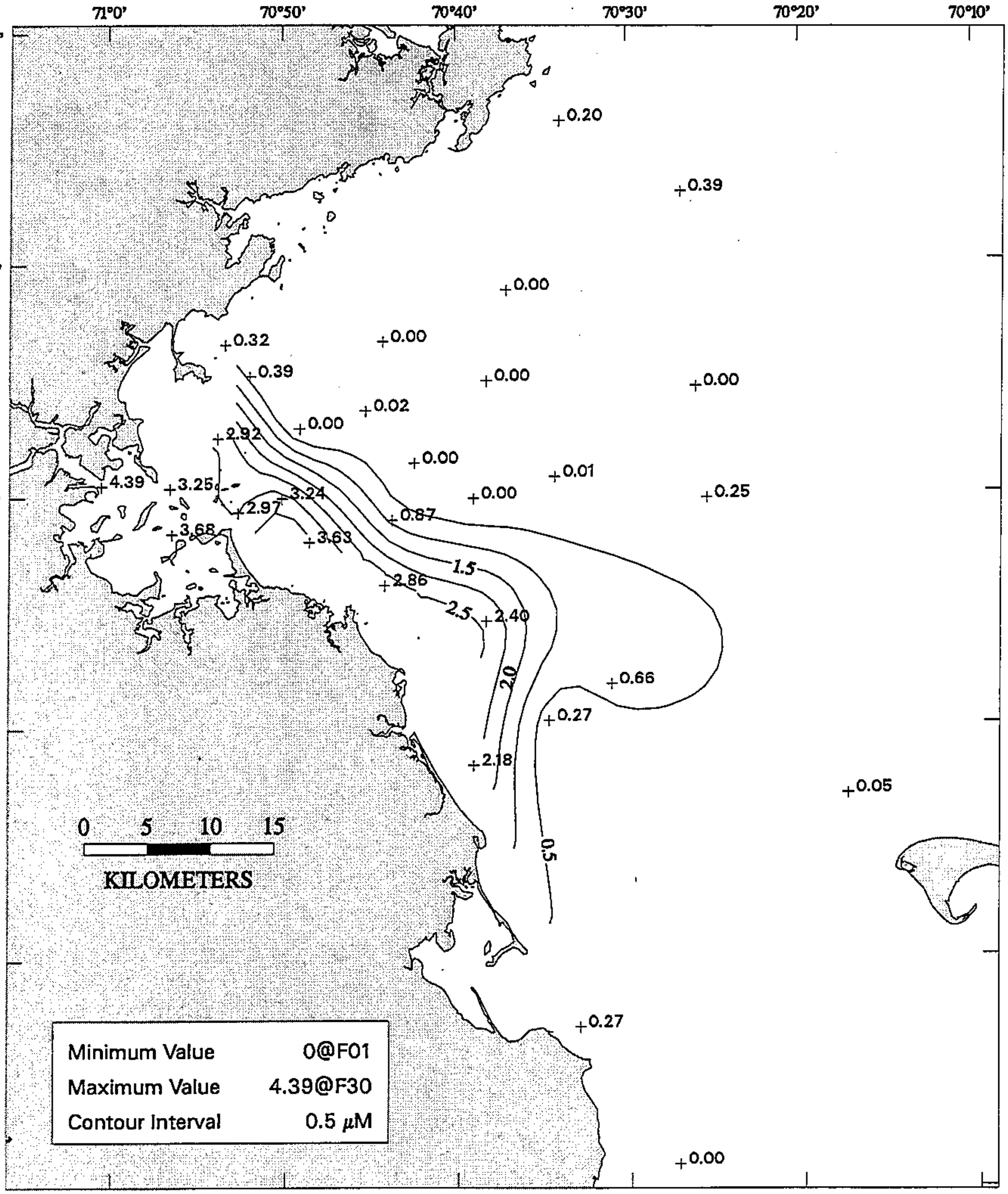
APPENDIX B
Surface Contour Plots - Farfield Surveys

All contour plots were created using data from the surface bottle sample (A). Each plot is labelled on the bottom right with the survey number ("9511"), and parameter as listed below. The minimum and maximum value, and the station where the value was measured, is provided for each plot, as well as the contour interval and parameter units.

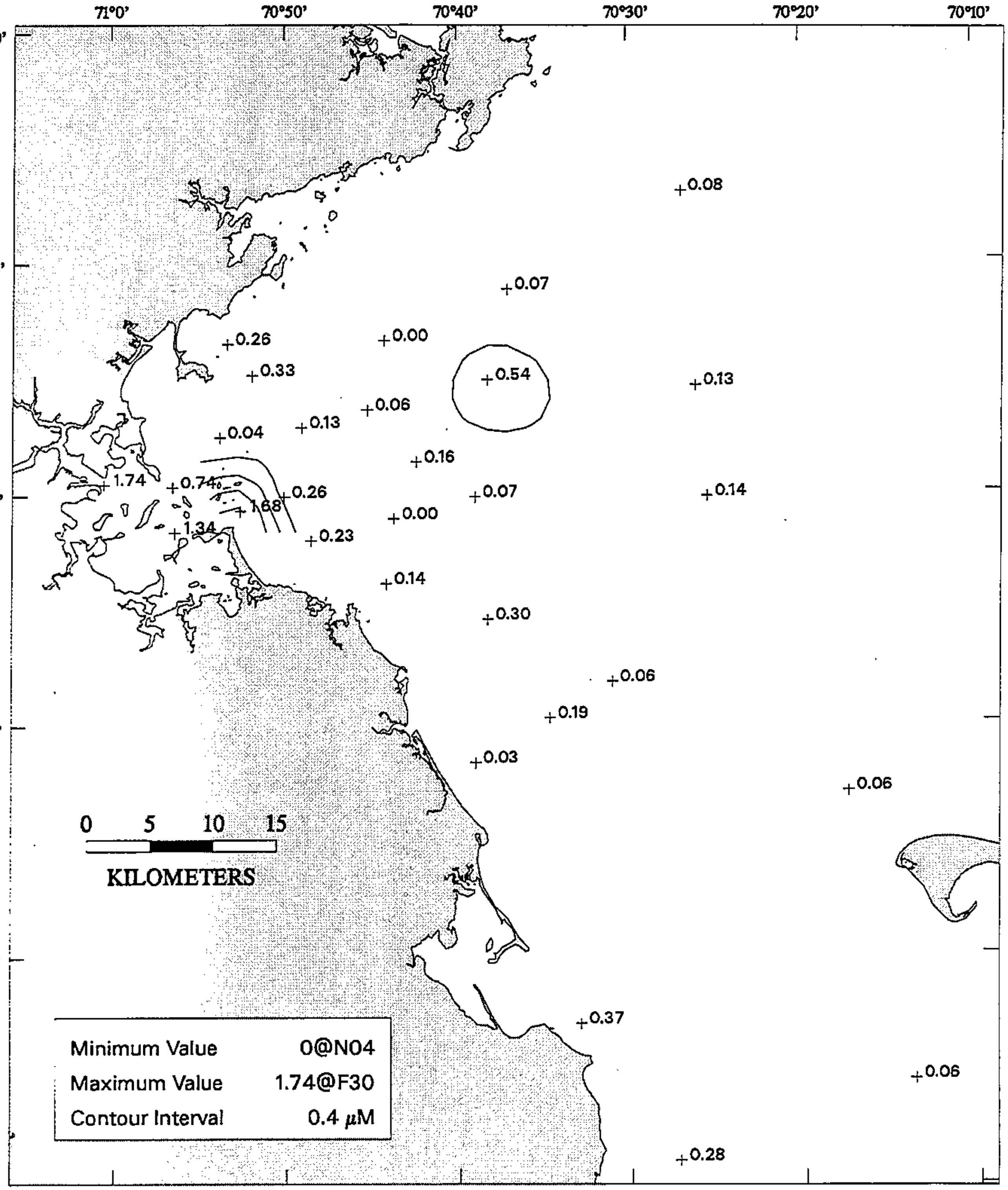
Appendix B: Table of Contents

Parameter Name	Map Parameter Name	Units
Temperature	temp_lin	°C
Salinity	sal_lin	SU
Transmissivity (beam attenuation)	tran_lin	/m
Nitrate (NO_3)	no3_lin	µM
Phosphate (PO_4)	po4_lin	µM
Silicate (SiO_4)	sio4_lin	µM
Dissolved Inorganic Nitrogen (DIN*)	din_lin	µM
Chlorophyll *a*	fluo_lin	µg/L

*$NO_3 + NO_2 + NH_4$

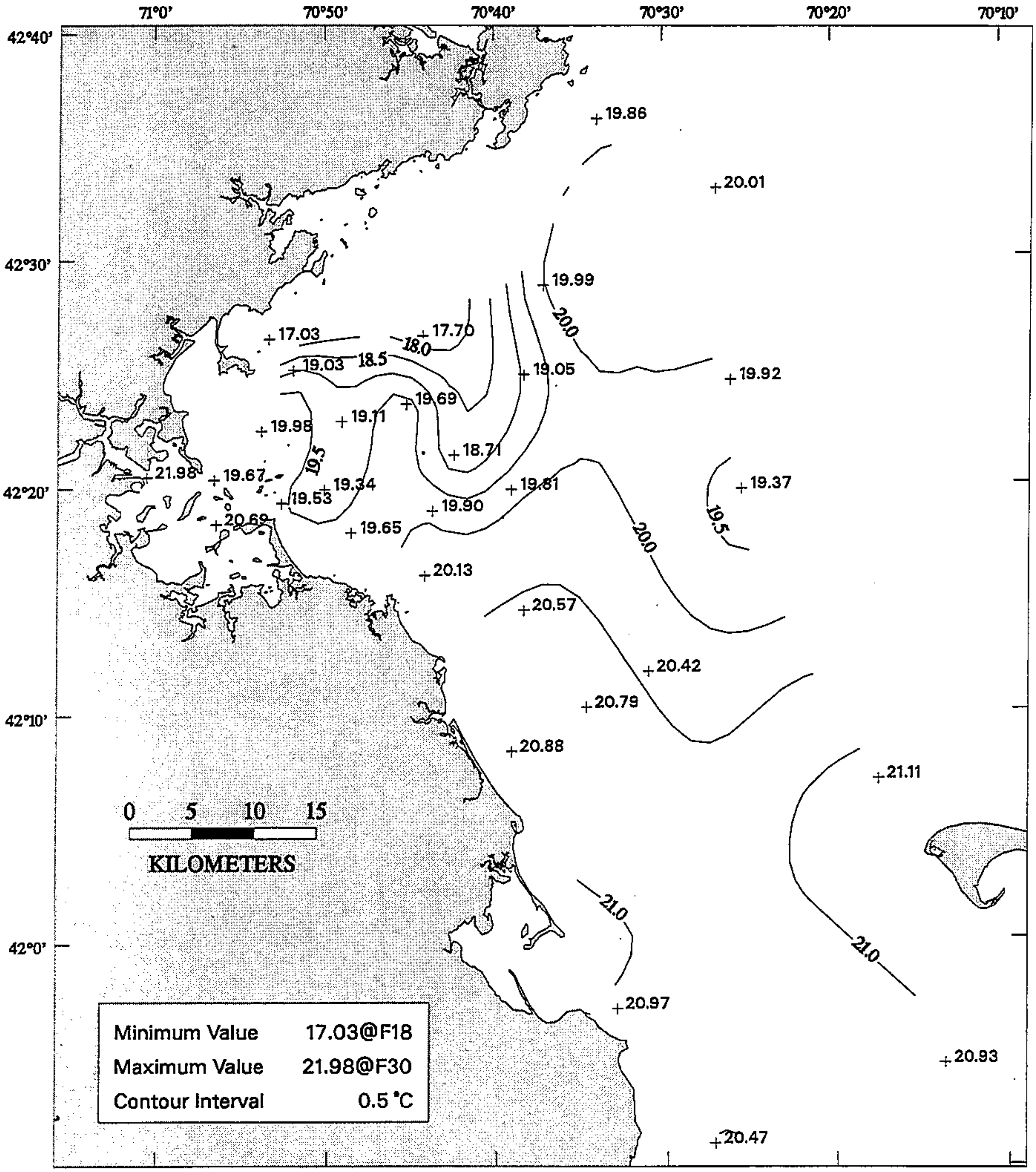


9514no3_lin
NO3

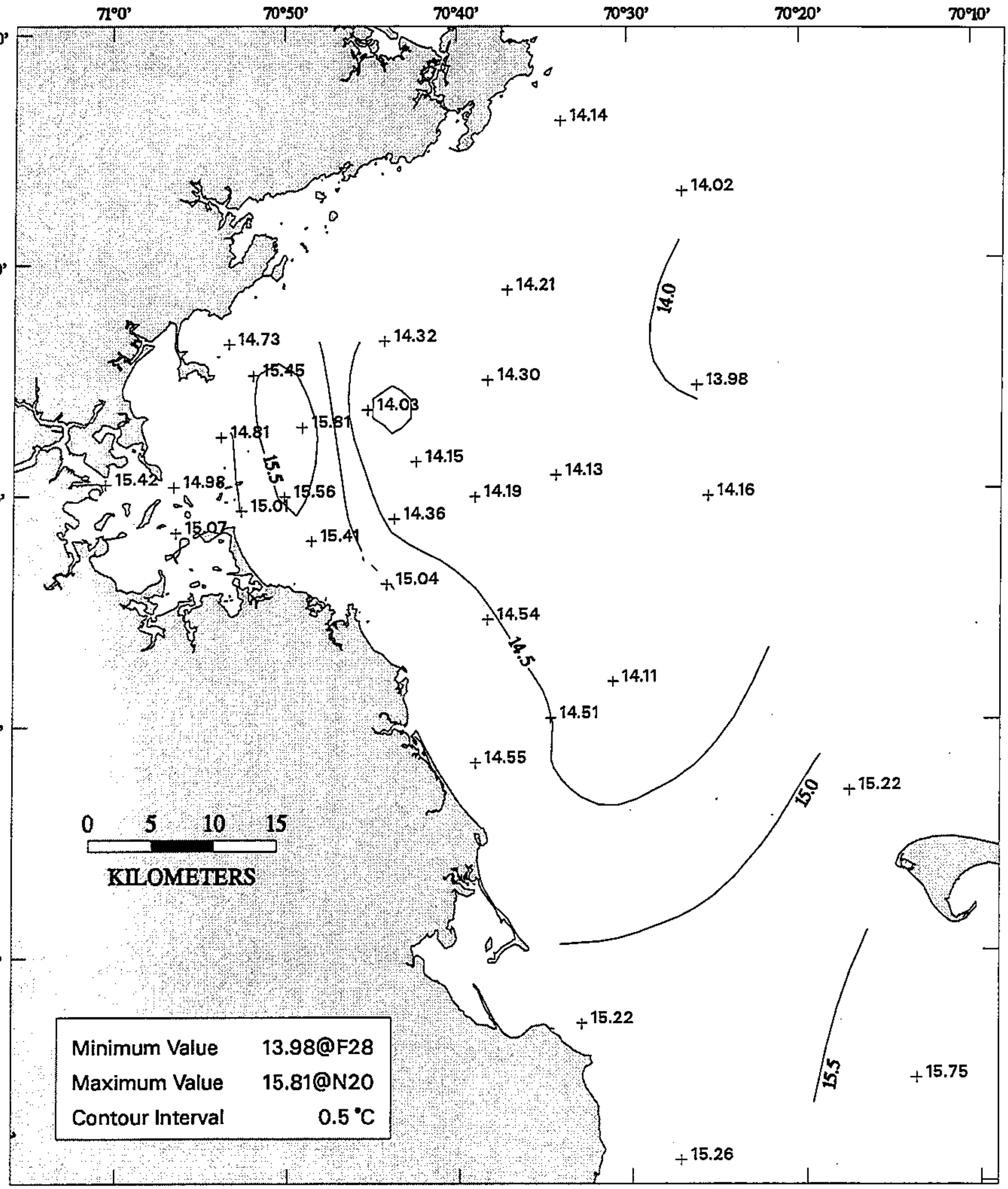


9511no3_lin

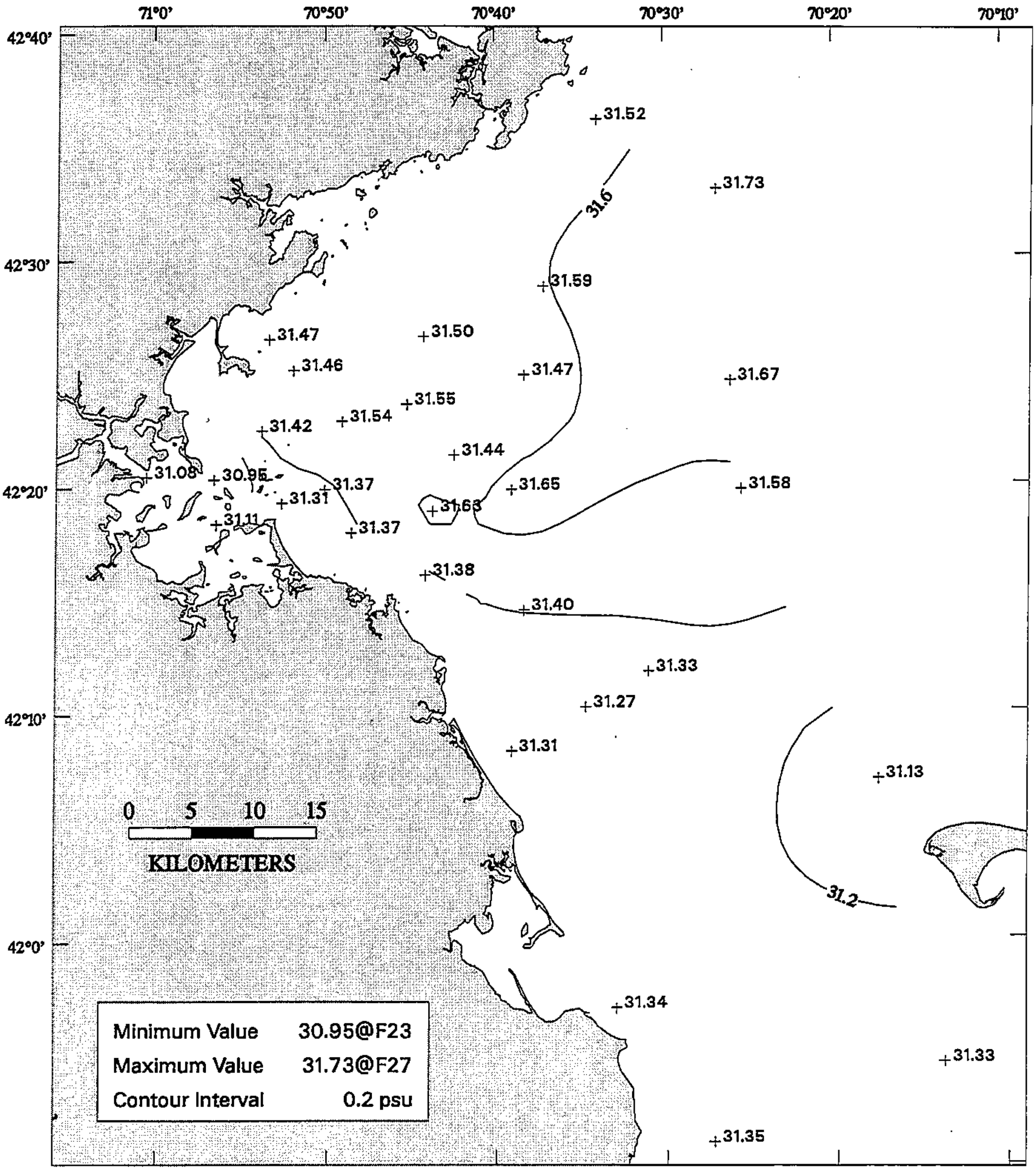
NO3



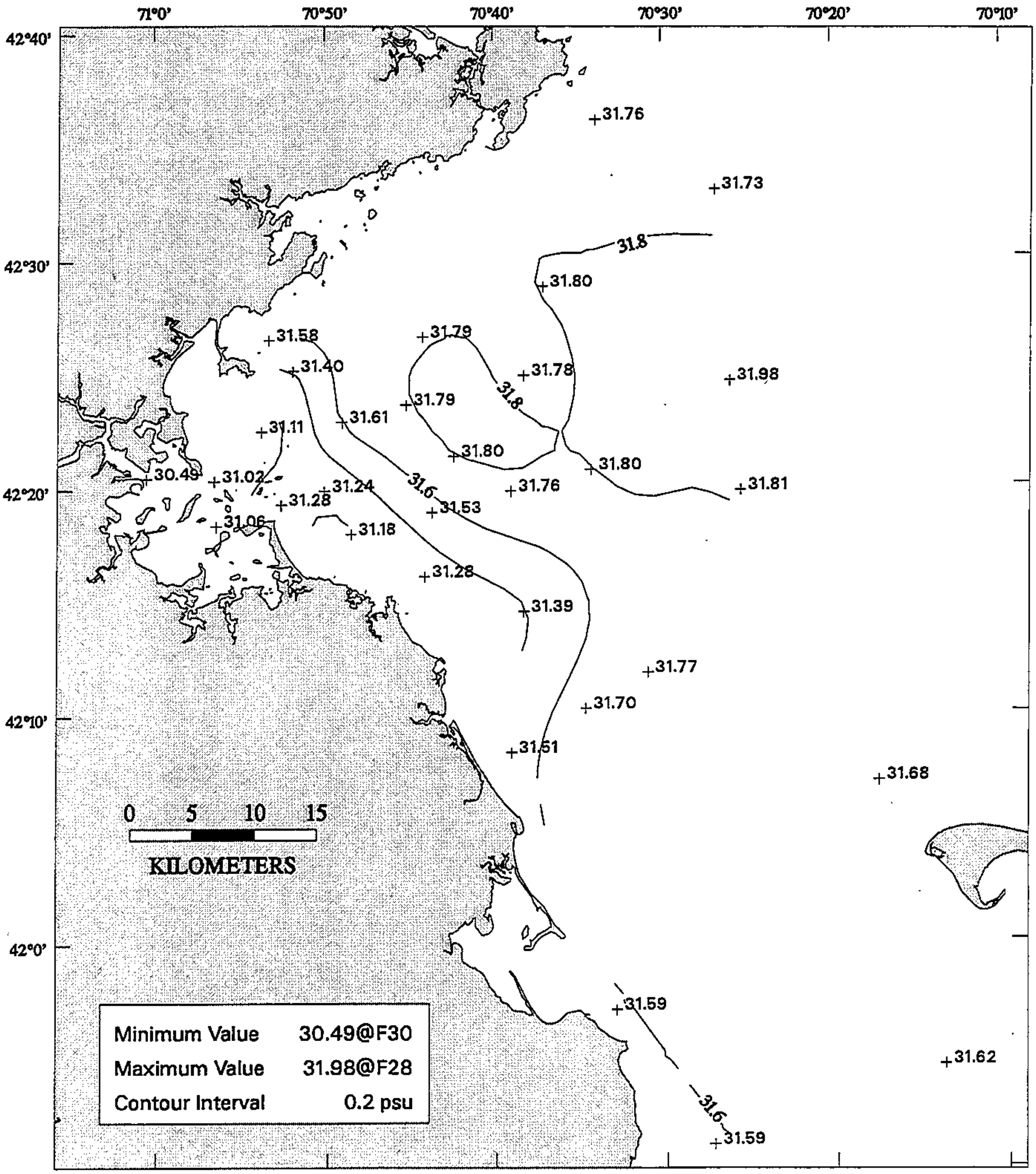
9511temp_lin
FLUO



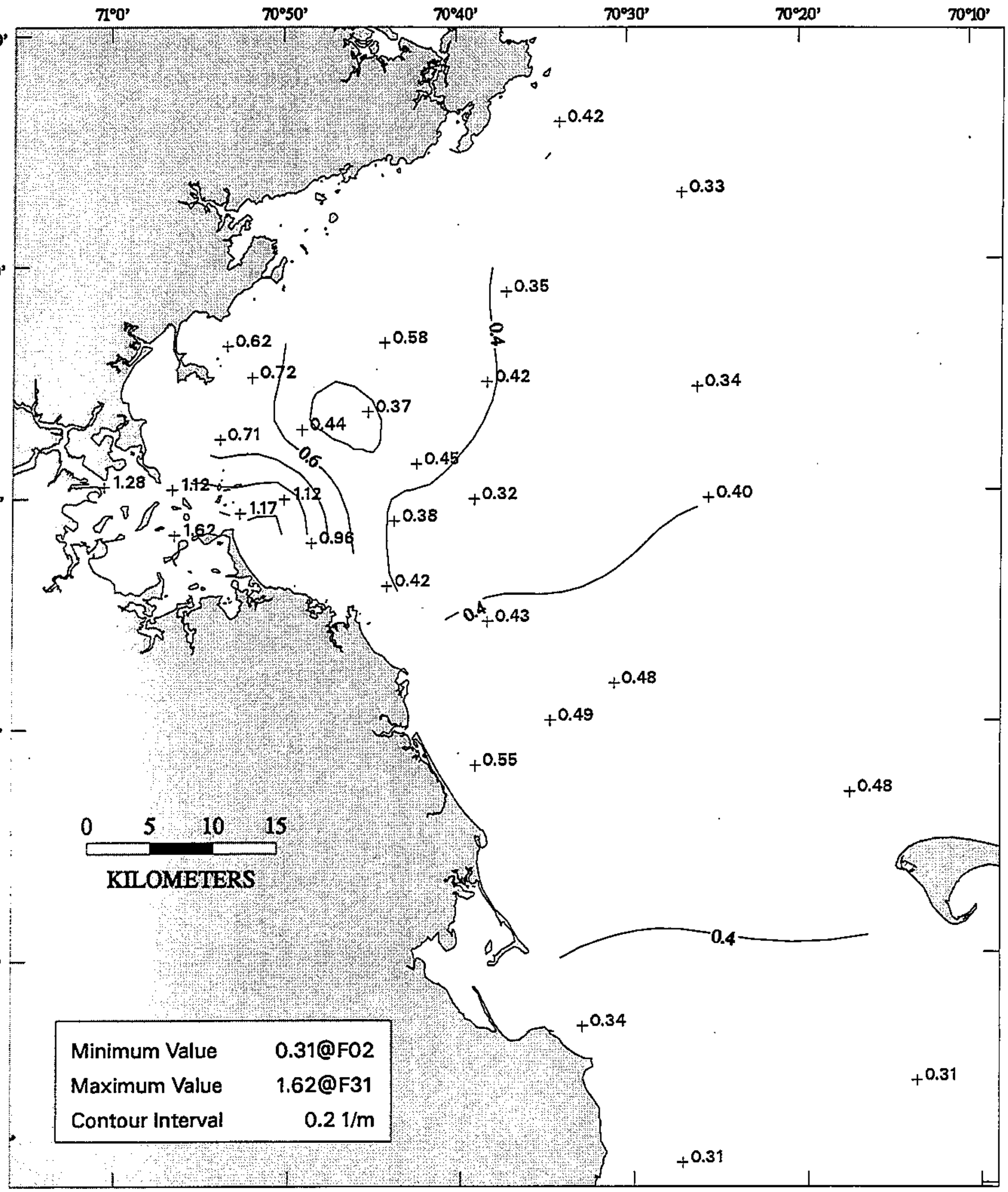
9514temp_lin
FLUO



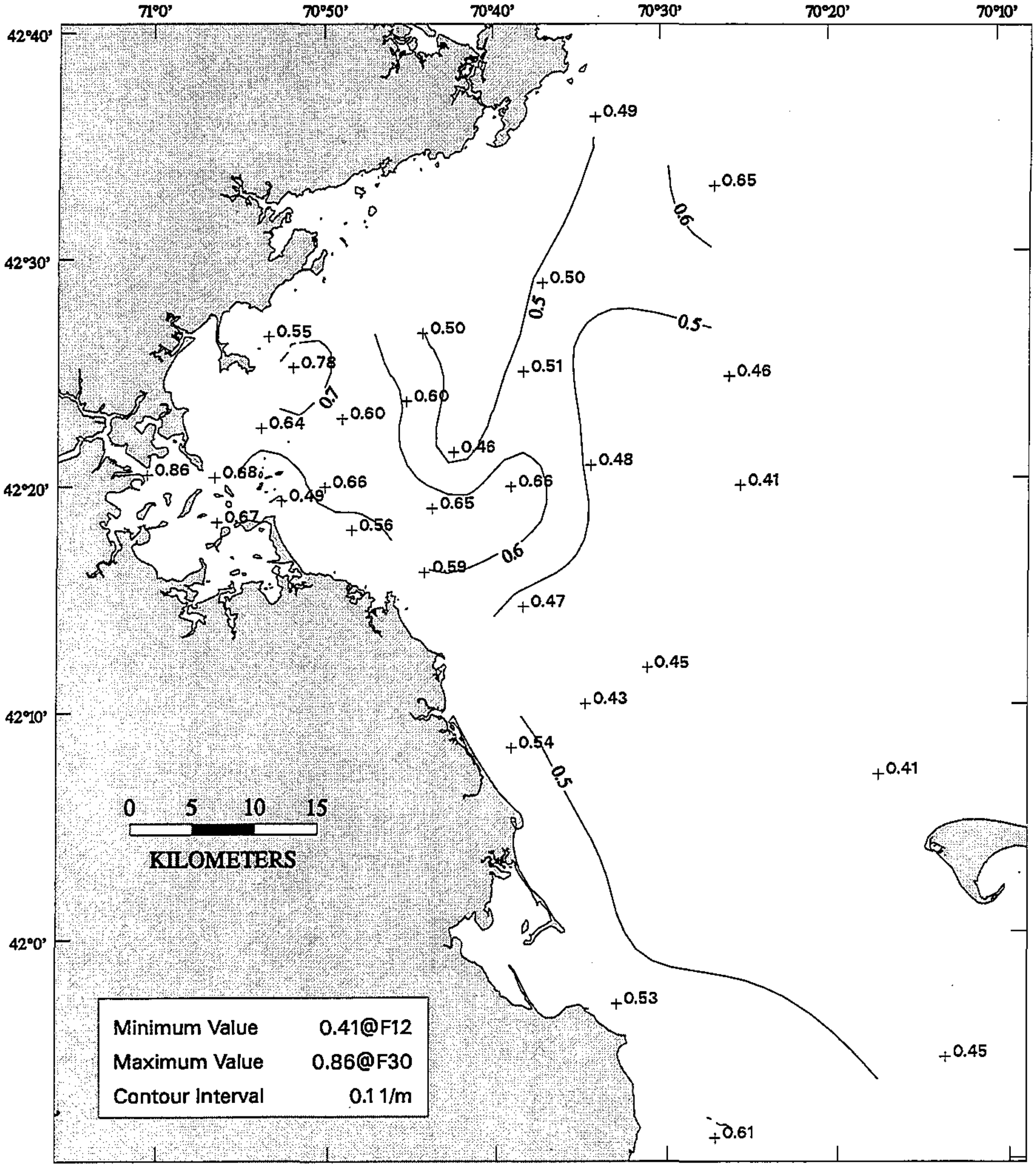
9511sal_lin
FLUO



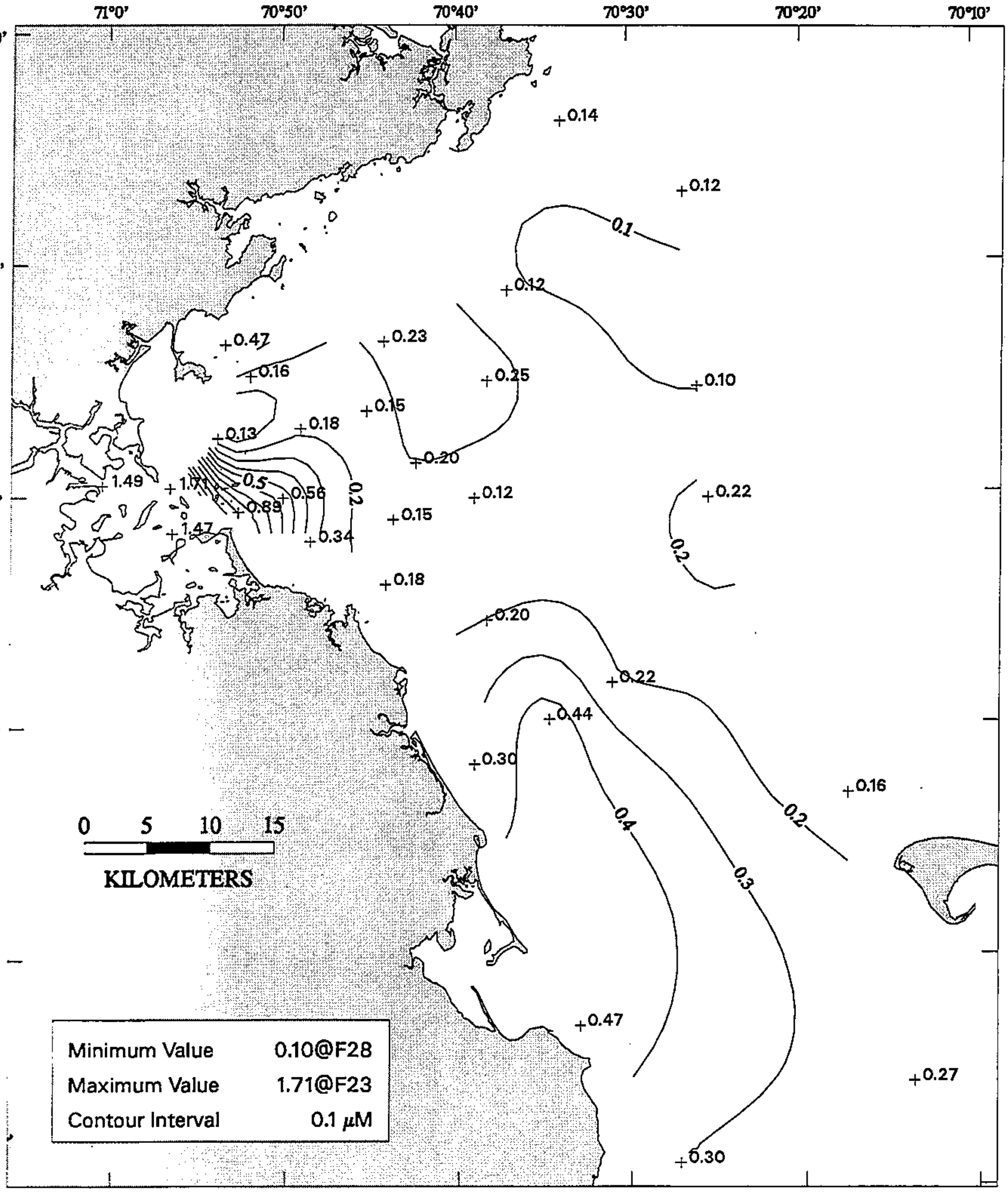
9514sal_lin
FLUO



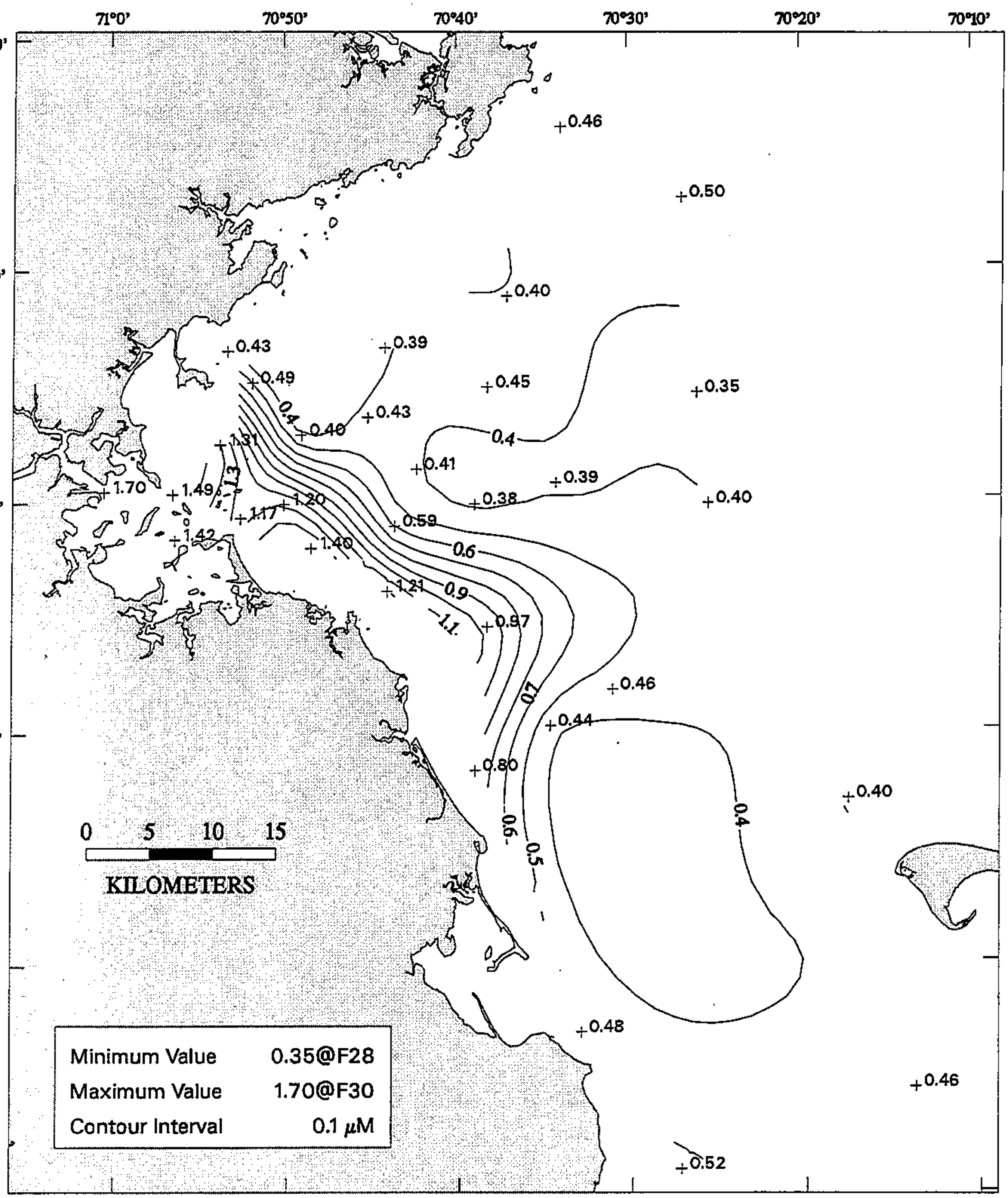
9511tran_lin
FLUO



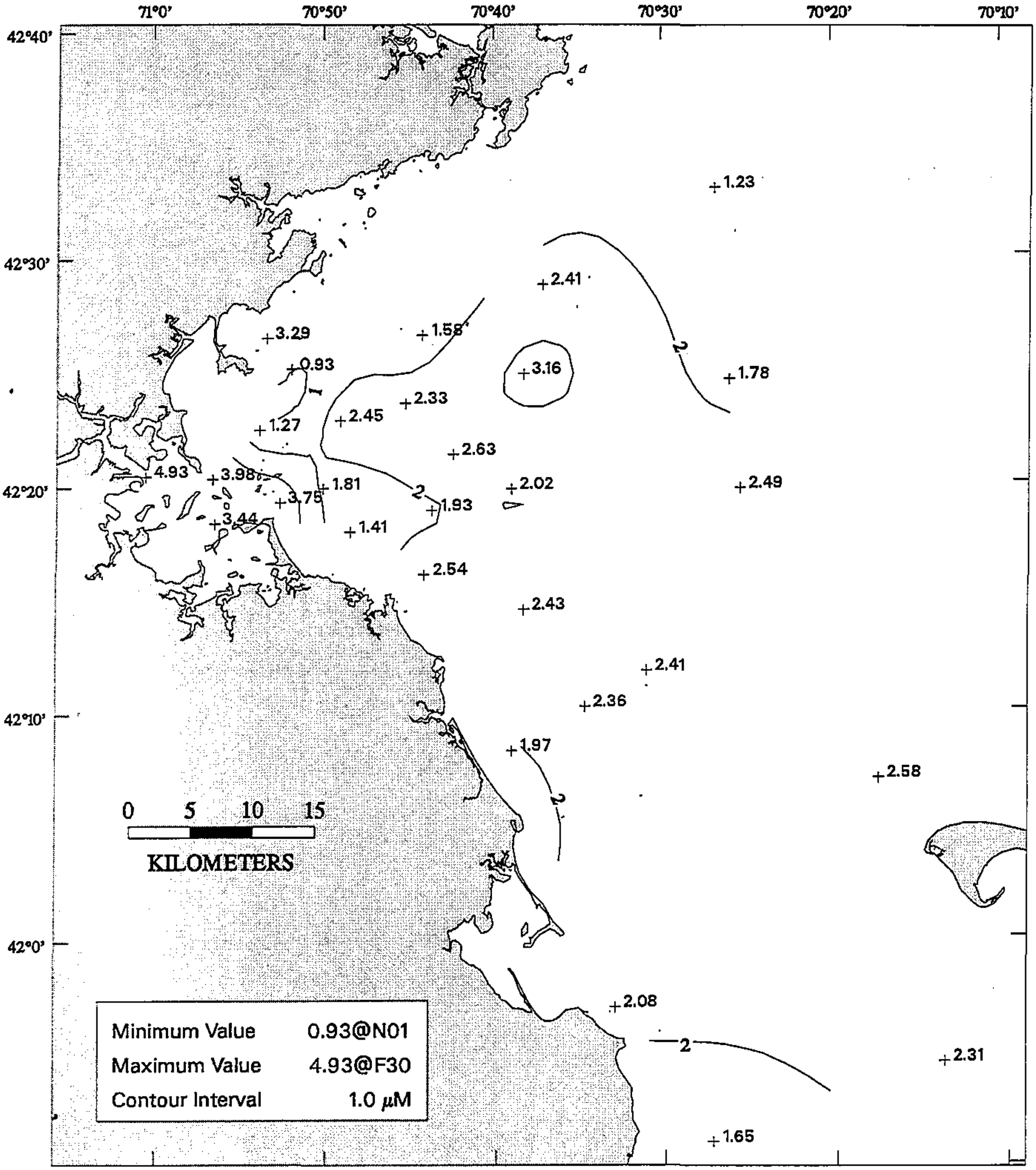
9514tran_lin
FLUO



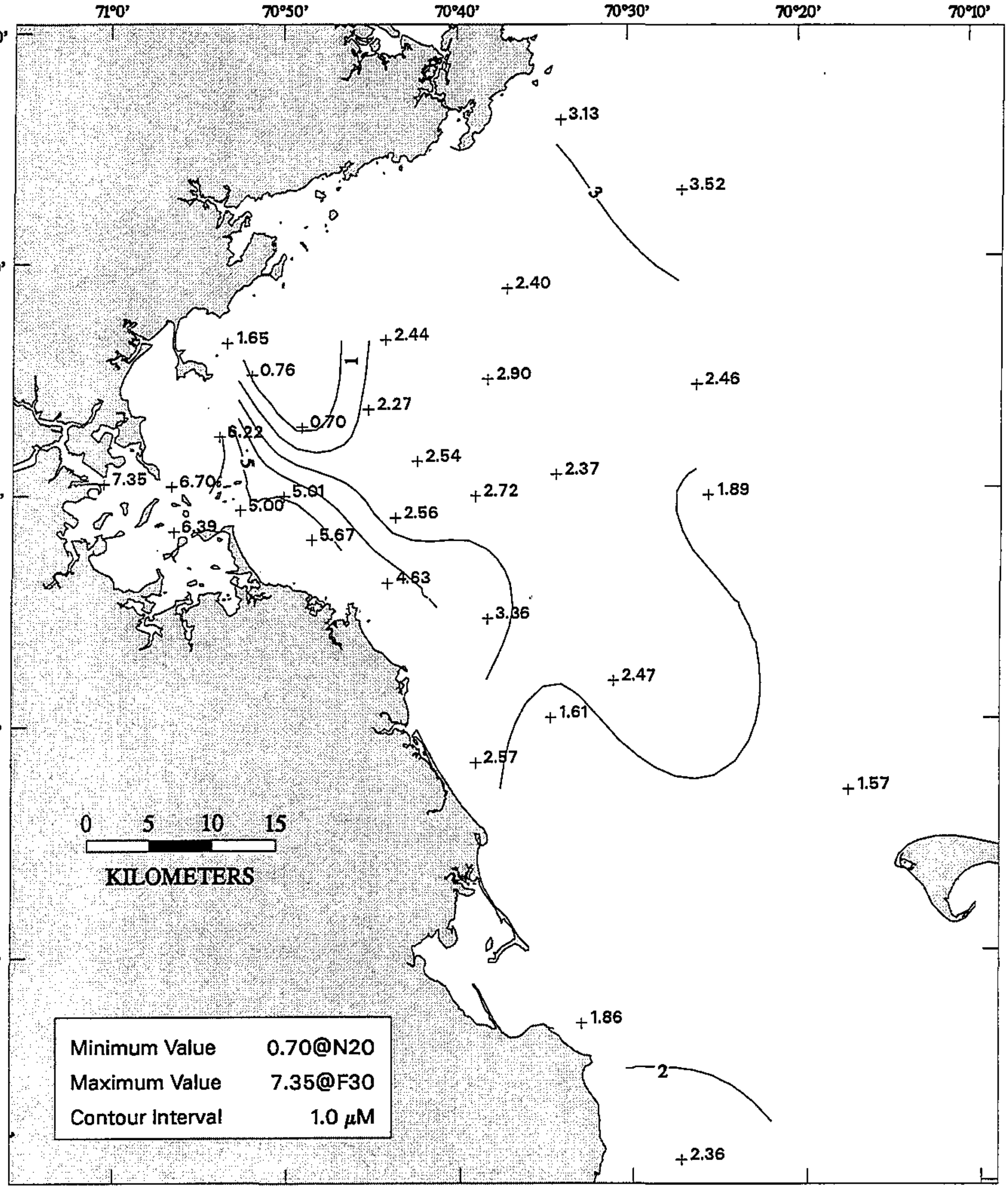
9511po4_lin
PO4



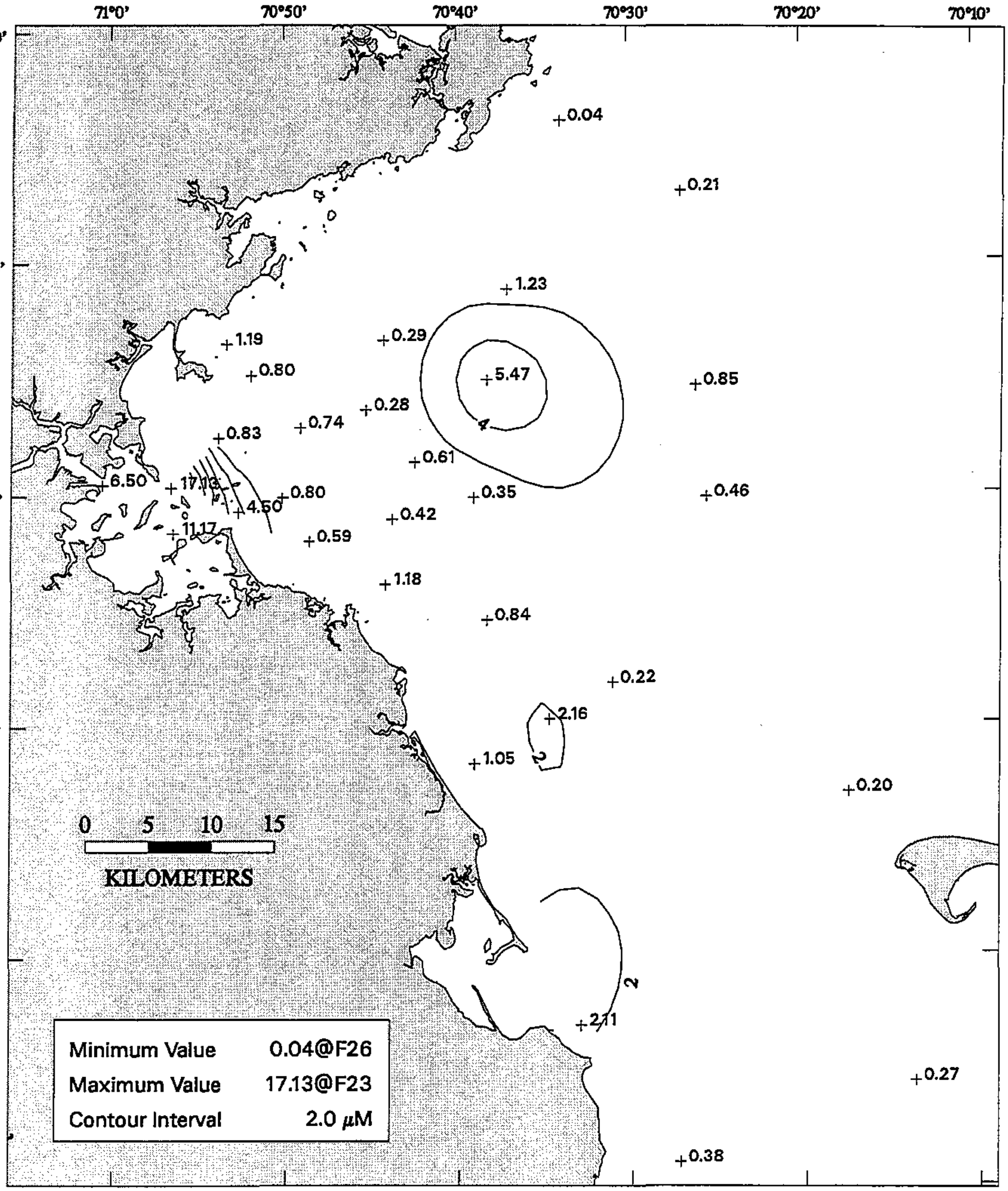
9514po4_lin
PO4



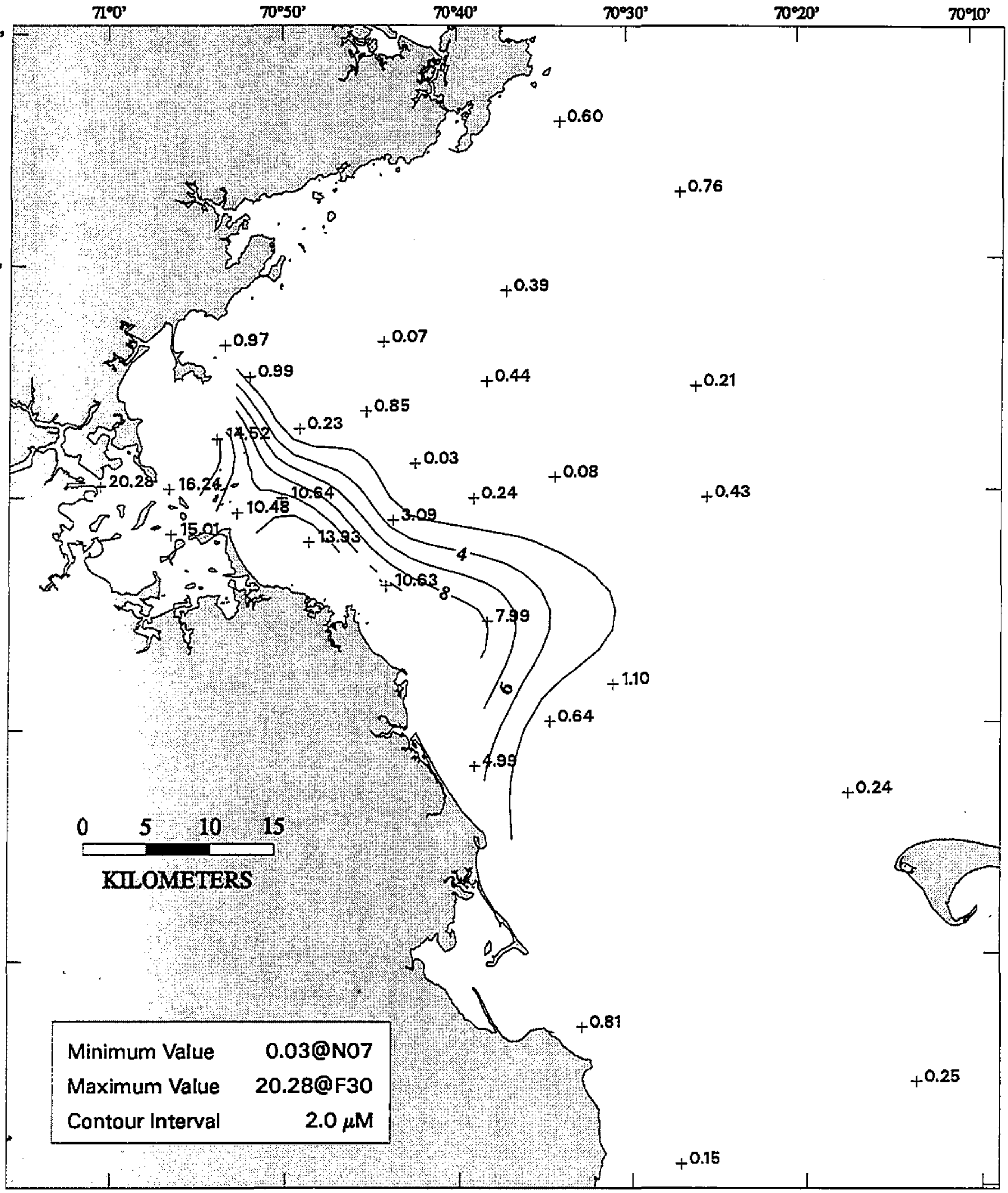
9511sio4_lin
SIO4



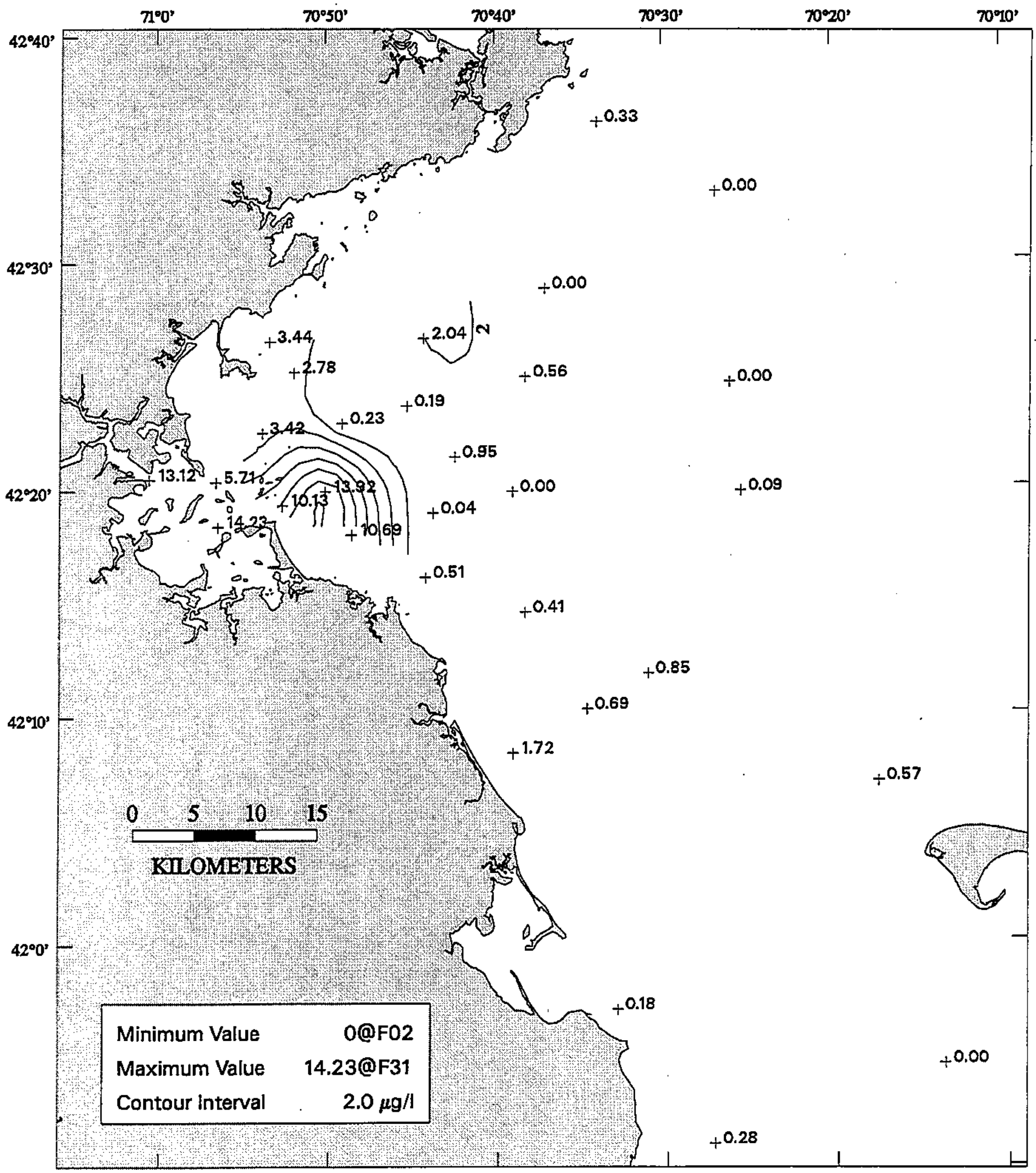
9514sio4_lin
SIO4



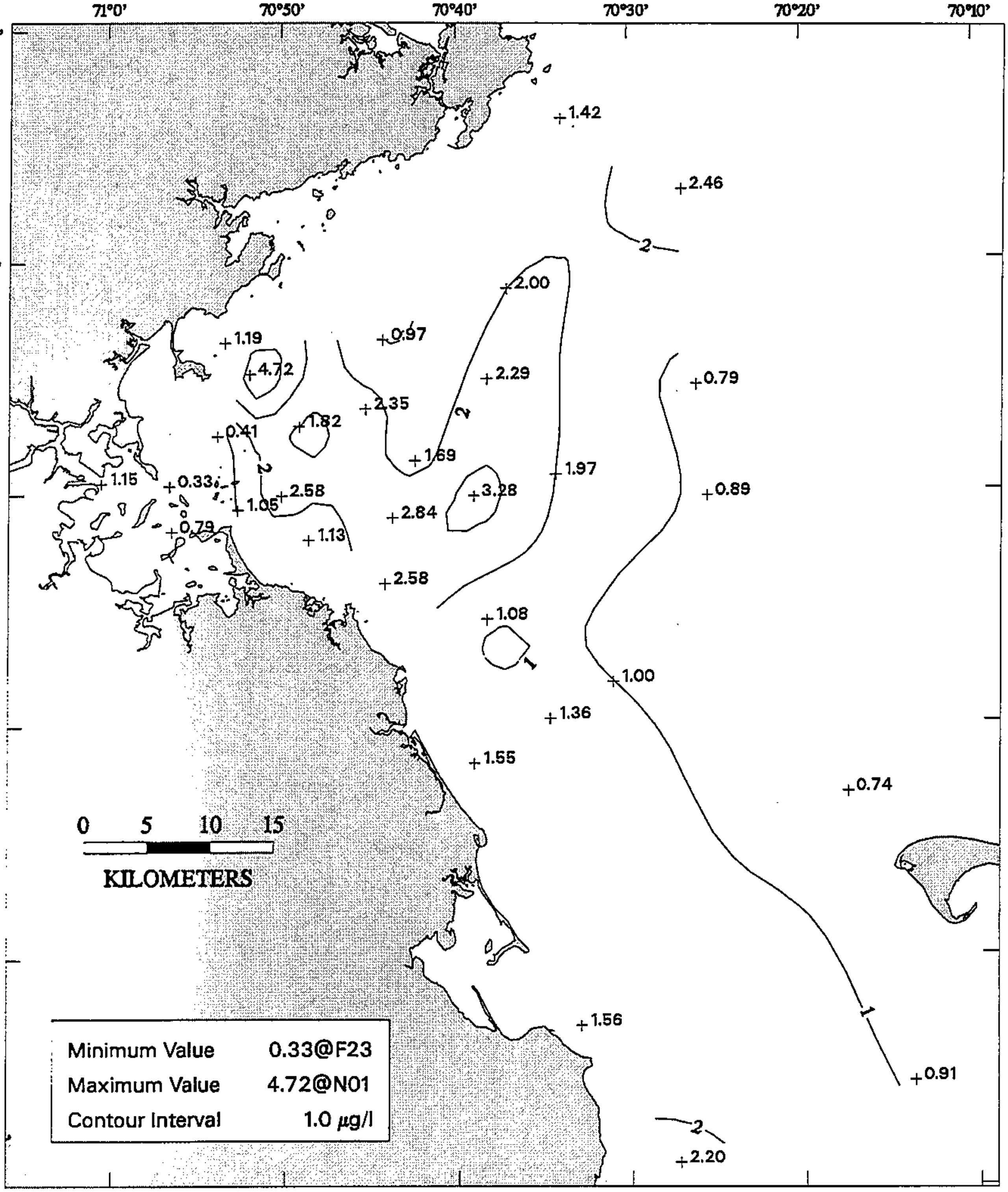
9511din_lin
DIN



9514din_lin
DIN



9511fluo_lin
FLUO



9514fluo_lin
FLUO

APPENDIX C

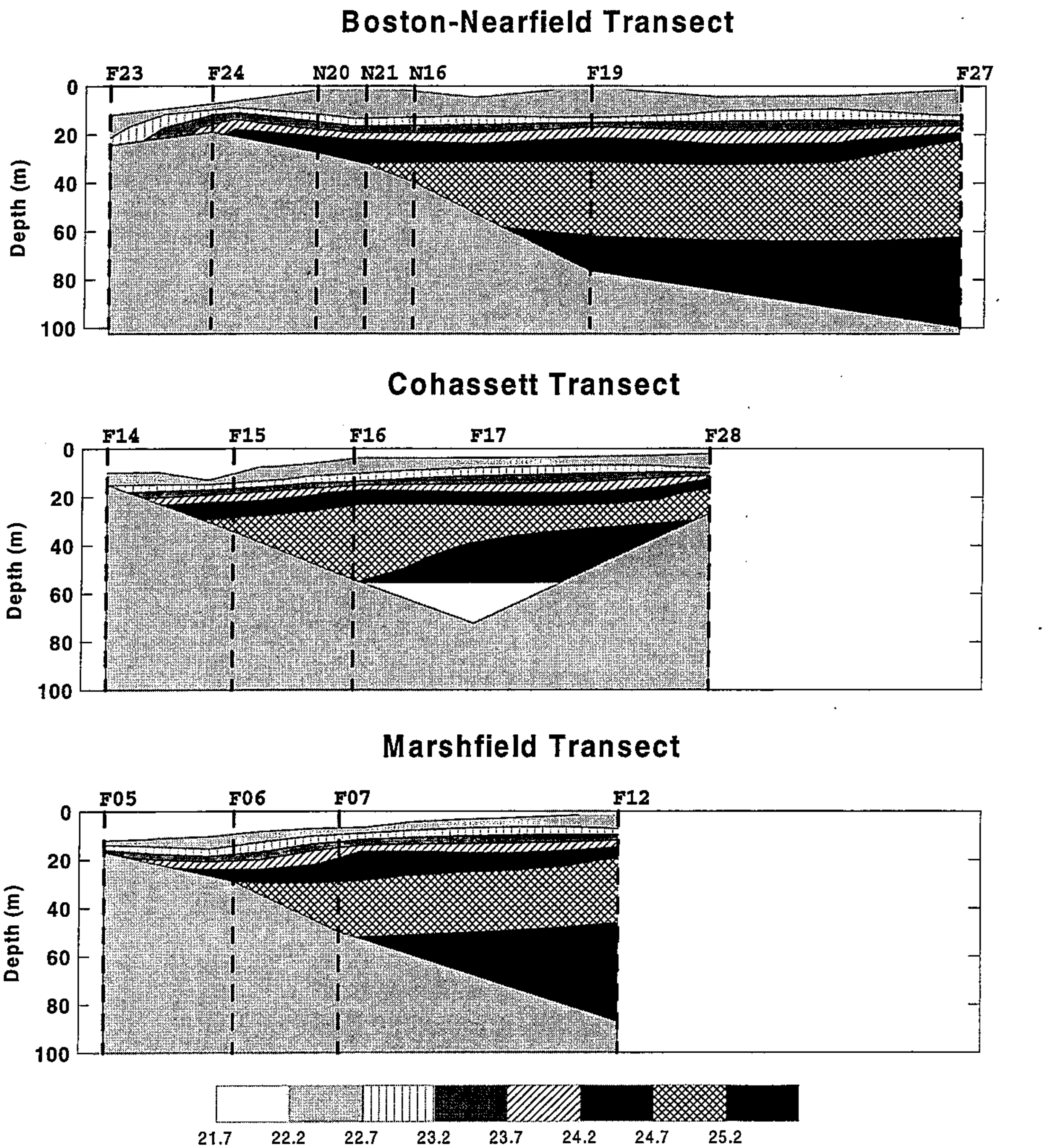
Transect Plots

Data were contoured relative to water depth and distance between stations as shown on the transects (Figure 1-3, text). Relative distances between stations and water depth at each station is shown on the transect. Water depth is labelled with negative values in meters, with zero depth at the sea surface, and shaded with slanted lines. Three transects (Boston-Nearfield, Cohasset, and Marshfield) are provided on each plot, as well as shaded contour levels on the scale bar at the bottom of the plot. Contour units are as noted on the table below. Each plot is labelled on the bottom right with the parameter as listed below, and the survey number ("9511").

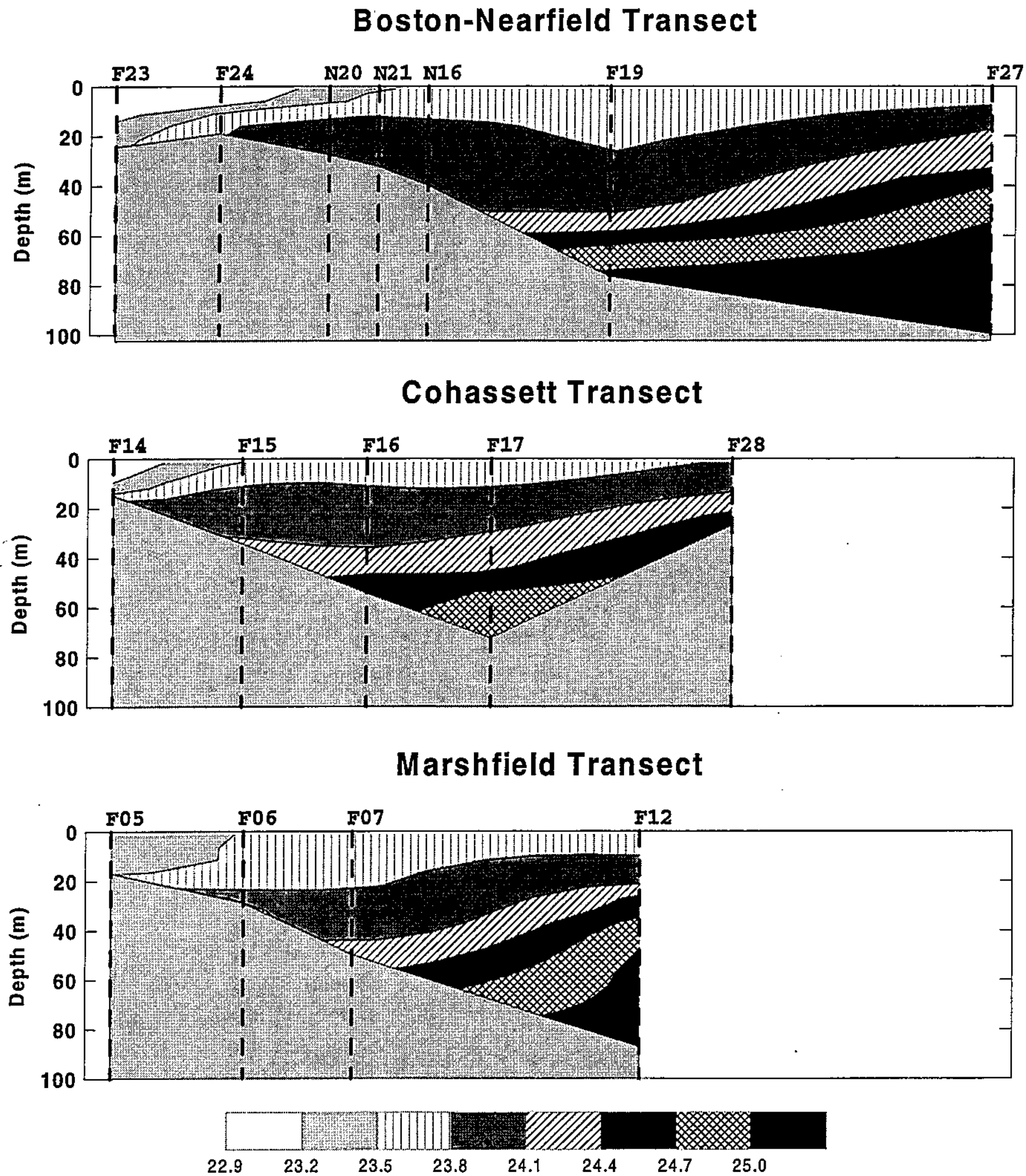
Appendix C: Table of Contents

Parameter Name	Map Parameter Name	Units
Sigma-T (σ_t)	Sigma-T	n/a
Temperature	Temperature	°C
Salinity	Salinity	PSU
Transmissivity (beam attenuation)	Trans	/m
Nitrate (NO_3)	NO3	µM
Phosphate (PO_4)	PO4	µM
Silicate (SiO_4)	SiO4	µM
Dissolved Inorganic Nitrogen (DIN*)	DI Nitro	µM
Chlorophyll *a*	Fluorescence	µg/L
DO Saturation	DO % Saturation	%

*$NO_3 + NO_2 + NH_4$

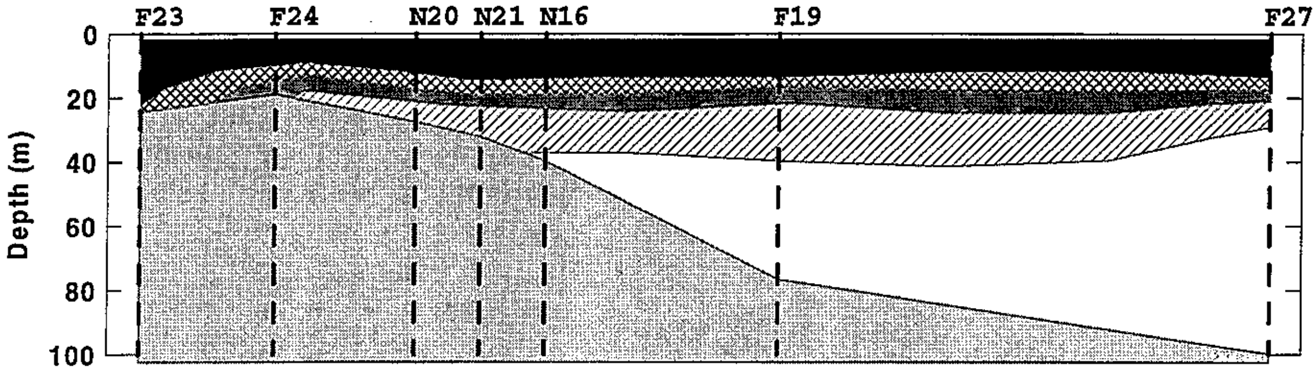

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
21.7
22.2
22.7
23.2
23.7
24.2
24.7
25.2

Sigma-T 9511

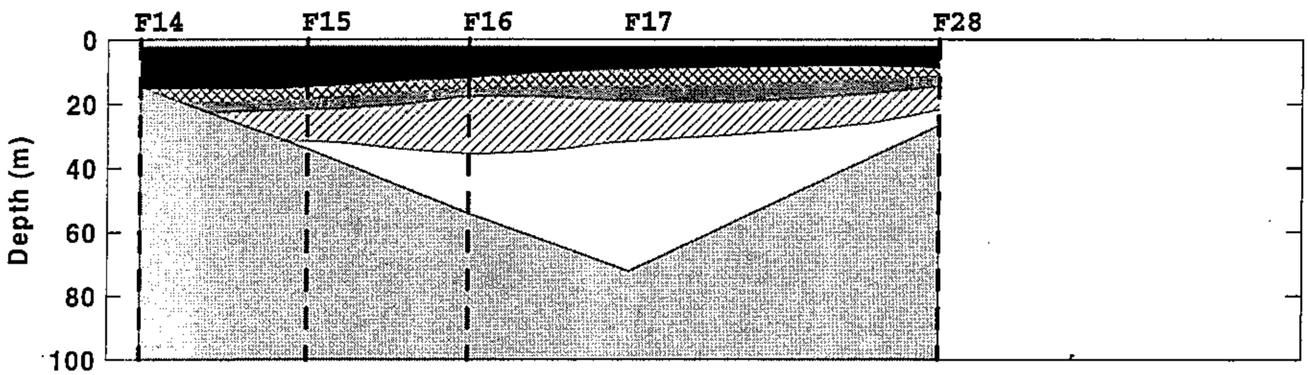

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
22.9
23.2
23.5
23.8
24.1
24.4
24.7
25.0

Sigma-T 9514

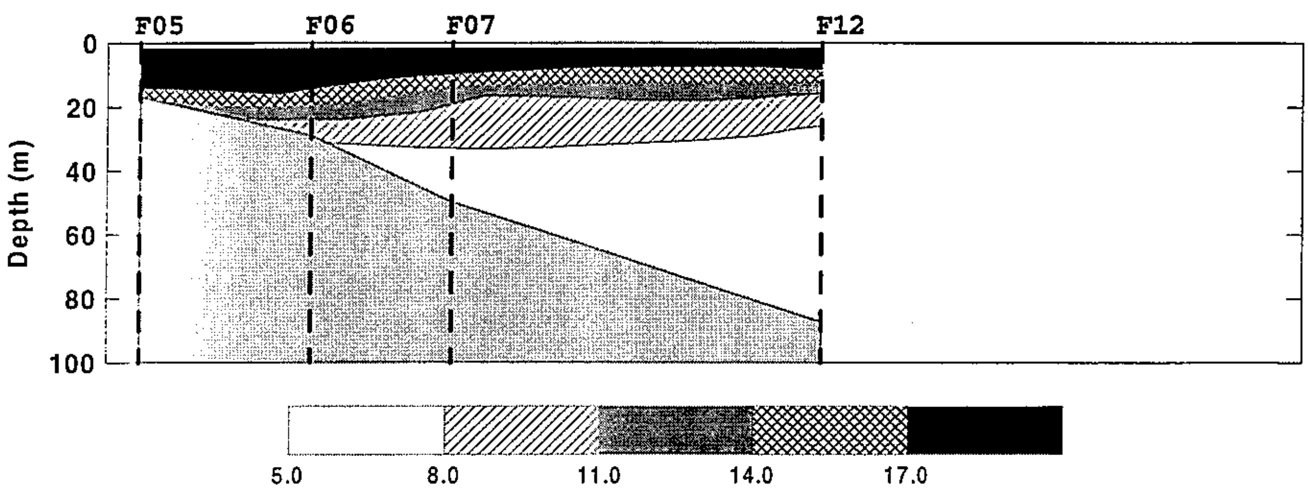
Boston-Nearfield Transect



Cohassett Transect

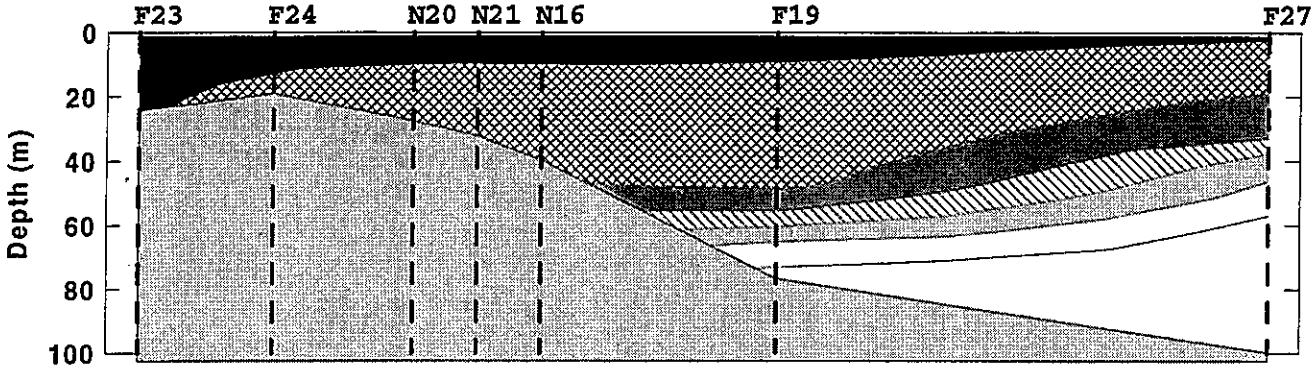


Marshfield Transect

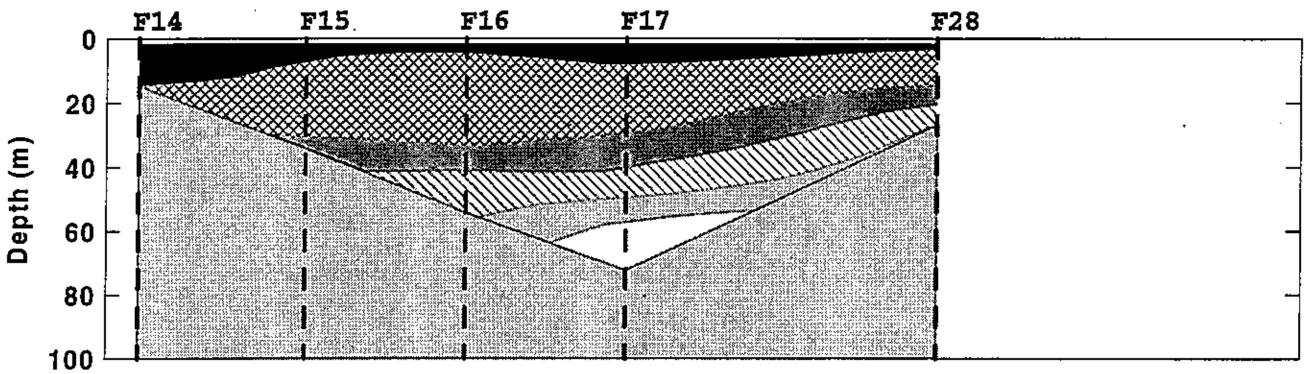


Temperature 9511

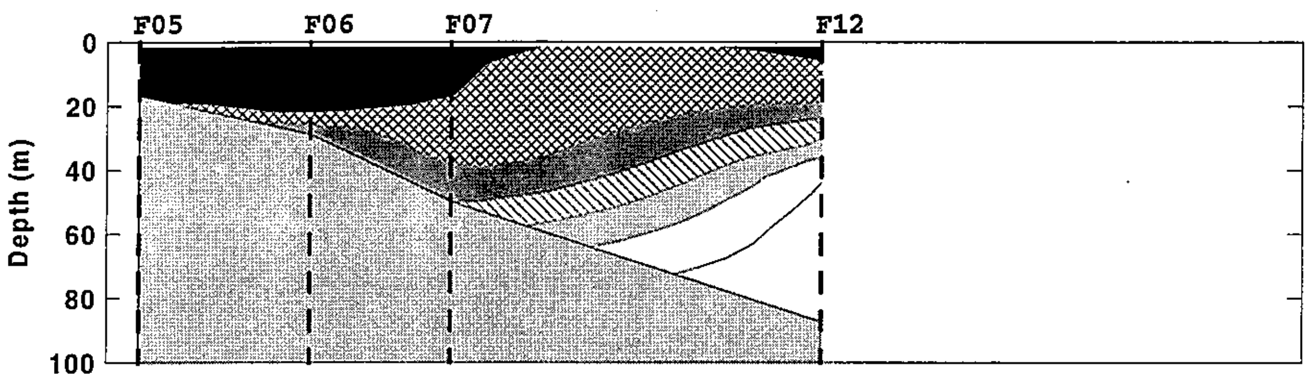
Boston-Nearfield Transect



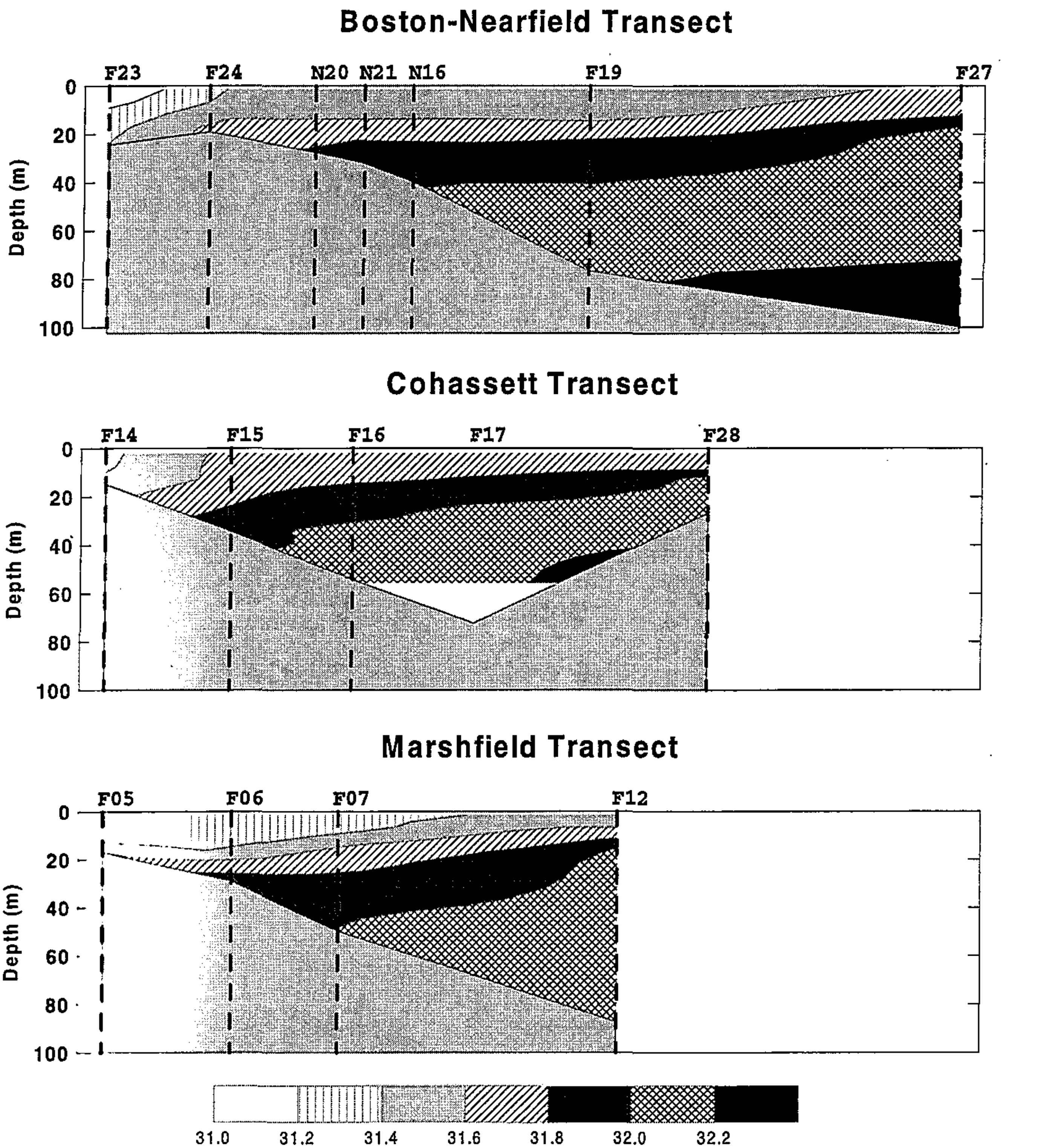
Cohassett Transect



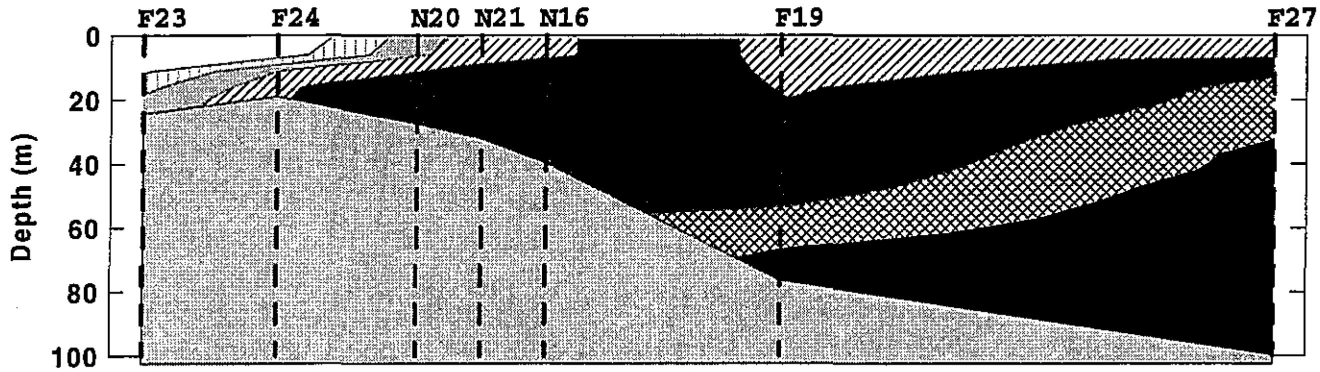
Marshfield Transect



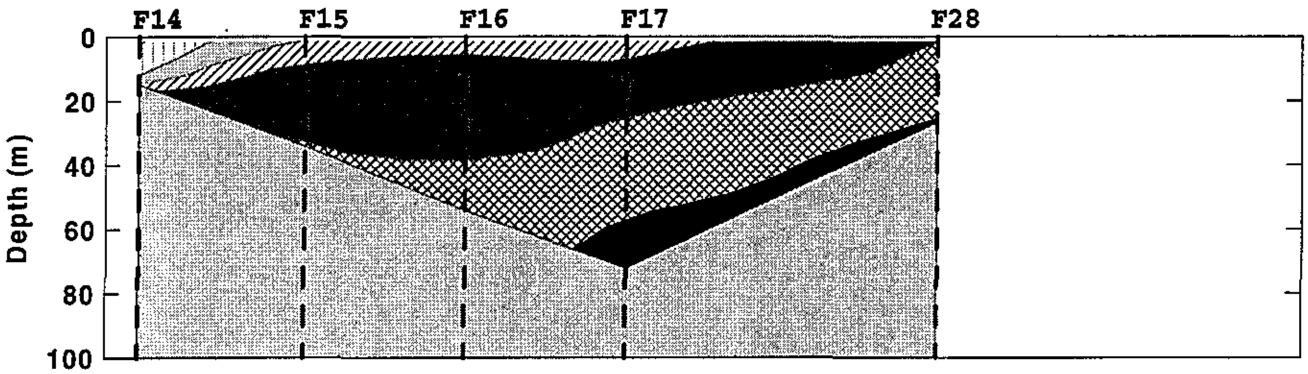
Temperature 9514


Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
31.0
31.2
31.4
31.6
31.8
32.0
32.2

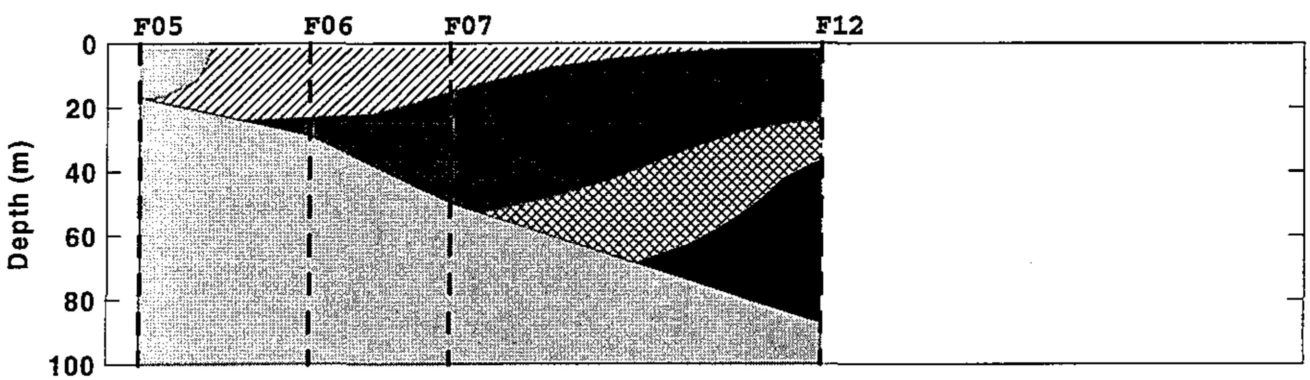
Boston-Nearfield Transect

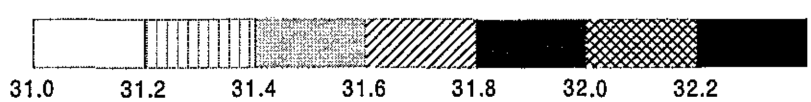


Cohassett Transect

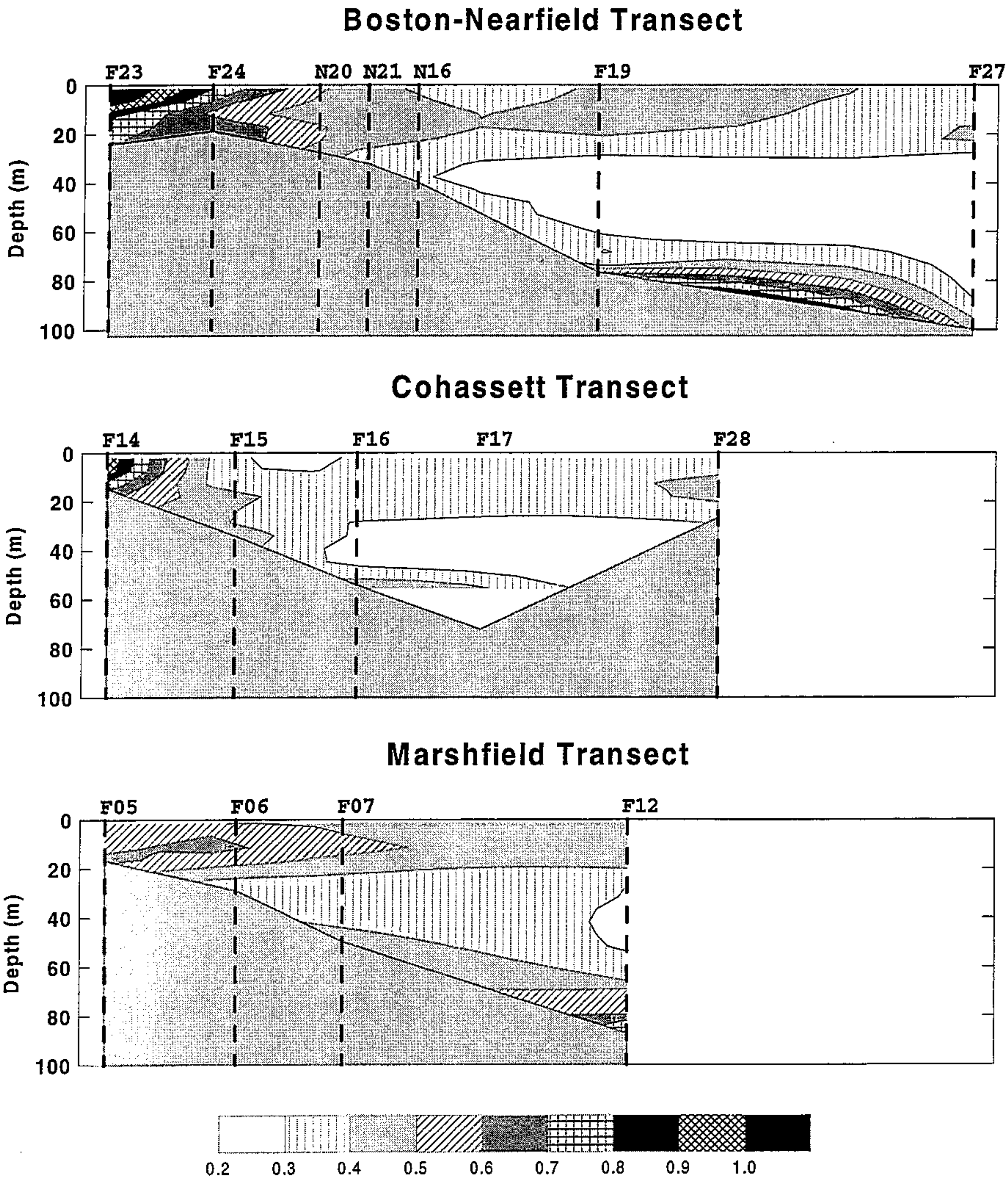


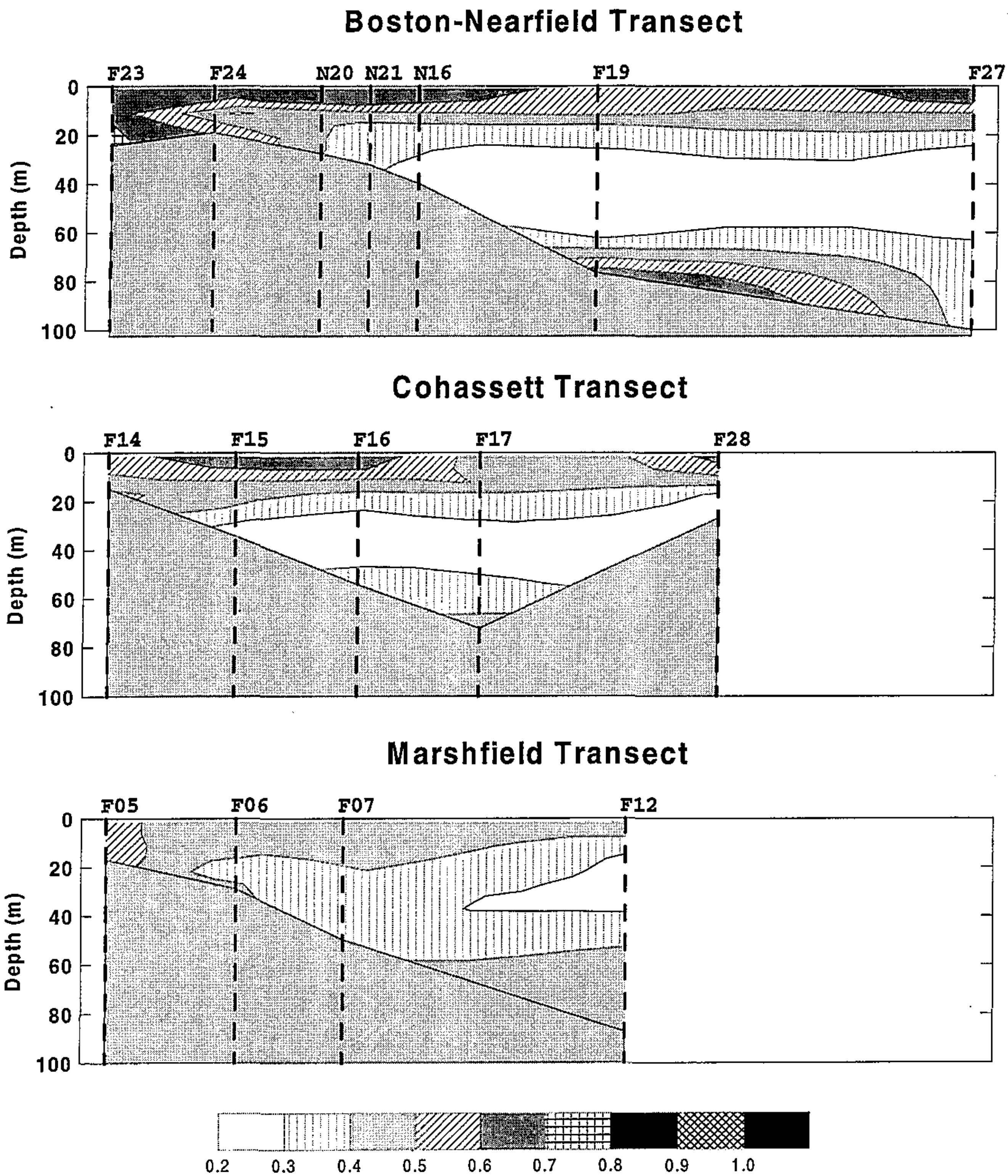
Marshfield Transect





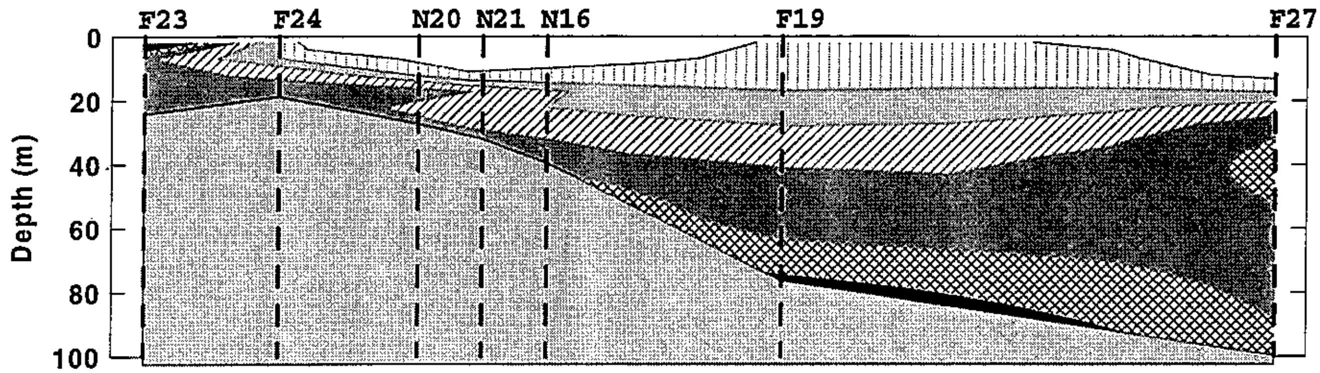
Salinity 9514


Boston-Nearfield Transect
F23 F24 N20 N21 N16 F19 F27
Depth (m)
0 20 40 60 80 100
Cohassett Transect
F14 F15 F16 F17 F28
Depth (m)
0 20 40 60 80 100
Marshfield Transect
F05 F06 F07 F12
Depth (m)
0 20 40 60 80 100
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0

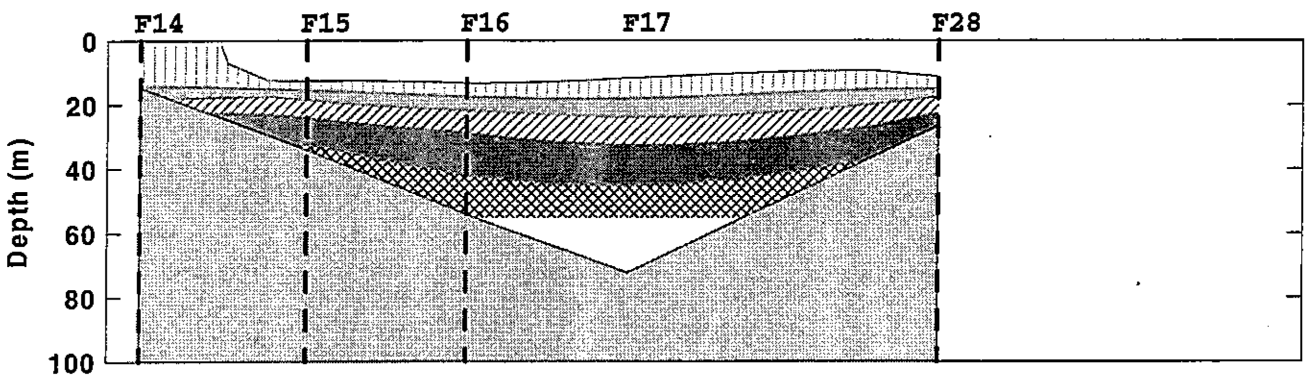

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Marshfield Transect
F05
F06
F07
F12
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

Trans 9514

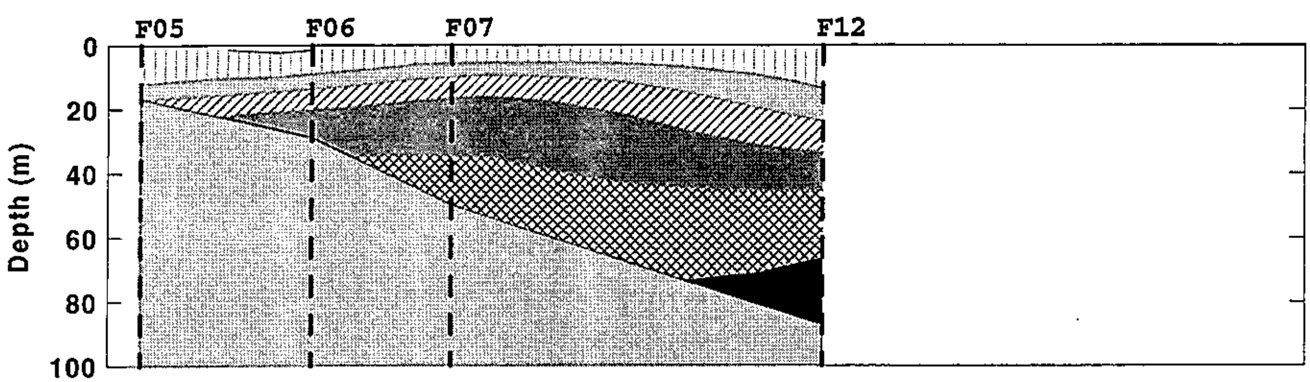
Boston-Nearfield Transect

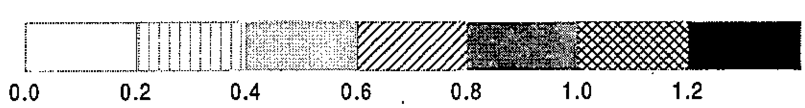


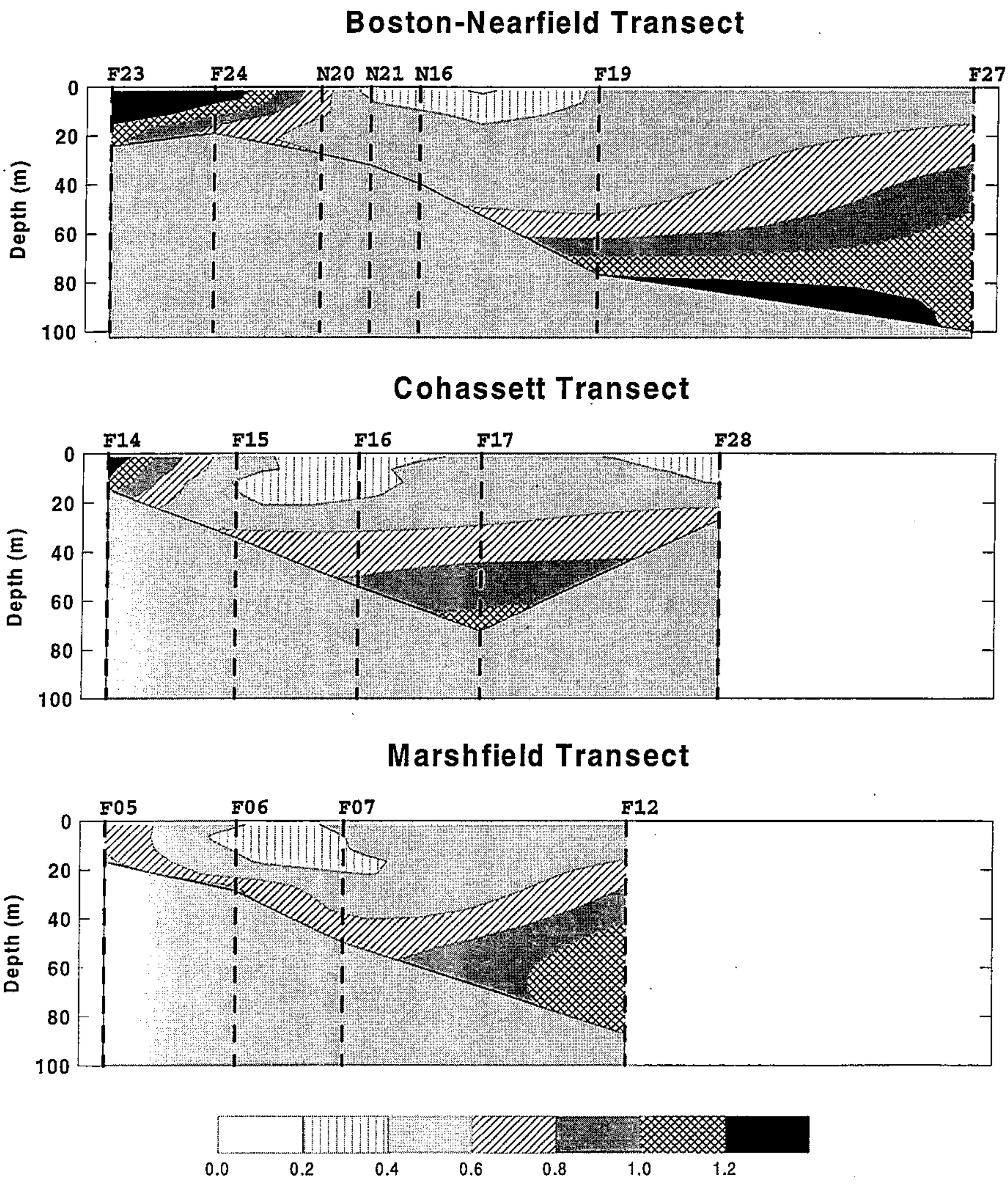
Cohassett Transect



Marshfield Transect

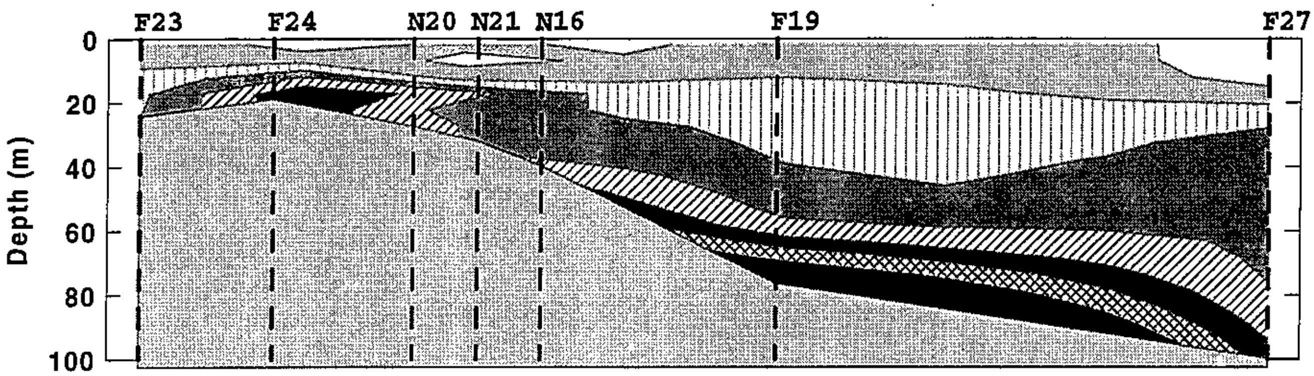




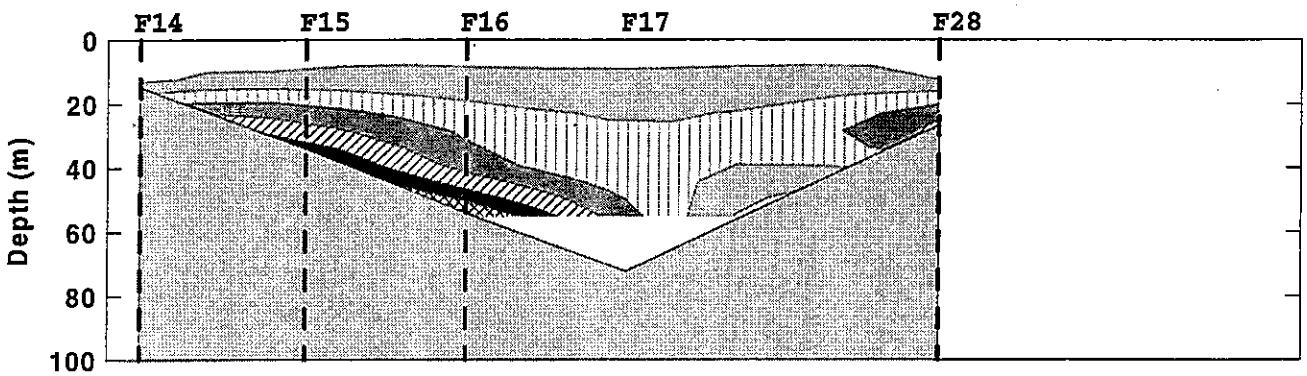

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0
1.2

PO4 9514

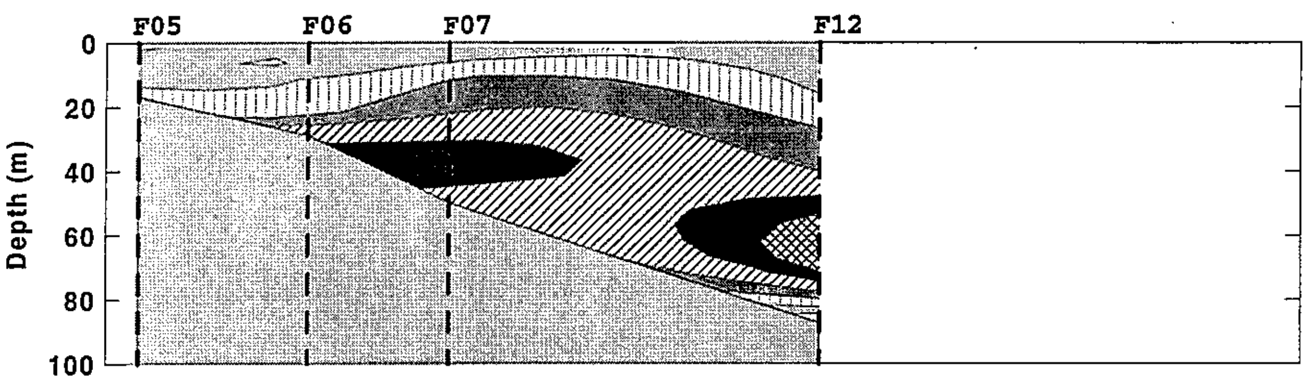
Boston-Nearfield Transect

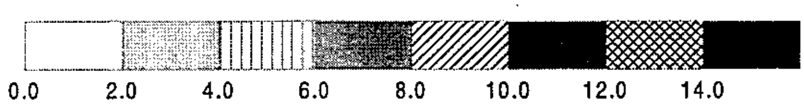


Cohassett Transect

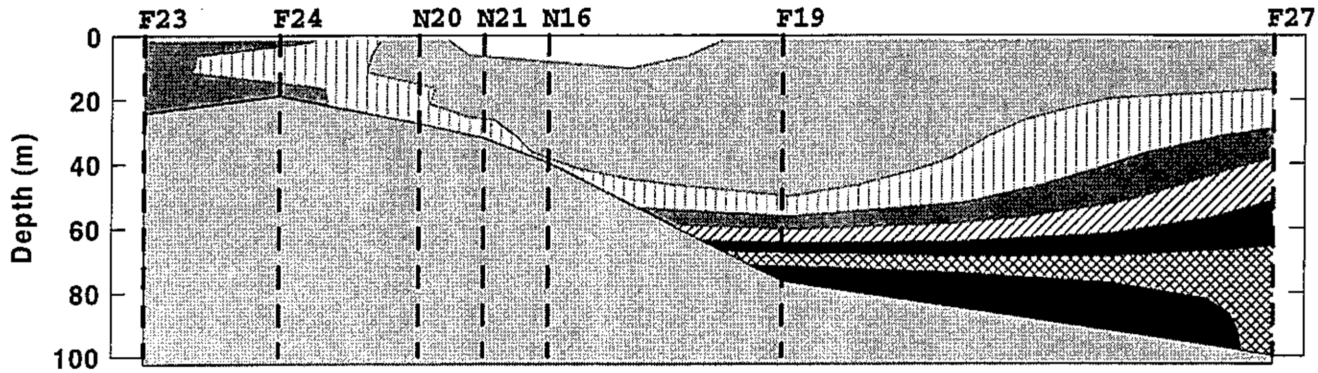


Marshfield Transect

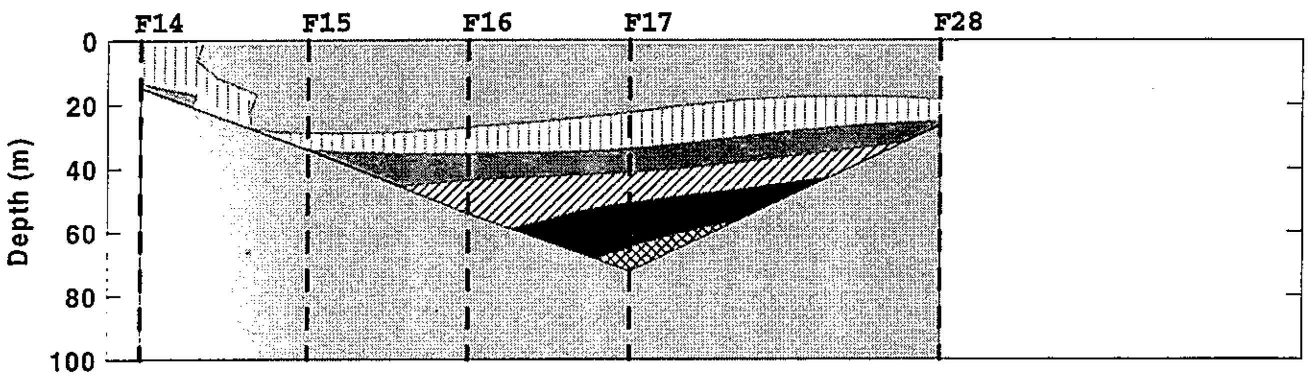




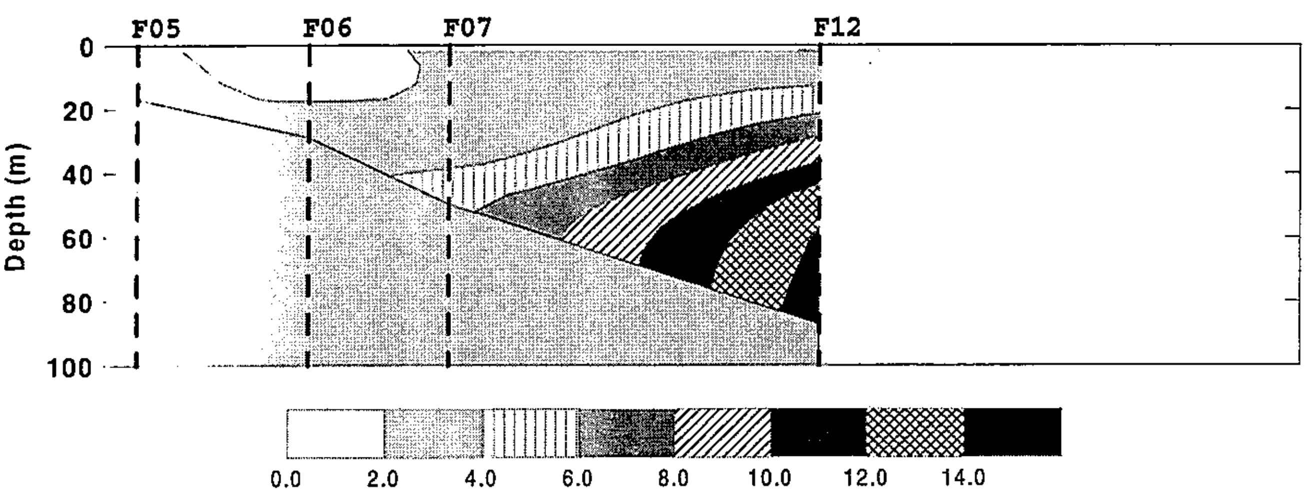
Boston-Nearfield Transect



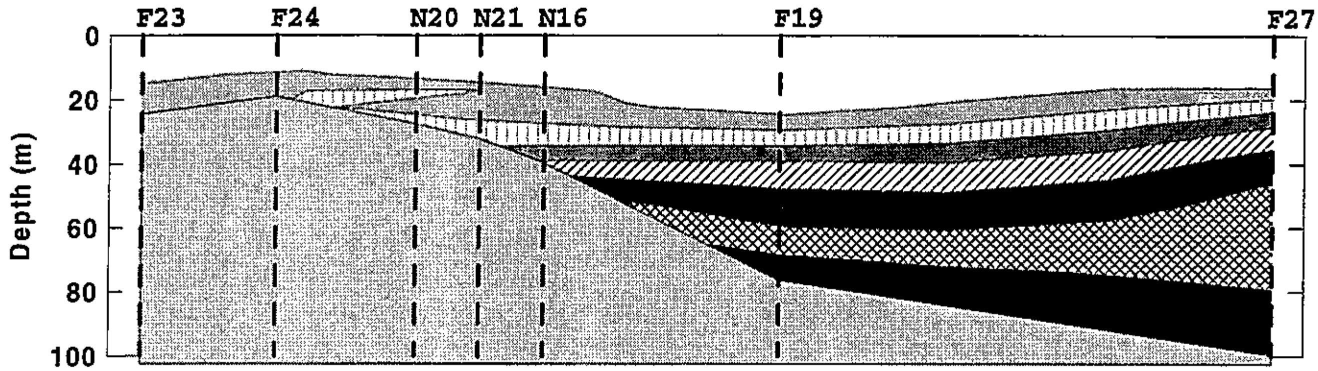
Cohassett Transect



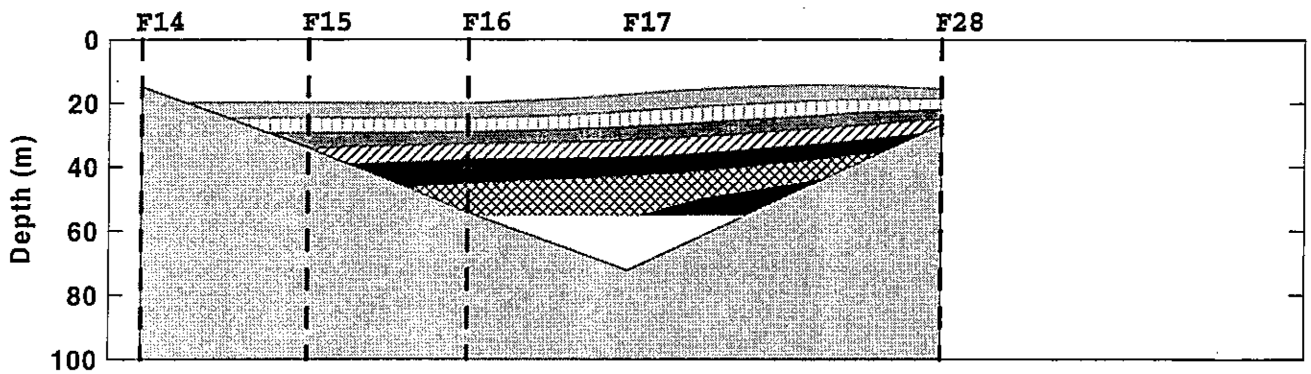
Marshfield Transect



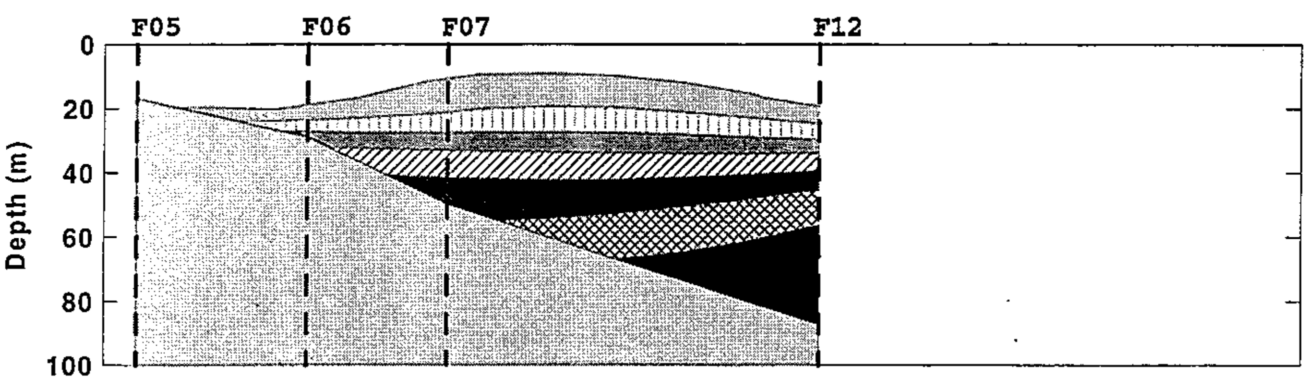
Boston-Nearfield Transect



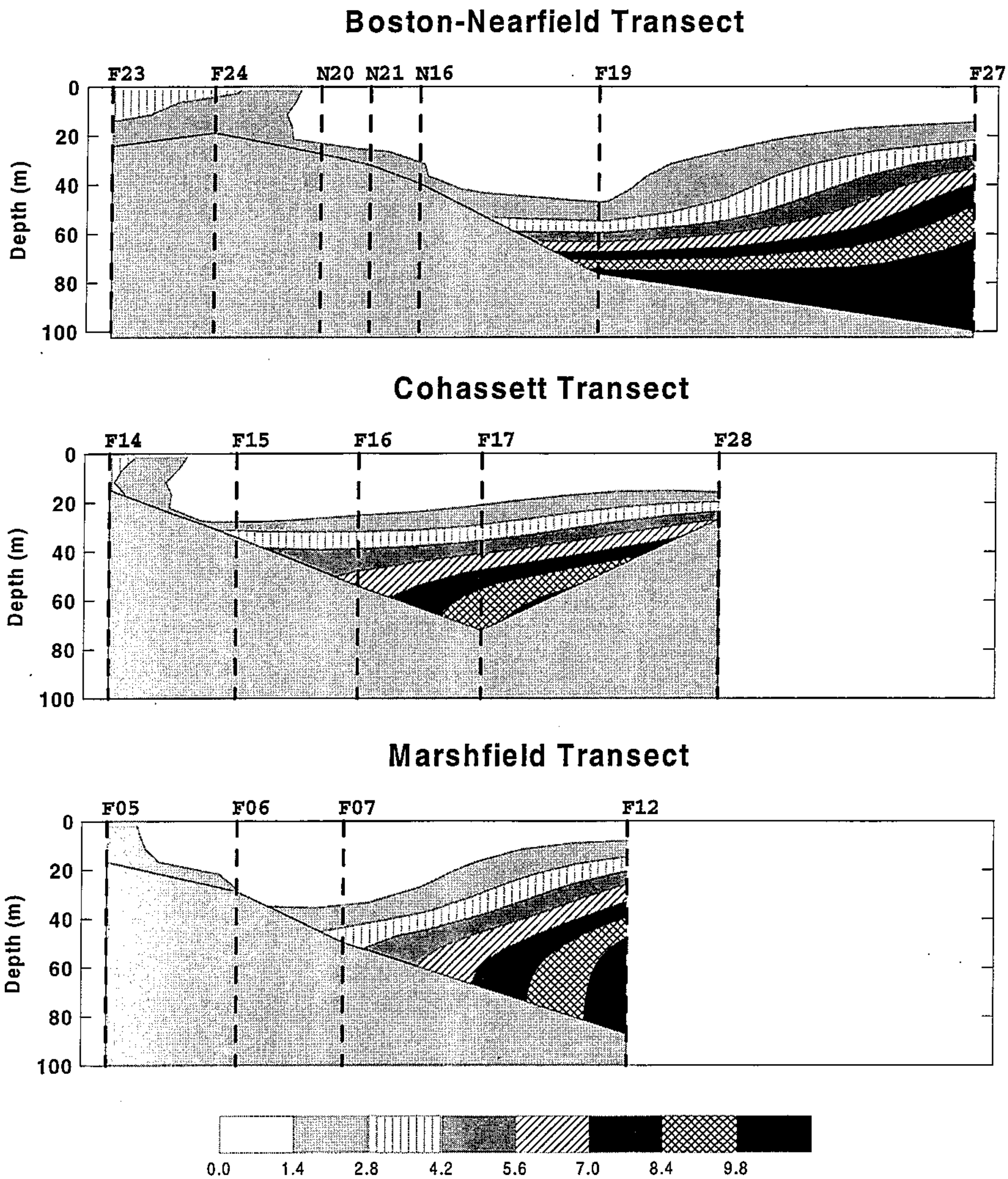
Cohassett Transect



Marshfield Transect

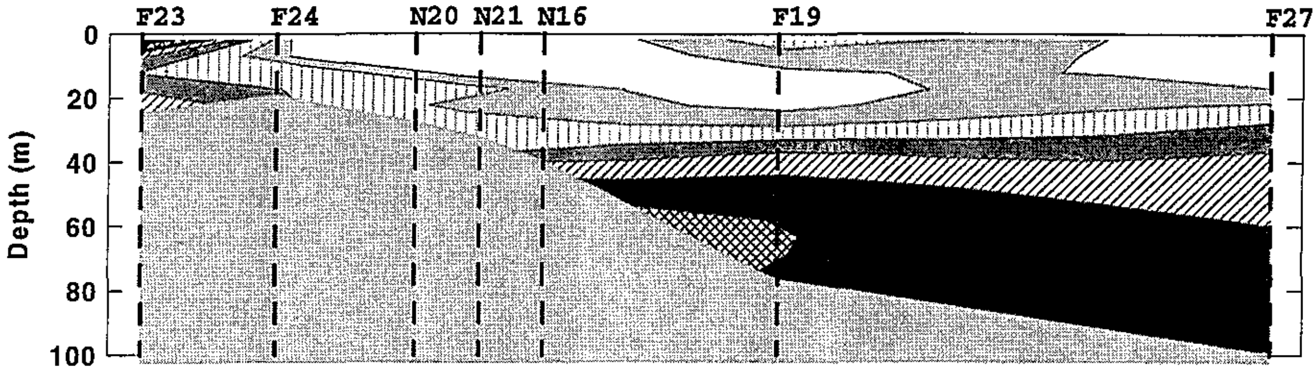


NO3 9511

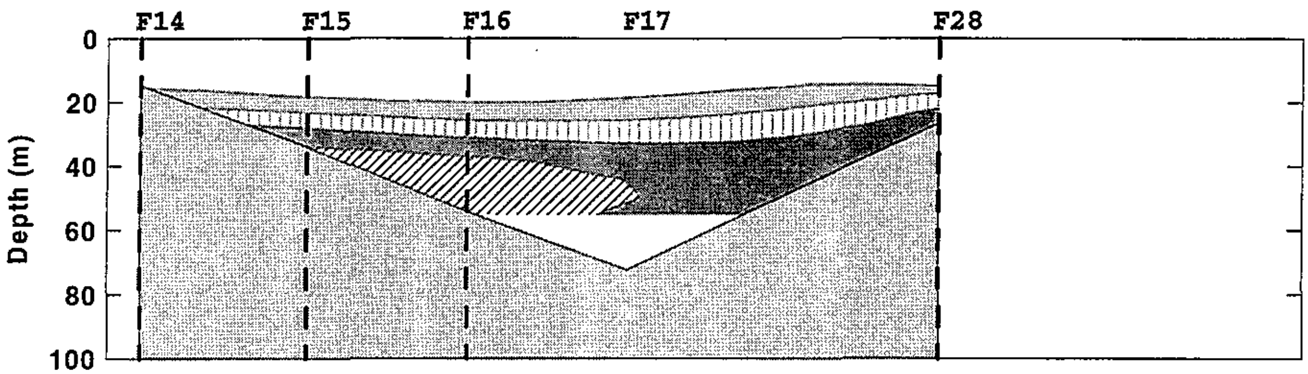

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.0
1.4
2.8
4.2
5.6
7.0
8.4
9.8

NO3 9514

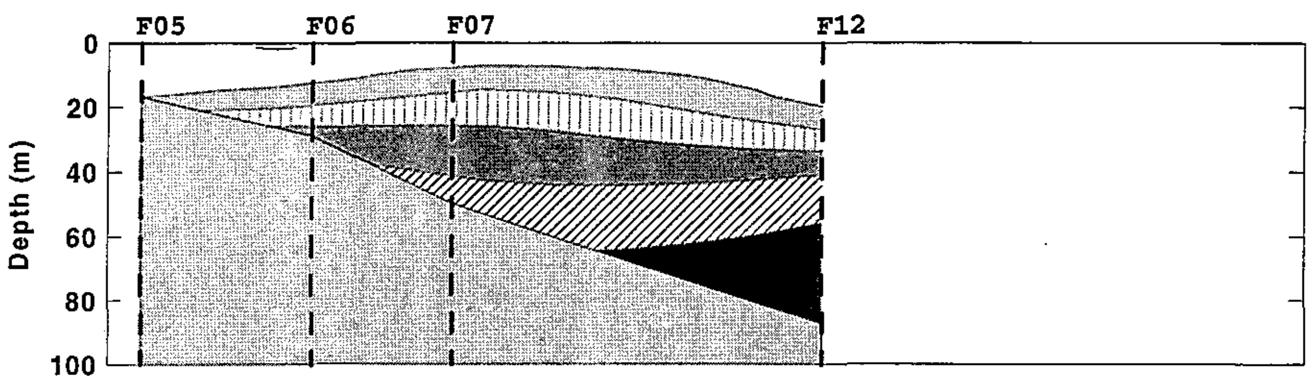
Boston-Nearfield Transect

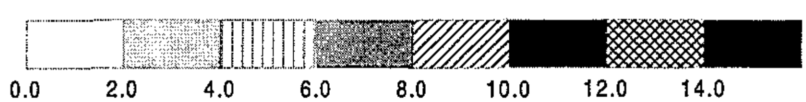


Cohassett Transect

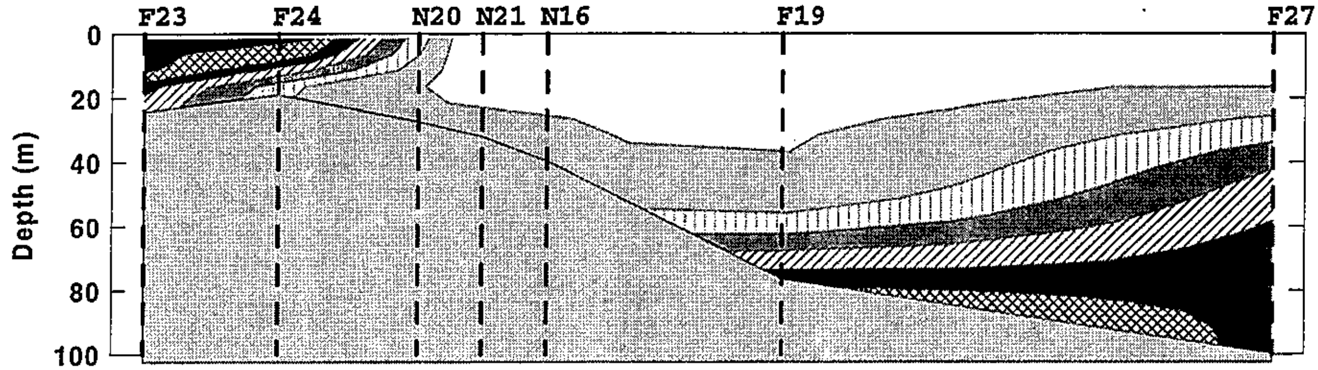


Marshfield Transect

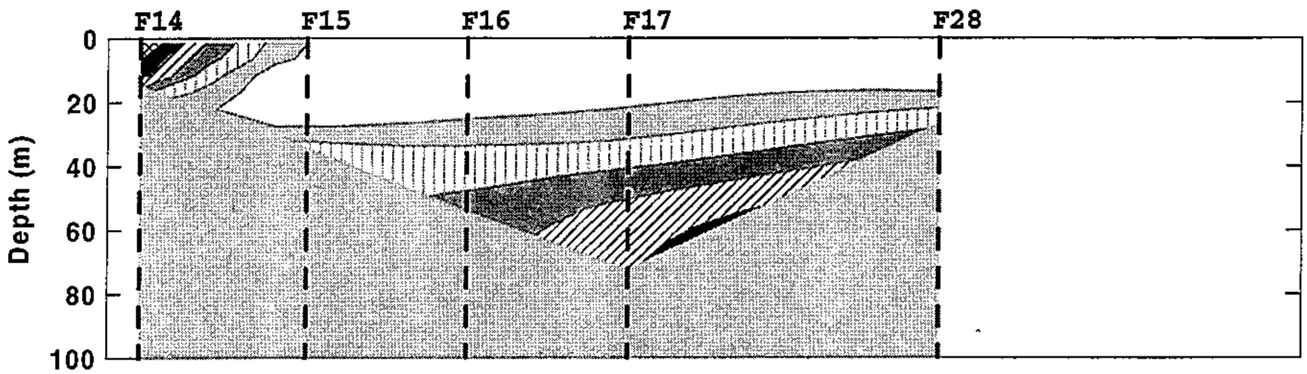




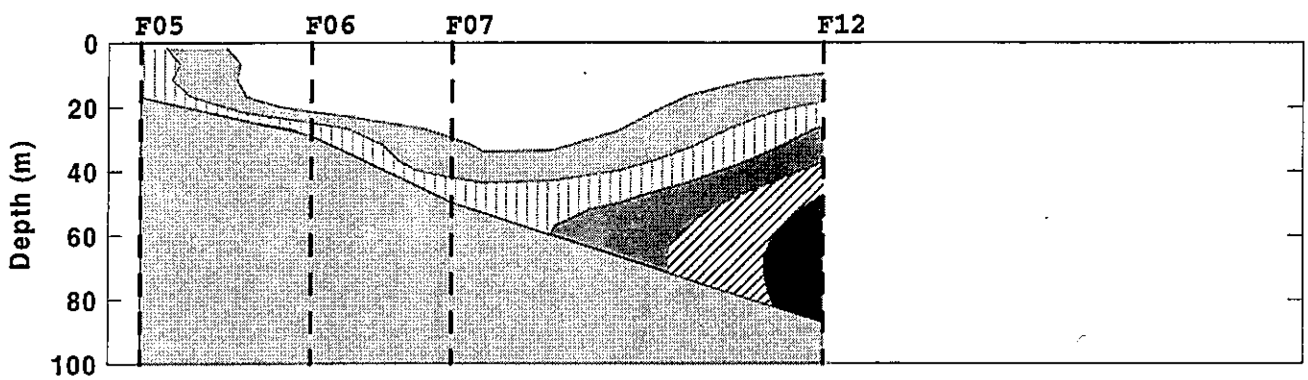
Boston-Nearfield Transect



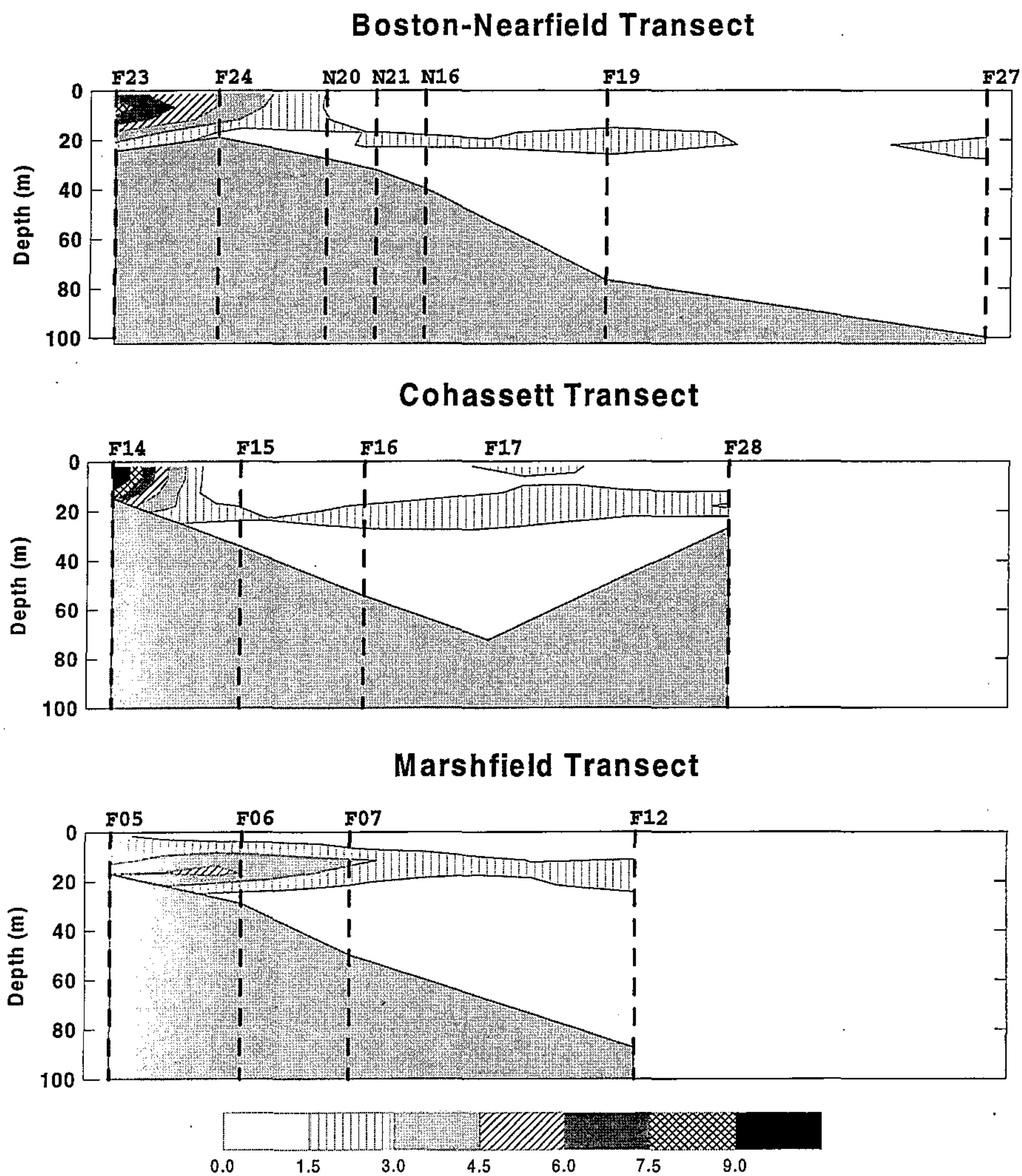
Cohassett Transect



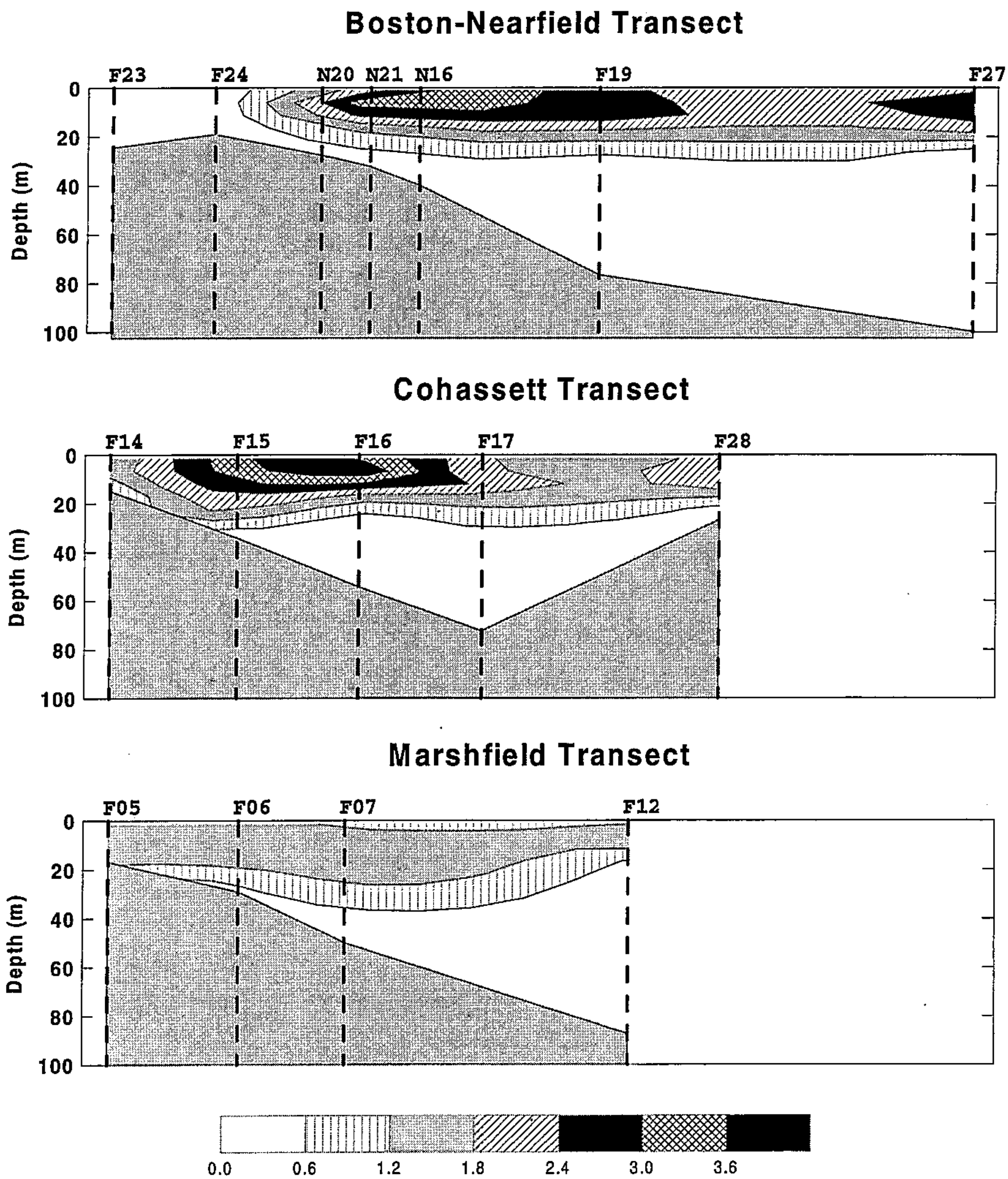
Marshfield Transect



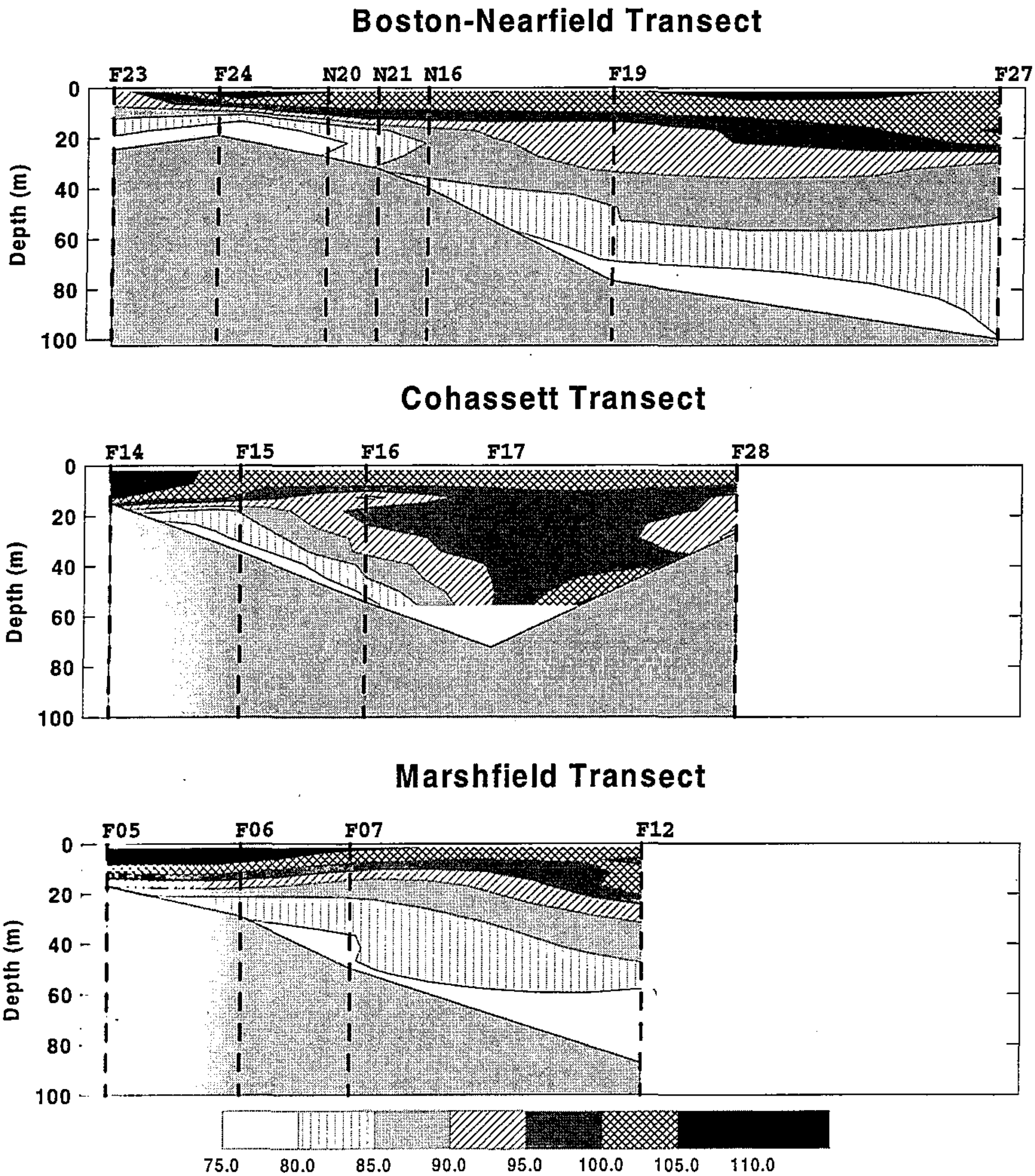
DI Nitro 9514



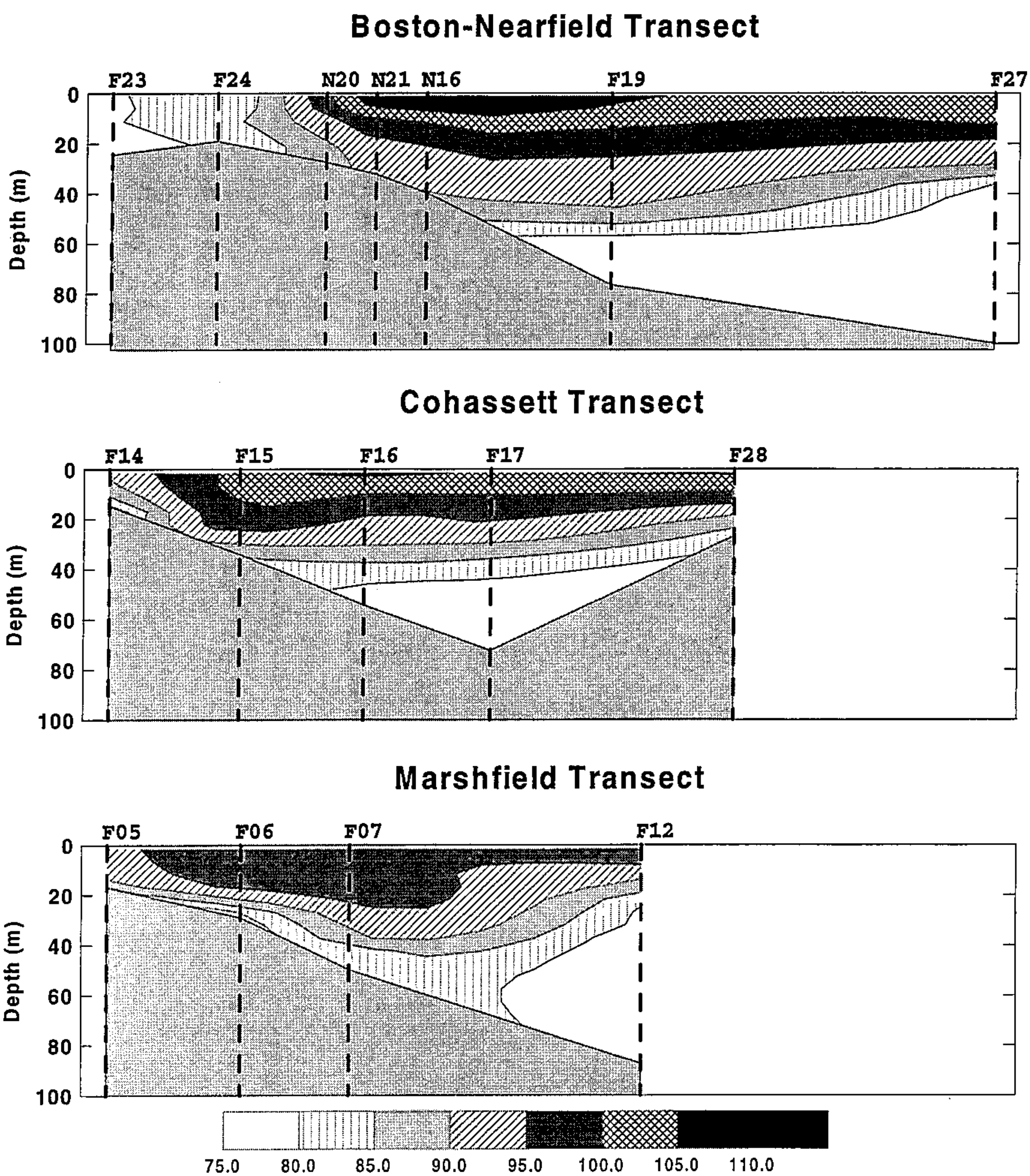
Fluorescence 9511



Fluorescence 9514



DO % Saturation 9511



DO % Saturation 9514

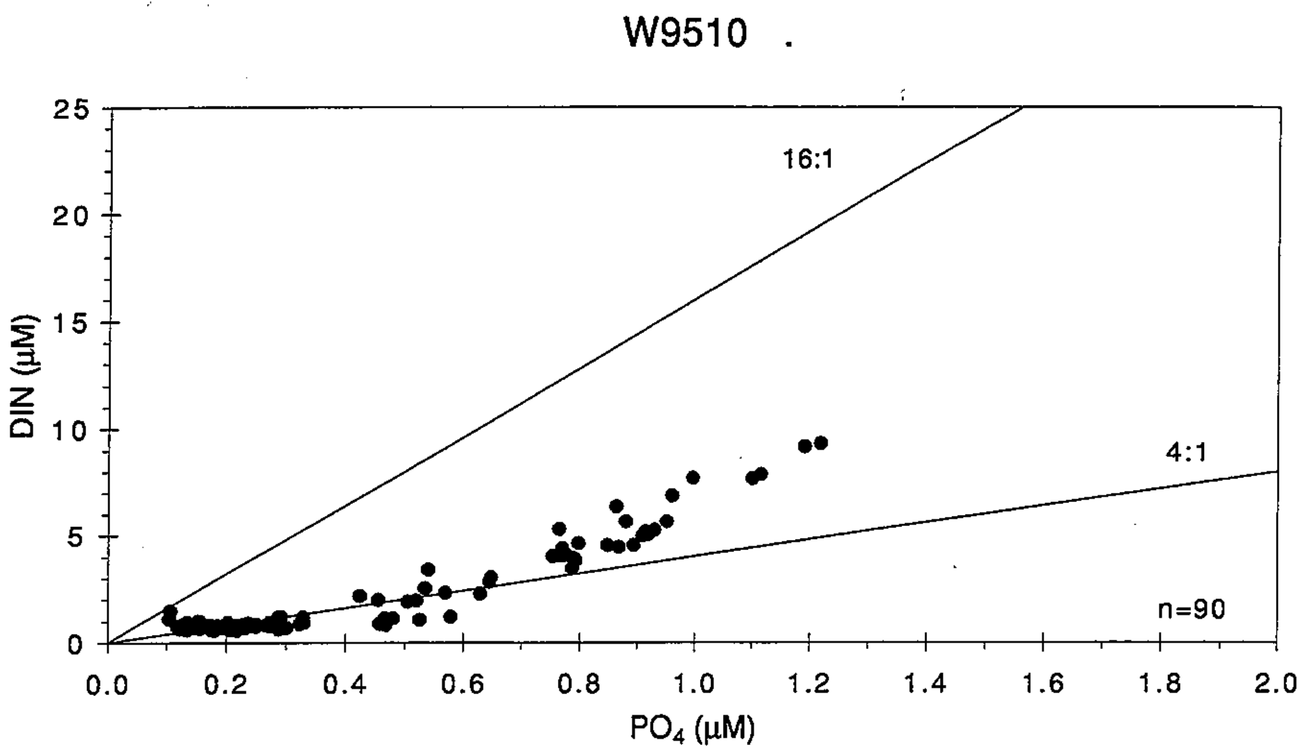
APPENDIX D

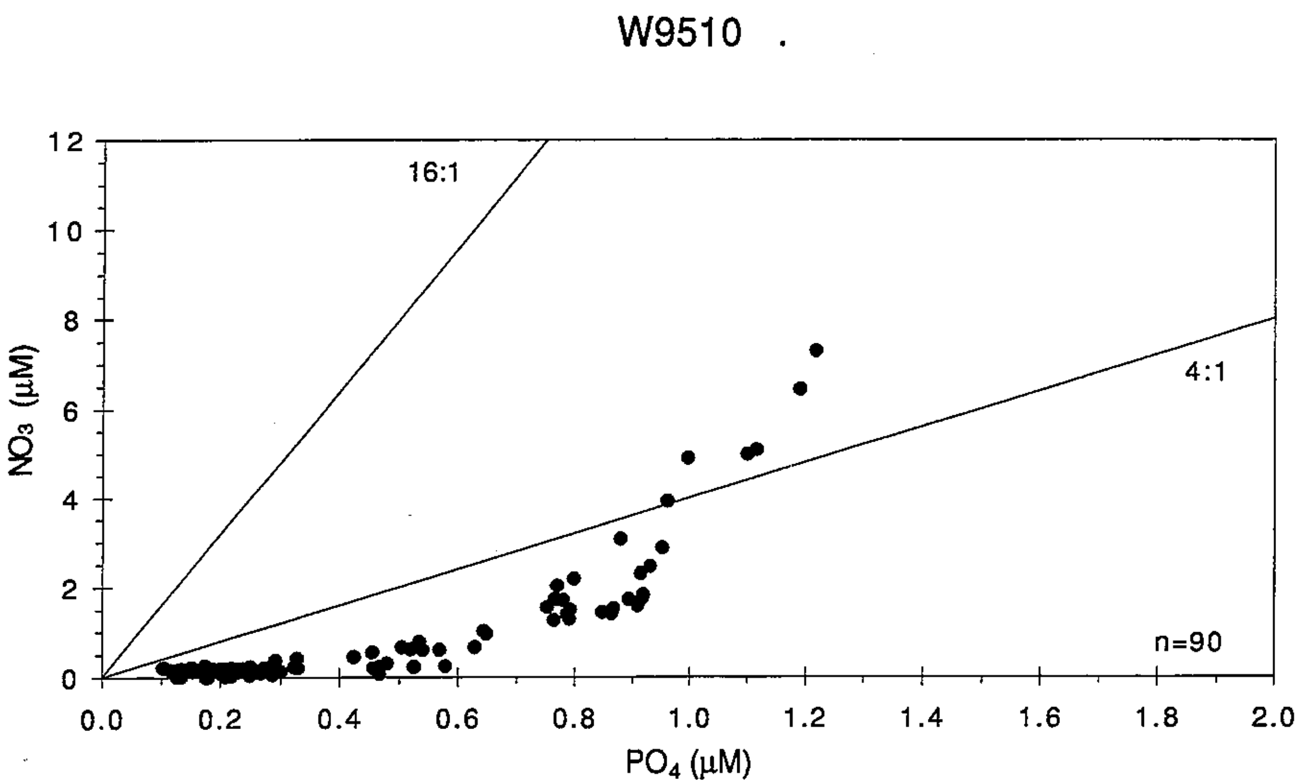
Nutrient Scatter Plots

Scatter plots are included for every survey conducted during the semi-annual period. Each plot includes all stations and all depths unless otherwise noted. The plots are organized by type of plot, and then by survey. Combined nearfield/farfield surveys show the regions with different symbols, including boundary (BOU), Cape Cod Bay (CCB), coastal (COA), Boston Harbor (BH), nearfield (NEA), and offshore (OFF). Available plots, in the order they appear in the appendix, are summarized in the table below.

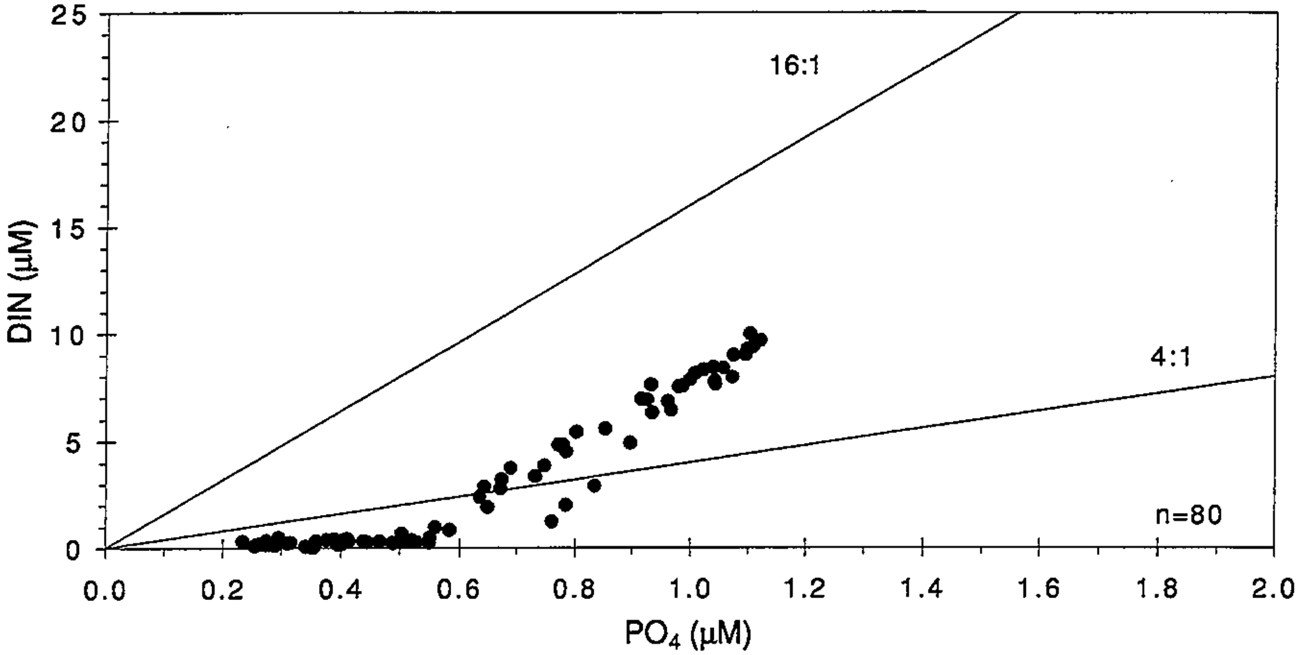
Type of Plot	Surveys	Comments
PO_4:DIN; PO_4:NO_3	W9511-17	Lines of nitrogen:phosphate
PO_4:NH_4; SiO_4:NH_4	W9511-17	
SiO_4:DIN; SiO_4:NO_3	W9511-17	Lines of nitrogen:silicate
Salinity:DIN	W9511-17	Stations types A,D,F,G
Salinity:NH_4 and NO_3	W9511-17	
Salinity:PO_4 and SiO_4	W9511-17	
Salinity:TN and DIN+PON	W9511-17	Station types A,D,F,G
Depth:DIN	W9511-17	
Depth:NH_4 and NO_3	W9511-17	
Depth:PO_4 and SiO_4	W9511-17	

Acronyms:
DIN = dissolved inorganic nitrogen
PON = particulate organic nitrogen
TN = total dissolved nitrogen + PON


W9510
16:1
4:1
n=90
DIN (μM)
PO4 (μM)
0
5
10
15
20
25
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0

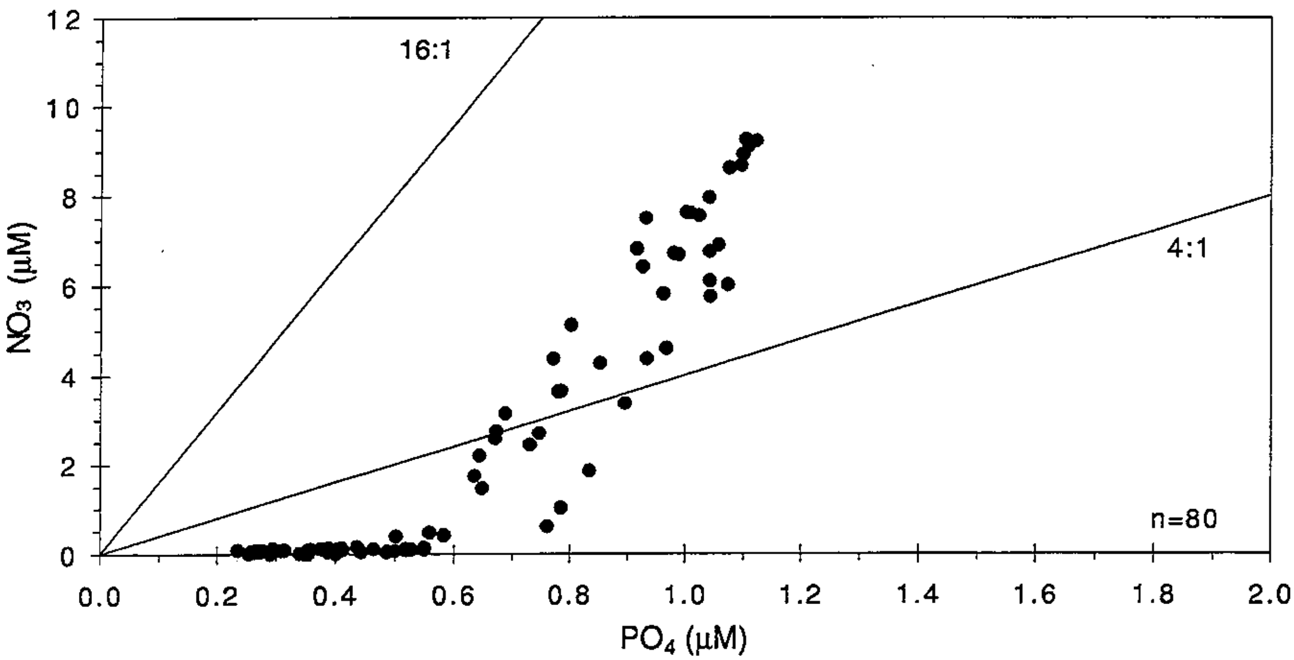

W9510
16:1
4:1
n=90
NO3 (μM)
PO4 (μM)
0
2
4
6
8
10
12
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0

W9512 .

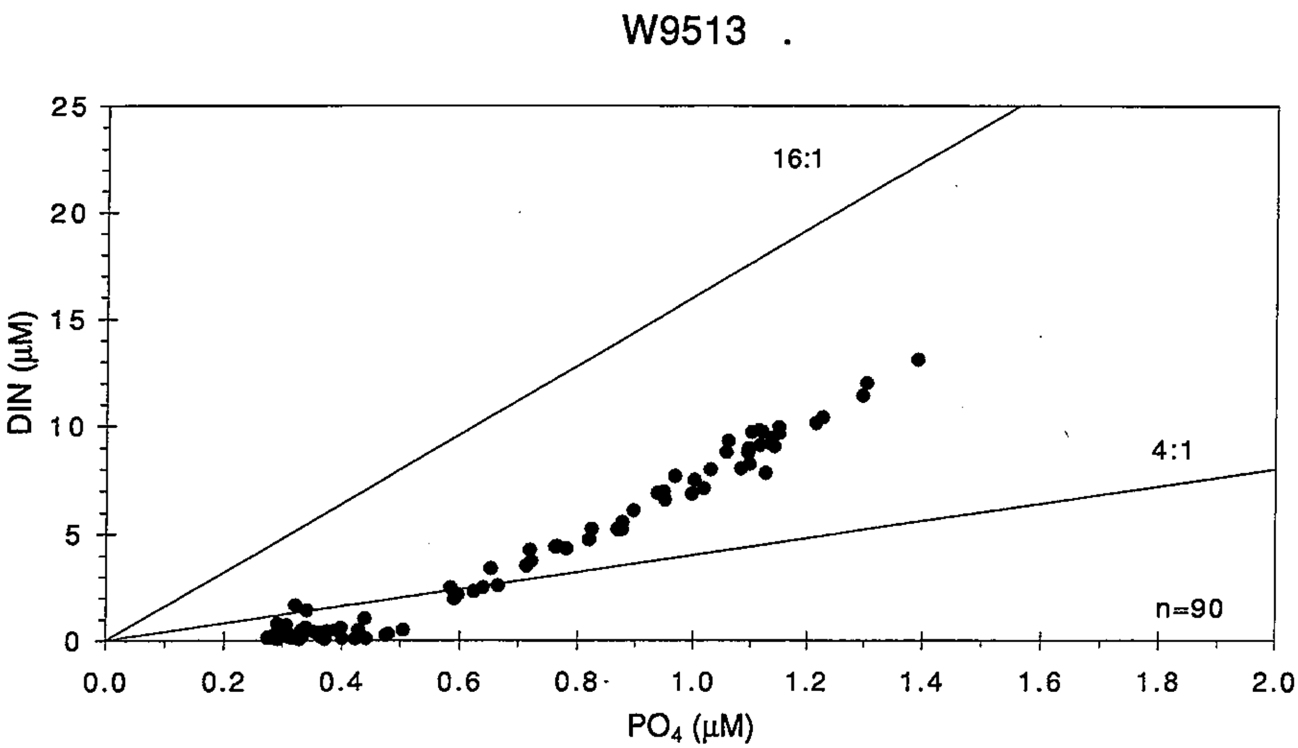


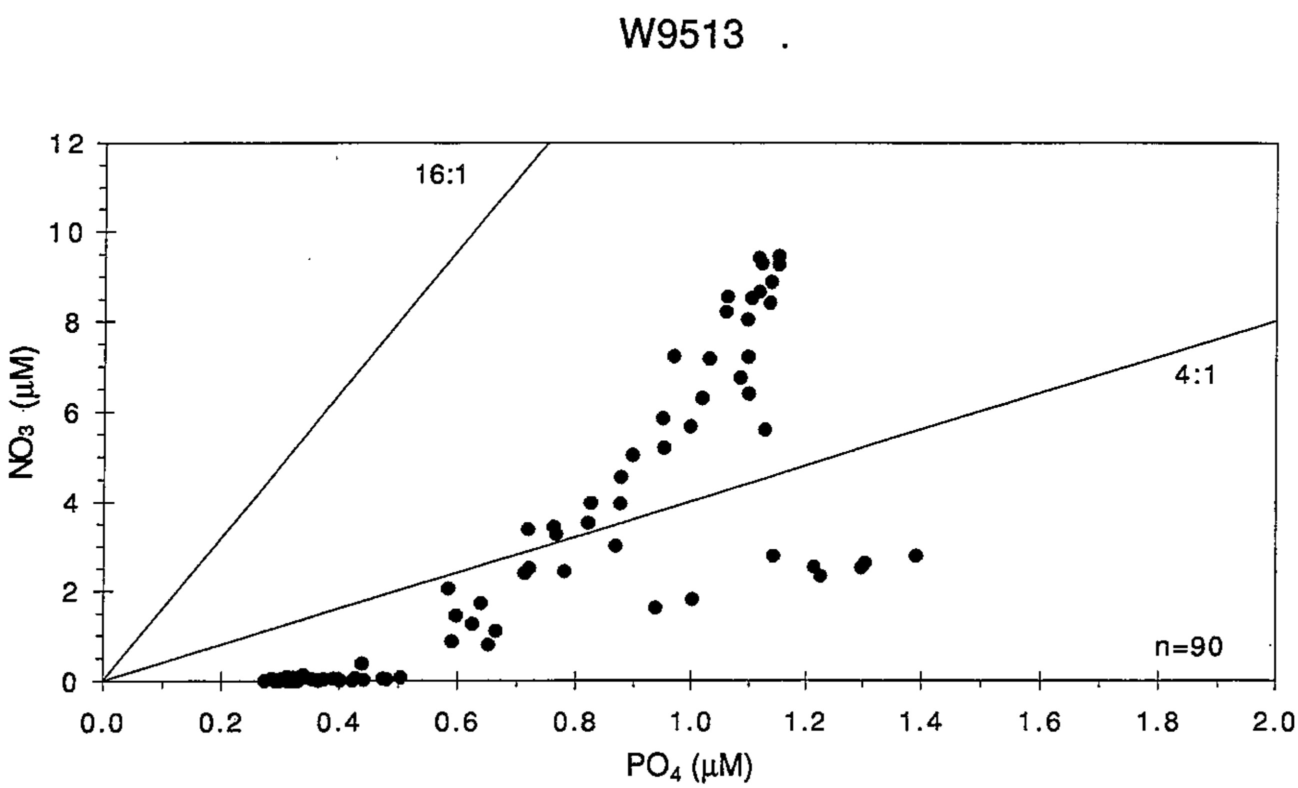
25
20
15
10
5
0
DIN (µM)
16:1
4:1
n=80
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

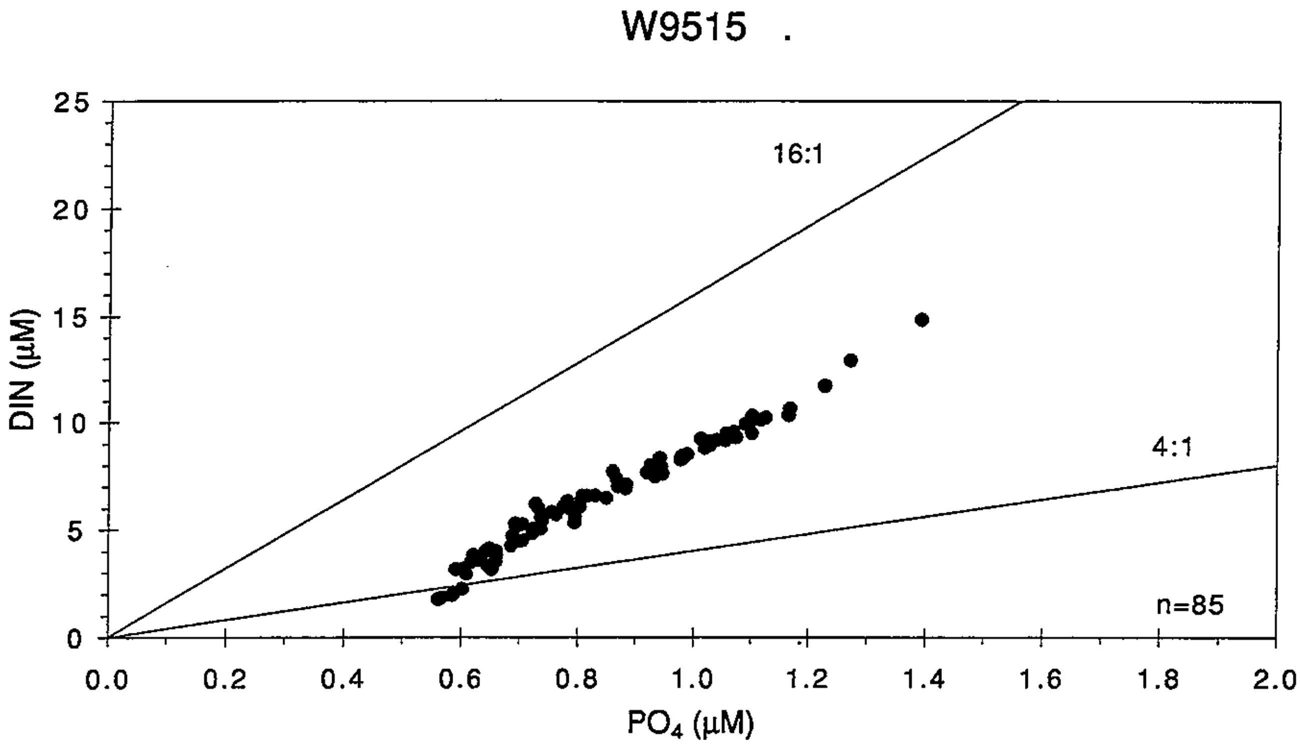
W9512 .

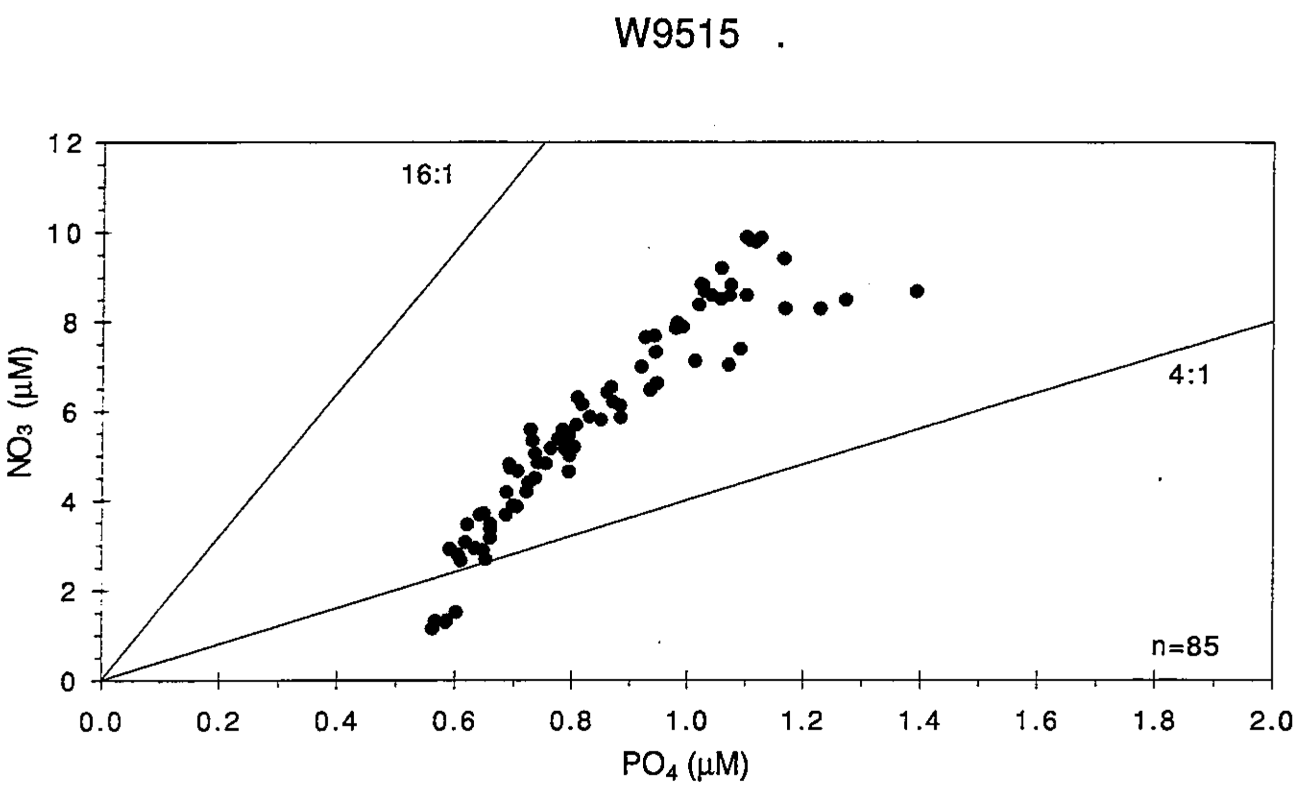


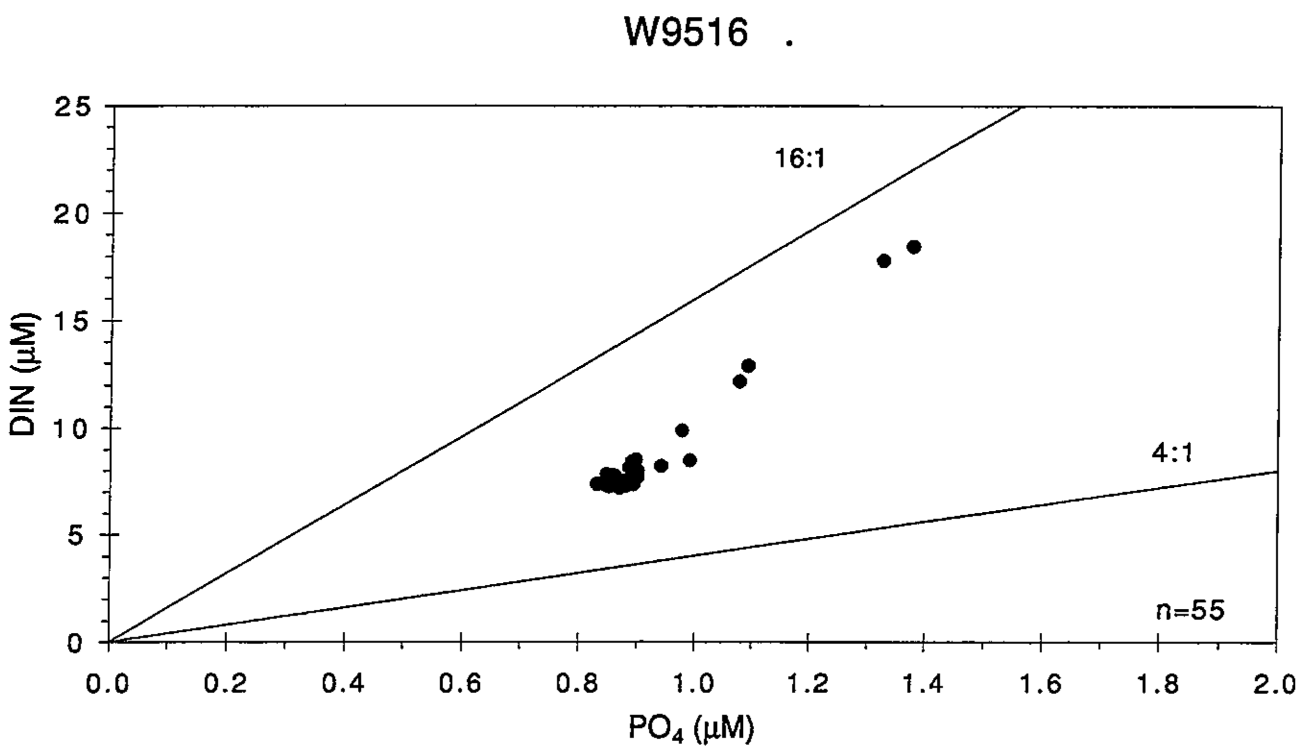
12
10
8
6
4
2
0
NO3 (µM)
16:1
4:1
n=80
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

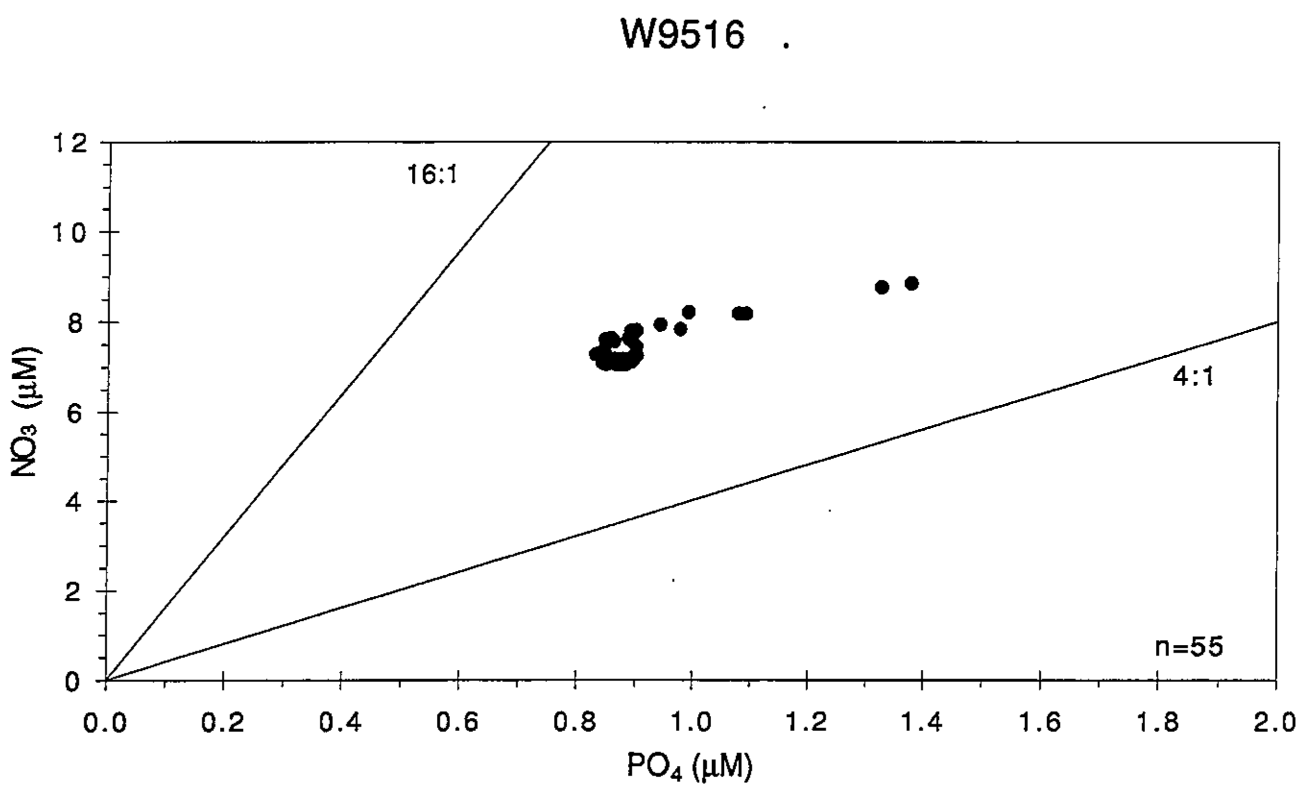

W9513 .
25
20
15
10
5
0
DIN (µM)
16:1
4:1
n=90
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)


W9513 .
12
10
8
6
4
2
0
NO3 (µM)
16:1
4:1
n=90
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

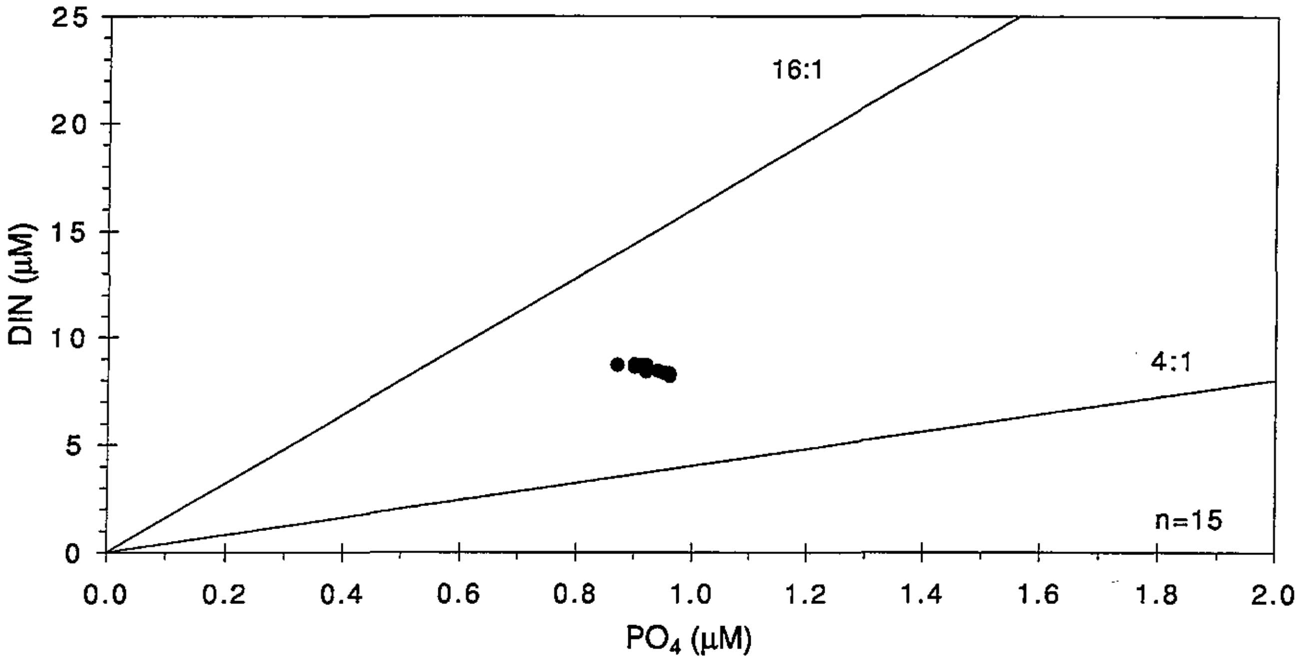

W9515 .
16:1
4:1
n=85
DIN (µM)
PO4 (µM)
0
5
10
15
20
25
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0


W9515 .
16:1
4:1
n=85
NO3 (µM)
PO4 (µM)
0
2
4
6
8
10
12
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0


W9516
16:1
4:1
n=55
DIN (μM)
PO4 (μM)
0
5
10
15
20
25
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0

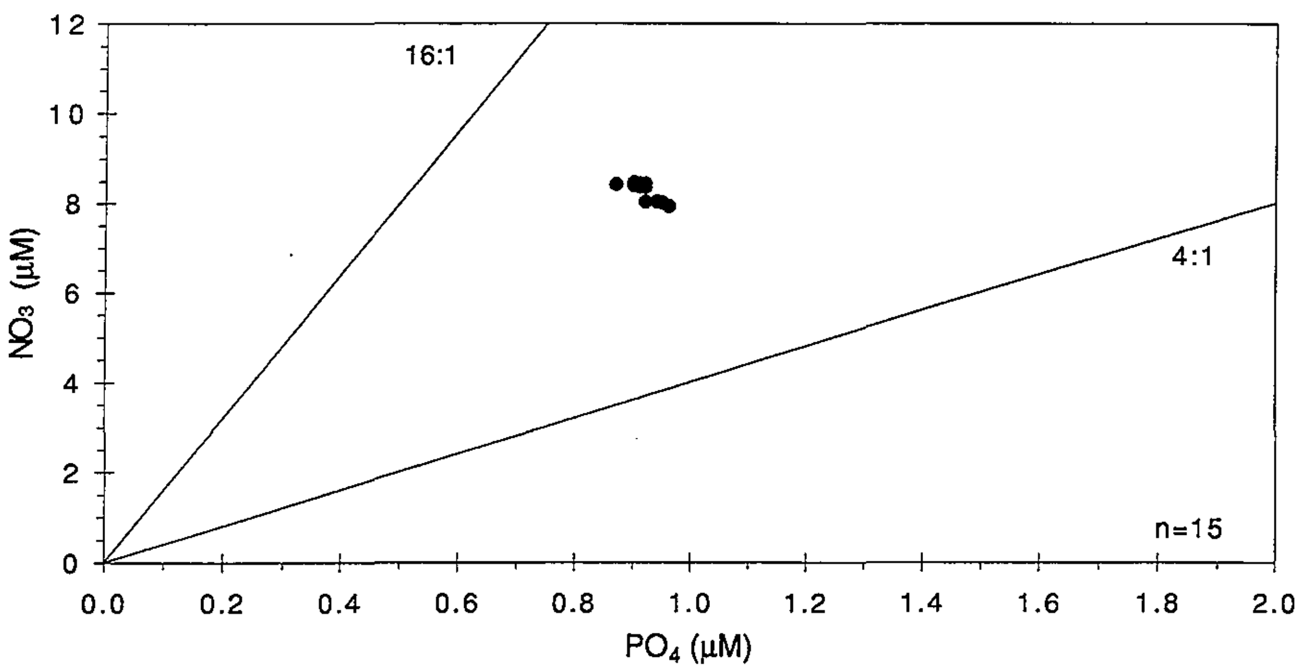

W9516
16:1
4:1
n=55
NO3 (μM)
PO4 (μM)
0
2
4
6
8
10
12
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0

W9517 .



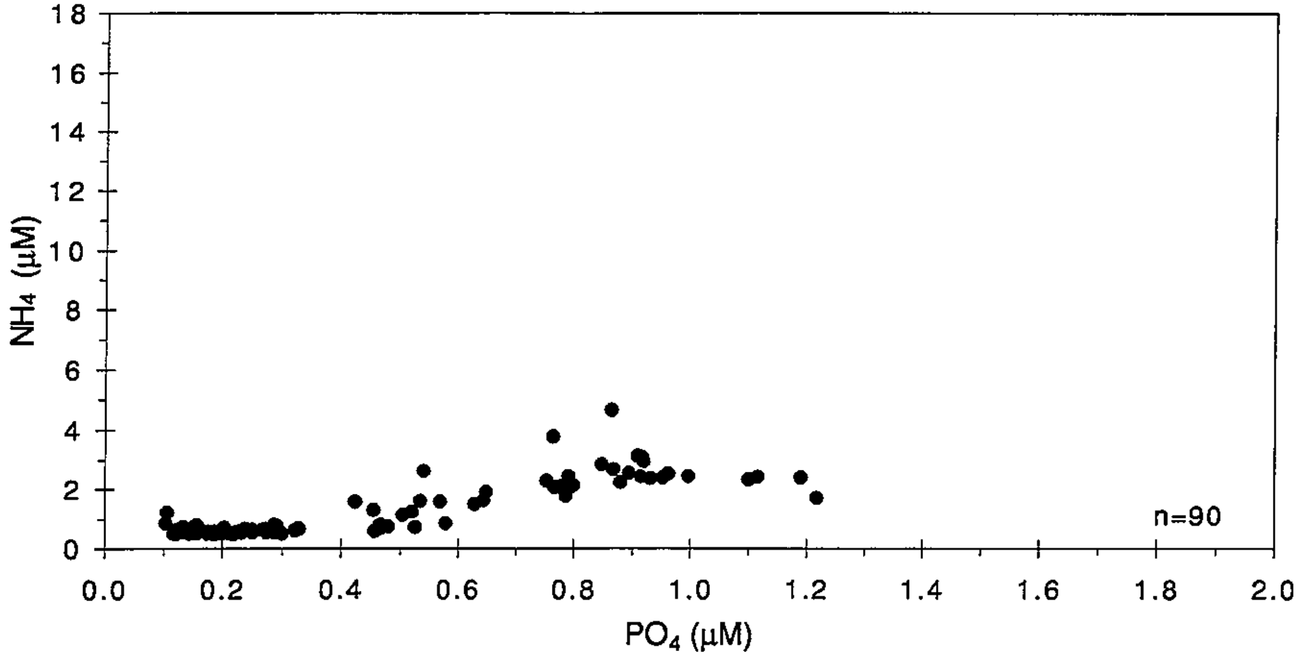
16:1
4:1
n=15
DIN (µM)
PO4 (µM)
0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0
0 5 10 15 20 25

W9517 .

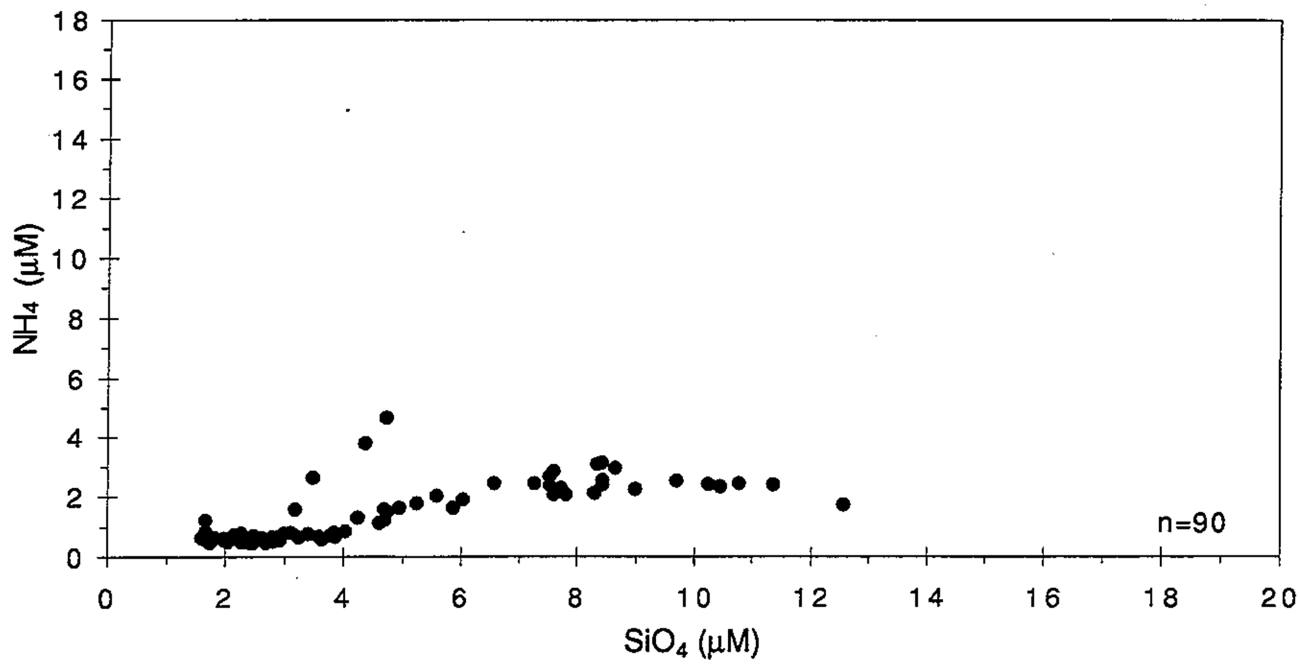


16:1
4:1
n=15
NO3 (µM)
PO4 (µM)
0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0
0 2 4 6 8 10 12

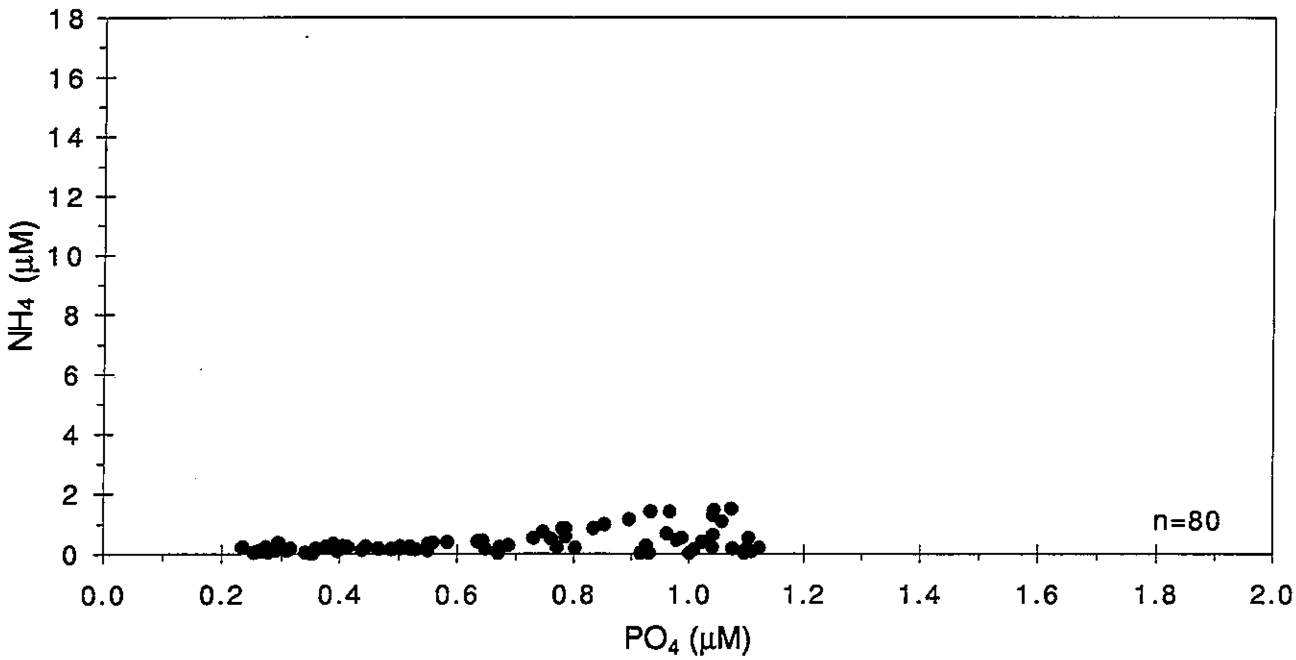
W9510 .


18
16
14
12
10
8
6
4
2
0
NH4 (µM)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)
n=90

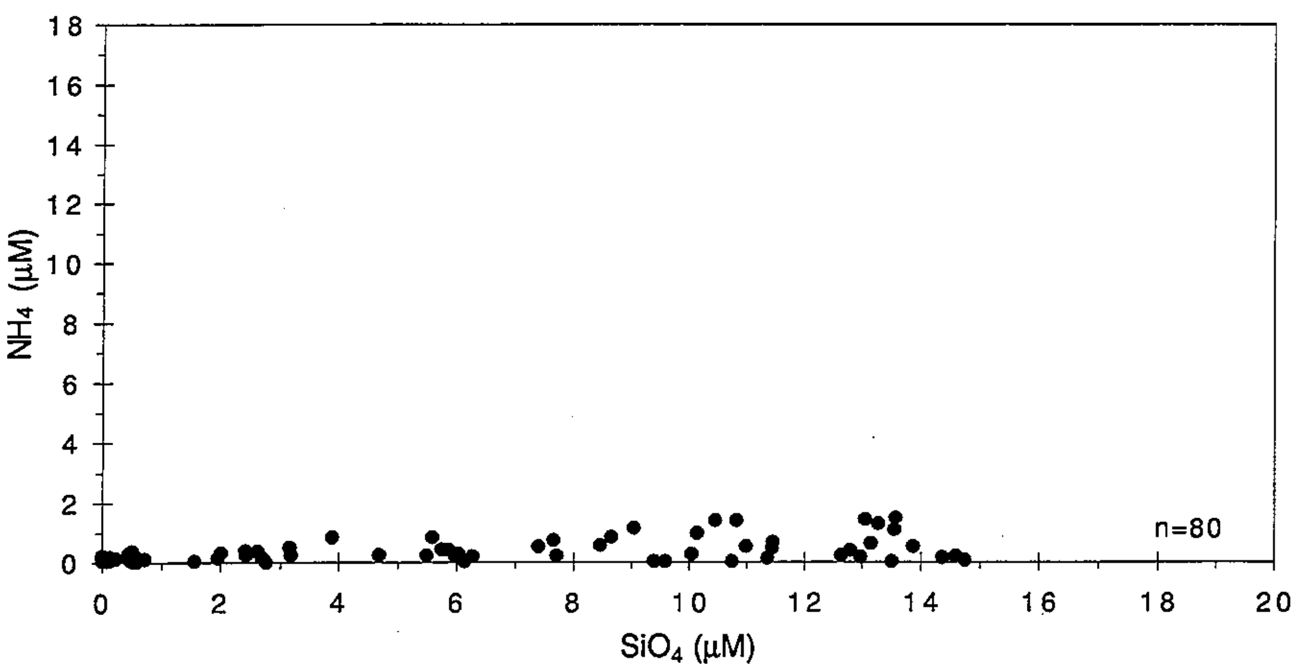
W9510 .


18
16
14
12
10
8
6
4
2
0
NH4 (µM)
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)
n=90

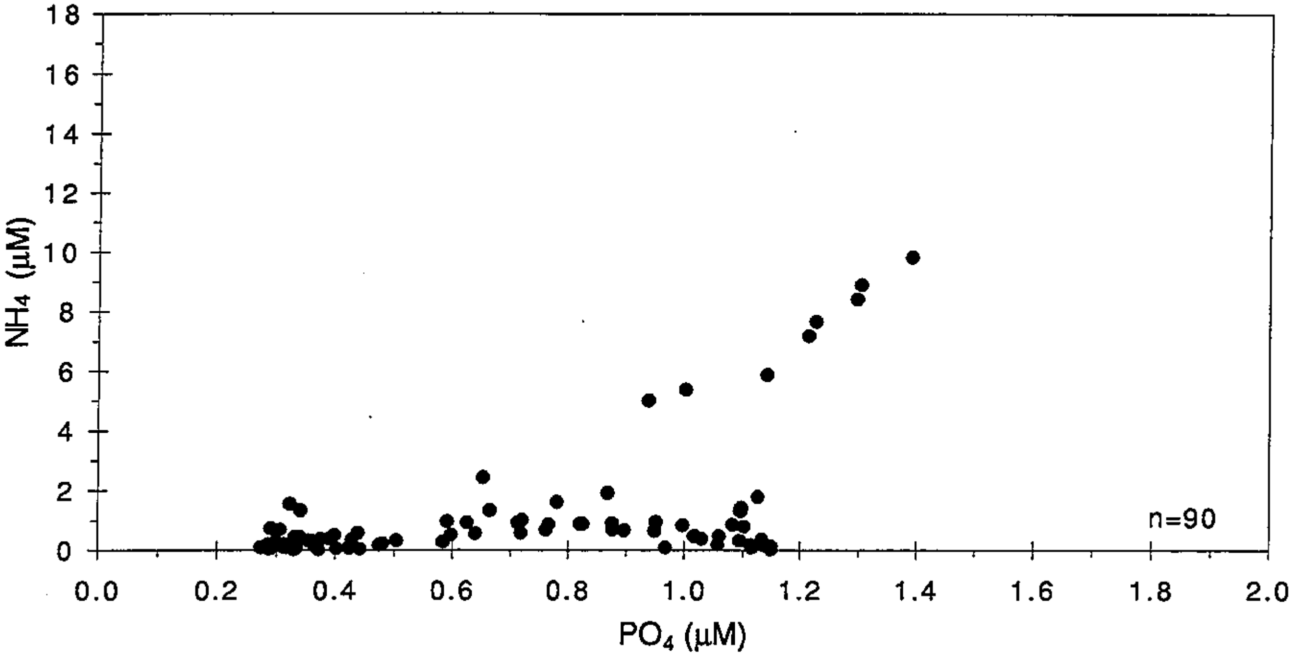
W9512 .


NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=80
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

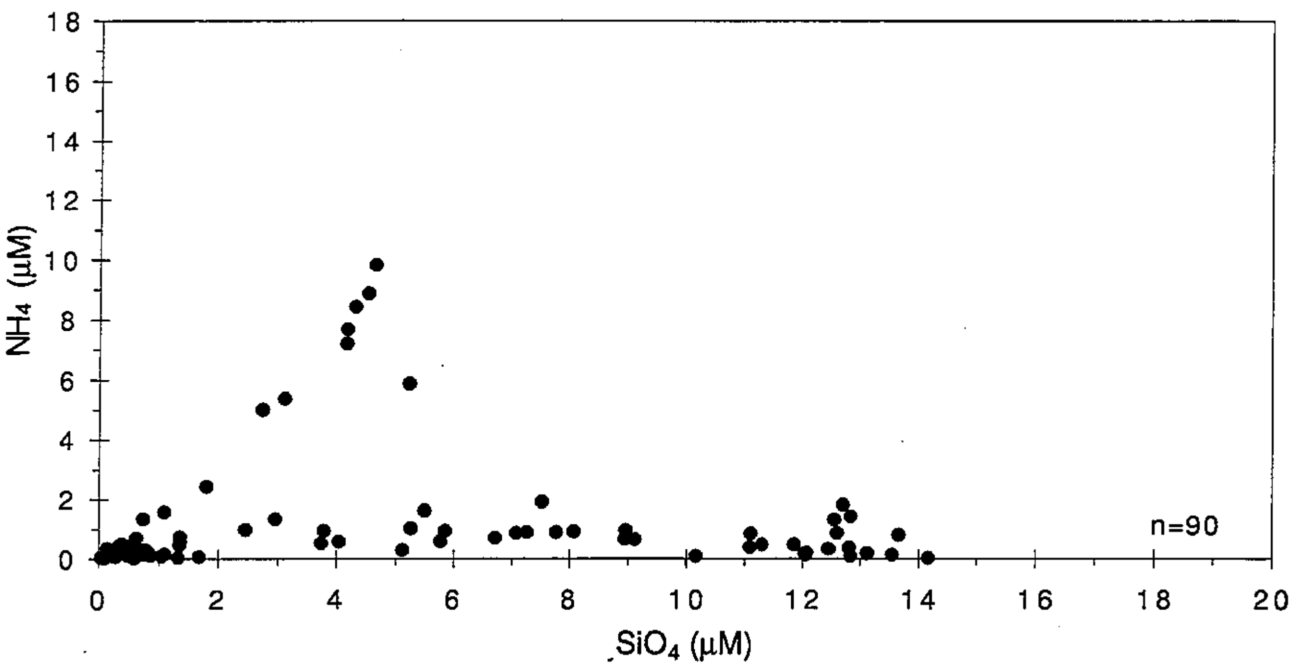
W9512 .

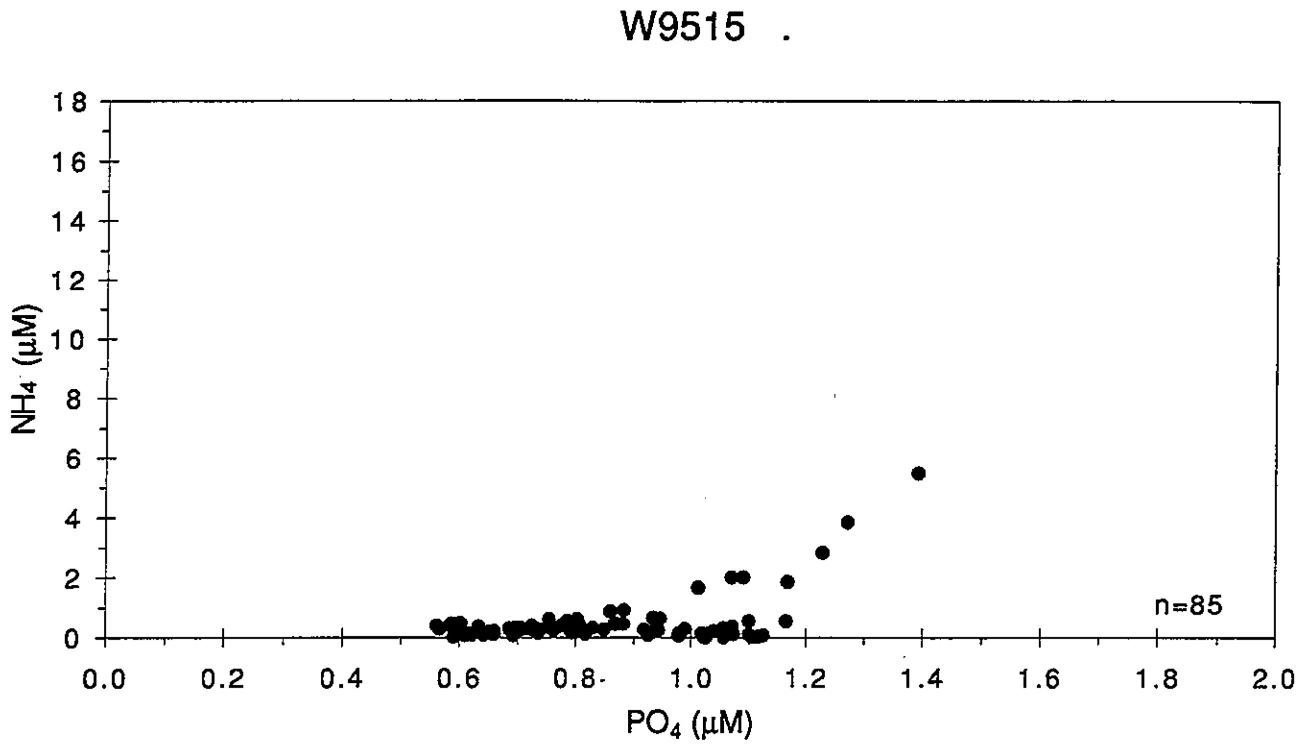

NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=80
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)

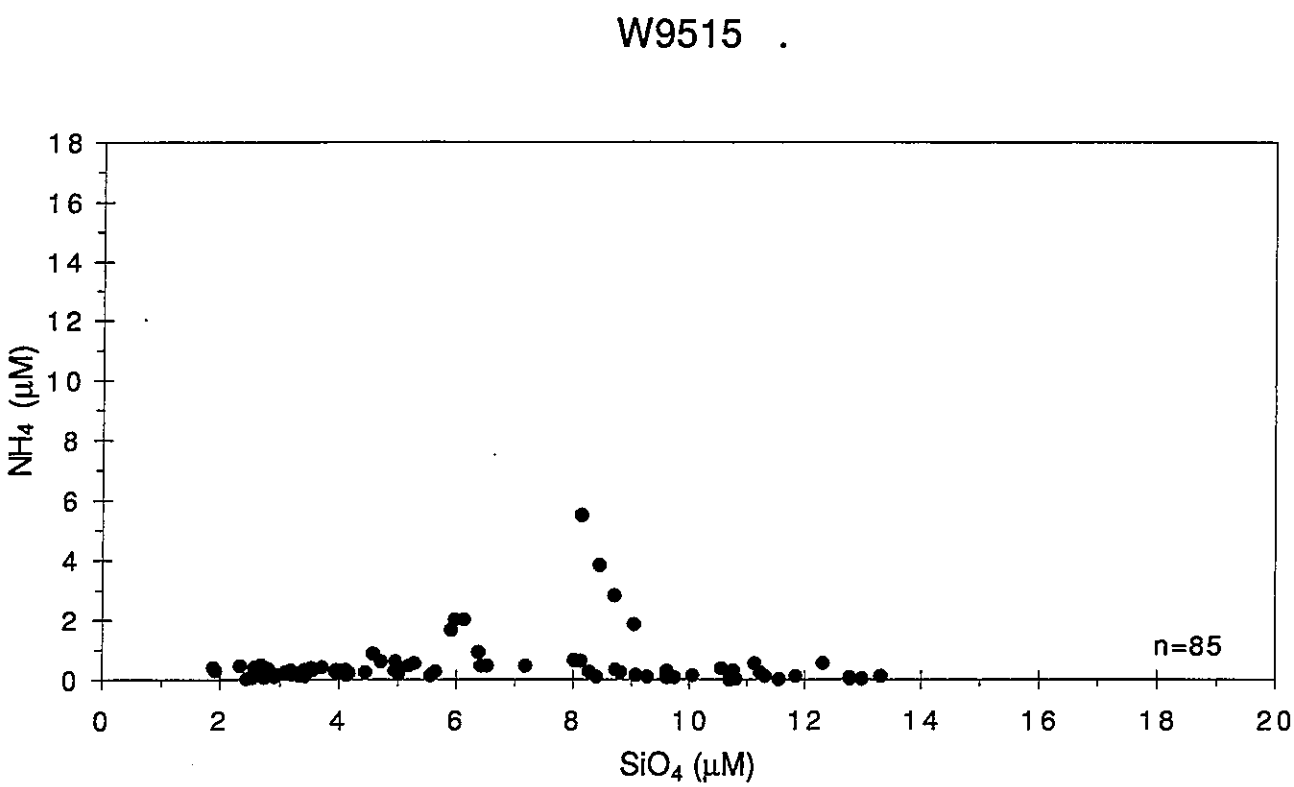
W9513



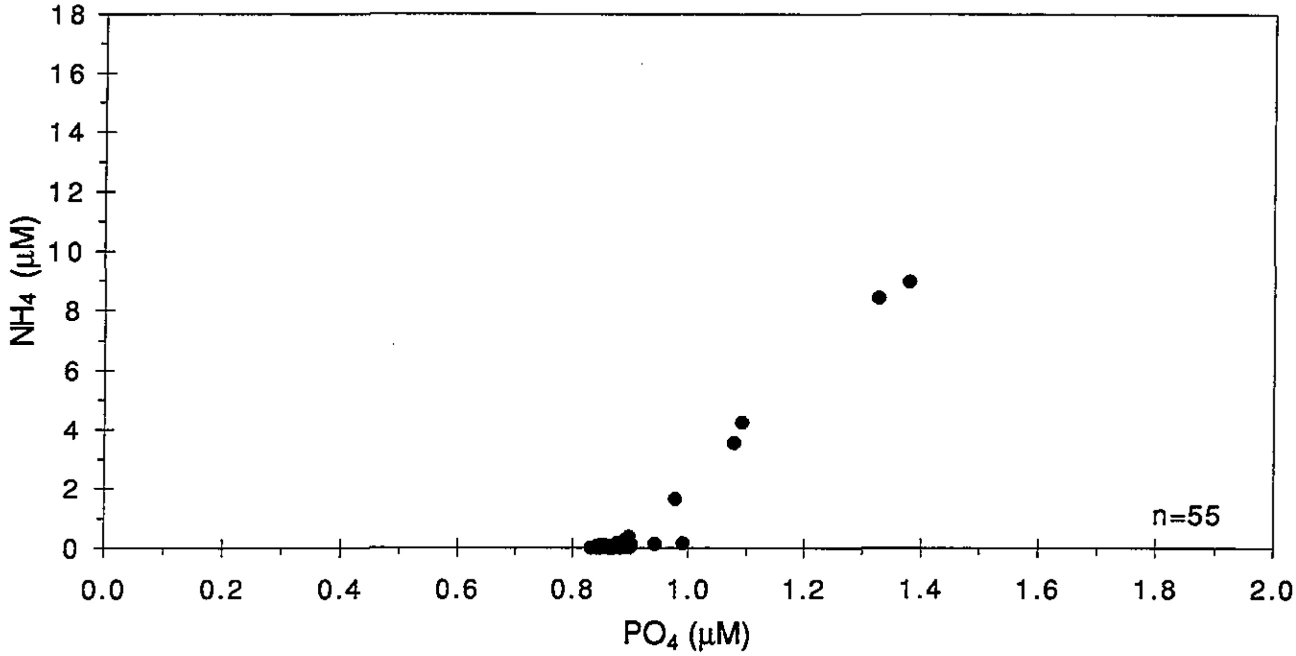
W9513



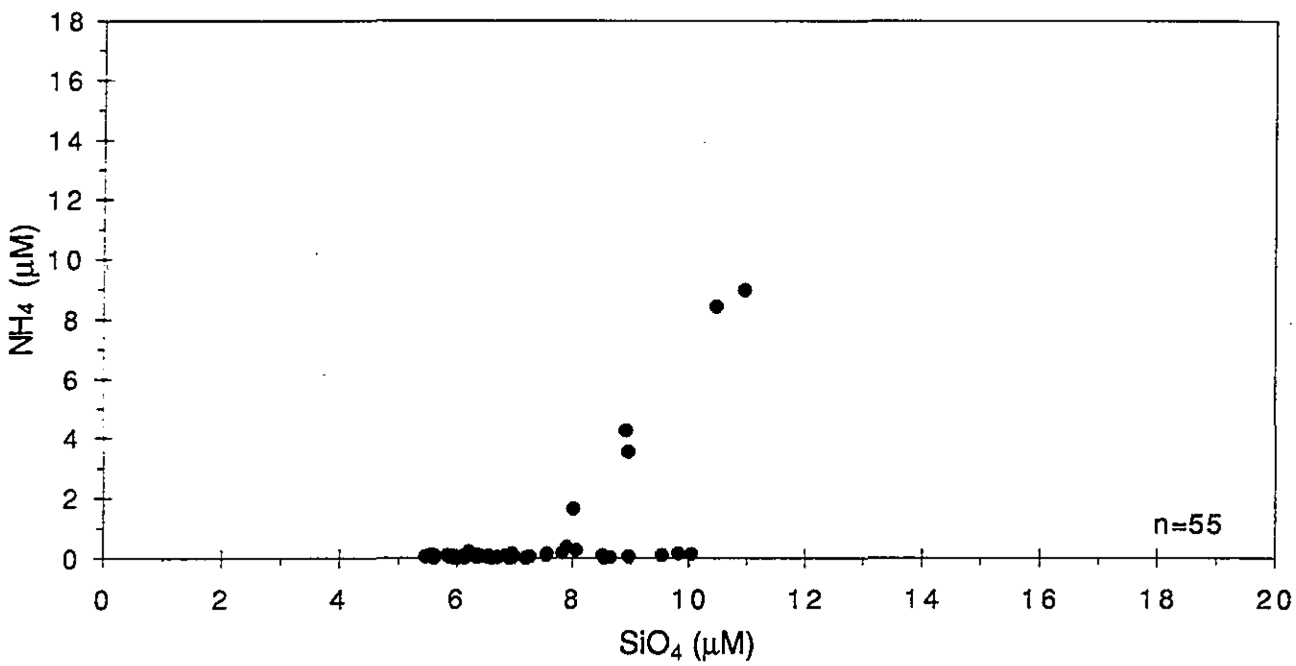

W9515 .
NH4 (µM)
PO4 (µM)
n=85
0
2
4
6
8
10
12
14
16
18
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0

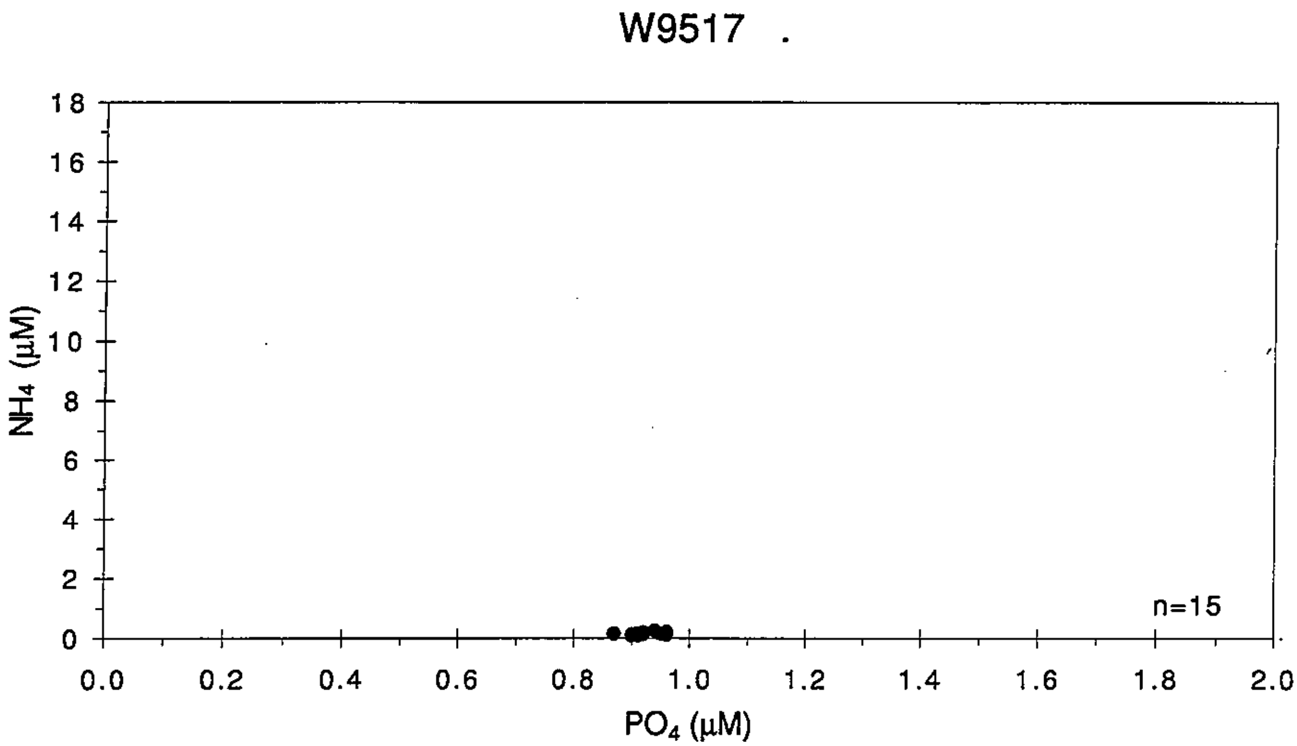

W9515 .
NH4 (µM)
SiO4 (µM)
n=85
0
2
4
6
8
10
12
14
16
18
20

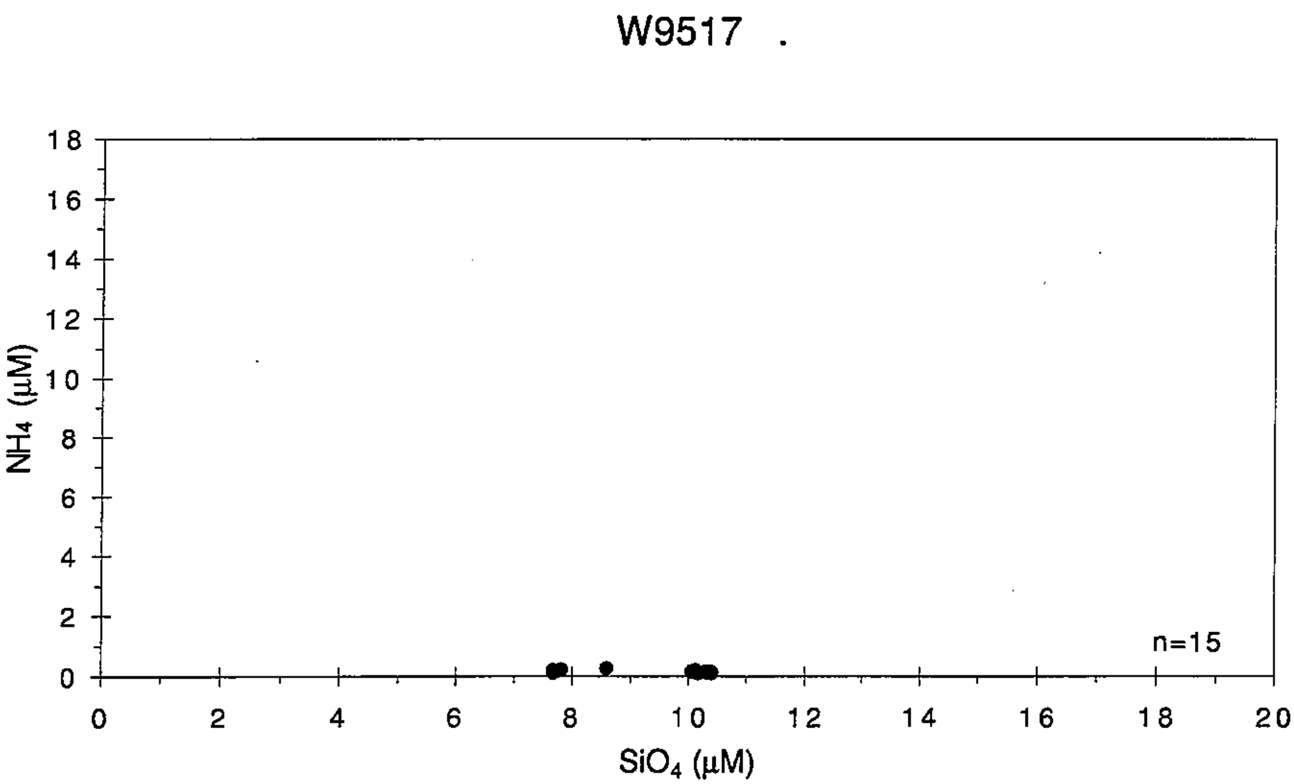
W9516 .


NH4 (µM)
PO4 (µM)
n=55
0
2
4
6
8
10
12
14
16
18
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0

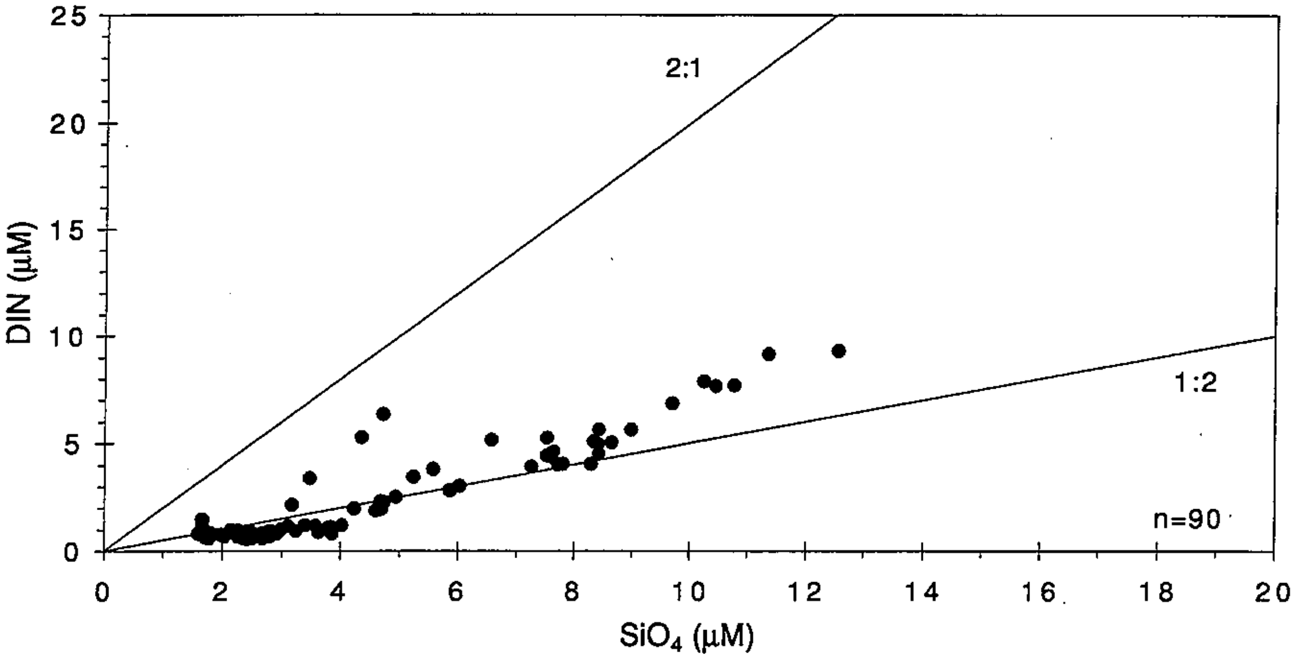
W9516 .


NH4 (µM)
SiO4 (µM)
n=55
0
2
4
6
8
10
12
14
16
18
0
2
4
6
8
10
12
14
16
18
20

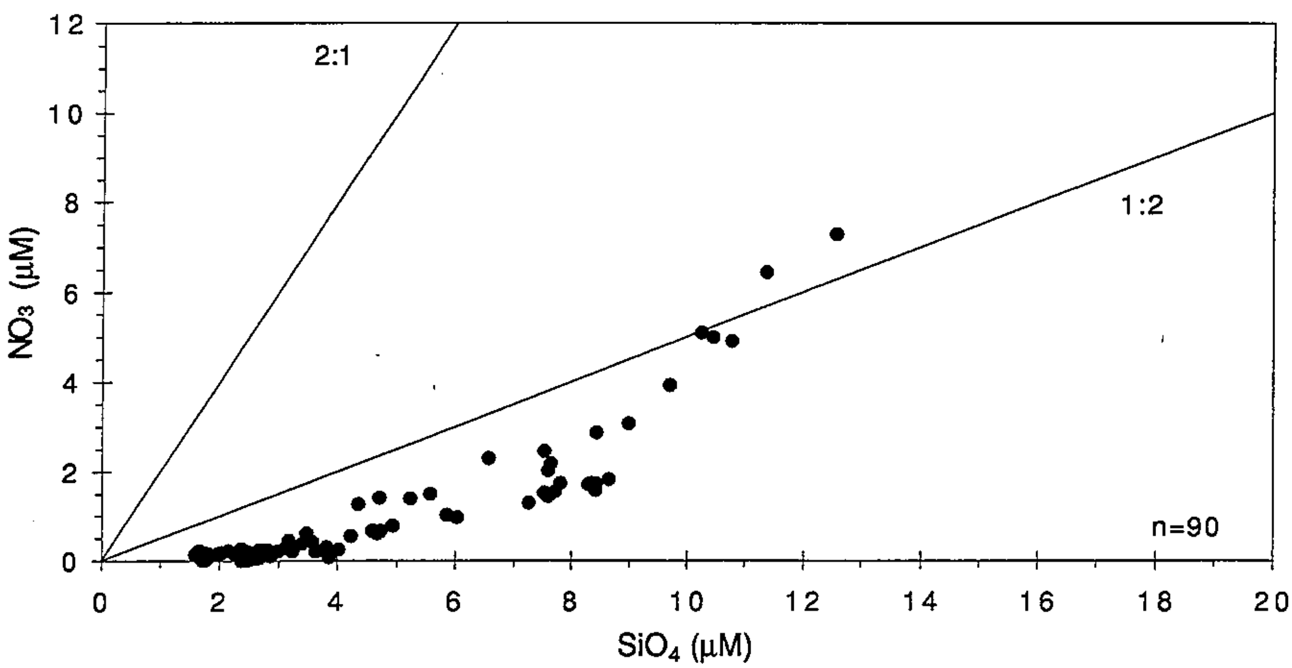

W9517 .
NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=15
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)


W9517 .
NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=15
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)

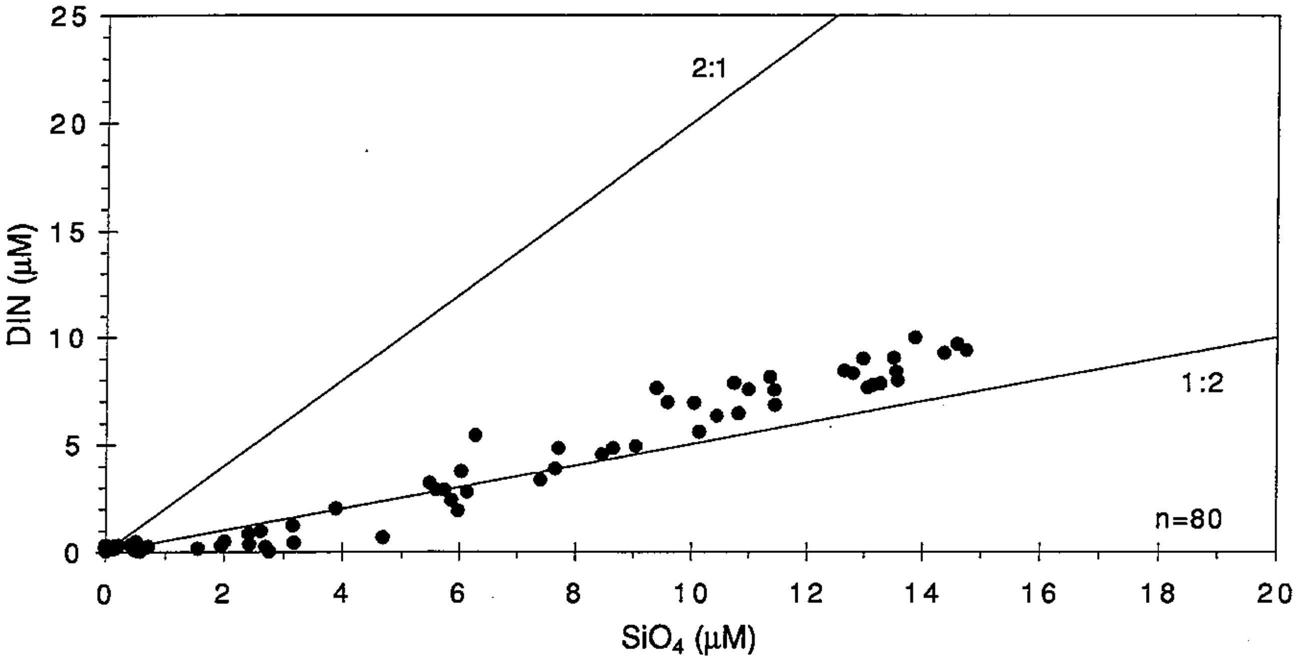
W9510



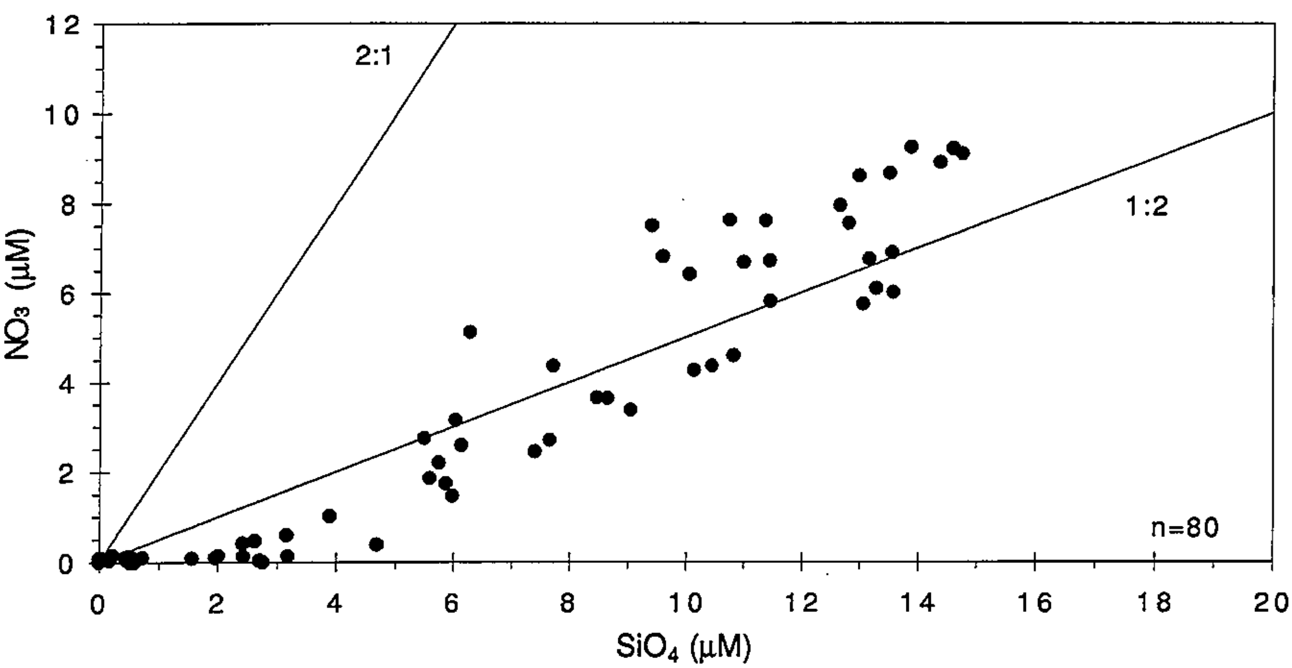
W9510

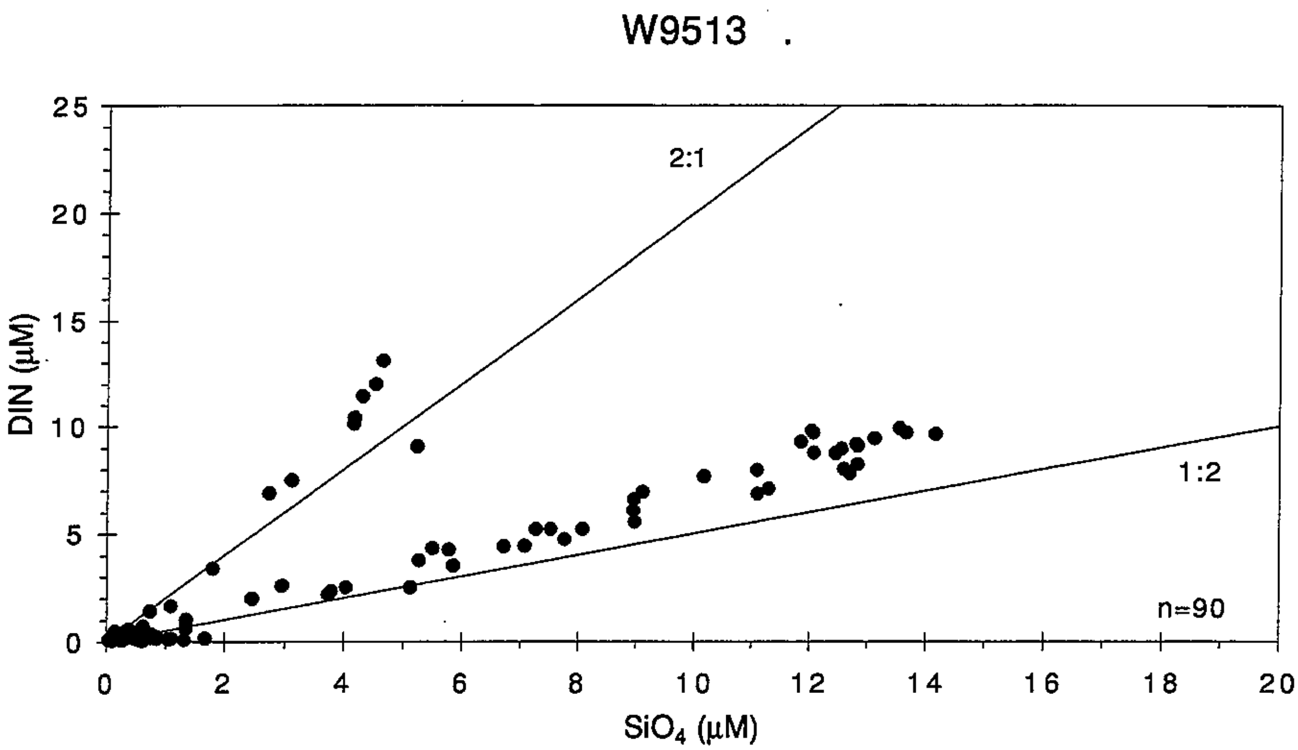


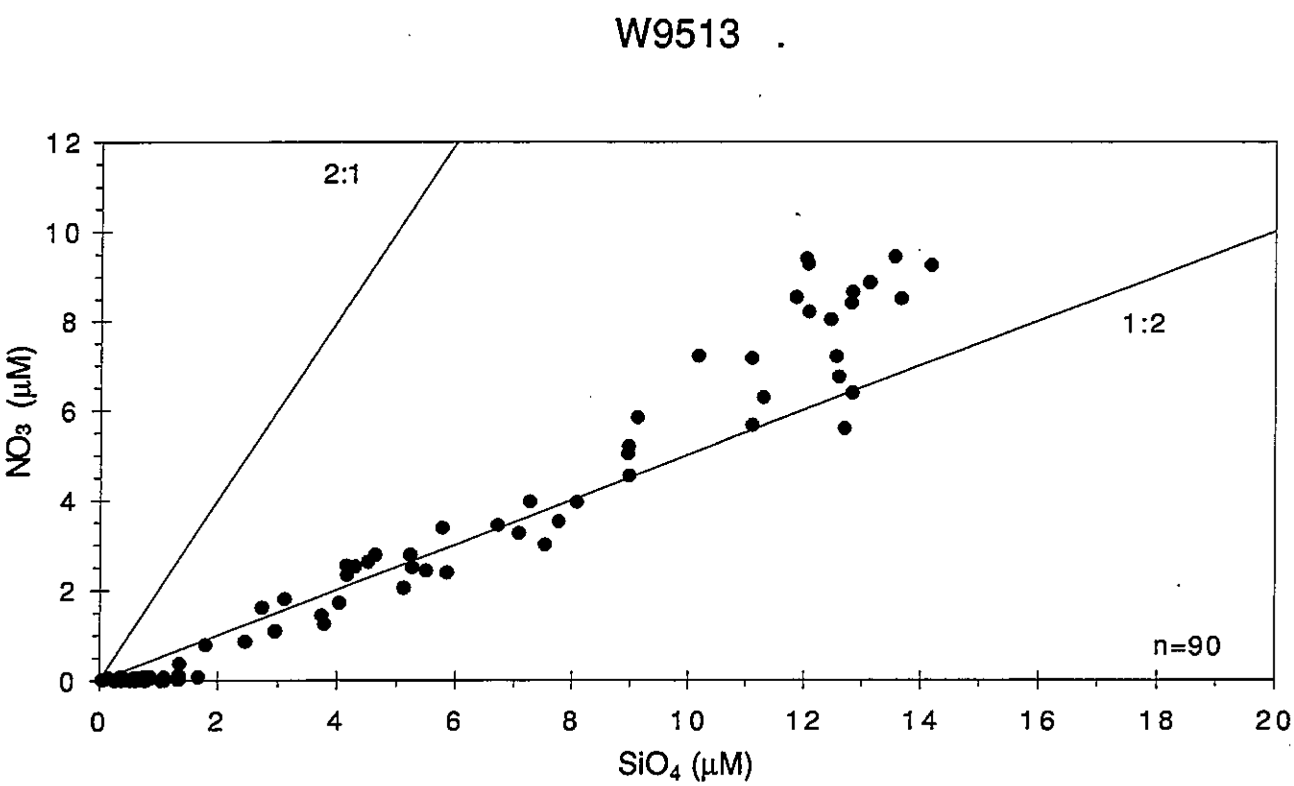
W9512 .

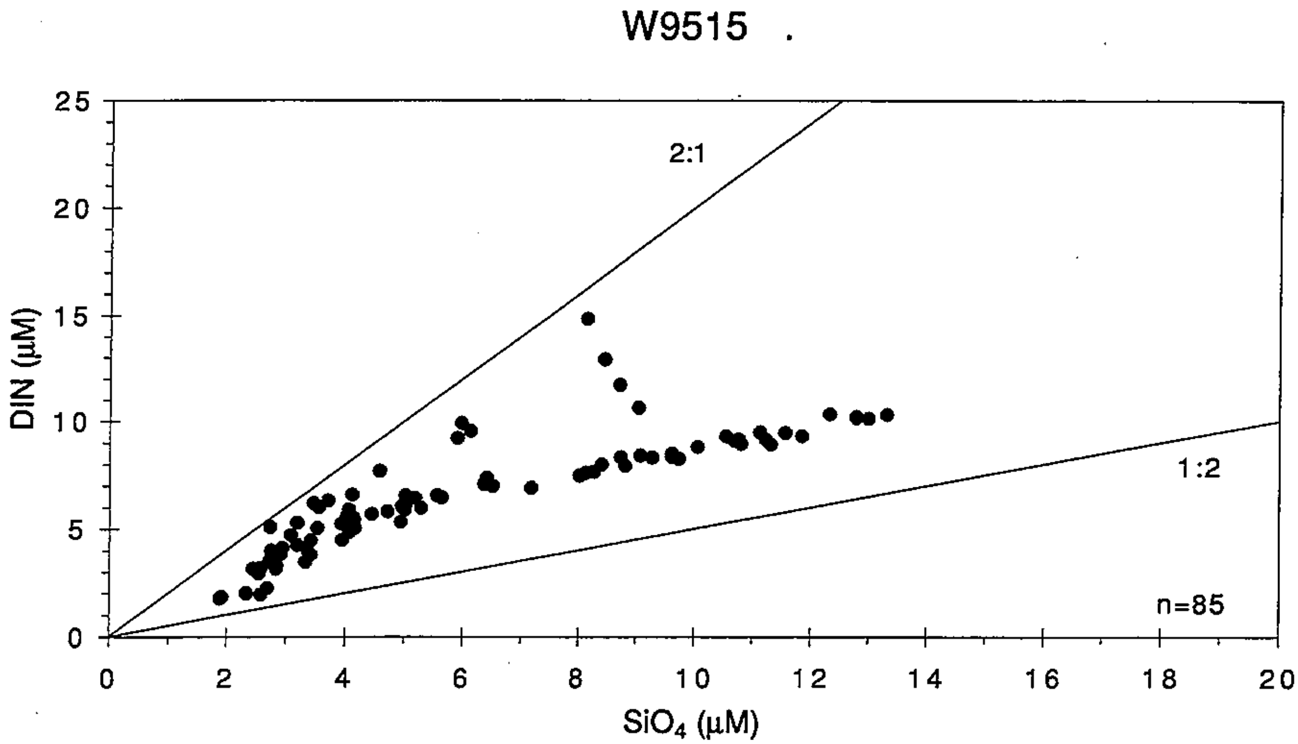


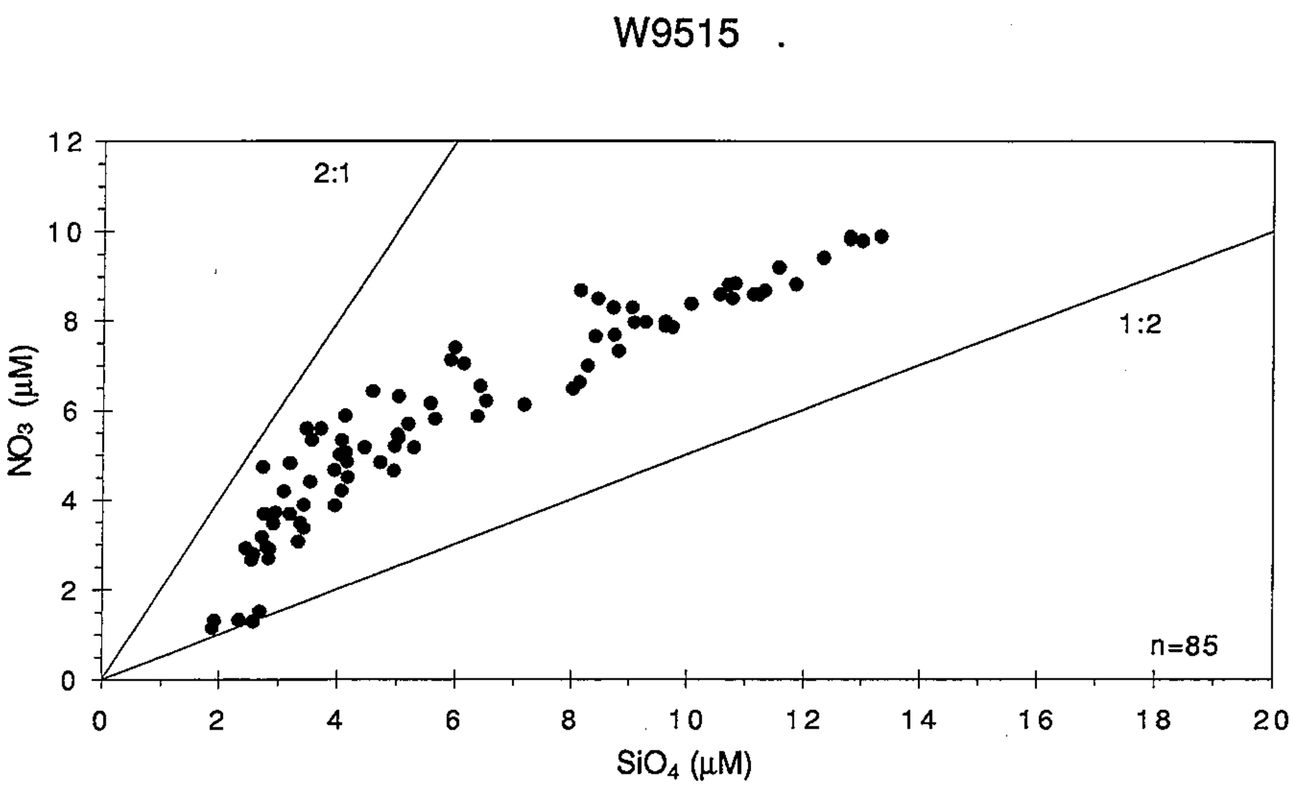
W9512 .

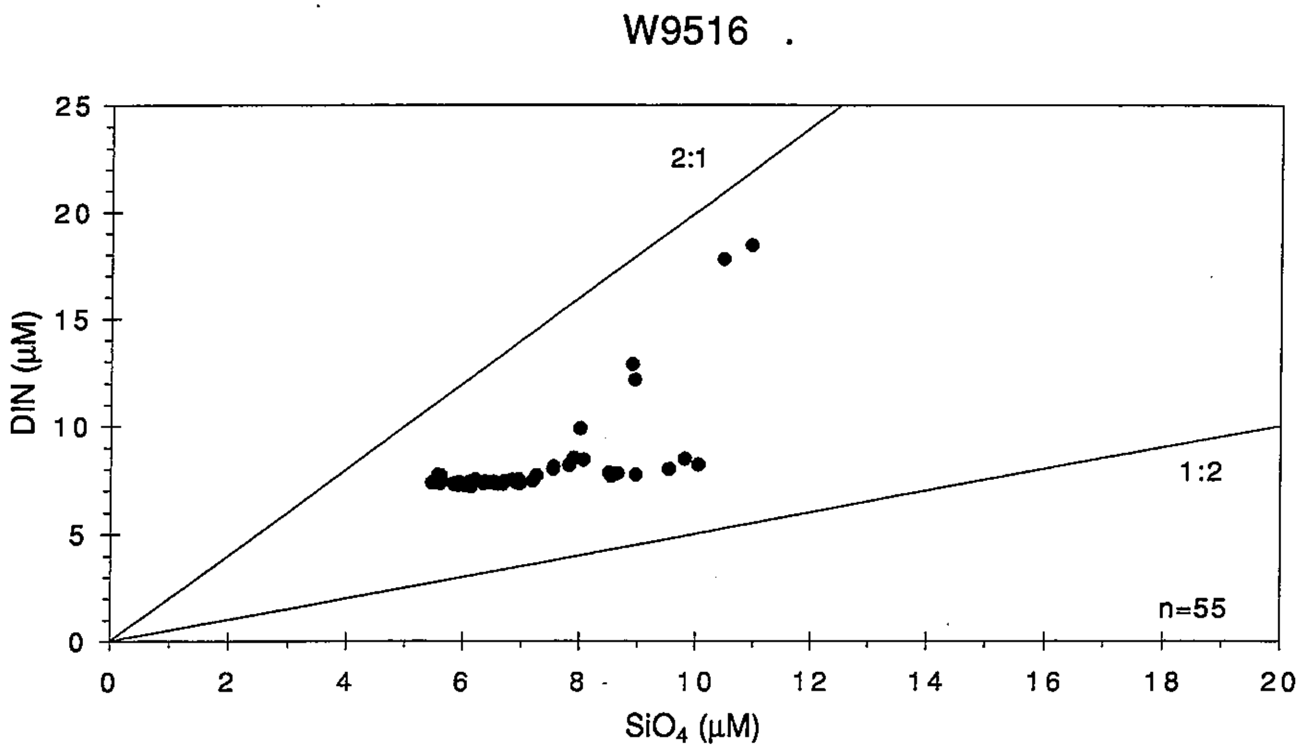


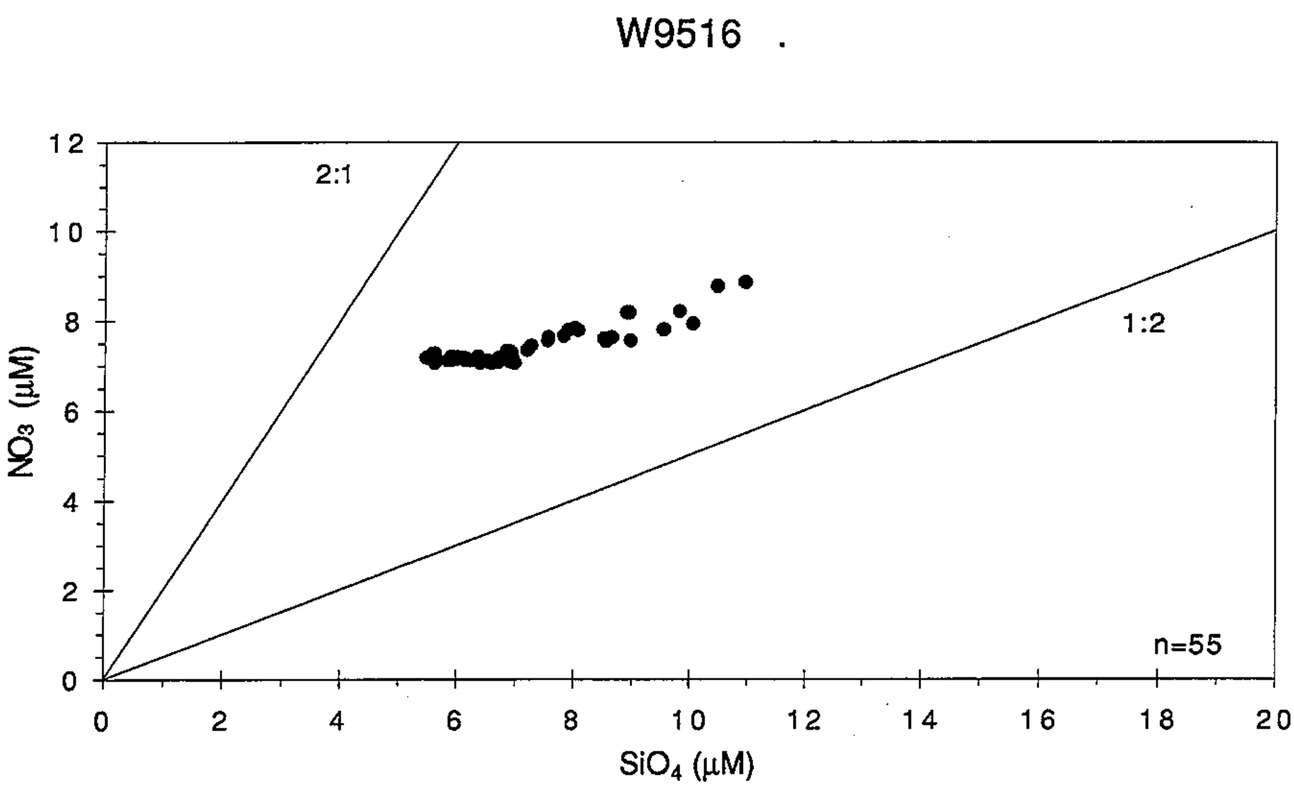

W9513
2:1
1:2
n=90
DIN (µM)
SiO4 (µM)
0
5
10
15
20
25
0
2
4
6
8
10
12
14
16
18
20


W9513
2:1
1:2
n=90
NO3 (µM)
SiO4 (µM)
0
2
4
6
8
10
12
0
2
4
6
8
10
12
14
16
18
20

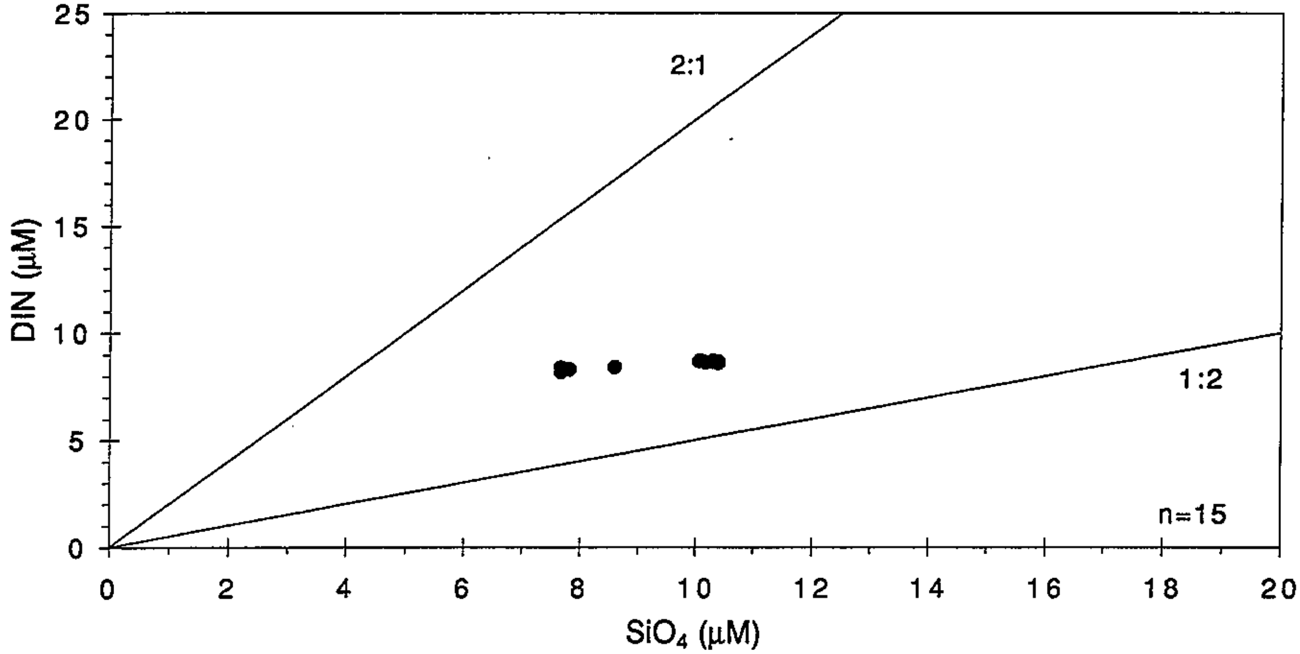

W9515 .
25
20
15
10
5
0
DIN (µM)
2:1
1:2
n=85
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)


W9515 .
12
10
8
6
4
2
0
NO3 (µM)
2:1
1:2
n=85
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)


W9516
2:1
1:2
n=55
DIN (µM)
SiO4 (µM)
0
5
10
15
20
25
0
2
4
6
8
10
12
14
16
18
20

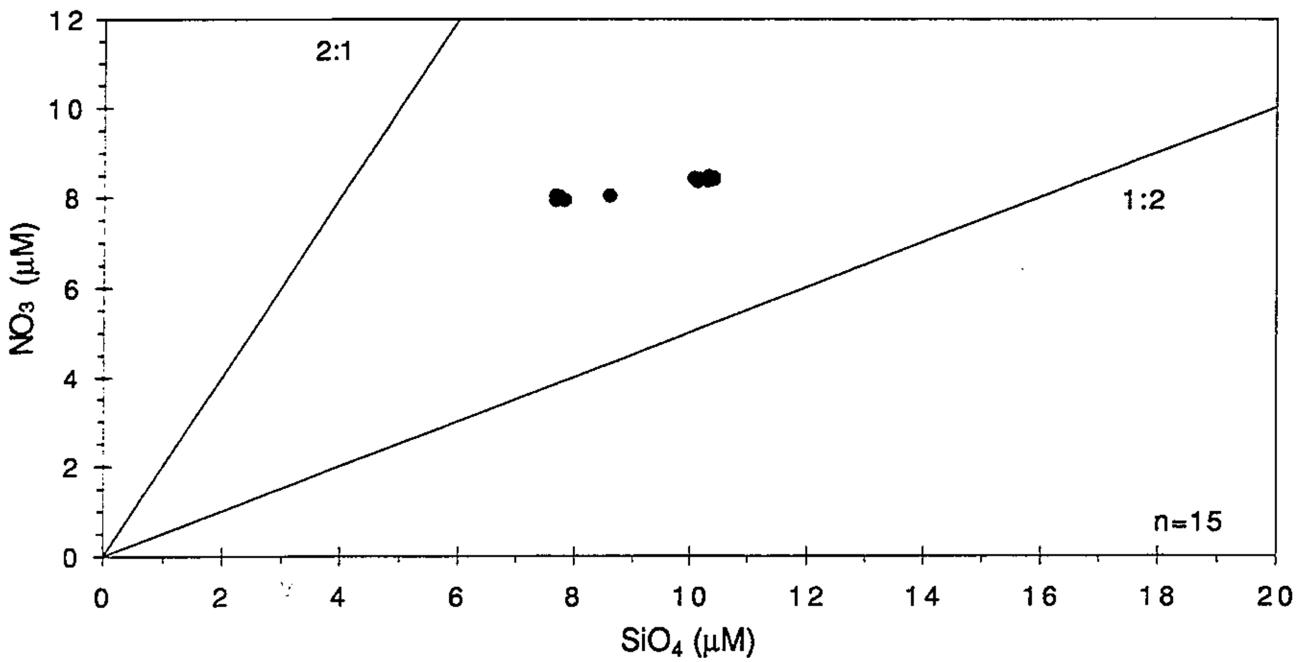

W9516
2:1
1:2
n=55
NO3 (µM)
SiO4 (µM)
0
2
4
6
8
10
12
0
2
4
6
8
10
12
14
16
18
20

W9517 .



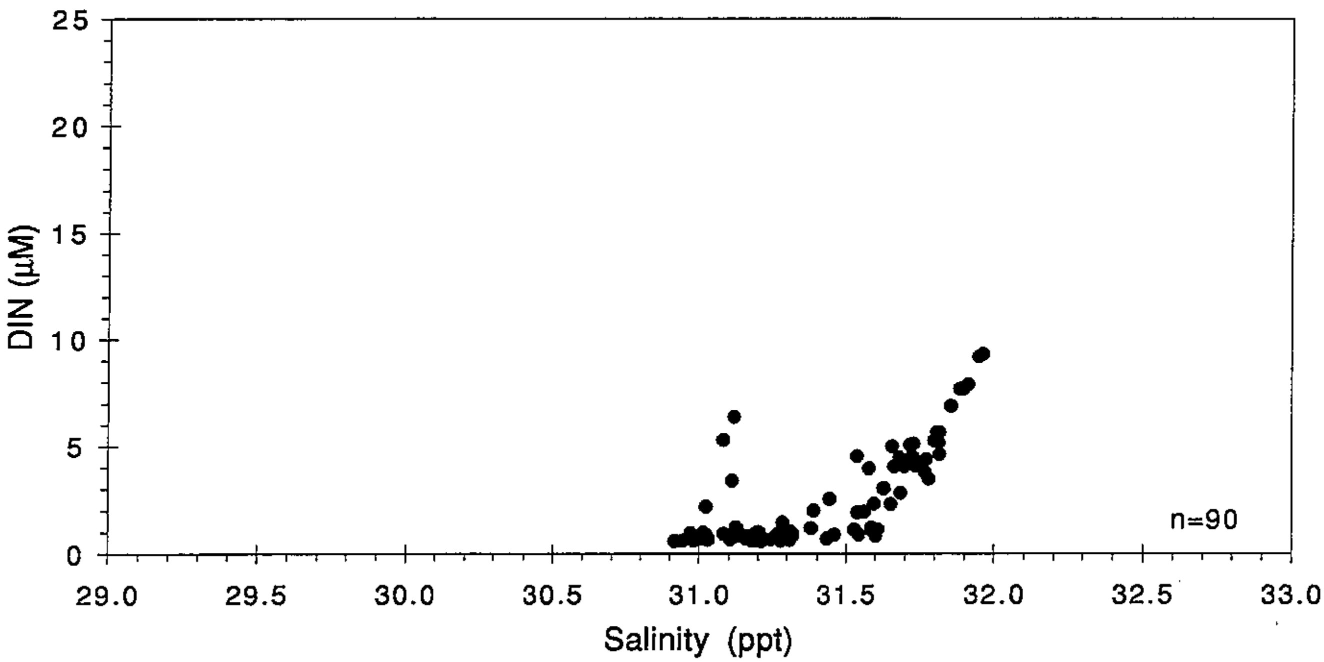
25
20
15
10
5
0
DIN (µM)
2:1
1:2
n=15
0 2 4 6 8 10 12 14 16 18 20
SiO4 (µM)

W9517 .

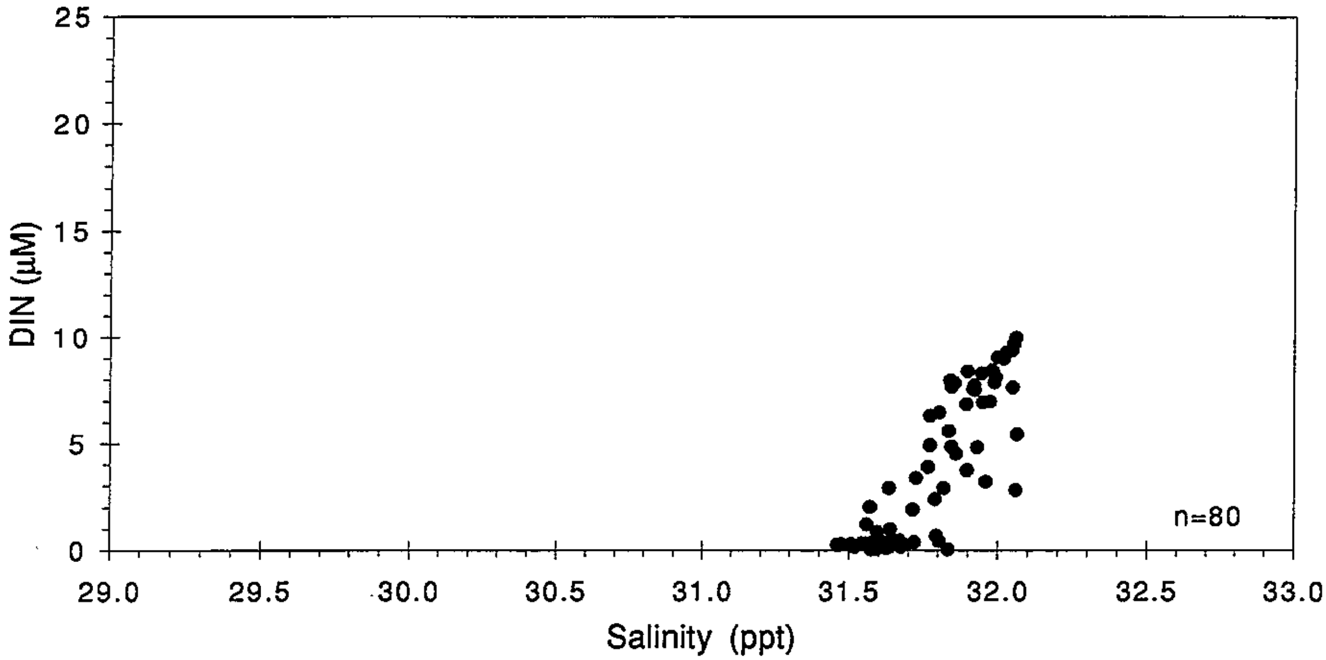


12
10
8
6
4
2
0
NO3 (µM)
2:1
1:2
n=15
0 2 4 6 8 10 12 14 16 18 20
SiO4 (µM)

W9510 .


25
20
15
10
5
0
DIN (µM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9512


25
20
15
10
5
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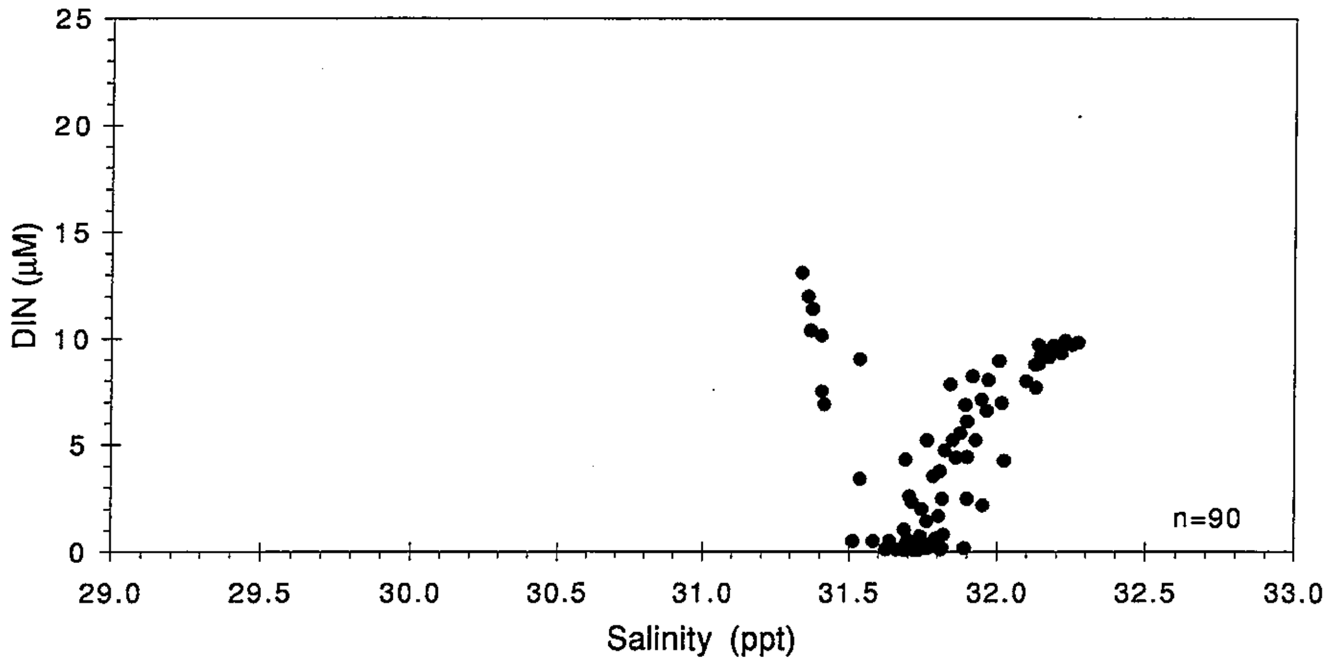
DIN (μM)
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=80

W9513



25
20
15
10
5
0
DIN (µM)
n=90
29.0
29.5
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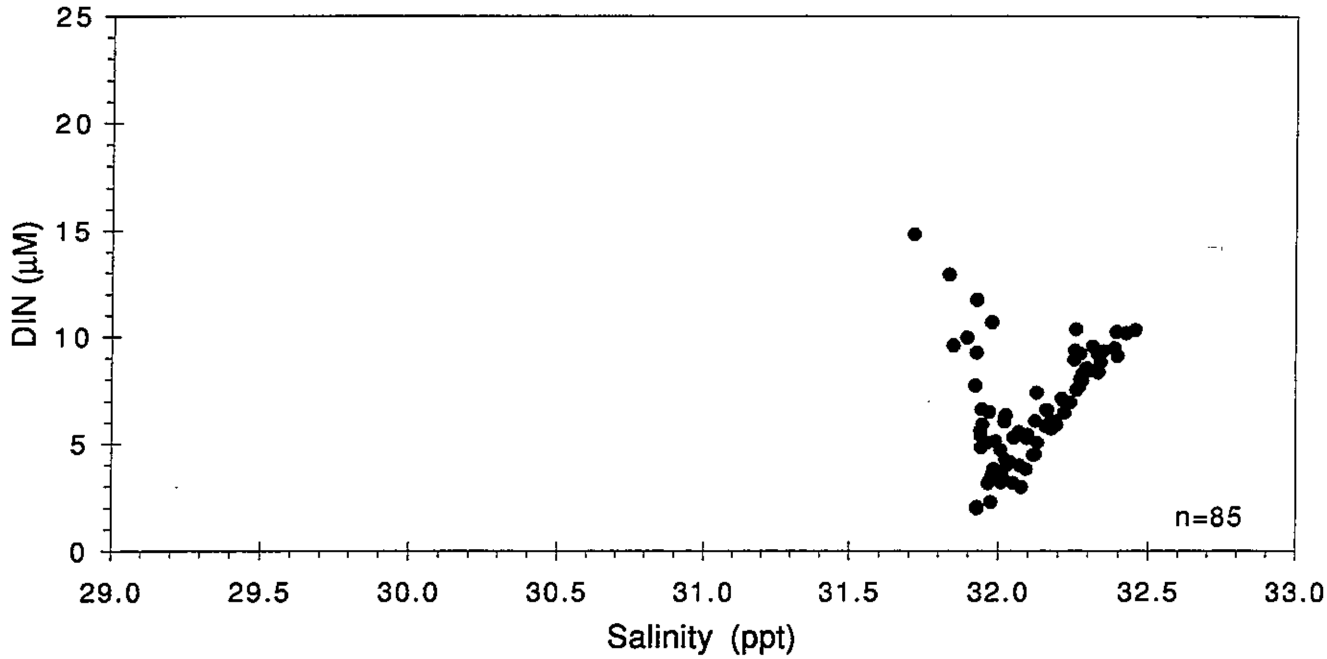
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9515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DIN (µM)
n=85
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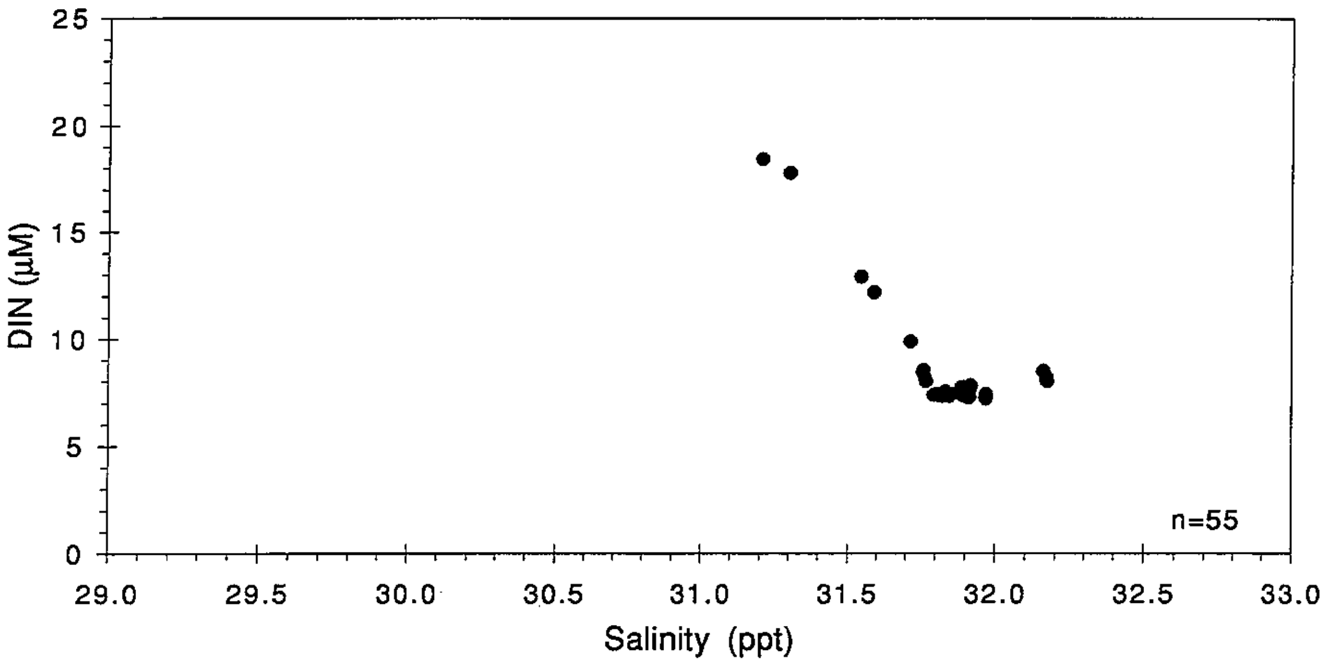
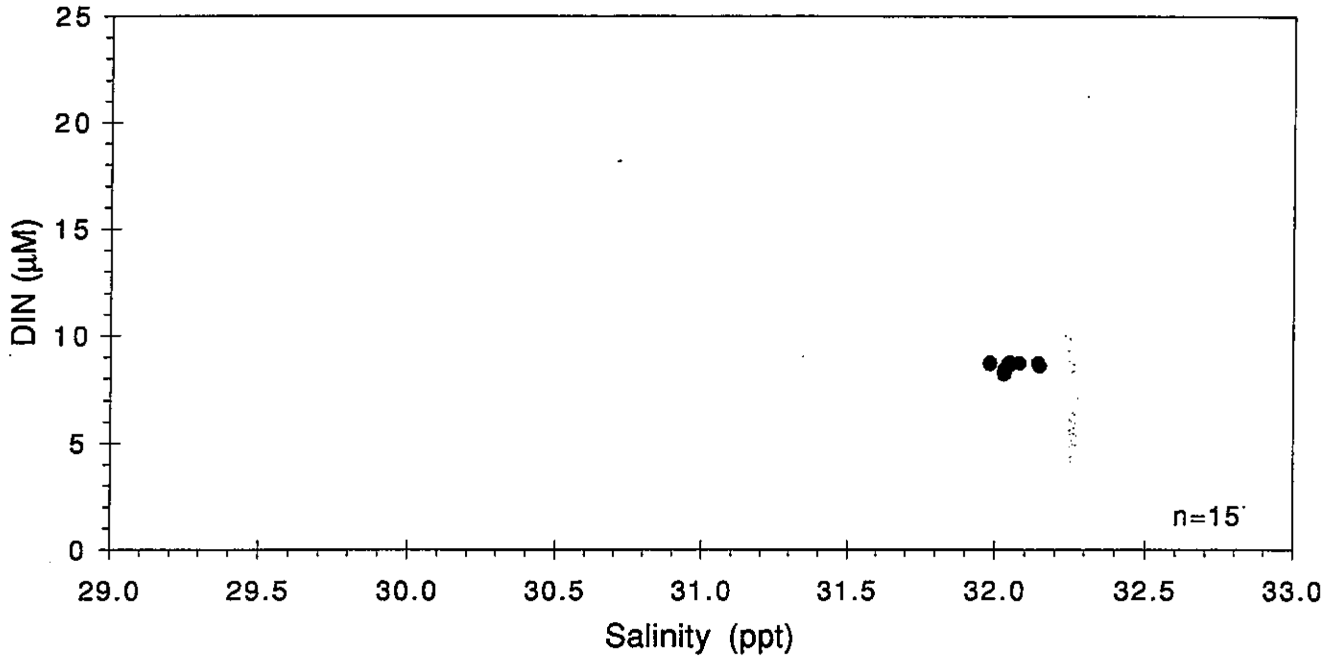
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9516



25
20
15
10
5
0
DIN (µM)
n=55
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9517



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20
15
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5
0
DIN (μM)
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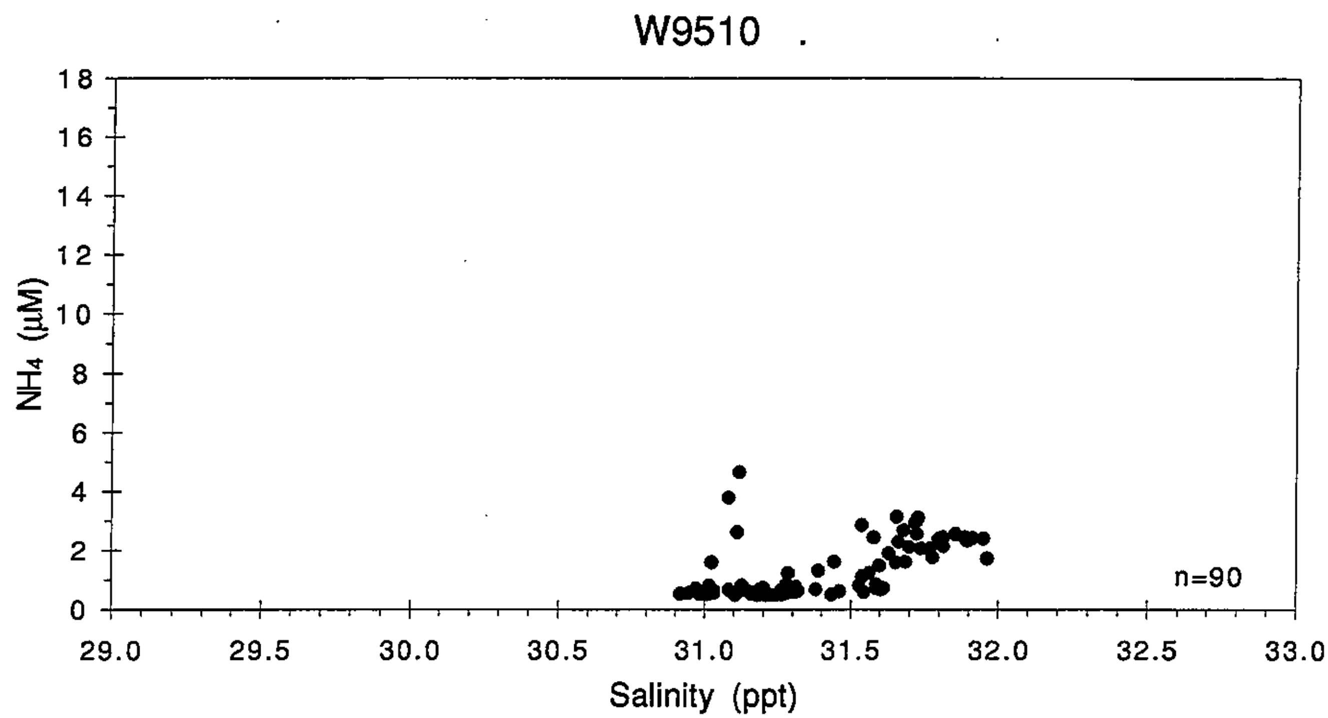
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9510
18
16
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8
6
4
2
0
NH4 (µM)
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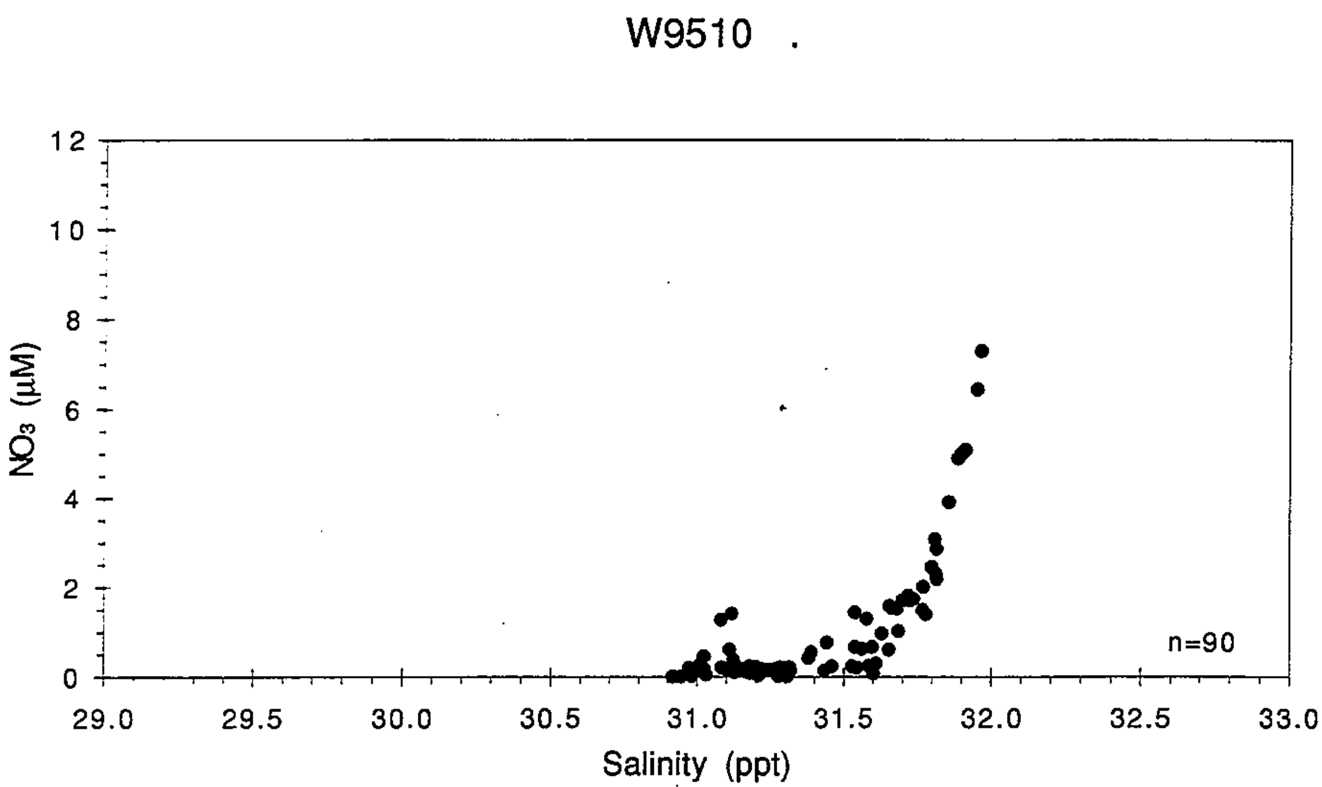
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9510
12
10
8
6
4
2
0
NO3 (µM)
n=90
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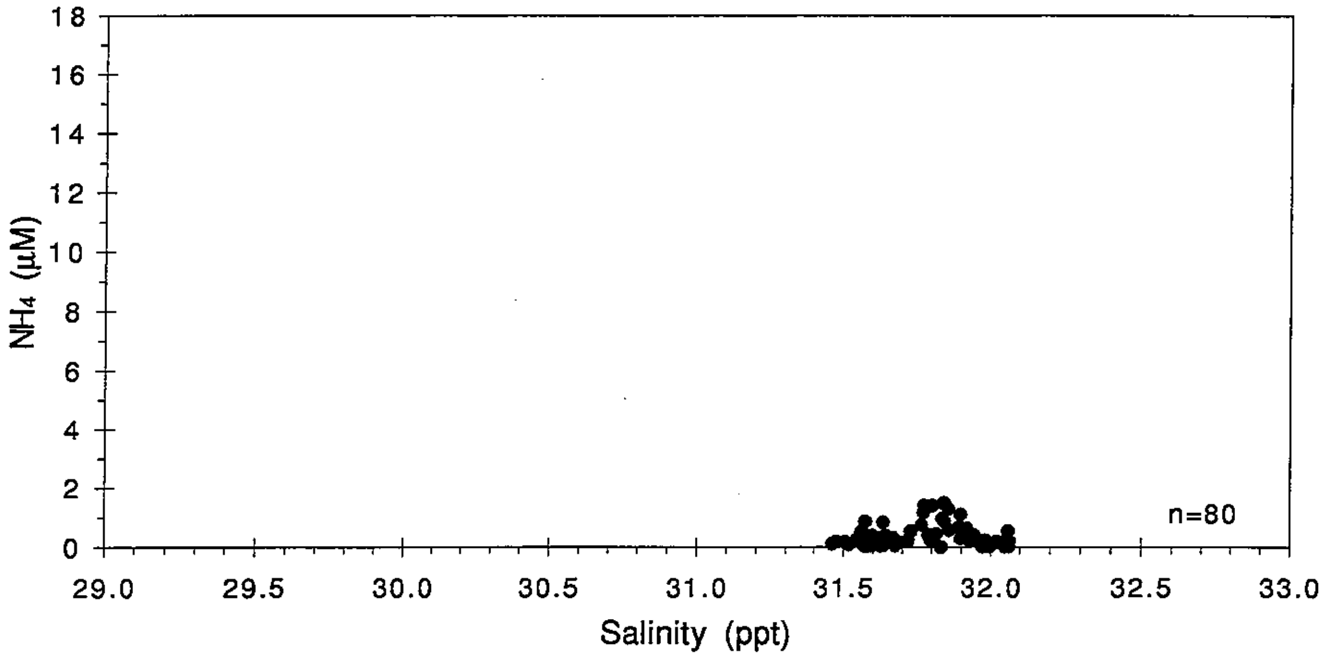
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9512 .



NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=80
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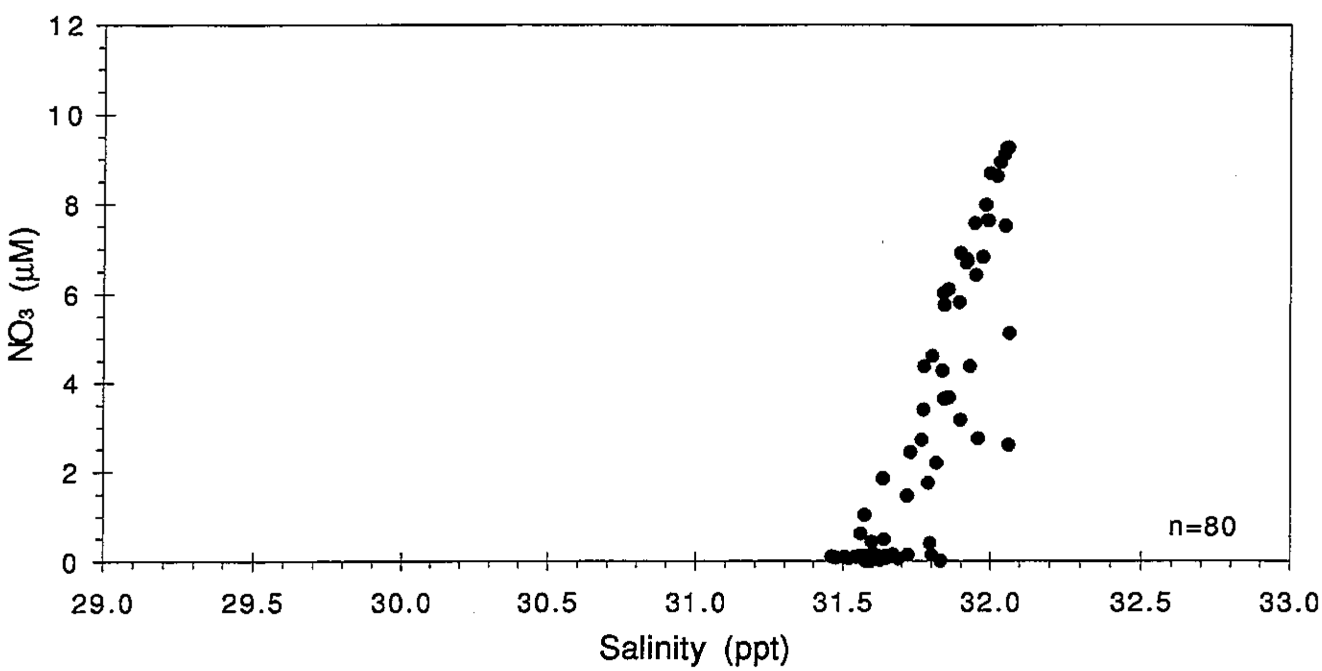
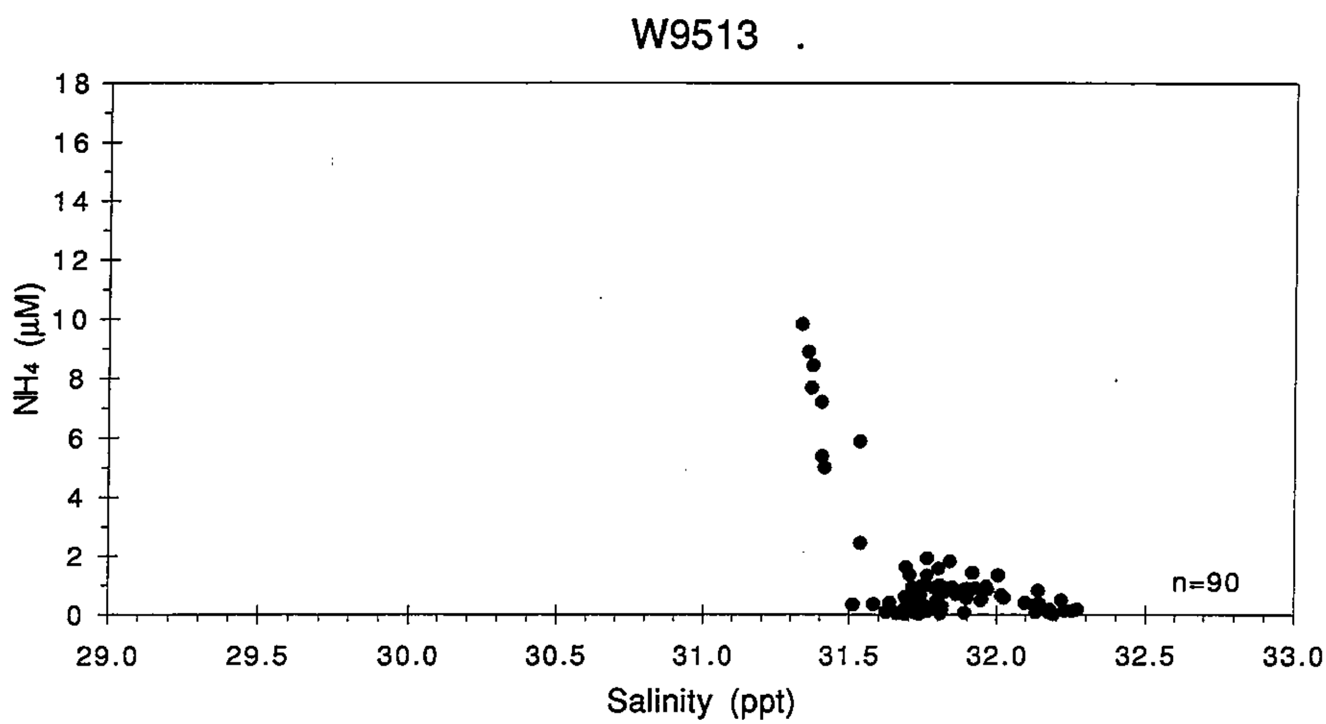
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9512 .



NO3 (µM)
12
10
8
6
4
2
0
n=80
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)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10
8
6
4
2
0
NH4 (µM)
n=90
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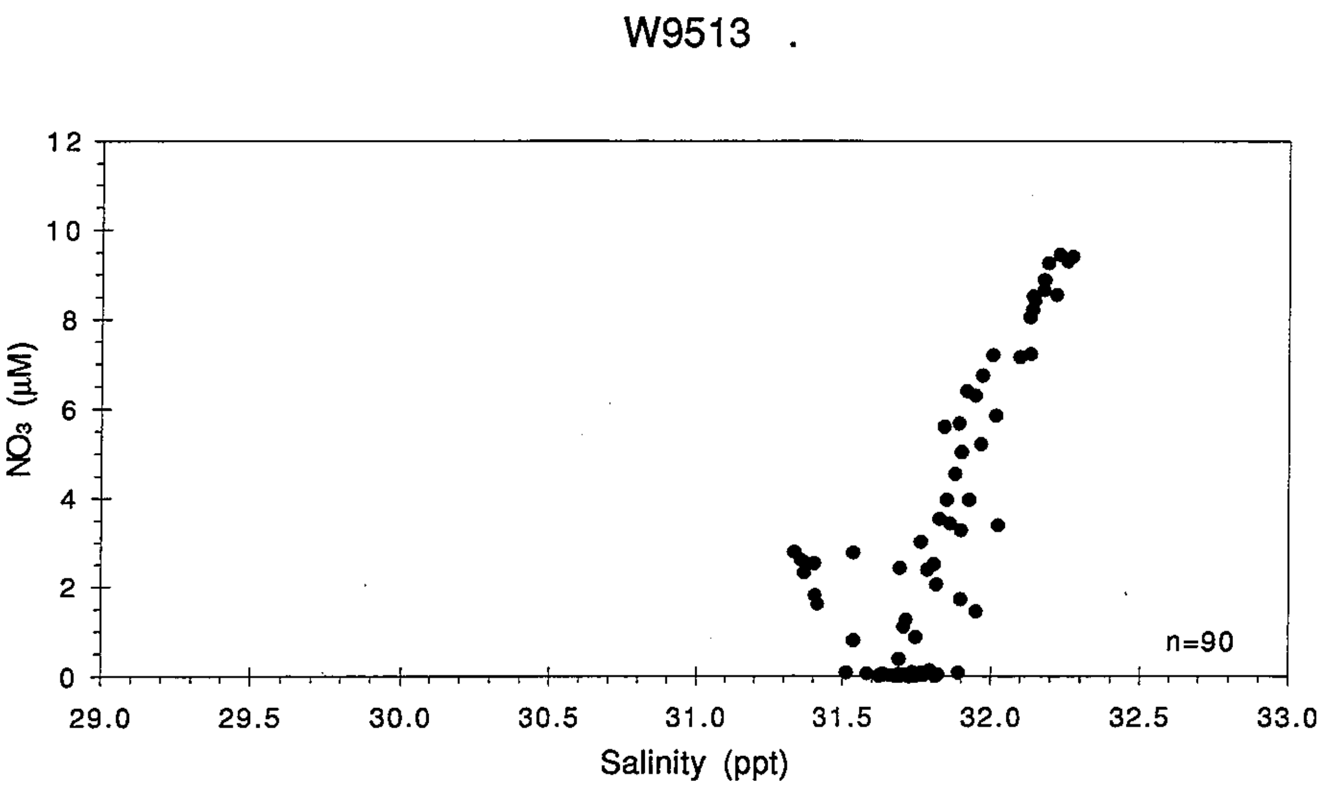
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)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12
10
8
6
4
2
0
NO3 (µM)
n=90
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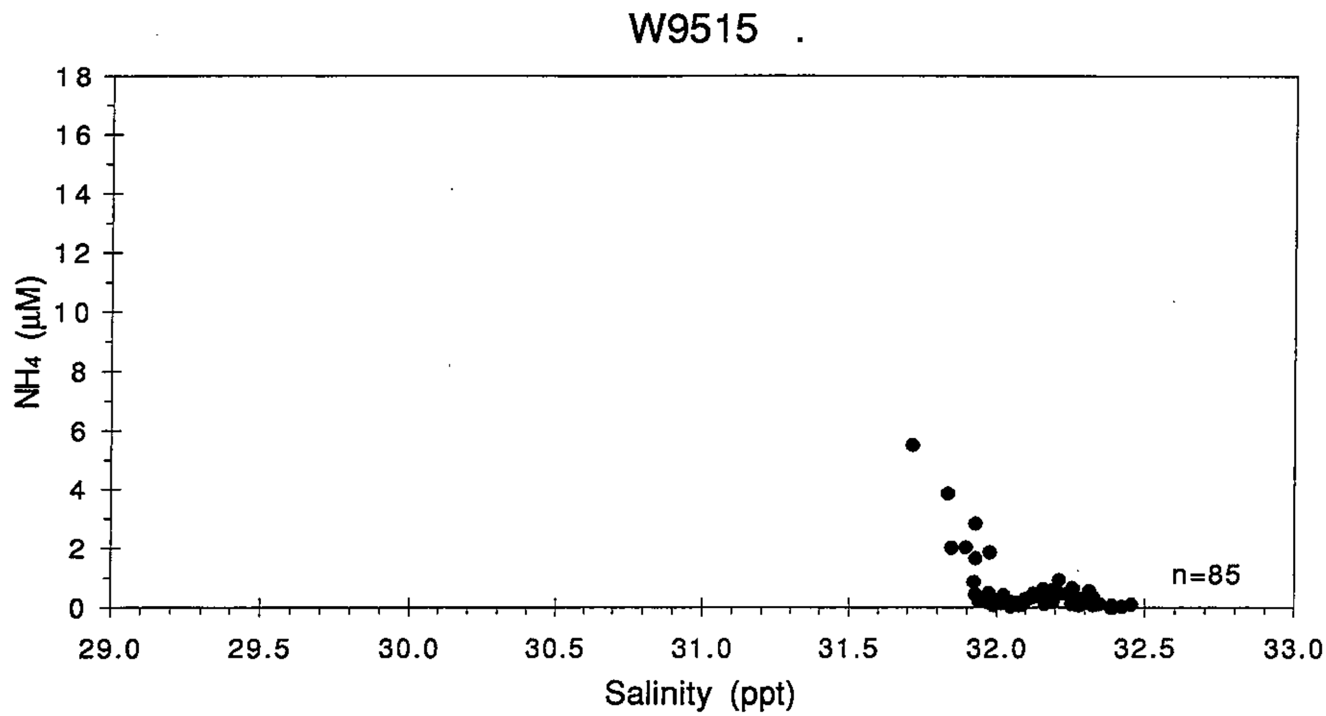
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9515 .
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16
14
12
10
8
6
4
2
0
NH4 (µM)
n=85
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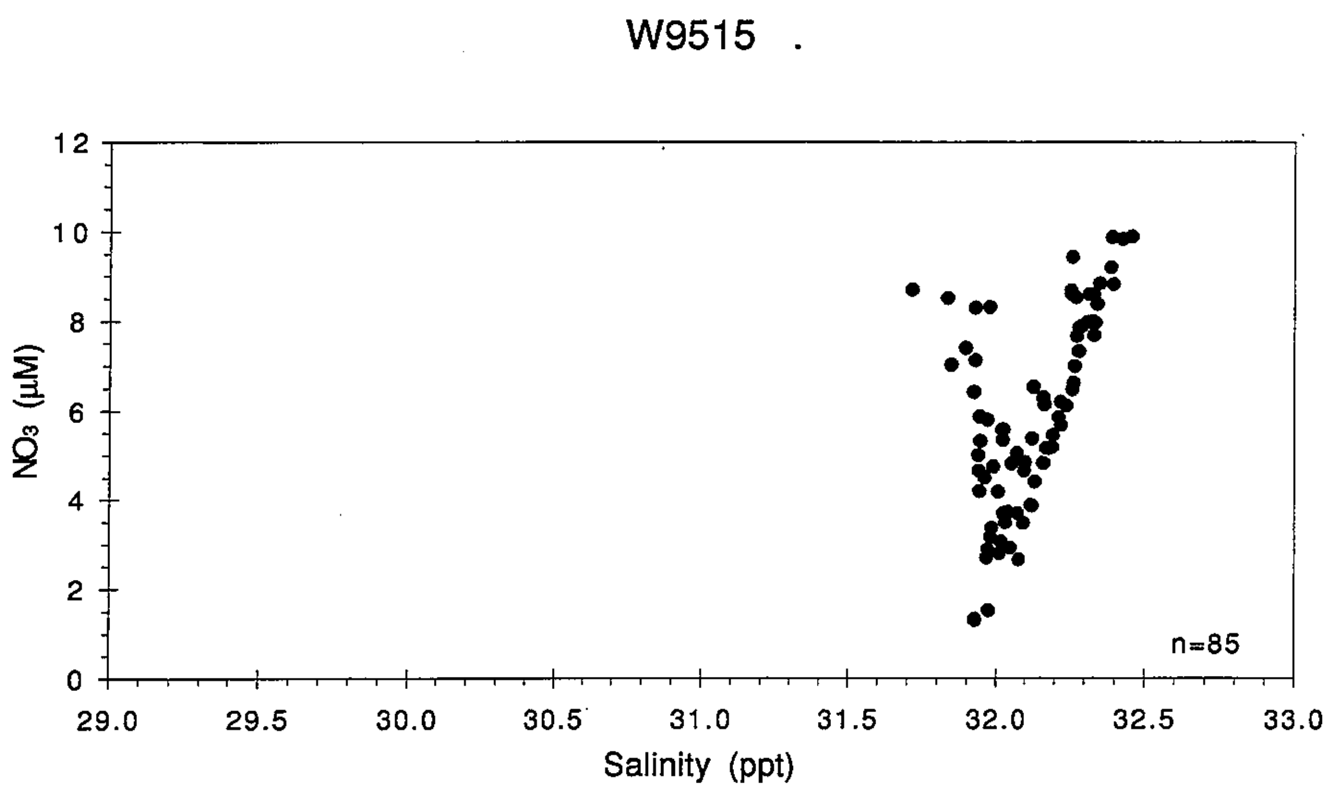
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)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12
10
8
6
4
2
0
NO3 (µM)
n=85
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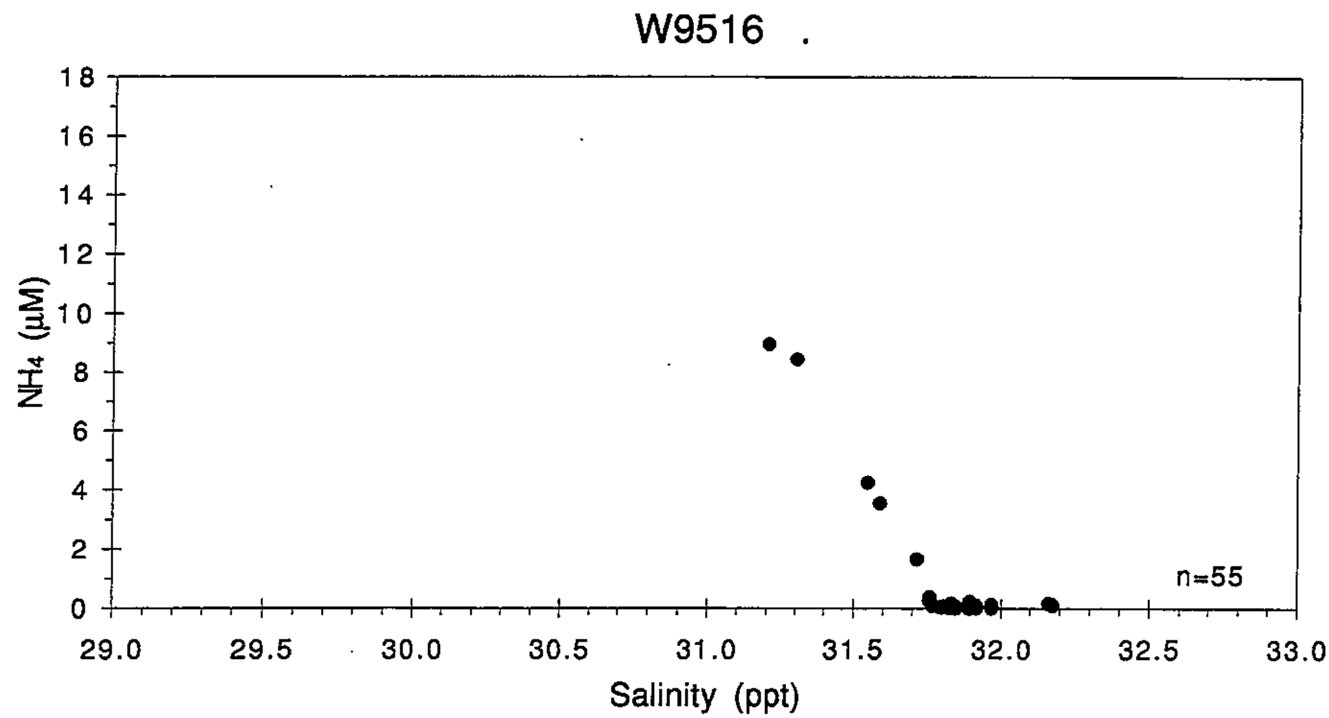
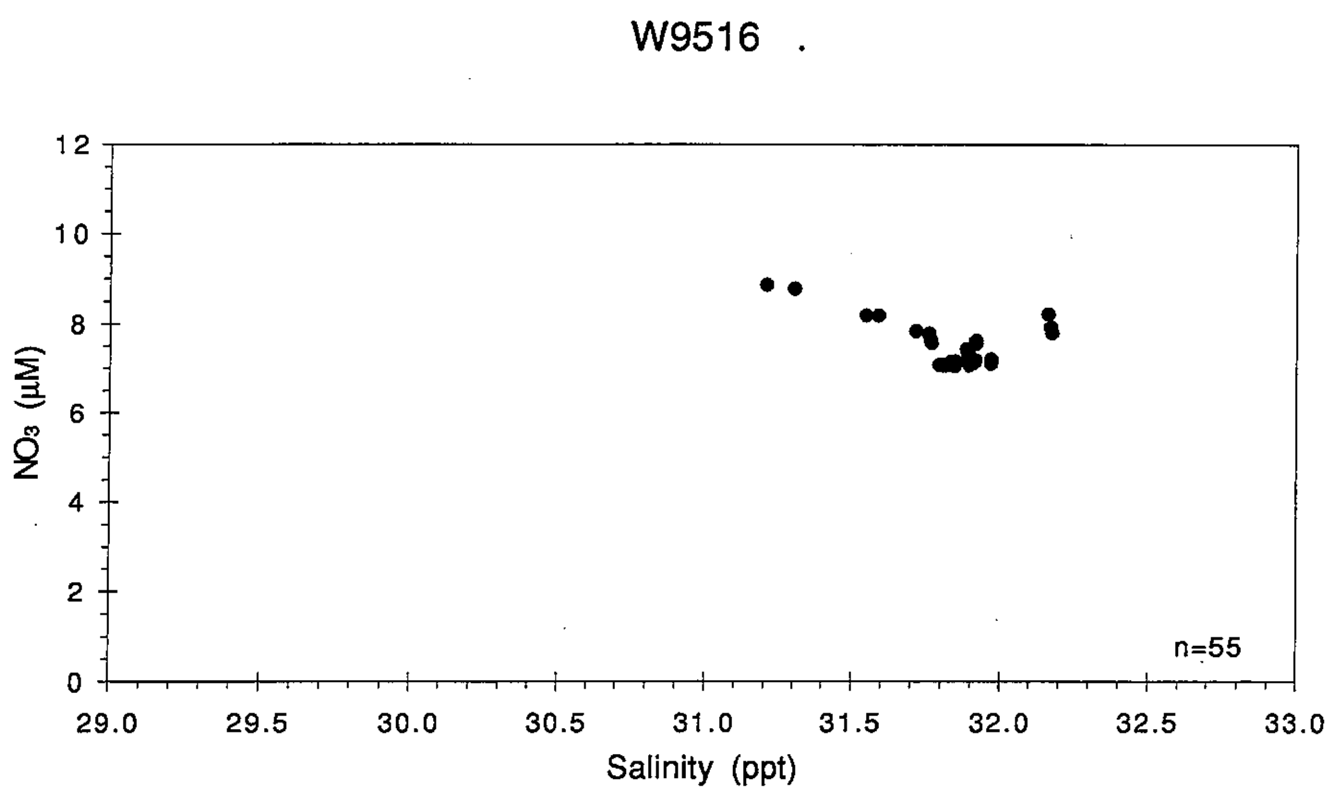
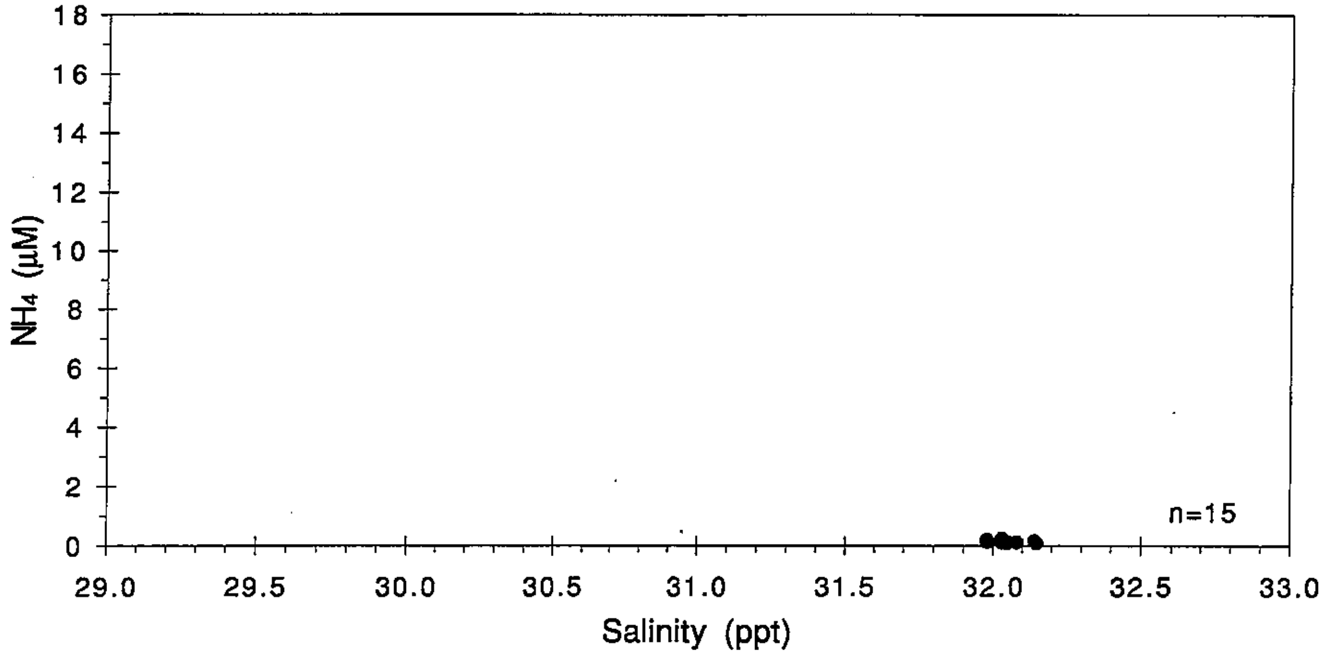
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9516
NH4 (µM)
n=55
Salinity (ppt)

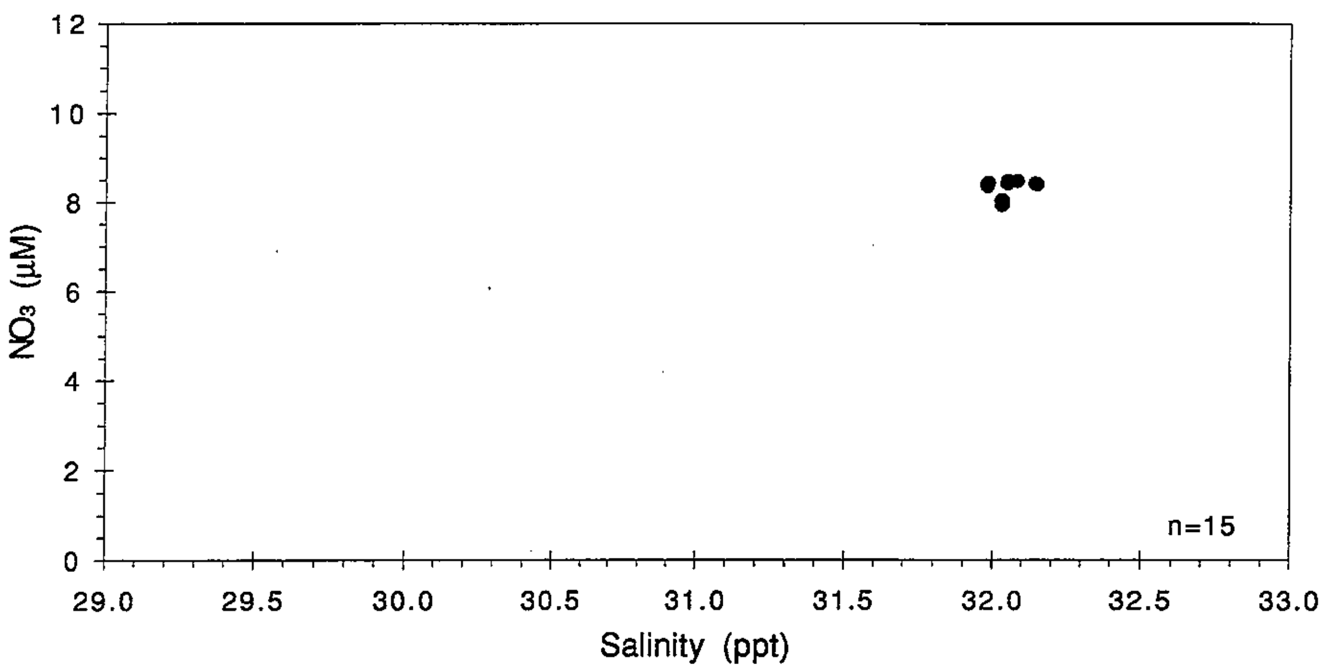

W9516
NO3 (µM)
n=55
Salinity (ppt)

W9517 .

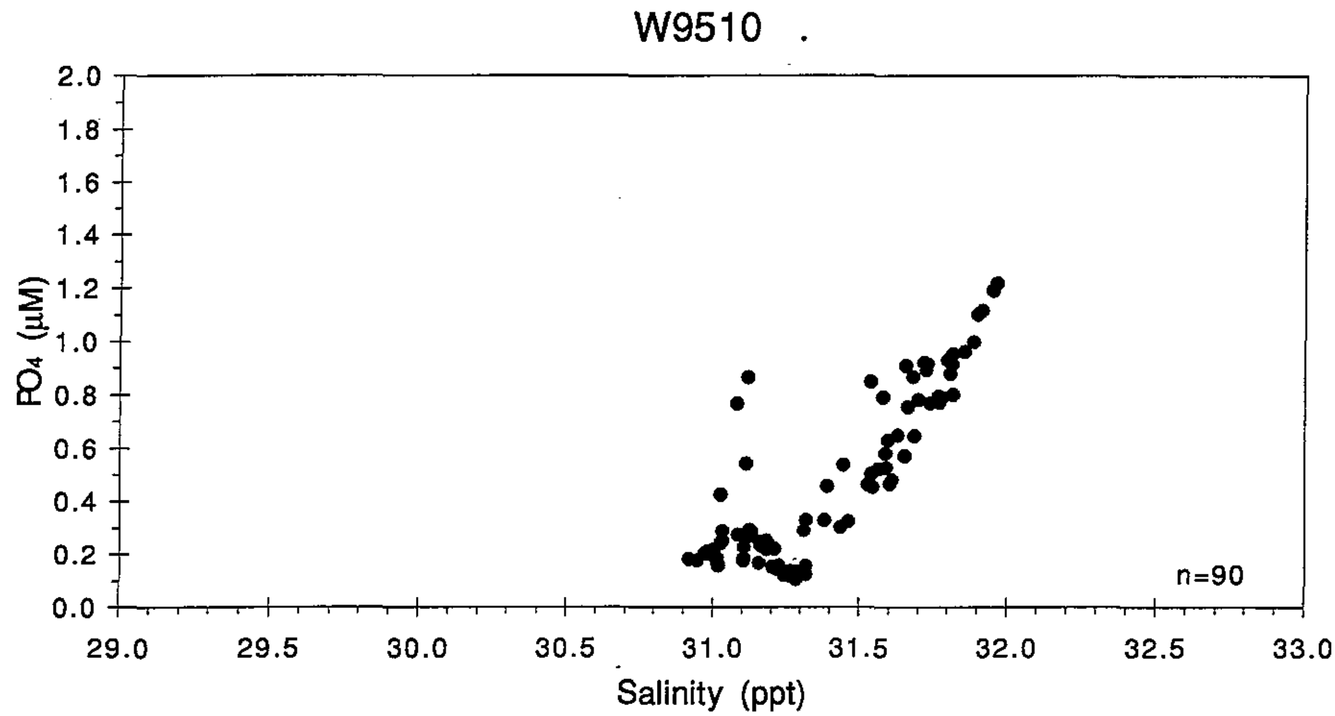


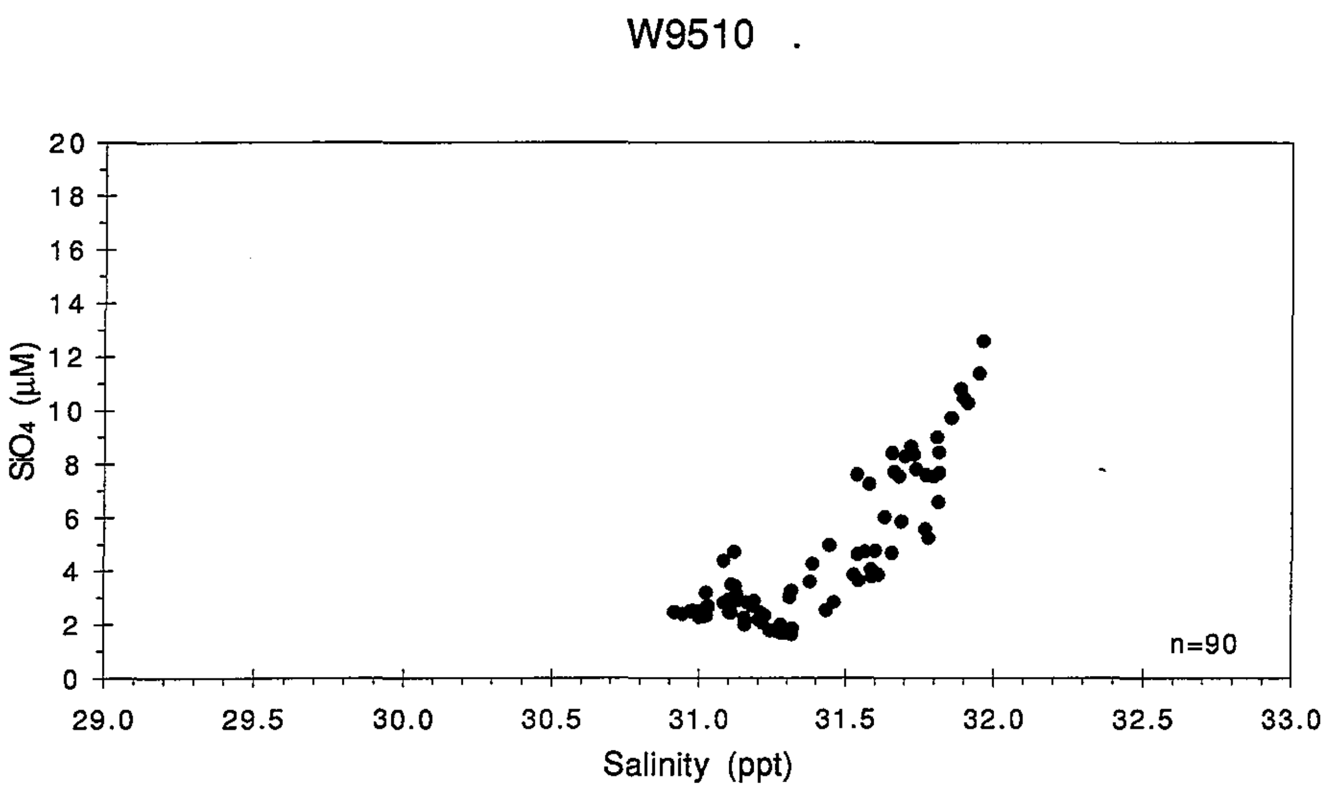
18
16
14
12
10
8
6
4
2
0
NH4 (µM)
n=15
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9517 .



12
10
8
6
4
2
0
NO3 (µM)
n=15
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9510
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (µM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9510
20
18
16
14
12
10
8
6
4
2
0
SiO4 (µM)
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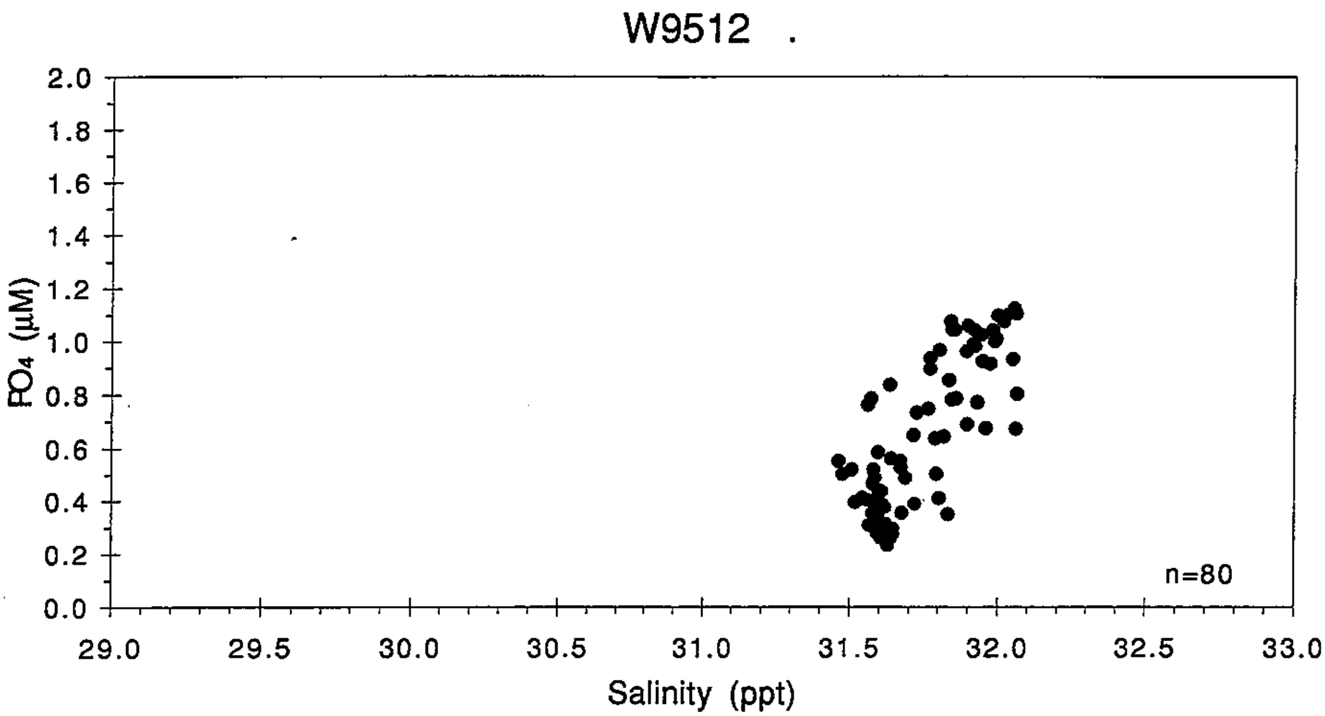
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9512 .
PO4 (µM)
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1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
n=80
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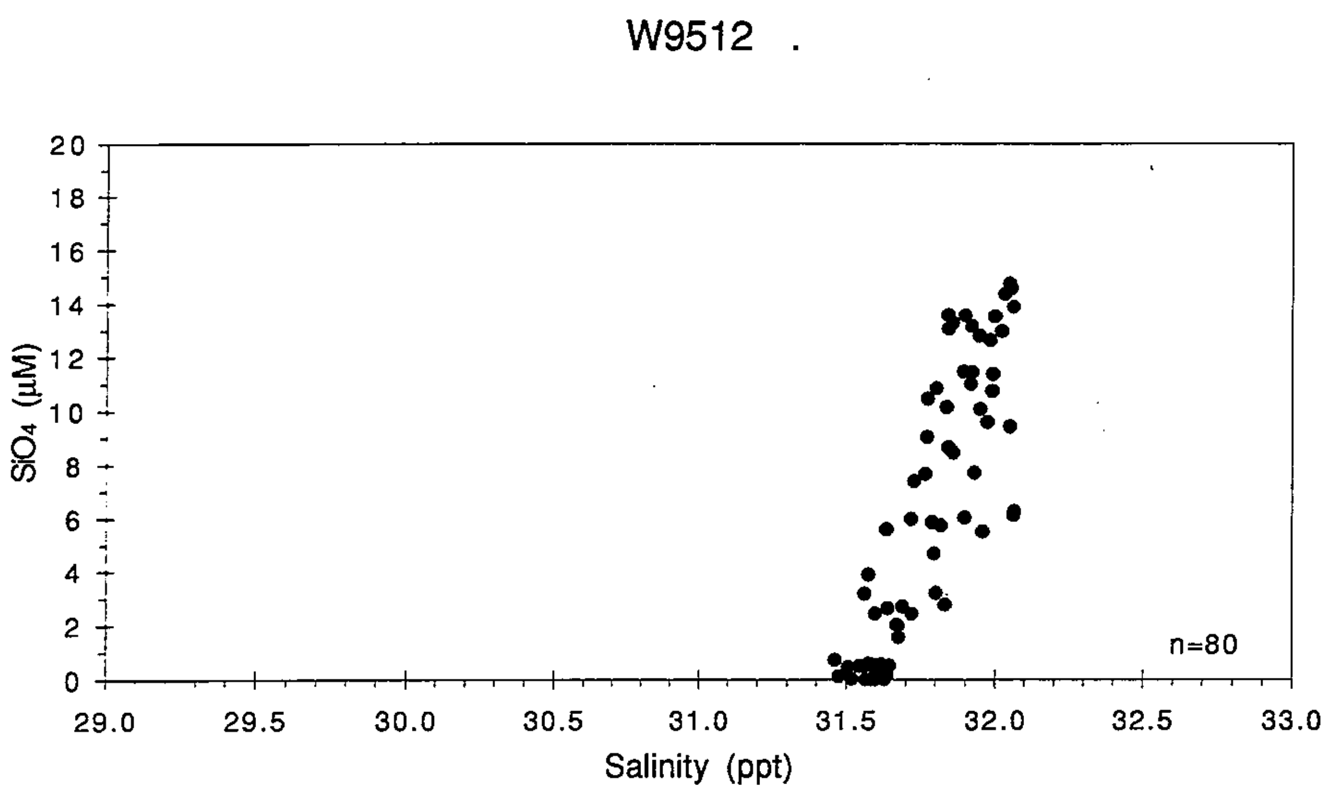
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)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SiO4 (µM)
20
18
16
14
12
10
8
6
4
2
0
n=80
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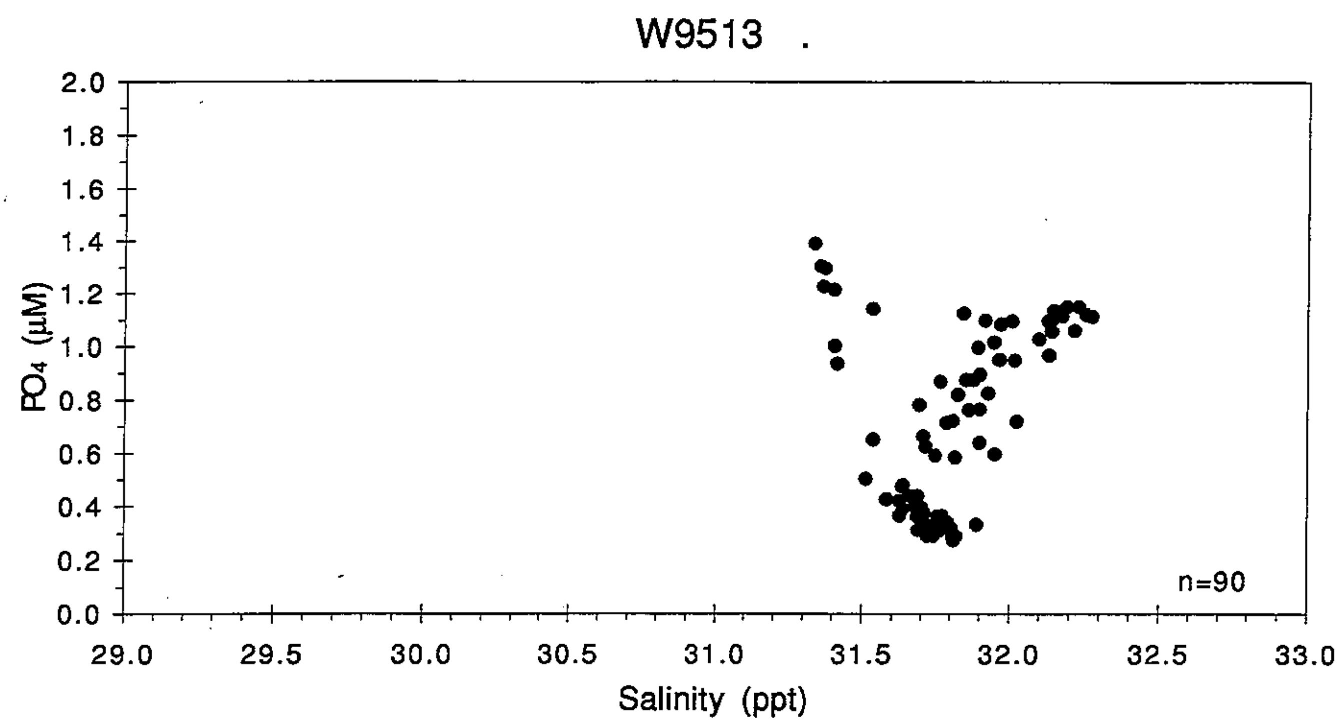
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)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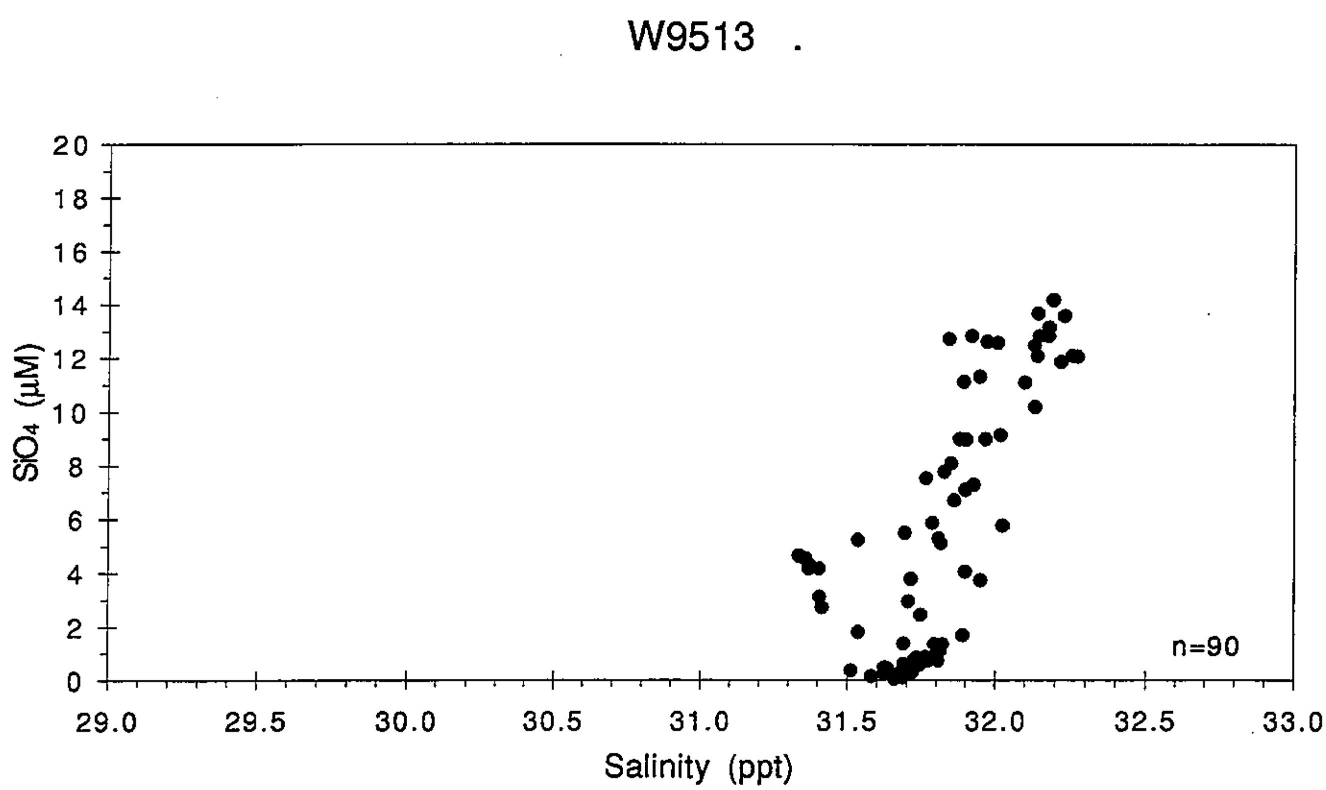
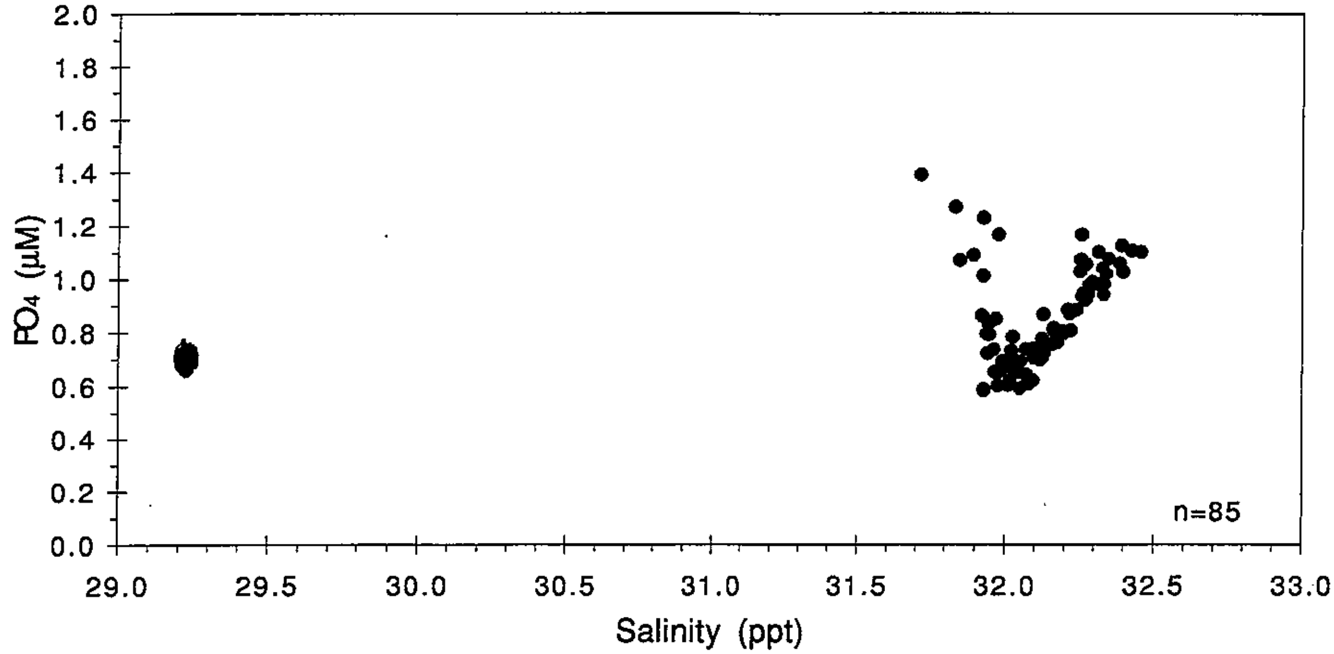
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (µM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9513 .
20
18
16
14
12
10
8
6
4
2
0
SiO4 (µM)
n=90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9515 .


2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (µM)
n=85
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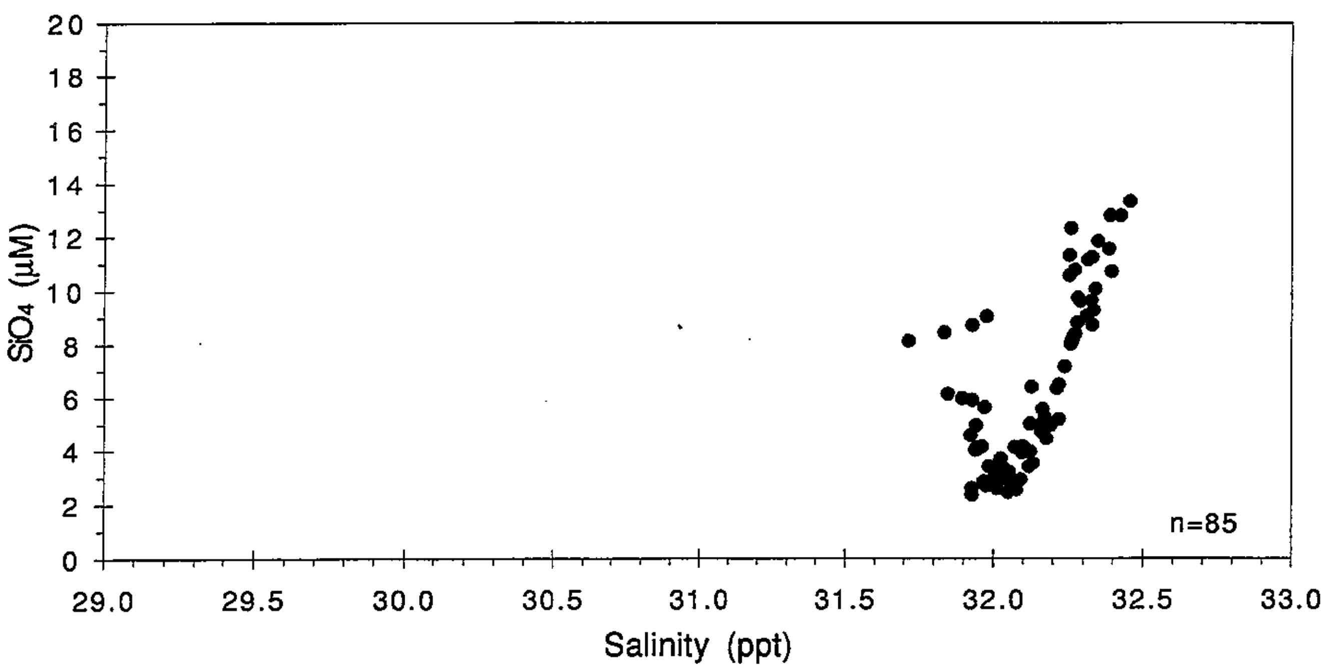
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9515 .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12
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8
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4
2
0
SiO4 (µM)
n=85
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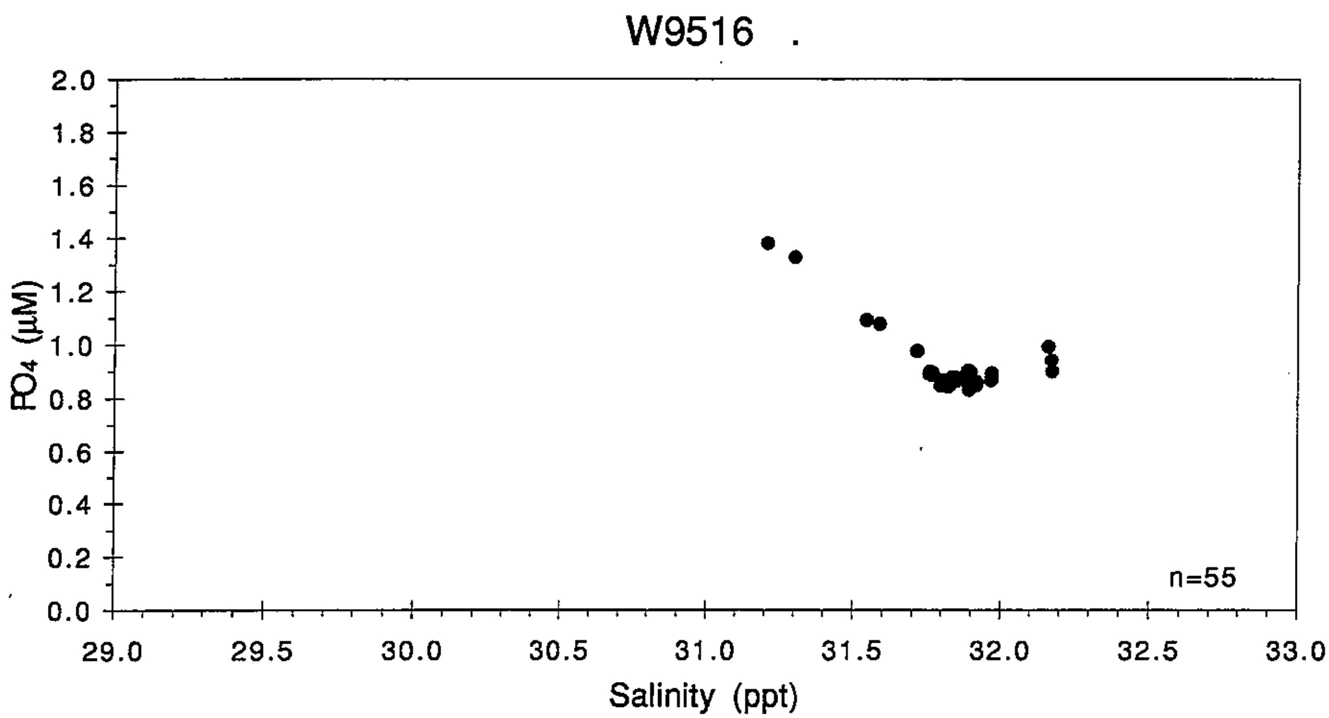
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)



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1.2
1.0
0.8
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0.4
0.2
0.0
PO4 (µM)
n=55
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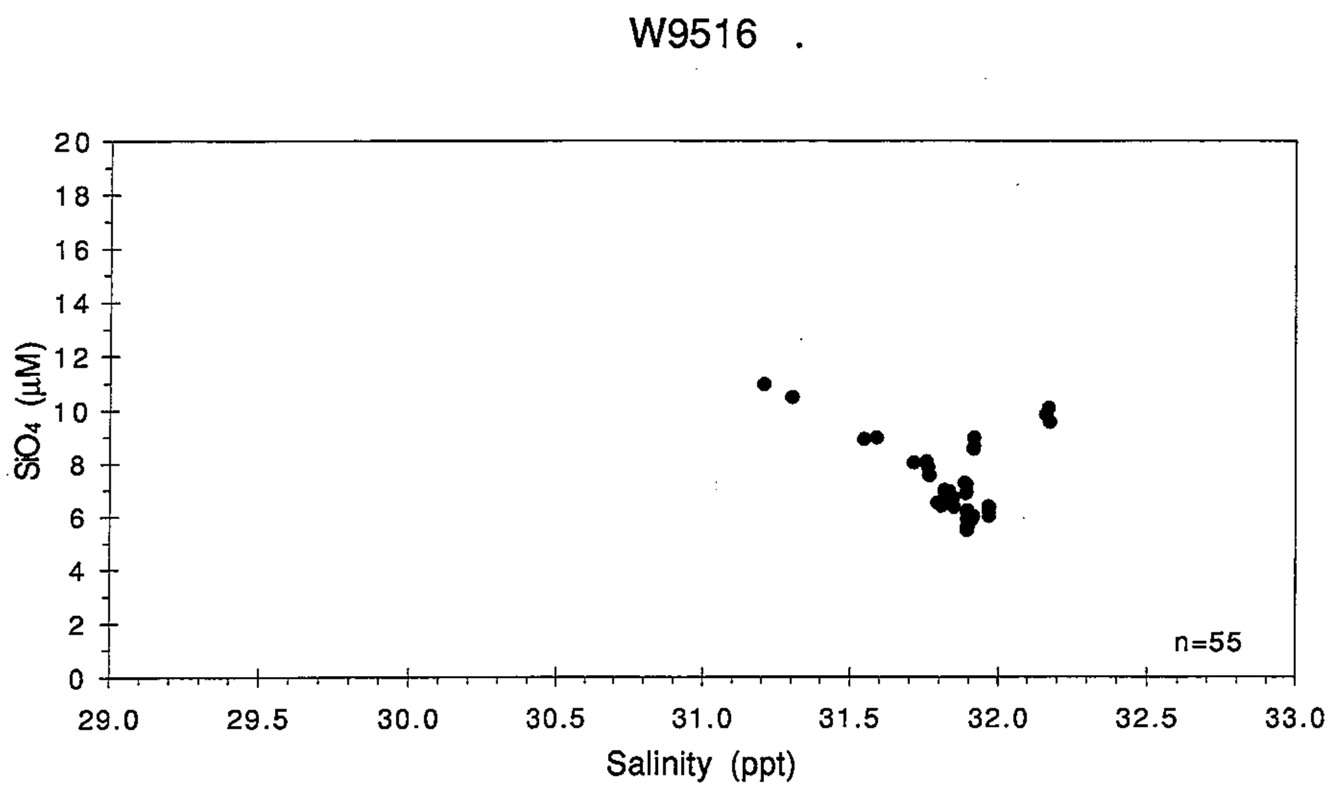
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)



W9516 .
20
18
16
14
12
10
8
6
4
2
0
SiO4 (µM)
n=55
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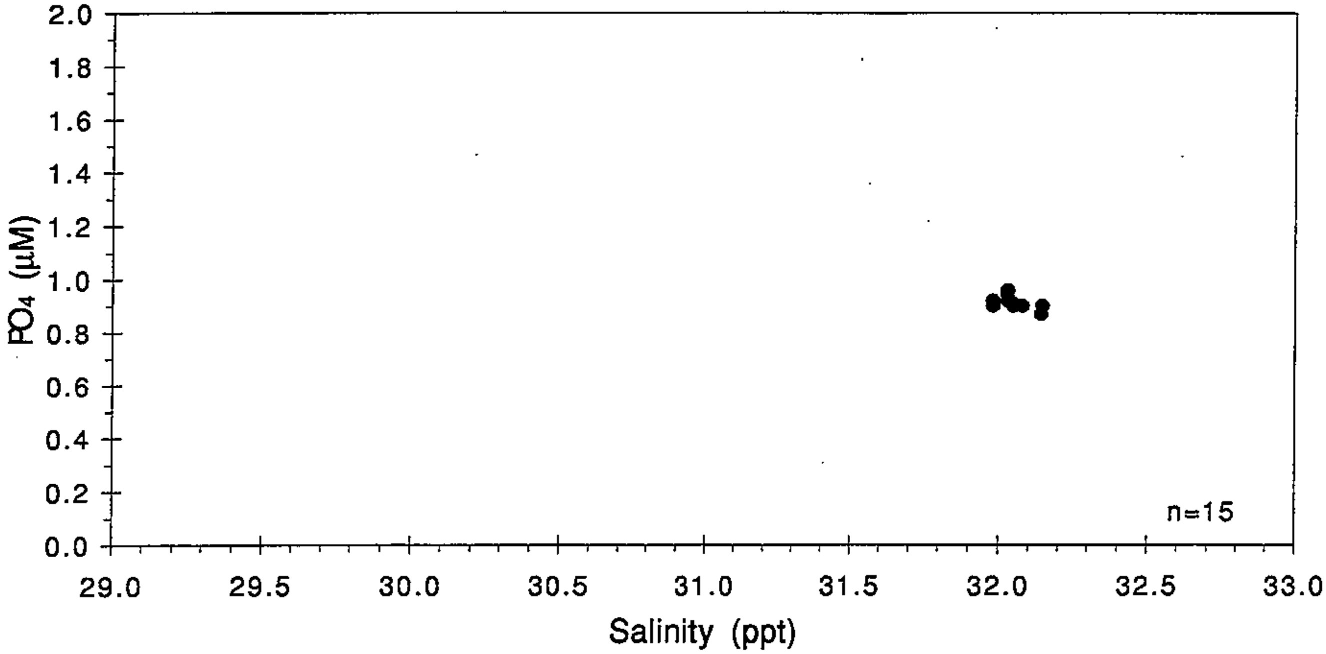
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9517 .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1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (µM)
n=15
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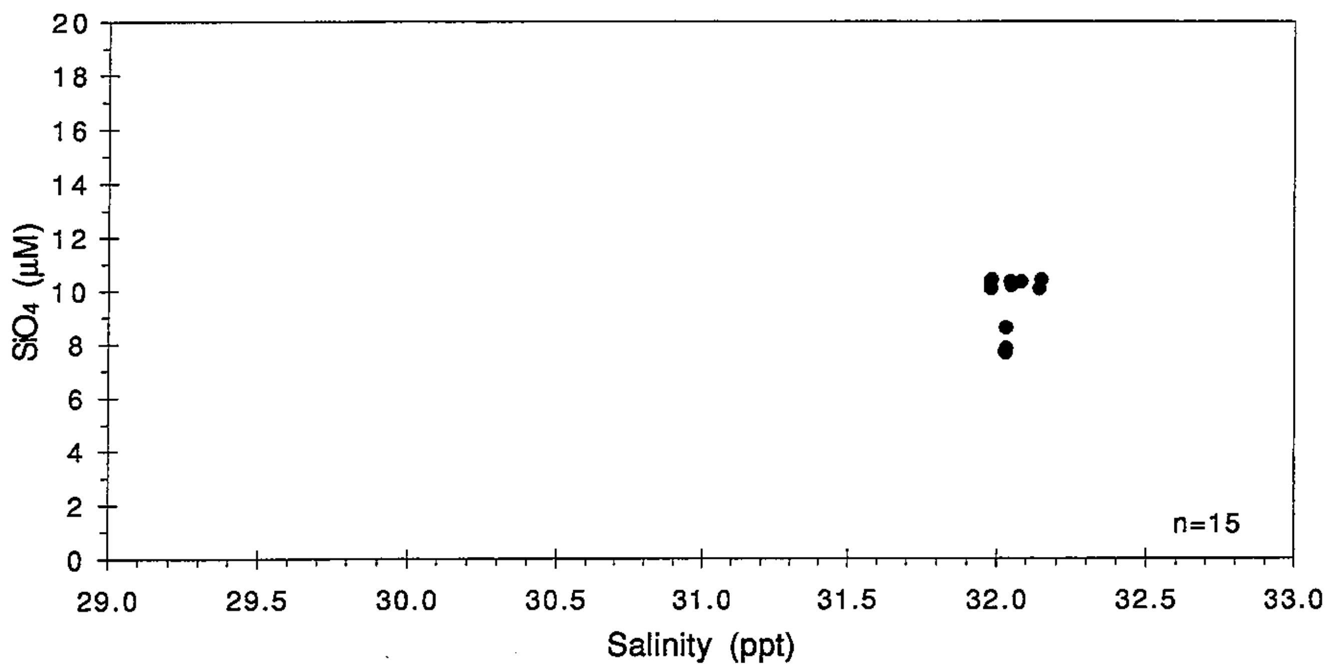
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9517 .


20
18
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14
12
10
8
6
4
2
0
SiO4 (µM)
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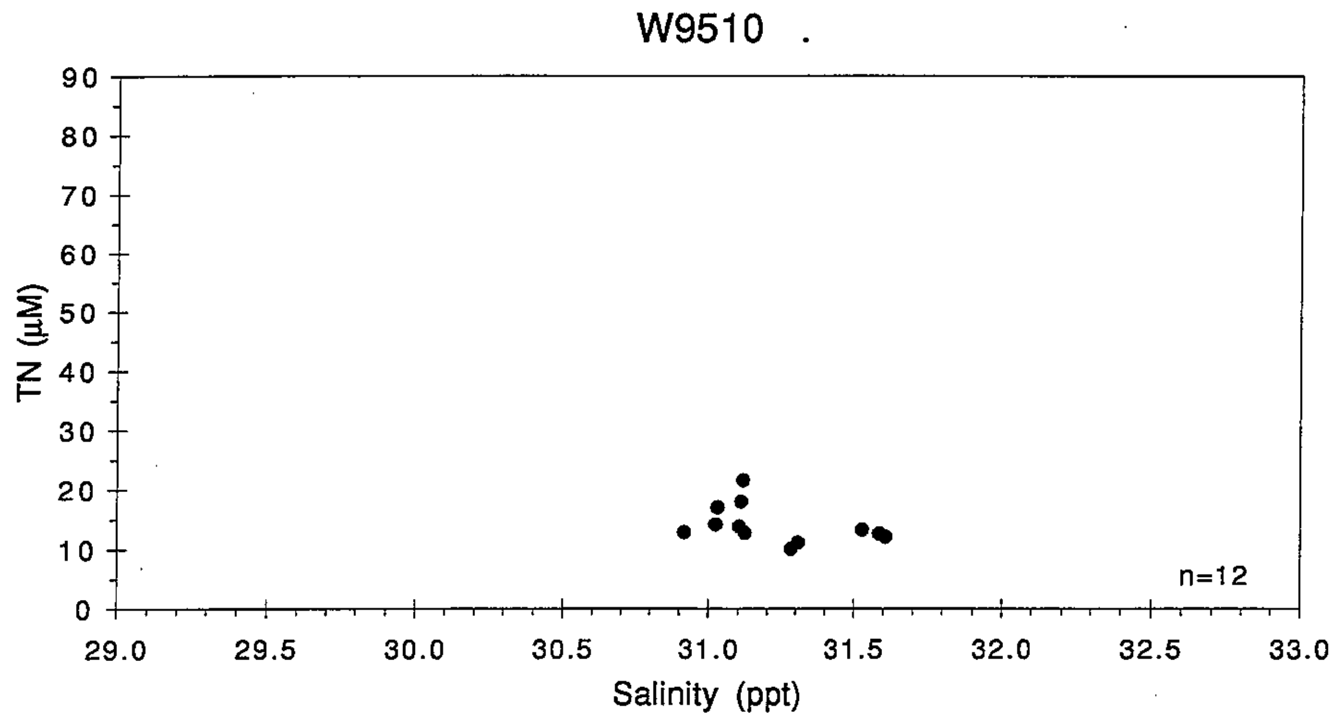
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9510
90
80
70
60
50
40
30
20
10
0
TN (µM)
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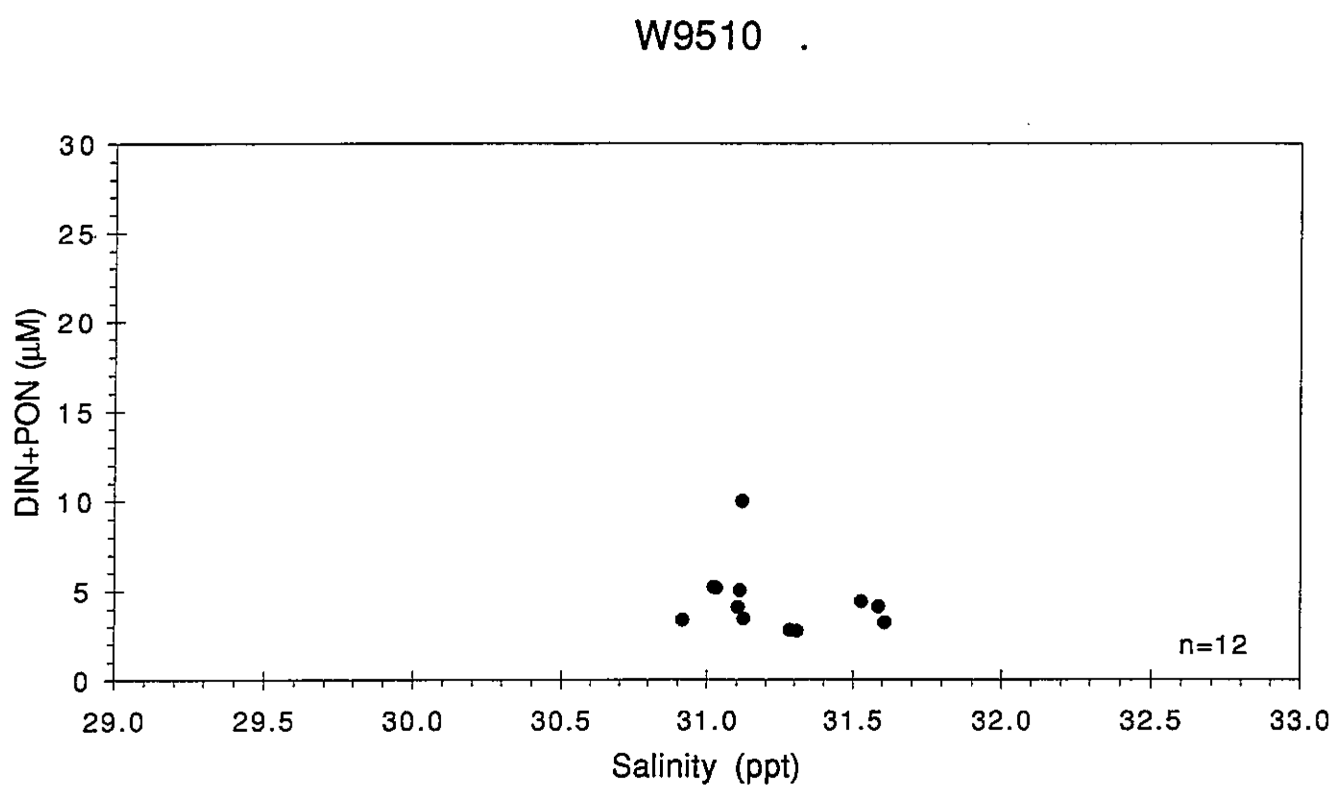
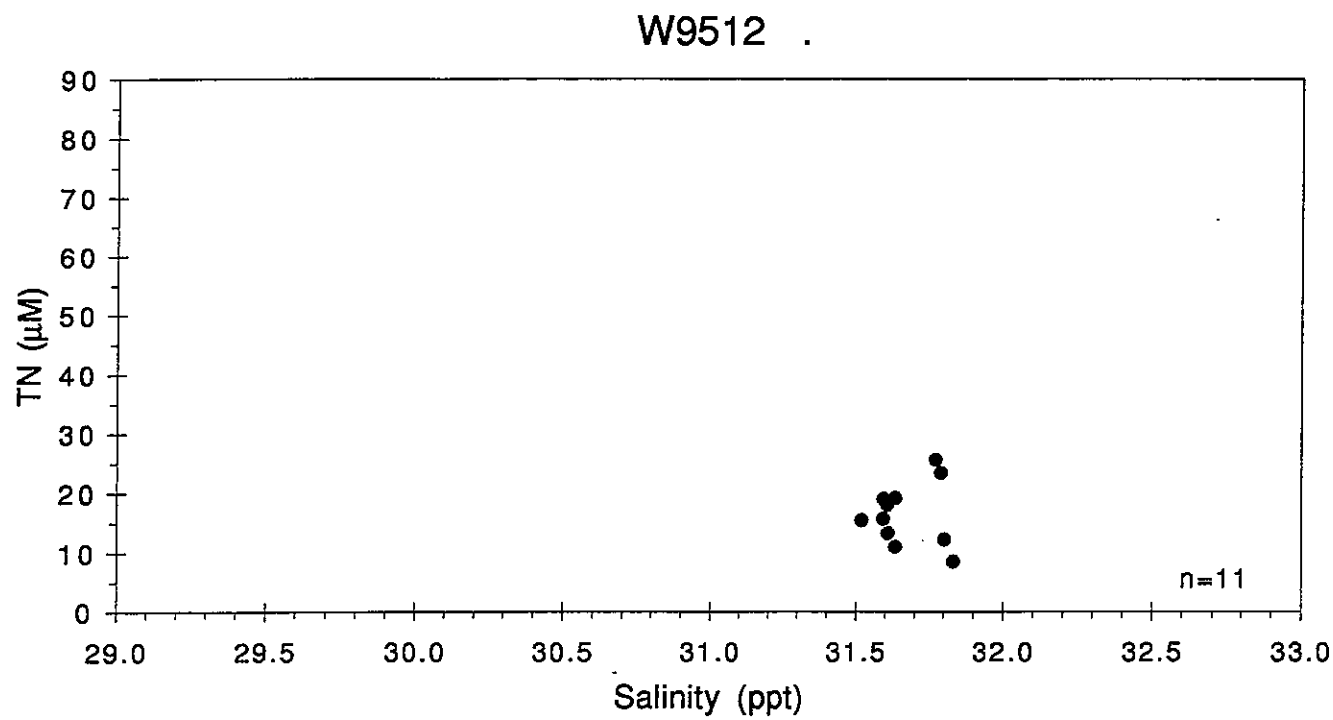
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9510
30
25
20
15
10
5
0
DIN+PON (µM)
n=12
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)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TN (µM)
90
80
70
60
50
40
30
20
10
0
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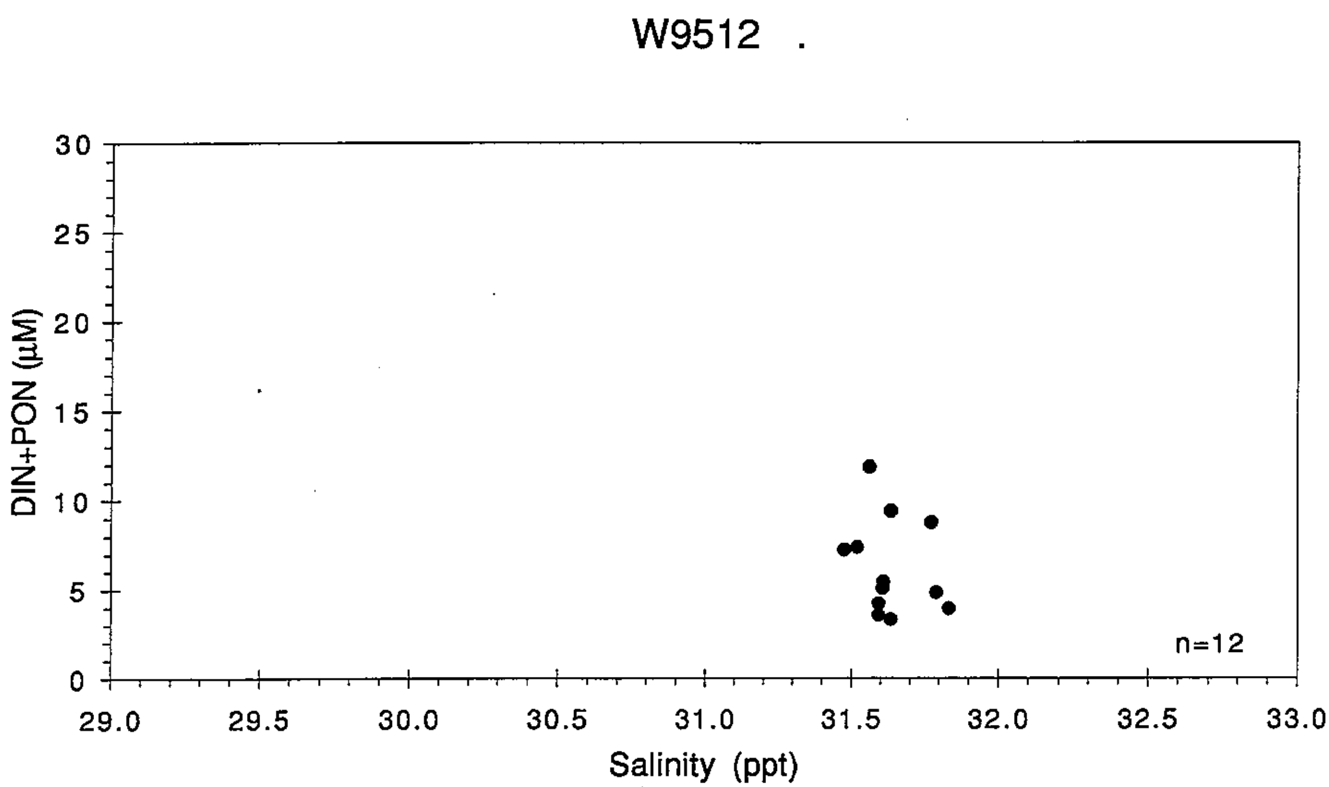
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9512 .
DIN+PON (µM)
30
25
20
15
10
5
0
n=12
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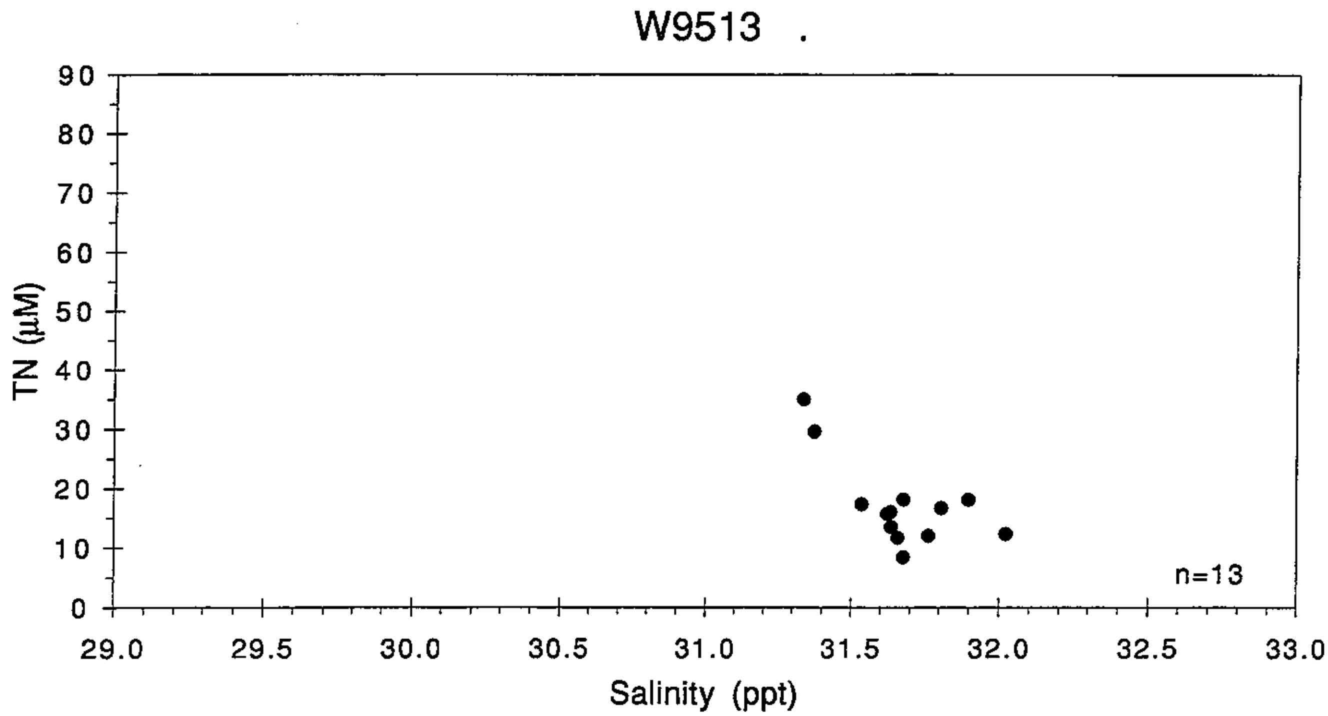
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)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TN (µM)
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20
10
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n=13
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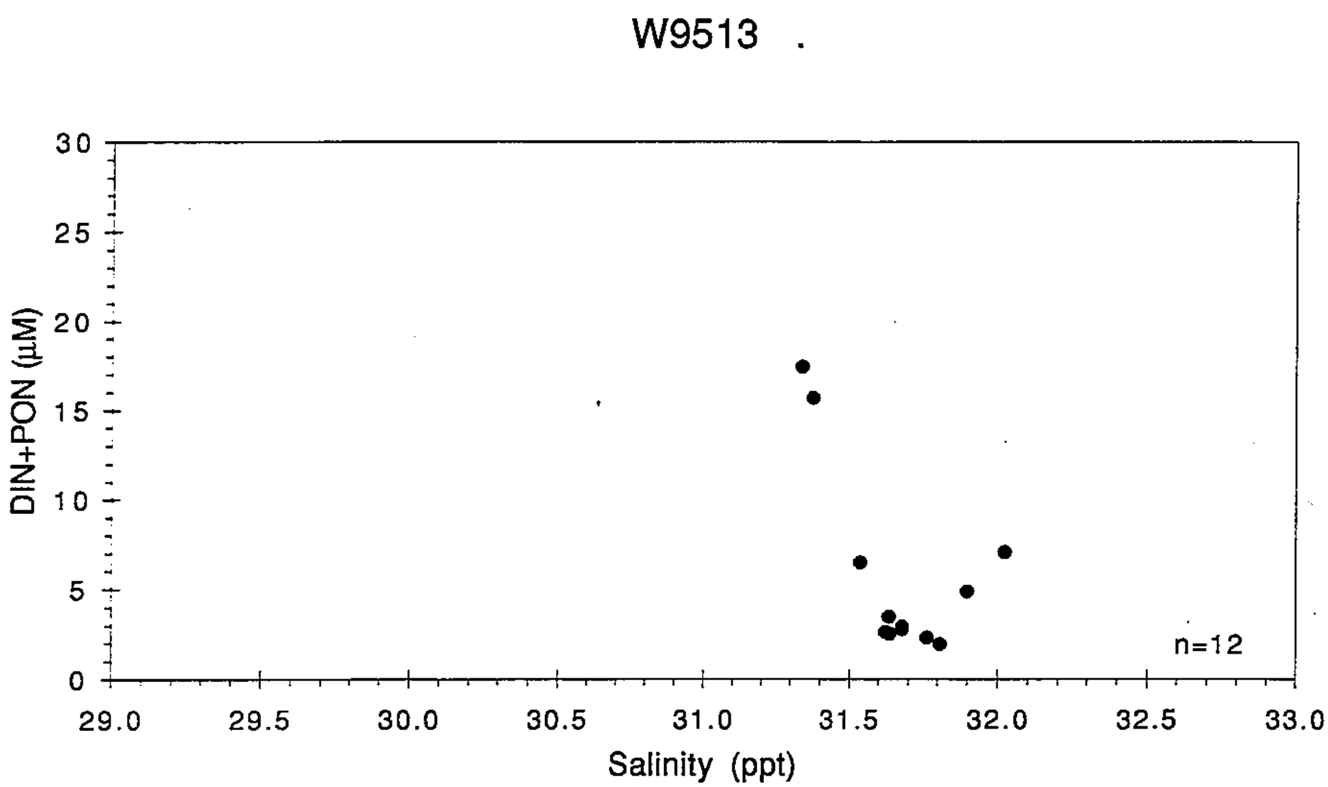
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9513 .
DIN+PON (µM)
30
25
20
15
10
5
0
n=12
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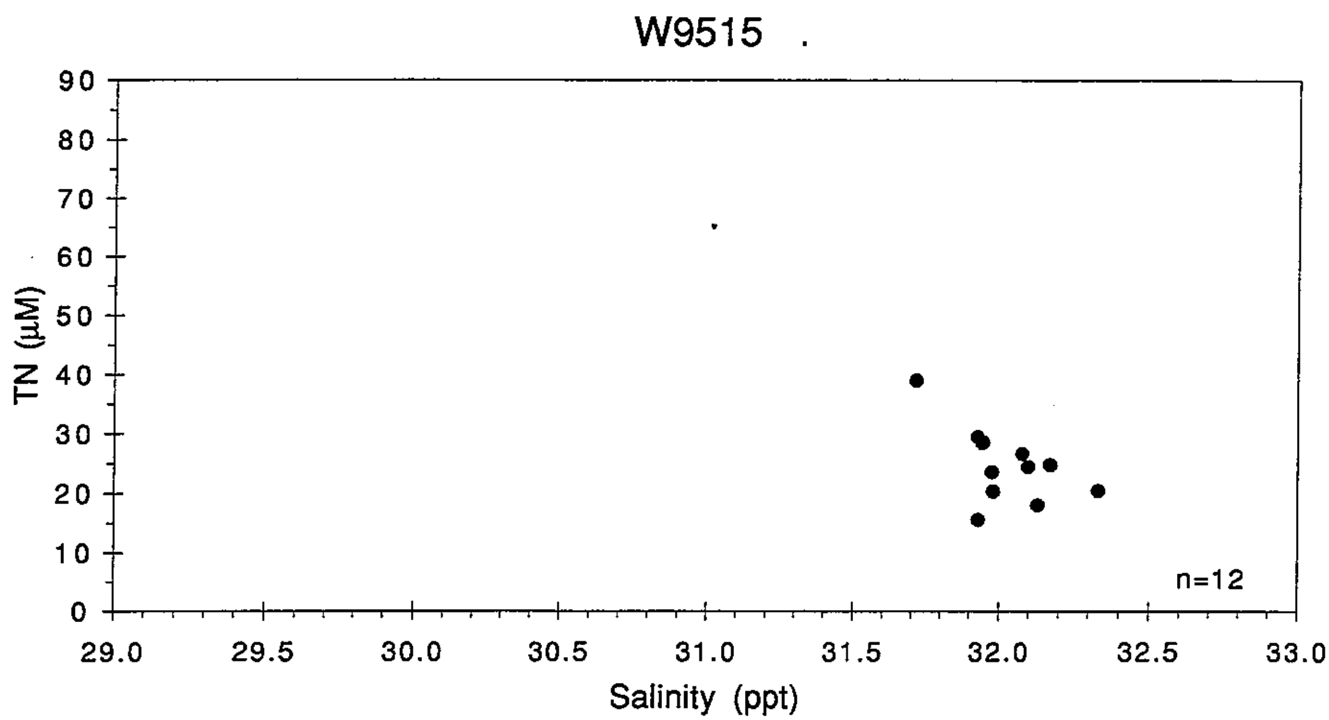
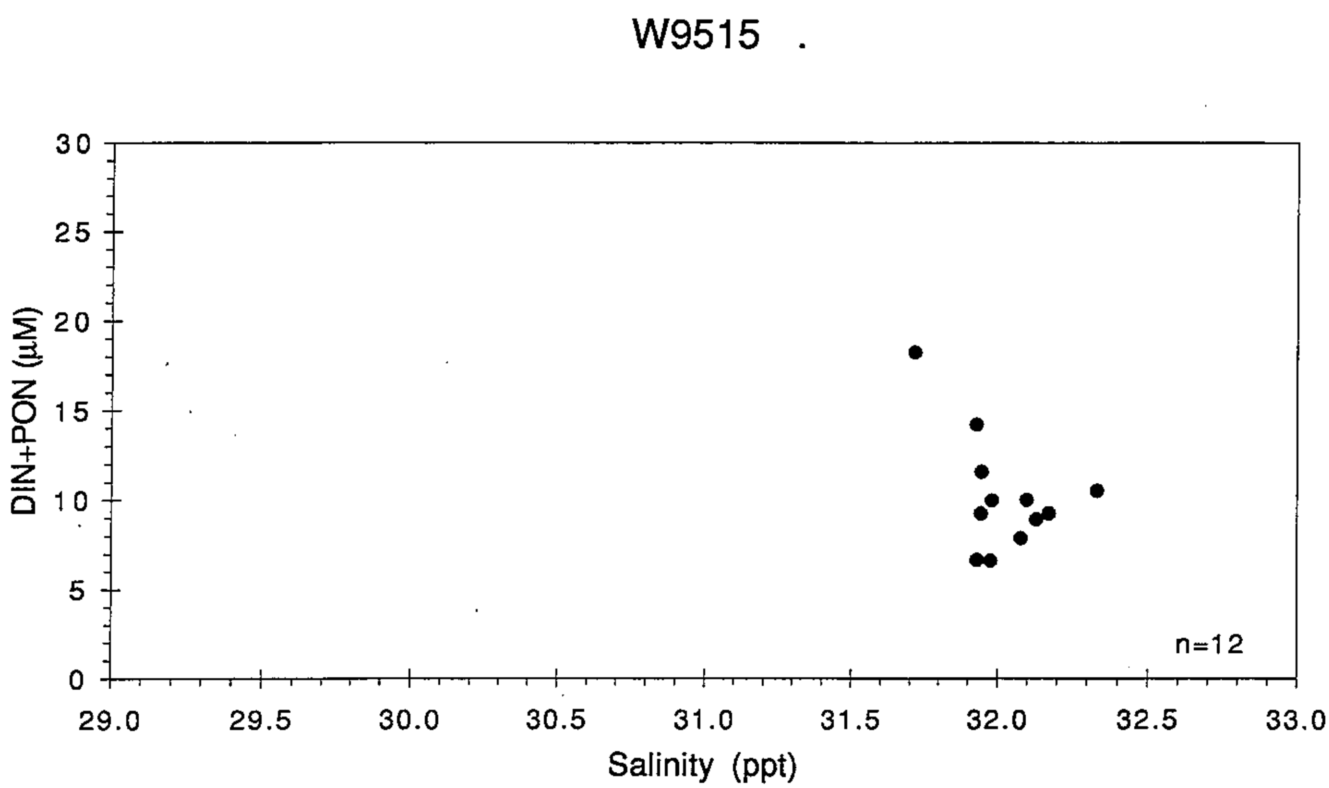
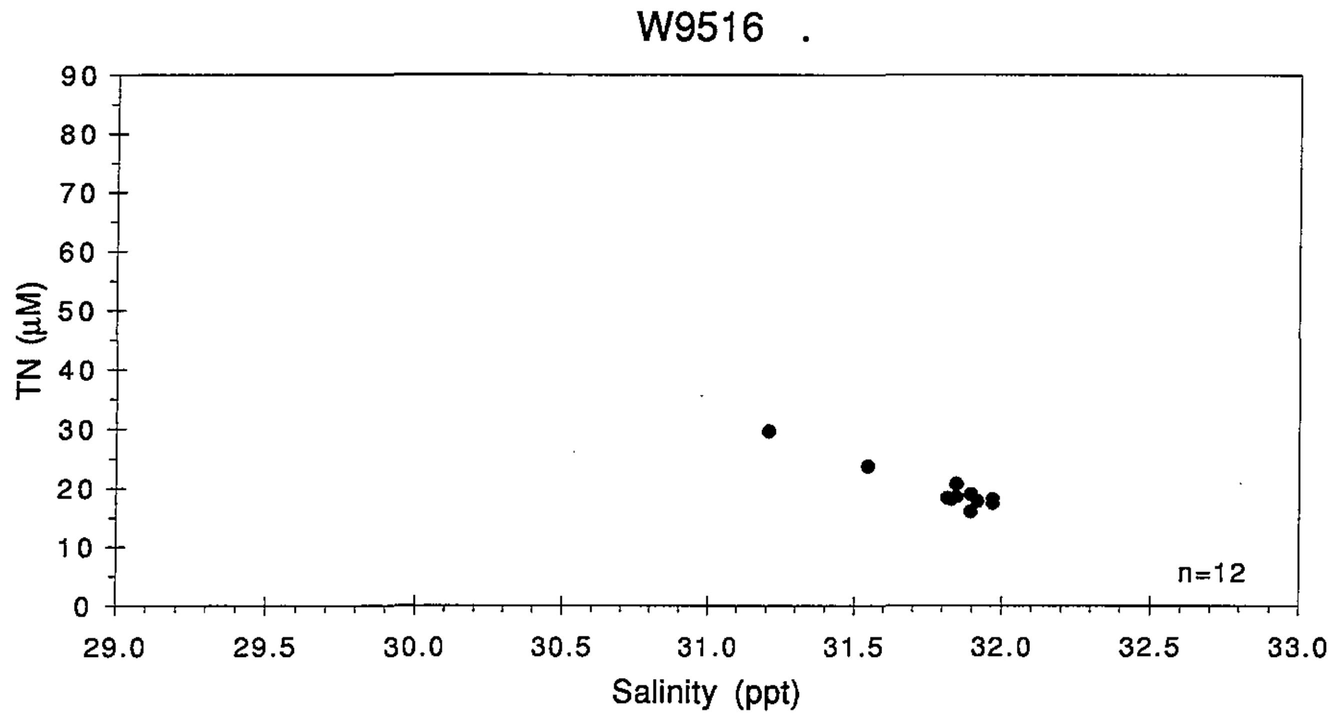
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9515
TN (µM)
n=12
Salinity (ppt)


W9515
DIN+PON (µM)
n=12
Salinity (ppt)


W9516 .
TN (µM)
90
80
70
60
50
40
30
20
10
0
n=12
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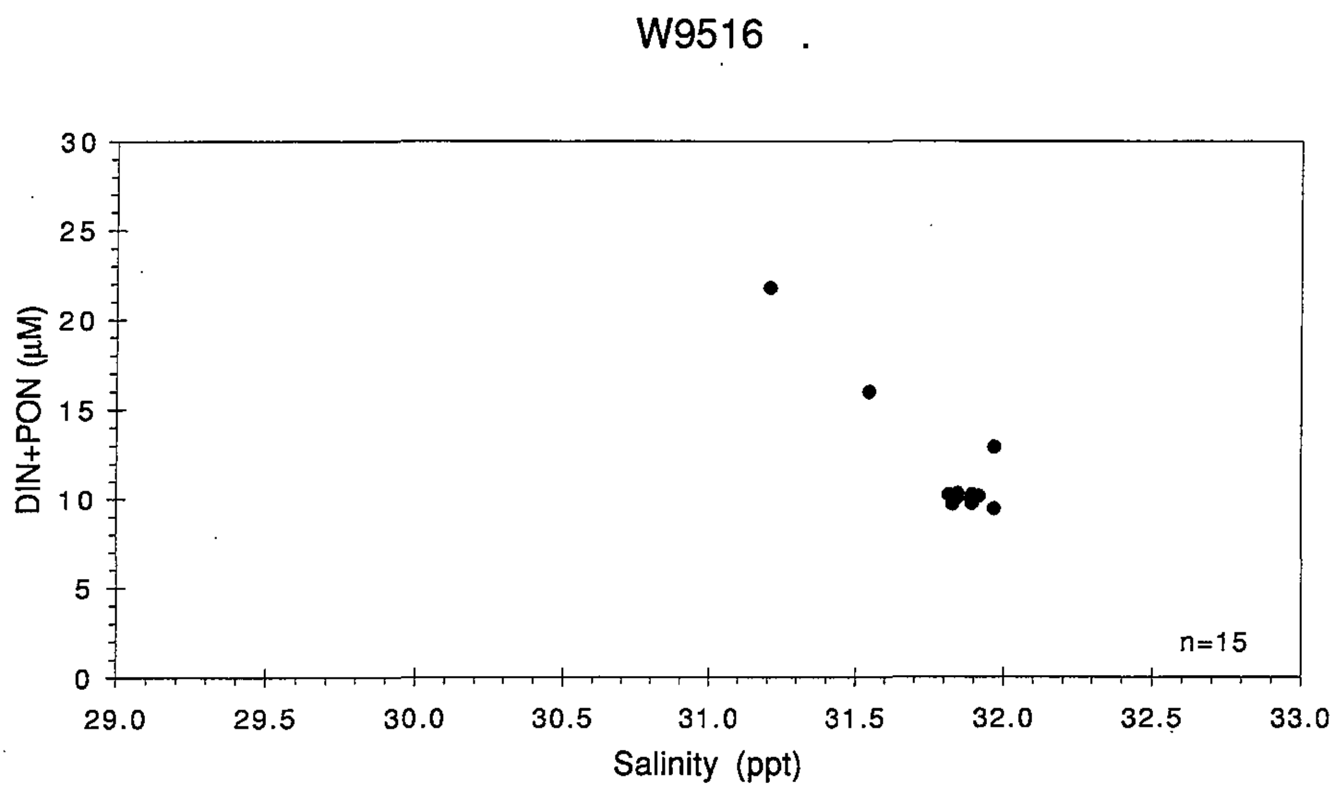
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9516 .
DIN+PON (µM)
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25
20
15
10
5
0
n=15
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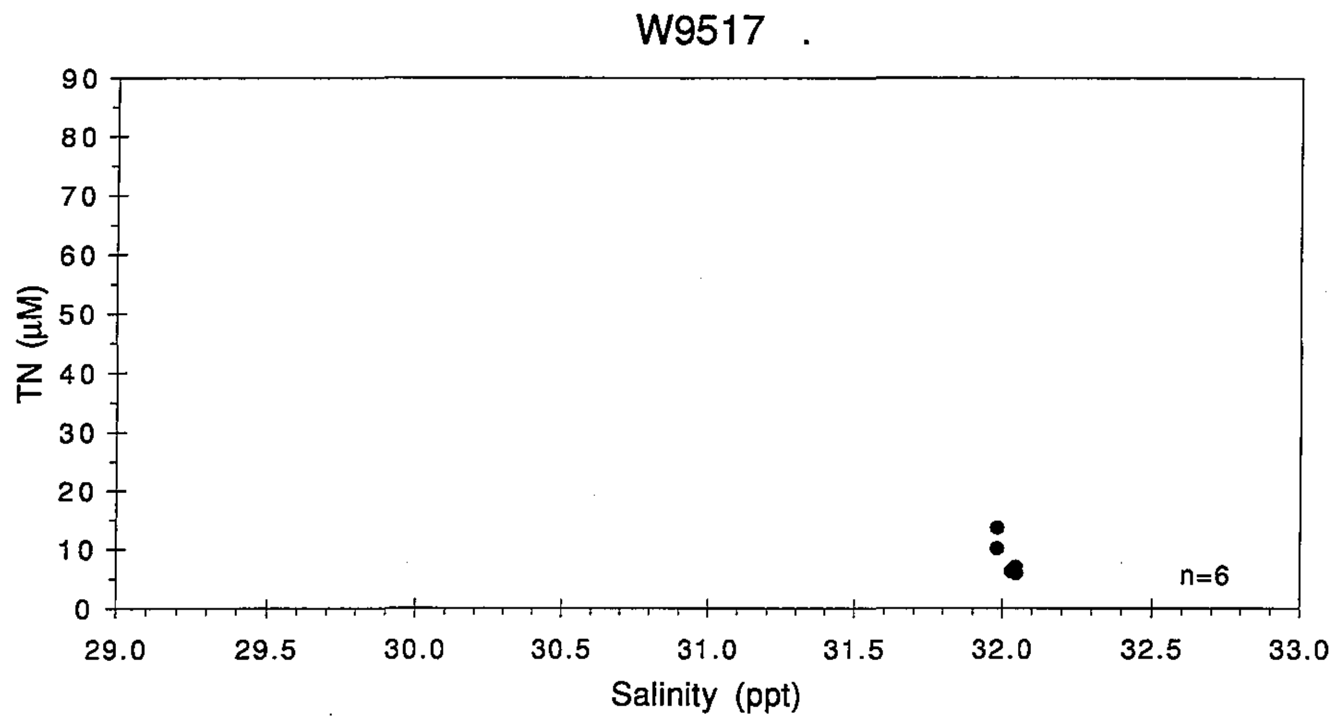
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9517 .
TN (µM)
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50
40
30
20
10
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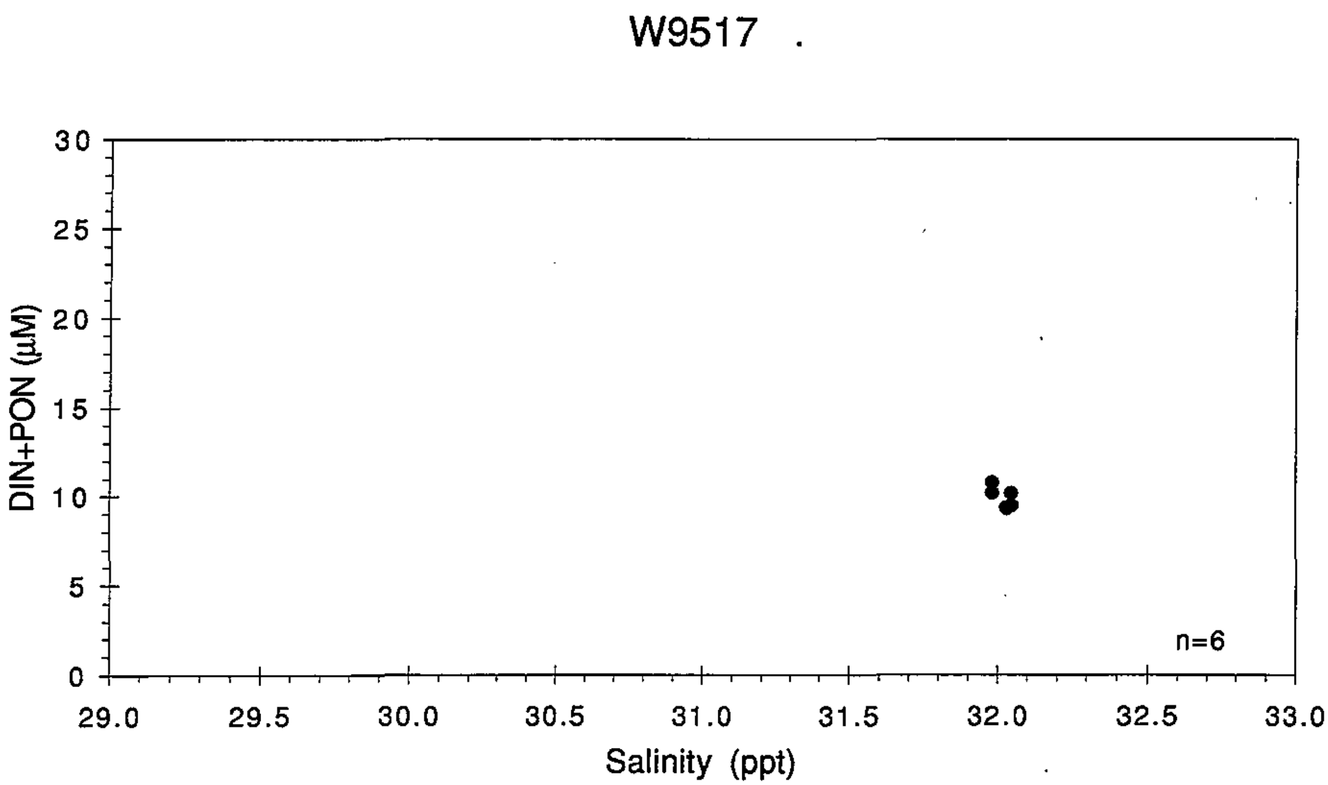
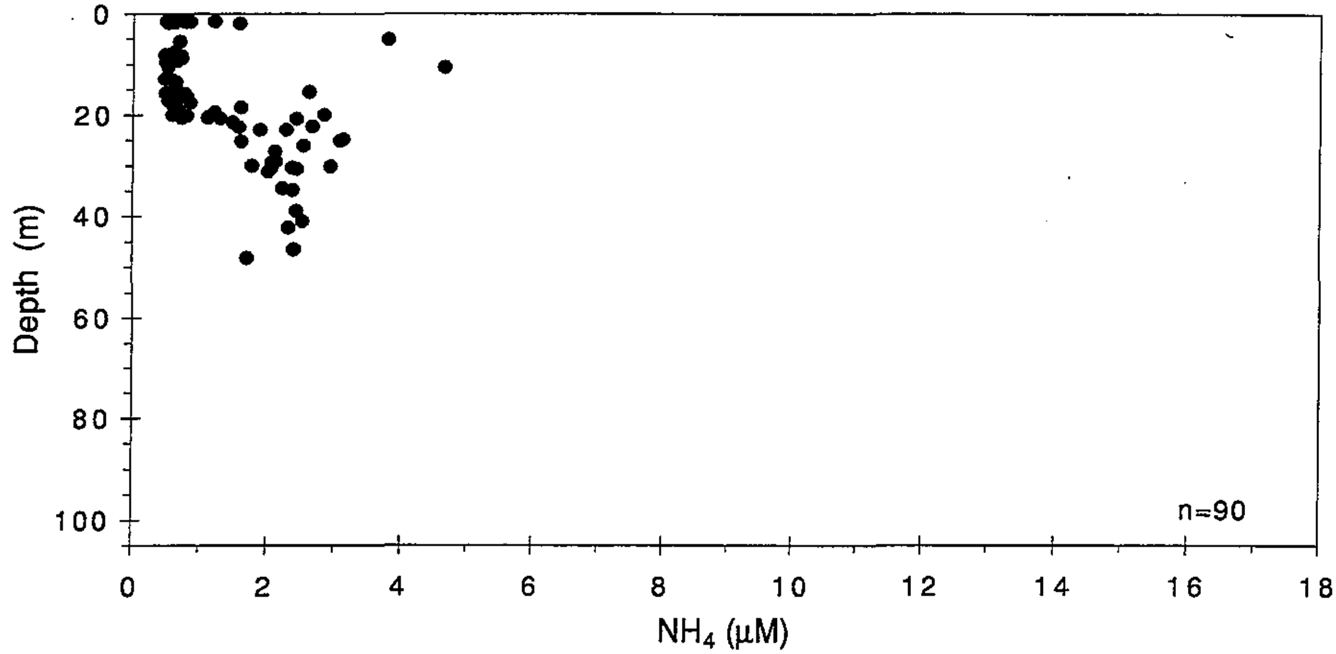
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=6

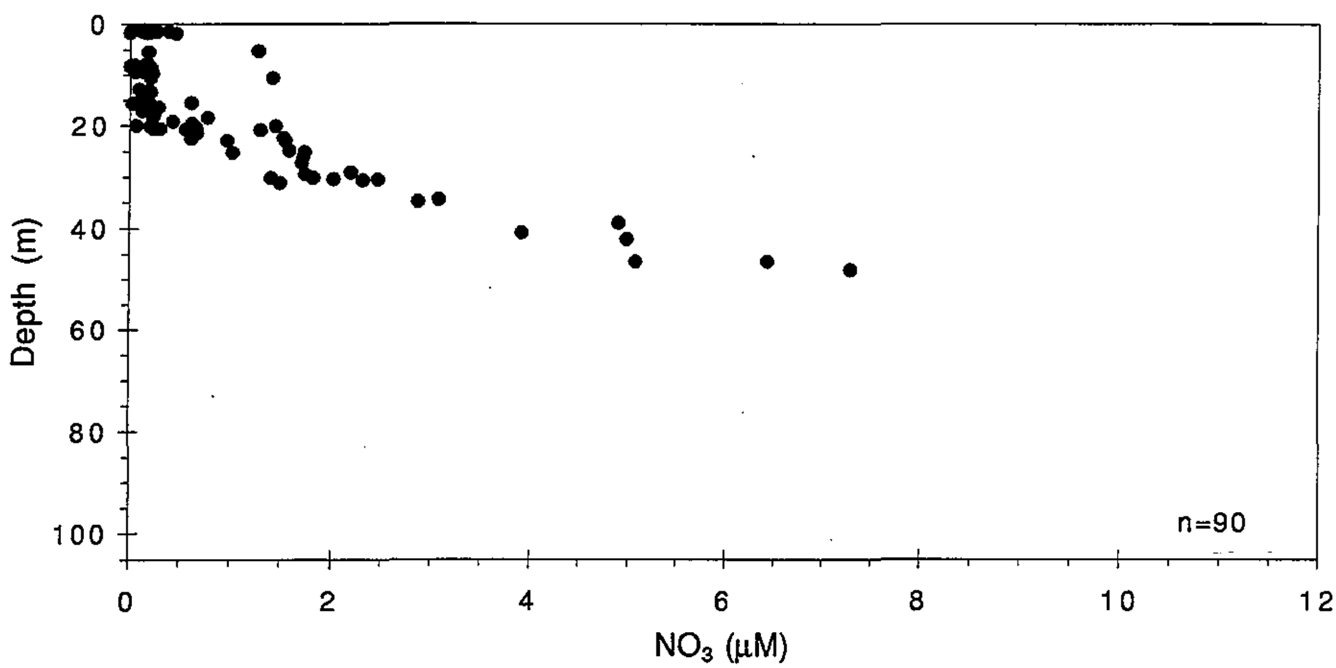

W9517 .
DIN+PON (µM)
30
25
20
15
10
5
0
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=6

W9510 .



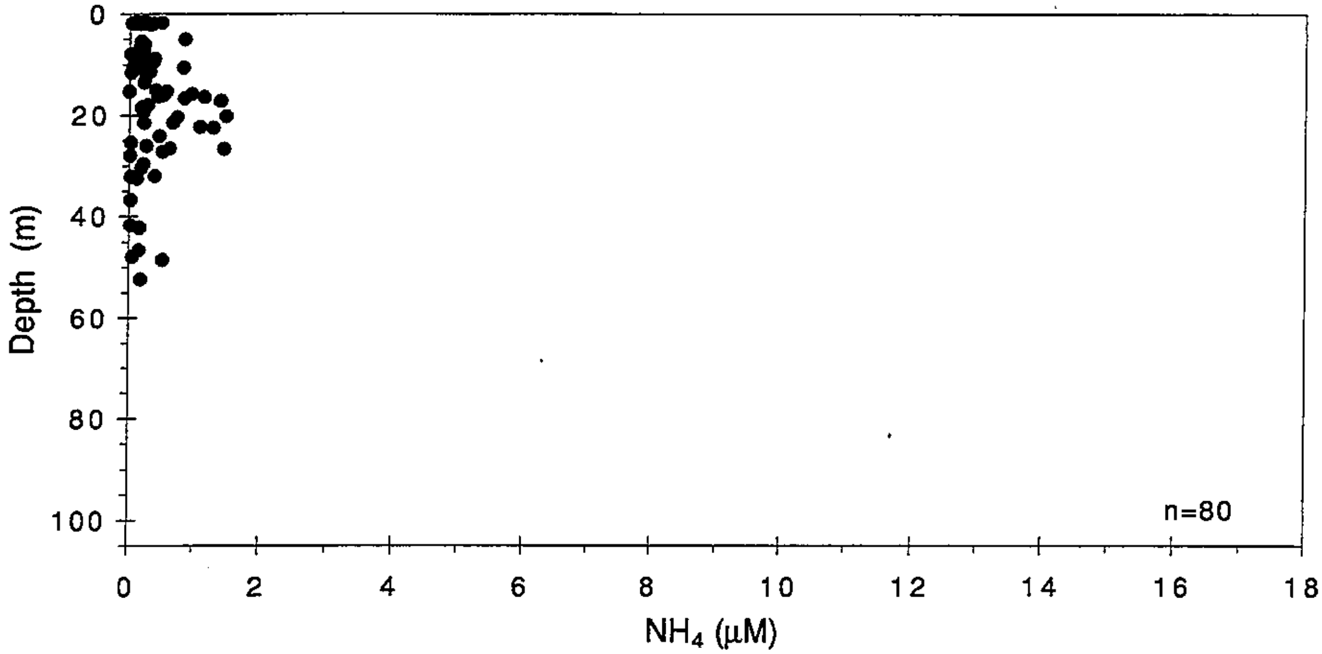
0
20
40
60
80
100
Depth (m)
n=90
0
2
4
6
8
10
12
14
16
18
NH4 (µM)

W9510 .



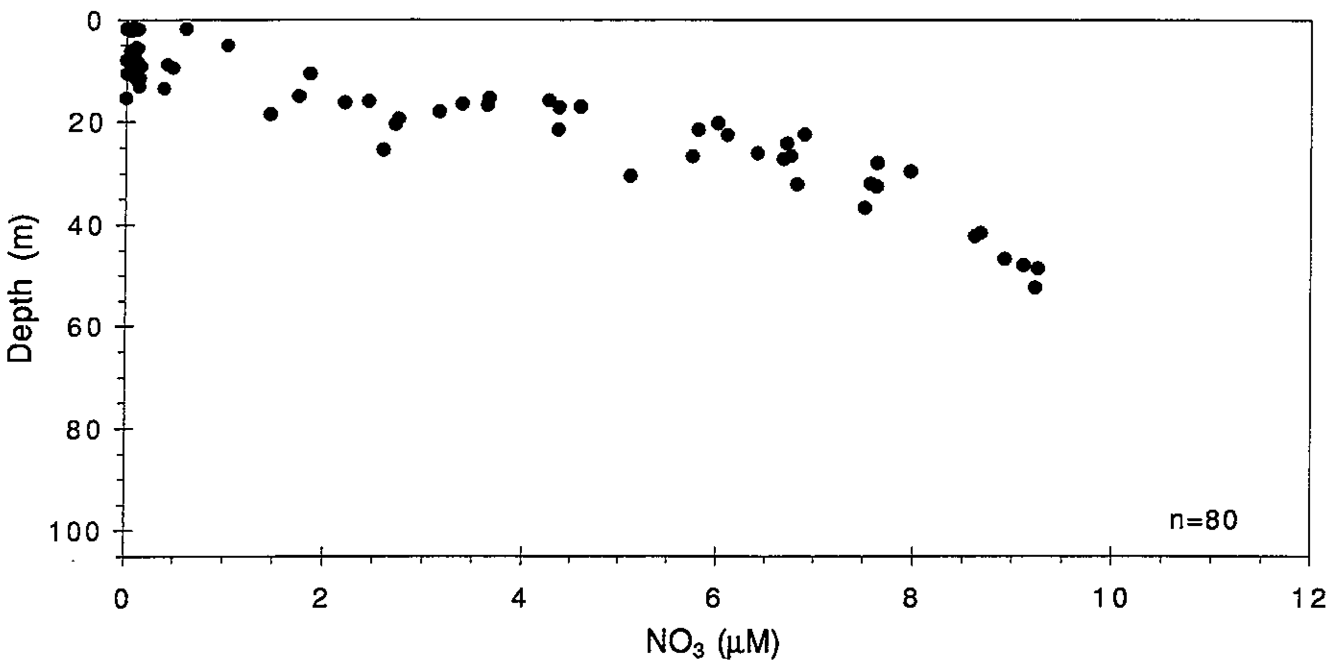
0
20
40
60
80
100
Depth (m)
n=90
0
2
4
6
8
10
12
NO3 (µM)

W9512 .

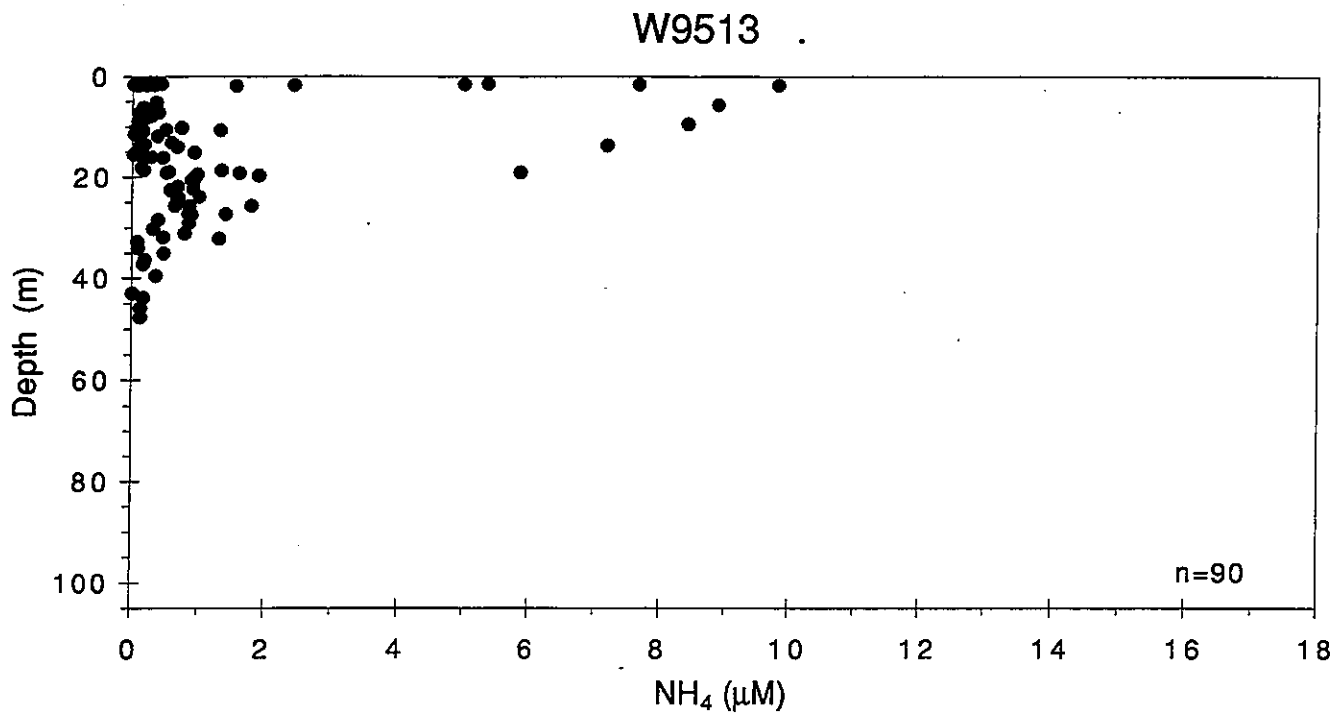


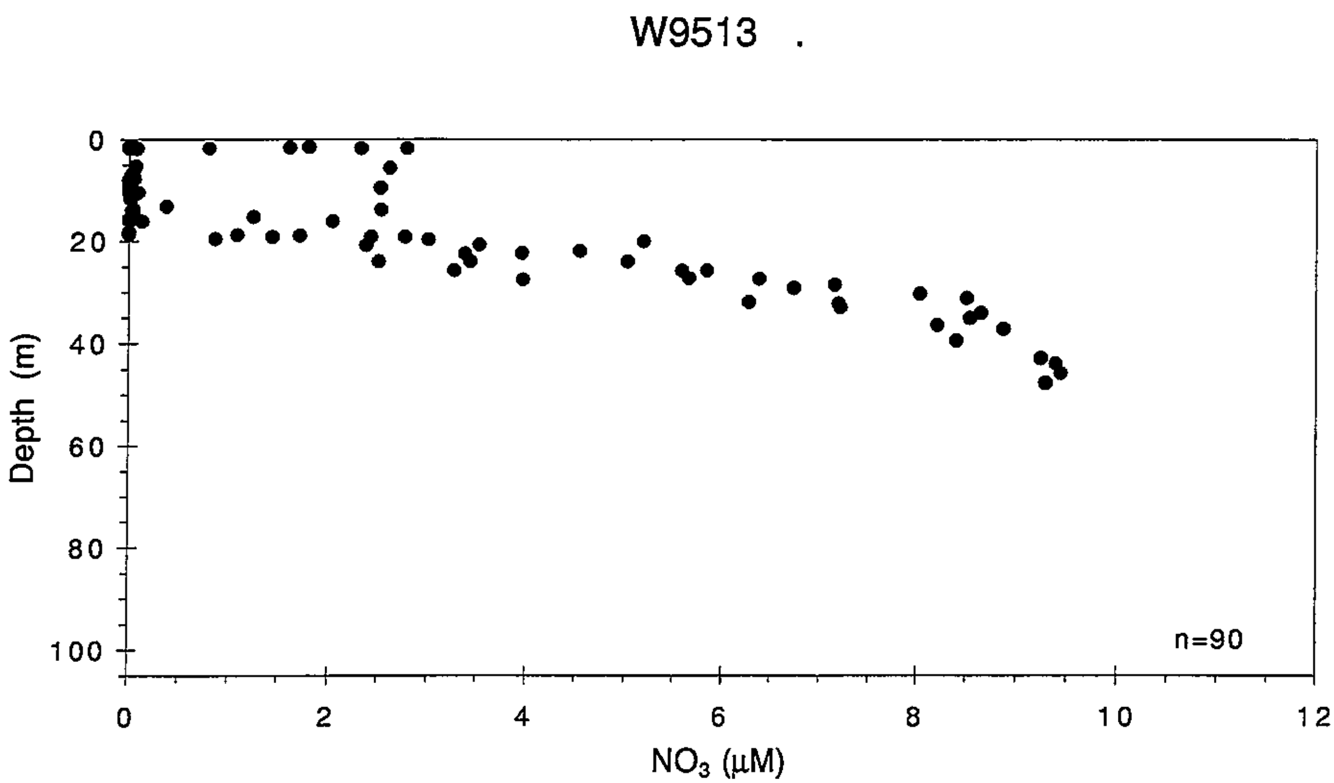
0
20
40
60
80
100
Depth (m)
n=80
0
2
4
6
8
10
12
14
16
18
NH4 (μM)

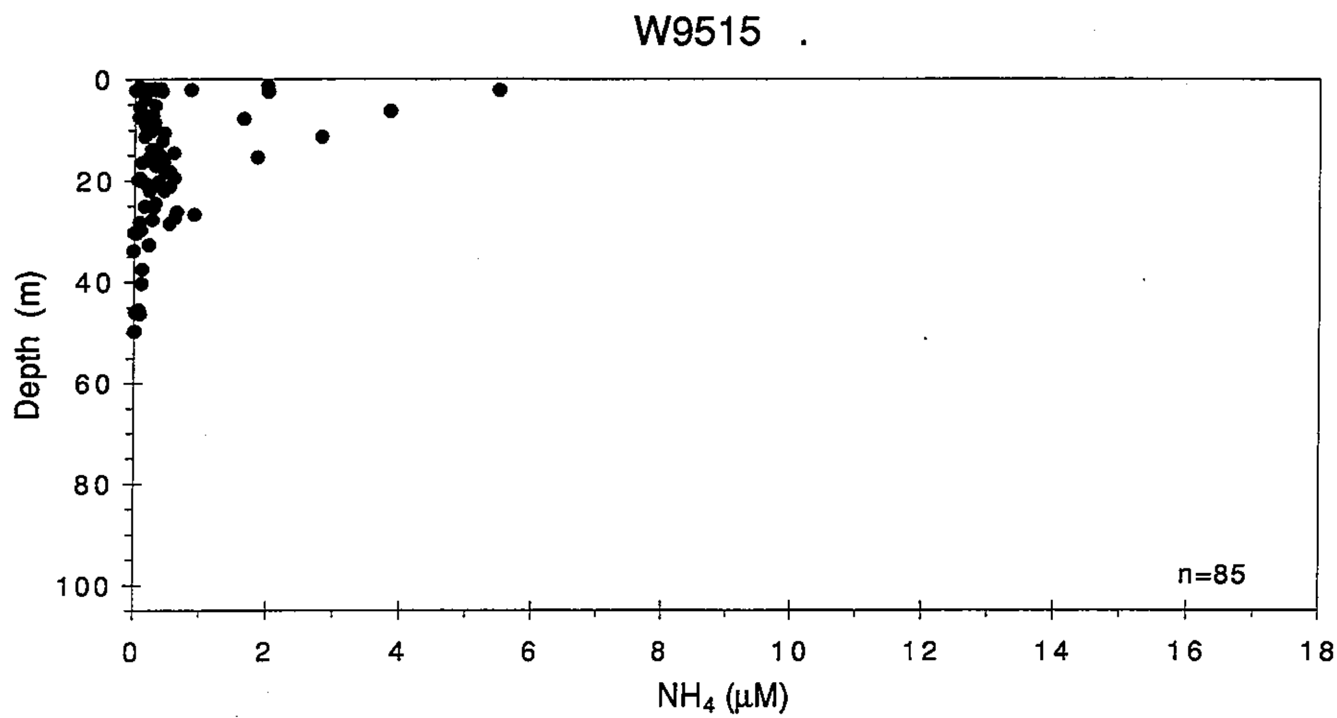
W9512 .

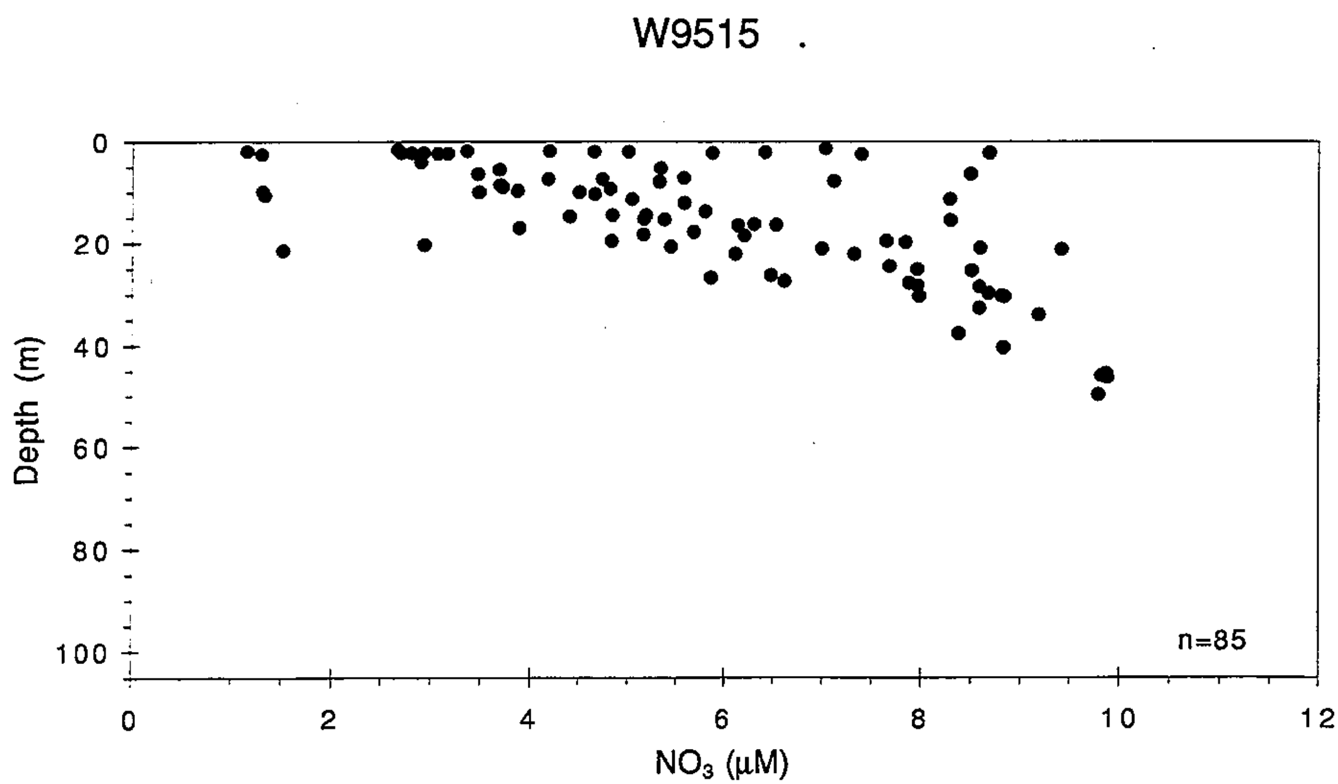


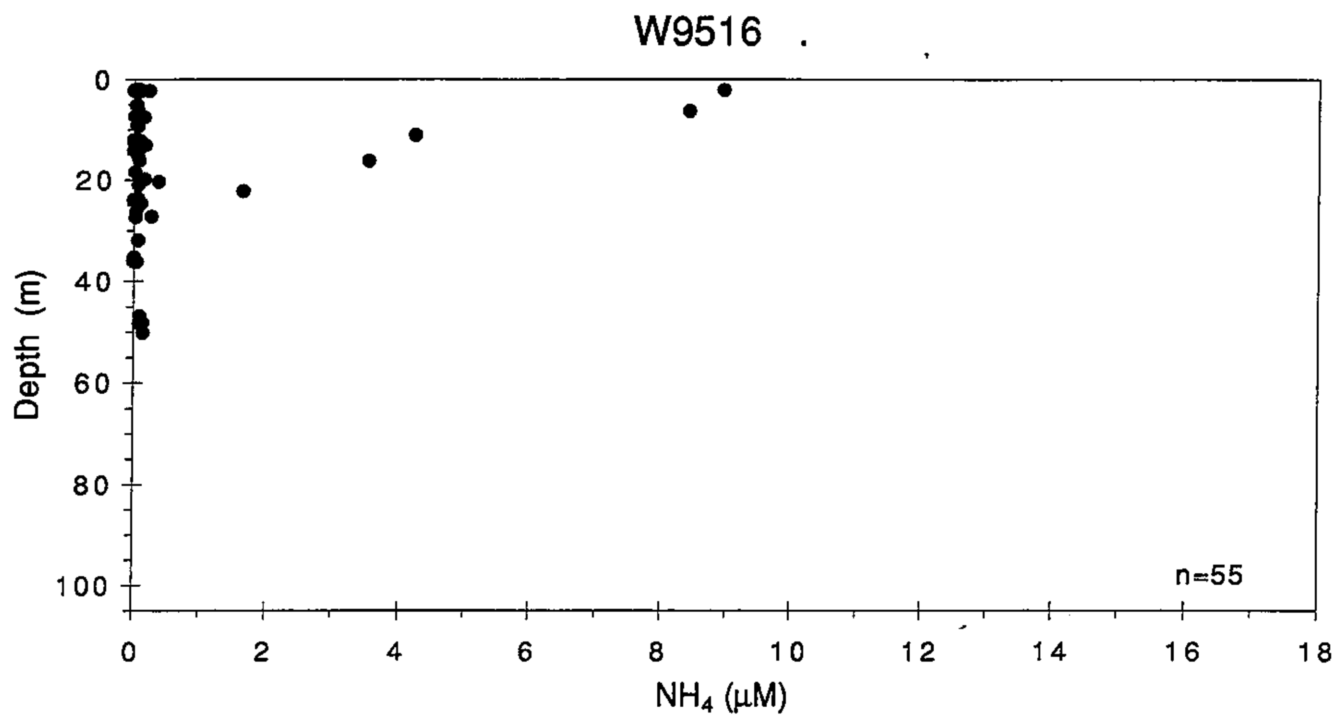
0
20
40
60
80
100
Depth (m)
n=80
0
2
4
6
8
10
12
NO3 (μM)

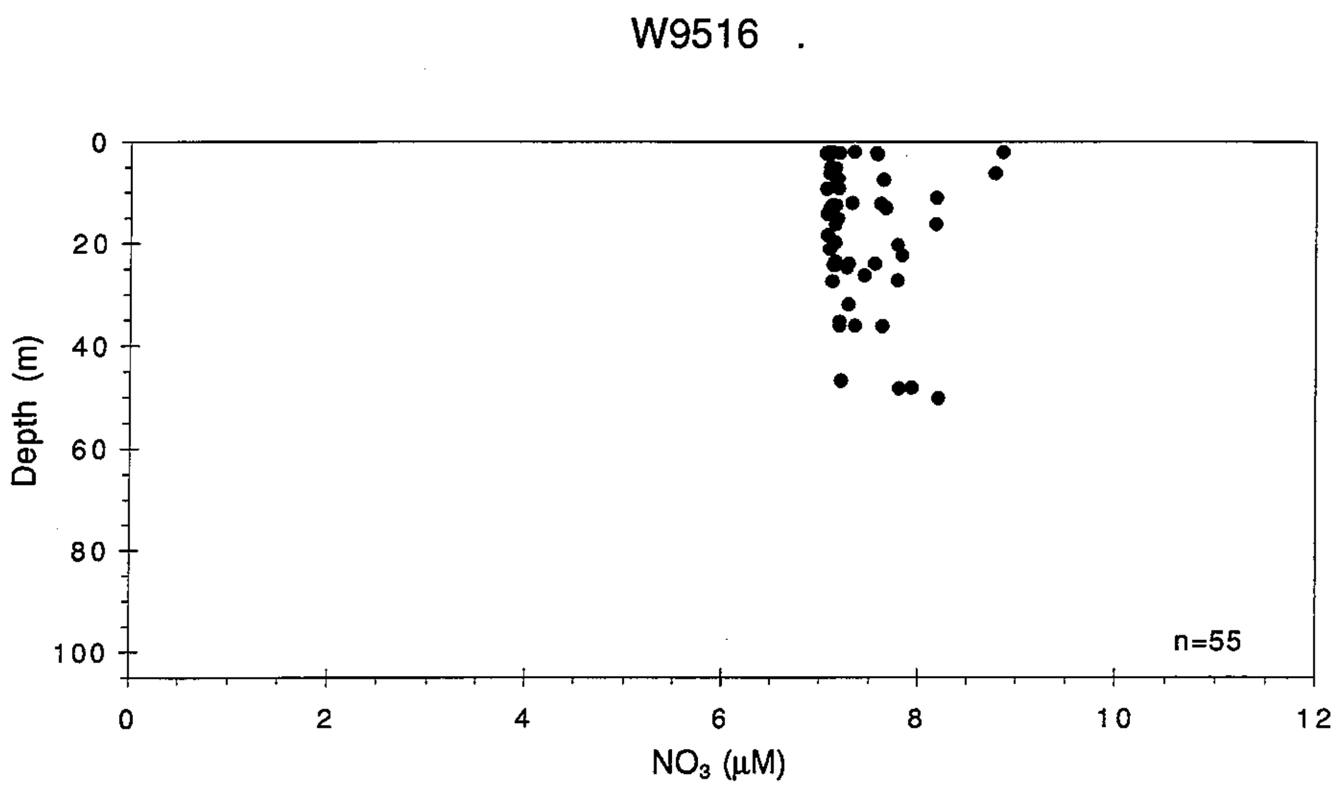

W9513
Depth (m)
0
20
40
60
80
100
n=90
0
2
4
6
8
10
12
14
16
18
NH4 (μM)


W9513
Depth (m)
0
20
40
60
80
100
n=90
0
2
4
6
8
10
12
NO3 (μM)

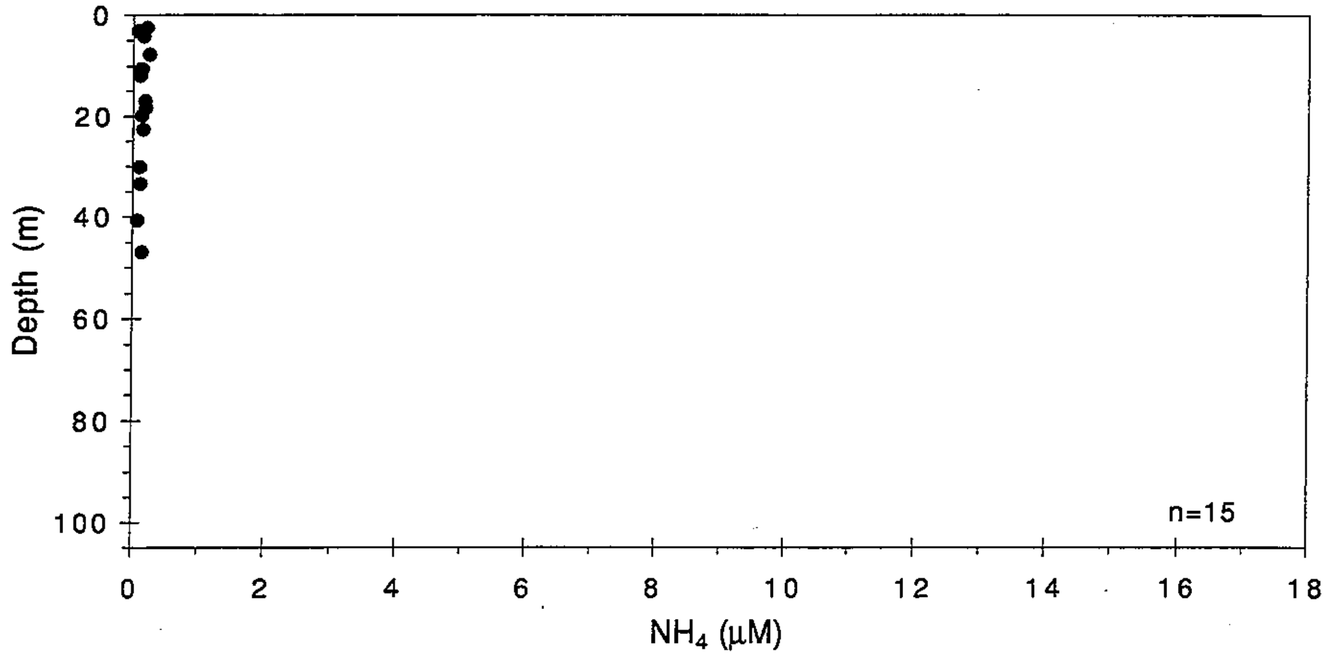

W9515
Depth (m)
0
20
40
60
80
100
n=85
0
2
4
6
8
10
12
14
16
18
NH4 (μM)


W9515
Depth (m)
0
20
40
60
80
100
n=85
0
2
4
6
8
10
12
NO3 (μM)


W9516
Depth (m)
NH4 (μM)
n=55
0
20
40
60
80
100
0
2
4
6
8
10
12
14
16
18

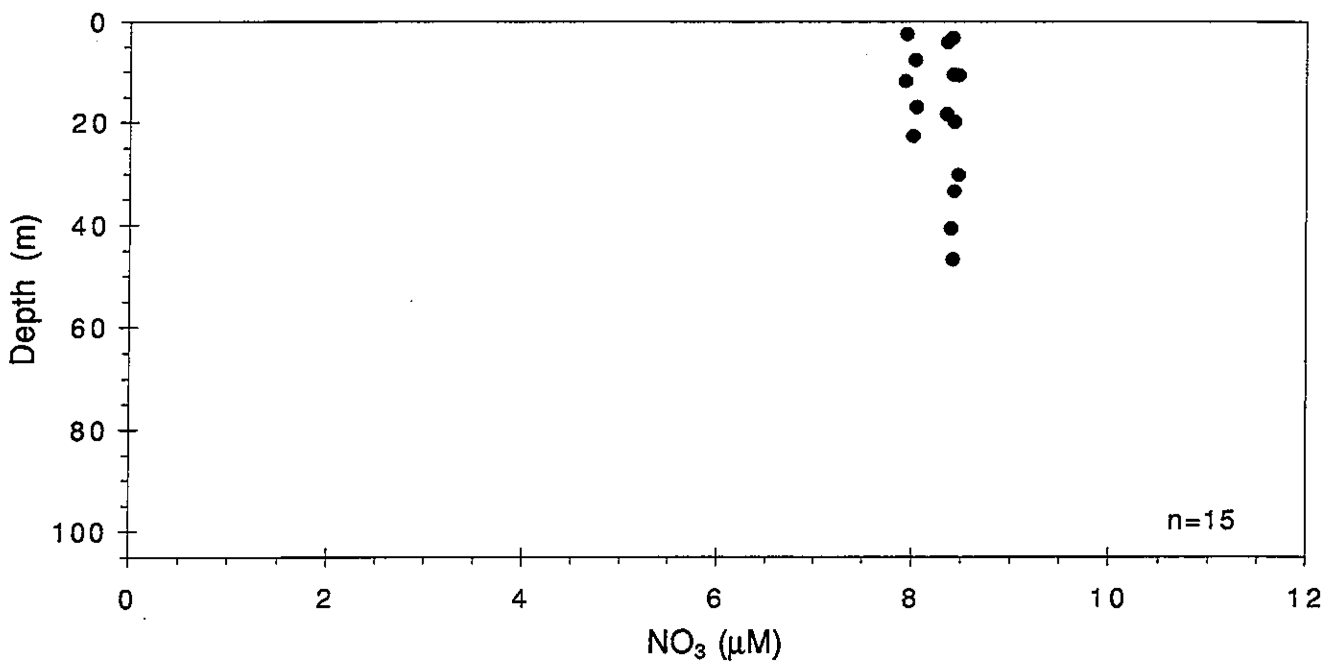

W9516
Depth (m)
NO3 (μM)
n=55
0
20
40
60
80
100
0
2
4
6
8
10
12

W9517 .

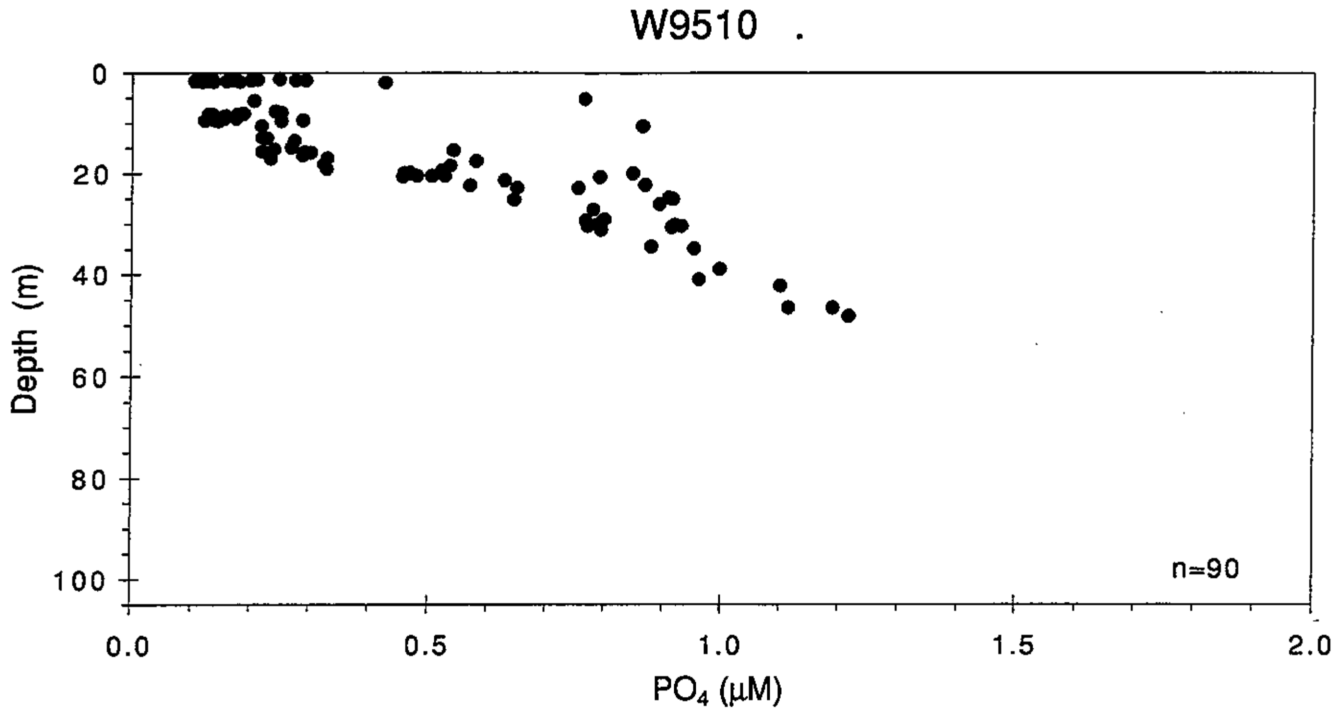


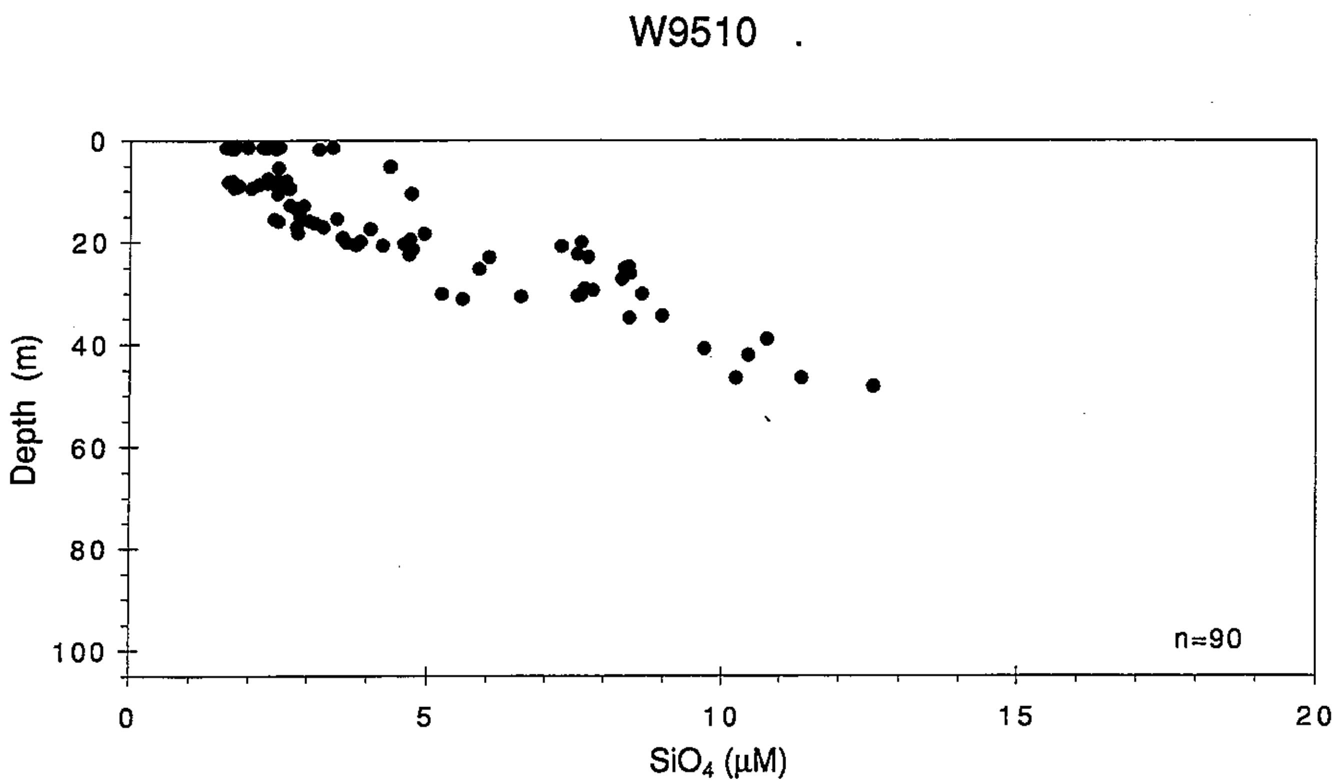
Depth (m)
0
20
40
60
80
100
n=15
0
2
4
6
8
10
12
14
16
18
NH4 (µM)

W9517 .

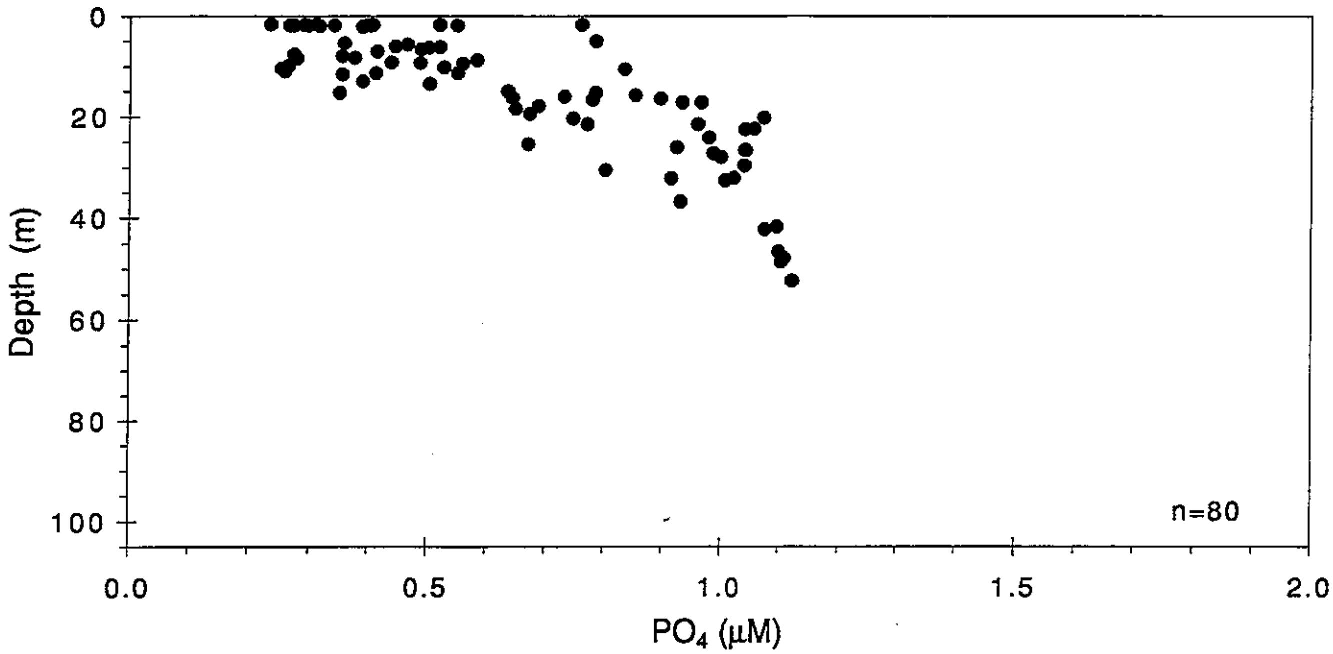


Depth (m)
0
20
40
60
80
100
n=15
0
2
4
6
8
10
12
NO3 (µM)


W9510 .
0
20
40
60
80
100
Depth (m)
n=90
0.0
0.5
1.0
1.5
2.0
PO4 (µM)

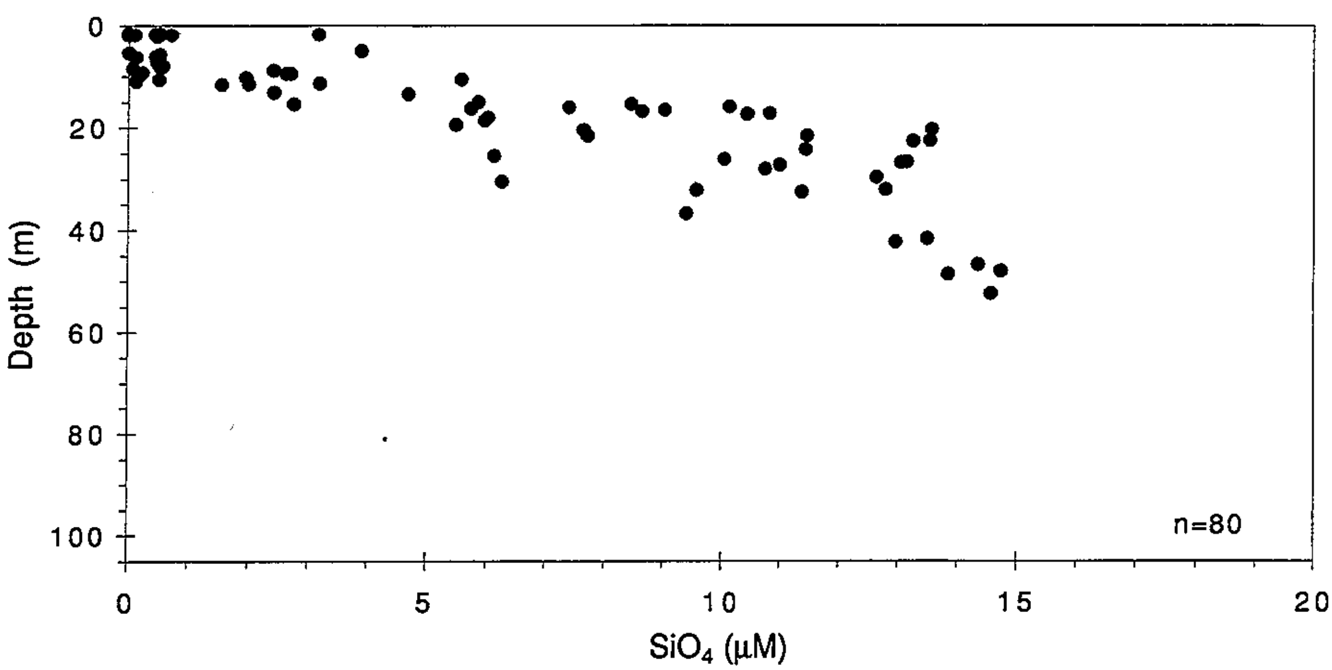

W9510 .
0
20
40
60
80
100
Depth (m)
n=90
0
5
10
15
20
SiO4 (µM)

W9512 .

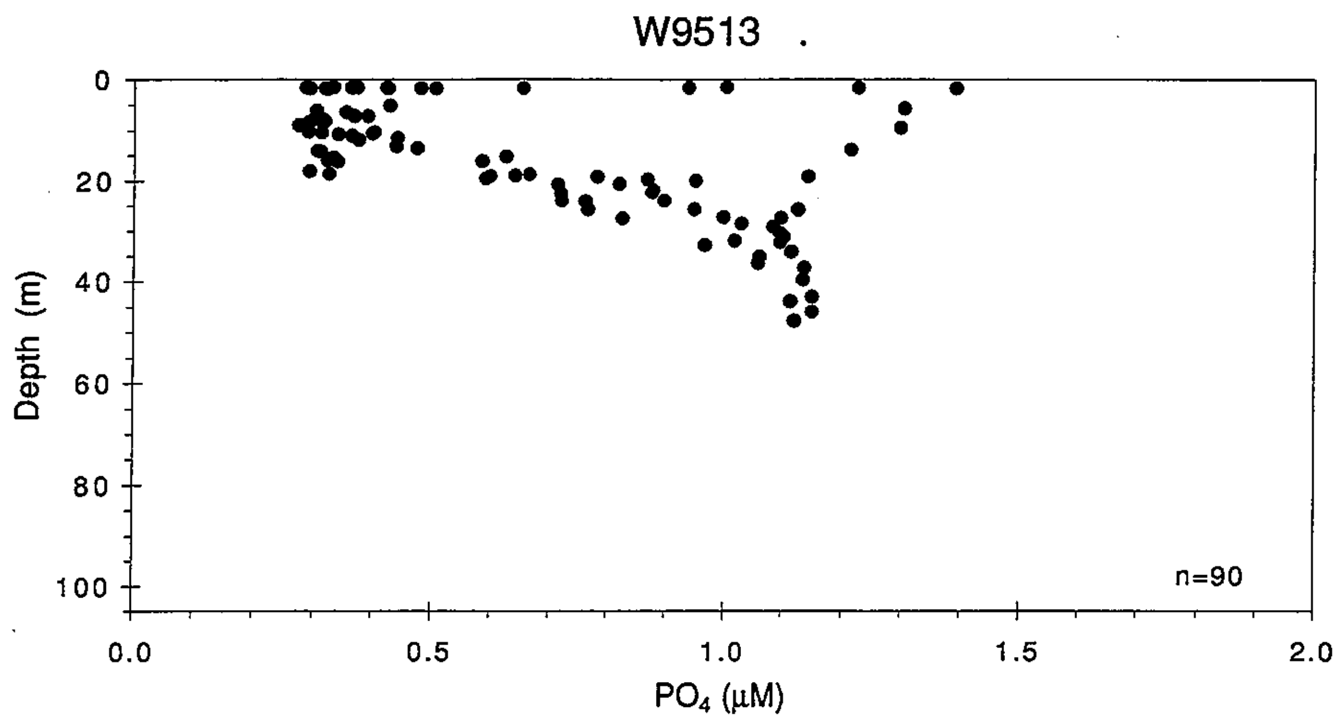


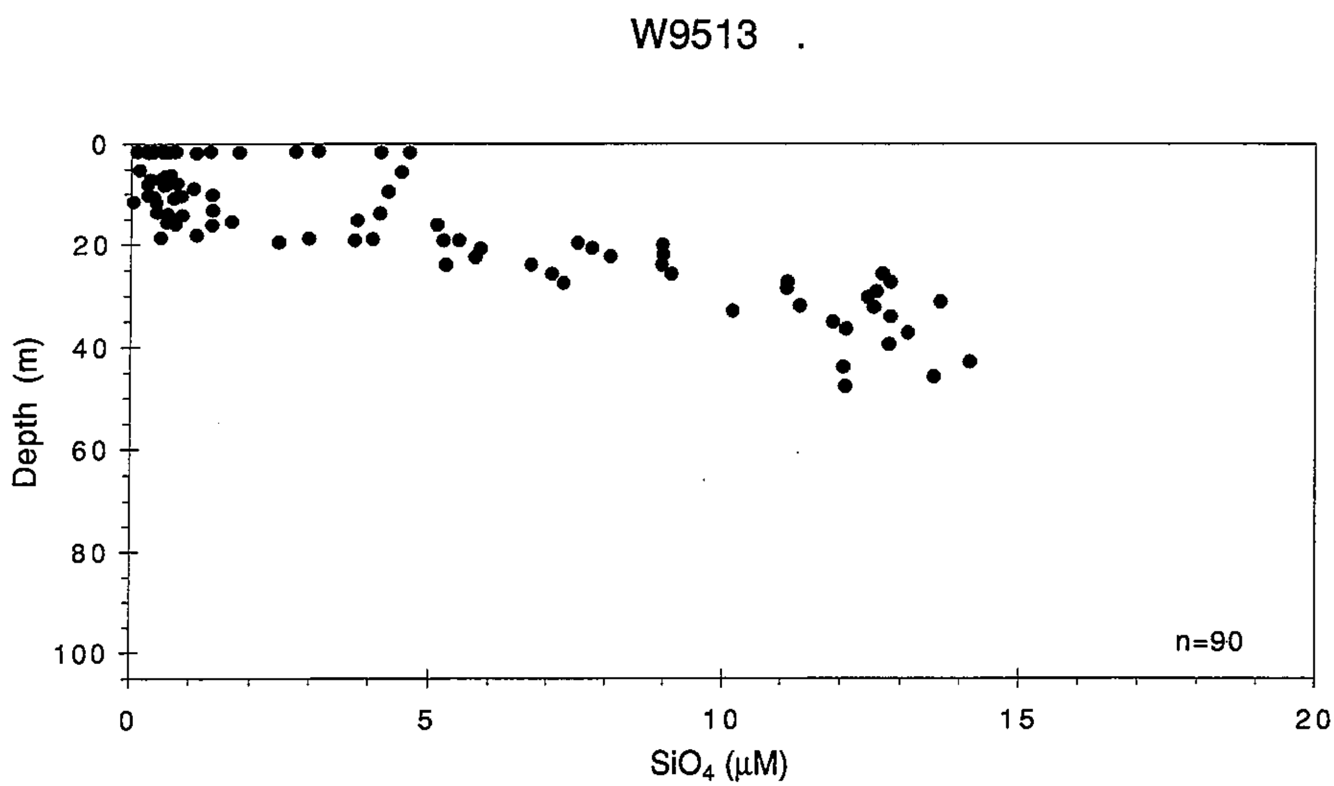
Depth (m)
0
20
40
60
80
100
n=80
0.0
0.5
1.0
1.5
2.0
PO4 (µM)

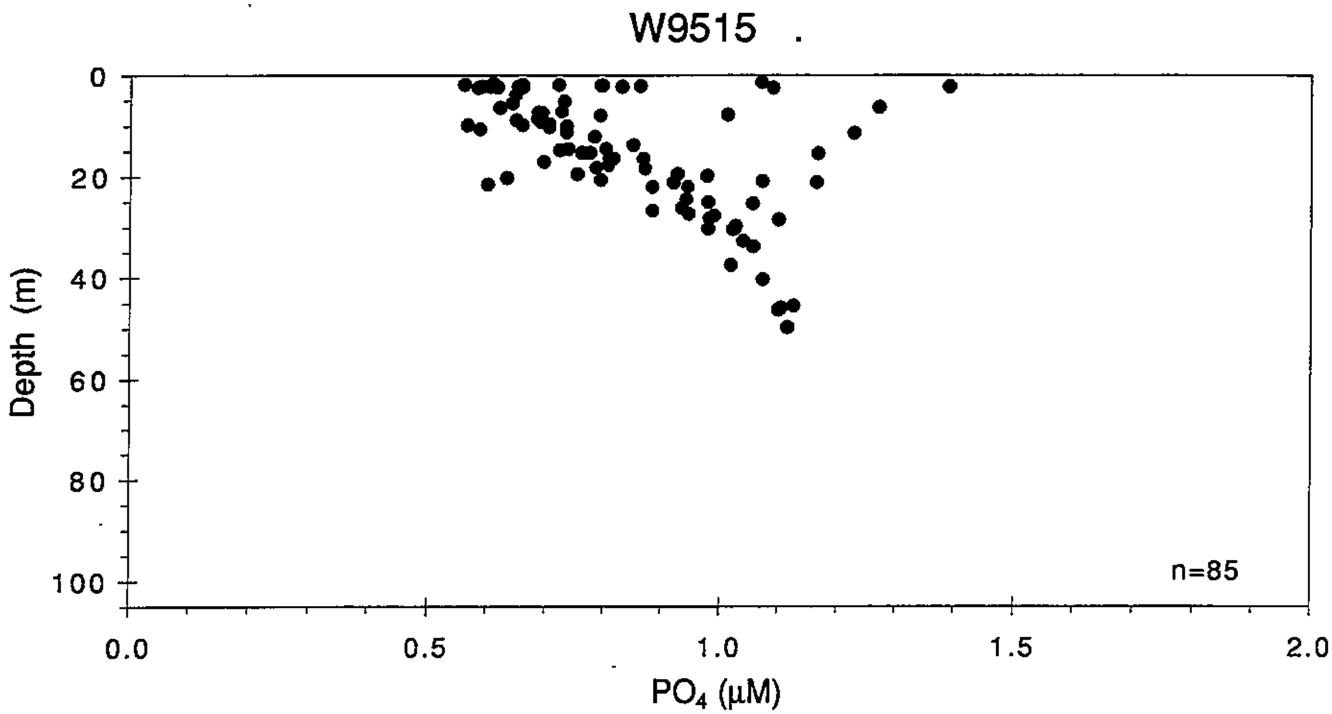
W9512 .

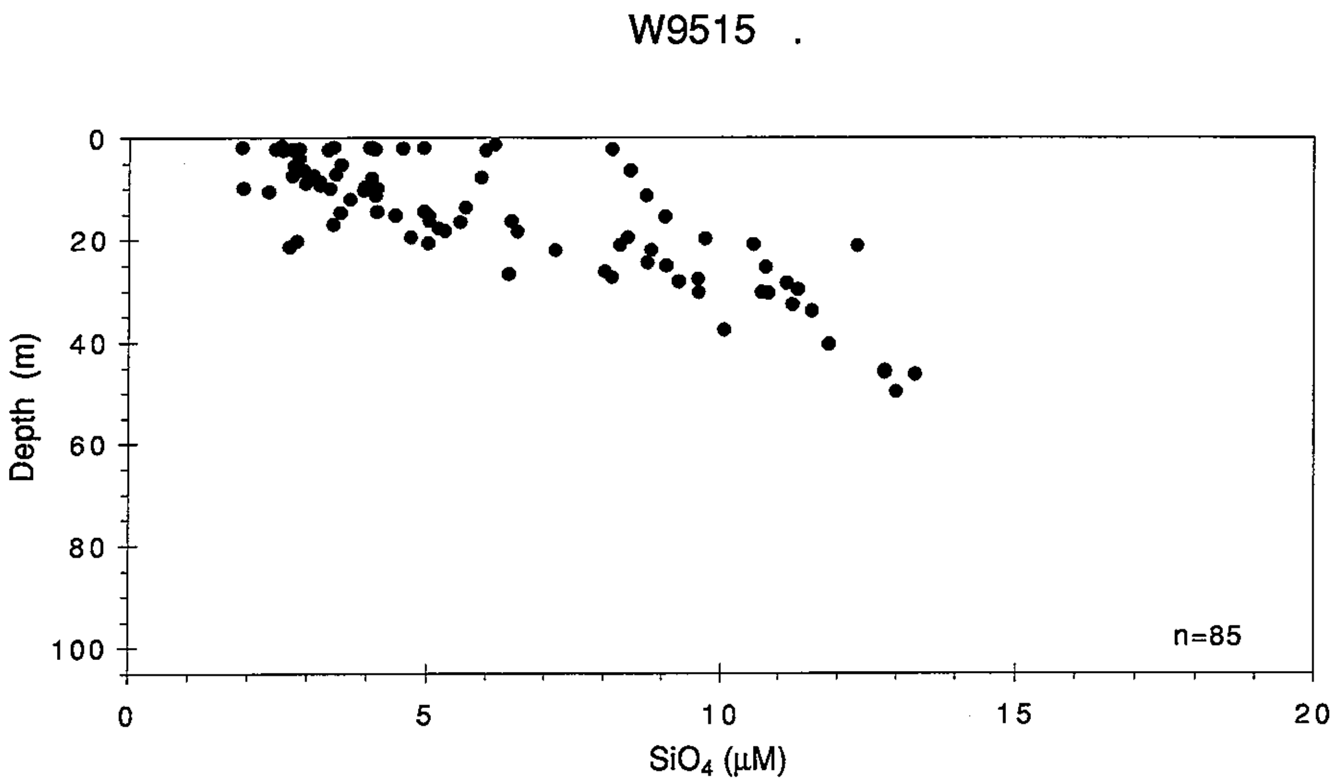


Depth (m)
0
20
40
60
80
100
n=80
0
5
10
15
20
SiO4 (µM)

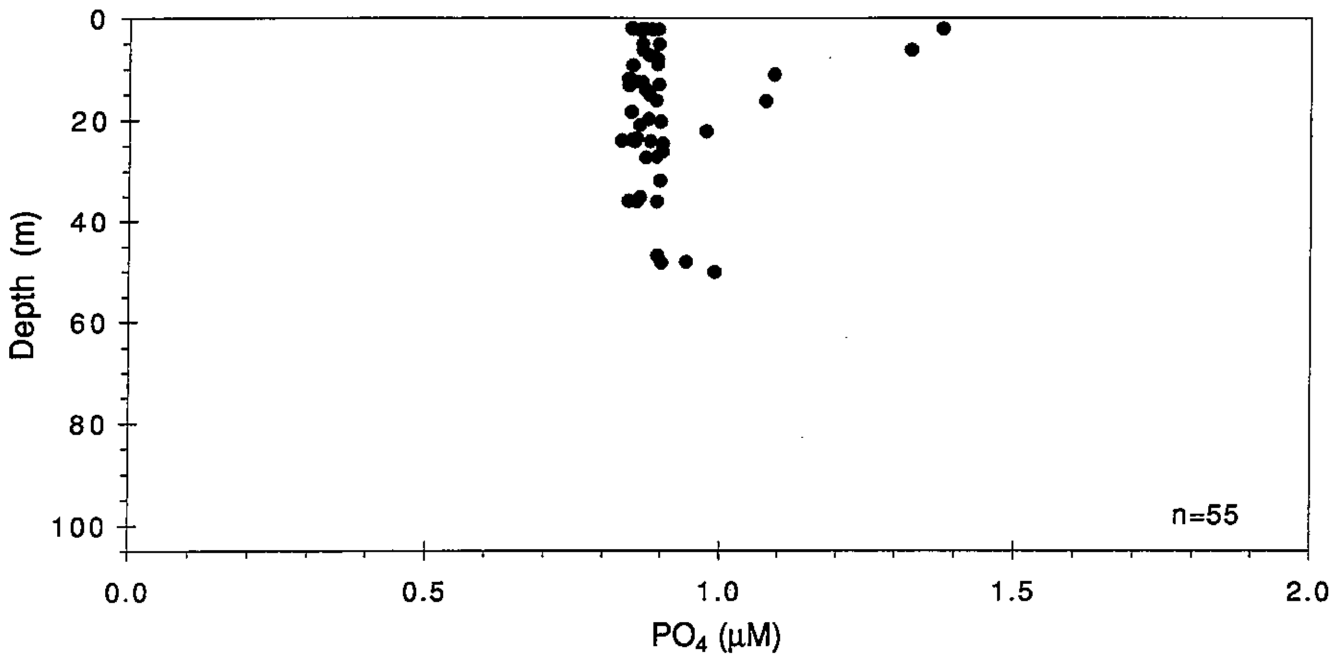

W9513
Depth (m)
0
20
40
60
80
100
n=90
0.0
0.5
1.0
1.5
2.0
PO4 (µM)


W9513
Depth (m)
0
20
40
60
80
100
n=90
0
5
10
15
20
SiO4 (µM)

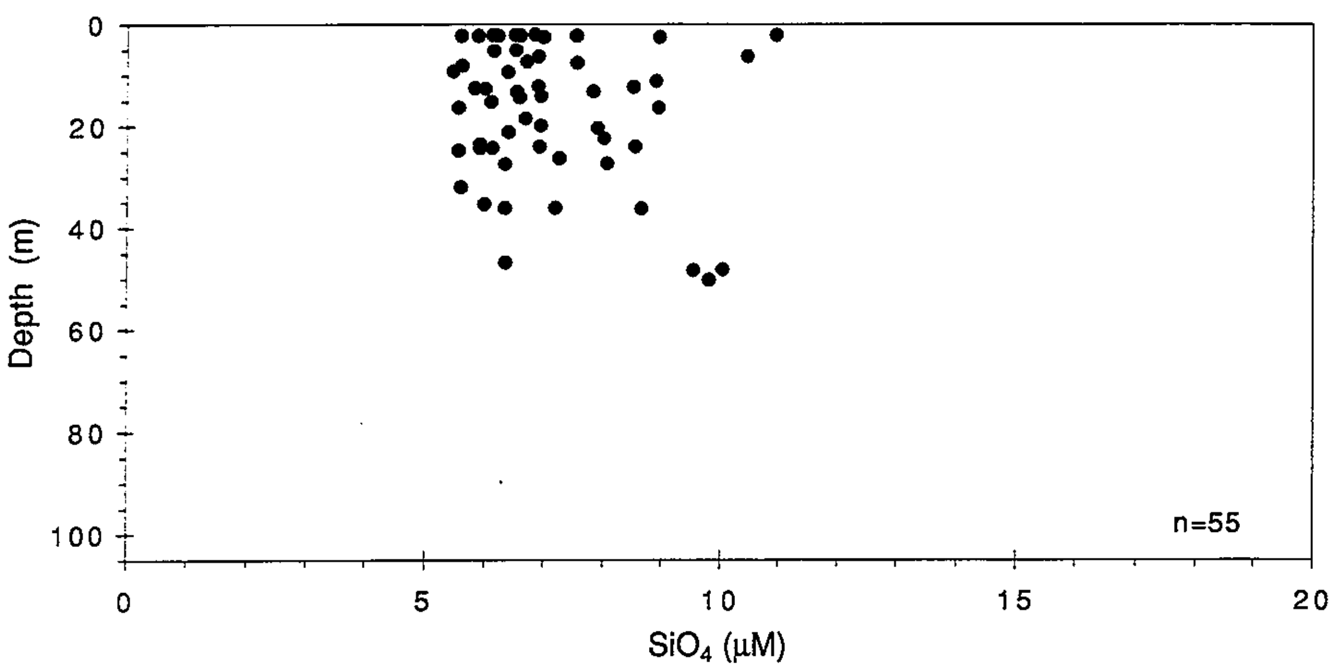

W9515 .
0
20
40
60
80
100
Depth (m)
n=85
0.0
0.5
1.0
1.5
2.0
PO4 (µM)

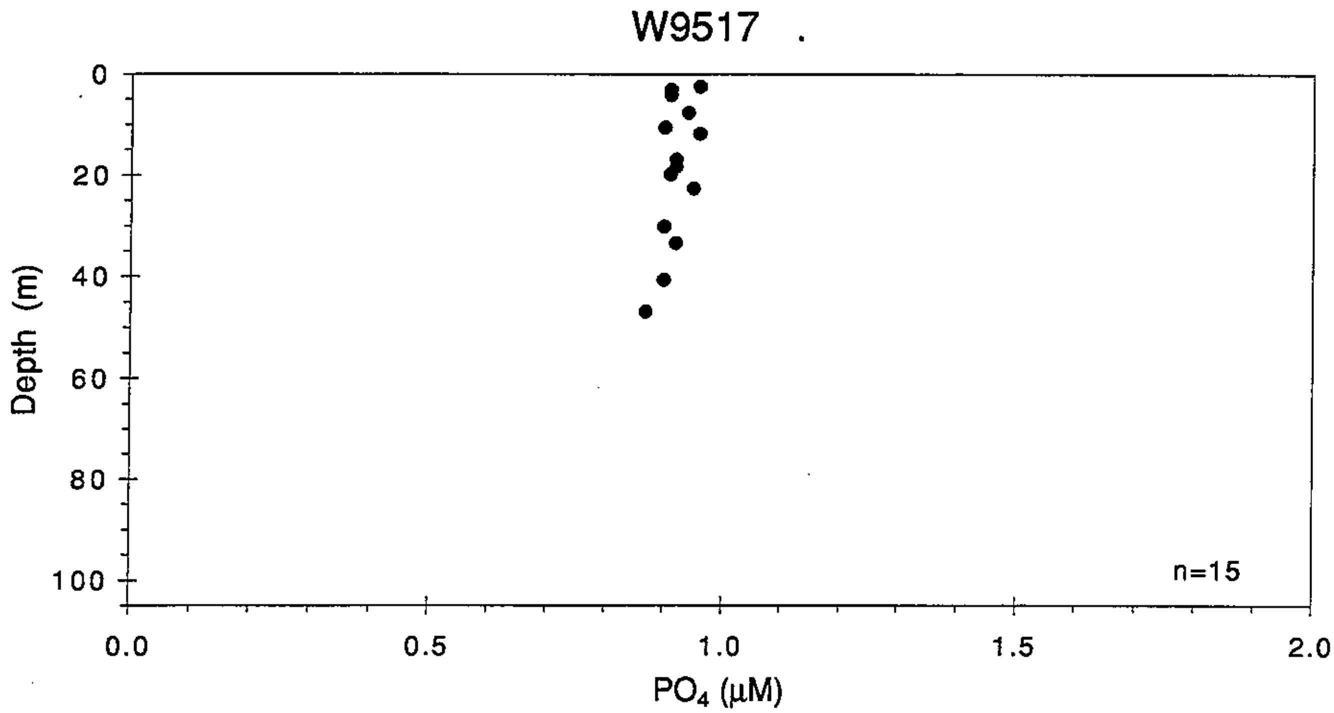

W9515 .
0
20
40
60
80
100
Depth (m)
n=85
0
5
10
15
20
SiO4 (µM)

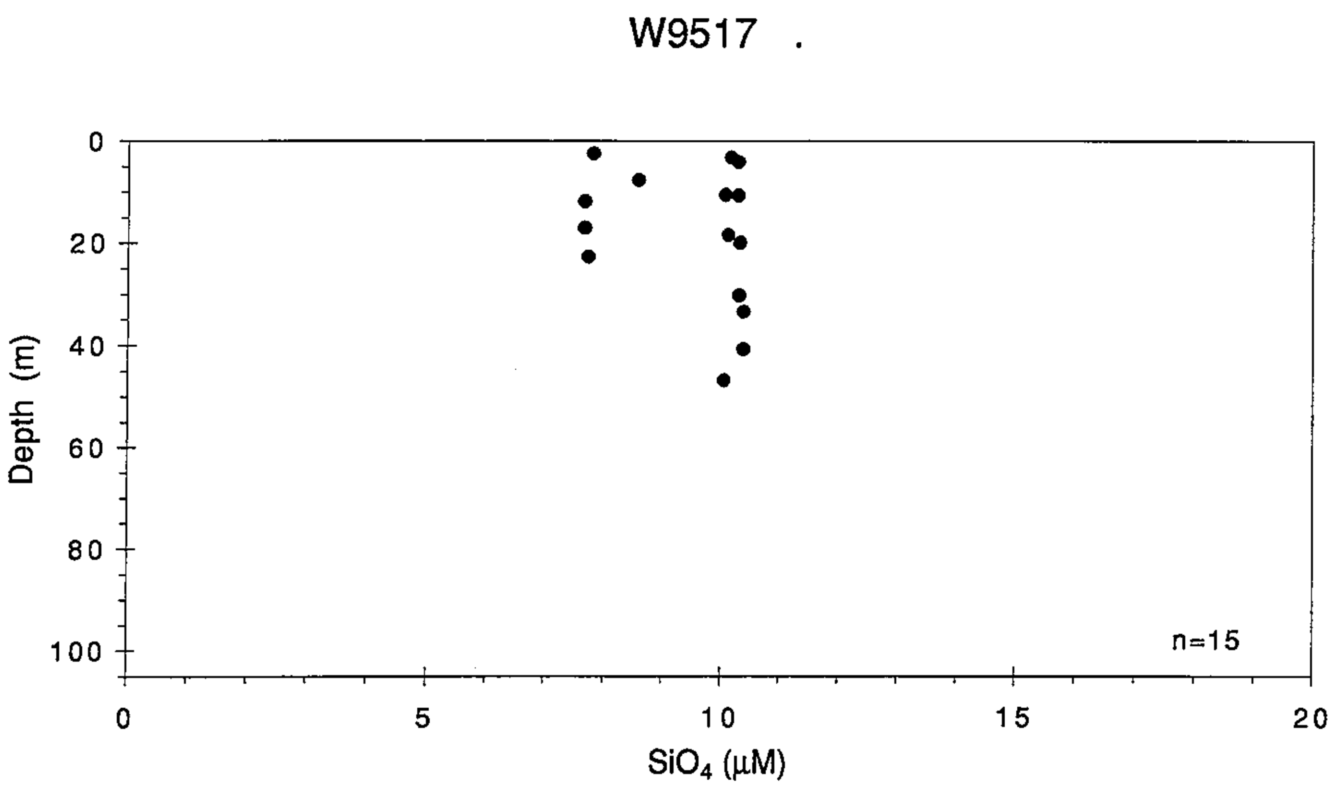
W9516 .


Depth (m)
0
20
40
60
80
100
0.0
0.5
1.0
1.5
2.0
PO4 (µM)
n=55

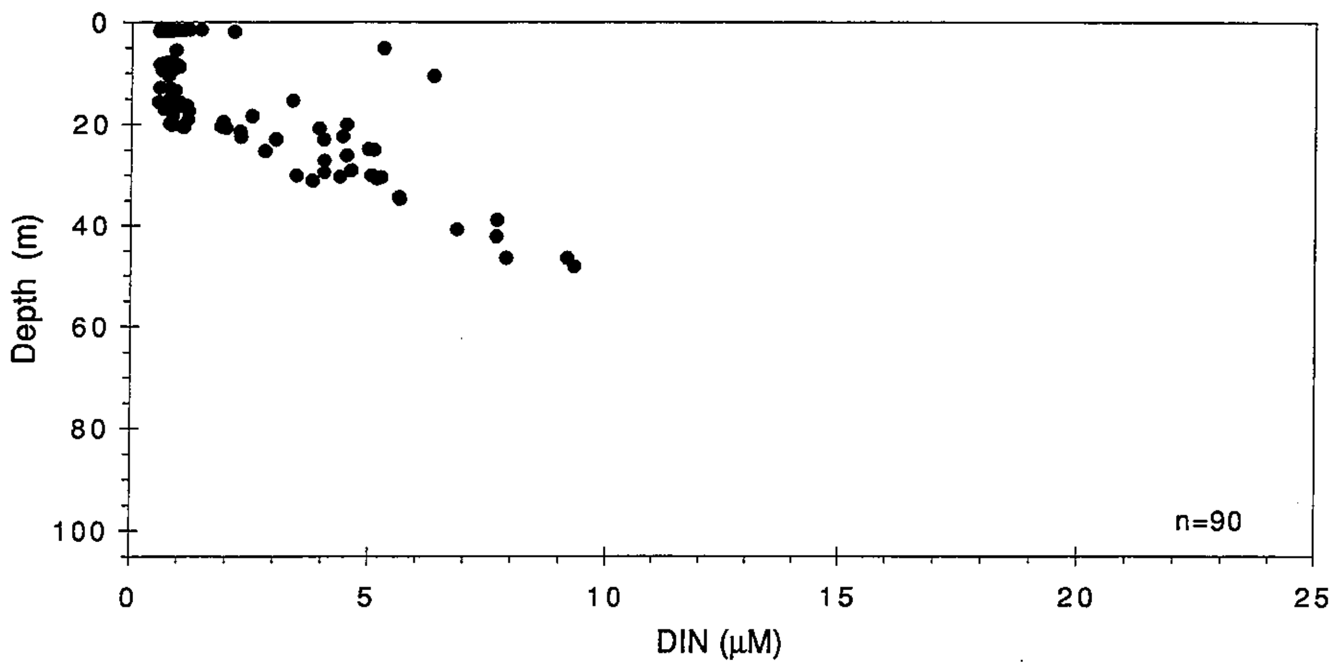
W9516 .


Depth (m)
0
20
40
60
80
100
0
5
10
15
20
SiO4 (µM)
n=55

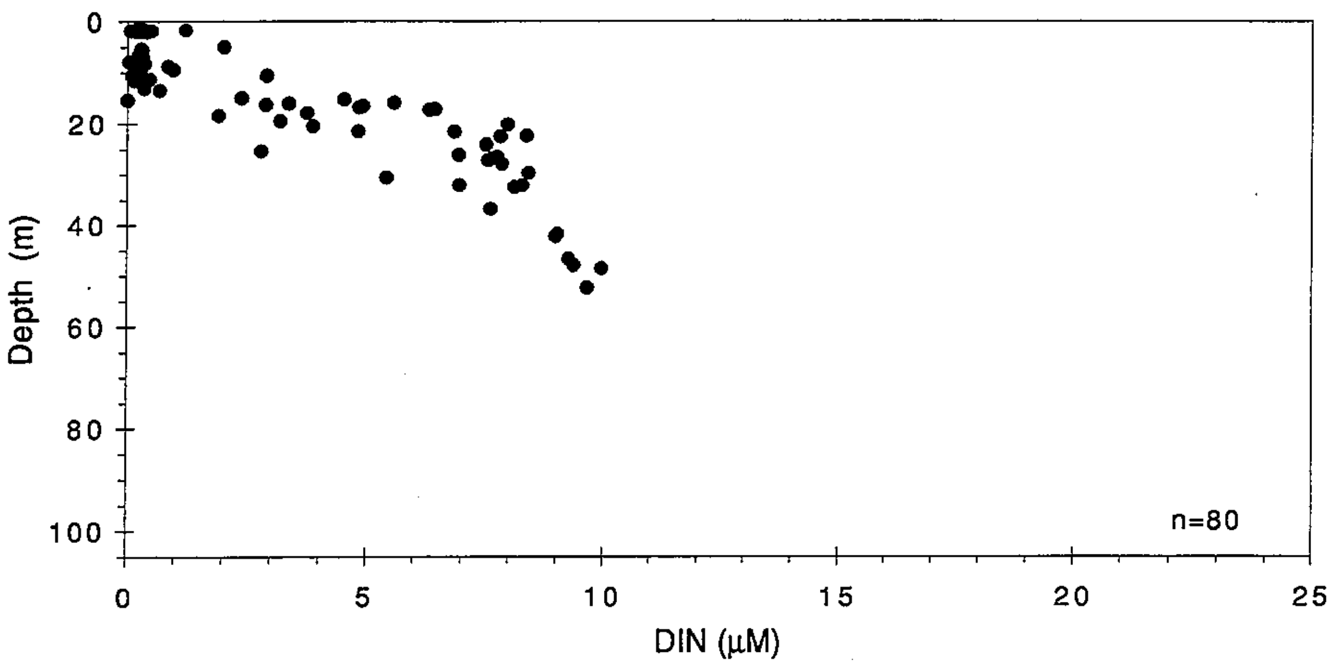

W9517
Depth (m)
0
20
40
60
80
100
n=15
0.0
0.5
1.0
1.5
2.0
PO4 (μM)


W9517
Depth (m)
0
20
40
60
80
100
n=15
0
5
10
15
20
SiO4 (μM)

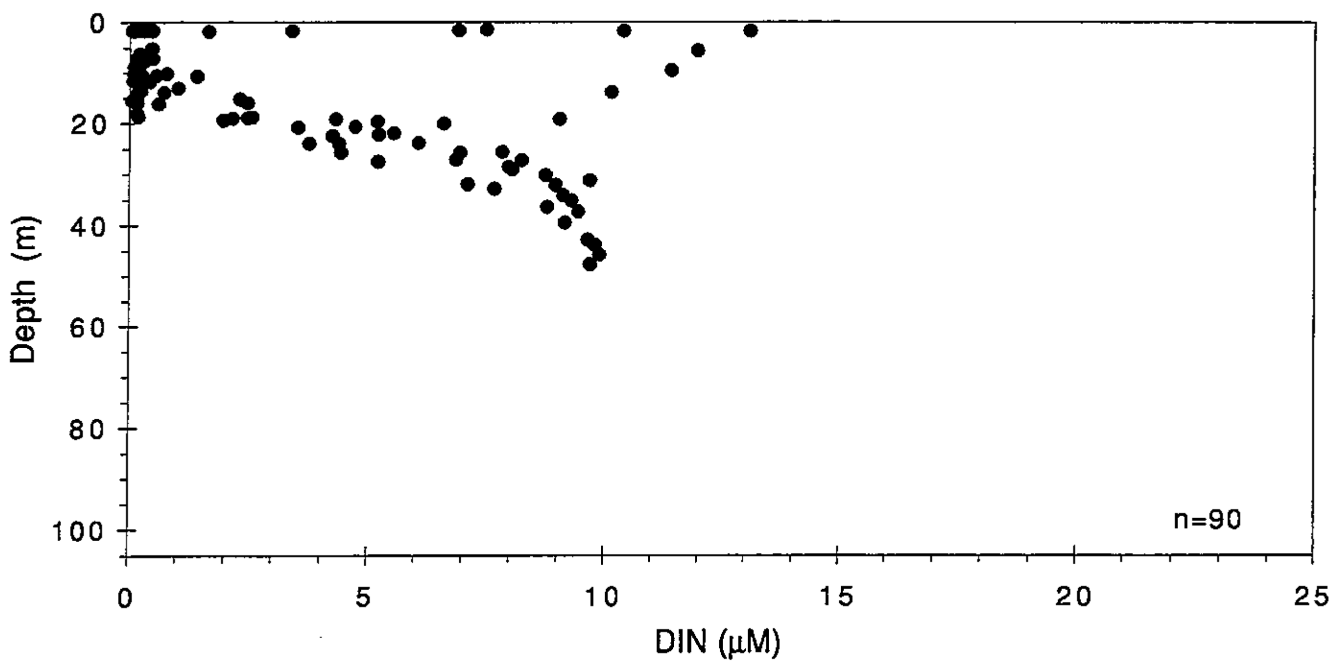
W9510 .



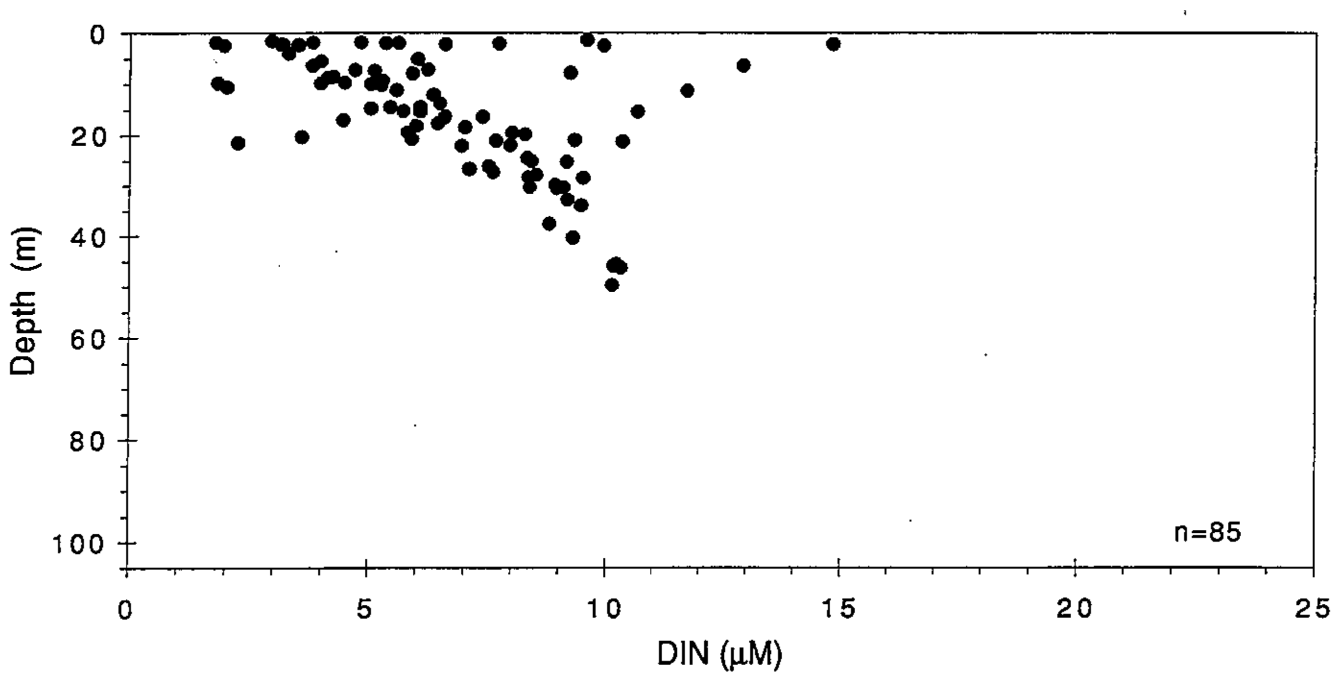
W9512



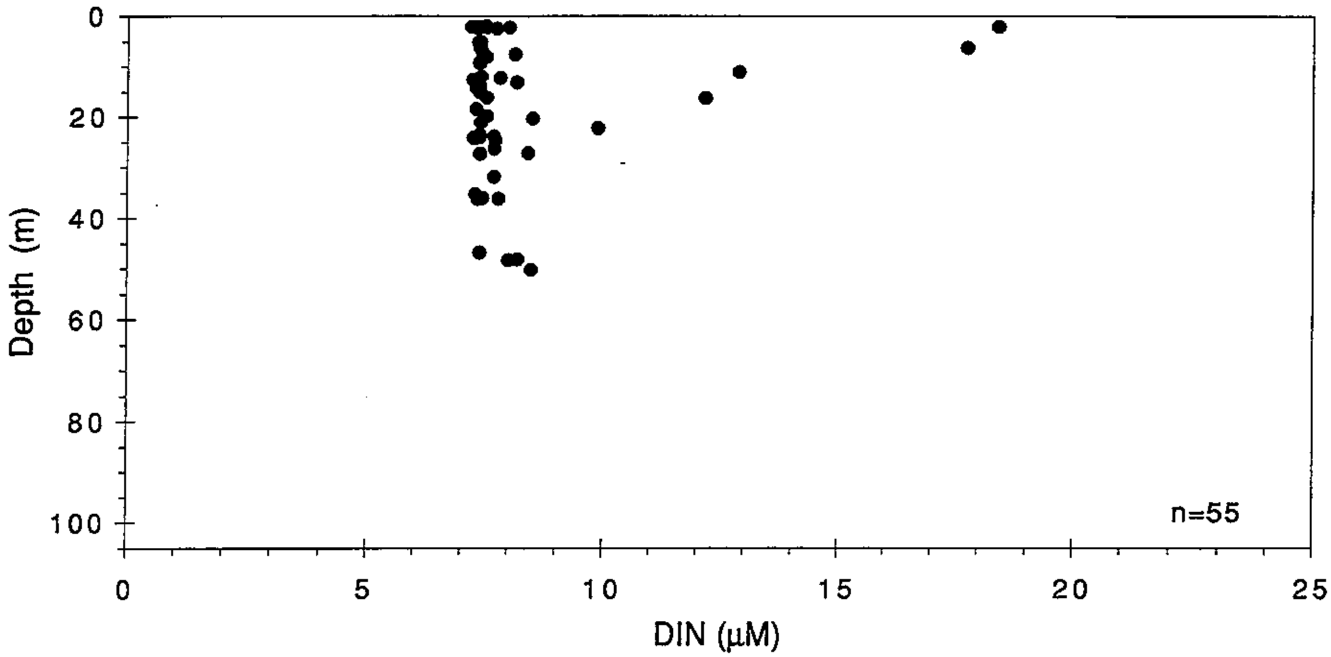
W9513



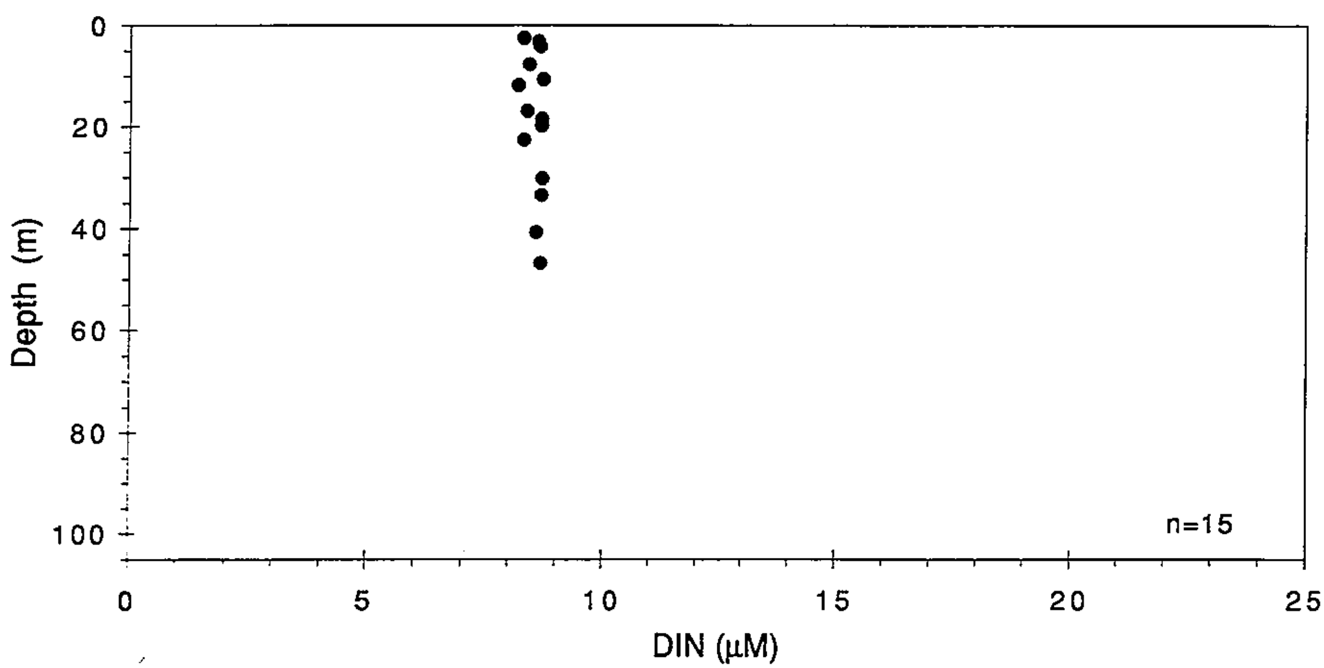
W9515



W9516



W9517



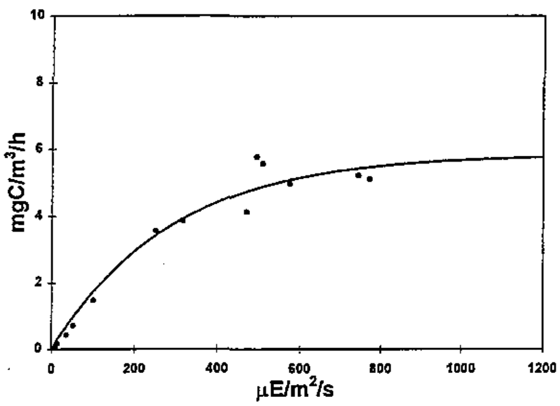
APPENDIX E

Photosynthesis-Irradiance (P-I) Curves

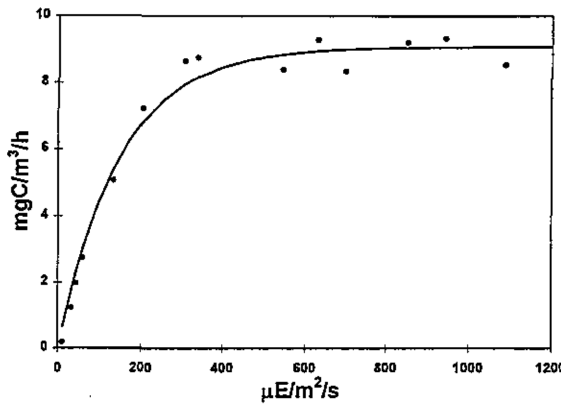
Productivity calculations (Appendix A) utilized light attenuation data from a CTD-mounted 4π sensor and incident light time-series data from an on-deck 2π irradiance sensor. After collection of the productivity samples, they were incubated in a temperature-controlled incubator. The resulting photosynthesis ($mgC/m^3/h$) versus light irradiance ($\mu E/m^2/s$, P-I) curves are comprehensively presented in this appendix. These data were used to determine hourly production at intervals throughout the day for each sampling depth.

W9510 Station N04

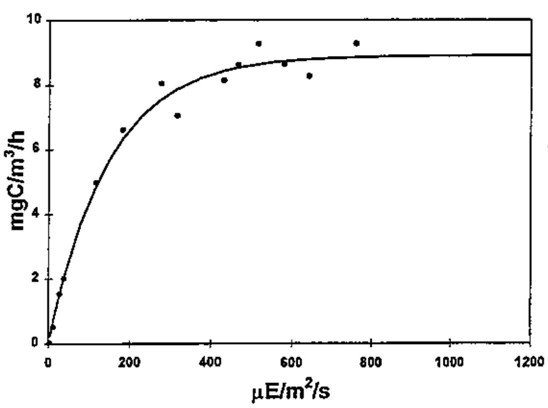
Surface



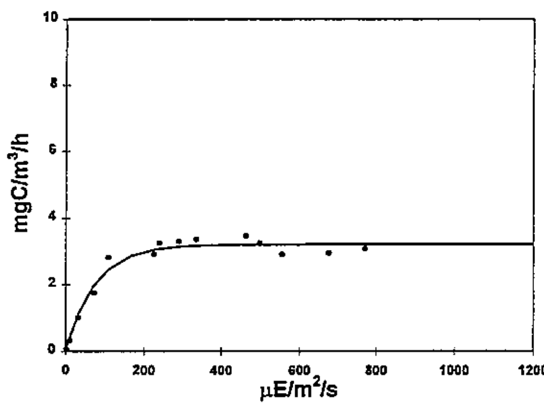
Mid Surface



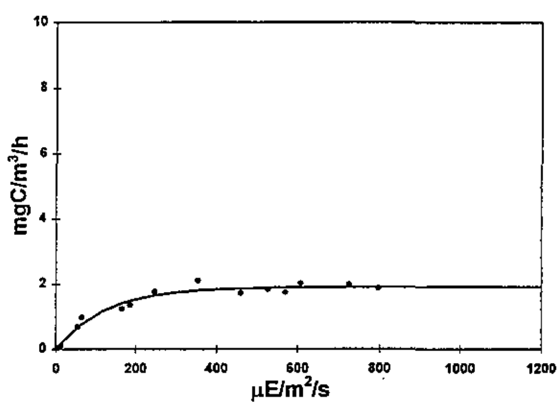
Middle



Mid Bottom

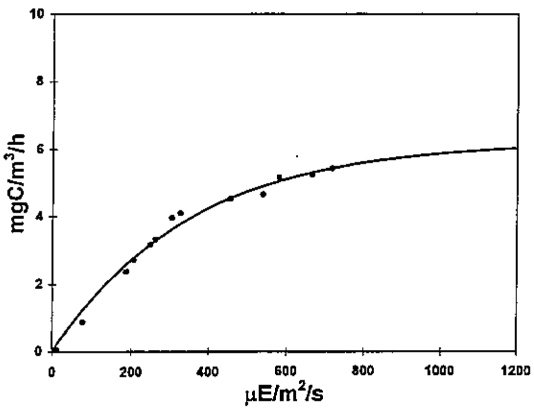


Bottom

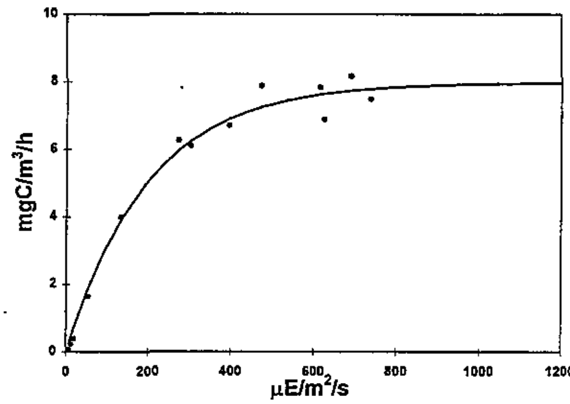


W9510 Station N16

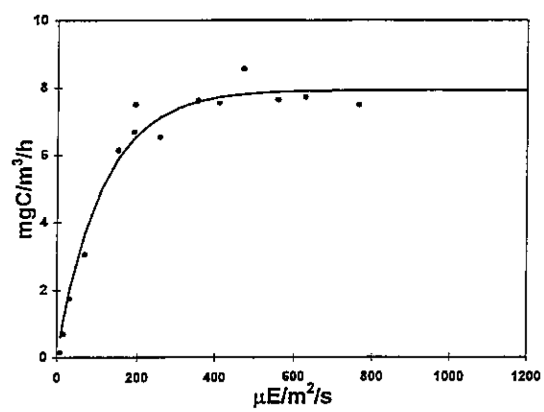
Surface



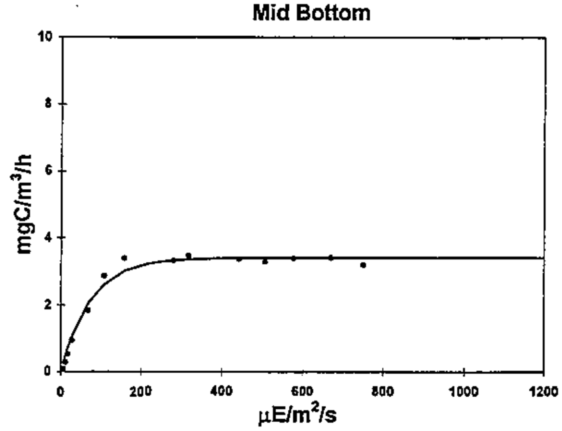
Mid Surface



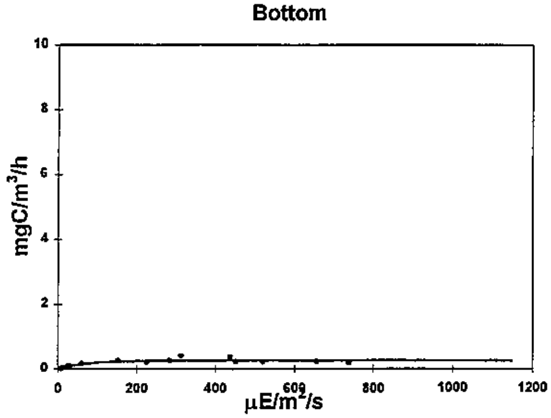
Middle



Mid Bottom

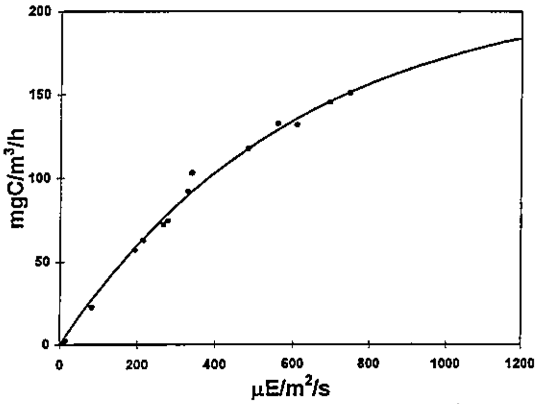


Bottom

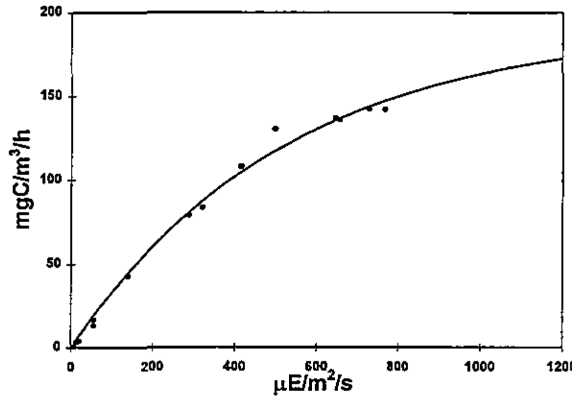


W9511 Station F23

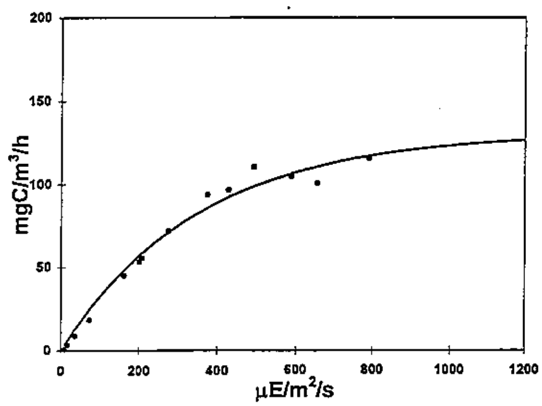
Surface



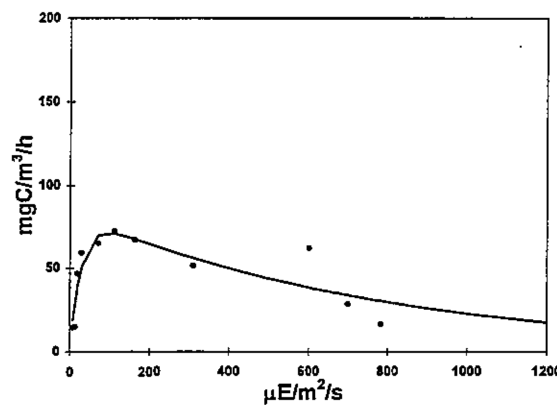
Mid Surface



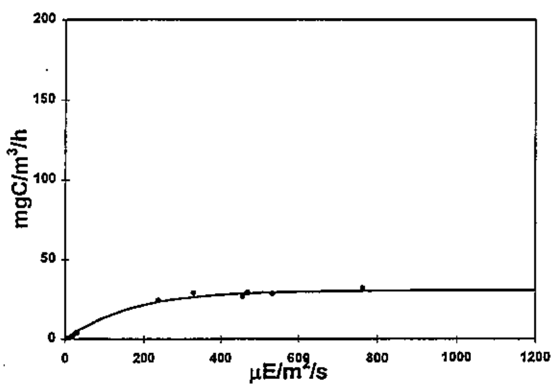
Middle



Mid Bottom

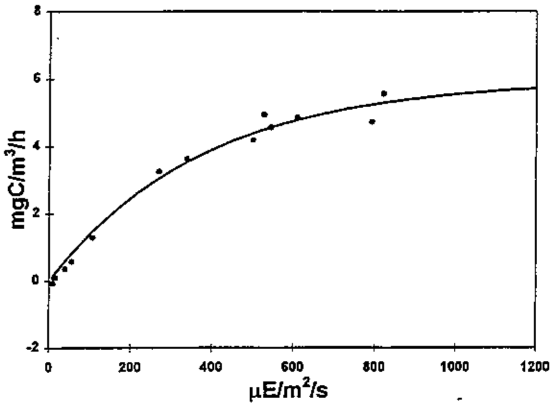


Bottom

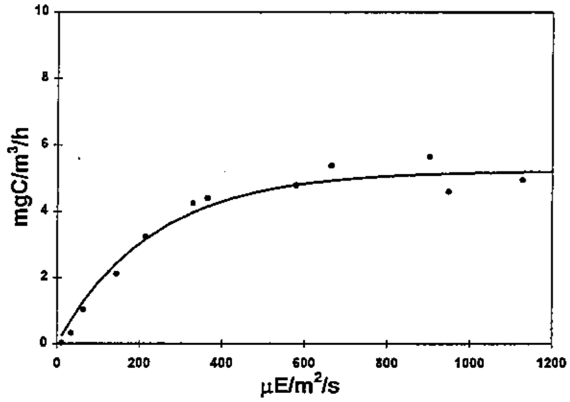


W9511 Station N16

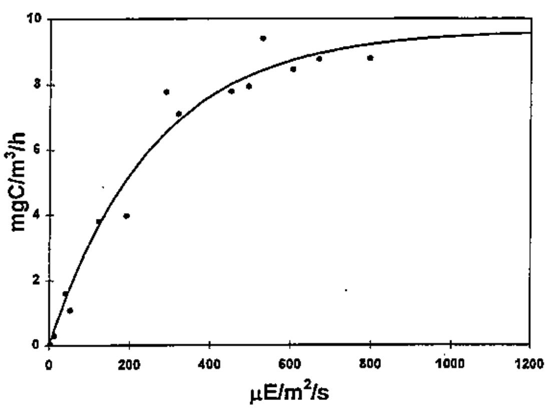
Surface



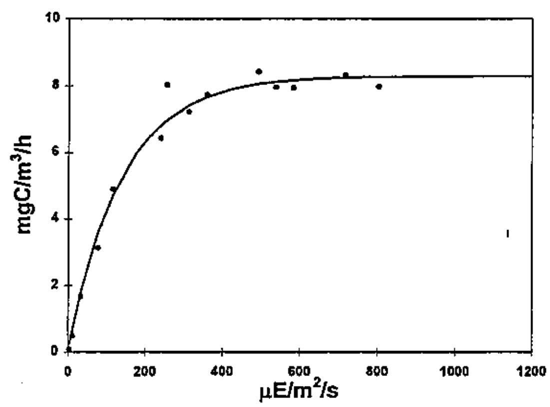
Mid Surface



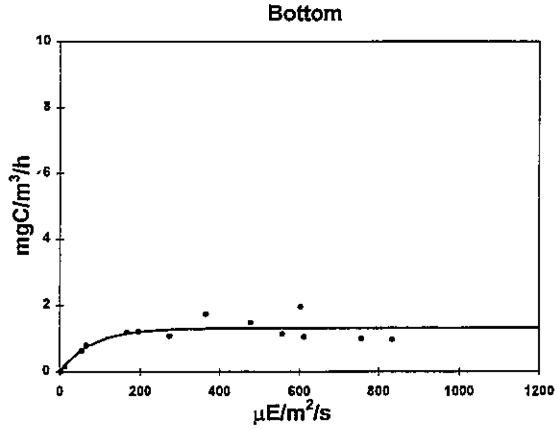
Middle



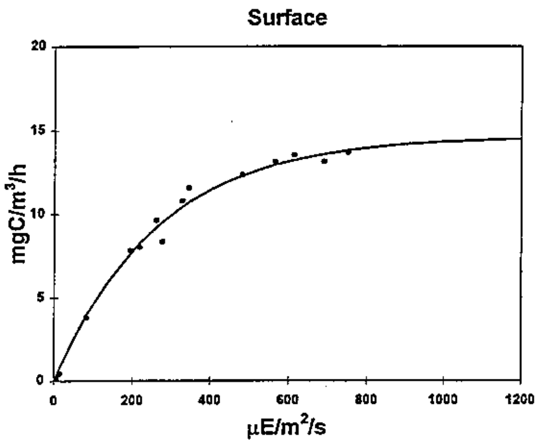
Mid Bottom

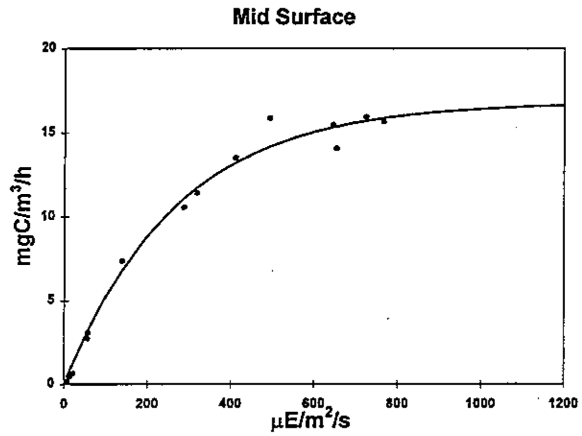


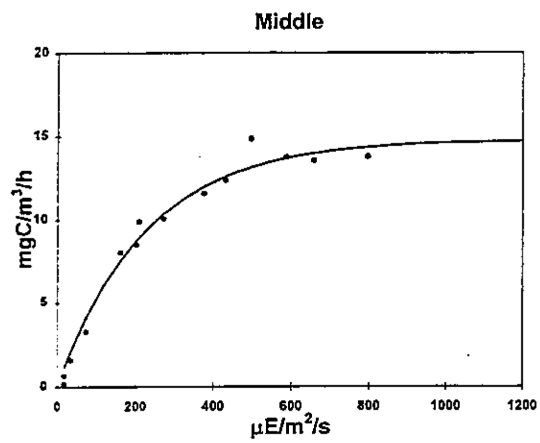
Bottom

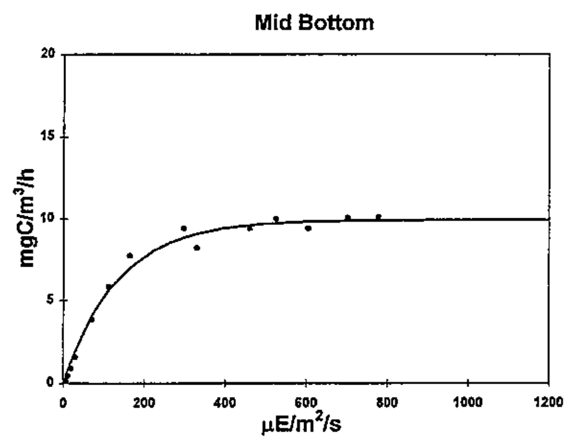


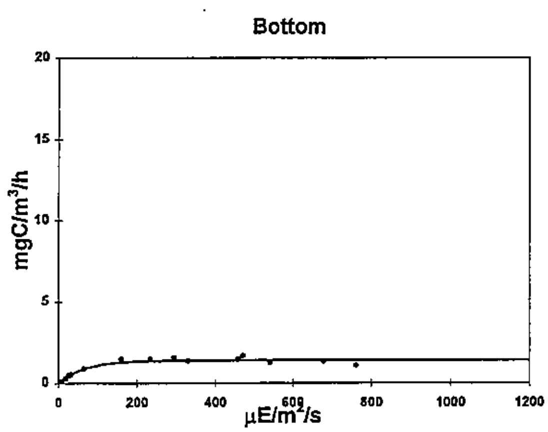
W9511 Station N04





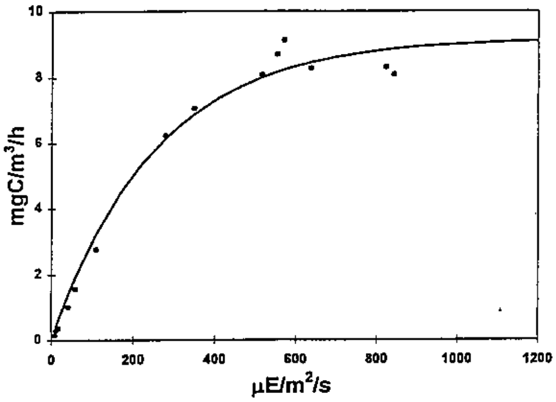




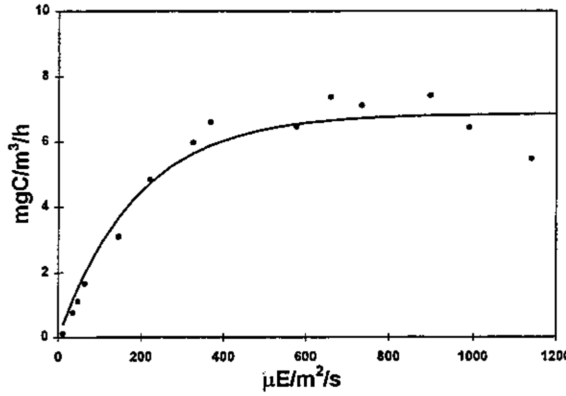


W9511 Station N07

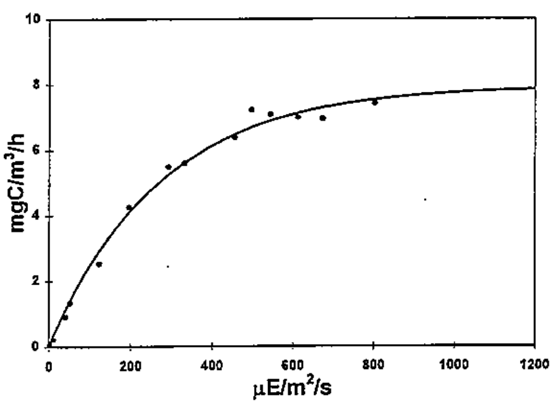
Surface



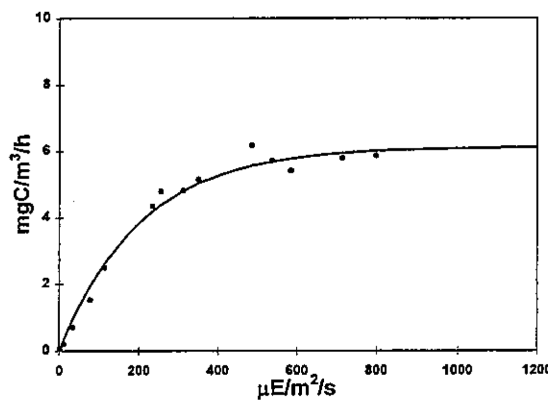
Mid Surface



Middle



Mid Bottom



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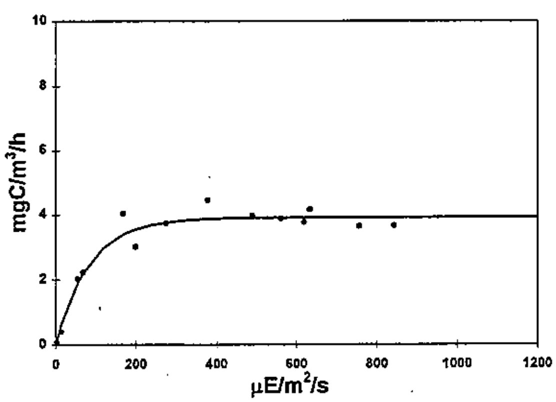
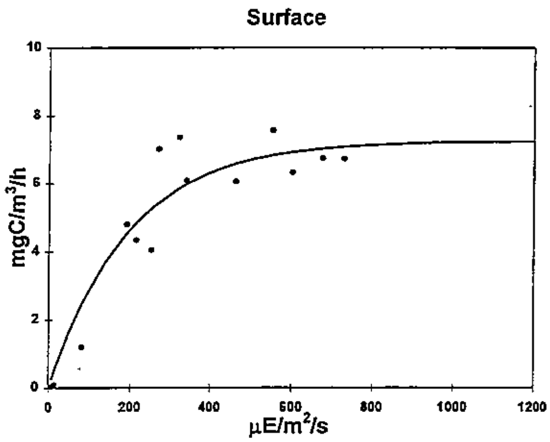
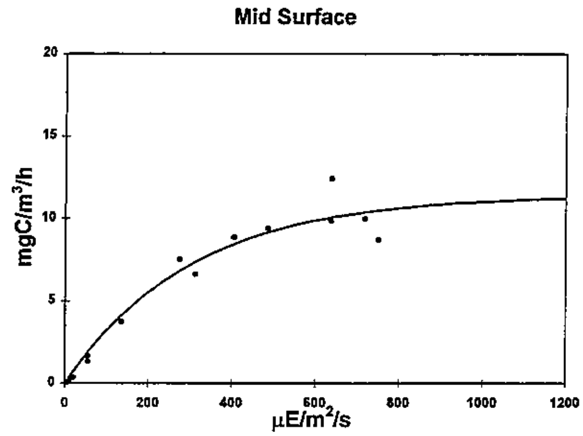
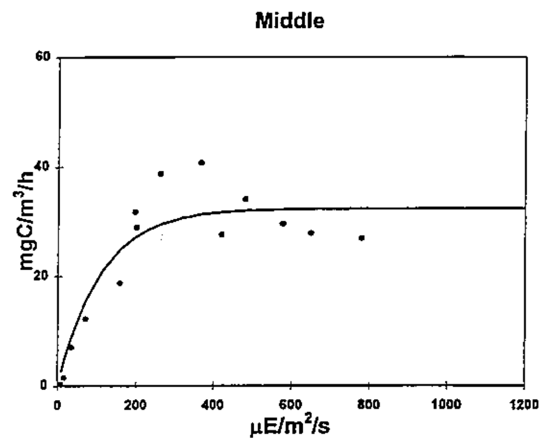
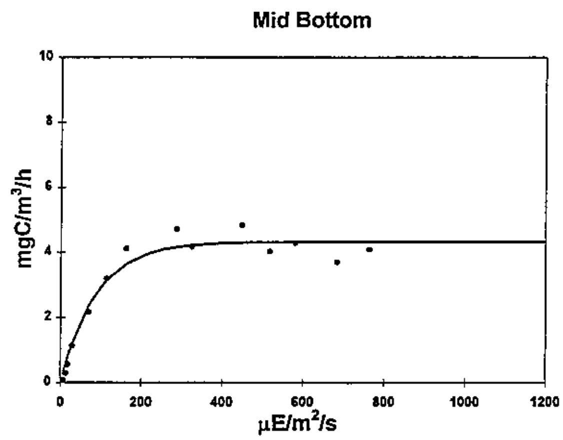


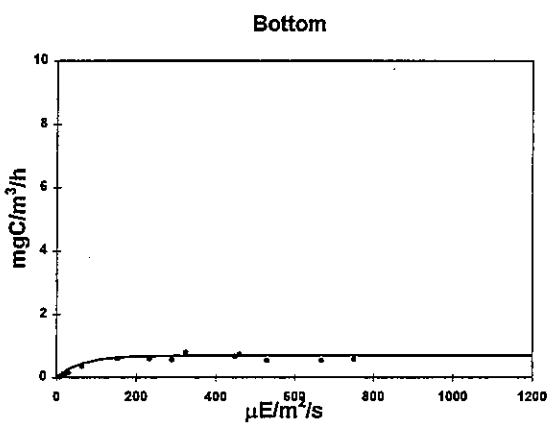
W9512 Station N16











W9513 Station N16

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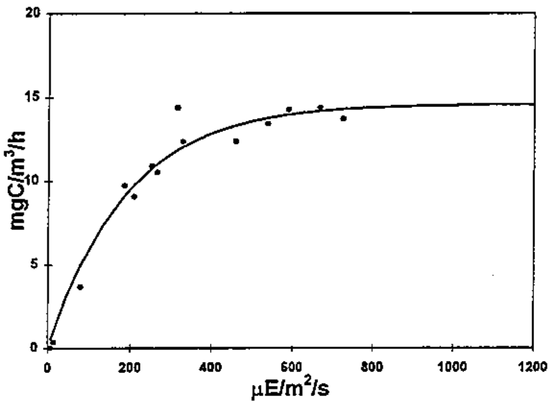

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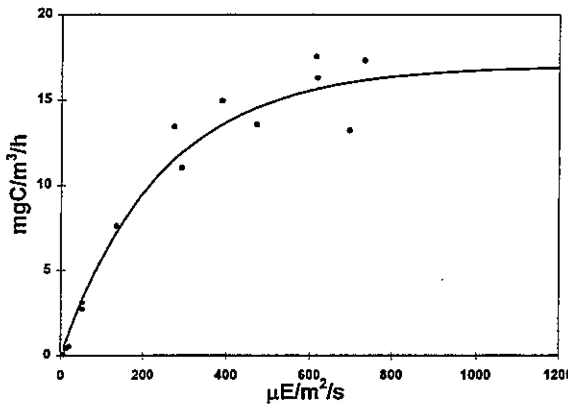

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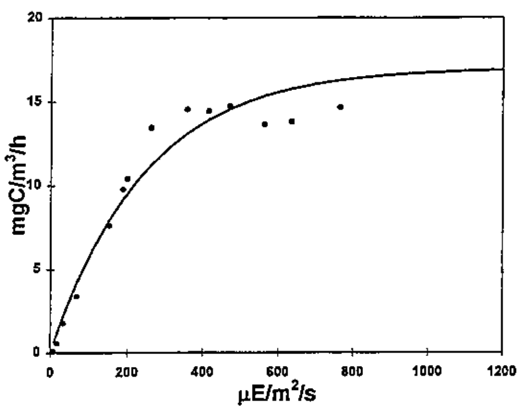

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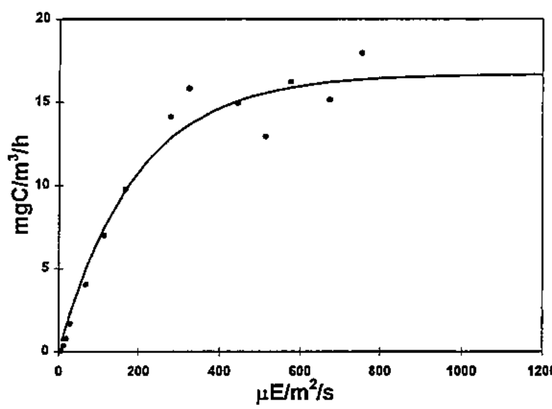

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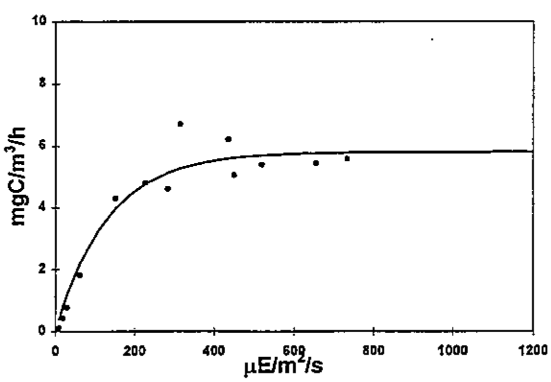

W9513 Station N04

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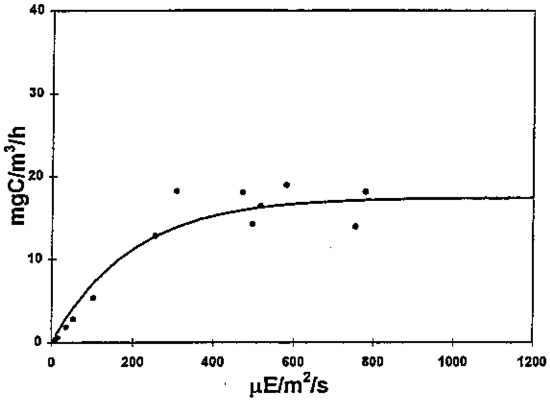

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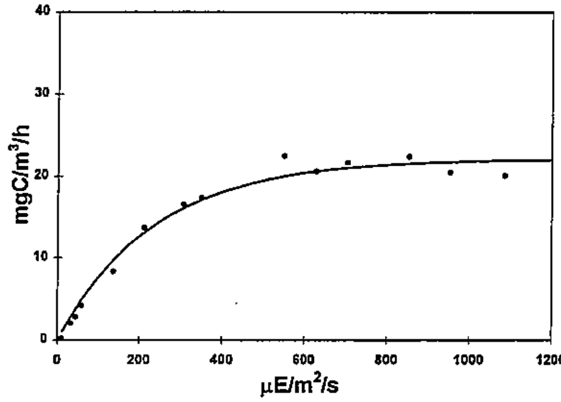

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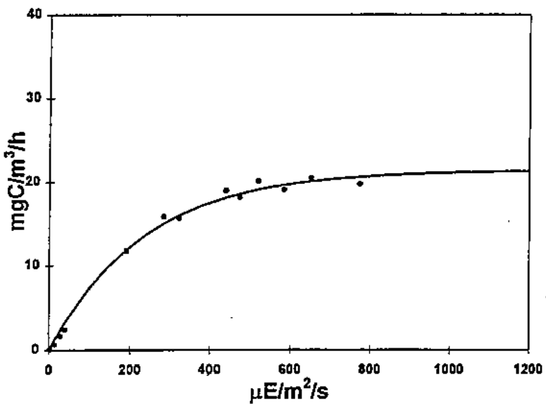

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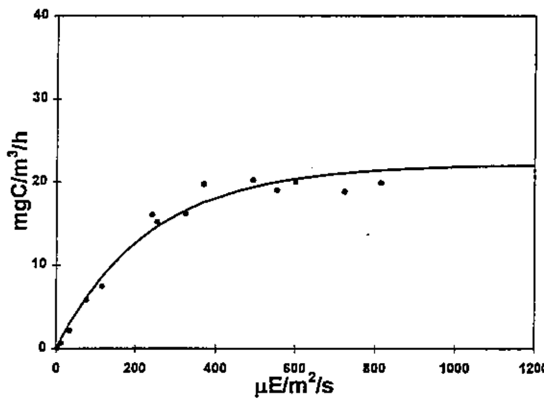

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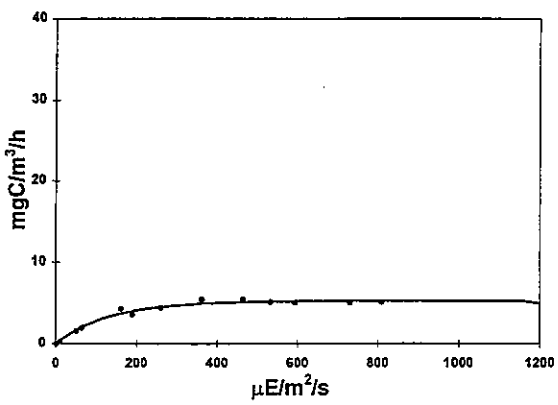

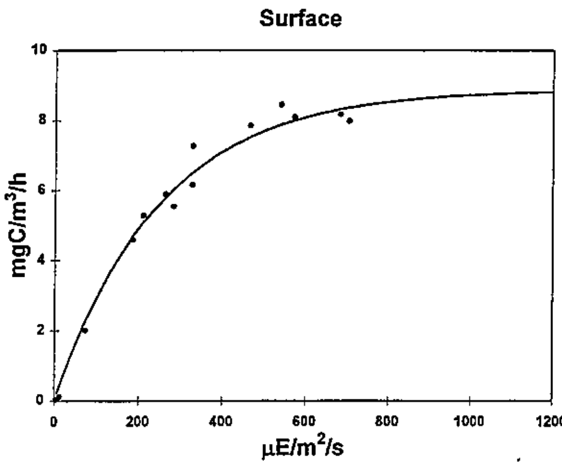
Surface
mgC/m3/h
μE/m2/s
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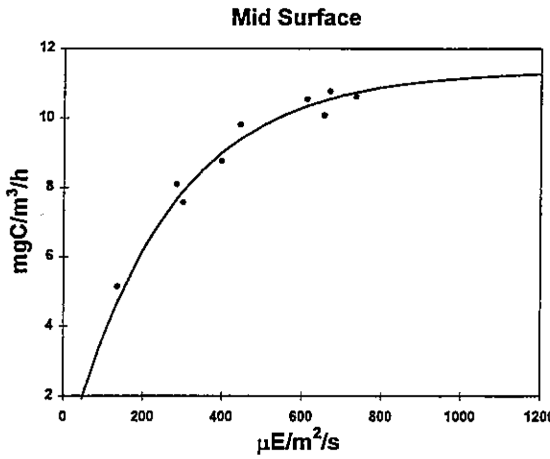
2
4
6
8
10
0
200
400
600
800
1000
1200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μE/m2/s
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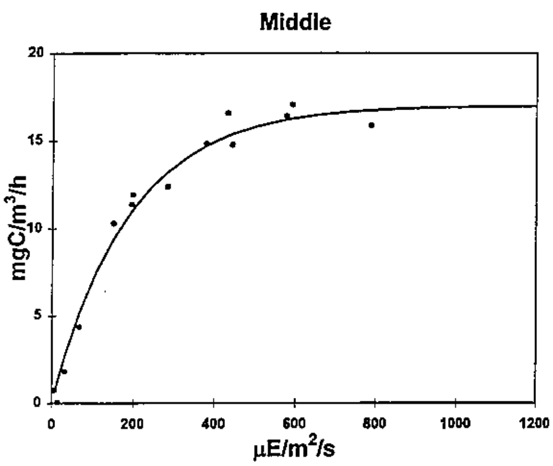
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μE/m2/s
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1000
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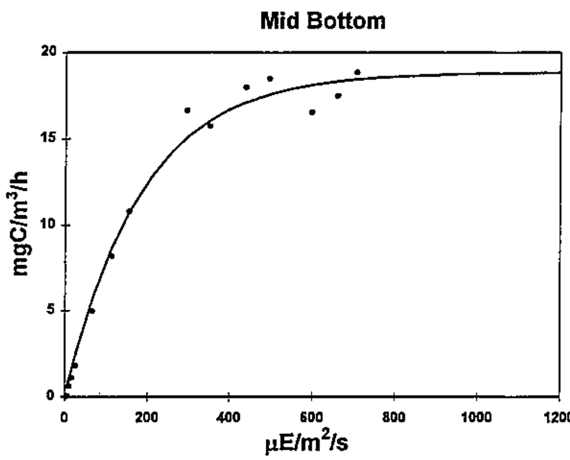
Mid Bottom
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μE/m2/s
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20
0
200
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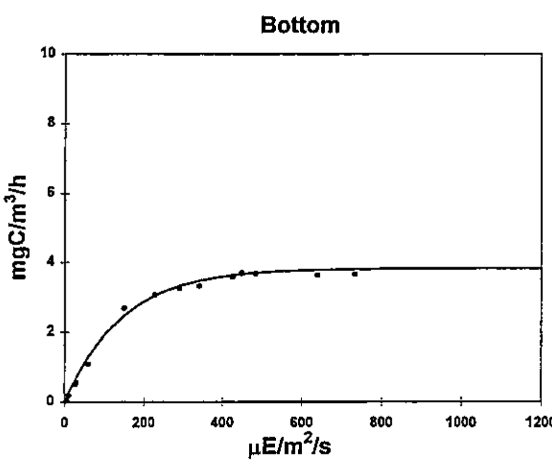
600
800
1000
1200


Bottom
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μE/m2/s
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4
6
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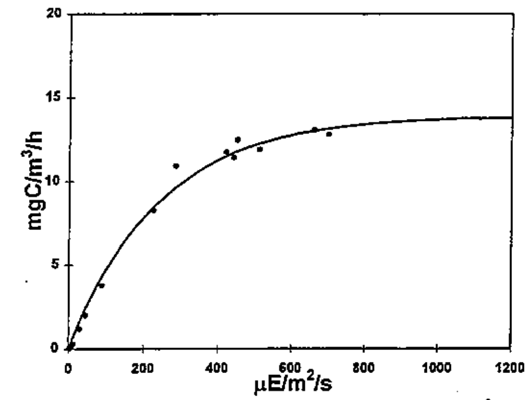
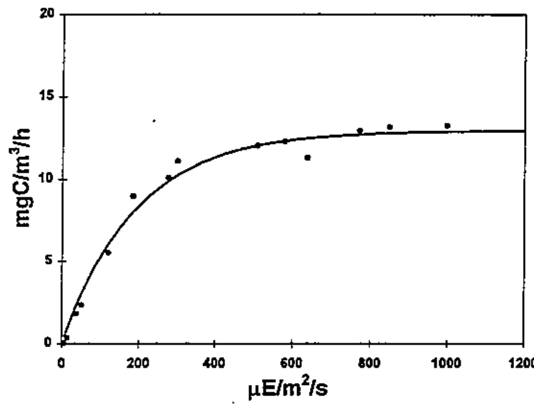
400
600
800
1000
1200

W9514 Station N07

Surface



Mid Surface



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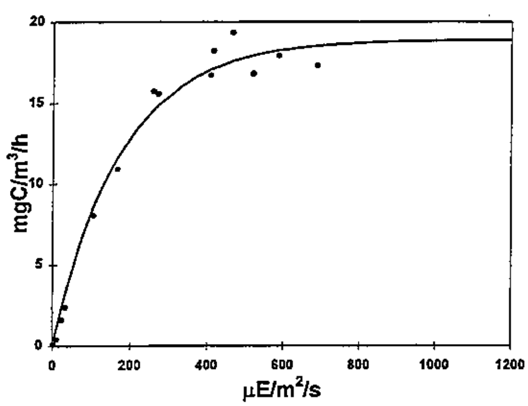

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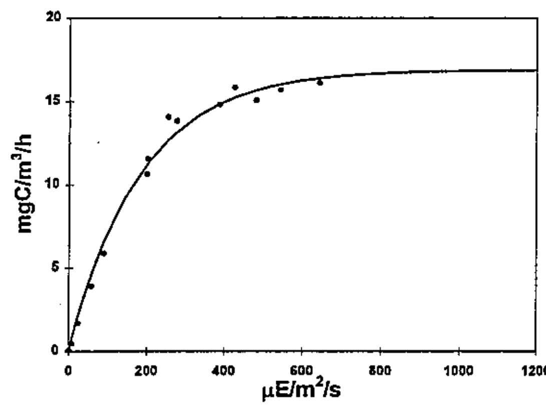

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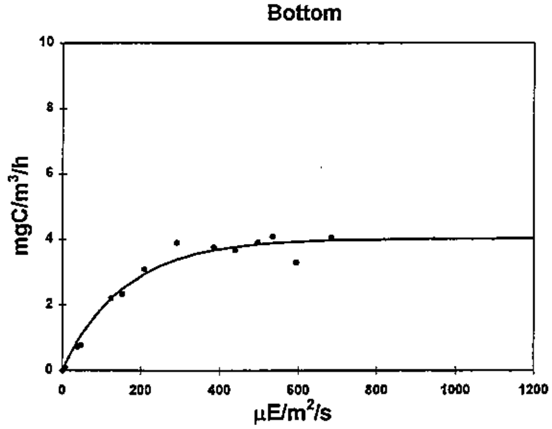
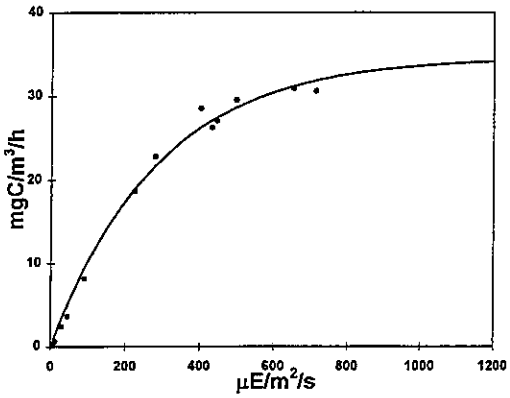


W9514 Station N16

Surface



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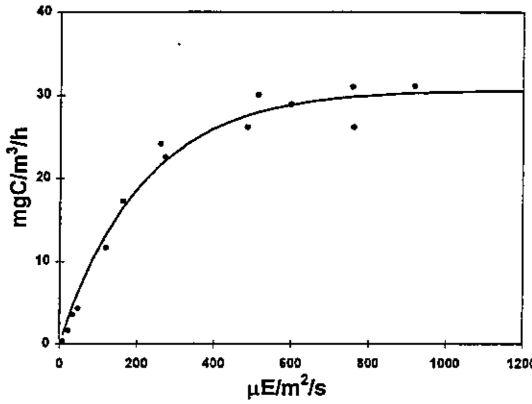

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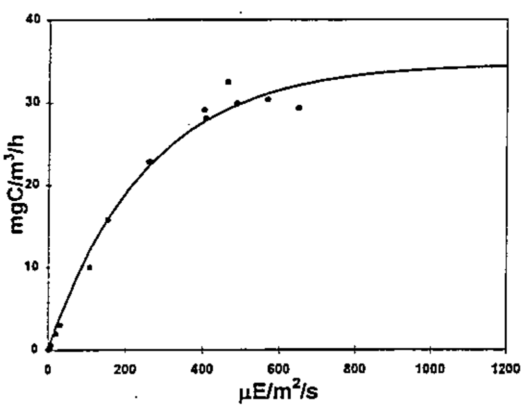

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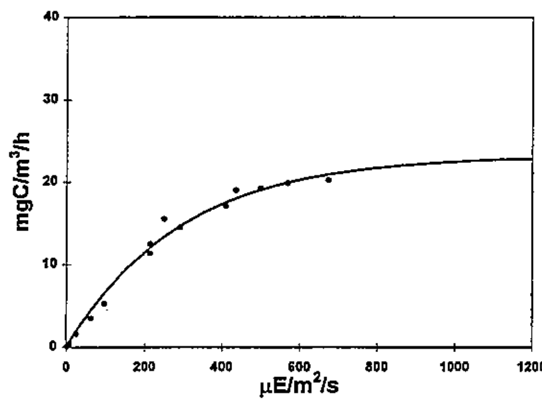

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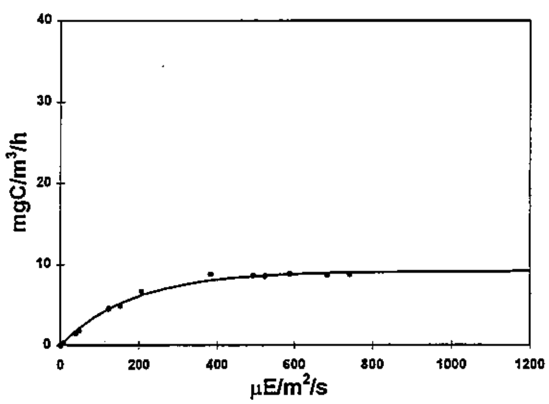
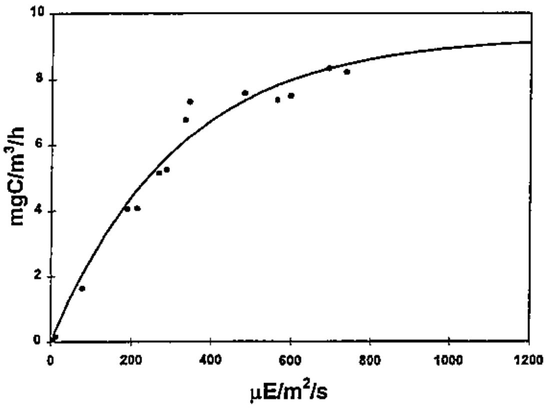
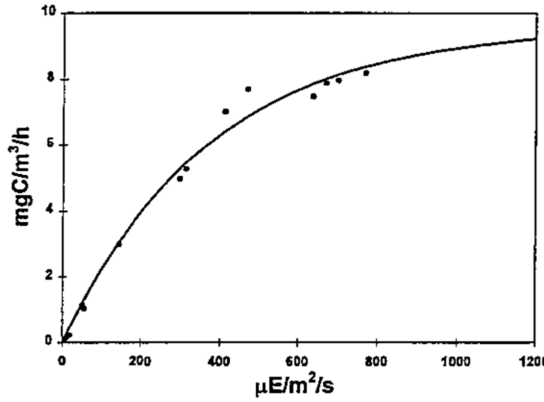


W9514 Station F23

Surface



Mid Surface



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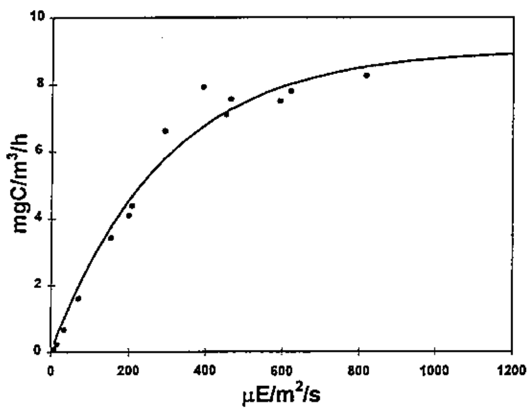

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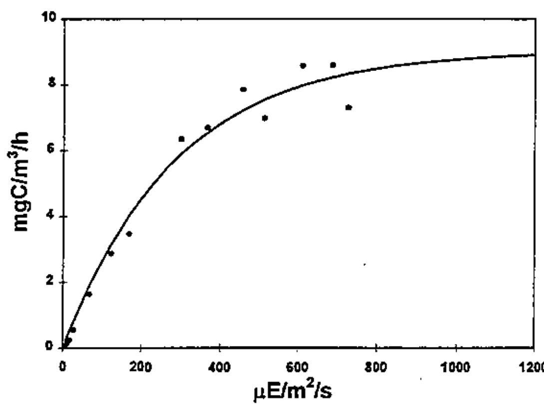

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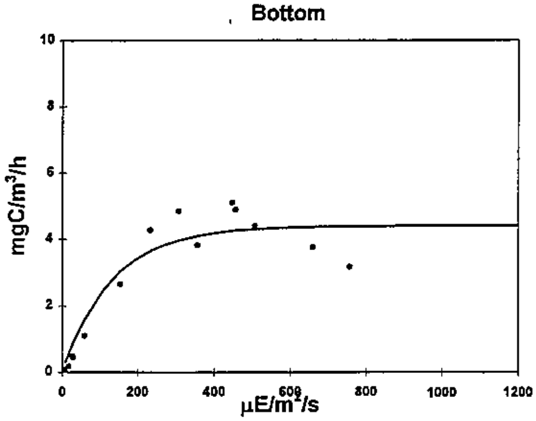
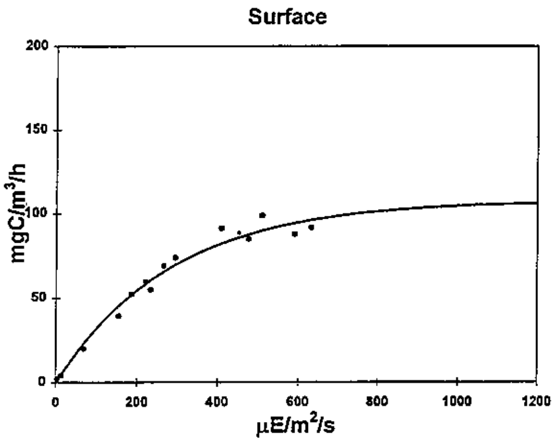
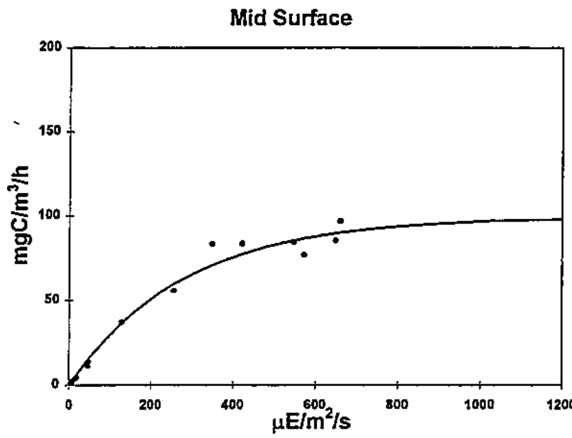
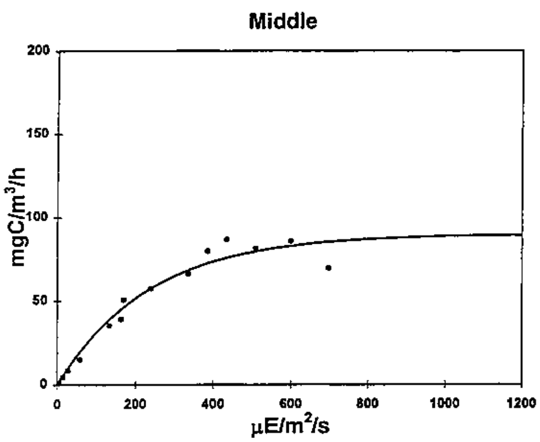
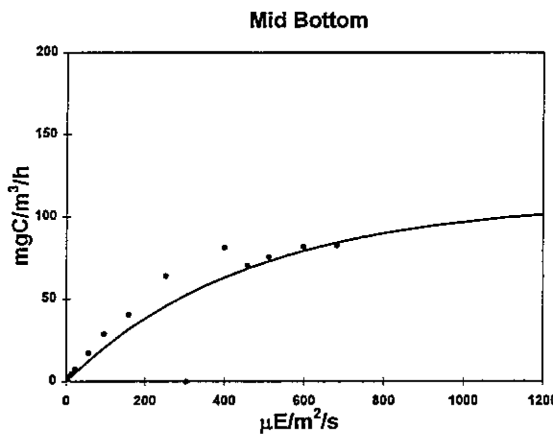


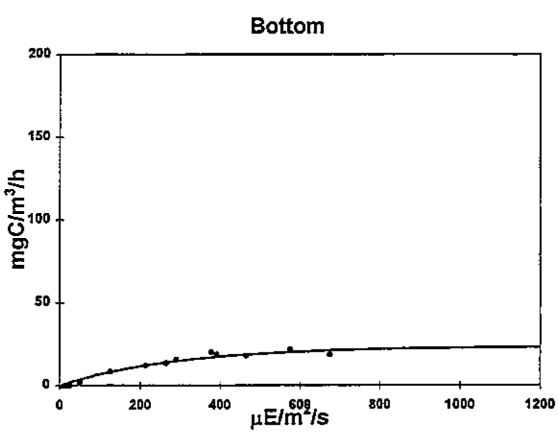
W9515 Station N16



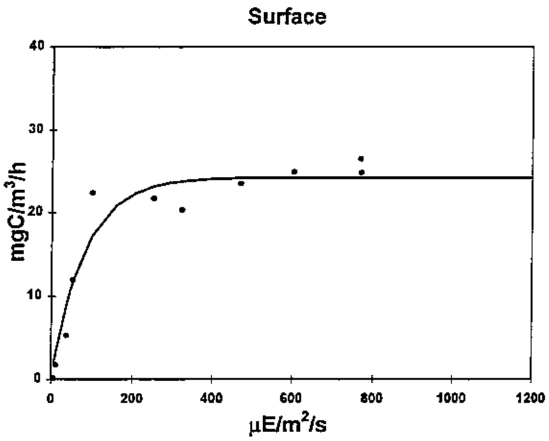


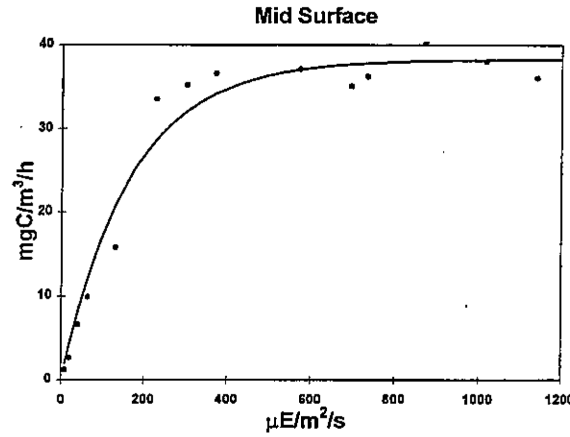


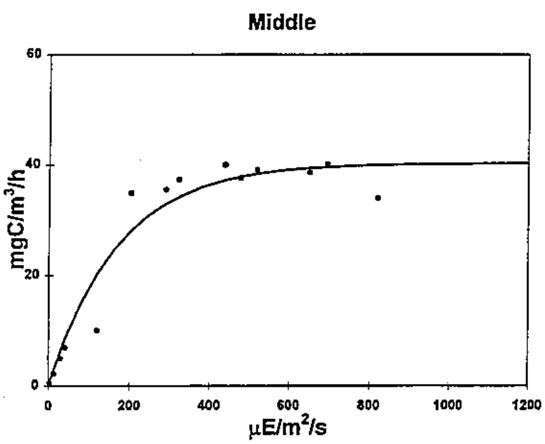


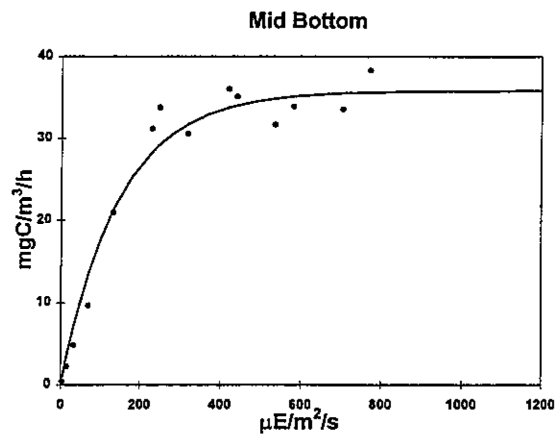


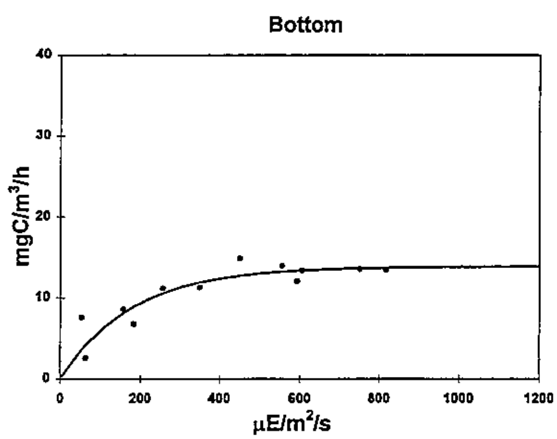
W9515 Station N04



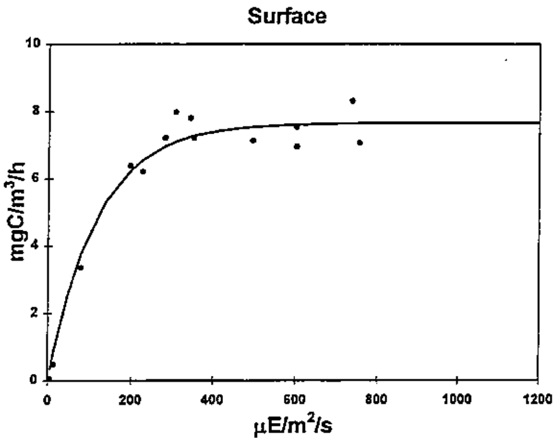


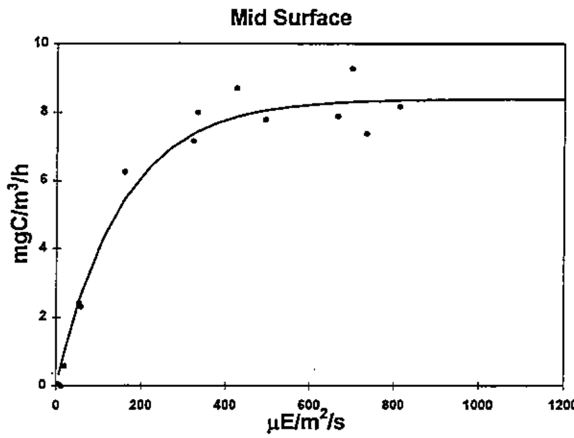


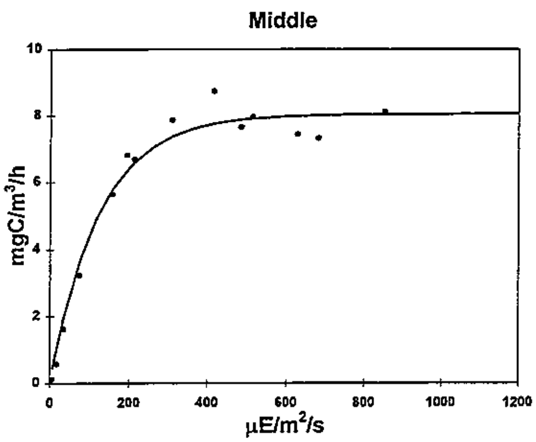


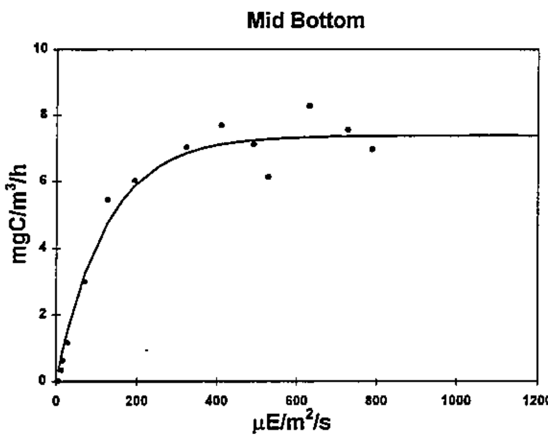


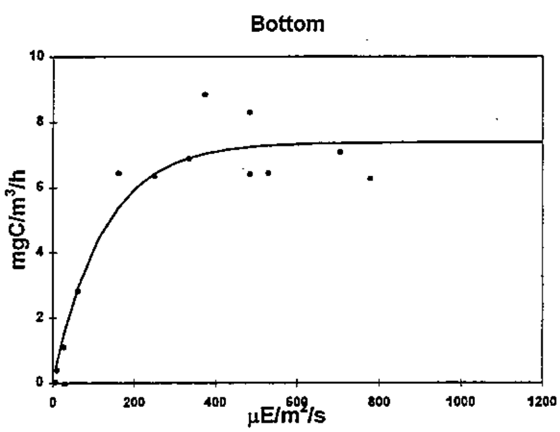
W9516 Station N16



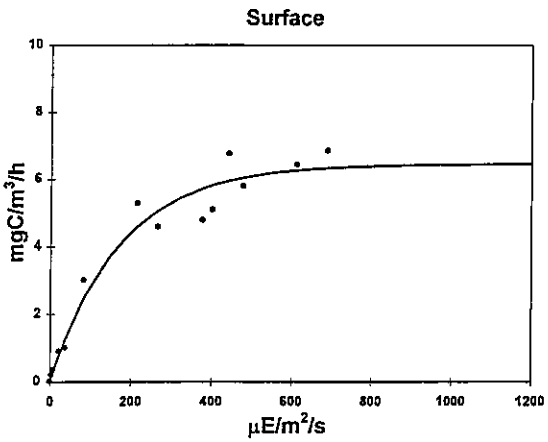


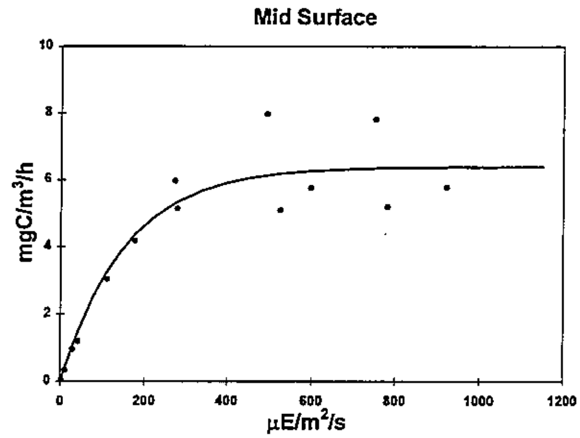


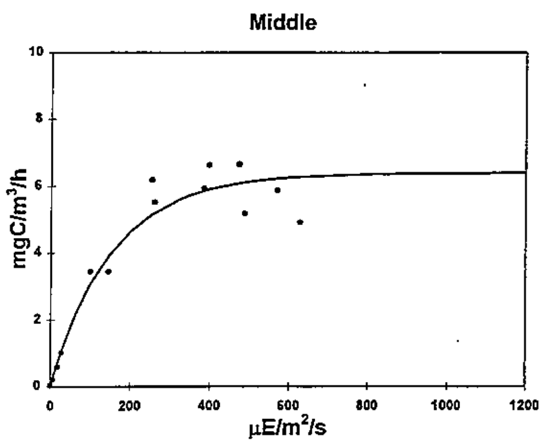


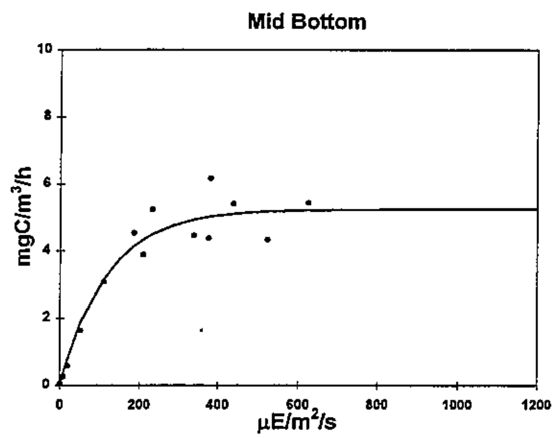


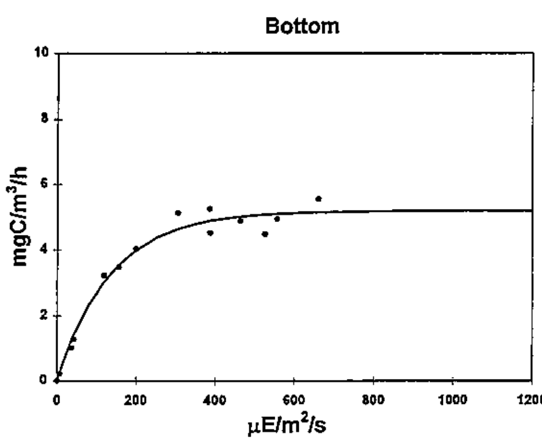
W9516 Station N04



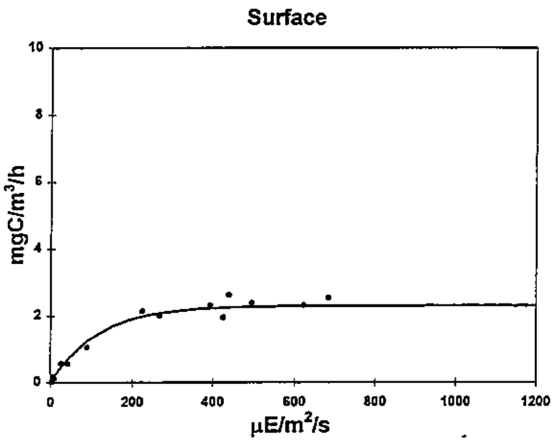


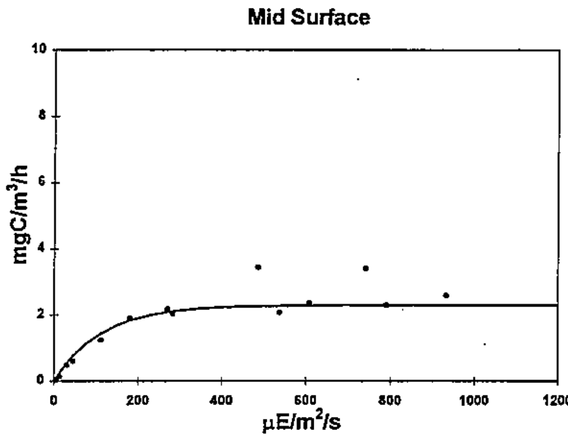


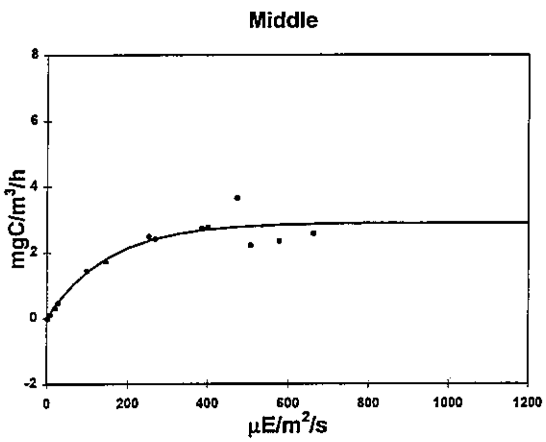


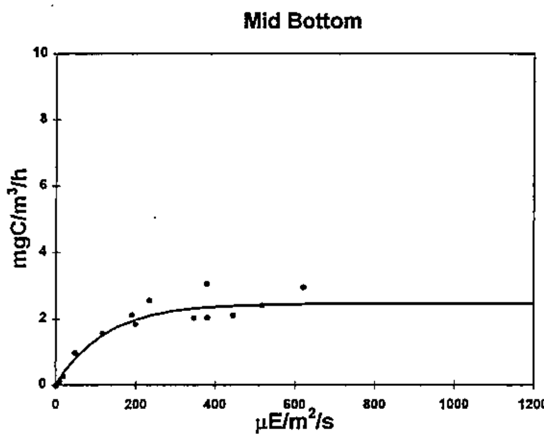


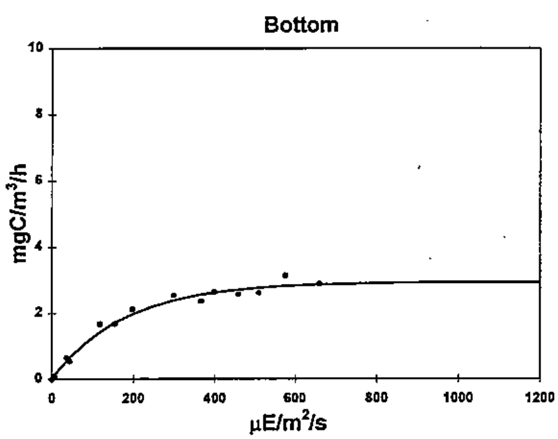
W9517 Station N16



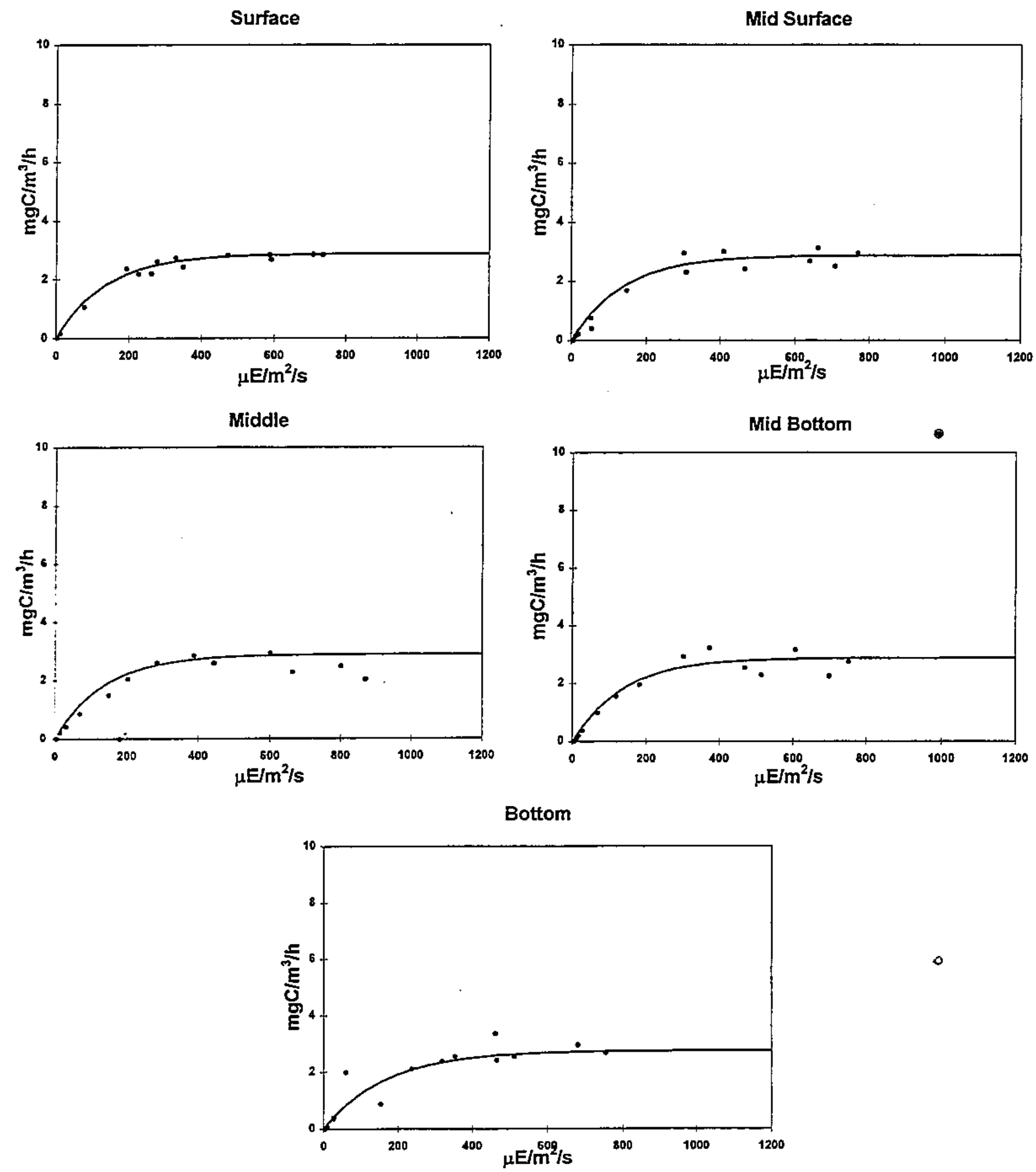








W9517 Station N04



APPENDIX F-1

ABUNDANCE OF PREVALENT SPECIES IN SURFACE SAMPLE

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, August 8, 1995 - August 10, 1995 (W9510)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.479	
		%	8	
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	1.249	0.128
		%	21	11
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	3.456	0.981
		%	58	81

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5 % Total Count) in Surface Sample Whole Water Phytoplankton, August 21, 1995 - August 26, 1995 (W9511)

			Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
Species	Group	Parameter	1F23	1F30	1F31	1F13	1F24	1F25	1N10	1N16	3N16	1F06	1F27	1F01	1F02
CHAETOCEROS SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L			2.409			0.915							
		%			15			8							
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L		0.579			0.213	0.610	1.338						
		%		8			6	6	11						
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L			0.976										
		%			6										
GYMNODINIUM SP#1 5-20UM W 10-20UM L	DF	10^6 Cells/L				0.329	0.366			0.244	0.360	0.335	0.111	0.155	
		%				9	9			9	10	9	7	7	
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L		1.403										0.133	
		%		20										6	
SKELETONEMA COSTATUM	CD	10^6 Cells/L	2.328		1.220		0.476	0.584	1.684						
		%	20		7		12	5	14						
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.998	0.793	2.714		0.427	1.245	1.103			0.232			
		%	9	11	17		11	11	9			6			
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	5.211	2.363	5.366	2.836	1.732	4.876	4.646	2.147	2.647	2.659	1.248	1.780	1.504
		%	46	33	33	76	45	44	39	81	76	73	81	77	90

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample
Whole Water Phytoplankton, September 6, 1995 - September 8, 1995 and September 11, 1995 - September 14, 1995
(W9512)

Species	Group	Parameter	Nearfield Stations	
			1N10	2N16
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L	6.174	1.142
		%	69	49
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.139
		%		6
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	1.677	0.826
		%	19	35

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, September 25, 1995 - September 29, 1995 (W9513)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.177	
		%	7	
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L		0.122
		%		5
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L	0.201	0.177
		%	8	8
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.316
		%		14
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	1.451	1.142
		%	57	49

Group Definitions:		
	CD	Centric Diatom
	DF	Dinoflagellate
	MF	Microflagellate
	O	Other
	PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, October 9 - October 13, 1995 (W9514)

			Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
Species	Group	Parameter	1F23	1F30	1F31	1F13	1F24	1F25	1N10	1N16	3N16	1F06	1F27	1F01	1F02
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.119	0.152	0.151		0.084	0.158	0.672		0.307		0.601		
		%	15	6	14		8	13	15		12		20		
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.055	0.482	0.081	0.316		0.167	1.146					0.335	
		%	7	18	7	13		14	25					9	
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L	0.090		0.059		0.082	0.100							0.122
		%	11		5		8	8							5
GYMNODINIUM SP #1 5-20UM W 10-20UM L	DF	10^6 Cells/L				0.166						0.071	0.209	0.567	0.139
		%				7						5	7	15	6
KATODINIUM ROTUNDATUM	DF	10^6 Cells/L										0.213	0.233		
		%										16	8		
LEPTOCYLINDRUS DANICUS	CD	10^6 Cells/L													
		%													
PYRAMIMONAS SP.	MF	10^6 Cells/L			0.073								0.153		
		%			7								5		
RHIZOSOLENIA DELICATULA	CD	10^6 Cells/L										0.136			
		%										10			
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L										0.078			
		%										6			
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.203		0.196		0.137	0.199	0.260		0.477				
		%	26		18		13	17	6		19				
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.200	1.37205	0.33877	1.303	0.516	0.357173	1.7522	6.02177	1.1606	0.633	1.37482	1.988	1.486
		%	26	51.66746	30.64116	53	49	29.84561	38.53119	75.647431	45.869276	48	46.11219604	54	61

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, November 1 - November 4, 1995 (W9515)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
ASTERIONELLA GLACIALIS	PD	10^6 Cells/L	0.538	1.594
		%	48	52
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.058	
		%	5	
PANDORINA SP.	O	10^6 Cells/L	0.082	
		%	7	
RHIZOSOLENIA DELICATULA	CD	10^6 Cells/L		0.191
		%		6
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.224
		%		7
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.104	
		%	9	

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, November 27, 1995 - December 5, 1995 (W9516)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
ASTERIONELLA GLACIALIS	PD	10^6 Cells/L	0.018	0.041
		%	5	9
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L		0.027
		%		6
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.036	
		%	10	
THALASSIONEMA NITZSCHIOIDES	PD	10^6 Cells/L		0.039
		%		8
THALASSIOSIRA SP#1 DIAM <20 MICRONS	CD	10^6 Cells/L	0.018	0.136
		%	5	29
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.044
		%		9
UNID. CHOANOFLAGELLATE	MF	10^6 Cells/L	0.031	
		%	9	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.142	0.026
		%	42	5

Group Definitions:

	CD	Centric Diatom
	DF	Dinoflagellate
	MF	Microflagellate
	O	Other
	PD	Pennate Diatom

Table 3-1a. Abundance of Prevalent Species (> 5% Total Count) in Surface Sample Whole Water Phytoplankton, December 17, 1995 - December 19, 1995 (W9517)

Species	Group	Parameter	Nearfield Stations	
			1N10	2N16
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.021	0.041
		%	21	22
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L		0.013
		%		7
CYLINDROTHECA CLOSTERIUM	PD	10^6 Cells/L	0.019	
		%	19	
DISTEPHANUS SPECULUM	O	10^6 Cells/L	0.006	
		%	6	
GYMNODINIUM SP #1 5-20UM W 10-20UM L	DF	10^6 Cells/L	0.006	0.011
		%	5	6
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.011	
		%	11	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.011	0.063
		%	10	33

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

APPENDIX F-2

ABUNDANCE OF PREVALENT SPECIES IN CHLOROPHYLL *a* MAXIMUM SAMPLE

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample Whole Water Phytoplankton, August 8, 1995 - August 10, 1995 (W9510)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.407	0.154
		%	7	7
UNID. BLUE GREEN SINGLE SPHERE	O	10^6 Cells/L		0.117
		%		5
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	1.045	
		%	17	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	3.760	1.819
		%	61	80

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll a Maxiumum Sample Whole Water Phytoplankton, August 21, 1995 - August 26, 1995 (W9511)

Species	Group	Parameter	Harbor Stations			Coastal Stations			Nearfield Stations			Offshore	Boundary	ape Cod Bay Station	
			1F23	1F30	1F31	1F13	1F24	1F25	1N10	1N16	3N16	1F06	1F27	1F01	1F02
CHAETOCEROS SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L	0.488	0.716	1.082			1.357	0.686						
		%	7	6	12			15	7						
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L		0.610	0.640				0.579		0.177				
		%		5	7				6		7				
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L													
		%													
GYMNODINIUM SP #1 5-20UM W 10-20UM L	DF	10^6 Cells/L					0.177					0.335	0.195		
		%					5					5	7		
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L		1.008					0.671						0.405
		%		9					7						18
SKELETONEMA COSTATUM	CD	10^6 Cells/L	1.585	1.167	0.579	0.256	0.470		2.256						
		%	24	10	6	10	14		23						
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.656	0.822	1.281	0.213	0.250	0.595	0.838			0.701			
		%	10	7	14	8	7	6	9			11			
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	2.868	5.276	3.644	1.317	1.762	4.025	3.156	3.965	2.177	4.223	2.336	2.195	1.513
		%	43	46	41	51	51	44	32	87	80	64	80	81	66

Group Definitions:

CD Centric Diatom
DF Dinoflagellate
MF Microflagellate
O Other
PD Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll a Maximum Sample Whole Water Phytoplankton, September 6, 1995 - September 8, 1995 and September 11, 1995 - September 14, 1995 (W9512)

Species	Group	Parameter	Nearfield Stations	
			1N10	2N16
LEPTOCYLINDRUS DANICUS	CD	10^6 Cells/L	0.869	
		%	13	
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L	4.025	1.162
		%	59	48
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	1.250	0.889
		%	18	36

Group Definitions:	CD	Centric Diatom
	DF	Dinoflagellate
	MF	Microflagellate
	O	Other
	PD	Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample Whole Water Phytoplankton, September 25, 1995 - September 29, 1995 (W9513)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L		0.890
		%		30
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.213
		%		7
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L		1.427
		%		48
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.390	
		%	15	
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L	0.183	
		%	7	
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.140	
		%	5	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	1.250	
		%	47	

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll a Maximum Sample Whole Water Phytoplankton, October 9 - October 13, 1995 (W9514)

			Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
Species	**Group**	**Parameter**	**1F23**	**1F30**	**1F31**	**1F13**	**1F24**	**1F25**	**1N10**	**1N16**	**3N16**	**1F06**	**1F27**	**1F01**	**1F02**
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.055		0.116		0.066	0.842			0.957	0.106	0.224		
		%	8		5		6	35			32	9	8		
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L		0.159	0.255	0.335								0.482	
		%		9	11	11								14	
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L	0.098	0.179			0.105	0.170					0.224		
		%	14	10			10	7					8		
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L								0.213				0.244	0.232
		%								6				7	9
KATODINIUM ROTUNDATUM	DF	10^6 Cells/L									0.221	0.163			
		%									7	14			
LEPTOCYLINDRUS DANICUS	CD	10^6 Cells/L	0.080				0.076								
		%	11				7								
PYRAMIMONAS SP.	MF	10^6 Cells/L													
		%													
RHIZOSOLENIA DELICATULA	CD	10^6 Cells/L										0.103			
		%										9			
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L							0.139			0.160			
		%							9			13			
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.098			0.187		0.113				0.191	0.195	
		%		5			18		8				7	6	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.307	0.955353	1.4358	1.707	0.408406	0.847573	1.00638	3.0429	1.49757	0.451	1.79172	2.043	1.359
		%	44	53.35121	62.34954	55	39.8167	35.36686	67.277674	78.65868	49.375921	38	67.36502125	58	55

Group Definitions:

CD	Centric Diatom
DF	Dinoflagellate
MF	Microflagellate
O	Other
PD	Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample Whole Water Phytoplankton, November 1 - November 4, 1995 (W9515)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
ASTERIONELLA GLACIALIS	PD	10^6 Cells/L	0.616	1.067
		%	63	46
RHIZOSOLENIA FRAGILISSIMA	CD	10^6 Cells/L		0.128
		%		6
THALASSIONEMA NITZSCHIOIDES	PD	10^6 Cells/L		0.208
		%		9
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.055	0.229
		%	6	10
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.053	0.155
		%	5	7

Group Definitions:		
	CD	Centric Diatom
	DF	Dinoflagellate
	MF	Microflagellate
	O	Other
	PD	Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample Whole Water Phytoplankton, November 27, 1995 - December 5, 1995 (W9516)

			Nearfield Stations	
Species	Group	Parameter	1N10	1N16
ASTERIONELLA GLACIALIS	PD	10^6 Cells/L		0.036
		%		8
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.033	0.038
		%	10	9
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.042	
		%	13	
THALASSIONEMA NITZSCHIOIDES	PD	10^6 Cells/L		0.033
		%		8
THALASSIOSIRA SP#1 DIAM <20 MICRONS	CD	10^6 Cells/L	0.029	0.162
		%	9	37
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.022	
		%	7	
UNID. CHOANOFLAGELLATE	MF	10^6 Cells/L	0.023	
		%	7	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.073	0.027
		%	23	6

Group Definitions:
- CD Centric Diatom
- DF Dinoflagellate
- MF Microflagellate
- O Other
- PD Pennate Diatom

Table 3-1b. Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample Whole Water Phytoplankton, December 17, 1995 - December 19, 1995 (W9517)

Species	Group	Parameter	Nearfield Stations	
			1N10	2N16
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.064	0.085
		%	40	39
CYCLOTELLA SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L	0.008	0.012
		%	5	6
CYLINDROTHECA CLOSTERIUM	PD	10^6 Cells/L	0.011	
		%	7	
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L		0.014
		%		6
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.019	0.046
		%	12	21

Group Definitions:

	CD	Centric Diatom
	DF	Dinoflagellate
	MF	Microflagellate
	O	Other
	PD	Pennate Diatom

APPENDIX G-1

ABUNDANCE OF ALL IDENTIFIED TAXA IN SCREENED SAMPLES NEAR THE SURFACE

Table 3-2a. Abundance of all identified taxa in screened samples near the surface August 8 - 10, 1995 (W9510)

Species	Group	Nearfield Stations 1N10A	1N16A
CERATIUM FUSUS	DF	0.001	0.005
CERATIUM LONGIPES	DF	0.009	0.003
CERATIUM SP.	DF	0.002	
CERATIUM TRIPOS	DF	0.004	0.005
DINOPHYSIS ACUMINATA	DF		
DINOPHYSIS NORVEGICA	DF		0.001
DINOPHYSIS PUNCTATA	DF	0.001	
DIPLOPSALIS SP.	DF		0.001
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF	0.001	
KATODINIUM ROTUNDATUM	DF		
PROTOPERIDINIUM DEPRESSUM	DF		0.001
SCRIPPSIELLA TROCHOIDEA	DF	0.001	
PYRAMIMONAS SP.	MF		
UNID. SILICOFLAGELLATE	MF		
UNID. BLUE GREEN TRICHOME	O	0.044	
UNID. BLUE GREEN TRICHOME (CELL)	O		0.256

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface August 21 - 26, 1995 (W9511)

		Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
Species	Group	1F23A	1F30A	1F31A	1F13A	1F24A	1F25A	1N10A	1N16A	3N16A	1F06A	1F27A	1F01A	1F02A
CERATIUM FUSUS	DF	0.001	0.003	0.001	0.002	0.019	0.001	0.012	0.028	0.023		0.013		
CERATIUM LONGIPES	DF	0.008	0.012	0.004	0.007	0.022	0.003	0.024	0.004	0.035	0.011	0.028		
CERATIUM MACROCEROS	DF													
CERATIUM SP.	DF	0.001												
CERATIUM TRIPOS	DF	0.005	0.003	0.002	0.003	0.005	0.001	0.016	0.009	0.029	0.008	0.038	0.007	0.004
DINOPHYSIS ACUMINATA	DF					0.001					0.001	0.001		
DINOPHYSIS NORVEGICA	DF													0.003
DINOPHYSIS OVUM	DF		0.002											
DINOPHYSIS PUNCTATA	DF													
DIPLOPSALIS LENTICULA	DF		0.009											
DIPLOPSALIS SP.	DF	0.001	0.028	0.018				0.005		0.001				0.001
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.190	0.077		0.035		0.214	0.103		0.233	0.100		
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF	0.004	0.011	0.268	0.001		0.149	0.001			0.003		0.002	
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF		0.005	0.001										
HETEROCAPSA TRIQUETRA	DF		0.008											
KATODINIUM ROTUNDATUM	DF											0.033		
PROROCENTRUM BALTICUM	DF		0.066											
PROROCENTRUM MAXIMUM	DF													0.003
PROROCENTRUM MICANS	DF													
PROROCENTRUM MINIMUM	DF		0.002	0.077			0.001		0.052	0.001				
PROROCENTRUM TRIESTINUM	DF													
PROTOPERIDINIUM DEPRESSUM	DF	0.001			0.001					0.001				
PROTOPERIDINIUM DIVERGENS	DF													0.002
PROTOPERIDINIUM GRANII	DF													
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF	0.073	0.379	0.001			0.149	0.393						0.001
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.020	0.095	0.023				0.004		0.001			0.002	0.001
PROTOPERIDINIUM SP.#3 76-150W 81-150L	DF													
SCRIPPSIELLA TROCHOIDEA	DF	0.007	0.190	0.011				0.178			0.013		0.002	
UNID. DINOFLAGELLATE	DF		0.003											
UNID. DINOFLAGELLATE CYST	DF													
EUGLENA SP.	MF													
EUTREPTIA LANOWII	MF			0.077										
PYRAMIMONAS SP.	MF									0.070				
UNID. CHOANOFLAGELLATE	MF								0.052	0.106		0.017		
UNID. SILICOFLAGELLATE	MF													
ACANTHOICA SP.	O													
DICTYOCHA FIBULA	O													
DISTEPHANUS SPECULUM	O													
EBRIA TRIPARTITA	O													
RHABDOSPHAERA HISPIDA	O					0.104		0.001						
UNID. BLUE GREEN TRICHOME	O		0.003											
UNID. BLUE GREEN TRICHOME (CELL)	O			0.383										

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all screened taxa near the surface September 6 - 8, 1995 and September 11 - 14, 1995 (W9512)

Species	Group	Nearfield Stations	
		1N10A	2N16A
CERATIUM FUSUS	DF	0.013	0.020
CERATIUM LONGIPES	DF	0.017	0.004
CERATIUM MACROCEROS	DF		
CERATIUM TRIPOS	DF	0.019	0.060
DINOPHYSIS NORVEGICA	DF		
DIPLOPSALIS SP.	DF	0.036	0.018
GONYAULAX POLYGRAMMA	DF		0.002
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	0.117	0.103
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF		
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF		
PROROCENTRUM MICANS	DF		
PROTOPERIDINIUM DEPRESSUM	DF		0.002
PROTOPERIDINIUM GRANII	DF		0.002
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.002
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.027	
SCRIPPSIELLA TROCHOIDEA	DF	0.004	0.034
EUTREPTIA SP.	MF		
DICTYOCHA FIBULA	O		
EBRIA TRIPARTITA	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface September 25 - 29, 1995 (W9513)

Species	Group	Nearfield Stations	
		1N10A	1N16A
CERATIUM FUSUS	DF	0.049	0.274
CERATIUM LINEATUM	DF		0.007
CERATIUM LONGIPES	DF	0.023	0.064
CERATIUM MACROCEROS	DF		0.104
CERATIUM TRIPOS	DF	0.061	0.333
DINOPHYSIS ACUMINATA	DF		0.009
DINOPHYSIS NORVEGICA	DF		0.002
DINOPHYSIS SP.	DF		0.002
DIPLOPSALIS SP.	DF	0.003	0.002
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.287
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF		0.002
HETEROCAPSA TRIQUETRA	DF		
PROROCENTRUM BALTICUM	DF		
PROROCENTRUM MAXIMUM	DF		0.014
PROROCENTRUM MICANS	DF		
PROROCENTRUM MINIMUM	DF		0.014
PROTOPERIDINIUM DEPRESSUM	DF		0.005
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.005
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.005	0.005
SCRIPPSIELLA TROCHOIDEA	DF		
UNID. SILICOFLAGELLATE	MF		
EBRIA TRIPARTITA	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface October 9 - 13, 1995 (W9514)

Species	Group	Harbor Stations 1F23A	1F30A	1F31A	Coastal Stations 1F13A	1F24A	1F25A	Nearfield Stations 1N10A	1N16A	2N16A	3N16A	Offshore Stations 1F06A	Boundary Stations 1F27A	Cape Cod Bay Stations 1F01A	1F02A
AMPHIDINIUM SPHENOIDES	DF														
CERATIUM FUSUS	DF	0.020	0.063	0.042	0.470	0.042	0.173	0.132	0.127		0.066	0.221	0.084	0.563	0.322
CERATIUM LINEATUM	DF	0.001	0.002	0.003	0.010	0.007	0.011	0.001	0.011		0.005	0.009	0.004	0.010	
CERATIUM LONGIPES	DF	0.009	0.003	0.001	0.050	0.049	0.007	0.048	0.052		0.013	0.011	0.038	0.012	0.107
CERATIUM MACROCEROS	DF														
CERATIUM SP.	DF	0.006										0.009			
CERATIUM TRIPOS	DF	0.025	0.049	0.115	0.651	0.131	0.263	0.217	0.716		0.428	0.600	0.383	0.517	0.392
DINOPHYSIS ACUMINATA	DF	0.001	0.001	0.004	0.011		0.003	0.003	0.005		0.001	0.010		0.005	
DINOPHYSIS CAUDATA	DF														
DINOPHYSIS NORVEGICA	DF	0.001	0.001	0.011	0.011	0.016	0.017	0.003	0.011		0.008	0.008	0.010		
DINOPHYSIS OVUM	DF														
DINOPHYSIS PUNCTATA	DF										0.003				
DINOPHYSIS SP.	DF					0.005	0.001								
DIPLOPSALIS SP.	DF		0.008		0.006	0.012	0.007		0.002		0.001		0.001		
GONYAULAX DIGITALIS	DF														
GONYAULAX POLYGRAMMA	DF			0.001			0.294				0.003				
GONYAULAX SP.	DF				0.005										
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	0.001	0.079	0.001	0.389	0.284		0.181			0.112		0.152	0.121	0.583
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF														
HETEROCAPSA TRIQUETRA	DF														
KATODINIUM ROTUNDATUM	DF	0.425	0.592	0.277	2.235	0.426		0.362				0.536	0.114	0.162	0.097
OXYTOXUM SP.	DF												0.038		
PROROCENTRUM BALTICUM	DF				0.002			0.121							0.097
PROROCENTRUM COMPRESSUM	DF			0.001	0.003		0.001				0.004	0.015	0.014	0.009	
PROROCENTRUM MAXIMUM	DF			0.009	0.069		0.024		0.016		0.012	0.015	0.009	0.547	0.194
PROROCENTRUM MICANS	DF	0.004	0.010	0.007	0.008	0.002	0.010	0.060				0.026	0.004	0.162	0.389
PROROCENTRUM MINIMUM	DF	0.003										0.003			
PROROCENTRUM TRIESTINUM	DF		0.005		0.011		0.001	0.001			0.001	0.016		0.003	
PROTOPERIDINIUM DEPRESSUM	DF	0.001	0.001	0.001	0.002		0.003	0.001	0.005		0.001		0.003	0.002	
PROTOPERIDINIUM DIABOLUM	DF														
PROTOPERIDINIUM PELLUCIDUM	DF														
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF			0.001							0.056			0.003	
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.001	0.003			0.002								0.001	
PROTOPERIDINIUM SP.#3 76-150W 81-150L	DF		0.001												
SCRIPPSIELLA TROCHOIDEA	DF		0.079	0.092	0.097	0.142							0.001		0.002
UNID. DINOFLAGELLATE CYST	DF						0.001								
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF														
PYRAMIMONAS SP.	MF										0.056				
UNID. CHOANOFLAGELLATE	MF														
UNID. MICRO-PHYTOFLAG LENGTH >10 MICRONS	MF														
CALCIOSOLENIA SP.	O				0.292						0.056	0.306		1.336	
CALYCOMONAS WULFII	O														
DICTYOCHA FIBULA	O			0.370	1.069		0.784	0.845	1.247		1.065	1.684	0.379	0.023	
DISTEPHANUS SPECULUM	O	0.128	0.079	0.185		0.284	0.098		0.002			0.077	0.076		
EBRIA TRIPARTITA	O														
EMILIANIA HUXLEYI	O						0.098								
OSCILLATORIA SP. (TRICHOME)	O														
PEDIASTRUM DUPLEX	O														
PEDIASTRUM DUPLEX V. CLATHRATUM	O		0.042												
PSEUDOPEDINELLA PYRIFORME	O		0.039												
RHABDOSPHAERA HISPIDA	O														
SCENEDESMUS QUADRICAUDA	O														
SCENEDESMUS SP.	O	0.006	0.158												
UNID. BLUE GREEN SINGLE SPHERE	O							1.446				3.903		9.051	10.302
UNID. BLUE GREEN TRICHOME	O		0.039												

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface November 1 - 4, 1995 (W9515)

Species	Group	Nearfield Stations	
		1N10A	1N16A
CERATIUM FUSUS	DF	0.005	0.080
CERATIUM LONGIPES	DF	0.005	0.035
CERATIUM TRIPOS	DF	0.047	0.270
DINOPHYSIS ACUMINATA	DF	0.002	0.002
DINOPHYSIS NORVEGICA	DF	0.002	0.002
DIPLOPSALIS SP.	DF		0.006
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		
PROROCENTRUM COMPRESSUM	DF		0.113
PROROCENTRUM MAXIMUM	DF	0.004	0.113
PROROCENTRUM MICANS	DF		0.113
PROROCENTRUM TRIESTINUM	DF		
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.004
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.002	0.004
DICTYOCHA FIBULA	O	0.126	3.955
DISTEPHANUS SPECULUM	O	0.126	2.034
EMILIANIA HUXLEYI	O	0.126	
SCENEDESMUS QUADRICAUDA	O	0.007	

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface November 27 - December 5, 1995 (W9516)

Species	Group	Nearfield Stations 1N10A	Nearfield Stations 1N16A
CERATIUM FUSUS	DF	0.042	0.081
CERATIUM LINEATUM	DF	0.003	0.001
CERATIUM LONGIPES	DF	0.009	0.006
CERATIUM TRIPOS	DF	0.249	0.178
DINOPHYSIS ACUMINATA	DF	0.002	0.004
DINOPHYSIS NORVEGICA	DF	0.033	0.003
DINOPHYSIS SP.	DF		
PROROCENTRUM COMPRESSUM	DF	0.002	0.005
PROROCENTRUM MAXIMUM	DF	0.003	0.009
PROROCENTRUM TRIESTINUM	DF		0.001
PROTOPERIDINIUM DEPRESSUM	DF	0.002	0.006
PROTOPERIDINIUM PALLIDUM	DF		
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF	0.002	
UNID. DINOFLAGELLATE CYST	DF		
UNID. CHOANOFLAGELLATE	MF	0.084	
DICTYOCHA FIBULA	O	0.293	3.110
DISTEPHANUS SPECULUM	O	0.481	1.788

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2a. Abundance of all identified taxa in screened samples near the surface December 17 - 19, 1995 (W9517)

Species	Group	Nearfield Stations	
		1N10A	2N16A
CERATIUM FUSUS	DF	0.006	0.025
CERATIUM LINEATUM	DF		0.012
CERATIUM LONGIPES	DF	0.001	0.005
CERATIUM SP.	DF	0.002	0.002
CERATIUM TRIPOS	DF	0.038	0.083
DINOPHYSIS ACUMINATA	DF		0.007
DINOPHYSIS CAUDATA	DF		0.001
DINOPHYSIS NORVEGICA	DF		0.004
PROROCENTRUM COMPRESSUM	DF	0.001	0.001
PROROCENTRUM MAXIMUM	DF		0.001
PROROCENTRUM MICANS	DF		0.015
PROROCENTRUM TRIESTINUM	DF	0.002	0.003
PROTOPERIDINIUM DEPRESSUM	DF	0.002	0.004
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.001
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		0.002
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF		
DICTYOCHA FIBULA	O		0.046
DISTEPHANUS SPECULUM	O	0.032	0.334
EBRIA TRIPARTITA	O		0.015
UNID. COCCOLITHOPHORE	O	0.032	

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

APPENDIX G-2

ABUNDANCE OF ALL IDENTIFIED TAXA IN SCREENED SAMPLES NEAR THE CHLOROPHYLL MAXIMUM

Table 3-2b. Abundance of all identified taxa in screened samples near the Chlorophyll maximum August 8 - 10, 1995 (W9510)

Species	Group	Nearfiled Stations 1N10C	1N16C
CERATIUM FUSUS	DF	0.003	0.010
CERATIUM LONGIPES	DF	0.034	0.155
CERATIUM SP.	DF		
CERATIUM TRIPOS	DF	0.010	0.016
DINOPHYSIS ACUMINATA	DF		0.001
DINOPHYSIS NORVEGICA	DF		0.001
DINOPHYSIS PUNCTATA	DF	0.001	
DIPLOPSALIS SP.	DF		
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.019
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF		
KATODINIUM ROTUNDATUM	DF		0.038
PROTOPERIDINIUM DEPRESSUM	DF		0.001
SCRIPPSIELLA TROCHOIDEA	DF		
PYRAMIMONAS SP.	MF	0.028	
UNID. SILICOFLAGELLATE	MF		0.395
UNID. BLUE GREEN TRICHOME	O	0.001	
UNID. BLUE GREEN TRICHOME (CELL)	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near the Chlorophyll maximum August 21 - 26, 1995 (W9511)

		Harbor Stations			Coastal Stations			Nearfield Stations				Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
Species	Group	1F23C	1F30C	1F31C	1F13C	1F24C	1F25C	1N10C	1N16C	2N16C	3N16C	1F06C	1F27C	1F01C	1F02C
CERATIUM FUSUS	DF	0.002	0.002	0.001	0.006	0.012	0.005	0.007	0.011		0.017	0.001	0.002	0.003	0.003
CERATIUM LONGIPES	DF	0.006	0.014	0.012	0.007	0.024	0.055	0.006	0.185		0.129	0.034	0.314	0.021	0.021
CERATIUM MACROCEROS	DF								0.017						
CERATIUM SP.	DF				0.002	0.003									
CERATIUM TRIPOS	DF	0.009		0.002	0.008	0.044	0.014	0.017	0.018		0.031	0.010	0.126	0.007	0.003
DINOPHYSIS ACUMINATA	DF						0.008		0.001		0.007		0.001		
DINOPHYSIS NORVEGICA	DF							0.001			0.004				
DINOPHYSIS OVUM	DF														
DINOPHYSIS PUNCTATA	DF											0.001	0.001		
DIPLOPSALIS LENTICULA	DF														
DIPLOPSALIS SP.	DF		0.025	0.009			0.006	0.034			0.001		0.001		
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.474						0.334			0.041	0.180	0.087	
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF			0.131										0.044	
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF													0.001	
HETEROCAPSA TRIQUETRA	DF														
KATODINIUM ROTUNDATUM	DF														
PROROCENTRUM BALTICUM	DF														
PROROCENTRUM MAXIMUM	DF										0.001				
PROROCENTRUM MICANS	DF		0.002											0.001	
PROROCENTRUM MINIMUM	DF		0.190	0.098					0.001						
PROROCENTRUM TRIESTINUM	DF		0.095												
PROTOPERIDINIUM DEPRESSUM	DF	0.001		0.002	0.001		0.001	0.001			0.003	0.013	0.001		
PROTOPERIDINIUM DIVERGENS	DF														
PROTOPERIDINIUM GRANII	DF							0.034							
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF	0.001	1.137			0.001		0.862			0.045			0.001	
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		0.009	0.024			0.015				0.004	0.007			
PROTOPERIDINIUM SP.#3 76-150W 81-150L	DF										0.001				
SCRIPPSIELLA TROCHOIDEA	DF		0.095	0.163		0.001	0.070	0.001			0.001	0.007			0.001
UNID. DINOFLAGELLATE	DF														0.001
UNID. DINOFLAGELLATE CYST	DF					0.002		0.001							
EUGLENA SP.	MF			0.098											
EUTREPTIA LANOWII	MF						0.070								
PYRAMIMONAS SP.	MF														
UNID. CHOANOFLAGELLATE	MF								0.030				0.045		
UNID. SILICOFLAGELLATE	MF										0.045				
ACANTHOICA SP.	O												0.022		
DICTYOCHA FIBULA	O							0.034							
DISTEPHANUS SPECULUM	O					0.001							0.045		
EBRIA TRIPARTITA	O			0.001			0.001							0.001	
RHABDOSPHAERA HISPIDA	O					0.001									
UNID. BLUE GREEN TRICHOME	O				0.001	0.001									
UNID. BLUE GREEN TRICHOME (CELL)	O														

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near the Chlorophyll maximum September 6 - 8, 1995 and September 11 - 14, 1995 (W9512)

Species	Group	Nearfiled Stations	
		1N10C	2N16C
CERATIUM FUSUS	DF	0.013	0.011
CERATIUM LONGIPES	DF	0.014	0.047
CERATIUM MACROCEROS	DF	0.009	0.002
CERATIUM TRIPOS	DF	0.009	0.018
DINOPHYSIS NORVEGICA	DF	0.002	
DIPLOPSALIS SP.	DF	0.007	0.002
GONYAULAX POLYGRAMMA	DF		
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.136
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF		0.011
GYMNODINIUM SP.#3 41-70UM W 51-70UM L	DF		0.002
PROROCENTRUM MICANS	DF	0.002	
PROTOPERIDINIUM DEPRESSUM	DF	0.002	0.004
PROTOPERIDINIUM GRANII	DF		
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.002
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF	0.011	0.022
SCRIPPSIELLA TROCHOIDEA	DF	0.002	0.007
EUTREPTIA SP.	MF		0.136
DICTYOCHA FIBULA	O		0.007
EBRIA TRIPARTITA	O		0.002

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near Chlorophyll maximum September 25 - 29, 1995 (W9513)

Species	Group	Nearfiled Stations 1N10C	1N16 B
CERATIUM FUSUS	DF	0.050	0.209
CERATIUM LINEATUM	DF		0.007
CERATIUM LONGIPES	DF	0.009	0.109
CERATIUM MACROCEROS	DF		0.075
CERATIUM TRIPOS	DF	0.074	0.273
DINOPHYSIS ACUMINATA	DF		0.002
DINOPHYSIS NORVEGICA	DF		0.002
DINOPHYSIS SP.	DF		
DIPLOPSALIS SP.	DF	0.006	
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF		
HETEROCAPSA TRIQUETRA	DF	0.004	
PROROCENTRUM BALTICUM	DF	0.002	0.011
PROROCENTRUM MAXIMUM	DF	0.226	
PROROCENTRUM MICANS	DF		0.004
PROROCENTRUM MINIMUM	DF	0.006	0.016
PROTOPERIDINIUM DEPRESSUM	DF		0.002
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		0.002
SCRIPPSIELLA TROCHOIDEA	DF		0.002
UNID. SILICOFLAGELLATE	MF		0.539
EBRIA TRIPARTITA	O	0.002	

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near Chlorophyll maximum October 9 - 13, 1995 (W9514)

Species	Group	Harbor Stations 1F23C	Coastal Stations 1F13B	Coastal Stations 1F24B	Nearfield Stations 1N18B	Offshore Stations 1F06C	Boundary Stations 1F27B	Cape Cod Bay Stations 1F01C	Cape Cod Bay Stations 1F02B
AMPHIDINIUM SPHENOIDES	DF								0.097
CERATIUM FUSUS	DF	0.027	0.358	0.054	0.038	0.230	0.015	0.558	0.531
CERATIUM LINEATUM	DF		0.113	0.008		0.008		0.008	0.003
CERATIUM LONGIPES	DF	0.002	0.060	0.008	0.048	0.062	0.002	0.009	0.069
CERATIUM MACROCEROS	DF		0.021						
CERATIUM SP.	DF					0.054			0.019
CERATIUM TRIPOS	DF	0.090	0.453	0.166	0.372	0.565	0.061	0.606	0.586
DINOPHYSIS ACUMINATA	DF			0.002	0.004	0.004		0.006	0.097
DINOPHYSIS CAUDATA	DF		0.001						
DINOPHYSIS NORVEGICA	DF		0.007	0.019	0.008	0.006	0.001	0.002	
DINOPHYSIS OVUM	DF		0.024						
DINOPHYSIS PUNCTATA	DF								
DINOPHYSIS SP.	DF				0.004				
DIPLOPSALIS SP.	DF		0.002			0.001			0.003
GONYAULAX DIGITALIS	DF							0.001	
GONYAULAX POLYGRAMMA	DF							0.003	
GONYAULAX SP.	DF								
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF		0.565		1.021	0.467	0.034	0.076	0.389
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF		0.001						
HETEROCAPSA TRIQUETRA	DF		0.038						
KATODINIUM ROTUNDATUM	DF		1.017	0.630	2.211	0.176		0.076	0.389
OXYTOXUM SP.	DF			0.265	0.085				
PROROCENTRUM BALTICUM	DF								
PROROCENTRUM COMPRESSUM	DF			0.012	0.002	0.009	0.001	0.029	0.010
PROROCENTRUM MAXIMUM	DF	0.002	0.058	0.017		0.233	0.006	0.245	0.194
PROROCENTRUM MICANS	DF		0.006	0.010	0.006	0.058		0.013	0.027
PROROCENTRUM MINIMUM	DF								
PROROCENTRUM TRIESTINUM	DF		0.010						0.013
PROTOPERIDINIUM DEPRESSUM	DF	0.002	0.003	0.006		0.003	0.001	0.001	
PROTOPERIDINIUM DIABOLUM	DF							0.001	
PROTOPERIDINIUM PELLUCIDUM	DF						0.001		
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		0.038			0.001	0.001	0.001	0.006
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		0.002			0.001			0.003
PROTOPERIDINIUM SP.#3 76-150W 81-150L	DF								
SCRIPPSIELLA TROCHOIDEA	DF		0.076		0.085			0.076	0.002
UNID. DINOFLAGELLATE CYST	DF	0.003					0.001		
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF								
PYRAMIMONAS SP.	MF								
UNID. CHOANOFLAGELLATE	MF						0.034		
UNID. MICRO-PHYTOFLAG LENGTH >10 MICRONS	MF						0.034		
CALCIOSOLENIA SP.	O					0.408		1.366	1.361
CALYCOMONAS WULFII	O				0.255	0.117			
DICTYOCHA FIBULA	O	0.323		0.265	1.106	0.700	0.006	0.152	0.389
DISTEPHANUS SPECULUM	O	0.108	0.753	0.008		0.058	0.001	0.001	
EBRIA TRIPARTITA	O								
EMILIANIA HUXLEYI	O			0.002					
OSCILLATORIA SP. (TRICHOME)	O								
PEDIASTRUM DUPLEX	O								
PEDIASTRUM DUPLEX V. CLATHRATUM	O								
PSEUDOPEDINELLA PYRIFORME	O								
RHABDOSPHAERA HISPIDA	O						0.001		
SCENEDESMUS QUADRICAUDA	O			0.008					
SCENEDESMUS SP.	O								
UNID. BLUE GREEN SINGLE SPHERE	O		1.243		5.273	3.441			7.873
UNID. BLUE GREEN TRICHOME	O								

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near Chlorophyll maximum November 1 - 4, 1995 (W9515)

Species	Group	Nearfield Stations 1N10C	Nearfield Stations 1N16C
CERATIUM FUSUS	DF	0.005	0.004
CERATIUM LONGIPES	DF	0.002	0.004
CERATIUM TRIPOS	DF	0.027	0.111
DINOPHYSIS ACUMINATA	DF		
DINOPHYSIS NORVEGICA	DF		
DIPLOPSALIS SP.	DF		
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	0.092	
PROROCENTRUM COMPRESSUM	DF		0.001
PROROCENTRUM MAXIMUM	DF	0.008	0.010
PROROCENTRUM MICANS	DF		
PROROCENTRUM TRIESTINUM	DF	0.002	
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		
DICTYOCHA FIBULA	O	0.092	0.099
DISTEPHANUS SPECULUM	O	0.165	0.013
EMILIANIA HUXLEYI	O		
SCENEDESMUS QUADRICAUDA	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near the Chlorophyll Maximum November 27 - December 5, 1995 (W9516)

Species	Group	Nearfield Stations	
		1N10C	1N16C
CERATIUM FUSUS	DF	0.031	0.071
CERATIUM LINEATUM	DF	0.003	0.006
CERATIUM LONGIPES	DF	0.017	0.010
CERATIUM TRIPOS	DF	0.273	0.325
DINOPHYSIS ACUMINATA	DF	0.001	0.004
DINOPHYSIS NORVEGICA	DF	0.004	0.006
DINOPHYSIS SP.	DF	0.001	
PROROCENTRUM COMPRESSUM	DF	0.001	0.012
PROROCENTRUM MAXIMUM	DF	0.007	0.022
PROROCENTRUM TRIESTINUM	DF		0.004
PROTOPERIDINIUM DEPRESSUM	DF		0.001
PROTOPERIDINIUM PALLIDUM	DF	0.001	
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		
UNID. DINOFLAGELLATE CYST	DF	0.003	
UNID. CHOANOFLAGELLATE	MF		
DICTYOCHA FIBULA	O	0.702	1.524
DISTEPHANUS SPECULUM	O	1.794	1.524

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Table 3-2b. Abundance of all identified taxa in screened samples near the Chlorophyll maximum December 17 - 19, 1995 (W9517)

Species	Group	Nearfield Stations	
		1N10C	2N16C
CERATIUM FUSUS	DF	0.007	0.016
CERATIUM LINEATUM	DF		0.003
CERATIUM LONGIPES	DF	0.001	0.001
CERATIUM SP.	DF	0.001	
CERATIUM TRIPOS	DF	0.042	0.056
DINOPHYSIS ACUMINATA	DF	0.002	0.004
DINOPHYSIS CAUDATA	DF	0.001	
DINOPHYSIS NORVEGICA	DF	0.008	0.002
PROROCENTRUM COMPRESSUM	DF		
PROROCENTRUM MAXIMUM	DF	0.003	0.001
PROROCENTRUM MICANS	DF	0.001	
PROROCENTRUM TRIESTINUM	DF		
PROTOPERIDINIUM DEPRESSUM	DF	0.001	0.001
PROTOPERIDINIUM SP.#1 10-30W 10-40L	DF		
PROTOPERIDINIUM SP.#2 31-75W 41-80L	DF		0.001
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF		0.022
DICTYOCHA FIBULA	O	0.173	
DISTEPHANUS SPECULUM	O	0.069	0.197
EBRIA TRIPARTITA	O		
UNID. COCCOLITHOPHORE	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

APPENDIX H

ZOOPLANKTON SPECIES DATA

TABLE A3
Zooplankton Species Data (ind/m^3)
W9510 - W9517

Event	Species	Life Stage	Group	1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
				Station Cast														
W9510	ACARTIA TONSA	C	C											686				
W9510	ACARTIA TONSA	F	C											171				
W9510	BIVALVIA SPP.	L	O											1714	1585			
W9510	CENTROPAGES TYPICUS	C	C											343	528			
W9510	CENTROPAGES TYPICUS	M	C											343	132			
W9510	COPEPOD SPP.	-	C											171				
W9510	COPEPOD SPP.	C	C											171	132			
W9510	COPEPOD SPP.	N	C											22457	20739			
W9510	CRUSTACEA:UNIDED CRUSTACEAN	-	O												132			
W9510	EURYTEMORA HERDMANI	C	C											1371				
W9510	EURYTEMORA HERDMANI	F	C											514				
W9510	EURYTEMORA HERDMANI	M	C											171				
W9510	METRIDIA LUCENS	C	C												132			
W9510	METRIDIA LUCENS	F	C											171				
W9510	MICROSETELLA NORVEGICA	-	C											171	264			
W9510	OITHONA SIMILIS CLAUS	C	C											16800	12153			
W9510	OITHONA SIMILIS CLAUS	F	C											4629	2246			
W9510	OITHONA SIMILIS CLAUS	M	C											514	528			
W9510	PODON SPP.	-	O											343				
W9510	POLYCHAETE SPP.	-	O											343				
W9510	POLYCHAETE SPP.	T	O											171				
W9510	PSEUDOCALANUS NEWMANI	C	C											5486	2774			
W9510	PSEUDOCALANUS NEWMANI	F	C											1200	2246			
W9510	PSEUDOCALANUS NEWMANI	M	C											171	396			
W9510	TEMORA LONGICORNIS	C	C											1886	396			
W9510	TEMORA LONGICORNIS	F	C											514	132			
W9510	TEMORA LONGICORNIS	M	C											1029	396			
W9510	UNIDENTIFIED LARVAE	L	O												132			
W9511	ACARTIA HUDSONICA	C	C				62	4819		449		4800	1621	2651				
W9511	ACARTIA HUDSONICA	F	C					912				300		442				
W9511	ACARTIA HUDSONICA	M	C				62	521		128		1500	232	442				
W9511	ACARTIA TONSA	C	C	359	176	1176	744	3256	1943	1155	242	22500	10189	4713				
W9511	ACARTIA TONSA	F	C	135	59		62	1563	648	128		900	1853	442				
W9511	ACARTIA TONSA	M	C	359	351		124	521		64		1800	1621	442	116			
W9511	BIVALVIA SPP.	L	O	90	234	1176	62	1953	24615	3081	181	2100	6252	3829	463			2435
W9511	BRYOZOA SPP.	-	O			471				64			695	442				
W9511	CALANUS FINMARCHICUS	C	C	45	59										116			
W9511	CALANUS FINMARCHICUS	F	C	45														
W9511	CALANUS FINMARCHICUS	M	C		176	235									232			

TABLE A3
Zooplankton Species Data (ind/m^3)
W9510 - W9517

Event	Species	Life Stage	Group	Station Cast														
				1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9511	CENTROPAGES TYPICUS	C	C	224	1404	471	1178		648		1391			1031	463			913
W9511	CENTROPAGES TYPICUS	F	C			235	434				181				347			913
W9511	CENTROPAGES TYPICUS	M	C		117	235	496				786			295	116			609
W9511	CIRRIPEDE SPP.	N	B				186					300						
W9511	COPEPOD SPP.	-	C	90	59	235		521	1296			300						3044
W9511	COPEPOD SPP.	C	C	45		3294			12955	385	847							4262
W9511	COPEPOD SPP.	N	C	2467	3569	34118	6509	31256		10012	5322	51600	25009	32105	9379			30139
W9511	CRUSTACEA:UNIDED CRUSTACEAN	-	O			235		130	648									
W9511	EURYTEMORA HERDMANI	C	C								60							
W9511	GASTROPODA;MOLLUSCA	L	O		117			521	648		121	600	695	295	116			304
W9511	HARPACTICOIDA SPP.	-	C					130				300						
W9511	METRIDIA LUCENS	C	C												232			913
W9511	MICROSETELLA NORVEGICA	-	C	404	117	235		260	5830	64	726	300			232			609
W9511	OIKOPLEURA DIOICA	-	O	224	936	235												
W9511	OITHONA ATLANTICA	-	C			706												
W9511	OITHONA SIMILIS CLAUS	-	C	179	59	235												
W9511	OITHONA SIMILIS CLAUS	C	C	2511	3861	24471	2913	2474	40161	1797	7015	2700	2084	4565	9842			27703
W9511	OITHONA SIMILIS CLAUS	F	C	404	1404	12471	992	260	6478	642	3870	600	463	1325	2895			17353
W9511	OITHONA SIMILIS CLAUS	M	C		59	2353	186		3239	257	181	300	463	442	695			1827
W9511	PARACALANUS PARVUS	C	C		59		992				1149		463	442				3653
W9511	PARACALANUS PARVUS	F	C				124				242		232					2131
W9511	PARACALANUS PARVUS	M	C		59		248			64	121		232	147				1522
W9511	PODON POLYPHEMOIDES	-	O					130										
W9511	PODON SPP.	-	O				186					1500						
W9511	POLYCHAETE SPP.	L	O		761			781		449		1200	695	295				
W9511	PSEUDOCALANUS NEWMANI	C	C	2825	1229	1412	186	1172	9716	385	605	1200			3011			609
W9511	PSEUDOCALANUS NEWMANI	F	C	897	234	1176		1042	5182	128	60				232			609
W9511	PSEUDOCALANUS NEWMANI	M	C		59			391	1296	64	242		232		116			304
W9511	TEMORA LONGICORNIS	C	C	179	234	3059	62	260	1943	193	181	300	695	295				1218
W9511	TEMORA LONGICORNIS	F	C		59	1176		391			60				232			609
W9511	TEMORA LONGICORNIS	M	C	45		3059		260	1296						116			304
W9511	UNIDENTIFIED LARVAE	L	O	45					4534	64	121	300	695	147				1218
W9512	ACARTIA HUDSONICA	M	C											104				
W9512	ACARTIA TONSA	C	C											5415			2021	
W9512	ACARTIA TONSA	F	C											2812			713	
W9512	ACARTIA TONSA	M	C											3020			832	
W9512	BIVALVIA SPP.	L	O											2708			1189	
W9512	BRYOZOA SPP.	-	O											312			238	
W9512	CENTROPAGES TYPICUS	C	C														951	

TABLE A3
Zooplankton Species Data (ind/m^3)
W9510 - W9517

Event	Species		Life Stage	Group	1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
					Station Cast														
W9512	CENTROPAGES TYPICUS		F	C														238	
W9512	CENTROPAGES TYPICUS		M	C														119	
W9512	COPEPOD SPP.		-	C											417				
W9512	COPEPOD SPP.		C	C											417			951	
W9512	COPEPOD SPP.		N	C											6144			15808	
W9512	CRUSTACEA:UNIDED CRUSTACEAN		-	O											312				
W9512	ECHINODERM PLUTEI		-	O														119	
W9512	EURYTEMORA HERDMANI		C	C														119	
W9512	GASTROPODA;MOLLUSCA		L	O											1041				
W9512	HARPACTICOIDA SPP.		-	C											104				
W9512	MEDUSA		-	O											208			119	
W9512	METRIDIA LUCENS		-	C											208				
W9512	MICROSETELLA NORVEGICA		-	C											833			238	
W9512	OIKOPLEURA DIOICA		-	O											3645			7607	
W9512	OITHONA SIMILIS	CLAUS	-	C														238	
W9512	OITHONA SIMILIS	CLAUS	C	C											3020			2734	
W9512	OITHONA SIMILIS	CLAUS	F	C											1250			951	
W9512	OITHONA SIMILIS	CLAUS	M	C											312			594	
W9512	PARACALANUS PARVUS		C	C														951	
W9512	PARACALANUS PARVUS		F	C											104			119	
W9512	PARACALANUS PARVUS		M	C														119	
W9512	PODON SPP.		-	O											208				
W9512	POLYCHAETE SPP.		L	O											521				
W9512	POLYCHAETE SPP.		T	O											104				
W9512	PSEUDOCALANUS NEWMANI		C	C											521			119	
W9512	PSEUDOCALANUS NEWMANI		F	C											729				
W9512	TEMORA LONGICORNIS		C	C											208				
W9512	TEMORA LONGICORNIS		F	C											104				
W9512	UNIDENTIFIED LARVAE		L	O											104			357	
W9513	ACARTIA TONSA		C	C												746			
W9513	ACARTIA TONSA		M	C												166			
W9513	BIVALVIA SPP.		-	O												22204			
W9513	BRYOZOA SPP.		-	O												249			
W9513	CALANUS FINMARCHICUS		C	C												83			
W9513	CENTROPAGES TYPICUS		C	C												911			
W9513	COPEPOD SPP.		-	C												83			
W9513	COPEPOD SPP.		C	C												414			
W9513	COPEPOD SPP.		N	C												4060			
W9513	ECHINODERM PLUTEI		-	O												166			

TABLE A3
Zooplankton Species Data (ind/m^3)
W9510 - W9517

Event	Species		Life Stage	Group	1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
					Station Cast														
W9513	EURYTEMORA HERDMANI		C	C												249			
W9513	GASTROPODA;MOLLUSCA		L	O												249			
W9513	MICROSETELLA NORVEGICA		-	C												580			
W9513	OIKOPLEURA DIOICA		-	O												2154			
W9513	OITHONA ATLANTICA		-	C												166			
W9513	OITHONA SIMILIS	CLAUS	C	C												4391			
W9513	OITHONA SIMILIS	CLAUS	F	C												663			
W9513	OITHONA SIMILIS	CLAUS	M	C												331			
W9513	PARACALANUS PARVUS		C	C												331			
W9513	PARACALANUS PARVUS		M	C												83			
W9513	PSEUDOCALANUS NEWMANI		C	C												83			
W9513	PSEUDOCALANUS NEWMANI		F	C												83			
W9513	PSEUDOCALANUS NEWMANI		M	C												83			
W9513	TEMORA LONGICORNIS		C	C												166			
W9513	UNIDENTIFIED LARVAE		L	O												663			
W9514	ACARTIA HUDSONICA		C	C					251	186									
W9514	ACARTIA HUDSONICA		F	C					125										
W9514	ACARTIA HUDSONICA		M	C												140			
W9514	ACARTIA TONSA		C	C	492	384	216		2824	931	2962	188	3583		563	701			301
W9514	ACARTIA TONSA		F	C		128	216		816	466	987		156		282	280			
W9514	ACARTIA TONSA		M	C	1476	256	216		627	1025	889	188	260		1056				151
W9514	ALTEUTHA DEPRESSA		-	C									52						
W9514	ASCIDIAN SPP.		L	O									52						
W9514	BIVALVIA SPP.		-	O	36402														
W9514	BIVALVIA SPP.		L	O		11904	4104		1192	8476	14414	2638	2025		3731	1402			3013
W9514	BRYOZOA SPP.		-	O	984		216				197	188	104		70	280			301
W9514	CALANUS FINMARCHICUS		C	C								283				140			151
W9514	CALANUS FINMARCHICUS		M	C								94							
W9514	CENTROPAGES TYPICUS		C	C	6887	1920	5400		1380	2794	1678	4900	156		4224	12200			17477
W9514	CENTROPAGES TYPICUS		F	C	492	640	432		188	186	99	283			634	280			301
W9514	CENTROPAGES TYPICUS		M	C	984	512	864		251	466	494				774	140			603
W9514	COPEPOD SPP.		-	C	492	128	432		251	186	395	471	52		282	140			151
W9514	COPEPOD SPP.		C	C	492	896	864		314	466	494	565	52		493				452
W9514	COPEPOD SPP.		N	C	37878	23424	19872		3388	2701	5134	15735	11527		7744	21454			27120
W9514	CRUSTACEA:UNIDED CRUSTACEAN		-	O		256	648				99					140			
W9514	ECHINODERM PLUTEI		-	O	492					93									
W9514	EURYTEMORA HERDMANI		C	C					188				260						
W9514	EURYTEMORA HERDMANI		F	C								94							
W9514	EURYTEMORA HERDMANI		M	C												140			

TABLE A3

Zooplankton Species Data (ind/m^3)

W9510 - W9517

Event	Species		Life Stage	Group	Station Cast														
					1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9514	EVADNE SPP.		-	O	5411		216		502	1118	1283	94	675		1126				
W9514	GASTROPODA;MOLLUSCA		L	O		256			627		987	283	727		70	280			
W9514	HARPACTICOIDA SPP.		-	C		128	648		188	186			104						
W9514	MEDUSA		-	O		512	216			93	99		52		70				151
W9514	MICROSETELLA NORVEGICA		-	C	984	512	1080		125	279	494	848			282	140			
W9514	OIKOPLEURA DIOICA		-	O	492	768	864		125	373	99		104		70	140			
W9514	OITHONA ATLANTICA		-	C	492							188	52						
W9514	OITHONA ATLANTICA		C	C												140			
W9514	OITHONA SIMILIS	CLAUS	-	C												280			151
W9514	OITHONA SIMILIS	CLAUS	C	C	11806	5120	9936		753	2049	3060	7632	779		2323	14724			11752
W9514	OITHONA SIMILIS	CLAUS	F	C	3935	1280	4968		565	931	1283	1696	363		1197	3365			2712
W9514	OITHONA SIMILIS	CLAUS	M	C		256	1080		125	93	691	283	104		141	421			151
W9514	PARACALANUS PARVUS		C	C	1476	1408	864				99	377			282	421			603
W9514	PARACALANUS PARVUS		F	C	984	128			63	93	494	1131			70				151
W9514	PARACALANUS PARVUS		M	C	984	128	432			93		94			141	140			301
W9514	PENILIA AVIROSTRIS		-	O	4919						99		52		70				
W9514	PODON SPP.		-	O					63				467						
W9514	POLYCHAETE SPP.		L	O	2952	384	216		627		395		2337						151
W9514	PSEUDOCALANUS NEWMANI		C	C		128			63	93		94				701			301
W9514	PSEUDOCALANUS NEWMANI		F	C						93		754			70	140			452
W9514	TEMORA LONGICORNIS		C	C		128	216			186	494	94	260						
W9514	TEMORA LONGICORNIS		F	C							99				70				301
W9514	TEMORA LONGICORNIS		M	C		128					99	94			211				
W9514	UNIDENTIFIED LARVAE		L	O	492		648		188	559	395		415		70	421			151
W9515	ACARTIA HUDSONICA		M	C											52				
W9515	ACARTIA TONSA		C	C											208	279			
W9515	ACARTIA TONSA		F	C											156				
W9515	ACARTIA TONSA		M	C											208				
W9515	BIVALVIA SPP.		L	O											3436	11517			
W9515	BRYOZOA SPP.		-	O											104				
W9515	CENTROPAGES TYPICUS		C	C											625	650			
W9515	CENTROPAGES TYPICUS		F	C												93			
W9515	COPEPOD SPP.		-	C											364				
W9515	COPEPOD SPP.		C	C											469	464			
W9515	COPEPOD SPP.		N	C											4738	23405			
W9515	EURYTEMORA HERDMANI		C	C											52				
W9515	EVADNE SPP.		-	O											625	464			
W9515	GASTROPODA;MOLLUSCA		L	O											729	93			
W9515	HARPACTICOIDA SPP.		-	C											208				

TABLE A3

Zooplankton Species Data (ind/m^3)

W9510 - W9517

Event	Species	Life Stage	Group	1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
				Station Cast														
W9515	HYDROZOA SPP.	-	O											52				
W9515	MICROSETELLA NORVEGICA	-	C											521	743			
W9515	OIKOPLEURA DIOICA	-	O											104	1300			
W9515	OITHONA ATLANTICA	F	C												93			
W9515	OITHONA SIMILIS CLAUS	C	C											1614	2972			
W9515	OITHONA SIMILIS CLAUS	F	C											573	557			
W9515	OITHONA SIMILIS CLAUS	M	C											52	186			
W9515	POLYCHAETE SPP.	-	O											52				
W9515	POLYCHAETE SPP.	L	O											312				
W9515	PSEUDOCALANUS NEWMANI	C	C											417				
W9515	PSEUDOCALANUS NEWMANI	F	C											156				
W9515	PSEUDOCALANUS NEWMANI	M	C											260				
W9515	TEMORA LONGICORNIS	C	C											312				
W9515	TEMORA LONGICORNIS	M	C											52				
W9515	UNIDENTIFIED LARVAE	L	O											52	93			
W9516	ACARTIA TONSA	C	C											26			83	
W9516	ACARTIA TONSA	F	C											52				
W9516	ACARTIA TONSA	M	C											26				
W9516	BIVALVIA SPP.	L	O											3185			2241	
W9516	BRYOZOA SPP.	-	O											26			83	
W9516	CENTROPAGES TYPICUS	C	C											209			1494	
W9516	CENTROPAGES TYPICUS	F	C											26				
W9516	COPEPOD SPP.	-	C											52			166	
W9516	COPEPOD SPP.	C	C											157			664	
W9516	COPEPOD SPP.	N	C											4125			15936	
W9516	ECHINODERM PLUTEI	-	O														83	
W9516	GASTROPODA;MOLLUSCA	L	O											183			664	
W9516	HARPACTICOIDA SPP.	-	C														83	
W9516	MICROSETELLA NORVEGICA	-	C											78			830	
W9516	OITHONA ATLANTICA	-	C														83	
W9516	OITHONA SIMILIS CLAUS	C	C											1018			3071	
W9516	OITHONA SIMILIS CLAUS	F	C											470			1079	
W9516	OITHONA SIMILIS CLAUS	M	C											52			83	
W9516	PARACALANUS PARVUS	F	C											26			166	
W9516	PARACALANUS PARVUS	M	C											26				
W9516	POLYCHAETE SPP.	L	O											104				
W9516	PSEUDOCALANUS NEWMANI	C	C														166	
W9516	PSEUDOCALANUS NEWMANI	F	C														332	
W9516	PSEUDOCALANUS NEWMANI	M	C														83	

TABLE A3
Zooplankton Species Data (ind/m^3)
W9510 - W9517

Event	Species	Life Stage	Group	1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
				Station Cast														
W9516	TEMORA LONGICORNIS	C	C											26				
W9516	TEMORA LONGICORNIS	F	C														83	
W9516	TEMORA LONGICORNIS	M	C											26				
W9517	ACARTIA TONSA	C	C														63	
W9517	BIVALVIA SPP.	L	O											576			251	
W9517	BRYOZOA SPP.	-	O											58			63	
W9517	CENTROPAGES TYPICUS	C	C											461			502	
W9517	CENTROPAGES TYPICUS	F	C											144			63	
W9517	CENTROPAGES TYPICUS	M	C											115				
W9517	COPEPOD SPP.	-	C											58			63	
W9517	COPEPOD SPP.	C	C											173			126	
W9517	COPEPOD SPP.	N	C											7436			12497	
W9517	GASTROPODA;MOLLUSCA	L	O														63	
W9517	HARPACTICOIDA SPP.	-	C											29				
W9517	MICROSETELLA NORVEGICA	-	C											404			188	
W9517	OIKOPLEURA DIOICA	-	O														314	
W9517	OITHONA ATLANTICA	-	C														63	
W9517	OITHONA SIMILIS CLAUS	C	C											2853			4208	
W9517	OITHONA SIMILIS CLAUS	F	C											951			754	
W9517	OITHONA SIMILIS CLAUS	M	C											115				
W9517	PARACALANUS PARVUS	C	C											86			126	
W9517	PARACALANUS PARVUS	F	C														63	
W9517	POLYCHAETE SPP.	L	O											29				
W9517	PSEUDOCALANUS NEWMANI	C	C											115				
W9517	PSEUDOCALANUS NEWMANI	F	C											58				
W9517	PSEUDOCALANUS NEWMANI	M	C											58				
W9517	TEMORA LONGICORNIS	C	C											29				
W9517	UNIDENTIFIED LARVAE	L	O											86			63	

Life Stage Definitions:

- C Copepodite stages I-V
- F Copepoda adult female
- L Larva
- M Copepoda adult male
- N Nauplii
- T Trochophore (larval stage of polychaete
- Y Cypris Larva of Barnacle

Group Definitions:

- B Barnacle
- C Copepod
- OZ Other Zooplankton

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