Semi-annual water column monitoring report: February-July 1995

Massachusetts Water Resources Authority

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Semi-Annual Water Column Monitoring Report
February - July, 1995

submitted to

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SEMI-ANNUAL REPORT 1995, 95-01

EXECUTIVE SUMMARY

Water quality monitoring data presented in this report were collected during the first 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 first nine 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 first half of 1995, two types of surveys were performed: nine nearfield surveys with stations located in the area over the future outfall site, and four more comprehensive nearfield/farfield combined surveys that included stations in Boston Harbor, Massachusetts Bay, and Cape Cod Bay.

Results from the first 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 influences the timing and impact of critical events such as dissolved oxygen depletion in bottom water. Results are organized, therefore, first by presenting data from the pre-stratification phase (W9501-W9506), and then from the early stratification phase (W9507-W9509).

During the pre-stratification phase in the winter-spring of 1995, Cape Cod Bay was the most productive region sampled. There was a regional late winter bloom in early March, as documented by nutrient data, dominated by a centric diatom bloom and a small *Gymnodinium* codominant. Maximum nutrient scavenging occurred in the nearfield and Cape Cod Bay, with regional scavenging of silicate by diatom production.

Productivity and respiration data indicated that there was a productivity event that occurred within the nearfield between the late March and early April surveys. Relatively high values of chlorophyll-specific production, in tandem with a peak of zooplankton abundance, suggested rapid grazing of newly-produced chlorophyll.

The spring bloom was in full swing by late April, with the maximum production of chlorophyll *a* centered at nearfield station N21. *Chaetoceros* spp. and a small (<20µm) *Gymnodinium* species were dominant during the spring bloom, while *Chaetoceros* and *Thalassiosira decipiens* were the dominant carbon producers. The impact of the spring bloom in April was concentrated in the surface water, but by the following survey in May, many bottom water quality parameters were altered, potentially from settling and decomposition of plankton. Supporting physical data indicated that a mixing event also had influenced bottom water parameters measured during this survey within the nearfield.

The early stratification phase in June began with a bloom concentrated in Boston Harbor, with the highest regional phytoplankton densities measured. Cape Cod Bay was the least productive region during this survey. In the nearfield, the impact of upwelling in July documented by physical data was seen in water column productivity parameters. A peak in chlorophyll-specific production in early July forecasted an onset of productivity. Biological parameters measured in late July, including an increase in carbon-specific respiration, were consistent with a mid-summer pulse of productivity in the nearfield.

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 first half of the 1995 monitoring year. Water column monitoring results for the first 9 of 17 surveys conducted in 1995 are included in this report (Table 1-1). There were two types of surveys performed: nine nearfield surveys with stations located in the area over the future outfall site, and four 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.

This report presents summarized data from the first nine surveys. 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 first nine 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 (Sections 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 transects, Boston-Nearfield, Cohasset, and Marshfield, allows three-dimensional analysis of water column conditions during each survey.

Results of water column physical data, including water properties, nutrients, chlorophyll *a*, 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. The timing of water column vertical stratification, and the physical and biological status of the water column at the onset of stratification, to a large degree determine 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-stratification stage (W9501-W9506), and then further delineates processes occurring during the early stratification stage (W9507-W9509). 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

Water Quality Surveys for W9501-W9509
January to July 1995

Survey #	Type of Survey	Survey Dates
W9501	Nearfield/Farfield	February 6-14
W9502	Nearfield/Farfield	February 28-March 5
W9503	Nearfield	March 20-22
W9504	Nearfield/Farfield	April 3-10
W9505	Nearfield/Farfield	April 24-27
W9506	Nearfield	May 15-173
W9507	Nearfield/Farfield	June 20-25
W9508	Nearfield	July 5-7
W9509	Nearfield	July 24-26

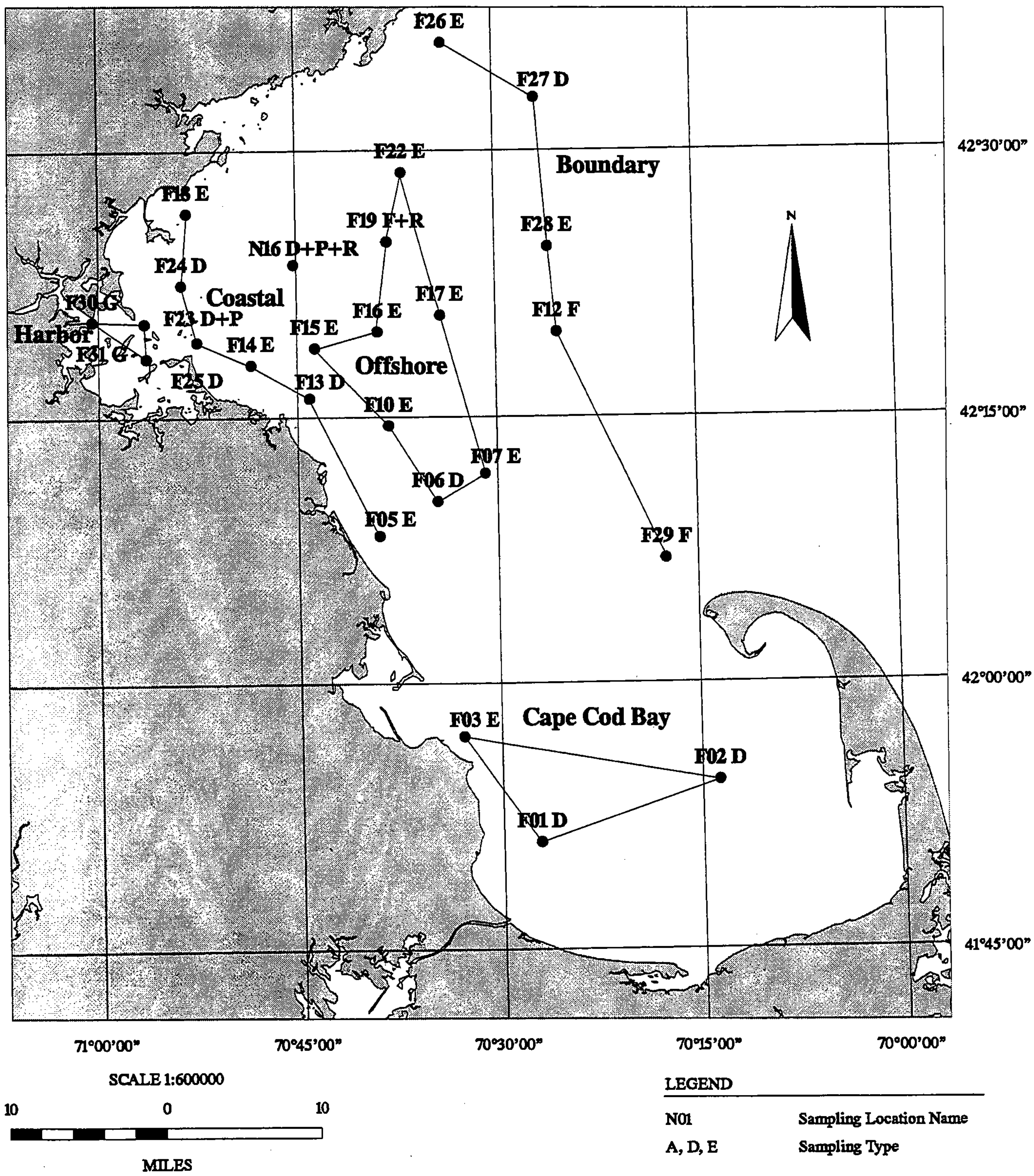


FIGURE 1-1
Farfield Stations Sampled During the First Semi-Annual Period, Showing Regional Geographic Classifications Used in Text

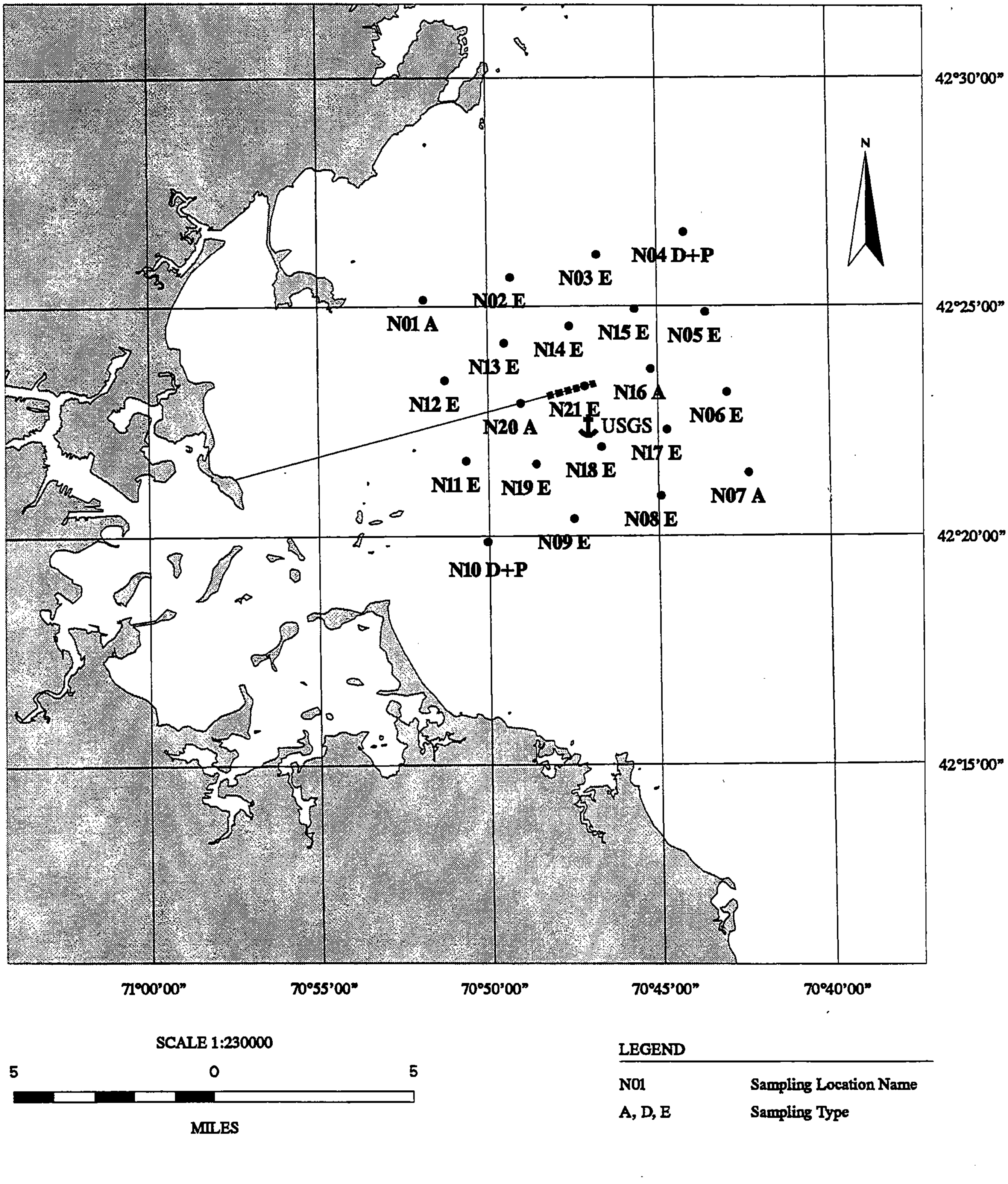


FIGURE 1-2
Nearfield Stations Sampled During the First 1995 Semi-Annual Period

MWRA 1996 Water Quality Sampling

Farfield Transects

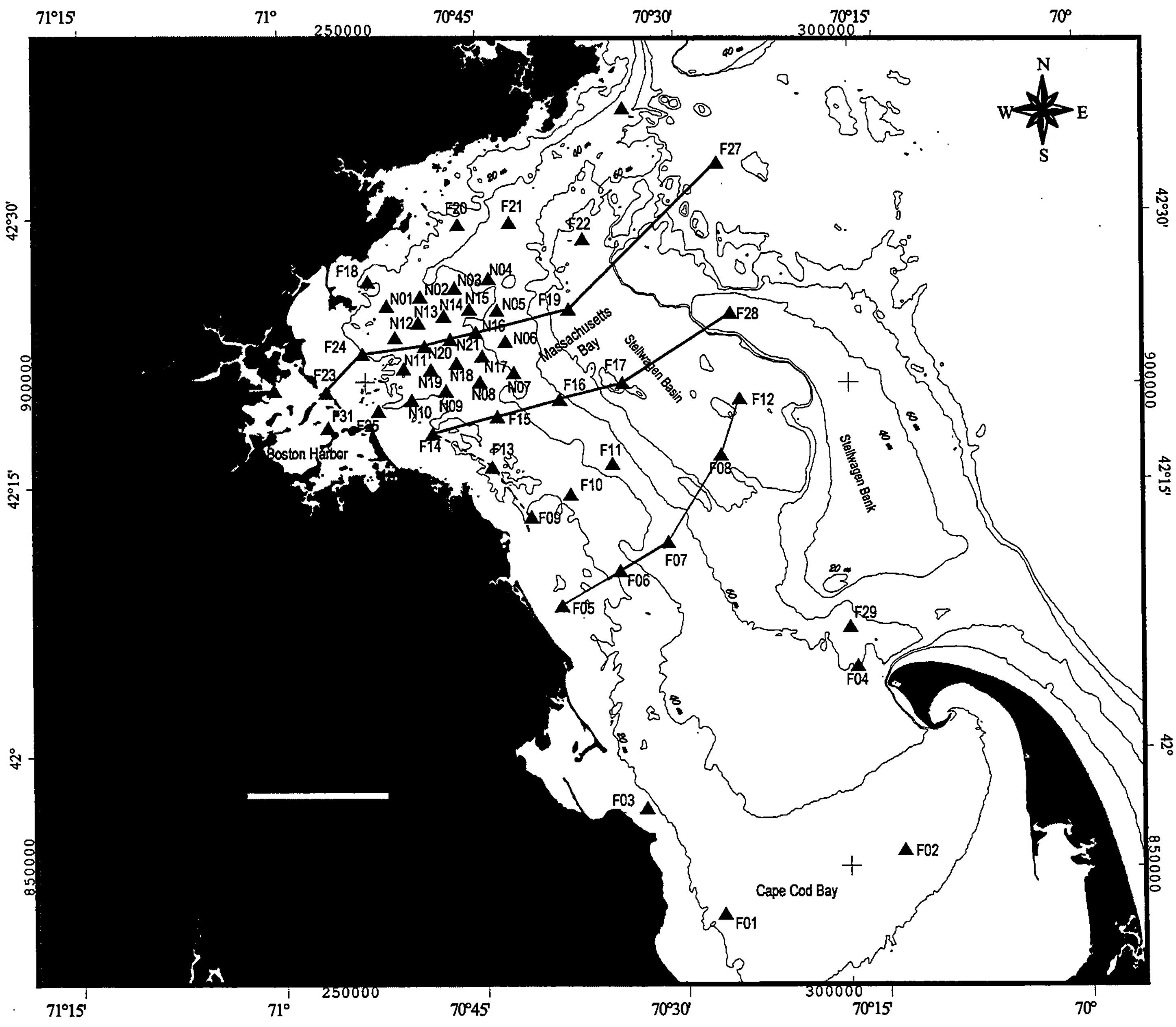


FIGURE 1-3
Locations of Stations Selected for Vertical Transect Graphics

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 were collected using a CTD/Niskin Bottle Rosette system. Hydrographic measurements of the water column included conductivity (salinity), temperature, pressure (depth), dissolved oxygen, transmissometry, irradiance, and relative fluorescence.

Water samples were collected at five depths: bottom, mid-bottom, middle, mid-surface, and surface; generally, 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 ammonia (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 phaeopigment, total suspended solids, dissolved oxygen, urea, estimates of plankton productivity and respiration rates, and plankton taxonomy and enumeration.

The sampling schema for these analyses are outlined in Table 1-1. 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 CW/QAPP (Bowen *et al.*, 1997) and Appendix A for productivity and respiration methods.

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/farfield survey in early February (W9501):

- Only 11 of the planned 21 nearfield stations were sampled due to inclement weather conditions and additional time required for areal productivity sampling at stations N04 and N07.

- Only 55 out of the planned 105 samples for DINuts were collected due to decreased number of stations.

Deviations from the CW/QAPP for the nearfield/farfield survey in late February/early March (W9502):

- Only 16 of the planned 21 nearfield stations were sampled due to time limitations.

- Only 80 out of 105 planned samples for DINuts were collected due to the decreased number of stations.

- Dissolved organic carbon (DOC) vials from Station F31 were accidentally labelled Station F23. The laboratory received two sets of DOC vials for Station F23 which could not be differentiated.

- Two urea vials broke after being frozen. The broken bottles and frozen contents were placed in larger plastic bottles and shipped to the laboratory.

- The flowmeter count for the zooplankton net tow was not recorded at Station N16 (first visit). This count was estimated using the count obtained on the following day at the same station under similar tow conditions.

Deviations from the CW/QAPP for the nearfield survey in late March (W9503):

- Only 11 out of the planned 21 nearfield stations were sampled due to time limitations.

- Only 55 out of 95 planned samples for DINuts were collected due to the decreased number of stations.

Deviations from the CW/QAPP for the nearfield survey in early April (W9504):

- Only 11 out of the planned 21 nearfield stations were sampled due to time limitations.

- Only 55 out of 95 planned samples for DINuts were collected due to the decreased number of stations.

No deviations were recorded for the late April survey (W9505).

Deviations from the CW/QAPP for the nearfield survey in mid-May (W9506):

- The midsurface bottle did not close at Stations N03, N10, and N18 resulting in no DINuts samples collected at that depth. No chlorophyll samples were collected for that depth at Station N10.

No deviations were recorded for the nearfield/farfield survey in late June (W9507).

Deviations from the CW/QAPP for the nearfield survey in early July (W9508):

- Only 12 out of the planned 21 nearfield stations were sampled due to technical problems resulting from the use of a new vessel.

- Only 59 out of 105 planned samples for DINuts were collected due to the decreased number of stations.

Deviations from the CW/QAPP for the nearfield survey in early July (W9508):

- Only 19 out of the planned 21 nearfield stations were sampled due to time limitations.

- Only 95 out of 105 planned samples for DINuts were collected due to the decreased number of stations.

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 3-9). Each table provides summary data from one survey; the survey dates are provided at the top of each table. Discussions 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 in this section. All raw data summarized in this report are available from MWRA in either 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, 1995).

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 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 (FF12, F26, F27, F28, F29), and three Cape Cod Bay stations (F01, F02, and F03). These 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 weighting 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. Results for phaeopigments, also from analysis of discrete water samples, are 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 fixed distance in the water column, and is provided in units of m^{-1}.

3.3 Nutrients

Analytical results for dissolved 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). Results of total dissolved inorganic nitrogen (DIN) are presented in graphical products of this report; DIN consists of NO_3, NO_2, and NH_4. Nutrients were measured in water samples collected at each of the A-E depths during the CTD casts. 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 (typically depth C) during the water column casts. Additional samples were taken at these two depths and screened through 20 µm 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.

TABLE 3-1
Semi-Annual Data Summary Table
Event W9501 (2/06/95 - 2/14/95)
Combined Nearfield/Farfield Survey

Region		Nearfield			Farfield														
					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	µg/L	0.0	2.3	1.2	0.0	1.3	0.6	0.3	2.0	1.1	0.0	1.4	0.8	0.0	2.7	0.6	0.0	4.5	2.1
Salinity	psu	32.0	32.6	32.6	31.1	32.4	31.9	31.9	32.6	32.3	32.4	32.9	32.6	32.2	33.0	32.7	32.2	32.5	32.4
Sigma_T		25.6	25.9	25.9	24.9	25.8	25.5	25.5	25.9	25.8	25.8	26.0	25.9	25.6	26.1	25.9	25.8	25.9	25.9
Temperature	°C	1.3	3.9	3.4	0.8	2.8	1.9	1.3	3.3	2.3	2.6	5.1	3.8	3.2	5.1	4.3	1.7	2.3	2.1
Transmissivity	m-1	0.33	0.47	0.37	0.39	0.64	0.50	0.37	0.52	0.44	0.31	0.51	0.40	0.33	0.44	0.39	0.51	0.51	0.51
Nutrients																			
NH_4	µM	0.32	5.41	1.13	2.75	9.85	7.49	0.67	6.26	2.93	0.34	1.40	0.84	0.31	1.16	0.57	0.47	1.02	0.62
NO_2	µM	0.14	0.26	0.18	0.20	0.35	0.28	0.18	0.27	0.23	0.16	0.22	0.19	0.15	0.20	0.17	0.18	0.23	0.19
$NO_2 + NO_3$	µM	9.0	9.9	9.4	9.6	11.7	10.6	9.4	10.6	10.0	9.6	10.2	9.9	8.8	10.1	9.6	8.2	9.9	8.5
PO_4	µM	0.88	1.11	0.94	1.01	1.39	1.23	0.91	1.22	1.05	0.93	1.05	0.97	0.91	1.03	0.97	0.77	0.90	0.81
SIO_4	µM	11.8	14.8	12.8	13.3	19.5	16.3	13.1	16.0	14.2	12.3	13.8	13.1	10.5	14.6	12.4	8.9	12.1	9.4
Phaeopigment	µg/L	0.15	1.03	0.38	0.16	0.88	0.28	0.25	0.95	0.68	0.59	0.85	0.70	0.34	0.74	0.55	0.01	2.07	1.17
DO																			
Concentration	mg/l	8.8	10.7	10.2	10.2	10.6	10.3	10.2	10.5	10.4	9.7	10.3	10.1	9.7	10.4	10.0	10.5	10.7	10.6
Saturation	%	83	98	95	90	94	92	92	96	94	93	97	95	95	96	95	94	97	95
Productivity																			
Alpha	see text	0.01	0.07	0.04	0.03	0.07	0.05												
Areal Production	$mgC/m^2/d$	680.6	896.9	761.8	405.3	405.3	405.3												
Pmax	see text	3.8	8.6	6.2	4.5	7.7	6.8												
Respiration	µmol/h	0.06	0.11	0.08	0.08	0.23	0.13				0.04	0.05	0.05						
Water Column																			
BIOSI	µM	0.98	2.32	1.83	0.87	2.65	1.82	0.89	2.78	2.08	2.77	2.78	2.78	1.23	1.74	1.54	4.55	5.06	4.84
DOC	mg/L	1.0	14.0	2.8	1.0	10.0	3.4	1.0	3.0	1.8	2.0	2.0	2.0	1.0	1.0	1.0	1.0	3.0	2.1
PART P	µM	0.08	0.31	0.14	0.16	0.35	0.31	0.15	0.28	0.20	0.14	0.15	0.14	0.07	0.09	0.08	0.20	0.28	0.24
POC	µM	8.4	39.6	12.8	16.9	73.3	32.2	17.2	22.0	20.2	8.9	58.7	34.9	12.8	14.3	13.5	17.7	26.3	21.9
PON	µM	0.60	2.81	1.20	1.82	6.29	3.59	1.29	2.18	1.51	1.13	1.35	1.28	0.67	0.76	0.71	2.98	5.35	4.15
TDN	µM	29.1	84.2	44.3	43.5	54.8	49.9	42.5	76.2	53.4	54.4	68.5	61.2	44.1	45.3	44.5	34.7	48.9	40.4
TDP	µM	0.99	1.29	1.06	1.19	1.60	1.44	1.05	1.37	1.21	1.06	1.11	1.08	0.99	1.04	1.02	0.91	0.97	0.93
TSS	mg/L	0.0	30.0	12.9	2.0	28.0	11.3	0.0	18.0	3.7	0.0	5.0	2.1	0.0	10.0	4.5	4.0	18.0	9.2
Urea	µM	0.17	0.53	0.37	0.35	0.77	0.54	0.14	0.80	0.43	0.21	0.56	0.39	0.20	0.20	0.20	0.64	1.70	0.94
Plankton (Surface samples only)																			
Total Phytoplankton	Mcell/L		1.0			1.8			1.5			0.5			0.5			0.9	
Centric diatoms	Mcell/L		0.07			0.18			0.14			0.03			0.02			0.43	
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		2.00E-03			NP			2.00E-03			NP			1.15E-04			1.00E-03	
Total Zooplankton	#/m3		15414			10323			29240			9378			8703			11625	

TABLE 3-2
Semi-Annual Data Summary Table
Event W9502 (2/28/95 - 3/05/95)
Combined Nearfield/Farfield Survey

Region		Nearfield			Farfield														
					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	1.4	0.7	0.2	1.1	0.8	0.0	1.7	0.8	0.1	1.5	0.8	0.5	2.5	1.3	2.3	5.4	3.8
Salinity	psu	32.0	32.6	32.5	30.3	32.0	31.4	31.5	32.5	32.2	32.4	32.7	32.6	32.0	32.7	32.5	32.1	32.5	32.2
Sigma_T		25.5	25.9	25.8	24.2	25.6	25.0	25.2	25.9	25.7	25.8	26.0	25.9	25.5	26.0	25.9	25.6	25.9	25.7
Temperature	°C	2.3	3.7	3.2	1.9	2.3	2.1	2.0	2.8	2.5	2.9	4.3	3.5	2.5	4.2	3.5	1.7	2.6	2.1
Transmissivity	m-1	0.27	0.46	0.33	0.48	0.73	0.64	0.37	0.69	0.46	0.28	0.71	0.33	0.27	0.51	0.34	0.39	0.72	0.52
Nutrients																			
NH_4	µM	0.81	4.49	1.45	4.20	7.40	5.94	1.20	7.50	3.96	0.89	1.82	1.13	0.36	1.40	0.86	0.57	1.72	0.97
NO_2	µM	0.14	0.29	0.18	0.26	0.43	0.33	0.15	0.31	0.24	0.15	0.21	0.18	0.14	0.21	0.17	0.08	0.21	0.14
$NO_2 + NO_3$	µM	3.4	6.1	4.4	6.0	11.1	7.8	2.9	7.4	5.8	4.5	8.0	6.9	4.2	8.9	7.6	0.7	3.7	1.9
PO_4	µM	0.55	0.80	0.63	0.92	1.02	0.96	0.57	0.97	0.87	0.77	1.02	0.87	0.66	0.89	0.82	0.31	0.62	0.44
SIO_4	µM	2.2	5.4	3.2	5.2	12.8	7.8	2.2	7.1	5.0	3.4	10.6	7.6	3.7	9.4	7.8	1.0	3.3	1.7
Phaeopigment	µg/L	0.00	1.36	0.40	0.53	0.78	0.64	0.33	0.77	0.49	0.23	0.41	0.32	0.17	0.32	0.22	0.37	1.22	0.78
DO																			
Concentration	mg/l	10.4	11.3	11.0	10.3	10.8	10.5	10.1	11.0	10.6	9.6	11.1	10.4	9.5	10.4	9.9	10.2	10.7	10.5
Saturation	%	96	105	103	92	97	95	92	101	96	90	104	97	90	95	93	93	97	95
Productivity																			
Alpha	see text	0.02	0.05	0.03	0.03	0.04	0.03												
Areal Production	$mgC/m^2/d$	328.0	860.6	552.5	324.5	324.5	324.5												
Pmax	see text	2.0	6.5	3.9	3.3	4.6	4.1												
Respiration	µmol/h	0.03	0.09	0.07	0.11	0.19	0.16				0.04	0.07	0.05						
Water Column																			
BIOSI	µM	0.74	2.63	1.36	2.06	3.79	2.57	1.55	2.84	2.19	1.63	1.79	1.71	1.00	1.13	1.07	1.75	2.79	2.21
DOC	mg/L	1.0	8.0	1.9	1.0	2.0	1.8	1.0	10.0	4.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.0	1.5
PART P	µM	0.10	0.30	0.18	0.29	0.53	0.43	0.24	0.43	0.31	0.09	0.09	0.09	0.05	0.11	0.08	0.20	0.24	0.22
POC	µM	2.4	44.9	16.1	24.0	46.5	32.8	18.9	34.3	24.8	8.7	30.0	12.6	7.3	7.8	7.6	23.7	37.2	28.1
PON	µM	0.17	8.90	2.64	4.18	7.83	5.44	2.96	5.02	4.11	1.51	2.90	2.12	1.71	4.02	2.91	3.00	5.07	3.59
TDN	µM	17.9	32.1	25.0	36.1	46.8	40.7	26.8	41.7	35.0	29.1	30.6	29.9	28.0	31.7	29.9	22.1	29.7	25.4
TDP	µM	0.63	1.13	0.78	1.06	1.19	1.13	0.99	1.21	1.06	0.98	1.01	1.00	0.95	0.96	0.95	0.57	0.75	0.67
TSS	mg/L	0.0	32.0	14.0	0.0	27.0	9.5	0.0	19.0	3.9	0.0	0.0	0.0	0.0	20.0	8.4	0.0	15.0	10.2
Urea	µM	0.45	1.26	0.78	0.81	5.73	1.78	0.52	0.95	0.75	0.43	2.38	1.37	0.39	0.84	0.62	0.64	2.91	1.27
Plankton (Surface samples only)																			
Total Phytoplankton	Mcell/L		0.7			1.0			1.2			0.2			0.3			1.6	
Centric diatoms	Mcell/L		0.04			0.08			0.05			0.02			0.01			0.22	
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		2.12E-03			1.79E-05			2.77E-05			2.52E-05			NP			1.00E-03	
Total Zooplankton	#/m3		24628			21108			33895			13234			8126			28164	

TABLE 3-3
Semi-Annual Data Summary Table
Event W9503 (3/20/95 - 3/22/95)
Nearfield Survey

Region		Nearfield		
Parameter	Unit	Min	Max	Avg
Physical				
Chlorophyll a	µg/L	0.00	0.18	0.08
Salinity	psu	31.2	32.6	32.0
Sigma_T		24.8	25.9	25.5
Temperature	°C	3.1	4.2	3.6
Transmissivity	m-1	0.2	0.5	0.3
Nutrients				
NH_4	µM	0.94	5.06	1.84
NO_2	µM	0.14	0.31	0.19
$NO_2 + NO_3$	µM	5.9	7.5	6.8
PO_4	µM	0.68	1.00	0.82
SIO_4	µM	7.7	11.2	9.3
Phaeopigment	µg/L	0.04	0.29	0.12
DO				
Concentration	mg/l	9.5	10.6	10.1
Saturation	%	89	99	95
Productivity				
Alpha	see text	0.00	0.01	0.00
Areal Production	$mgC/m^2/d$	131.1	133.7	132.4
Pmax	see text	0.27	0.89	0.58
Respiration	µmol/h	0.01	0.03	0.02
Water Column				
BIOSI	µM	0.21	1.38	0.68
DOC	mg/L	1.0	2.0	1.6
PART P	µM	0.04	0.18	0.10
POC	µM	6.1	40.5	13.6
PON	µM	0	6.5	1.8
TDN	µM	13.4	20.1	15.7
TDP	µM	0.76	1.06	0.86
TSS	mg/L	0.0	30.0	11.3
Urea	µM	0.89	3.59	1.80
Plankton (Surface samples only)				
Total Phytoplankton	Mcell/L		0.23	
Centric diatoms	Mcell/L		0.002	
Alexandrium tamarense	Mcell/L		NP	
Phaeocystis pouchetti	Mcell/L		NP	
Pseudo-nitzschia sp	Mcell/L		NP	
Total Zooplankton	#/m3		33748	

TABLE 3-4
Semi-Annual Data Summary Table
Event W9504 (4/03/95 - 4/10/95)
Combined Nearfield/Farfield Survey

Region		Nearfield			Farfield														
					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	0.2	0.9	0.4	0.5	1.0	0.7	0.3	0.8	0.5	0.3	1.2	0.6	0.2	2.0	0.6	0.5	4.2	2.1
Salinity	psu	31.3	32.3	31.8	29.4	31.1	30.8	31.1	31.9	31.5	31.6	32.6	32.0	31.4	32.5	32.1	31.6	31.9	31.7
Sigma_T		24.8	25.7	25.2	23.2	24.7	24.4	24.7	25.3	25.0	25.1	25.9	25.4	25.0	25.9	25.5	25.1	25.3	25.2
Temperature	°C	3.6	5.4	4.1	4.3	5.3	4.5	3.9	4.3	4.1	3.5	4.2	3.9	3.7	4.4	3.9	4.2	4.5	4.4
Transmissivity	m-1	0.19	0.34	0.23	0.48	0.65	0.54	0.21	0.46	0.30	0.21	2.15	0.32	0.21	1.14	0.32	0.35	0.81	0.49
Nutrients																			
NH_4	μM	0.67	5.76	1.60	5.81	11.84	8.40	1.38	5.27	3.00	0.68	2.76	1.24	0.67	2.63	1.15	0.16	1.24	0.52
NO_2	μM	0.15	0.25	0.17	0.26	0.53	0.34	0.16	0.42	0.23	0.14	0.24	0.17	0.13	0.21	0.17	0.12	0.21	0.16
$NO_2 + NO_3$	μM	5.3	7.8	6.1	5.3	10.8	6.4	5.2	6.2	5.7	5.5	7.8	6.3	4.8	7.2	6.4	2.1	6.1	4.4
PO_4	μM	0.73	1.02	0.80	0.89	1.31	1.09	0.75	0.94	0.84	0.71	1.03	0.79	0.66	1.00	0.81	0.36	0.72	0.56
SIO_4	μM	7.4	11.3	8.3	7.9	15.4	9.3	7.0	8.4	7.7	7.6	11.6	8.6	6.8	10.5	8.7	3.8	7.7	6.2
Phaeopigment	μg/L	0.04	0.40	0.12	0.28	0.70	0.42	0.08	0.40	0.24	0.16	0.23	0.19	0.11	0.64	0.19	0.66	3.05	1.59
DO																			
Concentration	mg/l	9.8	10.5	10.3	9.8	10.2	10.1	9.6	10.3	10.0	9.0	10.4	9.8	9.3	10.3	9.8	9.2	10.2	9.6
Saturation	%	92	101	97	93	97	95	90	97	94	85	99	93	88	96	92	87	97	92
Productivity																			
Alpha	see text	0.01	0.02	0.01	0.02	0.03	0.02												
Areal Production	$mgC/m^2/d$	302.8	380.7	353.3	178.0	178.0	178.0												
Pmax	see text	0.5	3.6	1.6	2.3	4.5	2.8												
Respiration	μmol/h	0.00	0.10	0.05	0.06	0.18	0.11				0.00	0.01	0.00						
Water Column																			
BIOSI	μM	0.08	0.92	0.38	0.43	2.37	1.46	0.25	1.63	0.92	0.44	0.55	0.50	0.57	0.75	0.66	2.24	4.21	2.97
DOC	mg/L	1.0	4.0	1.8	2.0	3.0	2.4	1.0	4.0	2.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	1.2
PART P	μM	0.06	0.17	0.10	0.03	0.54	0.39	0.12	0.28	0.18	0.12	0.12	0.12	0.09	0.11	0.10	0.22	0.32	0.26
POC	μM	6.0	15.7	10.1	30.2	45.3	37.5	11.6	26.8	17.4	6.5	13.8	11.7	12.6	13.1	12.9	21.8	43.0	33.0
PON	μM	0.00	2.65	1.41	3.14	5.62	4.73	1.64	3.76	2.62	1.28	2.92	2.00	1.40	2.49	1.96	1.90	4.43	3.19
TDN	μM	12.2	20.8	15.3	22.0	50.3	34.0	13.1	20.0	17.0	13.0	15.4	14.2	11.4	15.6	13.4	9.9	15.6	12.1
TDP	μM	0.67	0.95	0.77	0.96	1.37	1.20	0.77	1.14	0.92	0.68	0.79	0.74	0.72	0.75	0.74	0.55	0.91	0.66
TSS	mg/L	0.0	25.0	10.1	0.0	24.0	9.2	5.0	28.0	17.1	0.0	11.0	4.7	6.0	10.0	7.4	5.0	19.0	14.6
Urea	μM	0.30	3.65	1.39	0.58	1.47	1.12	0.64	2.12	1.09	0.81	0.90	0.85	0.77	0.80	0.78	0.24	0.72	0.50
Plankton (Surface samples only)																			
Total Phytoplankton	Mcell/L		1.1			3.0			2.1			0.6			0.4			2.9	
Centric diatoms	Mcell/L		0.01			0.03			0.01			0.01			0.001			0.02	
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		NP			NP			NP			NP			NP			NP	
Total Zooplankton	#/m3		43373			23052			43606			17124			18953			25515	

TABLE 3-5
Semi-Annual Data Summary Table
Event W9505 (4/24/95 - 4/27/95)
Nearfield Survey

Region		Nearfield		
Parameter	Unit	Min	Max	Avg
Physical				
Chlorophyll a	µg/L	0.32	8.93	2.60
Salinity	psu	31.5	32.3	31.9
Sigma_T		24.6	25.6	25.1
Temperature	°C	4.0	7.7	5.5
Transmissivity	m-1	0.21	0.66	0.36
Nutrients				
NH_4	µM	0.19	4.69	1.13
NO_2	µM	0.05	0.81	0.19
$NO_2 + NO_3$	µM	0.2	7.8	4.4
PO_4	µM	0.19	0.96	0.62
SIO_4	µM	0.6	10.9	6.1
Phaeopigment	µg/L	0.23	2.46	0.83
DO				
Concentration	mg/l	9.3	12.5	10.5
Saturation	%	88	127	103
Productivity				
Alpha	see text	0.01	0.19	0.06
Areal Production	$mgC/m^2/d$	1103.8	3846.9	2475.4
Pmax	see text	0.6	39.2	10.6
Respiration	µmol/h	0.00	2.37	0.43
Water Column				
BIOSI	µM	0.4	4.8	2.4
DOC	mg/L	1.0	4.0	1.6
PART P	µM	0.08	0.51	0.28
POC	µM	7.0	60.1	25.8
PON	µM	0.52	7.52	3.18
TDN	µM	7.7	19.7	13.4
TDP	µM	0.35	1.00	0.61
TSS	mg/L	0.0	35.0	15.1
Urea	µM	0.20	1.29	0.66
Plankton (Surface samples only)				
Total Phytoplankton	Mcell/L		3.8	
Centric diatoms	Mcell/L		0.19	
Alexandrium tamarense	Mcell/L		NP	
Phaeocystis pouchetti	Mcell/L		NP	
Pseudo-nitzschia sp	Mcell/L		8.10E-05	
Total Zooplankton	#/m3		42608	

TABLE 3-6
Semi-Annual Data Summary Table
Event W9506 (5/15/95 - 5/17/95)
Nearfield Survey

Region		Nearfield		
Parameter	Unit	Min	Max	Avg
Physical				
Chlorophyll a	µg/L	0.00	1.61	0.34
Salinity	psu	31.1	32.1	31.5
Sigma_T		24.0	25.4	24.6
Temperature	°C	4.9	9.6	7.3
Transmissivity	m-1	0.20	0.61	0.28
Nutrients				
NH_4	µM	0.28	8.16	1.68
NO_2	µM	0.03	0.22	0.08
$NO_2 + NO_3$	µM	0.2	4.1	0.8
PO_4	µM	0.34	0.87	0.46
SIO_4	µM	3.6	7.8	5.0
Phaeopigment	µg/L	0.09	0.45	0.19
DO				
Concentration	mg/l	9.2	11.3	10.7
Saturation	%	97	116	109
Productivity				
Alpha	see text	0.00	0.03	0.01
Areal Production	$mgC/m^2/d$	775.4	800.9	788.1
Pmax	see text	0.2	10.2	3.8
Respiration	µmol/h	0.12	0.19	0.16
Water Column				
BIOSI	µM	0.1	2.1	0.7
DOC	mg/L	1.0	2.0	1.6
PART P	µM	0.09	0.28	0.17
POC	µM	10.2	23.5	16.7
PON	µM	1.06	4.80	2.27
TDN	µM	6.3	43.6	18.8
TDP	µM	0.36	0.91	0.57
TSS	mg/L	0.0	14.0	3.9
Urea	µM	0.62	1.01	0.81
Plankton (Surface samples only)				
Total Phytoplankton	Mcell/L		1.8	
Centric diatoms	Mcell/L		0.008	
Alexandrium tamarense	Mcell/L		NP	
Phaeocystis pouchetti	Mcell/L		NP	
Pseudo-nitzschia sp	Mcell/L		1.34E-05	
Total Zooplankton	#/m3		77463	

TABLE 3-7
Semi-Annual Data Summary Table
Event W9507 (6/20/95 - 6/25/95)
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	0.1	3.2	0.7	0.9	6.5	3.1	0.2	3.9	1.4	0.1	1.1	0.4	0.0	1.2	0.4	0.1	1.2	0.5
Salinity	psu	31.0	32.0	31.5	30.6	31.1	31.0	31.0	31.7	31.2	30.8	32.2	31.7	30.7	32.3	31.8	31.1	31.9	31.4
Sigma_T		22.3	25.3	24.0	22.2	23.2	22.8	22.2	24.9	23.5	22.4	25.5	24.5	22.2	25.6	24.6	22.7	25.0	23.5
Temperature	°C	5.5	17.7	10.7	13.7	17.1	15.5	7.0	17.9	12.9	4.8	17.1	8.7	4.6	17.0	8.4	6.9	17.2	13.2
Transmissivity	m-1	0.27	1.26	0.49	0.77	1.80	1.11	0.38	1.25	0.65	0.30	0.77	0.38	0.28	0.90	0.42	0.37	0.76	0.47
Nutrients																			
NH_4	µM	0.00	4.60	0.81	0.46	2.42	1.66	0.00	2.78	0.79	0.00	4.65	1.40	0.00	3.70	1.56	0.33	5.35	1.59
NO_2	µM	0.00	0.23	0.06	0.03	0.17	0.09	0.01	0.19	0.07	0.01	0.30	0.11	0.02	0.26	0.15	0.02	0.20	0.07
$NO_2 + NO_3$	µM	0.0	3.6	0.6	0.1	0.8	0.4	0.0	1.9	0.4	0.0	6.7	1.9	0.0	8.0	3.8	0.2	1.9	0.6
PO_4	µM	0.05	0.97	0.38	0.34	0.98	0.56	0.16	0.69	0.44	0.08	1.03	0.51	0.01	1.12	0.65	0.21	0.78	0.38
SIO_4	µM	0.2	8.1	2.1	1.1	3.7	2.3	0.9	6.1	2.7	0.4	14.6	3.9	0.4	13.5	5.8	1.8	11.5	5.0
Phaeopigment	µg/L	0.09	1.36	0.53	0.90	3.23	1.92	0.45	2.52	1.36	0.14	0.51	0.33	0.05	0.65	0.29	0.10	0.60	0.29
DO																			
Concentration	mg/l	8.6	11.2	9.9	8.8	9.9	9.3	8.0	10.2	9.4	8.3	11.4	9.5	8.4	10.9	9.3	7.9	9.4	8.7
Saturation	%	86	136	109	106	124	112	87	123	108	80	118	100	81	113	97	81	110	101
Productivity																			
Alpha	see text	0.01	0.06	0.03	0.11	0.23	0.18												
Areal Production	$mgC/m^2/d$	1056.0	1441.2	1205.6	3634.4	3634.4	3634.4												
Pmax	see text	0.7	10.7	6.2	35.9	70.4	56.0												
Respiration	µmol/h	0.01	0.28	0.12	0.32	0.40	0.37				0.00	0.13	0.06						
Water Column																			
BIOSI	µM	0.25	4.32	1.52	2.42	6.26	4.71	1.35	4.35	3.02	0.19	1.14	0.58	0.07	0.63	0.36	0.72	0.96	0.83
DOC	mg/L	1.0	2.0	1.7	1.0	2.0	1.7	2.0	2.0	2.0	2.0	2.0	2.0	1.0	2.0	1.5	1.0	1.0	1.0
PART P	µM	0.18	0.64	0.32	0.48	1.22	0.86	0.29	0.78	0.60	0.14	0.30	0.19	0.09	0.12	0.11	0.18	0.25	0.22
POC	µM	10.7	55.1	25.6	44.5	88.4	61.7	26.3	73.9	53.4	14.8	18.2	16.9	7.1	12.4	9.7	18.1	21.9	20.7
PON	µM	1.35	8.96	3.58	3.88	13.92	8.84	4.08	10.61	7.28	1.82	2.84	2.50	2.25	2.34	2.29	1.60	3.50	2.70
TDN	µM	7.9	13.6	10.4	17.7	25.2	19.8	9.0	16.9	14.6	9.2	16.3	11.5	8.7	14.0	11.5	9.1	9.9	9.5
TDP	µM	0.32	0.64	0.48	0.82	1.64	1.11	0.47	0.94	0.76	0.21	0.95	0.48	0.15	0.87	0.52	0.36	0.46	0.40
TSS	mg/L	0.0	28.0	3.9	0.0	30.0	8.5	0.0	22.0	13.2	0.0	9.0	2.4	0.0	14.0	7.7	0.0	24.0	6.8
Urea	µM	0.11	0.32	0.19	0.28	1.23	0.52	0.19	0.36	0.26	0.12	0.18	0.15	0.32	0.36	0.34	0.15	0.29	0.23
Plankton (Surface samples only)																			
Total Phytoplankton	Mcell/L		17.6			36.9			22.6			2.2			0.6			3.7	
Centric diatoms	Mcell/L		0.80			1.84			0.78			0.0004			0.0002			0.001	
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		1.85E-02			2.35E-02			1.60E-02			NP			1.30E-04			NP	
Total Zooplankton	#/m3		130805			143424			81666			49898			28056			53051	

TABLE 3-8
Semi-Annual Data Summary Table
Event W9508 (7/05/95 - 7/07/95)
Nearfield Survey

Region		Nearfield		
Parameter	Unit	Min	Max	Avg
Physical				
Chlorophyll a	µg/L	0.00	2.41	0.40
Salinity	psu	31.2	32.0	31.7
Sigma_T		22.5	25.2	24.3
Temperature	°C	5.6	17.6	9.6
Transmissivity	m-1	0.24	1.01	0.44
Nutrients				
NH_4	µM	0.16	3.51	0.78
NO_2	µM	0.04	0.29	0.10
$NO_2 + NO_3$	µM	0.2	4.1	0.8
PO_4	µM	0.21	1.03	0.49
SIO_4	µM	1.2	8.5	3.5
Phaeopigment	µg/L	0.07	0.85	0.31
DO				
Concentration	mg/l	8.4	10.3	9.2
Saturation	%	85	124	99
Productivity				
Alpha	see text	0.00	0.05	0.03
Areal Production	$mgC/m^2/d$	1191.2	1284.1	1237.7
Pmax	see text	0.4	14.8	6.3
Respiration	µmol/h	0.00	0.30	0.10
Water Column				
BIOSI	µM	1.4	13.6	6.7
DOC	mg/L	2.0	2.0	2.0
PART P	µM	0.21	4.09	1.77
POC	µM	9.3	57.4	29.6
PON	µM	1.08	10.25	4.36
TDN	µM	8.5	15.9	11.9
TDP	µM	0.43	0.95	0.70
TSS	mg/L	0.0	13.0	1.1
Urea	µM	0.15	1.22	0.68
Plankton (Surface samples only)				
Total Phytoplankton	Mcell/L		14.0	
Centric diatoms	Mcell/L		1.9	
Alexandrium tamarense	Mcell/L		NP	
Phaeocystis pouchetti	Mcell/L		NP	
Pseudo-nitzschia sp	Mcell/L		0.001	
Total Zooplankton	#/m3		65381	

TABLE 3-9
Semi-Annual Data Summary Table
Event W9509 (7/24/95 - 7/26/95)
Nearfield Survey

Region		Nearfield		
Parameter	Unit	Min	Max	Avg
Physical				
Chlorophyll a	µg/L	0.00	3.71	0.75
Salinity	psu	31.2	32.0	31.6
Sigma_T		22.0	25.2	23.8
Temperature	°C	5.9	19.9	12.3
Transmissivity	m-1	0.26	0.99	0.40
Nutrients				
NH_4	µM	0.12	6.23	0.85
NO_2	µM	0.04	0.36	0.14
$NO_2 + NO_3$	µM	0.0	6.8	0.9
PO_4	µM	0.19	1.07	0.46
SIO_4	µM	1.1	8.8	3.8
Phaeopigment	µg/L	0.10	1.91	0.58
DO				
Concentration	mg/l	8.1	10.2	9.2
Saturation	%	81	126	105
Productivity				
Alpha	see text	0.01	0.11	0.05
Areal Production	$mgC/m^2/d$	505.8	527.9	516.9
Pmax	see text	0.6	9.2	6.4
Respiration	µmol/h	0.02	0.17	0.10
Water Column				
BIOSI	µM	0.5	8.6	2.4
DOC	mg/L	1.0	2.0	1.4
PART P	µM	0.22	0.84	0.38
POC	µM	6.9	49.3	23.6
PON	µM	1.32	7.50	3.50
TDN	µM	3.9	18.0	7.4
TDP	µM	0.30	0.72	0.46
TSS	mg/L	0.0	16.0	2.2
Urea	µM	1.05	1.22	1.12
Plankton (Surface samples only)				
Total Phytoplankton	Mcell/L		11.2	
Centric diatoms	Mcell/L		0.41	
Alexandrium tamarense	Mcell/L		NP	
Phaeocystis pouchetti	Mcell/L		NP	
Pseudo-nitzschia sp	Mcell/L		0.001	
Total Zooplankton	#/m3		173784	

4.0 RESULTS OF WATER COLUMN MEASUREMENTS

Of the four farfield surveys conducted during the first part of the 1995 monitoring season, three were part of the pre-stratification period, and one (W9507) was conducted during early stratification. Data collected during the farfield surveys (W9501, W9502, W9504, and W9507) 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) sample. A complete set of surface contour maps of water properties during the far field surveys is available in Appendix B. Classifying data by regions allows comparison of the horizontal distribution of water mass properties over the farfield area.

The vertical distribution of water column parameters is presented in the following sections along three transects in the survey area (Figure 1-3). Examining data trends along the three transects, Boston-Nearfield, Cohasset, and Marshfield, along with the surface contour plots, provides a three-dimensional perspective of water column conditions during each survey. A complete set of transect plots is contained in Appendix C.

Nine nearfield surveys were conducted during the semi-annual period (W9501-W9509). Nearfield surveys were conducted more frequently than farfield surveys, allowing better temporal resolution of the changes in water column parameters and onset of stratification. Vertical variability in nearfield data is examined and presented by comparing surface and bottom water concentrations (A and E depths), and by plotting individual parameters with depth in the water column.

Vertical stratification of the water column varies by parameter and through time with incursions of different water masses. For the purposes of this report, vertical stratification will be defined by the presence of a pycnocline with a density (σ_t) difference between the upper and lower water column of less than -1.0. Using this definition, a stable pycnocline developed between surveys W9506 (mid-May) and W9507 (mid-late June) in the nearfield (Figure 4-1). The degree of vertical stratification during the spring surveys in the nearfield varied by survey and by station (Section 4.1). There were no farfield surveys between W9504 (early April) and W9507, but by the W9507 survey, all stations in the farfield exhibited a well-developed pycnocline.

4.1 Physical Characteristics

4.1.1 Horizontal Distribution

Although the water column was vertically well-mixed during the winter-spring surveys of 1995, distinct horizontal gradients during this period allow differentiation of water masses relative to the geographic regions of the survey area. During the first two winter farfield surveys (W9501 and W9502), there was a gradient of surface water temperature from less than 2°C in the harbor and near the coast, up to 4°C offshore (Figure 4-2). A modest salinity gradient also was evident, ranging from less than 32 PSU in the harbor, to 32 PSU along the coast, to greater than 32 PSU offshore (Figure 4-3). A similar inshore-offshore gradient was present for temperature, salinity, and density during all of the winter surveys (Appendix B).

During the pre-stratification period, surface water temperatures and salinities generally were representative of the entire water column at each station, thus the regional water masses were identifiable from distinct TS (temperature-salinity) characteristics for each survey. During W9501 and W9502, for example, the offshore and boundary regions (only boundary station data are plotted) were distinct from coastal, Cape Cod Bay, and harbor water masses (Figure 4-4a). The boundary and offshore regions had the highest regional temperatures (approximately 3-5°C) and salinities (32-33 PSU).

For the other water masses, water temperatures were in a similar range during the first two surveys (approximately 1-3°C), but the harbor stations had the lowest salinities. Station F23, at the entrance to Boston Harbor, had TS characteristics more similar to the coastal region during W9501. The coastal and Cape Cod Bay regions were in the same salinity range, but Cape Cod Bay was slightly cooler during the winter surveys. Stations at the northern end of the coastal transect (F18 and F24) had water mass characteristics that were transitional to the boundary/offshore regions.

By W9504 in early April, horizontal differences in surface water temperature were less pronounced (Figure 4-4b), with a narrower temperature range of approximately 3.5 to 5°C. Cape Cod Bay was noticeably warmer than during the prior two surveys, exhibiting a warming trend comparable to the harbor. Coastal water had also warmed relative to the more offshore stations, and surface water temperatures indicated a local body of warmer water centered at nearfield station N20 (Figure 4-5). The salinity gradient was consistent with the prior surveys, with fresher to more saline waters from the harbor to offshore.

In contrast to the pre-stratification phase, during the final farfield survey (W9507) horizontal gradients had essentially ceased, and distinctions among water masses were controlled by depth because of vertical stratification. Surface waters had warmed considerably (Figure 4-6), and the salinity distribution was very narrow in surface waters (ranged from 30.6 to 31.4 PSU).

4.1.2 Vertical Distribution

Farfield. Transects from west to east (Figure 1-3) in Massachusetts Bay show the gradients of physical characteristics within the water column from Boston Harbor and coastal stations seaward. For example, density (σ_t) values during the first winter survey (W9501) ranged from 25.5 inshore to greater than 26.0 offshore (Figure 4-7). The increasing σ_t gradient between the harbor and offshore stations was controlled primarily by increasing salinity. Transects also show local variability of physical parameters, especially during the non-stratified period. A complete set of transect plots for water properties is provided in Appendix C.

The relative degree of vertical stratification can be shown schematically in a time-series presentation of the density difference value ($\Delta\sigma_t$), calculated by subtracting the bottom water σ_t value from the surface water. Regionally, all the water masses in the survey area were vertically stratified ($\Delta\sigma_t$ <-1.0) by June (W9507) except in the harbor, which remained relatively well-mixed throughout the semi-annual period (Figure 4-8).

Nearfield. More frequent sampling of nearfield stations provides a detailed dataset showing the onset of vertical stratification, and local variability, within the nearfield water column. The slight density gradient ($\Delta\sigma_t$) between the surface and bottom water of the inner nearfield (<-0.5; Figure 4-9a) during the winter-spring pre-stratification surveys (W9501-W9506) was primarily due to consistent salinity differences, as discussed below. The onset of vertical stratification between May (W9506) and June (W9507), with a $\Delta\sigma_t$ of <-1.0, was primarily due to the warming of surface waters.

Salinity in the nearfield showed an overall decreasing trend in both surface and bottom water during the pre-stratification period (Figure 4-10). Two periods of divergence from this trend occurred in the nearfield: during the March (W9503) survey, when the surface water salinity dropped, especially in the outer nearfield, and in late April (W9505), which showed an increase in salinity in both surface and bottom water of the nearfield.

During the pre-stratification period, a narrow but consistent salinity gradient of approximately 0.5 PSU was present between the surface and bottom waters of the inner nearfield. In the outer nearfield, there was no salinity gradient during the first two surveys, followed by the surface water salinity decrease of almost one PSU (from 32.5 to 31.5 PSU) in March (Figure 4-10). The gradient then stabilized to 0.5 as measured in the inner nearfield by the next survey in April (W9504).

Salinity during the early stratification summer surveys was very stable in bottom water, and showed a slight increase in surface water from 31.0 to 31.5 PSU, with a corresponding decrease of the salinity gradient, in both the inner and outer nearfield (Figure 4-10). The density gradient during the vertically-stratified summer period was primarily controlled by the relative change in water temperature between the surface and bottom waters.

The water column was well-mixed with respect to temperature during the first four nearfield surveys (Figure 4-11). The water column in the nearfield was progressively stratified as surface waters became warmer. Following the early April survey (W9504), surface water warmed up to 2°C within the upper 10-20 meters of the nearfield prior to the late April survey (W9505), without a concomitant rise in bottom water temperatures. During the following survey in mid-May, bottom water temperatures also increased from 2-4°C to 5-7°C, where they remained for the rest of the semi-annual period.

Results from the first early stratification survey in June (W9507) showed a strong density gradient ($\Delta\sigma_t$) of at least -2.0 in both the inner and outer nearfield (Figure 4-9). This gradient was primarily due to surface water warming, although a salinity gradient of almost 1 PSU also was present in the outer nearfield (Figure 4-10). During the following nearfield survey in July (W9508), surface waters were slightly cooler (Figure 4-11) and, although also less saline (Figure 4-10), resulted in a net $\Delta\sigma_t$ increase (smaller negative value) in both the inner and outer nearfield regions. This surface cooling may have been related to the upwelling event documented by satellite data in Western Massachusetts Bay at this time (Table 4-1). There was no relative change in bottom water characteristics during the early July (W9508) survey, and both surface and bottom water became warmer in late July (W9509). As will be discussed in Section 6.0, the physical water properties during the July surveys probably influenced biological activities in the nearfield water column.

4.1.3 Transmissometer Results

Water column beam attenuation (transmissometer) and fluorescence data were collected simultaneously with each CTD cast. The beam attenuation coefficient presented here was calculated from the ratio of light transmission/light incidence measured over one meter (/m). Fluorescence data were calibrated to measured chlorophyll *a* in the bottle samples, to allow continuous measurement of chlorophyll *a* in the water column. All of the discussion of chlorophyll *a* in this report refers to calibrated sensor data.

The two main sources of particulate matter in the water column are biogenic material (plankton), and suspended material from coastal runoff, the latter concentrated in Boston Harbor and along the coast. In order to evaluate these sources, beam attenuation values were compared to chlorophyll *a* in the water column, in order to qualitatively evaluate the influence of chlorophyll on beam attenuation measurements.

In the winter-spring months, there was essentially no relationship between beam attenuation and chlorophyll, indicating that chlorophyll was not a major fraction of the total particulate matter (Figure 4-12). The highest beam attenuation values (>0.5 /m) were concentrated in Boston Harbor and along the coast (Figure 4-13), consistent with the highest particulate matter being concentrated from coastal runoff.

During the summer (W9507-W9509), chlorophyll appeared to influence beam attenuation in the nearfield, indicating that the overall increase of particulate matter in the nearfield water column was related to the increase of chlorophyll during summer production (Figure 4-12).

4.2 Nutrients

Scatter plots of nutrient data from the semi-annual period are available in Appendix D. The plots include nutrient: nutrient data, nutrient: salinity relationships, and the distribution of nutrients with depth.

4.2.1 Horizontal Distribution

During the pre-stratification period, the spatial distribution of nutrient concentrations indicated that Boston Harbor consistently had the highest concentration of all nutrients measured, and Cape Cod Bay had the lowest. As with other water column parameters, the well-mixed winter-spring water showed little variation in nutrient concentrations with depth, so that surface water (depth "A") contour maps show the horizontal nutrient distribution. A complete set of farfield contour maps of all nutrient concentrations is available in Appendix B.

Nutrient concentrations throughout the regional surface waters during the first farfield survey (mid-February) generally were the highest measured in the semi-annual period, including NO_3 (8-11.5 μM), SiO_4 (9-17 μM), PO_4 (0.8-1.4 μM), and NH_4 (0.3-9.9 μM). Comparing the distribution of surface water nutrients between the first two farfield surveys (Appendix B) indicates that by the second survey in early March (W9502), nutrient concentrations had decreased throughout the region, suggesting depletion by a relatively widespread late winter bloom. Maximum nutrient depletion during this period was notable in the nearfield (discussed in more detail below), and Cape Cod Bay. Surface water nutrient concentrations in March were reduced to: <1 to 10.7 μM (NO_3), 1-13 μM (SiO_4), <1 μM (PO_4), and 0.4-7.5 μM (NH_4).

Results from the final pre-stratification farfield survey in April (W9504) indicated that nutrient concentrations had begun to recover after the late winter bloom, but concentrations remained less than those measured during the first winter survey. During the final, early stratification farfield survey (9507), surface waters were consistently nutrient-depleted (<1 μM NO_3, 0.2-2.9 μM SiO_4, and 0-0.8 μM PO_4). In contrast to pre-stratification conditions, nutrient concentrations were highest in Cape Cod Bay during this survey. The only regional stations with nitrate concentrations greater than 0.1 μM in surface waters during the June survey were in Boston Harbor and near the coast, and at the Cape Cod Bay stations.

4.2.2 Vertical Distribution

Farfield. Regional transect plots of nutrient concentrations demonstrate nutrient variability within the water column during the winter-spring surveys (Appendix C). The Boston-Nearfield transect (Figure 1-3), and to a lesser degree the Cohasset transect, shows that the area between the harbor and boundary regions (nearfield and offshore stations) commonly was quite dynamic. Silicate, for example, during W9502 (early March), shows maximum depletion in the nearfield water column, and also centered at station F15 of the Cohasset transect (Figure 4-14), indicating the extent of the late winter bloom in the nearfield region and implicating the likely domination by diatoms (Section 5.3).

This pattern of localized depletion within the nearfield was repeated for other nutrients analyzed during the first two regional surveys. For example, the Boston-Nearfield transect data for nitrate indicates that, although overall nitrate concentrations decreased between the first and second winter surveys in 1995, the relative areas of depletion were similar, and concentrated in the nearfield (Figures 4-15, 4-16). The same degree of nutrient depletion was not seen in the nitrate concentrations of the Cohasset and Marshfield transects.

The area of maximum nutrient depletion moved offshore during the third combined survey in April (W9504). This shift of nutrient scavenging is demonstrated most clearly in the surface water at the offshore station F19 (Boston-Nearfield transect), and in the mid-deep waters of offshore station F17 and boundary station F28 (Cohassett transect, Figure 4-17). By the June farfield survey (W9507), surface waters were generally nutrient-depleted, while concentrations increased with depth with the development of the summer pycnocline.

Nearfield. Because of the increased frequency of sampling, the nearfield data provided higher temporal resolution of nutrient concentrations at all nearfield stations throughout the monitoring period (Figure 4-18). Data from the first survey in February resulted in the highest measured values of all nutrients in the nearfield water column. The vertical distribution of nutrients shows the depletion effects of the winter bloom during early March (W9502); silicate levels were lower throughout the water column than during any other pre-stratification nearfield survey (2-4 μM). Following the depletion of early March, nutrient concentrations increased, and remained uniformally higher through early April (W9504).

The late April nearfield survey (W9505) was conducted during the spring bloom, resulting in decreased surface (<20 m) concentrations of nutrients in the nearfield, although concentrations below 20 m remained unchanged (Figure 4-18). The late April survey was alşo a time of transition for relative ratios of nutrients in the water column. The ratio of nitrate and nitrite (ammonium often had different trends relative to the other nitrogen nutrients, so DIN was not compared) to phosphate (NO_3+NO_2:PO_4) was plotted for the semi-annual survey period (Figure 4-19 and summarized by survey in Appendix D). The NO_3+NO_2:PO_4 ratio shifted from approximately 8:1 in February - April (through W9504), to 3:1 beginning in late April - early May, and remained at the same level through late July (end of semi-annual period). This shift suggests that the nearfield water was depleted in nitrogen relative to phosphorus during the late spring and early summer.

By the last pre-stratification survey in mid-May (W9506), the cycle of nutrient depletion throughout the water column began, and continued through the rest of the three nearfield surveys conducted during this semi-annual period. Silicate concentrations, however, remained at mid-levels (4-8 μM) until June. During all three nearfield summer surveys, surface waters remained nutrient-depleted, including silicate. Concentrations of nutrients began to increase with depth because of nutrient regeneration below the pycnocline.

4.3 Chlorophyll *a*

4.3.1 Horizontal Distribution

During the three pre-stratification farfield surveys, measured chlorophyll *a* concentrations (sensor data) remained below 3 μg/L at all farfield stations except in eastern Cape Cod Bay. Maximum values measured in Cape Cod Bay during the winter-spring surveys ranged from 4.2 to 5.4 μg/L. Outside of Cape Cod Bay, the highest chlorophyll *a* concentrations during the first survey in February (approximately 1 μg/L) were centered in the nearfield area (Figure 4-20). By survey W9502 (early March), chlorophyll *a* values of 1 μg/L or greater were more common in the surface waters of the boundary region (Figure 4-21); this geographic shift of maximum chlorophyll concentrations was also noted in the vertical distribution discussed below. Bloom conditions in Cape Cod Bay continued, and expanded to the western side (chlorophyll concentrations of >5 μg/L). By the third regional farfield survey (W9504) in mid-April, regional surface water concentrations of chlorophyll *a* had decreased throughout the survey area, to maximum values in Cape Cod Bay of 1.6 μg/L, and less than 1.0 μg/L everywhere else.

Regional chlorophyll *a* concentrations in the surface waters increased markedly by from the last pre-stratification farfield survey in April (W9504) to the early stratified period in June (W9507) in Boston Harbor and the coastal region (Figure 4-22). Offshore and boundary region chlorophyll concentrations remained low, while Cape Cod Bay concentrations decreased notably to <1 μg/L.

4.3.2 Vertical Distribution

Farfield. Mid-depth maximum chlorophyll *a* concentrations along the survey area transects (Figure 1-3) were located at inner nearfield stations and offshore (F19) of the Boston-Nearfield transect (Figure 4-23). The Cohassett and Marshfield transects show the eastern shift of the chlorophyll maximum from the nearfield in mid-February (W9501), to the boundary region, especially at the easternmost stations F28 and F12, in March (W9502; Figure 4-24).

By the third regional farfield survey in April (W9504), chlorophyll *a* concentrations throughout the water column had decreased to levels below 1.0 μg/L, except in Cape Cod Bay and in the deep boundary region waters. The maximum chlorophyll *a* concentrations were deeper in the water column by the April survey, especially apparent in the Cohasset and Marshfield transects (Figure 4-25).

The depth of the chlorophyll *a* maximum was tracked for both the nearfield and farfield. The five maximum values measured in each region were averaged, and plotted along with the average depth of each value (Figure 4-26). The depth of the chlorophyll *a* maximum remained within the upper 10-20 meters for all regions during the first farfield survey in February (W9501). Maximum chlorophyll values within the harbor, coastal, and Cape Cod Bay regions (Figure 4-26a) were in the upper ten meters during the second farfield survey (March), and remained there in the harbor and coast throughout the semi-annual period (Figure 4-26b).

Within the deeper waters of the boundary and offshore regions, the depth of the chlorophyll *a* maximum decreased to approximately 20-40 m during the March (W9502) survey, to approximately 25-30 m during the April (W9504) survey (Figure 4-26b). At the same time, as chlorophyll concentrations decreased in Cape Cod Bay, the depth of the chlorophyll maximum in Cape Cod Bay decreased from <10 m to approximately 10-20 m during the April (W9504) and June (W9507) surveys. During the beginning of summer (W9507), the chlorophyll maximum was again at approximately 20 m in the offshore and boundary regions. Maximum concentrations of up to 3 µg/L were measured in the surface water in the harbor and nearfield, indicating onset of a localized bloom (Figure 4-27).

Nearfield. Surface and bottom water nearfield values throughout the pre-stratification period of 1995 were consistent, and all <2 µg/L except during W9505 in late April (Figure 4-28). Chlorophyll *a* reached minimum values in both surface and bottom water during W9503 in mid-March.

The peak in chlorophyll *a* during W9505 (late April) in the nearfield was concentrated in the surface water, and reached a maximum of almost 9 µg/L at station N20. Overall, the depth of the chlorophyll maximum increased from >10 m in the winter-spring to <10 m during the summer surveys (Figure 4-26c). The distribution of depth-averaged chlorophyll *a* in the nearfield water column shows the localized concentration around N21 (Figure 4-29).

Following the bloom period in April, chlorophyll *a* concentrations returned to pre-bloom conditions until the onset of the early summer bloom in June. Within the nearfield, chlorophyll concentrations were highest in the surface waters of the inner nearfield (Figure 4-28), with average surface concentrations ranging from approximately 2 µg/L in June and early July, reaching concentrations of greater than 3 µg/L during the last nearfield survey in late July (W9509).

4.4 Dissolved Oxygen

4.4.1 Horizontal Distribution

In contrast to the horizontal gradients of other physical parameters in the farfield, ranges of DO concentrations were consistent among regional water masses during the pre-stratification and early stratification periods. Regional average concentrations in surface ("A" samples) and bottom ("E" samples) water ranged from approximately 9.5-10.5 mg/L during the first three farfield surveys in all five regions sampled (Figure 4-30, 3-31), and 8.5-9.5 during the June early stratification survey (W9507). There was a slightly larger variation in oxygen saturation values, with the lowest range of values in the boundary region (8.6-9.0%), followed by the harbor and coastal data (approximately 8.8-9.3%), and the highest values measured in the offshore and Cape Cod Bay regions (approximately 9.0-9.8%).

4.4.2 Vertical Distribution

Farfield. During the pre-stratification period, there was negligible difference between surface and bottom water average DO concentrations except in the boundary and offshore regions (Figure 4-30), and in the harbor (Figure 4-31) during the first survey (W9501). The consistent difference in surface and bottom water DO concentration in the offshore and boundary regions (0.2-0.5 mg/L) was due to a temperature differential at the deep water stations, inferred from the uniformity of DO saturation during the first two farfield surveys.

There was an overall decrease of bottom water DO concentration between the early March (W9502) and mid-April (W9504) pre-stratification farfield surveys. The decrease in DO concentration was concomitant with an increased difference between bottom and surface water DO saturation. DO remained undersaturated regionally in surface and bottom water throughout the pre-stratification period.

The trend of decreasing DO concentration continued through the early stratification farfield survey (W9507). The range of DO concentrations in regional bottom waters decreased from approximately 9.5-10.0 mg/L during the early April (W9504) survey, to 8.5-9.0 mg/L in June (Figure 4-30, 3-31). Surface water DO concentrations also dropped more than 1 mg/L in the boundary, offshore, and Cape Cod Bay regions, and approximately 0.5 mg/L in the harbor and coastal regions. There was negligible difference between bottom and surface water DO concentration during the June survey in all regions except the harbor and coast.

The greatest relative decrease in average bottom water DO concentration between April (W9504) and June (W9507) was in the harbor and Cape Cod Bay (1 mg/L). Bottom water DO values in Cape Cod Bay resulted in the minimum average DO concentration measured during this survey (8.5 mg/L). Minimum individual DO concentrations were analyzed because of the concern of the overall DO balance in

Massachusetts Bay. The minimum measured bottom water DO concentration was 7.95 mg/L at F02 in Cape Cod Bay, well above the state standard value of 6 mg/L.

In contrast to the DO concentration, the saturation of DO increased in regional surface waters, and was oversaturated in June with respect to DO in all regions measured (Figure 4-30, 3-31). Bottom water saturation of DO also increased between the April (W9504) and June (W9507) surveys in the harbor (>100% saturation) and coastal water, but showed little net change in the offshore, boundary, and Cape Cod Bay regions.

Maximum values of DO saturation were measured in mid-water regionally during the early stratification survey, except in Boston Harbor where the entire well-mixed upper water column was supersaturated with respect to oxygen (Figure 4-32). The mid-water DO maximum corresponded to the measured chlorophyll pattern (Figure 4-27). The mid-water maximum suggests that production was the controlling factor in the distribution of DO.

Nearfield. More frequent measurements in the nearfield permitted evaluation of smaller-scale variability between the surface and bottom water DO values (Figure 4-33). In the nearfield, surface and bottom water DO concentrations were similar during the first two surveys. DO was oversaturated in both nearfield surface and bottom water in later February (W9502), likely related to the late winter bloom suggested by nutrient data. Surface and bottom water DO concentrations and saturation diverged by March (W9503).

During the late April survey (W9505), both the surface concentration and percent saturation increased; the surface concentration during this survey was the highest measured during the semi-annual period. The nearfield surface water became oversaturated with respect to DO during this survey, and remained oversaturated for the rest of the semi-annual period.

The increase of DO was coincident with a decrease in surface water nutrient concentrations (Section 4.2), and the increase in chlorophyll *a* production (Section 4.3), indicating the DO was controlled by the spring bloom event. The biological data (productivity/respiration) were consistent with these data (Section 5.0).

Data from the final pre-stratification survey in May (W9506) indicated a merge of bottom and surface water DO (Figure 4-33). The percent saturation of bottom water increased almost 10% from the prior survey, and was fully saturated (>100%) for the last time during the semi-annual period. As discussed in Section 5.0, the late spring survey was conducted during the waning of the spring bloom, when respiration of settling phytoplankton, as well as grazing by zooplankton, influenced the physical character of the nearfield bottom water. Cumulative physical evidence, including continuous mooring data from the USGS buoy located in the center of the nearfield, suggested that merging of bottom and surface water parameters was caused by a small mixing event.

Bottom and surface water DO concentrations decreased between the last pre-stratification nearfield survey in May (W9506) and the first early stratification survey in June. Dissolved oxygen in the nearfield measured over the June-July 1995 period showed steadily decreasing surface water concentrations throughout the summer (Figure 4-33). Dissolved oxygen saturation in the nearfield surface water was at a maximum (>120%) during the first early stratification survey in June, and then decreased slightly during the final two July surveys.

Bottom water DO concentration continued the decreasing pattern during the first July survey (W9508), but then increased prior to the second July survey (W9509). Nearfield productivity in July suggested by physical and biological data was the controlling factor of the DO cycling in bottom water (Section 5.0).

4.5 Summary of Water Column Results

Physical Characteristics

- Regional horizontal gradients during the winter-spring surveys allowed differentiation of boundary/offshore, coastal, harbor, and Cape Cod Bay water masses;

- The boundary/offshore regions had the highest temperatures and salinities during the winter, and the harbor had distinctively lower salinities;

- All regional water masses except in Boston Harbor were vertically stratified ($\Delta\sigma_t < -1.0$) by June (W9507);

- Vertical density gradients ($\Delta\sigma_t$) between nearfield surface and bottom water were a function of salinity during the winter-spring surveys, and temperature during the summer stratified period;

- Salinity in the nearfield showed a gradual decreasing trend in both surface and bottom water during the pre-stratification period, except for a sharp decrease in surface water salinity (maximum 1 PSU) during March (W9503), and an overall increase in salinity throughout the water column in April (W9505).

- Temperature of the nearfield water column was relatively uniform prior to late April (W9505), when surface warming began, reaching bottom water by May (W9506);

- During the first summer survey (W9507) in June, a marked changed in $\Delta\sigma_t$ of at least -2.0 in both the inner and outer nearfield was primarily due to surface water warming;

- Cooling of nearfield surface water in early July (W9508) resulted in a net $\Delta\sigma_t$ increase of almost 1, potentially related to an early July upwelling event documented by satellite data, followed by surface and bottom water warming in late July;

- Beam attenuation data indicated a dominance of coastal runoff particulate matter through late April, followed by an influence of chlorophyll on beam attenuation data in June.

Nutrients

- Boston Harbor had consistently the highest, and Cape Cod Bay the lowest, measured nutrient concentrations throughout the pre-stratified period;

- In contrast to the winter-spring surveys, nutrient concentrations were highest in Cape Cod Bay during the early stratification survey in June;

- The first winter survey in February documented the highest concentrations of nutrients regionally for the entire semi-annual period;

- Regional depletion of nutrients, especially in the nearfield and Cape Cod Bay, occurred during the second survey in March (W9502), silicate recorded minimum semi-annual values, evidence of a late winter regional diatom bloom;

- Nutrient scavenging during the winter (first two farfield surveys) was locally concentrated in the nearfield;

- The area of maximum nutrient depletion moved offshore during the third pre-stratification survey in April;

- Nearfield depletion of nutrients in the surface waters occurred in late April (W9505), followed by a drop in bottom water nutrient concentrations in May (W9506);

- Late April was also the time of transition to increased nitrogen depletion relative to phosphate;

- Surface water was generally nutrient-depleted throughout the early stratification period.

Chlorophyll

- Chlorophyll was highest in Cape Cod Bay throughout the pre-stratification period, and lowest in Cape Cod Bay during the early stratification farfield survey in June;

- Within Boston Harbor and Massachusetts Bay, the chlorophyll maximum was in the nearfield during the first survey in February, and moved offshore during the second winter survey in March;

- The regional depth of the chlorophyll maximum remained in the upper 20 m, except within the deeper waters of the offshore/boundary regions, where the chlorophyll maximum was located at depths of 20-40 m in March-April;

- The maximum chlorophyll concentration during the pre-stratified period was measured in the nearfield during April (W9505); and

- Regional chlorophyll *a* concentrations were highest (up to 3 µg/L) in the surface waters of Boston Harbor and the inner nearfield during the early stratified (June) period, suggesting a localized bloom, and lowest (< 1 µg/L) in Cape Cod Bay.

Dissolved Oxygen

- The minimum measured bottom water DO concentration during the semi-annual period was 7.95 mg/L at F02 in Cape Cod Bay;

- Regional ranges of DO concentrations were consistent during the pre-stratification and early stratification period;

- The trend of decreasing regional surface and bottom water DO concentrations continued through the June farfield survey (W9507), when surface water values decreased by > 1 mg/L in the boundary, offshore, and Cape Cod Bay regions, and approximately 0.5 mg/L in the harbor and coastal regions, and bottom water decreased by a maximum of 1 mg/L in the harbor and Cape Cod Bay;

- Regional surface water was oversaturated with DO during the June farfield survey;

- Nearfield water was oversaturated with DO during W9502 in late February, coincident with the widespread late winter bloom documented by nutrient data;

- The surface DO concentration measured during the April (W9505) nearfield survey was the highest measured during the semi-annual period (>11 mg/L), and remained oversaturated for the rest of the semi-annual period;

- An increase of bottom water DO in May (W9506), along with a saturation increase of almost 10% between the April (W9505) and May nearfield surveys, resulted in bottom water oversaturation for the only time except during the late winter bloom;

- Saturation of DO in the nearfield surface water was at a maximum (>120%) during the first early stratification survey in June, and then decreased slightly during the final two July surveys;

- Decreasing nearfield bottom water DO concentrations continued through the early stratification period to early July (W9508), then increased prior to the second July survey (W9509).

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:

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

$$P\max'' = P_{sb}''[\alpha''/(\alpha'' + \beta'')][\beta''/(\alpha'' + \beta'')]^{\beta''/}$$ (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

TABLE 4-1

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

Month	Date	MWRA Survey Number	Upwelling	G.O.M. Intrusion	Image Number	Location
January	1/30/95			X	E9503017.MD7	Wilkinson Basin to Nearfield
February	2/17/95	1		X	E9504817.MD7	Wilkinson Basin to Nearfield
March	3/29/95				E9508812.MD7	
April	4/3/95	4			E9509312.MD7	
	4/25/95	5			E9511517.MD7	
May	5/4/95			X	E9512412.MD7	Northern Mass Bay
	5/14/95	6		X	E9513412.MD7	Mass Bay except western coast
	5/23/95				E9514312.MD7	
	5/28/95				E9514812.MD7	
June	6/1/95		X		E9515212.MD7	Western Mass and Cape Cod Bays
	6/6/95		X		E9515712.MD7	Western Mass Bay, north of Cape Ann
	6/16/95				E9516717.MD7	
	6/20/95				E9517112.MD7	
	6/27/95	7	X		E9517817.MD7	Southern Cape Cod Bay
July	7/5/95	8	X		E9518611.MD7	Western Mass Bay, north of Cape Ann
	7/6/95		X		E9518717.MD7	
	7/22/95	9			E9520312.MD7	
	7/31/95		X		E9521212.MD7	Southern Cape Cod Bay

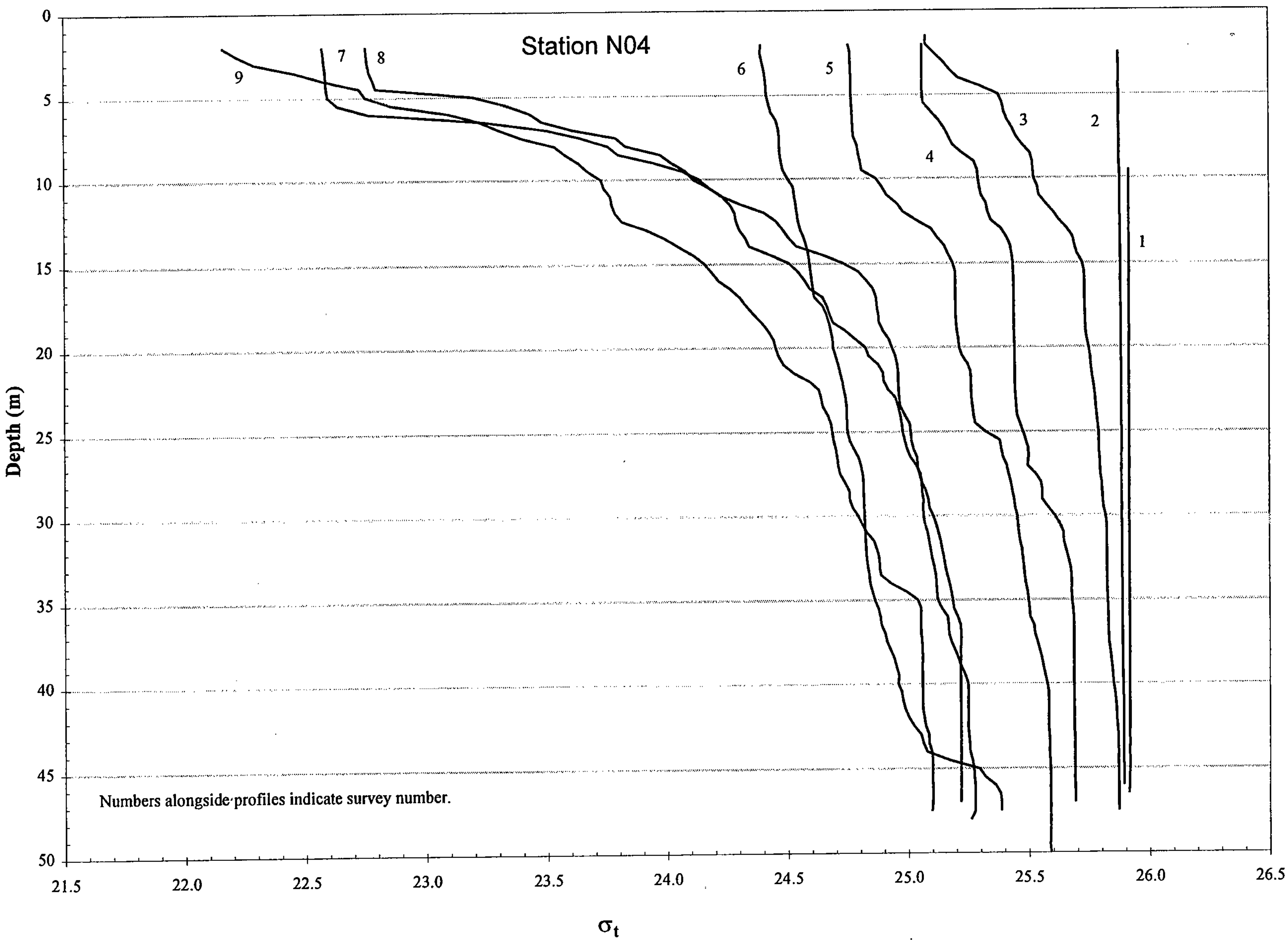


FIGURE 4-1
Density (σ_t) Profiles at Productivity/Respiration
Station N04 from all Surveys of the First Semi-Annual Period

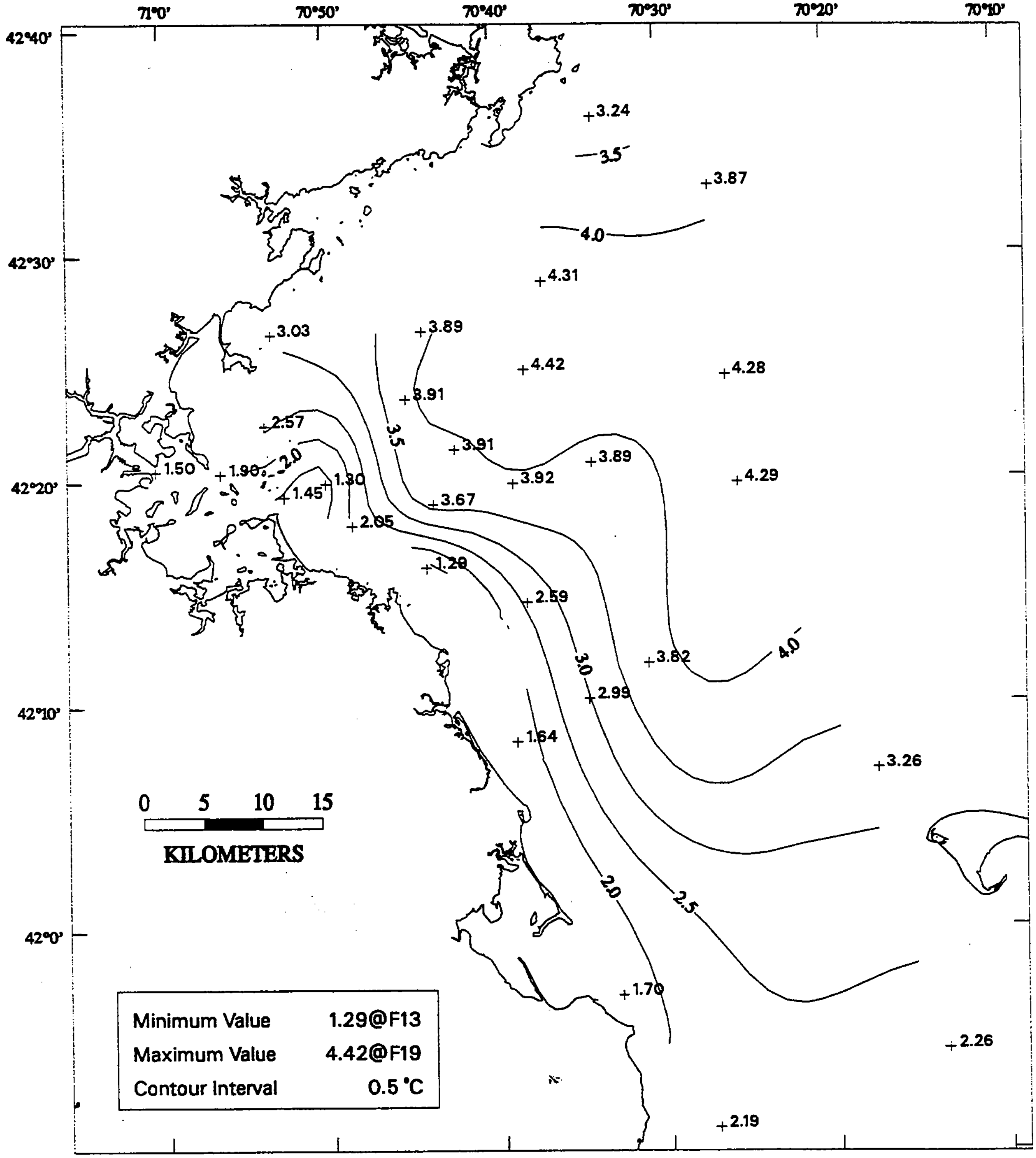


FIGURE 4-2
Regional Surface Water (A Bottle Samples)
Contour Plot of Temperature (°C) During Survey W9501 in February

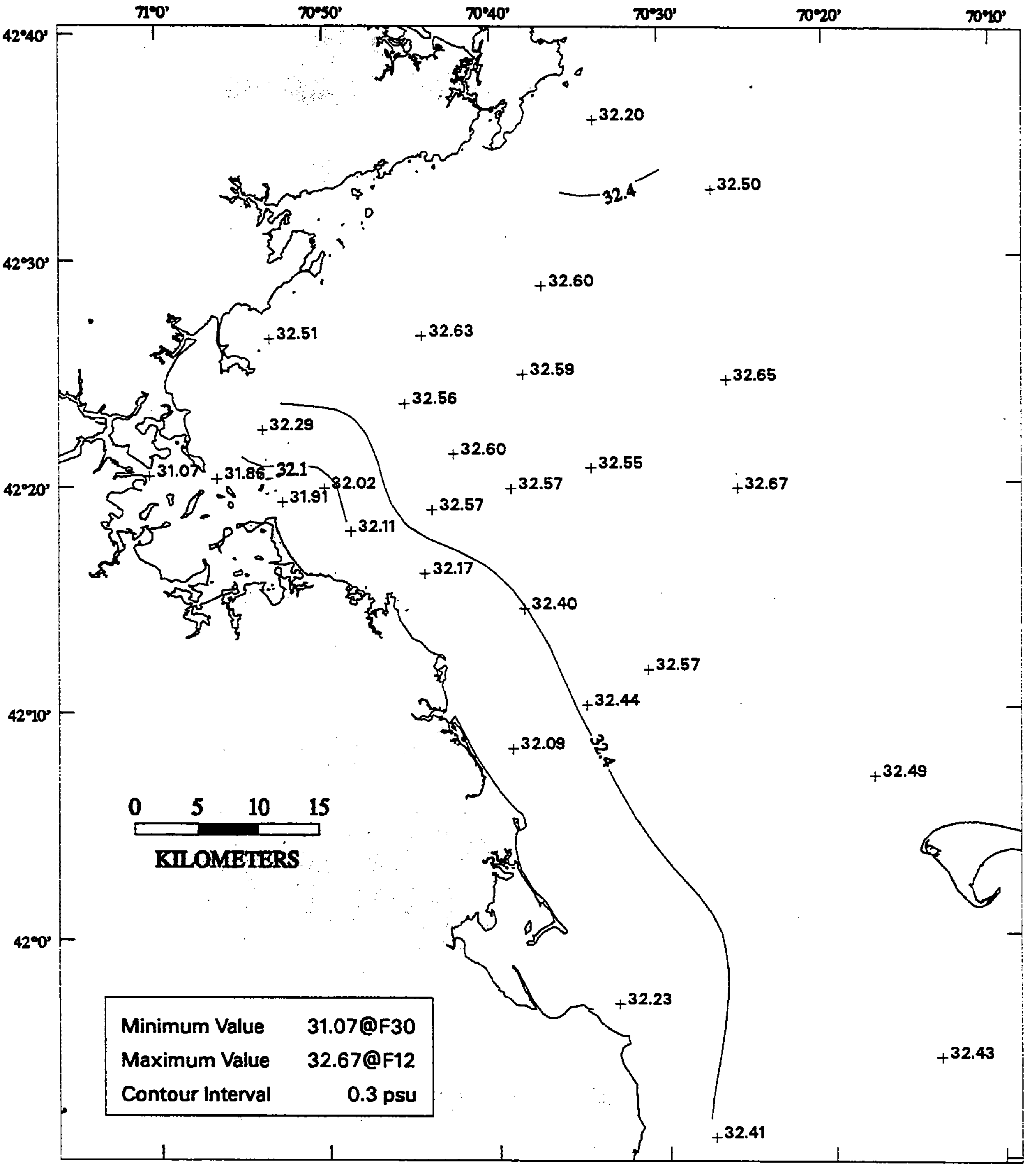
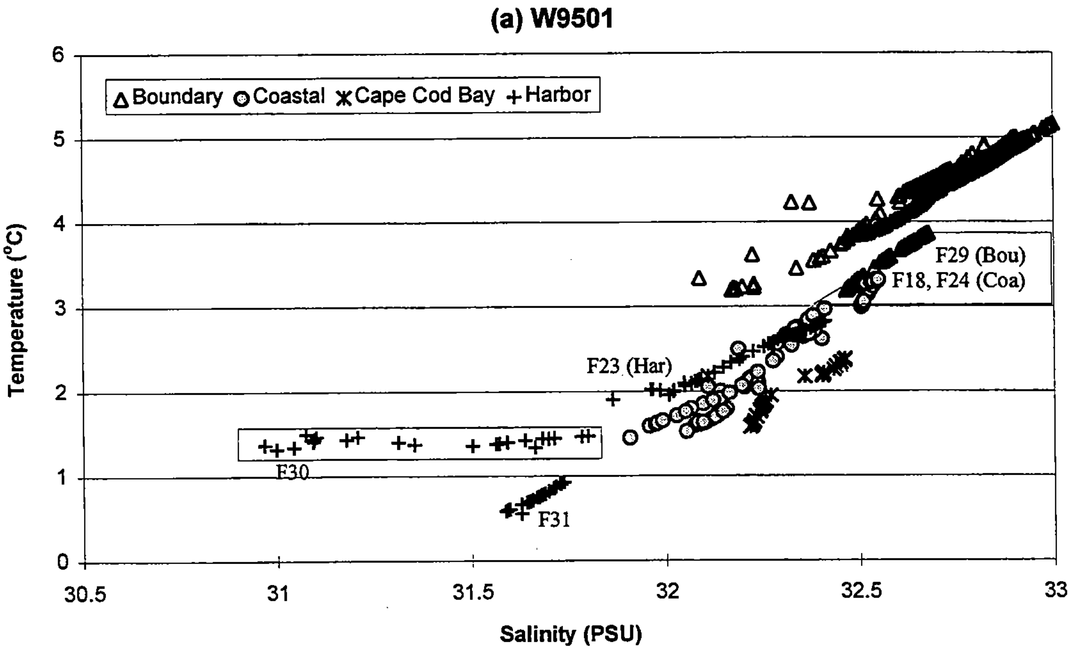


FIGURE 4-3
Regional Surface Water (A Bottle Samples)
Contour Plot of Salinity (PSU) During Survey W9501 in February



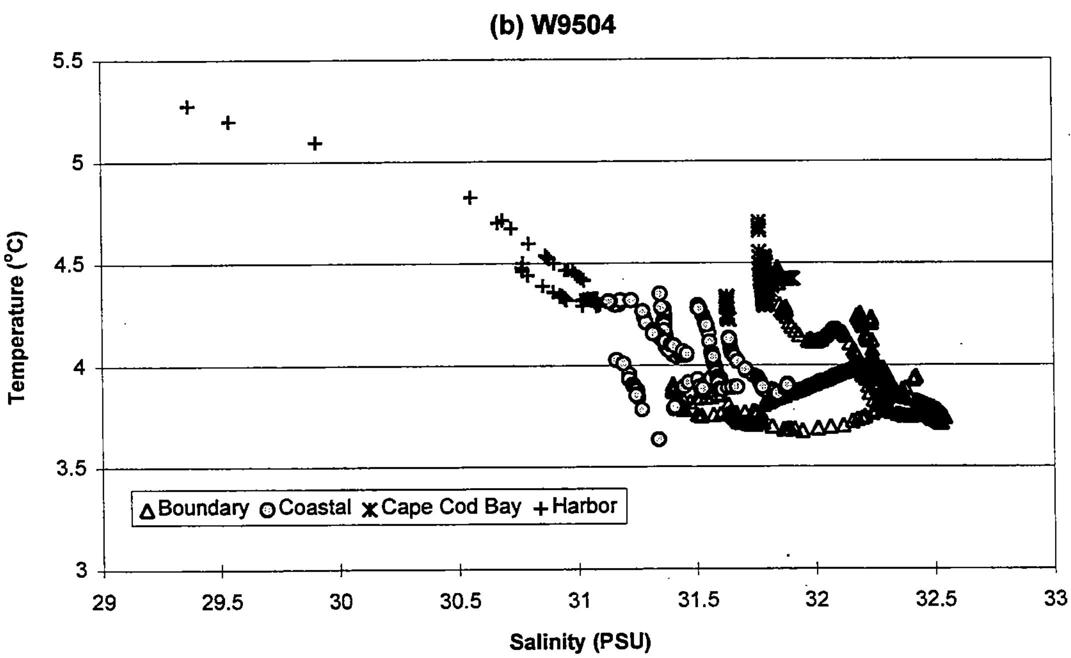


FIGURE 4-4
Temperature/Salinity Data for Four Farfield Regions During Survey (a) W9501 in February and (b) W9504 in April

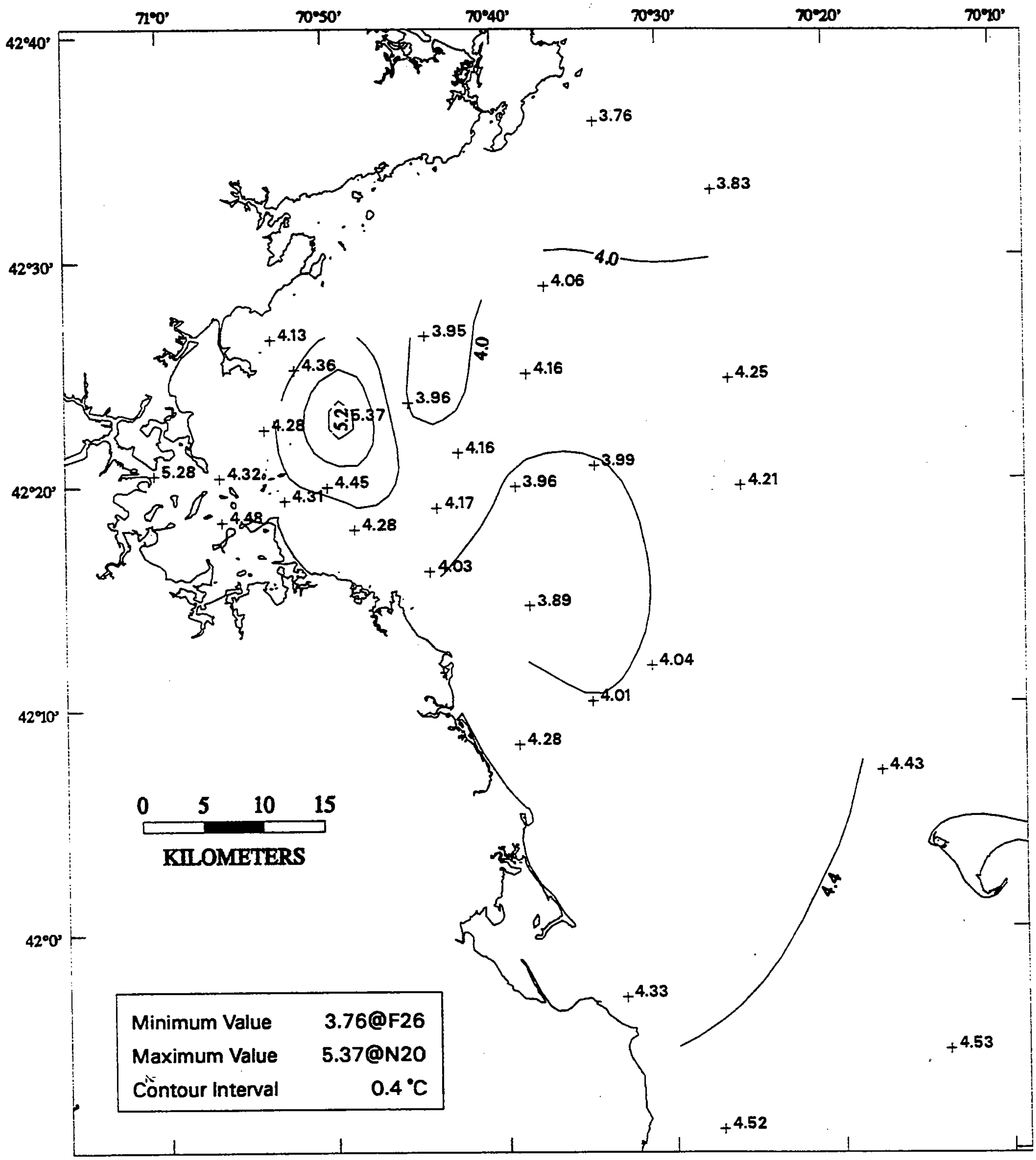


FIGURE 4-5
Regional Surface Water (A Bottle Samples) Contour Plot of
Temperature (°C) During Survey W9504 in April

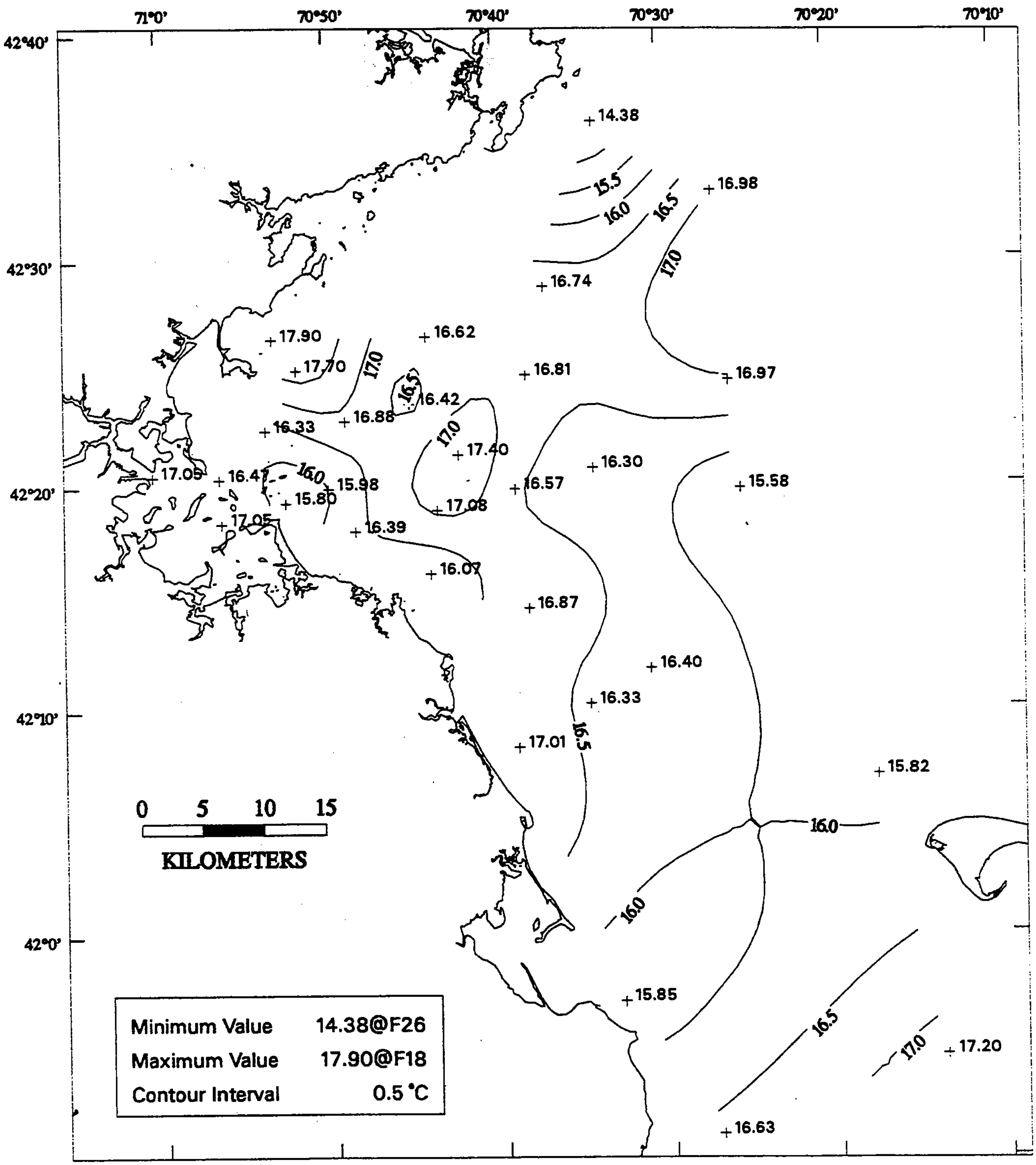


FIGURE 4-6
Regional Surface Water (A Bottle Samples)
Contour Plot of Temperature (°C) During Survey W9507 in June

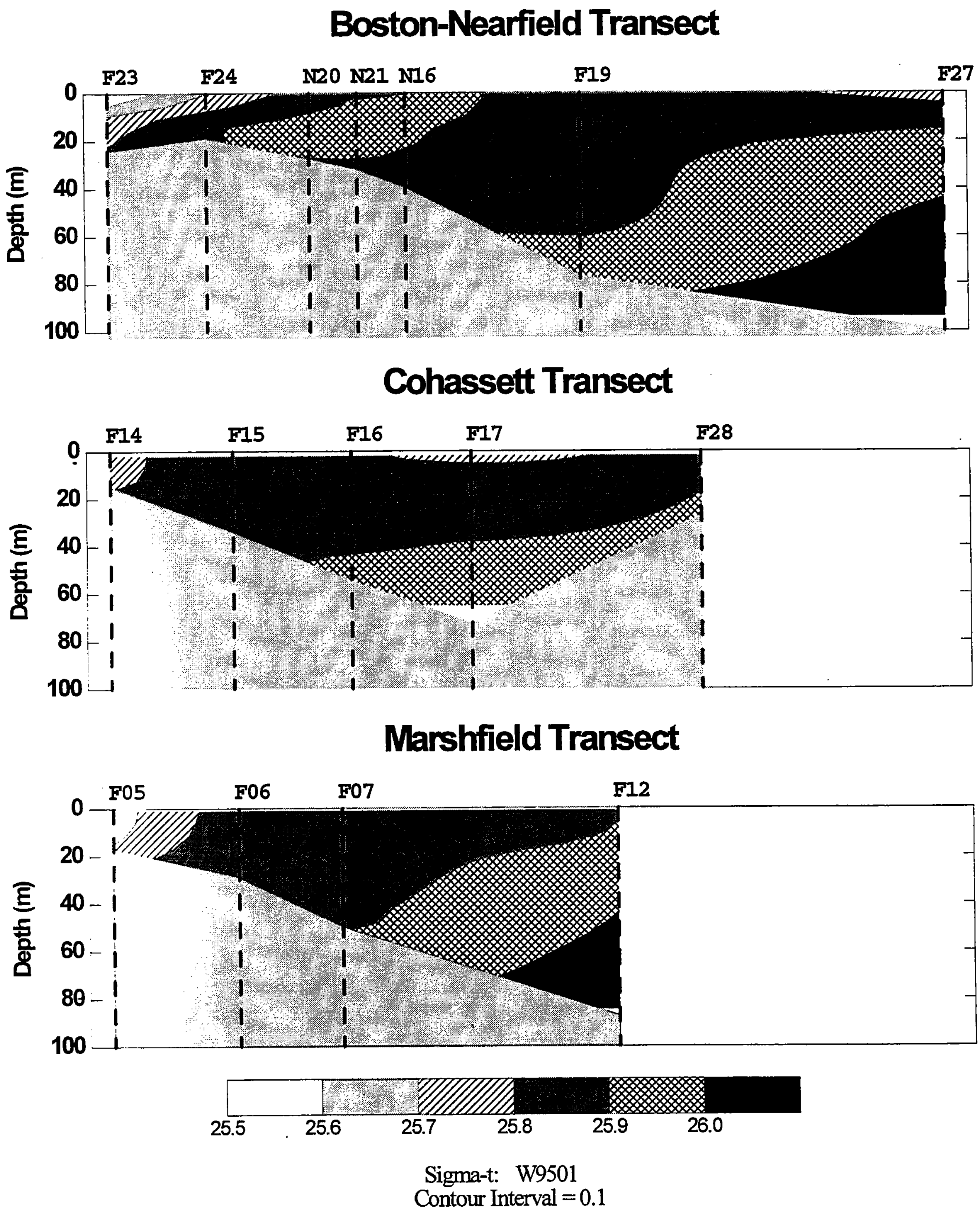


FIGURE 4-7
Transects Showing Density (σ_t) Contours During Survey W9501 in February
See Figure 1-3 for Location of Transects

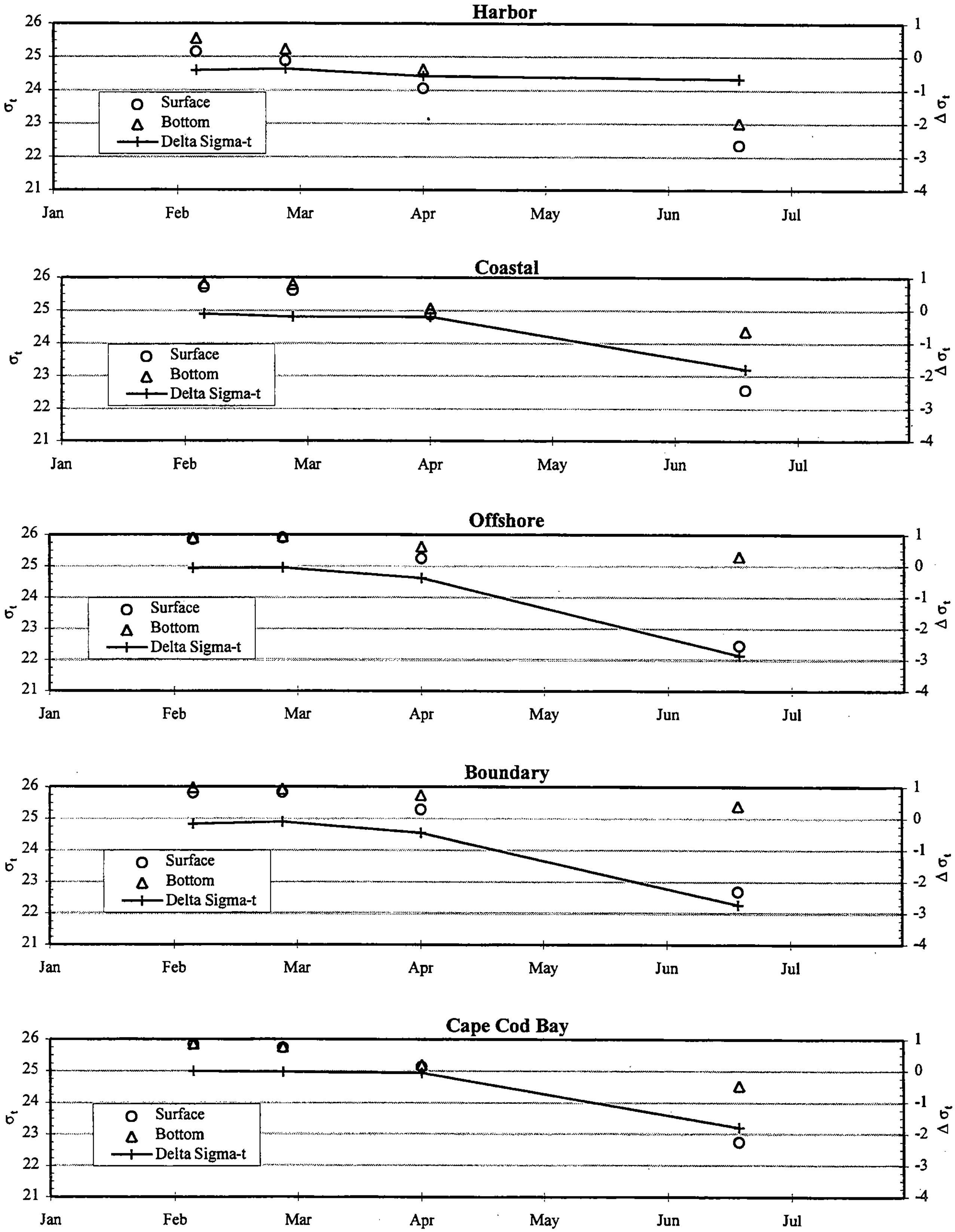
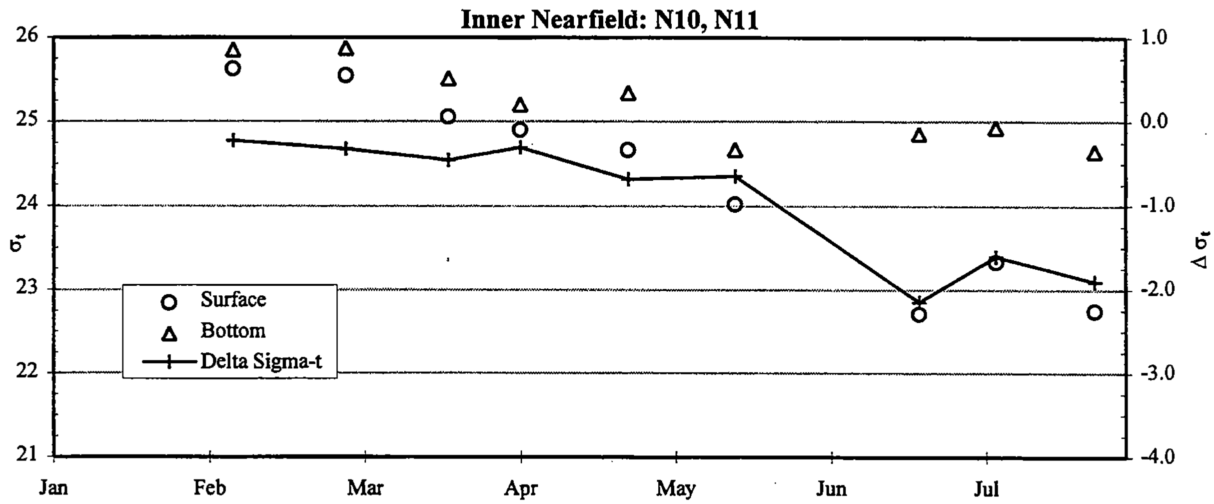


FIGURE 4-8
Time-series of Average Surface (A) and Bottom (E) Water Density (σ_t) and $\Delta\sigma_t$ (A-E) in Farfield Regions



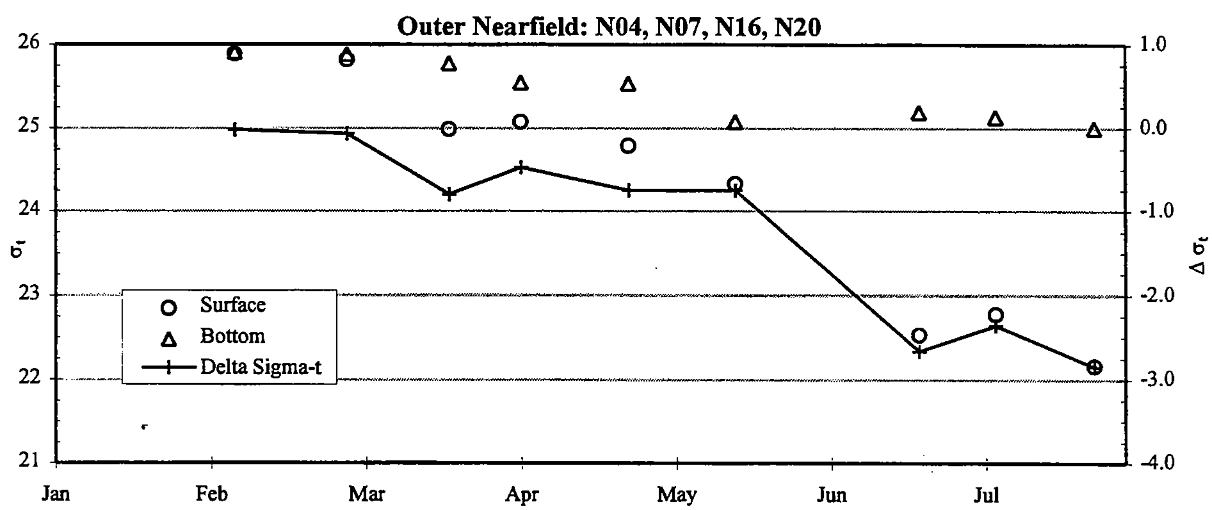
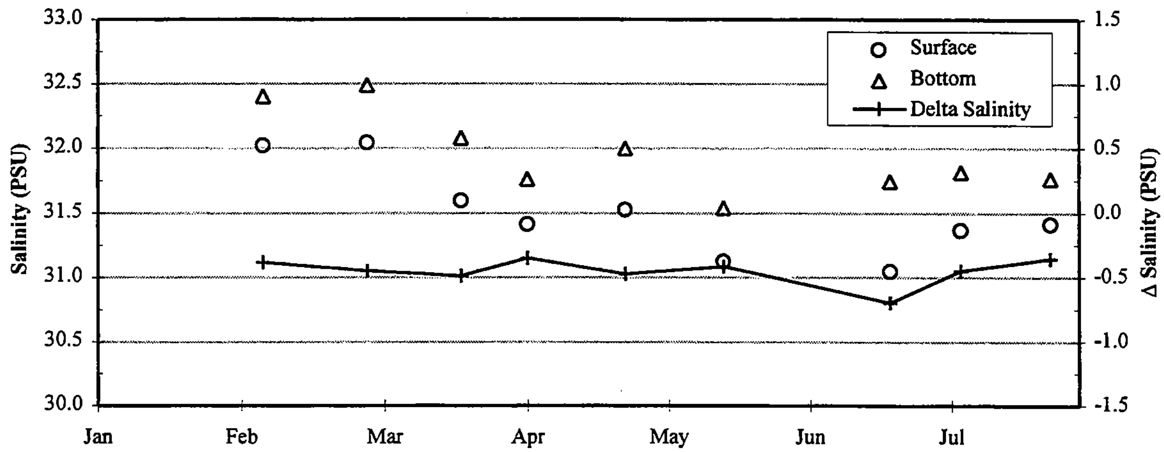


FIGURE 4-9
Time-Series of Average Surface and Bottom Water Density (σ_t) and $\Delta\sigma_t$ (Surface - Bottom) in the Inner and Outer Nearfield

Inner Nearfield: N10, N11



Outer Nearfield: N04, N07, N16, N20

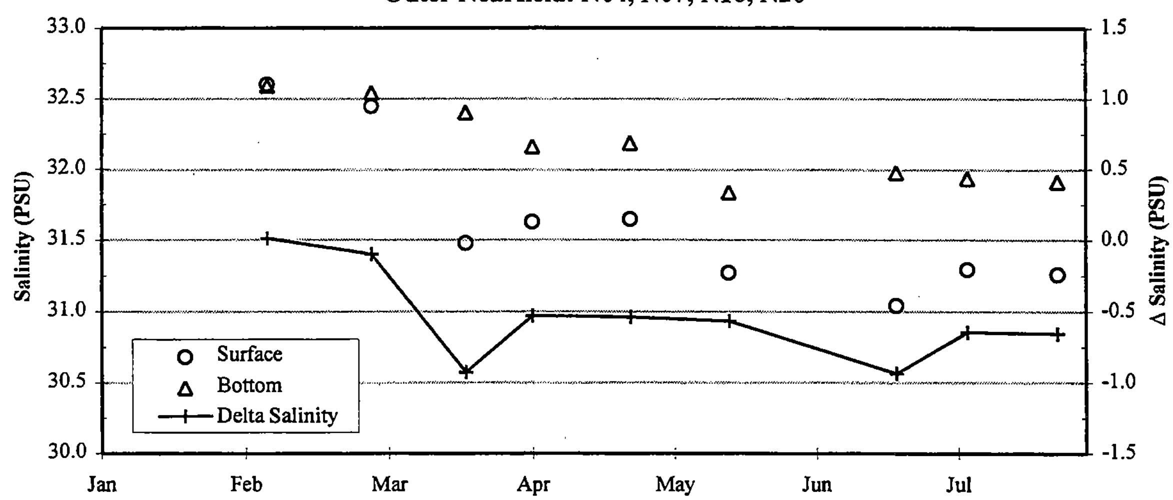
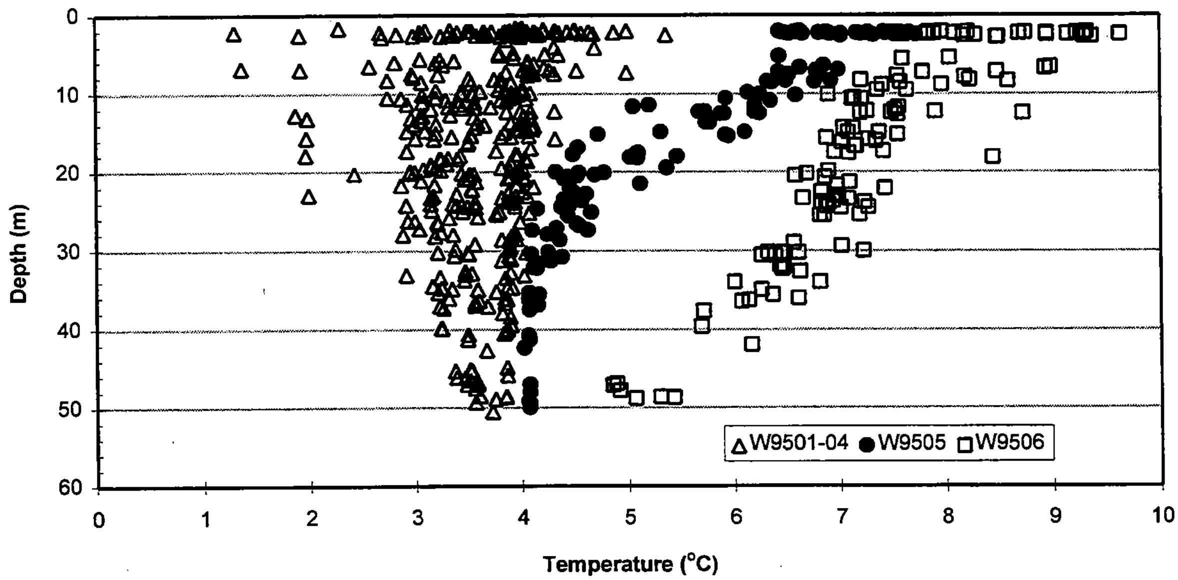


FIGURE 4-10

Time-Series of Average Surface (A) and Bottom (E) Water Salinity and ΔSalinity (A-E) in the Inner and Outer Nearfield

(a) Pre-Stratification Nearfield Temperature Distribution



(b) Early Stratification Nearfield Temperature Distribution

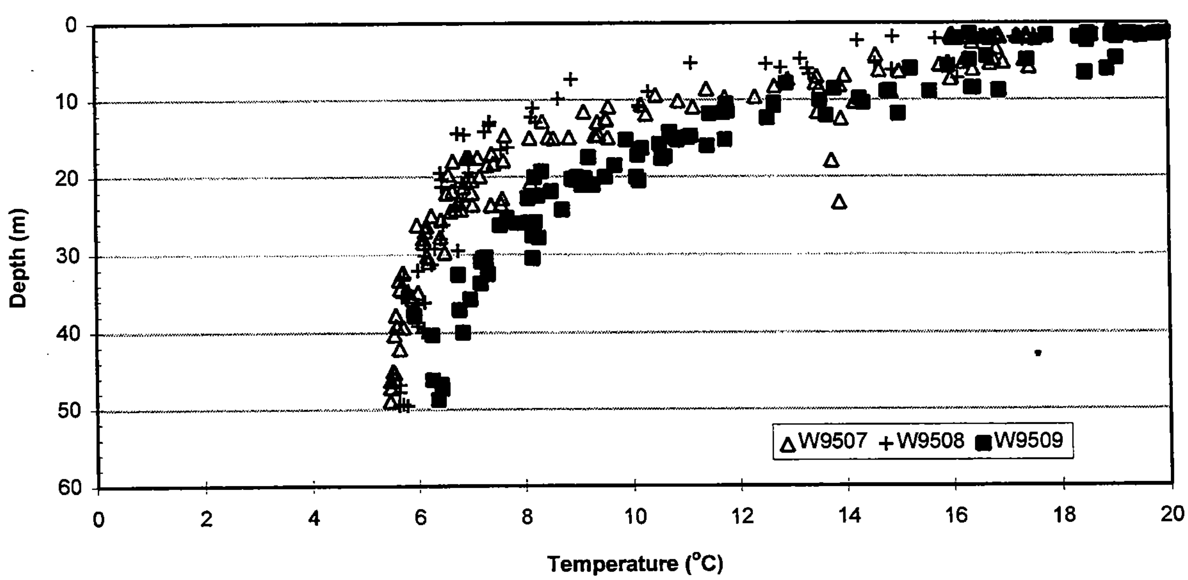


FIGURE 4-11

Scatter Plot of Measured Water Temperature with Depth in the Water Column for (a) Pre-Stratification and (b) Early Stratification Surveys

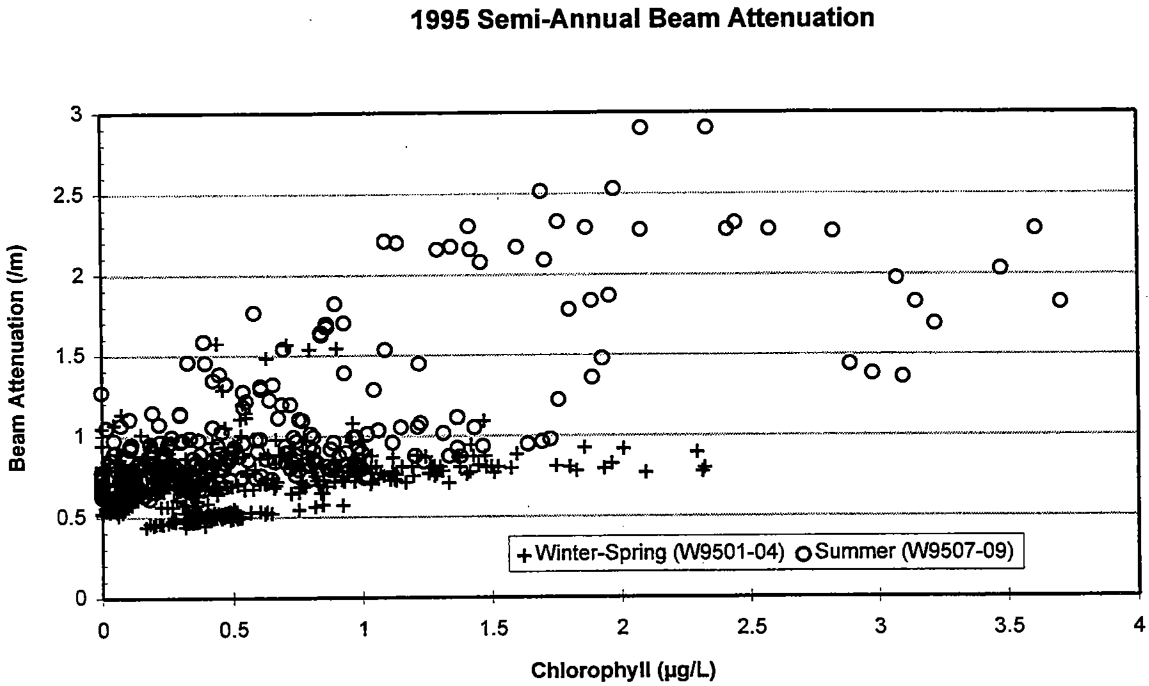


FIGURE 4-12
Scatter Plot of the Calculated Beam Attenuation Coefficient and Chlorophyll *a* for the Winter-Spring and Summer Surveys

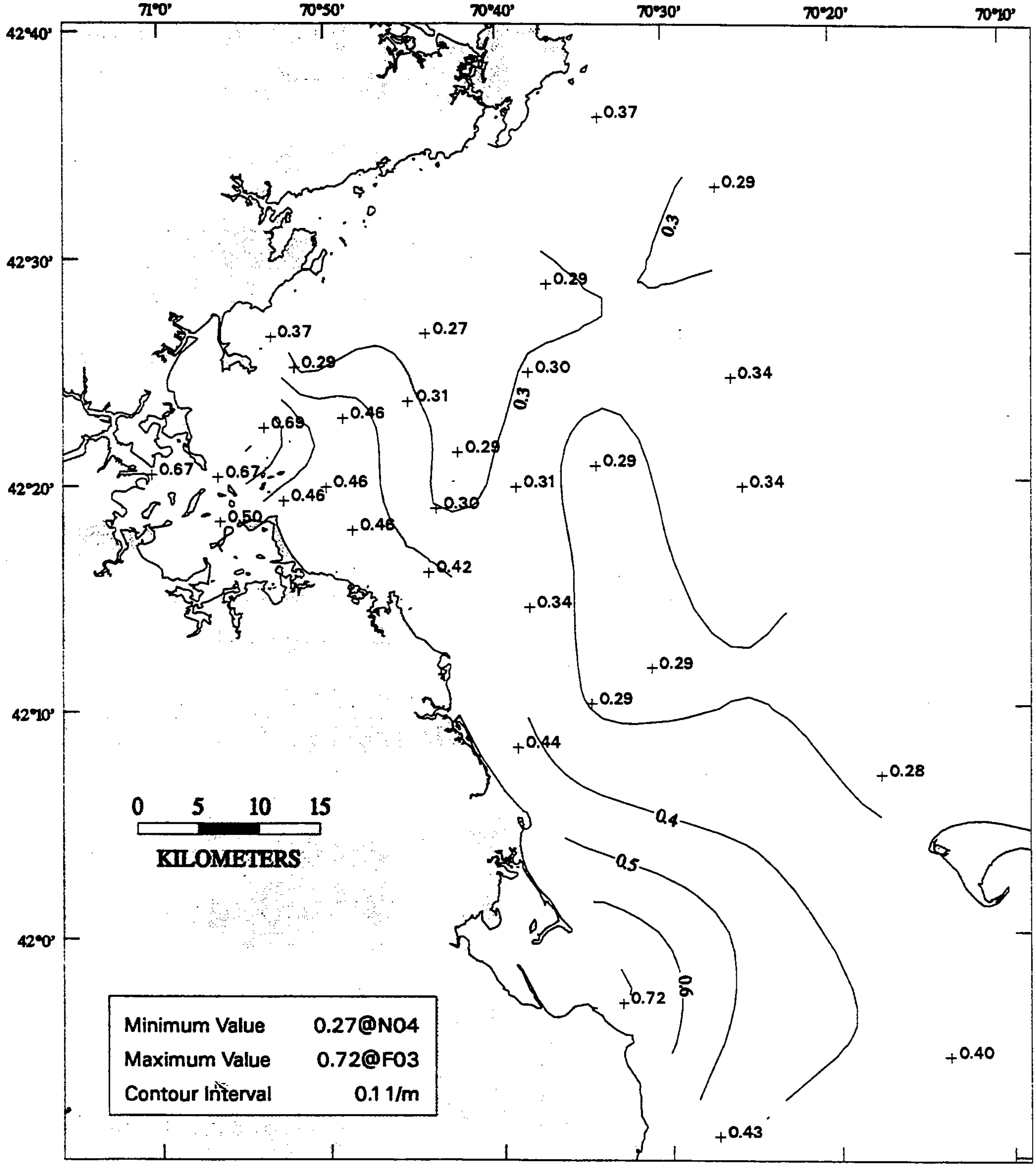


FIGURE 4-13
Regional Surface Water (A Bottle Samples) Contour Plot of Beam Attenuation (/m)
During Survey W9502 in March

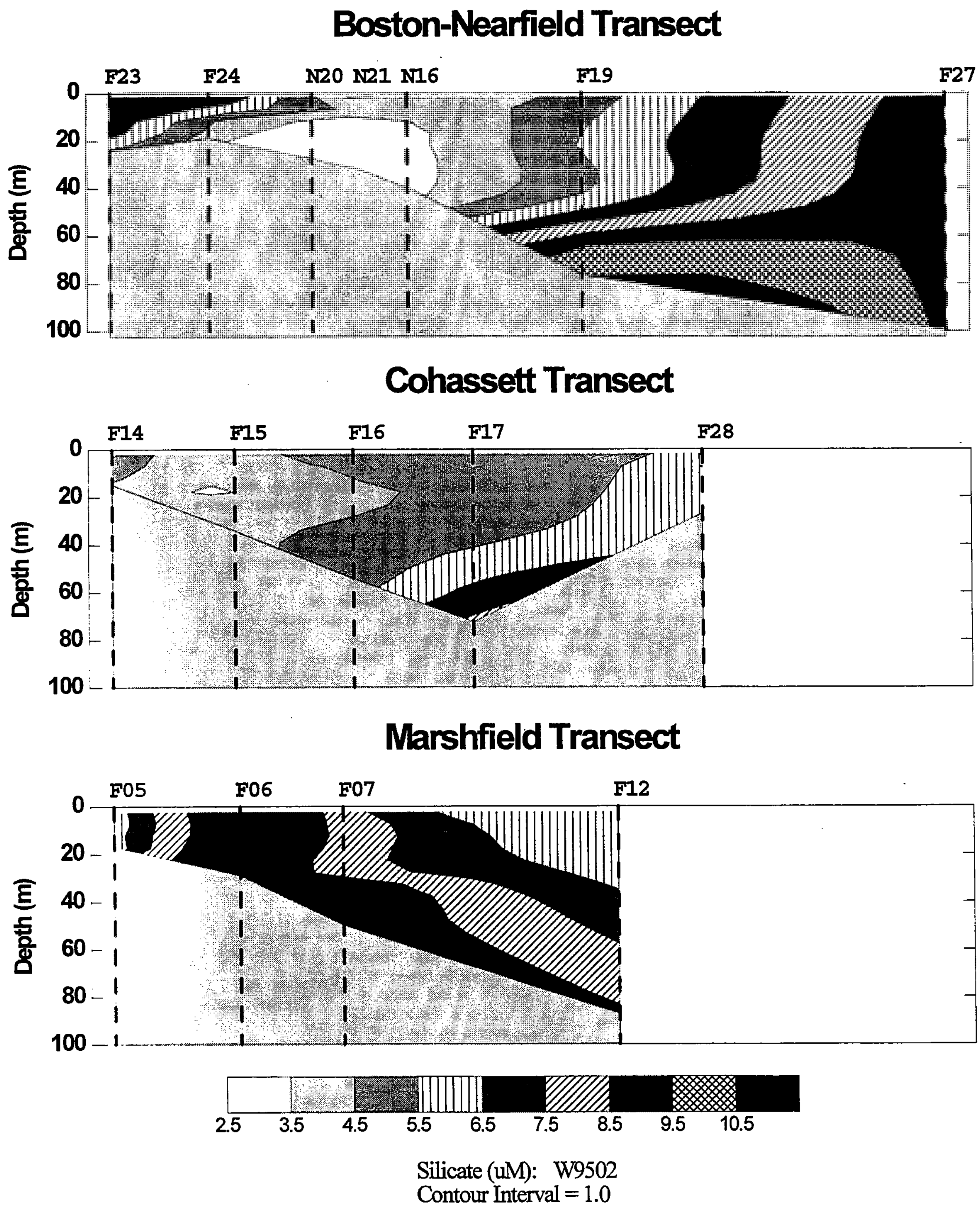


FIGURE 4-14
Transects Showing Dissolved Silicate Concentration (µM) Contours During Survey W9502 in March
See Figure 1-3 for Location of Transects

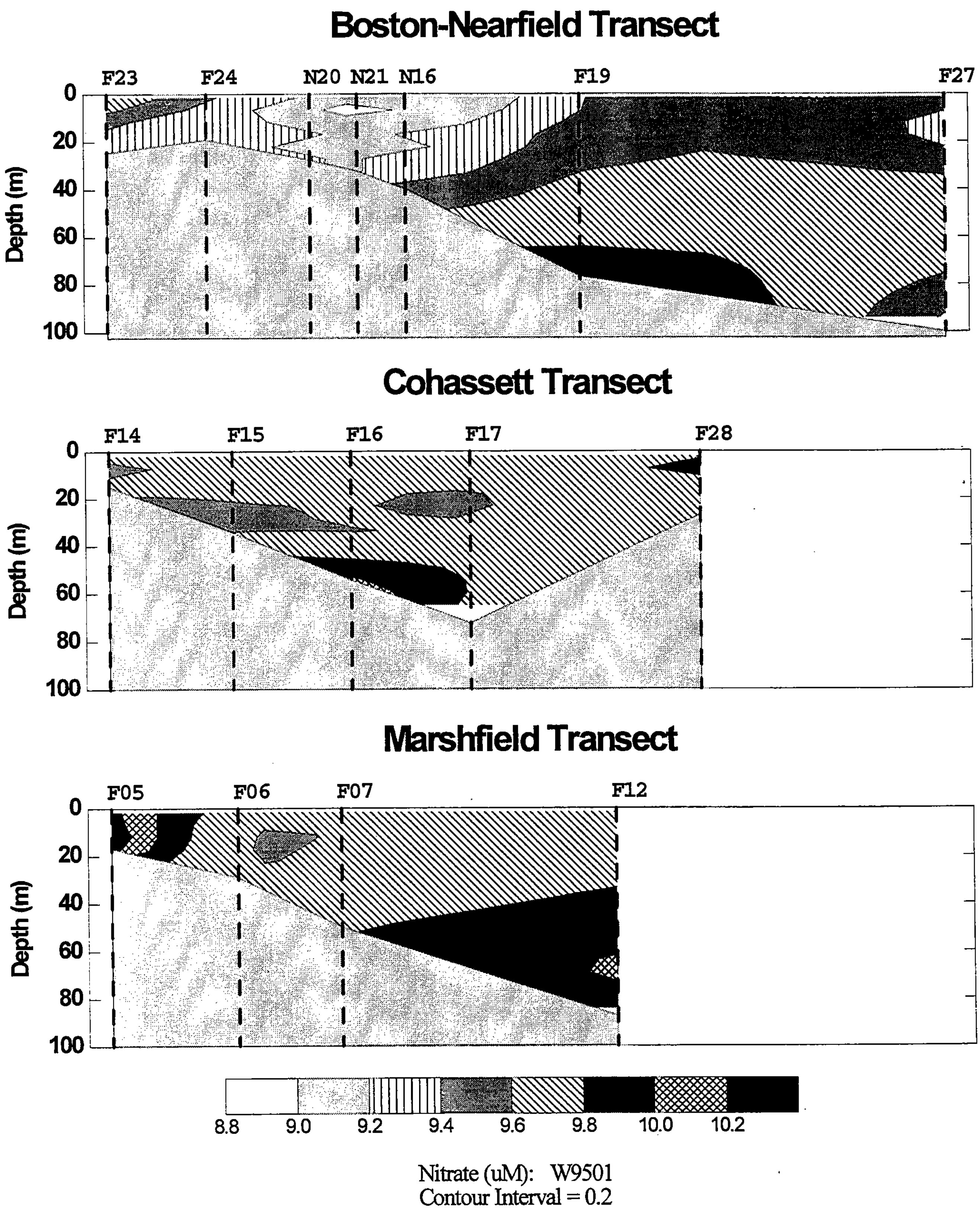


FIGURE 4-15
Transects Showing Dissolved Nitrate Concentration (µM) Contours During Survey W9501 in February
See Figure 1-3 for Location of Transects

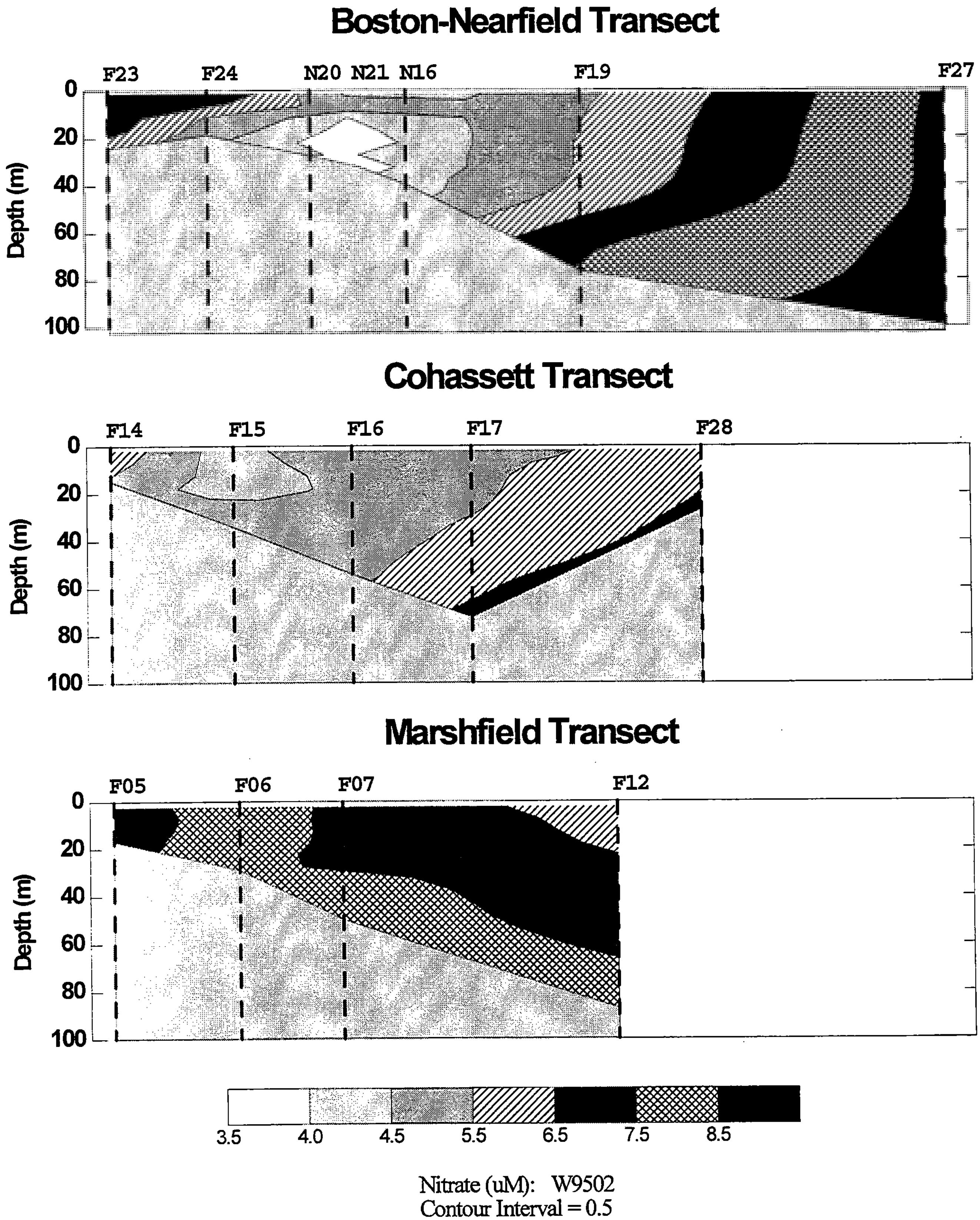


FIGURE 4-16
Transects Showing Dissolved Nitrate Concentration (μM) Contours During Survey W9502 in March
See Figure 1-3 for Location of Transects

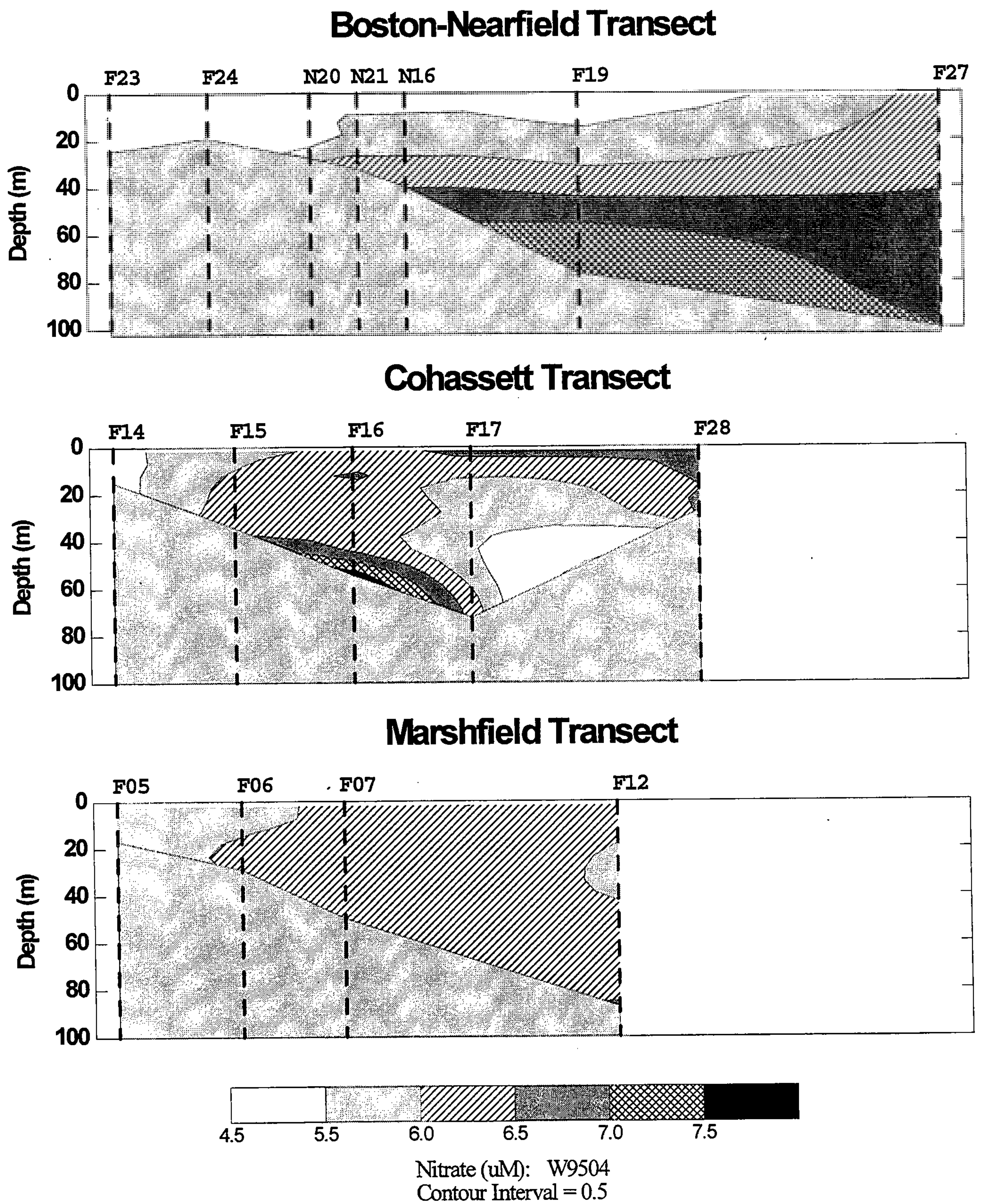
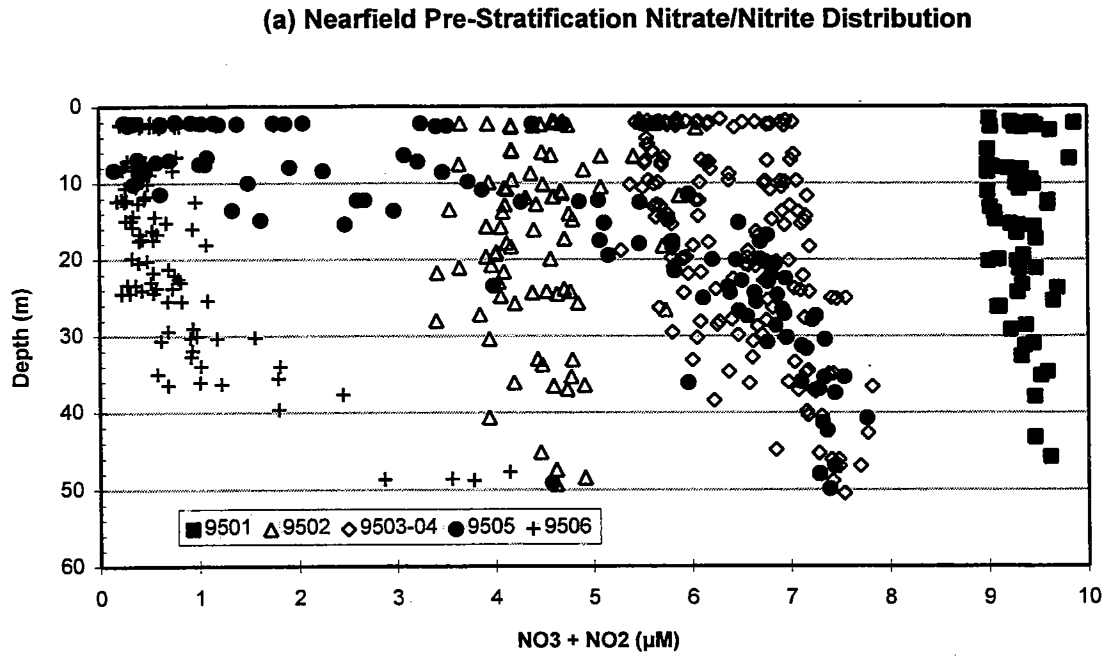


FIGURE 4-17
Transects Showing Dissolved Nitrate Concentration (µM) Contours
During Survey W9504 in April
See Figure 1-3 for Location of Transects



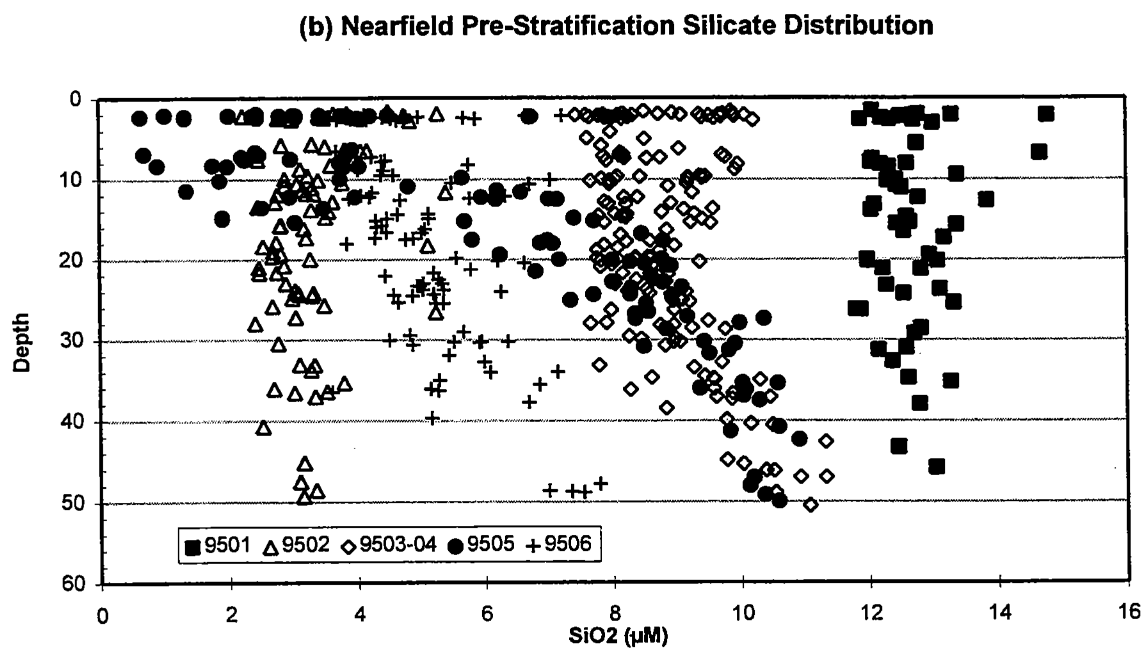


FIGURE 4-18

Scatter Plot of (a) Nitrate+Nitrite Concentrations (µM) and (b) Silicate Concentrations (µM) with Depth in the Water Column for the Pre-Stratification Surveys

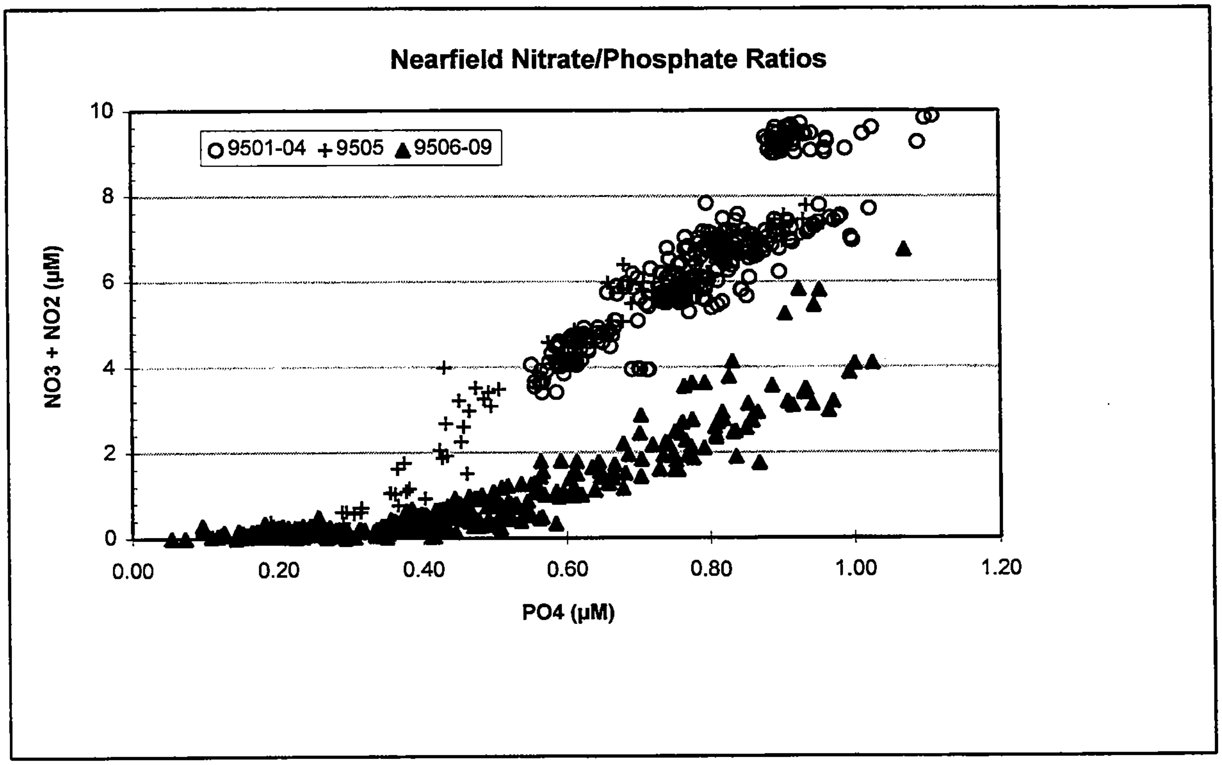


FIGURE 4-19

Scatter Plot of Nitrate+Nitrite and Phosphate Concentrations (µM) Over the Semi-Annual Period, Showing the Shift of the NO_3+NO_2:PO_4 Ratio Between the Winter-Spring and Summer Surveys.

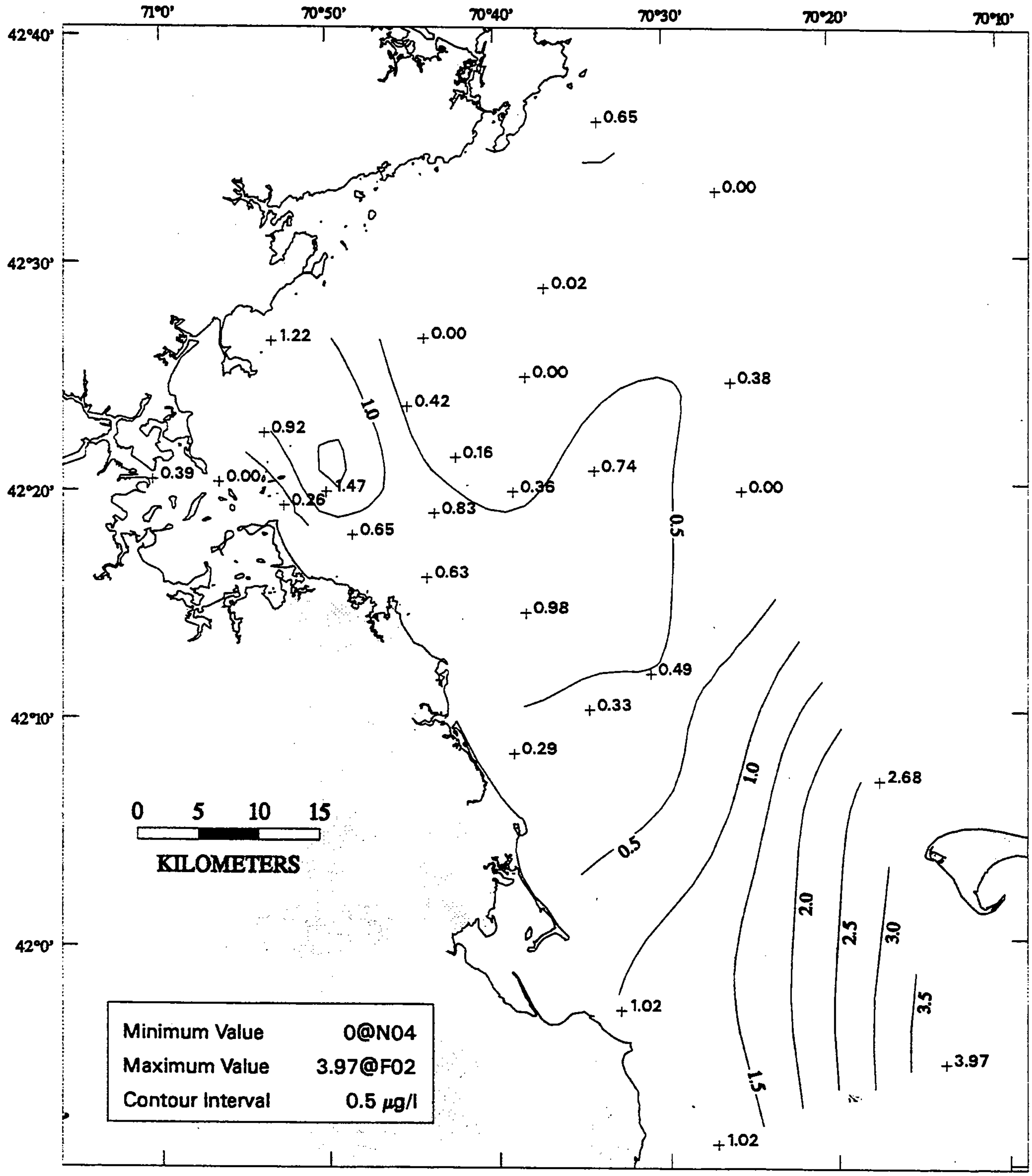


FIGURE 4-20
Regional Surface Water (a Bottle Samples) Contour Plot of Chlorophyll *a* (µg/L)
During Survey W9501 in February

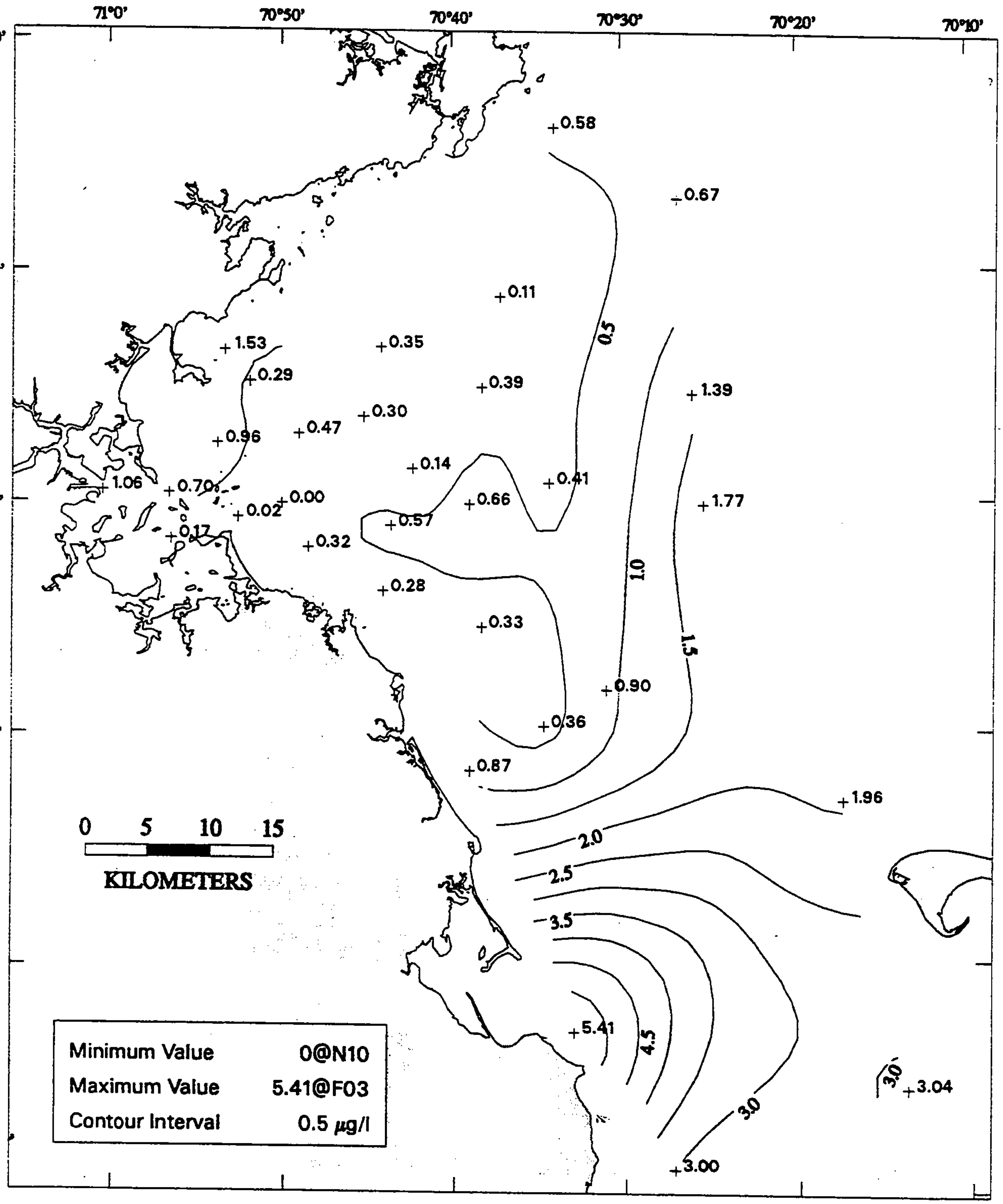


FIGURE 4-21

Regional Surface Water (a Bottle Samples) Contour Plot of Chlorophyll *a* (µg/L) During Survey W9502 in March

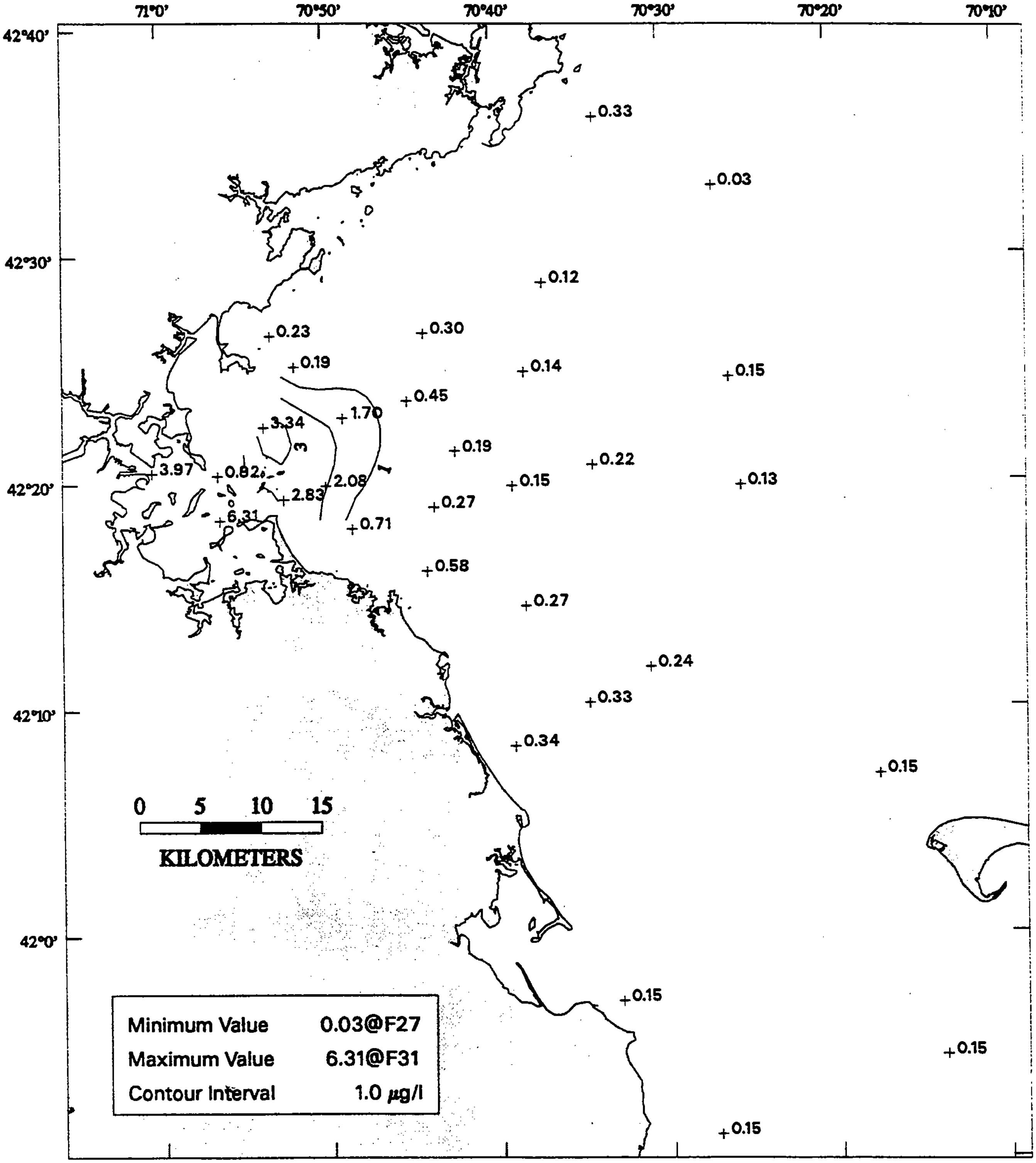


FIGURE 4-22
Regional Surface Water (a Bottle Samples) Contour Plot of Chlorophyll *a* (µg/L) During Survey W9507 in June.

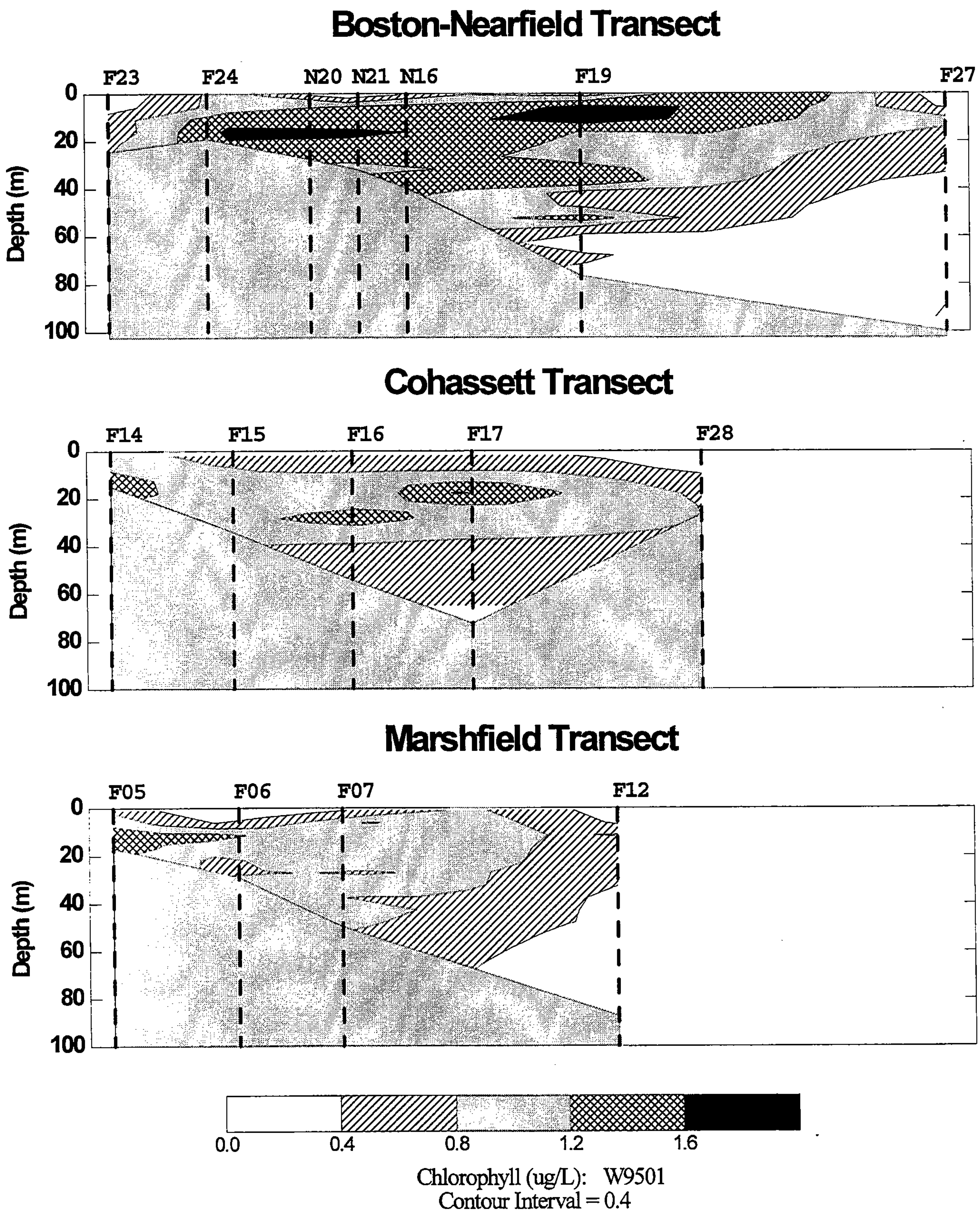


FIGURE 4-23
Transects Showing Chlorophyll *a* Concentration (µg/L) Contours During Survey W9501 in February
See Figure 1-3 for Location of Transects

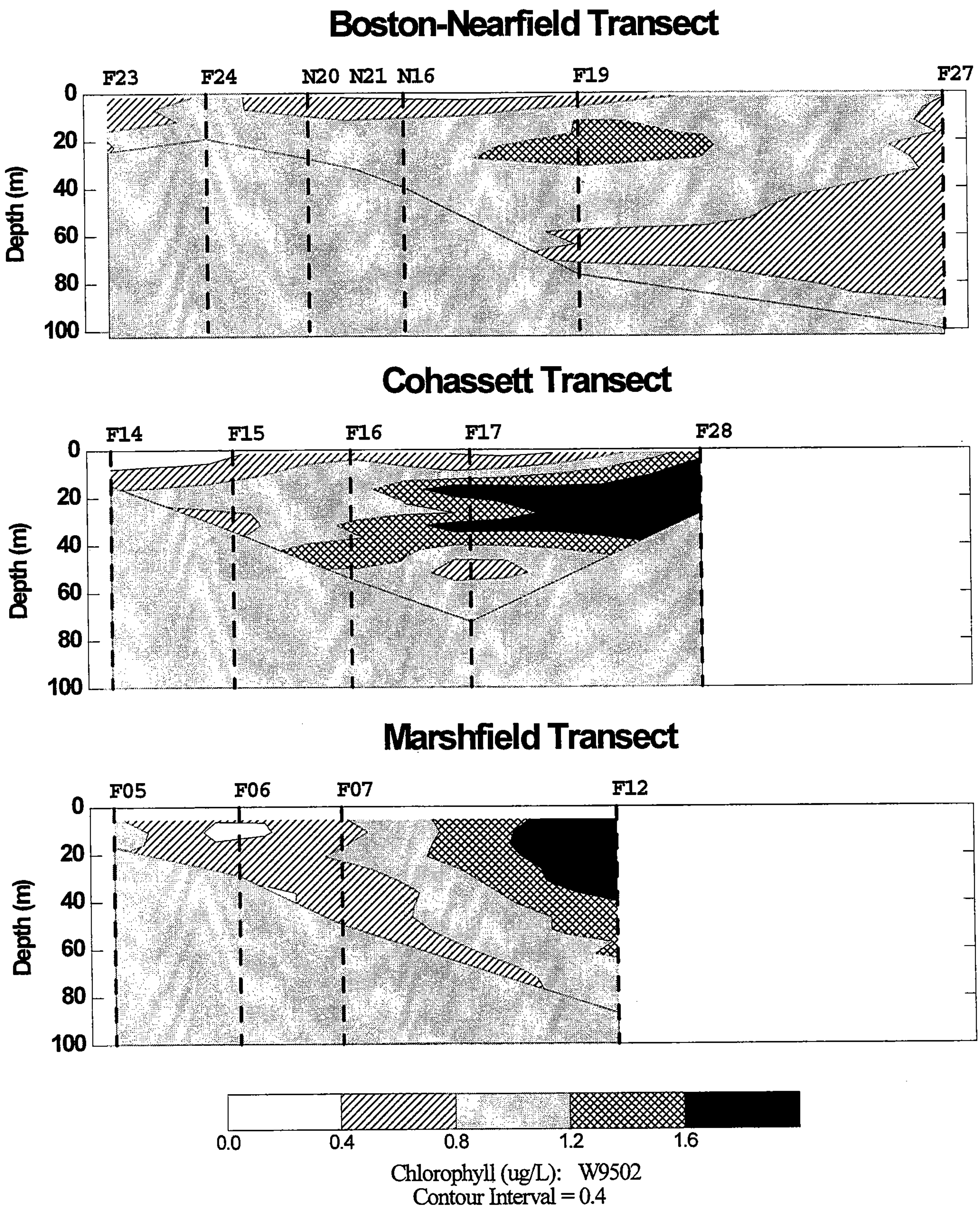


FIGURE 4-24
Transects Showing Chlorophyll *a* Concentration (µg/L) Contours During Survey W9502 in March
See Figure 1-3 for Location of Transects

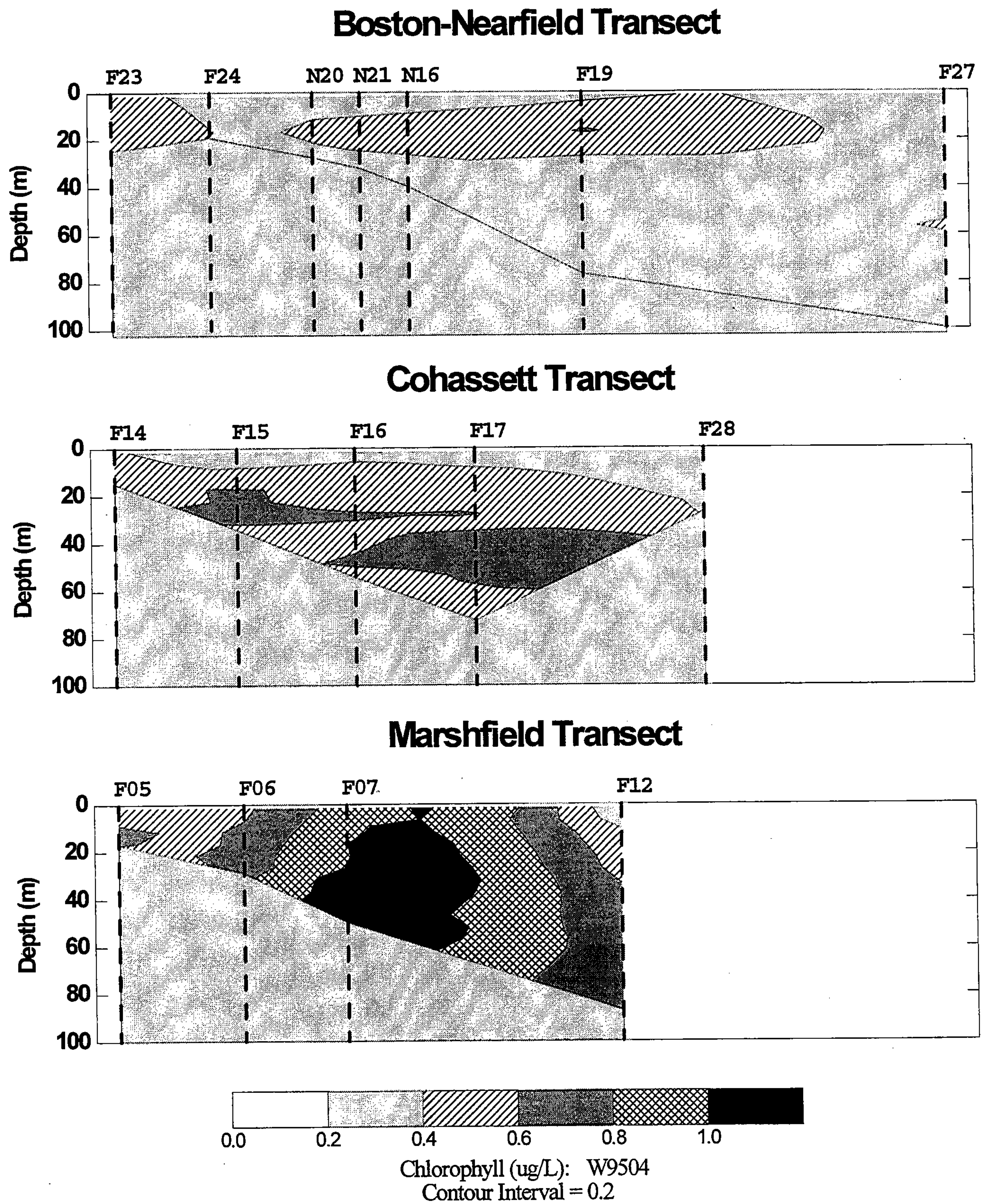


FIGURE 4-25
Transects Showing Chlorophyll *a* Concentration (µg/L) Contours During Survey W9504 in April. See Figure 1-3 for Location of Transects

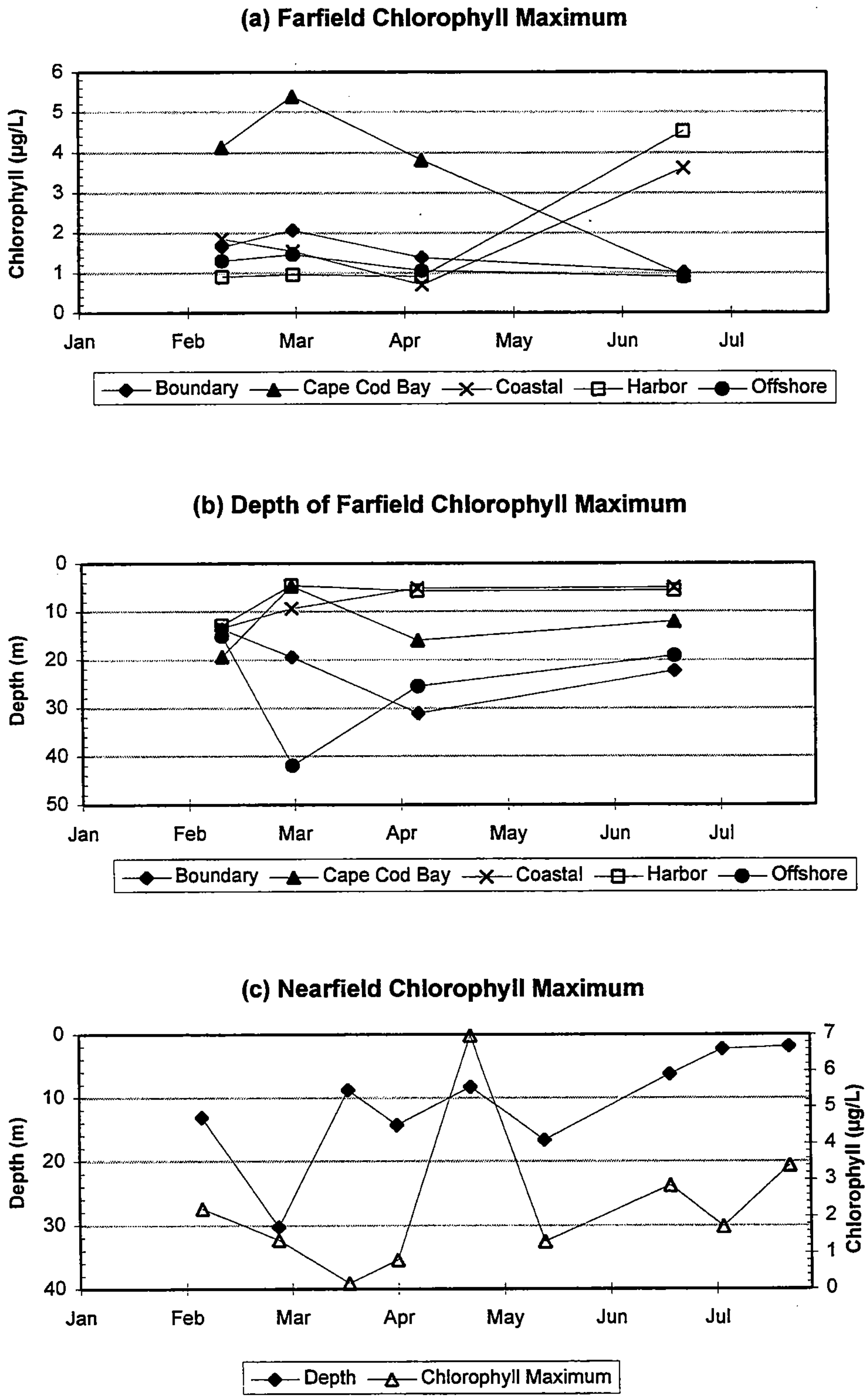


FIGURE 4-26

Time-Series of (a) the Average of Five Maximum Chlorophyll *a* Values Among all Stations in Each Farfield Region, (b) the Average Water Depth Where the Maximum Value Occurred, and (c) the Same Data for all Stations Within the Nearfield Region

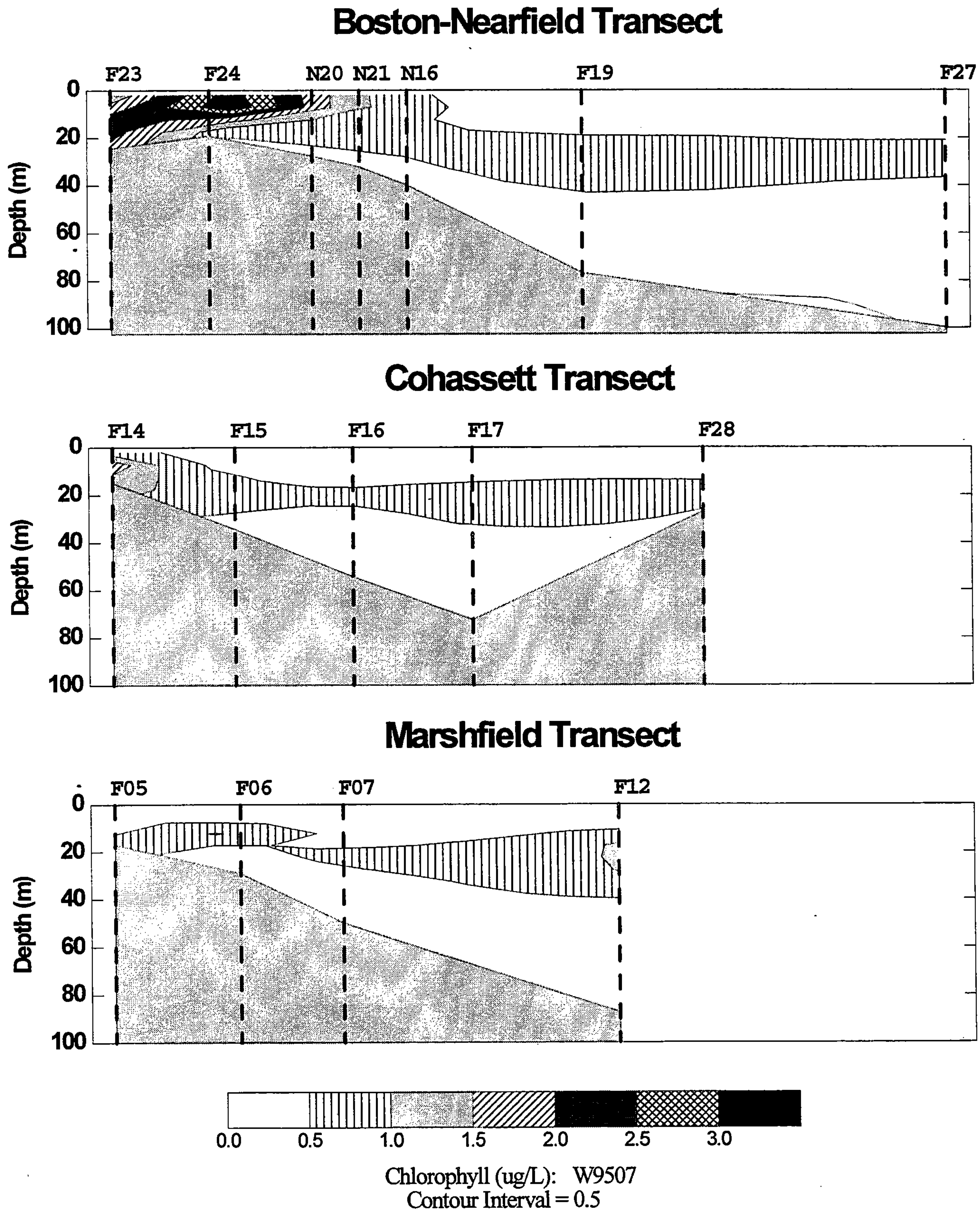


FIGURE 4-27
Transects showing Chlorophyll *a* Concentration (µg/L) Contours During Survey W9507 in June
See Figure 1-3 for Location of Transects

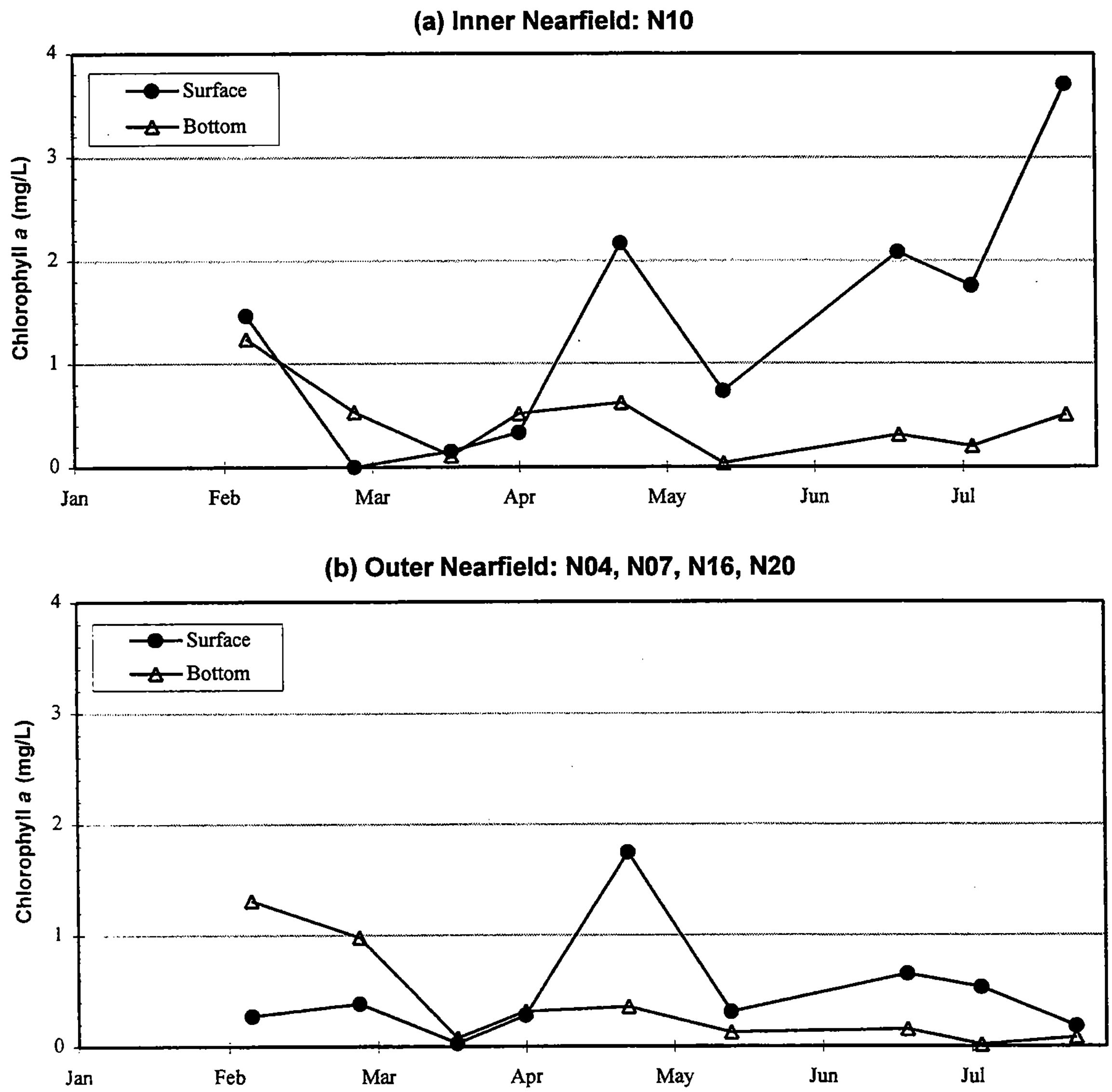


FIGURE 4-28
Time-Series of Average Surface (A) and Bottom (E) Water Chlorophyll *a* Values in the (a) Inner and (b) Outer Nearfield

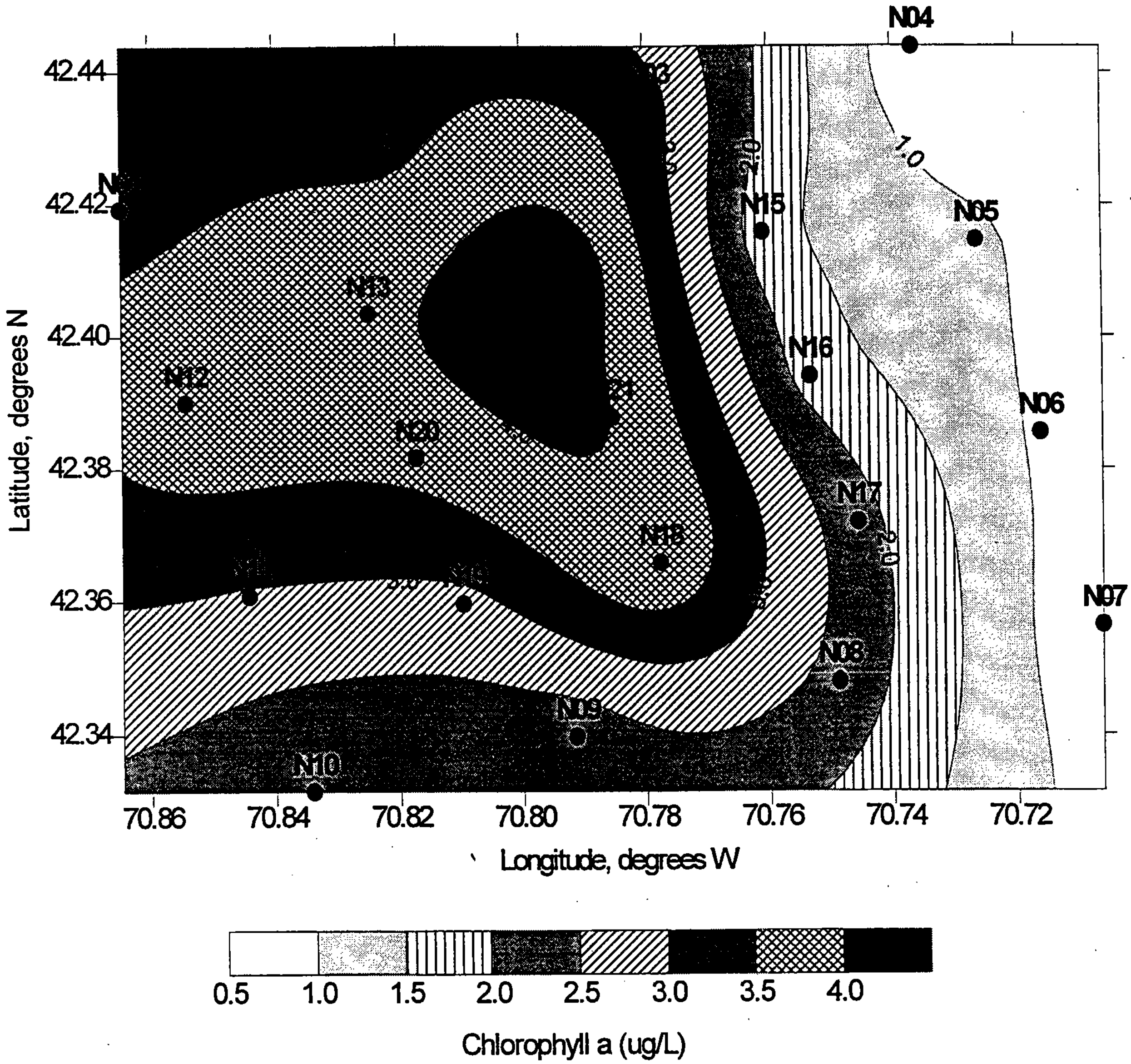


FIGURE 4-29
Distribution of Average Water Column Chlorophyll *a* in the Nearfield During the April Spring Bloom (W9505)

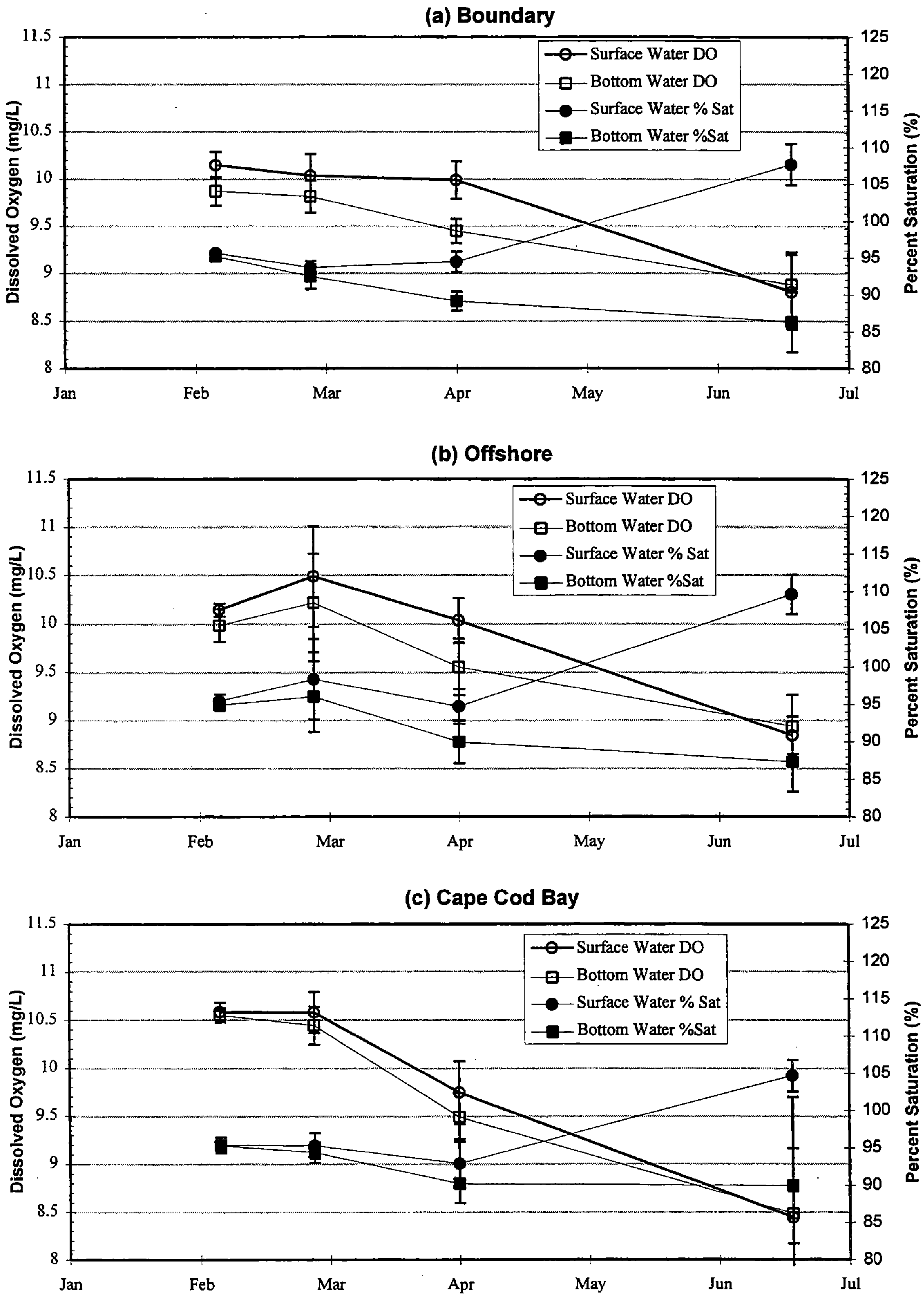
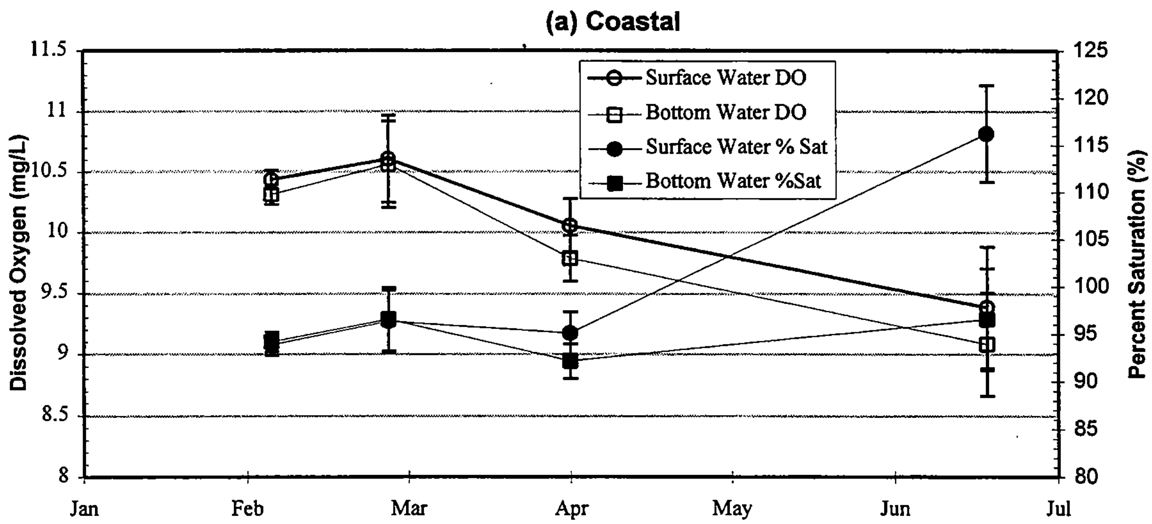


Figure 4-30
Time-Series of Average Surface (A) and Bottom (E) Water DO Concentration for (a) Boundary, (b) Offshore, and (c) Cape Cod Regions



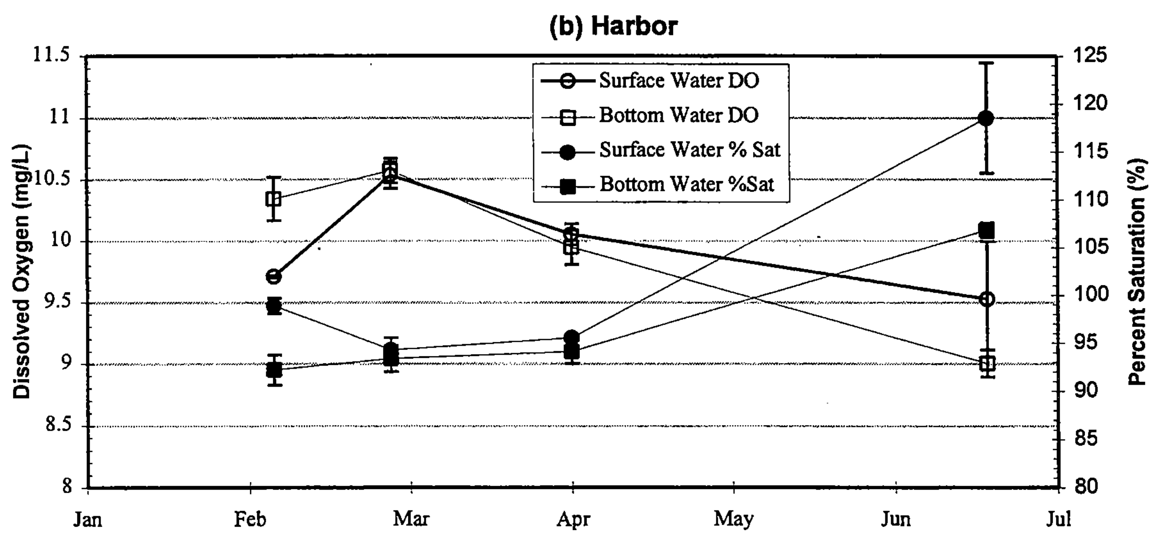


FIGURE 4-31
Time-Series of Average Surface (A) and Bottom Water (E) DO Concentration and Saturation for (a) Coastal, and (b) Harbor Regions

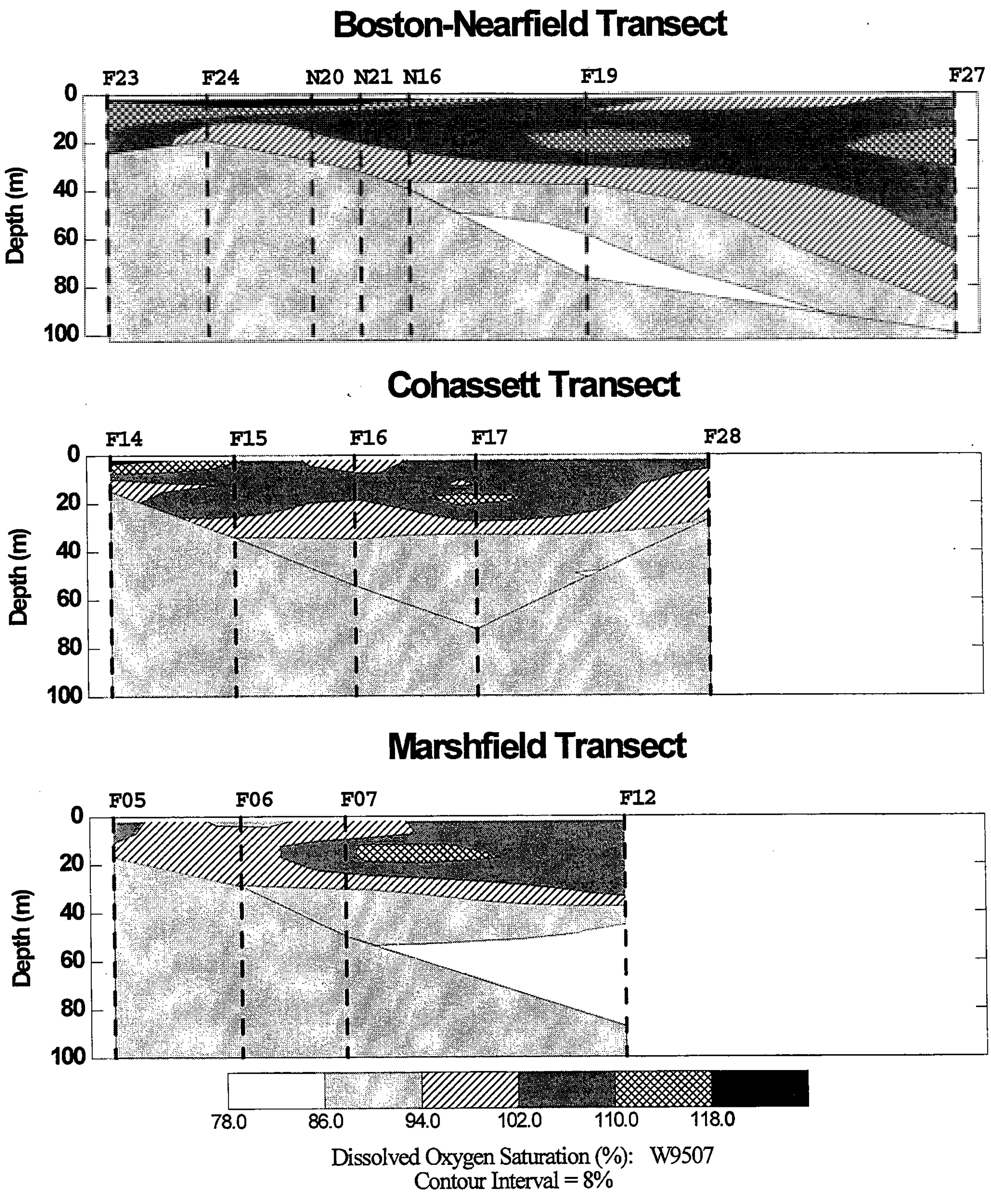


FIGURE 4-32
Transects Showing Dissolved Oxygen Saturation (%) Contours During Survey W9507 in June
See Figure 1-3 for Location of Transects

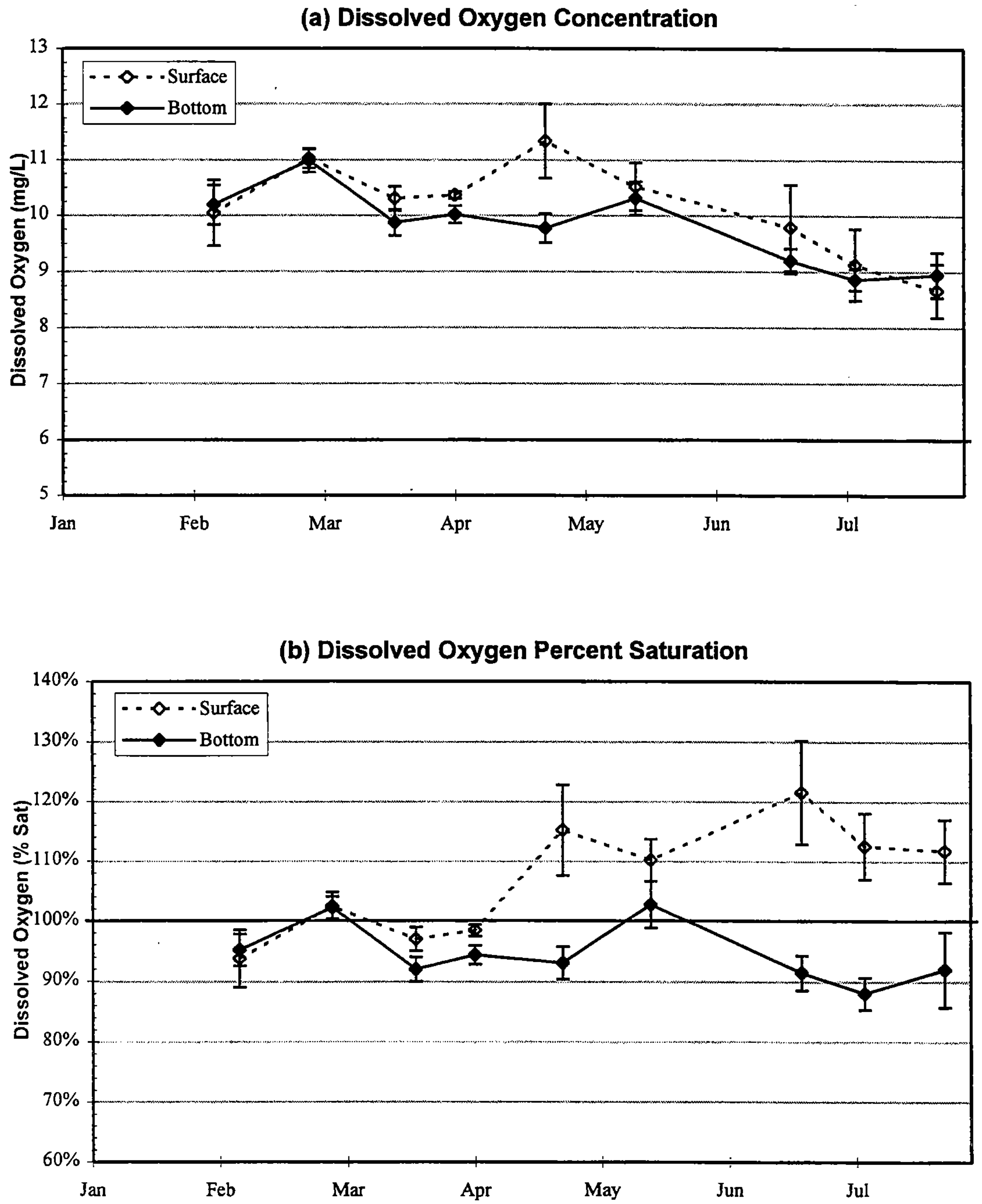


FIGURE 4-33
Time-Series of Average Surface and Bottom Water Dissolved Oxygen (a) Concentration (mg/L), and (b) Saturation (%) for Nearfield Region

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 four farfield surveys conducted during this semi-annual reporting period; additionally, N04 and N16 were sampled during all nine 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; detailed methods are available 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 ranged from approximately 325 to 900 $mgCm^{-2}d^{-1}$ during the first two winter surveys (W9501, W9502), then decreased to semi-annual minimum values in early March (W9503, 130 $mgCm^{-2}d^{-1}$). The subsequent farfield/nearfield survey in late March (W9504) showed only slightly elevated production values relative to the early March minima at all four stations sampled.

The two most noteworthy episodes of production occurred in the nearfield during the spring bloom in late April (W9505), and in June (W9507). Following the spring bloom in April (W9505), where peak bloom production reached 3,847 $mgCm^{-2}d^{-1}$ at Station N16, production decreased in May to activity levels similar to those measured in the first two surveys (Figure 5-2a). Productivity then increased to maximum summer levels of greater than 1,000 $mgCm^{-2}d^{-1}$ beginning in mid-June during W9507, with the maximum productivity measured at F23 (3,634 $mgCm^{-2}d^{-1}$). Areal production measured at the two nearfield stations

(N04, N16) during the first survey in July remained at activity levels of >1,000 $mgCm^{-2}d^{-1}$, but fell to approximately 500 $mgCm^{-2}d^{-1}$ during the last summer survey of the semi-annual period.

Average water column chlorophyll values were compiled to compare with the depth-integrated areal production measurements. Chlorophyll *a* concentrations, compiled from the calibrated upcast sensor readings (five sensor readings per station) were averaged, resulting in chlorophyll *a* values averaged over the depth of the water column. For the most accurate assessment of chlorophyll-normalized production, average chlorophyll values in the photic zone should be used. Because the five upcast sensor readings were selected, rather than integrating over all of the downcast sensor readings, the average chlorophyll *a* values presented below were of acceptable accuracy for the purposes of this data summary.

Temporal trends of areal production and average chlorophyll *a* concentrations were remarkably similar at the stations where productivity was measured (Figure 5-2b), especially during the winter and spring. As discussed previously, the maximum measured chlorophyll *a* concentration in the nearfield during the pre-stratification period occurred during W9505 in April.

During the increase of areal production in the summer (W9507-W9509), average chlorophyll *a* concentrations actually decreased relative to concentrations measured during the winter. This summer inverse relationship between chlorophyll *a* in the water column and production continued through the final survey of this semi-annual reporting period. The implications of the relationship between chlorophyll and productivity measurements were further analyzed using chlorophyll-specific calculations of production in the following section.

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. The spatial and temporal distributions of production and chlorophyll-specific production on a volumetric basis were summarized by showing contoured production through the first nine surveys of 1995, along with the depths of the samples collected and processed (Figures 5-3 and 5-4).

Daily production was concentrated in the upper water column during all of the surveys (Figure 5-3). Contours of daily production show the blooms documented at N16 in April and at F23 in June, and the overall trend towards increased production in the summer.

Chlorophyll-specific production is an estimate of the efficiency of photosynthesis. The distribution of chlorophyll-specific production (Figure 5-4) indicates several periods when, although measured daily production was relatively low, the efficiency of production was high relative to the amount of biomass present (as measured by total chlorophyll *a*). For example, a peak in chlorophyll-specific production during the March survey (W9503), most clearly noted at station N16, corresponded with an increase in zooplankton (Section 5.3), suggesting efficient removal of newly produced chlorophyll. Additional evidence of rapid photosynthesis, despite the lack of chlorophyll in the water column, occurred during the July surveys (W9508-W9509). This peak in chlorophyll-specific production was concomitant with the physical changes in the water column during the two July surveys, as discussed below (Section 5.2).

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 nine nearfield surveys during the first 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 $\mu MO_2/hr$) 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 rates during the winter and early spring surveys (W9501-W9504) in 1995 were less than 0.1 $\mu MO_2/hr$ for all of the stations measured except F23 (Figure 5-5, 5-6). Additionally, there was negligible difference between surface and bottom water rates at these stations. The similarity of respiration rates in a well-mixed water column is expected because respiration is a temperature-dependant reaction, and also the lack of a pycnocline allows unrestricted flux of particulate organic carbon (POC) to the bottom water.

The data from station F23 resulted in higher surface water respiration rates relative to the other sampled stations (Figure 5-5). The increased respiration at F23 was a function of the higher concentration of POC at this harbor-influenced station (Figure 5-7). The maximum respiration rate measured during winter-early spring (W9501-W9504) was 0.23 $\mu MO_2/hr$ in the surface water at F23 during February (W9501), as was the semi-annual maximum POC measurement (73.3 μM) among the respiration stations. The elevated POC levels at F23 were not mirrored in chlorophyll *a* concentrations; there was, however, a peak in chlorophyll-specific production at F23 in February (Figure 5-4).

During the April farfield survey (W9504), the trend of higher surface respiration rates relative to bottom water was reversed at N04, N16, and F23. Maximum respiration was measured in the bottom water at

F23, while the surface water rate was reduced to <0.1 μMO_2/hr, coincident with an increased flux of POC to the bottom water F23 (Figure 5-7). As suggested by the chlorophyll-specific production event during W9503, this POC flux was due to sinking of grazed plankton produced prior to April survey.

The maximum rate of surface water respiration for the semi-annual period was measured during the late April spring bloom at station N16 (2.4 μMO_2/hr), almost an order of magnitude larger than any other measured value. The other station measured during the late April survey (N04) also showed a modest increase in respiration (0.15 μMO_2/hr). Bottom water respiration during this survey was negligible. POC also was elevated in the surface water of N16 (Figure 5-8).

During the following survey in mid-May (W9506), surface respiration rates remained elevated (approximately 0.15 μMO_2/hr), but there was also an increase in bottom water respiration at both nearfield stations measured. This pattern of elevated surface water activity related to the April spring bloom, followed by bottom water changes in May, is seen in many physical and biological parameters. The increase of bottom water respiration in May most likely resulted from decomposition of settling plankton following the April spring bloom. With no concomitant increase in chlorophyll *a* (Figure 4-28) nor POC (Figure 5-8) in nearfield bottom water, the data suggest that the May survey was conducted at the twilight of the spring bloom event documented in April. Further analysis of the organic matter contribution to respiration measurements is discussed below (Section 5.2.2).

Vertical differences of water column respiration developed fully by the June survey (W9507) at all five respiration stations (Figures 5-5, 5-6). Surface water respiration rates were at least 0.1 μMO_2/hr greater than bottom water rates except at F23, where bottom water rates were higher. Except for the maximum respiration rate measured at N16 in April, station F23 exhibited the highest rates at all water depths (> 0.3 μMO_2/hr) during the June survey. Otherwise, bottom water respiration rates during the summer months were very low to below detection (e.g., F19).

At the two nearfield stations sampled during the final two surveys in July (N04 and N16), overall surface respiration rates remained elevated relative to winter rates (0.12 - 0.30 μMO_2/hr), and bottom water rates remained close to zero (Figure 5-6). Rates between the two stations were similar for the June (~0.25 μMO_2/hr) and late July (~0.15 μMO_2/hr) surveys. Data from the early July survey (W9508), however, indicated a difference between the two stations, with the highest summer rate between the two stations measured at N04 (0.3 μMO_2/hr), and the lowest at N16 (0.12 μMO_2/hr). The significance of biological data at the two nearfield stations in July was further delineated by analyzing carbon-specific respiration.

5.2.2 Carbon-Specific Respiration

Differences 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.

Comparison of respiration (Figures 5-5, 5-6) and carbon-specific respiration (Figures 5-9, 5-10) rates resulted in two primary periods showing a divergence of carbon-specific respiration. First, during early April (W9504), the bottom water carbon-specific respiration rate at N04, and the surface and bottom water rates at N07, were among the highest rates (~0.12 $\mu MO_2/\mu MC/hr$) measured in the semi-annual period. Considering that bottom water respiration was higher than surface water at several stations during this survey (Section 5.2.1), the cumulative data suggest a recent source of fresh planktonic material available for respiration. Evidence for a recent productivity event prior to this survey was the high values of chlorophyll-specific production measured in late March (W9503, Section 5.1) and relatively high zooplankton abundance during the period. The predictive chlorophyll-specific values, in tandem with the retrospective carbon-specific respiration values, suggest a productive period between these two surveys (W9503, W9504) with relatively rapid removal of chlorophyll from the water column and delivery to the bottom.

The second period highlighted by the carbon-specific respiration data was during the July nearfield surveys (W9508, W9509). Although the trends of surface water respiration (Figure 5-6) and POC (Figure 5-8) in early July (W9508) were different at nearfield stations N04 and N16, the resultant carbon-specific respiration data indicated a similar decrease in the surface water (Figure 5-10). A relative decrease of carbon-specific respiration in surface water means that the respiration rate is low relative to the available POC. These data suggest that the POC in the surface water during this survey was not easily oxidized, indicating senescent material. Satellite data from early July (Table 4-1), as well as moored temperature data from the USGS buoy located within the nearfield, indicated an upwelling event in Western Massachusetts Bay at the beginning of survey W9508. Upwelling is a potential mechanism for reversing the flux of senescent plankton from below the pycnocline to surface waters.

Following the early July survey, carbon-specific respiration increased in both surface and bottom water in late July (W9509). This increase in carbon-specific respiration, indicating an influx of higher quality POC available for respiration, in combination with productivity data showing a "gearing up" of productivity in July, provides supporting evidence for a July productivity event between surveys W9508 and W9509. The physical evidence for upwelling in July would provide a catalyst for a period of production which was waning by the end of July.

5.3 Plankton Results

The 1995 HOM Program included analysis of the plankton community in Boston Harbor, Massachusetts Bay, and Cape Cod Bay during 11 nearfield and six combined farfield surveys conducted from February to December. Two stations were occupied in the nearfield surveys, while an additional ten locations were sampled during the combined events (Figure 5-11). In this report, the first half of the 1995 plankton record is presented (surveys W9501 to W9509), including four of the six annual combined sampling events (W9501, W9502, W9504, and W9507). 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 *a* maximum. Zooplankton samples were collected at each station by oblique tow. Details regarding sampling and analysis can be found in the Combined Work Plan/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. Nuisance algae issues are also addressed. 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 presents zooplankton results.

5.3.1 Phytoplankton

5.3.1.1 Seasonal Trends in Total Phytoplankton Abundance

Prior to the onset of stratification, total abundance results from the whole water surface samples taken in the nearfield showed peaks during February and again in April (Figure 5-12). Patterns were quite similar in the mid-depth samples (Figure 5-12). Following the first survey when all regions were similar in total abundance, Cape Cod Bay densities were highest in the combined events during the pre-stratified period. Nearfield densities were typically intermediate with Cape Cod and coastal stations.

Overall abundances increased in all regions after the onset of stratification (mid-May), with the one combined nearfield/farfield sampling event in June reporting highest densities in the harbor (Fig 2a). During this survey, lowest densities were at the boundary station (F27), followed by the offshore station (F06) and Cape Cod Bay stations. Nearfield densities remained similarly high during the following two nearfield-only surveys.

5.3.1.2 Nearfield Phytoplankton Community Structure

Phytoplankton abundance and community composition at the two nearfield stations are depicted in Figure 5-13. Overall abundances at the two stations were generally similar prior to stratification, whereas abundance was much higher at N10 after the onset of stratification. With the exception of the late July survey results for N16, densities at the surface were typically higher than at mid-depth.

In both surface and mid-depth samples at each nearfield station, microflagellates were the numerically dominant plankton group in most samples (up to 96 percent of total density (Appendix F-1 and F-2). Cryptophyte species were also dominant during the pre-stratification surveys when overall abundance was low, especially during March (Appendix F-1). They were also prevalent in surface samples at N10 after stratification had begun (Figure 5-13).

Centric diatoms in early season samples (e.g., W9502) largely consisted of *Thalassiosira* spp, while *Chaetoceros* spp. were the dominant centric diatom during the April bloom (Figure 5-14). A small (<20μm) *Gymnodinium* species dominated the dinoflagellate group. During the early stratification period, *Rhizosolenia fragilissima* and a small (<10μm) centric diatom were prevalent, with both taxa reaching densities of 3 million cells per liter. Centric diatoms were noticeably less prevalent at mid-depth at N16 (Figure 5-13), which exhibited a larger proportion of flagellates, cryptophytes, and dinoflagellates. The comparably large (up to 250μm) dinoflagellate *Ceratium longipes* was the dominant dinoflagellate species, reaching densities of over 800 cells/L in June (Appendix G-2).

In terms of estimated carbon equivalence, phytoplankton carbon was relatively low during the pre-stratified period as compared with the peak concentrations which occurred after the onset of stratification (Figures 5-15 and 5-16). Early season carbon dominants included microflagellates, the small *Gymnodinium*, and a consortium of centric diatoms (Figure 5-17). *Chaetoceros* and *Thalassiosira decipiens* were the dominant carbon producers during the spring bloom. Peak carbon concentrations were seen during July at station N10, while at station N16 the peak occurred during June. The dominant carbon contributors were microflagellates, *Rhizosolenia fragilissima*, and *Ceratium longipes*.

5.3.1.3 Regional Phytoplankton Assemblages

Regionally, noticeable differences in community composition were evident in the harbor surface samples and in Cape Cod Bay during W9501. The W9501 harbor surface assemblage (stations F23, F30, and F31) yielded a relatively high number of the bluegreen algae *Oscillatoria* (Figure 5-18, Appendix F-1). Cape Cod stations F01 and F02 had a much higher proportion of centric diatoms than was seen in other regions, dominated by *Thalassiosira gravida* (Figure 5-18 and 18).

By W9502, eastern Cape Cod Bay appeared to experience a bloom of the small *Gymnodinium* species that was seen in the nearfield (Figure 5-19), with a peak density at mid-depth of nearly half a million cells per liter (Figure 5-19, Appendix G-1). Centric diatoms continued to have a large presence in Cape Cod Bay during W9502 relative to the other regions, comprised of *Thalassiosira* and *Rhizosolenia delicatula*. The comparably large presence of centric diatoms continued in western Cape Cod Bay through W9504 (Figure 5-20), however, the earlier dominant taxa were supplanted by *Chaetoceros* spp. which reached a density of over 1 million cells per liter (Appendix G-1).

By late June (W9507, Figure 5-21), small flagellates dominated most regions. The harbor and coastal areas (i.e., stations F24, F25, and N10) also has large densities of a small (<10 μm) centric diatom. There also appeared to be a localized bloom ($4x10^5$ cells/L) of the dinoflagellate *Katodinium rotundatum* in the mid-depth sample from station F13, off Cohasset (Appendix F-2).

5.3.2 Zooplankton

5.3.2.1 Seasonal Trends in Total Zooplankton Abundance

Zooplankton densities in the nearfield generally increased throughout the reporting period, following the trend observed in phytoplankton abundance (Figure 5-22). Total zooplankton abundance grew from around 8,000/m^3 in early February to maxima of over 100,000/m^3 at station N10 (July) and around 70,000/m^3 at station N16 (June and July). A late winter peak (March) was seen at station N16 which coincided with a drastic reduction in phytoplankton cell densities. Although the depressed phytoplankton densities were also seen at station N10, the zooplankton abundance did not show the same increase there.

Zooplankton abundances were low at both stations in early July but rebounded by the late July survey. This may have been a response to a phytoplankton bloom which apparently occurred between the two July surveys (Section 5.2.2).

5.3.2.2 Nearfield Zooplankton Community Structure

Zooplankton abundance during the early surveys was evenly distributed among polychaete larvae, copepod adults, and copepod nauplii (Figure 5-23). The more inshore station N10 had a larger contribution from barnacle nauplii than was seen at the more seaward station N16. As the season progressed, copepods and copepod nauplii dominated the zooplankton assemblage at both stations. These two groups produced the late winter peak in abundance reported at station N16 in the March 20th survey (W9503).

The numerically dominant species among the copepods during the reporting period was *Oithona similis*, with initial densities in February of around 1,200/m^3 and peak densities in July of almost 20,000 m^3 (Appendix H). Other dominant copepods included *Pseudocalanus newmani*, *Calanus finmarchicus*, and

Temora longicuris. 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 *Pseudocalanus newmani*, with an estimated carbon contribution of around $5x10^4$ µgC/m^3.

5.3.2.3 Regional Zooplankton Assemblages

Regional data for the first combined nearfield/farfield survey (W9501) showed highest zooplankton densities (around 15,000/m^3) outside of the harbor at station F24 (Figure 5-24), again numerically dominated by copepod adults and nauplii. Other stations were generally less than 10,000/m^3. The numerical dominance by copepods (primarily *Oithona similis* and *Pseudocalanus newmani*, Appendix H) was most pronounced at the boundary station (F27) and the two Cape Cod Bay stations (F01 and F02).

By the early March survey W9502, highest densities were found along the coast (stations F13, western Cape Cod Bay at F01, nearfield station N10, and station F06; Figure 5-25). Maximum densities reached 18,000/m^3. Both polychaete larvae and barnacle nauplii had a greater contribution to the total assemblage than that seen in early February.

During the April combined survey (W9504), increased numerical dominance by copepods (again *Oithona similis* and *Pseudocalanus newmani*) was evident (Figure 5-26), especially outside of Boston Harbor (stations F24, N10). Densities of *Calanus finmarchicus* peaked in eastern Cape Cod Bay during this period, with densities exceeding 2,000/m^3. Densities of the dominant copepods continued to increase into June, as did densities of inshore dominants *Acartia hudsonica* and *Eurytemora herdmani* (Figure 5-27). Maximum densities were seen in the nearfield and at the mouth of the harbor.

5.4 Summary of Water Column Biological Events

- Areal production ranged from approximately 100-900 mgCm^{-2}d^{-1} in the winter, to summer levels of >1000 mgCm^{-2}d^{-1}, then decreasing to 500 mgCm^{-2}d^{-1} during the last summer survey of the semi-annual period;

- The two most significant episodes of production occurred in the nearfield during the spring bloom in late April (N16, 3847 mgCm^{-2}d^{-1}) and at F23 during a nearfield "bloomlet" in June (3634 mgCm^{-2}d^{-1});

- Temporal and spatial patterns of areal production and average chlorophyll *a* concentrations were similar, especially during the pre-stratification period;

- A peak of chlorophyll-specific production in March, corresponding with an increase of zooplankton abundances, indicated rapid photosynthesis and rapid removal (grazing) of chlorophyll in the water column;

- Respiration rates during the winter and early spring surveys (W9501 - W9504) generally were <0.1 μMO_2/hr, except at station F23, where the maximum respiration rate of this period was measured, as was the maximum semi-annual value of POC;

- During the April survey (W9504), bottom water respiration exceeded surface water rates at several stations;

- Elevated carbon-specific respiration measured in April in the nearfield indicated a flux of fresh organic material, providing additional evidence for a productive period in March;

- The semi-annual maximum rate of surface water respiration was measured in late April at station N16 (2.4 μMO_2/hr), followed by an increase in bottom water respiration at both nearfield stations measured in May;

- July was a productive period, potentially related to upwelling, as inferred from carbon-specific respiration data collected during the early and late July surveys.

- Phytoplankton abundances in Cape Cod Bay were highest during the pre-stratified period;

- During the late winter bloom (W9502), eastern Cape Cod Bay experienced a bloom of the small *Gymnodinium* species, while centric diatoms continued to have a large presence in Cape Cod Bay relative to the other regions;

- *Chaetoceros* spp. were the dominant centric diatom, and a small (<20µm) *Gymnodinium* species dominated the dinoflagellate group during the spring bloom, while *Chaetoceros* and *Thalassiosira decipiens* were the dominant carbon producers;

- Overall phytoplankton abundances increased in all regions after mid-May, with the highest densities reported in the harbor during the June farfield survey;

- Microflagellates were the numerically dominant plankton group in both surface and mid-depth samples at each nearfield station.

- During the bloom in June, the dominant carbon contributors were microflagellates, *Rhizosolenia fragilissima*, and *Ceratium longipes*;

- Zooplankton densities in the nearfield generally increased throughout the reporting period, following the trend observed in phytoplankton abundance;

- Zooplankton abundances during the early surveys were evenly distributed among polychaete larvae, copepod adults, and copepod nauplii;

- A late winter (W9503) peak of zooplankton occurred at station N16, coinciding with a drastic reduction in phytoplankton cell densities;

- Zooplankton abundances were low at both stations in early July (W9508), but rebounded by the late July survey;

- *Calanus finmarchicus* was by far the zooplankton dominant species in terms of biomass.

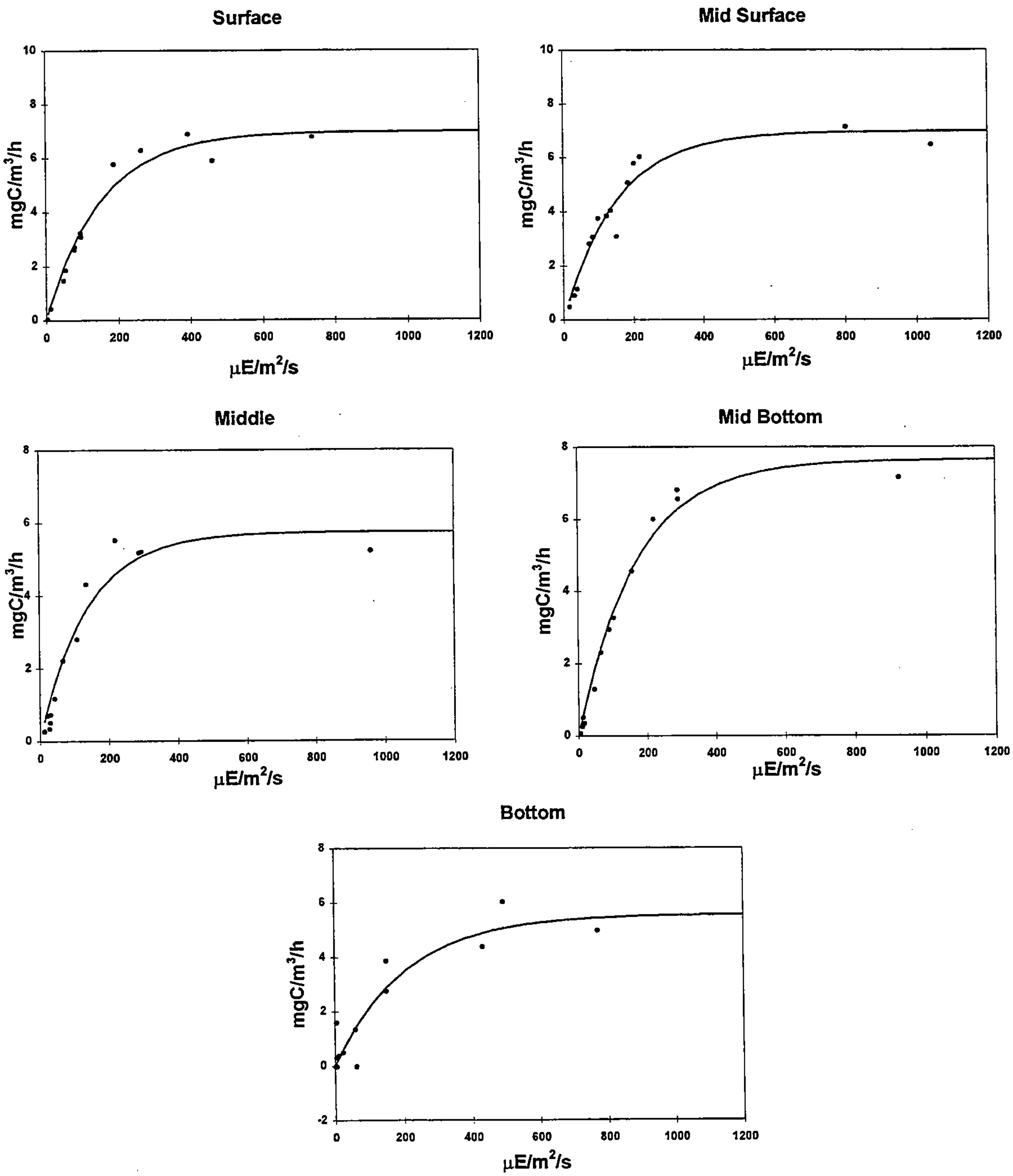
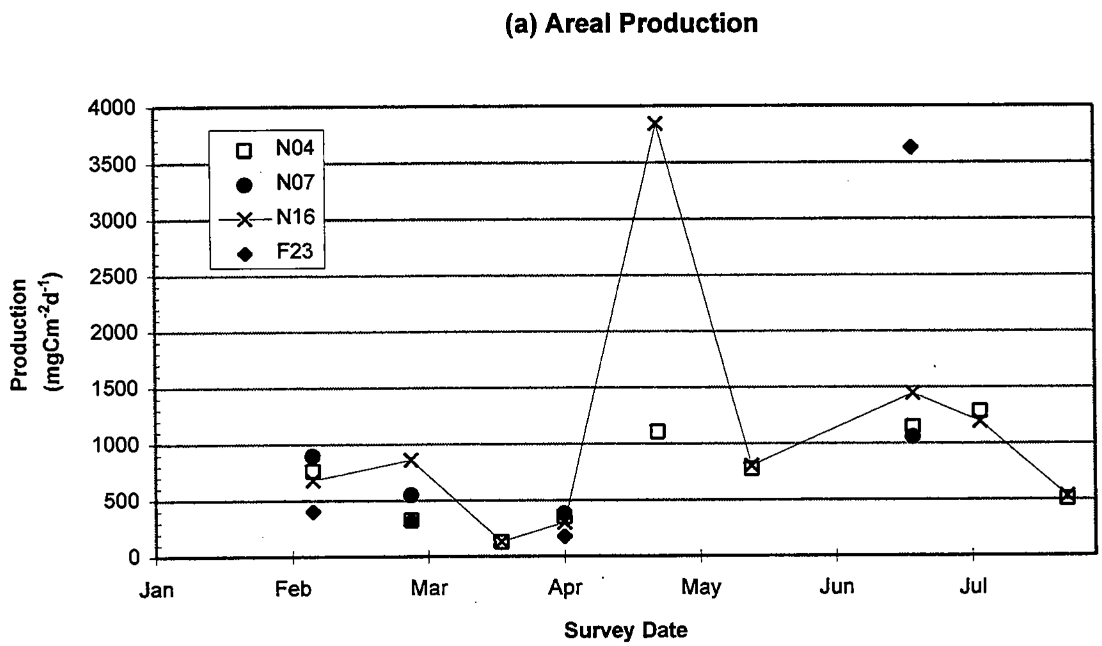


FIGURE 5-1
An Example of a Photosynthesis-Irradiance (P-I) Curve



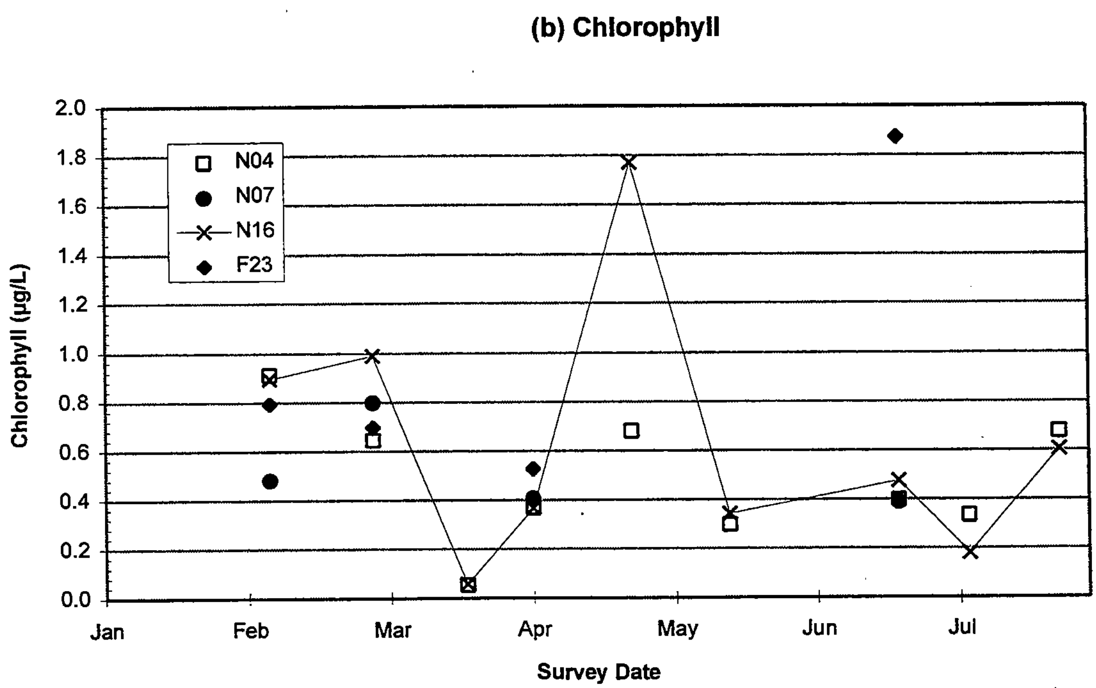


FIGURE 5-2
Time-Series of (a) Areal Production (mgC/m²/d) and (b) Chlorophyll *a* Concentration (µg/L) for Productivity Stations

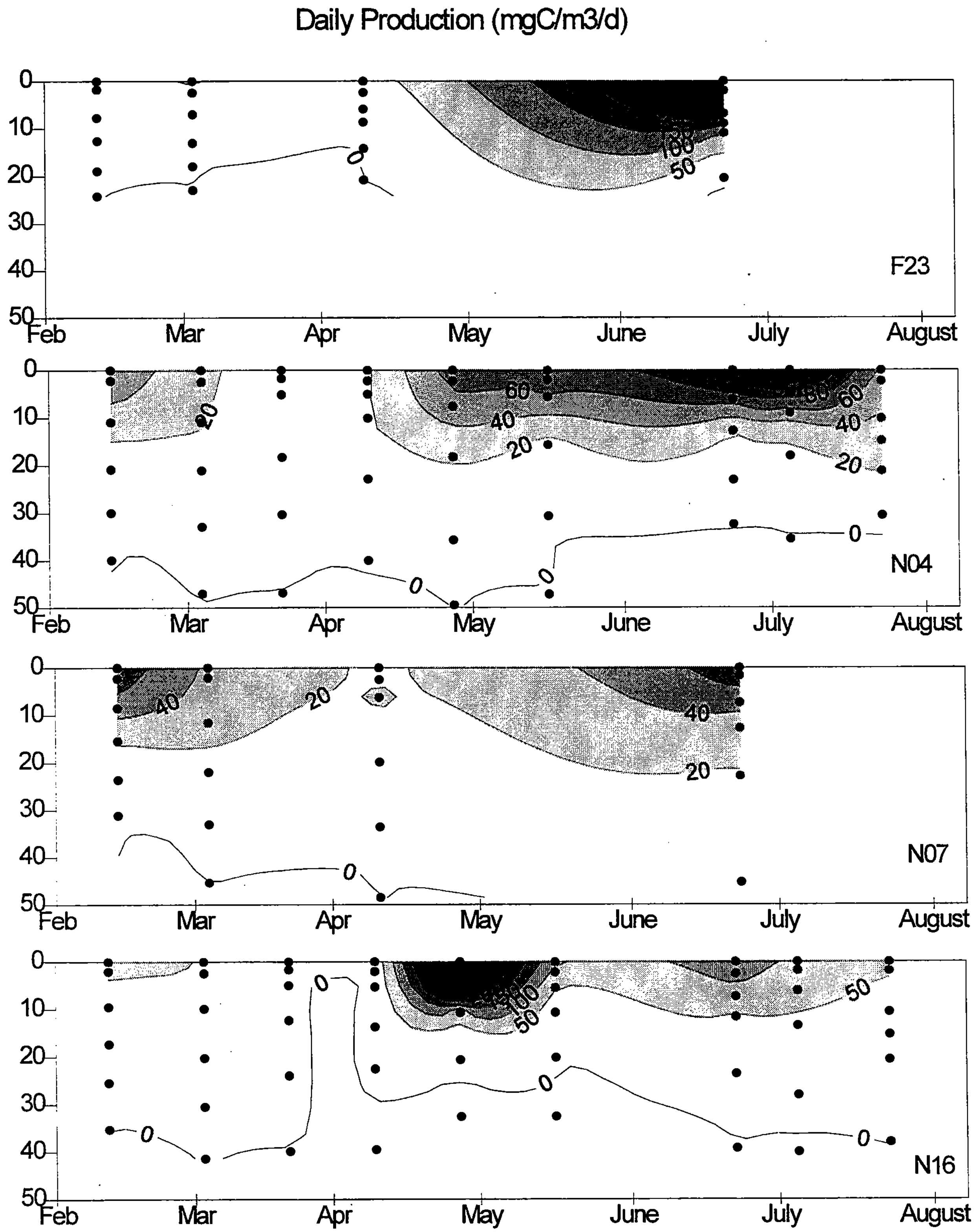


FIGURE 5-3
Time-Series of Contoured Daily Production (mgC/m^3/d) Over Water Depth, Showing Location of Discrete Production Measurements at Productivity Stations

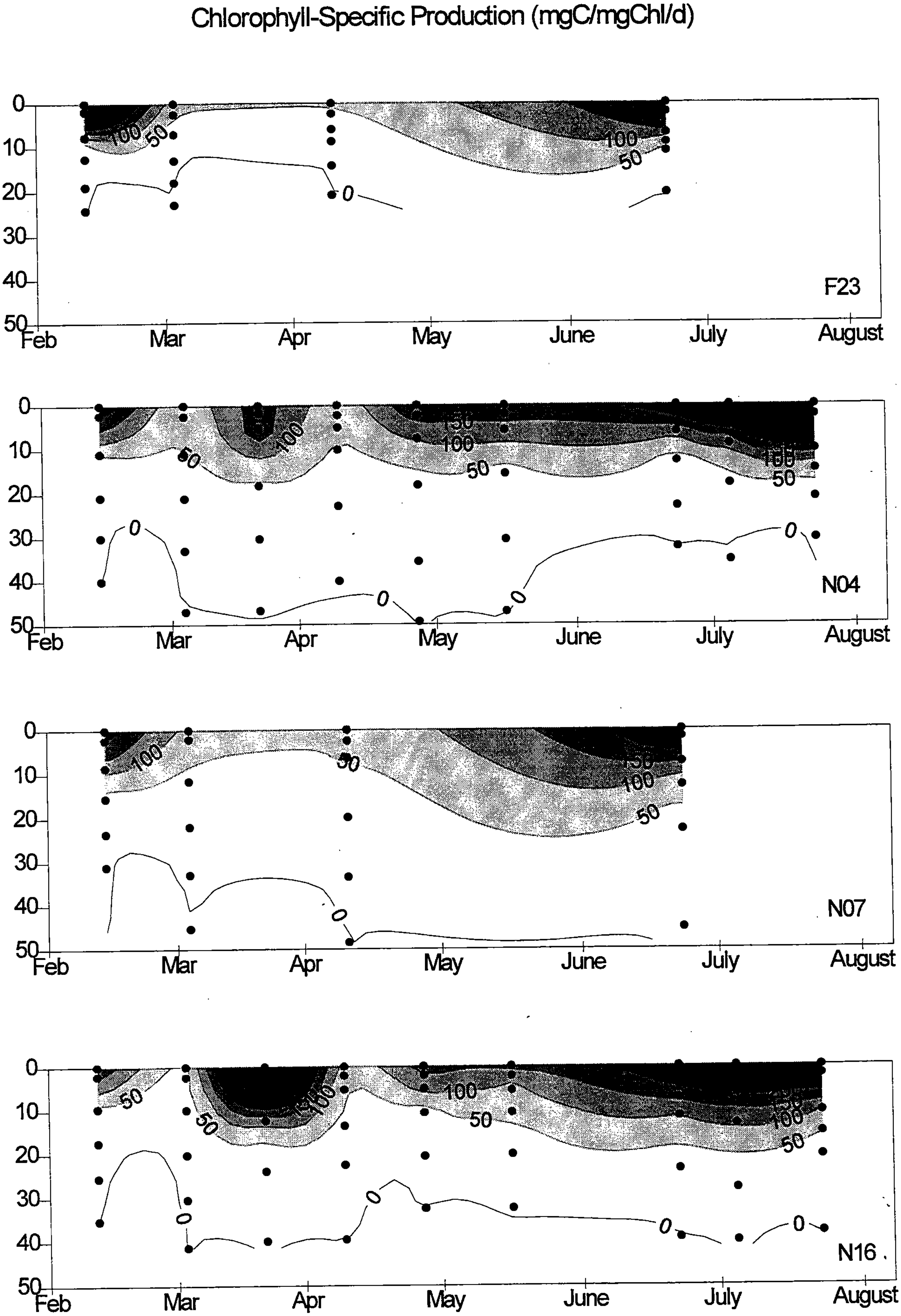
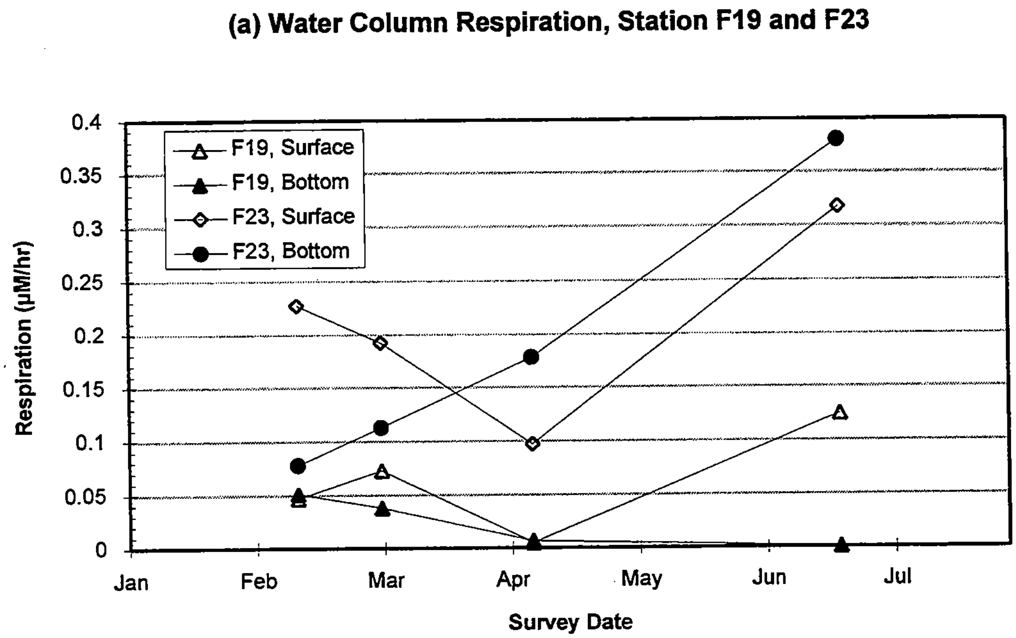


FIGURE 5-4
Time-Series of Contoured Chlorophyll-Specific Production (mgC/mgChl/d) Over Water Depth, Showing Location of Discrete Production Measurements at Productivity Stations



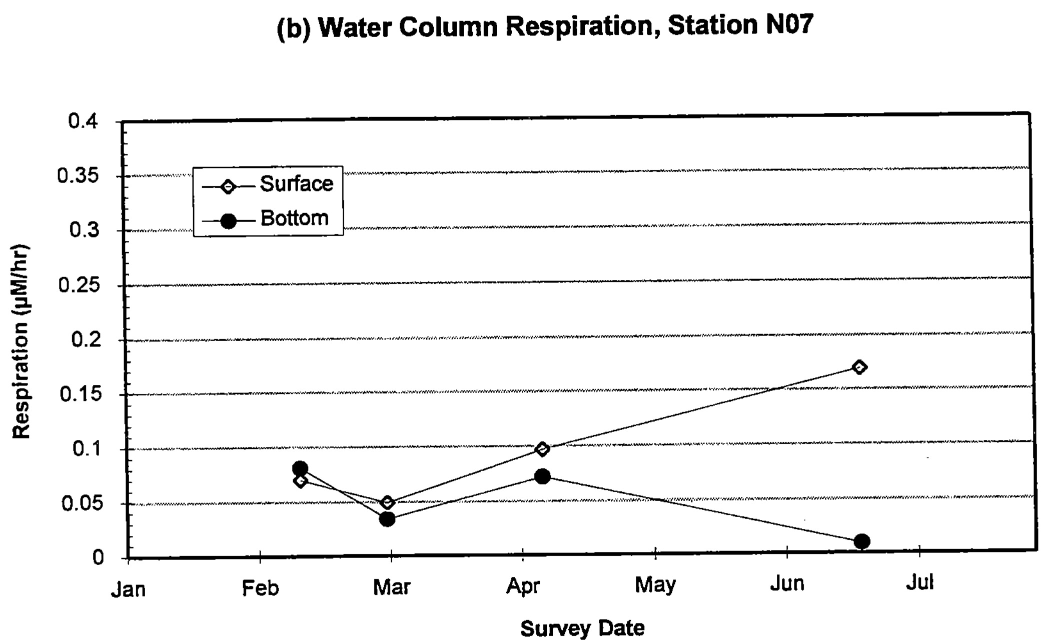


FIGURE 5-5

Time-Series of Water Column Respiration (µM/hr) Measured During Four Farfield Surveys in Surface Symbol (Open Symbols) and Bottom (Closed Symbols) Water for Respiration Stations (a) F19 and F23 and (b) N07

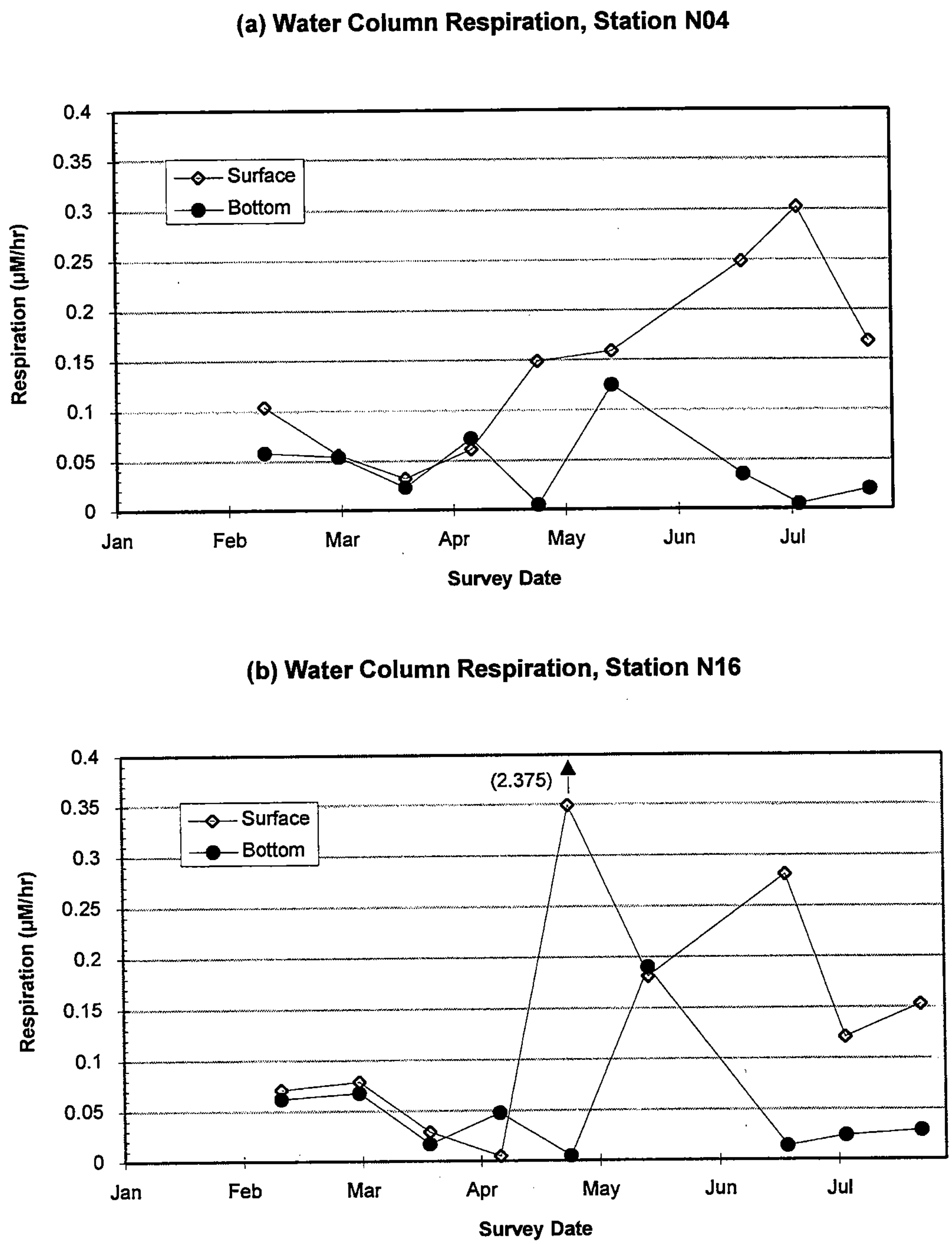
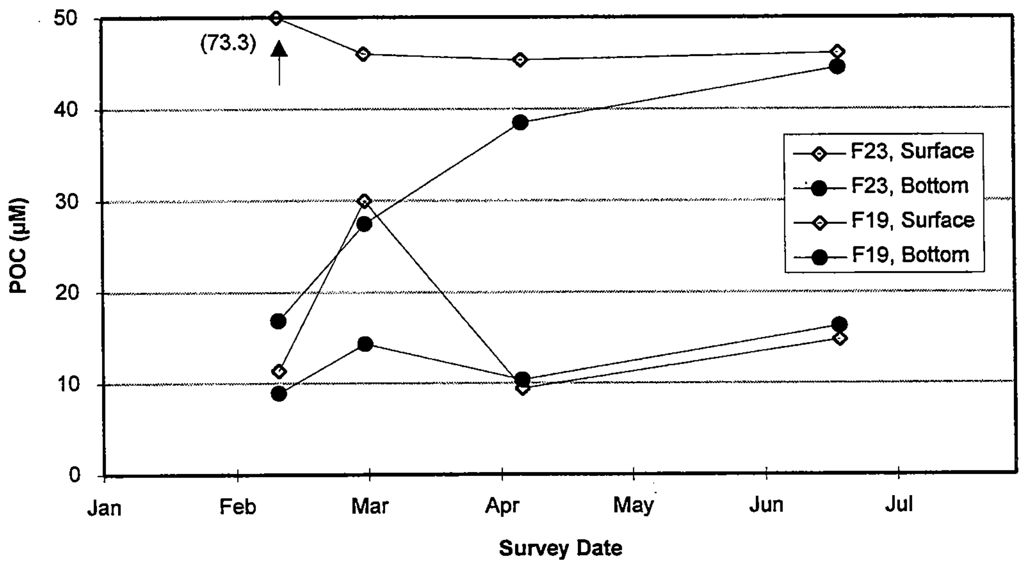


FIGURE 5-6

Time-Series of Water Column Respiration (µM/hr) Measured During Nine Nearfield Surveys in Surface (Open Symbols) and Bottom (Closed Symbols) Water for Respiration Stations (a) N04 and (b) N16

(a) POC, Station F19 and F23



(b) POC, Station N07

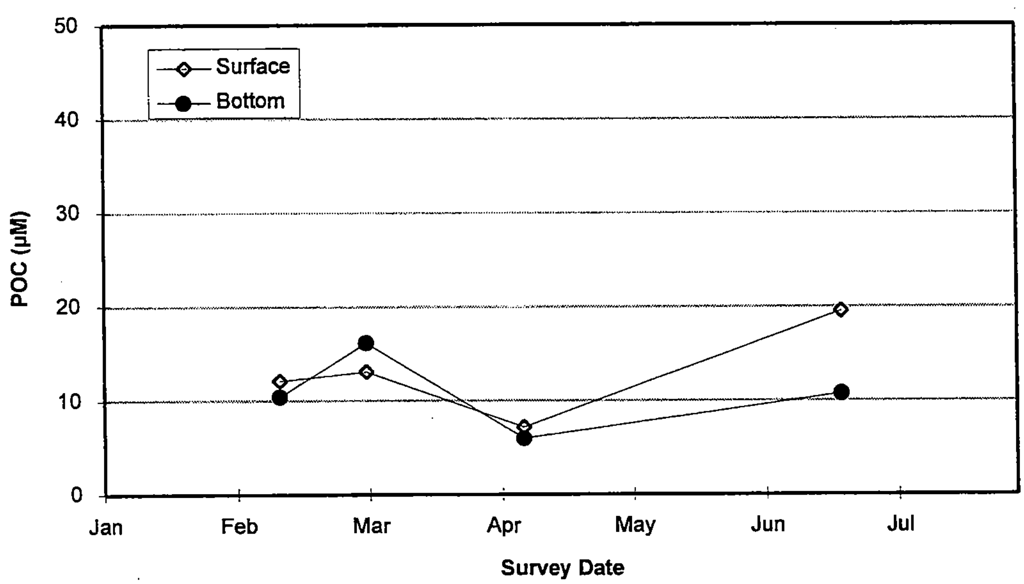
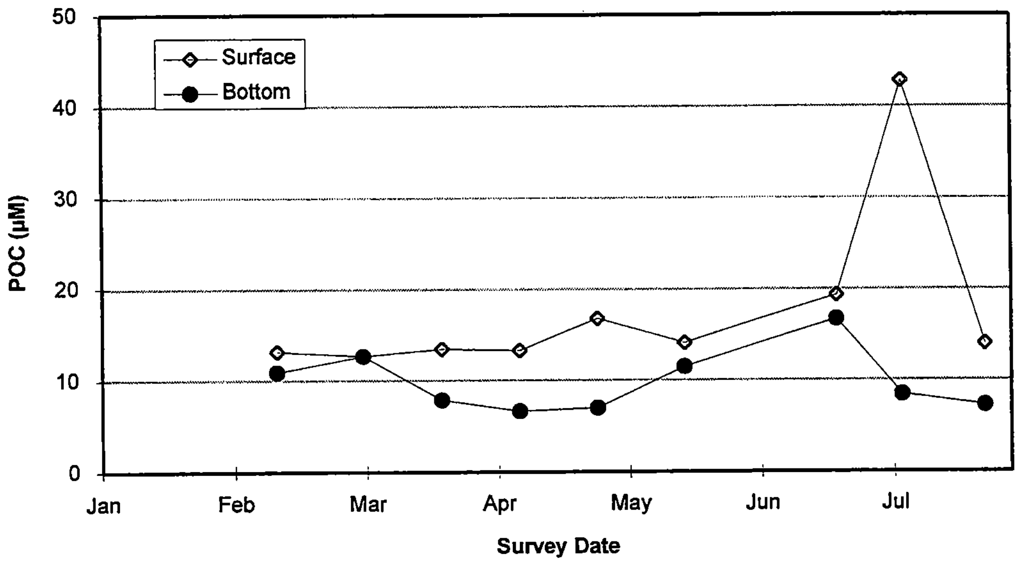


FIGURE 5-7
Time-Series of Water Column Particulate Organic Carbon (POC, µM) Measured During Four Farfield Surveys in Surface (Open Symbols) and Bottom (Closed Symbols) Water for Respiration Stations (a) F19 and F23 and (b) N07

(a) POC, Station N04



(b) POC, Station N16

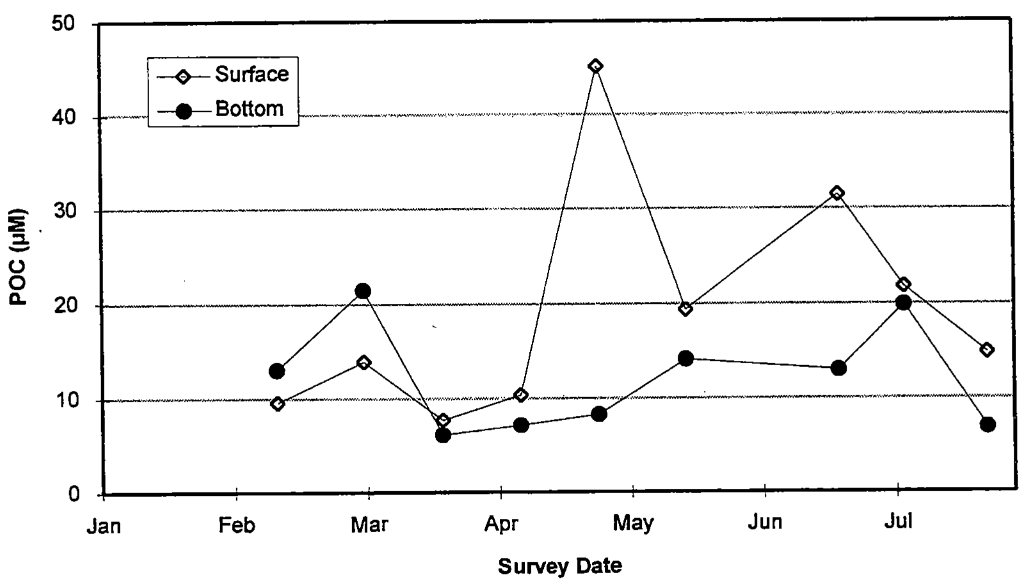


FIGURE 5-8

Time-Series of Water Column Particulate Organic Carbon (POC, µM) Measured During Nine Nearfield Surveys in Surface (open symbols) and Bottom (Closed Symbols) Water for Respiration Stations (a) N04 and (b) N16

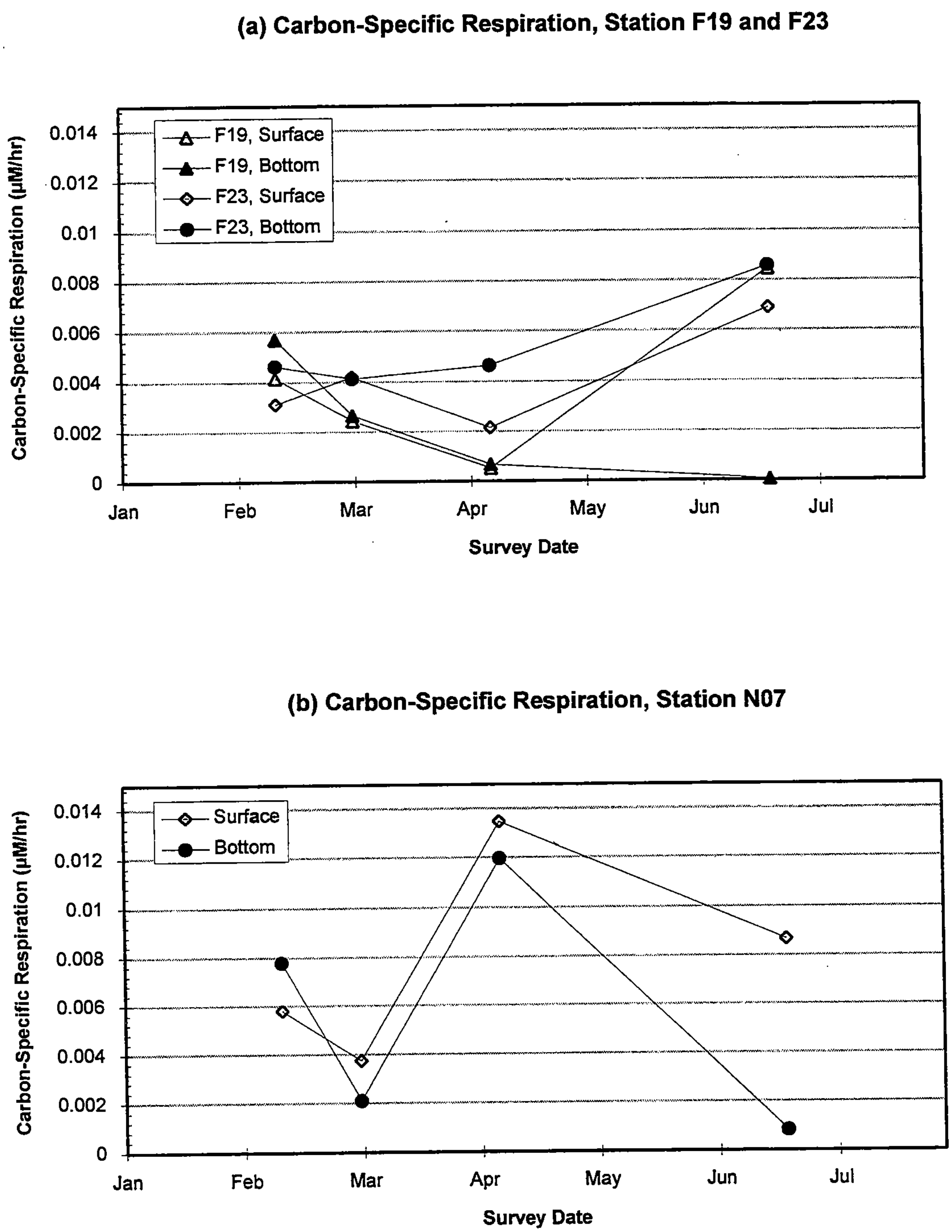
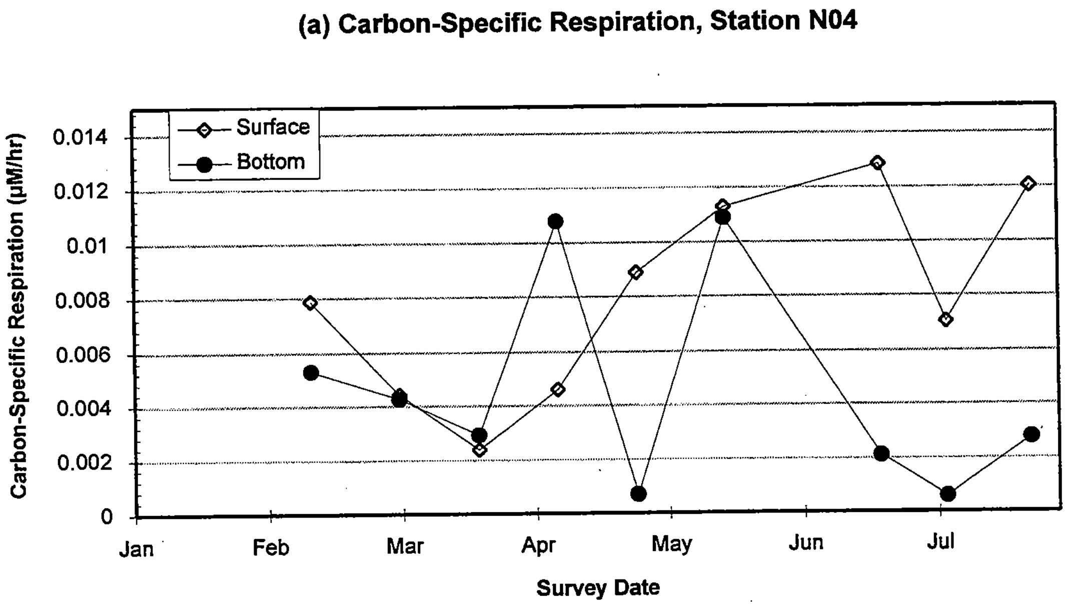


FIGURE 5-9
Time-Series of Carbon-Specific Water Column Respiration (µM/hr) Measured During Four Farfield Surveys in Surface (Open Symbols) and Bottom (Closed Symbols) Water for Respiration Stations (a) F19 and F23 and (b) N07



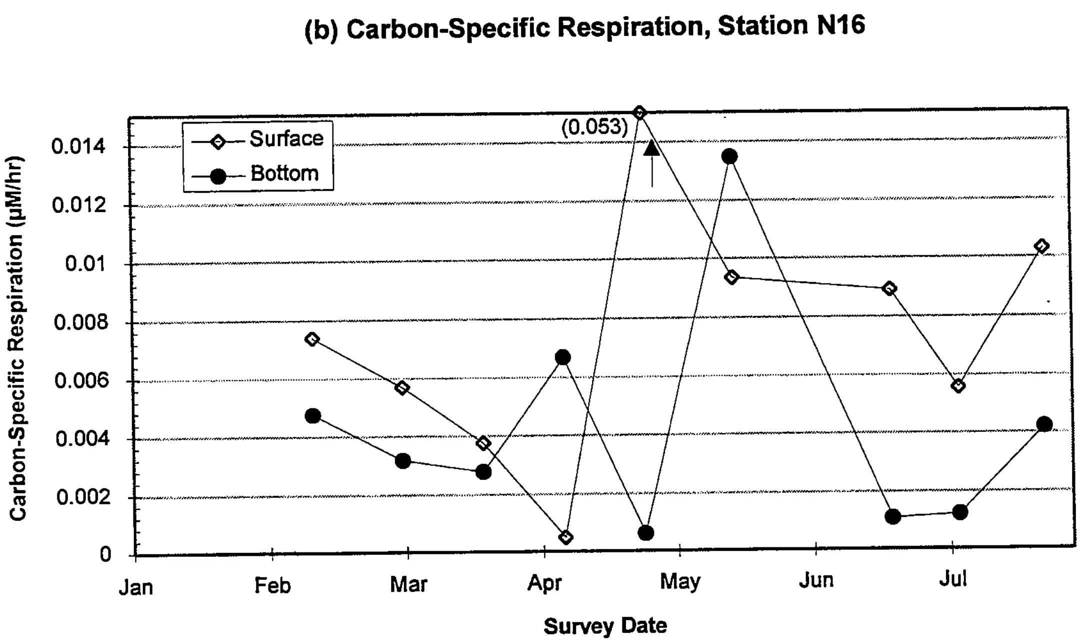


FIGURE 5-10
Time-Series of Carbon-Specific Water Column Respiration (µM/hr) Measured During Nine Nearfield Surveys in Surface (Open Symbols) and Bottom (Closed Symbols) Water for Respiration Stations (a) N04 and (b) N16

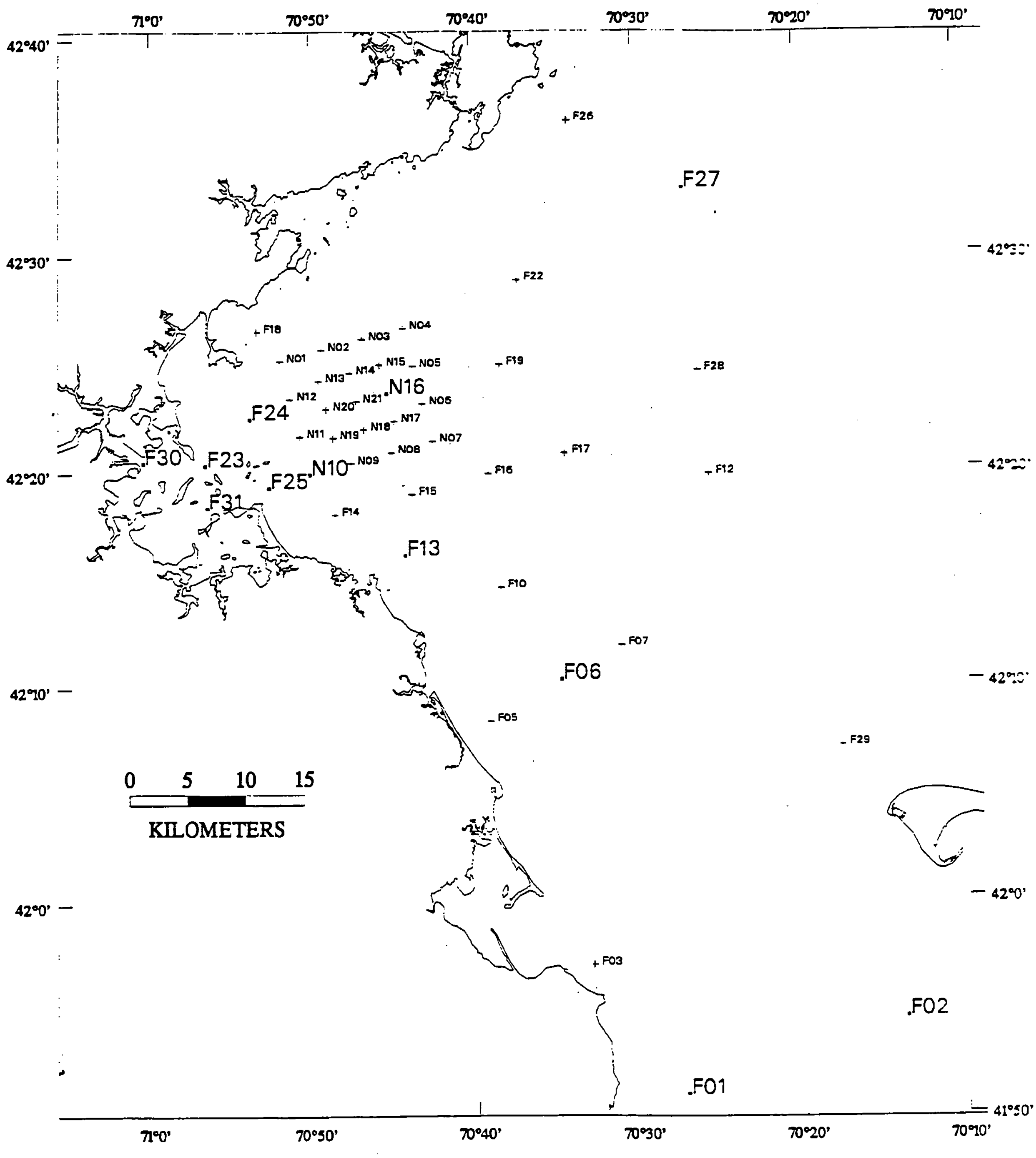


FIGURE 5-11
HOM Plankton Stations Locations (Shown in Enlarged Text)

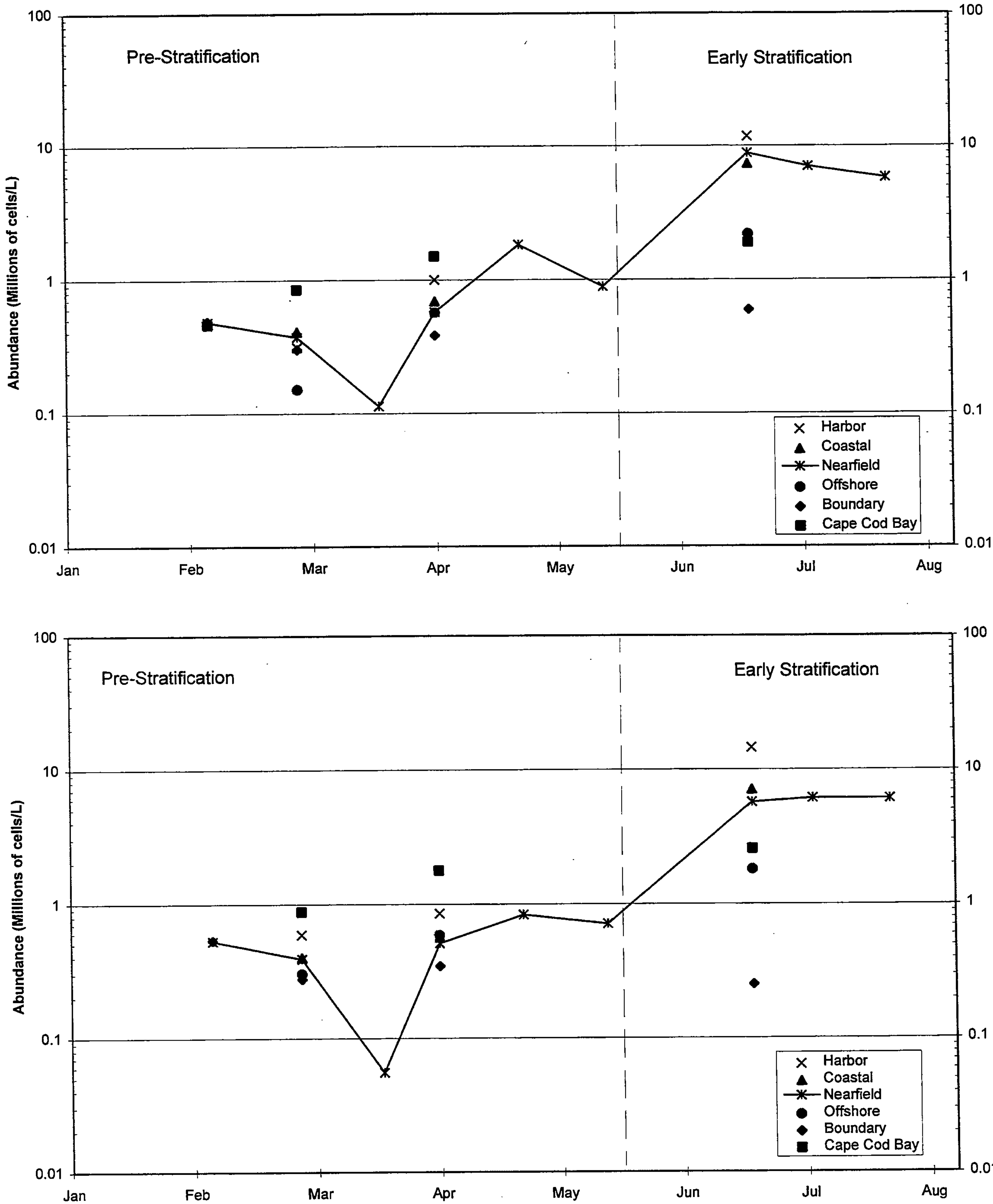


FIGURE 5-12
Regional Total Phytoplankton Abundance During Pre-Stratification and Early Stratification Periods.
Top: Surface Water Data. Bottom: Chlorophyll *a* Maximum Data.

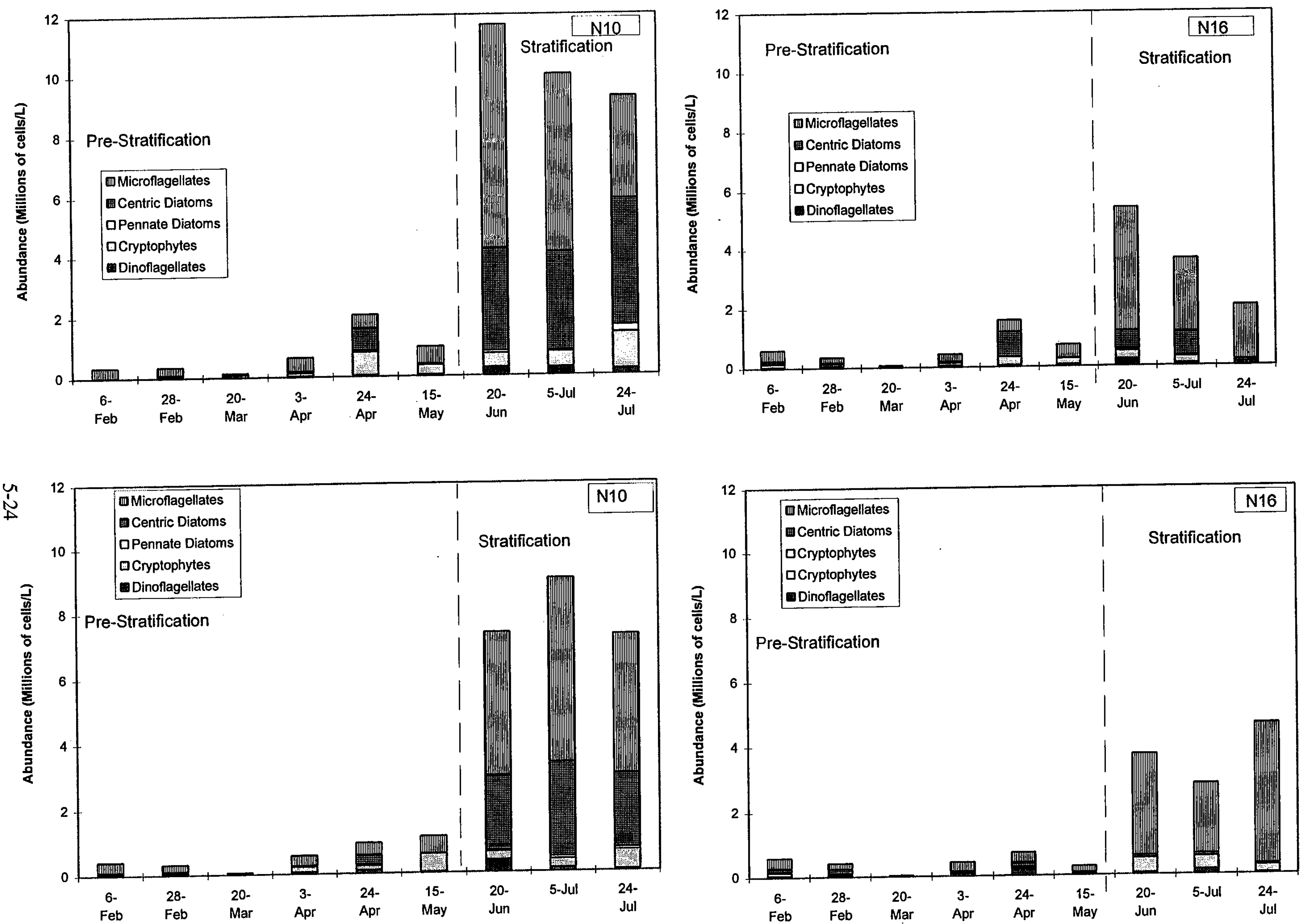


FIGURE 5-13
Distribution of Major Taxonomic Groups Measured During the
Semi-Annual Period at Nearfield Stations N10 and N16.
Top: Surface Water Data. Bottom: Chlorophyll *a* Maximum Data.

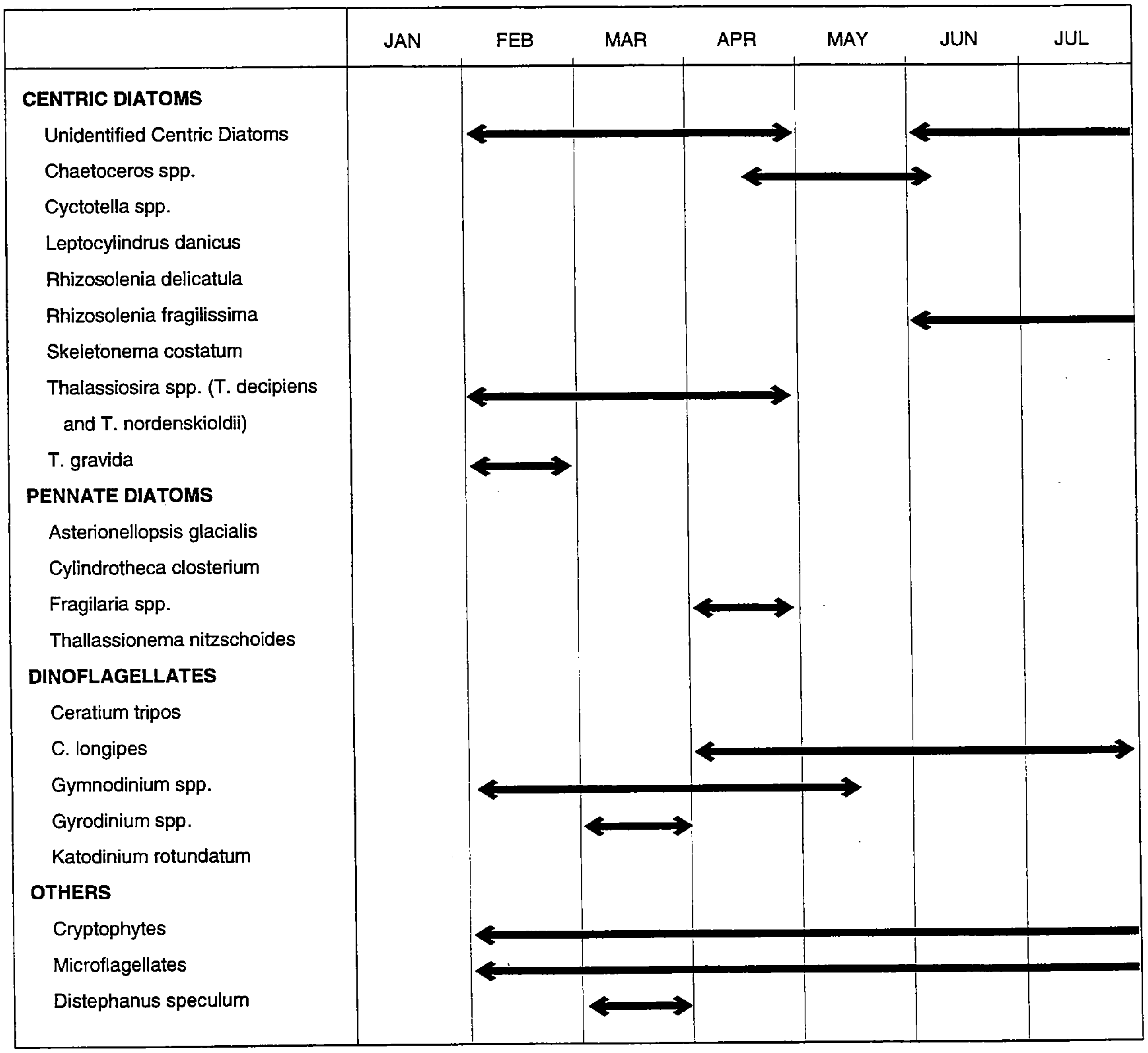
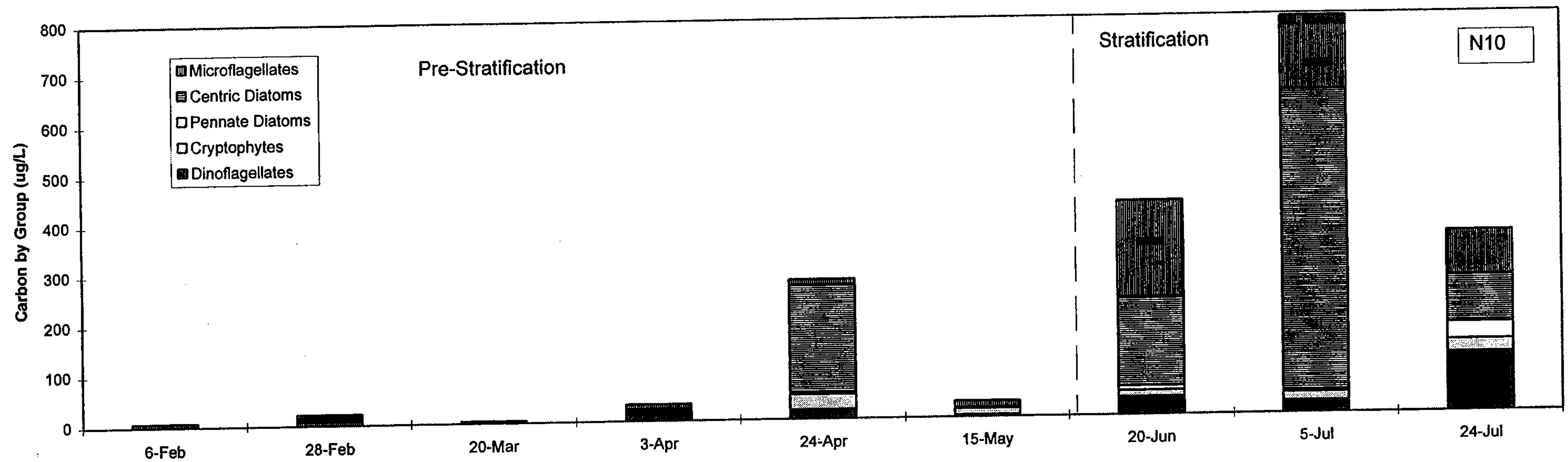


FIGURE 5-14
Dominant Phytoplankton Species by Abundance in the Nearfield



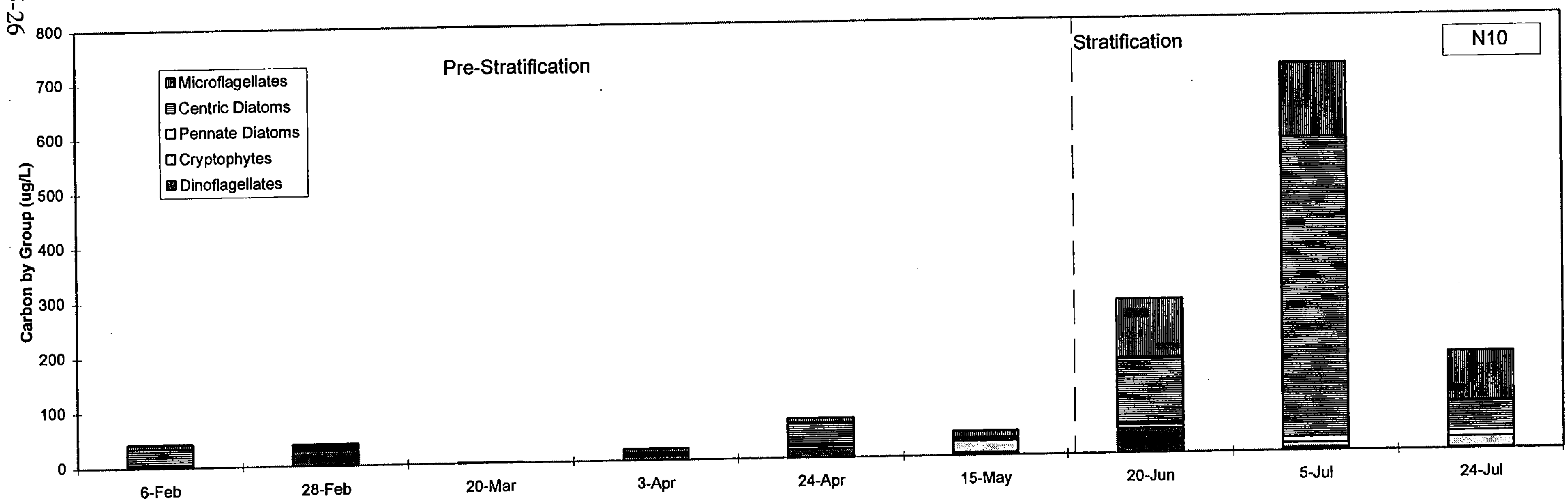


FIGURE 5-15
Distribution of Carbon by Major Taxonomic Groups Identified During the Semi-Annual Period at Nearfield Station N10
Top: Surface Water. Bottom: Chlorophyll *a* Maximum Data

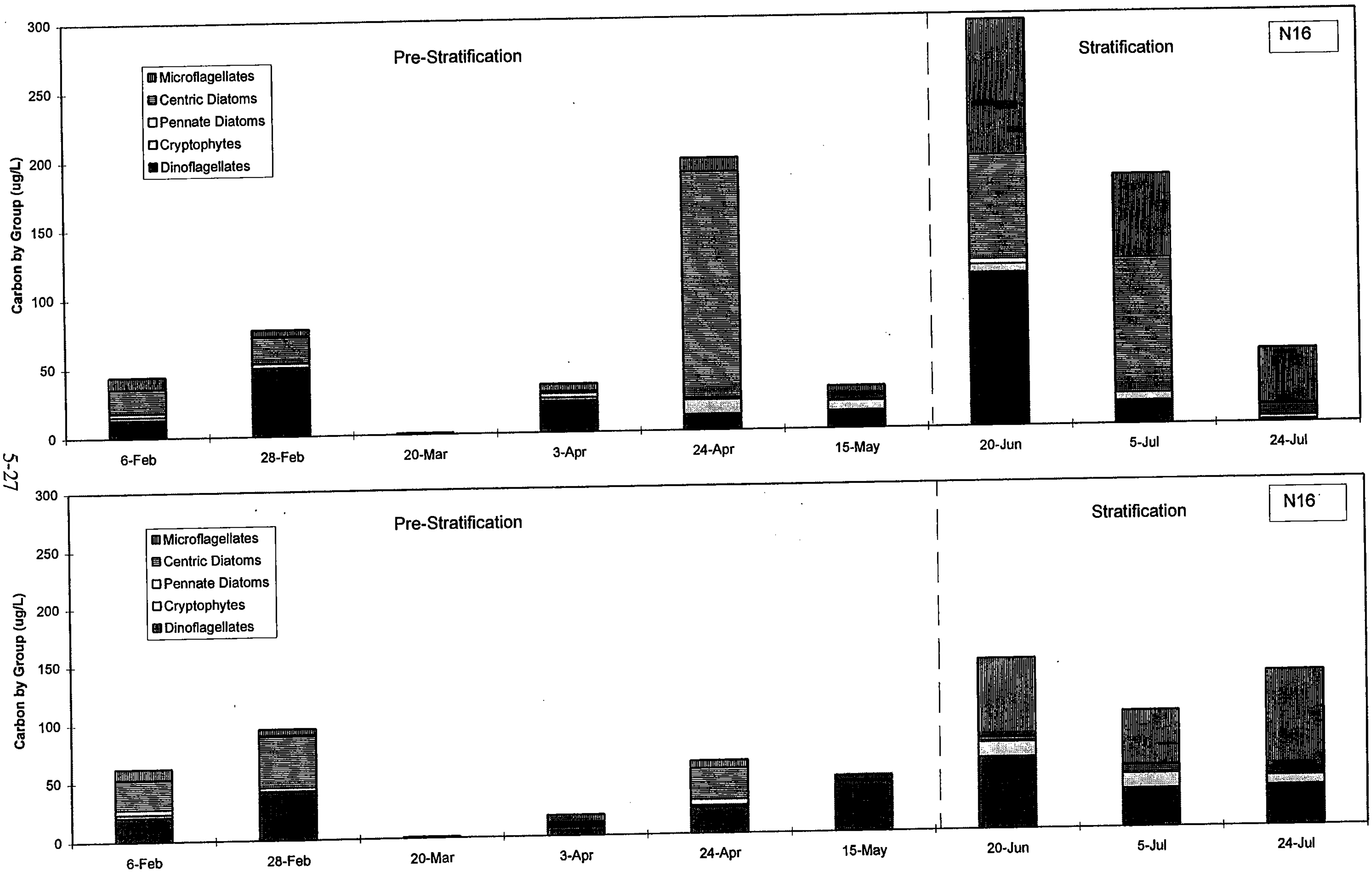


FIGURE 5-16
Distribution of Carbon by Major Taxonomic Groups Identified During the Semi-Annual Period at Nearfield Station N16.
Top: Surface Water. Bottom: Chlorophyll *a* Maximum Data

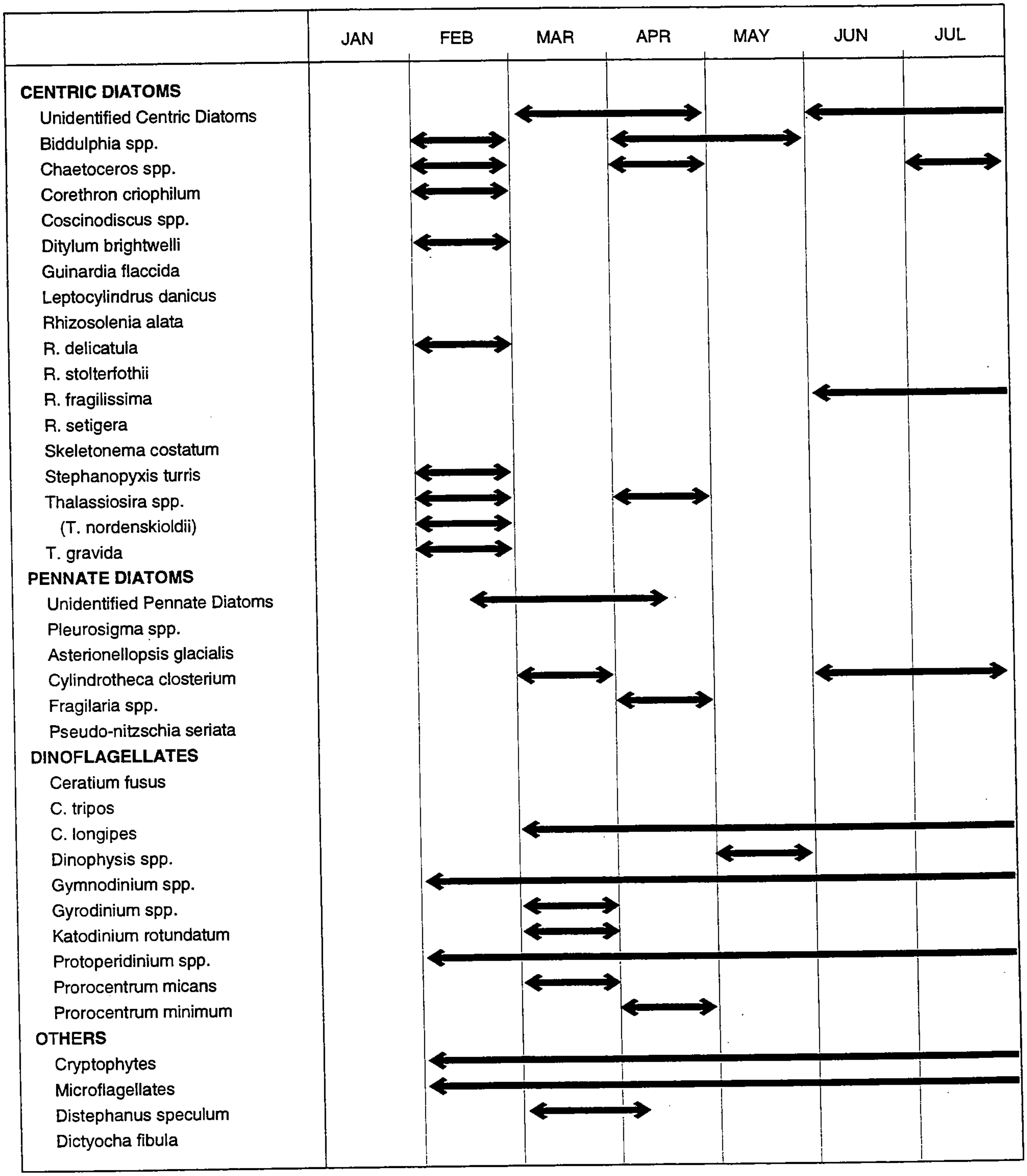
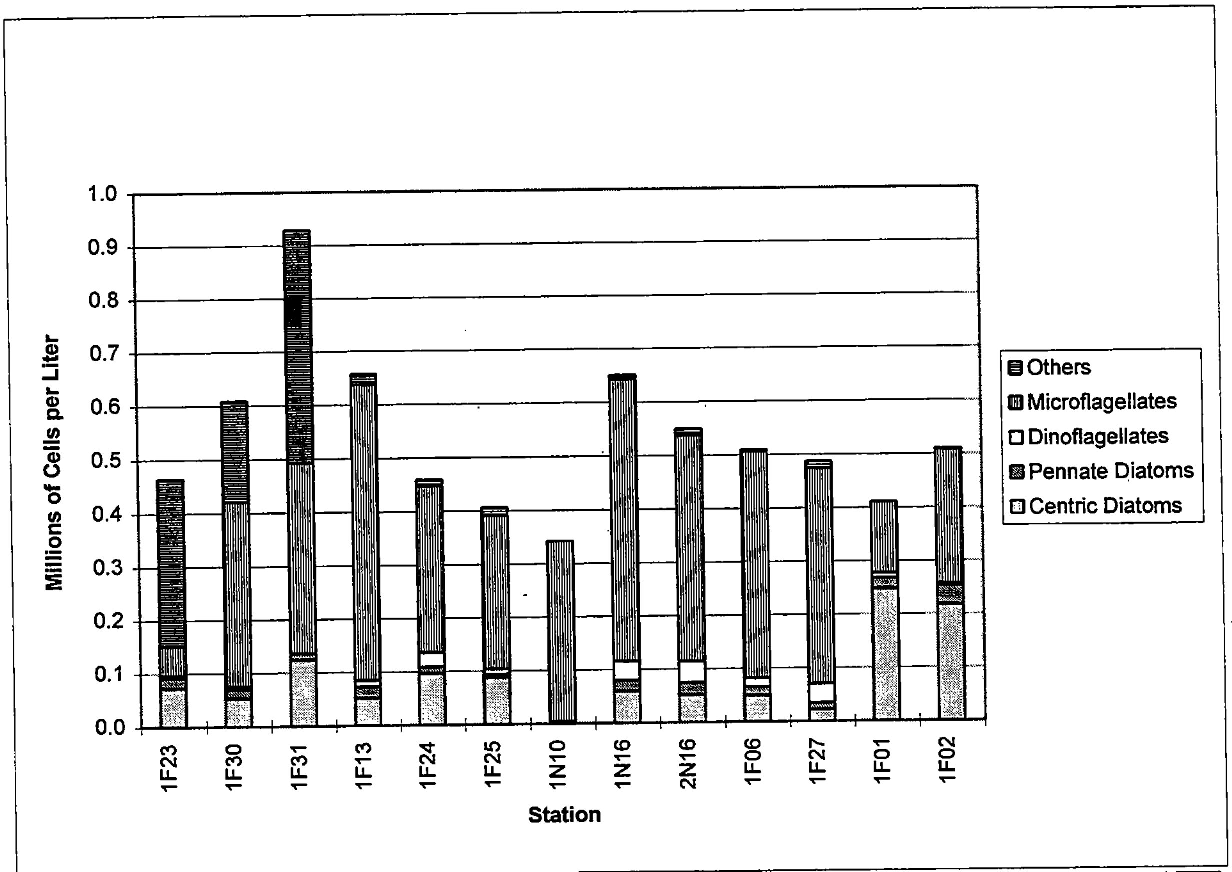


FIGURE 5-17
Dominant Phytoplankton Species by Carbon in the Nearfield



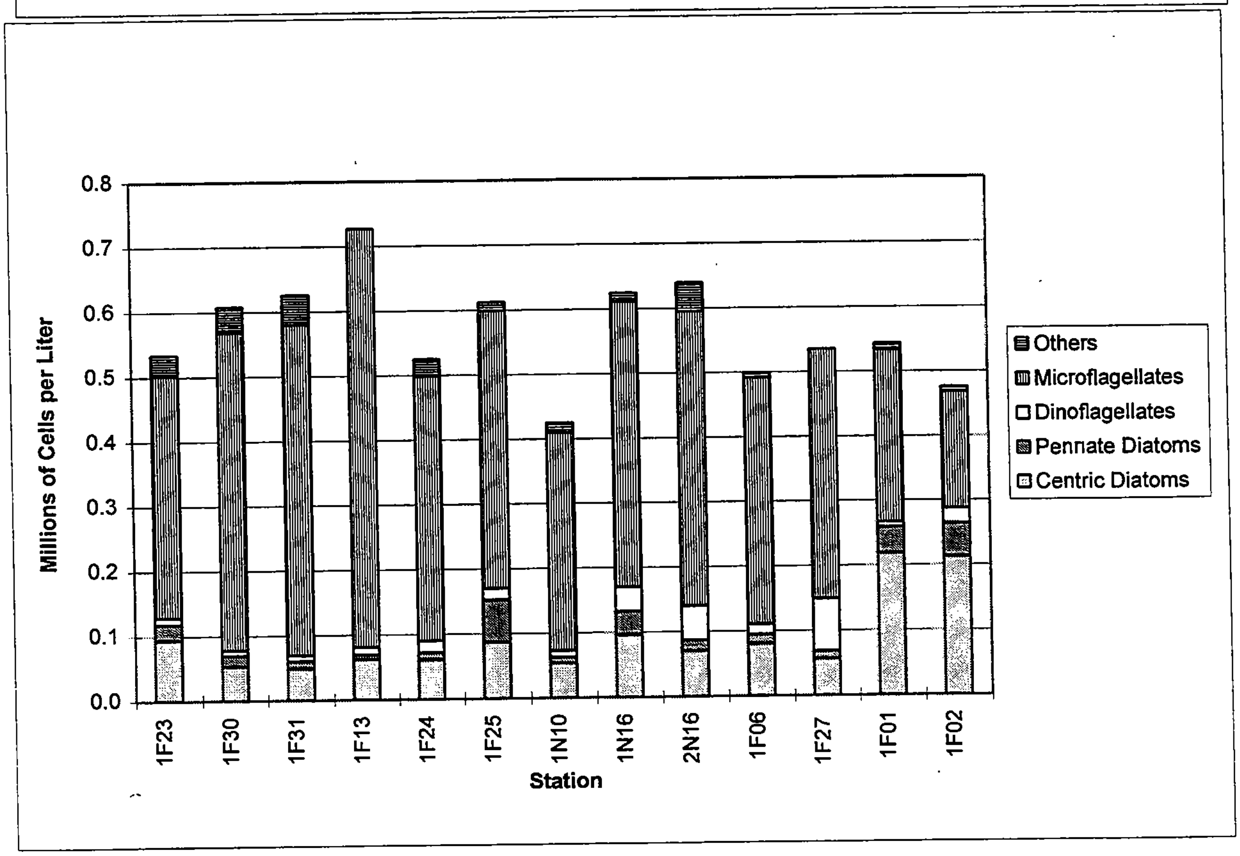
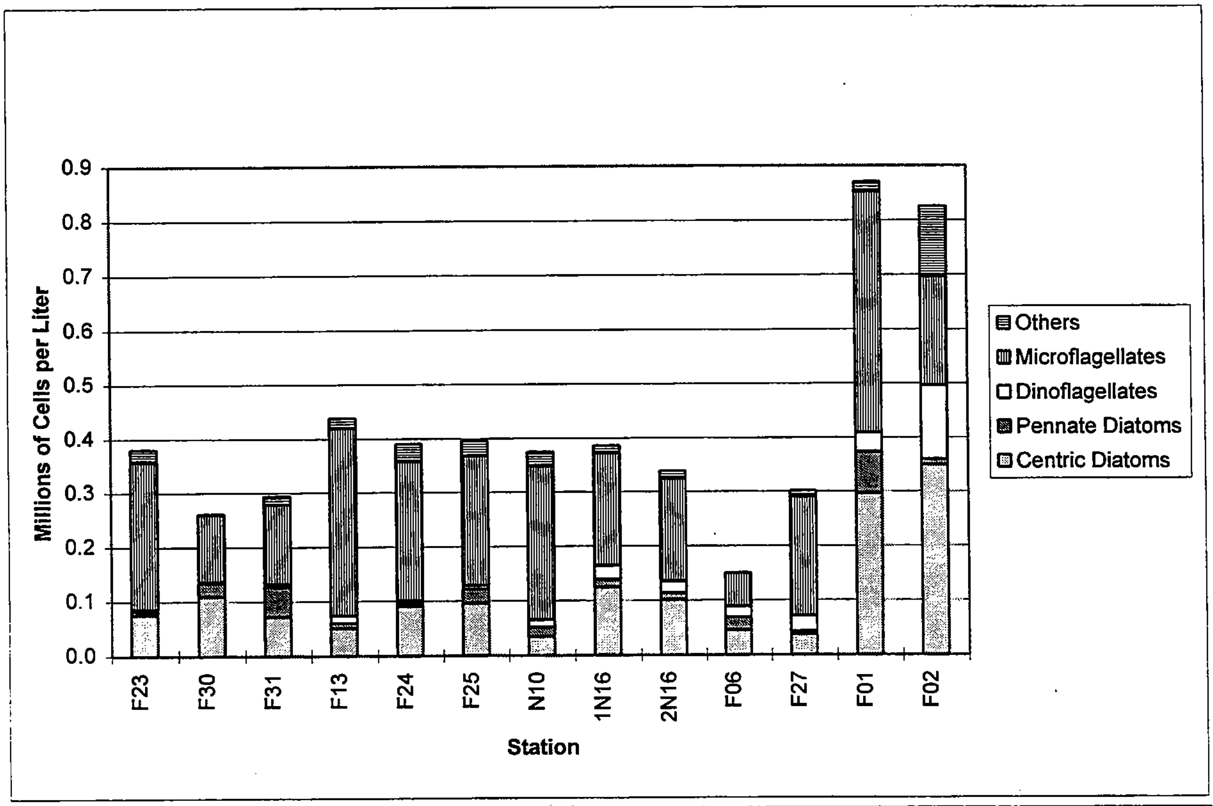


FIGURE 5-18

Total Phytoplankton Abundance by Taxonomic Groups Collected During W9501, February 6-14, 1995.
Top: Surface Water. Bottom: Chlorophyll *a* Maximum Data.



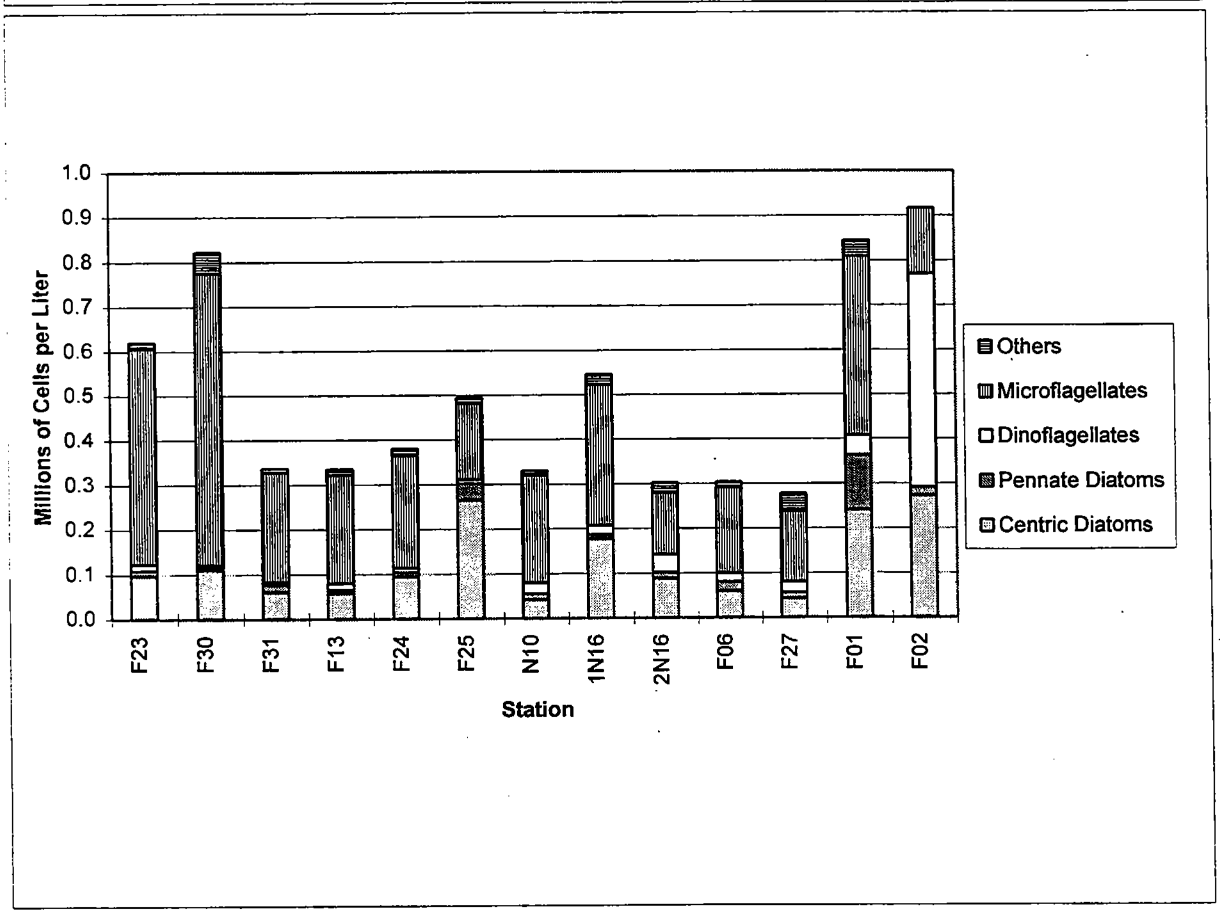
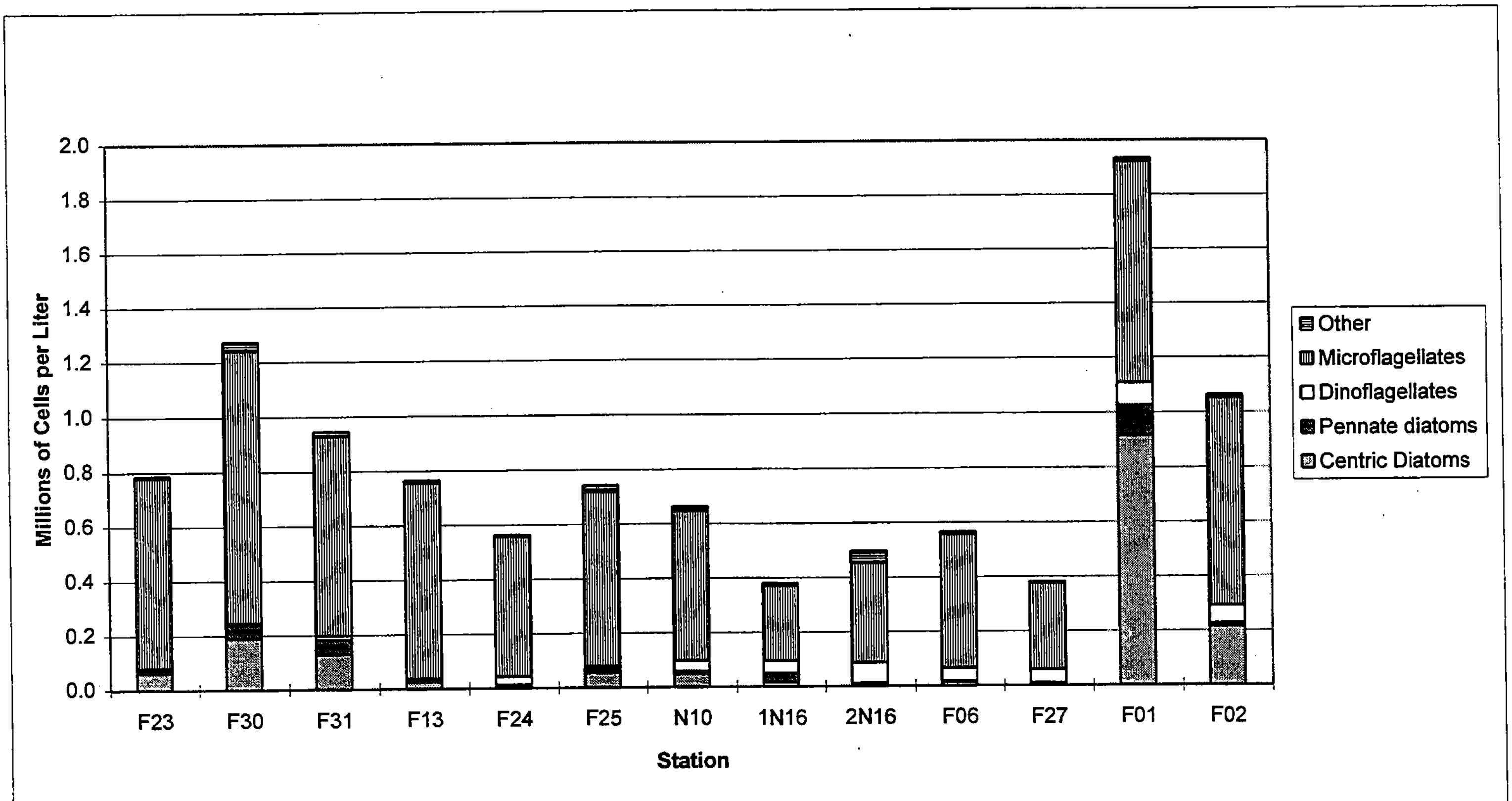


FIGURE 5-19

Total Phytoplankton Abundance by Taxonomic Groups Collected During W9502, February 28 - March 5, 1995, Top: Surface Water. Bottom: Chlorophyll *a* Maximum Data



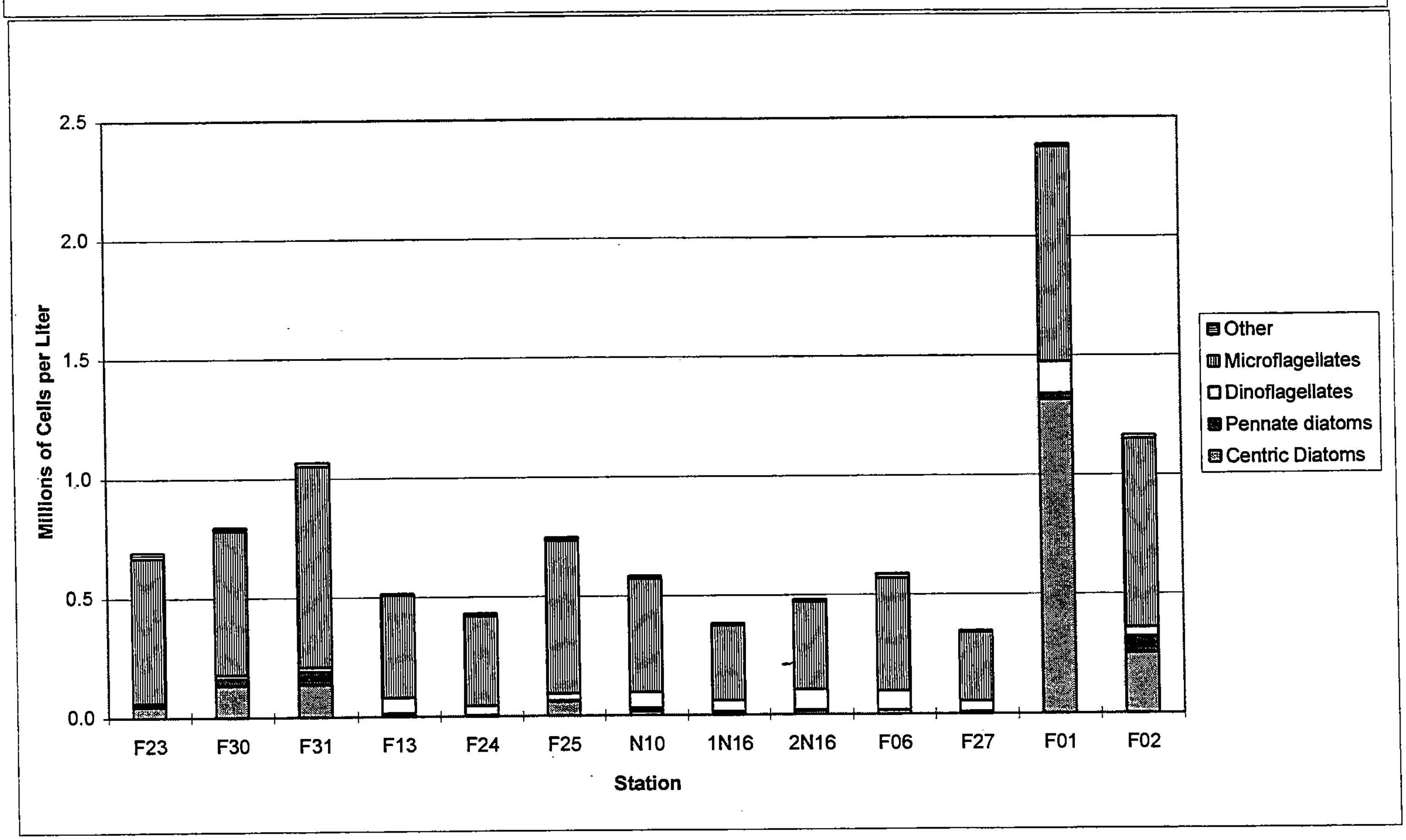
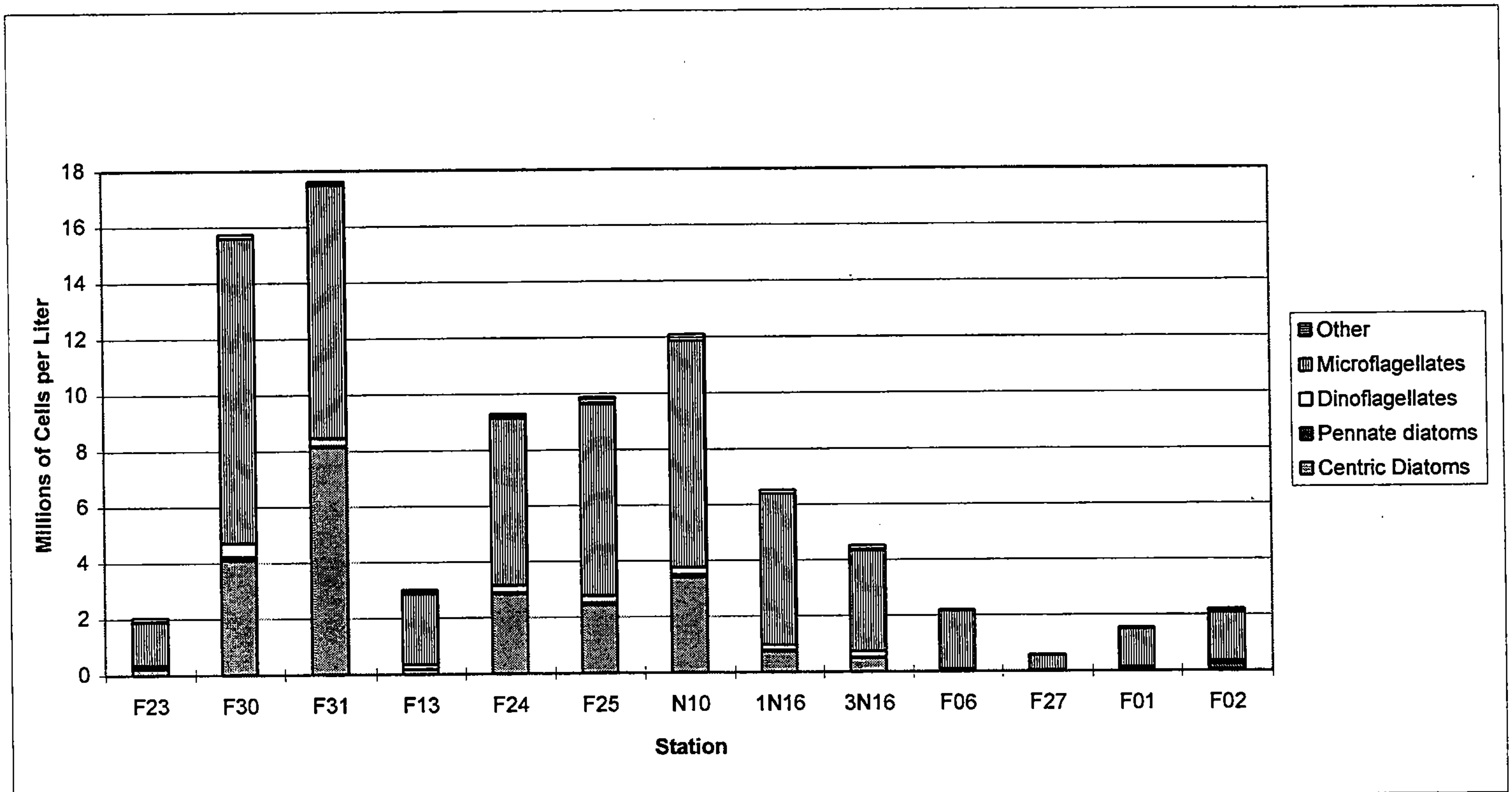


FIGURE 5-20

Total Phytoplankton Abundance by Taxonomic Groups Collected During W9504, April 3-10, 1995

Top: Surface Water. Bottom: Chlorophyll *a* Maximum Data.



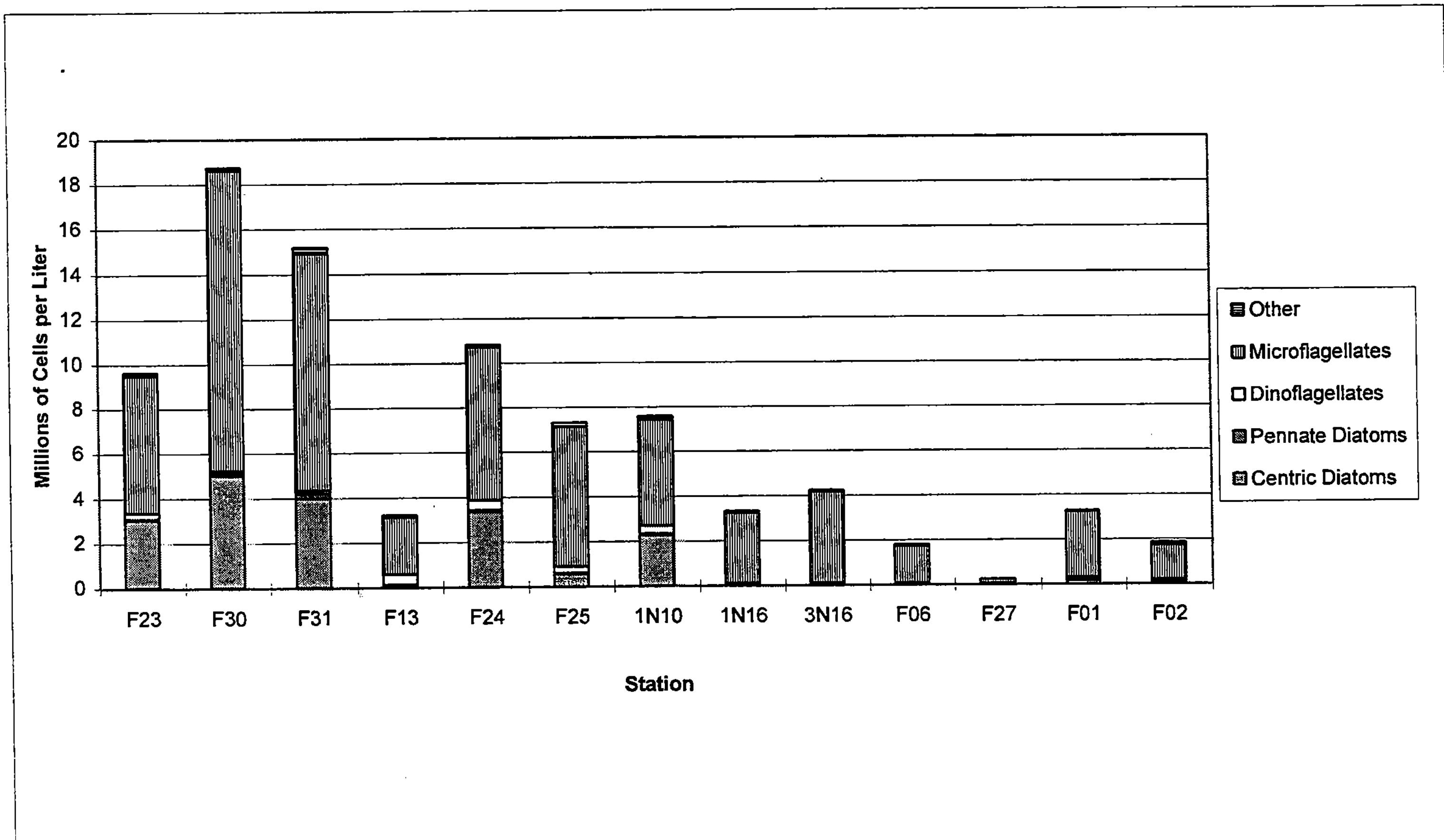


FIGURE 5-21
Total Phytoplankton Abundance by Taxonomic Groups Collected During W9507, June 20-25, 1995
Top: Surface Water. Bottom: Chlorophyll *a* Maximum Data.

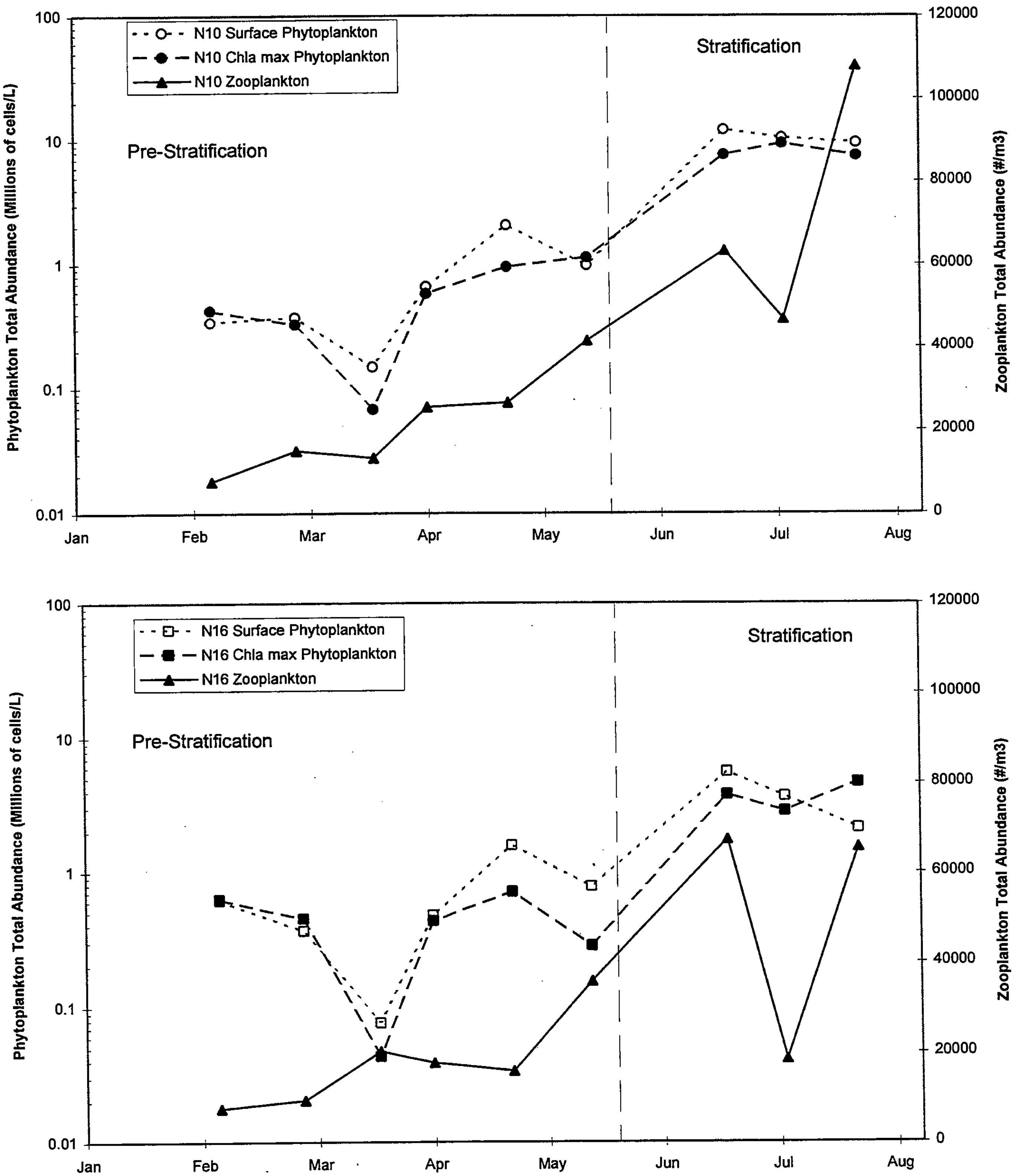


FIGURE 5-22

- Phytoplankton and Zooplankton Semi-Annual Cycles During Pre-Stratification and Early Stratification Periods
Top: Nearfield station N10. Bottom: Nearfield Station N16.

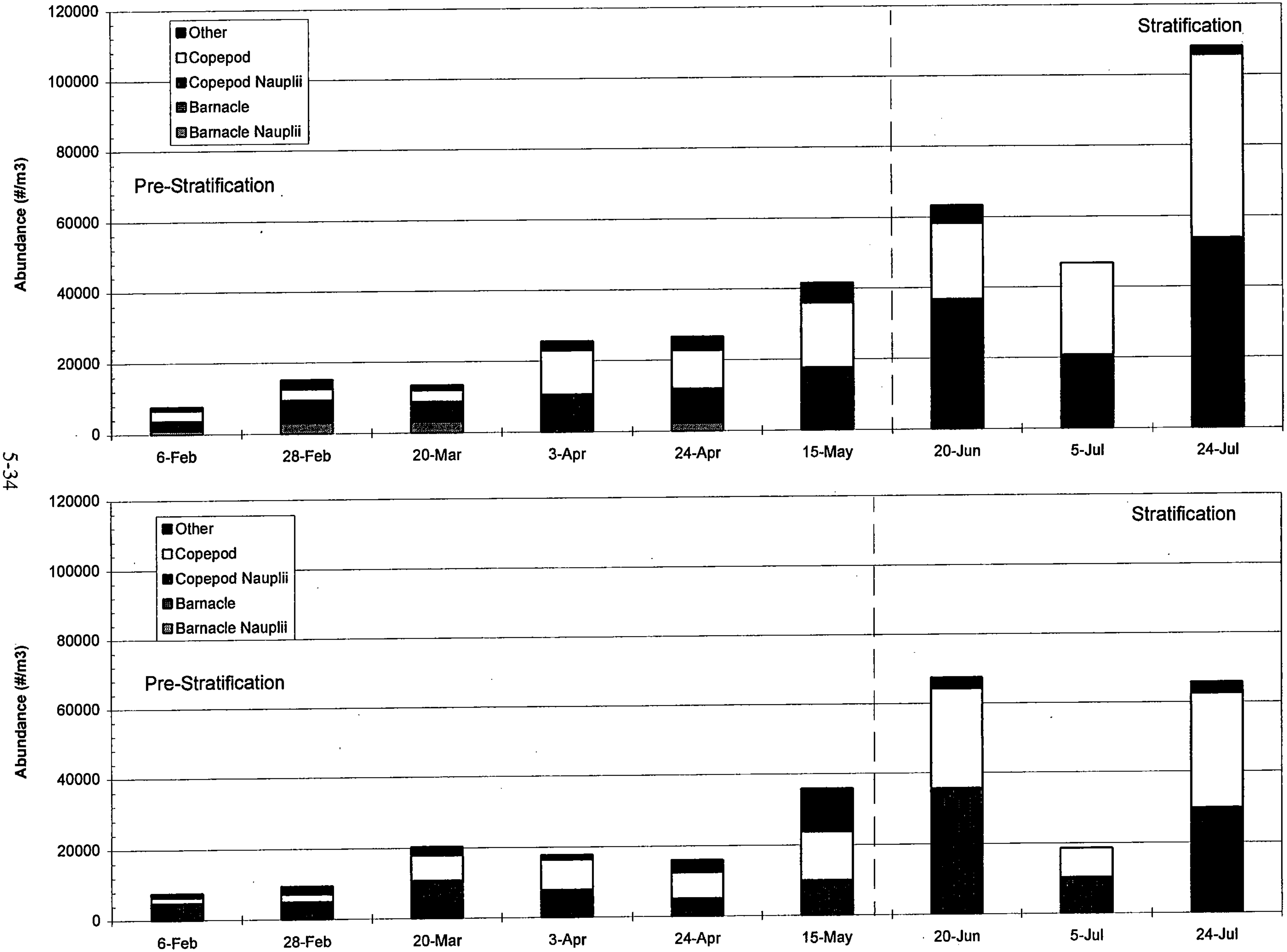


FIGURE 5-23
Total Zooplankton Abundance by Group in Surface Water During Pre-Stratification and Early Stratification Periods
Top: Nearfield Station N10. Bottom: Nearfield Station N16.

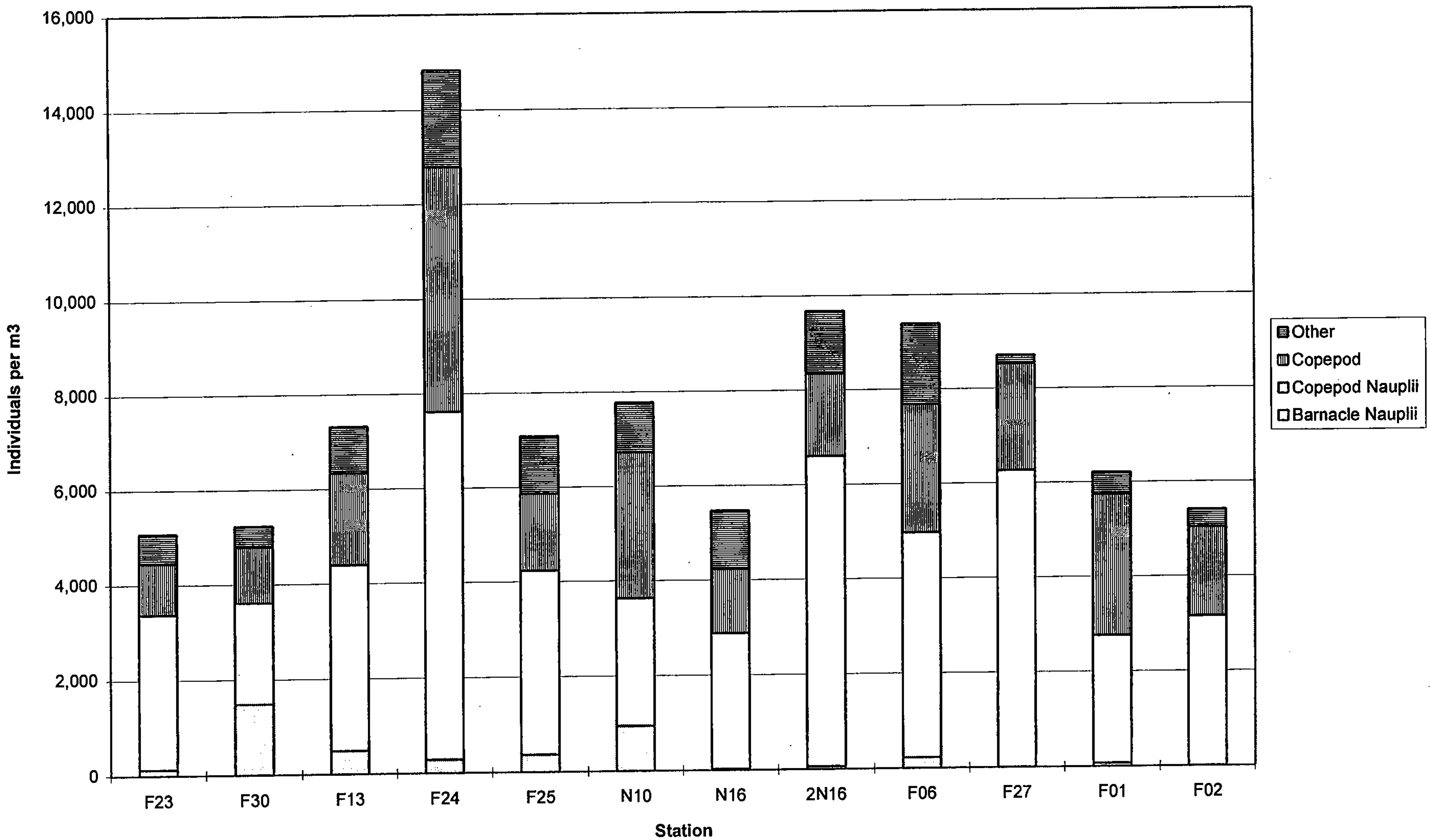


FIGURE 5-24
Zooplankton Abundance by Groups Collected During W9501, February 6-14, 1995

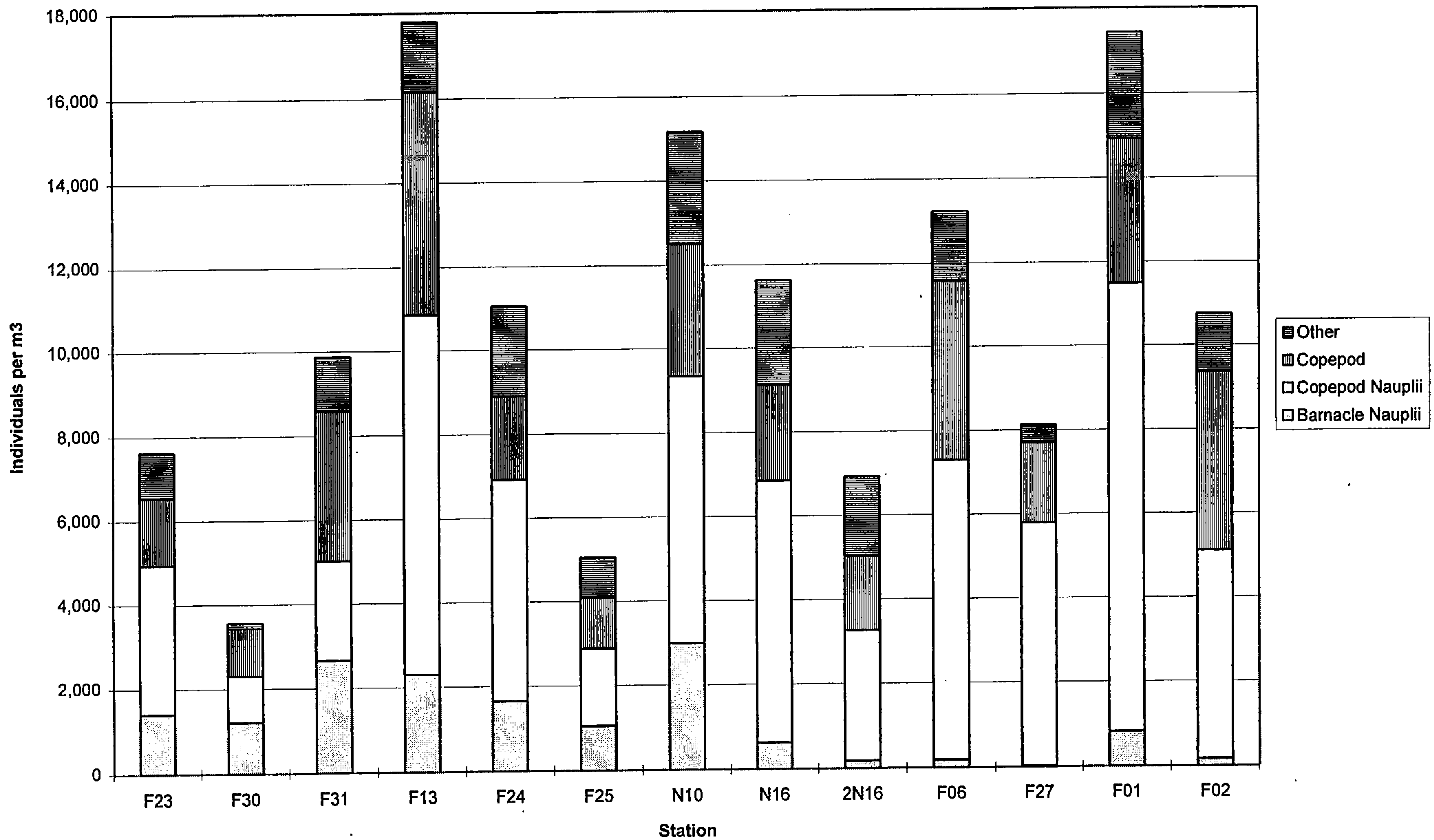


FIGURE 5-25
Zooplankton Abundance by Groups Collected During W9502, February 28 - March 5, 1995

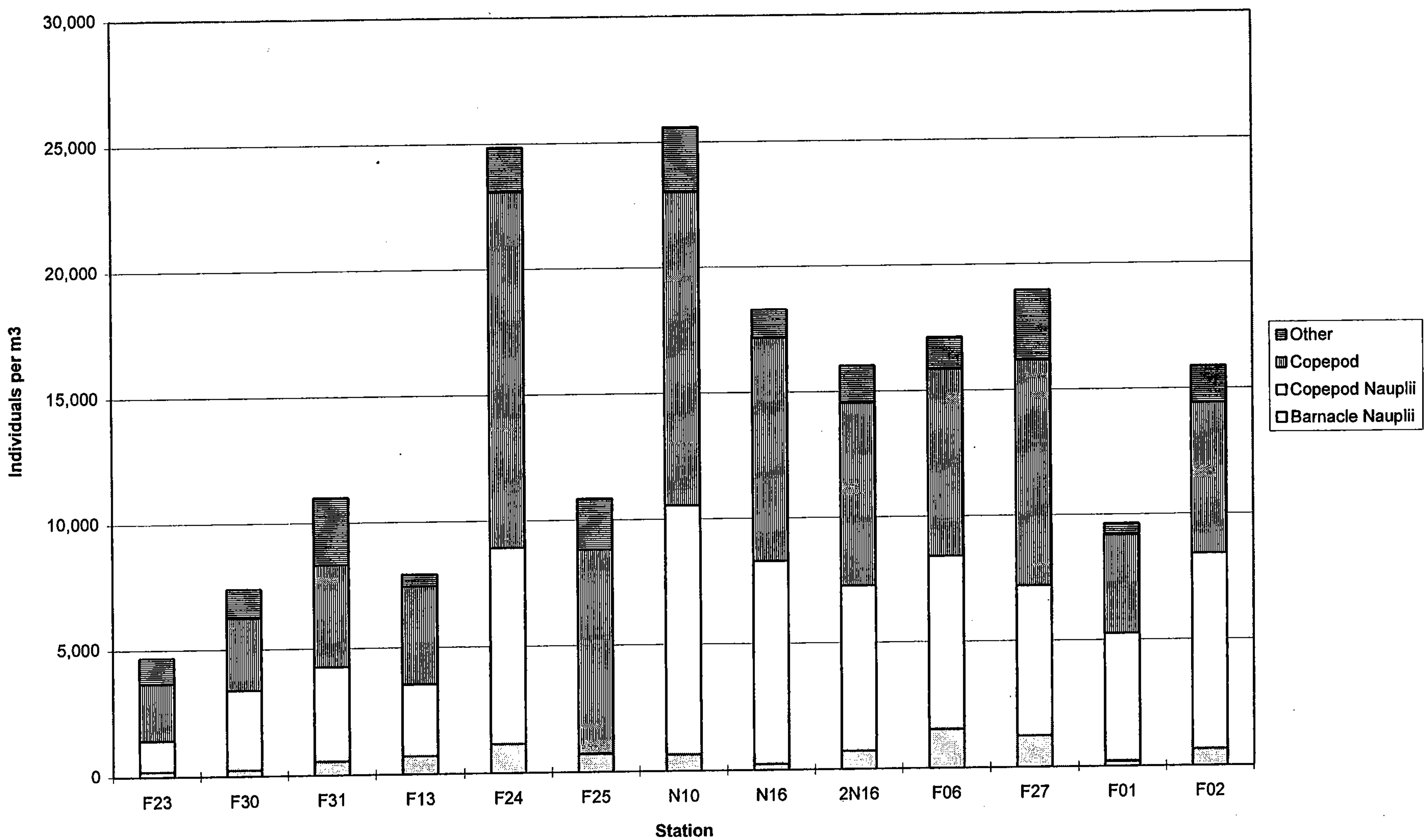


FIGURE 5-26
Zooplankton Abundance by Groups Collected During W9504, April 3-10, 1995

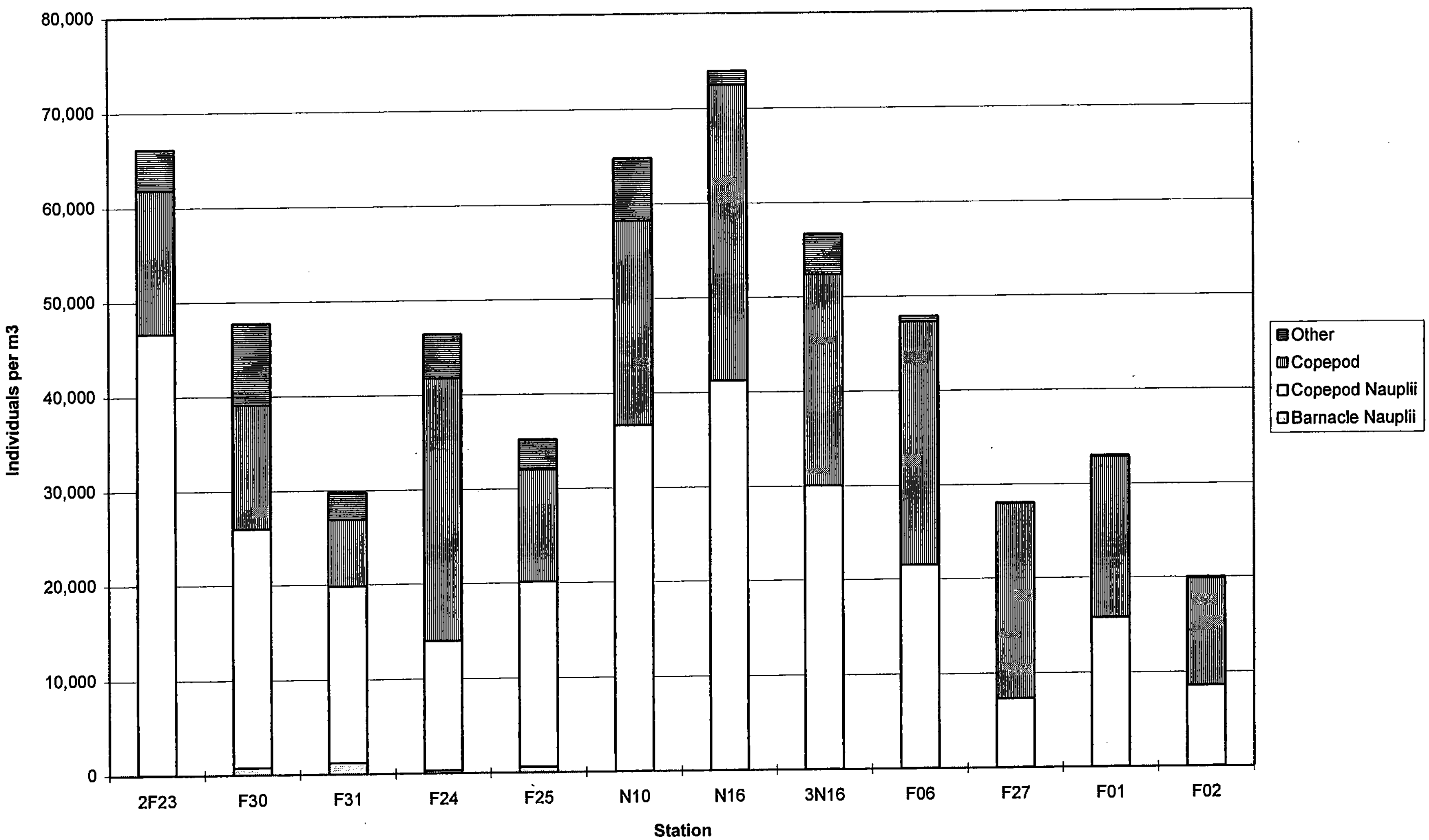


FIGURE 5-27
Zooplankton Abundance by Groups Collected During W9507, June 20-25, 1995

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 periodically conflicting 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.

Overall, during the pre-stratification phase in the winter-spring of 1995, Cape Cod Bay was the most productive region, with the highest chlorophyll concentrations, highest phytoplankton abundances, and consistently the lowest nutrient concentrations. During the early stratification survey in June, Cape Cod Bay was the least productive, with the lowest chlorophyll and phytoplankton abundance. Boston Harbor was the most productive region during this last farfield survey, with the highest chlorophyll, and the phytoplankton assemblage numerically dominated by small flagellates.

The first winter survey in February resulted in the highest nutrient concentrations in the water column throughout the semi-annual period. It was a period of low productivity, except, again, in Cape Cod Bay.

Nutrient data clearly documented a regional late winter bloom (early March, W9502), dominated by small *Gymnodinium* and centric diatom production. Maximum nutrient scavenging occurred in the nearfield and Cape Cod Bay, with regional scavenging of silicate by diatom production. During this survey, both the bottom and surface water in the nearfield were oversaturated with respect to DO, suggesting an influence of productivity on DO concentration during the bloom.

In late March (W9503), a peak in chlorophyll-specific production in nearfield surface water served as a predictor of a productivity event, indicating a "gearing up" of production without an apparent generation of chlorophyll. Plankton data showed a reduction in phytoplankton abundance during this survey, but a peak of zooplankton abundance indicated rapid grazing of the newly produced chlorophyll. The following survey in April (W9504) resulted in elevated carbon-specific respiration, indicating a flux of fresh organic material. The two datasets suggested that a productive period occurred between the two surveys in the nearfield.

The spring nearfield bloom occurred in April (W9505), supported by a wide variety of data, including maximum measured values of surface water chlorophyll *a*, DO, POC, maximum rates of production and respiration, and a depletion of nutrients in the surface water. The second highest production value (3,847 $mgCm^{-2}d^{-1}$), and the maximum rate of surface water respiration (2.4 $\mu MO_2/hr$) was measured at station N16 during this survey. Nearfield bottom water was oversaturated with respect to DO during this survey. Contours of chlorophyll *a* showed the center of production within the nearfield at station N21.

The spring bloom in April still had an effect on survey data collected in May (W9506). Most of the effect of the spring bloom in April was concentrated in the surface water, but by May, changes in bottom water indicated an effect from settling and decomposing plankton. Increased respiration rates indicated the availability of POC substrate material. Although phytoplankton abundances measured in May had decreased from April, zooplankton abundances had increased relative to the prior month suggesting increased grazing. At the same time, several bottom water parameter values began to merge with those measured in the surface water, including increases in temperature and DO, as well as a decrease in overall nutrient concentrations. An increase in bottom water DO can be attributed to biological production or mixing from surface water; in this case, the data suggest mixing occurred within the nearfield.

The second highest production episode was measured during the first summer survey in June (F23, 3,634 $mgCm^{-2}d^{-1}$). In addition to production rates, the maximum value of DO saturation in surface water of the semi-annual period was measured in the nearfield, and this survey also resulted in the highest phytoplankton densities. The data suggest that the June survey was conducted during a bloom, with maximum chlorophyll concentrations measured in Boston Harbor, nearfield, and coastal water.

The early July survey (W9508) was marked by a cooling of nearfield surface water, resulting in a $\Delta\sigma_t$ increase of almost 1. The data suggested an upwelling event, supported by satellite data, where an upwelling event was documented in Western Massachusetts Bay at this time, and by moored temperature data collected by USGS at a buoy located between stations N18 and N21. Although there was no evidence collected during the early July survey, a peak in chlorophyll-specific production suggested a "gearing up" of productivity.

Further evidence that a productivity event occurred in July was collected during the final semi-annual survey of 1995 in late July. Carbon-specific respiration values in both the surface and bottom water of the nearfield increased, suggesting a source of recently-produced POC. Phytoplankton populations were concentrated at mid-depths during this survey, as opposed to in the surface water as during prior surveys, potentially explaining the increased DO concentration increase measured during this survey. The abundances of zooplankton also rebounded from the low numbers in early July, suggesting that grazing was an important factor in reducing chlorophyll produced during the July productivity episode. Supporting satellite and moored temperature data suggesting an upwelling event in July was most likely a catalyst for a productivity episode in the middle of the summer in the nearfield.

7.0 REFERENCES

Bowen, J.D., R.A. Zavistoski, S.J. Cibik, T. Loder, B. Howes, and C. Talyor, 1997. Combined Work/Quality Assurance Plan for Baseline Water Quality Monitoring: 1995-1997. MWRA Enviro. Quality Dept. Misc. Rpt. No. ms-45. Massachusetts Water Resources Authority, Boston, MA. 93pp.

MWRA. 1997. Contingency Plan. 73pp.

APPENDIX A

PRODUCTIVITY AND RESPIRATION 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

b = β"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 ($\mu gC\ l^{-1}d^{-1}$) 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:

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

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

where:

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

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

APPENDIX B

SURFACE CONTOUR PLOTS - FARFIELD SURVEY

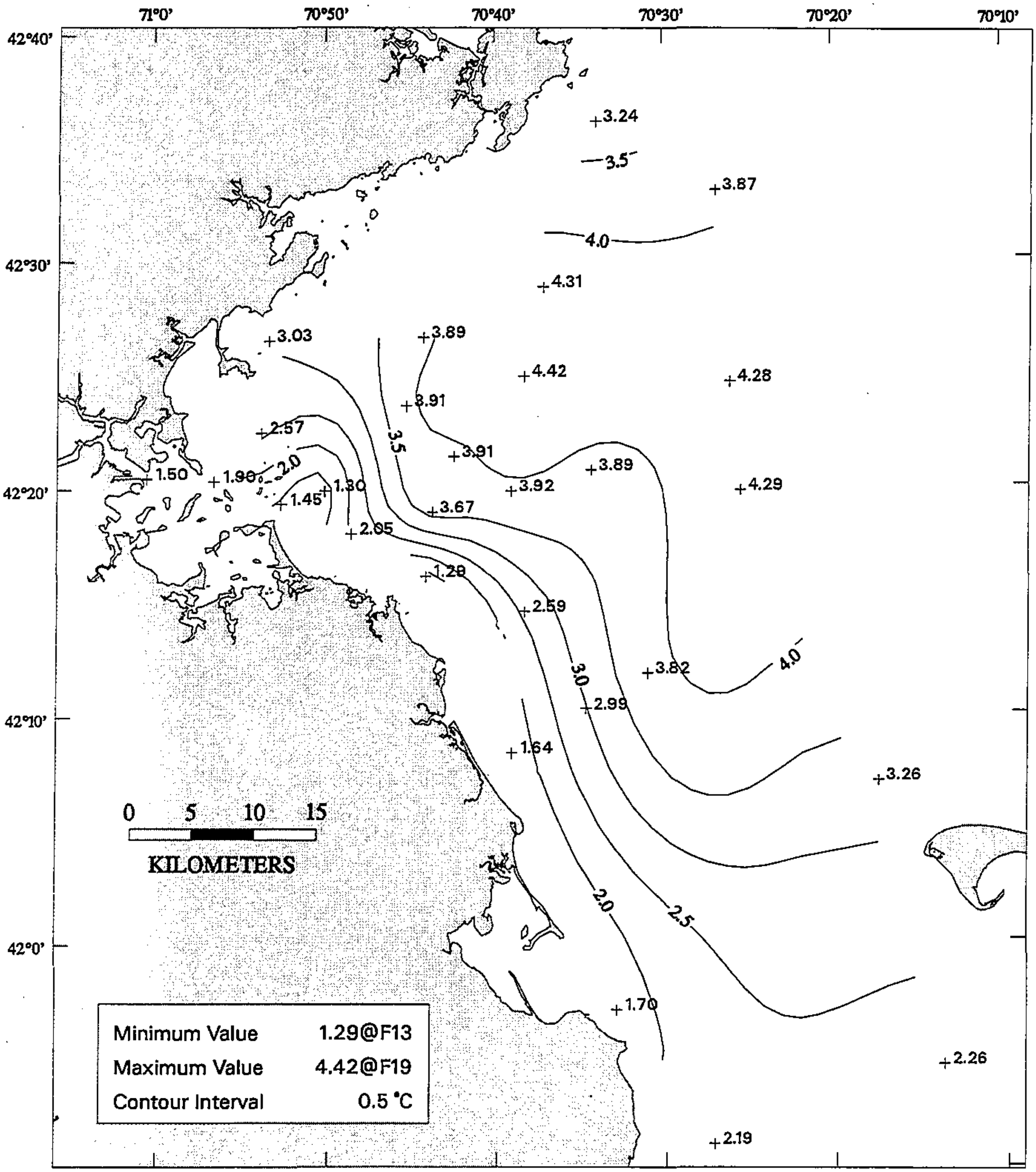
APPENDIX B

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 ("9501"), 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	PSU
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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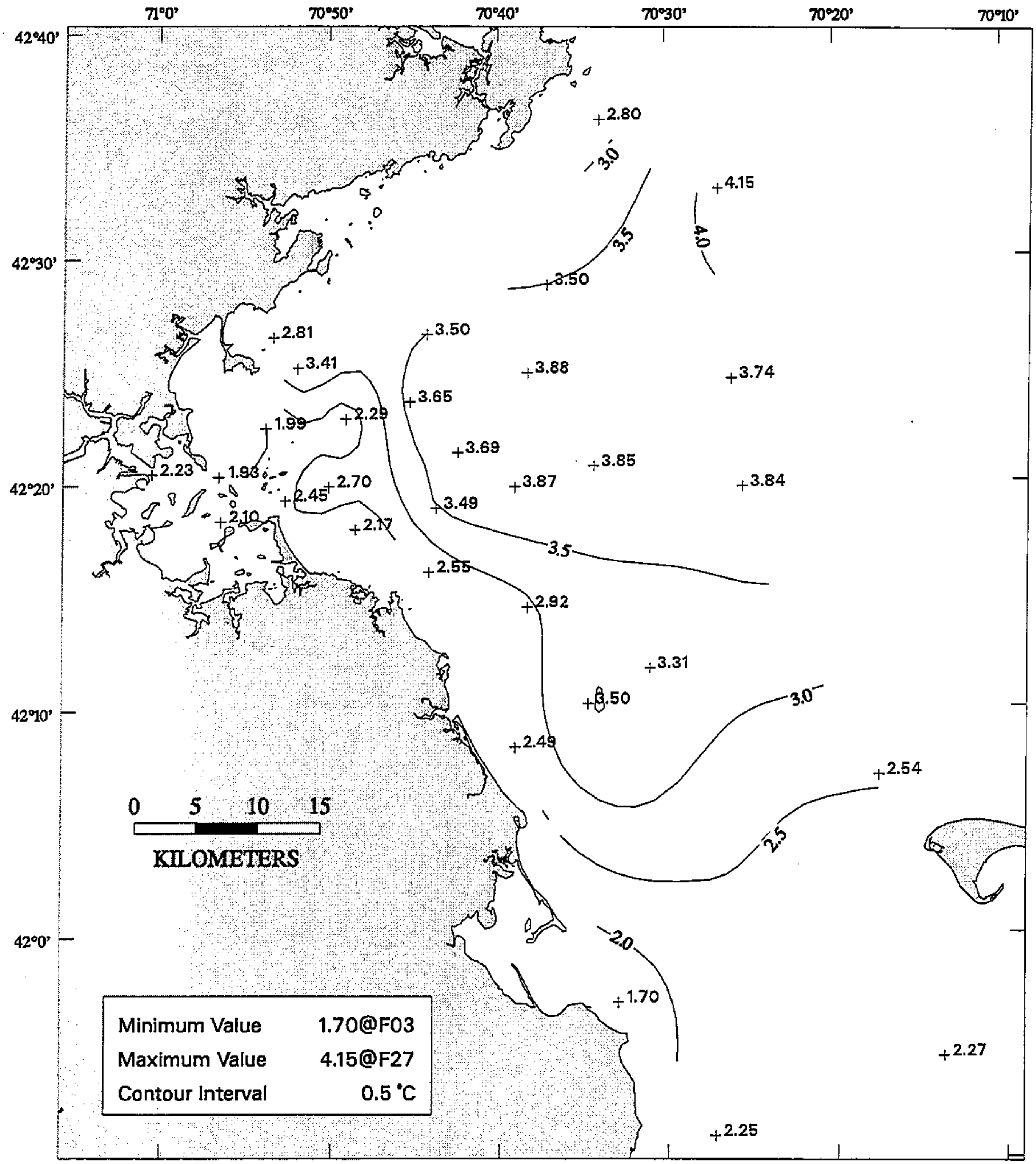

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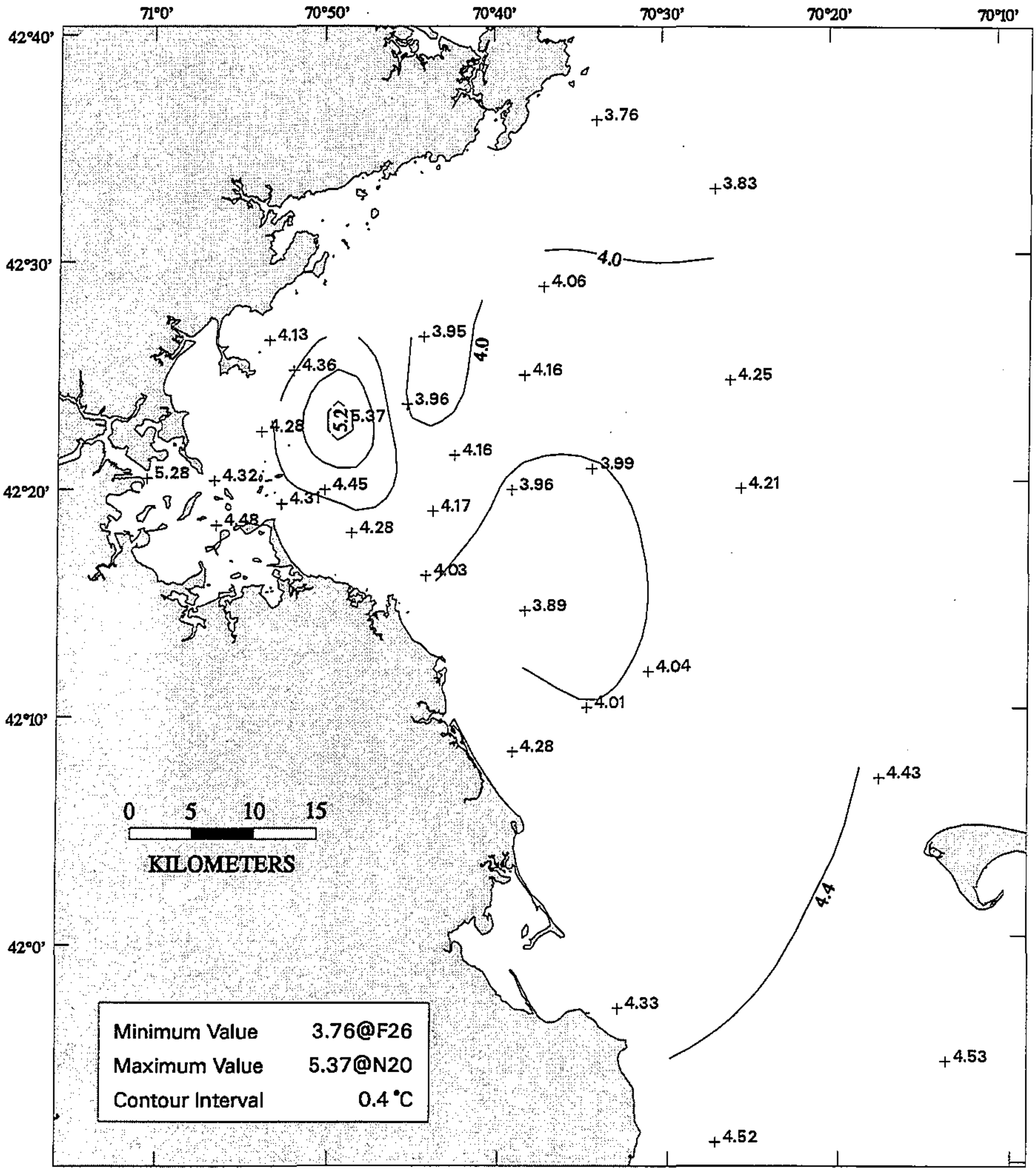

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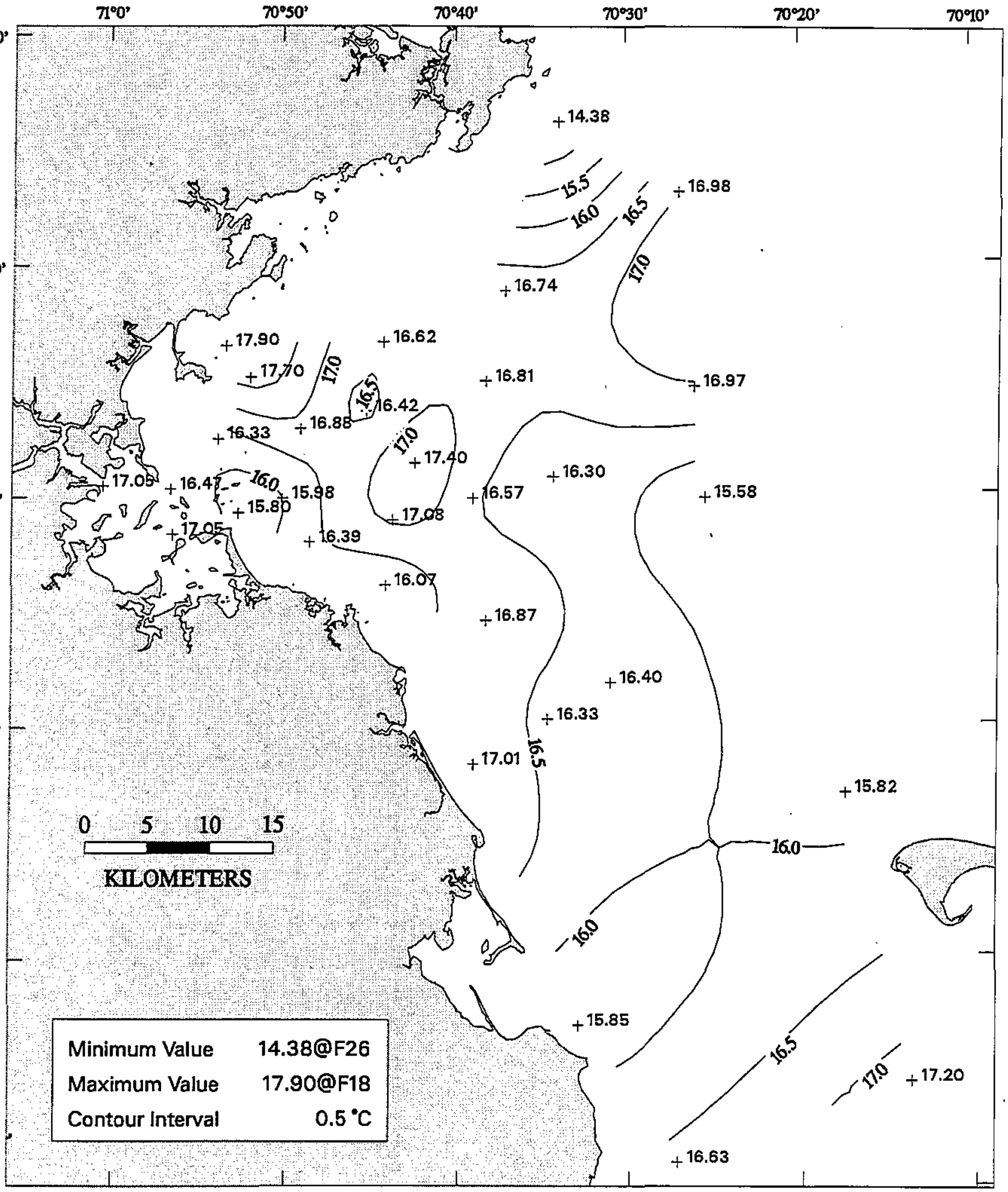

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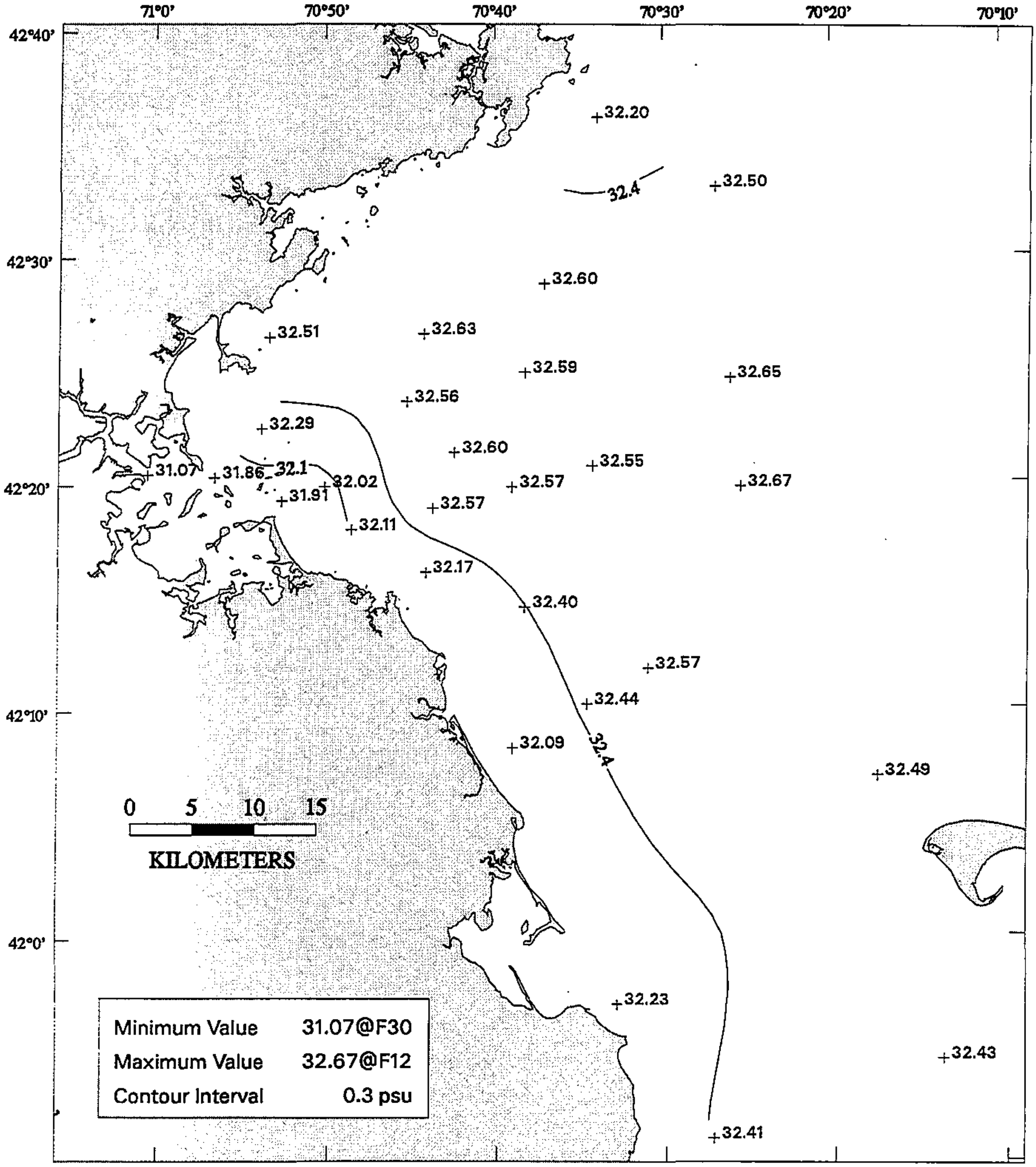

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32.57
32.11
32.17
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32.57
32.44
32.09
32.4
32.49
0 5 10 15
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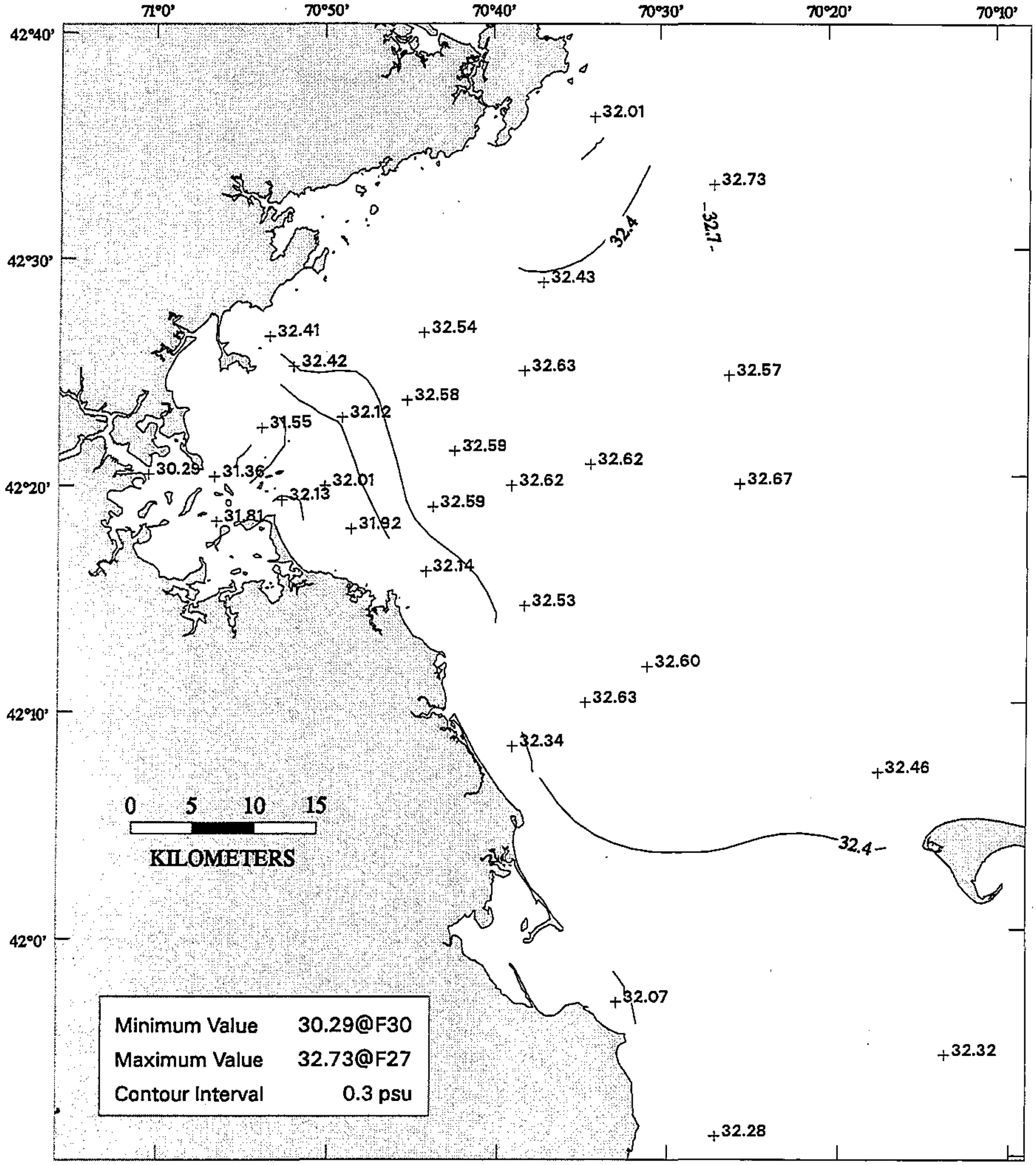
32.43
32.41
Minimum Value 31.07@F30
Maximum Value 32.67@F12
Contour Interval 0.3 psu

9501sal_lin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32.34
32.46
0 5 10 15
KILOMETERS
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32.32
32.28
Minimum Value 30.29@F30
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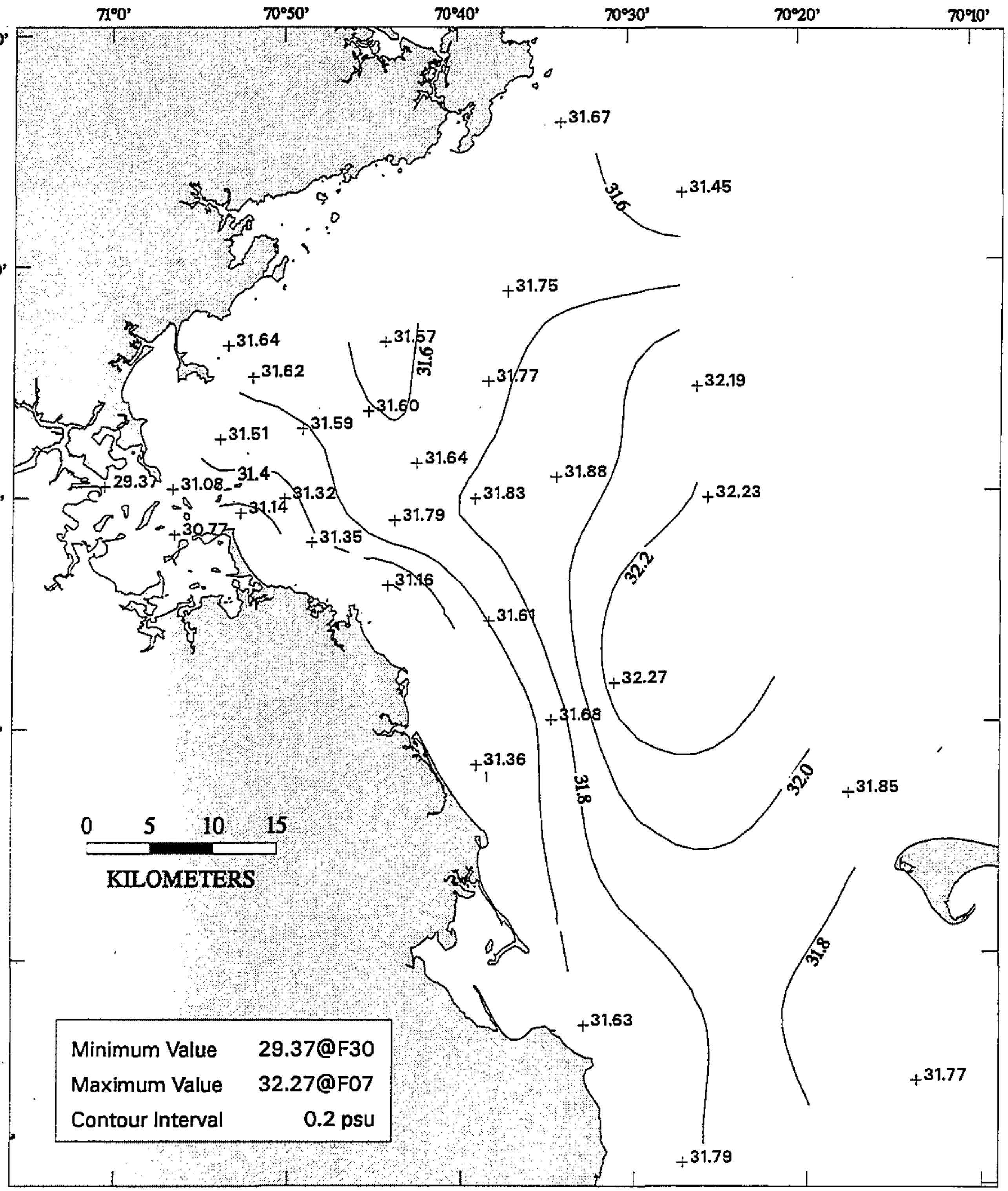
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32.27
31.68
31.36
31.8
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31.85
0
5
10
15
KILOMETERS
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31.63
Minimum Value 29.37@F30
Maximum Value 32.27@F07
Contour Interval 0.2 psu
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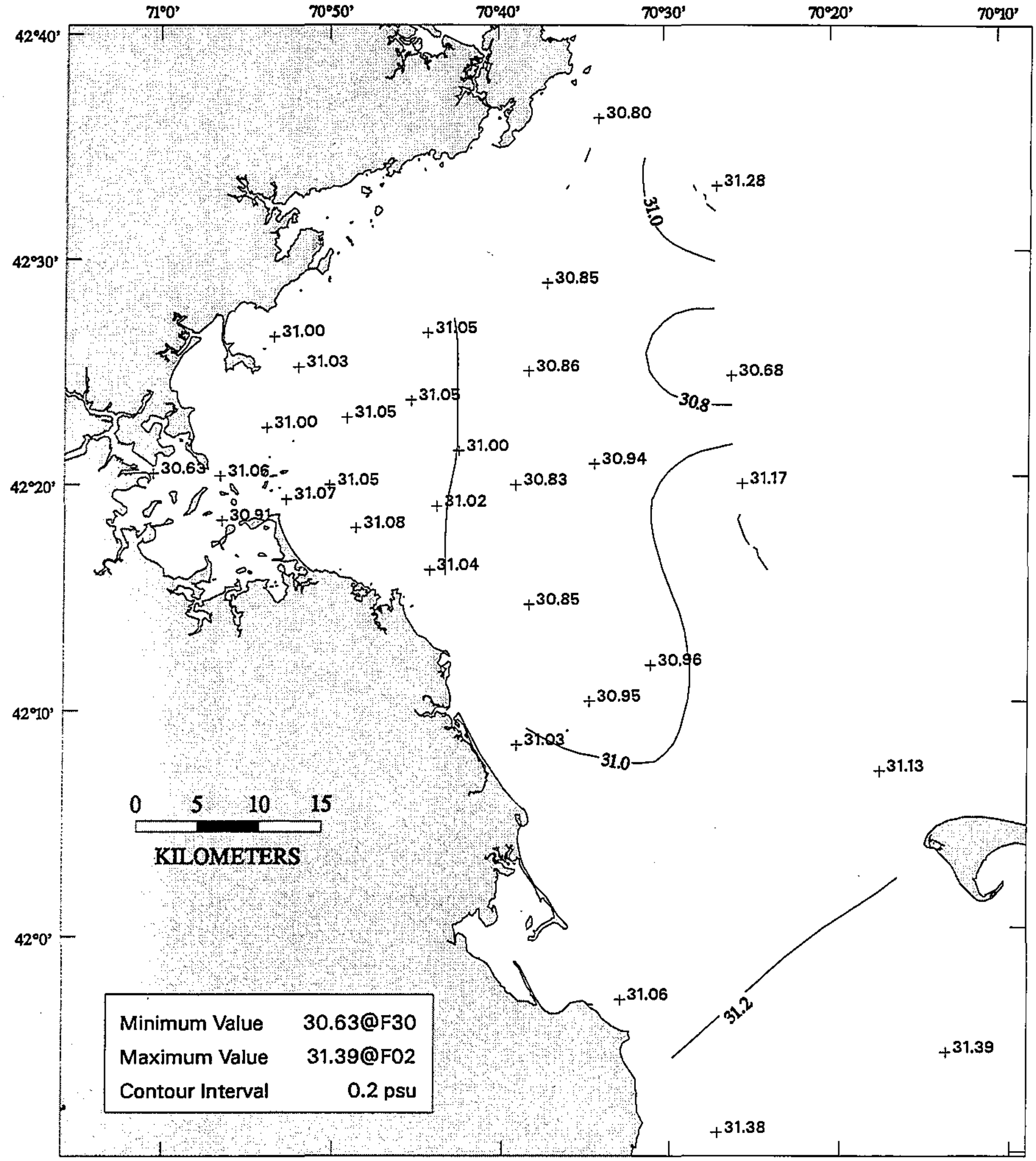
31.79

9504sal_lin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31.05
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30.96
30.95
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31.0
31.13
0 5 10 15
KILOMETERS
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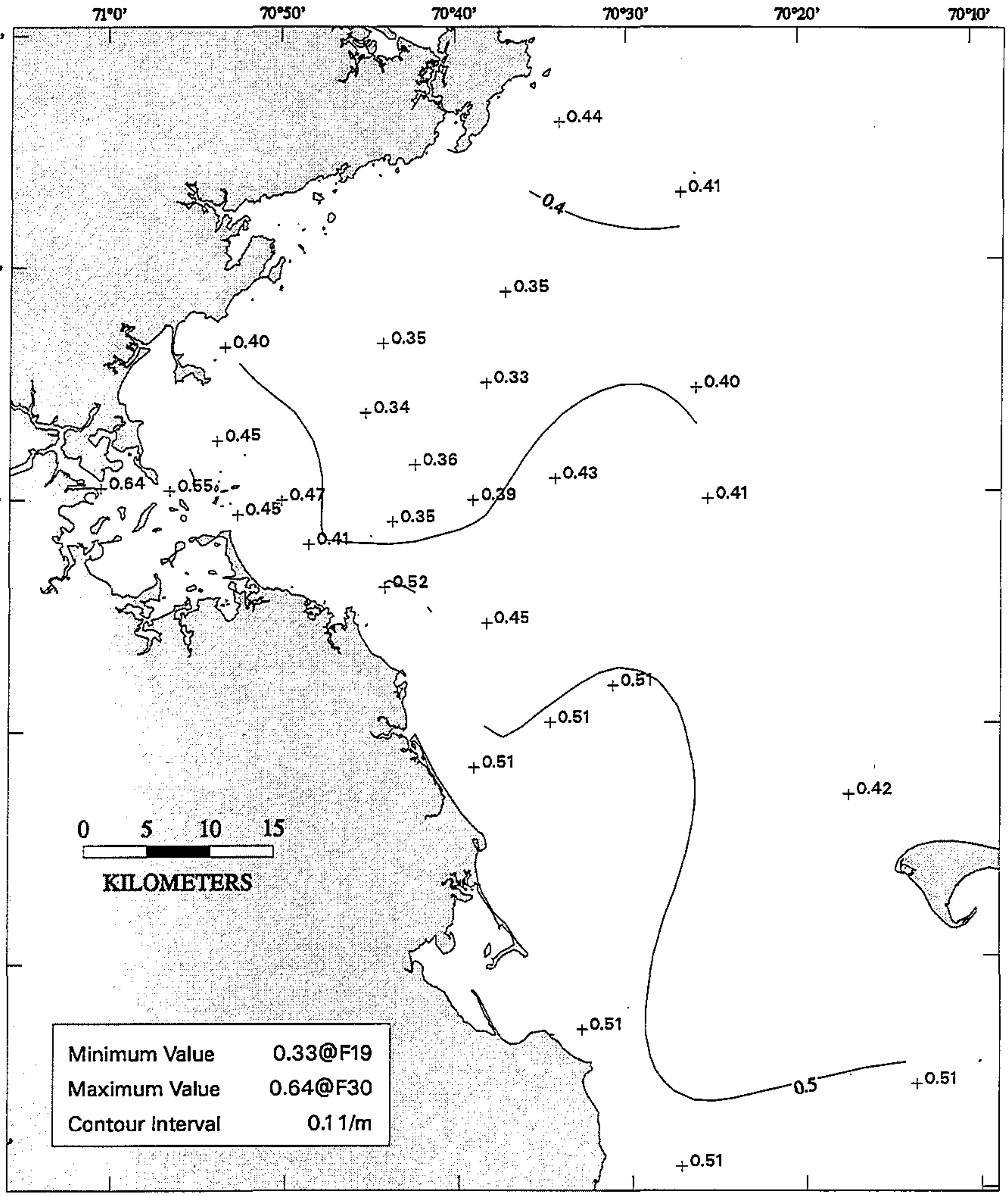
Maximum Value 31.39@F02
Contour Interval 0.2 psu

9507sal_lin



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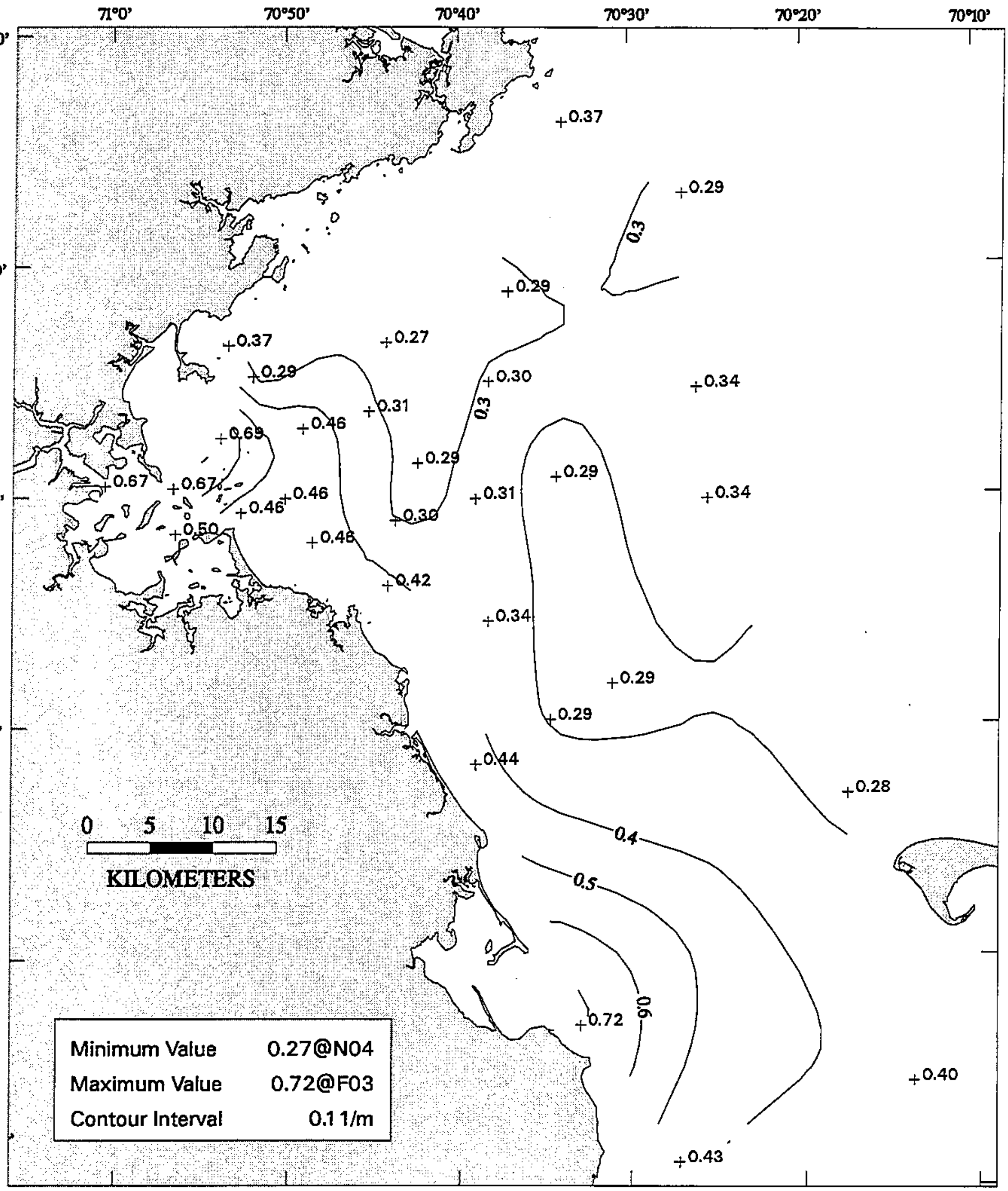

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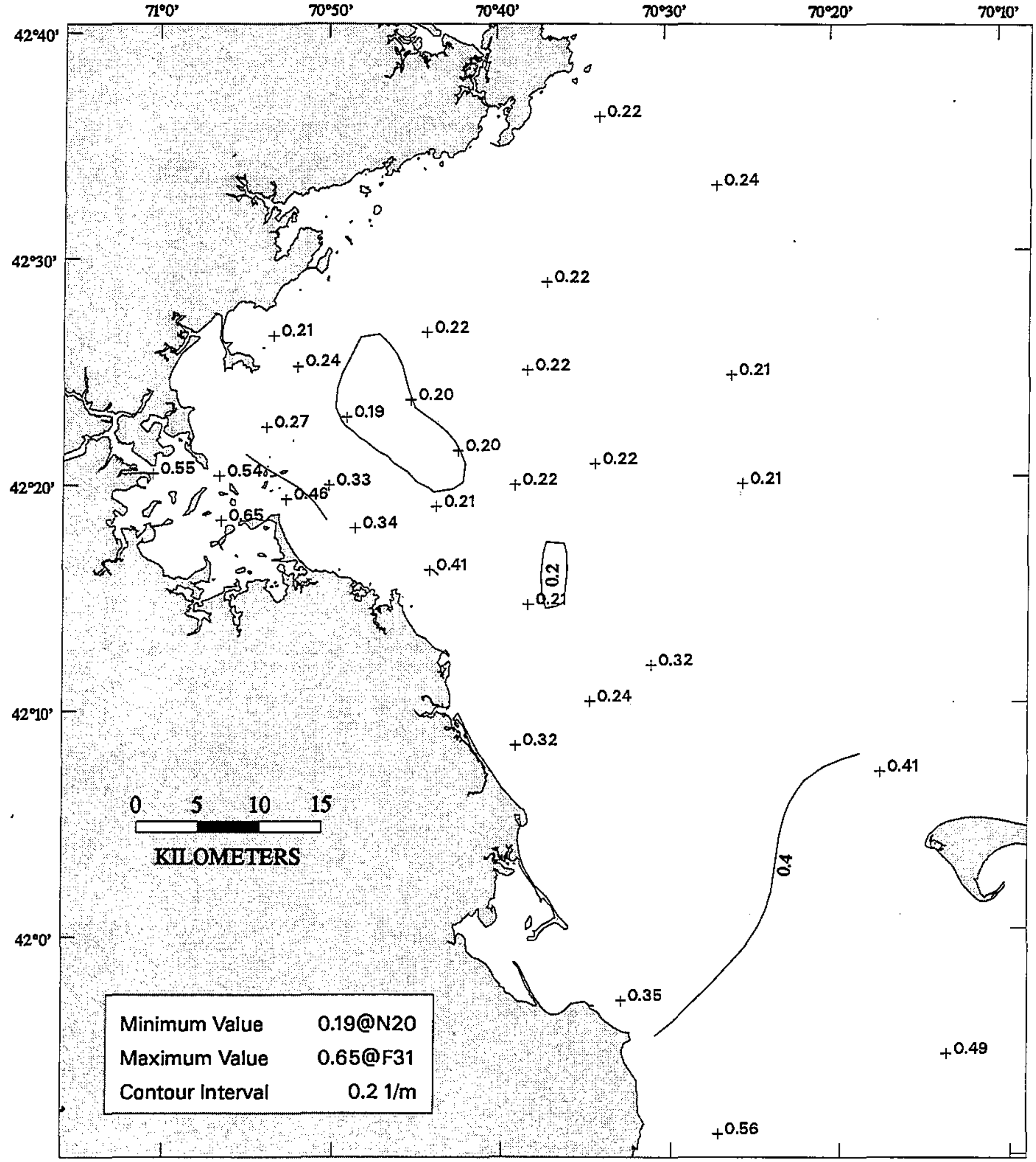

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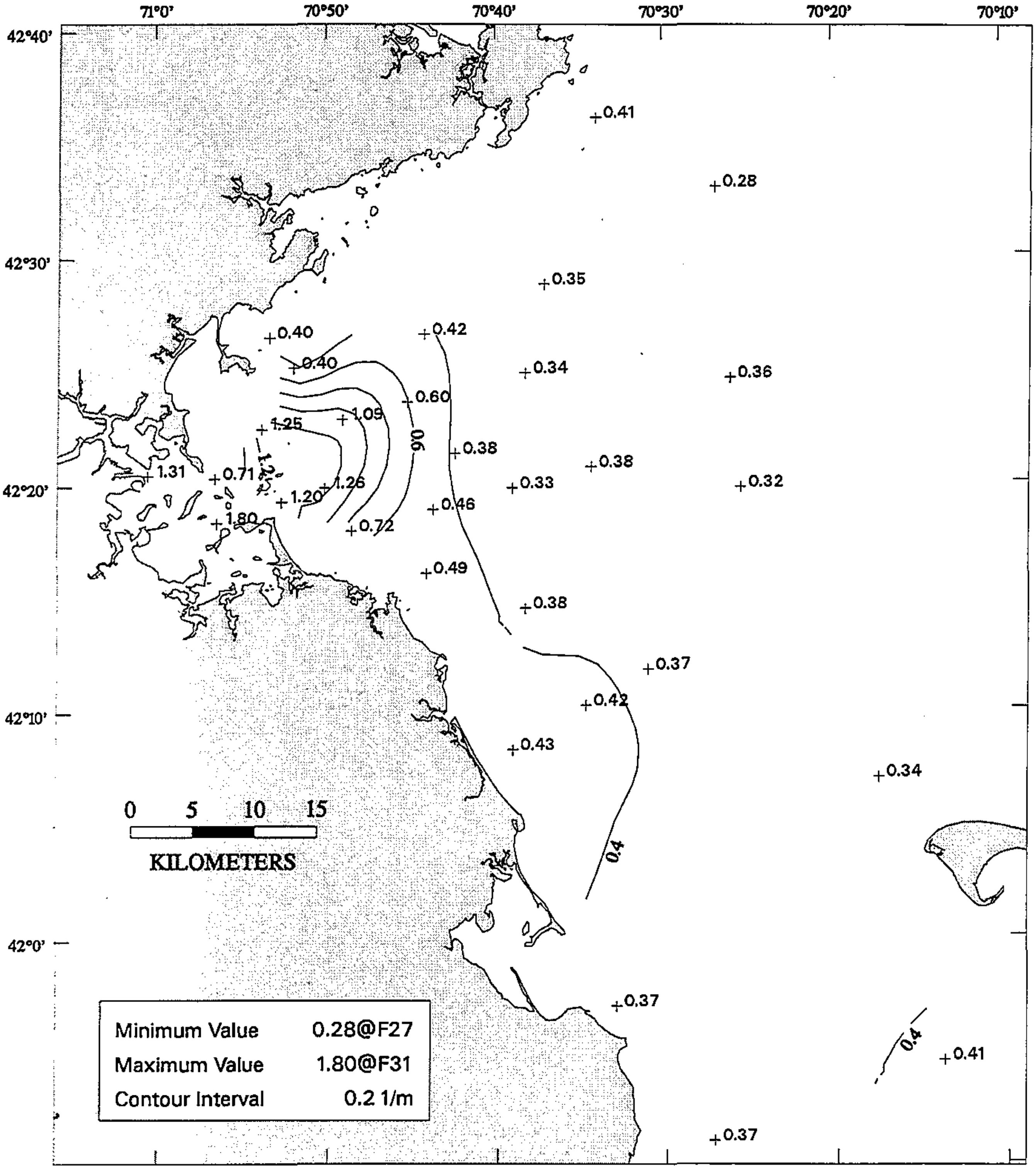

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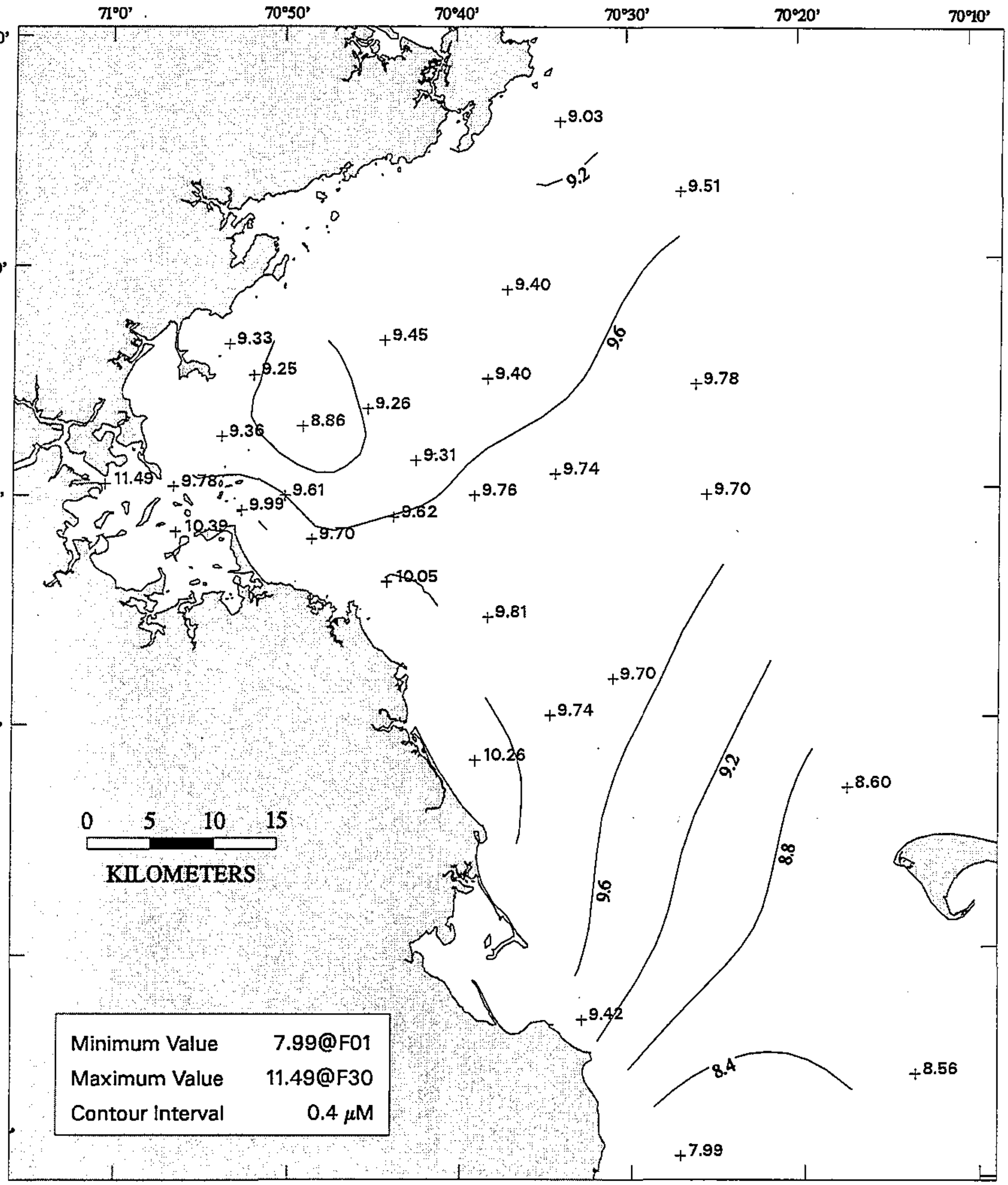

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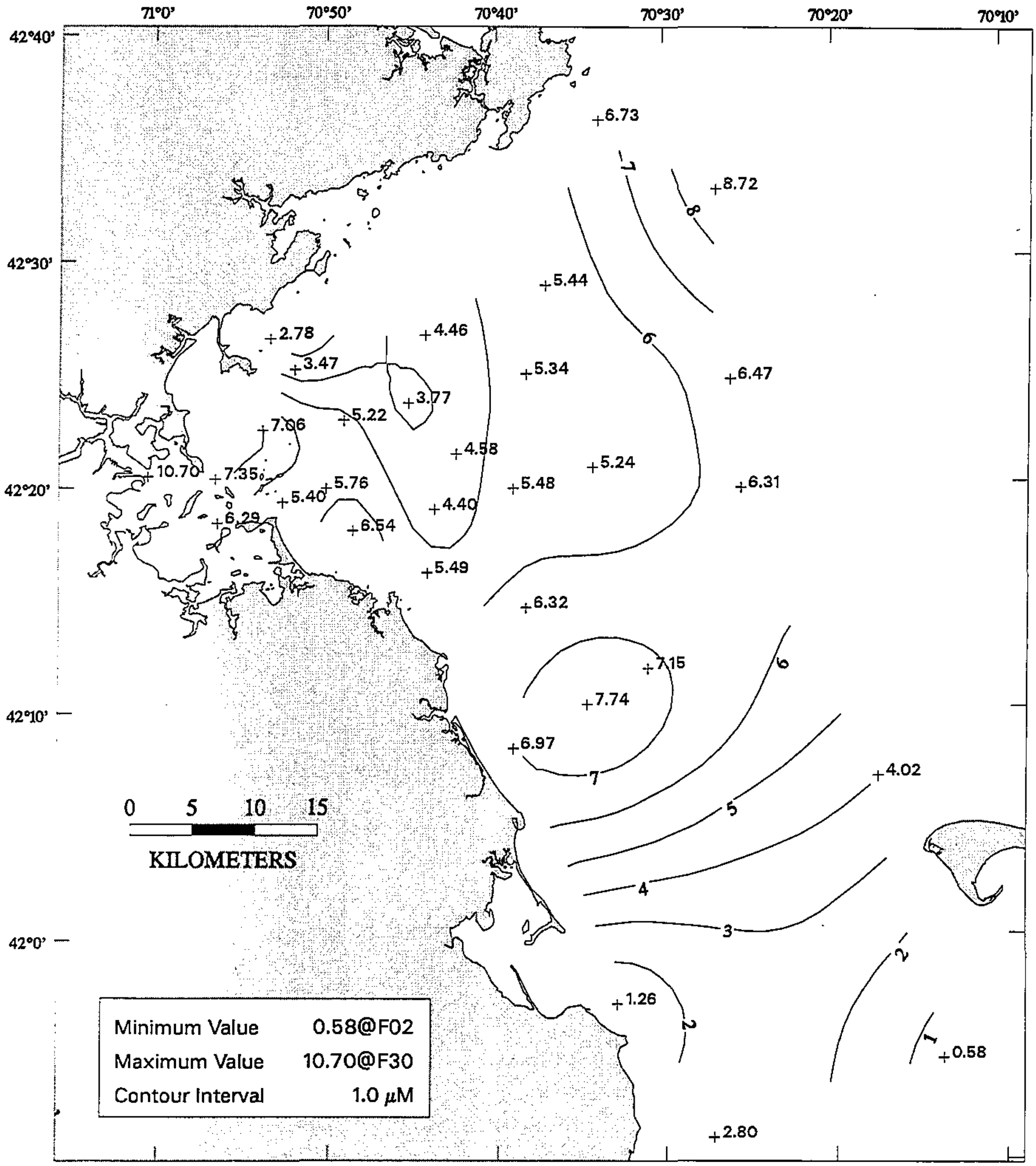
9.51
9.40
9.6
9.33
9.45
9.25
9.40
9.78
9.26
8.86
9.36
9.31
9.74
11.49
9.78
9.61
9.76
9.70
9.99
9.62
10.39
9.70
10.05
9.81
9.70
9.74
10.26
9.2
8.60
0 5 10 15
KILOMETERS
8.8
9.6
9.42
8.4
8.56
7.99
Minimum Value 7.99@F01
Maximum Value 11.49@F30
Contour Interval 0.4 μM

9501no3_lin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8.72
5.44
2.78
4.46
3.47
5.34
6.47
3.77
5.22
7.06
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7.35
5.76
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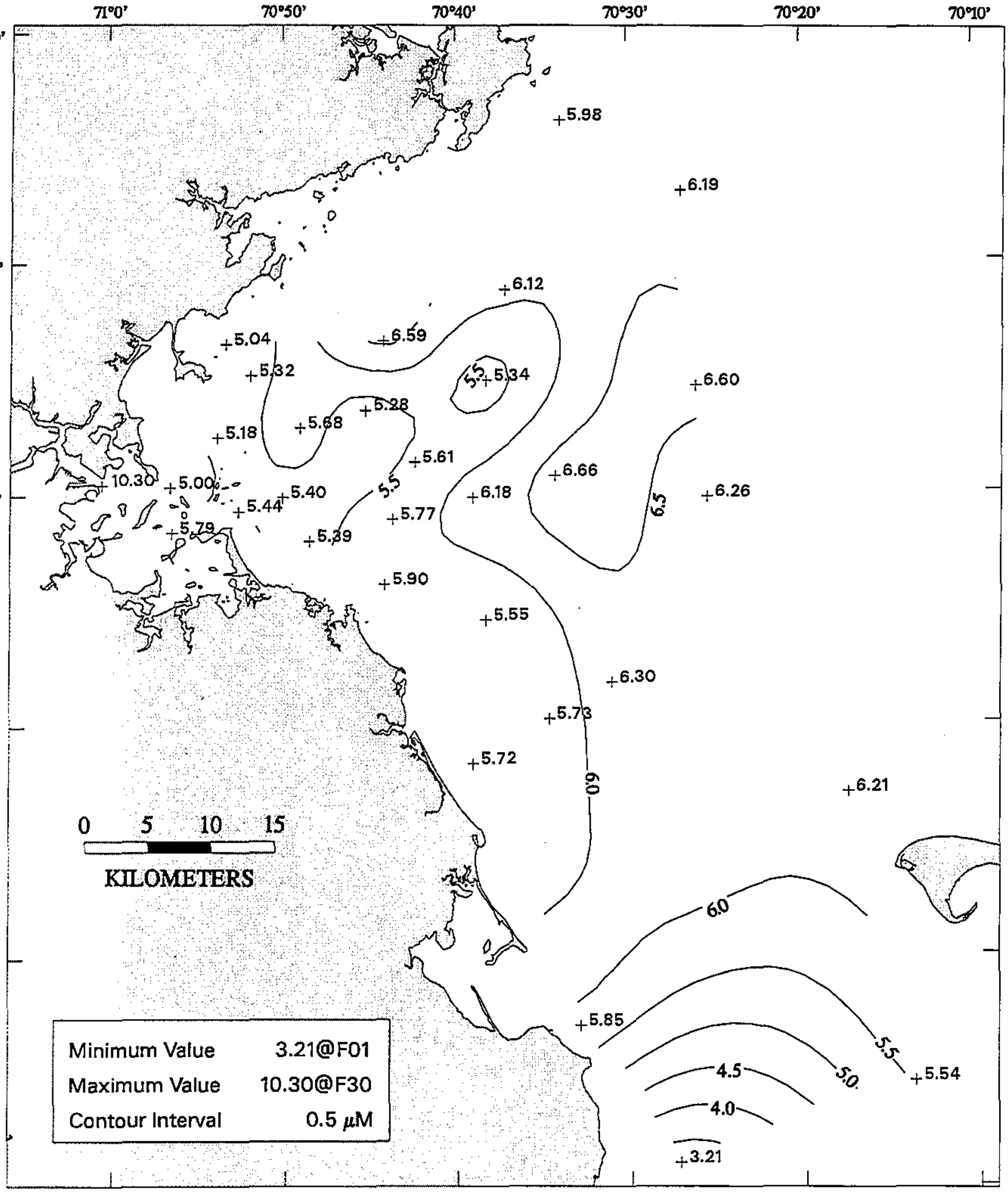
6.31
5.40
4.40
6.29
6.54
5.49
6.32
7.15
7.74
6.97
4.02
1.26
0.58
2.80
0 5 10 15
KILOMETERS
Minimum Value 0.58@F02
Maximum Value 10.70@F30
Contour Interval 1.0 µM

9502no3_lin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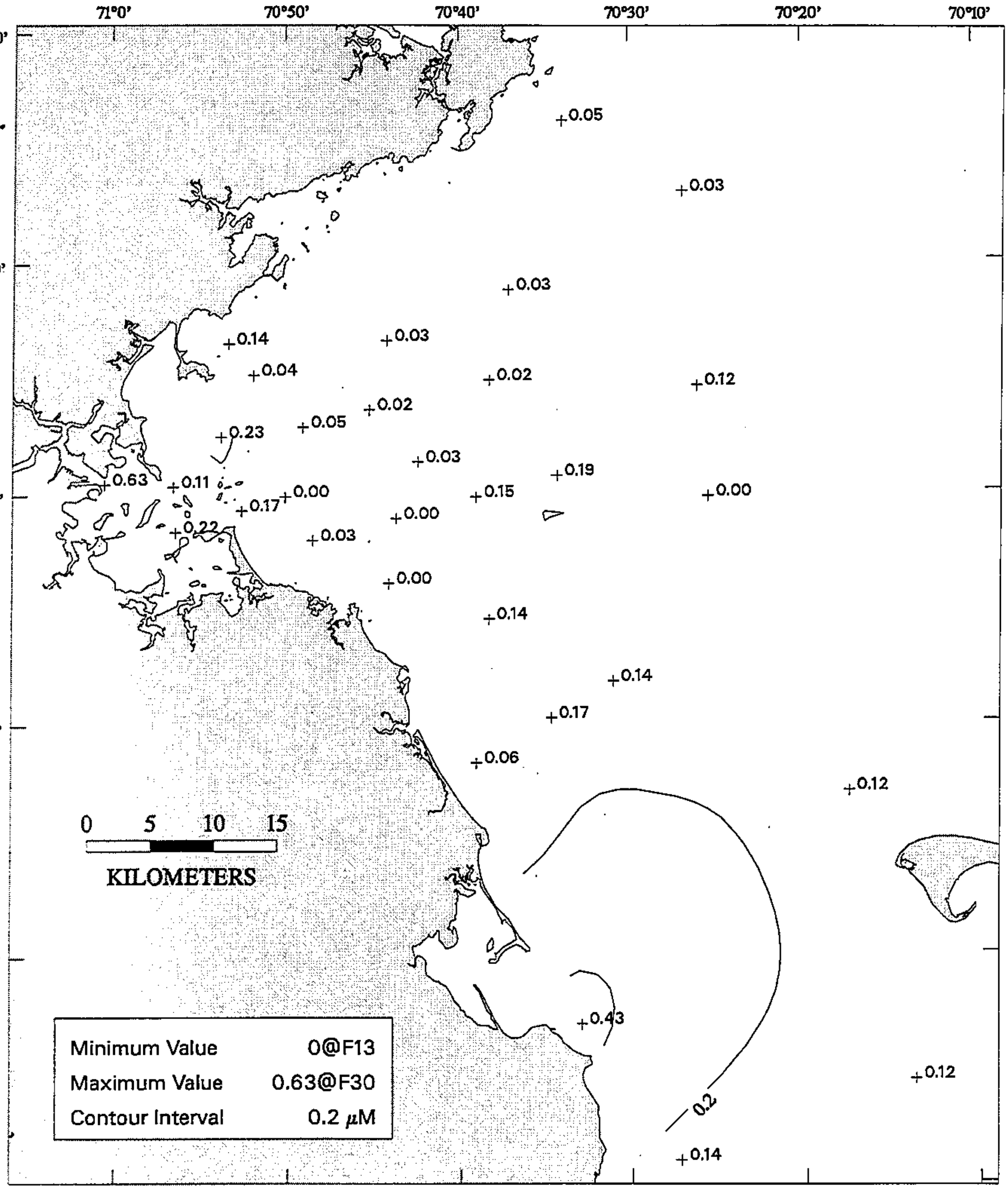
6.30
5.73
5.72
6.21
5.85
5.54
3.21
5.5
6.0
6.5
5.0
4.5
4.0
0 5 10 15
KILOMETERS
Minimum Value 3.21@F01
Maximum Value 10.30@F30
Contour Interval 0.5 μM

9504no3_lin



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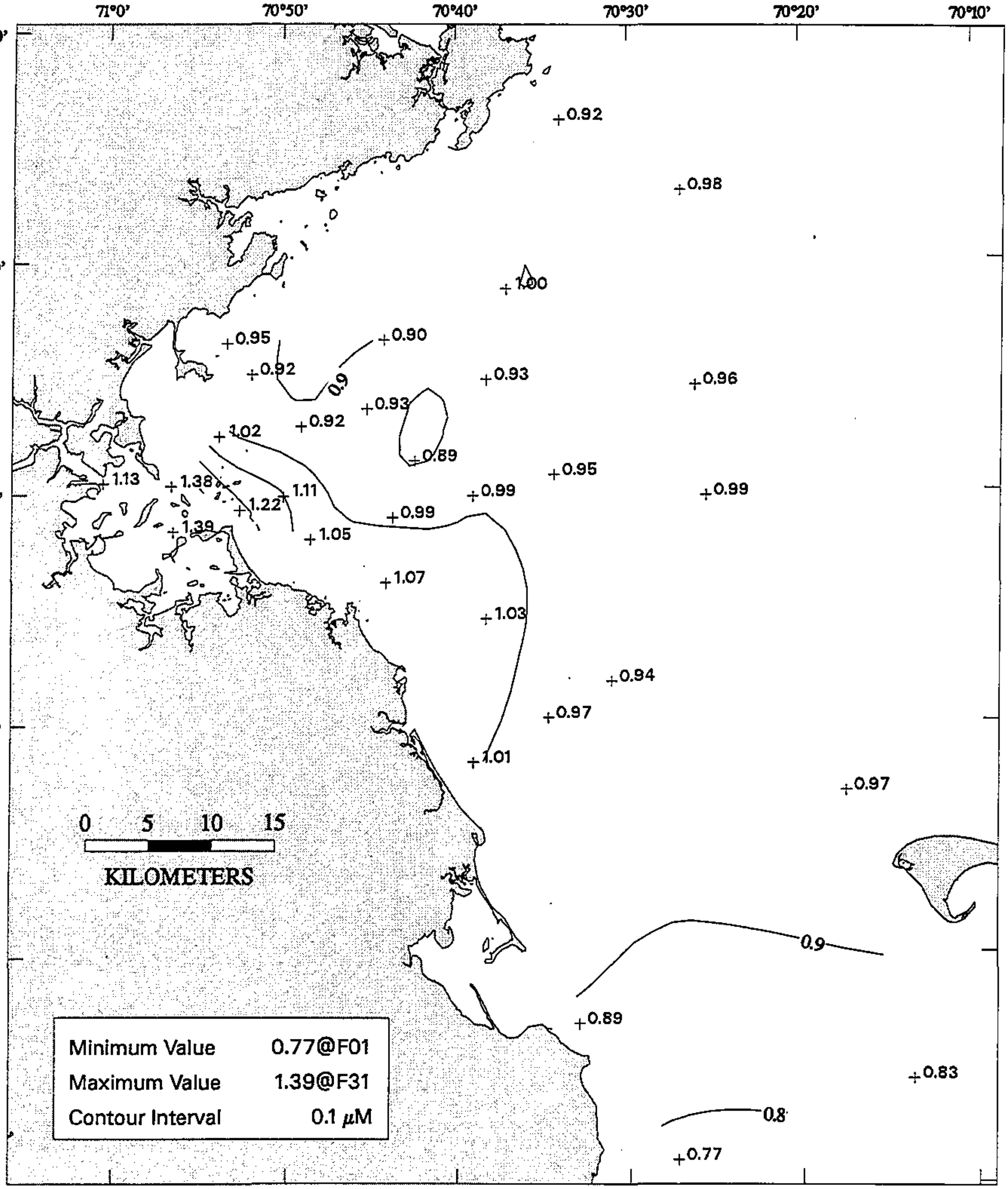
0.03
0.03
0.14
0.03
0.04
0.02
0.12
0.02
0.23
0.05
0.03
0.19
0.63
0.11
0.00
0.15
0.00
0.17
0.00
0.22
0.03
0.00
0.14
0.14
0.17
0.06
0.12
0 5 10 15
KILOMETERS
0.43
0.12
0.2
0.14
Minimum Value 0@F13
Maximum Value 0.63@F30
Contour Interval 0.2 μM

9507no3_lin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0.90
0.92
0.9
0.93
0.96
0.93
0.92
1.02
0.89
0.95
1.13
1.38
1.11
1.22
0.99
0.99
0.99
1.39
1.05
1.07
1.03
0.94
0.97
1.01
0.97
0 5 10 15
KILOMETERS
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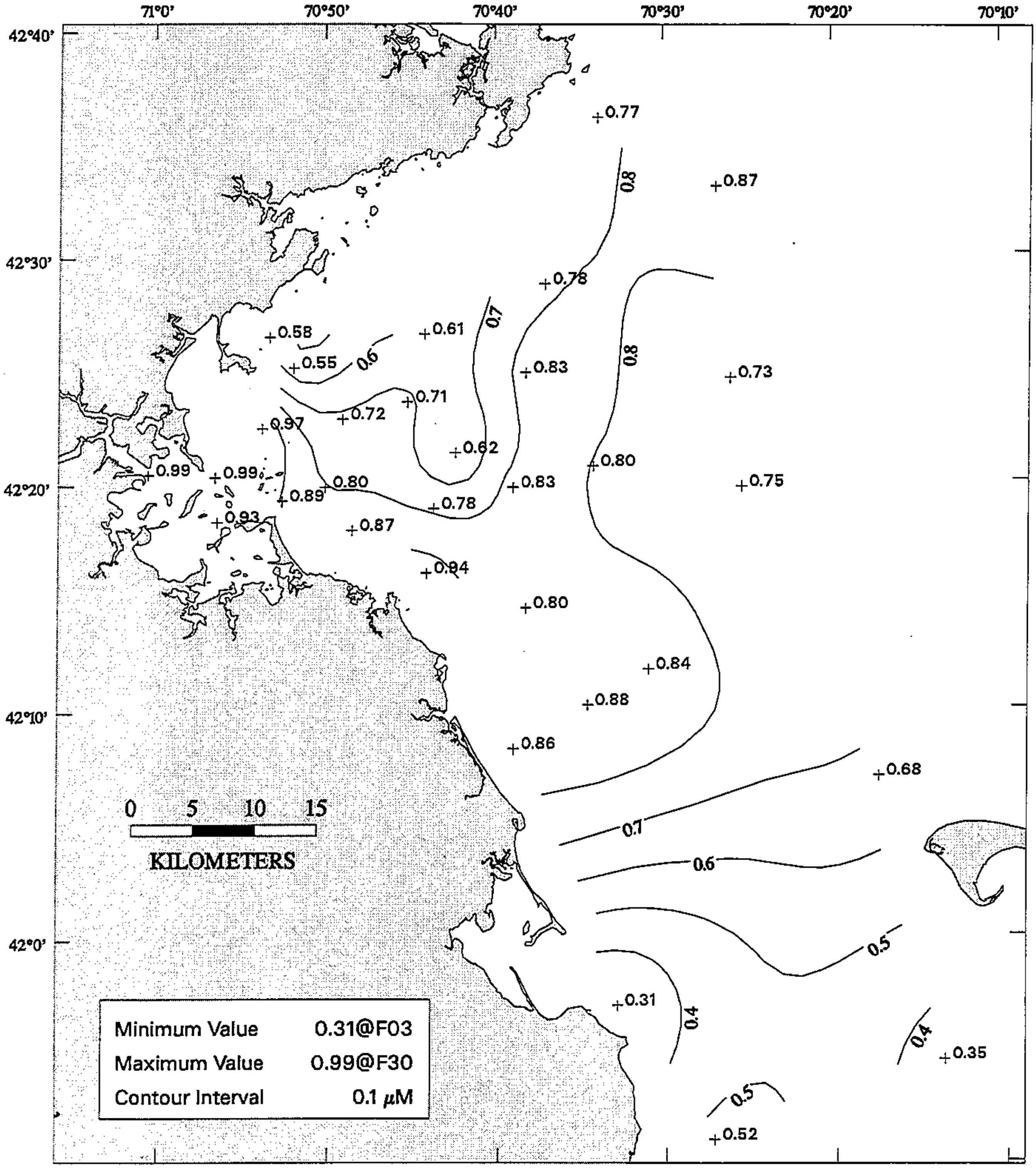
0.8
0.77
Minimum Value 0.77@F01
Maximum Value 1.39@F31
Contour Interval 0.1 µM

9501po4_lin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0.87
0.8
0.78
0.7
0.58
0.61
0.55
0.6
0.83
0.73
0.71
0.72
0.97
0.62
0.80
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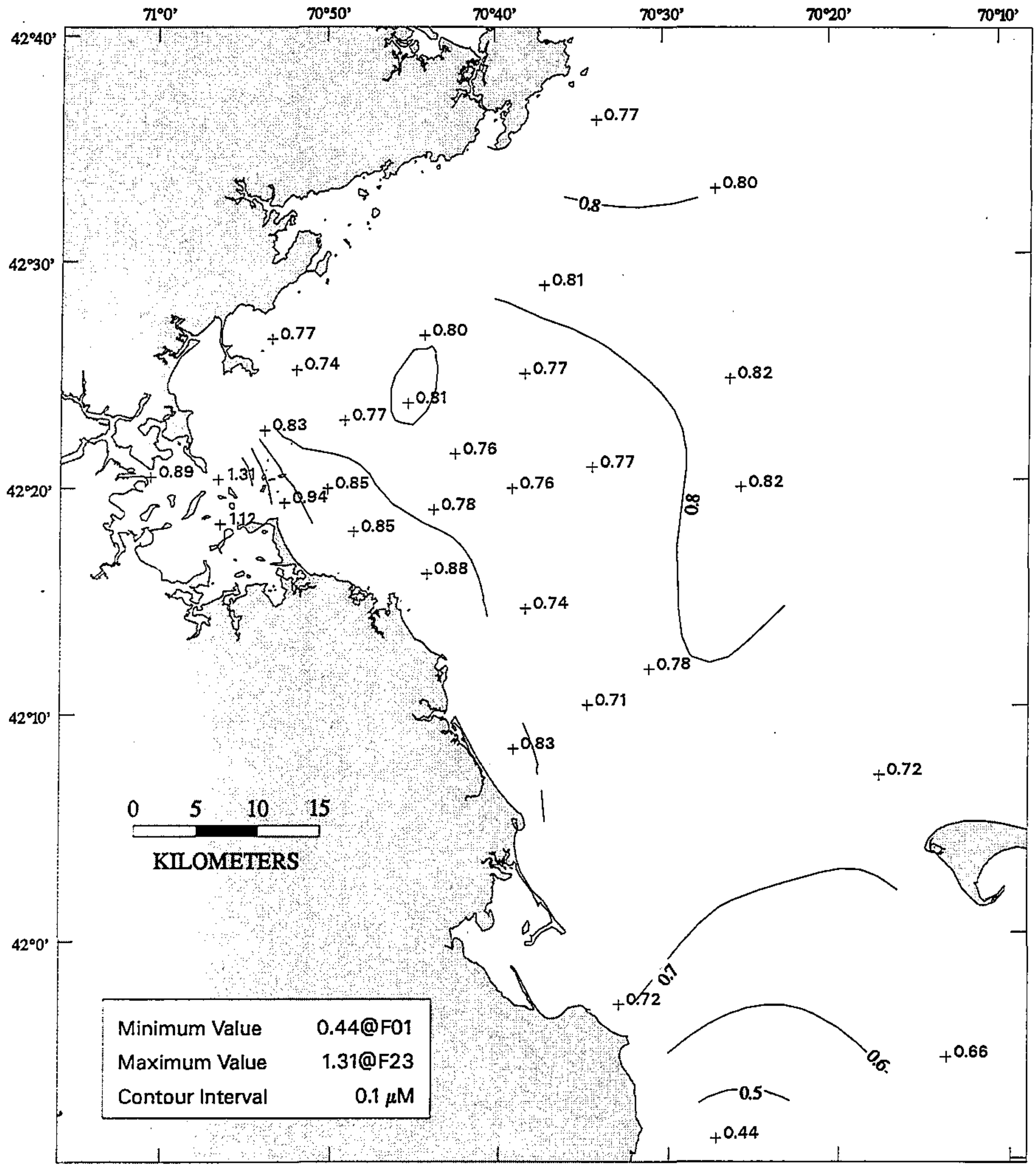
0.80
0.84
0.88
0.86
0.68
0.7
0.6
0.5
0.31
0.4
0.4
0.35
0.5
0.52
0 5 10 15
KILOMETERS
Minimum Value 0.31@F03
Maximum Value 0.99@F30
Contour Interval 0.1 µM

9502po4_lin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0.80
0.8
0.81
0.77
0.80
0.74
0.77
0.81
0.82
0.83
0.77
0.76
0.77
0.89
1.31
0.85
0.94
0.76
0.82
0.78
0.8
1.12
0.85
0.88
0.74
0.78
0.71
0.83
0.72
0 5 10 15
KILOMETERS
0.7
0.72
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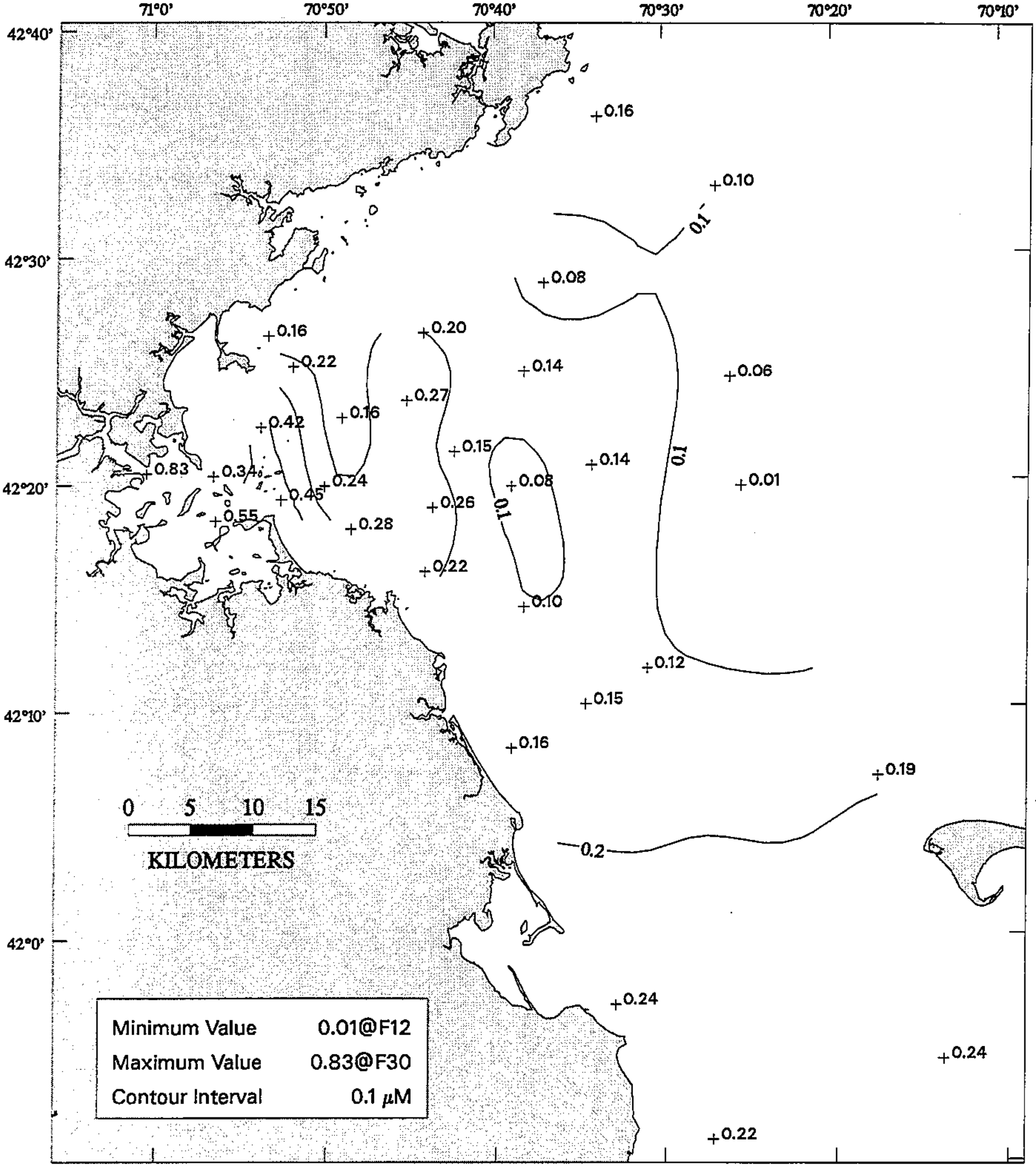
0.5
0.44
Minimum Value 0.44@F01
Maximum Value 1.31@F23
Contour Interval 0.1 μM

9504po4_lin



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42°0'
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0.10
0.1
0.08
0.16
0.20
0.22
0.14
0.06
0.27
0.16
0.42
0.15
0.14
0.1
0.83
0.34
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0.1
0.55
0.28
0.22
0.10
0.12
0.15
0.16
0.19
0 5 10 15
KILOMETERS
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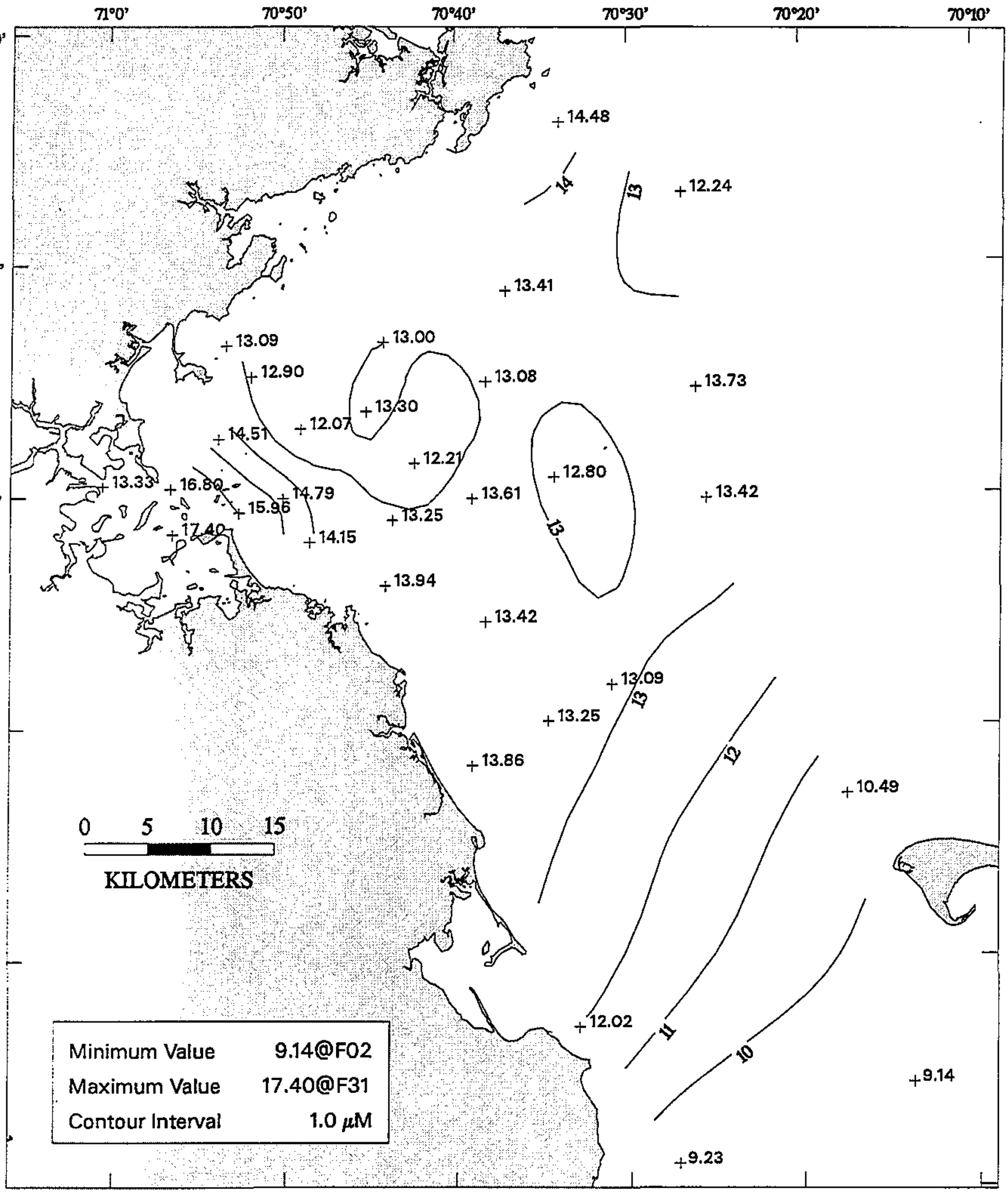
0.22
Minimum Value 0.01@F12
Maximum Value 0.83@F30
Contour Interval 0.1 μM

9507po4_lin



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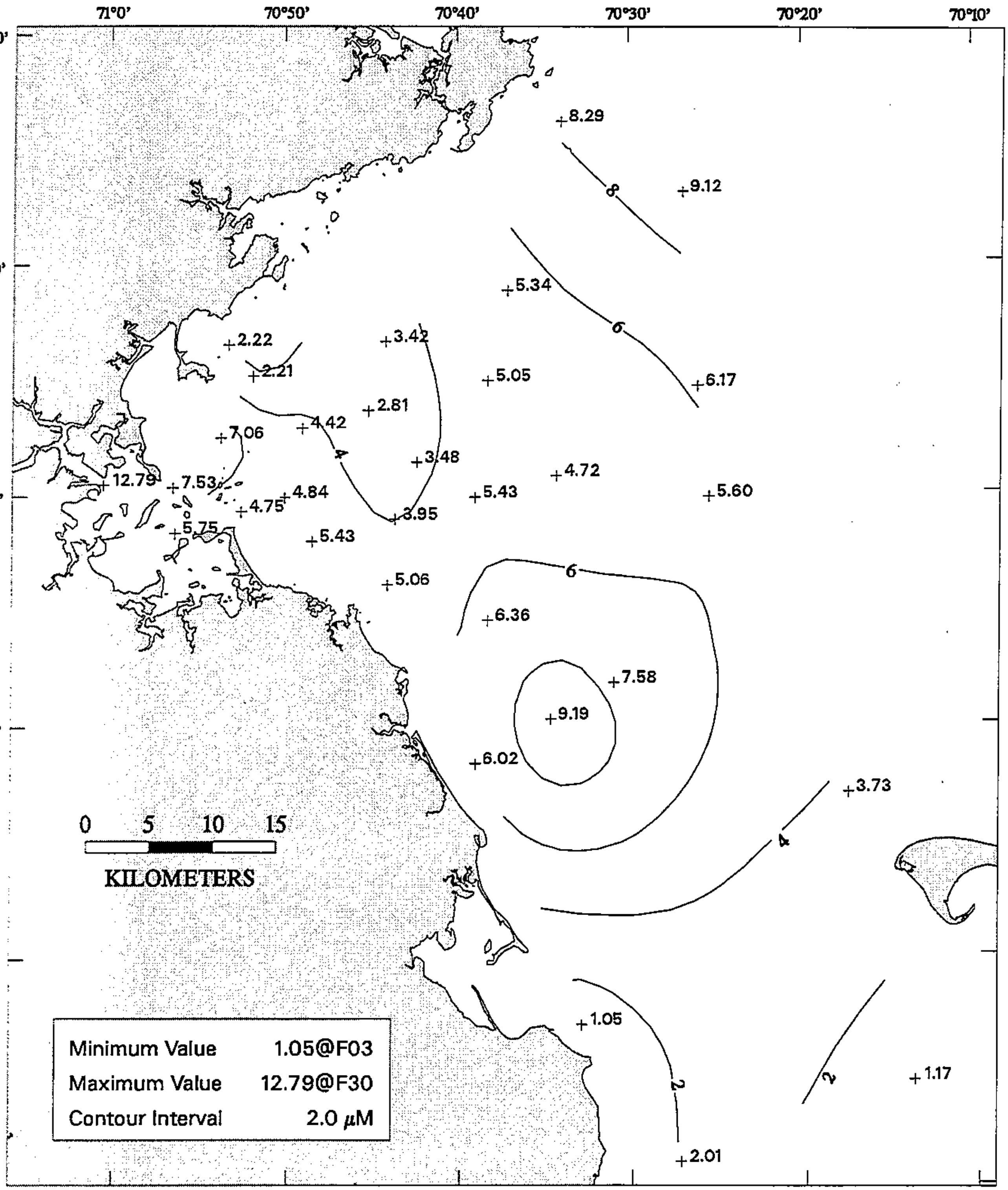

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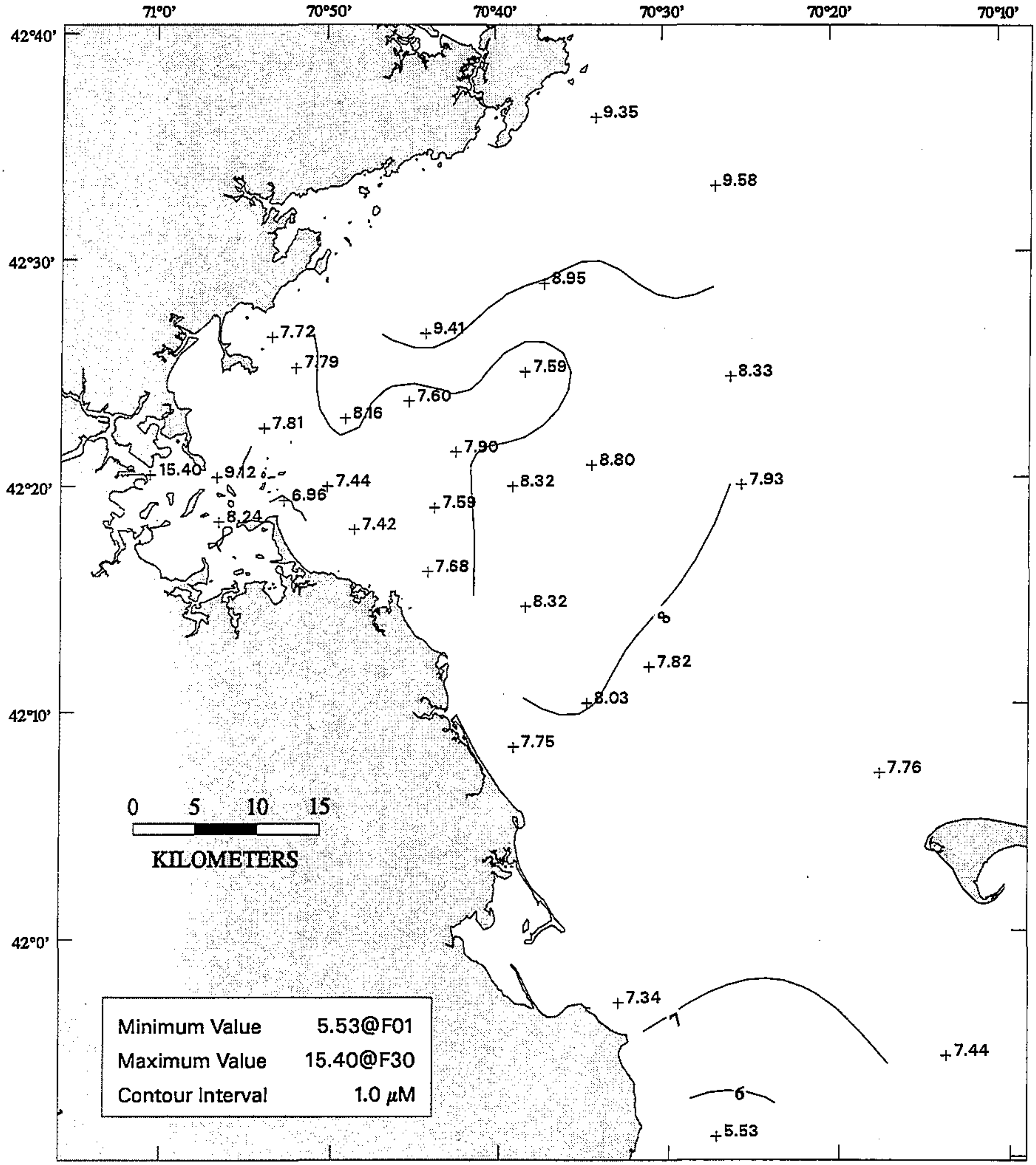

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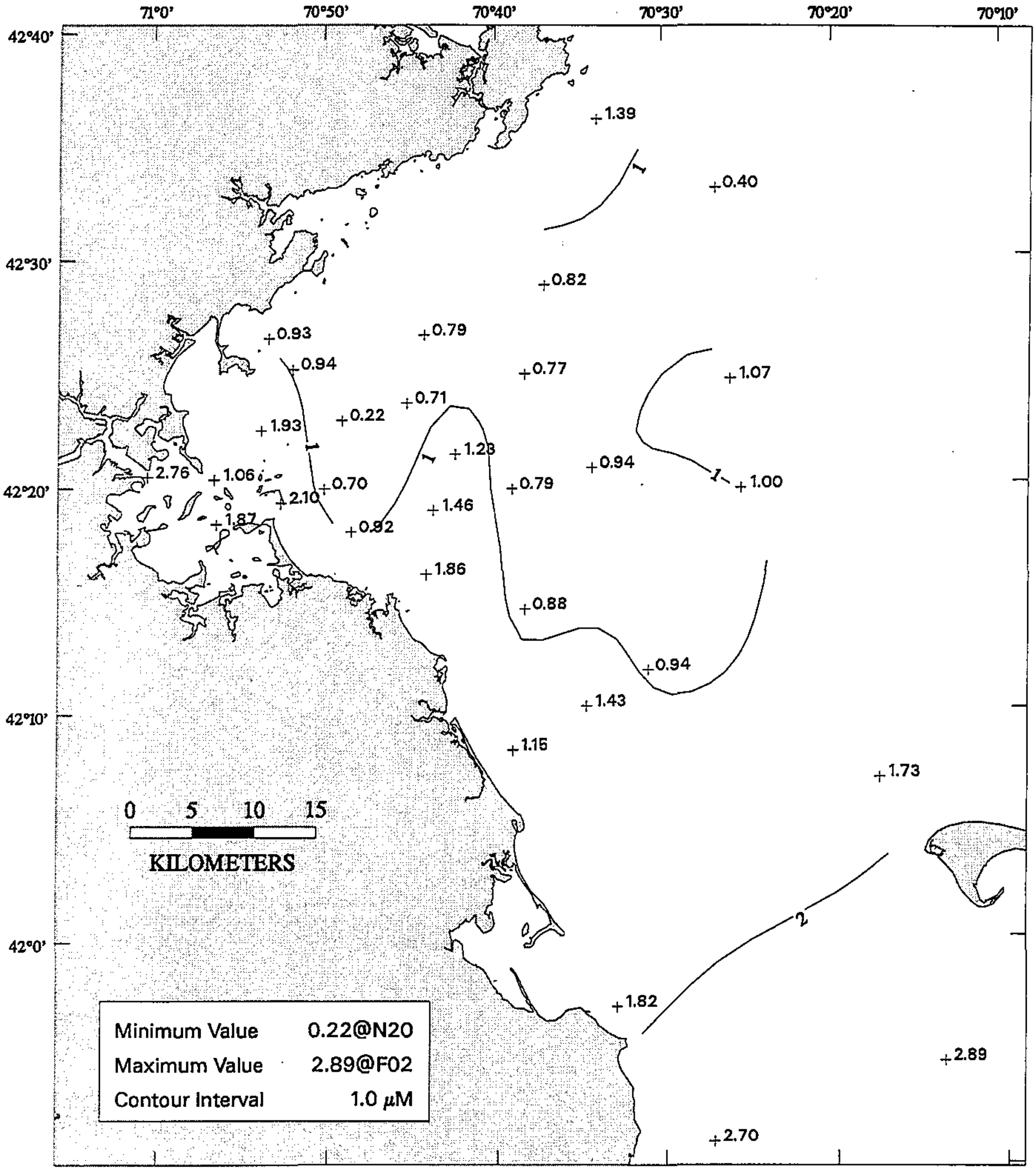

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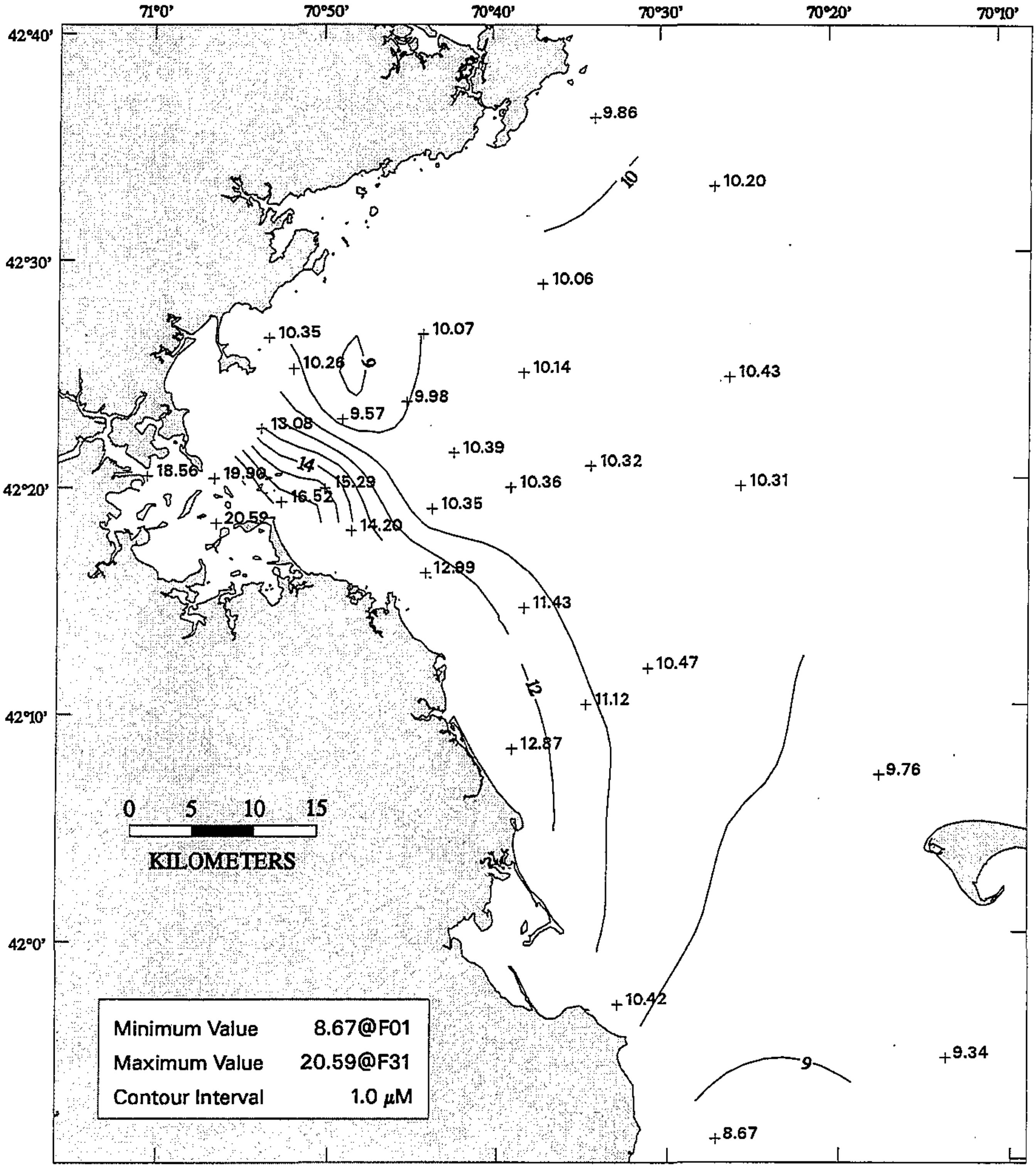

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10
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10.06
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10.07
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10.14
10.43
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9.57
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10.39
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18.56
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14
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10.36
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14.20
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11.43
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12
11.12
12.87
9.76
0 5 10 15
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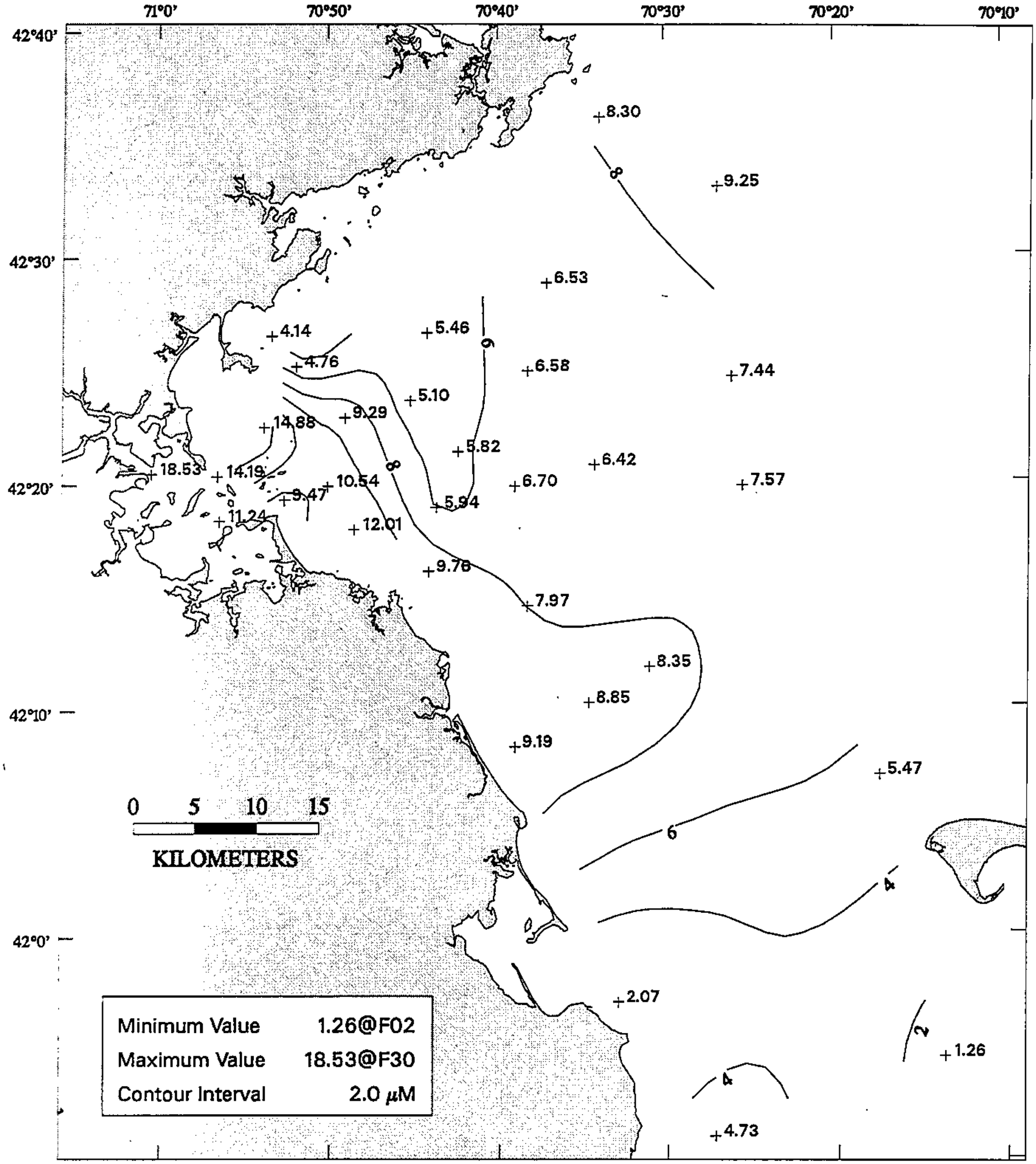
10.42
Minimum Value 8.67@F01
Maximum Value 20.59@F31
Contour Interval 1.0 μM
9
9.34
8.67

9501din_lin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5.47
2.07
1.26
4.73
8
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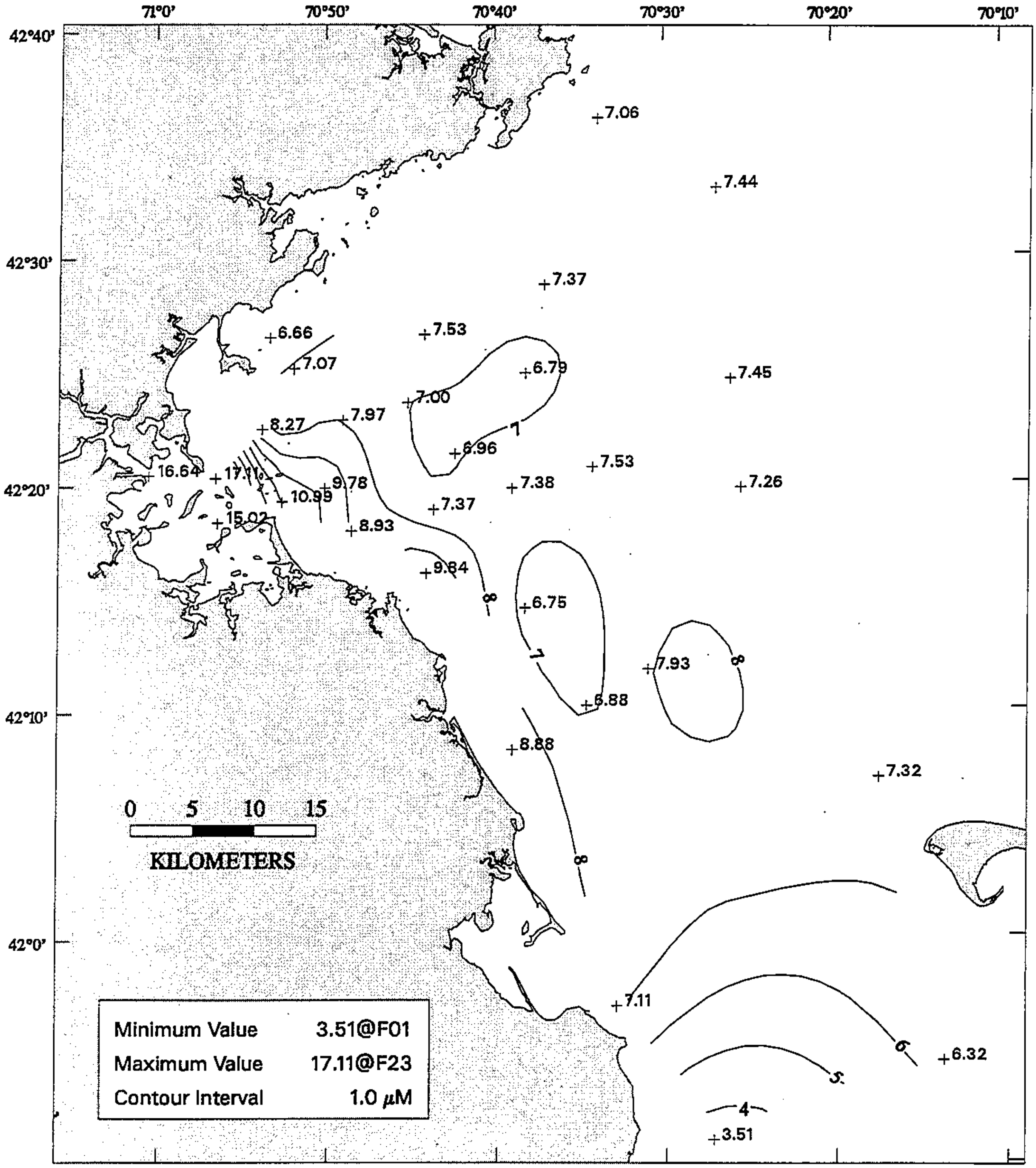
Minimum Value 1.26@F02
Maximum Value 18.53@F30
Contour Interval 2.0 μM

9502din_lin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6.88
8.88
7.32
7.11
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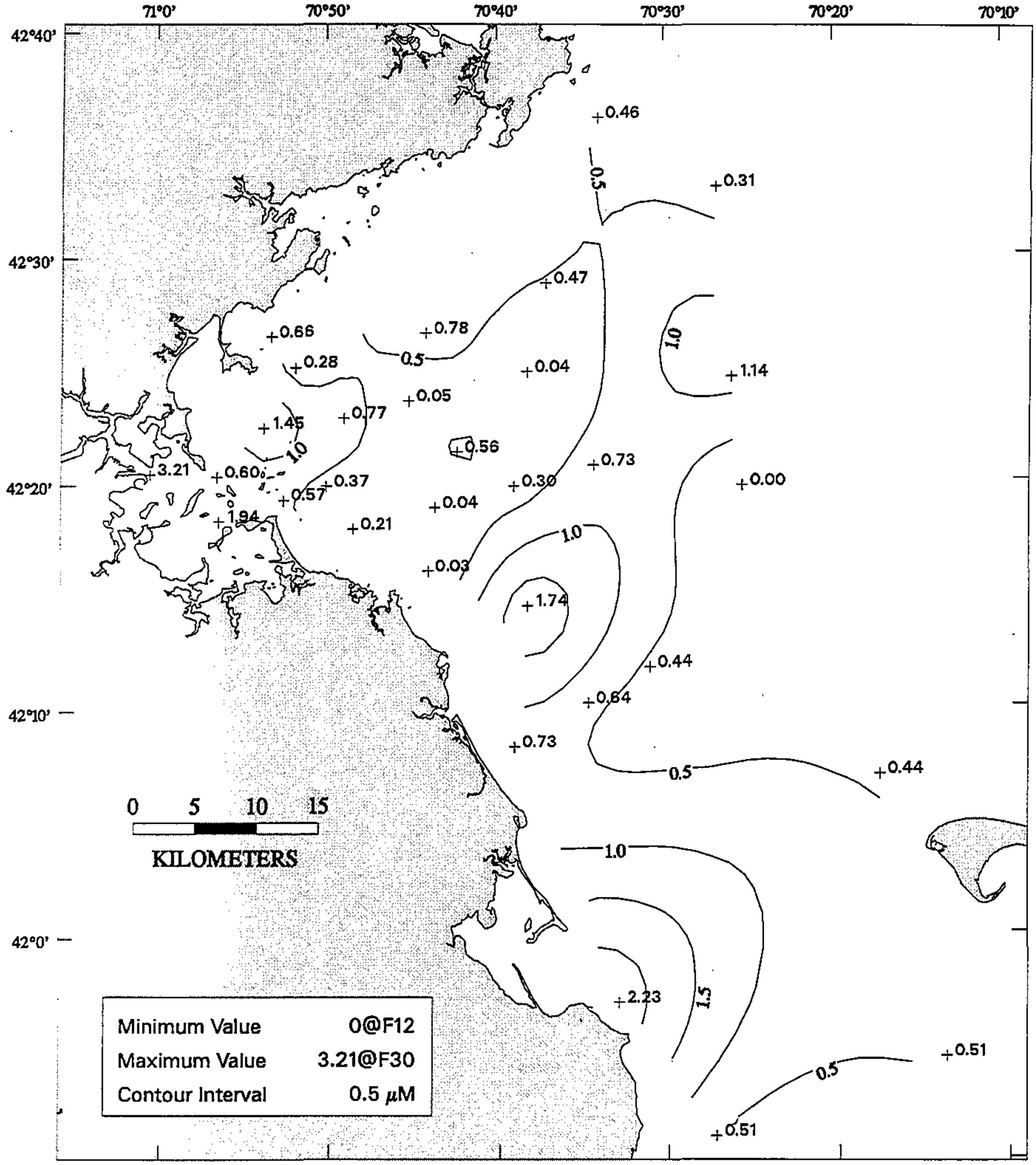
KILOMETERS
Minimum Value 3.51@F01
Maximum Value 17.11@F23
Contour Interval 1.0 μM

9504din_lin



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0.66
0.78
1.0
0.28
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1.14
0.05
1.45
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0.73
3.21
0.60
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0.30
0.00
0.57
0.04
1.94
0.21
1.0
0.03
1.74
0.44
0.64
0.73
0.5
0.44
0 5 10 15
KILOMETERS
1.0
1.5
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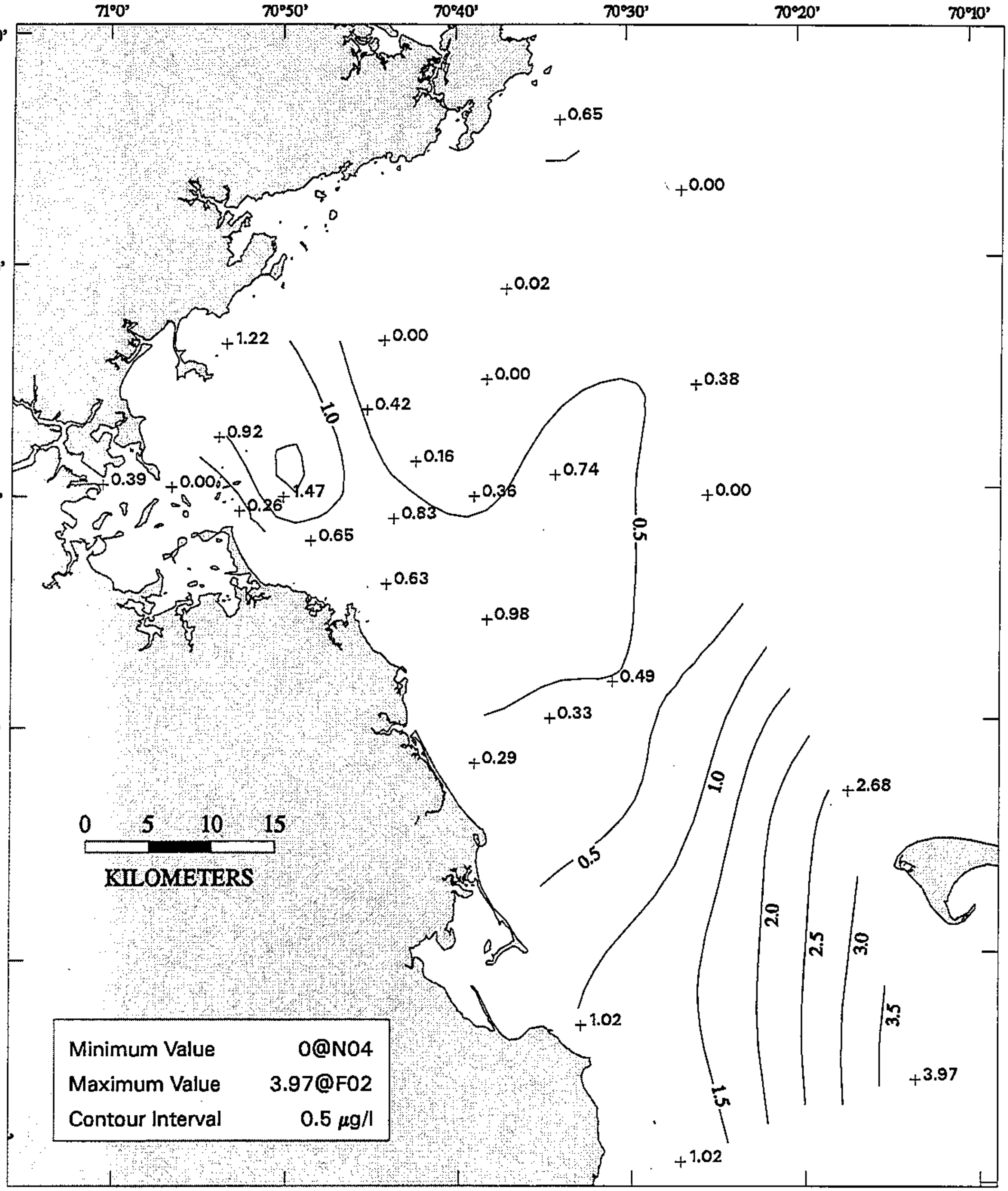
0.51
Minimum Value 0@F12
Maximum Value 3.21@F30
Contour Interval 0.5 μM

9507din_lin



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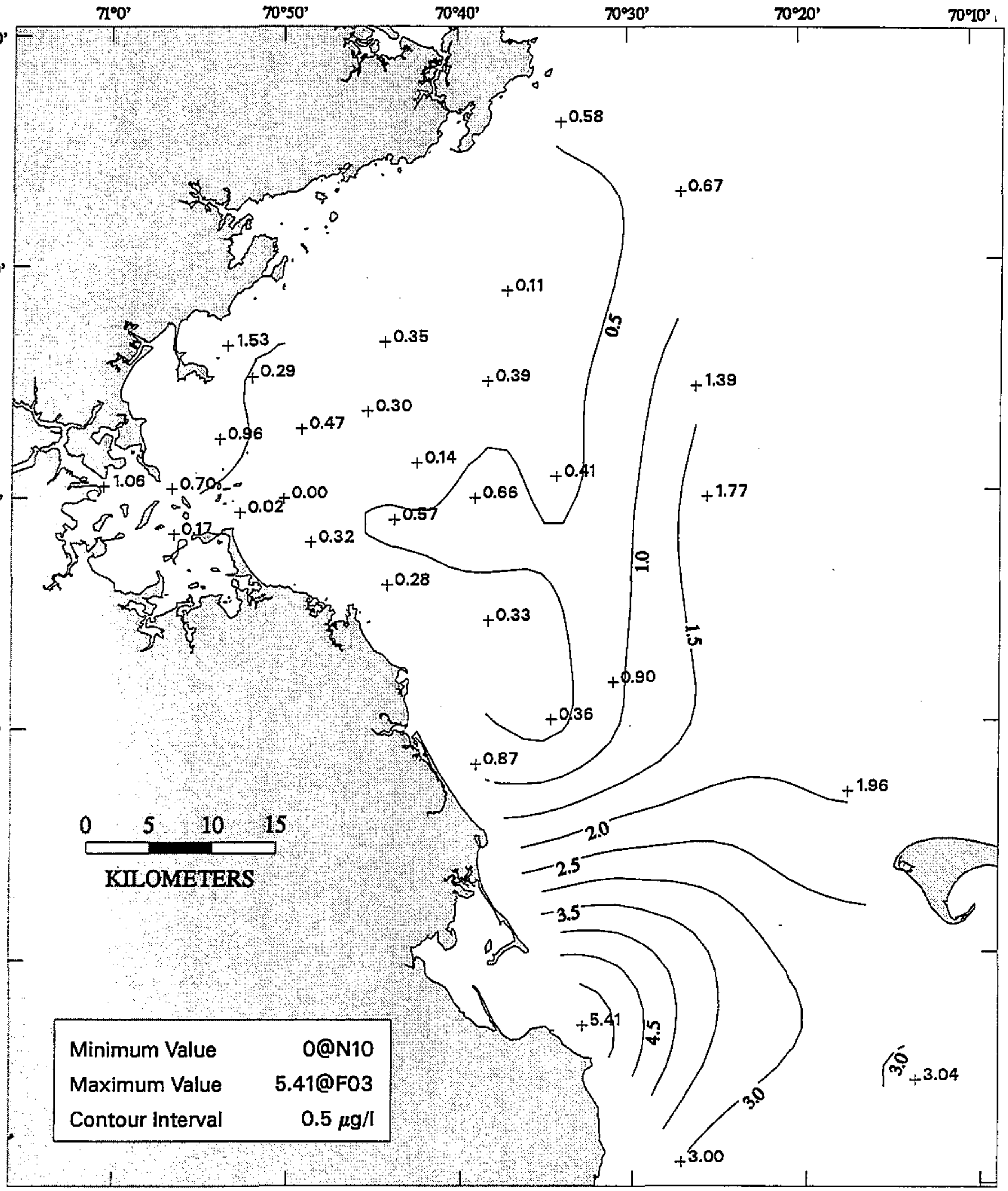

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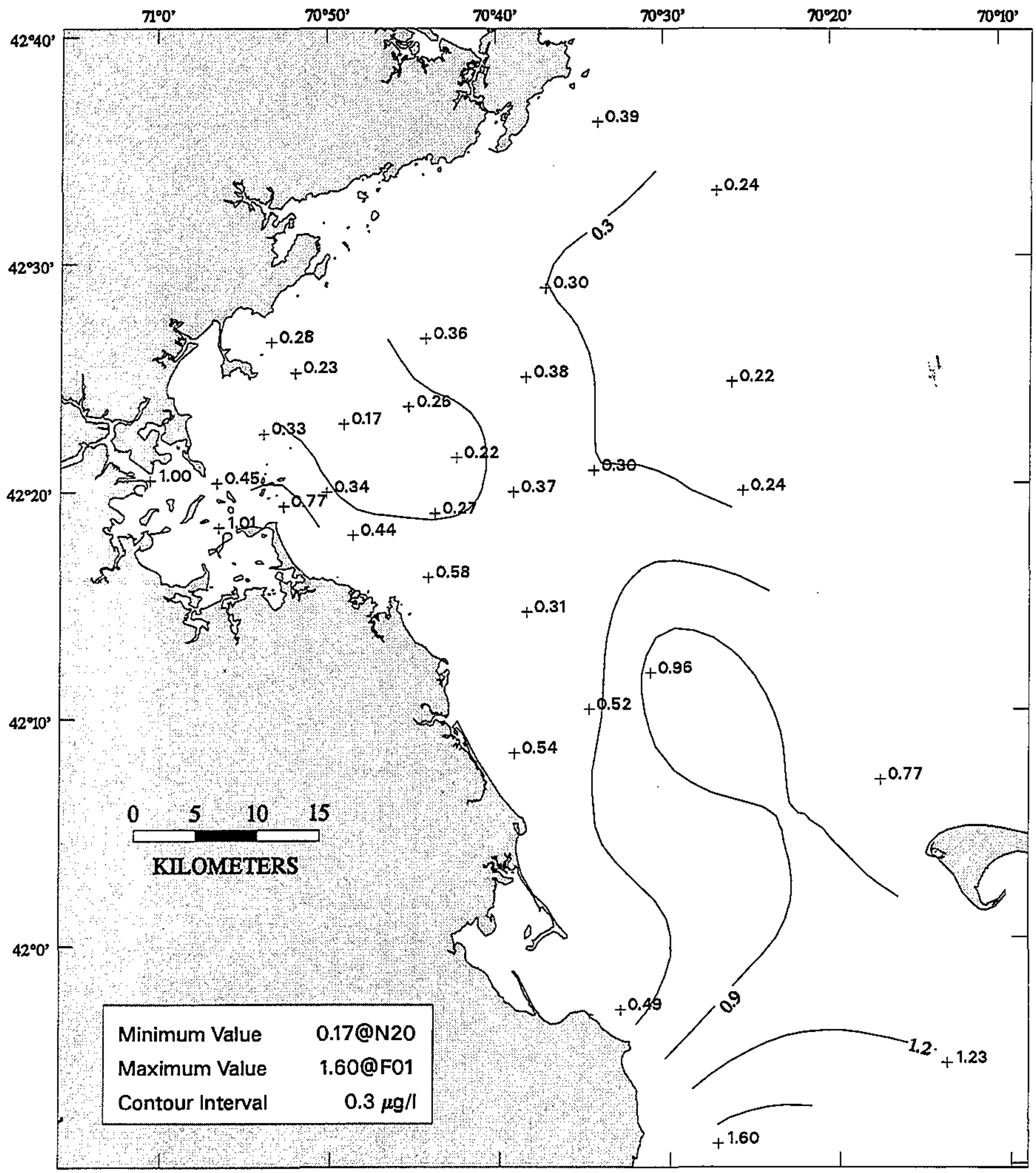

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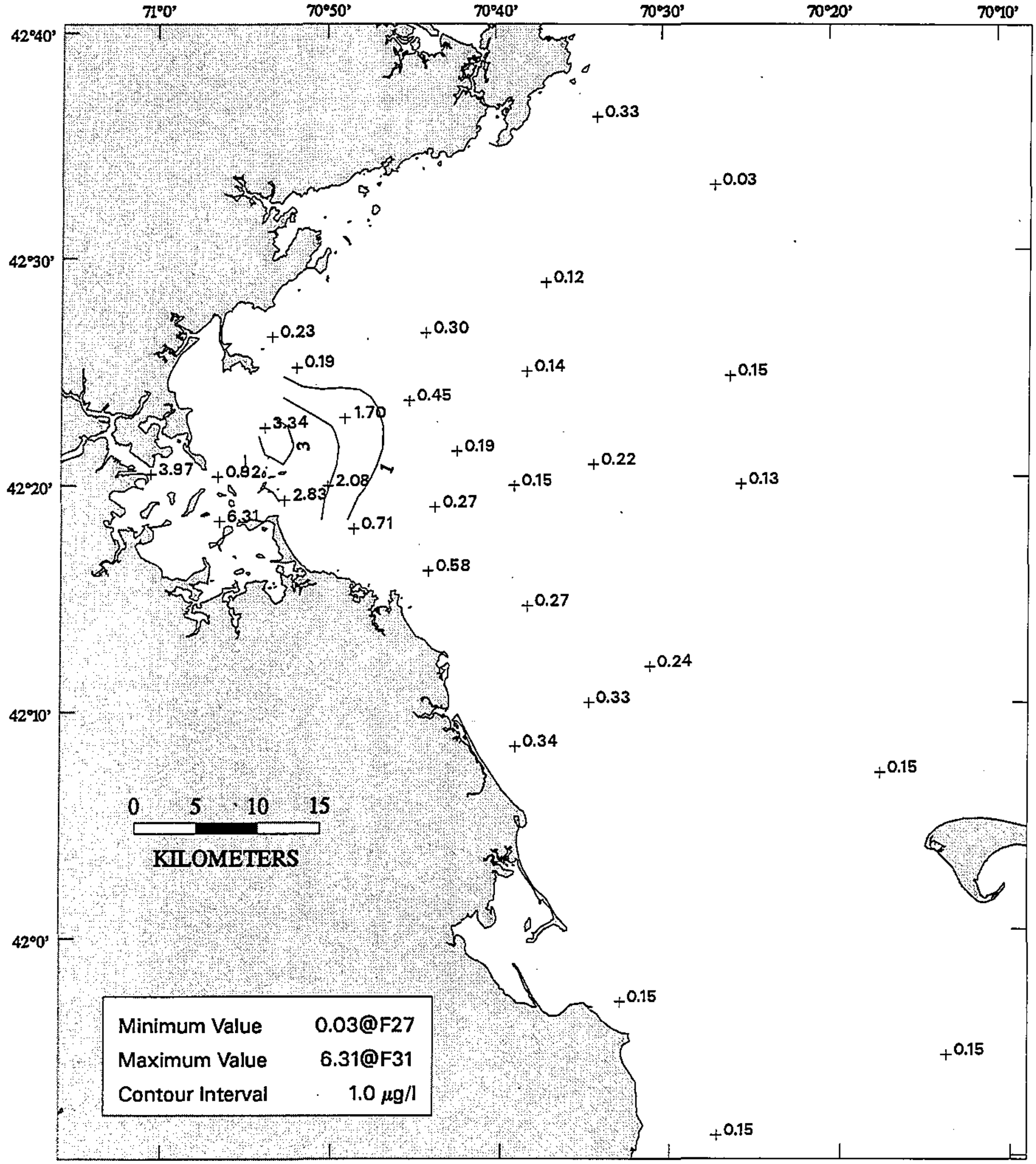


9507fluo_lin

APPENDIX C

TRANSECT PLOTS

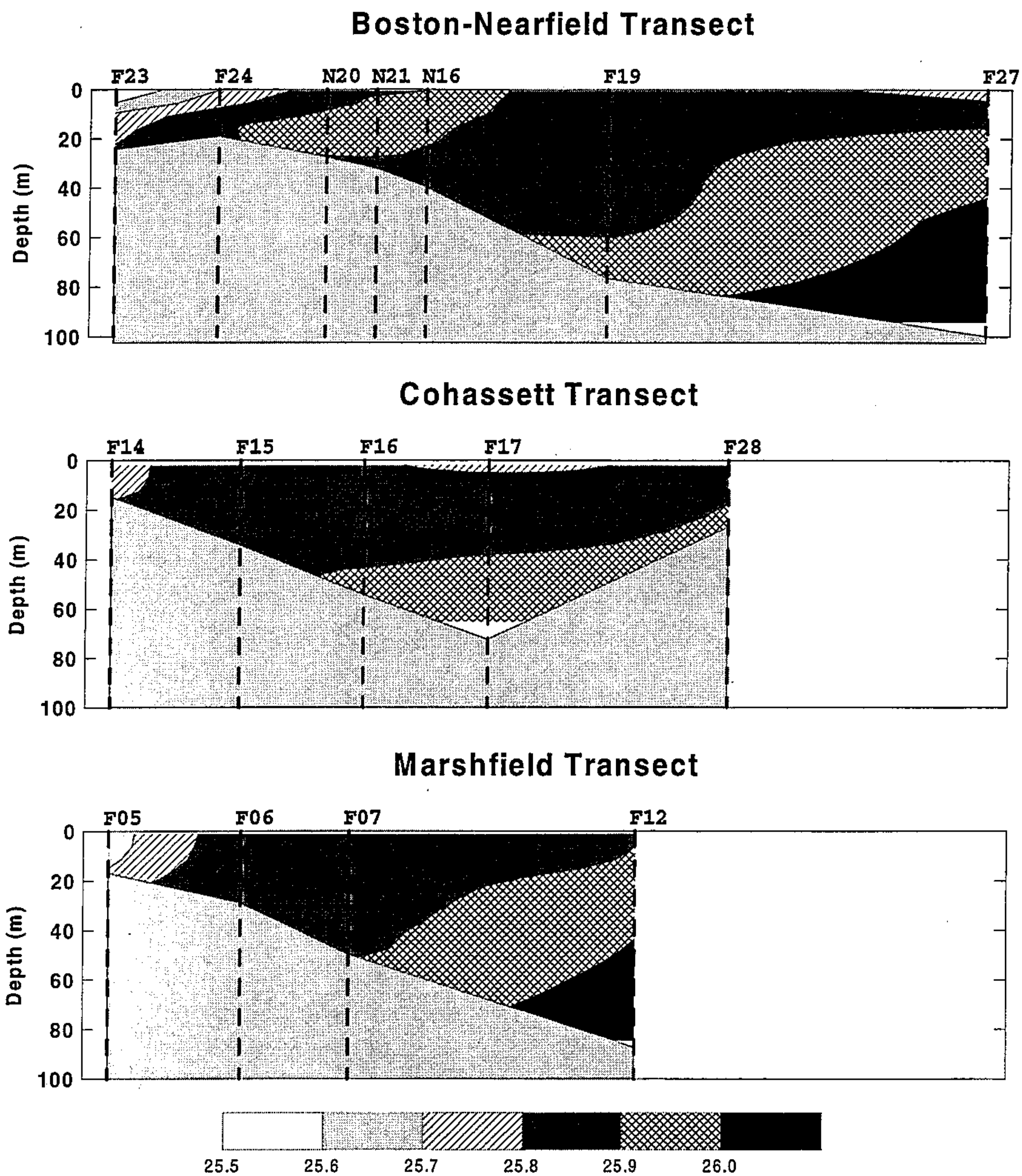
APPENDIX C

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 ("9501").

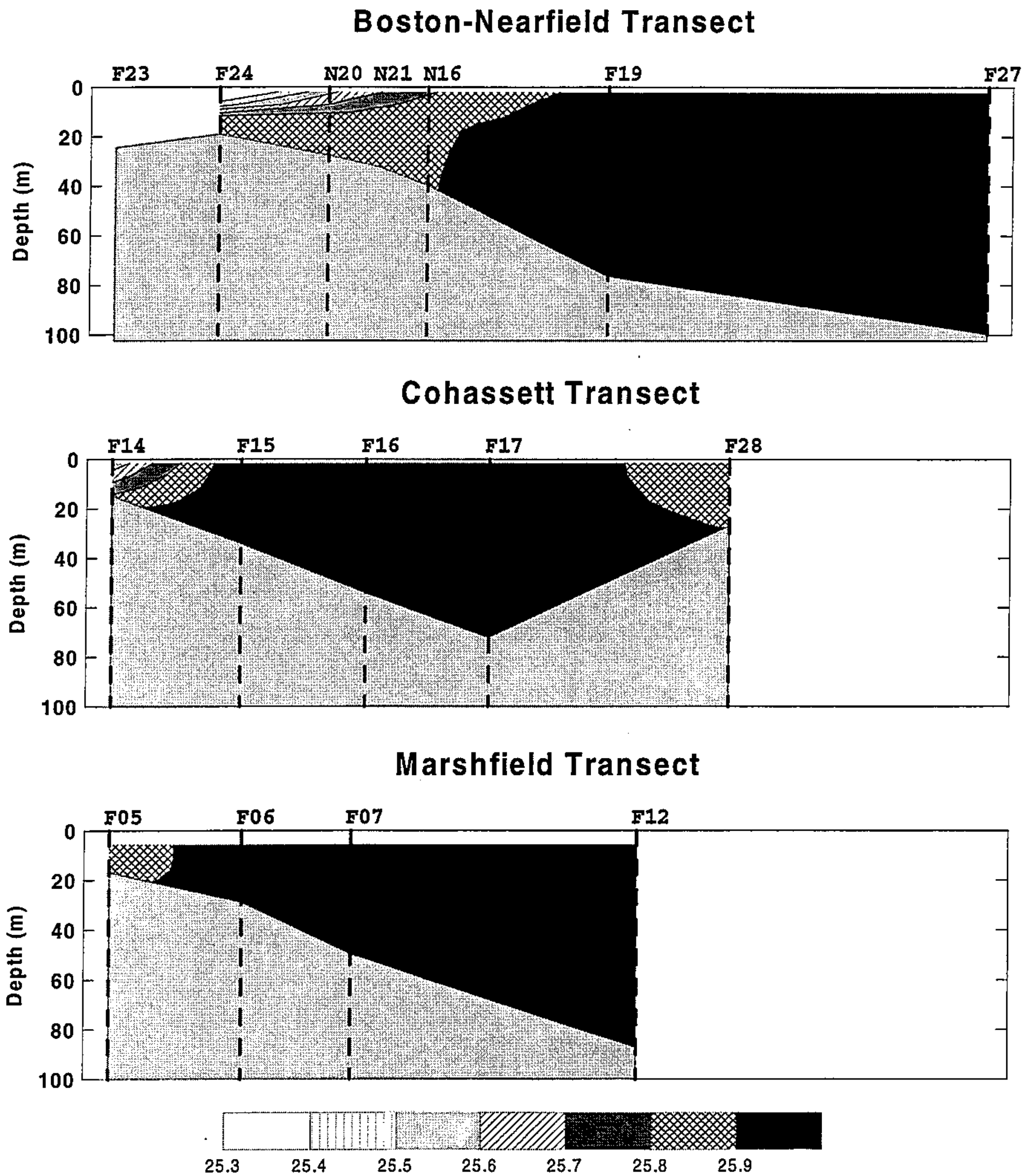
Appendix C: Table of Contents

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	%

*$NO_3 + NO_2 + NH_4$

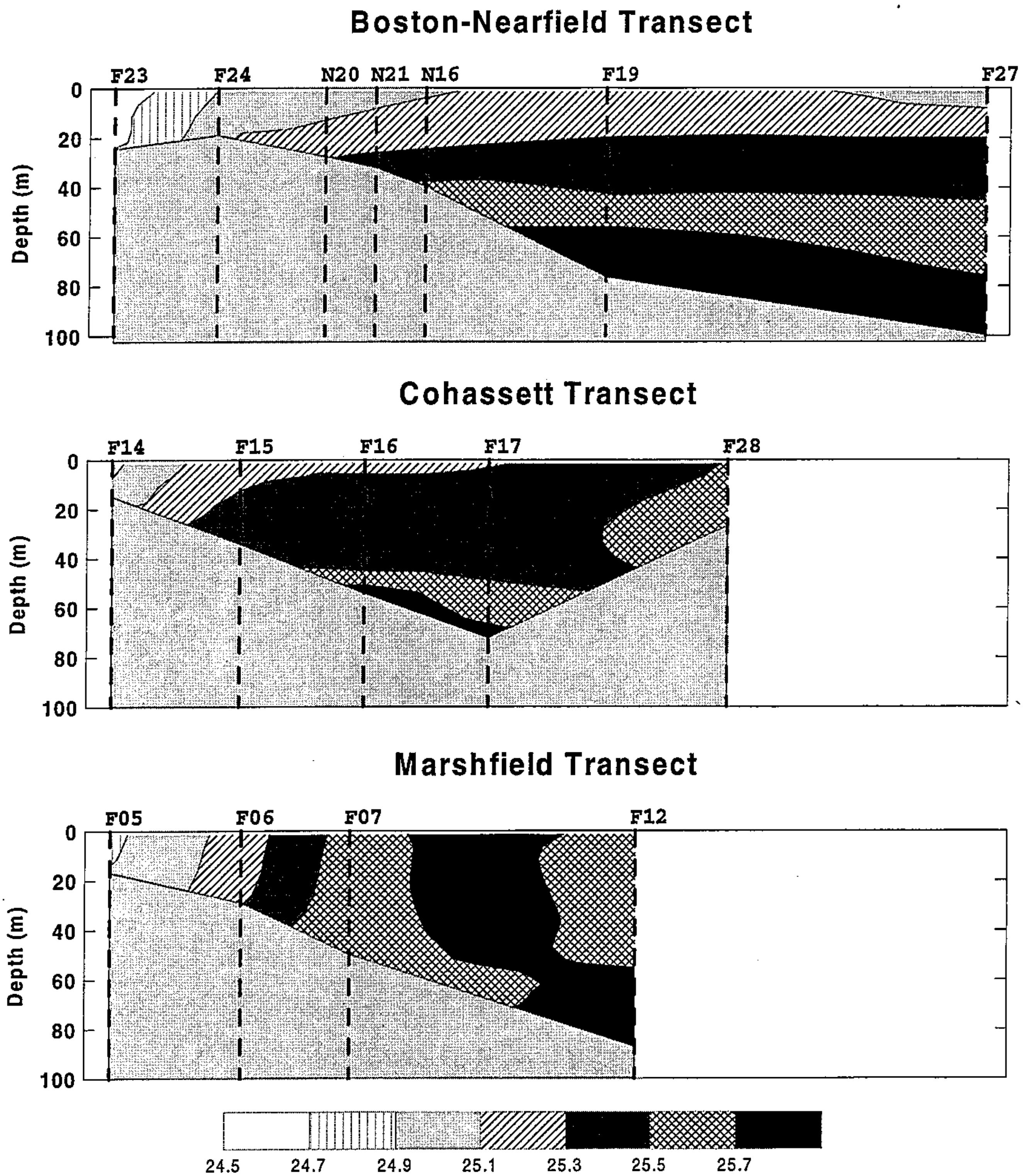

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
25.5
25.6
25.7
25.8
25.9
26.0

Sigma-T 9501



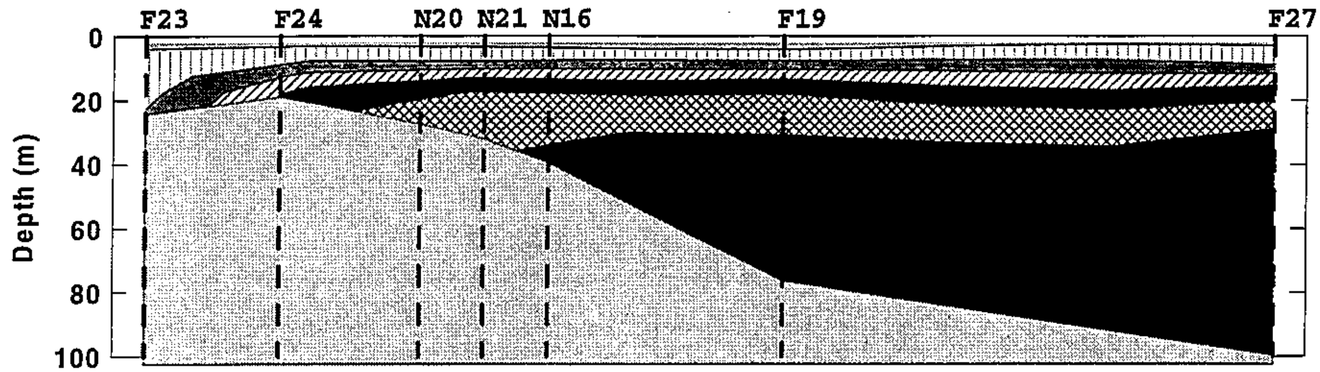
Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Marshfield Transect
F05
F06
F07
F12
25.3
25.4
25.5
25.6
25.7
25.8
25.9

Sigma-T 9502

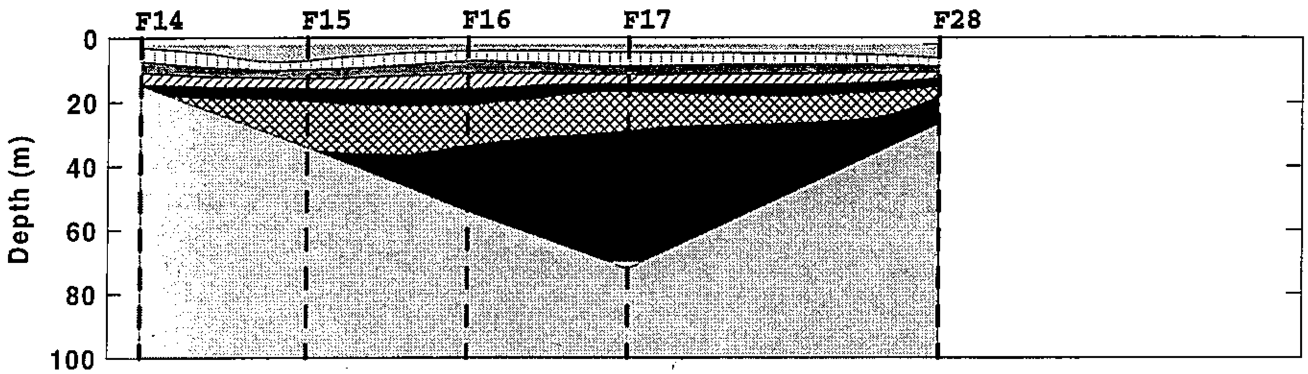

Boston-Nearfield Transect
F23 F24 N20 N21 N16 F19 F27
Depth (m)
0 20 40 60 80 100
Cohassett Transect
F14 F15 F16 F17 F28
Depth (m)
0 20 40 60 80 100
Marshfield Transect
F05 F06 F07 F12
Depth (m)
0 20 40 60 80 100
24.5 24.7 24.9 25.1 25.3 25.5 25.7

Sigma-T 9504

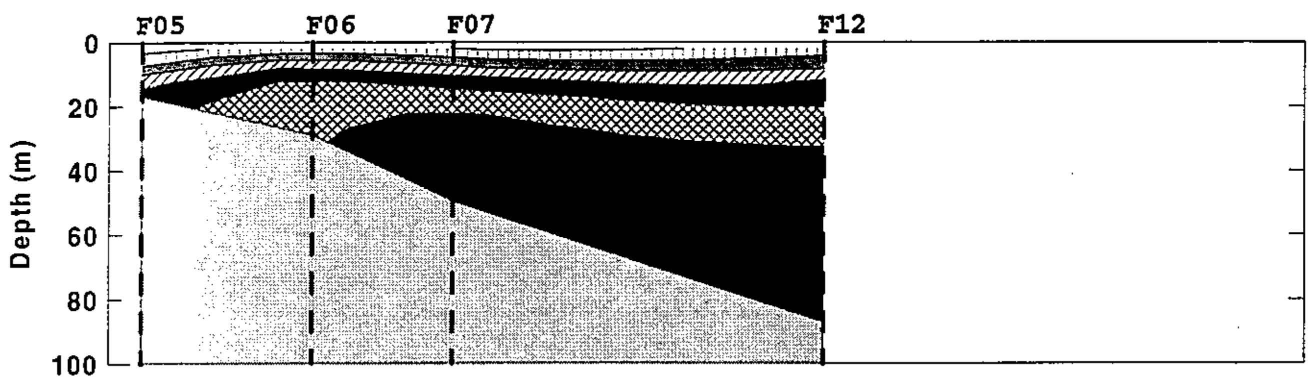
Boston-Nearfield Transect

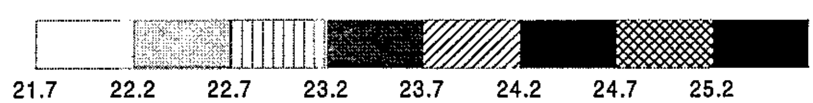


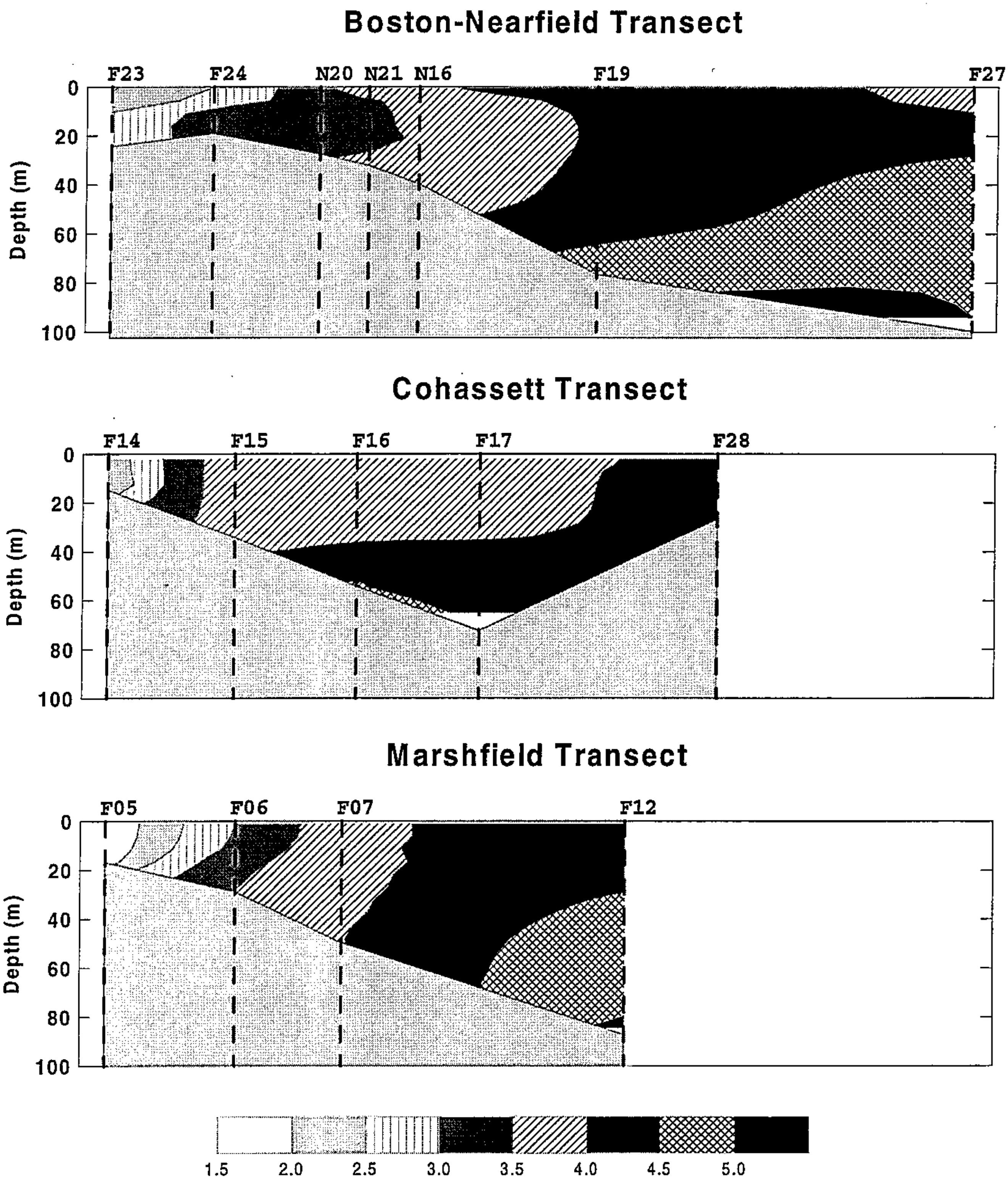
Cohassett Transect



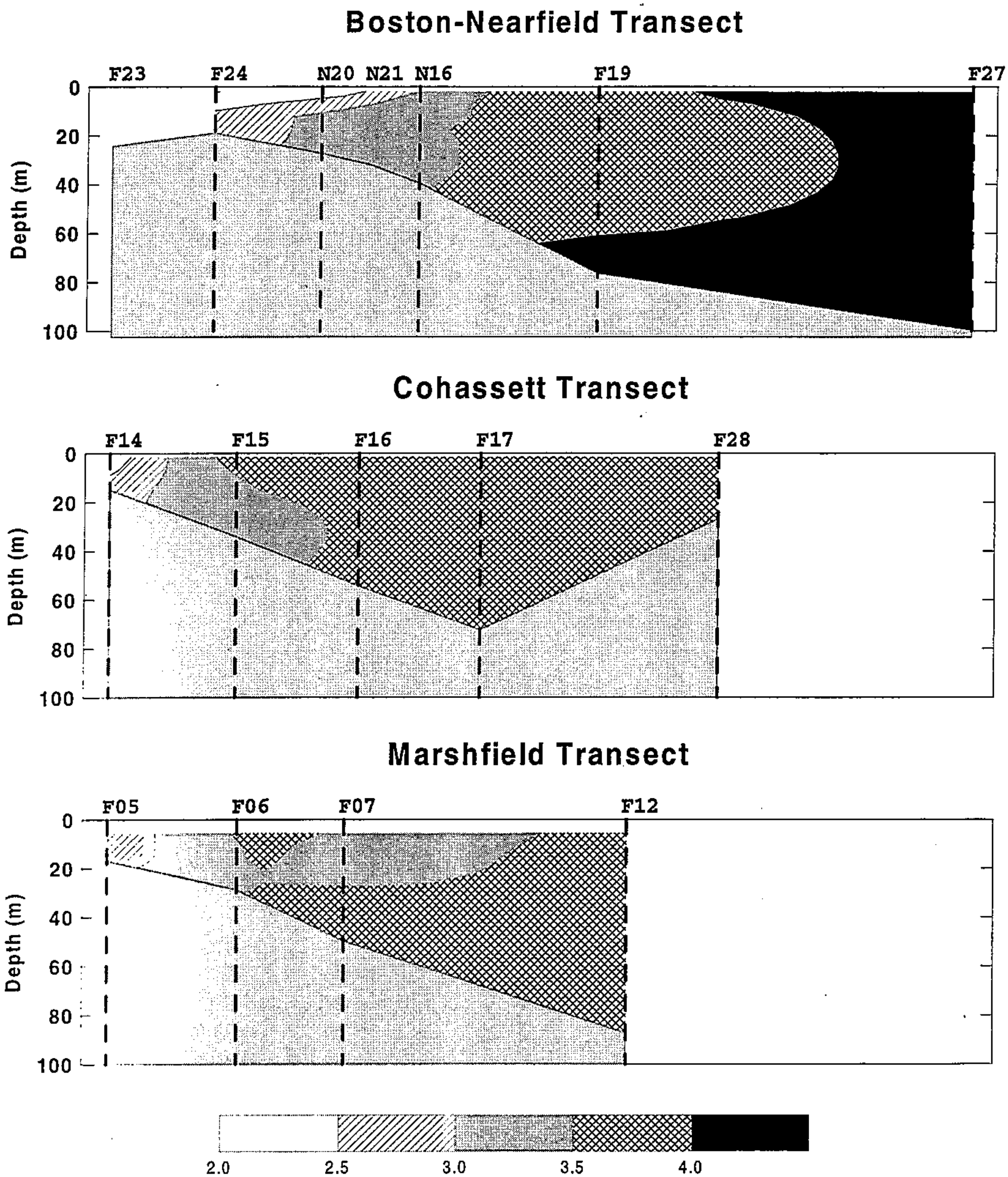
Marshfield Transect



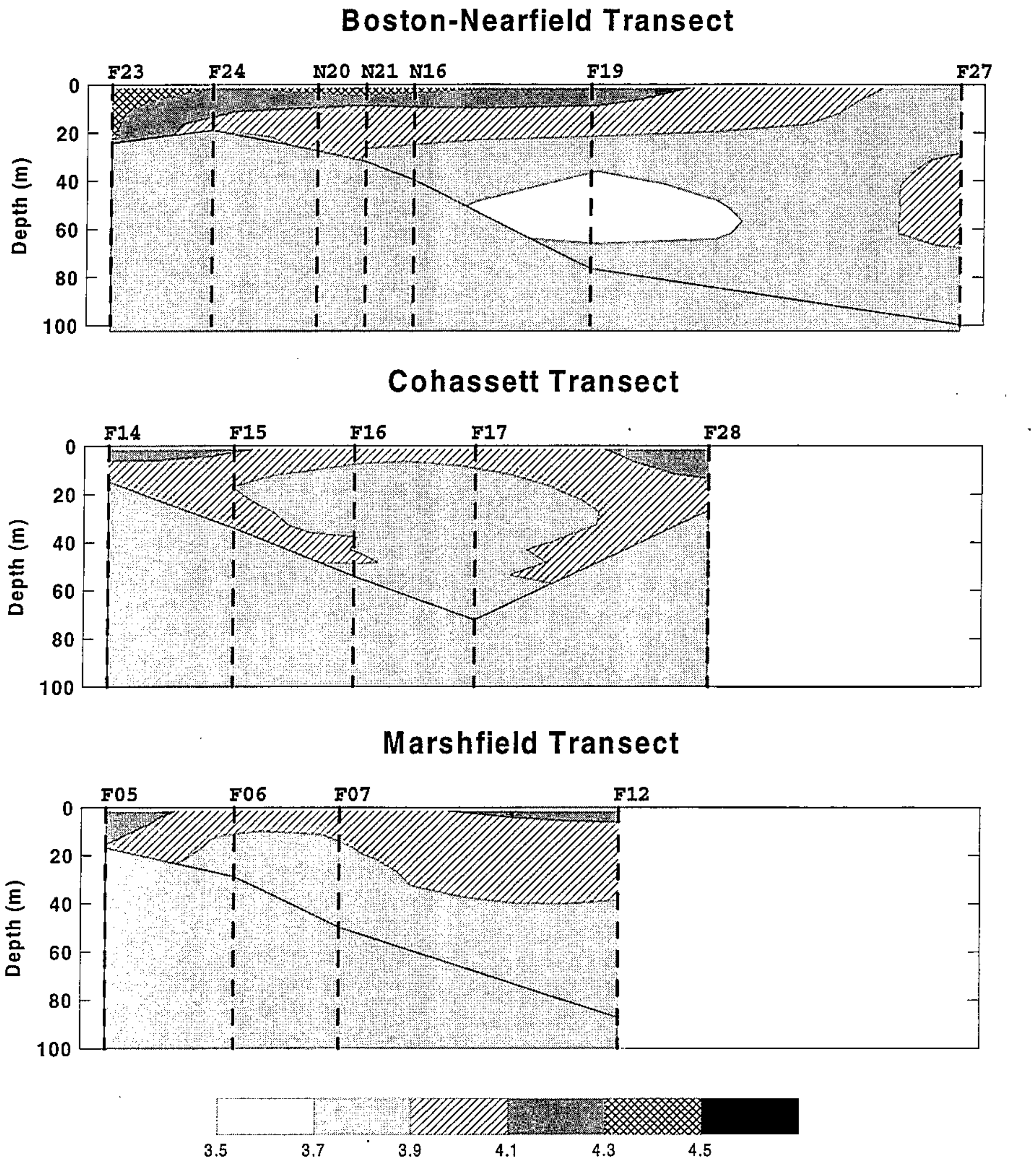


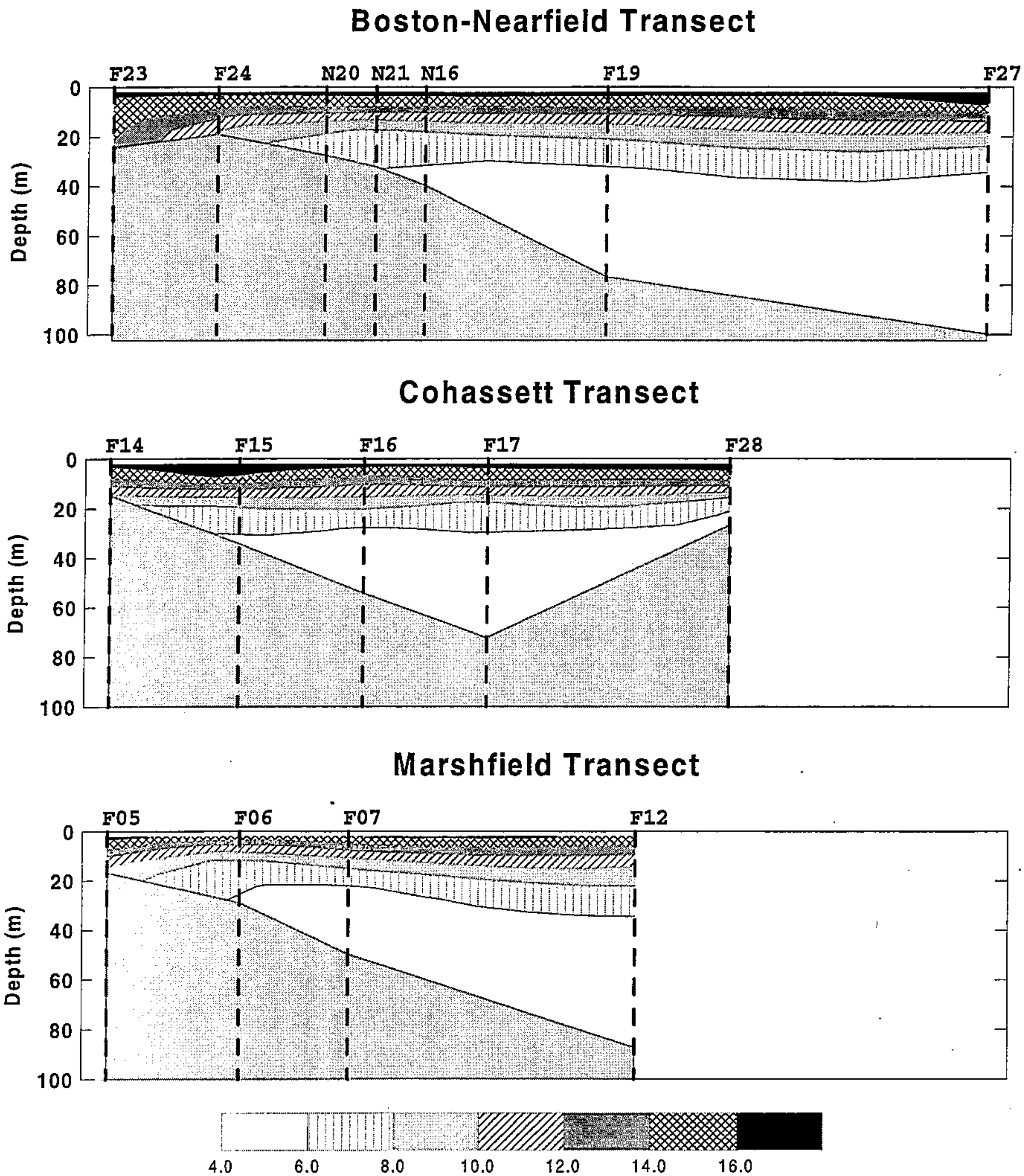


Temperature 9501



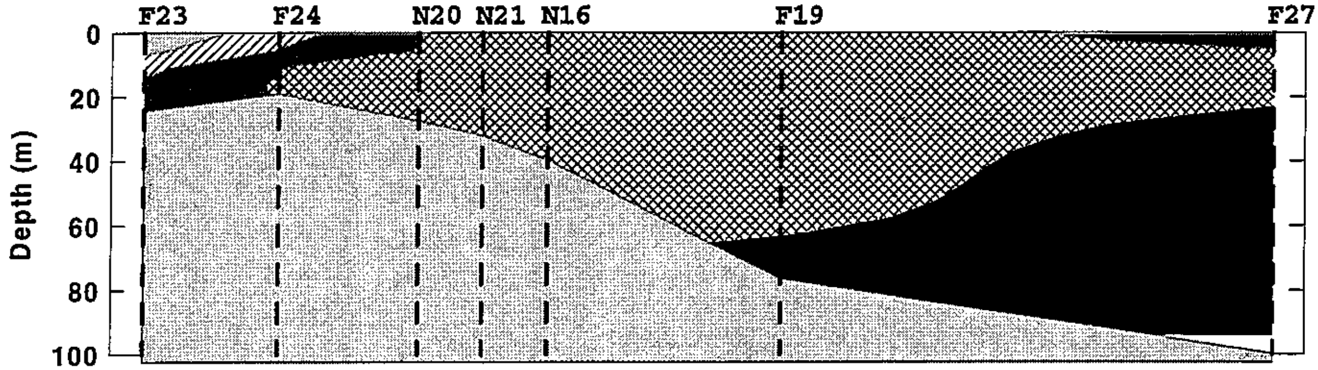
Temperature 9502


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
3.5
3.7
3.9
4.1
4.3
4.5

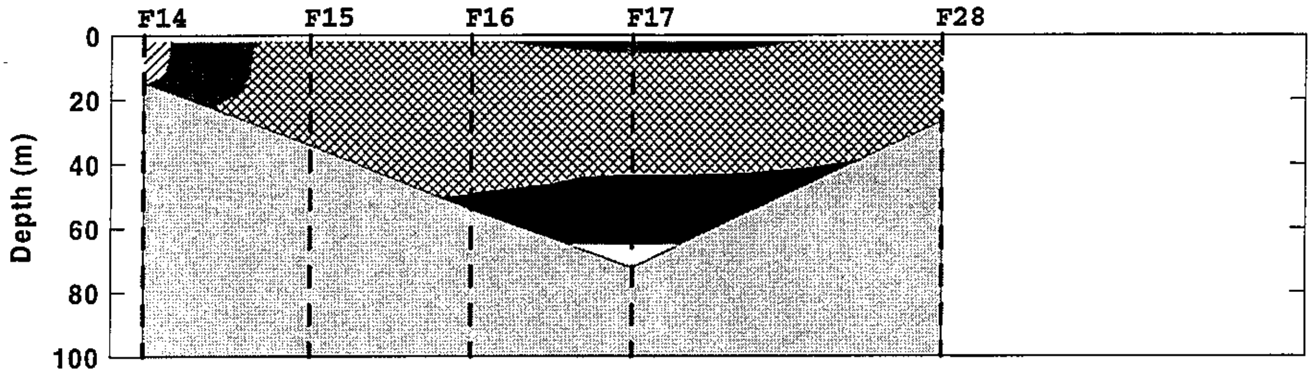


Temperature 9507

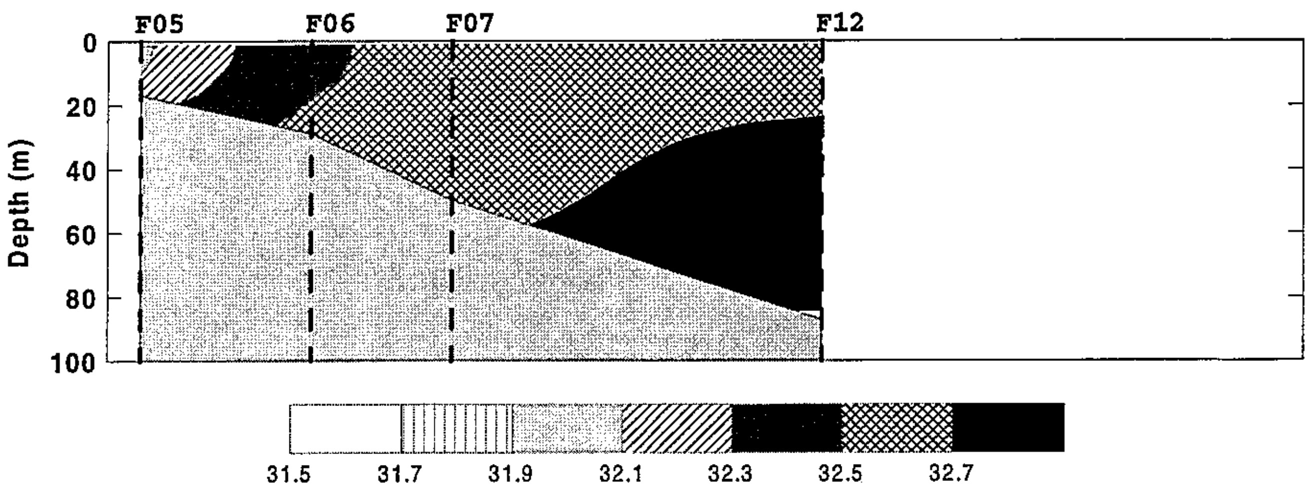
Boston-Nearfield Transect

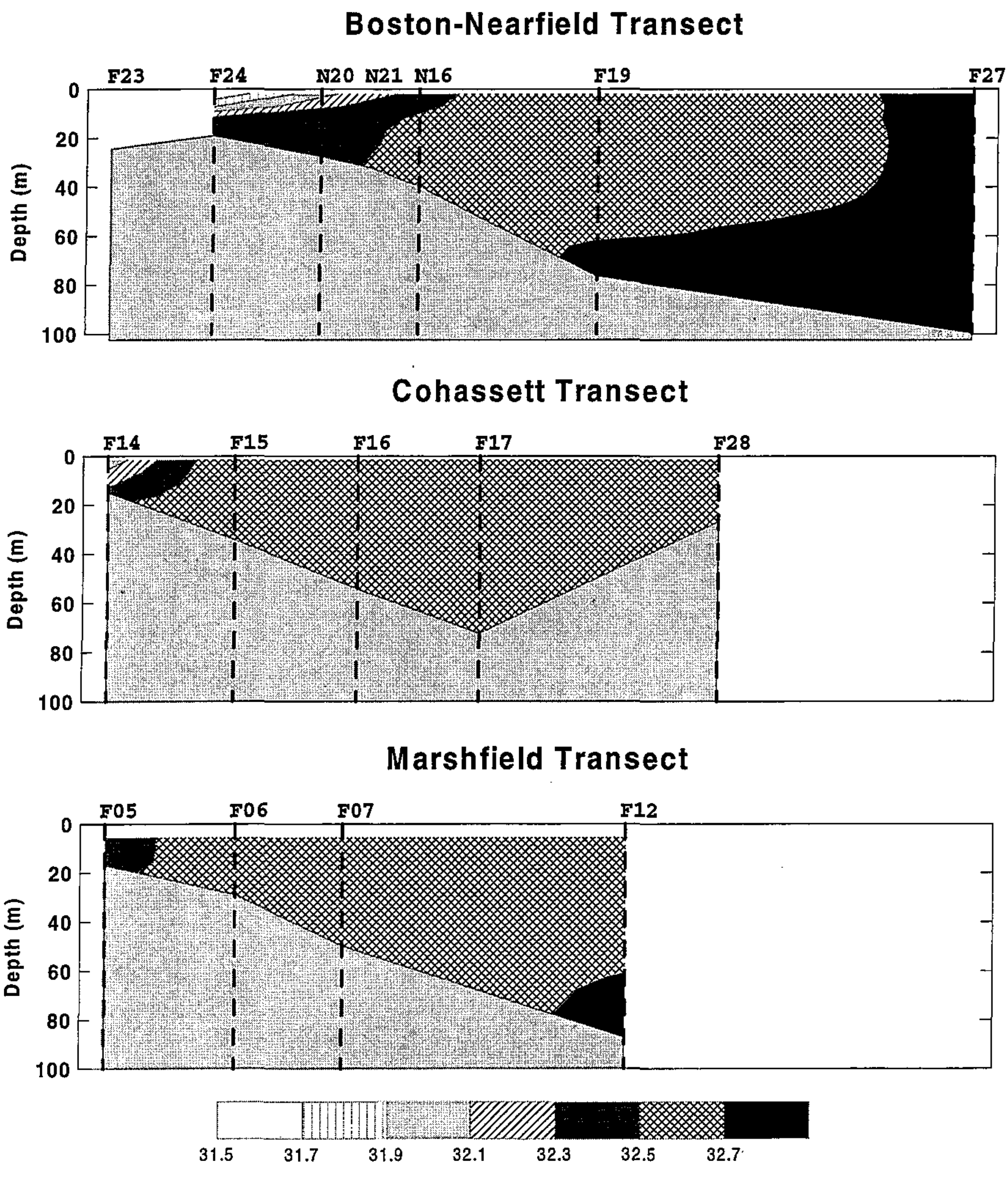


Cohassett Transect

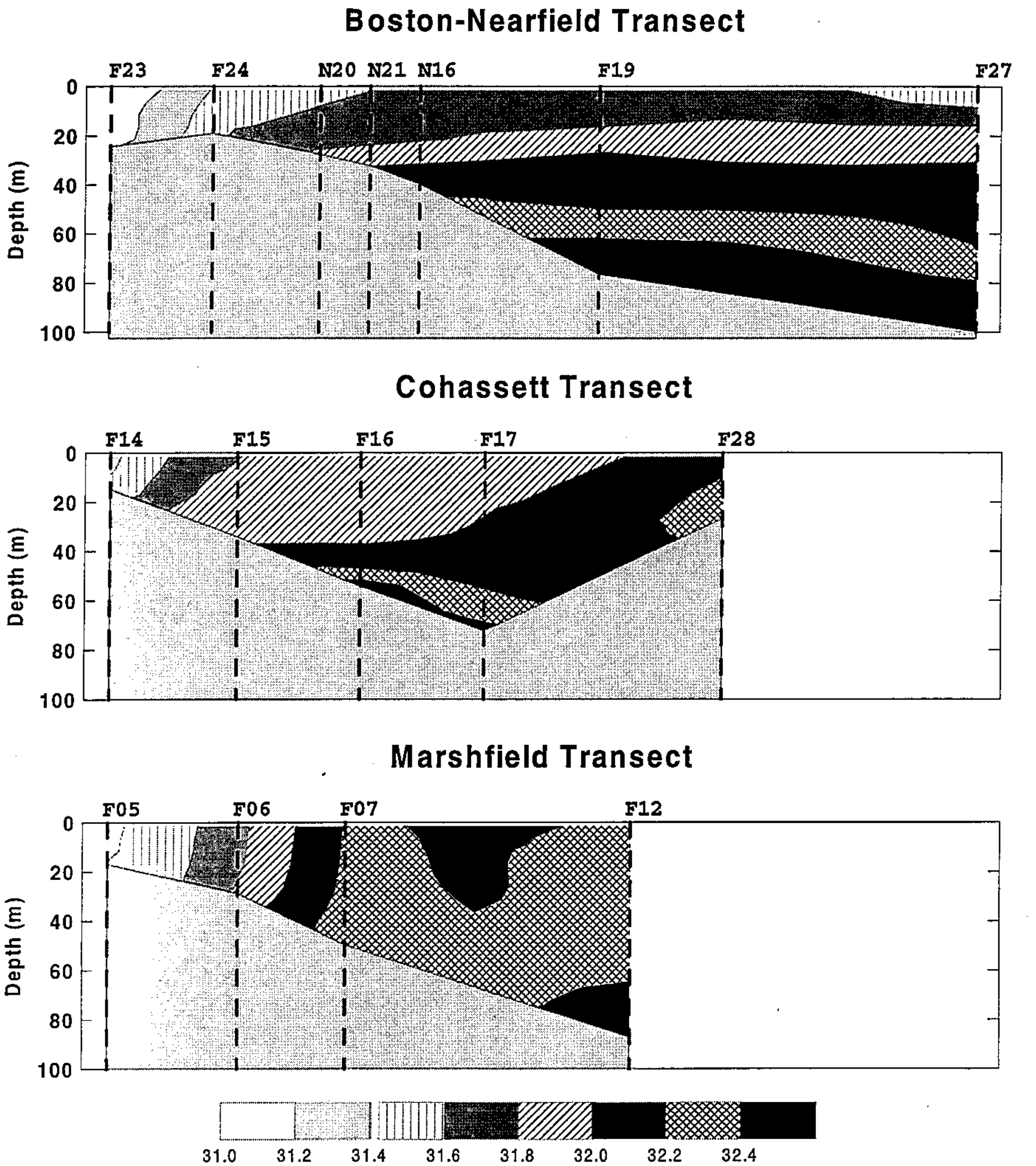


Marshfield Transect



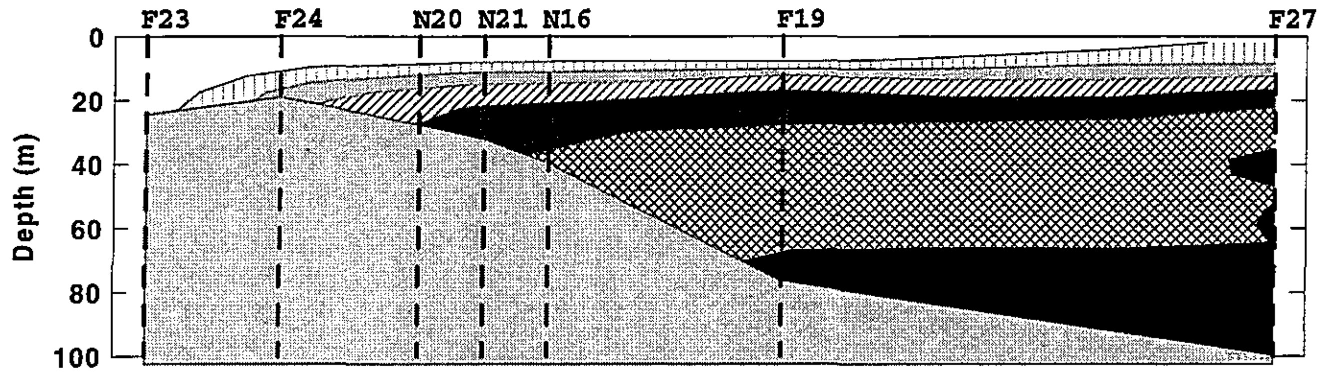


Salinity 9502

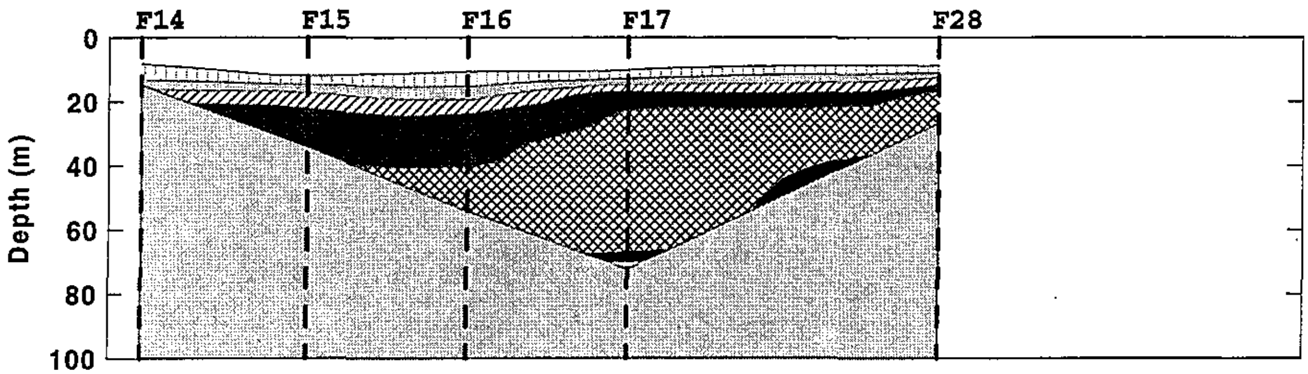


Salinity 9504

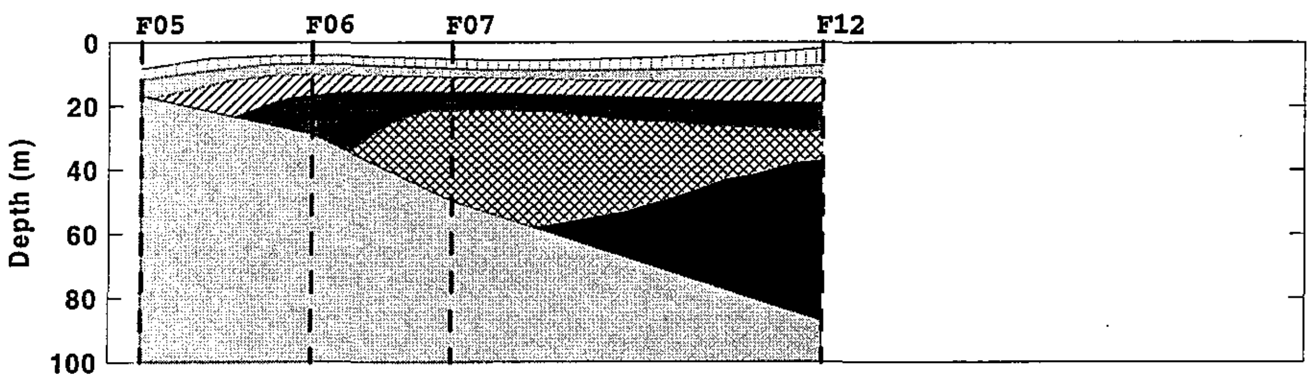
Boston-Nearfield Transect

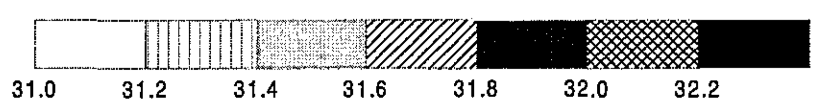


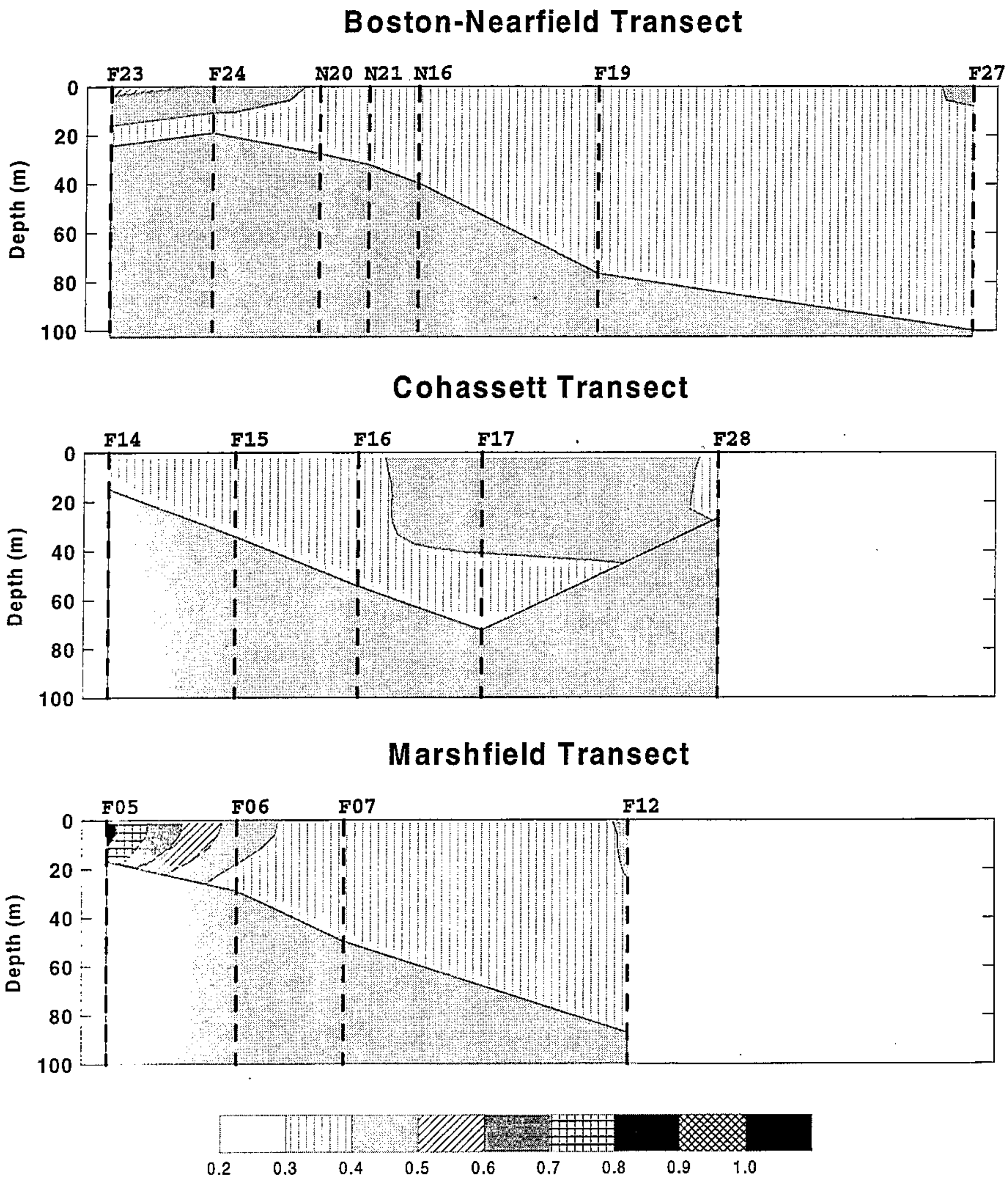
Cohassett Transect

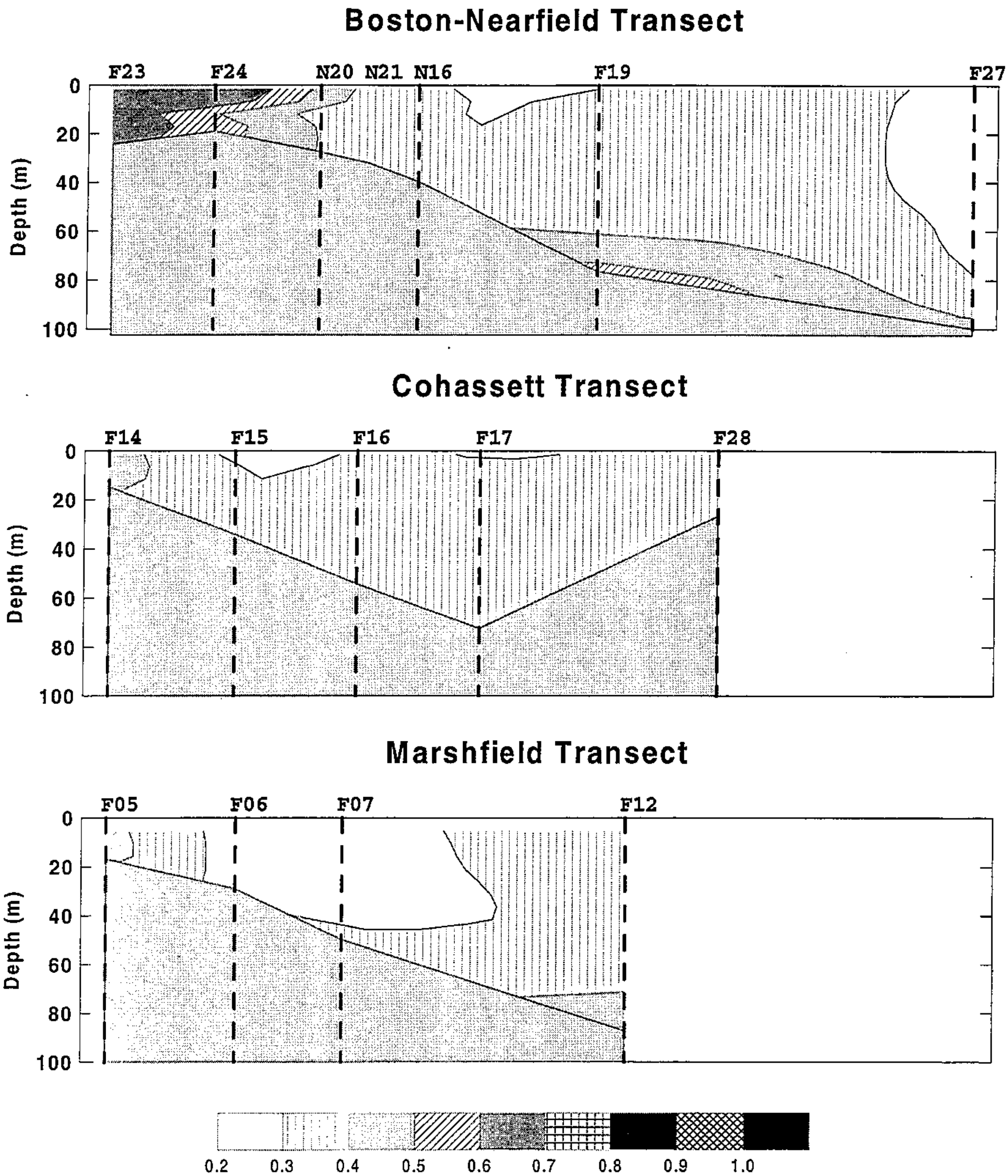


Marshfield Transect

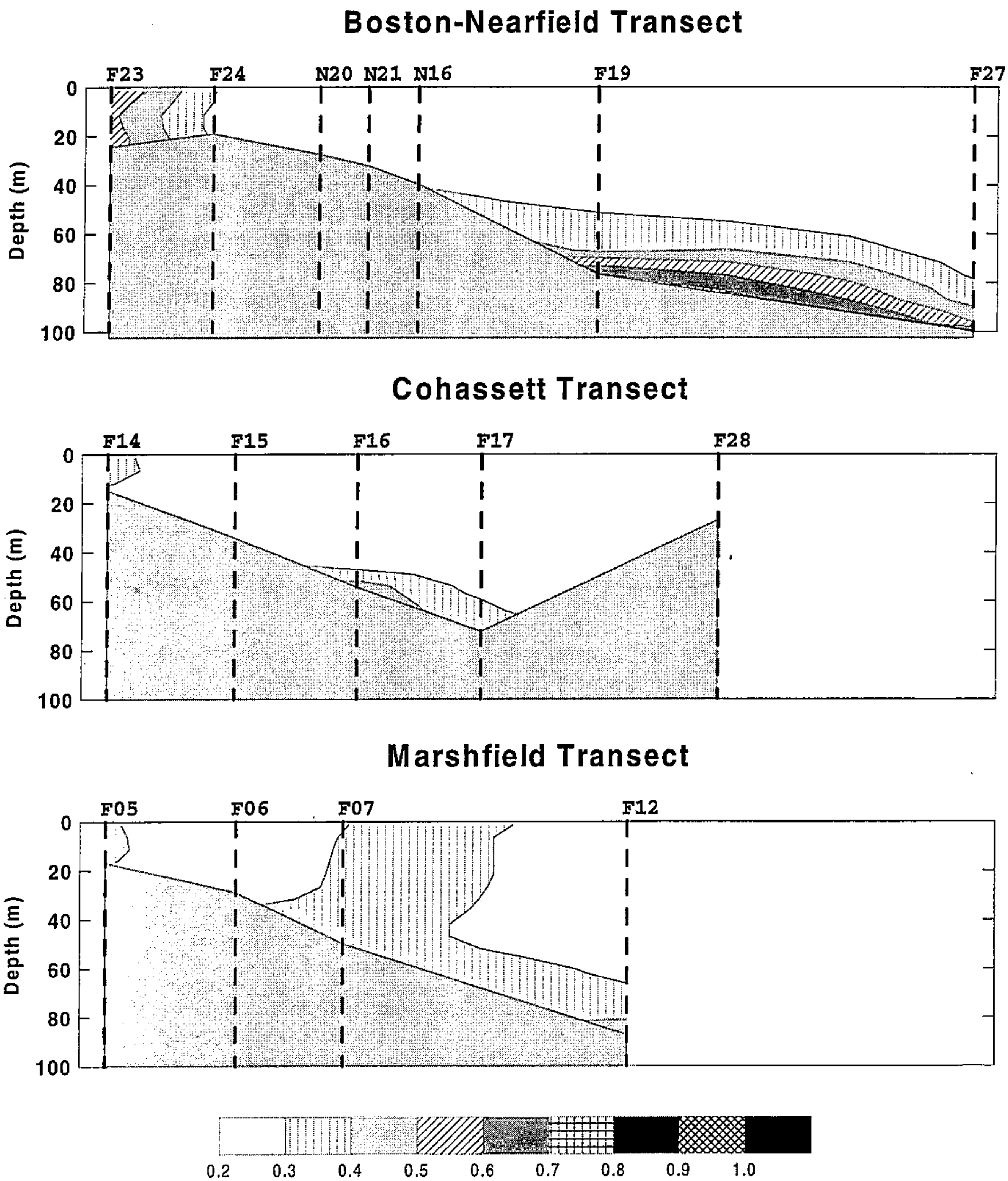




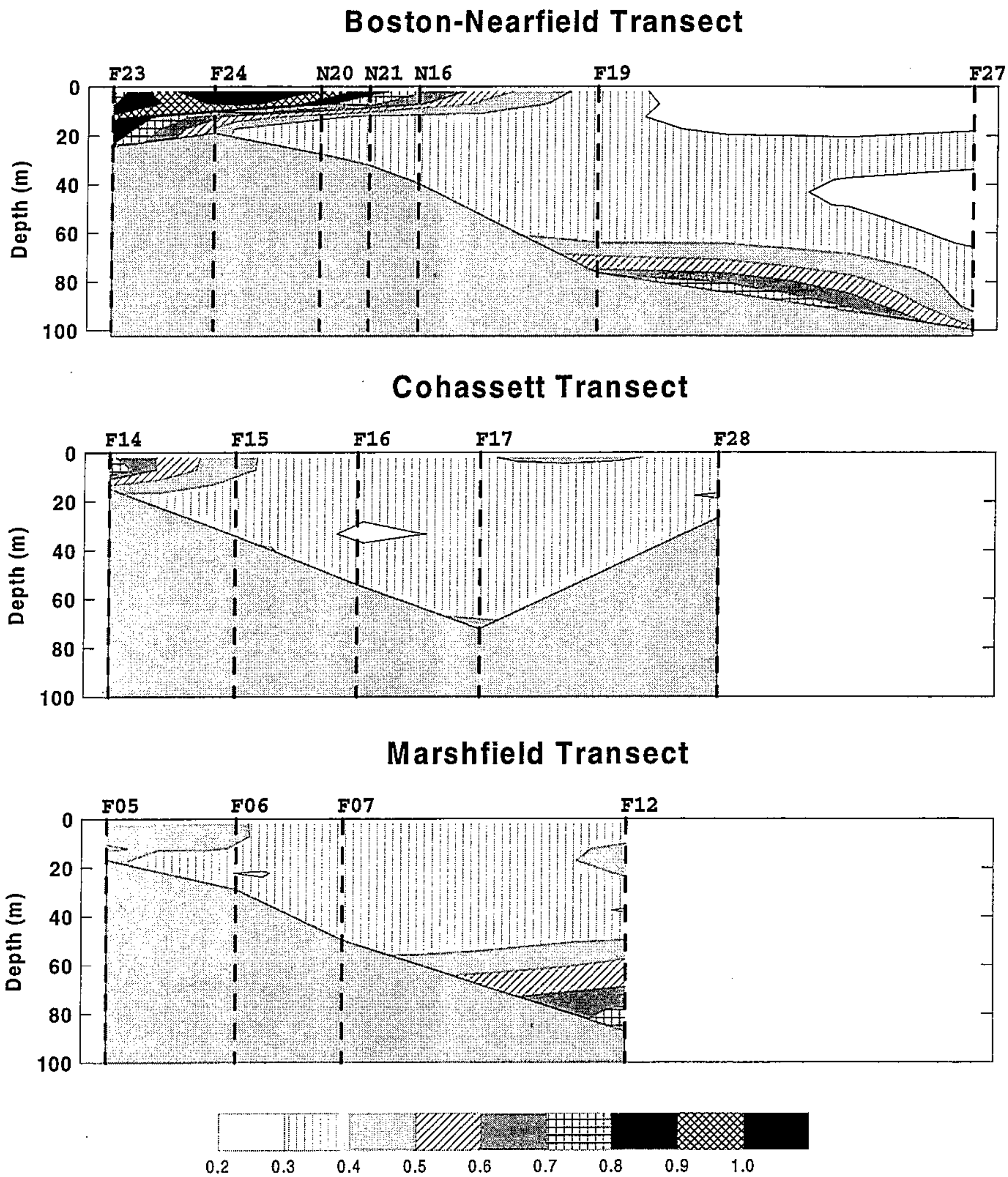

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0


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

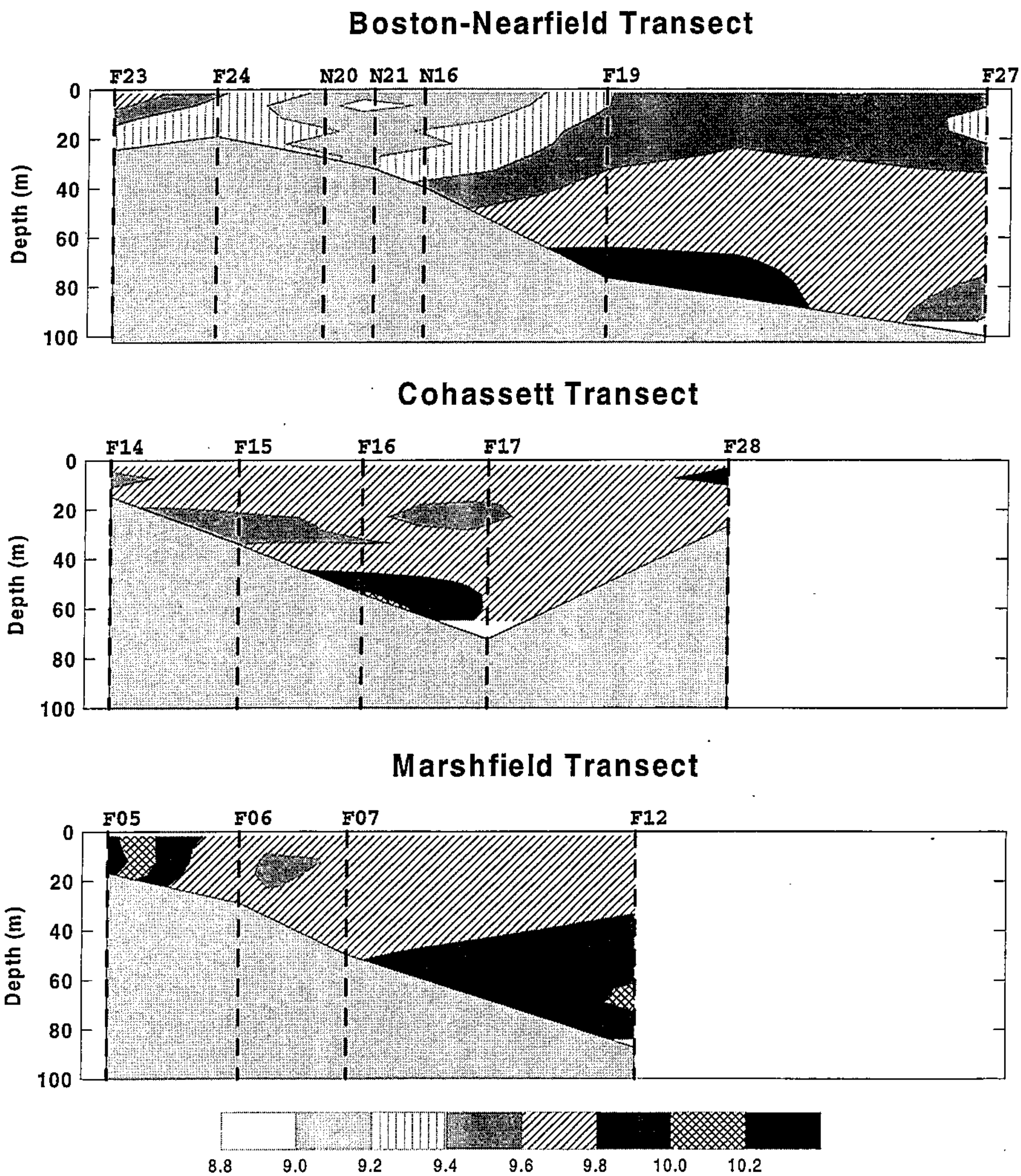
Trans 9502


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 9504

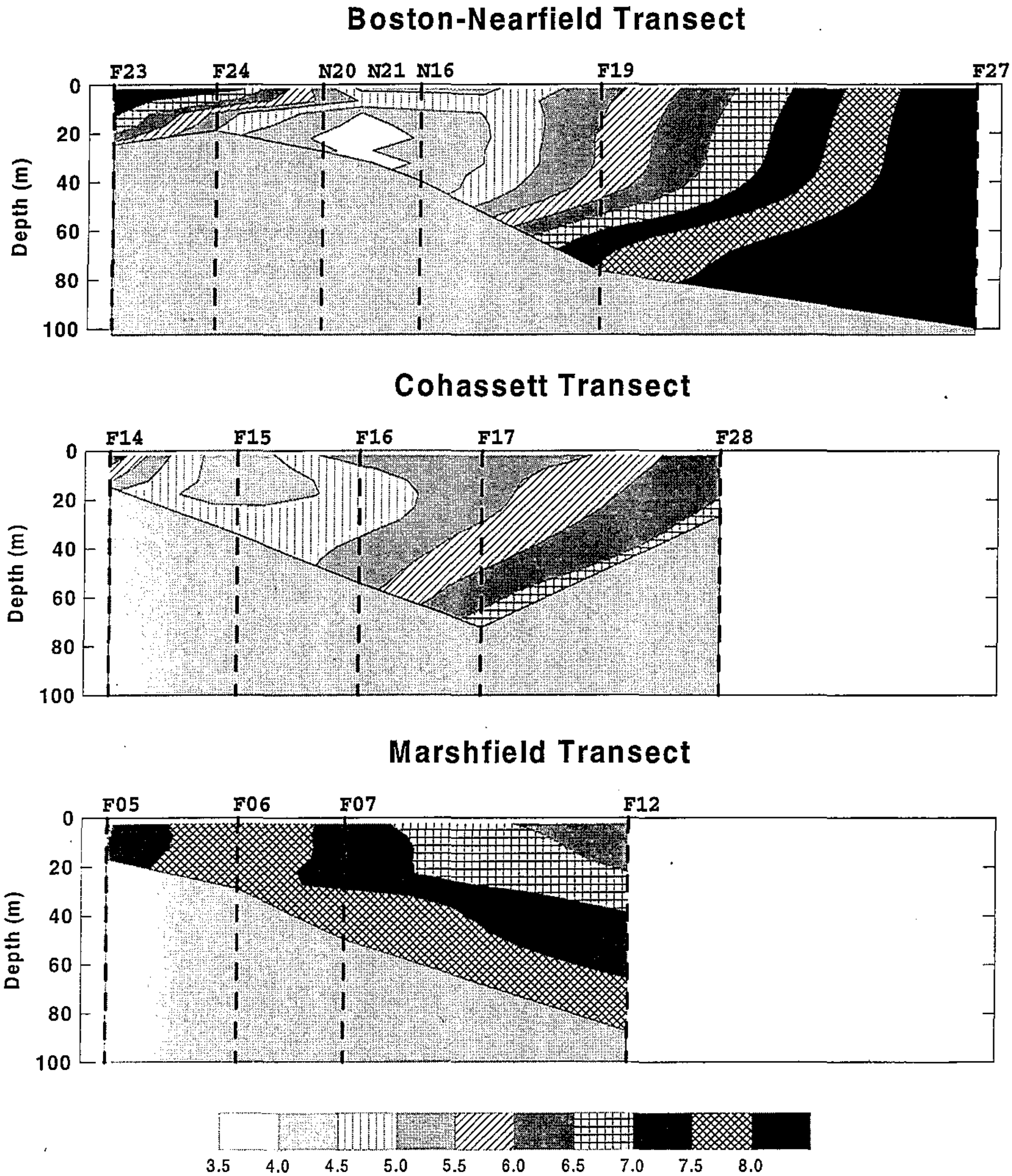

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

Trans 9507

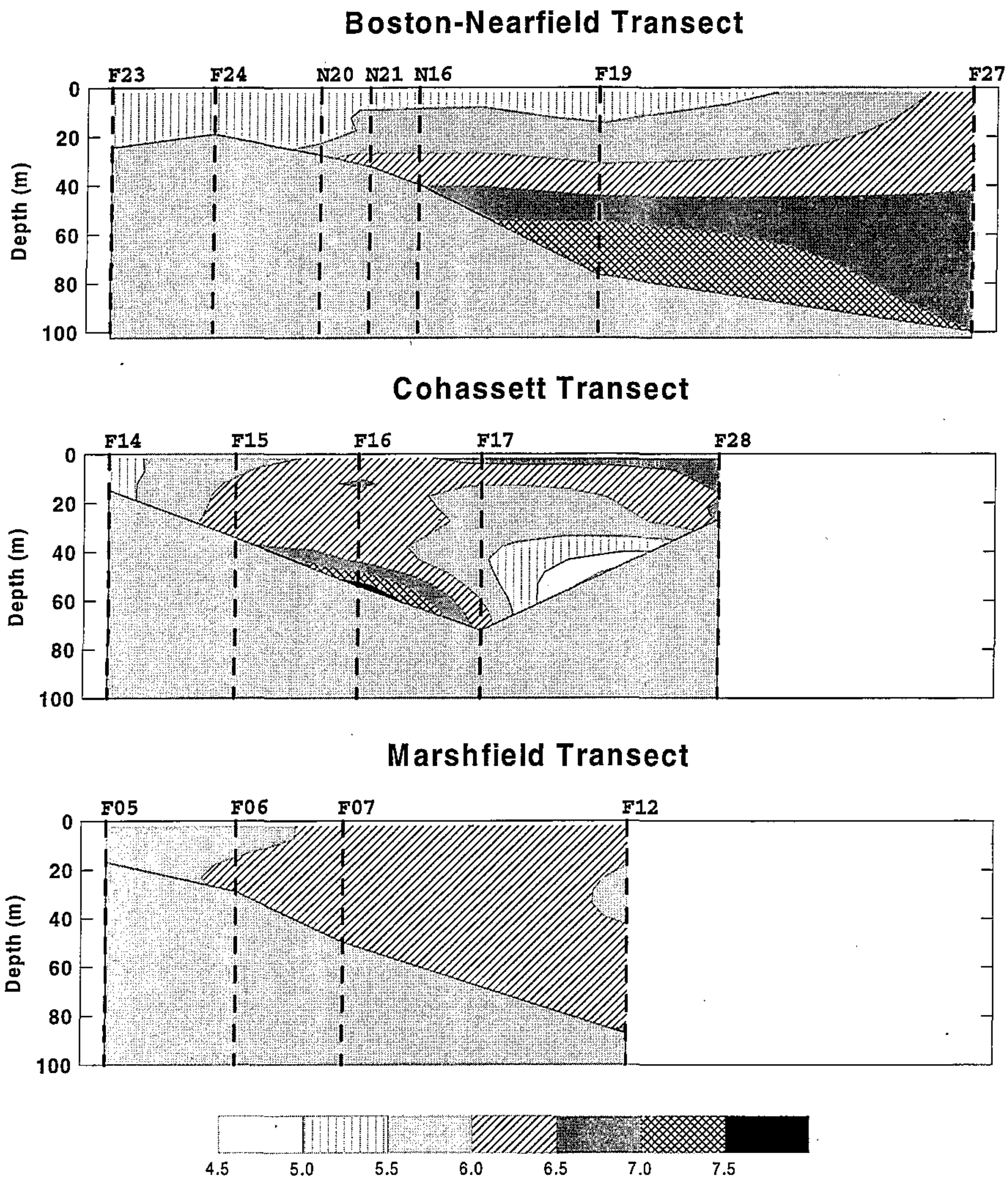


Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Marshfield Transect
F05
F06
F07
F12
8.8
9.0
9.2
9.4
9.6
9.8
10.0
10.2

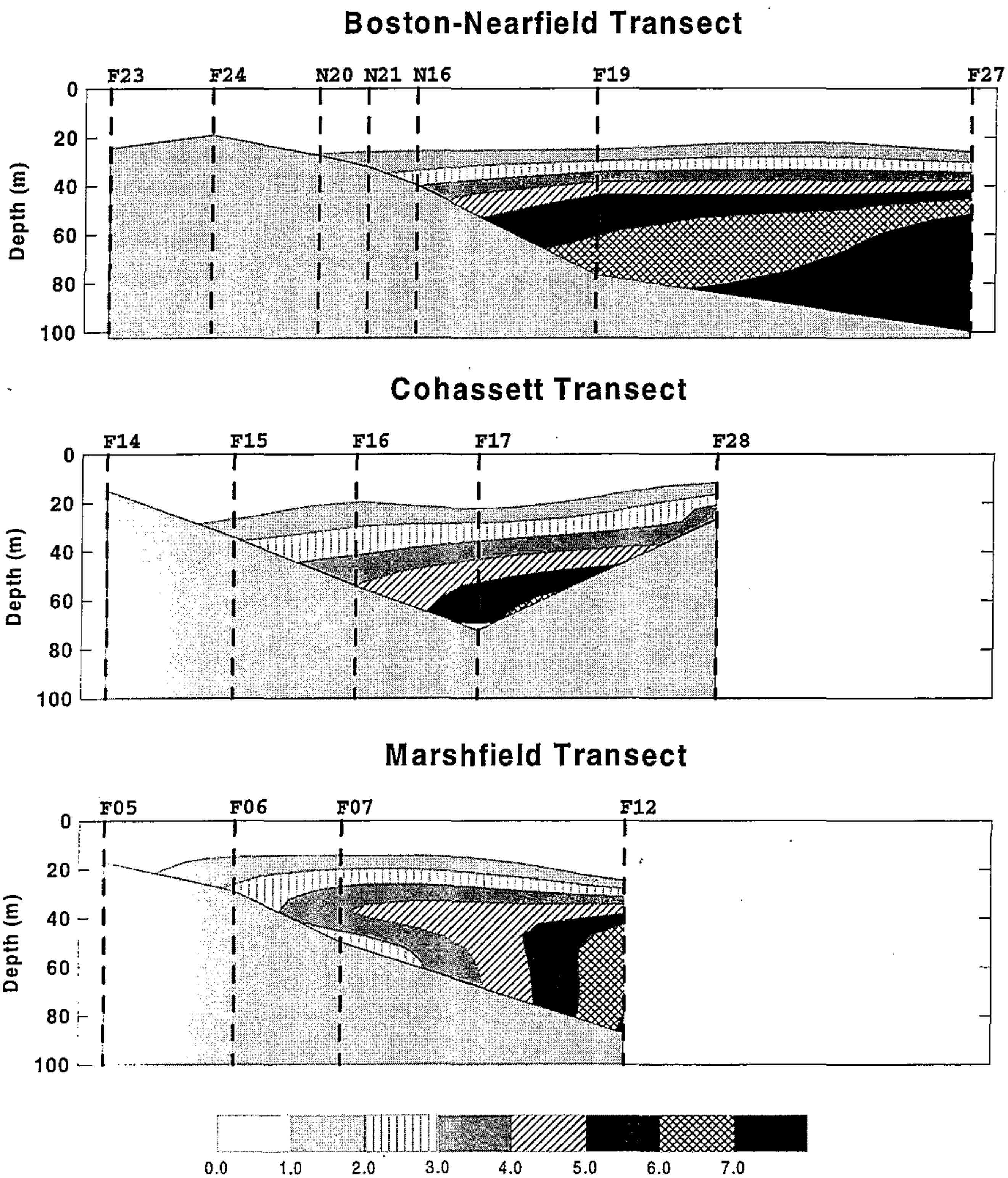
NO3 9501


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
3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0

NO3 9502


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
4.5
5.0
5.5
6.0
6.5
7.0
7.5

NO3 9504


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
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2.0
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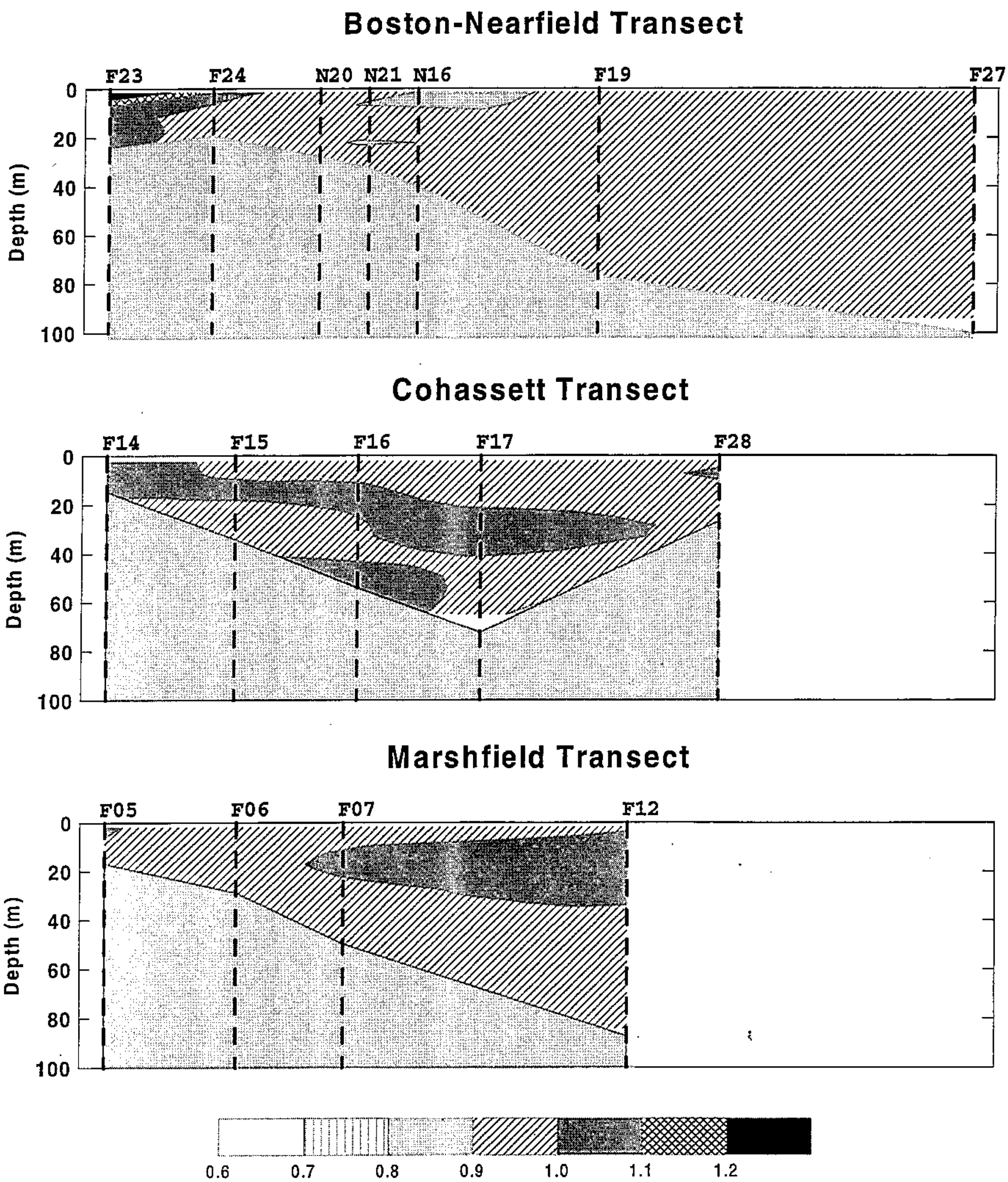
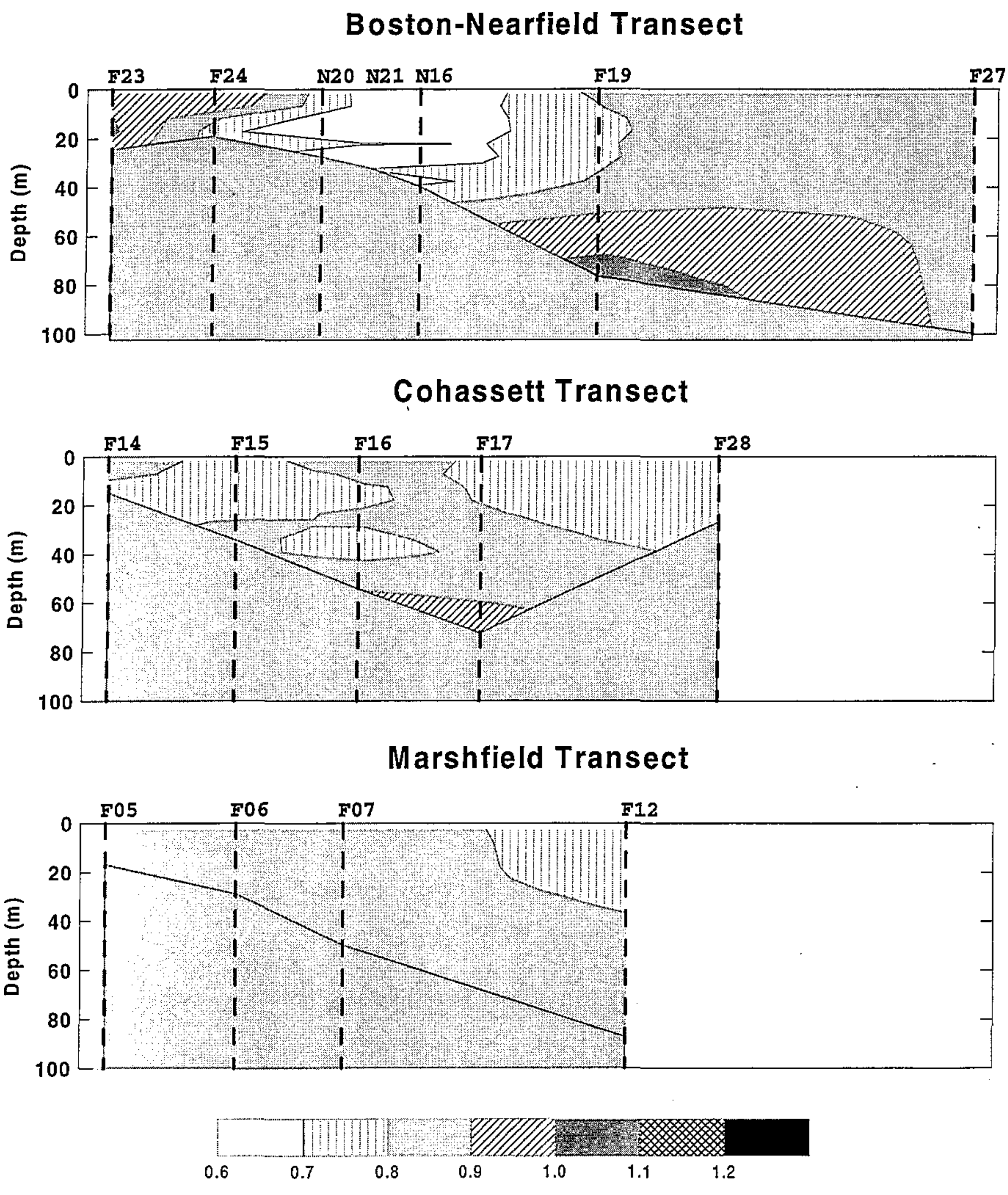
5.0
6.0
7.0

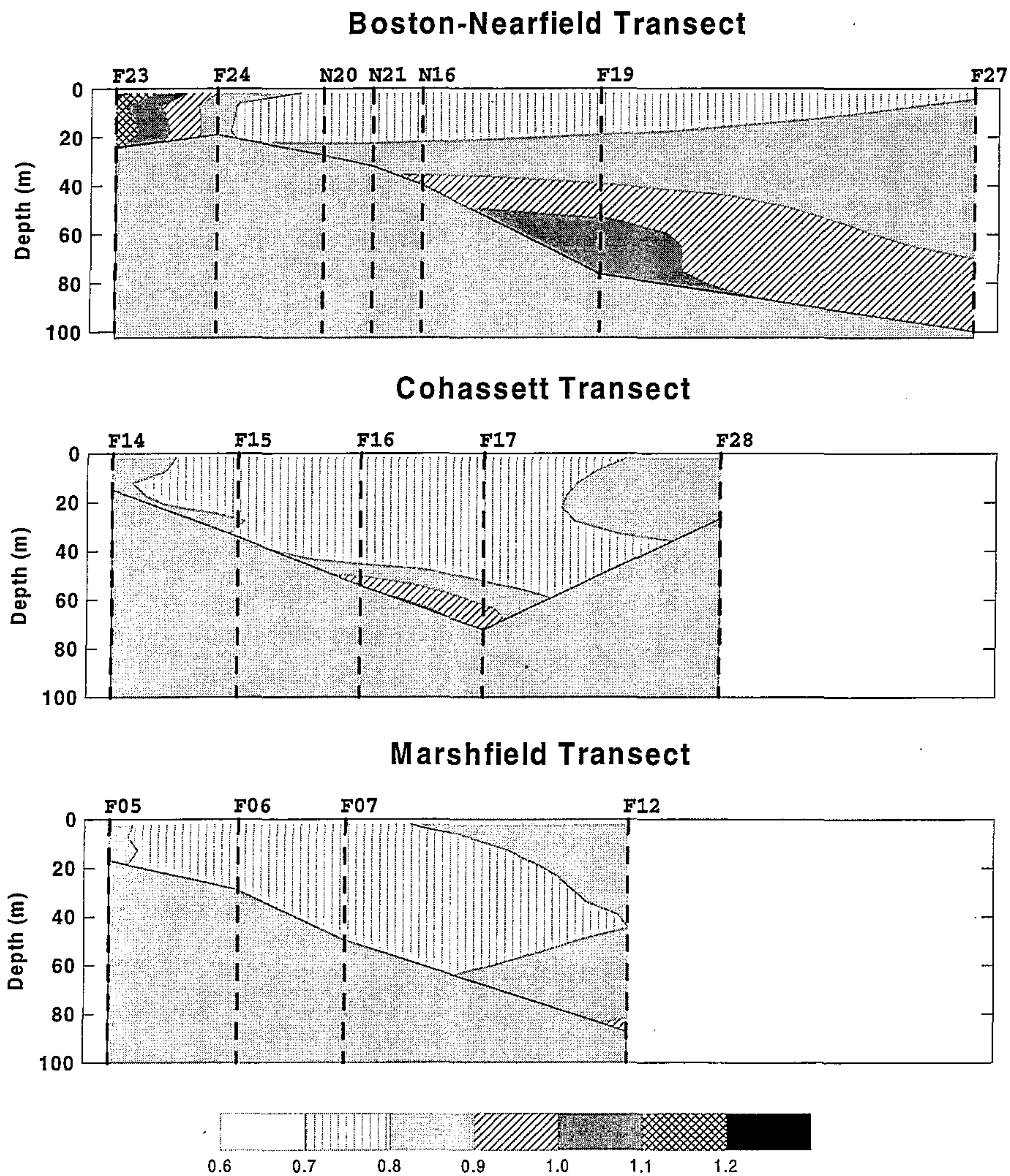
NO3 9507

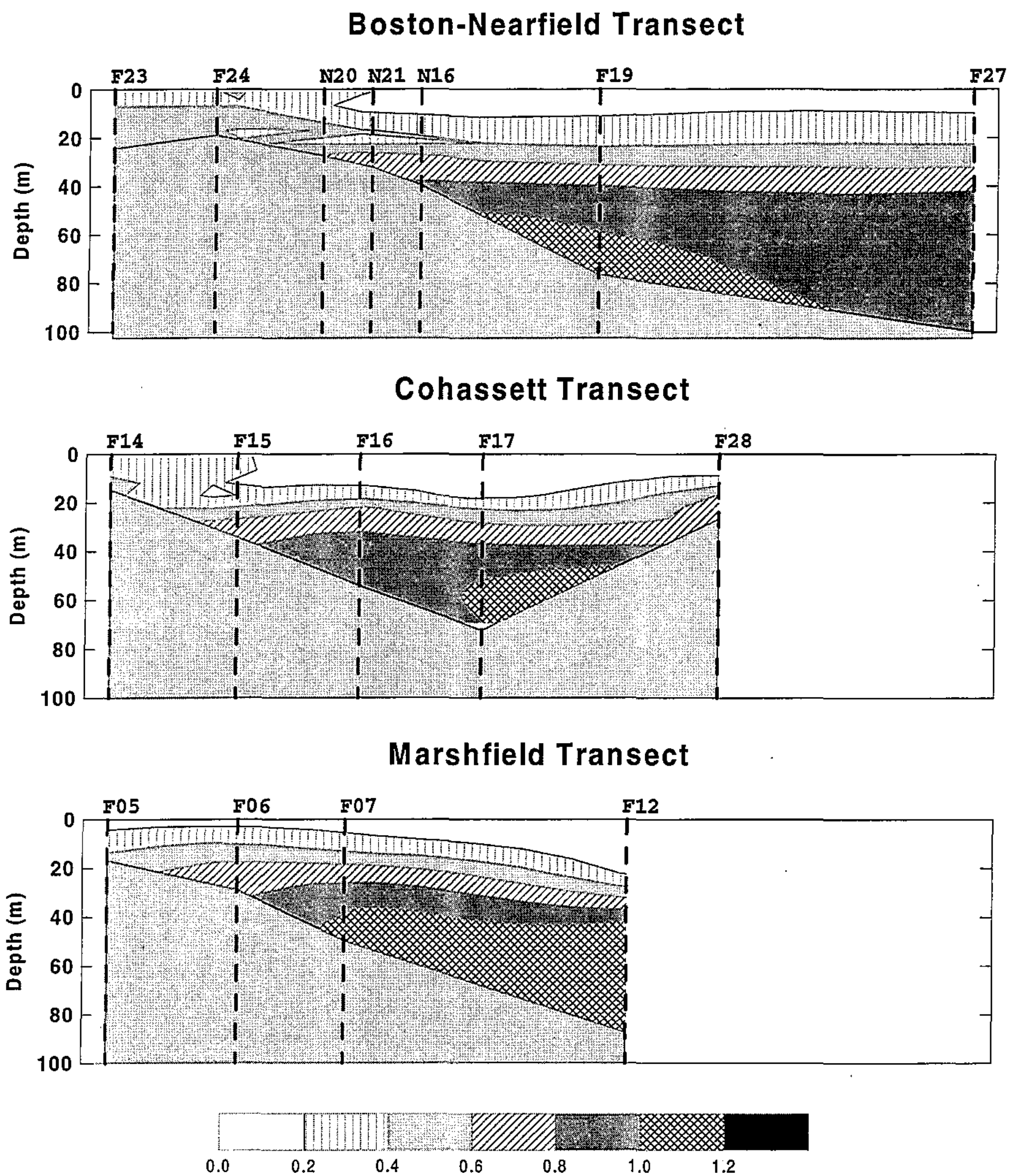

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.6
0.7
0.8
0.9
1.0
1.1
1.2

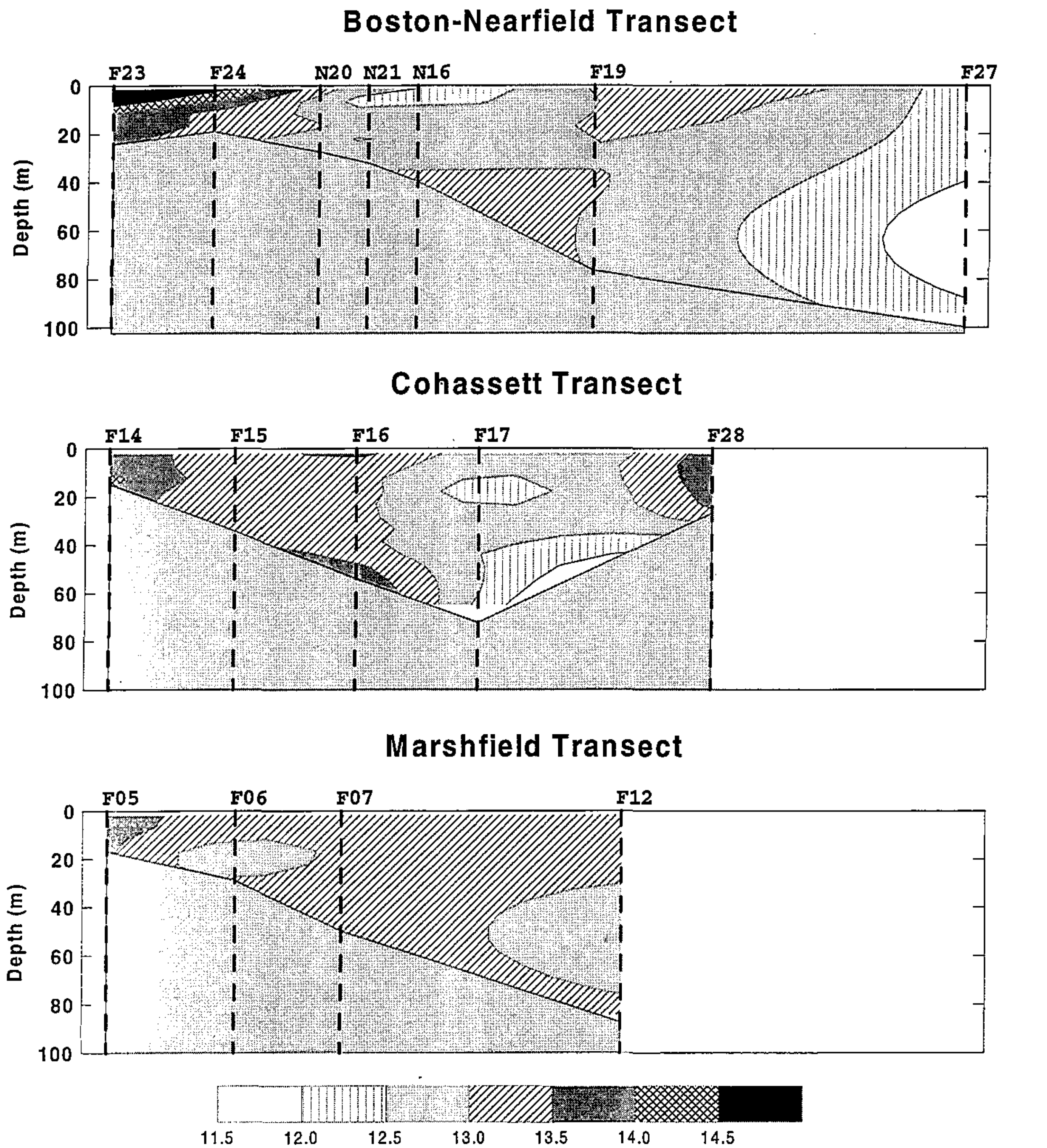
PO4 9501

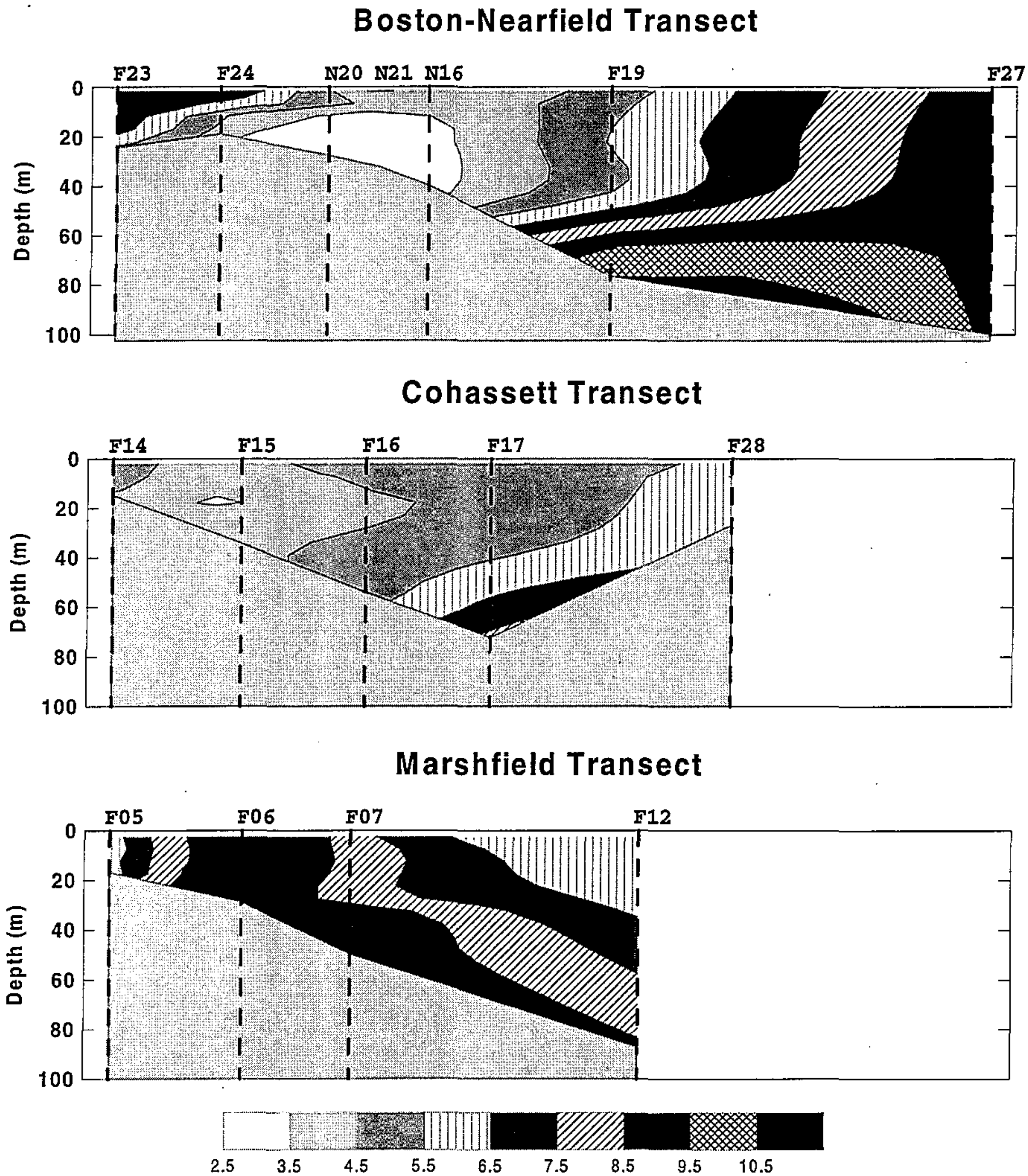

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.6
0.7
0.8
0.9
1.0
1.1
1.2

PO4 9502


Boston-Nearfield Transect
F23 F24 N20 N21 N16 F19 F27
Cohassett Transect
F14 F15 F16 F17 F28
Marshfield Transect
F05 F06 F07 F12
Depth (m)
0 20 40 60 80 100
0.6 0.7 0.8 0.9 1.0 1.1 1.2

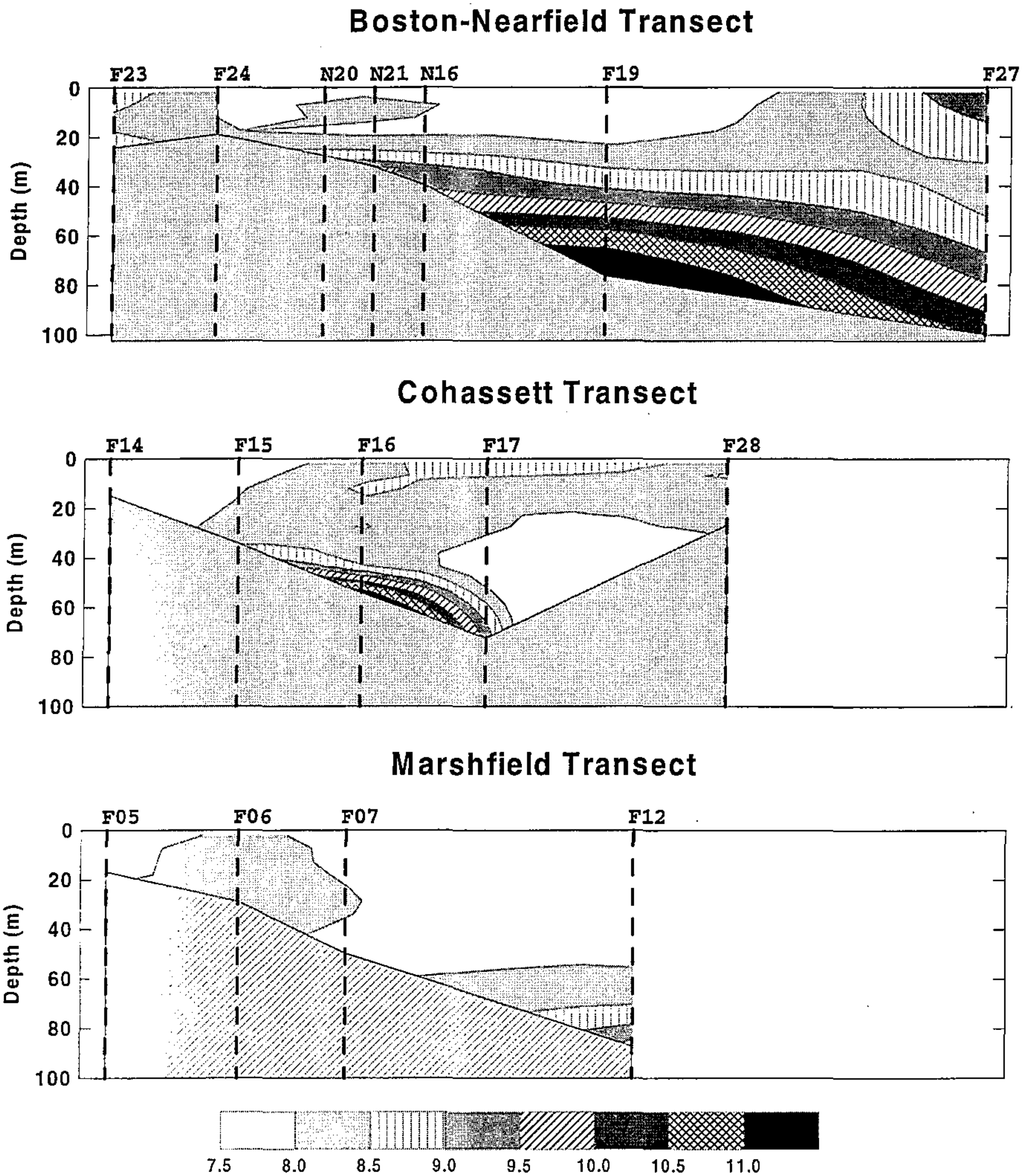

Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0
1.2


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
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
11.5
12.0
12.5
13.0
13.5
14.0
14.5

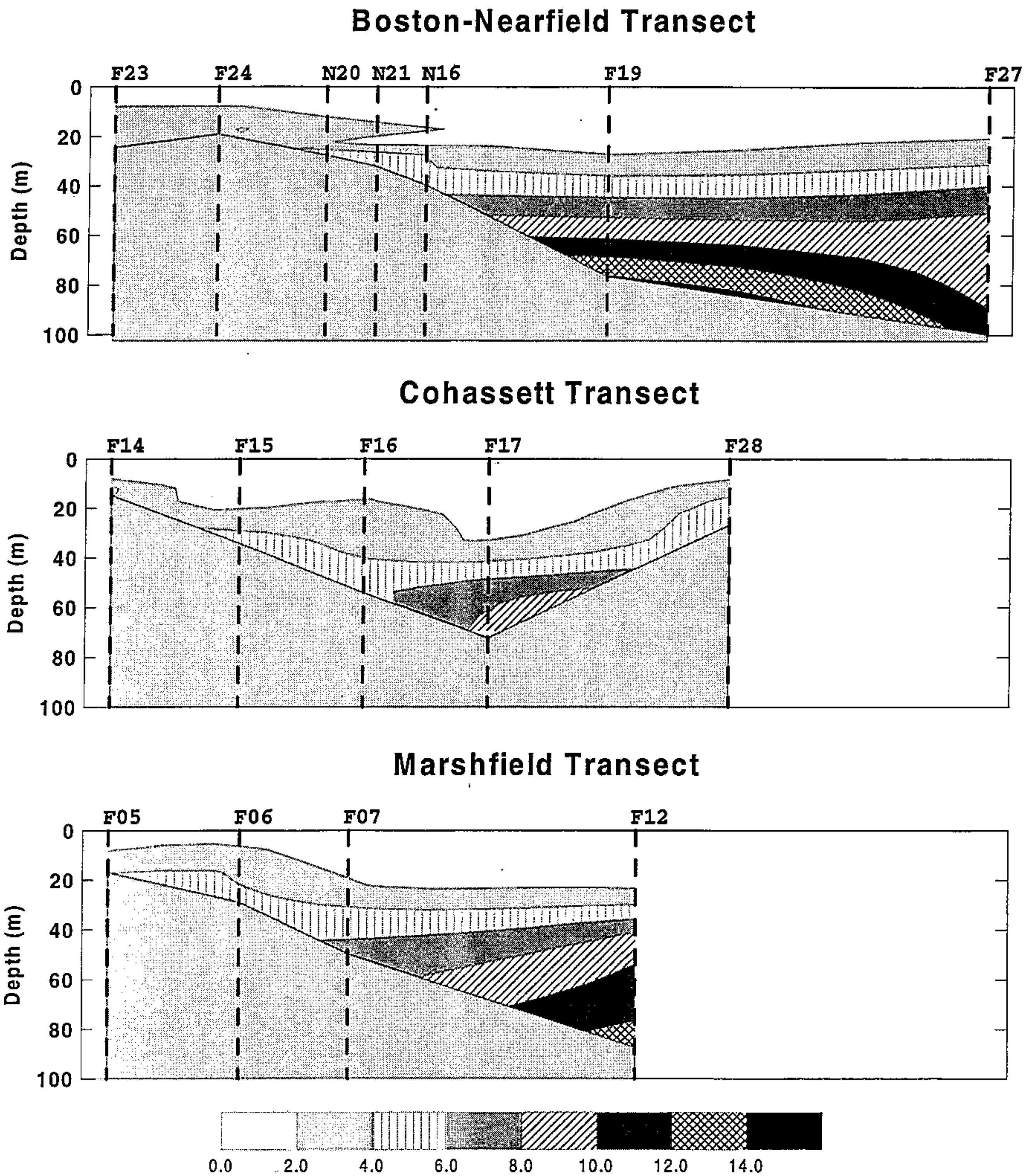


Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
2.5
3.5
4.5
5.5
6.5
7.5
8.5
9.5
10.5

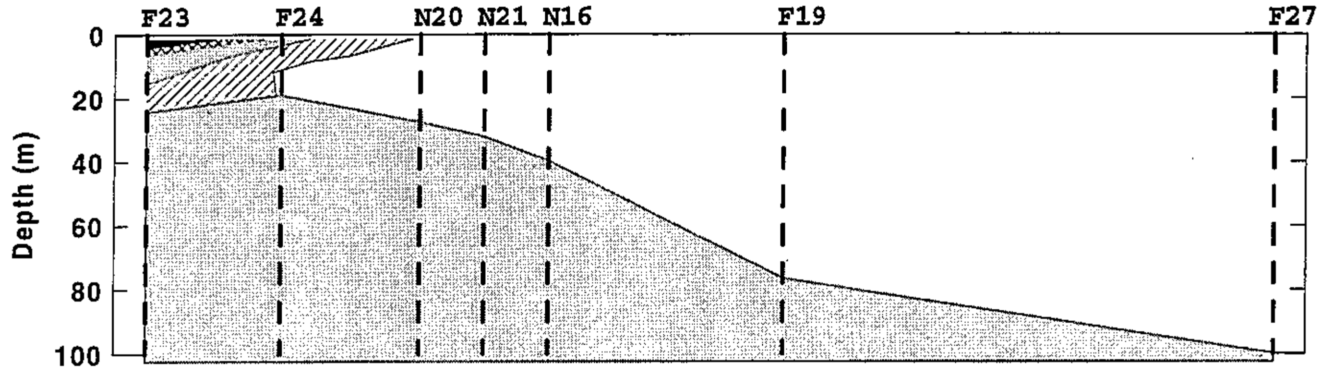
SIO4 9502



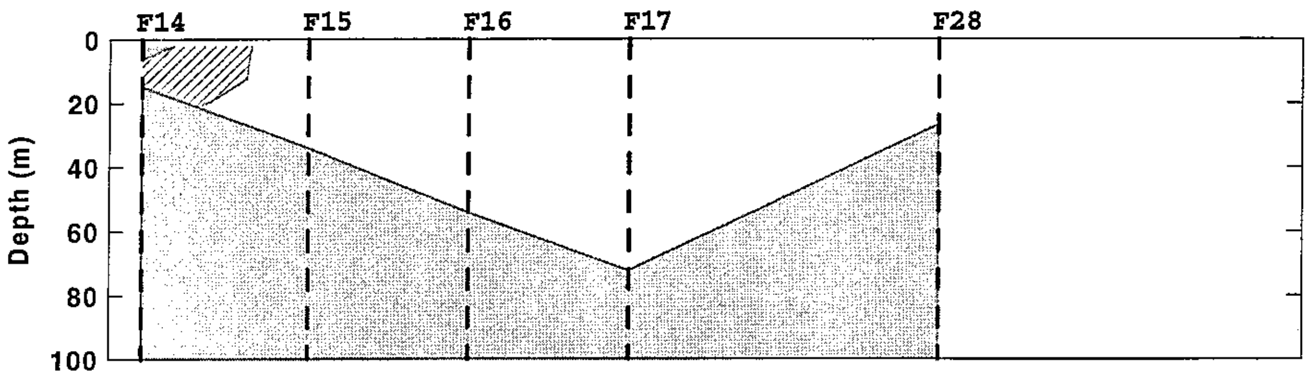
Boston-Nearfield Transect
F23
F24
N20
N21
N16
F19
F27
Depth (m)
0
20
40
60
80
100
Cohassett Transect
F14
F15
F16
F17
F28
Depth (m)
0
20
40
60
80
100
Marshfield Transect
F05
F06
F07
F12
Depth (m)
0
20
40
60
80
100
7.5
8.0
8.5
9.0
9.5
10.0
10.5
11.0


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

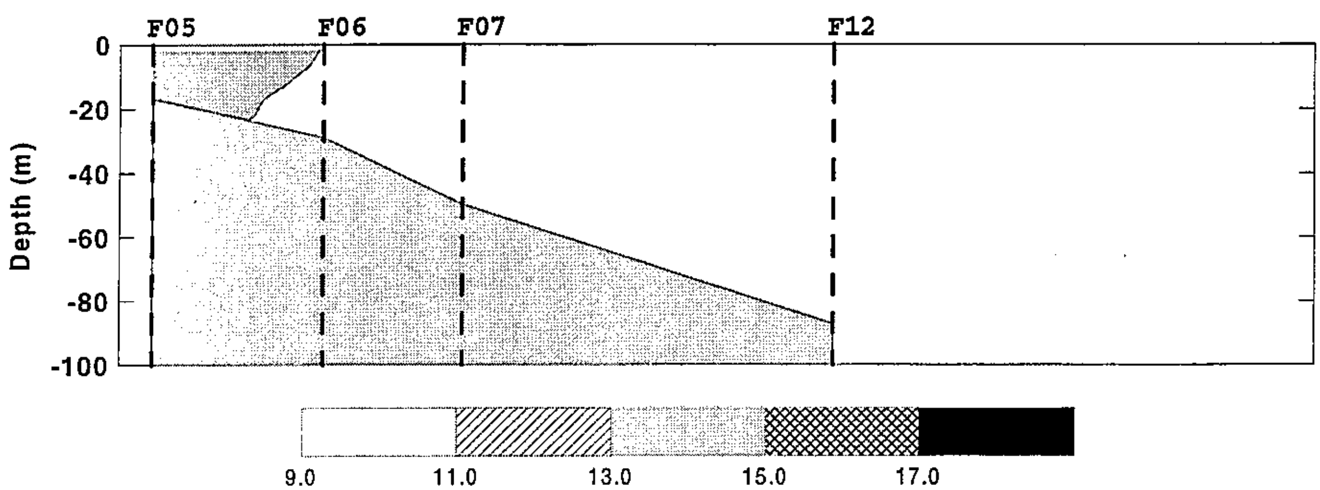
Boston-Nearfield Transect

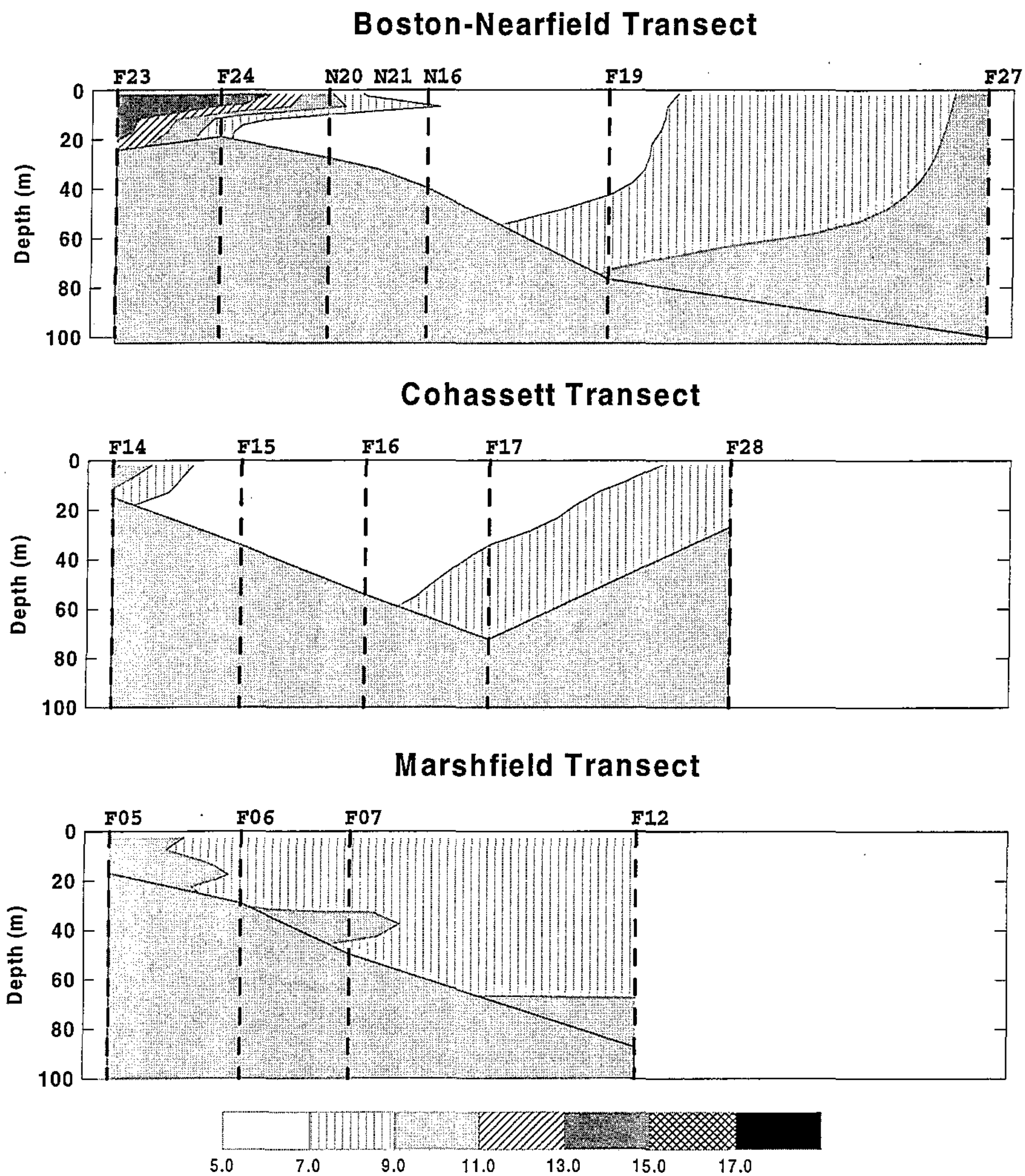


Cohassett Transect

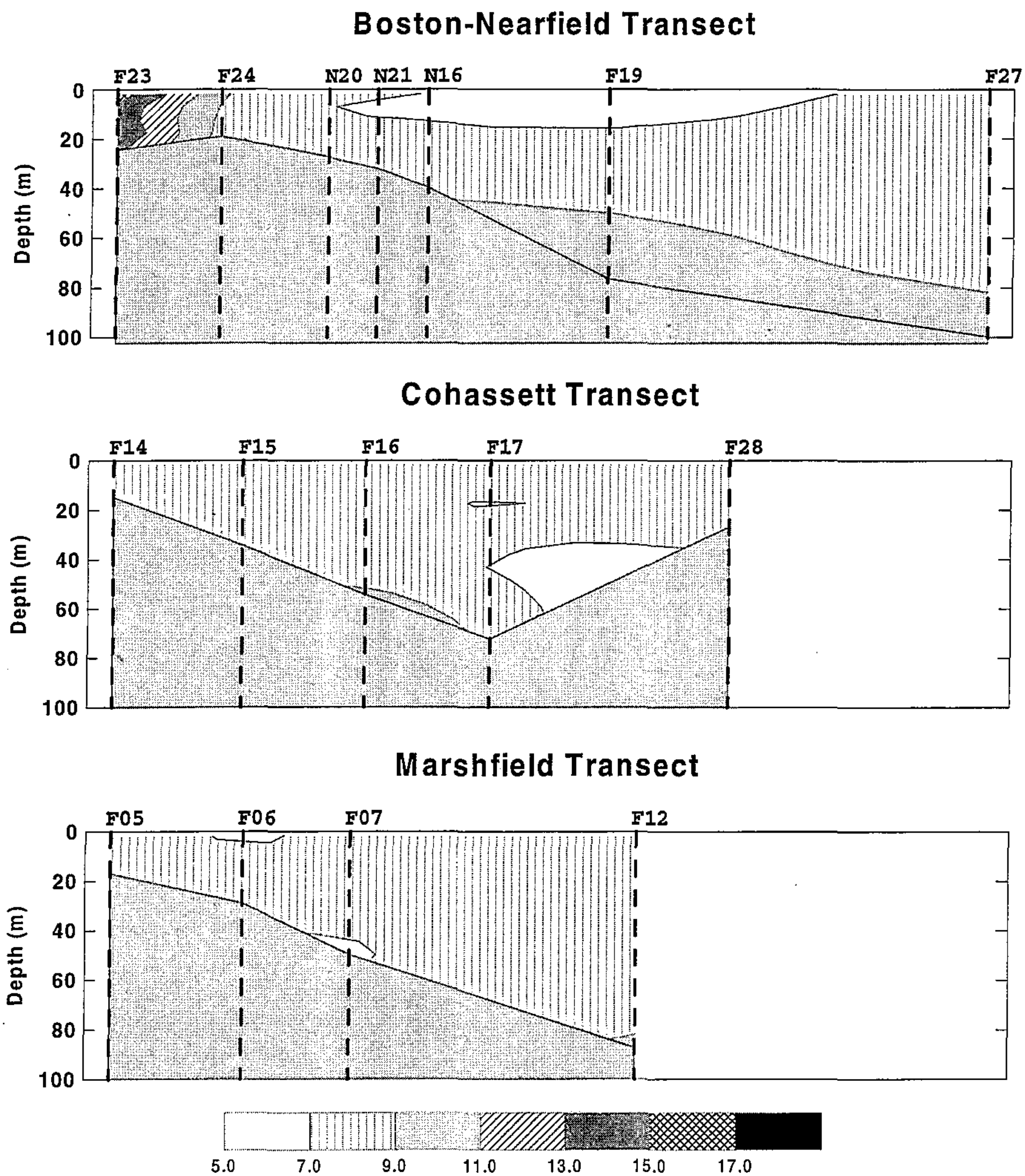


Marshfield Transect

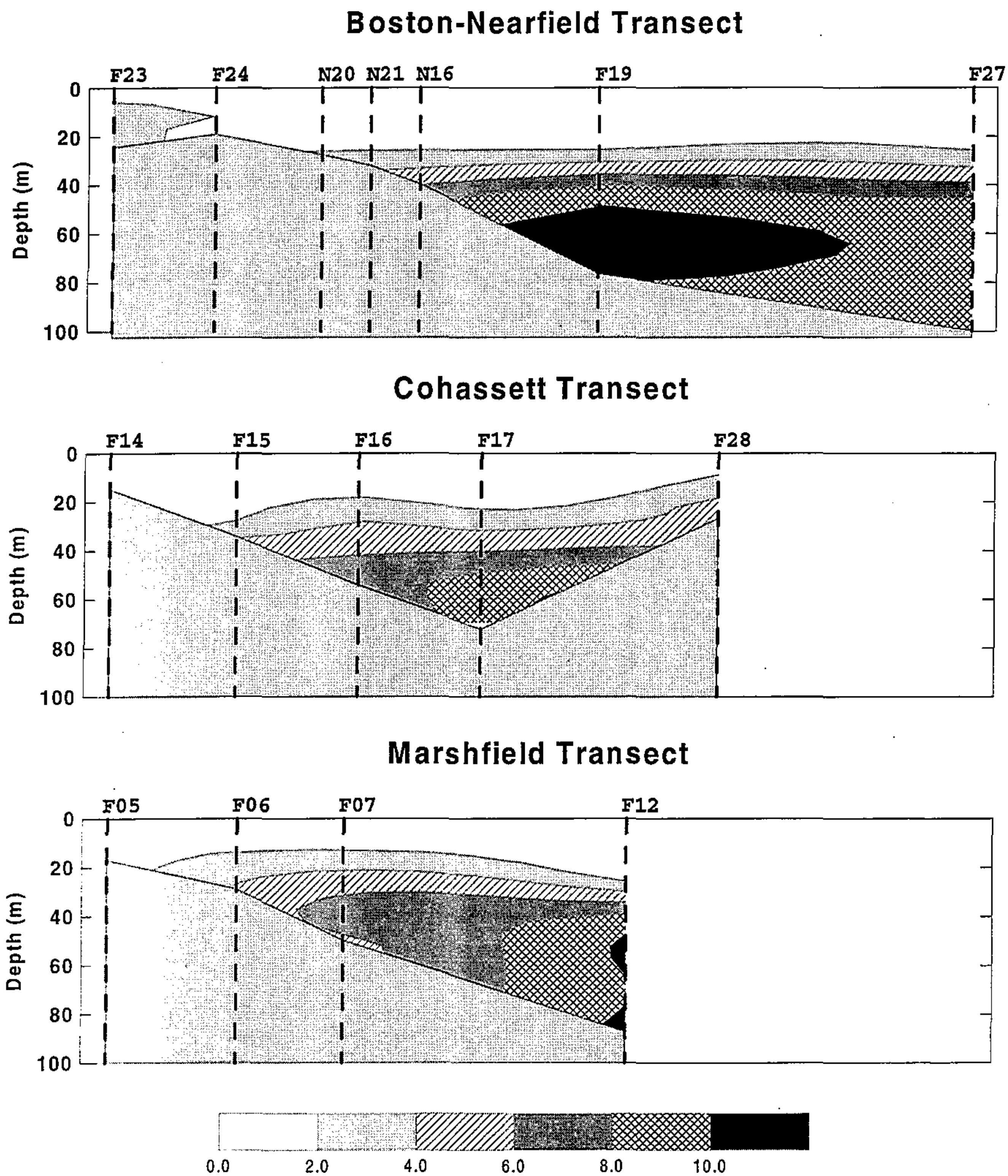




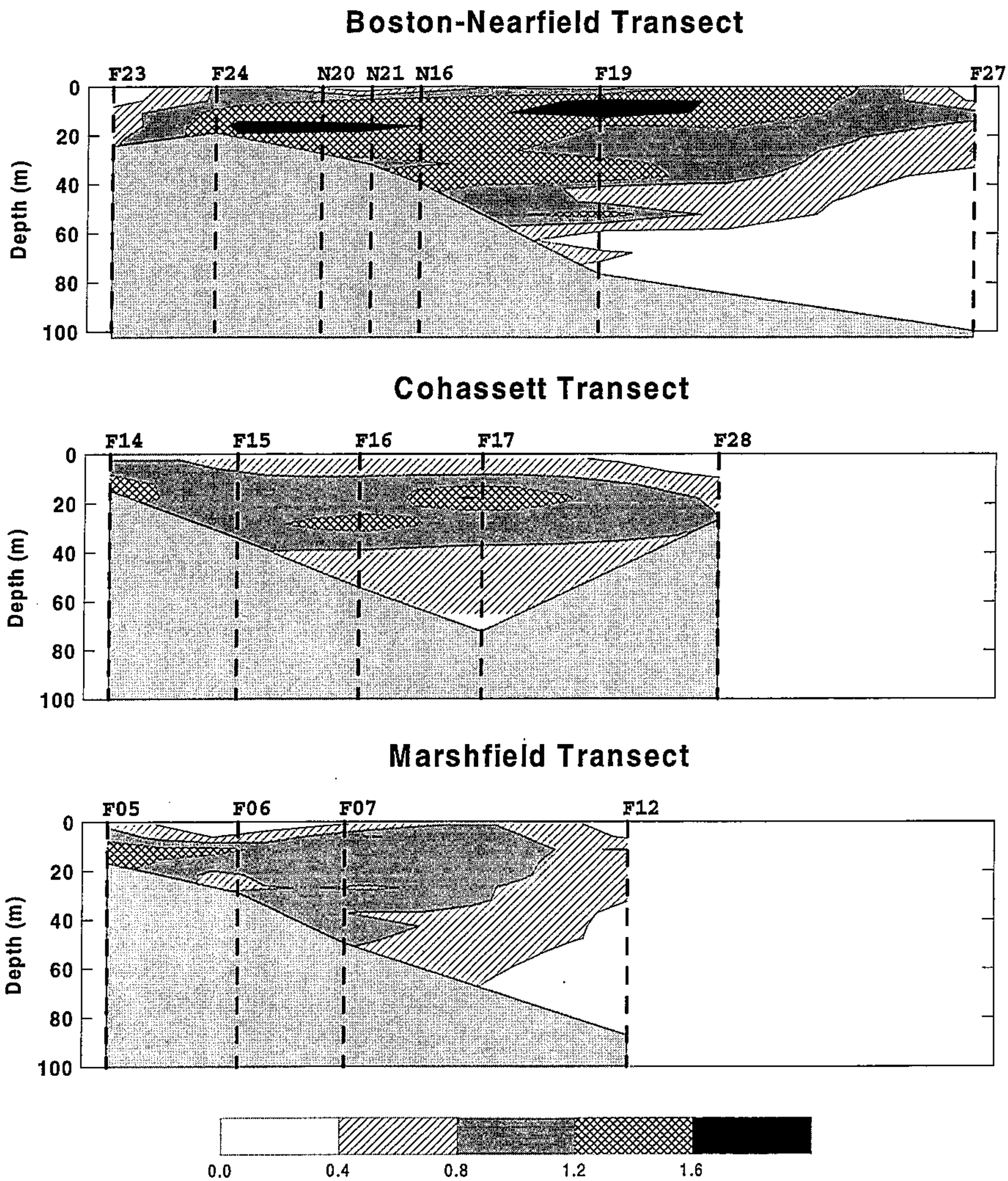
DI Nitro 9502



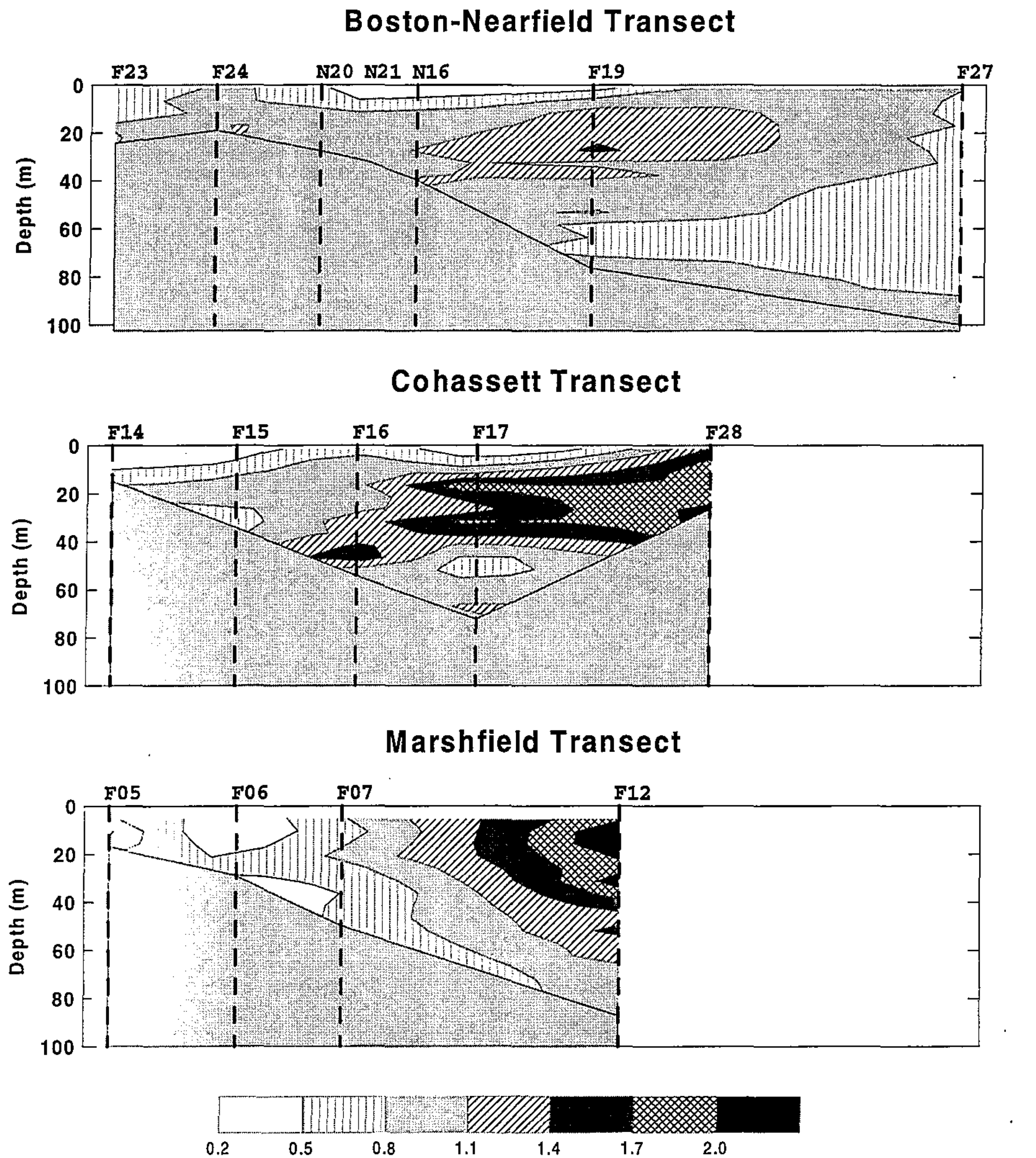
DI Nitro 9504



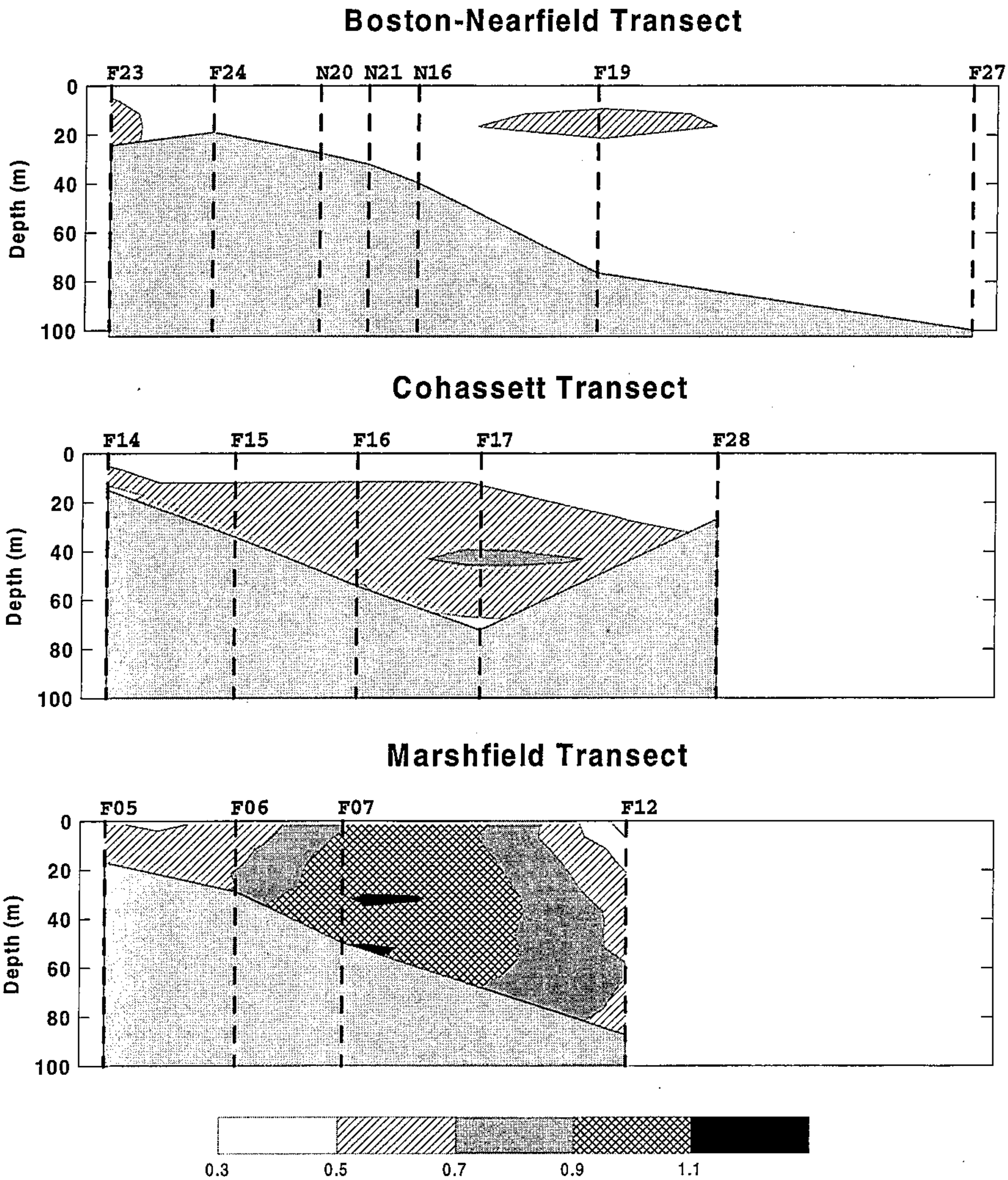
DI Nitro 9507



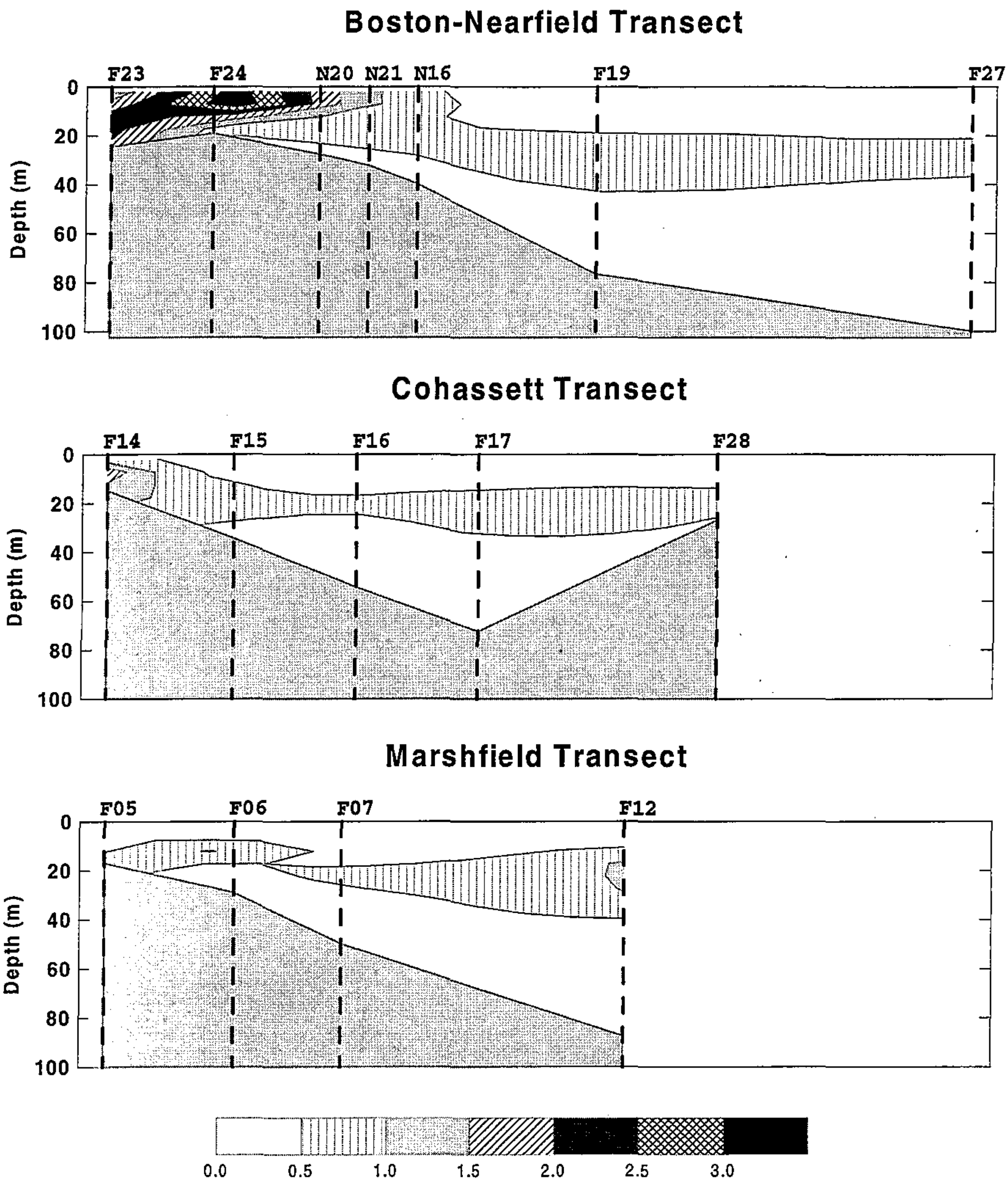
Fluorescence 9501



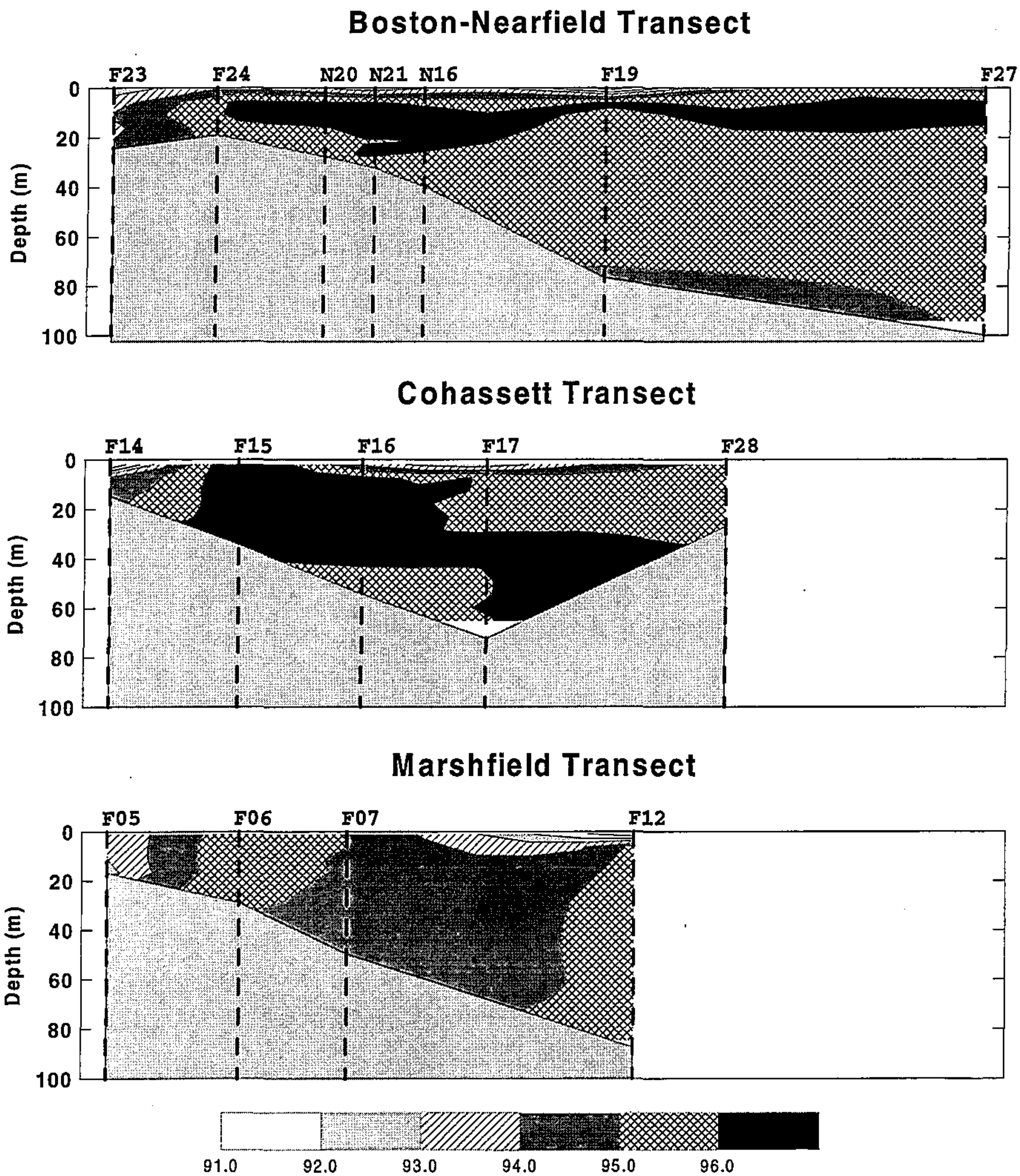
Fluorescence 9502



Fluorescence 9504

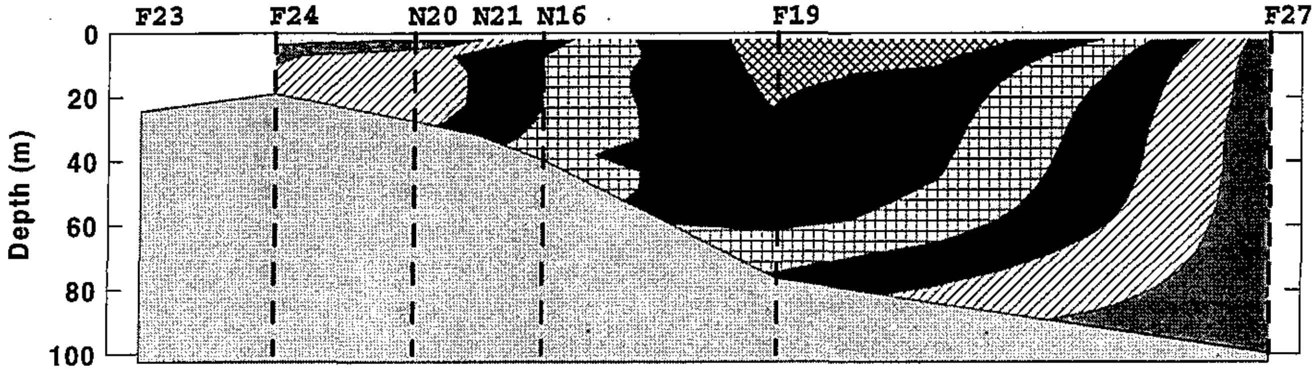


Fluorescence 9507

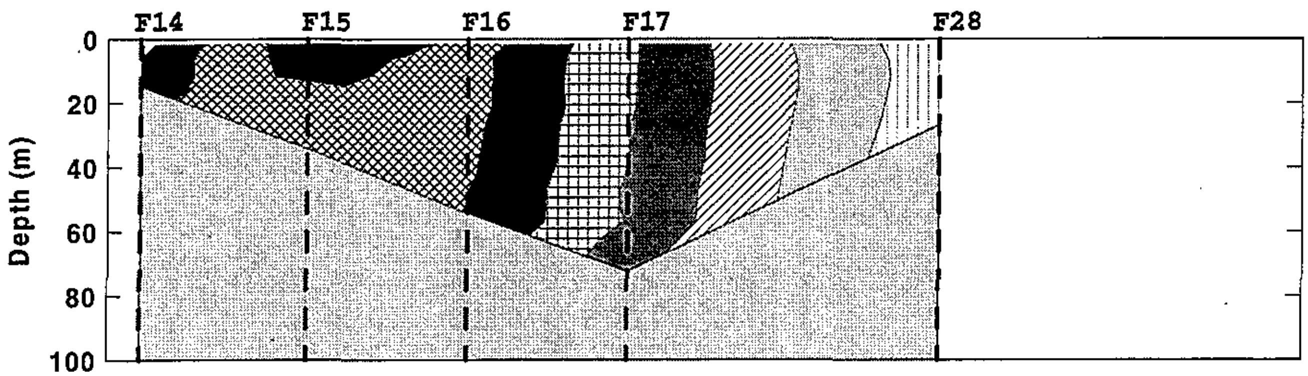


DO % Saturation 9501

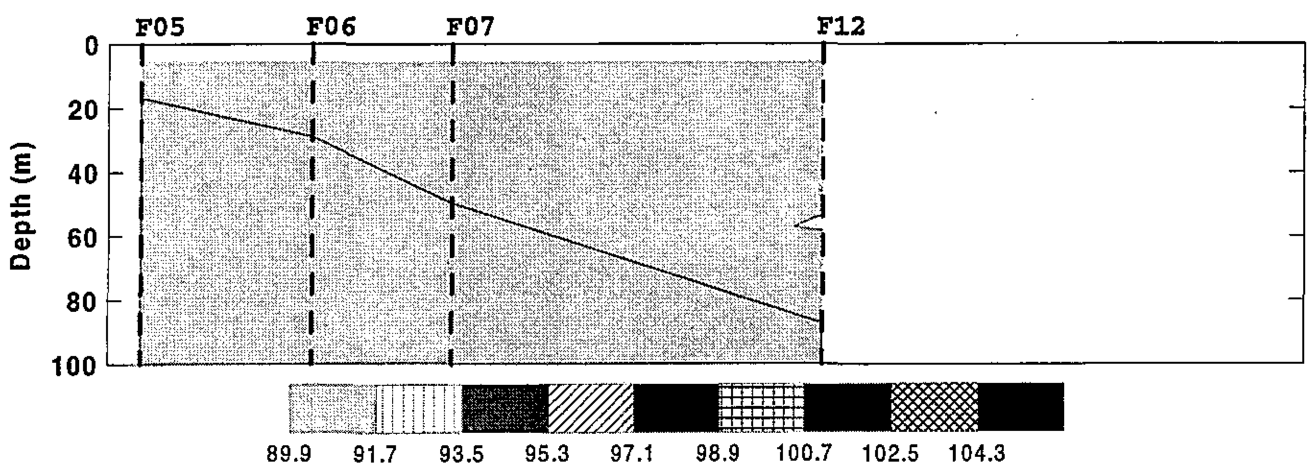
Boston-Nearfield Transect

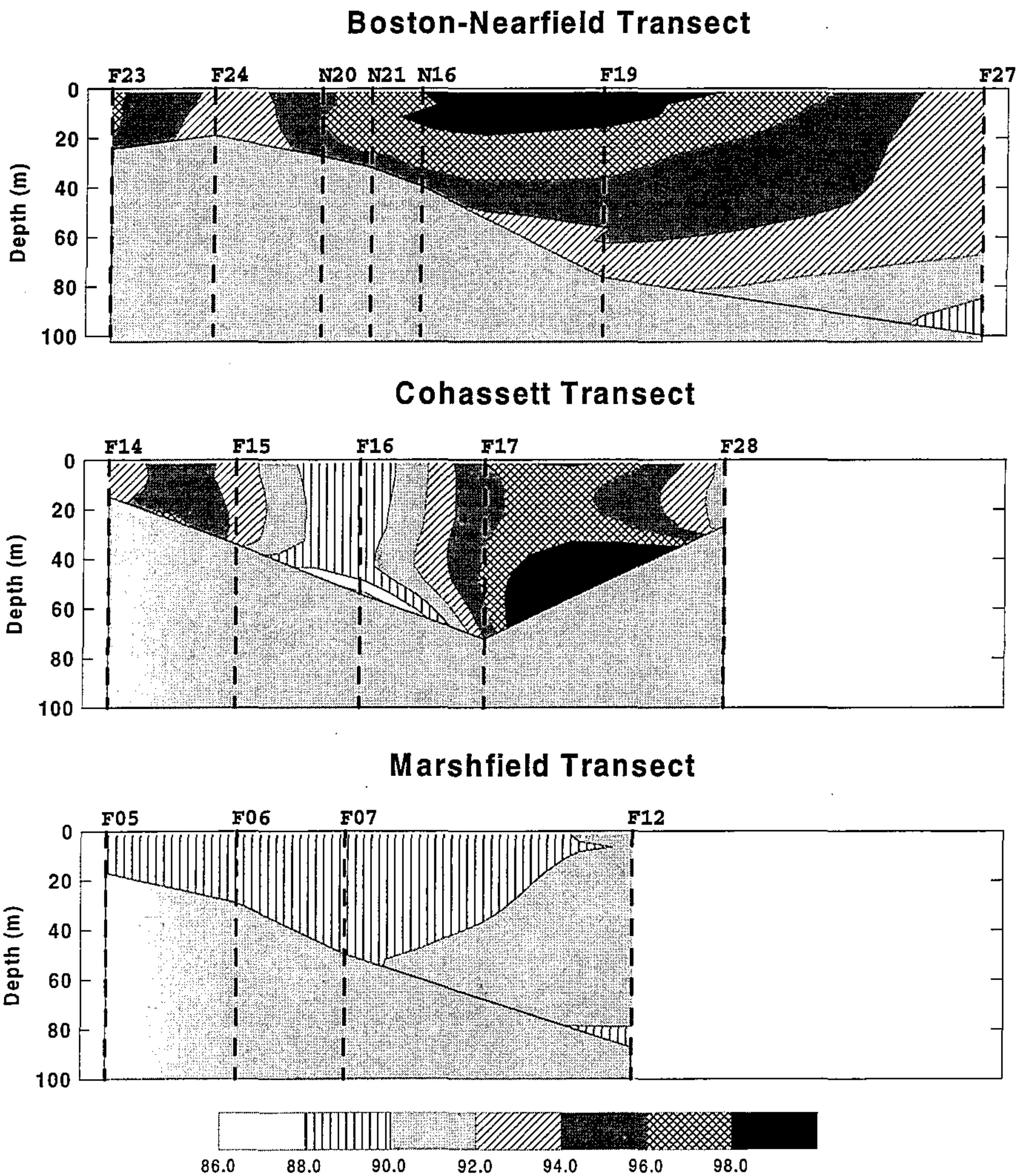


Cohassett Transect

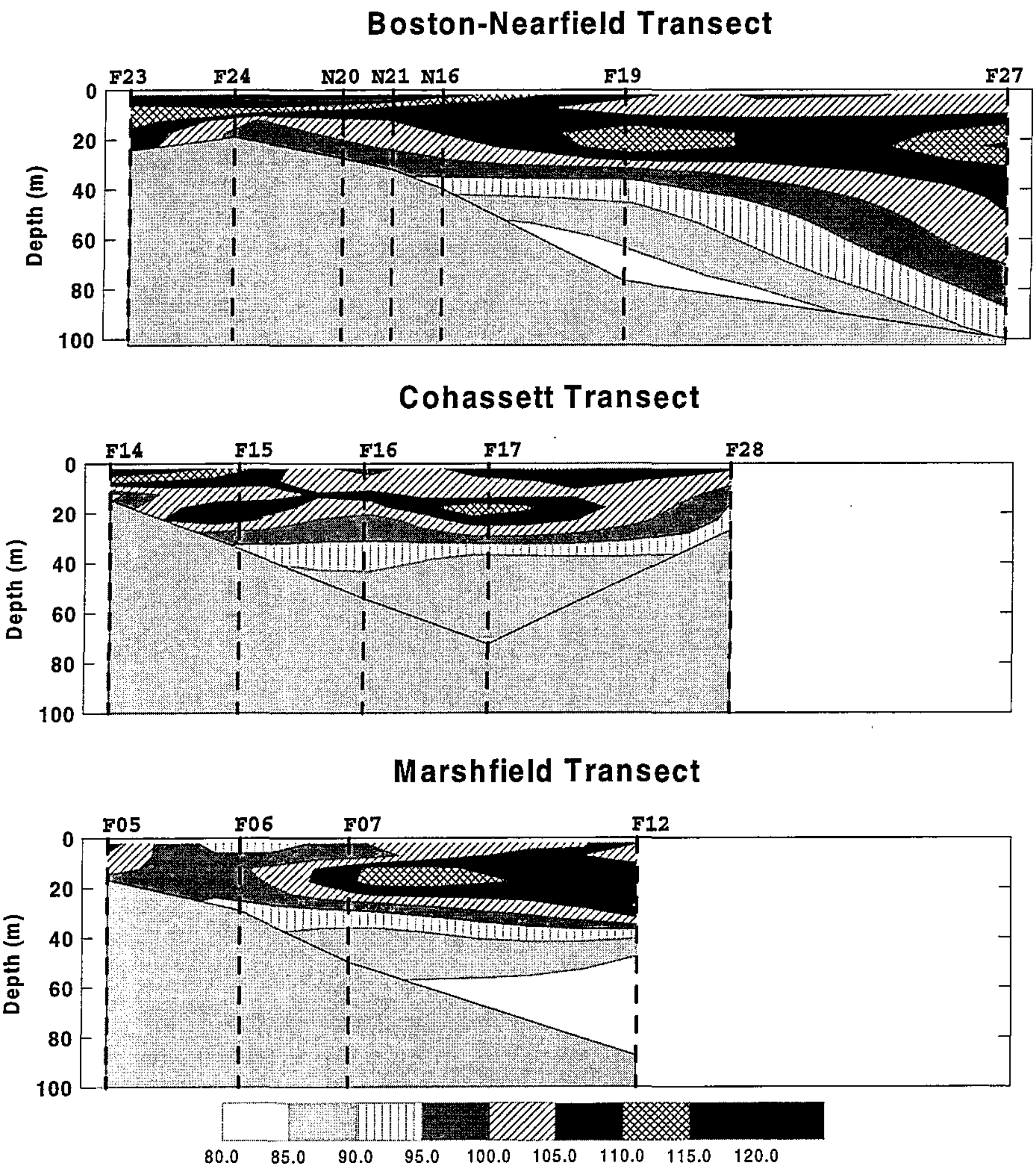


Marshfield Transect





DO % Saturation 9504



DO % Saturation 9507

APPENDIX D

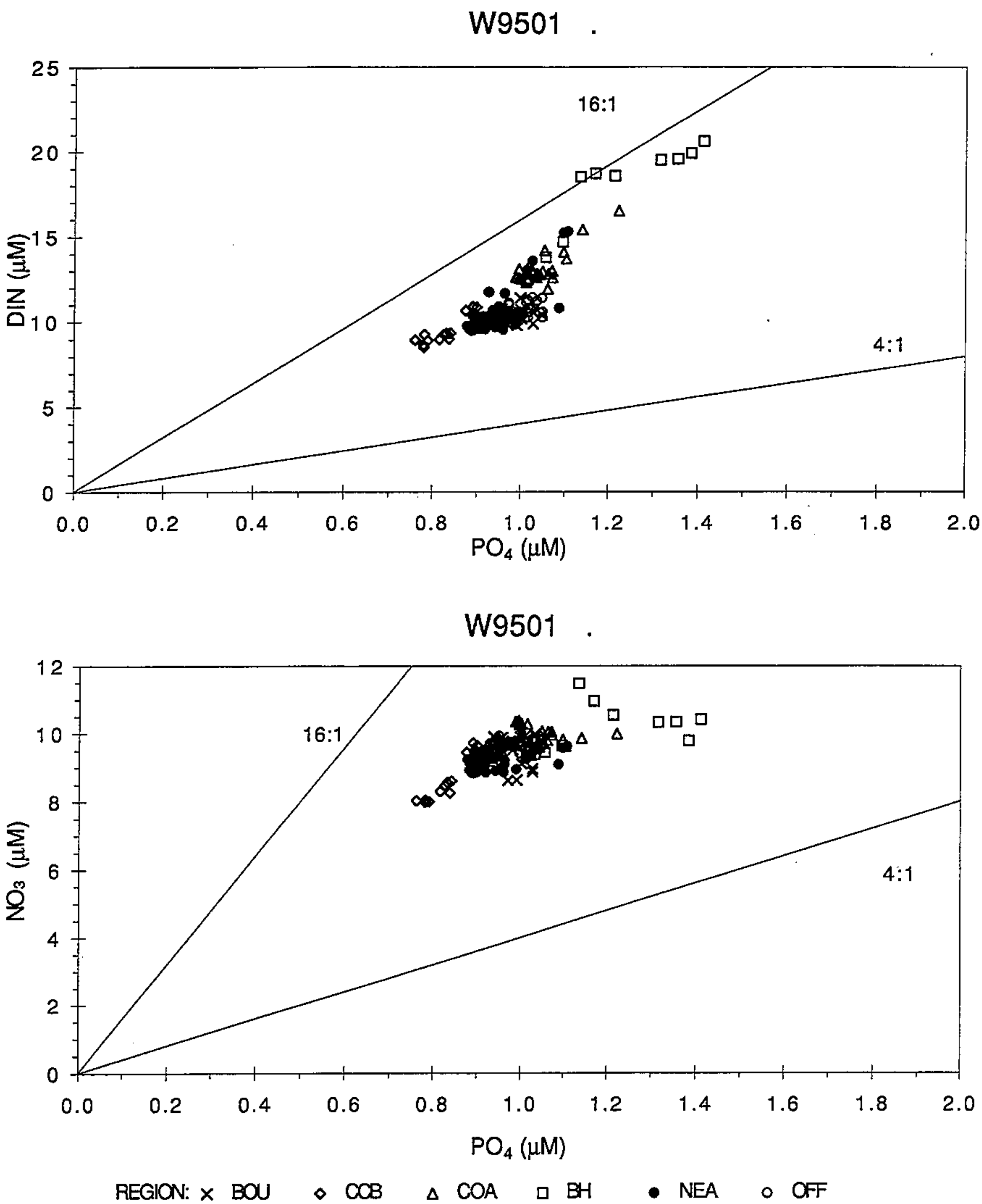
NUTRIENT SCATTER PLOTS

APPENDIX D

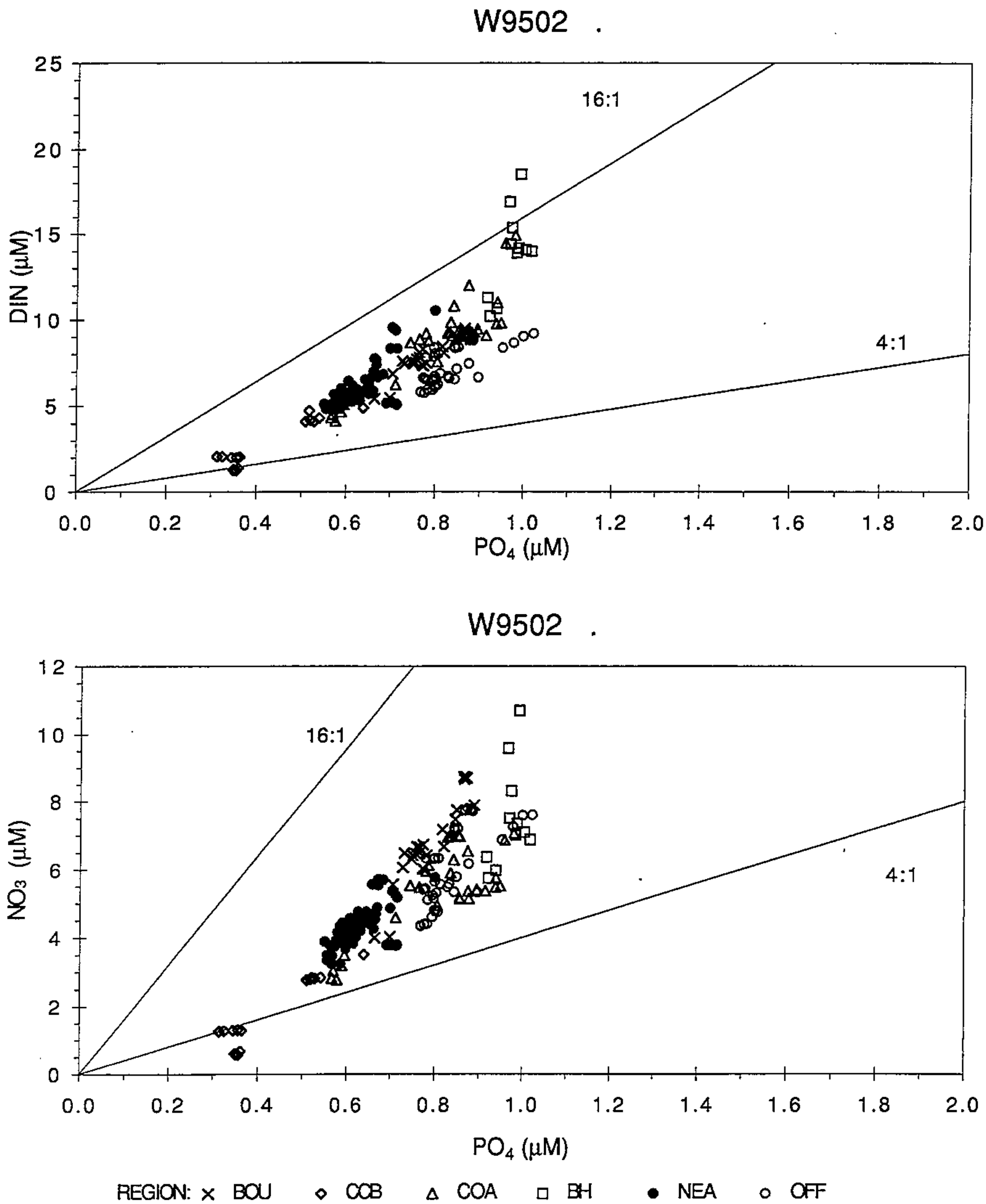
Scatter plots are included for every survey conducted during the semi-annual period. EAch plot includes all stations and all depths unless otherwise noted. The plots are organized by type of plot, and then by survey. Combined nearfield/farfield surveys show the regions with different symbols, including 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	W9501-09	Lines of nitrogen:phosphate
PO_4:NH_4; SiO_4:NH_4	W9501-09	
SiO_4:DIN; SiO_4:NO_3	W9501-09	Lines of nitrogen:silicate
Salinity:DIN	W9501-09	Stations types A,D,F,G
Salinity:NH_4 and NO_3	W9501-09	
Salinity:PO_4 and SiO_4	W9501-09	
Salinity:TN and DIN+PON	W9501-09	Station types A,D,F,G
Depth:DIN	W9501-09	
Depth:NH_4 and NO_3	W9501-09	
Depth:PO_4 and SiO_4	W9501-09	

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

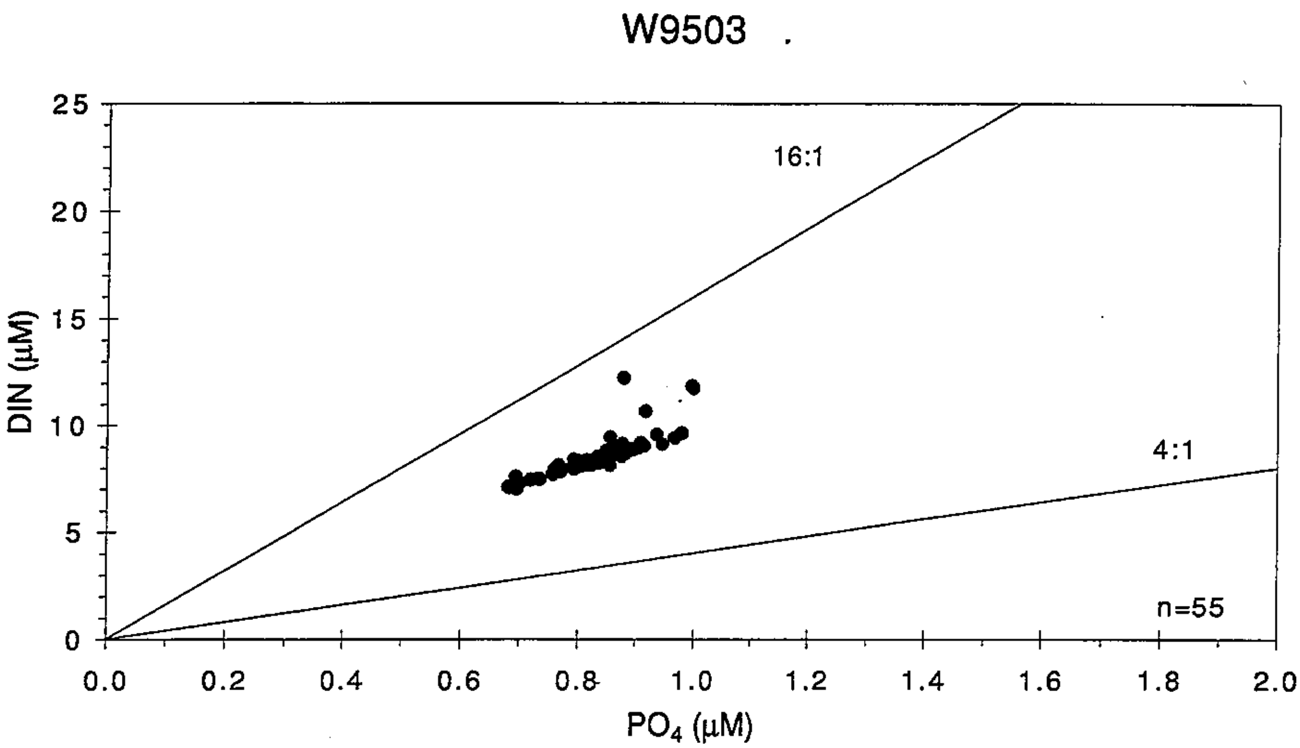

W9501 .
16:1
4:1
DIN (µM)
PO4 (µM)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
0
5
10
15
20
25
W9501 .
16:1
4:1
NO3 (µM)
PO4 (µM)
0
2
4
6
8
10
12
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

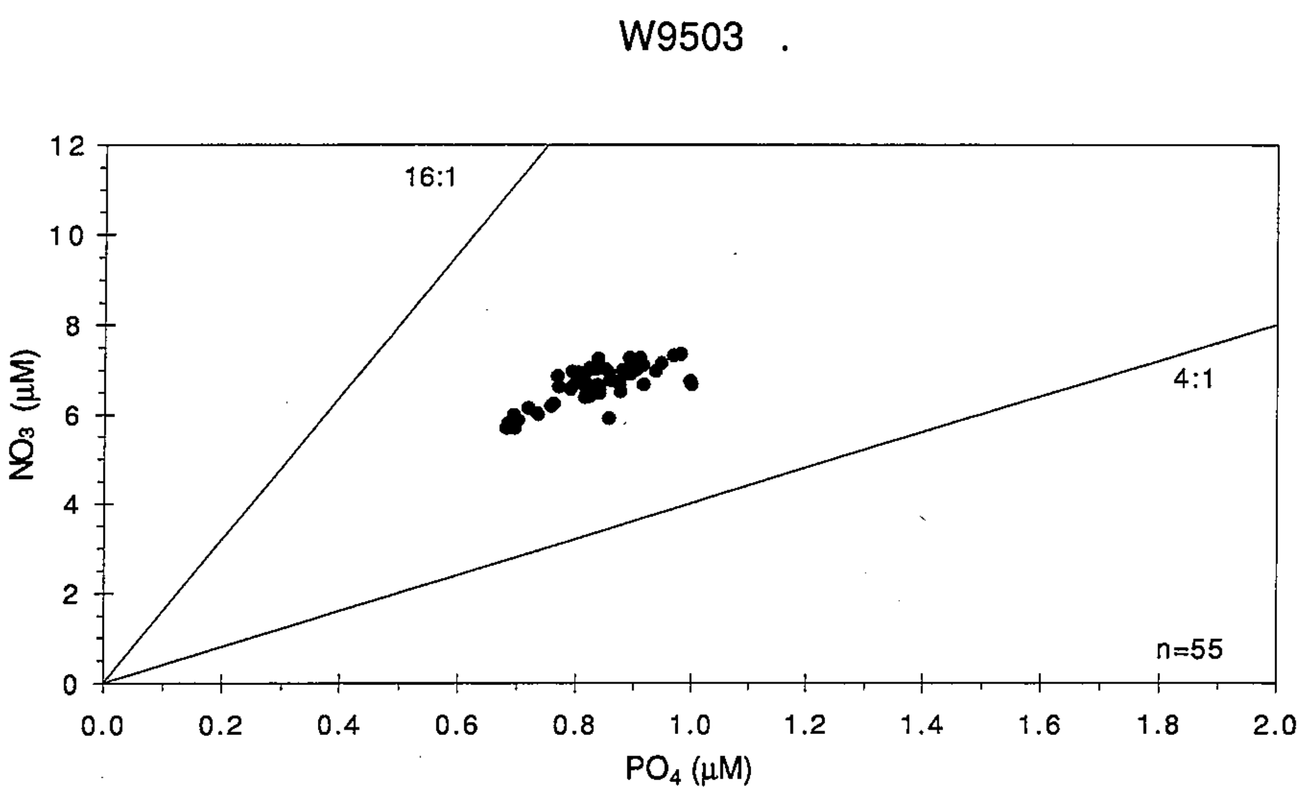
1A

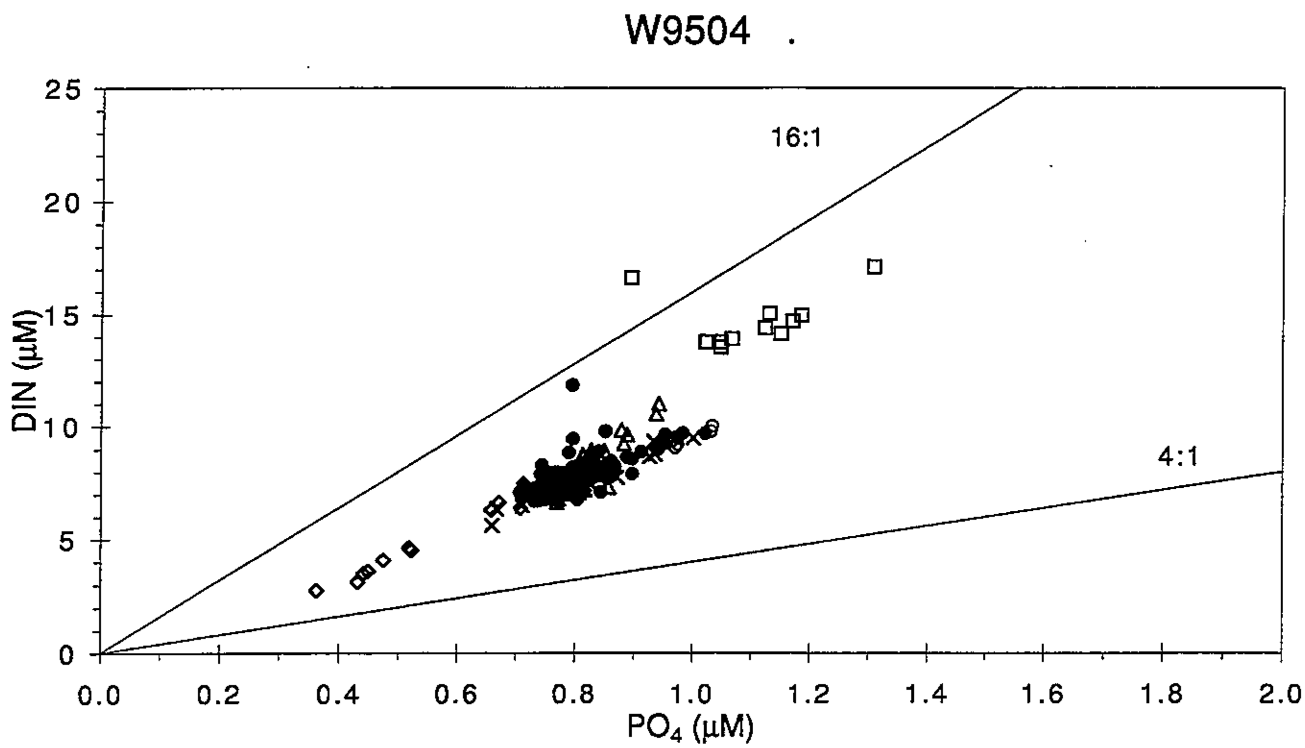


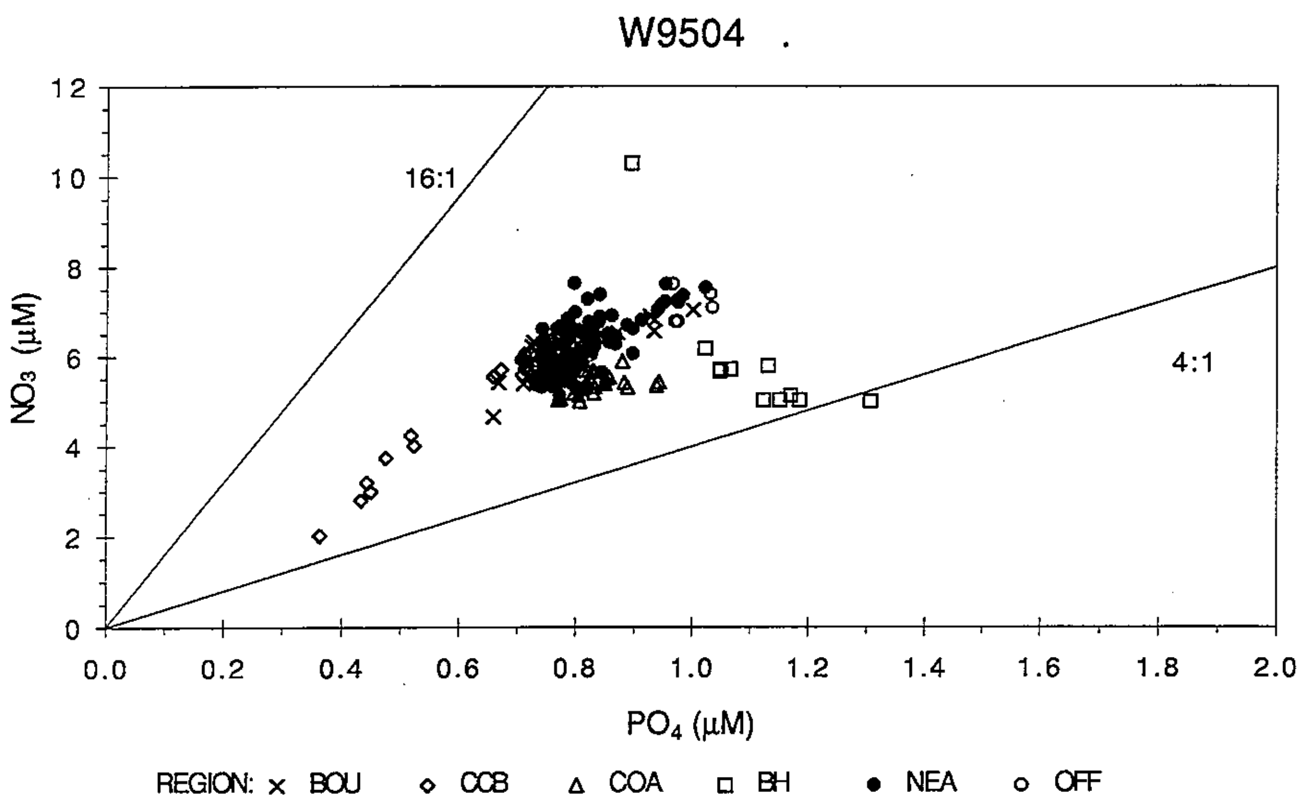
W9502
16:1
4:1
DIN (μM)
PO4 (μM)
W9502
16:1
4:1
NO3 (μM)
PO4 (μM)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

2A

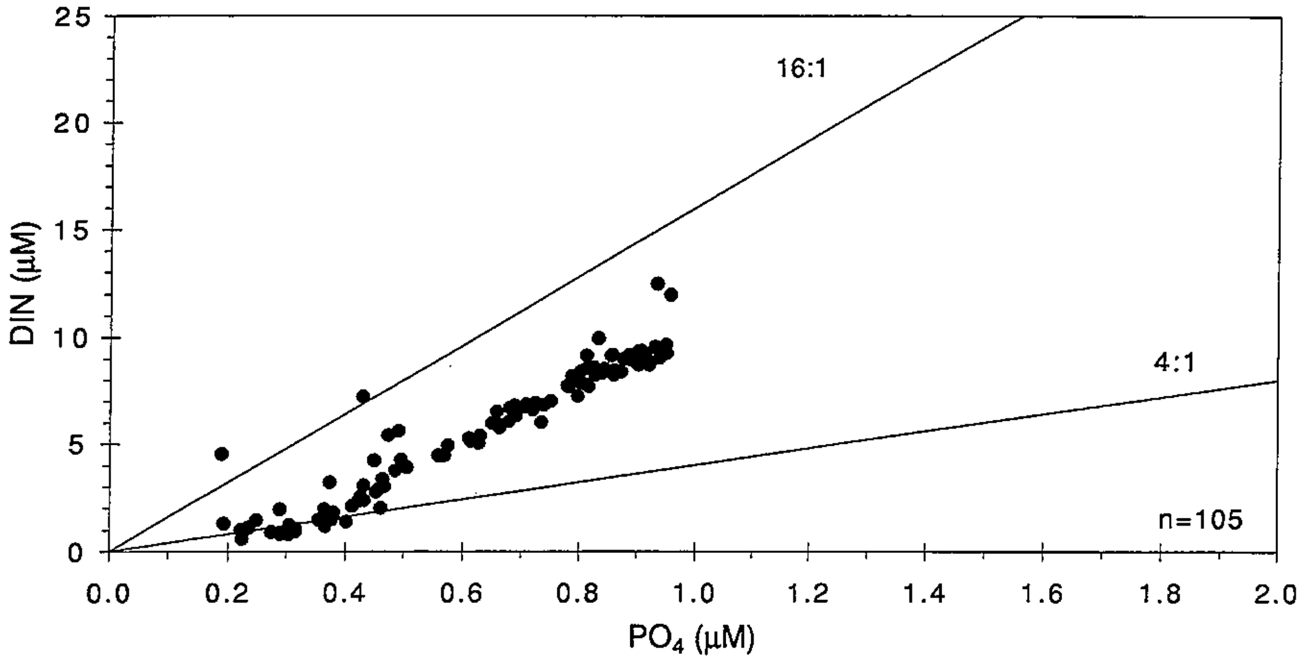

W9503 .
16:1
4:1
n=55
25
20
15
10
5
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
DIN (μM)
PO4 (μM)


W9503 .
16:1
4:1
n=55
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
NO3 (μM)
PO4 (μM)


W9504 .
16:1
4:1
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

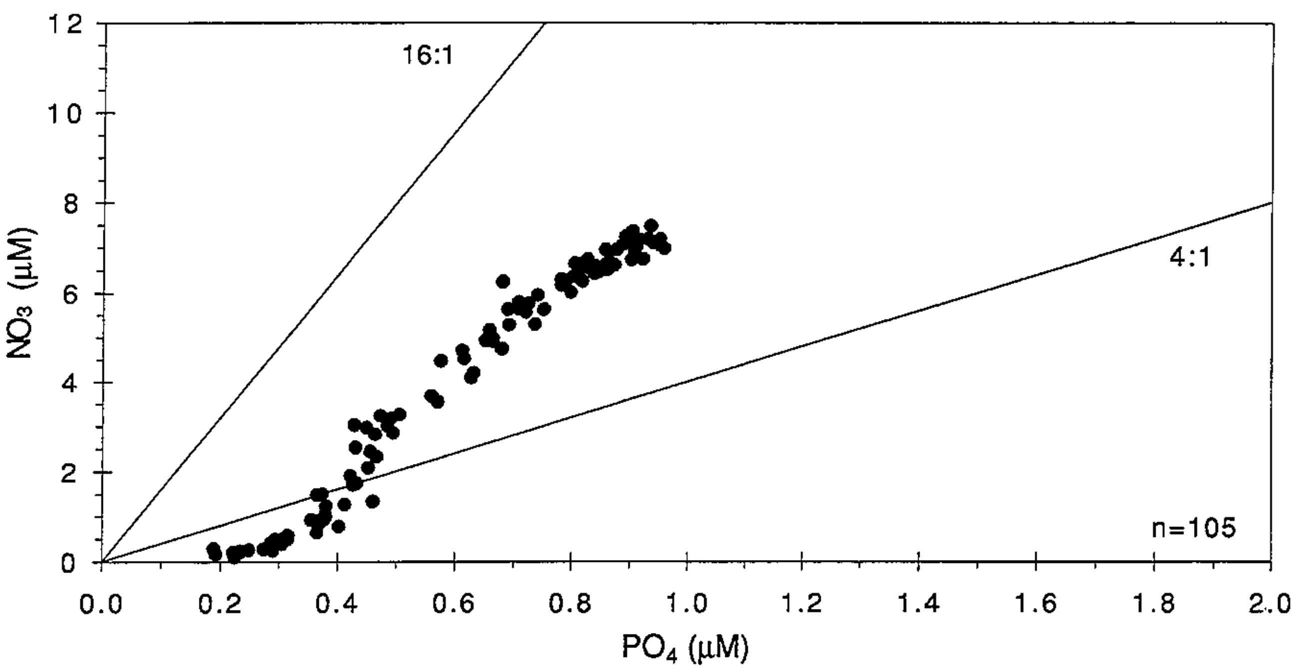

W9504 .
16:1
4:1
NO3 (µM)
PO4 (µM)
0
2
4
6
8
10
12
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

W9505 .

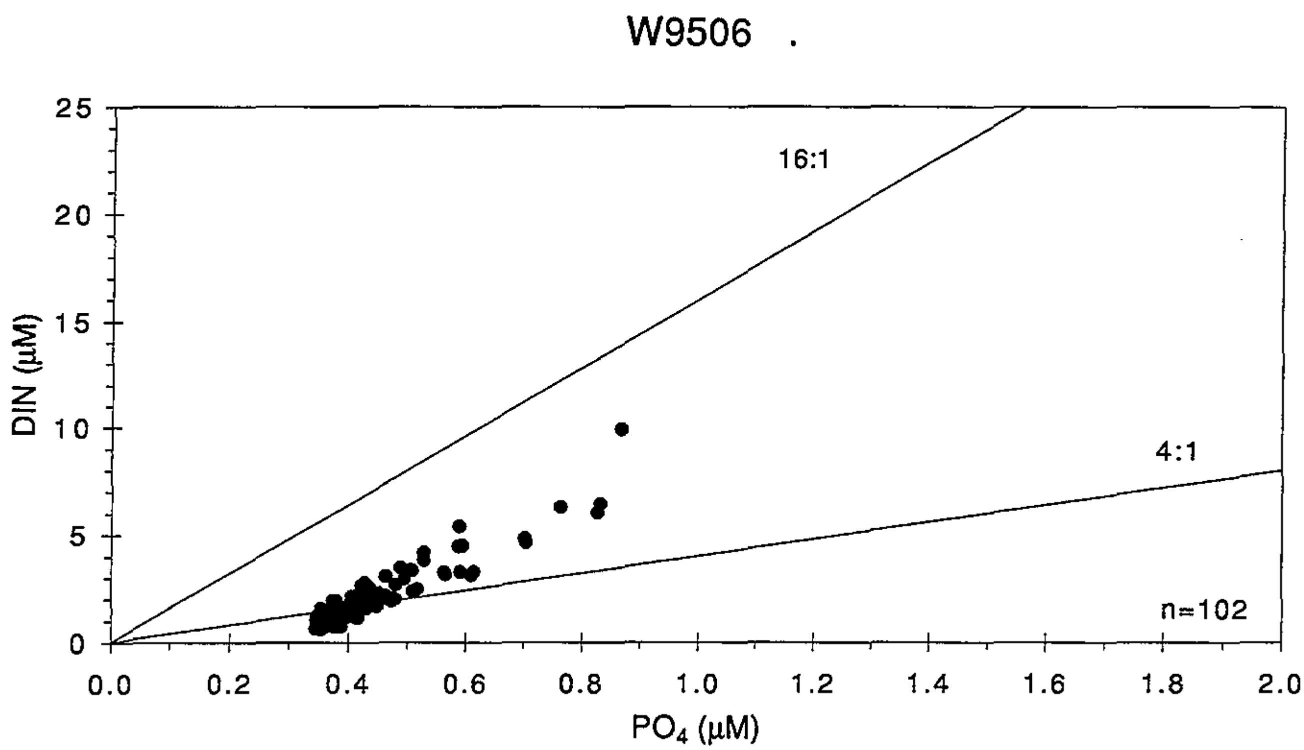


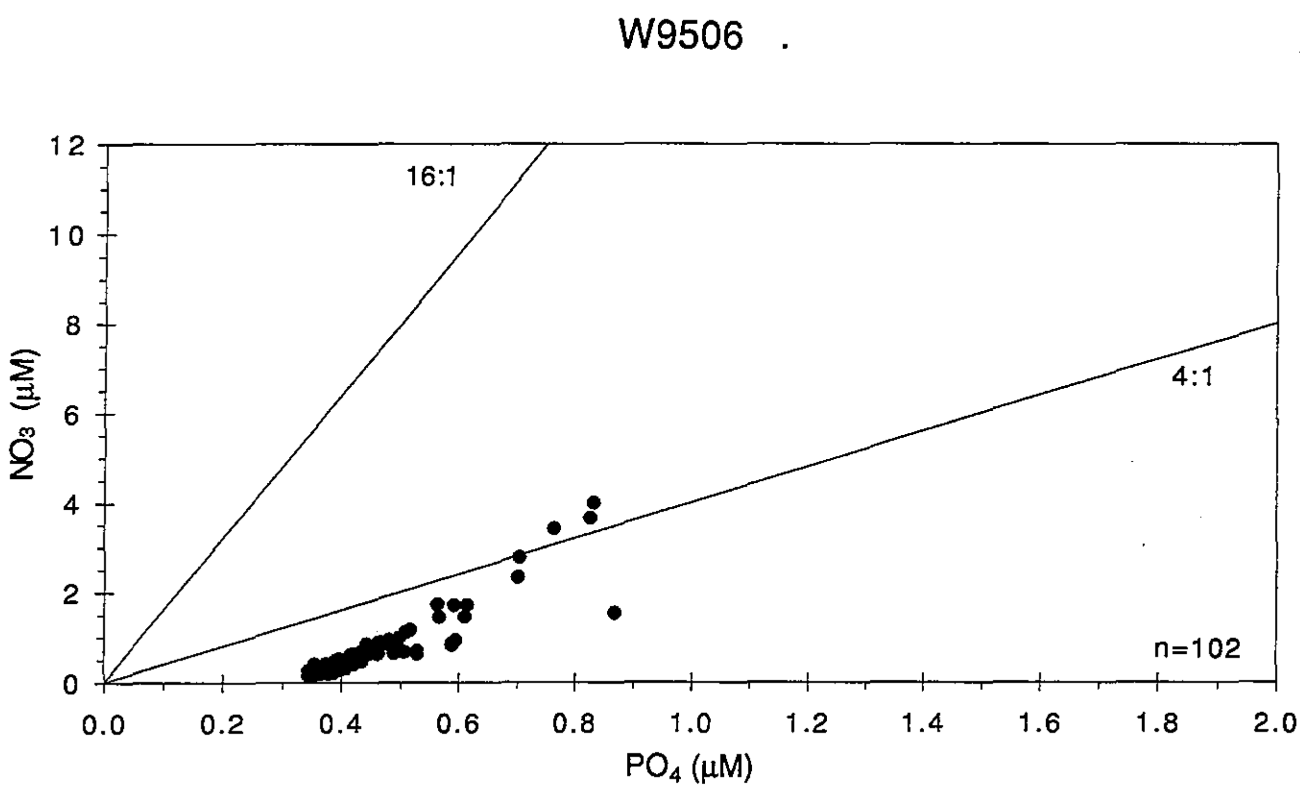
25
20
15
10
5
0
DIN (µM)
16:1
4:1
n=105
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

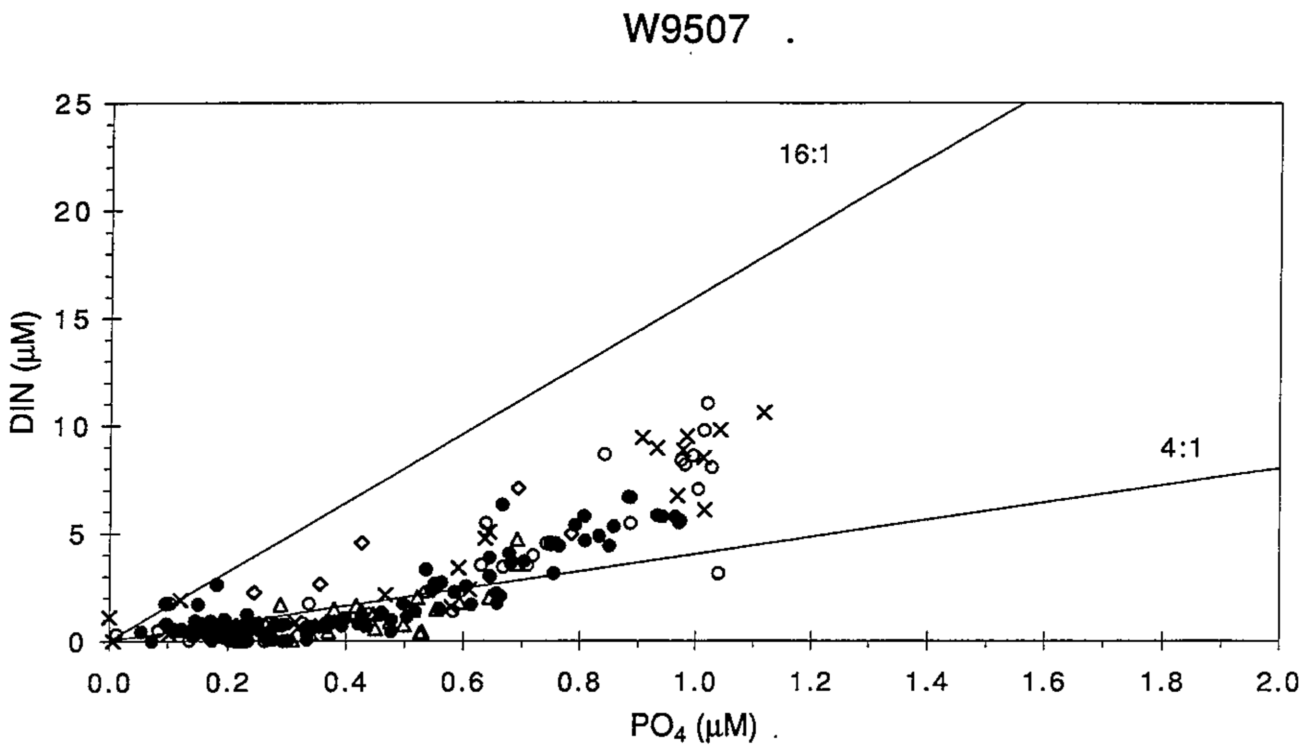
W9505 .

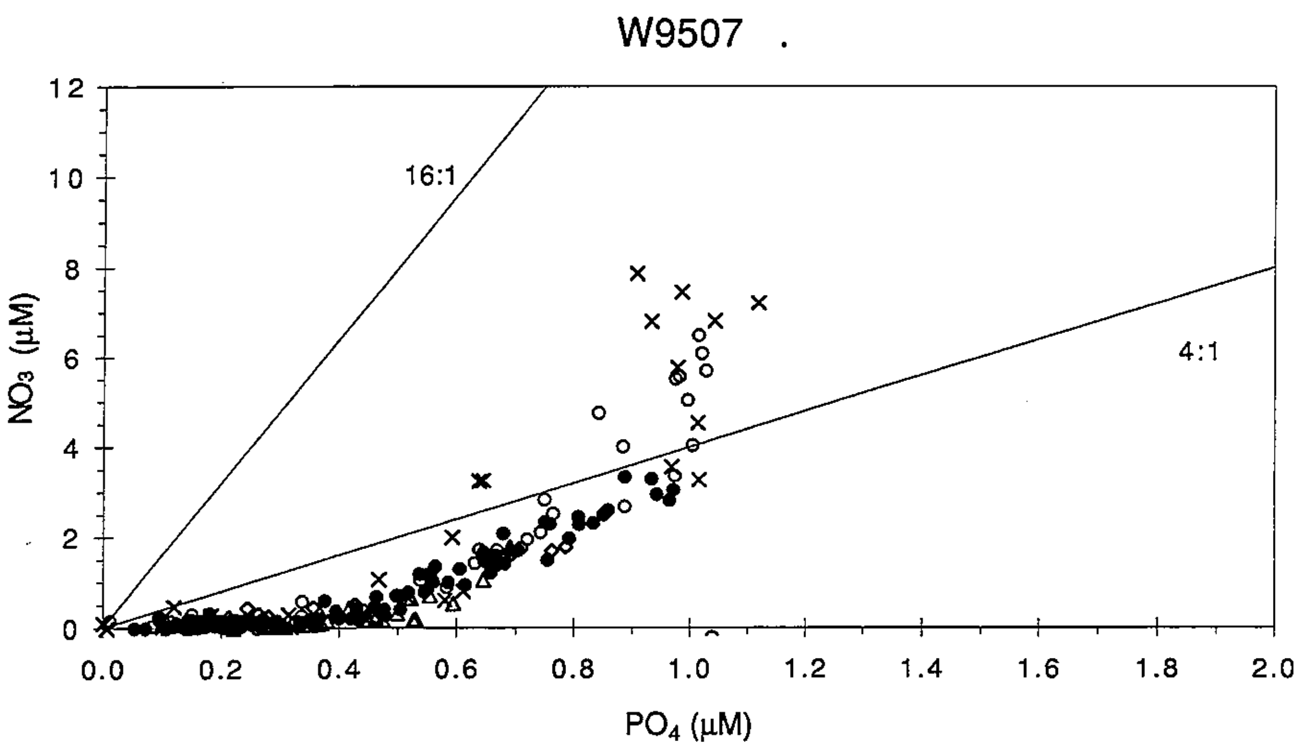


12
10
8
6
4
2
0
NO3 (µM)
16:1
4:1
n=105
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

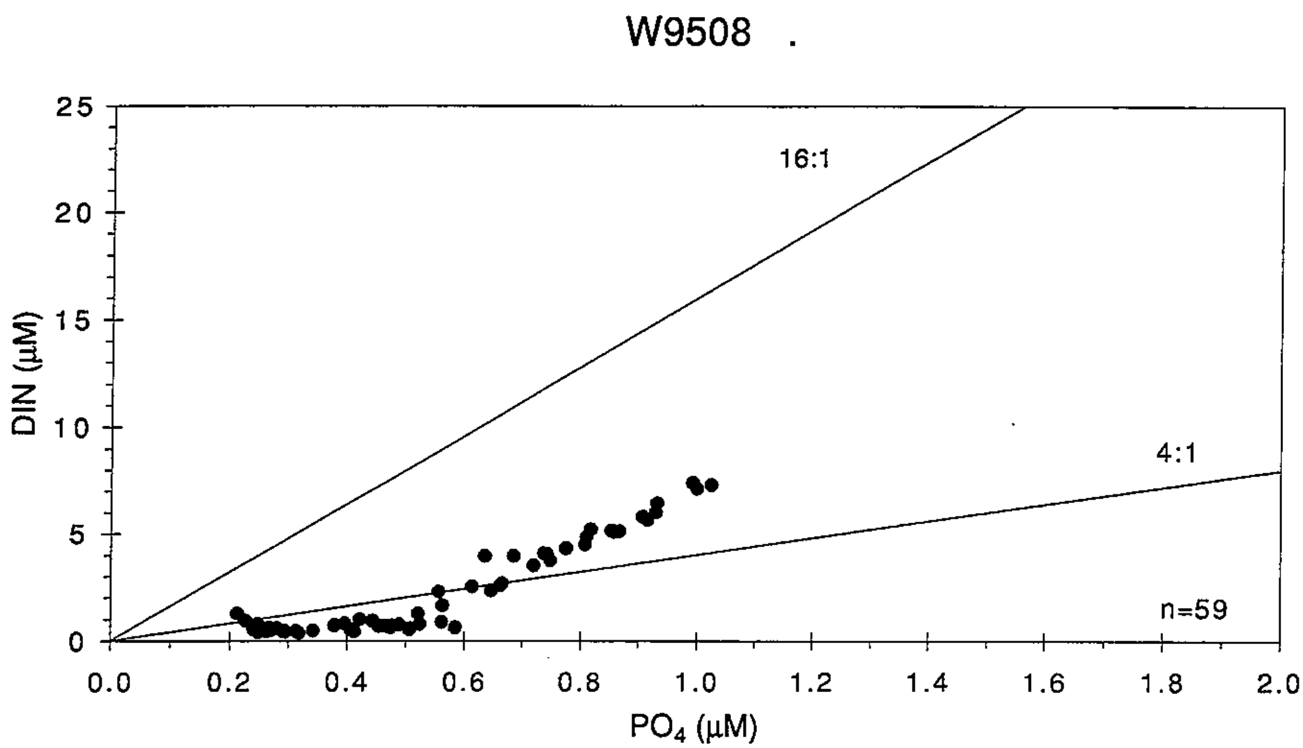

W9506
16:1
4:1
n=102
DIN (µM)
PO4 (µM)
0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0
0 5 10 15 20 25

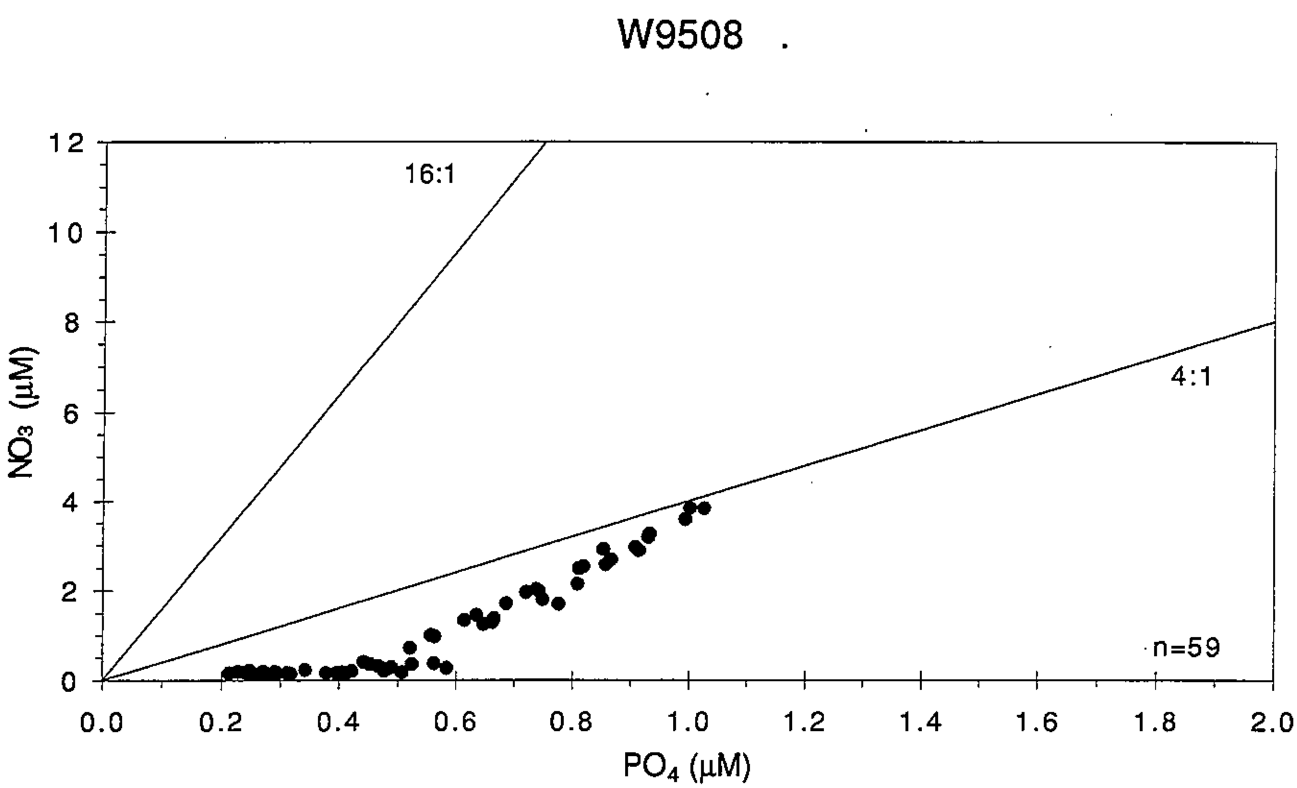

W9506
16:1
4:1
n=102
NO3 (µM)
PO4 (µM)
0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0
0 2 4 6 8 10 12

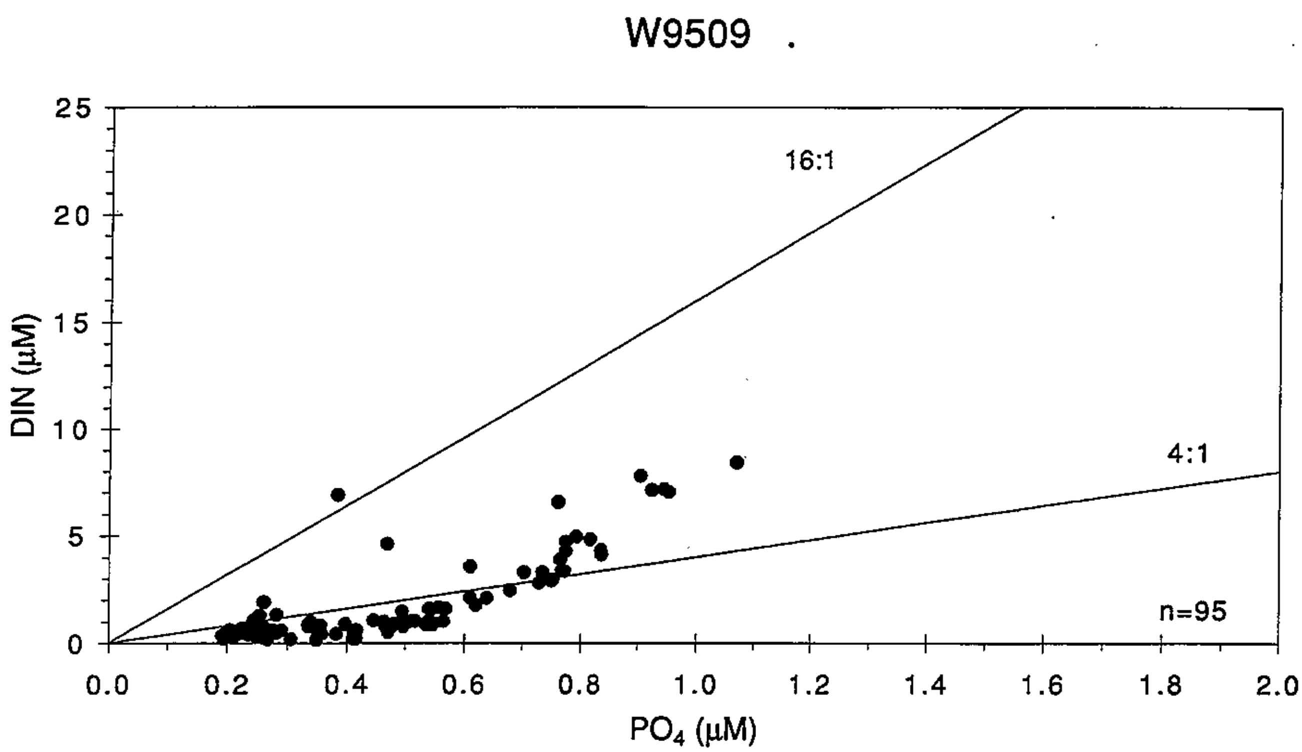


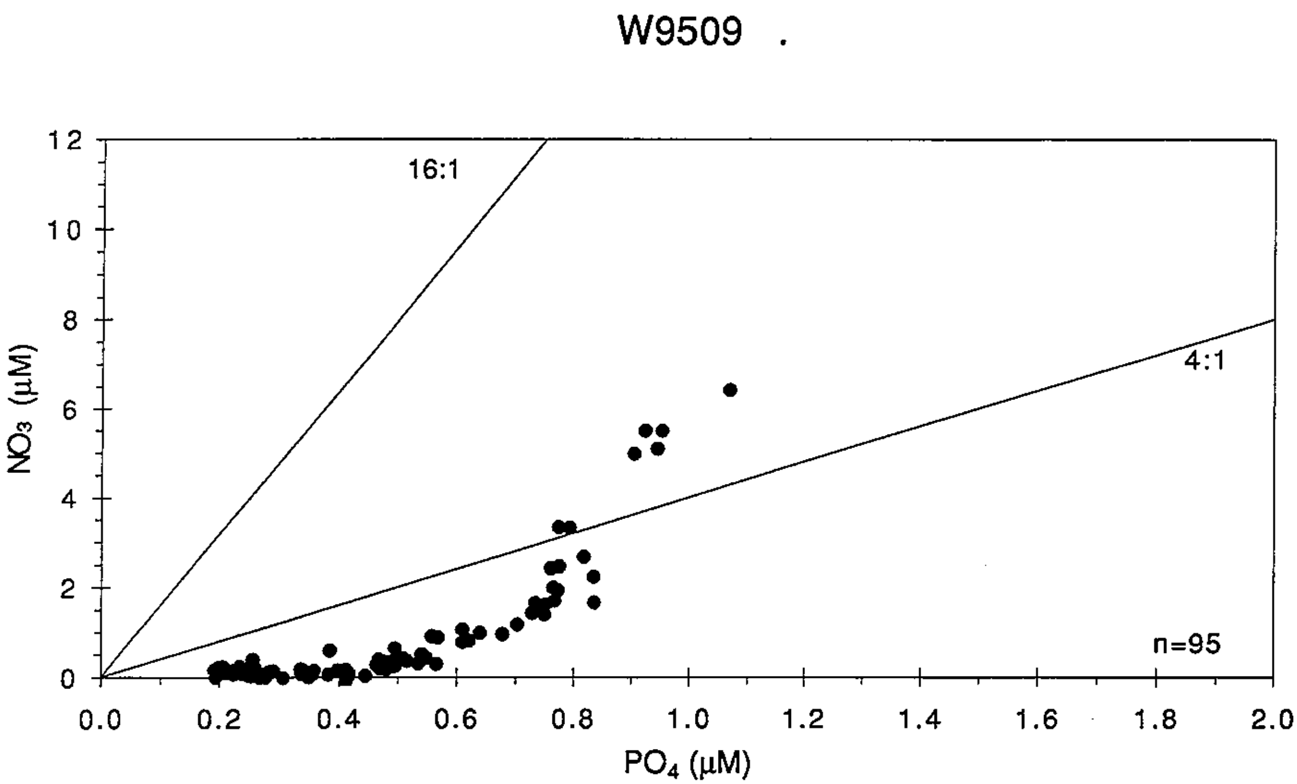


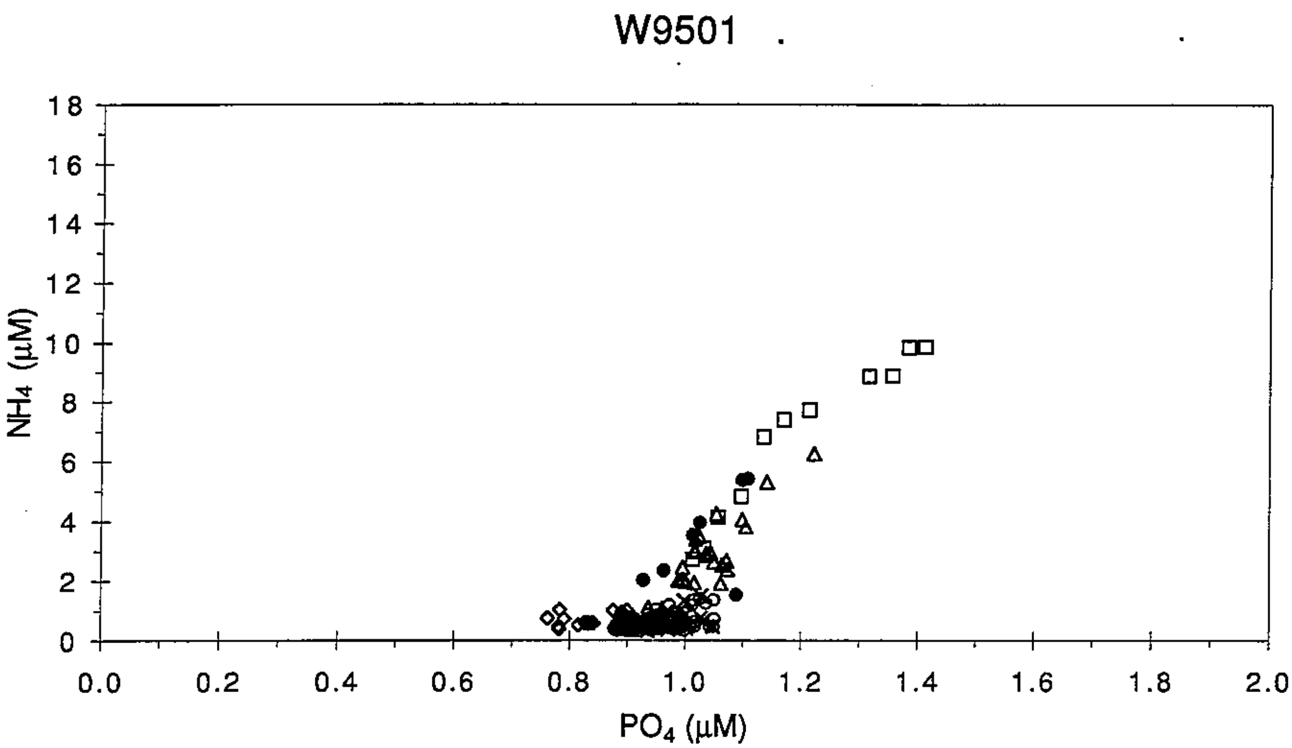
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

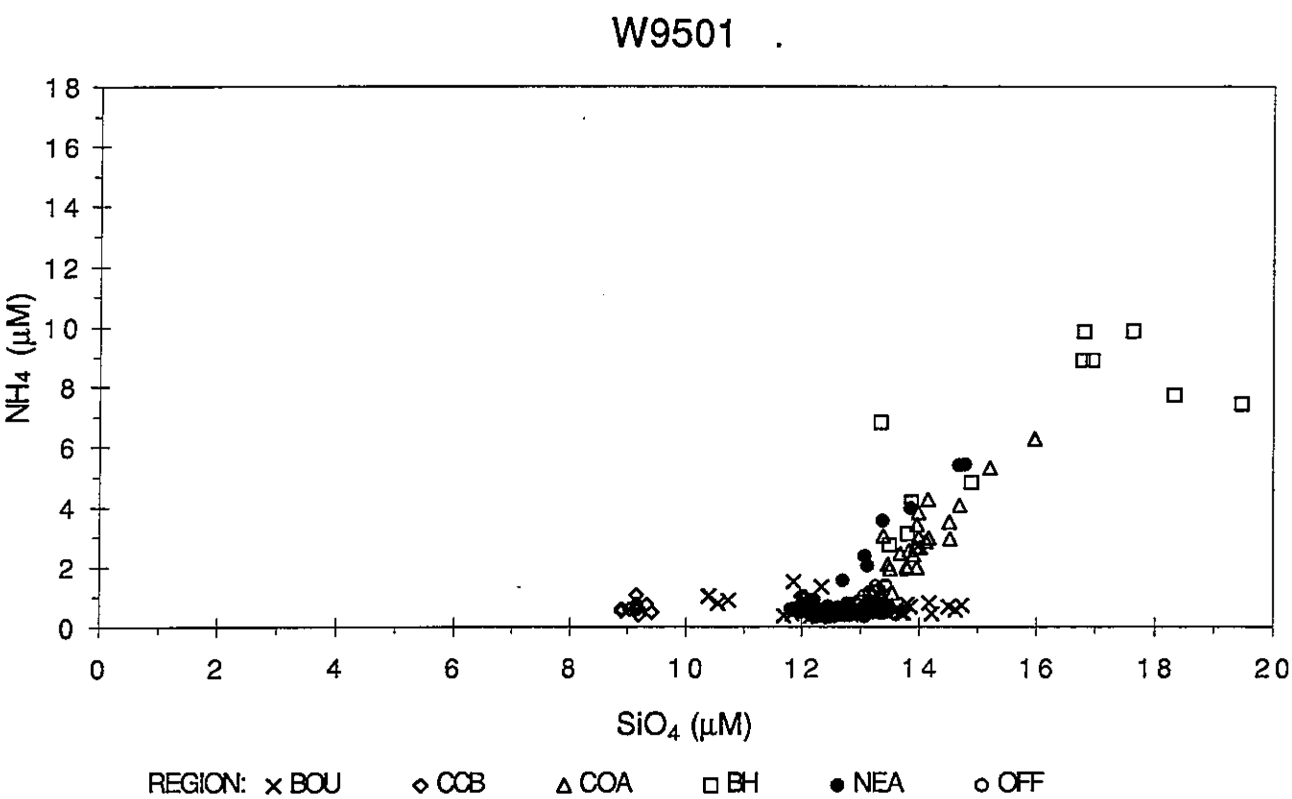

W9508 .
16:1
4:1
n=59
DIN (µM)
PO4 (µM)
0
5
10
15
20
25
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0


W9508 .
16:1
4:1
n=59
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

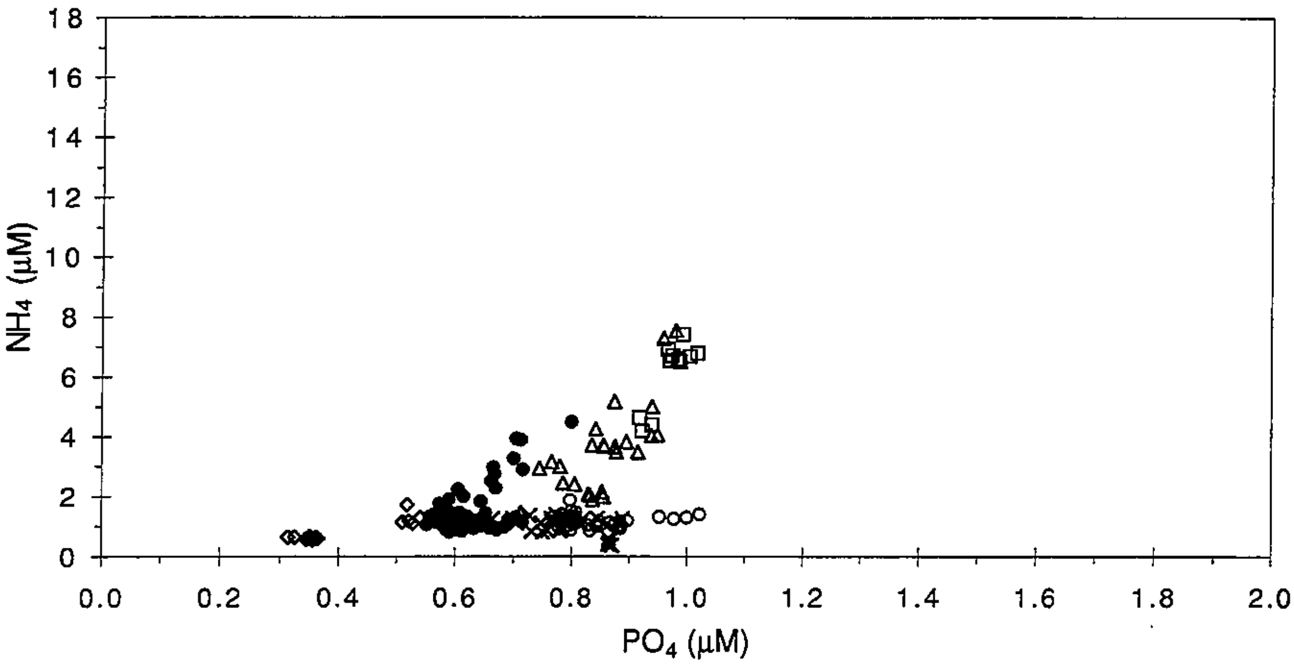

W9509
16:1
4:1
n=95
DIN (µM)
PO4 (µM)
0
5
10
15
20
25
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0


W9509
16:1
4:1
n=95
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

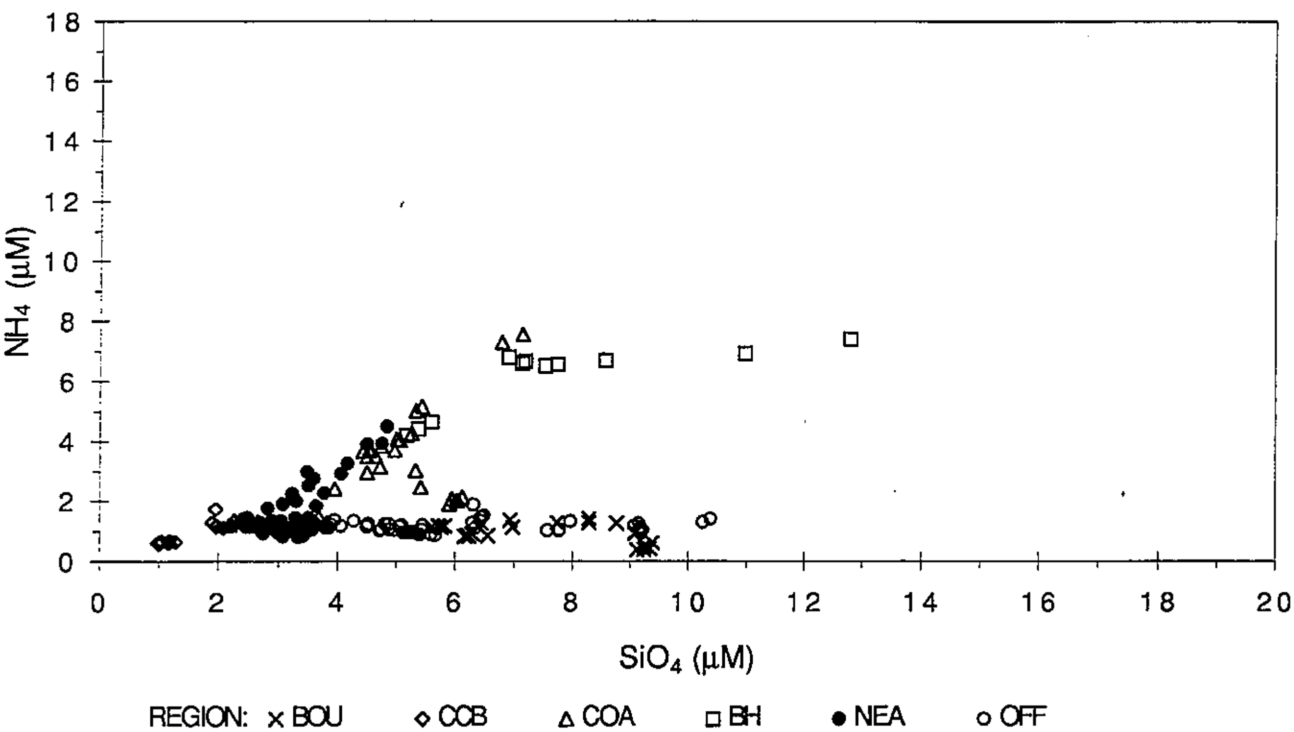

W9501
NH4 (µM)
PO4 (µM)
0
2
4
6
8
10
12
14
16
18
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0

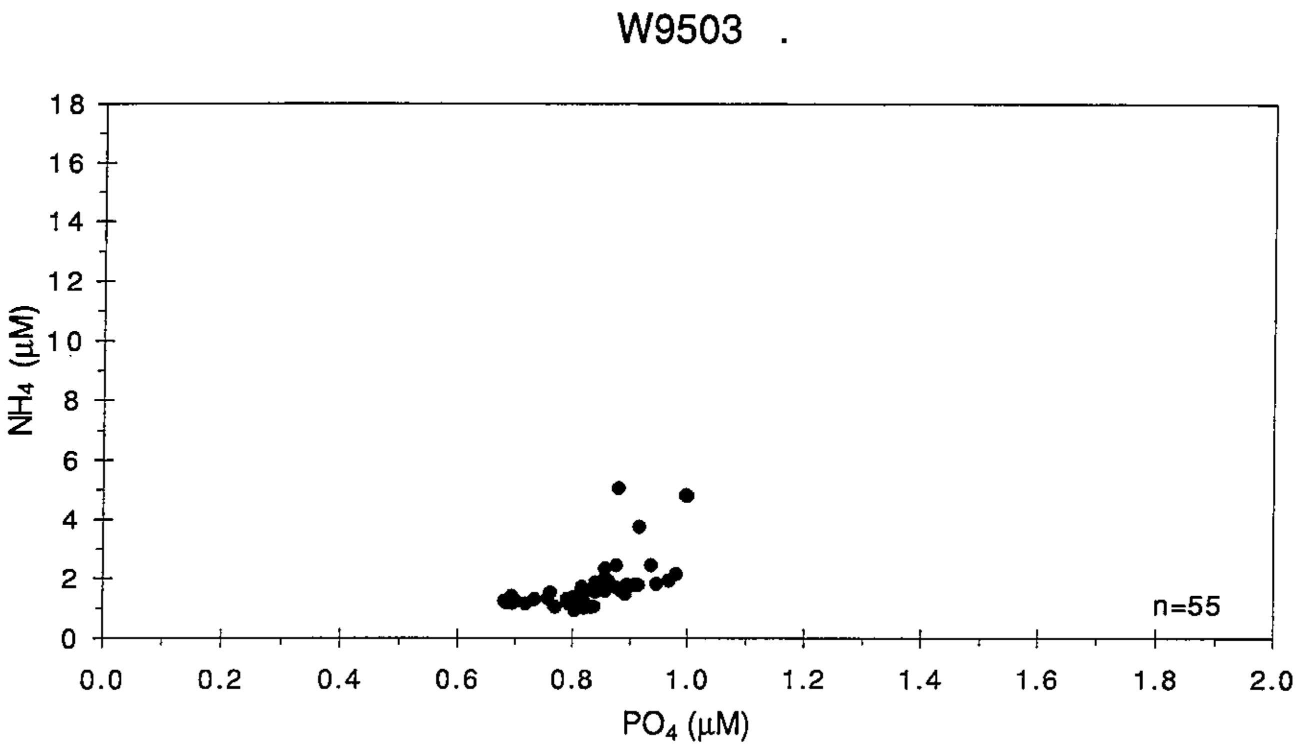

W9501
NH4 (µM)
SiO4 (µM)
0
2
4
6
8
10
12
14
16
18
20
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

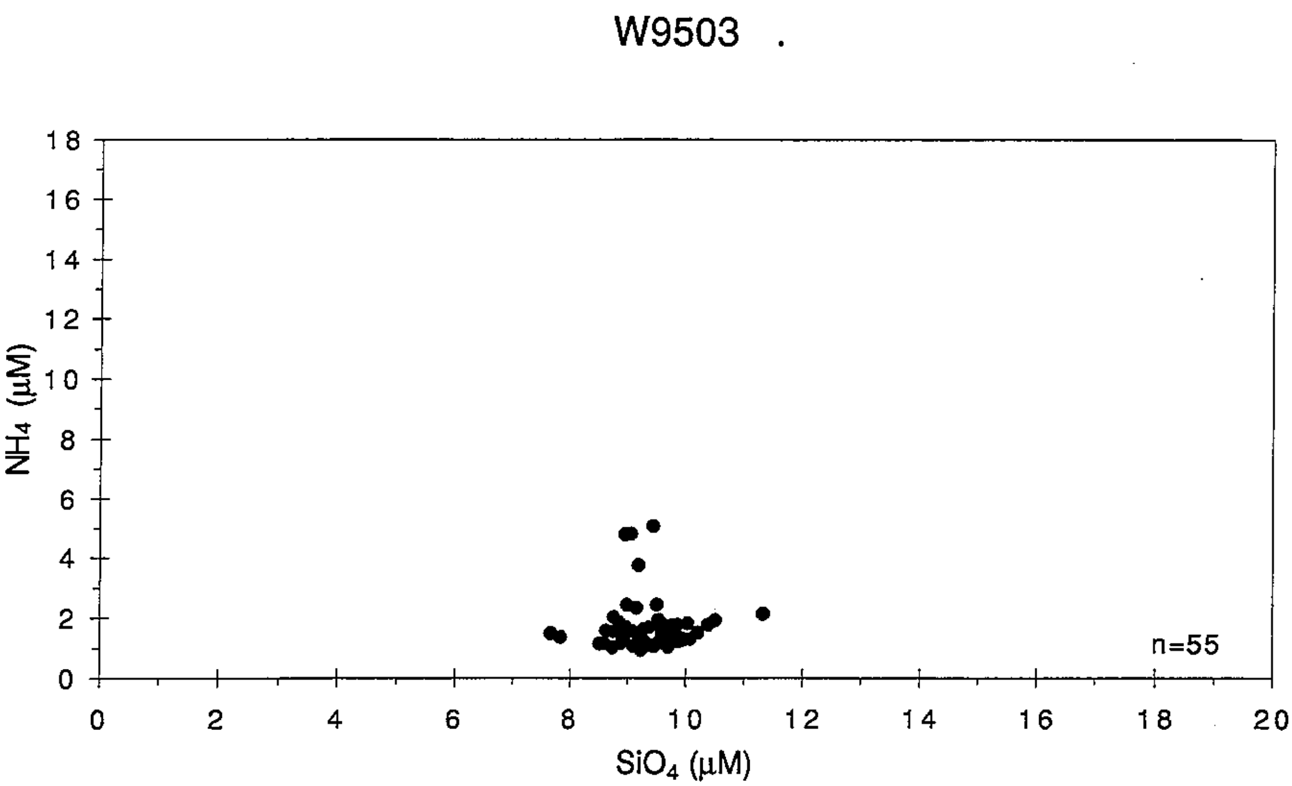
W9502 .


NH4 (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
14
16
18

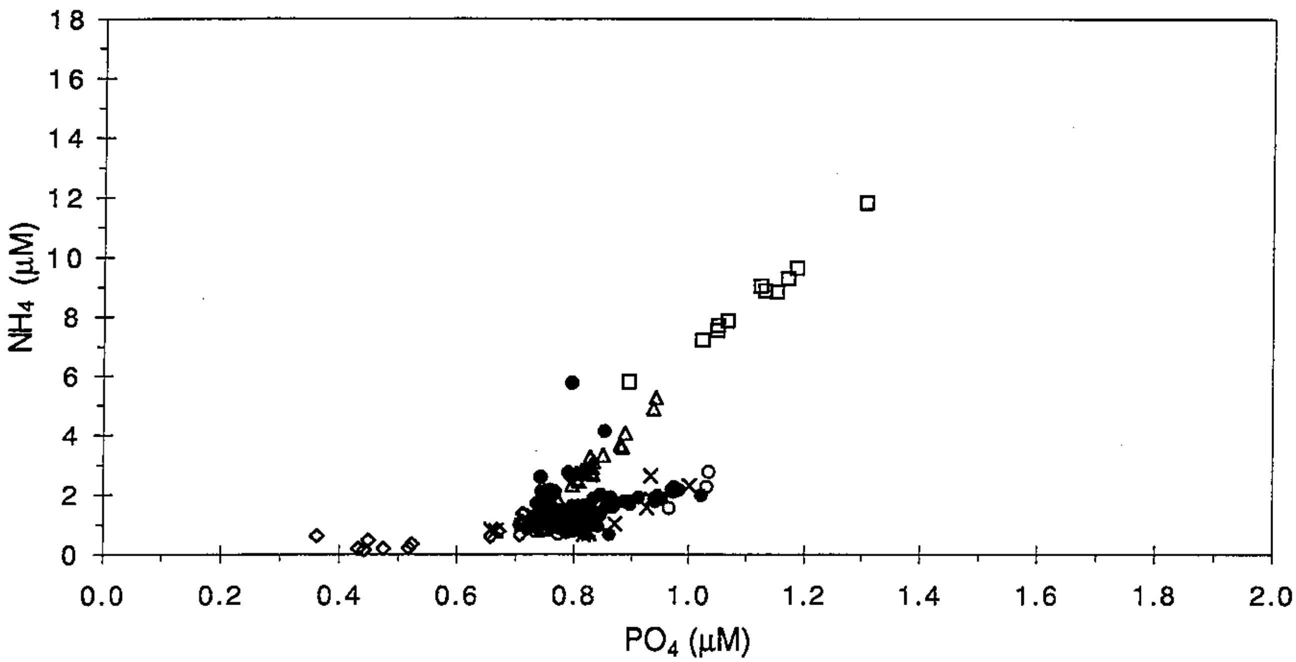
W9502 .


NH4 (µM)
SiO4 (µM)
0
2
4
6
8
10
12
14
16
18
20
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF


W9503 .
NH4 (μM)
PO4 (μM)
n=55
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

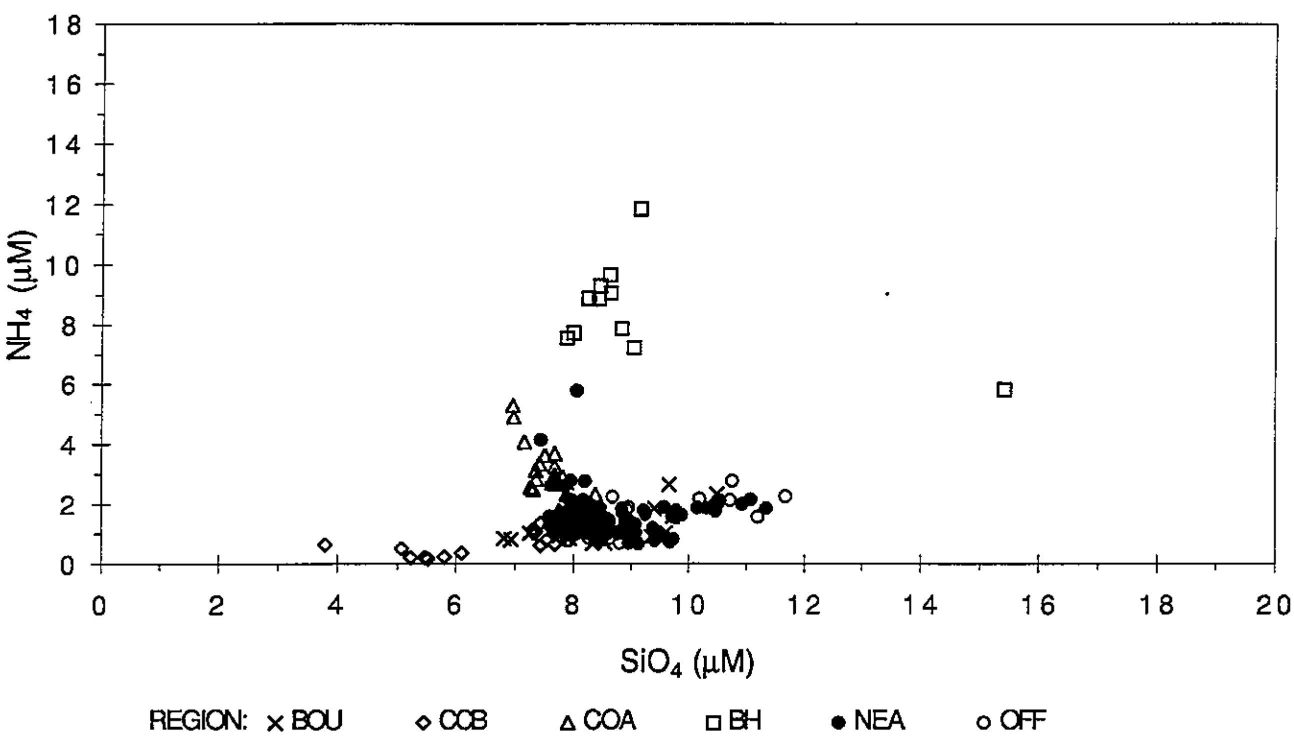

W9503 .
NH4 (μM)
SiO4 (μM)
n=55
18
16
14
12
10
8
6
4
2
0
0
2
4
6
8
10
12
14
16
18
20

W9504



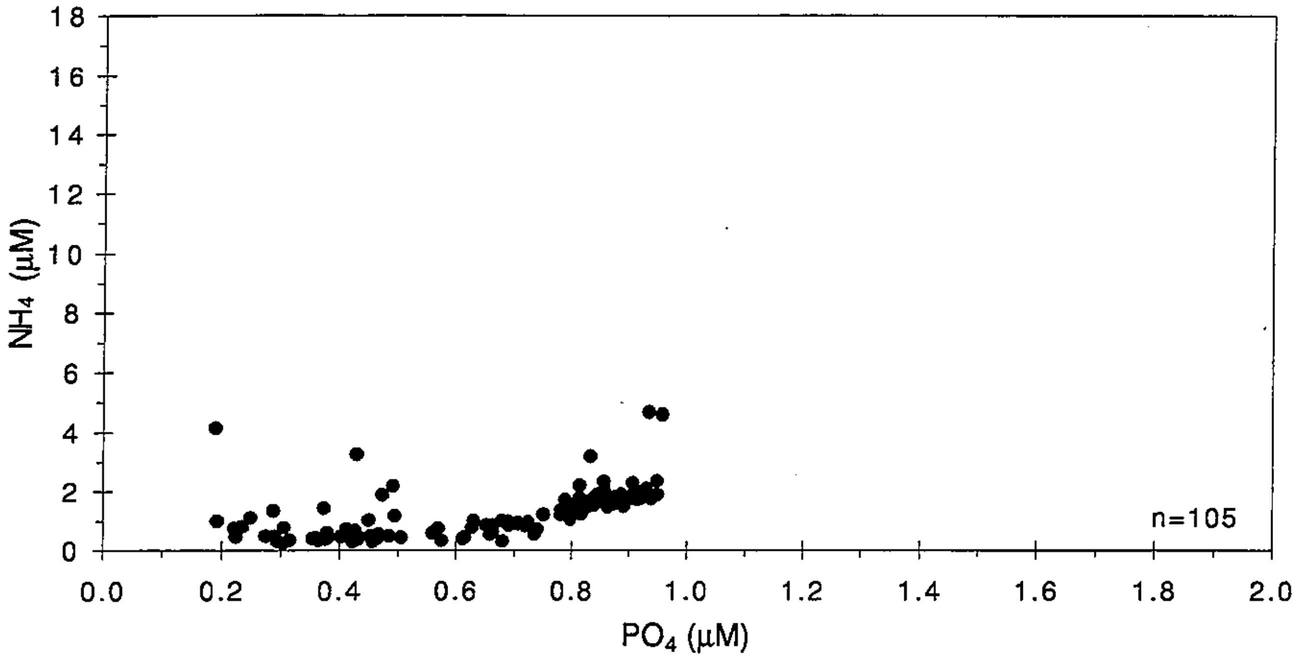
18
16
14
12
10
8
6
4
2
0
NH4 (µM)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

W9504



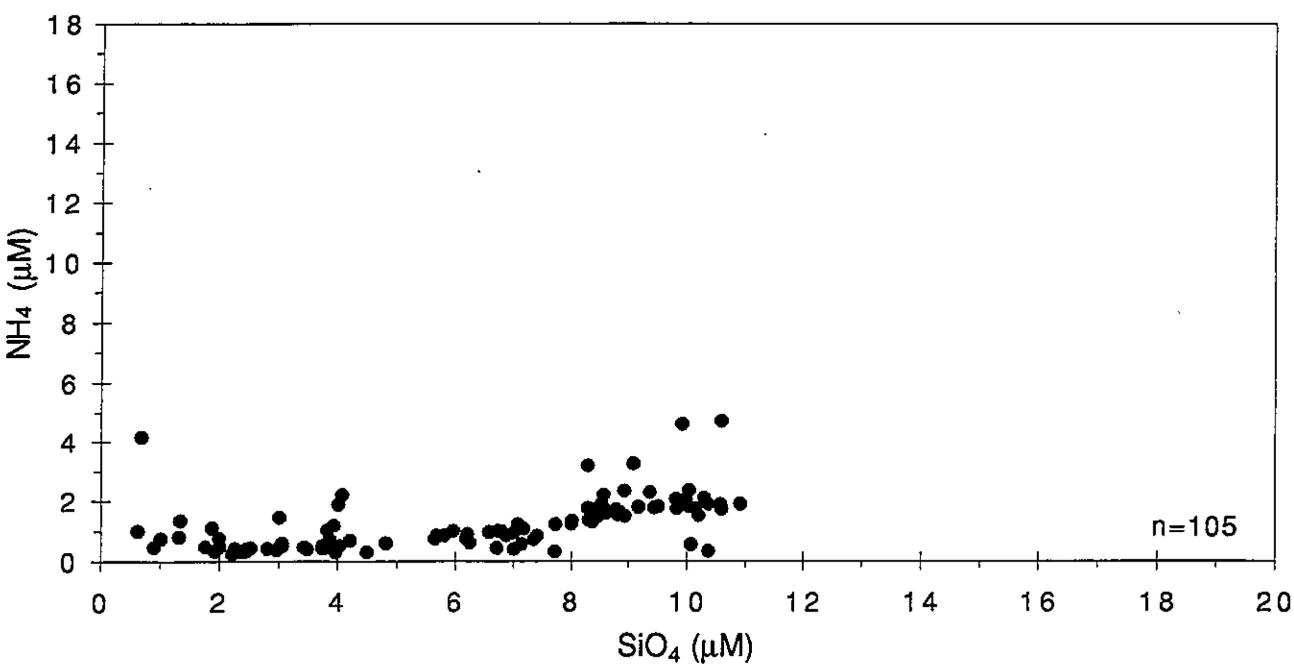
18
16
14
12
10
8
6
4
2
0
NH4 (µM)
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

W9505



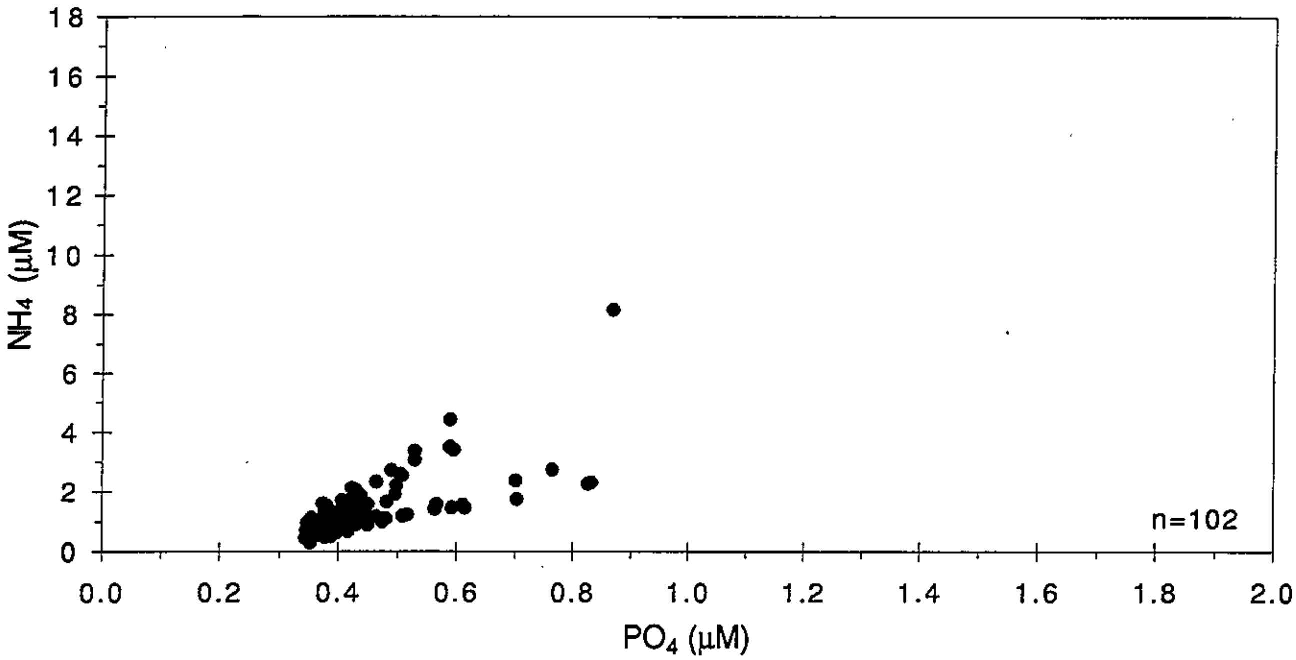
NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=105
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

W9505



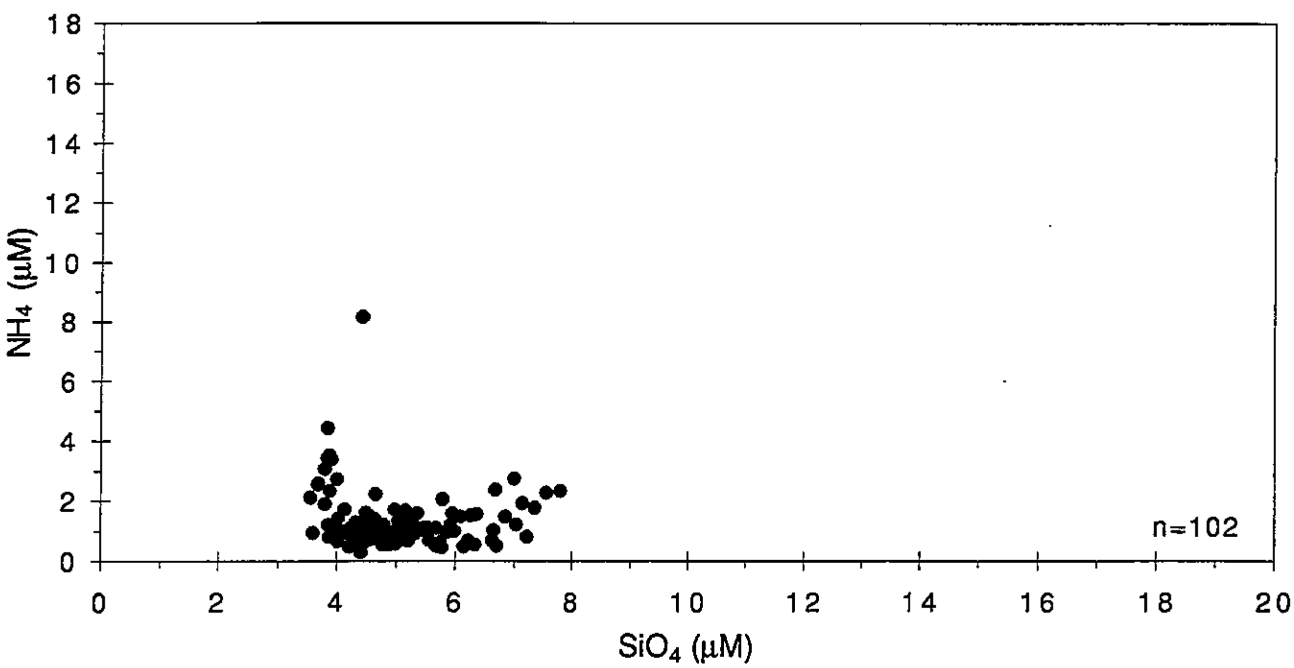
NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=105
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)

W9506



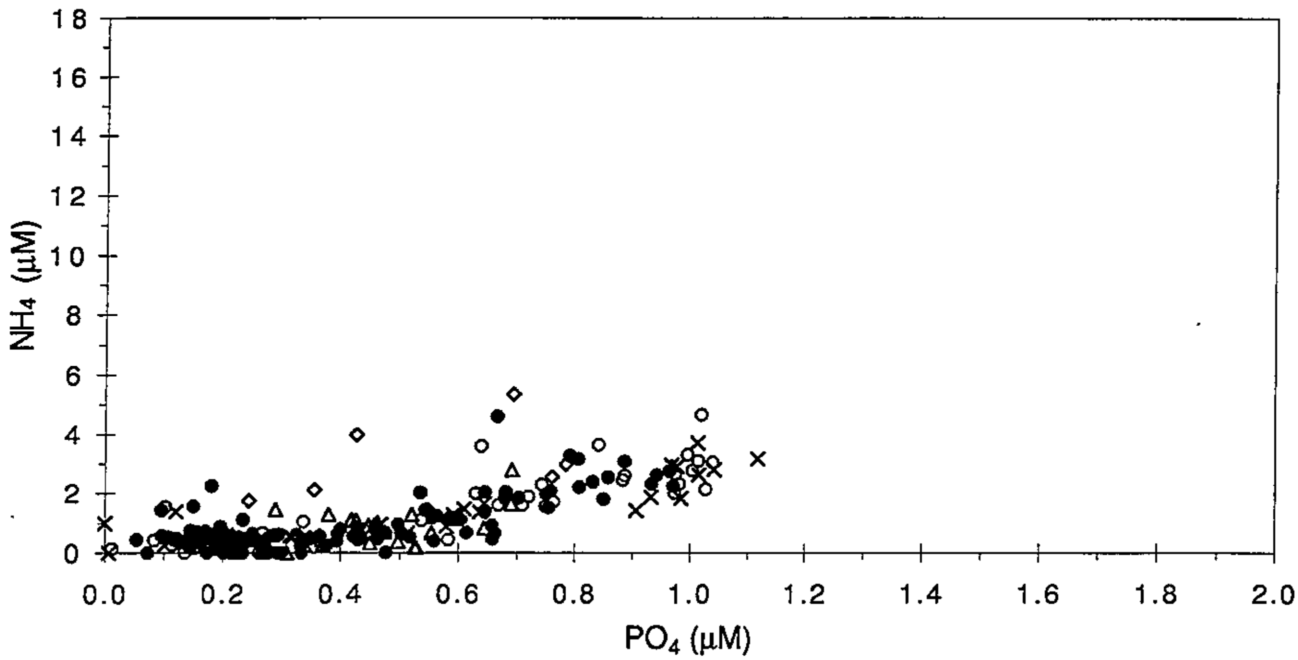
NH4 (µM)
0
2
4
6
8
10
12
14
16
18
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)
n=102

W9506

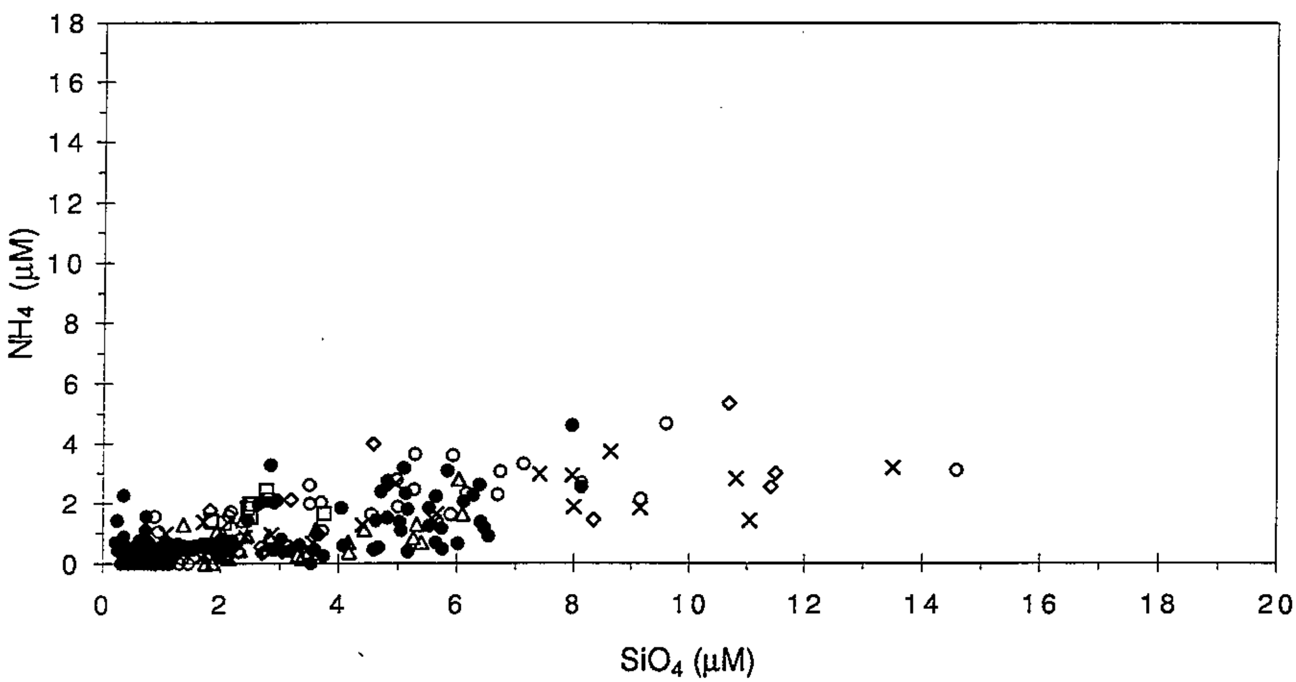


NH4 (µM)
0
2
4
6
8
10
12
14
16
18
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)
n=102

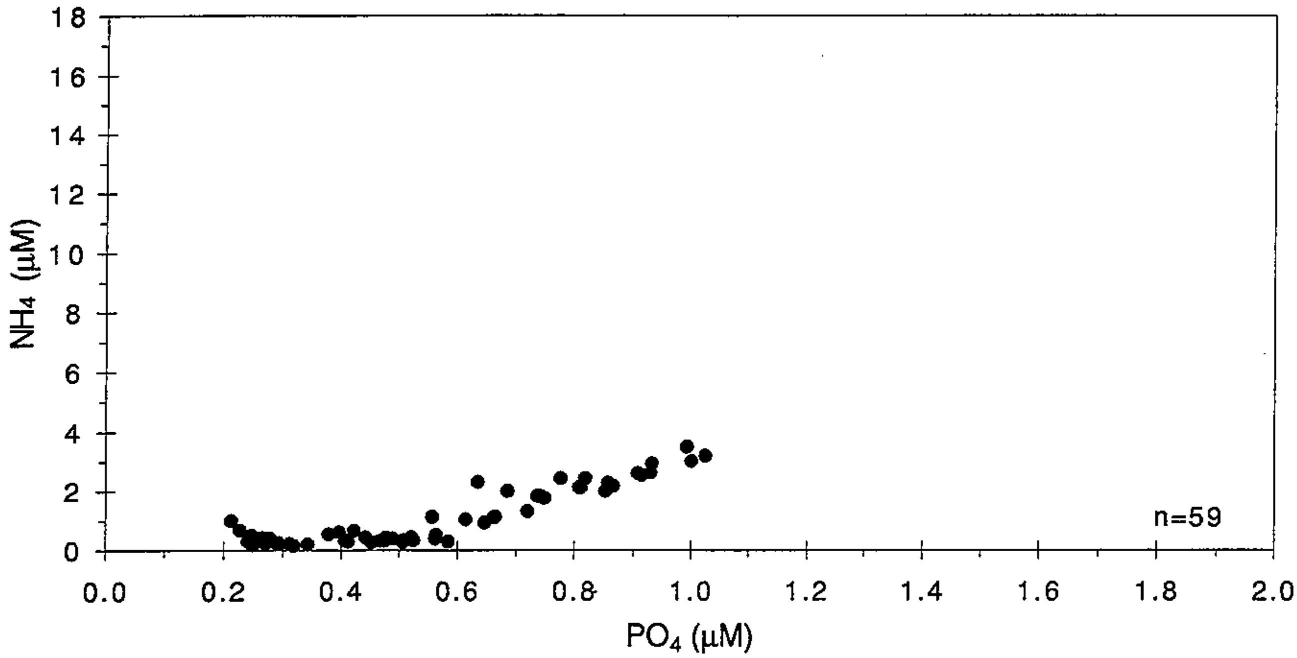
W9507 .



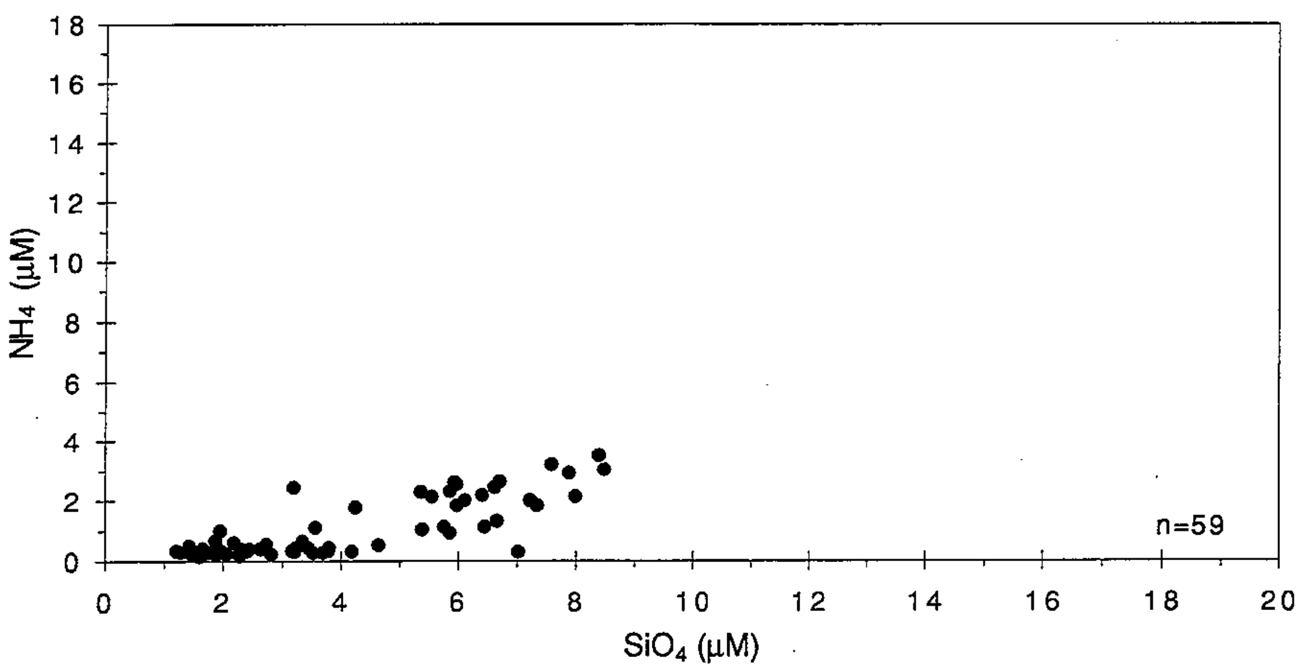
W9507 .



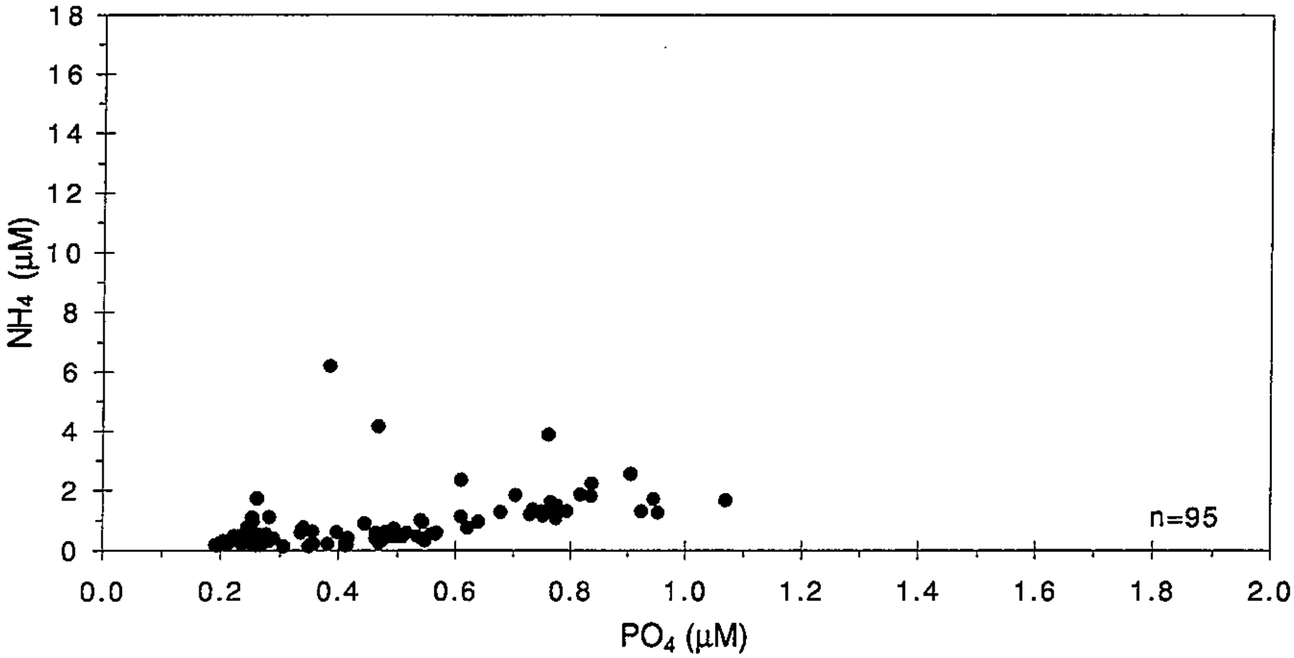
W9508 .



W9508 .

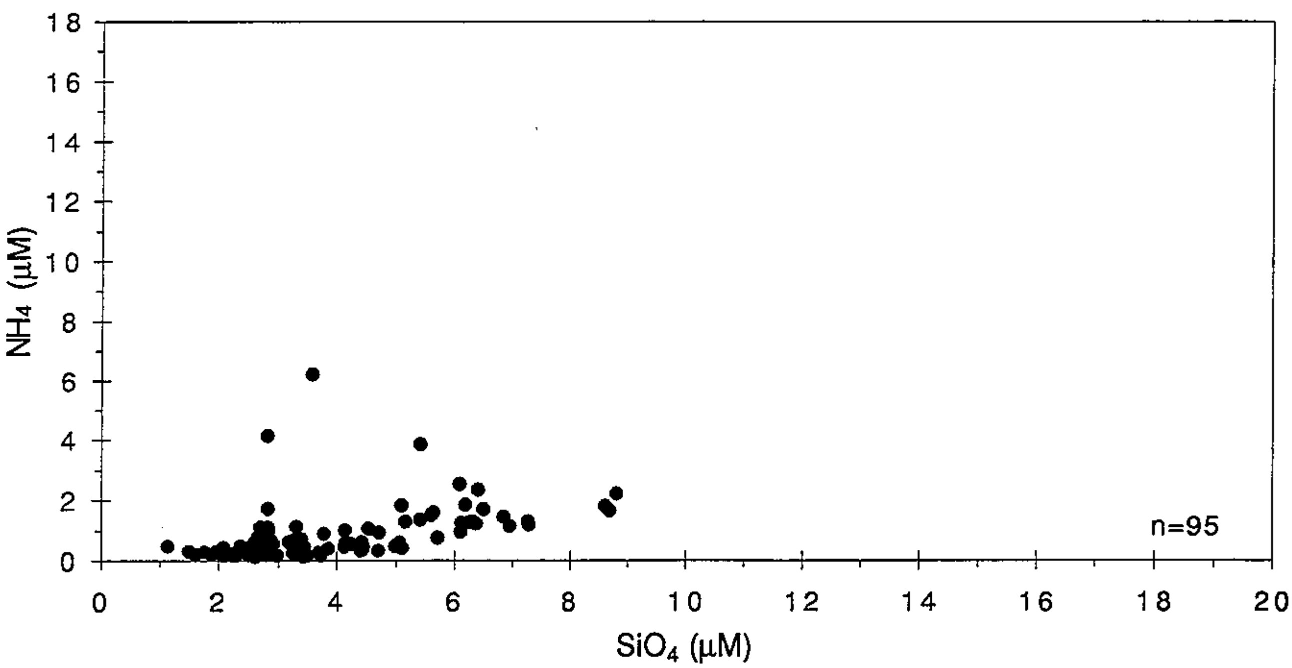


W9509 .

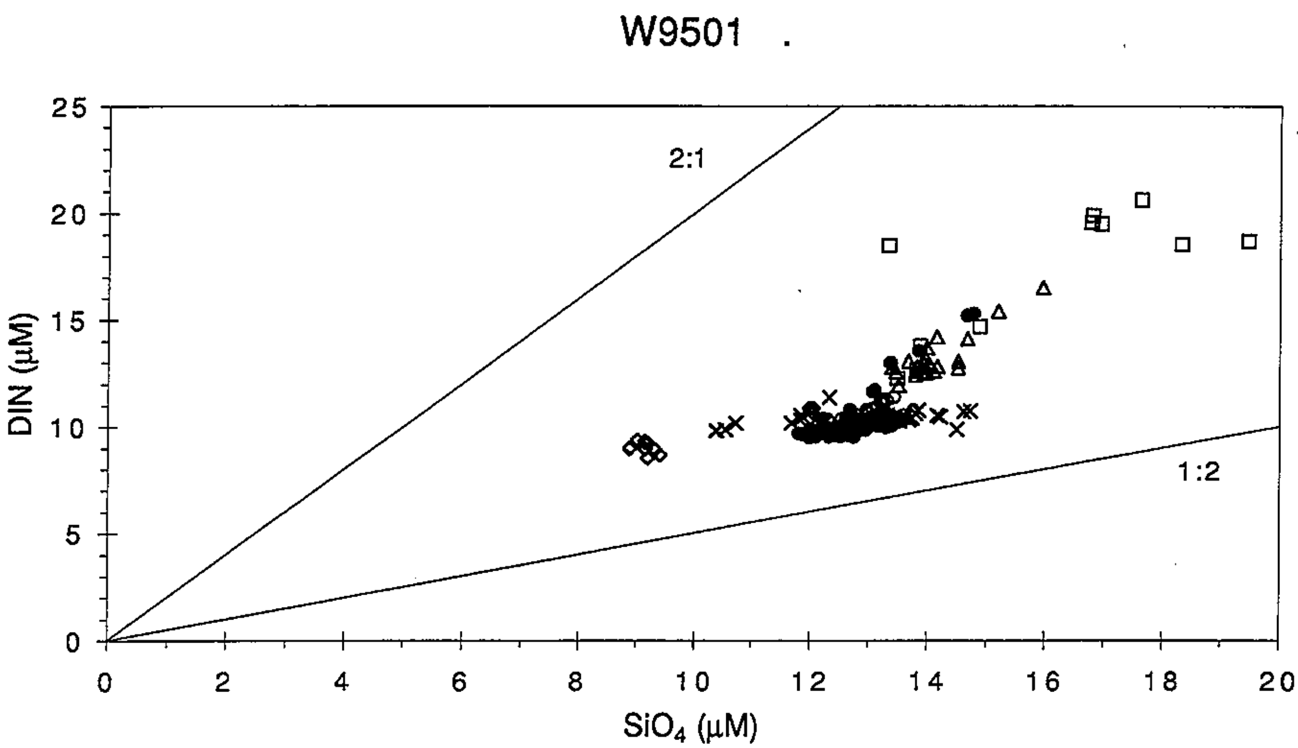


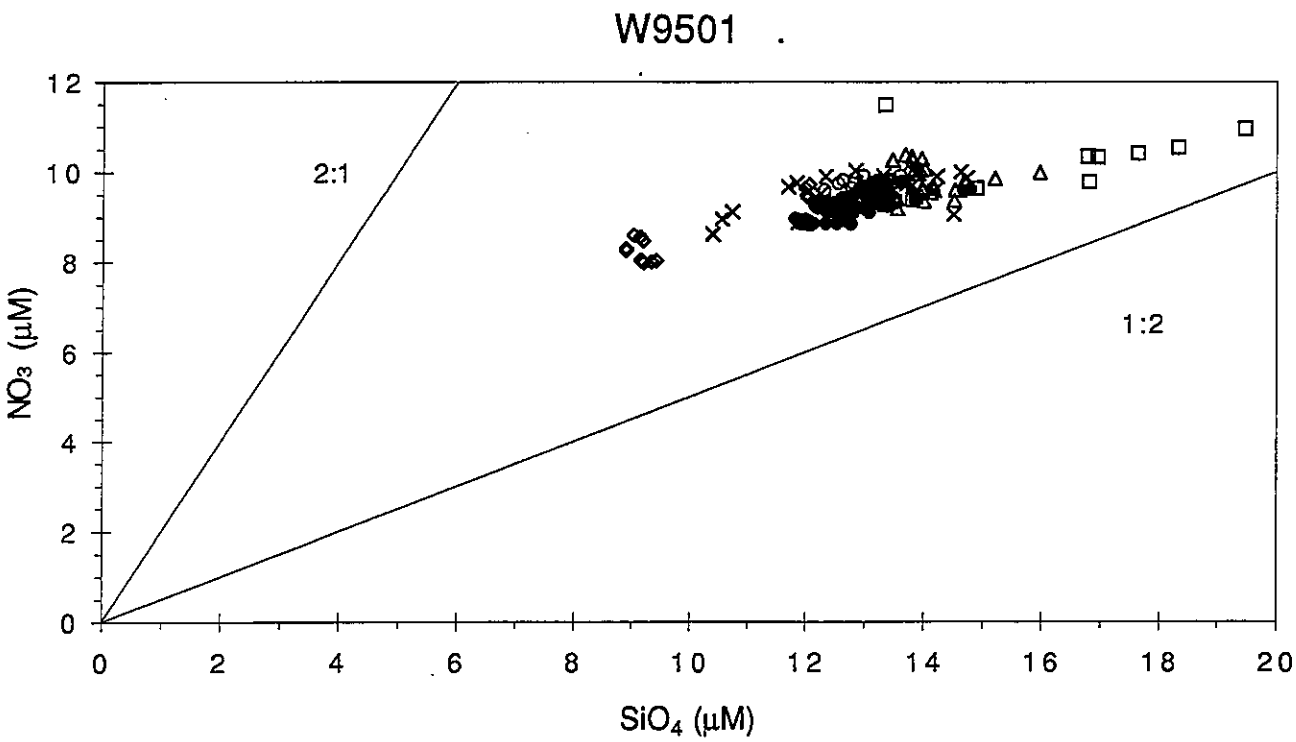
NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=95
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
PO4 (µM)

W9509 .

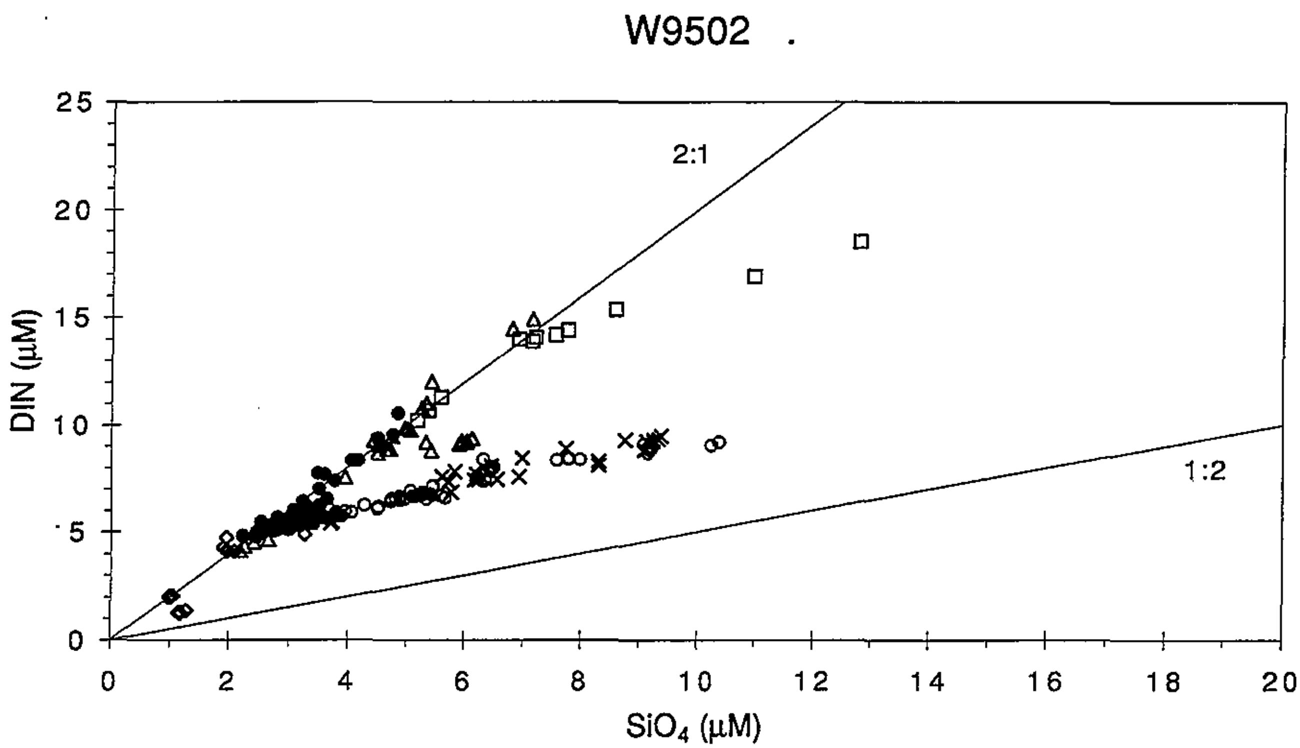


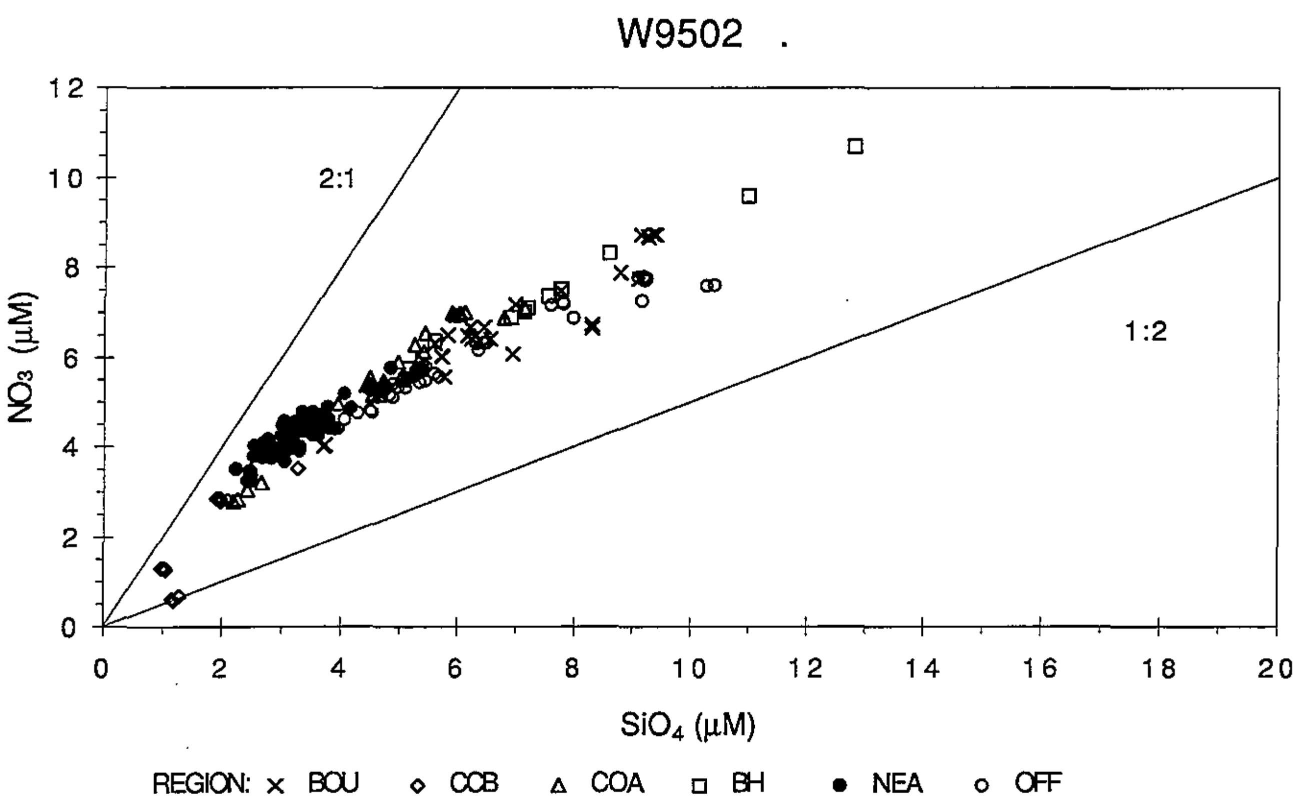
NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=95
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)

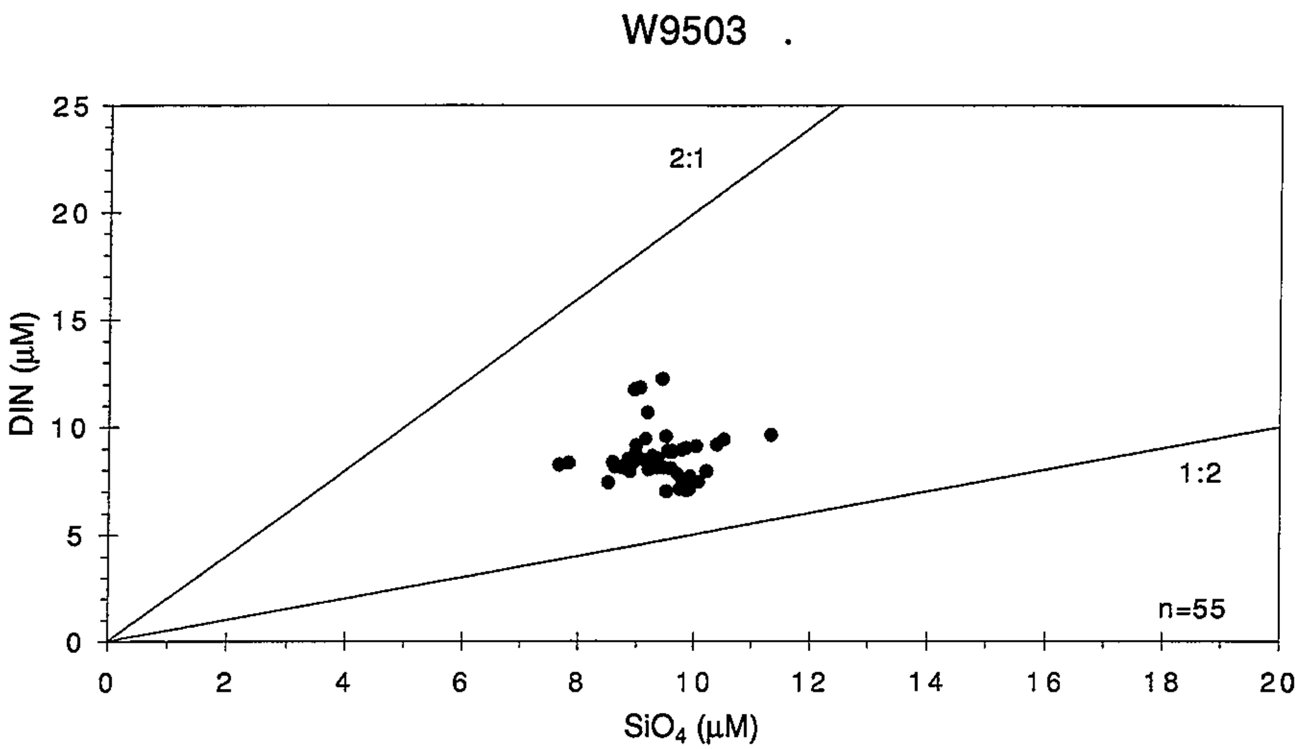


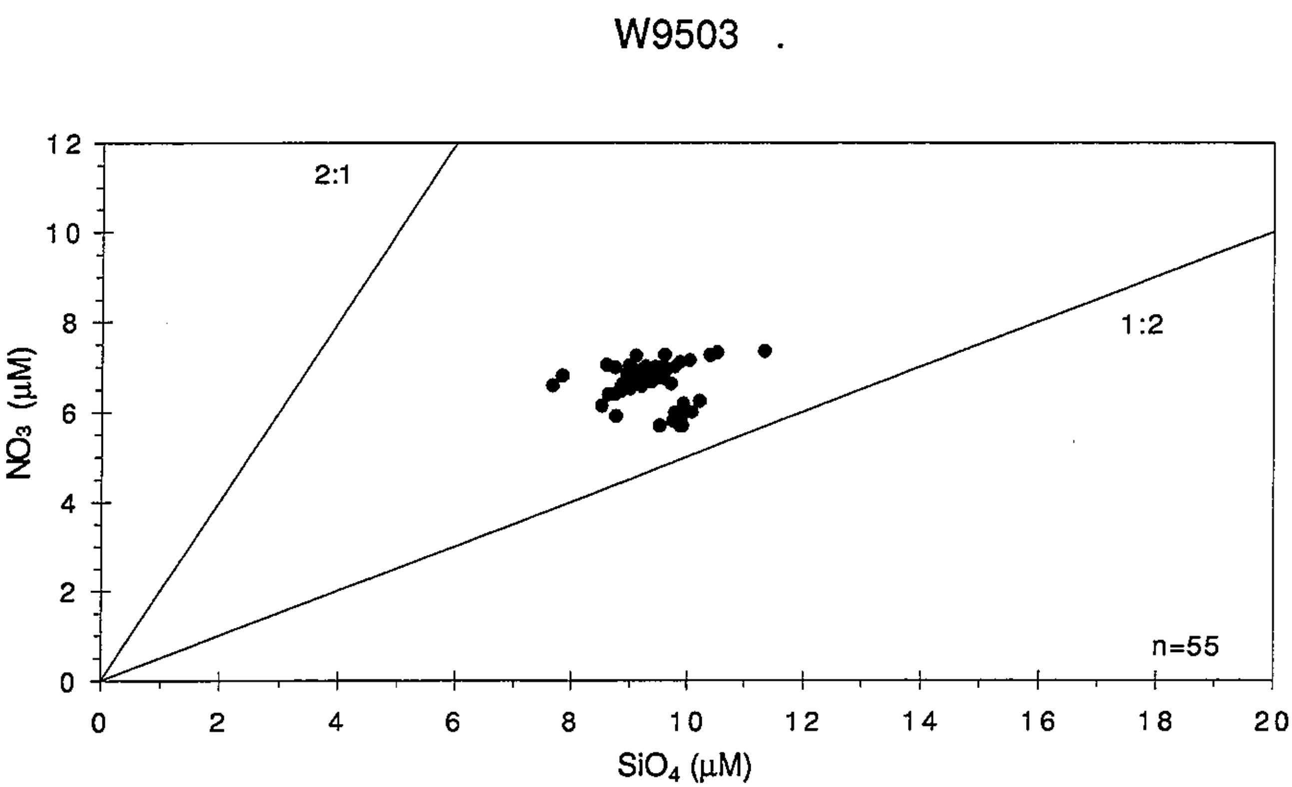


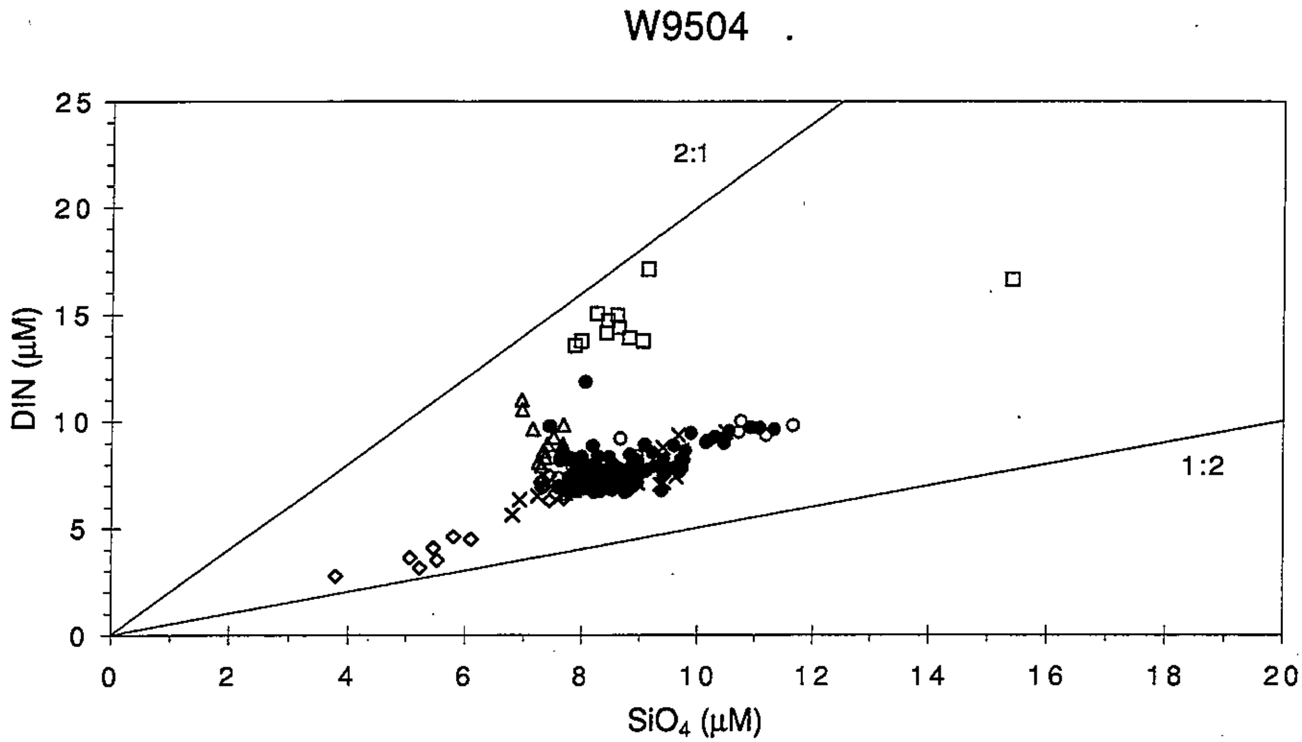
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF


W9502
2:1
1:2
DIN (µM)
SiO4 (µM)

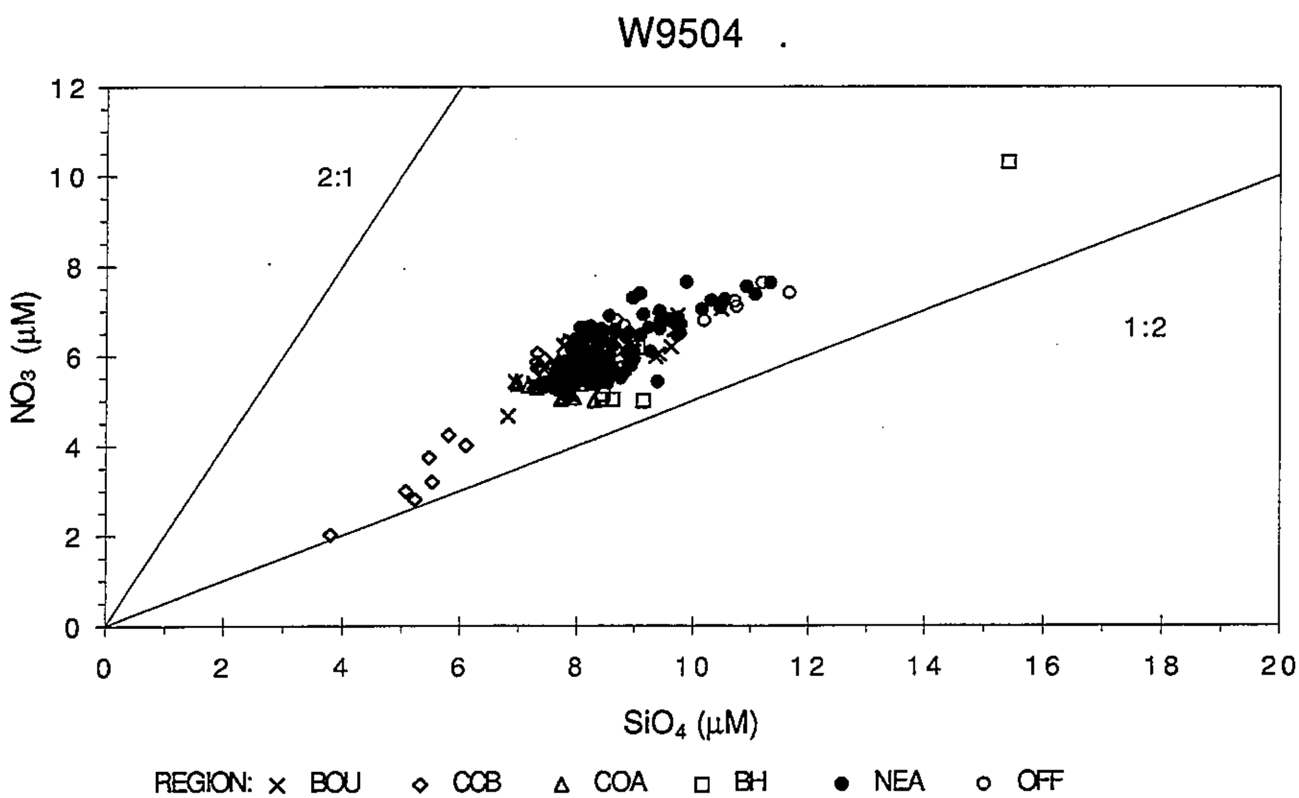

W9502
2:1
1:2
NO3 (µM)
SiO4 (µM)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF


W9503
2:1
1:2
n=55
DIN (μM)
SiO4 (μM)
0
5
10
15
20
25
2
4
6
8
12
14
16
18


W9503
2:1
1:2
n=55
NO3 (μM)
SiO4 (μM)
0
2
4
6
8
10
12
14
16
18
20

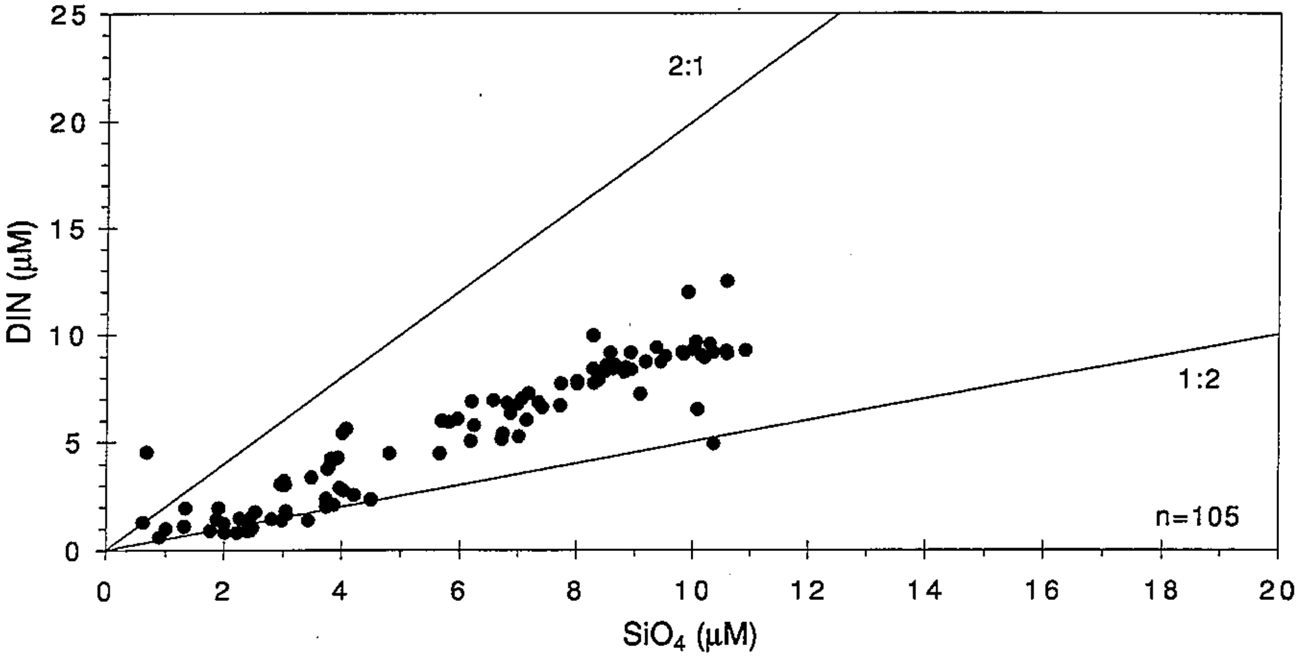


W9504
2:1
1:2
DIN (μM)
SiO4 (μM)
0
5
10
15
20
25
0
2
4
6
8
10
12
14
16
18
20



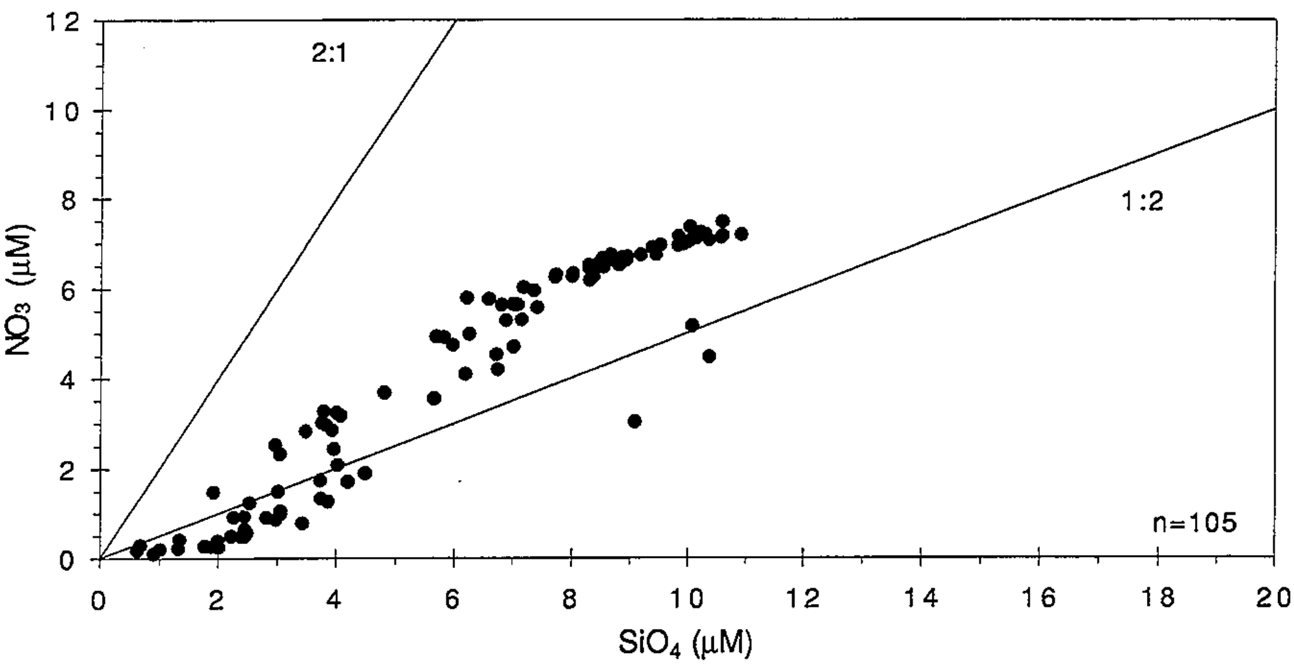
W9504
2:1
1:2
NO3 (μM)
SiO4 (μM)
0
2
4
6
8
10
12
0
2
4
6
8
10
12
14
16
18
20
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

W9505 .



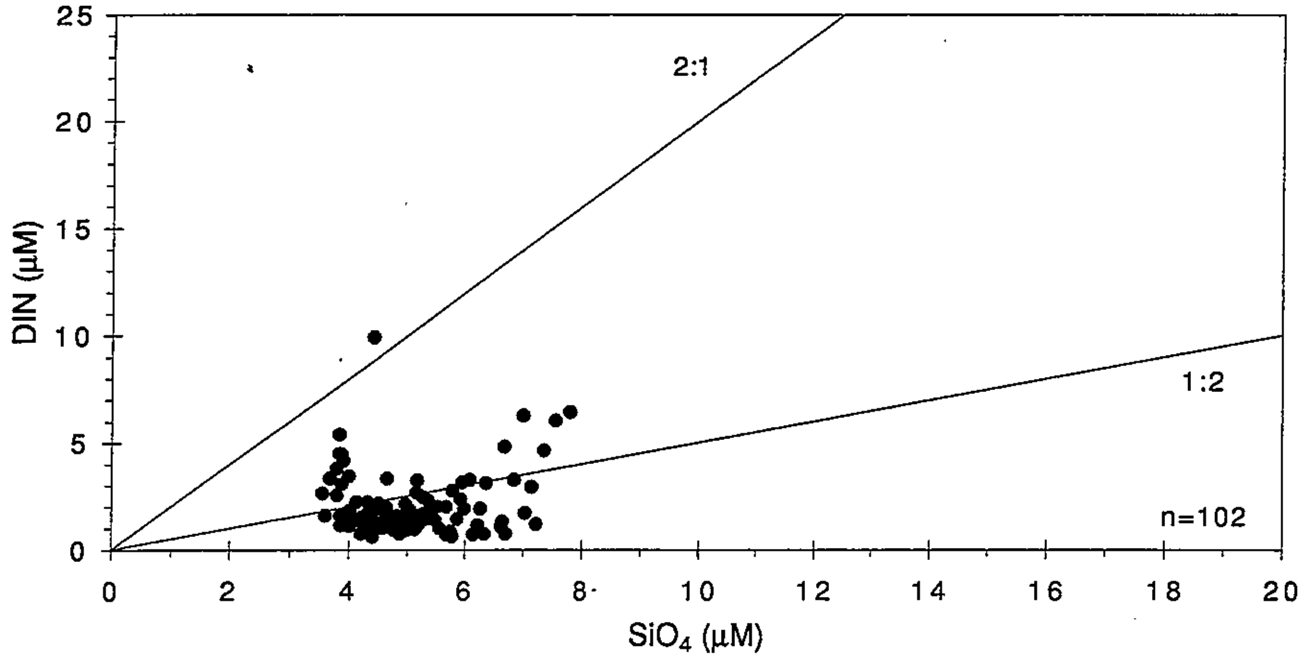
2:1
1:2
n=105
DIN (µM)
SiO4 (µM)
0
5
10
15
20
25
0
2
4
6
8
10
12
14
16
18
20

W9505 .

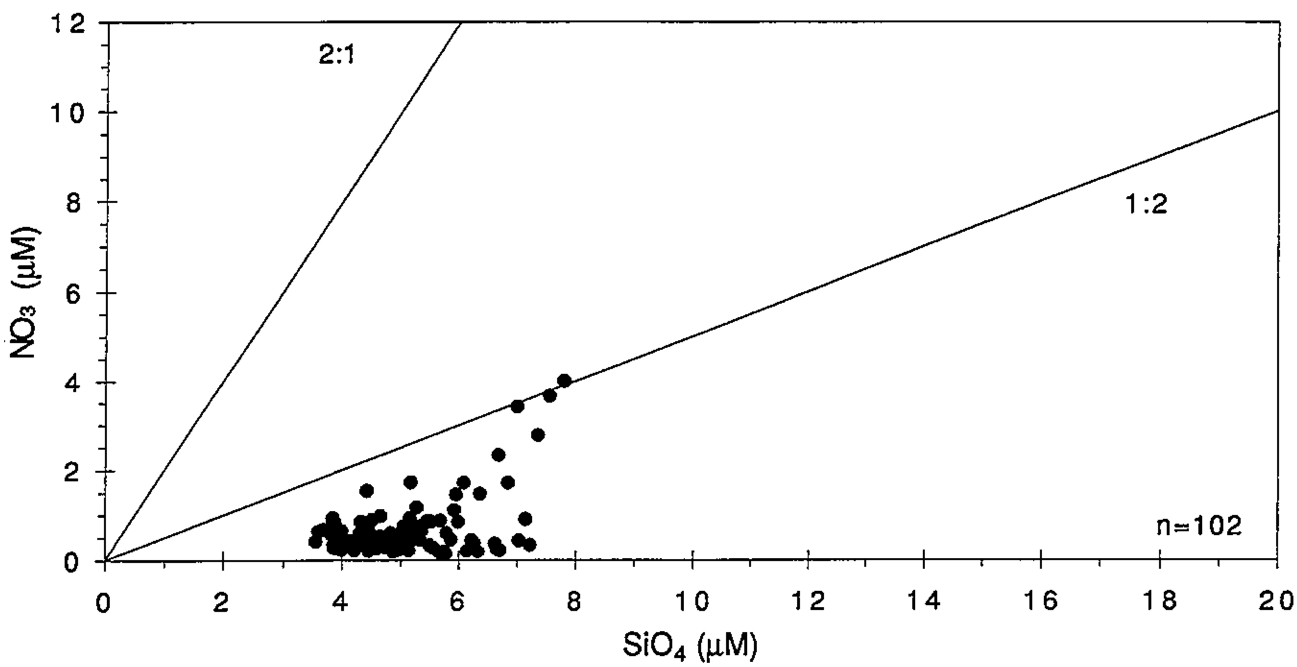


2:1
1:2
n=105
NO3 (µM)
SiO4 (µM)
0
2
4
6
8
10
12
0
2
4
6
8
10
12
14
16
18
20

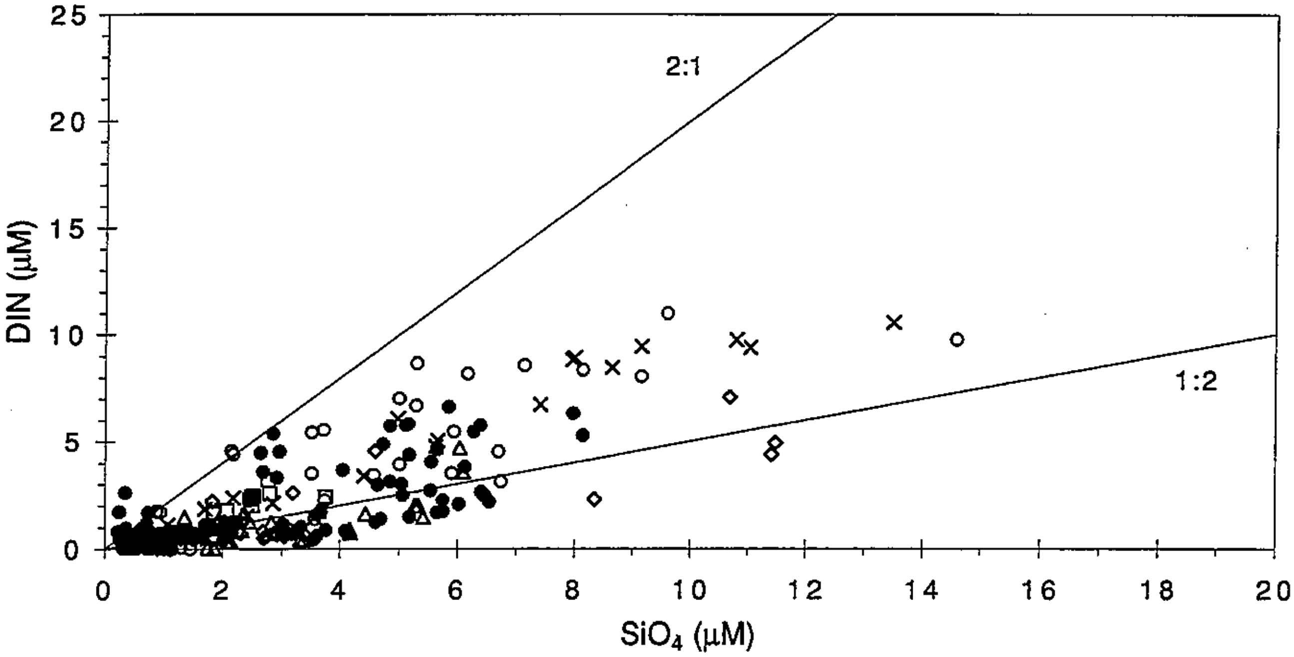
W9506 .



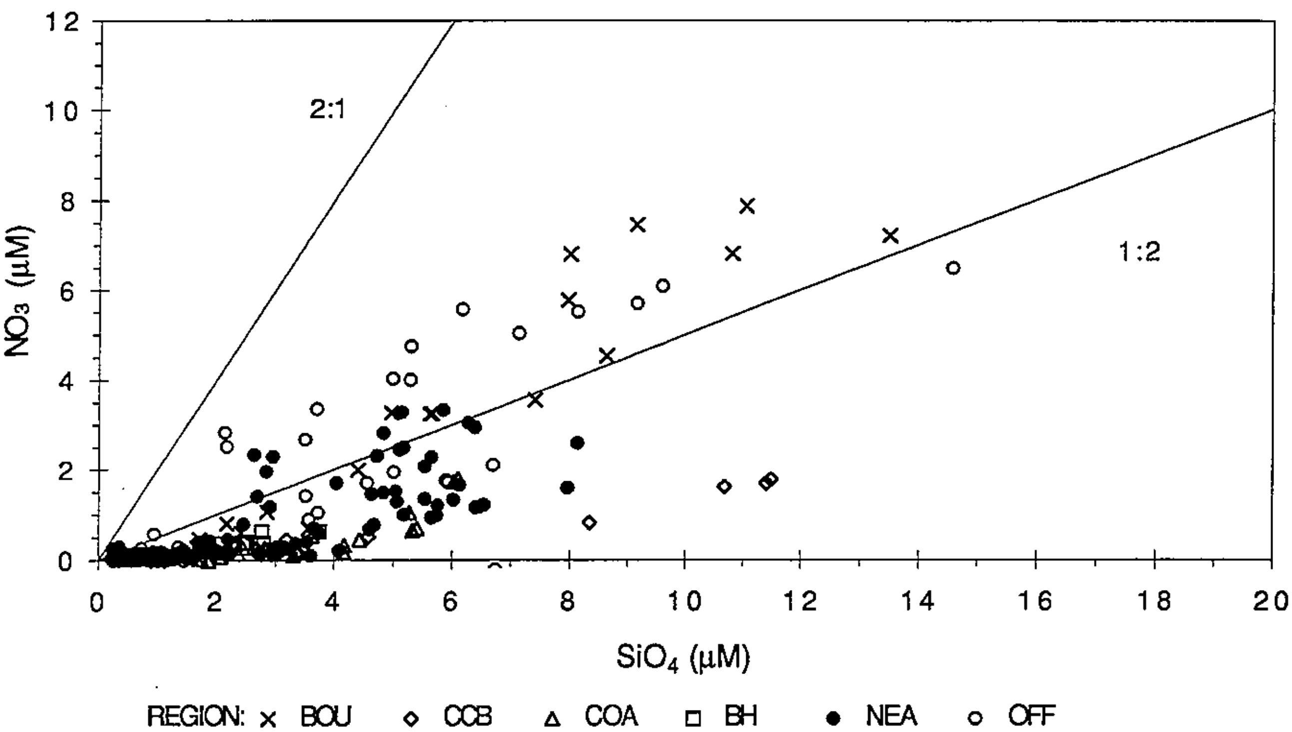
W9506 .



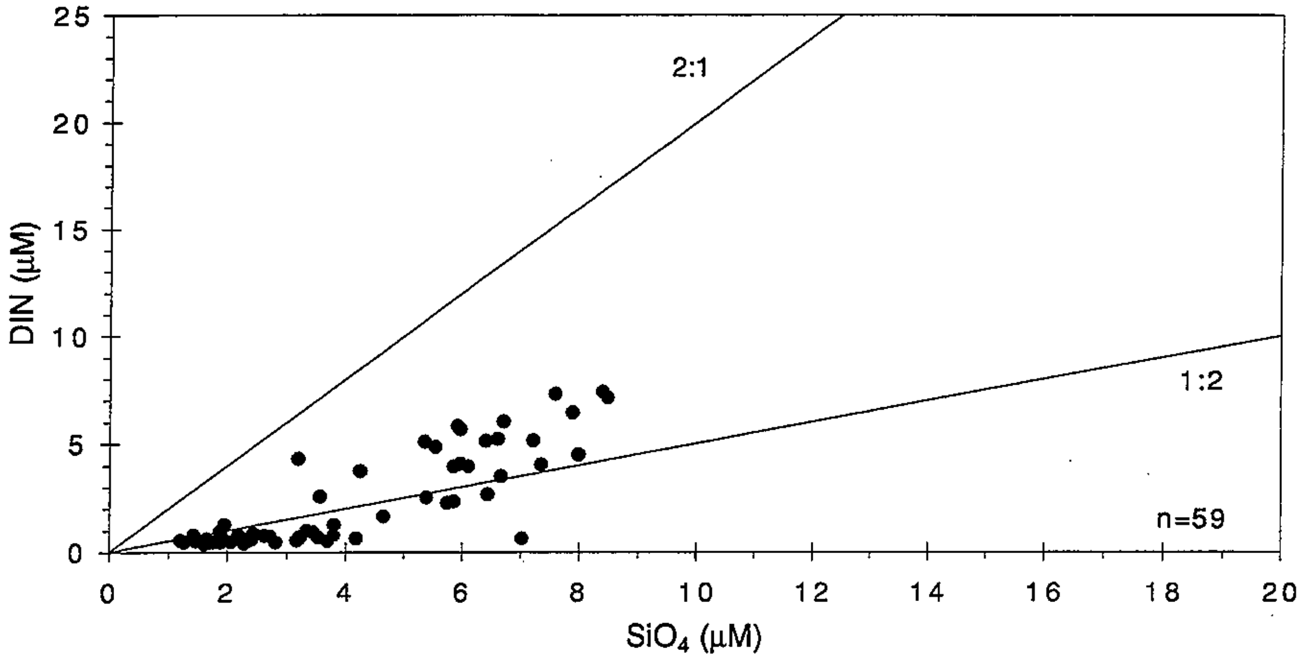
W9507 .


DIN (μM)
SiO4 (μM)
2:1
1:2

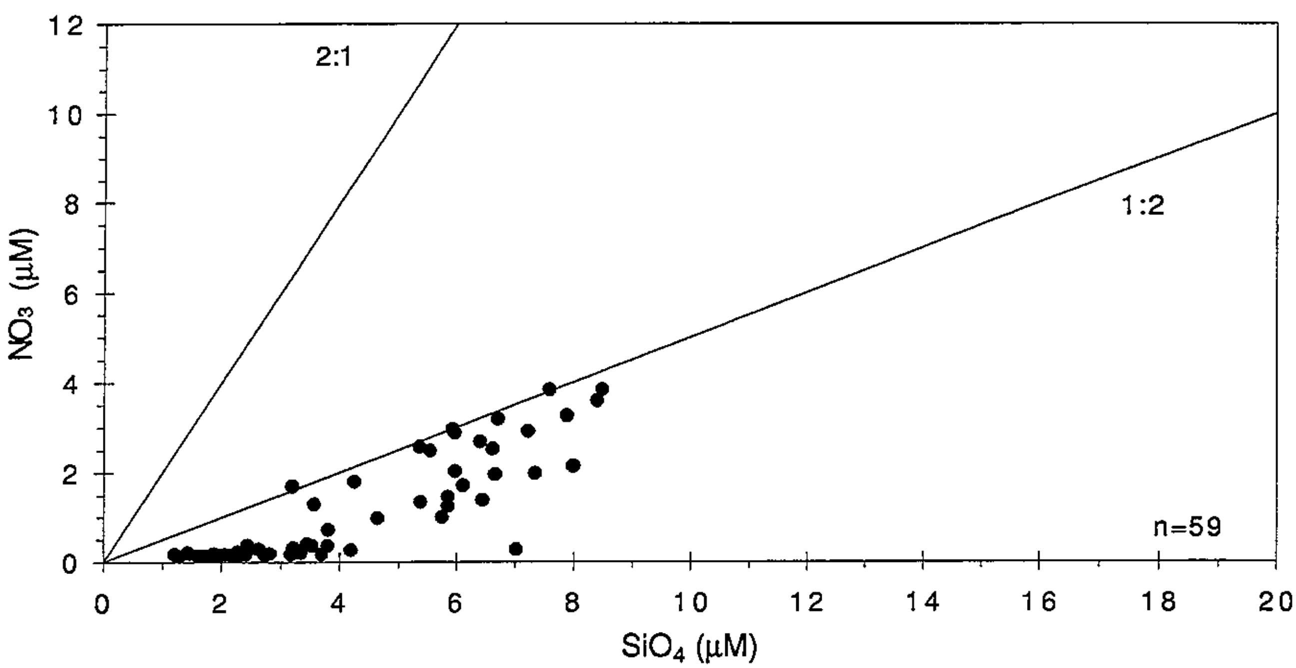
W9507 .


NO3 (μM)
SiO4 (μM)
2:1
1:2
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

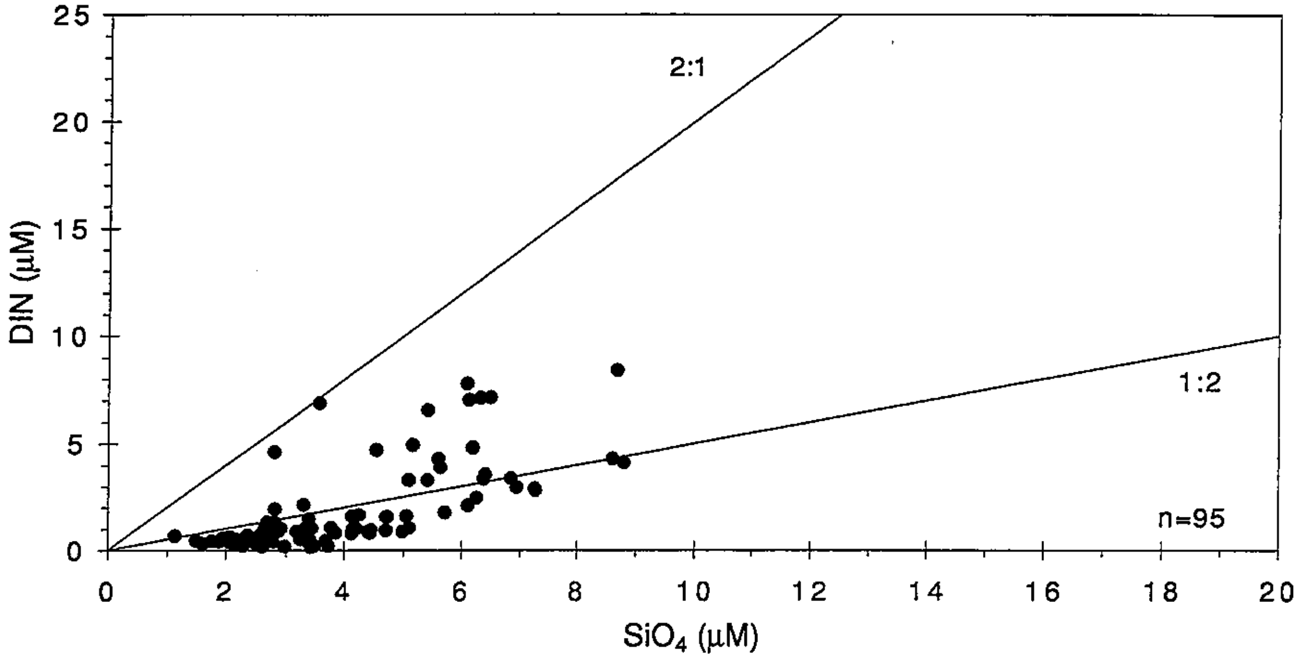
W9508 .


25
20
15
10
5
0
DIN (µM)
2:1
1:2
n=59
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)

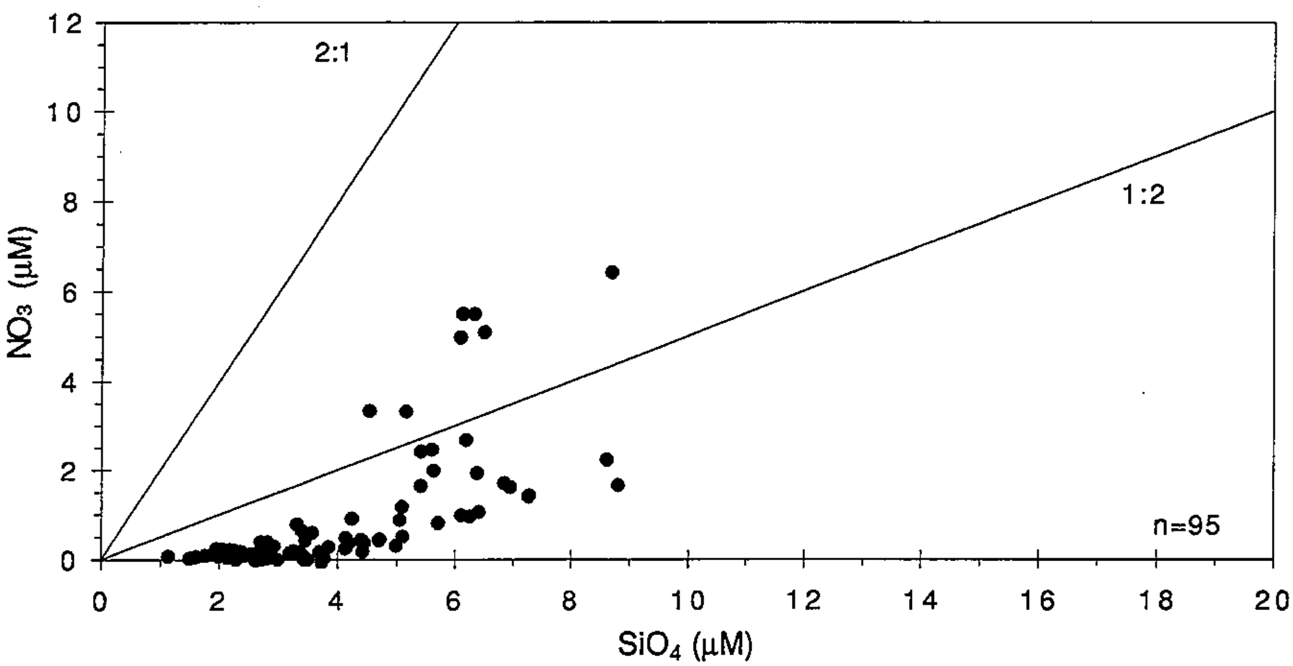
W9508 .

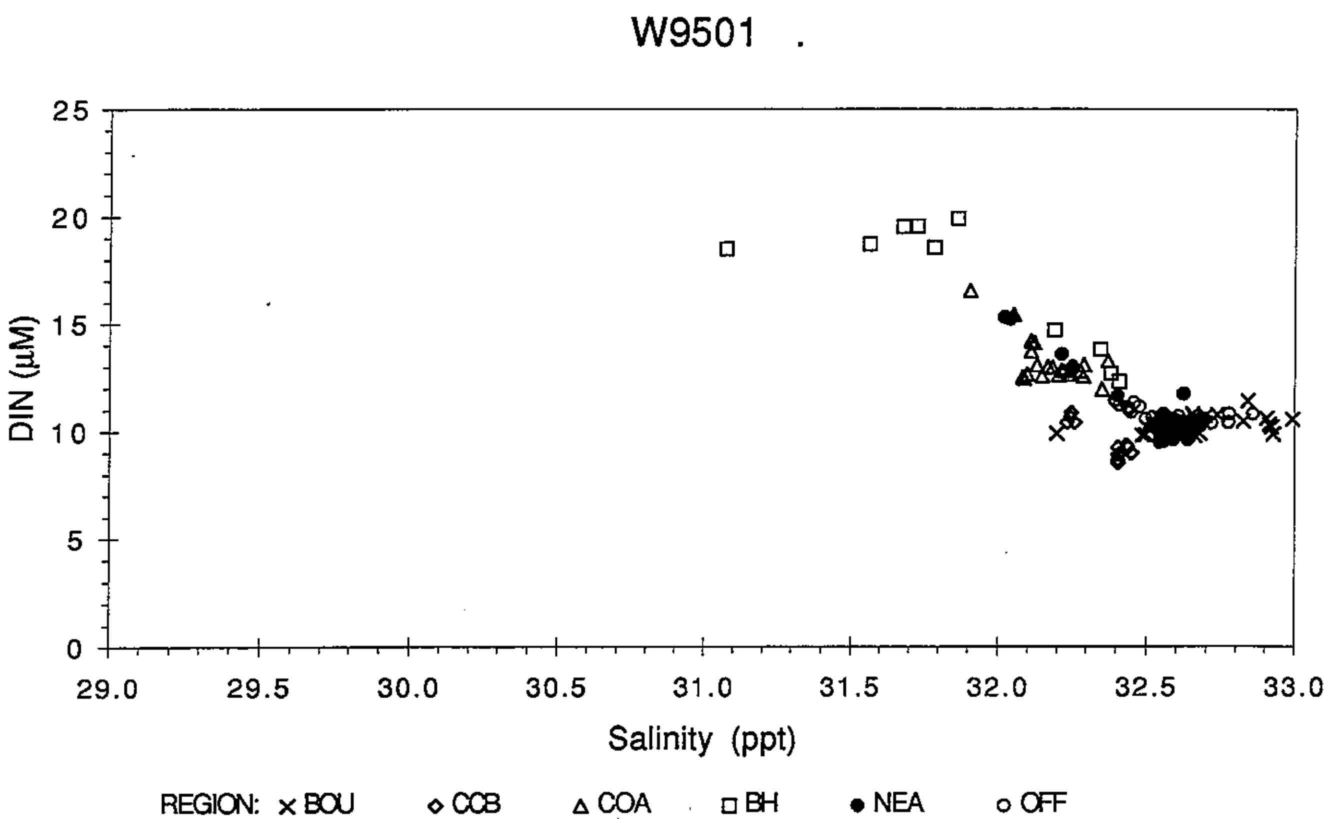

12
10
8
6
4
2
0
NO3 (µM)
2:1
1:2
n=59
0
2
4
6
8
10
12
14
16
18
20
SiO4 (µM)

W9509 .

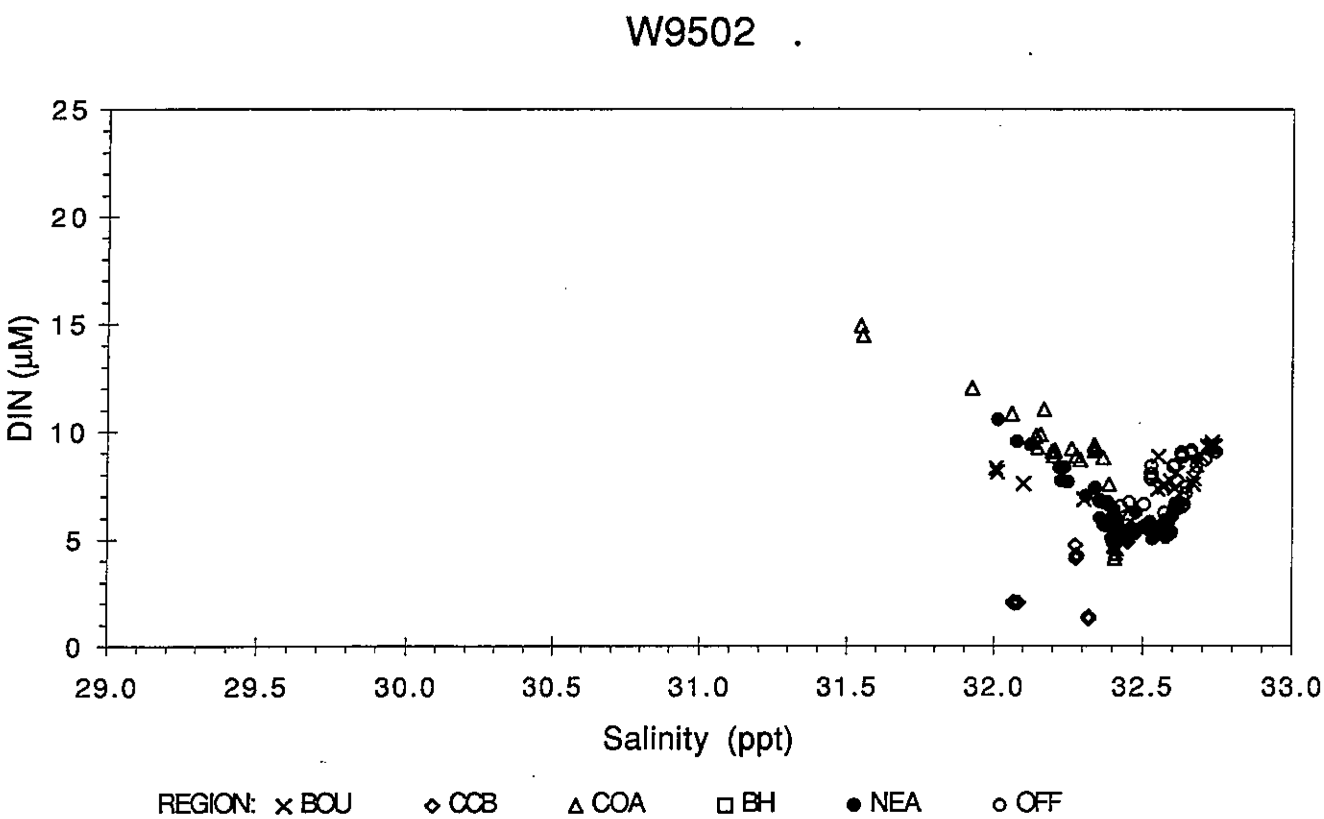

2:1
1:2
n=95
DIN (µM)
SiO4 (µM)
0
5
10
15
20
25
0
2
4
6
8
10
12
14
16
18
20

W9509 .

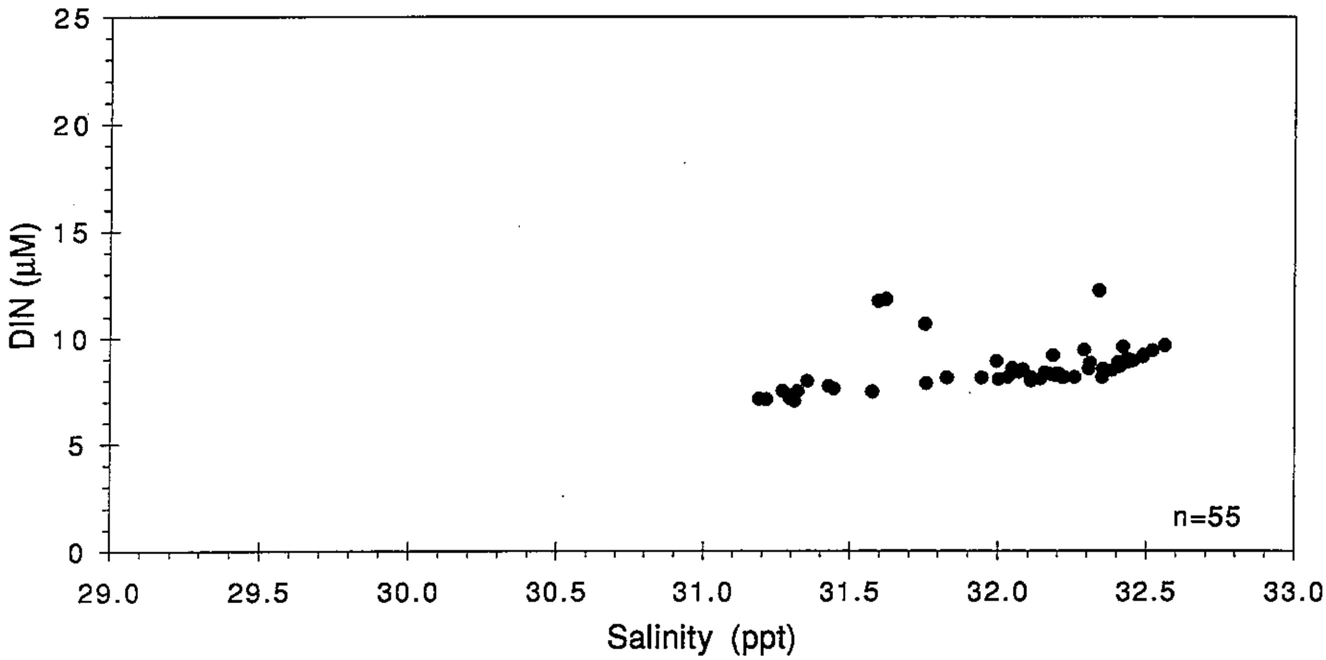

2:1
1:2
n=95
NO3 (µM)
SiO4 (µM)
0
2
4
6
8
10
12
0
2
4
6
8
10
12
14
16
18
20



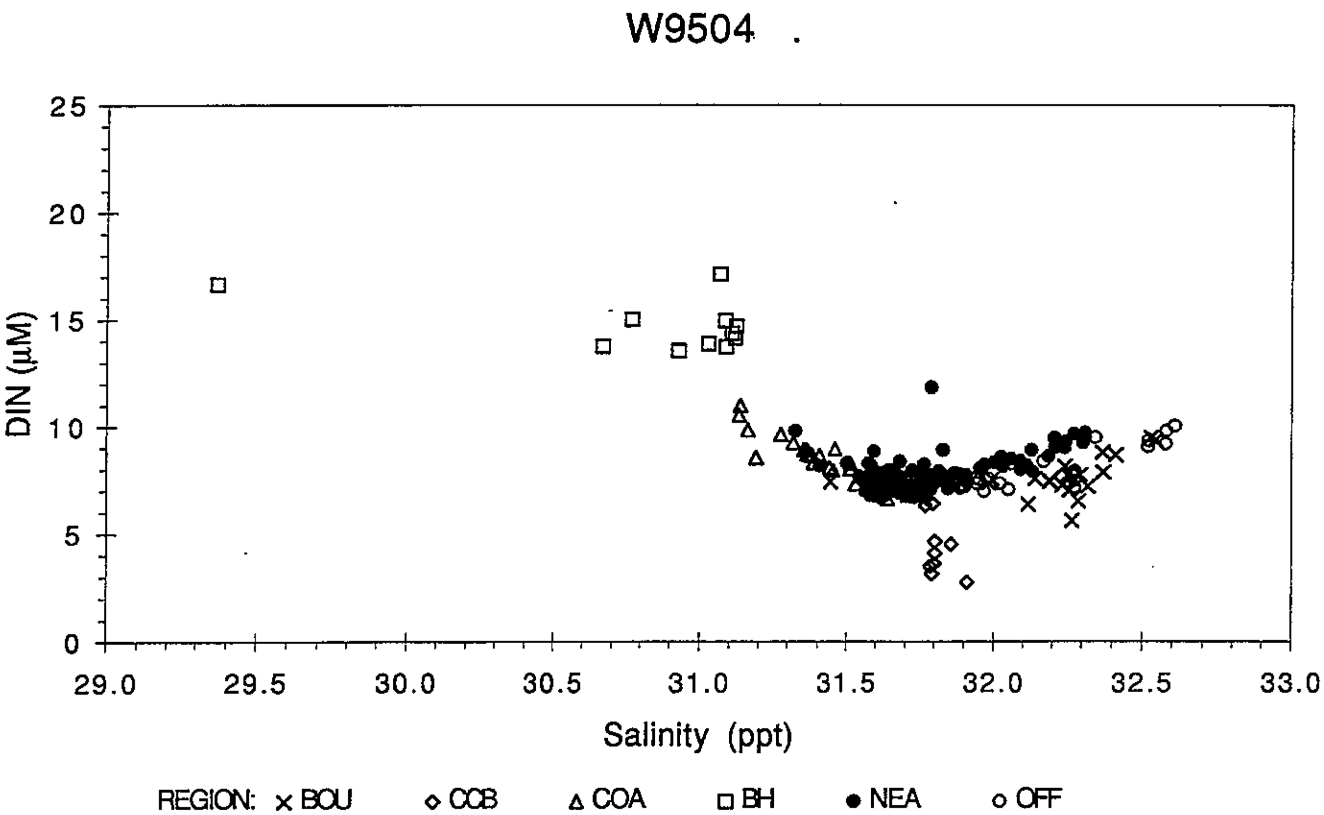
W9501
DIN (µM)
25
20
15
10
5
0
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF


W9502
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)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

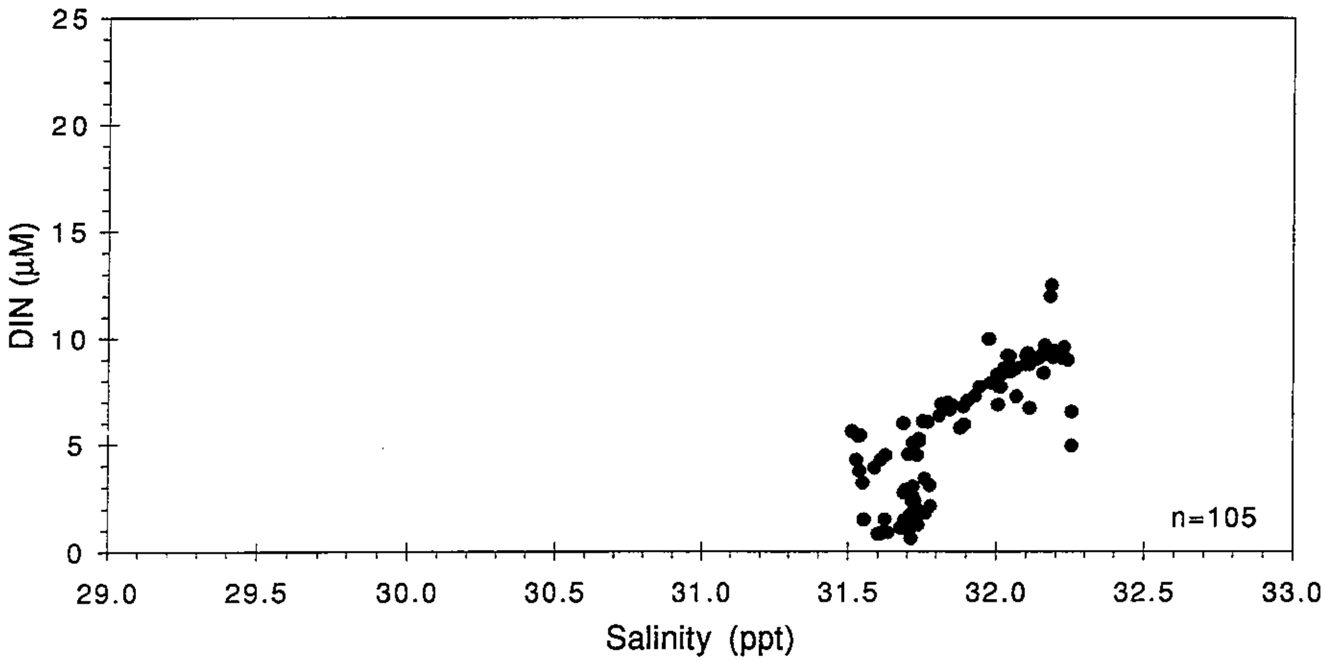
W9503



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

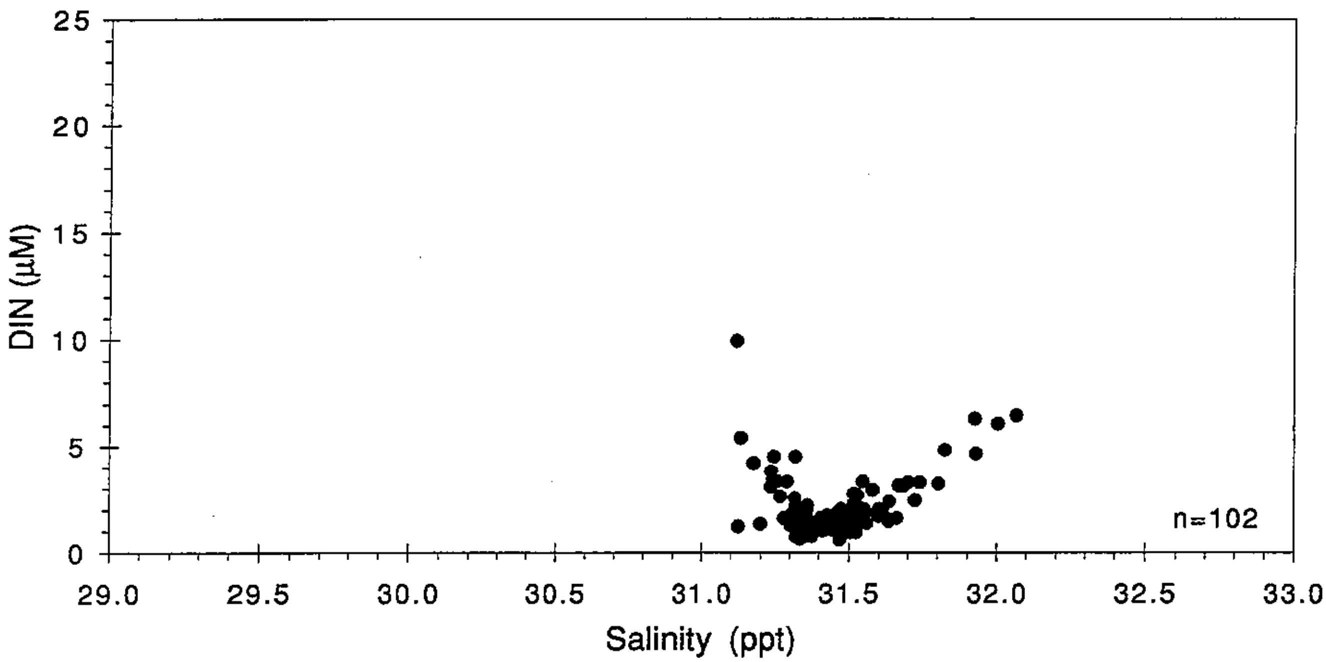

W9504
DIN (µM)
25
20
15
10
5
0
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

W9505



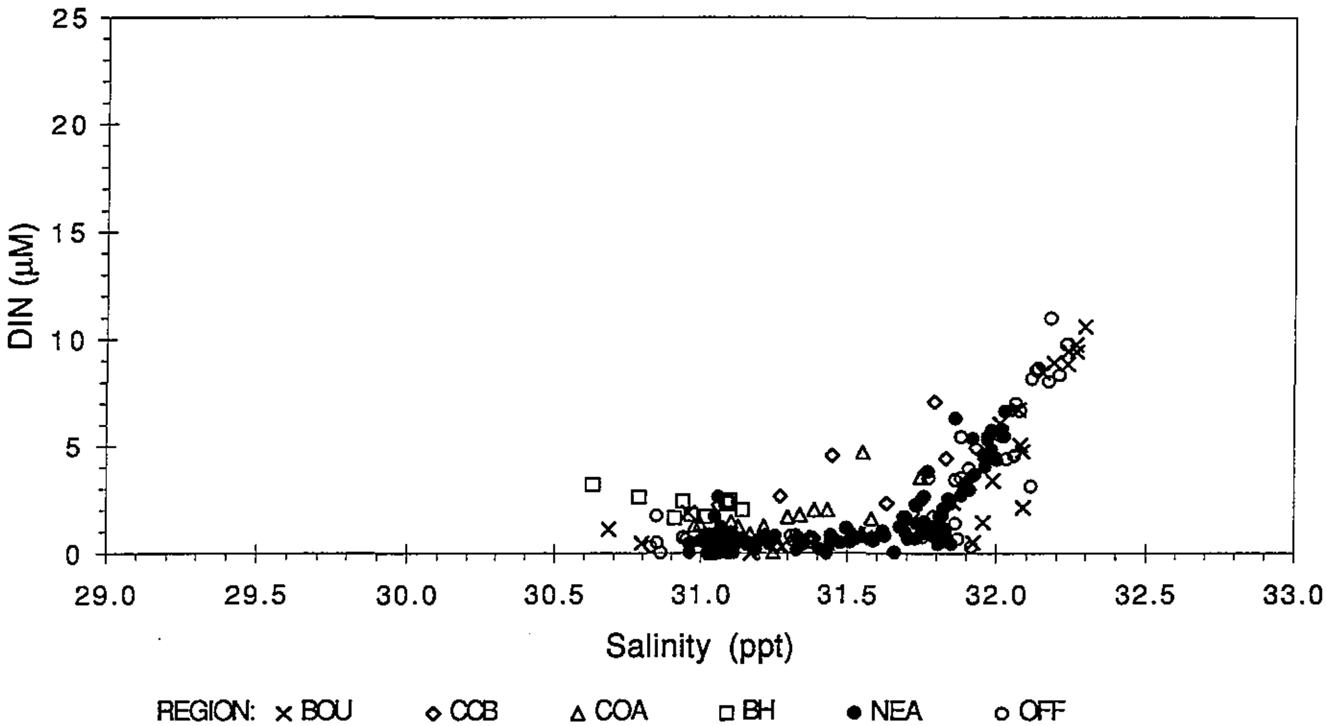
25
20
15
10
5
0
DIN (µM)
n=105
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9506



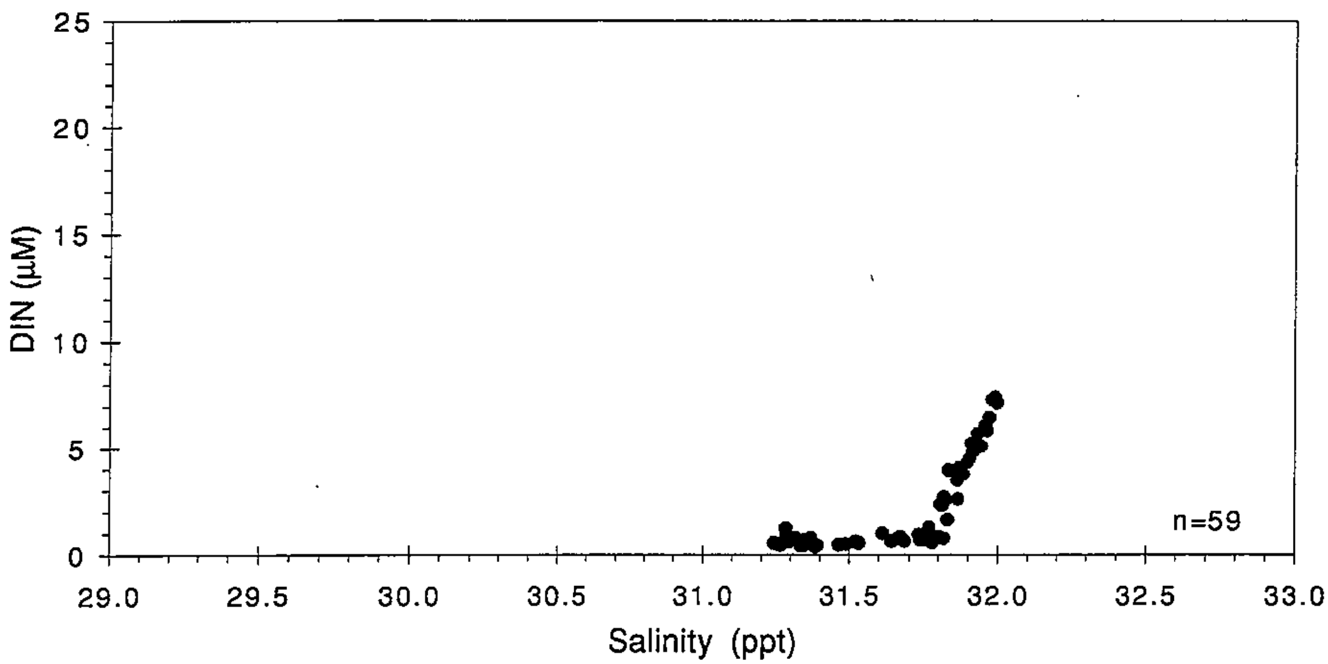
25
20
15
10
5
0
DIN (µM)
n=102
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9507

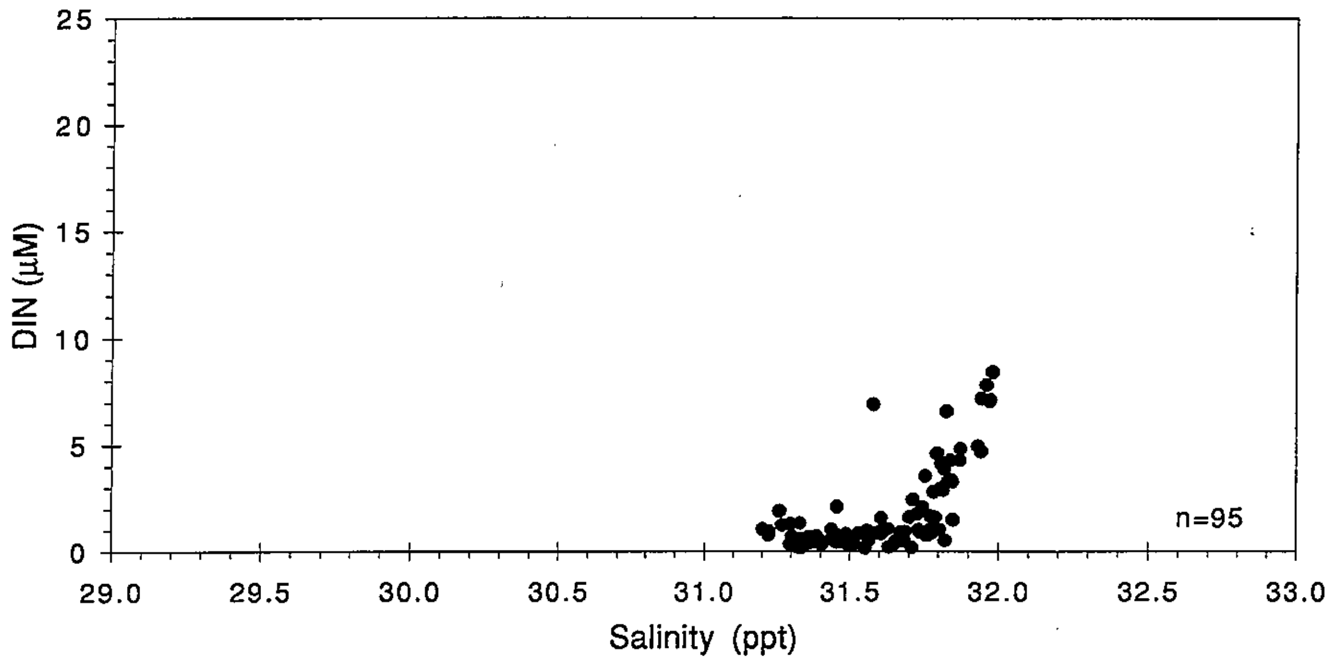


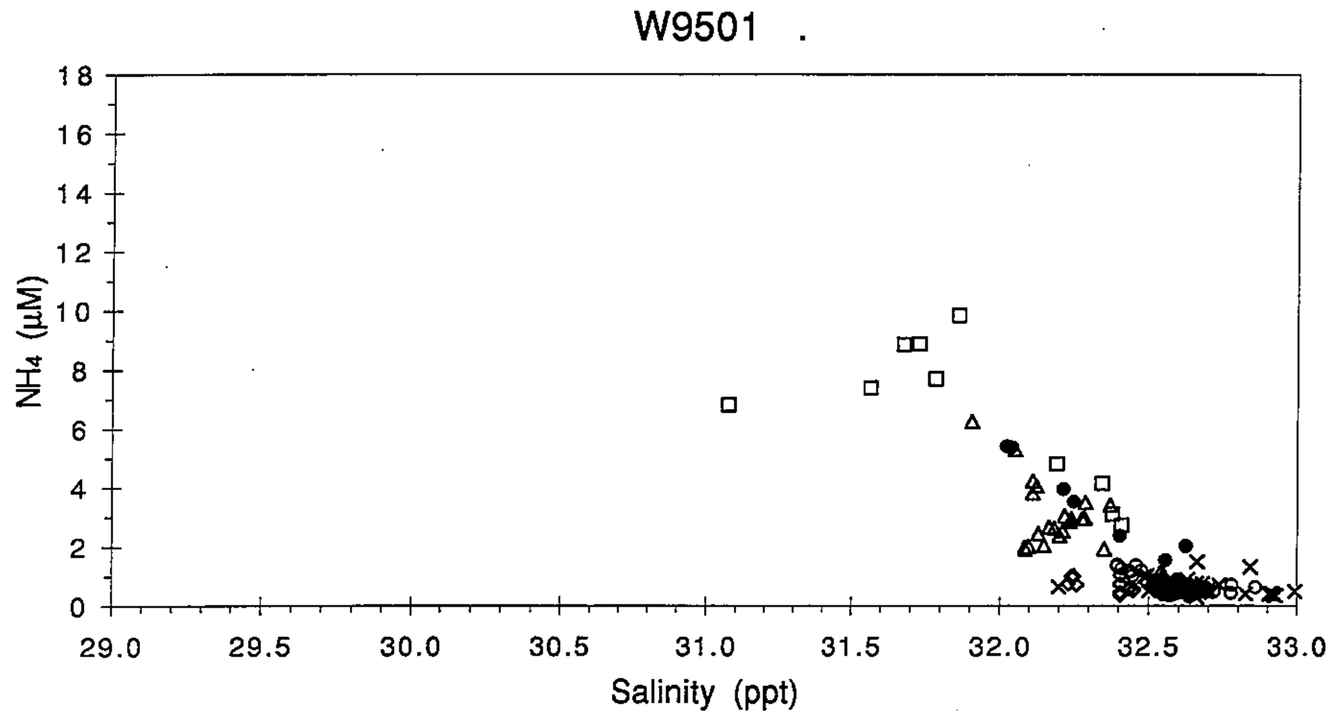
25
20
15
10
5
0
DIN (µM)
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

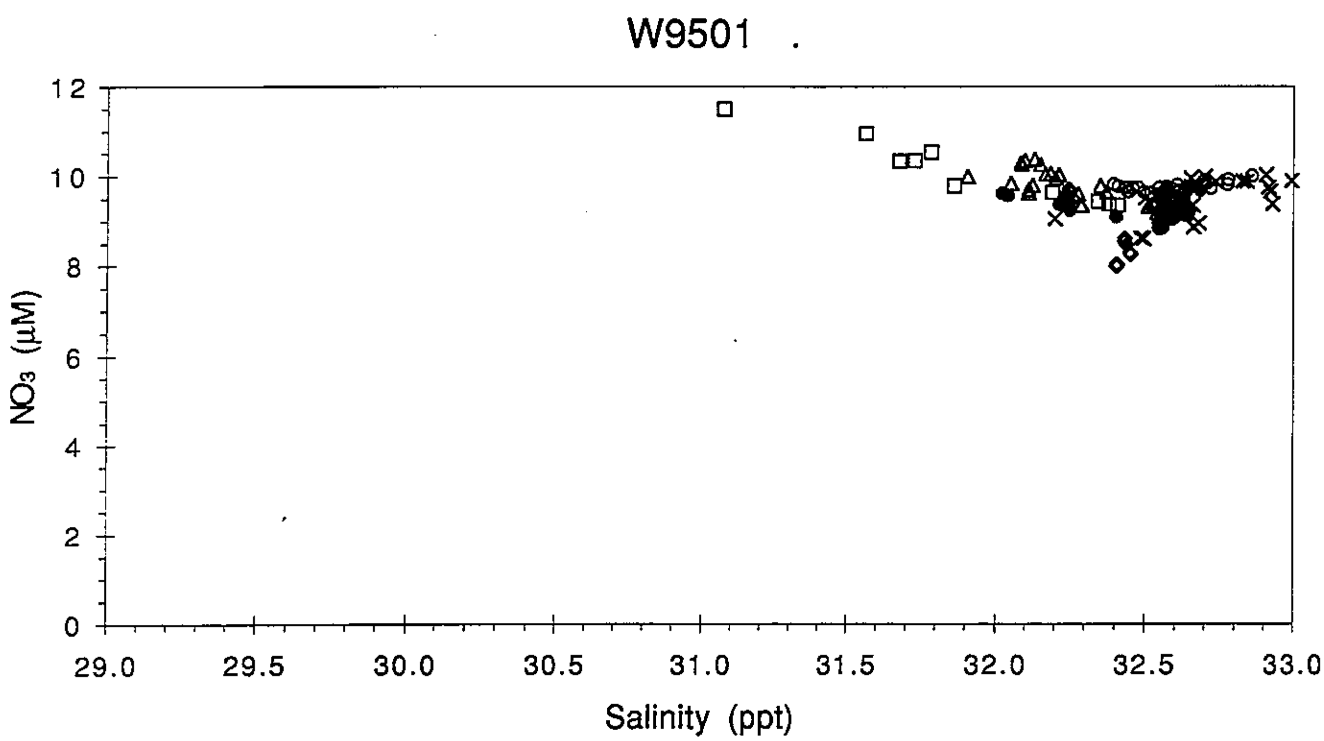
W9508


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=59

W9509

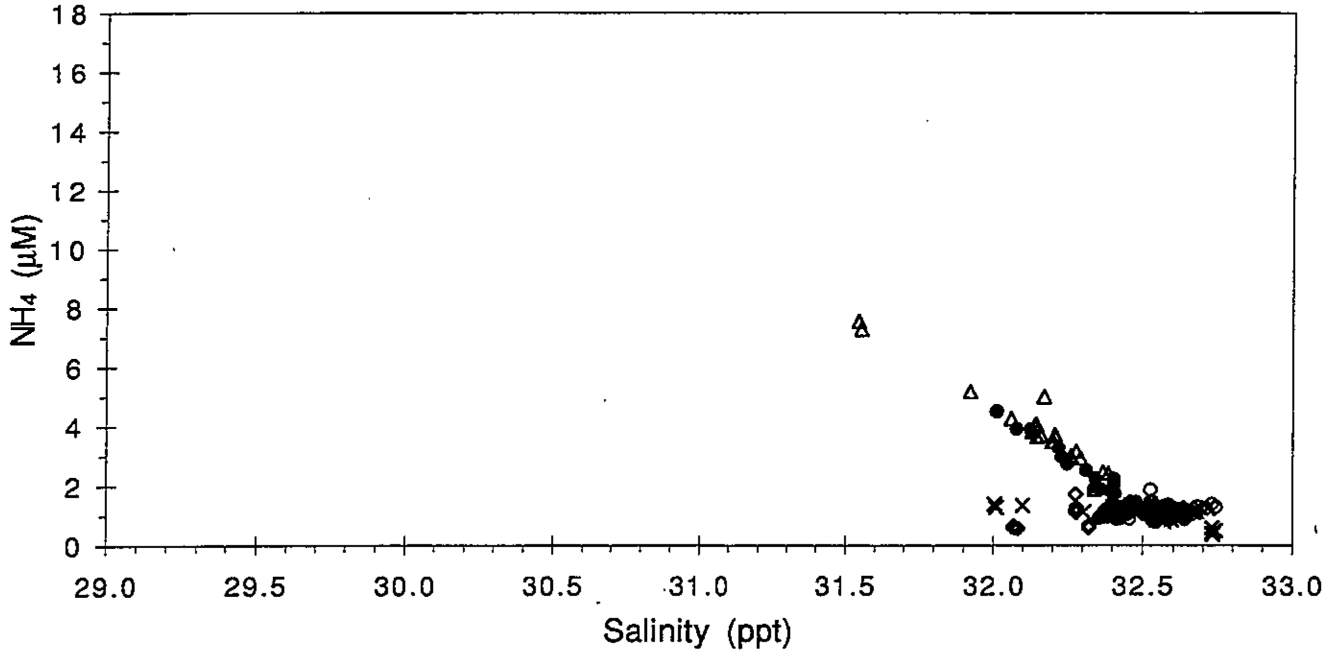

25
20
15
10
5
0
DIN (µM)
n=95
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)



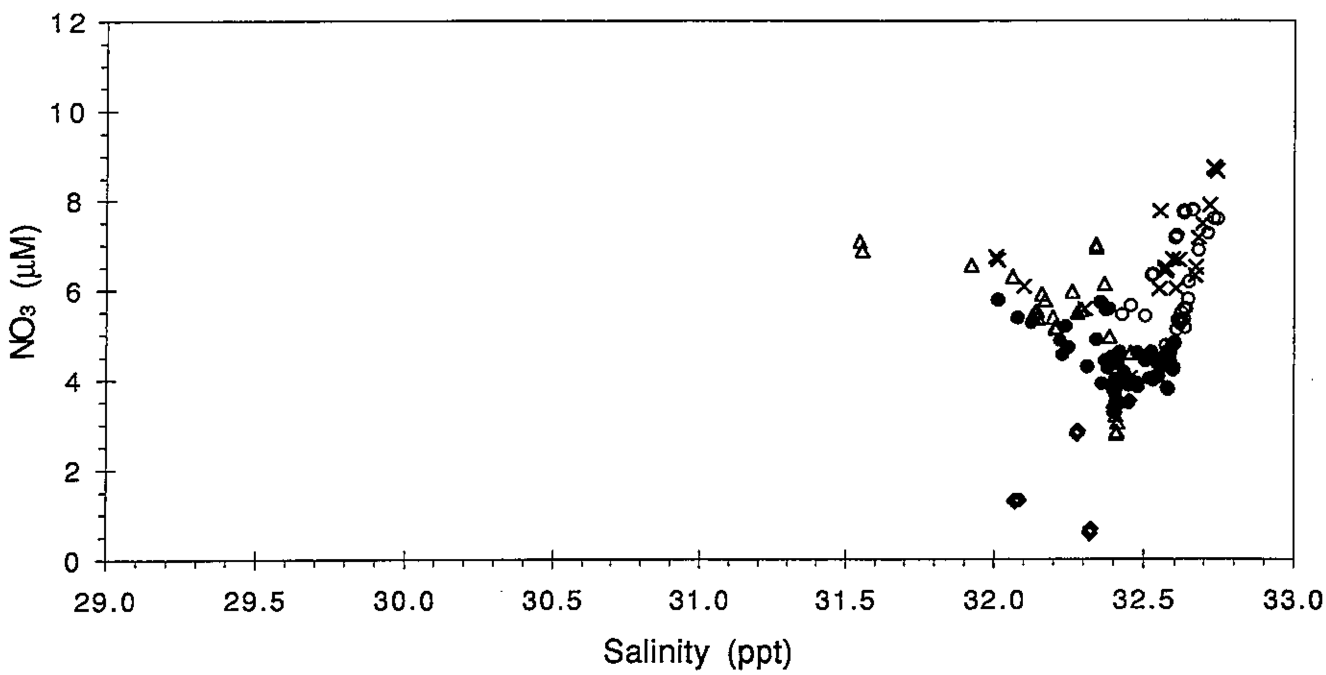


REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

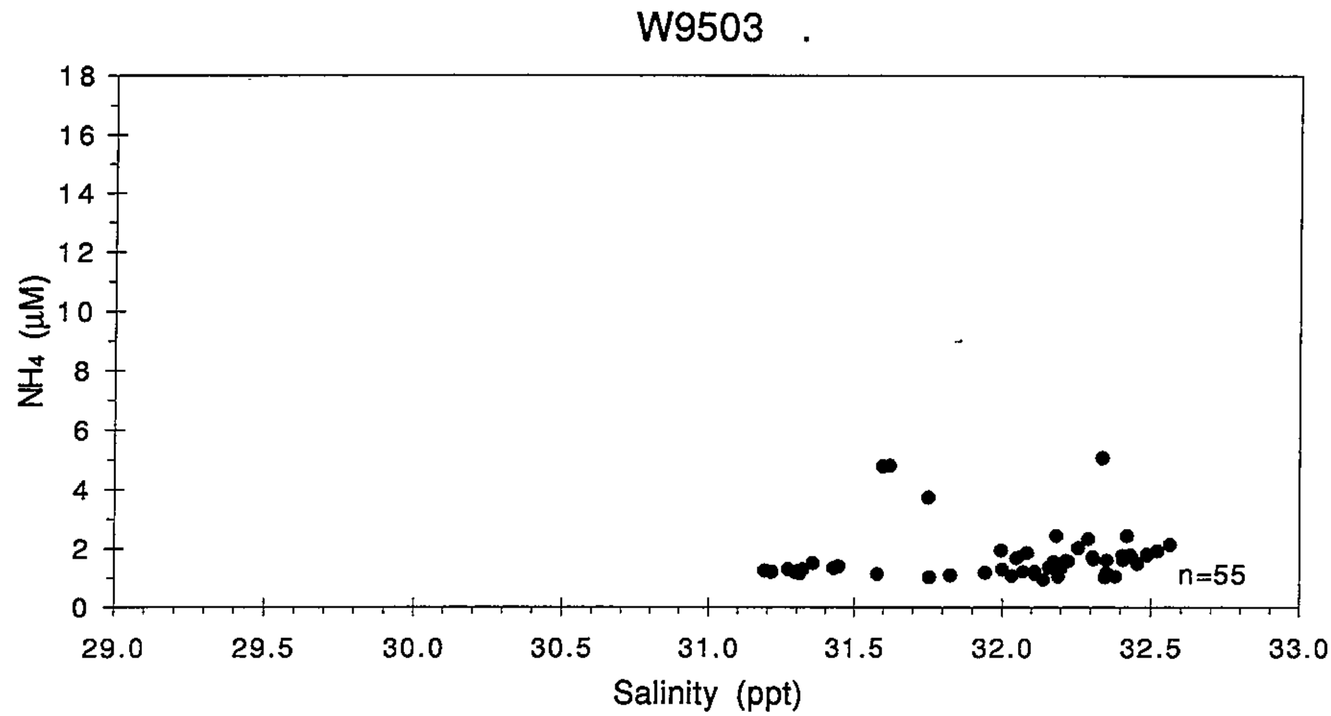
W9502 .

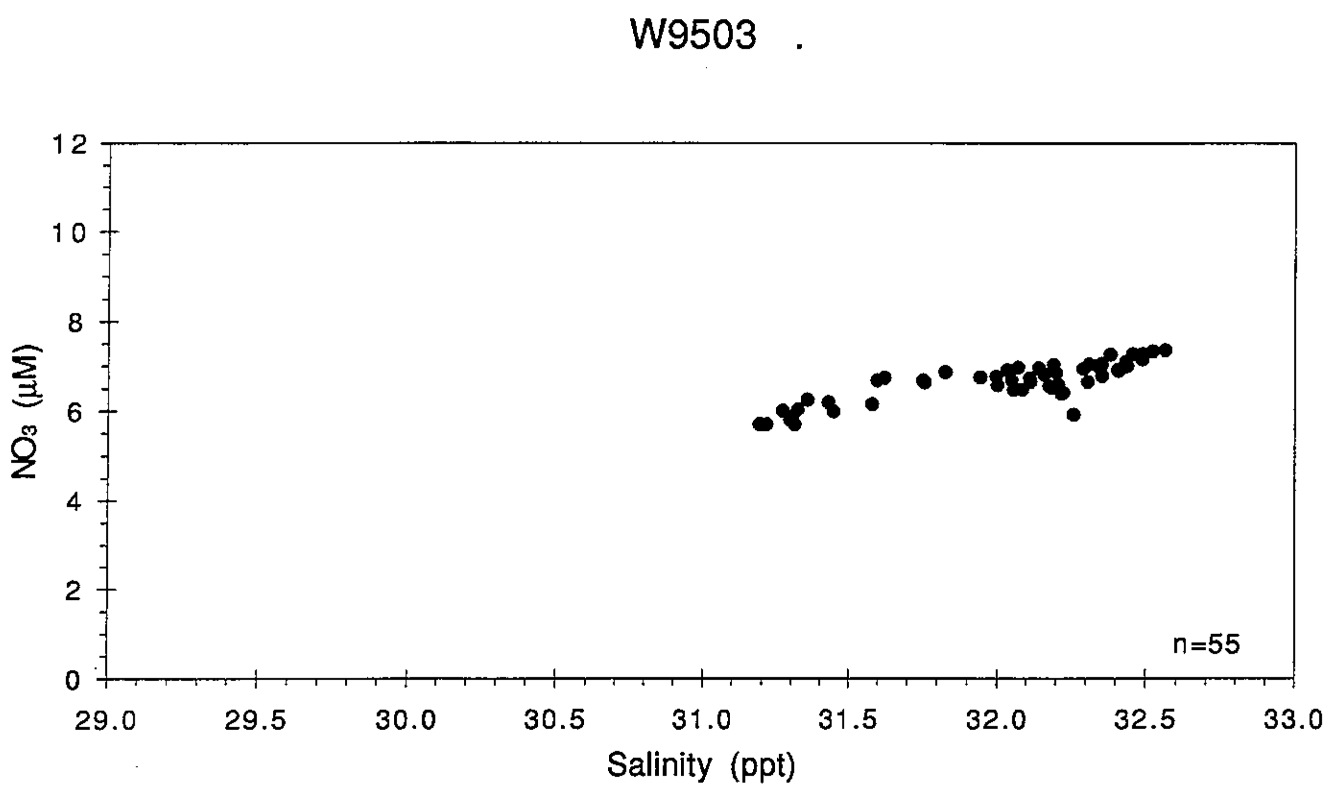


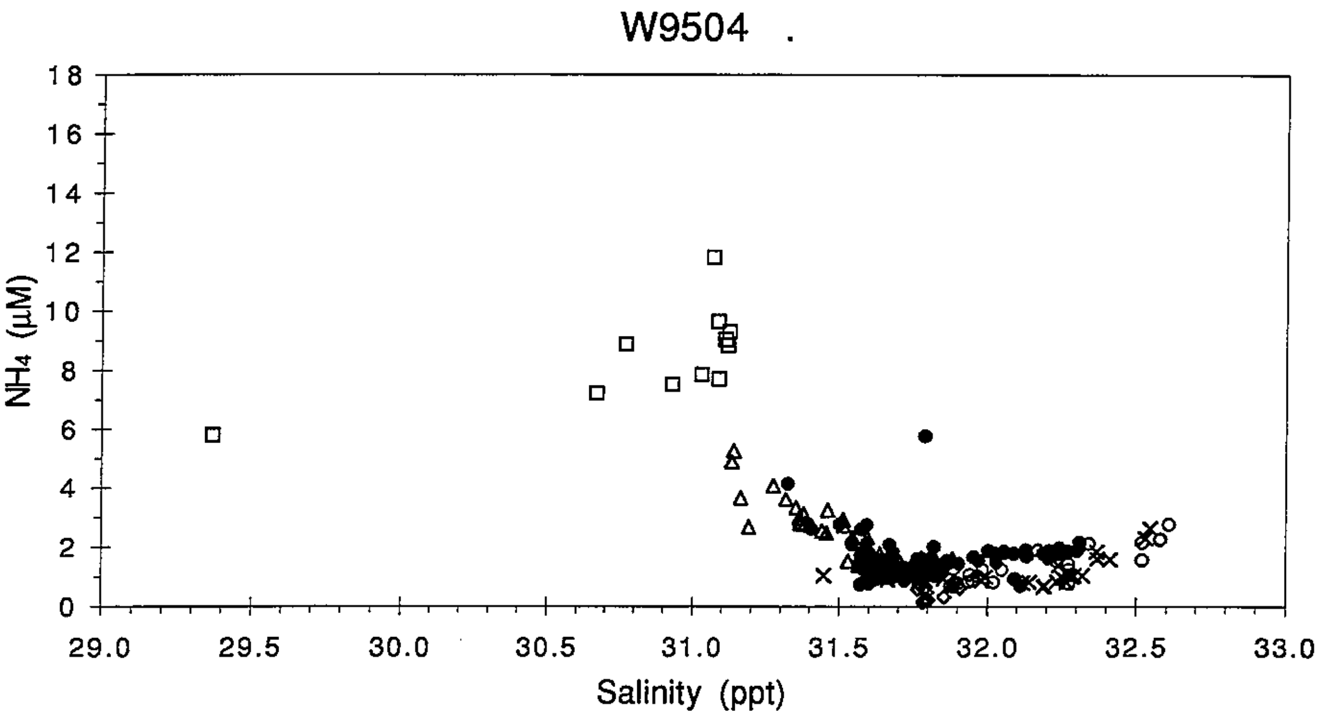
W9502 .



REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF


W9503 .
18
16
14
12
10
8
6
4
2
0
NH_4 (µM)
n=55
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9503 .
12
10
8
6
4
2
0
NO_3 (µM)
n=55
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9504 .
NH4 (µM)
Salinity (ppt)
18
16
14
12
10
8
6
4
2
0
29.0
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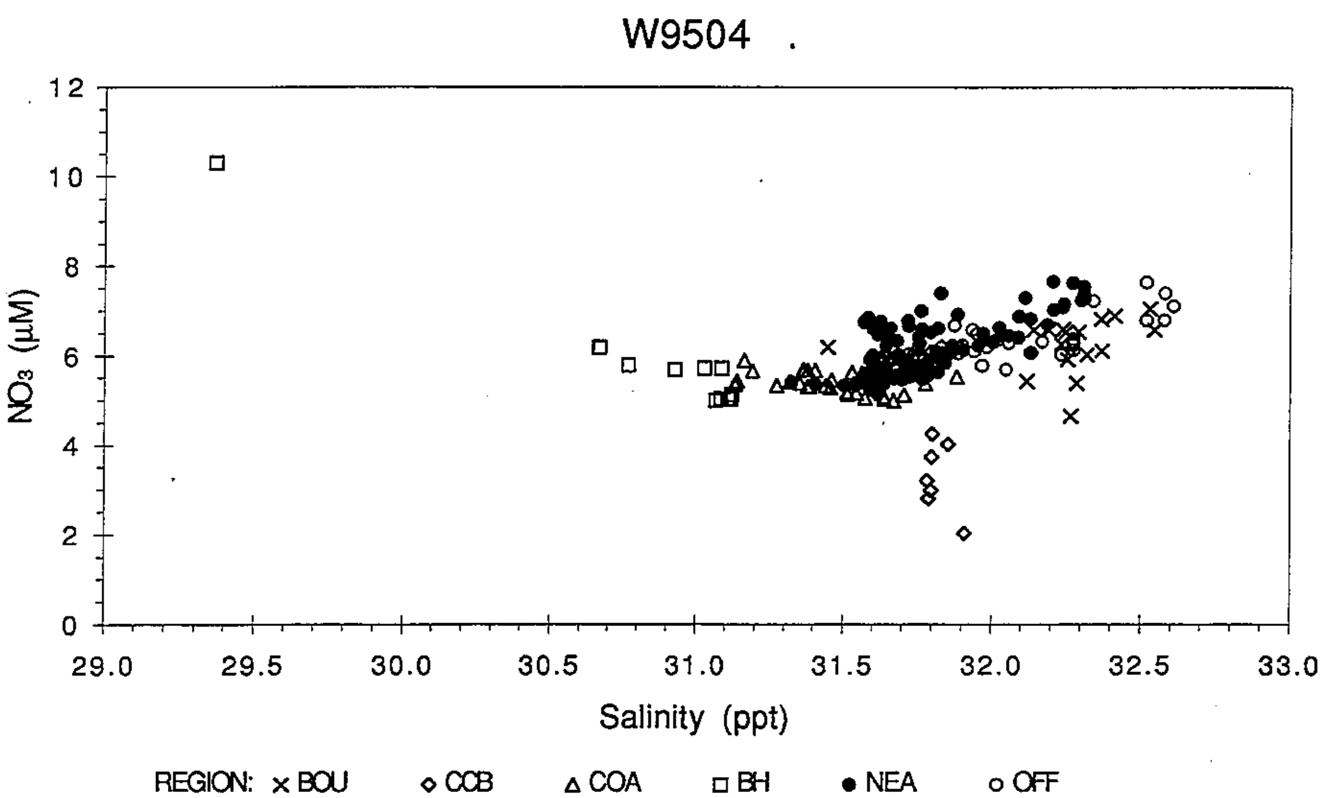
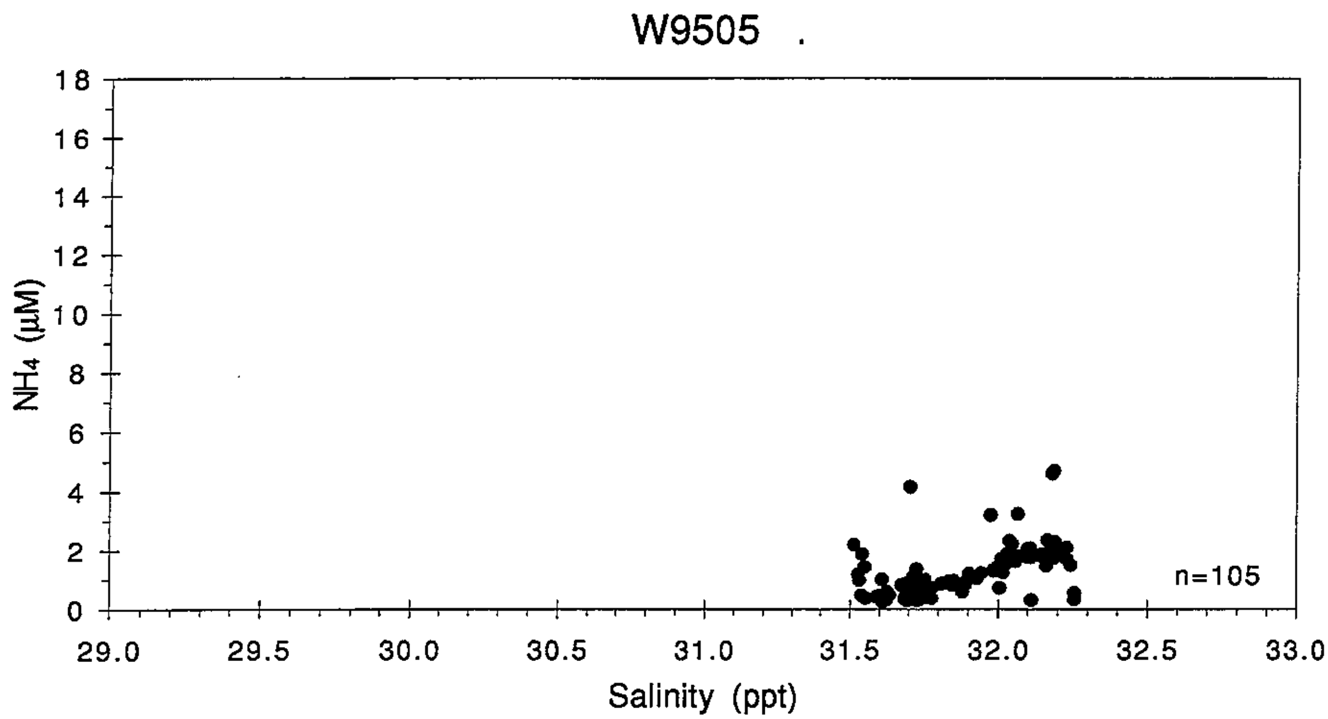
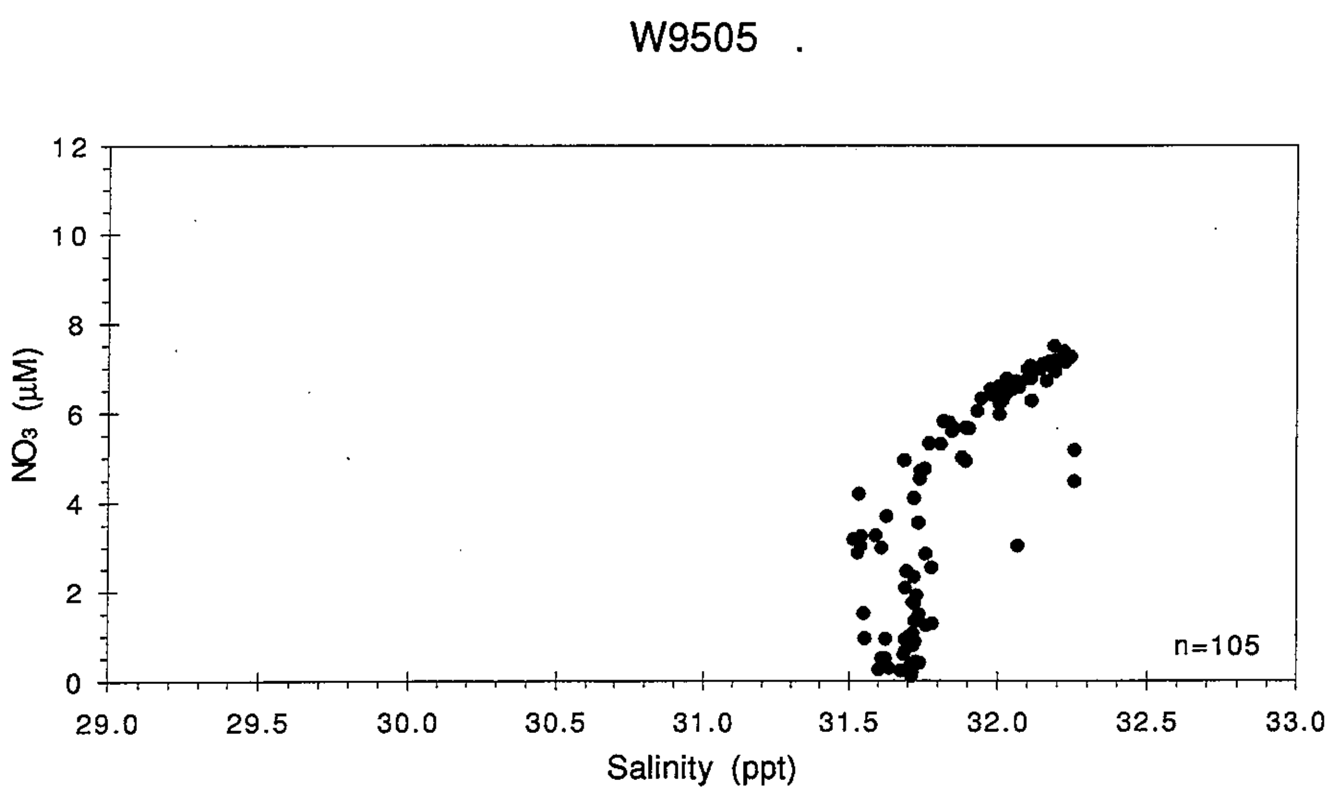
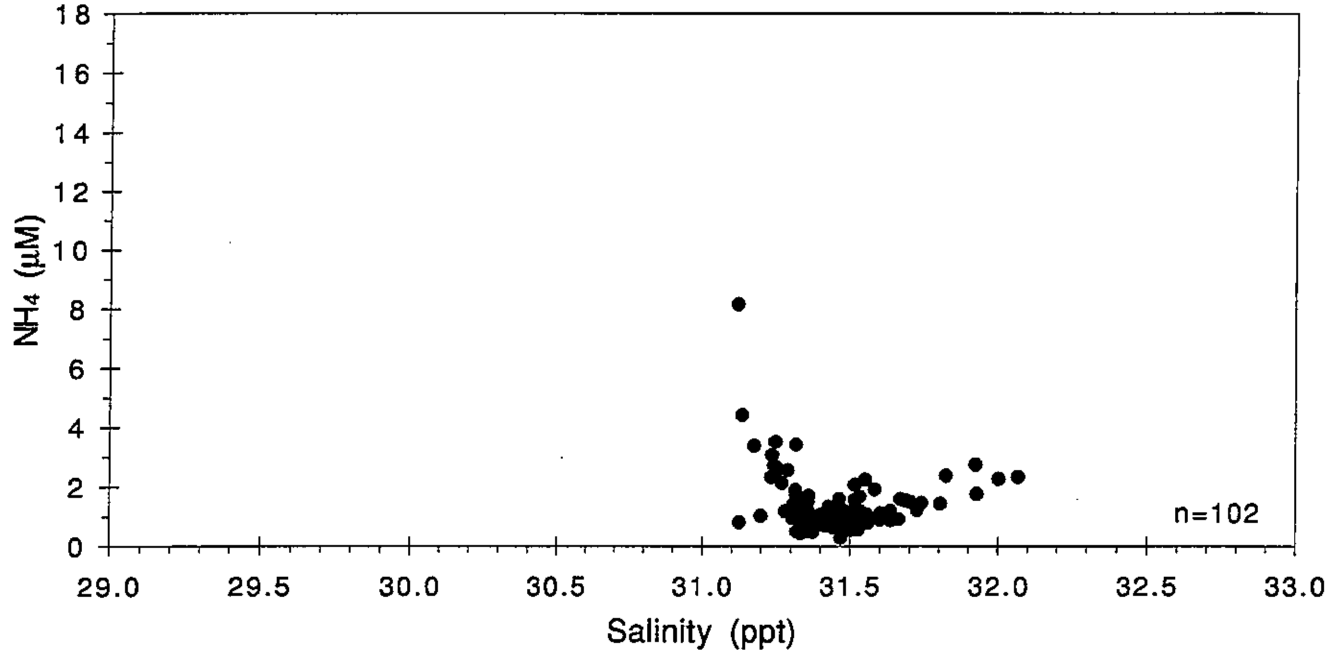
30.5
31.0
31.5
32.0
32.5
33.0


W9504 .
NO3 (µM)
Salinity (ppt)
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
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF


W9505 .
NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=105
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

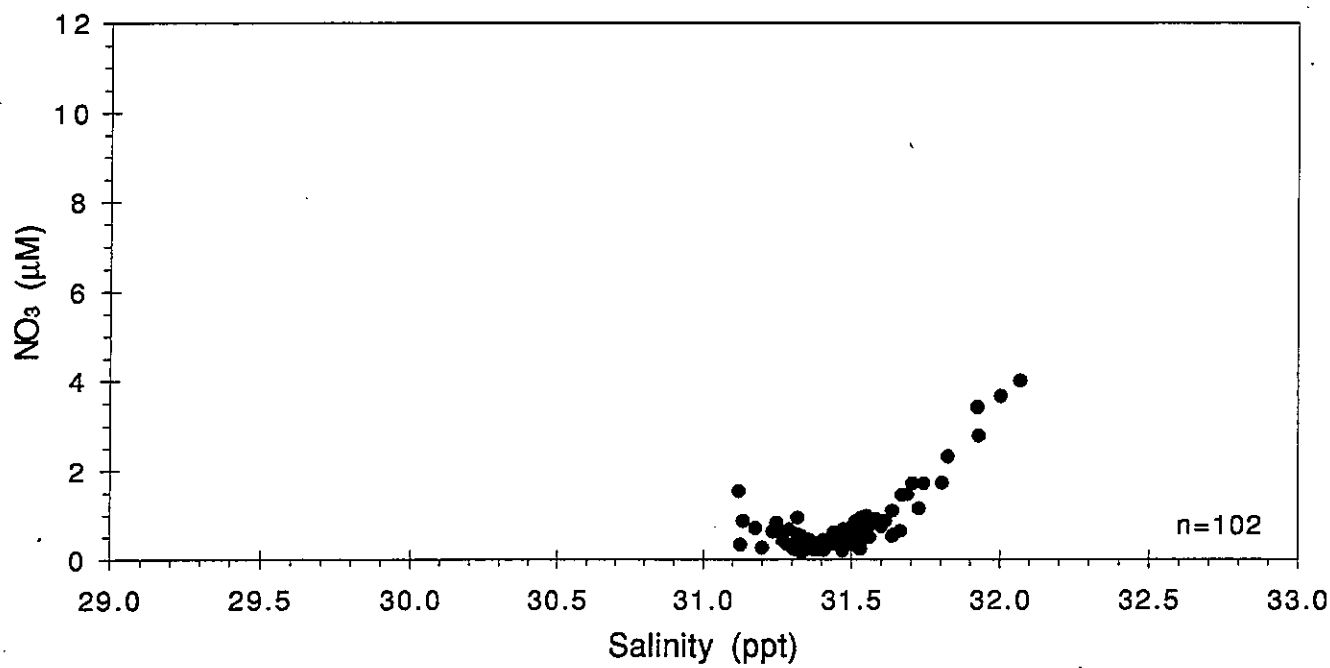

W9505 .
NO3 (µM)
12
10
8
6
4
2
0
n=105
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9506 .



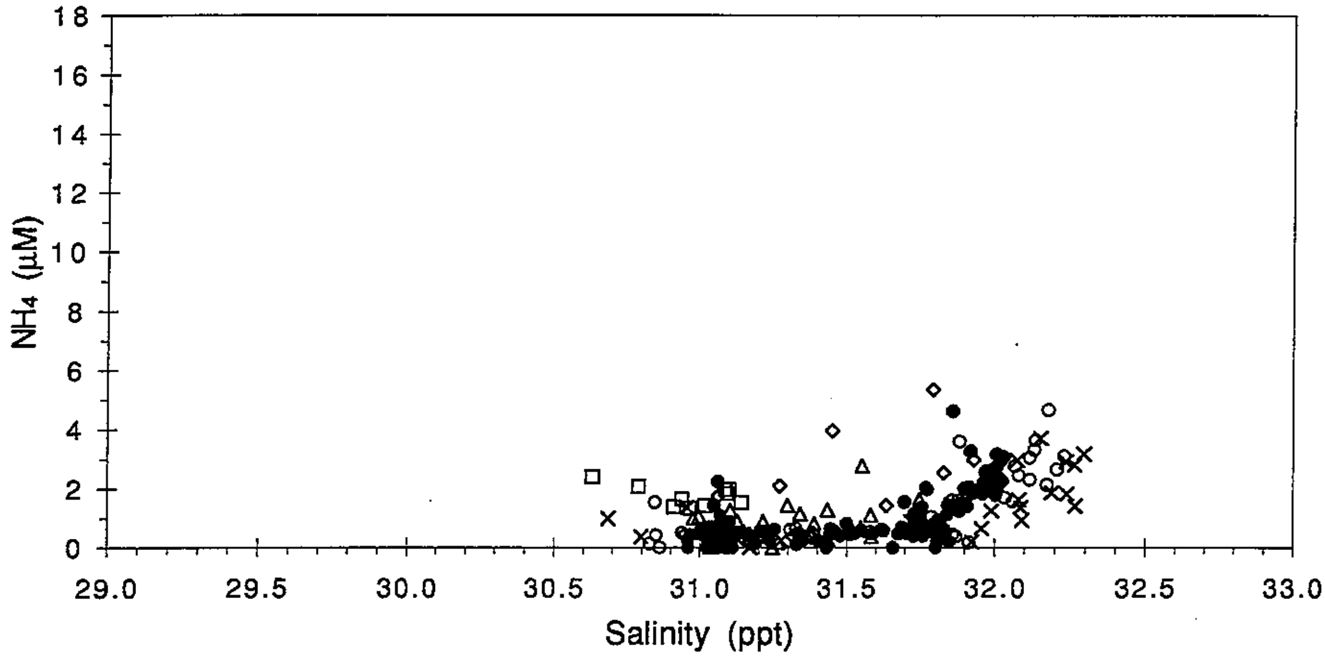
18
16
14
12
10
8
6
4
2
0
NH4 (µM)
n=102
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9506 .

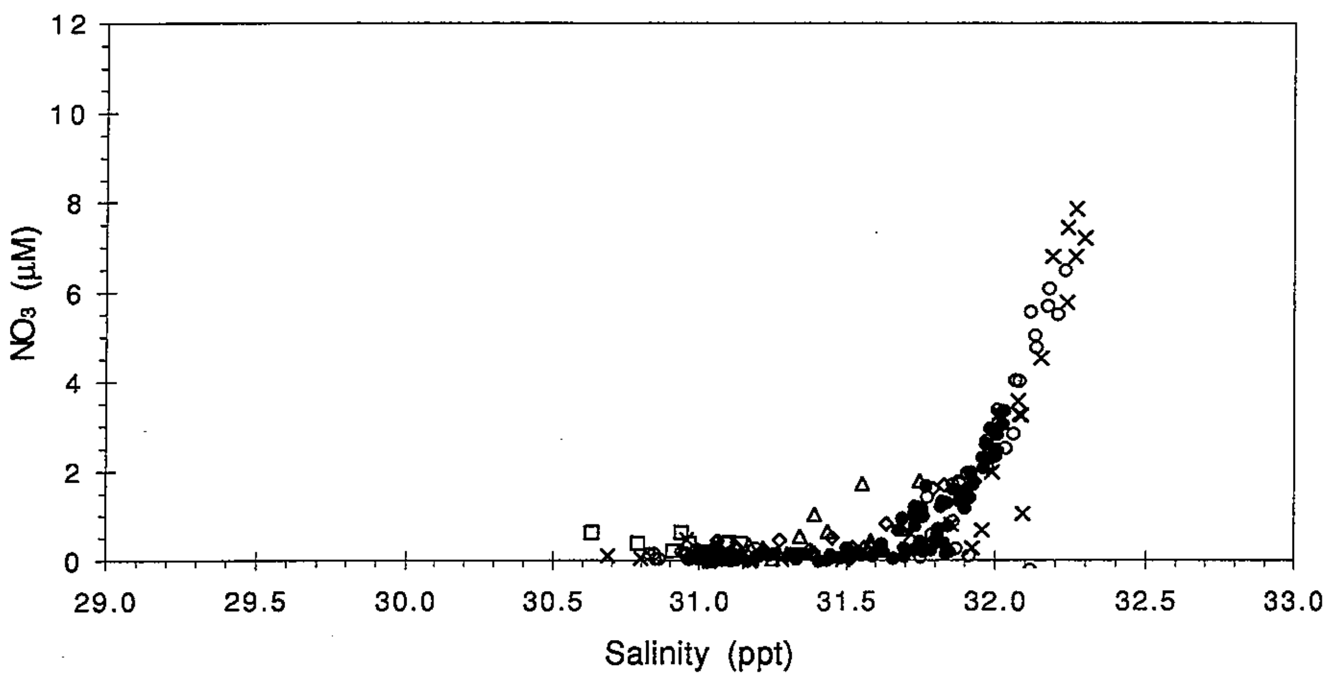


12
10
8
6
4
2
0
NO3 (µM)
n=102
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

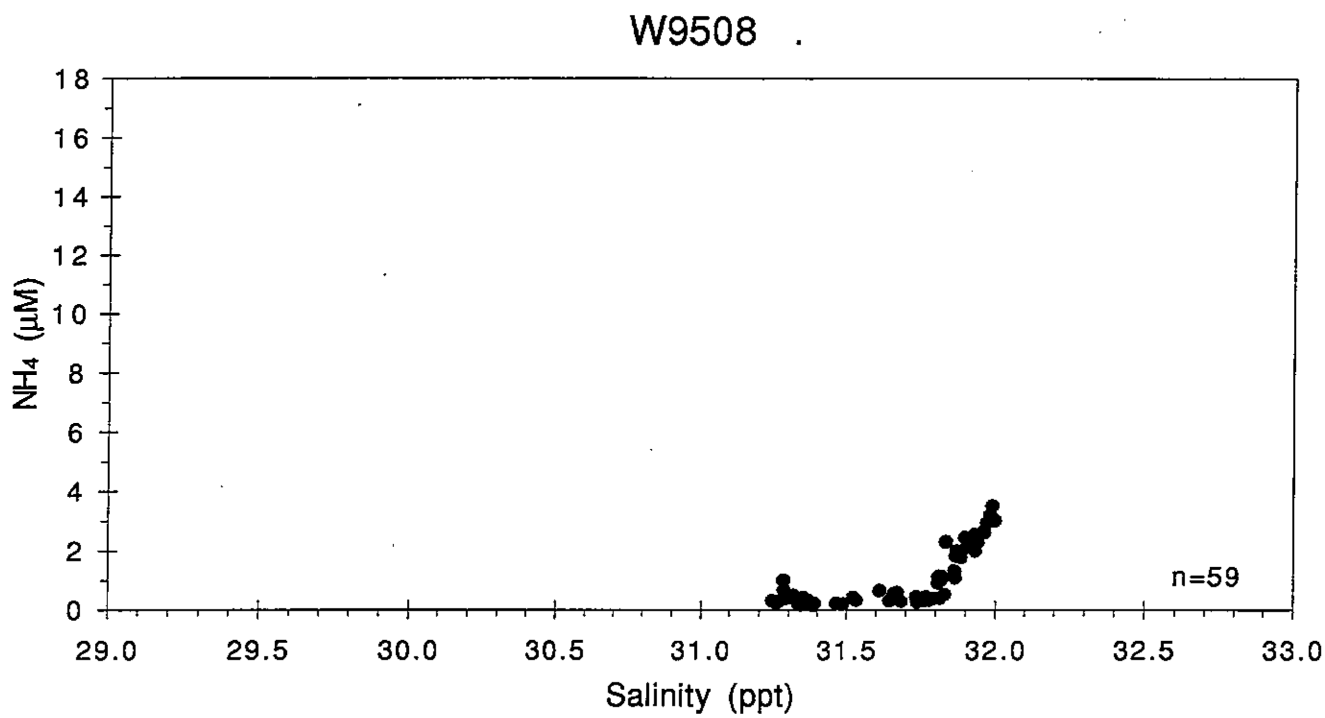
W9507 .

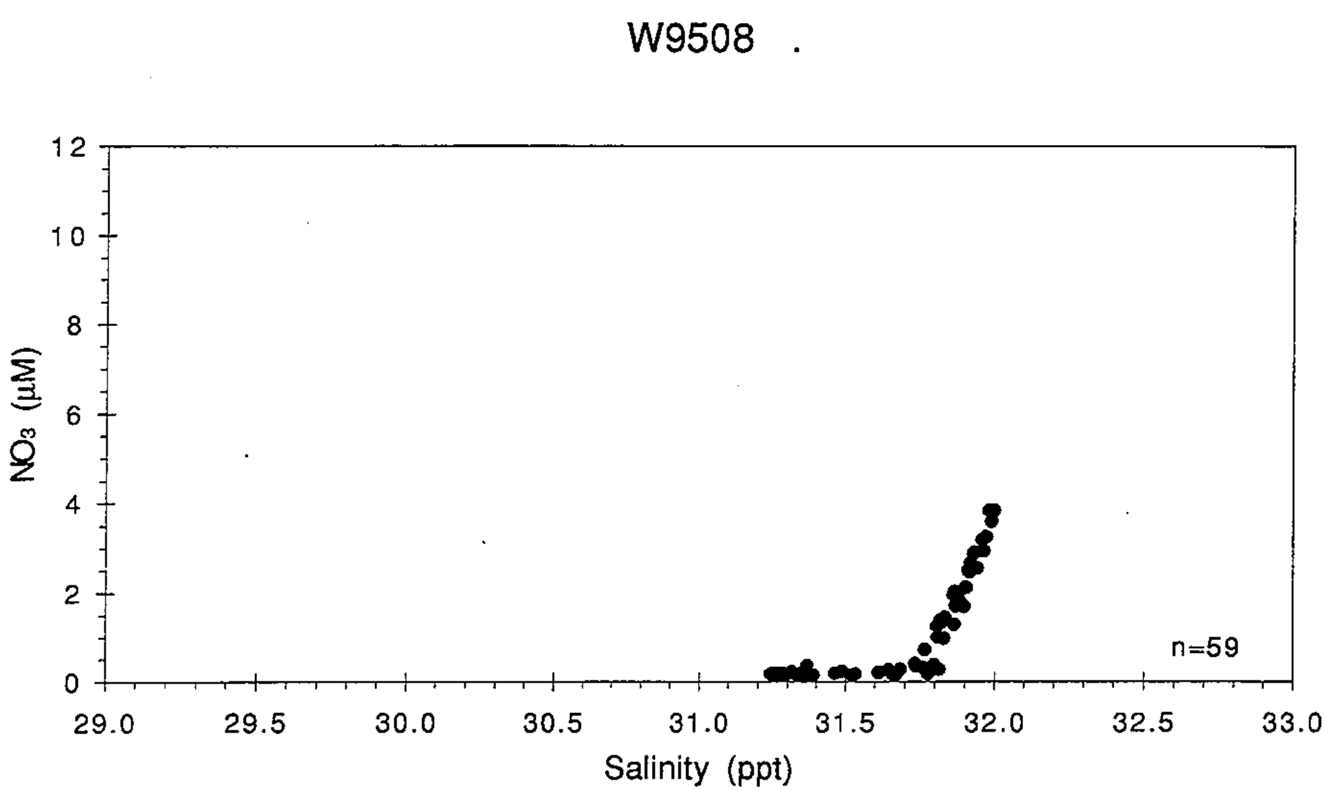


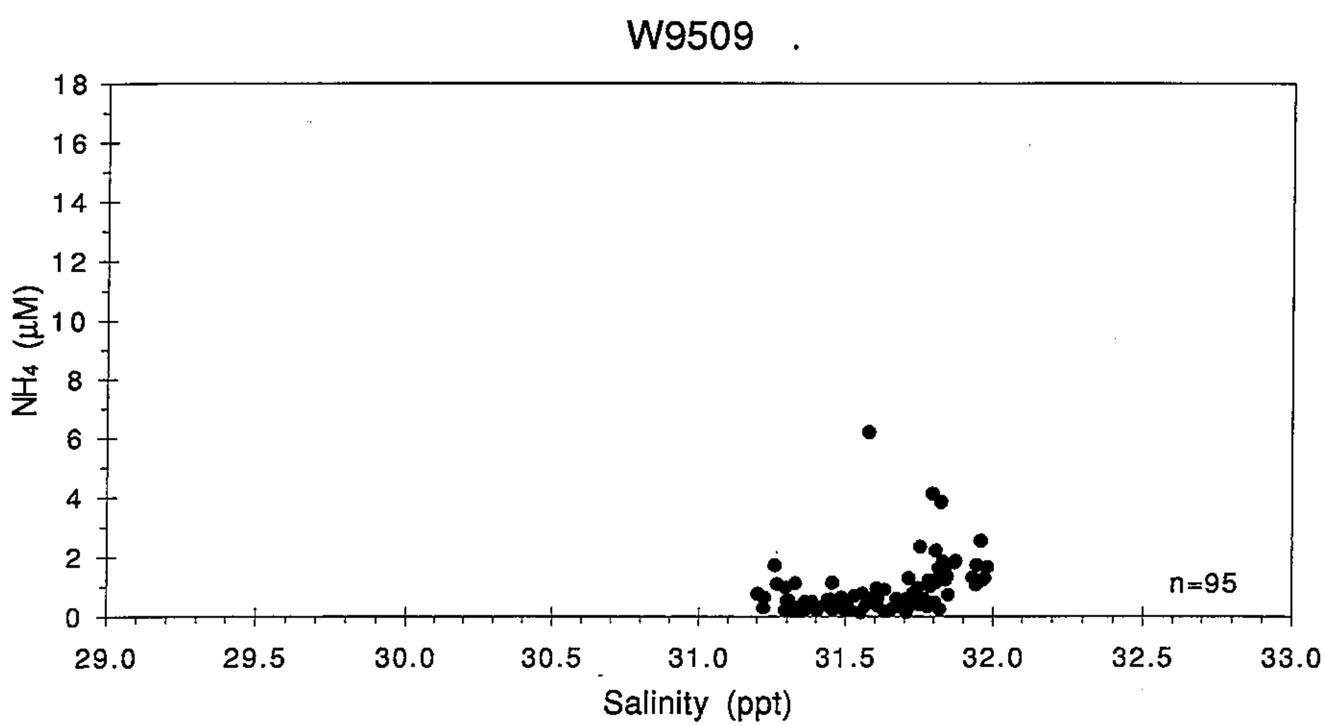
W9507 .

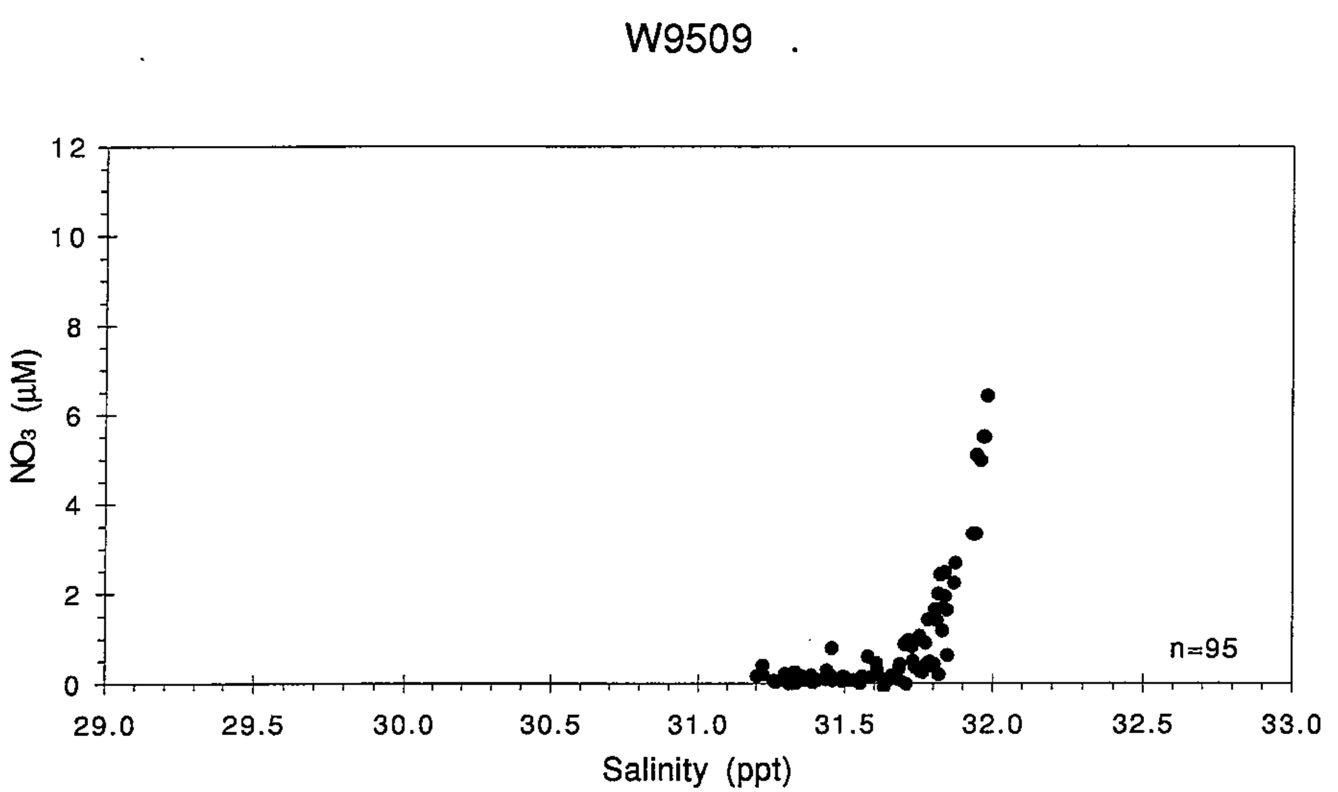


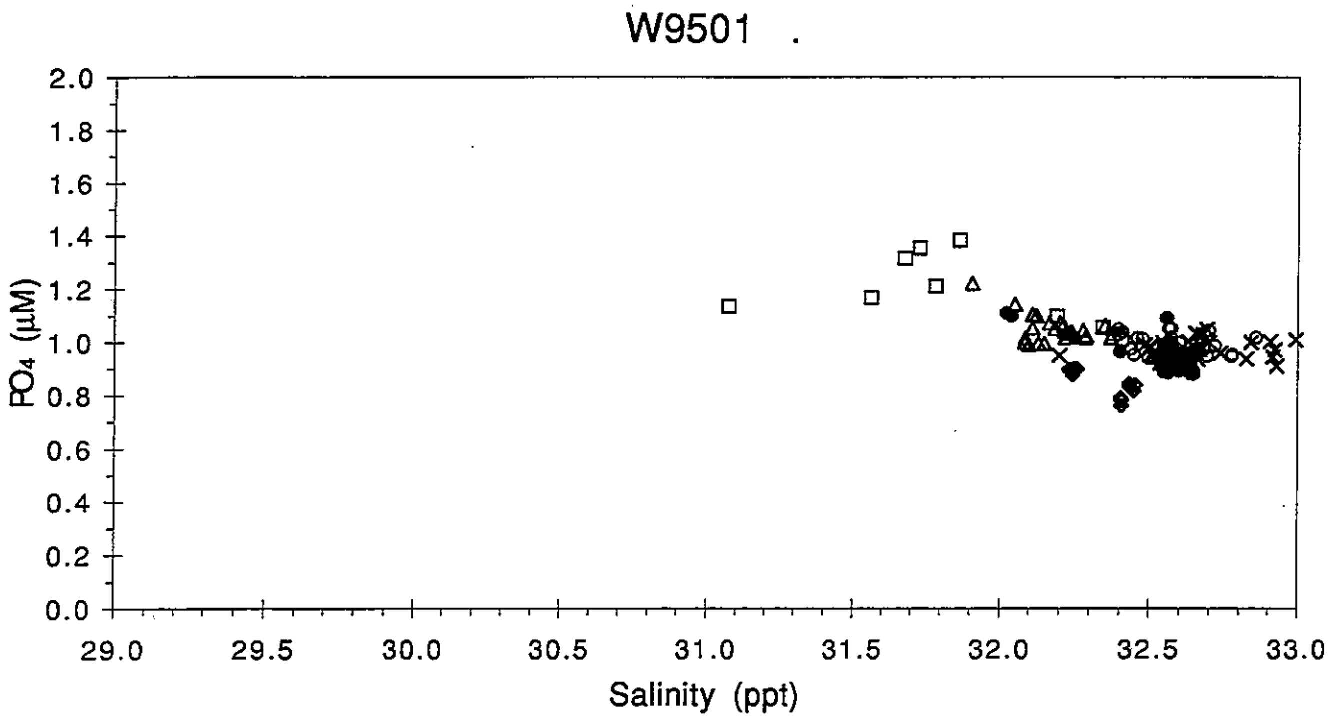
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

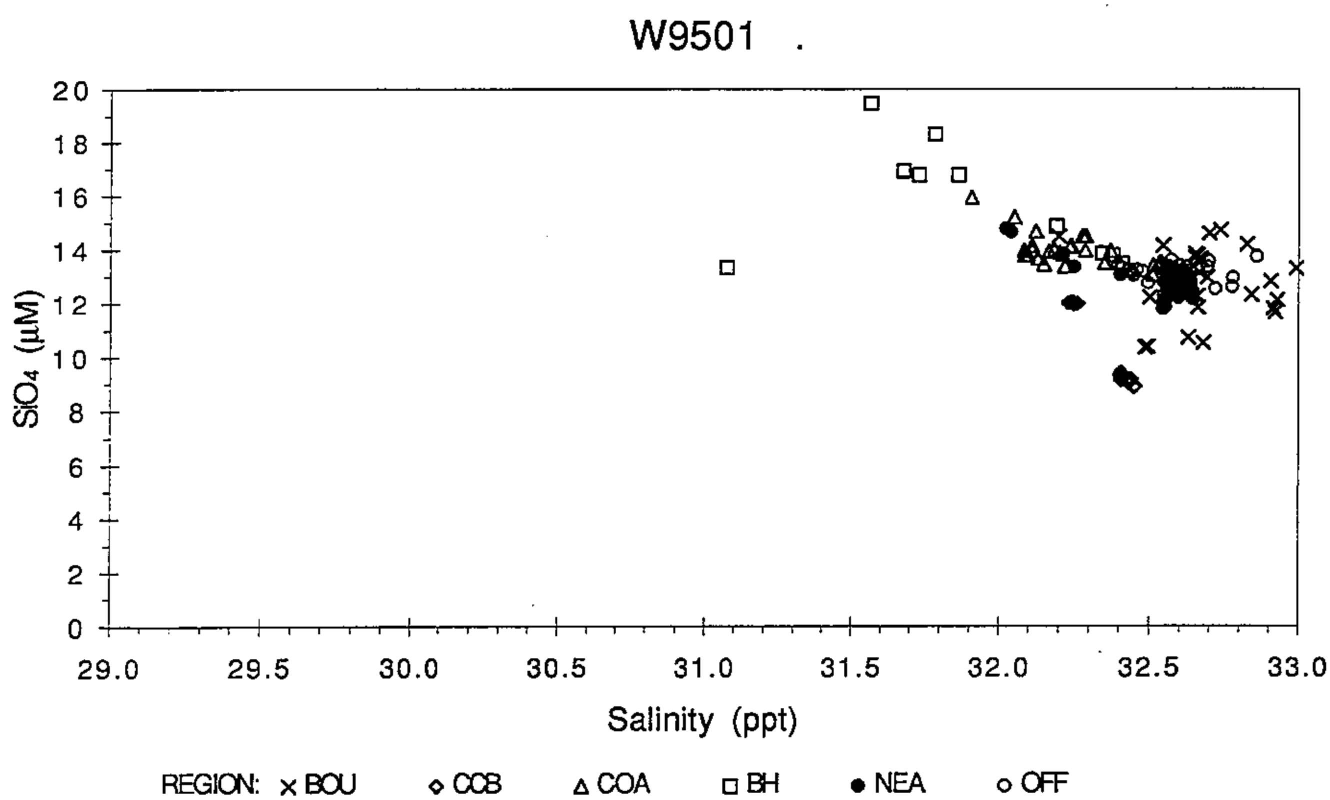

W9508 .
18
16
14
12
10
8
6
4
2
0
NH4 (µM)
n=59
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

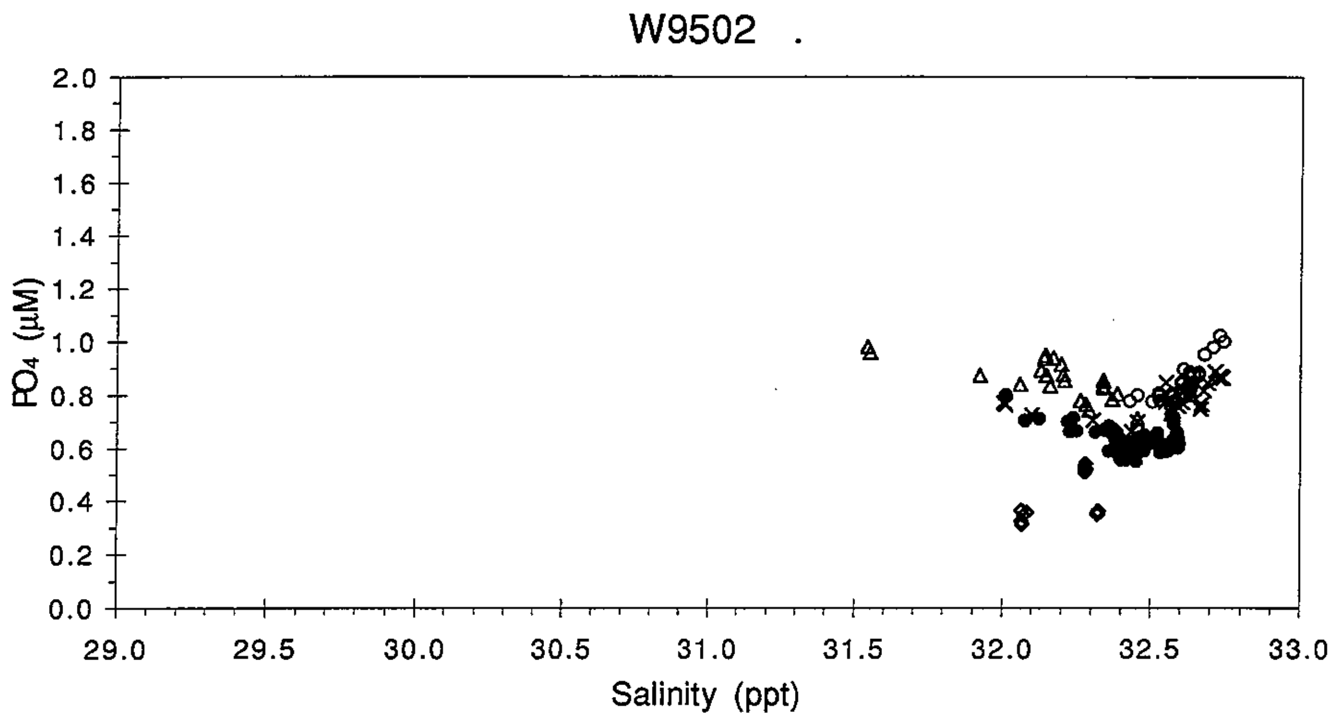

W9508 .
12
10
8
6
4
2
0
NO3 (µM)
n=59
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

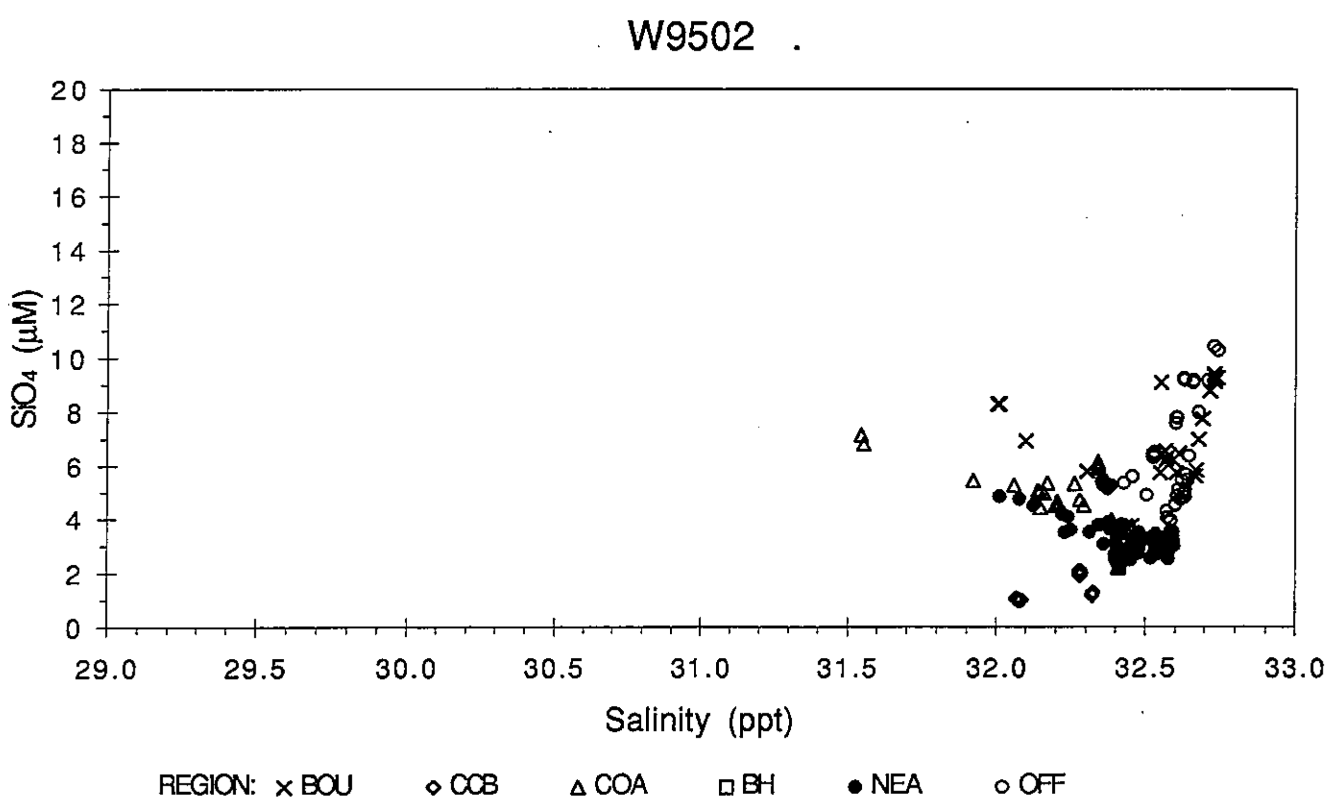

W9509
NH4 (µM)
18
16
14
12
10
8
6
4
2
0
n=95
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

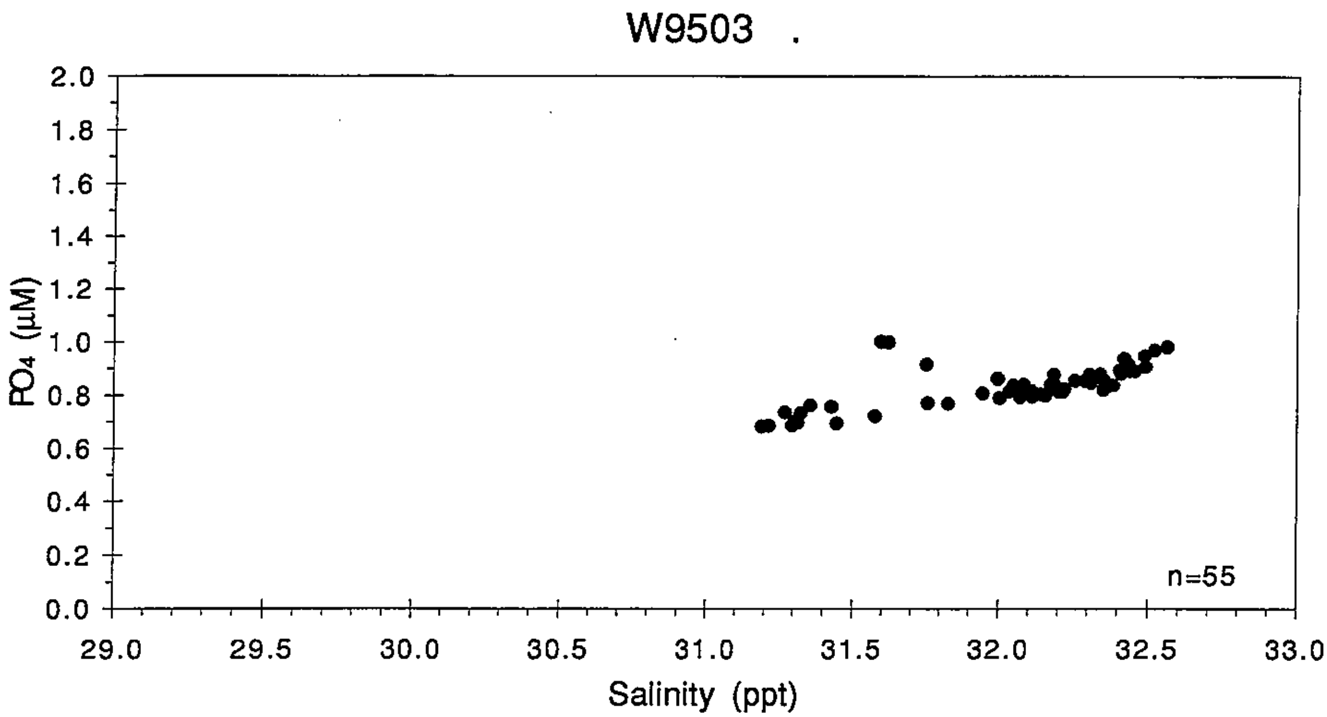

W9509
NO3 (µM)
12
10
8
6
4
2
0
n=95
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

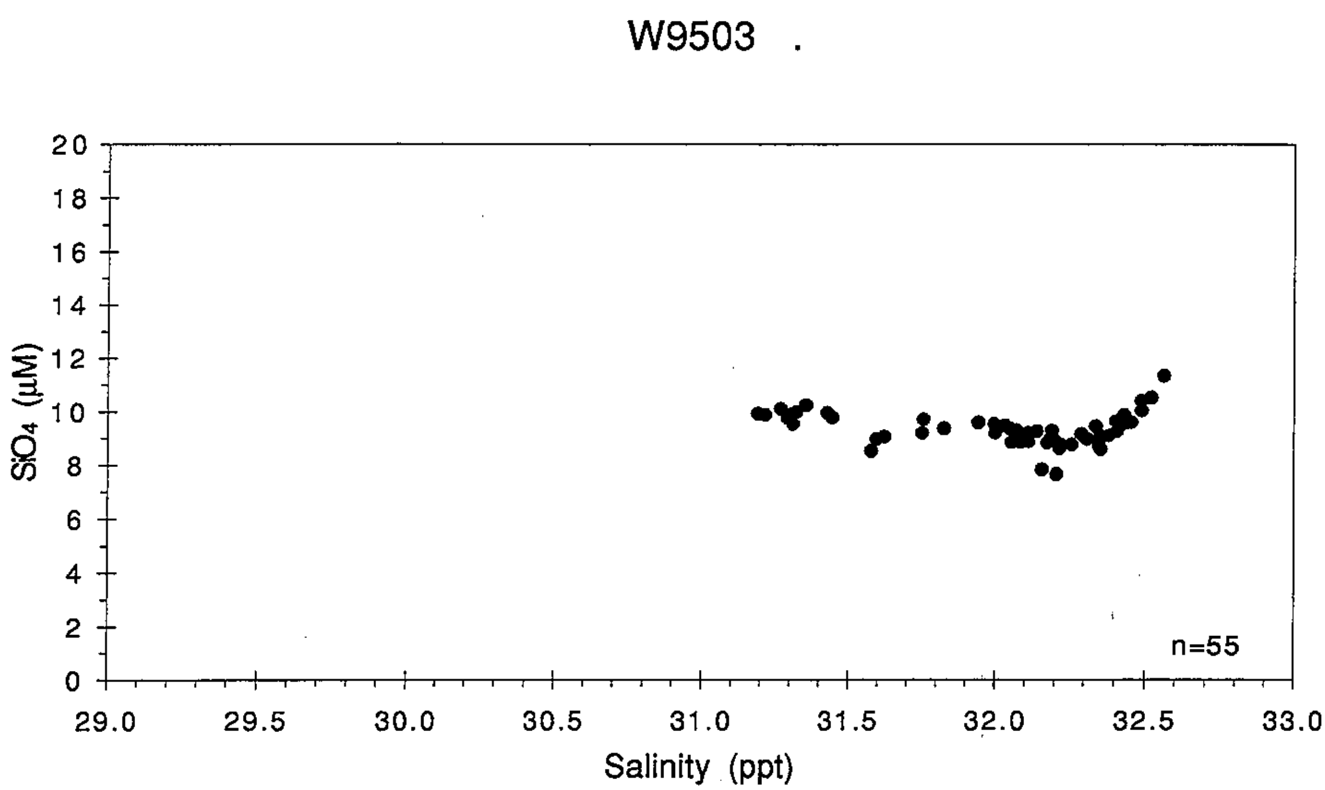

W9501 .
PO4 (µM)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

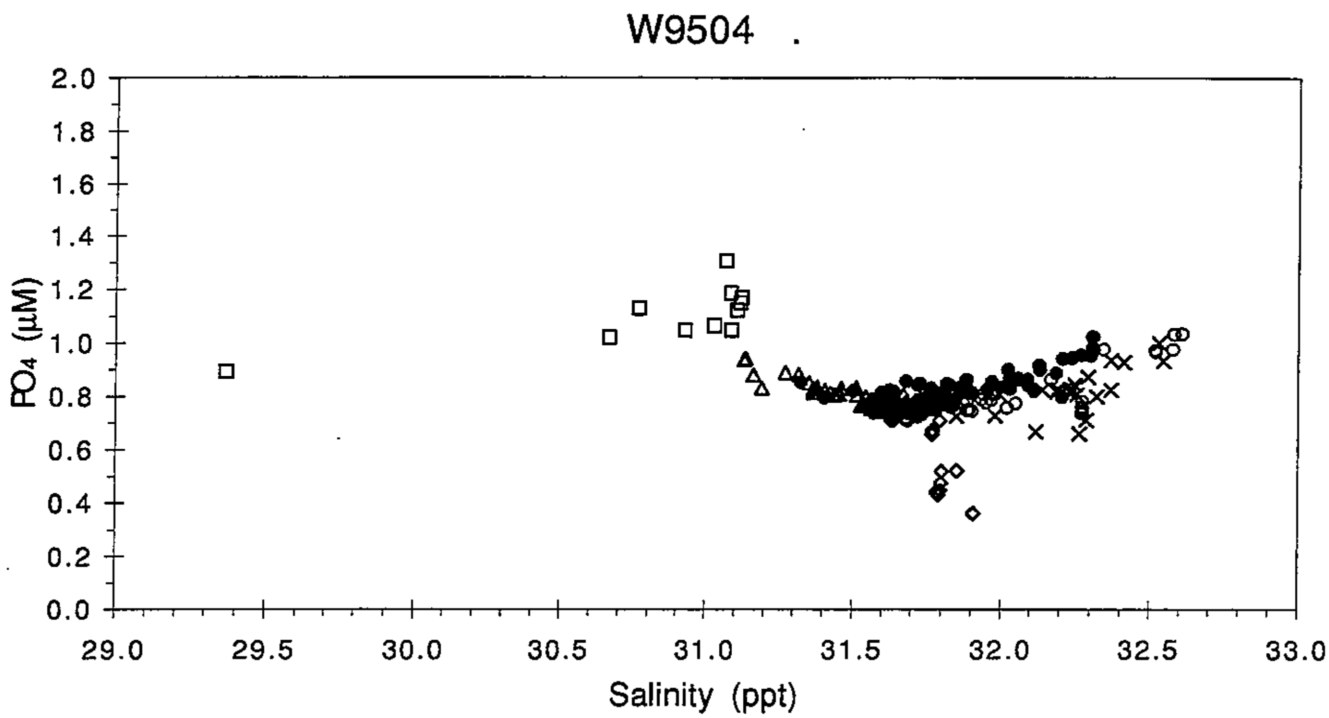

W9501 .
SiO4 (µM)
20
18
16
14
12
10
8
6
4
2
0
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

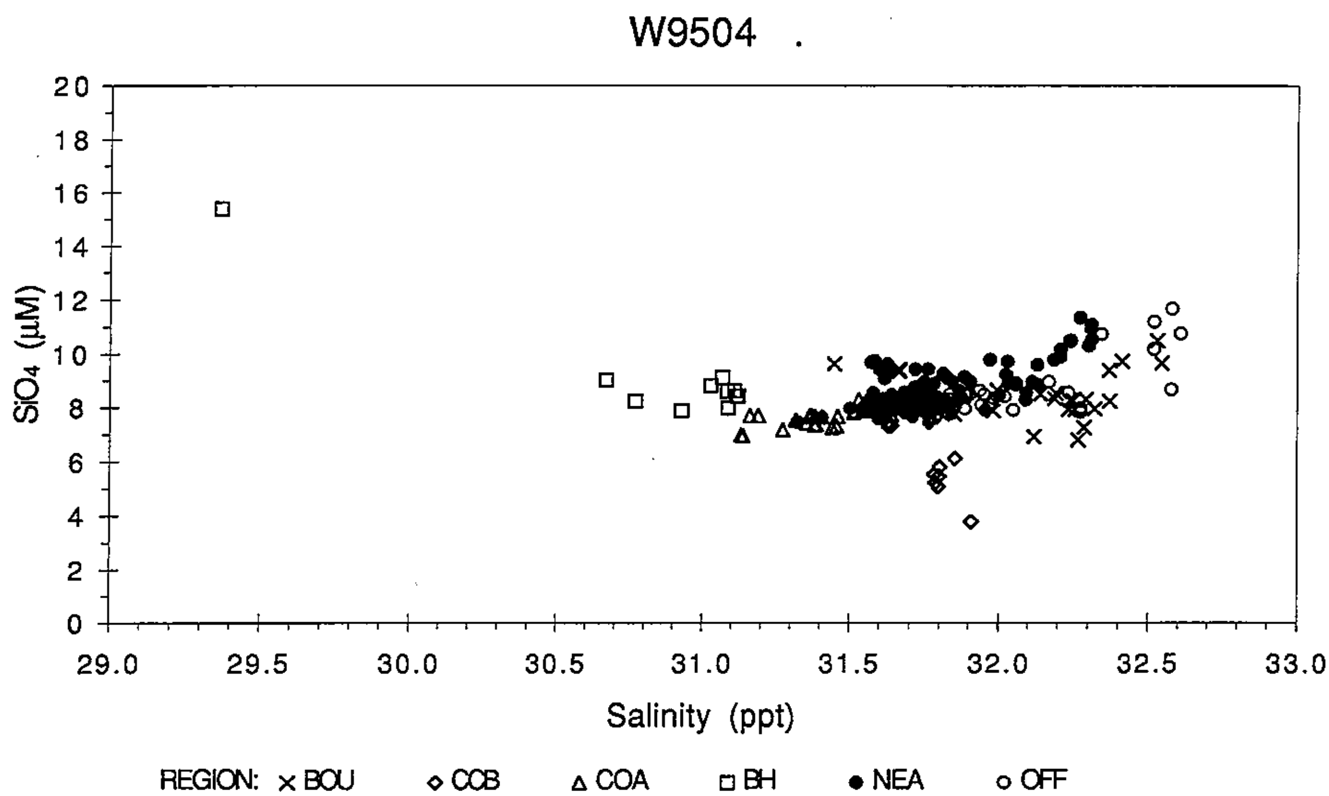

W9502 .
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (µM)
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

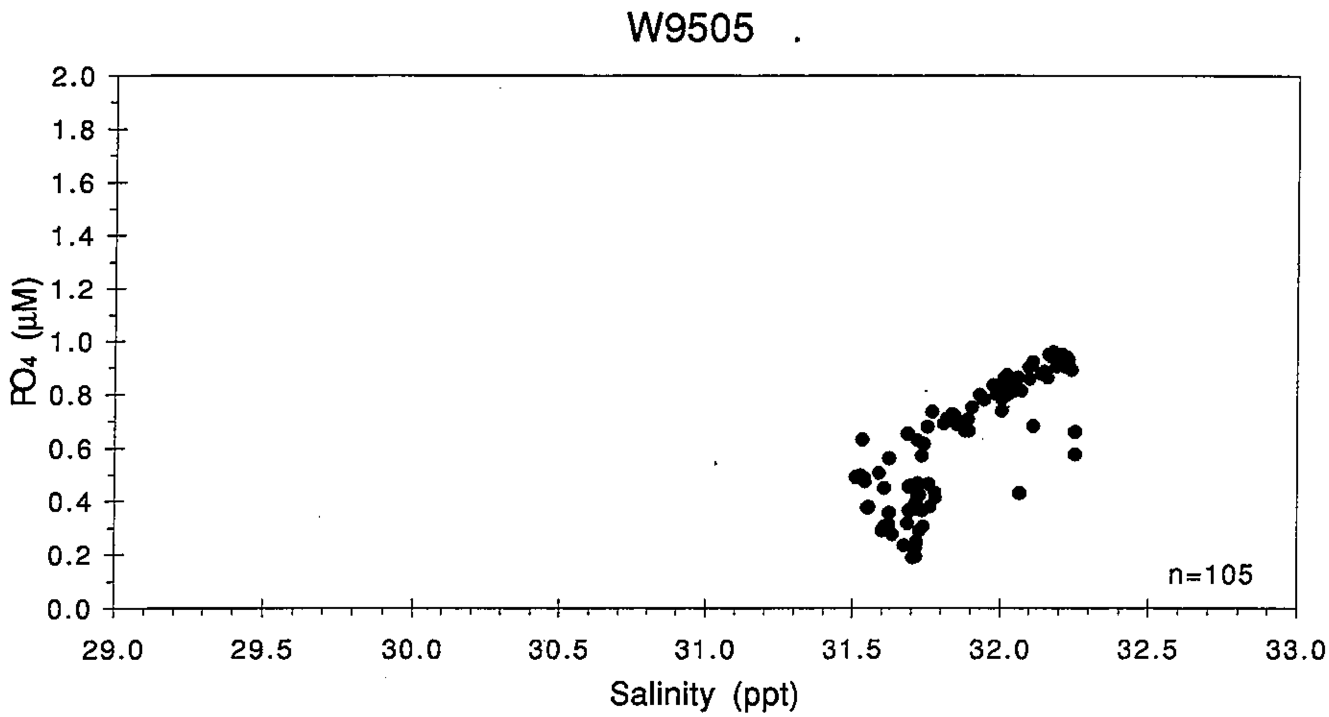

W9502 .
20
18
16
14
12
10
8
6
4
2
0
SiO4 (µM)
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

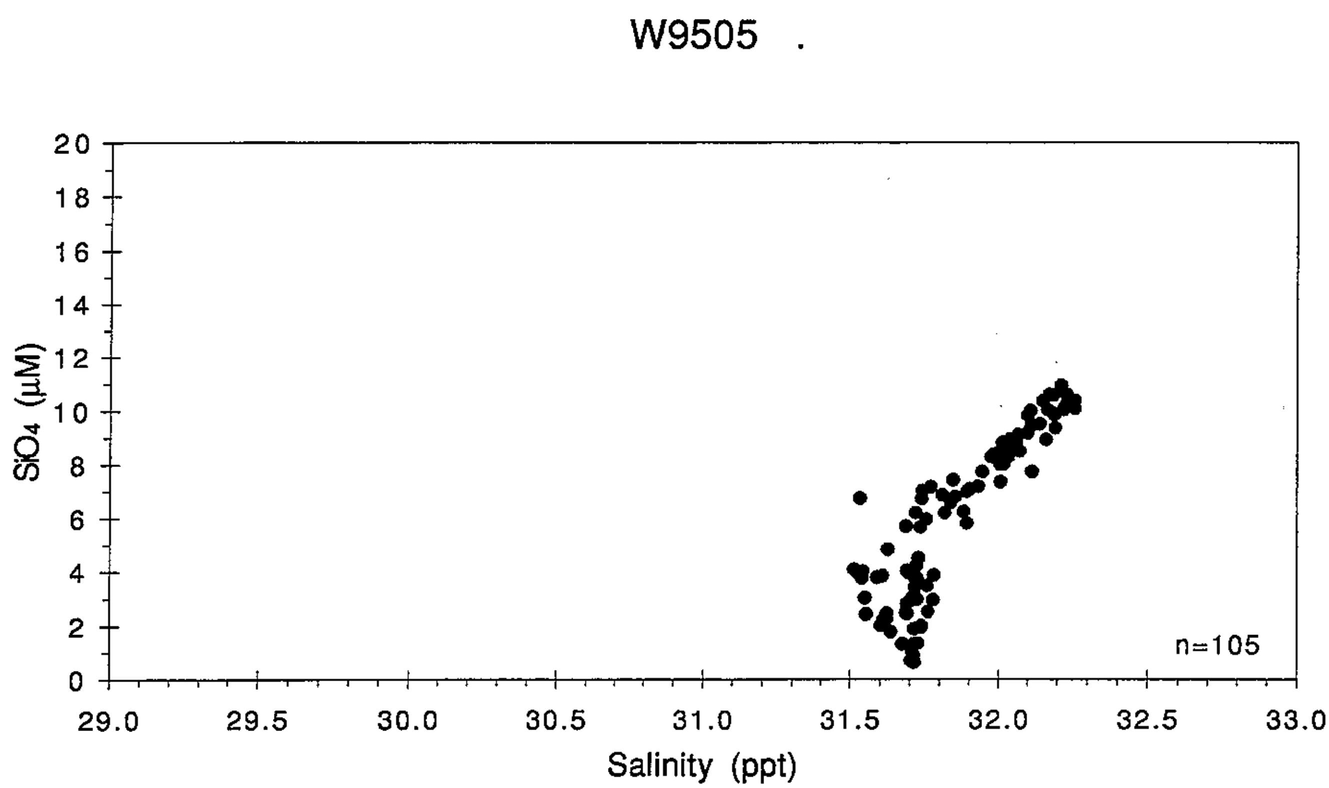

W9503 .
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (µM)
n=55
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

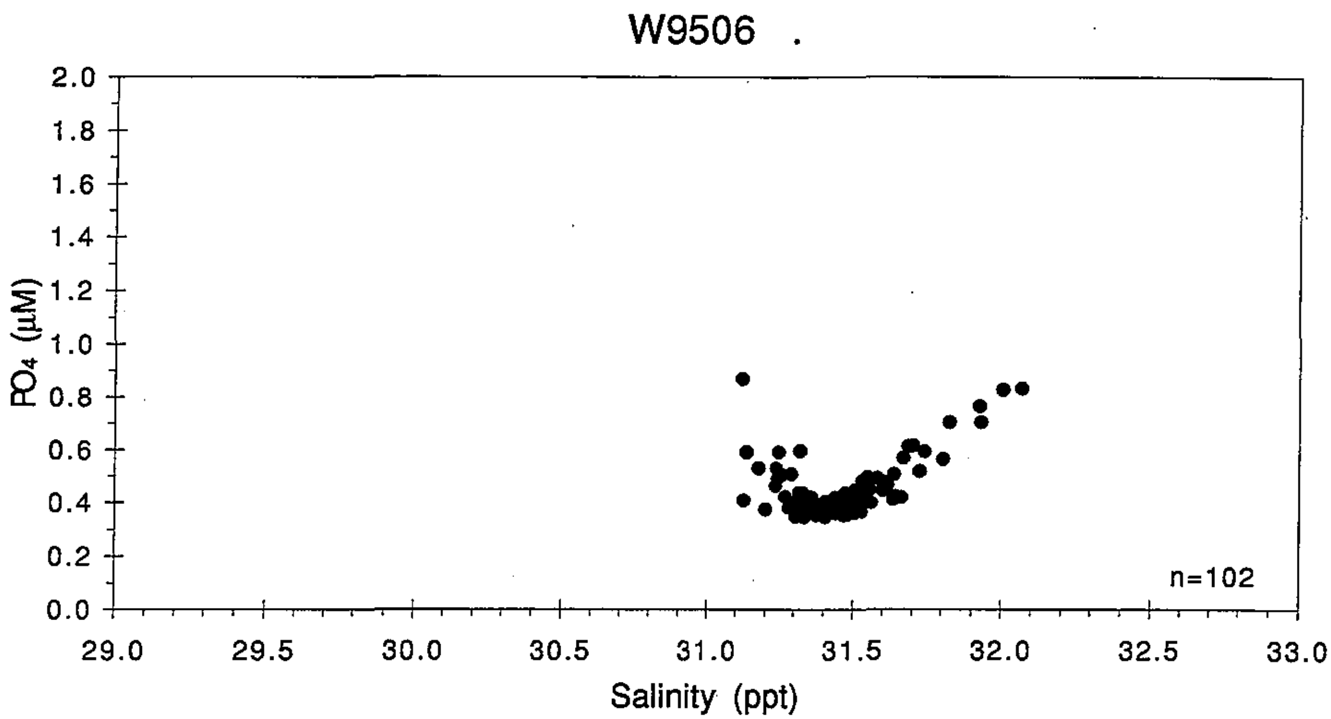

W9503 .
20
18
16
14
12
10
8
6
4
2
0
SiO4 (µM)
n=55
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9504
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (µM)
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

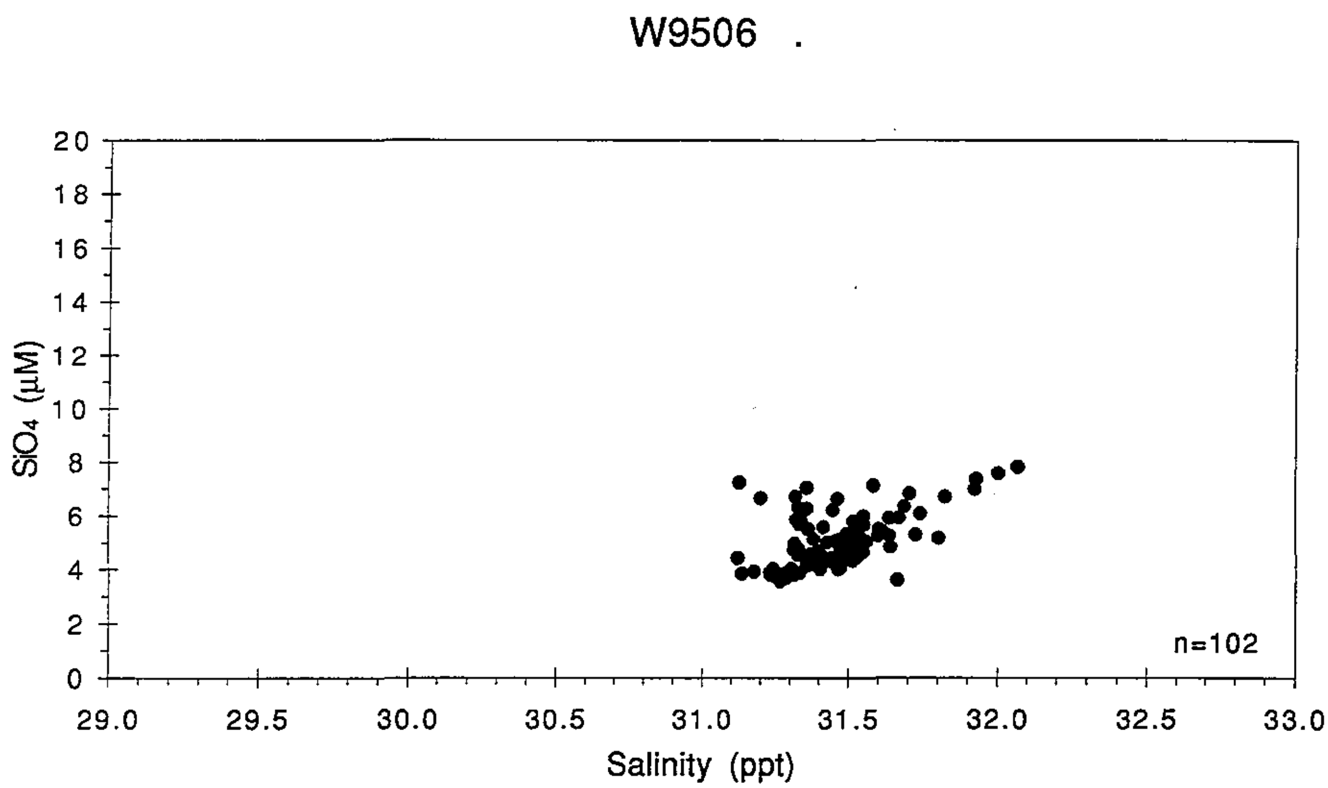

W9504
20
18
16
14
12
10
8
6
4
2
0
SiO4 (µM)
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF


W9505 .
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=105
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

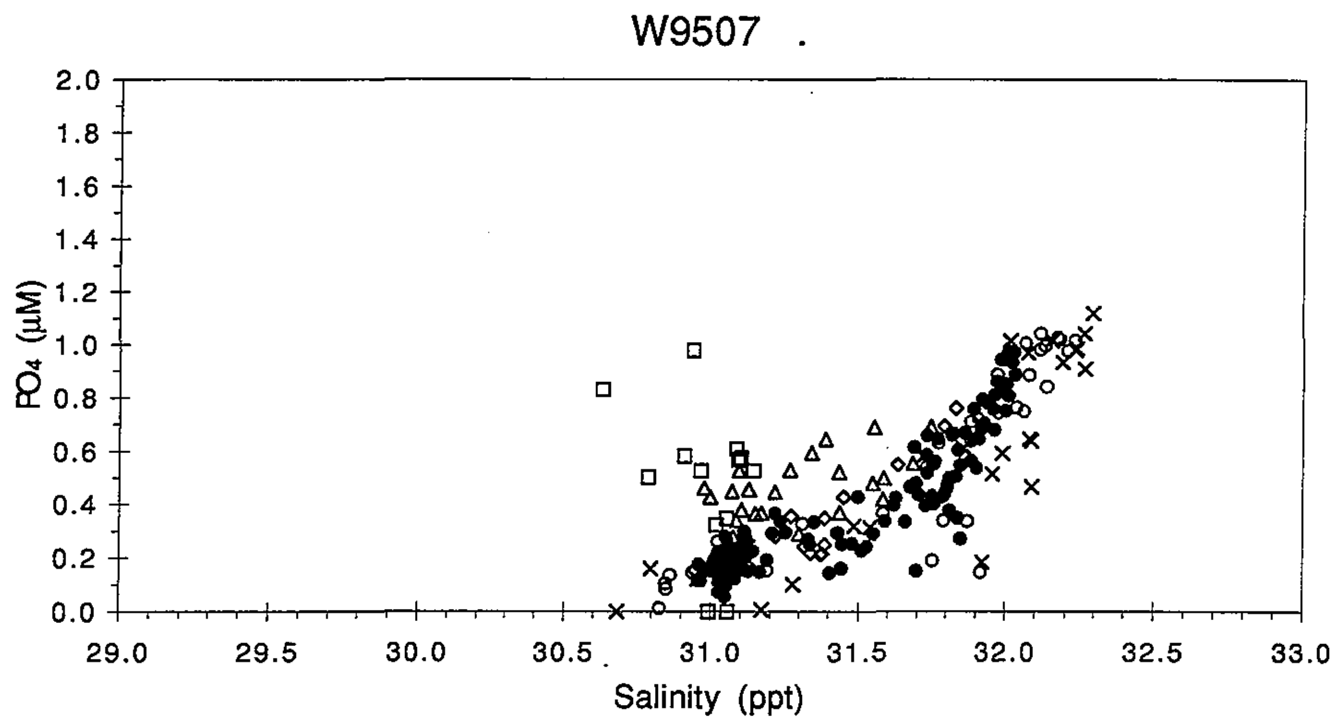

W9505 .
20
18
16
14
12
10
8
6
4
2
0
SiO4 (µM)
n=105
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

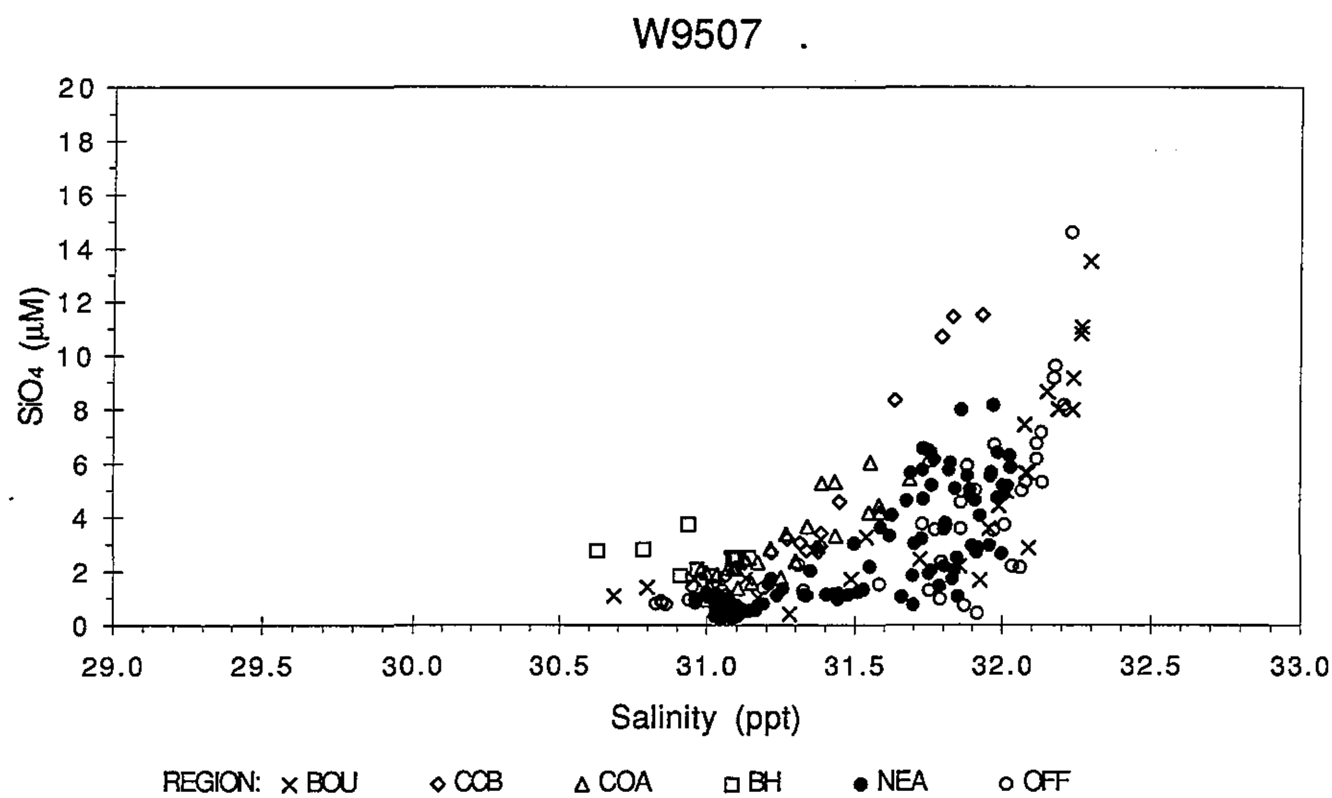


W9506
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (µM)
n=102
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

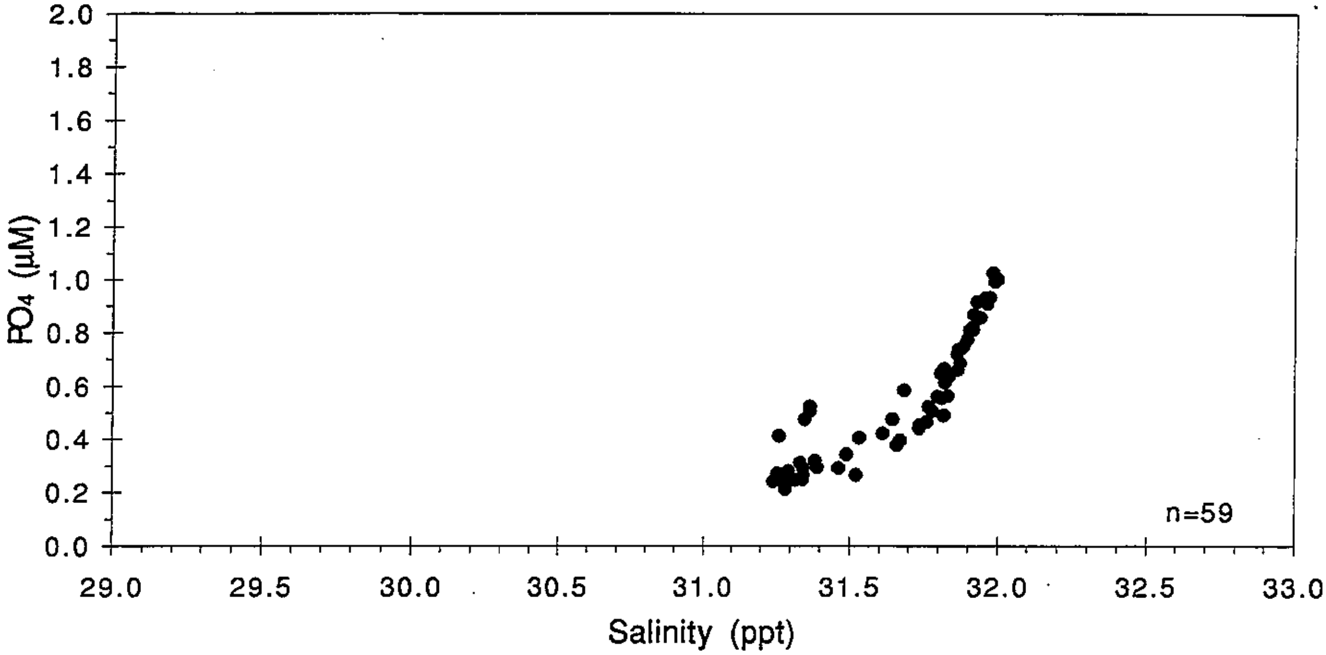


W9506
20
18
16
14
12
10
8
6
4
2
0
SiO4 (µM)
n=102
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9507 .
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)

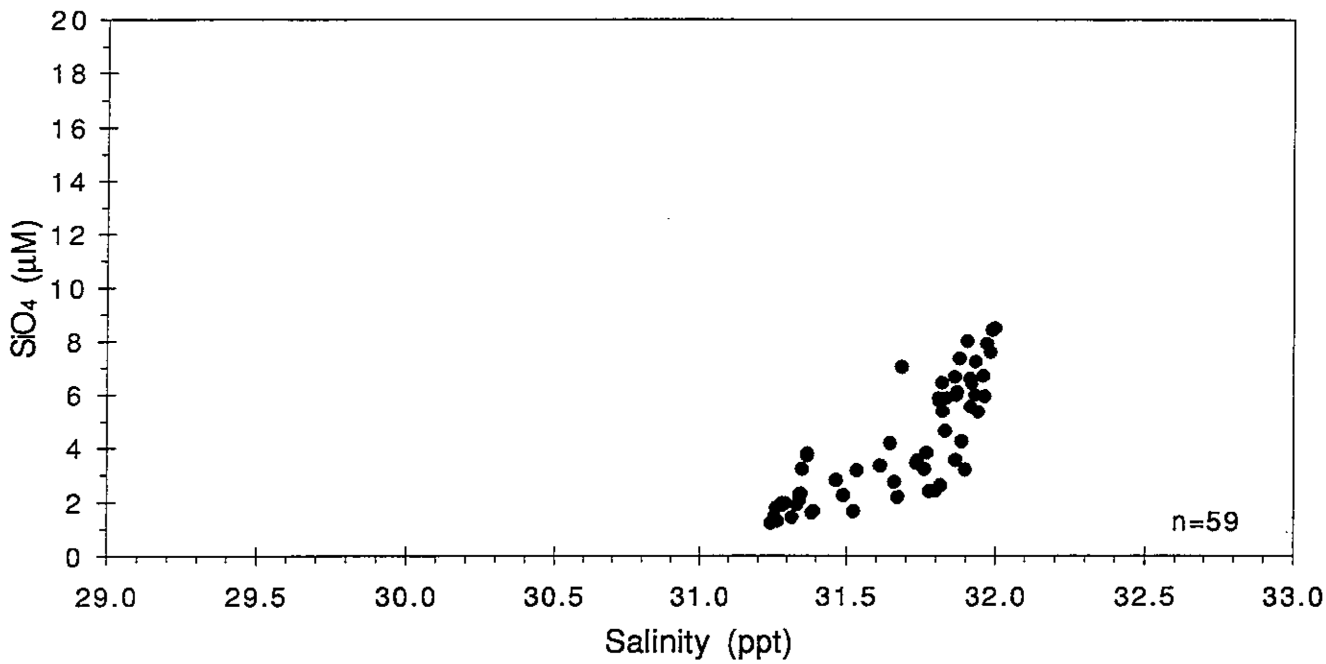

W9507 .
SiO₄ (µM)
20
18
16
14
12
10
8
6
4
2
0
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

W9508 .



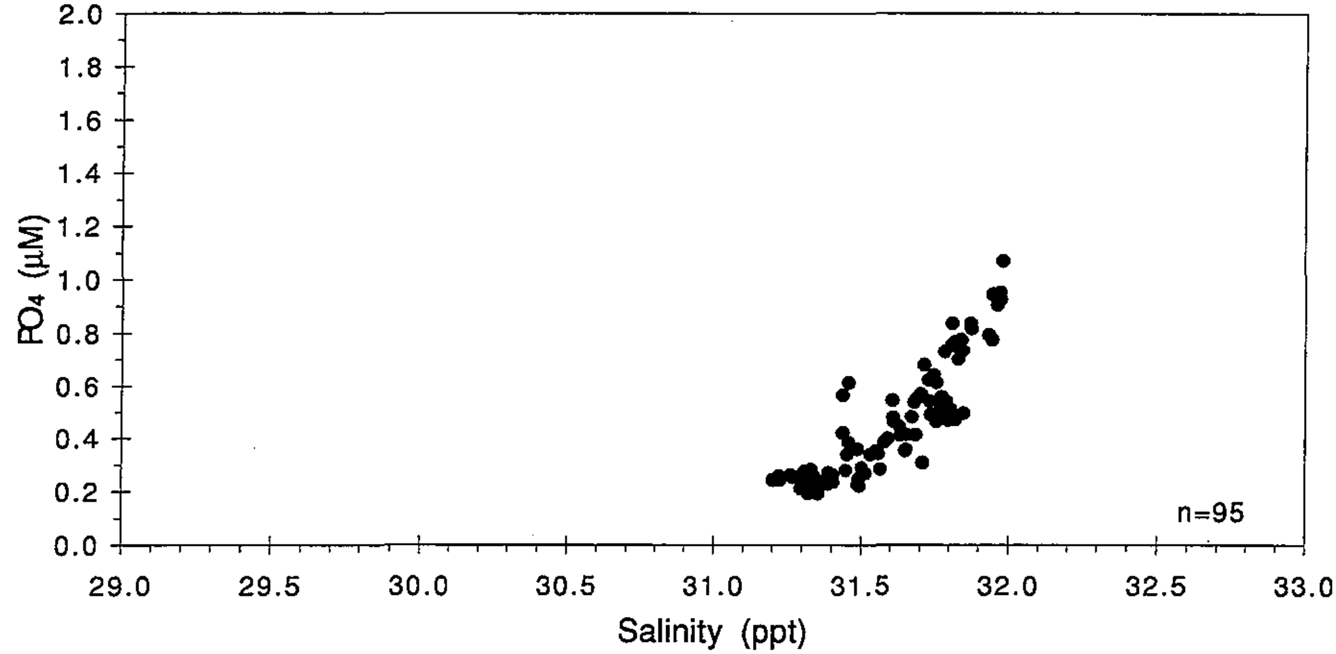
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (µM)
n=59
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9508 .



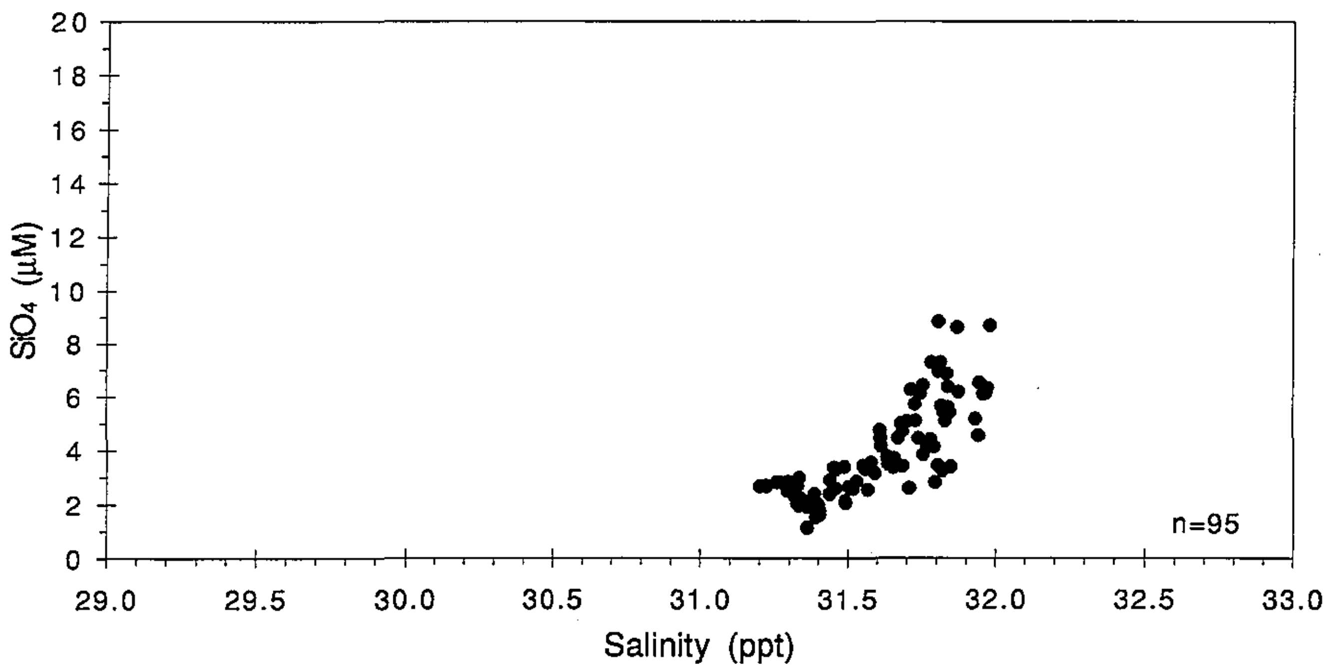
20
18
16
14
12
10
8
6
4
2
0
SiO4 (µM)
n=59
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9509 .

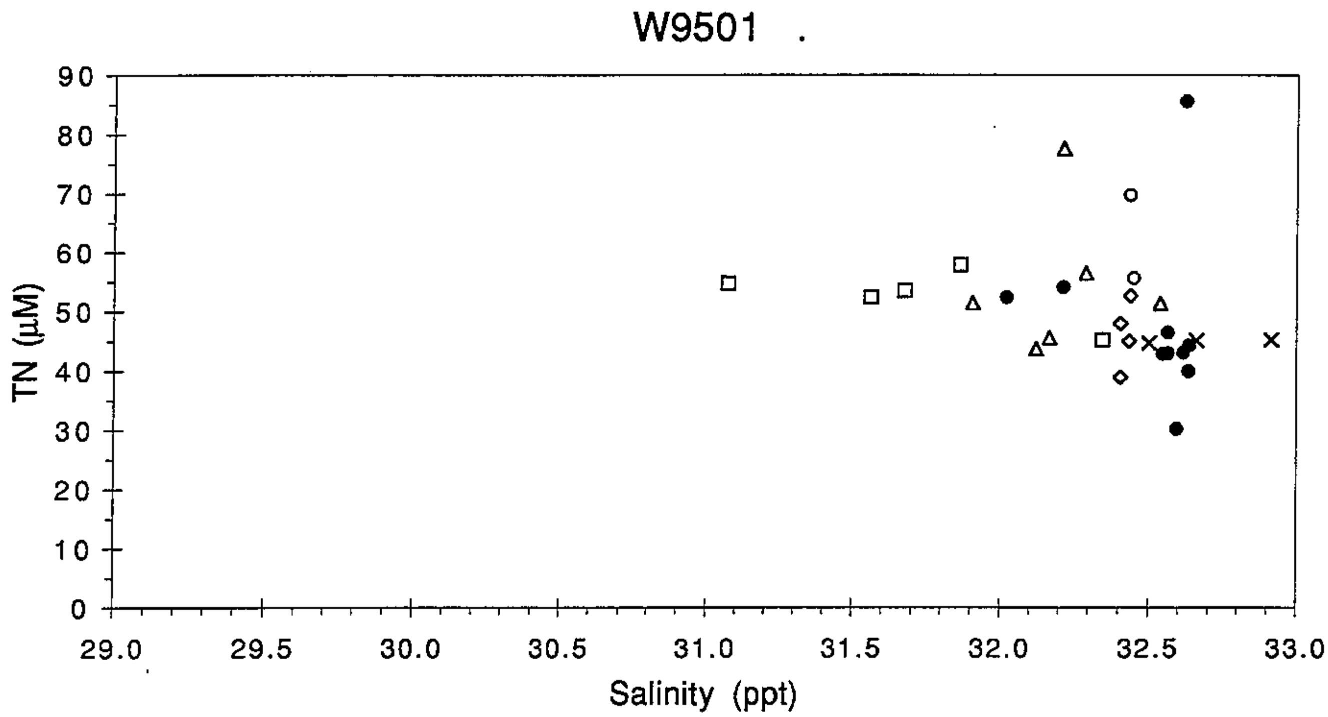


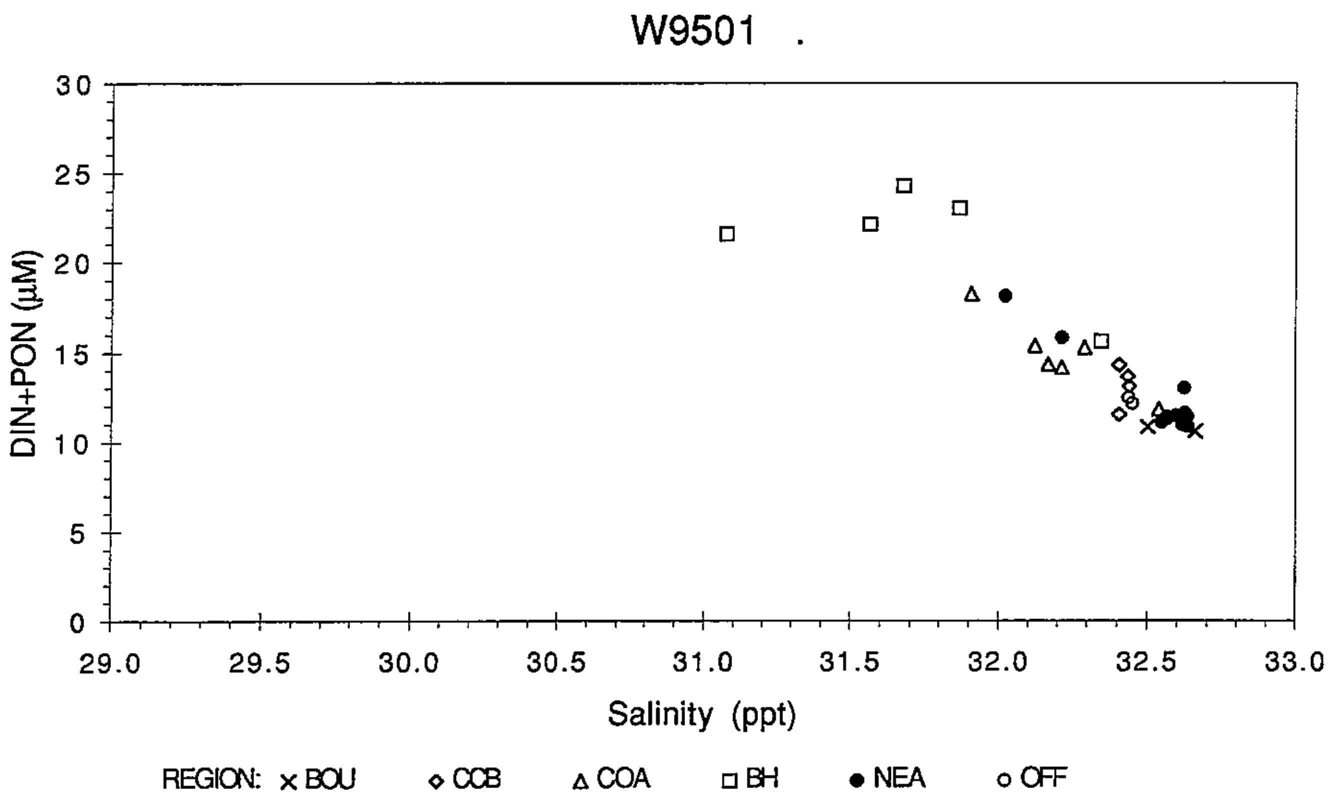
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
PO4 (µM)
n=95
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

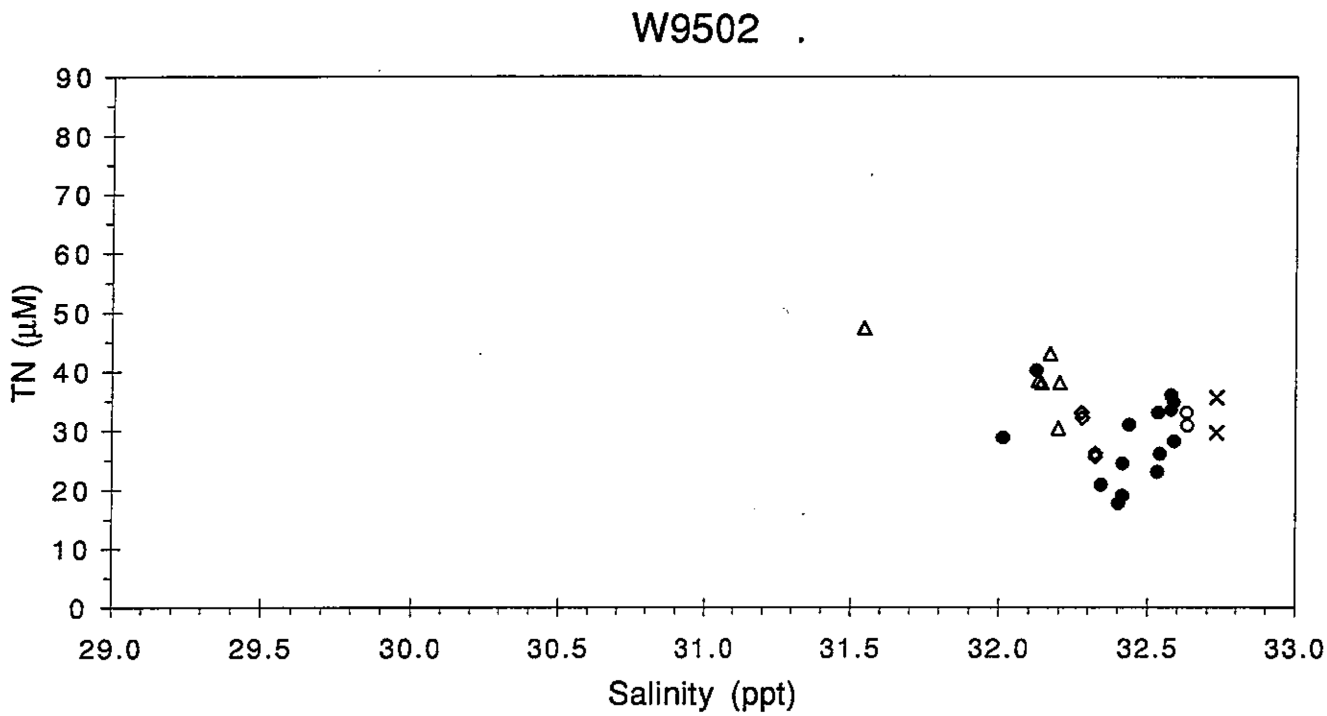
W9509 .

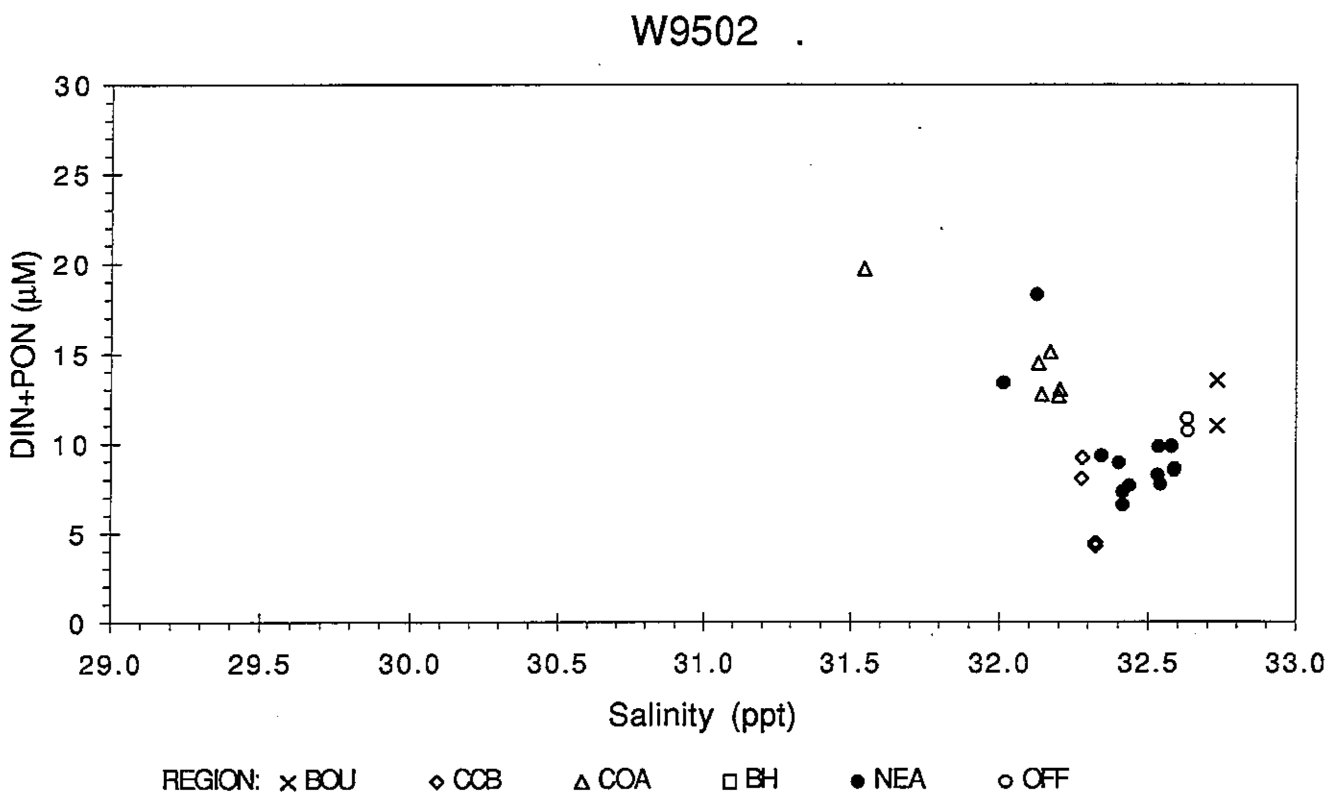


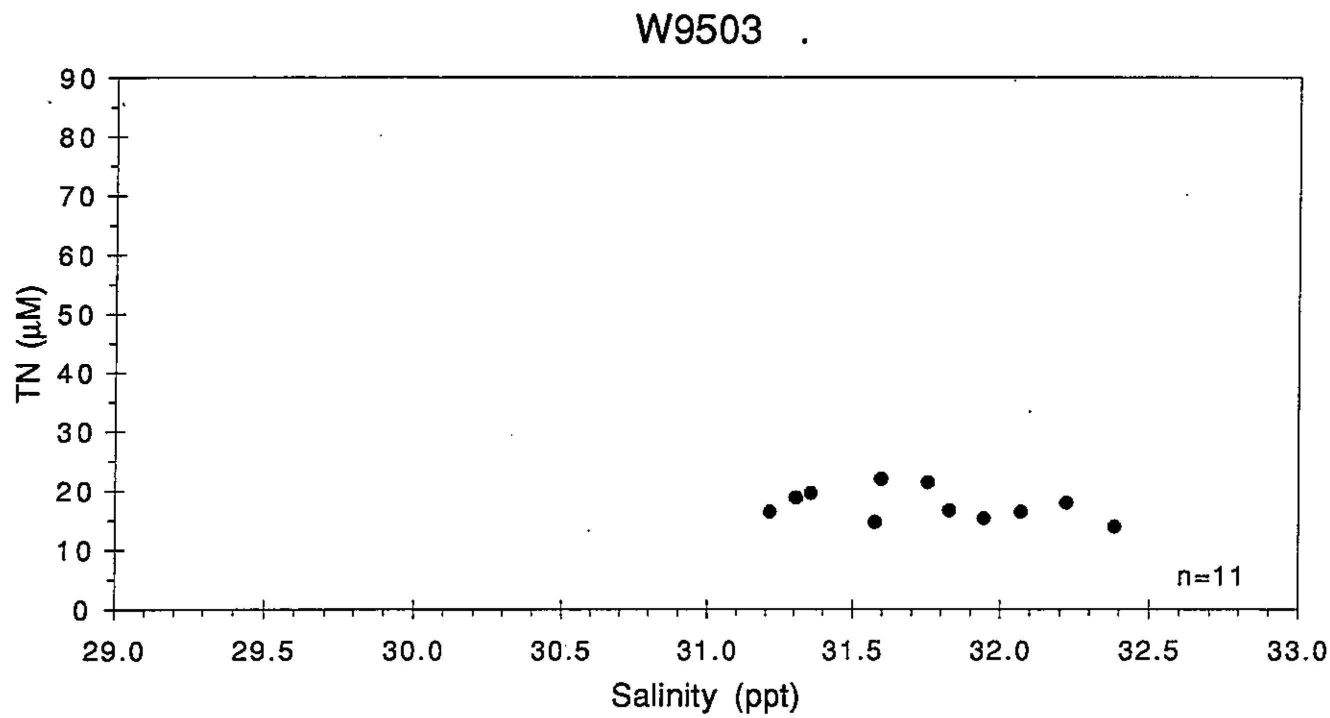
20
18
16
14
12
10
8
6
4
2
0
SiO4 (µM)
n=95
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

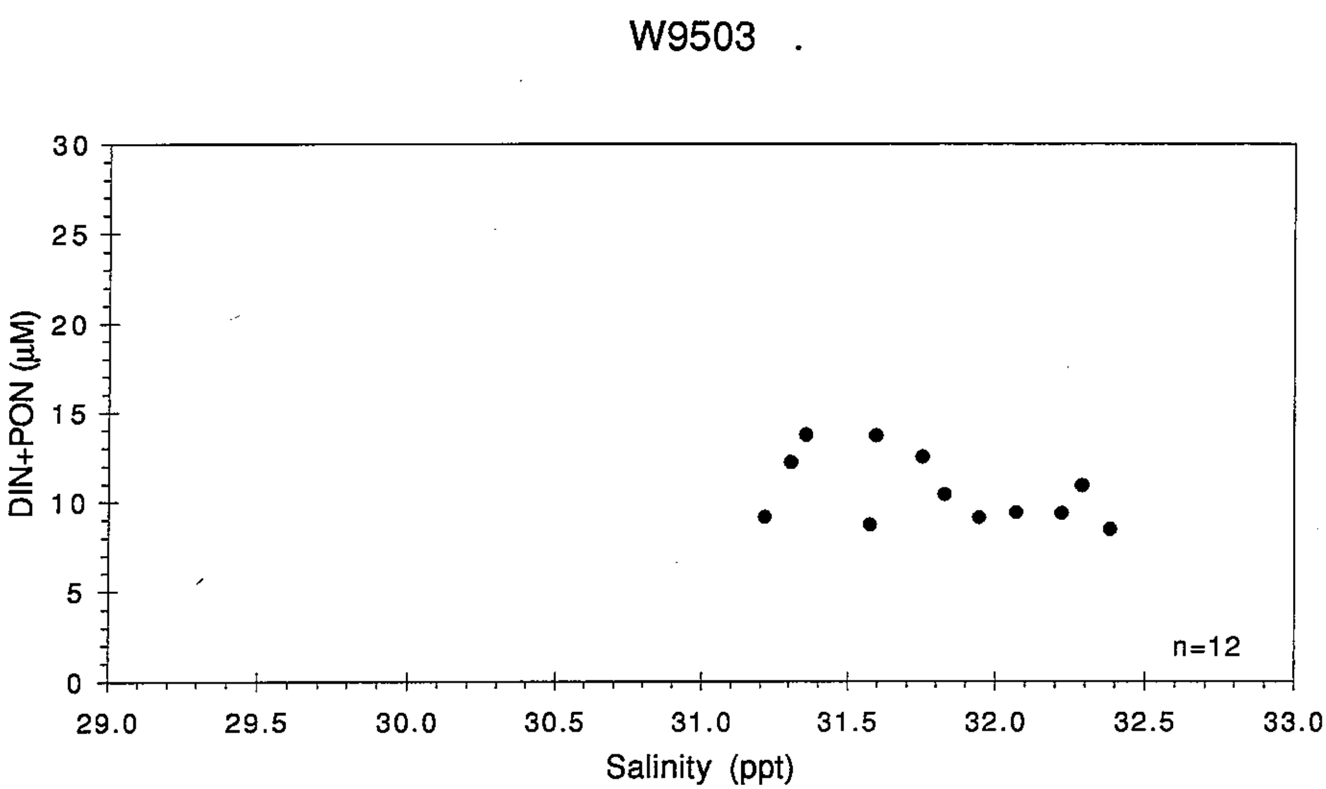

W9501 .
TN (µM)
Salinity (ppt)
90
80
70
60
50
40
30
20
10
0
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0


W9501 .
DIN+PON (µM)
Salinity (ppt)
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
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

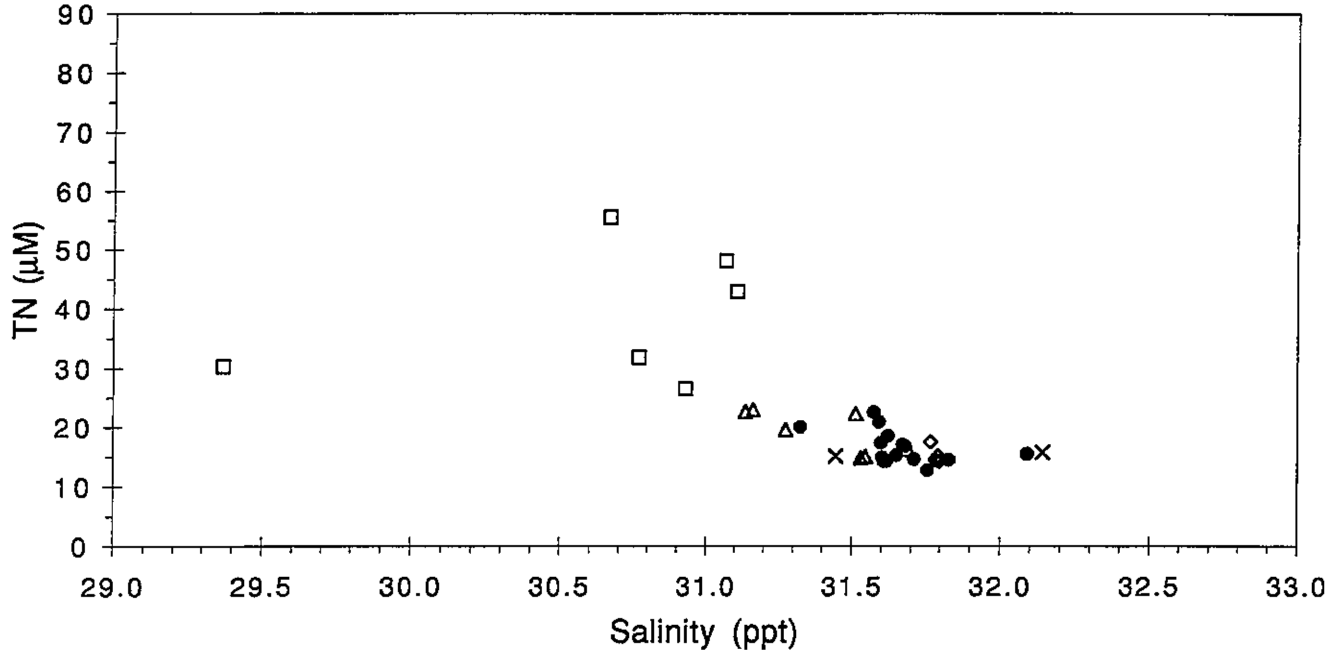

W9502 .
TN (μM)
0
10
20
30
40
50
60
70
80
90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)


W9502 .
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)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF


W9503
TN (μM)
n=11
Salinity (ppt)
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

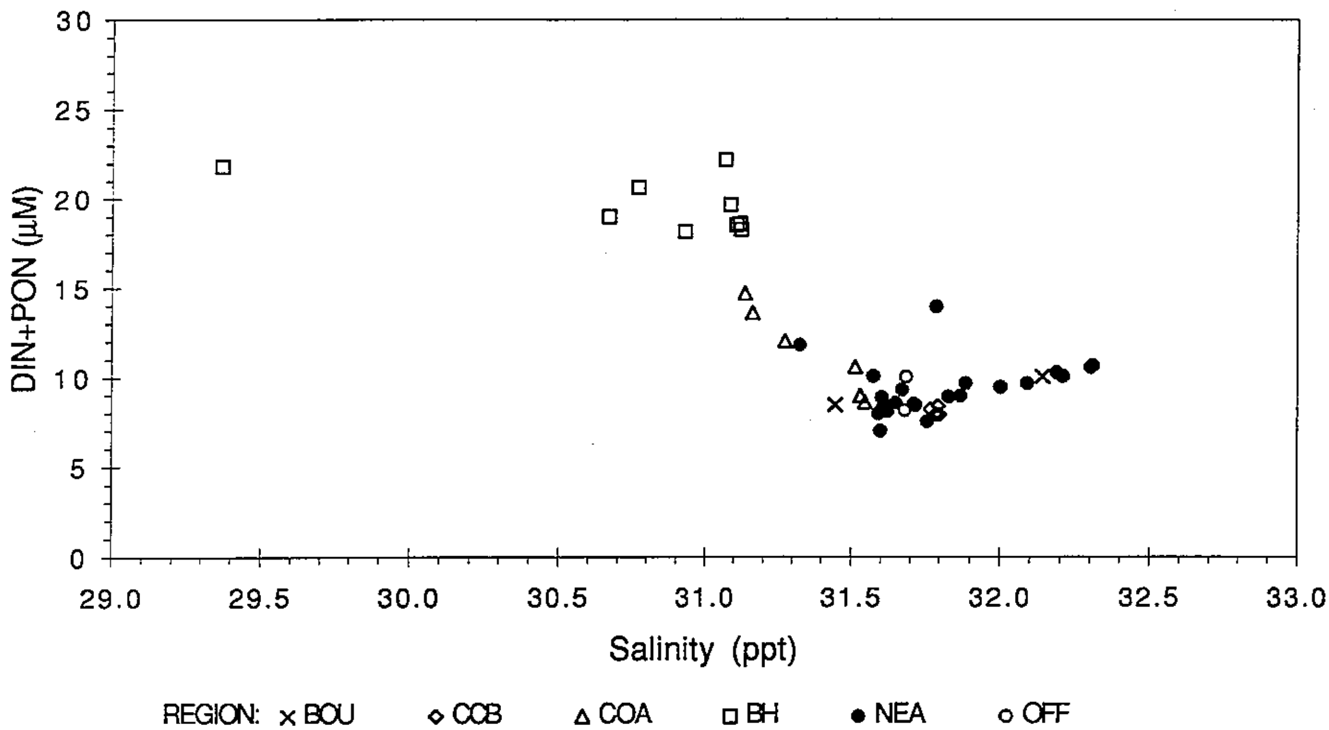

W9503
DIN+PON (μM)
n=12
Salinity (ppt)
0
5
10
15
20
25
30
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0

W9504 .

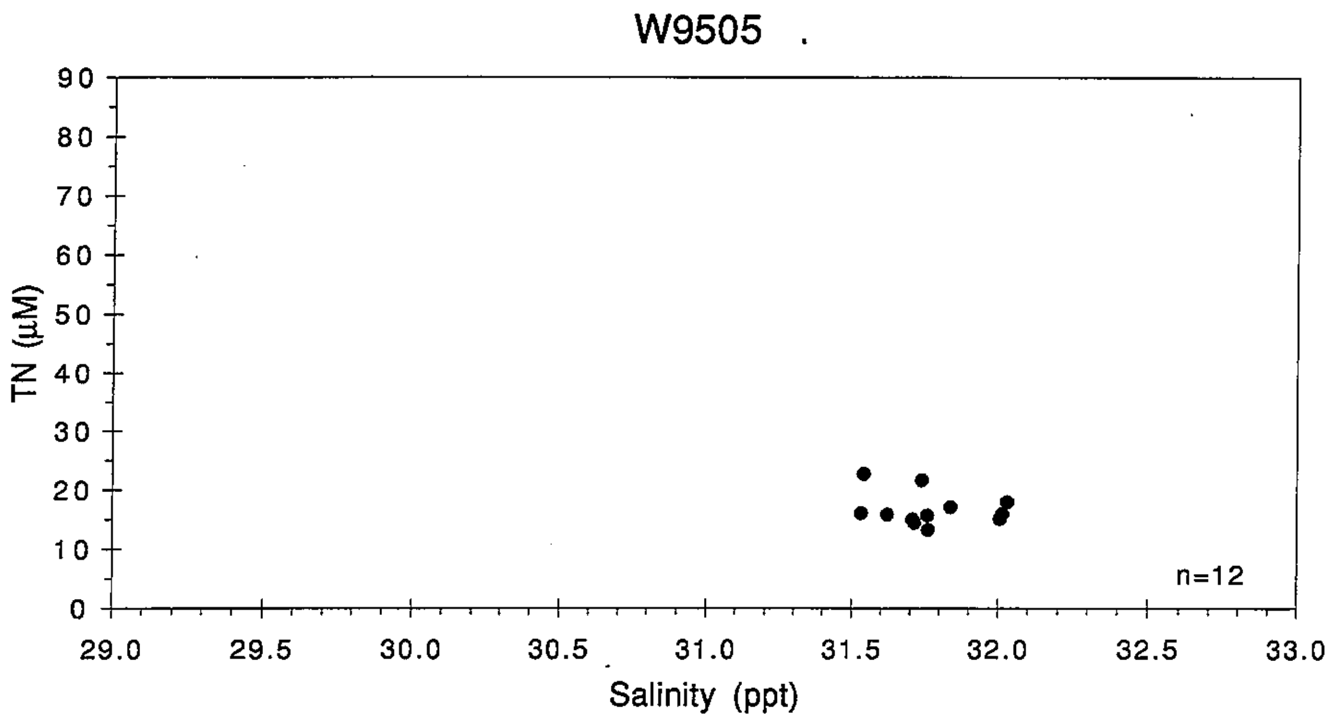


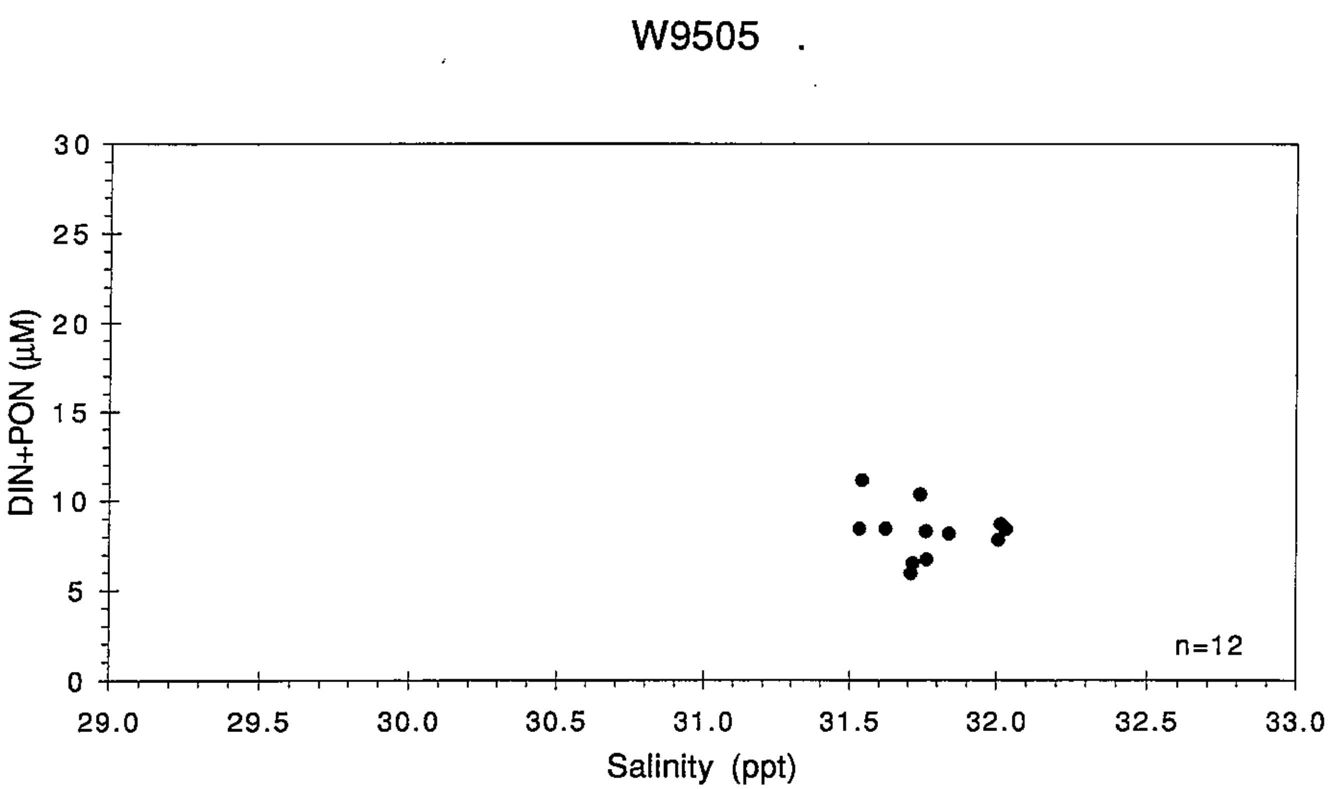
TN (µM)
0
10
20
30
40
50
60
70
80
90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

W9504 .

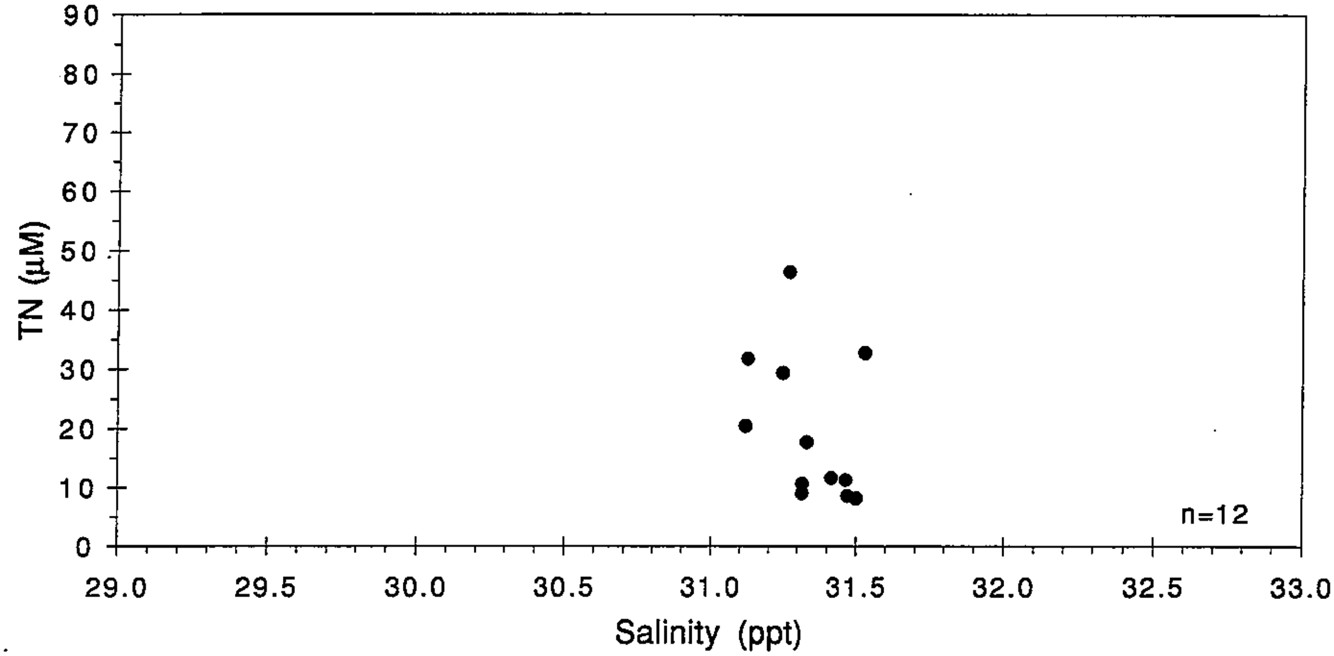


DIN+PON (µM)
0
5
10
15
20
25
30
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

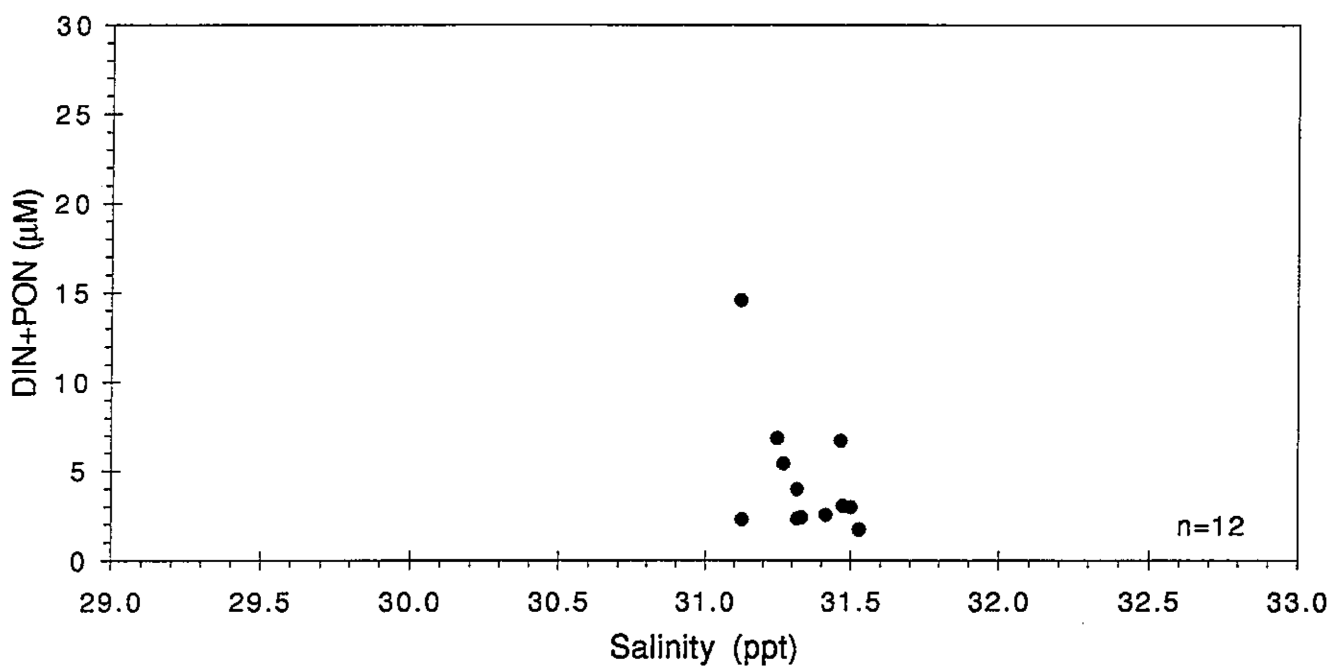

W9505
TN (µM)
90
80
70
60
50
40
30
20
10
0
n=12
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

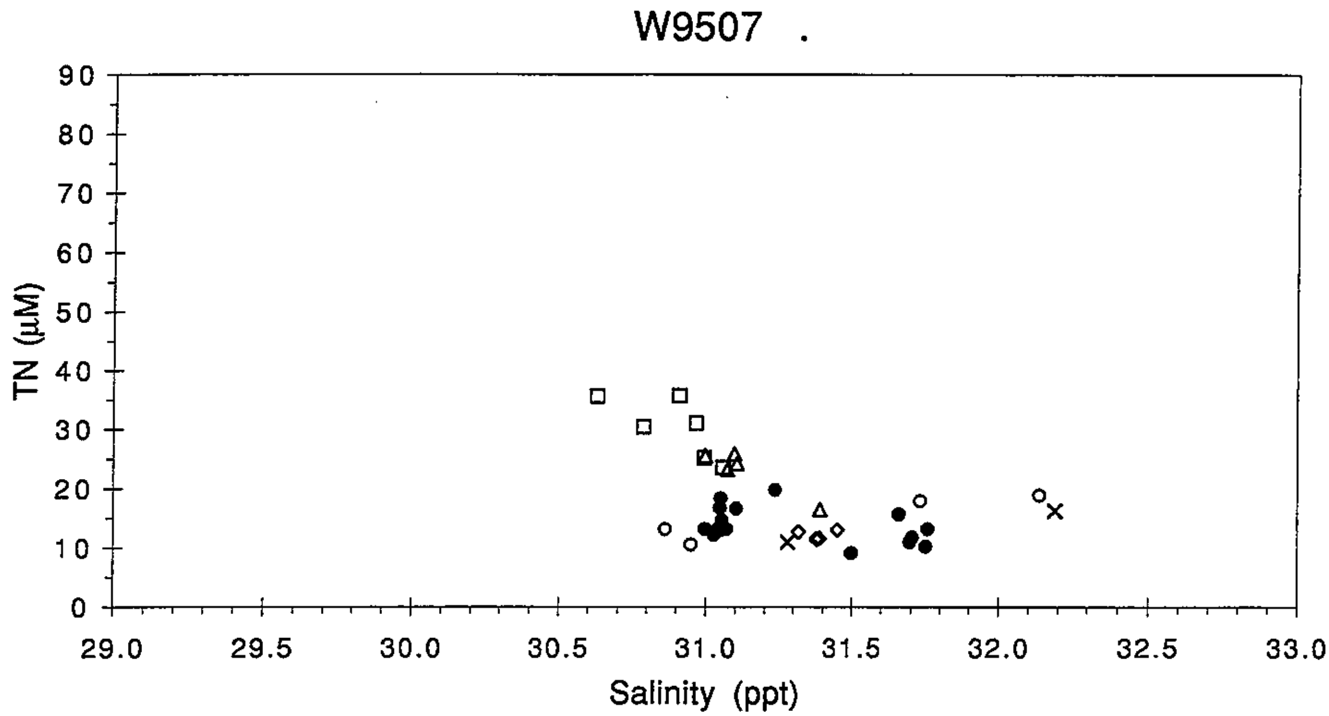

W9505
DIN+PON (µM)
30
25
20
15
10
5
0
n=12
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

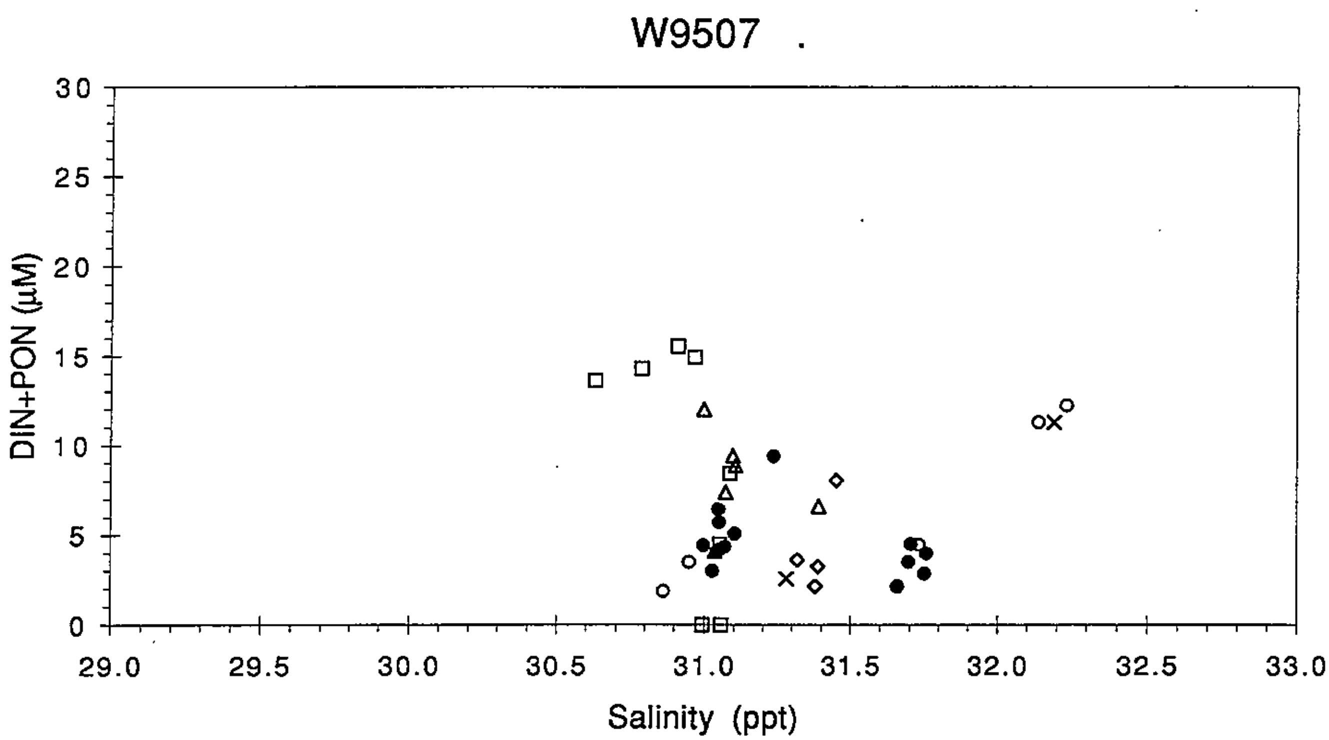
W9506 .


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

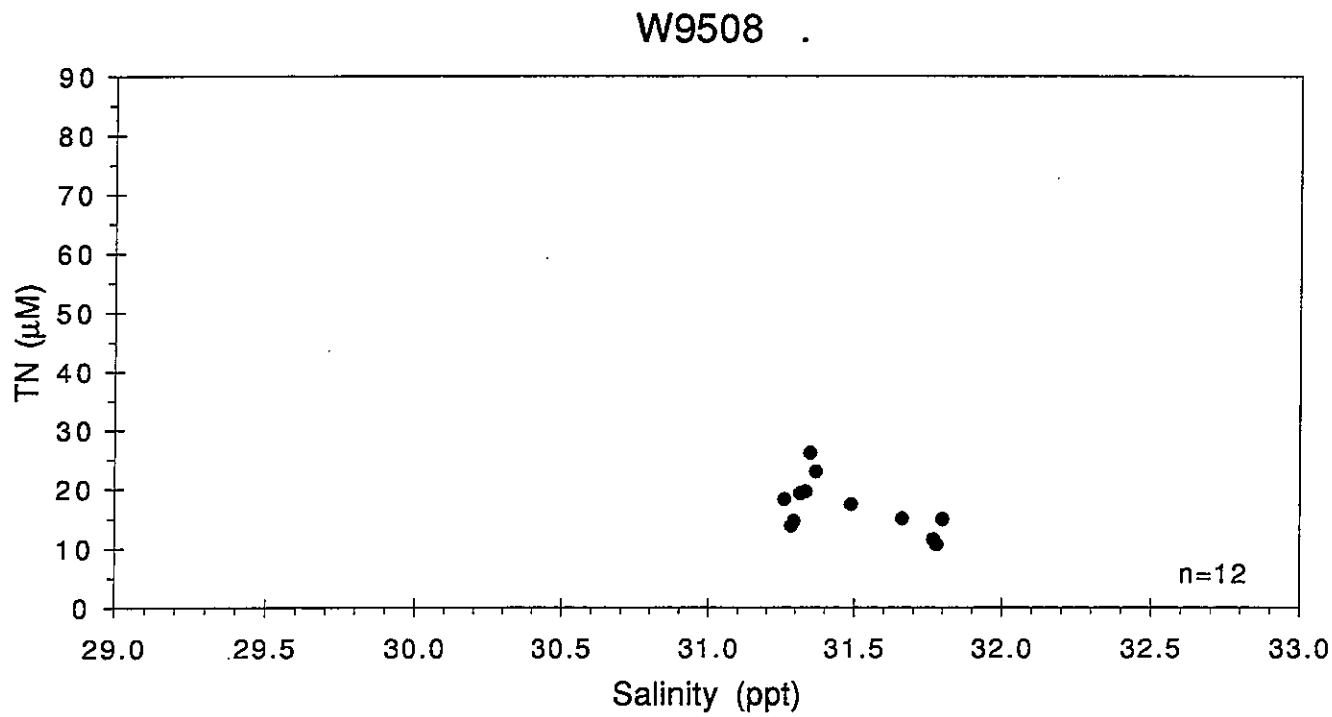
W9506 .

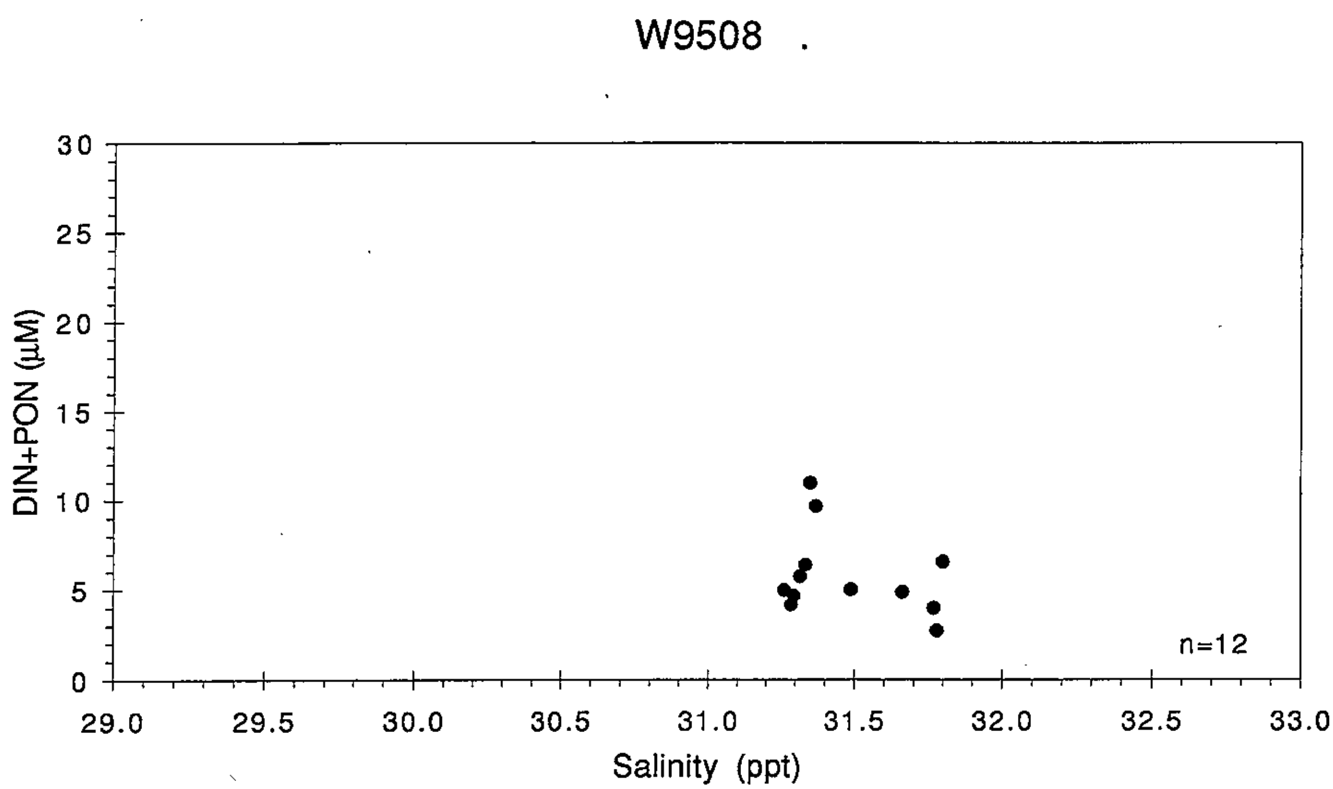

30
25
20
15
10
5
0
DIN+PON (µM)
n=12
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)

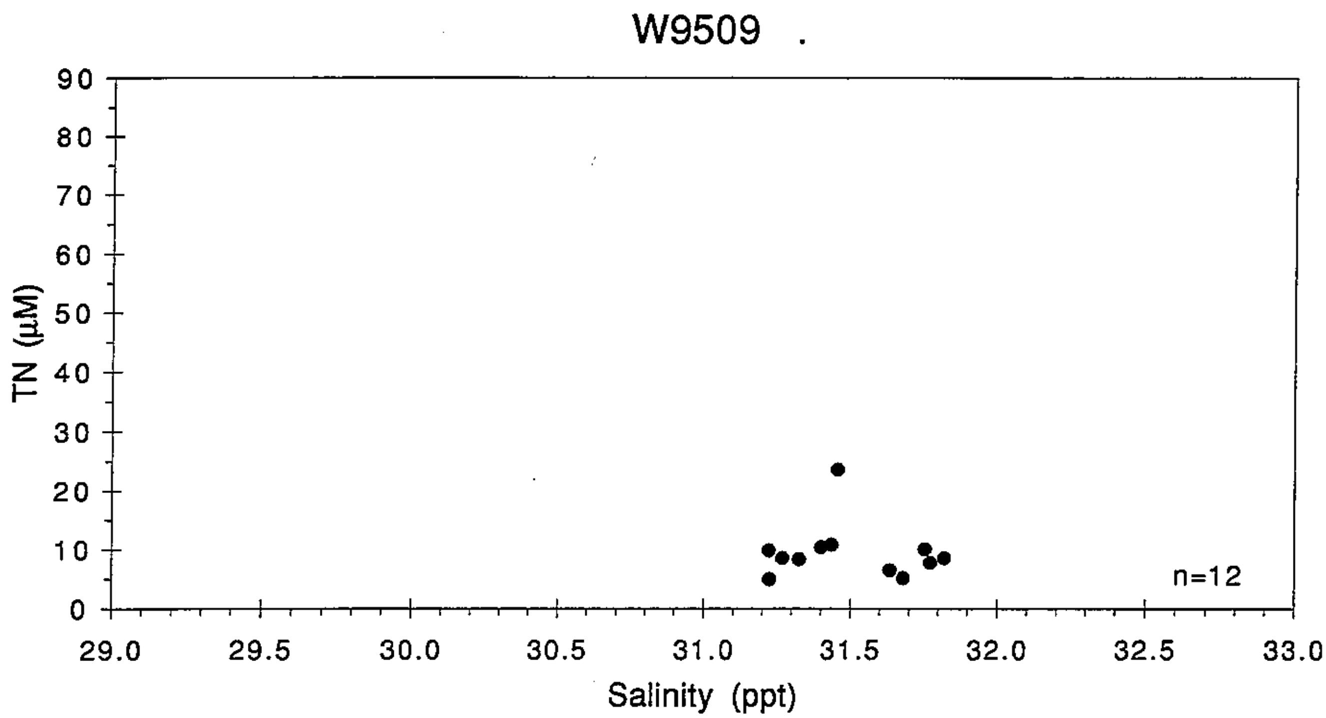


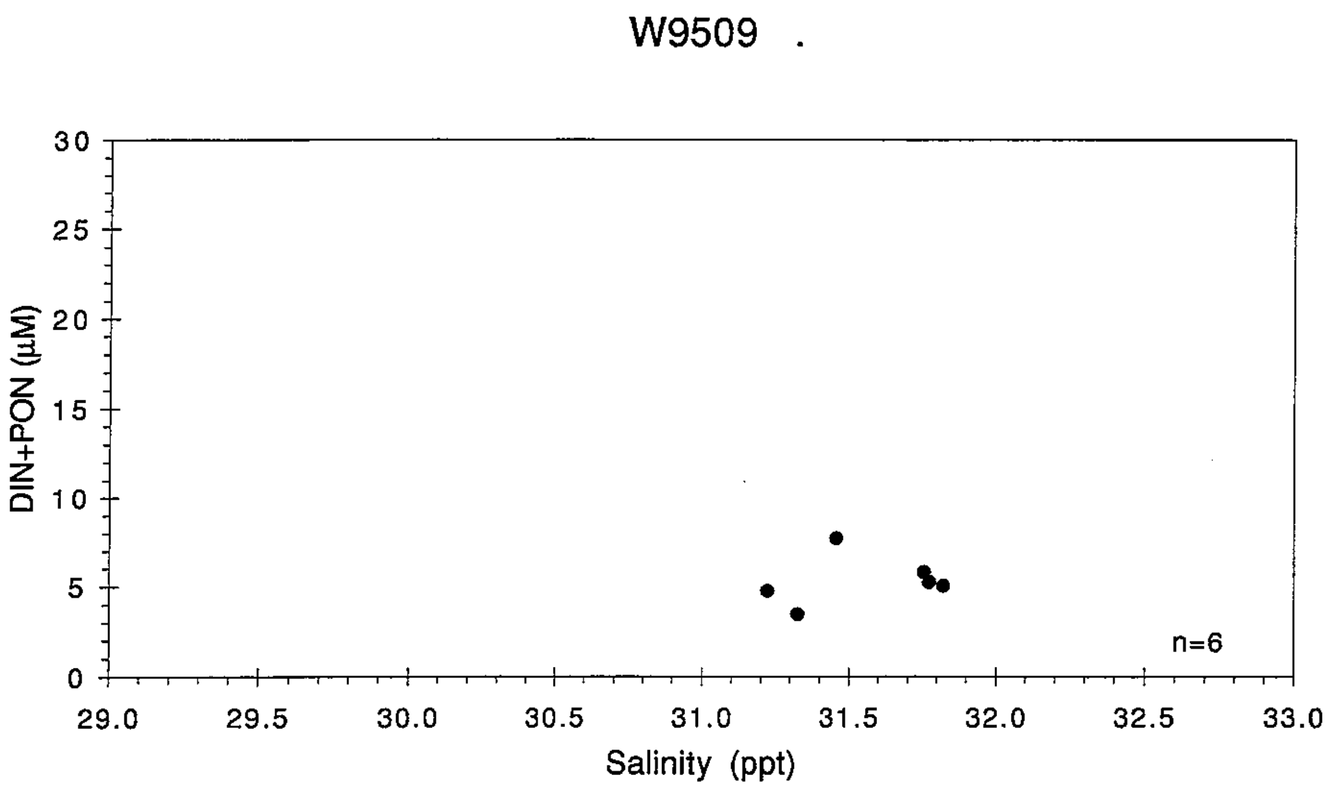


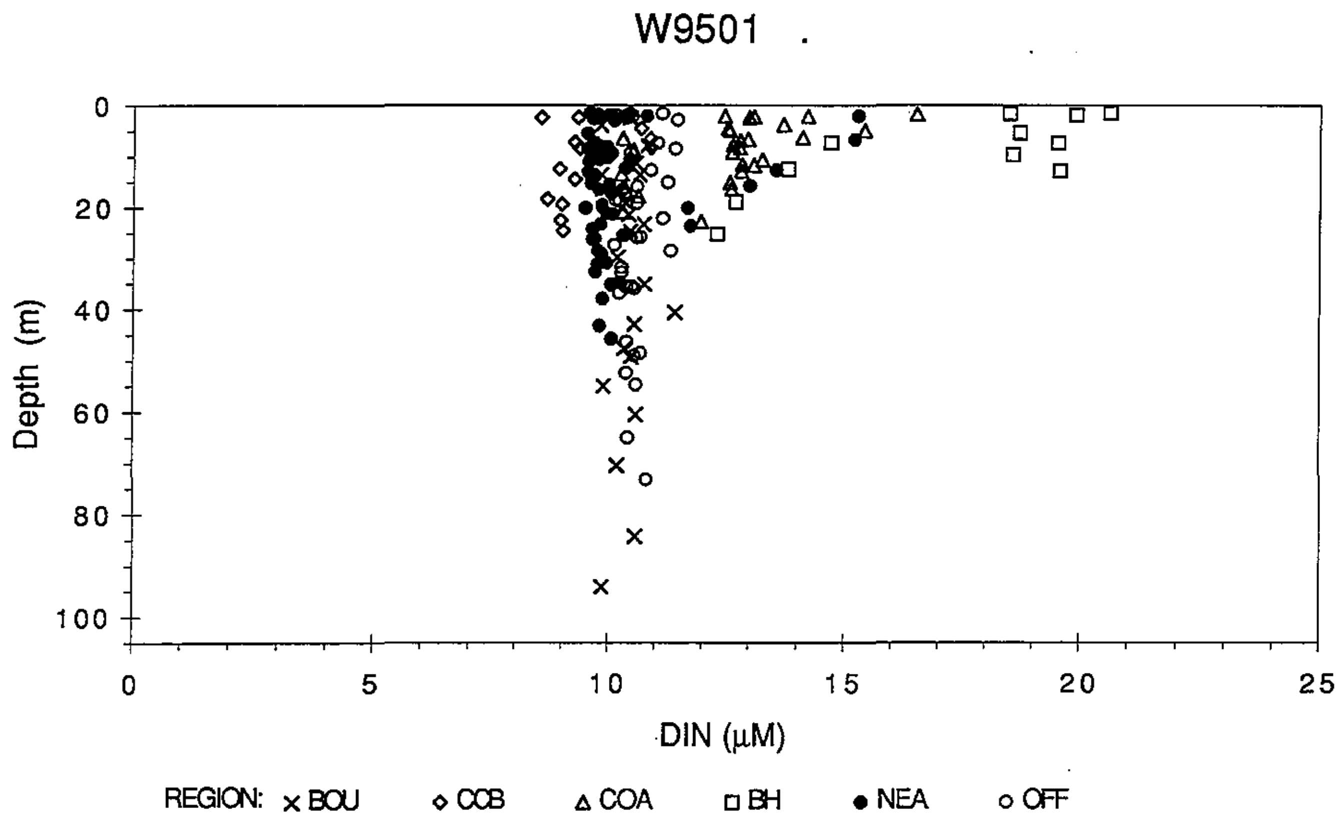
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

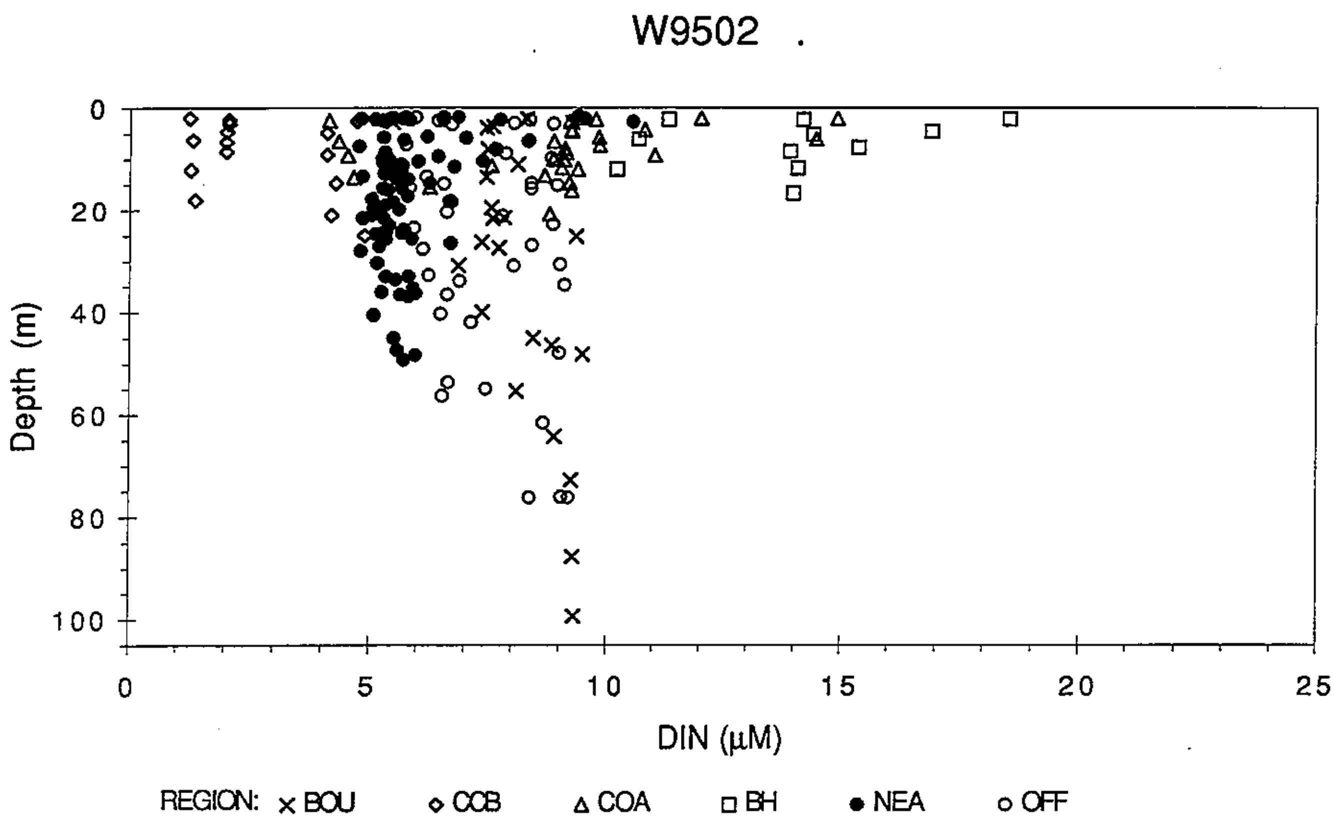

W9508
TN (µM)
0
10
20
30
40
50
60
70
80
90
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=12


W9508
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


W9509 .
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

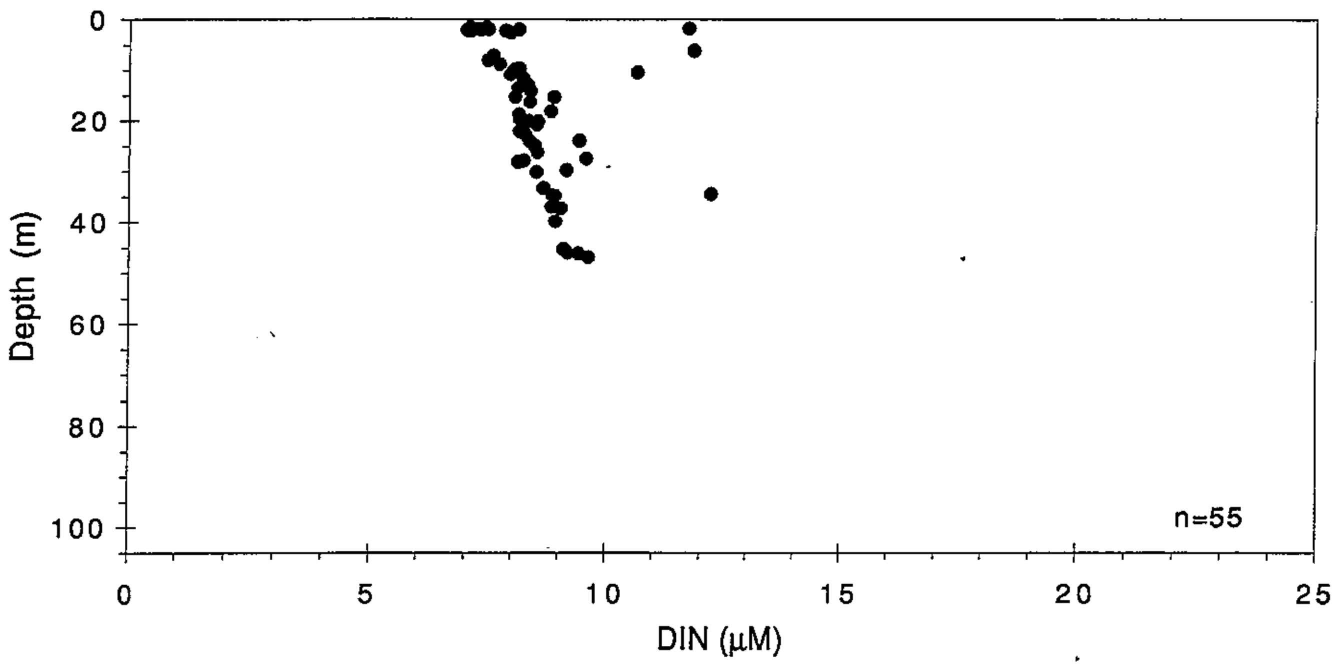

W9509 .
DIN+PON (µM)
30
25
20
15
10
5
0
29.0
29.5
30.0
30.5
31.0
31.5
32.0
32.5
33.0
Salinity (ppt)
n=6


W9501
Depth (m)
0
20
40
60
80
100
0
5
10
15
20
25
DIN (μM)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

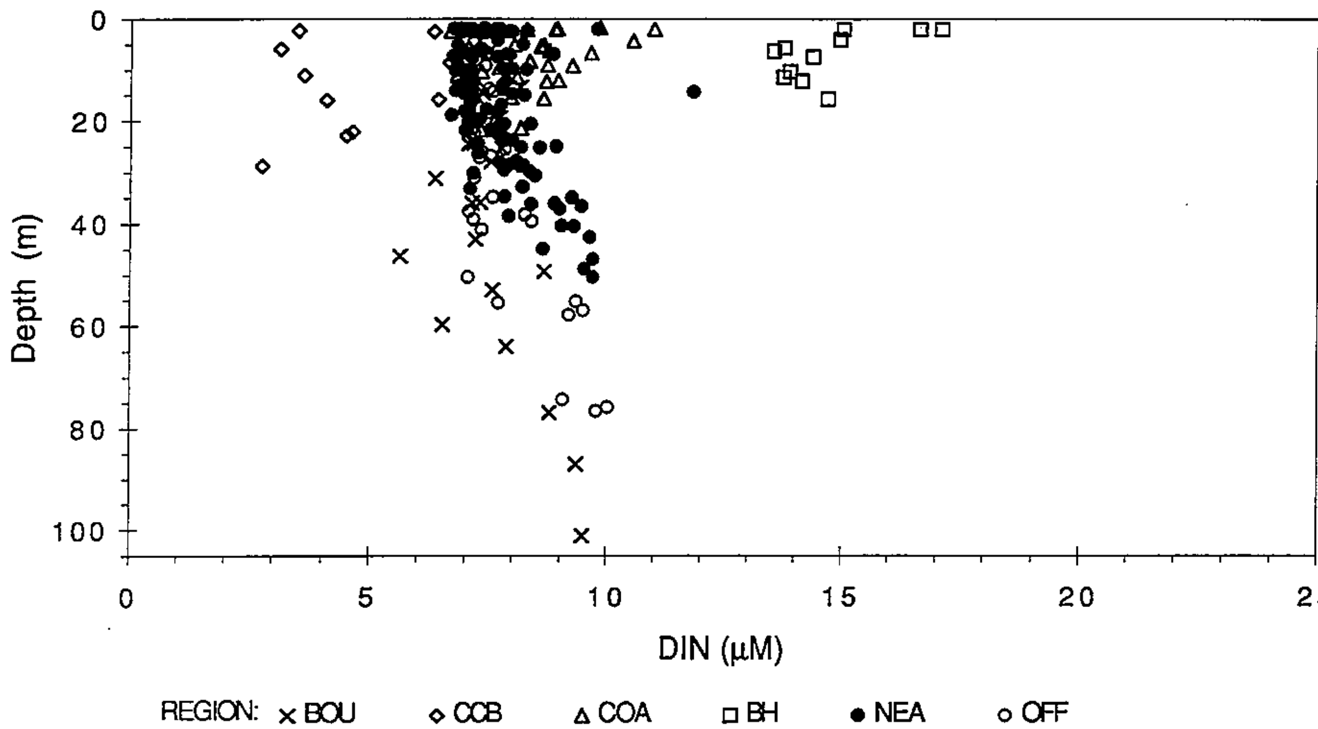


W9502
0
20
40
60
80
100
Depth (m)
0
5
10
15
20
25
DIN (µM)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

W9503

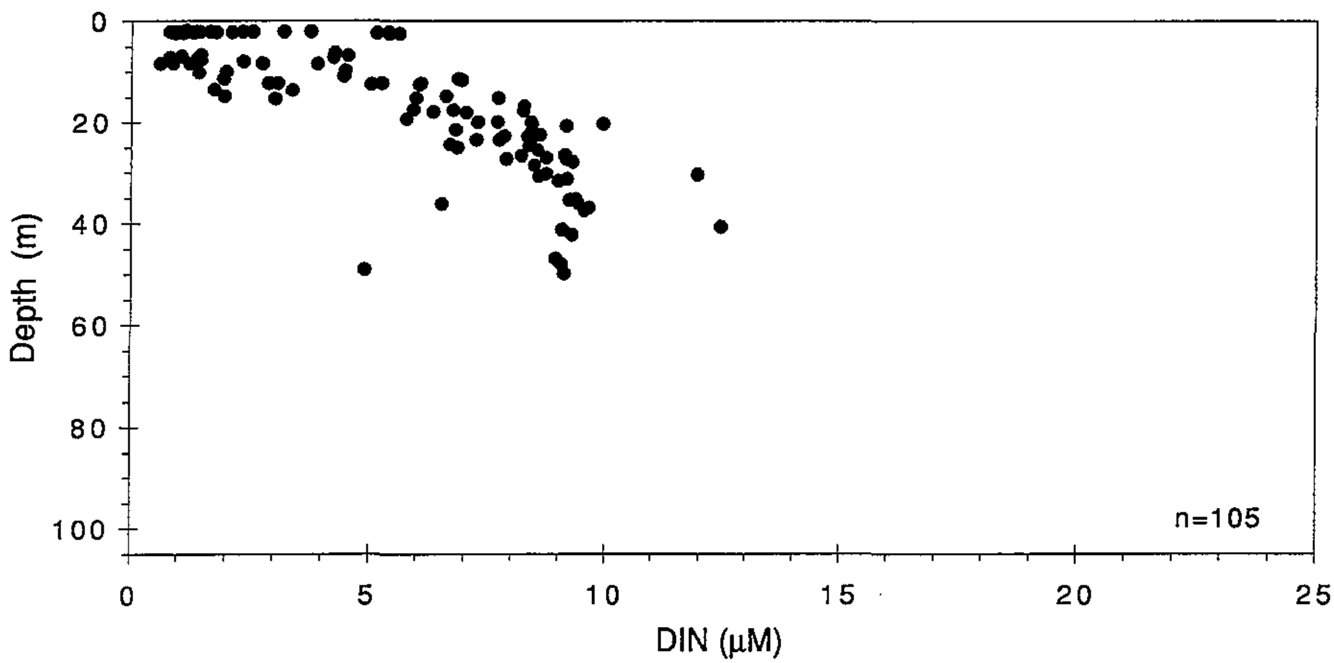


W9504

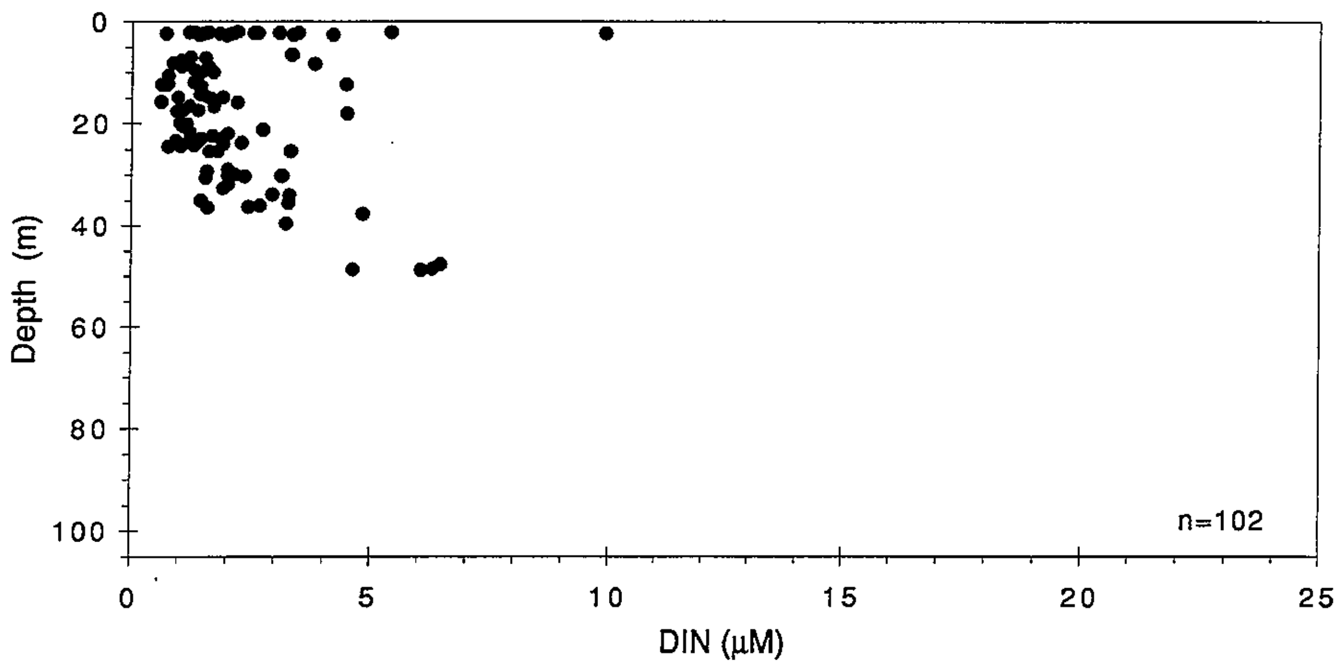


0
20
40
60
80
100
Depth (m)
0
5
10
15
20
25
DIN (μM)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

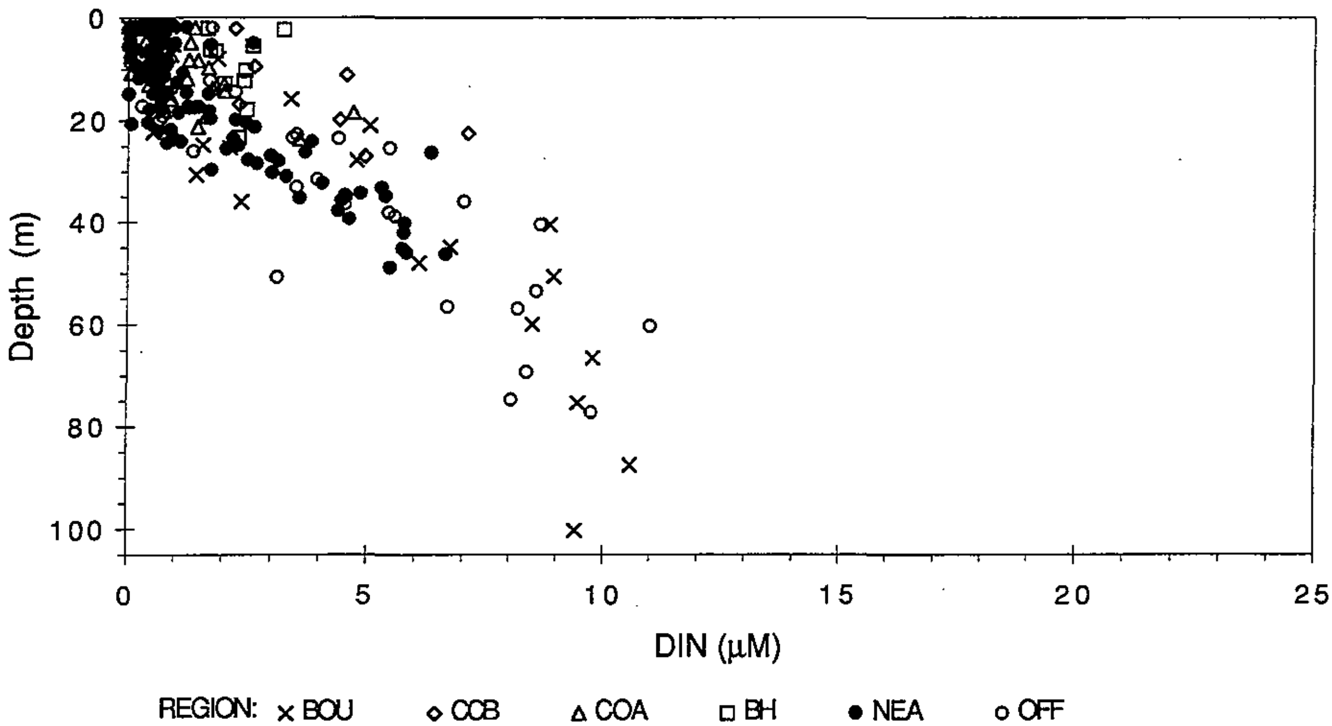
W9505



W9506

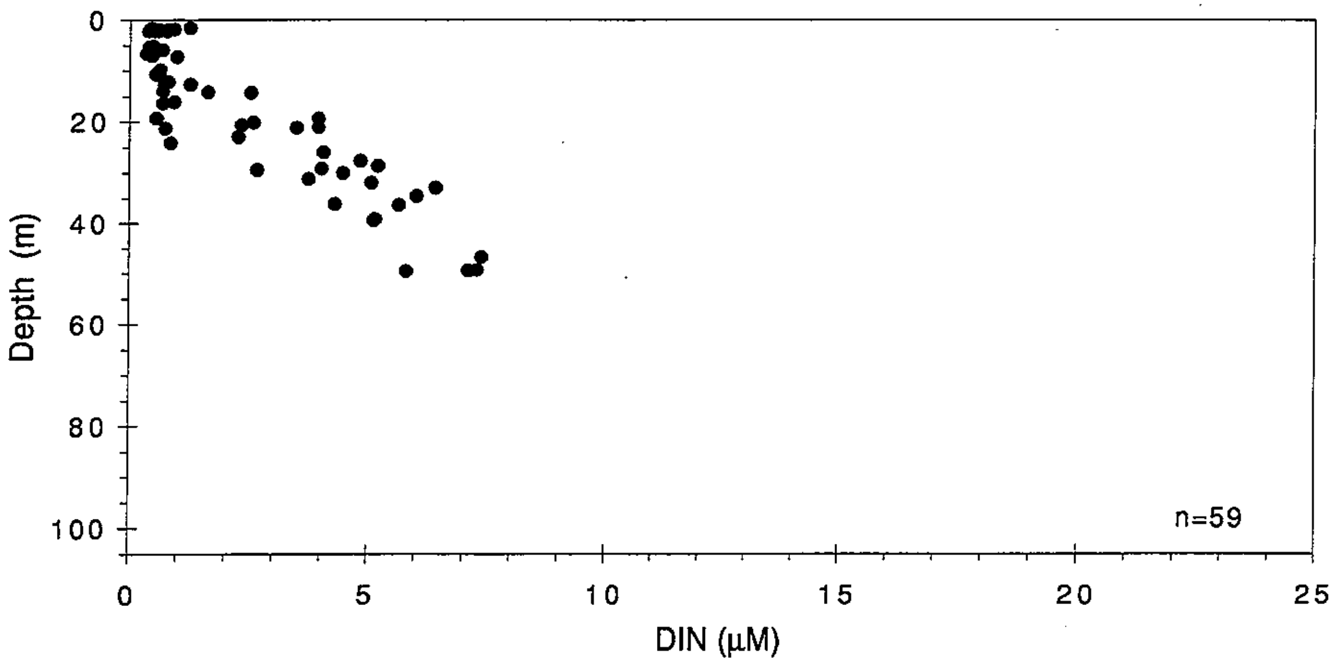


W9507

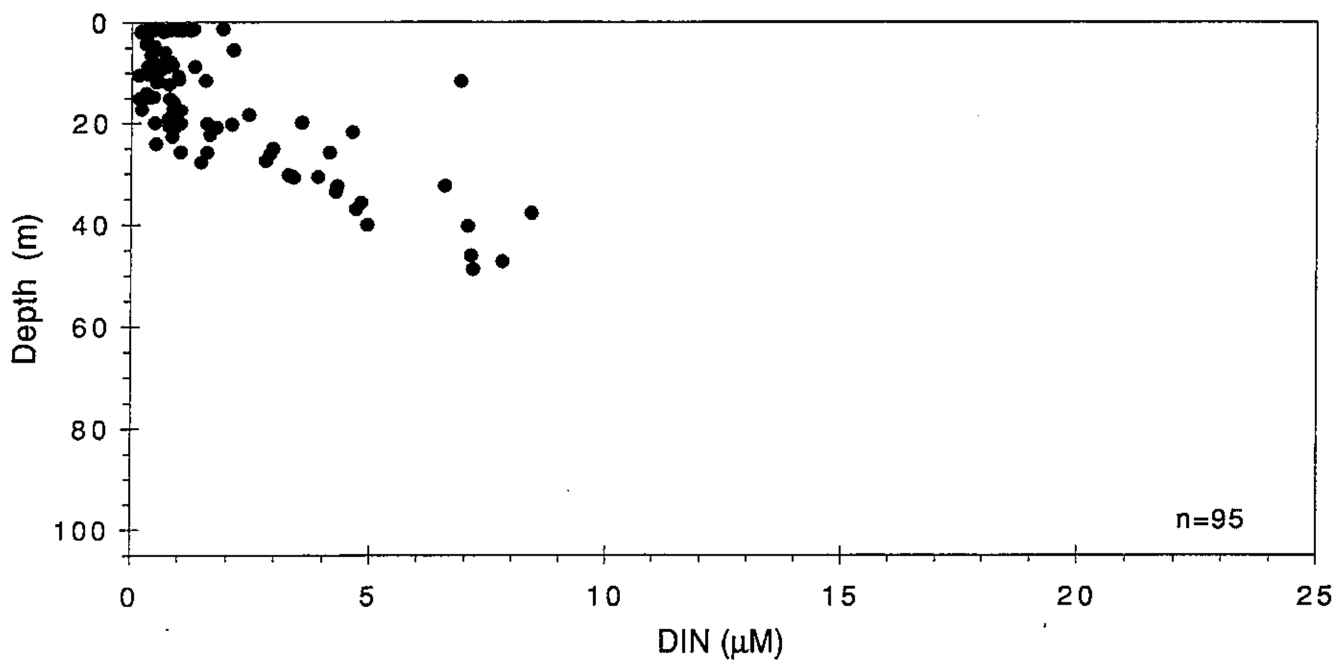


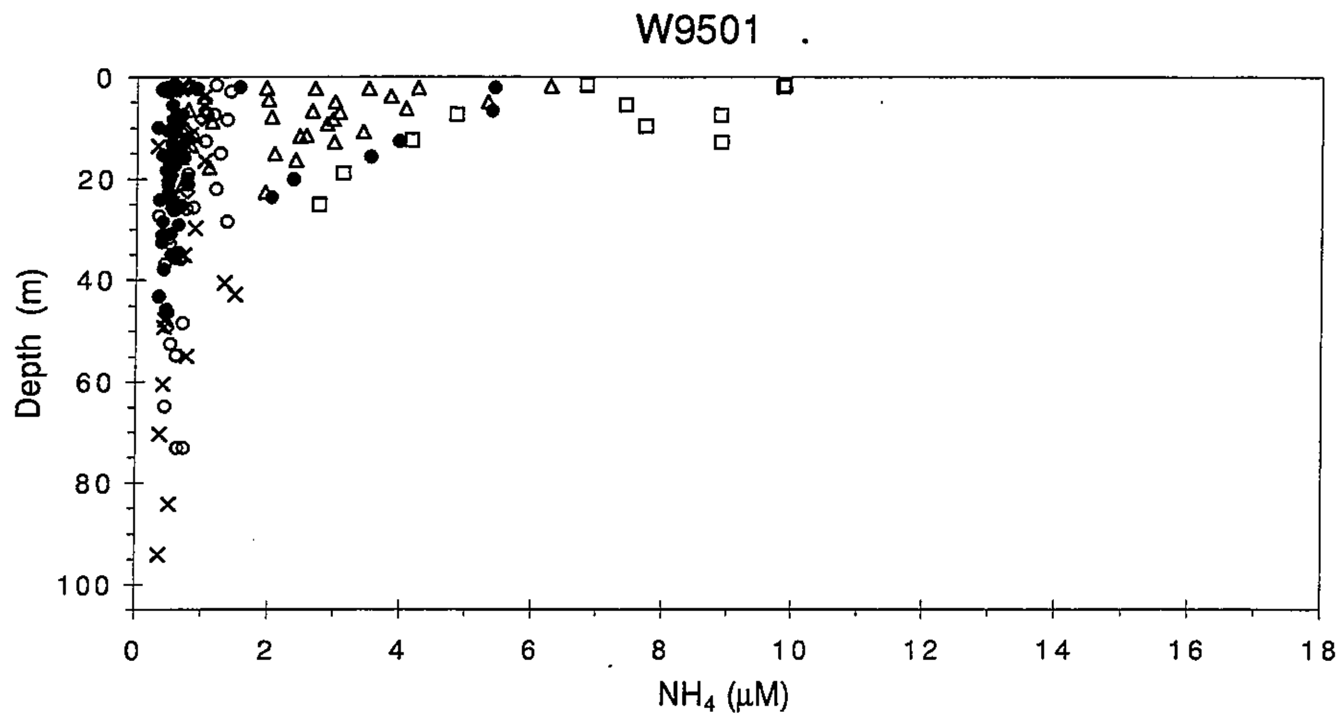
0
20
40
60
80
100
Depth (m)
0
5
10
15
20
25
DIN (µM)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

W9508

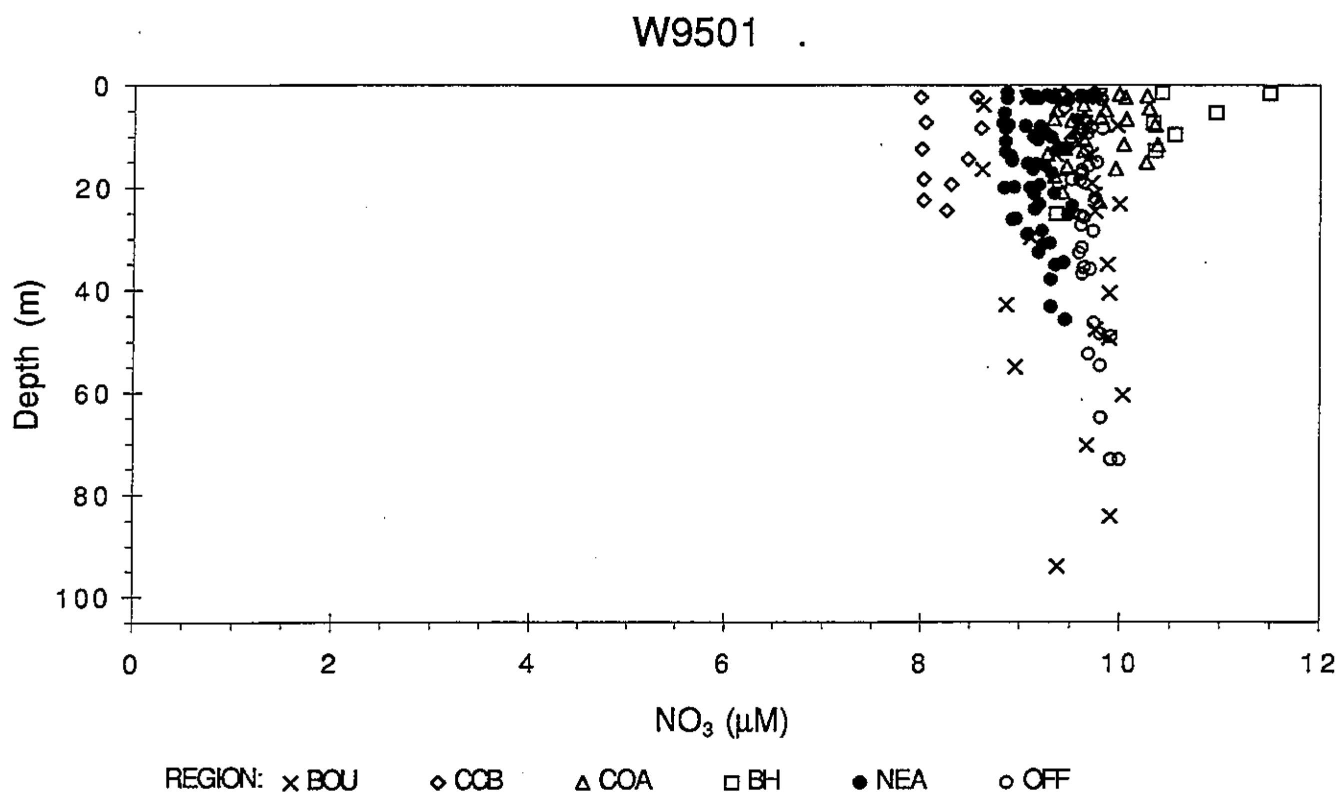


W9509 .

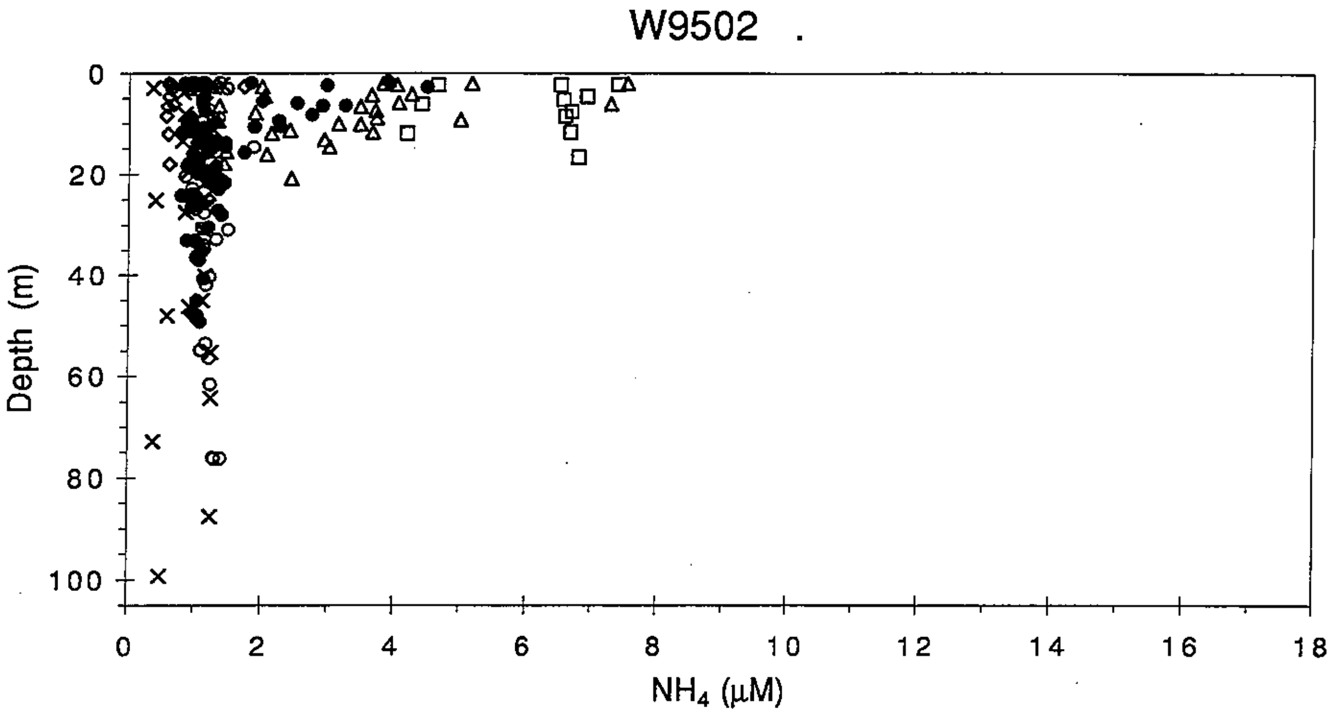


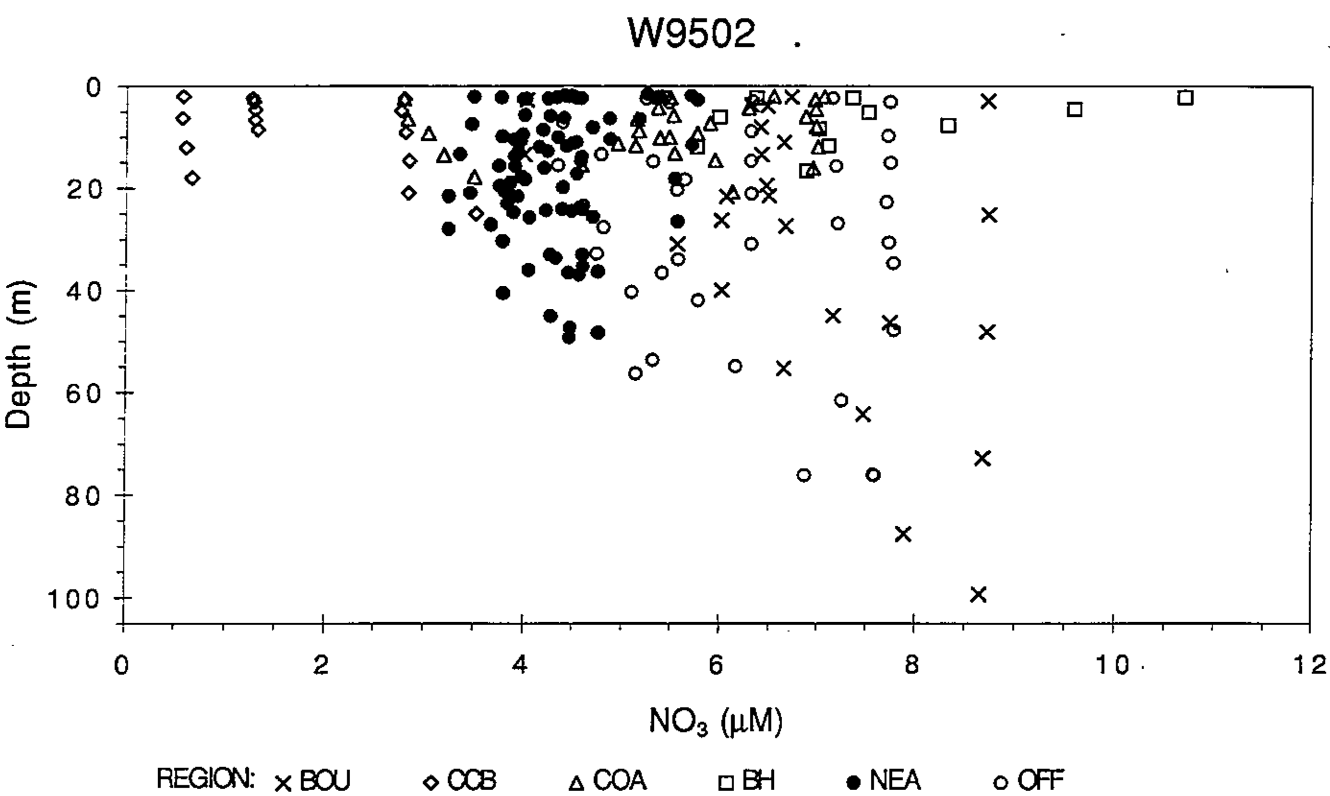


W9501
Depth (m)
0
20
40
60
80
100
0
2
4
6
8
10
12
14
16
18
NH4 (µM)

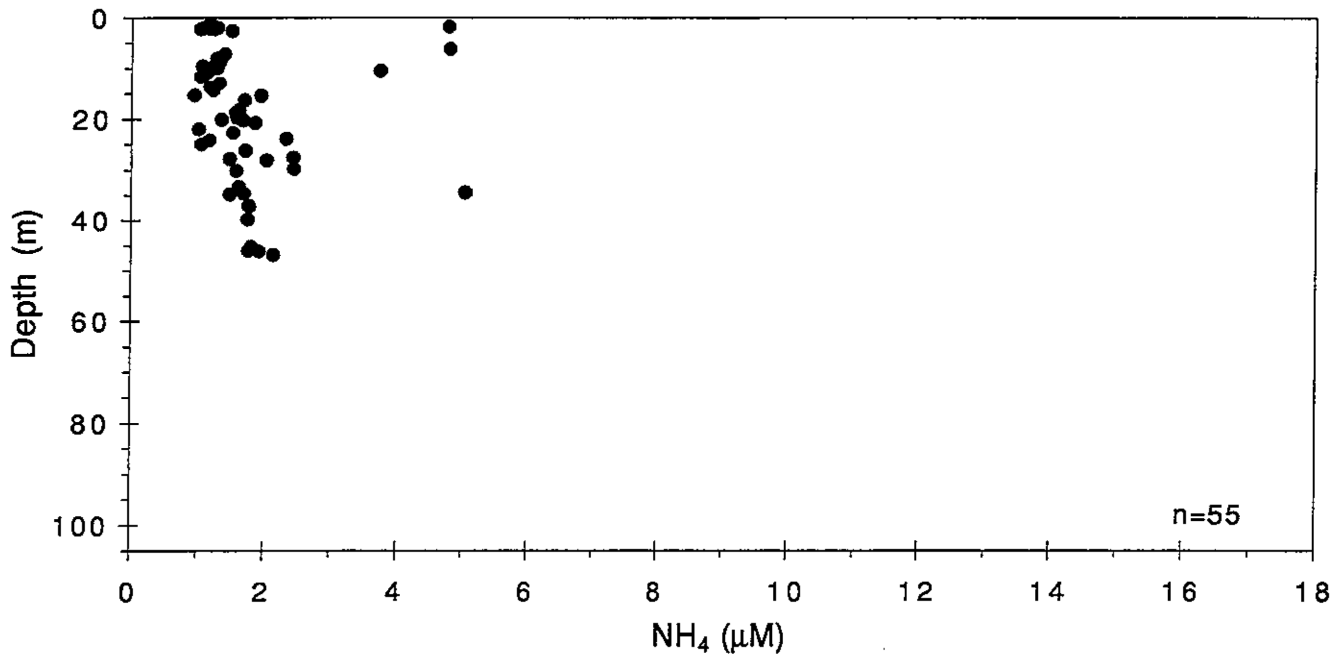


W9501
Depth (m)
0
20
40
60
80
100
0
2
4
6
8
10
12
NO3 (µM)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF


W9502 .
Depth (m)
NH4 (µM)
0
20
40
60
80
100
0
2
4
6
8
10
12
14
16
18

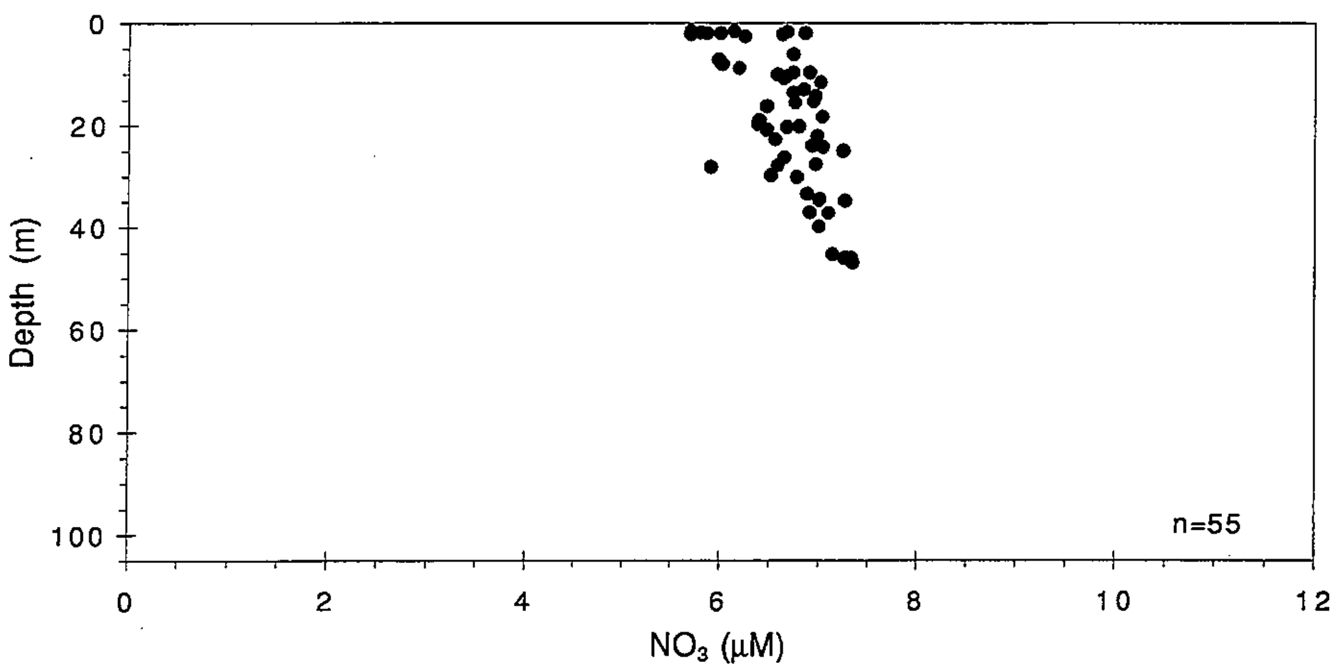

W9502 .
Depth (m)
NO3 (µM)
0
20
40
60
80
100
0
2
4
6
8
10
12
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

W9503 .

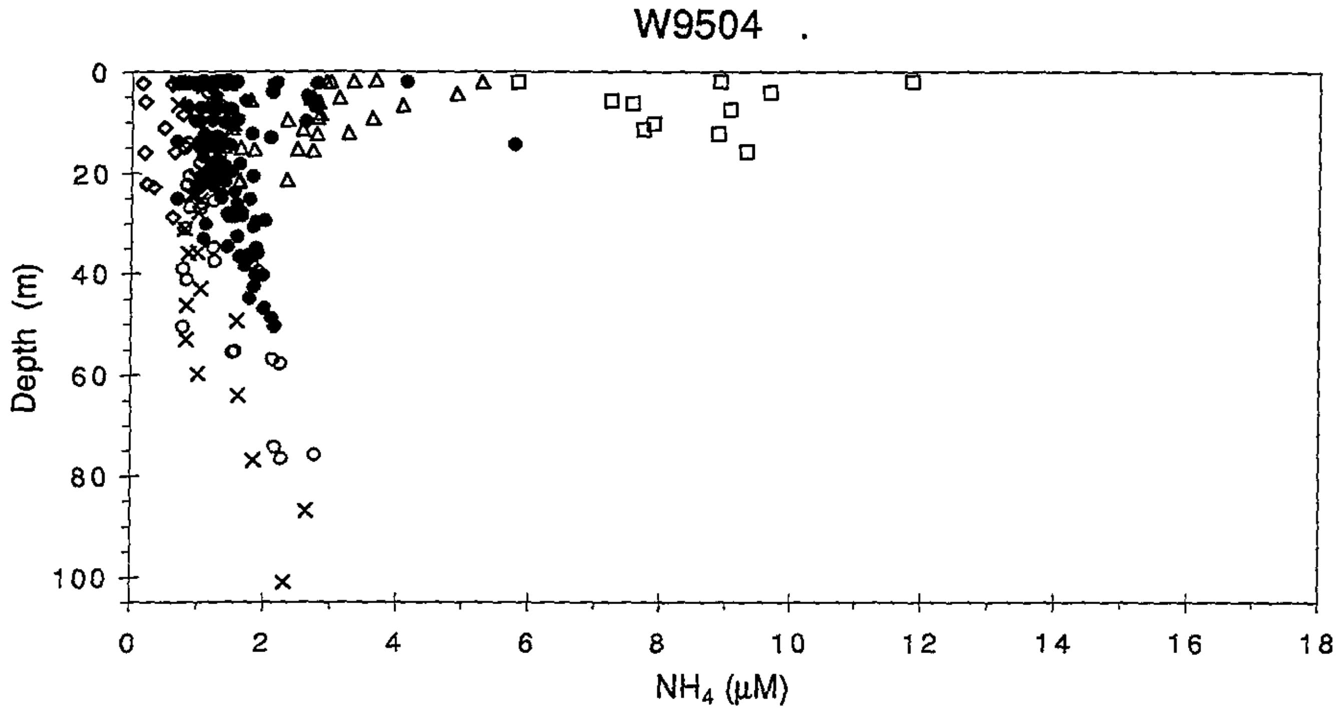


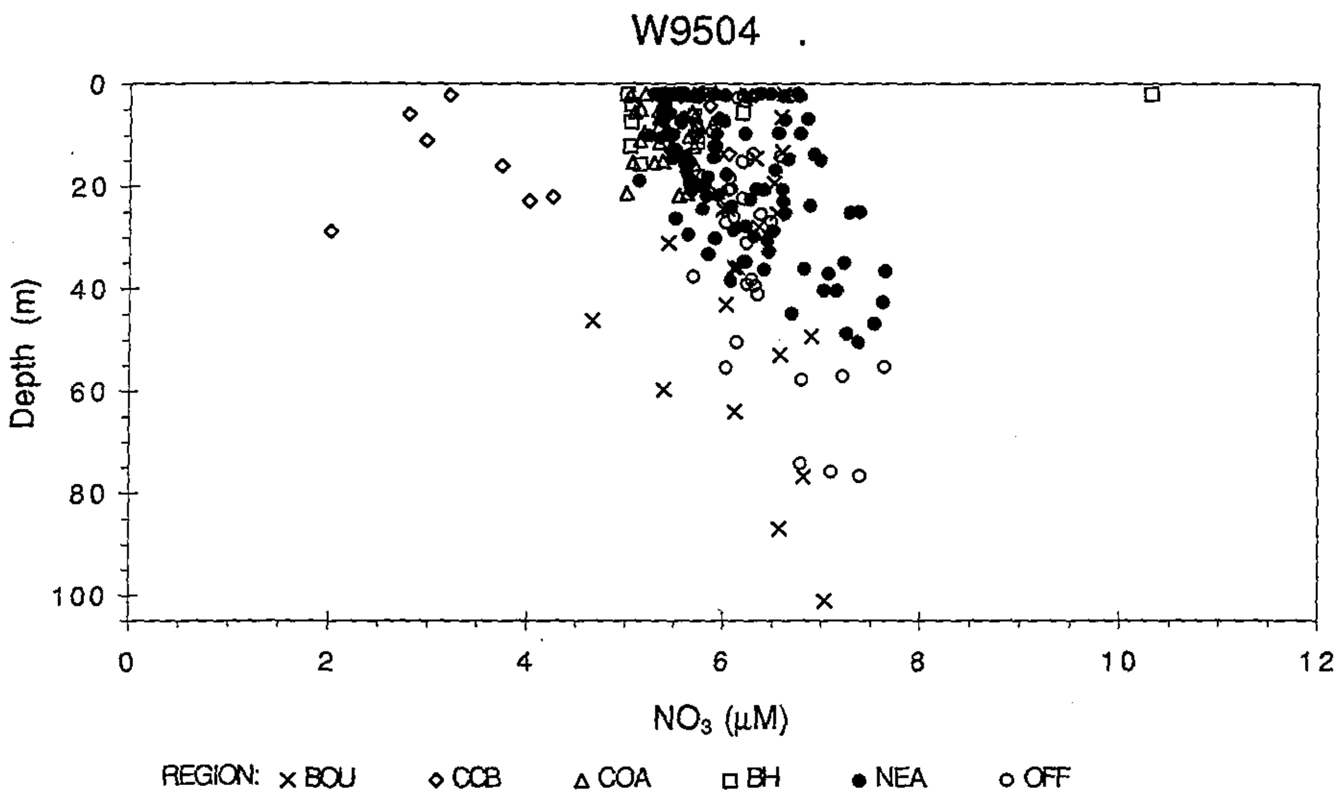
Depth (m)
0
20
40
60
80
100
n=55
0
2
4
6
8
10
12
14
16
18
NH4 (µM)

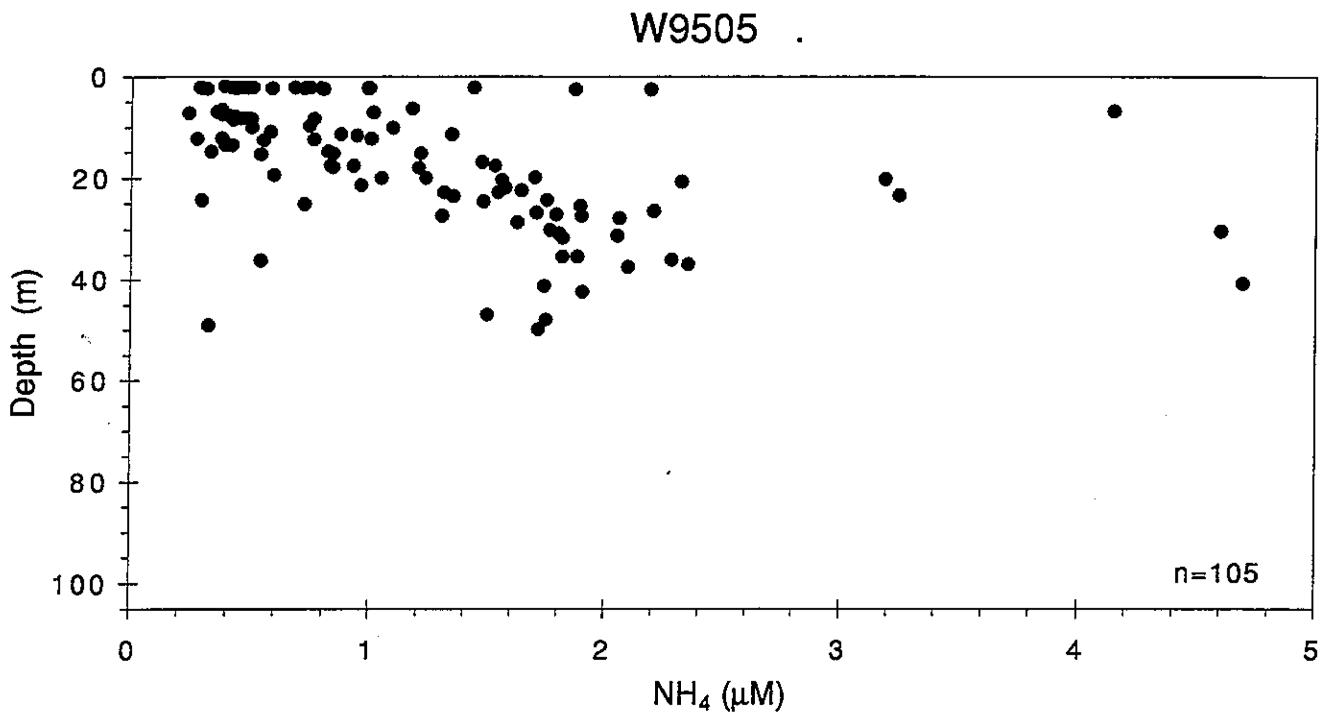
W9503 .

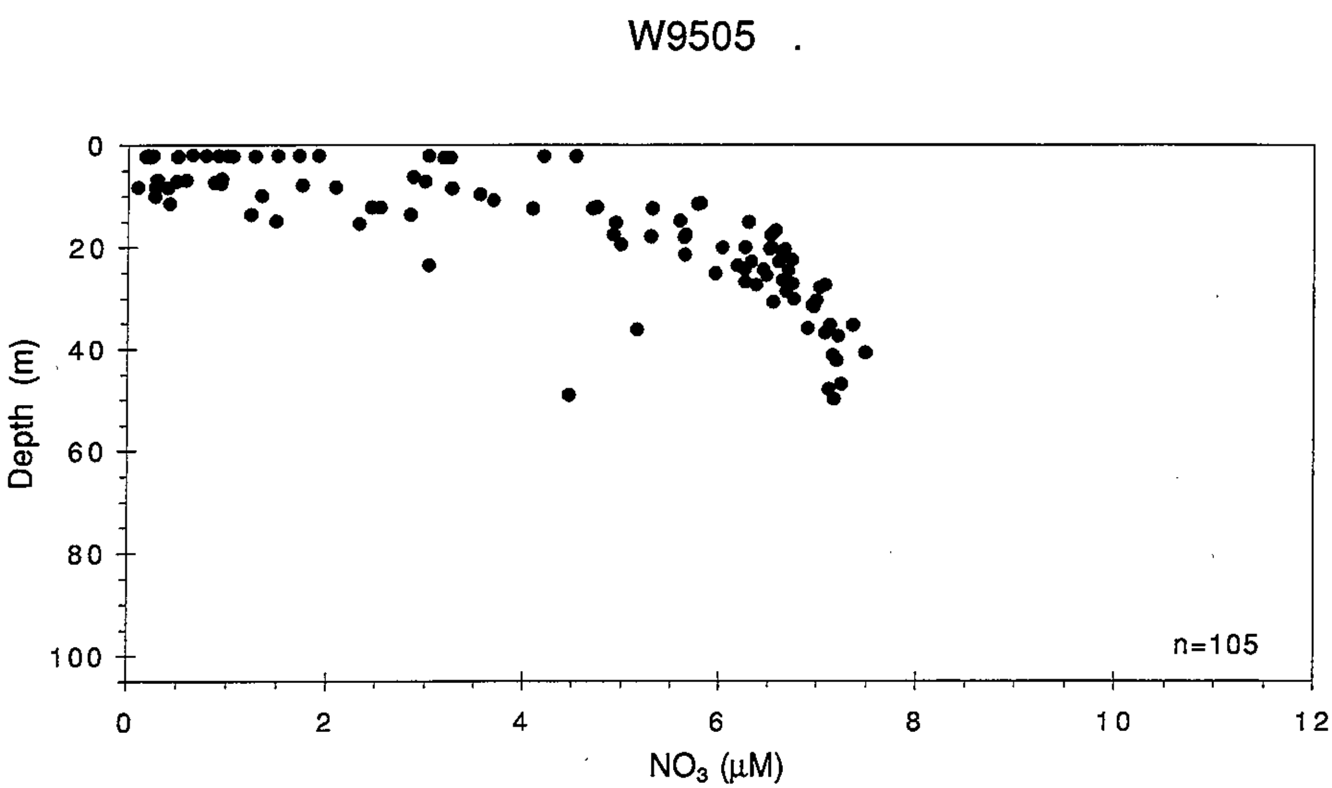


Depth (m)
0
20
40
60
80
100
n=55
0
2
4
6
8
10
12
NO3 (µM)

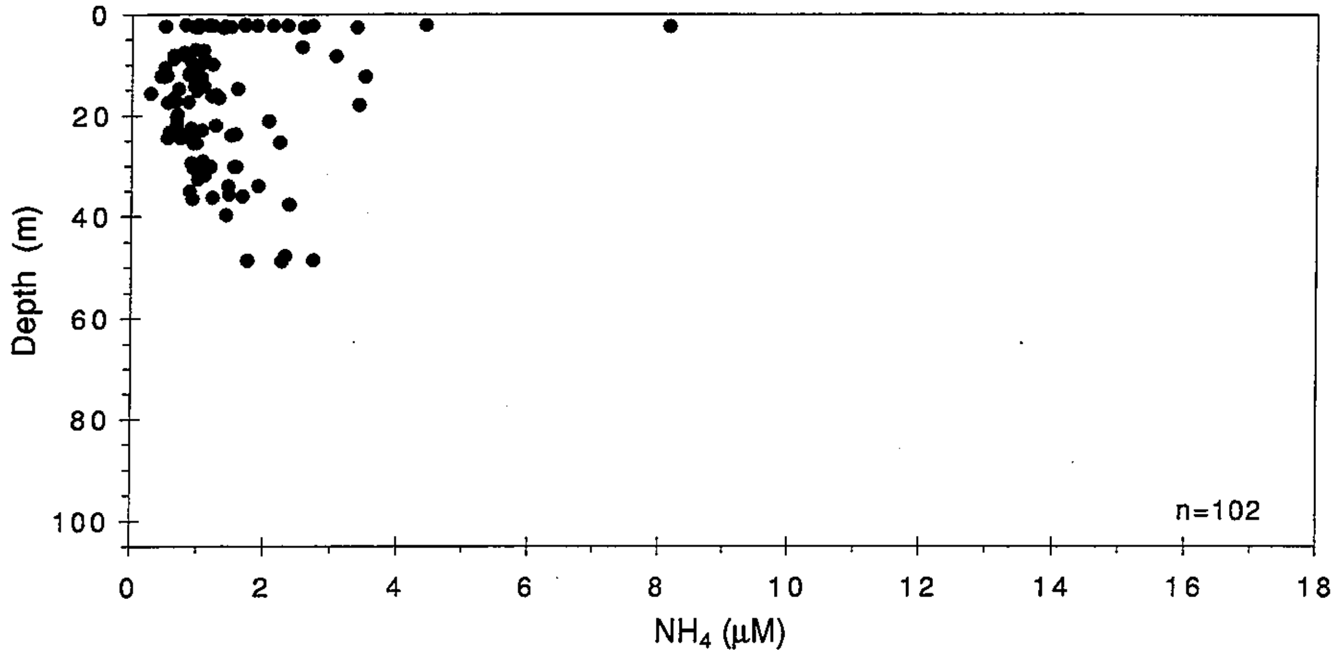

W9504
Depth (m)
0
20
40
60
80
100
0
2
4
6
8
10
12
14
16
18
NH4 (µM)


W9504
Depth (m)
0
20
40
60
80
100
0
2
4
6
8
10
12
NO3 (µM)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF


W9505 .
Depth (m)
0
20
40
60
80
100
n=105
0
1
2
3
4
5
NH4 (µM)

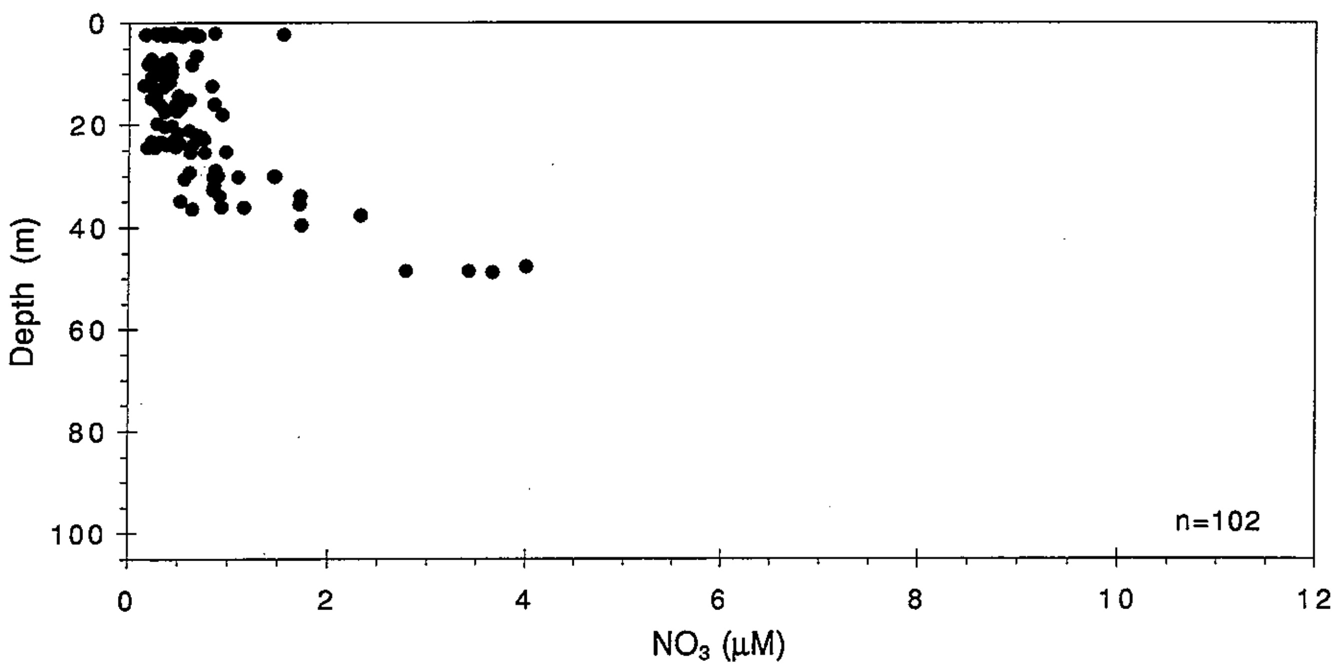

W9505 .
Depth (m)
0
20
40
60
80
100
n=105
0
2
4
6
8
10
12
NO3 (µM)

W9506 .

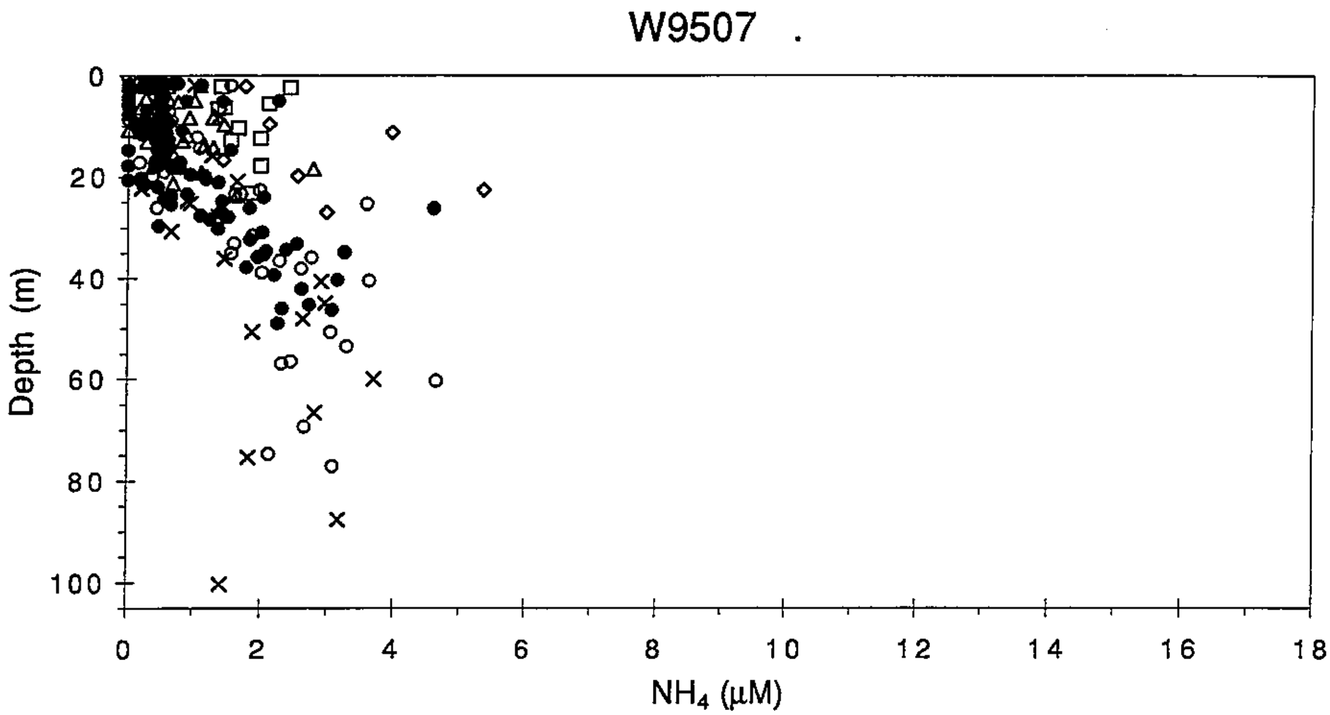


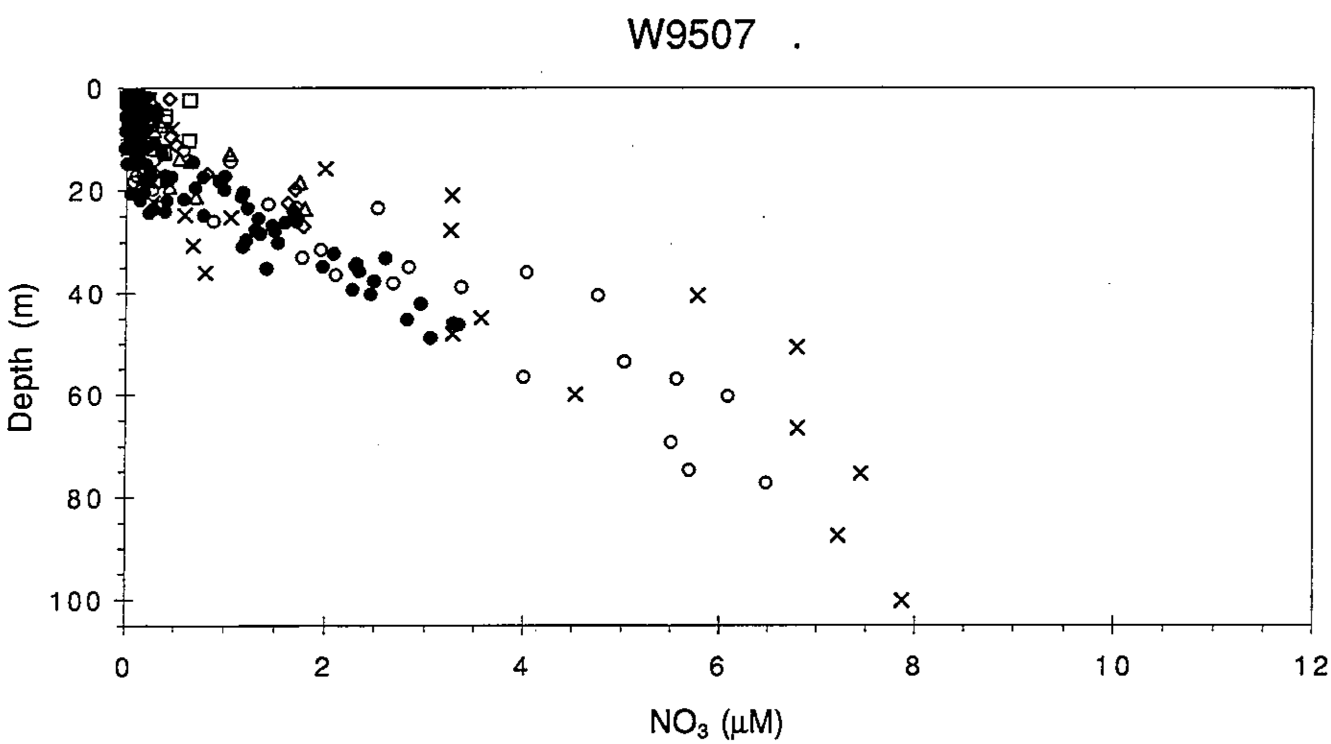
Depth (m)
0
20
40
60
80
100
n=102
0
2
4
6
8
10
12
14
16
18
NH4 (µM)

W9506 .

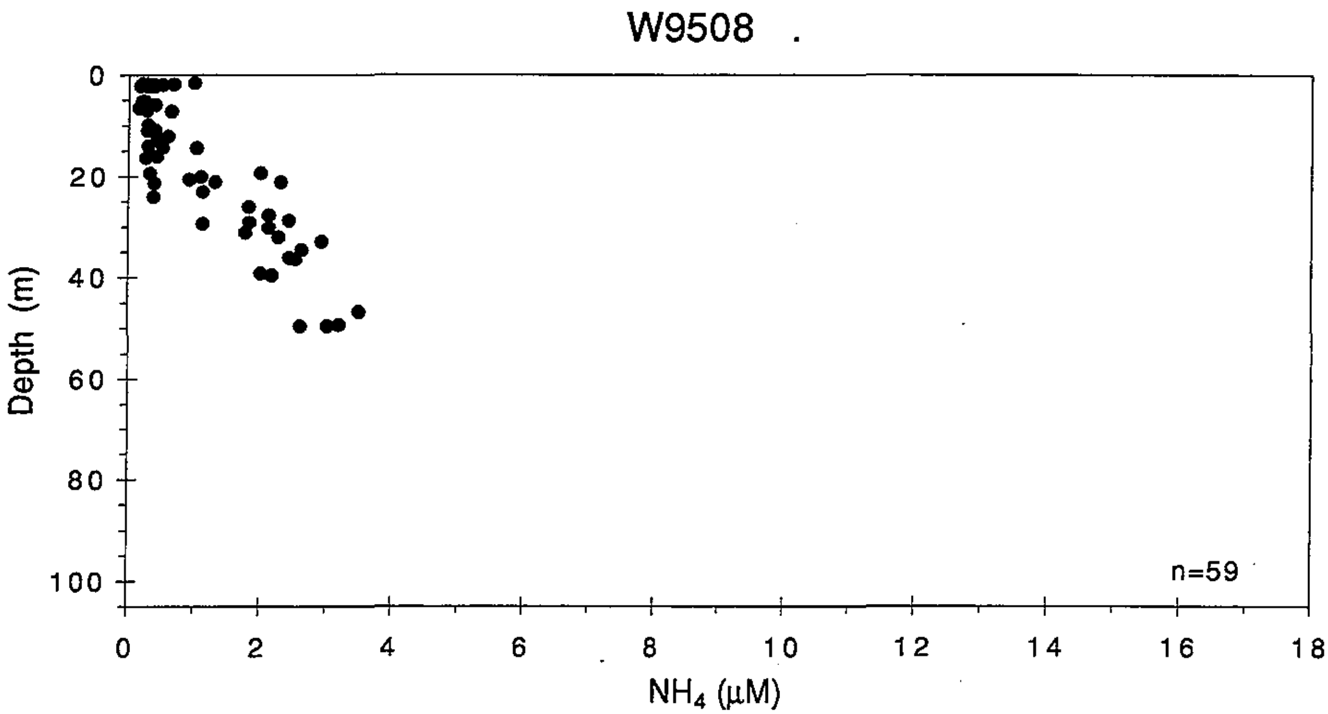


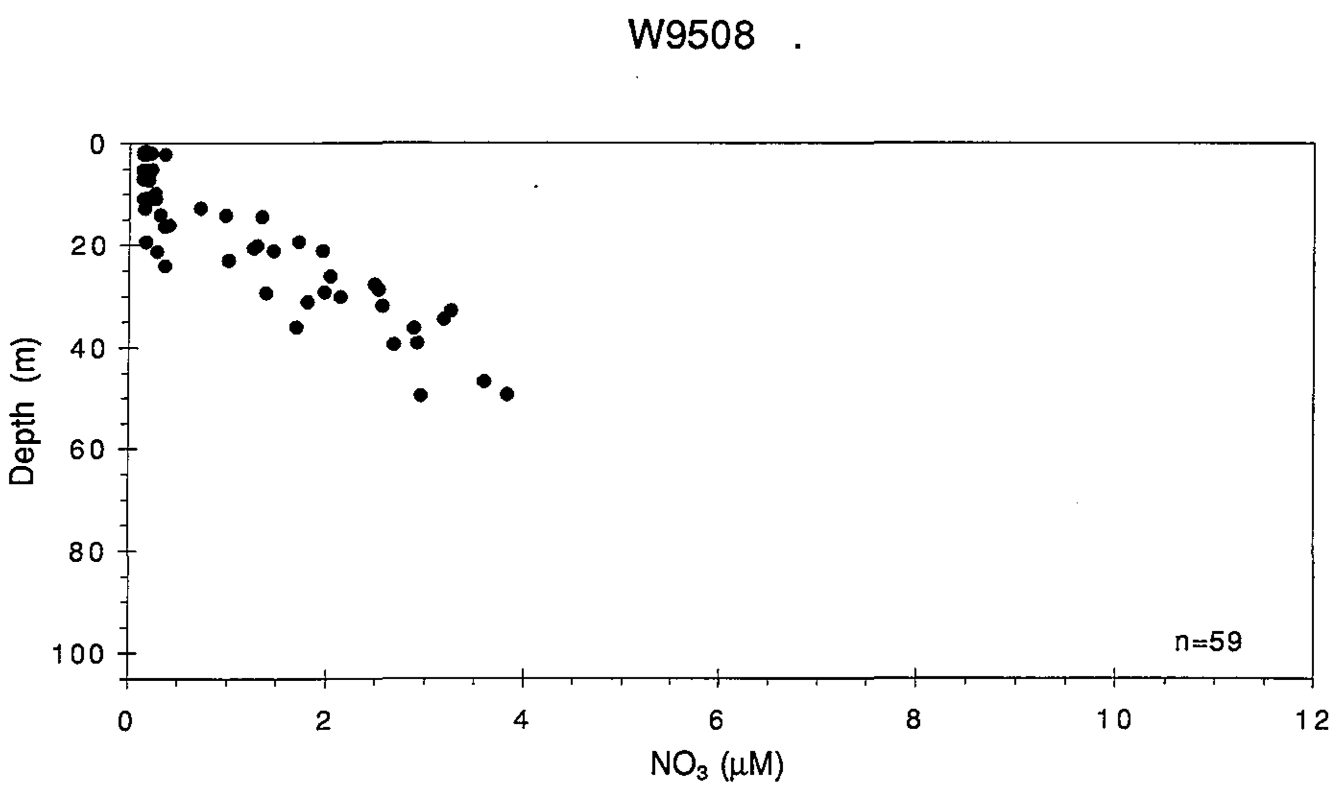
Depth (m)
0
20
40
60
80
100
n=102
0
2
4
6
8
10
12
NO3 (µM)

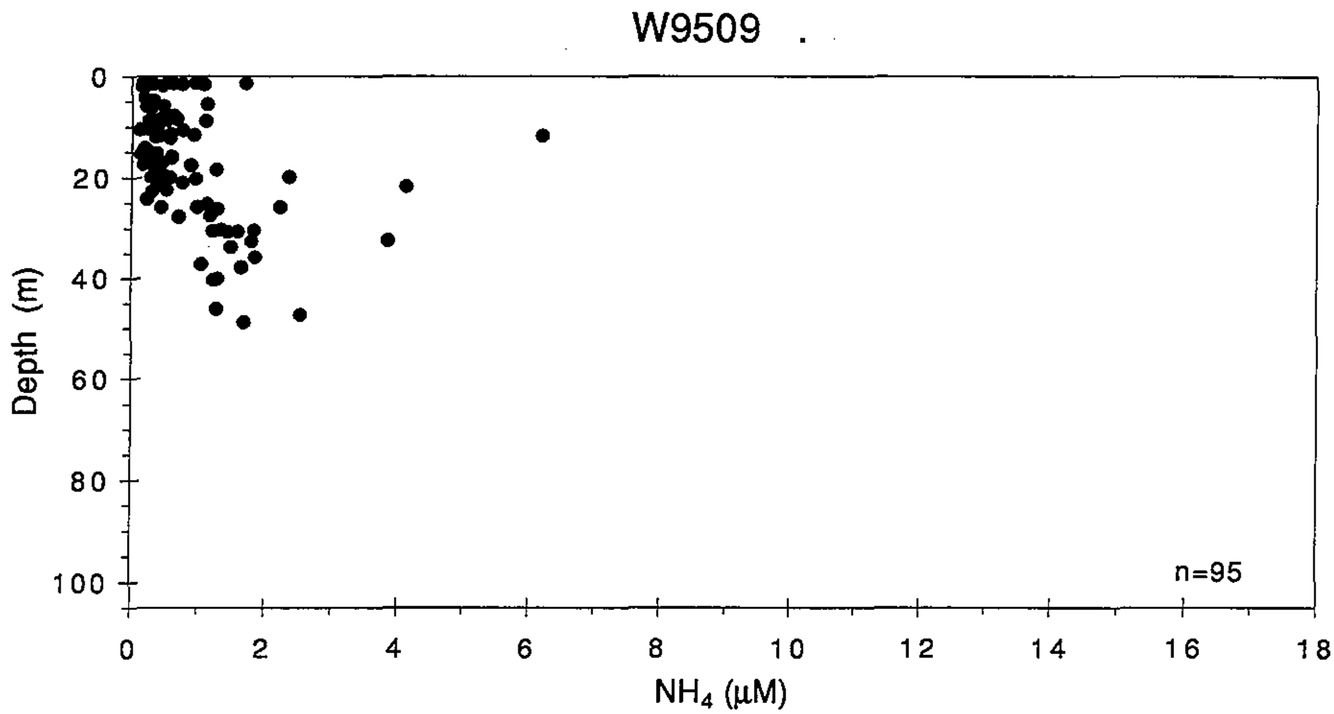


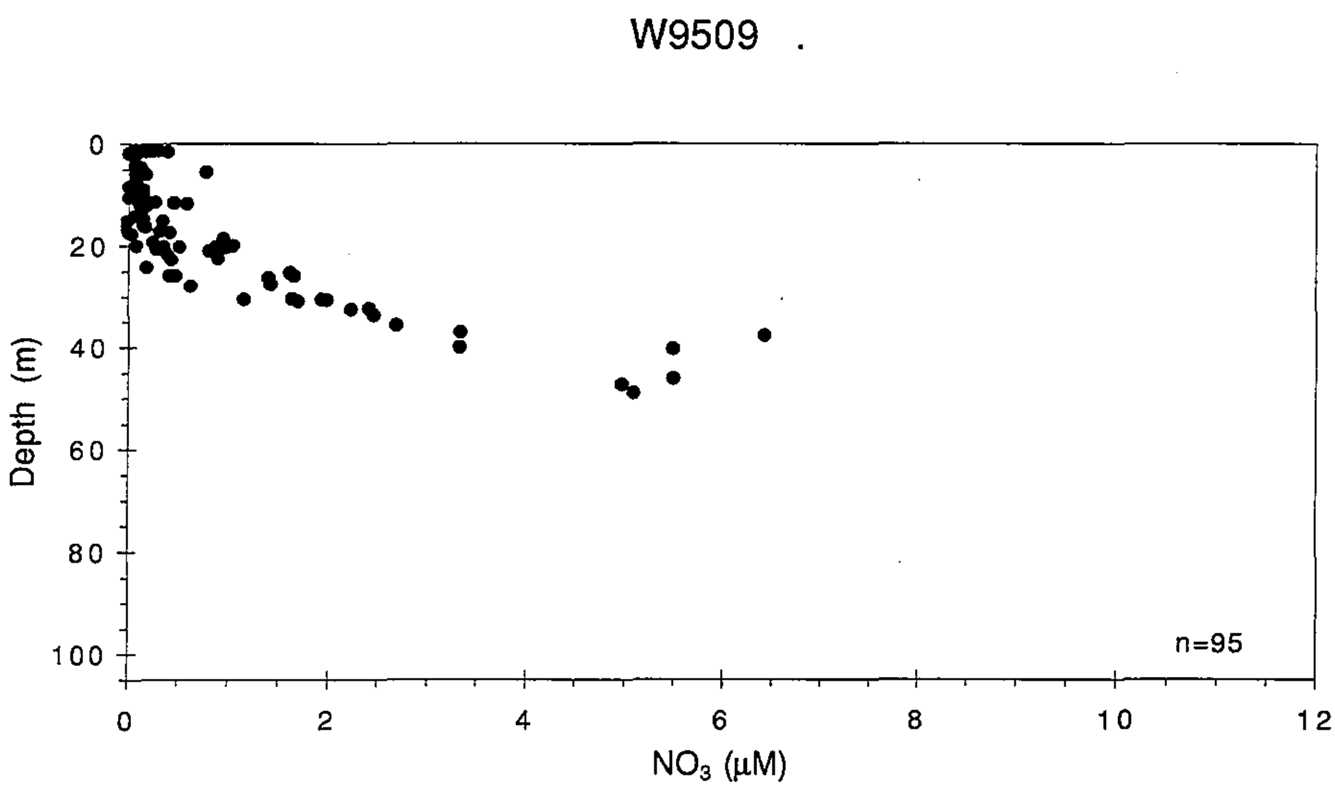


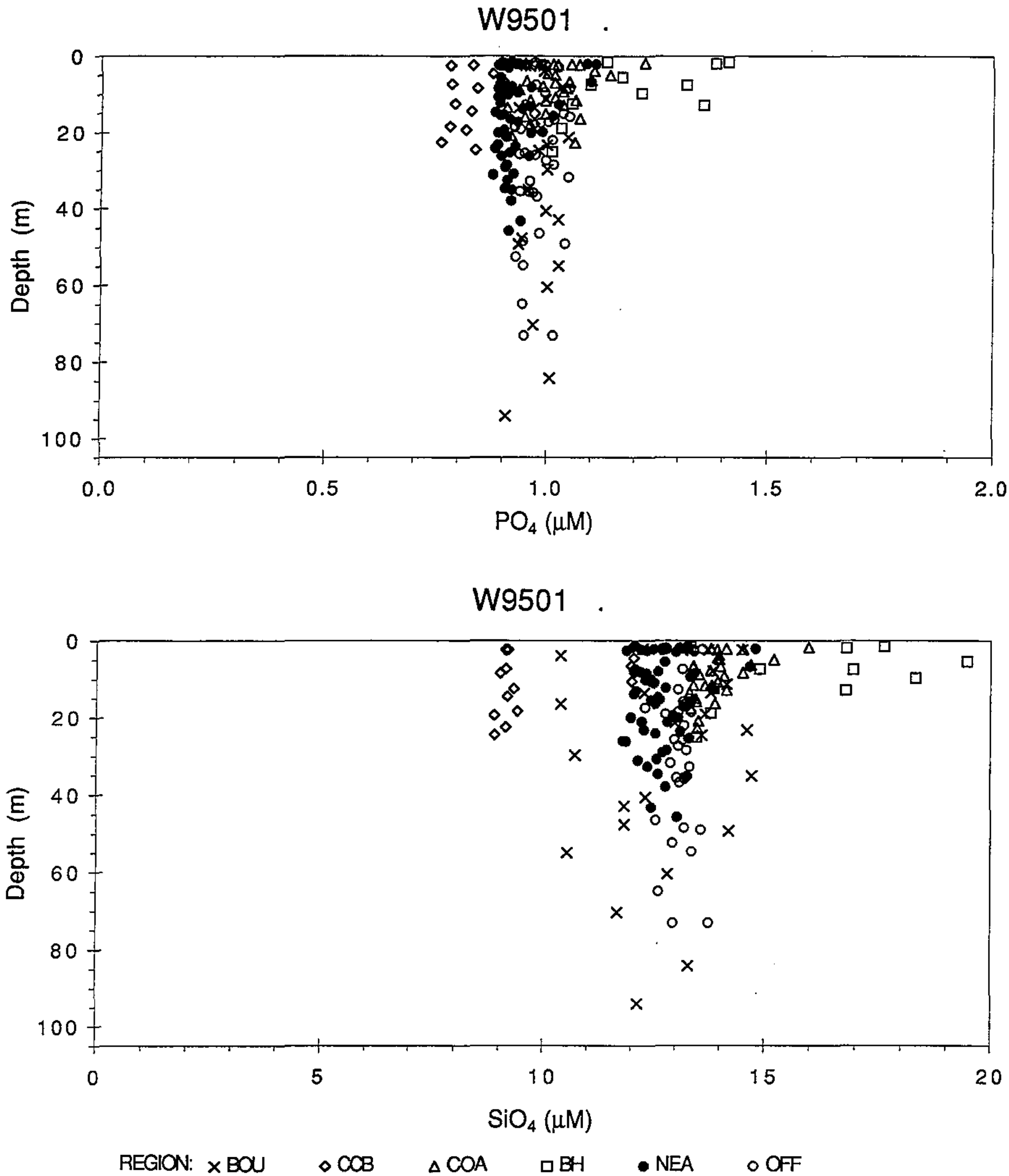
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

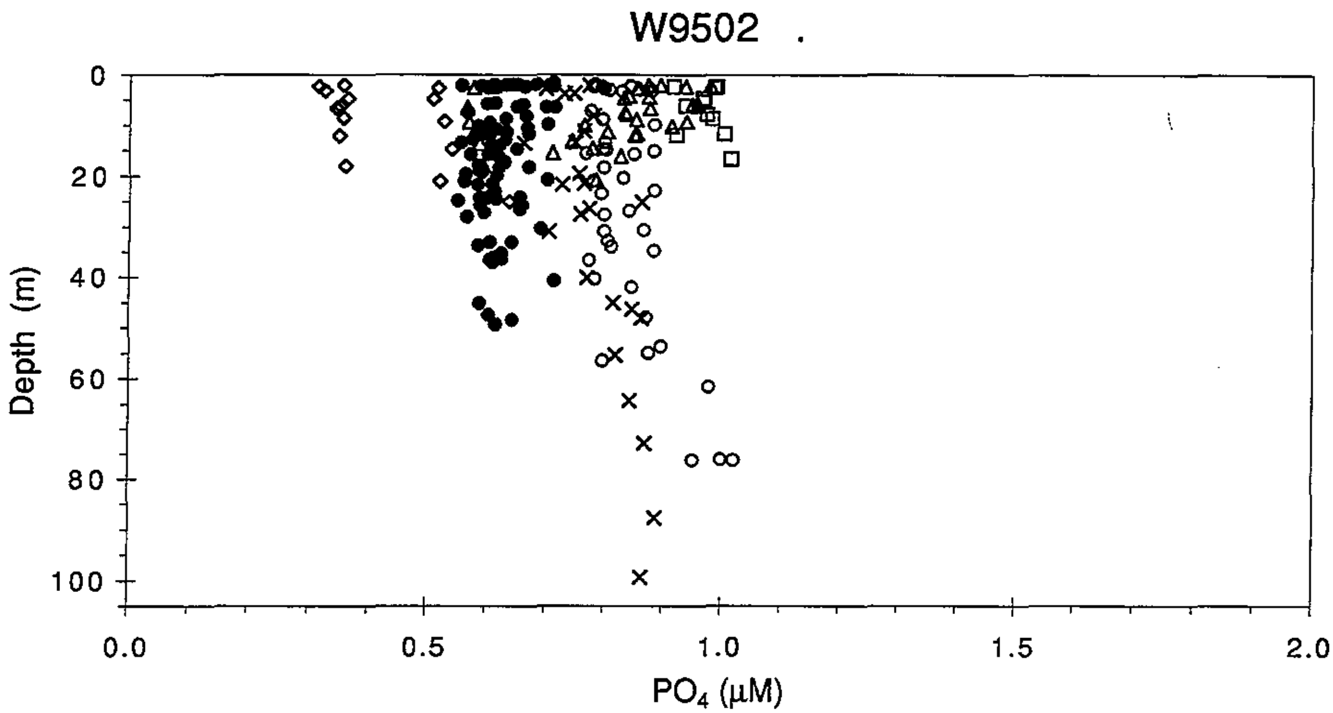

W9508 .
Depth (m)
0
20
40
60
80
100
n=59
0
2
4
6
8
10
12
14
16
18
NH4 (μM)

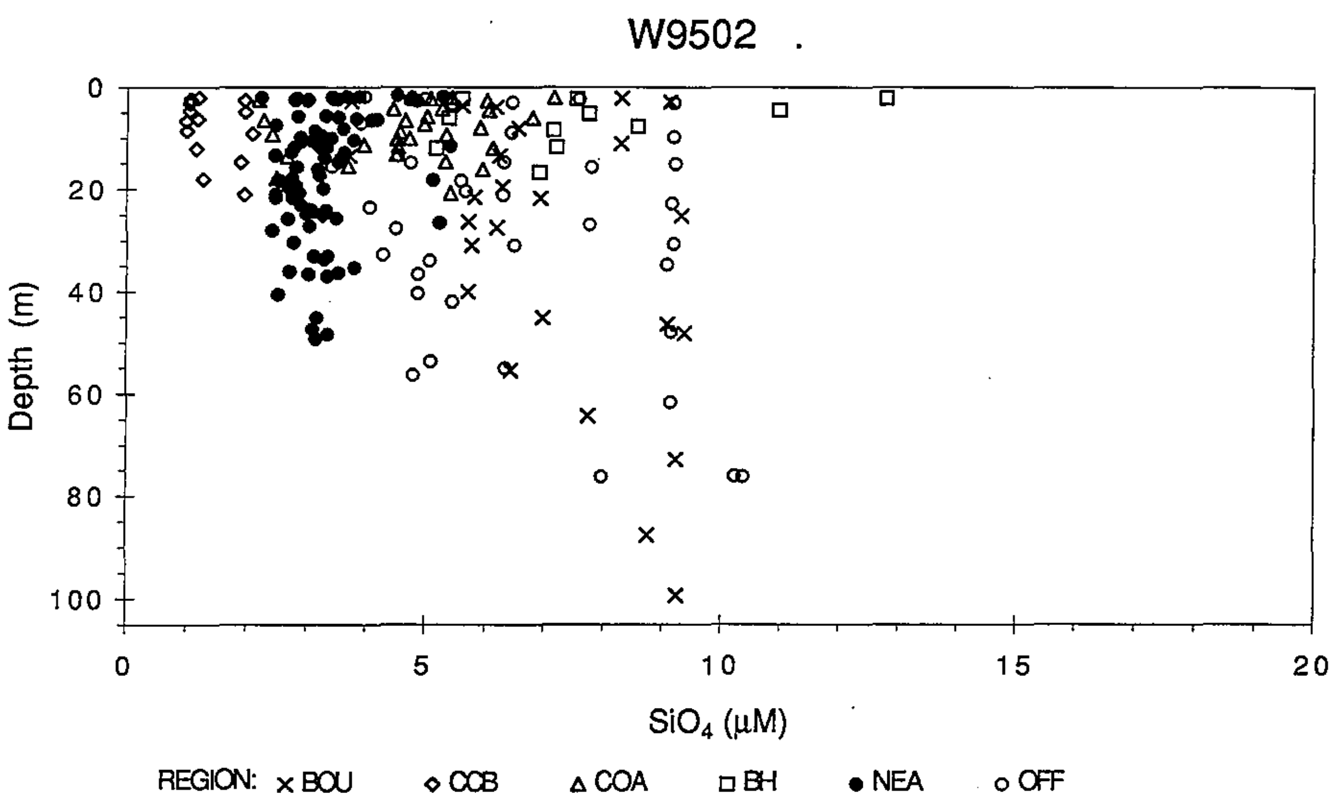

W9508 .
Depth (m)
0
20
40
60
80
100
n=59
0
2
4
6
8
10
12
NO3 (μM)

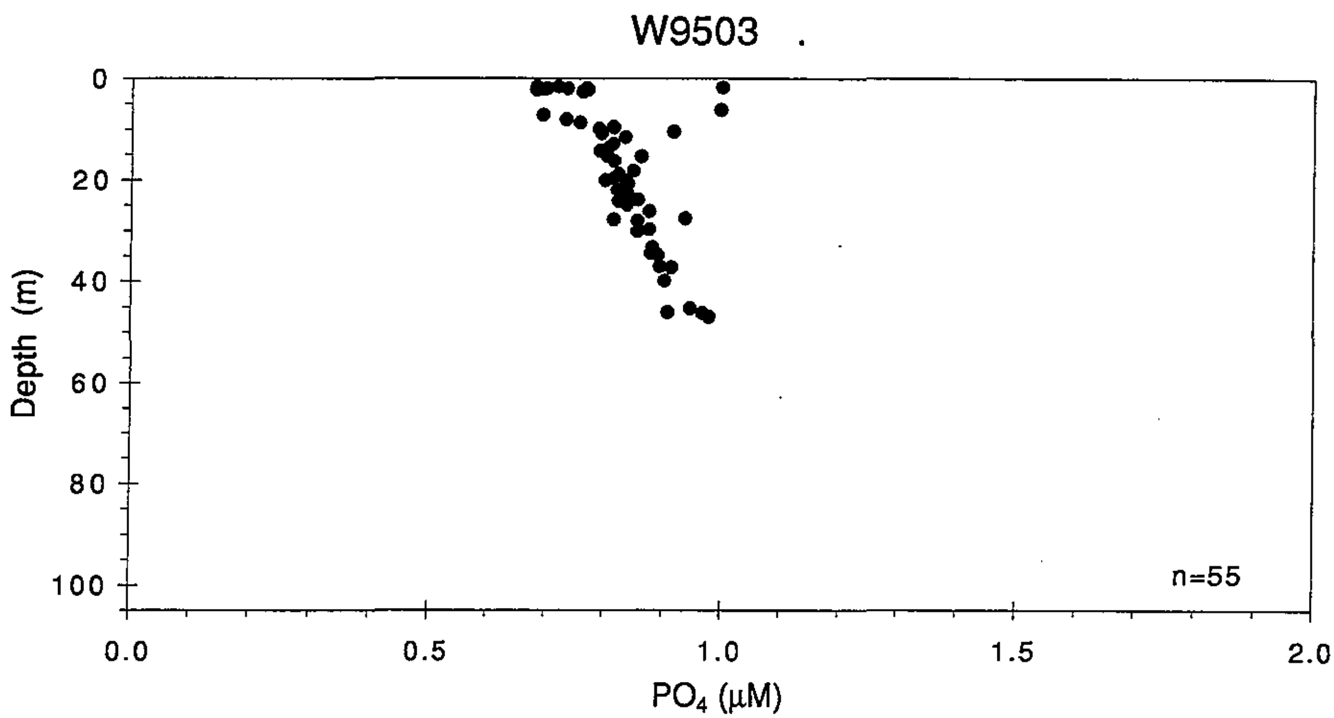

W9509
Depth (m)
0
20
40
60
80
100
n=95
0
2
4
6
8
10
12
14
16
18
NH4 (µM)

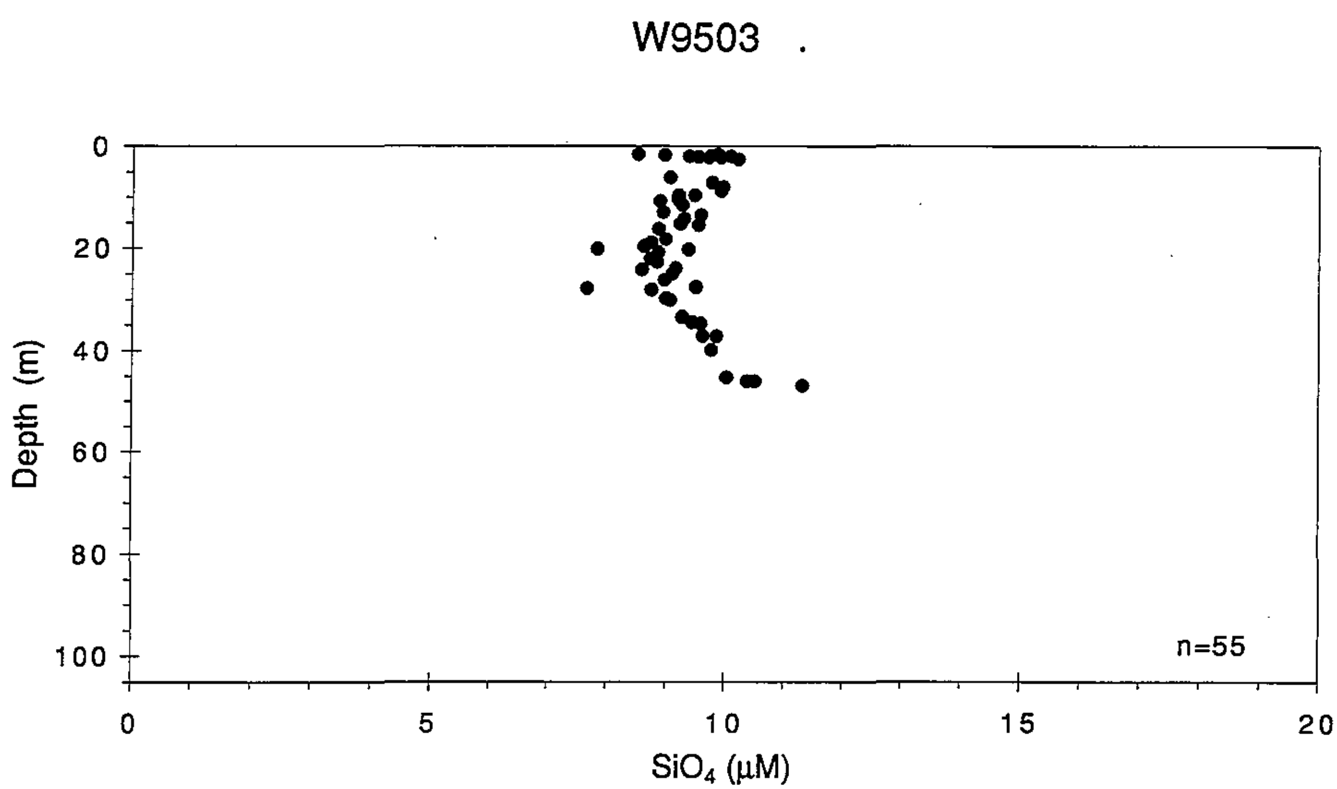

W9509
Depth (m)
0
20
40
60
80
100
n=95
0
2
4
6
8
10
12
NO3 (µM)

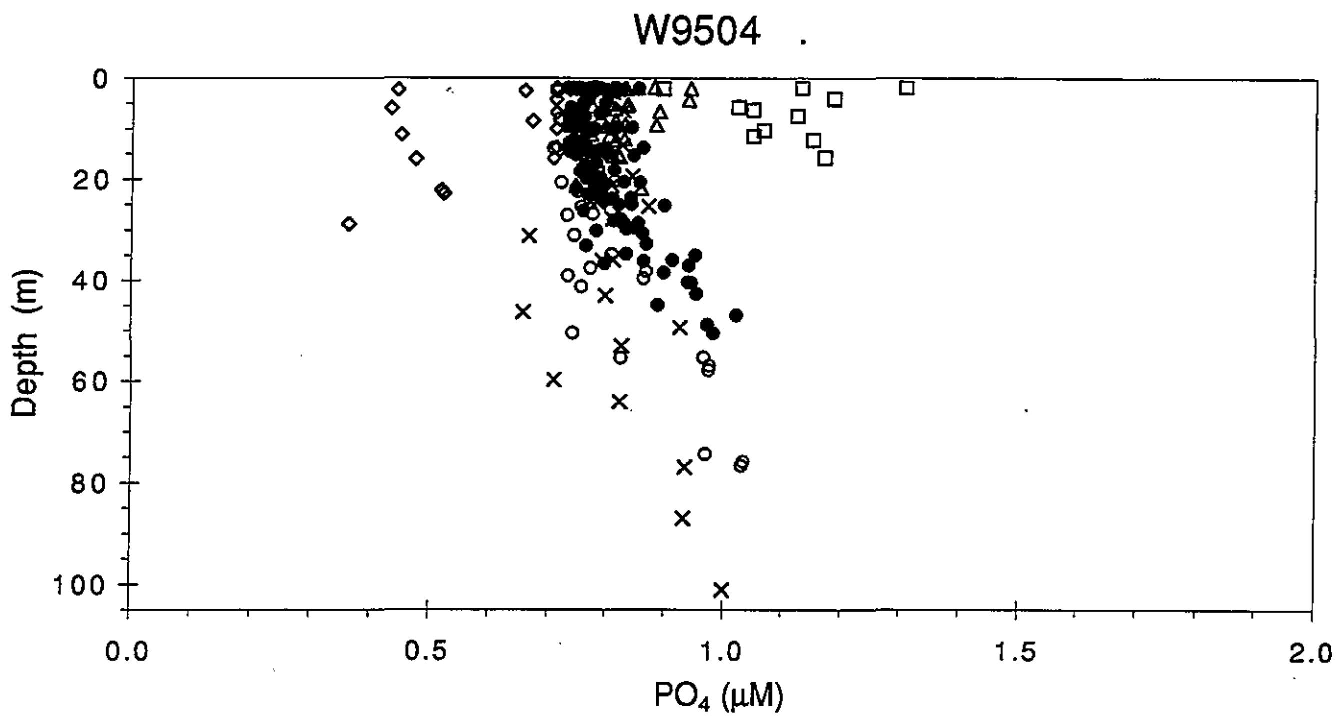

W9501
Depth (m)
PO4 (µM)
W9501
Depth (m)
SiO4 (µM)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

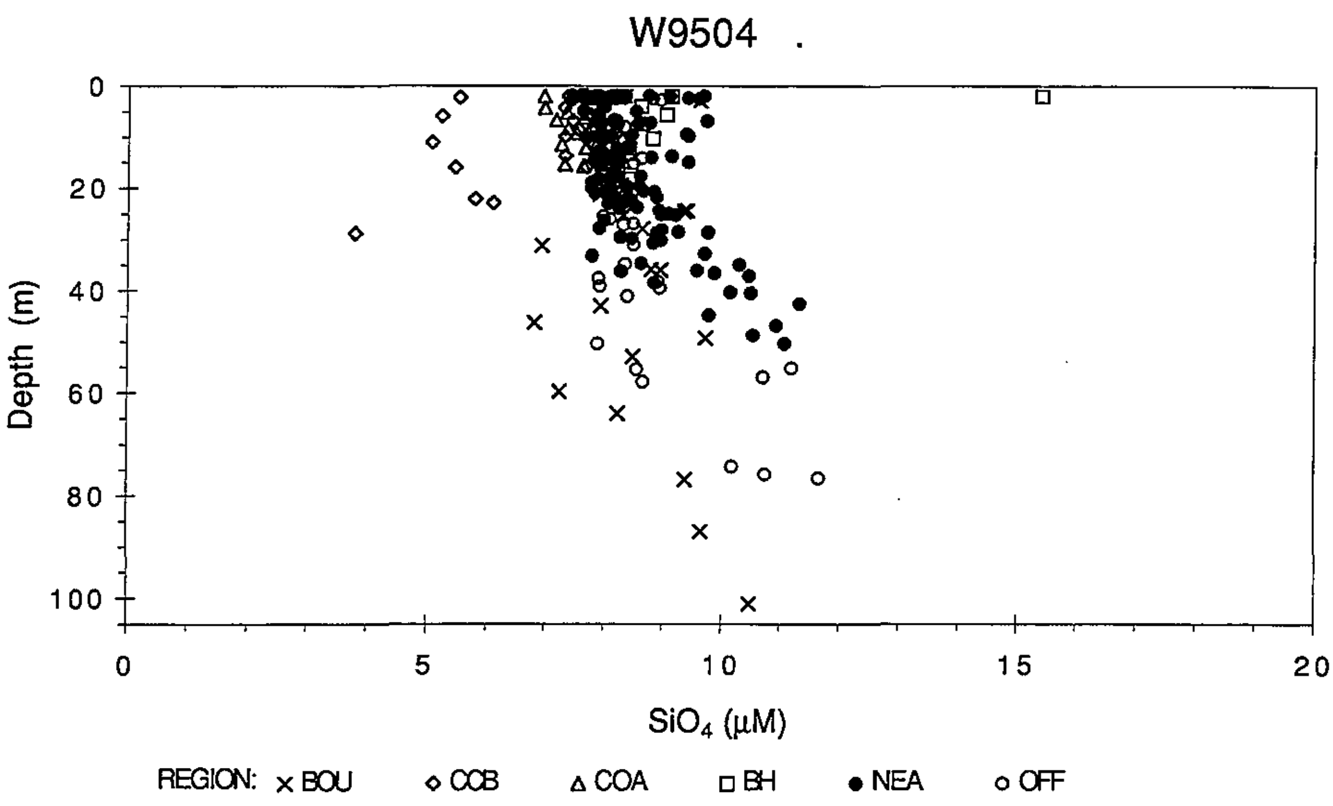

W9502 .
Depth (m)
0
20
40
60
80
100
0.0
0.5
1.0
1.5
2.0
PO4 (µM)


W9502 .
Depth (m)
0
20
40
60
80
100
0
5
10
15
20
SiO4 (µM)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

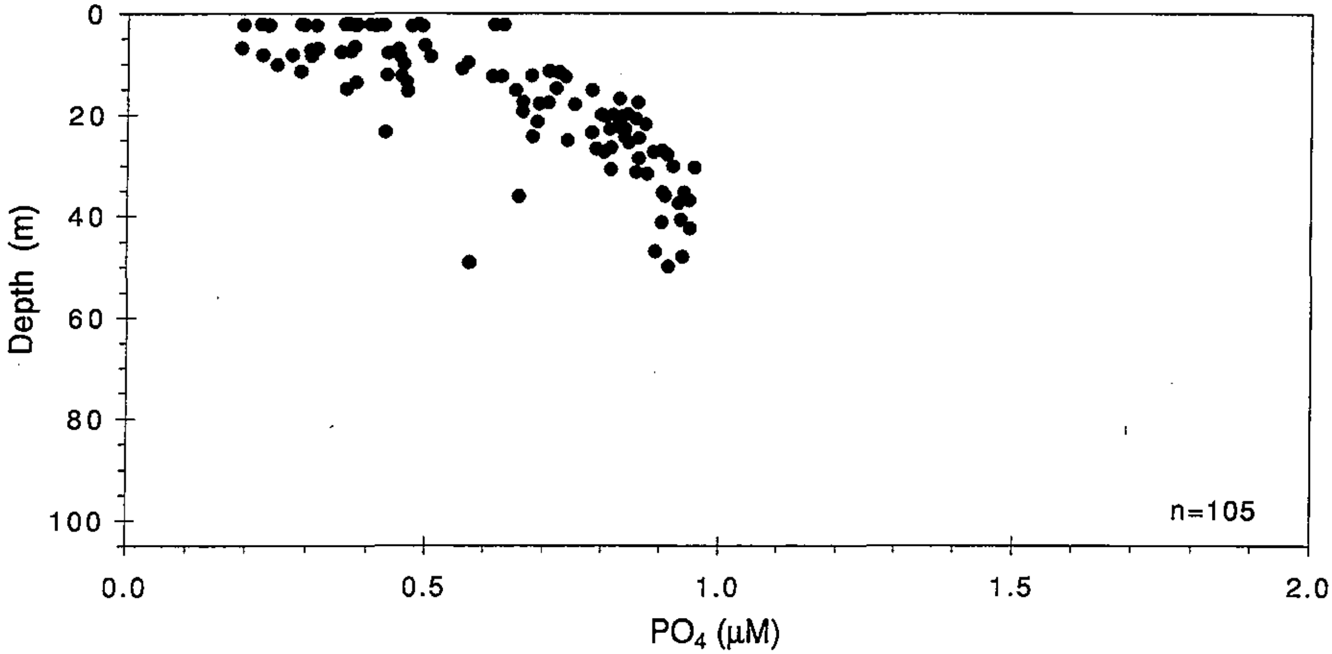

W9503
Depth (m)
0
20
40
60
80
100
n=55
0.0
0.5
1.0
1.5
2.0
PO4 (µM)


W9503
Depth (m)
0
20
40
60
80
100
n=55
0
5
10
15
20
SiO4 (µM)


W9504
Depth (m)
0
20
40
60
80
100
0.0
0.5
1.0
1.5
2.0
PO4 (µM)

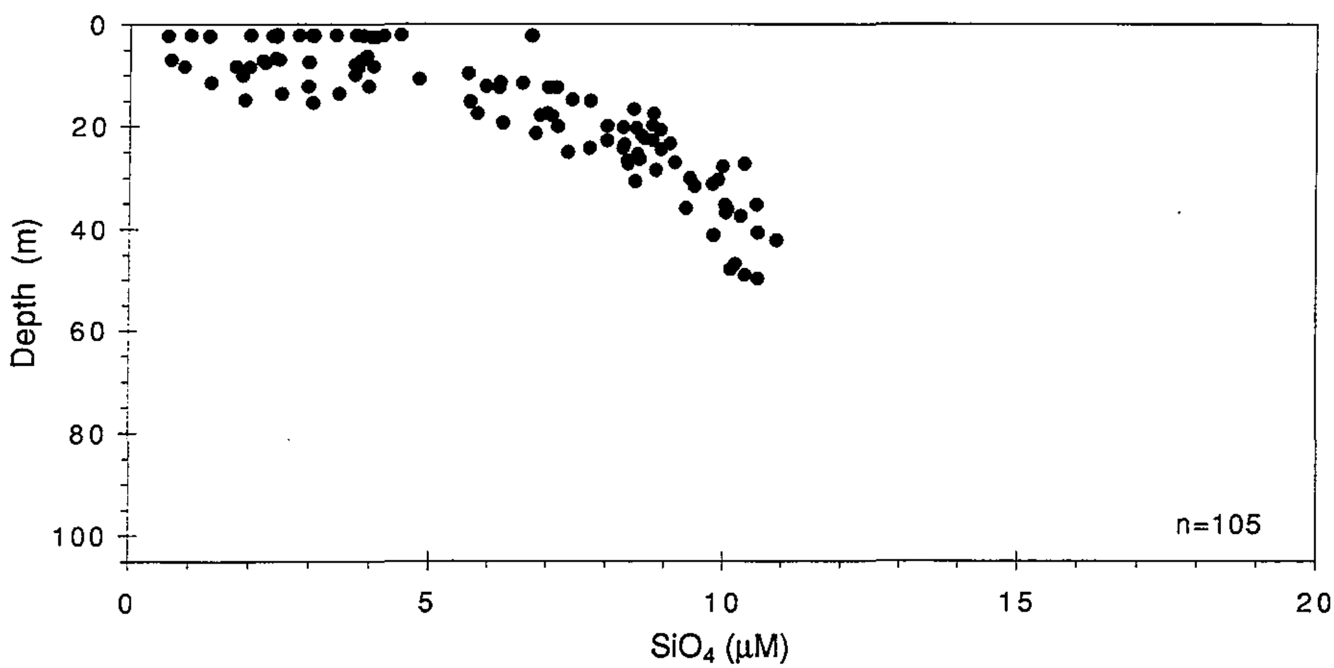

W9504
Depth (m)
0
20
40
60
80
100
0
5
10
15
20
SiO4 (µM)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF

W9505 .



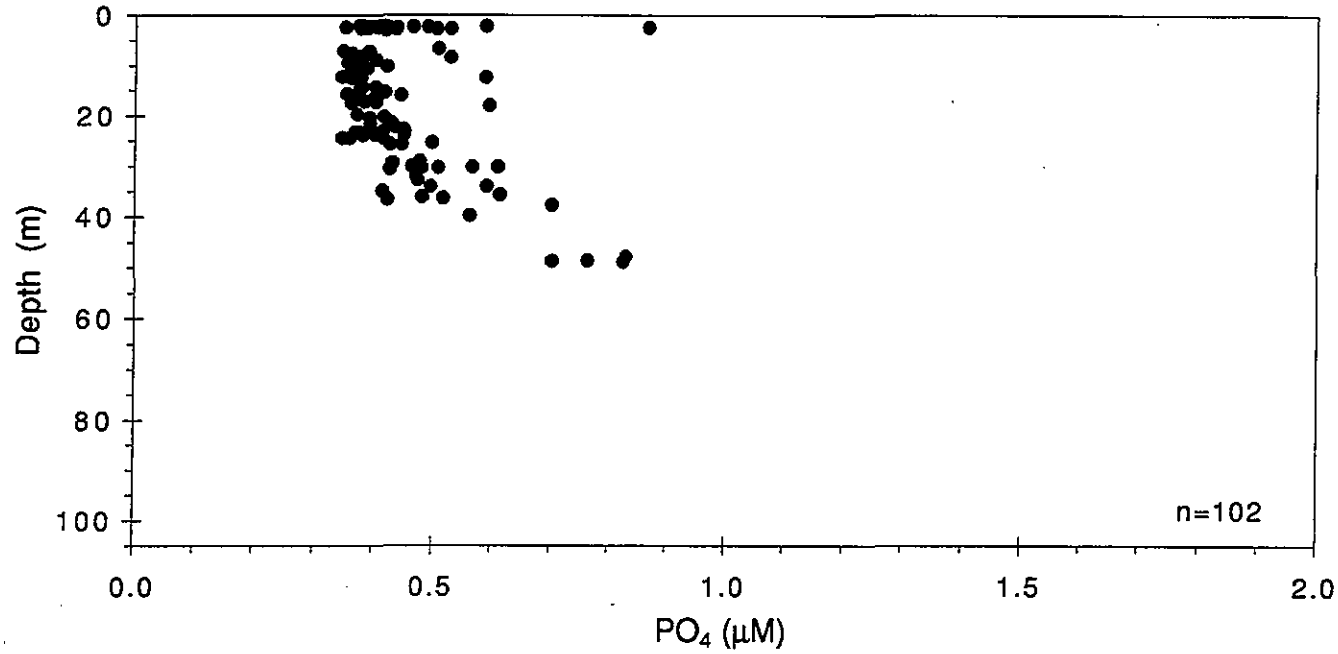
0
20
40
60
80
100
Depth (m)
n=105
0.0
0.5
1.0
1.5
2.0
PO4 (µM)

W9505 .



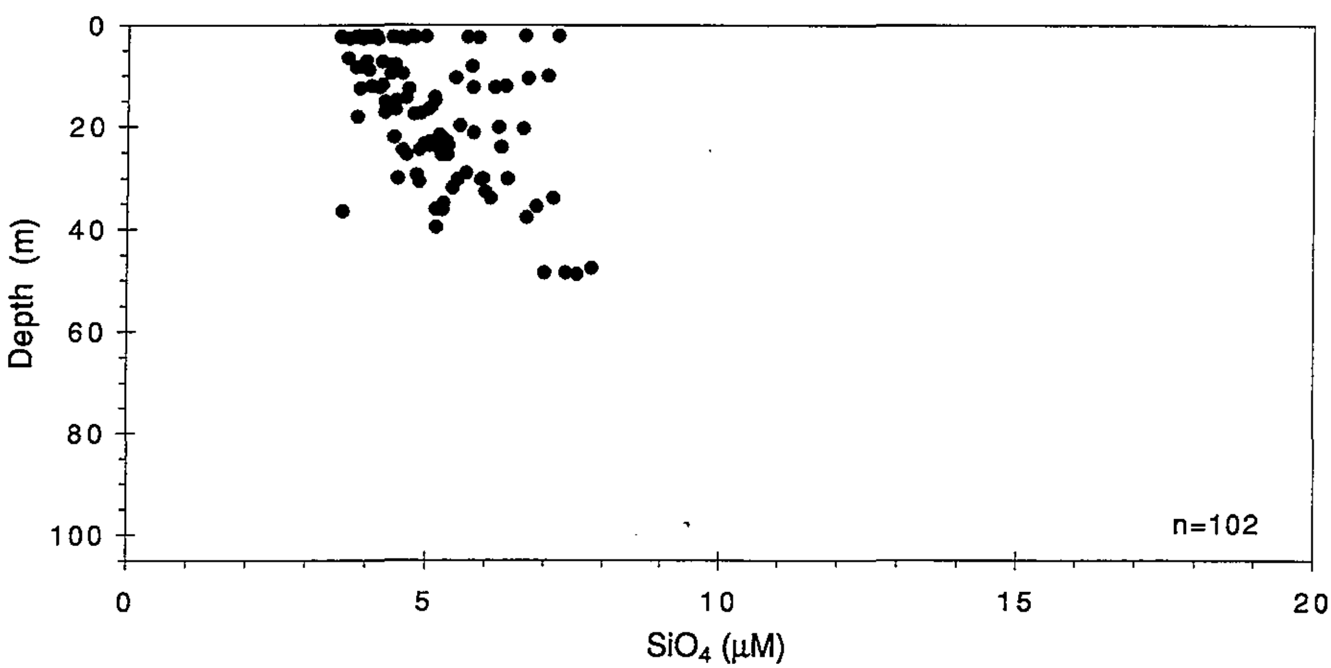
0
20
40
60
80
100
Depth (m)
n=105
0
5
10
15
20
SiO4 (µM)

W9506

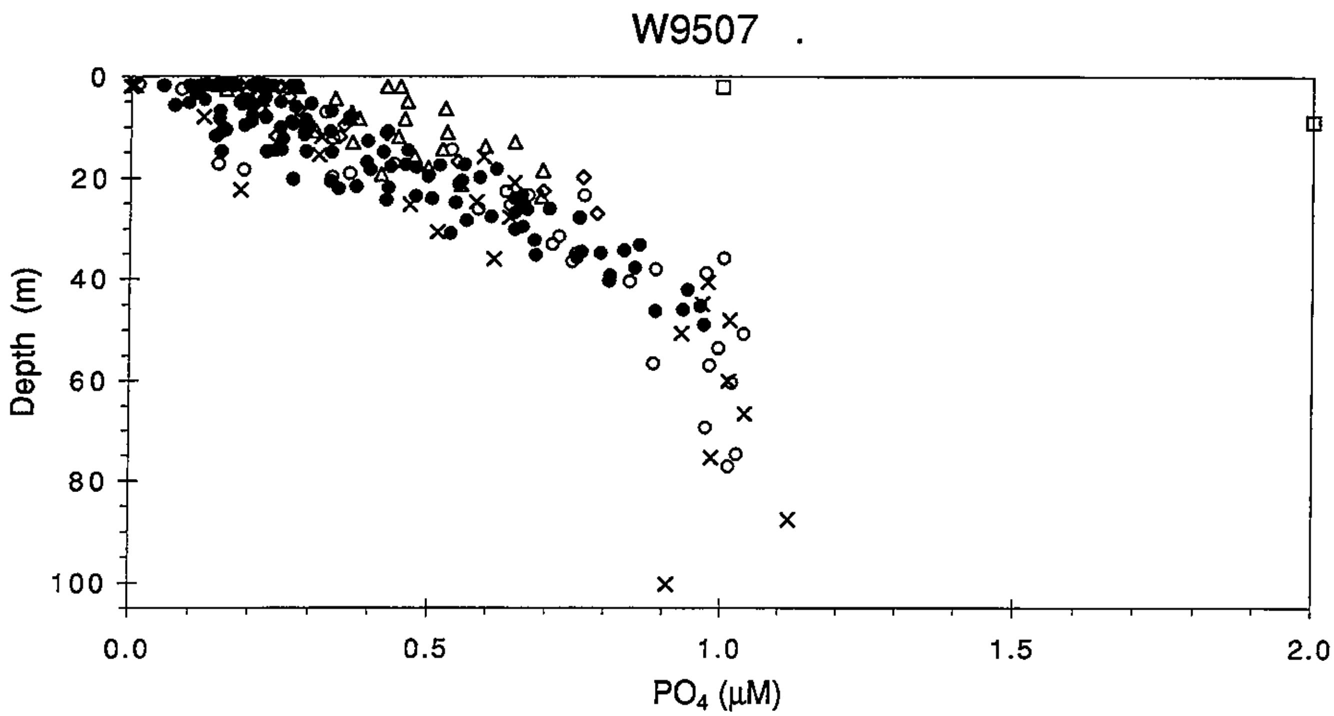


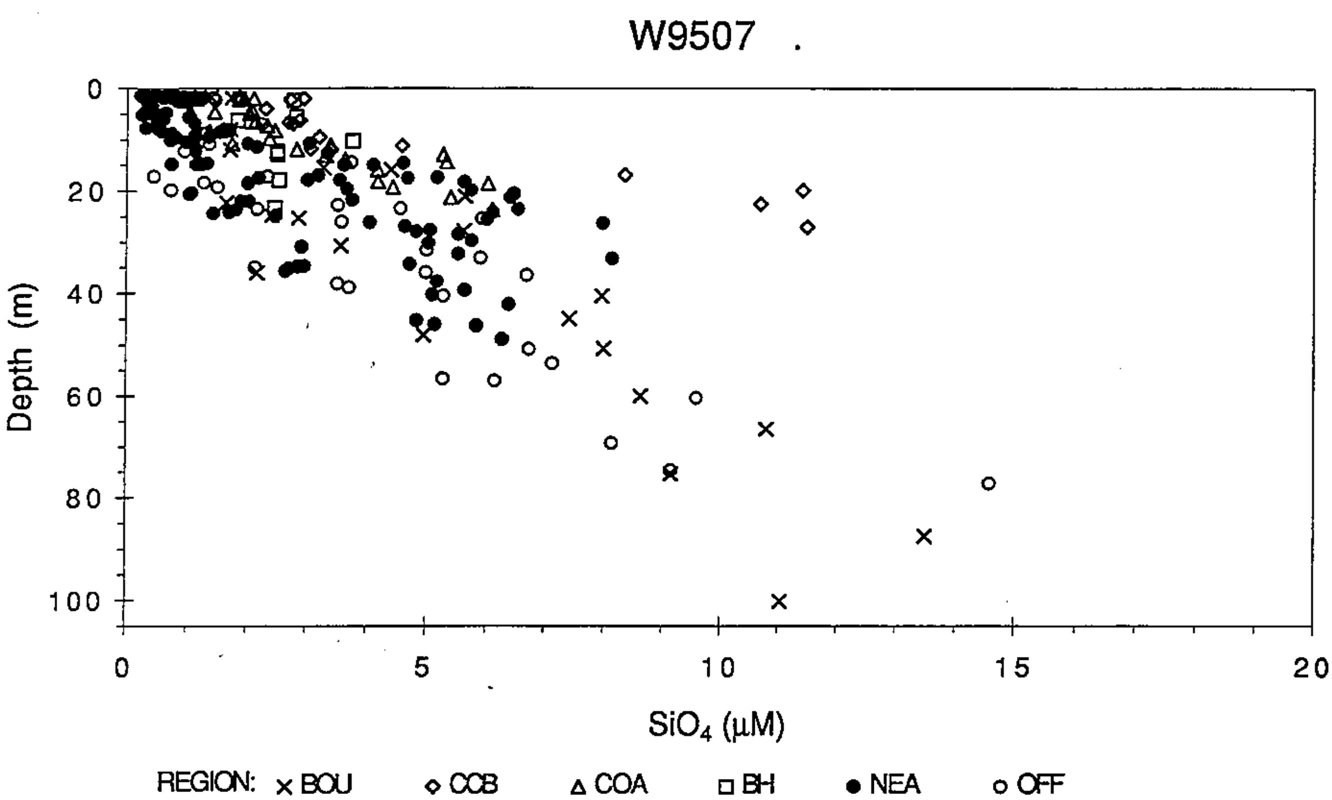
0
20
40
60
80
100
Depth (m)
0.0
0.5
1.0
1.5
2.0
PO4 (µM)
n=102

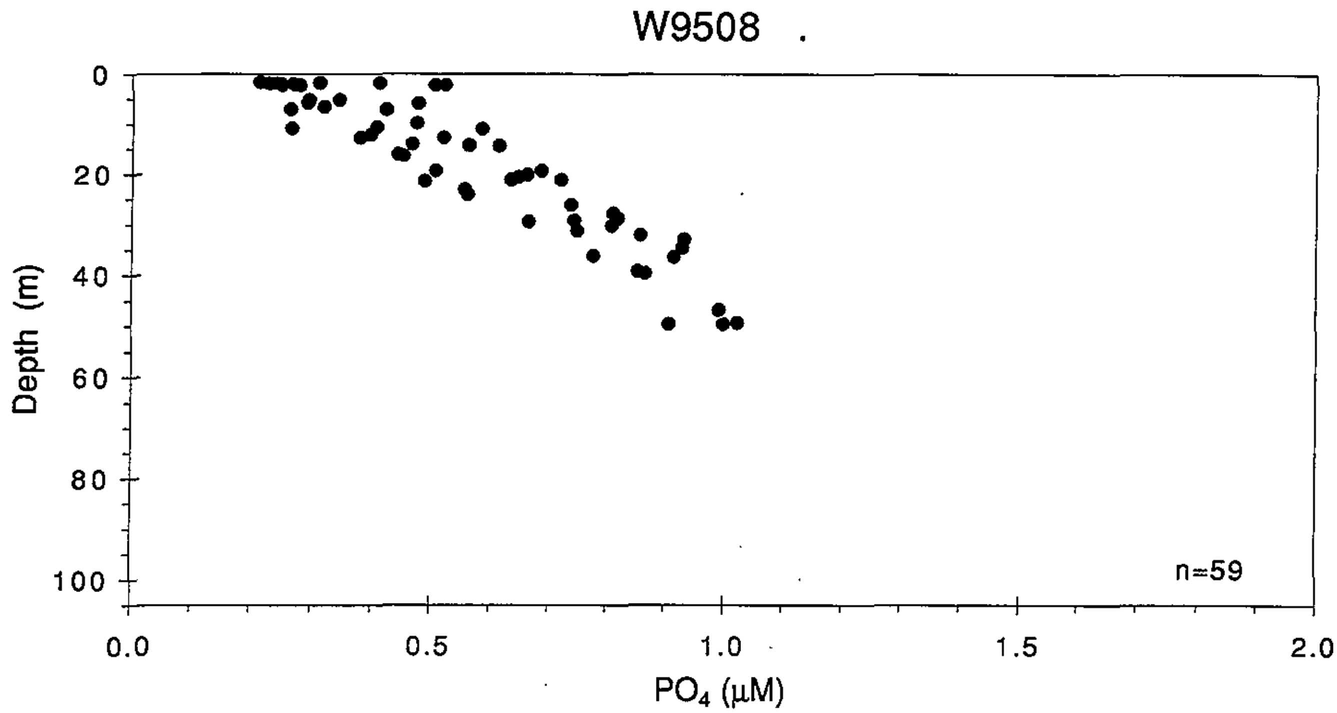
W9506

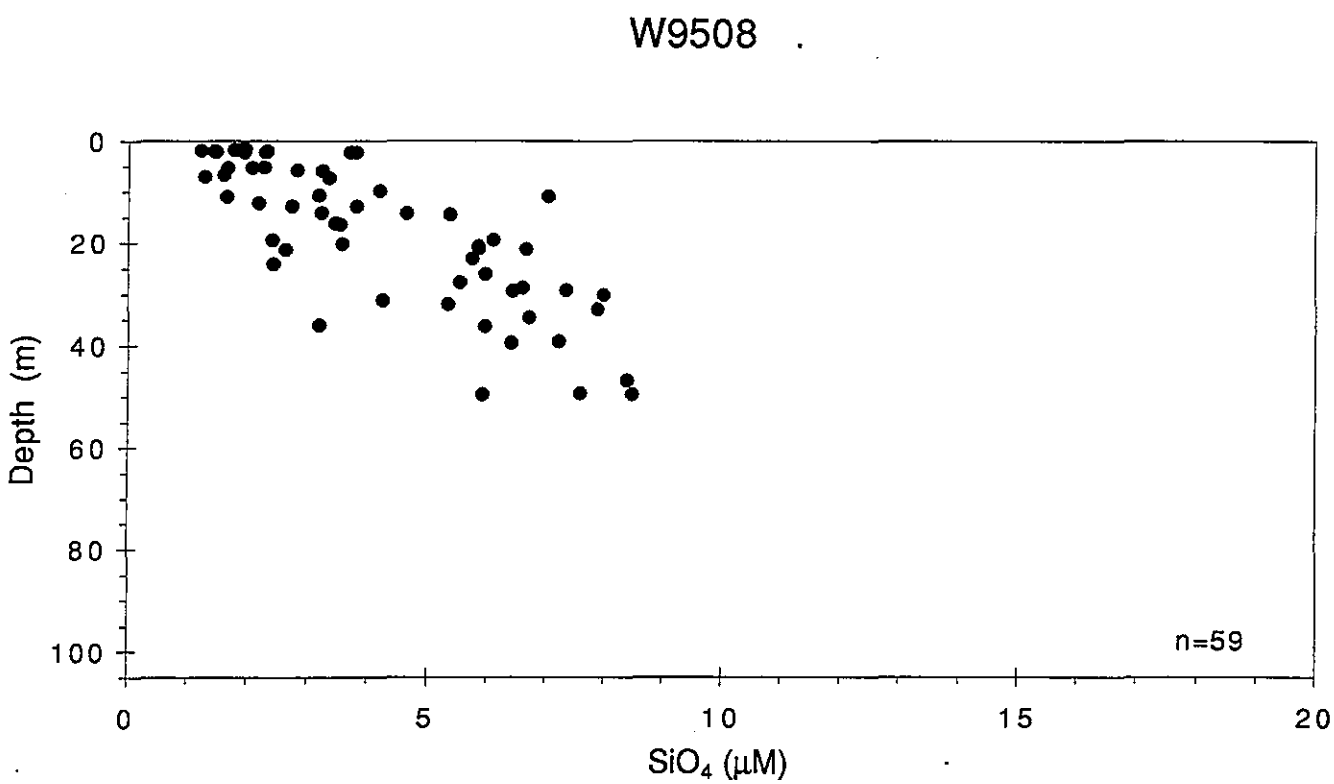


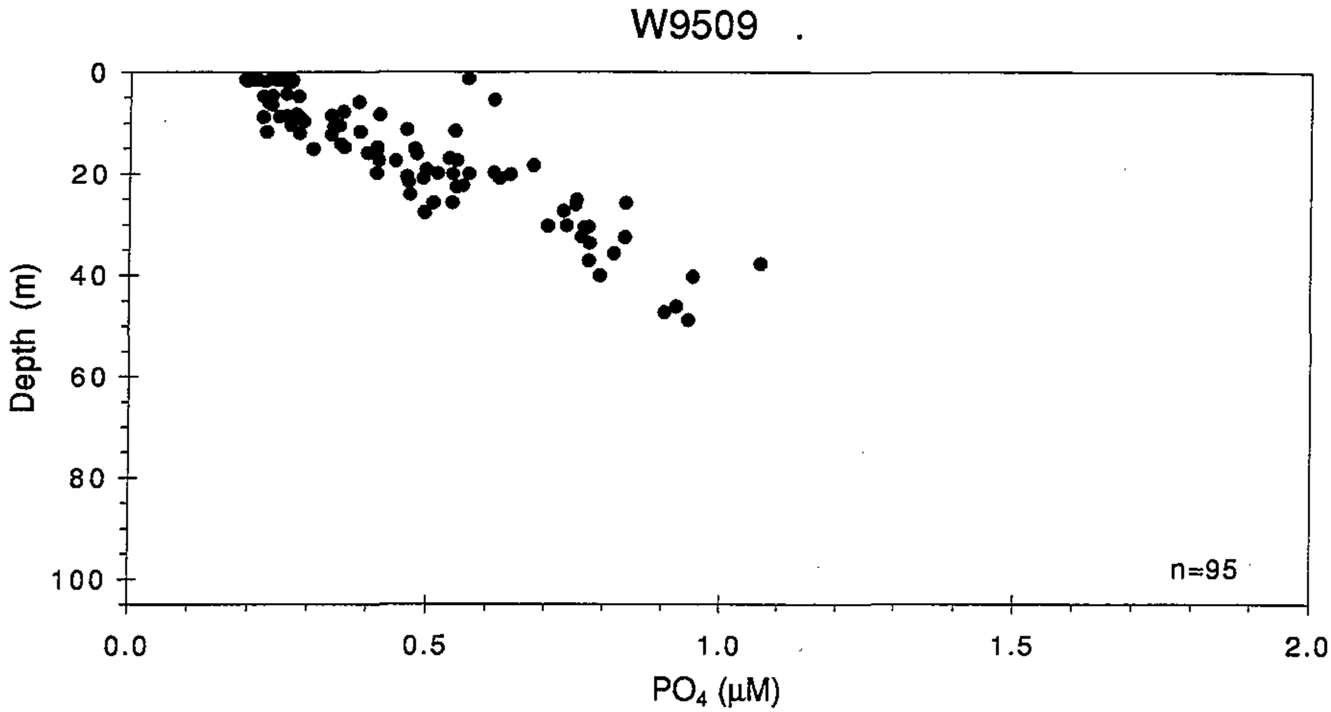
0
20
40
60
80
100
Depth (m)
0
5
10
15
20
SiO4 (µM)
n=102

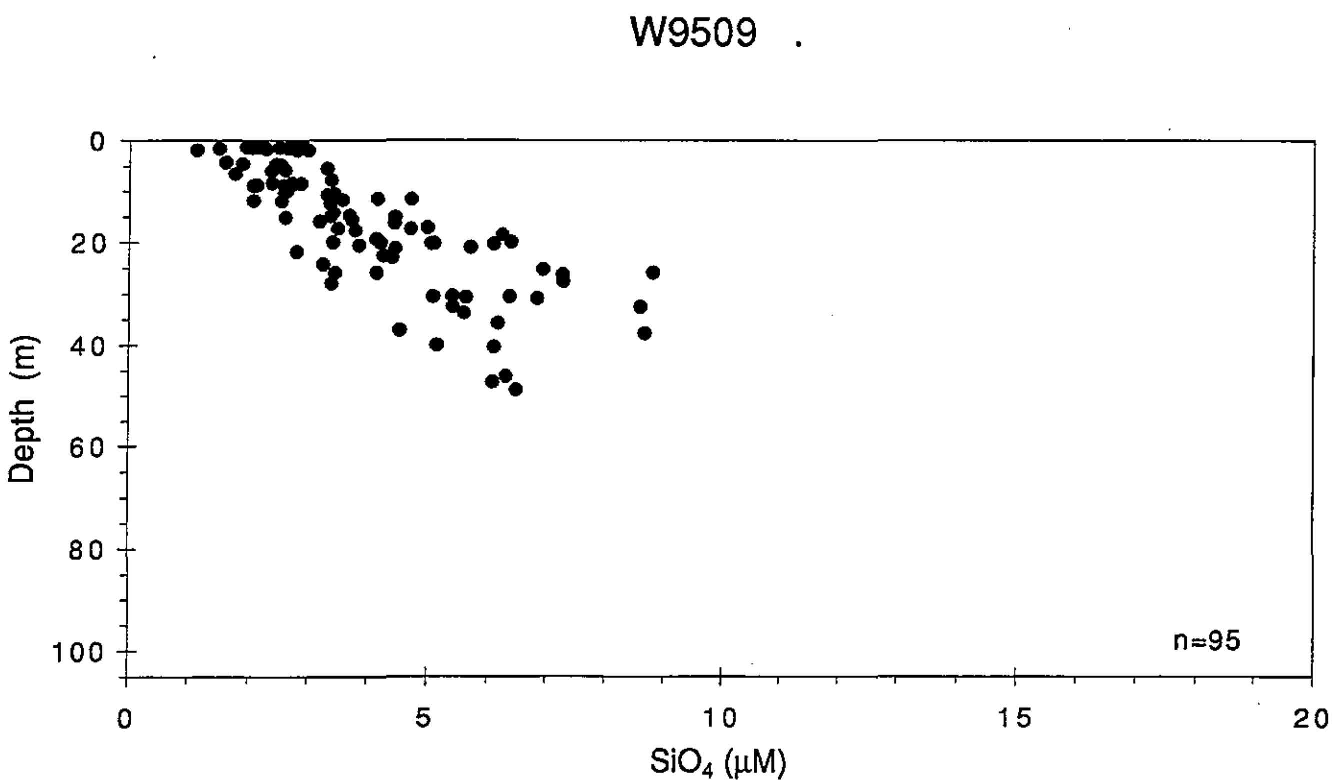

W9507 .
0
20
40
60
80
100
Depth (m)
0.0
0.5
1.0
1.5
2.0
PO4 (µM)


W9507 .
0
20
40
60
80
100
Depth (m)
0
5
10
15
20
SiO4 (µM)
REGION: × BOU ◇ CCB △ COA □ BH ● NEA ○ OFF


W9508
Depth (m)
0
20
40
60
80
100
n=59
0.0
0.5
1.0
1.5
2.0
PO4 (µM)


W9508
Depth (m)
0
20
40
60
80
100
n=59
0
5
10
15
20
SiO4 (µM)


W9509 .
0
20
40
60
80
100
Depth (m)
n=95
0.0
0.5
1.0
1.5
2.0
PO4 (µM)


W9509 .
0
20
40
60
80
100
Depth (m)
n=95
0
5
10
15
20
SiO4 (µM)

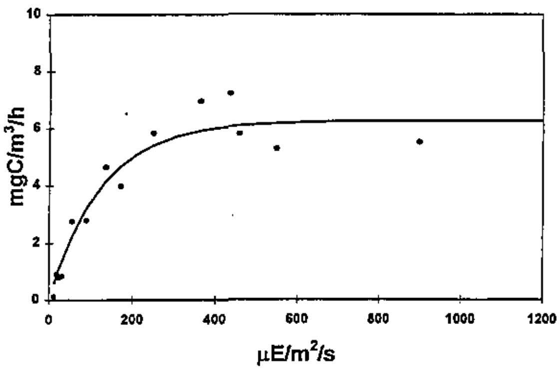
APPENDIX E

PHOTOSYNTHESIS-INTENSITY (P-I) CURVES

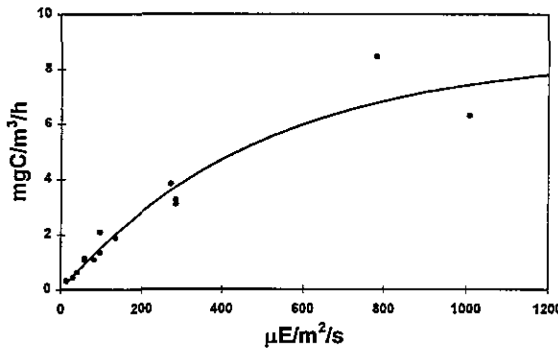
APPENDIX E

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 productivity ($mgC/m^3/h$) versus light intensity ($\mu E/m^2/s$, 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.

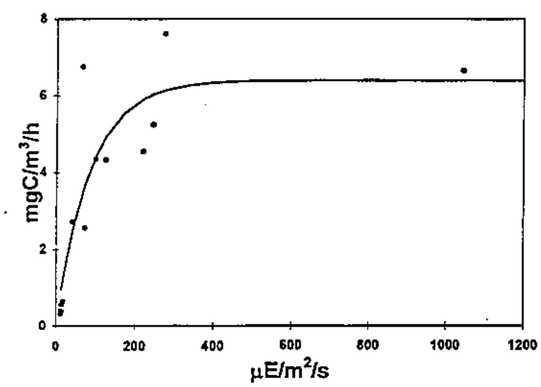
Surface



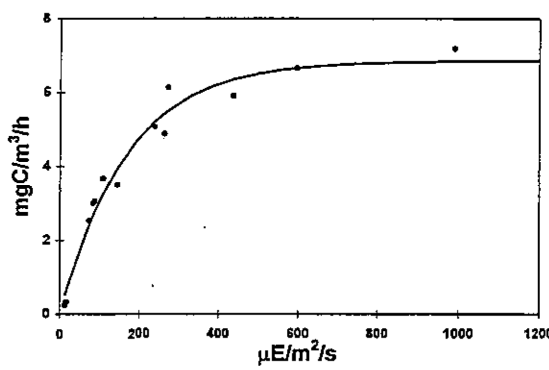
Mid Surface



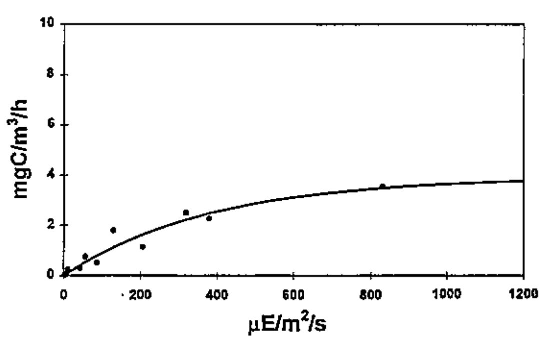
Middle



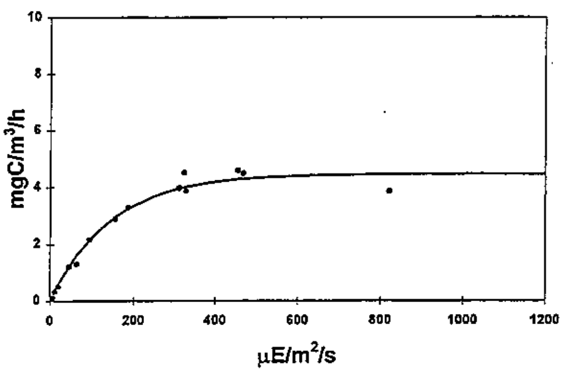
Mid Bottom



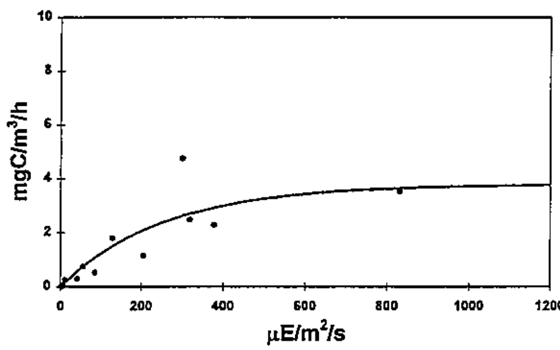
Bottom



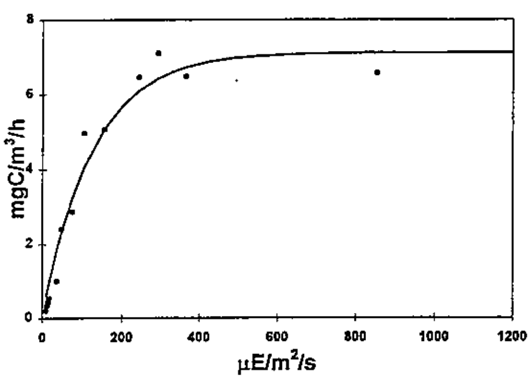
Surface



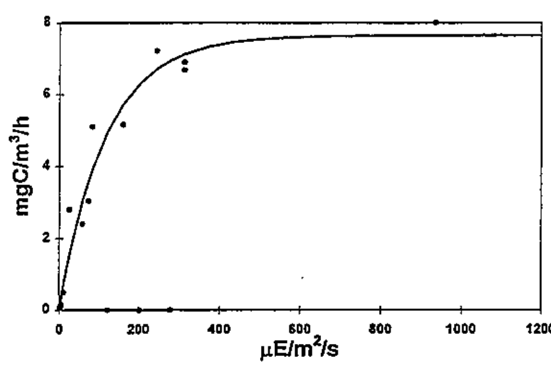
Mid Surface



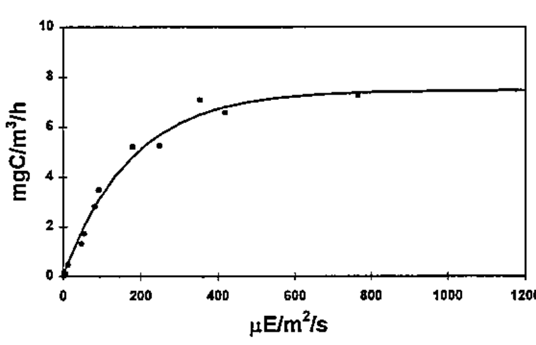
Middle



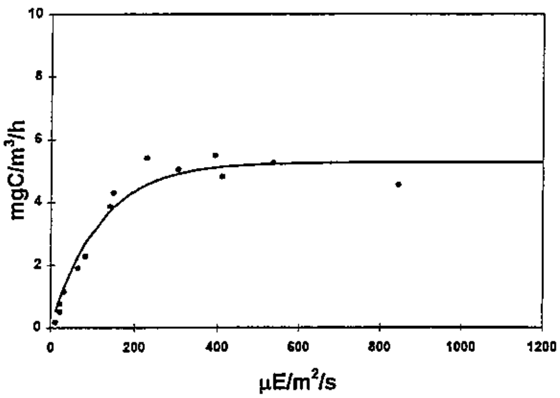
Mid Bottom



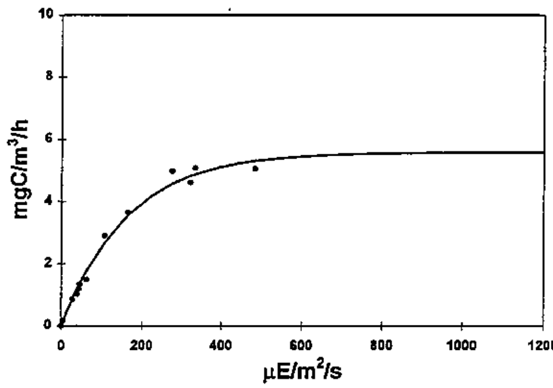
Bottom



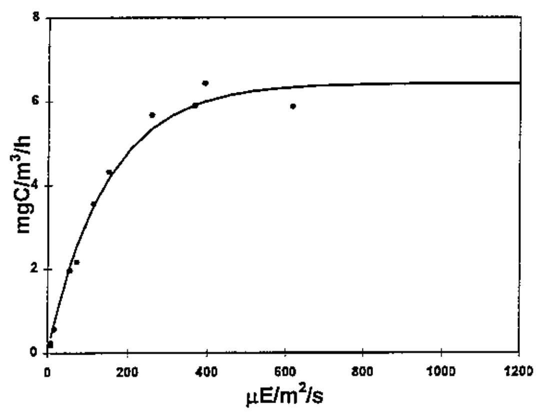
Surface



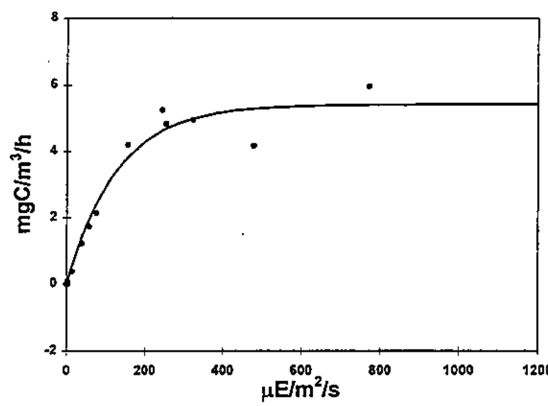
Mid Surface



Middle



Mid Bottom



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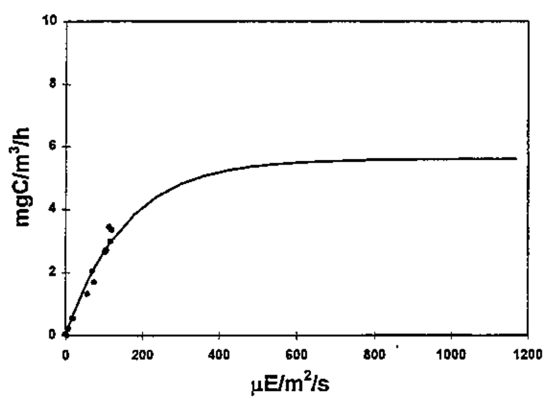

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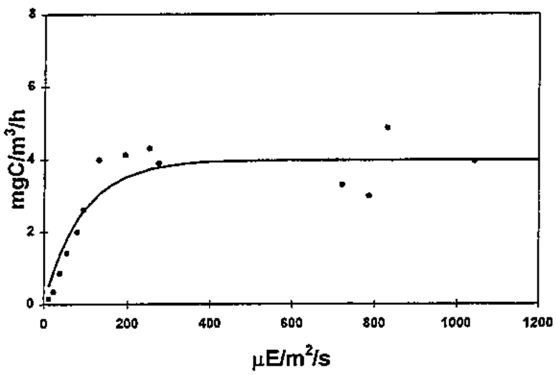

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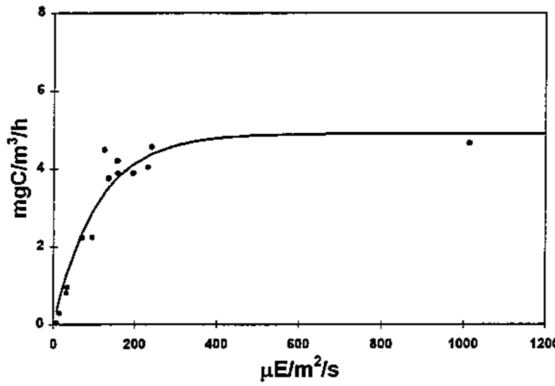

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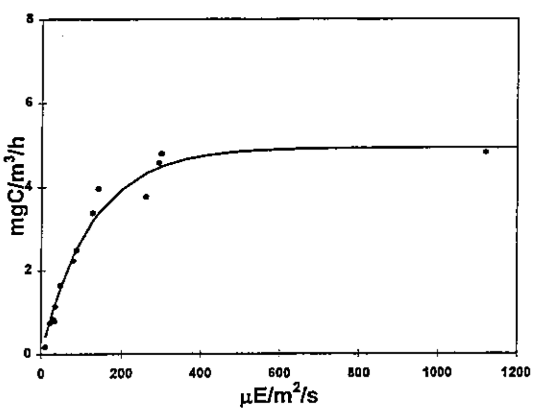

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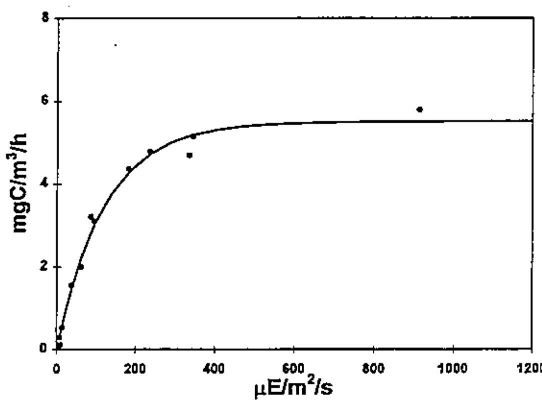

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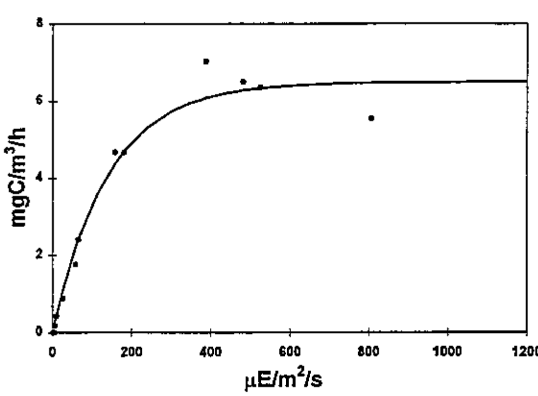

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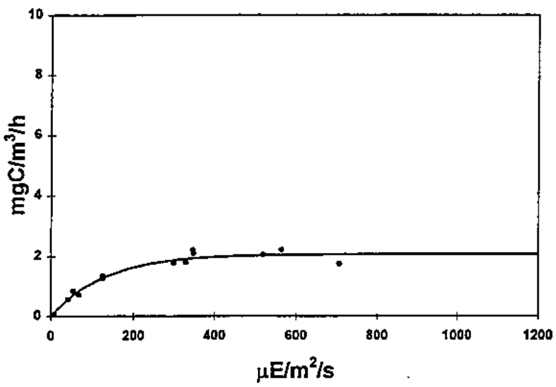

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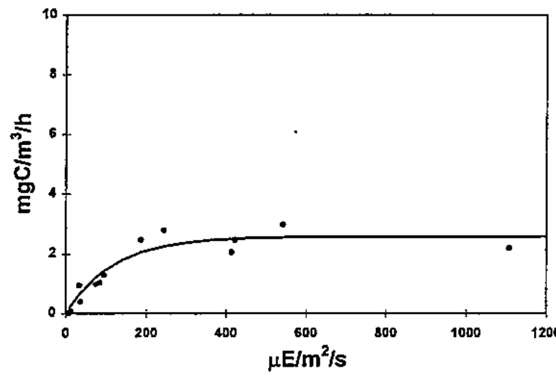

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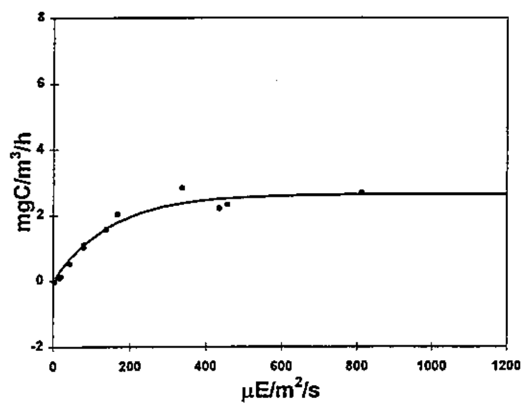

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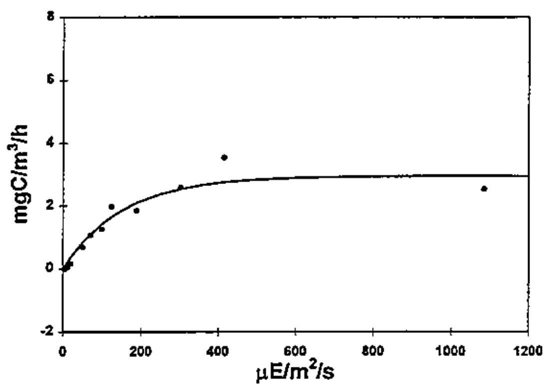

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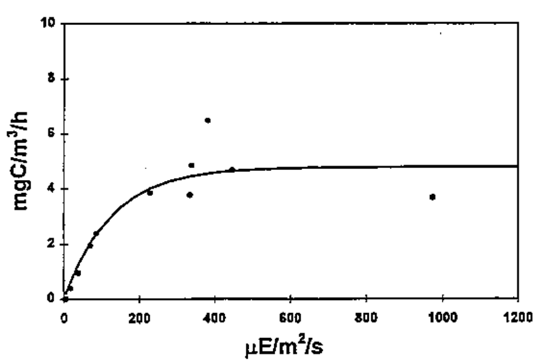

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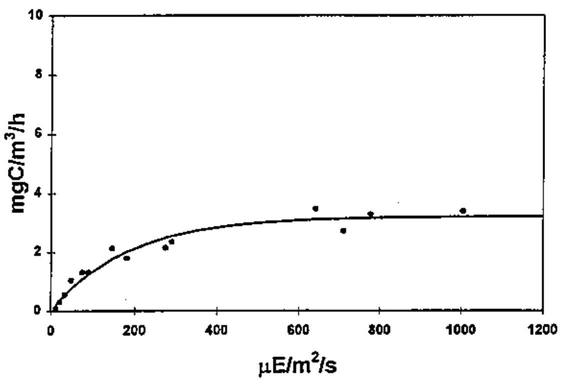

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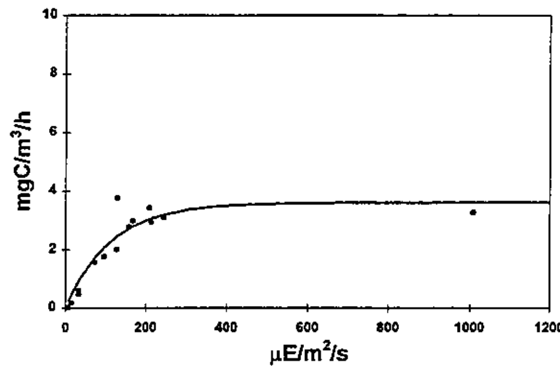

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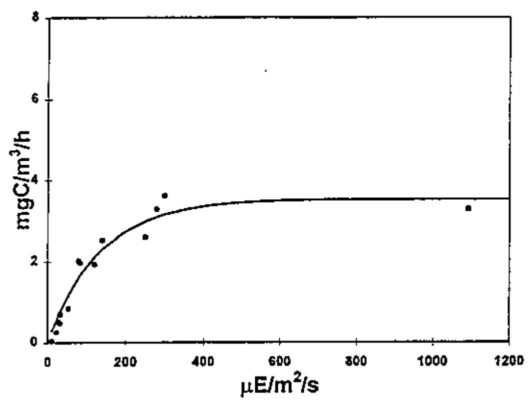

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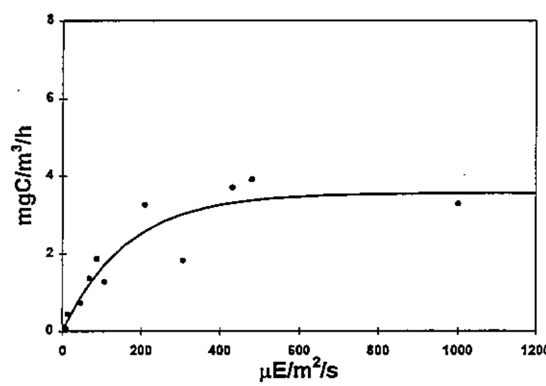

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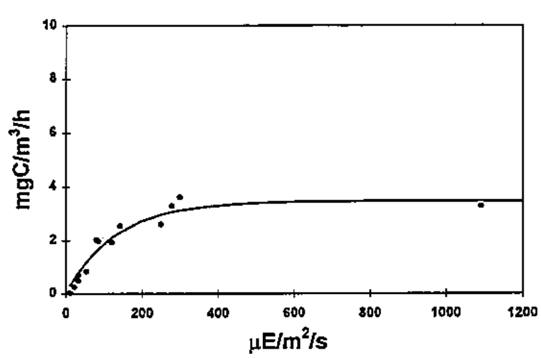

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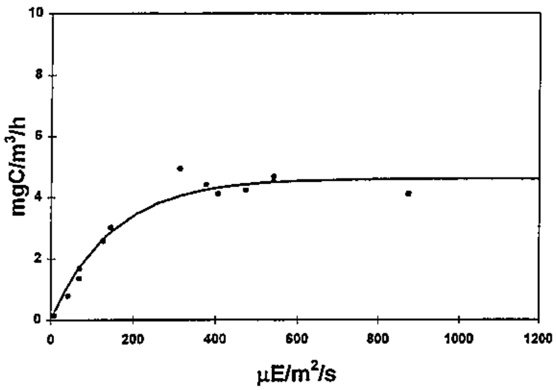

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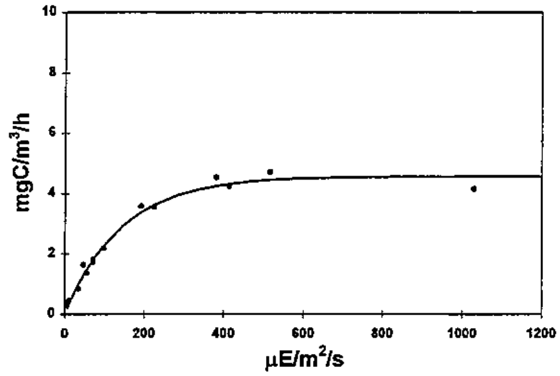

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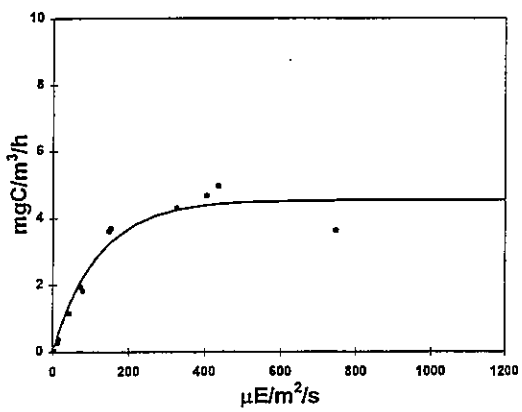

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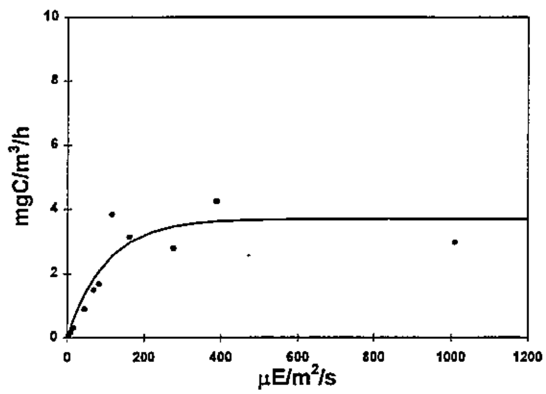

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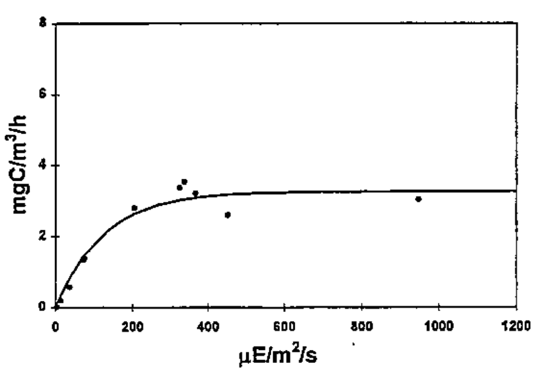
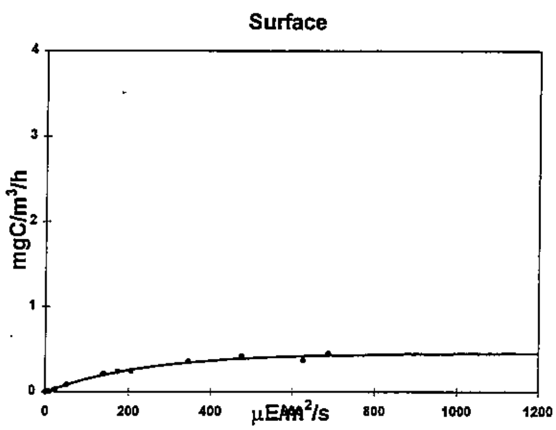
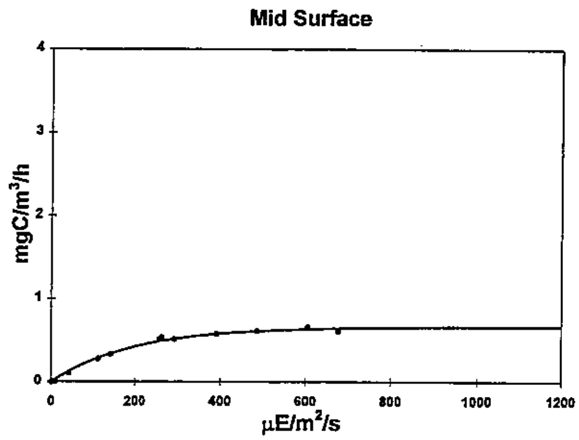
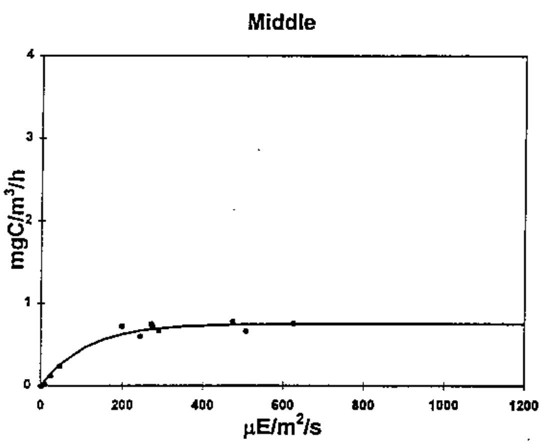
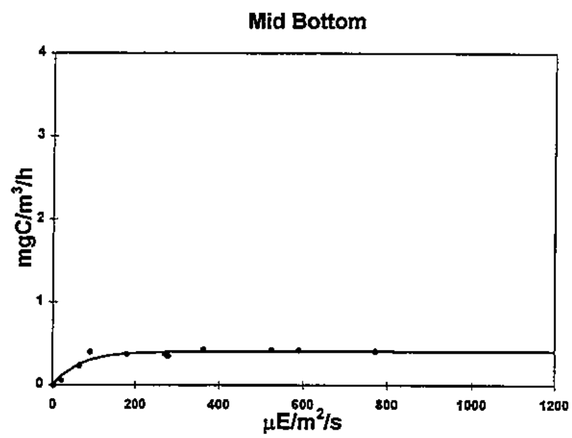


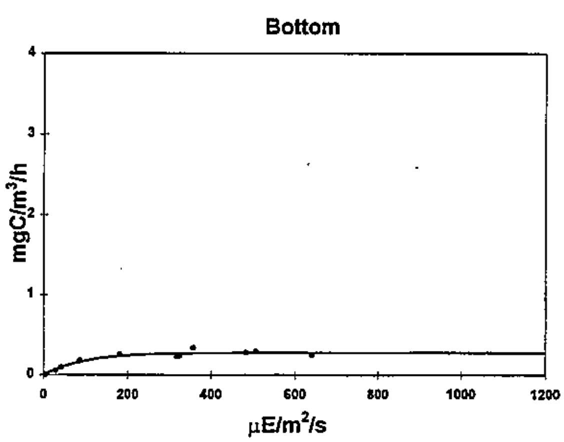
W9503 Station N04





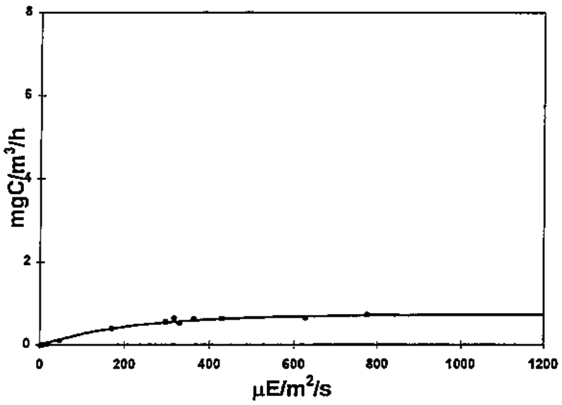






W9503 Station N16

Surface



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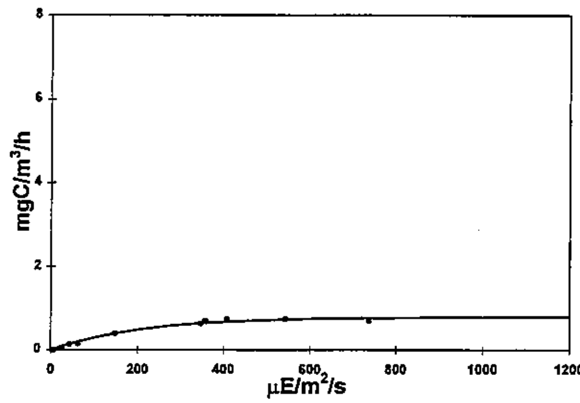

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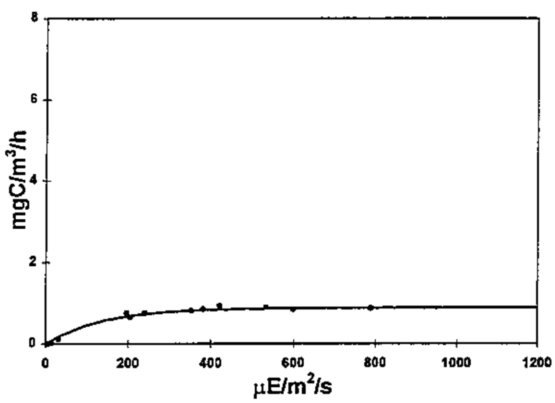

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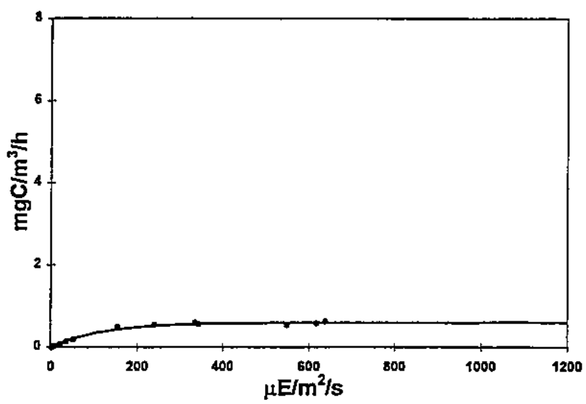

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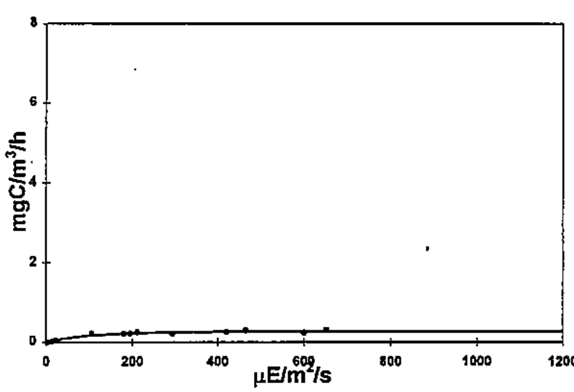
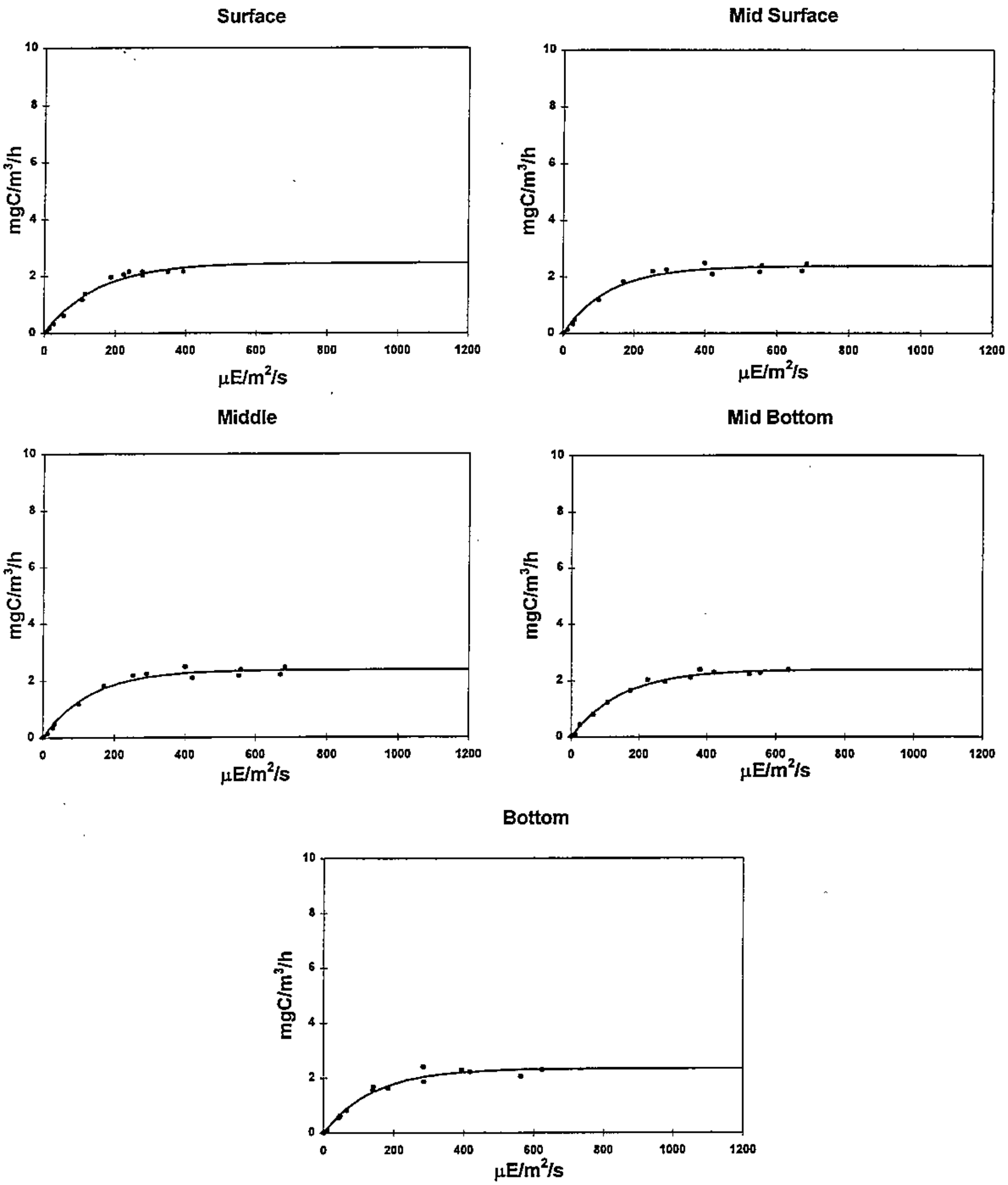
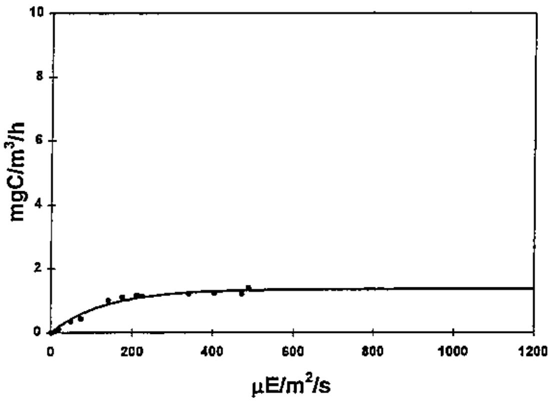


W9504 Station F23



W9504 Station N16

Surface



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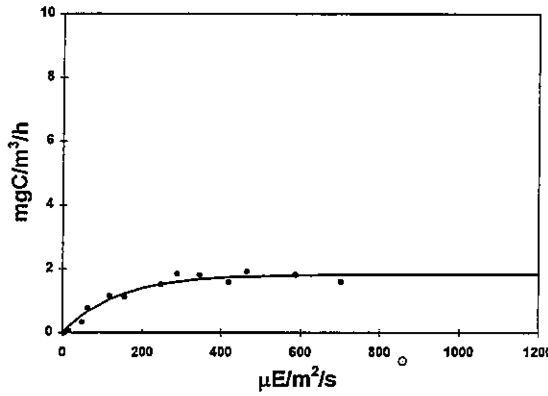

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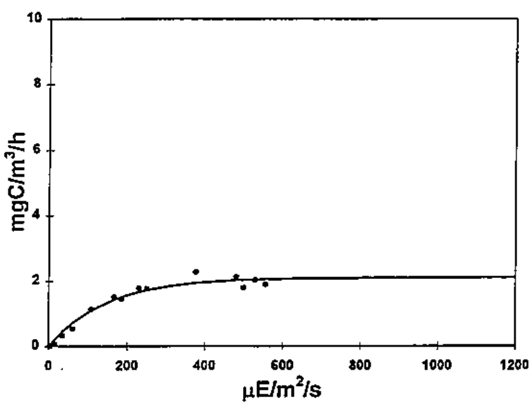

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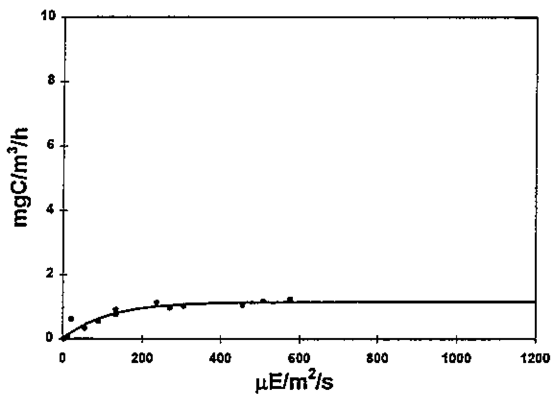

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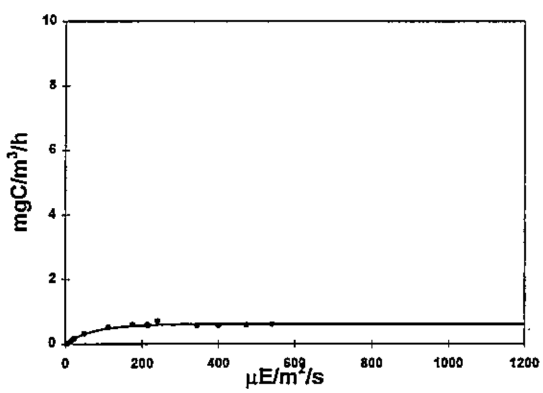
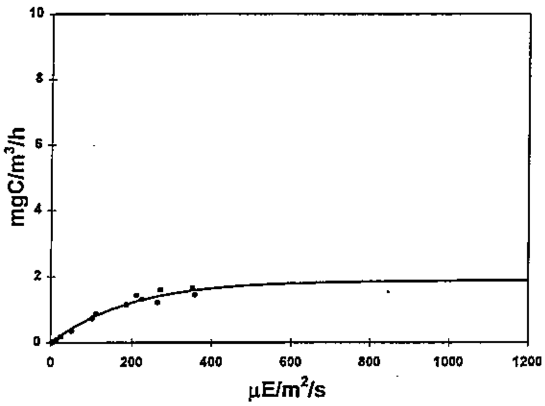


W9504 Station N04

Surface



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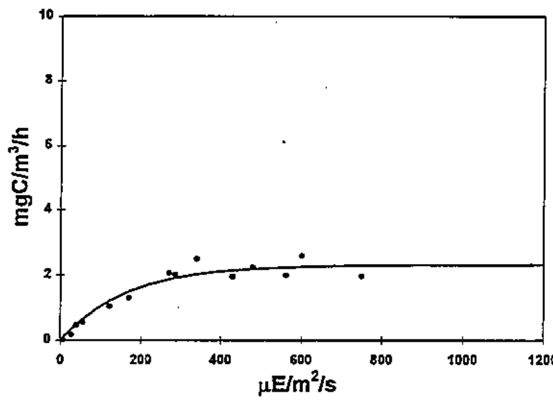

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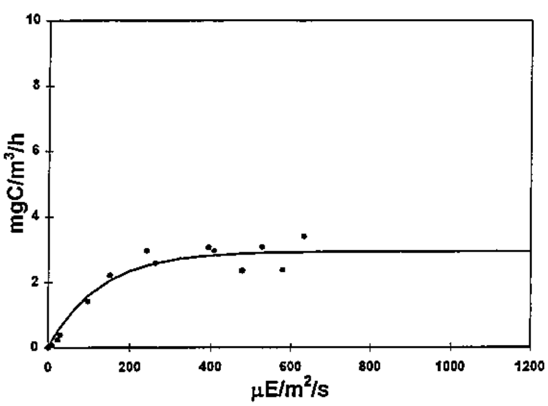

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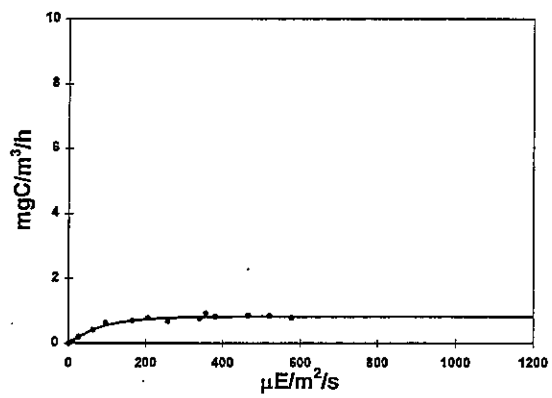

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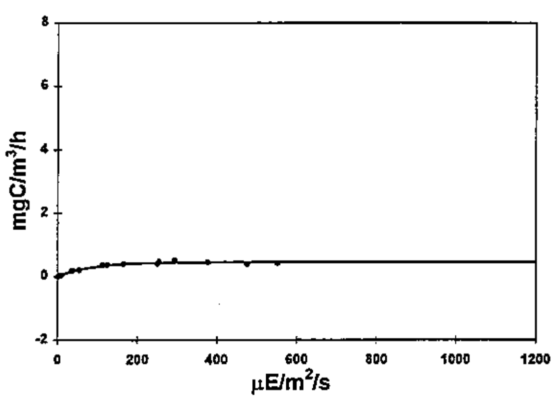
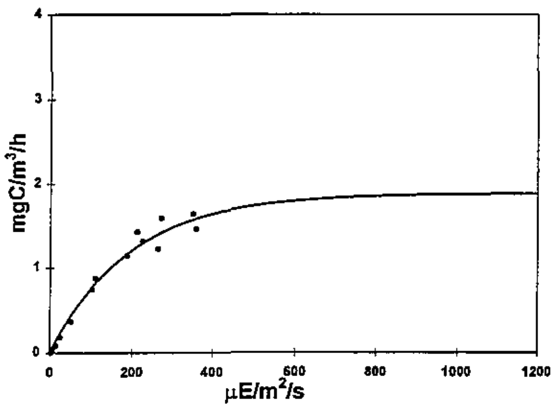


W9504 Station N07

Surface



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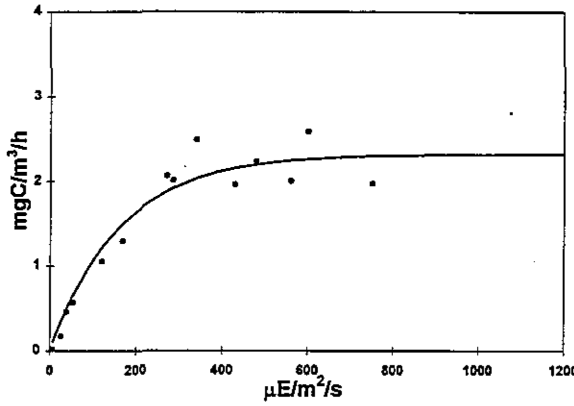

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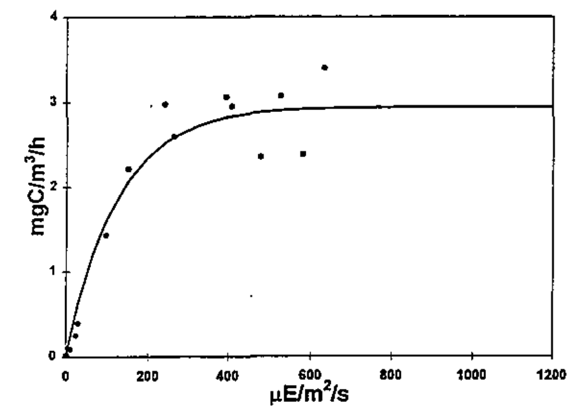

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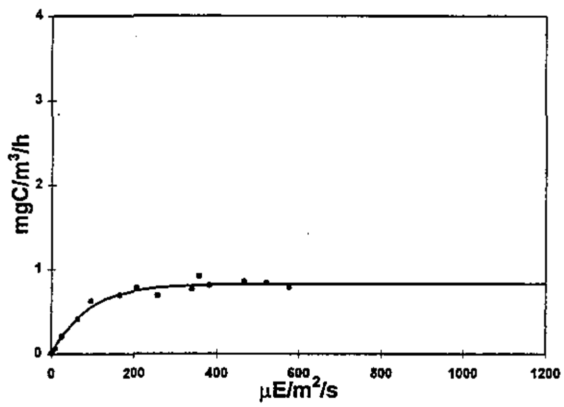

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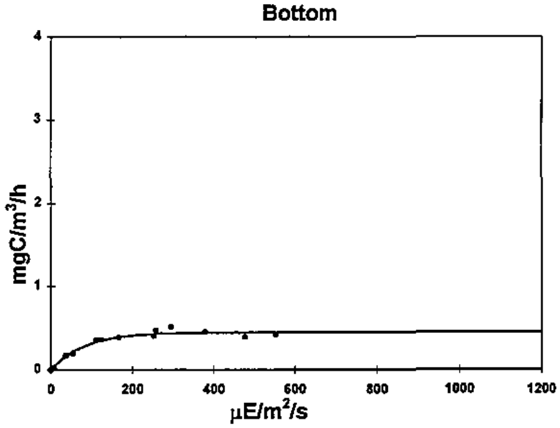
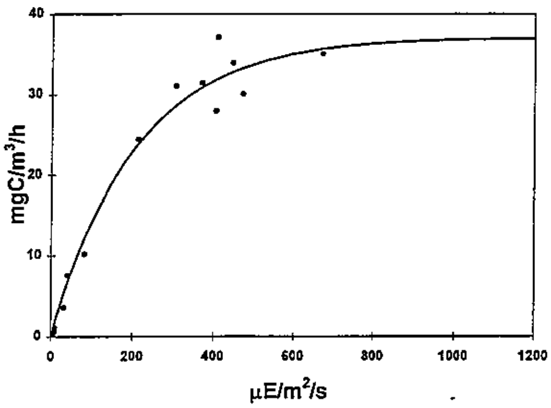


W9505 Station N16

Surface



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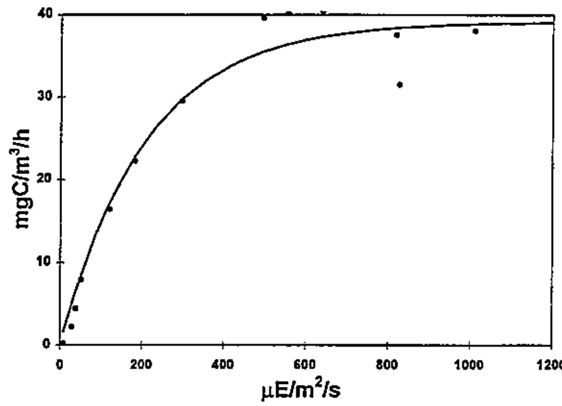

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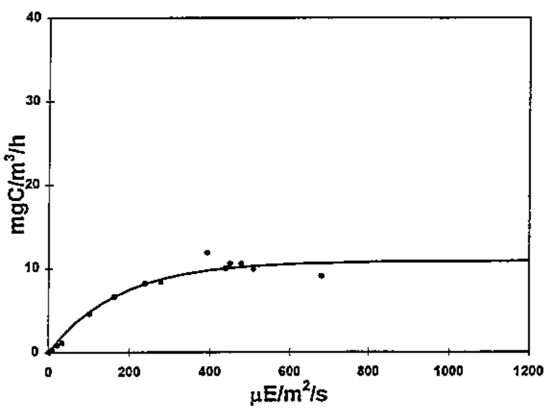

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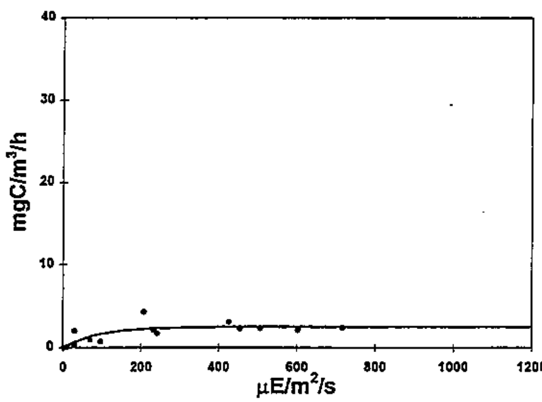

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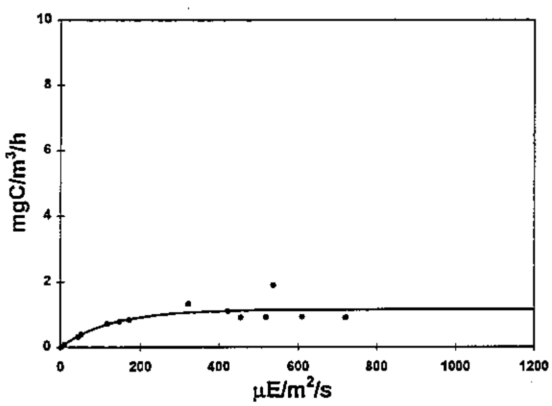
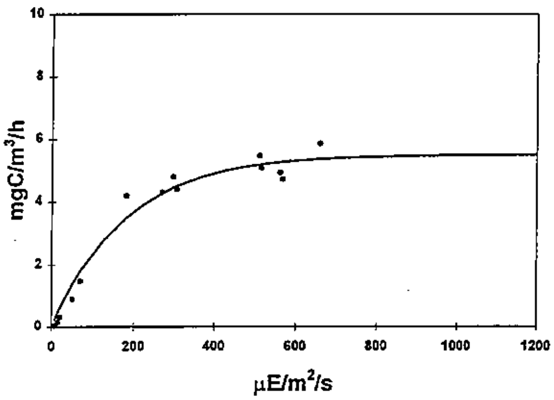


W9505 Station N04

Surface



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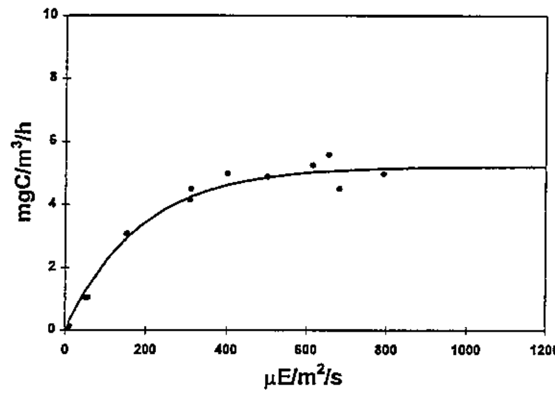

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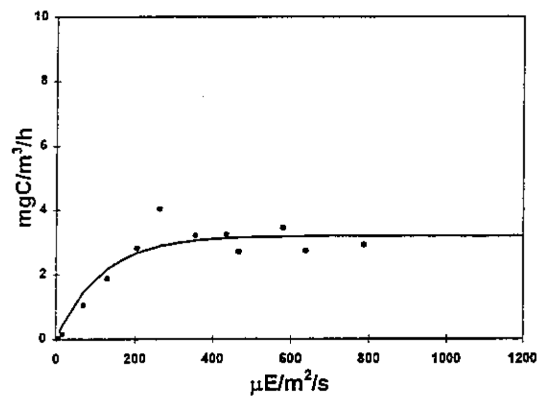

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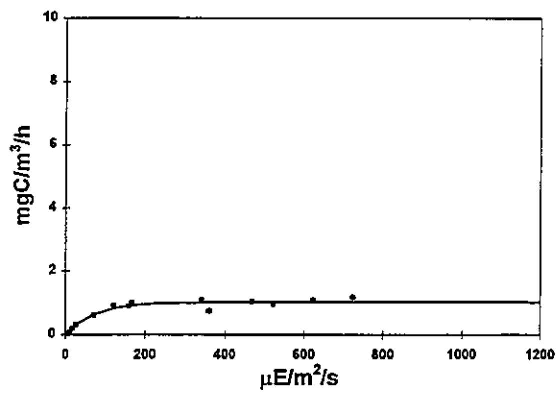

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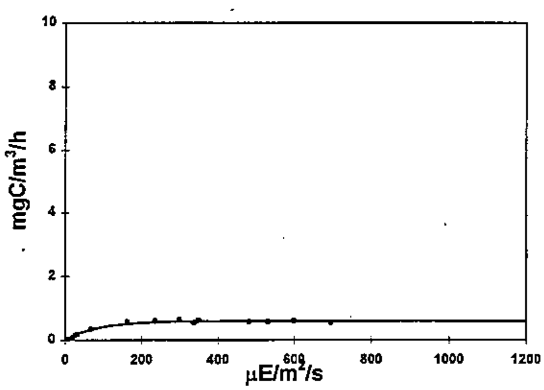
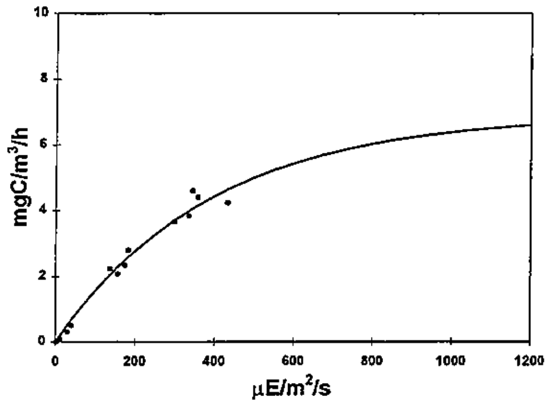


W9506 Station N04

Surface



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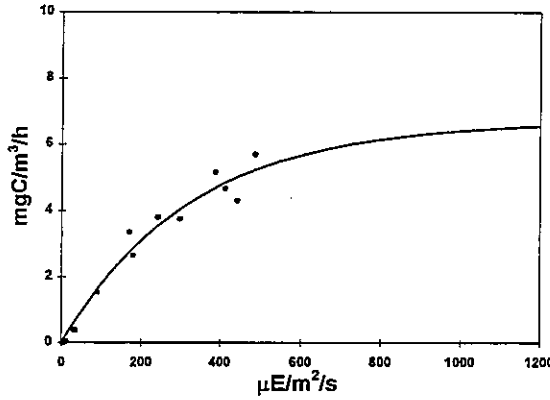

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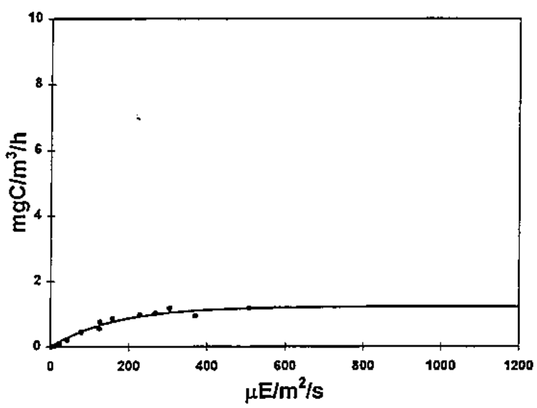

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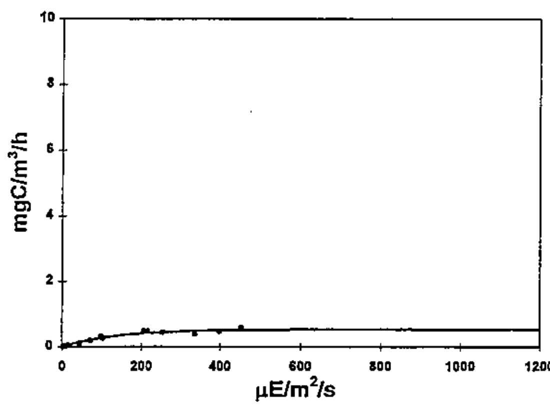

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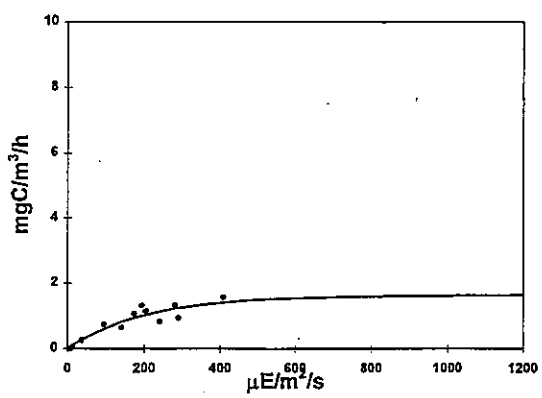
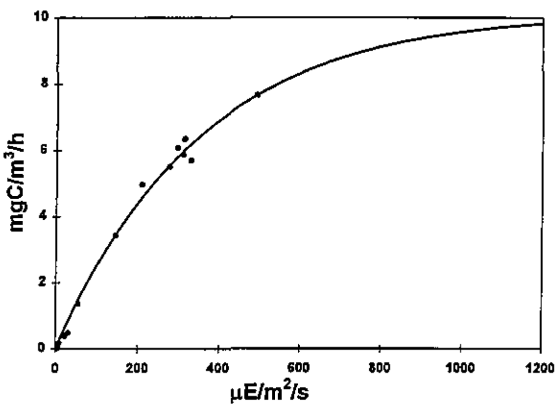


W9506 Station N16

Surface



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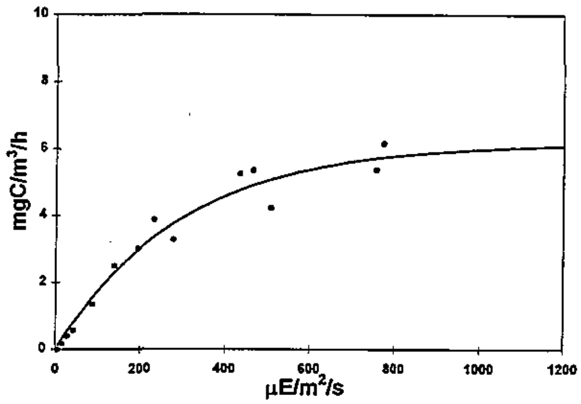

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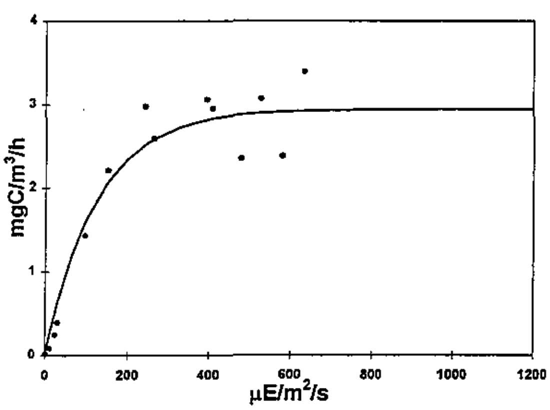

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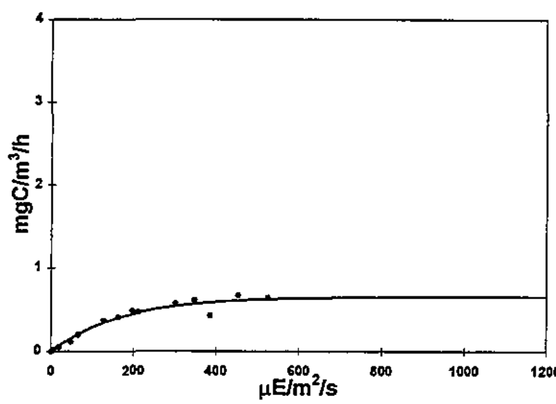

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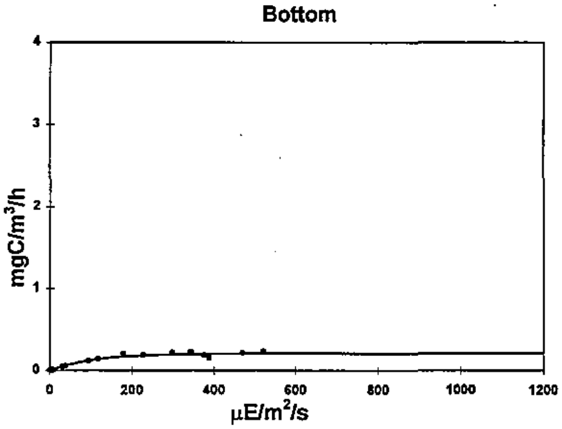
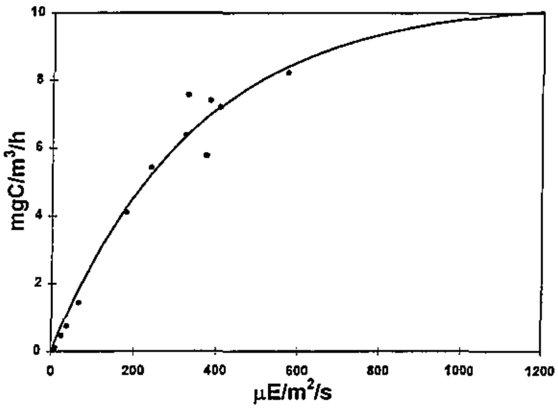


W9507 Station N04

Surface



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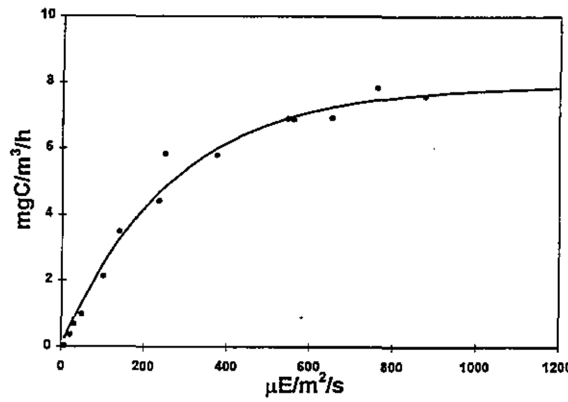

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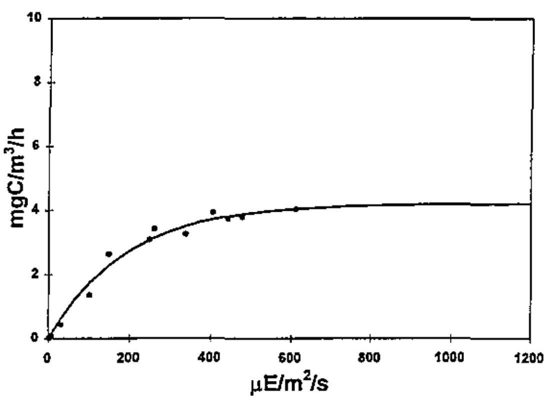

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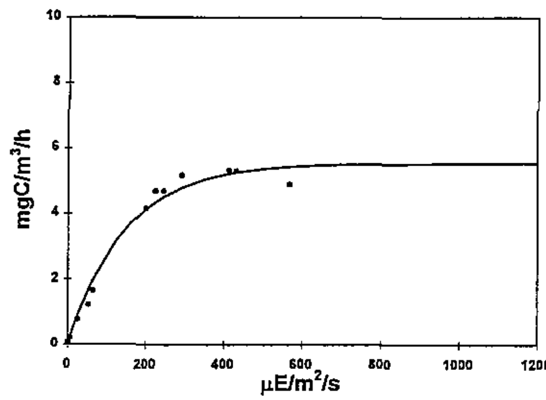

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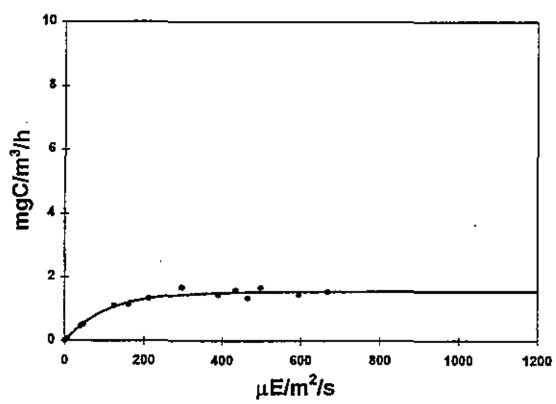
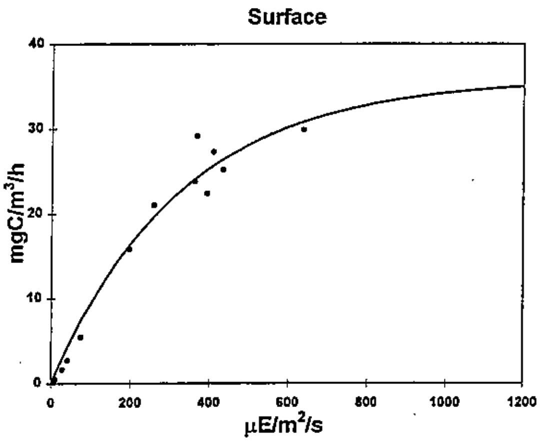
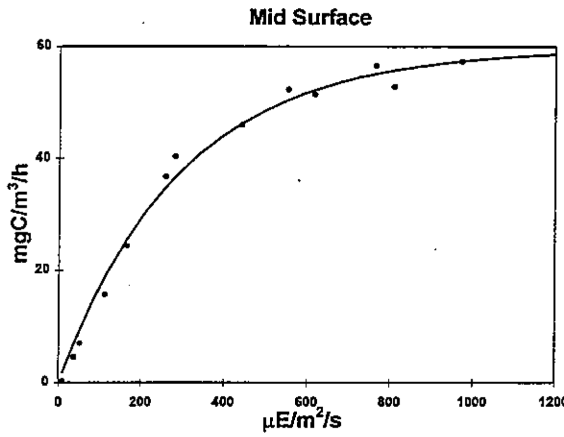
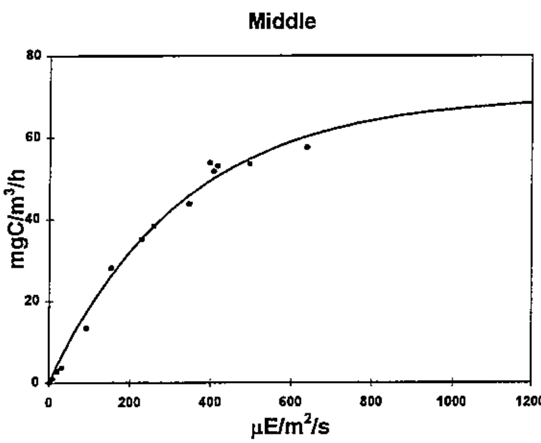
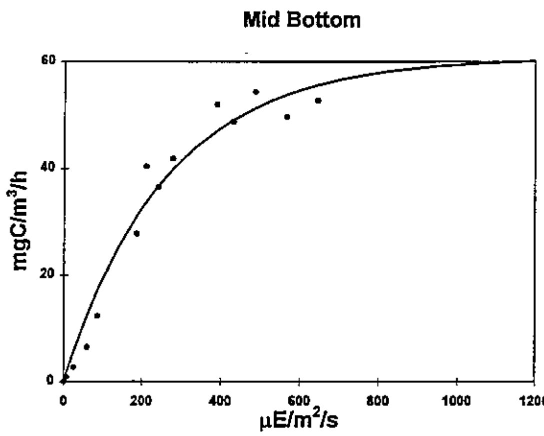


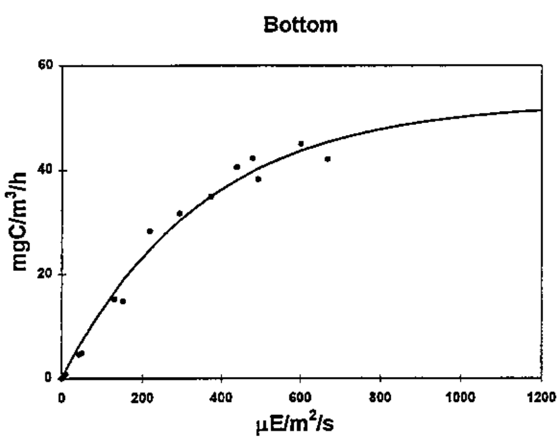
W9507 Station F23











W9507 Station N07

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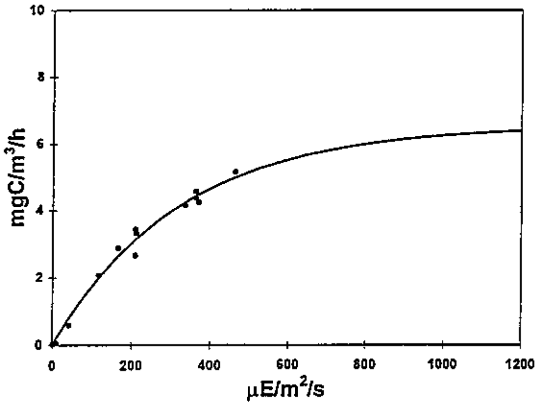

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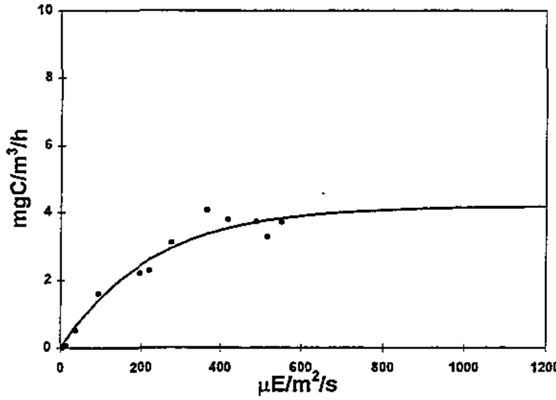

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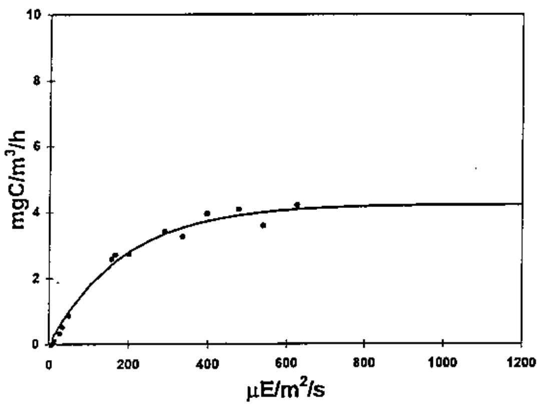

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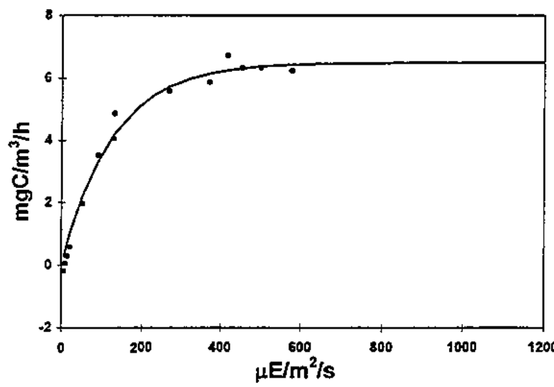

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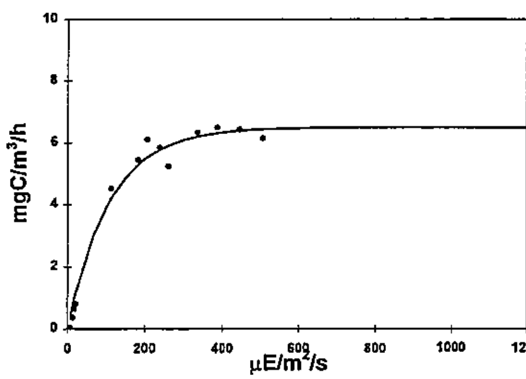

W9507 Station N16

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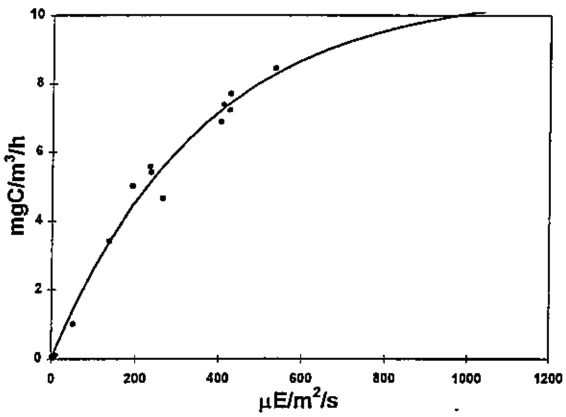

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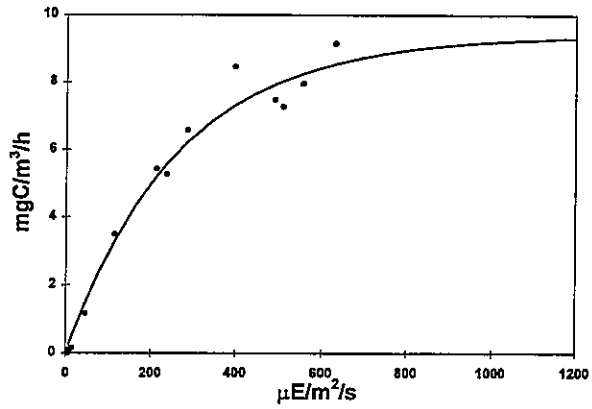

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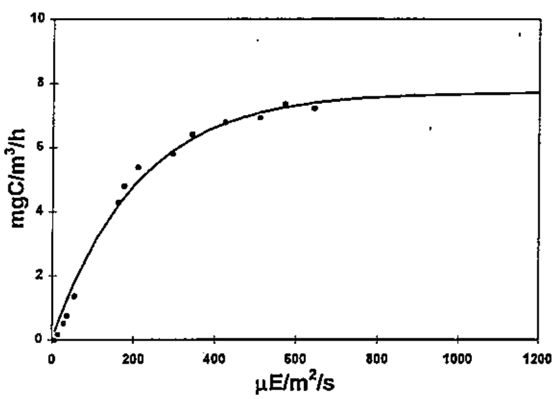

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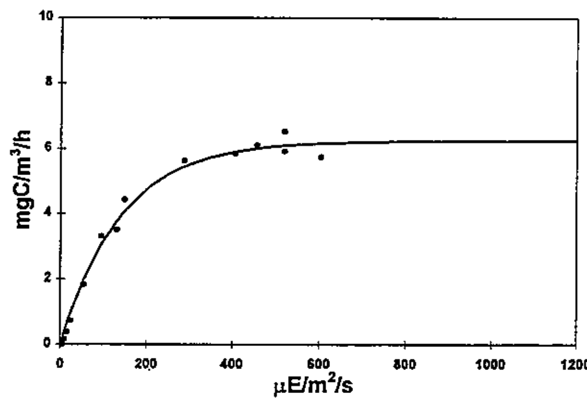

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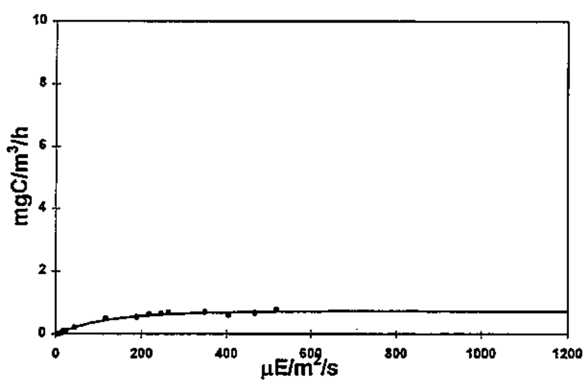

W9508 Station N16

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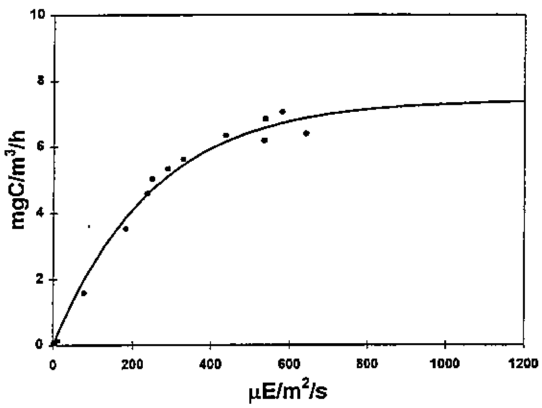

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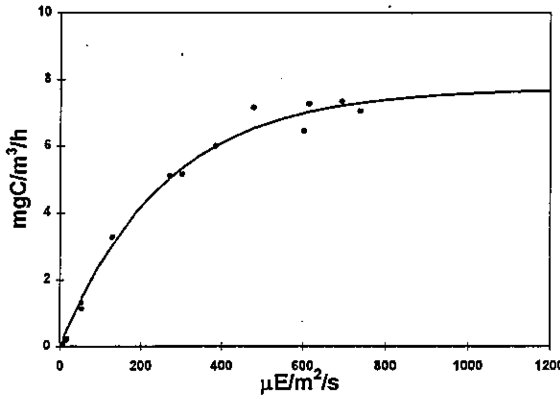

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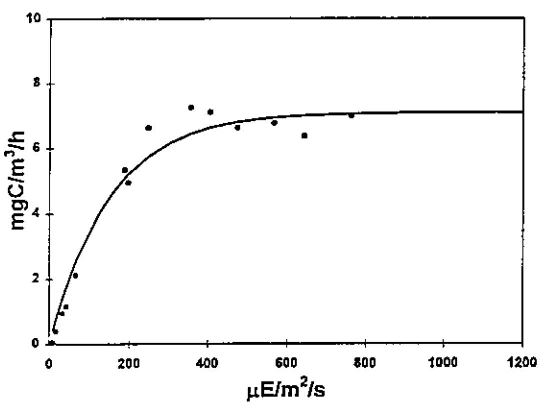

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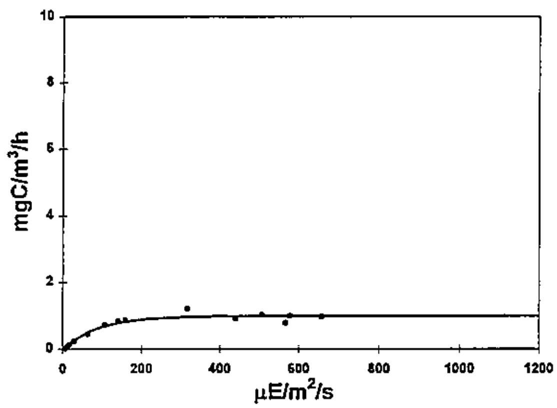

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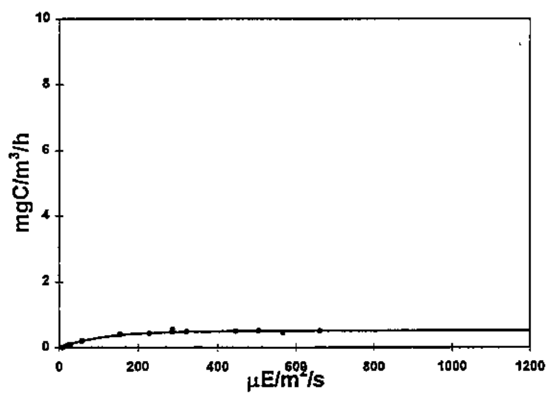

W9508 Station N04

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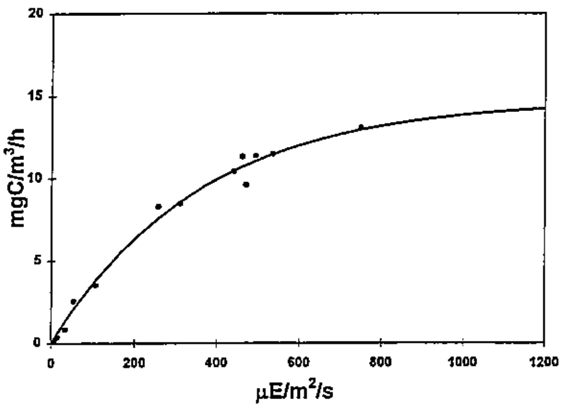

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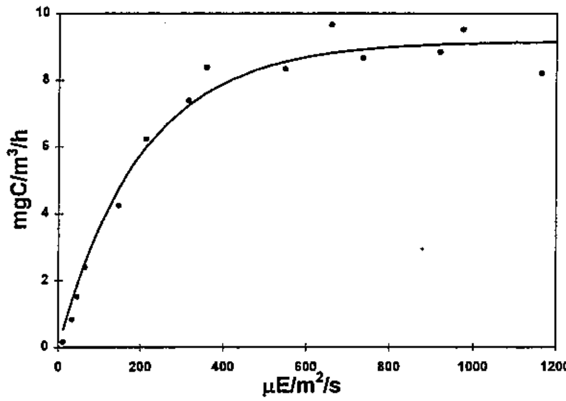

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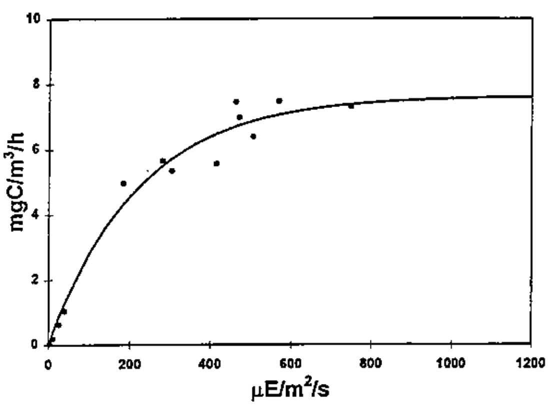

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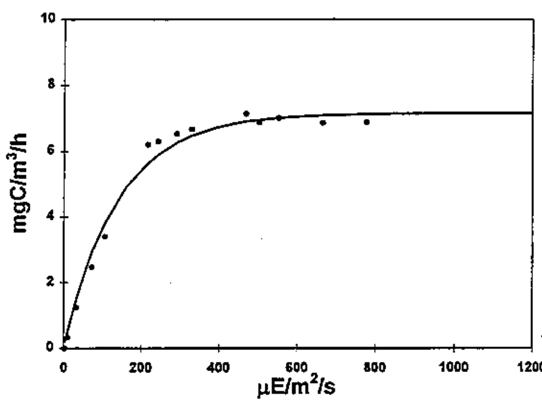

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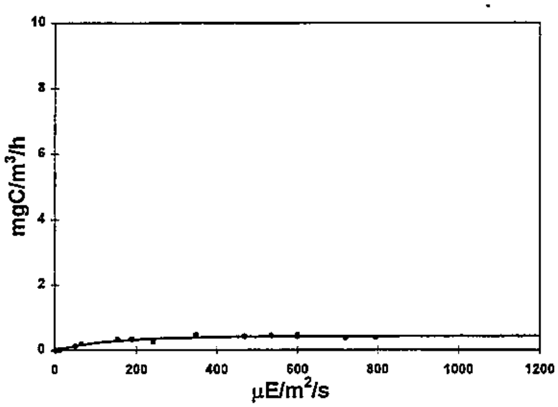

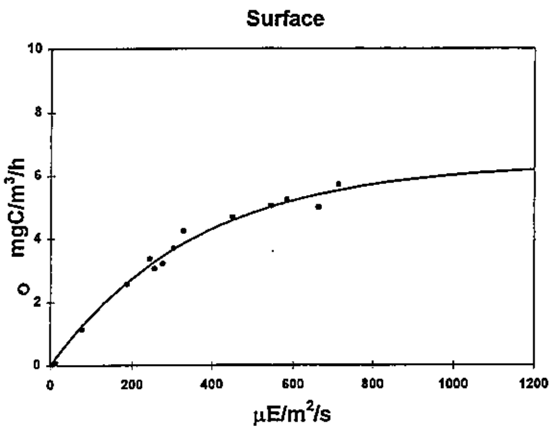
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µE/m²/s
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2
4
6
8
10
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200
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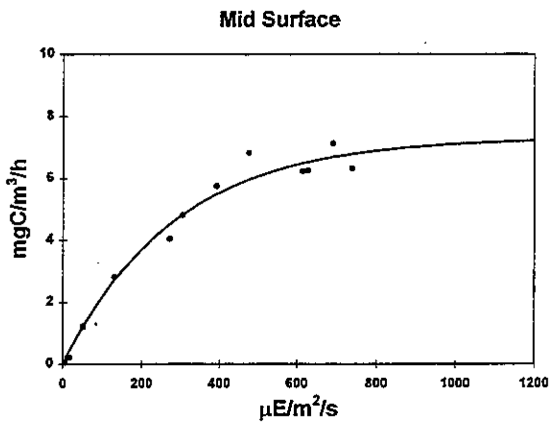
1000
1200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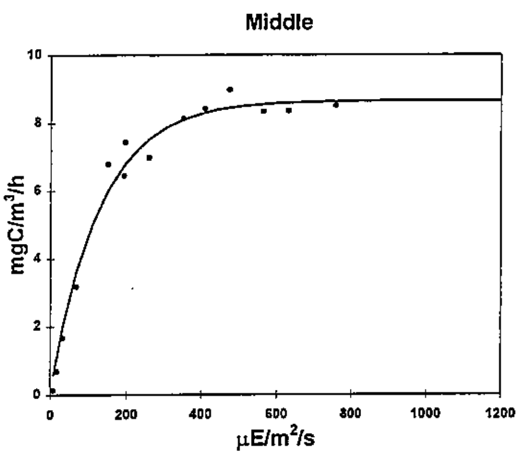
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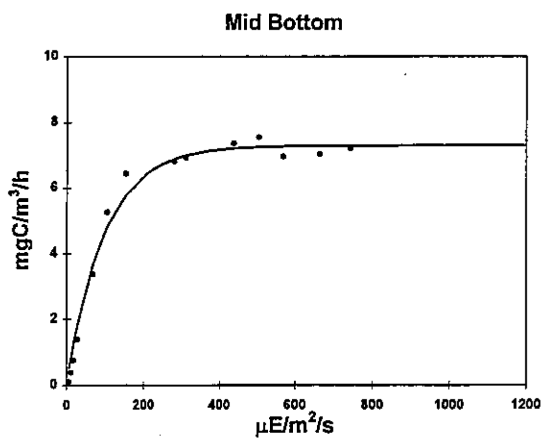
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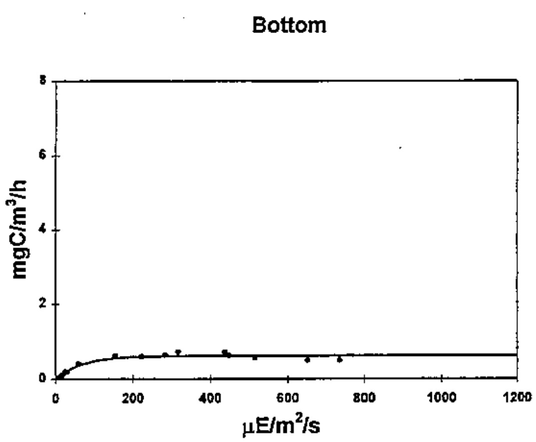
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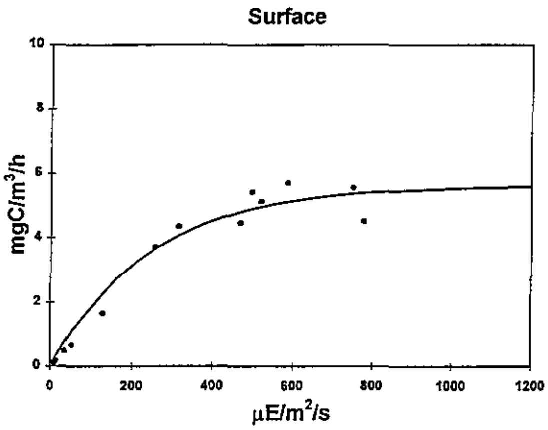
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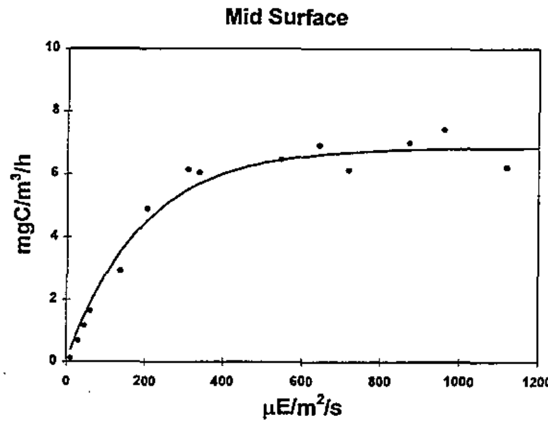
µE/m²/s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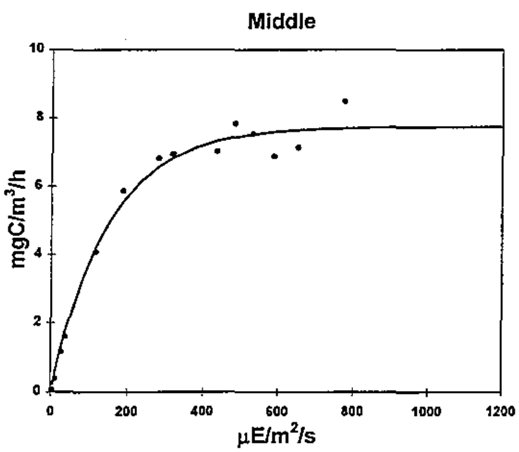
1200
µE/m²/s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2
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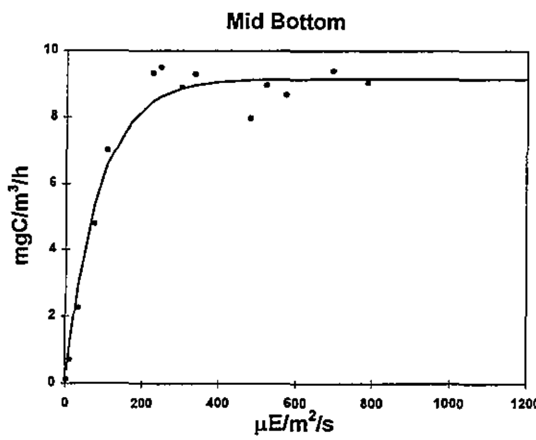
µE/m²/s


Mid Bottom
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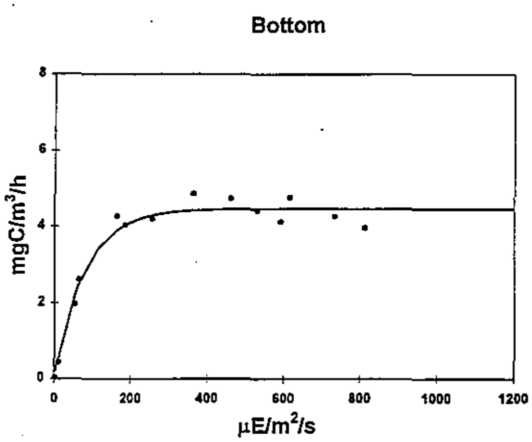
µE/m²/s


Bottom
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0
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µE/m²/s

APPENDIX F-1

ABUNDANCE OF PREVALENT SPECIES IN SURFACE SAMPLE
WHOLE WATER PHYTOPLANKTON
FEBRUARY 6-14, 1995

Abundance of Prevalent Species (> 5% Total Count) in Surface Sample
Whole Water Phytoplankton, February 6 - 14, 1995 (W9501)

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	2N16	1F06	1F27	1F01	1F02
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.031	0.037	0.068					0.066	0.046	0.032	0.045	0.077	0.085
		%	7	6	7					10	8	6	9	19	17
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L								0.064	0.033				
		%								10	6				
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L									0.029		0.028		
		%									5		6		
OSCILLATORIA CELLS #1 DIAM <5UM	O	10^6 Cells/L	0.313	0.133	0.341										
		%	67	22	37										
THALASSIOSIRA GRAVIDA	CD	10^6 Cells/L	0.033		0.068		0.024	0.023						0.113	0.124
		%	7		7		5	6						27	24
THALASSIOSIRA NORDENSKIOLDII	CD	10^6 Cells/L													0.031
		%													6
UNID. BLUE GREEN SINGLE SPHERE	O	10^6 Cells/L		0.053											
		%		9											
UNID. BLUE GREEN TRICHOME (CELL)	O	10^6 Cells/L			0.081										
		%			9										
UNID. CHOANOFLAGELLATE	MF	10^6 Cells/L												0.022	
		%												5	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L		0.202	0.207	0.463	0.251	0.237	0.330	0.369	0.306	0.343	0.317	0.032	0.144
		%		33	22	70	65	58	96	57	56	67	65	8	28
UNID. MICRO-PHYTOFLAG LENGTH >10 MICRONS	MF	10^6 Cells/L		0.072											
		%		12											

Group Definitions:

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

Abundance of Prevalent Species (> 5% Total Count) in Surface Sample
Whole Water Phytoplankton, February 28 - March 5, 1995, 1995 (W9502)

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	2N16	1F06	1F27	1FO1	1F02
CHAETOCEROS SP#1 DIAM <10 MICRONS	CD	10^6 Cells/L													0.057
		%													7
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L		0.026								0.035	0.024		0.086
		%		10								23	8		10
CYLINDROTHECA CLOSTERIUM	PD	10^6 Cells/L										0.010			
		%										7			
FRAGILARIA SP#2 LENGTH 30-60 MICRONS	PD	10^6 Cells/L			0.028									0.051	
		%			9									6	
GRAMMATOPHORA SP.	PD	10^6 Cells/L			0.021										
		%			7										
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L										0.012	0.025		0.133
		%										8	8		16
MELOSIRA SP#1 DIAM <20 MICRONS	CD	10^6 Cells/L			0.025			0.038							
		%			8			10							
RHIZOSOLENIA DELICATULA	CD	10^6 Cells/L												0.053	0.084
		%												6	10
THALASSIONEMA NITZSCHIOIDES	PD	10^6 Cells/L										0.010			
		%										7			
THALASSIOSIRA GRAVIDA	CD	10^6 Cells/L		0.017											
		%		6											
THALASSIOSIRA SP#1 DIAM <20 MICRONS	CD	10^6 Cells/L		0.035										0.081	0.043
		%		13										9	5
THALASSIOSIRA SP#2 DIAM >20 MICRONS	CD	10^6 Cells/L	0.034		0.021		0.041	0.027		0.030	0.024	0.015		0.073	
		%	9		7		10	7		8	7	10		8	
UNID. BLUE GREEN SINGLE SPHERE	O	10^6 Cells/L	0.023		0.015		0.032	0.024	0.025						0.127
		%	6		5		8	6	7						15
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.028		0.019		0.026			0.021	0.046				0.082
		%	7		7		7			5	14				10
UNID. CENTRIC DIATOM DIAM 10-30 MICRONS	CD	10^6 Cells/L		0.017								0.011			
		%		6								7			
UNID. CHOANOFLAGELLATE	MF	10^6 Cells/L		0.046											
		%		18											
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.240	0.049	0.130	0.308	0.230	0.226	0.250	0.172	0.152	0.023	0.169	0.361	0.094
		%	63	19	44	70	59	57	67	44	45	15	56	41	11

Group Definitions:

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

Abundance of Prevalent Species (> 5% Total Count) in Surface Sample
Whole Water Phytoplankton, March 20 - 22, 1995 (W9503)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.0683	0.0559
		%	46	72
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.0095	
		%	6	
UNID. CHOANOFLAGELLATE	MF	10^6 Cells/L	0.0102	
		%	7	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.0402	0.0092
		%	27	12

Group Definitions:

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

Abundance of Prevalent Species (> 5% Total Count) in Surface Sample
Whole Water Phytoplankton, April 3 - 10, 1995 (W9504)

			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	2N16	1F06	1F27	1F01	1F02
CHAETOCEROS SP#2 DIAM 10-30 MICRONS	CD	10^6 Cells/L												0.707	0.155
		%												37	15
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L									0.026	0.031			
		%									5	6			
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.181	0.468	0.240	0.061	0.069	0.122	0.072	0.040	0.060	0.043	0.028	0.143	0.114
		%	23	37	25	8	12	16	11	11	12	8	7	7	11
FRAGILARIA SP#3 LENGTH >60 MICRONS	PD	10^6 Cells/L								0.028					
		%								7					
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L								0.040	0.057	0.046	0.041		
		%								10	11	8	11		
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.107	0.072										
		%		8	8										
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.473	0.501	0.455	0.632	0.427	0.493	0.451	0.210	0.275	0.402	0.272	0.579	0.584
		%	60	39	48	83	76	66	68	55	55	71	71	30	55

Group Definitions:

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

Abundance of Prevalent Species (> 5% Total Count) in Surface Sample
Whole Water Phytoplankton, April 24 - 27, 1995 (W9505)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
CHAETOCEROS SP#2 DIAM 10-30 MICRONS	CD	10^6 Cells/L	0.4634	0.4025
		%	22	25
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.7379	0.2561
		%	36	16
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L		
		%		
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.1677	0.2165
		%	8	14
UNID. CENTRIC DIATOM DIAM 10-30 MICRONS	CD	10^6 Cells/L		
		%		
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.4208	0.3842
		%	20	24

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

Abundance of Prevalent Species (> 5% Total Count) in Surface Sample
Whole Water Phytoplankton, May 15 - 17, 1995 (W9506)

			Nearfield Stations	
Species	Group	Parameter	1N10	1N16
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.3093	0.1719
		%	31	22
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L		
		%		
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRON	MF	10^6 Cells/L	0.5532	0.4527
		%	56	58

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

Abundance of Prevalent Species (> 5% Total Count) in Surface Sample
Whole Water Phytoplankton, June 20 - 25, 1995 (W9507)

			Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
Species	Group	Parameter	2F23	1F30	1F31	1F13	1F24	1F25	1N10	1N16	3N16	1F06	1F27	1F01	1F02
Calycomonas Wulfii	O	10^6 Cells/L	0.132												
		%	6												
Cryptomonas Sp#1 Length <10 Microns	MF	10^6 Cells/L				0.159									
		%				5									
Cryptomonas Sp#2 Length >10 Microns	MF	10^6 Cells/L				0.213	0.564					0.351			
		%				7	6					16			
Fragilaria Sp#2 Length 30-60 Microns	PD	10^6 Cells/L													0.137
		%													6
Rhizosolenia Fragilissima	CD	10^6 Cells/L	0.132												
		%	6												
Unid. Centric Diatom Diam <10 Microns	CD	10^6 Cells/L		3.720	7.531		2.561	1.936	2.555	0.503	0.281				
		%		24	43		28	20	21	8	6				
Unid. Micro-Phytoflag Length <10 Microns	MF	10^6 Cells/L	1.307	10.001	8.019	2.006	3.903	6.052	7.056	4.787	3.267	1.601	0.507	1.217	1.504
		%	64	63	46	67	42	61	58	73	72	73	86	78	68
Unid. Micro-Phytoflag Length >10 Microns	MF	10^6 Cells/L					1.265								
		%					14								
Group Definitions:	CD	Centric Diatom													
	DF	Dinoflagellate													
	MF	Microflagellate													
	O	Other													
	PD	Pennate Diatom													

Abundance of Prevalent Species (> 5% Total Count) in Surface Sample
Whole Water Phytoplankton, July 5 - 7, 1995 (W9508)

Species	Group	Parameter	Nearfield Stations 1N10	Nearfield Stations 2N16
Rhizosolenia Fragilissima	CD	10^6 Cells/L	3.1100	
		%	15	
Unid. Centric Diatom Diam <10 Microns	CD	10^6 Cells/L	2.7136	1.1098
		%	13	15
Unid. Micro-Phytoflag Length <10 Microns	MF	10^6 Cells/L	11.3423	4.7930
		%	55	65
Group Definitions:	CD	Centric Diatom		
	DF	Dinoflagellate		
	MF	Microflagellate		
	O	Other		
	PD	Pennate Diatom		

Abundance of Prevalent Species (> 5% Total Count) in Surface Sample
Whole Water Phytoplankton, July 24 - 26, 1995 (W9509)

Species	Group	Parameter	Nearfield Stations	
			1N10	3N16
Cryptomonas Sp#2 Length >10 Microns	MF	10^6 Cells/L	0.7623	
		%	8	
Unid. Centric Diatom Diam <10 Microns	CD	10^6 Cells/L	4.1466	
		%	45	
Unid. Micro-Phytoflag Length <10 Microns	MF	10^6 Cells/L	3.2015	1.8396
		%	34	86

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 WHOLE WATER PHYTOPLANKTON FEBRUARY 6-14, 1995

Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample
Whole Water Phytoplankton, February 6 - 14, 1995 (W9501)

Species	Group		Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
			1F23	1F30	1F31	1F13	1F24	1F25	1N10	1N16	2N16	1F06	1F27	1F01	1F02
COSCINOSIRA POLYCHORDA	CD	10^6 Cells/L													0.026
		%													6
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.029							0.057	0.058		0.043	0.083	0.063
		%	5							5	9		8	15	13
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.034				0.032				0.056	0.035	0.101		
		%	6				6				9	7	19		
FRAGILARIA SP#2 LENGTH 30-60 MICRONS	PD	10^6 Cells/L						0.035							
		%						6							
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L									0.037		0.052		
		%									6		10		
RHIZOSOLENIA DELICATULA	CD	10^6 Cells/L													0.029
		%													6
THALASSIONEMA NITZSCHIOIDES	PD	10^6 Cells/L												0.028	0.044
		%												5	9
THALASSIOSIRA GRAVIDA	CD	10^6 Cells/L	0.030									0.026		0.122	0.086
		%	6									5		22	18
THALASSIOSIRA SP#2 DIAM >20 MICRONS	CD	10^6 Cells/L													0.025
		%													5
UNID. BLUE GREEN TRICHOME (CELL)	O	10^6 Cells/L		0.030											
		%		5											
UNID. CHOANOFLAGELLATE	MF	10^6 Cells/L												0.037	
		%												7	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRON	MF	10^6 Cells/L	0.285	0.389	0.395	0.556	0.334	0.343	0.279	0.519	0.294	0.290	0.203	0.145	0.095
		%	53	64	63	76	64	56	66	48	46	58	38	27	20
UNID. MICRO-PHYTOFLAG LENGTH >10 MICRON	MF	10^6 Cells/L		0.043	0.061						0.037				
		%		7	10						6				

Group Definitions:

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

Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample
Whole Water Phytoplankton, February 28 - March 5, 1995 (W9502)

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	2N16	1F06	1F27	1F01	1F02
ANABAENA SP.	O	10^6 Cells/L											0.030		
		%											11		
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L									0.058	0.017		0.065	0.070
		%									19	6		8	8
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L				0.020			0.023			0.021			
		%				6			7			7			
FRAGILARIA SP#2 LENGTH 30-60 MICRONS	PD	10^6 Cells/L												0.094	
		%												11	
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L									0.020		0.022		0.475
		%									7		8		52
GYMNODINIUM SP.#2 21-40UM W 21-50UM L	DF	10^6 Cells/L									0.015				
		%									5				
MELOSIRA SP#1 DIAM <20 MICRONS	CD	10^6 Cells/L						0.203					0.015		
		%						41					5		
RHIZOSOLENIA DELICATULA	CD	10^6 Cells/L												0.061	0.070
		%												7	8
THALASSIOSIRA SP#1 DIAM <20 MICRONS	CD	10^6 Cells/L								0.046	0.020			0.065	
		%								8	7			8	
THALASSIOSIRA SP#2 DIAM >20 MICRONS	CD	10^6 Cells/L	0.045		0.019	0.022	0.044			0.054		0.016	0.015		
		%	7		6	7	12			10		5	5		
UNID. BLUE GREEN SINGLE SPHERE	O	10^6 Cells/L		0.047							0.022				
		%		6							7				
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.043		0.020			0.020	0.028	0.017	0.016			
		%		5		6			6	5	6	5			
UNID. CHOANOFLAGELLATE	MF	10^6 Cells/L													0.057
		%													6
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.427	0.579	0.210	0.199	0.213	0.149	0.194	0.261	0.069	0.148	0.133	0.298	
		%	69	70	63	59	56	30	59	48	23	48	48	35	

Group Definitions:

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

Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample
Whole Water Phytoplankton, March 20 - 22, 1995 (W9503)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L	0.0338	0.0215
		%	50	49
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L		0.0038
		%		9
GYRODINIUM SP#1 5-20UM W 10-20UM L	DF	10^6 Cells/L		0.0024
		%		5
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.0034	
		%	5	
UNID. CHOANOFLAGELLATE	MF	10^6 Cells/L	0.0048	
		%	7	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.0140	0.0123
		%	21	28
Group Definitions:	CD	Centric Diatom		
	DF	Dinoflagellate		
	MF	Microflagellate		
	O	Other		
	PD	Pennate Diatom		

Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample
Whole Water Phytoplankton, April 3 - 10, 1995 (W9504)

			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	2N16	1F06	1F27	1F01	1F02
CHAETOCEROS SP#2 DIAM 10-30 MICRONS	CD	10^6 Cells/L												1.223	0.142
		%												51	12
CRYPTOMONAS SP#1 LENGTH <10 MICRONS	MF	10^6 Cells/L							0.076	0.025					
		%							13	7					
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.108	0.246	0.254	0.055	0.035	0.118	0.077	0.034	0.032	0.075		0.201	0.102
		%	16	31	24	11	8	16	13	9	7	13		8	9
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L				0.057	0.023		0.030	0.045	0.084	0.070	0.040		
		%				11	5		5	12	18	12	12		
KATODINIUM ROTUNDATUM	DF	10^6 Cells/L												0.125	
		%												5	
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L		0.047	0.068										
		%		6	8										
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.474	0.335	0.556	0.345	0.318	0.484	0.294	0.248	0.306	0.370	0.262	0.564	0.650
		%	68	42	52	67	74	65	50	65	64	63	75	24	56

Group Definitions:

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

Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample
Whole Water Phytoplankton, April 24 - 27, 1995 (W9505)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
CHAETOCEROS SP#2 DIAM 10-30 MICRONS	CD	10^6 Cells/L	0.0774	0.0488
		%	8	7
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.1243	0.0427
		%	13	6
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L	0.1009	0.1860
		%	11	26
UNID. CENTRIC DIATOM DIAM <10 MICRONS	CD	10^6 Cells/L	0.1079	0.0457
		%	11	6
UNID. CENTRIC DIATOM DIAM 10-30 MICRONS	CD	10^6 Cells/L	0.0563	
		%	6	
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRONS	MF	10^6 Cells/L	0.3846	0.2973
		%	40	41

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

Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample
Whole Water Phytoplankton, May 15 - 17, 1995 (W9506)

Species	Group	Parameter	Nearfield Stations	
			1N10	1N16
CRYPTOMONAS SP#2 LENGTH >10 MICRONS	MF	10^6 Cells/L	0.4955	0.0146
		%	43	5
GYMNODINIUM SP.#1 5-20UM W 10-20UM L	DF	10^6 Cells/L		0.0444
		%		16
UNID. MICRO-PHYTOFLAG LENGTH <10 MICRON	MF	10^6 Cells/L	0.5387	0.1929
		%	47	68

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

Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll a Maximum Sample
Whole Water Phytoplankton, June 20 - 25, 1995 (W9507)

			Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
Species	Group	Parameter	2F23	1F30	1F31	1F13	1F24	1F25	1N10	1N16	3N16	1F06	1F27	1F01	1F02
Cryptomonas Sp#1 Length <10 Microns	MF	10^6 Cells/L									0.224				
		%									5				
Cryptomonas Sp#2 Length >10 Microns	MF	10^6 Cells/L				0.183				0.232	0.335	0.118			
		%				6				7	8	7			
Katodinium Rotundatum	DF	10^6 Cells/L				0.402									
		%				13									
Unid. Centric Diatom Diam <10 Microns	CD	10^6 Cells/L	2.744	4.330	3.598		3.217		1.890				0.019		
		%	28	23	24		30		25				8		
Unid. Micro-Phytoflag Length <10 Microns	MF	10^6 Cells/L	5.473	12.166	9.879	2.067	6.113	5.625	4.223	2.728	3.445	1.468	0.199	2.567	1.414
		%	57	65	65	64	56	77	56	82	81	81	79	78	76

Group Definitions:

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

Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample
Whole Water Phytoplankton, July 5 - 7, 1995 (W9508)

			Nearfield Stations	
Species	Group	Parameter	1N10	2N16
Rhizosolenia Fragilissima	CD	10^6 Cells/L	2.8965	
		%	15	
Unid. Centric Diatom Diam <10 Microns	CD	10^6 Cells/L	2.3782	
		%	13	
Unid. Micro-Phytoflag Length <10 Microns	MF	10^6 Cells/L	10.9764	4.2808
		%	59	75

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

Abundance of Prevalent Species (> 5% Total Count) in Chlorophyll *a* Maximum Sample
Whole Water Phytoplankton, July 24 - 26, 1995 (W9509)

Species	Group	Parameter	Nearfield Stations 1N10	Nearfield Stations 3N16
Cryptomonas Sp#2 Length >10 Microns	MF	10^6 Cells/L	0.4574	
		%	6	
Unid. Centric Diatom Diam <10 Microns	CD	10^6 Cells/L	1.8751	
		%	25	
Unid. Micro-Phytoflag Length <10 Microns	MF	10^6 Cells/L	4.2686	4.3174
		%	57	92
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 COLLECTED NEAR THE SURFACE FEBRUARY 6-14, 1995

Abundance of all identified taxa in screened samples collected near the surface February 6 - 14, 1995 (W9501)

		Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
		1F23A	1F30A	1F31A	1F13A	1F24A	1F25A	1N10A	1N16A	2N16A	1F06A	1F27A	1F01A	1F02A
Species	**Group**													
Amphidinium Sp. Syn. Phalacroma Sp.	DF						0.038							
Ceratium Fusus	DF					0.005	0.002		0.004		0.013	0.002	0.004	0.002
Ceratium Lineatum	DF					0.002					0.004			0.007
Ceratium Longipes	DF								0.008				0.006	
Ceratium Macroceros	DF					0.002	0.002				0.004			
Ceratium Sp.	DF													
Ceratium Tripos	DF				0.002					0.002	0.009			
Diplopsalis Lenticula	DF													
Gymnodinium Sp.#2 21-40Um W 21-50Um L	DF						0.113					0.058		0.134
Prorocentrum Micans	DF	0.063	0.030	0.013	0.107	0.214	0.075	0.116	0.228	0.098		0.115	0.271	0.134
Prorocentrum Minimum	DF						0.038			0.196				0.004
Protoperidinium Brevipes	DF						0.038							
Protoperidinium Divergens	DF													
Protoperidinium Sp.#1 10-30W 10-40L	DF											0.058	0.090	
Protoperidinium Sp.#2 31-75W 41-80L	DF									0.098		0.004		
Protoperidinium Sp.#3 76-150W 81-150L	DF							0.116			0.013			
Unid. Dinoflagellate Cyst	DF	0.063		0.002					0.057					
Ochromonas Sp.	MF													0.134
Unid. Choanoflagellate	MF				0.132									
Unid. Silicoflagellate	MF				0.002	0.357					0.017			
Distephanus Speculum	O	0.002							0.171	0.002		0.288	0.090	0.011
Ebria Tripartita	O													
Oocystis Sp.	O													
Oscillatoria Cells #1 Diam <5Um	O			0.510					2.570					
Unid. Blue Green Trichome (Cell)	O													

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Abundance of all identified taxa in screened samples collected near the surface March 20 - March 22, 1995 (W9503)

Species	Group	Nearfield Stations	
		1N10A	1N16A
Ceratium Longipes	DF	0.006	0.006
Ceratium Massiliense	DF		
Ceratium Sp.	DF		0.035
Gymnodinium Sp.#1 5-20Um W 10-20Um L	DF		
Gymnodinium Sp.#3 41-70Um W 51-70Um L	DF		
Prorocentrum Micans	DF	0.002	
Prorocentrum Minimum	DF		
Protoperidinium Sp.#1 10-30W 10-40L	DF		
Protoperidinium Sp.#2 31-75W 41-80L	DF		
Eutreptia Sp.	MF		
Pyramimonas Sp.	MF		
Distephanus Speculum	O	0.146	0.423
Unid. Blue Green Single Sphere	O	0.474	

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Abundance of all identified taxa in screened samples collected near the surface February 28 - March 5, 1995 (W9502)

		Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
Species	Group	1F23A	1F30A	1F31A	1F13A	1F24A	1F25A	1N10A	1N16A	2N16A	1F06A	1F27A	1F01A	1F02A
Ceratium Fusus	DF										0.002			0.002
Ceratium Lineatum	DF													
Ceratium Longipes	DF			0.002								0.068		
Ceratium Massiliense	DF													
Ceratium Tripos	DF								0.003	0.002				
Dinophysis Sp.	DF				0.002					0.141				
Diplopsalis Sp.	DF													
Gymnodinium Sp.#1 5-20Um W 10-20Um L	DF			0.340	0.425		0.136	0.056	1.093	0.986	0.656	0.002	0.700	26.424
Gymnodinium Sp.#2 21-40Um W 21-50Um L	DF	0.116	0.215	0.227	0.425	0.191	0.272	0.394	1.822	0.986	0.328		0.544	
Gymnodinium Sp.#3 41-70Um W 51-70Um L	DF			0.002		0.096								
Prorocentrum Micans	DF		0.005	0.002	0.085	0.003			0.045	0.021	0.328	0.068	0.013	0.019
Prorocentrum Minimum	DF	0.002		0.113			0.002	0.006	0.012			0.002	0.078	
Protoperidinium Leonis	DF													
Protoperidinium Pellucidum	DF							0.002						
Protoperidinium Sp.#1 10-30W 10-40L	DF	0.002								0.002	0.002	0.068	0.003	0.002
Protoperidinium Sp.#2 31-75W 41-80L	DF			0.002			0.136	0.113	0.009	0.002	0.002		0.003	0.317
Unid. Dinoflagellate	DF													
Cryptomonas Sp#1 Length <10 Microns	MF													
Cryptomonas Sp#2 Length >10 Microns	MF													
Eutreptia Lenowii	MF													
Unid. Choanoflagellate	MF	0.116		0.113	0.425	1.626	0.136	0.113		0.282		0.136	0.156	0.106
Unid. Micro-Phytoflag Length >10 Microns	MF													
Distephanus Speculum	O		0.003		0.002			0.002	0.182	0.141	0.328		0.078	
Ebria Tripartita	O						0.136							
Oscillatoria Cells #1 Diam <5Um	O	3.471												

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Abundance of all identified taxa in screened samples collected near the surface April 3 - 10, 1995 (W9504)

		Harbor Stations			Coastal Stations			Nearfield Stations			Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
Species	Group	1F23A	1F30A	1F31A	1F13A	1F24A	1F25A	1N10A	1N16A	2N16A	1F06A	1F27A	1F01A	1F02A
Ceratium Fusus	DF	0.001		0.001		0.002		0.005				0.002		
Ceratium Lineatum	DF								0.001					
Ceratium Longipes	DF	0.003	0.004		0.010	0.018			0.031	0.146	0.046	0.015	0.024	0.052
Ceratium Macroceros	DF													
Ceratium Sp.	DF						0.003	0.007		0.013				
Ceratium Tripos	DF	0.001						0.069						0.003
Dinophysis Acuminata	DF								0.001		0.002			
Dinophysis Norvegica	DF													
Dinophysis Sp.	DF									0.001				
Gonyaulax Spinifera	DF										0.061			
Gymnodinium Sp.#1 5-20Um W 10-20Um L	DF					0.055				0.109				
Gymnodinium Sp.#2 21-40Um W 21-50Um L	DF	0.049												
Katodinium Rotundatum	DF	0.097			0.039						0.061			
Prorocentrum Balticum	DF		0.124								0.304			
Prorocentrum Micans	DF							0.069						
Prorocentrum Minimum	DF			0.002			0.001		0.001					
Protoperidinium Depressum	DF										0.002			
Protoperidinium Pallidum	DF													
Protoperidinium Pyriforme	DF				0.001				0.004		0.061			
Protoperidinium Sp.#1 10-30W 10-40L	DF							0.007			0.011			
Protoperidinium Sp.#2 31-75W 41-80L	DF	0.001			0.039	0.055			0.001		0.002	0.094		
Dinobryon Sp.	MF		0.025									0.094		
Eutreptia Lanowii	MF													0.103
Pyramimonas Sp.	MF	0.049												0.207
Unid. Choanoflagellate	MF	0.049		0.073			0.126	0.480				0.234		0.774
Unid. Micro-Phytoflag Length >10 Microns	MF													
Agmenellum Sp.	O				0.141									
Dictyocha Fibula	O												0.002	0.103
Distephanus Speculum	O	0.194	0.248	0.146	0.078	0.109	0.063	0.137	0.097	0.328	0.121	0.281	0.119	0.207
Gloeocystis Sp.	O		0.070											
Oscillatoria Sp. (Trichome)	O		0.248											
Pediastrum Simplex	O		0.007											
Rhabdosphaera Longistylis	O	0.097				0.002						0.140		
Scenedesmus Quadricauda	O		0.007											
Scenedesmus Sp.	O													
Staurastrum Sp.	O		0.002											
Unid. Blue Green Trichome (Cell)	O											0.515		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Abundance of all identified taxa in screened samples collected near the surface April 24 - April 27, 1995 (W9505)

Species	Group	Nearfield Stations 1N10A	2N16A
Ceratium Lineatum	DF		0.027
Ceratium Longipes	DF	0.100	0.699
Ceratium Sp.	DF	0.020	
Ceratium Tripos	DF		0.015
Dinophysis Norvegica	DF		0.009
Gymnodinium Sp.#2 21-40Um W 21-50Um L	DF		
Protoperidinium Pyriforme	DF		0.009
Protoperidinium Sp.#2 31-75W 41-80L	DF	0.004	0.063
Unid. Choanoflagellate	MF		
Distephanus Speculum	O	2.673	4.139

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Abundance of all identified taxa in screened samples collected near the surface May 15 - 17, 1995 (W9506)

Species	Group	Nearfield Stations 1N10A	2N16A
Ceratium Fusus	DF	0.002	0.004
Ceratium Lineatum	DF		0.024
Ceratium Longipes	DF	0.015	0.462
Ceratium Sp.	DF	0.002	
Ceratium Tripos	DF	0.002	0.002
Dinophysis Acuminata	DF		0.035
Dinophysis Norvegica	DF	0.013	0.112
Dinophysis Punctata	DF		0.002
Dinophysis Sp.	DF		
Gonyaulax Digitalis	DF		
Gymnodinium Sp.#3 41-70Um W 51-70Um L	DF		
Prorocentrum Balticum	DF		
Protoperidinium Depressum	DF		0.007
Protoperidinium Sp.#1 10-30W 10-40L	DF	0.007	0.004
Protoperidinium Sp.#2 31-75W 41-80L	DF	0.051	
Protoperidinium Sp.#3 76-150W 81-150L	DF	0.002	
Unid. Choanoflagellate	MF		
Distephanus Speculum	O	0.051	0.002
Pseudopedinella Pyriforme	O		
Unid. Blue Green Trichome (Cell)	O	0.044	

Group Definitions:

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

Abundance of all identified taxa in screened samples collected near the surface June 20 - June 25, 1995 (W9507)

Species	Group	Harbor Stations			Coastal Stations			Nearfield Stations				Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
		2F23A	1F30A	1F31A	1F13A	1F24A	1F25A	1N10A	1N16A	2N16A	3N16A	1F06A	1F27A	1F01A	1F02A
Amylax Triacantha Gonyaulax Triacantha	DF												0.032		
Ceratium Fusus	DF	0.019		0.003	0.016		0.004		0.016		0.020	0.002	0.010	0.050	0.019
Ceratium Lineatum	DF	0.004			0.005	0.005	0.011		0.013		0.005				
Ceratium Longipes	DF	0.131	0.048	0.038	0.484	0.080	0.109	0.090	0.208		0.242	0.315	0.079	0.217	
Ceratium Macroceros	DF				0.044				0.085		0.016				
Ceratium Sp.	DF				0.002			0.003	0.002		0.002				
Ceratium Tripos	DF										0.003	0.005	0.004	0.013	0.243
Dinophysis Acuminata	DF	0.007		0.009	0.091	0.040	0.088	0.021			0.032				0.029
Dinophysis Norvegica	DF	0.074	0.288		0.033	0.911	0.049		0.005		0.038	0.055	0.036	0.001	0.007
Dinophysis Punctata	DF	0.002		0.038				0.009			0.003	0.001		0.003	
Dinophysis Sp.	DF														
Diplopsalis Lenticula	DF		0.024												
Gonyaulax Digitalis	DF	0.002													
Gonyaulax Verior G. Diacantha	DF										0.095				
Gymnodinium Sp.#1 5-20Um W 10-20Um L	DF	0.241					0.213	0.182					0.032		0.053
Gymnodinium Sp.#2 21-40Um W 21-50Um L	DF		0.024	0.006	0.221										
Heterocapsa Triquetra	DF														
Katodinium Rotundatum	DF								1.264			0.033	0.875		
Miniscula Bipes = Protoperidinium Bipes	DF														
Prorocentrum Balticum	DF														
Prorocentrum Micans	DF												0.001		
Protoperidinium Depressum	DF	0.005		0.003		0.005	0.004	0.003			0.001	0.004			0.002
Protoperidinium Pallidum	DF													0.001	
Protoperidinium Pyriforme	DF												0.001	0.003	
Protoperidinium Sp.#1 10-30W 10-40L	DF	0.002												0.003	
Protoperidinium Sp.#2 31-75W 41-80L	DF			0.003			0.007				0.001				0.002
Protoperidinium Sp.#3 76-150W 81-150L	DF														
Scrippsiella Trochoidea	DF			0.009											
Euglena Sp.	MF	0.121						0.182							
Eutreptia Lanowii	MF														
Eutreptia Sp.	MF										0.047				
Pyramimonas Sp.	MF	1.328	1.656	0.176									0.227		
Unid. Choanoflagellate	MF														
Unid. Micro-Phytoflag Length >10 Microns	MF	0.121											0.324		
Crucigenia Tetrapedia	O														
Distephanus Speculum	O			0.006	0.111		0.011	0.364	0.003			0.002	0.032	0.043	0.003
Emiliania Huxleyi	O														
Micractinium Pusillum	O														
Oscillatoria Sp. (Trichome)	O					0.005									
Pediastrum Duplex V. Clathratum	O														
Pediastrum Duplex V. Gracilimum	O														
Pediastrum Simplex	O												0.015		
Rhabdosphaera Claviger	O														
Scenedesmus Quadricauda	O					0.020									
Scenedesmus Sp.	O														
Staurastrum Sp.	O														
Unid. Blue Green Single Sphere	O														0.316
Unid. Blue Green Trichome	O														0.053
Unid. Blue Green Trichome (Cell)	O			3.523				0.078							

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Abundance of all identified taxa in screened samples collected near the surface July 5 - 7, 1995 (W9508)

Species	Group	Nearfield Stations	
		1N10A	2N16A
Ceratium Fusus	DF	0.007	0.021
Ceratium Longipes	DF	0.101	0.111
Ceratium Macroceros	DF		0.014
Ceratium Sp.	DF		0.002
Ceratium Tripos	DF		
Dinophysis Acuminata	DF	0.007	
Dinophysis Norvegica	DF	0.014	0.002
Gymnodinium Sp.#1 5-20Um W 10-20Um L	DF		0.499
Protoperidinium Depressum	DF		
Scrippsiella Trochoidea	DF		0.125
Euglena Sp.	MF		
Unid. Choanoflagellate	MF		0.249

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Abundance of all identified taxa in screened samples collected near the surface July 24 - 26, 1995 (W9509)

Species	Group	Nearfield Stations	
		1N10A	3N16A
Ceratium Fusus	DF	0.002	
Ceratium Longipes	DF	0.010	0.062
Ceratium Tripos	DF	0.003	0.004
Dinophysis Norvegica	DF		0.001
Dinophysis Punctata	DF		
Diplopsalis Sp.	DF	0.275	
Gymnodinium Sp.#2 21-40Um W 21-50Um L	DF	0.004	
Gymnodinium Sp.#3 41-70Um W 51-70Um L	DF	0.005	
Heterocapsa Triquetra	DF	0.001	
Prorocentrum Rotundatum	DF	0.017	
Protoperidinium Depressum	DF	0.001	
Protoperidinium Sp.#2 31-75W 41-80L	DF	0.013	
Scrippsiella Trochoidea	DF	0.071	

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

APPENDIX G-2

ABUNDANCE OF ALL IDENTIFIED TAXA IN SCREENED SAMPLES NEAR THE CHLOROPHYLL MAXIMUM FEBRUARY 6-14, 1995

Abundance of all identified taxa in screened samples collected near the Chlorophyll maximum February 6 - 14, 1995 (W9501)

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	1F06C	1F27B	1F01C	1F02C
Amphidinium Sp. Syn. Phalacroma Sp.	DF													
Ceratium Fusus	DF					0.002			0.001			0.001		0.002
Ceratium Lineatum	DF								0.002		0.004		0.003	0.002
Ceratium Longipes	DF								0.001			0.001		0.002
Ceratium Macroceros	DF											0.002		
Ceratium Sp.	DF											0.001		
Ceratium Tripes	DF					0.002			0.001				0.003	
Diplopsalis Lenticula	DF												0.198	
Gymnodinium Sp.#2 21-40Um W 21-50Um L	DF								0.001					
Prorocentrum Micans	DF	0.315		0.048	0.969	0.353	0.211	0.061	0.265	0.077	0.059	0.058	0.198	0.105
Prorocentrum Minimum	DF		0.077						0.007	0.003	0.258			0.105
Protoperidinium Brevipes	DF													
Protoperidinium Divergens	DF										0.004			
Protoperidinium Sp.#1 10-30W 10-40L	DF												0.003	
Protoperidinium Sp.#2 31-75W 41-80L	DF	0.002								0.003		0.055		
Protoperidinium Sp.#3 76-150W 81-150L	DF													
Unid. Dinoflagellate Cyst	DF													
Ochromonas Sp.	MF													
Unid. Choanoflagellate	MF		0.077					0.061						
Unid. Silicoflagellate	MF											0.166		
Distephanus Speculum	O	0.158	0.004			0.283	0.005		0.133	0.077			0.007	0.105
Ebria Tripartita	O					0.002								
Oocystis Sp.	O			0.193										
Oscillatoria Cells #1 Diam <5Um	O													
Unid. Blue Green Trichome (Cell)	O	0.709												

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Abundance of all identified taxa in screened samples collected near the Chlorophyll maximum February 28 - March 5, 1995 (W9502)

		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	1F06C	1F27C	1F01C	1F02C
Ceratium Fusus	DF						0.002	0.002		0.003	0.002		0.002	
Ceratium Lineatum	DF				0.135			0.002		0.003			0.002	
Ceratium Longipes	DF					0.002		0.002		0.006				
Ceratium Massiliense	DF								0.002					
Ceratium Tripos	DF							0.002	0.006	0.003	0.002			
Dinophysis Sp.	DF							0.002						
Diplopsalis Sp.	DF							0.248						
Gymnodinium Sp.#1 5-20Um W 10-20Um L	DF	0.294	0.228	0.007	1.614	0.437	0.026	0.165	1.803	1.225	0.202	0.103	8.248	22.211
Gymnodinium Sp.#2 21-40Um W 21-50Um L	DF	0.147	0.228	0.401	0.135	0.875	0.729	1.817	0.515	1.400	0.506		1.356	0.079
Gymnodinium Sp.#3 41-70Um W 51-70Um L	DF				0.538		0.010		0.129					
Prorocentrum Micans	DF		0.002	0.004	0.012	0.146	0.012	0.008	0.030	0.009			0.011	0.003
Prorocentrum Minimum	DF	0.019	0.002		0.135		0.002		0.006		0.046			
Protoperidinium Leonis	DF							0.083						
Protoperidinium Pellucidum	DF													
Protoperidinium Sp.#1 10-30W 10-40L	DF			0.002	0.404		0.002	0.002	0.129	0.175			0.004	0.001
Protoperidinium Sp.#2 31-75W 41-80L	DF				0.003		0.005			0.175	0.002	0.002		0.001
Unid. Dinoflagellate	DF						0.243							
Cryptomonas Sp#1 Length <10 Microns	MF						0.364							
Cryptomonas Sp#2 Length >10 Microns	MF					0.146								
Eutreptia Lanowii	MF									0.350				
Unid. Choanoflagellate	MF	0.588			2.287	0.146	0.607	0.496			0.405		0.678	
Unid. Micro-Phytoflag Length >10 Microns	MF				0.135									
Distephanus Speculum	O				0.009		0.002	0.083	0.129		0.304	0.005	0.113	0.079
Ebria Tripartita	O													
Oscillatoria Cells #1 Diam <5Um	O													

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Abundance of all screened samples near the Chlorophyll maximum March 20 - 22, 1995 (W9503)

Species	Group	Nearfield Stations	
		1N10C	1N16C
Ceratium Longipes	DF	0.087	0.001
Ceratium Massiliense	DF	0.003	
Ceratium Sp.	DF		
Gymnodinium Sp.#1 5-20Um W 10-20Um L	DF	0.044	0.045
Gymnodinium Sp.#3 41-70Um W 51-70Um L	DF		0.045
Prorocentrum Micans	DF	0.004	0.001
Prorocentrum Minimum	DF		0.045
Protoperidinium Sp.#1 10-30W 10-40L	DF	0.044	0.001
Protoperidinium Sp.#2 31-75W 41-80L	DF	0.044	0.045
Eutreptia Sp.	MF		0.090
Pyramimonas Sp.	MF	0.044	
Distephanus Speculum	O	0.175	0.090
Unid. Blue Green Single Sphere	O	1.356	

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Abundance of all identified taxa in screened samples collected near the Chlorophyll maximum April 3 - 10, 1995 (W9504)

		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	1F06C	1F27C	1F01C	1F02C
Ceratium Fusus	DF	0.001		0.001		0.002			0.003				0.002	
Ceratium Lineatum	DF													
Ceratium Longipes	DF	0.008	0.003	0.002	0.012	0.014	0.005	0.026	0.149	0.007	0.024	0.001	0.005	0.037
Ceratium Macroceros	DF												0.109	
Ceratium Sp.	DF	0.001		0.004				0.004		0.002	0.067		0.007	
Ceratium Tripos	DF			0.002		0.005						0.001		
Dinophysis Acuminata	DF				0.001	0.002						0.001		
Dinophysis Norvegica	DF								0.003					
Dinophysis Sp.	DF													
Gonyaulax Spinifera	DF													
Gymnodinium Sp.#1 5-20Um W 10-20Um L	DF					0.104		0.265		0.134	0.334		0.547	
Gymnodinium Sp.#2 21-40Um W 21-50Um L	DF						0.001	0.066	0.002	0.002	0.067			
Katodinium Rotundatum	DF							0.066						
Prorocentrum Balticum	DF				0.034	0.157		0.199						0.090
Prorocentrum Micans	DF													
Prorocentrum Minimum	DF							0.002		0.004				
Protoperidinium Depressum	DF													
Protoperidinium Pallidum	DF		0.002											
Protoperidinium Pyriforme	DF		0.002		0.034	0.002		0.009						
Protoperidinium Sp.#1 10-30W 10-40L	DF		0.002	0.002					0.149					
Protoperidinium Sp.#2 31-75W 41-80L	DF	0.001				0.002	0.042		0.100	0.134	0.011	0.002		
Dinobryon Sp.	MF													
Eutreptia Lanowii	MF										0.067		0.164	
Pyramimonas Sp.	MF							0.066				0.035	0.328	
Unid. Choanoflagellate	MF			0.031		0.157	0.253	0.861	0.050	0.401		0.208	0.656	
Unid. Micro-Phytoflag Length >10 Microns	MF									0.067			0.109	0.090
Agmenellum Sp.	O													
Dictyocha Fibula	O				0.034									0.090
Distephanus Speculum	O	0.092	0.197	0.031	0.035	0.009	0.042	0.728	0.100	0.134	0.200	0.003	0.328	0.181
Gloeocystis Sp.	O													
Oscillatoria Sp. (Trichome)	O													
Pediastrum Simplex	O													1.085
Rhabdosphaera Longistylis	O						0.126	0.066		0.668		0.104		
Scenedesmus Quadricauda	O		0.006											
Scenedesmus Sp.	O	0.006		0.003										
Staurastrum Sp.	O													
Unid. Blue Green Trichome (Cell)	O						0.379							

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Abundance of all identified screened samples collected near the Chlorophyll maximum April 24 - April 27, 1995 (W9505)

Species	Group	Nearfiled Stations	
		1N10C	2N16C
Ceratium Lineatum	DF		
Ceratium Longipes	DF	0.009	0.011
Ceratium Sp.	DF		
Ceratium Tripos	DF		0.001
Dinophysis Norvegica	DF		
Gymnodinium Sp.#2 21-40Um W 21-50Um L	DF		0.050
Protoperidinium Pyriforme	DF	0.237	
Protoperidinium Sp.#2 31-75W 41-80L	DF		
Unid. Choanoflagellate	MF		0.050
Distephanus Speculum	O	0.031	0.150

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Abundance of all identified taxa in screened samples collected near the Clorophyll maximum May 15 - 17, 1995 (W9506)

Species	Group	Nearfiled Stations	
		1N10C	2N16C
Ceratium Fusus	DF	0.004	
Ceratium Lineatum	DF	0.006	
Ceratium Longipes	DF	0.233	0.022
Ceratium Sp.	DF		
Ceratium Tripos	DF		
Dinophysis Acuminata	DF	0.064	
Dinophysis Norvegica	DF	0.070	0.011
Dinophysis Punctata	DF	0.064	0.004
Dinophysis Sp.	DF		0.002
Gonyaulax Digitalis	DF		0.002
Gymnodinium Sp.#3 41-70Um W 51-70Um L	DF		0.002
Prorocentrum Balticum	DF	0.064	0.062
Protoperidinium Depressum	DF	0.004	0.009
Protoperidinium Sp.#1 10-30W 10-40L	DF		0.007
Protoperidinium Sp.#2 31-75W 41-80L	DF	0.064	0.009
Protoperidinium Sp.#3 76-150W 81-150L	DF		0.011
Unid. Choanoflagellate	MF	0.322	
Distephanus Speculum	O	0.004	0.062
Pseudopedinella Pyriforme	O		0.062
Unid. Blue Green Trichome (Cell)	O		

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Abundance of all Identified taxa in screened samples collected near the Chlorophyll maximum June 20 - 25, 1995 (W9507)

Species		Group	Harbor Stations			Coastal Stations			Nearfield Stations				Offshore Stations	Boundary Stations	Cape Cod Bay Stations	
			2F23C	1F30C	1F31C	1F13C	1F24C	1F25C	1N10B	1N16C	2N16C	3N16C	1F06C	1F27C	1F01C	1F02C
Amylax Triacantha	Gonyaulax Triacantha	DF														
Ceratium Fusus		DF	0.005				0.022		0.004	0.005		0.006	0.006	0.001	0.054	0.021
Ceratium Lineatum		DF	0.001				0.009		0.007			0.004	0.005		0.002	0.001
Ceratium Longipes		DF	0.113	0.040	0.040	0.133	0.307	0.088	0.237	0.847		0.545	0.231	0.019	0.481	0.428
Ceratium Macroceros		DF				0.004			0.019	0.002		0.074			0.002	
Ceratium Sp.		DF							0.004							0.001
Ceratium Tripos		DF	0.002										0.001	0.001	0.026	
Dinophysis Acuminata		DF			0.011	0.340	0.423	0.092	0.081	0.003		0.004		0.007		0.048
Dinophysis Norvegica		DF	0.112	0.180	0.021	2.867	0.683	0.072	0.074	0.128		0.019	0.673	0.008	0.176	0.027
Dinophysis Punctata		DF	0.006		0.042	0.008			0.211				0.002		0.006	
Dinophysis Sp.		DF			0.004											
Diplopsalis Lenticula		DF		0.020												
Gonyaulax Digitalis		DF											0.001			
Gonyaulax Verior	G. Diacantha	DF														
Gymnodinium Sp.#1 5-20Um W 10-20Um L		DF	0.610			0.462		0.243		0.115		0.236			0.039	0.087
Gymnodinium Sp.#2 21-40Um W 21-50Um L		DF				0.115								0.028		0.029
Heterocapsa Triquetra		DF	0.073													
Katodinium Rotundatum		DF				0.231						0.118			0.039	
Miniscula Bipes = Protoperidinium Bipes		DF		0.020												
Prorocentrum Balticum		DF													0.039	
Prorocentrum Micans		DF	0.001													
Protoperidinium Depressum		DF	0.004			0.006	0.018		0.004	0.007		0.016	0.032	0.002		
Protoperidinium Pallidum		DF														
Protoperidinium Pyriforme		DF	0.001							0.115			0.009		0.001	
Protoperidinium Sp.#1 10-30W 10-40L		DF		0.040						0.115						
Protoperidinium Sp.#2 31-75W 41-80L		DF	0.004	0.020	0.004	0.008	0.004	0.004	0.004	0.002		0.002		0.005		0.058
Protoperidinium Sp.#3 76-150W 81-150L		DF			0.002											
Scrippsiella Trocholdea		DF			0.002											
Euglena Sp.		MF	0.291													
Eutreptia Lanowii		MF			0.128		0.641									
Eutreptia Sp.		MF														
Pyramimonas Sp.		MF	0.437	1.380						0.229		0.118				
Unid. Choanoflagellate		MF										0.118				
Unid. Micro-Phytoflag Length >10 Microns		MF	0.291										0.040		0.156	
Crucigenia Tetrapedia		O	2.330													
Distephanus Speculum		O	0.073	0.020	0.128	0.231		0.024	0.011				0.040		0.117	0.029
Emiliania Huxleyi		O													0.039	
Micractinium Pusillum		O														0.039
Oscillatoria Sp. (Trichome)		O														
Pediastrum Duplex V. Clathratum		O														0.023
Pediastrum Duplex V. Gracilimum		O											0.016			
Pediastrum Simplex		O														
Rhabdosphaera Claviger		O										0.118				
Scenedesmus Quadricauda		O		0.080												
Scenedesmus Sp.		O					0.036									
Staurastrum Sp.		O														0.001
Unid. Blue Green Single Sphere		O														0.018
Unid. Blue Green Trichome		O														
Unid. Blue Green Trichome (Cell)		O						14.336								

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Abundance of all identified taxa in screened samples collected near the Chlorophyll maximum July 5 - 7, 1995 (W9508)

Species	Group	Nearfield Stations
		1N10B
Ceratium Fusus	DF	0.004
Ceratium Longipes	DF	0.128
Ceratium Tripos	DF	0.002
Dinophysis Acuminata	DF	0.004
Dinophysis Norvegica	DF	0.147
Protoperidinium Depressum	DF	0.002
Euglena Sp.	MF	0.002

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

Abundance of all identified taxa in screened samples collected near the Chlorophyll maximum July 24 - 26, 1995 (W9509)

Species	Group	Nearfiled Stations	
		1N10B	3N16C
Ceratium Fusus	DF		0.002
Ceratium Longipes	DF	0.023	0.405
Ceratium Tripos	DF	0.006	0.005
Dinophysis Norvegica	DF		0.003
Dinophysis Punctata	DF	0.001	
Diplopsalis Sp.	DF	0.025	
Gymnodinium Sp.#2 21-40Um W 21-50Um L	DF	0.001	
Gymnodinium Sp.#3 41-70Um W 51-70Um L	DF		
Heterocapsa Triquetra	DF		
Prorocentrum Rotundatum	DF		
Protoperidinium Depressum	DF	0.008	0.004
Protoperidinium Sp.#2 31-75W 41-80L	DF	0.003	
Scrippsiella Trochoidea	DF		0.001

Group Definitions:

DF	Dinoflagellate
MF	Microflagellate
O	Other

APPENDIX H

ZOOPLANKTON SPECIES DATA (IND/M^3)
W9501-W9509

Zooplankton Species Data (ind/m^3)
W9501 - W9509

Event	Species	Life Stage	Group	1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
				Station Cast														
W9501	ACARTIA HUDSONICA	C	C									24						
W9501	ACARTIA HUDSONICA	F	C				19	34				36						
W9501	ACARTIA HUDSONICA	M	C					17				36						
W9501	BIVALVIA SPP.	L	O			24			105	40				22				
W9501	BRYOZOA SPP.	-	O		20													
W9501	CALANUS FINMARCHICUS	C	C								26							
W9501	CALANUS FINMARCHICUS	F	C								26							
W9501	CENTROPAGES TYPICUS	C	C		400	73									44		55	
W9501	CENTROPAGES TYPICUS	F	C		80				35		26							
W9501	CENTROPAGES TYPICUS	M	C			24											18	
W9501	CHAETOGNATHIA SPP.	-	O					17		20								
W9501	CIRRIPEDE SPP.	N	B	64		219	493	122	279	360		1477		944	22		55	
W9501	COPEPOD SPP.	-	C			24	76		35	560				88				
W9501	COPEPOD SPP.	C	C	64		24			663								18	
W9501	COPEPOD SPP.	N	C	2675	3140	4750	3908	3238	7332	3880	6257	2131		2679	2836		6544	
W9501	EURYTEMORA HERDMANI	M	C							40								
W9501	GASTROPODA;MOLLUSCA	L	O		120					20	51				87		37	
W9501	HARPACTICOIDA SPP.	-	C	16		49	19		70			36		44				
W9501	MICROSETELLA NORVEGICA	-	C	193	20	24	76	244	314	60	51	61		527	131		92	
W9501	MICROSETELLA NORVEGICA	F	C				38											
W9501	MICROSETELLA NORVEGICA	M	C				19											
W9501	NEMATODA SPP.	-	O					17										
W9501	OIKOPLEURA DIOICA	-	O	177	180	1632	360	209	1222	160	129	85		263	589		533	
W9501	OITHONA ATLANTICA	-	C			73												
W9501	OITHONA SIMILIS CLAUS	C	C	1048	860	1949	778	400	3177	520	1596	448		1427	611		1213	
W9501	OITHONA SIMILIS CLAUS	F	C	548	300	390	360	226	489	140	386	85		483	175		129	
W9501	OITHONA SIMILIS CLAUS	M	C					34			26	109		44				
W9501	PARACALANUS PARVUS	C	C							120								
W9501	PLATYHELMINTHES:TURBELLARIA	-	O							20								
W9501	POLYCHAETE SPP.	L	O	113	60	24	360	313	594	760		182		615	502		423	
W9501	POLYCHAETE SPP.	T	O	16			228	70		200		133		88	65		18	
W9501	PSEUDOCALANUS NEWMANI	C	C	790	100	24	493	122	314	60	103	182		461	349		147	
W9501	PSEUDOCALANUS NEWMANI	F	C	226	60	24	38		35	100	26	61		22	65		37	
W9501	PSEUDOCALANUS NEWMANI	M	C	16	40	24	19											
W9501	TEMORA LONGICORNIS	C	C	32														
W9501	TEMORA LONGICORNIS	F	C	16					35									
W9501	TEMORA LONGICORNIS	M	C	16														
W9501	TORTANUS DISCAUDATUS	C	C														18	
W9501	TORTANUS DISCAUDATUS	M	C														18	

Zooplankton Species Data (ind/m^3)
W9501 - W9509

Event	Species	Life Stage	Group	Station Cast														
				1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9501	UNIDENTIFIED LARVAE	L	O	161		24	38		140			48		66			312	
W9502	ACARTIA HUDSONICA	C	C	103				90				85						
W9502	ACARTIA HUDSONICA	F	C	205				107				355	27					
W9502	ACARTIA HUDSONICA	M	C						42			70						
W9502	BIVALVIA SPP.	L	O	51	41	19		18						28				
W9502	CALANUS FINMARCHICUS	C	C	51	81	564	825	143	211	151	377	31	896	809	217		264	
W9502	CALANUS FINMARCHICUS	F	C				26						54					
W9502	CALANUS FINMARCHICUS	M	C		41		26											
W9502	CENTROPAGES TYPICUS	C	C			155	103							84	72		22	
W9502	CENTROPAGES TYPICUS	F	C			78	26										22	
W9502	CENTROPAGES TYPICUS	M	C			39						8		28	36			
W9502	CIRRIPEDE SPP.	-	B			19												
W9502	CIRRIPEDE SPP.	N	B	820	162	175	2293	1397	1644	1045	24	1205	2660	2984	615		176	
W9502	COPEPOD SPP.	C	C	51		19	26	36				15	27	112	36			
W9502	COPEPOD SPP.	N	C	10660	4944	7132	8554	3545	5270	1842	5771	1097	2361	6357	6225		3083	
W9502	ECHINODERM PLUTEI	-	O	51	81	39	77			27	47		27	195	977		352	
W9502	EURYTEMORA HERDMANI	F	C									15						
W9502	EURYTEMORA HERDMANI	M	C									23						
W9502	FISH SPP.	-	O									8						
W9502	GASTROPODA;MOLLUSCA	L	O	154	41	97	309	18	126	206	94		109	418	109		132	
W9502	HARPACTICOIDA SPP.	-	C			19		36	42			46			36			
W9502	MICROSETELLA NORVEGICA	-	C	154	162	136	180	36	84	27	24	23	109					
W9502	NEMATODA SPP.	-	O					18										
W9502	OIKOPLEURA DIOICA	-	O	410	608	797	773	125	675	302	188	15	136	1311	1122		1189	
W9502	OITHONA ATLANTICA	-	C		41					14							22	
W9502	OITHONA ATLANTICA	C	C														22	
W9502	OITHONA ATLANTICA	F	C					18		14								
W9502	OITHONA SIMILIS CLAUS	-	C	51	405	136				41		15	27		36		22	
W9502	OITHONA SIMILIS CLAUS	C	C	564	1013	2176	3015	716	970	660	966	162	1086	1701	1592		1035	
W9502	OITHONA SIMILIS CLAUS	F	C	564	284	214	593	125	211	234	306	62	380	195	145		220	
W9502	OITHONA SIMILIS CLAUS	M	C	154	81	155	103	36	211		71	8	109	84			22	
W9502	PARACALANUS PARVUS	M	C												36			
W9502	POLYCHAETE SPP.	-	O	51														
W9502	POLYCHAETE SPP.	L	O	820	446	525	361	537	1223	385	71	46	679	586	181		198	
W9502	POLYCHAETE SPP.	T	O	564	81	97	52	304	42	41		54	353	139	109			
W9502	PSEUDOCALANUS NEWMANI	C	C	1025	1054	466	309	161	211	55	165	131	543	56	36		66	
W9502	PSEUDOCALANUS NEWMANI	F	C	308	324	97	52	36				15	190	84	36		22	
W9502	PSEUDOCALANUS NEWMANI	M	C		243							15	27				22	
W9502	TEMORA LONGICORNIS	C	C	51			26						54					

Zooplankton Species Data (ind/m^3)
W9501 - W9509

Event	Species	Life Stage	Group	Station Cast 1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9502	TEMORA LONGICORNIS	F	C	51				18										
W9502	TEMORA LONGICORNIS	M	C									15						
W9502	TORTANUS DISCAUDATUS	M	C					18				15	27					
W9502	UNIDENTIFIED LARVAE	L	O	410	81	78	77	72	84		24	8					22	
W9503	ACARTIA HUDSONICA	C	C											46				
W9503	BIVALVIA SPP.	L	O											91				
W9503	CALANUS FINMARCHICUS	C	C											777	2967			
W9503	CALANUS FINMARCHICUS	F	C												52			
W9503	CENTROPAGES TYPICUS	C	C												208			
W9503	CENTROPAGES TYPICUS	F	C												52			
W9503	CENTROPAGES TYPICUS	M	C											46				
W9503	CIRRIPEDE SPP.	N	B											3109	208			
W9503	CIRRIPEDE SPP.	Y	B											46	52			
W9503	COPEPOD SPP.	C	C												156			
W9503	COPEPOD SPP.	N	C											5531	10515			
W9503	ECHINODERM PLUTEI	-	O											46	52			
W9503	GASTROPODA;MOLLUSCA	L	O											46	625			
W9503	HARPACTICOIDA SPP.	-	C											46				
W9503	METRIDIA LUCENS	M	C											46				
W9503	OIKOPLEURA DIOICA	-	O											823	1614			
W9503	OITHONA SIMILIS CLAUS	-	C											46	52			
W9503	OITHONA SIMILIS CLAUS	C	C											1691	2707			
W9503	OITHONA SIMILIS CLAUS	F	C											183	208			
W9503	OITHONA SIMILIS CLAUS	M	C											46	312			
W9503	POLYCHAETE SPP.	L	O											183	52			
W9503	POLYCHAETE SPP.	T	O											183	104			
W9503	PSEUDOCALANUS NEWMANI	C	C											229	260			
W9503	PSEUDOCALANUS NEWMANI	F	C											137	52			
W9503	PSEUDOCALANUS NEWMANI	M	C												104			
W9503	UNIDENTIFIED LARVAE	L	O											46				
W9504	ACARTIA HUDSONICA	C	C	55			30	14		30		134	176					
W9504	ACARTIA HUDSONICA	F	C					14				19						
W9504	ACARTIA HUDSONICA	M	C							30		38						
W9504	BIVALVIA SPP.	L	O	304	480	227	151	14		241	1023	77	132	315	45		250	
W9504	CALANUS FINMARCHICUS	C	C	994	2280	1285	1448	335	3402	662	585	403	132	1828	1310		849	
W9504	CALANUS FINMARCHICUS	F	C					14										
W9504	CALANUS FINMARCHICUS	M	C		80	38		14	81			38					150	
W9504	CENTROPAGES TYPICUS	C	C	166	40	302	121		486		341	19	44	189	361			
W9504	CENTROPAGES TYPICUS	F	C			38								63				

Zooplankton Species Data (ind/m^3)
W9501 - W9509

Event	Species		Life Stage	Group	Station Cast														
					1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9504	CENTROPAGES TYPICUS		M	C						81						45			
W9504	CIRRIPEDE SPP.		N	B	193	640	1512	694	196	1134	693	1218	230	528	630	226		699	
W9504	CIRRIPEDE SPP.		Y	B	28							49	19			45			
W9504	COPEPOD SPP.		-	C			76				30							50	
W9504	COPEPOD SPP.		C	C	55		76		14			49	19	44				50	
W9504	COPEPOD SPP.		N	C	5052	7760	6880	2836	1216	7775	3643	5944	3143	3737	9896	8041		6541	
W9504	CRUSTACEA;UNIDED CRUSTACEAN		-	O			38			81									
W9504	DECAPODA SPP.		-	O											63				
W9504	ECHINODERM PLUTEI		-	O	28											45		50	
W9504	EURYTEMORA HERDMANI		C	C					252		783		134	528	126				
W9504	EURYTEMORA HERDMANI		M	C					14				19	44					
W9504	GASTROPODA;MOLLUSCA		L	O	55	680	113	121	56	405	181	438	173	44	1198	361		549	
W9504	HARPACTICOIDA SPP.		-	C					154		60		192	132	63			50	
W9504	METRIDIA LUCENS		-	C											126				
W9504	MICROSETELLA NORVEGICA		-	C		40	38		28	243	30	97	38		378			250	
W9504	MICROSETELLA NORVEGICA		M	C					14										
W9504	OIKOPLEURA DIOICA		-	O		80	756	30		486	120	826			630	632		499	
W9504	OITHONA ATLANTICA		C	C						1296				176	504				
W9504	OITHONA ATLANTICA		F	C						81	60			396		45			
W9504	OITHONA ATLANTICA		M	C										88					
W9504	OITHONA SIMILIS	CLAUS	-	C	276	40						146	19		189	136		100	
W9504	OITHONA SIMILIS	CLAUS	C	C	1104	1960	3213	1388	783	5831	1174	4482	997	1671	5799	5466		3445	
W9504	OITHONA SIMILIS	CLAUS	F	C	359	480	491	211	168	729	331	731	173	176	1450	452		399	
W9504	OITHONA SIMILIS	CLAUS	M	C	55	240	265	60	98		60	341	134		126	136		50	
W9504	POLYCHAETE SPP.		L	O		120	38	60	783	162	1265	244	690	2242	126				
W9504	POLYCHAETE SPP.		T	O	28	80	38	60	126		211	97	134	132	63			100	
W9504	PSEUDOCALANUS NEWMANI		C	C	773	680	1550	422	293	1539	933	1949	345	352	1324	587		1698	
W9504	PSEUDOCALANUS NEWMANI		F	C	28	120	38	30	14	81	120				252	90		100	
W9504	PSEUDOCALANUS NEWMANI		M	C	28		38	30		324	60	49	19			45			
W9504	TEMORA LONGICORNIS		C	C	28	40		151	14		90	195	96	88	63	226		100	
W9504	TEMORA LONGICORNIS		M	C								49							
W9504	UNIDENTIFIED LARVAE		L	O	28	40	76	60	56	648	30	97	58	132	189			50	
W9505	ACARTIA HUDSONICA		C	C														58	
W9505	BIVALVIA SPP.		L	O											342			467	
W9505	CALANUS FINMARCHICUS		C	C											958			758	
W9505	CENTROPAGES TYPICUS		C	C											68				
W9505	CIRRIPEDE SPP.		N	B											2259			292	
W9505	CIRRIPEDE SPP.		Y	B											68			117	
W9505	COPEPOD SPP.		C	C											68			58	

Zooplankton Species Data (ind/m^3)
W9501 - W9509

Event	Species		Life Stage	Group	1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
					Station Cast														
W9505	COPEPOD SPP.		N	C											9514			4667	
W9505	CRUSTACEA:UNIDED CRUSTACEAN		-	O											68			117	
W9505	ECHINODERM PLUTEI		-	O											137			58	
W9505	EVADNE SPP.		-	O											68				
W9505	GASTROPODA;MOLLUSCA		L	O											684			2392	
W9505	MICROSETELLA NORVEGICA		-	C											205			292	
W9505	OIKOPLEURA DIOICA		-	O											2190			350	
W9505	OITHONA ATLANTICA		C	C											205			467	
W9505	OITHONA SIMILIS	CLAUS	-	C											68			350	
W9505	OITHONA SIMILIS	CLAUS	C	C											5818			3383	
W9505	OITHONA SIMILIS	CLAUS	F	C											890			875	
W9505	OITHONA SIMILIS	CLAUS	M	C											205			117	
W9505	POLYCHAETE SPP.		-	O											68				
W9505	POLYCHAETE SPP.		L	O											68			117	
W9505	POLYCHAETE SPP.		T	O											137				
W9505	PSEUDOCALANUS NEWMANI		C	C											1711			992	
W9505	PSEUDOCALANUS NEWMANI		F	C											137				
W9505	TEMORA LONGICORNIS		C	C											548				
W9505	TEMORA LONGICORNIS		F	C											68				
W9505	UNIDENTIFIED LARVAE		L	O											68			58	
W9506	ACARTIA HUDSONICA		C	C											269			84	
W9506	ACARTIA HUDSONICA		F	C														84	
W9506	ACARTIA HUDSONICA		M	C											135				
W9506	BIVALVIA SPP.		L	O											1480			9036	
W9506	CALANUS FINMARCHICUS		C	C											1480			1689	
W9506	CENTROPAGES TYPICUS		C	C											135			253	
W9506	CENTROPAGES TYPICUS		F	C											135			84	
W9506	CENTROPAGES TYPICUS		M	C											135				
W9506	CIRRIPEDE SPP.		N	B											404			591	
W9506	CIRRIPEDE SPP.		Y	B											538			84	
W9506	COPEPOD SPP.		-	C														84	
W9506	COPEPOD SPP.		N	C											16684			9289	
W9506	CRUSTACEA:UNIDED CRUSTACEAN		-	O														760	
W9506	ECHINODERM PLUTEI		-	O											135			1013	
W9506	EURYTEMORA HERDMANI		C	C											1884				
W9506	EURYTEMORA HERDMANI		F	C											807				
W9506	EURYTEMORA HERDMANI		M	C											1211				
W9506	EVADNE SPP.		-	O											538			169	
W9506	GASTROPODA;MOLLUSCA		L	O											807			84	

Zooplankton Species Data (ind/m^3)
W9501 - W9509

Event	Species	Life Stage	Group	1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
				Station Cast														
W9506	HARPACTICOIDA SPP.	-	C											404				
W9506	MICROSETELLA NORVEGICA	-	C											135			422	
W9506	OIKOPLEURA DIOICA	-	O											538			929	
W9506	OITHONA ATLANTICA	C	C														84	
W9506	OITHONA ATLANTICA	F	C														84	
W9506	OITHONA SIMILIS CLAUS	C	C											4978			6502	
W9506	OITHONA SIMILIS CLAUS	F	C											1749			1436	
W9506	OITHONA SIMILIS CLAUS	M	C											1076			591	
W9506	PODON SPP.	-	O											269				
W9506	POLYCHAETE SPP.	L	O											1076			169	
W9506	POLYCHAETE SPP.	T	O											673				
W9506	PSEUDOCALANUS NEWMANI	C	C											1884			1689	
W9506	PSEUDOCALANUS NEWMANI	F	C											269			84	
W9506	PSEUDOCALANUS NEWMANI	M	C											135			253	
W9506	TEMORA LONGICORNIS	C	C											1480			253	
W9506	TEMORA LONGICORNIS	F	C														84	
W9506	UNIDENTIFIED LARVAE	L	O											135				
W9507	ACARTIA HUDSONICA	C	C									4700	342		407	1003		
W9507	ACARTIA HUDSONICA	F	C						139			188				167		
W9507	ACARTIA HUDSONICA	M	C										171			502		
W9507	ACARTIA TONSA	C	C			152			139									
W9507	BIVALVIA SPP.	L	O		53	152			2773	568	73	2256	427	2678	813	1338		4070
W9507	BRYOZOA SPP.	-	O	115					139					223	136			
W9507	CALANUS FINMARCHICUS	C	C			1213			139		877			223	3795	836		1707
W9507	CALANUS FINMARCHICUS	F	C															656
W9507	CALANUS FINMARCHICUS	M	C			152					292					167		131
W9507	CENTROPAGES TYPICUS	C	C	231	53				139		2338				136			
W9507	CENTROPAGES TYPICUS	F	C		53	152					73							
W9507	CENTROPAGES TYPICUS	M	C								146							
W9507	CIRRIPEDE SPP.	N	B						277	568		752	1195					
W9507	CIRRIPEDE SPP.	Y	B										85					
W9507	COPEPOD SPP.	-	C	115	53				139	114	73		85			167		131
W9507	COPEPOD SPP.	C	C	346	53	303			555				342			167		
W9507	COPEPOD SPP.	N	C	15811	8552	21537			13728	19537	7306	25192	18614	36602	41201	46646		30064
W9507	CRUSTACEA:UNIDED CRUSTACEAN	-	O			152			139						136			
W9507	EURYTEMORA HERDMANI	C	C		53					227		2632	939			669		919
W9507	EURYTEMORA HERDMANI	F	C										85			167		
W9507	EURYTEMORA HERDMANI	M	C		53							188	427			836		
W9507	EVADNE SPP.	-	O						832	795		752	171	670	136	669		

Zooplankton Species Data (ind/m^3)
W9501 - W9509

Event	Species		Life Stage	Group	Station Cast 1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9507	GASTROPODA;MOLLUSCA		L	O		53				416	568		564	256	446		334		131
W9507	HARPACTICOIDA SPP.		-	C												271			263
W9507	MEDUSA		-	O			152			139	227				223		167		
W9507	METRIDIA LUCENS		C	C			303			139									263
W9507	MICROSETELLA NORVEGICA		-	C	115	321	303			139	114	365		85		813			131
W9507	OITHONA ATLANTICA		F	C	692											136			
W9507	OITHONA SIMILIS	CLAUS	-	C			152									136			
W9507	OITHONA SIMILIS	CLAUS	C	C	6463	5185	12588			5547	3521	13151	2632	1281	6026	18703	5016		12997
W9507	OITHONA SIMILIS	CLAUS	F	C	2077	1710	2123			1387	1022	877	1880	598	1562	2711	1338		1575
W9507	OITHONA SIMILIS	CLAUS	M	C	231	53	455			139	114	73		171	223	271	167		525
W9507	PARACALANUS PARVUS		F	C												407			
W9507	PODON POLYPHEMOIDES		-	O										427					
W9507	PODON SPP.		-	O							568		376		446				
W9507	POLYCHAETE SPP.		L	O						139	454		4324	1366	223		1505		
W9507	PSEUDOCALANUS NEWMANI		C	C	2654	1871	5763			6379	2499	73	752	683	5803	1762	669		1969
W9507	PSEUDOCALANUS NEWMANI		F	C	1385	1710	303			971	1249			342	670	678	836		919
W9507	PSEUDOCALANUS NEWMANI		M	C	231	107	152			277	227			85	223	271			
W9507	TEMORA LONGICORNIS		C	C	115		1668			10261	1931	2119	188	768	1785	813	1003		131
W9507	TEMORA LONGICORNIS		F	C	692					277	454	73		427	2455		669		
W9507	TEMORA LONGICORNIS		M	C	808	53				416	454	146		171	2232		836		
W9507	TORTANUS DISCAUDATUS		C	C	115					139									
W9507	TORTANUS DISCAUDATUS		F	C						139					223				
W9507	TORTANUS DISCAUDATUS		M	C	115					277									
W9507	UNIDENTIFIED LARVAE		L	O		53	152			139			376	171	223	271			131
W9508	ACARTIA TONSA		C	C											135			59	
W9508	BRYOZOA SPP.		-	O														59	
W9508	CALANUS FINMARCHICUS		C	C											808			1179	
W9508	CALANUS FINMARCHICUS		F	C											135			59	
W9508	CALANUS FINMARCHICUS		M	C											404			118	
W9508	COPEPOD SPP.		N	C											20749			10257	
W9508	MICROSETELLA NORVEGICA		-	C											674			59	
W9508	OITHONA ATLANTICA		C	C											135				
W9508	OITHONA SIMILIS	CLAUS	-	C											269				
W9508	OITHONA SIMILIS	CLAUS	C	C											8893			3891	
W9508	OITHONA SIMILIS	CLAUS	F	C											3503			884	
W9508	OITHONA SIMILIS	CLAUS	M	C											135			59	
W9508	PSEUDOCALANUS NEWMANI		C	C											5389			1238	
W9508	PSEUDOCALANUS NEWMANI		F	C											2425			472	
W9508	PSEUDOCALANUS NEWMANI		M	C											404			118	

Zooplankton Species Data (ind/m^3)
W9501 - W9509

Event	Species	Life Stage	Group	Station Cast 1F01Z	1F02Z	1F06Z	1F13Z	1F23Z	1F24Z	1F25Z	1F27Z	1F30Z	1F31Z	1N10Z	1N16Z	2F23Z	2N16Z	3N16Z
W9508	TEMORA LONGICORNIS	C	C											1213				
W9508	TEMORA LONGICORNIS	F	C											539			59	
W9508	TEMORA LONGICORNIS	M	C											539				
W9508	TORTANUS DISCAUDATUS	C	C											135				
W9508	TORTANUS DISCAUDATUS	F	C											135				
W9508	TORTANUS DISCAUDATUS	M	C											135				
W9509	ACARTIA TONSA	C	C											1625				
W9509	BIVALVIA SPP.	L	O											1625				3168
W9509	CALANUS FINMARCHICUS	C	C											1219				3335
W9509	CALANUS FINMARCHICUS	M	C											813				667
W9509	COPEPOD SPP.	N	C											53634				29683
W9509	CRUSTACEA:UNIDED CRUSTACEAN	-	O											406				
W9509	EURYTEMORA HERDMANI	C	C											1219				
W9509	GASTROPODA;MOLLUSCA	L	O											406				
W9509	METRIDIA LUCENS	C	C															167
W9509	MICROSETELLA NORVEGICA	-	C											1219				167
W9509	OITHONA SIMILIS CLAUS	C	C											18691				12674
W9509	OITHONA SIMILIS CLAUS	F	C											2032				1501
W9509	OITHONA SIMILIS CLAUS	M	C											2032				334
W9509	PSEUDOCALANUS NEWMANI	C	C											6907				12007
W9509	PSEUDOCALANUS NEWMANI	F	C											7314				1001
W9509	PSEUDOCALANUS NEWMANI	M	C											2032				334
W9509	TEMORA LONGICORNIS	C	C											4063				667
W9509	TEMORA LONGICORNIS	F	C											1219				
W9509	TEMORA LONGICORNIS	M	C											406				

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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