AN ABSTRACT FOR THE THESIS OF

Holly L. Corwith for the degree of Master of Science in Oceanography. Presented on August 24, 2000. Title: El Niño Related Variations in Nutrient and Chlorophyll Distributions off Oregon

Abstract approved _Patricia A. Wheeler_
Patricia A. Wheeler

The Oregon continental shelf waters are typically characterized by four to five major upwelling events that occur between May and October. The upwelled water is rich in nutrients, which fuels an increase in phytoplankton biomass. The onset of El Niño, however, can disrupt the normal physical processes along the Oregon coastline by decreasing upwelling, thereby potentially changing the distribution of nutrients and chlorophyll in this region. As part of the Eastern North Pacific GLOBEC program, we have examined the direct effect of El Niño on nutrient and chlorophyll distributions along the Oregon coast. We sampled chlorophyll and nutrients (phosphate, silicate, nitrate, nitrite, and ammonium) from September 1997 through July 1999 along 4 lines from 40°52.0' to 44°39.1'. Results showed that the shelf was nitrate limited, and chlorophyll concentrations were significantly lower off Newport during the El Niño summer. The percentage of large sized cells (> 10 μm) was decreased to 23% of the total population, as compared to 92% found during the more typical upwelling conditions in August, 1998, which indicates a

species composition change occurred during the El Niño period. The slope and offshore waters were less affected by the El Niño conditions during the upwelling season.

EL NINO RELATED VARIATIONS IN NUTRIENT AND CHLOROPHYLL DISTRIBUTIONS OFF OREGON

by
Holly L. Corwith

A THESIS

Submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

Presented August 24, 2000
Commencement June, 2001

Master of Science thesis of Holly L. Corwith presented on August 24, 2000.

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I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Holly L. Corwith

Holly L. Corwith, author

ACKNOWLEDGEMENTS

This thesis would not have been possible without the help of the following people:

My advisor, Pat Wheeler.

The members of Pat Wheeler's laboratory: Jon Hill, Nobu Kawasaki, Woody Moses, Lee Karp-Boss, Julie Arrington, and Jennifer Harmon.

The Northeast Pacific GLOBEC physical oceanography team: Bob Smith, Jane Huyer, Mike Kosro, Sheila O'Keefe, and Jane Fleischbein.

The Northeast Pacific GLOBEC zooplankton team: Bill Peterson, Julie Keister, and Leah Feinberg.

Lou Gordon's nutrient analysis laboratory: Andy Ross and Joe Jennings.

The crew of the R/V Wecoma.

Finally, Bill Corwith, Sally Corwith, and Michael Jensen.

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DEDICATION

I dedicate my thesis to my parents, Bill and Sally Corwith.

EL NINO RELATED VARIATIONS IN NUTRIENT AND CHLOROPHYLL DISTRIBUTIONS OFF OREGON

1. INTRODUCTION

Coastal upwelling systems are some of the most productive areas of the ocean. It has been estimated that although upwelling areas comprise less than 1% of the total ocean, they are responsible for over 50% of the protein that is harvested from the sea (Barber and Chavez, 1986). The upwelling system off the Oregon coast supports high productivity from May to October, which provides the base of an important food web that supports high standing stocks of zooplankton and fish. Perturbations to this system such as El Niño can potentially propagate up the food web and have a large impact on the higher trophic levels. It is surprising, then, that the affect of El Niño on nutrients and chlorophyll off the Oregon coast has not been directly examined. The timing of the 1997/98 El Niño, however, provided an opportunity to compare the differences in distributions of nutrients and chlorophyll during an El Niño year and a non El Niño year as part of the Northeast Pacific GLOBEC program. The goals of this thesis were to first determine if nitrate and chlorophyll concentrations were significantly lower during the El Niño conditions through all seasonal periods. Second, we examined the degree to which the intensity of the El Niño effect varied with distance from shore and with coastal topography. We examined nutrient ratios to determine the most likely limiting nutrient during El Niño and non El Niño conditions. Finally, we used the results to estimate and compare the size of the productive habitat off different parts of the Oregon coastline.

Chapter 2 of this thesis gives an overview of the normal physical oceanography off the Oregon coast. It also gives an overview of El Niño and the Pacific Decadal Oscillation. Chapter 3 presents the main results as prepared for publication in Progress in Oceanography. It includes nutrient and chlorophyll distributions during 1997-98 (El Niño) and 1998-99 (non El Niño), surface and integrated nutrient ratios, and offshore and alongshore variations in nitrate and chlorophyll. Chapter 3 has been submitted for publication in a special topic issue covering the 1997/98 El Niño (edited by F.P. Chavez). Chapter 4 of this thesis presents an overall summary and conclusions as well as a discussion of research that should be continued in the on-going GLOBEC program. Finally, Appendix A and B present the primary nutrient and chlorophyll data sets for 1997 through 1999 that were used in this thesis. This data is available through the NEP GLOBEC program office or from P.A. Wheeler at pwheeler@oce.orst.edu. Contour plots of nutrient and chlorophyll data for 1997-1999 will also be available as a CD distributed with the El Niño special issue of Progress in Oceanography (Chavez, 2001).

2. BACKGROUND INFORMATION

2.1. GENERAL CIRCULATION OFF OREGON

There are three large-scale currents that are important off Oregon; the California Current, the California Undercurrent, and the Davidson Current. The California Current carries cold, subarctic water southward along the U.S. west coast. Off of Newport, Oregon, it extends from the shelf break to 100 km offshore through the upper 500 m of the water column. Its average speed is 10 cm s^{-1}, and is at its maximum in the summer (Hickey, 1998). In this region, the maximum amount of flow for the California Current occurs 15-20 km from shore. South of Cape Blanco, however, the current is diverted further offshore. The current can stall or even reverse in the winter (Huyer, 1983). The California Undercurrent carries warm, salty, nutrient poor water poleward at depths of 100-300 m. The flow reaches its maximum in the summer over the mid and outer shelf (Huyer et al., 1989, Hickey, 1998). The poleward Davidson Current occurs in the fall and winter over the shelf and slope and up to 100 km offshore. It is thought that it is created by the surfacing of the California Undercurrent and is forced by the predominant southeasterly winds that occur in the winter (Hickey, 1998). It carries warm, salty, nutrient-poor water. The strongest flow (20-30 cm s^{-1}) occurs in January or

February, with the strongest part of the current over the inner shelf (Huyer et al., 1989).

The currents off Oregon have several important characteristics. Alongshore flow is much greater than the onshore-offshore flow. There is a high degree of variability in the current speed and direction. There is also a strong seasonality to the currents (Huyer and Smith, 1978).

The Columbia River drains into the ocean at 46° 15' North. The plume is carried northward off Washington during the winter, and southward off Oregon in the summer. In the summer, it forms a surface lens of warm, fresh water, with salinities of less than 32.5 (Small and Menzies, 1981). Although it usually flows offshore of the Oregon coast, there are times that its inshore boundary lines up with the upwelling water boundary, creating a strong front (Huyer, 1983) (Figure 2.1). In April and May, it typically has a distinct plume (Small and Menzies, 1981). The maximum amount of river discharge occurs in June. The Columbia River plume can increase water column stratification and create a large density front (Huyer and Smith, 1978). During this time, the inner boundary of the plume can limit the width of the upwelling band north of Cape Blanco (Huyer, 1983).

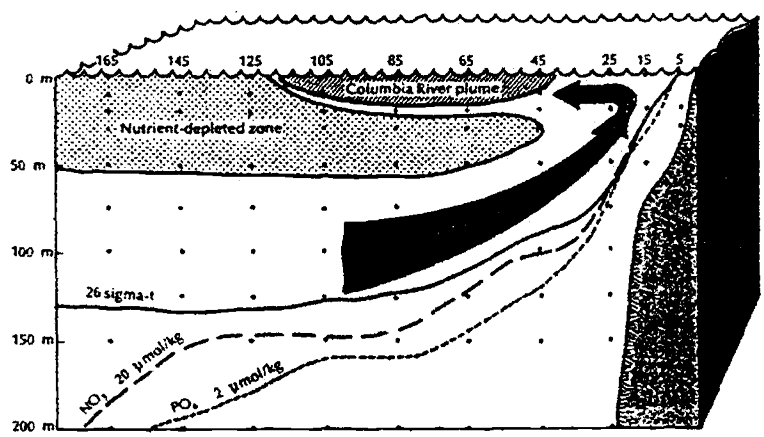

Figure 2.1. Diagram of the Columbia River plume. From Neshyba, 1987.

From October to April, the conditions off the Oregon coast predominantly favor downwelling. The poleward winds drive onshore Ekman transport, the water converges, and downwelling occurs (Figure 2.2).

Wind stress can be highly variable, however, and occasional upwelling favorable events can occur even in the winter (Huyer, 1983). Convective cooling and wind forcing often create a deep mixed layer (Huyer and Smith, 1978).

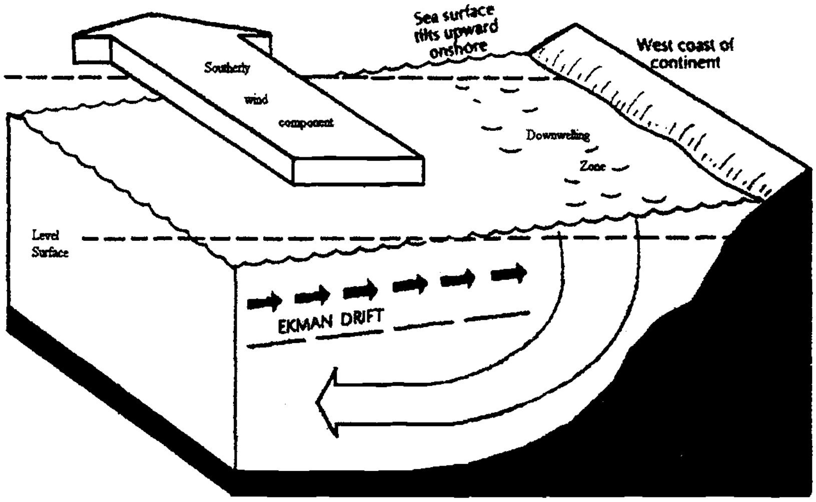

Figure 2.2. Diagram of downwelling off the Oregon coast. From Neshyba, 1987.

The spring transition occurs abruptly between March and April, when the winds shift from predominantly poleward to predominantly equatorward. Within a period of a few days, the currents reverse, the isopycnals change slope, the coastal sea level drops at least 10 cm, and conditions change from downwelling favorable to upwelling favorable (Hickey, 1998).

The upwelling season off the Oregon coast extends from May through September, and is characterized by intermittent upwelling events. Each upwelling event has a time scale of 2 to 10 days, with 4-5 major upwelling events per season and more frequent smaller scale events (Barber and Smith, 1981). Upwelling is driven by wind-forced Ekman transport away from the shore, and is usually found 10-15 km offshore (Figure 2.3). Cold, nutrient-rich water is typically upwelled from depths of 100-200 m (Barber and Smith, 1981). This process is associated with an equatorward coastal jet (Federiuk and Allen, 1995) that occurs over the mid-shelf in the upper water column (Barth et al., 2000). A strong front is created between the warmer, nutrient-poor offshore water and the cold, nutrient-rich upwelled water. These intermittent upwelling events provide the nutrients that are required for primary production throughout the summer.

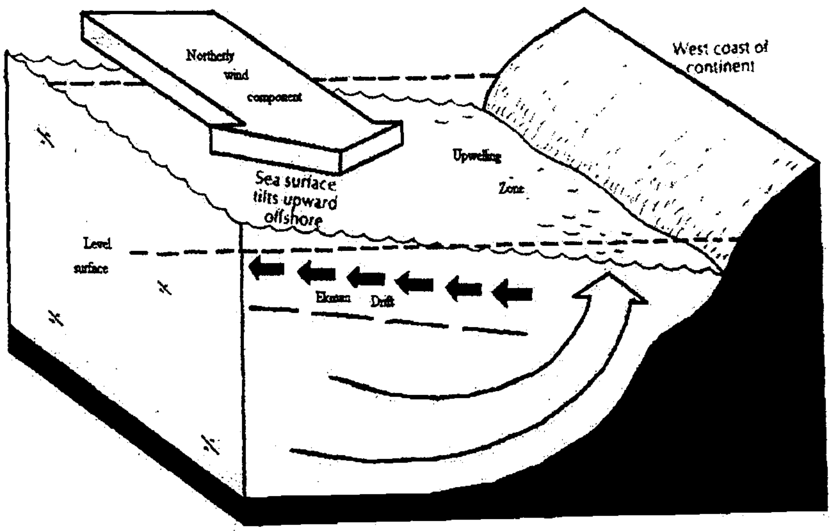

Figure 2.3. Diagram of summer upwelling off the Oregon coast. From Neshyba, 1987.

2.2. EL NINO

El Niño is due to large scale interactions between the ocean and the atmosphere. Under normal conditions, the trade winds blow east to west along the equator and water piles up in the western portion of the equatorial Pacific, generating a sea surface slope with a higher sea level in the west. The winds also set up a tilt in the thermocline and nutricline, with a much deeper mixed layer generated in the west. Every 2 to 10 years, however, this system is disrupted with the El Niño phenomenon. El Niño is often preceded by stronger than normal trade winds, which drive a higher than average sea level in the west, and a lower sea level in the east. El Niño occurs when the trade winds weaken. The sea surface slope collapses, which generates Kelvin waves. The equator acts as a wave guide, propagating Kelvin waves eastward. The waves reach the Peruvian coast, then continue north and south as coastally trapped waves, propagating the disturbance at speeds as high as 200-250 km d^{-1} (Chavez, 1996). The Kelvin waves depress the thermocline. At the same time, the collapse of the trade winds allows the large pool of warm water in the west Pacific to migrate eastward (McPhaden, 1999b). The east to west sea surface gradient disappears, which weakens the trade winds even more and sets up a positive feedback loop (McPhaden, 1999a).

El Niño is traditionally associated with the warming of the surface water off the coast of Peru and Ecuador. The phenomenon depresses the thermocline below 100 m off Peru (Barber et al., 1985). Water is then upwelled from above the thermocline, which results in low nutrient seawater being brought to the surface. Primary productivity can decrease to 5% of normal values (Barber et al., 1985). El Niño is not limited to the equator, however, it can also have a large scale impact on the oceanic ecosystem in other regions. When a strong El Niño occurs, such as those in 1957-1958 and 1982-1983, the disturbance can propagate as far north as British Columbia (Tabata, 1985).

There is historical data available about the physical affects of El Niño off Oregon, but there is less information about the chemical and biological affects. For example, the 1982/83 El Niño was one of the strongest on record, but there is not any data available about its effect on nutrients off the Oregon coast, and chlorophyll data is limited to surface water concentrations. Nonetheless, the 1982/83 El Niño is a good example of the typical sequence of events that can occur in the coastal waters off Newport, Oregon. By late 1982, the sea level off Newport, Oregon was 15 cm above normal and sea surface temperatures were anomalously high. There were greatly increased poleward winds, and a negative upwelling index (Huyer and Smith, 1985). Water was warmer than average as far as 200-250 km offshore, and to 300 m depth (Pearcy and Schoener, 1987). There were significant changes in biological standing stocks off the Oregon coast; in the summer of 1983 surface chlorophyll was only 1 $\mu g\ L^{-1}$, and there was a 70% decrease in zooplankton biomass(Pearcy and Schoener, 1987).

In 1997/98 another El Niño event occurred. It followed a typical sequence, but developed very rapidly. By December 1997, the sea surface temperature anomalies in the eastern equatorial Pacific were almost 4° C above normal, the largest ever recorded in this area (McPhaden, 1999b). By late 1997, the eastern equatorial Pacific thermocline had been depressed by greater than 90 m, and the western equatorial thermocline had shoaled by 20-40 m (McPhaden, 1999b). This was one of the strongest El Niños on record.

2.3. THE PACIFIC DECADAL OSCILLATION

One possible reason for the strength of the 1997/98 El Niño was that it was superimposed on another large climatic signal. The Pacific Decadal Oscillation (PDO) is a water temperature shift that occurs in the north Pacific on a time scale of 20 to 30 years. Mantua et al. (1997) identified two phases of the PDO; the warm phase and the cool phase (Figure 2.4). The phase is related to the relative strength of the Aleutian Low, the semi-permanent sub-polar low located near the Aleutian Islands (Ahrens, 1994). During a warm phase of the PDO, the Aleutian low is intensified, there is strong Alaskan gyral circulation, the Alaskan Current is stronger than normal, and the California Current is weaker than normal. Upwelling is decreased in the California Current region, and sea surface temperatures are higher than normal through the coastal northeast Pacific. A cold era is opposite; the Aleutian Low is weaker than normal, there is weaker Alaskan gyre circulation, the Alaskan Current is decreased, and the California Current is stronger than average. Upwelling in the California Current coastal region is stronger than normal, and sea surface temperatures are lower than normal along the northeast Pacific coast.

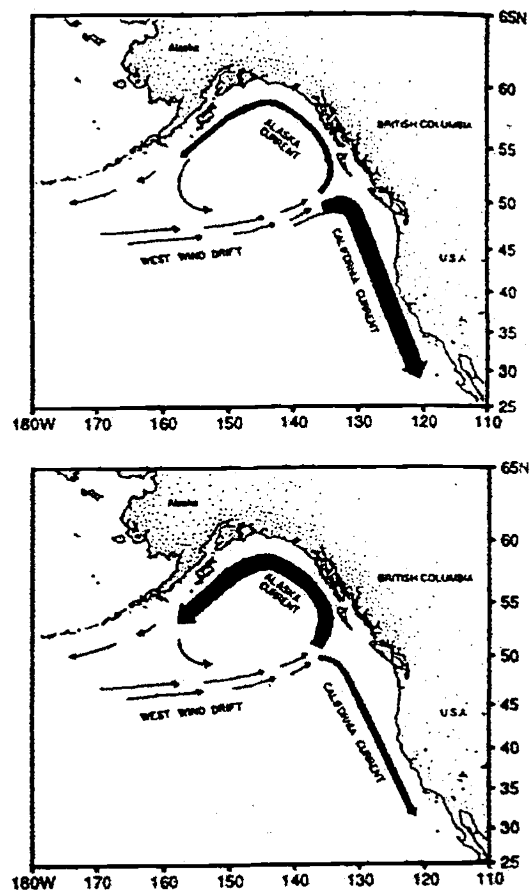

Figure 2.4. Diagram of the cool phase and the warm phase of the PDO. From Brodeur et al., 1996.

The warm phase and the cold phase of the PDO alternate. From 1947-1976, the northeast Pacific was dominated by a cool phase of the PDO. In 1976, however, there was a regime shift, and the PDO entered a warm phase. It is possible that the PDO affects the strength of the El Niño. For example, the 1972/73 El Niño occurred during the cool phase of the PDO. Although it was a strong event at the equator, it did not greatly impact the waters off Oregon. The 1982/83 El

Niño, however, occurred during the warm phase of the PDO. It was one of the strongest events ever recorded off Newport, Oregon. The 1997/98 El Niño also occurred during the warm phase of the PDO, and matched the 1982/83 event in intensity off Oregon. There is currently speculation that there was another regime shift in 1999 back to the cold phase of the PDO (A. Huyer, personal communication). Only time and continued monitoring will resolve that issue.

2. EL NINO RELATED VARIATIONS IN NUTRIENT AND CHLOROPHYLL DISTRIBUTIONS OFF OREGON.

H.L. Corwith and P.W. Wheeler

3.1. INTRODUCTION

3.1.1. General Circulation

The upwelling season off the Oregon coast extends from May through September, and is characterized by intermittent upwelling events. Each upwelling event has a time scale of 2 to 10 days, with 4-5 major upwelling events per season and more frequent smaller scale events (Barber and Smith, 1981). Upwelling is driven by wind-forced Ekman transport away from the shore, and is usually found 10-15 km offshore. Water is typically upwelled from depths of 100-200 m (Barber and Smith, 1981) and the process is associated with an equatorward coastal jet (Federiuk and Allen, 1995). A strong front is created between the warmer, nutrient-poor offshore water and the cold, nutrient-rich upwelled water. These intermittent upwelling events provide the nutrients that are required for primary production throughout the summer.

From October to April, the conditions off the Oregon coast predominantly favor downwelling. The poleward winds drive onshore Ekman transport, the water converges, and downwelling occurs. Convective cooling and wind forcing often create a deep mixed layer (Huyer and Smith, 1978). Between March and April (the spring transition), the winds shift from predominantly poleward to predominantly equatorward. Within a period of a few days, the currents reverse, the isopycnals change slope, the coastal sea level drops at least 10 cm, and conditions change from downwelling favorable to upwelling favorable (Hickey, 1998).

3.1.2. El Niño Conditions

El Niño is traditionally associated with the warming of the surface water off the coast of Peru and Ecuador. The phenomenon depresses the thermocline below 100 m off Peru (Barber et al., 1985). Water is then upwelled from above the thermocline, which results in low nutrient seawater being brought to the surface. Primary productivity can decrease to 5% of normal values (Barber et al., 1985). The El Niño is not limited to the equator; it can also have a large scale impact on the oceanic ecosystem in other regions. When a strong El Niño occurs, such as those in 1957-1958 and 1982-1983, the disturbance can propagate as far north as British Columbia (Tabata, 1985).

There is historical data available about the physical effects of El Niño off Oregon, but there is less information about the chemical and biological effects. For example, the 1982/83 El Niño was one of the strongest on record off Oregon (Huyer and Smith, 1985), but there is no data available on nutrient distributions and chlorophyll data is limited to surface concentrations. In late 1982, the sea level off Newport, Oregon was 15 cm above normal and sea surface temperatures were anomalously high. There were greatly increased poleward winds, a negative upwelling index, low surface chlorophyll (~ 1 μg L^{-1}), and a 70% decrease in zooplankton biomass numbers (Pearcy and Schoener, 1987). The connection between changes in nutrient availability and phytoplankton standing stock was not examined.

The magnitude and progression of the 1997-98 El Niño off Oregon are described by Huyer et al. (2000) and Kosro et al. (2000) and are briefly summarized here. In July 1997, offshore sea surface temperatures were > 6° C warmer than normal, and by September 1997, the inshore water was also 2° C warmer than normal. The coastal thermoclines sloped downward, and there was strong northward flow over the shelf. The local coastal upwelling index was less favorable than normal (Smith et al., 2000). Conditions continued to be anomalous from November 1997 to January 1998. Sea surface temperatures were 1° to 2° C warmer than normal, there was strong northward flow over the shelf (Davidson Current), and a mixed layer deeper than 100 m. During April 1998, ocean temperatures off Newport were still more than 2°C above normal. There was southward flow over the shelf and slope, and the nutricline sloped upwards towards the coast. Temperature and salinity profiles indicated that upwelling had begun (Kosro, 2000).

3.1.3. Purpose of This Study

The main purpose of this study was to evaluate and compare the direct effect of El Niño on the nutrient and chlorophyll distributions off the Oregon coast. The timing of the 1997/98 El Niño was fortuitously at the beginning of the long term observation program (LTOP) funded as part of the Northeast Pacific GLOBEC program. We used data from the first two years of this sampling program to examine the magnitude of effects of the El Niño conditions on seasonal variations in nutrient and chlorophyll distributions off Newport. We examined nutrient ratios to determine the most likely limiting nutrient during El Niño and non El Niño conditions and used additional data from three other transects to compare alongshore nutrient fields and potential productivity.

3.2. METHODS

Data for this study was collected during 10 cruises between September 1997 and July 1999 aboard the R.V. Wecoma. Samples were collected from 4 transects between 40° 52.0' N and 44° 39.1' N (Figure 3.1). The Newport hydroline was sampled every cruise; sampling of the other transects depended upon weather and season (Table 3.1). Temperature and salinity were measured with the SBE 9/11 Plus CTD system and are reported in Fleischbein et al. (1999). Data are available through the U.S. GLOBEC NEP Coordinating Office (http://www.powelllab.biol.berkeley.edu/nep/index.html). Water samples were collected with 5 L Niskin bottles on a 12 bottle rosette, with samples taken approximately every 10 m in the upper 70 m and at deeper depths to define the nutricline. The data for samples taken prior to August 1998 are reported in Fleischbein et al. (1999) and Hill (1999).

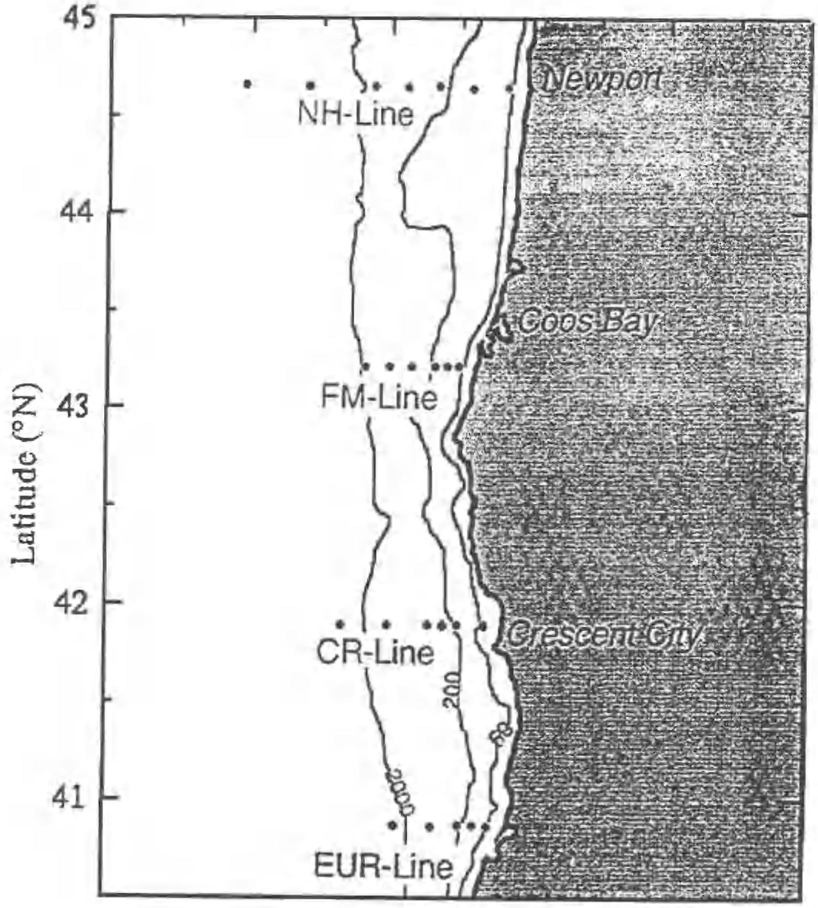

Figure 3.1. Map of the sampling lines for the GLOBEC study. Circles correspond to stations sampled. NH is the Newport Hydrographic line, FM is the Five Mile line, CR is the Crescent City line, and EU is the Eureka line. Taken from Fleischbein, 2000.

Table 3.1
List of stations with location and sampling dates. – means the station was not sampled.

Station	Longitude	Latitude	Sep 97	Nov 97	Jan 98	Apr 98	Aug 98	Sep 98	Nov 98	Feb 99	Apr 99	Jul 99
NH-05	44°39.1'	124°10.6'	x	x	x	x	x	x	x	x	x	x
NH-10	44°39.1'	124°17.7'		-	-	-	-	-	-	x	-	-
NH-15	44°39.1'	124°24.7'	x	x	x	x	x	x	x	x	x	x
NH-25	44°39.1'	124°39.1'	x	x	x	x	x	x	x	x	x	x
NH-35	44°39.1'	124°53.0'	x	x	x	x	x	x	x	x	x	x
NH-45	44°39.1'	125°07.0'	x	x	x	x	x	x	x	-	x	x
NH-65	44°39.1'	125°36.0'	x	x	x	x	x	x	x	-	x	x
NH-85	44°39.1'	126°03.0'	x	x	x	x	x	x	x	-	x	x
FM-3	43°13.0'	124°30.0'		x	x	x	x	-	x	-	x	x
FM-4	43°13.0'	124°35.0'		x	x	x	x	-	x	-	x	x
FM-5	43°13.0'	124°40.0'		x	x	x	x	-	x	-	x	x
FM-7	43°13.0'	124°50.0'		x	x	x	x	-	x	-	x	x
FM-8	43°13.0'	125°00.0'		x	x	x	x	-	x	-	x	x
FM-9	43°13.0'	125°10.0'		x	-	-	x	-	x	-	x	x
CR-1	41°54.0'	124°18.0'		x	-	x	x	-	x	-	x	x
CR-3	41°54.0'	124°30.0'		x	-	x	x	-	x	-	x	x
CR-4	41°54.0'	124°36.0'		x	-	x	x	-	x	-	x	x
CR-5	41°54.0'	124°42.0'		x	-	x	x	-	x	-	x	x
CR-7	41°54.0'	125°00.0'		x	-	x	x	-	x	-	-	x
CR-9	41°54.0'	125°20.0'		x	-	x	x	-	x	-	-	x
EU-1	40°52.0'	124°16.0'		-	-	-	x	-	-	-	-	x
EU-2	40°52.0'	124°22.0'		-	-	-	x	-	-	-	-	x
EU-3	40°52.0'	124°28.0'		-	-	-	x	-	-	-	-	x
EU-5	40°52.0'	124°40.0'		-	-	-	x	-	-	-	-	x
EU-7	40°52.0'	124°56.0'		-	-	-	x	-	-	-	-	x

3.2.1. Chlorophyll

Duplicate chlorophyll samples were collected in 125 ml Nalgene ™ amber rectangular polyethylene HDPE bottles. Size separations of chlorophyll were done using a 10 μm Nitex mesh. Samples were filtered through precombusted 25 mm Whatman™ GF/F filters (combusted at 400° C for 4 h) immediately after collection with vacuum filtration at less than 10 psi, then stored in glass Vacutainer™ tubes at -20° C. The filters were transferred to plastic centrifuge tubes just prior to processing. Chlorophyll was extracted for ≥ 12 h in the dark at -20° C using 95% methanol as the solvent (Parsons et al. 1984). Fluorescence was measured with a Turner Designs™ 10-au fluorometer that had been calibrated with Sigma Chlorophyll-a.

3.2.2. Nutrients

Water samples for nutrients (nitrate, phosphate, silicate, nitrite, and ammonium) were collected in acid-washed Nalgene™ 60 ml polyethylene HDPE bottles and immediately frozen. Nutrient samples were stored at -20° C, and processed within 4 months. Samples were analyzed by standard wet chemical methods according to the protocol of Gordon et al. (1995). Nutrients collected prior to August 1998 were run on a Technicon AA-II and processed by Sandy Moore. All other nutrient samples were run with phosphate and ammonium on a Technicon AA-II, and nitrate plus nitrite, silicate and nitrite on an Alpkem RFA-

300, and processed by H. Corwith. Nitrate was calculated by subtracting the total concentration of nitrite from the nitrate plus nitrite line. The coefficients of variation for duplicates at low nutrient concentrations for our analyses were typically < 1% for nitrate, phosphate, and silicate (Fleischbein et al., 1999). At high nutrient concentrations, coefficients of variation were 2.4%, 1.7%, and 2.9% for nitrate, phosphate, and silicate. Ammonium concentrations ranged from non-detectable to 2 μM with a detection limit and precision of 0.05 μM. Nitrite concentrations ranged from non-detectable to 0.5 μM with a detection limit and precision of 0.05 μM.

3.2.3. Calculations

To simplify analysis and to identify overall trends, stations were grouped as shelf, slope, or offshore. Shelf stations are defined as those within 30 km of shore and less than 150 m depth. Slope stations are defined as those 30-65 km from shore and 200-700 m in depth. Offshore stations are greater than 65 km from shore and deeper than 700 m. Statistical comparisons were done with Student t-tests unless otherwise noted.

The extinction coefficient for light penetration in the water column was calculated as $k = 0.04 + 0.0088C + 0.054C^{2/3}$ (Riley 1956) where C is the concentration of chlorophyll. The parameter k was calculated at 1 m intervals with Matlab, and the depth of the euphotic zone was taken as the depth where $k = 4.6$. A good correlation was found between our estimated euphotic zone depths, and those measure directly by Small and Menzies (1981) for these coastal and offshore waters.

3.2. RESULTS

3.3.1. 1997-1998 El Niño Depth Profiles for the Newport Transect

During the El Niño summer, nitrate, phosphate and silicate concentrations were very low through the upper 30 m all along the transect (Figure 3.2). A 0.2-0.4 μM subsurface nitrite maximum was present at 40 m along most of the transect. The nitrite maximum may have been related to microbial degradation of organic matter, or else may have been an indication of light-stressed phytoplankton cells at the base of the euphotic zone. Elevated ammonium concentrations were only present at depth over the shelf (Figure 3.2). Elevated ammonium can be related to zooplankton activity, microbial degradation of organic matter, and/or release from sediments. Chlorophyll concentrations were < 1 $\mu g\ L^{-1}$ chlorophyll all along the transect, with a very distinct subsurface chlorophyll maximum that was apparent between 35 and 40 m. The location of the subsurface chlorophyll maximum during the El Niño summer corresponded to the 2 μM nitrate isoline in slope and offshore waters. Chlorophyll in the surface water was present mostly in small phytoplankton with only 3-23 % in the > 10 μm size fraction (Table 3.2). These nutrient and chlorophyll distributions are characteristic of nutrient-poor waters with low productivity.

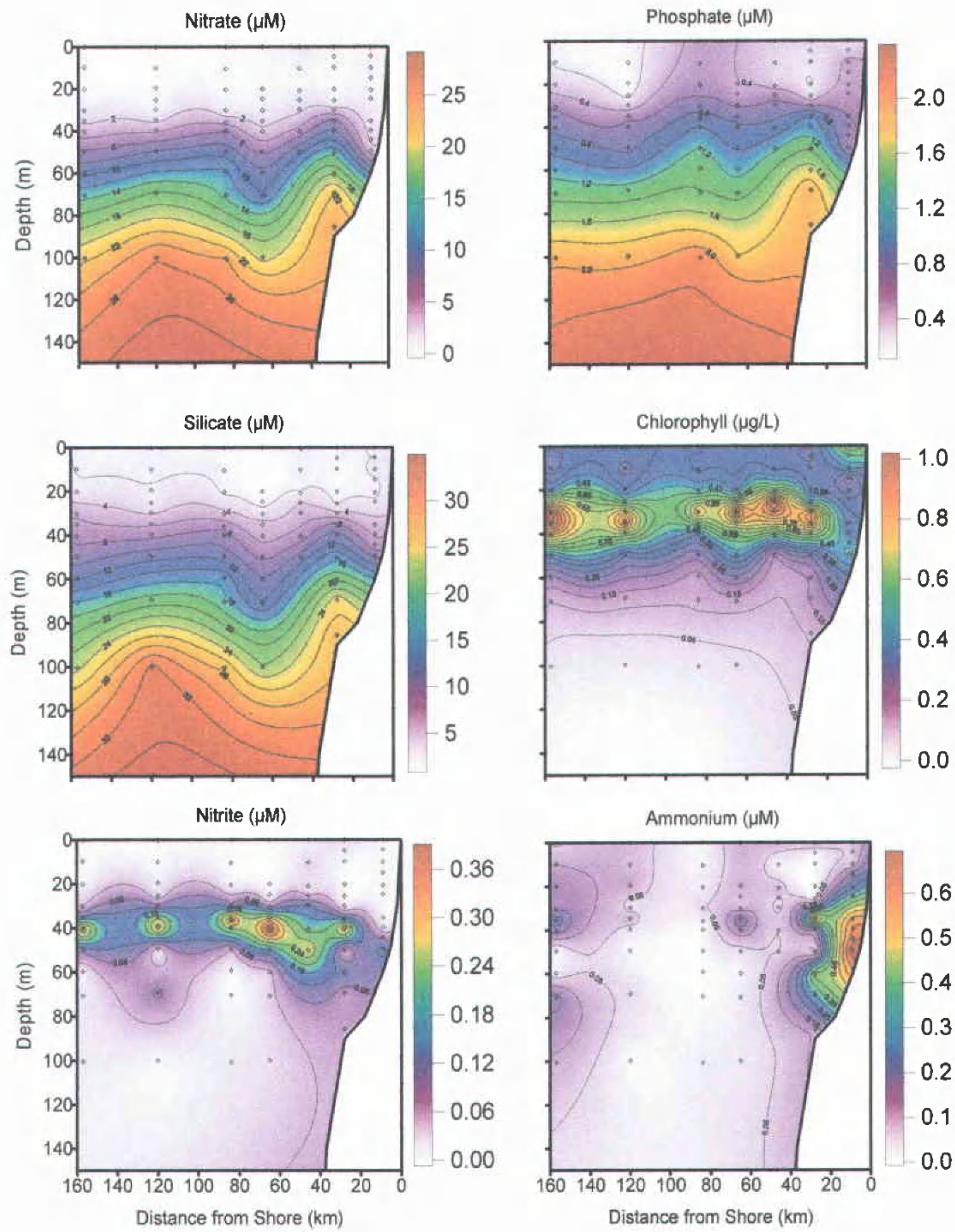

Figure 3.2. September 1997 nutrient and chlorophyll depth profiles for the Newport Hydrographic line. Open triangles represent depths where samples were collected.

Table 3.2.
Percentage of the surface phytoplankton population >10μm for samples collected off Newport, Oregon from Sep 97 through Jul 99. SD = ± one standard deviation for 'grouped' stations (See page 21).

	Shelf	Slope	Offshore
Date	Mean ± SD	Mean ± SD.	Mean ± SD
Sep 1997	23 ± 23	3 ± 5	13 ± 3
Nov 1997	1 ± 1	4 ± 5	3 ± 4
Jan 1998	16 ± 7	24 ± 6	13 ± 4
Apr 1998	50 ± 26	10 ± 15	30 ± 11
Aug 1998	92 ± 2	10 ± 9	19 ± 17
Sep 1998	76 ± 4	0 ± 0	5 ± 2
Nov 1998	24 ± 7	4 ± 1	3 ± 5
Feb 1999	20 ± 13	8 ± 5	na
Apr 1999	40 ± 39	6 ± 4	41 ± 51
Jul 1999	61 ± 2	21 ± 23	35 ± 13

*percentages greater than 100 were rounded to 100
na = not available, offshore stations were not sampled in Feb 1999.

During the El Niño winter conditions, cooler waters and the stronger than normal Davidson Current resulted in higher nutrient concentrations in the upper water column. Nitrate, phosphate and silicate were well mixed down to 60 m, with nitrate ranging from 2 to 4 μM, phosphate ranging from 1 to 2 μM, and silicate ranging from 4 to 15 μM (Figure 3.3). Nitrite concentrations were elevated (0.4 μM) in nearshore surface water, while ammonium showed no distinct pattern. Chlorophyll ranged from 0.5 to 1 μg L^{-1} in the upper 60 m (Figure 3.3), with < 23% present in the > 10 μm size fraction (Table 3.2).

During the El Niño spring, temperature and salinity profiles showed some evidence of upwelling (Huyer et al., 2000) but this was not yet reflected in nutrient or chlorophyll profiles (Figure 3.4). Nitrate, phosphate and silicate concentrations in the upper 30-50 m were lower than winter values with nitrate < 1 μM, phosphate < 0.8 μM, and silicate concentrations 2.5 to 5 μM.

A nitrite maximum (0.48 μM) was apparent over the shelf and extended into slope waters at 70 m depth. No strong patterns were evident in the ammonium depth profiles (Figure 3.4).

High chlorophyll concentrations (3 μg L^{-1}) were over the inner shelf at 20 m depth and extended offshore at 20-40 m depth (Figure 3.4). Over the shelf, approximately 50% of the surface phytoplankton were > 10 μm, but this dropped to 10-30% in slope and offshore waters (Table 3.2).

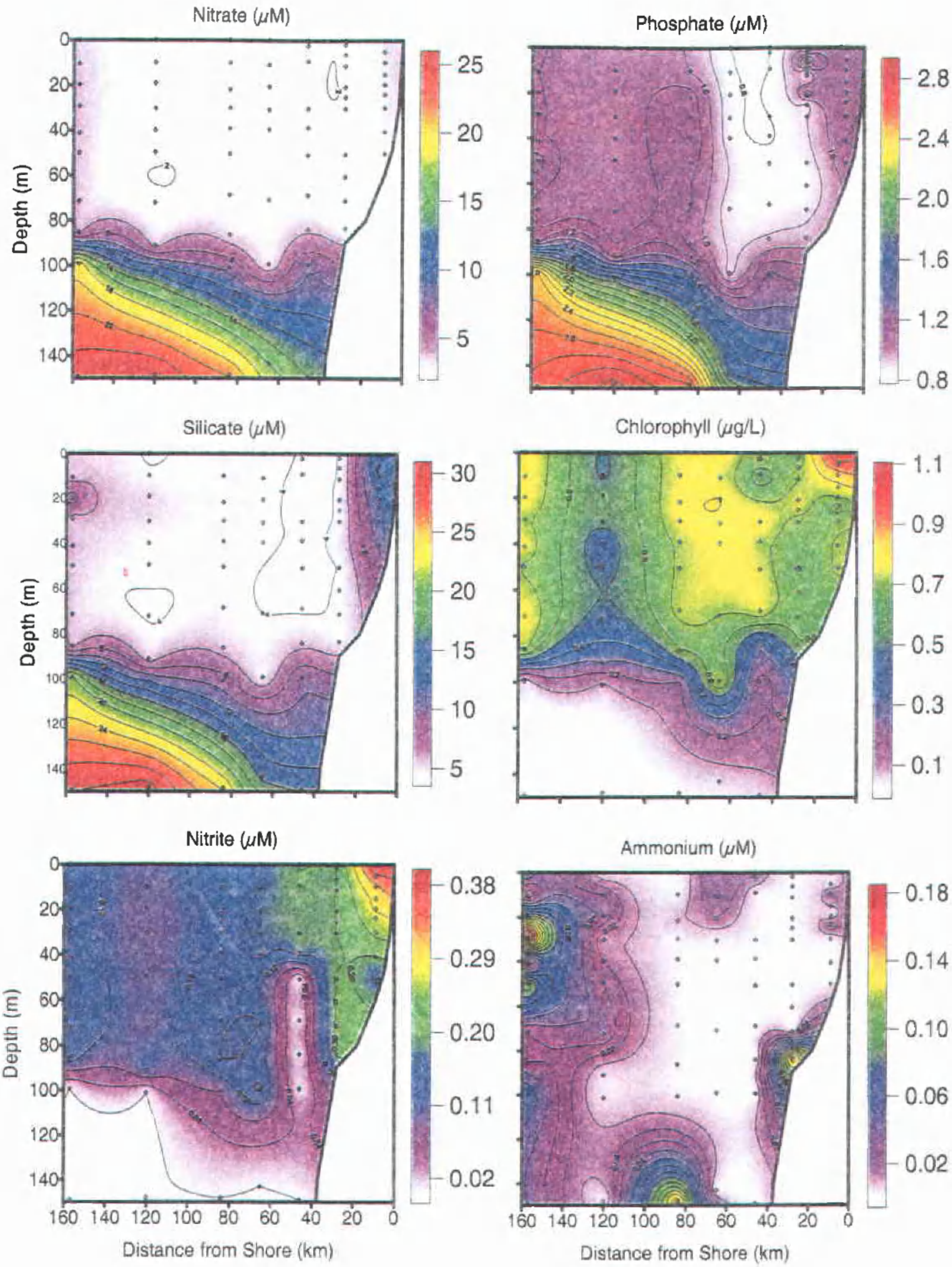

Figure 3.3. January 1998 nutrient and chlorophyll depth profiles for the Newport Hydrographic line. Open triangles represent depths where samples were collected.

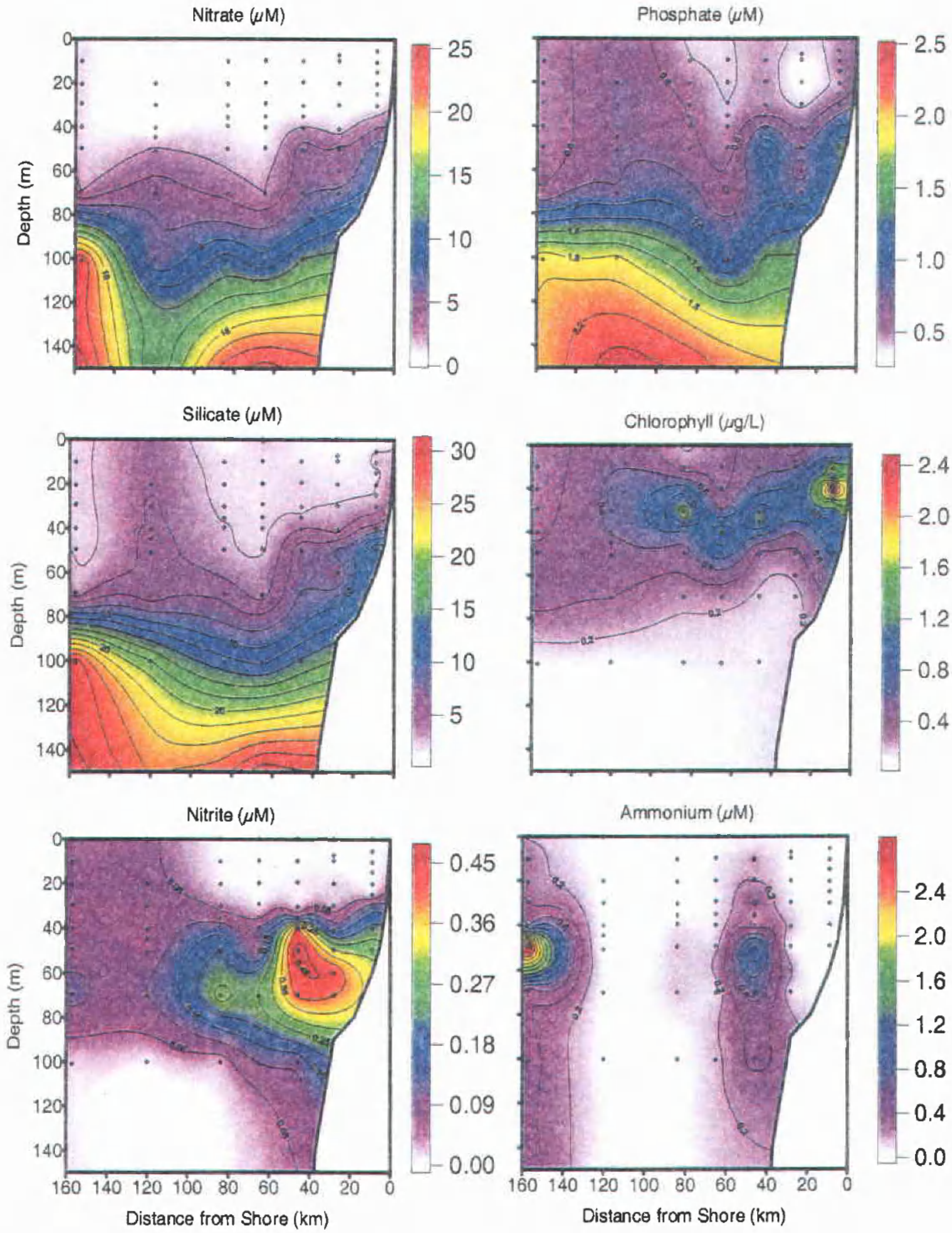

Figure 3.4. April 1998 nutrient and chlorophyll depth profiles for the Newport Hydrographic line. Open triangles represent depths where samples were collected.

3.3.2. 1998/99 Depth Profiles for Nutrients and Chlorophyll

Normal upwelling conditions had returned by August 1998. Off Newport, Oregon, the thermocline and nutricline sloped upward toward the coast, the upwelling front was located 5-15 km offshore, and acoustic doppler data showed a strong southward flow over the shelf and slope (Kosro, 2000). In general, surface nutrients and chlorophyll were elevated over the shelf (Figure 3.5). Surface nitrate was 8 μM at the upwelling front, but decreased to 1-2 μM within 25-45 km of the shore, and to less than 0.5 μM further offshore. Surface phosphate was typically 1.3 μM onshore, and decreased to 0.6 μM or less over the slope and offshore. Surface silicate was 12 μM nearshore, decreased to 5.9 μM within 28 km of shore, was undetectable over the slope, and was 1-3 μM further offshore. Maximum nitrite concentrations ranged from 0.1-0.3 μM at 30-80 m below the surface (Figure 3.5). Elevated ammonium concentrations were a common feature during the summer, but the levels and locations were variable. The increased ammonium concentrations may have been due to zooplankton activity, microbial degradation of organic matter, or sediment release. Ammonium is used rapidly by phytoplankton (Dickson and Wheeler, 1995), and elevated ammonium patches are not usually persistent throughout the season. Highest levels of chlorophyll (14 $\mu g\ L^{-1}$) were present in nearshore surface water (Figure 3.5). The concentrations of surface chlorophyll rapidly decreased off the shelf, and were < 1-2 $\mu g\ L^{-1}$ by 45 km offshore. An average of 92% of the surface phytoplankton population over the shelf was composed of cells > 10 μm, but this percentage decreased to 10%-19% further offshore (Table 3.2).

In November 1998, the mean flow of the current over the shelf and slope was poleward and conditions were predominantly downwelling favorable. There were intermediate concentrations of nutrients over the shelf (Figure 3.6). Surface nitrate concentrations were 2.4 μM nearshore, then decreased to < 0.5 μM further offshore. Surface phosphate concentrations were less than 0.5 μM along the entire line. Silicate concentrations ranged from 2 to 6 μM over the shelf and slope, and were < 1 μM offshore. Nearshore there was a small bottom nitrite maximum of 0.5 μM, and offshore weak subsurface elevations (~ 0.15 μM) at 40-50 m depth. Ammonium concentrations were generally low (≤0.06 μM) during the winter, but in November 1998, elevated concentrations were observed at one station (Figure 3.6). Chlorophyll concentrations were less than 1.0 μg L^{-1} but showed a strong offshore gradient (Figure 3.6). The percentage of the surface chlorophyll contained in cells > 10 μm was less than 25% over the entire line (Table 3.2).

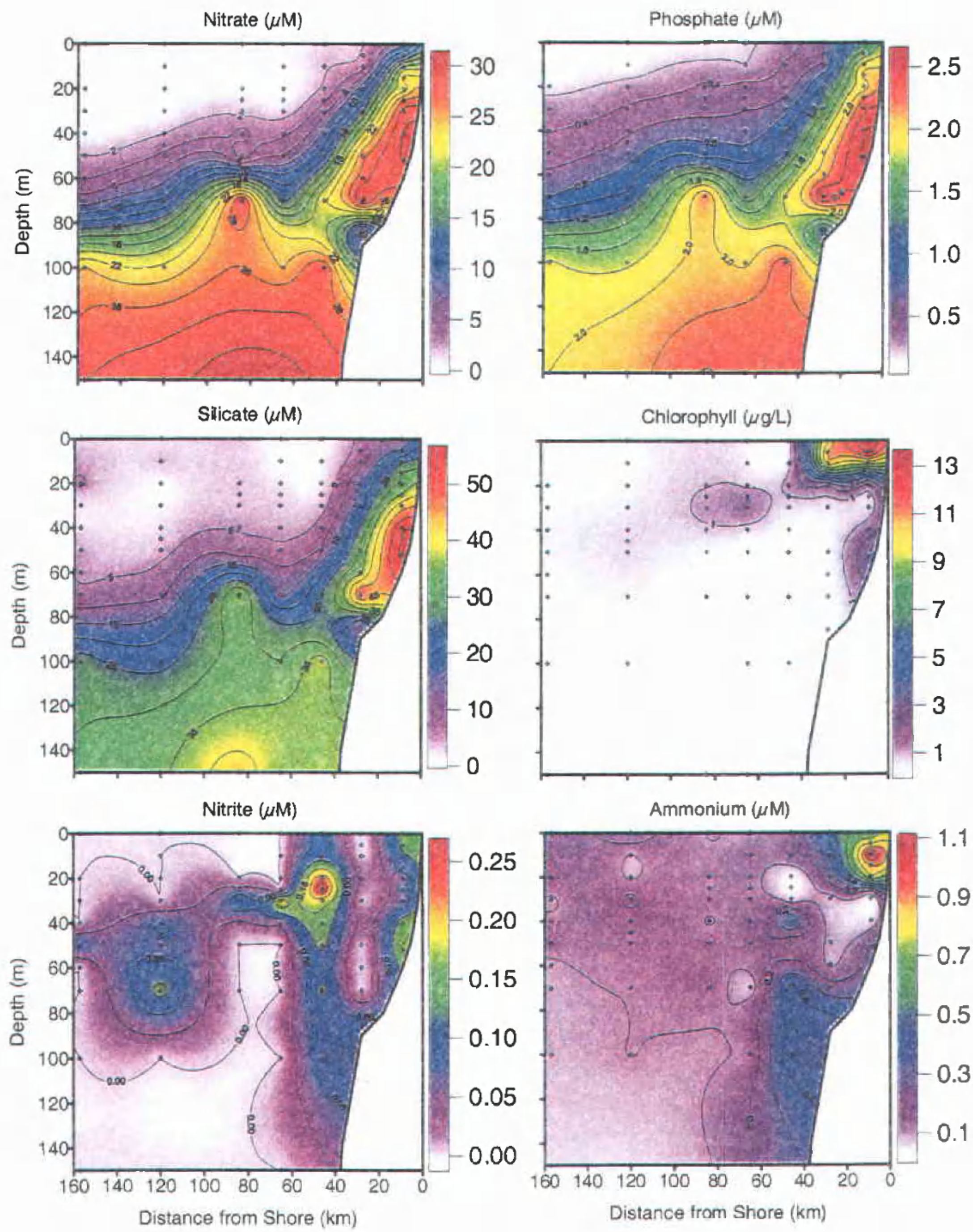

Figure 3.5. August 1998 nutrient and chlorophyll depth profiles for the Newport Hydrographic line. Open triangles represent depths where samples were collected.

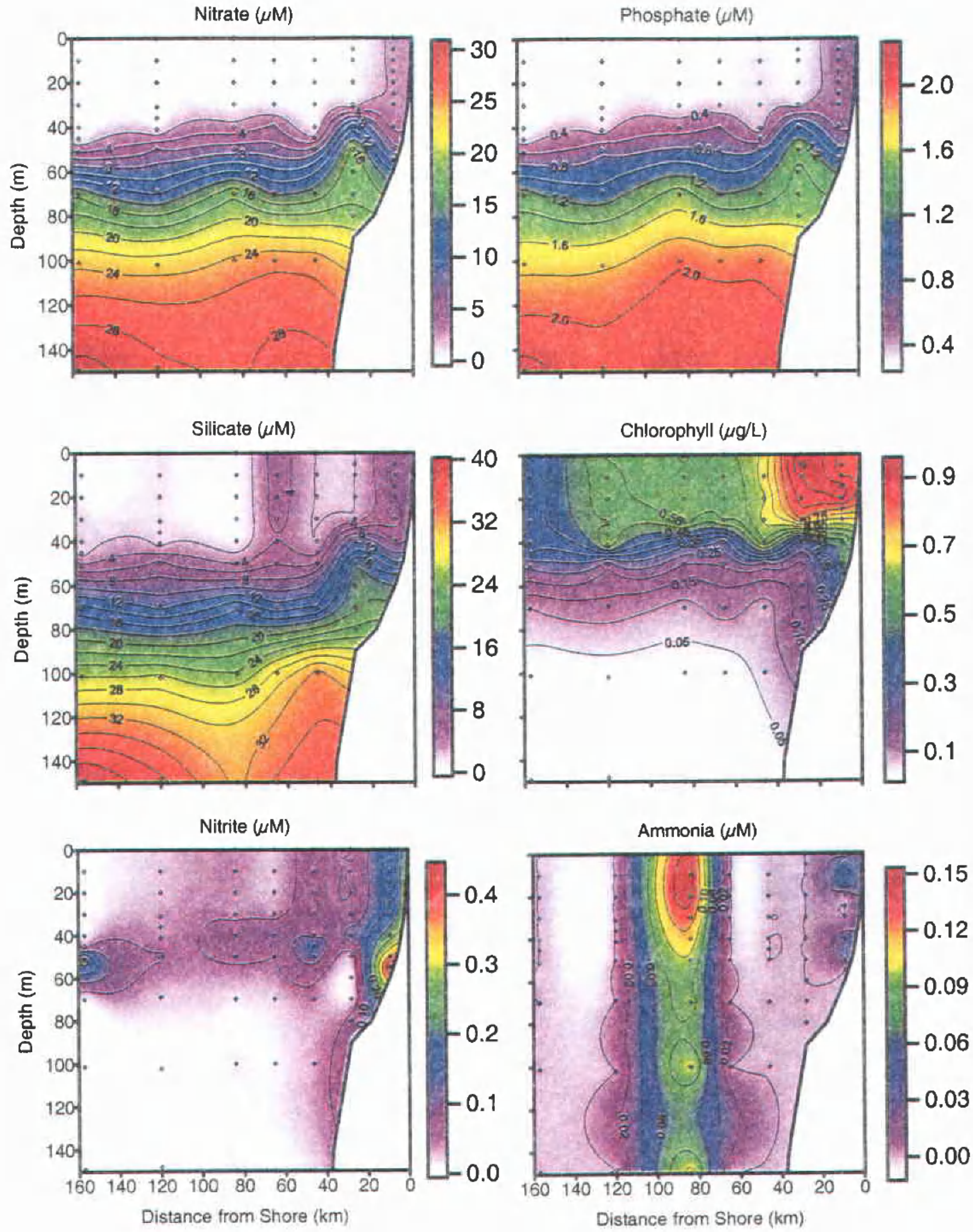

Figure 3.6. November 1998 nutrient and chlorophyll depth profiles for the Newport hydrographic line. Open triangles represent depths where samples were collected.

During the 1999 spring transition, mean flow over the shelf became southward and upwelling favorable. The nutriclines for nitrate, phosphate and silicate sloped upwards towards the shelf (Figure 3.7). A lens of freshwater 9 to 46 km from shore was nutrient depleted. Further offshore in the upper 50 m, nitrate concentrations ranged from 2.5 to 5.0 μM, phosphate concentrations ranged from 0.4 to 0.7 μM, and silicate ranged from 4 to 6 μM.

Nitrite and ammonium distributions were patchy, but both show elevated concentrations around 40 m depth over the shelf and slope (Figure 3.7). Chlorophyll concentrations in the upper 30 m showed a strong gradient with shelf concentrations of 5 $\mu g\ L^{-1}$ dropping to < 1 $\mu g\ L^{-1}$ offshore. An average of 40% of the nearshore chlorophyll was contained in cells > 10 μm; this dropped to 10% offshore (Table 3.2).

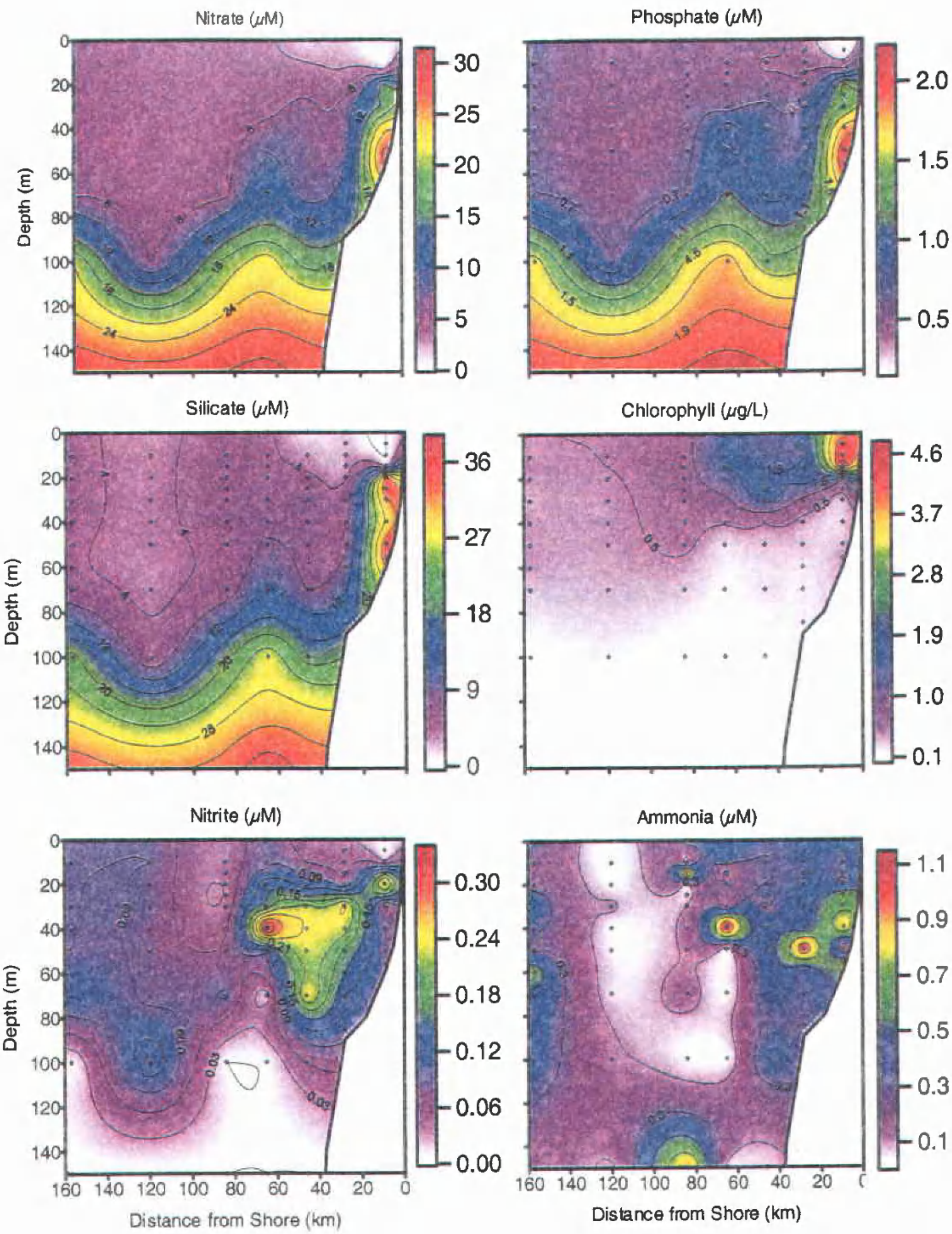

Figure 3.7. April 1999 nutrient and chlorophyll depth profiles for the Newport Hydrographic line. Open triangles represent depths where samples were collected.

3.3.3. Nutrient Ratios Along the Oregon Coast

Property versus property plots were examined to determine limiting nutrients in surface water and whether or not ratios varied with El Niño conditions (Figure 3.8). Nitrate versus phosphate plots (Fig.3.8A) clearly show that nitrate is depleted prior to phosphate. The y-intercepts indicated that 0.31 $\pm$ 0.01 and 0.53 $\pm$ 0.01 μM phosphate remained in surface water when nitrate was depleted for normal and El Niño conditions, respectively. The inverse of the slope for these plots indicated that the N:P ratios were similar for both conditions (15.1 $\pm$ 0.1 and 15.3 $\pm$ 0.3) and were close to reported Redfield ratios for Pacific waters.

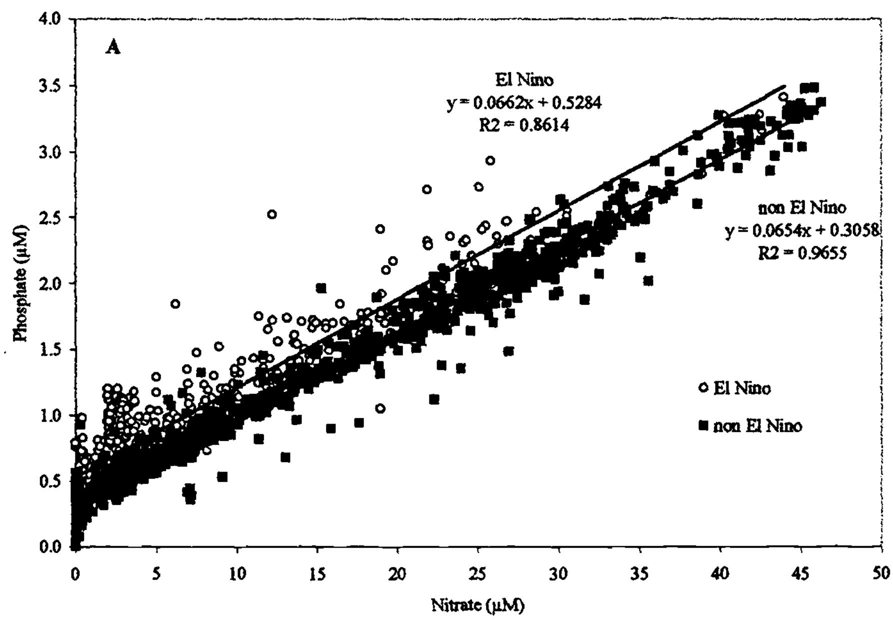

Figure 3.8a. Plot of nitrate versus phosphate for NH, FM, CR and EU Lines. Open circles represent samples taken during the El Niño year (Sep 97-Apr 98), and closed squares represent samples taken during non El Niño conditions (Aug 98- Jul 99).

Nitrate versus silicate plots (Figure 3.8b) also suggested that nitrate is depleted prior to silicate during El Niño conditions. In order to compare the relative rates of nitrate and silicate utilization in the upper portion of the water column, we examined the nitrate:silicate ratios for the linear portion of the curve (nitrate ranging from 0 to 30 μM). The y-intercept indicated that 2.60 $\pm$ 0.12 μM silicate remained in surface water when nitrate was depleted. In contrast, during normal conditions the y-intercept was indistinguishable from zero (0.11 $\pm$ 0.21 μM silicate), indicating that nitrate and silicate were depleted in parallel. Nitrate versus silicate follows a curvilinear plot that reflects the differential rates of remineralization of these two nutrients at depth. The inverse of the slope for these plots indicated that the N:Si ratios were lower (N:Si = 0.79 $\pm$ 0.01) during normal conditions compared to El Niño conditions (N:Si = 0.97 $\pm$ 0.02).

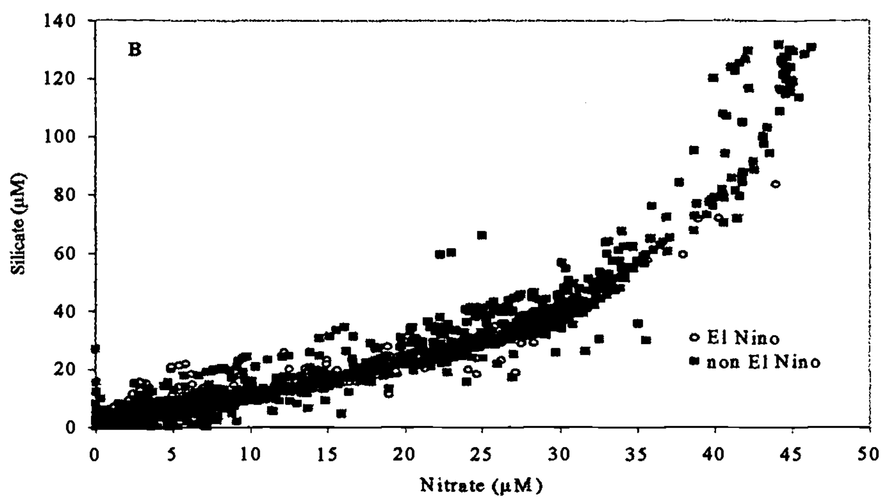

Figure 3.8b. Plot of nitrate versus silicate for NH, FM, CR and EU lines. Open circles represent samples taken during the El Niño year (Sep 97-Apr 98), and closed squares represent samples taken during non El Niño conditions (Aug 98-Jul 99).

In order to compare nutrient availability and possible effects of phytoplankton utilization on nutrient ratios, we calculated nitrate, phosphate, and silicate integrated over the euphotic zone for the Newport line (Figure 3.9). Throughout the 1997-98 El Niño conditions the depth of the euphotic zone averaged 53 m with little offshore or seasonal variation (Table 3.3). For August 1998 through July 1999, the euphotic depth varied with distance from shore and season (Table 3.3). Mean euphotic zone depth for all the winter sampling and the slope stations during summer was 56 $\pm$ 5 m. The shallowest euphotic depths were at shelf stations in summer and spring and slope stations during spring with a mean of 34 $\pm$ 5 m (Table 3.3).

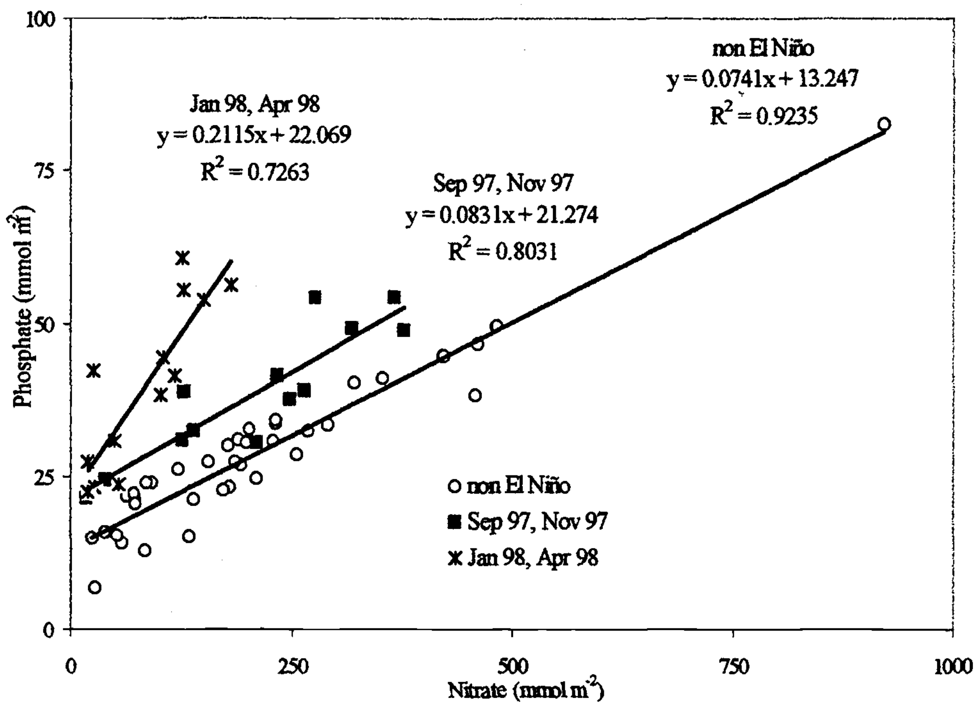

Figure 3.9a. Plot of integrated nitrate versus integrated phosphate. Nutrients are integrated to the depth of the euphotic zone.

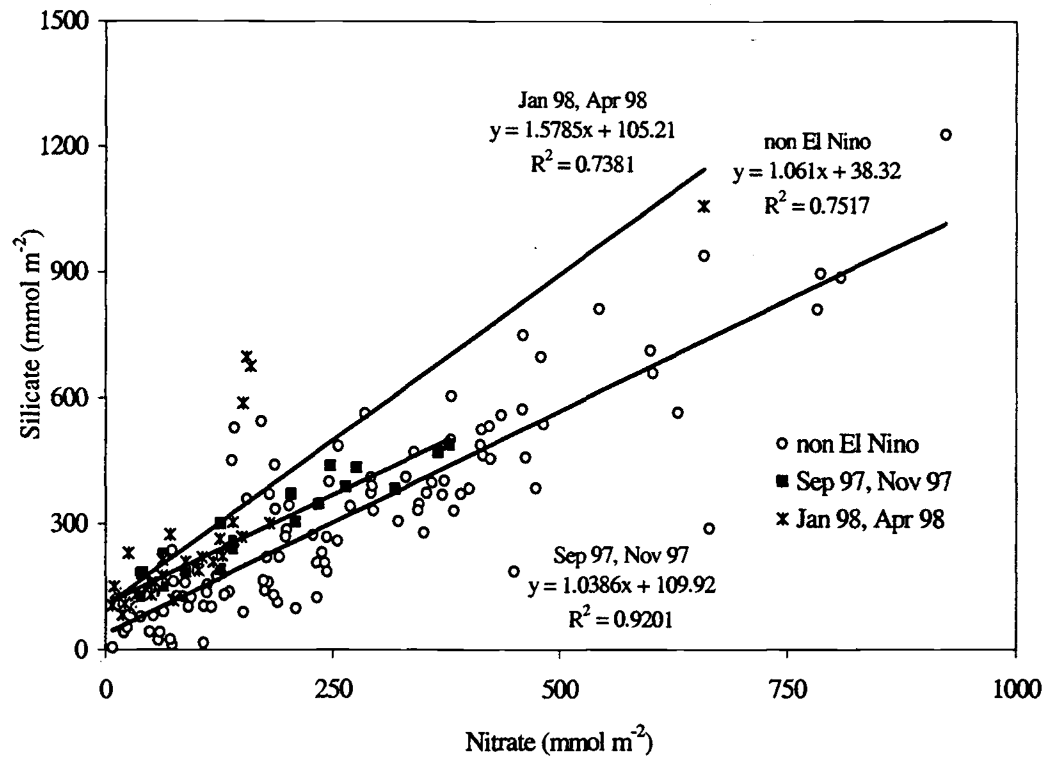

Figure 3.9b. Plot of integrated nitrate versus integrated silicate. Nutrients are integrated to the depth of the euphotic zone.

Table 3.3. Average depth of the euphotic zone estimated from chlorophyll distributions (see page 21) ± the standard deviation. a. all lines b. NH Line only

a. El Niño	Shelf	Slope	Offshore
Summer	55±9	59±1	61±4
Winter	47±7	49±4	53±5
Spring	41+17	48+4	53+7
Overall	46+8	50+4	54+5
Non El Niño	**Shelf**	**Slope**	**Offshore**
Summer	32±21	52±9	57±7
Winter	48±6	54±7	52±9
Spring	38+8	35+6	38+15
Overall	37±12	47+9	49±10

b. El Niño	Shelf	Slope	Offshore
Summer	55±9	59±1	61±4
Winter	46±7	48±5	52±6
Spring	47+10	52+3	57+7
Overall	49±5	53±6	57±4
Non El Niño	**Shelf**	**Slope**	**Offshore**
Summer	30±16	53±7	55±7
Winter	52±2	56±5	61±6
Spring	32+11	39+3	58+6
Overall	38+12	39+3	58+6

The linear regression of integrated nitrate versus phosphate for the Newport line showed that as nitrate was depleted from the euphotic zone, residual phosphate levels ranged from 14 to 22 mmol m^{-2} with higher residual phosphate during El

Niño conditions (Figure 3.9). This indicated that for the Newport line, nitrate rather than phosphate is limiting to phytoplankton. All data collected after the 1997/1998 El Niño (August 1998 through July 1999) fell along the same regression line with a slope of 0.073 $\pm$ 0.003 (Figure 3.9A). The slope for September and November 1997 was similar, 0.083 $\pm$ 0.012, while the slope for January and April 1998 was much higher 0.213 $\pm$ 0.040 (Figure 3.9A). The slope of the linear regression for normal conditions (August 1998 through July 1999) gives a N:P ratio of 13.5. The higher slope during January and April 1998 results from the El Niño related northward propagation of warmer, more saline water, which will be discussed below.

The linear regression for integrated nitrate versus integrated silicate showed that these two nutrients are used in approximately equal proportions (i.e. slopes close to 1, Figure 3.9B). During El Niño conditions, when nitrate was completely depleted from the euphotic zone, there was 109 $\pm$ 21 mmol m^{-2} residual silicate. In contrast, during non El Niño conditions, nitrate and silicate were depleted at approximately the same time as indicated by an intercept of 29 $\pm$ 24 mmol m^{-2}. These differences in intercepts probably result from the northward propagation of warm, high salinity water in the undercurrent and Davidson Current during the El Niño winter conditions and will be discussed in more detail below.

3.3.4. El Niño Related Variations in Nitrate and Chlorophyll

Shelf, slope, and offshore means for integrated nitrate and chlorophyll were examined to quantify the differences between El Niño and non El Niño conditions off Newport.

Highest integrated nitrate was at shelf stations during the summer, but because of the variability in nitrate between upwelling and relaxation events, this analysis does not show a significant difference between the El Niño summer conditions and the 1998-99 summer conditions (Figure 3.10). More frequent sampling would be needed for a more accurate and precise determination of changes in nitrate availability during the upwelling period. The most significant difference observed in nitrate integrated over the euphotic zone was the drastic reduction during spring for shelf, slope and offshore stations (Figure 3.10). As will be shown below, this reduction in nitrate results from the poleward movement of warm, high salinity, nutrient-poor water from the south, and is a good example of advective changes during the El Niño conditions.

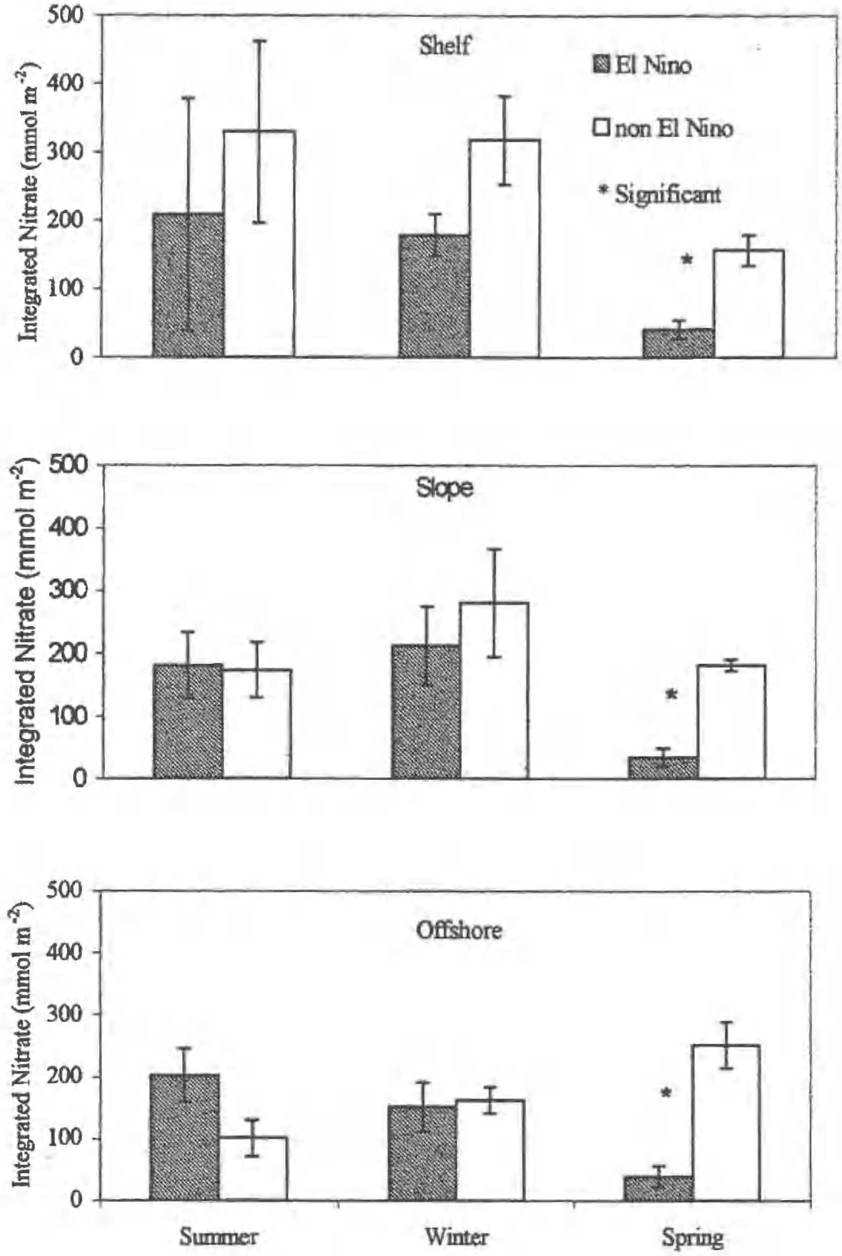

Figure 3.10. Mean nitrate for the shelf, slope, and offshore Newport Hydrographic line for summer, winter, and spring. Lines represent the standard error. The differences between El Niño and non El Niño are statistically significant (2 tailed t test, p value $\leq$0.05) for spring shelf, spring slope, and spring offshore.

Highest chlorophyll levels (mean = 75 mg m^{-2}) in the euphotic zone were observed during 1998-1999 upwelling conditions at shelf stations (Figure 3.11). These chlorophyll levels were significantly lower (< 25 mg mg m^{-2}) during the El Niño summer (Figure 3.11). Other significant El Niño effects on chlorophyll levels were increases in slope and offshore chlorophyll during the El Niño winter and a decrease in levels of chlorophyll in offshore waters during the spring (Figure 3.11).

3.3.5. Alongshore Variations in Nitrate and Chlorophyll

We examined alongshore variations in nitrate and chlorophyll during normal upwelling conditions for the four transect lines that ranged over a distance of 4° latitude (or 240 nautical miles) (Table 3.4). Highest nitrate concentrations were consistently found over the shelf for all four lines, with means ranging from 210 to 496 mmol m^{-2}. Due to the variable concentrations of nitrate during upwelling conditions, there was no distinct north to south pattern in the nitrate concentrations over the shelf. Nitrate concentrations decreased in slope and offshore waters compared to the shelf.

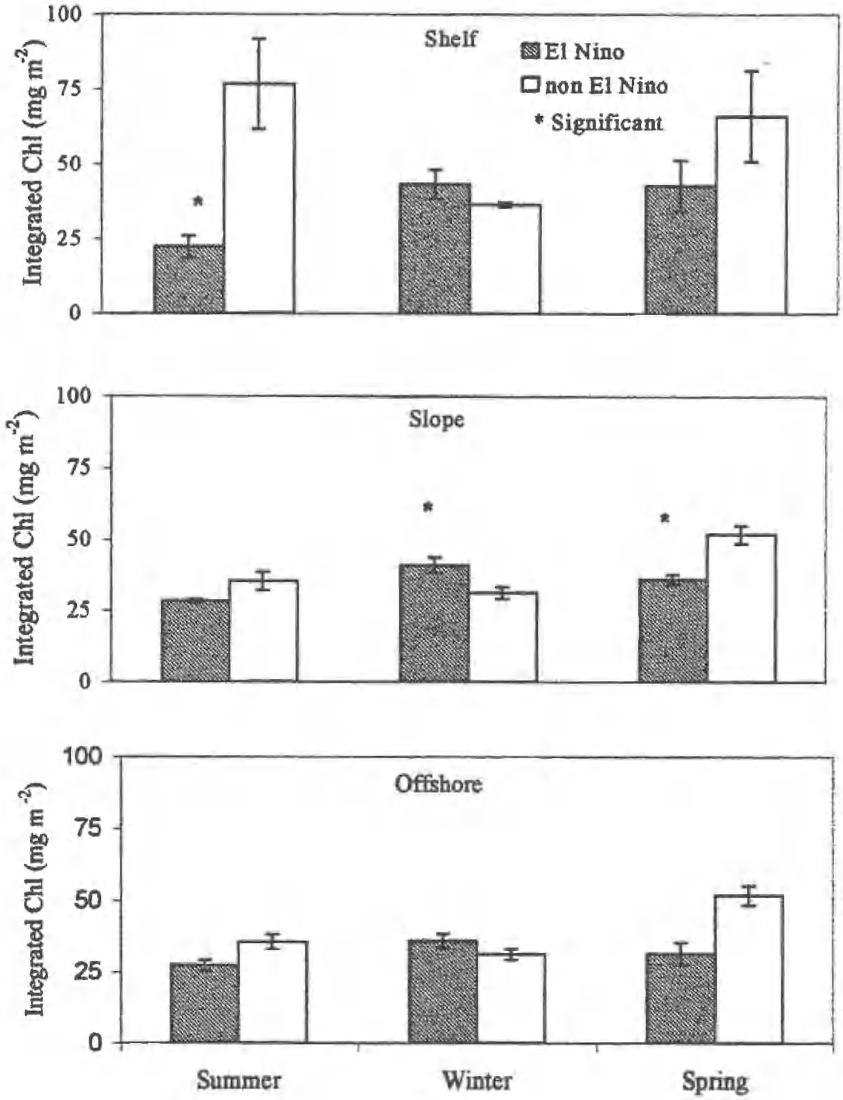

Figure 3.11. Mean chlorophyll for the shelf, slope, and offshore Newport Hydrographic line for summer, winter, and spring. Lines represent the standard error. The differences between El Niño and non El Niño are statistically significant (2 tailed t-test, p value ≤ 0.05) for summer shelf, winter slope, and spring slope.

Integrated chlorophyll was highest over the shelf for all lines except the Eureka line (Table 3.4) with concentrations ranging from 64 to 102 mg m^{-2}. There were no distinct along shore differences over the shelf. The Newport, Five Mile (off Coos Bay), and Crescent City lines had approximately 36 to 39 mg Chl m^{-2} over the slope, while Eureka had 72 mg Chl m^{-2} (Table 3.4). The amount of chlorophyll in the offshore regions increased continuously from north to south, with mean concentrations ranging from 33 to 69 mmol m^{-2} off Newport and Eureka, respectively.

Table 3.4: Mean integrated nitrate (mmol m^2) and chlorophyll (mg m^2) for samples collected during the 1998 and 1999 upwelling seasons (Aug 98, Sep 98, and Jul 99). Integrations were to the depth of the euphotic zone.

		SHELF	SLOPE	OFFSHORE
Line	Latitude	Mean NO_3^- ± SD	Mean NO_3^- ± SD	Mean NO_3^- ±SD
NH	44°39'	329 ± 327	174 ± 108	101 ± 89
FM	43°13'	210 ± 171	510 ± 226	351 ± 266
CR	41°54'	496 ± 200	247 ± 97	169 ± 63
EU	40°52'	424 ± 349	250 ± 170	164 ± 181
		Mean Chl ± SD	Mean Chl ± SD	Mean Chl ± SD
NH	44°39'	77 ± 37	36 ± 8	33 ± 8
FM	43°13'	102 ± 29	38 ± 7	43 ± 11
CR	41°54'	64 ± 37	39 ± 9	65 ± 19
EU	40°52'	71 ± 29	72 ± 23	69 ± 34

Integrated nitrate versus chlorophyll plots were examined to determine if there was any correlation between the concentrations of nitrate and chlorophyll in the euphotic zone (Figure 3.12). A subset of the data (Figure 3.12) was selected to include stations with recently upwelled water (nitrate > 500 mmol m^{-2}) and water with significantly elevated chlorophyll concentrations (i.e. phytoplankton blooms with chl >60 mg m^{-2}). A strong inverse correlation was apparent between nitrate in the euphotic zone and the accumulated chlorophyll standing stock (Figure 3.12). Linear regressions indicated a difference in both intercepts and slopes for the two northern transects compared with the two southern transects. Chlorophyll increased more rapidly as nitrate was depleted at the northern stations (slopes of -0.137 $\pm$ 0.014 versus - 0.084 $\pm$ 0.015 for northern and southern transects respectively, Figure 3.12). Similarly, chlorophyll reached higher standing stocks at the northern stations (intercepts of 126 $\pm$ 6 versus 98 $\pm$ 6 for northern and southern transects respectively, Figure 3.12).

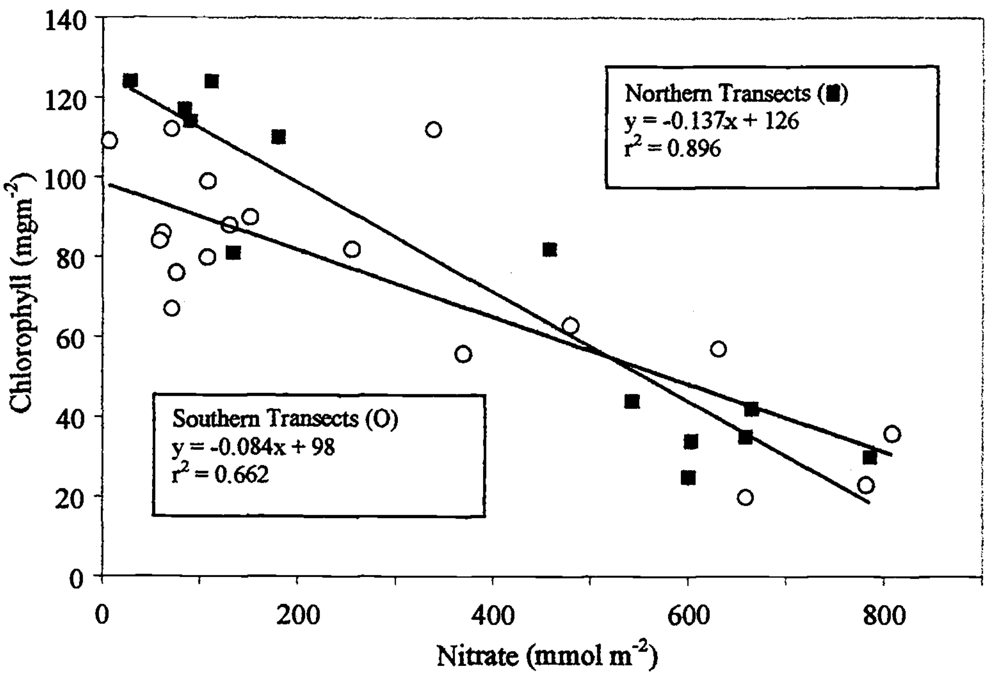

Figure 3.12. Integrated nitrate versus integrated chlorophyll for bloom conditions and upwelling conditions (see text) for all lines.

3.3.6. Alongshore Variations in Winter and Spring Nutrients.

El Niño conditions resulted in lower nitrate conditions during spring and winter. The seasonal intensification of the California Undercurrent and Davidson Current brought warm, higher salinity water as far north as the Oregon coast (Huyer et al., 2000). Within the euphotic zone, this resulted in unusually low N:P ratios (N:P = 1.3 to 3.0) first detected at the Crescent City line (42° N) in November 1997 and detected at the Newport Line 45° N in April 1998 (Table 3.5). The characteristics of this Undercurrent water are most evident between depths of 50-150 m, and are shown in Table 3.6 for 100 m over a slope station. The 100 m depth is a good representation of the California Undercurrent water (Kosro, 2000). During the El Niño winter and spring this water was warmer by more than 2° C, lower in nitrate and silicate by 60%, and lower in N:P by 50% (Table 3.6). These lower nutrient levels at depth and in the euphotic zone resulted from the northward propagation of equatorial water and were presumably the primary cause for the lower levels of chlorophyll during April 1998 (the El Niño spring period). By August, 1998, the N:P ratios had returned to higher values that remained consistent (low standard deviations, see figure 3.6) through July, 1999.

Table 3.5. Mean N:P ratios in the euphotic zone. Since alongshore and temporal variations were greater than differences among stations along a transect, this table presents the mean for each transect for each cruise. The ratios were calculated as integrated nitrate divided by the integrated phosphate over the depth of the euphotic zone at each station.

Date	NH Line	FM Line	CR Line	EU Line
September 1997	4.56			
November 1997	5.48	2.46	1.82	
January 1998	2.61	3.03		
April 1998	1.35	2.99	2.51	
August 1998	4.02	11.53	7.76	10.06
September 1998	7.17			
November 1998	5.75	9.05	8.23	9.35
February 1999	9.42			
April 1999	7.67	7.40	7.69	
July 1999	5.93	9.06	9.01	7.54

Table 3.6. Temperature, salinity, and nutrients for 100 m depth at station NH-45.

Dates	Temp (°C)	Salinity (psu)	Nitrate (µM)	Phosphate (µM)	Silicate (µM)	N:P
Sept/Nov 97	9 ± 0	34 ± 0	23 ± 2	2 ± 0	27 ± 1	10 ± 1
Jan/Apr 98	11 ± 1	33 ± 1	9 ± 3	1 ± 0	11 ± 2	6 ± 2
Aug 98-Jul 99	9 ± 1	34± 0	21 ± 8	2 ± 0	25 ± 9	13 ± 0

3.4. DISCUSSION

3.4.1. Effects of the 1997/98 El Niño off Newport During the Upwelling Season.

The 1997/98 El Niño was considered one of the strongest El Niños on record. In the eastern equatorial Pacific, new sea surface temperature highs were set every month between June and December 1997 (McPhaden, 1999a). In February 1998 off Newport, temperature anomalies were greater than 2° C for all water from the coast to 120 km offshore, down to depths of 500 m (Smith et al., 2000). In comparison, during the relatively strong El Niño of 1965/66, the water temperatures in November 1965 off Newport were 1.5 - 2° C warmer than normal from the coast to 46 km offshore, down to 175 m (Smith et al., 2000).

The present study is the first coherent sampling of hydrography, nutrients and chlorophyll off the coast of Oregon contrasting patterns during a strong El

Niño period followed by more normal conditions. Our analysis of nutrient depth profiles clearly showed that of the three macronutrients (nitrate, phosphate and silicate) utilized by phytoplankton in these waters, nitrate was the most limiting nutrient in the euphotic zone. We were able to distinguish major El Niño effects along the Newport line by comparing results from September 1997 with results from the upwelling season of 1998 and 1999 and the available historical data. During the El Niño upwelling season, surface nitrate over the Newport shelf was ≤ 0.2 μM, in contrast with normal upwelling concentrations of 5- 25μM nitrate (Table 3.7). Surface chlorophyll concentrations in September 1997 were < 1 μg L^{-1} over the shelf, in contrast to typical upwelling season concentrations of 2-57 μg L^{-1}. These results indicated that depressed upwelling during this period (Huyer et al. 2000) led to significant decreases in both nitrate and chlorophyll over the shelf.

Table 3.7. Typical surface nitrate and chlorophyll ranges during upwelling season off Newport, Oregon

Year	Nitrate (μM)	Chlorophyll (μg L^{-1})	Reference
1973	5-20	2-15	Small and Menzies, 1981
1985	20-49	2-23	Kokkinakis and Wheeler, 1987
1990-91	5-25	11-57	Dickson and Wheeler, 1995
1999		3-13	Peterson et al., 2000

Water over the slope and offshore typically has much lower concentrations of nutrients and chlorophyll than water over the shelf off Newport and, as expected, the 1997/98 El Niño had much less impact further offshore. Offshore nitrate was actually higher during El Niño by a factor of two, but much lower than the maximum observed over the shelf during upwelling conditions. Chlorophyll in offshore waters was essentially the same during normal and El Niño conditions, since the offshore water is always typically oligotrophic.

The other major difference observed between El Niño and normal upwelling seasons was in the size distribution of phytoplankton. During the 1997/98 El Niño summer, only 23% of the population over the shelf was composed of large cells. This contrasted sharply with the more typical upwelling scenario in August 1998, when 92% of the population over the shelf was composed of large cells. This is a good indication that the El Niño conditions in September 1997 induced a change in species composition as well as a change in the total chlorophyll standing stock. During normal upwelling conditions, larger cells (predominantly diatoms) typically make up the larger percentage of the population (Kokkinakis and Wheeler 1987, Chavez et al. 1991). It is logical, then, that during the low nutrient conditions induced by El Niño in September 1997, the phytoplankton population became dominated by smaller sized cells. These small sized phytoplankton cells are better able to adapt to nutrient limited conditions due to an increased surface area to cell volume ratio (Raymont, 1980).

3.4.2. El Niño Effects During Winter and Spring.

We were able to distinguish major El Niño effects on winter and spring nutrients along the Newport line and southward. The winter season is typically characterized by intermediate concentrations of nutrients and low concentrations of chlorophyll. Landry et al. (1989) reported surface nitrate values of approximately 5.0 μM, and surface chlorophyll concentrations of approximately 1 mg m^{-3}. Since chlorophyll remains low yet there is residual nitrate in the water, phytoplankton are most likely light limited during the winter (Small and Menzies, 1981).

We observed higher nutrients in the euphotic zone during the El Niño winter and spring compared to normal years, but lower nutrient concentrations at depths of 50 to 200m. As described previously, during the winter the California Undercurrent moves to the surface and transports water with Equatorial characteristics poleward. This poleward current was intensifed during the 1997-98 El Niño and had major effects on nutrient distributions in the euphotic zone and down to about 150 m. Our results showed a major northward extension of warmer, nutrient-poor water at depth at least as far as Newport during the winter and spring of 1998. This water had anomalously low N:P ratios that served as a good indicator for following the northward propagation of the Equatorial water during the winter and spring. The higher nutrient levels in the euphotic zone may have contributed to enhanced primary production during the 1998 spring transition period, although the total standing stocks (measured as chlorophyll) were still much smaller than the summer upwelling blooms.

3.4.3. Alongshore Variations in Nutrient Supply and Chlorophyll Distributions.

Although we do not have September 1997 data for the transects south of Newport, it is important to consider the possible affects of an El Niño in that region based upon what we know about the physical setting. There is evidence from hydrographic sections, Seasoar data, ADCP profiles, satellite and drifter data that there is a difference in the spatial structure of the water column north and south of Cape Blanco (Barth et al., 2000). North of Cape Blanco, the upwelling front and coastal jet are over the middle and outer shelf, and parallel to the coast. Upwelling is confined to inshore of the shelf break (40 km), and the productive region is limited to a narrow band inshore of the front (Barth, 2000). For example, for a km wide band off Newport, there is approximately 40 km^2 of productive habitat, while off Coos Bay, there is about 15 km^2 of productive habitat per km.

South of Cape Blanco, the physical setting changes. At the cape, the upwelling jet is diverted offshore, beyond the shelf break (Barth et al., 2000). The equatorward jet and the upwelling region can be found 100-300 km offshore (Barth et al., 2000). Water inshore of the jet has increased nutrients and chlorophyll, therefore this may expand the area of high productivity much further offshore than the northern region. For example, for each kilometer wide band, the region of productivity ranges from 100 to 300 km^2, which greatly exceeds the size of the high productivity regions area off Newport and Coos Bay. The largest difference in phytoplankton biomass between Newport (north of Cape Blanco) and Eureka (South of Cape Blanco) was in the offshore waters, with a two fold increase in offshore chlorophyll in the southern region. If upwelling is depressed during an El Niño along the entire Oregon coastline, then it is likely that productivity in the southern region would be subject to even larger decreases in chlorophyll standing stocks than observed for the Newport line.

3.4.4. Linkages Between Nutrient Supply and Trophic Effects of El Niño Conditions.

Higher trophic levels are known to be affected by El Niño conditions. For example, in the El Niño summer of 1983, upwelling was depressed along the Oregon coast, and chlorophyll levels were low (Brodeur and Pearcy, 1992). The low phytoplankton concentrations were accompanied by low standing stocks of zooplankton (Miller et al. 1985), most likely due to the decreased prey availability. There was also several times less fish larvae than during a typical upwelling season and the 1982/83 El Niño was devastating to the Oregon fisheries. (Pearcy and Schoener, 1987). It is thought that this was due to poor growth conditions, and decreased availability of prey (zooplankton) during El Niño.

Our study is the first of the El Niño evaluations off the coast of Oregon to demonstrate the direct effects on nutrients and chlorophyll standing stocks within the euphotic zone. It is obvious that the reduced nutrient levels lead to dramatic and immediate effects on chlorophyll distributions during the upwelling season. It is also obvious from studies of Peterson et al. (2000) that the reduced chlorophyll standing stocks are coincident with greatly reduced zooplankton stocks. This appears to be a clear example of bottom-up effects on the ecosystem. Both southern and northern zooplankton species have grazing half-saturation constants of about 1 μg Chl L^{-1} (Batchelder 1986, Batchelder and Miller, 1989). During summer 1997, surface chlorophyll concentrations averaged 0.1-0.2 μg L^{-1}. Higher levels (~ 1 μg Chl L^{-1}) were present in the narrow subsurface chlorophyll maximum. We conclude that based on these distributions the copepods were generally food limited during the El Niño upwelling season. Whether there are also top-down effects remains to be determined. However, an important aspect of trophic effects is the uncoupling of recovery of phytoplankton and zooplankton subsequent to resumption of normal upwelling. Phytoplankton standing stocks and size composition were fully recovered by August 1998. In comparison, zooplankton standing stocks and species composition were still primarily a subtropical grouping rather than the more normal subarctic assemblage (Peterson and Keister, 2000). The zooplankton biomass did not increase to levels near the historical average until July 1999 (Peterson and Keister 2000). The higher trophic levels were also affected. Salmon numbers were diminished during the 1997/98 El Niño (Peterson, personal communication). On-going studies are examining the time required for salmon stock to recover from the 1997-98 El Niño.

Intense sampling during 1997 to 1999 off the coast of Oregon has elucidated some of the important processes by which El Niño conditions influence nutrient and chlorophyll distributions. Phytoplankton are primarily nitrate-limited; reduced upwelling during El Niño conditions causes widespread nitrate depletion in the euphotic zone, especially over the shelf. Chlorophyll stocks were dramatically reduced and the phytoplankton assemblage was dominated by small cells rather than diatoms. Reduced zooplankton stocks were presumably caused by low food availability, and recovery of zooplankton stocks was one year longer than for phytoplankton. The strong 1997-98 El Niño also affected the distribution of winter and spring nutrients off Oregon. The intensified poleward jet brought warm, equatorial water much further north than usual during 1998. This water was lower than usual in nutrients within the euphotic zone and probably resulted in a lower chlorophyll distribution during the spring transition bloom. The physical dynamics north and south of Cape Blanco control, to some extent, the width of the productive habitat along the coast. The details of the spatial and temporal variability in the size of the productive region south of the cape, as well as the affects of large perturbations such as El Niño, have yet to be elucidated. Our results clearly show the dramatic effects of a strong El Niño on nutrients and productivity during the seasonal upwelling period off Newport. In addition, the intensified poleward jet changed nutrient distributions in the upper 150 m with an end result of decreasing chlorophyll concentrations during the El Niño spring transition.

4. CONCLUSIONS AND SUMMARY

El Niño oscillations are atmospherically driven changes in sea level and ocean circulation commencing in the equatorial Pacific and propagating northward and southward along the west coast of North and South America. These changes are known to affect nutrient distributions and productivity of lower and higher trophic levels, however the cascading effects have not been well documented with regard to spatial extent, temporal factors and biological interactions. The purpose of this thesis was to use results from the 1997-1999 GLOBEC sampling to address the magnitude and consequences of a strong El Niño specifically on the nutrient and chlorophyll distributions off Oregon. Parallel studies off British Columbia, California, and Mexico will be reported in the Progress and Oceanography issue on the 1997-1998 El Niño edited by Francisco Chavez.

The 1997/98 El Niño was one of the strongest on record in the twentieth century (Huyer et al., 2000). The description of nutrient and chlorophyll distributions presented here is the first comparison of nutrients and chlorophyll within the euphotic zone for El Niño and normal conditions off Oregon. I was successful in demonstrating that nitrate, rather than phosphate or silicate is the macronutrient limiting primary production in these waters. Depression of upwelling in September 1997 resulted in severe nitrate depletion over the shelf and dramatic decreases in surface chlorophyll, as well as chlorophyll integrated over the euphotic zone. This decrease in the chlorophyll standing stock was accompanied by a shift to small phytoplankton rather than the more usual shelf blooming diatoms.

I attempted to document the magnitude of the El Niño effects on the nutrient and chlorophyll distributions in the euphotic zone along the Newport line. This was not entirely successful because upwelling events are sporadic and nutrient concentrations vary over a broad range during the upwelling season. The means for nitrate integrated over the euphotic zone during El Niño and normal upwelling seasons were not significantly different because of this variability. Nonetheless, the means for integrated chlorophyll were statistically significant. Furthermore, the connection between nitrate availability and chlorophyll abundance was shown clearly by the inverse relationship between integrated nitrate and integrated chlorophyll for the euphotic zone for recently upwelled water and during bloom conditions during the summer upwelling season. Following an upwelling event, there is a strong net decrease in nitrate in the water column and a net increase in chlorophyll. This relationship did not apply to all of the data collected during this study. During winter and the spring transition there was no clear relationship between integrated nitrate and chlorophyll, possibly due to light limitation rather than nitrate limitation.

My alongshore comparison suggests a difference in the inverse relationship between nitrate and chlorophyll north and south of Cape Blanco during the upwelling season. The differences are not large, and could be due to differences in phytoplankton species, limitation by trace metals, or different predator/prey abundances for the phytoplankton and zooplankton. These possibilities are being investigated in on-going studies in this region. Although I was not able to examine alongshore El Niño variations during the upwelling season, I was able to document differences in nutrient and chlorophyll distributions during the subsequent more normal upwelling season. Higher levels and offshore extent of highly productive waters (higher nutrients and chlorophyll) were evident at the southern transect. As a consequence, I would predict even larger impacts of El Niño conditions along the southern portion of the Oregon coastline than reported here for the Newport hydrographic line.

My results suggest that nitrate plays a major role in controlling phytoplankton standing stocks in this region during the upwelling season. Other possible regulating factors include silicate, iron, and grazing pressure. Hutchins and Bruland (1998) showed that diatoms stressed by iron limitation deplete silicate faster than nitrate. My study found that nitrate and silicate were depleted at approximately the same rate over the shelf, and that residual silicate was usually present when nitrate was depleted. Hence, iron does not appear to be limiting over the shelf, although further studies should be done to completely rule out that possibility. It is possible, however, that iron is limiting over the slope or further offshore.

The significant role of zooplankton grazers in controlling phytoplankton stocks in this region is demonstrated in modeling studies (Wroblewsky 1977, Spitz pers. comm.), but there is a spatial offset from the upwelling front. My results contribute additional data for assessment of the relationship between phytoplankton and their predators. Zooplankton standing stocks had not recovered during the 1998 upwelling period but phytoplankton had. Future comparisons of 1998 and 1999 data (not yet available) will provide a good data set for comparing phytoplankton stocks with and without their normal grazers.

This summary of past, present and continuing research illustrates several important interactions of physical and biological processes in controlling primary production in coastal waters off Oregon. Clearly, decreased upwelling during El Niño conditions has a direct effect on phytoplankton through nitrate limitation. On a longer time scale, changes in the poleward jet affects winter nutrient and possibly phytoplankton production during the spring transition. Zooplankton are immediately affected by reduced phytoplankton stocks when El Niño conditions persist through the upwelling season. The longer recovery time of zooplankton allows phytoplankton to bloom the following season with reduced grazing pressure. Comparison of 1998 and 1999 results should provide a good evaluation of the top down effects of zooplankton on phytoplankton standing stocks.

In conclusion, the coastal waters off Oregon support a highly productive food web. As shown in this thesis, there are multiple controlling factors that depend upon location over the shelf and slope, seasonal effects, and El Niño effects. Examination of nutrients, phytoplankton and zooplankton standing stocks during the remainder of the 1997-2001 NEP GLOBEC program will continue to elucidate the important processes, as well as the spatial and temporal relationships affecting these processes.

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APPENDICES

Appendix A: September 1997 - April 1998 data

			[db]	[°C]		[μM]	[μM]	[μM]	[μM]	[μM]	[μM]	[μg/L]
Sep-97	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-5	44°39'	124°10'	3	17.6	31.64	0.28	0.06	2.44	0.19	0.00	0.22	0.62
NH-5	44°39'	124°10'	4	17.5	31.82	0.26	0.07	1.93	0.07	0.00	0.38	0.48
NH-5	44°39'	124°10'	10	17.4	31.92	0.46	0.06	2.63	0.03	0.00	0.28	0.44
NH-5	44°39'	124°10'	15	17.3	31.92	0.45	0.19	1.80	0.00	0.00	0.22	0.21
NH-5	44°39'	124°10'	21	17.2	32.07	0.45	0.22	1.75	0.11	0.00	0.29	0.29
NH-5	44°39'	124°10'	25	16.9	32.14	0.49	0.34	2.19	0.28	0.00	0.42	0.30
NH-5	44°39'	124°10'	35	15.9	32.37	0.60	0.57	4.95	1.05	0.00	1.09	0.38
NH-5	44°39'	124°10'	40	15.7	32.43	0.65	0.60	5.78	1.33	0.01	1.33	0.38
NH-5	44°39'	124°10'	44	15.1	32.51	0.63	0.62	6.49	1.85	0.07	1.77	0.44
NH-5	44°39'	124°10'	49	14.3	32.66	0.61	0.70	9.42	2.66	0.13	2.53	0.47
NH-15	44°39'	124°24'	4	17.3	31.62	0.32	0.12	1.41	0.12	0.02	0.10	0.31
NH-15	44°39'	124°24'	5	17.3	31.62	0.22	0.00	1.60	0.03	0.01	0.02	0.28
NH-15	44°39'	124°24'	10	17.3	31.62	0.23	0.00	1.44	0.03	0.00	0.03	0.32
NH-15	44°39'	124°24'	20	17.0	31.62	0.19	0.00	1.63	0.15	0.00	0.17	0.34
NH-15	44°39'	124°24'	26	17.0	31.62	0.25	0.00	1.74	0.06	0.00	0.12	0.44
NH-15	44°39'	124°24'	30	16.0	31.84	0.55	0.21	4.29	2.52	0.00	2.54	0.86
NH-15	44°39'	124°24'	35	12.6	32.47	1.13	0.59	9.02	7.14	0.11	7.03	0.86
NH-15	44°39'	124°24'	40	9.9	32.54	1.07	0.13	10.41	8.18	0.33	7.85	0.63
NH-15	44°39'	124°24'	50	9.1	32.78	1.37	0.04	15.43	13.46	0.03	13.43	0.26
NH-15	44°39'	124°24'	60	9.1	33.07	1.71	0.42	19.60	17.99	0.12	17.88	0.16
NH-15	44°39'	124°24'	69	9.2	33.33	1.91	0.30	25.21	22.12	0.06	22.06	0.16
NH-15	44°39'	124°24'	86	9.4	33.53	1.92	0.11	27.55	23.89	0.06	23.83	0.11
NH-25	44°39'	124°39'	3	17.7	31.76	0.29	0.09	2.09	0.75	0.00	0.75	0.33
NH-25	44°39'	124°39'	10	17.7	31.76		0.00	1.69	0.34	0.03	0.31	0.33
NH-25	44°39'	124°39'	21	16.7	31.82	0.32	0.08	2.11	0.29	0.02	0.27	0.58
NH-25	44°39'	124°39'	25	12.9	32.29	0.56	0.05	4.15	1.28	0.03	1.25	1.03
NH-25	44°39'	124°39'	30	12.2	32.37	0.64	0.04	4.94	1.69	0.13	1.56	0.92
NH-25	44°39'	124°39'	40	11.0	32.48	0.88	0.05	6.91	4.96	0.18	4.79	0.49
NH-25	44°39'	124°39'	50	9.8	32.72	1.17	0.05	10.97	10.12	0.28	9.84	0.15
NH-25	44°39'	124°39'	200	8.4	33.91	2.55	0.04	37.75	30.61	0.07	30.54	0.02
NH-25	44°39'	124°39'	214	8.4	33.91	2.51	0.00	38.19	30.53	0.02	30.51	0.03
NH-35	44°39'	124°53'	3	17.1	31.66	0.40	0.09	1.00	0.16	0.00	0.16	0.35
NH-35	44°39'	124°53'	20	17.1	31.66	0.41	0.09	0.80	0.16	0.00	0.16	0.37
NH-35	44°39'	124°53'	25	16.8	31.69	0.44	0.06	1.33	0.20	0.00	0.20	0.58
NH-35	44°39'	124°53'	30	15.5	31.90	0.58	0.07	2.89	0.64	0.06	0.58	0.99
NH-35	44°39'	124°53'	35	11.5	32.44	0.78	0.20	4.77	1.87	0.27	1.61	0.72
NH-35	44°39'	124°53'	40	11.1	32.48	0.81	0.13	5.13	2.72	0.41	2.32	0.55
NH-35	44°39'	124°53'	50	10.2	32.52	0.98	0.03	7.63	5.85	0.15	5.70	0.43
NH-35	44°39'	124°53'	60	9.7	32.58	1.13	0.01	10.18	8.47	0.03	8.45	0.24
NH-35	44°39'	124°53'	71	9.5	32.68	1.32	0.02	12.01	10.20	0.03	10.17	0.13
NH-35	44°39'	124°53'	100	8.9	33.20	1.80	0.02	22.05	19.34	0.02	19.32	0.04
NH-35	44°39'	124°53'	406	5.9	34.04		0.01	59.41	37.97	0.03	37.94	0.01

Appendix A: September 1997 - April 1998 data (continued)

			[db]	[°C]		[μM]	[μM]	[μM]	[μM]	[μM]	[μM]	[μg/L]
Sep-97	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-45	44°39'	125°07'	5	17.5	31.67	0.48	0.00	1.34	0.00	0.00	0.00	0.36
NH-45	44°39'	125°07'	10	17.5	31.67	0.48	0.01	1.82	0.00	0.00	0.00	0.34
NH-45	44°39'	125°07'	20	17.5	31.67	0.52	0.02	1.73	0.00	0.00	0.00	0.45
NH-45	44°39'	125°07'	30	13.8	32.20	0.68	0.05	4.51	0.79	0.09	0.70	0.78
NH-45	44°39'	125°07'	36	10.8	32.48	0.92	0.01	7.19	3.76	0.37	3.38	0.53
NH-45	44°39'	125°07'	40	10.3	32.52	1.01	0.00	9.02	6.31	0.24	6.07	0.35
NH-45	44°39'	125°07'	50	9.9	32.65	1.20	0.00	10.89	9.05	0.04	9.01	0.22
NH-45	44°39'	125°07'	59	9.0	32.68	1.34	0.00	15.41	12.42	0.00	12.43	0.13
NH-45	44°39'	125°07'	70	8.8	32.77	1.41	0.00	16.62	13.31	0.00	13.32	0.12
NH-45	44°39'	125°07'	101	8.6	33.52	2.14	0.02	27.59	24.06	0.01	24.05	0.02
NH-45	44°39'	125°07'	500	5.3	34.09	3.27	0.00	72.05	40.30	0.03	40.27	0.01
NH-45	44°39'	125°07'	682	4.8	34.20	3.41	0.06	83.66	43.97	0.01	43.96	0.01
NH-65	44°39'	125°36'	2	17.0	31.71	0.14	0.08	1.84	0.00	0.00	0.00	0.37
NH-65	44°39'	125°36'	10	17.0	31.71	0.15	0.07	1.75	0.01	0.00	0.01	0.27
NH-65	44°39'	125°36'	19	17.0	31.71	0.12	0.10	2.20	0.07	0.01	0.06	0.35
NH-65	44°39'	125°36'	25	16.7	31.78	0.18	0.05	2.20	0.02	0.02	0.01	0.47
NH-65	44°39'	125°36'	30	13.7	32.22	0.28	0.02	3.71	0.02	0.08	0.00	0.74
NH-65	44°39'	125°36'	35	11.7	32.45	0.55	0.10	5.77	1.73	0.22	1.51	0.90
NH-65	44°39'	125°36'	40	10.9	32.49	0.66	0.02	7.22	4.01	0.31	3.70	0.63
NH-65	44°39'	125°36'	49	9.7	32.56	0.73	0.00	11.27	8.10	0.01	8.10	0.30
NH-65	44°39'	125°36'	69	9.1	32.99		0.04	18.75	16.34	0.09	16.25	0.13
NH-65	44°39'	125°36'	100	8.7	33.69		0.00	32.41	25.78	0.00	25.79	0.02
NH-65	44°39'	125°36'	999	3.6	34.41		0.02		41.99	0.00	42.01	0.02
NH-85	44°39'	126°03'	3	17.4	31.69	0.18	0.04	1.91	0.00	0.00	0.00	0.31
NH-85	44°39'	126°03'	10	17.4	31.69	0.18	0.10	1.91	0.03	0.00	0.06	0.26
NH-85	44°39'	126°03'	20	17.3	31.69	0.30	0.14	2.42	0.00	0.00	0.02	0.39
NH-85	44°39'	126°03'	30	11.8	32.39	0.55	0.12	5.73	0.91	0.04	0.87	1.02
NH-85	44°39'	126°03'	35	11.4	32.42	0.71	0.25	6.44	1.75	0.12	1.63	1.02
NH-85	44°39'	126°03'	40	10.8	32.47	0.75	0.17	7.43	3.39	0.33	3.06	0.79
NH-85	44°39'	126°03'	50	10.2	32.54	0.93	0.00	8.92	6.37	0.09	6.28	0.37
NH-85	44°39'	126°03'	60	9.8	32.67	1.13	0.02	11.81	9.50	0.01	9.49	0.18
NH-85	44°39'	126°03'	70	9.4	32.88	1.32	0.17	16.20	13.41	0.01	13.40	0.10
NH-85	44°39'	126°03'	100	8.8	33.37	1.96	0.09	23.57	21.67	0.01	21.66	0.02
NH-85	44°39'	126°03'	870	4.0	34.36	3.28	0.01		42.46	0.00	42.46	0.01
NH-85	44°39'	126°03'	1006	3.7	34.41	3.16			42.62	0.01	42.61	0.01

Appendix A: September 1997 - April 1998 data (continued)

Nov-97 Station	Lat	Long	[db] P	[°C] T	S	[µM] PO_4	[µM] NH_4	[µM] SiO_2	[µM] N+N	[µM] NO_2	[µM] NO_3	[µg/L] Chl a
NH-5	44°39'	124°10'	2	12.4	32.47	0.79	0.05	8.50	3.94	0.18	3.76	1.27
NH-5	44°39'	124°10'	4	12.4	32.47	0.74	0.03	8.29	3.95	0.19	3.77	1.16
NH-5	44°39'	124°10'	10	12.4	32.47	0.72	0.03	8.46	3.94	0.18	3.75	1.33
NH-5	44°39'	124°10'	15	12.4	32.48	0.70	0.02	8.30	3.97	0.18	3.79	1.33
NH-5	44°39'	124°10'	22	12.0	32.64	0.82	0.05	11.15	6.40	0.32	6.08	1.25
NH-5	44°39'	124°10'	24	12.1	32.75	0.88	0.05	11.48	6.99	0.40	6.60	1.09
NH-5	44°39'	124°10'	28	12.1	32.83	0.97	0.04	10.63	7.45	0.59	6.87	0.87
NH-5	44°39'	124°10'	31	12.1	32.87	0.93	0.09	10.71	7.41	0.47	6.95	0.65
NH-5	44°39'	124°10'	43	12.0	33.02	0.94	0.20	10.09	6.81	0.28	6.53	0.46
NH-5	44°39'	124°10'	52	11.9	33.10	0.89	0.20	10.40	7.75	0.35	7.40	0.37
NH-15	44°39'	124°24'	3	12.2	32.96	0.69	0.00	7.50	4.91	0.24	4.67	1.79
NH-15	44°39'	124°24'	4	12.2	32.96	0.70	0.00	7.64	4.86	0.24	4.62	1.88
NH-15	44°39'	124°24'	10	12.2	32.96	0.74	0.00	7.59	4.88	0.24	4.64	1.94
NH-15	44°39'	124°24'	19	12.2	32.97	0.74	0.00	7.80	5.12	0.25	4.87	1.92
NH-15	44°39'	124°24'	30	11.8	33.16	0.98	0.18	9.23	7.21	0.34	6.86	1.16
NH-15	44°39'	124°24'	35	11.6	33.26	1.32	0.22	11.64	10.38	0.54	9.84	0.41
NH-15	44°39'	124°24'	41	11.1	33.33	1.55	0.01	16.20	14.02	0.44	13.57	0.31
NH-15	44°39'	124°24'	50	11.0	33.33	1.50	0.00	16.97	14.57	0.37	14.20	0.31
NH-15	44°39'	124°24'	60	10.8	33.35	1.69	0.00	19.39	15.83	0.28	15.55	0.24
NH-15	44°39'	124°24'	70	10.7	33.40	1.71	0.00	19.31	16.82	0.13	16.70	0.29
NH-15	44°39'	124°24'	88	10.4	33.48	1.79	0.00	22.99	18.99	0.03	18.96	0.28
NH-25	44°39'	124°39'	4	12.2	32.91	0.82	0.00	8.68	5.73	0.29	5.44	1.57
NH-25	44°39'	124°39'	10	12.2	32.91	0.76	0.01	8.59	5.71	0.29	5.42	1.49
NH-25	44°39'	124°39'	15	12.2	32.91	0.84	0.00	8.69	5.74	0.29	5.45	1.25
NH-25	44°39'	124°39'	19	12.2	32.92	0.88	0.01	8.74	5.78	0.32	5.46	1.29
NH-25	44°39'	124°39'	31	12.1	32.97	0.98	0.00	9.35	6.69	0.38	6.31	1.11
NH-25	44°39'	124°39'	39	11.6	33.20	1.41	0.03	12.64	10.83	0.57	10.26	0.65
NH-25	44°39'	124°39'	100	9.9	33.66	2.32	0.00	22.94	21.86	0.00	21.87	0.08
NH-25	44°39'	124°39'	151	9.5	33.73	2.31	0.00	19.84	24.14	0.02	24.12	0.07
NH-35	44°39'	124°53'	2	13.7	32.34	0.52	0.00	2.65	0.55	0.02	0.53	0.92
NH-35	44°39'	124°53'	20	13.2	32.60	0.75	0.02	4.75	2.81	0.14	2.67	0.94
NH-35	44°39'	124°53'	29	11.7	33.15	1.30	0.00	10.89	8.96	0.40	8.56	0.98
NH-35	44°39'	124°53'	40	11.0	33.38	1.66	0.00	16.64	14.90	0.18	14.72	0.48
NH-35	44°39'	124°53'	49	10.5	33.47	1.77	0.00	20.50	17.80	0.02	17.78	0.26
NH-45	44°39'	125°07'	5	12.7	32.52	0.72	0.02	5.93	2.87	0.15	2.72	1.37
NH-45	44°39'	125°07'	10	12.8	32.52	0.71	0.04	2.76	2.83	0.14	2.69	1.55
NH-45	44°39'	125°07'	20	12.6	32.61	0.75	0.03	6.10	3.15	0.16	3.00	1.62
NH-45	44°39'	125°07'	24	11.9	32.84	1.19	0.03	10.56	8.57	0.38	8.19	0.72
NH-45	44°39'	125°07'	30	11.2	33.05	1.35	0.05	11.51	10.22	0.36	9.86	0.47
NH-45	44°39'	125°07'	40	11.5	33.39	1.56	0.00	13.03	13.23	0.65	12.59	0.41
NH-45	44°39'	125°07'	50	11.0	33.48	1.84	0.00	17.04	16.46	0.04	16.43	0.19
NH-45	44°39'	125°07'	70	9.9	33.52	2.17	0.00	21.93	19.75	0.00	19.75	0.10
NH-45	44°39'	125°07'	100	9.2	33.58	2.29	0.00	26.04	21.92	0.00	21.93	0.03
NH-45	44°39'	125°07'	151	8.7	33.85	2.36	0.00	23.14	26.22	0.00	26.24	0.02

Appendix A: September 1997 - April 1998 data (continued)

Nov-97 Station	Lat	Long	[db] P	[°C] T	S	[µM] PO_4	[µM] NH_4	[µM] SiO_2	[µM] N+N	[µM] NO_2	[µM] NO_3	[µg/L] Chl a
NH-65	44°39'	125°36'	3	14.0	33.50	0.40	0.00	2.11	0.23	0.01	0.22	0.70
NH-65	44°39'	125°36'	11	14.0	33.34	0.41	0.00	2.17	0.25	0.01	0.24	0.68
NH-65	44°39'	125°36'	20	14.0	32.99	0.40	0.00	1.99	0.26	0.01	0.24	0.72
NH-65	44°39'	125°36'	29	14.0	32.37	0.44	0.00	2.09	0.26	0.02	0.24	0.74
NH-65	44°39'	125°36'	41	14.0	31.43	0.39	0.00	2.11	0.25	0.02	0.23	0.70
NH-65	44°39'	125°36'	50	13.5	30.63	0.44	0.00	3.05	0.97	0.07	0.90	0.61
NH-65	44°39'	125°36'	60	10.8	32.42	0.50	0.00	3.41	1.28	0.09	1.19	0.52
NH-65	44°39'	125°36'	70	9.9	32.81	1.42	0.00	12.82	11.63	0.01	11.62	0.18
NH-65	44°39'	125°36'	101	9.0	32.98	2.10	0.00	22.08	19.29	0.00	19.30	0.05
NH-65	44°39'	125°36'	149	8.0	33.28	2.47	0.00	33.04	26.80	0.00	26.82	0.01
NH-85	44°39'	126°03'	4	14.0	32.25	0.36	0.09	1.71	0.05	0.00	0.06	0.59
NH-85	44°39'	126°03'	10	14.0	32.25	0.36	0.09	1.69	0.06	0.00	0.08	0.53
NH-85	44°39'	126°03'	21	14.0	32.25	0.36	0.10	2.03	0.10	0.00	0.12	0.65
NH-85	44°39'	126°03'	29	14.1	32.25	0.36	0.09	2.17	0.05	0.00	0.08	0.59
NH-85	44°39'	126°03'	34	14.0	32.25	0.08	0.00	2.05	0.05	0.00	0.09	0.55
NH-85	44°39'	126°03'	40	14.0	32.25	0.40	0.00	2.16	0.13	0.00	0.17	0.48
NH-85	44°39'	126°03'	48	11.0	32.63	1.06	0.00	8.33	7.13	0.00	7.14	0.29
NH-85	44°39'	126°03'	71	9.8	33.10	1.66	0.00	17.27	15.51	0.00	15.57	0.13
NH-85	44°39'	126°03'	98	9.5	33.55	2.12	0.00	25.57	22.74	0.00	22.81	0.04
NH-85	44°39'	126°03'	152	7.9	33.83	2.54	0.00	35.60	28.62	0.00	28.64	0.01
FM-3	43°13'	124°30'	2	14.4	32.75	0.58	0.01	2.33	0.52	0.02	0.50	0.80
FM-3	43°13'	124°30'	10	14.4	32.76	0.44	0.02	2.35	0.51	0.02	0.49	0.91
FM-3	43°13'	124°30'	20	13.9	32.79	0.56	0.04	3.22	1.17	0.06	1.11	1.06
FM-3	43°13'	124°30'	31	13.8	32.80	0.54	0.07	3.48	1.31	0.07	1.24	0.69
FM-3	43°13'	124°30'	41	13.7	32.80	0.56	0.08	3.60	1.38	0.08	1.30	0.88
FM-3	43°13'	124°30'	51	13.7	32.80	0.55	0.08	3.62	1.42	0.09	1.34	0.82
FM-3	43°13'	124°30'	61	13.7	32.80	0.56	0.06	3.64	1.48	0.09	1.39	0.80
FM-4	43°13'	124°35'	3	14.4	32.78	0.43	0.00	2.33	0.56	0.02	0.54	1.09
FM-4	43°13'	124°35'	10	14.4	32.78	0.40	0.00	2.33	0.57	0.03	0.54	0.95
FM-4	43°13'	124°35'	20	14.3	32.77	0.44	0.04	2.36	0.57	0.03	0.54	0.66
FM-4	43°13'	124°35'	31	14.3	32.78	0.46	0.09	2.40	0.57	0.03	0.54	1.02
FM-4	43°13'	124°35'	41	14.0	32.81	0.53	0.19	3.03	1.14	0.06	1.09	0.66
FM-4	43°13'	124°35'	51	13.5	32.87	0.69	0.26	4.94	2.69	0.13	2.57	0.69
FM-4	43°13'	124°35'	60	13.0	32.90	0.85	0.27	7.02	4.18	0.16	4.02	0.66
FM-4	43°13'	124°35'	70	12.8	32.93	0.94	0.28	8.07	5.11	0.18	4.93	0.80
FM-4	43°13'	124°35'	80	12.8	32.93	0.89	0.00	8.27	5.14	0.18	4.96	0.69
FM-5	43°13'	124°40'	4	13.7	32.58	0.49	0.01	3.67	0.96	0.07	0.89	0.84
FM-5	43°13'	124°40'	10	13.7	32.58	0.48	0.04	4.49	0.96	0.07	0.89	0.82
FM-5	43°13'	124°40'	20	13.7	32.73	0.51	0.07	4.81	0.94	0.05	0.89	0.95
FM-5	43°13'	124°40'	32	13.7	32.79	0.53	0.00	5.48	1.19	0.00	1.20	0.75
FM-5	43°13'	124°40'	40	13.6	32.81	0.53	0.00	3.17	1.32	0.08	1.24	0.62
FM-5	43°13'	124°40'	40	13.6	32.81	0.48	0.00	3.11	1.36	0.08	1.28	0.62

Appendix A: September 1997 - April 1998 data (continued)

Nov-97			[db]	[°C]		[μM]	[μM]	[μM]	[μM]	[μM]	[μM]	[μg/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
FM-7	43°13'	124°50'	3	13.6	32.62	0.53	0.02	3.94	1.38	0.11	1.27	0.72
FM-7	43°13'	124°50'	10	13.6	32.62	0.52	0.02	3.82	1.39	0.11	1.28	0.72
FM-7	43°13'	124°50'	20	13.6	32.62	0.51	0.01	3.76	1.37	0.11	1.26	0.70
FM-7	43°13'	124°50'	30	13.6	32.63	0.52	0.07	3.77	1.42	0.11	1.31	0.69
FM-7	43°13'	124°50'	40	13.5	32.66	0.56	0.03	4.15	2.15	0.15	2.00	0.51
FM-7	43°13'	124°50'	45	12.7	32.93	0.82	0.00	6.01	5.06	0.34	4.72	0.42
FM-7	43°13'	124°50'	50	12.1	33.05	0.90	0.00	7.35	6.75	0.40	6.35	0.38
FM-7	43°13'	124°50'	70	10.3	33.28	1.49	0.00	15.58	15.72	0.00	15.72	0.10
FM-7	43°13'	124°50'	100	10.5	33.56	1.77	0.00	18.28	19.22	0.00	19.23	0.06
FM-7	43°13'	124°50'	151	9.9	33.70	2.02	0.05	24.88	22.88	0.02	22.87	0.07
FM-8	43°13'	125°00'	3	13.5	32.51	0.47	0.01	0.00	0.83	0.03	0.80	0.90
FM-8	43°13'	125°00'	10	13.5	32.52	0.47	0.01	3.40	0.88	0.03	0.84	0.79
FM-8	43°13'	125°00'	20	13.5	32.52	0.47	0.01	3.42	0.90	0.04	0.86	0.85
FM-8	43°13'	125°00'	30	13.5	32.52	0.47	0.01	3.46	0.85	0.03	0.81	0.76
FM-8	43°13'	125°00'	34	13.5	32.57	0.53	0.03	3.54	1.25	0.06	1.19	0.65
FM-8	43°13'	125°00'	39	13.4	32.66	0.57	0.02	3.80	1.86	0.12	1.74	0.60
FM-8	43°13'	125°00'	48	12.4	33.00	0.87	0.03	6.26	5.57	0.30	5.27	0.54
FM-8	43°13'	125°00'	70	11.2	33.20	1.28	0.00	10.95	11.56	0.01	11.55	0.19
FM-8	43°13'	125°00'	100	10.1	33.49	1.79	0.00	18.49	19.48	0.00	19.49	0.03
FM-8	43°13'	125°00'	150	9.2	33.83	2.30	0.00	29.15	26.29	0.00	26.30	0.04
FM-9	43°13'	125°10'	5	13.6	32.49	0.50	0.00	3.10	0.84	0.03	0.81	0.76
FM-9	43°13'	125°10'	10	13.6	32.49	0.50	0.00	3.35	0.85	0.03	0.82	0.78
FM-9	43°13'	125°10'	30	13.6	32.49	0.48	0.00	2.75	0.85	0.03	0.82	0.83
FM-9	43°13'	125°10'	39	13.6	32.51	0.49	0.00	2.96	0.92	0.04	0.88	0.78
FM-9	43°13'	125°10'	45	13.5	32.64	0.51	0.01	3.41	1.21	0.05	1.15	0.70
FM-9	43°13'	125°10'	51	13.3	33.14	0.72	0.12	5.20	4.02	0.20	3.82	0.55
FM-9	43°13'	125°10'	71	11.5	33.14	1.14	0.00	9.79	9.96	0.03	9.93	0.21
FM-9	43°13'	125°10'	101	10.1	33.39	1.65	0.00	17.55	17.85	0.00	17.85	0.06
FM-9	43°13'	125°10'	152	8.7	33.87	2.33	0.00	29.00	28.30	0.00	28.31	0.01
CR-1	41°54'	124°18'	4	13.3	32.56	0.80	0.00	7.02	1.85	0.24	1.61	1.10
CR-1	41°54'	124°18'	10	13.5	32.80	0.81	0.00	4.79	1.60	0.23	1.37	0.52
CR-1	41°54'	124°18'	20	13.1	32.78	0.95	0.00	6.40	2.20	0.27	1.93	0.73
CR-1	41°54'	124°18'	28	13.1	32.80	1.12	0.00	6.75	2.26	0.25	2.00	0.78
CR-1	41°54'	124°18'	30	13.1	32.81	1.20	0.00	7.32	2.23	0.24	1.99	0.93
CR-1	41°54'	124°18'	36	13.2	32.84	1.15	0.00	7.63	2.16	0.20	1.97	0.95

Appendix A: September 1997 - April 1998 data (continued)

Nov-97			[db]	[°C]		[µM]	[µM]	[µM]	[µM]	[µM]	[µM]	[µg/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
CR-3	41°54'	124°30'	3	14.5	32.93		0.01	3.01	1.09	0.12	0.96	0.92
CR-3	41°54'	124°30'	5	14.5	32.93		0.00	3.03	1.07	0.00	1.17	0.92
CR-3	41°54'	124°30'	10	14.6	32.95		0.03	3.09	1.17	0.13	1.04	0.96
CR-3	41°54'	124°30'	20	14.6	32.96		0.03	3.20	1.24	0.14	1.10	0.96
CR-3	41°54'	124°30'	30	14.6	32.96		0.02	3.20	1.32	0.15	1.18	1.00
CR-3	41°54'	124°30'	36	14.6	32.96		0.03	3.08	1.36	0.17	1.19	0.98
CR-3	41°54'	124°30'	41	14.6	32.96		0.04	3.14	1.35	0.17	1.19	0.92
CR-3	41°54'	124°30'	51	14.5	33.08		0.01	3.99	2.28	0.27	2.01	0.44
CR-3	41°54'	124°30'	60	14.3	33.17		0.02	5.03	3.56	0.37	3.19	0.34
CR-3	41°54'	124°30'	70	13.7	33.22		0.04	7.02	5.31	0.48	4.83	0.27
CR-3	41°54'	124°30'	100	13.0	33.38		0.08	10.43	9.11	0.19	8.93	0.18
CR-3	41°54'	124°30'	110	13.0	33.38		0.06	10.50	9.05	0.19	8.86	0.15
CR-4	41°54'	124°36'	3	14.2	32.81		0.03	2.73	1.19	0.07	1.12	0.84
CR-4	41°54'	124°36'	10	14.2	32.81		0.04	2.81	1.13	0.07	1.06	0.91
CR-4	41°54'	124°36'	21	14.3	32.81		0.03	2.90	1.11	0.08	1.03	0.86
CR-4	41°54'	124°36'	31	14.3	32.81		0.04	2.98	1.14	0.07	1.07	0.88
CR-4	41°54'	124°36'	40	14.3	32.84		0.04	3.54	1.33	0.09	1.24	0.71
CR-4	41°54'	124°36'	45	14.4	33.06		0.05	3.68	2.33	0.18	2.15	0.42
CR-4	41°54'	124°36'	50	14.4	33.16		0.02	4.71	3.16	0.22	2.94	0.35
CR-4	41°54'	124°36'	70	13.4	33.36		0.01	8.93	7.97	0.09	7.88	0.22
CR-4	41°54'	124°36'	100	12.0	33.49		0.02	12.98	12.86	0.01	12.85	0.13
CR-4	41°54'	124°36'	150	11.1	33.59		0.00	18.30	17.43	0.00	17.44	0.05
CR-5	41°54'	124°42'	3	14.3	32.75		0.00	2.33	0.47	0.03	0.44	1.07
CR-5	41°54'	124°42'	10	14.2	32.78		0.00	2.52	0.59	0.03	0.55	1.10
CR-5	41°54'	124°42'	20	14.2	32.79		0.01	2.43	0.78	0.05	0.73	0.98
CR-5	41°54'	124°42'	30	13.9	32.88		0.08	3.45	1.83	0.10	1.74	0.74
CR-5	41°54'	124°42'	40	13.0	33.04		1.16	6.15	5.59	0.09	5.50	0.34
CR-5	41°54'	124°42'	45	12.8	33.07		0.00	6.10	6.39	0.07	6.32	0.28
CR-5	41°54'	124°42'	50	12.3	33.10		0.01	7.08	7.17	0.06	7.11	0.23
CR-5	41°54'	124°42'	70	11.5	33.49		0.00	13.46	14.86	0.00	14.87	0.08
CR-5	41°54'	124°42'	100	10.9	33.59		0.01	18.13	18.19	0.00	18.20	0.05
CR-5	41°54'	124°42'	150	10.1	33.75		0.00	24.52	22.65	0.00	22.67	0.02
CR-7	41°54'	125°00'	3	14.5	32.47		0.05	2.34	0.67	0.03	0.63	0.65
CR-7	41°54'	125°00'	10	14.5	32.47		0.04	2.28	0.67	0.04	0.64	0.59
CR-7	41°54'	125°00'	20	14.4	32.47		0.05	2.40	0.68	0.04	0.64	0.66
CR-7	41°54'	125°00'	29	14.4	32.48		0.08	2.32	0.77	0.05	0.72	0.63
CR-7	41°54'	125°00'	34	14.3	32.54		0.09	2.85	1.11	0.09	1.02	0.50
CR-7	41°54'	125°00'	39	13.9	32.61		0.09	3.54	2.15	0.15	2.00	0.41
CR-7	41°54'	125°00'	50	13.2	32.74		0.09	5.26	4.03	0.20	3.83	0.35
CR-7	41°54'	125°00'	68	12.0	32.81		0.03	7.55	6.92	0.14	6.78	0.25
CR-7	41°54'	125°00'	101	10.6	33.22		0.02	13.67	14.08	0.00	14.09	0.12
CR-7	41°54'	125°00'	150	9.0	33.66		0.04	27.31	24.92	0.00	24.94	0.01

Appendix A: September 1997 - April 1998 data (continued)

Nov-97			[db]	[°C]		[μM]	[μM]	[μM]	[μM]	[μM]	[μM]	[μg/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
CR-9	41°54'	125°20'	4	14.2	32.42		0.10	2.52	0.78	0.05	0.73	0.95
CR-9	41°54'	125°20'	11	14.2	32.42		0.07	2.53	0.77	0.05	0.72	0.91
CR-9	41°54'	125°20'	20	14.2	32.42		0.07	2.49	0.77	0.05	0.72	0.85
CR-9	41°54'	125°20'	30	14.2	32.42		0.10	2.49	0.84	0.06	0.78	0.78
CR-9	41°54'	125°20'	41	14.2	32.43		0.14	2.54	0.84	0.06	0.78	0.67
CR-9	41°54'	125°20'	50	12.7	32.65		0.15	5.34	3.85	0.11	3.74	0.36
CR-9	41°54'	125°20'	70	10.1	32.88		0.04	11.04	10.40	0.00	10.40	0.14
CR-9	41°54'	125°20'	101	9.1	33.46		0.05	23.32	22.19	0.00	22.20	0.05
CR-9	41°54'	125°20'	153	8.5	33.81		0.05	28.90	27.53	0.00	27.54	0.01
COC-2	38°38'	123°26'	3	15.5	33.24	0.72	0.26	4.32	0.42	0.11	0.31	2.64
COC-2	38°38'	123°26'	5	15.6	33.25	0.68	0.24	4.34	0.42	0.10	0.32	2.79
COC-2	38°38'	123°26'	9	15.6	33.25	0.70	0.27	4.51	0.44	0.10	0.34	2.05
COC-2	38°38'	123°26'	15	15.6	33.27	0.70	0.25	4.34	0.42	0.09	0.32	1.65
COC-2	38°38'	123°26'	20	15.6	33.27	0.68	0.24	4.37	0.45	0.09	0.35	0.83
COC-2	38°38'	123°26'	26	15.7	33.31	0.64	0.18	4.34	0.49	0.12	0.37	0.59
COC-2	38°38'	123°26'	30	15.7	33.34	0.64	0.17	4.34	0.58	0.13	0.45	0.51
COC-2	38°38'	123°26'	42	15.7	33.36	0.69	0.22	4.16	0.60	0.14	0.46	0.57
COC-2	38°38'	123°26'	50	15.7	33.35	0.73	0.22	4.71	0.62	0.14	0.47	0.59
COC-2	38°38'	123°26'	61	15.7	33.35	0.83	0.24	4.71	0.58	0.14	0.44	0.62
COC-2	38°38'	123°26'	65	15.7	33.35	0.98	0.24	5.03	0.54	0.15	0.39	0.81
COC-4	38°36'	123°30'	4	15.8	33.31	0.51	0.08	2.90	0.33	0.04	0.30	0.81
COC-4	38°36'	123°30'	5	15.8	33.31	0.50	0.07	2.90	0.35	0.04	0.32	0.77
COC-4	38°36'	123°30'	11	15.8	33.31	0.52	0.08	3.00	0.35	0.04	0.32	0.75
COC-4	38°36'	123°30'	15	15.8	33.31	0.51	0.05	3.17	0.35	0.04	0.32	0.77
COC-4	38°36'	123°30'	20	15.8	33.32	0.52	0.06	3.07	0.44	0.04	0.40	0.70
COC-4	38°36'	123°30'	30	15.8	33.32	0.54	0.08	3.14	0.52	0.05	0.47	0.57
COC-4	38°36'	123°30'	40	15.7	33.33	0.57	0.09	3.27	0.85	0.10	0.76	0.62
COC-4	38°36'	123°30'	46	15.5	33.36	0.67	0.06	4.25	1.88	0.22	1.66	0.33
COC-4	38°36'	123°30'	52	15.3	33.37	0.76	0.04	5.22	2.62	0.30	2.32	0.70
COC-4	38°36'	123°30'	61	14.7	33.42	1.04	0.01	9.41	5.05	0.45	4.60	0.28
COC-4	38°36'	123°30'	72	14.6	33.42	1.29	0.10	11.01	5.44	0.46	4.98	0.29
COC-7	38°30'	123°39'	3	15.8	33.15	0.38	0.00	2.03	0.18	0.01	0.18	0.69
COC-7	38°30'	123°39'	10	15.8	33.15	0.62	0.00	1.96	0.20	0.00	0.20	0.73
COC-7	38°30'	123°39'	24	15.9	33.17	0.37	0.00	2.02	0.24	0.01	0.23	0.77
COC-7	38°30'	123°39'	30	15.9	33.20	0.42	0.00	2.22	0.30	0.01	0.28	0.77
COC-7	38°30'	123°39'	40	15.8	33.33	0.42	0.00	3.04	1.06	0.10	0.95	0.58
COC-7	38°30'	123°39'	50	15.0	33.41	0.57	0.00	4.37	3.21	0.24	2.97	0.31
COC-7	38°30'	123°39'	70	13.2	33.46	1.10	0.00	9.42	9.09	0.06	9.03	0.18
COC-7	38°30'	123°39'	99	12.3	33.50	1.26	0.00	12.10	12.31	0.06	12.25	0.10
COC-7	38°30'	123°39'	149	11.1	33.63	1.50	0.00	16.12	17.47	0.01	17.46	0.03

Appendix A: September 1997 - April 1998 data (continued)

Nov-97			[db]	[°C]		[μM]	[μM]	[μM]	[μM]	[μM]	[μM]	[μg/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
COC-9	38°24'	123°49'	5	15.8	32.99	0.35	0.00	1.52	0.00	0.00	0.02	0.42
COC-9	38°24'	123°49'	9	15.8	32.99	0.33	0.00	1.81	0.00	0.00	0.01	0.42
COC-9	38°24'	123°49'	21	15.8	33.00	0.34	0.00	1.97	0.00	0.00	0.00	0.44
COC-9	38°24'	123°49'	30	15.8	33.00	0.34	0.00	1.57	0.01	0.00	0.03	0.44
COC-9	38°24'	123°49'	40	15.1	33.01	0.36	0.00	2.52	0.10	0.02	0.09	0.58
COC-9	38°24'	123°49'	47	13.9	33.03	0.38	0.00	3.47	0.28	0.06	0.21	0.60
COC-9	38°24'	123°49'	48	13.7	33.01	0.41	0.00	2.88	0.36	0.00	0.39	0.47
COC-9	38°24'	123°49'	74	11.8	33.15	0.81	0.00	6.85	6.87	0.05	6.82	0.20
COC-9	38°24'	123°49'	100	11.4	33.59	1.40	0.00	15.65	16.38	0.03	16.35	0.04
COC-9	38°24'	123°49'	152	10.4	33.75	1.62	0.00	20.13	21.32	0.02	21.30	0.01
COC-11	38°17'	123°59'	4	15.6	32.92	0.43	0.00	1.79	0.00	0.00	0.00	0.36
COC-11	38°17'	123°59'	10	15.7	32.92	0.40	0.00	2.16	0.00	0.00	0.00	0.31
COC-11	38°17'	123°59'	21	15.7	32.93	0.37	0.00	1.96	0.00	0.00	0.00	0.36
COC-11	38°17'	123°59'	32	15.5	32.98	0.44	0.00	2.52	0.00	0.00	0.00	0.46
COC-11	38°17'	123°59'	40	14.8	33.06	0.50	0.00	3.09	0.36	0.10	0.26	0.58
COC-11	38°17'	123°59'	46	14.1	33.05	0.49	0.01	3.41	1.05	0.34	0.71	0.60
COC-11	38°17'	123°59'	52	13.4	33.02	0.53	0.00	4.30	1.62	0.49	1.13	0.53
COC-11	38°17'	123°59'	70	11.8	33.05	0.83	0.00	6.80	5.45	0.08	5.36	0.24
COC-11	38°17'	123°59'	100	10.6	33.32	1.45	0.00	13.32	14.51	0.00	14.52	0.06
COC-11	38°17'	123°59'	152	9.0	33.76	2.21	0.00	18.23	24.64	0.00	24.65	0.01
COC-13	38°07'	124°14'	3	16.1	33.20	0.36	0.00	2.05	0.02	0.00	0.03	0.51
COC-13	38°07'	124°14'	11	16.1	33.20	0.35	0.00	2.12	0.00	0.00	0.02	0.49
COC-13	38°07'	124°14'	21	16.1	33.20	0.37	0.00	2.27	0.00	0.00	0.00	0.51
COC-13	38°07'	124°14'	30	16.1	33.20	0.36	0.00	2.34	0.00	0.00	0.00	0.49
COC-13	38°07'	124°14'	40	16.1	33.20	0.37	0.00	2.01	0.00	0.00	0.00	0.53
COC-13	38°07'	124°14'	61	12.4	33.03	0.76	0.00	5.65	4.14	0.22	3.93	0.33
COC-13	38°07'	124°14'	71	11.5	33.16	1.07	0.00	8.17	8.76	0.00	8.75	0.17
COC-13	38°07'	124°14'	102	10.3	33.46	1.63	0.00	15.56	16.86	0.00	16.87	0.03
COC-13	38°07'	124°14'	151	8.9	33.80	2.01	0.00	23.79	24.65	0.00	24.67	0.01

Jan-98			[db]	[°C]		[μM]	[μM]	[μM]	[μM]	[μM]	[μM]	[μg/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-5	44°39'	124°10'	2	12.4	30.88	1.09	0.01	12.68	3.90	0.40	3.50	1.11
NH-5	44°39'	124°10'	5	12.4	31.25	1.06	0.00	15.08	3.61	0.35	3.27	0.97
NH-5	44°39'	124°10'	10	12.5	31.65	1.07	0.02	13.15	3.42	0.31	3.11	0.86
NH-5	44°39'	124°10'	15	12.5	31.75	1.07	0.01	12.61	3.38	0.29	3.09	0.77
NH-5	44°39'	124°10'	20	12.5	31.77	1.07	0.00	12.41	3.36	0.29	3.07	0.72
NH-5	44°39'	124°10'	24	12.5	31.87	1.07	0.03	11.41	3.29	0.26	3.02	0.54
NH-5	44°39'	124°10'	30	12.5	31.93	1.08	0.00	11.50	3.25	0.25	3.00	0.68
NH-5	44°39'	124°10'	41	12.5	32.22	1.10	0.00	10.21	2.95	0.20	2.75	0.72
NH-5	44°39'	124°10'	50	12.5	32.42	1.06	0.00	9.01	3.02	0.15	2.87	0.72

Appendix A: September 1997 - April 1998 data (continued)

Jan-98 Station	Lat	Long	[db] P	[°C] T	S	[μM] PO_4	[μM] NH_4	[μM] SiO_2	[μM] N+N	[μM] NO_2	[μM] NO_3	[μg/L] Chl a
NH-15	44°39'	124°24	2	12.1		0.95	0.00	4.17	2.26	0.20	2.06	0.61
NH-15	44°39'	124°25	6	12.1	32.77		0.00	4.24	2.28	0.20	2.08	0.70
NH-15	44°39'	124°26	11	12.1	32.77	0.84	0.00	4.33	2.26	0.20	2.06	0.77
NH-15	44°39'	124°27	21	12.1	32.77		0.00	4.50	2.24	0.20	2.05	0.75
NH-15	44°39'	124°28	25	12.1	32.77	0.86	0.00	4.49	2.25	0.20	2.04	0.73
NH-15	44°39'	124°29	30	12.1	32.77	0.90	0.00	4.39	2.27	0.20	2.07	0.66
NH-15	44°39'	124°30	51	12.1	32.77	0.86	0.00	4.08	2.31	0.21	2.11	0.59
NH-15	44°39'	124°31	51	12.1	32.77	0.86	0.00	4.08	2.31	0.21	2.11	0.61
NH-15	44°39'	124°32	61	12.1	32.77	0.82	0.00	4.36	2.28	0.21	2.08	0.64
NH-15	44°39'	124°33	71	12.1	32.77	0.87	0.00	4.35	2.31	0.21	2.10	0.64
NH-15	44°39'	124°34	84	12.1	32.77	0.94	0.14	4.37	2.34	0.21	2.13	0.59
NH-25	44°39'	124°39'	2	11.8	32.71	0.80	0.02	3.93	2.34	0.20	2.14	0.75
NH-25	44°39'	124°39'	9	11.8	32.71	0.80	0.00	3.93	2.33	0.20	2.13	0.80
NH-25	44°39'	124°39'	30	11.8	32.71	0.80	0.00	3.96	2.32	0.19	2.13	0.80
NH-25	44°39'	124°39'	39	11.8	32.70	0.79	0.00	4.00	2.33	0.18	2.15	0.72
NH-25	44°39'	124°39'	51	11.8	32.71	0.83	0.00	3.76	2.29	0.00	2.10	0.75
NH-25	44°39'	124°39'	69	11.7	32.69	0.82	0.00	3.86	2.38	0.00	2.19	0.77
NH-25	44°39'	124°39'	84	11.9	32.82	0.92	0.00	5.54	3.85	0.00	3.70	0.30
NH-25	44°39'	124°39'	99	11.7	33.08	1.23	0.00	9.86	8.02	0.00	7.97	0.16
NH-25	44°39'	124°39'	149	10.8	33.34	1.71	0.00	15.77	14.03	0.00	14.03	0.05
NH-35	44°39'	124°53'	2	11.6	32.66	0.80	0.03	4.29	2.42	0.16	2.25	0.80
NH-35	44°39'	124°53'	11	11.6	32.67	0.82	0.03	4.22	2.49	0.16	2.33	0.73
NH-35	44°39'	124°53'	21	11.6	32.69	0.84	0.02	4.28	2.50	0.17	2.34	0.80
NH-35	44°39'	124°53'	31	11.6	32.69	0.84	0.00	4.07	2.52	0.17	2.35	0.79
NH-35	44°39'	124°53'	40	11.6	32.69	0.84	0.00	4.20	2.59	0.17	2.43	0.77
NH-35	44°39'	124°53'	71	11.6	32.69	0.85	0.00	4.00	2.75	0.17	2.58	0.70
NH-35	44°39'	124°53'	99	11.7	32.70	0.87	0.00	4.31	2.73	0.17	2.55	0.72
NH-35	44°39'	124°53'	143	10.4	33.32	1.70	0.00	15.38	15.98	0.00	15.99	0.05
NH-45	44°39'	125°07'	2	11.4	32.64	0.99	0.00	4.48	2.71	0.14	2.57	0.77
NH-45	44°39'	125°07'	10	11.4	32.64	0.99	0.00	4.54	2.70	0.14	2.57	0.75
NH-45	44°39'	125°07'	22	11.4	32.64	1.16	0.01	4.43	2.71	0.14	2.57	0.79
NH-45	44°39'	125°07'	30	11.4	32.64	1.14	0.00	4.41	2.72	0.14	2.58	0.77
NH-45	44°39'	125°07'	39	11.4	32.64	1.20	0.00	4.61	2.73	0.14	2.59	0.72
NH-45	44°39'	125°07'	50	11.4	32.64	1.14	0.00	4.28	2.64	0.13	2.51	0.72
NH-45	44°39'	125°07'	69	11.5	32.66	1.12	0.00	4.57	2.88	0.15	2.73	0.73
NH-45	44°39'	125°07'	86	11.5	32.70	1.07	0.00	5.27	3.15	0.16	2.99	0.59
NH-45	44°39'	125°07'	101	11.4	32.95	1.47	0.00	8.98	7.55	0.08	7.47	0.18
NH-45	44°39'	125°07'	148	9.0	33.52	2.71	0.14	23.73	21.83	0.00	21.85	0.02

Appendix A: September 1997 - April 1998 data (continued)

Jan-98			[db]	[°C]		[µM]	[µM]	[µM]	[µM]	[µM]	[µM]	[µg/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-65	44°39'	125°36'	3	10.8	32.48	1.00	0.00	3.82	2.11	0.10	2.01	0.49
NH-65	44°39'	125°36'	10	10.8	32.48	1.04	0.03	4.16	2.37	0.10	2.28	0.49
NH-65	44°39'	125°36'	19	10.8	32.48	1.07	0.04	5.11	2.32	0.10	2.23	0.54
NH-65	44°39'	125°36'	30	10.8	32.48	1.01	0.01	4.93	2.11	0.09	2.02	0.52
NH-65	44°39'	125°36'	40	10.8	32.48	1.02	0.02	4.14	2.12	0.10	2.03	0.43
NH-65	44°39'	125°36'	50	10.8	32.48	1.01	0.03	4.46	2.23	0.10	2.12	0.47
NH-65	44°39'	125°36'	72	10.8	32.48	1.06	0.04	3.95	2.32	0.10	2.22	0.47
NH-65	44°39'	125°36'	91	10.7	32.52	1.13	0.00	4.99	3.45	0.12	3.33	0.31
NH-65	44°39'	125°36'	101	9.4	32.99	1.75	0.00	12.33	11.37	0.00	11.36	0.08
NH-65	44°39'	125°36'	148	8.4	33.71	2.93	0.00	30.84	25.80	0.00	25.83	0.02
NH-85	44°39'	126°03'	1	10.4	32.46	1.12	0.05	5.43	3.71	0.13	3.58	0.79
NH-85	44°39'	126°03'	11	10.4	32.46	1.10	0.01	5.11	3.72	0.14	3.59	0.78
NH-85	44°39'	126°03'	20	10.4	32.46	1.11	0.09	8.96	3.77	0.14	3.63	0.79
NH-85	44°39'	126°03'	29	10.4	32.47	1.12	0.19	5.37	3.74	0.14	3.61	0.70
NH-85	44°39'	126°03'	41	10.4	32.47	1.11	0.01	5.65	3.76	0.14	3.62	0.76
NH-85	44°39'	126°03'	50	10.4	32.47	1.25	0.10	5.40	3.70	0.14	3.56	0.69
NH-85	44°39'	126°03'	71	10.4	32.47	1.04	0.03	5.23	3.74	0.14	3.60	0.78
NH-85	44°39'	126°03'	85	10.1	32.66	1.18	0.03	5.46	3.74	0.14	3.60	0.72
NH-85	44°39'	126°03'	99	9.1	33.21	2.41	0.06	20.40	18.97	0.00	18.98	0.06
NH-85	44°39'	126°03'	149	8.1	33.67	2.73	0.04	29.85	25.10	0.00	25.12	0.01
FM-3	43°13'	124°30'	11	12.6	31.31	1.10	0.11	15.60	3.42	0.54	2.88	0.70
FM-3	43°13'	124°30'	15	12.6	31.38	1.13	0.08	14.64	3.42	0.52	2.91	0.72
FM-3	43°13'	124°30'	21	12.6	31.54	1.12	0.06	13.36	3.35	0.48	2.87	0.70
FM-3	43°13'	124°30'	25	12.6	31.71	1.11	0.14	12.94	3.37	0.42	2.94	0.54
FM-3	43°13'	124°30'	30	12.6	31.78	1.03	0.08	11.74	3.19	0.42	2.77	0.52
FM-3	43°13'	124°30'	41	12.8	32.19	1.08	0.05	10.42	3.29	0.41	2.88	0.43
FM-3	43°13'	124°30'	51	12.8	32.57	0.96	0.02	8.05	2.90	0.26	2.64	0.34
FM-3	43°13'	124°30'	56	12.8	32.57	0.96	0.07	8.04	3.13	0.28	2.85	0.32
FM-4	43°13'	124°35'	10	12.6	31.26	0.89	0.01	15.14	3.57	0.57	3.00	0.79
FM-4	43°13'	124°35'	21	12.6	31.45	0.83	0.00	15.51	3.39	0.55	2.85	0.81
FM-4	43°13'	124°35'	26	12.7	31.77	0.78	0.00	13.25	3.35	0.45	2.89	0.42
FM-4	43°13'	124°35'	30	12.7	31.89	0.74	0.00	12.52	3.27	0.40	2.87	0.47
FM-4	43°13'	124°35'	41	12.8	32.25	0.61	0.00	10.57	2.87	0.27	2.60	0.45
FM-4	43°13'	124°35'	51	12.8	32.44	1.01	0.09	8.51	3.03	0.32	2.72	0.51
FM-4	43°13'	124°35'	60	12.8	32.57	1.04	0.23	7.98	3.08	0.28	2.80	0.42
FM-4	43°13'	124°35'	71	12.8	32.81	1.05	0.06	6.89	3.37	0.23	3.14	0.34
FM-4	43°13'	124°35'	73	12.8	32.81	0.98	0.03	6.83	3.42	0.23	3.19	0.40

Appendix A: September 1997 - April 1998 data (continued)

Jan-98			[db]	[°C]		[μM]	[μM]	[μM]	[μM]	[μM]	[μM]	[μg/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
FM-5	43°13'	124°40'	1	12.8	32.74	0.83	0.01	6.08	2.78	0.27	2.51	0.73
FM-5	43°13'	124°40'	10	12.8	32.73	0.76	0.01	6.25	2.80	0.26	2.54	0.77
FM-5	43°13'	124°40'	20	12.8	32.79	0.74	0.00	6.05	2.74	0.25	2.49	0.72
FM-5	43°13'	124°40'	31	12.8	32.91	0.68	0.00	5.45	2.84	0.20	2.64	0.61
FM-5	43°13'	124°40'	41	12.8	32.92	0.92	0.04	5.13	2.95	0.18	2.77	0.54
FM-5	43°13'	124°40'	51	12.8	32.93	0.87	0.12	5.50	3.05	0.18	2.87	0.52
FM-5	43°13'	124°40'	59	12.8	32.93	0.84	0.02	5.29	2.95	0.17	2.78	0.46
FM-5	43°13'	124°40'	70	12.8	32.93	0.81	0.00	4.92	2.97	0.17	2.80	0.41
FM-5	43°13'	124°40'	80	12.8	32.94	0.81	0.04	4.98	3.05	0.17	2.88	0.48
FM-5	43°13'	124°40'	102	12.8	32.94	0.77	0.00	4.29	2.98	0.18	2.81	0.48
FM-5	43°13'	124°40'	129	12.8	32.97	0.83	0.05	5.91	3.25	0.16	3.09	0.46
FM-7	43°13'	124°50'	2	12.6	32.96	0.83	0.00	5.48	3.35	0.19	3.15	0.91
FM-7	43°13'	124°50'	11	12.6	32.96	0.85	0.02	5.34	3.31	0.19	3.12	0.86
FM-7	43°13'	124°50'	20	12.6	32.97	0.84	0.00	5.79	3.31	0.19	3.12	0.89
FM-7	43°13'	124°50'	31	12.6	32.97	0.90	0.00	6.03	3.42	0.19	3.22	0.89
FM-7	43°13'	124°50'	41	12.6	32.97	0.86	0.03	5.84	3.45	0.19	3.25	0.80
FM-7	43°13'	124°50'	50	12.6	32.97	0.88	0.01	5.68	3.42	0.20	3.22	0.86
FM-7	43°13'	124°50'	71	12.6	32.98	0.94	0.00	6.21	3.50	0.21	3.29	0.91
FM-7	43°13'	124°50'	86	12.6	32.99	0.95	0.00	6.20	3.64	0.20	3.44	0.80
FM-7	43°13'	124°50'	101	12.6	33.02	0.95	0.00	6.95	4.46	0.18	4.28	0.54
FM-7	43°13'	124°50'	121	12.5	33.07	1.03	0.00	7.70	5.25	0.16	5.09	0.46
FM-7	43°13'	124°50'	150	10.9	33.39	1.72	0.00	15.83	14.74	0.00	14.75	0.08
FM-8	43°13'	125°00'	5	11.3	32.60	0.67	0.02	7.27	1.30	0.04	1.27	0.45
FM-8	43°13'	125°00'	10	11.3	32.60	0.67	0.01	4.08	1.48	0.04	1.45	0.39
FM-8	43°13'	125°00'	20	11.3	32.60	0.69	0.02	2.73	1.50	0.03	1.46	0.41
FM-8	43°13'	125°00'	28	11.3	32.60	0.70	0.02	3.08	1.48	0.03	1.45	0.41
FM-8	43°13'	125°00'	39	11.3	32.60	0.73	0.02	2.63	1.42	0.03	1.38	0.43
FM-8	43°13'	125°00'	50	11.3	32.60	0.72	0.01	2.88	1.44	0.03	1.41	0.41
FM-8	43°13'	125°00'	70	11.3	32.60	0.73	0.01	3.22	1.42	0.03	1.38	0.43
FM-8	43°13'	125°00'	101	11.2	32.61	0.76	0.02	3.09	1.57	0.04	1.53	0.34
FM-8	43°13'	125°00'	121	10.1	32.77	1.09	0.03	8.03	7.00	0.04	6.97	0.11
FM-8	43°13'	125°00'	150	9.3	33.33	1.78	0.00	19.26	18.18	0.00	18.20	0.04
NH-15	44°39'	124°24'		12.3		0.95	0.00	4.17	2.26	0.20	2.06	0.61
NH-15	44°39'	124°24'		12.3		0.84	0.00	4.33	2.26	0.20	2.06	0.70
NH-15	44°39'	124°24'		12.3		0.84	0.00	4.33	2.26	0.20	2.06	0.77
NH-15	44°39'	124°24'		12.3		0.86	0.00	4.08	2.31	0.21	2.11	0.59
NH-15	44°39'	124°24'		12.3		0.86	0.00	4.08	2.31	0.21	2.11	0.61
NH-25	44°39'	124°24'		12.2		0.80	0.02	3.93	2.34	0.20	2.14	0.75
NH-25	44°39'	124°24'		12.2		0.80	0.00	3.93	2.33	0.20	2.13	0.52

Appendix A: September 1997 - April 1998 data (continued)

Apr-98			[db]	[°C]		[µM]	[µM]	[µM]	[µM]	[µM]	[µM]	[µg/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-5	44°39'	124°10'	2	11.8	31.89	0.45	0.00	0.26	0.06	0.00	0.08	0.73
NH-5	44°39'	124°10'	5	11.8	31.90	0.49	0.00	2.12	0.08	0.00	0.09	0.67
NH-5	44°39'	124°10'	10	11.8	31.93	0.49	0.00	2.44	0.05	0.00	0.06	1.59
NH-5	44°39'	124°10'	15	11.5	32.16	0.50	0.00	1.61	0.06	0.00	0.07	0.89
NH-5	44°39'	124°10'	20	11.1	32.43	0.44	0.00	2.04	0.06	0.00	0.07	2.68
NH-5	44°39'	124°10'	25	11.0	32.62	0.48	0.00	2.11	0.16	0.01	0.15	1.47
NH-5	44°39'	124°10'	30	10.9	32.68	0.65	0.00	3.11	0.68	0.13	0.55	1.10
NH-5	44°39'	124°10'	40	10.7	32.93	0.99	0.06	6.92	4.09	0.22	3.88	0.93
NH-5	44°39'	124°10'	49	10.5	33.01	1.35	0.00	13.63	7.18	0.28	6.90	0.86
NH-15	44°39'	124°24'	3	11.4	32.22	0.36	0.00	0.98	0.01	0.00	0.02	0.27
NH-15	44°39'	124°24'	7	11.4	32.50	0.40	0.02	1.20	0.12	0.01	0.11	0.47
NH-15	44°39'	124°24'	10	11.3	32.54	0.26	0.00	1.09	0.10	0.00	0.10	0.60
NH-15	44°39'	124°24'	20	11.1	32.60	0.26	0.01	1.44	0.11	0.02	0.09	0.87
NH-15	44°39'	124°24'	30	11.0	32.64	0.36	0.05	2.17	0.12	0.02	0.10	0.93
NH-15	44°39'	124°24'	41	11.0	32.66	0.55	0.17	3.29	1.24	0.13	1.12	0.56
NH-15	44°39'	124°24'	50	10.9	32.69	0.80	0.00	8.48	4.70	0.30	4.40	0.35
NH-15	44°39'	124°24'	60	11.1	32.79	0.73	0.23	6.25	4.80	0.45	4.35	0.23
NH-15	44°39'	124°24'	70	11.0	32.81	0.87	0.08	8.70	6.99	0.40	6.59	0.15
NH-25	44°39'	124°39'	2	11.6	32.62	0.48	0.00	1.12	0.00	0.00	0.00	0.54
NH-25	44°39'	124°39'	10	11.5	32.62	0.45	0.21	1.10	0.07	0.00	0.07	0.54
NH-25	44°39'	124°39'	20	11.4	32.63	0.50	0.18	2.00	0.10	0.01	0.09	0.71
NH-25	44°39'	124°39'	30	11.4	32.64	0.47	0.46	1.54	0.17	0.01	0.15	1.14
NH-25	44°39'	124°39'	35	11.4	32.64	0.58	0.17	2.36	0.55	0.09	0.46	1.21
NH-25	44°39'	124°39'	40	11.3	32.70	0.84	0.29	4.08	2.66	0.41	2.26	0.86
NH-25	44°39'	124°39'	50	11.2	32.75	1.17	1.28	7.39	5.47	0.48	4.99	0.33
NH-25	44°39'	124°39'	70	11.0	32.78	0.97	0.74	8.26	6.20	0.41	5.79	0.17
NH-25	44°39'	124°39'	100	10.5	33.08	1.43	0.47	14.38	12.16	0.11	12.04	0.10
NH-35	44°39'	124°53'	2	11.7	32.50	0.39	0.00	2.17	0.53	0.00	0.54	0.33
NH-35	44°39'	124°53'	10	11.7	32.50	0.38	0.05	1.26	0.09	0.00	0.10	0.32
NH-35	44°39'	124°53'	20	11.6	32.50	0.38	0.05	1.42	0.10	0.00	0.10	0.35
NH-35	44°39'	124°53'	29	11.5	32.53	0.40	0.06	1.32	0.33	0.00	0.33	0.55
NH-35	44°39'	124°53'	35	11.5	32.53	0.40	0.08	1.39	0.30	0.04	0.26	0.92
NH-35	44°39'	124°53'	40	11.5	32.60	0.47	0.07	1.66	0.77	0.11	0.66	1.16
NH-35	44°39'	124°53'	50	11.4	32.64	0.49	0.13	1.63	0.70	0.07	0.63	0.92
NH-35	44°39'	124°53'	70	11.1	32.67	0.58	0.05	3.26	2.26	0.25	2.01	0.27
NH-35	44°39'	124°53'	101	10.7	32.87	0.94	0.14	11.61	8.47	0.10	8.37	0.12
NH-35	44°39'	124°53'	150	8.8	33.60	2.15	0.13	31.40	24.85	0.02	24.83	0.09
NH-35	44°39'	124°53'	300	6.5	33.99	2.67	0.17	57.55	35.67	0.02	35.65	0.04
NH-35	44°39'	124°53'	400	5.7	34.05	2.83		71.62	38.94	0.01	38.92	0.05

Appendix A: September 1997 - April 1998 data (continued)

Apr-98			[db]	[°C]		[μM]	[μM]	[μM]	[μM]	[μM]	[μM]	[μg/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-45	44°39'	125°07'	2	12.1	32.10	0.37	0.00	0.10	0.00	0.00	0.00	0.18
NH-45	44°39'	125°07'	10	11.6	32.16	0.41	0.00	1.68	0.00	0.00	0.00	0.28
NH-45	44°39'	125°07'	20	11.4	32.64	0.52	0.00	1.23	0.00	0.00	0.00	0.94
NH-45	44°39'	125°07'	30	11.4	32.70	0.58	0.00	1.67	0.34	0.04	0.30	1.29
NH-45	44°39'	125°07'	36	11.4	32.72	0.59	0.00	1.70	0.64	0.07	0.57	1.14
NH-45	44°39'	125°07'	40	11.4	32.74	0.62	0.10	2.47	0.91	0.13	0.78	0.74
NH-45	44°39'	125°07'	50	11.4	32.74	0.68	0.16	2.38	1.38	0.20	1.19	0.50
NH-45	44°39'	125°07'	70	11.1	32.78	0.88	0.16	5.56	3.86	0.27	3.59	0.25
NH-45	44°39'	125°07'	100	10.6	33.05	1.43	0.00	12.81	11.03	0.02	11.01	0.10
NH-45	44°39'	125°07'	150	9.0	33.65	2.36	0.00	27.35	23.33	0.00	23.33	0.06
NH-65	44°39'	125°36'	10	11.0	32.67	0.76	0.00	4.06	0.07	0.06	0.01	0.53
NH-65	44°39'	125°36'	20	11.0	32.69	0.77	0.00	3.93	0.10	0.06	0.04	0.65
NH-65	44°39'	125°36'	30	10.9	32.69	0.77	0.00	4.19	0.17	0.06	0.10	0.65
NH-65	44°39'	125°36'	40	11.0	32.69	0.79	0.00	4.14	0.00	0.06	0.00	0.61
NH-65	44°39'	125°36'	45	10.9	32.69	0.72	0.00	4.82	0.55	0.06	0.49	0.55
NH-65	44°39'	125°36'	51	10.9	32.69	0.80	0.00	4.54	2.66	0.07	2.60	0.52
NH-65	44°39'	125°36'	70	10.9	32.71	0.82	0.00	4.80	5.47	0.10	5.37	0.41
NH-65	44°39'	125°36'	100	9.8	33.32	1.84	0.00	18.24	6.20	0.00	6.20	0.07
NH-65	44°39'	125°36'	150	8.4	33.76	2.52	0.00	25.87	12.16	0.00	12.19	0.02
NH-85	44°39'	126°03'	2	11.0	32.67	0.53	0.17	1.59	1.08	0.05	1.02	0.28
NH-85	44°39'	126°03'	10	11.0	32.67	0.49	0.38	1.75	1.10	0.06	1.04	0.27
NH-85	44°39'	126°03'	21	11.0	32.67	0.48	0.23	1.65	1.13	0.06	1.07	0.28
NH-85	44°39'	126°03'	29	11.0	32.67	0.50	0.41	1.83	1.11	0.07	1.05	0.32
NH-85	44°39'	126°03'	40	10.9	32.67	0.50	0.56	1.55	1.05	0.07	0.98	0.34
NH-85	44°39'	126°03'	50	10.9	32.67	0.52	2.97	1.86	1.17	0.08	1.10	0.50
NH-85	44°39'	126°03'	69	10.8	32.65	0.61	0.44	2.65	2.08	0.12	1.96	0.50
NH-85	44°39'	126°03'	101	10.2	32.91	1.93	0.51	29.36	23.66	0.01	23.65	0.07
NH-85	44°39'	126°03'	150	8.7	33.70	2.04	0.49	30.72	25.11	0.01	25.11	0.04
NH-85	44°39'	126°03'	864	3.9	34.34		0.00			0.01		0.01
NH-85	44°39'	126°03'	1006	3.6	34.40		0.00			0.01		0.01
FM-3	43°13'	124°30'	2	12.3	31.85	0.62	0.11	11.47	2.41	0.04	2.38	1.14
FM-3	43°13'	124°30'	5	11.7	32.14	0.63	0.23	9.24	2.27	0.15	2.12	1.13
FM-3	43°13'	124°30'	10	11.4	32.62	0.93	0.19	11.08	5.91	0.27	5.64	1.32
FM-3	43°13'	124°30'	15	10.9	32.87	1.11	0.19	14.67	9.15	0.27	8.89	1.13
FM-3	43°13'	124°30'	20	10.3	33.07	1.32	0.18	20.02	12.77	0.24	12.54	0.82
FM-3	43°13'	124°30'	25	10.1	33.19	1.46	0.17	23.10	15.14	0.17	14.97	0.73
FM-3	43°13'	124°30'	29	9.5	33.39	1.70	0.20	27.76	18.32	0.12	18.20	0.48
FM-3	43°13'	124°30'	41	9.3	33.47	1.80	0.17	29.31	20.27	0.13	20.14	0.22
FM-3	43°13'	124°30'	45	9.2	33.50	1.85	0.12	30.58	20.65	0.15	20.51	0.21
FM-3	43°13'	124°30'	49	9.2	33.50	1.80	0.11	30.54	20.95	0.12	20.83	0.22

Appendix A: September 1997 - April 1998 data (continued)

Apr-98			[db]	[°C]		[µM]	[µM]	[µM]	[µM]	[µM]	[µM]	[µg/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
FM-4	43°13'	124°35'	2	12.2	32.07	0.35	0.06	1.84	0.00	0.00	0.02	0.37
FM-4	43°13'	124°35'	5	12.2	32.07	0.38	0.06	1.81	0.00	0.00	0.00	0.37
FM-4	43°13'	124°35'	10	11.8	32.33	0.36	0.07	0.82	0.00	0.00	0.00	0.25
FM-4	43°13'	124°35'	20	11.8	32.56	0.48	0.10	2.34	0.37	0.10	0.26	0.93
FM-4	43°13'	124°35'	30	11.5	32.62	0.48	0.14	2.88	0.25	0.07	0.18	1.18
FM-4	43°13'	124°35'	36	11.3	32.64	0.54	0.22	3.85	0.66	0.10	0.56	0.97
FM-4	43°13'	124°35'	40	11.3	32.67	0.58	0.29	3.28	1.42	0.18	1.24	0.55
FM-4	43°13'	124°35'	45	11.2	32.71	0.66	0.24	4.14	2.84	0.31	2.54	0.35
FM-4	43°13'	124°35'	50	11.0	32.75	0.81	0.17	6.94	4.82	0.36	4.46	0.21
FM-4	43°13'	124°35'	60	10.5	32.96	1.16	0.18	14.43	10.03	0.03	10.01	0.14
FM-4	43°13'	124°35'	70	10.0	33.17	1.41	0.09	19.67	13.82	0.00	13.85	0.14
FM-4	43°13'	124°35'	75	9.1	33.51	1.74	0.13	27.64	18.88	0.00	18.90	0.13
FM-5	43°13'	124°40'	2	12.2	31.89	0.36	0.00	2.50	0.05	0.00	0.07	0.31
FM-5	43°13'	124°40'	10	11.7	32.36	0.41	0.00	1.49	0.01	0.00	0.02	0.35
FM-5	43°13'	124°40'	21	11.5	32.56	0.48	0.15	1.54	0.00	0.00	0.00	0.56
FM-5	43°13'	124°40'	30	11.4	32.59	0.51	0.00	1.67	0.02	0.00	0.02	1.08
FM-5	43°13'	124°40'	40	11.3	32.66	0.61	0.00	2.61	1.09	0.18	0.91	0.81
FM-5	43°13'	124°40'	51	11.3	32.70	0.62	0.17	2.94	1.79	0.26	1.53	0.45
FM-5	43°13'	124°40'	60	11.1	32.73	0.73	0.17	5.28	4.07	0.40	3.67	0.21
FM-5	43°13'	124°40'	71	10.9	32.79	0.87	0.00	7.83	6.54	0.38	6.16	0.17
FM-5	43°13'	124°40'	101	8.5	33.71	2.07	0.07	34.82	25.89	0.08	25.81	0.16
FM-5	43°13'	124°40'	135	7.9	33.87	2.26	0.00	40.50	29.49	0.05	29.44	0.14
FM-5	43°13'	124°40'	147	7.9	33.87	2.28	0.00	41.73	29.95	0.06	29.89	0.13
FM-7	43°13'	124°50'	2	11.6	32.44	0.36	0.00	1.29	0.01	0.00	0.04	0.45
FM-7	43°13'	124°50'	9	11.4	32.58	0.42	0.00	2.24	0.13	0.00	0.14	1.08
FM-7	43°13'	124°50'	20	11.4	32.60	0.48	0.02	2.39	0.52	0.00	0.52	1.12
FM-7	43°13'	124°50'	26	11.3	32.61	0.51	0.00	2.62	1.05	0.17	0.88	0.87
FM-7	43°13'	124°50'	30	11.3	32.64	0.49	0.00	2.06	0.83	0.12	0.70	1.03
FM-7	43°13'	124°50'	40	11.3	32.67	0.50	0.10	1.85	0.70	0.10	0.60	0.65
FM-7	43°13'	124°50'	50	11.3	32.70	0.60	0.14	3.22	2.17	0.27	1.90	0.33
FM-7	43°13'	124°50'	71	11.0	32.82	0.82	0.00	6.95	5.74	0.32	5.41	0.16
FM-7	43°13'	124°50'	101	9.7	33.45	1.63	0.00	22.01	19.65	0.03	19.62	0.12
FM-7	43°13'	124°50'	150	8.2	33.82	2.12	0.00	37.26	28.96	0.01	28.95	0.06

Appendix A: September 1997 - April 1998 data (continued)

Apr-98			[db]	[°C]		[µM]	[µM]	[µM]	[µM]	[µM]	[µM]	[µg/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
FM-8	43°13'	125°00'	2	11.6	32.21	0.42	0.00	2.10	0.08	0.00	0.10	0.32
FM-8	43°13'	125°00'	10	11.7	32.25	0.36	0.00	1.90	0.19	0.00	0.21	0.41
FM-8	43°13'	125°00'	20	11.5	32.45	0.41	0.00	1.62	0.00	0.00	0.02	0.75
FM-8	43°13'	125°00'	24	11.4	32.45	0.43	0.00	2.08	0.05	0.00	0.05	1.02
FM-8	43°13'	125°00'	30	11.4	32.50	0.45	0.00	2.61	0.17	0.03	0.15	1.16
FM-8	43°13'	125°00'	41	11.3	32.56	0.52	0.05	2.42	1.05	0.13	0.92	0.95
FM-8	43°13'	125°00'	50	11.3	32.62	0.57	0.07	2.80	1.78	0.29	1.49	0.61
FM-8	43°13'	125°00'	69	11.0	32.69	0.76	0.00	6.04	4.29	0.39	3.90	0.19
FM-8	43°13'	125°00'	100	10.3	33.08	1.24	0.00	15.32	12.52	0.04	12.48	0.13
FM-8	43°13'	125°00'	151	8.6	33.70	1.99	0.00	30.31	25.92	0.00	25.93	0.05
CR-1	41°54'	124°18'	2	10.9	31.33	0.83	0.00	21.53	5.96	0.17	5.80	7.88
CR-1	41°54'	124°18'	5	10.9	31.34	0.86	0.00	21.85	6.01	0.16	5.85	7.78
CR-1	41°54'	124°18'	8	10.9	31.42	0.85	0.01	21.22	5.59	0.16	5.43	8.62
CR-1	41°54'	124°18'	10	10.9	31.44	0.77	0.00	19.97	5.08	0.14	4.94	9.78
CR-1	41°54'	124°18'	15	11.0	31.66	0.83	0.00	20.80	5.08	0.15	4.94	9.93
CR-1	41°54'	124°18'	19	10.7	32.34	1.20	0.00	17.97	9.55	0.25	9.31	4.94
CR-1	41°54'	124°18'	25	10.5	32.73	1.36	0.00	17.01	11.91	0.26	11.65	1.33
CR-1	41°54'	124°18'	29	10.2	32.99	1.61	0.16	20.17	13.88	0.29	13.59	1.26
CR-1	41°54'	124°18'	34	10.0	33.14	1.70	0.12	21.71	15.23	0.28	14.95	1.47
CR-3	41°54'	124°30'	2	11.4	32.07	0.48	0.00	7.65	1.44	0.03	1.41	2.73
CR-3	41°54'	124°30'	5	11.4	32.07	0.50	0.00	7.52	1.44	0.03	1.41	2.76
CR-3	41°54'	124°30'	10	11.4	32.07	0.53	0.07	7.05	1.24	0.03	1.21	2.62
CR-3	41°54'	124°30'	19	11.0	32.15	0.78	0.00	13.87	5.51	0.13	5.37	6.23
CR-3	41°54'	124°30'	24	10.9	32.25	0.89	0.24	14.80	6.39	0.15	6.24	5.38
CR-3	41°54'	124°30'	31	10.8	32.72	1.11	0.06	13.39	8.26	0.27	7.99	1.15
CR-3	41°54'	124°30'	40	10.5	32.93	1.24	0.07	13.63	10.07	0.30	9.77	0.67
CR-3	41°54'	124°30'	50	10.1	33.05	1.54	0.00	19.37	13.98	0.22	13.76	0.69
CR-3	41°54'	124°30'	61	9.6	33.37	1.92	0.09	24.50	19.10	0.05	19.05	0.41
CR-3	41°54'	124°30'	70	8.8	33.70	2.33	0.05	31.08	24.36	0.05	24.31	0.15
CR-3	41°54'	124°30'	100	8.6	33.76	2.44	0.06	34.31	25.63	0.10	25.53	0.24
CR-3	41°54'	124°30'	117	8.6	33.76	2.41	0.00	35.36	25.43	0.13	25.30	0.35
CR-4	41°54'	124°36'	2	11.6	32.31	0.38	0.00	3.06	0.16	0.03	0.13	1.12
CR-4	41°54'	124°36'	10	11.6	32.31	0.39	0.00	3.36	0.16	0.04	0.13	1.13
CR-4	41°54'	124°36'	20	11.5	32.34	0.38	0.00	3.20	0.22	0.05	0.18	1.15
CR-4	41°54'	124°36'	29	11.5	32.37	0.40	0.00	2.93	0.34	0.07	0.27	1.08
CR-4	41°54'	124°36'	35	11.5	32.40	0.41	0.00	2.95	0.38	0.08	0.30	1.01
CR-4	41°54'	124°36'	40	11.5	32.43	0.43	0.00	3.14	0.60	0.10	0.50	0.99
CR-4	41°54'	124°36'	51	11.4	32.49	0.49	0.00	3.28	1.23	0.18	1.05	0.99
CR-4	41°54'	124°36'	70	10.8	32.82	0.83	0.00	7.86	6.24	0.26	5.98	0.29
CR-4	41°54'	124°36'	99	8.9	33.63	1.93	0.00	30.32	24.35	0.06	24.29	0.12
CR-4	41°54'	124°36'	149	7.7	33.92	2.25	0.00	41.08	30.35	0.00	30.35	0.08

Appendix A: September 1997 - April 1998 data (continued)

Apr-98 Station	Lat	Long	[db] P	[°C] T	S	[µM] PO_4	[µM] NH_4	[µM] SiO_2	[µM] N+N	[µM] NO_2	[µM] NO_3	[µg/L] Chl a
CR-5	41°54'	124°42'	4	11.3	32.47	0.40	0.00	2.42	0.00	0.00	0.02	0.94
CR-5	41°54'	124°42'	9	11.3	32.47	0.43	0.00	2.03	0.06	0.00	0.08	0.96
CR-5	41°54'	124°42'	20	11.3	32.47	0.44	0.00	2.27	0.05	0.00	0.04	0.83
CR-5	41°54'	124°42'	29	11.3	32.50	0.41	0.00	2.06	0.08	0.00	0.08	0.96
CR-5	41°54'	124°42'	40	11.2	32.56	0.50	0.00	2.81	0.45	0.06	0.39	1.03
CR-5	41°54'	124°42'	45	11.1	32.56	0.48	0.00	2.55	0.51	0.06	0.45	0.96
CR-5	41°54'	124°42'	50	11.1	32.57	0.51	0.00	2.70	0.99	0.15	0.84	0.76
CR-5	41°54'	124°42'	69	10.7	32.62	0.71	0.00	5.51	3.84	0.43	3.41	0.30
CR-5	41°54'	124°42'	101	10.8	33.00	1.02	0.00	11.84	9.76	0.04	9.72	0.09
CR-5	41°54'	124°42'	150	8.7	33.74	2.11	0.00	33.94	26.91	0.03	26.88	0.10
CR-7	41°54'	125°00'	2	11.5	32.54		0.10	2.50	0.09	0.02	0.08	1.06
CR-7	41°54'	125°00'	10	11.5	32.54		0.07	2.17	0.06	0.02	0.05	1.09
CR-7	41°54'	125°00'	20	11.5	32.54		0.09	2.60	0.01	0.03	0.00	1.09
CR-7	41°54'	125°00'	30	11.5	32.54		0.10	3.49	0.69	0.04	0.65	1.09
CR-7	41°54'	125°00'	40	11.5	32.54		0.09	3.83	0.93	0.04	0.89	0.99
CR-7	41°54'	125°00'	50	11.5	32.54		0.09	2.70	0.16	0.04	0.13	0.99
CR-7	41°54'	125°00'	60	11.6	32.59		0.14	2.69	0.27	0.06	0.22	0.82
CR-7	41°54'	125°00'	70	11.8	32.73		0.29	3.54	0.90	0.23	0.68	0.41
CR-7	41°54'	125°00'	100	11.1	32.72		0.13	6.05	3.87	0.38	3.49	0.09
CR-7	41°54'	125°00'	149	9.2	33.49		0.16	24.20	19.53	0.05	19.48	0.05
CR-9	41°54'	125°20'	3	12.1	32.80	0.39	0.12	2.52	0.15	0.02	0.13	0.58
CR-9	41°54'	125°20'	10	12.1	32.80	0.40	0.12	2.66	0.16	0.04	0.12	0.57
CR-9	41°54'	125°20'	19	12.1	32.80	0.42	0.03	2.62	0.17	0.04	0.12	0.58
CR-9	41°54'	125°20'	40	12.1	32.80	0.42	0.15	2.76	0.20	0.04	0.16	0.57
CR-9	41°54'	125°20'	51	12.1	32.80	0.42	0.06	2.74	0.17	0.02	0.15	0.53
CR-9	41°54'	125°20'	70	11.9	32.87	0.55	0.12	3.88	2.19	0.28	1.91	0.17
CR-9	41°54'	125°20'	101	11.1	33.13	0.96	0.03	9.98	9.32	0.02	9.30	0.07
COC-2	38°39'	123°27'	2	12.1	32.68	0.59	0.06	6.71	2.74	0.07	2.67	4.11
COC-2	38°39'	123°27'	5	12.1	32.67	0.59	0.08	7.11	2.82	0.07	2.75	4.00
COC-2	38°39'	123°27'	15	11.7	33.05	0.89	0.04	7.58	7.57	0.23	7.34	1.19
COC-2	38°39'	123°27'	21	11.5	33.07	0.97	0.05	8.72	8.52	0.26	8.26	1.13
COC-2	38°39'	123°27'	31	11.4	33.18	1.12	0.07	10.59	10.74	0.27	10.46	0.78
COC-2	38°39'	123°27'	41	11.2	33.24	1.21	0.08	12.19	12.12	0.27	11.85	0.58
COC-2	38°39'	123°27'	71	10.1	33.61	1.77	0.07	22.21	19.08	0.09	18.99	0.58
COC-4	38°36'	123°31'	2	11.7	33.03	0.89	0.09	10.31	6.37	0.10	6.27	3.78
COC-4	38°36'	123°31'	5	11.7	33.03	0.90	0.02	9.42	6.32	0.06	6.26	3.78
COC-4	38°36'	123°31'	10	11.7	33.03	0.92	0.01	10.05	6.33	0.07	6.27	3.67
COC-4	38°36'	123°31'	25	11.6	33.10	1.03	0.05	11.27	8.45	0.12	8.32	2.92
COC-4	38°36'	123°31'	30	11.4	33.16	1.14	0.04	11.56	10.27	0.17	10.10	1.86
COC-4	38°36'	123°31'	40	11.1	33.27	1.31	0.04	14.39	13.48	0.29	13.19	0.75
COC-4	38°36'	123°31'	51	10.9	33.34	1.41	0.00	14.56	14.72	0.17	14.55	0.44
COC-4	38°36'	123°31'	61	10.5	33.48	1.61	0.00	17.38	17.77	0.05	17.72	0.23
COC-4	38°36'	123°31'	101	9.6	33.71	2.07	0.03	26.70	23.04	0.15	22.88	0.17

Appendix A: September 1997 - April 1998 data (continued)

Apr-98 Station	Lat	Long	[db] P	[°C] T	S	[µM] PO_4	[µM] NH_4	[µM] SiO_2	[µM] N+N	[µM] NO_2	[µM] NO_3	[µg/L] Chl a
COC-5	38°34'	123°33'	10	12.1	32.82	0.45	0.03	4.53	1.44	0.02	1.41	2.34
COC-5	38°34'	123°33'	20	12.1	32.82	0.73	0.07	6.50	2.77	0.10	2.67	2.39
COC-5	38°34'	123°33'	31	12.1	32.89	0.75	0.07	5.54	3.84	0.20	3.64	0.75
COC-5	38°34'	123°33'	41	11.6	33.20	1.16	0.06	10.46	9.42	0.17	9.26	0.26
COC-5	38°34'	123°33'	49	11.3	33.23	1.24	0.13	13.06	11.55	0.22	11.33	0.29
COC-5	38°34'	123°33'	70	10.1	33.56	1.70	0.08	21.25	19.30	0.04	19.26	0.25
COC-5	38°34'	123°33'	99	9.6	33.68	1.85	0.02	24.82	21.92	0.00	21.92	0.10
COC-5	38°34'	123°33'	125	9.0	33.82	1.55	0.00	19.85	15.67	0.02	15.65	0.14
COC-7	38°30'	123°39'	3	12.5	32.80	0.30	0.04	2.64	0.24	0.00	0.25	0.74
COC-7	38°30'	123°39'	10	12.5	32.80	0.29	0.06	2.51	0.33	0.00	0.33	0.76
COC-7	38°30'	123°39'	20	12.5	32.79	0.32	0.03	2.87	0.39	0.00	0.40	0.80
COC-7	38°30'	123°39'	30	12.5	32.79	0.34	0.03	2.44	0.47	0.00	0.48	0.74
COC-7	38°30'	123°39'	41	12.5	32.80	0.34	0.04	2.12	0.38	0.00	0.39	0.78
COC-7	38°30'	123°39'	51	12.5	32.81	0.74	0.06	6.84	6.28	0.00	6.31	0.74
COC-7	38°30'	123°39'	71	11.8	33.27	0.57	0.06	4.94	3.45	0.00	3.47	0.15
COC-7	38°30'	123°39'	98	10.0	33.55	1.58	0.06	19.24	19.41	0.00	19.41	0.03
COC-7	38°30'	123°39'	151	9.0	33.84	1.99	0.15	28.54	25.68	0.01	25.67	0.03
COC-9	38°24'	123°49'	3	12.6	32.82	0.41	0.00	2.81	0.06	0.02	0.05	0.50
COC-9	38°24'	123°49'	10	12.6	32.82	0.37	0.01	2.66	0.16	0.01	0.15	0.50
COC-9	38°24'	123°49'	19	12.6	32.82	0.38	0.20	3.15	0.09	0.00	0.11	0.50
COC-9	38°24'	123°49'	29	12.6	32.82	0.41	0.00	2.86	0.42	0.01	0.41	0.51
COC-9	38°24'	123°49'	39	12.6	32.82	0.38	0.00	3.10	0.39	0.01	0.38	0.50
COC-9	38°24'	123°49'	50	12.6	32.82	0.32	0.00	2.44	0.14	0.01	0.13	0.55
COC-9	38°24'	123°49'	70	12.0	33.07	0.71	0.02	5.99	5.32	0.00	5.40	0.21
COC-9	38°24'	123°49'	80	11.2	33.24	1.05	0.03	11.20	18.90	0.00	18.92	0.10
COC-9	38°24'	123°49'	101	10.1	33.54	1.47	0.04	18.86	17.98	0.00	17.98	0.04
COC-9	38°24'	123°49'	150	8.6	33.89	2.01	0.09	18.86	27.17	0.00	27.17	0.03
COC-11	38°17'	123°59'	3	12.6	32.81	0.73	0.00	2.77	0.35	0.02	0.34	0.40
COC-11	38°17'	123°59'	10	12.6	32.81	0.46	0.08	3.46	0.47	0.02	0.45	0.42
COC-11	38°17'	123°59'	19	12.6	32.81	0.36	0.06	2.23	0.00	0.02	0.00	0.41
COC-11	38°17'	123°59'	29	12.6	32.81	0.36	0.00	2.14	0.00	0.03	0.00	0.43
COC-11	38°17'	123°59'	41	12.6	32.81	0.32	0.01	2.57	0.06	0.02	0.04	0.41
COC-11	38°17'	123°59'	50	12.6	32.81	0.43	0.05	2.74	0.02	0.00	0.02	0.42
COC-11	38°17'	123°59'	60	12.6	32.81	0.37	0.00	2.36	0.14	0.00	0.13	0.40
COC-11	38°17'	123°59'	70	12.5	32.87	0.52	0.03	3.78	2.19	0.00	2.26	0.31
COC-11	38°17'	123°59'	99	10.1	33.35	1.27	0.00	14.55	14.47	0.00	14.46	0.05
COC-11	38°17'	123°59'	151	8.7	33.77	1.69	0.00	25.93	22.81	0.01	22.80	0.02

Appendix A: September 1997 - April 1998 data (continued)

Apr-98			[db]	[°C]		[µM]	[µM]	[µM]	[µM]	[µM]	[µM]	[µg/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-5	44°39'	124°10'	3	11.7	32.04	0.45	0.00	0.26	0.06	0.00	0.08	1.59
NH-5	44°39'	124°10'	4	11.7	32.04	0.49	0.00	2.12	0.08	0.00	0.09	1.63
NH-5	44°39'	124°10'	10	11.7	32.04	0.49	0.00	2.44	0.05	0.00	0.06	1.59
NH-5	44°39'	124°10'	16	11.7	32.11	0.50	0.00	1.61	0.06	0.00	0.07	1.16
NH-5	44°39'	124°10'	20	11.7	32.10	0.44	0.00	2.04	0.06	0.00	0.07	1.26
NH-5	44°39'	124°10'	25	11.7	32.13	0.48	0.00	2.11	0.16	0.01	0.15	1.19
NH-5	44°39'	124°10'	30	11.5	32.42	0.65	0.00	3.11	0.68	0.13	0.55	1.30
NH-5	44°39'	124°10'	41	11.1	32.63	0.99	0.06	6.92	4.09	0.22	3.88	0.51
NH-5	44°39'	124°10'	51	10.8	32.82	1.35	0.00	13.63	7.18	0.28	6.90	1.08
NH-5	44°39'	124°10'	54	10.8	32.85	1.52	0.00	17.42	9.12	0.25	8.87	1.52
NH-15	44°39'	124°24'	2	11.6	31.49	0.37	0.00	1.56	0.02	0.00	0.03	0.99
NH-15	44°39'	124°24'	4	11.6	31.53	0.36	0.00	1.60	0.03	0.00	0.04	1.01
NH-15	44°39'	124°24'	10	11.6	31.55	0.35	0.00	1.42	0.04	0.00	0.06	1.03
NH-15	44°39'	124°24'	19	11.6	31.94	0.39	0.00	1.05	0.02	0.00	0.02	1.16
NH-15	44°39'	124°24'	31	11.0	32.46	0.55	0.00	2.63	0.91	0.05	0.87	1.45
NH-15	44°39'	124°24'	32	10.9	32.57	0.98	0.00	8.00	4.58	0.19	4.39	1.52
NH-15	44°39'	124°24'	39	10.7	32.72	1.24	0.00	10.87	7.09	0.14	6.95	0.85
NH-15	44°39'	124°24'	50	10.1	33.00	1.65	0.00	16.61	12.04	0.11	11.94	0.47
NH-15	44°39'	124°24'	60	10.0	33.02	1.72	0.00	17.22	12.35	0.15	12.20	0.36
NH-15	44°39'	124°24'	69	9.9	33.05	1.74	0.00	17.30	13.26	0.12	13.14	0.31

Appendix B: August 1998 - July 1999 data

Aug-98			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-5	44°39'	124°10'	2	10.61	33.22	1.07	0.62	10.75	5.91	0.11	5.81	13.64
NH-5	44°39'	124°10'	5	10.39	33.23	1.32	0.77	12.16	7.78	0.14	7.64	13.71
NH-5	44°39'	124°10'	10	10.00	33.26	1.45	1.15	15.23	11.63	0.14	11.49	9.44
NH-5	44°39'	124°10'	14	9.19	33.35	1.89	0.88	24.56	18.74	0.12	18.62	4.70
NH-5	44°39'	124°10'	20	8.66	33.40	2.05	0.83	29.61	23.03	0.02	23.02	1.59
NH-5	44°39'	124°10'	24	8.28	33.57	2.20	0.30	35.54	26.34	0.07	26.27	0.58
NH-5	44°39'	124°10'	30	8.01	33.70	2.32	0.00	42.57	28.91	0.06	28.85	0.56
NH-5	44°39'	124°10'	40	7.81	33.81	2.60	0.05	54.54	30.48	0.14	30.34	1.60
NH-5	44°39'	124°10'	52	7.80	33.81	2.63	0.21	56.61	30.28	0.17	30.11	3.10
NH-15	44°39'	124°24'	2	11.92	32.45	0.60	0.52	5.93	1.82	0.00	1.88	9.90
NH-15	44°39'	124°24'	4	11.82	32.48	0.60	0.36	7.02	2.31	0.00	2.39	10.94
NH-15	44°39'	124°24'	10	11.40	32.59	0.63	0.36	7.45	2.80	0.00	2.88	10.87
NH-15	44°39'	124°24'	19	9.64	32.54	1.11	0.25	16.22	9.61	0.03	9.57	1.74
NH-15	44°39'	124°24'	29	8.91	32.79	1.36	0.07	17.64	13.95	0.00	14.02	0.63
NH-15	44°39'	124°24'	49	8.93	33.32	1.84	0.09	30.70	20.66	0.06	20.60	0.37
NH-15	44°39'	124°24'	59	8.51	33.58	1.97	0.08	31.12	25.39	0.00	25.39	0.05
NH-15	44°39'	124°24'	70	8.40	33.66	2.09	0.24	33.86	26.87	0.00	26.87	0.04
NH-15	44°39'	124°24'	85			2.46	0.43	50.55	30.52	0.10	30.42	0.10
NH-25	44°39'	124°39'	2	14.55	31.80		0.13	0.00	1.96	0.10	1.87	0.45
NH-25	44°39'	124°39'	12	12.33	32.21	0.43	0.20	1.25	1.97	0.10	1.86	0.56
NH-25	44°39'	124°39'	22	10.36	32.52	0.50	0.00	1.02	2.57	0.22	2.35	1.30
NH-25	44°39'	124°39'	27	10.03	32.55	0.62	0.00	2.44	3.87	0.28	3.59	0.98
NH-25	44°39'	124°39'	32	9.85	32.56	0.73	0.04	3.20	5.66	0.18	5.49	0.59
NH-25	44°39'	124°39'	42	9.32	32.63	0.98	0.43	6.93	8.75	0.15	8.61	0.20
NH-25	44°39'	124°39'	52	9.08	32.83	1.15	0.12	10.66	11.74	0.13	11.61	0.17
NH-25	44°39'	124°39'	72	8.64	33.35	1.82	0.44	25.29	21.99	0.13	21.87	0.11
NH-25	44°39'	124°39'	102	8.11	33.69	2.29	0.49	37.94	28.27	0.11	28.16	0.12
NH-25	44°39'	124°39'	202	7.43	33.94	2.41		47.72	31.61		31.25	0.06
NH-35	44°39'	124°53'	2	15.30	31.58	0.17	0.09	0.00	0.41	0.00	0.41	0.50
NH-35	44°39'	124°53'	10	15.27	31.58	0.20	0.15	0.03	0.44	0.00	0.44	0.47
NH-35	44°39'	124°53'	20	11.61	32.33	0.46	0.12	1.40	0.00	0.00	0.00	0.67
NH-35	44°39'	124°53'	25	10.61	32.48	0.51	0.12	2.45	0.00	0.00	0.00	2.02
NH-35	44°39'	124°53'	30	10.38	32.51	0.59	0.11	2.52	1.38	0.20	1.18	1.98
NH-35	44°39'	124°53'	41	9.84	32.55	0.71	0.14	3.90	3.82	0.04	3.77	0.66
NH-35	44°39'	124°53'	51	9.50	32.60	0.85	0.14	5.93	6.06	0.00	6.06	0.07
NH-35	44°39'	124°53'	70	9.41	33.01	1.29	0.05	13.88	13.42	0.00	13.42	0.13
NH-35	44°39'	124°53'	100	8.48	33.46	1.96	0.12	30.03	23.86	0.00	23.86	0.06
NH-35	44°39'	124°53'	150	7.90	33.89	2.34	0.19	35.35	30.83	0.00	30.83	0.06
NH-35	44°39'	124°53'	234	7.18	33.97	2.40		49.63	31.20		30.86	0.07
NH-35	44°39'	124°53'	410	5.99	34.02	2.70		65.07	36.17		35.83	0.04

Appendix B: August 1998 - July 1999 data (continued)

Aug-98			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-45	44°39'	125°07'	1			0.08	0.09	3.01	0.23	0.00	0.23	0.73
NH-45	44°39'	125°07'	20	11.35	32.36	0.44	0.13	3.04	0.25	0.00	0.25	0.95
NH-45	44°39'	125°07'	25	10.60	32.50	0.47	0.10	3.08	1.32	0.05	1.27	1.18
NH-45	44°39'	125°07'	30	10.30	32.54	0.52	0.14	2.78	1.34	0.12	1.22	1.30
NH-45	44°39'	125°07'	41	9.71	32.57	0.74	0.09	4.79	5.11	0.03	5.08	0.83
NH-45	44°39'	125°07'	50	9.45	32.63	0.87	0.14	6.81	2.43	0.00	2.43	0.39
NH-45	44°39'	125°07'	100	8.17	33.77	2.20	0.15	35.92	28.48	0.00	28.48	0.05
NH-45	44°39'	125°07'	151	7.55	33.92	2.42	0.09	43.55	31.48	0.00	31.48	0.04
NH-45	44°39'	125°07'	500	5.66	34.06	2.84		72.22	37.25		36.91	0.02
NH-45	44°39'	125°07'	680	4.62	34.21	3.06		94.10	41.02		40.68	0.01
NH-65	44°39'	125°36'	2	16.77	30.77	0.10	0.31	1.27	0.00	0.00	0.00	0.29
NH-65	44°39'	125°36'	10	16.64	30.84	0.04	0.09	3.64	0.00	0.00	0.00	0.29
NH-65	44°39'	125°36'	20			0.30	0.08	0.09	0.00	0.00	0.00	0.36
NH-65	44°39'	125°36'	30	11.02	32.61	0.42	0.24	1.14	0.13	0.00	0.13	0.50
NH-65	44°39'	125°36'	40	10.56	32.59	0.58	0.14	1.86	2.09	0.08	2.00	0.71
NH-65	44°39'	125°36'	45	10.29	32.58	0.64	0.14	2.26	3.27	0.09	3.18	0.82
NH-65	44°39'	125°36'	50	9.80	32.57	0.70	0.13	3.31	4.65	0.06	4.59	0.74
NH-65	44°39'	125°36'	70	9.44	32.75	1.04	0.10	8.95	10.56	0.13	10.42	0.47
NH-65	44°39'	125°36'	100	8.97	33.44	1.77	0.10	23.14	22.45	0.00	22.45	0.03
NH-65	44°39'	125°36'	150	8.08	33.81	2.10	0.05	34.04	29.13	0.00	29.13	0.02
NH-65	44°39'	125°36'	1005	3.47	34.42	3.20		129.46	42.48		42.16	0.01
NH-85	44°39'	126°03'	2	17.57	31.46	0.04	0.13	2.37	0.00	0.00	0.00	0.21
NH-85	44°39'	126°03'	20	15.57	31.83	0.11	0.19	5.64	0.00	0.00	0.00	0.27
NH-85	44°39'	126°03'	30	11.59	32.53	0.34	0.08	1.36	0.00	0.00	0.00	0.37
NH-85	44°39'	126°03'	40	10.85	32.57	0.39	0.12	1.68	0.00	0.00	0.00	0.47
NH-85	44°39'	126°03'	50	10.42	32.59	0.53	0.14	4.62	2.20	0.09	2.11	0.49
NH-85	44°39'	126°03'	60	10.01	32.58	0.63	0.08	4.28	3.93	0.00	3.93	0.34
NH-85	44°39'	126°03'	70	9.85	32.69	0.79	0.08	5.91	6.82	0.00	6.82	0.21
NH-85	44°39'	126°03'	100	9.35	33.15	1.84	0.08	27.89	24.27	0.00	24.27	0.19
NH-85	44°39'	126°03'	150	8.12	33.78	2.00	0.05	31.16	27.93	0.00	27.93	0.09
NH-85	44°39'	126°03'	1005	3.54	34.41	3.22		126.54	42.33		42.01	0.00
FM-3	43°13'	124°30'	2	10.09	33.55	1.25	0.33	17.13	11.94	0.28	11.66	14.05
FM-3	43°13'	124°30'	5	9.77	33.55	1.28	0.41	17.37	12.46	0.26	12.20	13.05
FM-3	43°13'	124°30'	10	9.65	33.54	1.35	0.35	17.61	13.57	0.25	13.32	15.57
FM-3	43°13'	124°30'	15	9.51	33.54	1.47	0.42	19.50	15.08	0.34	14.74	13.84
FM-3	43°13'	124°30'	20	9.05	33.60	1.85	0.77	26.67	21.52	0.34	21.18	8.39
FM-3	43°13'	124°30'	25	8.65	33.73	2.19	0.91	34.16	27.17	0.27	26.90	0.95
FM-3	43°13'	124°30'	30	8.59	33.77	2.19	0.86	35.06	27.49	0.25	27.25	0.93
FM-3	43°13'	124°30'	41	8.52	33.82	2.24	0.77	38.27	28.31	0.19	28.11	0.52
FM-3	43°13'	124°30'	50	8.52	33.82	2.25	0.75	39.17	28.53	0.15	28.38	0.42
FM-3	43°13'	124°30'	61	8.52	33.82	2.29	0.75	39.08	28.45	0.18	28.27	0.44

Appendix B: August 1998 - July 1999 data (continued)

Aug-98			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
FM-4	43°13'	124°35'	2	10.58	33.35	0.82	0.61	6.61	5.96	0.15	5.80	10.15
FM-4	43°13'	124°35'	5	10.58	33.35	0.85	0.61	6.98	6.26	0.17	6.09	10.27
FM-4	43°13'	124°35'	8	10.24	33.37	1.04	1.01	9.32	8.30	0.18	8.11	9.43
FM-4	43°13'	124°35'	10	10.20	33.38	1.11	1.13	10.02	9.18	0.20	8.98	9.05
FM-4	43°13'	124°35'	20	9.58	33.48	1.68	1.68	19.96	17.59	0.29	17.30	2.05
FM-4	43°13'	124°35'	30	9.05	33.61	2.05	1.85	59.32	22.62	0.34	22.28	0.48
FM-4	43°13'	124°35'	41	9.08	33.68	2.09	2.01	60.01	23.31	0.30	23.01	0.38
FM-4	43°13'	124°35'	50	8.63	33.79	2.10	0.97	65.99	25.25	0.25	25.00	0.26
FM-4	43°13'	124°35'	60	8.45	33.84	2.23	0.46	40.25	27.19	0.28	26.91	1.08
FM-4	43°13'	124°35'	70	8.40	33.85	2.39	0.34	39.95	29.62	0.29	29.33	0.17
FM-4	43°13'	124°35'	77	8.40	33.85	2.37	0.36	40.32	29.44	0.29	29.15	0.18
FM-5	43°13'	124°40'	2	11.49	33.22	0.40	1.29	0.00	1.61	0.00	1.63	0.79
FM-5	43°13'	124°40'	15	11.40	33.22	0.43	1.30	0.00	1.74	0.00	1.74	0.78
FM-5	43°13'	124°40'	20			0.56	1.40	3.42	3.24	0.00	3.25	0.77
FM-5	43°13'	124°40'	10	10.71	33.25	0.94	1.78	9.60	7.41	0.08	7.34	0.59
FM-5	43°13'	124°40'	30	9.65	33.41	1.46	1.09	18.08	15.14	0.20	14.94	0.59
FM-5	43°13'	124°40'	40	8.86	33.60	1.71	1.03	22.28	20.01	0.20	19.81	0.42
FM-5	43°13'	124°40'	50	8.76	33.72	2.02	0.76	29.12	25.56	0.23	25.33	0.19
FM-5	43°13'	124°40'	60	8.70	33.77	2.11	0.76	32.32	26.97	0.23	26.74	0.11
FM-5	43°13'	124°40'	70	8.59	33.81	2.24	0.20	36.52	29.36	0.19	29.18	0.10
FM-5	43°13'	124°40'	100	8.36	33.87	2.34	0.09	40.06	30.67	0.15	30.52	0.13
FM-5	43°13'	124°40'	147	8.07	33.93	2.15	0.26	39.64	26.35	0.09	26.26	0.11
FM-7	43°13'	124°50'	3	12.06	33.00	0.35	0.34	0.00	2.65	0.14	2.51	1.51
FM-7	43°13'	124°50'	10	12.00	33.01	0.38	0.52	0.00	2.85	0.14	2.71	1.51
FM-7	43°13'	124°50'	15	11.64	33.06	0.46	0.79	0.00	3.34	0.15	3.19	1.74
FM-7	43°13'	124°50'	20	10.98	32.98	0.65	0.60	2.28	4.84	0.18	4.65	1.00
FM-7	43°13'	124°50'	30	9.24	33.04	1.35	0.25	14.16	15.38	0.31	15.08	0.74
FM-7	43°13'	124°50'	40	9.15	33.39	1.60	0.00	19.45	20.76	0.18	20.58	0.16
FM-7	43°13'	124°50'	70	8.88	33.71	1.71	0.00	22.09	22.55	0.18	22.37	0.08
FM-7	43°13'	124°50'	70	8.88	33.71	2.00	0.51	27.70	25.13	0.32	24.81	0.07
FM-7	43°13'	124°50'	100	8.56	33.83	2.13	0.06	31.34	28.42	0.36	28.06	0.07
FM-7	43°13'	124°50'	151	7.99	33.98	2.31	0.00	37.94	30.81	0.23	30.58	0.06
FM-7	43°13'	124°50'	249	7.62	34.01	2.44		47.99	30.67		30.25	0.04
FM-8	43°13'	125°00'	2	12.28	32.85	0.36	0.34	0.00	7.10	0.00	7.10	0.91
FM-8	43°13'	125°00'	10	12.16	32.84	0.39	0.30	0.00	7.19	0.00	7.19	0.97
FM-8	43°13'	125°00'	20	11.94	33.03	0.53	0.53	2.09	9.12	0.03	9.10	1.37
FM-8	43°13'	125°00'	25	10.73	32.88	0.68	0.63	8.11	13.08	0.06	13.02	0.87
FM-8	43°13'	125°00'	30	9.67	32.81	0.90	0.48	4.55	15.97	0.11	15.86	0.84
FM-8	43°13'	125°00'	40	9.30	33.12	1.35	0.19	15.53	24.07	0.09	23.98	0.62
FM-8	43°13'	125°00'	70	9.09	33.64	1.48	0.23	17.26	26.97	0.04	26.93	0.34
FM-8	43°13'	125°00'	71	9.09	33.64	1.88	0.87	26.25	31.88	0.26	31.62	0.23
FM-8	43°13'	125°00'	100	8.75	33.74	2.02	0.53	29.96	35.84	0.27	35.57	0.07
FM-8	43°13'	125°00'	150	8.24	33.94	2.28	0.11	36.65	29.86	0.12	29.74	0.09
FM-8	43°13'	125°00'	1005	3.66	34.41	3.22		122.66	41.69		41.36	0.01

Appendix B: August 1998 - July 1999 data (continued)

Aug-98			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
FM-9	43°13'	125°10'	2	12.53	33.00	0.42	0.40	1.19	6.91	0.00	6.91	0.93
FM-9	43°13'	125°10'	10	12.47	33.01	0.44	0.48	1.26	7.10	0.00	7.10	0.99
FM-9	43°13'	125°10'	20	12.39	33.03	0.82	0.73	5.63	11.44	0.08	11.36	0.74
FM-9	43°13'	125°10'	30	11.69	33.22	1.32	1.19	5.38	11.53	0.08	11.46	1.20
FM-9	43°13'	125°10'	40	10.98	33.30	0.96	0.97	6.44	13.85	0.12	13.73	1.57
FM-9	43°13'	125°10'	51	9.89	33.25	1.31	0.85	13.13	19.15	0.23	18.93	0.87
FM-9	43°13'	125°10'	70	9.29	33.46	1.70	0.39	21.79	26.29	0.28	26.01	0.22
FM-9	43°13'	125°10'	85	8.87	33.60	1.91	0.40	25.83	29.86	0.14	29.72	0.14
FM-9	43°13'	125°10'	100	8.63	33.65	2.07	0.16	30.20	32.56	0.02	32.54	0.07
FM-9	43°13'	125°10'	151	8.07	33.91	2.20	0.14	35.57	35.07	0.00	35.07	0.04
FM-9	43°13'	125°10'	1005	3.60	34.42	3.20		125.32	41.96		41.63	0.01
CR-1	41°54'	124°18'	2	11.67	33.42	1.12	0.41	17.78	5.95	0.23	5.72	2.20
CR-1	41°54'	124°18'	5	11.33	33.42	1.17	0.42	17.81	6.87	0.23	6.64	2.42
CR-1	41°54'	124°18'	10	10.46	33.46	1.36	0.31	19.81	14.48	0.25	14.23	2.42
CR-1	41°54'	124°18'	15	9.99	33.49	1.53	0.31	22.14	16.96	0.27	16.68	2.19
CR-1	41°54'	124°18'	20	9.91	33.51	1.57	0.35	22.50	18.06	0.30	17.75	1.93
CR-1	41°54'	124°18'	26	9.69	33.58	1.62	0.44	23.19	18.42	0.33	18.10	1.61
CR-1	41°54'	124°18'	36	9.29	33.69	1.97	0.75	31.75	23.01	0.44	22.57	0.52
CR-3	41°54'	124°30'	2	12.37	32.74	0.49	0.30	1.61	1.77	0.09	1.68	0.44
CR-3	41°54'	124°30'	5	12.33	32.74	0.51	0.33	1.94	2.39	0.09	2.30	0.61
CR-3	41°54'	124°30'	17	11.25	32.80	0.69	0.40	3.91	4.94	0.15	4.79	0.72
CR-3	41°54'	124°30'	20	10.48	32.90	0.91	0.09	7.51	8.87	0.18	8.69	0.70
CR-3	41°54'	124°30'	30	9.97	33.11	1.19	0.09	12.76	12.79	0.12	12.67	0.34
CR-3	41°54'	124°30'	40	9.70	33.24	1.35	0.22	15.38	15.25	0.06	15.19	0.17
CR-3	41°54'	124°30'	50	9.45	33.41	0.94	0.58	18.34	17.71	0.10	17.61	0.09
CR-3	41°54'	124°30'	61	9.31	33.52	1.53	0.19	20.96	18.06	0.09	17.96	0.08
CR-3	41°54'	124°30'	70	9.07	33.62	1.68	1.15	24.93	20.62	0.06	20.56	0.04
CR-3	41°54'	124°30'	100	8.61	33.87	2.10	0.10	33.16	26.58	0.06	26.53	0.04
CR-4	41°54'	124°36'	1	12.87	32.69	0.40	0.11	2.04	0.76	0.04	0.72	0.58
CR-4	41°54'	124°36'	10	12.38	32.71	0.45	0.14	2.40	1.66	0.08	1.58	0.63
CR-4	41°54'	124°36'	20	12.24	32.72	0.46	0.29	2.43	1.82	0.08	1.74	0.66
CR-4	41°54'	124°36'	25	12.21	32.72	0.50	0.30	2.13	1.62	0.09	1.53	0.62
CR-4	41°54'	124°36'	30	11.50	32.87	0.69	0.54	3.48	4.36	0.14	4.21	0.75
CR-4	41°54'	124°36'	40	10.25	32.86	0.89	0.64	6.46	7.55	0.22	7.33	0.49
CR-4	41°54'	124°36'	50	9.82	33.12	1.23	0.13	13.38	14.04	0.13	13.91	0.23
CR-4	41°54'	124°36'	70	9.23	33.44	1.59	0.01	21.29	20.53	0.01	20.53	0.06
CR-4	41°54'	124°36'	101	8.87	33.72	1.92	0.02	28.50	25.65	0.02	25.63	0.04
CR-4	41°54'	124°36'	150	8.17	33.91	2.11	0.00	35.39	29.39	0.00	29.39	0.03
CR-4	41°54'	124°36'	460	5.72	34.11	2.93		76.15	36.32		35.96	0.03

Appendix B: August 1998 - July 1999 data (continued)

Aug-98			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
CR-5	41°54'	124°42'	3	13.59	32.64	0.31	0.66	5.77	0.00	0.08	0.00	0.46
CR-5	41°54'	124°42'	10	13.58	32.64	0.32	0.64	5.63	0.00	0.08	0.00	0.45
CR-5	41°54'	124°42'	20	13.13	32.67	0.35	0.78	5.50	0.00	0.09	0.00	0.46
CR-5	41°54'	124°42'	30	13.15	32.82	0.55	0.82	6.31	2.15	0.17	1.99	0.57
CR-5	41°54'	124°42'	40	11.48	33.23	1.02	1.10	13.07	9.31	0.27	9.04	0.68
CR-5	41°54'	124°42'	47	10.57	33.29	1.28	1.16	17.27	12.63	0.37	12.26	0.66
CR-5	41°54'	124°42'	50	10.41	33.29	1.36	1.21	17.67	13.76	0.45	13.31	0.65
CR-5	41°54'	124°42'	70	9.66	33.43	1.59	0.92	22.68	18.49	0.42	18.07	0.20
CR-5	41°54'	124°42'	101	8.69	33.71	2.00	0.34	30.66	25.31	0.24	25.07	0.08
CR-5	41°54'	124°42'	150	7.90	33.89	2.27	0.36	38.92	29.54	0.09	29.45	0.03
CR-5	41°54'	124°42'	510	5.28	34.15	3.01		83.95	38.05		37.73	0.02
CR-7	41°54'	125°00'	2	13.69	32.80	0.69	0.76	13.28	3.60	0.22	3.39	1.10
CR-7	41°54'	125°00'	10	13.69	32.80	0.68	0.74	13.11	3.62	0.22	3.40	1.30
CR-7	41°54'	125°00'	20	13.68	32.80	0.70	0.70	12.94	3.67	0.21	3.46	1.09
CR-7	41°54'	125°00'	30	12.71	32.78	0.80	0.80	14.03	4.68	0.25	4.43	1.10
CR-7	41°54'	125°00'	40	10.94	33.27	1.15	1.25	18.85	9.85	0.36	9.49	2.43
CR-7	41°54'	125°00'	50	9.71	33.26	1.52	1.09	26.31	16.66	0.44	16.22	0.67
CR-7	41°54'	125°00'	70	9.24	33.59	1.79	0.90	32.93	22.40	0.39	22.01	0.29
CR-7	41°54'	125°00'	100	8.58	33.76	2.00	0.68	39.56	26.92	0.21	26.71	0.05
CR-7	41°54'	125°00'	150	8.08	33.90	2.11	0.65	44.10	29.31	0.20	29.10	0.05
CR-7	41°54'	125°00'	781	4.16	34.34	3.21		107.81	40.87		40.55	0.02
CR-9	41°54'	125°20'	3	13.46	32.83	0.65	0.70	11.17	3.02	0.25	2.78	1.11
CR-9	41°54'	125°20'	10	13.17	32.83	0.70	0.76	11.07	2.99	0.24	2.75	1.42
CR-9	41°54'	125°20'	20	11.98	32.77	0.66	0.74	15.00	2.76	0.23	2.53	1.13
CR-9	41°54'	125°20'	30	10.90	32.67	0.75	0.77	12.13	3.99	0.27	3.72	0.91
CR-9	41°54'	125°20'	40	10.40	32.63	0.83	0.75	12.72	5.37	0.29	5.07	0.98
CR-9	41°54'	125°20'	51	9.86	32.65	0.95	0.68	14.84	7.66	0.36	7.30	0.69
CR-9	41°54'	125°20'	71	9.90	33.09	1.25	0.69	20.57	14.12	0.22	13.90	0.15
CR-9	41°54'	125°20'	99	9.19	33.47	1.64	0.70	29.34	21.38	0.22	21.15	0.06
CR-9	41°54'	125°20'	150	8.06	33.89	2.07	0.68	43.80	28.86	0.21	28.66	0.03
CR-9	41°54'	125°20'	750	4.19	34.30	3.21		107.04	41.07		40.76	0.02
CR-9	41°54'	125°20'	1005	3.55	34.44	3.21		123.92	41.45		41.08	0.04
EU-1	40°52'	124°16'	1	12.92	33.32	0.51	0.10	1.29	3.44	0.23	3.21	6.03
EU-1	40°52'	124°16'	5	12.89	33.34	0.53	0.14	1.62	3.34	0.21	3.13	6.45
EU-1	40°52'	124°16'	10	12.14	33.47	0.77	0.18	7.23	6.23	0.27	5.95	5.79
EU-1	40°52'	124°16'	15	11.33	33.51	1.11	0.44	11.52	11.30	0.33	10.98	5.38
EU-1	40°52'	124°16'	20	10.98	33.53	1.22	0.50	12.84	13.09	0.36	12.74	4.24
EU-1	40°52'	124°16'	25	11.05	33.53	1.18	0.43	12.51	12.50	0.35	12.15	4.81
EU-1	40°52'	124°16'	30	10.87	33.55	1.28	0.54	13.83	13.99	0.38	13.62	3.68
EU-1	40°52'	124°16'	41	10.10	33.62	1.58	0.88	19.78	19.06	0.50	18.57	0.97
EU-1	40°52'	124°16'	51	9.12	33.79	1.99	0.00	27.37	25.13	0.51	24.62	0.43
EU-1	40°52'	124°16'	55	8.89	33.85	2.17	0.19	31.43	26.93	0.34	26.59	0.39

Appendix B: August 1998 - July 1999 data (continued)

Aug-98			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
EU-2	40°52'	124°22'	2	12.04	33.07	0.70	0.11	8.23	5.73	0.21	5.52	0.79
EU-2	40°52"	124°22'	5	11.78	33.10	0.76	0.14	9.25	7.00	0.24	6.76	0.82
EU-2	40°52'	124°22'	10	11.35	33.15	0.88	0.36	10.60	9.27	0.30	8.97	1.34
EU-2	40°52'	124°22'	21	10.33	33.24	1.10	0.21	13.91	13.01	0.31	12.71	1.18
EU-2	40°52'	124°22'	25	10.29	33.24	1.12	0.17	13.94	13.54	0.30	13.24	1.03
EU-2	40°52'	124°22'	31	9.98	33.36	1.30	0.23	17.25	16.28	0.38	15.89	0.59
EU-2	40°52"	124°22'	40	9.47	33.64	1.65	0.00	23.85	23.23	0.10	23.13	0.15
EU-2	40°52'	124°22'	50	9.08	33.78	1.80	0.00	27.16	24.59	0.08	24.50	0.08
EU-2	40°52'	124°22'	60	9.00	33.80	1.84	0.00	29.82	26.03	0.08	25.95	0.07
EU-2	40°52'	124°22'	71	8.95	33.81	1.84	0.00	29.85	26.20	0.09	26.11	0.09
EU-2	40°52'	124°22'	105	8.62	33.88	1.96	0.00	33.16	28.11	0.10	28.01	0.09
EU-3	40°52'	124°28'	1	11.74	33.09	0.74	0.19	7.24	7.65	0.25	7.40	1.30
EU-3	40°52'	124°28'	10	11.26	33.16	0.83	0.09	7.58	8.71	0.30	8.41	1.45
EU-3	40°52'	124°28'	19	10.90	33.24	0.99	0.00	10.64	11.53	0.40	11.13	1.78
EU-3	40°52'	124°28'	24	10.82	33.27	1.02	0.15	12.34	12.12	0.41	11.71	1.71
EU-3	40°52'	124°28'	30	10.80	33.31	1.07	0.21	13.36	12.35	0.42	11.92	1.58
EU-3	40°52'	124°28'	40	10.65	33.42	1.19	0.37	14.04	13.96	0.46	13.50	1.47
EU-3	40°52'	124°28'	49	10.30	33.52	1.37	0.31	17.09	16.97	0.44	16.53	1.05
EU-3	40°52'	124°28'	70	9.32	33.69	1.72	0.00	24.22	23.04	0.09	22.95	0.12
EU-3	40°52'	124°28'	101	9.04	33.85	2.01	0.03	34.07	26.97	0.06	26.91	0.13
EU-3	40°52'	124°28'	149	8.63	33.95	2.16	0.01	33.73	28.77	0.07	28.70	0.11
EU-3	40°52'	124°28'	325	6.39	34.07	2.74		63.99	33.47		33.11	0.04
EU-3	40°52'	124°28'	350	6.20	34.08	2.71		67.44	34.36		34.00	0.04
EU-5	40°52'	124°40'	2	13.59	32.91	0.51	0.09	4.53	4.40	0.15	4.25	0.72
EU-5	40°52'	124°40'	10	12.76	32.92	0.55	0.09	4.77	4.81	0.19	4.62	1.00
EU-5	40°52'	124°40'	20	11.60	33.21	0.85	0.08	11.46	9.95	0.32	9.63	1.52
EU-5	40°52'	124°40'	31	10.27	33.48	1.27	0.07	18.48	16.76	0.43	16.33	1.83
EU-5	40°52'	124°40'	41	9.84	33.63	1.49	0.04	21.44	20.33	0.28	20.05	1.01
EU-5	40°52'	124°40'	51	9.55	33.71	1.66	0.00	24.73	22.59	0.11	22.49	0.22
EU-5	40°52'	124°40'	70	9.12	33.79	1.80	0.02	28.37	25.23	0.05	25.17	0.11
EU-5	40°52'	124°40'	100	8.93	33.88	2.01	0.00	33.02	27.86	0.02	27.84	0.12
EU-5	40°52'	124°40'	150	8.74	33.93	2.09	0.03	34.62	29.01	0.02	28.99	0.12
EU-5	40°52'	124°40'	711	4.54	34.28	3.12			43.90		43.87	0.06
EU-7	40°52'	124°56'	3	13.31	32.69	0.17	0.00	0.11	0.00	0.04	0.00	0.36
EU-7	40°52'	124°56'	10	13.31	32.69	0.17	0.16	0.00	0.00	0.04	0.00	0.39
EU-7	40°52'	124°56'	21	12.00	32.77	0.31	0.00	1.13	0.87	0.08	0.79	0.99
EU-7	40°52'	124°56'				0.38	0.04	1.47	1.64	0.09	1.54	0.94
EU-7	40°52'	124°56'	30	11.20	32.81	0.53	0.00	3.17	4.07	0.09	3.97	0.68
EU-7	40°52'	124°56'	41	10.92	32.84	0.61	0.00	4.19	5.20	0.09	5.11	0.70
EU-7	40°52'	124°56'	50	10.62	32.91	0.67	0.02	5.21	7.26	0.07	7.19	0.33
EU-7	40°52'	124°56'	71	9.93	33.18	1.07	0.00	11.66	13.31	0.03	13.29	0.19
EU-7	40°52'	124°56'	101	9.11	33.64	1.51	0.00	21.85	21.22	0.03	21.19	0.04
EU-7	40°52'	124°56'	149	8.74	33.91	1.85	0.01	31.36	26.81	0.01	26.80	0.06
EU-7	40°52'	124°56'	316	6.51	34.04	2.48		58.86	35.36		35.36	0.03
EU-7	40°52'	124°56'	1004	3.65	34.42	3.12			44.29		44.31	0.01

Appendix B: August 1998 - July 1999 data (continued)

Aug-98 Station	Lat	Long	[db] P	[°C] T	S	[uM] PO_4	[uM] NH_4	[uM] SiO_2	[uM] N+N	[uM] NO_2	[uM] NO_3	[ug/L] Chl a
COC-2	38°38'	123°26'	3	10.68	33.64	1.77	1.46	34.35	21.04	0.52	20.52	0.58
COC-2	38°38'	123°26'	5	10.91	33.63	1.83	1.55	34.20	20.89	0.52	20.37	0.47
COC-2	38°38'	123°26'	10	10.81	33.64	1.85	1.41	34.18	20.93	0.53	20.41	0.54
COC-2	38°38'	123°26'	15	10.45	33.67	1.95	1.21	36.38	22.01	0.51	21.50	0.49
COC-2	38°38'	123°26'	30	10.24	33.69	1.89	1.02	34.42	22.85	0.53	22.32	0.35
COC-2	38°38'	123°26'	40	9.99	33.72	2.03	1.03	40.08	24.80	0.56	24.24	0.32
COC-2	38°38'	123°26'	50	9.91	33.75	2.06	0.86	40.48	25.38	0.53	24.85	0.25
COC-2	38°38'	123°26'	60	9.82	33.77	2.04	0.70	42.12	25.95	0.38	25.57	0.24
COC-2	38°38'	123°26'	72	9.79	33.77	2.06	0.90	43.21	26.11	0.35	25.76	0.33
COC-4	38°36'	123°30'	2	10.87	33.67	1.88	1.30	34.54	22.13	0.48	21.65	0.36
COC-4	38°36'	123°30'	11	10.69	33.68	1.92	1.27	34.69	22.29	0.48	21.80	0.34
COC-4	38°36'	123°30'	20	10.34	33.69	1.92	1.12	35.40	23.24	0.44	22.80	0.32
COC-4	38°36'	123°30'	29	9.99	33.73	1.98	0.96	36.10	24.43	0.39	24.04	0.28
COC-4	38°36'	123°30'	39	9.72	33.78	2.01	0.67	37.78	25.58	0.33	25.25	0.15
COC-4	38°36'	123°30'	50	9.66	33.80	2.03	0.65	38.63	25.84	0.31	25.54	0.15
COC-4	38°36'	123°30'	59	9.57	33.82	2.05	0.63	40.03	26.11	0.21	25.90	0.18
COC-4	38°36'	123°30'	70	9.51	33.84	2.08	0.62	40.32	26.42	0.19	26.23	0.14
COC-4	38°36'	123°30'	90	9.40	33.87	2.12	0.69	43.38	26.88	0.19	26.69	0.13
COC-4	38°36'	123°30'	101	9.35	33.88	2.11	0.67	43.70	26.96	0.20	26.76	0.14
COC-5	38°34'	123°33'	1	10.55	33.72	2.06	1.51	40.61	24.43	0.46	23.97	0.21
COC-5	38°34'	123°33'	10	10.53	33.72	2.04	1.48	40.57	24.40	0.47	23.94	0.21
COC-5	38°34'	123°33'	20	10.28	33.72	2.06	1.40	41.36	24.76	0.50	24.26	0.31
COC-5	38°34'	123°33'	30	10.15	33.73	2.08	1.38	40.21	24.72	0.53	24.20	0.47
COC-5	38°34'	123°33'	35	10.10	33.73	2.05	1.25	41.41	25.08	0.51	24.57	0.36
COC-5	38°34'	123°33'	40	9.94	33.75	2.07	1.11	41.23	25.50	0.42	25.09	0.26
COC-5	38°34'	123°33'	50	9.57	33.83	2.03	0.73	41.05	26.27	0.25	26.02	0.14
COC-5	38°34'	123°33'	70	9.37	33.88	2.11	0.69	44.48	27.28	0.20	27.08	0.15
COC-5	38°34'	123°33'	85	9.33	33.89	2.12	0.69	44.99	27.55	0.20	27.35	0.13
COC-5	38°34'	123°33'	100	9.32	33.89	2.15	0.74	45.78	27.67	0.21	27.47	0.13
COC-5	38°34'	123°33'	131	9.10	33.95	2.09	0.70	44.35	27.41	0.27	27.14	0.13
COC-7	38°30'	123°39'	2	12.17	33.30	0.99	0.51	19.91	8.57	0.40	8.16	2.03
COC-7	38°30'	123°39'	10	12.16	33.30	0.96	0.55	20.36	8.69	0.41	8.29	1.89
COC-7	38°30'	123°39'	20	12.02	33.32	0.87	0.60	20.94	9.53	0.41	9.12	1.41
COC-7	38°30'	123°39'	30	11.72	33.37	1.00	0.53	23.22	11.54	0.43	11.11	1.06
COC-7	38°30'	123°39'	40	11.52	33.39	1.15	0.52	24.46	12.93	0.45	12.48	1.18
COC-7	38°30'	123°39'	50	10.58	33.46	1.42	0.38	28.99	18.04	0.24	17.80	0.64
COC-7	38°30'	123°39'	69	10.15	33.76	1.58	0.42	32.98	20.52	0.17	20.36	0.12
COC-7	38°30'	123°39'	99	9.85	33.84	1.64	0.32	38.03	24.73	0.17	24.56	0.09
COC-7	38°30'	123°39'	150	9.40	33.95	1.76	0.48	40.19	25.88	0.17	25.71	0.05
COC-7	38°30'	123°39'	414	6.72	34.10	2.65		61.46				0.03

Appendix B: August 1998 - July 1999 data (continued)

Aug-98			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
COC-9	38°24'	123°49'	3	12.60	33.29	0.96	0.65	19.20	7.81	0.42	7.39	0.86
COC-9	38°24'	123°49'	11	12.59	33.30	0.93	0.60	19.20	7.57	0.40	7.17	0.76
COC-9	38°24'	123°49'	20	12.55	33.31	0.97	0.61	19.86	8.04	0.42	7.62	0.93
COC-9	38°24'	123°49'	29	12.50	33.31	1.02	0.57	20.38	8.59	0.43	8.16	0.81
COC-9	38°24'	123°49'	40	11.81	33.41	1.12	0.59	24.20	12.56	0.49	12.06	0.87
COC-9	38°24'	123°49'	49	11.45	33.48	1.30	0.70	25.78	14.36	0.48	13.88	0.42
COC-9	38°24'	123°49'	61	10.55	33.63	1.56	0.36	30.91	20.09	0.34	19.74	0.23
COC-9	38°24'	123°49'	71	10.19	33.71	1.74	0.57	34.32	22.72	0.17	22.55	0.16
COC-9	38°24'	123°49'	100	9.75	33.84	1.88	0.34	38.93	25.15	0.17	24.98	0.09
COC-9	38°24'	123°49'	150	9.39	33.92	1.95	0.33	41.56	26.76	0.17	26.59	0.08
COC-9	38°24'	123°49'	670	4.72	34.23	3.12		95.10	38.97		38.66	0.01
COC-9	38°24'	123°49'	1006	3.91	34.43	3.27		120.01	40.25		39.94	0.01
COC-11	38°17'	123°59'	2	12.36	33.42	0.94	0.80	24.17	10.44	0.70	9.74	0.86
COC-11	38°17'	123°59'	11	12.36	33.42	0.95	0.78	23.64	10.14	0.67	9.48	0.76
COC-11	38°17'	123°59'	16	12.36	33.42	0.97	0.84	22.84	9.85	0.63	9.22	0.93
COC-11	38°17'	123°59'	19	12.40	33.42	0.92	0.77	19.61	9.27	0.61	8.66	0.81
COC-11	38°17'	123°59'	30	12.18	33.43	1.01	0.82	20.71	10.83	0.50	10.33	0.87
COC-11	38°17'	123°59'	41	11.30	33.45	1.19	0.39	24.51	14.62	0.13	14.49	0.42
COC-11	38°17'	123°59'	50	11.11	33.53	1.47	0.57	27.09	18.24	0.11	18.13	0.23
COC-11	38°17'	123°59'	71	10.48	33.65	1.65	0.70	29.81	20.84	0.01	20.82	0.16
COC-11	38°17'	123°59'	99	9.91	33.78	1.89	0.70	33.07	23.26	0.00	23.29	0.09
COC-11	38°17'	123°59'	150	9.14	33.92	1.88	0.66	33.36	23.22	0.00	23.28	0.08
COC-11	38°17'	123°59'	800	4.48	34.35	3.24		104.69	42.12		41.78	0.02
COC-11	38°17'	123°59'	1001	3.85	34.44	3.24		116.57	42.55		42.21	0.01

Sep-98			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-5	44°39'	124°10'	2	10.32	32.90	1.50	0.62	16.62	15.23	0.17	15.06	2.24
NH-5	44°39'	124°10'	10	9.36	32.99	1.61	0.56	20.61	17.13	0.19	16.94	1.15
NH-5	44°39'	124°10'	15	9.45	32.98	1.61	0.57	20.32	17.03	0.19	16.84	1.40
NH-5	44°39'	124°10'	20	9.09	33.25	1.85	0.74	25.97	21.69	0.20	21.49	0.53
NH-5	44°39'	124°10'	30	9.06	33.47	1.97	1.05	31.62	22.55	0.20	22.34	0.61
NH-5	44°39'	124°10'	40	8.66	33.71	2.32	0.89	39.91	27.30	0.31	26.99	0.95
NH-5	44°39'	124°10'	47	8.46	33.73	2.48	0.53	46.22	28.63	0.32	28.31	1.47
NH-5	44°39'	124°10'	49			2.48	0.61	44.60	28.53	0.33	28.20	1.92
NH-5	44°39'	124°10'	55	8.45	33.73	2.48	0.58	45.96	28.53	0.32	28.21	2.02
NH-15	44°39'	124°24'	1	14.28	31.95	0.28	0.12	2.02	0.00	0.00	0.00	2.81
NH-15	44°39'	124°24'	11	12.13	32.30	0.41	0.30	3.41	1.17	0.01	1.16	2.73
NH-15	44°39'	124°24'	20	9.58	32.61	0.85	0.19	6.45	6.06	0.21	5.85	0.57
NH-15	44°39'	124°24'	29	9.31	32.67	1.06	0.00	10.15	9.38	0.15	9.23	0.43
NH-15	44°39'	124°24'	41	8.98	32.80	1.12	0.00	11.20	11.15	0.00	11.14	0.23
NH-15	44°39'	124°24'	49			1.49	0.00	19.53	17.20	0.00	17.20	0.15
NH-15	44°39'	124°24'	61	8.84	33.16	1.50	0.00	18.61	17.21	0.00	17.21	0.07
NH-15	44°39'	124°24'	71	8.72	33.42	1.79	0.00	26.93	21.90	0.00	21.90	0.14
NH-15	44°39'	124°24'	85	8.45	33.65	2.18	0.04	40.88	26.78	0.07	26.71	0.27

Appendix B: August 1998 - July 1999 data (continued)

Sep-98			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-25	44°39'	124°39'	2	15.32	32.16	0.16	0.30	0.00	0.30	0.00	0.30	0.55
NH-25	44°39'	124°39'	10	15.10	32.18	0.16	0.31	0.00	0.40	0.00	0.40	0.57
NH-25	44°39'	124°39'	15	14.49	32.22	0.25	0.40	0.00	0.60	0.00	0.60	0.59
NH-25	44°39'	124°39'	20	11.20	32.50	0.49	0.74	0.00	1.54	0.04	1.50	0.73
NH-25	44°39'	124°39'	30	10.57	32.56	0.49	0.56	0.00	1.44	0.08	1.36	0.57
NH-25	44°39'	124°39'	40	9.68	32.61	0.66	0.23	2.28	4.77	0.15	4.62	0.36
NH-25	44°39'	124°39'	50	9.45	32.65	0.81	0.12	3.30	7.15	0.03	7.12	0.27
NH-25	44°39'	124°39'	99	8.82	33.44	1.81	0.04	22.17	22.76	0.00	22.76	0.03
NH-25	44°39'	124°39'	149	8.31	33.76	2.22	0.33	32.77	28.19	0.00	28.19	0.03
NH-25	44°39'	124°39'	200	7.80	33.93	2.38		44.75	31.24		31.10	0.02
NH-25	44°39'	124°39'	210	7.73	33.96	2.43		47.09	31.96		31.80	0.02
NH-35	44°39'	124°53'	2	15.99	32.03	0.07	0.16	0.00	0.00	0.00	0.00	0.43
NH-35	44°39'	124°53'	10	15.81	32.03	0.29	0.28	0.00	0.00	0.00	0.00	0.52
NH-35	44°39'	124°53'	20	15.27	32.02	0.09	0.19	0.00	0.00	0.00	0.00	0.81
NH-35	44°39'	124°53'	25	15.17	32.01	0.15	0.31	0.00	0.00	0.00	0.00	0.88
NH-35	44°39'	124°53'	30	14.02	32.27	0.29	0.61	0.00	0.00	0.00	0.00	0.51
NH-35	44°39'	124°53'	40	10.72	32.54	0.44	0.65	0.00	0.95	0.04	0.91	0.33
NH-35	44°39'	124°53'	50	10.03	32.57	0.59	0.30	0.05	3.81	0.23	3.58	0.28
NH-35	44°39'	124°53'	70	9.41	32.69	0.91	0.12	4.75	8.77	0.00	8.77	0.15
NH-35	44°39'	124°53'	100	9.16	33.18	1.44	0.09	15.41	17.82	0.00	17.82	0.06
NH-35	44°39'	124°53'	150	8.04	33.87	2.30	0.14	36.63	30.49	0.00	30.49	0.03
NH-35	44°39'	124°53'	275	7.16	33.99	2.51		52.75	33.26		33.16	0.02
NH-35	44°39'	124°53'	430	5.33	34.09	3.06		70.36	40.72		40.60	0.01
NH-45	44°39'	125°07'	2	16.84	31.98	0.00	0.14	0.00	0.00	0.00	0.00	0.57
NH-45	44°39'	125°07'	10	16.82	31.98	0.00	0.15	0.00	0.00	0.00	0.00	0.58
NH-45	44°39'	125°07'	20	16.54	32.00	0.01	0.27	0.00	0.00	0.00	0.00	0.71
NH-45	44°39'	125°07'	27	14.98	32.14	0.16	0.30	0.00	0.00	0.00	0.00	0.97
NH-45	44°39'	125°07'	30	13.13	32.35	0.26	0.35	0.00	0.05	0.00	0.05	0.86
NH-45	44°39'	125°07'	40	11.15	32.52	0.43	0.66	0.00	0.91	0.00	0.91	0.37
NH-45	44°39'	125°07'	50	10.20	32.57	0.57	0.25	0.58	3.11	0.21	2.89	0.31
NH-45	44°39'	125°07'	70	9.55	32.70	1.40	0.15	16.19	17.11	0.00	17.11	0.12
NH-45	44°39'	125°07'	101	8.92	33.30	1.73	0.09	20.89	21.69	0.00	21.69	0.05
NH-45	44°39'	125°07'	150	7.86	33.86	2.20	0.07	34.19	29.79	0.00	29.79	
NH-45	44°39'	125°07'	500	5.19	34.11	3.07		71.79	41.58		41.46	
NH-45	44°39'	125°07'	580	4.89	34.16	3.19		88.43	42.65		42.54	
NH-65	44°39'	125°36'	3	15.96	32.07	0.02	0.20	0.00	0.00	0.00	0.00	0.45
NH-65	44°39'	125°36'	10	15.90	32.07	0.02	0.15	0.00	0.00	0.00	0.00	0.46
NH-65	44°39'	125°36'	20	15.49	32.10	0.06	0.17	0.00	0.06	0.00	0.06	0.57
NH-65	44°39'	125°36'	30	12.31	32.42	0.39	0.61	0.00	1.94	0.09	1.85	0.94
NH-65	44°39'	125°36'	35	11.01	32.58	0.53	0.67	0.00	3.46	0.15	3.31	0.66
NH-65	44°39'	125°36'	40	10.74	32.71	0.68	0.80	1.16	6.45	0.17	6.28	0.40
NH-65	44°39'	125°36'	50	10.31	32.75	0.79	0.94	2.96	7.00	0.19	6.81	0.29
NH-65	44°39'	125°36'	71	9.57	32.93	2.11	0.19	31.60	28.31	0.08	28.23	0.12
NH-65	44°39'	125°36'	100	9.09	33.59	1.95	0.11	23.93	25.14	0.07	25.08	0.06
NH-65	44°39'	125°36'	150	8.09	33.85	2.18	0.13	31.84	29.09	0.02	29.08	
NH-65	44°39'	125°36'	820	4.02	34.32	3.48			45.87		45.87	
NH-65	44°39'	125°36'	1000	3.62	34.41	3.47			45.28		45.28	

Appendix B: August 1998 - July 1999 data (continued)

Sep-98			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-85	44°39'	126°03'	3	17.68	31.90	0.00	0.00	0.00	0.00	0.00	0.00	0.43
NH-85	44°39'	126°03'	10	17.68	31.90	0.00	0.00	0.00	0.00	0.00	0.00	0.44
NH-85	44°39'	126°03'	19	17.68	31.90	0.00	0.00	0.00	0.00	0.00	0.00	0.44
NH-85	44°39'	126°03'	25	17.40	31.95	0.00	0.00	0.00	0.00	0.00	0.00	0.47
NH-85	44°39'	126°03'	30	14.97	32.21	0.25	0.11	1.29	0.00	0.00	0.00	0.68
NH-85	44°39'	126°03'	40	11.10	32.53	0.62	0.85	5.39	1.63	0.03	1.60	0.36
NH-85	44°39'	126°03'	50	9.91	32.61	1.29	0.00	16.10	14.04	0.03	14.01	0.22
NH-85	44°39'	126°03'	70	9.17	33.05	1.34	0.00	15.57	14.34	0.00	14.34	0.10
NH-85	44°39'	126°03'	100	8.41	33.66	2.08	0.00	32.88	26.85	0.00	26.85	0.03
NH-85	44°39'	126°03'	150	7.92	33.94	2.36	0.00	41.27	30.86	0.00	30.86	0.02
NH-85	44°39'	126°03'	999	3.67	34.40	3.36		118.53	45.12		44.99	0.01

Nov-98			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-5	44°39'	124°10'	2	12.20	32.27	0.50	0.00	6.50	2.58	0.18	2.40	0.84
NH-5	44°39'	124°10'	4	12.20	32.26	0.49	0.05	6.58	2.51	0.18	2.34	0.82
NH-5	44°39'	124°10'	10	12.19	32.27	0.50	0.05	6.49	2.58	0.18	2.40	0.84
NH-5	44°39'	124°10'	16	12.15	32.29	0.49	0.06	6.39	2.52	0.18	2.34	0.92
NH-5	44°39'	124°10'	20	12.15	32.31	0.48	0.00	5.95	2.39	0.17	2.23	0.91
NH-5	44°39'	124°10'	25	12.16	32.32	0.47	0.00	5.68	2.40	0.17	2.23	0.81
NH-5	44°39'	124°10'	31	12.18	32.32	0.46	0.00	5.41	2.40	0.17	2.23	0.70
NH-5	44°39'	124°10'	41	12.03	32.44	0.55	0.03	7.05	3.52	0.23	3.29	0.48
NH-5	44°39'	124°10'	51	11.75	32.56	0.81	0.03	12.16	6.76	0.34	6.42	0.47
NH-5	44°39'	124°10'	56	11.36	32.86	1.06	0.00	16.05	10.50	0.46	10.04	0.40
NH-15	44°39'	124°24'	2	12.98	32.36	0.29	0.00	1.99	0.32	0.05	0.28	0.91
NH-15	44°39'	124°24'	10	12.98	32.36	0.29	0.00	1.90	0.33	0.05	0.28	0.97
NH-15	44°39'	124°24'	21	12.99	32.36	0.29	0.00	1.98	0.40	0.05	0.35	0.90
NH-15	44°39'	124°24'	24	12.99	32.36	0.30	0.00	2.05	0.47	0.05	0.42	0.87
NH-15	44°39'	124°24'	30	12.91	32.31	0.32	0.00	2.31	0.66	0.06	0.61	0.81
NH-15	44°39'	124°24'	40	10.53	32.87	1.03	0.00	11.75	11.35	0.12	11.23	0.29
NH-15	44°39'	124°24'	52	9.93	33.15	1.39	0.00	17.90	16.58	0.02	16.56	0.19
NH-15	44°39'	124°24'	61	9.88	33.18	1.43	0.00	19.02	17.31	0.00	17.31	0.18
NH-15	44°39'	124°24'	70	9.86	33.19	1.45	0.00	19.44	17.51	0.00	17.50	0.18
NH-15	44°39'	124°24'	81	9.77	33.25	1.53	0.00	22.47	18.73	0.06	18.66	0.17
NH-25	44°39'	124°39'	2	12.82	32.39	0.32	0.00	1.91	0.32	0.07	0.25	0.66
NH-25	44°39'	124°39'	10	12.82	32.39	0.33	0.00	1.81	0.26	0.07	0.19	0.68
NH-25	44°39'	124°39'	20	12.83	32.39	0.33	0.00	1.89	0.26	0.07	0.19	0.64
NH-25	44°39'	124°39'	30	12.82	32.39	0.33	0.00	1.79	0.26	0.07	0.19	0.66
NH-25	44°39'	124°39'	39	12.81	32.37	0.34	0.00	2.05	0.45	0.08	0.36	0.59
NH-25	44°39'	124°39'	45	12.41	32.35	0.48	0.00	3.34	2.32	0.16	2.16	0.45
NH-25	44°39'	124°39'	50	10.47	32.46	0.80	0.00	6.19	6.56	0.13	6.43	0.23
NH-25	44°39'	124°39'	70	9.48	33.10	1.28	0.00	14.25	14.78	0.04	14.74	0.08
NH-25	44°39'	124°39'	101	9.00	33.52	1.95	0.00	32.71	25.00	0.03	24.96	0.07
NH-25	44°39'	124°39'	151	8.37	33.84	2.14	0.00	35.57	28.98	0.02	28.97	0.02
NH-25	44°39'	124°39'	200	7.63	33.91	2.23		43.06	30.48		30.35	0.01

Appendix B: August 1998 - July 1999 data (continued)

Nov-98 Station	Lat	Long	[db] P	[°C] T	S	[uM] PO_4	[uM] NH_4	[uM] SiO_2	[uM] N+N	[uM] NO_2	[uM] NO_3	[ug/L] Chl a
NH-35	44°39'	124°53'	3	12.79	32.36	0.29	0.00	4.93	0.00	0.02	0.00	0.58
NH-35	44°39'	124°53'	10	12.79	32.35	0.29	0.00	4.66	0.07	0.02	0.05	0.56
NH-35	44°39'	124°53'	20	12.80	32.35	0.29	0.00	4.74	0.00	0.02	0.00	0.55
NH-35	44°39'	124°53'	32	12.74	32.27	0.30	0.00	4.82	0.27	0.03	0.24	0.55
NH-35	44°39'	124°53'	40	10.86	32.54	0.62	0.00	4.03	4.40	0.10	4.31	0.28
NH-35	44°39'	124°53'	51	10.13	32.69	0.78	0.00	5.84	6.72	0.05	6.67	0.21
NH-35	44°39'	124°53'	70	9.61	32.95	1.20	0.00	12.86	13.64	0.02	13.63	0.14
NH-35	44°39'	124°53'	99	8.96	33.58	1.89	0.00	28.55	25.24	0.00	25.24	0.02
NH-35	44°39'	124°53'	150	8.19	33.82	2.06	0.00	34.35	28.77	0.00	28.77	0.01
NH-35	44°39'	124°53'	420	5.50	34.07	2.96		78.42	39.96		39.83	0.01
NH-45	44°39'	125°07'	2	12.85	32.33	0.24	0.15	0.00	0.00	0.04	0.00	0.55
NH-45	44°39'	125°07'	10	12.86	32.33	0.26	0.15	0.00	0.00	0.05	0.00	0.56
NH-45	44°39'	125°07'	20	12.93	32.35	0.27	0.15	0.00	0.20	0.04	0.16	0.60
NH-45	44°39'	125°07'	30	12.92	32.33	0.26	0.13	0.00	0.00	0.03	0.00	0.59
NH-45	44°39'	125°07'	40	11.99	32.42	0.51	0.11	0.16	2.68	0.09	2.59	0.33
NH-45	44°39'	125°07'	50	10.19	32.65	0.82	0.10	3.77	6.91	0.06	6.85	0.20
NH-45	44°39'	125°07'	70	9.55	33.21	1.52	0.09	15.66	17.50	0.01	17.50	0.08
NH-45	44°39'	125°07'	100	9.24	33.63	1.98	0.10	24.11	24.38	0.01	24.36	0.03
NH-45	44°39'	125°07'	150	8.45	33.82	2.20	0.11	31.52	27.53	0.02	27.51	0.02
NH-45	44°39'	125°07'	499	5.13	34.13	3.10		84.21	41.90		41.80	0.01
NH-65	44°39'	125°36'	2	12.89	32.27	0.28	0.00	1.07	0.07	0.02	0.05	0.56
NH-65	44°39'	125°36'	10	12.90	32.27	0.28	0.00	1.12	0.07	0.02	0.05	0.52
NH-65	44°39'	125°36'	20	12.90	32.27	0.28	0.00	1.16	0.02	0.02	0.00	0.54
NH-65	44°39'	125°36'	30			0.30	0.00	1.20	0.25	0.03	0.21	0.49
NH-65	44°39'	125°36'	36	12.86	32.27	0.28	0.00	1.07	0.13	0.03	0.10	0.52
NH-65	44°39'	125°36'	40	12.79	32.22	0.31	0.00	1.29	0.31	0.04	0.27	0.55
NH-65	44°39'	125°36'	50	10.09	32.60	0.76	0.00	6.76	6.21	0.05	6.16	0.21
NH-65	44°39'	125°36'	69	9.90	32.84	1.05	0.00	11.19	11.43	0.02	11.41	0.14
NH-65	44°39'	125°36'	101	8.86	33.42	1.77	0.00	26.64	23.07	0.00	23.07	0.03
NH-65	44°39'	125°36'	150	7.92	33.83	2.02	0.00	36.32	28.34	0.00	28.34	0.01
NH-65	44°39'	125°36'	1007	3.56	34.41	3.31		119.50	45.09		44.98	0.01
NH-85	44°39'	126°03'	1			0.26	0.00	0.75	0.00	0.01	0.00	0.35
NH-85	44°39'	126°03'	10	13.69	32.52	0.25	0.00	0.21	0.00	0.00	0.00	0.36
NH-85	44°39'	126°03'	21	13.69	32.52	0.26	0.00	0.18	0.00	0.01	0.00	0.35
NH-85	44°39'	126°03'	30	13.69	32.52	0.26	0.00	1.54	0.00	0.01	0.00	0.38
NH-85	44°39'	126°03'	40	13.68	32.51	0.26	0.00	1.69	0.00	0.01	0.00	0.36
NH-85	44°39'	126°03'	47	13.57	32.45	0.29	0.00	1.14	0.04	0.02	0.01	0.35
NH-85	44°39'	126°03'	51			0.59	0.00	4.76	4.35	0.23	4.12	0.25
NH-85	44°39'	126°03'	70	9.88	33.03	1.29	0.00	14.79	15.64	0.00	15.64	0.10
NH-85	44°39'	126°03'	100	8.58	33.47	1.74	0.00	25.87	23.53	0.00	23.53	0.02
NH-85	44°39'	126°03'	149	7.86	33.88	2.27	0.00	40.24	30.93	0.00	30.94	0.02
NH-85	44°39'	126°03'	1006	3.54	34.41	3.31		123.92	45.09		44.98	0.00

Appendix B: August 1998 - July 1999 data (continued)

Nov-98			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
FM-3	43°13'	124°30'	2	11.72	32.79	0.81	0.00	10.73	7.74	0.28	7.46	1.34
FM-3	43°13'	124°30'	4	11.73	32.79	0.82	0.00	12.87	7.68	0.28	7.40	1.39
FM-3	43°13'	124°30'	10	11.75	32.80	0.80	0.00	11.02	7.62	0.28	7.35	1.27
FM-3	43°13'	124°30'	15	11.77	32.82	0.80	0.00	11.60	7.69	0.28	7.41	1.28
FM-3	43°13'	124°30'	20	11.77	32.87	0.83	0.00	10.97	8.07	0.34	7.73	1.16
FM-3	43°13'	124°30'	24	11.79	32.99	0.86	0.00	11.72	8.89	0.38	8.51	0.98
FM-3	43°13'	124°30'	30	11.78	33.00	0.90	0.00	17.16	9.14	0.41	8.73	0.74
FM-3	43°13'	124°30'	40	11.75	33.01	0.92	0.16	12.71	9.77	0.42	9.35	0.62
FM-3	43°13'	124°30'	49			1.28	0.00	30.64	14.82	0.35	14.48	0.42
FM-4	43°13'	124°35'	2	11.80	32.92	0.77	0.00	8.99	8.00	0.32	7.68	0.89
FM-4	43°13'	124°35'	10	11.76	32.95	0.80	0.00	9.31	8.49	0.33	8.16	0.91
FM-4	43°13'	124°35'	15	11.65	33.03	0.92	0.00	12.93	10.50	0.41	10.09	0.96
FM-4	43°13'	124°35'	20	11.56	33.10	1.02	0.00	13.42	12.32	0.49	11.83	0.68
FM-4	43°13'	124°35'	29	11.60	33.20	0.98	0.00	12.01	11.59	0.40	11.19	0.54
FM-4	43°13'	124°35'	39	11.43	33.23	1.08	0.00	13.20	13.17	0.40	12.78	0.39
FM-4	43°13'	124°35'	50	11.39	33.25	1.11	0.00	13.52	13.48	0.37	13.11	0.42
FM-4	43°13'	124°35'	60	10.52	33.37	1.47	0.00	21.65	18.52	0.24	18.28	0.29
FM-4	43°13'	124°35'	71	10.39	33.41		0.00	22.83	19.61	0.20	19.42	0.28
FM-4	43°13'	124°35'	75	10.32	33.43		0.00	22.98	19.74	0.21	19.53	0.29
FM-5	43°13'	124°40'	3	11.96	32.87	0.69	0.00	8.15	6.30	0.30	5.99	1.14
FM-5	43°13'	124°40'	10	11.95	32.87	0.70	0.00	8.21	6.43	0.30	6.13	1.19
FM-5	43°13'	124°40'	20	11.80	32.93	0.84	0.00	11.39	8.80	0.37	8.44	1.16
FM-5	43°13'	124°40'	25	11.74	32.93	0.88	0.00	11.80	9.12	0.37	8.75	0.99
FM-5	43°13'	124°40'	30	11.72	32.95	0.90	0.00	12.04	9.69	0.39	9.29	0.93
FM-5	43°13'	124°40'	40	11.56	33.10	1.05	0.09	13.83	12.00	0.44	11.56	0.57
FM-5	43°13'	124°40'	51	10.70	33.42	1.50	0.00	20.14	19.04	0.04	19.00	0.21
FM-5	43°13'	124°40'	61	10.17	33.50	1.61	0.00	21.59	20.42	0.03	20.38	0.17
FM-5	43°13'	124°40'	70	10.05	33.52	1.67	0.00	23.03	21.67	0.04	21.63	0.14
FM-5	43°13'	124°40'	99	9.57	33.67	1.82	0.00	26.22	23.92	0.05	23.87	0.11
FM-5	43°13'	124°40'	156	8.76	33.83	2.13	0.00	35.30	28.41	0.14	28.27	0.06
FM-7	43°13'	124°50'	2	12.49	32.37	0.37	0.00	4.36	1.75	0.09	1.67	0.53
FM-7	43°13'	124°50'	10	12.30	32.55	0.42	0.00	5.28	2.68	0.13	2.55	0.54
FM-7	43°13'	124°50'	20			0.61	0.00	7.77	5.58	0.27	5.30	0.54
FM-7	43°13'	124°50'	26	12.01	32.78	0.65	0.00	7.99	6.10	0.29	5.81	0.50
FM-7	43°13'	124°50'	31	11.99	32.82	0.69	0.00	8.73	6.85	0.31	6.54	0.47
FM-7	43°13'	124°50'	40	11.41	33.15	0.99	0.00	12.63	11.72	0.31	11.41	0.39
FM-7	43°13'	124°50'	49	10.86	33.39	1.36	0.00	18.11	17.34	0.05	17.29	0.22
FM-7	43°13'	124°50'	70	10.37	33.49	1.57	0.00	21.83	20.64	0.02	20.62	0.13
FM-7	43°13'	124°50'	101	9.50	33.68	1.78	0.00	27.48	23.82	0.01	23.82	0.07
FM-7	43°13'	124°50'	337	6.12	34.04	2.74	0.00	60.42	37.02	0.11	36.91	0.01

Appendix B: August 1998 - July 1999 data (continued)

Nov-98 Station	Lat	Long	[db] P	[°C] T	S	[uM] PO_4	[uM] NH_4	[uM] SiO_2	[uM] N+N	[uM] NO_2	[uM] NO_3	[ug/L] Chl a
FM-8	43°13'	125°00'	2	13.36	32.39	0.26	0.00	1.83	0.02	0.01	0.00	0.50
FM-8	43°13'	125°00'	10	13.36	32.39	0.26	0.00	1.89	0.02	0.02	0.00	0.51
FM-8	43°13'	125°00'	20	13.31	32.39	0.27	0.00	1.96	0.31	0.02	0.29	0.51
FM-8	43°13'	125°00'	30	13.24	32.39	0.28	0.00	2.19	0.36	0.02	0.34	0.50
FM-8	43°13'	125°00'	35	13.22	32.39	0.28	0.00	2.43	0.42	0.03	0.39	0.52
FM-8	43°13'	125°00'	40	12.89	32.47	0.41	0.00	4.24	2.28	0.11	2.17	0.42
FM-8	43°13'	125°00'	50	11.03	33.16	1.24	0.00	17.09	15.02	0.13	14.89	0.33
FM-8	43°13'	125°00'	70	9.83	33.47	1.63	0.00	23.63	21.62	0.01	21.61	0.14
FM-8	43°13'	125°00'	100	9.19	33.64	1.82	0.00	28.07	24.92	0.00	24.92	0.04
FM-8	43°13'	125°00'	150	8.59	33.85	2.01	0.00	34.09	27.82	0.00	27.82	0.02
FM-8	43°13'	125°00'	1006	3.58	34.42	3.34		124.31	44.74		44.63	0.01
FM-9	43°13'	125°10'	3	13.39	32.38	0.26	0.00	1.46	0.00	0.01	0.00	0.54
FM-9	43°13'	125°10'	10	13.40	32.38	0.24	0.00	1.52	0.00	0.01	0.00	0.53
FM-9	43°13'	125°10'	20	13.38	32.39	0.25	0.00	1.58	0.00	0.01	0.00	0.52
FM-9	43°13'	125°10'	30	13.32	32.39	0.26	0.00	1.64	0.02	0.01	0.00	0.54
FM-9	43°13'	125°10'	34	13.32	32.39	0.26	0.00	1.70	0.02	0.02	0.00	0.53
FM-9	43°13'	125°10'	41	13.13	32.40	0.27	0.00	1.94	0.36	0.02	0.34	0.50
FM-9	43°13'	125°10'	50	10.76	32.62	0.52	0.00	2.35	3.84	0.08	3.76	0.31
FM-9	43°13'	125°10'	70	9.95	32.86	0.92	0.00	9.07	9.81	0.01	9.80	0.16
FM-9	43°13'	125°10'	102	9.45	33.46	1.56	0.00	22.79	21.51	0.00	21.50	0.04
FM-9	43°13'	125°10'	1007	3.62	34.42	3.34		117.03	45.00		44.92	0.01
CR-1	41°54'	124°18'	2	12.25	32.57	0.62	0.00	9.13	4.47	0.19	4.28	1.83
CR-1	41°54'	124°18'	5	12.17	32.63	0.62	0.00	9.15	4.59	0.20	4.39	1.91
CR-1	41°54'	124°18'	10	12.10	32.70	0.66	0.00	9.35	5.22	0.23	4.99	2.00
CR-1	41°54'	124°18'	15	12.10	32.73	0.69	0.00	9.54	5.51	0.24	5.27	1.73
CR-1	41°54'	124°18'	20	12.12	32.77	0.68	0.00	9.04	5.57	0.24	5.33	1.57
CR-1	41°54'	124°18'	25	12.15	32.92	0.70	0.00	8.89	5.68	0.27	5.41	1.15
CR-1	41°54'	124°18'	30	12.02	33.03	0.85	0.26	11.70	7.34	0.38	6.96	0.86
CR-1	41°54'	124°18'	34	11.98	33.05	0.93	0.45	13.46	8.20	0.42	7.78	0.88
CR-3	41°54'	124°30'	2	12.20	32.66	0.49	0.00	5.58	2.50	0.16	2.34	1.09
CR-3	41°54'	124°30'	5	12.26	32.78	0.52	0.00	6.47	3.13	0.18	2.95	1.15
CR-3	41°54'	124°30'	10	12.20	32.89	0.62	0.00	8.06	4.56	0.24	4.32	1.08
CR-3	41°54'	124°30'	15	12.14	32.93	0.69	0.00	8.43	5.70	0.28	5.43	1.01
CR-3	41°54'	124°30'	20	12.12	32.95	0.70	0.00	9.32	5.88	0.29	5.59	1.00
CR-3	41°54'	124°30'	30	12.04	32.96	0.71	0.00	8.82	6.22	0.32	5.91	0.83
CR-3	41°54'	124°30'	40	11.95	32.98	0.74	0.00	10.06	6.74	0.34	6.40	0.73
CR-3	41°54'	124°30'	49			0.83	0.00	10.26	8.00	0.33	7.67	0.54
CR-3	41°54'	124°30'	59	11.13	33.06	0.70	0.00	8.37	6.00	0.28	5.72	1.03
CR-3	41°54'	124°30'	70	10.77	33.30	1.30	0.00	17.79	15.89	0.18	15.71	0.25
CR-3	41°54'	124°30'	100	9.86	33.57	1.65	0.00	26.00	21.20	0.10	21.10	0.15

Appendix B: August 1998 - July 1999 data (continued)

Nov-98			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
CR-4	41°54'	124°36'	2	12.20	32.75	0.49	0.22	3.04	2.76	0.10	2.66	0.75
CR-4	41°54'	124°36'	10	12.21	32.75	0.51	0.16	3.23	2.75	0.10	2.66	0.83
CR-4	41°54'	124°36'	15	12.20	32.78	0.51	0.21	3.42	2.94	0.10	2.84	0.88
CR-4	41°54'	124°36'	20	12.18	32.79	0.54	0.20	3.92	3.42	0.13	3.29	0.96
CR-4	41°54'	124°36'	29	11.95	32.86	0.63	0.27	4.42	4.56	0.19	4.37	0.67
CR-4	41°54'	124°36'	40	11.85	32.95	0.71	0.15	6.49	5.99	0.26	5.73	0.51
CR-4	41°54'	124°36'	50	11.87	33.08	0.94	0.09	9.81	9.61	0.32	9.29	0.41
CR-4	41°54'	124°36'	70	10.40	33.43	1.50	0.00	17.52	18.58	0.00	18.58	0.14
CR-4	41°54'	124°36'	100	9.44	33.67	2.21	0.00	25.86	23.63	0.00	23.63	0.10
CR-4	41°54'	124°36'	150	8.60	33.87	2.07	0.04	32.94	27.26	0.00	27.26	0.05
CR-4	41°54'	124°36'	449	5.66	34.10	2.98		73.03	39.59		39.49	0.02
CR-5	41°54'	124°42'	2	12.28	32.86	0.56	0.12	4.58	3.65	0.09	3.55	1.21
CR-5	41°54'	124°42'	10	12.28	32.86	0.54	0.13	4.48	3.74	0.10	3.64	1.21
CR-5	41°54'	124°42'	21	11.88	33.03	0.68	0.31	6.27	5.73	0.15	5.59	1.19
CR-5	41°54'	124°42'	40	11.21	33.21	1.05	0.39	11.82	11.07	0.29	10.77	0.74
CR-5	41°54'	124°42'	49	10.93	33.27	1.15	0.36	13.57	12.98	0.37	12.60	0.49
CR-5	41°54'	124°42'	70	10.38	33.42	1.50	0.15	20.65	17.84	0.53	17.31	0.32
CR-5	41°54'	124°42'	100	9.99	33.52	1.61	0.06	22.10	20.03	0.19	19.84	0.21
CR-5	41°54'	124°42'	150	8.52	33.87	2.08	0.01	32.00	27.85	0.00	27.85	0.02
CR-5	41°54'	124°42'	351	6.36	34.05	2.68		61.07	36.13		36.03	0.01
CR-5	41°54'	124°42'	500	5.10	34.15	3.14		86.22	41.90		41.79	0.01
CR-7	41°54'	125°00'	3	12.35	32.77	0.44	0.01	4.56	2.12	0.08	2.04	1.13
CR-7	41°54'	125°00'	11	12.26	32.80	0.52	0.00	6.29	3.17	0.14	3.02	0.94
CR-7	41°54'	125°00'	20	11.61	33.02	0.84	0.00	9.28	8.07	0.40	7.67	0.67
CR-7	41°54'	125°00'	30	11.37	33.19	0.96	0.33	11.63	9.79	0.29	9.50	0.65
CR-7	41°54'	125°00'	41	11.07	33.26	1.05	0.38	13.36	11.03	0.28	10.76	0.47
CR-7	41°54'	125°00'	50	10.74	33.32	1.20	0.22	15.41	13.72	0.31	13.41	0.34
CR-7	41°54'	125°00'	71	9.84	33.55	1.61	0.00	23.43	20.44	0.04	20.40	0.20
CR-7	41°54'	125°00'	100	8.98	33.81	2.01	0.00	31.13	26.78	0.00	26.78	0.03
CR-7	41°54'	125°00'	152	8.50	33.93	2.16	0.26	35.70	28.99	0.00	28.99	0.02
CR-7	41°54'	125°00'	831	3.98	34.36	3.35		115.86	44.47		44.36	0.01
CR-9	41°54'	125°20'	2	12.61	32.73	0.50	0.00	2.05	1.64	0.12	1.52	0.93
CR-9	41°54'	125°20'	10	12.61	32.73	0.48	0.03	2.36	1.75	0.11	1.64	0.93
CR-9	41°54'	125°20'	20	12.60	32.73	0.51	0.11	2.67	2.14	0.13	2.01	0.87
CR-9	41°54'	125°20'	30	12.09	32.82	0.64	0.02	3.92	4.27	0.20	4.07	0.68
CR-9	41°54'	125°20'	40	11.09	33.13	1.07	0.00	9.91	11.24	0.06	11.18	0.31
CR-9	41°54'	125°20'	50	10.12	33.24	1.28	0.00	13.06	14.73	0.00	14.73	0.17
CR-9	41°54'	125°20'	70	9.87	33.52	1.65	0.09	26.94	20.92	0.00	20.92	0.08
CR-9	41°54'	125°20'	99	9.17	33.72	1.83	0.13	26.30	23.83	0.00	23.83	0.03
CR-9	41°54'	125°20'	149	8.28	33.87	2.03	0.01	33.56	27.70	0.00	27.70	0.01
CR-9	41°54'	125°20'	860	3.99	34.37	3.32		115.62	44.90		44.90	0.01
CR-9	41°54'	125°20'	995	3.70	34.42	3.32		119.63	44.74		44.64	0.01

Appendix B: August 1998 - July 1999 data (continued)

Nov-98 Station	Lat	Long	[db] P	[°C] T	S	[uM] PO_4	[uM] NH_4	[uM] SiO_2	[uM] N+N	[uM] NO_2	[uM] NO_3	[ug/L] Chl a
EU-1	40°52'	124°16'	2	11.80	32.95	0.78	0.11	6.46	6.39	0.15	6.24	1.89
EU-1	40°52'	124°16'	5	11.77	32.98	0.84	0.19	6.99	6.77	0.16	6.60	1.71
EU-1	40°52'	124°16'	10	11.69	33.05	0.85	0.26	7.52	7.43	0.19	7.24	1.55
EU-1	40°52'	124°16'	15	11.61	33.11	0.89	0.37	8.37	7.99	0.21	7.78	1.31
EU-1	40°52'	124°16'	20	11.48	33.15	0.95	0.63	9.21	8.94	0.22	8.72	1.10
EU-1	40°52'	124°16'	25	11.46	33.15	0.94	0.44	9.75	9.03	0.21	8.82	1.06
EU-1	40°52'	124°16'	30	11.35	33.17	1.03	0.45	10.91	10.16	0.24	9.93	0.84
EU-1	40°52'	124°16'	40	10.99	33.26	1.16	0.47	13.32	12.16	0.25	11.91	0.66
EU-1	40°52'	124°16'	50	10.62	33.34	1.32	0.26	16.36	14.92	0.25	14.67	0.41
EU-1	40°52'	124°16'	54	10.47	33.38	1.32	0.28	16.89	15.01	0.24	14.77	0.43
EU-2	40°52'	124°22'	1	12.11	32.95	0.63	0.06	7.78	4.59	0.17	4.42	1.34
EU-2	40°52'	124°22'	5	12.10	32.95	0.65	0.02	7.52	4.88	0.18	4.69	1.38
EU-2	40°52'	124°22'	9	12.05	32.98	0.68	0.00	7.79	5.17	0.20	4.97	1.36
EU-2	40°52'	124°22'	19	11.97	33.03	0.73	0.00	8.23	6.02	0.23	5.79	1.27
EU-2	40°52'	124°22'	30	11.26	33.19	0.93	0.00	11.63	9.91	0.33	9.58	0.55
EU-2	40°52'	124°22'	40	10.99	33.24	1.08	0.00	14.33	12.31	0.32	11.99	0.34
EU-2	40°52'	124°22'	50	10.73	33.32	1.24	0.01	18.25	14.54	0.33	14.21	0.34
EU-2	40°52'	124°22'	60	9.92	33.50	1.50	0.11	23.92	18.71	0.24	18.47	0.31
EU-2	40°52'	124°22'	70	9.58	33.58	1.62	0.00	25.93	20.99	0.20	20.80	0.23
EU-2	40°52'	124°22'	86	9.05	33.73	2.01	0.00	30.90	24.54	0.13	24.41	0.09
EU-2	40°52'	124°22'	106	8.43	33.88	1.95	0.00	36.21	27.28	0.05	27.23	0.05
EU-3	40°52'	124°28'	2	12.18	32.88	0.58	0.00	6.17	3.95	0.15	3.80	1.35
EU-3	40°52'	124°28'	10	12.18	32.88	0.60	0.00	6.26	3.95	0.15	3.80	1.40
EU-3	40°52'	124°28'	15	12.17	32.92	0.61	0.00	6.52	4.35	0.17	4.18	1.41
EU-3	40°52'	124°28'	20	12.10	33.01	0.70	0.12	7.31	5.44	0.22	5.22	0.91
EU-3	40°52'	124°28'	30	11.86	33.09	0.79	0.13	8.97	7.15	0.26	6.89	0.64
EU-3	40°52'	124°28'	40	11.48	33.15	0.92	0.00	10.80	9.44	0.30	9.14	0.38
EU-3	40°52'	124°28'	50	11.32	33.17	1.01	0.00	12.29	10.93	0.32	10.61	0.35
EU-3	40°52'	124°28'	70	10.00	33.44	1.41	0.00	19.87	18.12	0.07	18.06	0.16
EU-3	40°52'	124°28'	100	9.31	33.70	1.73	0.00	28.32	23.38	0.04	23.34	0.13
EU-3	40°52'	124°28'	151	8.71	33.81	1.83	0.00	31.90	25.44	0.06	25.38	0.07
EU-3	40°52'	124°28'	350	5.75	34.11	2.92		76.80	38.97		38.85	0.02
EU-5	40°52'	124°40'	3	12.37	32.94	0.56	0.05	5.66	4.76	0.01	4.75	1.43
EU-5	40°52'	124°40'	10	12.29	32.98	0.60	0.05	5.82	5.05	0.15	4.90	1.41
EU-5	40°52'	124°40'	15	12.22	33.01	0.62	0.06	6.60	5.72	0.16	5.56	1.29
EU-5	40°52'	124°40'	20	12.04	33.07	0.74	0.16	8.02	6.19	0.21	5.98	0.87
EU-5	40°52'	124°40'	29	11.47	33.18	0.94	0.27	11.63	9.36	0.27	9.09	0.52
EU-5	40°52'	124°40'	39	10.73	33.25	1.11	0.20	13.36	12.04	0.28	11.77	0.29
EU-5	40°52'	124°40'	50	10.11	33.33	1.36	0.01	16.98	16.36	0.16	16.20	0.15
EU-5	40°52'	124°40'	71	9.68	33.46	1.56	0.00	21.54	19.53	0.10	19.43	0.11
EU-5	40°52'	124°40'	101	9.10	33.76	1.94	0.00	30.82	25.29	0.04	25.25	0.07
EU-5	40°52'	124°40'	151	8.65	33.87	2.04	0.00	34.75	27.21	0.04	27.17	0.03
EU-5	40°52'	124°40'	500	5.40	34.14	3.08	0.00	81.41	41.45	0.10	41.35	0.01

Appendix B: August 1998 - July 1999 data (continued)

Nov-98			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
EU-7	40°52'	124°56'	3	12.15	32.88	0.52	0.00	3.45	3.36	0.32	3.03	2.20
EU-7	40°52'	124°56'	21	11.58	33.09	0.84	0.35	7.23	8.29	0.49	7.80	1.05
EU-7	40°52'	124°56'	29	11.07	33.25	1.05	0.06	10.06	11.68	0.55	11.13	0.64
EU-7	40°52'	124°56'	40	10.32	33.43	1.30	0.00	15.11	15.85	0.38	15.46	0.40
EU-7	40°52'	124°56'	49	9.88	33.52	1.50	0.00	18.25	18.95	0.22	18.73	0.19
EU-7	40°52'	124°56'	69	9.27	33.64	1.65	0.00	22.67	21.66	0.00	21.66	0.10
EU-7	40°52'	124°56'	100	8.53	33.85	1.97	0.00	30.23	26.89	0.00	26.89	0.03
EU-7	40°52'	124°56'	150	7.97	33.98	2.11	0.00	36.54	28.93	0.00	28.93	0.01
EU-7	40°52'	124°56'	886	3.93	34.38	3.35		119.24	45.09		44.99	0.01
EU-7	40°52'	124°56'	1005	3.64	34.43	3.33		118.85	45.18		45.08	0.01

Feb-99			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-5	44°39'	124°10'	1	9.25	32.51	0.88	0.07	9.64	8.31	0.57	7.73	0.70
NH-5	44°39'	124°10'	6	9.25	32.52	0.88	0.08	8.75	8.59	0.25	8.34	0.71
NH-5	44°39'	124°10'	10	9.25	32.54	0.88	0.09	8.82	8.69	0.25	8.44	0.73
NH-5	44°39'	124°10'	15	9.25	32.52	0.90	0.17	8.90	8.79	0.25	8.54	0.74
NH-5	44°39'	124°10'	20	9.25	32.54	0.89	0.21	8.97	8.69	0.25	8.44	0.70
NH-5	44°39'	124°10'	24	9.26	32.57	0.88	0.17	9.04	8.70	0.25	8.45	0.72
NH-5	44°39'	124°10'	30	9.27	32.59	0.89	0.13	9.11	8.70	0.25	8.45	0.69
NH-5	44°39'	124°10'	42	9.25	32.61	0.89	0.22	9.19	8.80	0.22	8.58	0.72
NH-5	44°39'	124°10'	50	9.25	32.61	0.95	0.30	9.90	9.00	0.26	8.74	1.21
NH-10	44°39'	124°17'	2	9.25	32.64	0.86	0.08	8.51	8.86	0.22	8.64	0.54
NH-10	44°39'	124°17'	6	9.25	32.64	0.85	0.09	8.54	8.75	0.22	8.53	0.54
NH-10	44°39'	124°17'	10	9.25	32.64	0.87	0.29	8.57	8.74	0.22	8.52	0.54
NH-10	44°39'	124°17'	23	9.25	32.65	0.89	0.09	8.59	8.73	0.22	8.51	0.54
NH-10	44°39'	124°17'	30	9.24	32.65	0.87	0.18	8.62	8.83	0.23	8.59	0.61
NH-10	44°39'	124°17'	41	9.24	32.65	0.85	0.09	8.32	8.82	0.22	8.60	0.67
NH-10	44°39'	124°17'	51	9.24	32.66	0.84	0.11	8.35	8.81	0.23	8.58	0.74
NH-10	44°39'	124°17'	61	9.29	32.69	0.88	0.65	8.38	8.70	0.23	8.47	0.86
NH-10	44°39'	124°17'	69	9.29	32.69	0.88	0.04	8.40	8.69	0.22	8.47	0.94
NH-15	44°39'	124°24'	1	9.31	32.73	0.88	0.23	10.17	8.64	0.25	8.38	0.70
NH-15	44°39'	124°24'	5	9.31	32.73	0.87	0.00	10.12	8.54	0.25	8.29	0.78
NH-15	44°39'	124°24'	9	9.31	32.73	0.91	0.43	10.39	8.54	0.26	8.29	0.71
NH-15	44°39'	124°24'	20	9.31	32.74	0.87	0.00	10.34	8.45	0.25	8.20	0.72
NH-15	44°39'	124°24'	29	9.31	32.74	0.87	0.14	10.61	8.55	0.25	8.30	0.70
NH-15	44°39'	124°24'	40	9.30	32.75	0.88	0.00	10.88	8.55	0.26	8.29	0.70
NH-15	44°39'	124°24'	51	9.31	32.75	0.88	0.03	10.20	8.55	0.26	8.29	0.67
NH-15	44°39'	124°24'	61	9.32	32.76	0.89	0.00	10.47	8.65	0.26	8.39	0.64
NH-15	44°39'	124°24'	70	9.32	32.76	0.88	0.11	10.74	8.75	0.26	8.49	0.69
NH-15	44°39'	124°24'	84	9.32	32.76	0.89	0.00	10.38	8.75	0.27	8.49	0.70

Appendix B: August 1998 - July 1999 data (continued)

Feb-99			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-25	44°39'	124°39'	2	9.30	32.72	0.91	0.11	9.70	9.21	0.31	8.90	0.60
NH-25	44°39'	124°39'	10	9.30	32.72	0.91	0.07	9.69	9.22	0.32	8.90	0.63
NH-25	44°39'	124°39'	21	9.31	32.72	0.92	0.09	10.00	9.23	0.29	8.94	0.61
NH-25	44°39'	124°39'	31	9.31	32.72	0.92	0.09	9.99	9.33	0.31	9.02	0.62
NH-25	44°39'	124°39'	42	9.31	32.72	0.92	0.07	9.98	9.34	0.44	8.90	0.67
NH-25	44°39'	124°39'	51	9.30	32.73	0.92	0.04	10.29	9.35	0.51	8.84	0.63
NH-25	44°39'	124°39'	70	9.32	32.75	0.93	0.00	10.28	9.55	0.45	9.10	0.53
NH-25	44°39'	124°39'	102	9.29	33.14	1.30	0.00	16.90	15.26	0.35	14.91	0.23
NH-25	44°39'	124°39'	153	8.55	33.76	2.02	0.01	31.50	26.58	0.00	26.58	0.06
NH-25	44°39'	124°39'	202	7.73	33.95	2.22		39.61	30.21		30.21	0.03
NH-25	44°39'	124°39'	286	6.58	34.00	2.49		55.10	34.40		34.40	0.02
NH-35	44°39'	124°53'	5	9.27	32.73	0.75	0.00	7.45	6.60	0.11	6.48	0.61
NH-35	44°39'	124°53'	10	9.28	32.73	0.74	0.00	6.46	6.41	0.11	6.30	0.63
NH-35	44°39'	124°53'	19	9.29	32.74	0.76	0.00	6.73	6.70	0.12	6.58	0.63
NH-35	44°39'	124°53'	30	9.29	32.74	0.77	0.00	6.99	6.70	0.12	6.58	0.62
NH-35	44°39'	124°53'	39	9.29	32.75	0.76	0.00	6.95	6.70	0.12	6.58	0.65
NH-35	44°39'	124°53'	48	9.29	32.75	0.77	0.03	7.21	6.71	0.13	6.58	0.65
NH-35	44°39'	124°53'	71	9.32	32.78	0.83	0.00	8.74	7.67	0.15	7.52	0.50
NH-35	44°39'	124°53'	98	9.00	33.50	1.71	0.00	25.68	21.89	0.00	21.89	0.11
NH-35	44°39'	124°53'	132	8.86	33.63	1.83	0.00	28.78	24.01	0.00	24.01	0.08
NH-35	44°39'	124°53'	149	8.79	33.68	1.93	0.04	28.79	24.77	0.00	24.77	0.08
NH-35	44°39'	124°53'	430	5.51	34.09	2.98		77.37	39.66		39.66	0.01

Apr-99			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH 5	44°39'	124°10'	1	10.20	31.85	0.16	0.47	0.00	0.00	0.02	0.00	3.75
NH 5	44°39'	124°10'	7	10.20	31.84	0.14	0.33	0.00	0.00	0.00	0.00	4.38
NH 5	44°39'	124°10'	10	10.14	31.91	0.32	0.33	0.00	0.00	0.03	0.00	4.19
NH 5	44°39'	124°10'	16	9.59	32.39	0.62	0.35	1.27	4.90	0.17	4.73	4.93
NH 5	44°39'	124°10'	21	8.73	33.09	1.34	0.23	33.43	15.82	0.26	15.56	0.98
NH 5	44°39'	124°10'	25	8.70	33.16	1.36	0.65	34.53	16.29	0.17	16.12	0.65
NH 5	44°39'	124°10'	31	8.63	33.27	1.28	0.64	31.33	15.19	0.05	15.14	0.30
NH 5	44°39'	124°10'	41	8.19	33.58	1.77	0.86	28.28	23.15	0.09	23.06	0.25
NH 5	44°39'	124°10'	51	8.11	33.73	2.05	0.13	34.48	27.40	0.09	27.32	0.33
NH 5	44°39'	124°10'	54	8.10	33.74	2.07	0.64	34.94	27.54	0.10	27.44	0.44
NH 15	44°39'	124°24'	1	10.06	31.69	0.39	0.36	2.10	2.27	0.04	2.24	1.77
NH 15	44°39'	124°24'	5	10.06	31.69	0.39	0.37	1.96	2.35	0.04	2.30	1.60
NH 15	44°39'	124°24'	10	9.86	31.87	0.43	0.37	2.63	2.76	0.06	2.71	1.42
NH 15	44°39'	124°24'	15	9.59	32.10	0.52	0.34	2.68	3.31	0.06	3.26	1.64
NH 15	44°39'	124°24'	20	9.87	31.85	0.50	0.36	3.15	3.59	0.06	3.53	1.71
NH 15	44°39'	124°24'	31	9.06	32.73	0.76	0.44	6.08	7.03	0.25	6.79	0.92
NH 15	44°39'	124°24'	41	9.00	32.77	0.80	0.35	6.55	7.24	0.22	7.02	0.37
NH 15	44°39'	124°24'	50	8.90	32.78	0.72	1.09	6.40	7.11	0.17	6.94	0.31
NH 15	44°39'	124°24'	59	8.86	32.83	0.91	0.34	9.54	9.24	0.15	9.09	0.17
NH 15	44°39'	124°24'	70	8.85	32.91	0.99	0.33	11.65	10.48	0.12	10.36	0.17
NH 15	44°39'	124°24'	85	8.83	33.03	1.19	0.27	15.00	13.65	0.10	13.55	0.18

Appendix B: August 1998 - July 1999 data (continued)

Apr-99			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH 25	44°39'	124°39'	1	10.00	31.97	0.68	0.33	0.47	1.73	0.04	1.69	1.30
NH 25	44°39'	124°39'	10	9.80	32.26	0.46	0.29	2.57	3.09	0.06	3.03	1.44
NH 25	44°39'	124°39'	20	9.38	32.46	0.58	0.30	4.66	4.94	0.11	4.84	1.53
NH 25	44°39'	124°39'	25	9.17	32.48	0.65	0.36	6.55	5.90	0.14	5.76	2.00
NH 25	44°39'	124°39'	30	9.05	32.59	0.73	0.27	6.98	7.13	0.22	6.91	1.65
NH 25	44°39'	124°39'	40	9.03	32.71	0.78	0.40	6.79	7.40	0.24	7.17	0.50
NH 25	44°39'	124°39'	50	8.98	32.74	0.81	0.43	7.02	7.68	0.23	7.45	0.33
NH 25	44°39'	124°39'	70	8.91	32.76	0.84	0.42	7.86	8.08	0.25	7.84	0.24
NH 25	44°39'	124°39'	101	8.77	33.17	1.33	0.44	18.08	16.65	0.06	16.58	0.14
NH 25	44°39'	124°39'	149	8.05	33.86	2.12	0.05	34.05	29.01	0.00	29.01	0.04
NH 25	44°39'	124°39'	199	6.99	33.98	2.39		46.83	33.11		33.11	0.04
NH 25	44°39'	124°39'	260	6.48	34.01	2.57		56.41	35.43		35.42	0.03
NH 35	44°39'	124°53'	3	9.80	32.64	0.51	0.45	4.71	3.56	0.09	3.47	1.51
NH 35	44°39'	124°53'	10	9.80	32.64	0.51	0.38	4.61	3.49	0.09	3.41	1.56
NH 35	44°39'	124°53'	15	9.79	32.63	0.52	0.00	4.77	3.65	0.09	3.55	1.52
NH 35	44°39'	124°53'	20	9.45	32.64	0.57	0.32	4.80	4.38	0.15	4.23	1.28
NH 35	44°39'	124°53'	30	9.27	32.71	0.62	0.12	5.23	4.97	0.16	4.81	0.90
NH 35	44°39'	124°53'	40	9.09	32.74	1.02	1.22	7.09	7.22	0.35	6.87	0.53
NH 35	44°39'	124°53'	50	9.04	32.80	0.89	0.00	8.43	9.11	0.09	9.02	0.22
NH 35	44°39'	124°53'	70	8.91	33.00	1.13	0.00	12.77	12.60	0.01	12.58	0.11
NH 35	44°39'	124°53'	101	8.51	33.49	1.80	0.00	27.04	22.67	0.00	22.67	0.07
NH 35	44°39'	124°53'	151	7.55	33.94	2.23	0.05	39.24	31.51	0.00	31.51	0.03
NH 35	44°39'	124°53'	422	5.30	34.12	3.11		79.89	40.56		40.55	0.05
NH 45	44°39'	125°07'	3	9.57	32.76	0.61	0.36	5.58	3.80	0.04	3.76	0.85
NH 45	44°39'	125°07'	10	9.57	32.75	0.58	0.02	5.44	3.74	0.03	3.71	0.86
NH 45	44°39'	125°07'	15	9.57	32.75	0.61	1.05	5.45	3.68	0.05	3.63	0.87
NH 45	44°39'	125°07'	21	9.57	32.75	0.58	0.02	6.10	3.62	0.03	3.58	0.86
NH 45	44°39'	125°07'	25	9.49	32.75	0.59	0.05	5.64	3.70	0.03	3.66	0.80
NH 45	44°39'	125°07'	30	9.14	32.77	0.62	0.10	5.66	4.06	0.04	4.02	0.59
NH 45	44°39'	125°07'	39	8.98	32.78	0.64	0.16	6.30	4.41	0.05	4.36	0.65
NH 45	44°39'	125°07'	51	8.89	32.78	0.66	0.12	5.37	4.77	0.07	4.71	0.59
NH 45	44°39'	125°07'	70	8.76	32.80	0.72	0.19	5.86	5.49	0.10	5.39	0.31
NH 45	44°39'	125°07'	100	8.63	33.39	1.54	0.00	19.55	18.90	0.00	18.90	0.08
NH 45	44°39'	125°07'	151	7.84	33.89	2.12	0.94	33.92	30.10	0.00	30.10	0.02
NH 45	44°39'	125°07'	689	4.36	34.28	3.24			44.72		44.72	0.01
NH-65	44°39'	125°36'	2	9.39	32.80	0.54	0.00	3.14	3.70	0.08	3.62	0.53
NH-65	44°39'	125°36'	10	9.39	32.80	0.54	0.00	3.30	3.71	0.09	3.62	0.53
NH-65	44°39'	125°36'	20	9.23	32.80	0.55	0.01	3.33	3.72	0.08	3.64	0.46
NH-65	44°39'	125°36'	30	9.00	32.80	0.59	0.14	3.50	3.87	0.09	3.79	0.43
NH-65	44°39'	125°36'	40	8.86	32.80	0.57	0.00	3.53	3.95	0.08	3.88	0.42
NH-65	44°39'	125°36'	50	8.81	32.80	0.57	0.03	3.56	4.18	0.08	4.10	0.41
NH-65	44°39'	125°36'	70	8.72	32.80	0.54	0.04	3.07	3.90	0.08	3.82	0.36
NH-65	44°39'	125°36'	100	8.68	32.86	0.70	0.13	4.67	6.01	0.15	5.86	0.19
NH-65	44°39'	125°36'	150	7.77	33.82	2.01	0.07	31.88	28.44	0.00	28.44	0.02
NH-65	44°39'	125°36'	465	5.20	34.10	2.97		79.54	41.62		41.62	0.00
NH-65	44°39'	125°36'	830	4.07	34.35	3.31		113.50	45.45		45.45	0.01
NH-65	44°39'	125°36'	1005	3.61	34.42	3.31		128.35	45.85		45.85	0.01

Appendix B: August 1998 - July 1999 data (continued)

Apr-99			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-85	44°39'	126°03'	2	9.52	32.78	0.66	0.31	4.88	5.06	0.08	4.98	0.46
NH-85	44°39'	126°03'	9	9.47	32.78	0.66	0.24	4.94	5.06	0.09	4.98	0.49
NH-85	44°39'	126°03'	19	9.37	32.78	0.65	0.25	5.00	5.07	0.09	4.98	0.44
NH-85	44°39'	126°03'	30	9.00	32.78	0.66	0.46	5.46	5.48	0.09	5.39	0.39
NH-85	44°39'	126°03'	41	8.95	32.78	0.67	0.31	5.31	5.49	0.09	5.40	0.42
NH-85	44°39'	126°03'	50	8.84	32.79	0.66	0.28	4.75	5.56	0.09	5.47	0.44
NH-85	44°39'	126°03'	59	8.80	32.79	0.69	0.62	4.81	5.77	0.11	5.66	0.43
NH-85	44°39'	126°03'	70	8.79	32.79	0.71	0.45	5.28	5.98	0.12	5.86	0.33
NH-85	44°39'	126°03'	101	8.49	33.42	1.59	0.41	21.36	20.96	0.00	20.96	0.07
NH-85	44°39'	126°03'	151	7.55	33.88	2.08	0.21	34.66	29.72	0.00	29.72	0.02
NH-85	44°39'	126°03'	970	3.48	34.43	3.27			45.58		45.58	0.01
NH-85	44°39'	126°03'	1006	3.43	34.43	3.29			45.57		45.57	0.01
FM 3	43°13'	124°30'	2	10.02	32.18	0.36	0.37	0.00	1.05	0.11	0.95	1.13
FM 3	43°13'	124°30'	5	9.73	32.29	0.40	0.23	0.00	1.35	0.12	1.22	2.17
FM 3	43°13'	124°30'	8	9.26	32.50	0.62	0.41	0.00	4.24	0.23	4.01	2.87
FM 3	43°13'	124°30'	10	9.22	32.52	0.63	0.44	0.00	4.90	0.25	4.64	2.07
FM 3	43°13'	124°30'	15	9.15	32.61	0.71	0.60	1.88	6.20	0.29	5.91	1.74
FM 3	43°13'	124°30'	20	9.04	32.78	0.85	0.68	6.61	8.09	0.31	7.77	0.90
FM 3	43°13'	124°30'	25	9.01	32.81	0.91	0.37	7.94	9.03	0.33	8.70	0.70
FM 3	43°13'	124°30'	30	8.82	33.05	1.23	0.21	14.37	13.52	0.26	13.26	0.46
FM 3	43°13'	124°30'	40	8.47	33.35	1.67	0.33	25.50	20.62	0.22	20.40	0.35
FM 3	43°13'	124°30'	50	7.81	33.75	2.11	0.68	37.81	27.58	0.18	27.40	0.13
FM 3	43°13'	124°30'	55	7.78	33.76	2.18	0.32	38.50	27.95	0.18	27.77	0.12
FM 4	43°13'	124°35'	2	10.23	32.30	0.37	0.29	0.00	1.20	0.03	1.17	2.03
FM 4	43°13'	124°35'	5	10.09	32.37	0.36	0.27	0.00	1.61	0.02	1.59	2.08
FM 4	43°13'	124°35'	10	9.97	32.41	0.33	0.40	0.00	1.74	0.02	1.72	2.02
FM 4	43°13'	124°35'	15	9.50	32.50	0.61	0.39	2.22	5.16	0.16	5.00	1.34
FM 4	43°13'	124°35'	20	9.29	32.64	0.65	0.40	4.31	6.19	0.25	5.94	0.79
FM 4	43°13'	124°35'	29	8.99	32.92	0.93	0.33	9.74	10.09	0.31	0.31	0.30
FM 4	43°13'	124°35'	40	8.65	33.32	1.44	0.26	20.79	18.52	0.09	18.42	0.13
FM 4	43°13'	124°35'	50	8.53	33.41	1.62	0.27	25.39	21.39	0.07	21.32	0.11
FM 4	43°13'	124°35'	60	8.43	33.46	1.68	0.28	27.28	22.35	0.09	22.26	0.12
FM 4	43°13'	124°35'	71	7.90	33.74	2.01	0.29	37.49	27.90	0.17	27.73	0.11
FM 4	43°13'	124°35'	80	7.67	33.85	2.18	0.33	41.46	30.02	0.19	29.83	0.10
FM 5	43°13'	124°40'	1	10.33	32.39	0.38	0.43	0.21	1.38	0.02	1.37	1.16
FM 5	43°13'	124°40'	10	10.33	32.39	0.38	0.33	0.23	1.40	0.02	1.38	1.18
FM 5	43°13'	124°40'	20	10.22	32.56	0.50	0.20	2.30	3.33	0.02	3.31	1.24
FM 5	43°13'	124°40'	25	9.46	32.62	0.61	0.50	3.34	4.44	0.05	4.39	1.18
FM 5	43°13'	124°40'	30	9.31	32.63	0.65	0.44	3.56	5.42	0.11	5.30	1.05
FM 5	43°13'	124°40'	40	9.05	32.75	0.76	0.30	5.64	7.12	0.28	6.84	0.44
FM 5	43°13'	124°40'	50	8.99	32.97	1.04	0.26	10.77	11.54	0.24	11.30	0.21
FM 5	43°13'	124°40'	60	8.73	33.28	1.44	0.23	19.42	18.08	0.05	18.03	0.12
FM 5	43°13'	124°40'	70	8.57	33.47	1.68	0.26	24.98	22.29	0.02	22.27	0.09
FM 5	43°13'	124°40'	100	7.81	33.78	2.07	0.28	37.12	28.07	0.19	27.88	0.11
FM 5	43°13'	124°40'	149	7.22	33.97	2.08	0.52	39.72	28.43	0.04	28.40	0.06

Appendix B: August 1998 - July 1999 data (continued)

Apr-99			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
FM 7	43°13'	124°50'	2	10.22	32.45	0.36	0.00	1.49	0.52	0.00	0.52	1.90
FM 7	43°13'	124°50'	10	10.20	32.48	0.37	0.18	1.66	0.60	0.00	0.60	1.88
FM 7	43°13'	124°50'	20	9.34	32.58	0.57	0.21	4.04	3.48	0.13	3.36	1.42
FM 7	43°13'	124°50'	30	9.26	32.61	0.66	0.25	4.68	4.69	0.24	4.44	1.08
FM 7	43°13'	124°50'	41	9.10	32.80	0.84	0.73	7.53	7.22	0.35	6.87	0.46
FM 7	43°13'	124°50'	50	8.93	33.03	1.10	0.17	12.57	12.01	0.09	11.91	0.21
FM 7	43°13'	124°50'	70	8.60	33.60	1.77	0.54	25.16	27.04	0.00	27.04	0.06
FM 7	43°13'	124°50'	100	8.25	33.79	1.99	0.33	31.46	27.61	0.00	27.61	0.04
FM 7	43°13'	124°50'	151	7.49	33.96	2.15	1.23	39.02	30.94	0.00	30.94	0.03
FM 7	43°13'	124°50'	338	5.86	34.07	2.60		67.56	38.62		38.62	0.02
FM 8	43°13'	125°00'	2	10.37	32.47	0.53	0.74	1.70	2.38	0.04	2.34	0.93
FM 8	43°13'	125°00'	10	10.20	32.52	0.44	1.32	1.51	2.39	0.03	2.36	0.91
FM 8	43°13'	125°00'	20	9.50	32.68	0.54	0.28	4.20	3.37	0.03	3.34	1.35
FM 8	43°13'	125°00'	27	9.44	32.70	0.54	0.32	4.01	3.38	0.02	3.36	1.43
FM 8	43°13'	125°00'	30	9.43	32.70	0.55	0.35	4.23	3.46	0.02	3.44	1.44
FM 8	43°13'	125°00'	40	9.34	32.71	0.61	0.37	4.25	4.57	0.08	4.49	0.84
FM 8	43°13'	125°00'	50	9.22	32.73	0.67	0.40	4.68	5.34	0.12	5.21	0.70
FM 8	43°13'	125°00'	70	9.01	32.91	1.03	0.40	10.45	11.19	0.11	11.08	0.16
FM 8	43°13'	125°00'	100	8.43	33.76	1.95	0.27	30.39	26.73	0.00	26.73	0.04
FM 8	43°13'	125°00'	151	7.30	33.97		0.05	41.47	31.54	0.00	31.54	0.03
FM 8	43°13'	125°00'	839	4.12	34.33				44.92		44.92	0.01
FM 8	43°13'	125°00'	1005	3.75	34.41				44.97		44.97	0.01
FM 9	43°13'	125°10'	2	10.18	32.62	0.53	0.08	5.98	3.49	0.03	3.45	1.02
FM 9	43°13'	125°10'	10	10.18	32.62	0.54	0.30	5.37	3.43	0.04	3.39	0.97
FM 9	43°13'	125°10'	15	9.95	32.63	0.53	0.56	5.81	3.65	0.03	3.62	1.05
FM 9	43°13'	125°10'	21	9.68	32.64	0.55	0.41	6.04	4.01	0.03	3.98	1.20
FM 9	43°13'	125°10'	30	9.29	32.69	0.66	0.50	6.47	5.80	0.12	5.68	1.08
FM 9	43°13'	125°10'	40	9.22	32.73	0.68	0.36	6.70	5.54	0.09	5.45	0.91
FM 9	43°13'	125°10'	50	9.04	32.75	0.67	0.39	6.92	5.83	0.09	5.74	0.80
FM 9	43°13'	125°10'	70	8.92	32.77	0.65	0.38	5.90	5.64	0.09	5.54	0.44
FM 9	43°13'	125°10'	153	7.99	33.90	2.06	0.07	33.08	28.74	0.00	28.74	0.02
FM 9	43°13'	125°10'	970	3.70	34.42	3.26			44.67		44.67	0.01
FM 9	43°13'	125°10'	1005	3.62	34.43	3.27			44.94		44.94	0.01
CR-1	41°54'	124°18'	1	9.36	33.09	1.46	0.07	27.59	18.23	0.15	18.08	1.21
CR-1	41°54'	124°18'	4	9.27	33.13	1.47	0.29	27.13	18.46	0.16	18.31	0.94
CR-1	41°54'	124°18'	10	8.88	33.31	1.62	0.29	28.78	20.57	0.13	20.44	0.95
CR-1	41°54'	124°18'	20	8.41	33.62	1.85	0.34	32.68	24.02	0.12	23.89	0.45
CR-1	41°54'	124°18'	31	7.97	33.75	1.94	0.10	37.34	25.45	0.17	25.28	0.28

Appendix B: August 1998 - July 1999 data (continued)

Apr-99 Station	Lat	Long	[db] P	[°C] T	S	[uM] PO_4	[uM] NH_4	[uM] SiO_2	[uM] N+N	[uM] NO_2	[uM] NO_3	[ug/L] Chl a
CR-3	41°54'	124°30'	1	9.98	32.63	0.84	0.47	11.80	9.29	0.11	9.17	1.66
CR-3	41°54'	124°30'	5	9.92	32.63	0.81	0.35	10.15	8.68	0.11	8.58	1.69
CR-3	41°54'	124°30'	10	9.71	32.65	0.82	0.35	9.34	8.56	0.14	8.42	1.72
CR-3	41°54'	124°30'	20	9.47	32.71	0.80	0.31	8.32	8.44	0.16	8.27	1.81
CR-3	41°54'	124°30'	25	9.43	32.73	0.83	0.30	8.54	8.65	0.20	8.46	1.55
CR-3	41°54'	124°30'	29	9.08	32.89	0.96	0.31	12.10	10.45	0.34	10.11	0.80
CR-3	41°54'	124°30'	40	8.94	33.11	1.96	0.28	16.70	15.46	0.18	15.28	0.35
CR-3	41°54'	124°30'	50	8.77	33.38	1.37	0.82	20.88	18.97	0.10	18.87	0.19
CR-3	41°54'	124°30'	60	8.56	33.54	1.69	0.27	26.52	22.89	0.08	22.81	0.20
CR-3	41°54'	124°30'	70	8.24	33.73	1.91	0.27	32.16	26.39	0.03	26.36	0.11
CR-3	41°54'	124°30'	100	7.60	33.93	2.11	0.26	39.67	29.83	0.03	29.81	0.04
CR-3	41°54'	124°30'	111	7.47	33.95	2.20	0.26	43.02	31.01	0.05	30.96	0.04
CR-4	41°54'	124°36'	2	10.05	32.47	0.33	0.11	1.23	1.55	0.02	1.53	2.33
CR-4	41°54'	124°36'	10	10.04	32.47	0.35	0.09	0.21	1.62	0.02	1.61	2.33
CR-4	41°54'	124°36'	19	9.71	32.52	0.42	0.11	0.90	2.78	0.03	2.75	2.23
CR-4	41°54'	124°36'	25	9.66	32.53	0.45	0.15	1.19	3.36	0.04	3.33	2.21
CR-4	41°54'	124°36'	30	9.58	32.54	0.49	0.18	1.35	3.58	0.06	3.52	1.93
CR-4	41°54'	124°36'	40	9.33	32.68	0.65	0.50	3.86	5.46	0.21	5.25	1.05
CR-4	41°54'	124°36'	50	9.21	32.75	0.73	0.37	5.06	6.26	0.27	5.99	0.70
CR-4	41°54'	124°36'	70	8.89	33.31	1.52	0.00	19.72	18.93	0.06	18.87	0.14
CR-4	41°54'	124°36'	100	8.30	33.78	2.00	0.03	30.46	26.68	0.00	26.68	0.06
CR-4	41°54'	124°36'	150	7.64	33.95	2.14	0.33	36.96	30.13	0.00	30.13	0.03
CR-4	41°54'	124°36'	360	5.89	34.06	2.66		63.86	36.65		36.65	0.02
CR-4	41°54'	124°36'	451	5.44	34.12	2.51		63.52	32.93		32.93	0.02
CR-5	41°54'	124°42'	2	10.06	32.52	0.37	0.34	3.55	0.49	0.00	0.49	3.28
CR-5	41°54'	124°42'	10	10.06	32.52	0.36	0.15	0.89	0.51	0.00	0.51	3.23
CR-5	41°54'	124°42'	20	10.00	32.52	0.39	0.18	1.22	0.95	0.00	0.95	3.01
CR-5	41°54'	124°42'	25	9.79	32.58	0.47	0.27	2.50	1.95	0.01	1.94	2.10
CR-5	41°54'	124°42'	30	9.58	32.64	0.57	0.47	3.14	3.73	0.09	3.63	0.91
CR-5	41°54'	124°42'	40	9.51	32.67	0.61	0.51	4.10	4.03	0.10	3.92	0.56
CR-5	41°54'	124°42'	51	9.41	32.74	0.66	0.59	4.59	4.82	0.14	4.68	0.38
CR-5	41°54'	124°42'	69	9.31	32.83	0.68	0.28	4.45	5.96	0.12	5.84	0.27
CR-5	41°54'	124°42'	99	8.86	33.57	1.68	0.09	23.64	22.40	0.00	22.40	0.08
CR-5	41°54'	124°42'	150	8.08	33.87	2.03	0.15	31.90	28.22	0.00	28.22	0.05
CR-5	41°54'	124°42'	657	4.68	34.26	3.22		97.50	43.19		43.19	0.04

Appendix B: August 1998 - July 1999 data (continued)

Jul-99 Station	Lat	Long	[db] P	[°C] T	S	[uM] PO_4	[uM] NH_4	[uM] SiO_2	[uM] N+N	[uM] NO_2	[uM] NO_3	[ug/L] Chl a
NH-5	44°39'	124°10'	1	13.47	29.93	0.05	0.02	0.00	0.00	0.00	0.00	3.40
NH-5	44°39'	124°10'	5	10.87	31.72	0.82	0.39	7.32	6.61	0.11	6.51	6.19
NH-5	44°39'	124°10'	10	9.57	32.40	1.33	0.72	15.20	13.51	0.20	13.31	5.81
NH-5	44°39'	124°10'	12	8.23	33.20	1.95	0.75	27.31	23.08	0.30	22.78	3.54
NH-5	44°39'	124°10'	15	8.27	33.29	2.21	1.07	34.09	27.10	0.29	26.81	2.53
NH-5	44°39'	124°10'	20	7.67	33.71	2.32	0.20	40.39	31.19	0.08	31.12	0.66
NH-5	44°39'	124°10'	25	7.58	33.74	2.30	0.01	40.88	31.70	0.01	31.70	0.49
NH-5	44°39'	124°10'	30	7.48	33.81	2.34	0.01	41.99	32.21	0.00	32.22	0.36
NH-5	44°39'	124°10'	40	7.33	33.88	2.58	0.00	53.32	33.99	0.00	33.99	0.38
NH-5	44°39'	124°10'	50	7.16	33.93	2.73	0.01	62.14	34.71	0.00	34.71	0.53
NH-5	44°39'	124°10'	54	7.15	33.93	2.73	0.01	62.31	34.66	0.00	34.66	0.61
NH-15	44°39'	124°24'	1	16.05	23.87	0.00	0.00	27.00	0.00	0.00	0.00	1.29
NH-15	44°39'	124°24'	5	14.53	30.20	0.00	0.00	4.76	0.00	0.00	0.00	1.19
NH-15	44°39'	124°24'	10	12.39	31.79	0.04	0.00	2.79	0.00	0.00	0.00	1.19
NH-15	44°39'	124°24'	19	9.68	32.53	0.54	0.00	7.78	2.12	0.00	2.12	1.42
NH-15	44°39'	124°24'	20	9.31	32.62	0.62	0.19	9.15	4.20	0.09	4.11	1.18
NH-15	44°39'	124°24'	31	8.63	32.74	0.81	0.61	10.51	7.17	0.32	6.84	0.68
NH-15	44°39'	124°24'	34	8.52	32.74	0.84	0.60	10.66	7.70	0.39	7.32	0.56
NH-15	44°39'	124°24'	40	8.30	32.78	0.92	0.00	12.17	9.98	0.42	9.56	0.29
NH-15	44°39'	124°24'	50	8.06	33.06	1.35	0.00	19.59	16.71	0.01	16.71	0.14
NH-15	44°39'	124°24'	60	7.82	33.30	1.95	0.00	31.69	25.32	0.21	25.11	0.16
NH-15	44°39'	124°24'	71	7.98	33.49	1.90	0.00	32.15	25.53	0.00	25.53	0.07
NH-15	44°39'	124°24'	80	7.86	33.60	2.03	0.00	34.87	26.86	0.00	26.86	0.07
NH-25	44°39'	124°39'	2	16.19	26.25	0.00	0.00	15.46	0.00	0.00	0.00	0.79
NH-25	44°39'	124°39'	9	13.81	31.14	0.04	0.00	5.30	0.00	0.00	0.00	0.88
NH-25	44°39'	124°39'	21	10.55	32.19	0.54	0.00	7.99	1.54	0.02	1.52	1.94
NH-25	44°39'	124°39'	22	10.14	32.27	0.69	0.00	9.65	3.47	0.06	3.41	2.03
NH-25	44°39'	124°39'	30	9.12	32.67	0.81	0.45	13.84	6.01	0.21	5.80	0.97
NH-25	44°39'	124°39'	40	8.74	32.76	0.81	0.00	12.50	7.31	0.38	6.94	0.41
NH-25	44°39'	124°39'	49	8.45	32.78	0.87	0.00	12.96	8.62	0.36	8.26	0.22
NH-25	44°39'	124°39'	70	8.24	33.12	1.42	0.00	22.39	17.55	0.01	17.54	0.08
NH-25	44°39'	124°39'	100	8.02	33.76	2.08	0.00	37.64	28.75	0.00	28.75	0.03
NH-25	44°39'	124°39'	151	7.15	33.94	2.36	0.00	48.73	33.11	0.00	33.11	0.03
NH-25	44°39'	124°39'	160	7.06	33.94	2.39	0.00	50.11	33.34	0.00	33.34	0.03
NH-25	44°39'	124°39'	200	6.60	33.98	2.54		56.79	35.31		35.27	0.03
NH-35	44°39'	124°53'	2	16.17	27.34	0.00	0.00	12.33	0.03	0.00	0.03	0.36
NH-35	44°39'	124°53'	10	15.20	30.75	0.13	0.00	4.31	0.05	0.00	0.05	0.43
NH-35	44°39'	124°53'	19	11.00	32.42	0.37	0.00	5.84	0.00	0.00	0.00	0.67
NH-35	44°39'	124°53'	30	9.39	32.70	0.66	0.00	8.64	4.00	0.09	3.91	1.36
NH-35	44°39'	124°53'	36	9.34	32.70	0.73	0.00	9.74	5.71	0.22	5.49	1.03
NH-35	44°39'	124°53'	40	8.98	32.71	0.89	0.00	10.69	8.50	0.63	7.87	0.76
NH-35	44°39'	124°53'	50	8.63	32.75	0.94	0.00	11.93	9.82	0.64	9.18	0.37
NH-35	44°39'	124°53'	70	8.37	32.91	1.17	0.00	15.87	13.61	0.03	13.58	0.11
NH-35	44°39'	124°53'	100	8.14	33.71	2.00	0.00	33.78	27.34	0.01	27.33	0.04
NH-35	44°39'	124°53'	151	7.57	33.91	2.18	0.00	41.24	30.89	0.00	30.89	0.02
NH-35	44°39'	124°53'	225	6.60	33.98	2.46		54.58	34.72		34.72	0.01
NH-35	44°39'	124°53'	424	5.58	34.08	2.91		76.09	39.88		39.88	0.02

Appendix B: August 1998 - July 1999 data (continued)

Jul-99			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
NH-45	44°39'	125°07'	2	15.87	26.83	0.00	0.02	7.82	0.00	0.00	0.00	0.44
NH-45	44°39'	125°07'	9	14.60	31.86	0.15	0.02	0.00	0.00	0.00	0.00	0.33
NH-45	44°39'	125°07'	20	12.61	32.73	0.29	0.01	0.00	0.00	0.00	0.00	0.63
NH-45	44°39'	125°07'	30	11.65	32.79	0.38	0.04	0.60	0.06	0.00	0.06	1.32
NH-45	44°39'	125°07'	35	11.36	32.78	0.42	0.03	1.55	0.89	0.01	0.88	1.30
NH-45	44°39'	125°07'	39	10.59	32.79	0.48	0.05	2.19	1.87	0.05	1.82	1.11
NH-45	44°39'	125°07'	50	9.87	32.82	0.64	0.11	3.14	4.66	0.24	4.41	0.71
NH-45	44°39'	125°07'	69	9.15	32.85	0.77	0.01	5.01	7.07	0.12	6.95	0.18
NH-45	44°39'	125°07'	99	8.73	33.33	1.48	0.01	18.17	18.88	0.00	18.88	0.03
NH-45	44°39'	125°07'	150	7.95	33.85	2.03	0.00	36.51	28.16	0.00	28.16	0.01
NH-45	44°39'	125°07'	871	4.04	34.35	3.29		114.69	44.59		44.59	0.01
NH-65	44°39'	125°36'	2	15.60	30.65	0.00	0.02	0.00	0.00	0.00	0.00	0.27
NH-65	44°39'	125°36'	10	14.90	32.12	0.15	0.02	0.00	0.00	0.00	0.00	0.26
NH-65	44°39'	125°36'	20	13.77	32.54	0.23	0.07	0.00	0.00	0.00	0.00	0.35
NH-65	44°39'	125°36'	30	12.88	32.74	0.27	0.02	0.00	0.00	0.00	0.00	0.53
NH-65	44°39'	125°36'	40	11.02	32.69	0.35	0.06	1.85	0.00	0.00	0.00	1.42
NH-65	44°39'	125°36'	46	10.25	32.77	0.48	0.08	3.42	1.30	0.01	1.29	1.37
NH-65	44°39'	125°36'	50	9.93	32.80	0.53	0.12	3.45	2.51	0.04	2.47	0.87
NH-65	44°39'	125°36'	71	8.97	32.80	0.76	0.12	5.16	6.35	0.19	6.16	0.38
NH-65	44°39'	125°36'	100	9.09	33.04	1.04	0.07	9.47	11.62	0.00	11.62	0.09
NH-65	44°39'	125°36'	150	7.94	33.81	1.82	0.00	33.26	25.61	0.00	25.61	0.01
NH-65	44°39'	125°36'	240	6.63	33.94	2.29		49.93	32.24		32.24	0.01
NH-65	44°39'	125°36'	1004	3.64	34.41	3.29		126.08	44.33		44.33	0.01
NH-85	44°39'	126°03'	1	15.49	30.21	0.00	0.00	0.00	0.00	0.00	0.00	0.30
NH-85	44°39'	126°03'	10	15.41	30.54	0.04	0.00	0.00	0.00	0.00	0.00	0.31
NH-85	44°39'	126°03'	20	11.66	32.35	0.28	0.00	0.00	0.00	0.00	0.00	0.55
NH-85	44°39'	126°03'	30	10.39	32.68	0.42	0.00	0.07	0.00	0.00	0.00	2.27
NH-85	44°39'	126°03'	34	9.75	32.74	0.66	0.13	5.04	3.09	0.15	2.93	2.05
NH-85	44°39'	126°03'	41	9.23	32.75	0.71	0.16	7.16	4.53	0.33	4.20	1.07
NH-85	44°39'	126°03'	50	8.81	32.76	0.80	0.00	6.14	6.93	0.22	6.71	0.27
NH-85	44°39'	126°03'	70	8.46	32.83	0.88	0.00	7.51	8.29	0.08	8.21	0.12
NH-85	44°39'	126°03'	100	8.53	33.38	1.63	0.00	21.18	20.98	0.00	20.98	0.03
NH-85	44°39'	126°03'	151	7.74	33.84	1.96	0.00	36.07	27.52	0.00	27.52	0.01
NH-85	44°39'	126°03'	885	3.81	34.36	3.30		121.01	44.61		44.61	0.00
NH-85	44°39'	126°03'	1005	3.60	34.41	3.27		131.67	44.18		44.18	0.01
HH-1	44°00'	124°12'	1	13.75	32.46	0.13	0.00	2.24	0.00	0.00	0.00	5.64
HH-1	44°00'	124°12'	5	13.01	32.61	0.38	0.00	3.26	1.54	0.01	1.52	14.62
HH-1	44°00'	124°12'	10	9.43	33.19	1.75	0.85	24.68	20.38	0.41	19.97	10.77
HH-1	44°00'	124°12'	15	8.38	33.35	2.09	0.70	32.30	25.74	0.39	25.35	1.31
HH-1	44°00'	124°12'	20	7.97	33.54	2.18	0.00	39.07	29.11	0.09	29.02	0.75
HH-1	44°00'	124°12'	25	7.89	33.66	2.25	0.00	41.23	30.34	0.05	30.29	0.56
HH-1	44°00'	124°12'	30	7.74	33.74	2.24	0.00	43.82	30.89	0.03	30.86	0.41
HH-1	44°00'	124°12'	40	7.37	33.86	2.62	0.00	57.34	33.88	0.01	33.87	0.42
HH-1	44°00'	124°12'	48	7.30	33.88	2.67	0.00	60.88	33.89	0.07	33.81	0.71

Appendix B: August 1998 - July 1999 data (continued)

Jul-99			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
HH-2	44°00'	124°24'	1	14.12	30.38	0.06	0.00	2.18	0.00	0.00	0.00	2.32
HH-2	44°00'	124°24'	5	13.28	30.65	0.22	0.00	4.20	0.71	0.02	0.69	2.58
HH-2	44°00'	124°24'	11	9.44	32.31	1.04	0.00	14.12	10.05	0.29	9.76	2.96
HH-2	44°00'	124°24'	20	8.16	32.84	1.38	0.22	18.87	23.15	0.38	22.76	1.58
HH-2	44°00'	124°24'	30	7.96	33.59	2.32	0.05	39.43	30.96	0.23	30.73	0.87
HH-2	44°00'	124°24'	40	7.63	33.79	2.49	0.00	47.20	33.65	0.07	33.58	0.28
HH-2	44°00'	124°24'	50	7.37	33.87	2.56	0.00	51.23	34.26	0.07	34.20	0.39
HH-2	44°00'	124°24'	60	7.27	33.89	2.53	0.00	52.96	34.27	0.04	34.23	0.22
HH-2	44°00'	124°24'	70	7.37	33.94	2.23	0.00	44.92	32.36	0.05	32.32	0.13
HH-2	44°00'	124°24'	100	6.97	33.96	2.45	0.07	51.25	33.75	0.09	33.65	0.10
HH-2	44°00'	124°24'	116	6.87	33.97	2.75	0.89	62.18	34.59	0.48	34.11	0.13
HH-3	44°00'	124°36'	1	14.59	29.64	0.00	0.00	0.00	0.00	0.16	0.00	1.28
HH-3	44°00'	124°36'	10	10.66	32.08	0.40	0.00	1.95	0.00	0.19	0.00	4.08
HH-3	44°00'	124°36'	15	8.92	32.49	1.03	0.13	8.72	8.83	0.25	8.58	2.96
HH-3	44°00'	124°36'	20	8.78	32.87	1.55	0.74	15.35	16.08	0.33	15.75	1.23
HH-3	44°00'	124°36'	30	7.96	33.29	2.04	0.00	29.28	26.11	0.19	25.91	0.38
HH-3	44°00'	124°36'	40	7.82	33.49	2.18	0.00	34.12	28.67	0.02	28.65	0.19
HH-3	44°00'	124°36'	50	7.80	33.63	2.30	0.00	38.36	30.39	0.00	30.39	0.18
HH-3	44°00'	124°36'	59	7.67	33.77	2.28	0.00	39.91	30.57	0.00	30.57	0.10
HH-3	44°00'	124°36'	71	7.46	33.86	2.37	0.00	42.96	32.06	0.00	32.06	0.08
HH-3	44°00'	124°36'	100	7.35	33.95	2.28	0.00	41.23	31.78	0.00	31.78	0.04
HH-3	44°00'	124°36'	120	7.09	33.96	2.34	0.00	44.28	32.65	0.00	32.66	0.04
HH-3	44°00'	124°36'	147	6.92	33.97	2.59	1.32	59.67	33.36	0.32	33.04	0.10
HH-4	44°00'	124°48'	1	15.31	29.18	0.00	0.00	2.85	0.00	0.00	0.00	0.71
HH-4	44°00'	124°48'	5	15.29	29.18	0.00	0.00	2.45	0.00	0.00	0.00	0.73
HH-4	44°00'	124°48'	10	14.12	30.70	0.07	0.00	0.00	0.00	0.00	0.00	1.24
HH-4	44°00'	124°48'	15	10.04	32.26	0.68	0.17	3.02	3.67	0.07	3.61	2.73
HH-4	44°00'	124°48'	20	9.06	32.52	0.88	0.46	4.29	6.08	0.21	5.88	1.62
HH-4	44°00'	124°48'	31	8.39	32.72	1.02	0.61	6.94	8.64	0.53	8.11	1.07
HH-4	44°00'	124°48'	41	8.12	32.86	1.27	0.17	11.72	13.99	0.49	13.50	0.58
HH-4	44°00'	124°48'	50	7.96	33.35	1.95	0.00	28.41	25.12	0.17	24.95	0.26
HH-4	44°00'	124°48'	59	7.83	33.70	2.17	0.00	35.49	29.26	0.00	29.26	0.06
HH-4	44°00'	124°48'	69	7.83	33.78	2.17	0.00	34.17	29.64	0.00	29.64	0.03
HH-4	44°00'	124°48'	96	7.27	33.95	2.30	0.00	40.48	31.30	0.00	31.30	0.04
HH-5	44°00'	125°00'	1	14.92	29.90	0.02	0.00	3.04	0.00	0.00	0.00	0.90
HH-5	44°00'	125°00'	10	13.52	30.93	0.26	0.04	2.83	1.12	0.04	1.08	1.93
HH-5	44°00'	125°00'	15	10.96	32.12	0.89	1.00	8.46	7.91	0.20	7.71	1.34
HH-5	44°00'	125°00'	20	9.26	32.73	1.64	1.10	20.35	18.55	0.32	18.23	0.77
HH-5	44°00'	125°00'	30	8.07	33.14	1.92	0.05	28.39	24.42	0.25	24.16	0.38
HH-5	44°00'	125°00'	40	7.96	33.53	2.05	0.00	33.59	27.82	0.01	27.80	0.05
HH-5	44°00'	125°00'	49	7.81	33.66	2.15	0.00	37.08	29.44	0.01	29.43	0.05
HH-5	44°00'	125°00'	70	7.56	33.79	2.30	0.00	41.99	31.61	0.00	31.61	0.06
HH-5	44°00'	125°00'	100	7.20	33.93	2.38	0.00	47.33	33.39	0.00	33.39	0.04
HH-5	44°00'	125°00'	150	6.88	33.98	2.36	0.00	50.80	33.22	0.00	33.21	0.01
HH-5	44°00'	125°00'	500	5.49	34.10	2.88		79.07	40.01		40.00	0.02
HH-5	44°00'	125°00'	929	4.01	34.36	3.24		121.33	44.46		44.46	0.01

Appendix B: August 1998 - July 1999 data (continued)

Jul-99			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
HH-7	44°00'	125°12'	1	14.79	30.06	0.00	0.00	0.00	0.00	0.00	0.00	0.95
HH-7	44°00'	125°12'	9	14.69	30.10	0.00	0.01	0.00	0.00	0.00	0.00	1.19
HH-7	44°00'	125°12'	15	12.69	31.19	0.30	0.14	0.00	0.57	0.03	0.54	2.62
HH-7	44°00'	125°12'	19	10.09	32.21	0.98	0.61	7.16	8.31	0.19	8.12	2.14
HH-7	44°00'	125°12'	30	8.25	33.08	1.82	0.47	23.05	21.54	0.28	21.26	0.53
HH-7	44°00'	125°12'	40	8.07	33.33	2.05	0.07	29.79	26.28	0.22	26.05	0.23
HH-7	44°00'	125°12'	50	7.94	33.47	2.18	0.00	33.94	28.53	0.03	28.50	0.14
HH-7	44°00'	125°12'	70	7.62	33.74	2.32	0.00	40.68	31.16	0.00	31.16	0.09
HH-7	44°00'	125°12'	100	7.33	33.88	2.44	0.00	45.44	33.04	0.00	33.04	0.06
HH-7	44°00'	125°12'	150	6.54	33.99	2.51	0.00	57.13	35.00	0.00	35.00	0.03
HH-7	44°00'	125°12'	200	6.22	34.02	2.64		62.69	36.57		36.48	0.02
HH-7	44°00'	125°12'	1005	3.79	34.39	3.27		127.37	44.50		44.50	0.01
HH-9	44°00'	125°24'	1	16.07	27.49	0.00	0.00	8.23	0.00	0.00	0.00	0.49
HH-9	44°00'	125°24'	10	15.74	28.54	0.00	0.00	5.30	0.00	0.00	0.00	0.58
HH-9	44°00'	125°24'	20	11.37	32.06	0.27	0.00	0.00	0.00	0.00	0.00	1.40
HH-9	44°00'	125°24'	30	9.72	32.43	0.49	0.00	2.05	0.00	0.00	0.00	2.38
HH-9	44°00'	125°24'	35	9.39	32.63	0.69	0.13	2.52	1.95	0.10	1.85	1.43
HH-9	44°00'	125°24'	40	8.98	32.69	0.83	0.36	4.34	4.11	0.20	3.91	1.25
HH-9	44°00'	125°24'	50	8.67	32.71	0.87	0.40	5.87	5.16	0.29	4.87	1.01
HH-9	44°00'	125°24'	70	8.22	32.80	1.07	0.10	8.89	9.87	0.55	9.33	0.36
HH-9	44°00'	125°24'	100	7.70	33.69	2.29	0.00	39.22	30.46	0.00	30.46	0.11
HH-9	44°00'	125°24'	150	7.07	33.95	2.43	0.00	47.95	33.89	0.00	33.89	0.04
HH-9	44°00'	125°24'	555	4.98	34.18	3.19		94.18	43.55		43.55	0.01
HH-9	44°00'	125°24'	1005	3.73	34.40	3.37		130.52	46.27		46.27	0.02
FM-3	43°13'	124°30'	2	13.05	32.56	0.50	0.00	12.38	3.40	0.10	3.30	4.23
FM-3	43°13'	124°30'	5	12.90	32.58	0.61	0.00	15.38	4.77	0.12	4.66	5.05
FM-3	43°13'	124°30'	10	9.55	33.37	1.52	0.00	31.24	16.93	0.27	16.66	10.00
FM-3	43°13'	124°30'	15	8.54	33.52	1.12	0.00	37.82	22.57	0.30	22.27	8.66
FM-3	43°13'	124°30'	20	7.71	33.73	2.27	0.00	45.31	30.06	0.23	29.83	1.69
FM-3	43°13'	124°30'	22	7.66	33.75	2.31	0.00	46.81	30.75	0.24	30.51	1.09
FM-3	43°13'	124°30'	25	7.52	33.81	2.44	0.00	51.00	32.12	0.31	31.81	0.88
FM-3	43°13'	124°30'	31	7.32	33.88	2.45	0.65	53.40	32.94	0.36	32.59	0.65
FM-3	43°13'	124°30'	40	7.20	33.91	2.64	1.55	57.30	33.91	0.38	33.53	0.36
FM-3	43°13'	124°30'	50	7.20	33.91	2.63	1.57	57.31	34.11	0.37	33.74	0.28
FM-3	43°13'	124°30'	54	7.20	33.91	2.63	1.56	57.31	33.77	0.38	33.39	0.33
FM-4	43°13'	124°35'	2	14.71	31.77	0.00	0.00	3.18	0.00	0.00	0.00	1.41
FM-4	43°13'	124°35'	5	14.60	31.82	0.05	0.00	3.33	0.00	0.00	0.00	1.20
FM-4	43°13'	124°35'	10	12.25	32.32	0.25	0.00	6.01	0.64	0.02	0.62	2.97
FM-4	43°13'	124°35'	15	9.83	32.72	0.00	0.00	3.47	0.00	0.00	0.00	1.32
FM-4	43°13'	124°35'	20	8.75	33.04	1.80		27.38	20.00	0.32	19.69	2.37
FM-4	43°13'	124°35'	25	8.59	33.32	1.86	0.53	33.36	23.02	0.26	22.75	2.51
FM-4	43°13'	124°35'	30	8.07	33.59	1.93	0.00	45.76	30.23	0.22	30.01	0.67
FM-4	43°13'	124°35'	40	7.33	33.88	2.51	0.64	52.33	32.90	0.27	32.64	0.23
FM-4	43°13'	124°35'	51	7.21	33.94	2.40	0.00	48.89	33.24	0.21	33.03	0.16
FM-4	43°13'	124°35'	60	7.18	33.94	2.41	0.04	49.93	32.96	0.19	32.77	0.20
FM-4	43°13'	124°35'	71	7.07	33.96	2.46	1.11	52.77	33.02	0.18	32.84	0.21
FM-4	43°13'	124°35'	78	7.03	33.96	2.45	0.97	52.76	32.88	0.17	32.71	0.21

Appendix B: August 1998 - July 1999 data (continued)

Jul-99			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
FM-5	43°13'	124°40'	1	15.20	31.07	0.00	0.00	3.03	0.00	0.00	0.00	0.77
FM-5	43°13'	124°40'	10	13.94	31.53	0.09	0.01	3.63	0.00	0.00	0.00	1.48
FM-5	43°13'	124°40'	20	9.25	32.34	1.23	1.83	15.80	10.31	0.25	10.06	1.90
FM-5	43°13'	124°40'	25	8.40	32.65	1.61	1.71	23.62	16.97	0.37	16.60	0.84
FM-5	43°13'	124°40'	30	8.11	32.79	1.71	0.68	27.98	20.21	0.41	19.80	0.43
FM-5	43°13'	124°40'	40	8.03	33.13	1.76	0.03	29.17	22.19	0.31	21.87	0.36
FM-5	43°13'	124°40'	50	8.02	33.46	2.04	0.04	35.18	26.70	0.24	26.46	0.38
FM-5	43°13'	124°40'	60	7.71	33.75	2.26	0.05	43.15	30.68	0.16	30.53	0.21
FM-5	43°13'	124°40'	71	7.39	33.88	2.44	0.17	47.43	32.80	0.31	32.49	0.34
FM-5	43°13'	124°40'	100	6.94	33.97	2.30	0.13	48.51	32.23	0.11	32.12	0.07
FM-5	43°13'	124°40'	147	6.72	33.99	2.56	0.66	55.35	34.13	0.15	33.98	0.10
FM-7	43°13'	124°50'	2	14.97	30.71	0.00	0.00	3.02	0.00	0.00	0.00	0.40
FM-7	43°13'	124°50'	10	12.29	32.06	0.23	0.00	0.00	0.00	0.00	0.00	0.38
FM-7	43°13'	124°50'	20	9.88	32.60	0.56	0.04	3.10	1.92	0.07	1.84	1.10
FM-7	43°13'	124°50'	25	9.29	32.68	0.71	0.16	4.36	4.56	0.24	4.31	1.14
FM-7	43°13'	124°50'	29	8.98	32.72	0.79	0.22	4.72	6.05	0.41	5.64	0.83
FM-7	43°13'	124°50'	40	8.63	32.75	0.89	0.14	6.27	8.92	0.68	8.24	0.56
FM-7	43°13'	124°50'	49	8.44	32.77	0.98	0.03	8.72	9.56	0.55	9.02	0.37
FM-7	43°13'	124°50'	60	8.40	32.88	1.05	0.00	9.53	11.05	0.13	10.92	0.18
FM-7	43°13'	124°50'	70	8.60	33.19	1.24	0.00	13.33	14.77	0.00	14.77	0.05
FM-7	43°13'	124°50'	100	8.02	33.76	2.03	0.00	31.89	27.56	0.00	27.56	0.03
FM-7	43°13'	124°50'	150	7.23	33.93	2.47	0.50	50.91	32.84	0.19	32.65	0.05
FM-7	43°13'	124°50'	342	5.74	34.07	2.82		72.70	38.72		38.72	0.03
FM-8	43°13'	125°00'	2	15.51	30.20	0.00	0.00	0.19	0.00	0.00	0.00	0.32
FM-8	43°13'	125°00'	10	14.41	31.09	0.11	0.02	0.00	0.00	0.00	0.00	0.33
FM-8	43°13'	125°00'	20	10.53	32.56	0.34	0.02	0.68	0.00	0.00	0.00	0.85
FM-8	43°13'	125°00'	25	9.57	32.68	0.56	0.09	3.74	2.84	0.13	2.71	1.05
FM-8	43°13'	125°00'	30	9.10	32.74	0.73	0.04	5.59	6.23	0.32	5.91	0.74
FM-8	43°13'	125°00'	39	8.74	32.77	0.84	0.02	6.52	8.26	0.03	8.24	0.28
FM-8	43°13'	125°00'	50	8.78	32.85	0.71	0.19	3.79	5.79	0.28	5.50	0.24
FM-8	43°13'	125°00'	70	8.58	33.04	1.01	0.01	9.76	11.13	0.00	11.13	0.06
FM-8	43°13'	125°00'	13	8.61	33.60	1.82	0.03	25.18	24.06	0.00	24.06	0.01
FM-8	43°13'	125°00'	150	7.36	33.92	2.21	0.00	43.80	31.03	0.00	31.03	0.02
FM-8	43°13'	125°00'	998	3.90	34.39	3.30		124.96	44.44		44.44	0.01
FM-9	43°13'	125°10'	2	15.35	30.24	0.00	0.08	0.00	0.00	0.00	0.00	0.37
FM-9	43°13'	125°10'	10	13.73	31.24	0.04	0.13	0.00	0.00	0.00	0.00	0.45
FM-9	43°13'	125°10'	17	11.13	31.79	0.42	0.13	0.10	1.60	0.03	1.57	2.81
FM-9	43°13'	125°10'	20	10.59	31.95	0.58	0.24	1.68	3.03	0.04	2.99	2.79
FM-9	43°13'	125°10'	29	10.65	32.53	0.34	0.07	1.43	0.00	0.00	0.00	1.67
FM-9	43°13'	125°10'	40	8.97	32.75	0.79	0.04	5.76	7.25	0.20	7.05	0.67
FM-9	43°13'	125°10'	50	8.93	32.75	1.12	0.01	12.83	12.90	0.03	12.87	0.30
FM-9	43°13'	125°10'	70	8.67	32.81	0.65	0.06	4.34	6.58	0.00	6.58	0.19
FM-9	43°13'	125°10'	100	8.17	33.43	1.77	0.03	25.45	22.98	0.00	22.98	0.05
FM-9	43°13'	125°10'	150	7.64	33.90	2.11	0.00	40.32	30.02	0.00	30.02	0.02
FM-9	43°13'	125°10'	850	4.18	34.34	3.31		116.49	44.22		44.22	0.01
FM-9	43°13'	125°10'	1004	3.80	34.39	3.31		127.44	44.70		44.70	0.01

Appendix B: August 1998 - July 1999 data (continued)

Jul-99			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
CR-1	41°54'	124°18'	1	8.28	33.89	1.72	0.00	33.02	22.61	0.27	22.34	9.94
CR-1	41°54'	124°18'	5	8.08	33.90	1.89	0.00	35.94	25.55	0.25	25.29	10.23
CR-1	41°54'	124°18'	10	7.80	33.92	2.04	0.00	37.58	28.25	0.23	28.02	8.28
CR-1	41°54'	124°18'	15	7.73	33.93	2.08	0.05	37.22	28.11	0.23	27.88	1.17
CR-1	41°54'	124°18'	20	7.62	33.94	2.13	0.16	40.00	29.19	0.23	28.96	7.96
CR-1	41°54'	124°18'	25	7.54	33.94	2.23	0.31	42.06	30.13	0.23	29.89	5.85
CR-1	41°54'	124°18'	30	7.54	33.94	2.24	0.34	42.28	30.21	0.23	29.98	6.16
CR-1	41°54'	124°18'	35	7.53	33.94	2.20	0.36	42.06	30.14	0.22	29.92	6.48
CR-3	41°54'	124°30'	1	12.89	32.94	0.41	0.13	0.00	1.55	0.13	1.42	1.10
CR-3	41°54'	124°30'	5	12.21	32.94	0.44	0.16	0.00	1.80	0.13	1.67	1.11
CR-3	41°54'	124°30'	10	10.52	32.99	0.70	0.17	0.00	5.51	0.18	5.33	1.63
CR-3	41°54'	124°30'	20	9.63	33.22	1.24	0.32	11.67	13.90	0.24	13.66	2.43
CR-3	41°54'	124°30'	30	8.75	33.31	1.62	0.07	22.15	20.53	0.17	20.37	0.98
CR-3	41°54'	124°30'	40	8.82	33.70	1.74	0.25	26.22	22.48	0.24	22.24	5.72
CR-3	41°54'	124°30'	50	8.58	33.78	1.84	0.34	29.25	24.19	0.23	23.95	5.89
CR-3	41°54'	124°30'	60	8.56	33.79	1.87	0.36	29.74	24.36	0.24	24.13	5.73
CR-3	41°54'	124°30'	70	8.42	33.82	1.90	0.47	30.08	24.84	0.24	24.61	5.22
CR-3	41°54'	124°30'	99	7.84	33.90	2.22	0.69	38.62	28.25	0.24	28.01	2.62
CR-3	41°54'	124°30'	120	7.69	33.94	2.19	0.56	38.36	27.88	0.22	27.67	6.91
CR-3	41°54'	124°30'	128	7.69	33.94	2.19	0.55	38.25	27.83	0.22	27.60	6.67
CR-4	41°54'	124°36'	1	12.19	32.74	0.37	0.04	0.00	0.39	0.09	0.29	1.45
CR-4	41°54'	124°36'	10	11.76	32.71	0.46	0.10	0.67	1.14	0.11	1.03	1.58
CR-4	41°54'	124°36'	15	10.24	32.73	0.76	0.11	5.41	5.95	0.29	5.67	1.62
CR-4	41°54'	124°36'	21	9.59	32.82	0.85	0.31	5.58	7.54	0.32	7.22	1.27
CR-4	41°54'	124°36'	30	9.58	32.91	0.84	0.13	5.29	7.69	0.23	7.46	0.92
CR-4	41°54'	124°36'	40	9.40	33.05	1.09	0.03	8.97	11.90	0.06	11.84	0.65
CR-4	41°54'	124°36'	50	8.78	33.29	1.52	0.00	19.05	19.05	0.08	18.97	0.20
CR-4	41°54'	124°36'	70	8.71	33.58	1.87	0.07	28.68	24.84	0.36	24.47	0.17
CR-4	41°54'	124°36'	100	8.09	33.82	2.14	0.00	34.79	29.35	0.06	29.29	0.09
CR-4	41°54'	124°36'	150	7.43	33.95	2.19	0.00	43.20	30.87	0.00	30.87	0.03
CR-4	41°54'	124°36'	450	5.59	34.11	3.01		79.06	40.61		40.61	0.02
CR-4	41°54'	124°36'	490	5.44	34.13	3.01		81.78	40.48		40.48	0.03
CR-5	41°54'	124°42'	1	13.37	32.66	0.23	0.00	0.00	0.00	0.00	0.00	1.00
CR-5	41°54'	124°42'	10	13.24	32.67	0.23	0.00	0.00	0.00	0.00	0.00	0.99
CR-5	41°54'	124°42'	15	12.95	32.70	0.26	0.00	0.00	0.00	0.00	0.00	1.03
CR-5	41°54'	124°42'	20	12.53	32.71	0.35	0.08	0.00	0.00	0.05	0.00	1.04
CR-5	41°54'	124°42'	30	10.72	32.83	0.65	0.17	0.00	2.59	0.21	2.38	0.97
CR-5	41°54'	124°42'	40	10.01	32.93	0.84	0.28	9.25	8.03	0.21	7.82	0.90
CR-5	41°54'	124°42'	49	9.21	33.01	1.00	0.00	7.50	8.92	0.01	8.91	0.18
CR-5	41°54'	124°42'	70	8.78	33.32	1.47	0.00	17.33	16.84	0.02	16.82	0.17
CR-5	41°54'	124°42'	100	8.49	33.67	2.00	0.00	31.67	25.88	0.35	25.53	0.12
CR-5	41°54'	124°42'	151	7.70	33.90	2.27	0.00	40.30	30.37	0.11	30.26	0.07
CR-5	41°54'	124°42'	499	5.18	34.15	3.03		87.62	41.86		41.86	0.01
CR-5	41°54'	124°42'	621	4.61	34.24	2.96		103.12	43.41		43.41	0.02

Appendix B: August 1998 - July 1999 data (continued)

Jul-99			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
CR-7	41°54'	125°00'	2	12.76	33.10	0.48	0.69	0.00	3.04	0.19	2.85	2.08
CR-7	41°54'	125°00'	11	12.70	33.10	0.52	0.94	0.68	3.20	0.19	3.01	2.17
CR-7	41°54'	125°00'	20	11.06	33.24	0.78	0.70	0.77	6.80	0.24	6.56	4.87
CR-7	41°54'	125°00'	25	10.72	33.29	0.89	0.66	2.30	8.04	0.26	7.77	6.33
CR-7	41°54'	125°00'	30	9.83	33.31	1.18	0.79	12.02	12.87	0.31	12.55	6.80
CR-7	41°54'	125°00'	40	9.13	33.44	1.59	1.08	23.76	19.15	0.32	18.83	4.14
CR-7	41°54'	125°00'	51	8.84	33.71	1.80	1.25	28.89	22.60	0.27	22.34	3.88
CR-7	41°54'	125°00'	70	8.38	33.78	2.02	0.94	35.73	26.67	0.25	26.42	1.42
CR-7	41°54'	125°00'	101	7.91	33.88	2.22	0.69	40.14	29.51	0.24	29.27	0.49
CR-7	41°54'	125°00'	149	7.15	33.96	2.33	0.00	48.94	33.04	0.05	32.99	0.10
CR-7	41°54'	125°00'	500	4.96	34.15	3.08		91.36	42.49		42.49	0.03
CR-7	41°54'	125°00'	817	3.96	34.37	3.25		122.53	44.65		44.65	0.03
CR-9	41°54'	125°20'	2	11.32	33.01	0.82	0.23	2.24	8.02	0.22	7.80	4.95
CR-9	41°54'	125°20'	10	9.64	32.80	1.12	0.16	12.27	10.81	0.21	10.60	3.57
CR-9	41°54'	125°20'	20	9.17	32.88	1.28	0.16	15.00	13.60	0.28	13.32	2.86
CR-9	41°54'	125°20'	24	9.21	32.96	1.31	0.20	15.04	14.31	0.30	14.02	2.32
CR-9	41°54'	125°20'	30	9.02	33.02	1.39	0.17	17.02	15.72	0.29	15.43	2.25
CR-9	41°54'	125°20'	40	9.44	33.22	1.41	0.46	17.06	15.97	0.29	15.68	1.20
CR-9	41°54'	125°20'	49	9.16	33.38	1.58	0.66	20.24	18.45	0.22	18.23	0.79
CR-9	41°54'	125°20'	69	8.40	33.70	1.91	0.00	28.33	25.85	0.00	25.85	0.07
CR-9	41°54'	125°20'	100	8.01	33.83	2.07	0.00	37.63	28.99	0.10	28.89	0.08
CR-9	41°54'	125°20'	150	7.31	33.94	2.29	0.03	47.72	32.62	0.32	32.30	0.08
CR-9	41°54'	125°20'	1006	3.71	34.42	3.25		130.02	44.88		44.88	0.03
EU-1	40°52'	124°16'	1	11.11	33.60	0.41	0.12	0.00	3.12	0.13	2.99	4.85
EU-1	40°52'	124°16'	5	11.05	33.60	0.42	0.13	0.00	3.65	0.12	3.52	4.89
EU-1	40°52'	124°16'	10	11.15	33.61	0.56	0.17	0.00	5.15	0.15	5.00	4.80
EU-1	40°52'	124°16'	15	10.86	33.60	0.72	0.24	2.58	7.48	0.16	7.32	5.31
EU-1	40°52'	124°16'	20	10.55	33.61	1.76	0.73	25.64	22.22	0.28	21.94	1.89
EU-1	40°52'	124°16'	25	8.73	33.74	1.94	0.78	30.25	24.77	0.30	24.47	1.23
EU-1	40°52'	124°16'	30	8.36	33.79	2.02	0.80	30.43	25.97	0.37	25.60	0.91
EU-1	40°52'	124°16'	40	8.09	33.83	2.14	0.69	35.04	27.93	0.40	27.53	0.82
EU-1	40°52'	124°16'	50	7.75	33.91	2.39	1.00	43.00	30.18	0.29	29.89	0.31
EU-1	40°52'	124°16'	56	7.71	33.92	2.39	0.96	41.66	30.18	0.27	29.91	0.30
EU-2	40°52'	124°22'	1	12.37	33.53	0.31	1.21	0.00	1.80	0.07	1.73	1.48
EU-2	40°52'	124°22'	5	11.53	33.51	0.65	0.71	0.84	6.59	0.16	6.43	2.26
EU-2	40°52'	124°22'	10	9.70	33.51	1.26	1.01	9.34	15.08	0.22	14.86	2.64
EU-2	40°52'	124°22'	15	9.45	33.54	1.39	1.48	12.14	16.55	0.23	16.33	1.93
EU-2	40°52'	124°22'	20	9.14	33.56	1.67	0.58	21.64	21.50	0.12	21.38	1.49
EU-2	40°52'	124°22'	30	8.76	33.64	1.79	0.15	24.31	23.75	0.05	23.70	0.87
EU-2	40°52'	124°22'	40	8.51	33.73	1.95	0.00	30.24	26.84	0.04	26.80	0.40
EU-2	40°52'	124°22'	50	8.43	33.82	1.97	0.00	31.20	27.40	0.03	27.36	0.20
EU-2	40°52'	124°22'	60	8.03	33.89	2.09	0.00	35.71	29.26	0.12	29.14	0.24
EU-2	40°52'	124°22'	70	7.92	33.90	2.14	0.00	37.38	29.89	0.18	29.71	0.25
EU-2	40°52'	124°22'	105	7.23	33.98	2.36	0.34	46.59	32.45	0.20	32.25	0.11

Appendix B: August 1998 - July 1999 data (continued)

Jul-99			[db]	[°C]		[uM]	[uM]	[uM]	[uM]	[uM]	[uM]	[ug/L]
Station	Lat	Long	P	T	S	PO_4	NH_4	SiO_2	N+N	NO_2	NO_3	Chl a
EU-3	40°52'	124°28'	2	11.90	33.19	0.28	0.00	1.77	0.00	0.08	0.00	4.17
EU-3	40°52'	124°28'	10	10.88	33.21	0.62	0.00	3.53	4.26	0.19	4.07	4.84
EU-3	40°52'	124°28'	15	9.82	33.33	1.00	0.00	10.55	11.68	0.24	11.44	4.11
EU-3	40°52'	124°28'	20	9.59	33.37	1.23	0.17	15.03	14.42	0.23	14.19	4.29
EU-3	40°52'	124°28'	30	9.17	33.46	1.54	0.10	24.45	19.91	0.14	19.77	1.94
EU-3	40°52'	124°28'	40	8.69	33.63	1.71	0.00	29.22	23.62	0.00	23.62	0.17
EU-3	40°52'	124°28'	50	8.53	33.72	1.97	0.00	36.40	27.39	0.00	27.40	0.06
EU-3	40°52'	124°28'	70	8.05	33.85	1.89	0.00	35.64	27.46	0.00	27.46	0.04
EU-3	40°52'	124°28'	101	7.62	33.93	2.04	0.00	40.87	29.24	0.00	29.24	0.03
EU-3	40°52'	124°28'	150	7.32	34.00	2.25	0.00	49.79	32.84	0.32	32.51	0.08
EU-3	40°52'	124°28'	300	6.59	34.05	2.59		59.43	35.59		35.53	0.04
EU-3	40°52'	124°28'	349	6.27	34.07	2.69		65.00	37.15		37.08	0.05
EU-5	40°52'	124°40'	1	11.70	33.44	0.16	0.00	0.00	0.00	0.00	0.00	7.17
EU-5	40°52'	124°40'	5	11.62	33.44	0.17	0.00	0.00	0.00	0.00	0.00	7.58
EU-5	40°52'	124°40'	10	11.09	33.45	0.43	0.15	0.00	0.00	0.03	0.00	9.88
EU-5	40°52'	124°40'	20	9.50	33.55	1.27	0.64	9.03	12.72	0.19	12.53	6.11
EU-5	40°52'	124°40'	30	9.19	33.58	1.55	0.50	16.16	17.53	0.20	17.33	4.64
EU-5	40°52'	124°40'	40	8.81	33.64	1.73	0.48	21.79	20.91	0.13	20.78	1.95
EU-5	40°52'	124°40'	50	8.59	33.72	1.81	0.59	24.87	22.13	0.13	22.01	1.27
EU-5	40°52'	124°40'	70	8.35	33.79	2.00	0.48	30.95	25.35	0.23	25.12	1.01
EU-5	40°52'	124°40'	100	7.93	33.89	2.09	0.00	34.33	28.09	0.00	28.09	0.07
EU-5	40°52'	124°40'	150	7.47	33.98	2.15	0.00	43.15	30.53	0.00	30.53	0.31
EU-5	40°52'	124°40'	500	5.48	34.20	2.87		85.73	41.12		41.12	0.03
EU-5	40°52'	124°40'	690	4.83	34.25	2.85		100.03	43.14		43.14	0.02
EU-7	40°52'	124°56'	2	11.64	33.04	0.50	0.04	0.89	0.00	0.19	0.00	4.19
EU-7	40°52'	124°56'	10	11.70	33.04	0.57	0.05	0.84	0.00	0.19	0.00	4.23
EU-7	40°52'	124°56'	20	10.16	32.95	0.84	0.11	3.81	8.11	0.25	7.87	3.02
EU-7	40°52'	124°56'	31	9.48	32.89	0.91	0.01	8.65	9.80	0.28	9.52	3.10
EU-7	40°52'	124°56'	40	8.97	32.97	1.09	0.00	14.06	12.80	0.18	12.62	1.36
EU-7	40°52'	124°56'	51	8.93	33.20	1.38	0.00	20.62	17.63	0.22	17.40	0.65
EU-7	40°52'	124°56'	70	8.93	33.56	1.69	0.41	25.74	21.77	0.35	21.42	3.19
EU-7	40°52'	124°56'	85	8.80	33.66	1.68	0.83	25.12	22.46	0.29	22.18	3.32
EU-7	40°52'	124°56'	101	8.62	33.77	1.68	1.63	22.34	21.25	0.25	21.00	3.54
EU-7	40°52'	124°56'	150	7.66	33.94	2.03	0.05	40.57	29.82	0.02	29.80	0.17
EU-7	40°52'	124°56'	714	4.40	34.26	3.04		108.72	44.23		44.23	0.02
EU-7	40°52'	124°56'	1008	3.69	34.42	3.04		129.34	45.11		45.11	0.02