ECOHAB PNW 4 CRUISE REPORT

R/V Atlantis AT11-30
July 7- July 27, 2005

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Area of Operations

Coastal Waters off Washington State and Vancouver Island

Itinerary

Depart Seattle, WA, July 7, 2005
Arrive Seattle, WA, July 27, 2005

Participating Organizations

NOAA/Northwest Fisheries Science Center
Romburg Tiburon Center, San Francisco State University
University of Maine
University of Washington
University of Western Ontario

Chief Scientist

Dr. Barbara M. Hickey, School of Oceanography, University of Washington

Personnel

Principle Investigators

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Dr. Evelyn Lessard, University of Washington
Dr. Vera Trainer, NOAA/Northwest Fisheries Science Center
Dr. Charlie Trick, University of Western Ontario

Staff

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Mike Foy, University of Washington
Susan Geier, University of Washington
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Andrew Ohana-Richardson, University of Oregon
Stacey DeAmicis, University of Washington

Cruise Objectives and Sampling Scheme

The purpose of this cruise was to determine the physical, chemical and physiological conditions under which diatoms of the genus *Pseudo-nitzschia (PN)* produce the neurotoxin domoic acid (DA), and the ecophysiological conditions which promote cellular release of toxin to the surrounding environment. We attempted to observe the conditions under which toxic cells advect towards the coast of Washington where they are consumed by shellfish. Such occurrences lead to closure of beaches to razor clam collection to avoid outbreaks of amnesic shellfish poisoning.

Sampling was organized around a comprehensive grid of stations, sampled repeatedly as environmental conditions changed. Continuous surface water measurements included: temperature, salinity and in vivo fluorescence, discrete surface samples for planktonic community analysis and species identification with net tows. Property profiles were obtained with a CTD (conductivity, temperature, depth) including additional sensors that measured in vivo fluorescence, photosynthetically active radiation (PAR), beam attenuation (light transmission), and oxygen concentration. During CTD casts discrete samples were collected with Niskin water samplers for chlorophyll, nutrient analyses, species and community identification (via FlowCAM and flow cytometer analyses), particulate and dissolved DA. A trace metal clean, underway sampling system was employed to measure iron concentrations on board, and to collect samples for multi-element determination (including copper) ashore. On-deck incubations of phytoplankton assemblages were conducted for growth and grazing experiments, and shipboard analyses of the plankton were routinely conducted using both traditional (microscopic) and advanced (FlowCAM image and flow cytometric analyses) methods. Satellite-tracked drifters were released in the Strait of Juan de Fuca, near the Juan de Fuca eddy and off the coast of Washington. One drifter was followed, sampling the water properties with CTD and Niskin water samples at 1-2 hour intervals. The cruise was diverted to Neah Bay on July 13 to exchange personnel. The overall ship track and CTD stations are shown in Figure 1.

Operations

ADCP lines: ~3000 km
Flow-Through system track with T,S,FL sensors: ~2000 km
CTD casts: 225
Satellite-tracked buoy deployments: 11

Samples Collected

Chlorophyll samples: >200 stations and deck-board experiments (~1500 samples)
Nutrient samples: >150 stations and deck-board experiments (>2000 samples)
^{14}C Uptake (P vs. E) rates: 50 experiments (~1000 samples)
Heterotrophic Bacterial Productivity: 50 experiments (350 samples and controls)
Flow Cytometry samples (nanoplankton, cyanobacteria, bacteria): >125 Stations and Deckboard incubation experiments (~700 samples)
HPLC Pigment samples: >125 Stations at 5 m depth
Dilution growth and grazing experiments: 17
Microplankton samples (preserved): ~13 stations and 17 dilution experiments
FlowCAM samples: ~ 500 stations and experiments
Phytoplankton/DA samples: 228 stations
Surface (4 m) samples for Fe determination and samples for analysis of other bioactive trace metals (Zn, Co, Cu, Ni, Cd) ~120 samples
Sinking Rates: 50 stations
Particulate DA: 1010 samples (650 survey, 360 grow out experiments)
Dissolved DA: 1010 samples (650 survey, 360 grow out experiments)
Preserved net tow samples (650 survey samples) for scanning electron microscopy
Whole water samples (650 survey samples) for *PN* cell counts

Cruise Summary

Introduction

The ECOHAB-PNW 4 cruise has provided an important contrast to the 2003 and 2004 cruises. During ECOHAB-PNW 4, approximately 95% of our normal study area was devoid of *PN* cells producing measurable amounts of DA, and concentrations of both the diatom and the toxin DA never reached maximal levels experienced in previous cruises. Perhaps equally interesting, the cruise took place during a summer with anomalously weak upwelling. The lack of upwelling and media reports of a crashing ecosystem were reported in a number of prominent West Coast newspapers (e.g., Seattle Times, San Francisco Chronicle) as well as on National Public Radio. Our research team was able to measure the system in the reduced upwelling state, but also were able to follow its recovery in a strong, persistent upwelling period that lasted for ~2 weeks of the cruise period.

The study obtained multi-disciplinary data from a large scale grid (Section 1), sampling water properties and plankton while following a drifter (Section 2), deployment of surface drifters (Section 3), satellite imagery (Section 4), and on-board laboratory studies using water/plankton collected at selected sites (Section 5).

The setting of cruise sampling events with respect to wind direction (upwelling or downwelling-favorable) is shown in Figure 2. For simplicity we have characterized the wind patterns into two periods: predominantly downwelling (1) and strong, persistent upwelling (2). All data sections and maps on the website are grouped into these two periods.

Over 200 water column profiles were obtained. Satellite imagery [Sea surface temperature (SST) and chlorophyll] was limited during the first week of the cruise (one useable image). However a number of very good surface fluorescence (Chl a) and turbidity images were obtained during the upwelling period during the second half of the cruise. Cruise activities were recorded in a sequential “Event” log (Table 1) from which summary tables discussed below were derived.

Our cruises to date have been highly successful—moreover we have been able to sample sufficiently different biological, chemical and physical conditions in our study area to allow a comparative analysis of various environmental factors and their effects on *PN*, growth, grazing, nutrient pathways and DA production. In particular, with the new information obtained during this cruise we have shown that:

- The Juan de Fuca eddy is more eddy-like during periods of downwelling winds.

Thus development of a large bloom in the eddy such as in September 2004 likely requires a substantial period of downwelling.

- Phytoplankton (including *PN*) and their associated toxins escape from the eddy primarily during periods of upwelling.
- In contrast with the nearshore coastal regions, the Juan de Fuca eddy region has substantial surface macronutrients (nitrate, silicate) even during extended periods of no coastal upwelling. Thus plankton in the eddy experience a different nutrient environment (N and Si present at saturating concentrations for uptake and growth of diatoms) than the plankton communities near the coast where sub-saturating concentrations are more prevalent.

Four problems were encountered on the cruise: 1) freezers (both -20 and -70 C) were turned off without notice before the cruise left, leading to a meltdown of important reagents and nutrient (non-radioactive) stocks prior to leaving University of Washington; 2) the nutrient autoanalyzer malfunctioned due to severe organic contamination of water used for baseline and reagent preparation. Two days were spent troubleshooting the instrument. The problem was finally traced to substandard Milli-Q water on the R/V Atlantis. The filter set was changed (despite indicator readings suggesting ‘clean’ water) and the problem was eventually solved within another 2 days; 3) the light on the ECOHAB mooring near the eddy center (EH3) was found to be out. A new light was purchased, brought to the ship at Neah Bay and subsequently installed by Amy MacFadyen (UW) and Julian Herndon (SFSU); 4) one of the two recirculating water baths used to regulate water temperature for the P vs E incubators malfunctioned, and could not be repaired despite assistance from the Ship’s Engineering Department and the manufacturer; this necessitated a reduction in scheduled number of P vs E experiments completed during the cruise.

1. Regional Surveys (ECOHAB PNW team)

The large scale survey grid was designed to include areas influenced by the Strait of Juan de Fuca, the Juan de Fuca eddy region and the coastal upwelling region off the Washington coast (Fig. 3). Data collected on surveys included conductivity (C), temperature (T), light transmission, PAR, oxygen and fluorescence (Fl) profiles, and bottle samples for phytoplankton biomass (Chlorophyll a), whole cell fluorescent molecular probe assays, particulate DA, dissolved DA, FlowCAM and Flow cytometry samples, samples for scanning electron microscopy of *PN* species, plankton (including *PN* cell counts) and macronutrients, all at selected depths in the water column. Surface net tows for qualitative community assessment were taken at all survey stations. Water samples containing *PN* were placed in medium for isolation and culturing in the laboratory. Underway data included T, S and Fl pumped from a depth of about 4 m as well as ADCP current profiles from a 150 kHz narrowband RDI ADCP. An ISUS nitrate sensor was tested during this cruise.

In addition to surveys, a time series at a fixed location (LAB3) was obtained. The time series was taken to determine whether the enhanced upper water column upwelling previously observed at this station was due to tidal forcing. The series was continued for 25 hours, CTD profiles were taken every 2 hours.

A list of CTD stations organized by sample line and including bottle sample types taken is given in Table 2. Lines were sampled in whichever direction made best use of ship time. CTD profiles were taken to 500 m where possible. Deeper data were taken on the OZ line only once and the section occurred during the downwelling period. For the first time in our ECOHAB-PNW studies, the northern line LD was sampled. Several calibration stations were taken at the three mooring sites.

Chlorophyll a (size-fractionated samples: >5 µm and GF/F filters), particulate and dissolved DA and plankton samples (for both microscope and molecular probe analysis) were taken near the surface (~0 m), 5 m and 10 m (and at 15 m at stations after the initial grid survey). DA samples were also taken at 15, 30 and 50 m at other stations, in particular, at Juan de Fuca Strait stations. Flow cytometry and HPLC pigment samples were taken at 5 m depth. Macronutrients (nitrate + nitrite, silicate) were taken generally at the surface, 5 m, 10 m, 15 m, 30 m, 50 m, 100 m, 200 m, 500 m and ~5-10 m above bottom if the bottom was less than 500 m deep. In the Juan de Fuca Strait survey, samples were taken also at 150 m. Whole water samples (4 L) from these deep stations were concentrated through a 20 micron mesh and plankton were visualized through the FlowCAM. On transects, macro-nutrients were taken in most cases at the two stations closest to shore on a line and then every other station on each line. Chlorophyll samples were taken at all stations at 3-4 depths (0, 5 10 m, and chlorophyll maximum depth)

The ISUS nitrate sensor, mounted on the instrumented rosette can be used for vertical profiling, with appropriate calibration. Zero values had an offset of 5-8 µm, and low values were not reliable as the offset diminished with magnitude, but not linearly. These data could be improved with some careful comparison with bottle samples. Above values of ~15 µm nitrate, the sensor was very accurate (plus/minus 1 µm) during this cruise. Missing casts are due to battery failure.

More emphasis was placed this year on determining the source of cells to the Juan de Fuca eddy. At a few stations, 4 L of water was concentrated from the bottom boundary layer to investigate this issue. These samples were both placed into f/2 medium for culturing (Trainer) and analyzed with the FlowCAM (Lessard). Sediment grabs were taken at two stations. A drop of sediment was added to f/2 medium to determine what types of cells are still viable in the sediment surface layers. We hypothesize that the silica cell walls of *PN* (and therefore other diatoms as well) will assist their survival in the upper layers of sediment.

Upper water column iron samples were taken at selected stations (Tables 1 and 2). These samples were obtained by flying the trace-metal sampler “FISH” below the surface (~4 m). Samples were taken as the ship approached station (within 10-min). Water was pumped for roughly 10 minutes (20 min prior to station location) to flush the lines thoroughly before samples were taken. In addition to FISH sampling for trace metals, all physiological measures and growth rates (phytoplankton and bacteria) were obtained from the FISH, as well as samples for deckboard incubation experiments.

The CTD data were partially edited onboard ship. Shipboard editing included replacing downcast data with upcast data at one station where the CTD pump was inadvertently not turned on in the upper water column. The shipboard data were used to construct the preliminary maps and sections appended to the report. Following the cruise, salinity calibration will be performed and more detailed editing completed (Hickey group). Although water property spatial patterns are likely robust, actual values may change slightly following the final editing which we hope to complete this fall. ADCP set up was performed by Susan Geier onboard ship. ADCP data require more extensive processing and will be provided later this year (Foreman group). Preliminary water property maps and sections obtained from CTD data are given on the ECOHAB-PNW website (T, S, O2, Chl, Fl maps at selected depths; T, S, density, Fl, O2 transects versus depth for all transects, 0-100 m and 0-500 m scales). Maps of relative abundance of *PN* at the surface are also included.

The CTD data are organized into two groups: Survey 1 (July 7-13) and Survey 2 (July 13-26). Grid stations sampled in each period are shown in Figures 4a-c. Survey 2, which took place during persistent and strong upwelling-favorable winds, was the only complete survey (Fig. 4b). However, sufficient CTD and underway sampling were done in Survey 1 to define the large scale patterns during downwelling reasonably well.

Underway data should be treated with caution. Improvements were made over last cruise. Sensors are available at 4 m from mid ship at 4 m (SBE) and at 5 m from the standard location near the bow thruster. Even so, we noticed that because of the draft of the ship, underway data were sometimes compromised when we were on station and the pycnocline was shallow: the ship mixed up deeper water. However the underway data did provide reasonable maps for both sample periods when some smoothing was incorporated into the plotting routines. We did not perform a systematic evaluation of underway sensors.

This is the first year we have been able to sample a very strong and prolonged period of downwelling and also a prolonged period of upwelling. In prior years winds have been much more variable. The data thus provide important end points in terms of water properties as well as plankton distributions and physiology.

Only one drift study was performed on the cruise. This was primarily because *PN* were present only in low numbers and DA levels were also low. The focus of this cruise was to obtain systematic patterns of trace-metal ambient concentrations, water properties, phytoplankton physiological "health" and growth and grazing rates, and bacterial productivity over the entire study area; this had not been attempted in prior cruises. The one drift, which began at station LAB9 was undertaken primarily to investigate changes in mixed layer depth. The drift lasted about 22 hours.

CTD/nutrient transects were made along and across the Strait of Juan de Fuca during the weak downwelling period and neap tides (Fig. 4b) and again during strong upwelling and spring tides (Fig. 4c). In each case the along-strait survey started near the mouth during max ebb and the tide was ebbing during much of the survey. The first near cross-strait section was performed on ebb, the second on flood tide. No chlorophyll data were taken on the last cross-strait section as the ship was headed in and there was not time to process samples. Deeper nutrients as well as ammonium and urea samples were collected on these sections. In the first strait survey, sections were also made across the mouth and midway down the strait.

Some Preliminary Results:

The first survey clearly captured the coastal downwelling that was occurring during the sampling period (see web site surface maps). Fresher water was observed along the Washington coast; this is the signature of a plume from the Columbia River, which flows northward and hugs the coast during downwelling-favorable wind events. Fresher water was also observed off the Vancouver Island coast: this is the signature of water emanating from the strait, forming the Vancouver Island Coastal Current that typically hugs the Vancouver Island coast. In spite of the lack of coastal upwelling, relatively high macronutrients were observed in the eddy region. However, along the Washington coast surface nitrate was below detection ($< 0.1\ \mu M$).

The second survey successfully captured the change to upwelling-favorable conditions. The survey was started several days after the onset of upwelling—the time needed for freshwater to move offshore and permit upwelling on the Washington coast. High nutrients were observed along the coast and well out into the eddy.

The surface fluorescence during the period showed higher fluorescence in the region corresponding to the eddy and near the Washington coast in the Columbia plume water in survey 1. Thus in spite of the lack of upwelling and media claims that the ecosystem is failing, plankton persist in the eddy and near the

Washington coast in reasonable numbers. In survey 2, fluorescence increased dramatically in the eddy and along the coast, during and following the change from downwelling to upwelling-favorable winds. Areas of high fluorescence spread well offshore along the coast, in the eddy region, and north of the eddy region (from satellite images as well as survey data).

PN cell numbers and particulate DA were extremely low, especially during survey 1. Numbers of cells increased in the second period along with the generally increasing biomass (perhaps doubled). During survey 2, toxin levels were low but detectable, similar in value to estimates made in June 2003. In general highest particulate DA was observed on the fringes of the eddy. Some *PN* were also observed near the Washington coast—these did not appear to have associated DA. Molecular probe work indicated that *P. australis* and *P. pungens* were present both in the Juan de Fuca Strait and the eddy region.

2. Drift Surveys (Amy MacFadyen, Barbara Hickey, drifters; whole team for water samples)

One drift study was performed, following a water patch with a satellite-tracked Brightwaters drifter. To avoid regions of high current shear, no drogues were used—the drifters average the top meter of the flow. Deployment and recovery times and deployment location are listed in Table 3. Note that drifts are being numbered sequentially beginning each ECOHAB year. CTD profiles and bottle casts were taken at 1-2 hourly intervals (1 hour around noon and after midnight). Nutrients were taken at the usual depths plus 20 and 40 m every 2 hours, starting on the third cast.

The drifter (#3938) was deployed at LAB8 on July 23. The purpose was to study possible effects of atmospheric surface heating and cooling. Dr. Hickey had noted that deep mixed layers were observed at stations at the ends of transects and that these stations were always taken late at night when surface cooling might be significant. The drifter moved southwest in the large scale coastal flow well offshore of the shelf break (Fig. 5). The drift continued for 20 hours.

3. Drifter Deployments (Amy MacFadyen, Barbara Hickey, James Falkner, Sue Geier)

Several Davis-type Brightwaters drifter were deployed to delineate patterns and speeds of surface flows in the eddy area, as well as to determine the ultimate fate of eddy water. Drifter deployment and recovery times and deployment locations are given in Table 3.

Data were stored at the University of Washington and also available online on the ship as the ship had web access. Drifter location and water temperatures are available at 30 minute intervals during deployment periods. Four drifters will continue to collect data until about the end of August. All drifters were deployed at the surface (i.e. no drogues were used).

Three drifters were deployed at the beginning of the cruise: one (#3819) just inside the strait; a second (#3861) near the expected center of the eddy; a third (#3885) near the southwest edge of the eddy (Fig. 6). All three drifters were deployed prior to any real time information about the eddy location. Only the drifter deployed inside the strait (#3819) escaped the eddy during the cruise period: this drifter apparently entered the Vancouver Island Coastal Current. It was recovered after passing Barkley Sound. The drifter deployed near the center of the eddy (#3861) made a complete circuit and a half of the eddy during the downwelling wind period, finally escaping the eddy on its western side on July 19 after 11 days of deployment (note dates are GMT).

The drifter deployed near the southwest edge of the eddy (#3885) also made a complete circuit of the eddy during the downwelling-favorable wind period. It was on the north side of the eddy starting to pass Barkley Sound when winds changed to upwelling-favorable (July 13). The drifter immediately turned southward, then traveled southeastward passing along the south side of the eddy. The drifter subsequently joined the coastal current over the slope and continued south along the coast to Oregon (Fig. 6).

When the cruise began it was unknown whether a southeastward slope current would exist, given the lack of seasonal upwelling. Thus a drifter was deployed in the northwest region at station LC10 on July 13 (#3819) and moved southeast, confirming the existence of the seasonal slope current. This drifter continued southeast throughout the cruise, traveling persistently about 200 km in about 14 days (about 15 km per day).

To determine the location of the coastal jet over the shelf, several drifters were deployed just south of the eddy region (#3775 on July 10, #3917 on July 8, #3901 on July 9). Two of the drifters turned north, joining the eddy rather than joining the coastal jet. The third drifter barely moved in the first 3 days. When the winds changed to upwelling-favorable all 3 drifters turned southward immediately joining the coastal jet on the shelf. #3917 was recovered on July 18 just south of the GH line. #3775 was also recovered. However #3901 passed through the survey grid and went south to Oregon.

To study very nearshore flow direction under upwelling conditions, one drifter (#3861) was deployed at LP1 on July 19. It headed southward along the isobaths but, perhaps surprisingly, did not move offshore. This could be an example of nearshore Ekman layer shutdown.

To contrast with drifter paths deployed during downwelling conditions, two drifters were again deployed at EH1 (#3818, July 20) and on the north side of the eddy (#3917, July 22). Both of the drifters joined the eddy rather than the Vancouver

Island Coastal Current. However they both escaped the eddy on its south side and joined the coastal jet, where they were recovered. Thus, during upwelling winds, more water appears to be exported to the eddy rather than the coast of Vancouver Island, and also water can escape the eddy more readily than during downwelling, especially on the west and south sides.

4. Satellite Imagery (Dana Woodruff, Rick Stumpf)

Satellite imagery during the cruise was provided by two groups who sent data to the ECOHAB PNW ftp site—Dana Woodruff from Battelle Northwest Laboratory provided SST imagery and surface chlorophyll and turbidity imagery was provided by Rick Stumpf at NOAA. The available imagery and an assessment of its quality are listed in Table 4. In general, because of the predominantly downwelling wind conditions, few good images were available during the downwelling period. Good chlorophyll images were obtained during the upwelling period. Those chlorophyll and temperature images illustrated a filament of high biomass moving down the coast away from the eddy.

5. Laboratory Analyses

a) Lessard Group (Evelyn Lessard, Brady Olson, Mike Foy, Stacey DeAmicis)

The main goal of this component of ECOHAB PNW is to determine the role of grazers in *PN* population dynamics and DA production. We used the dilution technique to experimentally alter grazing rate and nutrient recycling to determine the effects of grazers on the net growth rate of the whole and size fractionated phytoplankton community, specific species and groups of phytoplankton, and the production of dissolved and particulate DA. These experiments also provide estimates of the in situ growth rates of *PN* and other phytoplankton. We took FlowCAM and fixed samples to follow the in situ spatial and temporal changes in the protist grazing community in relation to *PN* and hydrography. We also conducted an experiment to determine the fate of dissolved DA in seawater.

On this cruise, we performed the following:

1. *17 dilution growth and grazing experiments*: These experiments are part of the Ph. D. research of Brady Olson. In these experiments, we followed changes in <5 µm, >5 µm and total chlorophyll, particulate DA, dissolved DA, *PN* species, and macronutrients (including ammonium in association with Cochlan group). Samples were also preserved and processed onboard for microscopic enumeration of major phytoplankton species later in the laboratory. Chlorophylls were analyzed onboard as well as macronutrients (measured by Cochlan's group), dissolved and particulate DA (Trainer's group), and cyanobacteria (Trick's group). Seventeen

microplankton dilution experiments were conducted during this cruise. Of these experiments, 13 were done in regions devoid of *PN*. This is in stark contrast to 2004, and will provide data necessary to determine the selective constraints imposed on *PN*, both biotic and abiotic.

2. *High frequency abundance estimates of PN and other plankton with the FlowCAM*: Discrete samples from ~3 depths as well as the Fe pump at all inshore stations and select offshore stations along all transect lines during the survey were analyzed with the FlowCAM. Most initial and final samples from the dilution experiments were also analyzed with the FlowCAM. The data files were stored and will be edited and calibrated in the lab to obtain quantitative counts. Replicate fixed samples were taken for microscopic enumerations and calibration of the FlowCAM. During surveys, the FlowCAM proved particularly useful for a quick assessment of *PN* abundance and community composition at the surface and at depth. In addition, the FlowCAM was used to analyze 10 bottom boundary layer samples taken with the CTD (in collaboration the with Trainer's group).
3. *Vertical profiles of micro- and nanoplankton*: We took preserved plankton samples at thirteen stations on the large scale survey for microscopic determination of autotrophic and heterotrophic nanoplankton, and heterotrophic/mixotrophic dinoflagellates and ciliates.
4. *Dissolved DA degradation experiment*: We conducted a controlled experiment (in collaboration with Trainer's group) to determine degradation rates and the ultimate fate of dissolved DA. Four treatments consisting of whole seawater, <0.2 µm seawater (light and dark), and <0.8 µm seawater were run in parallel with a control. All treatments were spiked with ~50 nM dissolved DA. Four time points were taken and the concentration of dissolved DA will be analyzed later.

b) RTC/SFSU Research Group (Bill Cochlan, Julian Herndon, Maureen Auro, Julia Betts)

The primary objective of this component of ECOHAB-PNW is to examine the relationship between elevated concentrations of the pennate diatom *PN* and its toxin DA, and ambient concentrations of macro-nutrients and phytoplankton biomass. In addition bioassays (grow-out experiments described below) were conducted to determine the relationship between copper, iron and DA production. At each station of the survey sampling grid, size-fractionated phytoplankton biomass levels were estimated from Chlorophyll *a* (Chl *a*) concentrations determined using in vitro fluorometry (aboard ship) after extraction for 24 h with 90% acetone. Chl *a* samples generally were collected at three depths (0, 5, 10 m) and, at an additional depth corresponding to the chlorophyll maximum layer, when present. Size-fractionated biomass estimates were conducted as follows: total planktonic community was collected on Whatman GF/F filters (nominal pore-size of 0.7 µm), and cells >5 µm in size were collected on Poretics silver membranes. At every second station, dissolved inorganic nutrients were collected at 0, 5, 10, 15, 30, 50, 100, 200 m and near bottom) and analyzed using appropriate colorimetric methods for determination of nitrate plus nitrite, and silicate with a Lachat Instruments QuickChem 8000 Series Flow Injection Automated Ion Analyzer. Both Chl *a* and nutrients were determined at the two most-shoreward stations of each sampling line. Vertical profiles of dissolved inorganic nutrients were also determined at the drifter stations, during deep canyon profiles, and at a series of 6-7 vertical stations in the Strait of Juan de Fuca on both of the strait transits. Samples from the Juan de Fuca transit were also analyzed for ammonium and urea, in addition to the standard inorganic nutrients. Dissolved nutrients were determined at the beginning (time-zero) and end (time-final) of all of the dilution experiments performed by Lessard's research group.

A series of 45 shipboard incubation experiments (termed 'grow-outs') were designed to assess the role of trace metal (Cu and Fe) availability on the growth of *PN* and DA production. These multi-day experiments were conducted with water collected from the surface mixed layer (~ 4 m) using the trace-metal clean sampling system (FISH; Wells Group) at stations throughout the sampling grid, with particular emphasis in regions previously found to harbor elevated concentrations of *PN* and DA. This is the first such extensive survey of the ECOHAB-PNW study area, and it also will provide estimates of the spatial and temporal variability of autotrophic and heterotrophic productivity in relation to the physical and chemical water mass properties of the study area. During all grow-out experiments, samples were analyzed onboard for bacterial and picoplankton abundance by the University of Western Ontario team using flow cytometry (Becton Dickinson, FACSCalibur), and will be used to generate specific rates of bacterial productivity from the bacterial protein synthesis estimates (^{3}H-leucine method). Photosynthetic-irradiance (P-E) curves were generated from short-term (1h) ^{14}C uptake experiments using photosynthetrons at the initiation of all grow-out experiments and at selected stations in the Strait of Juan de Fuca; these results will be used to describe the efficiency and capacity of phytoplankton photosynthesis with respect to light intensity. P-E curves were generated for all shipboard incubation experiments at the beginning of the 3 to 4-day grow-out incubations. Phytoplankton biomass estimates (as previously described) were determined for all metal and macronutrient treatments at the initiation and termination of each incubation experiments. These measures, together with draw-down rates of macronutrients, will be used to estimate the growth response (including DA production) of the phytoplankton community to copper and iron amendments. Other biological measurements conducted during the grow-out experiments included: microscopic taxonomy, sinking rates (Trick Group), total and dissolved DA (Wells and Trainer Groups), trace metals (Wells Group), and cellular fluorescence capacity (CFC; as measured using the inhibitor DCMU).

Expected Results:

1. *Dissolved Nutrients*: Over 60% of collected samples were analyzed onboard and final, processed concentration data made available. This enabled working maps of nutrients to be developed that helped guide further sampling strategies. The remainder will be available by December 1, 2005 using automated and manual colorimetric methods. Inadequate clean water supply aboard the R/V Atlantis precluded complete analysis of all samples collected during the 3-week cruise.
2. *Phytoplankton Biomass*: All initial survey grid samples, drifter profiles and onboard deck experiments were analyzed onboard, and are currently available in draft form.
3. *Photosynthetic Efficiency*: Radio-isotope samples (^{14}C) were prepared on board for liquid scintillation counting ashore at RTC; P-E curves should be generated by December 1.
4. *Cellular Fluorescence Capacity*: All samples analyzed onboard and are available in draft form.
5. *Bacterial Productivity*: Radio-isotope samples (^{3}H) were prepared on board for liquid scintillation counting ashore at NWFSC; rates should be generated by September 1, 2005.

c) Trick Research Group (Charlie Trick, Liza McClintock, Benjamin Beall, Sean Doran, Caroline Whiston)

Our contribution to the ECOHAB project is two-fold: 1) to provide flow cytometric analysis (FCM) and HPLC pigment analysis to characterize the community assemblage; and 2) to provide experimental evidence of factors that either increase the competitive ability of *PN* or increase the level of DA per cell. Samples for FCM were collected at all survey stations at 5 m and 10 m depths and at 5 m and 30 m in the Strait of Juan de Fuca surveys. HPLC samples were collected at the 5 m depth throughout the grid and Strait of Juan de Fuca surveys. This will allow for quantitative analysis of bacteria, cyanobacteria, and nanoplankton communities, complemented by pigment analysis to characterize the phytoplankton assemblage, which will be performed using HPLC isolation-and-characterization methods. This method uses the presence or absence of the taxon-specific pigments (often referred to as the “minor or accessory” pigments) in relation to the ubiquitous photosynthetic pigments (chlorophyll) to describe the phytoplankton community structure. Our analysis by HPLC will establish the composition of the communities before and after the presence of the diatom communities, thus serving as an important oceanographic descriptor. These samples will be analyzed within ~ 1-2 months since they preserve poorly. Maps of reconstructed photosynthetic communities will be available soon thereafter.

In our second major contribution to the cruise mandate, the personnel from the Cochlan, Wells and Trick labs carried out deckboard incubation growth experiments. All labs offered their expertise to the common goal of all growth experiments (biomass formation, nutrient drawdown measurements, DA analysis (particulate and dissolved), community structure changes, bacterial and phytoplankton productivity, sinking rates and photosynthetic efficiency and capacity). The overall foundation of these grow-out experiments was aimed at elucidating the factors that influence the initiation, formation and/or maintenance of *PN* blooms or DA levels (either cellular or extracellular). The working hypothesis for this set of experiments was that *PN* benefits from producing DA because DA serves as an iron and/or copper chelator. Thus in the presence of macronutrients (either in upwelling sites or in the areas of high nutrients associated with the Juan de Fuca eddy) DA would act as an iron chelator, ensuring that the cells would have a supply of iron as iron concentrations diminish, either through colloid formation or utilization. Alternatively DA could serve as a copper chelator, reducing the levels of cupric ion to less inhibitory levels, allowing *PN* to fully utilize the macro-nutrients and grow effectively.

d) Trainer Group (Vera Trainer, Keri Baugh, Shelly Nance, Sheryl Day, Brian Bill, Alan Sarich, Andrew Ohana-Richardson, Jessica Hendrickson)

At each survey and drift station, samples were routinely taken at 0, 5, 10 m for measurement of particulate and dissolved levels of DA, whole cell counts of *PN*, enumeration of *PN* size classes, and scanning electron microscopy for species determination in selected samples. A net tow was taken at every station to rapidly determine the presence or absence of *PN* and their relative abundance. At Juan de Fuca Strait stations, depth profiles of cells and toxins were done at some of the following depths: 0, 5, 10, 20, 30, 50 m.

Particulate DA was analyzed by filtering 1 L seawater through a Nucleopore HA filter (0.45 micron pore size). Filters were minced in 5 ml distilled water with a thin metal spatula and sonicated for 2 h in a bath sonicator to lyse cells. An aliquot of each sample was analyzed using a receptor binding assay in 96-well plate format using a multiwell harvester and Top Count scintillation counter. The receptor binding assay tests the displacement of [^{3}H]kainate by DA in a sample from a cloned glutamate receptor. Each plate of samples is compared to known DA standards analyzed on the same plate. Endogenous glutamate was digested prior to sample analysis using glutamate dehydrogenase.

1. *Whole cell hybridization assay*: Approximately 15 ml sample was filtered and fixed with saline-ethanol for 2 hours. Then specific *P. australis* (auD1) *P. multiseries* (muD2) and *P. pungens* (puD1) probes (fluorescein labeled) were incubated with samples from stations with abundant *PN* (assessed by surface net tows) taken at several depths. Fluorescence intensity was compared to uniC (positive universal species control) and uniR (negative control) probes. Positively labeled cells on each filter were counted using fluorescence microscopy. Slides were kept in the dark for cell counting in our land-based laboratory.

2. *Dissolved DA*: These samples were filtered through a 0.45 mm syringe filter and refrigerated until analysis. Selected samples from grow out experiments were tested using a commercially available enzyme-linked immunosorbent assay (ELISA) with picomolar sensitivity (Beacon Analytical System). This ELISA was developed using antibodies produced at NWFSC, therefore kits can be produced by Beacon at great savings ($100 per kit) over the Biosense ELISA kits (>$300 per plate).
3. *PN culturing*: At stations throughout the cruise where *PN* cells were present, a drop of sample was placed in f/2 medium for isolation and culturing upon return to the lab. *PN* cells will be allowed to grow in artificial seawater medium and growth and toxin production will be determined for several isolates. This will allow us to understand the relative levels of dissolved and particulate toxin each species is contributing to our cruise samples. Monoclonal isolates from the eddy and nearshore regions will be used to assess the genetic diversity among certain *PN* species using microsatellite DNA markers. This information will be used to make a preliminary determination of the relationship between *PN* populations in the eddy and nearshore regions (Nicolaus Adams, Master's thesis).

e) Wells Group (Eric Roy, Peggy Hughes)

The University of Maine component of the ECOHAB PNW cruise had two primary goals: to collect seawater samples from the study area for trace metal analysis and to optimize and field test a flow injection based method for iron analysis. Roughly 110 surface samples from the survey station grid and the Strait of Juan de Fuca were collected underway, through a trace-metal clean sampling fish. The collected samples will be later analyzed at the University of Maine by high resolution Inductively Coupled Plasma Mass Spectrometry to observe spatial and tidal variability of trace metals, and to serve as means for comparison with the shipboard iron method.

The shipboard method for iron provided preliminary iron concentrations to guide various grow-out experiments conducted by Cochlan's and Trick's research team. As a general pattern, total iron concentrations were high (1-2 nM) at nearshore stations and decreased with distance offshore. Elevated iron concentrations were observed at the seaward end of several survey lines.

Acknowledgements

We would like to thank the captain and crew of the R/V Atlantis for their support and extra effort that made the July 2005 cruise successful. We thank the crew and officers of CCGS J.P Tully and the IOS/OSAP/UW mooring team of Susan Geier, Jim Johnson, Tom Juhasz, Dave Spears and Rick Thomson for their help in mooring deployment in May and recovery in October. This research was supported through the Ecology and Oceanography of Harmful Algal Blooms program by National Oceanographic and Atmospheric Administration/Coastal Ocean Program Award No. NA17OP2789 and National Science Foundation Award No. 0234587. Mooring recovery on the Tully was made possible by Canadian support to Richard Thomson at the Institute of Ocean Sciences.

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Figure 1. Cruise track with sampling stations

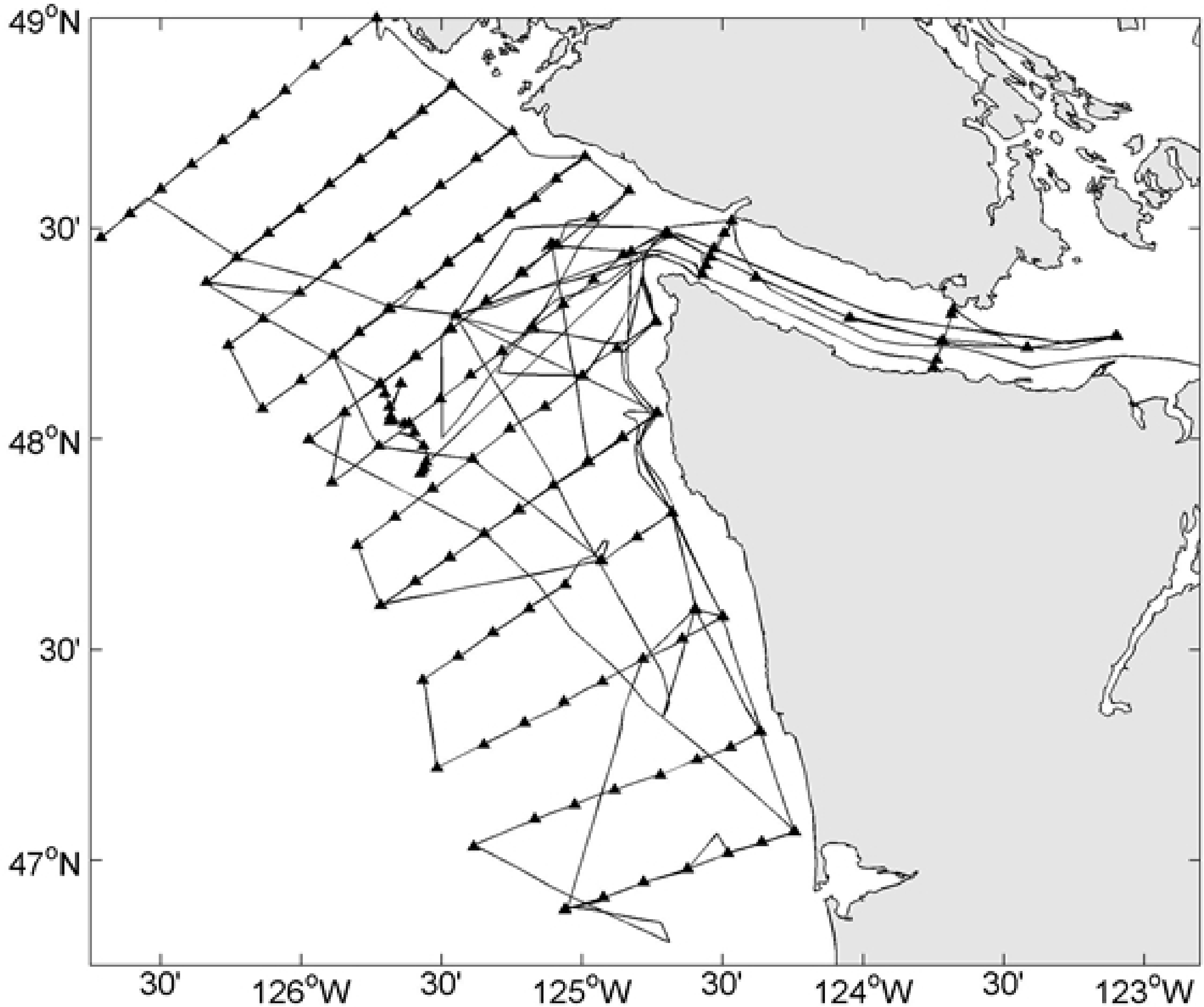


Figure 2. Time series of buoy vector winds during cruise

Sampling events are shown below the x-axis. Vectors show the direction to which the wind is directed; thus, upwelling favorable below the zero line and downwelling favorable above it. Timing of Periods 1 (downwelling) and 2 (upwelling) discussed in report text are also shown as well as approximate duration of surveys.

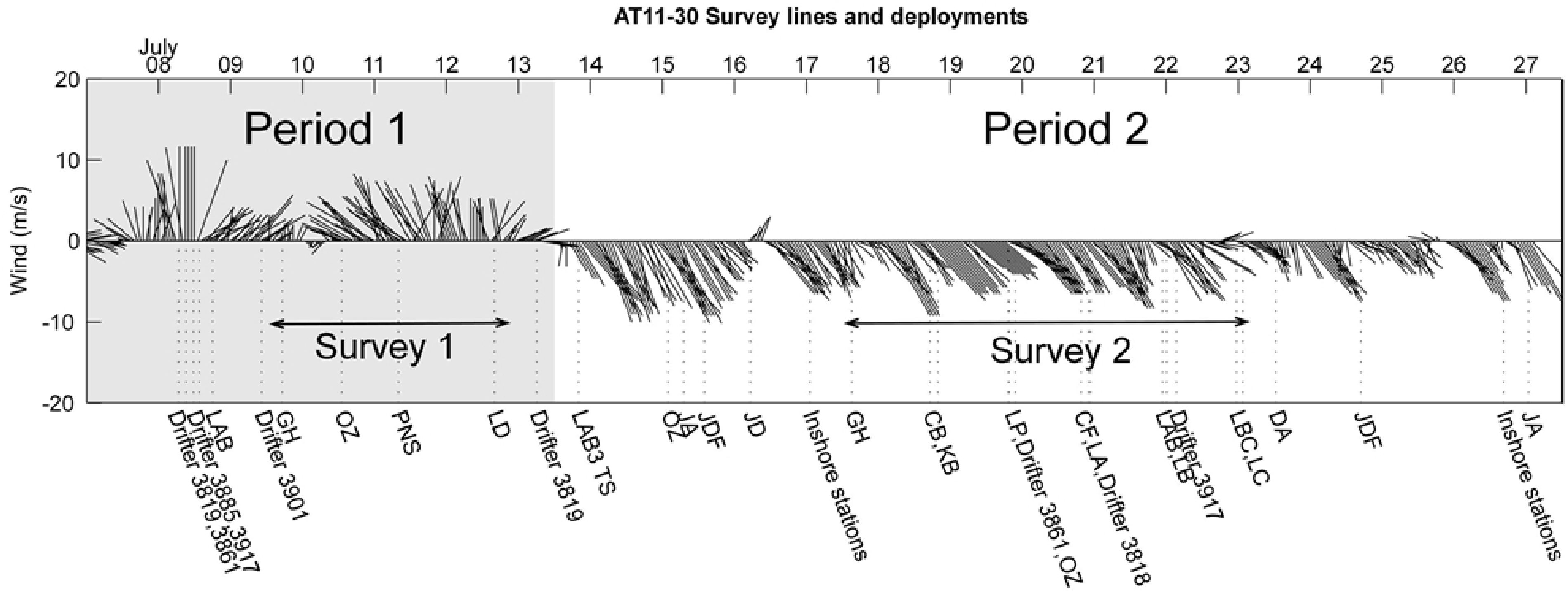


Figure 3 Theoretical survey grid and locations of moored arrays

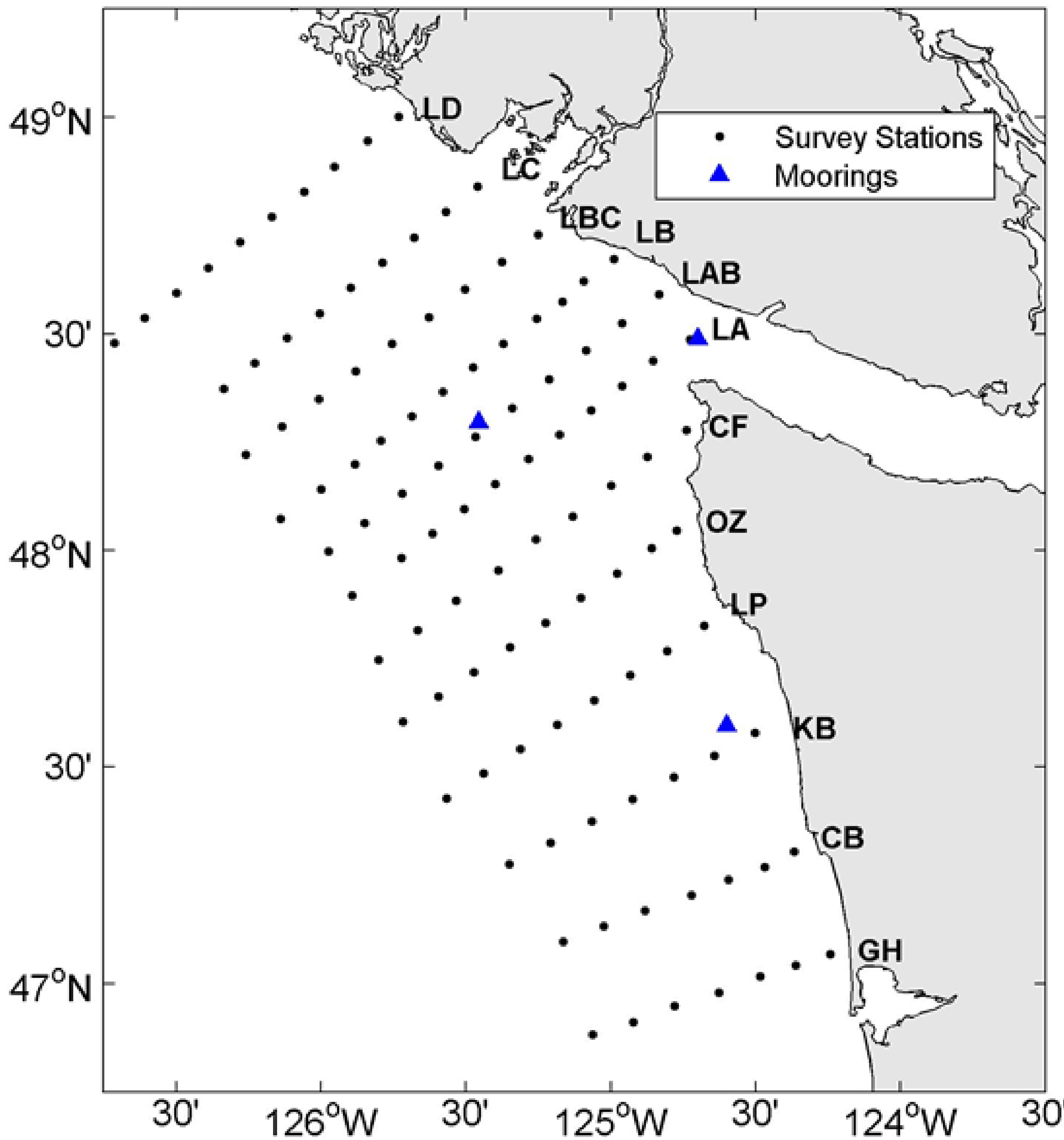


Figure 4a. CTD station numbers for Survey 1

Survey 1 (CTD casts 1-48)

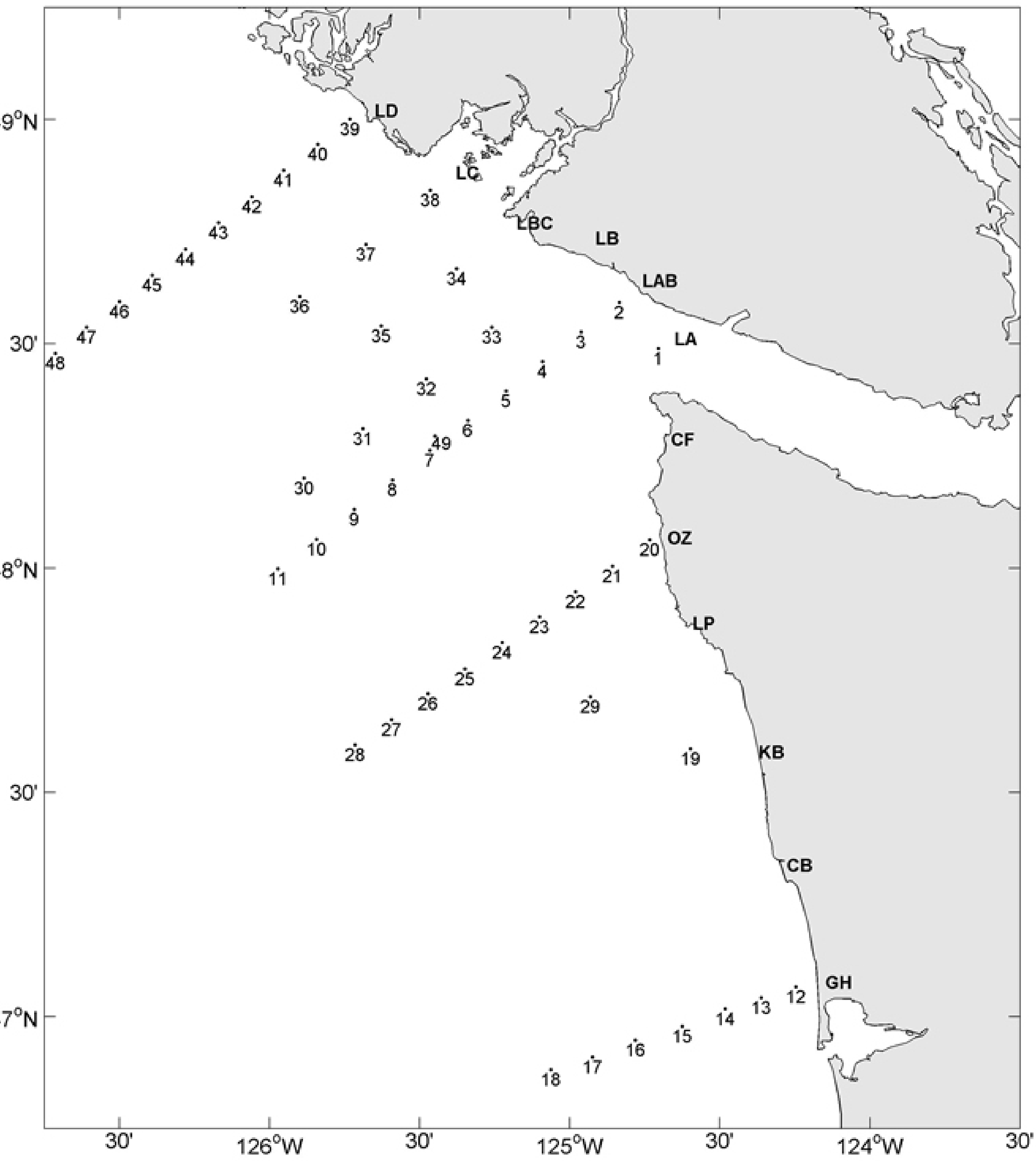


Figure 4b. CTD station numbers for Survey 2

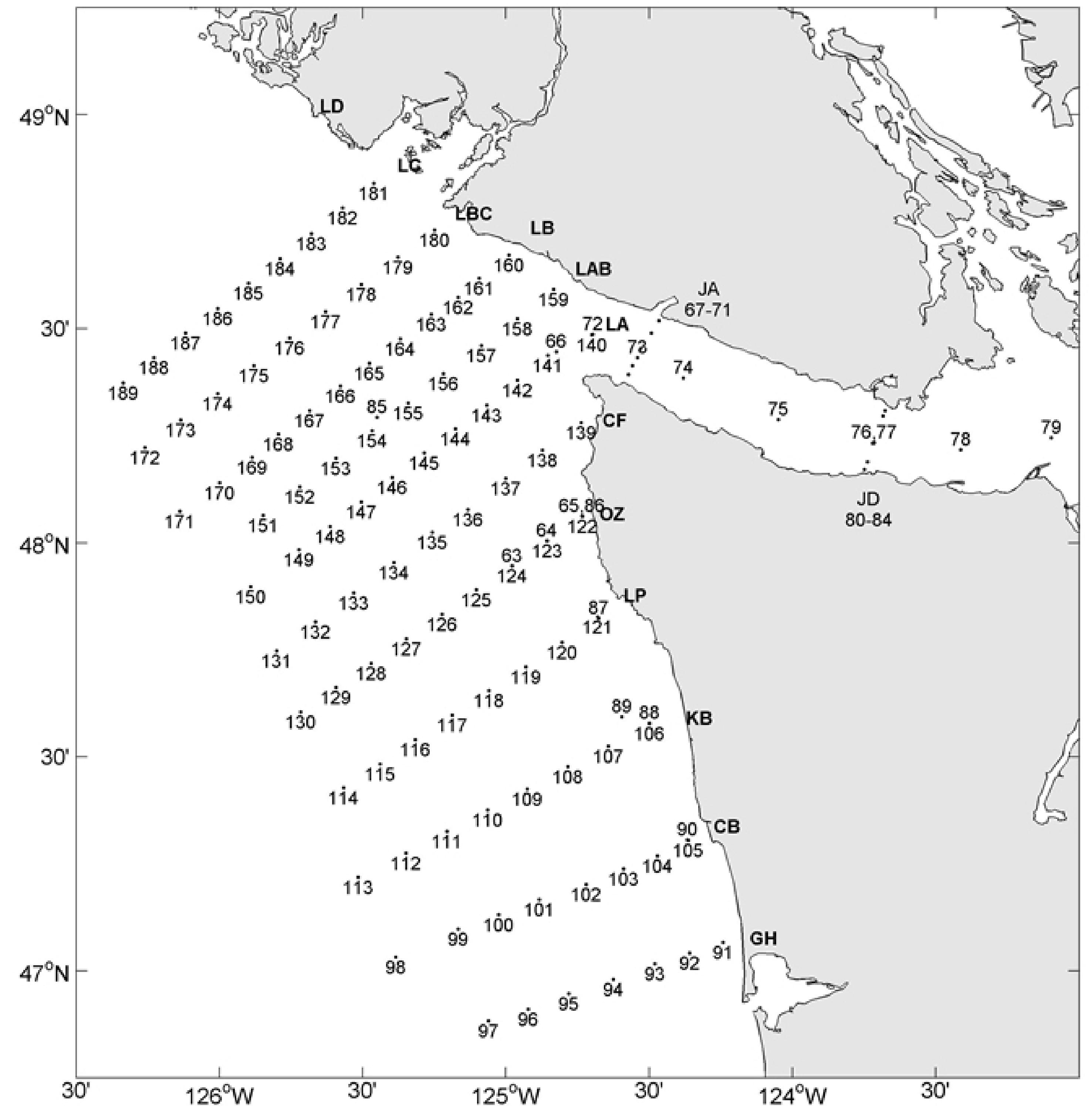


Figure 4c. CTD station numbers for Period 2

Final stations (CTDs 193,206-225)

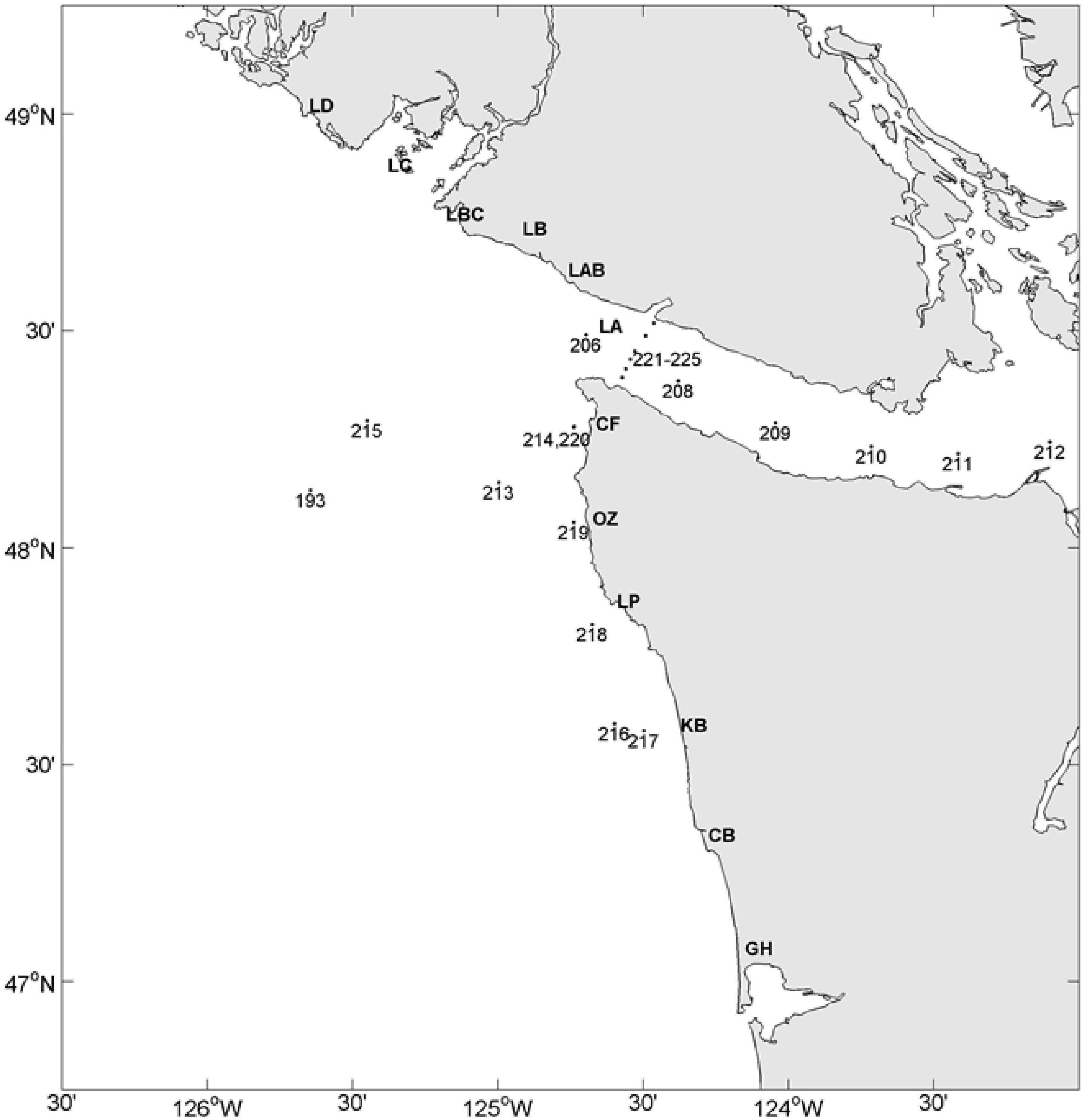


Figure 5. Drifter track during Drift A (*) with CTD cast numbers

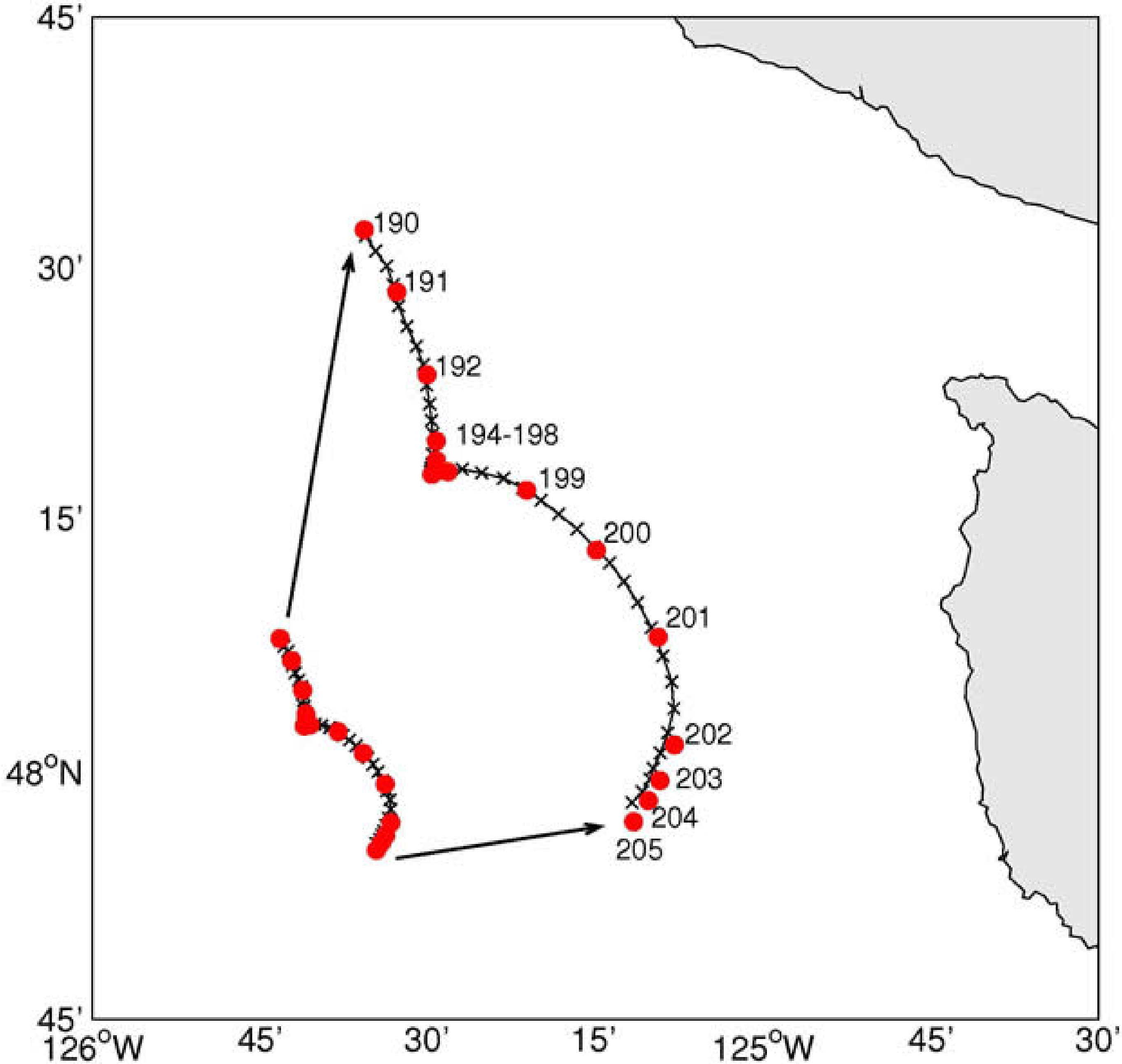


Figure 6. Trajectories of all drifters deployed during the cruise

Drifters were deployed off of Northern Washington in the vicinity of the Juan de Fuca eddy. Solid dots mark beginning of drifter track; black outlined dots separate 48 hour periods.

Period 1 *Period 2*

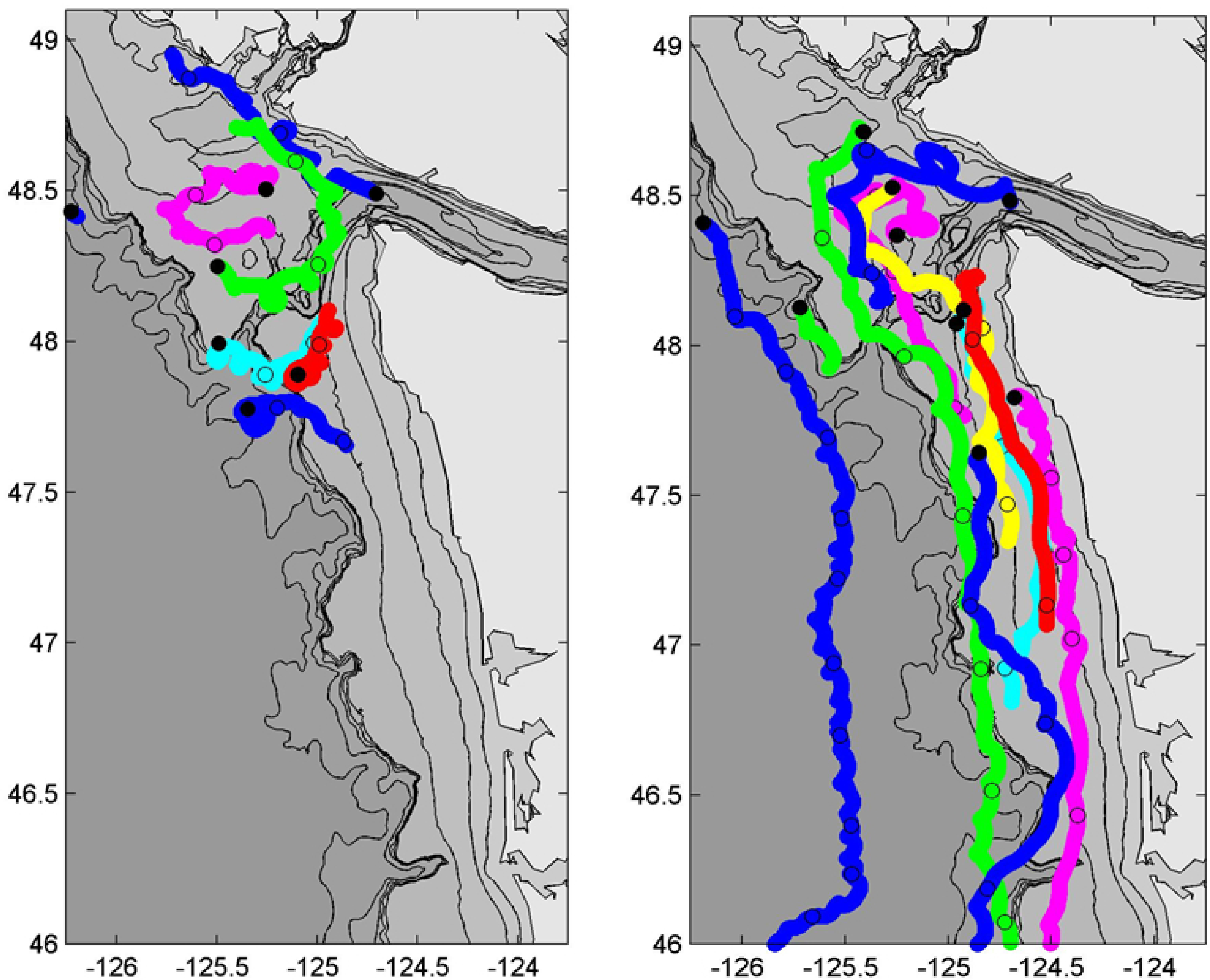
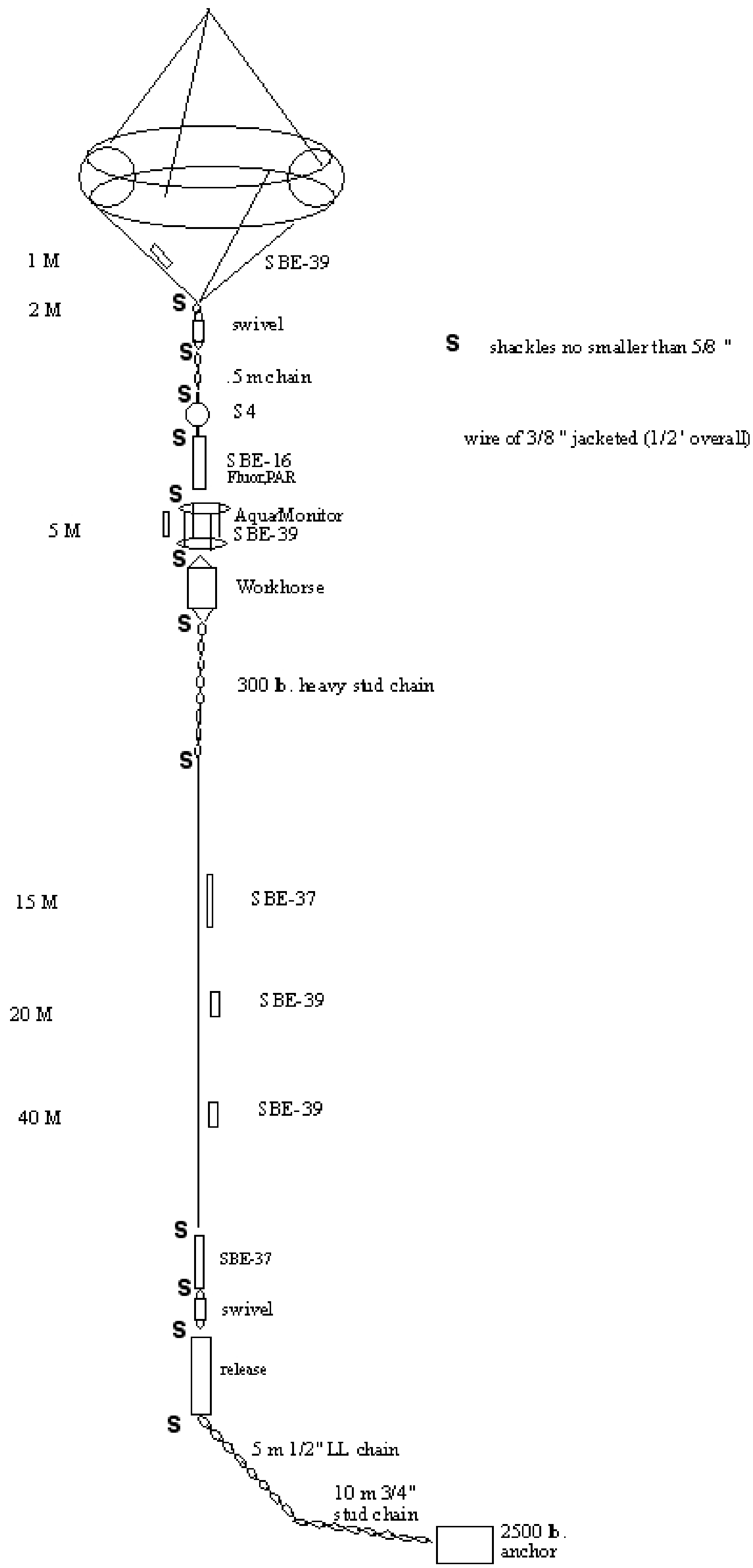


Figure 7. Mooring schematic



Wind and PAR sensors are mounted on the buoy tower (not shown).

Table 1. Event Log

Event Number	Date (GMT)	Start Time (GMT)	End Time (GMT)	Lat degree (N)	Lat minute	Lon degree (W)	Lon minute	Grid/ Station ID	Event Description	Samples Taken	Water depth (m)
1	7/8/2005	06:06	06:30	48	29.41	124	42.11	EH01	CTD001	Nuts, Chl	256
2	7/8/2005	06:40	06:40	48	29.33	124	42.29	EH01	Deployed drifter 3819		256
3	7/8/2005	09:14	09:14	48	29.96	125	15.03	VT01	Deployed drifter 3861		148
4	7/8/2005	09:22	09:22	48	29.96	125	15.03	VT01	Net Tow		148
5	7/8/2005	11:41	11:41	48	14.96	125	30.21	VT02	Deployed drifter 3885		~150
6	7/8/2005	11:43	11:43	48	14.96	125	30.21	VT02	Net Tow		~150
7	7/8/2005	13:36	13:36	48	0.00	125	29.90	VT02	Deployed drifter 3917		~174
8	7/8/2005	13:39	13:39	48	0.00	125	29.90	VT03	Net Tow/Bucket		~174
9	7/8/2005	18:04	18:17	48	35.52	124	50.06	LAB01	CTD002	Nuts, Chl, VT	60
10	7/8/2005	18:04		48	35.52	124	50.06	LAB01	Net Tow		
11	7/8/2005	19:21	19:30	48	31.59	124	57.70	LAB02	CTD003	Chl, VT	60
12	7/8/2005	19:21		48	31.59	124	57.70	LAB02	Net Tow		
12.5	7/8/2005	19:40		48	31.59	124	57.70	LAB02	Fe fish deployed		
13	7/8/2005	21:11	21:27	48	27.64	125	5.44	LAB03	CTD004	Chl, VT	170
14	7/8/2005	21:11		48	27.64	125	5.44	LAB03	Net Tow		
15	7/8/2005	22:37	22:56	48	23.69	125	12.66	LAB04	CTD005	Nuts, Chl, VT, Lessard	185
16	7/8/2005	22:37		48	23.69	125	12.66	LAB04	Net Tow		
17	7/9/2005	00:02	00:19	48	19.73	125	20.38	LAB05	CTD006	Chl, VT	115
18	7/9/2005	00:02		48	19.73	125	20.38	LAB05	Net Tow		
19	7/9/2005	01:28	01:45	48	15.79	125	27.89	LAB06	CTD007	Nuts, Chl, VT	138
20	7/9/2005	01:28		48	15.79	125	27.89	LAB06	Net Tow		
21	7/9/2005	01:45	01:45	48	15.79	125	27.89	LAB06	Fe fish recovered		
22	7/9/2005	02:52	03:41	48	11.80	125	35.49	LAB07	CTD008	Chl, VT	161
23	7/9/2005	02:52		48	11.80	125	35.49	LAB07	Net Tow		
24	7/9/2005	04:19	04:44	48	7.86	125	43.09	LAB08	CTD009		317
25	7/9/2005	04:19		48	7.86	125	43.09	LAB08	Net Tow		
26	7/9/2005	05:49	06:20	48	3.86	125	50.75	LAB09	CTD010	Chl	772
27	7/9/2005	05:49		48	3.86	125	50.75	LAB09	Net Tow		
28	7/9/2005	07:14	07:50	47	59.94	125	58.33	LAB10	CTD011	Nuts, Chl VT	1422
29	7/9/2005	07:14		47	59.94	125	58.33	LAB10	Net Tow		
30	7/9/2005	10:28	10:28	47	46.49	125	20.61	OZ06	Deployed drifter 3901		854
31	7/9/2005	16:00	16:15	42	3.98	124	14.80	GH01	Fe fish deployed		
32	7/9/2005	17:14	17:20	42	3.98	124	14.80	GH01	CTD012	Nuts, Chl, VT	20
33	7/9/2005	17:14		42	3.98	124	14.80	GH01	Net Tow		
34	7/9/2005	18:12	18:29	47	2.54	124	21.66	GH02	CTD013	Nuts, Chl, VT	45

35	7/9/2005	18:12		47	2.54	124	21.66	GH02	Net Tow		
36	7/9/2005	19:20	19:31	47	1.00	124	28.89	GH03	CTD014	Chl, VT, Lessard	67
37	7/9/2005	19:20		47	1.00	124	28.89	GH03	Net Tow		
38	7/9/2005	20:27	20:48	46	58.72	124	37.59	GH04	CTD015	Nuts, Chl, VT	100
39	7/9/2005	20:27		46	58.72	124	37.59	GH04	Net Tow		
40	7/9/2005	21:47	22:02	46	56.88	124	46.91	GH05	CTD016	Chl, VT	153
41	7/9/2005	21:47		46	56.88	124	46.91	GH05	Net Tow		
42	7/9/2005	22:57	23:20	46	54.65	124	55.38	GH06	CTD017	Nuts, Chl, VT	445
43	7/9/2005	22:57		46	54.65	124	55.38	GH06	Net Tow		
44	7/10/2005	00:27	01:20	46	52.94	125	3.73	GH07	CTD018	Chl, VT, Ben	835
45	7/10/2005	00:27		46	52.94	125	3.73	GH07	Net Tow		
46	7/10/2005	00:29		46	52.94	125	3.73	GH07	Fe fish recovered		
47	7/10/2005	05:21	05:37	47	28.60	124	47.01	KB03	Sediment grab	Brian B.	118
48	7/10/2005	07:02	07:20	47	35.82	124	35.75	EH02	CTD019	Nuts, Chl, VT	47
49	7/10/2005	08:54		47	49.53	124	40.78	LP01	Net Tow		39
50	7/10/2005	13:03	13:23	48	3.81	124	44.01	OZ01	CTD020	Nuts, Chl, VT	31
51	7/10/2005	13:03		48	3.81	124	44.01	OZ01	Net Tow		
52	7/10/2005	13:25		48	3.81	124	44.05	OZ01	Fe fish deployed		
53	7/10/2005	14:24	14:44	48	0.32	124	51.38	OZ02	CTD021	Nuts, Chl, VT	53
54	7/10/2005	14:24		48	0.32	124	51.38	OZ02	Net Tow		
55	7/10/2005	15:53	15:49	47	56.89	124	58.76	OZ03	CTD022	Chl, VT, Lessard	110
56	7/10/2005	15:53		47	56.89	124	58.76	OZ03	Net Tow		
57	7/10/2005	16:50	17:14	47	53.45	125	6.06	OZ04	CTD023	Nuts, Chl, VT	147
58	7/10/2005	16:50		47	53.45	125	6.06	OZ04	Net Tow		
59	7/10/2005	17:20		47	53.47	125	6.06	OZ04	Deployed drifter 3775		
60	7/10/2005	18:17	18:55	47	50.04	125	13.51	OZ05	CTD024	Chl, VT	438
61	7/10/2005	18:17		47	50.04	125	13.51	OZ05	Net Tow		
62	7/10/2005	19:45	20:43	47	46.53	125	20.91	OZ06	CTD025	Nuts, Chl, VT, Deep CTD	840
63	7/10/2005	19:45		47	46.53	125	20.91	OZ06	Net Tow		
64	7/10/2005	21:41	22:39	47	43.12	125	28.28	OZ07	CTD026	Chl, VT	1009
65	7/10/2005	21:41		47	43.12	125	28.28	OZ07	Net Tow		
66	7/10/2005	23:39	00:33	47	39.77	125	35.28	OZ08	CTD027	Nuts, Chl, VT, Deep CTD	1200
67	7/10/2005	23:39		47	39.77	125	35.28	OZ08	Net Tow		
68	7/11/2005	01:40	02:32	47	36.35	125	42.92	OZ09	CTD028	Chl, VT, Deep CTD	1440
69	7/11/2005	01:40		47	36.35	125	42.92	OZ09	Net Tow		
70	7/11/2005	05:20	5:45	47	42.73	124	55.95	LP03	CTD029 + bucket	Lessard bottom water + VT surface (bucket)	120
71	7/11/2005	05:20		47	42.73	124	55.95	LP03	Net Tow		
72	7/11/2005	07:58	08:05	47	57.17	125	23.40	CF06/PNS01	Net Tow + Bucket	VT - Start of Pseudo-nitzschia search (PNS)	709
73	7/11/2005	09:19	09:25	47	58.99	125	43.67	LA10/PNS02	Net Tow + Bucket	VT	923
74	7/11/2005	11:00	11:08	48	12.05	125	53.16	LB13	CTD030	VT, Chl (5 m), Nuts	620

										(5 m)	
75	7/11/2005	11:00		48	12.05	125	53.16	LB13	Net Tow		
76	7/11/2005	11:48	11:55	48	15.20	125	47.82	LB11/PNS03	Net Tow + Bucket	VT	208
77	7/11/2005	12:35	12:45	48	18.58	125	41.37	LB10	CTD031	VT, Chl (5 m), Nuts (5 m)	155
78	7/11/2005	12:35		48	18.58	125	41.37	LB10	Net Tow		
79	7/11/2005	13:20	13:28	48	20.58	125	38.20	INT01/PNS04	Net Tow + Bucket	VT	145
80	7/11/2005	13:35	14:07	48	21.00	125	35.00	LB09/PNS05	Net Tow + Bucket	VT	
81	7/11/2005	14:57	15:07	48	25.31	125	28.68	LB08	CTD032	VT, Chl (5 m), Nuts (5 m)	148
82	7/11/2005	14:57		48	25.31	125	28.68	LB08	Net Tow		
83	7/11/2005	15:48	15:52	48	28.69	125	22.11	LB07/PNS06	Net Tow + Bucket	VT	157
84	7/11/2005	16:46	16:56	48	32.17	125	15.56	LB06	CTD033	VT, Chl (5 m), Nuts (5 m)	115
85	7/11/2005	16:46		48	32.17	125	15.56	LB06	Net Tow		
86	7/11/2005	17:45		48	32.64	125	10.31	LB05/PNS07	Net Tow	VT	102
87	7/11/2005	18:33		48	37.38	125	5.62	LB03/PNS08	Net Tow + Bucket	VT	94
88	7/11/2005	19:36		48	40.41	124	59.55	LB01/PNS09	Net Tow + Bucket	VT	
89	7/11/2005	20:20		48	44.10	125	15.36	LBC01/PNS10	Net Tow + Bucket	VT	
90	7/11/2005	22:24	22:37	48	39.98	125	22.64	LBC02	CTD034	VT, Lessard	70
91	7/11/2005	22:24		48	39.98	125	22.64	LBC02	Net Tow		
92	7/11/2005	22:36		48	36.25	125	30.13	LBC03/PNS11	Net Tow + Bucket	VT	160
93	7/11/2005	00:30	00:41	48	32.46	125	37.65	LBC04	CTD035	VT, Chl (5 m), Nuts (5 m)	80
94	7/11/2005	00:30		48	32.46	125	37.65	LBC04	Net Tow		
95	7/12/2005	01:44		48	28.63	125	45.32	LBC05/PNS12	Net Tow + Bucket	VT	108
96	7/12/2005	01:40	02:00	48	28.63	125	45.32	LBC05	Fe fish recovered		
97	7/12/2005	02:35		48	24.82	125	52.86	LBC06/PNS13	Net Tow + Bucket	VT	160
98	7/12/2005	03:27		48	21.02	126	0.41	LBC07/PNS14	Net Tow + Bucket	VT	634
99	7/12/2005	04:52	04:58	48	22.40	126	20.13	LC10/PNS15	Net Tow + Bucket	VT	1250
100	7/12/2005	05:36	05:46	48	25.91	126	13.76	LC09/PNS16	Net Tow + Bucket	VT	650
101	7/12/2005	06:24	06:30	48	29.39	126	7.20	LC08/PNS17	Net Tow + Bucket	VT	203
102	7/12/2005	07:05	07:12	48	32.82	126	0.58	LC07/PNS18	Net Tow + Bucket	VT	126
103	7/12/2005	07:50	08:03	48	36.38	125	54.00	LC06	CTD036	VT	93
104	7/12/2005	07:50		48	36.38	125	54.00	LC06	Net Tow		93
105	7/12/2005	08:44	08:47	48	39.98	125	47.35	LC05/PNS19	Net Tow +	VT	65

									Bucket		
106	7/12/2005	09:25	09:37	48	43.29	125	40.74	LC04	CTD037	VT	168
107	7/12/2005	09:25		48	43.29	125	40.74	LC04	Net Tow	VT	168
108	7/12/2005	10:16	10:22	48	46.89	125	34.41	LC03/PNS20	Net Tow + Bucket	VT	132
109	7/12/2005	11:04	11:18	48	50.45	125	27.84	LC01	CTD038	VT	98
110	7/12/2005	11:04		48	50.45	125	27.84	LC01	Net Tow	VT	98
111	7/12/2005	15:00	15:20	48	57.78	125	43.72		Drifter 3819 recovered		72
112	7/12/2005	15:20	15:30	48	57.78	125	43.72		Fe fish deployed		72
113	7/12/2005	16:00	16:11	49	0.10	125	44.86	LD01	CTD039	Nuts, Chl, VT	34
114	7/12/2005	16:00		49	0.10	125	44.86	LD01	Net Tow		
115	7/12/2005	17:01	17:12	48	56.67	125	50.27	LD03	CTD040	Nuts, Chl, VT	44
116	7/12/2005	17:01		48	56.67	125	50.27	LD03	Net Tow		
117	7/12/2005	18:05	18:19	48	53.20	125	57.08	LD04	CTD041	Chl, VT, Lessard	60
118	7/12/2005	18:05		48	53.20	125	57.08	LD04	Net Tow		
119	7/12/2005	19:10	19:27	48	49.70	126	3.52	LD05	CTD042	Nuts, Chl, VT	90
120	7/12/2005	19:10		48	49.70	126	3.52	LD05	Net Tow		
121	7/12/2005	20:27	20:43	48	46.20	126	10.21	LD06	CTD043	Chl, VT	130
122	7/12/2005	20:27		48	46.20	126	10.21	LD06	Net Tow		
123	7/12/2005	21:33	22:12	48	42.71	126	16.76	LD07	CTD044	Nuts, Chl, VT	542
124	7/12/2005	21:33		48	42.71	126	16.76	LD07	Net Tow		
125	7/12/2005	23:07	23:34	48	39.18	126	23.39	LD08	CTD045	Chl, VT	780
126	7/12/2005	23:07		48	39.18	126	23.39	LD08	Net Tow		
127	7/13/2005	00:20	00:54	48	35.72	126	29.90	LD09	CTD046	Nuts, Chl, VT	1070
128	7/13/2005	00:20		48	35.72	126	29.90	LD09	Net Tow		
129	7/13/2005	01:47	02:23	48	32.26	126	36.49	LD10	CTD047	Nuts, Chl, VT	1479
130	7/13/2005	01:47		48	32.26	126	36.49	LD10	Net Tow		
131	7/13/2005	03:08	03:38	48	28.70	126	42.85	LD11	CTD048	Nuts, Chl, VT	1620
132	7/13/2005	03:08	03:38	48	28.70	126	42.85	LD11	Net Tow		
133	7/13/2005	06:09	06:11	48	25.88	126	13.60	LC09	Drifter 3819 deployed		613
134	7/13/2005	09:23	09:46	48	17.73	125	27.02	EH03	CTD049	Chl (5 m), VT, calibration +K148+ K200 for mooring	129
135	7/13/2005	09:23		48	17.73	125	27.02	EH03	Net Tow		
136	7/13/2005	16:00	18:00	48		124			Package Pickup - Neah Bay		
137	7/13/2005	20:00	20:10	48	27.72	125	6.31		Fe fish deployed		
138	7/13/2005	20:10	20:34	48	27.72	125	6.31	TS01	CTD050	Nuts, Chl, VT	187
139	7/13/2005	20:10		48	27.72	125	6.31	TS01	Net Tow		
140	7/13/2005	22:10	22:35	48	27.68	125	6.38	TS01	CTD051	Nuts, Chl, VT Lessard	187
141	7/13/2005	22:10		48	27.68	125	6.38	TS01	Net Tow		
142	7/14/2005	00:03	00:27	48	27.75	125	6.43	TS01	CTD052	Nuts, Chl, VT	189
143	7/14/2005	00:03		48	27.75	125	6.43	TS01	Net Tow		
144	7/14/2005	01:59	02:32	48	27.77	125	6.44	TS01	CTD053	Nuts, Chl, VT	189
145	7/14/2005	01:59		48	27.77	125	6.44	TS01	Net Tow		

146	7/14/2005	04:05	04:25	48	27.77	125	6.41	TS01	CTD054	Nuts, Chl, VT	188
147	7/14/2005	04:05		48	27.77	125	6.41	TS01	Net Tow		
148	7/14/2005	06:03	06:24	48	27.76	125	6.52	TS01	CTD055	Nuts, Chl, VT	188
149	7/14/2005	06:03		48	27.76	125	6.52	TS01	Net Tow		
150	7/14/2005	08:01	08:28	48	27.70	125	6.61	TS01	CTD056	Nuts, Chl, VT	185
151	7/14/2005	08:01		48	27.70	125	6.61	TS01	Net Tow		
152	7/14/2005	10:01	10:26	48	27.78	125	6.33	TS01	CTD057	Nuts, Chl, VT	185
153	7/14/2005	10:01		48	27.78	125	6.33	TS01	Net Tow		
154	7/14/2005	12:05	12:30	48	27.73	125	6.64	TS01	CTD058	Nuts, Chl, VT, flow cam	187
155	7/14/2005	12:05		48	27.73	125	6.64	TS01	Net Tow		
156	7/14/2005	13:59	14:21	48	27.57	125	6.62	TS01	CTD059	Nuts, Chl, VT	187
157	7/14/2005	13:59		48	27.57	125	6.62	TS01	Net Tow		
158	7/14/2005	16:01	16:24	48	27.87	125	6.55	TS01	CTD060	Nuts, Chl, VT, Lessard	187
159	7/14/2005	16:01		48	27.87	125	6.55	TS01	Net Tow		
160	7/14/2005	18:04	18:32	48	27.72	125	6.58	TS01	CTD061	Nuts, Chl, VT	187
161	7/14/2005	18:04		48	27.72	125	6.58	TS01	Net Tow		
162	7/14/2005	20:01	20:34	48	27.68	125	6.33	TS01	CTD062	Nuts, Chl, VT	186
163	7/14/2005	20:01		48	27.68	125	6.33	TS01	Net Tow		
164	7/14/2005	20:22		48	27.68	125	6.33	TS01	Fe fish recovered		
165	7/14/2005	23:28	23:43	47	56.62	124	58.64	OZ03	CTD063	Chl, VT	110
166	7/14/2005	23:28		47	56.62	124	58.64	OZ03	Net Tow		
167	7/15/2005	00:44	00:56	48	0.32	124	51.44	OZ02	CTD064	Chl, VT	62
168	7/15/2005	00:44		48	0.32	124	51.44	OZ02	Net Tow		
169	7/15/2005	01:55	02:10	48	3.74	124	44.13	OZ01	CTD065	Chl, VT	32
170	7/15/2005	01:55		48	3.74	124	44.13	OZ01	Net Tow		
171	7/15/2005	05:03	05:37	48	26.77	124	49.52	JH02	CTD066	Julian standards, bottom water Evelyn, Chl, VT	327
172	7/15/2005	05:03		48	26.77	124	49.52	JH02	Net Tow		
173	7/15/2005	07:10	07:36	48	31.16	124	28.04	JA01	CTD067	Nuts, Chl, VT	77
174	7/15/2005	07:10		48	31.16	124	28.04	JA01	Net Tow		
175	7/15/2005	08:01	08:31	48	29.46	124	29.57	JA02	CTD068	Nuts, Chl, VT	177
176	7/15/2005	08:01		48	29.46	124	29.57	JA02	Net Tow		
177	7/15/2005	09:00	09:35	48	27.20	124	31.84	JA03	CTD069	Nuts, Chl, VT	238
178	7/15/2005	09:00		48	27.20	124	31.84	JA03	Net Tow		
179	7/15/2005	10:01	10:29	48	24.79	124	33.50	JA04	CTD070	Nuts, Chl, VT	189
180	7/15/2005	10:01		48	24.79	124	33.50	JA04	Net Tow		
181	7/15/2005	10:53	11:09	48	23.60	124	34.36	JA05	CTD071	Nuts, Chl, VT	78
182	7/15/2005	10:53		48	23.60	124	34.36	JA05	Net Tow		
183	7/15/2005	12:23		48	29.25	124	41.83	EH01	deploy Fe fish		
184	7/15/2005	12:23		48	29.25	124	41.83	EH01	Net Tow		
185	7/15/2005	12:26	12:52	48	29.23	124	41.82	EH01	CTD072	Nuts, Chl, VT + NH4/Urea	258
186	7/15/2005	12:26		48	29.23	124	41.82	EH01	Net Tow		
187	7/15/2005	14:03	14:33	48	26.01	124	32.56	JDFA	CTD073	Nuts, Chl, VT + NH4/Urea	245

188	7/15/2005	14:03		48	26.01	124	32.56	JDFA	Net Tow		
189	7/15/2005	16:02	16:36	48	23.14	125	22.91	JDFB	CTD074	Nuts, Chl, VT, Lessard (12) + NH4/Urea	238
190	7/15/2005	16:02		48	23.14	125	22.91	JDFB	Net Tow		
191	7/15/2005	18:35	19:00	48	17.31	124	3.02	JDFC	CTD075	Nuts, Chl, VT + NH4/Urea	193
192	7/15/2005	18:35		48	17.31	124	3.02	JDFC	Net Tow		
193	7/15/2005	21:01	21:21	48	14.00	123	42.95	JDFD	CTD076	Nuts, Chl, VT + NH4/Urea	167
194	7/15/2005	21:01		48	14.00	123	42.95	JDFD	Net Tow		
195	7/15/2005	22:02	22:15	48	13.99	123	43.37	JDFD	CTD077	Lessard and cast for EV	167
196	7/16/2005	00:00	00:16	48	13.02	123	25.03	JDFE	CTD078	Nuts, Chl, VT	124
197	7/16/2005	00:00		48	13.02	123	25.03	JDFE	Net Tow		
198	7/16/2005	01:58	02:24	48	14.67	123	6.16	JDFF	CTD079	Nuts, Chl, VT	148
199	7/16/2005	01:58		48	14.67	123	6.16	JDFF	Net Tow		
200	7/16/2005	05:22	05:41	48	18.53	123	40.66	JD01	CTD080	Nuts, Chl, VT	136
201	7/16/2005	05:22		48	18.53	123	40.66	JD01	Net Tow		
202	7/16/2005	06:01	06:28	48	17.77	123	41.05	JD02	CTD081	Nuts, Chl, VT	171
203	7/16/2005	06:01		48	17.77	123	41.05	JD02	Net Tow		
204	7/16/2005	07:03	07:28	48	13.94	123	43.00	JD03	CTD082	Nuts, Chl, VT	164
205	7/16/2005	07:03		48	13.94	123	43.00	JD03	Net Tow		
206	7/16/2005	07:53	08:12	48	11.33	123	44.28	JD04	CTD083	Nuts, Chl, VT	103
207	7/16/2005	07:53		48	11.33	123	44.28	JD04	Net Tow		
208	7/16/2005	08:20	08:55	48	10.31	123	45.00	JD05	CTD084	Nuts, Chl, VT	46
209	7/16/2005	08:20		48	10.31	123	45.00	JD05	Net Tow		
210	7/16/2005	20:00	22:00	48	17.64	125	27.12	EH03	Replaced mooring light		128
211	7/16/2005	22:09	22:24	48	17.64	125	27.12	EH03	CTD085	Mooring Cal., Nuts, Chl, VT	128
212	7/16/2005	20:00		48	17.64	125	27.12	EH03	Net Tow		
213	7/17/2005	01:14	01:24	48	3.79	124	44.06	OZ01	CTD086	Nuts, Chl, VT	33
214	7/17/2005	01:14		48	3.79	124	44.06	OZ01	Net Tow		
215	7/17/2005	03:00	03:20	47	49.50	124	40.68	LP01	CTD087	Nuts, Chl, VT	37
216	7/17/2005	03:00		47	49.50	124	40.68	LP01	Net Tow		
217	7/17/2005	04:48	04:58	47	34.71	124	29.97	KB01	CTD088	Nuts, Chl, VT	30
218	7/17/2005	04:48		47	34.71	124	29.97	KB01	Net Tow		
219	7/17/2005	05:46	05:58	47	35.58	124	35.80	EH02	CTD089	Nuts, Chl, VT	43
220	7/17/2005	05:46		47	35.58	124	35.80	EH02	Net Tow		
221	7/17/2005	07:45	07:58	47	18.36	124	22.05	CB01	CTD090	Nuts, Chl, VT	28
222	7/17/2005	07:45		47	18.36	124	22.05	CB01	Net Tow		
223	7/17/2005	15:15	15:19	47	3.99	124	14.56	GH01	CTD091	Nuts, Chl, VT	20
224	7/17/2005	15:15		47	3.99	124	14.56	GH01	Net Tow		
225	7/17/2005	16:11	16:26	47	2.51	124	21.58	GH02	CTD092	Nuts, Chl, VT	46
226	7/17/2005	16:11		47	2.51	124	21.58	GH02	Net Tow		
227	7/17/2005	17:13	17:25	47	1.04	124	28.87	GH03	CTD093	Chl, VT	69
228	7/17/2005	17:13		47	1.04	124	28.87	GH03	Net Tow		
229	7/17/2005	18:15		47	3.87	124	31.43		Drifter 3775		

									recovered		
230	7/17/2005	19:16	19:34	46	58.80	124	37.51	GH04	CTD094	Nuts, Chl, VT, Salt	100
231	7/17/2005	19:16		46	58.80	124	37.51	GH04	Net Tow		
232	7/17/2005	20:36	20:52	46	56.86	124	46.88	GH05	CTD095	Chl, VT	150
233	7/17/2005	20:36		46	56.86	124	46.88	GH05	Net Tow		
234	7/17/2005	21:48	22:20	46	54.65	124	55.39	GH06	CTD096	Nuts, Chl, VT, Salt	431
235	7/17/2005	21:48		46	54.65	124	55.39	GH06	Net Tow		
236	7/17/2005	23:16	23:46	46	52.96	125	3.67	GH07	CTD097	Nuts, Chl, VT, Salt	825
237	7/17/2005	23:16		46	52.96	125	3.67	GH07	Net Tow		
238	7/18/2005	01:48		46	48.22	124	41.42		Drifter 3917 Recovered		
239	7/18/2005	07:34	08:36	47	1.93	125	23.09	CB08	CTD098	Nuts, Chl, VT, Brian	1884
240	7/18/2005	07:34		47	1.93	125	23.09	CB08	Net Tow		
241	7/18/2005	09:46	10:23	47	5.80	125	9.98	CB07	CTD099	Chl, VT	1507
242	7/18/2005	09:46		47	5.80	125	9.98	CB07	Net Tow		
243	7/18/2005	11:10	11:47	47	7.87	125	1.62	CB06	CTD100	Nuts, Chl, VT	888
244	7/18/2005	11:10		47	7.87	125	1.62	CB06	Net Tow		
245	7/18/2005	12:45	13:02	47	10.01	125	53.08	CB05	CTD101	Chl, VT	155
246	7/18/2005	12:45		47	10.01	125	53.08	CB05	Net Tow		
247	7/18/2005	13:54	14:12	47	12.16	124	43.32	CB04	CTD102	Nuts, Chl, VT, Salt	114
248	7/18/2005	13:54		47	12.16	124	43.32	CB04	Net Tow		
249	7/18/2005	15:07	15:24	47	14.36	124	35.50	CB03	CTD103	Chl, VT, Lessard (12)	77
250	7/18/2005	15:07		47	14.36	124	35.50	CB03	Net Tow		
251	7/18/2005	16:12	16:42	47	16.08	124	28.26	CB02	CTD104	Nuts, Chl, VT, Lessard (12)	49
252	7/18/2005	16:12		47	16.08	124	28.26	CB02	Net Tow		
253	7/18/2005	17:14	17:29	47	18.27	124	22.05	CB01	CTD105	Nuts, Chl, VT	35
254	7/18/2005	17:14		47	18.27	124	22.05	CB01	Net Tow		
255	7/18/2005	17:39		47	18.27	124	22.05	CB01	Fe fish recovered		
256	7/18/2005	19:31		47	33.40	124	29.40		Fe fish deployed		
257	7/18/2005	19:51	20:00	47	34.69	124	30.00	KB01	CTD106	Nuts, Chl, VT	30
258	7/18/2005	19:51		47	34.69	124		KB01	Net Tow		
259	7/18/2005	21:07	21:23	47	31.58	124	38.52	KB02	CTD107	Nuts, Chl, VT	68
260	7/18/2005	21:07		47	31.58	124	38.52	KB02	Net Tow		
261	7/18/2005	22:26	22:39	47	28.63	124	47.03	KB03	CTD108	Lessard BBL, Chl, VT	119
262	7/18/2005	22:26		47	28.63	124	47.03	KB03	Net Tow		
263	7/18/2005	23:40	00:13	47	25.57	124	55.55	KB04	CTD109	Nuts, Chl, VT, Salt	1070
264	7/18/2005	23:40		47	25.57	124	55.55	KB04	Net Tow		
265	7/19/2005	01:10	01:45	47	22.24	125	3.91	KB05	CTD110	Chl, VT	1432
266	7/19/2005	01:10		47	22.24	125	3.91	KB05	Net Tow		
267	7/19/2005	02:40	03:12	47	19.57	125	12.31	KB06	CTD111	Nuts, Chl, VT	1690
268	7/19/2005	02:40		47	19.57	125	12.31	KB06	Net Tow		
269	7/19/2005	04:13	04:43	47	16.47	125	20.95	KB07	CTD112	Chl, VT	1698
270	7/19/2005	04:13		47	16.47	125	20.95	KB07	Net Tow		
271	7/19/2005	05:50	06:19	47	13.14	125	30.96	KB08	CTD113	Nuts, Chl, VT	1575
272	7/19/2005	05:50		47	13.14	125	30.96	KB08	Net Tow		

273	7/19/2005	08:18	08:58	47	25.66	125	33.99	LP08	CTD114	Nuts, Chl, VT	1476
274	7/19/2005	08:18		47	25.66	125	33.99	LP8	Net Tow		
275	7/19/2005	09:46	10:19	47	29.04	125	26.42	LP07	CTD115	Chl, VT	1201
276	7/19/2005	09:46		47	29.04	125	26.42	LP07	Net Tow		
277	7/19/2005	11:12	11:47	47	32.45	125	18.94	LP06	CTD116	Nuts, Chl, VT	1024
278	7/19/2005	11:12		47	32.45	125	18.94	LP06	Net Tow		
279	7/19/2005	12:40	13:00	47	35.85	125	11.21	LP05	CTD117	Chl, VT	596
280	7/19/2005	12:40		47	35.85	125	11.21	LP05	Net Tow		
281	7/19/2005	14:07	14:26	47	39.28	125	3.55	LP04	CTD118	Nuts, Chl, VT, Salt	178
282	7/19/2005	14:07		47	39.28	125	3.55	LP04	Net Tow		
283	7/19/2005	15:53		47	45.51	124	54.73		Drifter 3861 recovered		
284	7/19/2005	16:02		47	45.43	124	54.59		Fe fish deployed		
285	7/19/2005	16:51	17:11	47	42.74	124	55.85	LP03	CTD119	Chl, VT	119
286	7/19/2005	16:51		47	42.74	124	55.85	LP03	Net Tow		
287	7/19/2005	18:02	18:23	47	46.07	124	48.31	LP02	CTD120	Nuts, Chl, VT	82
288	7/19/2005	18:02		47	46.07	124	48.31	LP02	Net Tow		
289	7/19/2005	19:20	19:35	47	49.57	124	41.81	LP01	CTD121	Nuts, Chl, VT	37
290	7/19/2005	19:20		47	49.57	124	41.81	LP01	Net Tow		
291	7/19/2005	19:37		47	49.54	124	40.94	LP01	Drifter 3861 deployed		38
292	7/19/2005	21:44	21:55	48	3.74	124	44.50	OZ01	CTD122	Nuts, Chl, VT	32
293	7/19/2005	21:44		48	3.74	124	44.50	OZ01	Net Tow		
294	7/19/2005	22:49	23:01	48	0.33	124	51.37	OZ02	CTD123	Nuts, Chl, VT, Lessard	61
295	7/19/2005	22:49		48	0.33	124	51.37	OZ02	Net Tow		
296	7/20/2005	00:00	00:14	47	56.89	124	58.68	OZ03	CTD124	Chl, VT, Nuts for ISUS/02 anomaly - non-standard depths	110
297	7/20/2005	00:00		47	56.89	124	58.68	OZ03	Net Tow		
298	7/20/2005	01:14	01:32	47	53.48	125	6.11	OZ04	CTD125	Nuts, Chl, VT	152
299	7/20/2005	01:14		47	53.48	125	6.11	OZ04	Net Tow		
300	7/20/2005	02:25	02:51	47	50.06	125	13.39	OZ05	CTD126	Chl, VT	451
301	7/20/2005	02:25		47	50.06	125	13.39	OZ05	Net Tow		
302	7/20/2005	03:38	04:14	47	46.57	125	20.82	OZ06	CTD127	Nuts, Chl, VT, non-standard depths for ISUS/2 anomaly	839
303	7/20/2005	03:38		47	46.57	125	20.82	OZ06	Net Tow		
304	7/20/2005	04:58	05:26	27	43.14	125	28.22	OZ07	CTD128	Chl, VT	1006
305	7/20/2005	04:58		27	43.14	125	28.22	OZ07	Net Tow		
306	7/20/2005	06:18	06:56	47	39.71	125	35.57	OZ08	CTD129	Nuts, Chl, VT	1193
307	7/20/2005	06:18		47	39.71	125	35.57	OZ08	Net Tow		
308	7/20/2005	00:00	08:03	47	36.30	125	43.04	OZ09	CTD130	Chl, VT	1440
309	7/20/2005	00:00		47	36.30	125	43.04	OZ09	Net Tow		
310	7/20/2005	09:02	09:32	47	44.89	124	48.09	CF09	CTD131	Chl, VT	1307
311	7/20/2005	09:02		47	44.89	124	48.09	CF09	Net Tow		
312	7/20/2005	10:17	10:55	47	48.93	125	39.99	CF08	CTD132	Nuts, Chl, VT	1084
313	7/20/2005	10:17		47	48.93	125	39.99	CF08	Net Tow		

314	7/20/2005	11:42	12:11	47	52.99	125	31.96	CF07	CTD133	Chl, VT	774
315	7/20/2005	11:42		47	52.99	125	31.96	CF07	Net Tow		
316	7/20/2005	12:59	13:35	47	57.19	125	23.55	CF06	CTD134	Nuts, Chl, VT, Salt	710
317	7/20/2005	12:59		47	57.19	125	23.55	CF06	Net Tow		
318	7/20/2005	14:24	14:40	48	1.48	125	15.52	CF05	CTD135	Chl, VT	158
319	7/20/2005	14:24		48	1.48	125	15.52	CF05	Net Tow		
320	7/20/2005	15:23	15:41	48	4.68	125	7.97	CF04	CTD136	Nuts, Chl, VT	129
321	7/20/2005	15:23		48	4.68	125	7.97	CF04	Net Tow		
322	7/20/2005	15:30		48	4.68	125	7.97	CF04	Fe fish deployed		
323	7/20/2005	16:48	17:16	48	9.00	125	0.05	CF03	CTD137	Chl, VT, Lessard (12)	339
324	7/20/2005	16:48		48	9.00	125	0.05	CF03	Net Tow		
325	7/20/2005	18:17	18:31	48	12.98	124	52.43	CF02	CTD138	Nuts, Chl, VT	56
326	7/20/2005	18:17		48	12.98	124	52.43	CF02	Net Tow		
327	7/20/2005	19:37	19:46	48	16.83	124	44.30	CF01	CTD139	Nuts, Chl, VT	32
328	7/20/2005	19:37		48	16.83	124	44.30	CF01	Net Tow		
329	7/20/2005	22:05	22:37	48	29.14	124	42.01	LA01	CTD140	Nuts, Chl, VT, Salt	256
330	7/20/2005	22:05		48	29.14	124	42.01	LA01	Net Tow		
331	7/20/2005	22:41		48	29.14	124	42.01	LA01	Drifter 3818 deployed		
332	7/20/2005	23:37	00:02	48	26.29	124	51.26	LA02	CTD141	Nuts, Chl, VT, Salt	308
333	7/20/2005	23:37		48	26.29	124	51.26	LA02	Net Tow		
334	7/21/2005	00:56	01:09	48	22.84	124	57.65	LA03	CTD142	Chl, VT	111
335	7/21/2005	00:56		48	22.84	124	57.65	LA03	Net Tow		
336	7/21/2005	02:02	02:23	48	19.35	125	4.07	LA04	CTD143	Nuts, Chl, VT	192
337	7/21/2005	02:02		48	19.35	125	4.07	LA04	Net Tow		
338	7/21/2005	03:14	03:26	48	15.97	125	10.52	LA05	CTD144	Chl, VT	118
339	7/21/2005	03:14		48	15.97	125	10.52	LA05	Net Tow		
340	7/21/2005	04:06	04:20	48	12.65	125	17.18	LA06	CTD145	Nuts, Chl, VT	112
341	7/21/2005	04:06		48	12.65	125	17.18	LA06	Net Tow		
342	7/21/2005	05:00	05:11	48	9.18	125	23.78	LA07	CTD146	Chl, VT	114
343	7/21/2005	05:00		48	9.18	125	23.78	LA07	Net Tow		
344	7/21/2005	05:52	06:10	48	5.76	125	30.31	LA08	CTD147	Nuts, Chl, VT	141
345	7/21/2005	05:52		48	5.76	125	30.31	LA08	Net Tow		
346	7/21/2005	06:49	07:14	48	2.35	125	36.87	LA09	CTD148	Chl, VT	352
347	7/21/2005	06:49		48	2.35	125	36.87	LA09	Net Tow		
348	7/21/2005	07:52	08:28	47	59.03	125	43.32	LA10	CTD149	Nuts, Chl, VT	918
349	7/21/2005	07:52		47	59.03	125	43.32	LA10	Net Tow		
350	7/21/2005	09:19	09:49	47	53.85	125	53.47	LA11	CTD150	Chl, VT	1554
351	7/21/2005	09:19		47	53.85	125	53.47	LA11	Net Tow		
352	7/21/2005	10:54	11:34	48	3.83	125	50.81	LAB09	CTD151	Chl, VT	768
353	7/21/2005	10:54		48	3.83	125	50.81	LAB09	Net Tow		
354	7/21/2005	12:19	12:47	48	7.72	125	43.46	LAB08	CTD152	Nuts, Chl, VT	313
355	7/21/2005	12:19		48	7.72	125	43.46	LAB08	Net Tow		
356	7/21/2005	13:35	13:48	48	11.75	125	35.69	LAB07	CTD153	Chl, VT	158
357	7/21/2005	13:35		48	11.75	125	35.69	LAB07	Net Tow		
358	7/21/2005	14:05							Fe fish deployed		

359	7/21/2005	15:02	15:22	48	15.73	125	28.04	LAB06	CTD154	Nuts, Chl, VT	135
360	7/21/2005	15:02		48	15.73	125	28.04	LAB06	Net Tow		
361	7/21/2005	16:29	16:45	48	19.67	125	20.46	LAB05	CTD155	Chl, VT	111
362	7/21/2005	16:29		48	19.67	125	20.46	LAB05	Net Tow		
363	7/21/2005	18:38	19:02	48	23.68	125	12.94	LAB04	CTD156	Nuts, Chl, VT	105
364	7/21/2005	18:38		48	23.68	125	12.94	LAB04	Net Tow		
365	7/21/2005	20:14	20:31	48	27.61	125	5.25	LAB03	CTD157	Chl, VT	167
366	7/21/2005	20:14		48	27.61	125	5.25	LAB03	Net Tow		
367	7/21/2005	21:33	21:47	48	31.46	124	57.62	LAB02	CTD158	Nuts, Chl, VT	65
368	7/21/2005	21:33		48	31.46	124	57.62	LAB02	Net Tow		
369	7/21/2005	22:46	22:59	48	35.54	124	50.08	LAB01	CTD159	Nuts, Chl, VT	60
370	7/21/2005	22:46		48	35.54	124	50.08	LAB01	Net Tow		
371	7/22/2005	00:13	00:24	48	40.35	124	59.40	LB01	CTD160	Nuts, Chl, VT	36
372	7/22/2005	00:13		48	40.35	124	59.40	LB01	Net Tow		
373	7/22/2005	01:18	01:32	48	37.18	125	5.60	LB03	CTD161	Nuts, Chl, VT	95
374	7/22/2005	01:18		48	37.18	125	5.60	LB03	Net Tow		
375	7/22/2005	02:10	02:20	48	34.42	125	10.01	LB05	CTD162	Chl, VT	103
376	7/22/2005	02:10		48	34.42	125	10.01	LB05	Net Tow		
377	7/22/2005	03:00	03:15	48	32.07	125	15.56	LB06	CTD163	Nuts, Chl, VT	114
378	7/22/2005	03:00		48	32.07	125	15.56	LB06	Net Tow		
379	7/22/2005	03:25		48	31.68	125	16.46	LB06	Drifter 3917 Deployed		
380	7/22/2005	03:56	04:09	48	28.63	125	22.17	LB07	CTD164	Chl, VT	156
381	7/22/2005	03:56		48	28.63	125	22.17	LB07	Net Tow		
382	7/22/2005	04:47	05:04	48	25.21	125	28.61	LB08	CTD165	Nuts, Chl, VT	133
383	7/22/2005	04:47		48	25.21	125	28.61	LB08	Net Tow		
384	7/22/2005	05:40	05:54	48	22.01	125	34.73	LB09	CTD166	Chl, VT BBL	151
385	7/22/2005	05:40		48	22.01	125	34.73	LB09	Net Tow		
386	7/22/2005	06:43	07:01	48	18.53	125	41.11	LB10	CTD167	Nuts, Chl, VT	153
387	7/22/2005	06:43		48	18.53	125	41.11	LB10	Net Tow		
388	7/22/2005	07:39	07:58	48	15.21	125	47.70	LB11	CTD168	Chl, VT Brian (4)	207
389	7/22/2005	07:39		48	15.21	125	47.70	LB11	Net Tow		
390	7/22/2005	08:31	09:08	48	11.97	125	53.12	LB13	CTD169	Nuts, Chl, VT	604
391	7/22/2005	08:31		48	11.97	125	53.12	LB13	Net Tow		
392	7/22/2005	09:45	10:16	48	8.45	125	59.99	LB14	CTD170	Chl, VT	1185
393	7/22/2005	09:45		48	8.45	125	59.99	LB14	Net Tow		
394	7/22/2005	11:03	11:37	48	4.39	126	8.33	LB15	CTD171	Nuts, Chl, VT	1549
395	7/22/2005	11:03		48	4.39	126	8.33	LB15	Net Tow		
396	7/22/2005	13:03	13:31	48	13.36	126	15.57	LBC09	CTD172	Chl, VT	1216
397	7/22/2005	13:03		48	13.36	126	15.57	LBC09	Net Tow		
398	7/22/2005	14:15	14:49	48	17.17	126	8.12	LBC08	CTD173	Nuts, Chl, VT, Salt	1142
399	7/22/2005	14:15		48	17.17	126	8.12	LBC08	Net Tow		
	7/22/2005	14:20							Fish Deployed		
400	7/22/2005	15:56	16:39	48	20.70	126	0.46	LBC07	CTD174	Chl, VT	
401	7/22/2005	15:56		48	20.70	126	0.46	LBC07	Net Tow		
402	7/22/2005	17:31	18:00	48	24.82	125	52.96	LBC06	CTD175	Nuts, Chl, VT	155
403	7/22/2005	17:31		48	24.82	125	52.96	LBC06	Net Tow		
404	7/22/2005	18:58	19:12	48	28.64	125	45.42	LBC05	CTD176	Chl, VT	106

405	7/22/2005	18:58		48	28.64	125	45.42	LBC05	Net Tow		
406	7/22/2005	20:07	20:21	48	32.41	125	37.83	LBC04	CTD177	Nuts, Chl, VT	79
407	7/22/2005	20:07		48	32.41	125	37.83	LBC04	Net Tow		
408	7/22/2005	21:16	21:33	48	36.21	125	30.32	LBC03	CTD178	Chl, VT, Lessard	104
409	7/22/2005	21:16		48	36.21	125	30.32	LBC03	Net Tow		
410	7/22/2005	22:28	22:41	48	40.01	125	22.66	LBC02	CTD179	Nuts, Chl, VT	68
411	7/22/2005	22:28		48	40.01	125	22.66	LBC02	Net Tow		
412	7/22/2005	23:37	23:51	48	43.82	125	15.01	LBC01	CTD180	Nuts, Chl, VT	70
413	7/22/2005	23:37		48	43.82	125	15.01	LBC01	Net Tow		
414	7/23/2005	01:32	01:51	48	50.39	125	27.65	LC01	CTD181	Nuts, Chl, VT	95
415	7/23/2005	01:32		48	50.39	125	27.65	LC01	Net Tow		
416	7/23/2005	02:37	02:53	48	47.02	125	34.10	LC03	CTD182	Nuts, Chl, VT	135
417	7/23/2005	02:37		48	47.02	125	34.10	LC03	Net Tow		
418	7/23/2005	02:40		48	47.02	125	34.10	LC03	Fe fish recovered		
419	7/23/2005	03:33	03:47	48	43.40	125	40.77	LC04	CTD183	Chl, VT	167
420	7/23/2005	03:33		48	43.40	125	40.77	LC04	Net Tow		
421	7/23/2005	04:28	04:39	48	39.89	125	47.32	LC05	CTD184	Nuts, Chl, VT	63
422	7/23/2005	04:28		48	39.89	125	47.32	LC05	Net Tow		
423	7/23/2005	05:20	05:32	48	36.42	125	53.89	LC06	CTD185	Chl, VT	91
424	7/23/2005	05:20		48	36.42	125	53.89	LC06	Net Tow		
425	7/23/2005	06:14	06:31	48	32.91	126	0.40	LC07	CTD186	Nuts, Chl, VT	127
426	7/23/2005	06:14		48	32.91	126	0.40	LC07	Net Tow		
427	7/23/2005	07:10	07:30	48	29.45	126	7.07	LC08	CTD187	Chl, VT	199
428	7/23/2005	07:10		48	29.45	126	7.07	LC08	Net Tow		
429	7/23/2005	08:05	08:39	48	25.95	126	13.74	LC09	CTD188	Nuts, Chl, VT	615
430	7/23/2005	08:05		48	25.95	126	13.74	LC09	Net Tow		
431	7/23/2005	09:16	09:47	48	22.42	126	20.23	LC10	CTD189	Chl, VT	1250
432	7/23/2005	09:16		48	22.42	126	20.23	LC10	Net Tow		
433	7/23/2005	12:33	12:44	48	7.83	125	43.12	DA01 (LAB08)	CTD190	Chl, VT	305
434	7/23/2005	12:33		48	7.83	125	43.12	DA01 (LAB08)	Net Tow		
435	7/23/2005	12:54		48	7.83	125	43.12	DA01 (LAB08)	Drifter 3938 deployed		
436	7/23/2005	14:31	14:40	48	6.45	125	42.19	DA02	CTD191		249
437	7/23/2005	14:31		48	6.45	125	42.19	DA02	Net Tow		
438	7/23/2005	16:39	16:54	48	4.69	125	41.21	DA03	CTD192	Nuts	532
439	7/23/2005	16:39		48	4.69	125	41.21	DA03	Net Tow		
440	7/23/2005	17:27	17:38	48	4.08	125	38.61	BO01	CTD193	Lessard (10)	180
441	7/23/2005	17:27		48	4.08	125	38.61	BO01	Net Tow		
442	7/23/2005	18:33	18:48	48	3.30	125	40.89	DA04	CTD194	Nuts	753
443	7/23/2005	18:33		48	3.30	125	40.89	DA04	Net Tow		
444	7/23/2005	19:31	19:45	48	2.90	125	40.95	DA05	CTD195		623
445	7/23/2005	19:31		48	2.90	125	40.95	DA05	Net Tow		
446	7/23/2005	20:30	20:47	48	2.63	125	41.00	DA06	CTD196	Nuts	617
447	7/23/2005	20:30		48	2.63	125	41.00	DA06	Net Tow		
448	7/23/2005	21:35	21:48	48	2.57	125	41.10	DA07	CTD197		627
449	7/23/2005	21:35		48	2.57	125	41.10	DA07	Net Tow		
450	7/23/2005	22:29	22:47	48	2.61	125	40.59	DA08	CTD198	Nuts	580

451	7/23/2005	22:29		48	2.61	125	40.59	DA08	Net Tow		
452	7/24/2005	00:31	00:43	48	2.23	125	38.06	DA09	CTD199	Nuts	441
453	7/24/2005	00:31		48	2.23	125	38.06	DA09	Net Tow		
454	7/24/2005	02:32	02:45	48	0.98	125	35.85	DA10	CTD200	Nuts	196
455	7/24/2005	02:32		48	0.98	125	35.85	DA10	Net Tow		
456	7/24/2005	04:33	04:47	47	59.14	125	33.89	DA11	CTD201	Nuts	183
457	7/24/2005	04:33		47	59.14	125	33.89	DA11	Net Tow		
458	7/24/2005	06:33	06:49	47	56.85	125	33.26	DA12	CTD202	Nuts	221
459	7/24/2005	06:33		47	56.85	125	33.26	DA12	Net Tow		
460	7/24/2005	07:35	07:43	47	55.99	125	33.82	DA13	CTD203		215
461	7/24/2005	07:35		47	55.99	125	33.82	DA13	Net Tow		
462	7/24/2005	08:34	08:49	47	55.65	125	34.09	DA14	CTD204	Nuts	211
463	7/24/2005	08:34		47	55.65	125	34.09	DA14	Net Tow		
464	7/24/2005	09:37	09:45	47	55.25	125	34.65	DA15	CTD205		265
465	7/24/2005	09:37		47	55.25	125	34.65	DA15	Drifter 3938 recovered		
466	7/24/2005	14:10		48	26.45	124	46.23		Fe fish deployed		
467	7/24/2005	15:20	15:50	48	29.40	124	41.79	EH01	CTD206	Nuts, Chl, VT, Ben (3)	249
468	7/24/2005	15:20		48	29.40	124	41.79	EH01	Net Tow		
469	7/24/2005	16:58	17:33	48	26.10	124	32.66	JDFA	CTD207	Nuts, Chl, VT	241
470	7/24/2005	16:58		48	26.10	124	32.66	JDFA	Net Tow		
471	7/24/2005	18:56	19:22	48	23.08	124	22.73	JDFB	CTD208	Nuts, Chl, VT, Salt	238
472	7/24/2005	18:56		48	23.08	124	22.73	JDFB	Net Tow		
473	7/24/2005	21:35	21:55	48	17.27	124	2.82	JDFC	CTD209	Nuts, Chl, VT	192
474	7/24/2005	21:35		48	17.27	124	2.82	JDFC	Net Tow		
475	7/24/2005	23:34	23:57	48	14.04	123	42.91	JDFD	CTD210	Nuts, Chl, VT	162
476	7/24/2005	23:34		48	14.04	123	42.91	JDFD	Net Tow		
477	7/25/2005	01:29	01:46	48	13.01	123	25.00	JDFE	CTD211	Nuts, Chl, VT, Lessard	123
478	7/25/2005	01:29		48	13.01	123	25.00	JDFE	Net Tow		
479	7/25/2005	03:30		48	14.66	123	5.97	JDFF	Fe fish recovered		
480	7/25/2005	03:32	03:57	48	14.66	123	5.97	JDFF	CTD212	Nuts, Chl, VT	147
481	7/25/2005	03:32		48	14.66	123	5.97	JDFF	Net Tow		
482	7/25/2005	12:30							Drifter 3818 recovered		
483	7/25/2005	14:06	14:16	48	9.02	124	59.67	CF03	CTD213	Lessard (12)	342
484	7/25/2005	18:36	18:41	48	16.76	124	44.39	CF01	CTD214	naked	
485	7/26/2005	03:04	03:19	48	17.57	125	26.98	EH03	CTD215	VT, Salt	127
486	7/26/2005	13:05		47	20.52	124	42.79		Drifter 3917 Recovered		
487	7/26/2005	15:20	15:55	47	35.60	124	35.92	EH02	CTD216	Nuts, VT	46
488	7/26/2005	15:20		47	35.60	124	35.92	EH02	Net Tow		
489	7/26/2005	16:28	16:36	47	34.69	124	29.98	KB01	CTD217	VT	27
490	7/26/2005	16:28		47	34.69	124	29.98	KB01	Net Tow		
491	7/26/2005	18:16	18:27	47	49.47	124	40.68	LP01	CTD218	VT	34
492	7/26/2005	18:16		47	49.47	124	40.68	LP01	Net Tow		

493	7/26/2005	20:37	20:46	48	3.64	124	44.29	OZ01	CTD219	VT	34
494	7/26/2005	20:37		48	3.64	124	44.29	OZ01	Net Tow		
495	7/26/2005	22:38	22:45	48	16.77	124	44.29	CF01	CTD220	VT	32
496	7/26/2005	22:38		48	16.77	124	44.29	CF01	Net Tow		
497	7/27/2005	00:45	00:54	48	23.57	124	34.38	JA05	CTD221	VT	77
498	7/27/2005	00:45		48	23.57	124	34.38	JA05	Net Tow		
499	7/27/2005	01:49	02:05	48	24.79	124	33.62	JA04	CTD222	VT, BBL, Salt	193
500	7/27/2005	01:49		48	24.79	124	33.62	JA04	Net Tow		
501	7/27/2005	02:38	02:57	48	27.20	124	31.81	JA03	CTD223	VT, Salt	238
502	7/27/2005	02:38		48	27.20	124	31.81	JA03	Net Tow		
503	7/27/2005	03:24	03:42	48	29.35	124	29.53	JA02	CTD224	VT, BBL, Salt	185
504	7/27/2005	03:24		48	29.35	124	29.53	JA02	Net Tow		
505	7/27/2005	04:05	04:17	48	31.12	124	27.88	JA01	CTD225	VT	78
506	7/27/2005	04:05		48	31.12	124	27.88	JA01	Net Tow		

Table 2. CTD stations organized by sample line and date, showing types of bottle samples taken as well as associated surface iron samples

Date (GMT)	Line ID	Direction	CTD Cast Nos.	Stn IDs	Nutrient Sites	Fe Sampling Sites	Lessard Dilutions Expts	Sedimentation
7/8/2005	Strait mooring		1	EH01	EH01			
7/8-9/2005	La Perouse AB	E-W	2-11	LAB01-10	LAB01-04,06,10		LAB04	
7/9-10/2005	Grays Harbor	E-W	12-18	GH01-07	GH01,02,04,06	GH02,04,06	GH03	GH02,04,06
7/10/2005	Wash Shelf mooring		19	EH02	EH02			
7/10-11/2005	Ozette	E-W	20-28	OZ01-09	OZ01,02,04,06,08	OZ02,04,06,08	OZ3	OZ02,04,06,08
7/11/2005	La Push		29	LP03			LP03	
7/11/2005	La Perouse B	W-E	30-33	LB13,10,08,06				
7/11/2005	La Perouse BC	E-W	34-35	LBC02,04		LBC04	LBC02	LBC02
7/12/2005	La Perouse C	W-E	36-38	LC06,04,01				
7/12-13/2005	La Perouse D	E-W	39-48	LD01,03-11	LD01,03,05,07,09-11	LD01,04,06,08	LD03	LD01,04,06,08
7/13/2005	Eddy mooring		49	EH03				
7/13-14/2005			50-62	TS01	TS01 (all casts)		TS01	
7/14-15/2005	Ozette	W-E	63-65	OZ03-01				
7/15/2005			66	JH02				
7/15/2005	Strait mouth	N-S	67-71	JA01-05	JA01-05			
7/15/2005	Strait mooring		72	EH01	EH01			
7/15-16/2005	Juan de Fuca	W-E	73-79	JDFA-F	JDFA-F	JDFD,E	JDFD	JDFD,E
7/16/2005	Mid-Strait	N-S	80-84	JD01-05	JD01-05			
7/16/2005	Eddy mooring		85	EH03	EH03			
7/17/2005	Ozette		86	OZ01	OZ01			
7/17/2005	La Push		87	LP01	LP01			
7/17/2005	Kalaloch Beach		88	KB01	KB01			
7/17/2005	Wash Shelf mooring		89	EH02	EH02			
7/17/2005	Copalis Beach		90	CB01	CB01			
7/17/2005	Grays Harbor	E-W	91-97	GH01-07	GH01,02,04,06,07			GH02,04,06
7/18/2005	Copalis Beach	W-E	98-105	CB08-01	CB08,06,04,02,01		CB03,02	CB03,01

7/18-19/2005	Kalaloch Beach	E-W	106-113	KB01-08	KB01,02,04,06,08	KB03,05	KB03	KB01,03,05
7/19/2005	La Push	W-E	114-121	LP08-01	LP08,06,04,02,01	LP03		LP03,01
7/19/2005	Ozette	E-W	122-130	OZ01-09	OZ01,02-04,06,08	OZ01,03,05	OZ02	OZ01,03,05
7/19-20/2005	Cape Flattery	W-E	131-139	CF09-01	CF08,06,04,02,01	CF01	CF03	CF03,01
7/20-21/2005	La Perouse A	E-W	140-150	LA01-11	LA01,02,04,06,08,10	LA01,03,05		LA01,03,05
7/21/2005	La Perouse AB	W-E	151-159	LAB09-01	LAB08,06,04,02,01	LAB06,04,02		LAB06,04
7/22/2005	La Perouse B	E-W	160-171	LB01,03,05-11,13-15	LB01,03,06,08,10,13,15	LB03,06		LB05
7/22/2005	La Perouse BC	W-E	172-180	LBC09-01	LBC08,06,04,02,01	LBC07,03,01	LBC03	LBC07,05,03,01
7/23/2005	La Perouse C	E-W	181-189	LC01,03-10	LC01,03,05,07,09	LC03		LC03
7/23/2005	Drift A		190-2	DA01-03	DA03			
7/23/2005	Brady Olson		193	BO01				
7/23-24/2005	Drift A		194-205	DA04-15	DA04,06,08-12,14			
7/24/2005	Strait mooring		206	EH01	EH01			
7/24-25/2005	Juan de Fuca	W-E	207-212	JDFA-F	JDFA-F		JDFE	
7/25/2005	Cape Flattery	W-E	213,214	CF03,01			CF03	
7/26/2005	Eddy mooring		215	EH03				
7/26/2005	Wash Shelf mooring		216	EH02	EH02			
7/26/2005	Kalaloch Beach		217	KB01				
7/26/2005	La Push		218	LP01				
7/26/2005	Ozette		219	OZ01				
7/26/2005	Cape Flattery		220	CF01				
7/26/2005	Strait mouth	S-N	221-225	JA05-01				

Table 3. Drifter deployment locations and times

Drifter ID	Model	Deployed	Lat deg	Lat min	Lon deg	Lon min	Recovered/Last transmit	Drift	Comments
3819	115	7/8/2005 6:40	48	29.33	124	42.29	7/12/2005 15:20		Deployed at EH1 - JDF Strait
3861	115	7/8/2005 9:14	48	29.96	125	15.03	7/19/2005 15:53		Deployed at VT01 - Eddy center
3885	115	7/8/2005 11:41	48	14.96	125	30.21			Deployed at VT02 - SW eddy
3917	115	7/8/2005 13:36	48	0	125	29.9	7/18/2005 1:48		Deployed at VT02 - WA1
3901	115	7/9/2005 10:28	47	46.49	125	20.61			Deployed at OZ06 - WA2
3775	115	7/10/2005 17:20	47	53.47	125	6.06	7/17/2005 18:15		Deployed at OZ04 - WA3
3819	115	7/13/2005 6:09	48	25.88	126	13.6			Deployed at LC09 - VI SBC
3861	115	7/19/2005 19:37	47	49.54	124	40.94			Deployed at LP01 - WA Inner shelf
3818	104a	7/20/2005 22:05	48	29.14	124	42.01	7/25/2005 12:30		Deployed at LA01
3917	115	7/22/2005 3:25	48	31.68	125	16.46	7/26/2005 13:08		Deployed at LB06
3938	104a	7/23/2005 12:54	48	7.83	125	43.12	7/24/2005 9:37	DA	Deployed at LAB08

Table 4. Satellite Imagery

Filename	Notes
062720052101_670_ECOHAB.gif	
062720052101_670_ECOHAB.tif	
062720052101_670_ECOHAB.tif.xml	
062720052101_CHL_ECOHAB.gif	
062720052101_CHL_ECOHAB.tif	
062920052044_670_ECOHAB.gif	
062920052044_670_ECOHAB.tif	
062920052044_CHL_ECOHAB.gif	
062920052044_CHL_ECOHAB.tif	
063020052125_670_ECOHAB.gif	
063020052125_670_ECOHAB.tif	
063020052125_CHL_ECOHAB.gif	
063020052125_CHL_ECOHAB.tif	
070120052027_670_ECOHAB.gif	
070120052027_670_ECOHAB.tif	
070120052027_CHL_ECOHAB.gif	
070120052027_CHL_ECOHAB.tif	
070220052107_670_ECOHAB.gif	
070220052107_670_ECOHAB.tif	
070220052107_CHL_ECOHAB.gif	
070220052107_CHL_ECOHAB.tif	
070320052148_670_ECOHAB.gif	
070320052148_670_ECOHAB.tif	
070320052148_CHL_ECOHAB.gif	
070320052148_CHL_ECOHAB.tif	
070420052050_670_ECOHAB.gif	
070420052050_670_ECOHAB.tif	
070420052050_CHL_ECOHAB.gif	
070420052050_CHL_ECOHAB.tif	
070620052032_670_ECOHAB.gif	
070620052032_670_ECOHAB.tif	
070620052032_CHL_ECOHAB.gif	
070620052032_CHL_ECOHAB.tif	
070720052113_670_ECOHAB.gif	
070720052113_670_ECOHAB.tif	
070720052113_CHL_ECOHAB.gif	
070720052113_CHL_ECOHAB.tif	
071020052136_670_ECOHAB.gif	
071020052136_670_ECOHAB.tif	
071020052136_CHL_ECOHAB.gif	
071020052136_CHL_ECOHAB.tif	
071120052038_670_ECOHAB.gif	
071120052038_670_ECOHAB.tif	
071120052038_CHL_ECOHAB.gif	
071120052038_CHL_ECOHAB.tif	

071220052118_670_ECOHAB.gif	
071220052118_670_ECOHAB.tif	
071220052118_CHL_ECOHAB.gif	
071220052118_CHL_ECOHAB.tif	
071320052021_670_ECOHAB.gif	
071320052021_670_ECOHAB.tif	
071320052021_CHL_ECOHAB.gif	
071320052021_CHL_ECOHAB.tif	
071520052141_670_ECOHAB.gif	
071520052141_670_ECOHAB.tif	
071520052141_CHL_ECOHAB.gif	
071520052141_CHL_ECOHAB.tif	
071620052044_670_ECOHAB.gif	
071620052044_670_ECOHAB.tif	
071620052044_CHL_ECOHAB.gif	
071620052044_CHL_ECOHAB.tif	
071720052124_670_ECOHAB.gif	
071720052124_670_ECOHAB.tif	Good overall image.
071720052124_CHL_ECOHAB.gif	
071720052124_CHL_ECOHAB.tif	Good overall image.
071820052026_670_ECOHAB.gif	
071820052026_670_ECOHAB.tif	Okay image; somewhat pixelated. Data missing for area close to coast.
071820052026_CHL_ECOHAB.gif	
071820052026_CHL_ECOHAB.tif	Okay image; somewhat pixelated. Data missing for area close to coast.
071920052106_670_ECOHAB.gif	
071920052106_670_ECOHAB.tif	
071920052106_CHL_ECOHAB.gif	
071920052106_CHL_ECOHAB.tif	
072020052147_670_ECOHAB.gif	
072020052147_670_ECOHAB.tif	Okay image for along coast and in strait; some data missing off coast.
072020052147_CHL_ECOHAB.gif	
072020052147_CHL_ECOHAB.tif	Okay image for along coast and in strait; some data missing off coast.
072120052049_670_ECOHAB.gif	
072120052049_670_ECOHAB.tif	Good image for BC coast, in strait, and N. WA; some data missing along coast of WA.
072120052049_CHL_ECOHAB.gif	
072120052049_CHL_ECOHAB.tif	Good image for BC coast, in strait, and N. WA; some data missing along coast of WA.
072220052129_670_ECOHAB.gif	
072220052129_670_ECOHAB.tif	
072220052129_CHL_ECOHAB.gif	
072220052129_CHL_ECOHAB.tif	
cruise_support_metadata.txt	

Table 5. Mooring locations, bottom depths, deployment times and satellite PTT ID

Mooring	Location	Lat deg	Lat min	Lon deg	Lon min	Deployed (GMT)	Depth (m)	PTT ID
E1	Juan de Fuca Strait	48	29.33	124	41.97	05/02/05 09:54	255	
E2	Washington shelf	47	35.78	124	35.90	05/01/05 13:36	45	
E3	Juan de Fuca eddy	48	17.77	125	27.28	05/02/05 15:01	126	