

CRUISE REPORT

Cruise Number: TN179 –Leg 1
FOCI Number: 1TT05
Ship: R/V Thomas G. Thompson

Area of Operations: Gulf of Alaska
Seattle, WA – APRIL 26, 2005
Seward, AK – May 8, 2005

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Objectives of Cruise:

Eco-FOCI's goal is to understand the effects of abiotic and biotic variability on ecosystems of the North Pacific Ocean and Bering Sea in order to discern the physical and biological processes that determine recruitment variability of commercially valuable finfish and shellfish stocks in Alaskan waters. This cruise was in support of the goals of Eco-FOCI, and in collaboration with the Institute of Ocean Sciences (Fisheries and Oceans Canada) in Sydney, British Columbia. In addition, scientists from the University of British Columbia, the Cetacean Research Laboratory of the Vancouver Aquarium Marine Science Centre, the University of California at Santa Cruz, and the University of Göteborg, Sweden participated during the cruise or in the post-cruise analysis of samples collected.

The objective of the cruise was to sample two-three deep mesoscale eddies that form off the continental shelves of British Columbia, and Southeast Alaska during late winter to early spring each year. Latter in the spring, these eddies start to move westward across the Gulf of Alaska,

and can be traced for up to 2-3 years. Our targets were: the Haida Eddy, the Sitka Eddy, and perhaps the Yakutat Eddy, each named for the area of its origin. By the time of the cruise, the pattern of eddies was more complex than usually observed, with as many as 7 eddies appearing in the SeaWiFs chlorophyll images. We were able to sample three of them: the Haida, the main Sitka Eddy, and another eddy immediately to the northwest of the Sitka, which we are calling the North Sitka. We were also able to transit through a newly formed Yakutat eddy, taking ADCP and surface water property measurements as we went.

To sample these eddies we made CTD casts, Go-Flo casts, MARMAP bongo tows (0.333mm and 0.150mm mesh size) and deployed satellite-tracked drifters to help us find the centers of the eddies and to track the movement of them. Flow-through instruments measured temperature, salinity and fluorescence. Discrete sampling of the flow-through system for surface nutrient samples took place on two of the long transects. Nearly continuous collection of shipboard Acoustic Doppler Current Profiling occurred. Discrete samples were taken for: chlorophyll, nutrients, iron and other trace metals, DIC (dissolved inorganic carbon), HPLC analysis of chlorophyll, phytoplankton identification and salinity (for calibrations).

Our efforts to pinpoint the location of the centers of these features were aided by sea surface altimetry data produced by Ssalto/Duacs as part of the Environment and Climate EU Enact project (ECK2-CT2001-00117)) and distributed by Aviso (<http://www.aviso.oceanobs.com>). Bill Crawford at IOS sent MODIS (or Moderate Resolution Imaging Spectroradiometer) images acquired from the NOAA/PMEL Live Access Server (http://ferret.wrc.noaa.gov/Ferret/LAS/ferret_LAS.html), which were extremely useful because the good weather provided several opportunities for clear views of our research area. Figures 1 and 2 show enhanced color imagery of the surface chlorophyll in the vicinity of the Haida, and Sitka Eddies just prior to our sampling. Figures 1 and 2 show the chlorophyll images of the Haida and Sitka (North and South) Eddies respectively.

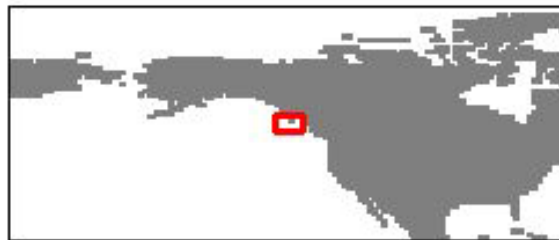
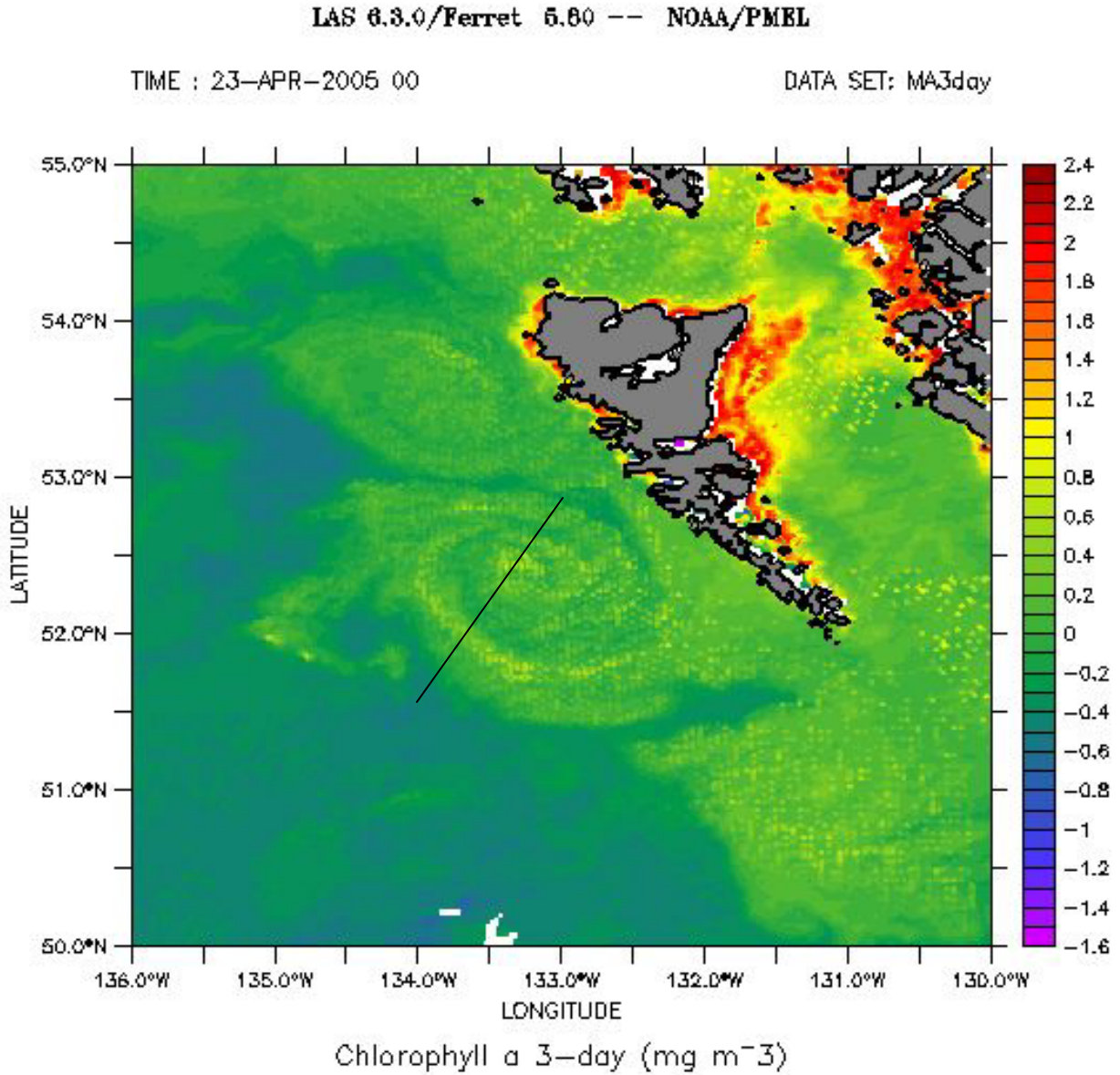


Fig.1 – MODIS imagery of the region of the Haida Eddy on April 29, 2005. The line shows the approximate location of our Haida H-transect.

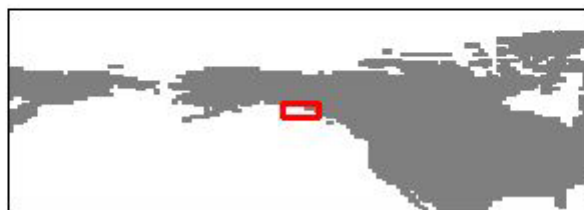
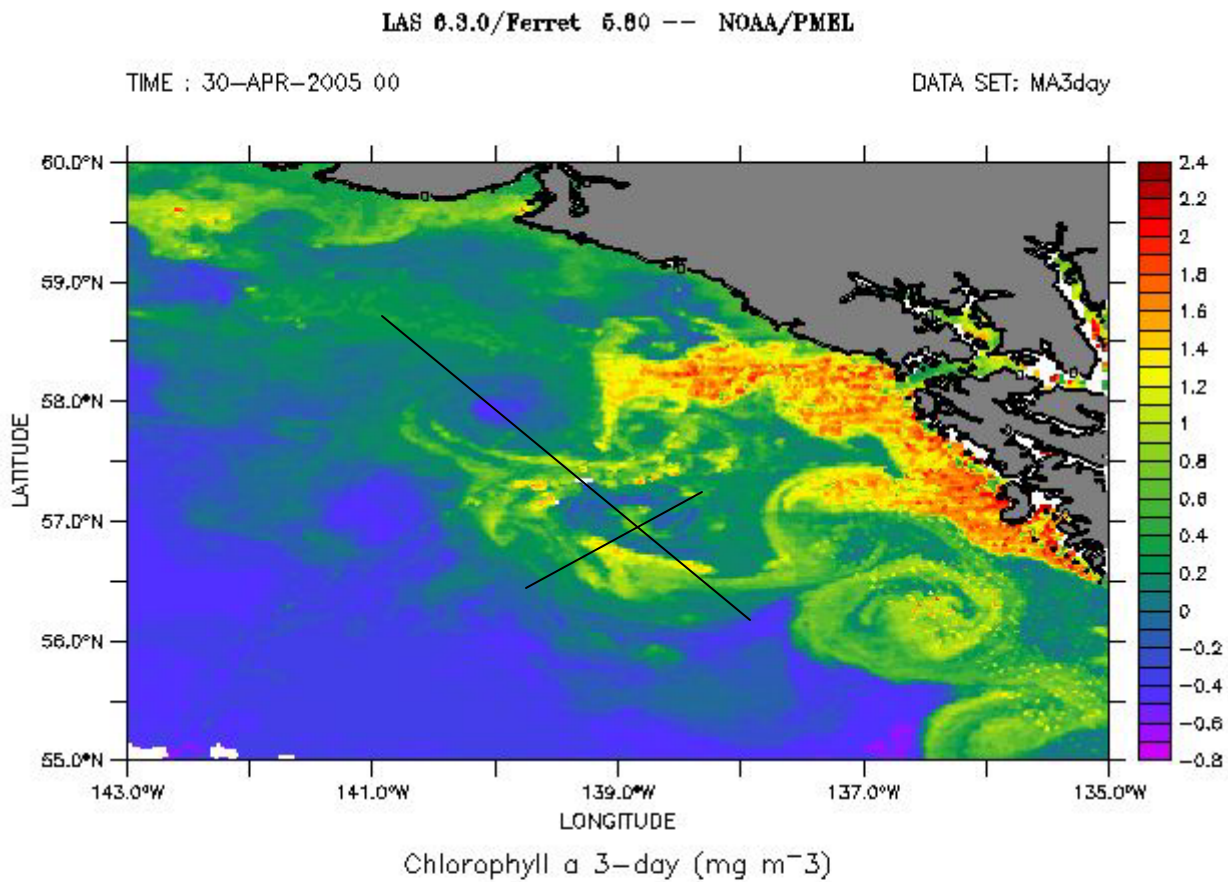


Fig.2 – MODIS imagery of the region of the Sitka Eddy (at $\sim 57^\circ\text{N}$, 139°W) and the North Sitka Eddy ($\sim 58^\circ\text{N}$, 139.5°W) on April 29, 2005. The line shows the approximate position of our Sitka SN and SE transects.

Cruise Summary:

After a three hour delay caused by the late delivery of vital equipment from the Institute of Ocean Sciences (IOS), R/V Thompson departed Seattle at 12:00 PM of Tuesday April 26, 2005 and began the two-day transit up Puget Sound, through the Straits of Juan de Fuca and offshore to a location southwest of the Haida Eddy which was centered at ~ 52.5°N, 133°W.

The following day, April 27, when we reached open waters we were able to let out 800m of Kevlar to reposition and tighten on drum. Each Go-Flo bottle was lowered to 50 m for sampling and bottle integrity test. Seawater was left in the bottled for 2.5 to 3 hours before sub-sampling to exaggerate any contamination.

Sampling was initiated on April 28th at a “reference” station (H500) chosen NW of Vancouver Island and SW of the Queen Charlottes, approximately 25 miles from the edge of the Haida Eddy, in an area that was free or high chlorophyll on SeaWiFs images. The next 2.5 days, we sampled across the Haida Eddy, conducting CTD casts to 1500 or 2000m at each station (Appendix, Fig. 4), MARMAP Bongo tows at 7 stations (Appendix, Fig. 5), Go-Flo casts to 800m (Appendix, Fig. 6) and Go-Flo samples at two depths (Fig. 7). These are CTD002-016, Stations 2-15, H501-H514. At CTD003 the ship lost power for 75 minutes while the CTD package was in the vicinity of 1200m. The cast was aborted, returned to the surface, and repeated as CTD004.

On May 1 we transited northward for 12 hours to a site offshore from Dixon Entrance, a place that appeared in the SeaWiFS images to be free from blooming phytoplankton and outside any eddies. There we sampled another reference station for the iron studies. The preliminary results showed the some iron enrichment in the upper waters, indicating a coastal water source.

On May 2 we transited for 14 hours to the eastern edge of the southern Sitka Eddy. During the transit we collected nutrient samples from the Flow-through system approximately every half hour (10km) because the nutrient meter attached to that system failed to work properly. We then began a hydrographic transect with CTD casts to 500m, or 600m west-southwest across the eddy to ascertain the position of the center (CTD 18-29, Stations 17-28, SE501-SE512). On either side

of the presumed center, we deployed a satellite-tracked drifter. This allowed us to refine our estimate of the central core of the eddy. With this information we laid out a hydrographic line that went from SSE to NNW across the core of the Southern Sitka, then through the presumed core of the Northern Sitka Eddy (CTD 30-61, Stations 29-60, SN501-SN532). CTD casts went to 1000m 1500m or 2000m along this line in a pattern that enabled us to save time, yet give us enough data at depth to enable calculations of geostrophic transports to 2000m. Another 2 satellite-tracked drifters were deployed in the North Sitka Eddy as we passed. Figure 3 shows tracks for May 6-10 for all the drifters deployed in the three eddies.

On the following transit to Seward, AK we took a course though the possible center of the Yakutat Eddy. On the way, we collected ADCP data, and once again took nutrient samples from the flow-through system.

We arrived in Resurrection bay on Sunday morning, May 8, 2005 at 0730. We were met by a fishing boat, the Ocean Dawn, for a transfer of personnel and equipment for leg B, for which Dr. Russell Hopcroft was chief scientist.

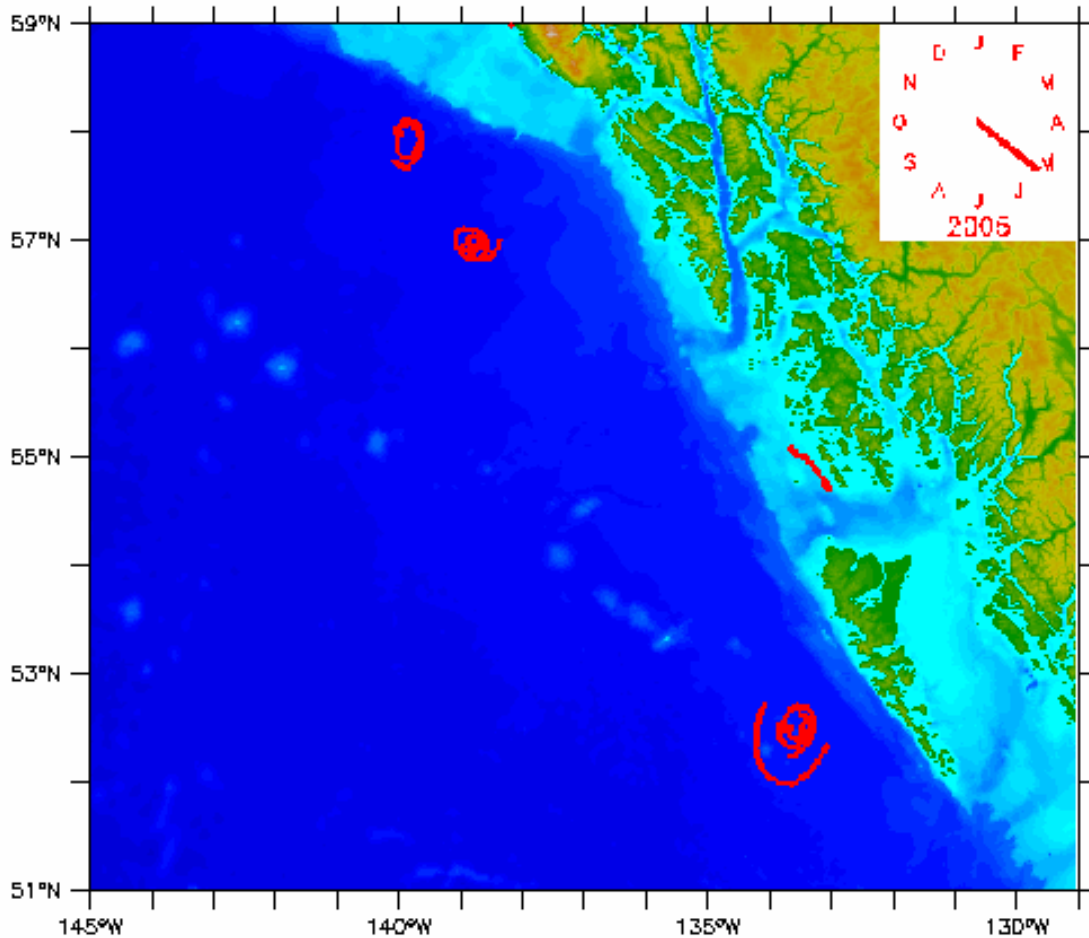


Fig.3 – Tracks for satellite-tracked drifters the five days prior to May 11, 2005 for all the drifters deployed in the study area. All motions are anticyclonic (clockwise). A movie of the 5-day drifter tracks can be seen at:

<http://www.pmel.noaa.gov/foci/visualizations/drifter/sitk2005.html>.

Sampling methods:

A. CTD and Chlorophyll Sampling - Nancy Kachel, Carol Ladd, David Kachel, Dylan Righi, Elizabeth Dobbins, and Doug Anderson

The SeaBird 911 plus CTD was equipped with dual temperature and conductivity sensors, plus a fluorometer, SBE043 Oxygen sensor, and a transmissometer were attached. On each cast, salinity, chlorophyll and nutrient samples were taken from the Niskin bottles. Chlorophyll samples (786) were filtered onto GFF filters and frozen and stored for later analysis. Nutrient

samples were analyzed aboard ship (see below). Salinity samples were taken for the purpose of calibrating the CTD salinity results.

B. MARMAP Bongo Tows- Nancy Kachel, Carol Ladd, David Kachel, Dylan Righi, Elizabeth Dobbins, and Doug Anderson

The MARMAP bongo net sampling included two sets of bongo nets: 60cm diameter with 0.333mm mesh size; and 20 cm diameter nets with 0.153mm mesh. A pumped SBE-19 SeaCat was also attached to the wire, just above the nests. This allowed the bongo depth to be tracked and the bongos to be towed accurately to 300 meters. Once on deck, the nets were washed down and samples stored in jars, preserved with a 10% solution of Formalin.

C. Satellite Tracked Drifters- Nancy Kachel, Carol Ladd, David Kachel, Dylan Righi, Elizabeth Dobbins

A total of 5 satellite-tracked drifters, drogued at 40 m were deployed. One was deployed in the center of the Haida Eddy, two each in the centers of the northern and southern Sitka Eddies. Access to the Internet from aboard the ship permitted us to track their positions. Those positions were retrieved from ARGOS every three hours during the cruise to assist us in locating the centers of the eddies more precisely. That allowed us to sample the core waters of each eddy and to know the distance of or transect from the center. Two other drifters were deployed approximately one week prior to the cruise by the Canadian Coast Guard vessel CCCG Ricker. Those drifters helped us locate the center of the Haida Eddy without the need for a preliminary transect. The tracks of these drifters are shown in Figure 3 for the 5 day period ending May 11.

D. Nutrient Sampling- Janet Barwell-Clarke and Peter Proctor

Nutrient analysts onboard Thomas G. Thompson Cruise TN179 were Janet Barwell-Clarke (Institute of Ocean Sciences, Sidney, B.C.) and Peter Proctor (NOAA/PMEL). A Technicon AutoAnalyzer II was used to analyze nitrate, silicate and phosphate samples. The reagents and standards were provided by IOS and the nutrient methods were those described in the IOS Nutrient Methods and Analysis, J. Barwell-Clarke and F. Whitney, 1996. Data from the colorimeters was converted to a digital signal and logged on a computer and an analog strip chart recorder. The software used to calculate the nutrient data was developed by David Jones at the Department of Oceanography, University of B.C., Vancouver.

Nutrient samples were drawn from rosette casts, GO-FLO casts, and the underway, uncontaminated seawater supply to the aft wet lab. Samples were collected in polycarbonate test tubes and these test tubes were placed directly into the autoanalyzer sampling tray. The test tubes were rinsed three times with sample before filling to within 1 cm of the top. The tubes were rinsed with 10 % HCl every 3-4 days. Nutrient samples were drawn immediately from the Niskin bottles and were stored in the fridge for up to 12 hours before analysis.

Nutrient samples were collected from the surface bottle of every CTD cast and from the following sampling depths of approximately every other rosette/CTD cast: 0, 10, 20, 30, 40, 50, 60, 75, 100, 120, 150, 200, 250, 300, 400, 600, 800, 1000, 1250, 1500, 1750, and 2000 meters for a total of 680 samples. Nutrients were sampled from seven GO-FLO casts from the following depths: 50, 75, 100, 150, 200, 300, 400, 600 and 800 meters and from nine stations at 10 and 100 m for a total of ~90 samples. Several samples were analyzed from the NAS-2E nitrate system to verify standard concentrations. Underway samples were collected between stations S500 and SE501 every ½ hour and analyzed onboard for comparison with the NAS. Underway samples were also collected every ½ hour after station SN 532 en route to Seward and frozen. Peter Proctor will analyze these samples upon his return to the T. Thompson.

At the start of the cruise two 5-liter samples were collected from 10 and 500 meters. These two samples were analyzed with every set of nutrient samples and will be used to monitor day-to-day variability in analytical procedures. These samples will also be analyzed by Terry Whitledge (on TN179B) and Peter Proctor (on TN179C) for an intercomparison.

E. Iron and Trace Metal Sampling: W.K. Johnson, N. Sutherland, S. Crispo and A. Shiel
Sampling was initiated on April 28th at a “reference” station (H5-00) chosen NW of Vancouver Island and SW of the Queen Charlottes in an area that wasn’t showing high chlorophyll on SeaWiFs plots. Surface Sampling was conducted from the ship’s Zodiac/Hurricane rigid hull inflatable away from the Thompson using wide mouth bottles (1L and 500ml). Sampling was somewhat difficult due to the high freeboard. The samples were then filtered and processed in the clean bubble in the ship’s main lab.

The surface mixed layer depths of 10, 20, 30, and 40 meters were sampled using the air driven, double bellows, all plastic/Teflon Asti pump and Teflon lined PVC half inch ID tubing. These samples were filtered in the on-deck HEPA hood in the staging bay. Samples were collected for iron analysis by IOS (2*125ml plus 2* 250ml) and for trace metal analyses (2* 500ml) by UBC. For depths of 50, 75, 100, 150, 200, 300, 400, 600, and 800m twelve liter General Oceanic (G.O.) Go-Flos or X-Niskins were used and sub-sampled in the wet lab using bell jar dust covers and 0.22u Opticap cartridge filters. All samples for UBC were filtered and half those for iron were filtered. DIC and nutrient samples were also collected from the G. O. sample bottles.

Of the 4 sub-samples collected for iron, one filtered (dissolved) and one unfiltered (labile) were analyzed onboard by FIA chemiluminescence in the clean tent. The other 2 were acidified to pH 1.7 with 1 ml of 6N HCL per 125 ml seawater for later analysis of total dissolved iron and total iron. All UBC samples were acidified within 8 hours of sampling for storage and transport back to UBC.

Samples for iron, trace metals, DIC, and nutrients were similarly collected for H5-08 (Haida centre), H5-13 (Haida edge), S5-00 (reference station outside Dixon Entrance), SN5-02 (Sitka edge on north line), SN5-10 (Sitka centre on north line) and SN5-23 (second Sitka eddy centre). All profiles were sampled identically except for SN5-23, which did not have a surface or zero meter iron samples, and DIC samples were not collected as all bottles had been used.

In addition to the profiles surface transect samples were collected as follows. For the Haida eddy additional samples were collected from 10 and 40 m from stations H5-02, H5-05 and H5-10. For the Sitka eddy samples from 10 and 100m were collected on the east line from stations SE5-01, SE5-03, SE5-05, SE5-07, SE5-09, and SE5-11.

Iron analysis were continuously run by Nes Sutherland, assisted by K. Johnson for the entire expedition on a 24 hour a day basis up until 1300 on the last day. Sampling was undertaken by K. Johnson, S. Crispo and A. Shiel. The UBC seawater samples will be transported back to UBC for total dissolved metal analysis. The trace metals that will be analyzed are: aluminium, cadmium, copper, cobalt, gallium, manganese and zinc.

E. Cetacean Observations: Nadine Pinnell

Nadine Pinnell from the Vancouver Aquarium Marine Science Centre was interested in investigating whether or not concentrations of cetaceans occurred in more productive areas of the eddy and in collecting sightings of cetaceans in offshore waters. While the ship was in transit, she scanned the area around the ship for the presence of cetaceans using a combination of binoculars and the naked eye. Observations were also made while the ship was on station if there were cetaceans in the area. Sightings will be corrected for effort and for observations from different sections of the eddies. The results will then be compared and correlated with the other oceanographic parameters measured.

Data responsibilities:

Phyllis Stabeno and Nancy Kachel are responsible for the CTD data, compiling flow-through system data, and analysis of the ADCP data. Jeff Napp is in charge of the chlorophyll and zooplankton analyses. Janet Barwell-Clarke and Frank Whitney are responsible for the compilation of the sub-surface nutrient analyses. Tawnya Peterson of University of California Santa Cruz will identify the phytoplankton samples, and Angela Pena will do HPLC analyses. Mellissa Chierici of the University of Goteborg, Sweden will analyze the dissolved inorganic carbon (DIC) samples. Kristin Orians of the University of British Columbia is responsible for analyses of the non-ferrous trace metals. Keith Johnson is primarily responsible for the Fe analyses. He and Frank Whitney will compile all the data from the analyses from the Go-Flo bottles. Nadine Pinnell will compile the results of the cetacean sightings. Drifter results are available from the PMEL website in two forms: individual drifter plots, and movies. These can be found at:

<http://www.pmel.noaa.gov/foci/visualizations/drifter/sitk2005.html> for the movie; and http://www.pmel.noaa.gov/foci/visualizations/drifter/one_by_one/buoys_by_time.html.

Table 1: Summary of Operations	# Events
CTD with bottle samples (CTD)	61
60cm bongo (60Bon) (0.150mm)	23
20cm bongo (20Bon) (0.150mm)	23
Seabird SeaCat CTD (CAT)	23
Deployment of satellite-tracked drifters (SatBuoy)	5
Small boat operations to collect Fe –samples at surface	6
Stations with Go-Flo and pumping for Fe measurements to 800m	7
Stations with Go-Flo at 2 depths for Fe measurements at 10 and 40m	3
Stations with Go-Flo at 2 depths for Fe measurements at 10 and 100m	6

Table 2: Summary of Samples Collected	Number
SeaBird CTD (CTD casts)	61
SeaBird SeaCat CTD (CAT)	23
MARMAP Bongo Tows	23
Extracted chlorophyll (Chlor)	~300
Stimulated fluorescence measured during CTD casts (Fluor)	all
Dissolved oxygen measured during CTD casts (O2)	all
Light Transmission collected during CTD casts (Trans)	all
Photosynthetically Active Radiation during CTD casts (PAR)	none
Quantitative tows (150 and 333m net)	
preserved in formalin (QTowF)	23
Nutrient analyses of water samples from CTD casts	680
Nutrient analyses of water samples from Go-Flo casts	~90
Nutrient analyses of water samples from flow-through system	~70
Samples for trace metals analysis –(See details in Table 3)	115
Samples for Dissolved Inorganic Carbon analysis (DIC)	90
13 at each major Go-Flo stations (except SN523)	
10 transect samples and duplicates	
Samples for HPLC analysis for chlorophyll at surface	24
Samples for phytoplankton identification	
Preserved in Lugols	22
Preserved in Formalin	22
Bathymetry Data	~1500mi
Flow- Through System, T, S, Fluorescence Data	~1500mi
Shipboard ADCP Data	~1500mi

Table 3. Summary of heavy metal samples collected:

7 profiles surface to 800m for Iron (4 phases) and Trace Metals
 6 Profiles for DIC (TCO₂) 1-800m (1-40m from Rosette and 50-800 from trace metal
 clean samplers.

Surface- by hand samples	iron 4 phases	6 ea.
Pump (10-40m)	iron 4 phases	28 ea.
	Trace Metals	28 in duplicate.
Water samplers (50-800m)	iron 4 phases	63 ea.
	Trace Metals	63 in duplicate.
	DIC	54
Rosette	DIC	28
Surface transects		
Haida (10 & 40m)	iron 4 phases	4-6 ea.
	Trace metals	4 –6 in duplicate
Sitka (10 & 100m)	iron 4 phases	12 ea.
	Trace metals	12 in duplicate
Samples analyzed at sea		
Dissolved iron		115 plus duplicates
Labile iron (not filtered)		115 plus duplicates
Samples stored for later analysis		
Total dissolved iron		115 plus duplicates
Total Iron		115 plus duplicates
Total dissolved metals		107 plus duplicates

Table 4. Event log for R/V Thomas G. Thompson Cruise TN179:

Event No.	GMT Date	GMT Time	Cast # & Gear	Alt ID	Latitude (N)	Longitude (W)	Stn.	Haul	Bot. Depth	Gear Depth	Samples (and comments)
1	28-Apr-05	18:30	Small Boat	H500	51 24.00 N	134 0.00 W	1		3215	surface	Fe
2	28-Apr-05	20:00	CTD001	H500	51 23.97 N	134 0.04 W	1	1	3213	2000	Chlor, CTD, DIC, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
3	28-Apr-05	21:20	Pump	H500	51 24.00 N	134 0.00 W	1		3213	40	Fe and TM at 10, 20, 30, 40 m
4	28-Apr-05	23:00	GoFLO	H500	51 24.00 N	134 0.00 W	1		3213	170	Fe, TM, DIC, and Nuts at 95 and 170 (should have been 75 and 150)
5	28-Apr-05	23:56	BON001	H500	51 24.13 N	134 1.06 W	1	2	3200		60Bon, 20Bon, CAT
6	29-Apr-05	1:10	GoFLO	H500	51 24.00 N	134 0.00 W	1		3213	800	Fe, TM, DIC, and Nuts at 75, 200&300, and 400&600&800 m
7	29-Apr-05	5:41	BON002	H501	51 45.09 N	133 43.10 W	2	1	2945	300	60Bon, 20Bon, CAT
8	29-Apr-05	7:10	CTD002	H501	51 45.01 N	133 43.01 W	2	2	2949	2000	Chlor, CTD, Fluor, HPLC, O2, Trans, Sal
9	29-Apr-05	9:00	CTD003	H502	51 50.00 N	133 39.37 W	3	1	2892	1280	CTD, Fluor, O2, Trans, (no bottles)
10	29-Apr-05	9:15		H502							Ship's power down. CTD cast aborted.
11	29-Apr-05	10:00		H502							Ship's power up. CTD retrieved.
12	29-Apr-05	11:45	CTD004	H502	51 50.01 N	133 39.33 W	3	2	2893	1500	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
13	29-Apr-05	12:30	GoFLO	H502	51 50.01 N	133 39.33 W	3		2893	40	Fe, TM, DIC, and Nuts at 10 and 40 m
14	29-Apr-05	14:41	CTD005	H503	51 55.00 N	133 35.67 W	4	1	2887	1500	Chlor, CTD, Fluor, 1 Nuts, O2, Trans, Sal
15	29-Apr-05	17:05	CTD006	H504	52 0.02 N	133 31.99 W	5	1	2835	1500	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
16	29-Apr-05	18:33	BON003	H504	51 59.65 N	133 31.66 W	5	2	2838	300	60Bon, 20Bon, CAT
17	29-Apr-05	20:38	CTD007	H505	52 4.99 N	133 28.35 W	6	1	2750	2000	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal (no bottle file)

Event No.	GMT Date	GMT Time	Cast # & Gear	Alt ID	Latitude (N)	Longitude (W)	Stn.	Haul	Bot. Depth	Gear Depth	Samples (and comments)
18	29-Apr-05	21:56	GoFLO	H505	52 5.00 N	133 28.35 W	6		2750	40	Cleaning bottle. Will compare with numbers from other 40m cast
19	29-Apr-05	22:08	GoFLO	H505	52 5.00 N	133 28.35 W	6		2750	40	Fe, TM, DIC, and Nuts
20	29-Apr-05	22:17	GoFLO	H505	52 5.00 N	133 28.35 W	6		2750	10	Fe, TM, DIC, and Nuts
21	30-Apr-05	0:10	CTD008	H506	52 10.00 N	133 24.00 W	7	1	2744	1500	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
22	30-Apr-05	1:30	Small Boat	H508	52 19.60 N	133 17.30 W	9		2656	surface	Fe and TM at distance of 500 m
23	30-Apr-05	3:20	CTD009	H507	52 14.99 N	133 21.04 W	8	1	2699	1500	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
24	30-Apr-05	5:05	BON004	H507	52 14.72 N	133 20.83 W	8	2	2698	301	60Bon, 20Bon, CAT
25	30-Apr-05	7:09	CTD010	H508	52 20.00 N	133 17.38 W	9	1	2654	2000	Chlor, CTD, DIC, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
26	30-Apr-05	8:45	Pump	H508	52 19.99 N	133 17.38 W	9		2654	40	Fe and TM at 10, 20, 30, 40 m
27	30-Apr-05	10:15	GoFLO	H508	52 19.99 N	133 17.38 W	9		2654	150	Fe, TM, DIC, and Nuts at 50 & 100 & 150 m
28	30-Apr-05	10:55	BON005	H508	52 19.50 N	133 17.32 W	9	2	2657		60Bon, 20Bon, CAT
29	30-Apr-05	11:57	GoFLO	H508	52 19.99 N	133 17.38 W	9		2654	300	Fe, TM, DIC, and Nuts at 75 & 200 & 300 m
30	30-Apr-05	13:01	GoFLO	H508	52 19.99 N	133 17.38 W	9		2654	800	Fe, TM, DIC, and Nuts at 400 & 600 & 800 m
31	30-Apr-05	13:35	Drifter	H508	52 19.94 N	133 17.36 W	9		2656	40	Deployed #53310
32	30-Apr-05	14:36	BON006	H509	52 24.97 N	133 12.94 W	10	1	2710	300	60Bon, 20Bon, CAT
33	30-Apr-05	15:50	CTD011	H509	52 25.41 N	133 13.15 W	10	2	2713	1500	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
34	30-Apr-05	18:05	CTD012	H510	52 30.83 N	133 8.89 W	11	1	2781	1500	Chlor, CTD, Fluor, 1 Nuts, O2, Trans, Sal
35	30-Apr-05	19:01	GoFLO	H510	52 30.82 N	133 8.88 W	11		2781	40	Fe, TM, DIC, and Nuts

Event No.	GMT Date	GMT Time	Cast # & Gear	Alt ID	Latitude (N)	Longitude (W)	Stn.	Haul	Bot. Depth	Gear Depth	Samples (and comments)
36	30-Apr-05	19:06	GoFLO	H510	52 30.82 N	133 8.88 W	11		2781	10	Fe, TM, DIC, and Nuts
37	30-Apr-05	20:32	CTD013	H511	52 36.24 N	133 4.67 W	12	1	2902	1500	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
38	30-Apr-05	22:30	CTD014	H512	52 41.66 N	133 0.40 W	13	1	2917	1500	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
39	01-May-05	1:15	CTD015	H513	52 47.07 N	132 56.22 W	14	1	2913		Chlor, CTD, DIC, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
40	01-May-05	2:59	Pump	H513	52 47.07 N	132 56.22 W	14		2913	40	Fe and TM at 10, 20, 30, 40 m
41	01-May-05	4:08	GoFLO	H513	52 47.07 N	132 56.22 W	14		2913	100	Fe, TM, DIC, and Nuts at 50 & 75 & 100 m
42	01-May-05	5:02	BON007	H513	52 46.99 N	132 55.49 W	14	2	2915	300	60Bon, 20Bon, CAT
43	01-May-05	6:01	GoFLO	H513	52 47.08 N	132 56.22 W	14		2913	300	Fe, TM, DIC, and Nuts at 150 & 200 & 300 m
44	01-May-05	7:35	GoFLO	H513	52 47.08 N	132 56.22 W	14		2913	800	Fe, TM, DIC, and Nuts at 400 & 600 & 800 m
45	01-May-05	9:40	CTD016	H514	52 52.49 N	132 51.98 W	15	1	1795	1500	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
46	01-May-05	10:49	BON008	H514	52 51.94 N	132 51.19 W	15	2	1800	300	60Bon, 20Bon, CAT
47	01-May-05		Small Boat	S500	54 37.19 N	135 0.00 W	16		2669	surface	Fe and TM at distance of 500 m
48	01-May-05	23:57	CTD017	S500	54 37.19 N	135 0.00 W	16	1	2669	2000	Chlor, CTD, DIC, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
49	02-May-05	1:40	Pump	S500	54 37.21 N	134 60.00 W	16		2669	40	Fe and TM at 10, 20, 30, 40 m
50	02-May-05	3:08	GoFLO	S500	54 37.20 N	134 59.97 W	16		2669	100	Fe, TM, DIC, and Nuts at 50 & 75 & 100 m
51	02-May-05	3:42	BON009	S500	54 37.46 N	134 59.33 W	16	2	2668	300	60Bon, 20Bon, CAT
52	02-May-05	4:52	GoFLO	S500	54 37.20 N	134 59.97 W	16		2669	300	Fe, TM, DIC, and Nuts at 150 & 200 & 300 m
53	02-May-05	6:00	GoFLO	S500	54 37.23 N	134 59.97 W	16		2669	800	Fe, TM, DIC, and Nuts at 400 & 600 & 800 m

Event No.	GMT Date	GMT Time	Cast # & Gear	Alt ID	Latitude (N)	Longitude (W)	Stn.	Haul	Bot. Depth	Gear Depth	Samples (and comments)
54	02-May-05	7:06			Underway	Underway					Nutrient Sampling underway every 1/2 hour for comparison with NAS
55	02-May-05	22:21	BON010	SE501	57 14.40 N	138 5.50 W	17	1	2737	300	60Bon, 20Bon, CAT
56	02-May-05	23:26	GoFLO	SE501	57 14.99 N	138 4.99 W	17		2737	100	Fe, TM, and Nuts at 10 & 100
57	03-May-05	0:09	CTD018	SE501	57 14.99 N	138 4.99 W	17	2	2717	500	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
58	03-May-05	1:18	CTD019	SE502	57 12.25 N	138 14.96 W	18	1	2843	500	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
59	03-May-05	2:43	CTD020	SE503	57 10.46 N	138 24.98 W	19	1	2976	600	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
60	03-May-05	3:23	GoFLO	SE503	57 10.49 N	138 25.01 W	19		2976	100	Fe, TM, and Nuts at 10 & 100
61	03-May-05	4:39	CTD021	SE504	57 8.25 N	138 36.01 W	20	1	3008	600	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
62	03-May-05	6:05	CTD022	SE505	57 5.99 N	138 45.02 W	21	1	3139	600	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
63	03-May-05	6:35	GoFLO	SE505	57 5.99 N	138 45.00 W	21		3139	100	Fe, TM, and Nuts at 10 & 100
64	03-May-05	6:45	Drifter	SE505	57 5.99 N	138 45.02 W	21		3139	40	Deployed #53308
65	03-May-05	8:02	CTD023	SE506	57 0.85 N	138 52.28 W	22	1	3158	600	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
66	03-May-05	9:17	CTD024	SE507	56 55.70 N	138 59.56 W	23	1	3232	600	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
67	03-May-05	9:55	GoFLO	SE507	56 55.70 N	138 59.55 W	23		3232	100	Fe, TM, and Nuts at 10 & 100
68	03-May-05	10:08	Drifter	SE507	56 55.65 N	138 59.58 W	23		3232	40	Deployed #53321
69	03-May-05	11:18	CTD025	SE508	56 50.56 N	139 6.85 W	24	1	3306	600	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
70	03-May-05	12:44	CTD026	SE509	56 45.43 N	139 14.12 W	25	1	3374	600	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
71	03-May-05	13:27	GoFLO	SE509	56 45.43 N	139 14.12 W	25		3374	100	Fe, TM, and Nuts at 10 & 100

Event No.	GMT Date	GMT Time	Cast # & Gear	Alt ID	Latitude (N)	Longitude (W)	Stn.	Haul	Bot. Depth	Gear Depth	Samples (and comments)
72	03-May-05	14:55	CTD027	SE510	56 40.29 N	139 21.41 W	26	1	3359	600	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
73	03-May-05	16:16	CTD028	SE511	56 35.13 N	139 28.71 W	27	1	3331	600	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
74	03-May-05	17:06	GoFLO	SE511	56 35.13 N	139 28.71 W	27		3331	100	Fe, TM, and Nuts at 10 & 100
75	03-May-05	18:25	CTD029	SE512	56 30.00 N	139 35.99 W	28	1	3339	600	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
76	03-May-05	19:14	BON011	SE512	56 29.88 N	139 35.40 W	28	2	3339	300	60Bon, 20Bon, CAT
77	04-May-05	0:12	CTD030	SN501	56 24.01 N	138 14.98 W	29	1	3077	2000	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
78	04-May-05	3:00	Small Boat	SN502	56 28.21 N	138 19.40 W	30			surface	Fe and TM at distance of 500 m
79	04-May-05	3:25	CTD031	SN502	56 28.21 N	138 19.40 W	30	1	3116	2000	Chlor, CTD, DIC, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
80	04-May-05	4:44	Pump	SN502	56 28.21 N	138 19.41 W	30		3116	40	Fe and TM at 10, 20, 30, 40 m
81	04-May-05	6:13	GoFLO	SN502	56 28.21 N	138 19.42 W	30		3116	100	Fe, TM, DIC and Nuts at 50, 75 & 100
82	04-May-05	6:46	BON012	SN502	56 28.39 N	138 20.26 W	30	2	3120	300	60Bon, 20Bon, CAT
83	04-May-05	8:30	GoFLO	SN502	56 28.20 N	138 19.42 W	30		3116	300	Fe, TM, DIC and Nuts at 150, 200 & 300
84	04-May-05	9:21	GoFLO	SN502	56 28.19 N	138 19.42 W	30		3116	800	Fe, TM, DIC and Nuts at 400, 600 & 800
85	04-May-05	10:41	CTD032	SN503	56 32.41 N	138 23.82 W	31	1	3134	1000	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
86	04-May-05	12:11	CTD033	SN504	56 36.60 N	138 28.22 W	32	1	3157	1000	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
87	04-May-05	14:16	CTD034	SN505	56 40.81 N	138 32.62 W	33	1	3169	1500	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
88	04-May-05	15:24	BON013	SN505	56 41.15 N	138 33.31 W	33	2	3174	300	60Bon, 20Bon, CAT
89	04-May-05	16:53	CTD035	SN506	56 45.00 N	138 37.01 W	34	1	3163	1000	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal

Event No.	GMT Date	GMT Time	Cast # & Gear	Alt ID	Latitude (N)	Longitude (W)	Stn.	Haul	Bot. Depth	Gear Depth	Samples (and comments)
90	04-May-05	18:32	CTD036	SN507	56 49.19 N	138 41.41 W	35	1	3162	1000	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
91	04-May-05	20:01	CTD037	SN508	56 53.40 N	138 45.82 W	36	1	3151	1500	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
92	04-May-05	21:43	CTD038	SN509	56 58.20 N	138 47.82 W	37	1	3135	1000	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
93	04-May-05	22:53	BON014	SN509	56 58.03 N	138 48.84 W	37	2	3152	300	60Bon, 20Bon, CAT
94	04-May-05		Small Boat	SN510	57 3.00 N	138 49.77 W	38				Fe, TM, DIC and Nuts at 400, 600 & 800
95	05-May-05	1:00	BON015	SN510	57 2.90 N	138 50.58 W	38	1	3141		60Bon, 20Bon, CAT
96	05-May-05	2:34	Pump	SN510	57 3.00 N	138 49.77 W	38		3132	40	Fe and TM at 10, 20, 30, 40 m
97	05-May-05	4:17	GoFLO	SN510	57 2.99 N	138 49.82 W	38		3132	100	Fe, TM, DIC and Nuts at 50, 75 & 100
98	05-May-05	5:10	CTD039	SN510	57 2.95 N	138 49.82 W	38	2	3132	2000	Chlor, CTD, DIC, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
99	05-May-05	6:15	GoFLO	SN510	57 2.99 N	138 49.82 W	38		3132	300	Fe, TM, DIC and Nuts at 150, 200 & 300
100	05-May-05	7:21	GoFLO	SN510	57 2.99 N	138 49.82 W	38		3132	800	Fe, TM, DIC and Nuts at 400, 600 & 800
101	05-May-05	8:59	CTD040	SN511	57 7.15 N	138 55.45 W	39	1	3194	1000	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
102	05-May-05	10:42	CTD041	SN512	57 11.30 N	139 1.06 W	40	1	3241	1500	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
103	05-May-05	12:35	CTD042	SN513	57 15.46 N	139 6.71 W	41	1	3257	1000	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
104	05-May-05	14:13	CTD043	SN514	57 19.61 N	139 12.34 W	42	1	3222	1500	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
105	05-May-05	16:14	CTD044	SN515	57 23.77 N	139 17.98 W	43	1	3215	1500	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
106	05-May-05	17:26	BON016	SN515	57 24.10 N	139 18.44 W	43	2	3215	300	60Bon, 20Bon, CAT
107	05-May-05	18:44	BON017	SN516	57 27.56 N	139 24.26 W	44	1	3251	300	60Bon, 20Bon, CAT

Event No.	GMT Date	GMT Time	Cast # & Gear	Alt ID	Latitude (N)	Longitude (W)	Stn.	Haul	Bot. Depth	Gear Depth	Samples (and comments)
108	05-May-05	20:25	CTD045	SN516	57 27.92 N	139 23.59 W	44	2	3247	2000	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
109	05-May-05	22:04	CTD046	SN517	57 32.08 N	139 29.23 W	45	1	3271	1500	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
110	05-May-05	23:35	BON018	SN517	57 32.22 N	139 29.87 W	45	2	3275	300	60Bon, 20Bon, CAT
111	06-May-05	0:22	CTD047	SN518	57 36.22 N	139 34.87 W	46	1	3297	2000	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
112	06-May-05	2:58	CTD048	SN519	57 40.50 N	139 40.50 W	47	1	3262	1000	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
113	06-May-05	4:05	CTD049	SN520	57 44.40 N	139 46.13 W	48	1	3212	1000	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
114	06-May-05	5:46	CTD050	SN521	57 48.88 N	139 51.76 W	49	1	3140	1500	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
115	06-May-05	7:25	CTD051	SN522	57 52.84 N	139 57.39 W	50	1	3254	1500	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
116	06-May-05	8:22	BON019	SN522	57 53.32 N	139 57.95 W	50	2	3263	300	60Bon, 20Bon, CAT
117	06-May-05	8:40	Drifter	SN522	57 53.77 N	139 58.55 W	50		3263	40	Deployed drifter #53304
118	06-May-05	9:31	BON020	SN523	57 56.78 N	140 2.77 W	51	1	3345	300	60Bon, 20Bon, CAT
119	06-May-05	10:57	CTD052	SN523	57 57.00 N	140 3.02 W	51	2	3349	2000	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
120	06-May-05	12:24	Pump	SN523	57 57.00 N	140 3.03 W	51		3349	40	Fe and TM at 10, 20, 30, 40 m
121	06-May-05	13:55	GoFLO	SN523	57 57.01 N	140 3.02 W	51		3349	100	Fe, TM, DIC and Nuts at 50, 75 & 100
122	06-May-05	14:51	GoFLO	SN523	57 57.01 N	140 3.01 W	51		3349	300	Fe, TM, DIC and Nuts at 150, 200 & 300
123	06-May-05	16:08	GoFLO	SN523	57 57.01 N	140 3.01 W	51		3349	800	Fe, TM, DIC and Nuts at 400, 600 & 800
124	06-May-05	16:48	Drifter	SN523	57 57.29 N	140 3.25 W	51		3349	40	Deployed drifter #53306
125	06-May-05	17:58	CTD053	SN524	58 1.15 N	140 8.61 W	52	1	3407	1500	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal

Event No.	GMT Date	GMT Time	Cast # & Gear	Alt ID	Latitude (N)	Longitude (W)	Stn.	Haul	Bot. Depth	Gear Depth	Samples (and comments)
126	06-May-05	19:02	BON021	SN524	58 1.49 N	140 9.23 W	52	2	3400	300	60Bon, 20Bon, CAT
127	06-May-05	20:17	CTD054	SN525	58 5.30 N	140 14.21 W	53	1	3428	1000	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
128	06-May-05	21:41	CTD055	SN526	58 9.44 N	140 19.82 W	54	1	3426	1000	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
129	06-May-05	22:38	BON022	SN526	58 10.12 N	140 19.98 W	54	2	3420	297	60Bon, 20Bon, CAT
130	07-May-05	0:37	CTD056	SN527	58 13.69 N	140 25.40 W	55	1	3409	2000	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
131	07-May-05	2:49	CTD057	SN528	58 17.75 N	140 31.00 W	56	1	3329	1000	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
132	07-May-05	4:36	CTD058	SN529	58 21.89 N	140 36.62 W	57	1	3278	2000	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
133	07-May-05	6:18	CTD059	SN530	58 26.04 N	140 42.22 W	58	1	3782	1500	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
134	07-May-05	7:35	BON023	SN530	58 26.50 N	140 42.91 W	58	2	3782	300	60Bon, 20Bon, CAT
135	07-May-05	9:04	CTD060	SN531	58 30.20 N	140 47.82 W	59	1	3290	1000	Chlor, CTD, Fluor, Nuts, O2, Trans, Sal
136	07-May-05	10:45	CTD061	SN532	58 34.36 N	140 53.41 W	60	1	3226	2000	Chlor, CTD, Fluor, HPLC, Nuts, O2, Phyto, Trans, Sal
137	07-May-05	12:54			Underway	Underway					Nutrient Sampling every 1/2 hour underway

Gear = CTD | Bongo (BON) | Small Boat | GoFlo (GF) | Pump | Drifter

Sample = CTD (incl. Fluor., O2, trans) | Nuts. | Chl. | Zoop (incl. 60, 20 and SeaCAT) | Fe | Trace Metals (TM) | HPLC | Phyto

APPENDIX:

Fig.4 – [Location of all CTD casts on TN179A.](#)

Fig.5 – [Location and Station names of MARMAP bongo tows during TN179A.](#)

Fig.6 – [Location of major Go-Flo casts.](#)

Fig.7 – [Location of stations with two Go-Flo bottles taken.](#)

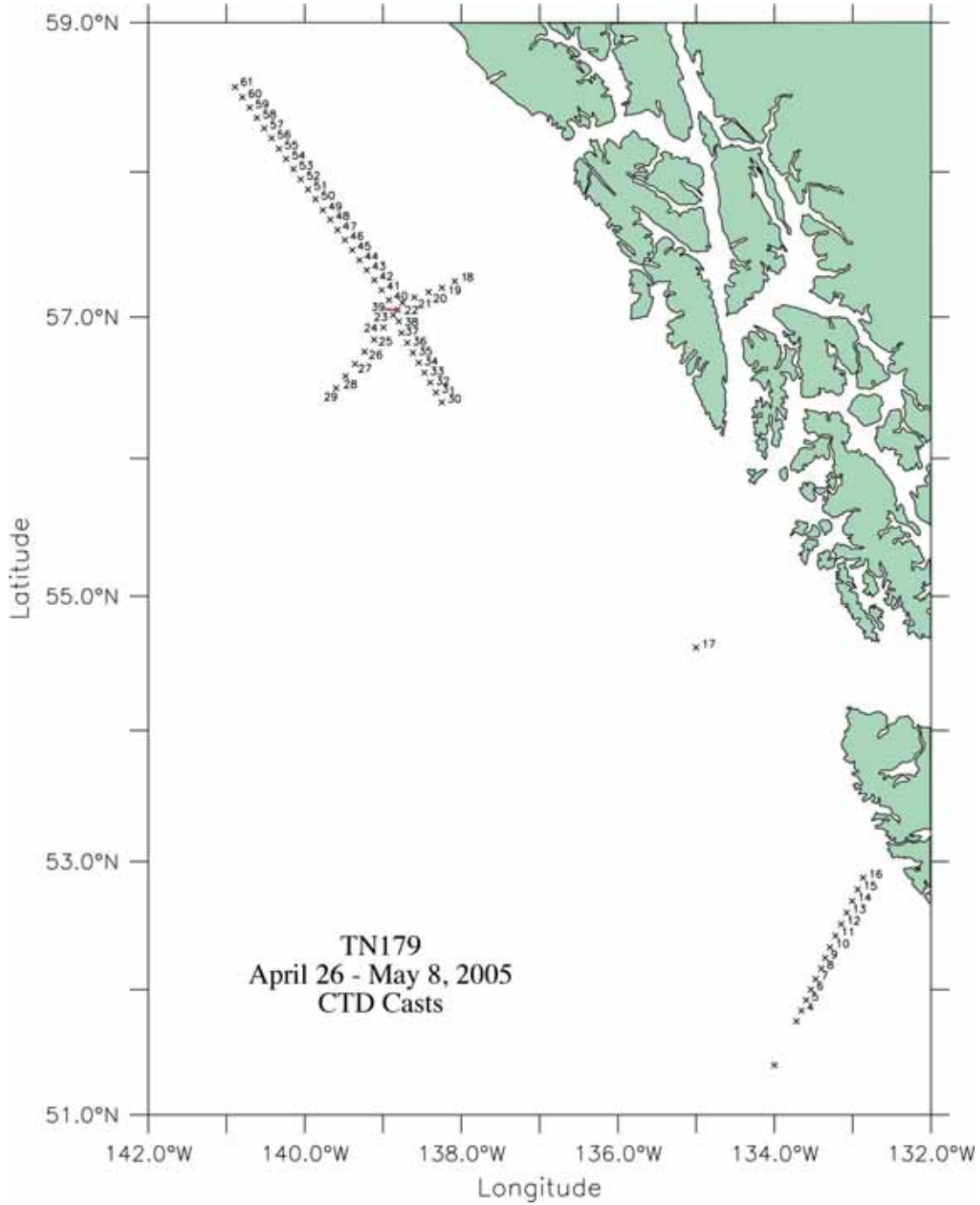


Fig.4 – Location of all CTD casts on TN179A.

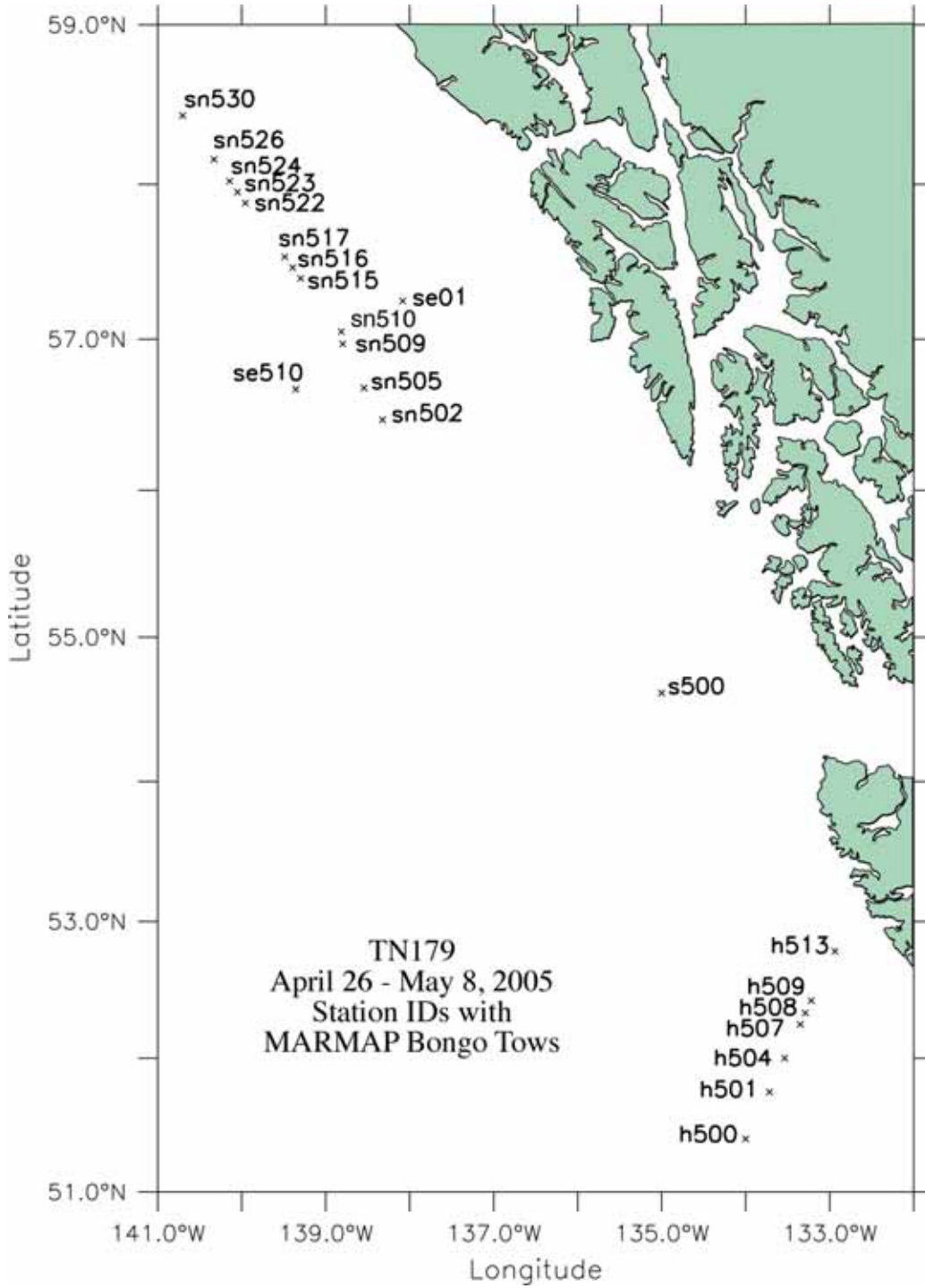


Fig.5 – Location and Station names of MARMAP bongo tows during TN179A.

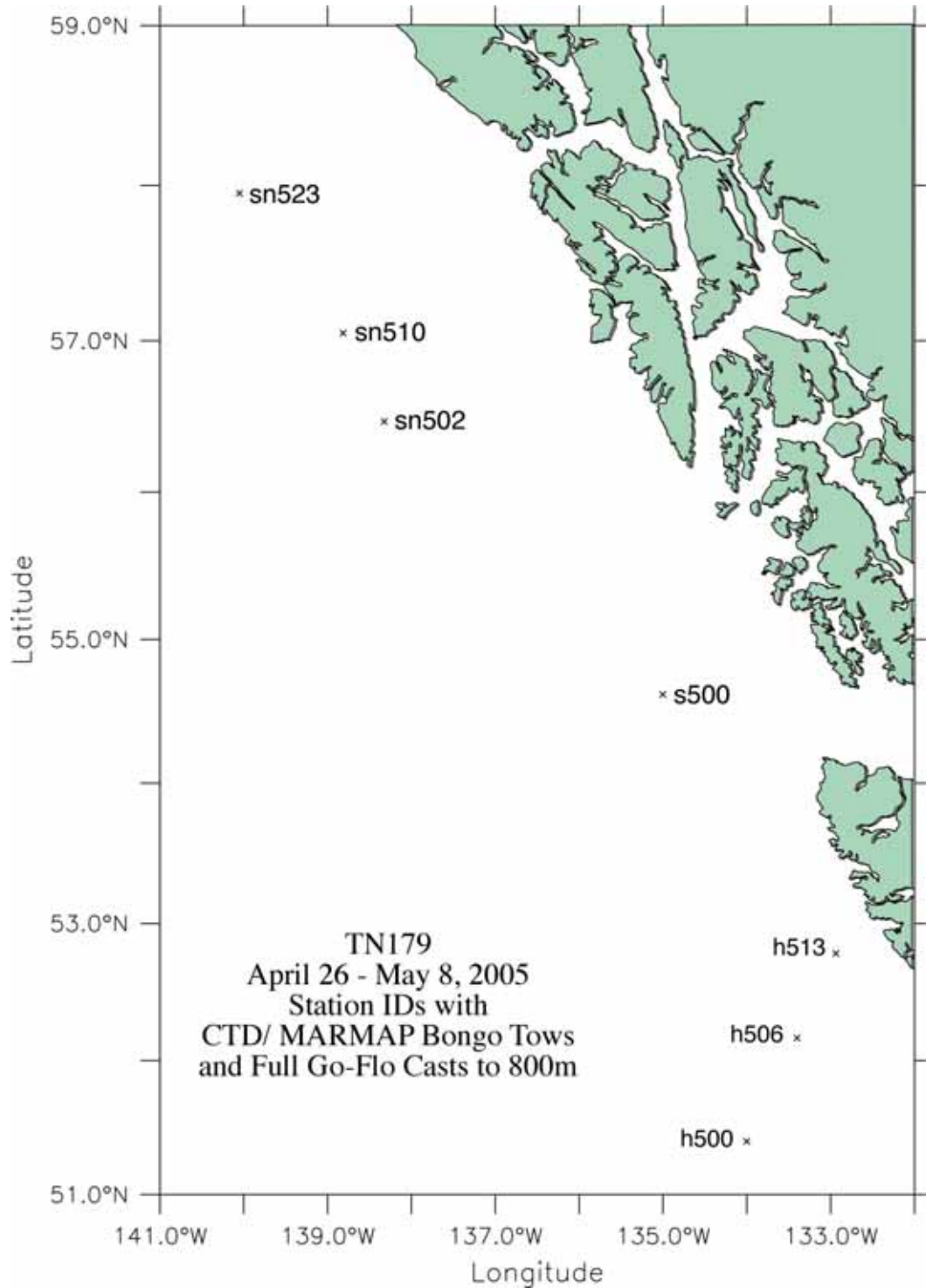


Fig.6 – Location of major Go-Flo casts. These stations included a small boat operation (except at SN523) to collect surface water away from the ship, a CTD cast to 2000m, a MARMAP bongo tow, pumping for at 10,20,30 and 40m depth, and Go-Flo sampling for iron, trace metals, dissolved inorganic carbon, and nutrients at 75, 200, 300, 400, 600 and 800m depths.

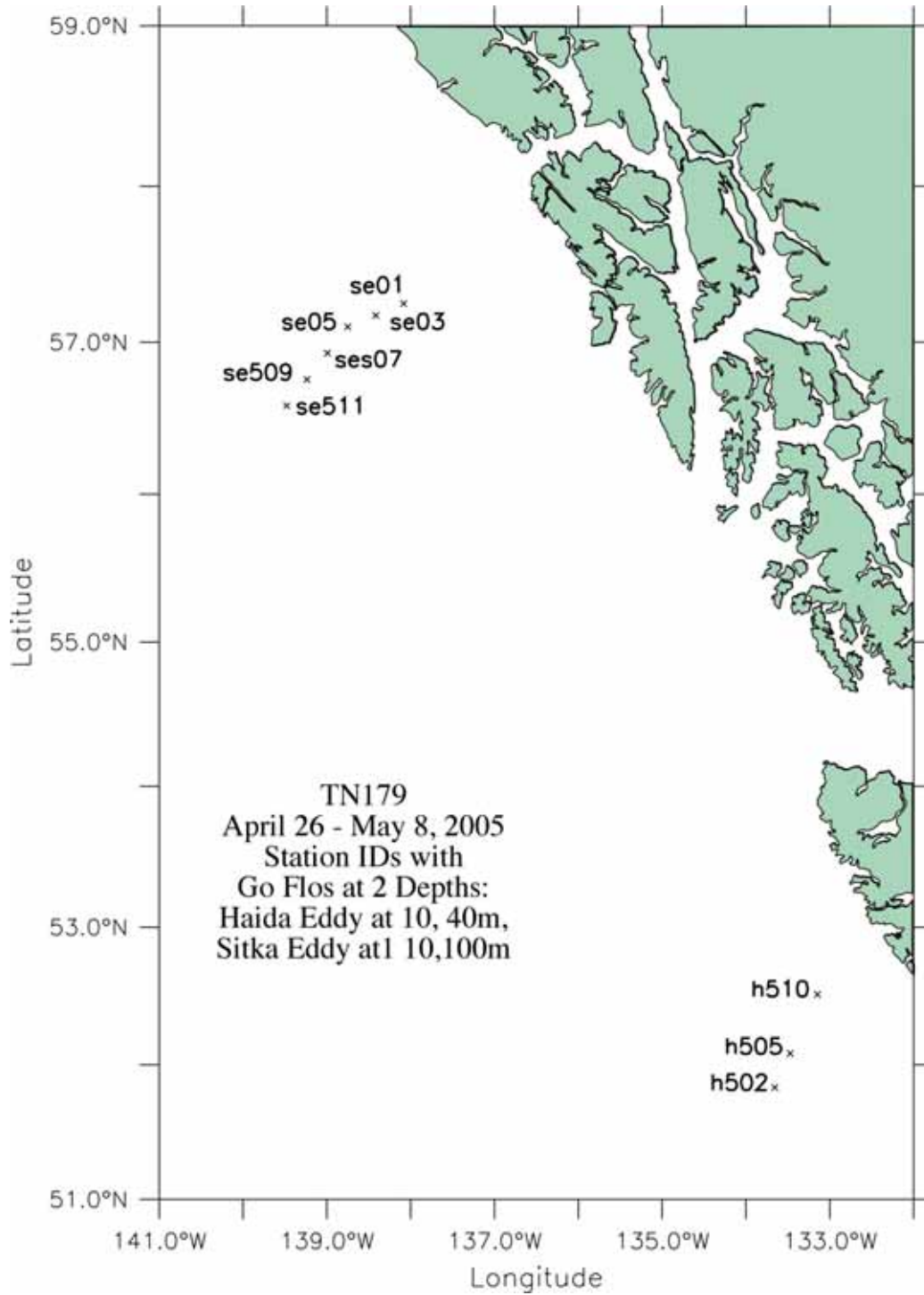


Fig.7 – Location of stations with two Go-Flo bottles taken. The Go-Flo sampling for iron, trace metals, dissolved inorganic carbon, and nutrients at 0 and 40m at the Haida (H) stations and at 0 and 100m at the Sitka (SE) stations.