Canada's Three Oceans 2007
Cruise Report

Report on the Oceanographic Research Conducted aboard the *CCGS Louis S. St-Laurent,* July 4 to 26, 2007

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OVERVIEW

The C30 scientific research program carried out from the CCGS Louis S. St-Laurent from Halifax to Kugluktuk, July 4 to 26, 2007, is a major initiative within the global framework of International Polar Year Activities.

Key objectives of C3O:

To obtain a snapshot and establish the scientific basis for a long-term, legacy-based monitoring of the subarctic and arctic waters around Canada, their unique biogeographic domains, and the response of these interconnected domains to climate change.

To scientifically integrate all of Canada's three oceans.

Address the interconnectedness of arctic and subarctic domains and how such domain boundaries may be impacted in a changing climate.

CRUISE SUMMARY

Working from CCGS Louis S. St-Laurent an ambitious multi faceted research program was attempted and accomplished. There were 23 science personnel (see Appendix A) participating directly in 11 different research programs. Measurements were taken and samples collected aimed at integrating these different research programs to gain understanding of the Arctic marine food web and the influence of physical oceanography on ecosystem function. This multi-faceted research program not only will allow for new insight into the marine food web, but also increases our understanding of the effect of physical changes on ecosystem function. In addition the information collected and provides an extremely important baseline from which to judge future changes.

PROGRAM COMPONENTS

Distance Covered: 6850km (see Figure 1 for cruise track and station names and Appendix B for station and activity detail)

Measurements\activities:

- 62 CTD/Rosette Casts at 42 Stations
- Ocean current measurements from Acoustic Doppler Current Profiler deployment at 31 stations.
- Water Samples
  At all stations: Salinity, Oxygen, Nutrients, Barium, O-18, Bacteria, Alkalinity, Colored Dissolved Organic Matter, Chlorophyll-a.
  At selected stations: particulate organic carbon, nitrogen and silica, total suspended sediments, ammonium, urea, nitrite, phosphate, dissolved inorganic carbon, RNA, DNA, biogenic silica, HPLC and FISH, virus.
- 2 Mooring Deployments in Bellot Strait.
- Underway data collection of ship's meteorological, depth, sea surface, and navigation sensors.
- 19 XCTD (expendable temperature, salinity and depth profiler)
- 29 XBT (expendable temperature and depth profiler)
- 8 Shallow CTD SBE19+ casts hand lowered from helicopter

- 68 Vertical Net Casts, to 100m or 200m depth, at 23 stations
- 195 Drift Bottles Deployed
- 8 Deployments of video camera to document benthos
- 34 bottom grabs at 11 stations

Figure 1. Cruise track and station names.

PROGRAM COMPONENT DESCRIPTIONS

Rosette/CTD Casts

Rosette casts were taken with a Seabird SBE911+ CTD. The rosette water sampler, SBE32, was configured with 24 10-liter Niskin bottles to take chemistry samples: Salinity, Dissolved Oxygen, Nitrate (NO3), Silicate (SiO4), Phosphate (PO4), Chlorophyll-a (filtered at 0.7 µm with chlorophyll-a and phaeopigment values for each), Coloured Dissolved Organic Matter (CDOM), Alkalinity, Oxygen-18 isotope (O18), Barium, Bacteria. On selected casts we sampled Particulate Organic Carbon (POC), Dissolved Inorganic Carbon (DIC), RNA, DNA, Biogenic Silica and virus.

The Seabird SBE9+ CTD was configured with a 24- position SBE-32 pylon and ice-strengthened rosette frame with 10L Niskin bottles fitted with internal stainless steel springs. The data were collected real-time using the SBE 11+ deck unit and computer running Seasave Win32 V 5.37d acquisition software. The CTD was set up with two temperature sensors, two conductivity sensors, two oxygen sensors, fluorometer, transmissometer, altimeter, a bottom contact switch and surface reference PAR. On casts shallower than 1000m, there were also nitrate and PAR sensors.

A second CTD used for casts from the helicopter was an internally recording SBE19+ CTD configured with pumped temperature and conductivity. No water samples were taken during these casts.

During a typical deployment:
The transmissometer(s) windows and nitrate sensor window were wiped with deionized water soaked Kim wipe or Q-tip prior to each deployment. The PAR sensor was wiped periodically.

The package was lowered to 5m, taking a PAR measurement just below the surface if required. The pumps were turned on the system soaked for 3 minutes. The package was then brought up to just below the surface to begin a clean cast, and lowered to the requested depth at 60m/m. The casts were typically to the bottom or 1000m whichever was shallower. Full depth casts (over 1000m) were performed near the Ocean Station Bravo site and along the Baffin Bay section. Niskin bottles were closed during the up cast after waiting 30seconds at each trip depth. Shallower cast to collect water for virus concentration were carried out periodically during the last week of operations.
The instrumented sheave (Brook Ocean Technology) readouts to the winch operator, CTD operator and bridge allowed all three to monitor cable out, wire angle and CTD depth.

Improvements to the CTD system this year:

- The wire on the winch was adjusted so that it now lays correctly on the drum removing the wrapping problem experienced in 2006.
- A new CTD operation room. Due to the degradation of the existing CTD lab container, a new container lab was built to specifications for a functional space that opens (door and windows) to the work area. After the electrical wiring, GPS and LAN were in place this has proved to be a very nice lab space.
- All the auxiliary channels were changed to wet-pluggable connectors from the normal impulse dry-plug connectors.

Data/Performance notes:

Problems were seen intermittently with Secondary Conductivity and Secondary Oxygen perhaps due to cable problems. Conductivity reads 990 mS/cm and Oxygen values are all above 10ml/l. The primary sensors appear to have worked well throughout.

PAR sensor had problems with leaking connector early in the program. The leak was at the PAR bulkhead cable interface. The PAR performed well following a cleaning of the connectors.

The SPAR sensor was not put in its final location up above the hanger near the incubation tanks until a few days into the program. Prior to this, the SPAR was placed near the CTD deployment area where it could have been in shaded by the lab container.

The nitrate sensor required battery change once during the cruise. This was done before the sensor ran out of power so should not be noticed in the data.

Four Niskin bottles broke due to implosion of Niskin #2 at depth. It appears the lanyard broke, closing the bottle before it went very deep.

Figure 2. The 24-bottle rosette with the SBE9+ CTD is deployed by Mike Dempsey.

Sampling took place immediately after each cast in the heated rosette room. The order of sampling was fixed, based on sampling water most susceptible to temporal changes first. Dissolved Oxygen, Salinity, and Ammonium were measured in laboratories on board. All other samples were prepared and stored for analysis on shore. Real-time analysis was critical for oxygen and ammonium and important for the others due to the higher accuracy achieved from the methods used with fresh samples.

SAMPLING AND ANALYSIS ACTIVITIES:

Oxygen Analysis-Melissa Hennekes.

Analytical Procedure:

Dissolved oxygen concentration was determined using an automated titration system consisting of a Brinkman dosimat (model 665) and a PC 910 Colorimeter which is connected to a computer using the **NewAutoOxy.exe** program to calculate Dissolved Oxygen ml/L. The titration information is saved in data file ***.o2** and header file ***.oxy**.

The "***.oxy** and ***.o2**" files will be then manually edited by analyst to correct minor mistakes (i.e. entering wrong station name and/or depth pressure).

The IOSShell Program is used to calibrated to proper Blank and Standard values resulting in a ***.DOX** file. The IOSShell Program is then used to add a flag channel resulting in a "***.add**" file. Where necessary data points are manually flagged in each file and comments are made accordingly in the file. The ***.add** file is the final data file that will be used in the excel spreadsheet.

Data Processed

A total of 36 stations (shown below) were sampled and analysed during the cruise. Standards were run at regular intervals during analysis. Some data was processed using IOSShell, but not all could be completed.

Station	Cast	# of samples
1	3	16
2	5	14
LS4	7	2
4	8	22

LS5	10	20
LS6	11	20
LS7	13	20
BB1	15	17
BB2	16	17
BB3	17	21
BB4	18	21
BB5	21	21
BB6	22	21
BB7	23	22
BB8	25	12
BB9	26	20
BB10	27	20
BO1	29	10
BO1	30	23
BEW03	31	26
BEW05	32	23
BEW07	33	7
BEW09	34 & 35	6
BEW11	36	14
BB11	38	6
CAA1	39	14
CAA2	40	6
CAA3	41	15
CAA4	42	11
CAA5	45	3
CAA9	50	17
CAA10	52	14
CAA11	54	10
CAA12	55	11
CAA13	58	10
CAA14	59	4

Problems and Solutions

Problem: While analysing stations 1 through LS5 the colorimeter was drifting and not returning to 100% when placed in deionized water. Graphed data was not indicating a clear endpoint to the titration.

Solution: Colorimeter probe was replaced with a new one. The old probe appeared to have a scratch on the glass cover.

Problem: Stations BB4 and BB6 had bubbles in the flasks. Bubbles seemed to be due to bright sunlight shining through the window in the lab.

Solution: Samples were kept out of direct sun.

DNA and RNA sampling - Connie Lovejoy's lab (Connie Lovejoy, Karen Scarcella and Emilie Didierjean).

At each of the stations the following were sampled for at every depth (generally): DNA, DAPI and Chla. RNA was sampled for at 4 of the 6 depths (the 4 shallowest). FISH and HPLC was sampled for at the chl max and surface depths.

Generally the depths sampled represented the surface, chl max, upper nitracline, lower nitracline, oxygen minimum, oxygen maximum, thermocline and halocline.

Stations sampled:

Stn 1	BB1	BEW11	CAA6
Stn 2	BB5	CAA1	CAA10
LS4	BB8	CAA2	CAA12
LS7	BB10	CAA5	CAA16

Phytoplankton Productivity and Nutrient Dynamics in Surface Waters of the Western Canadian Arctic-Diana Varela and Ian Wrohan (University of Victoria)

Introduction

Phytoplankton play a critical role in the cycling of elements in the ocean by taking up dissolved nutrients (e.g., C, N, Si, P) and returning them back to seawater upon their death and decomposition. Phytoplankton physiology is then responsible for changes in the C balance in the upper water column, which in turn influence atmospheric CO_2 concentrations and modify global climate.

The study of the nutrient physiology of phytoplankton contributes to the understanding of biogeochemical cycling and ecosystem dynamics in surface waters. Over spatio-temporal scales that approximate the residence time of water in the mixed layer, the rate of "new production" (nitrate-based primary productivity) can be used as an indicator of the vertical flux of organic matter out of the euphotic zone. High rates of new production are normally attributed to diatoms. In contrast, high rates of "regenerate primary production" (ammonium and urea-based) are generally indicative of low export rates and the presence of phytoplankton assemblages characterized by small cells (less of a diatom contribution). The predominance of one phytoplankton group over another has a direct impact on food web structure in surface waters, and on the magnitude of primary and export production available for consumption at higher trophic levels.

Diatoms, a group of phytoplankton from the Class Bacillariophyceae, are major primary producers and key exporters of organic matter and opal in marine coastal waters and upwelling regions throughout the world's oceans. Diatoms have an absolute requirement for Si, which is precipitated as amorphous hydrated silica in their cell walls. Hence, diatoms control the cycling of Si and contribute significantly to the downward flux of biogenic silica, N and C in most oceanic regions. In the Southern Ocean, diatoms are responsible for as much as 75% of the annual primary production. In particular, the area between the Antarctic Polar Front and the northern extent of the marginal sea ice is the site of massive diatom blooms.

It is critical that comprehensive studies of phytoplankton process are carried out in surface waters of the Western Canadian Arctic in order to determine the potential effects of Arctic climatic changes on nutrient dynamics, autotrophic biomass and productivity, and export fluxes.

Overall Objective

The goals of our project are: (1) to investigate the dynamics of nutrient cycling and the rates of phytoplankton (total, new and regenerated) production and (2) to assess how variability in physical and chemical gradients affect phytoplankton dynamics in surface waters of the Western Canadian Arctic.

In order to achieve these goals, our Specific Objectives are:

(1) *The study of nutrient pools in surface waters*.

We collected samples for the measurement of dissolved nutrients (NH_4, N-urea, NO_3, $Si(OH)_4$, PO_4) and particulate C, N and Si.

(2) The determination of the structure of the phytoplankton community.

We collected samples for:

- The measurement of total and size-fractionated chlorophyll *a* (0.7 and 5 µm)
- The composition of phytoplankton assemblages by light microscopy and Flow-Cam.

(3) The determination of the magnitude of total, new and regenerated production by phytoplankton.

We performed experiments with live phytoplankton assemblages by inoculating the cultures with:

- ^{14}C, $^{15}NO_3$, $^{15}NH_4$ and ^{15}N-urea

Cultures were grown in on deck incubators for 24 hs.
This work was carried out along a vertical profile throughout the euphotic zone (at ~6 depths corresponding to 100, 50, 30, 12, 1 and 0.1% of surface irradiance) at selected stations, which were strategically chosen to identify extreme conditions or different ecosystems.

The following is a list of stations and depths sampled:

- Station 1: 5m
- LS2: 2, 5, 10, 15, 25 and 50 m
- LS4: 2, 5, 10, 13, 40 and 60 m
- LS7: 2, 5, 10, 15, 25 and 50 m
- BB1: 2, 35 and 80 m
- BB5: 2, 5, 10, 20, 40 and 65 m
- BB8: 5, 40 and 60 m
- BB10: 2, 5, 10, 20, 40 and 70 m
- BEW11: 5, 10, 15, 40 and 70 m
- CAA2: 2, 5, 12, 30, 40 and 50 m
- CAA5: 2, 6, 9, 17, 32 and 54 m
- BE2: 15 m
- CAA6: 5, 10, 20, 30 and 70 m
- CAA10: 5, 7, 17, 37 and 50 m

- CAA12: 5, 8, 14, 25, 46 and 55 m
- CAA16: 2, 5, 10, 16, 30 and 57 m

HPLC Pigments and bacteria- Bill Li Bedford Institute of Oceanography.
Samples collected from the rosette and filtered from:

1. Surface
2. Depth of the chlorophyll maximum

For each of the 2 samples, water was filtered for:

1. Total pigments (filtering onto 25mm glass fibre filter).
2. Picoplankton pigments (filtering water through a 3 micron polycarbonate filter and then onto the 25 mm glass fibre filter).

After filtration, the filters were folded, placed into vials and put into Liquid Nitrogen. They were removed after freezing and placed into the -80C freezer.

Stations Sampled

Stn 1	LS7	BB10	CAA6
Stn 2	BB1	BEW11	CAA10
LS4	BB5	CAA1	CAA12
LS5	BB8	CAA5	CAA16

Bacteria was also sampled at each of these stations at the depths requested by C. Lovejoy's lab.

Bacteria
A single water sample was collected from every depth of each geochemistry cast. 1.8mL of each sample was added to a cryogenic vial. 0.2mL of 10% paraformaldehyde was then added to each vial for fixation. The vials were then mixed, left to stand for 15 minutes and then placed into the -80C freezer.
Stations Sampled for bacteria

Viral Studies – Curtis Suttle and Christian Winter – University of British Columbia
Water samples were collected from the rosette for studies of:

1. prokaryotic and viral abundance
2. viral DNA and RNA diversity
3. prokaryotic DNA and RNA diversity
4. transmission electron microscopy to determine viral infectivity
5. archival samples for virus culture collection

Samples were filtered and concentrated virus stored in liquid nitrogen.
Stations sampled:

LS1	BB1	CAA1
LS2	BB5	CAA5

LS4	BB8	CAA6
LS5	BB10	CAA9
LS7	BEW11	CAA10
		CAA12

Vertical Net Tows

Zooplankton sampling was performed using a modified Bongo net system. Two large bongo hoops were fitted with coarse mesh nets of 150µm and 236µm. A second set of smaller hoops were fitted perpendicular to the large hoops. These smaller hoops were fitted with finer 53µm mesh nets. The four nets were fitted with unidirectional flow meters which measure the amount of water flowing through the hoops. Between cast the nets were stored on the foredeck in a box, built by the ship specifically to accommodate the bongo net.

Figure 3. Zooplankton nets.

Four casts, typically to either 200m or 100m were performed per station to collect enough samples for identification, DNA analysis and biomass measurements. Samples from the first cast were preserved in formalin with samples from the nets with 53µm-sized mesh combined to form one sample. From the second cast, the samples from the nets with 236µm mesh and combined nets of 53µm mesh were preserved in 95% ethanol. The sample from the net with 150µm mesh was washed with 4% ammonium formate and dried at 50^{o}C for 24 hours for biomass measurements. 48 casts were performed at 24 stations. The third and fourth casts were separated to genus for a study of Bow Head whale feeding. Locations sampled are listed in the appendix.

XCTD and XBT Casts

XCTD (expendable conductivity, temperature and depth profiler, Tsurumi-Seiki Co., Ltd.) probes were deployed into the ocean off the stern of the ship using a hand launcher LM-3A (Tsurumi-Seiki Co., Ltd.). The probes made vertical profiles of temperature and salinity to the bottom or a depth of 1100 m, whichever was shallower. The data were communicated back to a shipboard computer via a digital data converter MK-130

(Tsurumi-Seiki Co., Ltd.) connected to the probe by a fine copper wire which breaks when the probe reaches its maximum depth.

According to the manufacturer's nominal specifications, the range and accuracy of parameters measured by the XCTD are as follows;

Parameter	Range	Accuracy
Conductivity	0 ~ 60 [mS/cm]	+/- 0.03 [mS/cm]
Temperature	-2 ~ 35 [deg-C]	+/- 0.02 [deg-C]
Depth	0 ~ 1000 [m]	5 [m] or 2 [%] (either of them is major)

In this cruise, 19 XCTDs were successfully launched. In open water the probe was launched while the ship steamed at 12 knts. In heavy ice, the ship stopped before deployment due to the fragility of the conducting wire.

XBT (expendable bathy thermograph, Sippican Ltd.) T-5 probes were deployed into the ocean off the stern of the ship using the same method, equipment and software as the XCTDs. The probes made vertical profiles of temperature to the bottom or a depth of 2000 m, whichever was shallower. In open water the probe was launched while the ship steamed at 6 knts. In heavy ice, the ship stopped before deployment due to the fragility of the conducting wire. In this cruise, 29 XBT probes were successfully launched. The failure rate was high, with approximately 50% failed probes, although this was not unexpected as the probes are approximately 20 years old and well past their expiration date.

Camera.

A video camera mounted in a rosette frame was deployed at eight stations from the foredeck A-frame. Because the camera was internally recording with out a transmission cable the camera was lowered at approximately 1 m/s to 20 to 30 m from the bottom as judged by the bridge sounder and then lowered dead slow until the bottom was touched as judged by slackness of the wire. The camera was then raised approximately one meter and held there for 20 minutes with constant monitoring of the wire tension. Camera station are listed in Appendix B.

Mud Grabs.

A Van Veen bottom sampler was deployed 32 times at 11 stations. Three repetitions were done at each station to get a statistically representative sample. Once on deck the samples were washed using a table made by the ship especially for this activity. Benthic animals sampled were preserved in formalin. See Appendix B. for list of stations where benthic sampling took place.

Seabird and marine mammal observations: Sea bird and marine mammal observations were made from the bridge along the entire ships track by John Wells.

ADCP

A 300kHz broadband Acoustic Doppler Current Profiler (ADCP) and a Dual Frequency Sounder (110 kHz and 220kHz) were deployed at the starboard side off the main lab. Generally, deployment started at the beginning of each station and data were recorded throughout the entire station. Stations where the ADCP was deployed are listed in Appendix B.

Moorings.
Two mooring were deployed in Bellot Strait a “biochemical” mooring and a “physics” mooring

Biochemical Mooring - Deployed by Doug Sieberg.
Drop Location and Time:
22 July 2007, 1040 Local, 1340 UTC
71 56.625N 94 15.952W
105m water depth

Figure 4. Assembly of biochemical mooring.
Releases: Tandem Benthos 865A-DB’s
#728 Rx 13.5Khz Tx 12.0Khz En. A Rel. B Option 5A 5B
#729 Rx 14.0Khz Tx 12.0Khz En. B Rel. A Options 6B 6A
Triangulation on mooring after deployment - Transducer put over on starboard side just aft of foredeck A-frame. Transducer lowered to depth of 7.5m.
Use release #728 for ranging. Left enabled with understanding that release will disable after a time-out period of 16 hours.
Location A

1	526	71 56.738	94 16.708
2	534		
3	541		

Location B

4	582	71 56.832	94 15.319
5	585	71 56.834	94 15.326
6	586	71 56.94	94 15.334

Location C

7	465	71 56.381	94 16.010
8	465	71 56.382	94 16.014
9	464	71 56.383	94 16.023

Mooring Components:
Top T-pod SN 2050 at 9m above top of WASP
WASP
Yellow ORE 30" steel float.
BioChem Instrument Package
- AURAL M-2 SN 382031
- ARG
- CTD SN 4523/ GTD SN 22-017-05/ SBE43 Oxygen SN 637
- Fluorometer SN 206 (the style with the wiper)

Orange ORE 22" steel float SN M325
SAMI PCO2 SN 27 (5/16")
T-pod SN 7, at 1.7m from top of Kevlar line (line is 23.7m)
T-pod SN 13, at 13.7m from top of Kevlar line
SBE37 SeaCat SN 4447 (5/16")
T-pod SN 7m from top of Kevlar line (line is 23.7)
T-pod SN 14m from top of Kevlar line
T-pod SN 22m from top of Kevlar line
Yellow ORE 30" steel float SN 576
Tandem Benthos 865A-DB's with SBE37
- #728 Rx 13.5Khz Tx 12.0Khz En. A Rel. B Option 5A 5B
- #729 Rx 14.0Khz Tx 12.0Khz En. B Rel. A Options 6B 6A
- SBE 37 SeaCat SN 3502 on release frame

Dual train wheels
Comments:

- Approx 1.5m of chain was added to mooring between top of releases and the swivel below the 30" steel float.
- We had six t-pods instead of the five shown in the mooring diagram so a third was added to the lower Kevlar line.
- Set-up slower than expected – this could have been made much easier if package had been fully assembled prior to being packed.
- WASP was set up according to Phillipe Benoit's instructions. See file wasp_setup_2.TXT for details. Set-up went fine however once logging began the data coming out to hyperterminal was the same character (u hat) repeated, even with tapping and rubbing the transducer surface. The transducer click could be heard, so it did appear to be working. The package was reset a number of times but with same results. Phillipe and Svien were contacted. Svein agreed that after a few restarts even with the same results, the WASP should be deployed. Phillipe said this behaviour was typical so assumes everything is actually fine.

- 5/8” Shackle on release missing pin. Swapped out for new shackle.
- 10/10 ice conditions in drop area meant performing an anchor first deployment. This was at the request of the Captain and made sense due to ice conditions.
- To deploy anchor first, WHOI’s block was used, a hook line was attached to the A-frame, and the winch ‘Blacky’ was repositioned and hooked up to the power pack.
- During the deployment, focus had slid away from the line in the water to the next pick of the biochem package. Doug spotted the upper Kevlar line was out of position. An ice block had come up against the line and was pulling it forward. The A-frame was quickly put out to avoid cutting the Kevlar line on the heard edge of the bulwark cut-out and move line off the ice. The ship then added bubbler to move ice clear. No damage could be seen from the deck but we did not bring it back in for inspection. Otherwise deployment went smoothly.

Notice to mariners:
Mooring at eastern entrance to Bellot Strait (“Bio-Chemical Mooring”)
Location **71 56.63N   94 15.95W**
Top of mooring is at 22m depth
Contact: Humfrey Melling, DFO 250-363-6552

Bellot Strait Physics Mooring - Deployed by Doug Sieberg.
Drop Location and Time:
21 July 2007, 1330 Local, 1630 UTC
72 00.48N   94 38.743W
121m water depth

Figure 5. Physics mooring being deployed in Bellot Strait.

Releases:
Paul Channel 4 Release 13
Lyn Channel 1 Release 28

Range on mooring immediately after deployment, all within 10 minutes.

1	121	72 00.48N	94 38.74W
1	123	72 00.52N	94 38.67W
4	131	72 00.52N	94 38.68W
1	130		
4	137	72 00.51N	94 38.70W
1	123	72 00.50N	94 38.70W

Mooring Components:
WH-300kHz Sentinel ADCP SN 2281
41” Yellow steel float (ORE)
Torsionally rigid backbone
SBE37 CT recorder SN 5135
Battery Case in frame SN KSO213
Tandem 501AR releases with aluminium swing link SN Paul and Lyn
Universal joint
2500# Train wheel with chain clump

ADCP: Johannes G. programmed this according to Humfrey M.’s set up notes.

SBE37: Sarah programmed this according to Humfrey M.'s set up notes. See sbe37_5135setup.cap for full setup information. Partial:
S>DS
SBE37-SM V 2.6b SERIAL NO. 5135 21 Jul 2007 05:15:57
logging not started
sample interval = 900 seconds
sample number = 0, free = 190277
do not transmit real-time data
do not output salinity with each sample
do not output sound velocity with each sample
store time with each sample
number of samples to average = 1
serial sync mode disabled
wait time after serial sync sampling = 30 seconds
internal pump not installed
temperature = 16.62 deg C
S>STARTLATER
start time = 21 Jul 2007 06:00:00

Comments:
ADCP start time difficult to set but Johannes figured it out with call back to Humfrey.
One pick deployment went quickly once mooring fully assembled.
Ice conditions and current were fine for deployment.
Range on both releases afterwards showed both were talking and agreeing on distance.
The inner pole was approximately 3/16" too long to allow releases to set. After shortening inner pole the releases were able to be set.
There were only two anodes put on the two aluminium flat bars that parallel the steel arm welded to the 42" ORE float. There was good isolation between the steel and the aluminium and the two anodes made good contact.
There should have been 50% more of all hardware for both moorings.

Drift-Bottle Deployments

This is simple science at its best. 195 numbered bottles with messages inside were tossed over the side, typically with each CTD cast. In two years we expect to start hearing back as people find these bottles washed up on shore. From the returned information, the starting and ending positions, probable route and a maximum transit time can be determined. Two sets of bottles were tossed. The first set was a put together by Bonita Leblanc, an 8th grade student, for a school science fair project. She chose toss locations throughout the ship's transit from Dartmouth NS into the Canada Basin. See appendix C for release locations.

Figure 6. Drift bottle deployment by S. Romaine

Opportunistic Study
Upper Ocean CTD casts using a SBE19Plus: At eight locations a SBE19+ was deployed from the helicopter by Ed Carmack and one assistant (see appendix B for locations of deployment).

COMMENTS ON OPERATION
Ice conditions
Heavy land-fast ice in Baffin Bay precluded reaching stations as planned however we were able to change the station location to accomplish the objective of sampling in that area. Current, wind and shifting ice conditions in Bellot Strait made operating there challenging and planning for deployment of moorings was made on the fly according to conditions as they were encountered. This approach worked well as both moorings we successfully deployed.

Planned activities that were not completed
All objectives were met.

5.3 Ship improvements completed for 2007

Items critical for this year's Canada's Three Oceans and JOIS-2007 programs were addressed as well as other improvements made possible with funding for the International Polar Year. Some of the highlighted outcomes of last winter's efforts are listed below. Additionally, we were glad to have the ship's fifth engine back in operation.

- Fume hood and vent installation in the main lab with chemical locker below. This system allows for the safe use of chemicals in the lab. The fume hood worked well. Understanding how to set and operate the alarm system was not intuitive although this could be fixed with posting of the instruction manual.

- New temperature controlled container lab (within 2 deg), suited for salinity and oxygen analysis.

- New container lab divided into CTD operation section and a section with a fumehood (suitable for solvents) and explosion proof refrigerator.

- An uncontaminated seawater supply, delivered to the main lab, in which sensors (i.e. Seabird SBE 21 thermosalinograph) were installed and water samples drawn.

- Repair to the rosette container lab door.

- Removing and rewinding the CTD conducting wire on to the drum to solve the bad-wrap problem.

- Forward container lab was removed and replaced with repaired container lab from boatdeck previously used for CTD operation.

- Sink, counter and floor on outboard side of main lab replaced and/or repaired.

- Antifatigue mats, chairs and stools added to labs

- Foredeck container to be completed in time for the 2008 field program.

5.4 Suggestions for 2008

The following is a list of suggested improvements to and comments about the ship's equipment and lab spaces. The lists are written in order of priority and depend on unidentified funding.

General Ship:

- Add air conditioning to the forward science lab for performance and operation of ship's network servers, sounder equipment and computers as well as to make a more comfortable work space.

- Network speed is variable by location and at some areas takes too long to move or open files put on public drive. Boardroom, 301 and other port side 300 level cabins are slow places, to mention a few.

Science:

- Pivot pins on rosette A-frame need examination/ service. The A-frame "clunks" as the rosette is deployed and recovered.

- Wooden deck outside rosette lab needs repair as the pallet jack sinks into the wood when the rosette is moved.

- Add drain to the rosette container, diagonally in 1-m from aft outboard corner. The existing drain in the same corner (next to the wall) is good but not sufficient.

- Inspect plumbing from main lab double sink: has leak been fixed (i.e. can. both basins be used)? This is the sink next to the fume hood.

- Step from the lab containers to the deck need to be deeper (~>12 inches) – i.e. extend out from the door farther. Step from the temperature controlled lab to cover the bolt on deck as it is often tripped over.

- Add coat hooks to all lab spaces, specifically, add hooks for mustang suits/ hats/ gloves to rosette lab and main lab.

- Insulate sea water loop manifold and hoses running out of lab (if there are hoses) to prevent condensation.

- Brooks Ocean Instrumented Block software experienced intermittent communication interruptions between the block, CTD computer and winch display which required turning the system off and on. To be discussed with Brooks Ocean.

- Add shelves to the lab attached to main lab (aft most lab), some at 4.5 feet, some at 5 feet.

- Add tie down points below benches to secure boxes (nutrient lab and main lab)

- Addition of a speed control valve on the winch to ease operation during the long 3 hour casts.

- If possible, move the GPS antenna so that it is mounted directly over the ship's 12kHz transducer

For discussion (not required for Canada Basin work in 2008)

- Options for making a dedicated chemical storage in ventilated, temperature controlled room (maintained above freezing and less than ~25ºC).

- Personnel on science legs to attend to ship's network, data collection from ship's sounder and underway instruments, as well as handle the additional networking and email demands from the science group.

- New access to Aft Lab area through new door (in way of window) into Aft Lab A from exterior alleyway

- Add sinks to outboard after labs.

- Add a second seawater supply from the small sea chest aft and port side of ship (sea chest does not receive recirculated water and stays ice-free more readily than the forward intake). This system could be used when more water is needed or when forward intake is clogged with ice.

- Winch on the foredeck for mooring work.

- Winch with non-conducting wire for foredeck operation and block

- Spare conducting wire for CTD winch

Science to purchase:

- Mylar blinds to windows and fan to temperature controlled lab.

- Fan for aft-most lab adjoining main lab.

- Stand-up freezer (22 cu Ft) for programs requiring little freezer space so that ship's large walk-in freezer is not used.

ACKNOWLEDGMENTS

The science team would like to thank the Coast Guard for their support and particularly Captains McNeill, and Klebert and the Crews of the *CCGS Louis S. St-Laurent*. In addition to everyone's assistance at sea, a substantial number of projects were completed by the ship in preparation for the summer science season resulting in very successful International Polar Year programs. We'd also like to thank the Canadian Ice Service for their assistance with ice images and weather information as well as the helicopter pilots and mechanics for their valuable help with ice observations and transport. Thanks to the *CCGS Sir Wilfrid Laurier* for transferring and transporting equipment and samples back to Victoria. Importantly, we'd like to acknowledge DFO, and NSERC, for their continued support of this program.

APPENDIX A: Participants

Person	Institution
John Nelson	IOS
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Corrine Pomerleau	DFO-UBC
Ed Hendrycks	Museum of Nature
Bill Li	BIO
Diane Horn	DND
John Leslie Wells	EC
Vladimir Kostylev	BIO
Louise Thomassie	Northern Student
Paul Galipeau	Northern Student
Tom Craig	INAC

Affiliation Abbreviation

DFO	Department of Fisheries and Oceans, Canada
UBC	University of British Columbia, BC
UVic	University of Victoria, BC
CBS	Columbia Broadcasting Service
INAC	Indian and Northern Affairs Canada
Bio	Bedford Institute of Oceanography

APPENDIX B: Science Station Locations and activities

Station Name	Day-July	UTC	Cast Type	Lat Deg	Lat Min	Lon Deg	Lon Min	Bottom Depth	Max Depth
MFS	4	2208	ADC	44	25.601	-63	6.767	87	5
MFS	4	2224	ROS	44	25.513	-63	6.794	84	60
MFS	4	2255	GRB	44	25.472	-63	6.814	84	84
LS1	6		ADC	51	4.808	-57	25.2	82	5
LS1	6	1323	ROS	51	4.808	-57	25.2	82	77
LS1	6	1541	ROS	51	5.948	-57	25.612	75	71
LS1	6		NET	51	4.967	-57	25.166	82	77
LS2	7	1114	ADC	54	15.258	-54	6.027	216	5
LS2	7	1117	ROS	54	15.258	-54	6.027	216	206
LS2	7	1338	ROS	54	15.57	-54	6.045	219	214
LS2	7		NET	54	15.16	-54	5.974	220	200
LS2	7		NET	54	15.16	-54	5.974	220	200
LS2	7	1413	GRB	54	15.784	-54	6.11	219	219
LS2	7	1427	GRB	54	15.871	-54	6.148	212	212
LS2	7	1439	GRB	54	15.892	-54	6.116	210	210
LS3	7		ADC	55	58.038	-53	15.65		5
LS3	7	2217	ROS	55	58.038	-53	15.65		1000
LS4	7		ADC	58	29.053	-53	39.709	3382	5
LS4	7	1224	ROS	58	29.016	-53	39.74	3382	3000
LS4	7	1554	ROS	58	29.853	-53	40.954	3472	3468
LS4	7	1129	ROS	58	29.053	-53	39.709	3382	300
LS4	7		NET	58	29.558	-53	40.558	3382	200
LS4	7		NET	58	29.558	-53	40.558	3382	200
XBT01	8	2214	XBT	59	2	-53	50		
XBT02	8	2222	XBT	59	3.076	-53	50.337		2000
XCTD03	8	2231	XCTD	59	3.738	-53	50.512		1100
LS5	9	1117	ADC	61	51.79	-54	57.406	2643	5
LS5	9	1122	ROS	61	51.867	-54	57.406	2643	1000
LS5	9		NET	61	51.929	-54	57.331	2640	200
LS5	9		NET	61	51.929	-54	57.331	2640	200
LS5	9		NET	61	51.929	-54	57.331	2640	200
LS5	9		NET	61	51.929	-54	57.331	2640	200
LS5	9		NET	61	51.929	-54	57.331	2640	200
LS6	9	2100	ADC	62	32.117	-55	54.156	1182	5
LS6	9	2132	ROS	63	32.117	-55	54.156	1182	1000
XCTD04	9	1740	XCTD	62	48.805	-55	32.069		1100

XCTD05	10	0135	XCTD	64	9.939	-55	17.258		742
XCTD06	10	0502	XCTD	64	53.859	-56	48.205		736
XCTD07	10	0830	XCTD	65	34.59	-57	18.98		635
LS7	10		ADC	66	0.104	-57	39.996	590	5
LS7	10	1113	ROS	66	0.104	-57	39.996	590	582
LS7	10	1337	ROS	66	0.007	-57	40.377	590	582
LS7	10		NET	66	0.092	-57	40.77	577	200
LS7	10		NET	66	0.092	-57	40.77	577	200
LS7	10		NET	66	0.092	-57	40.77	577	200
LS7	10		NET	66	0.092	-57	40.77	577	200
LS7	10	1514	GRB	65	59.768	-57	40.123	588	588
LS7	10	1541	GRB	65	59.66	-57	40.4	581	581
LS7	10	1607	GRB	65	59.55	-57	40.009	589	589
LS7	10	1750	CAM	65	57.826	-57	43.066	592	592
XCTD08	11	0012	XCTD	66	54.967	-58	32.815		990
XCTD09	11	0221	XCTD	67	17.991	-58	50.291		1277
BB1	11	1106	ADC	68	11.72	-56	25.13	254	5
BB1	11	1109	ROS	68	11.72	-56	25.13	254	244
BB1	11	1242	ROS	68	11.7	-56	25.28	252	245
BB1	11		NET	68	11.071	-56	25.25	240	200
BB1	11		NET	68	11.071	-56	25.25	240	200
BB1	11		NET	68	11.071	-56	25.25	240	200
BB1	11		NET	68	11.071	-56	25.25	240	200
BB1	11	1325	GRB	68	11.678	-56	25.113	242	242
BB1	11	1338	GRB	68	11.668	-56	25.201	241	241
BB1	11	1351	GRB	68	11.628	-56	25.174	239	239
BB1	11	1410	CAM	68	11.607	-56	25.271	240	240
XCTD10	11	1548	XCTD	68	17.615	-57	4.984	410	410
BB2	11	1735	ADC	68	23.338	-57	43.845	324	5
BB2	11	1739	ROS	68	23.338	-57	43.845	324	312
BB2	11	1749	CAM	68	23.31	-57	43.848	319	
XCTD11	11	2049	XCTD	68	28.885	-58	40.028	331	331
BB3	11	2255	ROS	68	34.222	-59	42.524	1025	1015
XCTD12	12	0109	XCTD	68	37.522	-60	7.474	1498	1489
BB4			ADC	68	40.807	-60	30.829	1679	5
BB4	12	0249	ROS	68	40.807	-60	30.829	1679	1000
XCTD15	12	0707	XCTD	68	44.321	-61	7.789	1783	1783

BB5	12		ADC	68	49.832	-61	45.435		
BB5	12	1057	ROS	68	49.832	-61	45.435	1800	1000
BB5	12	1226	ROS	68	49.845	-61	45.59	1850	1000
BB5	12	1443	ROS	68	49.787	-61	45.38	1850	1000
BB5	12		NET	68	49.838	-61	45.599	1849	200
BB5			NET	68	49.838	-61	45.599	1849	200
BB5			NET	68	49.838	-61	45.599	1849	200
XCTD16	12		XCTD	68	40.175	-62	18.252		
XCTD17		2211	XCTD	68	19.332	-63	15.488		1423
BB6	12	2015	ADC	68	25.644	-62	56.24	1608	5
BB6	12	2117	ROS	68	25.644	-62	56.24	1608	1005
BB7	12		ADC	68	14.885	-63	33.081	1250	5
BB7	12	2323	ROS	68	14.885	-63	33.081	1250	1005
XCTD18	13	0241	XCTD	68	9.56	-63	48.5		932
BB8	13		ADC	68	5.445	-64	0.387	156	5
BB8	13	0303	ROS	68	5.445	-64	0.387	156	153
BB8	13	0448	ROS	68	5.366	-63	59.964	155	150
BB8	13		NET	68	5.322	-64	0.229	168	160
BB8	13		NET	68	5.322	-64	0.229	168	160
BB8	13		NET	68	5.322	-64	0.229	168	160
BB8	13		NET	68	5.322	-64	0.229	168	160
BB8	13	0523	GRB	68	5.391	-63	59.89	162	162
BB8	13	0535	GRB	68	5.405	-63	59.85	162	162
BB8	13	0544	GRB	68	5.446	-63	59.794	162	162
BB8	13	0613	CAM	68	5.446	-63	59.804	160	160
HELICTD1	13		CTD	68	2	-64	13		200
HELICTD2	13		CTD	68	0	-64	22		200
HELICTD3	13		CTD	67	58	-64	31		100
HELICTD4	13		CTD	67	57	-64	36		60
HELICTD5	13		CTD	67	56	-64	31		30
XCTD19	13	1813	XCTD	69	8.196	-63	18.942	732	732
BB9	13		ADC						
BB9	13	2037	ROS	69	40.533	-62	44.781	1972	1000
BB9	13		NET	69	40.541	-62	44.715	2002	200
BB9	13		NET	69	40.541	-62	44.715	2002	200
BB9	13		NET	69	40.541	-62	44.715	2002	200
XCTD20	14	0223	XCTD	70	11.659	-63	24.443	1824	1824
XCTD21	14	0537	XCTD	70	35.137	-63	59.62	2138	2138

XBT23	14	0925	XBT	71	4.197	-64	40.371	2100	2100
BB10	14	1302	ADC	71	33.252	-65	24.942	2230	5
BB10	14	1306	ROS	71	33.252	-65	24.942	2230	1000
BB10	14	1542	ROS	71	33.906	-65	23.962	2300	2296
BB10	14		NET	71	33.423	-65	24.481	2282	200
BB10	14		NET	71	33.423	-65	24.481	2282	200
BB10	14		NET	71	33.423	-65	24.481	2282	200
BB10	14		NET	71	33.423	-65	24.481	2282	200
XCTD24	14	1940	XCTD	71	51.518	-65	43.027	2328	2328
XCTD25	14	2202	XCTD	72	18.409	-66	22.31	2365	2365
B01	15		ADC	72	44.982	-66	59.937	2350	5
B01	15	0037	ROS	72	44.982	-66	59.937	2350	150
B01	15	0224	ROS	72	45.407	-67	0.813	2355	
B01	15		NET	72	45.244	-67	0.506	2386	200
B01	15		NET	72	45.244	-67	0.506	2386	200
B01	15		NET	72	45.244	-67	0.506	2386	200
B01	15		NET	72	45.244	-67	0.506	2386	200
BEW02	15	0602	XBT	72	42.905	-67	56.543	2306	2306
BEW03	15	0847	ROS	72	39.86	-68	59.344	2094	2089
BEW04	15	??35	XBT	72	37.3	-70	0.3	1833	1833
BEW05	15		ADC	72	35.121	-70	48.456	1478	5
BEW05	15	1359	ROS	72	35.121	-70	48.456	1478	1473
BEW06	15	??29	XBT	72	37.195	-71	29.062		1156
BEW07	15		ADC	72	29.958	-71	59.477	1049	5
BEW07	15	1805	ROS	72	29.958	-71	59.477	1049	1042
BEW08	15	2028	XBT	72	27.314	-72	36.22	910	910
BEW09	15		ADC	72	24.901	-73	9.936	685	5
BEW09	15	2141	ROS	72	24.901	-73	9.936	685	681
BEW09	16	0024	ROS	72	24.942	-73	10.826	669	667
BEW09	15	1959	GRB	72	24.889	-73	10.089	690	690
BEW09	15	2027	GRB	72	24.911	-73	10.164	690	690
BEW09	15	2048	GRB	72	24.932	-73	10.181	690	690
BEW10	16	0230	XBT	72	22.696	-73	47.085	167	167
BEW11	16	1607	ADC	72	23.116	-73	53.873	153	5
BEW11	16	1623	ROS	72	23.116	-73	53.873	153	149

BEW11	16	1753	ROS	72	23.077	-73	53.63	149	146
BEW11	16		NET	72	23.113	-73	53.845	153	130
BEW11	16		NET	72	23.113	-73	53.845	153	130
BEW11	16		NET	72	23.113	-73	53.845	153	130
BEW11	16		NET	72	23.113	-73	53.845	153	130
BEW11	16	1731	GRB	72	23.076	-73	53.665	154	154
BEW11	16	1741	GRB	72	23.079	-73	53.616	154	154
BEW11	16	1754	GRB	72	23.083	-73	53.604	154	154
BEW11	16	1818	CAM	72	23.052	-73	53.523	150	150
HELICTD6	16		CTD	72	19	-74	30		
HELICTD7	16		CTD	72	18	-74	55		
HELICTD8	16		CTD	72	18	-74	39		
BB11	17	0604	ROS	74	7.45	-77	45.114	849	820
BB11	17		NET	74	7.459	-77	45.089	839	200
CAA1	17	1252	ADC	74	8.466	-81	33.222	785	5
CAA1	17	1316	ROS	74	8.466	-81	33.222	785	762
CAA1	17		NET	74	8.886	-81	35.725	700	200
CAA1	17		NET	74	8.886	-81	35.725	700	200
CAA1	17	1504	GRB	74	7.41	-81	33.279	767	767
CAA1	17	1538	GRB	74	7.018	-81	33.03	763	763
CAA1	17	1606	GRB	74	6.734	-81	33.377	760	760
CAA2	17		ADC	74	13.061	-85	39	556	5
CAA2	17	2323	ROS	74	13.061	-85	39	556	536
CAA2	18		NET	74	13.125	-85	40.726	544	200
CAA2	18		NET	74	13.125	-85	40.726	544	200
CAA2	18		NET	74	13.125	-85	40.726	544	200
CAA2	18		NET	74	13.125	-85	40.726	544	200
CAA2	18		GRB	74	13.064	-85	38.476	544	544
CAA2	18		GRB	74	13.004	-85	38.287	548	548
CAA2	18		GRB	74	12.994	-85	38.221	548	548
CAA2	18	0157	CAM	74	12.929	-85	38.212	545	545
CAA3	18		ADC	74	13.406	-89	42.854	217	5
CAA3	18	0737	ROS	74	13.406	-89	42.854	217	204
CAA3	18	0818	CAM	74	13.316	-89	42.968	223	223
CAA4	18		ADC	74	25.57	-93	29.074		
CAA4	18	1326	ROS	74	25.57	-93	29.074	159	150
CAA4	18		NET	74	25.785	-93	28.768	170	150
CAA4	18		NET	74	25.785	-93	28.768	170	150
CAA4	18		NET	74	25.785	-93	28.768	170	150
CAA4	18		NET	74	25.785	-93	28.768	170	150
CAA4	18		CAM	74	25.225	-93	29.973	172	172
XBT33	20	1959	XBT	73	59.6	-89	30.5		

CAA5	20	2207	ADC	73	31.639	-89	30.052	434	5
CAA5	20	2217	ROS	73	31.639	-89	30.052	434	100
CAA5	20	2303	ROS	73	31.55	-89	30.514	434	430
CAA5	21	0023	ROS	73	31.379	-89	31.835	440	435
CAA5			NET						
CAA5			NET						
CAA5			NET						
CAA5			NET						
CAA5	21		GRB	73	31.29	-89	33.08	432	432
CAA5	21		GRB	73	31.28	-89	33.65	456	456
CAA5	21		GRB	73	31.24	-89	34.38	456	456
XBT35	21		XBT	72	59.312	-90	40.266	430	430
XBT36	21	0748	XBT	72	29.404	-92	2.168	263	263
CAA5B	21	1417	ROS	71	55.914	-94	4.325	69	62
BE1	21	1734	ROS	71	58.492	-95	3.838	386	229
BE2	21	1851	ROS	72	0.36	-94	35.149		
BE2	21		NET						
Physics Mooring	21		MOR	72	00.48	-94	38.743		
BioChem Mooring	22		MOR	71	56.63	-94	15.95		
CAA6	22	1525	ROS	71	56.923	-94	17.331		
XBT37	22	1643	XBT	71	59.787	-94	45.99	50	50
XBT39	22	1726	XBT	71	58.63	-94	59.86	354	354
XBT40	22	2004	XBT	71	53.68	-95	38.94	307	307
CAA9	22	2156	ROS	71	50.882	-95	48.35	291	286
XBT41	23	0150	XBT	71	25.403	-97	0.869	254	254
XBT42	23	0524	XBT	70	59.92	-98	0.257	148	148
CAA10	23	1102	ADC	70	39.071	-98	34.91	199	5
CAA10	23	1122	ROS	70	39.071	-98	34.91	199	192
CAA10	23	1228	ROS	70	39.044	-98	35.1	195	192
CAA10	23	1338	ROS	70	39.05	-98	35.297	197	190
CAA10	23		NET						
CAA10	23		NET						
CAA10	23		NET						
CAA10	23		NET						

CAA10	23		GRB	70	39.029	-98	35.382	206	
CAA10	23		GRB	70	39.017	-98	35.425	209	
CAA10	23		GRB	70	39.007	-98	35.445	209	
XBT46	23	1723	XBT	70	16.311	-99	0.169	200	
CAA11	23	2210	ROS	69	53.7	-99	31.575	861-868	
XBT47	24	0103	XBT	69	31.08	-100	2.73	61	61
XBT48	24	0335	XBT	69	11.519	-100	46.49	72	72
XBT49	24	0556	XBT	68	56.29	-101	41.55	45	45
XBT50	24	0750	XBT	68	43.489	-102	42.546	108	108
CAA12	24		ADC	68	40.769	-103	55.052	107	5
CAA12	24	1300	ROS	68	40.769	-103	55.052	107	100
CAA12	24	1417	ROS	68	40.418	-103	55.023	103	90
CAA12	24	1212	ROS	68	40.974	-103	55.032	103	94
CAA12	24		NET						
CAA12	24		NET						
CAA12	24		NET						
CAA12	24		NET						
CAA12	24		GRB	68	40.353	-103	54.83	109	109
CAA12	24		GRB	68	40.292	-103	54.888	107	107
CAA12	24		GRB	68	40.246	-103	54.814	108	108
XBT51	24	1819	XBT	68	49.6	-105	17.803	64	64
CAA13	24	2020	ROS	68	55.897	-105	45.073	112	104
XBT52	24	2256	XBT	68	57.86	-106	30.18	91	91
XBT53	25	0033	XBT	68	47.92	-107	51.99	76	76
CAA14	25		ADC	68	42.415	-108	29.711	126	5
CAA14	25	0145	ROS	68	42.415	-108	29.711	126	121
XBT54	25	0252	XBT	68	39.115	-108	56.057	106	106
XBT56	25		XBT	68	31.775	-109	58.869	90	90
XBT57	25	0612	XBT	68	28.103	-111	3.302	76	76
CAA15	25	0740	ROS	68	25.336	-111	59.702	233	
CAA16	25	1310	ADC	68	22.999	-113	6.901	222	5
CAA16	25	1313	ROS	68	22.999	-113	6.901	222	216
CAA16	25	1435	ROS	68	22.944	-113	7.144	216	210

CAA16	25		NET							
CAA16	25		NET							
CAA16	25		NET							
CAA16	25		NET							
XBT58	25	1610	XBT	68	16.163	-113	34.504	153	153
XBT59	25	1847	XBT	67	56.411	-114	54.127	57	57

GRB- bottom grab
ROS –CTD/Rosette
NET – Plankton Net
ADC - ADCP
MOR- Mooring
CAM - Camera

Appendix C. Drift bottle release locations.

Bottle Log -CCGS Louis S St Laurent -2007

Bottle Number	mm/dd/yr Date	UTC Time	Ship Track (Fugawi) Lat N degree	Long E degree
1	7/07/07	23:00	55.9636837	-53.2548582
2	7/07/07	23:00	55.9636837	-53.2548582
3	7/07/07	23:00	55.9636837	-53.2548582
4	7/07/07	23:00	55.9636837	-53.2548582
5	7/07/07	23:00	55.9636837	-53.2548582
13	7/07/07	23:00	55.9636837	-53.2548582
14	7/07/07	23:00	55.9636837	-53.2548582
15	7/07/07	23:00	55.9636837	-53.2548582
16	7/07/07	23:00	55.9636837	-53.2548582
17	7/07/07	23:00	55.9636837	-53.2548582
18	7/07/07	23:00	55.9636837	-53.2548582
19	7/07/07	23:00	55.9636837	-53.2548582
20	7/07/07	23:00	55.9636837	-53.2548582
21	7/07/07	23:00	55.9636837	-53.2548582
22	7/07/07	23:00	55.9636837	-53.2548582
23	7/07/07	23:00	55.9636837	-53.2548582
24	7/07/07	23:00	55.9636837	-53.2548582
25	7/07/07	23:00	55.9636837	-53.2548582
26	7/07/07	23:00	55.9636837	-53.2548582
27	7/07/07	23:00	55.9636837	-53.2548582

28	7/07/07	23:00	55.9636837	-53.2548582
29	7/07/07	23:00	55.9636837	-53.2548582
30	7/07/07	23:00	55.9636837	-53.2548582
31	7/07/07	23:00	55.9636837	-53.2548582
32	7/07/07	23:00	55.9636837	-53.2548582
33	7/07/07	23:00	55.9636837	-53.2548582
35	7/07/07	23:00	55.9636837	-53.2548582
36	7/07/07	23:00	55.9636837	-53.2548582
37	7/10/07	210	64.2867833	-56.3688333
38	7/10/07	210	64.2867833	-56.3688333
39	7/10/07	210	64.2867833	-56.3688333
40	7/10/07	210	64.2867833	-56.3688333
41	7/10/07	210	64.2867833	-56.3688333
42	7/10/07	210	64.2867833	-56.3688333
43	7/10/07	1300	66.00133333	-57.68116667
44	7/10/07	1300	66.00133333	-57.68116667
45	7/10/07	1300	66.00133333	-57.68116667
46	7/10/07	1300	66.00133333	-57.68116667
47	7/10/07	1300	66.00133333	-57.68116667
48	7/10/07	1300	66.00133333	-57.68116667
49	7/11/07	1456	68.2193	-56.585
50	7/11/07	1456	68.2193	-56.585
51	7/11/07	1456	68.2193	-56.585
52	7/11/07	1456	68.2193	-56.585
53	7/11/07	1456	68.2193	-56.585
54	7/11/07	1456	68.2193	-56.585
55	7/11/07	1820	68.38765	-57.7326833
56	7/11/07	1820	68.38765	-57.7326833
57	7/11/07	1820	68.38765	-57.7326833
58	7/11/07	1820	68.38765	-57.7326833
59	7/11/07	1820	68.38765	-57.7326833
60	7/11/07	1820	68.38765	-57.7326833
61	7/11/07	2357	68.5695833	-59.7009
62	7/11/07	2357	68.5695833	-59.7009
63	7/11/07	2357	68.5695833	-59.7009
64	7/11/07	2357	68.5695833	-59.7009
65	7/11/07	2357	68.5695833	-59.7009
66	7/11/07	2357	68.5695833	-59.7009
67	7/12/07	400	68.6824	-60.5121833

68	7/12/07	400	68.6824	-60.5121833
69	7/12/07	400	68.6824	-60.5121833
70	7/12/07	400	68.6824	-60.5121833
71	7/12/07	400	68.6824	-60.5121833
72	7/12/07	400	68.6824	-60.5121833
73	7/12/07	2000	68.4265667	-62.9321333
74	7/12/07	2000	68.4265667	-62.9321333
75	7/12/07	1130	68.8307667	-61.7589167
76	7/12/07	2000	68.4265667	-62.9321333
77	7/12/07	2000	68.4265667	-62.9321333
78	7/12/07	1130	68.8307667	-61.7589167
79	7/12/07	2000	68.4265667	-62.9321333
80	7/12/07	1130	68.8307667	-61.7589167
81	7/12/07	1130	68.8307667	-61.7589167
82	7/12/07	2000	68.4265667	-62.9321333
83	7/12/07	2000	68.4265667	-62.9321333
84	7/12/07	1130	68.8307667	-61.7589167
85	7/12/07	2337	68.2468667	-63.5533333
86	7/12/07	2337	68.2468667	-63.5533333
87	7/12/07	2337	68.2468667	-63.5533333
88	7/12/07	2337	68.2468667	-63.5533333
89	7/12/07	2337	68.2468667	-63.5533333
90	7/12/07	2337	68.2468667	-63.5533333
91	7/13/07	521	68.0911333	-64.0141
92	7/13/07	521	68.0911333	-64.0141
93	7/13/07	521	68.0911333	-64.0141
94	7/13/07	521	68.0911333	-64.0141
95	7/13/07	521	68.0911333	-64.0141
96	7/13/07	521	68.0911333	-64.0141
97	7/13/07	2200	69.6737333	-62.7388667
98	7/13/07	2200	69.6737333	-62.7388667
99	7/13/07	2200	69.6737333	-62.7388667
100	7/13/07	2200	69.6737333	-62.7388667
101	7/13/07	2200	69.6737333	-62.7388667
102	7/13/07	2200	69.6737333	-62.7388667
103	7/14/07	1756	71.5934	-65.4028
104	7/14/07	1756	71.5934	-65.4028
105	7/14/07	1756	71.5934	-65.4028
106	7/14/07	1756	71.5934	-65.4028

107	7/14/07	1756	71.5934	-65.4028
108	7/14/07	1756	71.5934	-65.4028
109	7/15/07	425	72.7594	-67.04475
110	7/15/07	425	72.7594	-67.04475
111	7/15/07	425	72.7594	-67.04475
112	7/15/07	425	72.7594	-67.04475
113	7/15/07	425	72.7594	-67.04475
114	7/15/07	425	72.7594	-67.04475
115	7/15/07	425	72.7594	-67.04475
116	7/15/07	1030	72.6644833	-68.99165
117	7/15/07	1030	72.6644833	-68.99165
118	7/15/07	1030	72.6644833	-68.99165
119	7/15/07	1030	72.6644833	-68.99165
120	7/15/07	1030	72.6644833	-68.99165
121	7/15/07	1515	72.5924	-70.8139333
122	7/15/07	1515	72.5924	-70.8139333
123	7/15/07	1515	72.5924	-70.8139333
124	7/15/07	1515	72.5924	-70.8139333
125	7/15/07	1515	72.5924	-70.8139333
126	7/15/07	1515	72.5924	-70.8139333
127	7/15/07	1545	72.4971833	-71.9992333
128	7/15/07	1545	72.4971833	-71.9992333
129	7/15/07	1545	72.4971833	-71.9992333
130	7/15/07	1545	72.4971833	-71.9992333
131	7/15/07	1545	72.4971833	-71.9992333
132	7/15/07	1545	72.4971833	-71.9992333
133	7/15/07	1545	72.4971833	-71.9992333
134	7/15/07	120	72.4104333	-73.2557167
135	7/15/07	120	72.4104333	-73.2557167
136	7/15/07	120	72.4104333	-73.2557167
137	7/15/07	120	72.4104333	-73.2557167
138	7/15/07	120	72.4104333	-73.2557167
139	7/15/07	120	72.4104333	-73.2557167
140	7/16/07	1235	72.33995	-74.0810167
141	7/16/07	1235	72.33995	-74.0810167
142	7/16/07	1235	72.33995	-74.0810167
143	7/16/07	1235	72.33995	-74.0810167
144	7/16/07	1235	72.33995	-74.0810167
145	7/17/07	841	74.1286	-78.6928

146	7/17/07	841	74.1286	-78.6928
147	7/17/07	841	74.1286	-78.6928
148	7/17/07	841	74.1286	-78.6928
149	7/17/07	841	74.1286	-78.6928
150	7/17/07	841	74.1286	-78.6928
151	7/17/07	1242	74.1416833	-81.5644333
152	7/17/07	1242	74.1416833	-81.5644333
153	7/17/07	1242	74.1416833	-81.5644333
154	7/17/07	1242	74.1416833	-81.5644333
155	7/17/07	1242	74.1416833	-81.5644333
156	7/17/07	1242	74.1416833	-81.5644333
157	7/18/07	807	74.2231833	-89.7152
158	7/18/07	807	74.2231833	-89.7152
159	7/18/07	807	74.2231833	-89.7152
160	7/18/07	807	74.2231833	-89.7152
161	7/18/07	807	74.2231833	-89.7152
162	7/18/07	807	74.2231833	-89.7152
163	7/18/07	807	74.2231833	-89.7152
164	7/18/07	1331	74.4259833	-93.4866333
165	7/18/07	1331	74.4259833	-93.4866333
166	7/18/07	1331	74.4259833	-93.4866333
167	7/18/07	1331	74.4259833	-93.4866333
168	7/18/07	1331	74.4259833	-93.4866333
169	7/20/07	103	73.5212167	-89.5453833
170	7/20/07	103	73.5212167	-89.5453833
171	7/20/07	103	73.5212167	-89.5453833
172	7/20/07	103	73.5212167	-89.5453833
173	7/20/07	103	73.5212167	-89.5453833
174	7/20/07	103	73.5212167	-89.5453833
175	7/22/07	103	73.5212167	-89.5453833
176	7/22/07	103	73.5212167	-89.5453833
177	7/22/07	103	73.5212167	-89.5453833
178	7/22/07	103	73.5212167	-89.5453833
179	7/22/07	103	73.5212167	-89.5453833
180	7/22/07	103	73.5212167	-89.5453833
181	7/22/07	2002	71.8951667	-95.64315
182	7/22/07	2002	71.8951667	-95.64315
183	7/22/07	2002	71.8951667	-95.64315
184	7/22/07	2002	71.8951667	-95.64315

185	7/22/07	2002	71.8951667	-95.64315
186	7/22/07	2002	71.8951667	-95.64315
187	7/23/07	2252	69.8408167	-99.5749833
188	7/23/07	2252	69.8408167	-99.5749833
189	7/23/07	2252	69.8408167	-99.5749833
190	7/23/07	2252	69.8408167	-99.5749833
191	7/23/07	2252	69.8408167	-99.5749833
192	7/23/07	2252	69.8408167	-99.5749833
193	7/25/07	242	68.6626833	-108.8393667
194	7/25/07	242	68.6626833	-108.8393667
195	7/25/07	242	68.6626833	-108.8393667