Cruise Report

RV/ISELIN Cruise CI9407 to Georges Bank

US GLOBEC

NW ATLANTIC/GEORGES BANK STUDY

25 May - 16 June 1994

Cruise Report

RV *COLUMBUS ISELIN* CRUISE 9407
to Georges Bank

24 May - 16 June 1994

Acknowledgements

This report was prepared by the Chief Scientist, with input from all Principal Investigators. The contributions of Maria Bemis, Bob Campbell, Peter Garrahan and Charlie Miller are greatly appreciated.

We are grateful for the excellent support provided by the Captain and crew of the RV *Columbus Iselin*. The professional atmosphere enabled our research efforts to run smoothly and allowed the scientific party to achieve all of its goals and objectives.

This cruise was sponsored by the National Science Foundation and the National Oceanographic and Atmospheric Administration. All data contained in this report are to be considered preliminary.

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Objectives of the cruise

Field work for the U.S.-GLOBEC Georges Bank Program began in the spring of 1994. This cruise aboard the RV *Columbus Iselin* was one of six separate seagoing efforts scheduled for 1994 (Table 1). Two earlier cruises on RV *Albatross IV* were devoted to process work on the southern flank of Georges Bank and adjacent well mixed areas. A cruise aboard the RV *Albatross IV* was conducting bank-wide acoustic studies during the period of this cruise.

Our efforts were focused on measuring vital physiological rates of target species on the Bank, primarily the calanoid copepods, *Calanus finmarchicus* and *Pseudocalanus* spp., and larval cod, *Gadus morhua*. A major objective of field activities in 1994 was to shakedown methods and protocols for the intensive 1995 field season and to integrate the various program components. Specific objectives were:

(1) To conduct a rapid broad-scale survey of U.S. GLOBEC target zooplankton species in order to determine their distribution and abundance.

(2) To conduct a hydrographic survey of the Bank, including CTD data, in vivo fluorescence, and transmissometry with ancillary measurements of size-fractionated chlorophyll, nutrients, and microplankton.

(3) To perform experiments measuring vital physiological rates (including growth, feeding, lipid deposition, and egg laying) of target zooplankton and larval fish species under stratifed and well-mixed water column conditions.

(4) To examine target species distribution and abundance on sub-Bankwide scales using the video plankton recorder (VPR) and acoustic (TAPS) technologies.

The work was a combination of underway activities and station-keeping. Underway activities included CTD casts, stratified MOCNESS sampling for zooplankton, and VPR deployments. Hydrographic data included CTD, fluorometry and transmissometry, with bulk water samples collected for analysis of nutrients, size-fractionated chlorophyll (total, $<20\ \mu m$ and $<5\ \mu m$), and microplankton. Microplankton samples were collected for analysis by flow cytometry, automated epifluorescence microscopy, and inverted microscopy in order to describe the entire suite of nano- and microplankton including phytoplankton and protozoa. MOCNESS (150 μm mesh) samples were collected on Georges Bank from three depth strata at stations < 100m depth and four strata at stations > 100m depth. MOCNESS samples were collected from 9 strata in two deep basins in the southern Gulf of Maine. Other underway activities included 2 onbank-offbank hydrographic sections of 17 and 10 stations respectively, and a 27-hour VPR transect extending from slopewater off the southern flank of Georges Bank through the well-mixed area and into Georges Basin.

Station-keeping activities consisted of experimental work to measure vital rates in conjunction with twice daily (1200 and 2400) hydrocasts, MOCNESS and pump sampling, and multiple deployments of TAPS and VPR. Station-keeping was conducted in stratified and well-mixed areas of the Bank. Sites were selected on the basis of information obtained during the initial bank-wide survey. A drogued ARGOS drifter was deployed at each site, and tracked by the ship's bridge for the duration of station-keeping operations.

Ancillary activities not funded by the U.S.-GLOBEC program included three overflights by a group from M.I.T.'s Lincoln Laboratory to collect airborne LIDAR fluorescence measurements, phytoplankton net collections for Drs. P.E. Hargraves and J.E. Rines of the University of Rhode Island, and protozoan collections for Mr. R. Pierce of the University of Rhode Island.

Table 1. U.S.-GLOBEC cruises to Georges Bank during 1994.

Dates	Vessel	Chief Scientist	Activities
3-6 May	R.V. *Columbus Iselin*	J. Irish	Test moorings
2-13 May	R.V. *Albatross IV*	L. Madin	Predator vital rates and distributions
16-27 May	R.V. *Albatross IV*	G. Lough	Larval fish vital rates and distributions
24 May-16 June	R.V. *Endeavor*	D. Gifford	Zooplankton vital rates and distributions
31 May-10 June	R.V. *Albatross IV*	P. Wiebe	Acoustic survey
28 June-1 July	R.V. *Endeavor*	J. Irish	Test moorings
19-26 October	R.V. *Endeavor*	J. Irish	Mooring deployment

The cruise was an unqualified success. Not only did we shake-down methods and gear for GLOBEC's intensive 1995 field season, a great deal of interesting science was done. Overall, PIs accomplished more than their stated goals. Despite the enormous amount of equipment and scientific personnel crowded into the *Iselin*'s small dry lab, morale was high, and we were all still speaking to each other when we left the ship at the end of the cruise. The *Iselin*'s Captain and crew were competent and extremely helpful. Their skill in locating our sometimes dysfunctional ARGOS drifters under conditions of fog and darkness was truly impressive.

Cruise Narrative

Background. Sea surface temperature maps processed and analyzed from AVHRR data by James Bisagni and associates at the National Marine Fisheries Service Narragansett Laboratories greatly improved our ability to plan our sampling program, particularly with respect to sites where we did NOT want to be because of the presence of streamers from Gulf Stream rings. The images show that sea surface temperature increased from ~7°C to ~9°C during the duration of cruise CI9407. Sea surface temperature maps from March 1994 showed a large Gulf Stream ring located in slope water off the northeast peak of Georges Bank. As the season progressed, the ring moved south and west along the Bank, and a second large ring moved off the northeast peak. By the time cruise CI9407 was on the Bank, both rings were pressed against the Bank's southern flank and a number of jets and streamers from the two rings had crossed the 100 meter isobath (Figures 1, 2 and 3).

Initial broadscale survey. 25 - 29 May 1994. The R.V. *Columbus Iselin* departed Narragansett at 0900 (EDT), sailing to our first station north of the Great South Channel. The initial, rapid bankwide survey sampled 18 stations. The cruise track began north of the Great South Channel, proceeded east across the Bank crest, then southeast to the 100 m isobath (Figure 4). The track proceeded toward the northeast peak between the 60m and 100m isobaths to approximately 41.5 °N, then went north to a station in Georges Basin in the southern Gulf of Maine. From here, we steamed to a station in slopewater east of the northeast peak, then sampled at three more stations in a southwesterly direction to conclude the survey. The original cruise plan called for two stations in the slope water at the end of each of the first two transect legs, but these were cancelled due to inclement weather on 26-27 May.

CTD casts and stratified MOCNESS sampling for zooplankton were done at each station. Hydrographic data collected included CTD, fluorometry and transmissometry, with bulk water samples collected for analysis of major nutrients, size-fractionated chlorophyll (total, <20 μm and <5 μm), and microplankton (=phytoplankton + protozoa). Microplankton samples were collected for analysis by flow cytometry, automated epifluorescence microscopy, and inverted microscopy in order to describe the entire suite of nano- and microplankton prey potentially available to target copepods and larval fish. MOCNESS (150 μm mesh) samples were collected on Georges Bank from three depth strata at stations $<$ 100m depth and four strata at stations $>$ 100m depth. MOCNESS samples were collected from 9 strata in deep basins in the southern Gulf of Maine.

Stratified site. 29 - 31 May 1994; Station 21. Although cruises working on the Bank immediately prior to CI9407 reported well developed stratification on the southern flank, by the time we arrived, a series of storms had completely mixed the water column at every on-bank station sampled in the initial survey. Thus, the initial "stratified site", located in ~90 m of water, was chosen because the bankwide survey observed abundant *Calanus finmarchicus* in the area, primarily stages CV and adult females, with some

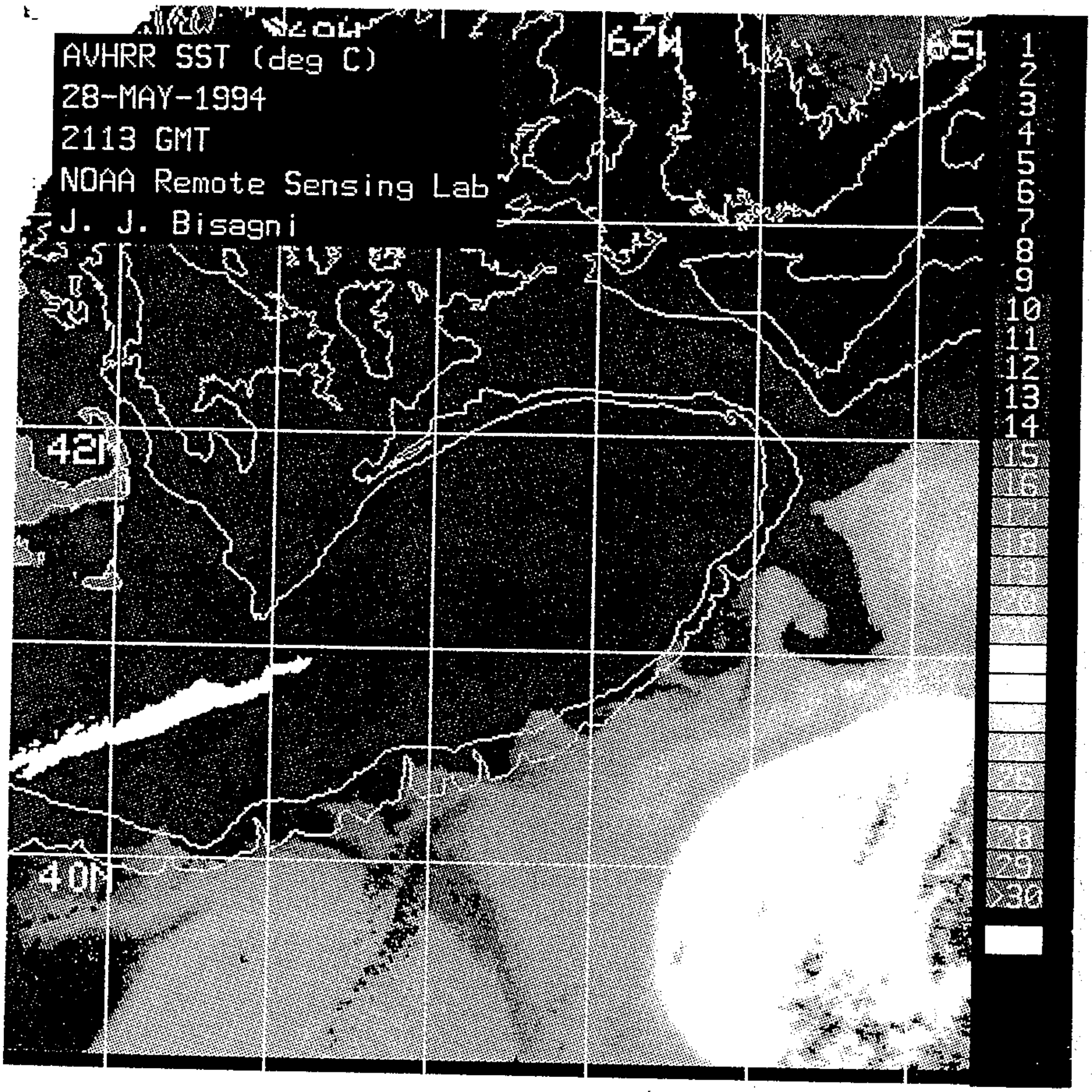

Figure 1. Sea surface temperature on 28 May 1994. 100 m and 200 m isobaths are shown.

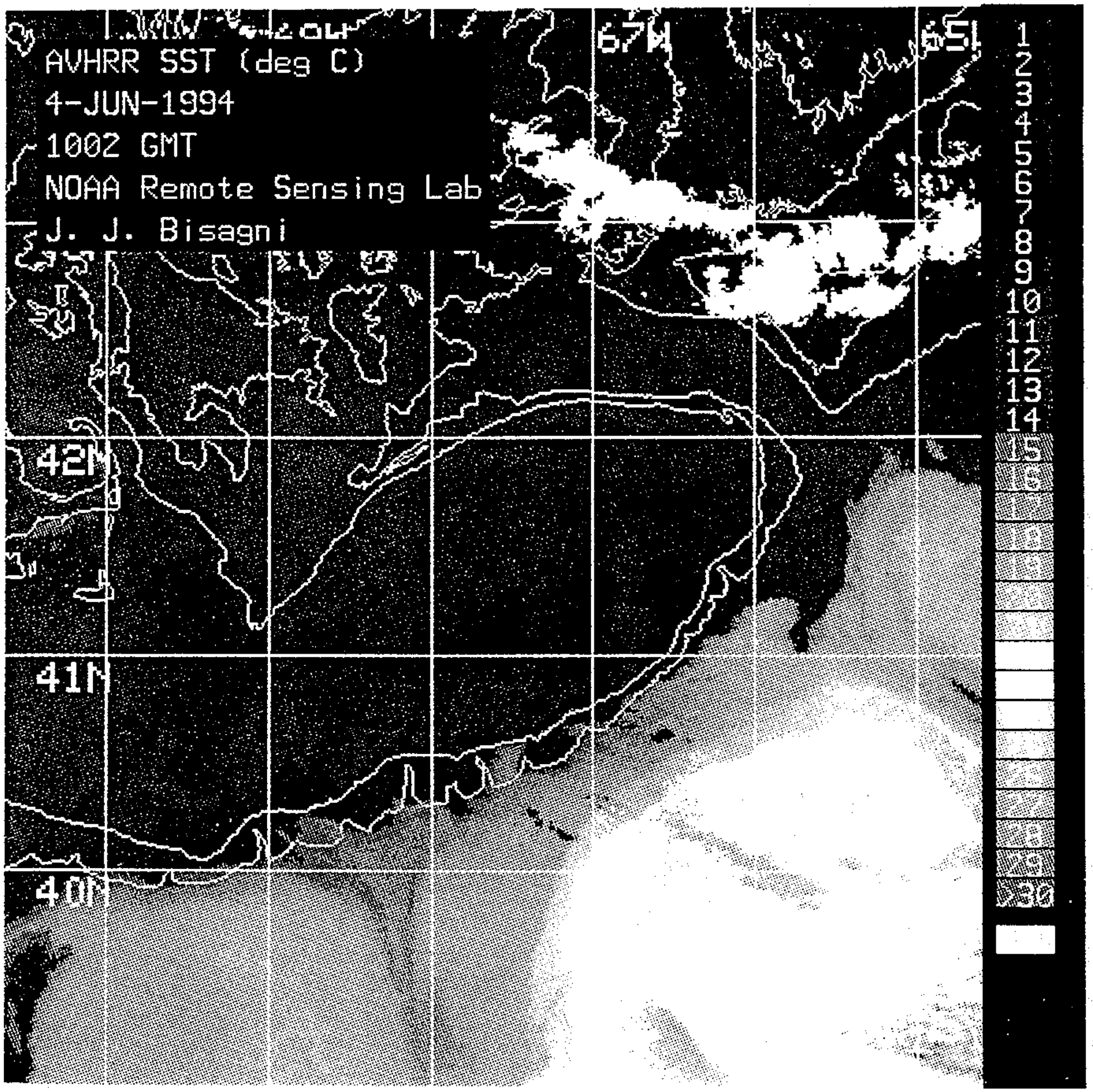

Figure 2. Sea surface temperature on 4 June 1994. 100 m and 200 m isobaths are shown.

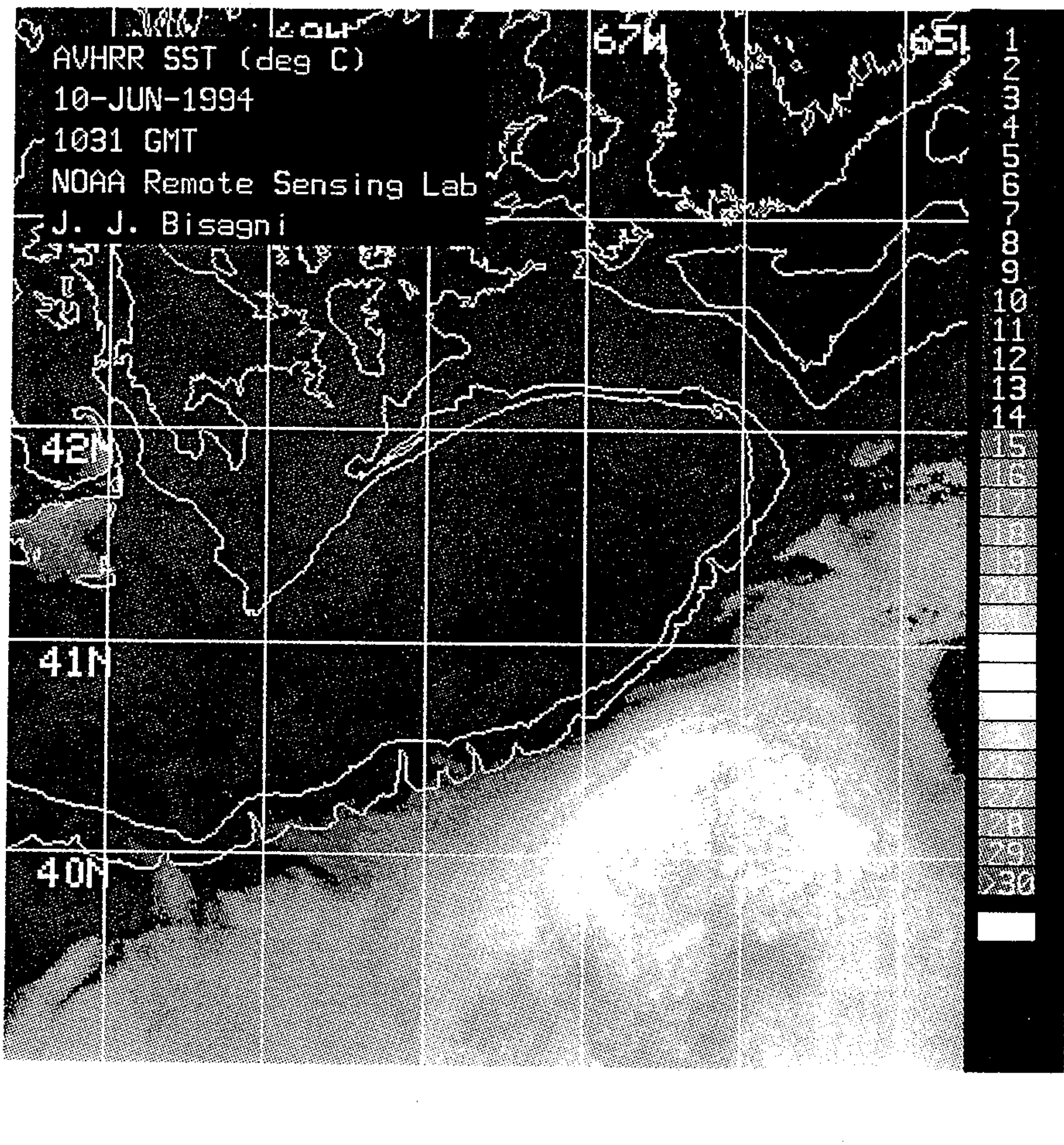

Figure 3. Sea surface temperature on 10 June 1994. 100 m and 200 m isobaths are shown.

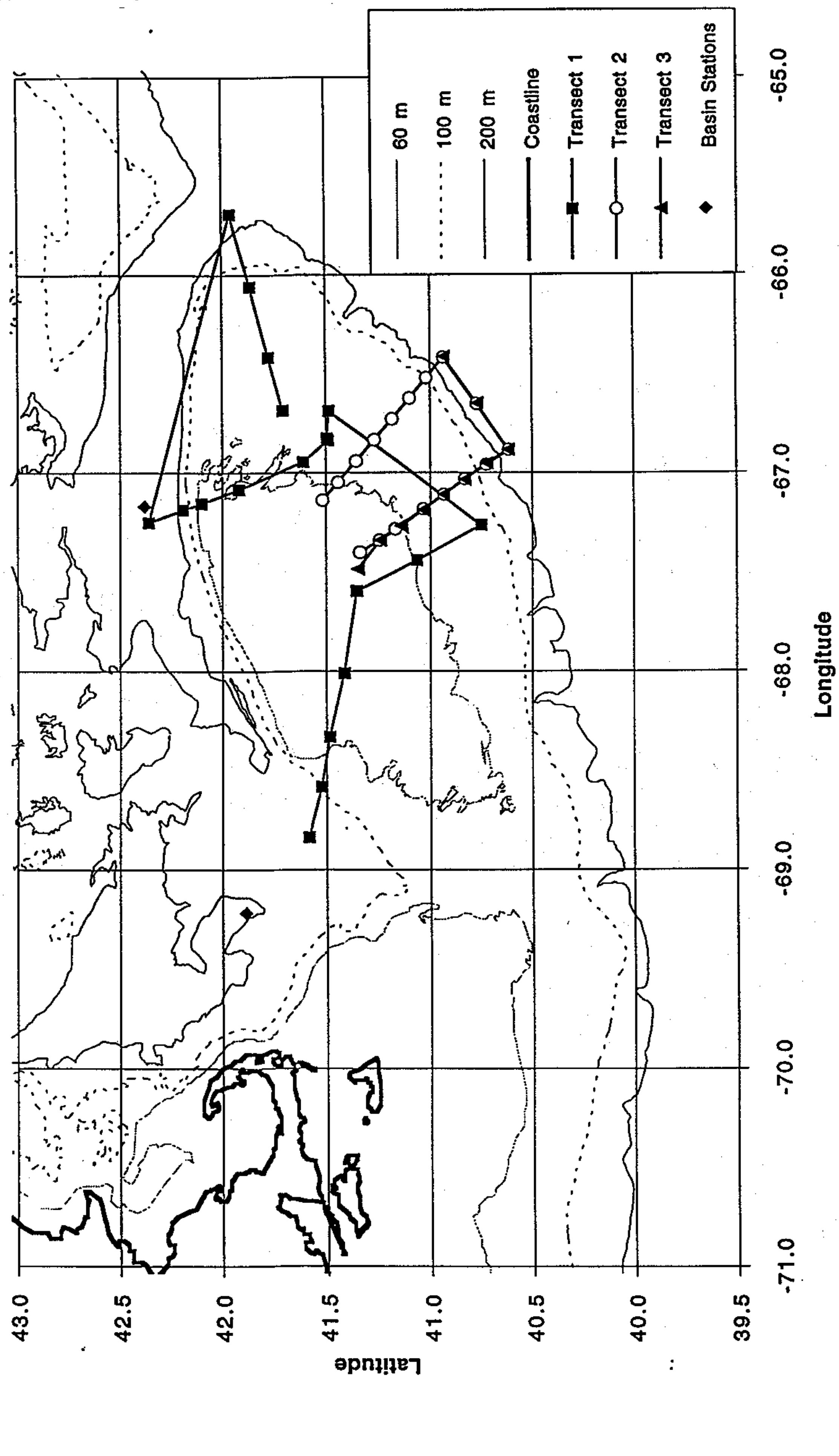

Figure 4. Locations of CTD casts on bank-wide survey, hydro sections and at basin stations.

CIVs. An ARGOS drifter drogued at 10 meters was deployed at the site (initial location 41°49.94'N, 66°12.57'W) and tracked by the ship's bridge for the 48-hour duration of station-keeping operations. Station-keeping activities began with a CTD cast and ring-net tows to characterize the water column and the zooplankton, followed by rosette casts and diaphragm pump deployments to collect water for experiments. A series of net tows, usually with a 150 μm mesh 3/4m ring net, were then done to collect live zooplankton for experiments. Vital rates measured were growth, feeding and egg-laying of target copepods, and growth, condition and feeding of larval cod.

CTD, MOCNESS and zooplankton pump deployments were done at approximately 1200 and 2400 each day to collect data on hydrography and zooplankton distribution and abundance. Discrete water samples were collected from each noon CTD cast as described for the bankwide survey; in the midnight casts only the CTD was deployed. The TAPS and VPR were deployed at regular intervals throughout each day/night cycle.

The drifter followed the tidal ellipse, moving slowly southward during the 48 hours the station was occupied (Figure 5). The water column remained well mixed during this time. Upon completion of operations at Station 21, the drifter was left in place, and we proceeded to a station located in the mixed area of the Bank.

Mixed site. 31 May - 2 June 1994, Station 22. Our initial mixed site was chosen to lie within the 60 meter isobath on the southern flank of the Bank, but well away from shoal areas. The protocol at this station was as described for the stratified station. In contrast to the stratified station, *Calanus finmarchicus* were not abundant, and the zooplankton biomass was dominated by the pelagic hydroids, later identified as *Clytia cylindrica*, also observed during the predation cruise. The copepod assemblage at this station consisted of *Centropages* in the upper water column, and *Temora* and *Pseudocalanus* throughout the water column. The drifter at this station (initial location 41°19.66'n, 67°15.52'W) also followed the tidal ellipse, moving slowly along the 60 meter isobath in a southerly direction during the 48-hour duration of station-keeping (Figure 5). Failure of the VPR's one and only strobe early in station-keeping operations rendered the instrument unusable for the remainder of Leg A. Upon completion of operations at Station 22, the drifter was left in place, and we began a hydrographic section to collect data for GLOBEC investigator, Bob Beardsley.

Hydrosection 1. 2-3 June 1994. CTD casts were done at 11 stations of a hydrosection consisting of two cross-bank and one along-bank transects (open circles in Figure 4). The cross-bank transect consisted of 8 stations running from the well-mixed area near the Bank crest (41° 20.38'N, 67° 24.18'W) to the edge of a warm-core ring at the shelf break (40°36.93'N, 66°52.99'W), the along-bank transect consisted of 3 stations oriented parallel to the shelf break (40°36.93'N, 66°52.99'W to 40°56.08'N, 66°25.00'W), and the second 8-section transect extended from the ring water (40°56.08'N, 66°25.00'W) back onto the crest of the bank (41°30.96', 67°08.43'W). MOCNESS casts were done at 3 stations on each transect. The airborne LIDAR group's first fly-by occurred on 3 June

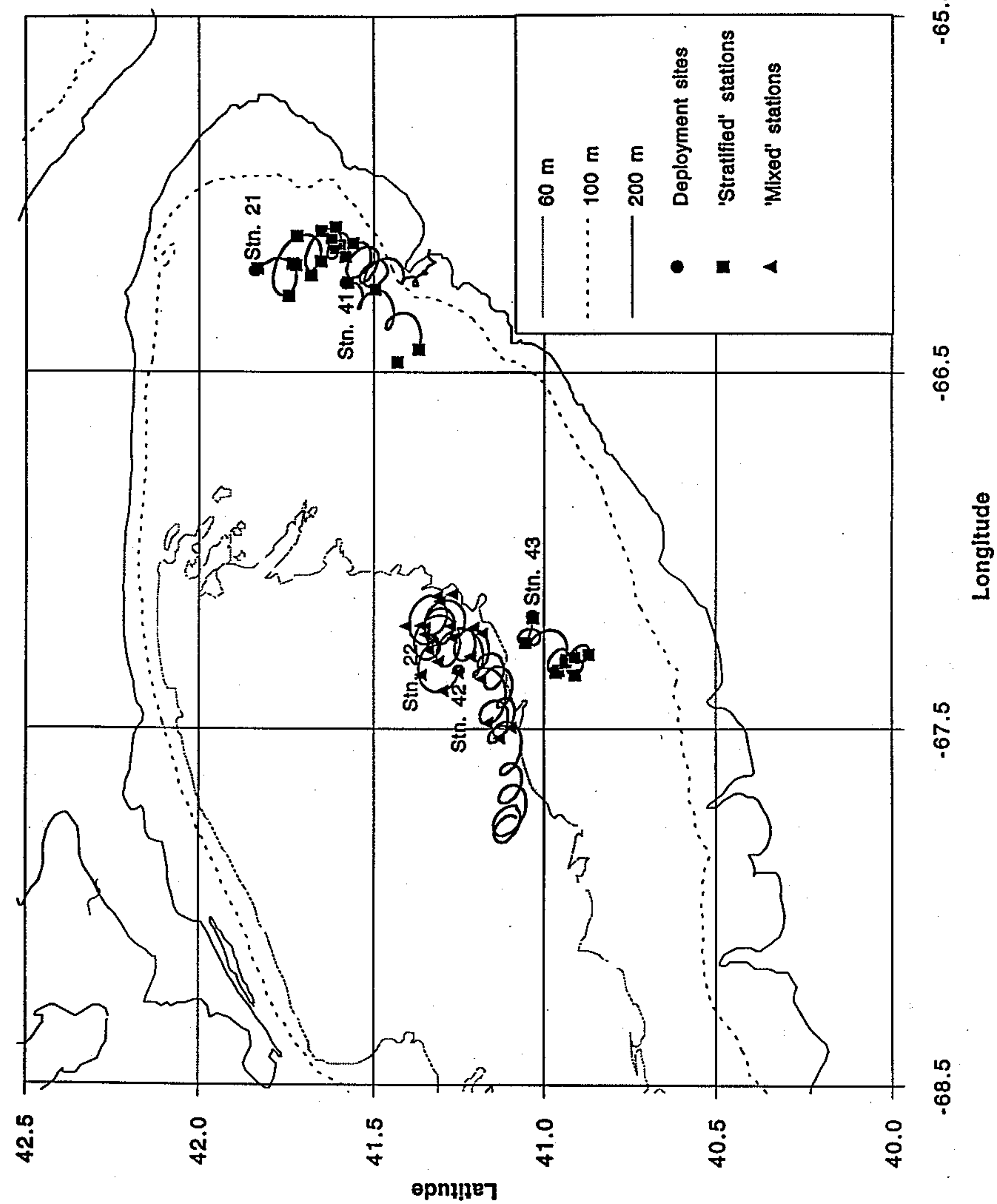

Figure 5. Locations of CTD casts during drifter stations.

at 1424 (GMT).

Return to stratified site. 3-5 June 1994. After completing the hydrosection, we returned to the first drifter at the "stratified" site. Although we arrived in the vicinity of the drifter in the dark, and the drifter's strobe had failed, the bridge, ably assisted by Peter Garrahan, was able to home in on the drifter's ARGOS signal and pick the drifter's high flyer out of a veritable potpourri of noise on the ship's radar. Upon arrival at station, the drifter was retrieved for a minor repair recommended by its manufacturer, then redeployed. We occupied the station for 24-hours, following a truncated version of the previous 48-hour routine. By the time station-keeping activities were concluded, the water column had begun to stratify weakly. Upon termination of station-keeping activities, the drifter was retrieved because it had become entrained in a streamer from the northernmost Gulf Stream ring, and had begun to spiral off-bank (Figure 5). The ship then steamed to Woods Hole for a scheduled personnel change.

Port stop. 5-6 June 1994. Flying at record speed (15 knots on a 14-knot vessel), the *Iselin* arrived in Woods Hole exactly 3 hours before the bars closed, allowing scientists and crew a pleasant, not-too-rowdy, night on the town. On 6 June, the TAPS (Mark Berman and Joe Kane) and larval fish (Ione Hunt von Herbing and Linda Davis) contingents as well as VPR jockeys Frederika Norrrbin and Marty Marra, zooplankton biologist Jeff Runge, hydrographer Ari Epstein and Durbin assistant Jonathan Hopkins left us and were replaced by hydrographer Ed Dever, Durbin assistant Dave Avery, VPR personnel Andy Girard and Phil Alatalo, and WHOI summer student Lucie Blanchard. The VPR group spent June 6th coaxing their instrument back to life. At one point it was declared brain dead, and the group began offloading their gear. Moments later, Al Morton called from North Falmouth to say he'd located the problem. The gear was re-loaded, the VPR was tested off the side of the ship for an hour, and CI9407-Leg B got underway only a few hours late at 1500 (EDT) beneath gray skies with a brisk wind.

Return to mixed site. 7-10 June 1994, Station 42. We returned to the mixed site, with the bridge and Peter Garrahan locating the drifter without problems in the fog. Station-keeping protocol was as before, with the exception that the station was occupied for 72 hours. The increase in station-keeping time was arrived at as a group decision in order to accomplish more experimental work at each station while allowing the experimenters to get more than a few hours of sleep. The drifter continued to follow the tidal ellipse moving southwest along the 60 meter isobath (Figure 5). It was retrieved at the end of station-keeping activities. The airborne LIDAR group's second fly-by occurred on 8 June at 1428 (GMT).

Return to stratified site. 10-13 June 1994, Station 43. We steamed to the spot where our hydrographer's best guess said the drifter would have gone during the time elapsed had it not been entrained in the streamer (Figure 5), and deployed the drifter. Station-keeping protocol was as before, with the exception that the station was occupied for 72 hours. The drifter followed the tidal ellipse while moving south and west between the 60 and 100 meter isobaths. Stratification evolved during the 72 hours we occupied the station. A chlorophyll maximum developed at ~20m and slowly moved deeper over time. The phytoplankton flora in the maximum appeared to be dominated by diatoms contained in a gelatinous matrix, later identified as *Chaetoceros socialis*. An assemblage of abundant microheterotrophs including heterotrophic flagellates, heterotrophic dinoflagellates and aloricate ciliates was associated with the chlorophyll maximum. Upon completion of operations, the drifter was retrieved, and we began a hydrographic section to collect data for GLOBEC investigator, Bob Beardsley. The airborne LIDAR group's third and last fly-by occurred on 10 June at 1650 (GMT).

Hydrosection 2. 13 June 1994. The hydrosection done during Leg A was repeated during Leg B. The first cross-bank transect was repeated as a CTD transect (solid triangles in Figure 4), with MOCNESS casts done at 3 stations. The second was done as a VPR tow-yo transect, described below.

VPR transect. 13-15 June 1994. One long (approximately 200 km and 26 hrs) tow-yo transect was done across Georges Bank from slope water (40°54.62'N, 66°23.39'W), across the mixed area and into Georges Basin (42°38.25'N, 67°16.81'W). Data collected by the VPR included CTD, fluorometry, transmissometry and zooplankton counts.

Deep basin sampling. 15 June 1994. Georges Basin and Wilkinson Basin (solid diamonds on Figure 4) in the southern Gulf of Maine were sampled to collect critical information concerning *Calanus* diapause strategies for Charlie Miller. CTD casts with full hydrographic sampling were done and MOCNESS samples were collected from 9 depth strata at each station. An additional MOCNESS cast was done at the Wilkinson Basin station to collect and freeze *Calanus* for use in a mackerel feeding study being done by GLOBEC investigator Ann Durbin.

Upon completion of sampling, we began steaming to Narragansett. After some delay due to fog, we arrived at the GSO dock at 1000 (EDT) hours on 16 June 1994.

Individual PI Reports

A. Hydrography (Ari Epstein and Edward Dever)

Leg A: 25 May-5 June 1994

Sixty-seven CTD casts were made on CI94-07A, including two hydrographic transects: one 8-station transect running from the well-mixed area near the top of Georges Bank, across the Bank's southern flank and off the shelf break into the edge of a warm-core ring, and another 8-station transect from the ring water back onto the top of the Bank. (These sections were repeated in leg B; the first transect was repeated as a CTD transect, and the second as a VPR tow-yo transect.) The CTD was also used during the bank-wide survey made at the beginning of Leg A and during various 24- and 48-hour stations. The CTD was a Neil Brown Mark III CTD. Data were acquired using the EG&G Data-acquisition model (version 5.1 revision 9) and processed using the EG&G Post-processing module (version 3.0). Most CTD casts (except for "TAPS yo-yo's") were made while the hydrowire was paying out at 30 meters/minute. 150-kHz and 600-kHz RDI ADCPs were running nearly continuously throughout the leg.

The bank-wide survey was done between May 25 and May 29, and included CTD casts 1-19. Casts 1-5 were made during a transect from the northern Great South Channel to a point just south of Georges Shoal, near the center of Georges Bank. Casts 5-7 were made on a transect that extended southward across the shelf-slope front; two casts that had been planned for this transect and the next one were cancelled due to weather. Fog and heavy weather, with some thunderstorms, were present for much of the bank-wide survey. Casts 8-15 were made on a transect from the Bank's southern flank across the northern flank and into Georges Basin. Cast 16 was made in the Northeast Channel, and casts 16-19 were made during a transect from the Northeast Channel to a point near the Hague Line, about halfway between the northern and southern edges of the Bank. During the survey, very little stratification was found in waters shallower than about 80 meters. (The deeper casts, casts 15 and 16, showed the expected degree of stratification, and T-S diagrams there indicated the presence of the expected water masses.)

Casts 20-33 were made during Leg A's first 48-hour station (May 29-31), which was located near the northeast corner of the Bank in about 90 meters of water. This site was chosen in lieu of the expected "stratified site". Casts 34-46 were made during the Leg A's second 48-hour station (May 31 - June 2), located at a site south of Georges Shoal. Many of the CTD casts were "TAPS yo-yo's", in which the CTD was raised and lowered about 5 times at a wire speed of 10 meters/minute. To ensure good CTD data, TAPS yo-yo's were followed by regular CTD casts, made at 30 meters/minute.

Casts 47-54 were made during the hydrographic transect from the top of the Bank across the southern flank and into the edge of a warm-core ring. Casts 54-56 were made while cruising northward along the 500-fathom isobath, and casts 56-63 were made during the transect from the 500-meter isobath back to the top of the Bank.

Casts 64-67 were made during a 24-hour station, located in about 90 meters of water, at a site south of the site of the second 48-hour station.

Leg B: 7 - 16 June 1994

CTD operations for Leg B of CI9407 were carried out using a Neil Brown Mk III CTD with EG&G Data Acquisition Module version 5.1 rev 9 and EG&G Post-Processing Module version 3.0. This CTD was attached to a 12 bottle tone fire rosette, unlike the CTD used for Leg A, which was attached to a conventional rosette. The CTD was also equipped with a fluorometer and transmissometer. All casts in water depths of less than 200 m were made at a descent/ascent rate of 30 m/minute. In depths deeper than 200 m a descent/ascent rate of 45 m /minute was used in most cases. CTD casts were taken upon arrival at a mixed layer site within the 60m isobath (casts 68--76), at a stratified site between the tidal front and the shelf/slope front (casts 77--86), in a cross-bank (87--95) and along-bank (95--97) section, in Georges Basin (98), and on the southern edge of the Wilkinson Basin (99). All CTD casts are listed with station numbers in the GLOBEC event log for CI9407 as well as the CTD log. Casts 68 and 69 were subject to severe noise problems. This was not due to an inherent problem with the CTD, but instead may have been a problem in the termination of the conducting cable or in the deck box or power supply. Unfortunately, the data from casts 68 and 69 are for most purposes unusable. The first usable cast, 70, was taken approximately 6 hrs after arrival at Station 42, and indicated top to bottom uniformity at this site. Therefore, it should be possible to use the top and bottom bottle salinities from cast 68 and the ship's sea surface temperature measurements to get a fairly good idea of hydrographic conditions upon arrival at station 42. Also, comparison of casts 70 and 71 indicate initially slow temporal evolution of temperature and salinity at Station 42.

Subsequent CTD casts were not subject to the severe noise problems of Stations 68 and 69. Some spiking (which should be removed in post-processing) was evident. Minor problems with bottle misfires, operator errors, etc are noted in the CTD log. Three casts (80, 82, and 89) were immediately repeated when larger problems were encountered.

CTD casts at the mixed site, Station 42, indicated the drifter could have been moving toward the tidal mixing front. The first successful cast, 70, was uniform in both temperature (~0.02 deg C) and salinity (~0.01ppt). As the drifter moved south and west, subsequent stations showed a thin near surface layer of warm water (top to bottom differences up to 1.5 °C), and especially in casts 75 and 76, a slight salinity increase toward bottom (~0.1ppt). This is consistent with Station 42 VPR tows which indicate the mixing front was nearby. It should also be noted that after June 8, seas were calm, with little wind stress, so that wind induced vertical mixing was probably unimportant.

Stratified site casts (Station 43) showed top to bottom temperature differences of roughly 1.6 ° C and above. Near surface warming in the upper five meters or so probably occurred, as wind speeds were light during this time and skies were nearly clear. This can be checked since all data necessary to make surface heat flux calculations (except incoming long wave radiation) were recorded by the ship. Though temperature stratification (below the near surface layer) was not much greater than at Station 42, far greater salinity stratification existed than at station 42. Top to bottom differences of at least 0.1 ppt and up to 0.5 ppt existed. Near bottom salinity varied from 33.05 to 33.28, while surface salinity tended to be from 32.7 to 32.8 ppt. The strongest stratification existed in the upper 25--30 m. A maximum in fluoresence and minimum in transmission was coincident with the base of the stratification at 25--30m.

The cross bank CTD transect was a repeat of the transect (47--54) performed during Leg A of CI9407. Both showed the tidal mixing front at the 60 m isobath and the shelf slope front. However, there were some differences. During Leg A, the 33 ppt salinity contour was nearly vertical; during leg B, it had a wedge shape and penetrated further onshelf below 30 m. Higher salinity warm core ring water evident during leg A retreated approximately one station spacing (7 nautical miles) further off-shelf, confirmed by satellite sea surface temperature imagery. Overall warming also occurred on the Bank and the cold band was less evident during leg B.

B. Ancillary Hydrographic Data: chlorophyll, nutrients, phytoplankton and microzooplankton (Dian Gifford, Michael Sieracki and Terrance Cucci)

Objective: To describe quantitatively and qualitatively the nano- and micro- plankton prey fields potentially available to copeods and early stage larval fish on Georges Bank. The data are to be used in interpreting experiments done with target copepods and larval fish described in sections E. and G. below.

Bulk water samples for chlorophyll, major nutrients and phytoplankton and microzooplankton identification were collected from all CTD/rosette casts during the initial bank-wide survey and from each noon CTD/rosette cast during station-keeping operations. At stations where the water column was mixed, samples were collected from the top, middle, and bottom of the water column. At stations where the water column was stratified, samples were collected from 5-9 depths, determined by the particular combination of water column depth and hydrographic features present. For example, if a chlorophyll maximum or density discontinuity was present, samples were collected from above, within and below the feature.

Chlorophyll. One-liter of water was drained through silicone tubing into dark collecting bottles. Samples to assay 3 size fractions of chlorophyll (total, <20 μm and <5 μm) were collected by gentle vacuum filtration of 50 ml onto GF/F filters, which were frozen in liquid nitrogen, then transferred to a freezer until analysis. Size fractionation was done by passing 50 ml of sample through sieves constructed of Nitex mesh of the appropriate porosity. All chlorophyll samples were collected in triplicate. Chlorophyll analysis was by fluorometry.

Nutrients. ~50 ml of water from the chlorophyll bottles was poured into precleaned plastic bottles from the chlorophyll bottles following three rinses of ~50 ml each with the same water. The samples were frozen until analysis with a nutrient autoanalyzer.

Flow cytometry. 50 ml of water was collected from each Niskin bottle into plastic vials. Subsamples were analyzed immediately using a Beckton-Dickson FACscan flow cytometer. This yielded counts of phytoplankton in size classes of 1-5 μm, 5-10 μm, and greater than 10 μm.

Image analysis-Epifluorescence microscopy. 50 ml of water was collected from each chlorophyll bottle and preserved with glutaraldehyde. Subsamples were post-stained with a mixture of proflavine and DAPI, filtered onto black 0.2 μm Nucelopore filters, mounted on glass slides in a drop of non-fluorescent oil, and frozen pending subsequent analysis of nano- and micro- phytoplankton and nano-zooplankton by automated epifluorescence microscopy. Some samples were analyzed aboard ship but the majority will be analyzed back at the lab. They will provide numerical abundance, biomass and size distributions for both the phototrophic and heterotrophic nanoplankton which comprise part of the *Calanus* prey field.

Inverted microscopy. Two hundred and fifty ml of water was drained from each Niskin bottle into sample bottles containing an amount of acid Lugol's solution appropriate for a final preservative concentration of 10% (vol:vol). Samples were stored in the dark pending analysis using an inverted microscope. These samples will provide numerical abundance, biomass, and size distributions of the micro-phytoplankton and nano- and microzooplankton which comprise part of the *Calanus* prey field.

Preliminary results: Preliminary observations of the survey samples indicate an extremely diverse assemblage of nano- and microplankton on the Bank including diatoms (chains and single cells), phototrophic dinoflagellates, Prymnesiophytes, Cryptophytes, mixotrophic ciliates, and a diversity of heterotrophic (colorless) protists including ciliates, dinoflagellates, choanoflagellates, and undistinctive flagellates from 2 μm to 15 μm in size.

C. Zooplankton Process Studies: Growth and development rates of *Calanus finmarchicus* and *Pseudocalanus sp.* (The Durbin Group: Ann Durbin, Edward Durbin and the Planktoneers: Robert Campbell, Maria Bemis, Peter Garrahan, David Avery and Jonathan Hopkins)

Objectives:

(1) To estimate the recruitment of *Calanus* and *Pseudocalanus* on Georges Bank during the study period.
(2) To determine the production rates of *Calanus* and *Pseudocalanus* at the mixed and stratified sites.

Methods:

MOCNESS and Pump sampling. An initial MOCNESS (150 μm mesh nets) survey, and several cross-bank transects later in the study (Figure C-1), were conducted to determine zooplankton abundances throughout the region . At the drifter sites both MOCNESS and pump (50 μm mesh nets) samples were taken at 12 hour intervals for a period of 48 to 72 hours (Figure C-2). These samples will be counted to determine abundance and stage distributions of the target species *Calanus* and *Pseudocalanus* as well as other important species such as, *Centropages* and *Temora*. It should also be possible to determine recruitment and development rates of the target species at the drifter locations if distinct cohorts are present.

Mesocosm experiments. Development rates of *Calanus* and *Pseudocalanus* were determined in 30-50 gallon mesocosms at the drifter sites. Artificial cohorts were created by screening (Kimmerer and McKinnon 1987) and incubated on deck, in tanks containing ambient water and ambient water enriched with a mixed phytoplankton culture. The mesocosms were sampled every 12 hours for 2 to 3 days and the animals preserved for later stage enumeration. In addition, initial and final samples of copepods from the dominant stages in each size fraction were taken for length, carbon and nitrogen content. The results from the mesocosm experiments will provide estimates of development rate that can be compared to in situ estimates of development rate from MOCNESS and pump samples, as well as determine if development rates were food limited by comparing development rates in ambient and enriched treatments.

Growth experiments. The growth in weight of one selected copepodite stage (C4 - *Calanus* or C5 *Pseudocalanus*) was determined at the drifter locations. Copepods were sorted into bottles (2 or 8 liters) containing ambient water from predetermined depths or enriched water, and incubated in a water bath for 1 to 2 days. An initial subsample of copepods was videotaped for length determination and placed in tin boats and dried over desicant for later carbon and nitrogen analysis. At the end of the incubation animals were also collected for length, carbon and nitrogen analysis. The results from these experiments will provide estimates of growth in terms of length, carbon and nitrogen, as well as determine if growth is food limited.

General observations. During most of the cruise there was an absence of early copepodite stages (C1-C3) of *Calanus*, so most of our experimental work focused on stage C4 *Calanus* and *Pseudocalanus* copepodites. However, we did observe what appeared to be *Calanus* nauplii in the small size fraction mesocosm experiments, and in the final mesocosm experiment at Station 43, early *Calanus* copepodites (C1 and C2) were found at the end of the incubation. So, it appears that we were too late in the season to obtain good estimates of growth and development rates on the first generation of *Calanus*, but perhaps we will be able to determine development rates on the second generation through the pump samples and mesocosm experiments.

D. Zooplankton Process Studies: Egg production and recruitment rates of *Calanus finmarchicus* and *Pseudocalanus* sp. (Jeffrey Runge and Stephane Plourde)

Objectives:

(1) Examine the hypothesis that the daily production of eggs of *C. finmarchicus* and *Pseudocalanus* sp. in the water column (eggs m^{-2} d^{-1}) is different between stratified and mixed regions on Georges Bank, due to variations in both the specific egg laying rate (eggs $female^{-1}d^{-1}$) and the abundance of females (females m^{-2}).

(2) Conduct preliminary studies of magnitude and causes of mortality of eggs, an estimate of which is needed to determine recruitment rates, where recruitment is defined as the number of eggs hatching $m^{-2}d^{-1}$.

Methods:

C. finmarchicus. Egg laying rates were measured during the first leg at Sta. 17 (in the northeast Channel), Sta. 21 (first drifter station), Sta. 22 (second drifter station) ,Sta. 41 (third drifter station) and during the secong leg at Sta. 42 (fourth drifter station, well-misted region), Sta 43 (fifth dirfter station, statified region) and Sta. 54 (Georges Basin). At all stations, a standard method was employed to estimate egg production. Forty females were sorted from the catch of an oblique plankton tow (bottom to surface) taken in the afternoon. Individual females were placed into filtered seawater in petri dishes, which were incubated at 8-9 °C for 24 h on a 12 h cycle of darkness and dim light. The dishes were inspected at approximately 8 h intervals and the numbers of eggs released were recorded. At some stations, additional females were sorted and variations of the standard method, including incubations in beakers containing seawater enriched with a high concentration of *Gymnodinium* and incubations in 45 ml. culture flasks (as a

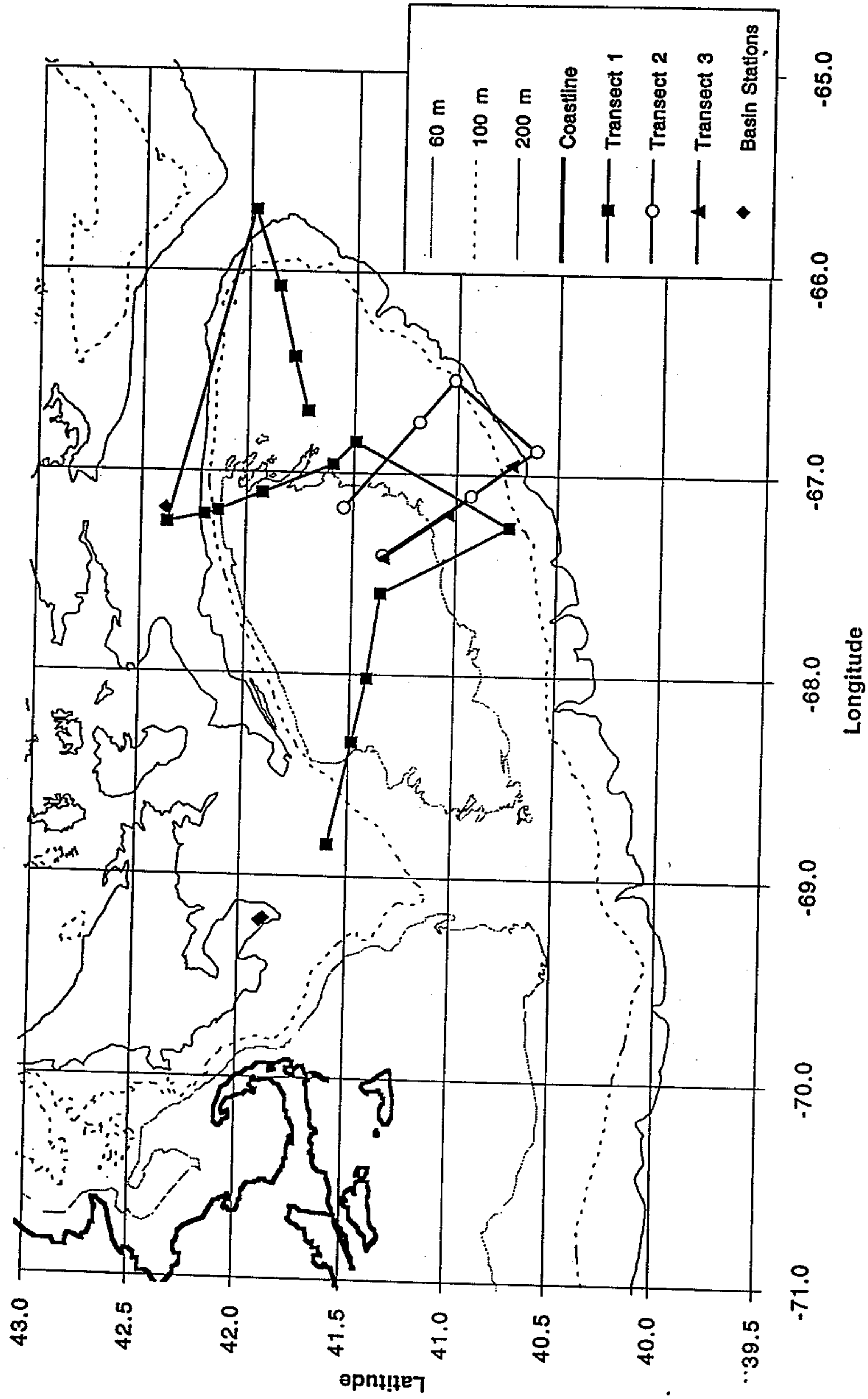

Figure C-1. Location of MOCNESS stations during transects. Transect 1 shows station positions during the initial Bank-wide survey (25-28 May). Transect 2 (2-3 June) and transect 3 (13-14 June) are hydrographic sections 1 and 2. The deep basin stations (15 June) are also shown.

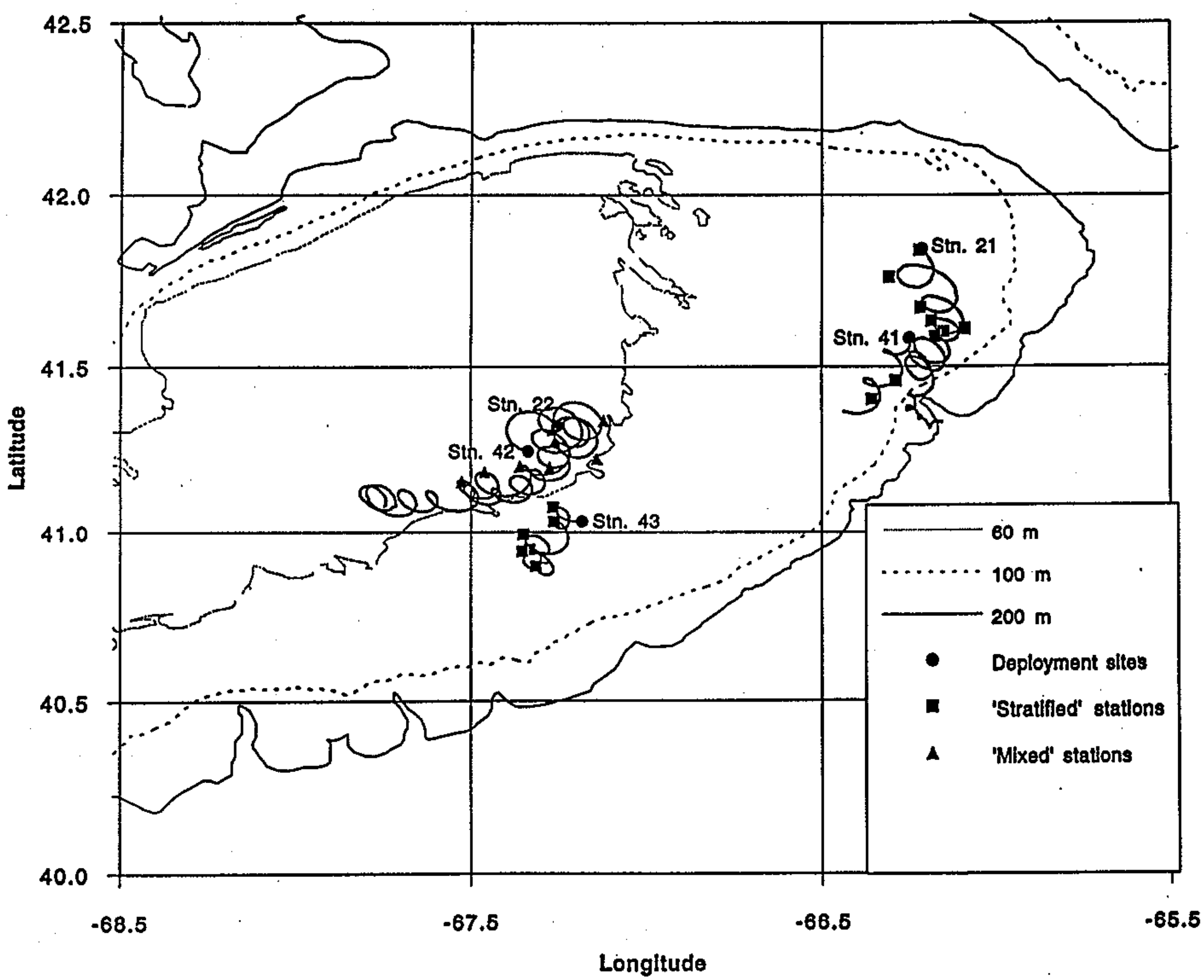

Figure C-2. Drifter paths. Positions of initial drifter deployments and each of the MOCNESS and zooplankton pump stations are shown. Stations 21 (29-31 May), 41 (4-5 June) and 43 (10-13 June) are located at the Startified Site. Stations 22 (31 May-2 June) and 42 (7-10 June) are located at the Mixed Site.

simpler alternative to petri dishes), were carried out. Pump and MOCNESS samples taken at these stations will be analyzed for water column abundance of eggs and females, respectively.

Pseudocalanus sp. Egg production rates (i.e. rate of production of clutches of eggs, which are carried by the females until hatching) were estimated at the three drifter stations. Non-bearing females (50-100) were sorted from the catch of the net tow and incubated in ambient seawater (5-15m) at 8-9°C for 24 h. Another batch of females bearing a complete (approx. 20 eggs) or partial (typically 1-5 eggs) clutch were incubated individually in petri dishes for 24 h. The females were preserved for later analysis. To estimate birth rate (i.e., recruitment rates), females and eggs were collected from the water column with a pump, the outflow from which was filtered through a 50 μm mesh plankton net. At the third drifter station, *Pseudocalanus* was also collected with a 50 μm plankton net towed vertically from the bottom to the surface.

Egg production of *Temora* and *Centropages*. At the second drifter station, egg production rates of these two species (identified as *T. longicornis* and *C. hamatus*) were measured by the standard incubation technique described above for *C. finmarchicus*.

Predation on copepod eggs by polyps of hydroids. At the well-mixed site (second drifter station), a predation experiment was carried out, in order to obtain a preliminary estimate of feeding rates of hydroids on the eggs of dominant copepods at this site. A revised protocol (based on experiences from the preliminary experiment) is attached.

Results and discussion:

C. finmarchicus. Egg production rates ranged between 15 eggs female^{-1}d^{-1} at Sta. 17 to 35 eggs female^{-1} d^{-1} at the third drifter station. Egg production rates of females fed *Gymnodinium* were not significantly different from the standard estimate (three separate experiments). The number of eggs released during a spawning event averaged 50, which is consistent with previous observations of clutch size of females of equivalent body size (Runge and Plourde 1994). During the secong leg, it wasn't possible to measure egg production rate of *C. finmarchicus* at the well-mixted station due to low fermales density. Howerver, egg production rate of the species at Sta. 43 (startified region) was >60 eggs female $^{-1}$ d^{-1} during the first 2 days and decreased to 40 eggs female^{-1} d^{-1} on the last day at the station. Finally, at the Georges Basin station, preliminary observations showed that the majority of the females in the population at this location were reproductively active at the start of the egg laying experiment, suggesting that the egg production rate should be of the same magnitude as rates measured previously at the stratified station.

Assuming (until actual measurements are made at URI) carbon weights of females and eggs of 112 μgC and 0.23 μgC, respectively, levels observed during the first leg represent an egg laying rate of 3%-7% of body carbon per day . Laboratory experiments indicate that maximum egg production rate of *C. finmarchicus* at the measured ambient surface layer temperatures (8-9 °C) is 6-7% per day (Runge and Plourde 1994). This implies that the *Calanus* populations on the Bank were laying eggs at approximately one half maximum level at Station 17 and at near maximum levels at the second and third drifter stations. Examination of the state of reproductive maturity of females in the catch indicated that a small but significant fraction (perhaps up to 25% at some stations) either carried a spermataphore (these females are typically not ready to spawn) or were filled with lipid and appeared to be in diapause mode. During the second leg, egg laying rates represented 8%-14% of body carbon per day. It has to be noted that incubation temperatures ranged between 9-11° C and that surface temperature were ranged between 10-12° C at the stratified station during experiments. These high temparature combined with the high spawning frequency observed (>85%) might explain these high egg production rates.

Pseudocalanus. There appear to be at least two species of *Pseudocalanus* at the study sites (*P. moultoni* and *P. newmani*). Most females were not bearing eggs; a relatively small fraction (estimated to be about 15-20%) were carrying small clusters of 1-5 eggs. Rarely, females were observed with full clutches (18-22 eggs), although some fraction produced full clutches during the 24 h incubation. It appears that egg clusters are easily separated from females during net tows, and accurate estimates of egg ratio will require careful counts of free *Pseudocalanus* eggs (120 μm diameter on average) in sample jars.

Temora and Centropages. Temora and *Centropages* females were abundant at the well-mixed drifter station (in contrast to *C. finmarchicus* , which was relatively uncommon). All *Temora* females spawned, averaging 71 eggs per clutch, during two separate 24 h incubations. Sixty percent of *Centropages* females released an average of 46 eggs, yielding a population egg production rate of 28 eggs $female^{-1} d^{-1}$. Another experiment was done during the secong leg at the well-mixed site (Sta. 42), with similar egg production rates anticipated for *Temora* and *Centropages.*

Predation on copepod eggs at the well-mixed station. During the counting of *Calanus* eggs at Sta.22, it was observed that a hydroid polyp, accidentally transferred to a petri dish, had ingested 11 recently spawned eggs. Ten hours later, seven partially-digested eggs were still visible. Subsequent observations showed that hydroid polyps are adept at sweeping up and feeding on substantial numbers of eggs clustered at the bottom of the dish and that the digestive tracts of some hydroids captured in net tows from the station were packed with copepod eggs.

Two prey-disappearance experiments were designed to estimate feeding rates of polyps on suspended eggs. Between 10 and 40 hydroid polyps were introduced into 1 liter bottles containing 100 *Temora* or *Calanus* eggs (first experiment) and 150 Temora eggs (second experiment). Replicate bottles were incubated with controls for 3, 13, and

17 h intervals (first experiment) and 3, 6, 9 h intervals (second experiment). The Frost equations were used to calculate clearance rate. During the first experiment, in all replicates, eggs were found in the digestive tract of at least some polyps; the maximum number of eggs observed in a single polyp was 5. Maximum (based on numbers of eggs remaining at the end of the experiment, corrected for controls) and minimum (based on the actual number of eggs found in polyp digestive tracts) clearance rates were 2.2 and 0.6 ml polyp^{-1}h^{-1}, respectively, on *Calanus* eggs and 2.8 and 1.1 ml polyp^{-1}h^{-1} on *Temora* eggs. Preliminary examination of data from the second experiment seems to confirm these results despite a problem with the last control bottle (9h interval, lower number of eggs recovered).

Copepod recruitment rates on Georges Bank between 24 May and 17 June 94: first impressions. There is the potential for large, meso-scale spatial and temporal variation in copepod recruitment rates on Georges Bank during this period (*Pseudocalanus* species may be the exception). Specific egg production rates of *Calanus* varied by a factor of two, probably due in part to food limitation, but also due to spatial variability in the proportion of reproductively active females. Egg production rates were highest at the third drifter station, probably reflecting the higher primary production associated with the onset of stratification. At the same time, there is the potential for great variability in the number of females. Bank-wide, the abundance of females is probably growing as some proportion of the first generation CV's molt into reproductively active adults as suggested by higher egg production rates and spawing frequency measured at the stratified station during the second leg. On the shallow center of the Bank females are probably being eaten as fast as they drift in, so that, even though specific egg production rates are high, recruitment rate, in terms of number per m^2, is low.

In addition to variablity in numbers of eggs produced, there are clear indications of strong meso-scale variations in the abundance and composition of predators on copepod eggs and nauplii. The presence of hydroids on the central part of the Bank is potentially devasting to recruitment of *Calanus* , *Temora*, and *Centropages*, all species that spawn their eggs into the water. The preliminary experiments (assuming for the moment that encounter rates in botlles on a grazing wheel accurately reflect encounter rates of eggs with hydroids in the water column) suggest that a concentration of between 15 and 70 polyps (not colonies, but individual tentacular polyps) are sufficient to clear the water daily of eggs. *Pseudocalanus* eggs, which are borne by their parent, may be able to avoid the tentacular clutches of hydroids. In any case, the qualitative impression is that the central Bank is relatively devoid of early life stages of copepods, despite the relative high production rates of dominant species (like *Temora*, and *Centropages*) and that the source of exceptionally high early mortality is the invertebrate predator field. For related reasons, the central part of the Bank does not appear to be conducive to growth and survival of fish larvae.

Reference: Runge, J. A. and S. Plourde. 1994. Fecundity of *Calanus finmarchicus* in coastal waters of eastern Canada. ICES Workshop on the trans-latitudinal study of

Calanus finmarchicus in the North Atlantic. Oslo, 6-8 April, 1994.

E. Zooplankton Process Studies: Feeding rates and diet of *Calanus finmarchicus*. (Dian Gifford, Michael Sieracki and Terrance Cucci)

Objective: To document the contributions of nano- and micro- zooplankton and phytoplankton prey to the diets of all copepodid stages of *Calanus finmarchicus* under conditions of water column mixing and stratification and to measure *Calanus*' ingestion rates on the prey items.

Methods:

Twelve experiments were done with *Calanus finmarchicus*, summarized in Table E-1. Copepods from live net tows were sorted into 1-liter polycarbonate incubation bottles containing the natural prey assemblage, and the disappearance of prey was followed over 24-hour experimental duration. Control treatments consisted of the natural assemblage alone; experimental treatments were the natural assemblage with copepods added. The bottles were incubated on-deck on a slowly rotating plankton wheel whose temperature was controlled by flowing seawater. Experiments were done with adult females and copepodid stages C4 and C5. Two categories of stage C5 were recognized: "fat" copepods with full oil sacs and "thin" copepods with partly full oil sacs.

The numerical abundance and biomass of phytoplankton prey were quantified in 3 size fractions of chlorophyll a (total, $<20\ \mu m$ and $< 5\mu m$), cells counted by flow cytometry, cells counted by image analysis-epifluorescence microscopy, and cells counted by inverted microscopy. The numerical abundance and biomass of nano- and micro-zooplankton prey were quantified in cells counted by image analysis-epifluorescence microscopy, and cells counted by inverted microscopy. All copepods were collected from the incubation bottles at the end of each experiment for CHN analysis.

Microscopic analyses will be performed in our home laboratories, and final results will not be available for several months. However, preliminary results from flow cytometry indicated that the 3 life history stages of *Calanus* examined consumed cells $> 5\ \mu m$, especially cells $> 10\ \mu m$. "Fat" stage CVs did not have a resolvable feeding signal, presumably because they were about to enter diapause and had ceased feeding. In contrast, "thin" CVs consumed the phytoplankton prey resolved by the flow cytometer at rates expected for that life history stage. The results will ultimately be interpreted in the context of growth, production, and lipid deposition rates measured by other GLLOBEC investigators.

Table E-1. *Calanus finmarchicus* ingestion experiments.

Date	Location	Depth	Life history stage	Number copeods/ bottle
5-29-94	Stratified Station 21	Middle mixed layer	Female	1
5-29-94	Stratified Station 21	Middle mixed layer	C5 "fat"	2
5-29-94	Stratified Station 21	Middle mixed layer	C4	3
5-31-94	Mixed Station 22	Middle mixed layer	Female	1
5-31-94	Mixed Station 22	Middle Mixed Layer	C5 "fat"	2
5-31-94	Mixed Station 22	Middle mixed layer	C5 "thin"	2
6-07-94	Mixed Station 42	Middle mixed layer	Female	1
6-07-94	Mixed Station 42	Middle mixed layer	C5 "thin"	2
6-10-94	Stratified Station 43	Chl max	Female	1
6-10-94	Stratified Station 43	Middle mixed layer	Female	1
6-11-94	Stratified Station 43	Chl max	C5 "thin"	2
6-11-94	Stratified Station 43	Middle mixed layer	C5 "thin"	2

F. Zooplankton Process Studies: Copepod Population Processes (Charles Miller and Cheryl Morgan)

Our interest in this expedition is to test methods for study of *Calanus finmarchicus* and *Pseudocalanus* spp. over Georges Bank. Our goals included:

(1) Extensive preserved collections of plankton from many sites over and adjacent to Georges Bank for analysis of stage composition. The goal is to determine the field development rates implied by advance of the stock through copepodite stages. The collections are also intended for examination of the morphological correlates of life history transitions. In particular, we intend to examine tooth and gonad development of individuals approaching both maturation and entry to diapause.

(2) Collection and storage of *Calanus* and *Pseudocalanus* of various sizes and stages for analysis of storage lipid content and composition. This is coupled with video imaging of small groups of individuals in order to compare projection estimates of storage oil content with analytical results. Live vs. preserved size comparisons will also be derived from the video files.

(3) A general reconnaissance of the planktology of Georges Bank and surrounding waters for late May-early June of 1994.

All of these goals were accomplished well beyond our likely ability to deal with all of the resulting samples by the beginning of next year's Broad Scale Survey cruises. Sampling was mostly with the URI MOCNESS system, which worked well throughout, largely thanks to careful maintenance by David Nelson. We expect a completed cast series of 50 tows, most of them to three depths, some to four, two to eight. The total product is in excess of 200 samples. Sorting for lipid samples frozen in liquid nitrogen produced almost 400 small groups of matched individuals, all with associated video images. These include late life stages of *Calanus*, *Pseudocalanus*, *Centropages hamatus, Centropages typicus,* and *Metridia lucens*. Detailed analysis will be done ashore. We will need to study this large collection selectively.

Most of the *Calanus finmarchicus* population was in the fifth copepodite stage (C5) when we arrived in the western Gulf of Maine on 25 May. There were still modest numbers of C4. There were very few adults. As the cruise progressed, shallow samples in deeper areas showed fewer and fewer C4 and many more adults. Deep samples mostly contained C5 obviously in diapause (see below). In the last few days of the cruise we began to see *Calanus* in late naupliar and C1-C2 stages. The composition of the *Calanus* stock over the Bank proper was much the same, but its numbers were very low. Sampling over the Bank throughout the cruise shows that the plankton of the shallower, well-mixed areas are not dominated by *Calanus*. There are more *Calanus* over the northeast peak, but basically the Bank is not *Calanus* habitat. The dominant copepod over Georges Bank is *Centropages hamatus* mixed with substantial numbers of both *Pseudocalanus moultoni* and *Pseudocalanus newmani*. There were also some *Temora* sp. With practice we were able to distinguish the *Pseudocalanus* species without difficulty, but only in the adult and C5 stages. Both *Centropages* and *Pseudocalanus* were reproductively active (egg bearing, young of all stages present) at all locations on the Bank. It seems unlikely that any cohort structure will exist in this season by which to trace population progress in these species. It is my opinion that despite earlier characterizations of winter plankton over the Bank, we will find relatively few *Calanus* in the well-mixed areas and early starts of *Centropages* and *Pseudocalanus*. Population processes leading to the present composition remain to be revealed by the GLOBEC sampling of next winter and beyond.

Sampling over Georges Bank consistently produced large volumes of hydroids, possibly of the species referred to as *Clytia cylindrica* by H. B. Bigelow. These small polyps on branched stalks are clearly, as Bigelow pointed out, not simply live flotsam ripped from the benthos. Their stalk ends are all healed, usually with formation of polyps at all free points. We watched these polyps eat *Calanus* eggs, whole *Pseudocalanus*, *Sagitta* end on, worms, etc. The polyps are nearly neutrally buoyant and are dispersed through the whole water column. The MOCNESS revealed no particular concentration of them at any level. It was sampling well, since *Centropages* were mostly (not totally) confined to the upper 15 m and abundant pelagic larvae of some polychaete worms were confined to the bottom stratum. *Sagitta elegans* was also very abundant over the Bank, occasionally making a plankton sample look like a pot of saimin.

The distinctiveness of the plankton of the well-mixed region over the Bank was the strongest lesson for me as a West Coast oceanographer. You can read forever about the current loop around Georges Bank isolating a special habitat without quite getting the idea. The intensity of the distinction between the plankton over the Bank and that in the apparently seamlessly adjacent waters is astounding.

The sequence of events in the *Calanus* stock during CI9407 leads to an hypothesis about at least one aspect of its life history. During Leg B we have seen progressively larger numbers of adult males and females. Experiments by Jeff Runge and Stephane Plourde showed that these were spawning very actively indeed. We have also seen the near disappearance of C4 and substantial accumulations near the bottom over deeper sections of the bank and offshore of C5 clearly in diapause (massive lipid storage, no gonadal development, the motionless hanging posture of resting *Calanus*). There are few or no C4 in this resting group.

The hypothesis expands slightly on the long recognized fact that C. *finmarchicus* has two stratgies in June. One strategy is to enter diapause immediately, a strategy undertaken as C5. We have added a visit to one of the basins of the Gulf of Maine to check whether the early accumulation of diapausing individuals is all or nearly all C5. That station remains to sample at this writing, but the prediction is that it will be nearly all C5. The other strategy is to mature at about year day 150, reproduce, develop rapidly in warmed spring waters and enter diapause as C4, probably in early to mid-July. This would account for the recurringly large fraction (30 to 50%) of C4 in the October resting stock in the Gulf of Maine. We will somehow obtain autumn 1994 samples from the Gulf for comparison.

The exact nature of the immediately diapausing and maturing substocks remains obscure. They could be genotypes (or equivalently distinct groups) competing for fractional representation with outcomes depending upon relative survival over the year as whole. The variability of outcomes among years would insure the continuance of both types. Alternatively, the diapause vs. mature decision might depend in some way upon individual experience. This agrees with experimental results (Miller, unpublished) from the Gulf of Maine where all spring and summer collections of C3 maintained in the laboratory matured regardless of photoperiod and temperature treatment. There was no sign in that work of an obligate diapause.

Performance of Dian Gifford as chief scientist on CI9407 was excellent. She kept good order among competing operations, marshalled people to do the general work without needing a whip, and still had energy to do her own science. She designed smart, effective watch schedules of different kinds for different types of operation. She even managed to make the transitions painless. The *Iselin* and crew performed well in all respects, although the crew were rather cold at the outset. That was inevitable given the high impact loading of the ship on 24 May. Over twenty people and an astounding mass of gear went aboard and were assembled in eight hours. It's understandably hard to be properly welcoming in the midst of swarming new faces, not all of them sailing. Still, it took substantial work to warm the crew up to having interlopers on their ship, but I think we have slowly done it. A very well spent port stop in Woods Hole helped a lot. It also helps that most of the science team are obviously old hands and know their stuff. Those that aren't have been taken in hand and shown the ropes. The crew can see they are working with professionals of their own caliber, and they've grown appreciative. The ship itself is not particularly seakindly, forcing us to shut down work in very modest seas (State 3+). Fortunately, we have had plenty of excellent weather and only two blows that stopped our work for about a day each.

G. Zooplankton Process Studies: Larval Cod Feeding and Growth (Scott Gallager and Ione Hunt Von Herbing)

The objectives of this study were to examine grazing by newly hatched cod larvae on natural assemblages of microzooplankton and determine growth and survival rates of larvae fed assemblages collected at two different depths, thermocline and surface. The hypothesis was the following: the microzooplankton assemblage will be both quantitatively and qualitatively different between the these locations and thus will influence larval cod grazing and growth differentially.

To test this hypothesis, we conducted numerous experiments on ship board to determine grazing rates and growth and survival of cod larvae exposed to water collected non-destructively from various locations in the water column. Cod embryos were spawned in the laboratory weeks ahead of the cruise and incubated between 2 and 10 °C. Embryonic development was timed so that larvae would be hatching throughout the 25 day cruise period. In addition, a second batch of embryos were to be flown down from Newfoundland (Dr. Joe Brown, Memorial University) and placed on the ship during the layover in Woods Hole on June 6 for experiments during the second leg of the cruise. During the first leg, larvae hatched from four batches each containing about 5,000 to 10,000 embryos. The largest batch was due to hatch about June 4 and would have supplied larvae for two to three more experiments. Unfortunately, all embryos died at the developmental stage of late primitive streak/early tail bud stage. Presumably, this was due to overcrowding and/or lack of oxygen, although no definite reason can be given. The batch of eggs due to arrive in Woods Hole for pick- up on the second leg did not arrive, due to miscomunications with Memorial University confounded by a US and Canadian holiday. Therefore, we were not able to conduct further experiments with new larvae on the second leg, although we did complete a number of experiments initiated on the first leg during the latter half of the cruise.

Long-term Experiments. Two long-term growth and survival experiments were established using larvae hatching on a particular day: one on May 29 with water collected in the region of the stratified drifter (Station 21, LT1) and another on May 31 in the area of the mixed site drifter (Station 22, LT2). LT1 was established with 200 larvae per 12 liter tank. Each tank received water from either the thermocline or surface which was passed through 333 μm mesh to remove large organisms. There were six treatments, one of each of the following from both the thermocline and surface:

1. Natural: all organisms smaller than 333 μm;
2. Large: organisms between 333 and 75 μm;
3. Small: organisms less than 75 μm.

A second growth experiment was established at Station 22 where samples were taken only at the surface. Since there was some evidence that sampling through the orifice of a Niskin bottle disrupted fragile forms, all samples were siphoned from the top of the Niskin or collected at the surface with a bucket, as indicated below. Buckets supplied all water for LT2 and size fractionation experiments.

Interpretation of the results of these experiments awaits comparison with data from the natural zooplankton assemblages collected simultaneously and fixed in Lugols. In general, yolk sac absorption was least, and growth and survival were greatest in treatments from the mixed water column. However, prey concentrations (microzooplankton and copepod nauplii) were very low at both stations tested, so it is difficult to establish a solid relationship between prey availability and growth.

Short-Term Grazing Experiments. Throughout the two long-term experiments described above and at approximately daily intervals, subsamples were removed from each treatment and exposed to six prey treatments for a period of 3 hours:

1. Natural: <333 μm (fractions between 333 μm and 75 μm were separated and stained with calcien blue (CB) while the <75 μm fraction was stained with acridine orange (AO); the small and large fractions were then combined);

2. Large: 75-333μm fraction stained with calcien blue;

3. Small: <75 μm stained with acridine orange.

4. Natural + Enhanced: natural treatment plus 0.5/ml stained *Balanion* and 0.05/ml stained nauplii (*Pseudodiomtomus* sp.)

5. Large + Enhanced: Large fraction plus nauplii

6. Small+Enhanced: Small fraction plus *Balanion*

After grazing for three hours in an illuminated incubator, larvae were removed, mounted on slides and examined under epifluorescence microscopy using either blue or UV excitation for AO or CB, respectively. Fluorescent images of larval guts were captured and stored digitally for quantification of gut fluorescence post cruise. Standard morphological measurements were also made on the stored image (length, height, yolk sac area, myotomal height, eye diameter, etc).

Other studies. In addition to the scheduled grazing experiments outlined above, several ideas concerning the grazing process were also tested. Ship vibrations were though to interfere with feeding by larvae. Therefore we conducted an experiment in which the incubation vessels were suspended in the incubatior using bungie cord. Results suggest that, indeed, larval feeding may be reduced by the ship's vibrations. Future experiment will have to take this into account.

Results of the grazing experiments on various size fractions showed that newly hatched cod larvae feed directly on natural assemblages of microplankton, including protozoans. No copepod nauplii were ingested before day 5 following hatching. Compared with larvae fed enhanced levels of the aloricate ciliate *Balanion*, however, rates were low, suggesting prey concentration was limiting. A major conclusion from these experiments is that larval growth and survival in the water column at this time of the year would be very poor compared with the prey density we would expect to see earlier in the year when cod and haddock larvae are present. This supports the match-mismatch hypothesis of larval timing in the water column coinciding with maximal prey levels.

Prey Motility Experiments. Fourteen hours of video information were recorded on motility patterns and particle size composition in the water column at various depths following collection both invasively (Niskin port sample) and non-invasively (bucket from the surface or siphon from Niskin bottle). Prey motility patterns will be digitized and calculated with our Motion Analysis System back at Woods Hole and compared with larval capture success from the natural assemblages.

Ancillary Observations. Many hours of recordings were also made of the diatom balls (*Chaetoceros* sp.) collected at various sites and depths where the CTD and VPR fluorometer pegged. Macro views showed regularly organized structures of varying spherical morphologies. High mag (630x) showed chains with spines meshed into a matrix of fibers. Few nano- or picoplankton were associated with these colonies. Further interpretation awaits SEM and culture experiments at the lab.

General Comments. CI9407 was a great success both in terms of data collection and learning valuable lessons of culturing cod larvae and their prey at sea. We thank the whole crew of the *Columbus Iselin* for providing a pleasant and efficient working environment.

H. Video Plankton Recorder Studies (Cabell Davis and Scott Gallager)

The goal of the VPR sampling was to determine the fine-scale (centimeters to meters) vertical and horizontal distribution of the planktonic community in relation to hydrography in the vicinity of the stratified and well-mixed drifter sites. The main purpose was to measure the degree to which zooplankton are aggregated at the pycnocline. A second purpose was to sample the 3-dimensional distribution of the plankton community in within a 1-km radius of the drifter. The latter sampling will enable us to determine the extent to which "single-point-sampling" (eg. a single double oblique VPR haul, net haul, CTD cast, or pump deployment) at the drifter itself is representative of the the local (1-km) pelagic environment.

Twenty VPR towyos were made during the cruise. After our initial test deployments at the north edge of the bank (VPR 1) and in the Northeast channel on May 28 (VPR 2), we conducted a series of day/night grids at the first drifter site. The first (VPR 3) consisted of 3 parallel transects each about 4 km long. The remaining grids (VPR 4 to 9) consisted of left-handed square inward spirals having an outside dimension of about 2 km (actually 1 nm). All grids were centered on the drifter and thus had a moving coordinate frame. The left-handed grids were used so that the ship could always turn to port, keeping the wire away from the ship (the VPR was towed from the main crane off the port side). The strobe on the VPR malfunctioned at the end of the first leg, and, during the remaining time, we analyzed the video and were able to create 3-D maps of several planktonic groups from the last grid VPR-9. The strobe was repaired in port on May 6 and we obtained a backup strobe as well.

On the second leg of the cruise we conducted 3 grids while following the mixed-area drifter (VPR 11-13) and two while following the stratified drifter (VPR 14-15). We also conducted several short transects (VPR 16-19) in the stratified area and one very long (approx. 200 km and 26 hrs) transect (VPR 20) across Georges Bank from the Slope Water to the mixed area and into the Gulf of Maine (Georges Basin). Prior to the first grid, the VPR winch hydraulic motor failed and the ships hydraulic system was used to run the VPR winch. This changeover actually proved quite beneficial to us, as we were then able to run the winch remotely, in the comfort of the ship's electronics lab. The strobe again failed during VPR 17 and was replaced by the backup which functioned properly for the remainder of the cruise.

We found the crew of the Iselin to be friendly, interested in the science, and helpful. In particular, the engineers (Bob, Jack, and Ralph) helped greatly in connecting the VPR winch to the ship's hydraulic system. The bridge (Mike, Chris, and Rhett) were also very helpful and flexible and were adept at following the drifter along the grid track. The boatswain Steve on the first leg was superb; he was willing to listen, was easy to work with, and developed an efficient method for safe deployment and recovery of the VPR. Other crew were also helpful and competent including Erik, Bob, and John. The cooks Susan and Tori were superb and extremely hard working, and the good food helped keep everyone happy. Chip helped us with electronic hookups and e-lab instrumentation and Dave Nelson was also helpful in loaning us parts (conductivity cell, pinger, and reed-switch).

In all, the cruise was highly successful for us in terms of data acquired and will provide us with unique new insights into the fine-scale distributions of the planktonic community in relation to hydrographic features and circulation. We believe the problem with the VPR strobe was due to adverse effects of bulb failure on the electronics. As expected, the problems encountered during this pilot cruise will enable us to be well-prepared for the full GLOBEC study in 1995.

I. Acoustic Studies (TAPS) (Mark Berman and Joseph Kane)

The purpose of our research was to further develop techniques for assessing the spatial and temporal distribution of the copepod community on Georges Bank using the Tracor Acoustic Profiling System. Two types of deployment were used, both with TAPS mounted on the CTD frame. The first technique was for quickly surveying the vertical distribution of the copepods. In this mode TAPS collected data during a normal CTD cast, integrating data over 3 m vertical bins. Twenty-five TAPS deployments were made in this mode, during the transects and at the 48 hr stations.

The second mode was used only at the long stations, while the ship kept station with the drifter. In this mode the CTD and TAPS were yoyoed up and down through the top 50 m (water depth permitting) at 10 m/min continuously for 1 hour. This allowed TAPS to assess the size distribution and concentration of the copepods with a 1 m vertical resolution to characterize the size, position, and frequency of plankton patches. During the latter part of the cruise, the modes were combined to minimize sampling time. For this the TAPS/CTD was yoyoed slowly for 50 min, with the last 10 minutes of the hour going to a normal CTD cast. A total of 11 yoyo casts were completed during this cruise.

A hardware problem within TAPS was discovered during the latter portion of Leg A. It is not yet clear how much of the data collected can be corrected through post-processing. However, the deployment techniques developed here appear to be satisfactory, and will be used on upcoming GLOBEC stratification studies

J. Airborne Lidar Fluorescence Measurements (Charles Primmerman)

On the mornings of 3,8, and 10 June 1994, personnel from the Massachusetts Institute of Technology's Lincoln Laboratory conducted airborne surveys over Georges Bank. These surveys consisted of airborne-lidar fluorescense monitoring of phytoplankton population distribution and abundance. In addition, on the 10 June survey, sea-surface temperature was monitored using an airborne infrared radiometer. The primary objectives of these flights were to provide a 'snapshot' of phytoplankton distribution over a broad region of Georges Bank and to determine the level of 'patchiness' in the phytoplankton distribution. Excellent data were collected on all three flights, and the flight objectives appear to have been accomplished.

The airborne-lidar measurements were coordinated with GLOBEC cruise CI9407 on the research vessel *Columbus Iselin*. The airborne-lidar measurements were not directly funded by the GLOBEC program, but it is expected that the results will be useful to GLOBEC. Conversely, data collected by the *Iselin* are expected to be useful as comparison points for the airborne measurements.

The MIT Lincoln Laboratory airborne-monitoring system is described below, and the important system parameters are listed. The flights paths and data associated with them are indicated in terms of their latitude, longitude, and GMT times. Pictorial representations of these flight paths are also provided. Finally, an overview of fluorescence monitoring results is presented, and some selected IR data are provided.

Airborne monitoring system. MIT Lincoln Laboratory's fluorescence monitoring system was mounted on a Gulfstream G-1/59 flown out of the MIT Lincoln Laboratory Flight Facility at Hanscom Field in Bedford, Massachusetts. The aircraft was equipped with a Global Positioning System (GPS) receiver and a LORAN system to assist in course heading determination. During the Georges Bank monitoring missions, the aircraft was flown at a speed of approximately 140 kts, at an altitude of approximately 300 ft. Chlorophyll fluorescence was excited using a 20-mJ doubled Nd:YAG laser operating at a wavelength of 532 nm. The laser-beam transmitter produced an 80-cm spot on the ocean's surface. The laser was operated at a 20-Hz repetition rate so that the horizontal separation between samples was approximately 3.5 meters. Fluorescence radiation in a 30-nm band centered at 685 nm, water Raman radiation at 647 nm, and laser backscatter at 532 nm were collected by an 8-inch Celestron telescope and reimaged onto three avalanche photodiodes through the appropriate filters. Detector output was digitized in 2 nsec increments, to give depth-resolved information, and recorded on a PC-based data acquisition system. A separate 5-cm aperture was used to collect infrared radiation to determine sea-surface temperature. Radiation in the 3-5 micron band was imaged through a germanium filter onto a liquid-nitrogen-cooled indium-antimonide detector. Detector input was chopped at 300 Hz, and its output sampled using a lock-in amplifier. The amplifier's signal was digitized and recorded along with LIDAR data. Sunlight levels were monitored and recorded using a silicon-PIN detector mounted on top of the aircraft. Some important system parameters and hardware specifications are listed in Table J-1.

Flight profiles. The flight paths for 3, 8, and 10 June overlaid on the 50-fathom isobath at Georges Bank are shown in Figures J-1 to J-3. For each mission, the approximate flight path of the aircraft is indicated by the line overlayed on a chart of Georges Bank. The fluorescence data recorded along the indicated flight paths are presented as a normalized ratio, computed by dividing the depth-integrated fluorescence signal by the water-Raman signal. The color bar on the right of each plot relates this ratio to a color. These particular paths were chosen based upon discussions with members of the Woods Hole GLOBEC cruise team. Of particular interest were the northeastern region of the Bank, and the Bank's southern edge , as defined by the 50-fathom isobath.

3 June Mission:
Take-off from Hanscom Field was at 0730 hours (EDT). The airplane was re-fueled at Nantucket airport and departed for the northeastern region of Georges Bank at approximately 0900 hrs. The conditions at the Bank were clear and sunny. The first descent to 300 ft. was made at 41 degrees 17.6 minutes latitude, 67 degrees 35.5 minutes longitude, at time 13:40:23 (GMT). A 300 ft. altitude was maintained for the next 4 hours, and the flight path indicated in Figure J-1 was flown. This flight path brought the airplane over the *Iselin*'s location at approximately 14:24 (GMT), at coordinates 41 degrees 3.1 minutes latitude, 66 degrees 36.8 minutes longitude. The flight path was completed at approximately 17:59 (GMT), and the airplane began the return trip to Hanscom Field.

8 June Mission:
The *Iselin* was contacted by INMARSAT telephone at 0730 hours (EDT), and its location and cruise plans for the day were provided to us. A flight plan to cover the southern edge of the Bank and overlap with the ship was filed before departing Hanscom field at approximately 0814 hours (EDT). The flight path for the 8 June mission is shown in Figure J-2. Descent to 300 ft. altitude was made at time 13:27 (GMT) at location 41 degrees 51.4 minutes latitude, 66 degrees 32.5 minutes longitude. Data collection began

at this time. The flight path intersected the ship's location at approximately 14:28 (GMT), at location 41 degrees 17 minutes latitude, 67 degrees 19.8 minutes longitude. Data collection continued along the indicated flight path until 17:13:37 (GMT), at which time the airplane began the return trip to Hanscom Field.

10 June Mission:
The airplane departed Hanscom Field at approximately 0830 hours (EDT) on route to the planned starting location in the northeast region of the Bank. Descent to 300 ft. altitude was made at location 42 degrees 11.0 minutes latitude, 66 degrees 54.8 minutes longitude, at time 13:36 (GMT). Data collection was begun, and continued along the flight path shown in Figure J-3. This flight path took the airplane within a few kilometers of the *Iselin*'s location at approximately 16:50 (GMT) at location 40 degrees 52 minutes latitude, and 67 degrees 30 minutes longitude. The IR sensor collected data along with the lidar during this flight. Near the end of the data collection, a test was made using the IR sensor without the laser propagating. No change in the IR data stream was noted. Data collection was completed at approximately 17:14 (GMT) at location 40 degrees 44.8 minutes latitude, 68 degrees 30.3 minutes longitude.

Overview of Results. In addition to the chlorophyll fluorescence data provided in Figures 1-3, an example of depth-integrated fluorescence (normalized to the water Raman signal) is plotted versus distance in Figure J-4. These particular data were collected during the 8 June mission, along a 10 mile stretch over the southeast region of the Bank. The starting and stopping coordinates are given in the figure. The data shown in Figure 4 are representative of the level of structure and spatial scales present in the phytoplankton population distribution for all three missions. Similar spatial scales are seen in data from the infrared radiometer. A sample is presented in Figure J-5. Preliminary analysis of the depth-resolved lidar returns suggests that under certain conditions sufficient signal-to-noise is present to permit measurements of chlorophyll concentration to a depth of 10 meters or more.

Table J-1. COMPONENT PARAMETERS.

AIRFRAME	
Model	Gulfstream G-1/59
Airspeed	140 kts (approximately)
Altitude	300 ft.
Navigation System	GPS and LORAN
LASER AND TRANSMITTER GEOMETRY	
Configuration	x2 Nd:YAG, diode pumped
Wavelength	532 nm
Energy	20 mJ
Pulse Length	10 ns
Repetition Rate	20 Hz
Fluence (at ocean surface)	4 mJ/cm2
Spot Size	80-cm Diameter
Spot-to-Spot Separation	3.5 meters (approximately)
RECEIVER	
Configuration	Cassegrain, f/11
Aperture Diameter	8 inches
Imaging to Detectors	f/3
SEA-SURFACE TEMPERATURE SENSOR	
Type	InSb (at 77 K)
Spectral Band	3 - 4.5 microns (approximately)
Field-of-View	2 degrees
Sampling Bandwidth	1 Hz
Spatial Resolution	3 x 70 meters
Noise-equivalent Temperature	0.5 Kelvin
DETECTORS	
Type	Avalanche photodiodes
Configuration:	532 nm (backscatter)
	647 nm (water Raman)
	685 ± 15 nm (fluorescence)
DIGITIZING AND DATA RECORDING	
Configuration	4-channel, EISA interface
Sample Period	2 ns
(All data is IRIG time-stamped, and recorded with GPS Coordinates.)	

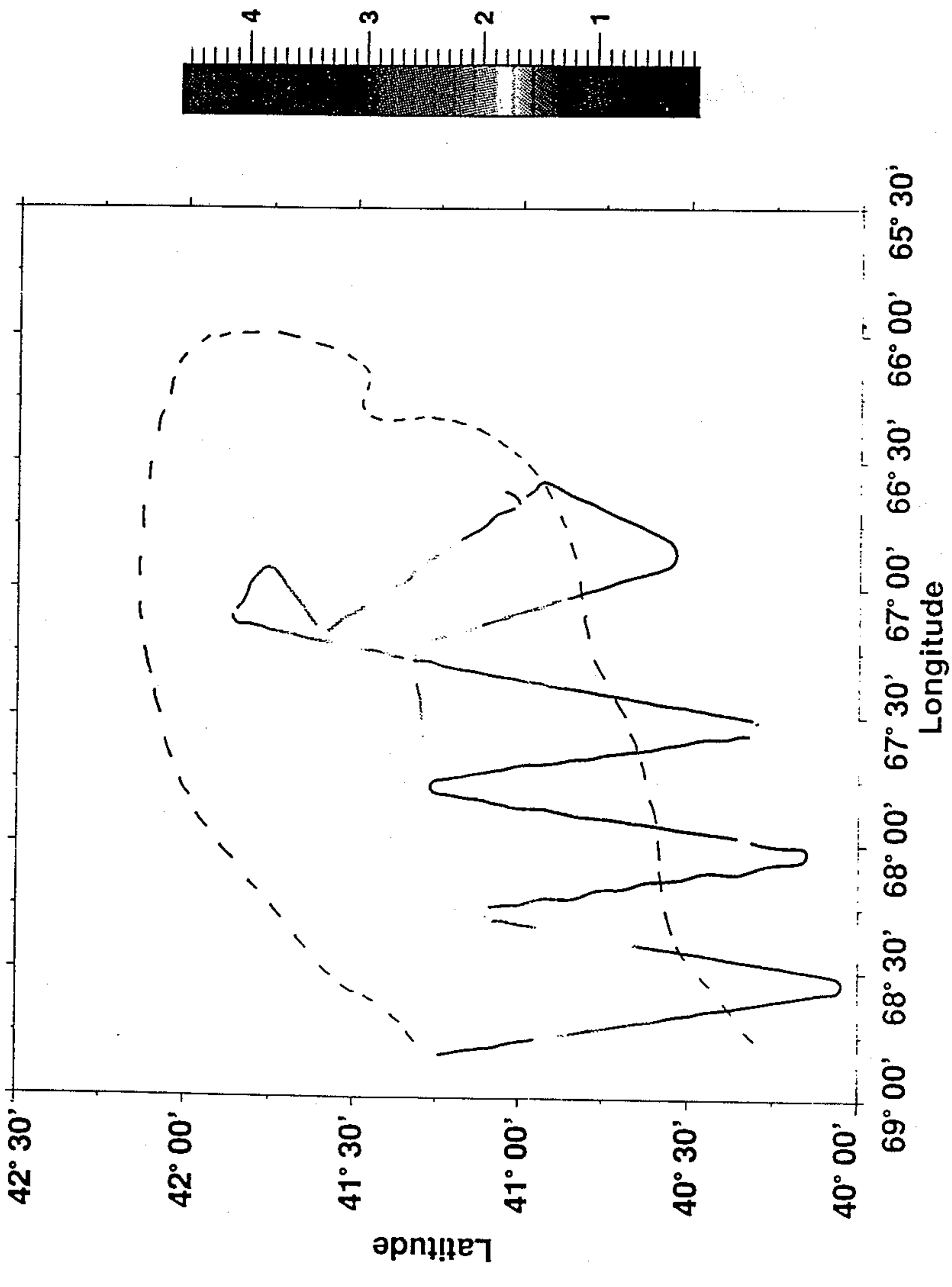

Figure J-1. Flight path for June 3, superimposed on 50-fathom isobath of Georges Bank. (Scale indicates normalized fluorescence returns).

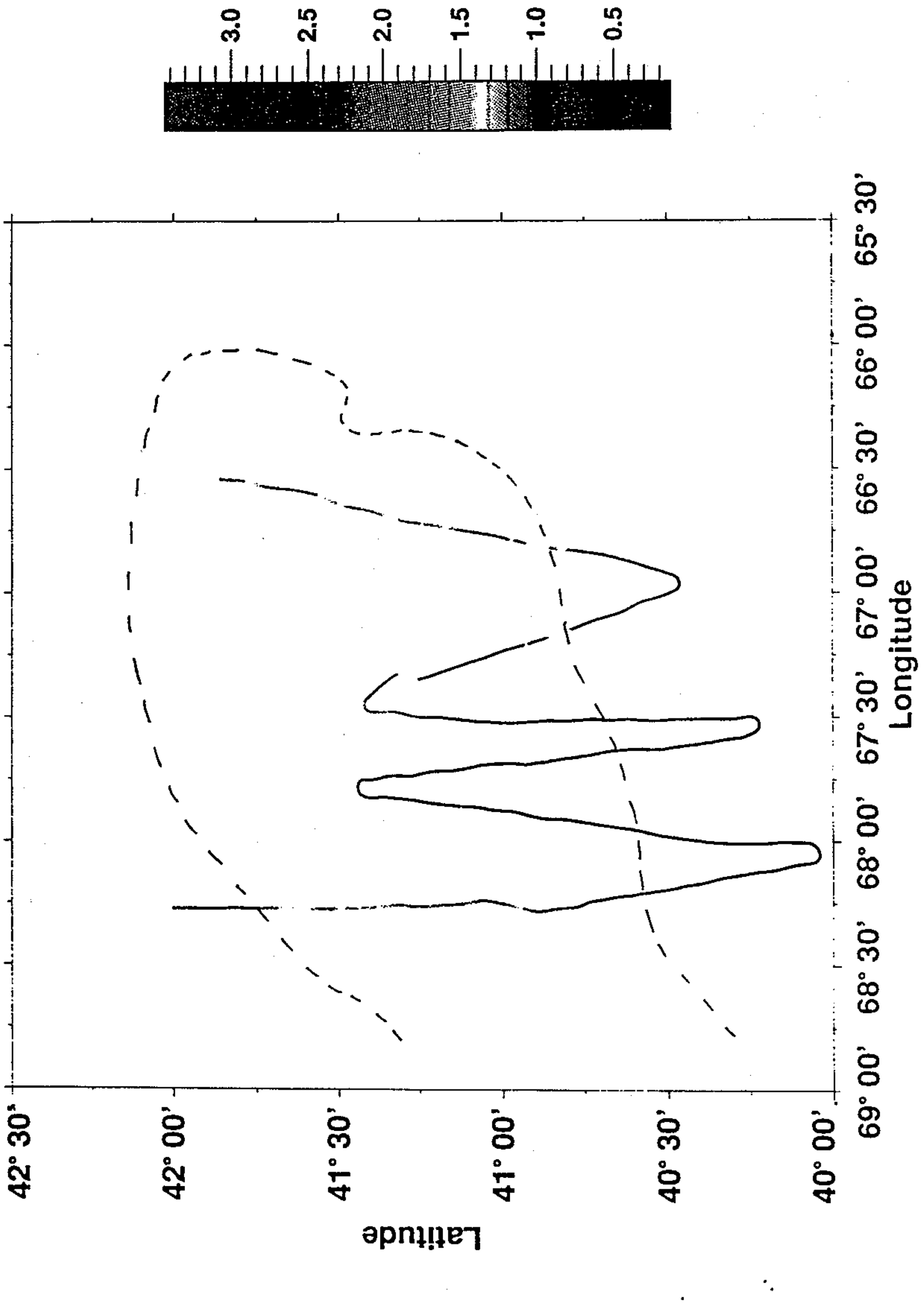

Figure J-2. Flight path for June 8, superimposed on 50-fathom isobath of Georges bank. (Scale indicates normalized fluorescence returns).

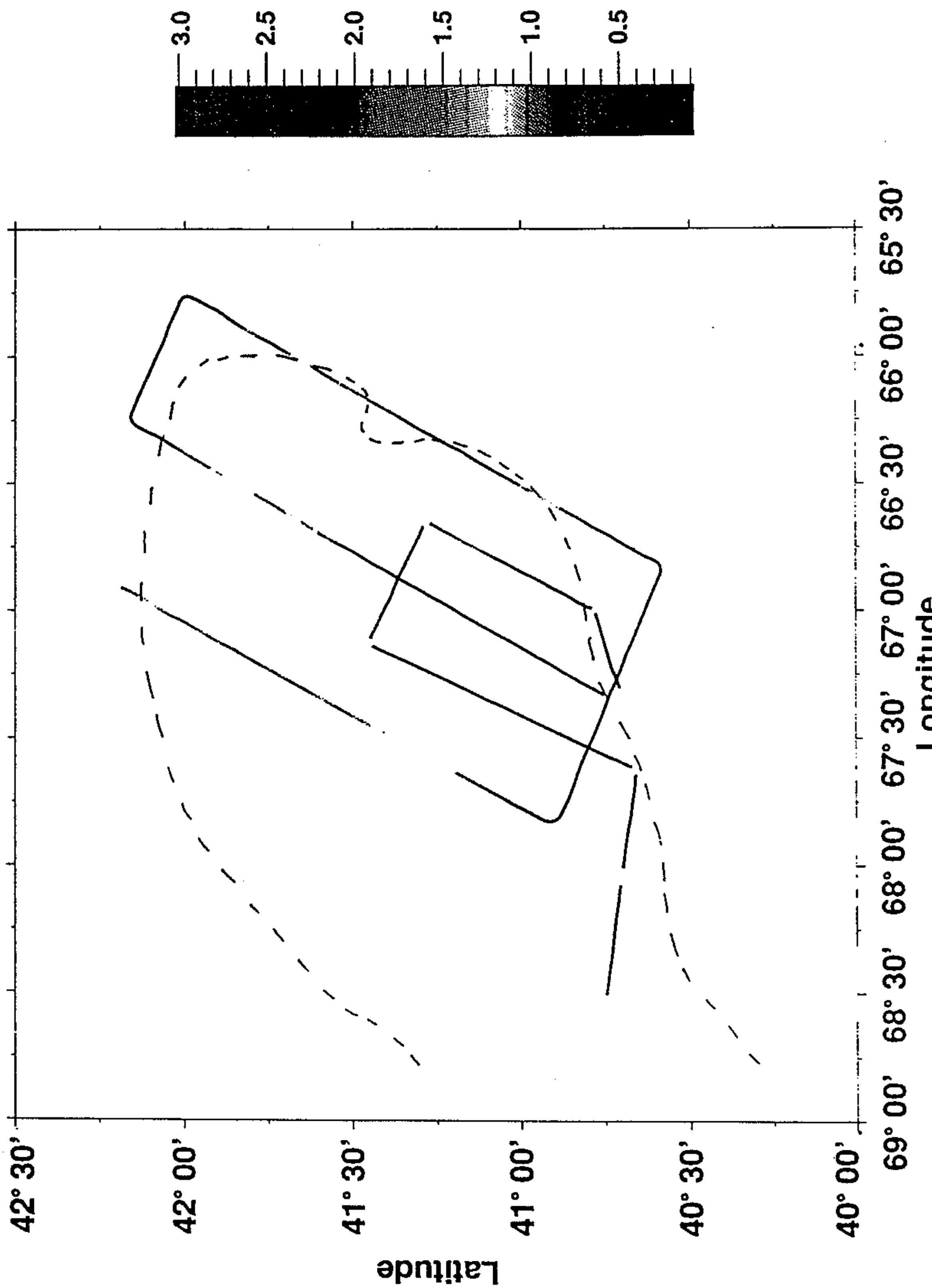

Figure J-3. Flight path for June 10, superimposed on 50-fathom isobath of Georges bank. (Scale indicates normalized fluorescence returns).

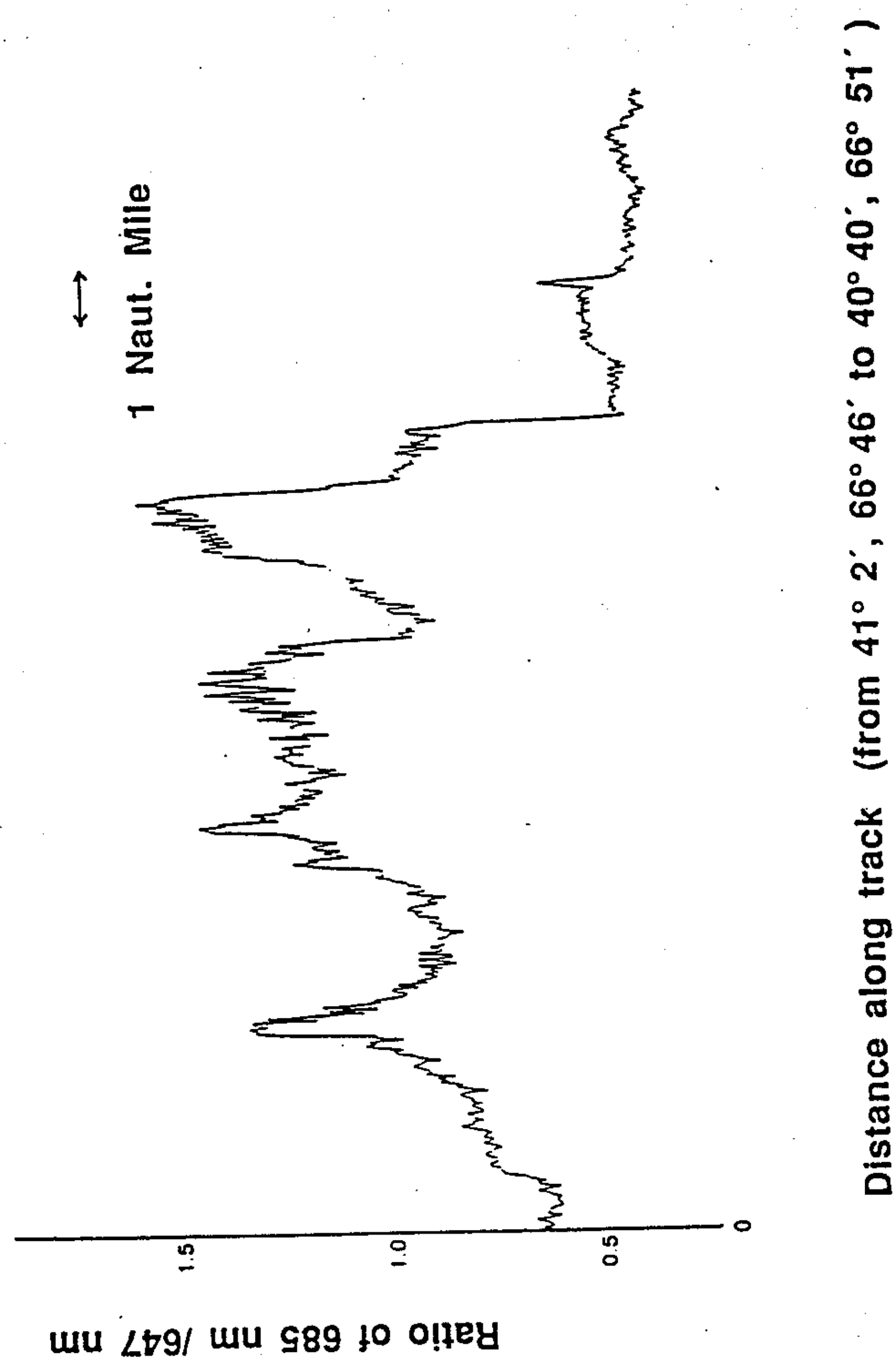

Figure J-4. Integrated LIDAR returns (June 8, File 1349).

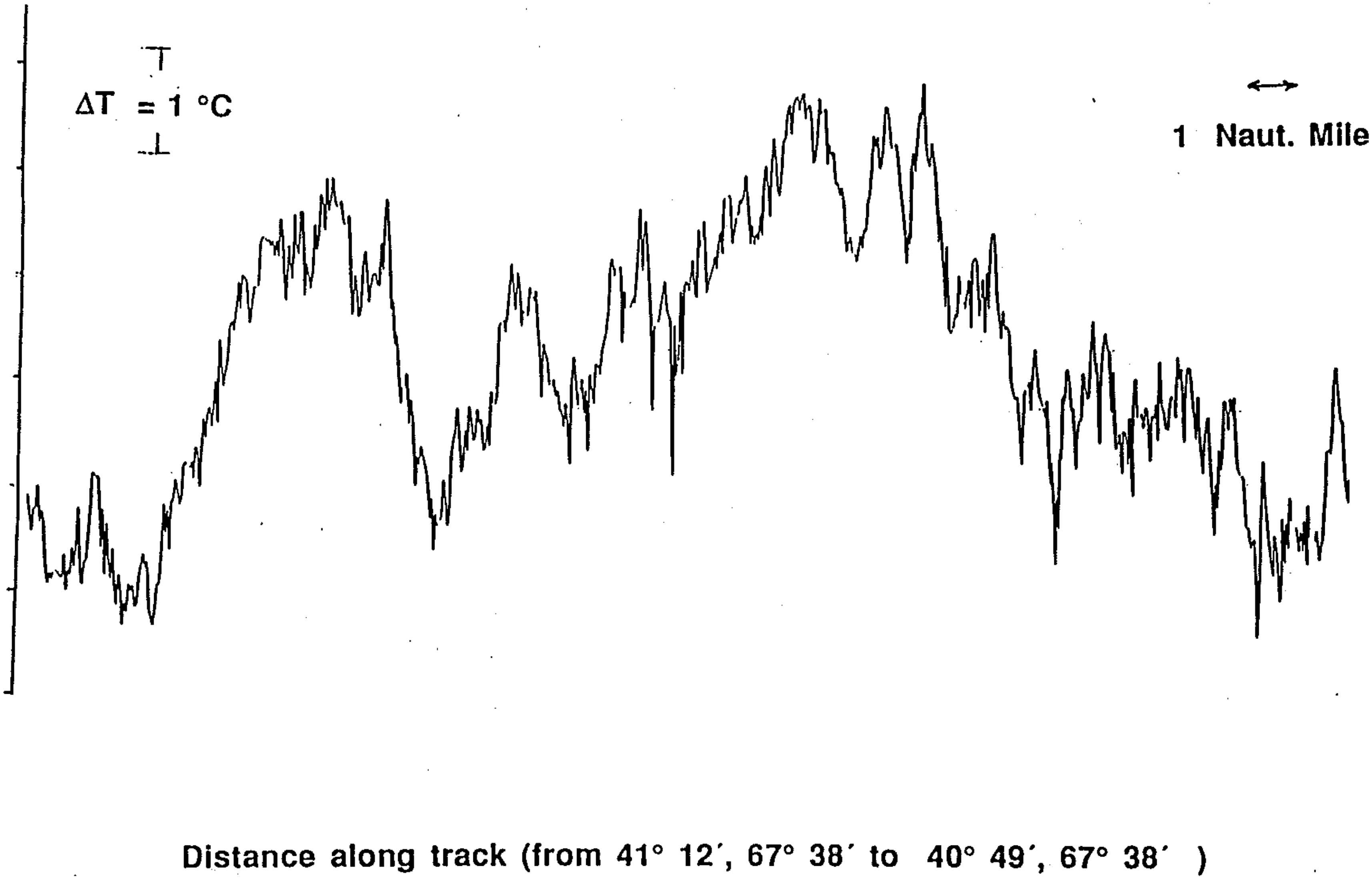

Figure J-5. IR radiometer signals (June 10, File 1402).

Scientific Personnel Leg A

Name		Title	Organization
1.	Dian Gifford	Chief Scientist	University of Rhode Island
2.	Robert Campbell	Post-doctoral Fellow	University of Rhode Island
3.	Maria Bemis	Scientist	University of Rhode Island
4.	Peter Garrahan	Scientist	University of Rhode Island
5.	Richard Bohrer	Scientist	University of Rhode Island
6.	Jonathan Hopkins	Marine Technician	University of Rhode Island
7.	David Nelson	Marine Technician	University of Rhode Island
8.	Charles Miller	Scientist	Oregon State University
9.	Cheryl Morgan	Scientist	Oregon State University
10.	Ari Epstein	Student	Woods Hole Oceanographic Institution
11.	Michael Sieracki	Scientist	Bigelow Laboratory for Ocean Science
12.	Terrance Cucci	Scientist	Bigelow Laboratory for Ocean Science
13.	Scott Gallager	Scientist	Woods Hole Oceanographic Institution
14.	Ione Hunt von Herbing	Post-doctoral Fellow	Woods Hole Oceanographic Institution
15.	Linda Davis	Scientist	Woods Hole Oceanographic Institution
16.	Cabell Davis	Scientist	Woods Hole Oceanographic Institution
17.	Martin Marra	Scientist	Woods Hole Oceanographic Institution
18.	Frederika Norrbin	Scientist	Woods Hole Oceanographic Institution
19.	Jeffrey Runge	Scientist	Institute Maurice Lamontaigne
20.	Stephane Plourde	Scientist	Institute Maurice Lamontaigne
21.	Mark Berman	Scientist	National Marine Fisheries Service
22.	Joseph Kane	Scientist	National Marine Fisheries Service
23.	Chip Maxwell	Marine Technician	University of Miami
24.	Donald Cucchiara	Marine Technician	University of Miami

RV Columbus Iselin Officers and Crew Leg A

Name		Title
1.	Mike Dick	Captain
2.	Chris Vogel	Chief Mate
3.	Rhett McMunn	Second Mate
4.	Steve Vetra	Bosum
5.	Jack Crawford	Chief Engineer
6.	Bob Lapsley	First Engineer
7.	Ralph Harvey	Second Engineer
8.	John Cawley	Seaman
9.	Erik Hutchinson	Seaman
10.	Bob Loos	Seaman
11.	Susan Rafferty	Steward
12.	Torii Young	Cook

Scientific Personnel Leg B

Name		Title	Organization
1.	Dian Gifford	Chief Scientist	University of Rhode Island
2.	Robert Campbell	Post-doctoral Fellow	University of Rhode Island
3.	Maria Bemis	Scientist	University of Rhode Island
4.	Peter Garrahan	Scientist	University of Rhode Island
5.	Richard Bohrer	Scientist	University of Rhode Island
6.	David Avery	Scientist	University of Rhode Island
7.	David Nelson	Marine Technician	University of Rhode Island
8.	Charles Miller	Scientist	Oregon State University
9.	Cheryl Morgan	Scientist	Oregon State University
10.	Edward Dever	Student	Woods Hole Oceanographic Institution
11.	Michael Sieracki	Scientist	Bigelow Laboratory for Ocean Science
12.	Terrance Cucci	Scientist	Bigelow Laboratory for Ocean Science
13.	Scott Gallager	Scientist	Woods Hole Oceanographic Institution
14.	Andrew Girard	Student	Woods Hole Oceanographic Institution
15.	Lucie Blanchard	Student	Woods Hole Oceanographic Institution
16.	Cabell Davis	Scientist	Woods Hole Oceanographic Institution
17.	Philip Alatalo	Scientist	Woods Hole Oceanographic Institution
18.	Stephane Plourde	Scientist	Institute Maurice Lamontaigne
19.	Chip Maxwell	Marine Technician	University of Miami
20.	Donald Cucchiara	Marine Technician	University of Miami

RV Columbus Iselin Officers and Crew Leg B

Name		Title
1.	Mike Dick	Captain
2.	Chris Vogel	Chief Mate
3.	Rhett McMunn	Second Mate
4.	Jack Crawford	Chief Engineer
5.	Bob Lapsley	First Engineer
6.	Ralph Harvey	Second Engineer
7.	John Cawley	Seaman
8.	Erik Hutchinson	Seaman
9.	Bob Loos	Seaman
10.	Susan Rafferty	Steward
11.	Torii Young	Cook

APPPENDIX 1: CI4907 EVENT LOG

INSTRUMENT ABBREVIATIONS:

CTD: CTD: Conductivity/tempersture/depth sensing package
DFT: ARGOS drifter
MOC: MOCNESS: Multiple opening-closing net and environmental sensing system
PPN: Phytoplankton net
TAP: Tracor acoustic profiling system
VPR: Videoplankton recorder
ZPN: Zooplankton net
ZPP: Zooplankton pump

CI9407 EVENT LOG

EVENT#	Instrumen	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDe	InsDep	PI	Region	Comment
vvdddyy.eee	IIIIII	xxx	vvccccl.sss	YYMMDD:	HHMMSS:	YYMMDD:	HHMMSS:	DDMM.FF	DDMM.FF	DDDD:	dddd:	*NNNN*	*RRR PPP	*CCC TTT
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI14594.001	MOC	001	CI9407A.001	940525	234000	940525	194000	4134.86	6849.91	0145	0000	Miller/Durbin		Begin
				940526	001000		201000	4134.56	6850.31		0139			survey
CI14694.001	CTD	001	CI9407A.001	940525	013300	940525	223300	4135.08	6850.14	0145	0000	Gifford/Durbin	N of GSC	Fog
	TAP	001			020000		230000	4134.87	6850.20		0135	Berman		Lightning
CI14694.002	CTD	002	CI9407A.002	940526	040500	940526	000500	4131.41	6834.83	0110	0000	Gifford/Durbin		Rain
	TAP	002			042700		002700	4131.26	6834.14		0090	Berman		
CI14694.003	CTD	003	CI9407A.003	940526	061500	940526	021500	4128.94	6819.76	0050	0000	Gifford/Durbin	Mixed	Rain
	TAP	003			062100		022100	4128.36	6819.01		0031	Berman		
CI14694.004	MOC	002	CI9407A.003	940526	065100	940526	025100	4128.62	6820.04	0048	0000	Miller/Durbin	Mixed	Rain
					072300		032300	4127.13	6819.51		0042			
CI14694.005	CTD	004	CI9407A.004	940526	092747	940526	052700	4125.48	6800.28	0036	0000	Gifford/Durbin		Fog
	TAP	004			093600		053600	4125.27	6800.12		0030	Berman		
CI14694.006	MOC	003	CI9407A.004	940526	095500	940526	055500	4124.60	6800.59	0037	0000	Miller/Durbin		Fog
					101000		061000	4124.31	6800.81		0030			
CI14694.007	CTD	005	CI9407A.005	940526	131500	940526	091500	4121.20	6735.66	0035	0000	Gifford/Durbin		
	TAP	005			133000		093000	4121.52	6735.85		0020	Berman		
CI14694.008	MOC	004	CI9407A.005	940526	142200	940526	102200	4121.06	6735.22	0037	0000	Miller/Durbin	Stratified	Cloudy
					144100		104100	4121.37	6734.91	0096	0090			
CI14694.009	CTD	006	CI9407A.006	940526	172000	940526	132600	4103.93	6726.47	0095	0000	Gifford/Durbin	Stratified	
	TAP	006			173800		133800	4103.50	6726.20		0041	Berman		
CI14694.010	CTD	007	CI9407A.007	940526	200500	940526	161500	4044.29	6715.31	0095	0000	Gifford/Durbin	Stratified	Cloudy
	TAP	007			203500		163300	4044.40	6715.33		0075	Berman	S. Flank	
CI14694.011	MOC	005	CI9407A.007	940526	205500	940526	165500	4043.52	6715.39	0095	0000	Miller/Durbin	S. Flank	Cloudy
					211000		171000	4043.01	6715.73		0090			Rough
CI14694.012	PPN	001	CI9407A.007	940526	205500	940526	165500	4043.52	6715.34	0095	0000	Durbin	S. Flank	Cloudy
					210000		170000	4043.01	6715.73		0001			Windy
CI14794.001	CTD	008	CI9407A.010	940527	121107	940527	081107	4120.77	6641.40	0071	0000	Gifford/Durbin		Windy
					122400		082400	4120.53	6641.67		0057			Rough

CI9407 EVENT LOG

EVENT#	Instrumen	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDe	InsDep	PI	Region	Comment
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				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI14794.002	CTD	009	CI9407A.011	940527	164600	940527	124600	4129.48	6648.68	0070	0000	Gifford/Durbin		Bad cast
					171200		131200	4129.55	6649.75		0050			Windy
CI14794.003	CTD	010	CI9407A.011	940527	173000	940527	133100	4129.47	6650.20	0070	0000	Gifford/Durbin		Windy,
					174000		134000	4129.48	6650.33		0050			rough
CI14794.004	MOC	006	CI9407A.011	940527	175200	940527	135200	4129.30	6650.41	0068	0000	Miller/Durbin		Windy,
					181100		141100	4129.09	6650.34		0066			rough
CI14794.005	CTD	011	CI9407A.012	940527	200600	940527	160600	4136.53	6656.86	0060	0000	Gifford/Durbin	Mixed	Cloudy
					201600		161600	4136.58	6656.87		0050			Fog
CI14794.006	MOC	007	CI9407A.012	940527	203300	940527	163300	4135.49	6656.82	0068	0000	Miller/Durbin	Mixed	Cloudy
					204600		164600	4134.66	6656.90		0050			Fog
CI14794.007	CTD	012	CI9407A.013	940527	233600	940527	193600	4155.24	6705.04	0060	0000	Gifford/Durbin		Clearing
					235268		195500	4155.27	6705.51		0050			
CI14894.001	MOC	008	CI9407A.013	940528	000800	940527	200800	4155.37	6705.65	0049	0000	Miller/Durbin	Mixed	Clearing
					002100		202100	4155.74	6706.89	0060	0040			
CI14894.002	CTD	013	CI9407A.014	940528	023901	940527	203901	4206.08	6709.25	0052	0000	Gifford/Durbin		
					024727	025800	225000	4206.66	6709.95		0039			
CI14894.003	MOC	009	CI9407A.014	940528	032700	940527	232700	4207.58	6711.42	0062	0000	Miller/Durbin		
					034600	4207.86	6711.91	4207.58	6711.42		0052			
CI14894.004	CTD	014	CI9407A.015	940528	044445	940528	004445	4211.56	6711.17	0188	0000	Gifford/Durbin		
					050800		010800	4211.46	6712.17		0169			
CI14894.005	MOC	010	CI9407A.015	940528	052100	940528	012100	4211.50	6712.50	0185	0000	Miller/Durbin		
					055800	015800	015800	4211.75	6713.62		0180			
CI14894.006	CTD	015	CI9407A.016	940528	072459	940528	032459	4221.75	6715.06	0325	0000	Gifford/Durbin	GOM	
					075700		035700	4221.90	6715.27		0310			
CI14894.007	MOC	011	CI9407A.016	940528	081100	940528	041100	4222.29	6715.07	0325	0000	Miller/Durbin	GOM	
					091300		051300	4224.23	6713.28		0308			
CI114894.008	VPR	001	CI9407A.016	940528	051600	940528	091600	4208.53	6619.25	0325	NA	Davis	GOM	VPR test
					082000		112000	4208.37	6617.95		NA			

CI9407 EVENT LOG

EVENT#	Instrument	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDe	insDep	PI	Region	Commen
vvdddyy.sss	IIIII	XXX	vvccccl.sss	YYMMDD	HHMMSS	YYMMDD	HHMMSS	DDMM.FF	DDMM.FF	DDDD	dddd:	"NNNN"	"RRR PPP"	"CCC TT
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI14894.009	CTD	016	CI9407A.017	940528	180200	940528	140200	4157.36	6541.93	0250	0000	Gifford/Durbin	NE Chan.	Sunny
					182600		142600	4157.73	6541.22		0235			Cool
CI14894.010	MOC	012	CI9407A.017	940528	183800	940528	143800	4157.90	6541.27	0259	0000	Miller/Durbin	NE Chan.	Sunny
					191700		151700	4158.67	6541.32	0263	0249			Cool
CI14894.011	ZPN	001	CI9407A.017	940528	193441	940528	153400	4158.62	6541.12	0347	0000	Runge	NE Chan.	Sunny
					195300		155300	4158.91	6540.52		0150			Cool
CI14894.012	VPR	002	CI9407A.017	940528	202400	940528	162400	4158.42	6540.14	0458	NA	Davis	NE Chan.	Sunny
					232100		192100	4155.72	6548.96		NA			Cool
CI149.94.001	CTD	017	CI9407A.018	940529	002830	940528	202830	4151.81	6603.50	0094	0000	Gifford/Durbin	NE peak	Cool
					004238		204600	4151.26	6603.91		0080			Clear
CI14994.002	MOC	013	CI9407A.018	940529	010656	940528	210656	4151.34	6603.89	0095	0000	Miller/Durbin	NE peak	Cool
					012200		212200	4151.47	6603.92		0085			Clear
CI14994.003	CTD	018	CI9407A.019	940529	031546	950528	241540	4146.47	6624.98	0079	0000	Gifford/Durbin	NE peak	Cool
					033100		243100	4146.81	6625.26		0065			Clear
CI14994.004	MOC	014	CI9407A.019	940529	034200	940528	234200	4146.69	6625.20	0070	0000	Miller/Durbin	NE peak	Cool
					035900		235900	4147.05	6625.50		0070			Clear
CI14994.005	CTD	019	CI9407A.020	940529	052211	940528	012211	4142.21	6641.15	0078	0000	Gifford/Durbin	NE peak	Cool
					053800		013800	4142.62	6640.99		0060			Clear
CI14994.006	MOC	015	CI9407A.020	940529	055000	940529	015000	4142.65	6640.90	0065	0000	Miller/Durbin	NE peak	Cool
					061000		021000	4142.56	6641.01		0062			Clear
CI14994.007	ZPN	002	CI9407A.021	940529	093947	940529	053900	4150.38	6612.69	0080	0000	Gifford, Durbin	Stratified	Live tow
					094900		NA	NA	6612.69		0050	Runge	site	
CI14994.008	DFT	001	CI9407A.021	940529	021300	940529	061300	4149.94	6612.57	0000	0000	Durbin	Stratified	Deploy
					NA		NA	NA	NA	NA			site	drifter
CI14994.009	CTD	020	CI9407A.021	940529	103308	940529	063308	4150.03	6612.60	0080	0000	Gifford/Durbin	Stratified	Cool
					104400		064400	4150.01	6612.71		0060		site	Clear

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EVENT#	Instrument	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDe	insDep	PI	Region	Commen
vvdddyy.eee	IIIII	XXX	VVccccl.sss	YYMMDD:	HHMMSS:	YYMMDD:	HHMMSS:	DDMM.FF	DDMM.FF	DDDD:	dddd:	"NNNN"	"RRR PPP"	"CCC TT
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI14994.010	MOC	016	CI9407A.021	940529	105100	940529	065100	4149.67	6612.78	0081	0000	Miller/Durbin	Stratified	Clear
					111200		071200	4148.75	6612.93		0068		station	Calm
CI14994.011	ZPP	001	CI9407a.021	940529	120000	940529	080000	4146.57	6610.31	0084	0000	Durbin	Stratified	Clear
					131500		091500	4144.76	6609.70		0057		station	Calm
CI14994.012	CTD	021	CI9407A.021	940529	134645	940529	094645	4144.12	6611.72	0088	0000	Gifford/Durbin	Stratified	Collect
					135800		095800	4143.73	6611.89		0050		station	water
CI14994.013	CTD	022	CI9407A.021	940529	143659	940529	103659	4143.58	6612.03	0087	0000	Gifford/Durbin	Stratified	Collect
					144900		104490	4143.01	6612.44		0065		station	water
CI14994.014	DPP	001	CI9407A.021	940529	151000	940529	111000	4143.48	6614.15	0088	0015	Durbin	Stratified	Collect
					161500		121500	4143.55	6614.87				station	water
CI14994.015	CTD	023	CI9407A.021	940529	165056	940529	125056	4144.76	6617.20	0086	0000	Gifford/Durbin	Stratified	
	TAP	008			170500		130500	4145.07	6619.96		0072	Berman	station	
CI14994.016	MOC	017	CI9407A.021	940529	172100	940529	132100	4145.22	6617.34	0083	0000	Miller/Durbin	Stratified	Clear
					173700		133700	4145.38	6617.92		0070		station	Sunny
CI14994.017	ZPN	003	CI9407A.021	940529	180100	940529	140100	4145.98	6616.73	0080	0000	Runge	Stratified	Live tow
					182500		142500	NA	NA		0070	Gifford	station	
CI14994.018	ZPN	004	CI9407A.021	940529	183000	940529	143000	4145.98	6616.73	0080	0000	Durbin	Stratified	Live tow
					184200		144200	4146.85	6616.49		0070		station	
CI14994.019	DFT	002	CI9407A.021	940529	194600	940529	154600	4146.73	6615.54	0084	0000	Durbin	Stratified	Retrieve
					NA		NA	NA	NA		NA		station	for repair
CI14994.020	DFT	003	CI9407A.021	940529	195300	940529	155300	4147.37	6614.92	0084	0000	Durbin	Stratified	Deploy
					NA		NA	NA	NA		NA		station	drifter
CI14994.021	VPR	003	CI9407A.021	940529	203200	940529	161600	4147.16	6614.58	0084	NA	Davis	Stratified	
					NA		193600	4144.54	6607.24		NA		station	
CI14994.022	CTD	024	CI9407A.021	940529	235000	940529	200000	4143.40	6607.05	0093	0000	Gifford/Durbin	Stratified	
	TAP	009		940530	245900		205900	4141.28	6606.07		0050	Berman	station	

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EVENT#	Instrument	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDe	InsDep	PI	Region	Commen
vvdddyy.sss	lllll	xxx	vvccccl.sss	YYMMDD	HHMMSS	YYMMDD	HHMMSS	DDMM.FF	DDMM.FF	DDDD	dddd	"NNNN"	"RRR PPP"	"CCC TT"
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI15094.001	VPR	004	CI9407A.021	940530	013900	940529	213900	4140.42	6607.03	0084	NA	Davis	Stratified	
					040800		000800	4138.61	6609.31		NA		station	
CI15094.002	CTD	025	CI9407A.021	940530	043000	940530	003000	4139.30	6611.31	0087	0000	Gifford/Durbin	Stratified	
					044500		004500	4139.56	6611.99		0070		station	
CI15094.003	MOC	018	CI9407A.021	940530	045800	940530	005800	4139.72	6612.64	0091	0000	Miller/Durbin	Stratified	Clear
					051300		011300	4139.69	6613.36	0092	0082		station	night
CI15094.004	ZPP	002	CI9407A.021	940530	060000	940530	020000	4139.44	6607.71	0085	0000	Durbin	Stratified	
					064500		024500	4139.52	6607.41		0057		station	
CI15094.005	CTD	026	CI9407A.021	940530	070300	940530	030300	4141.02	6613.59	0082	0000	Gifford/Durbin	Stratified	
	TAP	010			075200		035200	4141.91	6612.41		0050	Berman	station	
CI15094.006	VPR	005	CI9407A.021	940530	080000	940530	040000	4142.17	6612.16	0082	NA	Davis	Stratified	
					110500		071500	4140.01	6606.93		NA		station	
CI15094.007	CTD	027	CI9407A.021	940530	115300	940530	075300	4139.19	6606.23	0098	0000	Gifford/Durbin	Stratified	
	TAP	011			125800		085800	4137.34	6604.44	0092	0050	Berman	station	
CI15094.008	ZPN	005	CI9407A.021	940530	131000	940530	091000	4136.51	6604.63	0092	0000	Miller/Runge	Stratified	Live tow
					132200		092200	4137.01	6604.28		0050		station	
CI15094.009	VPR	006	CI9497A.021	940530	133700	940630	093700	4136.09	6605.20	0092	NA	Davis	Stratified	
					161600		121600	4135.95	6608.56		NA		station	
CI15094.010	CTD	028	CI9407A.021	940530	163006	940530	123006	4135.92	6608.60	0097	0000	Gifford/Durbin	Stratified	
	TAP	012			173400		133400	4137.60	6609.35	0098	0050	Berman	station	
CI15094.011	CTD	029	CI9407A.021	940530	171300	940530	131300	4136.60	6609.08	0097	0000	Gifford/Durbin	Stratified	Collect
					173400		133400	4137.00	6609.35		0070		station	water
CI15094.012	MOC	019	CI9407A.021	940530	175300	940530	135300	4136.04	6608.66	0095	0000	Miller/Durbin	Stratified	
					181800		141800	4135.92	6611.24		0093		station	
CI15094.013	ZPP	003	CI9407A.021	940530	184500	940530	144500	4137.07	6610.45	0096	0000	Durbin	Stratified	
					192500		152500	4137.80	6610.28		0057		station	
CI15094.014	MOC	020	CI9407A.021	940530	193800	940530	153800	4137.58	6610.71	0094	0000	Miller/Durbin	Stratified	
					195500		155500	4137.42	6611.02		0080		station	

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EVENT#	Instrum	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDep	InsDep	PI	Region	Comment
vvdddyy.eee	IIIII	XXX	vvccccl.sss	YYMMDD:	HHMMSS:	YYMMDD:	HHMMSS:	DDMM.FF	DDMM.FFF	DDDD:	dddd:	"NNNN"	"RRR PPP"	"CCC TTT"
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI15094.015	ZPN	006	CI9407A.021	940530	201600	940530	161600	4137.97	6610.56	0094	NA	Runge	Stratified	Live tow
					202700		162700	4137.86	6610.48		NA		station	
CI15094.016	VPR	007	CI9407A.021	940530	203900	940530	163900	4137.53	6610.78	0095	NA	Davis	Stratified	
					223900		193700	4137.74	6608.05		NA		station	
CI15094.017	CTD	030	CI9407A.021	940530	235545	940530	195545	4137.45	6607.43	0094	0000	Gifford/Durbin	Stratified	
	TAP	013		940531	010700		210700	4136.53	6605.24	0093	0050	Berman	station	
CI15194.001	CTD	031	CI9407A.021	940531	005812	940530	205812	4136.71	6605.56	0093	0000	Gifford/Durbin	Stratified	
					010627		210627	NA	NA		0075		station	
CI15194.002	MOC	021	CI9407A.021	940531	011600	940530	211600	4136.33	6605.30	0095	0000	Miller/Durbin	Stratified	
					012900		212900	4136.12	6605.84		0083		station	
CI15194.003	ZPP	004	CI9407A.021	940531	014000	940530	214000	4135.83	6605.89	0095	0000	Durbin	Stratified	
					023000		223000	3912.10	6607.20		0057		station	
CI15194.004	VPR	008	CI9407A.021	940531	030000	940531	230000	4135.40	6607.75	0095	NA	Davis	Stratified	
					083700		043700	NA	NA		NA		station	
CI15194.005	CTD	032	CI9407A.021	940531	100944	940531	064100	4135.40	6610.62	0095	0000	Gifford/Durbin	Stratified	Clear
					102600		062600	4135.43	6610.13		0060		station	Calm
CI15194.006	MOC	022	CI9407A.021	940531	104700	940531	064700	4134.72	6609.95	0095	0000	Miller/Durbin	Stratified	Clear
					110000		070000	4134.29	6609.83		0082		station	Calm
CI15194.007	ZPP	005	CI9407A.021	940531	111500	940531	071500	4134.66	6609.57	0095	0000	Durbin	Stratified	Clear
					121000		081000	4134.29	6608.45		0057		station	Calm
CI15194.008	CTD	033	CI9407A.021	940531	122743	940531	082743	4134.25	6608.50	0095	0000	Gifford/Durbin	Stratified	
					123700		083700	4133.43	6607.99		0070		station	
CI15194.009	ZPN	007	CI9407A.022	940531	132000	940531	092000	4133.76	6608.35	0047	0000	Runge	Mixed	Live tow
					132600		092600	4132.26	6607.89		0030		station	Fog
CI15194.010	ZPN	008	CI9407A.022	940531	180000	940531	140000	4119.66	6715.52	0047	0000	Runge	Mixed	Live tow
					181000		141000	4119.78	6715.50		0040		station	
CI15194.011	DFT	004	CI9407A.022	940531	181000	940531	141000	4119.66	6715.52	0047	0000	Durbin	Mixed	Deploy
					NA		NA	NA	NA		NA		station	Drifter

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EVENT#	Instrum	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDep	InsDep	PI	Region	Comment
vvdddyy.eee	IIIII	XXX	vvccccl.sss	YYMMDD	HHMMSS	YYMMDD	HHMMSS	DDMM.FF	DDMM.FFF	DDDD	dddd	"NNNN"	"RRR PPP"	"CCC TTT"
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI15194.012	CTD	034	CI9407A.022	940531	220400	940531	180400	4124.32	6712.71	0047	0000	Gifford/Durbin	Mixed	Fog
					221200		181200	4123.80	6711.81		0040		station	
CI15194.013	DPP	002	CI9407A.022	940531	222000	940531	182000	4123.15	6709.82	0047	0015	Durbin	Mixed	Collect
					231000		191000	4123.74	6709.76				station	water
CI15294.001	ZPP	006	CI9407A.022	940601	010000	940531	210000	4121.01	6707.68	0055	0000	Durbin	Mixed	Pump
					014500		214500	4120.19	6707.17		0047		station	failure
CI15294.002	MOC	023	CI9407A.022	940601	015400	940531	215400	4119.91	6707.18	0056	0000	Miller/Durbin	Mixed	
					020500		220500	4119.51	6707.36		0045		Station	
CI15294.003	CTD	035	CI9407A.022	940601	022700	940531	222700	4118.88	6707.68	0056	0000	Gifford/Durbin	Mixed	
					023800		223800	4118.61	6707.74		0040		station	
CI15294.004	ZPN	009	CI9407A.022	940601	040000	940601	000000	4116.70	6710.51	0055	0040	Gifford, Durbin,	Mixed	Live tow
					044800		004800	4117.22	6710.81		0000	Runge	station	
CI15294.005	VPR	009	CI9407A.022	940601	011000	940601	221000	NA	NA	0055	NA	Davis	Mixed	VPR
					NA		NA	NA	NA		NA		station	fried
CI15294.006	ZPN	010	CI9407A.022	940601	042000	940601	020000	4116.70	6710.51	0055	0040	Gifford, Durbin,	Mixed	Live tow
					NA		NA	NA	NA		0000	Runge	station	
CI15294.007	ZPN	011	CI9407A.022	940601	044000	940601	040000	4116.70	6710.51	0055	0040	Gifford, Durbin	Mixed	Live tow
					044800		004800	4117.22	6710.81		0000	Runge	Station	
CI15294.008	CTD	036	CI9407A.022	940601	100000	940601	060000	4120.97	6712.92	0048	0000	Gifford/Durbin	Mixed	Live tow
	TAP	014			105600		065600	4120.82	6711.56	0046	0035	Berman	station	
CI15294.009	ZPN	012	CI9407A.022	940601	121200	940601	081200	4119.60	6710.03			Miller	Mixed	
					122300		082300	4119.33	6709.77				station	
CI15294.010	CTD	037	CI9407A.022	940601	154748	940601	114748	4116.42	6712.58	0054	0000	Gifford/Durbin	Mixed	
	TAP	015			170500		130500	4116.68	6113.00		0035	Berman	station	
CI15294.011	CTD	038	CI9407A.022	940601	172500	940601	132500	4116.50	6712.72	0054	0000	Gifford/Durbin	Mixed	
					NA		NA	NA	NA		35		Station	
CI15294.012	ZPP	007	CI9407A.022	940601	172000	940601	132000	4115.88	6713.44	0053	0000	Durbin	Mixed	
					180500		140500	4117.50	6709.67		0047		station	

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EVENT#	Instrum	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDep	InsDep	PI	Region	Comment
vvdddyy.sss	IIIII	XXX	vvccccl.sss	YYMMDD	HHMMSS	YYMMDD	HHMMSS	DDMM.FF	DDMM.FFF	DDDD	dddd	"NNNN"	"RRR PPP"	"CCC TTT"
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI15294.013	MOC	024	CI9407A.022	940601	182500	940601	142500	4116.47	6714.89	0054	0000	Miller/Durbin	Mixed	
					183400		143400	4116.42	6715.38		0045		station	
CI15294.014	ZPN	012	CI9407A.022	940601	191500	940601	151500	4118.08	6715.08	0065	0000	Runge	Mixed	Live tow
					NA		NA	NA	NA		0045		Station	
CI15294.015	ZPN	013	CI9407A.022	940601	193000	940601	153000	4118.08	6715.08	0055	0000	Runge	Mixed	Live tow
					NA		NA	NA	NA		0045		station	
CI15294.016	ZPN	014	CI9407A.022	940601	194500	940601	154500	4118.08	6715.08	0055	0000	Runge	Mixed	Live tow
					194500		154500	4118.26	6716.32		0045		station	
CI15294.017	DPP	003	CI9407A.022	940601	195600	940601	155600	4118.96	6715.79	0055	0015	Durbin	Mixed	Collect
					200400		160400	NA	NA		NA		station	water
CI15294.018	CTD	039	CI9407A.022	940601	221000	940601	181000	4120.93	6714.06	0049	0000	Gifford/Durbin	Mixed	
	TAP	016			230400		190400	4121.75	6712.32		0035	Berman	station	
CI15294.019	CTD	040	CI9407A.022	940601	225700	940601	185470	4121.68	6712.56	0049	0000	Gifford/Durbin	Mixed	
					230500		190500	NA	NA		0035		station	
CI15394.001	CTD	041	CI9407A.022	940602	020600	940601	220600	4118.37	6708.50	0055	0000	Gifford/Drubin	Mixed	
	TAP	017			030100		230100	4115.76	6707.27		0040	Berman	Station	
CI15394.002	CTD	042	CI9407A.022	940602	025300	940601	225300	4116.14	6707.30	0060	0000	Gifford/Durbin	Mixed	
					030000		230000	NA	NA		0040		station	
CI15394.003	ZPP	008	CI9407A.022	940602	030000	940601	230000	4118.12	6702.09	0057	0000	Durbin	Mixed	
					040500	940602	000500	4117.78	6709.53		0047		station	
CI15394.004	MOC	025	CI9407A.022	940602	042000	940602	000200	4112.97	6707.85	0061	0000	Miller/Durbin	Mixed	
					043500		003500	4112.57	6708.33		0049		station	
CI15394.005	CTD	043	CI9407A.022	940602	100500	940602	060500	4116.16	6714.79	0054	0000	Gifford/Durbin	Mixed	
	TAP	018			110600		070600	4116.28	6714.08	0055	0040	Berman	station	
CI15394.006	DFT	005	CI9407A.022	940602	113000	940602	073000	4116.38	6713.88	0054	0000	Durbin	Mixed	Repair
					NA		NA	NA	NA		NA		Station	drifter

CI9407 EVENT LOG

EVENT#	Instrum	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDep	InsDep	PI	Region	Comment
vvdddyy.sss	IIIII	XXX	vvccccl.sss	YYMMDD	HHMMSS	YYMMDD	HHMMSS	DDMM.FF	DDMM.FFF	DDDD	dddd	"NNNN"	"RRR PPP"	"CCC TTT"
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI15394.007	DFT	006	CI9407A.022	940602	125000	940602	085000	4116.29	6713.73	0054	0000	Durbin	Mixed	Redeploy
					NA		NA	NA	NA		NA		station	drifter
CI15394.008	ZPN	015	CI9407A.022	940602	133300	940602	093300	4116.63	6712.79	0050	NA	Miller	Mixed	Live tow
					134300		094300	4116.33	6712.75		NA		station	
CI15394.009	CTD	044	CI9407A.022	940602	155845	940602	115845	4112.38	6712.94	0057	0000	Gifford/Durbin	Mixed	
	TAP	019			170300		130300	4110.67	6714.29		0040	Berman	station	
CI15394.010	CTD	045	CI9407A.022	940602	164900	940602	124900	4111.01	6713.86	0057	0000	Gifford/Durbin	Mixed	
					170100		130100	NA	NA		0040		station	
CI15394.011	ZPP	009	CI9407A.022	940602	172500	940602	132500	4112.08	6714.81	0057	0000	Durbin	Mixed	
					180500		140500	4111.62	6715.85		0037		station	
CI15394.012	MOC	026	CI9407A.022	940602	181300	940602	141300	4111.64	6715.88	0055	0000	Miller/Durbin	Mixed	
					182200		142200	4111.35	6716.33		0045		Station	
CI15394.013	CTD	046	CI9407A.022	940602	200100	940602	160100	4112.87	6717.76	0056	0000	Gifford/Durbin	Mixed	
					200800		160800	4112.98	6717.77		0040		station	
CI15494.014	ZPN	016	CI19407A.02	940602	211600	940602	171600	4114.34	6718.54	NA	NA	Runge	Mixed	Live
					212800		172800	4114.39	6718.87	NA	NA		station	tow
CI15394.015	CTD	047	CI9407A.023	940602	221849	940602	181849	4120.38	6724.78	0047	0000	Gifford/Durbin	Hydro	
					223400		183400	4120.98	6724.78		0035		section	
CI15394.016	MOC	027	CI9407A.023	940602	224800	940602	184800	4120.79	6724.28	0043	0000	Miller/Durbin	Hydro	
					225300		185300	4120.67	6724.14		0033		section	
CI15394.017	CTD	048	CI9407A.024	940602	234413	940602	194613	4115.49	6720.81	0048	0000	Gifford/Durbin	Hydro	
					235200		195200	4114.69	6720.17		0030		section	
CI15494.001	CTD	049	CI9407A.025	940603	002259	940602	205259	4110.26	6717.01	0057	0000	Gifford/Durbin	Hydro	
					244400		204400	4108.25	6715.38		0040		section	
CI15494.002	CTD	050	CI9407A.026	940603	012916	940602	212916	4102.13	6711.13	0068	0000	Gifford/Durbin	Hydro	
					014000		214000	4101.87	6710.64		0040		section	
CI15494.003	CTD	051	CI9407A.027	940603	022400	940602	222400	4055.90	6706.60	0080	0000	Gifford/Durbin	Hydro	
					023100		223100	4055.59	6706.29		0070		section	

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EVENT#	Instrum	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDep	InsDep	PI	Region	Comment
vvdddyy.sss	IIIII	XXX	vvccccl.sss	YYMMDD:	HHMMSS:	YYMMDD:	HHMMSS:	DDMM.FF	DDMM.FFF:	DDDD:	dddd:	"NNNN"	"RRR PPP"	"CCC TTT"
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI15494.004	MOC	028	CI9407A.027	940603	023600	940602	223600	4055.33	6706.22	0081	0000	Miller/Durbin	Hydro	Clear
					025400		225400	4054.49	6706.15		0070		section	rough
CI15494.005	CTD	052	CI9407A.028	940603	034200	940602	234200	4049.60	6701.96	0089	0000	Gifford/Durbin	Hydro	Clear
					035300		235300	4049.28	6701.82		0080		section	rough
CI15494.006	CTD	053	CI9407A.029	940603	044500	940603	004500	4043.29	6657.57	0125	0000	Gifford/Durbin	Hydro	
					045900		005900	4043.01	6657.73		0115		section	
CI15494.007	CTD	054	CI9407A.030	940603	055200	940603	015200	4036.93	6652.99	0480	0000	Gifford/Durbin	Hydro	
					063100		023100	4036.16	6652.32		0470		section	
CI15494.008	MOC	029	CI9407A.030	940603	063500	940603	023500	4036.14	6652.38	0612	0000	Miller/Durbin	Hydro	
					071600		031600	4036.53	6653.20	0490	0298		section	
CI15494.009	CTD	055	CI9407A.031	940603	084500	940603	044500	4046.07	6639.00	1060	0000	Gifford?Durbin	Hydro	
					091400		051400	4046.00	6639.20		0508		section	
CI15494.010	CTD	056	CI9407A.032	940603	102931	940603	062931	4056.08	6625.00	1082	0000	Gifford/Durbin	Hydro	
					111000		071000	4056.12	6625.18		0510		section	
CI15494.011	CTD	057	CI9407A.033	940603	121230	940603	081230	4101.04	6631.24	0100	0000	Gifford/Durbin	Hydro	
					132900		092900	4100.76	6631.29		0080		section	
CI15494.012	MOC	030	CI9407A.033	940603	123800		083800	4100.60	6631.50	0101	0000	Miller/Durbin	Hydro	
					125800		085800	4100.24	6631.92		0091		section	
CI15494.013	FLY	001	CI9407A.036	940603	134023	940603	094023	4117.60	6735.50	NA	NA	Primmerman	Airborne	Fly-by
					175900		135900	NA	NA		NA		LIDAR	
CI15494.014	CTD	058	CI9407A.034	940603	141320	940603	101320	4106.04	6637.44	0085	0000	Gifford/Durbin	Hydro	No
					142200		102200	4105.74	6637.45		0070		section	bottles
CI15494.015	CTD	059	CI9407A.035	940603	152424	940603	112424	4111.18	6643.77	0070	0000	Gifford/Durbin	Hydro	
					153200		113200	4111.89	6643.81		0055		section	
CI15494.016	MOC	031	CI9407A.035	940603	153700		113700	4110.76	6643.81	0070	0000	Miller/Durbin	Hydro	
					160000		120000	4110.17	6644.62		0063		section	

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EVENT#	Instrume	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDep	InsDep	PI	Region	Comment
vvdddyy.sss	iiiii	xxx	vvccccl.sss	YYMMDD	HHMMSS	YYMMDD	HHMMSS	DDMM.FF	DDMM.FF	DDDD	dddd	'NNNN'	'RRR PPP'	'CCC TTT'
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI15494.017	CTD	060	CI9407A.036	940603	165913	940603	125913	4116.28	6650.07	0070	0000	Gifford/Durbin	Hydro	
					170600		130600	4116.02	6650.30		0057		section	No bottles
CI15494.018	CTD	061	CI9407A.037	940603	118011	940603	140115	4121.39	6656.58	0065	0000	Gifford/Durbin	Hydro	
					181200		141200				0050		section	
CI15494.019	CTD	062	CI9407A.038	940603	190952	940603	150952	4126.45	6702.98	0059	0000	Gifford/Durbin	Hydro	
					191900		151900	4126.53	6703.52		0040		section	
CI15494.020	CTD	063	CI9407A.039	940603	195604	940603	155604	4130.96	6708.43	0051	0000	Gifford/Durbin	Hydro	
					202100		162100	4131.67	6709.20		0035		section	
CI15494.021	MOC	032	CI9407A.039	940603	202000	940603	162000	4131.96	6709.76	0050	0000	Miller/Durbin	Hydro	
					203000		163000	4132.23	6710.12		0050		section	
CI15594.001	DFT	006	CI9407A.040	940604	000200	940603	200000	4120.12	6609.30	0087	0000	Durbin	Stratified	Drifter
					NA		NA	NA	NA		NA		station	repair
CI15594.002	ZPN	015	CI9407A.040	940604	022300	940603	222300	4119.94	6609.01	0087	0000	Durbin	Stratified	Live
					023600		223600	4119.83	6609.09		0000		station	tow
CI15594.003	DFT	007	CI9407A.041	940604	043500	940604	030500	4134.84	6615.01		0000	Durbin	Stratified	Deploy
					NA		NA	NA	NA	0088	NA		station	drifter
CI15594.004	CTD	064	CI9407A.041	940604	044300	940604	004300	4134.59	6614.95	0088	0000	Gifford/Durbin	Stratified	
					045800		005800	4134.12	6614.67		0071		station	
CI15594.005	ZPN	016	CI9407A.041	940604	050000	940604	010000	4134.16	6614.62	0088	0000	Durbin	Stratified	Live
					052700		012700	4133.30	6614.14		0030		station	tow
CI15594.006	DPP	004	CI9407A.041	940604	054700	940604	014700	4133.45	6614.21	0088	0000	Durbin	Stratified	Collect
					064200		024200	4132.92	6614.11		0015		station	water
CI15594.007	ZPN	017	CI9407A.041	940604	121400	940604	081400	4132.81	6618.71	NA	NA	Miller	Stratified	
					122400		082400	4132.72	6618.65		NA		station	
CI15594.008	CTD	065	CI9407A.041	940604	160401	940604	120401	4129.77	6616.10	0091	0000	Gifford/Durbin	Stratified	
					162100		122100	4129.32	6615.79		0070		station	

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EVENT#	Instrume	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDep	insDep	PI	Region	Comment
vvdddyy.eee	IIIII	XXX	vvccccl.sss	YYMMDD	HHMMSS	YYMMDD	HHMMSS	DDMM.FF	DDMM.FF	DDDD	dddd	"NNNN"	"RRR PPP"	"CCC TTT"
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI15594.009	ZPP	010	CI9407A.041	940604	170000	940604	130000	4128.45	6616.38	0091	0000	Durbin	Stratified	
					180500		140500	4127.51	6616.69		0057		site	
CI15594.010	MOC	033	CI9407A.041	940604	181100	940604	141100	4127.34	6616.82	0091	0000	Miller/Durbin	Stratified	
					183000		143000	4126.73	6617.59		0080		site	
CI15594.011	DPP	005	CI9407A.041	940604	184500	940604	144500	4127.01	6618.49	0090	0015	Durbin	Stratified	Collect
					191000		151000	4126.93	6618.65				site	water
CI15594.012	ZPN	018	CI9407A.041	940604	191500	940604	151500	4126.89	6618.75	0091	0000	Runge	Stratified	Live tow
					194500		154500	4126.93	6619.75		0080	Durbin	site	
CI15594.013	ZPN	019	CI9407A.041	940604	194500	940604	154500	4126.89	6619.75	0092	0000	Runge	Stratified	Live tow
					195100		155100	4126.87	6619.58		0080	Durbin	site	
CI15594.014	ZPN	020	CI9407A.041	940604	241900	940604	081400	4127.81	6622.47	NA	NA	Miller	Stratified	
					242900		082400	4127.8	6622.46		NA		site	
CI15694.001	CTD	066	CI9407A.041	940605	040400	940605	000400	4125.34	6628.49	0093	0000	Gifford/Durbin	Stratified	
					041300		001300	4125.47	6620.50		0070		site	
CI15694.002	ZPP	011	CI9407A.041	940605	043000	940605	003000	4125.09	6620.54	0090	0000	Durbin	Stratified	
					052000		012000	4123.96	6620.86		0057		site	
CI15694.003	MOC	034	CI9407A.041	940605	053000	940605	013000	4123.76	6620.87	0091	0000	Miller/Durbin	Stratified	
					055600		015600	4123.72	6620.53		0082		site	
CI15694.004	CTD	067	CI9407A.041	940605	103100	940605	063100	4122.04	6626.19	0093	0000	Gifford/Durbin	Stratified	
					103700		063700	4122.06	6626.34		0090		site	
CI15694.005	DFT	008	CI9407A.041	940605	100700	940605	060700	4122.04	6626.15	0093	0000	Durbin	Stratified	Retrieve
					NA		NA	NA	NA		NA		site	drifter
CI15894.001	DFT	009	CI9407B.042	940607	070000	940607	030000	4104.87	6744.72	0041	0000	Durbin	Mixed	Repair
					NA		NA	NA	NA		NA		site	drifter
CI15894.002	DFT	010	CI9407B.042	940607	090300	940607	050300	4115.07	6720.19	0041	0000	Durbin	Mixed	Redeploy
					NA		NA	NA	NA		NA		site	drifter
CI15894.003	CTD	068	CI9407B.042	940607	093468	940607	053468	4115.27	6720.53	0048	0000	Gifford/Durbin	Mixed	Collect
					094800		054800	4115.46	6721.19		0035		site	water

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EVENT#	Instrume	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDep	InsDep	PI	Region	Comment
vvdddyy.eee	lllll	xxx	vvccccl.sss	YYMMDD	HHMMSS	YYMMDD	HHMMSS	DDMM.FF	DDMM.FF	DDDD	dddd	"NNNN"	"RRR PPP"	"CCC TTT"
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI15894.004	ZPN	021	CI9407B.042	940607	100000	940607	060000	4115.87	6721.48	0045	0000	Runge	Mixed	Live
					101000		061000	4116.02	6721.55		0045		site	tow
CI15894.005	DPP	006	CI9407B.042	940607	102000	940607	062000	4116.14	6722.45	0045	0015	Durbin	Mixed	Collect
					112500		072500	4118.67	6723.38		NA		site	water
CI15894.006	CTD	069	CI9407B.042	940607	120000	940607	080000	4117.97	6723.57	0044	0000	Gifford/Durbin	Mixed	Collect
					122900		082900	4118.20	6723.17		0035		site	water
CI15894.007	ZPN	022	CI9407B.042	940607	133500	940607	093500	4120.18	6722.12	0044	0000	Durbin, Gifford	Mixed	Live
					135500		095500	4120.16	6721.92		0025	Runge	site	tow
CI15894.008	ZPN	023	CI9407B.042	940607	140000	940607	100000	4120.16	6721.89	0040	NA	Durbin, Gifford	Mixed	Live
					140500		100500	4120.15	6721.60		NA	Runge	site	tow
CI15894.009	CTD	070	CI9407B.042	940607	150000	940607	110000	4121.73	6720.84	0047	0000	Gifford/Durbin	Mixed	Fog
					151100		111100	4126.60	6720.32		0030		site	rough
CI15994.001	CTD	071	CI9407B.042	940608	020000	940607	220000	4120.30	6716.72	0045	0000	Gifford/Durbin	Mixed	Heavy
					022200		222000	4120.13	6713.39		0030		site	seas
CI15994.002	ZPN	024	CI9407B.042	940608	120900	940608	080900	4113.88	6718.82	0030	0000	Miller	Mixed	
					121800		081800	4113.89	6719.14		0018		site	
CI15994.003	FLY	002	CI9407B.042	940608	132700	940608	092700	4151.4	6718.8	NA	NA	Primmerman	Mixed	Fly-by
					171337		131337	NA	NA		NA		site	
CI15994.004	CTD	072	CI9407B.042	940608	145600	940608	105600	4118.68	6718.58	0047	0000	Gifford/Durbin	Mixed	
					151200		111200	4118.62	6718.49		0035		site	Clear
CI15994.005	ZPP	012	CI9407B.042	940608	155500	940608	115500	4118.91	6717.33	0045	0037	Durbin	Mixed	Collect
					163000		123000	4118.28	6717.01		NA		site	water
CI15994.006	MOC	035	CI9407B.042	940608	164100	940608	124100	4118.40	6715.51	0046	0000	Miller/Durbin	Mixed	Clear
					170400		130400	4118.09	6715.36		0040		site	
CI15994.007	ZPN	025	CI9407B.042	940608	173000	940608	133000	4117.55	6714.89	0045	0000	Runge	Mixed	Live
					174500		134500	4117.00	NA		0041		site	tow
CI15994.008	ZPN	026	CI9407B.042	940608	175000	940608	135000	4117.17	6714.44	0041	0000	Runge	Mixed	Live
					175800		135800	4116.84	6714.33		0045		site	tow

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vvdddyy.sss	IIIII	XXX	Wccccl.sss	YYMMDD	HHMMSS	YYMMDD	HHMMSS	DDMM.FF	DDMM.FF	DDDD	dddd:	'NNNN'	'RRR PPP'	'CCC TTT'
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI15994.009	VPR	010	CI9407B.042	940608	181300	940608	141300	4116.87	6714.29	0040	NA	Davis	Mixed	Winch
					200500		160500	4108.71	6716.16		NA		site	failed
CI16094.001	ZPN	027	CI9407B.042	940609	004000	940608	204000	4110.82	6719.37	0054	0000	Durbin	Mixed	Live
					010000		210000	4110.65	6720.26		0040		site	tow
CI16094.002	CTD	073	CI9407B.042	940609	020000	940608	220000	4111.14	6721.52	0052	0000	Gifford/Durbin	Mixed	
					022000		222000	4111.16	6722.07		0035		site	
CI16094.003	ZPP	013	CI9407B.042	940609	030000	940608	230000	4112.13	6721.10	0050	0000	Durbin	Mixed	
					033000		233000	4112.10	6721.54		0037		site	
CI16094.004	MOC	036	CI9407B.042	940609	040100	940609	000100	4112.15	6721.31	0049	0000	Miller/Durbin	Mixed	
					041500		001500	4112.13	6721.28		0045		site	
CI16094.005	VPR	011	CI9407B042	940609	005900	940609	015900	4112.47	6720.46	0060	0000	Davis	Mixed	
					091839		051837	4107.50	6721.52		0040		site	
CI16094.006	ZPN	028	CI9407B.042	940609	121800	940609	081800	4110.11	6727.19	0050	NA	Miller	Mixed	
					122600		082600	4110.17	6727.40		NA		site	
CI16094.007	CTD	074	CI9407B.042	940609	145500	940609	105500	4110.02	6728.98	0050	0000	Gifford/Durbin	Mixed	
					150100		110700	4110.18	6728.88		0035		site	
CI16094.008	ZPP	014	CI9407B.042	940609	160000	940609	120000	4111.07	6728.29	0048	0000	Durbin	Mixed	Collect
					164500		124500	4111.13	6726.93		0042		site	water
CI16094.009	MOC	037	CI9407B.042	940609	165900	940609	125900	4111.10	6726.97	0048	0000	Miller/Durbin	Mixed	
					170600		130600	4110.96	6727.10		0045		site	
CI16094.010	ZPN	029	CI9407B.042	940609	173000	940609	133000	4109.78	6726.29	0048	0000	Runge	Mixed	Live
					174400		134400	NA	NA		0045		site	tow
CI16094.011	ZPN	030	CI9407B.042	940609	174500	940609	134500	4109.78	6726.29	0048	0000	Runge	Mixed	Live
					175500		135500	4110.48	6726.21		0045		site	tow
CI160.94.012	VPR	012	CI9407B.042	940609	181334	940609	141334	4109.18	6726.40	0053	0000	Davis	Mixed	
					224712		184712	4106.37	6727.46		0043		site	

CI9407 EVENT LOG

EVENT#	Instrume	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDep	InsDep	PI	Region	Comment
vvdddyy.eee	IIIII	XXX	vvccccl.sss	YYMMDD	HHMMSS	YYMMDD	HHMMSS	DDMM.FF	DDMM.FF	DDDD	dddd	'NNNN'	'RRR PPP'	'CCC TTT'
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI16194.001	CTD	075	CI9507B.042	940610	020500	940609	220500	4107.97	6731.43	0055	0000	Gifford/Durbin	Mixed	
					021800		221800	4108.39	6731.42		0040		site	
CI16194.002	ZPP	015	CI9407B.042	940610	030000	940609	230000	4108.75	6732.08	0055	0000	Durbin	Mixed	
					030400		234000	4109.06	6731.32		0047		site	
CI16194.003	MOC	038	CI9407B.042	940610	040300	940610	000300	4109.25	6731.35	0051	0000	Miller/Durbin	Mixed	
					041700		001700	4109.23	6731.43		0047		site	
CI16194.004	VPR	013	CI9407B.042	940610	051444	940610	011444	4109.18	6730.19	0050	0040	Davis	Mixed	
					081765		041755	4100.45	6723.13		0000		site	
CI16194.005	CTD	076	CI9407B.042	940610	091900	940610	051900	4105.89	6729.70	0056	0040	Gifford/Durbin	Mixed	Last mixed
					093200		053200	4105.61	6729.74		0042		site	site cast
CI16194.006	DFT	011	CI9407B.042	940610	094700	9406610	054700	4105.54	6730.13	0056	0000	Durbin	Mixed	Retrieve
					NA		NA	NA	NA		NA		site	drifter
CI16194.007	DFT	012	CI9407B.043	9406610	115000	940610	075000	4102.01	6716.13	0057	0000		Startified	Redeploy
					NA		NA	NA	NA		NA		site	drifter
CI16194.008	ZPN	031	CI9407B.043	940610	110000	940610	070000	4102.15	6711.69	0058	0000	Durbin	Stratified	Live
					112000		072000	4101.86	6711.52		0055		site	tow
CI16194.009	CTD	077	CI9407B.043	940610	120200	940610	080200	4101.89	6711.33	0069	0000	Gifford/Durbin	Startified	
					121300		081300	4101.90	6711.72		0051		site	
CI16194.010	DPP	007	CI9407B.043	940610	132000	940610	092000	4102.23	6713.77	0068	0015	Durbin	Stratified	Collect
					142000		102000	4103.39	6715.66		NA		site	water
CI16194.011	FLY	003	CI9407B.043	940610	133600	940610	093600	4211	6654.8	NA	NA	Primmerman	Startified	Fly-by
					165000		125000	NA	NA		NA		site	
CI16494.012	CTD	078	CI9407B.043	940610	150400	940610	110400	4103.21	6715.47	0065	0000	Gifford/Durbin	Stratified	
					151800		111800	4103.56	6715.45		0050		site	
CI16194.013	ZPP	016	CI9407B.043	940610	152000	940610	112000	4104.17	6715.01	0064	0000	Durbin	Startified	
					161500		121500	4104.28	6715.21		0057		site	

CI9407 EVENT LOG

EVENT#	Instrums	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDep	InsDep	PI	Region	Comment
vvdddyy.sss	IIIII	XXX	vvccccl.sss	YYMMDD	HHMMSS	YYMMDD	HHMMSS	DDMM.FF	DDMM.FF	DDDD	dddd	'NNNN'	'RRR PPP'	'CCC TTT'
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI16194.014	MOC	039	CI9407B.043	940610	162000	940610	122000	4104.35	6715.50	0064	0000	Miller/Durbin	Stratified	
					163000		123000	4104.51	6715.23		0054		site	
CI16194.015	ZPN	032	CI9407B.043	940610	170000	940610	130000	4104.28	6715.17	0063	0000	Durbin, Gifford	Stratified	Live
					171000		131000	4104.52	6715.30		0060	Runge	site	tow
CI16194.016	ZPN	033	CI9407B.043	940610	171500	940610	131500	4104.52	6715.30	0062	0000	Durbin, Gifford	Stratified	Live
					NA		NA	NA	NA		0040	Runge	site	tow
CI16194.017	ZPN	034	CI9407B.043	940610	173000	940610	133000	4104.52	6715.30	0065	0000	Durbin, Gifford	Stratified	Live
					NA		NA	NA	NA		0055	Runge	site	tow
CI16194.018	ZPN	035	CI9407B.043	940610	174500	940610	134500	4104.52	6715.30	0065	0000	Durbin, Gifford	Stratified	Live
					173400		133400	4104.66	6715.45		0045	Runge	site	tow
CI16294.001	CTD	079	CI9407B.043	940611	020200	940610	220200	4101.31	6715.15	0070	0000	Gifford/Durbin	Stratified	
					021700		221700	4101.48	6715.50		0050		site	
CI16294.002	ZPP	017	CI9407B.043	940611	030000	940610	230000	4101.63	6715.71	0068	0000	Durbin	Stratified	
					034500		234500	4102.02	6715.52		0057		site	
CI16294.003	MOC	040	CI9407B.043	940611	035100	940610	235100	4102.00	6715.43	0069	0000	Miller/Durbin	Stratified	
					041500		001500	4101.43	6715.39		0059		site	
CI16294.004	VPR	014	CI9407B.043	940611	005020	940611	005020	4101.84	6715.39	0061	NA	Davis	Stratified	Sunny, flat,
					071110		071119	4056.35	6715.15		NA		site	calm
CI19294.005	CTD	080	CI9407B.043	940611	150000	940611	110000	4057.50	6720.11	0076	0000	Gifford/Durbin	Stratified	Computer
					151800		111800	4057.95	6720.36		0055		site	problem
CI16294.006	CTD	081	CI9407B.043	940611	152400	940611	112400	4057.97	6720.41	0075	0000	Gifford/Durbin	Stratified	Repeat
					153400		113400	4058.17	6720.49		0065		site	cast
CI16294.007	ZPP	018	CI9407B.043	940611	160000	940611	120000	4058.41	6720.64	0073	0000	Durbin	Stratified	
					165500		125500	4059.38	6720.69		0057		site	
CI16294.008	MOC	041	CI9407B.043	940611	170100	940611	130100	4059.33	6720.55	0071	0000	Miller/Durbin	Stratified	
					171200		131200	4059.19	6720.05		0063		site	

CI9407 EVENT LOG

EVENT#	Instrume	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDep	InsDep	PI	Region	Comment
vvdddyy.sss	IIIII	XXX	Vvccccl.sss	YYMMDD:	HHMMSS:	YYMMDD:	HHMMSS:	DDMM.FF:	DDMM.FF:	DDDD:	dddd:	"NNNN"	"RRR PPP"	"CCC TTT"
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI16294.009	ZPN	036	CI9407B.043	940611	172500	940611	132500	4059.54	6720.43	0071	0000	Runge	Stratified	Live
					NA		NA	NA	NA		0060		site	tow
CI16294.010	ZPN	037	CI9407B.043	940611	171500	940611	133000	4059.54	6720.43	0071	0000	Runge	Stratified	Live
					175100		135100	4059.80	6719.40		0050		site	tow
CI16294.011	VPR	015	CI9407B.043	940611	180900	940611	140900	4059.58	6719.14	0065	NA	Davis	Stratified	
					214258		174258	4044.84	6712.07		NA		site	
CI16294.012	ZPN	038	CI9407B.043	949611	230000	940611	190000	4056.50	6716.51	0079	0000	Durbin	Stratified	Live
					232000		192000	4056.41	6716.48		0070		site	tow
CI16394.001	ZPN	039	CI9407B.043	940612	000600	940611	200500	4056.16	6717.05	0079	0000	Durbin	Stratified	Live
					001600		201500	4056.07	6717.30		0075		site	tow
CI16394.002	ZPN	040	CI9407B.043	940612	010000	940611	210000	4055.82	6717.63	0079	0000	Gifford	Stratified	Live
					011300		211300	4055.72	6717.60		0070		site	tow
CI16394.003	CTD	082	CI9407B.043	940612	020200	940611	220200	4056.08	6718.35	0079	0000	Gifford/Durbin	Stratified	No bottles
					022000		222000	4056.40	6718.72		0060		site	fired
CI16394.004	CTD	083	CI9407B.043	9406612	022600	940611	222600	4056.24	6718.82	0078	0000	Gifford/Durbin	Stratified	Collect
					024100		224100	4056.35	6718.82		0060		site	water
CI16394.005	ZPP	019	CI9407B.043	940612	030000	940611	230000	4056.32	6718.93	0078	0000	Durbin	Stratified	
					035500		235500	4056.43	6719.61		0067		site	
CI16394.006	MOC	042	CI9407B.043	940612	035900	940611	235900	4056.48	6719.57	0078	0000	Miller/Durbin	Stratified	
					041800	940612	001800	4055.90	6719.99		0064		site	
CI16394.007	VPR	016	CI9407B.043	940612	050722	940612	010800	4056.35	6719.67	0076	0000	Davis	Stratified	
					071900		031800	4103.06	6724.08		0060		site	
CI16394.008	CTD	084	CI9407B.043	940612	150500	940612	110500	4054.66	6720.87	0076	0000	Gifford/Durbin	Stratified	
					151500		111500	4054.91	6720.91		0060		site	
CI16394.009	ZPP	020	CI9407B.043	940612	160000	940612	120000	4055.36	6720.79	0079	0000	Durbin	Stratified	
					164500		124500	4055.31	6720.41		0057		site	

CI9407 EVENT LOG

EVENT#	Instrume	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDep	InsDep	PI	Region	Comment
vvdddyy.eee	IIIII	XXX	VVccccl.sss	YYMMDD	HHMMSS	YYMMDD	HHMMSS	DDMM.FF	DDMM.FF	DDDD	dddd	"NNNN"	"RRR PPP"	"CCC TTT"
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI16394.010	MOC	043	CI9407B.043	940612	165000	940612	125000	4056.27	6720.66	0078	0000	Miller/Durbin	Stratified	
					170800		130800	4056.01	6719.92		0075		site	
CI16394.011	ZPN	041	CI9407B.043	940612	172000	940612	132000	4055.99	6719.71	0078	NA	Runge	Stratified	Live
					174500		134500	4056.19	6719.00		NA		site	tow
CI16394.012	VPR	017	CI9407B.043	940612	181030	940612	141030	4055.77	6718.51	0073	0000	Davis	Stratified	Sunny, flat
					193800		153800	4055.44	6717.35		0063		site	calm
CI16494.001	CTD	085	CI9407B.043	940613	020000	940612	220000	4052.21	6717.43	0085	0000	Gifford/Durbin	Stratified	
					021600		221600	4052.40	6717.50		0065		site	
CI16494.002	ZPP	021	CI9407B.043	940613	025500	940612	225500	4052.59	6718.19	0084	0000	Durbin	Stratified	
					034000		234000	4053.11	6718.38		0065		site	
CI16494.003	MOC	044	CI9407B.043	940613	035000	940613	235000	4052.99	6718.46	0084	0000	Miller/Durbin	Stratified	
					041000		241000	4053.86	6718.15		0080		site	
CI16494.004	VPR	018	CI9407B.043	940613	050800	940613	010800	4053.26	6718.63	0084	NA	Davis	Stratified	
					063800		023800	4054.38	6718.12		NA		site	
CI16494.005	CTD	086	CI9407B.043	940613	070200	940613	030200	4054.60	6717.95	0081	0000	Gifford/Durbin	Stratified	
					071700		031700	4054.72	6717.76		0061		site	
CI16494.006	DFT	013	CI9407B.043	940613	080300	940613	040300	4054.18	6716.65	0084	NA	Durbin	Stratified	Recover
					NA		NA	NA	NA		NA		site	drifter
CI16494.007	CTD	087	CI19407B.04	940613	110400	940613	070400	4120.94	6725.06	0042	0000	Gifford/Durbin	Hydro	
					111100		071100	4120.80	6725.03		0031		section	
CI16494.008	MOC	045	CI9407B.044	940613	112000	940613	072000	4120.63	6725.04	0044	0000	Miller/Durbin	Hydro	
					113000		073000	4153.86	6718.15		0035		section	
CI16494.009	CTD	088	CI9407B.045	940613	122000	940613	082000	4114.72	6720.48	0048	0000	Gifford/Durbin	Hydro	
					122900		082900	4114.67	6720.72		0035		section	
CI16494.010	CTD	089	CI9407B.046	940613	132000	940613	092000	4108.47	6715.85	0058	0000	Gifford/Durbin	Hydro	Severe
					133300		093300	4108.57	6716.15		0042		section	spiking

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EVENT#	Instrume	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDep	InsDep	PI	Region	Comment
vvdddyy.eee	IIIIII	XXX	vvccccl.sss	YYMMDD	HHMMSS	YYMMDD	HHMMSS	DDMM.FF	DDMM.FF	DDDD	dddd;	"NNNN"	"RRR PPP"	"CCC TTT"
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI16494.011	CTD	090	CI9407B.046	940613	133900	940613	093900	4108.62	6716.24	0068	0000	Gifford/Durbin	Hydro	Repeat
					134600		094600	4108.69	6716.37		0040		section	cast
CI16494.012	CTD	091	CI9407B.047	940613	145200	940613	105200	4102.22	6711.42	0068	0000	Gifford/Durbin	Hydro	
					150000		110000	4102.38	6711.60		0050		section	
CI16494.013	MOC	046	CI9407B.047	940613	150700	940613	110700	4102.28	6711.56	0068	0000	Miller/Durbin	Hydro	
					151800		111800	4102.31	6711.57		0063		section	
CI16494.014	CTD	092	CI9407B.048	940613	162300	940613	122300	4055.97	6706.66	0062	0000	Gifford/Durbin	Hydro	
					163300		123300	4055.99	6706.91		0081		section	
CI16494.015	CTD	093	CI9407B.049	940613	173300	940613	133300	4049.59	6702.12	0090	0000	Gifford/Durbin	Hydro	
					174400		134400	4049.67	6702.04		0075		section	
CI16494.016	CTD	094	CI9407B.050	940613	184100	940613	144100	4043.30	6657.12	0131	0000	Gifford/Durbin	Hydro	
					185400		145400	4043.15	6656.56		0120		section	
CI16494.017	MOC	047	CI9407B.050	940613	185500	940613	145500	4043.29	6657.06	0143	0000	Miller/Durbin	Hydro	
					192800		152800	4042.55	6655.77		0135		section	
CI16494.018	CTD	095	CI9407B.051	940613	202500	940613	162500	4037.04	6652.95	0491	0000	Gifford/Durbin	Hydro	
					211800		171800	4037.76	6649.02		0470		section	
CI16494.019	CTD	096	CI9407B.052	940613	222300	940613	182300	4046.03	6638.86	0783	0000	Gifford/Durbin	Hydro	
					225400		185400	4046.00	6638.18		0485		section	
CI16594.001	CTD	097	CI9407B.053	940614	001100	940613	201100	4055.91	6624.76	1187	0000	Gifford/Durbin	Hydro	
					004300		204300	4055.12	6624.05		0480		section	
CI16594.002	VPR	019	CI9407B.053	940614	010349	940613	210349	4054.62	6623.39	1783	0000	Davis	Transect	
				940615	040900	940615	000900	4238.35	6716.81		0126			
CI16694.001	ZPN	041	CI9407B.054	940615	045300	940615	005300	4222.77	6710.09	0344	NA	Runge	Georges	Live
					050900		010900	4222.56	6710.1		NA		Basin	tow
CI16694.002	CTD	098	CI9407B.054	940615	053600	940615	013500	4222.95	6710.13	0344	0330	Gifford/Durbin	Georges	
					061100		021100	4222.75	6710.75				Basin	

CI9407 EVENT LOG

EVENT#	Instrume	Cast#	STATION#	GMTdate	GMTtime	Locdate	Loctime	Latitude	Longitude	WatDep	InsDep	PI	Region	Comment
vvdddyy.sss	IIIII	XXX	vvccccf.sss	YYMMDD	HHMMSS	YYMMDD	HHMMSS	DDMM.FF	DDMM.FF	DDDD	dddd	"NNNN"	"RRR PPP"	"CCC TTT"
				yymmdd	hhmmss	yymmdd	hhmmss	ddmm.fff	ddmm.fff	dddd	DDDD			
CI16694.003	MOC	048	CI9407B.054	940615	062600	940615	022600	4222.49	6710.71	0338	0000	Miller/Durbin	Georges	Diapause
					073000		033000	4221.4	6712.92	0359	0322		Basin	collection
CI16694.004	CTD	099	CI9407B.055	940615	174800	940615	134800	4153.33	6913.09	0220	0000	Gifford/Durbin	Wilkinson	
					181000		141000	4153.75	6913.21		0190		Basin	
CI16694.005	MOC	049	CI9407B.055	940615	181500	940615	141500	4153.66	6913.22	0215	0000	Miller/Durbin	Wilkinson	Diapause
					190700		150700	4155.68	6911.92		0199		Basin	collection
CI16694.006	MOC	050	CI9407B.055	940615	194500	940615	154500	4153.07	6912.33	0218	0000	Miller/Durbin	Wilkinson	Calanus
					220100		180100	4151.93	6906.72		0035		Basin	soup

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