Cruise Report

R/V ENDEAVOR Cruise 308 to Georges Bank

U.S. GLOBEC

NW ATLANTIC/GEORGES BANK STUDY

21 - 26 October 1997

Acknowledgments

This cruise and preliminary data report was prepared by Jim Irish, Bill Williams, and Jeff van Keuren from cruise logs and notes as a first draft documents of the activities, positions and data collected during R/V ENDEAVOR cruise EN308. We acknowledge the excellent support of Captain Taylor and the crew of the Research Vessel ENDEAVOR for their hard work and assistance that allowed us to deploy new and recover old Southern Flank moorings and take supportive CTD profiles and sections between storms.

The GLOBEC research effort is sponsored by the National Science Foundation and the National Oceanic and Atmospheric Administration. Support for the Long-Term Moored Program, as part of the U.S. GLOBEC Northwest Atlantic/Georges Bank Study, was provided by NSF research grant OCE-96-32348. All data and results in this report are to be considered preliminary.

OCE - 9631468

Cruise Report
GLOBEC R/V ENDEAVOR EN308

Table of Contents

List of Pictures:

List of Tables:

Cruise Report

GLOBEC R/V ENDEAVOR - EN308

US State Department Cruise No. 97-
Woods Hole, to Georges Bank to Woods Hole
21 - 26 October 1997

Purpose

The primary purpose of EN308 was to support the US GLOBEC Long-Term moored program on Georges Bank. Specifically, to:

(1) deploy a refurbished science mooring with two guard buoys at the southern flank site,
(2) recover the old science mooring and guard buoys at the southern flank site,
(3) take supportive CTD yo-yos at the mooring site for *in situ* calibrations,
(4) take standard CTD sections in support of the GLOBEC program, and
(5) take biological samples at standard stations to obtain a picture of the zooplankton present on Georges Bank in the fall.

The ship's track sailed on EN308 is shown in Figure 1.

Accomplishment Summary

Science buoy D and two guards were deployed at the southern flank site. The science mooring was deployed between the two guard buoys, and the array aligned along the depth contour with a 60°T heading. After the deployment an hour long yo-yo CTD was made as an *in-situ* calibration check on the new science mooring and an end of deployment check on the old mooring. A Sea Data bottom pressure instrument in a separate frame with acoustic release was finally deployed between the science and guard moorings. Then the recovery operations for the old moorings commenced.

Science buoy E, in place on the southern flank site since June 1997, was successfully recovered as was foam guard buoy F. Steel guard buoy C was missing from the site and presumed cut loose by fishing activities or lost due to mooring failure during a storm and is now probably lost to the program. Data was dumped from the science buoy, the Seacats and ADCP instruments on the mooring and preliminary data checked. The overall data return was excellent.

The standard long-term moored CTD sections from the Atlantic up onto the crest of the Bank and from the crest out into the Northeast Channel were made. The southern flank section was repeated twice. Solar radiation observations were made with a shipboard PAR sensor, as well as with the CTD profiling PAR and reference PAR. As part of this survey water samples were also taken for biological studies to determine zooplankton population distributions on Georges Bank in the fall.

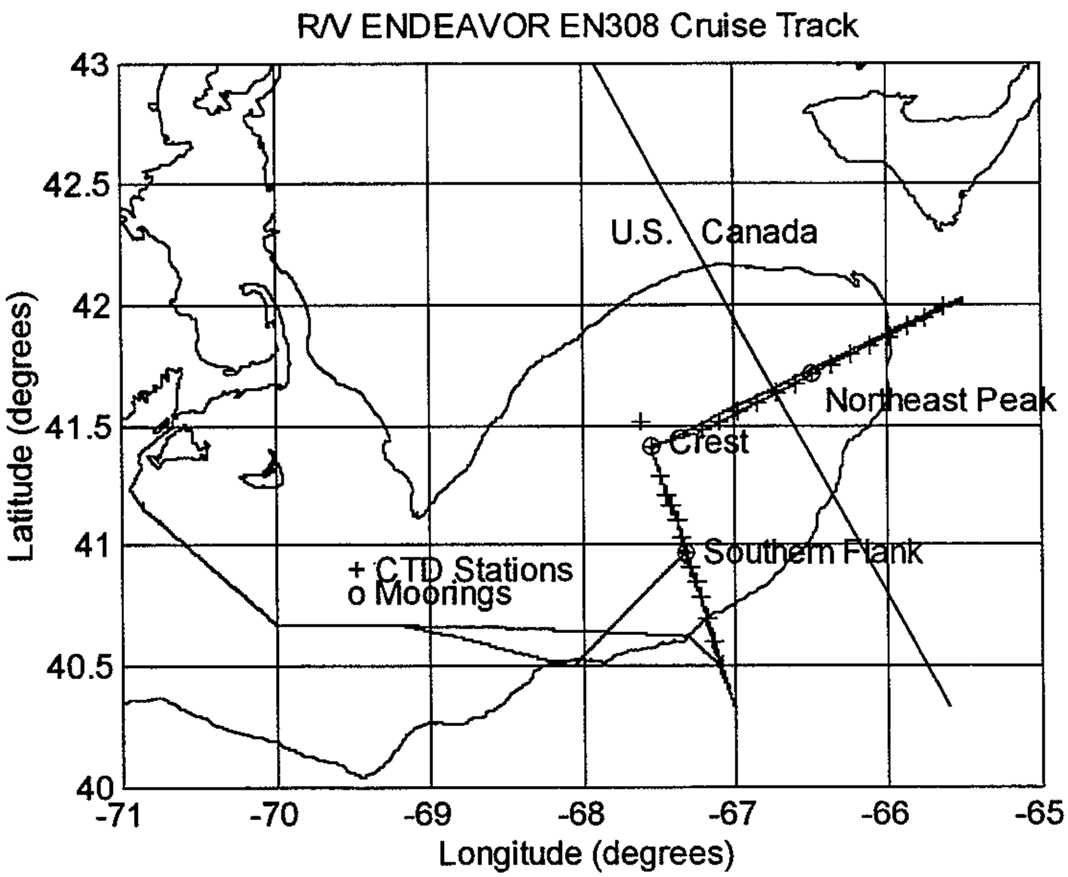


Figure 1. R/V ENDEAVOR Cruise EN308 Cruise Track. The cruise track is shown with a line, the standard CTD stations shown with a '+', and the long-term mooring locations with a 'o'. The Northeast Peak CTD section extends into the Northeast Channel and Canadian waters.

Cruise Results:

Mooring Deployments

Guard Buoys: In order to reduce the damage due to fishing activities on the scientific moorings, two guard buoys have been placed on either side of the main science mooring. These guard buoys (Picture 1) are steel flotation spheres filled with foam. They have towers on top which hold a guard light, radar reflector, two solar panels and a battery in a pressure case. The mooring configuration for both guard moorings is shown in Figure 2. Two buoys labeled "A" and "B" were deployed along the bottom contour at 76 meters depth about 1/4 mile apart on a heading of about 60°. The times of deployment and positions of these two guard moorings are given in Table 1 and shown in Figure 4. The science buoy and bottom pressure instrument were subsequently deployed between these two guard moorings.

Science Buoy D: A new science mooring with newly cleaned and calibrated sensors, and mooring hardware was prepared prior to leaving WHOI on this cruise, so that no instrumentation had to be turned around at sea. The mooring configuration for the science mooring is shown in Figure 3 and the sensors used listed in Table 2. Because the winter water on the southern flank of

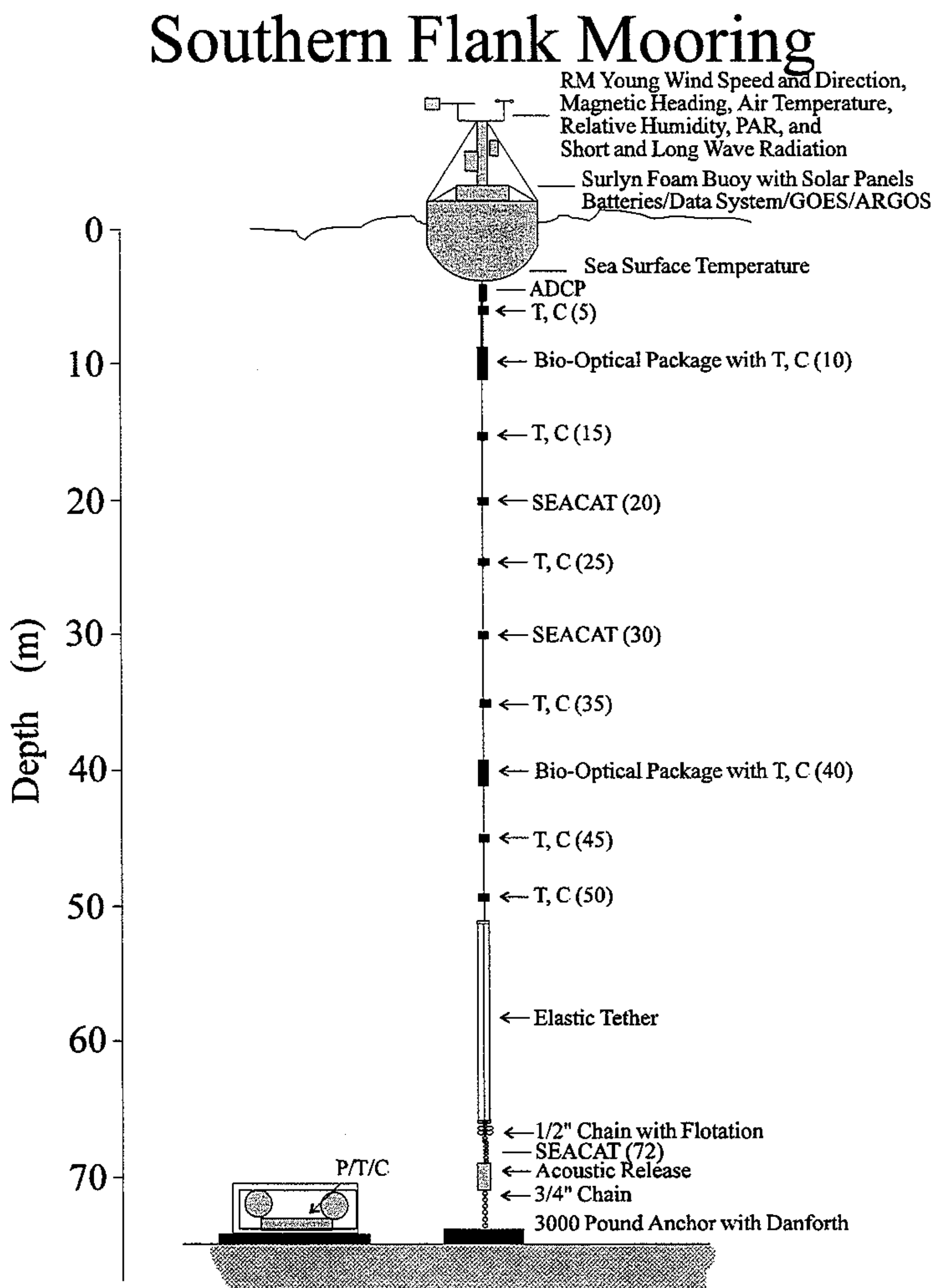
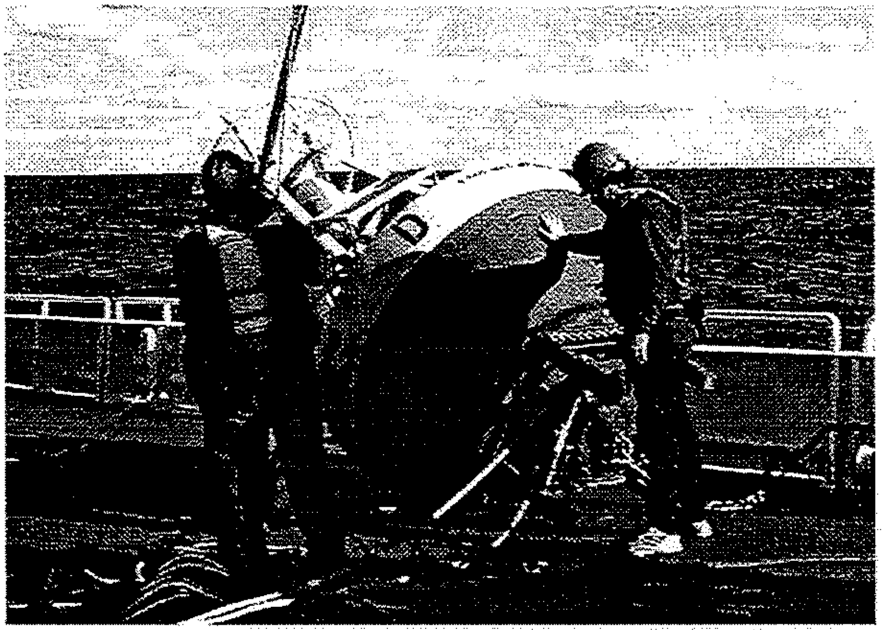
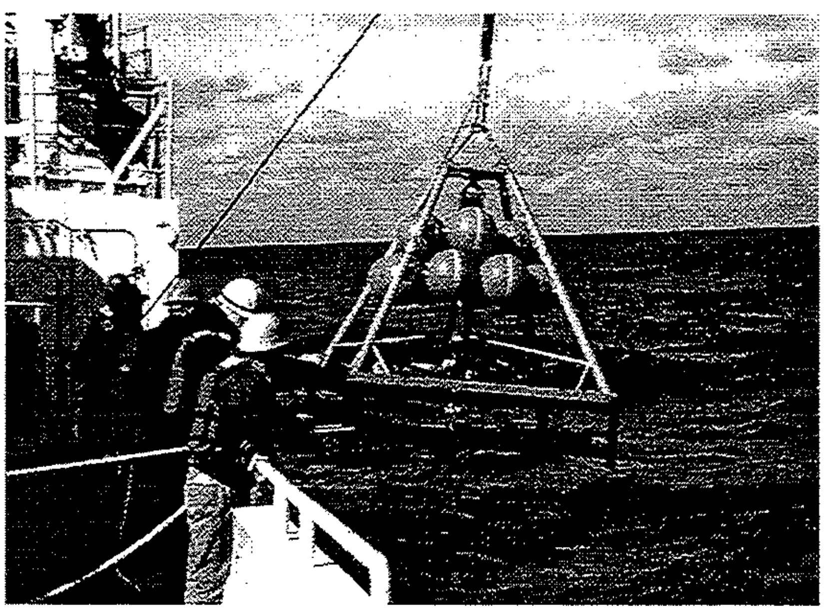


Figure 3. The southern flank science mooring configuration. This is the configuration of the mooring recovered. The mooring deployed is missing some temperature conductivity sensor pairs as is listed in Table 2. The bottom pressure is also shown for completeness.



Picture 2. Southern flank science mooring D ready for deployment on the R/V Endeavor. Bos'n Jack Buss is on the left and Kent Bradshaw on the right. The top of the ADCP frame is shown at the far right sitting on deck. The garden hose and fire hose protects the electrical cable as it runs around the chain just below the buoy.

Bottom Pressure: In order to analyze for tides, and low-frequency sea level fluctuations, a bottom pressure instrument is being deployed. In the past we utilized older Sea Data instruments which have proven unreliable at the end of their life. These have been retired, and a Sea Bird Seagauge deployed on the bottom frame this time (see Picture 3). The instrument was deployed between the science and a guard mooring (see Table 1 and Figure 4).



Picture 3. The bottom pressure instrument being deployed. The pressure instrument is mounted horizontally in the aluminum frame just above the steel anchor frame and can just be seen. The pressure port is between two parallel plates to reduce current effects on the bottom pressure observation. An acoustic release is upright in the middle of the frame, and releases the anchor so the package returns to the surface on the buoyancy supplied by the plastic balls at the top.

Table 2. Sensor Type, Depth and Serial Numbers

				Recovered	Deployed
Measurement	Sensor Type	Company	Model	Serial Number	Serial Number
Buoy Met	Air Temperature	Rotronics		35851	16302
	RElative Humidity	Rotronics		35851	16302
	Wind Speed and Dir	RM Young			
	PAR	LiCor	UWQ	5018	4949
	Short Wave Rad	Eppley		27953F3	28300
	Long Wave Rad	Eppley		27953	
Sea Surf Temp	Temp at 1 m	Sea Bird	SBE-3	31632	32176
	Cond at 1 m	Sea Bird	SBE-4	N/S	41340
Current Profiles	ABDP	RD Instruments	Workhorse	125	130
T/C at 5 m	Temp at 5 m	Sea Bird	SBE-3	32429	32173
	Cond at 5 m	Sea Bird	SBE-4	41890	41342
BIOP at 10 m		Luigi		1	5
	Temp at 10 m	Sea Bird	SBE-3	484	478
	Cond at 10 m	Sea Bird	SBE-4	68	41379
	OBS at 10 m	Sea Point		demo	N/S
	Trans at 10 m	Sea Tech	25 cm	620	626
	Fluor at 10 m	Sea Tech			305
	PAR at 10 m	LiCor	SPQA	1659	1972
T/C at 15	Temp at 15 m	Sea Bird	SBE-3	32430	N/S
	Cond at 15 m	Sea Bird	SBE-4	41890	N/S
T/C at 20	Temp/Cond at 20 m	Sea Bird	SBE-16 Seacat	2359	1820
T/C at 25	Temp at25 m	Sea Bird	SBE-3	32432	N/S
	Cond at 25 m	Sea Bird	SBE-4	41713	N/S
T/C at 30	Temp/Cond at 30 m	Sea Bird	SBE-16 Seacat	2360	1735
T/C at 35	Temp at 35 m	Sea Bird	SBE-3	32431	N/S
	Cond at 35 m	Sea Bird	SBE-4	41367	N/S
BIOP at 40 m		Luigi		2	4
	Temp	Sea Bird	SBE-3	32178	477
	Cond	Sea Bird	SBE-4	59	41377
	Trans	Sea Tech	25 cm	621	628
	Fluor	Sea Tech			306
	PAR	LiCor	SPQA	1971	1792
T/C at 45	Temp at 45 m	Sea Bird	SBE-3	32177	N/S
	Cond at 45 m	Sea Bird	SBE-4	41365	N/S
T/C at 50	Temp at 50	Sea Bird	SBE-3	31624	32064
	Cond at 50	Sea Bird	SBE-4	41711	41342
T/C at 72	Temp/Cond at 72 m	Sea Bird	SBE-16 Seacat	1861	2006
Acoustic Release		EG&G	BACS	17962	17306
Bottom Pressure Instrumentation					
	Pressure Instrument	Sea Bird	SBE-26		49
	Conductivity	Sea Bird	SBE-4		41164
	Acoustic Release	EG&G	BACS		17308

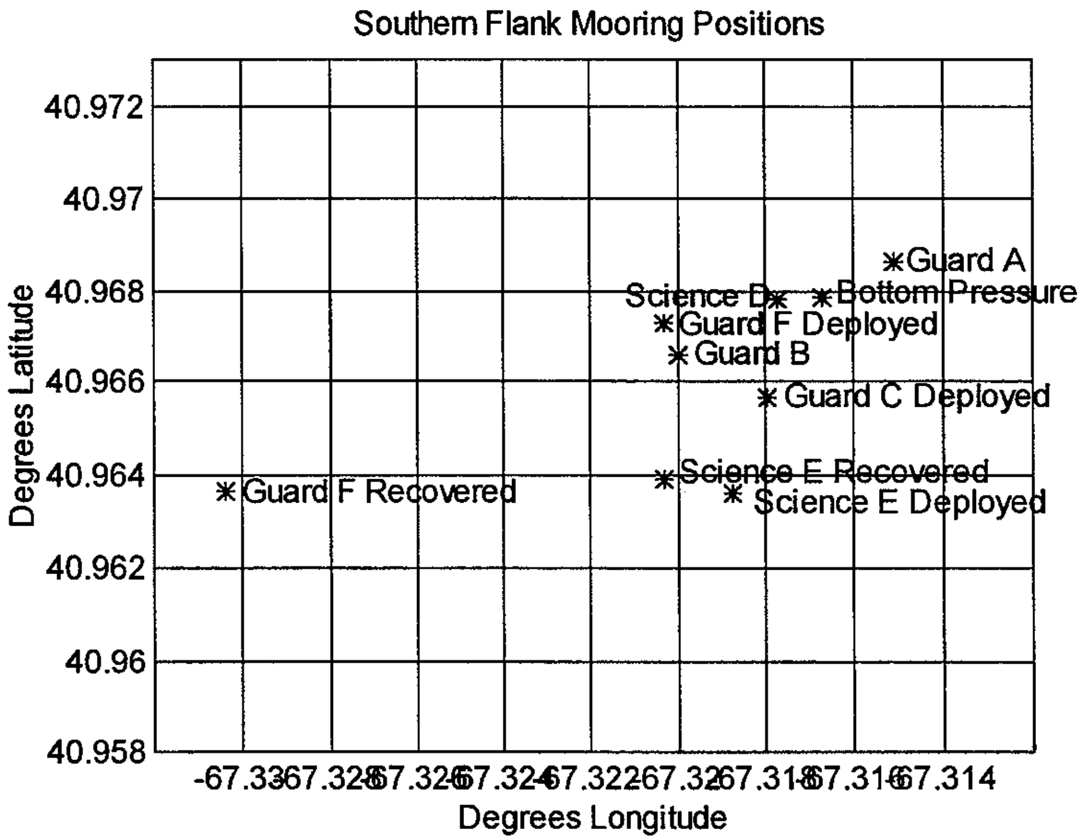
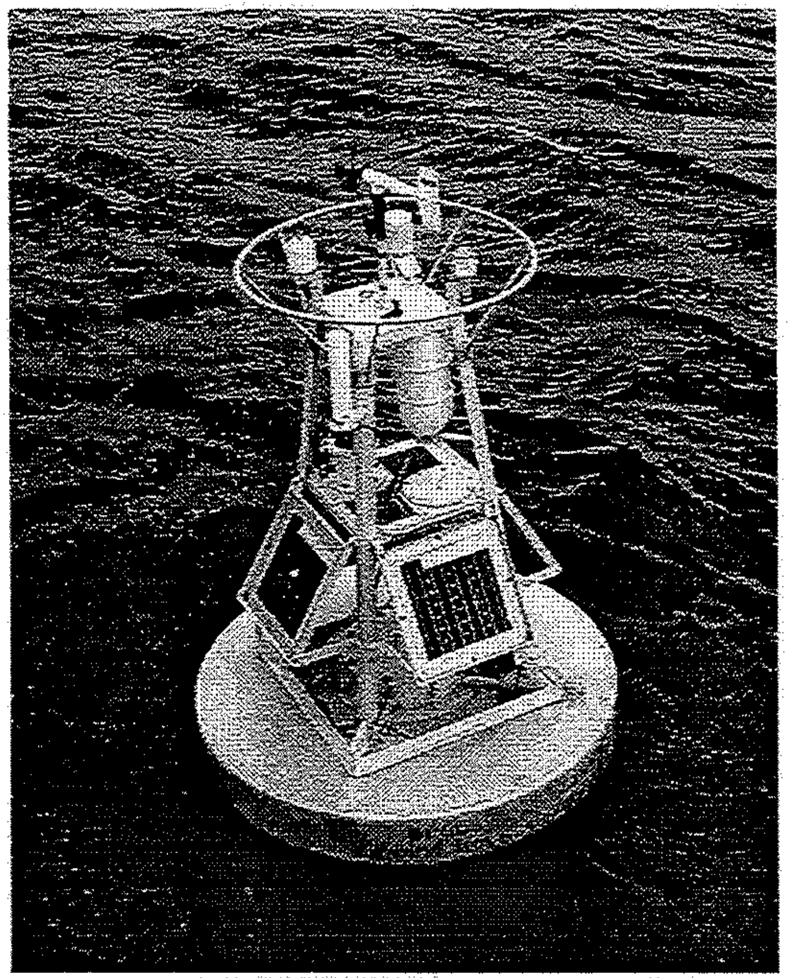


Figure 4. Mooring positions. The positions of the moorings from GPS fixes at deployment or recovery time. Note the movement of Guard Buoy F from deployment to recovery which is most likely due to fishing activities.

Mooring Recovery

Science Buoy E: After the new guard, science mooring and bottom pressure were deployed, science buoy E was recovered. This mooring was deployed in April from the R/V KNORR, recovered in May by the R/V ALBATROSS IV when it was cut loose by fishing activities and redeployed 21 June 1997 from the R/V OCEANUS. The mooring was released from the anchor by its acoustic release on the first command and the subsurface float surfaced. As the ship moved in for recovery, Picture 1 shows an excellent view of the meteorological sensors.

The buoy was in good physical condition and most of the sensors were functioning properly when the it was recovered. There was no observable wear on the mooring components, although the whole mooring, including the bio-optical packages, was moderately bio-fouled. When on deck the data was dumped from the PCMCIA storage in the buoy, from the ADCP memory and from the Seacats. As an assessment of buoy system performance and first order normalization of the records were done with old calibration constants and data plotted out in Figures 5 through 11 for a quick look.



Picture 4. Southern Flank Science Buoy E during recovery. The meteorological sensor suite (located on top of the buoy) can be clearly seen. The anemometer is centrally located at the highest point. The long-wave radiation sensor is on the left and the short-wave radiation sensor on the right. The air temperature/relative humidity sensor in a Gill radiation shield is on the far side, and the small dark cylinder on the near side of the top is the PAR sensor (cosine collector). The white cylinder on the outside of the near tower leg is the GOES and ARGOS satellite antenna. The radar reflector and guard light (behind the GOES antenna) are in the top section of the tower. To the right of the light, the plate above the solar panel covered with Plexiglas is the backup ARGOS transmitter antenna. The four 20 watt solar panels mounted on the four tower legs and can hinge up to gain access to the electronics well in the center of the buoy.

The hourly averaged meteorology from the buoy is shown in Figure 5. The air temperature shows the usual fluctuations and the cooling with the end of summer, and is typical of past years. The winds show one significant storm toward the end of the record. The gust record is the maximum 1 Hz sample during the hour, and during storms is typically significantly higher (1.5 times) than the averaged winds. The radiation data (Figure 6) shows that the PAR(integrated 400 to 700 nm) and the short wave (integrated 300 to 5,000 nm) are quite similar, indicating that the visible light is the largest contribution to the signal. The long wave radiation (3 to 100 μm)

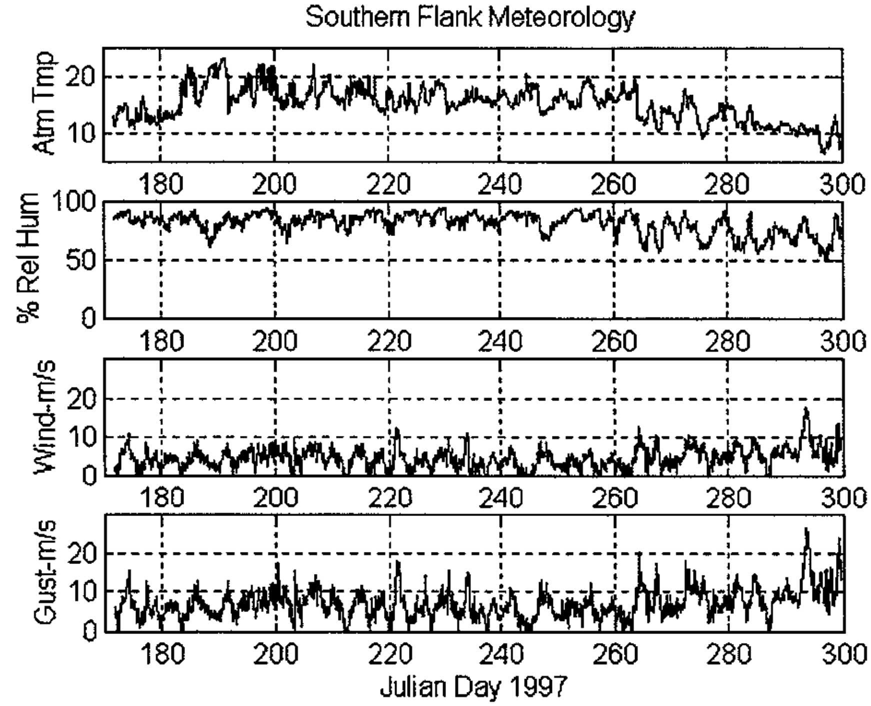


Figure 5. The unedited Southern Flank mooring meteorology data. The atmospheric temperature is given in degrees C. The observations are hourly averages, except for the wind gust, which is the fastest single observations (sampled at 1 Hz) during the hour.

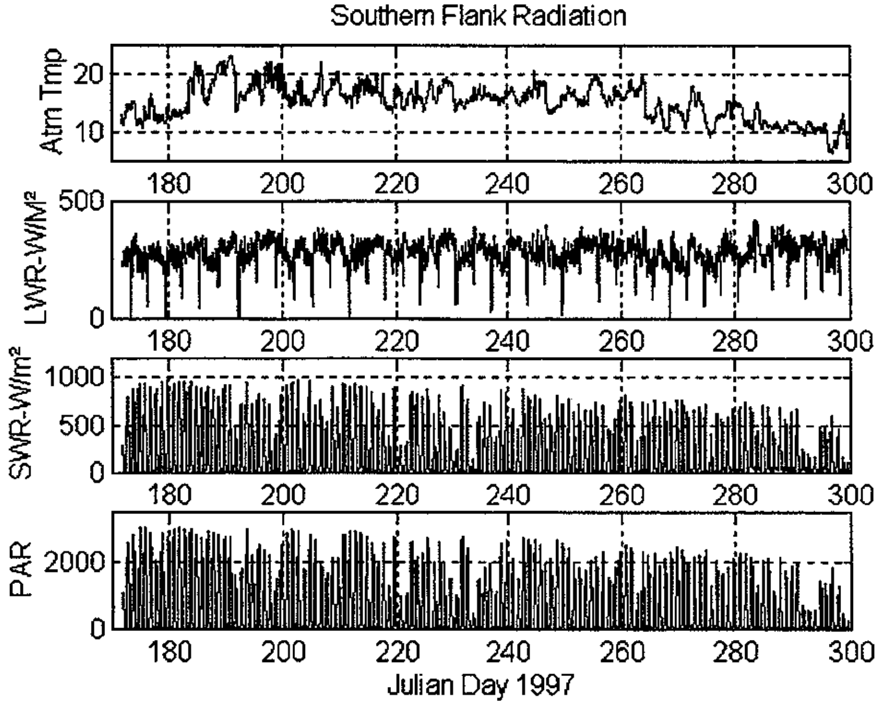


Figure 6. The unedited Southern Flank mooring radiation data. The atmospheric temperature is in degrees C. The observations are hourly averages of more rapidly sampled data. The long-wave radiation contains spikes at both a 30 hour period and at times of GOES transmissions which will be removed. The units of PAR are micro Einsteins/second/meter^2.

has several data system related spikes which make the high frequency variability appear larger than it actually is. These errors are easily corrected in post processing. The larger spikes at roughly 30 hour intervals are a persistent feature that we have yet to adequately explain, but is instrumental.

The Sea Bird temperature and conductivity (converted to salinity) records from the mooring at the odd 5 meter increments are plotted in Figures 7 and 8. The data appear to be good, except for the temperature at 50 meters, which appears to go bad, probably due to a cabling problem, after JD280. This is reflected in the salinity series at 50 meters. The conductivity record at this depth appears to be good. The salinity record at 5 meters (Figure 8) also appears to go bad just before JD280. This is a problem with the conductivity sensor.

The Seacat temperature and conductivity (converted to salinity) records are plotted in Figures 9 and 10. These are 1 minute samples, and show the high-frequency internal wave events seen in the past. The Seacat at 30 meters appears to have a shift in temperature after a few days deployment. This was a new instrument, and probably suffered an electronic failure. The record appears to be realistic, but shifted, as if the oscillator were running at higher than expected frequency. This sensor is being recalibrated to see if its behavior is consistent enough that we can have confidence in a corrected record.

The temperature and salinity records (Figures 7, 8, 9, and 10) show a remarkable feature starting about JD185 1997 (4 July). There is a large, warm-core-ring like effect where the surface temperatures warm by 12° C and salinity increases by nearly 4 PSU. The records remain high for more than a week. This is not the advection of the shelf slope front across the mooring, but a significant on Bank intrusion of warm salty water. The effects are mostly confined above 40 meters, but the effects extend down to the bottom where a 5°C and 2 PSU signal is seen. This is significantly greater than any intrusive effects seen in the past two years and the dominant signal seen in the moored records. The effects of warm salty water are seen in the mooring in decreasing magnitudes through JD220 (8 Aug). The fall is surpassingly event free, and the surface cooling of the water after this time is clearly seen. This has not been possible in previous years because of warm, salty intrusive events during this time.

The ADCP water velocity profiles show the typical low-frequency down shelf transport and higher frequency tidal fluctuations. Figure 11 shows the time series of Northgoing and Eastgoing velocities at 13 meters. The tidal signals are almost lost in the 5 month long record, but the lower frequency modulation of the record and to a lesser extent the fortnightly beating of the solar and lunar tides is apparent. There is no obvious relationship with the wind and current events as was seen during hurricane Edouard in 1996. There is significant baroclinic structure in the currents which is not shown.

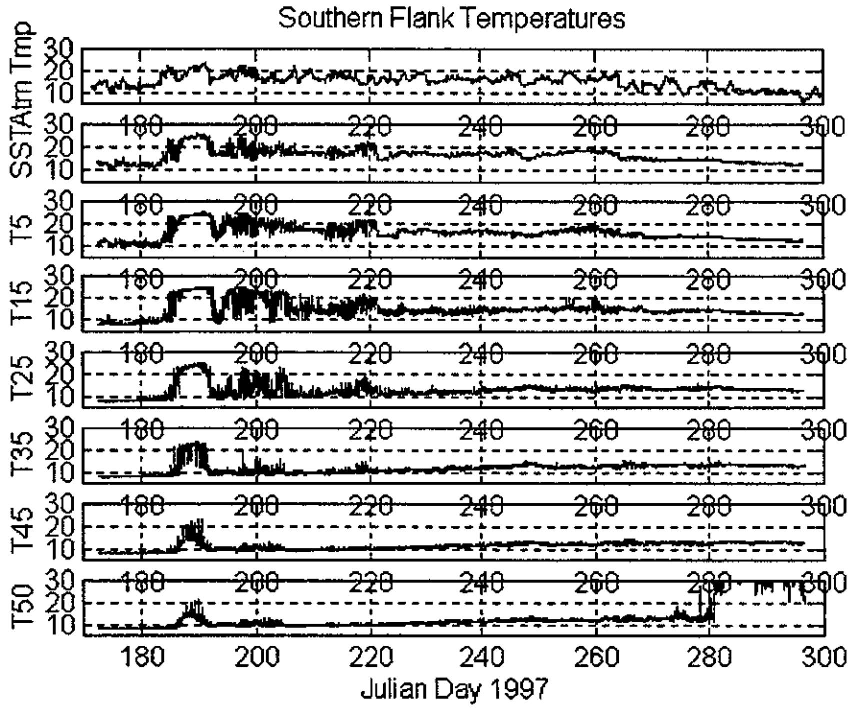


Figure 7. Unedited Southern Flank temperature records. The temperature at 50 meters appears to go bad after JD280 and is most likely due to a cabling problem.

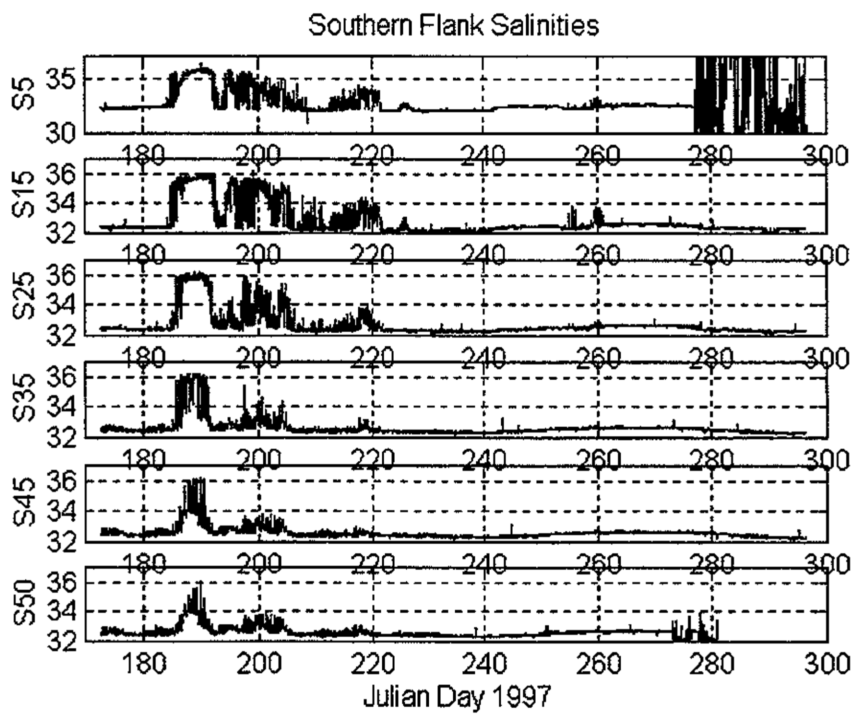


Figure 8. The unedited Southern Flank Salinity records. The 5 meter salinity sensor appears to go bad about JD275. The bad data in the 50 meter salinity is due to cable problems in the temperature record (see Figure 7).

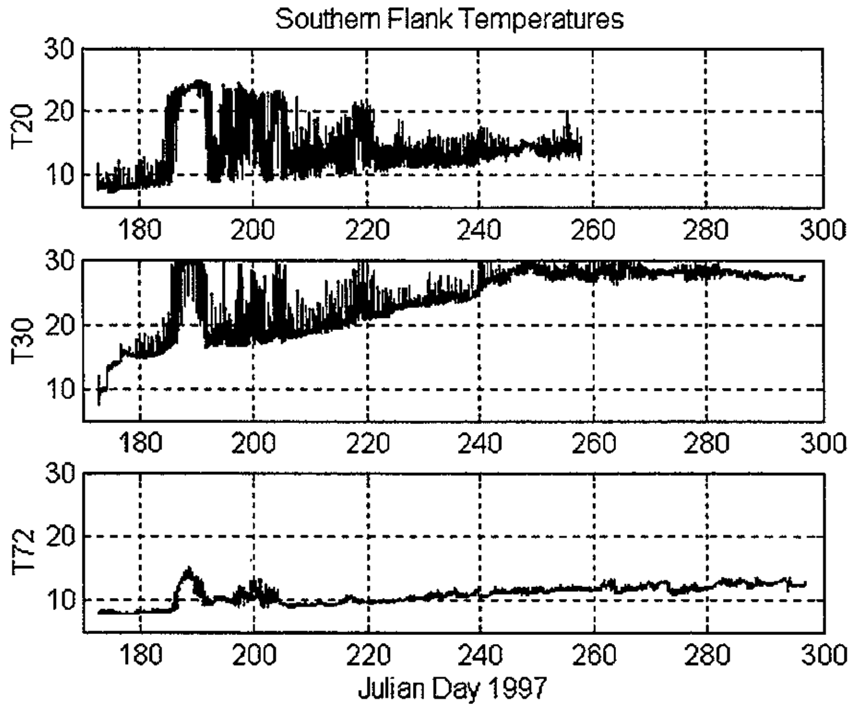


Figure 9. The unedited Southern Flank Seacat temperature records. The 30 meter Seacat had a failure which caused a shift in calibration after a few days.

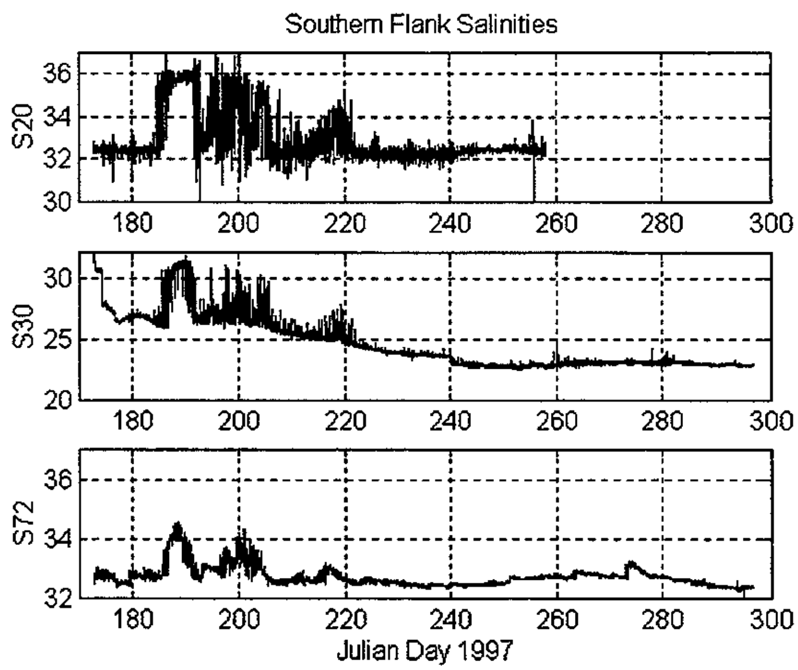


Figure 10. Unedited Southern Flank Seacat salinity records. The shift in temperature sensor appears as a shift in computed salinity. The conductivity record appears OK.

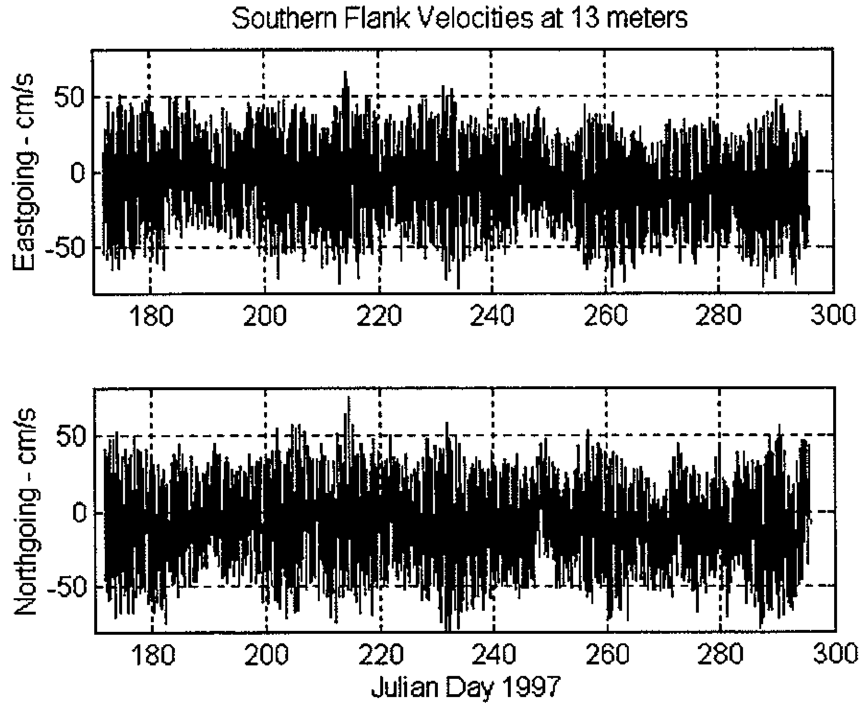


Figure 11. ADCP currents (Eastgoing and Northgoing) at about 13 meters depth from the southern flank mooring. The strongest signal is the tidal fluctuations upon which is superimposed the low frequency weather forced variations and the normal downshelf flow.

Guard Buoy F: After the recovery of the science buoy, the foam guard buoy F was recovered. It was well out of deployment position (Figure 4). It appeared to be in good shape as we approached, except the light was not working, and the top of the tower (light guard) was bent as if the buoy had been hit. When the buoy was lifted out of the water, the metal section came out of the foam. The tie rods which tied the top with the base were in the top, but the base was not attached. Since the top section held the mooring chain, it was firmly held onto the foam by mooring tension. The chain was attached to the mooring winch and pulled in. When the anchor was reached, it pulled the foam, base (which had slid down the chain and was resting on the anchor), and anchor aboard. It was apparent that the base had come loose from the buoy over time. The tie rod holes in the base were enlarged to where the washers could pull out. The holes in the foam for the tie rods were worn into horn shape with the bell at the base. The base had also warn into the foam as one tow and three tie rods came loose and the base was rocked back and forth by the sea. It is not clear what caused the tie rods to become slack and allow the base to move back and forth. This is a design problem with these buoys which should be corrected by the addition of braces which hold the base to the central battery well and prevent the base from moving horizontally. Therefore, if the tie rods were to become slack, then the base could not move back and forth to wear where the tie rods attach. The buoy has been deployed nearly continuously for 2½ years and shows little wear and corrosion. The solar panels were working properly and the battery fully charged. The light was wet, and the electrical terminals corroded.

CTD Sections:

Yo-Yo *In Situ* Calibration Profiles: While both the new and the old science moorings were in place at the Southern Flank Site, a one hour CTD yo-yo series was taken beside them for in situ calibration purposes. Practically, it is quite difficult to do a good *in-situ* calibration because of the natural variability of the water, and the difficulty in keeping the surveying vessel by the mooring. However, the CTD yo-yo's do give a comparison of the CTD and moored observations at the ends of the deployment and, in times of low horizontal and vertical variability, the comparsons are good. In particular, when temperatures agree quite well, then the salinities can be used to correct for moored conductivity sensor drift. Since the moorings average each sensor's output over one hour, the CTDs used for comparison should be averaged over the same time interval - extending from the half hour to the next half hour.

Long-Term Southern Flank Section: The standard Long-Term Section (see "+" in Figure 1) was occupied twice during this cruise. Once inbetween mooring operations at the southern flank site on 22, 23, 24 October 1997 and again on 25 October 1997. Contour plots of the final data from this section are shown in Figures 12 though 21 (temperature, salinity, potential density, transmissometer output and fluorometer output) and a T-S plot of all the data collected on the section shown in Figure 22.

The continuous series of profiles takes about 12 to 14 hours to make. It stretches from the well-mixed region over the crest of the bank past the southern flank mooring site and across the shelf break front into the North Atlantic. It should be noted that the first time this section was occupied on this cruise it was not a continous series of profiles. The largest gap in time occurs between CTD casts 1 and 12 which are adjacent in the section but taken one day apart.

Starting at the on-bank end of the section, where the water depth is < 60 m, the water is within the tidal mixing front and so is well mixed. The temperature there is about 14 deg C and salinity 32.4 PSU. Between the tidal mixing front and the shelf-break, the surface waters have a roughly constant temperature and salinity of 12 to 13 deg C and 32.2 to 32.4 PSU. Below the surface waters there is a transition from the surface water to the Maine Intermediate Water found at the shelf-break. This creates both horizontal and vertical stratification with the temperature ranging from 12 to 9 deg C and the salinity from 32.6 to 34.2 PSU. A vertically homogeneous bottom boundary layer due to tidal mixing can be seen in some of the CTD casts in this region.

Beyond the shelf-break there are four water masses present. Below about 130 m, there is oceanic water in two layers. The upper layer of this water is Warm Slope Water with a maximum temperature of about 12 deg C and a salinity of > 34.2 PSU. The salinity is about 35.4 PSU at the maximum temperature. Below this is slope water, which is cooler than the Warm Slope Water above it. Its temperature ranged from 11 deg C to 7 deg C and its salinity was > 35 PSU. Above about 130 m the water masses originate from the shelf. At the surface down to about 70 deep there is the same water mass that is at the surface over the southern flank. The temperature is 12 to 14 deg C and salinity is 32.2 to 32.4 PSU. Sandwiched between the Warm Slope Water and the surface water there is a band of Maine Intermediate Water from the Gulf of Maine that stretches from the shelf break to the end of the section. It forms a temperature minimum of 7 deg C and the salinity at that point is about 33 PSU. It is unusual that the core of this water is not at the shelf break but some distance off shore.

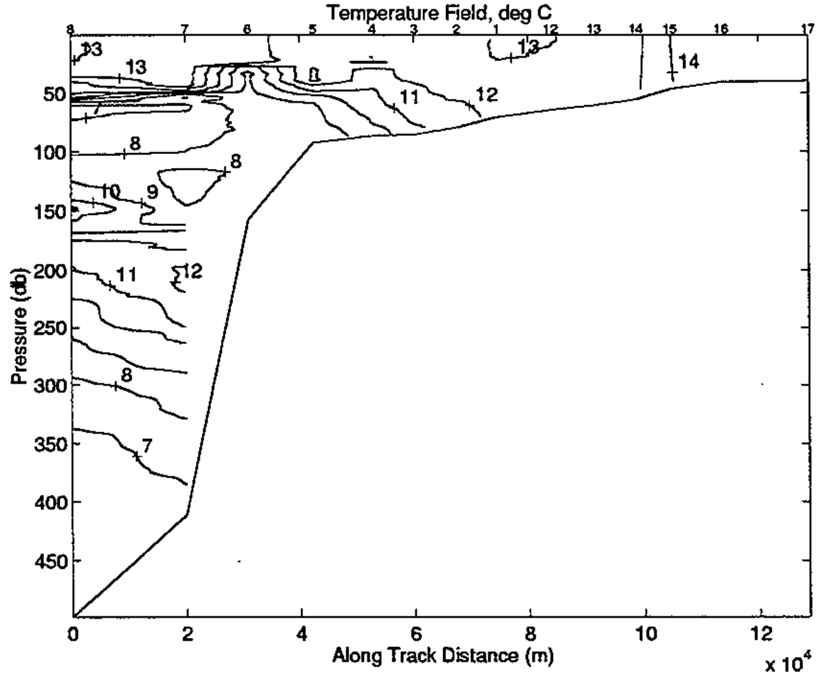


Figure 12. Contours of temperature at 1° C intervals for the Long-Term Section conducted on 22, 23, 24 October 1997. The blanked out region shows the depth to which data was collected and closely follows the bathymetry except in the deep casts. The numbers at the top of the figure are the CTD cast numbers and mark the position of each profile of the section.

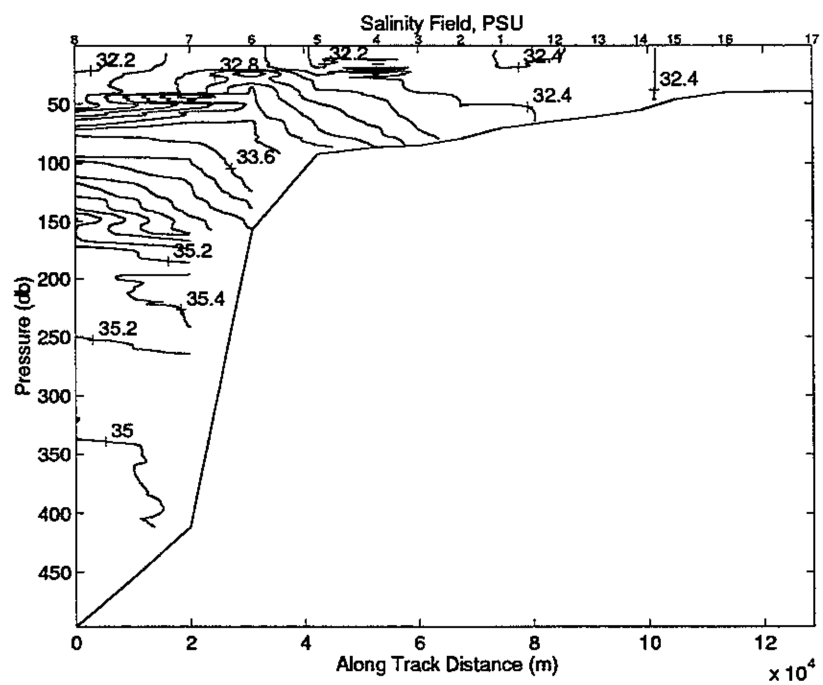


Figure 13. Contours of salinity at 0.2 PSU intervals for the Long-Term Section conducted on 22, 23, 24 October 1997. The blanked out region shows the depth to which data was collected and closely follows the bathymetry except in the deep casts. The numbers at the top of the figure are the CTD cast numbers and mark the position of each profile of the section.

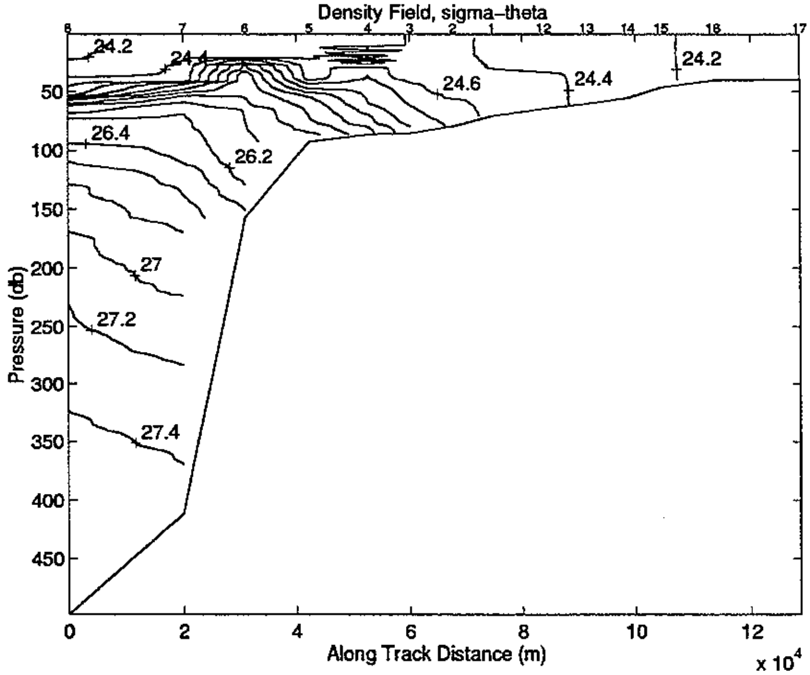


Figure 14. Contours of potential density at 0.2 kg/m^3 intervals for the Long-Term Section conducted on 22, 23, 24 October 1997. The blanked out region shows the depth to which data was collected and closely follows the bathymetry except in the deep casts. The numbers at the top of the figure are the CTD cast numbers and mark the position of each profile of the section.

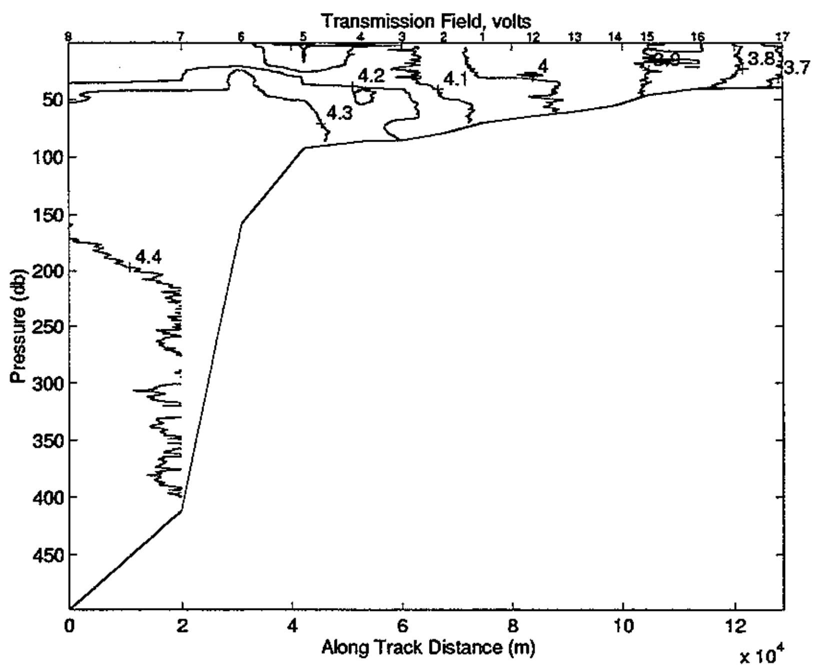


Figure 15. Contours of transmission at 0.1 V intervals for the Long-Term Section conducted on 22, 23, 24 October 1997. The blanked out region shows the depth to which data was collected and closely follows the bathymetry except in the deep casts. The numbers at the top of the figure are the CTD cast numbers and mark the position of each profile of the section.

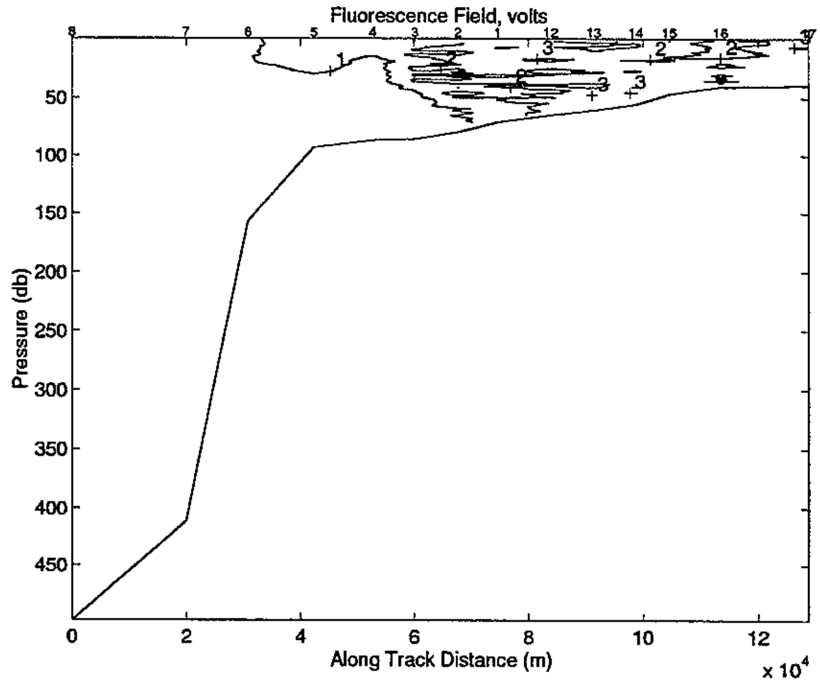


Figure 16. Contours of relative fluorescence at 1 V intervals for the Long-Term Section conducted on 22, 23, 24 October 1997. The blanked out region shows the depth to which data was collected and closely follows the bathymetry except in the deep casts. The numbers at the top of the figure are the CTD cast numbers and mark the position of each profile of the section.

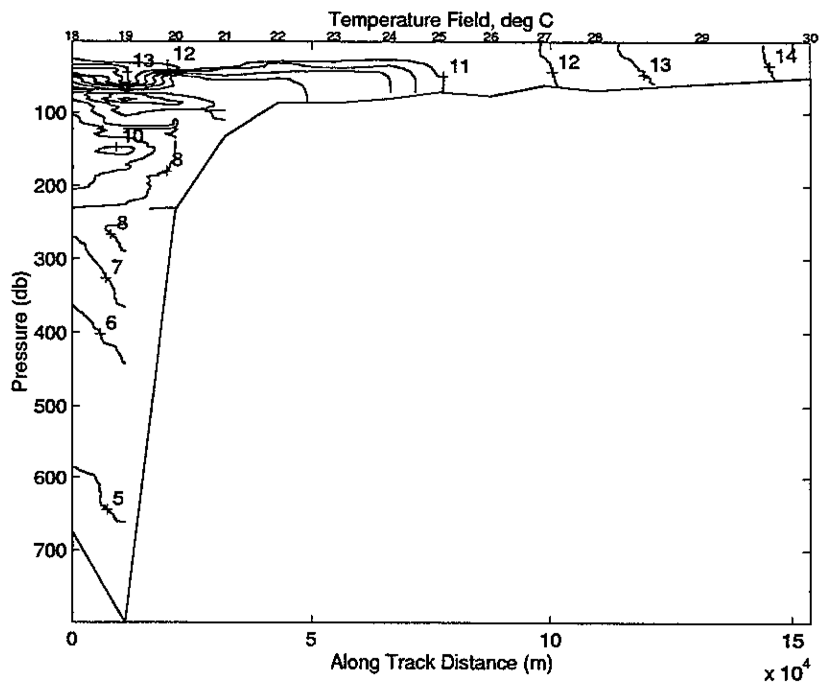


Figure 17. Contours of temperature at 1° C intervals for the Long-Term Section conducted on 25 October 1997. The blanked out region shows the depth to which data was collected and closely follows the bathymetry except in the deep casts. The numbers at the top of the figure are the CTD cast numbers and mark the position of each profile of the section.

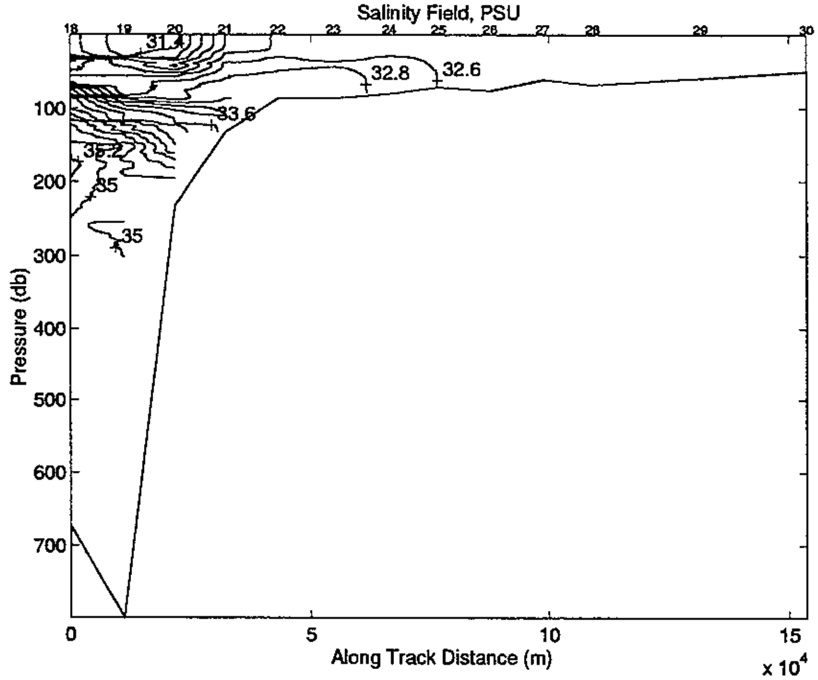


Figure 18. Contours of salinity at 0.2 PSU intervals for the Long-Term Section conducted on 25 October 1997. The blanked out region shows the depth to which data was collected and closely follows the bathymetry except in the deep casts. The numbers at the top of the figure are the CTD cast numbers and mark the position of each profile of the section.

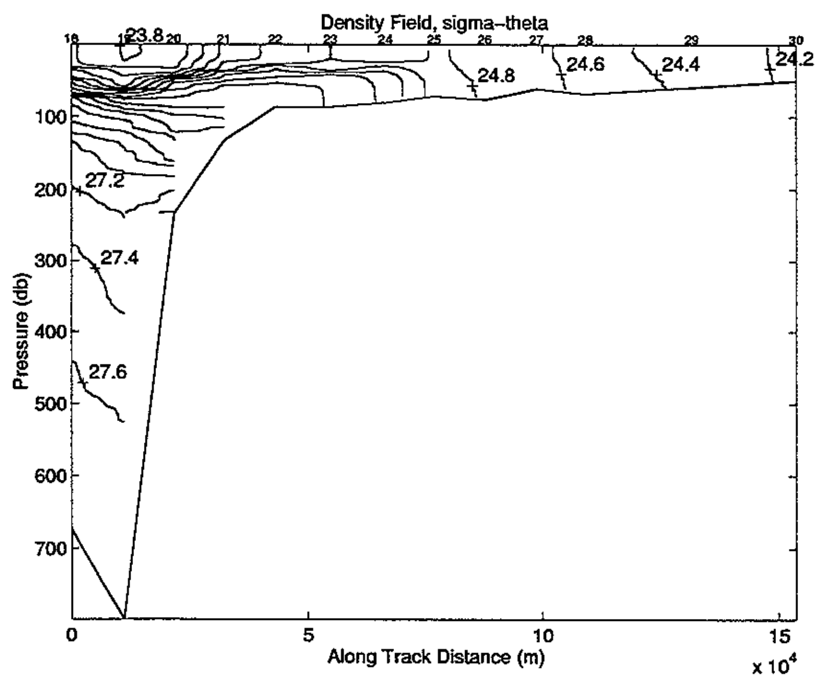


Figure 19. Contours of potential density at 0.2 kg/m^3 intervals for the Long-Term Section conducted on 25 October 1997. The blanked out region shows the depth to which data was collected and closely follows the bathymetry except in the deep casts. The numbers at the top of the figure are the CTD cast numbers and mark the position of each profile of the section.

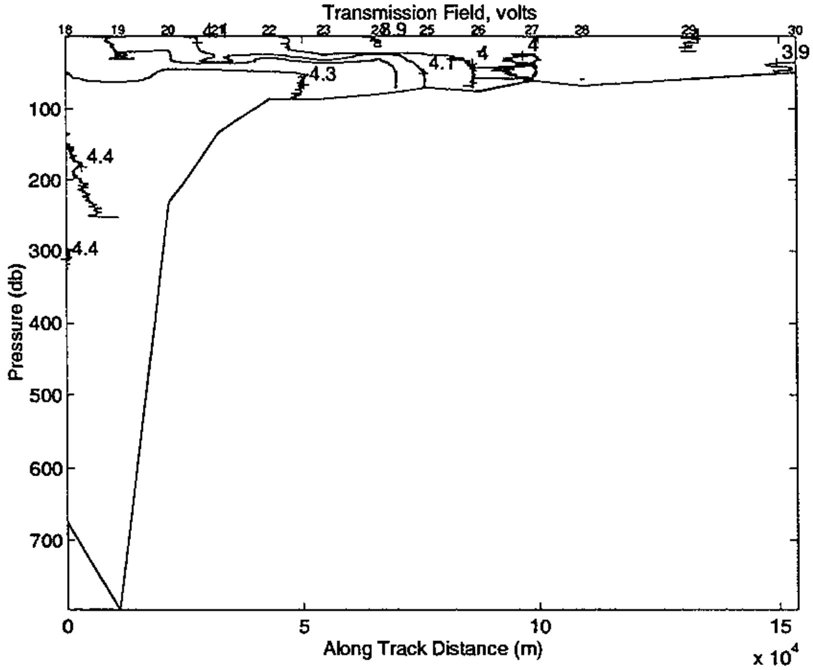


Figure 20. Contours of transmission at 0.1 V intervals for the Long-Term Section conducted on 25 October 1997. The blanked out region shows the depth to which data was collected and closely follows the bathymetry except in the deep casts. The numbers at the top of the figure are the CTD cast numbers and mark the position of each profile of the section.

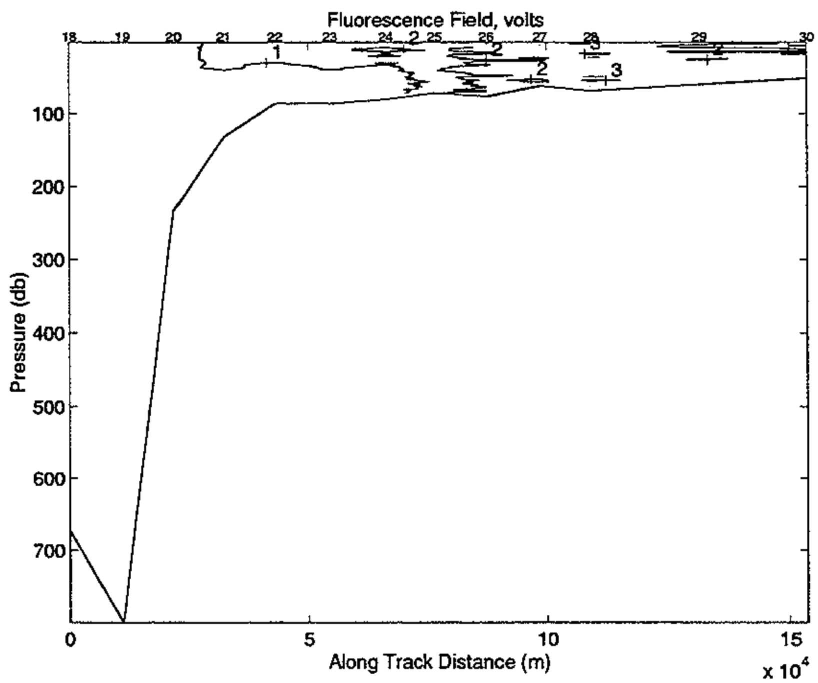


Figure 21. Contours of relative fluorescence at 1 V intervals for the Long-Term Section conducted on 25 October 1997. The blanked out region shows the depth to which data was collected and closely follows the bathymetry except in the deep casts. The numbers at the top of the figure are the CTD cast numbers and mark the position of each profile of the section.

characteristics of these prey organisms are being documented. During EN308, microzooplankton samples were obtained at selected stations along both the Long-Term southern flank and Northeast Peak transects to extend the seasonal microzooplankton sampling coverage for 1997. The selection of sampling sites was based on proximity to high priority, GLOBEC Georges Bank Broadscale stations which have been sampled on each of the five Broadscale Cruises conducted this year. A list of stations and depths sampled during this cruise is provided in Table 3.

Water samples were obtained from the standard Seabird SBE911 CTD casts at each transect station. Upcast water bottle sampling depths were selected based on the mixing properties of the water column as indicated by temperature and salinity profiles during the associated CTD downcast. Samples were removed from the 5 liter Niskin sampling bottles by gentle siphoning from the opened tops of the bottles. The resulting subsamples were immediately placed within a refrigerated incubator, quickly filmed for prey size, abundance and motility, and then preserved with Lugols solution. Laboratory analysis, to be completed at the Environmental Systems Lab (ESL) at WHOI, will include size and swimming behavior measurements for each microzooplankton group, as well as actual microscope-based abundance counts.

EN308 Personnel:

WHOI Mooring and CTD Crew:

James D. Irish, Chief Scientist
Jeff van Keuren, Scientist
William J. Williams, Scientist
Pat O'Malley, Technician
Kenton J. Bradshaw, Technician
Nick Witzell, Engineer
Dave Schroeder, Technician
Jennifer Frese, Student
Thomas Orvash, URI Marine Technician

R/V ENDEAVOR Crew

Thomas Tyler, Captain
Everett McMunn, Mate
Stephen Vetra, 2nd Mate
Jack Buss, Bosn
Glenn Prouth, AB
Richard Foley, AB
Dave Rocha, AB
James Cobleigh, Engineer
William Appleton, Chief Engineer
Timothy Varney, Engineer
Daniel Butler, Steward
Brian Miller, Messman

Table 3. Microzooplankton Measurements Obtained During EN308.

Cruise Station	Date (GMT)	Time (GMT)	Sample Depth (m)	Broadscale(BS) Station No.	Comments
LT12	10/23/97	01:37	11m	near BS07	surface mixed layer
LT12	10/23/97	01:37	32m	near BS07	beneath pycnocline
LT08	10/23/97	15:10	02m	BS09	surface mixed layer (well mixed)
LT02	10/24/97	01:57	20m	BS12	surface mixed layer (well mixed)
LT02	10/24/97	01:57	40m	BS12	surface mixed layer (well mixed)
NE14	10/24/97	13:44	10m	middle of	surface mixed layer NE Channel
NE14	10/24/97	13:44	50m	middle of	intermediate, warm, NE Channel, salty layer
NE14	10/24/97	13:44	120m	middle of	within seasonal NE Channel, pycnocline
NE11	10/24/97	17:53	12m	near BS24	surface mixed layer
NE11	10/24/97	17:53	38m	near BS24	within pycnocline
NE07	10/24/97	22:38	71m	near BS20	near bottom sample (surface bottle misfired)
NE06	10/25/97	0000	10m	near BS20	surface sample (well mixed)
NE06	10/25/97	0000	62m	near BS20	near bottom sample (well mixed)
NE03	10/25/97	0248	12m	near BS19	surface sample (well mixed)
NE03	10/25/97	0248	59m	near BS19	near bottom sample (well mixed)
LT08	10/25/97	1042	12m	BS09	surface mixed layer (slight stratification)
LT08	10/25/97	1042	50m	BS09	above pycnocline (slight stratification)
LT08	10/25/97	1042	65m	BS09	beneath pycnocline (slight stratification)
CTD44	10/25/97	1714	21.5m	near BS07	surface mixed layer
CTD44	10/25/97	1714	47m	near BS07	within pycnocline
CTD44	10/25/97	1714	98m	near BS07	near bottom sample

Table 4. EN308 Event Log

Event	Instrument	Cast	Station	Year	Month	Day	HR:MN	S/E	N. Latitude	W. Longitude	Cast Dept	Water De	Comments
1	Guard B		S. Flank	1997	Oct	22	17:30		40 57.995	67 19.199		76 m	Deploy
2	Guard A		S. Flank	1997	Oct	22	18:48		40 58.120	67 18.907			Deploy
3	SBE911	1	LT08	1997	Oct	22	22:08	S	40 57.18	67 20.20	70	76	Bottle #1
							22:28	E	40 56.74	67 20.40			
4	SBE911	2	LT09	1997	Oct	22	23:00	S	40 54.24	67 17.11	78	82	Bottle #2
							23:16	E	40 53.94	67 17.18			
5	SBE911	3	LT10	1997	Oct	22	23:51	S	40 50.35	67 15.21	86	91	Bottle #3
						23	0:02	E	40 50.10	67 15.32			
6	SBE911	4	LT11	1997	Oct	23	0:39	S	40 46.77	67 13.10	86	93	Bottle #4 mid & surf for bio
							0:53	E	40 46.34	67 13.30			
7	SBE911	5	LT12	1997	Oct	23	1:37	S	40 41.36	67 10.72	95	103	Bottle #5 mid & surf for bio
							1:52	E	40 41.03	67 11.31			
8	SBE911	6	LT13	1997	Oct	23		S			160	468	Bottle #6
							3:00	E	40 35.22	67 08.77			
9	SBE911	7	LT14	1997	Oct	23	3:45	S	40 30.02	67 05.05	414	440	Bottle #7
							4:16	E	40 29.74	67 06.05			
10	SBE911	8	LT15	1997	Oct	23	5:34	S	40 19.96	66 59.96	500	2000	Bottle #8
							5:57	E	40 19.98	67 00.06			
11	Science D		S. Flank	1997	Oct	23	14:18	D	40 58.069	67 19.063			Deploy
12	SBE911	9	LT08	1997	Oct	23	14:41	S	40 57.58	67 18.79		76	SF yo-yo
							15:10	E	40 57.42	67 18.84			
13	SBE911	10	LT08	1997	Oct	23	15:10	S	40 57.42	67 18.84		76	SF yo-yo, Bottle #9
							15:45	E	40 57.67	67 18.86			
14	Bot. Press		S. Flank	1997	Oct	23	16:30	D	40 58.027	67 19.004			
15	Science E		S. Flank	1997	Oct	23	1700	R	40 57.833	67 19.220			Recover
16	Guard F		S. Flank	1997	Oct	23	1830	R	40 57.819	67 19.823			Recover
17	SBE911	11	LT08	1997	Oct	23	20:33	S	40 58.17	67 19.39	71	76	Bottle #10
							20:43	E	40 58.16	67 19.23			
18	SBE911	12	LT07	1997	Oct	23	21:21	S	41 01.94	67 20.74	63	67	Bottle #11
							21:42	E	41 01.95	67 20.58			
19	SBE911	13	LT06	1997	Oct	23	22:08	S	41 05.87	67 22.37	62	65	Bottle #12
							22:18	E	41 05.85	67 22.12			
20	SBE911	14	LT05	1997	Oct	23	22:53	S	41 09.47	67 24.46	56	59	Bottle #13
							23:00	E	41 09.42	67 24.25			
21	SBE911	15	LT04	1997	Oct	23	23:44	S	41 12.35	67 26.46	48	50	Bottle #14
							23:52	E	41 12.20	67 26.23			

Table 4. EN308 Event Log

22	SBE911	16	LT03	1997	Oct	24	0:40	S	41 16.92	67 28.52	40	43	Bottle #15		
							0:48	E	41 16.71	67 28.36					
23	SBE911	17	LT02	1997	Oct	24	1:57	S	41 24.44	67 32.53	40	45	Bottle #16		
							2:08	E	41 24.17	67 32.52					
24	SBE911	18	NE15	1997	Oct	24	12:02	S	42 01.08	65 30.09	670	820	Bottle #17		
							12:32	E	42 00.58	65 29.92					
25	SBE911	19	NE14	1997	Oct	24	13:44	S	41 59.10	65 37.43		850	Bottle #19		
							14:24	E	41 58.48	65 37.65	780	950			
26	SBE911	20	NE13	1997	Oct	24	5:29	S	41 56.51	65 44.54	230	240	Bottle #20		
								E	41 56.14	65 44.50					
27	SBE911	21	NE12	1997	Oct	24	16:45	S	41 54.58	65 51.67	130	133	Bottle #21		
							16:56	E	41 54.41	65 51.77					
28	SBE911	22	NE11	1997	Oct	24	17:53	S	41 52.09	65 58.90	85	92	Bottle #22 & 37 & 10 m for bio		
							18:03	E	41 52.19	65 59.01					
29	SBE911	23	NE10	1997	Oct	24	19:03	S	41 49.74	66 06.68	85	92	Bottle #23		
							19:12	E	41 49.84	66 06.82					
30	SBE911	24	NE09	1997	Oct	24	20:15	S	41 47.43	66 14.52	80	83	Bottle #24		
							20:23	E	41 47.42	66 14.76					
31	SBE911	25	NE08	1997	Oct	24	21:19	S	41 45.20	66 21.60	70	75	Bottle #49		
							21:26	E	41 45.34	66 21.54					
32	SBE911	26	NE07	1997	Oct	24	22:38	S	41 42.87	66 28.66	71	76	Bottle #50		
							22:47	E	41 43.04	66 28.85					
33	SBE911	27	NE06	1997	Oct	25	0:00	S	41 40.34	66 35.96	62	68	Bottle #51 & bio @ 10 m		
							0:09	E	41 40.21	66 35.97					
34	SBE911	28	NE05	1997	Oct	25	1:05	S	41 38.17	66 42.99	68	73	Bottle #52		
							1:13	E	41 37.97	66 42.91					
35	SBE911	29	NE03	1997	Oct	25	2:48	S	41 33.29	66 57.74	59	64	Bottle #53 & 10m for bio		
							2:56	E	41 33.09	66 57.66					
36	SBE911	30	NE01	1997	Oct	25	4:17	S	41 28.40	67 12.23	49	55	Bottle #54		
							4:24	E	41 28.33	67 12.25					
38	SBE911	31	LT02	1997	Oct	25	6:05	S	41 24.57	67 32.72	37	40	Bottle #55		
							6:07	E	41 24.60	67 32.75					
39	SBE911	32	LT03	1997	Oct	25	7:04	S	41 17.05	67 28.60	43	47	Bottle #56		
							7:10	E	41 17.13	67 28.68					
40	SBE911	33	LT04	1997	Oct	25	7:51	S	41 12.60	67 26.58	45	48	Bottle #57		
							7:58	E	41 12.57	67 26.65					
41	SBE911	34	LT05	1997	Oct	25	8:30	S	41 09.52	67 24.56	55	58	Bottle #58		

Table 4. EN308 Event Log

							8:39	E	41 09.66	67 24.62					
42	SBE911	35	LT06	1997	Oct	25	9:13	S	41 06.04	67 22.50	61	65	Bottle #59		
							9:22	E	41 06.22	67 22.49					
43	SBE911	36	LT07	1997	Oct	25	9:57	S	41 01.94	67 20.75	67	70	Bottle #60		
							10:05	E	41 02.06	67 20.68					
44	SBE911	37	LT08	1997	Oct	25	10:42	S	40 58.18	67 18.27	74	79	Bottle #61, & 65, 50 & 12 m for bio		
							10:55	E	40 58.34	67 18.26					
45	SBE911	38	LT09	1997	Oct	25	11:36	S	40 54.50	67 16.97	83	85	Bottle #62		
							11:45	E	40 54.48	67 16.82					
47	SBE911	39	LT10	1997	Oct	25	12:18	S	40 50.46	67 14.99	96	96	Bottle #63		
							12:29	E	40 50.42	67 14.91					
49	SBE911	40	LT11	1997	Oct	25	12:59	S	40 46.93	67 13.01	93	98	Bottle didn't close		
							13:09	E	40 46.87	67 12.96					
51	SBE911	41	LT12	1997	Oct	25	13:48	S	40 41.44	67 10.51	100	105	Bottle #64		
							13:59	E	40 41.30	67 10.54					
52	SBE911	42	LT13	1997	Oct	25	14:43	S	40 35.68	67 08.05	161	168	Bottle #65		
							14:59	E	40 35.48	67 08.32					
53	SBE911	43	LT14	1997	Oct	25	15:41	S	40 29.98	67 05.06	440	480	Bottle #66 & 22, 47 &98 m for bio		
							16:02	E	40 29.85	67 05.45					
54	SBE911	44	BS07	1997	Oct	25	17:14	S	40 37.05	67 18.01	100	105	Bottle #67		
							17:28		40 37.08	67 18.40					

Chief Scientist Cruise Log

Tues - 21 October 1997

EDT Load Guard buoys, secure one by port rail, second ready for launch
Load foam science buoy by port rail forward of guard buoy
Four anchors in rails - use wooden launch pallet
Subsurface float by air tugger and a-frame base
Bottom Pressure instrument aft of CTD on starboard rail
Diesel winch on port rail - 6800 pounds
Chain for two guard moorings wound on winch

1539 - NOAA weather report
Georges Bank - 15-20 kts, 6-10' seas
Wed - 15-20 kts, 5 - 9'
Wed nit/Thurs 20-25 kts 5 - 9'
Cashes Ledge Buoy - 16 kts, 48°F, 10' seas
Georges Bank Buoy - 14 kts, 54°F, 9' seas
Nantucket Shoals Buoy - 12 kts, 53°F, 9' seas
Decision was made to start with CTDs rather than mooring work and to start at LT15 on the southern flank section.

1630 - All aboard and secured

1705 - away from WHOI dock
Sunny, wind about 10 kts

1800 - safety drill

1930 - stopped for small sailboat headed for Florida with broken rudder

Wednesday - 22 October 1997

EDT

0800 - wind 10 kts, seas 4', heading for southern flank site, eta 12:30

1200 - approaching site think only can see two buoys

1215 - only two buoys seen - science buoy and foam guard "F"
steel guard "C" missing

1230 - run by for positions - passing with buoy 100' to port
Science Buoy - 40° 57.833'N x 67° 19.220'W
Foam Guard Buoy - 40° 57.810'N x 67° 19.823'W
Science buoy is in approximate deployment position
Foam Guard buoy is > 1/2 mile out of position
With buoys in position they are in, then try to deploy on old configuration. Therefore, try to put first buoy at
40° 58.00' N x 67° 19.20' W

Guard Buoy "B":
Light Battery 14.74v no load
Connectors cleaned, greased and plugged in
Light plugged in and working
Photocell shutoff works

1330 - Deploy Guard Buoy "B" anchor at
40° 57.995' N x 67° 19.199' W
Deployment started 1/2 nm below launch site (to east)
Headed up into seas at about 1 kt
Anchor dropped when ship's DGPS said that we were on position
Try for separation of 0.25 nm at a heading of 060°T
Guard Buoy "A":
Light Battery 14.13v no load
Connectors cleaned, greased and plugged in
Light plugged in and working
Photocell shutoff works
1420 - Start deployment of Guard "A"
1448 - Anchor Drop on Guard "A"
40° 58.120' N x 67°18.907' W
Wind at 18 kts from 275°T
1500 - move anchor and science buoy "D" into launch position
prep mooring for deployment
1610 - decided not to deploy today, but complete prep and secure for tomorrow.
1730 - secured deck operations and starting CTD station LT08.
1808 - CTD01 at LT08
1903 - CTD02 at LT09
1951 - CTD03 at LT10
2000 - started bottom pressure gauge s/n 49
tide measurements every 15 minutes
10 minute burst every day at 2 sec for waves
2039 - CD04 at LT11
2100 - Wind 18-19 kts
2137 - CTD05 at LT12
2235 - CTD06 at LT13
2345 - CTD07 at LT14

Thursday - 23 October 1997

EDT
0134 - CTD08 at LT15
0700 - Wind about 16 kts, seas 6' - up a bit from yesterday
Finalizing Science Buoy D
Light on all times - replaced with new light
0935 - start launch
0944 - EM cable and sensors deployed
0948 - strungout and towing on anchor
1.5 kts through water to get 0.5 over ground
wind down to 7 kts, sun out, seas calming
1018 - anchor dropped between two guard buoys
40° 58.069' N x 67° 19.063' W

1041 - one hour yo-yo - CTD09 and CTD10 at LT08
1200 - checking out pressure instrument release - OK
1220 - wind 16 kts, few white caps, sunny
1230 - Bottom pressure instrument deployed
40° 58.027' N x 67° 19.004 W
between science mooring D and Guard A
1242 - check bottom pressure release #308
Disable - vertical, disabled, not released
1244 - check Science D release #306
Disable - vertical, disabled, not released
1250 - Science buoy E release #17972
Release, acknowledged
Floats seen on surface
1301 - Line on buoy and start recovery
1350 - all on deck and sensor packages broken out of array
1403 - buoy standing by rail ready for recovery of guard F
Guard F - buoy looked OK from top, but base broken off as before. Recovered top, pulled chain with winch and recovered foam, base and anchor. Foam showed that tie rods were loose and base rattled around before falling to anchor. Base bright where chain dragged it around with rotary tidal currents. 3/4" chain in mud shows significant wear starting, but still not close to failing. buoy had been deployed for one year and been moved by fishermen at least twice.
1633 - CTD11 @ LT08
1721 - CTD12 @ LT07
1808 - CTD13 @ LT06
1853 - CTD14 @ LT05
1944 - CTD15 @ LT04
2030 - checking seacat 2360 - 30 meters deep
sampling right on minute, and had full 194k samples.
2040 - CTD16 @ LT03
2130 - checking seacat 2359 - 20 meters deep
low battery voltage, stopped 15 Sept with 128k samples.
2157 - CTD17 @ LT02
2215 - checking seacat 2361 - 72 meters deep
5 minute sampling program, 36864 samples
Since didn't have calibrations for these sensors on board,
used 2006's constants to normalize data for quick look

Friday - 24 October 1997

0700 - Wind and seas up - wind 20+ kts, seas 7'
Dumping ADCP data - still pinging - 9.3 MB of data
Sorting and converting to ASCII - data looks good
0802 - CTD18 @ NE15
0944 - CTD19 @ NE14
1129 - CTD20 @ NE13

ADCP batteries in aux. pack are both 36.8v no load
This implies that they were about 1/2 discharged.
1245 - CTD21 @ NE12 - Wind 27 kts and steady, seas 7-8'
1353 - CTD22 @ NE11
1503 - CTD23 @ NE10
1615 - CTD24 @ NE09
1719 - CTD25 @ NE08
1834 - CTD26 @ NE07 - Wind 18 kts
2000 - CTD27 @ NE06
2105 - CTD28 @ NE05 - Wind 14 kts
2248 - CTD29 @ NE03 - Wind < 1 kt

Saturday - 25 October 1997

0017 - CTD30 @ NE01
0205 - CTD31 @ LT02
0304 - CTD32 @ LT03
0351 - CTD33 @ LT04
0430 - CTD34 @ LT05
0513 - CTD35 @ LT06
0557 - CTD36 @ LT07 - Ship could see lights of all three buoys
0642 - CTD37 @ LT08 - Wind 12 kts
0715 - Run by buoys with buoys passing to starboard - all look OK
Guard Buoy A:
40° 58.128 N x 67° 18.883 W
Science Buoy D:
40° 58.050 N x 67° 19.038 W
Guard Buoy B
40° 58.005 N x 67° 19.169 W
0736 - CTD38 @ LT09
0818 - CTD39 @ LT10
0859 - CTD40 @ LT11
0948 - CTD41 @ LT12
1043 - CTD42 @ LT13 - Wind 18 kts
1141 - CTD43 @ LT14
1314 - CTD44 @ BS07
Completed Science - heading for WHOI on rising wind and rain.

Sunday - 26 October 1997

0800 - winds 18 kts, cloudy, 10 miles off Gay Head
1205 - at WHOI dock tying up