Cruise Report

R/V ENDEAVOR Cruise 274 to Georges Bank

US GLOBEC

NW ATLANTIC/GEORGES BANK STUDY

29 September - 5 October 1995

Acknowledgments

This report and on-board preliminary data was prepared by Jim Irish, Brian Racine and Peter Garrahan from cruise logs and notes as a first draft document of the activities, positions, data collected, etc. We acknowledge the support provided by Captain Tom Taylor and the crew of the R/V ENDEAVOR (especially Jack Buss) in the tedious task of dragging for (and eventually retrieving all of) our reluctant equipment.

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Cruise Report
GLOBEC R/V ENDEAVOR CRUISE EN-274

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Cruise Report

GLOBEC R/V ENDEAVOR Cruise EN-274
U.S. State Department Cruise No. 95-051

Narragansett, RI to Georges Bank to Woods Hole
29 September - 5 October 1995

Purpose:

The primary purpose of GLOBEC EN-274 was to recover the Long-Term Moorings on Georges Bank at the end of their first year in the water for servicing and to take supportive CTD profiles for *in-situ* calibrations. Additionally we would recover the University of Southern California acoustic mooring for servicing. As time permits, a series of five ARGOS tracked drifters would be deployed, as well as MOCNESS tows and CTDs taken at standard biological sampling stations.

Accomplishment Summary:

The Crest mooring was recovered without incident. The acoustic release worked, and the surbsurface float surfaced immediately. The buoy, sensors and mooring hardware were in excellent shape. The Southern Flank instrumentation was also completely recovered. One guard buoy had sunk, and was recovered when dragging for other equipment. The second guard was recovered normally. The science buoy's release was tangled in line, so could not release the anchor. The bottom-mounted ADCP's release mechanism was fouled with barnacles and did not release. We successfully dragged for all gear and recovered it. Generally all equipment was in good shape but fouled with biology (and fishermen's line).

The Long-Term Moored CTD Section was made from the Crest site to the Atlantic. Shallower than about 60 meters, the profiles were well mixed with little across bank stratification. The warmer saltier Atlantic water was seen in the offshore station, with fresher water deeper between (Gulf of Maine water).

Five MOCNESS and ring net tows with accompanying CTDs were taken at the moorings and two other standard biological sampling sites in the Atlantic and the Great South Channel.

Because of the loss of time dragging for our instrumentation, the cruise was extended one day from that intended, and only one drifter was deployed. The cruise did not go into Canadian waters. The cruise track is shown in Figure 1.

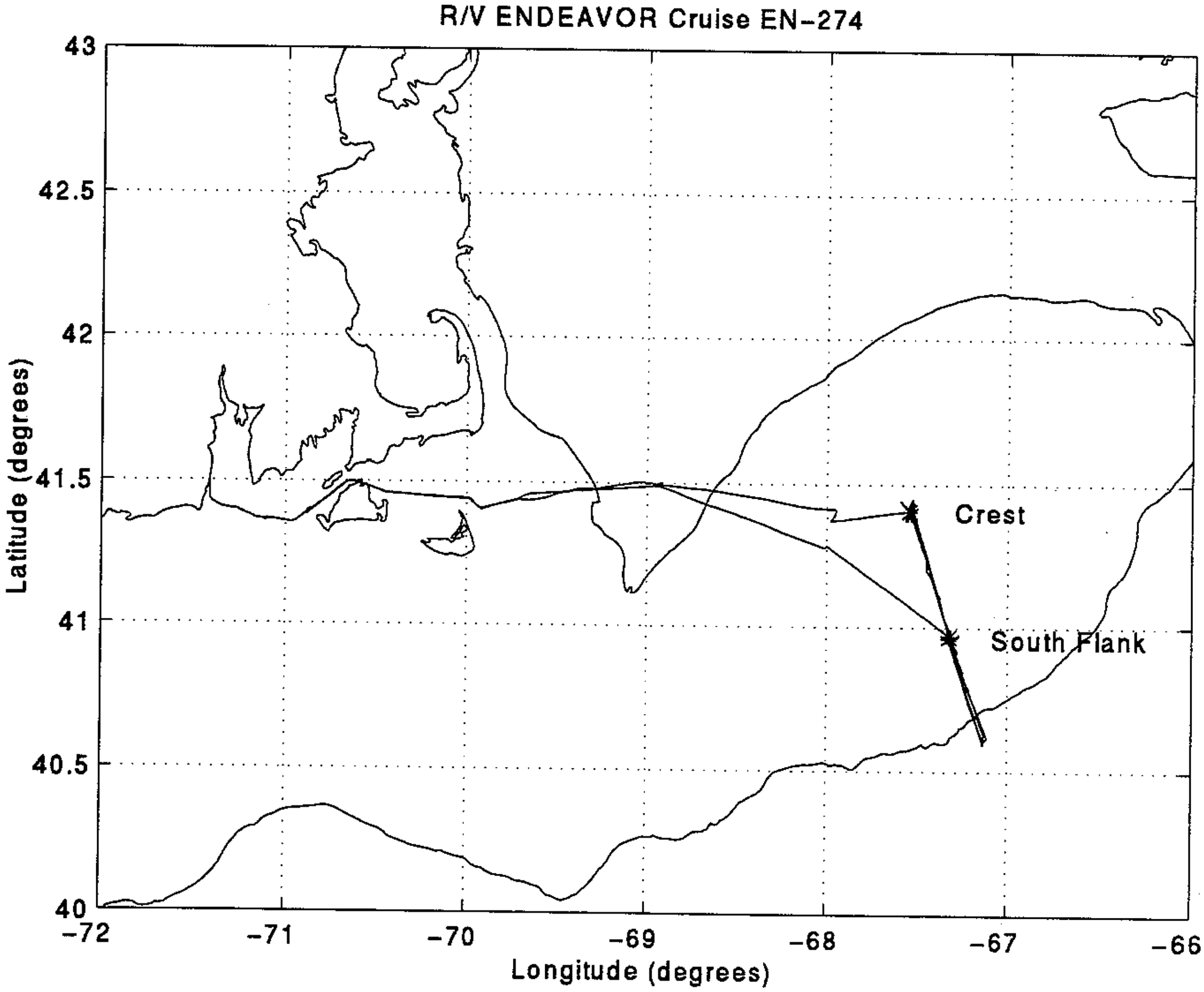

Figure 1. Ship's track of the R/V ENDEAVOR Cruise EN-274 from Narragansett, RI to Georges Bank to Woods Hole from the ship's GPS log. The 100 meter contour is plotted to outline Georges Bank. The Crest and South Flank mooring sites, the CTD, MOCNESS and drifter deployment sites are shown, and listed in Table 1.

Cruise Results

Crest Scientific Buoy

The Crest mooring was deployed on 1 April 1995, and had air temperature, PAR, sea surface temperature and conductivity (salinity), and a bio-optical package at 10 meters depth. The bio-optical package had temperature, conductivity (salinity), transmissometer, fluorometer and PAR sensors on a self contained recording package. The data from the buoy was telemetered back to the laboratory via GOES and ARGOS successfully as well as being recorded internally.

The buoy was released by acoustic command, and a subsurface float brought the acoustic release and bottom of the mooring to the surface for recovery. With the mooring no longer attached to the bottom, but freely drifting, recovery was accomplished by picking up the surface buoy and securing it on deck, then pulling the the bottom part of the mooring on board by hand to bring the subsurface float and acoustic release to the side of the ship. These were then picked up and placed on deck by the ship's crane. Mechanically the mooring was in excellent condition, and the buoy had little rust or corrosion evident. The Buoytech elastic compliant tethers were in good shape, and enabled the mooring to remain in place on the bank for 11 months. Since no one else has been able to do this with conventional technology, we have demonstrated that with this new technology, moorings can be placed, and remain moored in shallow water harsh environments (in this case a water depth of 42 m, with tidal currents often exceeding 2 m/s, and waves during the winter of greater than 15 meters height).

The data from the buoy (Figure 2) shows that the environmental sensors worked well, and that excellent data was returned. Solar radiation is measured by a PAR sensor on the buoy, but the solar panels-battery voltages also give an uncalibrated measure of the radiation as seen in Figure 3. Any low-radiation day in the PAR sensor record also shows up as a low day in the solar panel-battery voltage. The bio-optical package at 10 meters also had good data return (Figure 4), but fouling and connector problems shortened some records. The temperature records show a well mixed profile (SST and T at 10 m being the same) with rising temperatures through the end of August where the temperatures level off, the start dropping in late September. The salinity shows the opposite trend, by freshening throughout the spring and summer, then salting up again in the fall. Tidal variations are seen in both records indicative of the strong tidal currents, and the ~20 km water horizontal movement associated with it. This implies that although the water is well mixed vertically, there are still horizontal gradients which can cause the observed variability.

The PAR sensor on the surface buoy shows more variability, but the low radiation about JD165 is clearly seen in both PAR and solar panel/battery records. The fluorometer record abruptly stops around JD210 because of cabling problems. The transmissometer shows a steadily deteriorating record from about JD140 due to biofouling and is unusable after about JD210.

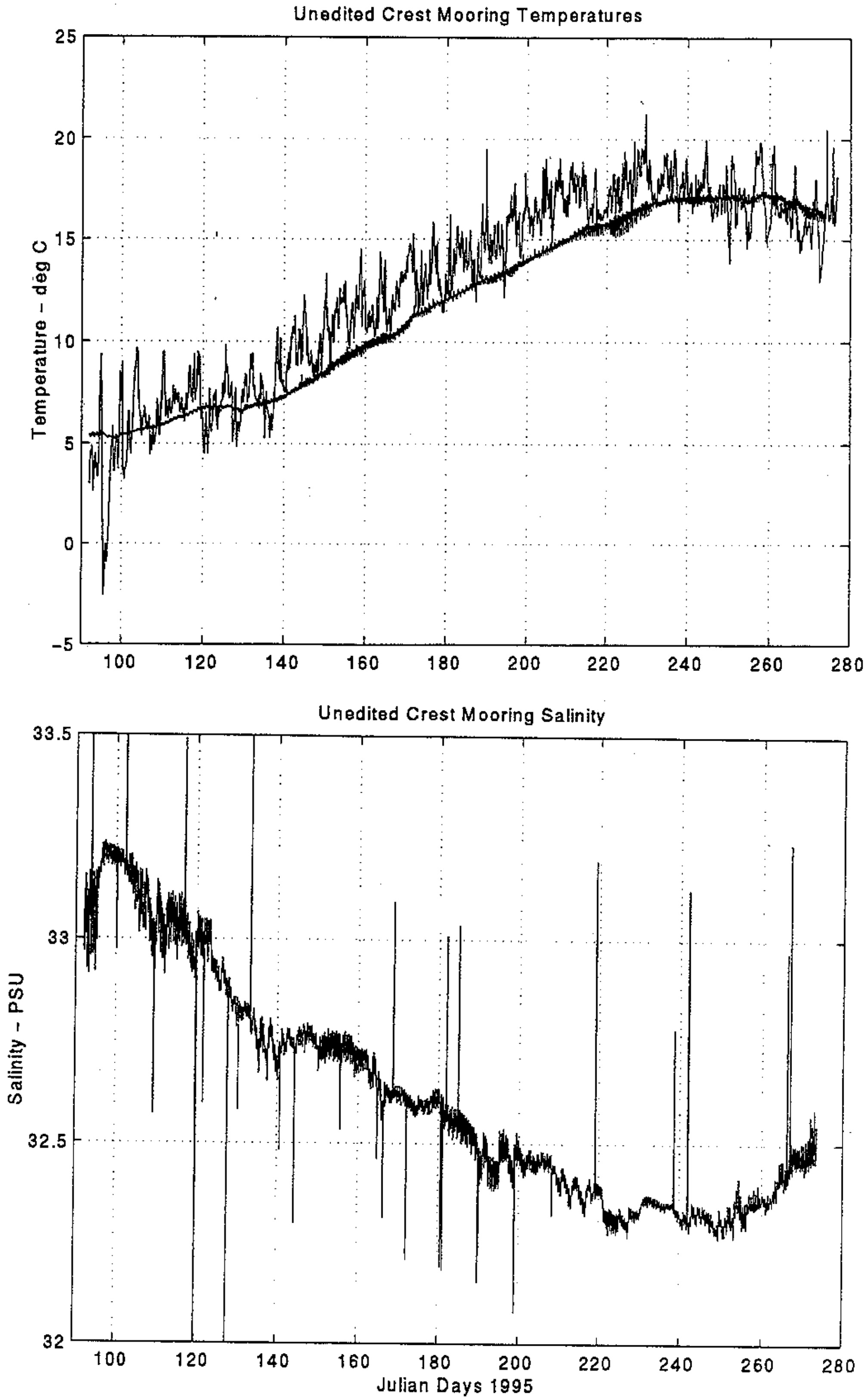

Figure 2. Crest mooring uncorrected, and unedited temperature and salinity. The top panel shows the air temperature and sea surface temperature superimposed. The air temperature has the larger variability, and appears to lead the sea surface temperature in heating and cooling as expected. The salinity shows tidal variability and a reasonably smooth freshening during the spring and summer.

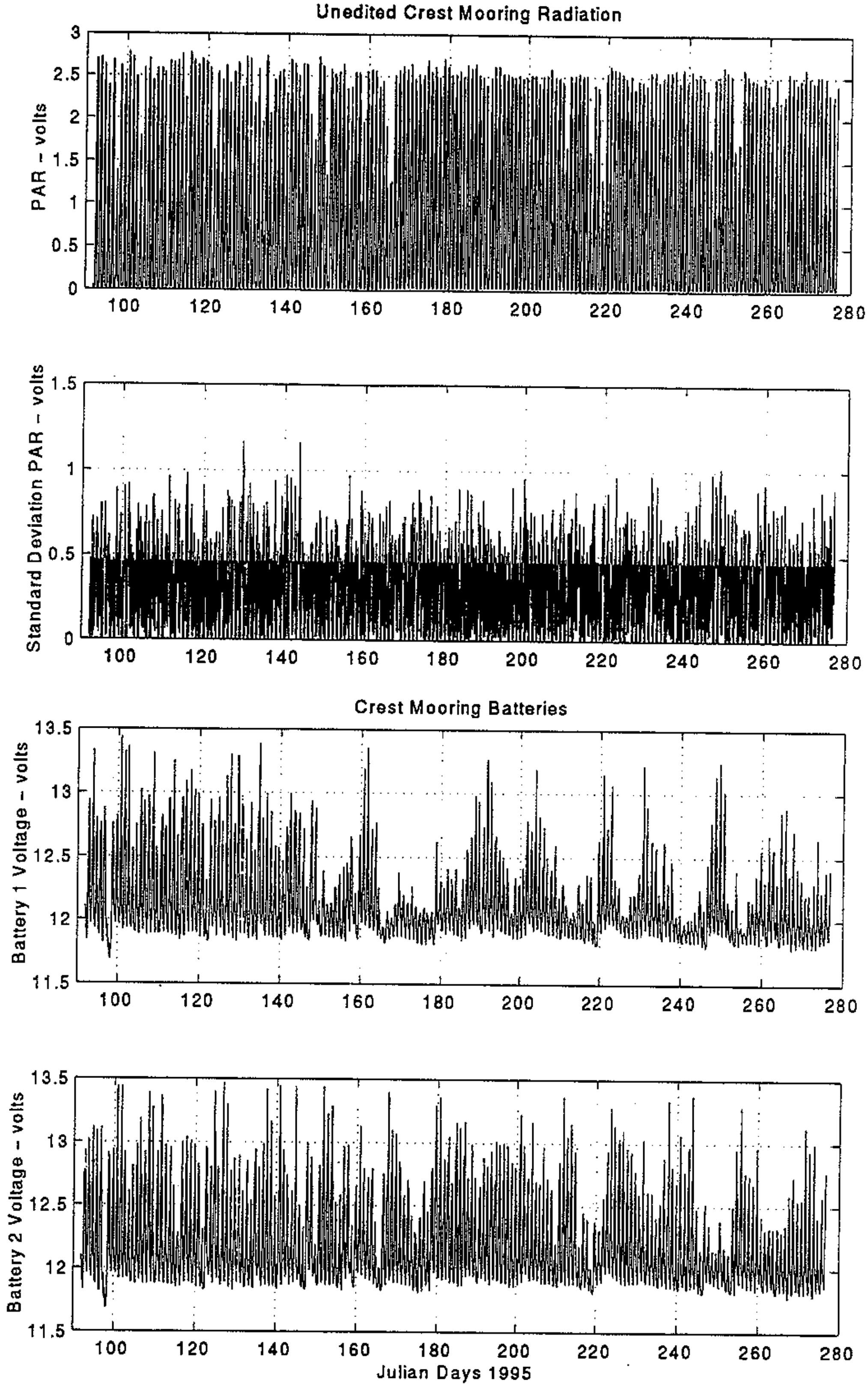

Figure 3. Crest mooring radiation. The PAR average, and standard deviation over the hourly samples are shown on the top two panels, and the output of the solar panels to the two batteries shown in the bottom two panels.

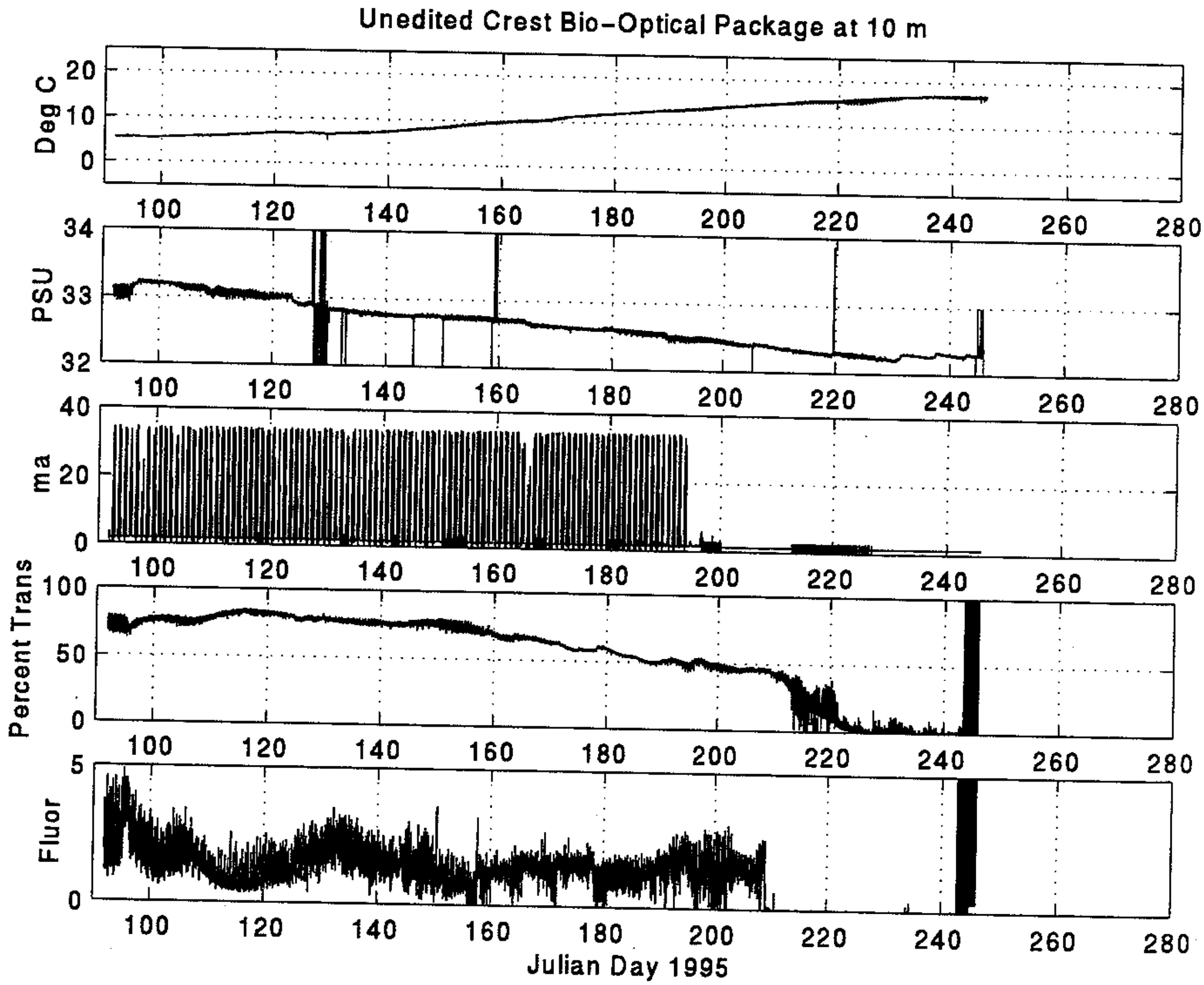

Figure 4. Crest mooring bio-optical package at 10 meters depth. The temperature overlays nicely with the SST record shown in Figure 2. The salinity is also very similar to the surface salinity with the exception to what may be sediment effects causing the "bumps" as seen around JD330. The PAR, transmissometer and fluorometer show effects of connector problems and biofouling.

Southern Flank Scientific Buoy

The Southern Flank scientific mooring was deployed 26 April 1995. This mooring was cut loose by a fisherman in early March, and retrieved by the R/V Seward Johnson in late March, too late to be turned around on our normal turnaround cruise (R/V Seward Johnson cruise SJ9504). Therefore this mooring was deployed at the start of the turbulence cruise (SJ9506). This mooring had air temperature, PAR and sea surface temperature as did the Crest mooring. Also the mooring had temperature-conductivity sensor pairs at 5 meter increments to 50 meters depth. Bio-optical packages (as on the Crest mooring) were located at 10 and 40 meters depth. The temperature and conductivity data were telemetered back to WHOI in near real-time as well as being recorded internally. The bio-optical sensor data was recorded internally.

The recovery of this mooring did not go smoothly. The buoy was in position in excellent condition, but the acoustic release did not release. After several attempts to release the buoy, we hooked the buoy and dragged it to see if we could shake the anchor loose. This did not work, so we rigged to drag for the lower part of the mooring. The ship deployed the grapnel, then was to steam around the mooring paying out cable, then pull it taught. In the process, the ship managed to hit the buoy three times, wrap the wire around the mooring cable and tangle it in the sensors at mid-depth. Therefore, the mooring was cut in two. The top portion was recovered in the normal fashion. The bottom part was positioned acoustically, then successfully dragged for and recovered without problem. Therefore, all hardware was recovered.

The failure of the acoustic release was due to polypropylene line wrapped around the release and anchor chain. This line prevented the release mechanism from opening even though the release had mechanically released. There were no other signs of fouling on the mooring, but on a stratification program mooring, a fisherman's float system was tangled in the discus buoy. Also, we believe that the foam guard buoy was sunk by a fisherman rather than weather (see below). Therefore, in spite of the guard buoys, the real problems we have encountered with keeping moorings at the Southern Flank site are related to fishermen who will not keep away. By keeping guard buoys around the mooring site and by having ARGOS transmitters on all scientific moorings, we should minimize the loss of equipment and data due to fishing activities.

Although the data from the scientific mooring was successfully returned via ARGOS and GOES for the full duration of the deployment, the data was dumped from the internal PCMCIA recorder and processed for analysis. (This data has no telemetry errors, and so is easier to process.) Figure 5 shows the air temperature, sea surface temperature, PAR and battery voltages. Again, the solar panel-battery voltages show a relationship with PAR. The temperatures from 5 m through 50 m (Figure 6) show large fluctuations associated with tidal advection of horizontal gradients past the sensor at tidal periods, plus large longer term temperature changes associated with different water masses, in particular the warm core rings and movement of the shelf slope front. The event seen around Julian day 30 is seen mostly in the bottom of the water column. The events around Julian day 220 are seen in the upper part of the water column. The final event around Julian day 270 is seen at all depths. This same pattern is seen in the salinities (Figure 7). However, note that the broad temperature event around Julian day 190 is barely seen in the salinity record.

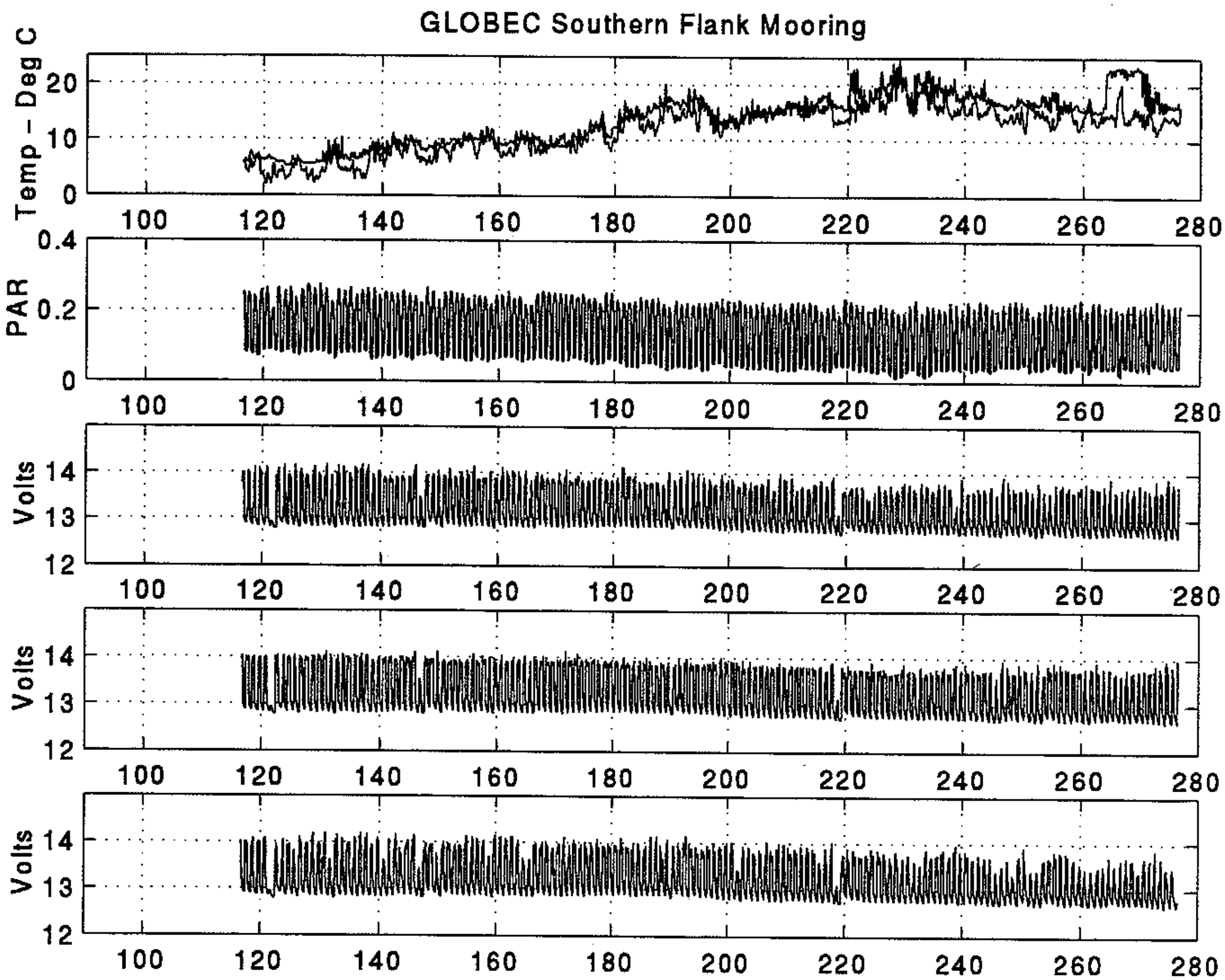

Figure 5. Southern Flank buoy observations. Air temperature and sea surface temperature are shown in the top panel. Air temperature appears colder than the sea surface temperature. The PAR record and solar panel and three battery voltages are shown below as for the Crest buoy.

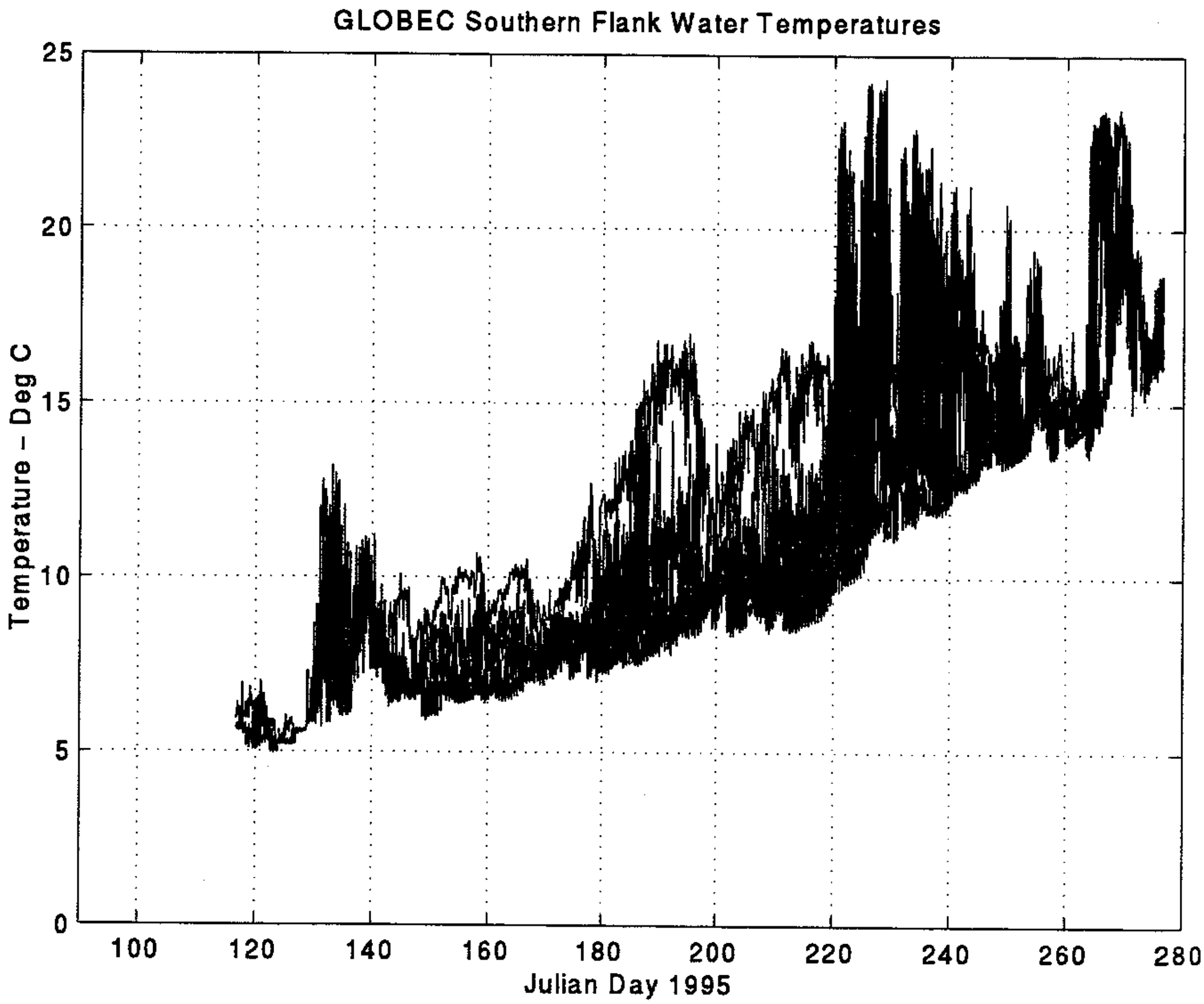

Figure 6. Southern Flank mooring water temperatures. The temperatures from 5 through 50 meters depth are plotted on one another. The general seasonal trends in temperature are nearly masked by the large changes due to tidal adjection of horizontal structure, and the advection of different warmer water masses past the mooring.

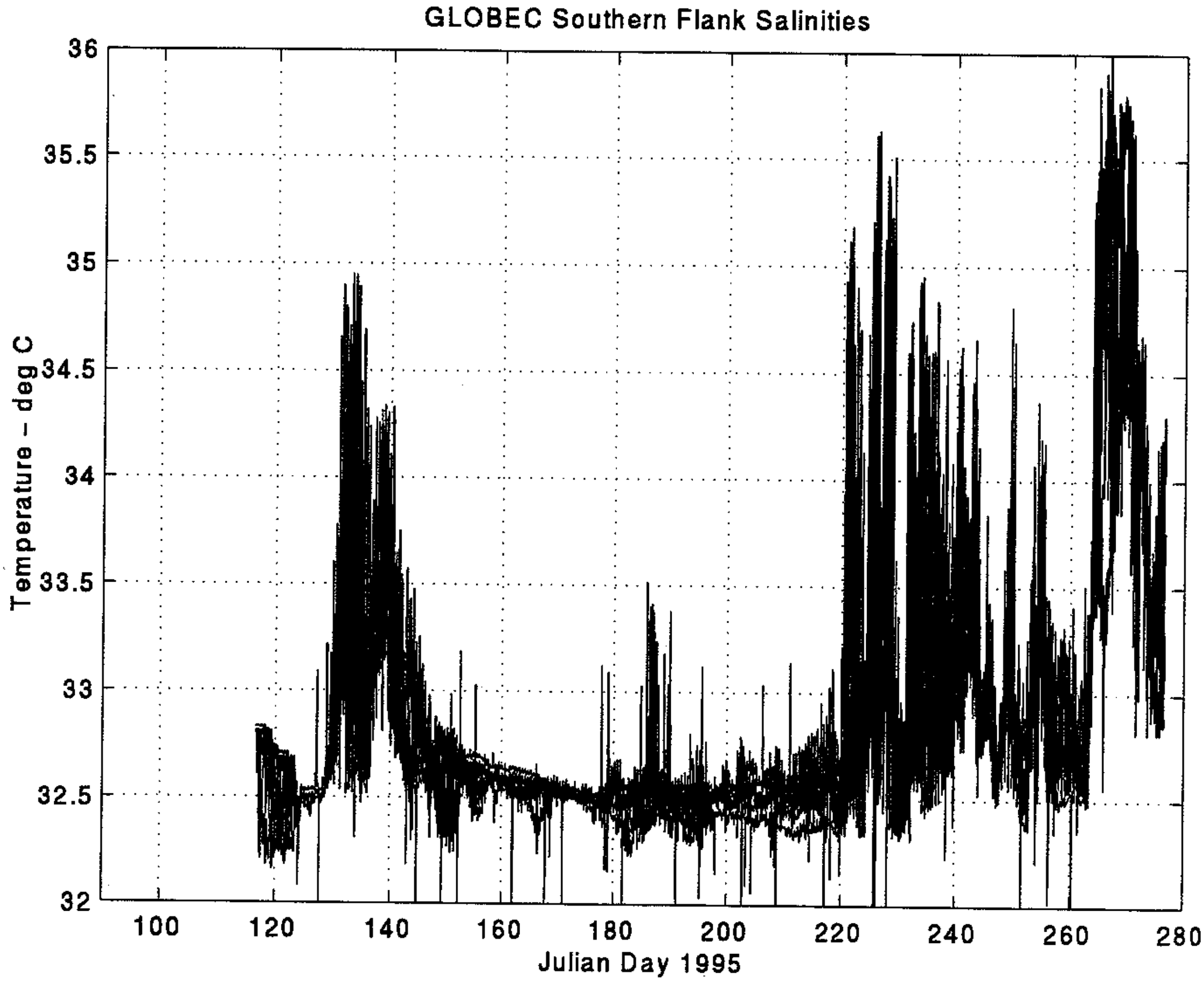

Figure 7. Southern Flank mooring salinities. The salinities from 5 through 50 meters depth are plotted on one another. The general seasonal trends in salinity are nearly masked by the large changes due to tidal adjection of horizontal structure, and the advection of different saltier water masses past the mooring.

The Southern Flank bio-optical packages (Figures 8 and 9) also show the same results as the temperature and salinity shown in Figures 6 and 7. The PAR at 40 meters is an order of magnitude smaller as expected. Biofouling and connector problems shortened the useful records obtained. The loss of the external temperature record at 40 meters can be recovered by utilizing a slower thermistor in the recorder pressure case. It is obvious that the limiting factor in the optical records is biofouling, and that we will have to do better or service the moorings mid-summer.

Bottom-mounted ADCP/Pressure Instrument

To measure the waves, tides and currents, a bottom-mounted pressure sensor and a 300 kHz RDInstruments broad-band ADCP were deployed next to the scientific mooring. This was a self contained package with acoustic release and flotation for recovery. The ADCP was gimbaled in the frame with a locking mechanism which released after a few hours to hold the ADCP securely. The instrument was deployed 1 April 1995.

This instrument also failed to return on acoustic command. The instrument was then successfully dragged up and we were able to ascertain that a large number of barnacles had grown on the release mechanism of the frame and prevented the release of the anchor. Also, there was severe barnacle growth on the ADCP transducers which not only covered the potting but also grew down into it. This had to be dissolved with weak acid and the transducers repotted before the next deployment. There were virtually no barnacles on the moorings higher up in the water column, but the bottom frame was completely covered with severe barnacle growth. We also tested the trawlproof design of the ADCP frame with the days of dragging spent in retrieving it. Lines would easily slide over the top without snagging, and we had to really "get lucky" to hit it properly.

The bottom pressure instrument had an electronic failure in the recorder which terminated the record after 37 days, but good pressure and temperature records were returned before that. Figure 10 shows the records returned. The mean water depth of 76.76 meters agrees well with the 76.5 meters determined during the site survey and deployment cruises.

RDInstruments broadband ADCPs have been having a severe hardware-software problem which causes them to go to sleep and not wake up. We experienced this on the fall deployment, and have been in contact with RDI since then on a fix. Unfortunately, it was obtained too late for this deployment, and the instrument only recorded about 7 days of data before going to sleep. After the software and hardware modification were made to the other ADCP, laboratory tests were run for about two months on battery power with no problems observed. The ADCP data is still awaiting processing for a quick look, but a tabular printout of several profiles indicates that good data was collected.

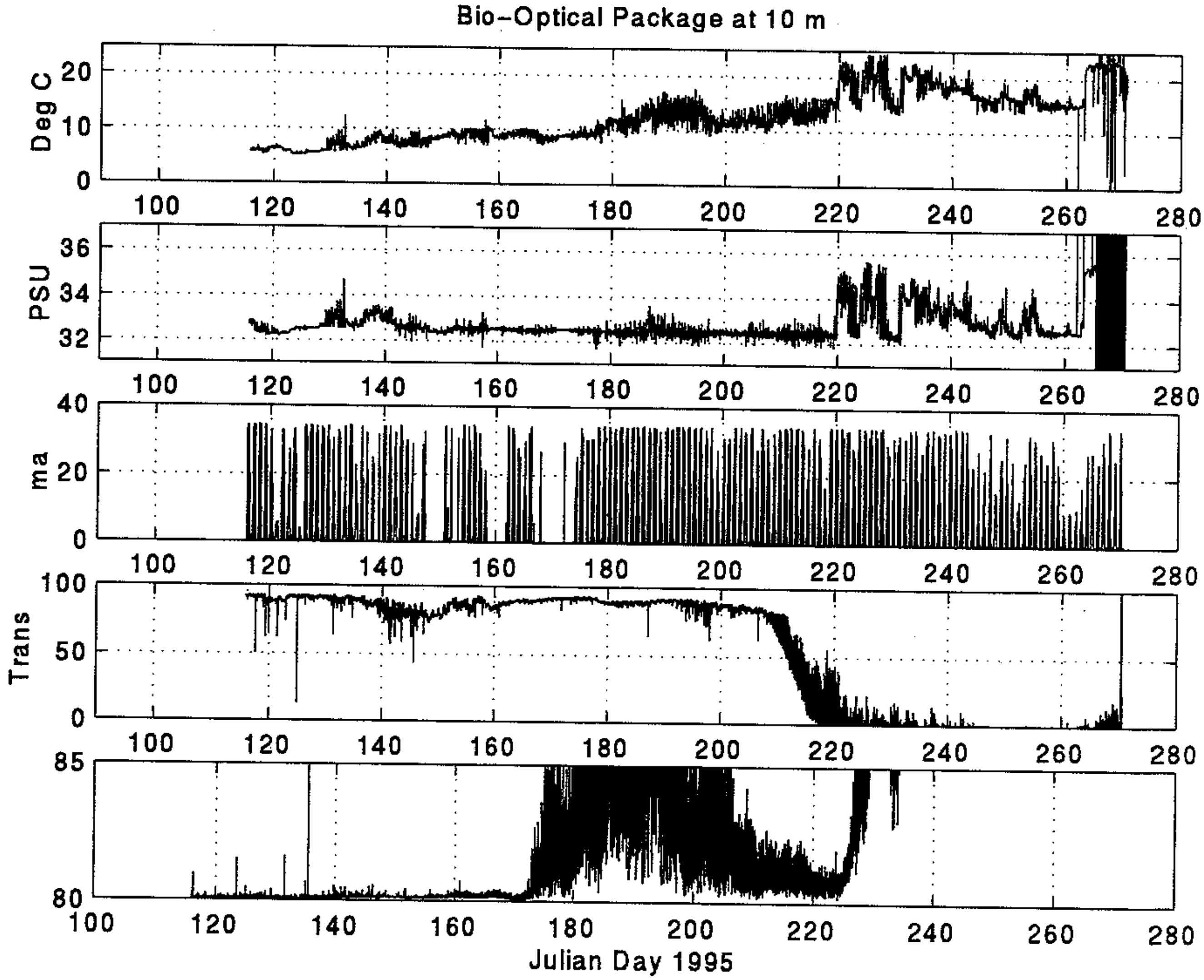

Figure 8. Southern Flank mooring bio-optical package at 10 meters. The temperature and salinity records are shown in the top two panels, the PAR in the middle panel, and the transmissometer and fluorometer results in the bottom two panels. Biofouling limited the optical observations after about 100 days.

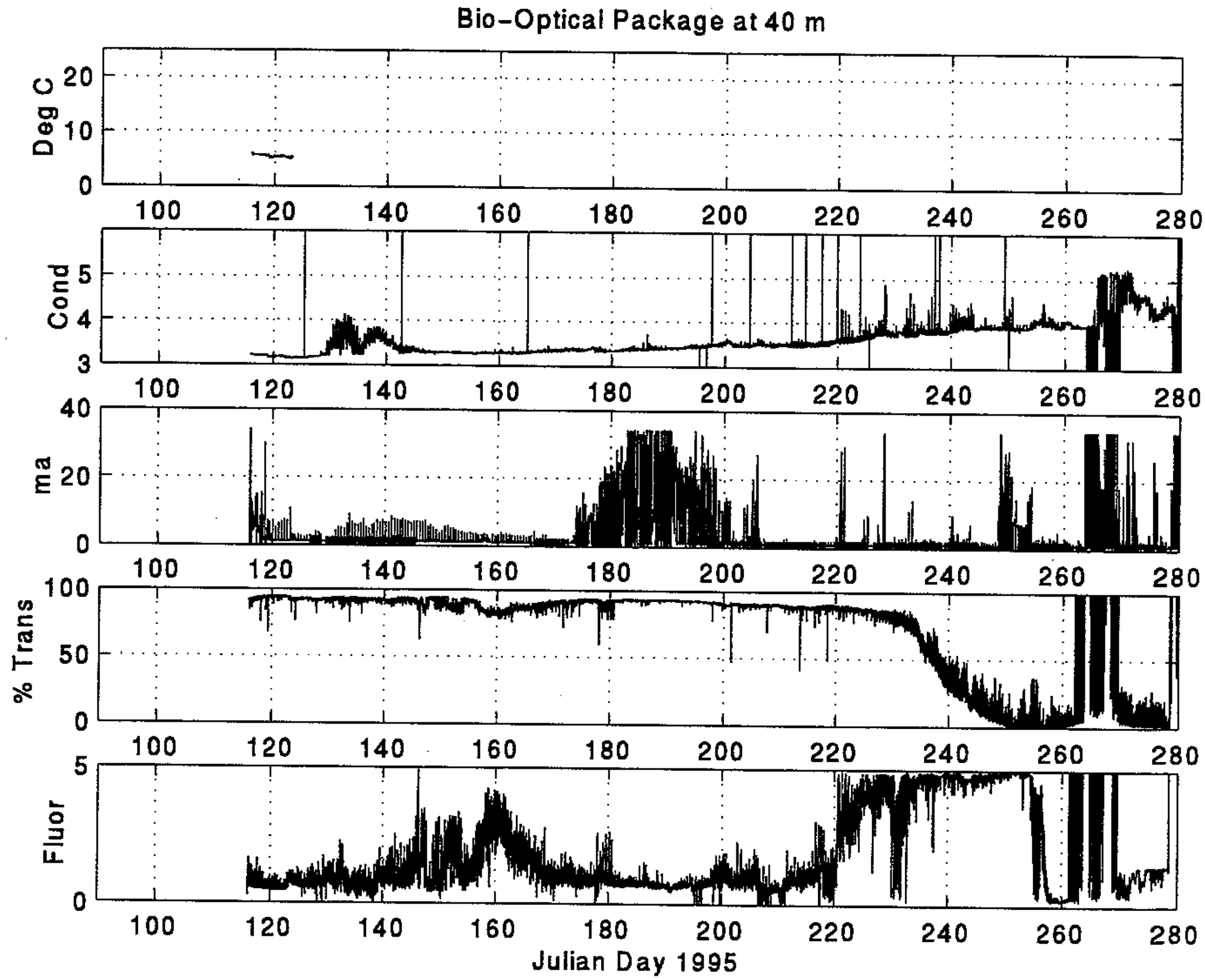

Figure 9. Southern Flank mooring bio-optical package at 40 meters. The temperature and salinity records are shown in the top two panels, the PAR in the middle panel, and the transmissometer and fluorometer results in the bottom two panels. Biofouling limited the optical observations after about 120 days.

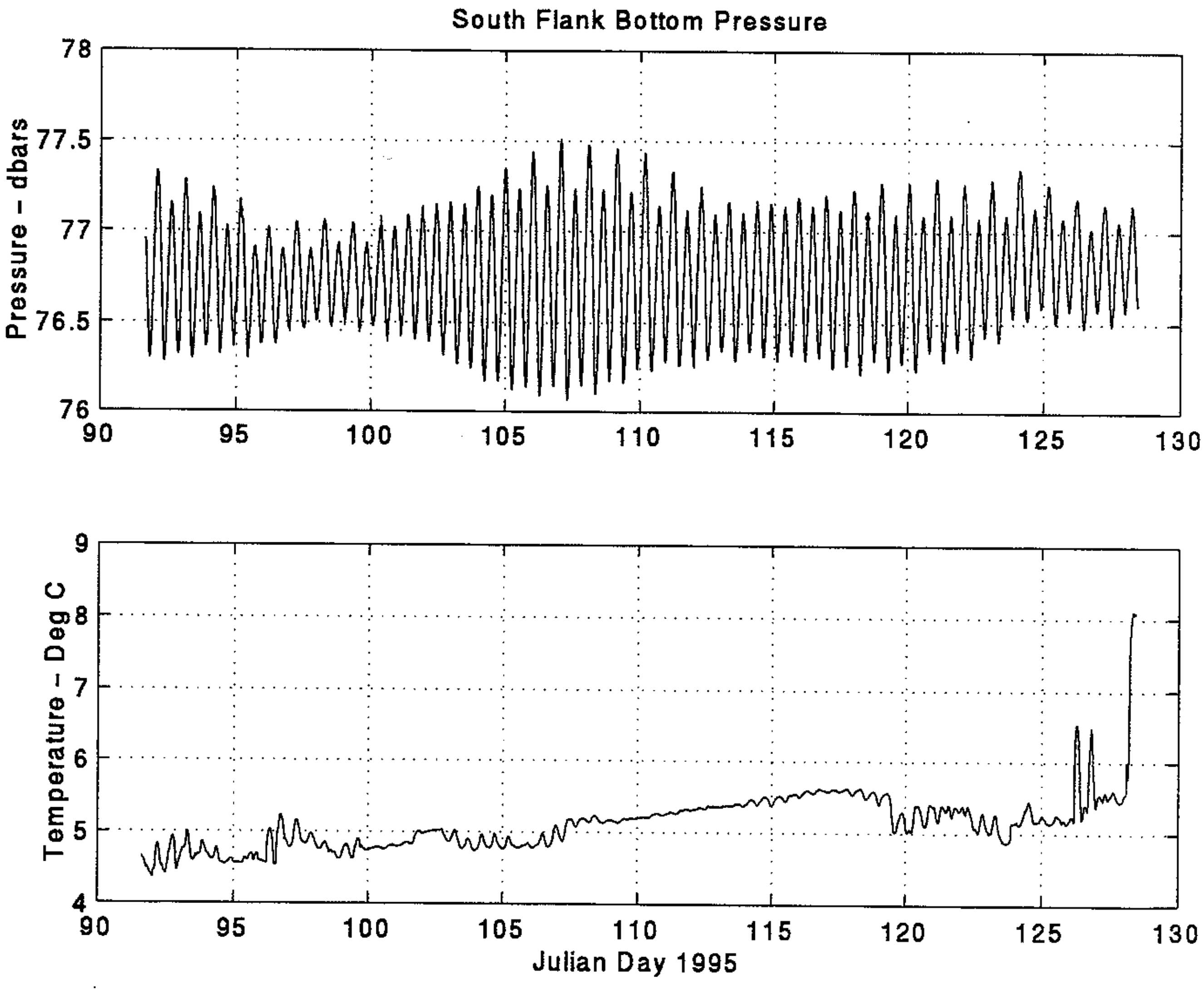

Figure 10. Southern Flank mooring bottom-mounted pressure/temperature instrument. The normalized pressure record is shown at the top and the temperature record from the end cap thermistor shown at the bottom. A pressure sensor internal temperature measurement is essentially the same as the thermistor record shown.

Guard Buoys

Two guard buoys were deployed at the site to protect the scientific moorings and bottom pressure package. One guard was an old CODE style steel buoy with solar charged battery and flashing light with chain connecting it to the anchor. This mooring was deployed 27 October 1994, so was in the water without servicing for 11 months and was working when recovered. The guard mooring was retrieved by picking up the buoy, then breaking off the chain and winding it up on a winch mounted on deck. The chain was lead through a block on the crane, then to the winch. This allowed for easy, quick recovery of the moorings without acoustic release. The chain was in good shape, but there were two shackles in the 3/4" chain at the bottom which had dragged along the sandy bottom which had lost their nuts, and the pins were being held in only by the cotter pins. This mooring could not have lasted much longer, so we will have to be careful and weld the nuts on future moorings that have breaks in the 3/4" chain. This mooring shows that we can leave the guard moorings in place for one full year, and do not have to turn them around in the spring unless there is a guard light problem.

The second guard mooring at the Southern Flank site was a standard WHOI Gilman foam guard buoy. This buoy had less reserve buoyancy, but was moored with the same chain mooring layout. This mooring was designed for recovery and redeployment by others with instruments inserted in the mooring chain. This buoy was not used for this purpose this past year because other investigators were not ready to utilize it. Therefore, it was deployed 1 April 1995, as a replacement for a steel CODE style guard buoy which was recovered to check the mooring hardware and for repair of the flashing light. The foam guard buoy remained in for 5 months.

This mooring had 5 temperature sensors borrowed from the Upper Ocean Processes Group at WHOI. Pacific Marine Environmental Laboratory style recorders were placed on the surface buoy (1 m depth), and attached to the chain at 10, 20 and 50 meters depth. They were initially placed on the mooring to fill in the gap in time left by the Southern Flank scientific mooring which was cut loose by a fisherman, and was not redeployed until 26 April 1995.

This buoy was missing when we arrived on station. It was assumed that it had broken loose, and was lost. However, when dragging for other instrumentation, this mooring was recovered. Sometime in the afternoon of 8 October 1995, the mooring sunk. This may have been due to a storm, but was most probably caused by a fishermen who dragged the buoy below the foam's crush depth, so that the buoy then lost buoyancy and fell to the bottom. It is not clear that this was not partially caused by the 500 pounds additional weight of the chain mooring over 3/8" jacketed wire rope. To prevent this in the future, the foam size will be increased to provde 3000 pounds of buoyancy to more than double the reserve buoyancy. This foam buoy weighs less than 1000 pounds, or about half that of the steel guard buoys.

The four temperature sensors worked well, and full data sets were recovered, which allowed us to determine when the mooring sank. Post cruise calibrations showed no significant change (with the exception that one sensor did not work during calibration), so the sensors were "adjusted" to read the same temperature at the start and end when they were together in a box in the laboratory, and when they were all on the bottom in mid-October. The adjusted temperature record obtained (Figure 11) shows that there was little temperature variability until mid-May when the Southern Flank Scientific mooring was installed and working.

University of Southern California/Tracor Acoustic Buoy

The University of Southern California (Richard Pieper) and Tracor (Van Holliday) deployed an acoustic mooring on Endeavor cruise EN271 in August 1995 as part of the Stratification Mooring recovery operations. This mooring was recovered on EN274 without USC or Tracor personnel to facilitate the turnaround and will be redeployed on ALBATROSS cruise AL-95-13 at the end of October 1995. The mooring was wire rope from the buoy to near the bottom , and then 3/4" chain to the anchor. The electronics and transducers were attached to the wire with clamps at 25 and 50 meter depths.

The buoy was recovered on Monday, 2 October without difficulty. The buoy was brought aboard, and the wire rope broken from the buoy and attached to a rope going to the mooring winch mounted thwartships. The rope ran through a block on the crane, which could be positioned to hold the wire rope away from the ship during recovery. The winch then slowly pulled the mooring aboard. When the electronics packages were reached, the crane brought the packages to the rail for easy removal. However, when the top instrument package reached the surface, internal pressure due to a slow leak caused the recorder pressure case's end cap to be blown off. The electronics case was drained, but we were unable to completely remove the electronics to wash everything off due to corrosion in the pressure case. The other electronics cases appeared to be in good shape and were rinsed off and secured.

When on deck, the flashing light from the buoy was turned off by opening the light and removing the bulbs. There was no other way of shutting off the light as requested by the ship. Also at this time, the R.M. Young wind sensor was taped to prevent the propellor from rotating and the vane from moving to reduce wear. All the underwater electronics and pressure cases were returned to USC/Tracor for rework between cruises, while the buoy was stored on the WHOI dock.

CTD Survey

After the Crest mooring was recovered, the weather quickly deteriorated and became too rough for mooring work. Therefore, the standard Long-Term CTD Section was run from deep water back up through the Southern Flank site to the Crest mooring site. The profiles were made with a Neil Brown MarkIII CTD with General Oceanics rosette sampler owned and maintained by the University of Rhode Island. Water samples were taken about 5 meters off the bottom of each cast for salinity determination and later salinity correction to the observations. The system also carried a Sea Tech 25 cm path length transmissometer, a Chelsea Fluorometer, and an oxygen sensor. (The oxygen data was recorded, but as standards were not taken, data from this sensor should not be used.) The system did not have an altimeter (a convenience we had grown

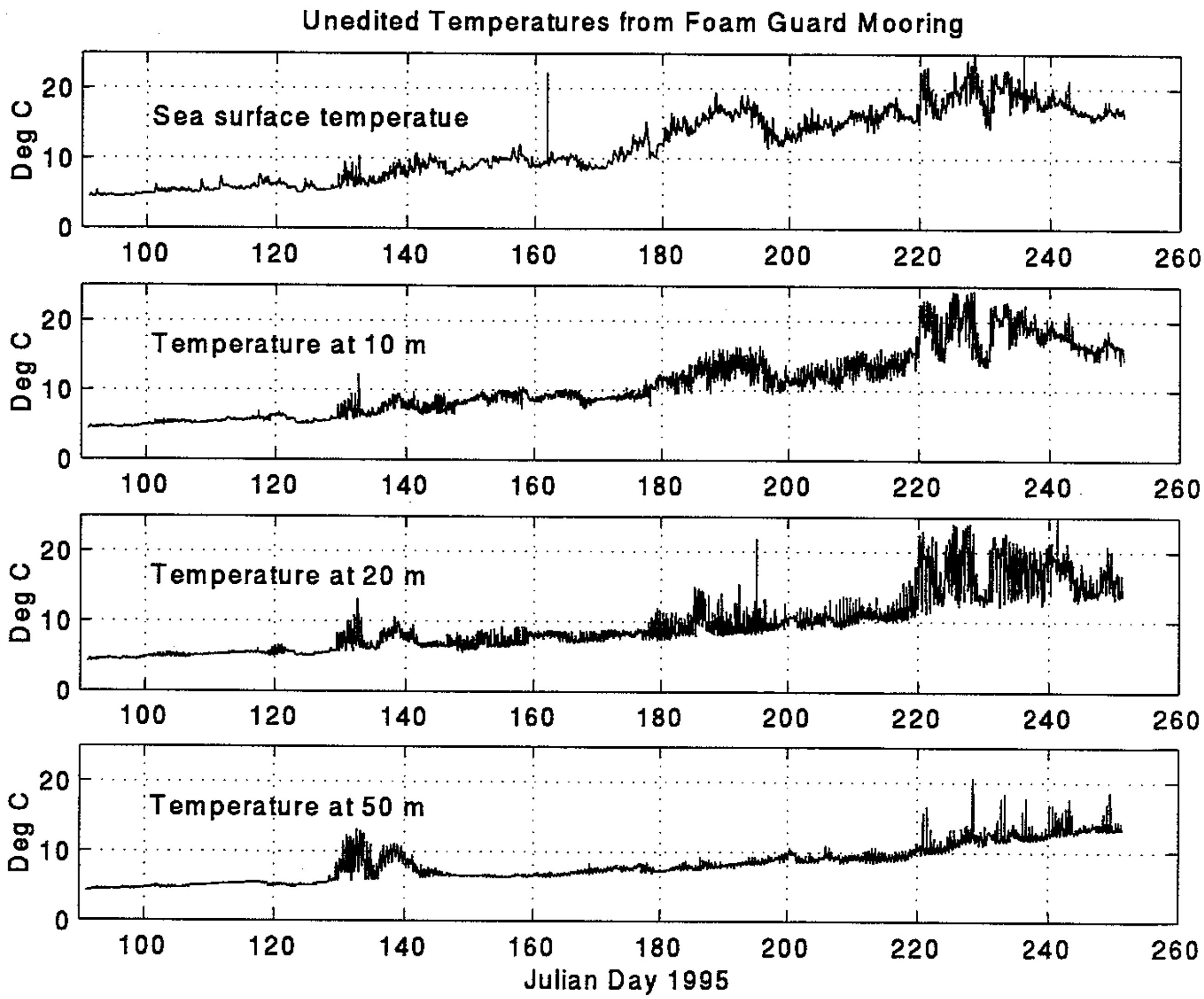

Figure 11. Temperature records from recorders on the guard mooring at the surface, 10, 20 and 50 meters depth.

accustomed to on the R/V SEWARD JOHNSON), but we tried to make profiles to within about 5 meters of the bottom by using wire out, chirp sonar depth and the CTD's pressure sensor reading. The locations of the CTD profiles are listed in Table 1.

A temperature section is shown in Figure 12, and the corresponding salinity and density sections are shown in Figures 13 and 14 respectively. The temperature and salinity were well mixed vertically at stations shallower than 60 meters. There was a tendency of the temperature to cool off going off the crest and reaching a minimum at water depths about 60 meters. The surface waters warmed up going off the bank, while the bottom waters had a minimum in temperature at about 90 meters (the shelf break). Salinity remained fairly constant coming off the crest until about 80 meters depth where there was a deep water relative maximum, then minimum associated with the cold water at 90 meters. Then both the salinity and temperature increased as the shelf slope front was reached. Obviously the fall cooling has had a major effect on the region and it is well underway toward winter conditions, although there is still some stratification remaining at the Southern Flank station. The T-S relationship from the section (Figure 15) is interesting in that the offshore station is definitely in different water, but the sections across the bank also show different T-S relationships indicating a variety of waters present from various sources, indicative of the complexity of the region during the fall cooling period.

For an end-of-deployment calibration, a 1 hour series of yo-yo CTD profiles were made by the moorings. The Crest mooring average (Figure 16) shows that the temperature and salinity are fairly well mixed (temperature to within 0.02°C and salinity to within 0.01 PSU), as is normally observed at this site. The Southern Flank yo-yo average (Figure 17) does show some stratification remaining, but not nearly as large as observed earlier in the year.

Zooplankton Abundance, Physiological Condition, and Growth Rates

E. Durbin, P. Garrahan, P. Heredia, J. Gibson

Objectives: (1) To collect zooplankton samples during the long interim between broadscale surveys. (2) To determine the size (length, carbon, nitrogen) and condition (condition factor, RNA/DNA ratio) of Calanus finmarchicus at selected sites on the Bank, and (3) To determine whether the stage 5 copepodites present are actively feeding or in diapause.

Methods: Zooplankton tows were made with the 1-m2 MOCNESS equipped with one 300 um mesh down net and four 150 um mesh upcast nets. The MOC-1 stations occupied were Broadscale standard stations 38, 12, 9 and another station off-slope near station 7 (see Table 1 for station positions). The following sampling intervals were used: surface-bottom; bottom-100m; 100m-40m; 40m-15m; and 15m-surface. Samples were preserved in 4% formaldehyde. Additional oblique ring net hauls were made to collect animals in the top 40 - 70 m. Station 38 was re-occupied before the end of the cruise and additional samples were collected.

Prior to preservation, 60 - 100 C. finmarchicus stage 5copepodites were sorted from bottom and surface nets. These animals were video-taped for size measurements and were frozen in liquid nitrogen for RNA/DNA analysis or were placed in tin weighing boats and dried over desiccant for CHN analysis.

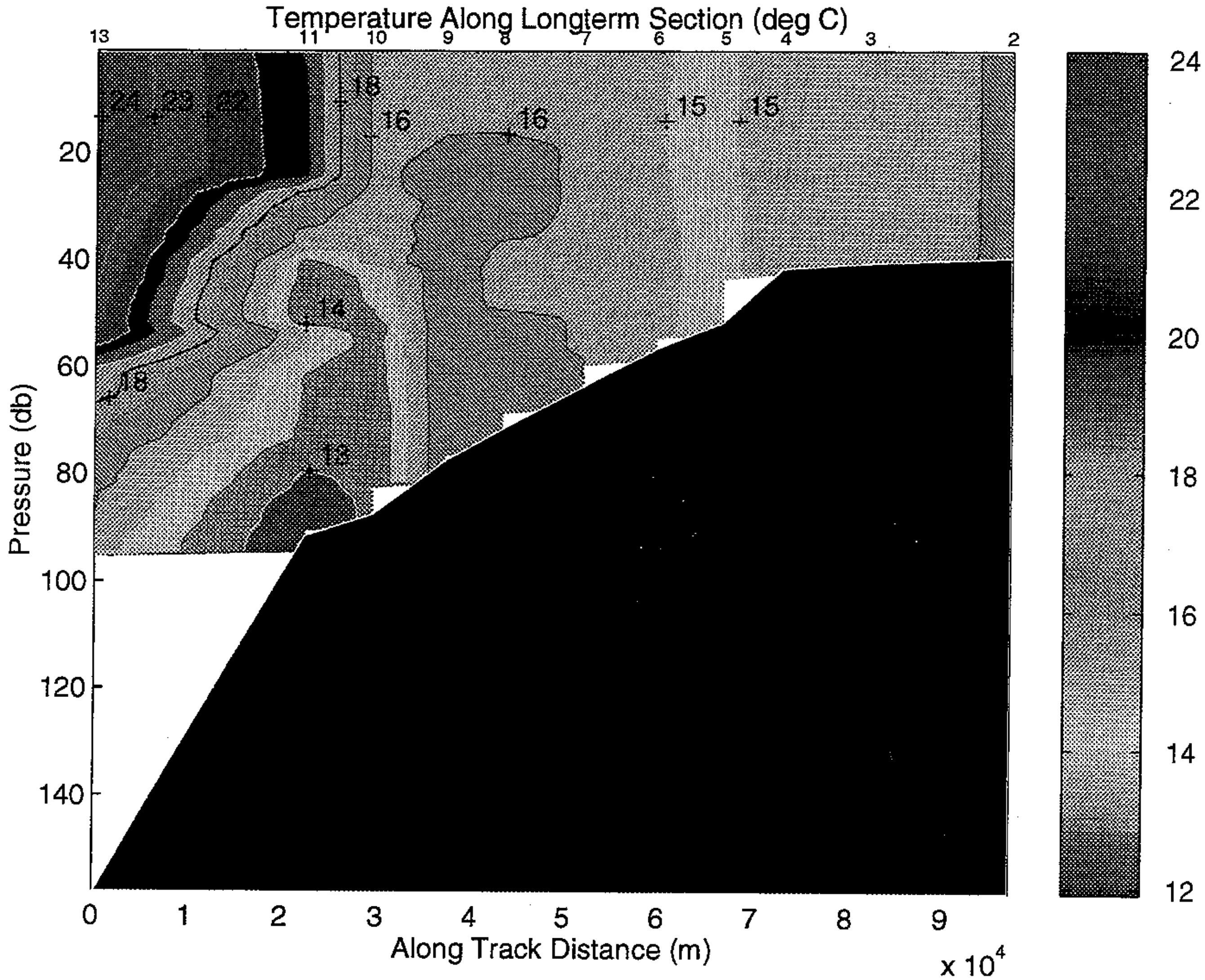

Figure 12. Long-Term Temperature Section from the shelf slope front up onto the crest through the two moorings.

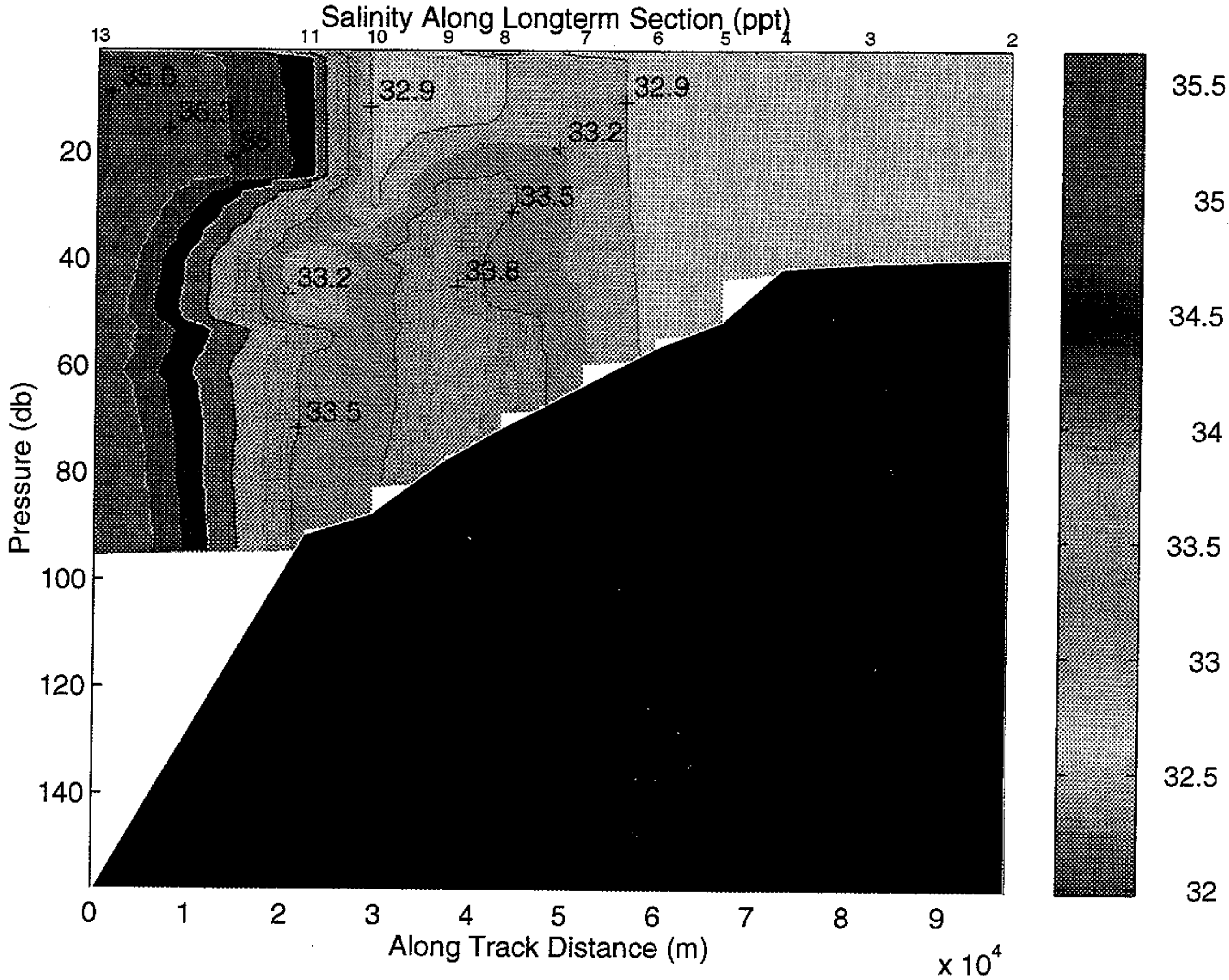

Figure 13. Long-Term Salinity Section from the shelf slope front up onto the crest through the two moorings.

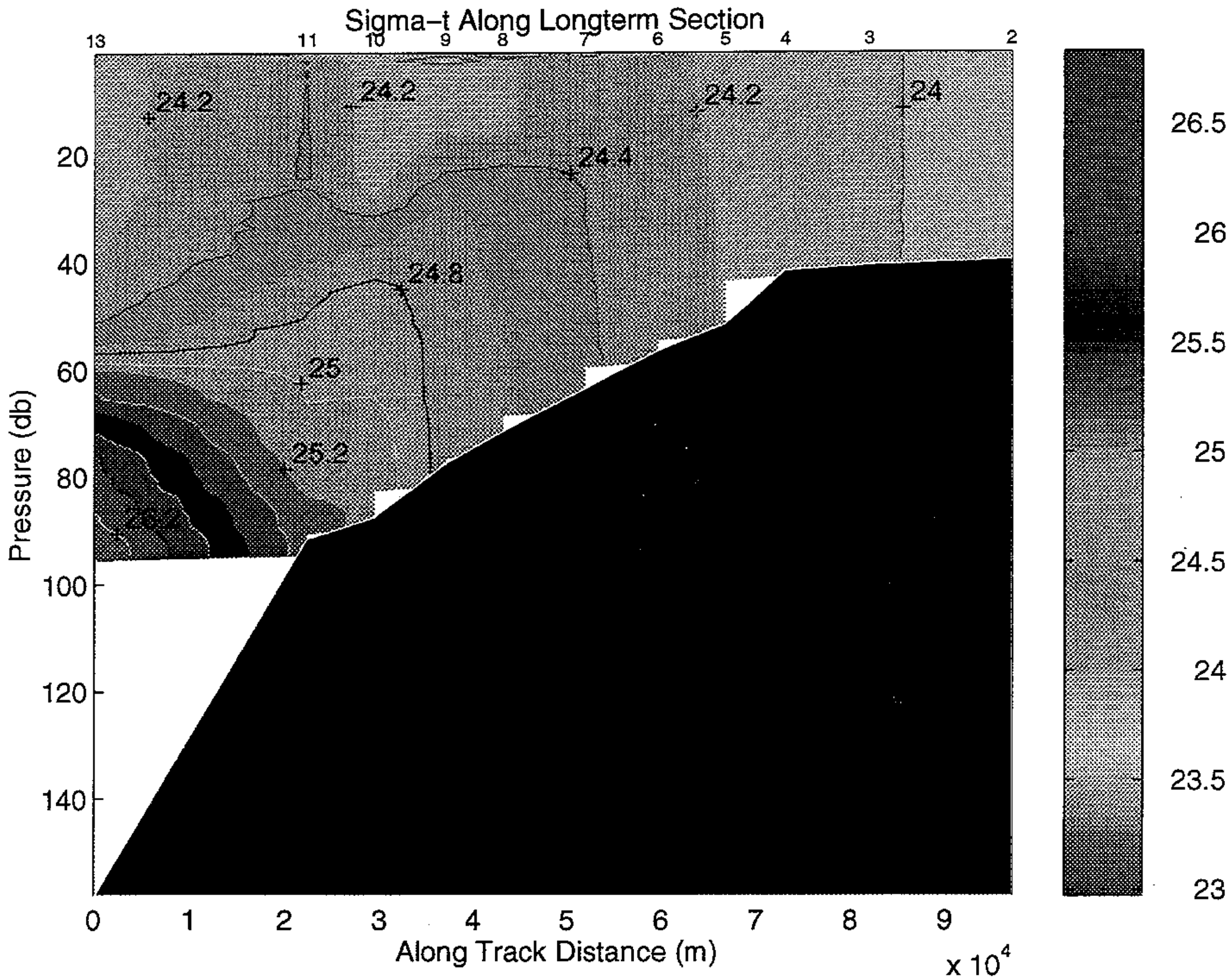

Figure 14. Long-Term Density (Sigma-t) Section from the shelf slope front up onto the crest through the two moorings.

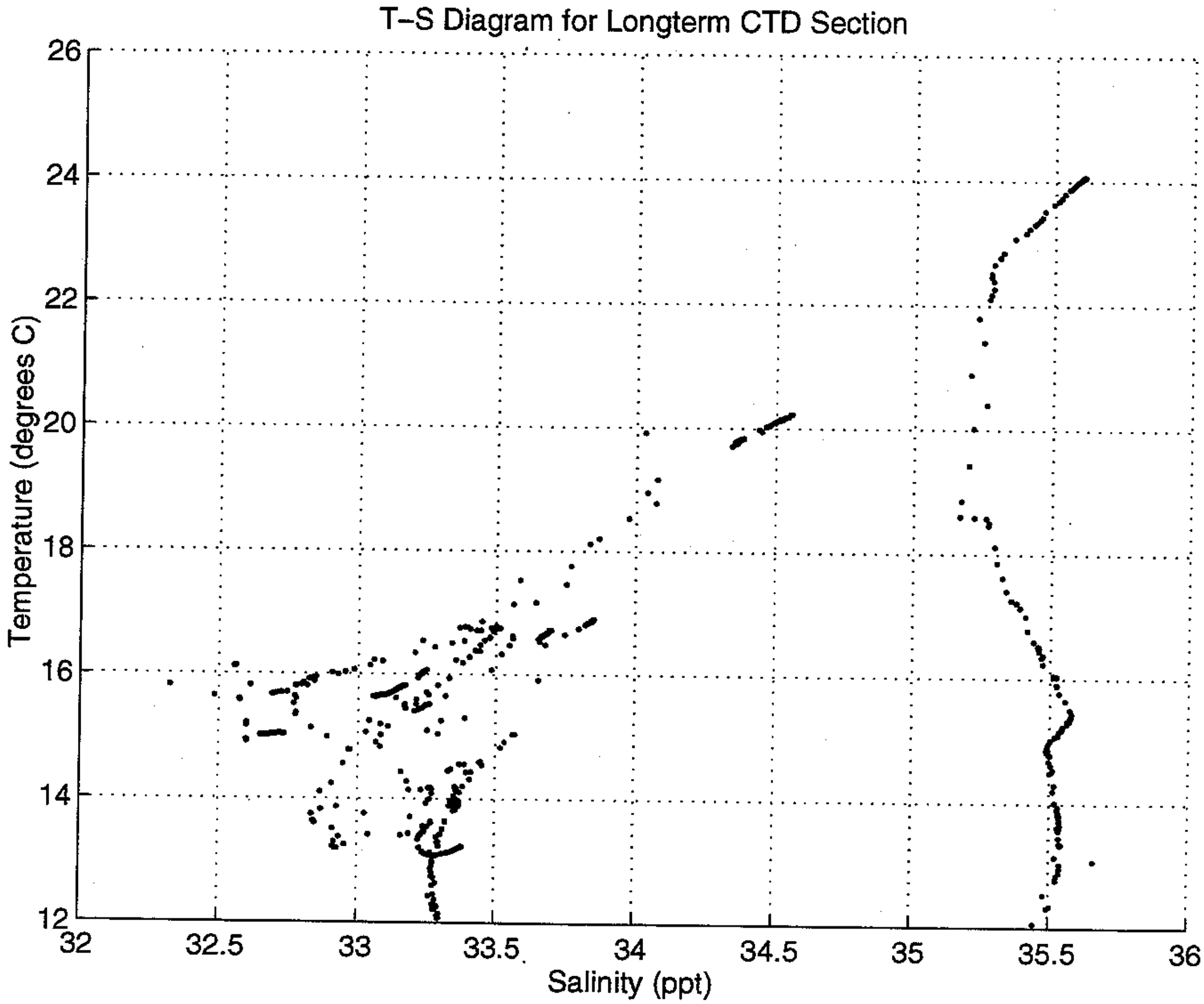

Figure 15. Long-Term Temperature - Salinity relationship from the section from the shelf slope front up onto the crest as shown in Figures 12 and 13.

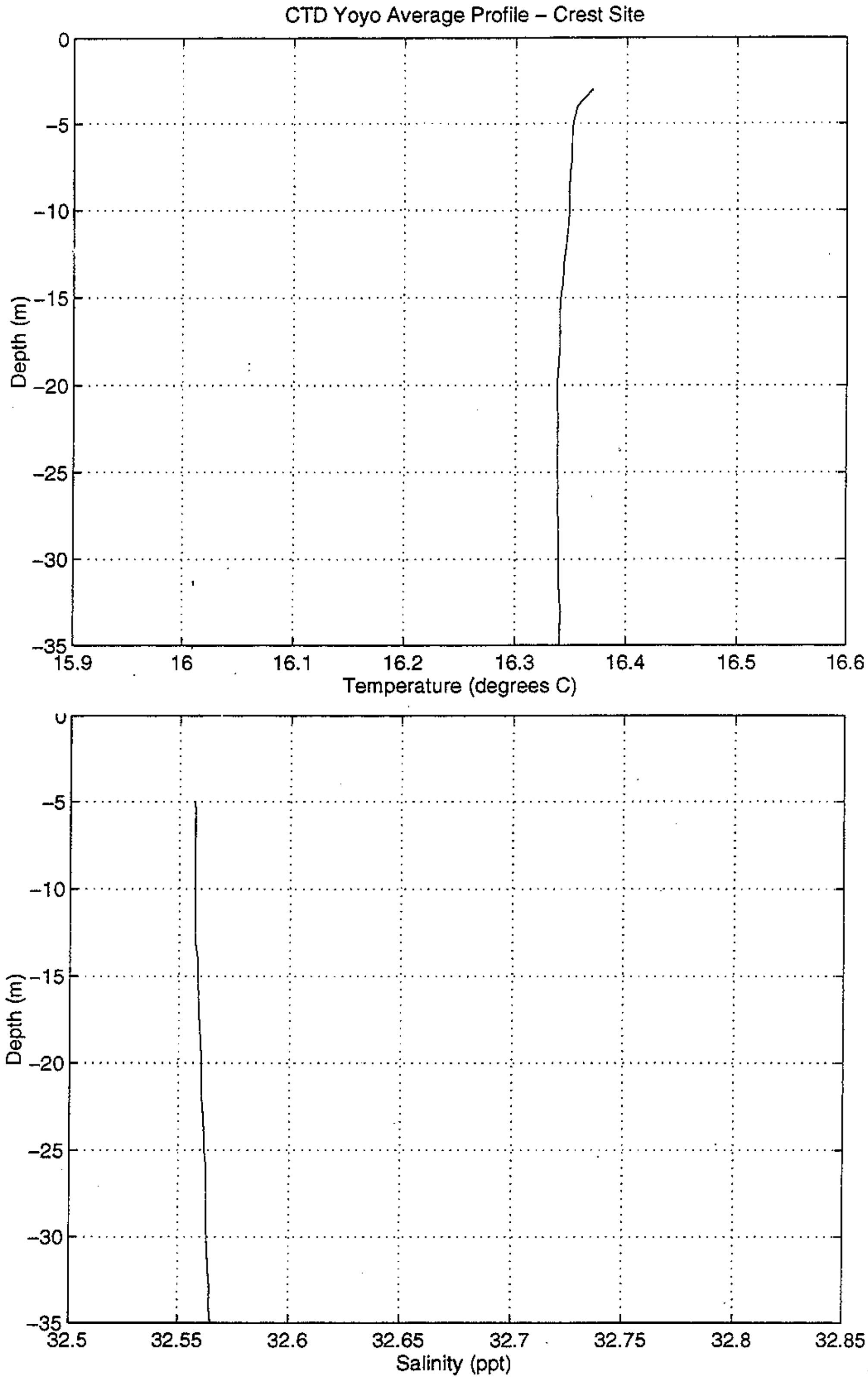

Figure 16. Average Crest temperature and salinity profiles from an hour yo-yo series beside the Crest mooring.

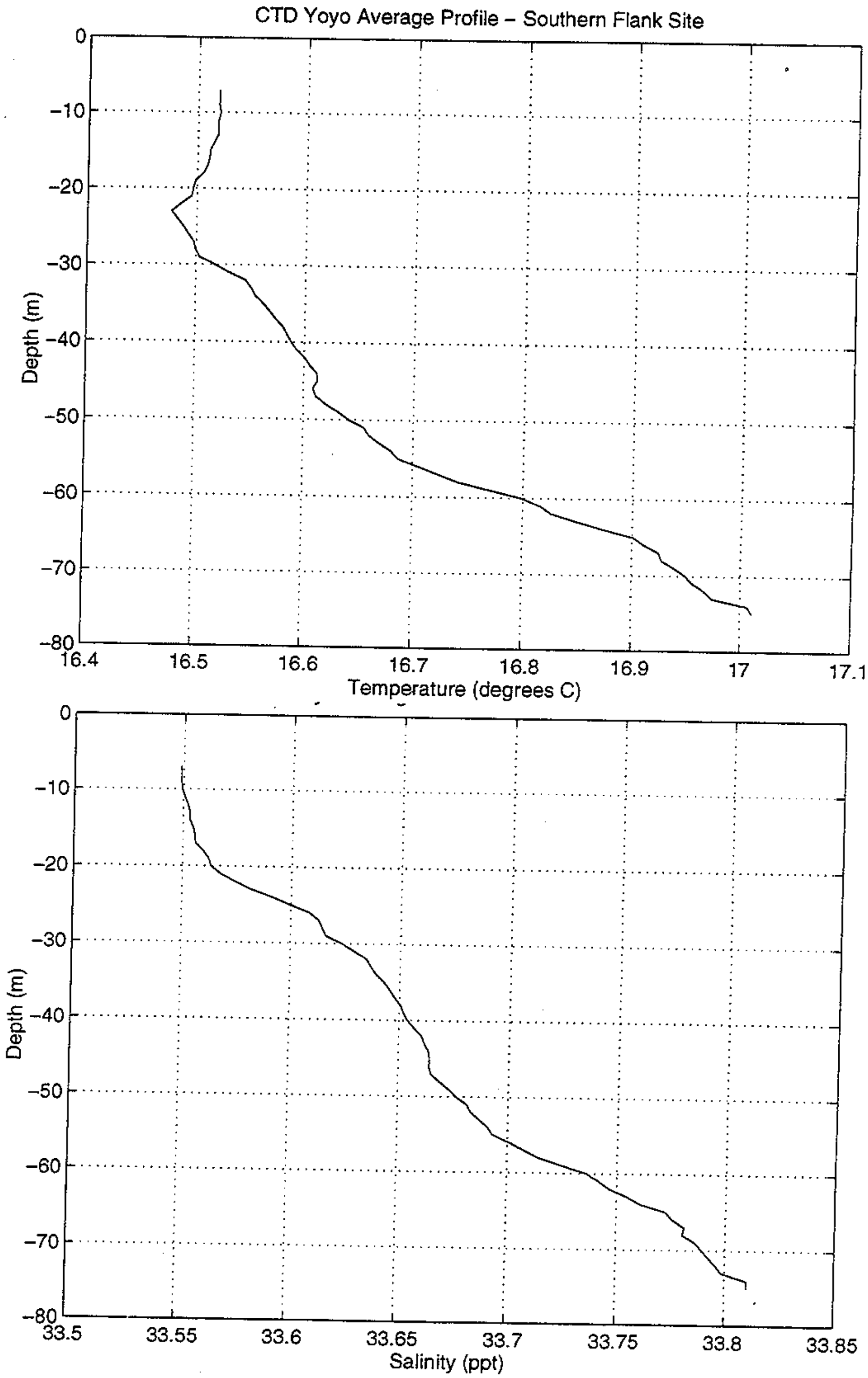

Figure 17. Average Southern Flank Temperature and Salinity profiles from an hour yo-yo beside the Southern Flank mooring

Preliminary results: Calanus finmarchicus were most abundant at station 38 in the Great South Channel. Animals near the bottom were mostly C5's and appeared to be in diapause. Some C4's and adult females were found at the surface with smaller C5's that appeared to be feeding. Fewer C. finmarchicus were found on the Bank while there were none found at station 7a (off slope). The slope station tows comprised mainly Pleuromamma spp. and Candacia armata. These species indicated the presence of slope water or possibly warm core ring water.

Personnel:

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James Gibson, URI
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URI, Marine Technician
William Fanning

Principal Crew of R/V ENDEAVOR
Thomas Tyler, Master
Everett McMunn, Chief Mate
Steve Vetra, Second Mate
James Cobleigh, Chief Engineer
Jack Buss, Bos'n

			US GLOBEC Geroges Bank Event Log - EN274								Water	Cast	
Event	Instrument	Cast #	Station #	Year	Mon	Day	HHMM	s/e	Latitude	Longitude	Depth	Depth	PI
1	CTD	0		95	9	29							
2	Moc1	1	38	95	9	30	1:44	s	1 29.5	68 57.06	156	151	Durbin
3	CTD	1	38	95	9	30	2:48	s	1 29.4	68 57.06	158	150	Irish
4	ZPN	1	38	95	9	30	3:30	s	1 29.6	68 57.76	157	40	Durbin
5	CTD yoyo	2	Crest	95	9	30	11:33	s	1 24.7	67 33.02	45	35	Irish
6	CTD yoyo	3	Crest	95	9	30	11:39	s	1 24.8	67 33.31	45	35	Irish
7	CTD yoyo	4	Crest	95	9	30	11:44	s	1 24.9	67 33.43	45	35	Irish
8	CTD yoyo	5	Crest	95	9	30	11:46	s	1 25.0	67 33.65	45	35	Irish
9	CTD yoyo	6	Crest	95	9	30	11:50	s	1 25.1	67 33.79	40	32	Irish
10	CTD yoyo	7	Crest	95	9	30	11:54	s	1 25.2	67 33.93	40	32	Irish
11	CTD yoyo	8	Crest	95	9	30	11:58	s	1 25.3	67 34.06	45	32	Irish
12	CTD yoyo	9	Crest	95	9	30	12:01	s	1 25.4	67 34.25	43	32	Irish
13	CTD yoyo	10	Crest	95	9	30	12:08	s	1 25.6	67 34.45	42	30	Irish
14	CTD yoyo	11	Crest	95	9	30	12:12	s	1 25.7	67 34.62	43	32	Irish
15	CTD yoyo	12	Crest	95	9	30	12:16	s	1 25.8	67 34.77	42	32	Irish
16	CTD yoyo	13	Crest	95	9	30	12:20	s	1 25.9	67 34.90	44	32	Irish
17	CTD yoyo	14	Crest	95	9	30	12:24	s	1 26.0	67 35.04	42	32	Irish
18	CTD yoyo	15	Crest	95	9	30	12:28	s	1 26.2	67 35.20	35	30	Irish
19	CTD yoyo	16	S Flank	95	9	30	18:30	s	0 57.7	67 18.96	75	72	Irish
20	CTD yoyo	17	S Flank	95	9	30	18:36	s	0 57.6	67 18.78	77	72	Irish
21	CTD yoyo	18	S Flank	95	9	30	18:43	s	0 57.5	67 18.67	77	72	Irish
22	CTD yoyo	19	S Flank	95	9	30	18:49	s	0 57.4	67 18.51	77	72	Irish
23	CTD yoyo	20	S Flank	95	9	30	18:56	s	0 51.4	67 18.36	77	72	Irish
24	CTD yoyo	21	S Flank	95	9	30	19:02	s	0 57.4	67 18.20	77	72	Irish
25	CTD yoyo	22	S Flank	95	9	30	19:08	s	0 57.4	67 18.04	77	72	Irish
26	CTD yoyo	23	S Flank	95	9	30	19:15	s	0 57.4	67 17.85	77	72	Irish
27	CTD yoyo	24	S Flank	95	9	30	19:20	s	0 57.4	67 17.70	77	72	Irish
28	CTD yoyo	25	S Flank	95	9	30	19:26	s	0 57.4	67 17.57	77	72	Irish
29	CTD	26	LT11	95	10	1	2:25	s	0 47.3	67 12.98	97	90	Irish
30	CTD	27	LT11	95	10	1	2:48	s	0 47.1	67 12.98	97	91	Irish
31	CTD	28	LT10	95	10	1	3:34	s	0 50.6	67 14.96	95	88	Irish
32	CTD	29	LT09	95	10	1	4:22	s	0 54.4	67 16.90	85	80	Irish
33	CTD	30	LT08	95	10	1	5:12	s	0 57.5	67 18.31	77	72	Irish
34	MOC1	2	BIO9	95	10	1	5:47	s	40 58.1	67 17.2	77	70	Durbin
35	MOC1	2	BIO9	95	10	1	6:05	e	40 58.4	67 16.4	77	70	Durbin
36	ZPN	2	BIO9	95	10	1	6:30	s	40 58.3	67 16.4	77	40	Durbin
37	CTD	31	LT07	95	10	1	9:06	s	1 01.9	67 20.84	69	64	Irish
38	CTD	32	LT06	95	10	1	10:06	s	1 05.9	67 22.54	63	58	Irish
39	CTD	33	LT05	95	10	1	10:58	s	1 09.4	67 24.56	58	53	Irish
40	CTD	34	LT04	95	10	1	11:35	s	1 02.5	67 26.59	47	43	Irish
41	CTD	35	LT03	95	10	1	12:55	s	1 17.0	67 28.53	45	40	Irish
42	CTD	36	LT02	95	10	1	14:04	s	1 24.7	67 32.38	45	39	Irish
43	MOC1	3	BIO12	95	10	1	14:27	s	41 25.5	67 32.3	48	38	Durbin
44	MOC1	3	BIO12	95	10	1	14:37	e	41 25.0	67 32.1	48	38	Durbin
45	ADCP/PDR Survey			95	10	1	16:30		Crest	Region			Irish
46	CTD	37	LT13	95	10	2	10:50	s	0 35.7	67 07.98	165	160	Irish
47	MOC1	4	BIO7A	95	10	2	11:09	s	40 35.9	67 08.1	162	145	Durbin
48	MOC1	4	BIO7A	95	10	2	11:53	e	40 37.7	67 07.8	142	145	Durbin
49	CTD	38	BIO38	95	10	5	16:37	s	1 29.5	68 57.8	156	152	Irish
50	MOC1	5	BIO38	95	10	5	17:07	s	41 29.8	68 57.9	156	150	Durbin
51	MOC1	5	BIO38	95	10	5	17:47	e	41 29.8	69 00.0	156	150	Durbin

GLOBEC Long-Term Moored Program Recovery Cruise
R/V ENDEAVOR - 29 September to 6 October 1995

Cruise Log

Friday 29 September 1995 - JD272
EDT
after lunch - removed magnet from ARGOS drifter 23772, Telonics ID 07388
1400 - Depart URI Narragansett Dock
1430 - Boat, Fire, Abandon Ship drill
1447 - Secure from all drills
1508 - Start test CTD#00, fire all 12 bottles - system worked
1525 - Completed CTD test, underway to Biostation #38 in Great South Channel

Saturday 30 September 1995 - JD273
0134 - MOCNESS 001 @ Biology Station BIO#38
0248 - CTD001 @ Biology Station BIO#38
0320 - Ring net cast @ Biology Station BIO#38
0700 - Weather overcast, seas 4-5', wind NE 20 kts ETA at Crest 0900
At 41° 24' N x 68° 00' W no sign of crest ripples on chirp
0730 - Main engine cooling water leak, engine shut down for repair
0915 - Main engine back on line and clutch in gear, starting out again
1125 - At Crest mooring site - buoy is still there, and looks in good shape. Buoy has a 20° list due to currents, wind about 20 kts, seas 4', whitecaps. Ship was setting was about 1 kt to north steaming into site.
1133 - Start series of yo-yos by Crest buoy, ship drifting.
CTD002 start of series
SST = 16.4°C, SSS = 31.59 PSU
1228 - CTD015 end of series
Ship drifted about 2 kts so final position was 3 miles from buoy
1235 - CTD secured, heading for Crest buoy
1308 - Hydrophone of acoustic command unit in water, enabled acoustic release, range was about 800 meters
1309 - Release command, questionable acknowledge
1310 - Bridge reported subsurface float on surface
1343 - Crest Buoy on board
1354 - Bio-Optical package on board
Buoy Delaunch: Minor rust streaks on buoy. No major corrosion on tower as during first deployment. Visual checks of: PAR-ok, Air Temperature-OK, Antenna-ok, Flashing light works & is dry, electronics case-ok, solar panels and cables look ok, "hair" on T and C sensors, conductivity sensor tube clean inside, ARGOS beacon slipped down but still held on by three stainless hose clamps. Make better bracket if use this scheme again.
Bio-Optical package: Temperature and conductivity sensors tight in mounting bracket but hose clamps fastening PVC clamp to round rod broke. We should weld a mounting

plate to cross bar to mount T & C sensor clamp. NOTE: one end of electronics pressure case does not have any biofouling on it! NOTE: loose 33 tape on transmissometer can flap into view of transmissometer. Lots of "hair" growth on bio-optical package. Some does get in way of transmissometer path. PAR sensor clear of dense hair, but has brown "rust" colored stuff growing on it.

Release and Mooring: Acoustic release 15988 had hair all over it. Release zincs in good shape, only slightly corroded. Rubber bands in excellent condition. Zincs gone on one mooring bridles, some left on other. Zinc gone on swivel, but still swivels. Chain looks good, shackles clean. Only one with visible wear on it. Took picture. Rest have shiny spot where thimble or pear ring sat against it.

1430 - Crane cradled, Crest buoy secured on Port aft by rail standing. Tied by ratchet straps. Subsurface buoy secured to aft rail behind buoy.

1433 - And off to Southern Flank site

1720 - Approaching Southern Flank mooring site
Three buoys visible, WHOI foam marker buoy with temperature sensors is missing! It was here end of August when the USC mooring was deployed. The CODE steel guard was there in good shape, Foam scientific and USC mooring are present. Buoys appear to be in good condition, no missing parts, or bent towers.

1737 - Standing by for acoustic release of bottom ADCP frame.
Enable release, release command, acknowledge release command

1747 - No backup recovery balls or ADCP frame on surface, so recheck acoustics. Range 357 m and opening, so package probably still on bottom.

1754 - Range 590 m, drift rate is about 1.2 kts SSE

1800 - 0.1 nm from ADCP site, range 282 m - probably still on bottom,
282 m slant => 271 m = 0.146 nm => 0.046 nm = 85 m difference of acoustic range and original deployment site

1807 - 0.04 nm from ADCP site, range 184 m and decreasing - OK
184 m slant => 165 m = 0.09 nm => 0.05 nm = 92 m difference of acoustic range and original deployment site

1810 - 0.01 nm from ADCP site, range 139 m and steady
139 m slant => 116 m = 0.06 nm => 0.05 nm = 92 m difference of acoutic range and original deployment position. GPS receiver says we are getting good Differential GPS signal - Ship says the DGPS is good out to 200 miles and only goes bad when you get into Canadian waters!

1815 - Heading back to 1/4 mile below buoy site for CTD series at Southern Flank buoys for end of data calibration

1830 - CTD016 and start of one hour CTD survey series at Southern Flank station. Little vertical stratification in temperature and salinity profiles show the end of the stratification with fall cooling.

1926 - CTD025 and end of 1 hour CTD survey

2003 - Back at buoys - Ship had drifted 1.25 nm during CTDs - wind about 20 kts from ENE - Ranging on ADCP from 0.12 nm from DGPS position and 335 m range 335 m slant => 326 m = 0.176 nm => 0.056 nm = 103 m difference from deployment position. OK

2008 - Depart Southern Flank site for LT13

Sunday - 1 October 1995 - JD274

Weather at LT13 too poor to do CTD, or MOCNESS
Weather at LT12 too poor to do CTD

0225 - CTD026 LT11 - caps on sensors so had to redo profile
0248 - CTD027 LT11
0334 - CTD028 LT10
0422 - CTD029 LT09
0512 - CTD030 LT08 back at South flank site
0546 - MOCNESS at BIO #09
0630 - Net cast
0730 - Winds 24-29 kts, seas 8' so can not do any buoy work. Forcast is for 15 kts in evening and less than 15 kts by Monday with calming seas.
0745 - Ranging on ADCP to get good position for dragging
40° 57.5130' x -67° 19.2516' - range = 1185 m = 0.64 nm
40° 58.4841' x -67° 19.6209' - range = 1030 m = 0.55 nm
40° 58.4675' x -67° 19.6289' - range = 1015 m = 0.55 nm
40° 58.5061' x -67° 18.6289' - range = 905 m = 0.49 nm
40° 58.4988' x =67° 18.6360' - range = 890 m = 0.48 nm
plotted acoustic ADCP fix = 40° 58' 08" N x 67° 19' 03.2" W
0830 - Underway to LT07 CTD
0906 - CTD031 at LT07
1006 - CTD032 at LT06
1058 - CTD033 at LT05
1135 - CTD034 at LT04 - wind speed pretty steady at 21 kts
1255 - CTD035 at LT03
1400 - Wind speed 25 kts, Air temp 16.8°C 101% RH. SST=16.5
1404 - CTD036 at LT02 or Crest Site
1425 - Start MOCNESS at Crest Site
1440 - MOCNESS on board
Cleaning up and getting ready for ring net profile
1502 - Ring net tow
1510 - Ring tow complete

Setting up Chirp sonar for ADCP/Chirp survey. Had to boot system to get working. When starting, login with "bottom" to start software. To slow down paper rate, set depth to 375 m to slow down ping rate. Trying to get EPC recorder working with help of Bill Fanning.

Then noticed that ADCP appeared to have quit around 1253 EDT?????

Try ADCP setup:
- 8 meter bins
- 60 second averages
- get 97 to 112 pings per ensemble
- random error is then 0.6 to 0.7 cm/sec

NOTE ADCP time is in GMT

Slowing the ship to about 3 kts for survey. This is slowest we could keep position with wind and seas. Plan is to go back and forth through the Crest Mooring site, 2 nm on each side continually.

1630 - ADCP and Chirp on, so start of 12.5 hour series

1640 - Crest ripple peak to peak distance in Chirp record is about 7 minutes @ 3.1 kts = 670 m

1650 - Reversing course to north

1700 - North velocity = 0, East about +40 cm/sec, Vertical a few cm/sec negative - getting 95-106 pings per ensemble

1750 - North = -30 cm/sec, East = 55 cm/sec, Vertical positive a few cm/sec over bathymetry peak negative few cm/sec after peak. Sean noted that ADCP was missing any NAV data - messing arournd with ADCP software to try and get DGPS postions on screen.

1830 - East = 50 cm/sec, North = -40 cm/sec, vertical -10 cm.sec
Moved ADCP software to directory ADCPE274

1905 - East = +30 cm/sec, North = -60 cm/sec, Vertical = -10 cm/sec
Wind about 16 kts.

1930 - North = -80 cm/sec, East = +25 cm/sec, vertical = 0 cm/sec

1935 - At ridge peak, vertical = -20 cm/sec, at last peak the vertical velocity was positive.
Set of peaks at 2330 UTC and 2334 UTC on chart are 4 minutes apart @ 1.6 kts => 200 m peak to peak.

1937 - Vertical velocity about 0, East = 25 cm/sec, North = -80 cm/sec

2003 - East = 10 cm/sec, North = -80 cm/sec, Vert = -10 cm/sec
Wind 20 kts

2009 - Above peak @ 2005, vert = +10 cm/sec, next peak @ 2008 , vert = -10 cm/sec

2010 - Vert = 0 to -1 cm/sec

2030 - East = -10cm/sec, North = -80cm/sec, vert = -5 cm/sec, flat bottom @ 45 m. Winds 18-20 kts

2100 - East = -25cm/sec, North = -70cm/sec, vert = 0cm/sec

2130 - East = -35 cm/sec, North = -75 cm/sec, vert = 0, coming off peak

Monday - 2 October 1995 - JD275

0230 - ADCP and EPS running fine

0500 - End ADCP and EPS plotter, Chirp left on
Heading for Southern Flank mooring site

0800 - At site, foggy, wind < 15 kts.
Ship won't recover due to heave of swells and poor visibility

0830 - Ranging on ADCP instrument - 808 m
40° 57.7123' x 67° 18.8561' - range = 818 m
Position consistent with other fixes
Heading for LT13/MOCNESS BIO#7A/NET
Try and be back by 1600 to pull at least one buoy

1045 - Approaching LT12 - depth 165 m
Had to reboot Chirp system. Chirp is quite sensitive, when ship is rolling and you are holding trackball it is easy to press right button and it will bring up the background computer operating system, and then Chirp will not hold tracking on bottom, and has to be rebooted to run. Not very bulletproof. If it needs booting often, should make it easier

to come up in Chirp software. Forget the login, forget the computer part, make it an instrument which works. Also system does not work reliably in scroll mode. Basically, Chirp is a great improvement, and a great convenience to have digital depth, and have digital chart record. Again, Chirp system is not robust enough for normal use. Had difficulty turning on. Suggest that someone from URI or the company go to sea when it is being used and watch the scientists and the problems that they have with it. It takes lots of "fiddling" to get a good automatic trace following bottom. The convenience of the system is great in getting depth in to normal shipboard data streams.

1047 - CTD in water - ADCP shows two layer flow features

1100 - CTD on board, preparing for MOCNESS

1106 - MOCNESS in water, depth about 155 meters, with 5 nets, one on way down and three on way back with one at surface.

1200 - Underway back to Southern Flank mooring site. Fog is less at LT13, but visibility is still limited.

1230 - Fog is closing in but not as bad as this morning.

1300 - Fog is really going now and sea is laying down

1430 - At South Flank site, wind 20 kts, seas about 4' looks OK to work

1440 - Commanding ADCP again
Release says horizontal and released, Range = 871 m

1445 - Moving up on buoys, going for Southern Flank Scientific buoy
Current appears to be going NNW

1455 - Hydrophone in water to command release
USC buoy swaying back and forth +10° to -30°
Southern Flank bungee mooring ±<10°

1500 - Can not enable release, put hydrophone all the way down
Release enabled, transponding, commanding release

1505 - No sursurface float on surface, sending another release command
Acknowledgement says release is vertical and released
No indication from buoy that it is released

1534 - Moved up on buoy. Decided to pull on buoy. Put a line on the buoy and let the ship slowly move, pulling on buoy. The buoy "sat" down in the water a bit and tipped, but not close to going under. The buoy is moving down in water, but shows no sign of dropping the anchor, and we appear to be dragging the buoy and anchor, so dropped the line. Why did two of three, and both releases at Southern Flank site not release? Do we have a release problem or severe fouling problem?

1540 - Commanding release again, says released, Range 316 m

1541 - Range 251 to buoy

1542 - Enabling ADCP, range 311 m

1550 - Rigging for USC buoy recovery

1620 - Buoy hooked

1622 - Buoy on deck

1624 - Anchor chain broken off at swivel

1630 - Upper electronics package at surface. As package reached shallow water, a large air bubble was seen in the water, and as the electronics package broke the surface, the upper end cap on the lower pressure case came loose and was flopping in the air. Later check showed that electronics corroded into case, that leak had been earlier and that electronics are probably destroyed. Tried to take out the electronics to clean with water but was unable to do so. Therefore, closed up case and tied to bench. There was some corrosion on this case not seen on the others which probably is indicative of a shorting problem. The two transducer pressure cases are clean looking.

1638 - To break electronics pressure cases broken off wire, takes over 5 minutes of two or three people working at rail to get off wire. Should consider mounting rod through center of two cases and breaking the wire to speed recovery process. When we tried to pull swivel and associated hardware through the level wind of the winch, the wind bent back into winch and had to be bent back by a come-along before recovery could continue. It was rigged on deck wrong at start. Level wind was too high for placement of block and pulling plate. Had to remove swivel and hardware and remove line from level wind. USC buoy appeared to be in good shape. No damage was apparent.
We turned off flashing light by taking out bulbs.

1653 - Second electronics group out of water

1654 - Sensors unplugged, taking off wire, electronics labeled #1

1701 - Anchor on deck

1712 - Anemometer fan and vane taped so won't rotate

1717 - Buoy secured to Port rail forward of Crest buoy

1739 - Anchor stowed on starboard aft deck out of way of air tugger and MOCNESS
Cleaning up deck

2000 - Can see two flashing lights of guard and science buoy in position.

Tues - 3 October 1995, JD276

0715 - Wind calm, seas 2', sunny

0725 - 505 m to buoy, command release, 4 short, 4 long, says released

0730 - Disable buoy, enable ADCP, 738 to ADCP
command release, - 4 long, w short, says released

0733 - Disable ADCP

0814 - Going for CODE guard buoy

0827 - Approaching buoy

0824 - Missed, current carrying ship away, around again

0840 - Buoy on board, secured

0849 - Pulling on chain, nuts missing on shackles on 3/4" chain in sand!

0912 - Buoy upright at tied down on deck, cleaning up deck

0914 - Moving into position, rigging drag

1015 - Paying out 200 m of trawl wire, wind 13 kts, scattered whitecaps, seas 3'

1040 - Turned ship too early and ran down buoy, luckily buoy went under trawl wire streatched out from stern

1048 - Starting 180 around buoy and putting out wire

1100 - Back to 0° heading

1105 - Ran down buoy again, probably tangled wire on sensors and cut EM cable

1116 - Trying to pass by buoy again,

1124 - Running down buoy again, think that we may have unwrapped loop around buoy. Buoy running down starboard side this time

1129 - Requested ship to pull out and see what we did
1132 - Standing by to haul in
1140 - Pulling in trawl wire, 400 m out. Buoy appears to ride higher in water and bounding, tipping more, trawl wire in, nothing on hook. Wind 14 kts
1212 - Approaching buoy, 40° 57.697 x 67° 19.116
1215 - Starting turn
1221 - On reciprocal path
1223 - Back by buoy, buoy abeam
position 40° 57.430 x 67° 19.116
going 180° around buoy
position 40° 57.343 x 67° 19.250
winch says have tension, running away from buoy, line not heading for buoy
1240 - Pulling back on wire
1248 - 100 m out and not aimed at buoy,
1250 - Transponding on buoy release, 1700 m
1304 - Ready to pick up buoy and remains of mooring
1312 - Hooked on boy
1314 - Buoy on deck
1315 - T1/C1 out of water, Bio-optical package #1 and T3/C3, cable cut 20m down at T4/C4
1324 - Buoy secured on deck, buoy relatively clean of biofouling, no noticeable corrosion.
Significant bioufouling on all parts of mooring.
Continuing to drag at location of ADCP
1345 - Stop data system, "STOP, 16 OFF, A60 TEST.A"
1352 - TDS still ticking
1354 - Dumped data to "SFLANK.DMP"
1358 - on day 56
1400 - on day 90
1402 - on day 120
1404 - on day 148
1405 - on day 161
end of data on day 164 @ 1700 UTC
this would be data written at 1630 or 1230 EDT are we an hour out?
1406 - Dumping again to "BACKUP.DMP"
Sean put shorting plug in light, check fuses, diodes, etc
data file has 3908 hours of data
NOTE need to change name of format file to run PCMCIA quick look at data.
SFLANK1.FMT however, then need latest calibration coefficients in TEMP.DAT and COND.DAT.
1547 - Hooked a piece of 3/4" chain, this is a long piece so it must be the WHOI foam marker buoy that was missing when we arrive on the site
1614 - Anchor on board, pulling rest of chain through A-frame with winch. PMEL temperature sensors were still on wire and were cut off as they came out of the water. During this pull and cutting, the foam marker buoy appeared under port side of boat. The foam was crushed, and the flashing light was imploded, and bulb changer missing.

1634 - Buoy and chain aboard. Pat vented battery well, and only very slight pressure. Metal showed that buoy was on bottom on side in mud.
- Buoy had temperature sensor 3239.
- Dumping data from Crest mooring. Data in "CREST.DMP" and "BACKUP2.DMP"
- Continuting to drag for ADCP rest of day

2000 - discontinue dragging for day
ranging on ADCP and Scientific mooring to get positions

Wednesday - 4 October 1995, JD277

0130 - New positions
ADCP - 40° 58.129' x 67° 19.043' W
Science Buoy Anchor- 40° 58.1875' x 67° 19.083' W

0615 - On deck, wind calm, no sea, fog fast disappearing, preparing to drag for bottom of science buoy will try doing a 270° wrap while paying out trawl wire at 60 meters/minute out ot 650 meters, then pull back at 20 m/s

0730 - Have bottom piece of mooring. Release mechanism held shut by poly rope fouled all around release and chain. While trying to see how to safely recover, the release opened and dropped the anchor so that only the poly held it. Then the poly lines let go and we did not have to figure out how to safely recover it. Pulled the bungie cords, and bottom half of the mooring through the A-frame by hand.

0745 - All bottom parts of mooring secured on deck.
Southern Flank Science Buoy System Delaunch:
Tethers: Zincs on bottom bridle 1/2 gone, loose on the top bridle they are OK. little rust on bridles, no wear on mechanical pieces. Very little fouling on bungies themselves, top splice has medium growth of hair.
EM Cable: Cable looks good (except we cut it). Light hair growth all over cable. T/C Sensor pairs have light hair growth also, but no barnacles.
Bio-Optical: Labeled #2, @ 40 m. Package has moderate hair growth. Growth is uniform on all sections. Transmissometer has light path slightly blocked by hair. Another locking sleeve loose on wire. PAR coated with hair.
Release: Light hair growth, especially on bronze ends and less on case. Zincs look good.

1530 - Hooked ADCP package, brought up to 30 m from surface, and dropped off hook!
Survey of ADCP position - 40° 57.9775' N x 67° 19.053' W
Continuing to drag for ADCP for rest of day

Thurs - 5 October 1995, JD278

0615 - Overcast, wind <10 kts, seas flat <2'

0630 - Started dragging again, try circle around it first then straight passes.

0745 - Bridge sighted orange balls on surface! Prepare to recover recovery balls (and hopefully ADCP), rigged line through block on crane to winch and hauled, snapped-on backup line and air tugger set to pull ADCP on board.

0823 - ADCP aboard and secured!
Delaunch ADCP: frame covered with fouling, mainly barnacles. Barnacles on release mechanism prevented it working. Recovery was by us ripping out the backup

recovery balls, then not snagging and cutting the line. Frame shows scrape marks on four legs where trawl wire rubbed along it. Also on side away from acoustic release, the balls show that the line, grapnel, weight hit the balls bending and cutting the plastic hardhats. No corrosion on pressure cases, or frame Zincs look OK. ADCP transducers have heavy barnacle growth where barnacles have grown down into potting, and pitting the potting. Pressure washer works slowly on barnacle growth but does remove it slowly.

0855 - Deck secured and heading for drifter #5, ETA 1230
Drifter ID=23772 on deck ready to deploy
Telonics check ok, but ID=7388 on TSURB (note moduly 16384).

1227 - Deployed drifter 23772 @ 41° 16.9342' N x 67° 00.1444' W
Moving MOCNESS back under A-frame

1630 - On BIO#38 again

1637 - CTD038 - problem with winch delayed actual start of cast

1707 - MOCNESS #5

1750 - MOCNESS aboard

1802 - Ring net tow

1830 - Underway to WHOI