Cruise Report

R/V ALBATROSS IV Cruise 9607 to Georges Bank

US GLOBEC

NW ATLANTIC/GEORGES BANK STUDY

3 - 13 June 1996

Acknowledgements

We appreciate and acknowledge the efforts and professionalism of the officers and crew of the ALBATROSS IV. Their dedication and cooperation made the success of this cruise possible.

This cruise was sponsored by the National Oceanographic and Atmospheric Administration and the National Science Foundation. This report was prepared by all members of the Scientific Party on this cruise (see Appendix A).

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PURPOSE OF THE CRUISE

The cruise aboard ALBATROSS IV (ALB-9607) was the last in a series of six Broad Scale surveys conducted monthly from January to June during 1996 to monitor the changing biological and physical status in the Georges Bank ecosystem. These six cruises are the second year of broad scale surveys conducted as part of the U.S. Globec Georges Bank Program. The personnel who participated in this cruise are listed in Appendix A.

The principle objectives of the cruise were to:

(1) determine the distribution and abundance of the ichthyoplankton and zooplankton community on the Bank and in adjacent Gulf of Maine and slope waters. Emphasis is on target fish (eggs, larval and juvenile cod and haddock) and copepod species (all stages of *Calanus finmarchicus* and *Pseudocalanus* sp.) and their predators and prey.

(2) provide systematic collections of larval and juvenile cod and haddock for age and growth estimates and feeding habits.

(3) collect individuals of *Calanus* and the euphausiid, *Meganyctiphanes norvegica*, for population genetics studies.

(4) conduct a hydrographic survey of the Bank.

(5) conduct a high frequency bioacoustic survey of the Bank.

(6) map the Bank wide velocity field using an Acoustic Doppler Current Profiler.

SAMPLING OPERATIONS

The plan for the GLOBEC Broad Scale surveys is to accomplish the objectives above by sampling at a grid of 39 "standard station" locations which covers the entire bank (Figure 1a). The Broad Scale sampling protocol separates these 39 stations into two groups, full stations and partial stations. At the 19 full stations, a complete set of sampling operations is conducted. This involved a double-oblique bongo net tow, a CTD cast, a 1-m^2 MOCNESS (Multiple Opening Closing Net Environmental Sampling System , MOC-1) tow, a plankton pump cast and a 10-m^2 MOCNESS (MOC-10) tow. At the partial stations only the bongo tow, CTD cast and MOC-1 tow are done. On the previous surveys in 1996 additional bongo net tows were added between the standard stations to increase the sampling density for cod and haddock larvae. Since by June the larvae were expected to have grown beyond the size range appropriate for the bongo net sampler, the extra bongo net tows were not done. Instead, MOC-10 tows were done at all stations to more adequately sample the gadid juvenile population.

High frequency bioacoustic sampling was conducted continuously during the cruise by a two frequency acoustic towed body deployed from the starboard side J-frame. Current measurements also were collected continuously by a hull mounted 300 kHz Acoustic Doppler Current Profiler (ADCP).

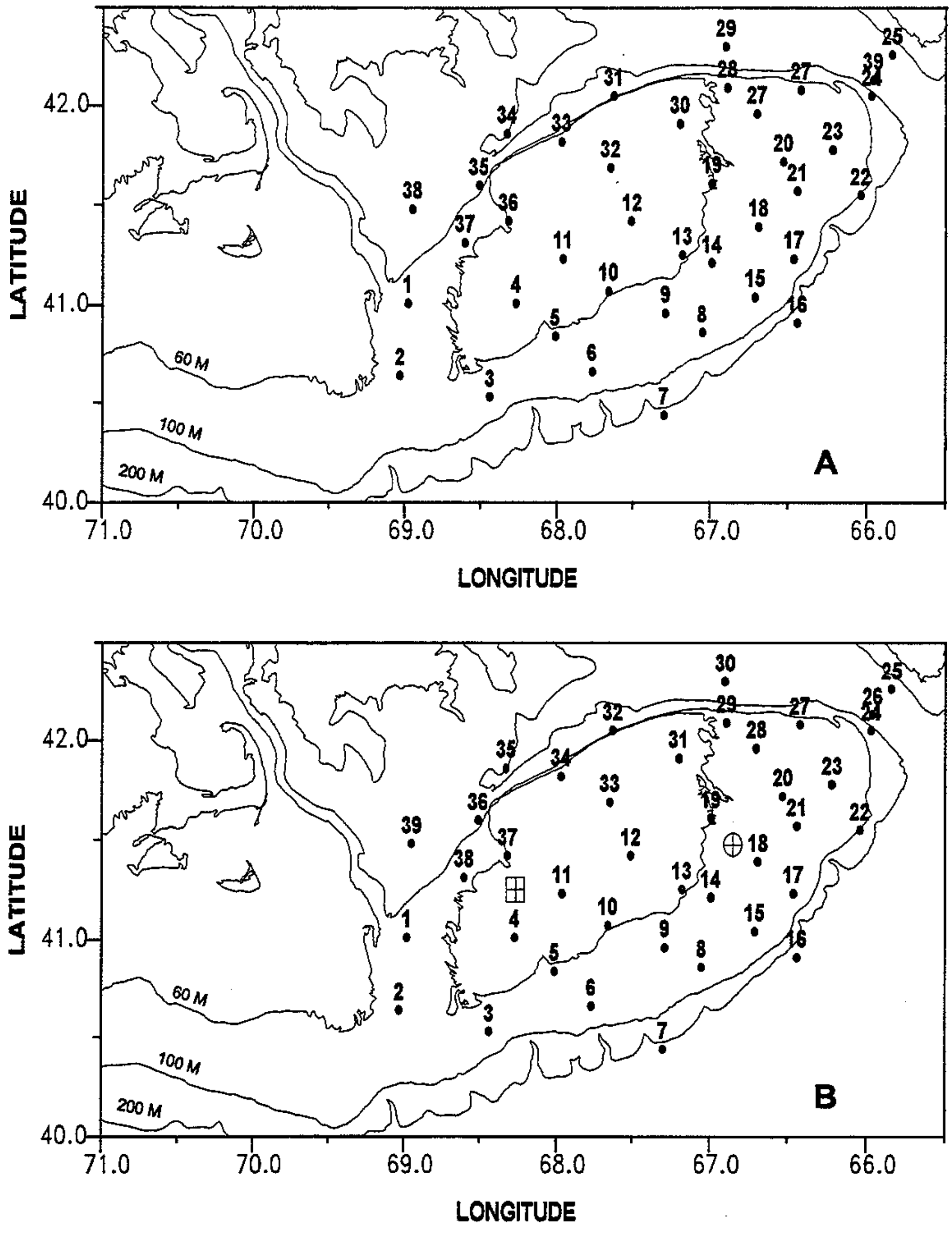


Figure 1. Distribution of the standard Broad Scale stations (A) and the consecutive stations (B) occupied during GLOBEC Broad Scale survey ALB9607.

⊕ = location of BIOMAPPER search

⊞ = location of acoustic grid

Occasional samples were collected during normal station operations for two cooperating programs participating in this cruise. Copepod samples were collected for contaminant analyses (A. Weisbrod, North Carolina State University) and plankton samples were collected for comparison with samples taken in the early 1980's (S. Copeland, Hampton University).

Two operations beyond the scope of the Broad Scale survey plan also were conducted in the cruise. The location of the acoustic towed body 'BIOMAPPER' lost during the March Broad Scale survey was determined by measuring the range to a transponder on the instrument from a number of nearby positions. Also, at the end of the cruise a one mile square grid of six transect lines was completed to investigate fine scale (of order 100m along tack) high frequency bioacoustic structure.

Bongo tows were made with a 0.61-meter frame fitted with paired 0.335-mm mesh nets. A 45-kilogram (kg) ball was attached beneath the bongo frame to depress the sampler. Digital flow meters were suspended in the mouth of each net to determine the volume of water filtered. Tows were made according to standard MARMAP procedures, (i.e., double oblique from surface to within five meters of bottom or to a maximum depth of 200 meters while maintaining a constant wire angle throughout the tow). Wire payout and retrieval rates were 50m/min and 20m/min respectively. These rates were reduced in shallow water (<60m) to obtain a minimum of a five minute tow. A Seabird CTD was attached to the towing wire above the bongo to monitor sampling depth in real time mode and to measure and record temperature and salinity. Once back on board, the 0.335-mm mesh nets were each rinsed with seawater into a 0.335-mm mesh sieve. The contents of one sieve was preserved in 4% formalin and kept for ichthyoplankton species composition, abundance and distribution. The other sample was kept for age and growth analysis of any larval fish collected and preserved in 95% ethanol. After 24 hours of initial preservation, the alcohol was changed. The used ethanol was retained for disposal or recycling ashore.

The MOC-1 was equipped with ten plankton nets per tow. Nets 1-4 were 0.150-mm mesh and nets 0, 5-9 were 0.335-mm mesh. Tows were double oblique from the surface to a maximum depth of 10 m off the bottom or 500 m. The depth strata sampled were 0-15 m, 15-40 m, 40-100 m, and 100 m to the bottom. Winch rates varied from 10-20 m/min to control volumes filtered and maintain a frame angle of 45 degrees. Samples from nets 0-4 were preserved in 10% formalin, while nets 5-9 were preserved in 95% ethanol. Samples with a large biomass from nets 0-4 were split onboard using a 2-L plankton splitter. Ethanol was changed 24 hours after the initial preservation and the waste ethanol was retained for later disposal.

At selected sites, 90-180-ml subsamples for C. Miller (OSU) were removed from the bottom and surface 0.150-mm mesh nets and preserved in formalin. At high priority stations, 90-ml subsamples for A. Bucklin (UNH) were removed from the 0.150-mm nets 2, 3, and 4 and preserved in 95% ethanol. These subsamples were collected for ongoing *Calanus finmarchicus* life history studies and *Pseudocalanus* spp. genetic population studies.

At stations deeper than 150 m where C. Miller required subsamples for live analysis, the MOC-1 was hauled out after the first oblique. Samples from nets 0-4 were collected and the MOCNESS was then immediately redeployed to complete the tow.

For pump sampling the intake hose of the submersible plankton pump was fitted with a 1.7-liter

Niskin bottle cut in half lengthwise and was attached to the winch wire off the port side boom. When sea conditions warranted, a Seabird CTD was attached to the wire approximately 1 m below the suction end. When seas were calm, the wire out reading was used to determine the depth of the cast. Two 90-kg weights were used to depress the entire array. Three 30-m sections of 7-cm diameter hose were connected to the pump to attain a maximum depth of approximately 80 meters. Three integrated depth samples were collected with 0.035-mm mesh nets- maximum depth to 36 m, 36 to 12 m, and 12 m to surface. Samples were sieved through 0.030-mm mesh and preserved in 10% formalin. At shallow stations the intake hose nozzle was lowered to 3-5 meters off the bottom. Wire retrieval rate was approximately 4-5 m/min to obtain volumes of 500 L per 5-m depth interval sampled.

For the live *Calanus finmarchicus* and pteropod collection 125-L plastic trash cans were filled with seawater from 30 m using the submersible pump system. At standard station 38, a 0.150-mm mesh, 1-meter ring net fitted with a codend was taken down to 100 m several times to collect animals. The plankton was gently released into the trash cans. The pteropods were allowed to settle to the bottom of the codend, after the *C. finmarchicus* were decanted off and were poured into separate cans.

The MOC-10 was initially loaded with five 3.0-mm mesh nets. Tows were double oblique from surface to 15 meters from bottom or a maximum depth of 300 meters. The same depth strata were sampled as with the MOC-1. The winch rate for retrieval varied between 5 and 15m/min depending on the depth stratum. The slow winch rates were used in order to filter at least 4,000-5,000m^3 of water per depth stratum sampled. A stepped oblique tow profile during retrieval was used to achieve this, if needed. Catches were sieved through a 0.335-mm mesh, and preserved in 10% formalin.

The primary hydrographic data were collected using a Neil Brown Mark V CTD instrument (MK5), which provides measurements of pressure, temperature, conductivity, fluorescence and light transmission. The MK5 records at a rate of 16 observations per second, and is equipped with a rosette for collecting water samples at selected depths. In addition a Seabird Electronics Seacat model 19 profiling instrument (SBE19 Profiler) was used on each bongo tow to provide depth information during the tow. Pressure, temperature, and salinity observations are recorded twice per second by the Profiler. The Profiler was also used during some of the pump operations to provide depth information during the sampling.

The MK5 was deployed with 6 bottles on the rosette and samples were collected for various investigators. On each MK5 cast, samples were to be collected for oxygen isotope analysis at selected depths for R. Houghton (LDGO) and a sample was taken at the bottom for calibrating the instrument's conductivity data. On stations which included pump operations, samples for chlorophyll analysis were collected using the rosette from the bottom, 20 meters depth, and surface. Chlorophyll samples (three, 50 ml replicates) were filtered for three size fractions: total, < 20 microns, and < 5 microns. The chlorophyll analysis was conducted at sea using an acetone extraction method and results were read 24 hours later on a calibrated fluorometer. Total chlorophyll filtration results were also used for comparing the data from the MK5 fluorometer. Surface samples for phytoplankton species composition were collected for J. O'Reilly (NMFS) at the "full" standard stations.

Sampling operations and number of samples collected are summarized in Table 1.

Equipment notes:

All systems functioned well during the cruise with only occasional, minor problems. The e/o plug on the MOC-1 termination failed on the first station. This was quickly fixed and no further electrical problems were encountered. During the first tow it was recognized that the inclinometer was operating in the reverse direction. The electronics canisters on the MOC-1 frame were turned around before the second station and the inclinometer functioned properly. Occasionally nets did not appear to have tripped as commanded, but no systematic problem was identified.

The SeaBird CTD profiler #1447 used on the Bongo net tows malfunctioned on standard station 16. The temperature data appeared incorrect. The raw data stored in the Profiler's internal memory also showed bad temperature values indicating that the temperature sensor or data channel in the instrument had failed. Profiler #0456 was used the rest of the cruise without problem until the last tow, when it stopped sending data, likely because of low battery voltage.

The MkV CTD/rossette and the plankton pump systems experienced no problems during the cruise.

Toward the end of the cruise, the fluorometer used to read the extracted chlorophyll samples began to read erratically. It was decided that the remainder of the samples would be read on a different fluorometer upon return to port.

The MOC-10 hit bottom on station 2 because the incorrect pressure calibration file was used. The flange holding the release wire on the first net bar (top of net 0, bottom of net 1) broke off. The 0 net was also badly damaged. For the rest of cruise the first net bar was tied to the bottom of the frame, and only nets 1, 2, 3 and 4 were used. The nets required frequent replacement of grommets along the sides, but only one net needed to be replaced during the cruise. On the fifth station, the MOC-10 electrical cable on the frame parted. It was repaired, but no tow was made at station 5.

CRUISE NARRATIVE

The cruise departed Woods Hole at 1500 on Monday, June 3. The watch schedule was set for the 0600-1200, 1200-1800, 1800-0000, 0000-0600 ('6 and 6') traditionally observed on the ALBATROSS IV. The vessel arrived at the first station at 0035 on June 4. With only the minor instrument system problems noted above, the routine of sampling operations was quickly established. Many in the scientific party had been on 8 or more of the Broad Scale survey cruises in 1995 and 1996, and efficient team work occurred without direction. The weather throughout the cruise was calm (although foggy), with winds above 20 kts only for a brief period on the second day. No time was lost due to weather.

At standard station 11, the MOC-1 nets were full of brown 'glop', which was comprised of massive numbers of hydroids. The hydroids were visible in the water from the deck, and from the bridge wing discoloration of the water caused by the hydroids was evident in large, patchy distributions. Hydroids were also found at stations 12 and 13, although not in the numbers found at station 11.

Between standard stations 18 and 19, the precise location of the 'BIOMAPPER' acoustic towed body lost in March was determined. The search focused on last estimated position of the instrument after the recovery attempts that had been made on the previous ALBATROSS IV cruise (AL96-06, Coastal Ocean Program Predator/Prey study). Ranging on the BIOMAPPER's transponder from points about 500m from last position, a small area of overlap was determined within which the instrument is believed located.

At the last scheduled station (standard station 38), two vertical ring net tows were done to collect live samples of pteropods and calanus for experimental work by other GLOBEC researchers.

Because of the calm weather and the trouble-free nature of the sampling operations, the scheduled sampling was finished ahead of schedule. After review of the observations during the cruise it was decided to return to shallow part of the Bank where the hydroids had been found and where vertical striations in the bioacoustic records had been observed. The acoustic pattern had been observed on previous GLOBEC cruises and thought to be caused by a secondary cell structure in the current field associated with the strong tidal currents on the shallow part of the Bank. The vessel steamed from standard station 38 toward standard station 11, where the largest concentration of hydroids have been observed. When the bioacoustic record showed backscatter similar to that observed when hydroids were found, a bongo net tow was done to confirm the presence of hydroids. The first time this was done, hydroids were observed, but in small numbers. After steaming further, a second bongo tow revealed greater numbers of hydroids, although not approaching that originally observed at station 11. This site was selected for the additional sampling. A MOC-1 tow (using only the 150 um nets) was done to collect hydroids for analysis of chlorophyll content (C. Miller) and for comparison with the high frequency bioacoustics data. A pump cast was done to determine the abundance of sand grains in the water column, which could influence the backscatter observed in the bioacoustic data. Then a one square mile grid, consisting of 3 approximately east-west legs and 3 north-south legs, was conducted to collect bioacoustic data. The grid was made relative to a drogue that was deployed to indicate the movement of the water. During this work the ADCP configuration was changed to collect data more frequently (10 second averaging time) to provide better spatial resolution in the currents structures.

At the completion of the grid, sampling operations were terminated and the vessel steamed to Woods Hole, arriving at 1400 on Thursday, June 13.

The times of sun rise and sun set recorded by the bridge are listed in Table 2.

Table 1. Sampling operations and samples collected during cruise AL96-07

Gear	Tows/Casts	Number of Samples
Bongo nets, 0.61-m	49 tows	
0.335-mm mesh		44 preserved, 5% formalin
		47 preserved, EtOH
MOCNESS, 1-m^2	43 tows	
0.150-mm mesh		118 preserved, 10% formalin
0.335-mm mesh		43 preserved, 10% formalin
0.335-mm mesh		159 preserved, EtOH
MOCNESS, 10-m^2	38 tows	
3.0-mm mesh		142 preserved, 10% formalin
Pump	20 profiles	
0.035-mm mesh		59 preserved, 10% formalin
MK5 CTD/Rosette	39 casts	
calibration		37
oxygen isotope		144
chlorophyll		171
species composition		18
SBE19 Profiler CTD		
Bongo tow profiles	49 tows	
Pump profiles	6 profiles	
Calibration casts	8 casts	

Table 2. Times (local, +4) of sunrise and sunset

Date	Rise	Set
June 4	0504	2001
June 5	0500	2003
June 6	0457	1958
June 7	0454	2006
June 8	0453	2008
June 9	0448	2010
June 10	0451	2004
June 11	0455	2010
June 12	0459	2007

INDIVIDUAL REPORTS

Station numbers referred to in the following reports are standard station numbers (figure 1a), unless otherwise noted.

Hydrography

Maureen Taylor and David Mountain:

The SBE19 Profiler and the MK5 data were post-processed at sea. The Profiler data were processed using the Seabird manufactured software: DATCNV, ALIGNCTD, BINAVG, DERIVE, ASCIIOUT to produce 1 decibar averaged ascii files. The raw MK5 data files were processed using the manufacturer's software CTDPOST in order to identify bad data scans by "first differencing." The latter program flags any data where the difference between sequential scans of each variable exceed some preset limit. The "Smart Editor" within CTDPOST was then used to interpolate over the flagged values. The cleaned raw data were converted into pressure averaged, pressure centered 1 decibar files using algorithms provided by R. Millard of WHOI, which had been adapted for use with the MK5.

Figure 1 shows the standard and consecutive station locations occupied during the bank - wide survey. The surface and bottom temperature and salinity distributions are shown in Figures 2 - 3. Surface and bottom anomalies of temperature and salinity as well as a stratification index (sigma-t difference from the surface to 30 meters) were calculated using the NMFS MARMAP hydrographic data set as a reference. The anomaly distributions are shown in figures 4-6. Profiles of each MK5 CTD cast with a compressed listing of the preliminary data are found in Appendix C.

The volume average temperature and salinity of the upper 30 meters were calculated for the Bank as a whole and for the four sub-regions shown in Figure 7. These values are compared with characteristic values that have been calculated from the MARMAP data set for the same areas and calendar days. The volume of Georges Bank water (salinity < 34 psu) was also calculated and compared against the expected values. Similar to other Broad Scale surveys, all four regions were at least 0.3 psu fresher than the expected salinity values. Scotian Shelf water was observed in varying degree at standard stations 8, 16, 17, 22, 24, 25, and 39. Scotian Shelf water was not observed on the Bank during the May Broad Scale survey ALB9605. The volume average temperature anomaly for the northwest region was approximately 0.75°C warmer than the temperature anomalies for the rest of the Bank.

Relatively warm and fresh water was observed in the northwest region of the Bank. Salinity < 31.5 psu occurred in the upper 15 meters of the water column at standard station 38. The surface temperature and salinity distribution figures show a horizontal gradient in the northwest region that extends toward the typically homogenous center of the Bank. The contoured distributions suggest the encroachment of water from the Gulf of Maine extended further into the shallow central region of the Bank than has characteris-tically been observed.

Seasonal temperature and density stratification was established along the southern flank of the Bank. For example, the temperature and density difference from the surface to 25 meters at standard station #9 was approximately 3.4°C and 0.75 sigma-t units respectively. Vertically well-mixed conditions existed at this station during the previous Broad Scale survey in May.

A preliminary comparison of the MK5 fluorescence data (in volts) with the total chlorophyll-a (mg/m^3)

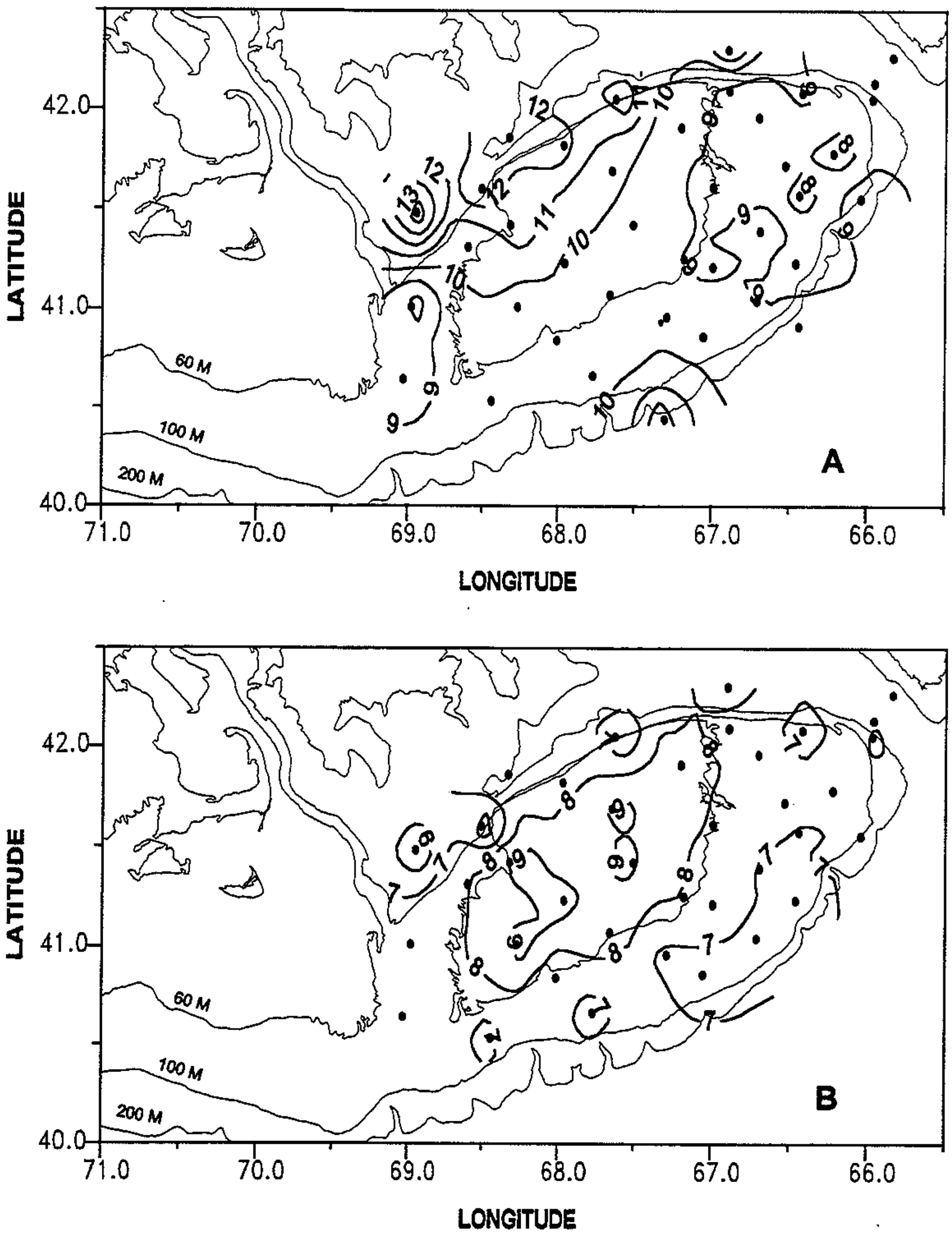


Figure 2. Surface (A) and bottom (B) temperature distributions during Broad Scale survey ALB9607.

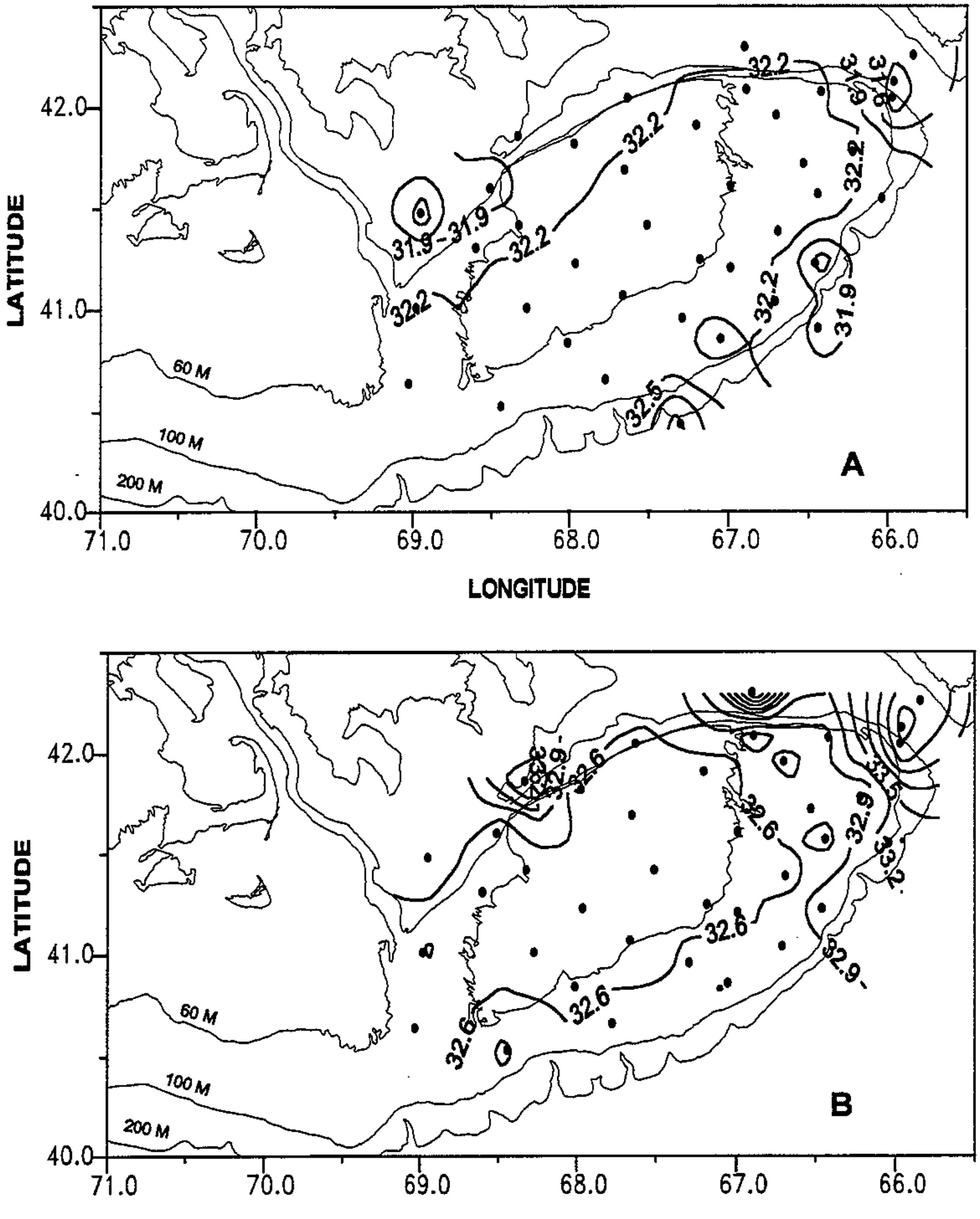
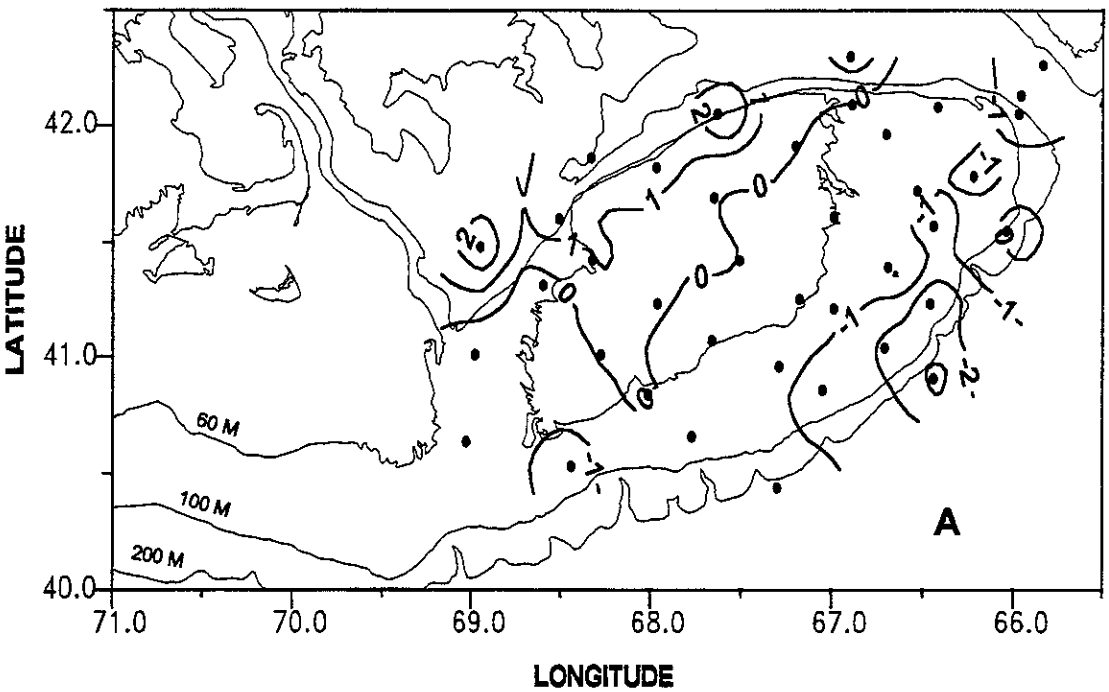


Figure 3. Surface (A) and bottom (B) salinity distributions during Broad Scale survey ALB9607.



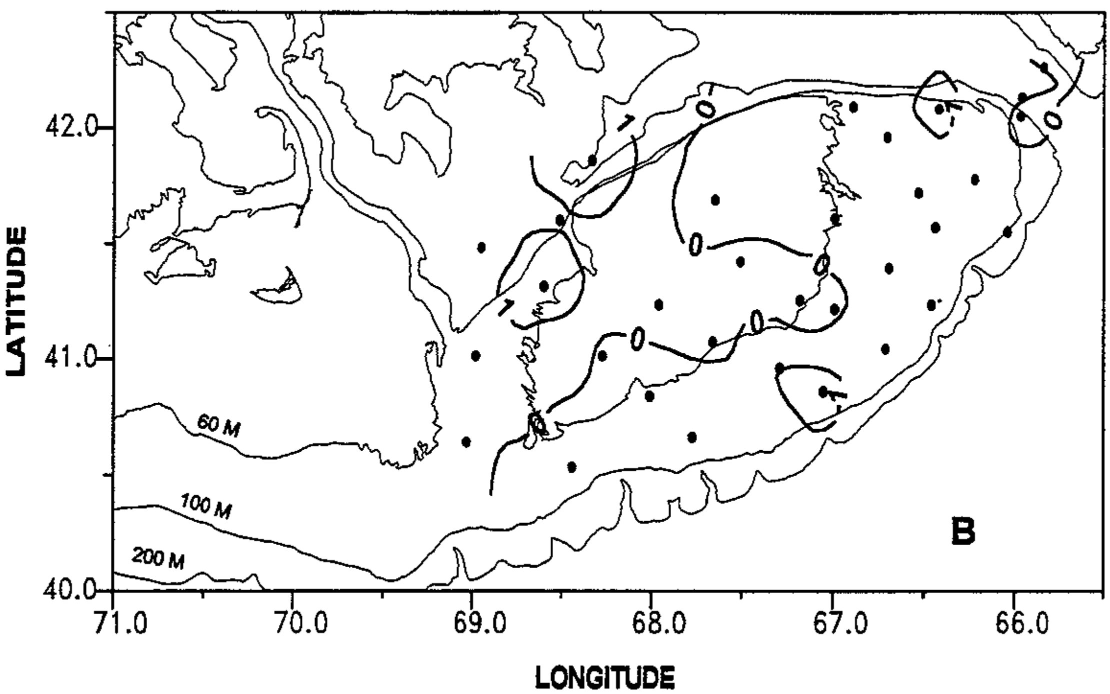


Figure 4. Surface (A) and bottom (B) temperature anomaly distributions during Broad Scale survey ALB9607.

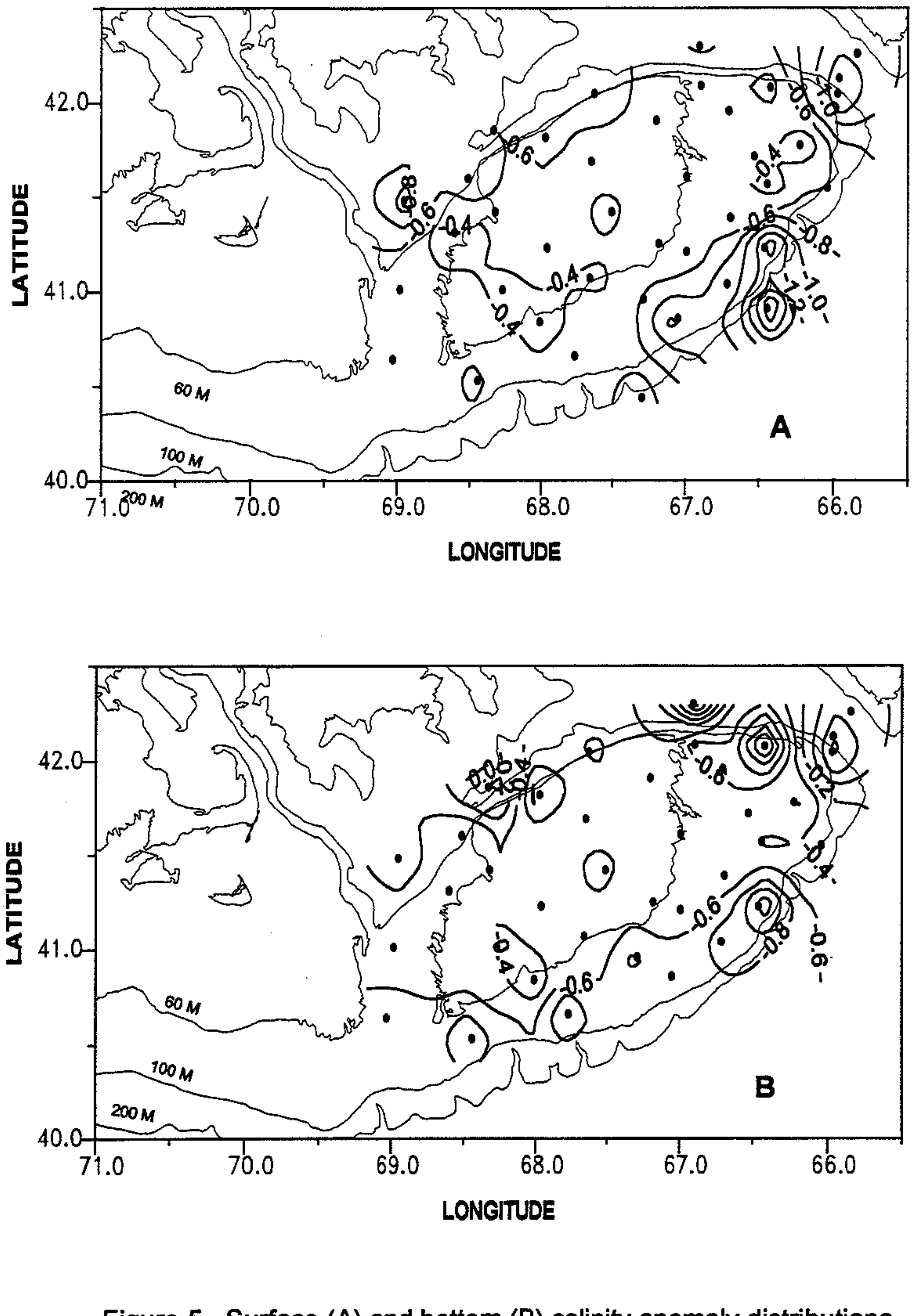
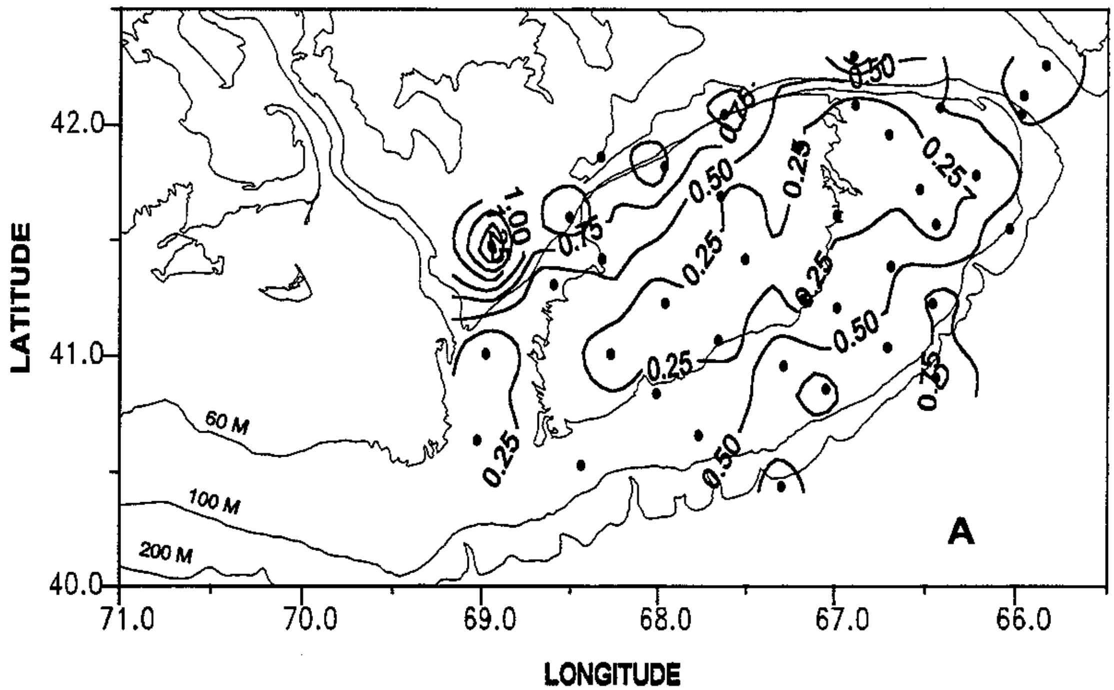


Figure 5. Surface (A) and bottom (B) salinity anomaly distributions during Broad Scale survey ALB9607.



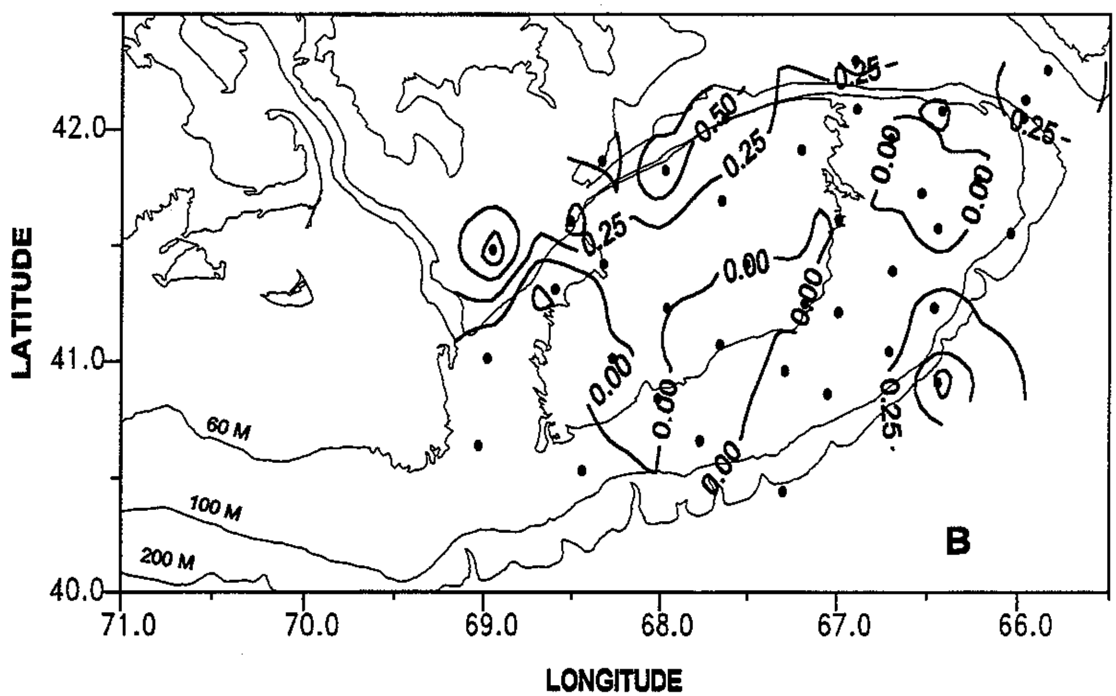
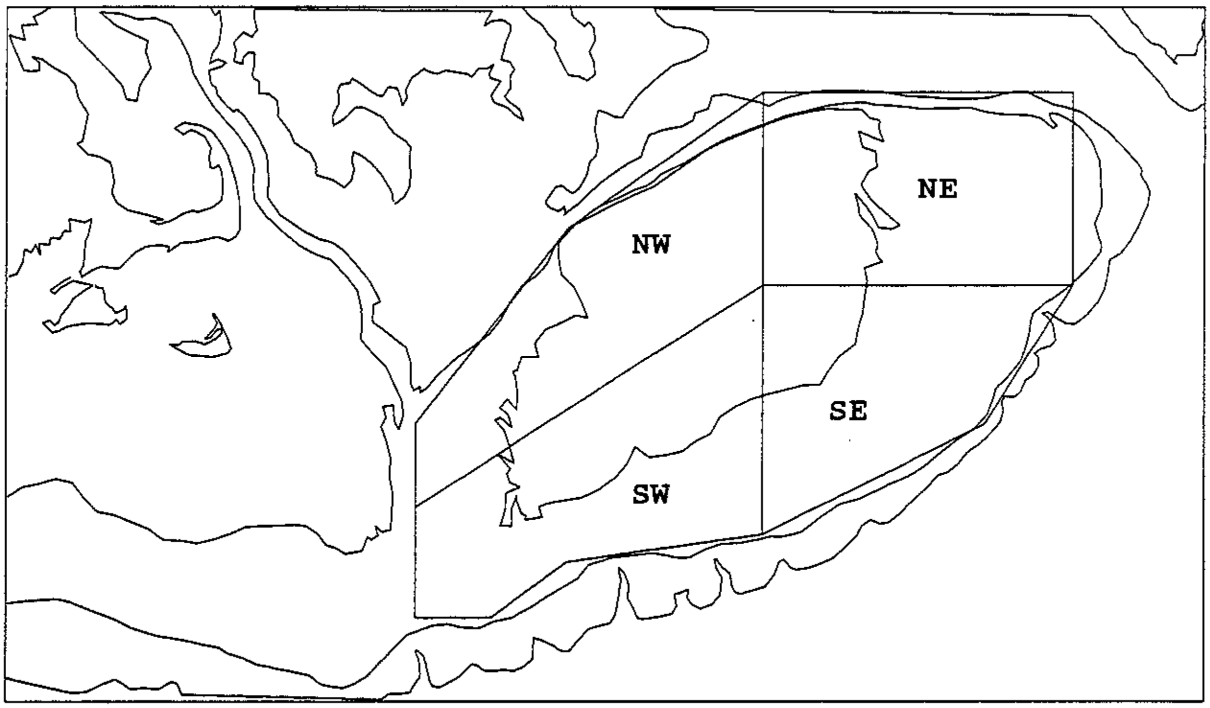


Figure 6. Distributions of statification (A) and stratification anomaly (B) for the upper 30 meters of the water column during Broad Scale survey ALB9607.

Figure 7. Volume Average Water Properties (0-30m depth)

Temperature, Salinity and Volume of Georges Bank Water (<34 PSU)



Area	Day	Temp	Anom	Salt	Anom	Volume	Anom
Bank	157.	8.50	-0.55	32.42	-0.37	1035.	6.8
NW	156.	9.54	0.25	32.41	-0.35	240.	0.0
NE	158.	7.90	-0.62	32.45	-0.34	280.	0.0
SE	157.	8.06	-0.51	32.42	-0.33	248.	3.8
SW	156.	8.39	-0.86	32.45	-0.38	260.	1.9

[preliminary data]

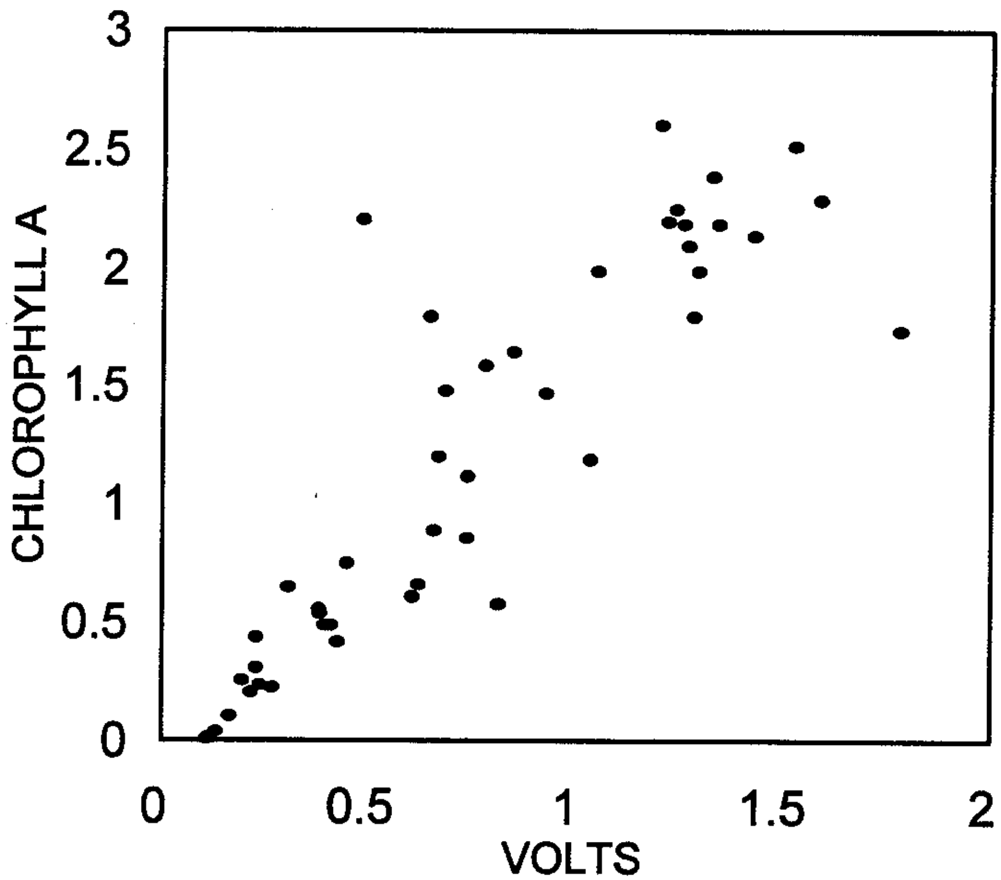


Figure 8. Comparison of the observed MK5 fluorometer readings with the extracted chlorophyll concentrations done at sea during Broad Scale survey ALB9607. The R^2 for this data is approximately .78.

was made for the samples that were read at sea. The R^2 for the data that had been analyzed by cruise completion was approximately 0.78 (Figure 8).

Zooplankton

Peter Garrahan, Jim Gibson, and Pilar Heredia:

Our main objective was to survey Georges Bank to determine the distribution, abundance, and stage composition of the target species *Calanus finmarchicus* and *Pseudocalanus* spp. and other non-target copepod species. This objective was accomplished by using the 1-m^2 MOCNESS, a vertically discrete, multiple opening and closing net system, to sample the larger zooplankton. A submersible pump system was also used to collect younger copepodite and naupliar stages of copepods. Additional objectives were to collect live *Calanus finmarchicus* and the shelled pteropod, *Limacina*, at Standard Station 38 using a 0.150-mm mesh 1-m ring net for Erich Horgan and Scott Gallager at WHOI for ongoing experiments and to subsample *Pseudocalanus* spp. from 1-m^2 MOCNESS hauls for population genetic studies for Ann Bucklin at the University of New Hampshire.

Observations of zooplankton species composition were made at many, but not all stations. Unless otherwise noted observations were made from net 0, MOC-1 samples.

Station 4
Mostly *Pseudocalanus* spp. and *Centropages* spp. in equal abundance.

Station 6
Very patchy samples (comparing the first 5 nets to last 5 nets). Pteropods in the surface in the first tow (net3). Mostly *Metridia, Pseudocalanus,* and *C. finmarchicus.* (C5 and few C6F). Marine snow present in samples.

Station 10
Pseudocalanus spp. (females and males present) and *Centropages hamatus* were found in about equal abundance in net 0. Amphipods present in few numbers (*Gammarus*)
Net 1: some *C. finmarchicus,* and a few females unfertilized.

Station 11
Hydroids!! *Pseudocalanus* spp.,*Centropages* spp., and *Temora.*

Station 13
Few hydroids. *Pseudocalanus* spp., *Centropages* spp., and *Temora. Pseudocalanus* most abundant (females & males).

Station 16
Strawberry daiquiri sample of *C. finmarchicus.* Few C4 *C. hyperboreus.*

Station 17
C. finmarchicus. C4-C6F mostly. Few *Metridia, Pseudocalanus.*

<u>Station</u> <u>22</u>
C. finmarchicus. C3-C6F, *Pseudocalanus* all stages, & *Metridia* C1-C5.

<u>Station</u> <u>24</u>
Strawberry daiquiri sample of *C. finmarchicus* C5 and C6F. Few C4 *C. hyperboreus*, *Metridia*, *Pseudocalanus*.

<u>Station</u> <u>27</u>
Bank mix (*Pseudocalanus* and *Centropages*), not many hydroids, some *Coscinodiscus*. In surface net only a few *C. finmarchicus*.

<u>Station</u> <u>28</u>
Mostly *Pseudocalanus* spp. all stages.

<u>Station</u> <u>32</u>
A bank mix of copepods:*Centropages hamatus*, *Pseudocalanus* spp., *Temora*, decapod larvae, *C. finmarchicus* C4-C5 (only a few C3's), pteropods, and very few hydroids.

<u>Station</u> <u>37</u>
Net 3: Most of *C. finmarchicus* at the surface (C3-C6F and C6M). Most abundant were *Pseudocalanus* spp. C1-C5, and *Centropages hamatus* C1-C5. *Oithona* present.

Charles B. Miller:

Patterns

Georges Bank now has its summer plankton configuration. Plankton over the core of the bank (inside the 60 m contour) are dominated at most sites by *Centropages hamatus* with lesser and more erratic numbers of *Pseudocalanus* spp. Abundance of *C. hamatus* was extremely high at many stations, often more than 1/2 liter of settled plankton in <50 m^3. The hydroid *Clytia* is present everywhere and extremely abundant in patches (see below). Larval worms, clams and crab zoeae were abundant at various shallow sites.

We found the deep assemblage surrounding the bank dominated by *Calanus*, most of which have begun their summer-autumn rest phase. At some stations (Stn. 29 in particular) *Calanus* resting at depth were accompanied by large numbers of *Microcalanus* . Because of their miniscule size, these did not constitute much biomass, although even the adults may be under sampled by 150 mm mesh. Surface plankton in deeper waters were sparse, however in places there were very large numbers, but trivial biomass, of *Oithona similis*.

The 60-100 m zone over NE peak and around the south flank showed a variable mixture of the on-bank and deep water plankton assemblages. *Centropages hamatus*, *Pseudocalanus*, and a few hydroids were mixed with a few *C. finmarchicus*. This was the only area with significant numbers of reproducing *Calanus*, and nauplii were present in modest numbers in the 150 mm mesh samples.

Calanus

In 1996 the *Calanus finmarchicus* stock in the Gulf of Maine (GOM), NE Channel and slope water stations was almost entirely in the rest phase, very few individuals actively feeding or reproducing in the surface layer. At Stn. 38, for example, there was no splitting of the C5 stock between near-surface "pink" and deep-layer "purple" stocks, as was seen in SCOPEX and in 1994 and 1995 on GLOBEC cruises. The GOM resting stock were "pink" and they were subsurface. At Stn. 38, sampled just after noon, the peak density was between 100 and 40 m, not between 100 m and the bottom (154 m). At Stn. 29 (16:00) the deepest sample had the most. A resting stock was found within our sampling range in slope water at Stns. 7 and 16, where last year we saw warm water plankton advected near the bank by Gulf Stream rings. Rings, if any, were offshore and *Calanus* were present above 500 m. Almost all specimens were in the deepest of the MOC-1 nets.

The *Calanus* resting stock at all NE Channel and GOM locations was much less abundant than was established by June and July in 1995. This year the largest discarded sample split was 1/2, leaving no more than 0.5 liter of drained 'strawberry daiquiri'. In 1996 we were discarding 7/8 or 15/16 to get the same settled volumes for preservation. The resting stock at all deeper sites included females (<5%), which have loaded with fat (oil sac extending far into the head, in the manner of C5), shut down ovarian activity and entered a diapause phase. Many do have a medium-sized oocyte or two in the lower limb of the anterior diverticulum of the oviduct, implying that they were previously active spawners. It's clear that a female can reproduce both at the end of one *Calanus* season and at the beginning of the next Rest stocks consistently included a small number of C4, perhaps 5%. Actively reproducing females, with a modest number of males present as well, were found on the south flank inside 100 m, from Stn. 2 on around to about Stn. 27. Some were present at Stn. 36 on the narrower western edge, as well. Lipid amounts in C5 were substantially less on average at stations shallower than 100 m than over deeper waters where diapause entry was nearly complete. Many specimens caught over the bank had virtually no oil accumulation, suggesting nutritional difficulties. I saw one C1, never a C2 or C3 throughout the cruise. *If* another generation is coming through, it is almost entirely separated from the one most recently completed, and it is almost entirely in naupliar stages in June 1996.

Other Copepods

While extremely patchy, *Pseudocalanus* were much more abundant than on cruises in January and April, 1996. They were also more abundant than at any time in 1995. There were substantial numbers mixed with *C. hamatus* on the bank and large numbers on the flank from Stn. 16 up to Stn. 27. In one instance (Stn. 28, just at the north edge of the NE peak) they produced a bulky 'strawberry daiquiri' without assistance from *Calanus*. They are not found as more than occasional specimens at deeper stations off the bank. The similarity of *Pseudocalanus* sp. occurrence patterns to those of *C. hamatus* suggests some resemblance in life history strategy. However, it is hard to imagine *Pseudocalanus* having resting eggs. Ann Bucklin's question, "where are the *Pseudocalanus* resting stocks?", is a good one. Beats me.

As stated above, *C. hamatus* was extremely abundant in shallow water over the bank. It's brown spots create a typical khaki color to summer plankton on the bank, a color very much the same as when *Clytia* are very abundant. This make it essential not to conclude that "just another hydroid sample" has been taken. A big haul of *C. hamatus* can look very much the same. None of the plankton observers aboard saw a specimen of *Centropages typicus* at any time during the cruise. In 1994 and 1995 they were scattered about during June. They were present in January 1996. Their absence now is conspicuous.

Other Plankton

One, single *Evadne* sp. was seen at Stn. 37. A search of the sample produced not even one more. I do not recall seeing this cladoceran on the bank previously. Chaetognaths were present at virtually all stations. They were never markedly abundant, never dominant in the plankton as seen a number of times in 1995.

Massive Hydroid Patch

In the vicinity of BroadScale Stn 11 (6 June) we encountered a record biomass of the hydroid *Clytia*. The top net of the MOC-1 was filled with them right out past the front of the cod end bucket. Over the side we could see them as yellow masses alongside the ALBATROSS. On the green bomber sonar trace there was extremely strong echo at 420 kHz. This seemed to wax and wane over short scales. From the wing of the bridge the ocean was blotched with yellow green, each patch some 30-70 m across and separated from its neighbors by narrower bands of bluer water. Peter Wiebe suggests this is caused by division of the surface layer, carrying the hydroids, by the upward limbs of convective or turbulent flow cells. Cleaner, near-bottom water rises to the surface, breaking the surface layer into isolated blobs. It seemed that many blobs were under surface slicks. Slicks are usually found at flow convergences, which squares with Peter's idea that there are small, busy, vertical flow cells over Georges Bank.

The ecological problem posed by the huge mass of *Clytia* is that the "biomass pyramid" is inverted. We have a huge mass of predators dependent upon a modest stock of prey. There are lots of *Centropages hamatus*, a small copepod that is a component of the usual 'bank mix', but hardly enough to support so many carnivorous polyps as we saw today. One possible explanation was seen in the ethanol preservation jars. The ethanol extracted lots of green pigment from the mass. Possibly, like reef corals and many anemones, *Clytia* could have zooxanthellae. We ran an acetone extraction of chlorophyll from counted groups of *Clytia* polyps, following the procedure for extraction of filtered phytoplankton. Fluorescence was measured with a Turner Designs fluorometer calibrated for chlorophyll against coproporphyrin. The extract showed substantial chlorophyll. Calculated as chlorophyll content per polyp, the four extracted groups gave the following amounts per polyp:

No. polyps	Chl.-a ng polyp^{-1}	Phaeopigment ng polyp^{-1}
20	.35	.45
40	.81	.68
80	.45	.62
160	.59	.67
Weighted Mean	.57	.64

A repeat observation at Stn. 20 also showed chlorophyll, but less:

No. polyps	Chl.-a ng polyp^{-1}	Phaeopigment ng polyp^{-1}
50	.11	.09
50	.15	.12
50	.17	.13
100	.20	.13
100	.16	.19
100	.085	.11
150	.17	.14
150	.16	.12
150	.13	.16
Unweighted Mean	.154	.132

This is not so much chlorophyll and chlorophyll breakdown product that only zooxanthellae could explain it. A single large copepod eating typical algae can easily have 10 ng or more of chlorophyll-derived pigments in its gut. Moreover, a healthy phytoplankton assemblage would not have a phaeopigment to chlorophyll-a ratio greater than 1.0. Most cniderian-zooxanthella relations are not based on digesting a fraction of the plant cells on a regular basis, thus converting their chlorophyll to phaeopigment breakdown products. Rather, reef corals and anemones use 'excess' photosynthate secreted by the zooxanthellae.

Several possibilities are open for further investigation. 1) *Clytia* may actually eat phytoplankton, although that is not obvious. That would also be a partial solution to the 'pyramid problem'. 2) There are zooxanthellae, but capture in nets may initiate an emergency process in which zooxanthellae are eliminated. Dumping of zooxanthellae is commonly seen in stressed corals (one form of "coral bleaching"). Or, possibly the zooxanthellae are stressed by the capture process; chlorophyll breakdown is very rapid in damaged plants. 3) *Clytia* stolons are coated with algal scum. This was, in fact, observed on some colonies. They were scrupulously avoided in sorting for extraction. Only colonies with clean, smooth stolons were included. 4) Some other substance extractable by ethanol and acetone is found in *Clytia* and has significant fluorescence at the test wavelengths. This is probably only one of a list of possible artifacts that will have to be scrupulously eliminated if zooxanthellae are to be demonstrated in *Clytia.*

I have no idea what the substantial difference between stations means. Relative quantities of chlorophyll-a and phaeopigments were about the same. Another observation is in process as ALBATROSS heads into Woods Hole.

An inquiry has been placed with Barbara Sullivan of the Georges Bank Predation Group as to whether they have observed chlorophyll associated with *Clytia* polyps or have considered the possiblity that zooxanthellae are important to the energetics of massive *Clytia* "blooms". If not, this is the first report suggesting *Clytia* has a photosynthetic booster system.

Ichthyoplankton

Antonie Chute, Amy Tesolin, Alyse Weiner:

Samples collected at 39 GLOBEC Broadscale standard stations from the bongo and 10 meter MOCNESS nets were examined shipboard for the presence of fish eggs and larvae. This was done in an attempt to determine their occurrence on the bank and obtain a gross estimate of distribution, abundance and size range. Samples from the bongo nets were examined in the jar after preservation; samples from the MOC 10 were examined while still in the bucket, unpreserved. Juvenile cod and haddock were counted and removed from MOC 10 samples for further study. The following are observations based on these examinations:

Cod (*Gadus morhua*): The cod collected this month were no longer larvae, but juveniles, ranging in size from 15mm to 64mm. Most measured between 20 and 30mm. The vast majority of them were captured in the MOC 10; at their size the bongo nets are probably easily avoided. They were found all over the bank (see figure ?) with apparent concentrations at stations 1 and 2 in the southeast region. The expectation that most juvenile cod would be found on the north side of the bank did not hold true.

Haddock (*Melanogrammus aeglefinus*): In comparison to cod, few juvenile haddock were collected. Nine in total were found at only three stations, 25 in the Northeast channel, and 35 and 37 toward the Northeast side. They averaged 26mm in length, ranging from 20 to 39mm.

Sand lance (*Ammodytes* sp.): 60-70mm sand lance were abundant at several stations, at one point swarming around the boat in the lights for the CTD. Catches of sand lance began at station 14, continued as we rounded the northeast peak and then tapered off, although the occasional individuals were still captured.

Atlantic herring: No Atlantic herring (*Clupea harengus*) were observed on this cruise. Most have probably grown beyond our ability to capture them with plankton equipment.

Sculpins: *Myoxocephalus* sp., common bongo-net denizens for the past few months, were only observed twice, at stations 18 and 20. At station 20 several were under 10mm, the rest were over 15mm and looked like miniature adults.

Miscellaneous fishes: Other fishes found in the bongo and MOC 10 samples included:
Redfish (*Sebastes* sp.)
Hake (*Urophysis* sp.)
Butterfish (*Peprilus triacanthus*)
Plaice (*Hippoglossoides platessiodes*)
Bristlemouth (*Cyclothone* sp.)
Barracudinas (fam. Paralepididae)
Lanternfish (fam. Myctophidae)
Hatchetfish (fam. Sternoptichidae)
Argentine (fam. Argentinidae)

Alligatorfish (*Aspidophoroides monopterygius*)
Unidentified leptocephalus larvae

Fish eggs: Small-to-medium fish eggs were found in very low numbers in many of the samples. However, just south of the northeast peak (at stations 18, 20, 21, 22 and 23) the bongo samples were loaded with fish eggs, maybe thousands per sample in some cases. We never saw any tiny larvae, and eggs investigated under the microscope did not look ready to hatch. So somebody is spawning, we just don't know who yet.

High Frequency Acoustics

Peter Wiebe, Karen Fisher, and Andrew Pershing:

The primary focus of the bioacoustical effort on this cruise was to make high resolution volume backscattering measurements of plankton and nekton throughout the Georges Bank region. The acoustical data are intended to provide acoustical estimates of the spatial distribution of biomass of acoustical targets which span the size range of the target species (cod, haddock, *Calanus*, and *Pseudocalanus*) and their predators. Work on this cruise was designed to provide intensive continuous acoustic sampling along all the shipboard survey tracklines in order to cover the entire Georges Bank region. The spatial acoustical map is also intended to provide an essential link between the physical oceanographic conditions on the Bank and the biological distributions of the species as determined from the net collections at the stations distributed throughout the Georges Bank region. Continuous acoustic data between stations can be used to identify continuity or discontinuity in water column structure which can in turn be used to qualify the interpretation of biological and physical data based on the point source sampling.

The acoustic and environmental sensor packages were mounted in an ENDECO towed 5-foot V-fin fish nicknamed the "Greene Bomber". The tow-body has dimensions of 1.5 m length x 1.5 m width x 0.9 m height, and, on this cruise, weighed approximately 100 kg in air. For this cruise, the interior of the tow-body carried a pair of BioSonics, Inc. digital transducers (120 kHz and 420 kHz) and a transmit pressure case. The transducers were operated in a down-looking mode. In addition, an environmental sensing system was mounted inside the V-fin with temperature, conductivity, and fluorescence sensors placed in front of the fiberglass housing on a stainless steel round-stock framework. The tow-body was deployed from the starboard quarter of ALBATROSS and collected data both during and between stations. The preferred towing speed was ~8 knots, but speeds up to 10 knots were reached. Conditions for conducting an echosounder survey of the Bank were ideal during this cruise because there was very little wind and the seas remained flat for essentially the entire cruise (a very unusual circumstance). As a result acoustical data were successfully obtained along the entire cruise track (Standard Stations 1 to 39 - distance traveled was ~800 nm). A listing of the acoustic transects is given in Appendix D.

The acoustical mapping reinforced earlier observations and provided additional insights into the structure of the water column and the distribution of the animals (Figure 10). Compared to July 1995, the backscattering across the entire Bank region was substantially lower, perhaps suspiciously lower. The data collected on this cruise must be carefully checked to make sure the calibration factors were properly determined and that the postprocessing software worked correctly. All raw data are, however, stored, and this issue will be addressed after the cruise. The

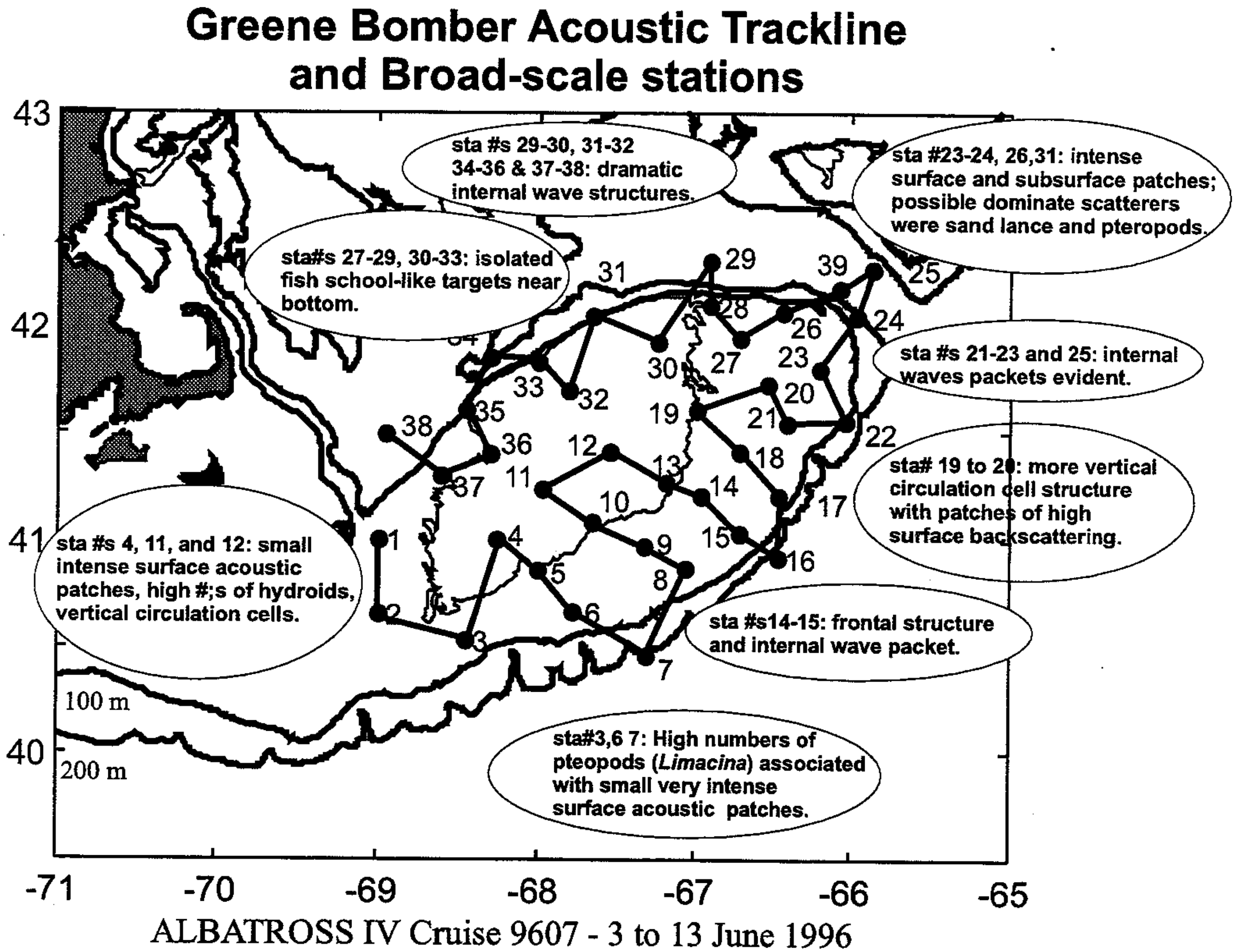


Figure 10. Acoustic measurements were made along the entire trackline of the cruise starting at Standard Station 1 and ending at Station 38. In addition, acoustics data were collected at an experimental site located west of Station 11 at the end of the cruise. Highlights of the acoustics observations and ancillary data are presented in balloons around the Bank.

plankton tows, however, seemed to produce lower catches and the subjective impression was that plankton concentrations were lower than on previous cruises.

The large scale picture from the acoustical records showed relatively low volume backscattering off the Bank, higher backscattering in the vicinity of the shelf water/Slope Water front, somewhat lower backscattering on the southern flank of the Bank, and then increasing backscatter with shoaling depths. Highest values occurred throughout the water column on the top of the Bank. The section running from Standard Station 9 to 12 was typical of most of the southern flank to Bank crest (Figure 11). This large scale pattern was associated with changes in vertical structure. In the deeper portions of the survey area (stratified waters), backscatter was typically stratified with highest values towards the surface, though considerable patchiness was observed both horizontally and vertically. As bottom depth shoaled and approached about 60-50 m, the vertical structure became more homogenous. This trend was substantiated further inward. At bottom depths of 40-30 m, the volume backscattering often, but not always appeared to be completely homogeneously distributed vertically. There were areas, particularly at Standard Stations 11 and 12 where hydroids dominated the plankton and appeared in very small-scale surface patches. At these depths, vertical striations (i.e. bands of horizontal patchiness) were recurrently observed, a phenomenon we have postulated that is associated with vertical circulation cells caused by tidal flow over a rough bottom.

In the offshore Slope Water areas south of the Bank at Standard Station 7, very intense small-scale patches of volume backscattering occurred right at the surface or within 15 m of the surface. One large patch and several smaller patches were observed twice, once during the 1-m^2 MOCNESS tow and again during the 10-m^2 MOCNESS tow when the ship's course was reversed (Figure 12). The dominant animal in the patches that were sampled with net tows was the pteropod, *Limacina retroversa*. In this particular case, the largest patch was about 500 meters wide and 10 to 12 meters deep. In some areas, individuals of *Limacina* were quite large and were effectively retained by the 10-m^2 MOCNESS trawl nets (3 mm mesh) as well as the smaller meshed samplers. In others, the individuals were much smaller and only occurred in the 1-m^2 MOCNESS or Bongo tows (150 or 333 mm mesh). Differences in the size of the pteropods should be reflected in relative differences in the volume scattering levels observed with the 120 and 420 kHz transducers. In the northeast channel region, the sand lance, *Ammodytes*, seemed to co-occur with the pteropods in the heavy scattering layers and may also have contributed significantly to the acoustic patchiness.

Last year during the July broad-scale cruise, sand particles occurred in many of the MOCNESS and pump plankton samples from the shallow regions of the Bank including those taken at the surface. Preliminary analysis of the effects of those particles on the backscattering strongly indicated that signals from the sand could have overridden those of biological origin. On this cruise, sand was present in far fewer samples. At Standard Station 19, sand was reported in all of the 1-m^2 MOCNESS samples and at Standard Station 27 sand was observed in the pump samples. The absence of sand from much of the water column in most of the Bank regions on this cruise may, in part, be the explanation for the generally lower backscattering levels.

Internal waves were particularly evident in the stratified waters along the perimeter of the Bank. They were usually centered between 15 and 30 meters (in the pycnocline) and typically had amplitudes of 10 to 15 meters. None of the internal wave packets off the southern perimeter of Georges Bank approached the size of that observed between Standard Stations 6 and 7 on the

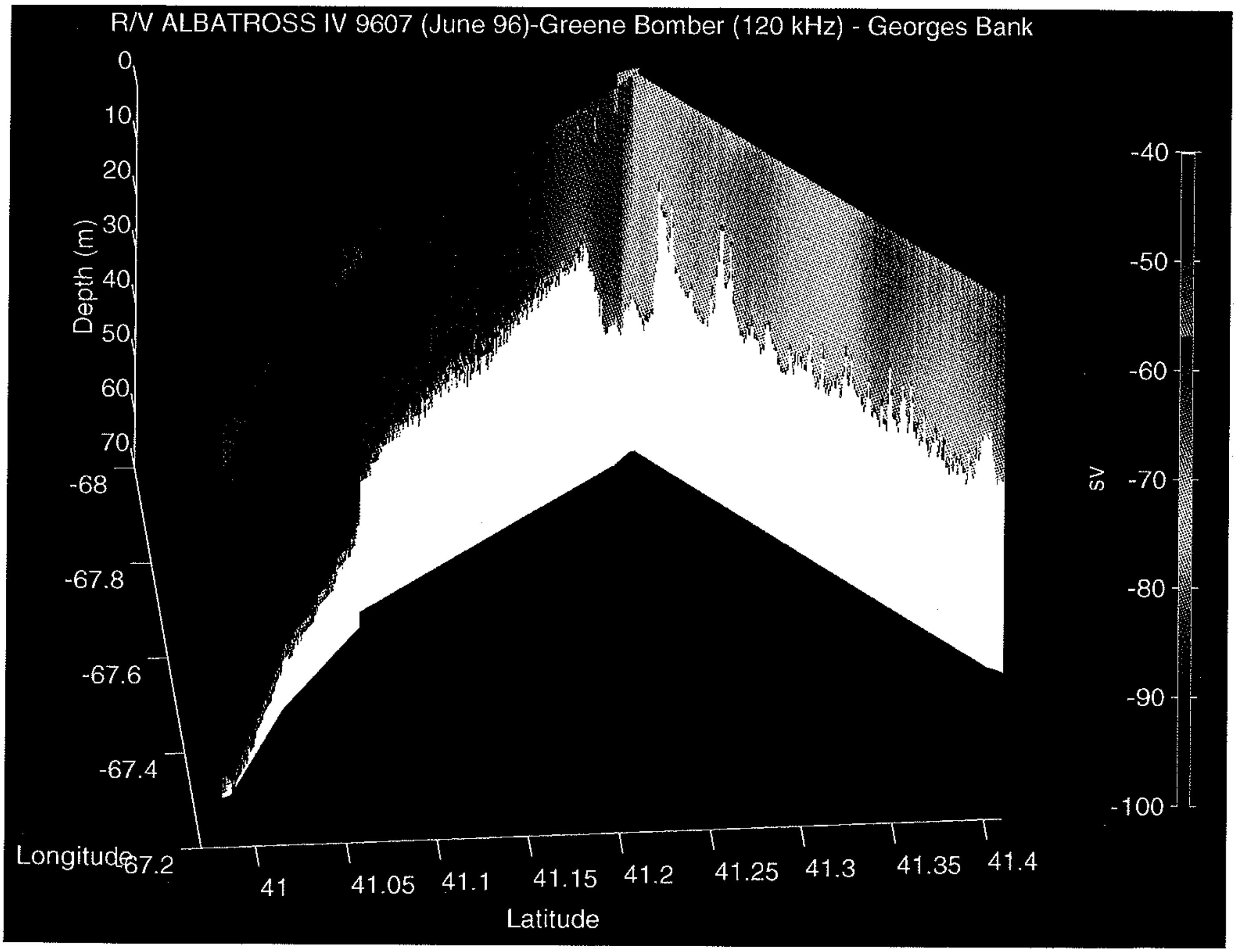


Figure 11. Curtain of acoustic data collected starting at Standard Station 9 (lower left side of curtain) and running up to Station 11 (middle of curtain) and then over to Station 12. Hydroids in very large numbers and "boils" or secondary circulation cells were encountered along the transect between Stations 11 and 12.

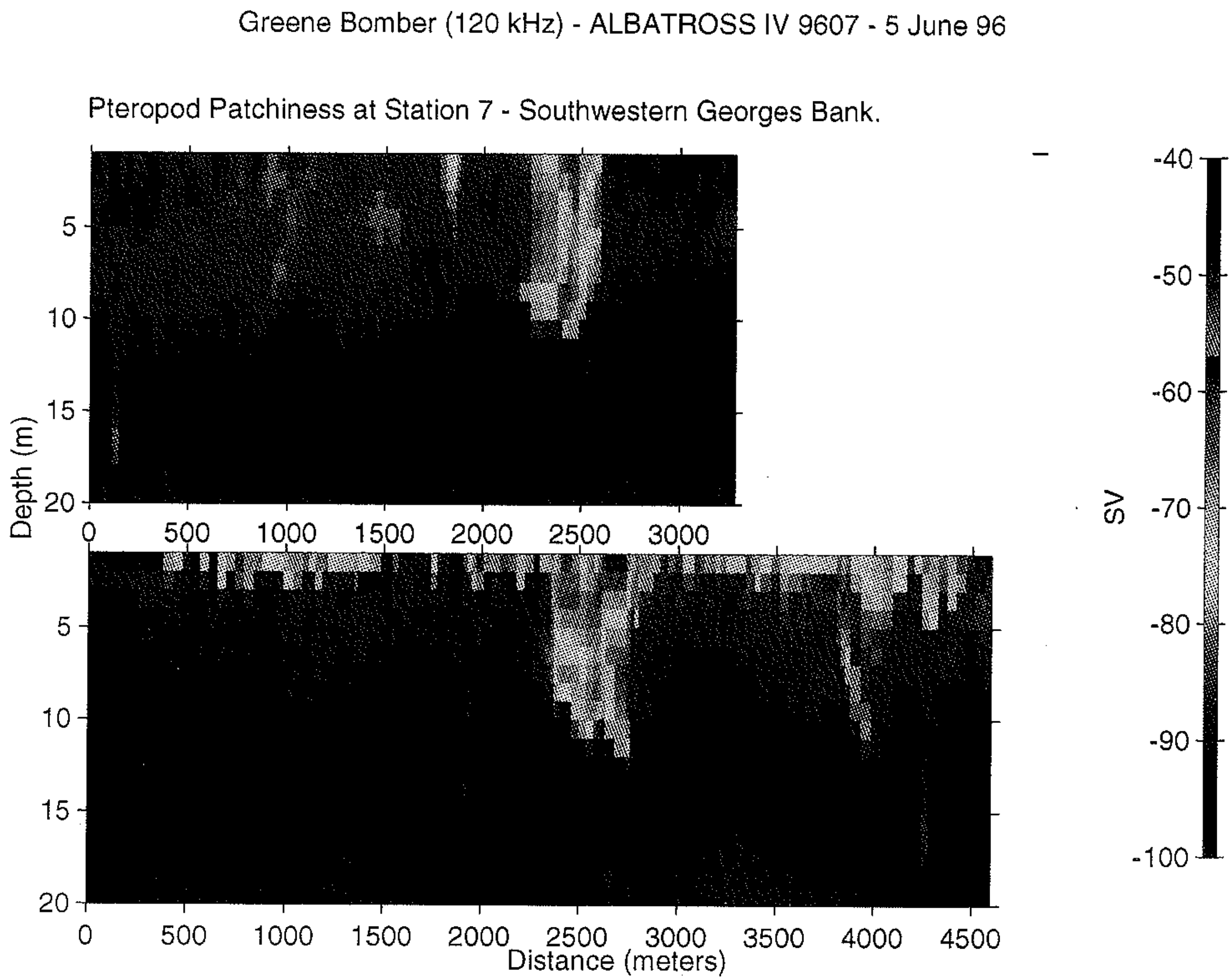


Figure 12. Acoustic images of what are believed to be patches of the pteropod, *Limacina retroversa* along the path of two net tows at Standard Station 7.

March 1996 broad-scale cruise (50 m amplitude), although they had similar characteristics in terms of spatial extent and number of wave crests in the packet. A particularly large internal packet similar in size to the one observed in March, or perhaps even larger, was present as we came onto Standard Station 38 in the southern Wilkinson Basin. Its acoustic signature could be seen in vertical fluctuations of the scattering layers from the surface to as deep as 90 meters. The wave was first observed minutes before we approached station 38, and we continued observing the wave for over 30 minutes while on station.

While steaming between stations 35 and 36, an unusual pattern developed on the 120 echogram (Figure 13). The vertical distribution of volume backscattering was highest in the upper 20 meters where there was a well developed acoustical layer. Below these depths, scattering levels decreased and then increased to form a subsurface layer between 30 and 50 m. The core of the surface layer had enhanced backscattering centered between 10 and 15 m. The layer could be traced up to an abrupt vertical front-like feature past which the volume backscattering throughout the water column decreased markedly and became much less structured. A similar enhancement of backscattering in the core of the deeper layer developed as the front was approached. These two layers, one turning downward and the other upward, merged in this frontal feature. The impression gained from this image was of water and organisms flowing towards the front at the surface, then turning downward at the front and flowing back as a return flow in the deeper layer. A very similar acoustic structure was observed between Standard Stations 29 and 30 except that after the layers merged, an internal wave packet extended towards the Bank, followed by another apparent front (Figure 14). After the second front, two new layers appeared, one near the surface and the other near the bottom.

No substantial diel changes in vertical distribution could be seen in the acoustical records on the Bank, while diel vertical migration was particularly apparent in deeper waters north of the Bank in Franklin Basin. The net samples from Standard Station 34 suggest that the euphausiid, *Meganyctiphanes norvegica*, was responsible for the vertical migration observed at that station.

<u>Secondary Cell Circulation Experiment.</u>

On the last full day of the cruise (June 12, 1996), we conducted an experiment to test the idea that the vertical lineations in acoustical structure that are so evident in many of the well-mixed areas of Georges Bank were associated with vertical circulation cells created by strong tidal flow over an irregular bottom. The experiment was also intended to provide additional samples for hydroid studies. The experiment consisted of (1) high frequency acoustical measurements made with the Greene Bomber (120 and 420 kHz) along a grid of transect lines laid out relative to a drogue which traced the horizontal motion of the water, (2) measurements of horizontal and vertical currents made with the ship's 300 kHz ADCP, and (3) water sampling with a Bongo net, MOCNESS, and the Pacer Pumping system to collect organisms and suspended sediments. The ADCP settings were changed from those typically used while mapping the entire Bank to values that increased our ability to measure fine-scale horizontal and vertical velocity field while doing the experiment (Table 3).

After completing the work at Standard Station 38, the ALBATROSS steamed back toward Standard Station 11 where earlier in the cruise there had been strong visual as well as acoustical evidence that such cells were in existence and where there had been very high concentrations of hydroids in the water column. Once in shallow water about 15 nm from Standard Station 11, the

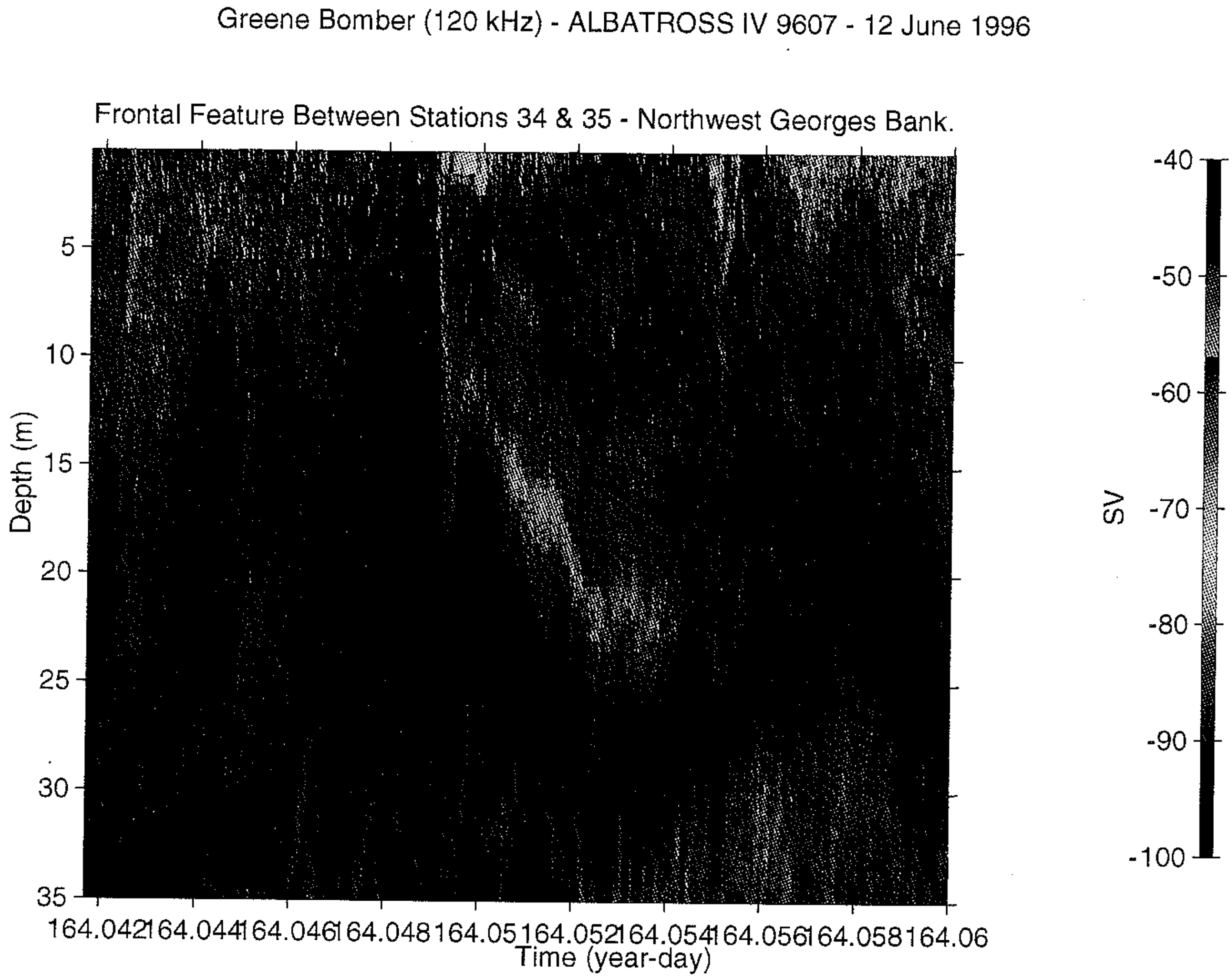


Figure 13. An acoustical frontal feature observed while steaming between Standard Stations 34 and 35.

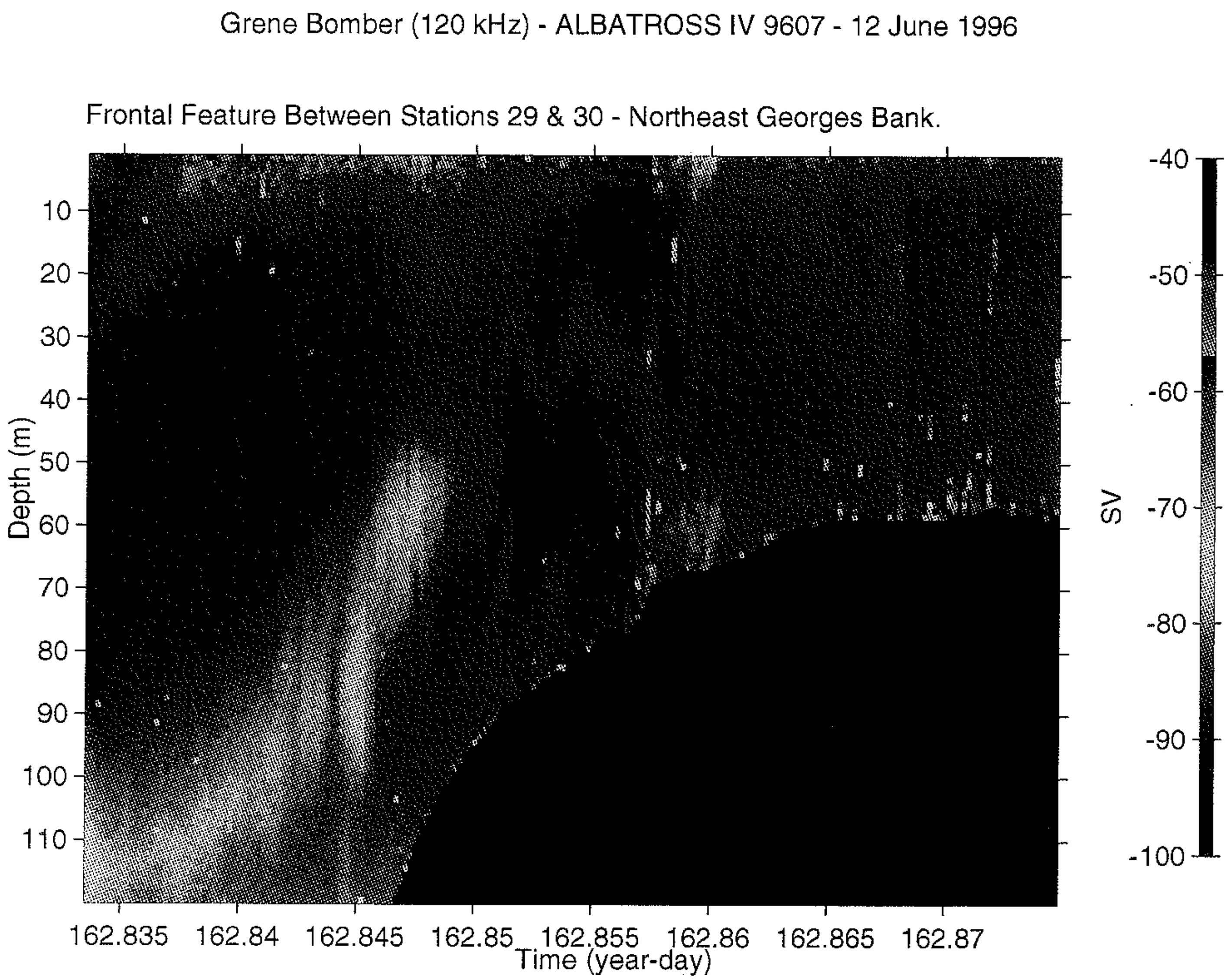


Figure 14. An acoustical frontal feature similar to that in Figure 4, but observed further to the east on the northern flank of the Bank along the section between Standard Stations 29 and 30.

Table 3. The configuration settings of the ADCP used during the Secondary Cell Circulation Experiment.

```
BEGIN RDI CONFIGURATION FILE
COMMUNICATIONS
{
ADCP          ( ON   COM1 9600 N 8 1 ) [ Port Baud Parity Databits Stopbits ]
ENSOUT        ( OFF  COM4 9600 N 8 1 ) [ Port Baud Parity Databits Stopbits ]
NAV           ( ON   COM3 4800 N 8 1 ) [ Port Baud Parity Databits Stopbits ]
REFOUT        ( ON   COM2 9600 N 8 2 ) [ Port Baud Parity Databits Stopbits ]
EXTERNAL      ( OFF  COM4 9600 N 8 1 ) [ Port Baud Parity Databits Stopbits ]
}

ENSEMBLE OUT
{
ENS CHOICE    ( N N N N N N N )  [ Vel Corr Int %Gd Status Leader BTrack ]
ENS OPTIONS   (  NONE   1   8   1   8 )  [ Ref First Last Start End ]
}


ADCP HARDWARE
{
Firmware        ( 4.15 )
Angle           (      30 )
Frequency       (     300 )
System          (    BEAM )
Mode            (       4 )
Orientation     (    DOWN )
Pattern         ( CONCAVE )
}

DIRECT COMMANDS
{
WS100
WF200
BX800
WN080
WD111100000
WP00010
BP005
WM4
TP000025
BM0
EZ1121111
}

RECORDING
{
Deployment ( G96A )
Drive 1    (   C  )
Drive 2    (   C  )
ADCP       ( YES )
Average    ( YES )
Navigation (  NO )
}
```

```
CALIBRATION
{
ADCP depth                    (    5.00 m       )
Heading / Magnetic offset     (   0.00       0.00 deg )
Transducer misalignment       (   -0.50 deg     )
Intensity scale               (    0.43 dB/cts )
Absorption                    (   0.062 dB/m    )
Salinity                      (    35.0 ppt     )
Speed of sound correction     (   NO   1500.0   )
Pitch & roll compensation     (     YES         )
Top discharge estimate        (    CONSTANT     )
Bottom discharge estimate     (    CONSTANT     )
Power curve exponent          (      0.1667    )
}

PROCESSING
{
Average every ( 10.00 s )
Depth sounder (  NO )
Timeout ( OFF )
Refout_info (   1   8   1.00   1.000 ) [bins: 1st last, KtsChngLimit,
NewWeight]
External_formats   ( N N Y N )  [ HDT HDG RDID RDIE ]
External_decode    ( Y N N N ) [ heading pitch roll temp ]
}

GRAPHICS
{
Units          ( SI )
Velocity Reference ( NAVIGATION )
East_Velocity      ( -150.0  150.0  cm/s )
North_Velocity     ( -150.0  150.0  cm/s )
Vert_Velocity      (  -50.0   50.0  cm/s )
Error_Velocity     (  -50.0   50.0  cm/s )
Depth              (      1     80   bin )
Intensity          (      0    200    dB)
Discharge          (  -1000   1000  m3/s )
East_Track         ( -27808 631809     m )
North_Track        ( -374129 321743     m )
Ship track         (  1 bin  100.0  cm/s )
Proj_Velocity      ( -100.0  100.0  cm/s )
Proj_Angle         (    0.0  deg from N )
Bad_Below_Bottom   (   NO   )
Line1              (                                                    )
Line2              (                                                    )
}

HISTORY
{
SOFTWARE        ( BB-TRANSECT )
Version         ( 2.63 )
}

END RDI CONFIGURATION FILE
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echograms showed the now familiar vertical lineation signature of a well-mixed water column. A Bongo net tow was taken to see if hydroids were present in significant numbers. While there were hydroids present, along with numerous post-larval clams, the copepod, *Centropages*, and other plankton, it was decided to steam another 20 minutes to get closer to Station 11 before conducting the experiment. A second Bongo tow was taken at the second sampling site, and based upon that sample, the site was selected to do the experiment.

A 1-m^2 MOCNESS tow was taken in the ~55 m water column sampling 50 to 40 m, 40 to 15 m, and 15 to 0 m using 150 mm mesh nets. These samples were intended to provide material for hydroid experiments and for developing the zooplankton data needed to interpret the acoustical data. This was followed by a Pacer pump profile to see if there was any sand in the water column. The pump sampled for 5 minutes (2 m^3) at three depths: 40 m (10 m above the bottom), 25 m, and 5 m. Sand was present in all three of the pump samples.

A high flyer drifter, with a piece of MOCNESS netting tied off at 15 m to serve as a sub-surface drogue, was assembled by John Cravo and others on the 6-12 watch. This drifter was launched after the pumping was finished and was used as the point of navigation for a six legged grid along which the acoustical survey was conducted. The square grid, one nautical mile on a side, was laid out on the ship's radar scope and the ship was steamed (under the excellent guidance of NAV Joel Michalski) so that the drifter's radar reflector appeared as a target that moved along the grid lines. Beginning at 0047, three legs of the grid were run east/west and three were run north/south. The parallel legs were separated by a half mile. At the beginning, middle, and end of a grid line, times were marked and the ship's GPS position and the range and bearing of the drifter were obtained so that the path of the drifter could be determined (Table 4). Along the trackline, Greene Bomber observations were made of volume backscattering throughout the water column at 120 and 420 kHz and surface temperature and fluorescence measurements were made. Velocity measurements were made with the ADCP.

Sea conditions were ideal for this experiment because there was very little wind and the sea was almost flat; only a slight swell was running. The experiment was completed at 0307.

The survey of BIOMAPER.

A reconnaissance of the region in which BIOMAPER was lost during the March broad-scale cruise aboard R/V OCEANUS 275 was done during the early morning hours of 8 June 1996. The purpose of this activity was to make sure we could still talk to BIOMAPER via an acoustic transponder system and to precisely determine where it was now resting. This survey was based upon the last known position of BIOMAPER provided by Executive Officer Derick Sutten after an attempt to recover it was made on the previous ALBATROSS cruise (9606). [Thanks very much to Mike Fogarty and Bill Michaels for volunteering to do this and to Ace Nelson for providing the net]. The position determined after a final grapnel tow was: 41° 28.54' N; 66° 50.96' W. This position was used as the center point for three calculated survey positions 120 degrees on the compass apart and about 500 m from the location i.e.

Bearing	Latitude		Longitude	
240	41.473417°N	41° 28.40502'N	-66.854534°W	-66° 51.27204'W
120	41.473417°N	41° 28.40502'N	-66.844132°W	-66° 50.64792'W
0	41.480167°N	41° 28.81002'N	-66.849333°W	-66° 50.95980'W

Table 4. **Location of ship during the Secondary Cell Circulation Experiment grid survey with range and bearings to the drogue.**

Mark	Leg	Approx. heading	Time	Lat (N)	Lon (W)	Range (nm)	Bearing
1	1	W	47	41 16.993	68 16.609	1.03	178
2		W	55	41 16.717	68 17.159	1.09	150
3		W	102	41 16.537	68 17.662	1.38	133
4	2	E	116	41 15.680	68 17.474	1.1	115
5		E	123	41 15.487	68 16.712	0.7	132
6		E	130	41 15.329	68 16.986	0.48	179
7	3	W	142	41 14.518	68 15.890	0.03	000
8		W	150	41 14.363	68 16.591	0.49	083
9		W	156	41 14.265	68 16.158	1.00	087
10	4	N	204	41 14.108	68 17.152	1.02	088
11		N	210	41 14.453	68 17.137	1.12	114
12		N	217	41 14.803	68 17.133	1.37	132
13	5	S	228	41 14.623	68 16.443	1.09	152
14		S	236	41 13.988	68 16.511	0.69	131
15		S	243	41 13.415	68 16.536	0.5	087
16	6	N	254	41 13.262	68 15.939	5m	270
17		N	300	41 13.669	68 16.006	0.46	181
18		N	307	41 14.082	68 16.069	0.97	178

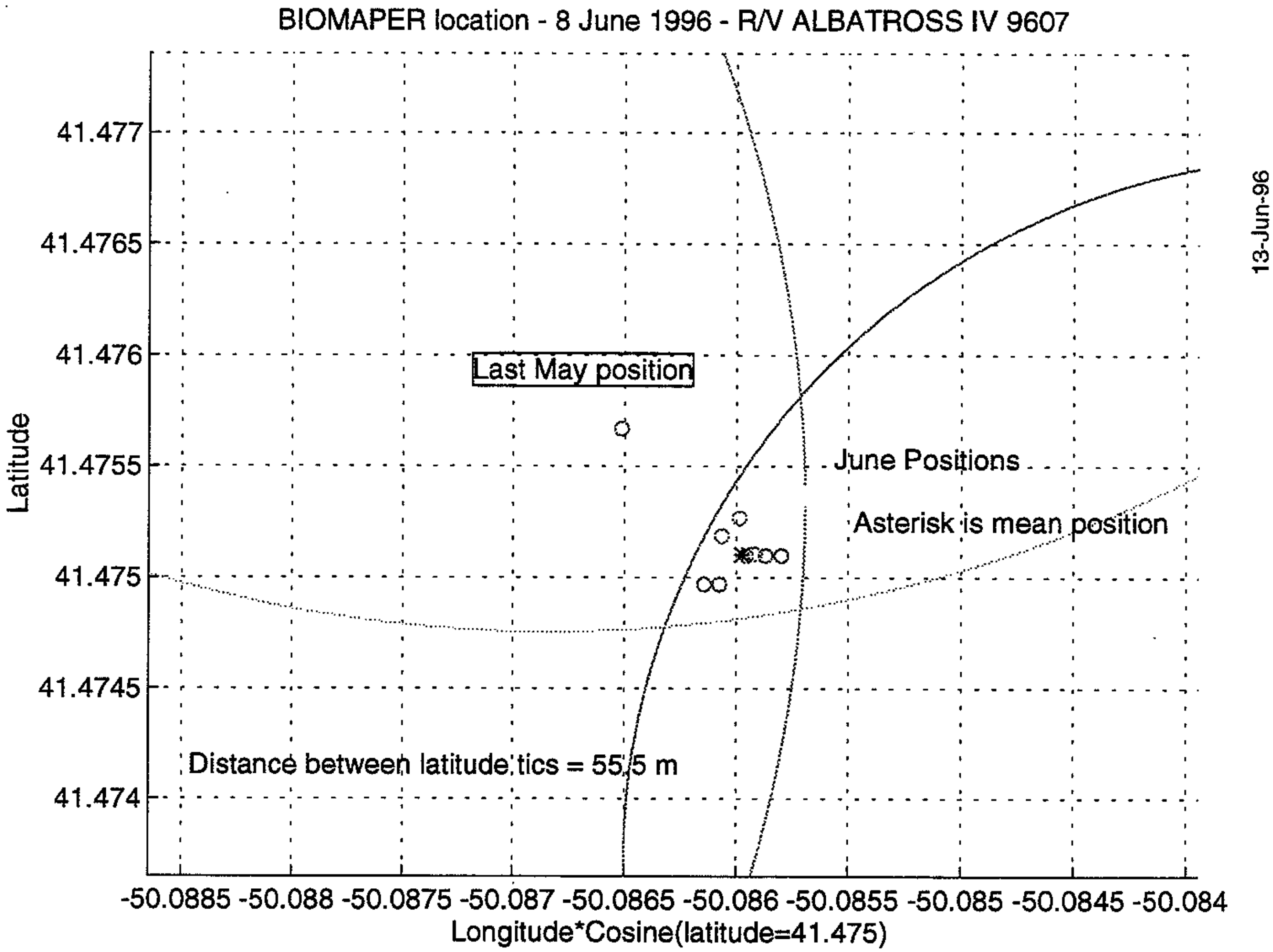


Figure 15. Matlab plot of the estimated position (asterisk) of BIOMAPER on 8 June 1996 based on an acoustic survey conducted from R/V ALBATROSS IV. The survey positions are plotted as is the position last determined on the May ALBATROSS cruise (9606). The longitude correction in the figure makes the Latitude and Longitude equal distance scales as on a Mercador projection (-50.085 is 66.85° W).

The ALBATROSS steamed to the positions and we made slant range measurements using a Benthos transponder interrogator. There were two separate surveys done to make the slant range measurements. At each of the three positions on a survey, there were two observers writing down the ship's position at the moment a slant range to BIOMAPER was obtained. At each position, two observations were made a minute or so apart. Thus, there was a total of 2*2*2 or 8 separate estimates of BIOMAPERs position.

The fact that we obtained a good set of slant ranges means that BIOMAPER was present and still able to communicate. Analysis of the measurements was done using a Matlab mfile (acosfix2.m). This program computed and displayed the circle of possible positions for each of the three ship positions and associated slant range measurements in a given data set. The best estimate of the location of BIOMAPER was the center point of area defined by the intersection of the three circles and this was determined by placing the cursor on that point and clicking the mouse button (ginput). Some error is incurred by the subjective nature of choosing that location. The results showed that differences between observers writing down the positions was smaller than differences between replicates observations on a survey or between surveys. All of the estimated positions fall within an area about 40 m on a side. The mean of these positions (41° 28.50616' N; 66° 50.91683' W) is about 100 m away from where the previous cruise thought it to be (Figure 15).

Equipment Notes:

On this cruise, we had two problems with equipment in the Greene Bomber. The 420 kHz transducer failed to perform according to the specifications. Signal to noise problems plagued the unit and on occasion, it would spontaneously jump settings, significantly altering and usually degrading the sensitivity of the system. The SeaBird conductivity sensor was rendered non-operational by a yet to be determined problem. Two different salinity probes and two different underwater electronic units were used in an attempt to get the system to work. While bench tests indicated the units were working, when mounted in the towed body and deployed in sea water, the raw conductivity signals were out of range. A ground loop problem may have been responsible. It is possible that the problems with the 420 kHz transducer and the conductivity probe are related.

Cooperating Programs

North Carolina State University

Annie Weisbrod:

Samples were collected for a project entitled "Organic contaminant bioaccumulation and trophic transfer in the NW Atlantic cetacean food chain." The purpose of this study is to identify pollutant bioaccumulation in four whale species, their food and water. Ultimately, the results will be used to validate a mass balance bioaccumulation model developed to assess the risk of contaminant exposure and the fate of these compounds. Over 90 compounds including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and chlorinated pesticides (e.g. DDTs, chlordanes, mirex) will be measured in dissolved and particulate water fractions, zooplankton (Calanus sp.), phytoplankton (dominant green algae, dinoflagelletes, diatoms), herring, mackarel (Scromber sp.), long-finned squid (Loligo sp.) and whale tissues (right, humpback, and pilot whales, and white-sided dolphins). Water, plankton, and fish data from approximately 20 stations in the NW Atlantic extending from Cape Hatteras to the Gulf of Maine have been collected and will be applied in the bioaccumulation model.

Copepod samples were collected with a bongo net at five stations representing different regions of the Bank and different source regions for waters on the Bank - stations 16, 23, 25, 32, 38. Samples were stored in analytically-clean glass jars and frozen immediately after collection. Sample preparation and analysis by gas chromatography/mass spectrometric detection (GC/MS) and electron capture detection (GC/ECD) will be performed at NCSU.

Hampton University Volunteer Program

Shannon Copeland:

As a graduate student studying Environmental Sciences at Hampton University in Hampton, Virginia, I was selected to participate as a volunteer on the R/V Albatross IV GLOBEC 9607 broad-scale survey cruise of the U.S. East Coast (Georges Bank). My participation in this program is being sponsored by Gladys Reese at the Southeast Region, National Marine Fisheries Service. My objective was to acquire hands on experience and to obtain a clear picture of the sampling methodology employed in copepod research. As a member of the night shift, I received a wealth of knowledge while under the tutelage of Peter Garrahan, night shift chief, Antonie Chute, Maureen Taylor, and Jim Gibson. These includeed instruction on how to sample with the Bongo, Pump, Moc-1, and Moc-10 equipment.

Under the supervision of Dr. Robert Jordan, an Associate Professor in the Marine and Environmental Sciences Department, Hampton University, I work as his research assistant performing taxonomic identification of copepod samples obtained from 64*u*m mesh nets on a 1983 NMFS MARMAP cruise. The 1983 samples will generate data to help analyze predator-prey relationships on Georges Bank. This focuses on copepods and their respective predators, but may include other predators associated in the food web.

Additional samples were collected with the Bongo 335*u*m mesh nets from Standard Stations 16, 25 and 39 (see figure 1a). They will be used comparison with the samples obtained on the 1983 cruise and for instruction at Hampton University.

APPENDIX A

Officers and Crew of the ALBATROSS IV

CO	Gary Bulmer
XO	Denise Gruccio
NAV	Joel Michalski
3WO	Steven Wagner
CME	Kevin Cruise
1AE	John Hurder
3AE	Larry Jackson
JE	Orlando Thompson
GVA	Royce Fells
CB	Kenneth Rondeau
SF	John Cravo
SF	Antonio Alvernaz
SF	William Amaro
SF	Anthime Burnette
GVA	Douglas Roberts
CS	Richard Whitehead
CC	Jerome Nelson
GVA	Ernest Foster
RET	Henry Jenkins
RET	Robert Yates

Scientific Party

David Mountain (Chief Scientist)	NMFS, Woods Hole, MA
Maureen Taylor	NMFS, Woods Hole, MA
Amy Tesolin	NMFS, Woods Hole, MA
Antonie Chute	NMFS, Narragansett, RI
Alyce Weiner	NMFS, Sandy Hook, NJ
Peter Wiebe	WHOI, Woods Hole, MA
Charles Miller	OSU, Corvallis, OR
Peter Garrahan	URI, Narragansett, RI
Maria Pilar Heredia	URI, Narragansett, RI
James Gibson	URI, Narragansett, RI
Karen Fisher	Cornell U, Ithaca, NY
Andrew Pershing	Cornell U, Ithaca, NY
Annie Weisbrod	NCSU, Raleigh, NC
Shanon Copeland	HU, Hampton, VA

APPENDIX B

The event log for cruise AL96-07 is contained on the following pages.

						L	O	C A L				Water	Cast			
		Instr	cast#	Sta#	Sta_std	Mth	Day	hhmm	s/e	Lat	Lon	Depth	Depth	PI	Region	Comments
AL15596.00	AL15596.00	DEPART	0	0	0	6	3	1505	s	4131.540	7040.490	8	0	Mountain		Departed Woods Hole
AL15696.1	AL15696.1	BongoSB	1	1	1	6	4	35	s	4100.500	6859.500	84	77	Sibunka	Broadscale	
AL15696.2	AL15696.2	BongoSB	1	1	1	6	4	46	e	4100.300	6859.300	84	77	Sibunka	Broadscale	
AL15696.3	AL15696.3	MkVCTD	1	1	1	6	4	55	s	4100.400	6859.000	78	72	Mountain	Broadscale	
AL15696.4	AL15696.4	GreeneB	1	1	1	6	4	112	s	4100.800	6858.700	76	2	Wiebe	Broadscale	
AL15696.5	AL15696.5	MOC1	1	1	1	6	4	231	s	4059.300	6858.900	83	80	Durbin	Broadscale	inclinometer set wrong; frame angle off
AL15696.6	AL15696.6	MOC1	1	1	1	6	4	315	e	4059.100	6901.000	82	80	Durbin	Broadscale	
AL15696.7	AL15696.7	MOC10	1	1	1	6	4	410	s	4056.600	6901.400	83	71	Madin	Broadscale	
AL15696.8	AL15696.8	MOC10	1	1	1	6	4	442	e	4054.400	6901.600	85	71	Madin	Broadscale	
AL15696.9	AL15696.9	BongoSB	2	2	2	6	4	713	s	4038.900	6900.400	67	58	Sibunka	Broadscale	
AL15696.10	AL15696.10	BongoSB	2	2	2	6	4	720	e	4038.500	6900.700	67	58	Sibunka	Broadscale	
AL15696.11	AL15696.11	GreeneB	1	1	2	6	4	740	e	4038.400	6902.000	67	2	Wiebe	Broadscale	
AL15696.12	AL15696.12	GreeneB	2	2	2	6	4	740	s	4038.400	6902.000	67	2	Wiebe	Broadscale	attached stern line to stop twisting
AL15696.13	AL15696.13	MkVCTD	2	2	2	6	4	750	s	4038.400	6901.800	67	58	Mountain	Broadscale	
AL15696.14	AL15696.14	MOC1	2	2	2	6	4	836	s	4038.900	6859.700	69	56	Durbin	Broadscale	
AL15696.15	AL15696.15	MOC1	2	2	2	6	4	908	e	4038.100	6900.200	67	62	Durbin	Broadscale	
AL15696.16	AL15696.16	MOC10	2	2	2	6	4	1001	s	4038.600	6858.700	69	60	Madin	Broadscale	hit bottom; cable for Net0 broken
AL15696.17	AL15696.17	MOC10	2	2	2	6	4	1041	e	4039.500	6857.500	69	60	Madin	Broadscale	
AL15696.18	AL15696.18	BongoSB	3	3	3	6	4	1414	s	4031.500	6827.200	91	88	Sibunka	Broadscale	
AL15696.19	AL15696.19	BongoSB	3	3	3	6	4	1422	e	4031.300	6827.200	91	88	Sibunka	Broadscale	
AL15696.20	AL15696.20	Pump	1	3	3	6	4	1426	s	4031.300	6827.300	91	65	Durbin	Broadscale	
AL15696.21	AL15696.21	MkVCTD	3	3	3	6	4	1502	s	4031.800	6826.600	89	84	Mountain	Broadscale	
AL15696.22	AL15696.22	MOC1	3	3	3	6	4	1520	s	4131.700	6826.200	90	84	Durbin	Broadscale	
AL15696.23	AL15696.23	MOC1	3	3	3	6	4	1608	e	4029.700	6826.400	90	86	Durbin	Broadscale	
AL15696.24	AL15696.24	MOC10	3	3	3	6	4	1622	s	4029.800	6826.300	95	85	Madin	Broadscale	
AL15696.25	AL15696.25	MOC10	3	3	3	6	4	1655	e	4030.300	6825.500	94	85	Madin	Broadscale	
AL15696.26	AL15696.26	BongoSB	4	4	4	6	4	2114	s	4059.500	6815.300	54	49	Sibunka	Broadscale	
AL15696.27	AL15696.27	BongoSB	4	4	4	6	4	2118	e	4059.400	6815.600	54	49	Sibunka	Broadscale	
AL15696.28	AL15696.28	Pump	2	4	4	6	4	2125	s	4059.500	6815.800	52	47	Durbin	Broadscale	
AL15696.29	AL15696.29	MkVCTD	4	4	4	6	4	2153	s	4100.300	6816.400	47	40	Mountain	Broadscale	
AL15696.30	AL15696.30	MOC1	4	4	4	6	4	2214	s	4100.400	6816.400	47	43	Durbin	Broadscale	
AL15696.31	AL15696.31	MOC1	4	4	4	6	4	2239	e	4100.600	6818.300	47	42	Durbin	Broadscale	
AL15696.32	AL15696.32	MOC10	4	4	4	6	4	2308	s	4100.400	6816.000	49	41	Madin	Broadscale	
AL15696.33	AL15696.33	MOC10	4	4	4	6	4	2341	e	4100.400	6816.600	47	41	Madin	Broadscale	
AL15796.1	AL15796.1	BongoSB	5	5	5	6	5	221	s	4050.800	6800.700	62	59	Sibunka	Broadscale	
AL15796.2	AL15796.2	BongoSB	5	5	5	6	5	227	e	4050.600	6800.700	62	59	Sibunka	Broadscale	
AL15796.3	AL15796.3	SBwater	1	5	5	6	5	230	s	4050.700	6800.700	63	45	Mountain	Broadscale	
AL15796.4	AL15796.4	MkVCTD	5	5	5	6	5	240	s	4050.600	6800.600	63	56	Mountain	Broadscale	
AL15796.5	AL15796.5	MOC1	5	5	5	6	5	255	s	4050.600	6800.200	65	59	Durbin	Broadscale	
AL15796.6	AL15796.6	MOC1	5	5	5	6	5	331	e	4049.000	6800.000	68	58	Durbin	Broadscale	
AL15796.7	AL15796.7	MOC10		5	5	6	5	340	s	4049.000	6800.000	68	0	Madin	Broadscale	Cable termination parted; tow aborted
AL15796.8	AL15796.8	BongoSB	6	6	6	6	5	535	s	4040.100	6746.500	76	73	Sibunka	Broadscale	
AL15796.9	AL15796.9	BongoSB	6	6	6	6	5	541	e	4039.800	6746.400	76	73	Sibunka	Broadscale	
AL15796.10	AL15796.10	MkVCTD	6	6	6	6	5	545	s	4039.600	6746.400	76	70	Mountain	Broadscale	
AL15796.11	AL15796.11	MOC1	6	6	6	6	5	605	s	4039.300	6746.000	78	70	Durbin	Broadscale	
AL15796.12	AL15796.12	MOC1	6	6	6	6	5	649	e	4037.100	6745.800	80	70	Durbin	Broadscale	
AL15796.13	AL15796.13	MOC10	5	6	6	6	5	721	s	4037.600	6745.800	78	68	Madin	Broadscale	

						L	O	C A L				Water	Cast			
		Instr	cast#	Sta#	Sta_std	Mth	Day	hhmm	s/e	Lat	Lon	Depth	Depth	PI	Region	Comments
AL15796.14	AL15796.14	MOC10	5	6	6	6	5	809	e	4038.400	6745.600	78	68	Madin	Broadscale	
AL15796.15	AL15796.15	GreeneB	2	7	7	6	5	1130	e	4026.500	6718.100	328	2	Wiebe	Broadscale	
AL15796.16	AL15796.16	BongoSB	7	7	7	6	5	1133	s	4026.500	6718.100	328	203	Sibunka	Broadscale	
AL15796.17	AL15796.17	BongoSB	7	7	7	6	5	1154	e	4026.100	6718.100	373	203	Sibunka	Broadscale	
AL15796.18	AL15796.18	SBwater	2	7	7	6	5	1200	s	4026.100	6718.100	375	65	Mountain	Broadscale	
AL15796.19	AL15796.19	Pump	3	7	7	6	5	1208	s	4026.100	6718.100	371	77	Durbin	Broadscale	
AL15796.20	AL15796.20	MkVCTD	7	7	7	6	5	1243	s	4026.300	6718.200	350	300	Mountain	Broadscale	
AL15796.21	AL15796.21	GreeneB	3	7	7	6	5	1305	s	4026.500	6718.200	311	2	Wiebe	Broadscale	
AL15796.22	AL15796.22	MOC1	7	7	7	6	5	1311	s	4026.400	6718.200	340	330	Durbin	Broadscale	
AL15796.23	AL15796.23	MOC1	7	7	7	6	5	1544	e	4024.300	6723.600	550	300	Durbin	Broadscale	
AL15796.24	AL15796.24	MOC10	6	7	7	6	5	1604	s	4024.300	6723.200	480	200	Madin	Broadscale	
AL15796.25	AL15796.25	MOC10	6	7	7	6	5	1702	e	4025.000	6720.800	376	200	Madin	Broadscale	
AL15796.26	AL15796.26	BongoSB	8	8	8	6	5	2103	s	4051.700	6702.300	91	85	Sibunka	Broadscale	
AL15796.27	AL15796.27	BongoSB	8	8	8	6	5	2110	e	4051,6	6702.900	91	85	Sibunka	Broadscale	
AL15796.28	AL15796.28	MkVCTD	8	8	8	6	5	2117	s	4051.500	6703.100	90	83	Mountain	Broadscale	
AL15796.29	AL15796.29	MOC1		8	8	6	5	2145	s	4051.200	6704.000	91	80	Durbin	Broadscale	Tow aborted; nets tangled
AL15796.30	AL15796.30	MOC1		8	8	6	5	2228	e	4050.000	6706.600	93	83	Durbin	Broadscale	samples fouled; not saved
AL15796.31	AL15796.31	MOC10	7	8	8	6	5	2311	s	4052.400	6702.400	92	84	Madin	Broadscale	
AL15796.32	AL15796.32	MOC10	7	8	8	6	5	2355	e	4052.500	6704.500	89	84	Madin	Broadscale	
AL15896.1	AL15896.1	MOC1	8	8	8	6	6	7	s	4052.600	6705.100	89	81	Durbin	Broadscale	Retow cast 8
AL15896.2	AL15896.2	MOC1	8	8	8	6	6	57	e	4053.500	6707.700	89	79	Durbin	Broadscale	
AL15896.3	AL15896.3	BongoSB	9	9	9	6	6	207	s	4057.100	6717.500	77	74	Sibunka	Broadscale	
AL15896.4	AL15896.4	BongoSB	9	9	9	6	6	214	e	4057.300	6717.800	79	74	Sibunka	Broadscale	
AL15896.5	AL15896.5	Pump	4	9	9	6	6	217	s	4057.400	6717.900	78	63	Durbin	Broadscale	
AL15896.6	AL15896.6	MkVCTD	9	9	9	6	6	248	s	4057.700	6717.500	76	71	Mountain	Broadscale	
AL15896.7	AL15896.7	MOC1	9	9	9	6	6	303	s	4058.000	6717.100	79	70	Durbin	Broadscale	
AL15896.8	AL15896.8	MOC1	9	9	9	6	6	347	e	4058.900	6717.700	76	70	Durbin	Broadscale	
AL15896.9	AL15896.9	MOC10	8	9	9	6	6	403	s	4059.100	6718.200	76	66	Madin	Broadscale	
AL15896.10	AL15896.10	MOC10	8	9	9	6	6	431	e	4059.400	6718.500	74	66	Madin	Broadscale	
AL15896.11	AL15896.11	BongoSB	10	10	10	6	6	650	s	4104.600	6739.000	56	51	Sibunka	Broadscale	
AL15896.12	AL15896.12	BongoSB	10	10	10	6	6	656	e	4104.500	6739.400	56	51	Sibunka	Broadscale	
AL15896.13	AL15896.13	SBwater	3	10	10	6	6	659	s	4104.500	6739.400	56	20	Mountain	Broadscale	on first try, bottle didn't trip
AL15896.14	AL15896.14	MkVCTD	10	10	10	6	6	710	s	4104.300	6739.400	56	48	Mountain	Broadscale	
AL15896.15	AL15896.15	MOC1	10	10	10	6	6	723	s	4104.100	6739.200	56	48	Durbin	Broadscale	
AL15896.16	AL15896.16	MOC1	10	10	10	6	6	753	e	4104.200	6738.600	58	49	Durbin	Broadscale	
AL15896.17	AL15896.17	MOC10	9	10	10	6	6	812	s	4104.400	6739.100	55	46	Madin	Broadscale	
AL15896.18	AL15896.18	MOC10	9	10	10	6	6	847	e	4104.600	6740.400	51	46	Madin	Broadscale	
AL15896.19	AL15896.19	BongoSB	11	11	11	6	6	1029	s	4113.500	6757.000	45	42	Sibunka	Broadscale	
AL15896.20	AL15896.20	BongoSB	11	11	11	6	6	1035	e	4113.600	6757.500	47	42	Sibunka	Broadscale	
AL15896.21	AL15896.21	MkVCTD	11	11	11	6	6	1040	s	4113.800	6757.800	50	44	Mountain	Broadscale	
AL15896.22	AL15896.22	MOC1	11	11	11	6	6	1058	s	4114.000	6758.300	50	41	Durbin	Broadscale	
AL15896.23	AL15896.23	MOC1	11	11	11	6	6	1122	e	4114.800	6800.500	47	40	Durbin	Broadscale	
AL15896.24	AL15896.24	MOC10	10	11	11	6	6	1137	s	4114.000	6800.000	49	34	Madin	Broadscale	
AL15896.25	AL15896.25	MOC10	10	11	11	6	6	1210	e	4114.700	6759.800	48	34	Madin	Broadscale	
AL15896.26	AL15896.26	BongoSB	12	12	12	6	6	1451	s	4124.000	6732.700	37	35	Sibunka	Broadscale	
AL15896.27	AL15896.27	GreeneB	3	12	12	6	6	1454	e	4124.400	6732.100	43	2	Wiebe	Broadscale	retrieved to check CTD
AL15896.28	AL15896.28	BongoSB	12	12	12	6	6	1500	e	4124.700	6731.700	39	35	Sibunka	Broadscale	

						L	O	C A L				Water	Cast			
		Instr	cast#	Sta#	Sta_std	Mth	Day	hhmm	s/e	Lat	Lon	Depth	Depth	PI	Region	Comments
AL15896.29	AL15896.29	Pump	5	12	12	6	6	1510	s	4124.900	6731.100	35	31	Durbin	Broadscale	
AL15896.30	AL15896.30	GreeneB	4	12	12	6	6	1510	s	4125.100	6730.900	37	2	Wiebe	Broadscale	returned; still no C
AL15896.31	AL15896.31	MkVCTD	12	12	12	6	6	1527	s	4125.400	6730.600	38	34	Mountain	Broadscale	
AL15896.32	AL15896.32	MOC1	12	12	12	6	6	1539	s	4125.600	6730.200	41	36	Durbin	Broadscale	
AL15896.33	AL15896.33	MOC1	12	12	12	6	6	1603	e	4125.600	6730.300	42	36	Durbin	Broadscale	
AL15896.34	AL15896.34	MOC10	11	12	12	6	6	1614	s	4125.600	6730.400	42	34	Madin	Broadscale	
AL15896.35	AL15896.35	MOC10	11	12	12	6	6	1637	e	4125.500	6730.400	40	34	Madin	Broadscale	
AL15896.36	AL15896.36	Drifter	1	12	12	6	6	1648	s	4125.399	6730.320	38	10	Limeburner	Broadscale	ID# 23809
AL15896.37	AL15896.37	BongoSB	13	13	13	6	6	1838	s	4116.200	6710.300	56	49	Sibunka	Broadscale	
AL15896.38	AL15896.38	BongoSB	13	13	13	6	6	1846	e	4115.700	6710.600	56	49	Sibunka	Broadscale	
AL15896.39	AL15896.39	Pump	6	13	13	6	6	1902	s	4115.200	6710.800	56	52	Durbin	Broadscale	
AL15896.40	AL15896.40	MkVCTD	13	13	13	6	6	1928	s	4114.700	6710.600	56	50	Mountain	Broadscale	
AL15896.41	AL15896.41	MOC1	13	13	13	6	6	1943	s	4114.200	6710.800	59	50	Durbin	Broadscale	
AL15896.42	AL15896.42	MOC1	13	13	13	6	6	2012	e	4113.200	6710.100	59	50	Durbin	Broadscale	
AL15896.43	AL15896.43	MOC10	12	13	13	6	6	2044	s	4115.600	6710.000	56	46	Madin	Broadscale	
AL15896.44	AL15896.44	MOC10	12	13	13	6	6	2121	e	4114.200	6709.500	56	49	Madin	Broadscale	
AL15896.45	AL15896.45	BongoSB	14	14	14	6	6	2234	s	4112.800	6659.500	68	62	Sibunka	Broadscale	
AL15896.46	AL15896.46	BongoSB	14	14	14	6	6	2241	e	4112.600	6659.300	68	62	Sibunka	Broadscale	
AL15896.47	AL15896.47	MkVCTD	14	14	14	6	6	2249	s	4112.600	6659.200	69	62	Mountain	Broadscale	
AL15896.48	AL15896.48	MOC1	14	14	14	6	6	2302	s	4112.500	6659.400	69	60	Durbin	Broadscale	
AL15896.49	AL15896.49	MOC1	14	14	14	6	6	2330	e	4112.300	6658.800	69	60	Durbin	Broadscale	
AL15896.50	AL15896.50	MOC10	13	14	14	6	6	2344	s	4112.200	6658.300	69	56	Madin	Broadscale	
AL15996.1	AL15996.1	MOC10	13	14	14	6	7	18	e	4112.200	6657.800	70	56	Madin	Broadscale	
AL15996.2	AL15996.2	BongoSB	15	15	15	6	7	221	s	4102.900	6642.300	78	74	Sibunka	Broadscale	
AL15996.3	AL15996.3	BongoSB	15	15	15	6	7	229	e	4102.600	6642.300	79	74	Sibunka	Broadscale	
AL15996.4	AL15996.4	SBwater	4	15	15	6	7	231	s	4102.500	6642.300	79	34	Mountain	Broadscale	
AL15996.5	AL15996.5	MkVCTD	15	15	15	6	7	246	s	4102.500	6642.300	78	72	Mountain	Broadscale	
AL15996.6	AL15996.6	MOC1	15	15	15	6	7	253	s	4102.400	6642.100	80	72	Durbin	Broadscale	
AL15996.7	AL15996.7	MOC1	15	15	15	6	7	340	e	4101.100	6641.300	78	68	Durbin	Broadscale	
AL15996.8	AL15996.8	MOC10	14	15	15	6	7	355	s	4100.600	6641.000	81	74	Madin	Broadscale	
AL15996.9	AL15996.9	MOC10	14	15	15	6	7	424	e	4059.900	6640.300	86	74	Madin	Broadscale	
AL15996.10	AL15996.10	BongoSB	16	16	16	6	7	552	s	4054.900	6627.300	600	202	Sibunka	Broadscale	
AL15996.11	AL15996.11	BongoSB	16	16	16	6	7	616	e	4054.000	6628.200	600	202	Sibunka	Broadscale	
AL15996.12	AL15996.12	BongoSB	17	16	16	6	7	630	s	4054.700	6627.900	600	201	Weisbrod &	Broadscale	
AL15996.13	AL15996.13	BongoSB	17	16	16	6	7	650	e	4055.100	6627.300	600	201	Copeland	Broadscale	
AL15996.14	AL15996.14	Pump	7	16	16	6	7	659	s	4055.100	6627.100	600	75	Durbin	Broadscale	
AL15996.15	AL15996.15	MkVCTD	16	16	16	6	7	732	s	4054.800	6626.700	1000	301	Mountain	Broadscale	
AL15996.16	AL15996.16	MOC1	16	16	16	6	7	806	s	4054.600	6626.500	1400	500	Durbin	Broadscale	
AL15996.17	AL15996.17	MOC1	16	16	16	6	7	1200	e	4051.900	6630.200	1000	500	Durbin	Broadscale	
AL15996.18	AL15996.18	MOC10	15	16	16	6	7	1213	s	4051.900	6630.300	850	501	Madin	Broadscale	
AL15996.19	AL15996.19	MOC10	15	16	16	6	7	1344	e	4053.200	6628.200	850	501	Madin	Broadscale	
AL15996.20	AL15996.20	BongoSB	18	17	17	6	7	1611	s	4111.900	6627.500	94	90	Sibunka	Broadscale	
AL15996.21	AL15996.21	BongoSB	18	17	17	6	7	1622	e	4112.900	6627.700	94	90	Sibunka	Broadscale	
AL15996.22	AL15996.22	Pump	8	17	17	6	7	1626	s	4113.200	6627.700	93	72	Durbin	Broadscale	
AL15996.23	AL15996.23	GreeneB	4	17	17	6	7	1656	e	4113.400	6627.800	92	2	Wiebe	Broadscale	
AL15996.24	AL15996.24	MkVCTD	17	17	17	6	7	1708	s	4113.700	6627.700	91	85	Mountain	Broadscale	
AL15996.25	AL15996.25	MOC1	17	17	17	6	7	1722	s	4113.600	6627.300	94	86	Durbin	Broadscale	

						L	O	C A L				Water	Cast			
		Instr	cast#	Sta#	Sta_std	Mth	Day	hhmm	s/e	Lat	Lon	Depth	Depth	Pi	Region	Comments
AL15996.26	AL15996.26	MOC1	17	17	17	6	7	1817	e	4111.600	6626.000	90	86	Durbin	Broadscale	
AL15996.27	AL15996.27	GreeneB	5	17	17	6	7	1830	s	4111.900	6626.700	2	90	Wiebe	Broadscale	
AL15996.28	AL15996.28	MOC10	16	17	17	6	7	1838	s	4111.600	6626.300	90	82	Madin	Broadscale	
AL15996.29	AL15996.29	MOC10	16	17	17	6	7	1925	e	4112.000	6626.900	95	82	Madin	Broadscale	
AL15996.30	AL15996.30	BongoSB	19	18	18	6	7	2138	s	4123.400	6641.200	82	77	Sibunka	Broadscale	
AL15996.31	AL15996.31	BongoSB	19	18	18	6	7	2146	e	4123.600	6641.500	82	77	Sibunka	Broadscale	
AL15996.32	AL15996.32	Pump	9	18	18	6	7	2158	s	4123.600	6641.400	83	59	Durbin	Broadscale	hose caught under hull on up haul - freed ok
AL15996.33	AL15996.33	MkVCTD	18	18	18	6	7	2232	s	4123.300	6641.400	82	75	Mountain	Broadscale	
AL15996.34	AL15996.34	MOC1	18	18	18	6	7	2240	s	4123.300	6641.400	82	77	Durbin	Broadscale	
AL15996.35	AL15996.35	MOC1	18	18	18	6	7	2333	e	4123.300	6643.900	82	74	Durbin	Broadscale	
AL15996.36	AL15996.36	MOC10	17	18	18	6	7	2352	s	4124.700	6644.200	80	74	Madin	Broadscale	
AL16096.1	AL16096.1	MOC10	17	18	18	6	8	22	e	4124.900	6643.800	83	74	Madin	Broadscale	
AL16096.2	AL16096.2	Biomappe	1			6	8	140	s	4128.506	6650.917	71		Wiebe		
AL16096.3	AL16096.3	Biomappe	1			6	8	300	s	4128.506	6650.917	71		Wiebe	Broadscale	triangulation to find Biomapper position
AL16096.4	AL16096.4	BongoSB	20	19	19	6	8	409	s	4136.200	6658.400	59	55	Sibunka	Broadscale	
AL16096.5	AL16096.5	BongoSB	20	19	19	6	8	419	e	4136.400	6658.900	61	55	Sibunka	Broadscale	
AL16096.6	AL16096.6	MkVCTD	19	19	19	6	8	424	s	4136.400	6659.200	60	55	Mountain	Broadscale	
AL16096.7	AL16096.7	MOC1	19	19	19	6	8	437	s	4136.600	6658.800	60	54	Durbin	Broadscale	
AL16096.8	AL16096.8	MOC1	19	19	19	6	8	510	e	4136.800	6656.600	63	54	Durbin	Broadscale	
AL16096.9	AL16096.9	MOC10	18	19	19	6	8	530	s	4136.700	6656.500	64	28	Madin	Broadscale	
AL16096.10	AL16096.10	MOC10	18	19	19	6	8	559	e	4136.700	6656.500	65	28	Madin	Broadscale	
AL16096.11	AL16096.11	BongoSB	21	20	20	6	8	829	s	4143.700	6631.900	75	70	Sibunka	Broadscale	
AL16096.12	AL16096.12	BongoSB	21	20	20	6	8	837	e	4143.700	6632.000	75	70	Sibunka	Broadscale	
AL16096.13	AL16096.13	SBwater	5	20	20	6	8	841	s	4143.700	6632.000	75	23	Mountain	Broadscale	
AL16096.14	AL16096.14	Pump	10	20	20	6	8	849	s	4143.500	6631.800	75	70	Durbin	Broadscale	
AL16096.15	AL16096.15	MkVCTD	20	20	20	6	8	922	s	4142.900	6631.500	75	68	Mountain	Broadscale	
AL16096.16	AL16096.16	MOC1	20	20	20	6	8	935	s	4142.700	6631.400	74	66	Durbin	Broadscale	
AL16096.17	AL16096.17	MOC1	20	20	20	6	8	1020	e	4143.100	6631.400	74	67	Durbin	Broadscale	
AL16096.18	AL16096.18	MOC10	19	20	20	6	8	1035	s	4143.300	6631.000	76	66	Madin	Broadscale	
AL16096.19	AL16096.19	MOC10	19	20	20	6	8	1117	e	4143.500	6630.800	76	66	Madin	Broadscale	
AL16096.20	AL16096.20	BongoSB	22	21	21	6	8	1249	s	4134.500	6625.600	89	85	Sibunka	Broadscale	
AL16096.21	AL16096.21	BongoSB	22	21	21	6	8	1259	e	4134.200	6626.300	89	85	Sibunka	Broadscale	
AL16096.22	AL16096.22	MkVCTD	21	21	21	6	8	1303	s	4134.100	6626.500	89	84	Mountain	Broadscale	
AL16096.23	AL16096.23	MOC1	21	21	21	6	8	1320	s	4133.900	6627.100	90	83	Durbin	Broadscale	
AL16096.24	AL16096.24	MOC1	21	21	21	6	8	1410	e	4133.300	6629.800	87	80	Durbin	Broadscale	
AL16096.25	AL16096.25	MOC10	20	21	21	6	8	1435	s	4133.400	6628.000	87	82	Madin	Broadscale	
AL16096.26	AL16096.26	MOC10	20	21	21	6	8	1503	e	4133.700	6627.300	88	82	Madin	Broadscale	
AL16096.27	AL16096.27	BongoSB	23	22	22	6	8	1727	s	4132.900	6601.800	114	110	Sibunka	Broadscale	
AL16096.28	AL16096.28	BongoSB	23	22	22	6	8	1741	e	4132.700	6602.100	114	110	Sibunka	Broadscale	
AL16096.29	AL16096.29	WaterSB	6	22	22	6	8	1745	s	4132.600	6602.200	113	30	Mountain	Broadscale	
AL16096.30	AL16096.30	MkVCTD	22	22	22	6	8	1752	s	4132.700	6602.100	115	107	Mountain	Broadscale	
AL16096.31	AL16096.31	MOC1	22	22	22	6	8	1807	s	4132.800	6601.900	115	105	Durbin	Broadscale	
AL16096.32	AL16096.32	MOC1	22	22	22	6	8	1902	e	4132.800	6603.400	109	106	Durbin	Broadscale	
AL16096.33	AL16096.33	MOC10	21	22	22	6	8	1922	s	4132.800	6602.500	110	101	Madin	Broadscale	
AL16096.34	AL16096.34	MOC10	21	22	22	6	8	2006	e	4132.500	6600.100	133	101	Madin	Broadscale	
AL16096.35	AL16096.35	BongoSB	24	23	23	6	8	2244	s	4146.800	6611.000	87	82	Sibunka	Broadscale	

						L	O	C A L				Water	Cast			
		Instr	cast#	Sta#	Sta_std	Mth	Day	hhmm	s/e	Lat	Lon	Depth	Depth	PI	Region	Comments
AL16096.36	AL16096.36	BongoSB	24	23	23	6	8	2254	e	4147.000	6611.200	87	82	Sibunka	Broadscale	
AL16096.37	AL16096.37	BongoSB	25	23	23	6	8	2300	s	4147.200	6611.200	87	81	Weisbrod	Broadscale	
AL16096.38	AL16096.38	BongoSB	25	23	23	6	8	2311	e	4147.300	6611.300	87	81	Weisbrod	Broadscale	
AL16096.39	AL16096.39	Pump	11	23	23	6	8	2318	s	4147.400	6611.300	87	67	Durbin	Broadscale	
AL16096.40	AL16096.40	BongoSB	26	23	23	6	8	2350	s	4146.800	6611.900	88	30	Weisbrod	Broadscale	
AL16196.1	AL16196.1	BongoSB	26	23	23	6	9	11	e	4146.700	6613.100	88	30	Weisbrod	Broadscale	
AL16196.2	AL16196.2	MkVCTD	23	23	23	6	9	14	s	4146.700	6613.400	84	80	Mountain	Broadscale	
AL16196.3	AL16196.3	MOC1	23	23	23	6	9	30	s	4146.700	6613.600	89	80	Durbin	Broadscale	
AL16196.4	AL16196.4	MOC1	23	23	23	6	9	118	e	4147.400	6612.900	87	81	Durbin	Broadscale	
AL16196.5	AL16196.5	MOC10	22	23	23	6	9	133	s	4147.500	6612.600	87	80	Madin	Broadscale	
AL16196.6	AL16196.6	MOC10	22	23	23	6	9	215	e	4147.800	6612.200	87	80	Madin	Broadscale	
AL16196.7	AL16196.7	BongoSB	27	24	24	6	9	435	s	4203.000	6557.000	176	171	Sibunka	Broadscale	
AL16196.8	AL16196.8	BongoSB	27	24	24	6	9	457	e	4203.200	6558.100	172	171	Sibunka	Broadscale	
AL16196.9	AL16196.9	MkVCTD	24	24	24	6	9	500	s	4203.200	6558.300	168	164	Mountain	Broadscale	
AL16196.10	AL16196.10	MOC1	24	24	24	6	9	520	s	4203.200	6557.900	176	150	Durbin	Broadscale	
AL16196.11	AL16196.11	MOC1	24	24	24	6	9	634	e	4201.400	6555.200	175	165	Durbin	Broadscale	
AL16196.12	AL16196.12	MOC10	23	24	24	6	9	646	s	4201.500	6555.100	176	166	Madin	Broadscale	
AL16196.13	AL16196.13	MOC10	23	24	24	6	9	740	s	4201.900	6555.500	180	166	Madin	Broadscale	
AL16196.14	AL16196.14	GreeneB	5	25	25	6	9	944	e	4216.800	6551.000	223	2	Wiebe	Broadscale	re-plug TV camera on J-frame
AL16196.15	AL16196.15	GreeneB	6	25	25	6	9	957	s	4217.200	6555.000	220	2	Wiebe	Broadscale	
AL16196.16	AL16196.16	BongoSB	28	25	25	6	9	1005	s	4217.200	6551.200	221	201	Sibunka	Broadscale	
AL16196.17	AL16196.17	BongoSB	28	25	25	6	9	1027	e	4216.400	6551.500	221	201	Sibunka	Broadscale	
AL16196.18	AL16196.18	BongoSB	29	25	25	6	9	1035	s	4216.100	6551.600	228	201	Wiesbrod	Broadscale	
AL16196.19	AL16196.19	BongoSB	29	25	25	6	9	1056	e	4215.700	6550.800	227	201	Wiesbrod	Broadscale	
AL16196.20	AL16196.20	Pump	12	25	25	6	9	1104	s	4215.700	6550.800	225	69	Durbin	Broadscale	
AL16196.21	AL16196.21	MkVCTD	25	25	25	6	9	1134	s	4215.600	6550.400	226	220	Mountain	Broadscale	
AL16196.22	AL16196.22	MOC1	25	25	25	6	9	1154	s	4215.600	6550.300	224	216	Durbin	Broadscale	
AL16196.23	AL16196.23	MOC1	25	25	25	6	9	1402	e	4218.100	6554.600	231	217	Durbin	Broadscale	
AL16196.24	AL16196.24	MOC1	26	25	25	6	9	1430	s	4217.100	6553.200	230	228	Durbin	Broadscale	
AL16196.25	AL16196.25	MOC1	26	25	25	6	9	1515	e	4216.800	6552.500	228	228	Durbin	Broadscale	
AL16196.26	AL16196.26	MOC10	24	25	25	6	9	1530	s	4216.800	6552.500	228	221	Madin	Broadscale	
AL16196.27	AL16196.27	MOC10	24	25	25	6	9	1622	e	4216.500	6551.900	229	221	Madin	Broadscale	
AL16196.28	AL16196.28	BongoSB	30	26	39	6	9	1756	s	4207.500	6559.900	222	202	Sibunka	Broadscale	
AL16196.29	AL16196.29	BongoSB	30	26	39	6	9	1820	e	4207.600	6558.700	228	202	Sibunka	Broadscale	
AL16196.30	AL16196.30	WaterSB	7	26	39	6	9	1823	s	4207.700	6558.600	227	53	Mountain	Broadscale	
AL16196.31	AL16196.31	Pump	13	26	39	6	9	1835	s	4207.700	6558.200	229	69	Durbin	Broadscale	
AL16196.32	AL16196.32	MkVCTD	26	26	39	6	9	1908	s	4207.900	6557.700	229	220	Mountain	Broadscale	
AL16196.33	AL16196.33	MOC1	27	26	39	6	9	1931	s	4208.100	6557.400	228	219	Durbin	Broadscale	
AL16196.34	AL16196.34	MOC1	27	26	39	6	9	2146	e	4207.400	6557.300	230	219	Durbin	Broadscale	
AL16196.35	AL16196.35	MOC10	25	26	39	6	9	2206	s	4207.200	6558.500	228	216	Madin	Broadscale	
AL16196.36	AL16196.36	MOC10	25	26	39	6	9	2254	e	4207.700	6558.500	212	216	Madin	Broadscale	
AL16296.1	AL16296.1	BongoSB	31	27	26	6	10	119	s	4204.500	6623.500	86	82	Sibunka	Broadscale	
AL16296.2	AL16296.2	BongoSB	31	27	26	6	10	133	e	4204.500	6624.500	85	82	Sibunka	Broadscale	
AL16296.3	AL16296.3	MkVCTD	27	27	26	6	10	137	s	4204.500	6624.900	84	79	Mountain	Broadscale	
AL16296.4	AL16296.4	MOC1	28	27	26	6	10	151	s	4204.800	6625.300	86	75	Durbin	Broadscale	
AL16296.5	AL16296.5	MOC1	28	27	26	6	10	228	e	4205.300	6627.500	82	73	Durbin	Broadscale	
AL16296.6	AL16296.6	MOC10	26	27	26	6	10	242	s	4205.300	6627.700	81	73	Madin	Broadscale	

		Instr	cast#	Sta#	Sta_std	L O C A L Mth	Day	hhmm	s/e	Lat	Lon	Water Depth	Cast Depth	PI	Region	Comments
AL16296.7	AL16296.7	MOC10	26	27	26	6	10	308	e	4205.400	6627.300	82	73	Madin	Broadscale	
AL16296.8	AL16296.8	Drifter	2	27	26	6	10	317	s	4205.352	6627.036	82	10	Limeburner	Broadscale	ID# 23804
AL16296.9	AL16296.9	BongoSB	32	28	27	6	10	519	s	4156.700	6641.900	67	64	Sibunka	Broadscale	
AL16296.10	AL16296.10	BongoSB	32	28	27	6	10	526	e	4156.600	6641.900	68	64	Sibunka	Broadscale	
AL16296.11	AL16296.11	Pump	14	28	27	6	10	531	s	4156.700	6642.000	68	65	Durbin	Broadscale	
AL16296.12	AL16296.12	MkVCTD	28	28	27	6	10	559	s	4157.400	6642.100	69	59	Mountain	Broadscale	
AL16296.13	AL16296.13	MOC1	29	28	27	6	10	612	s	4157.600	6641.800	69	62	Durbin	Broadscale	
AL16296.14	AL16296.14	MOC1	29	28	27	6	10	644	e	4157.000	6641.700	69	62	Durbin	Broadscale	
AL16296.15	AL16296.15	MOC10	27	28	27	6	10	659	s	4156.800	6641.500	68	63	Madin	Broadscale	
AL16296.16	AL16296.16	MOC10	27	28	27	6	10	743	e	4156.600	6642.000	68	63	Madin	Broadscale	
AL16296.17	AL16296.17	BongoSB	33	29	28	6	10	933	s	4205.200	6653.800	67	62	Sibunka		
AL16296.18	AL16296.18	BongoSB	33	29	28	6	10	941	e	4205.200	6653.800	67	62	Sibunka		
AL16296.19	AL16296.19	MkVCTD	29	29	28	6	10	946	s	4205.300	6653.600	67	61	Mountain		
AL16296.20	AL16296.20	MOC1	30	29	28	6	10	958	s	4205.100	6653.400	68	61	Durbin		
AL16296.21	AL16296.21	MOC1	30	29	28	6	10	1026	e	4205.100	6652.900	67	60	Durbin		
AL16296.22	AL16296.22	MOC10	28	29	28	6	10	1038	s	4205.000	6652.800	66	58	Madin		
AL16296.23	AL16296.23	MOC10	28	29	28	6	10	1118	e	4205.100	6652.700	65	58	Madin		
AL16296.24	AL16296.24	BongoSB	34	30	29	6	10	1312	s	4217.100	6653.500	286	200	Sibunka		
AL16296.25	AL16296.25	BongoSB	34	30	29	6	10	1352	e	4217.800	6654.300	293	200	Sibunka		
AL16296.26	AL16296.26	Pump	15	30	29	6	10	1357	s	4217.700	6654.400	293	70	Durbin		
AL16296.27	AL16296.27	MkVCTD	30	30	29	6	10	1425	s	4217.900	6654.100	294	289	Mountain		
AL16296.28	AL16296.28	MOC1	31	30	29	6	10	1445	s	4218.300	6654.100	297	284	Durbin		
AL16296.29	AL16296.29	MOC1	31	30	29	6	10	1606	e	4217.100	6655.800	288	284	Durbin		
AL16296.30	AL16296.30	MOC1	32	30	29	6	10	1623	s	4217.600	6654.900	293	191	Durbin		
AL16296.31	AL16296.31	MOC1	32	30	29	6	10	1735	e	4218.700	6651.800	302	191	Durbin		
AL16296.32	AL16296.32	MOC10	29	30	29	6	10	1803	s	4218.400	6652.200	304	287	Madin		
AL16296.33	AL16296.33	MOC10	29	30	29	6	10	1918	e	4216.600	6651.800	277	287	Madin		
AL16296.34	AL16296.34	BongoSB	35	31	30	6	10	2224	s	4155.200	6711.600	62	52	Sibunka		
AL16296.35	AL16296.35	BongoSB	35	31	30	6	10	2232	e	4155.100	6711.900	58	52	Sibunka		
AL16296.36	AL16296.36	Pump	16	31	30	6	10	2235	s	4155.100	6712.000	58	52	Durbin		
AL16296.37	AL16296.37	MkVCTD	31	31	30	6	10	2305	s	4154.400	6711.800	57	52	Mountain		
AL16296.38	AL16296.38	MOC1	33	31	30	6	10	2317	s	4154.300	6711.900	55	51	Durbin		
AL16296.39	AL16296.39	MOC1	33	31	30	6	10	2340	e	4154.300	6712.400	57	40	Durbin		
AL16396.1	AL16396.1	MOC10	30	31	30	6	11	29	s	4155.400	6714.200	57	46	Madin		
AL16396.2	AL16396.2	MOC10	30	31	30	6	11	49	e	4155.700	6714.400	59	46	Madin		
AL16396.3	AL16396.3	Drifter	3	31	30	6	11	59	s	4155.830	6714.478	58	10	Limeburner		
AL16396.4	AL16396.4	BongoSB	36	32	31	6	11	302	s	4203.000	6737.300	98	95	Sibunka		
AL16396.5	AL16396.5	BongoSB	36	32	31	6	11	313	s	4203.000	6737.800	100	95	Sibunka		
AL16396.6	AL16396.6	MkVCTD	32	32	31	6	11	317	s	4202.900	6737.900	98	92	Mountain		
AL16396.7	AL16396.7	MOC1	34	32	31	6	11	335	s	4202.900	6738.200	104	100	Durbin		
AL16396.8	AL16396.8	MOC1	34	32	31	6	11	436	e	4202.500	6740.700	106	107	Durbin		
AL16396.9	AL16396.9	MOC10	31	32	31	6	11	449	s	4202.500	6740.600	104	93	Madin		
AL16396.10	AL16396.10	MOC10	31	32	31	6	11	528	e	4202.400	6739.500	97	93	Madin		
AL16396.11	AL16396.11	BongoSB	37	33	32	6	11	822	s	4141.300	6739.000	54	50	Sibunka		
AL16396.12	AL16396.12	BongoSB	37	33	32	6	11	828	e	4141.500	6739.100	55	50	Sibunka		
AL16396.13	AL16396.13	MkVCTD	33	33	32	6	11	832	s	4141.600	6739.200	50	47	Mountain		
AL16396.14	AL16396.14	MOC1	35	33	32	6	11	850	s	4141.500	6739.100	55	46	Durbin		

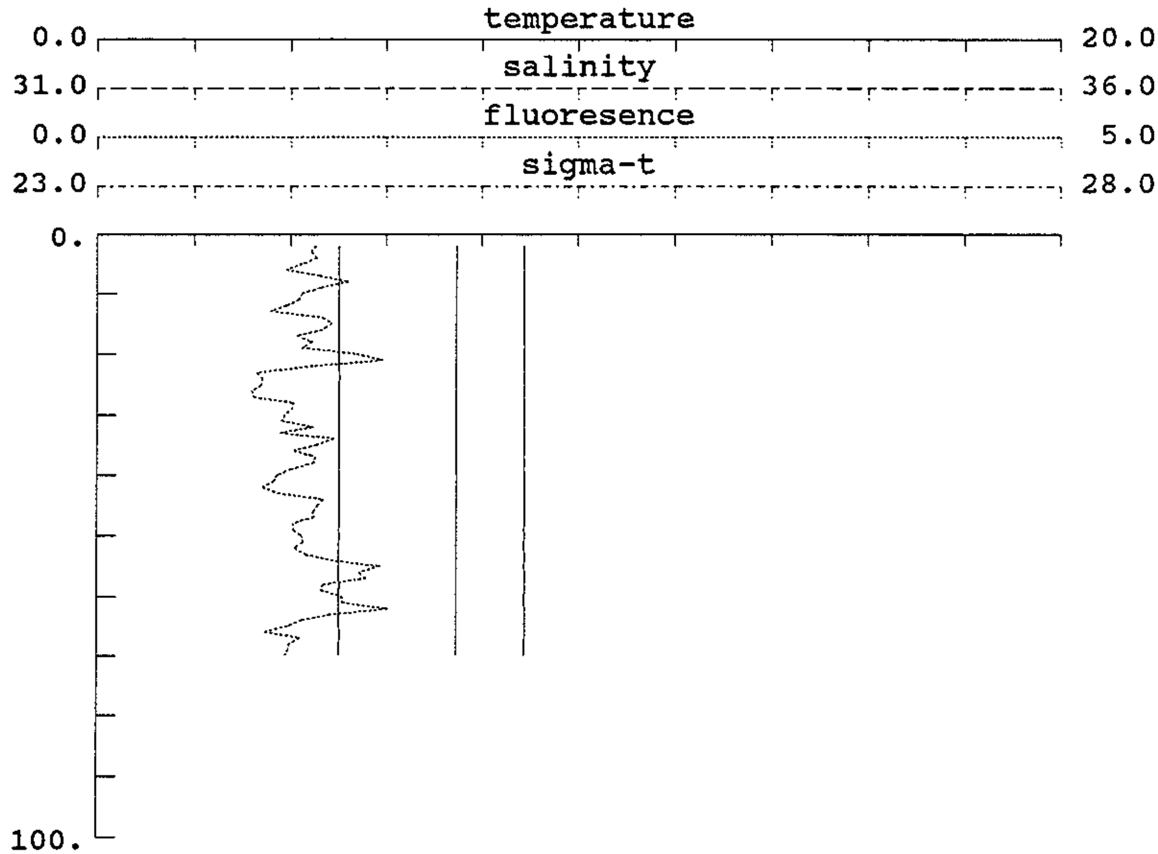
						L	O	C A L				Water	Cast			
		Instr	cast#	Sta#	Sta_std	Mth	Day	hhmm	s/e	Lat	Lon	Depth	Depth	PI	Region	Comments
AL16396.15	AL16396.15	MOC1	35	33	32	6	11	912	e	4141.800	6739.200	56	47	Durbin		
AL16396.16	AL16396.16	BongoSB	38	33	32	6	11	924	s	4141.800	6739.200	55	51	Weisbrod		
AL16396.17	AL16396.17	BongoSB	38	33	32	6	11	931	e	4142.000	6739.200	56	51	Weisbrod		
AL16396.18	AL16396.18	MOC10	32	33	32	6	11	940	s	4142.000	6739.300	55	43	Madin		
AL16396.19	AL16396.19	MOC10	32	33	32	6	11	1015	e	4142.100	6739.400	55	43	Madin		
AL16396.20	AL16396.20	BongoSB	39	34	33	6	11	1249	s	4149.200	6758.300	52	49	Sibunka		
AL16396.21	AL16396.21	BongoSB	39	34	33	6	11	1255	e	4149.200	6758.400	52	49	Sibunka		
AL16396.22	AL16396.22	MkVCTD	34	34	33	6	11	1303	s	4149.200	6758.500	52	45	Mountain		
AL16396.23	AL16396.23	MOC1	36	34	33	6	11	1312	s	4149.000	6758.600	53	42	Durbin		
AL16396.24	AL16396.24	MOC1	36	34	33	6	11	1337	e	4149.200	6759.400	55	49	Durbin		
AL16396.25	AL16396.25	MOC10	33	34	33	6	11	1347	s	4149.400	6759.700	55	50	Madin		
AL16396.26	AL16396.26	MOC10	33	34	33	6	11	1410	e	4149.800	6800.400	60	50	Madin		
AL16396.27	AL16396.27	Drifter	4	34	33	6	11	1417	s	4149.857	6500.532	60	10	Limeburner		
AL16396.28	AL16396.28	BongoSB	40	35	34	6	11	1551	s	4150.900	6817.500	207	201	Sibunka		
AL16396.29	AL16396.29	BongoSB	40	35	34	6	11	1621	e	4151.000	6819.400	215	201	Sibunka		
AL16396.30	AL16396.30	Pump	17	35	34	6	11	1626	s	4151.100	6819.600	218	70	Durbin		
AL16396.31	AL16396.31	MkVCTD	35	35	34	6	11	1655	s	4151.400	6819.600	215	209	Mountain		
AL16396.32	AL16396.32	MOC1	37	35	34	6	11	1714	s	4151.500	6819.600	218	203	Durbin		zoo net tow
AL16396.33	AL16396.33	MOC1	37	35	34	6	11	1807	e	4150.900	6820.600	212	203	Durbin		pulled MOC after zoo nets to get better samples
AL16396.34	AL16396.34	MOC1	38	35	34	6	11	1813	s	4150.900	6820.600	212	203	Durbin		ichthyo net tow
AL16396.35	AL16396.35	MOC1	38	35	34	6	11	1921	e	4158.400	6820.000	197	201	Durbin		
AL16396.36	AL16396.36	MOC10	34	35	34	6	11	1936	s	4153.500	6819.100	208	201	Madin		
AL16396.37	AL16396.37	MOC10	34	35	34	6	11	2026	e	4152.400	6818.100	222	201	Madin		
AL16396.38	AL16396.38	BongoSB	41	36	35	6	11	2301	s	4135.800	6829.800	110	105	Sibunka		
AL16396.39	AL16396.39	BongoSB	41	36	35	6	11	2311	e	4135.700	6830.100	114	105	Sibunka		
AL16396.40	AL16396.40	WaterSB	8	36	35	6	11	2314	s	4135.700	6830.200	115	27	Mountain		
AL16396.41	AL16396.41	MkVCTD	36	36	35	6	11	2322	s	4135.700	6830.300	116	106	Mountain		
AL16396.42	AL16396.42	MOC1	39	36	35	6	11	2332	s	4135.300	6830.200	112	106	Durbin		
AL16496.1	AL16496.1	MOC1	39	36	35	6	12	47	e	4134.700	6829.600	95	96	Durbin		
AL16496.2	AL16496.2	MOC10	35	36	35	6	12	120	s	4134.600	6826.200	51	42	Madin		
AL16496.3	AL16496.3	MOC10	35	36	35	6	12	144	e	4135.000	6825.800	55	42	Madin		
AL16496.4	AL16496.4	BongoSB	42	37	36	6	12	307	s	4125.400	6819.400	51	47	Sibunka		
AL16496.5	AL16496.5	BongoSB	42	37	36	6	12	315	e	4125.200	6819.100	51	47	Sibunka		
AL16496.6	AL16496.6	Pump	18	37	36	6	12	320	s	4125.200	6818.900	51	50	Durbin		
AL16496.7	AL16496.7	MkVCTD	37	37	36	6	12	345	s	4125.200	6819.200	51	46	Mountain		
AL16496.8	AL16496.8	MOC1	40	37	36	6	12	359	s	4125.200	6819.400	54	46	Durbin		
AL16496.9	AL16496.9	MOC1	40	37	36	6	12	429	e	4124.600	6820.700	58	50	Durbin		
AL16496.10	AL16496.10	MOC10	36	37	36	6	12	442	s	4124.600	6820.500	58	36	Madin		
AL16496.11	AL16496.11	MOC10	36	37	36	6	12	509	e	4124.700	6819.800	58	36	Madin		
AL16496.12	AL16496.12	Drifter	5	37	36	6	12	517	s	4124.800	6819.600	53	10	Limeburner 23806		
AL16496.13	AL16496.13	BongoSB	43	38	37	6	12	706	s	4118.200	6835.700	70	64	Sibunka		
AL16496.14	AL16496.14	BongoSB	43	38	37	6	12	714	e	4118.500	6836.100	72	64	Sibunka		
AL16496.15	AL16496.15	MkVCTD	38	38	37	6	12	720	s	4118.800	6836.200	73	65	Mountain		
AL16496.16	AL16496.16	MOC1	41	38	37	6	12	732	s	4119.200	6836.100	75	69	Durbin		
AL16496.17	AL16496.17	MOC1	41	38	37	6	12	809	e	4119.100	6837.000	77	69	Durbin		
AL16496.18	AL16496.18	MOC10	37	38	37	6	12	821	s	4119.000	6837.200	76	66	Madin		
AL16496.19	AL16496.19	MOC10	37	38	37	6	12	902	e	4118.700	6838.000	76	66	Madin		

						L	O	C A L				Water	Cast			
		Instr	cast#	Sta#	Sta_std	Mth	Day	hhmm	s/e	Lat	Lon	Depth	Depth	PI	Region	Comments
AL16496.20	AL16496.20	BongoSB	44	39	38	6	12	1119	s	4129.100	6856.600	153	148	Sibunka		
AL16496.21	AL16496.21	BongoSB	44	39	38	6	12	1134	e	4129.300	6856.600	153	148	Sibunka		
AL16496.22	AL16496.22	BongoSB	45	39	38	6	12	1140	s	4129.400	6856.600	154	150	Weisbrod		too much phytoplankton to get clean sample
AL16496.23	AL16496.23	BongoSB	45	39	38	6	12	1155	e	4129.600	6856.800	155	150	Weisbrod		
AL16496.24	AL16496.24	Pump	19	39	38	6	12	1200	s	4129.600	6856.900	154	80	Durbin		
AL16496.25	AL16496.25	MkVCTD	39	39	38	6	12	1234	s	4128.900	6857.000	151	146	Mountain		
AL16496.26	AL16496.26	MOC1	42	39	38	6	12	1250	s	4128.200	6857.300	152	135	Durbin		
AL16496.27	AL16496.27	MOC1	42	39	38	6	12	1414	e	4127.900	6858.700	150	143	Durbin		
AL16496.28	AL16496.28	BongoSB	46	39	38	6	12	1437	s	4128.200	6858.900	153	100	Weisbrod		not enough copepods to make a good sample
AL16496.29	AL16496.29	BongoSB	46	39	38	6	12	1457	e	4128.900	6859.400	151	100	Weisbrod		
AL16496.30	AL16496.30	MOC10	38	39	38	6	12	1502	s	4128.900	6859.200	154	141	Madin		
AL16496.31	AL16496.31	MOC10	38	39	38	6	12	1554	e	4128.100	6857.400	154	141	Madin		
AL16496.32	AL16496.32	Ringnet	1	39	38	6	12	1627	s	4128.200	6857.400	151	100	Campbell		two vertical tows, changing cod ends in between
AL16496.33	AL16496.33	Ringnet	1	39	38	6	12	1647	e	4128.900	6857.200	153	100	Campbell		
AL16496.34	AL16496.34	BongoSB	47	39	38	6	12	1710	s	4129.500	6857.100	154	115	Weisbrod		
AL16496.35	AL16496.35	BongoSB	47	39	38	6	12	1750	e	4129.400	6859.100	154	115	Weisbrod		
AL16496.36	AL16496.36	Drifter	6	39	38	6	12	1755	s	4129.300	6859.200	154	40	Limeburner		ID 23807
AL16496.37	AL16496.37	Drifter	6	39	38	6	12	1756	s	4129.300	6859.100	154	10	Limeburner		ID 23811
AL16496.38	AL16496.38	BongoSB	48	40		6	12	2204	s	4118.900	6819.600	57	52	Wiebe		Looking for hydroids to place acoustic grid
AL16496.39	AL16496.39	BongoSB	48	40		6	12	2211	e	4118.800	6820.000	56	52	Wiebe		
AL16496.40	AL16496.40	BongoSB	49	41		6	12	2238	s	4118.000	6817.100	50		Wiebe		SBE cut out in mid-cast, probably battery
AL16496.41	AL16496.41	BongoSB	49	41		6	12	2242	e	4118.000	6817.000	50		Wiebe		hydroids found in modest numbers
AL16496.42	AL16496.42	MOC1	43	41		6	12	2256	s	4117.700	6817.700	55	51	Wiebe		tow to compare with acoustics and catch hydroids
AL16496.43	AL16496.43	MOC1	43	41		6	12	2306	e			55	51	Wiebe		
AL16496.44	AL16496.44	Pump	20	41		6	12	2327	s	4117.100	6818.000	51	40	Wiebe		looking for sand
AL16596.1	AL16596.1	Drogue	1	41		6	13	25	s	4116.700	6817.000		15	Wiebe		
AL16596.2	AL16596.2	Grid	1	41		6	13	47	s	4117.000	6816.600			Wiebe		begin acoustic grid
AL16596.3	AL16596.3	Grid	1	41		6	13	307	e	4114.100	6816.100	48		Wiebe		end acoustic grid
AL16596.4	AL16596.4	GreenB	6	41		6	13	330	e	4112.900	6816.400	42	2	Wiebe		recovery of Greene Bomber
AL16596.5	AL16596.5	Drogue	1	41		6	13	333	e	4112.900	6816.400	42	15	Wiebe		recovery of drogue
AL16596.6	AL16596.6	Arrive				6	13	1400	e	4131.540	7040.490	8		Mountain		arrive Woods Hole, end of cruise

APPENDIX C.

Plots and compressed listings of CTD data.

ALB9607 Standard Sta #: 001
Cast #: 001 Date(y\m\d): 96\6\4
Lat: 41 .4 N Hour (GMT): 4.9
Lon: 68 59. W Bottom depth: 78

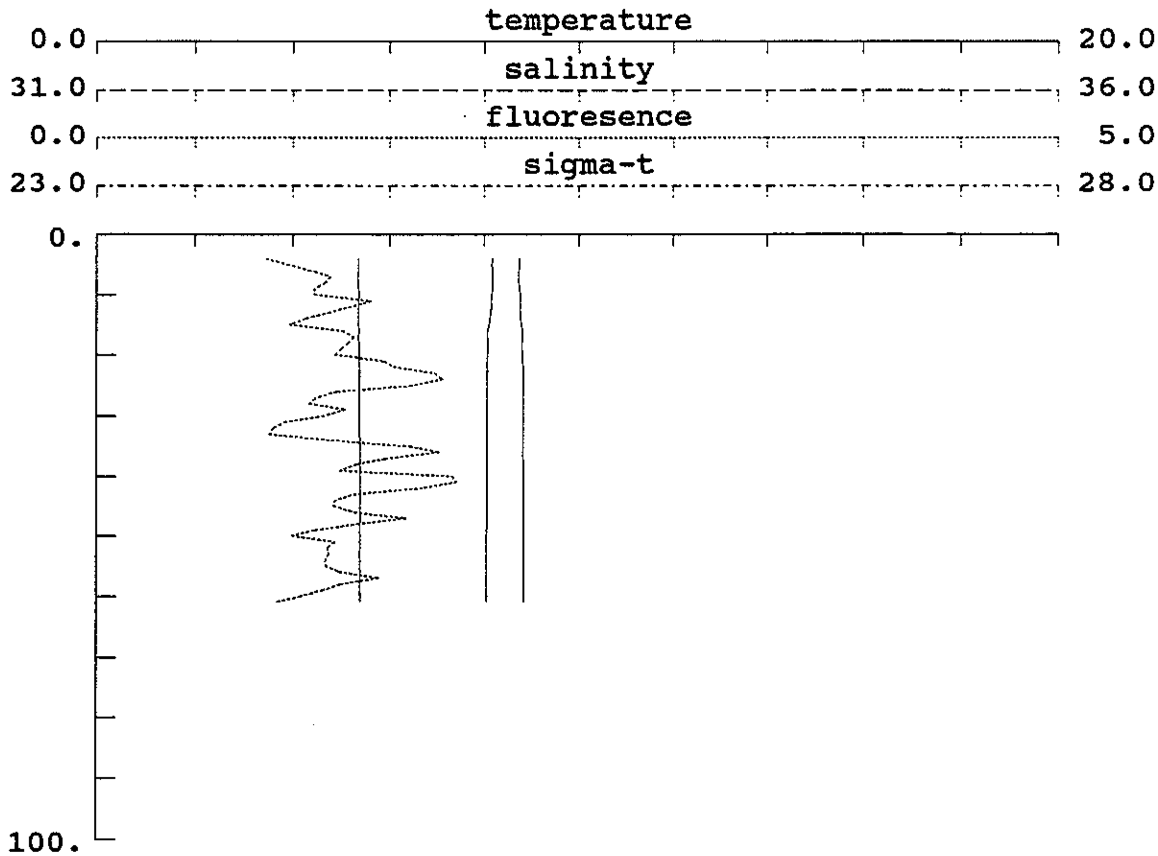


Depth	Temp	Salt	Flur	Sigma-t
2.00	7.47	32.25	1.13	25.22
5.00	7.48	32.25	1.06	25.22
10.00	7.47	32.25	1.06	25.22
15.00	7.46	32.25	1.21	25.22
20.00	7.47	32.25	1.35	25.22
25.00	7.47	32.26	0.85	25.22
30.00	7.46	32.25	0.97	25.22
40.00	7.47	32.26	0.93	25.22
50.00	7.47	32.26	1.06	25.22
70.00	7.46	32.25	0.97	25.22

[** Note: this is uncorrected data **]

ALB9607
Cast #: 002
Lat: 40 38.4 N
Lon: 69 1.8 W

Standard Sta #: 002
Date(y\m\d): 96\6\4
Hour (GMT): 11.8
Bottom depth: 67

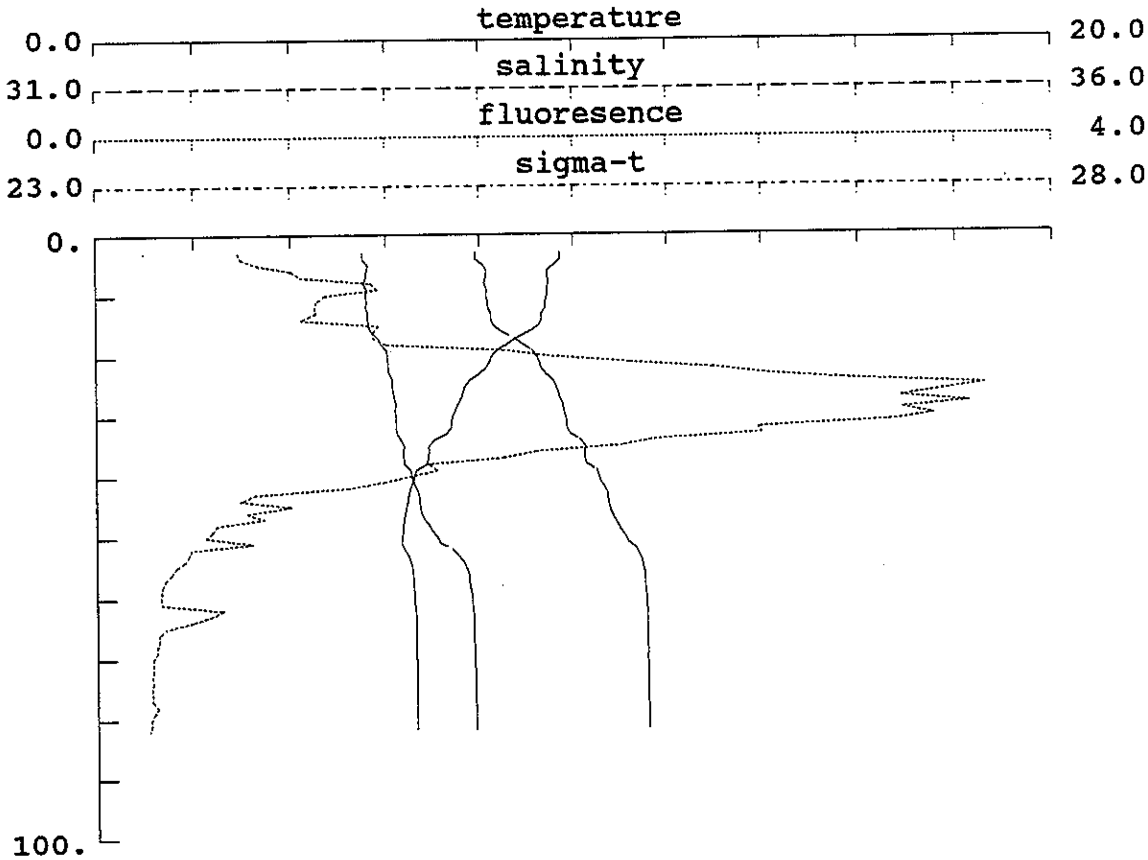


Depth	Temp	Salt	Flur	Sigma-t
4.00	8.17	32.34	0.86	25.18
5.00	8.16	32.34	0.97	25.18
10.00	8.16	32.34	1.11	25.19
15.00	8.11	32.34	0.98	25.19
20.00	8.07	32.34	1.21	25.20
25.00	8.07	32.34	1.61	25.20
30.00	8.07	32.34	1.16	25.20
40.00	8.07	32.35	1.83	25.21
50.00	8.05	32.35	1.00	25.21
61.00	8.06	32.35	0.91	25.21

[** Note: this is uncorrected data **]

ALB9607
Cast #: 003
Lat: 40 31.8 N
Lon: 68 26.6 W

Standard Sta #: 003
Date(y\m\d): 96\6\4
Hour (GMT): 19.
Bottom depth: 89

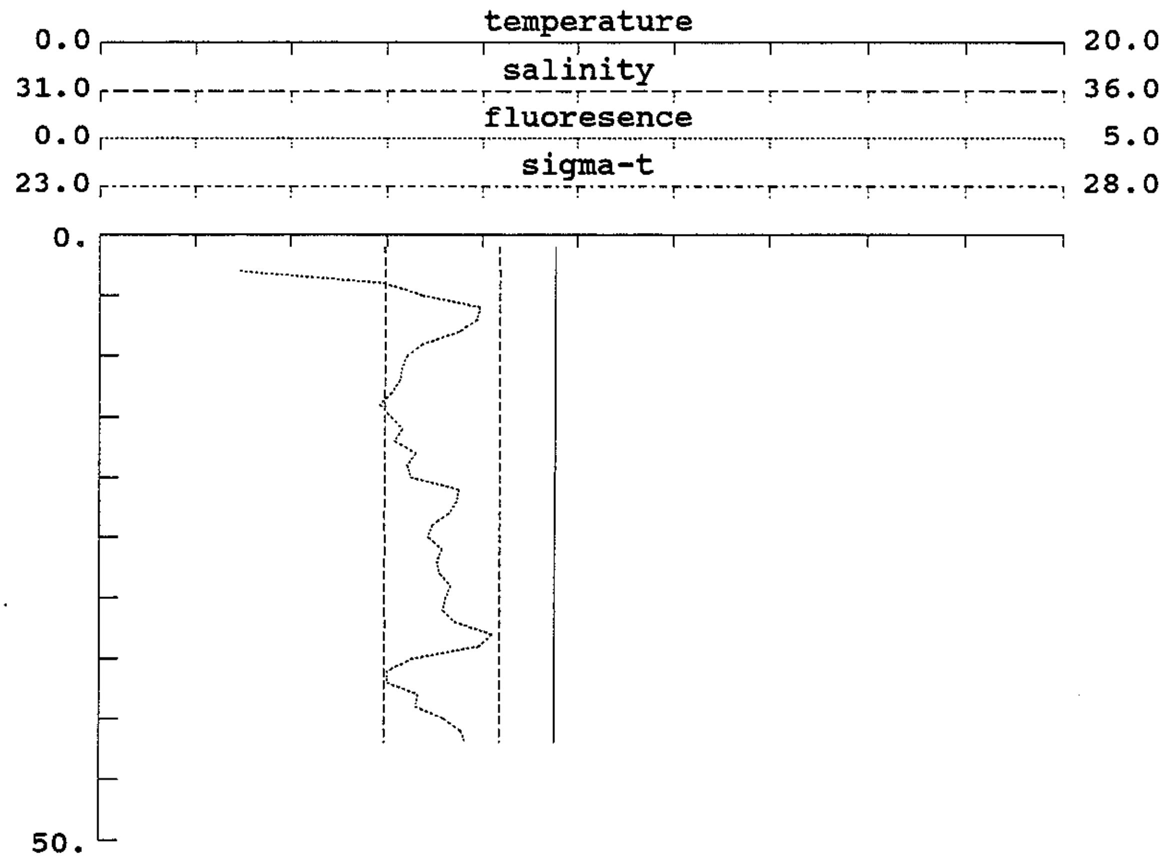


Depth	Temp	Salt	Flur	Sigma-t
3.00	9.70	32.38	0.58	24.98
5.00	9.60	32.41	0.66	25.02
10.00	9.44	32.40	0.95	25.03
15.00	9.25	32.41	1.17	25.08
20.00	8.25	32.51	1.89	25.30
25.00	7.69	32.53	3.72	25.41
30.00	7.42	32.55	3.51	25.46
40.00	6.60	32.63	1.31	25.63
50.00	6.34	32.77	0.45	25.77
75.00	6.63	32.97	0.22	25.89
82.00	6.63	32.97	0.21	25.89

[** Note: this is uncorrected data **]

ALB9607
Cast #: 004
Lat: 41 .3 N
Lon: 68 16.4 W

Standard Sta #: 004
Date(y\m\d): 96\6\5
Hour (GMT): 1.8
Bottom depth: 47

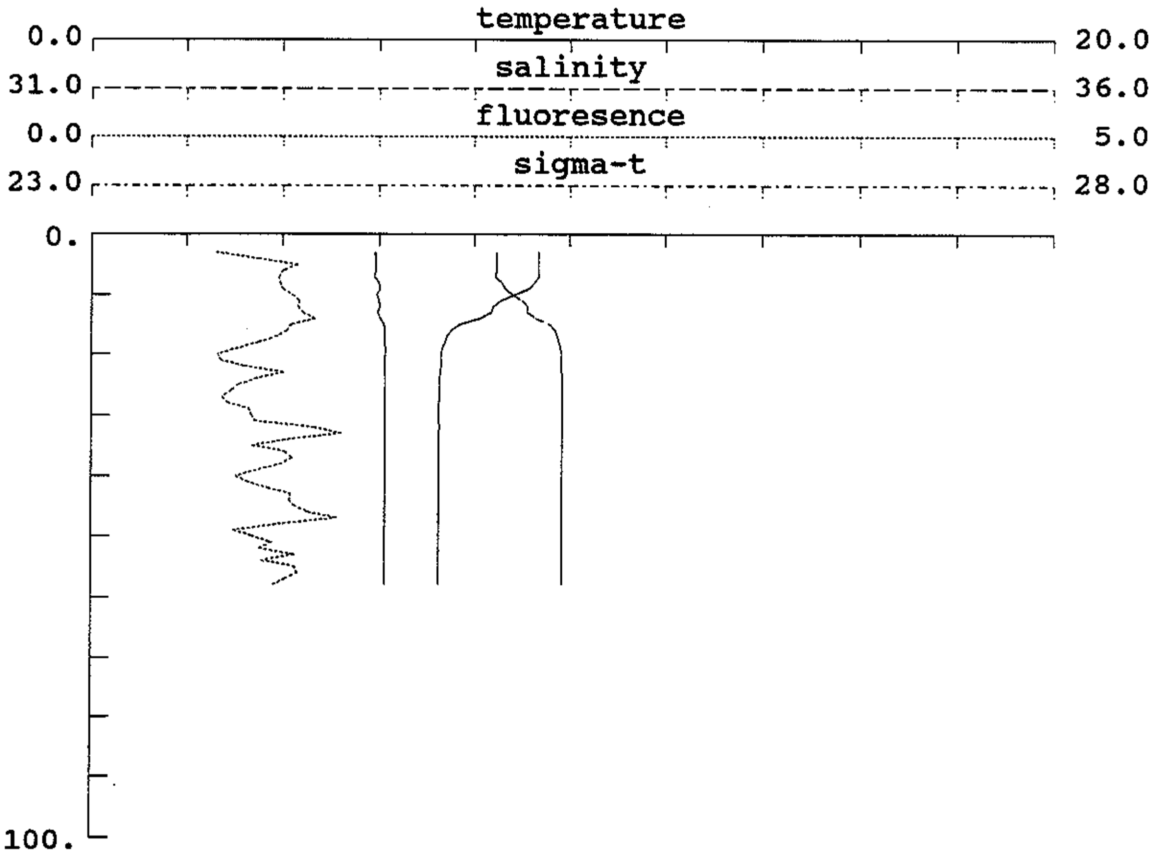


Depth	Temp	Salt	Flur	Sigma-t
1.00	9.55	32.49	0.03	25.09
5.00	9.55	32.49	1.68	25.09
10.00	9.55	32.49	1.61	25.09
15.00	9.54	32.49	1.52	25.09
20.00	9.54	32.49	1.63	25.09
25.00	9.54	32.49	1.72	25.09
30.00	9.53	32.49	1.81	25.09
40.00	9.53	32.49	1.80	25.09
42.00	9.53	32.49	1.92	25.09

[** Note: this is uncorrected data **]

ALB9607
Cast #: 005
Lat: 40 50.6 N
Lon: 68 .6 W

Standard Sta #: 005
Date(y\m\d): 96\6\5
Hour (GMT): 6.6
Bottom depth: 63

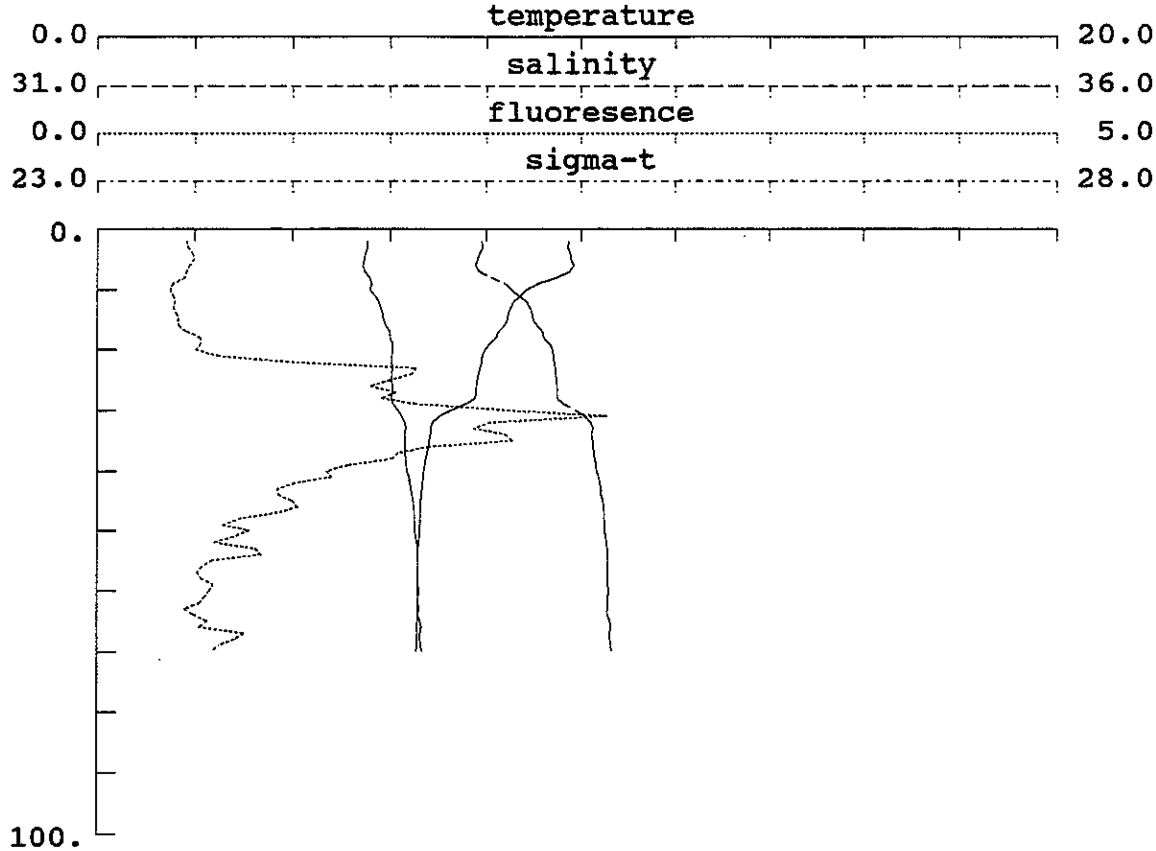


Depth	Temp	Salt	Flur	Sigma-t
3.00	9.34	32.48	0.65	25.12
5.00	9.34	32.48	1.07	25.12
10.00	8.85	32.49	1.05	25.20
15.00	7.70	32.53	1.04	25.40
20.00	7.30	32.53	0.66	25.46
25.00	7.28	32.53	0.77	25.46
30.00	7.27	32.53	0.84	25.46
40.00	7.27	32.53	0.76	25.46
50.00	7.27	32.53	0.84	25.46
58.00	7.26	32.53	0.95	25.46

[** Note: this is uncorrected data **]

ALB9607
Cast #: 006
Lat: 40 39.6 N
Lon: 67 46.4 W

Standard Sta #: 006
Date(y\m\d): 96\6\5
Hour (GMT): 9.7
Bottom depth: 76

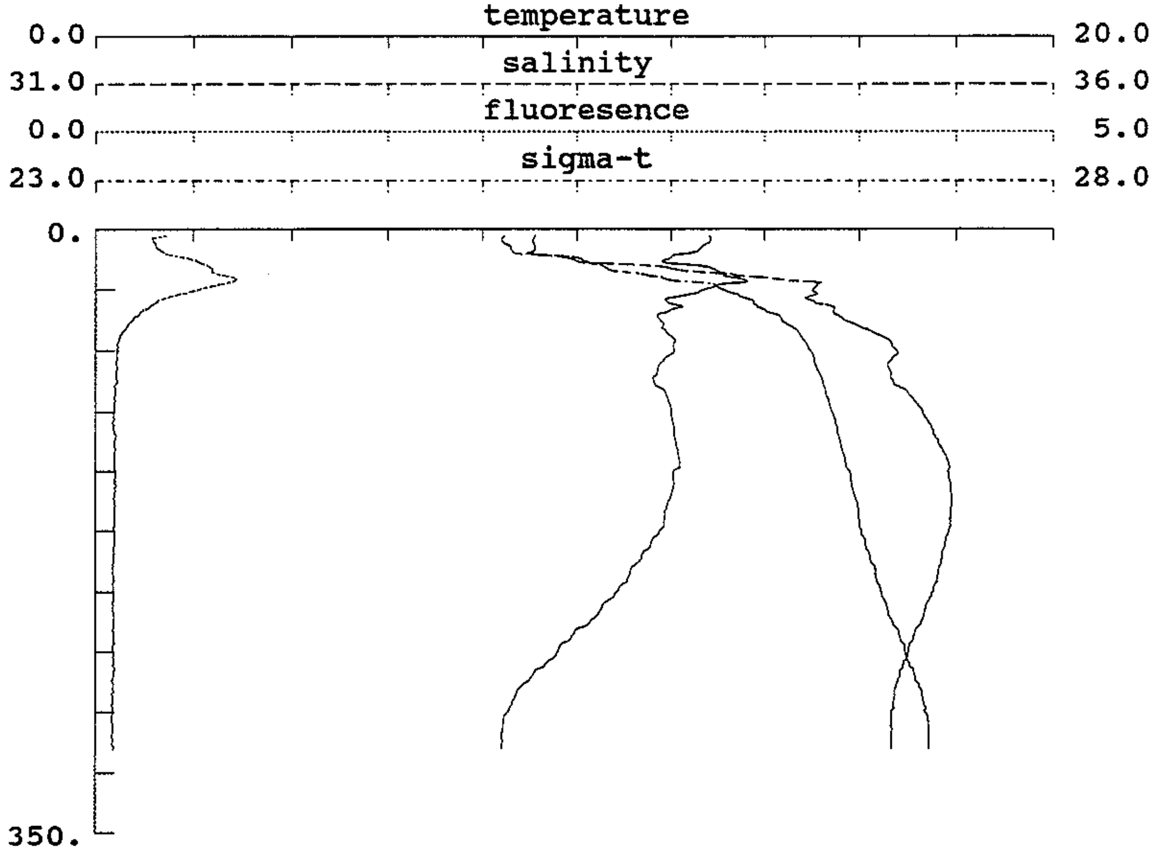


Depth	Temp	Salt	Flur	Sigma-t
2.00	9.73	32.38	0.46	24.98
5.00	9.79	32.37	0.50	24.95
10.00	8.84	32.40	0.38	25.13
15.00	8.44	32.47	0.42	25.24
20.00	7.98	32.51	0.51	25.35
25.00	7.82	32.51	1.50	25.37
30.00	7.25	32.54	2.11	25.47
40.00	6.71	32.59	1.17	25.58
50.00	6.62	32.63	0.78	25.63
70.00	6.54	32.67	0.58	25.66

[** Note: this is uncorrected data **]

ALB9607
Cast #: 007
Lat: 40 26.3 N
Lon: 67 18.2 W

Standard Sta #: 007
Date(y\m\d): 96\6\5
Hour (GMT): 16.7
Bottom depth: 350

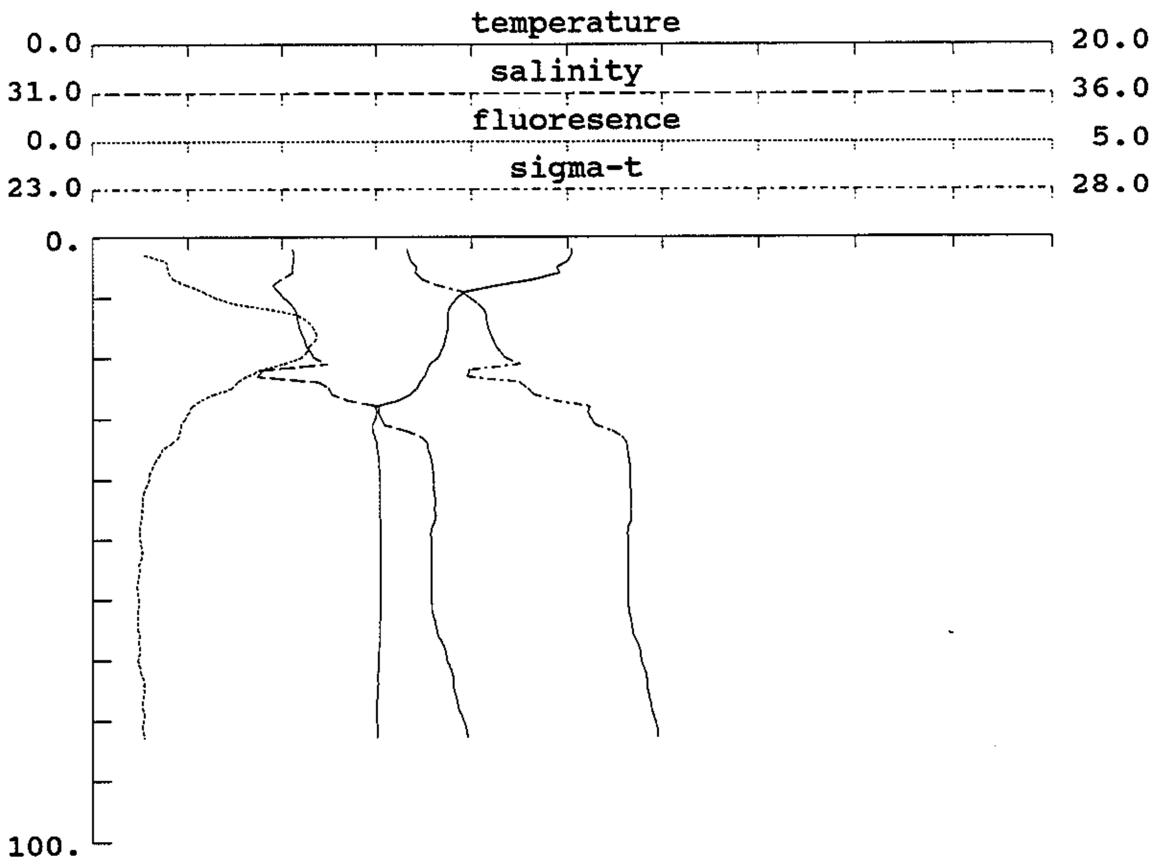


Depth	Temp	Salt	Flur	Sigma-t
3.00	12.84	33.28	0.41	25.11
5.00	12.85	33.27	0.29	25.11
10.00	12.68	33.28	0.31	25.15
15.00	12.06	33.31	0.38	25.29
20.00	12.00	33.66	0.54	25.57
25.00	13.01	34.15	0.60	25.75
30.00	13.62	34.64	0.71	26.01
40.00	11.93	34.72	0.35	26.40
50.00	11.71	34.90	0.22	26.58
75.00	11.85	35.17	0.11	26.77
100.00	11.96	35.30	0.10	26.84
150.00	12.05	35.47	0.10	26.97
200.00	11.14	35.41	0.09	27.09
250.00	9.45	35.25	0.10	27.26
300.00	8.42	35.17	0.10	27.36
302.00	8.41	35.17	0.10	27.36

[** Note: this is uncorrected data **]

ALB9607
Cast #: 008
Lat: 40 51.5 N
Lon: 67 3.1 W

Standard Sta #: 008
Date(y\m\d): 96\6\6
Hour (GMT): 1.2
Bottom depth: 90

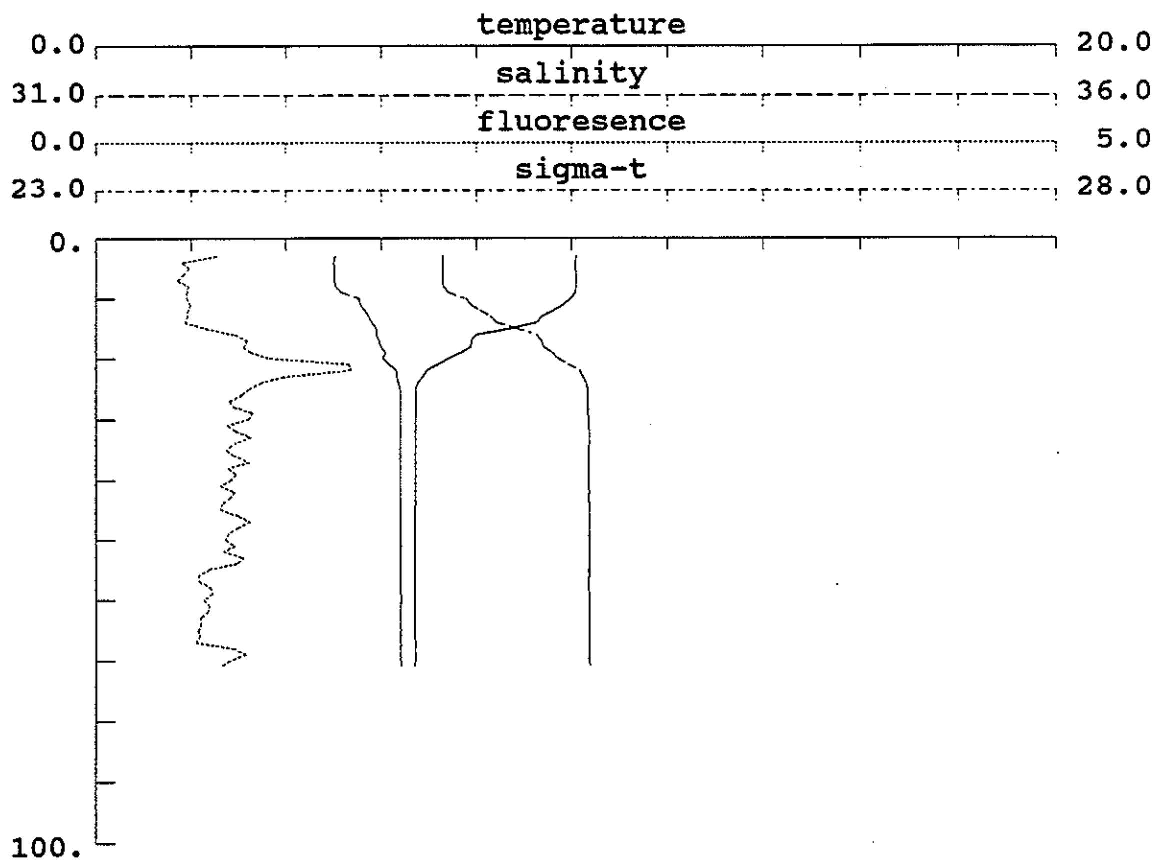


Depth	Temp	Salt	Flur	Sigma-t
2.00	10.08	32.06	0.02	24.66
5.00	9.78	32.05	0.39	24.71
10.00	7.70	32.01	0.64	24.99
15.00	7.50	32.09	1.17	25.09
20.00	7.30	32.17	1.10	25.18
25.00	6.86	32.25	0.73	25.30
30.00	5.99	32.53	0.48	25.63
40.00	6.08	32.80	0.30	25.83
50.00	6.09	32.79	0.25	25.82
75.00	6.03	32.91	0.27	25.92
83.00	6.03	32.98	0.28	25.98

[** Note: this is uncorrected data **]

ALB9607
Cast #: 009
Lat: 40 57.7 N
Lon: 67 17.5 W

Standard Sta #: 009
Date(y\m\d): 96\6\6
Hour (GMT): 6.8
Bottom depth: 76

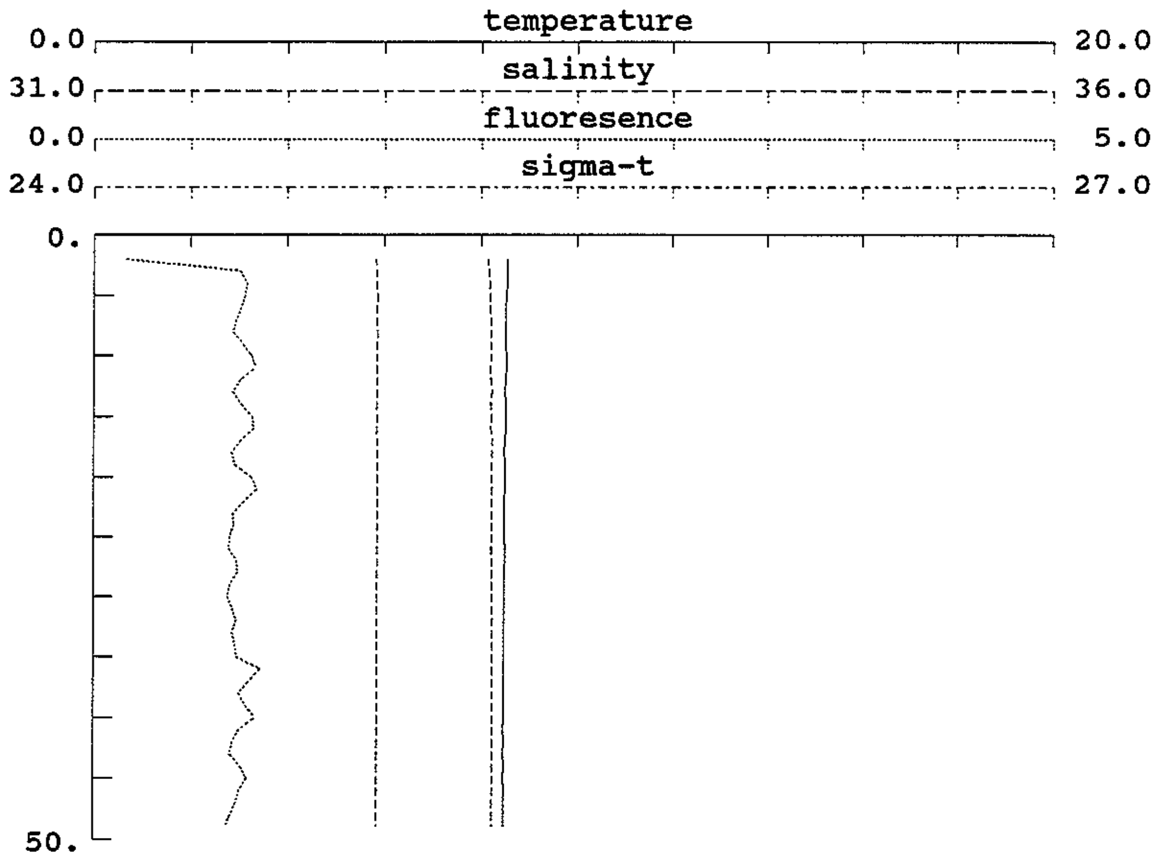


Depth	Temp	Salt	Flur	Sigma-t
3.00	10.09	32.26	0.63	24.82
5.00	10.09	32.26	0.49	24.82
10.00	9.97	32.39	0.48	24.94
15.00	8.73	32.48	0.58	25.21
20.00	7.41	32.51	0.92	25.42
25.00	6.73	32.60	0.81	25.59
30.00	6.72	32.60	0.80	25.59
40.00	6.72	32.60	0.71	25.59
50.00	6.71	32.60	0.68	25.59
71.00	6.71	32.61	0.66	25.60

[** Note: this is uncorrected data **]

ALB9607
Cast #: 010
Lat: 41 4.3 N
Lon: 67 39.4 W

Standard Sta #: 010
Date(y\m\d): 96\6\6
Hour (GMT): 11.1
Bottom depth: 56

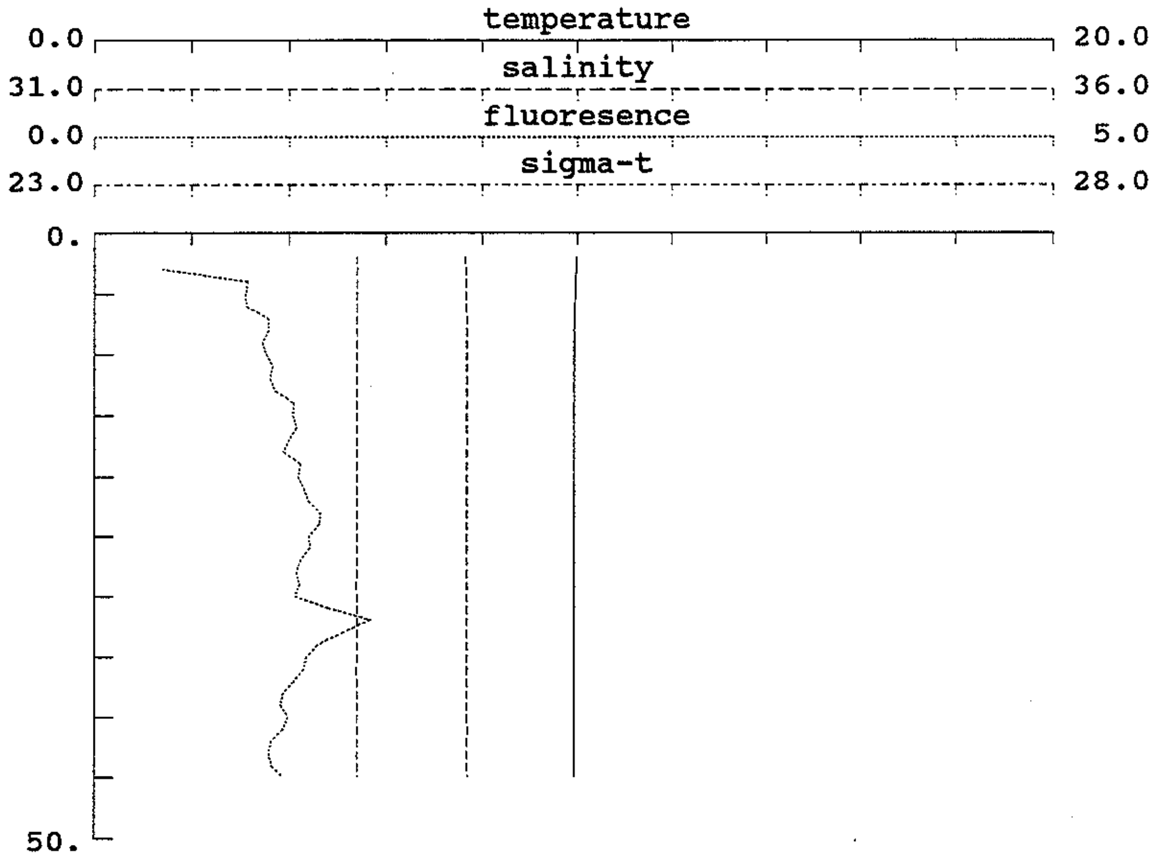


Depth	Temp	Salt	Flur	Sigma-t
2.00	8.54	32.45	0.17	25.22
5.00	8.52	32.46	0.78	25.23
10.00	8.51	32.46	0.81	25.23
15.00	8.50	32.46	0.82	25.23
20.00	8.49	32.46	0.81	25.23
25.00	8.49	32.46	0.71	25.23
30.00	8.48	32.46	0.69	25.23
40.00	8.47	32.46	0.83	25.24
49.00	8.48	32.46	0.68	25.24

[** Note: this is uncorrected data **]

ALB9607
Cast #: 011
Lat: 41 13.8 N
Lon: 67 57.8 W

Standard Sta #: 011
Date(y\m\d): 96\6\6
Hour (GMT): 14.6
Bottom depth: 50

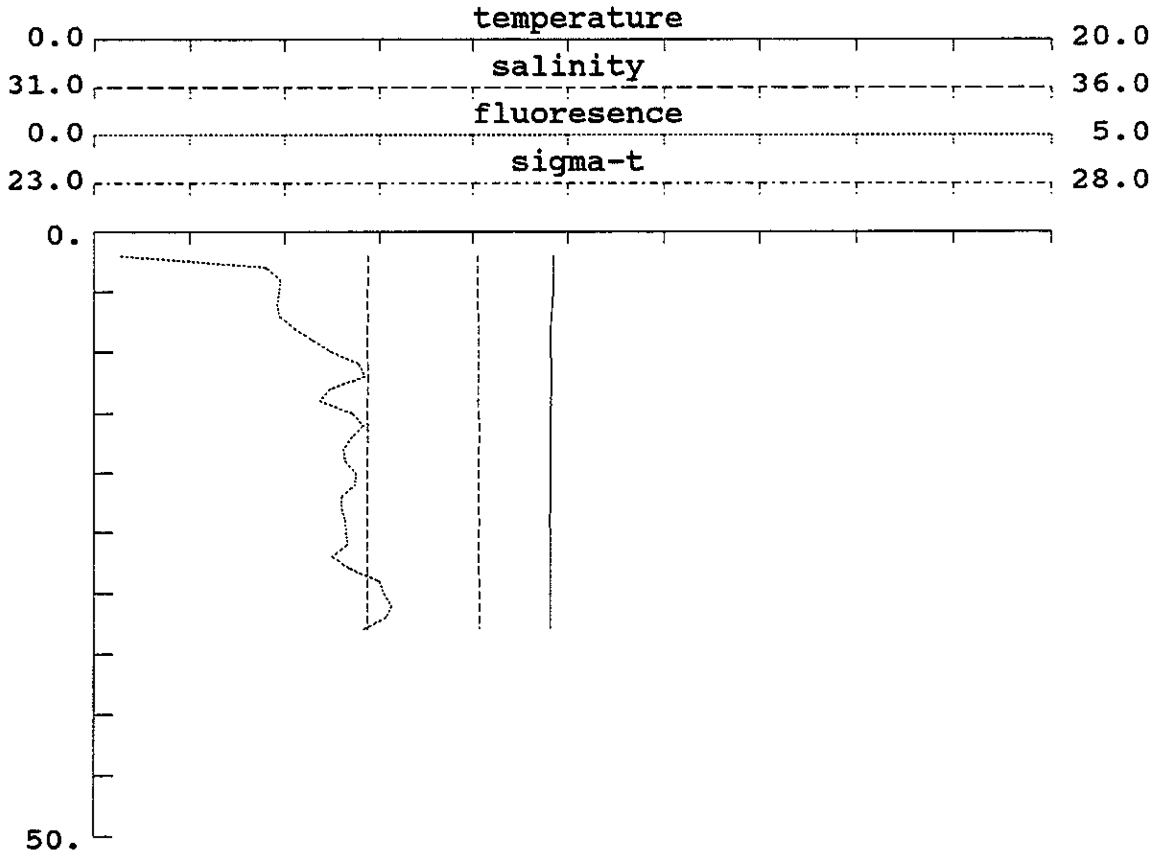


Depth	Temp	Salt	Flur	Sigma-t
2.00	9.98	32.35	0.04	24.91
5.00	9.96	32.35	0.78	24.92
10.00	9.94	32.35	0.88	24.92
15.00	9.93	32.35	1.02	24.92
20.00	9.93	32.35	1.05	24.92
25.00	9.93	32.35	1.11	24.92
30.00	9.93	32.35	1.03	24.92
40.00	9.93	32.35	0.99	24.92
45.00	9.93	32.36	0.97	24.92

[** Note: this is uncorrected data **]

ALB9607
Cast #: 012
Lat: 41 25.4 N
Lon: 67 30.6 W

Standard Sta #: 012
Date(y\m\d): 96\6\6
Hour (GMT): 19.4
Bottom depth: 38

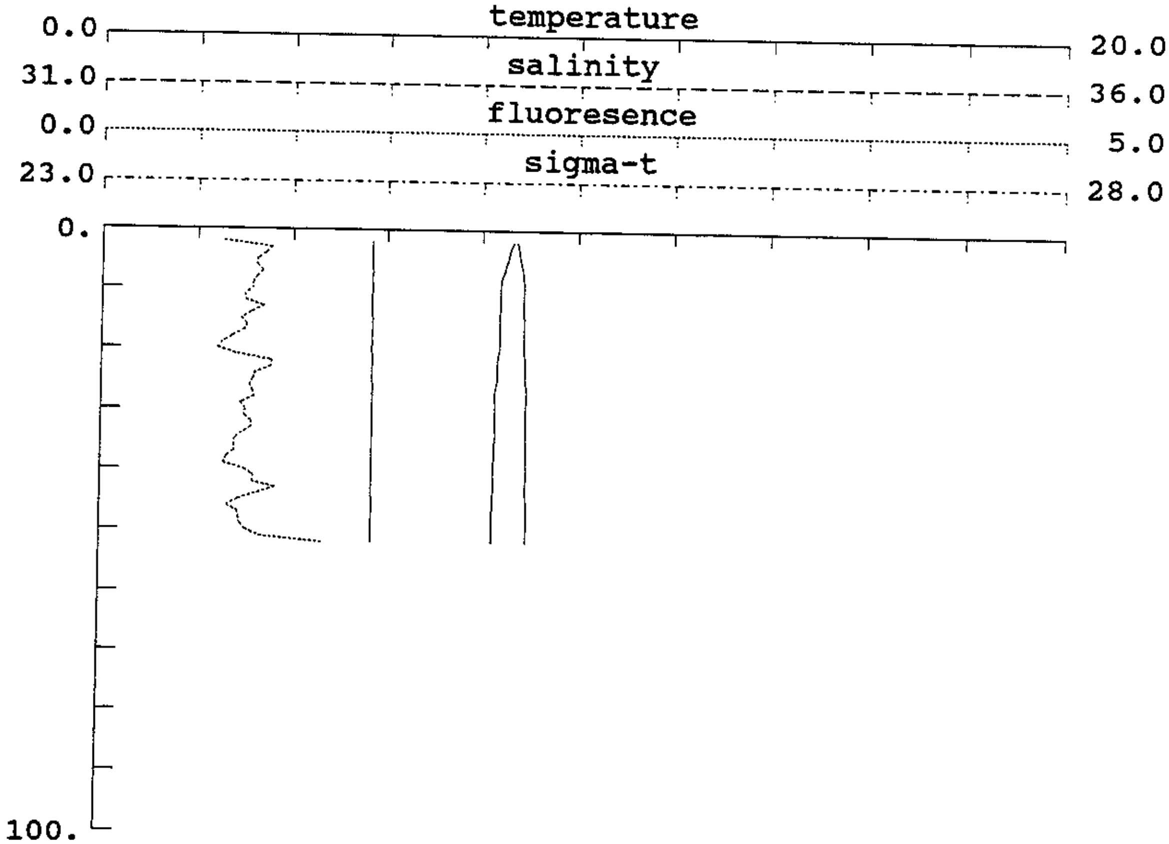


Depth	Temp	Salt	Flur	Sigma-t
2.00	9.69	32.44	0.14	25.03
5.00	9.70	32.44	0.97	25.03
10.00	9.64	32.44	1.25	25.03
15.00	9.64	32.44	1.36	25.03
20.00	9.64	32.44	1.37	25.03
25.00	9.63	32.44	1.33	25.03
30.00	9.64	32.44	1.53	25.04
33.00	9.64	32.44	1.42	25.04

[** Note: this is uncorrected data **]

ALB9607
Cast #: 013
Lat: 41 14.7 N
Lon: 67 10.6 W

Standard Sta #: 013
Date(y\m\d): 96\6\6
Hour (GMT): 23.4
Bottom depth: 56

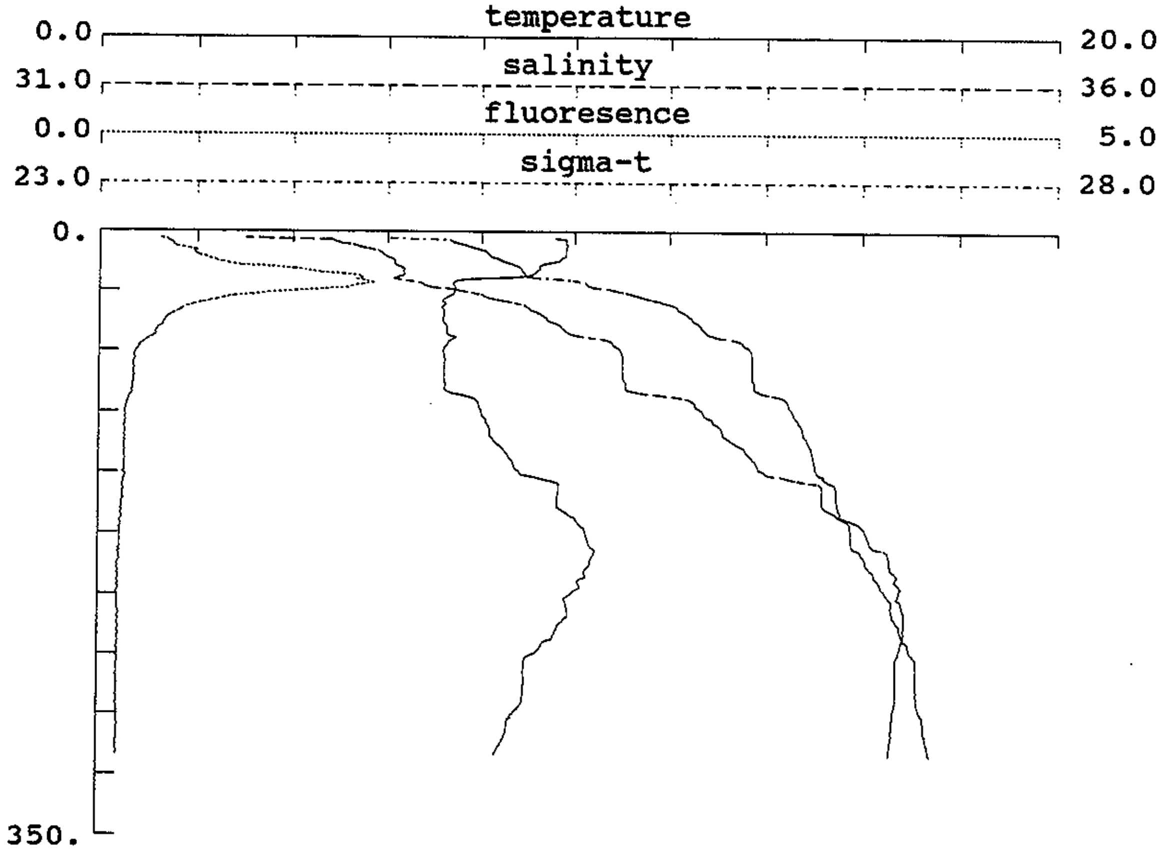


Depth	Temp	Salt	Flur	Sigma-t
1.00	8.63	32.41	0.65	25.17
5.00	8.51	32.42	0.81	25.20
10.00	8.38	32.42	0.79	25.22
15.00	8.37	32.42	0.72	25.22
20.00	8.37	32.42	0.61	25.22
25.00	8.33	32.42	0.79	25.23
30.00	8.30	32.43	0.75	25.23
40.00	8.27	32.43	0.75	25.24
50.00	8.26	32.43	0.76	25.24
52.00	8.26	32.43	1.17	25.24

[** Note: this is uncorrected data **]

ALB9607
Cast #: 016
Lat: 40 54.8 N
Lon: 66 26.7 W

Standard Sta #: 016
Date(y\m\d): 96\6\7
Hour (GMT): 11.5
Bottom depth: 1000

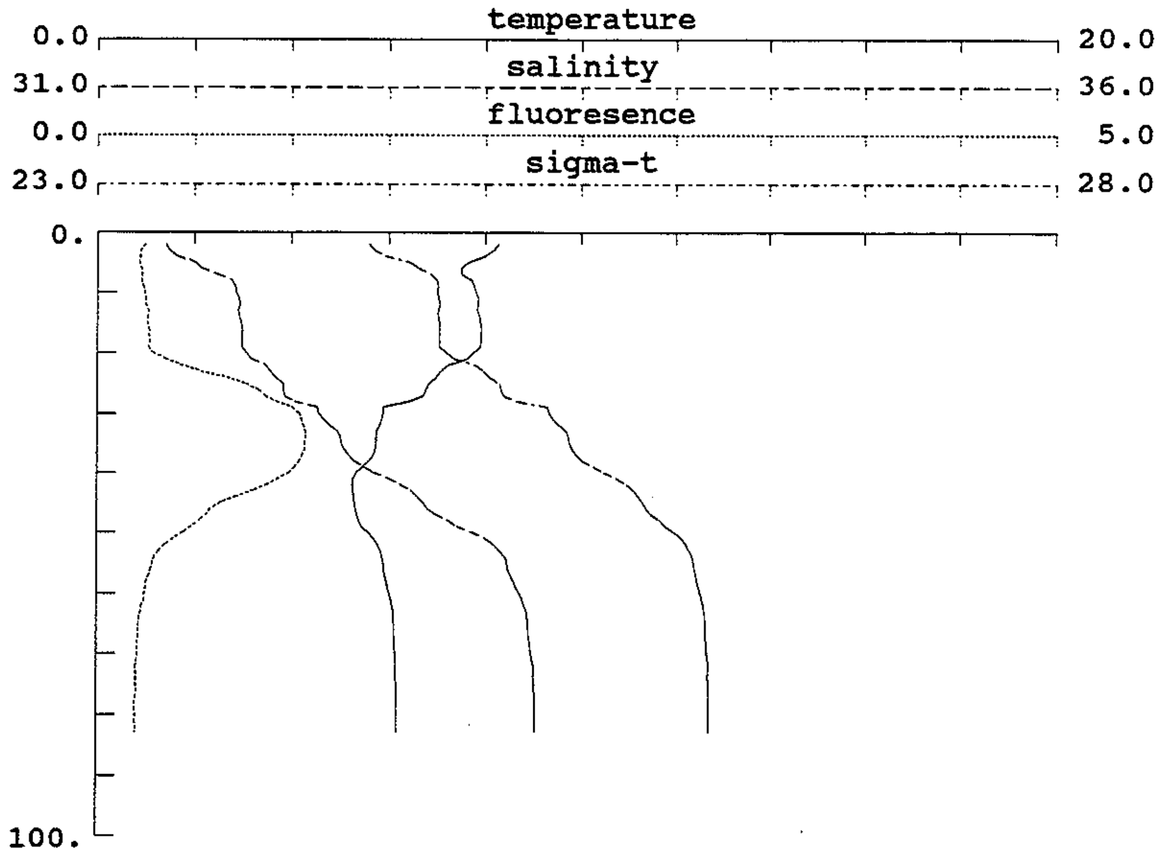


Depth	Temp	Salt	Flur	Sigma-t
2.00	9.65	31.70	-0.01	24.46
5.00	9.81	32.21	0.35	24.83
10.00	9.81	32.40	0.46	24.97
15.00	9.78	32.49	0.54	25.05
20.00	9.26	32.55	0.73	25.18
25.00	9.13	32.59	1.27	25.23
30.00	7.40	32.67	1.43	25.56
40.00	7.18	33.08	0.60	25.91
50.00	7.19	33.34	0.35	26.11
75.00	7.22	33.76	0.18	26.43
100.00	7.96	34.14	0.14	26.62
150.00	9.68	34.80	0.12	26.87
200.00	10.26	35.19	0.10	27.07
250.00	8.97	35.19	0.10	27.29
300.00	8.42	35.16	0.10	27.35
304.00	8.36	35.16	0.10	27.36

[** Note: this is uncorrected data **]

ALB9607
Cast #: 017
Lat: 41 13.7 N
Lon: 66 27.7 W

Standard Sta #: 017
Date(y\m\d): 96\6\7
Hour (GMT): 21.1
Bottom depth: 91

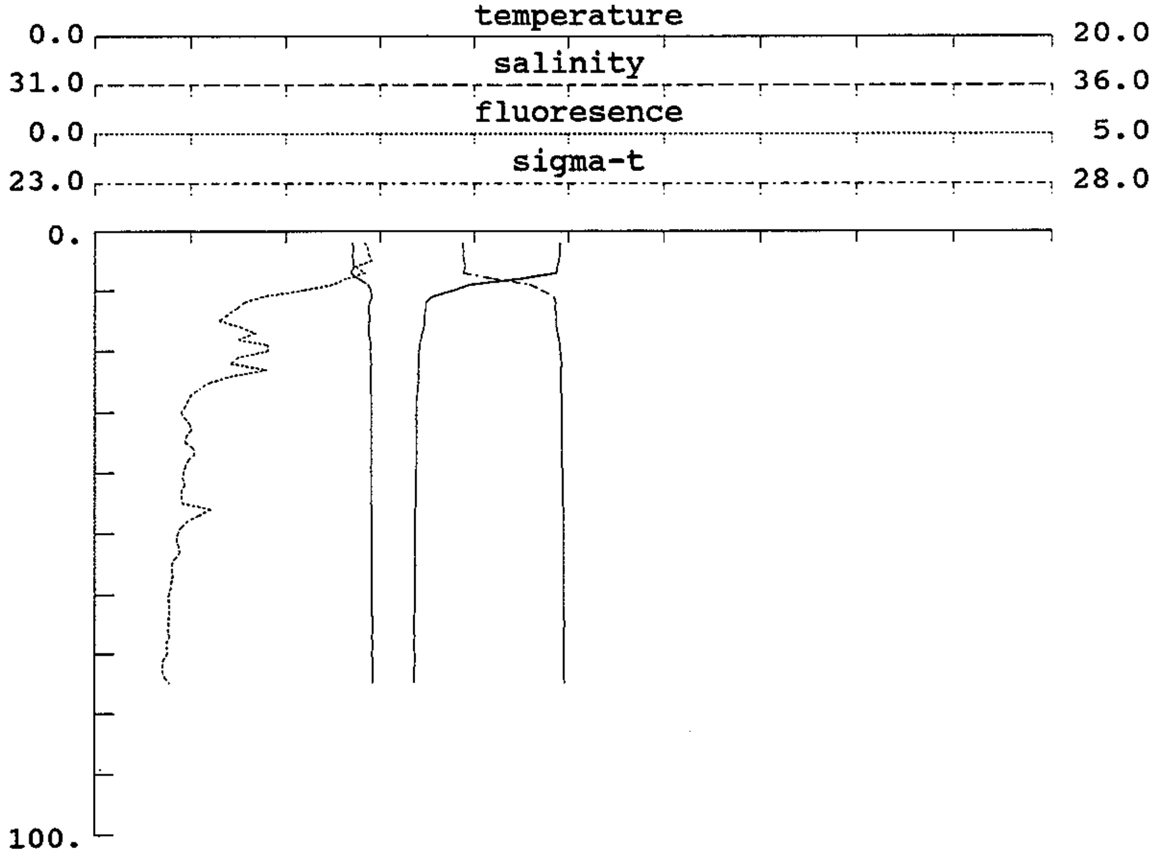


Depth	Temp	Salt	Flur	Sigma-t
2.00	8.27	31.35	0.24	24.40
5.00	7.65	31.50	0.22	24.60
10.00	7.79	31.71	0.24	24.75
15.00	7.90	31.74	0.26	24.76
20.00	7.74	31.77	0.29	24.80
25.00	6.81	31.96	0.77	25.08
30.00	5.89	32.14	1.04	25.33
40.00	5.34	32.42	0.99	25.62
50.00	5.58	32.93	0.44	26.00
75.00	6.17	33.26	0.20	26.18
83.00	6.18	33.26	0.20	26.18

[** Note: this is uncorrected data **]

ALB9607
Cast #: 018
Lat: 41 23.3 N
Lon: 66 41.4 W

Standard Sta #: 018
Date(y\m\d): 96\6\8
Hour (GMT): 2.5
Bottom depth: 82

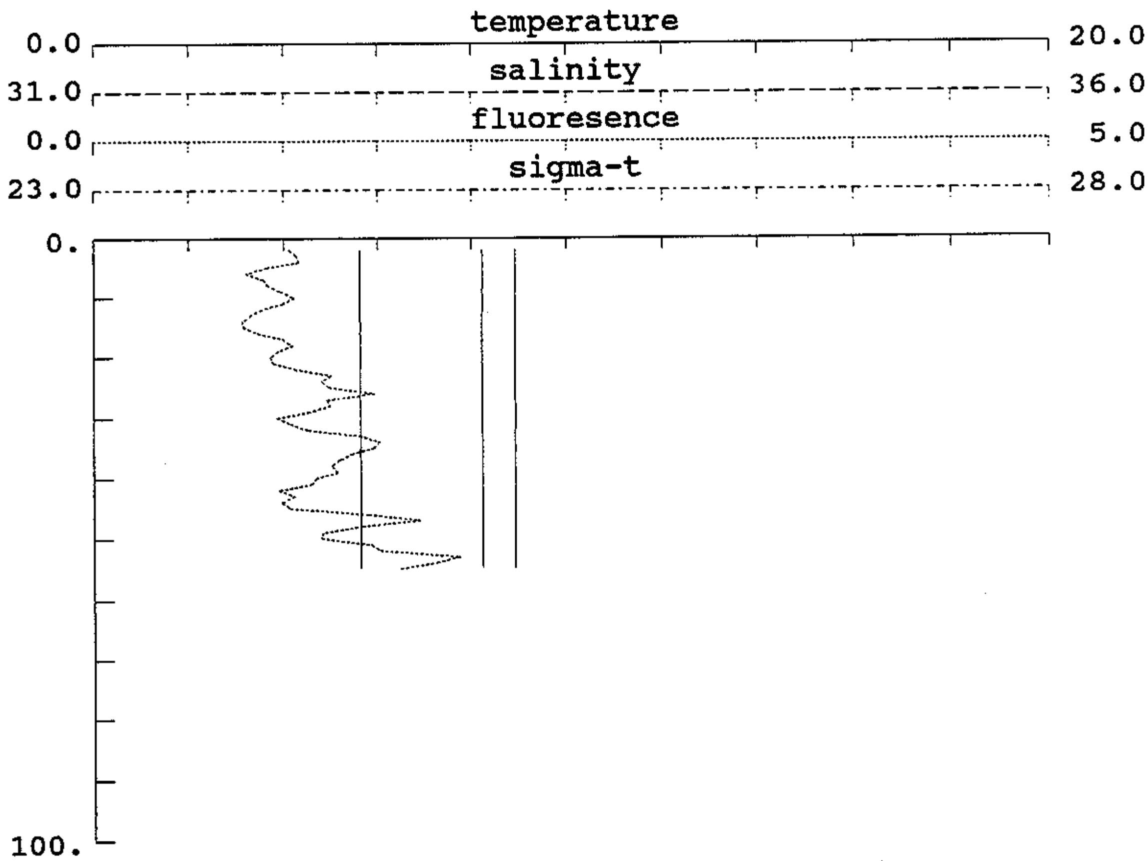


Depth	Temp	Salt	Flur	Sigma-t
2.00	9.82	32.35	1.42	24.94
5.00	9.80	32.36	1.46	24.95
10.00	7.57	32.45	1.09	25.36
15.00	6.95	32.44	0.65	25.44
20.00	6.83	32.45	0.91	25.46
25.00	6.81	32.45	0.60	25.46
30.00	6.78	32.45	0.45	25.47
40.00	6.76	32.45	0.46	25.47
50.00	6.74	32.46	0.43	25.47
75.00	6.72	32.46	0.39	25.48
75.00	6.72	32.46	0.39	25.48

[** Note: this is uncorrected data **]

ALB9607
Cast #: 019
Lat: 41 36.4 N
Lon: 66 59.2 W

Standard Sta #: 019
Date(y\m\d): 96\6\8
Hour (GMT): 8.4
Bottom depth: 60

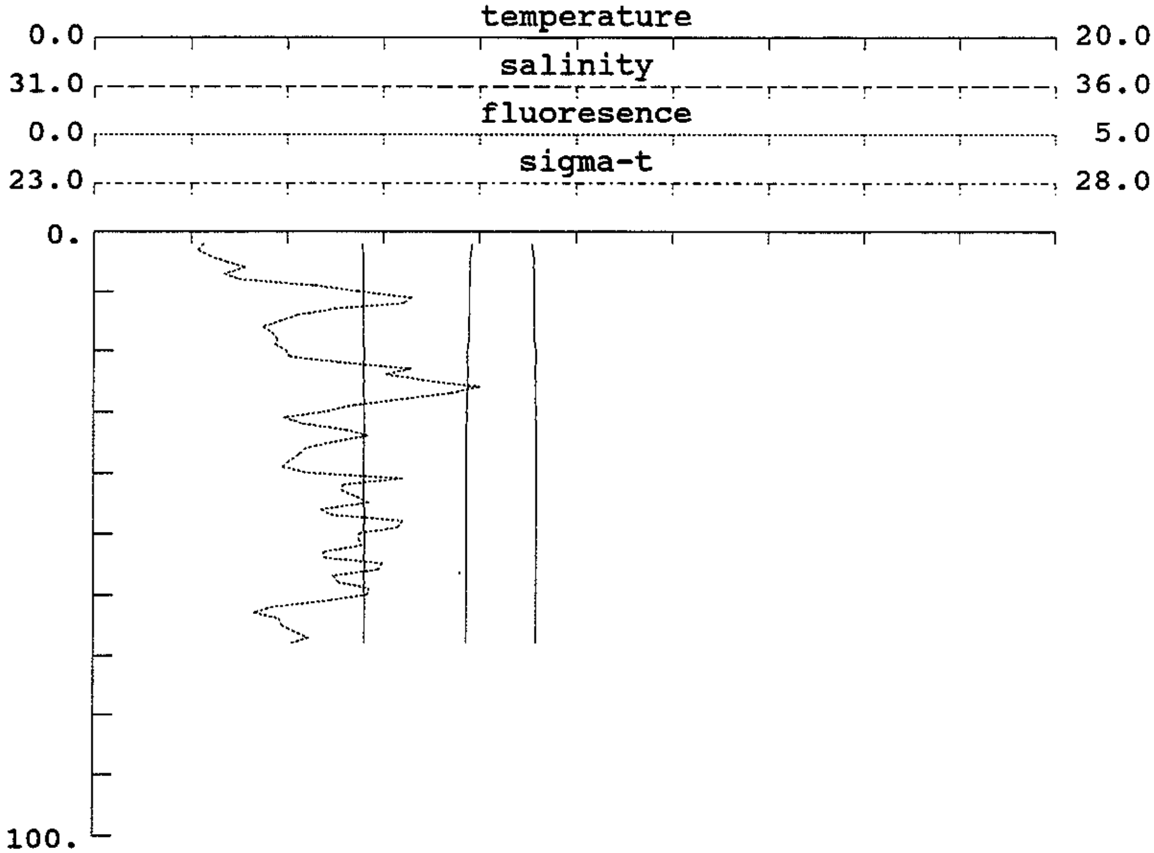


Depth	Temp	Salt	Flur	Sigma-t
2.00	8.22	32.41	1.03	25.23
5.00	8.22	32.41	0.91	25.23
10.00	8.22	32.41	1.06	25.23
15.00	8.22	32.41	0.79	25.23
20.00	8.22	32.41	0.93	25.23
25.00	8.22	32.41	1.24	25.23
30.00	8.22	32.41	0.96	25.23
40.00	8.22	32.41	1.17	25.23
50.00	8.23	32.41	1.20	25.23
55.00	8.23	32.41	1.62	25.23

[** Note: this is uncorrected data **]

ALB9607
Cast #: 020
Lat: 41 42.9 N
Lon: 66 31.5 W

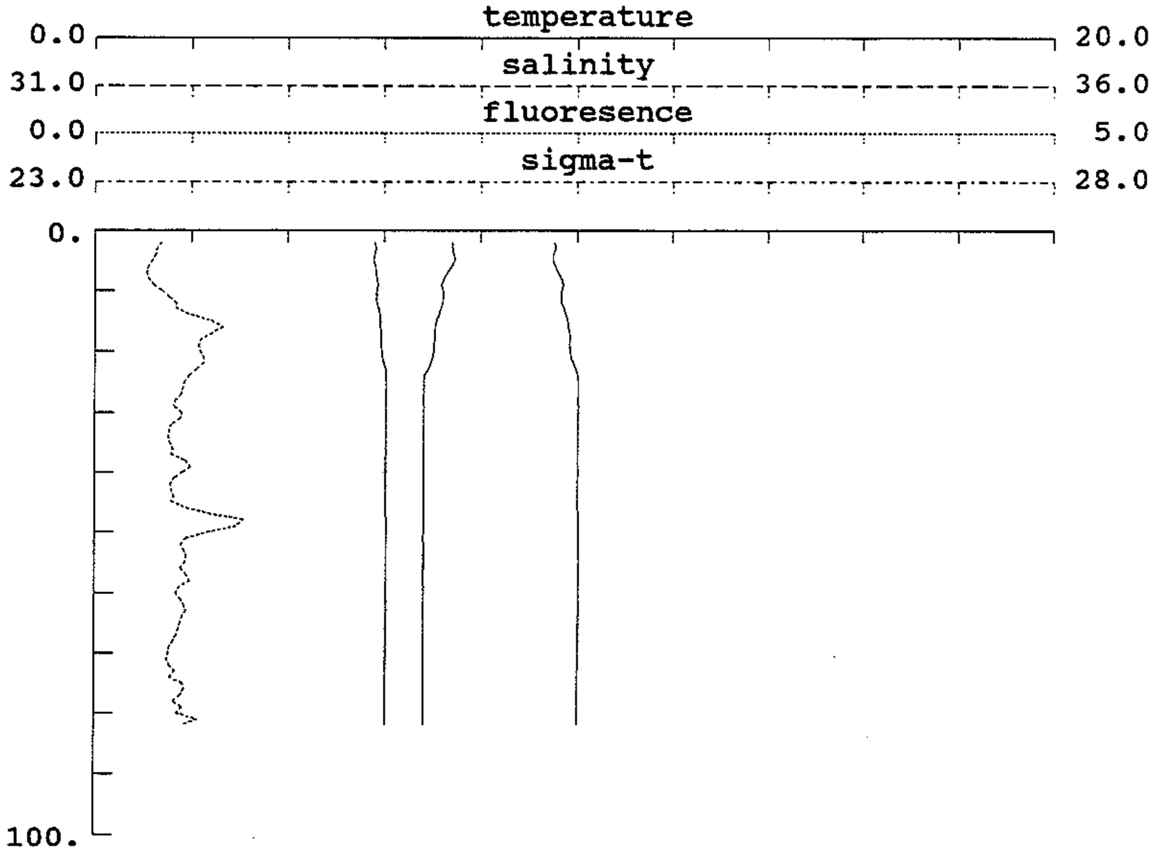
Standard Sta #: 020
Date(y\m\d): 96\6\8
Hour (GMT): 13.3
Bottom depth: 75



Depth	Temp	Salt	Flur	Sigma-t
2.00	7.85	32.39	0.56	25.27
5.00	7.81	32.40	0.68	25.28
10.00	7.80	32.40	1.37	25.28
15.00	7.79	32.40	0.97	25.28
20.00	7.76	32.40	1.00	25.29
25.00	7.76	32.40	1.73	25.29
30.00	7.75	32.40	1.20	25.30
40.00	7.74	32.41	1.11	25.30
50.00	7.75	32.41	1.38	25.30
68.00	7.75	32.41	1.02	25.30

[** Note: this is uncorrected data **]

ALB9607 | Standard Sta #: 021
Cast #: 021 | Date(y\m\d): 96\6\8
Lat: 41 34.1 N | Hour (GMT): 17.
Lon: 66 26.5 W | Bottom depth: 89

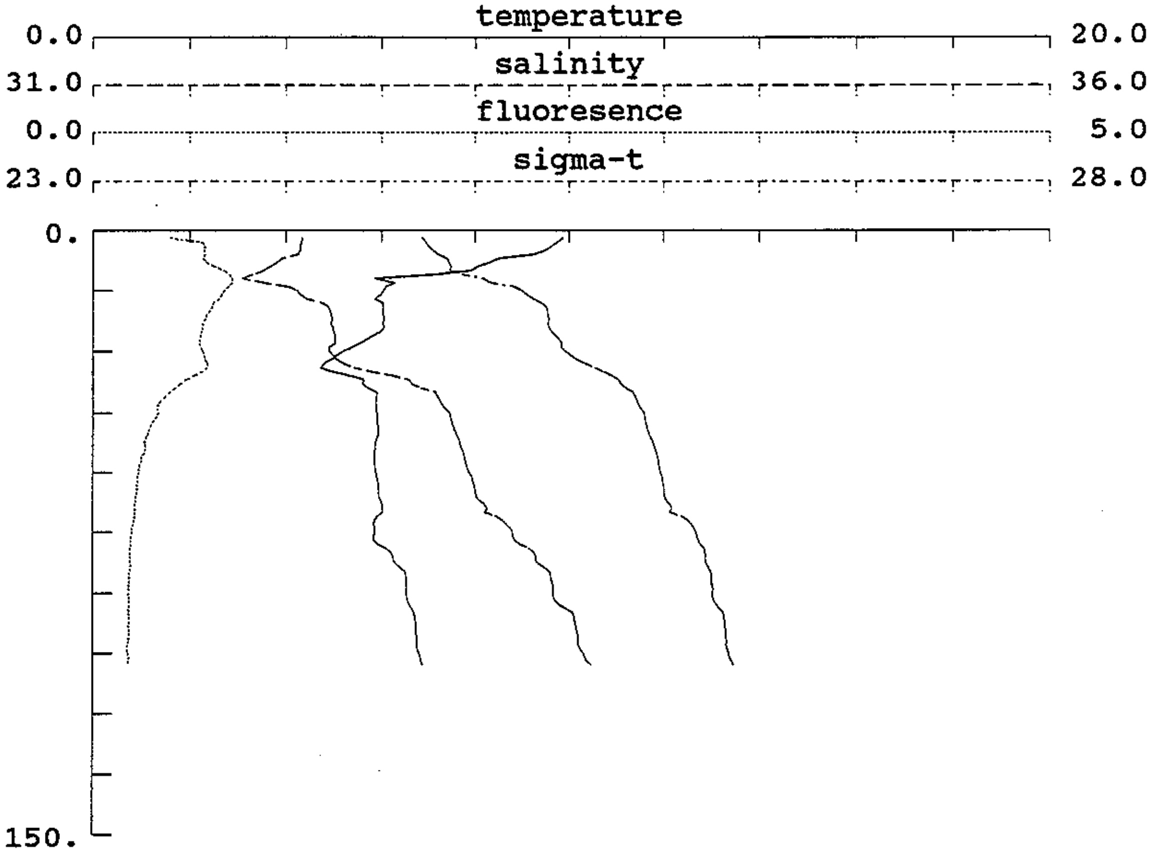


Depth	Temp	Salt	Flur	Sigma-t
1.00	7.41	32.45	0.35	25.38
5.00	7.45	32.45	0.30	25.37
10.00	7.21	32.46	0.35	25.42
15.00	7.09	32.48	0.60	25.45
20.00	7.03	32.49	0.54	25.46
25.00	6.82	32.51	0.46	25.51
30.00	6.82	32.51	0.45	25.51
40.00	6.82	32.51	0.45	25.51
50.00	6.82	32.51	0.59	25.51
75.00	6.83	32.51	0.46	25.50
82.00	6.83	32.51	0.45	25.50

[** Note: this is uncorrected data **]

ALB9607
Cast #: 022
Lat: 41 32.7 N
Lon: 66 2.1 W

Standard Sta #: 022
Date(y\m\d): 96\6\8
Hour (GMT): 21.8
Bottom depth: 115

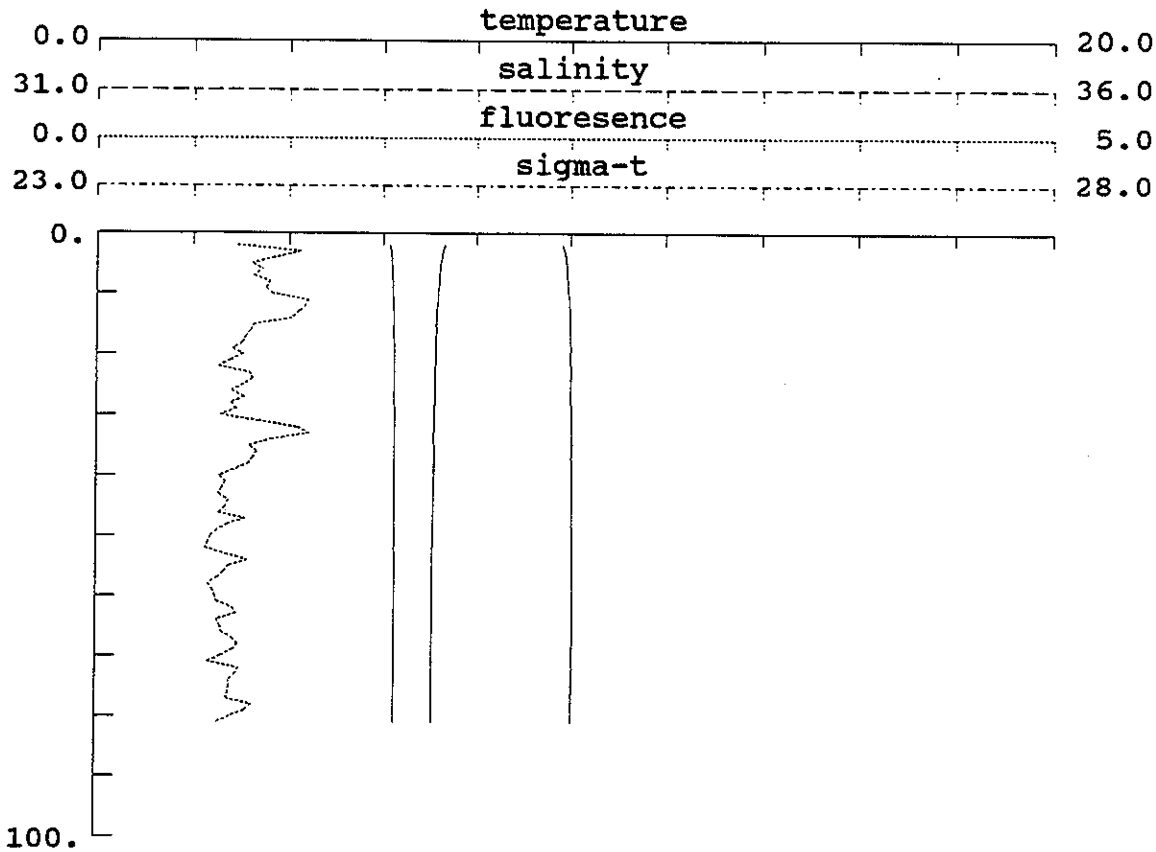


Depth	Temp	Salt	Flur	Sigma-t
1.00	10.11	32.08	0.04	24.68
5.00	9.50	32.07	0.57	24.77
10.00	7.90	31.88	0.68	24.86
15.00	6.03	32.06	0.68	25.25
20.00	6.03	32.23	0.60	25.39
25.00	5.99	32.25	0.56	25.41
30.00	5.19	32.22	0.57	25.48
40.00	5.90	32.79	0.40	25.84
50.00	5.93	32.90	0.29	25.92
75.00	5.87	33.20	0.20	26.17
100.00	6.75	33.55	0.19	26.33
108.00	6.90	33.62	0.18	26.37

[** Note: this is uncorrected data **]

ALB9607
Cast #: 023
Lat: 41 46.7 N
Lon: 66 13.4 W

Standard Sta #: 023
Date(y\m\d): 96\6\9
Hour (GMT): 4.2
Bottom depth: 84

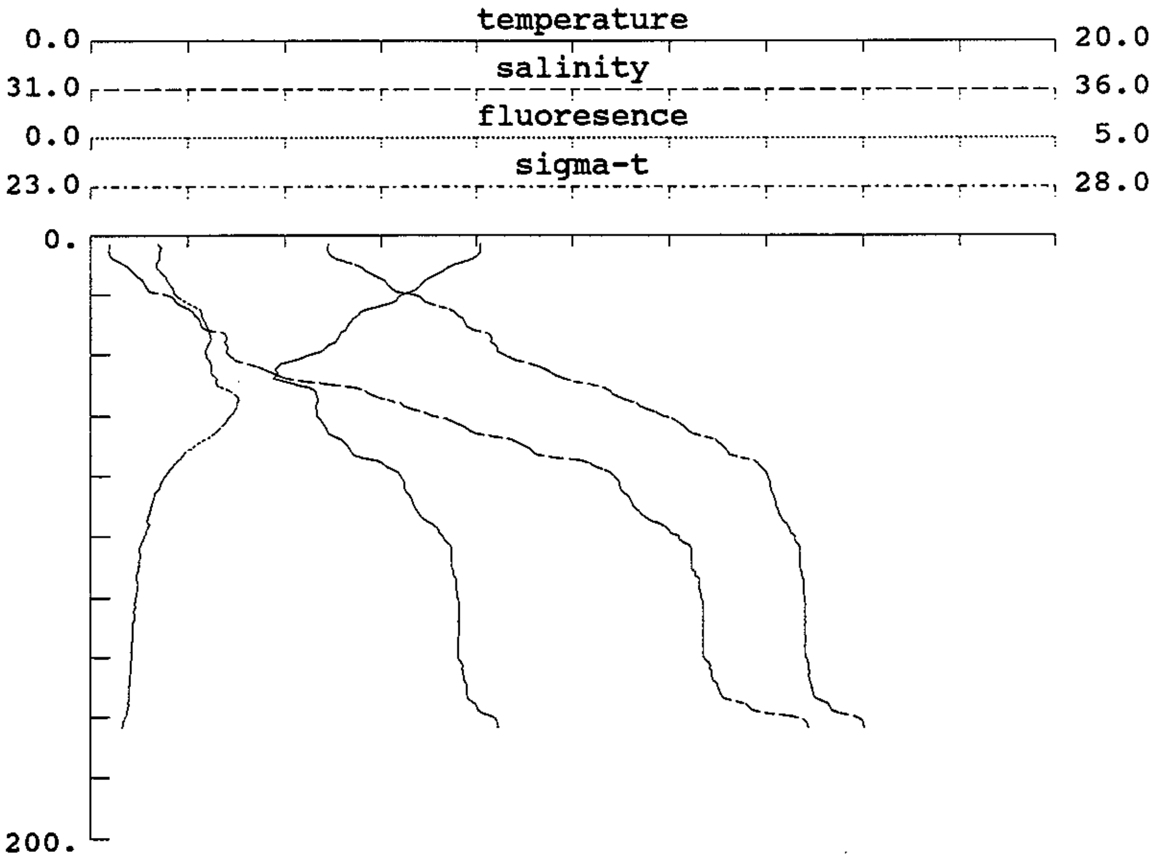


Depth	Temp	Salt	Flur	Sigma-t
2.00	7.33	32.53	0.73	25.46
5.00	7.24	32.54	0.81	25.48
10.00	7.19	32.55	0.91	25.49
15.00	7.15	32.56	0.82	25.50
20.00	7.14	32.56	0.76	25.50
25.00	7.14	32.56	0.76	25.50
30.00	7.12	32.56	0.65	25.51
40.00	7.11	32.56	0.64	25.51
50.00	7.10	32.57	0.59	25.51
75.00	7.09	32.57	0.70	25.51
81.00	7.09	32.57	0.62	25.51

[** Note: this is uncorrected data **]

ALB9607
Cast #: 024
Lat: 42 3.2 N
Lon: 65 58.3 W

Standard Sta #: 024
Date(y\m\d): 96\6\9
Hour (GMT): 9.
Bottom depth: 168

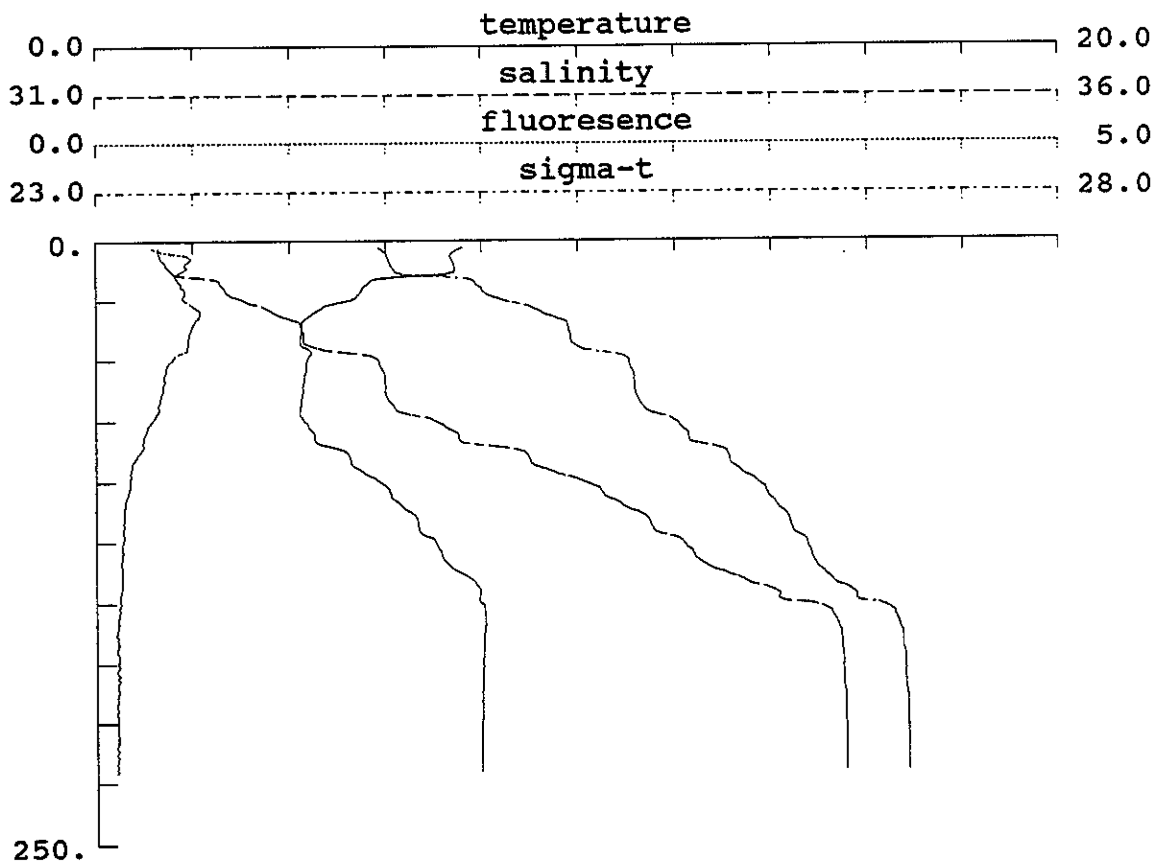


Depth	Temp	Salt	Flur	Sigma-t
2.00	8.09	31.08	0.38	24.21
5.00	8.08	31.09	0.36	24.22
10.00	7.53	31.17	0.34	24.36
15.00	6.93	31.27	0.39	24.51
20.00	6.44	31.39	0.43	24.67
25.00	5.70	31.51	0.56	24.86
30.00	5.34	31.57	0.59	24.94
40.00	4.57	31.71	0.60	25.14
50.00	4.25	32.25	0.65	25.60
75.00	5.92	33.55	0.45	26.44
100.00	7.29	34.05	0.28	26.65
150.00	7.79	34.25	0.20	26.74
164.00	8.45	34.72	0.16	27.01

[** Note: this is uncorrected data **]

ALB9607
Cast #: 025
Lat: 42 15.6 N
Lon: 65 50.4 W

Standard Sta #: 025
Date(y\m\d): 96\6\9
Hour (GMT): 15.5
Bottom depth: 226

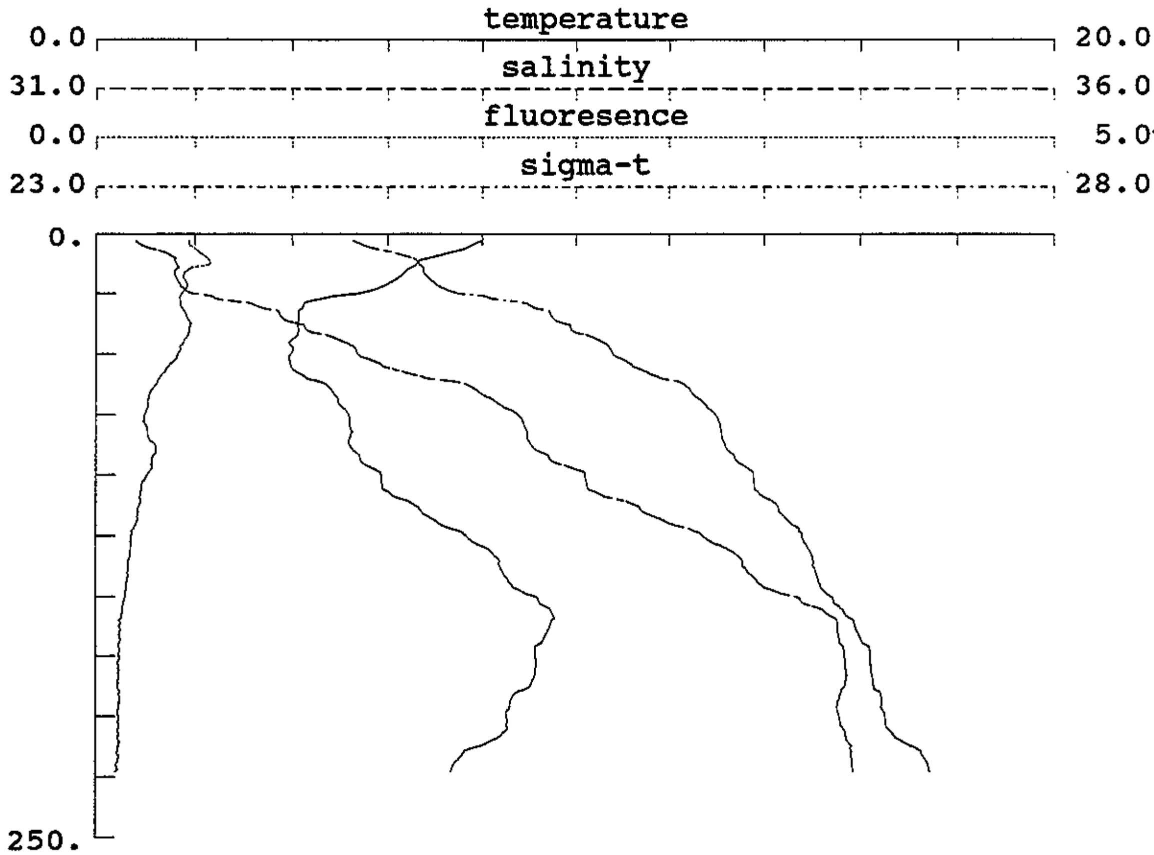


Depth	Temp	Salt	Flur	Sigma-t
2.00	7.74	31.32	-0.11	24.45
5.00	7.39	31.32	0.40	24.50
10.00	7.42	31.36	0.45	24.52
15.00	6.27	31.52	0.41	24.80
20.00	5.50	31.66	0.45	25.00
25.00	5.27	31.77	0.46	25.11
30.00	4.50	31.92	0.54	25.31
40.00	4.21	32.07	0.48	25.46
50.00	4.36	32.46	0.39	25.76
75.00	4.30	32.75	0.29	25.99
100.00	5.86	33.52	0.17	26.42
150.00	7.95	34.56	0.13	26.96
200.00	7.99	34.88	0.11	27.20
221.00	7.99	34.89	0.10	27.21

[** Note: this is uncorrected data **]

ALB9607
Cast #: 026
Lat: 42 7.9 N
Lon: 65 57.7 W

Standard Sta #: 039
Date(y\m\d): 96\6\9
Hour (GMT): 23.1
Bottom depth: 229

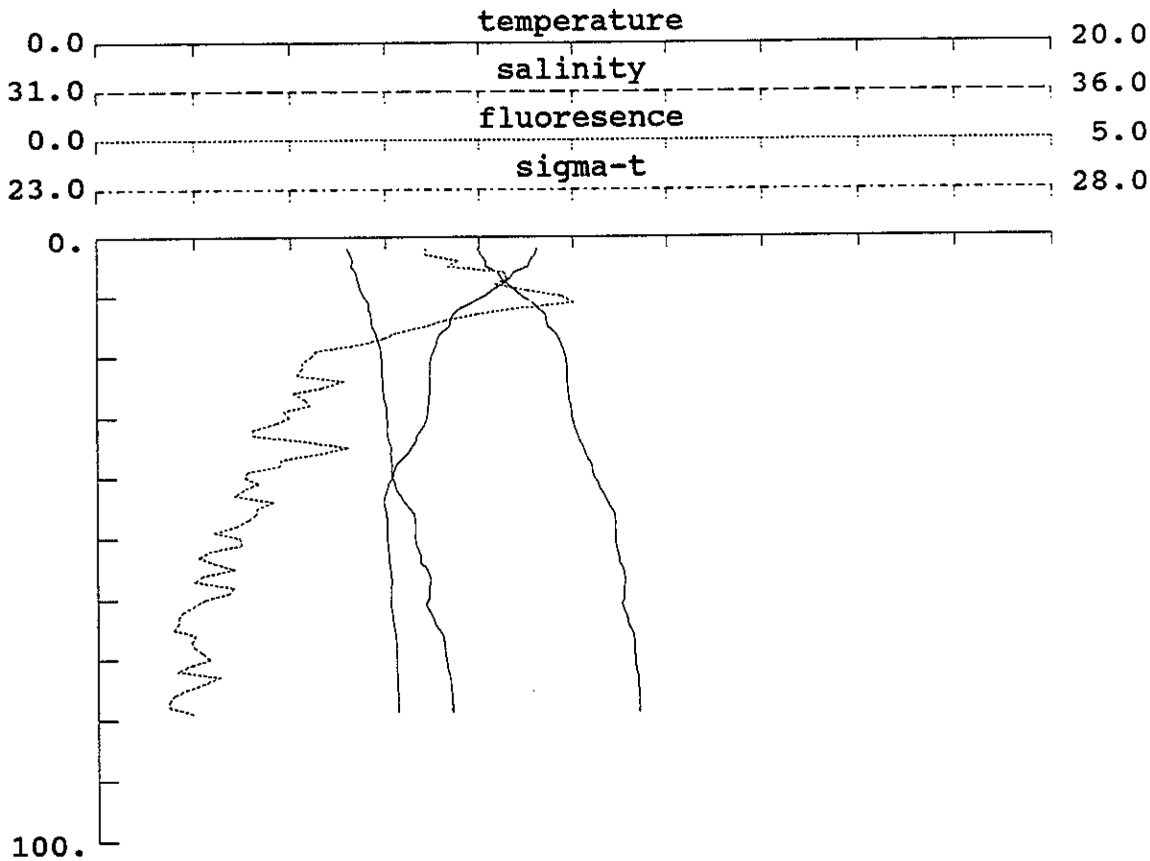


Depth	Temp	Salt	Flur	Sigma-t
2.00	8.26	31.17	0.42	24.26
5.00	7.75	31.24	0.48	24.38
10.00	6.84	31.40	0.56	24.63
15.00	6.40	31.40	0.47	24.69
20.00	6.08	31.41	0.45	24.74
25.00	5.38	31.48	0.43	24.87
30.00	4.24	31.81	0.43	25.26
40.00	4.14	32.08	0.47	25.47
50.00	3.98	32.34	0.41	25.70
75.00	5.19	33.19	0.24	26.25
100.00	5.86	33.55	0.26	26.45
150.00	9.14	34.67	0.14	26.85
200.00	8.53	34.89	0.12	27.13
223.00	7.35	34.97	0.09	27.36

[** Note: this is uncorrected data **]

ALB9607
Cast #: 027
Lat: 42 4.5 N
Lon: 66 24.9 W

Standard Sta #: 027
Date(y\m\d): 96\6\10
Hour (GMT): 5.6
Bottom depth: 84

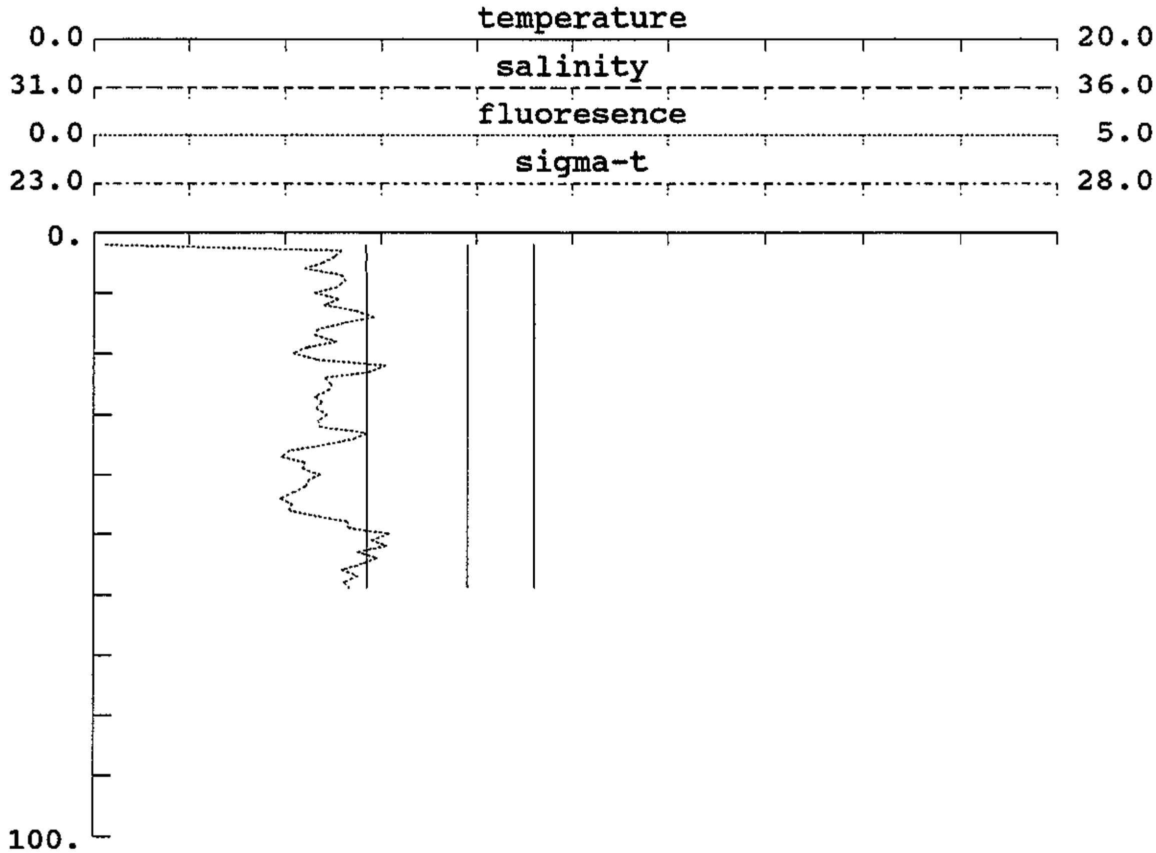


Depth	Temp	Salt	Flur	Sigma-t
2.00	9.24	32.30	1.72	24.99
5.00	9.06	32.32	1.83	25.03
10.00	8.10	32.38	2.44	25.23
15.00	7.36	32.43	1.71	25.37
20.00	6.97	32.48	1.11	25.46
25.00	6.94	32.48	1.16	25.47
30.00	6.87	32.50	0.99	25.49
40.00	6.14	32.53	0.76	25.61
50.00	6.02	32.65	0.73	25.72
75.00	6.23	32.84	0.46	25.84
79.00	6.25	32.85	0.49	25.85

[** Note: this is uncorrected data **]

ALB9607
Cast #: 028
Lat: 41 57.4 N
Lon: 66 42.1 W

Standard Sta #: 027
Date(y\m\d): 96\6\10
Hour (GMT): 9.9
Bottom depth: 69

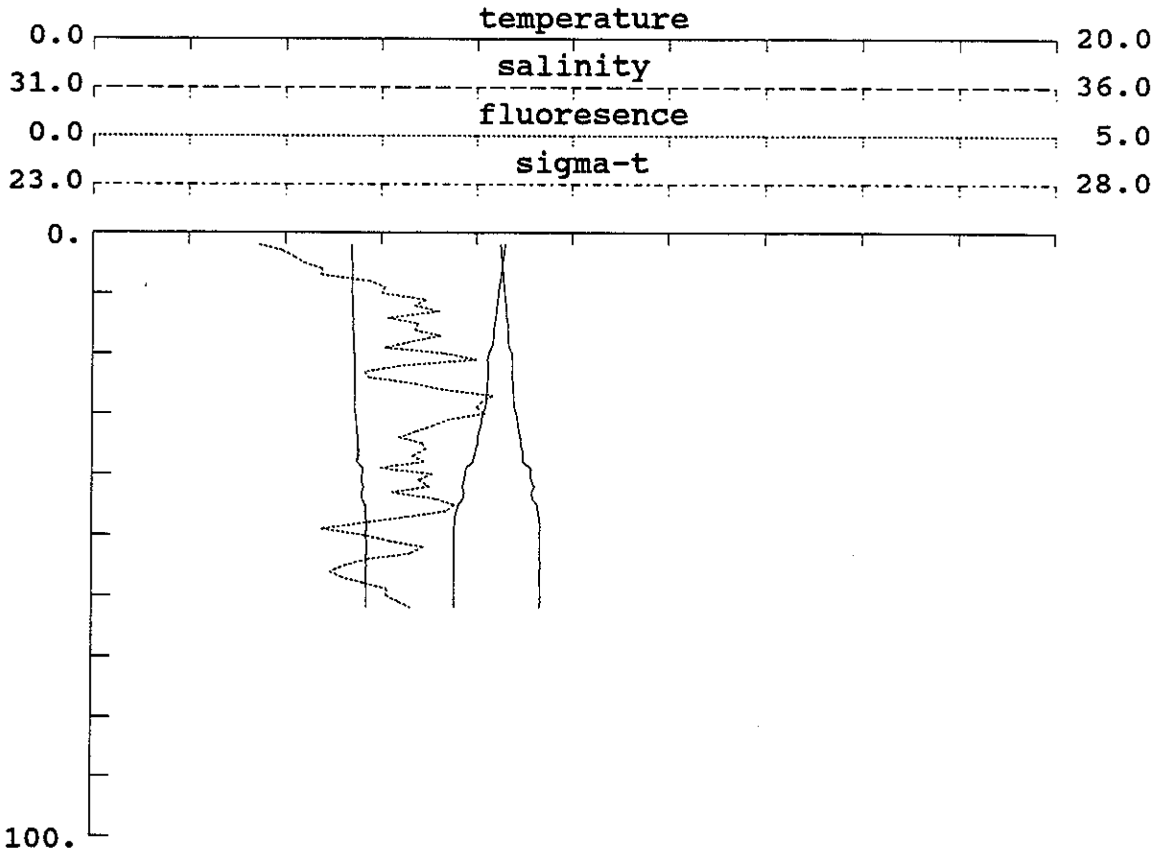


Depth	Temp	Salt	Flur	Sigma-t
2.00	7.82	32.42	0.06	25.30
5.00	7.82	32.42	1.19	25.30
10.00	7.82	32.42	1.16	25.30
15.00	7.82	32.42	1.31	25.30
20.00	7.82	32.42	1.04	25.30
25.00	7.82	32.43	1.24	25.30
30.00	7.82	32.43	1.22	25.30
40.00	7.81	32.43	1.18	25.30
50.00	7.81	32.43	1.54	25.30
59.00	7.81	32.43	1.34	25.31

[** Note: this is uncorrected data **]

ALB9607
Cast #: 029
Lat: 42 5.3 N
Lon: 66 53.6 W

Standard Sta #: 028
Date(y\m\d): 96\6\10
Hour (GMT): 13.7
Bottom depth: 67

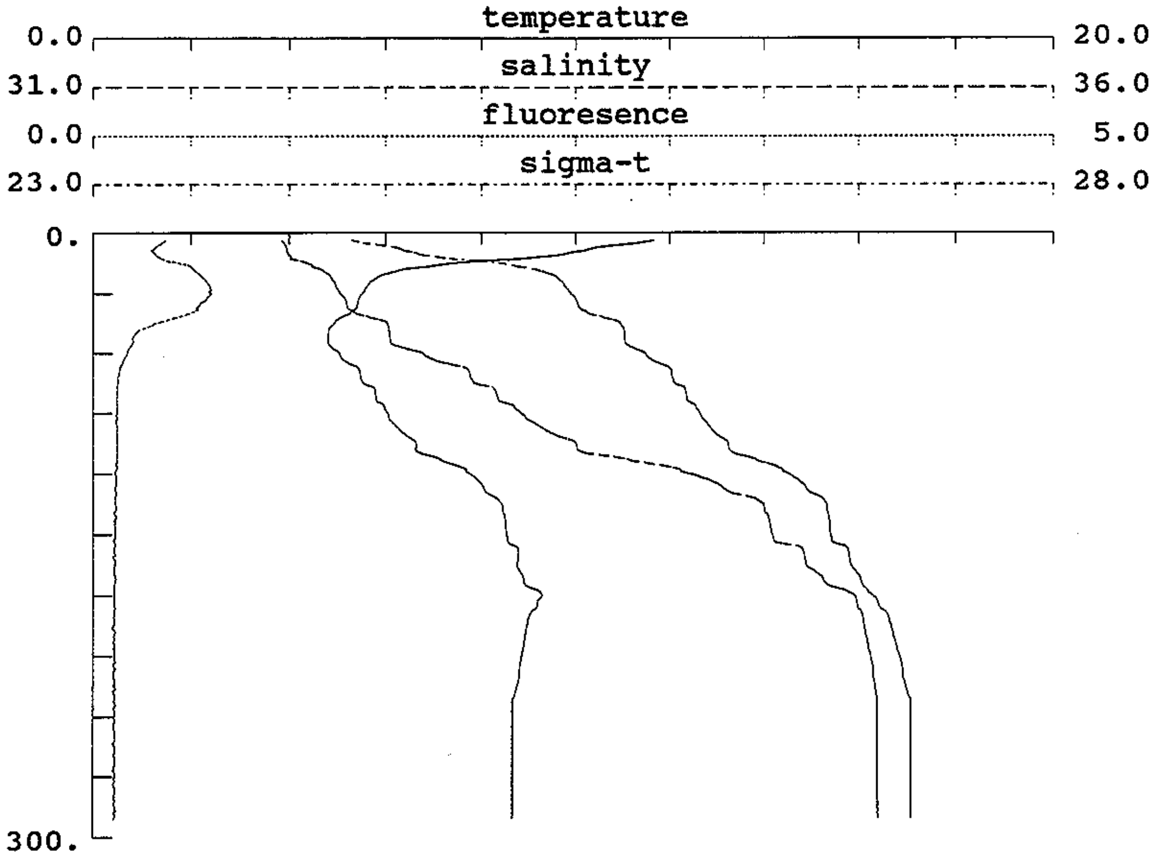


Depth	Temp	Salt	Flur	Sigma-t
2.00	8.60	32.35	0.86	25.13
5.00	8.54	32.35	1.10	25.14
10.00	8.46	32.35	1.50	25.15
15.00	8.39	32.36	1.69	25.17
20.00	8.26	32.36	1.84	25.19
25.00	8.24	32.37	1.68	25.20
30.00	8.15	32.37	2.05	25.21
40.00	7.79	32.41	1.77	25.29
50.00	7.56	32.43	1.41	25.34
62.00	7.57	32.43	1.66	25.34

[** Note: this is uncorrected data **]

ALB9607
Cast #: 030
Lat: 42 17.9 N
Lon: 66 54.1 W

Standard Sta #: 029
Date(y\m\d): 96\6\10
Hour (GMT): 18.4
Bottom depth: 294

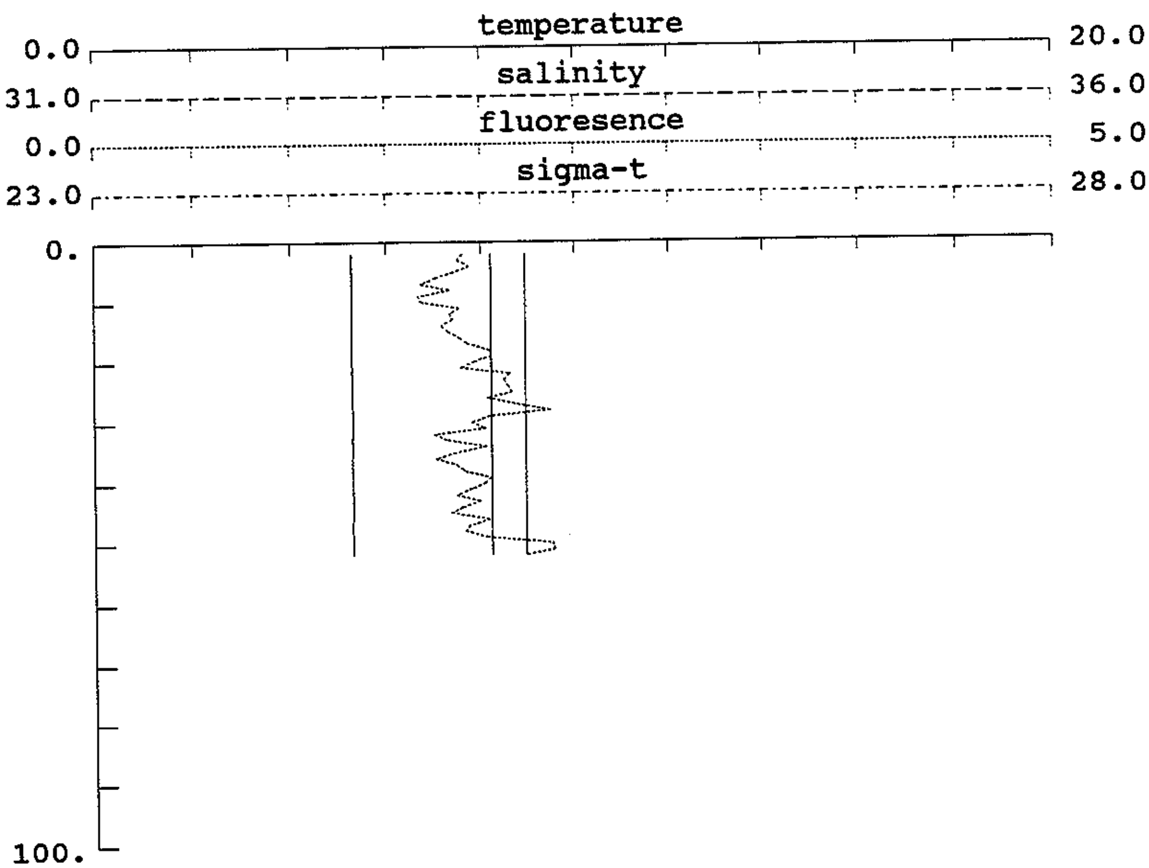


Depth	Temp	Salt	Flur	Sigma-t
2.00	12.04	31.97	0.43	24.26
5.00	11.35	31.97	0.35	24.38
10.00	9.87	31.99	0.31	24.65
15.00	7.43	32.09	0.44	25.09
20.00	6.05	32.19	0.54	25.35
25.00	5.65	32.23	0.59	25.43
30.00	5.51	32.26	0.60	25.47
40.00	5.24	32.35	0.48	25.57
50.00	4.79	32.52	0.22	25.76
75.00	5.52	32.96	0.13	26.02
100.00	6.36	33.36	0.12	26.24
150.00	8.54	34.55	0.11	26.85
200.00	8.92	35.04	0.11	27.18
250.00	8.65	35.10	0.11	27.27
291.00	8.65	35.10	0.10	27.27

[** Note: this is uncorrected data **]

ALB9607
Cast #: 031
Lat: 41 54.4 N
Lon: 67 11.8 W

Standard Sta #: 030
Date(y\m\d): 96\6\11
Hour (GMT): 3.
Bottom depth: 57

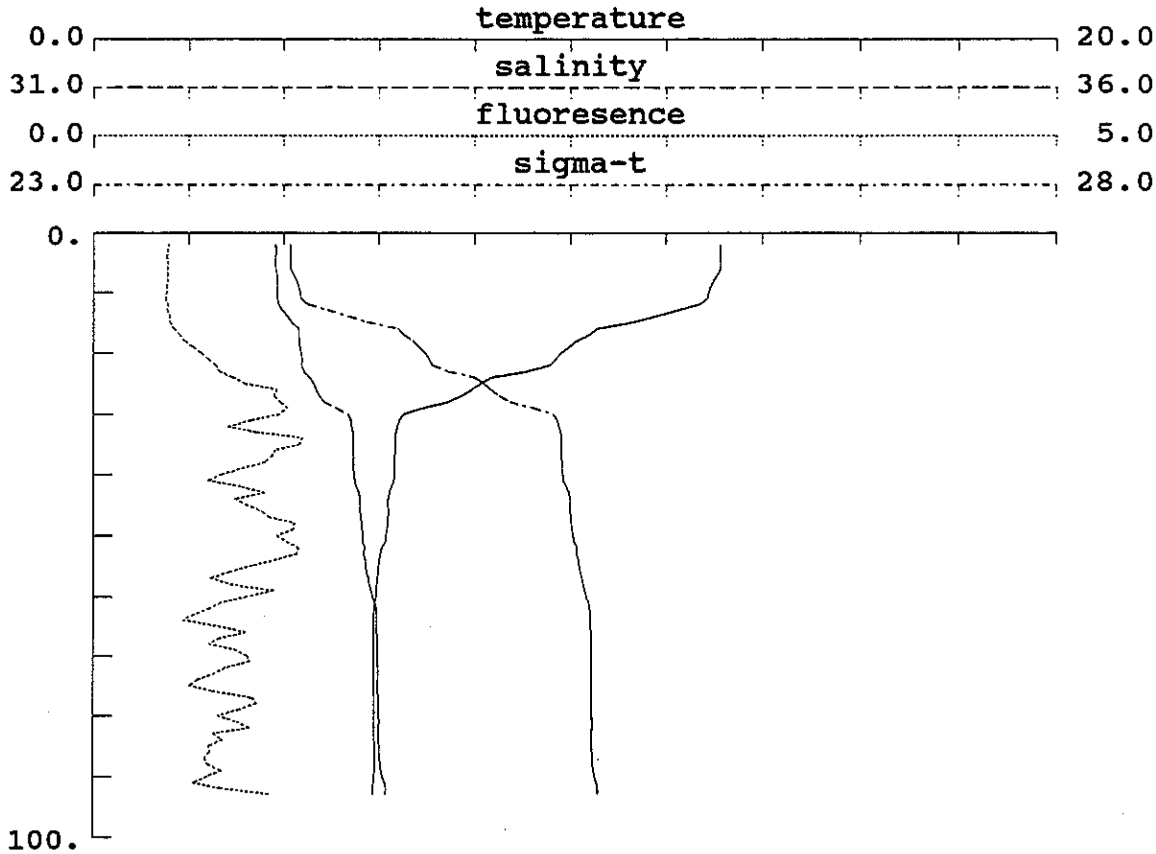


Depth	Temp	Salt	Flur	Sigma-t
1.00	8.95	32.32	1.78	25.05
5.00	8.94	32.32	1.86	25.05
10.00	8.94	32.32	1.69	25.05
15.00	8.94	32.32	1.83	25.05
20.00	8.94	32.32	1.96	25.05
25.00	8.94	32.32	2.16	25.05
30.00	8.94	32.32	1.95	25.05
40.00	8.95	32.32	2.02	25.05
50.00	8.95	32.32	2.38	25.05
52.00	8.95	32.32	2.24	25.05

[** Note: this is uncorrected data **]

ALB9607
Cast #: 032
Lat: 42 2.9 N
Lon: 67 37.9 W

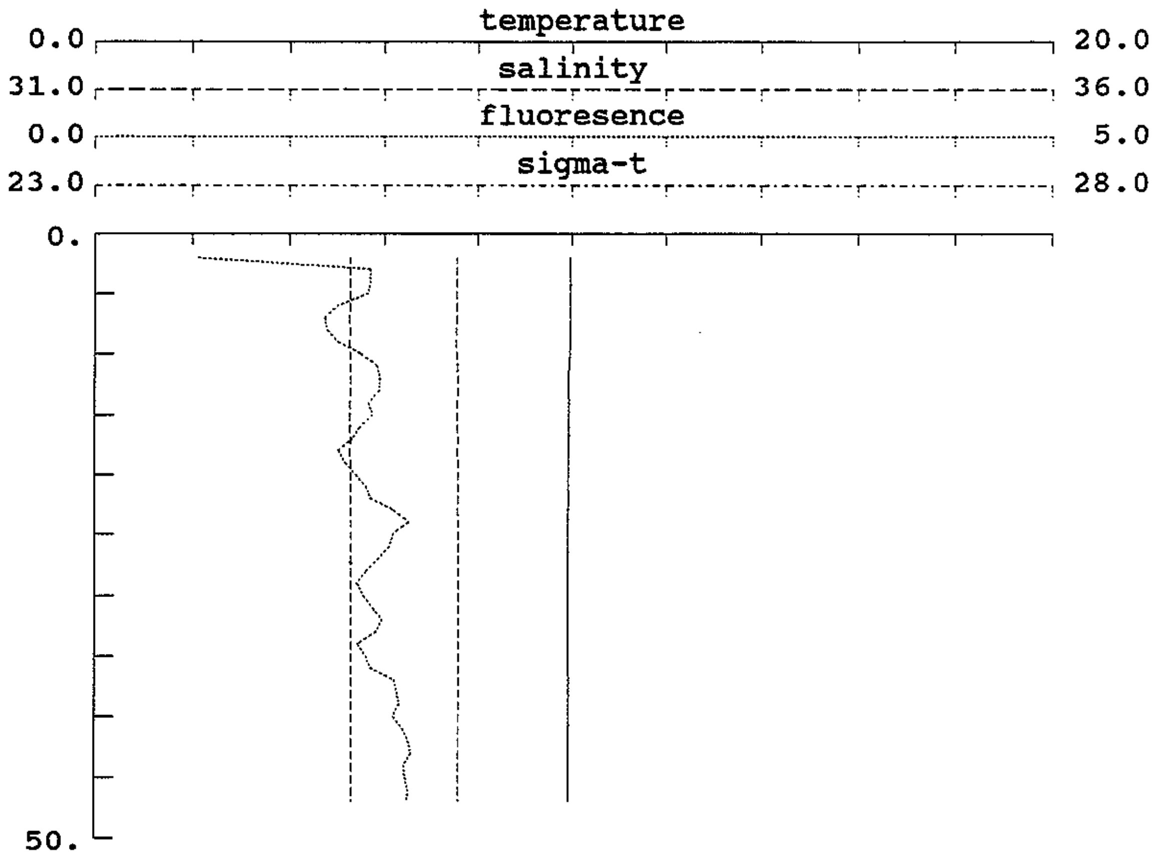
Standard Sta #: 031
Date(y\m\d): 96\6\11
Hour (GMT): 7.2
Bottom depth: 98



Depth	Temp	Salt	Flur	Sigma-t
2.00	13.14	31.96	0.39	24.03
5.00	13.14	31.96	0.39	24.03
10.00	12.90	31.96	0.38	24.09
15.00	11.31	32.04	0.40	24.44
20.00	9.80	32.09	0.57	24.74
25.00	8.12	32.16	0.80	25.05
30.00	6.53	32.34	0.98	25.41
40.00	6.33	32.37	0.67	25.46
50.00	6.16	32.42	0.97	25.52
75.00	5.89	32.49	0.50	25.61
93.00	5.89	32.54	0.94	25.65

[** Note: this is uncorrected data **]

ALB9607		Standard Sta #:	032
Cast #:	033	Date(y\m\d):	96\6\11
Lat:	41 41.6 N	Hour (GMT):	12.5
Lon:	67 39.2 W	Bottom depth:	50

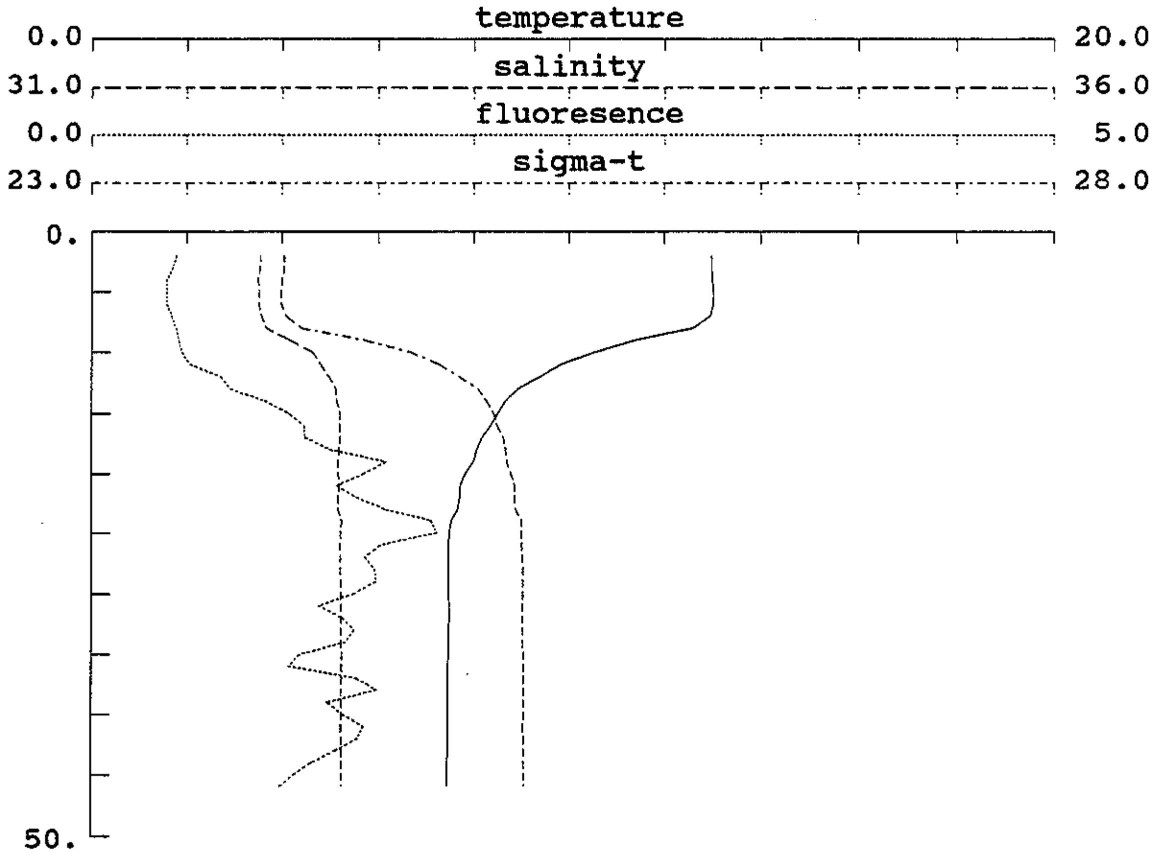


Depth	Temp	Salt	Flur	Sigma-t
2.00	9.96	32.32	0.53	24.89
5.00	9.97	32.32	1.41	24.88
10.00	9.96	32.32	1.37	24.89
15.00	9.95	32.32	1.44	24.89
20.00	9.94	32.32	1.35	24.89
25.00	9.94	32.32	1.55	24.90
30.00	9.94	32.32	1.39	24.90
40.00	9.94	32.32	1.55	24.90
47.00	9.94	32.33	1.62	24.90

[** Note: this is uncorrected data **]

ALB9607
Cast #: 034
Lat: 41 49.2 N
Lon: 67 58.5 W

Standard Sta #: 033
Date(y\m\d): 96\6\11
Hour (GMT): 17.
Bottom depth: 52

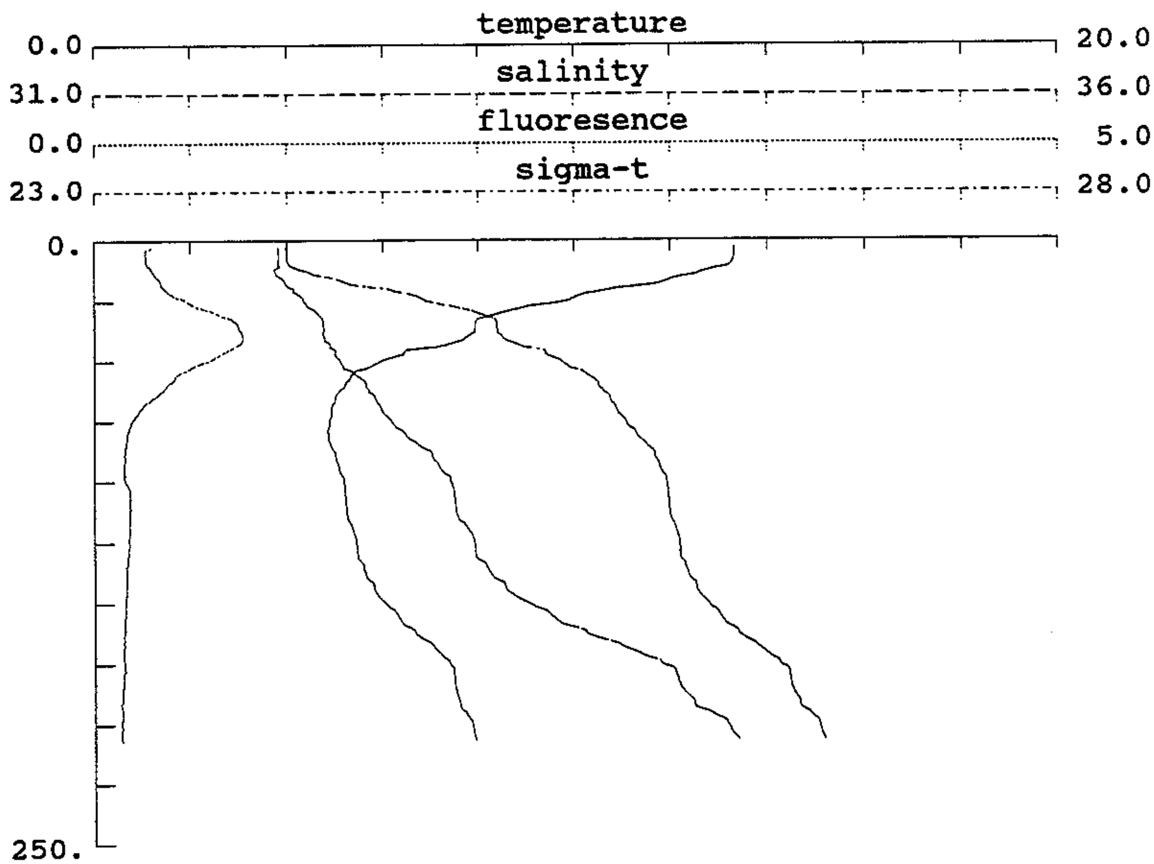


Depth	Temp	Salt	Flur	Sigma-t
2.00	12.97	31.89	0.44	24.01
5.00	13.02	31.88	0.40	24.00
10.00	10.55	32.16	0.48	24.66
15.00	8.50	32.30	1.04	25.11
20.00	7.83	32.29	1.43	25.20
25.00	7.50	32.31	1.80	25.25
30.00	7.48	32.31	1.38	25.26
40.00	7.47	32.31	1.32	25.26
46.00	7.45	32.31	0.99	25.27

[** Note: this is uncorrected data **]

ALB9607
Cast #: 035
Lat: 41 51.4 N
Lon: 68 19.6 W

Standard Sta #: 034
Date(y\m\d): 96\6\11
Hour (GMT): 20.9
Bottom depth: 215

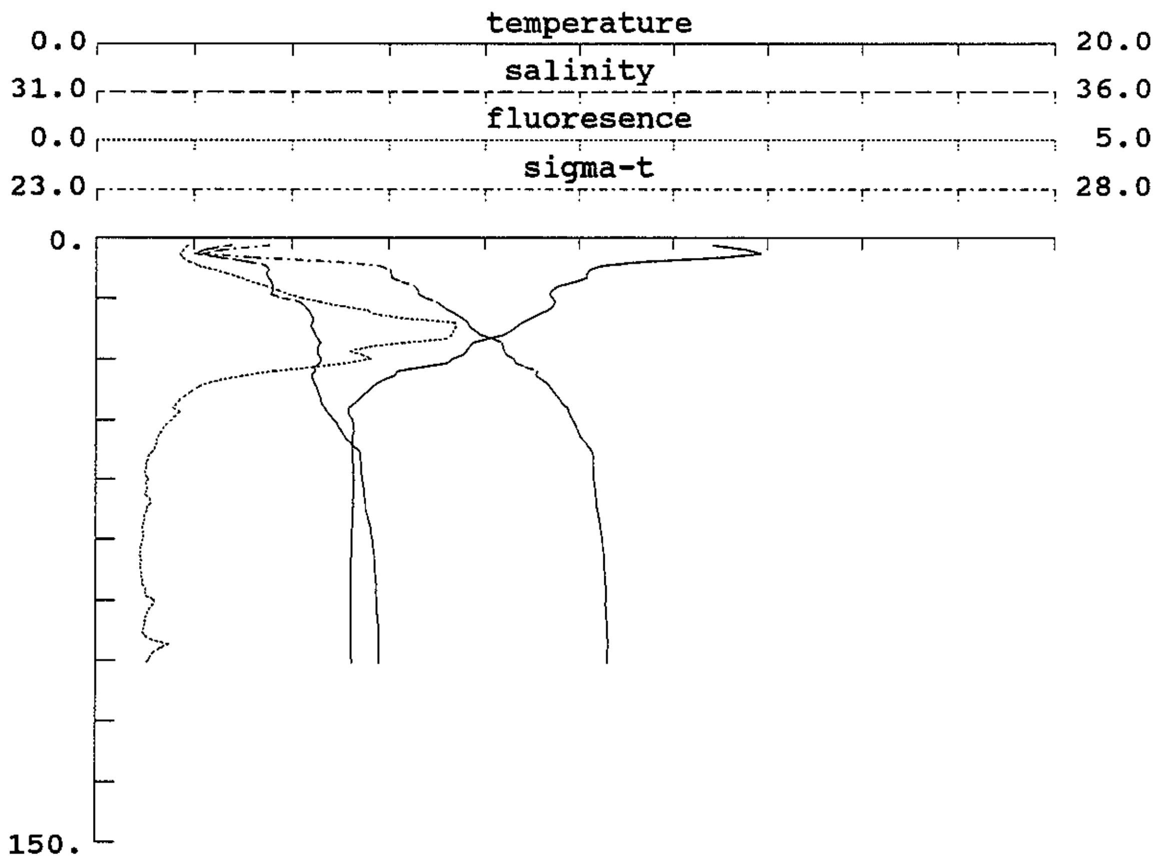


Depth	Temp	Salt	Flur	Sigma-t
2.00	13.32	31.96	0.33	24.00
5.00	13.32	31.96	0.27	24.00
10.00	13.25	31.96	0.28	24.01
15.00	12.29	31.96	0.32	24.20
20.00	10.85	32.04	0.37	24.52
25.00	9.88	32.09	0.49	24.72
30.00	8.45	32.16	0.64	25.00
40.00	7.74	32.19	0.77	25.13
50.00	5.96	32.28	0.59	25.43
75.00	4.86	32.54	0.19	25.77
100.00	5.17	32.85	0.16	25.98
150.00	6.04	33.25	0.16	26.19
200.00	7.86	34.29	0.13	26.76
207.00	7.94	34.35	0.14	26.79

[** Note: this is uncorrected data **]

ALB9607
Cast #: 036
Lat: 41 35.7 N
Lon: 68 30.3 W

Standard Sta #: 035
Date(y\m\d): 96\6\12
Hour (GMT): 3.3
Bottom depth: 116

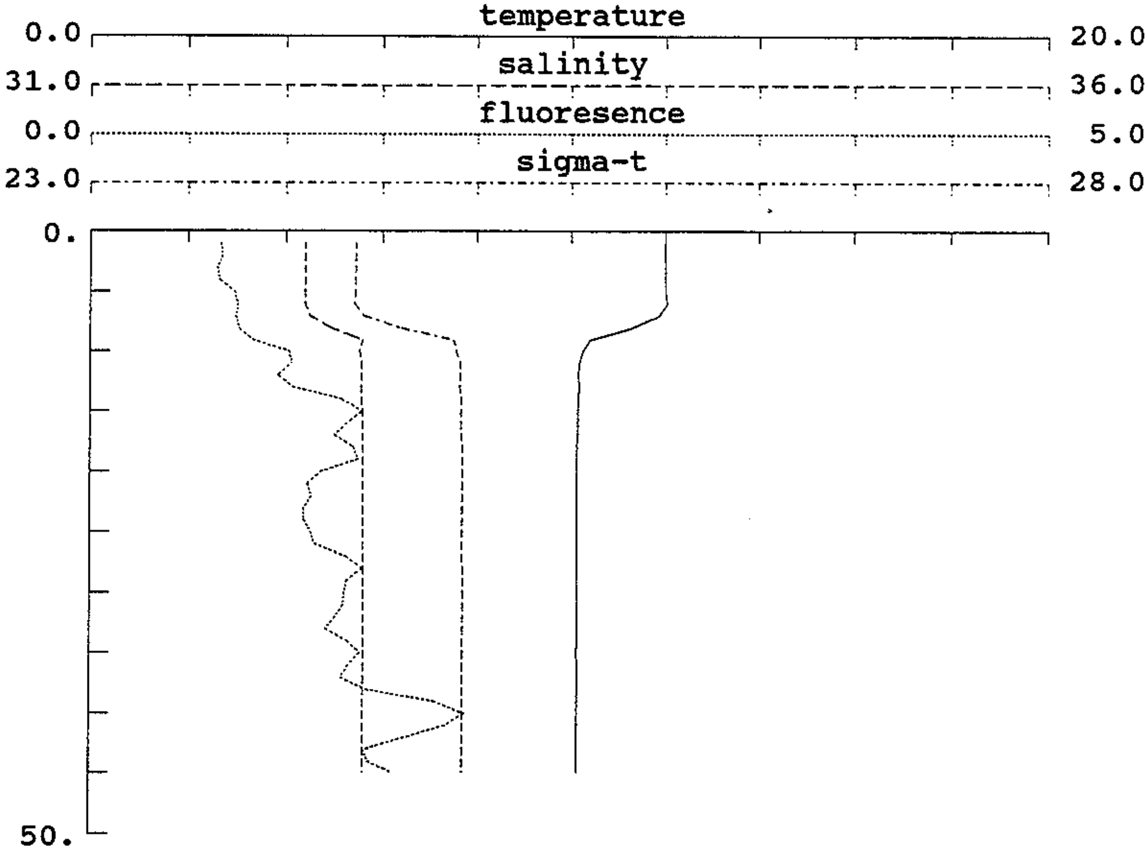


Depth	Temp	Salt	Flur	Sigma-t
2.00	12.83	31.69	0.47	23.89
5.00	13.05	31.63	0.44	23.80
10.00	10.16	31.88	0.74	24.52
15.00	9.44	31.95	1.05	24.69
20.00	8.97	32.11	1.59	24.89
25.00	8.05	32.14	1.80	25.04
30.00	7.35	32.15	1.41	25.15
40.00	5.39	32.15	0.43	25.40
50.00	5.26	32.28	0.31	25.52
75.00	5.25	32.42	0.24	25.63
100.00	5.24	32.45	0.28	25.66
106.00	5.25	32.45	0.26	25.65

[** Note: this is uncorrected data **]

ALB9607
Cast #: 037
Lat: 41 25.2 N
Lon: 68 19.2 W

Standard Sta #: 036
Date(y\m\d): 96\6\12
Hour (GMT): 7.7
Bottom depth: 51

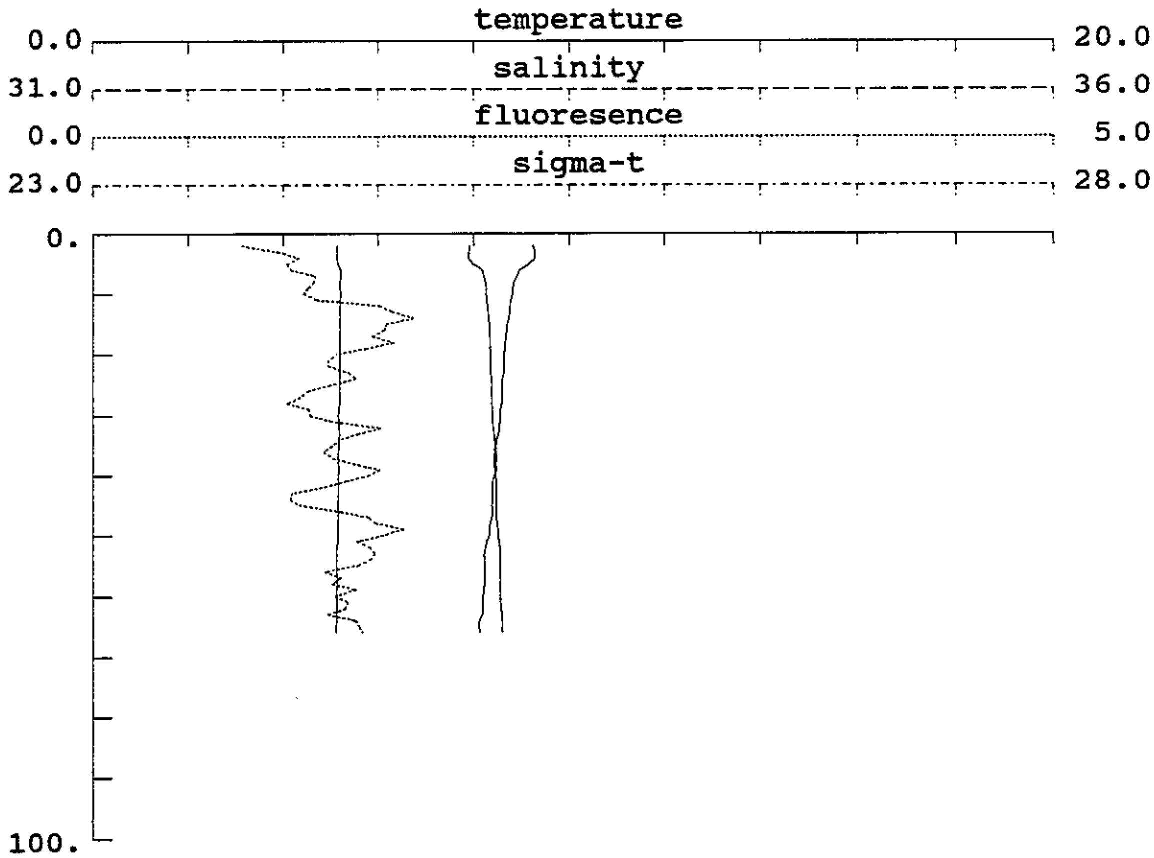


Depth	Temp	Salt	Flur	Sigma-t
1.00	11.99	32.10	0.66	24.36
5.00	12.00	32.10	0.73	24.36
10.00	10.25	32.38	1.02	24.89
15.00	10.15	32.40	1.40	24.92
20.00	10.14	32.40	1.18	24.92
25.00	10.14	32.40	1.12	24.92
30.00	10.14	32.40	1.30	24.93
40.00	10.14	32.40	1.94	24.93
45.00	10.14	32.40	1.56	24.93

[** Note: this is uncorrected data **]

ALB9607
Cast #: 038
Lat: 41 18.8 N
Lon: 68 36.2 W

Standard Sta #: 037
Date(y\m\d): 97\6\12
Hour (GMT): 11.3
Bottom depth: 73

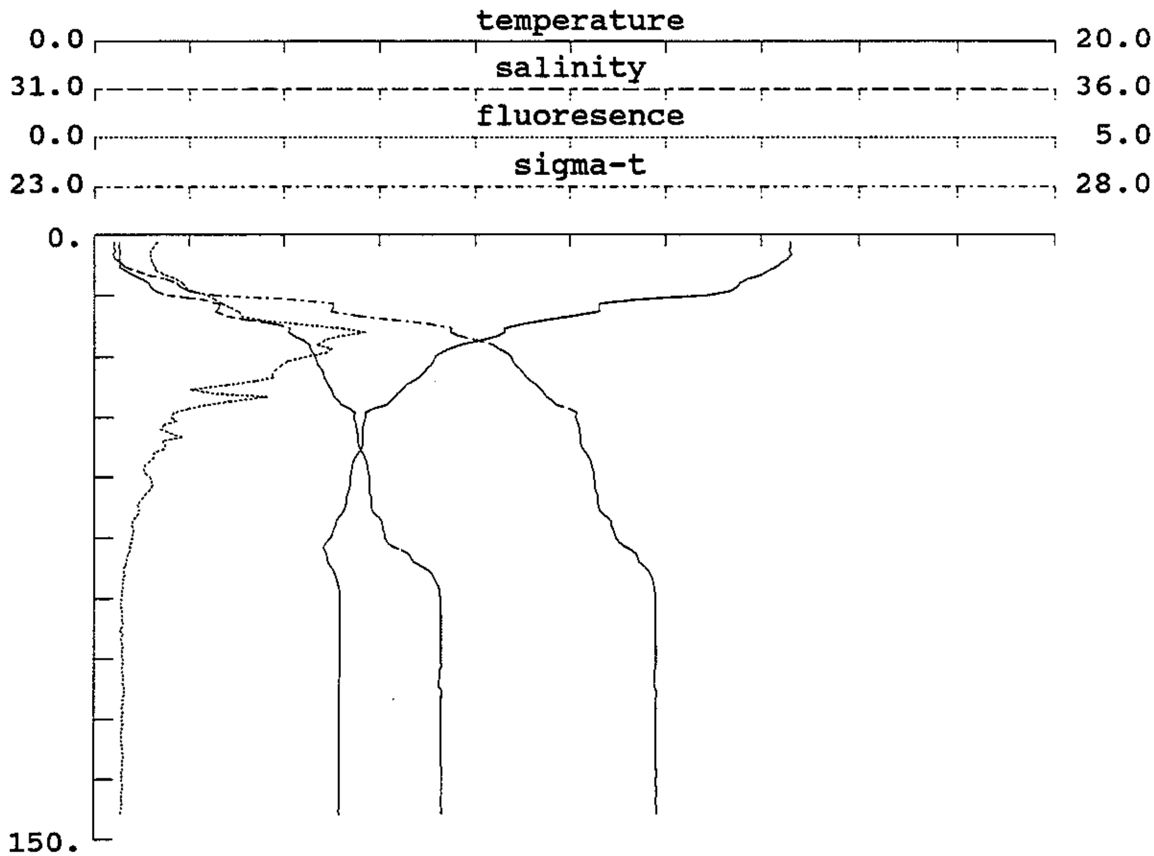


Depth	Temp	Salt	Flur	Sigma-t
2.00	9.23	32.29	0.78	24.98
5.00	9.15	32.29	1.02	25.00
10.00	8.80	32.31	1.11	25.06
15.00	8.68	32.30	1.54	25.08
20.00	8.62	32.30	1.28	25.09
25.00	8.58	32.30	1.25	25.09
30.00	8.53	32.29	1.14	25.10
40.00	8.43	32.29	1.45	25.11
50.00	8.32	32.29	1.53	25.12
66.00	8.11	32.28	1.42	25.15

[** Note: this is uncorrected data **]

ALB9607
Cast #: 039
Lat: 41 28.9 N
Lon: 68 57. W

Standard Sta #: 038
Date(y\m\d): 96\6\12
Hour (GMT): 16.5
Bottom depth: 151



Depth	Temp	Salt	Flur	Sigma-t
2.00	14.59	31.13	0.33	23.10
5.00	14.62	31.13	0.30	23.10
10.00	14.00	31.21	0.38	23.28
15.00	12.93	31.38	0.60	23.63
20.00	10.06	31.70	0.78	24.39
25.00	8.46	32.06	1.29	24.92
30.00	7.18	32.17	1.12	25.19
40.00	6.33	32.27	0.91	25.38
50.00	5.67	32.39	0.46	25.56
75.00	5.00	32.53	0.20	25.74
100.00	5.20	32.82	0.14	25.95
144.00	5.18	32.83	0.14	25.96

[** Note: this is uncorrected data **]

Appendix D. Acoustic Data Summary and concomitant observations.

Station	LAT N	LON W	Local	GMT	Data files	Concurrent or overlapping measurments	Remarks
			Date Time on stn Time off stn	Date Time on stn Time off stn			
1	40 00.40 40 54.40	68 59.00 69 01.60	June 4 0055 0442	June 4 0455 0842	A9607_01.pro, .raw, .tab	CTD, MOC 1, MOC 10, ADCP	The Greene Bomber is in the water and acoustic data acquisition was initiated as we steamed to station 2. Salinity not giving good values.
2	40 38.90 40 39.50	68 00.40 68 57.50	June 4 0713 1041	June 4 1113 1441	A9607_02.pro, .raw, .tab	Bongo, CTD, MOC 1, MOC 10, ADCP	Stopped acoustics to untwist the Greene Bomber. Attatched tag line from port shackel on the towed body to starboard rail. Uniform scattering throughout water column. MOC 10 crashed, but survived. Tow restarted. Becoming more layered as 3 is approached. A few very strong patches near the surface. Some perfectly vertical striations which are probably the side-lobes of the beam detecting the boat when the fish roles.
3	40 31.50 40 30.30	68 27.20 68 25.50	June 4 1414 1655	June 4 1814 2055	A9607_03.pro, .raw, .tab	Bongo, Pump, CTD, MOC 1, MOC 10, ADCP	Strong scattering layer centered on 10 meters depth Caught piles of pteropods, lots of algae in 12 to 36 meters. Caught *Calanus* surface to 12 meters Thermocline starts 12 to 15 meters, Fluoresence peak just below. Topography gets rougher as station 4 is approached. Some strong scattering associated with the peaks.
4	40 59.50 41 00.40	68 15.30 68 16.60	June 4 2114 2341	June 5 0114 0341	A9607_04.pro, .raw, .tab	Bongo, Pump, CTD, MOC 1, MOC 10, ADCP	Moderate scattering patches at surface trail off to depths, probably secondary cells. Curtains of secondary circulation cells observed on way to next station. Nets caught mostly mysids and gelatinous animals at Station 4.
5	40 50.80 40 49.00	68 00.70 68 00.00	June 5 0221 0340	June 5 0621 0740	A9607_05..pro, .raw, .tab	Bongo,water sample, CTD, MOC 1, ADCP	Surface layers with "rain" coming down from them. Some intense patches in the surface layers. Problems with the MOC 10, so no samples. Some hints of internal waves en route to 6.

Appendix D. Acoustic Data Summary and concomitant observations.

Station	LAT N	LON W	Local Date Time on stn Time off stn	GMT Date Time on stn Time off stn	Data files	Concurrent or overlapping measurments	Remarks
1	40 00.40 40 54.40	68 59.00 69 01.60	June 4 0055 0442	June 4 0455 0842	A9607_01.pro, .raw, .tab	CTD, MOC 1, MOC 10, ADCP	The Greene Bomber is in the water and acoustic data acquisition was initiated as we steamed to station 2. Salinity not giving good values.
2	40 38.90 40 39.50	68 00.40 68 57.50	June 4 0713 1041	June 4 1113 1441	A9607_02.pro, .raw, .tab	Bongo, CTD, MOC 1, MOC 10, ADCP	Stopped acoustics to untwist the Greene Bomber. Attatched tag line from port shackel on the towed body to starboard rail. Uniform scattering throughout water column. MOC 10 crashed, but survived. Tow restarted. Becoming more layered as 3 is approached. A few very strong patches near the surface. Some perfectly vertical striations which are probably the side-lobes of the beam detecting the boat when the fish roles.
3	40 31.50 40 30.30	68 27.20 68 25.50	June 4 1414 1655	June 4 1814 2055	A9607_03.pro, .raw, .tab	Bongo, Pump, CTD, MOC 1, MOC 10, ADCP	Strong scattering layer centered on 10 meters depth Caught piles of pteropods, lots of algae in 12 to 36 meters. Caught *Calanus* surface to 12 meters Thermocline starts 12 to 15 meters, Fluoresence peak just below. Topography gets rougher as station 4 is approached. Some strong scattering assosciated with the peaks.
4	40 59.50 41 00.40	68 15.30 68 16.60	June 4 2114 2341	June 5 0114 0341	A9607_04.pro, .raw, .tab	Bongo, Pump, CTD, MOC 1, MOC 10, ADCP	Moderate scattering patches at surface trail off to depths, probably secondary cells. Curtains of secondary circulation cells observed on way to next station. Nets caught mostly mysids and gelatinous animals at Station 4.
5	40 50.80 40 49.00	68 00.70 68 00.00	June 5 0221 0340	June 5 0621 0740	A9607_05..pro, .raw, .tab	Bongo,water sample, CTD, MOC 1, ADCP	Surface layers with "rain" coming down from them. Some intense patches in the surface layers. Problems with the MOC 10, so no samples. Some hints of internal waves en route to 6.

Station	LAT N	LON W	Local	GMT	Data files	Concurrent or overlapping measurments	Remarks
			Date Time on stn Time off stn	Date Time on stn Time off stn			
6	40 40.10 40 38.40	67 46.50 67 45.6	June 5 0535 0809	June 5 0935 1209	A9607_06..pro, .raw, .tab started after Bongo (0546)	Bongo, CTD, MOC 1, MOC 10, ADCP	Wavelike scatter 25-45 meters on 120 kHz data. Mocness crew found many pteropods in near surface and mid layer (30-40). Lowered fish by 1m to try to clear up the echograms. Didn't help much. More layers: surface mainly, with less defined layers deeper. More wave hints.
7	40 26.50 40 25.00	67 18.10 67 20.30	June 5 1130 1702	June 5 1530 2102	A9607_07..pro, .raw, .tab A9607_7B..pro, .raw, .tabpro	Bongo,water sample, Pump, CTD, MOC 1, MOC 10, ADCP	Removed Greene bomber to replace conductivity unit. Attached tag line to a shackler nearer the center to keep fish from rotating. Seems to have cleared up images. Intense surface scattering above 8 meters, and at 10-12, clear patches with abrupt boundaries horizontally and vertically. Surface net on Moc-1 brought back numerous pteropods (Limacina). Strong patches enroute to station 8.
8	40 51.70 40 53.50	67 02.30 67 07.70	June 5/6 2103 0057	June 6 0103 0457	A9607_8..pro, .raw, .tab	Bongo, CTD, MOC 1, MOC 10, ADCP	Surface layer that gradually diminishes with depth. 420 stops working again. Had to redo MOC 1 tow due to tangled nets. Acoustics monotonous, little structure.
9	40 57.10 40 59.40	67 17.50 67 18.50	June 6 0207 0431	June 6 0607 0831	A9607_8..pro, .raw, .tab	Bongo, Pump, CTD, MOC 1, MOC 10, ADCP	Typical layers. A few strong patches near the surface, and some evidence of waves. Layers give way to gradual reduction from surface layer, which isn't especially strong. A few whisps extending down from stronger patches in the surface scatter, but all in all, very weak scattering.
10	41 04.60 41 04.60	67 39.00 67 40.40	June 6 0650 0847	June 6 1050 1247	A9607_10..pro, .raw, .tab	Bongo, water sample, CTD, MOC 1, MOC 10, ADCP	Same as the transect from 9-10, but scattering might be a bit stronger. Bottom bumpy, possible sand swails on 120.

Station	LAT N	LON W	Local Date Time on stn Time off stn	GMT Date Time on stn Time off stn	Data files	Concurrent or overlapping measurment s	Remarks
11	41 13.50 41 14.70	67 57.00 67 59.80	June 6 1029 1210	June 6 1429 1610	A9607_11..pro, .raw, .tab	Bongo, CTD, MOC 1, MOC 10, ADCP	Hydroids in huge numbers, after significant surface scatter observed near end of Moc-1 trawl. Patches that might reasonably correspond to circulation cells concentrating them, and slicks, visible from bridge, and on acoustics, basking sharks or porpoises off port side.
12	41 24.00 41 25.40	67 32.70 67 30.32	June 6 1451 1648	June 6 1851 2048	A9607_12..pro, .raw, .tab	Bongo, Pump, CTD, MOC 1, MOC 10, ADCP, drifter	Pulled the Bomber out of the water to change the cable on the conductivity unit. Didn't seem to help. Similar to 11, but patches slightly farther apart. Patches give way to weak layers as 13 is approached.
13	41 16.20 41 14.20	67 10.30 67 09.50	June 6 1838 2121	June 6/7 2238 0121	9607_13..pro, .raw, .tab(no GPS) a9607_13..pro, .raw, .tab(no GPS)	Bongo, Pump, CTD, MOC 1, MOC 10, ADCP	Nothing of note (light scattering near surface).
14	41 12.80 41 12.20	66 59.50 66 57.80	June 6/7 2234 0018	June 7 0234 0418	A9607_14..pro, .raw, .tab	Bongo, CTD, MOC 1, MOC 10, ADCP	Stronger scattering at the surface and a patchy layer between 20 and 40m. The mid water layer is made up of hydroids and isopods. A few very strong surface patches. Hints of waves. Downwelling plumes and an internal wave packet observed en route to station 15.
15	41 02.09 40 59.90	66 41 90 66 40.30	June 7 0221 0424	June 7 0621 0824	A9607_14..pro, .raw, .tab	Bongo, water sample, CTD, MOC 1, MOC 10, ADCP	Internal (possibly lee) waves. Strong scattering at the surface above the wave troughs.

Station	LAT N	LON W	Local Date Time on stn Time off stn	GMT Date Time on stn Time off stn	Data files	Concurrent or overlapping measurments	Remarks
16	40 54.90 40 53.20	66 27.30 66 28.20	June 7 0552 1344	June 7 0952 1744	A9607_16..pro, .raw, .tab	Bongo, Bongo, pump, CTD, MOC 1, MOC 10, ADCP	Thin layers from the surface to 20m. Thick layer between 20 and 30m--probably *Calanus.* A few patches and layers below, but nothing strong or consistent.
17	41 11.90 41 12.00	66 27.50 66 26.90	June 7 1611 1925	June 7 2011 2325	A9607_17..pro, .raw, .tab	Bongo, Pump, CTD, MOC 1, MOC 10, ADCP	Layers, strongest is between 5 and 15 A few internal waves with amplitudes of around 5m and wavelengths of approximately 120-400m were observed while steaming towards 18. The scattering at the surface is slightly stronger over the wave troughs.
18	41 23.40 41 24.90	66 42.03 66 43.80	June 7/8 2138 0022	June 7 0138 0422	A9607_18..pro, .raw, .tab	Bongo, Pump, CTD, MOC 1, MOC 10, ADCP	Typical near surface layer. *The Hunt for the Dead Biomaper* Cell structure becoming more apparent as 19 is approached.
19	41 36.20 41 36.70	66 58.40 66 56.50	June 8 0409 0559	June 8 0809 0959	A9607_19..pro, .raw, .tab	Bongo, CTD, MOC 1, MOC 10, ADCP	Cell structure with high surface concentration in centers, and at edges. Sand in the nets.
20	41 43.70 41 43.50	66 31.90 66 30.80	June 8 0829 1117	June 8 1229 1517	A9607_20..pro, .raw, .tab	Bongo, water sample, Pump, CTD, MOC 1, MOC 10, ADCP	Typical near surface layer (similar to 18).

Station	LAT N	LON W	Local	GMT	Data files	Concurrent or overlapping measurments	Remarks
			Date Time on stn Time off stn	Date Time on stn Time off stn			
21	41 34.50 41 33.70	66 25.60 66 27.30	June 8 1249 1503	June 8 1649 1903	A9607_20..pro, .raw, .tabA9607_21.. pro, .raw, .tabstarted after MOC 1	Bongo, CTD, MOC 1, MOC 10, ADCP	Surface layer and patches around 30m. The surface layer had a jagged bottom near the end of the station that correllated with temperature fluctuations. Maybe a high-frequency internal wave. Front and internal wave packet observed while steaming.
22	41 32.90 41 32.50	66 01.80 66 00.10	June 8 1727 2006	June 8/9 2127 0006	A9607_22..pro, .raw, .tab	Bongo, water sample, CTD, MOC 1, MOC 10, ADCP	Surface layer from 10-26 and a thinner layer near 30m. Also some wispy layers deeper. A strong surface-10m patch at the start of the transect. Later, an internal wave developed.
23	41 46.80 41 47.80	66 11.00 66 12.20	June 8/9 2244 0215	June 9 0244 0615	A9607_23..pro, .raw, .tab	Bongo, Bongo, Pump, Bongo, CTD, MOC 1, MOC 10, ADCP	A temperature and scattering front. Also some strong scattering near the bottom (fishy?). Pteropods and sand lance near surface. Pteropods and amphipods deeper. En route to next station, a surface patch and whisps below. Some very intense scattering near the surface. Something called "fireworks" with soundbite written before it. Maybe some fish schools
24	42 03.00 42 01.90	65 57.00 65 55.50	June 9 0435 0740	June 9 0835 1140	A9607_24..pro, .raw, .tab	Bongo, CTD, MOC 1, MOC 10, ADCP	Typical stratified stuff: surface scattering and whisps below.
25	42 16.80 42 16.50	65 51.00 65 51.90	June 9 0944 1622	June 9 1344 2022	A9607_25..pro, .raw, .tab	Bongo, Bongo, CTD, MOC 1, MOC 10, ADCP	Surface layer and whisps below. A few patches of strong surface scatter. A very dramatic internal wave!

Station	LAT N	LON W	Local	GMT	Data files	Concurrent or overlapping measurments	Remarks
			Date Time on stn Time off stn	Date Time on stn Time off stn			
39	42 07.50 42 07.70	65 59.90 65 58.50	June 9 1756 2254	June 9/10 2156 0254	A9607_39..pro, .raw, .tab	Bongo, water sample, Pump, CTD, MOC 1, MOC 10, ADCP	A few strong surface patches and the usual layers. The surface layer is probably big stuff like amphipods, pteropods and gelatinous zooplankton. A few whispy deeper layers are probably *Calanus*.
26	42 04.50 42 05.35	66 23.50 66 27.04	June 10 0119 0317	June 10 0519 0717	A9607_26..pro, .raw, .tab	Bongo, CTD, MOC 1, MOC 10, ADCP, drifter	Layer from surface to 40m. Petrels found on board. Front in temperature data as we moved on to the Bank, but nothing of interest acoustically.
27	41 56.70 41 56.60	66 41.90 66 42.00	June 10 0519 0743	June 10 0919 1143	A9607_27..pro, .raw, .tab	Bongo, Pump, MOC 1, MOC 10, ADCP	Cloudy patches near the surface with hints of vertical lineations. Also saw several strong patches near the bottom. Fish?
28	42 05.20 42 05.10	66 53.80 66 52.70	June 10 0933 1118	June 10 1312 1918	A9607_28..pro, .raw, .tab	Bongo, CTD, MOC 1, MOC 10, ADCP	Echogram becoming more layerd. Hints of waves, maybe, and more fishy stuff.
29	42 17.10 42 16.60	66 53.50 66 51.80	June 10 1312 1918	June 10 1712 2318	A9607_29. pro	Bongo, CTD, MOC 1, MOC 10, ADCP	Very boring: simple green surface layer composed mostly of pteropods and *Calanus*. En route to station 30, things became interesting: a layer developed around 100m that rose gradually. Just before the bottom became visible, this layer and the surface layer became wavy. The bottom rose rapidly and the wave seemed to break and the mid-layer bifurcated into a surface layer and a layer very close to the bottom. Immediately after the wave broke up, the characteristic convection-like cells were visible. The remainder of the transect consisted of these cells and fish-like echos near the bottom. The topography was very rough and vertical lines were often associated with the peaks.

Station	LAT N	LON W	Local	GMT	Data files	Concurrent or overlapping measurments	Remarks
			Date Time on stn Time off stn	Date Time on stn Time off stn			
30	41 55.20 41 55.83	67 11.60 67 14.48	June 10/11 2224 0059	June 11 0224 0459	A9607_30..pro, .raw, .tab	Bongo, Pump, MOC 1, MOC 10, ADCP	More shallow Bank stuff and fish schools aka. "Lions on the plain" or "Lions at the base of the mountain" depending on topography. Acoustics becoming more layered as we steamed off the Bank. Very rough topography, sometimes with higher scattering above the peaks.
31	42 03.00 42 02.40	67 37.30 67 39.50	June 11 0302 0528	June 11 0702 0928	A9607_31..pro, .raw, .tab	Bongo, Pump, MOC 1, MOC 10, ADCP, drifter	Layers at surface and deeper. Lots of sandlance near the surface (visible from ship). Caught lots of copepods and krill "Nifty" Internal wave at the beginning of transect. Very rough topography, mix of convection patches and layers with on-Bank pattern becoming more apparent closer to the station.
32	41 41.30 41 42.10	67 39.00 67 39.40	June 11 0822 1015	June 11 1222 1415	A9607_32..pro, .raw, .tab	Bongo, CTD, MOC 1, Bongo, MOC 10, ADCP	On-Bank patches and some patches of very strong scattering (probably pteropods). Return of layers, bottom patches, and hints of waves as next station is approached.
33	41 49.20 41 49.86	67 58.30 68 00.53	June 11 1249 1417	June 11 1649 1817	A9607_33..pro, .raw, .tab	Bongo, CTD, MOC 1, MOC 10, ADCP, drifter	"Magnificent" patch from 20-30m. Herring? Layers, but lots of interesting patches.

Station	LAT N	LON W	Local	GMT	Data files	Concurrent or overlapping measurments	Remarks
			Date Time on stn Time off stn	Date Time on stn Time off stn			
34	41 50.90 41 52.40	68 17.50 68 18.10	June 11 1551 2026	June 11/12 1951 0026	A9607_34..pro, .raw, .tab	Bongo, Pump, MOC 1, MOC 10, ADCP	Typical 10-30m layer that is mostly comprised of pteropods. The netters caught a lot of copepods deeper, but these show up only as whispy filaments if at all. The MOC 10 caught a lot of krill in the deep nets. As the net was being hauled up, a layer appeared at the bottom of the screen, moved shallower and became more defined. Probably the krill doing their diel migration. Internal waves as we came back on to the Bank. The first came before a rise in the bathymetry and appeared to break up over the top. The bottom deepened again and a new wave appeared. Somewhat different than the others in that it was most visible in the bottom of the surface layer than in a midwater layer (the midwater layer formed only near the end).
35	41 35.80 41 35.00	68 29.80 68 25.80	June 11/12 2301 0144	June 12 0301 0544	A9607_35..pro, .raw, .tab	Bongo, water sample, MOC 1, MOC 10, ADCP	Moc-1 tow in 100 meters of water... lots of *Meganictyphanes* from 40-15 meters. (90-15?)saw layer at 30 meters to go with it. Moc-10 in 50 meters of water, with an overturning frontal structure high scatter layer that wraps from the surface to 30 meters at the edge of the bump coming up the Bank. Small amplitude surface wave like at 34.
36	41 25.40 41 24.80	68 19.40 68 19.60	June 12 0307 0517	June 12 0707 0917	A9607_36..pro, .raw, .tab	Bongo, Pump, MOC 1, MOC 10, ADCP, drifter	Fish schools (strong enough to be seen below the false bottom) during the Moc-10, probably herring.
37	41 18.20 41 18.70	68 35.70 68 38.00	June 12 0706 0902	June 12 1106 1302	A9607_37..pro, .raw, .tab	Bongo, MOC 1, MOC 10, ADCP, drifter	Scattering from the surface down to 30m. Discrete patches at mid-depths. Lots of fishy echos very close to the bottom.

Station	LAT N	LON W	Local	GMT	Data files	Concurrent or overlapping measurments	Remarks
			Date Time on stn Time off stn	Date Time on stn Time off stn			
38	41 29.10 41 29.30	68 56.60 69 59.10	June 12 1119 1756	June 12 1519 2156	A9607_38..pro, .raw, .tab	4 Bongos, pump, CTD, MOC 1, MOC 10, ringnet, ADCP, 2 drifters	Observed really neat wave on way to station that continued during the first part. There is very little scattering in the water except for clouds coming up from below the echogram, the layers between 10-20m which are waving, and a few fishy patches in between.
Grid Survey	Bongo 41 18.00 MOC 1 41 17.70 Drogue 41 16.70 End 41 17.00	 68 17.10 68 17.70 68 17.00 68 16.60	June 12/13 2238 0047	June 13 0238 0447	A9607_gr..pro, .raw, .tabA9607_gs.. pro, .raw, .tab	Bongo, MOC 1, Pump, ADCP	Ran 1.5 nm grid around a drogue to examine the secondary cell circulation. The cell pattern was more obvious on the legs across the current than on the legs parallell with the current. From the net tows and pump samples, it appears that the scattering is due largely to sand, small copepods (*Centropages*, *Pseudocalanus*), amphipods. lots of post-larval clams, and a few hydroids.