

Acknowledgements

We thank the officers and crew of the RV/ALBATROSS IV for their assistance. Without their help on deck and navigational expertise on the bridge, we would not have data.

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Purpose of the Cruise

AL9403-II (Lough) was one of several cruises in the spring of 1994. It was the second in a series of three RV-ALBATROSS IV cruises. AL9403-I (Madin) preceded ours and the AL9404 (Wiebe) acoustic survey followed ours. RV-COLUMBUS ISELIN cruise CI9407 (Gifford) also followed ours. The AL9403-II sampling operations were conducted on the southern flank of Georges Bank from May 17 - 28, 1993. The location of the sampled grid of stations and the time-series sites are shown in Figure 1 & 2.

The objectives of the cruise were: (1) to determine the abundance and distribution of larval and pelagic juvenile cod and haddock on the southern flank of Georges Bank in relation to water column conditions; and (2) conduct site studies to determine their vertical distribution in relation to water column stratification, diurnal variability, and predator-prey relationships.

Cruise Narrative

After departing Woods Hole on May 17, 0730 h, the sea state beyond Great Round Shoals was too rough for sampling so we returned to Woods Hole by 1800 and departed the next day May 18, 1310. Initially, a grid of stations was sampled on the southern flank of Georges Bank to locate cod and haddock larvae using a 61-cm BONGO-NET equipped with a Seabird CTD (Figures 1 and 2). These series of parallel transects were 10 miles apart and were oriented northwest to southeast from about the 50- to 100-m isobaths. Stations on transects were 5 miles apart. Forty two BONGO-NET hauls were completed from May 18, 2330 to 21 May, 1000. Fish larvae were picked from the 0.505-mm mesh sample, identified and enumerated. Based on the larval haddock catches, an initial Stratified Site I was located approximately in the center of the BONGO-NET grid: 40° 52.0' N, 67° 34.0 W (73-m bottom depth).

At Stratified Site I, the ARGOS/GPS/VHF drifter (Brightwaters Model 140) was fitted with a 6-m "holey sock" drogue at the end of a 10-m tether, deployed on May 21, at 1920 and followed closely as it transmitted its position every 5 minutes to the vessel (Figure 3). The MOCNESS hauls and CTD casts commenced centered on the drifter to follow the same parcel of water in which the larvae were expected to reside. The 1-m² MOCNESS (Multiple Opening Closing Net Environmental Sampling System) with nine nets of 0.333-mm mesh was deployed by the boom off the port side and used to obtain a vertical profile of fish larvae and larger zooplankton. Each net typically sampled the water column in 10-m strata for 5 minutes to strain about 250 m³ of water. The 1/4-m² MOCNESS had nine nets of 0.064-mm mesh and was used to obtain vertical profiles of the smaller zooplankton such as copepod nauplii that are prey for fish larvae. The sampling profile was the same as for the 1-m² MOCNESS, only each net was opened for 2-3 minutes to filter about 25 m³ of water. A 10-m² MOCNESS with five 3.0-mm mesh nets, deployed off the stern, was used to sample the larger pelagic juvenile fish and micro-nekton. The water column was sampled in 20-m strata, each net open about 20 minutes filtering 14,000 m³. Only two 10-m² MOCNESS hauls were made during the cruise period. On site, following the drifter, the 1-m² and 1/4-m² MOCNESS's hauls were usually alternated, with a CTD profile made

before each haul. The MarkV-CTD, Conductivity, Temperature, and Depth measuring system equipped with a fluorometer and rosette water sampler, was deployed from the starboard hydrographic A-frame for both vertical profiles while the vessel was stationary, and for tow-yo sampling while the vessel steamed at 2.5 knots. Larval fish were picked from the MOCNESS samples and frozen in liquid nitrogen for laboratory analysis of biochemical indicators of larval growth and condition and for comparing those results with local prey availability and the monitored hydrographic conditions.

On May 22 the drifter was picked-up and redeployed by 1535 a few miles north on a new Stratified Site II: 40° 55.0' N, 67° 35.0' W (68-m bottom depth), where we expected to find more larvae. MOCNESS and CTD operations resumed until May 23; the drifter was picked-up at 1820 and the final MOCNESS haul was completed at this site by 2330.

A CTD tow-yo section was conducted on May 24 from 0038 to 0412. We arrived at the selected Mixed Site by 0600: 41° 7.0' N, 67° 38.0' W (48-m bottom depth). The drifter was deployed at 0810 and MOCNESS-CTD operations resumed.

On May 25 0900 the drifter was retrieved; we left the Mixed Site by noon and returned to Stratified Site II and resumed MOCNESS-CTD operations by 1400. The drifter was not redeployed because of rolling seas so this site was fixed for sampling operations.

On May 27 0935, we moved 6.5 miles southwest to Stratified Site III: 40° 51.0' N, 67° 41.0' W (68-m bottom depth) since our larval catches were low. MOCNESS-CTD operations continued at this site until 2015 when we departed for Woods Hole. We arrived in Woods Hole on May 28 0900.

Note that the Delaware II conducted operations with the Albatross IV on all stratified and mixed sites.

Individual Reports

Bongo Survey

A patch of larval haddock was located from the BONGO-NET grid of 42 stations on the southern flank of Georges Bank (Fig. 2). The larval patch, identified by haul catches greater than 4, was about 15 x 30 miles in extent, centered on the 70-m isobath. Highest catches were in the range of 10-20 per haul. A few (1-7) cod larvae were caught on most stations, but no identifiable patch. The size of cod and haddock larvae ranged from recently hatched to 14-19 mm; modal size appeared to be 7-8 mm.

Drifter

The drogued drifter was deployed on three occasions, twice in the stratified area and once in the

well-mixed water (Fig. 3). The ship and drifter positions, displayed on a laptop screen, were used to guide the ships track during MOCNESS hauls. The results were satisfactory as most of the MOCNESS hauls intersected the drifter track at about their mid-point. Two of the drifter tracks at Stratified Site I and Mixed Site performed as expected in the bank's circulation having a 10 km semidiurnal tidal excursion and a southwestward mean drift along isobaths of about 12 cm/s (10 km/day). However, on Stratified Site II, May 22-23, the expected tidal excursion was observed but there was little mean drift. The difference is most likely due to changes in the wind pattern during the cruise.

MOCNESS

Fifty three successful MOCNESS hauls were made: 37 1-m² MOCNESS, 14 1/4-m² MOCNESS, and 2 10-m² MOCNESS. Thirty seven hauls were made on the stratified sites and 16 hauls on the mixed site. A single 10-m² MOCNESS haul was made at Stratified Site II and the Mixed Site, and since no pelagic juvenile cod or haddock were caught, this sampler was not used further. Most 1-m² MOCNESS hauls had replicate profiles so that one profile-set of samples could be used for picking larval fish for biochemical analysis. Yellow-tail flounder (*Hippoglossoides platessoides*) were much more abundant than haddock and cod larvae. A total of 2,512 larvae were frozen (1,072 haddock, 236 cod, 1,204 yellow-tail), and 1,803 larvae preserved in alcohol (219 haddock, 56 cod, 1,522 yellow-tail) for otolith analysis. Because of the variability observed in the vertical distribution of larval fish, it was difficult to generalize patterns until all the samples are fully processed.

Hydrography

A total of 131 CTD casts were made which included 58 with the Seabird's Seacat (Figure 4) and 73 with the MarkV-CTD. The later instrument was fitted with a fluorometer. Water bottle samples were processed for chlorophyll calibration at eight of the MarkV-CTD stations at three different depths.

Contours of the horizontal and vertical structure of the bongo grid are plotted for temperature and salinity in Figures 5-15. The vertical sections are labeled in Figure 4. The most significant oceanographic observation was the presence of warm (>13° C), salty (>34 PSU) water impinging on the bank in the southwestern corner of the survey (Figure 5, 6, 7, and 12). Aside from this feature the hydrography of southern flank water of Georges Bank was consistent with expected observations for this time of year (9° C and 33 PSU). Surface water in the stratified area increased to 9-10° C with a thermocline near 12-m depth (Fig. 16). Fluorescence values also increased near the surface (Figure 16).

Two tow-yo sections were conducted during an off-bank phase of the tide in the early hours of May 24. These two sections, taken over a five-hour period, account for 41 of the 73 MarkV-CTD casts. In Figure 17, the most notable feature is the relatively high values of fluorescence near the tidal front and distributed throughout the water column.

Due to persistent cloud cover, very little satellite imagery was available during the cruise. Attempts to download an image via Inmarsat were limited due to the high cost of transmission.

Analysis of available images were radioed to the vessel by Jim Bisagni.

Shipboard Computer System

The shipboard computer system (SCS) worked well. Over a 100 sensors were recorded and logged continuously throughout the cruise. The most useful parameters were accurate GPS, surface salinity and temperature, and wind. The time series of wind speed during the cruise showed a three-day period of 20 knot winds, followed by four days of 10 knot winds, ending with another three days of 20 knot winds (Fig. 18). The affect of these wind periods coincide with the degree of water column stratification observed at the stratified sites.

Acoustic Doppler Current Profiler

An Acoustic Doppler Current Profiler (ADCP) was installed the weekend prior to sailing and tested during the cruise by a technician from NOAA's Atlantic Marine Center. The instrument and software worked fairly well except when the vessel speed exceeded 4 knots and other acoustic pingers caused interference. These problems were resolved on the subsequent cruise.

Scientific Personnel

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References

Mountain, D. and T. J. Holzwarth, 1989, Surface and Bottom Temperature Distribution for the Northeast Continental Shelf, NOAA Tech. Memo. NMFS-F/NEC-73. NMFSC, Woods Hole, Ma. 32p.

Appendix I Data Inventory - Event Log

The bongo, MOCNESS, and CTD physical oceanographic data will be processed at the Northeast Fisheries Science Center in Woods Hole, MA. The Argos/GPS/VHF drifter data will be processed at the Woods Hole Oceanographic Institution, Woods Hole, MA. RNA/DNA analyses of larval fish samples will be conducted at the Northeast Fisheries Science Center, Narragansett, R.I. We hope to have most of this data available via the JGOFS/GBIS within the coming year. For further information contact: Gregory Lough, National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, Massachusetts 02543-1097. Telephone (508) 548-5123.

Instrument codes in event log that follows:

BongoSB = Bongo tow (typically 5-12 minutes) along with Seabird CTD profiler
MrkV CTD = General Oceanics (formally EG&G & Neal Brown) MarkV CTD
Moc1 = 1 meter MOCNESS
Moc10 = 10 meter MOCNESS
Moc1/4 = 1/4 meter MOCNESS
Drifter = Brightwaters Model 105 Drifter with Holey Sock drogue at 10m

event#	Instr	cast#	Sta#	Year	Mth	Day	Hr	Minut	Lat	Lon	Water	Cast	Pl	Region
AL13994.00	BongoSB	24	22	1994	5	19	3	47	4042.5	6813.4	71	71	Lough	bongogrid
AL13994.00	BongoSB	25	23	1994	5	19	6	14	4056.6	6807.5	41	41	Lough	bongogrid
AL13994.00	BongoSB	26	23	1994	5	19	6	25	4056.8	6807.8	41	35	Lough	bongogrid
AL13994.00	BongoSB	27	24	1994	5	19	7	39	4052.5	6804.9	60	56	Lough	bongogrid
AL13994.00	BongoSB	28	25	1994	5	19	8	32	4047.7	6802.9	62	61	Lough	bongogrid
AL13994.00	BongoSB	29	26	1994	5	19	9	31	4043	6759.6	76	71	Lough	bongogrid
AL13994.00	BongoSB	30	27	1994	5	19	10	51	4038	6756.6	87	87	Lough	bongogrid
AL13994.00	BongoSB	31	27	1994	5	19	11	10	4037.8	6755.8	87	84	Lough	bongogrid
AL13994.00	BongoSB	32	28	1994	5	19	11	55	4033.4	6755	95	93	Lough	bongogrid
AL13994.01	BongoSB	33	29	1994	5	19	13	37	4033.5	6739.8	113	104	Lough	bongogrid
AL13994.01	BongoSB	34	30	1994	5	19	14	53	4038	6742.1	75	75	Lough	bongogrid
AL13994.01	BongoSB	35	31	1994	5	19	17	14	4042.6	6744.6	72	69	Lough	bongogrid
AL13994.02	BongoSB	36	31	1994	5	19	17	28	4042.9	6744.5	72	71	Lough	bongogrid
AL13994.02	BongoSB	37	32	1994	5	19	18	27	4047.2	6747.5	66	58	Lough	bongogrid
AL13994.02	BongoSB	38	33	1994	5	19	19	27	4051.7	6750.4	66	62	Lough	bongogrid
AL13994.02	BongoSB	39	34	1994	5	19	20	31	4056.3	6753.8	60	57	Lough	bongogrid
AL13994.02	BongoSB	40	35	1994	5	19	21	19	4101.1	6756	51	44	Lough	bongogrid
AL13994.02	BongoSB	41	36	1994	5	19	22	20	4105.2	6758	40	39	Lough	bongogrid
AL13994.02	BongoSB	42	36	1994	5	19	22	32	4105.3	6757.4	43	41	Lough	bongogrid
AL13994.02	BongoSB	43	37	1994	5	19	23	37	4109	6746.5	41	39	Lough	bongogrid
AL14094.00	BongoSB	44	38	1994	5	20	0	35	4104.4	6744.8	51	49	Lough	bongogrid
AL14094.00	BongoSB	45	39	1994	5	20	1	45	4100	6741	63	47	Lough	bongogrid
AL14094.00	BongoSB	46	39	1994	5	20	2	2	4059.8	6740	64	63	Lough	bongogrid
AL14094.00	BongoSB	47	40	1994	5	20	2	54	4055.6	6738.2	67	66	Lough	bongogrid
AL14094.00	BongoSB	48	41	1994	5	20	4	56	4051.1	6735.4	75	67	Lough	bongogrid
AL14094.00	BongoSB	49	41	1994	5	20	5	9	4051.1	6735.3	75	74	Lough	bongogrid
AL14094.00	BongoSB	50	42	1994	5	20	6	54	4046.5	6733.2	80	75	Lough	bongogrid
AL14094.00	BongoSB	51	43	1994	5	20	8	16	4041.7	6730.5	90	83	Lough	bongogrid
AL14094.00	BongoSB	52	44	1994	5	20	9	36	4037.3	6727.9	92	89	Lough	bongogrid
AL14094.01	BongoSB	54	45	1994	5	20	11	33	4045.9	6718.3	93	93	Lough	bongogrid
AL14094.01	BongoSB	55	45	1994	5	20	11	52	4045.9	6718	95	91	Lough	bongogrid
AL14094.01	BongoSB	56	46	1994	5	20	13	3	4050.5	6721.4	86	86	Lough	bongogrid
AL14094.01	BongoSB	57	47	1994	5	20	14	15	4055	6724.1	78	78	Lough	bongogrid
AL14094.01	BongoSB	58	48	1994	5	20	17	7	4059.6	6727.2	70	66	Lough	bongogrid
AL14094.01	BongoSB	59	48	1994	5	20	17	29	4059.6	6727.1	70	68	Lough	bongogrid
AL14094.01	BongoSB	60	49	1994	5	20	18	30	4104.5	6729.5	60	56	Lough	bongogrid
AL14094.01	BongoSB	61	50	1994	5	20	19	28	4109	6732.7	54	50	Lough	bongogrid
AL14094.01	BongoSB	62	51	1994	5	20	20	23	4113.6	6735.8	38	35	Lough	bongogrid
AL14094.01	BongoSB	63	52	1994	5	20	23	0	4108.3	6718.3	58	56	Lough	bongogrid
AL14094.02	BongoSB	65	52	1994	5	20	23	25	4108.5	6717.6	58	56	Lough	bongogrid

event#	Instr	cas#	Sta#	Year	Mth	Day	Hr	Minut	Lat	Lon	Water	Cast	PI	Region
AL14194.00	BongoSB	66	53	1994	5	21	0	22	4103.5	6714.9	69	66	Lough	bongogrid
AL14194.00	BongoSB	67	54	1994	5	21	1	38	4058.9	6712	76	74	Lough	bongogrid
AL14194.00	BongoSB	68	55	1994	5	21	2	52	4054.4	6709.6	84	81	Lough	bongogrid
AL14194.00	BongoSB	69	56	1994	5	21	4	39	4048.5	6727.1	85	78	Lough	bongogrid
AL14194.00	BongoSB	70	56	1994	5	21	4	56	4048.4	6726.7	86	82	Lough	bongogrid
AL14194.00	BongoSB	71	57	1994	5	21	6	9	4053	6729.2	79	75	Lough	bongogrid
AL14194.00	BongoSB	72	58	1994	5	21	7	35	4057.4	6732.5	66	62	Lough	bongogrid
AL14194.00	BongoSB	73	59	1994	5	21	8	49	4102	6735.1	63	60	Lough	bongogrid
AL14194.00	BongoSB	74	60	1994	5	21	10	18	4058	6746.8	58	55	Lough	bongogrid
AL14194.01	BongoSB	75	60	1994	5	21	10	30	4058.3	6746.2	59	57	Lough	bongogrid
AL14194.01	BongoSB	76	61	1994	5	21	11	20	4053.6	6744.4	66	64	Lough	bongogrid
AL14194.01	BongoSB	77	62	1994	5	21	12	40	4049	6741.6	69	68	Lough	bongogrid
AL14194.01	BongoSB	78	63	1994	5	21	14	0	4043.9	6739	77	75	Lough	bongogrid
AL14194.01	MOC1	1100	1994	1994	5	21	19	42	4051.4	6734.7	72	68	Lough	Drifter
AL14194.01	MOC1	1100	1994	1994	5	21	20	56	4053.6	6732.3	73	68	Lough	Drifter
AL14194.01	MirV CT	1	1994	1994	5	21	21	21	4054	6732	72	71	Manning	Drifter
AL14294.00	Drifter	1	1994	1994	5	22	0	15	4052	6733.9	78	13	Churchill	Drifter
AL14294.00	MOC1	1101	1994	1994	5	22	0	46	4051.5	6734.9	75	70	Lough	Drifter
AL14294.00	MOC1	1101	1994	1994	5	22	1	50	4052.1	6731.1	75	73	Lough	Drifter
AL14294.00	MirV CT	2	1994	1994	5	22	2	18	4051.6	6732	76	73	Manning	Drifter
AL14294.00	MOC1/4	1102	1994	1994	5	22	4	13	4049.7	6731.2	77	70	Lough	Drifter
AL14294.00	MOC1/4	1102	1994	1994	5	22	4	43	4049	6730	79	70	Lough	Drifter
AL14294.00	MirV CT	3	1994	1994	5	22	5	26	4048.5	6730.7	81	73	Manning	Drifter
AL14294.00	MOC1	1103	1994	1994	5	22	6	1	4047.7	6731.8	79	70	Lough	Drifter
AL14294.01	MOC1	1103	1994	1994	5	22	7	3	4047.9	6730	81	70	Lough	Drifter
AL14294.01	MOC1	1104	1994	1994	5	22	10	28	4048.3	6736.1	73	70	Lough	Drifter
AL14294.01	MOC1	1104	1994	1994	5	22	11	33	4050.6	6733.9	75	70	Lough	Drifter
AL14294.01	MirV CT	4	1994	1994	5	22	12	33	4050.4	6735.5	77	73	Manning	Drifter
AL14294.01	MOC1	1105	1994	1994	5	22	13	5	4050.4	6736.7	71	67	Lough	Drifter
AL14294.01	MOC1	1105	1994	1994	5	22	14	15	4050.4	6732.6	76	67	Lough	Drifter
AL14294.01	MOC1/4	1106	1994	1994	5	22	15	34	4049.5	6734.8	72	70	Lough	Drifter
AL14294.01	MOC1/4	1106	1994	1994	5	22	16	2	4049.3	6733.4	75	70	Lough	Drifter
AL14294.01	MirV CT	5	1994	1994	5	22	16	37	4048.7	6733.4	76	74	Manning	Drifter
AL14294.01	Drifter	1	1994	1994	5	22	17	5	4048.4	6733.6	76	13	Churchill	Drifter
AL14294.02	Drifter	2	1994	1994	5	22	18	43	4055.1	6735.1	68	13	Churchill	Drifter
AL14294.02	MOC1	1107	1994	1994	5	22	18	50	4054.9	6736.4	70	60	Lough	Drifter
AL14294.02	MOC1	1107	1994	1994	5	22	19	51	4054.4	6734.6	73	60	Lough	Drifter
AL14294.02	MirV CT	6	1994	1994	5	22	20	12	4054	6736.6	68	63	Manning	Drifter
AL14294.02	MOC1	1108	1994	1994	5	22	21	29	4055.5	6739.3	69	60	Lough	Drifter
AL14294.02	MOC1	1108	1994	1994	5	22	22	20	4056.3	6737.6	66	49	Lough	Drifter

deployed

bottles ml

New Ter

BOTTLE

recovery

deployed

event#	Instr	cast#	Sta#	Year	Mth	Day	Hr	Minut	Lat	Lon	Water	Cast	PI	Region	Recovery
AL14294.02	MrkV CT	7		1994	5	22	22	54	4057.4	6739	67	56	Manning	Drifter	
AL14294.02	MOC1/4	1109		1994	5	22	23	37	4058.6	6739.8	63	49	Lough	Drifter	
AL14394.00	MOC1/4	1109		1994	5	23	0	2	4059.1	6738.7	63				
AL14394.00	MOC1	1110		1994	5	23	1	24	4100.7	6738.8	60	49	Lough	Drifter	
AL14394.00	MOC1	1110		1994	5	23	2	24	4059.2	6736	63				
AL14394.00	MOC1	1111		1994	5	23	4	29	4058.7	6735	63	49	Lough	Drifter	
AL14394.00	MOC1	1111		1994	5	23	5	31	4056	6733.2	68				
AL14394.00	MOC1	1112		1994	5	23	7	36	4056.4	6734	67	60	Lough	Drifter	
AL14394.00	MOC1	1112		1994	5	23	8	34	4054.2	6735.5	72	60	Lough	Drifter	
AL14394.00	MOC1	1113		1994	5	23	10	42	4056.9	6738.9	65	49	Lough	Drifter	
AL14394.00	MOC1	1113		1994	5	23	11	48	4055.9	6739.9	65				
AL14394.01	MOC1	1114		1994	5	23	14	19	4101.2	6738.4	61	49	Lough	Drifter	
AL14394.01	MOC1	1114		1994	5	23	15	9	4059.5	6737.7	62				
AL14394.01	MOC1/4	1115		1994	5	23	16	34	4100	6735.9	62	49	Lough	Drifter	
AL14394.01	MOC1/4	1115		1994	5	23	16	58	4058.8	6735.5	64				
AL14394.01	MOC1/4	1116		1994	5	23	18	34	4056.7	6735.2	66	49	Lough	Drifter	
AL14394.01	MOC1/4	1116		1994	5	23	19	25	4057	6735.2	66				
AL14394.01	MOC1	1117		1994	5	23	20	42	4056.1	6737.3	66	60	Lough	Drifter	
AL14394.01	MOC1	1117		1994	5	23	21	36	4056.3	6735.8	67				
AL14394.01	Drifter	2		1994	5	23	22	20	4057	6737.9				Churchill	Recovery
AL14394.01	MOC1/4	1118		1994	5	23	22	56	4056.3	6737.3	65	60	Lough	Drifter	ABORTE
AL14394.02	MOC1/4	1118		1994	5	23	23	10	4056.3	6735.8	65				
AL14394.02	MOC1/4	1119		1994	5	23	23	56	4058.5	6737.1	65	60	Lough	Drifter	
AL14494.00	MOC1/4	1119		1994	5	24	0	27	4058	6737.2	65				
AL14494.00	MOC10	1120		1994	5	24	1	35	4058.4	6736.5	65	60	Lough	Drifter	
AL14494.00	MOC10	1120		1994	5	24	2	58	4054.7	6735	68				
AL14494.00	MrkV CT	13		1994	5	24	5	38	4100	6735	65	49	Manning	Front	Tow-Yo#1
AL14494.005		23		1994	5	24	6	29	4057	6732.9	70				
AL14494.00	MrkV CT	24		1994	5	24	6	41	4057	6732.9	70	49	Manning	Front	Tow-Yo#2
AL14494.007		54		1994	5	24	9	12	4103.5	6738.6	56				
AL14494.00	MOC1/4	1121		1994	5	24	10	47	4107.7	6739.8	48	60	Lough	Mixed	
AL14494.00	MOC1/4	1121		1994	5	24	11	15	4107.8	6739.6	48				
AL14394.01	Drifter	3		1994	5	24	12	0	4107.4	6739.2				Churchill	Drifter
AL14494.01	MOC1	1122		1994	5	24	12	40	4107.8	6740.2	48	60	Lough	Mixed	
AL14494.01	MOC1	1122		1994	5	24	13	49	4109.2	6737.7	50				
AL14494.01	MrkV CT	55		1994	5	24	15	5	4110.2	6738.1	53	49	Manning	Mixed	
AL14494.01	MOC1	1123		1994	5	24	15	35	4109.8	6739.4	50	60	Lough	Mixed	
AL14494.01	MOC1	1123		1994	5	24	16	36	4109.5	6735.3	50				
AL14494.01	MrkV CT	56		1994	5	24	17	0	4108.8	6735.9	51	49	Manning	Mixed	
AL14494.01	MOC1/4	1124		1994	5	24	17	33	4108.9	6736.2	51	60	Lough	Mixed	

event#	Instr	cast#	Sta#	Year	Mth	Day	Hr	Minut	Lat	Lon	Water	Cast	PI	Region
AL14494.01	MOC1/4	1124		1994	5	24	18	1	4107.1	6735	53			
AL14494.01	MOC1	1125		1994	5	24	18	41	4106.7	6735.6	52	60	Lough	Mixed
AL14494.02	MOC1	1125		1994	5	24	18	54	4105.9	6735.3	54			ABORTE
AL14494.02	MOC1	1126		1994	5	24	19	28	4105.7	6736	53	60	Lough	Mixed
AL14494.02	MOC1	1126		1994	5	24	20	19	4103.4	6735.8	58			
AL14494.02	MOC1	1127		1994	5	24	21	19	4104.1	6738.8	55	60	Lough	Mixed
AL14494.02	MOC1	1127		1994	5	24	22	11	4102.6	6739.2	57			
AL14494.02	MrkV CT	57		1994	5	24	22	50	4103.8	6740.7	55	49	Manning	Mixed
AL14494.02	MOC1/4	1128		1994	5	24	23	38	4105.4	6742.2	44	60	Lough	Mixed
AL14594.00	MOC1/4	1128		1994	5	25	0	14	4105.2	6742.6	44			
AL14594.00	MOC1	1129		1994	5	25	0	37	4108.7	6743	46	60	Lough	Mixed
AL14594.00	MOC1	1129		1994	5	25	2	32	4107.7	6742.4	48			
AL14594.00	MrkV CT	58		1994	5	25	3	15	4108.5	6741.7	53	67	Manning	Mixed
AL14594.00	MOC1	1130		1994	5	25	4	29	4108.2	6740.6	47	60	Lough	Mixed
AL14594.00	MOC1	1130		1994	5	25	5	21	4105.9	6737.6	52			
AL14594.00	MrkV CT	59		1994	5	25	7	18	4102.5	6737.6	60	67	Manning	Mixed
AL14594.00	MOC1	1131		1994	5	25	7	49	4100.7	6738.3	60	60	Lough	Mixed
AL14594.00	MOC1	1131		1994	5	25	8	39	4101.3	6739.3	59			
AL14594.01	MOC1	1132		1994	5	25	10	35	4059.8	6743.1	56	60	Lough	Mixed
AL14594.01	MOC1	1132		1994	5	25	11	43						
AL14594.01	MrkV CT	60		1994	5	25	12	16	4101.4	6744.6	55	67	Manning	Mixed
AL14394.01	Drifter	3		1994	5	25	13	0	4102.5	6745.5			Churchill	Drifter
AL14594.01	MOC1	1133		1994	5	25	13	35	4103.2	6745.9	53	60	Lough	Mixed
AL14594.01	MOC1	1133		1994	5	25	15	19						
AL14594.01	MrkV CT	61		1994	5	25	16	33	4055.1	6734.8	71	67	Manning	Stratified
AL14594.01	MOC1	1134		1994	5	25	16	56	4055	6734.6	68	60	Lough	Mixed
AL14594.01	MOC1	1134		1994	5	25	18	9	4052.9	6735.9	69			
AL14594.01	MrkV CT	62		1994	5	25	19	9	4054.5	6734.6	71	67	Manning	Stratified
AL14594.02	MOC1/4	1135		1994	5	25	19	22	4054.4	6734.7	69	60	Lough	Stratified
AL14594.02	MOC1/4	1135		1994	5	25	19	49	4054.3	6735.8	68			
AL14594.02	MrkV CT	63		1994	5	25	20	10	4055	6734.9	71	67	Manning	Stratified
AL14594.02	MOC1	1136		1994	5	25	20	50	4055	6733.9	69	60	Lough	Stratified
AL14594.02	MOC1	1136		1994	5	25	21	59	4055.2	6737.5	71			
AL14594.02	MrkV CT	64		1994	5	25	22	30	4054.9	6735	71	67	Manning	Stratified
AL14594.02	MOC1/4	1137		1994	5	25	22	54	4054.9	6734.1	69	60	Lough	Stratified
AL14594.02	MOC1/4	1137		1994	5	25	23	25						
AL14594.02	MrkV CT	65		1994	5	25	23	50	4055.1	6735.6	72	67	Manning	Stratified
AL14694.00	MrkV CT	66		1994	5	26	0	5	4055.6	6735.7	71	69	Manning	Stratified
AL14694.00	MOC1/4	1138		1994	5	26	0	41	4055.7	6735.2	68	60	Lough	Stratified
AL14694.00	MOC1/4	1138		1994	5	26	1	12						

Recovery

event#	Instr	cast#	Sta#	Year	Mth	Day	Hr	Minut	Lat	Lon	Water	Cast	PI	Region
AL14694.00	MrKV CT	67		1994	5	26	1	40	4055.1	6735.6	71	69	Manning	Stratified
AL14694.00	MOC1	1139		1994	5	26	2	14	4055.2	6734.3	69	60	Lough	Stratified
AL14694.00	MrKV CT	68		1994	5	26	3	9	4055	6735	70	70	Manning	Stratified
AL14694.00	MOC1	1139		1994	5	26	3	26	4055.6	6736.4	68	60	Lough	Stratified
AL14694.00	MOC1	1140		1994	5	26	5	35	4054.7	6734.6	68	60	Lough	Stratified
AL14694.00	MOC1	1140		1994	5	26	6	45	4055.2	6735.3	67	60	Lough	Stratified
AL14694.01	MOC1	1141		1994	5	26	8	14	4055	6733.8	68	60	Lough	Stratified
AL14694.01	MOC1	1141		1994	5	26	9	23	4054.4	6736.9	68	60	Lough	Stratified
AL14694.01	MrKV CT	69		1994	5	26	9	50	4055	6735	69	68	Manning	Stratified
AL14694.01	MOC1	1142		1994	5	26	11	10	4055	6733.7	69	60	Lough	Stratified
AL14694.01	MOC1	1142		1994	5	26	11	20	4055	6733.7	69	60	Lough	Stratified
AL14694.01	MOC1	1143		1994	5	26	11	44	4055.1	6733.4	69	60	Lough	Stratified
AL14694.01	MOC1	1143		1994	5	26	12	54	4056.1	6737.8	66	60	Lough	Stratified
AL14694.01	MrKV CT	70		1994	5	26	13	55	4054.9	6735.6	71	68	Manning	Stratified
AL14694.01	MOC1/4	1144		1994	5	26	15	35	4055.1	6734.2	69	60	Lough	Stratified
AL14694.01	MOC1/4	1144		1994	5	26	16	10	4055.6	6735.5	68	60	Lough	Stratified
AL14694.02	MrKV CT	71		1994	5	26	16	55	4055.1	6734.1	72	70	Manning	Stratified
AL14694.02	MOC1	1145		1994	5	26	17	16	4054.9	6734.6	68	60	Lough	Stratified
AL14694.02	MOC1	1145		1994	5	26	18	7	4053.4	6735.1	69	60	Lough	Stratified
AL14694.02	MOC1	1146		1994	5	26	18	53	4056	6734.8	67	60	Lough	Stratified
AL14694.02	MOC1	1146		1994	5	26	20	3	4052.9	6735.7	69	60	Lough	Stratified
AL14694.02	MOC1/4	1147		1994	5	26	21	6	4055.7	6734.3	68	60	Lough	Stratified
AL14694.02	MOC1/4	1147		1994	5	26	21	40	4054.6	6735.2	68	60	Lough	Stratified
AL14694.02	MrKV CT	72		1994	5	26	22	36	4055.3	6734.6	71	49	Manning	Stratified
AL14694.02	MOC1	1148		1994	5	26	23	5	4055.8	6734.1	69	60	Lough	Stratified
AL14794.00	MOC1	1148		1994	5	27	0	21	4054.9	6737.6	68	49	Manning	Stratified
AL14794.00	MrKV CT	73		1994	5	27	1	40	4054.7	6735	71	60	Lough	Stratified
AL14794.00	MOC1	1149		1994	5	27	1	50	4055	6735.1	69	49	Manning	Stratified
AL14794.00	MOC1	1149		1994	5	27	3	6	4054.6	6737.4	68	60	Lough	Stratified
AL14794.00	MOC1	1150		1994	5	27	5	39	4054.7	6734.6	69	60	Lough	Stratified
AL14794.00	MOC1	1150		1994	5	27	6	50	4052.1	6735.2	70	60	Lough	Stratified
AL14794.00	SB	79		1994	5	27	8	36	4055.6	6734.1	67	63	Lough	BongoGrid
AL14794.00	MOC1	1151		1994	5	27	8	50	4055.2	6734.2	69	60	Lough	Stratified
AL14794.00	MOC1	1151		1994	5	27	9	20	4056	6734.6	67	60	Lough	Stratified
AL14794.01	MOC1	1152		1994	5	27	9	45	4055.2	6738.3	66	60	Lough	Stratified
AL14794.01	MOC1	1152		1994	5	27	10	58	4051.4	6740.4	66	60	Lough	Stratified
AL14794.01	MOC1	1153		1994	5	27	13	2	4051.4	6744.5	63	60	Lough	Stratified
AL14794.01	MOC1	1153		1994	5	27	14	18	4051.4	6741.6	69	60	Lough	Stratified
AL14794.01	MOC1/4	1154		1994	5	27	15	52	4051.1	6741.6	69	60	Lough	Stratified
AL14794.01	MOC1/4	1154		1994	5	27	16	10	4051.1	6741.6	69	60	Lough	Stratified

ABORTE

ABORTE

ABORTE

event#	Instr	cast#	Sta#	Year	Mth	Day	Hr	Minut	Lat	Lon	Water Cast	PI	Region
AL14794.01	MOC1/4	1155		1994	5	27	17	20	4051.2	6740.4	69	60	Lough Stratified
AL14794.01	MOC1/4	1155		1994	5	27	17	45	4051.9	6740.4	68		
AL14794.01	SB	80		1994	5	27	18	16	4051	6740.8	68	68	Lough BongoGrid
AL14794.01	MOC1	1156		1994	5	27	18	32	4050.9	6740.1	67	60	Lough Stratified
AL14794.02	MOC1	1156		1994	5	27	19	39	4051.4	6737.6	68		
AL14794.02	SB	81		1994	5	27	21	6	4050.3	6739.8	67	68	Lough BongoGrid
AL14794.02	MOC1	1157		1994	5	27	21	23	4050.3	6739.3	67	60	Lough Stratified
AL14794.02	MOC1	1157		1994	5	27	22	23	4050.3	6738	69		
AL14794.02	MOC1/4	1158		1994	5	27	23	11	4050.5	6742.1	67	60	Lough Stratified
AL14794.02	MOC1/4	1158		1994	5	27	23	46	4051.1	6741.7	67		
AL14894.00	SB	82		1994	5	28	0	9	4051.2	6741.8	70	67	Manning Stratified

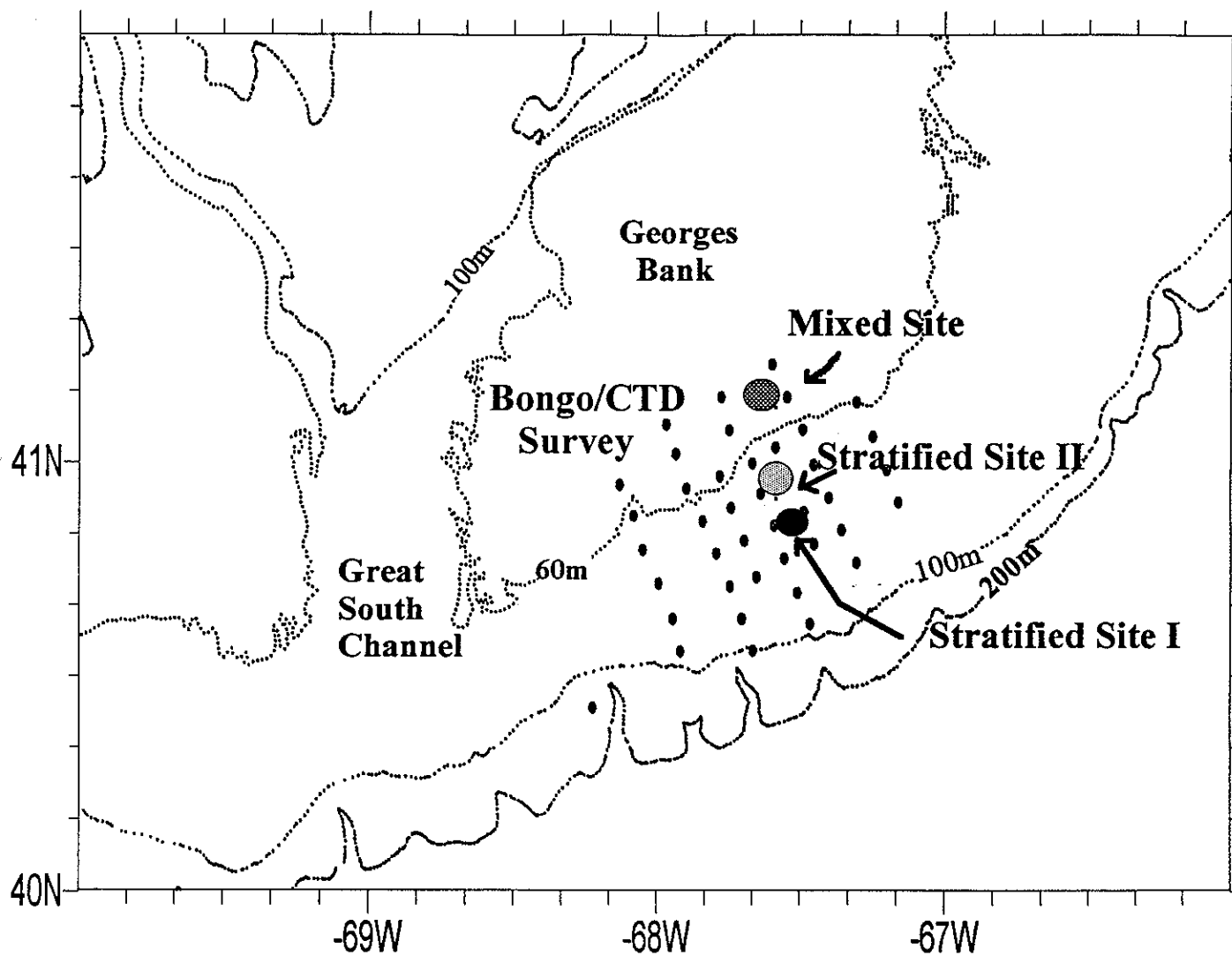


Figure 1. Small dots represent bongo/ctd cast. A drifter was deployed at each of the designated sites.

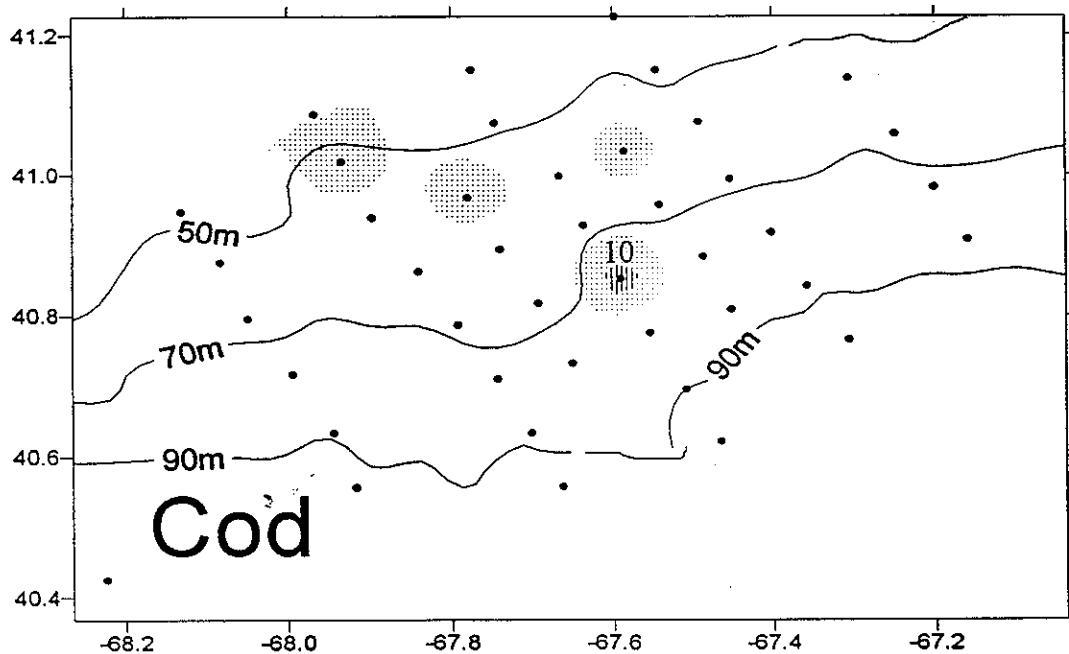
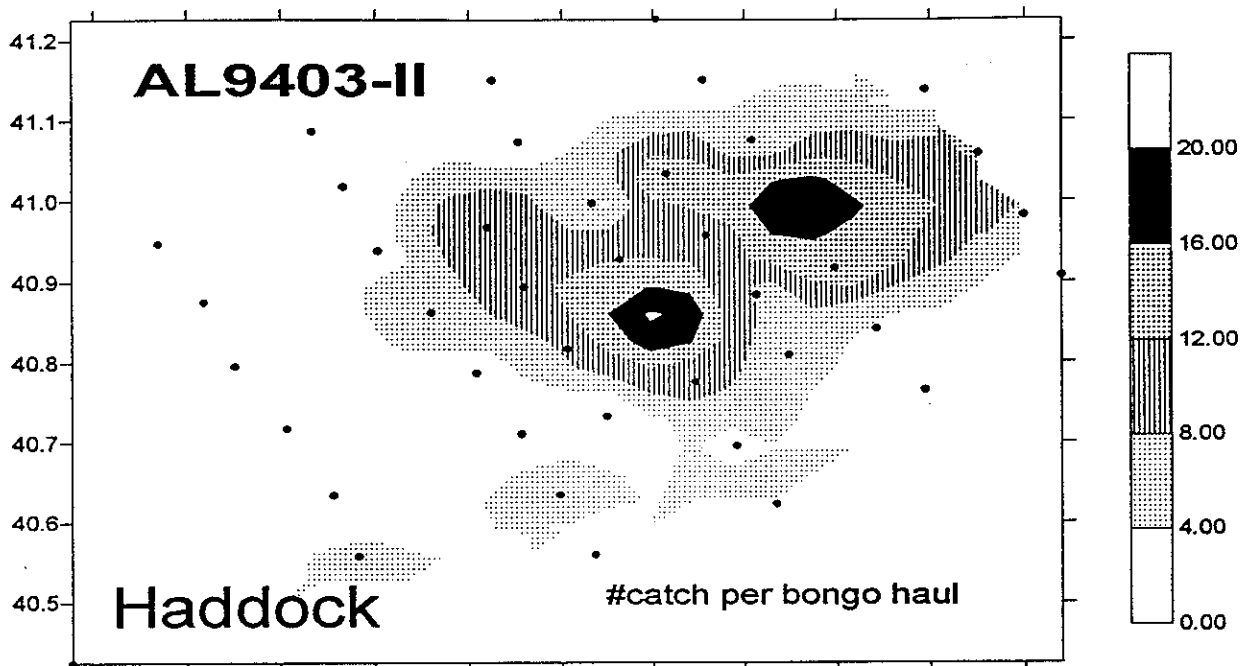


Figure 2. Grid of stations on the southern flank of Georges Bank sampled with BONGO-NET showing shaded contours of larval haddock and cod, May 19-21, 1994, Albatross IV 9403(II). Line contours of bottom depth (50,70,and 90m) are drawn in the bottom panel.

Georges Bank May 1994 drifter tracks

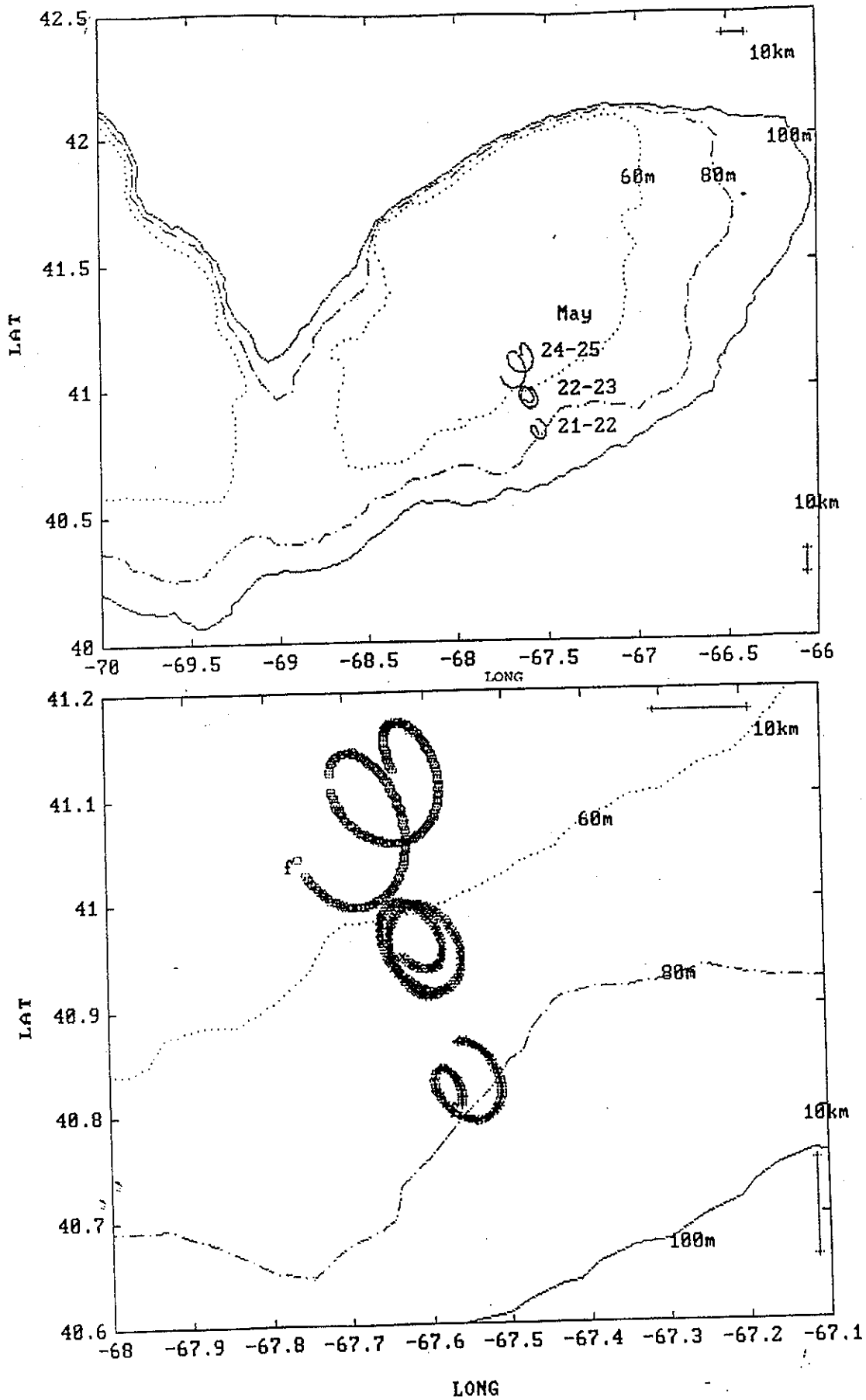


Figure 3. Large scale (upper panel) and small scale (lower panel) view of drifter tracking during the AL9403II cruise. Stratified Site I: 0020-1700 GMT May 22; Stratified Site II: 1835 May 22 - 2220 May 23; Mixed Site: 1200 May 24 - 1300 May 25.

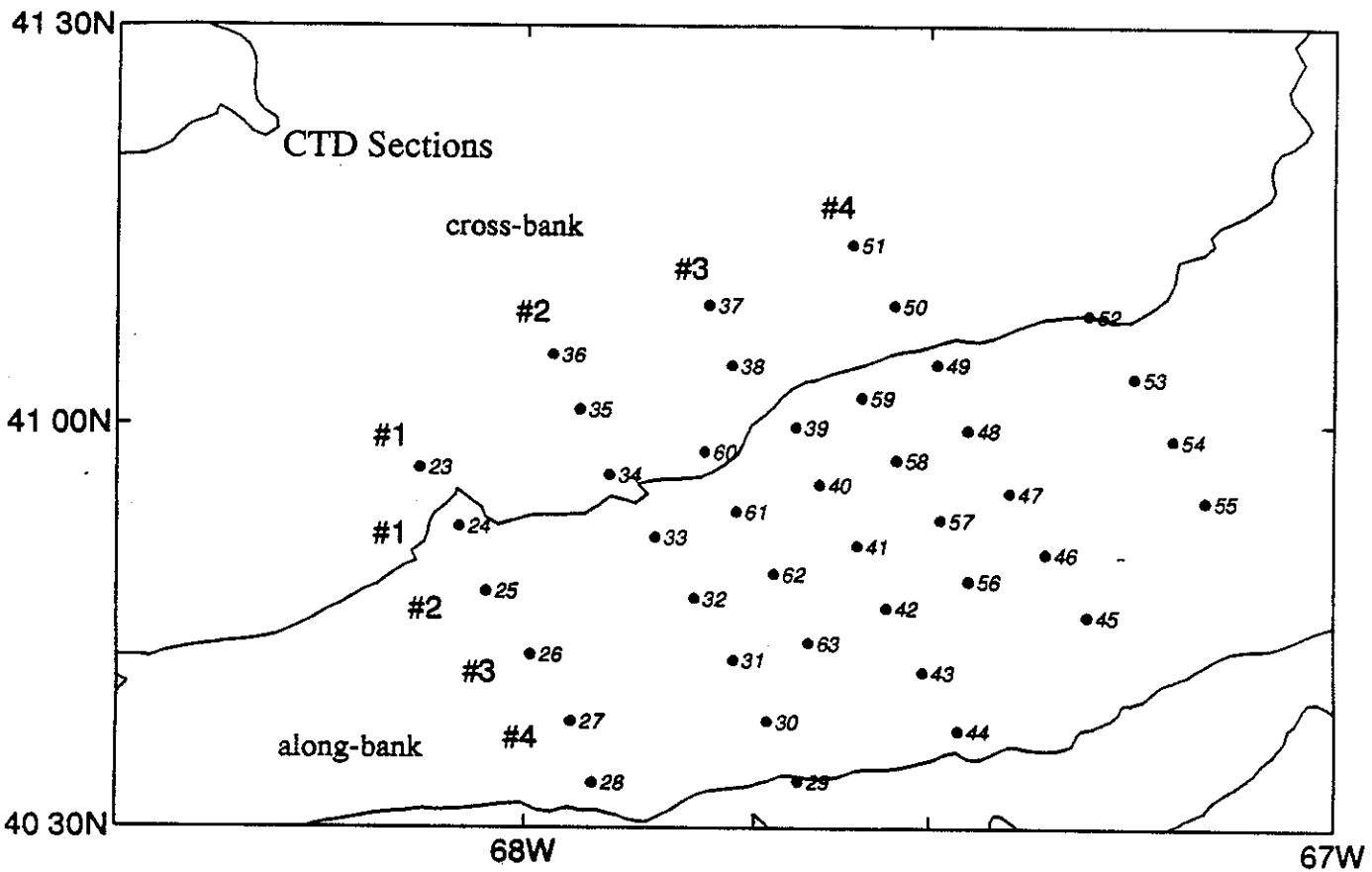


Figure 4. Bongo/CTD grid with cross-sections labeled. Along-bank and cross-bank are labeled separately.

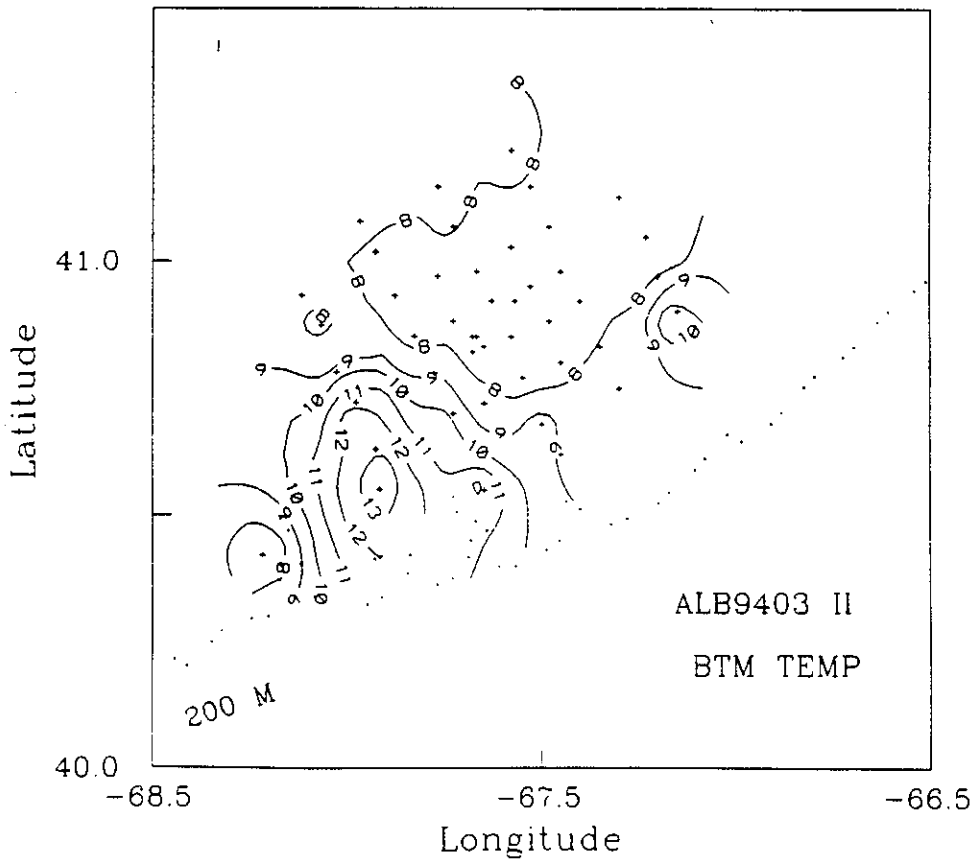
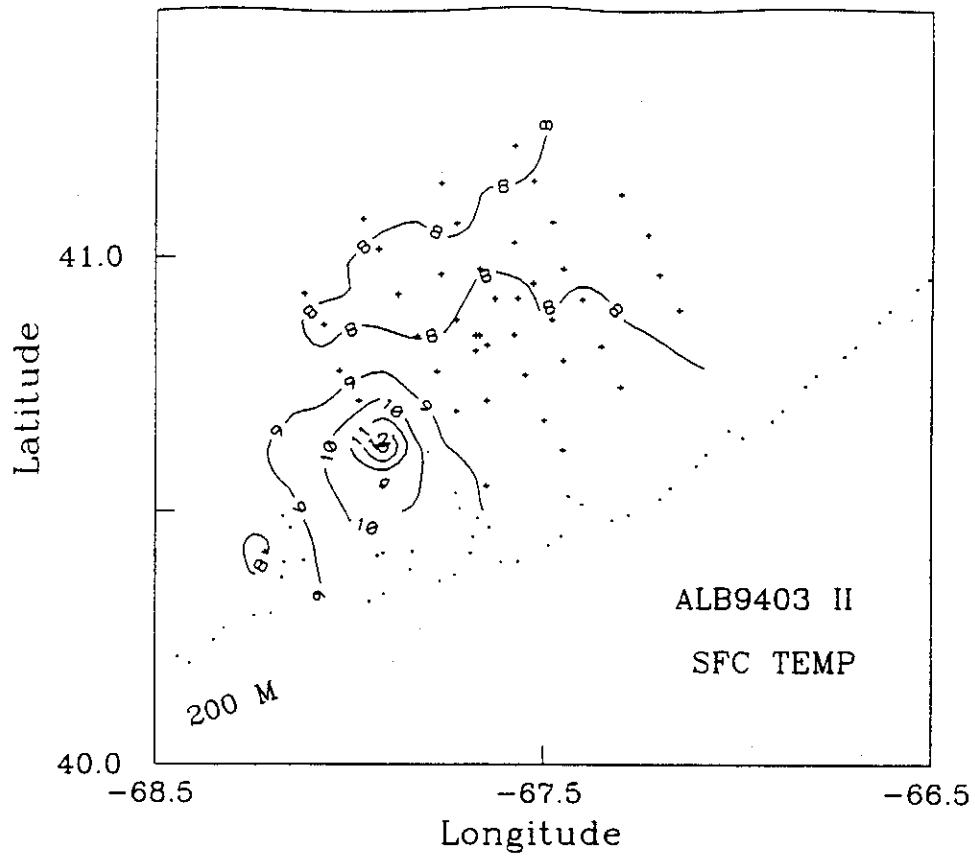


Figure 5. AL9403II temperature ($^{\circ}\text{C}$) distribution at the surface (top) and bottom (bottom) as measured by the Seabird CTD cast.

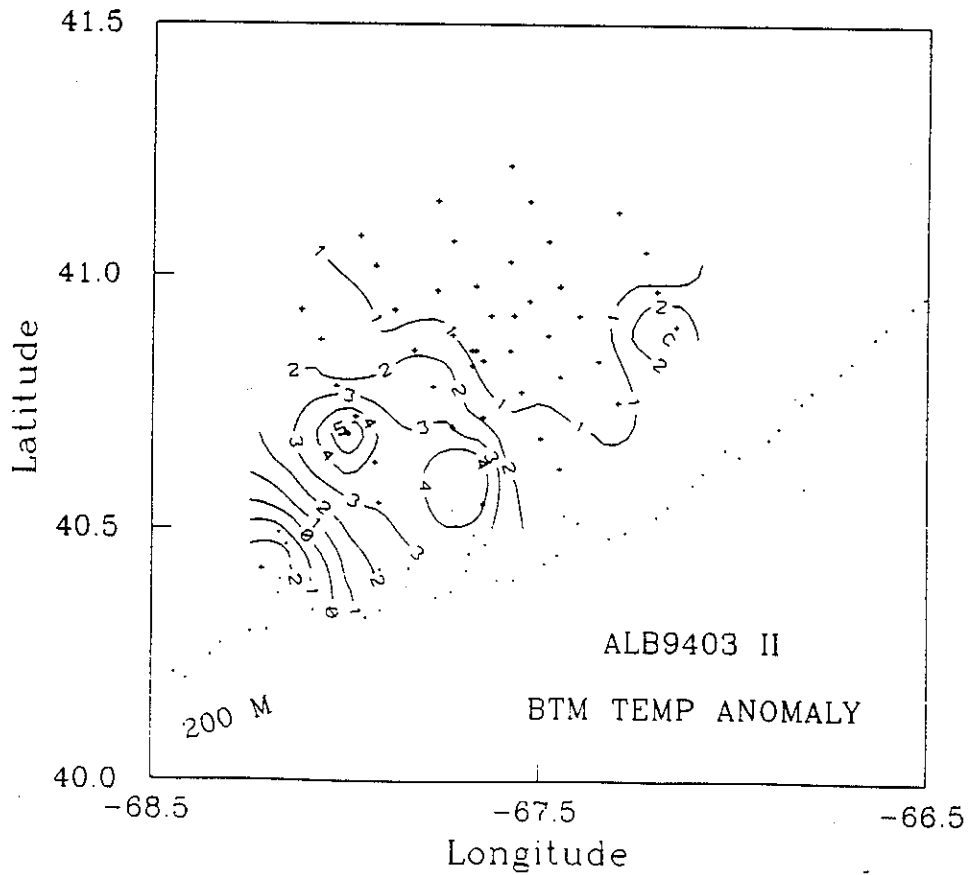
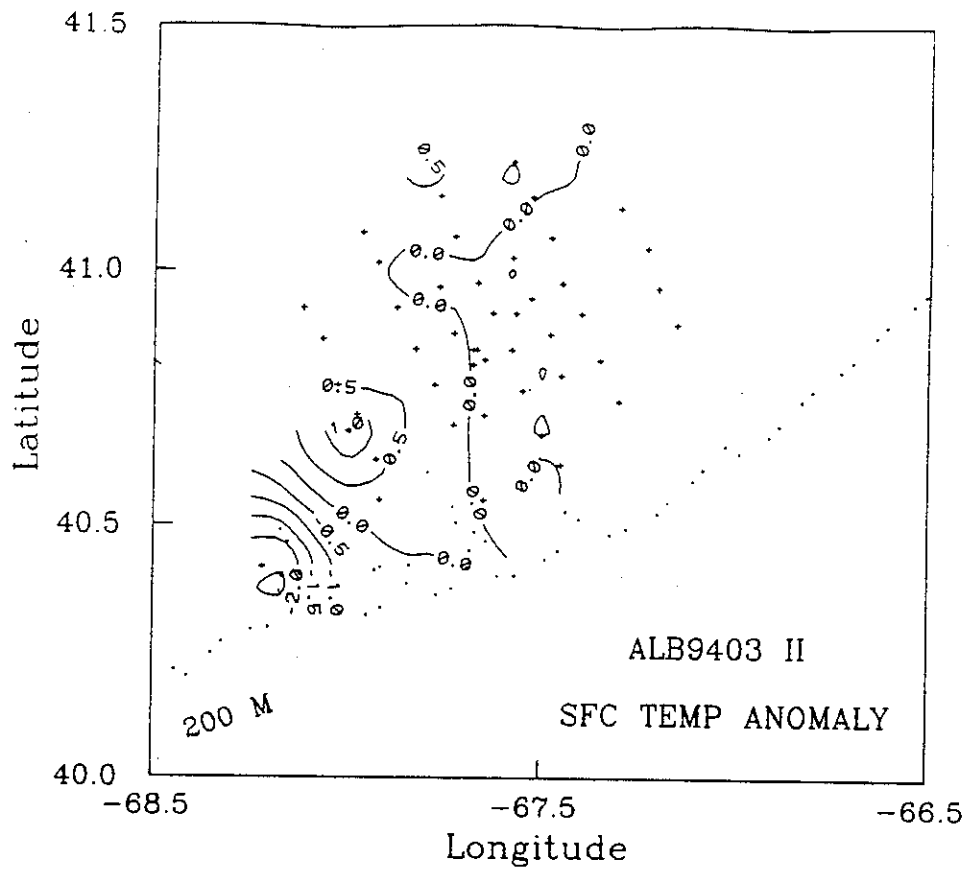


Figure 6. AL9403II temperature anomaly distribution at the surface (top) and bottom (bottom) as measured by the Seabird CTD cast relative to the 10-year MARMAP mean for these sites (Mountain and Holzwarth, 1989).

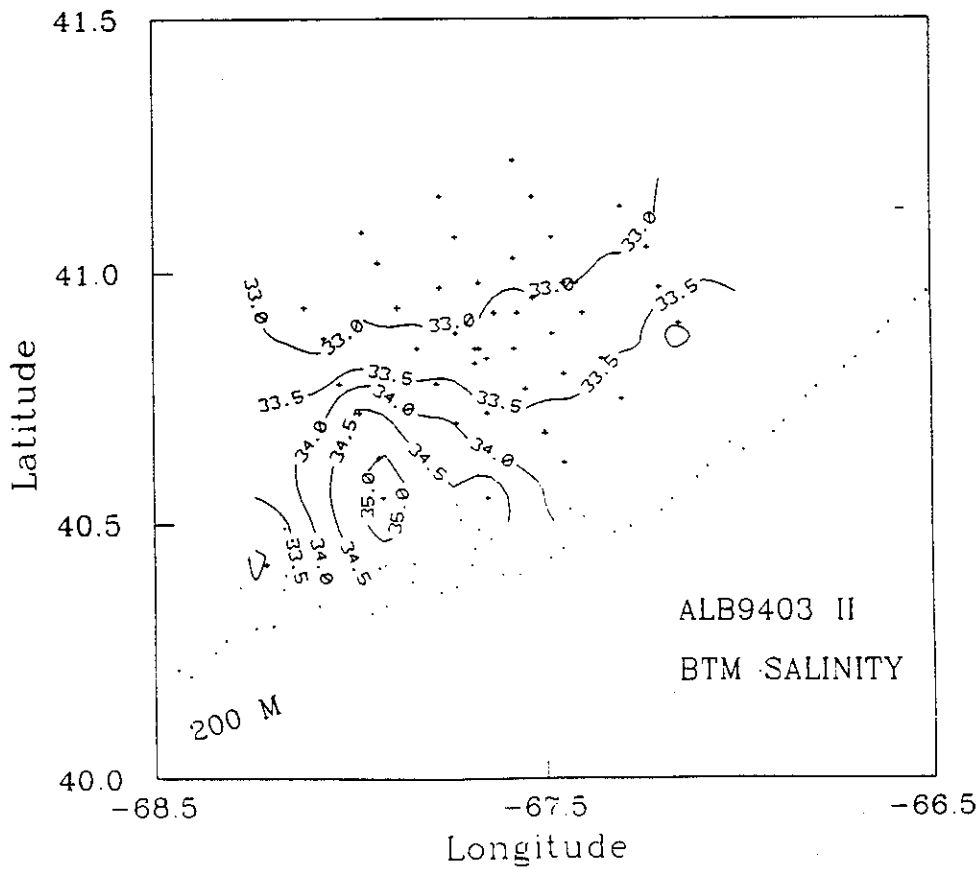
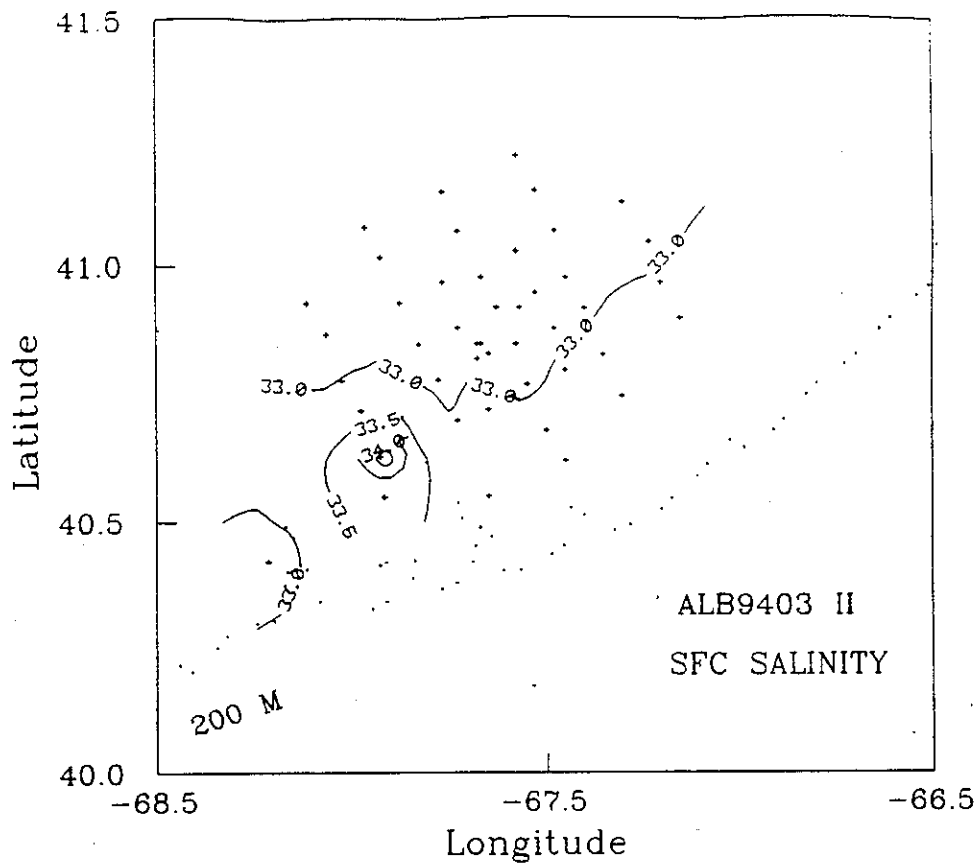


Figure 7. AL9403II salinity distribution at the surface (top) and bottom (bottom) as measured by the Seabird CTD cast.

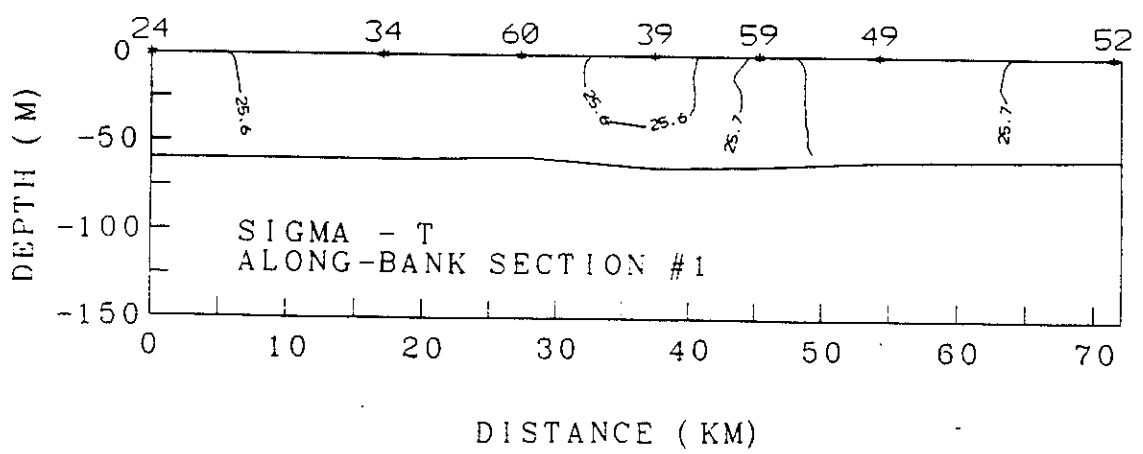
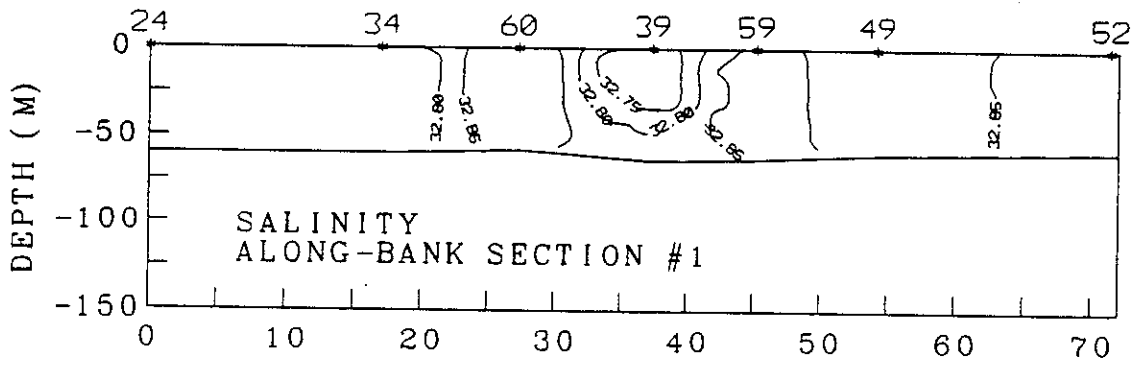
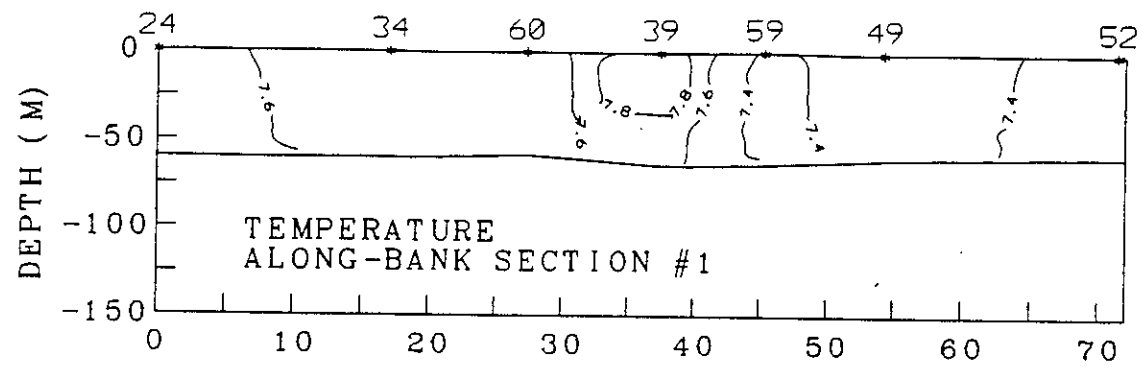


Figure 8. Along-bank CTD section #1 on AL9403II.

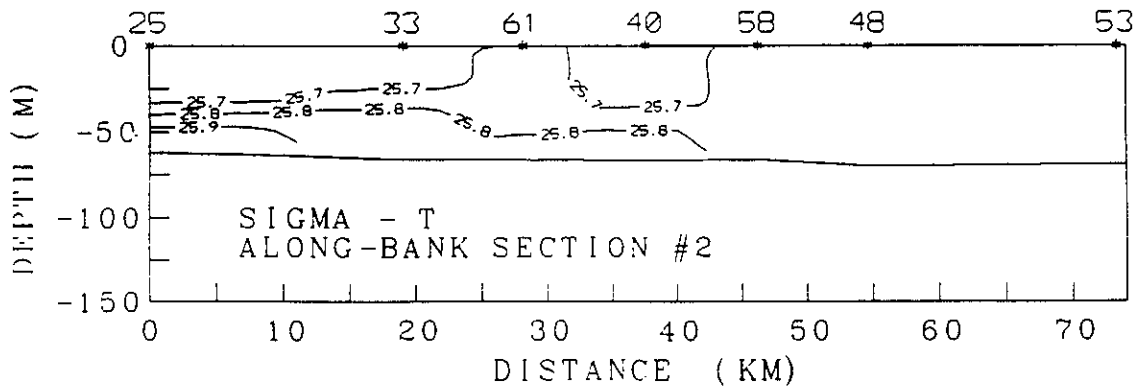
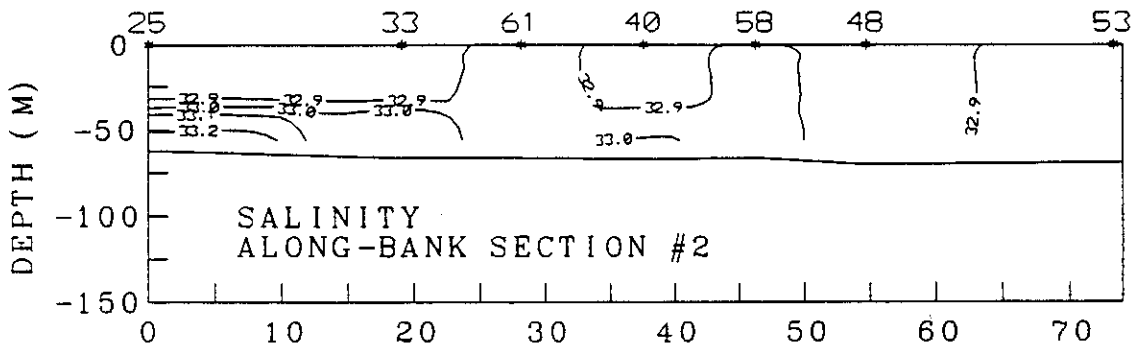
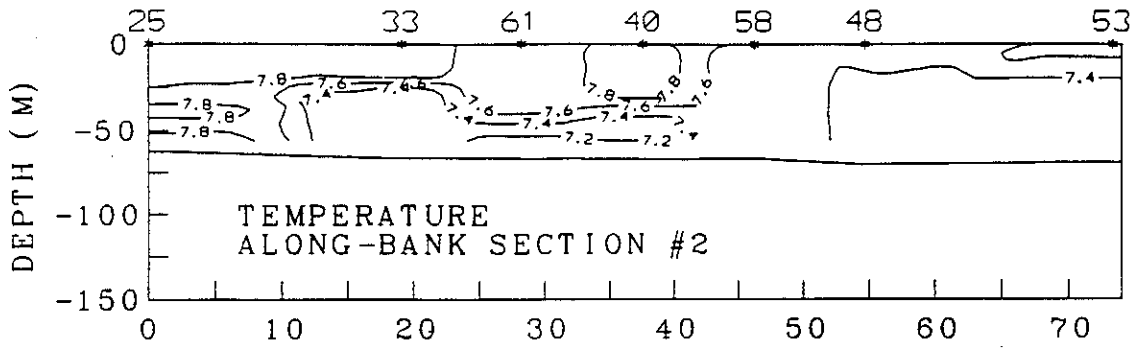


Figure 9. Along-bank CTD section #2 on AL9403II.

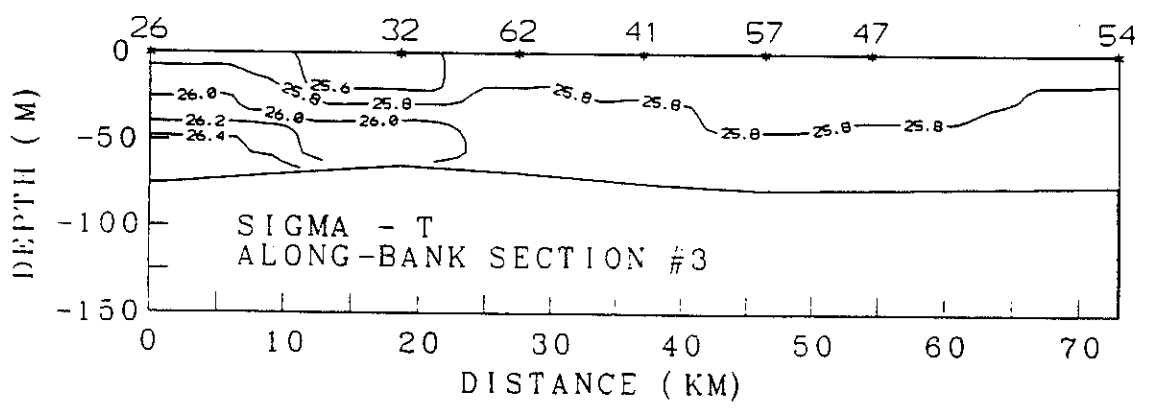
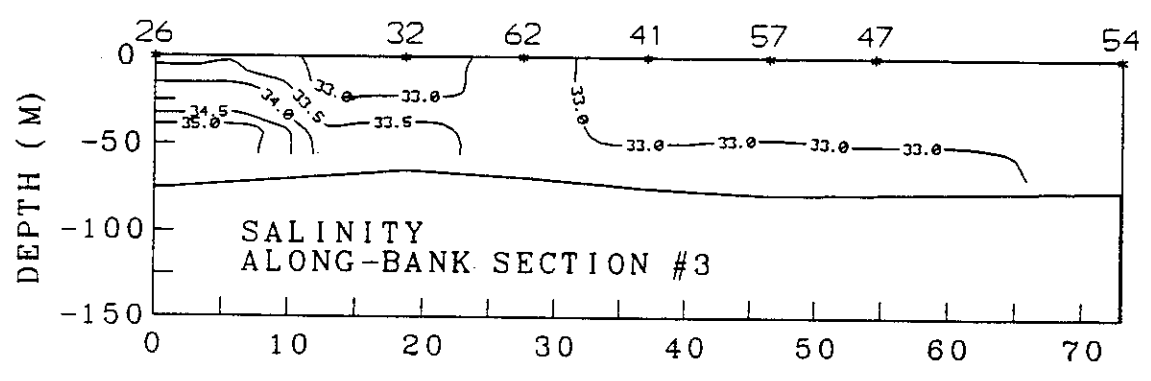
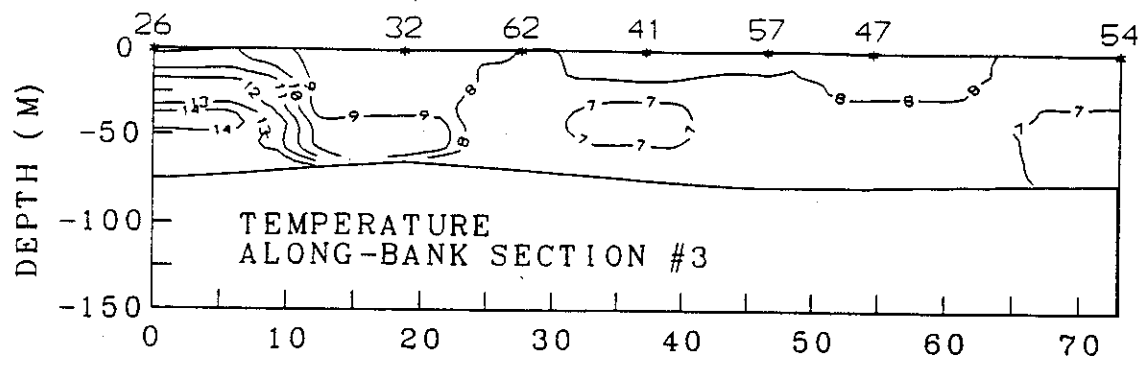


Figure 10. Along-bank CTD section #3 on AL9403II.

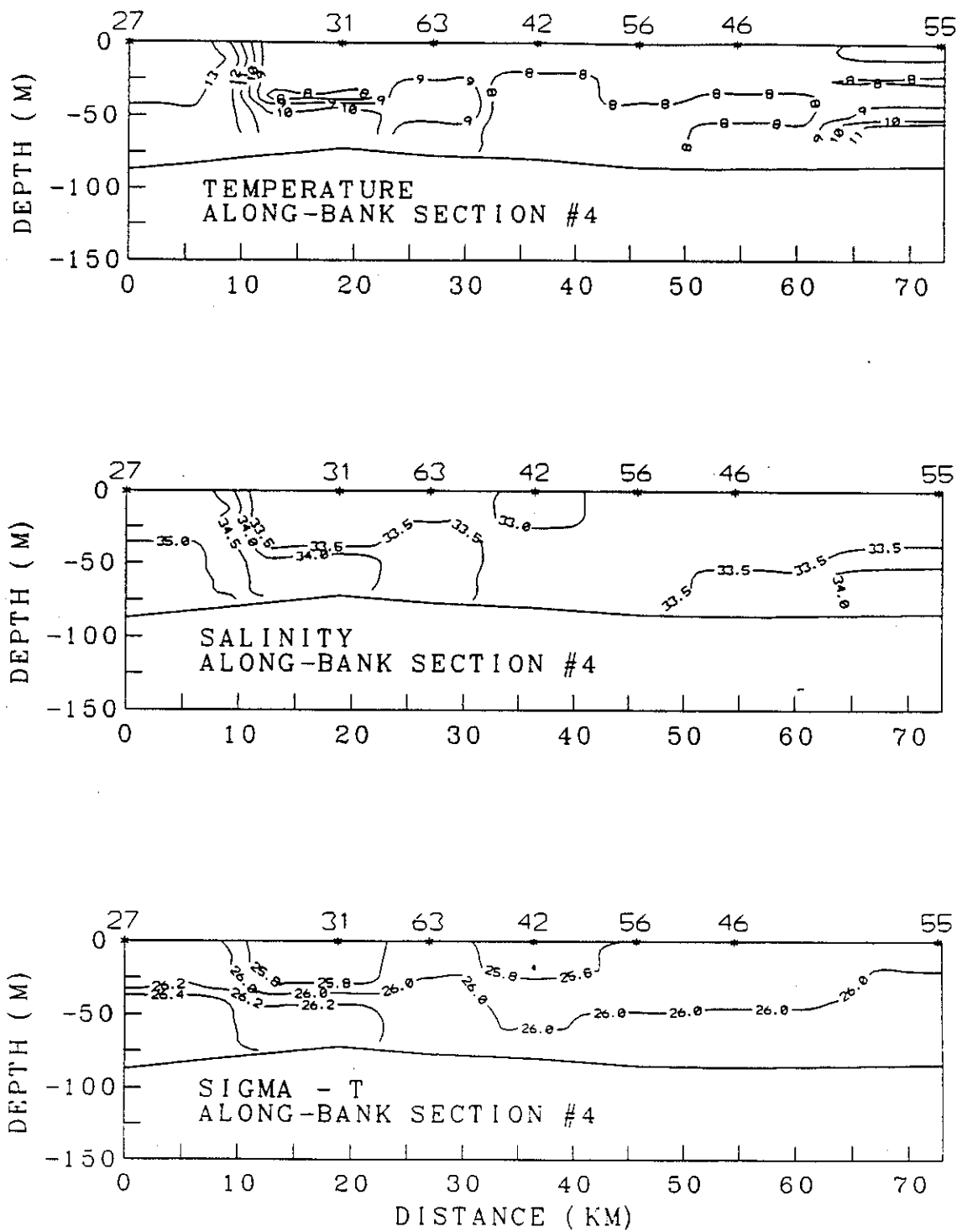


Figure 11. Along-bank CTD section #4 on AL9403II.

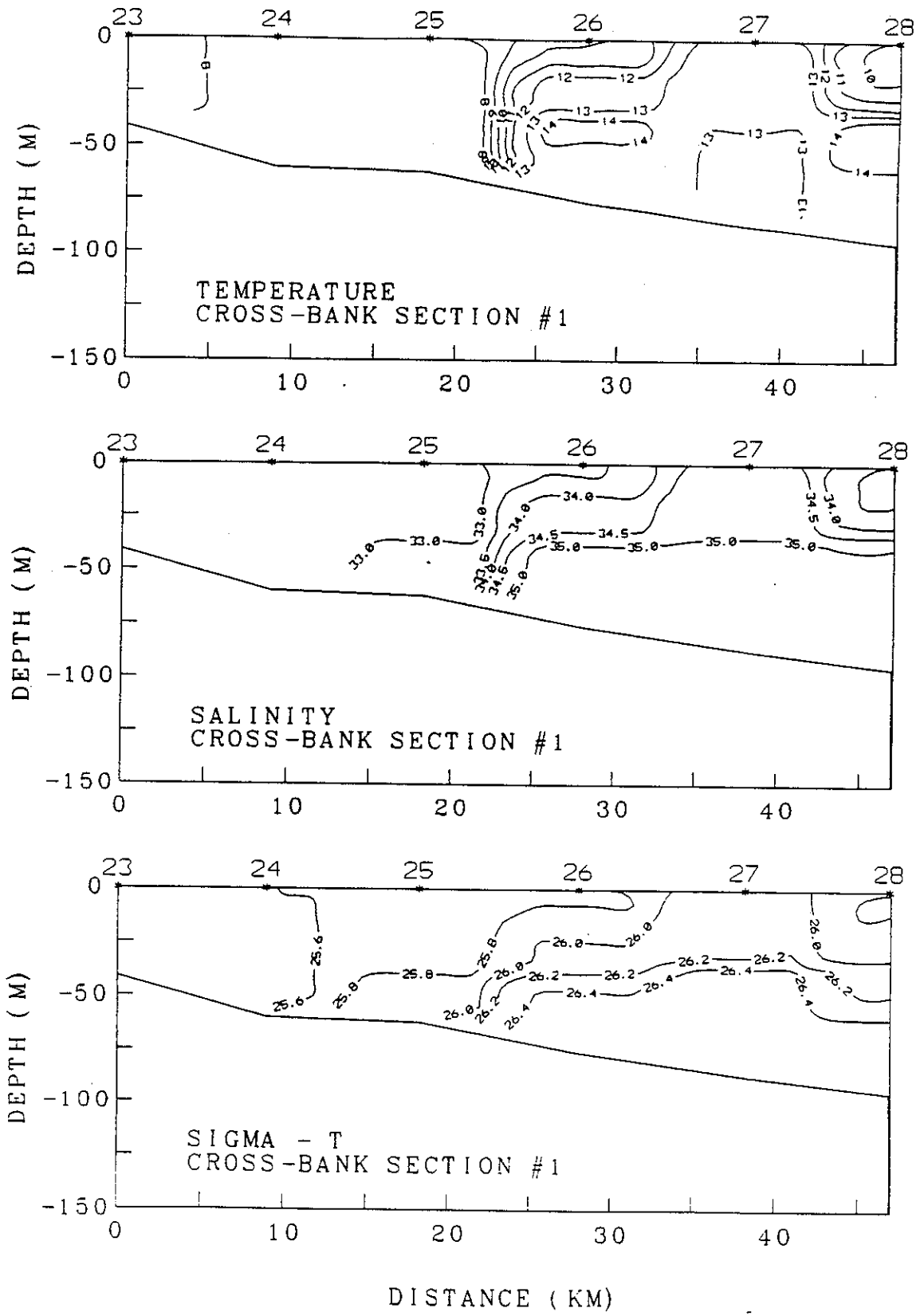


Figure 12. Cross-bank CTD section #1 on AL9403II.

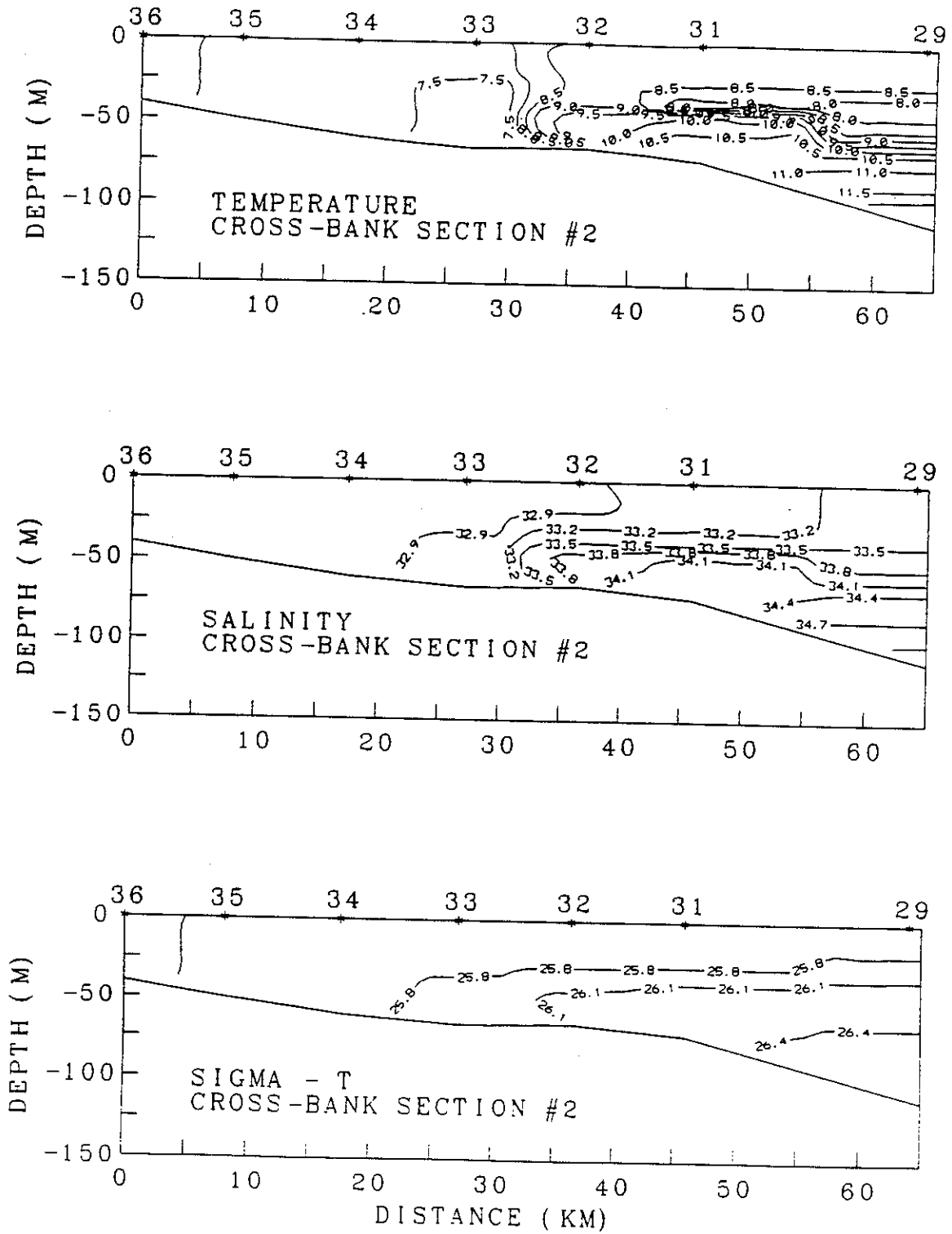


Figure 13. Cross-bank CTD section #2 on AL9403II.

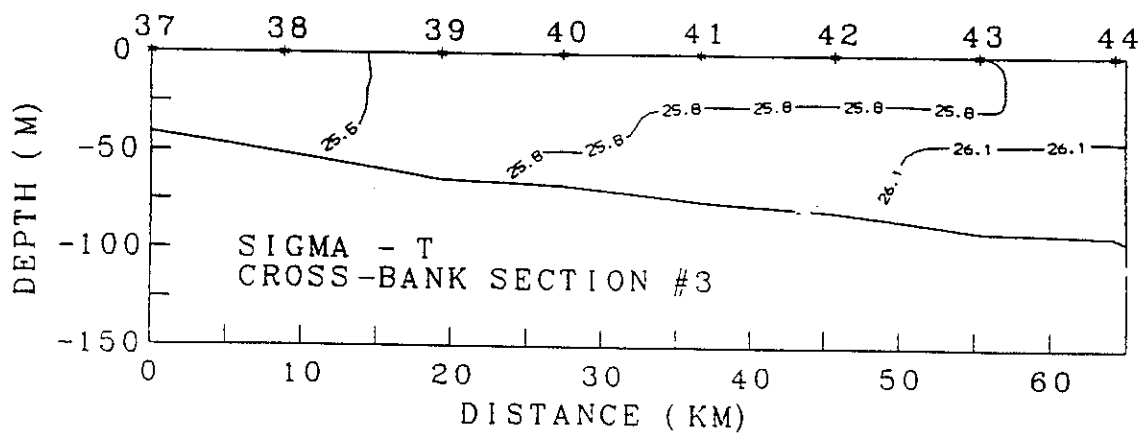
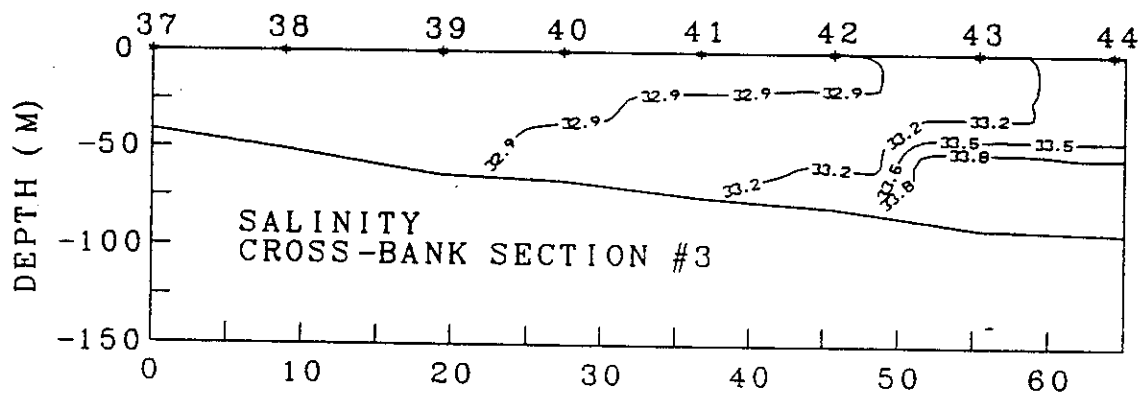
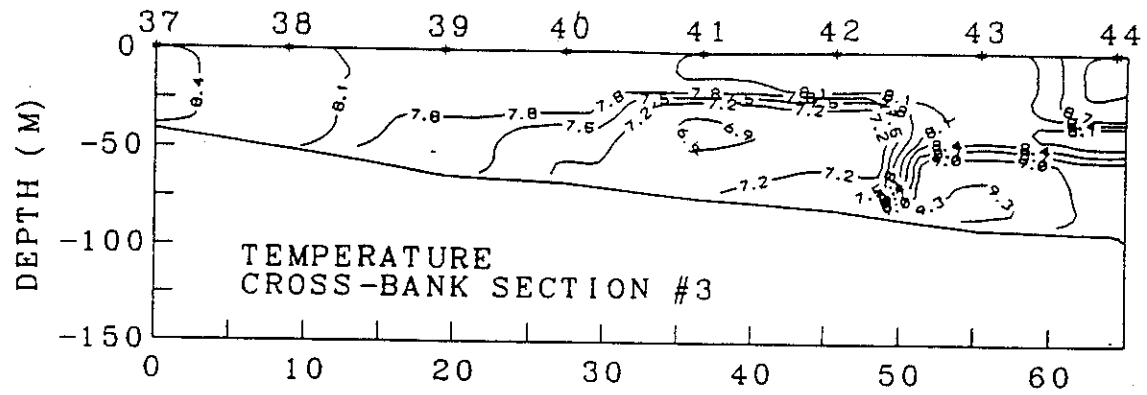


Figure 14. Cross-bank CTD section #3 on AL9403II.

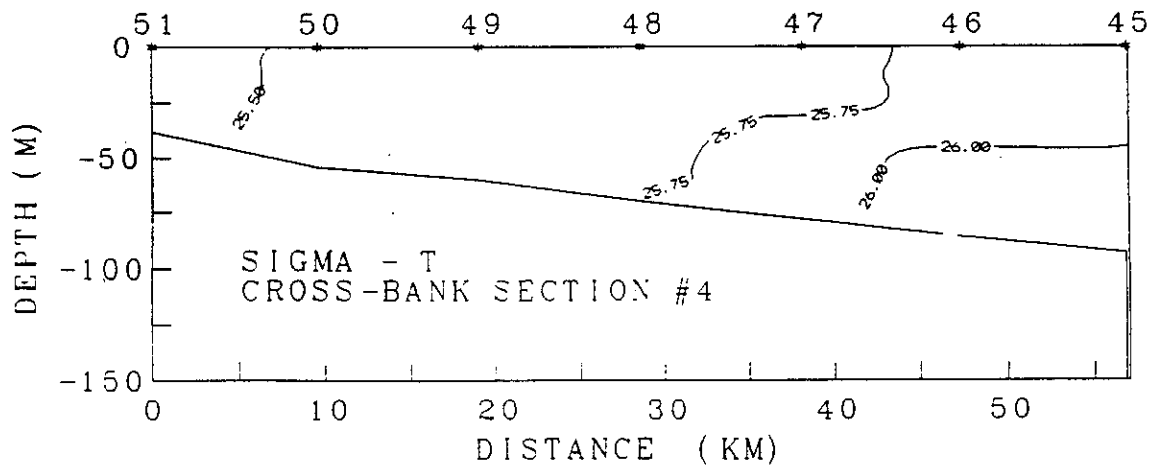
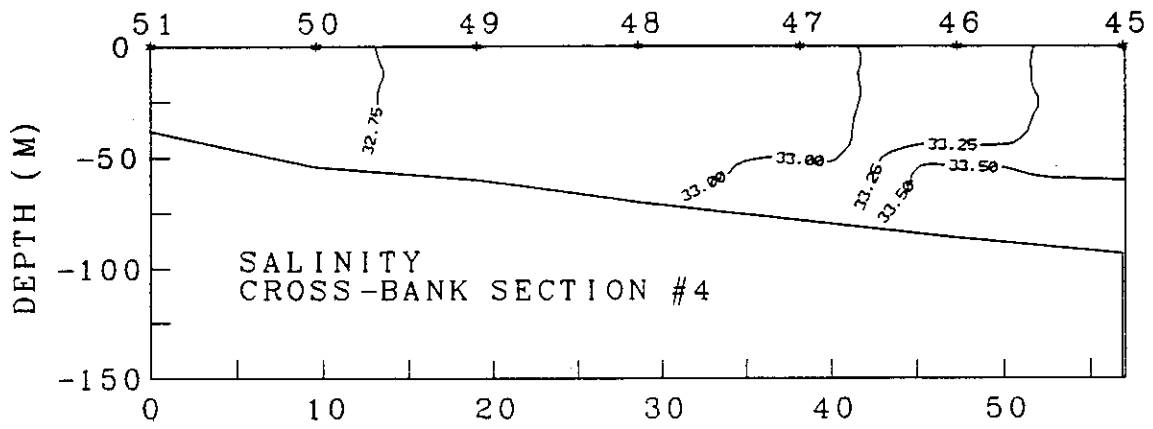
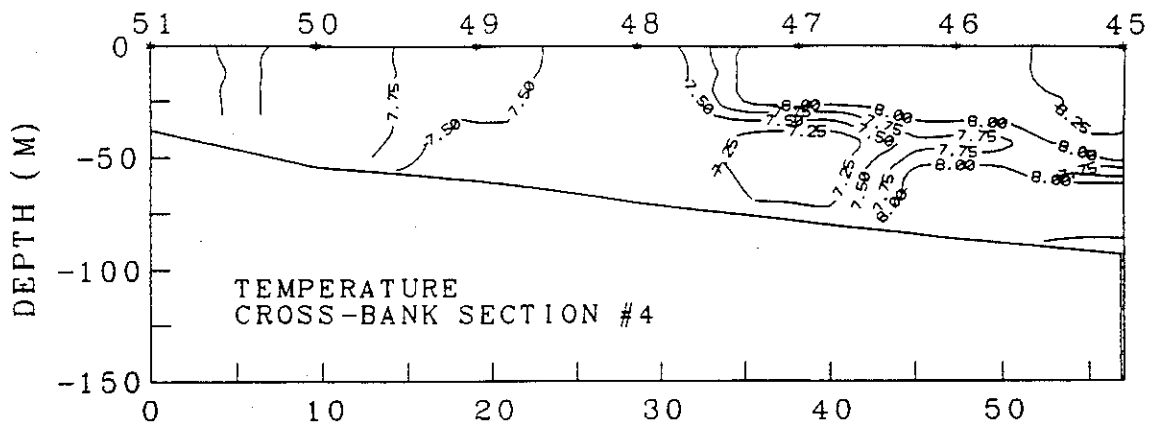


Figure 15. Cross-bank CTD section #4 on AL9403II.

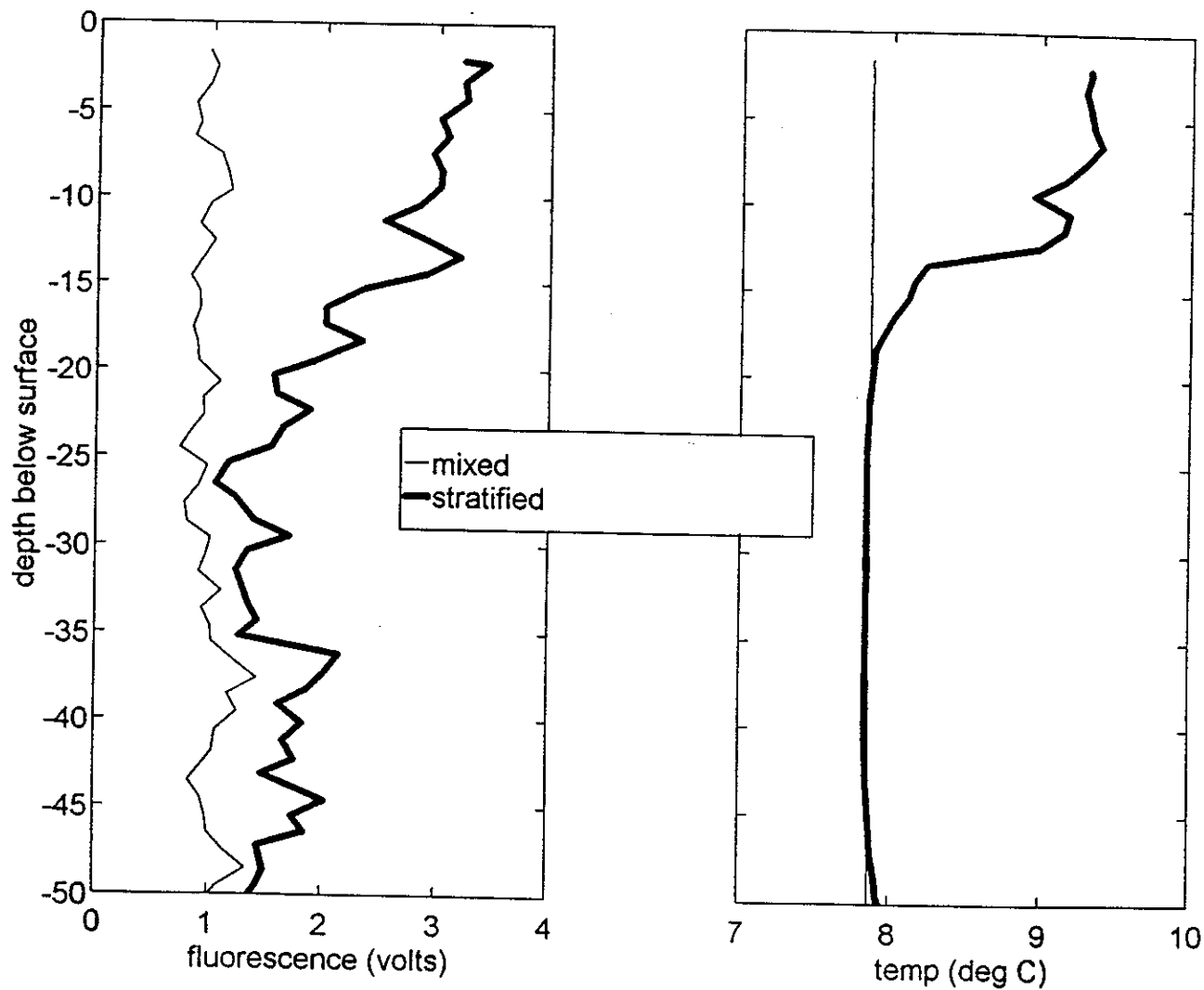


Figure 16. The fluorescence levels (left panel) throughout the water column provide an index of plankton distribution as a function of depth at a typical station in the mixed (thin line) region of the bank and a typical station in the stratified (heavy line) region of the bank. The higher values were found at the stratified sites. The right panel shows the corresponding temperature distribution for the two stations.

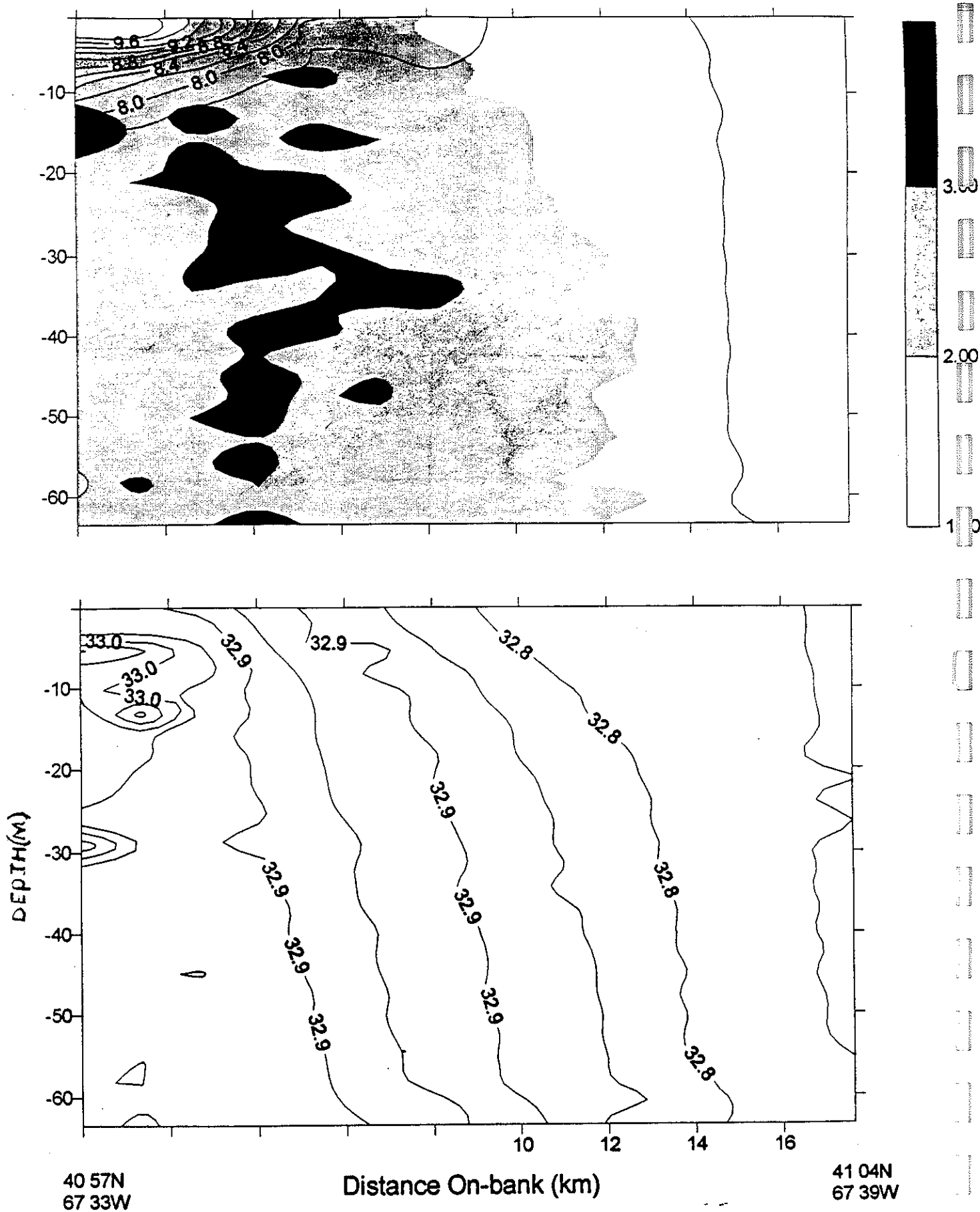


Figure 17 Temperature (top) and salinity (bottom) contoured for tow-yo section #2. Fluorescence levels are shaded in units of volts (see legend) in top panel. A total of 60 CTD cast were taken on this tow-yo during an off-bank phase of the tide (0641-0912 GMT, May 24, 1994).

AL9403-II Ship Recorded

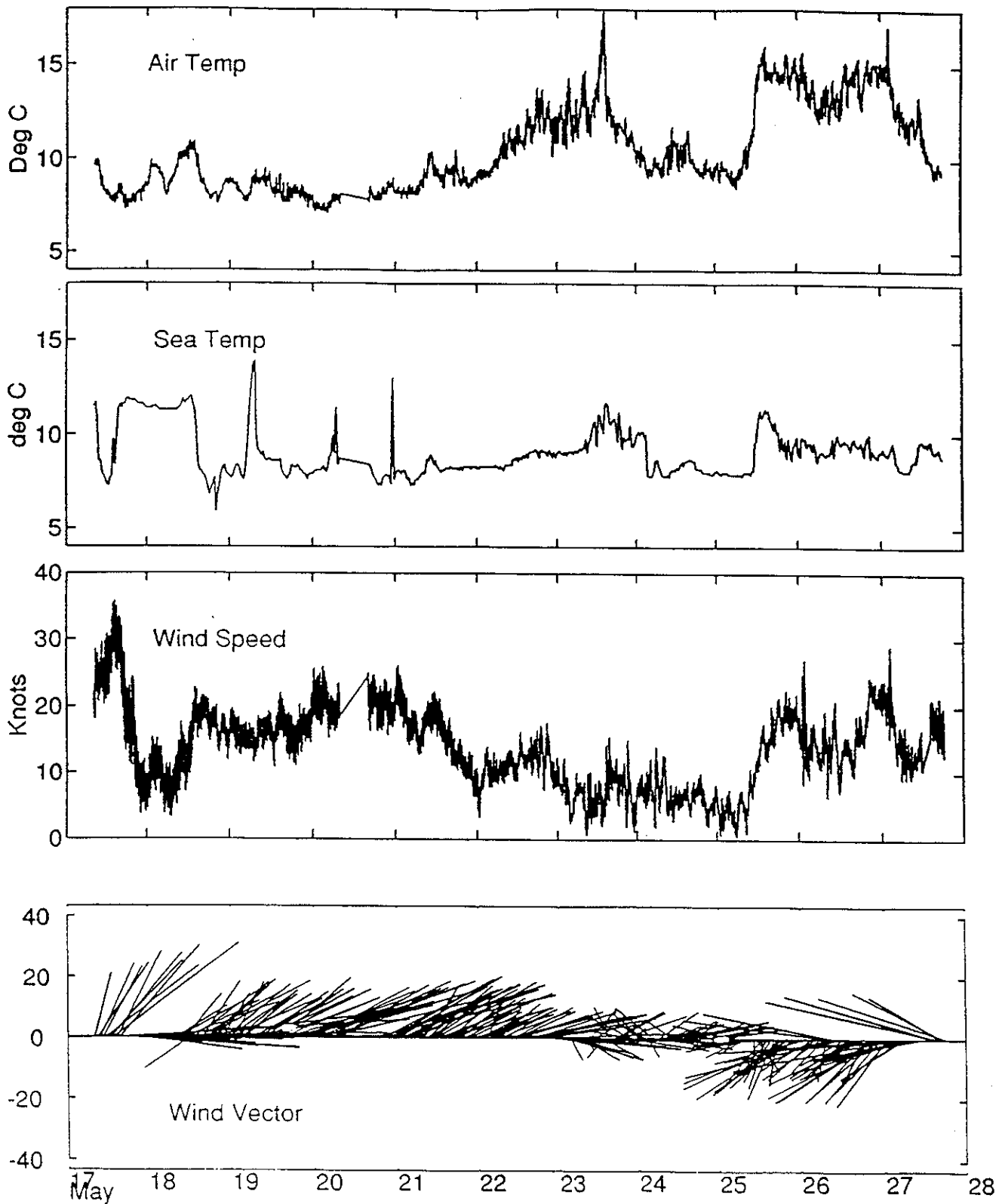


Figure 18. Examples of sensor data from the Shipboard Computer System (SCS). The seasurface temperature increases (ie stratification buildup) on May 22 and May 25 are likely due to both a decrease in wind speed and increase in air temperature. The difference in along-bank drift as recorded by the drogue deployments #2 vs #3 (Figure 2) is likely due to shift in wind direction that occurred on May 25th from northeastward to southwestward.

