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Description of the 1997 Oceanographic Conditions on the Northeast Continental Shelf

by

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Abstract

A summary of hydrographic observations for 19 surveys on the northeast continental shelf during 1997 is presented. Distributions of station position, surface and bottom temperature, salinity, and anomalies are portrayed. The average surface and bottom temperature and salinity have been calculated for each survey in five geographic regions over the northeast continental shelf: western Gulf of Maine (GOMW), eastern Gulf of Maine (GOME), Georges Bank (GB), northern Middle Atlantic Bight (MABN) and southern Middle Atlantic Bight (MABS).

Nearly the entire northeast continental shelf experienced fresher salinity conditions during the 1997 field season, although the trend in salinity anomalies was approaching "expected" conditons relative to the MARMAP reference period toward the latter part of the year. The temperature distributions for all five regions show a fairly typical seasonal pattern. Much of the "noise" seen in the anomaly distributions can be attributed to either biased station coverage within a particular region or to too few stations sampled (note especially those calculations made using less than 10 observations).

Introduction

The Northeast Fisheries Science Center (NEFSC) conducts several different surveys off the northeast continental shelf each year. Complete coverage of the shelf (Cape Hatteras to the Gulf of Maine) occurs during the spring and fall bottom trawl surveys only. Station coverage on other cruises throughout the year varies. Included in this report are hydrographic distributions from the six GLOBEC Broad-Scale surveys of Georges Bank that provided good coverage from

January through June. Further information on the U.S. GLOBEC field program may be obtained in the individual cruise reports available through the GLOBEC program office.

Temperature and salinity observations from 19 NEFSC surveys conducted during 1997 are summarized and presented in this report. Cruise operation summaries are presented for all cruises. Distribution plots of surface and bottom temperature, salinity, and temperature anomaly are contoured where sufficient data are available. Areal average temperature and salinity and the corresponding anomalies are also presented for the five different regions on the shelf. The data are presented chronologically in atlas form. No attempt has been made here to analyze the data or discuss in detail individual observations from the cruises.

Data and Methods:

Temperature and salinity measurements were obtained with a Seabird SBE model 19 profiling CTD (Profiler), which measures the pressure, temperature and conductivity of the water twice per second. Two different methods of deployment were used depending upon the type of work conducted at a station. Whenever a plankton haul was done, the Profiler was placed above the bongo nets (sensors facing up), and a double oblique tow was made. Upcast data are used as the primary data when the Profiler is deployed with bongo nets. The turbulence generated by the bongo nets during the downcast adversely effects the temperature and conductivity data quality. If no plankton haul was done, the Profiler was deployed vertically (sensors facing down) through the water column and the downcasts are processed as the primary data. Salinity samples are taken from the bottom of a vertical profile cast in order to calibrate the conductivity data. These samples are analyzed on shore with a Guildline Autosal salinometer.

All raw Profiler data were processed using the Seabird manufactured software: DATCNV, FILTER, ALIGNCTD, BINAVG, DERIVE, and ASCIIOUT to produce 1 decibar averaged ascii files. The data were edited, cleaned, and converted to a standard 80-column ASCII formatted cruise file and were archived in the NEFSC anonymous FTP account (whsun2:/ftp/pub/hydro).

Station distributions and horizontal contour plots of the surface and bottom temperature, salinity, and temperature anomaly were prepared for each survey if coverage was sufficient. Areal average temperatures and salinities were calculated for the five regions of the northeast continental shelf shown in Figure 1: western and eastern Gulf of Maine, Georges Bank, and the northern and southern Middle Atlantic Bight. The areal averaging was done using the method described in Holzwarth and Mountain (1990). The areal averages and anomalies were plotted against the mid-date (calendar day) of all observations within a region for each cruise.

Results

The NEFSC cruises for which data are presented in this report are listed in Table 1. A summary of each cruise is listed in Appendix A and includes information on the type of cruise, its objectives, dates, the number of hydrographic stations, type(s) of instruments used, salinity calibration value, and notes pertaining to instrument performance. Note that cruise names have been modified for cruises that were on Oceanus (GLOBEC) to include the year (ex. OC301 was renamed OCE9701). No salinity correction was applied to the cruise data if the mean salinity offset was less that +/- 0.01 psu.

Table 2 lists the surface and bottom areal average temperatures and temperature anomalies that were calculated for each of the five regions. Table 3 lists the surface and bottom areal

average salinity and salinity anomalies for the same five regions. For most cruises, the areal averages and anomalies could not be calculated for all regions due to limited station coverage. In many cases a simple average (not an areal weighted mean) was determined for the observations in the region; these values are indicated in tables 2 and 3 by an asterisk. The standard deviations are also listed. SDV1 indicates how well the calculated anomaly represents the true regional average anomaly. SDV2 is an indicator of how closely the areal average matches the anomaly at any particular location within that region (see Holzwarth and Mountain, 1990 for explanation of SDV1 and SDV2).

Figures 2 through 5 present the time series of surface and bottom average temperature/ salinity and temperature/salinity anomaly for each region. Station positions and distributions of surface and bottom temperature, salinity, and anomalies for the different cruises are presented in figures 6 through 88. Contour distribution figures were not prepared for some of the cruises because of poor station coverage.

Discussion

Nearly the entire northeast continental shelf showed fresher salinity conditions relative to the MARMAP reference period, similar to what was observed during the 1996 field season (Taylor and Kiladis, 1997). However, the trend in salinity anomalies shown in figure 5 suggest that salinity observations are approaching "expected" conditions and that this event of fresher conditions that has been observed for nearly two years may no longer be observed durng the 1998 field season.

Observations in the southern Middle Atlantic Bight during both the Marine Mammal

survey (DEL9705) and the Spring Bottom trawl (ALB9704) showed warmer (> 1.5 deg. C) and fresher (< 1.5 psu) conditions. This may be a result of fresh water influence from the Chesapeake Bay area (see salinity distributions: figures 30 and 37). The cause for the warmer temperatures is unclear. The warmer surface temperatures may be attributed to warmer atmospheric conditions. The surface salinity distrubution during the Spring Bottom Trawl (figure 30) showed no indication that the shelf / slope front had encroached onto the shelf that would account for the warmer temperatures.

Some of the high variability observed in the temperature anomaly time series may be attributed to those cruises that had either poor spatial coverage or insufficient stations occupied within the regions. For example, the Scallop survey competed 487 ctd casts but spatial coverage within the regions was poor (figure 75). Simple regional averages were computed for this cruise.

We were not able to resolve small scale, localized events because of the regional averaging method used in this report.

References

Holzwarth, T.J. and D. Mountain. 1990. Surface and bottom temperature distributions from the Northeast Fisheries Center spring and fall bottom trawl survey program, 1963-1987. Woods Hole, MA: Northeast Fisheries Center. Reference Document 90-03. Available from: Information Services Section, NMFS/Northeast Fisheries Science Center, Woods Hole, MA; 02543

Taylor, M. H. and M. E. Kiladis. 1997. Description of the 1996 oceanographic conditions on the northeast continental shelf. Woods Hole, MA: Northeast Fisheries Science Center. Reference Document 97-16. Available from: Information Services Section, NMFS/ Northeast Fisheries Science Center, Woods Hole, MA; 02543.

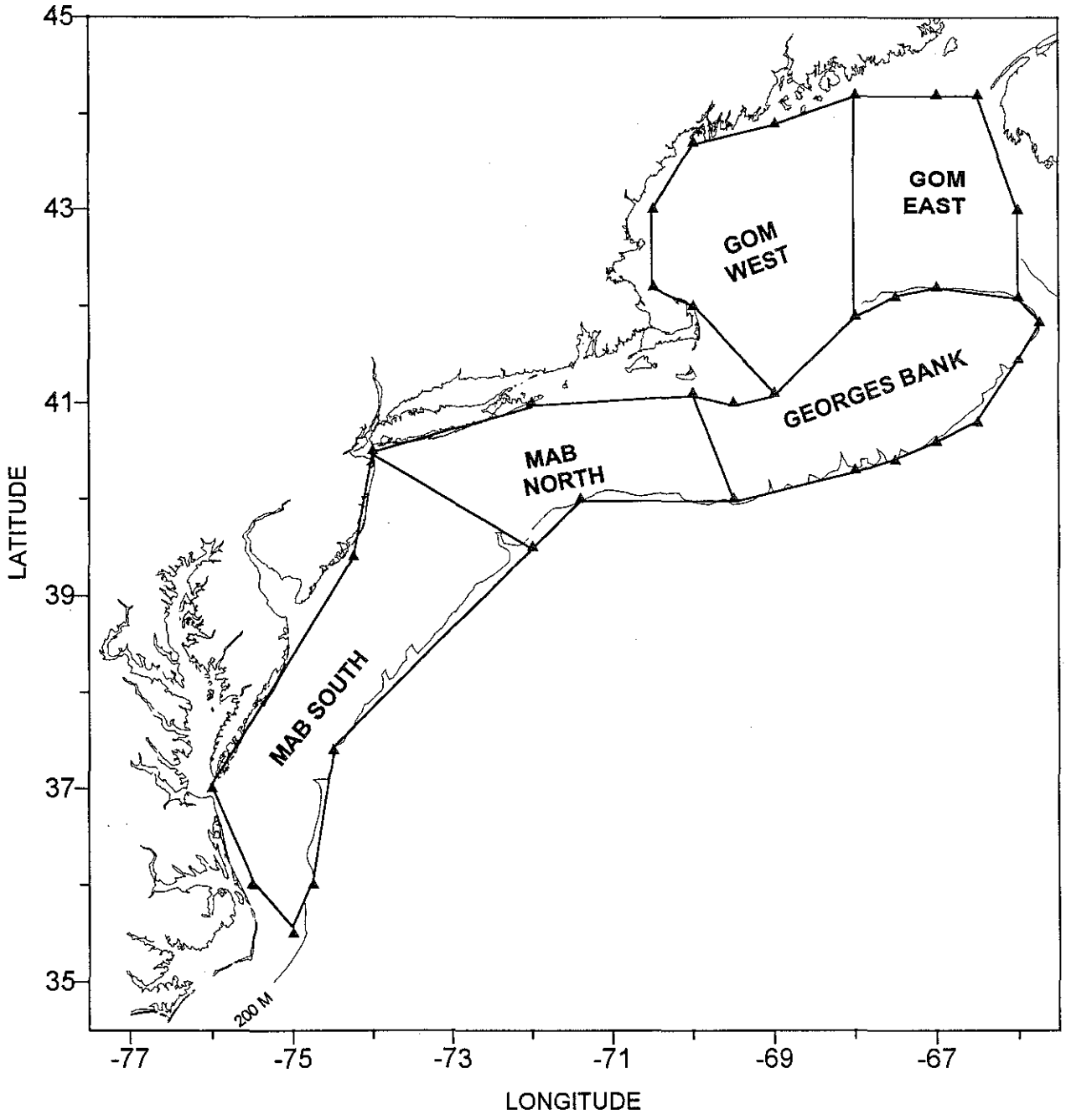

Figure 1. The regions of the northeast continental shelf covered by the Northeast Fisheries Science Center cruises during 1997.

Table 1. Summary of 1997 Cruises.

Cruise	Program	Dates	Region(s)[1]
ALB9701	GLOBEC Broad Scale Survey #1	14 - 19 January	GB
OCE9798	GLOBEC Broad Scale Survey #2	11 - 23 February	GB
ALB9703	Winter Bottom Trawl Survey	04 - 26 February	MAB, GB
ALB9704	Spring Bottom Trawl Survey	03 March - 23 April	NE Shelf
DEL9705	Marine Mammal Survey	06 - 18 March	MAB
OCE9730	GLOBEC Broad Scale Survey #3	17 - 28 March	GB
OCE9701	GLOBEC Process Cruise #1	05 - 16 April	GB
OCE9702	GLOBEC Broad Scale Survey #4	22 April - 01 May	GB
OCE9703	GLOBEC Process Cruise #2	08 - 22 May	GB
DEL9706	Clam Gear Cruise	18 May - 08 June	MAB
ALB9705	GLOBEC Broad Scale Survey #5	20 - 28 May	GB
DEL9707	Clam Survey	09 June - 14 July	MAB,GB
ALB9707	GLOBEC Broad Scale Survey #6	18 - 28 June	GB
ALB9708	Marine Mammal Survey	07 - 14 July	GB,GOM
DEL9708	Bio Acoustic Survey	02 -07 August	GOM
GLM9714	Shrimp Survey	28 July - 08 August	GOM
AJ9701	Marine Mammal Survey	23 August - 03 September	SEA MOUNTS
ALB9709	Scallop Survey	22 July - 17 August	MAB, GB
ALB9711	Fall Bottom Trawl Survey	09 September - 31 October	NE Shelf

[1] Regional Abbreviations

GB = Georges Bank
GOM = Gulf of Maine
MAB = Middle Atlantic Bight
NE Shelf = Northeast Continental Shelf

Table 2. Areal average surface and bottom temperature and temperature anomalies for the 1997 NEFSC cruises in the five regions of the northeast continental shelf as shown in Figure 1 [1]

		SURFACE					BOTTOM				
CRUISE	CD	#obs	Temp	Anomaly	SDV1	SDV2	#obs	Temp	nomaly	SDV1	SDV2
					Gulf of Maine West						
AL9704	109	37	4.87	0.09	0.20	0.61	37	6.18	1.25	0.16	0.77
GM9714	213	48	17.62	0.94	0.18	1.65*	48	6.55	0.88	0.12	.83*
AL9711	300	34	12.16	0.25	0.18	0.61	34	7.54	0.48	0.15	0.88
					Gulf of Maine East						
OC9798	48	17	4.73	0.12	0.22	.57*	15	6.06	0.51	0.23	.68*
OC9730	81	13	3.92	-0.43	0.25	.68*	12	5.80	0.38	0.25	.79*
AL9704	99	31	4.15	-0.46	0.22	0.80	27	6.84	0.60	0.21	0.84
OC9702	116	8	5.31	-0.49	0.31	.82 *	7	6.53	0.48	0.33	1.28*
AL9705	144	13	7.67	-0.35	0.25	.91*	12	7.15	-0.14	0.26	1.50*
AL9707	173	6	12.70	1.77	0.40	1.25*	5	7.66	-1.06	0.41	2.05*
AL9711	291	34	11.53	-0.94	0.21	1.05	28	8.65	-0.65	0.20	1.50
					Georges Bank						
AL9701	16	13	6.21	-0.27	0.25	.39*	13	6.73	-0.20	0.29	.99*
OC9798	48	82	4.84	-0.10	0.17	0.76	78	5.04	-0.43	0.22	1.11
AL9703	56	22	5.01	0.07	0.34	.5 *	17	5.47	-0.18	0.35	1.45*
OC9730	81	69	4.54	0.10	0.20	0.73	65	4.70	-0.16	0.24	0.98
AL9704	91	52	4.84	-0.03	0.20	0.76	45	5.02	-0.13	0.26	1.34
OC9701	98	123	4.59	-0.35	0.11	.54*	116	4.78	-0.79	0.14	1.24*
OC9702	116	57	5.48	-0.22	0.20	0.77	52	5.46	-0.04	0.23	0.83
OC9703	133	131	6.90	-0.39	0.09	.72*	127	6.17	-0.40	0.11	.64*
AL9705	144	74	7.77	-0.28	0.20	0.85	70	6.90	-0.15	0.22	1.19
AL9707	173	35	11.79	0.46	0.27	1.29	34	9.49	0.55	0.31	1.61
DE9707	177	8	14.42	1.65	0.30	1.81*	8	11.55	-0.42	0.32	2.38*
AL9709	223	191	17.36	1.65	0.12	2.19	187	12.24	1.08	0.14	2.84
AL9711	288	78	15.06	0.37	0.16	0.97	71	12.99	0.32	0.22	1.55
					MAB North						
AL9703	50	42	5.39	0.48	0.26	1.36	34	6.75	1.41	0.33	1.11
DE9705	69	3	5.97	1.25	0.86	1.62*	3	7.86	2.60	0.93	.84*
AL9704	80	61	5.28	1.06	0.27	0.67	55	6.56	1.57	0.33	1.48
DE9707	177	4	17.63	1.57	0.67	1.03*	4	9.94	0.50	0.70	1.34*
AL9709	214	82	20.50	0.20	0.16	.82*	82	8.32	0.17	0.17	1.81*
AL9711	271	54	18.23	0.80	0.27	1.06	48	13.17	0.66	0.33	2.12

MAB South

AL9703	39	56	7.00	0.13	0.25	2.06	47	7.81	0.86	0.30	1.35
DE9705	69	19	7.37	2.71	0.42	.92*	18	7.40	3.16	0.45	.92*
AL9704	71	88	7.50	1.73	0.23	1.74	79	8.65	2.70	0.28	1.70
DE9707	177	18	18.70	-0.49	0.37	1.35*	18	11.56	1.93	0.39	1.11*
AL9709	207	161	22.74	-0.91	0.13	1.11*	159	8.59	1.05	0.16	1.09*
AL9711	257	83	22.64	0.57	0.25	1.06	76	14.96	0.68	0.30	2.36

(1) "CRUISE", the code name for a cruise: "CD", the calendar mid-data of all the stations within a region for a cruise: "# obs", the number of observations included in each average: "Temp", the areal average temperature: "Anomaly" the areal average temperature anomaly: "SDV1", the standard deviation associated with the average temperature anomaly: "SDV2", the standard deviation of the individual anomalies from which the average anomaly was derive

(*) A true areal average could not be calculated due to poor station coverage. The average values listed were derive from a simple average of the observations within the region.

Table 3. Areal average surface and bottom salinity and salinity anomalies for the 1997 NEFSC cruises in the five regions of the northeast continental shelf as shown in Figure 1 [1]

		SURFACE					BOTTOM				
CRUISE	CD	#obs	Salt	Anomaly	SDV1	SDV2	#obs	Salt	Anomaly	SDV1	SDV2
Gulf of Maine West											
AL9704	109	37	32.23	-0.33	0.09	0.38	36	33.22	-0.16	0.05	0.35
AL9711	300	34	32.39	-0.16	0.08	0.55	34	33.57	-0.10	0.05	0.24
Gulf of Maine East											
OC9798	48	17	32.30	-0.62	0.09	.24*	17	33.35	-0.45	0.07	.43*
OC9730	81	12	32.18	-0.74	0.10	.12*	12	33.43	-0.34	0.08	.44*
AL9704	99	30	32.05	-0.43	0.10	.33	30	33.79	-0.18	0.07	.54
OC9702	116	8	32.36	-0.47	0.13	.18*	8	33.41	-0.23	0.10	.34*
AL9705	144	13	32.13	-0.62	0.10	.34*	13	33.33	-0.25	0.09	.55*
AL9707	173	6	32.02	-0.56	0.16	.15*	6	33.54	-0.23	0.12	.31*
AL9711	291	34	32.48	-0.09	0.11	.33	34	33.96	-0.16	0.08	.42
Georges Bank											
AL9701	16	12	32.23	-0.61	0.10	.14*	12	32.62	-0.45	0.10	.49*
OC9798	48	81	32.17	-0.74	0.06	.21	77	32.26	-0.83	0.07	.50
AL9703	56	22	32.15	-0.77	0.12	.23*	17	32.38	-0.82	0.12	.41*
OC9730	81	69	32.27	-0.65	0.07	.21	65	32.36	-0.78	0.08	.45
AL9704	91	52	32.41	-0.53	0.08	.31	45	32.53	-0.67	0.09	.55
OC9701	98	123	32.25	-0.58	0.04	.22*	116	32.40	-0.84	0.05	.49*
OC9702	116	57	32.34	-0.54	0.07	.23	52	32.50	-0.58	0.08	.32
OC9703	133	131	32.23	-0.57	0.03	.09*	127	32.55	-0.52	0.04	.30*
AL9705	144	73	32.22	-0.60	0.07	.27	69	32.53	-0.53	0.07	.43
AL9707	173	35	32.35	-0.37	0.09	.35	34	32.71	-0.29	0.10	.62
DE9707	177	8	32.04	-0.59	0.11	.39*	8	32.24	-0.43	0.10	.19*
AL9709	223	94	32.32	-0.17	0.03	.65*	93	32.70	0.00	0.03	.51*
AL9711	288	78	32.54	-0.20	0.06	.34	71	32.80	-0.20	0.08	.24
MAB North											
AL9703	50	42	31.98	-1.07	0.12	.44	34	32.55	-0.83	0.12	.41
DE9705	69	3	32.03	-0.88	0.52	.08*	3	32.73	-0.71	0.35	.91*
AL9704	80	61	31.87	-0.99	0.13	.48	55	32.46	-0.87	0.11	.62
DE9707	177	4	30.26	-1.62	0.58	.79*	4	31.88	-0.64	0.28	.19*
AL9711	271	54	32.85	0.11	0.13	.69	48	33.06	-0.28	0.12	.70

MAB South

AL9703	39	56	32.36	-1.41	0.15	.54	47	32.76	-1.05	0.11	.47
DE9705	69	19	30.51	-1.96	0.31	2.19*	18	30.84	-2.07	0.19	2.36*
AL9704	71	88	31.79	-1.41	0.13	1.07	79	32.66	-0.85	0.10	1.32
DE9707	177	17	30.53	-0.96	0.25	1.01*	17	31.85	-0.86	0.16	.17*
AL9711	257	83	31.80	-0.45	0.14	1.03	76	32.68	-0.52	0.10	.70

(1) "CRUISE", the code name for a cruise: "CD", the calendar mid-data of all the stations within a region for a cruise: "# obs", the number of observations included in each average: "salt", the areal average salinity: "Anomaly", the areal average salinity anomaly: "SDV1", the standard deviation associated with the average salinity anomaly: "SDV2", the standard deviation of the individual anomalies from which the average anomaly was derived.

(*) A true areal average could not be calculated due to poor station coverage. The average values listed were derived from a simple average of the observations within the region.

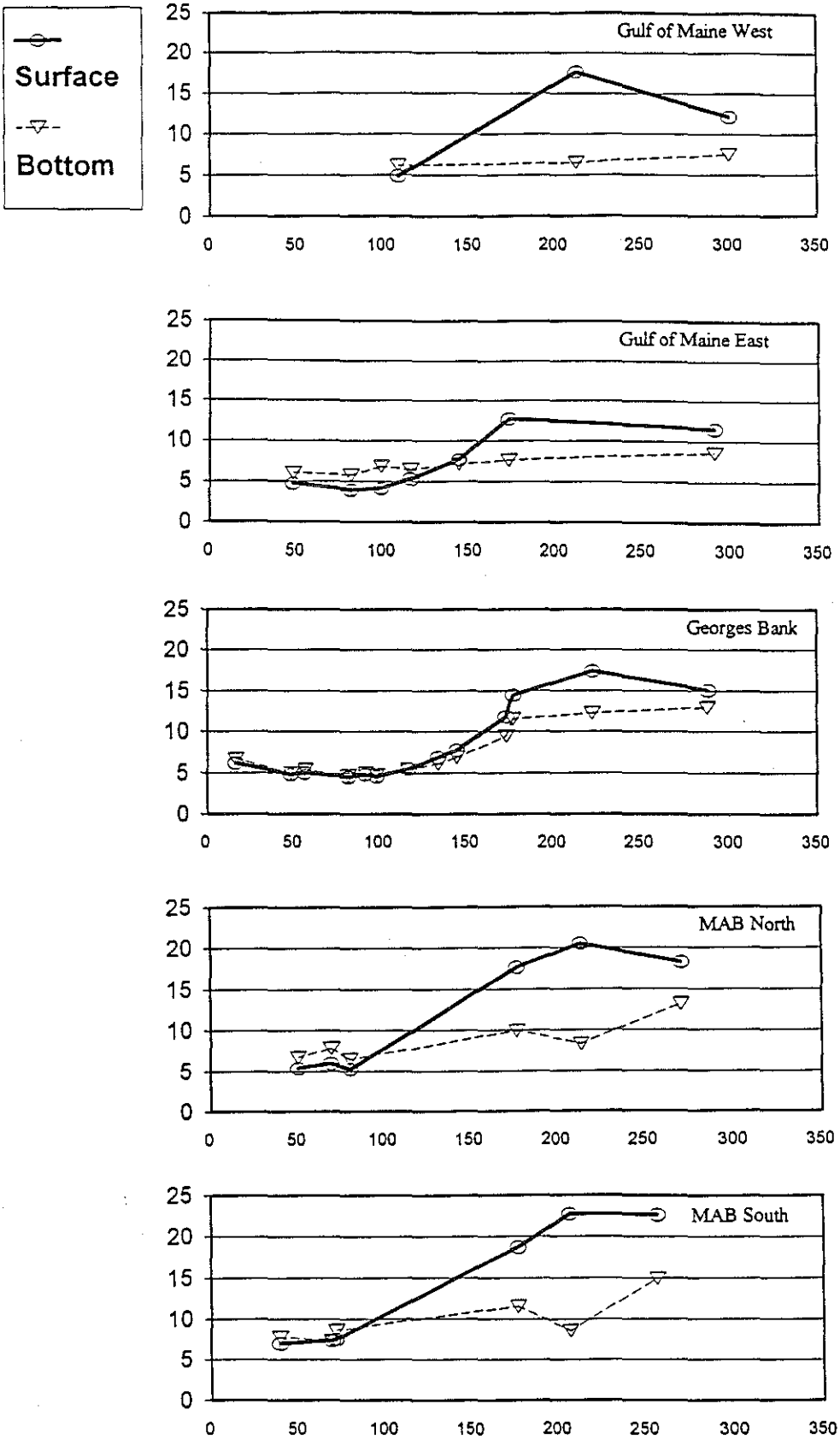

Figure 2. The 1997 areal average surface and bottom temperature values from Table 2.

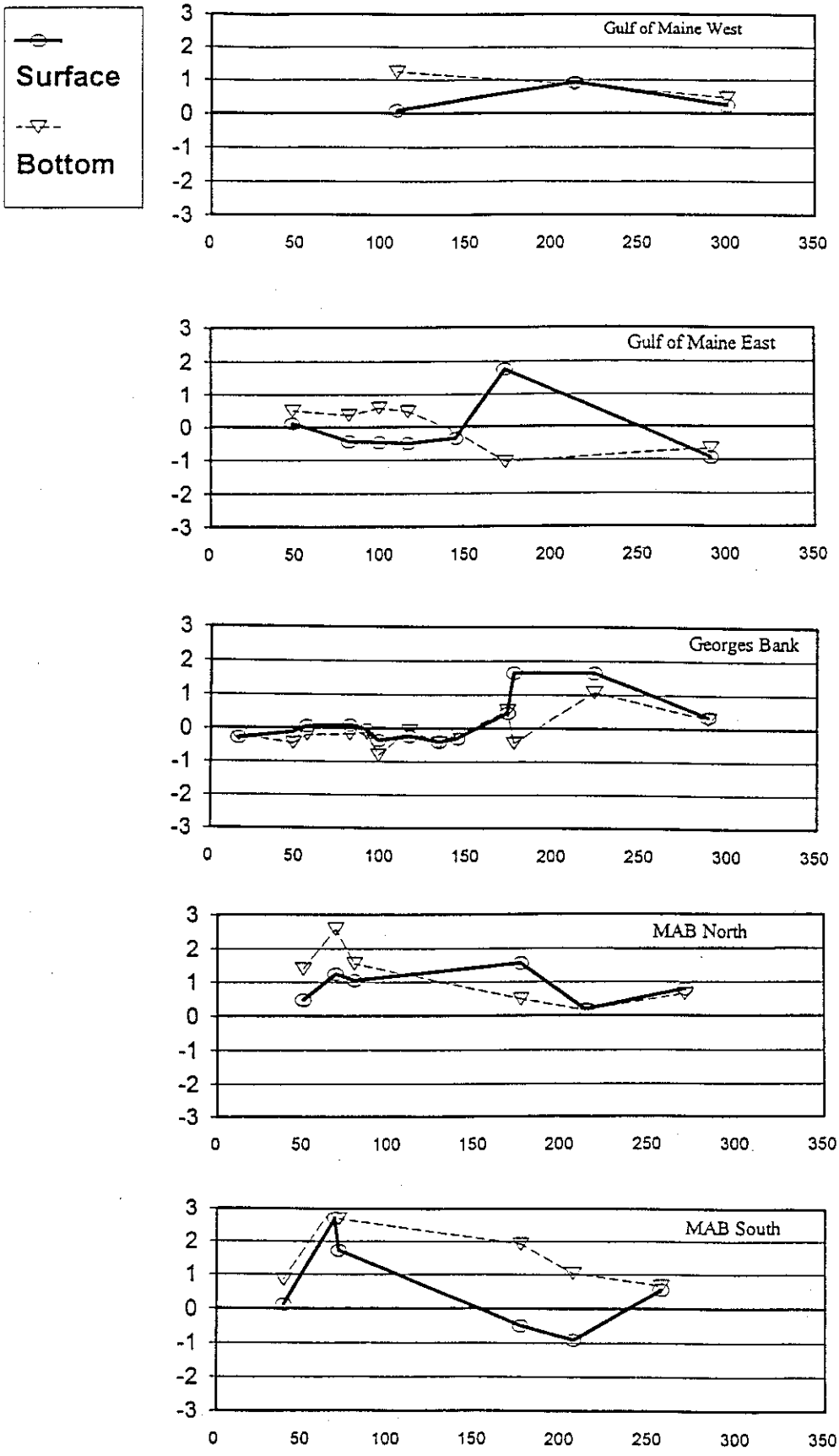

Figure 3. The 1997 areal average surface and bottom temperature anomalies from Table 2.

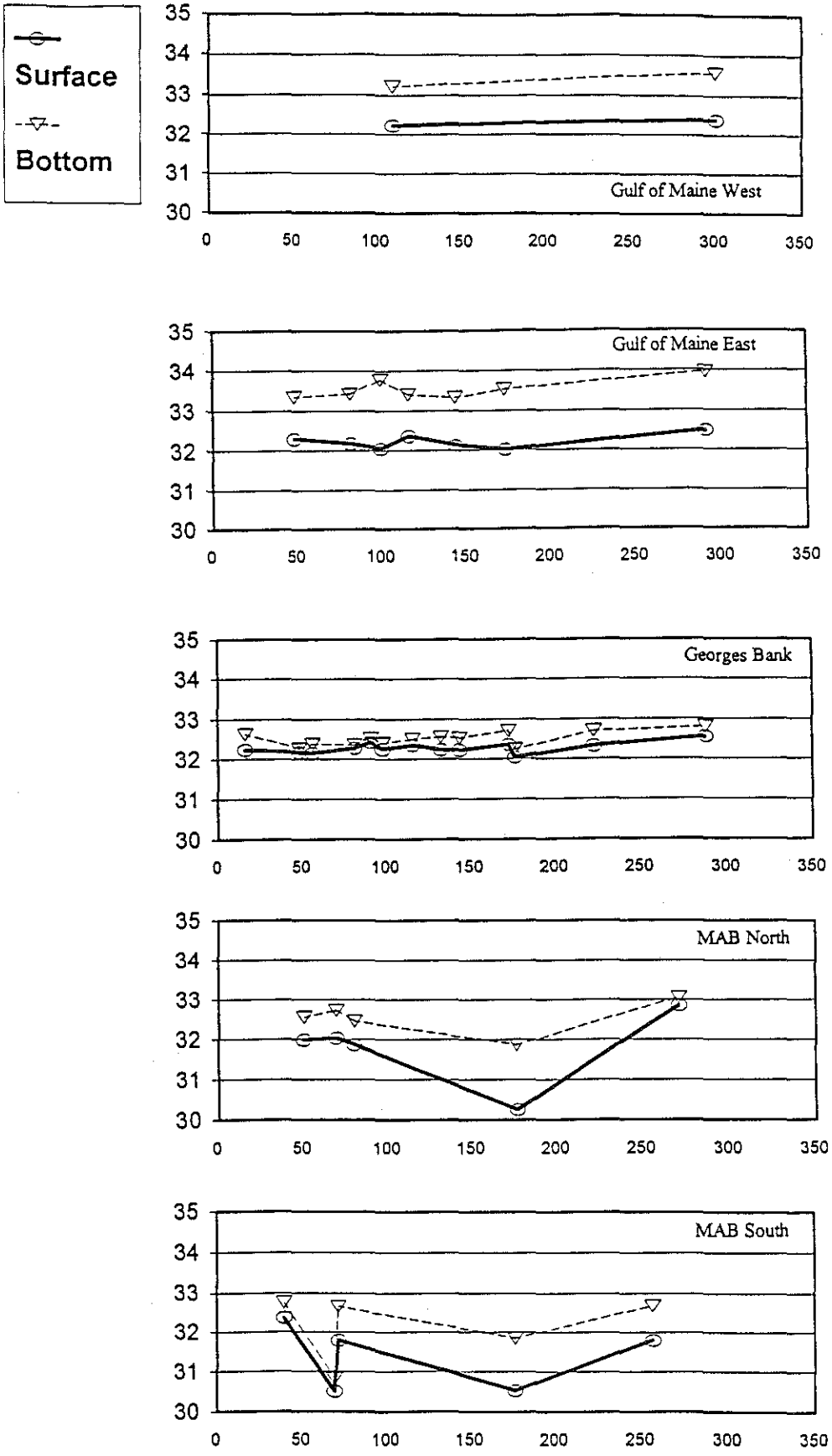

Figure 4. The 1997 areal average surface and bottom salinity values from Table 3.

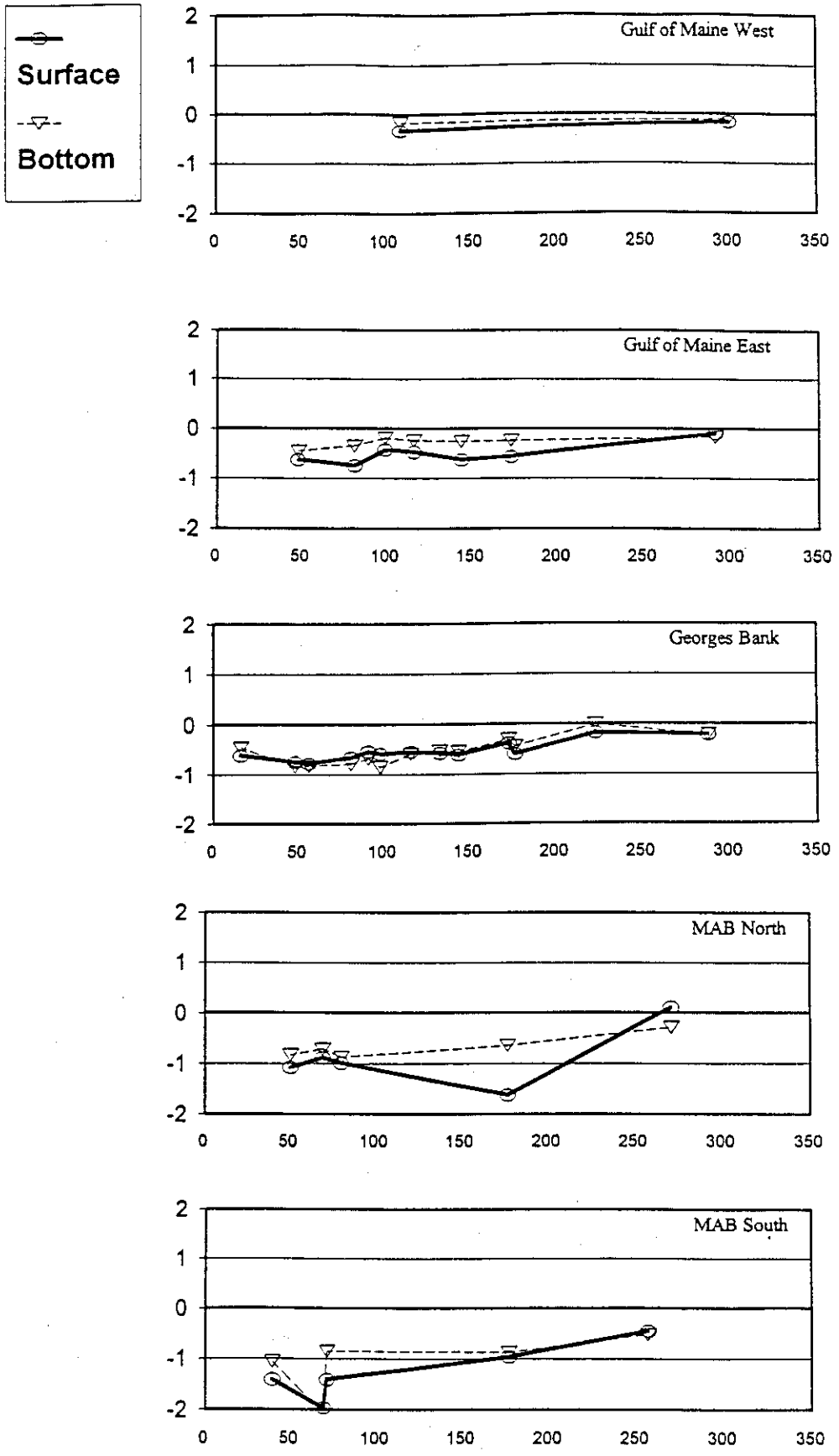

Figure 5. The 1997 areal average surface and bottom salinity anomalies from Table 3.

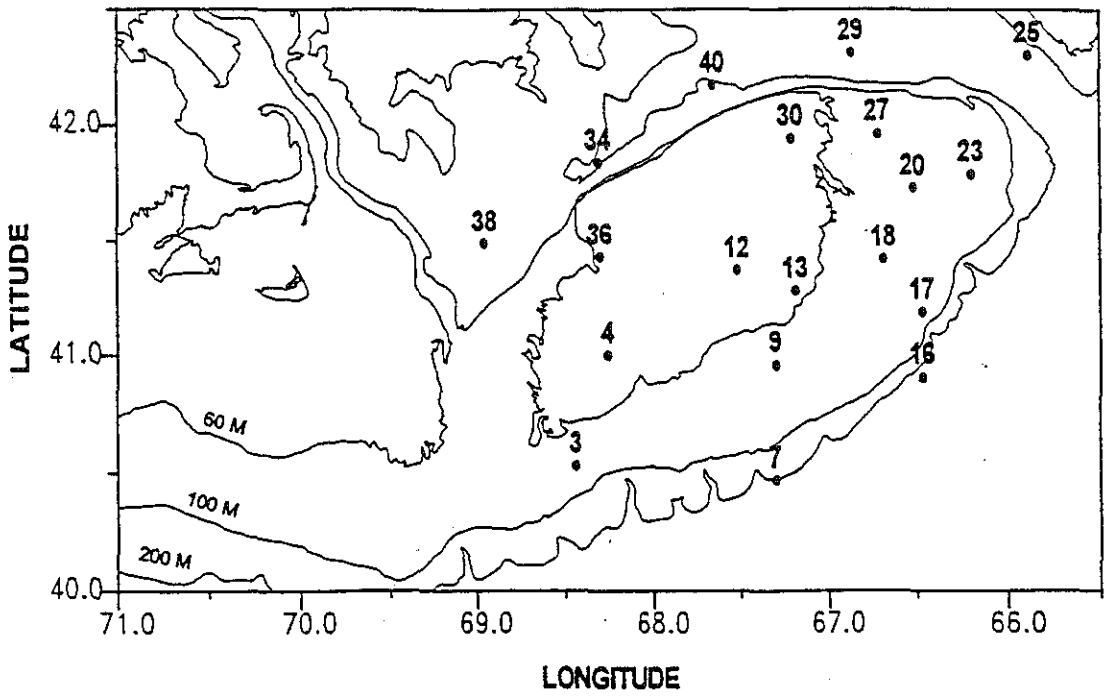

Figure 6. Hydrographic stations occupied during the U.S. GLOBEC Broad Scale Survey ALB9701.

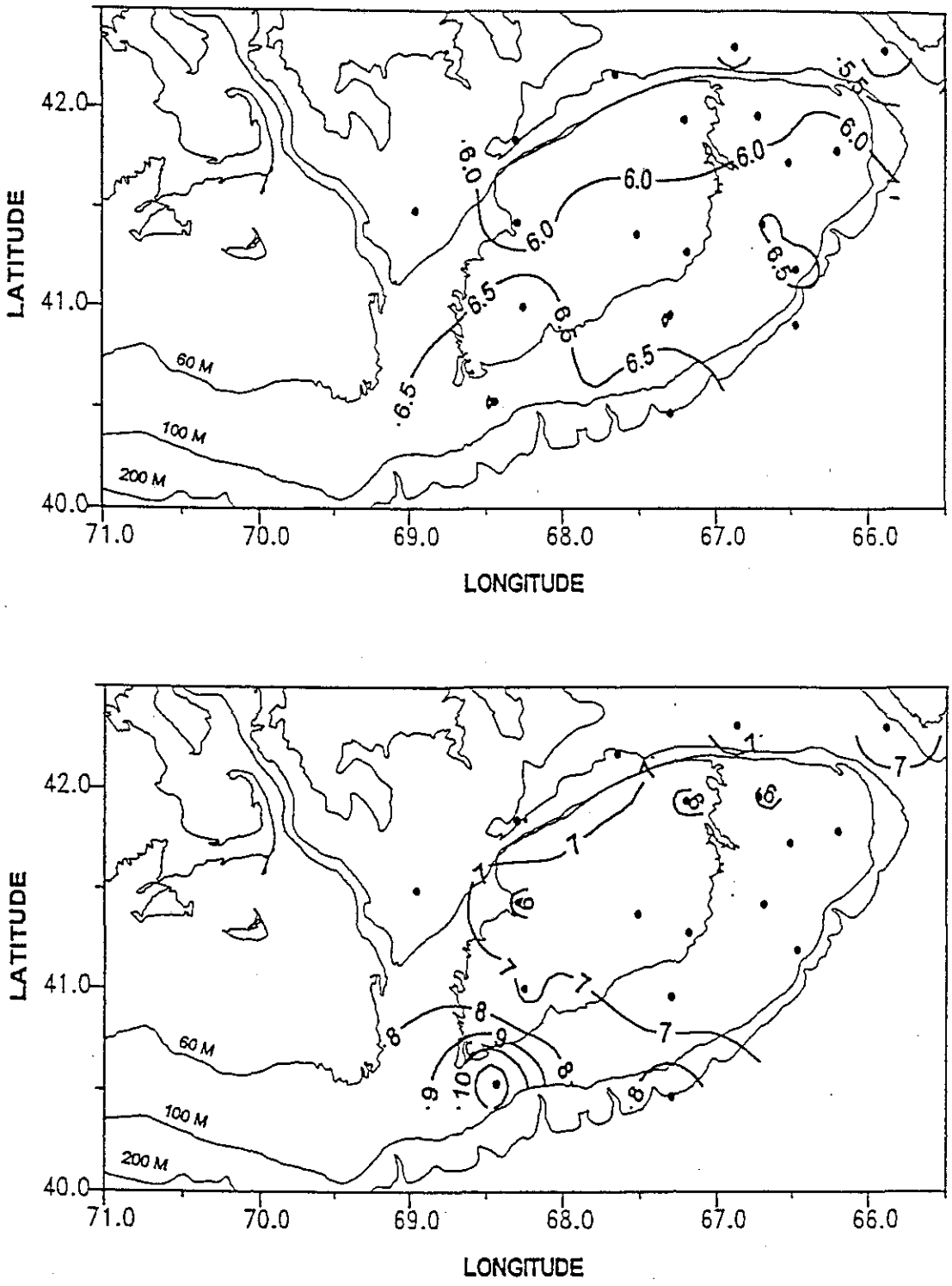

Figure 7. The surface and bottom temperature distributions for the U.S. GLOBEC Broad Scale Survey ALB9701.

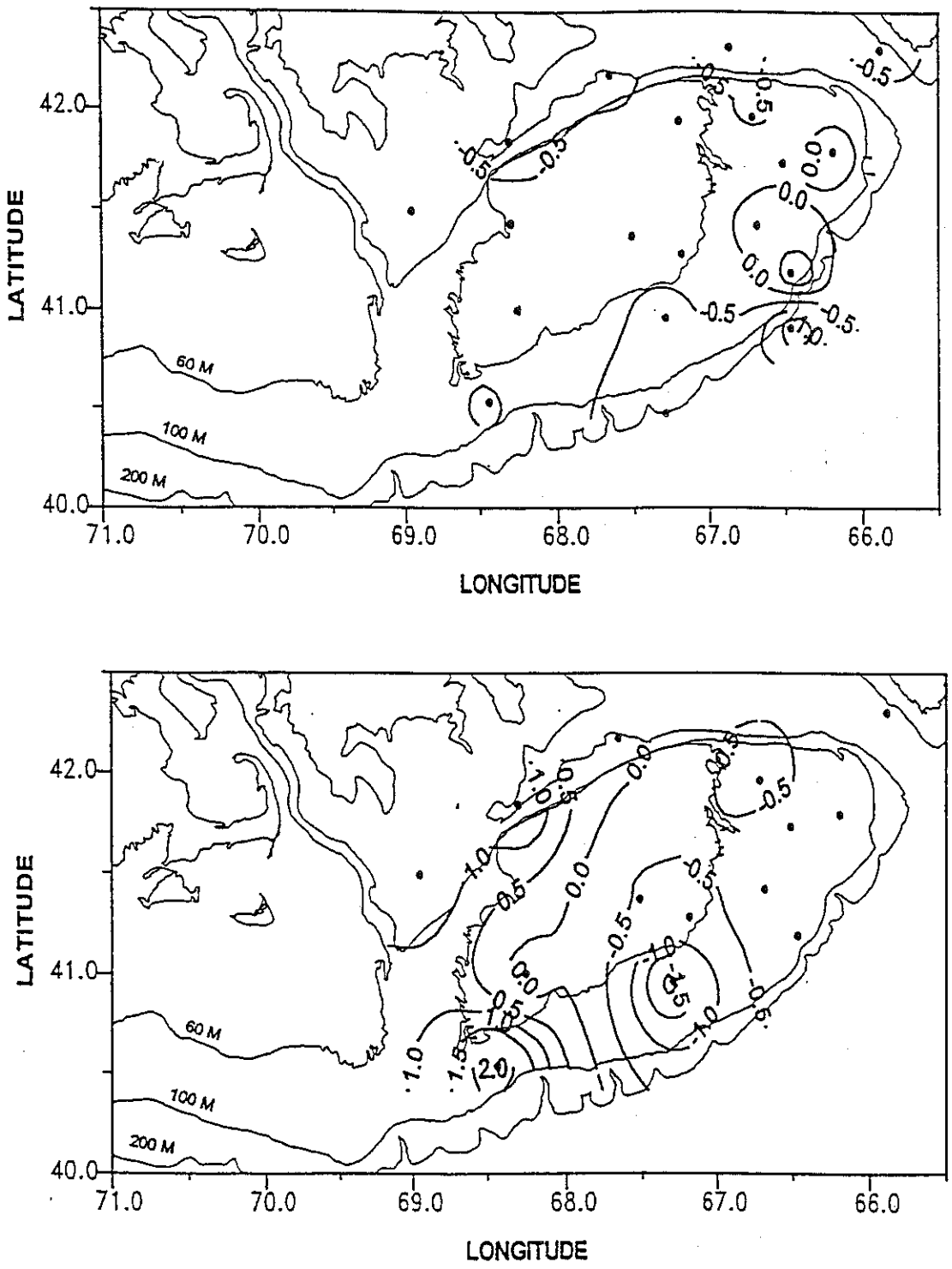

Figure 8. The surface and bottom temperature anomaly distributions for the U.S. GLOBEC Broad Scale Survey ALB9701.

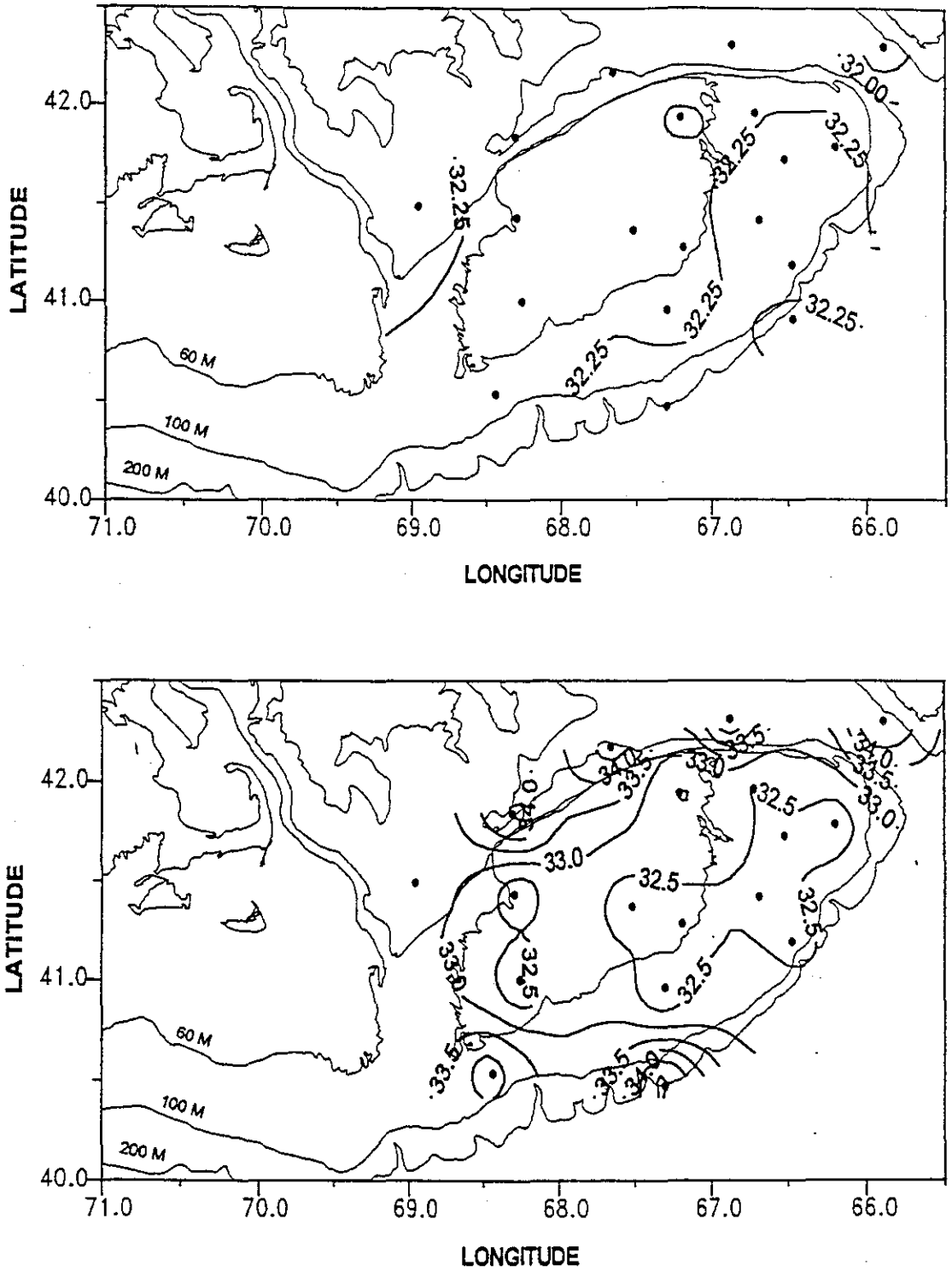

Figure 9. The surface and bottom salinity distribution for the U.S. GLOBEC Broad Scale Survey ALB9701.

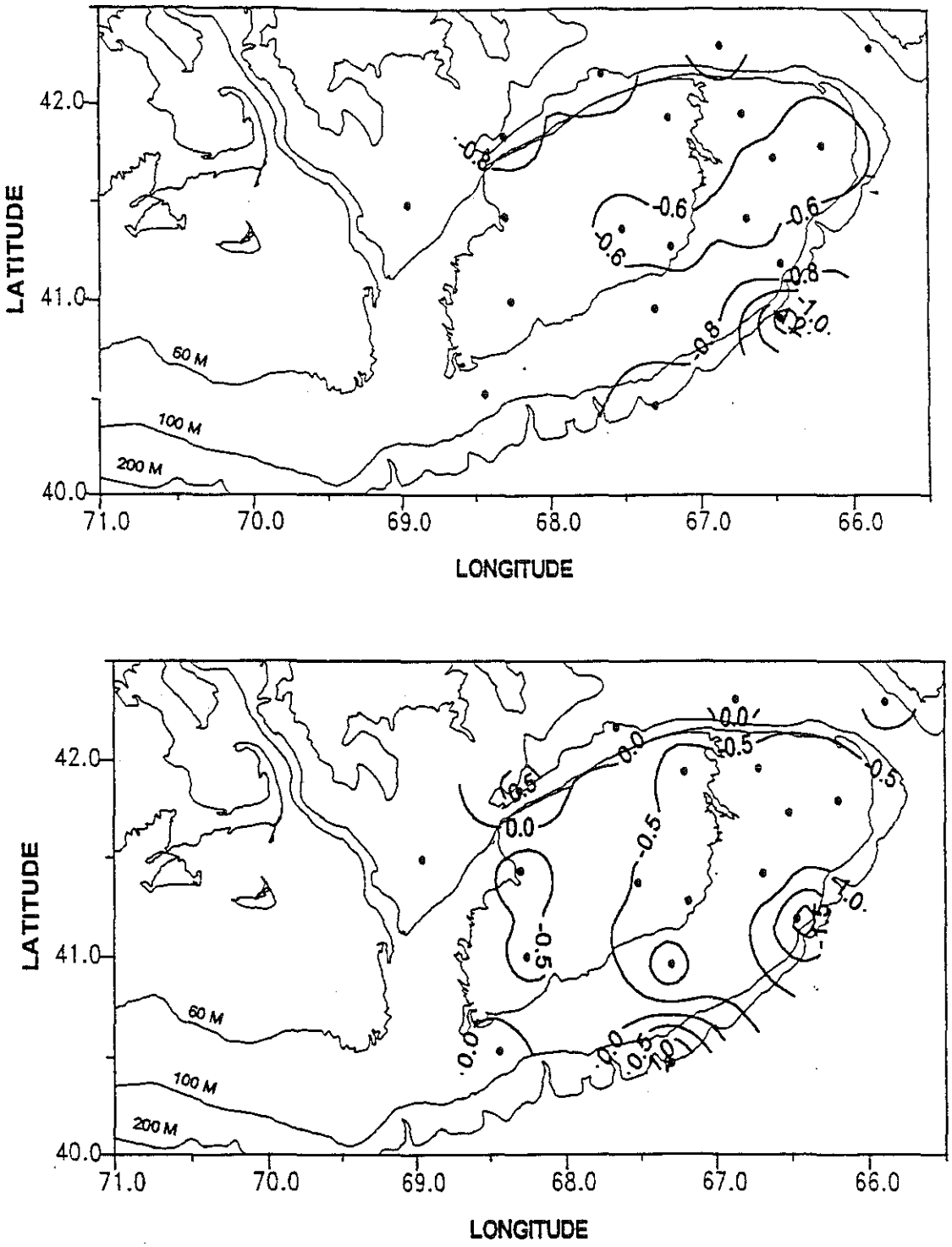

Figure 10. The surface and bottom salinity anomaly distribution for the U.S. GLOBEC Broad Scale Survey ALB9701.

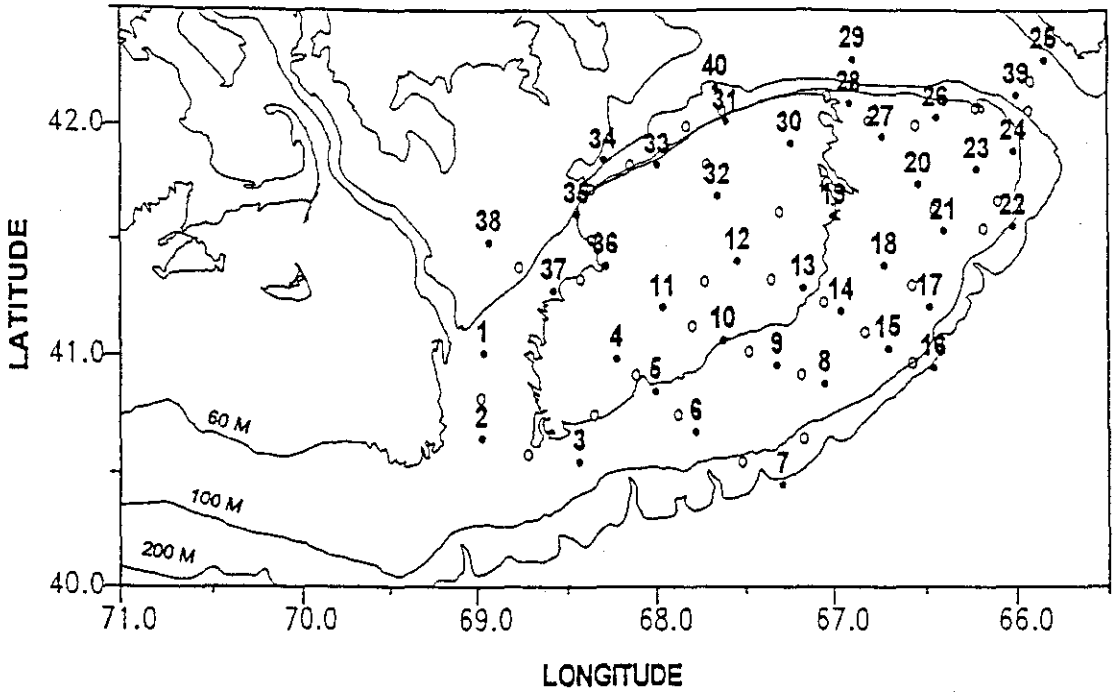

Figure 11. The hydrographic stations occupied during the U.S. GLOBEC Broad Scale Survey OCE9798.

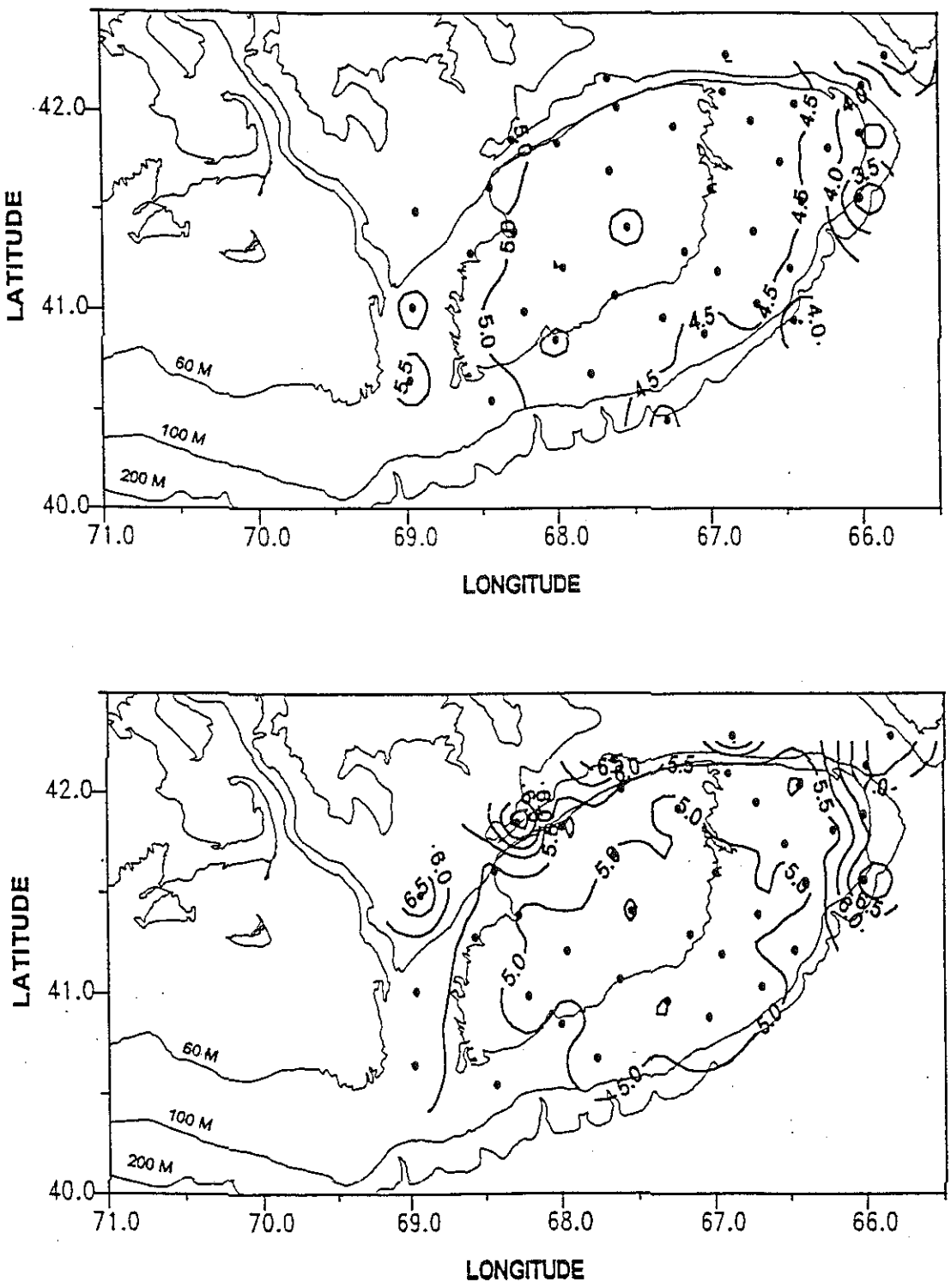

Figure 12. The surface and bottom temperature distributions for the U.S. GLOBEC Broad Scale Survey OCE9798

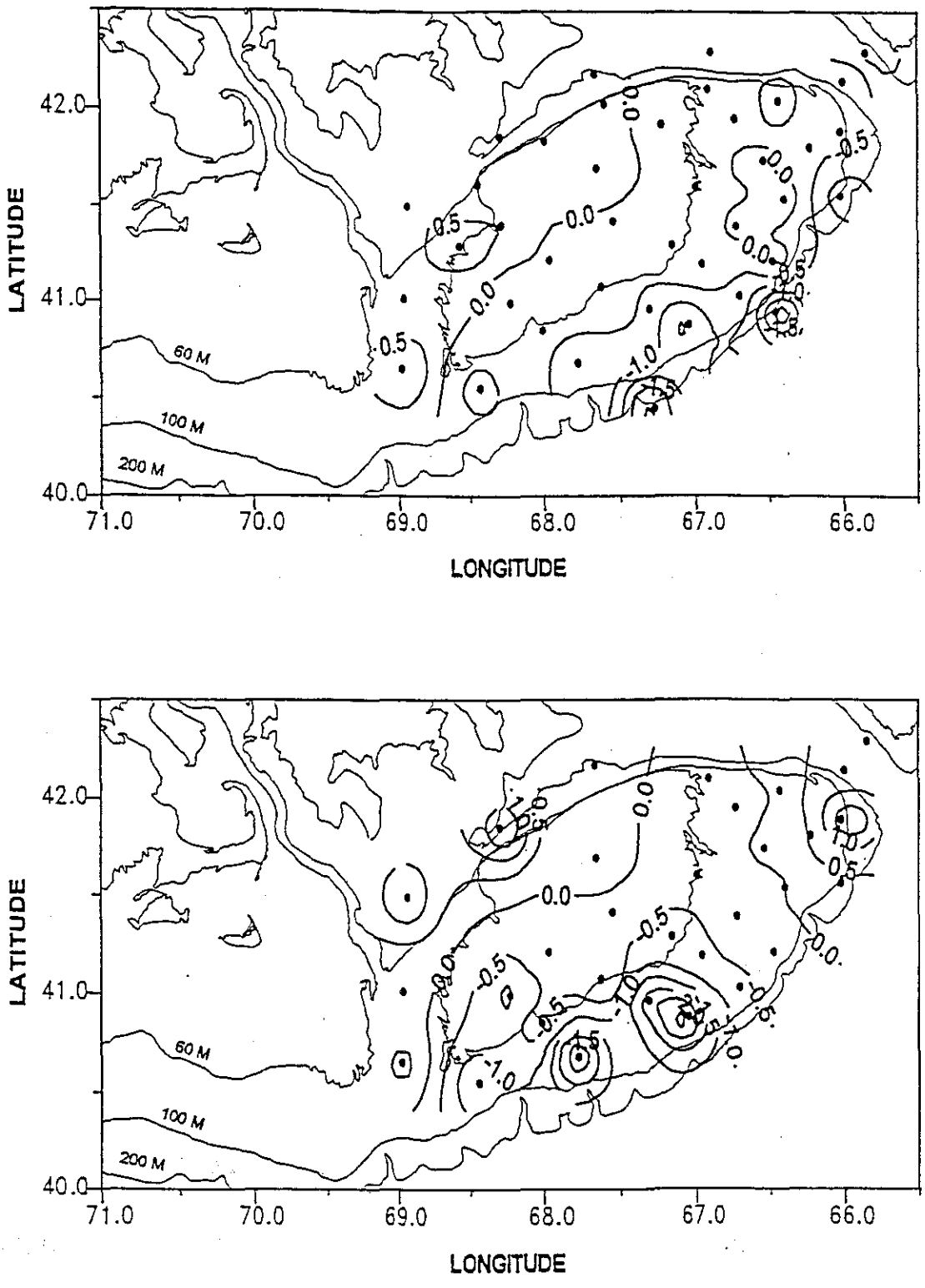

Figure 13. The surface and bottom temperature anomaly distributions for the U.S. GLOBEC Broad Scale Survey OCE9798.

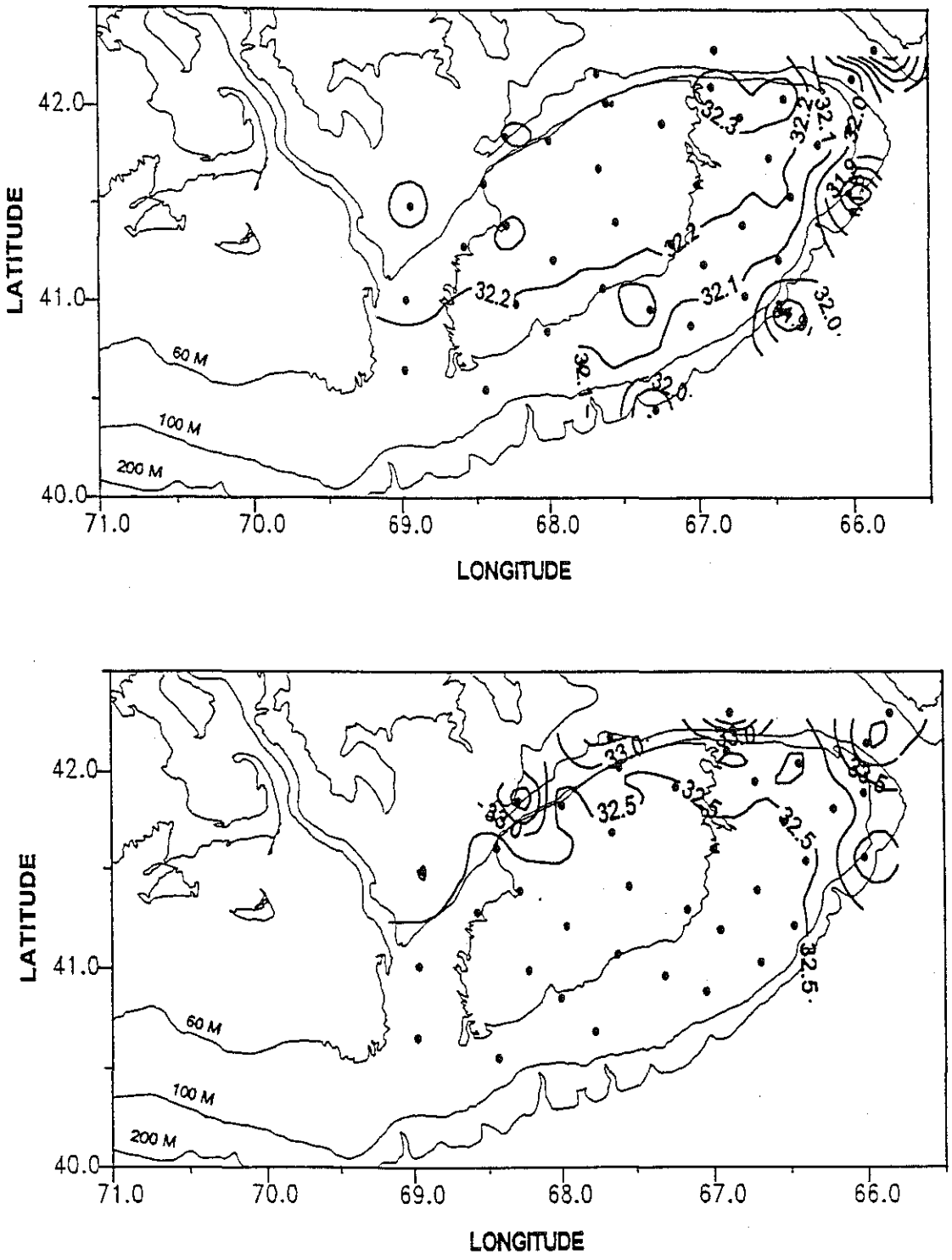

Figure 14. The surface and bottom salinity distribution for the U.S. GLOBEC Broad Scale Survey OCE9798.

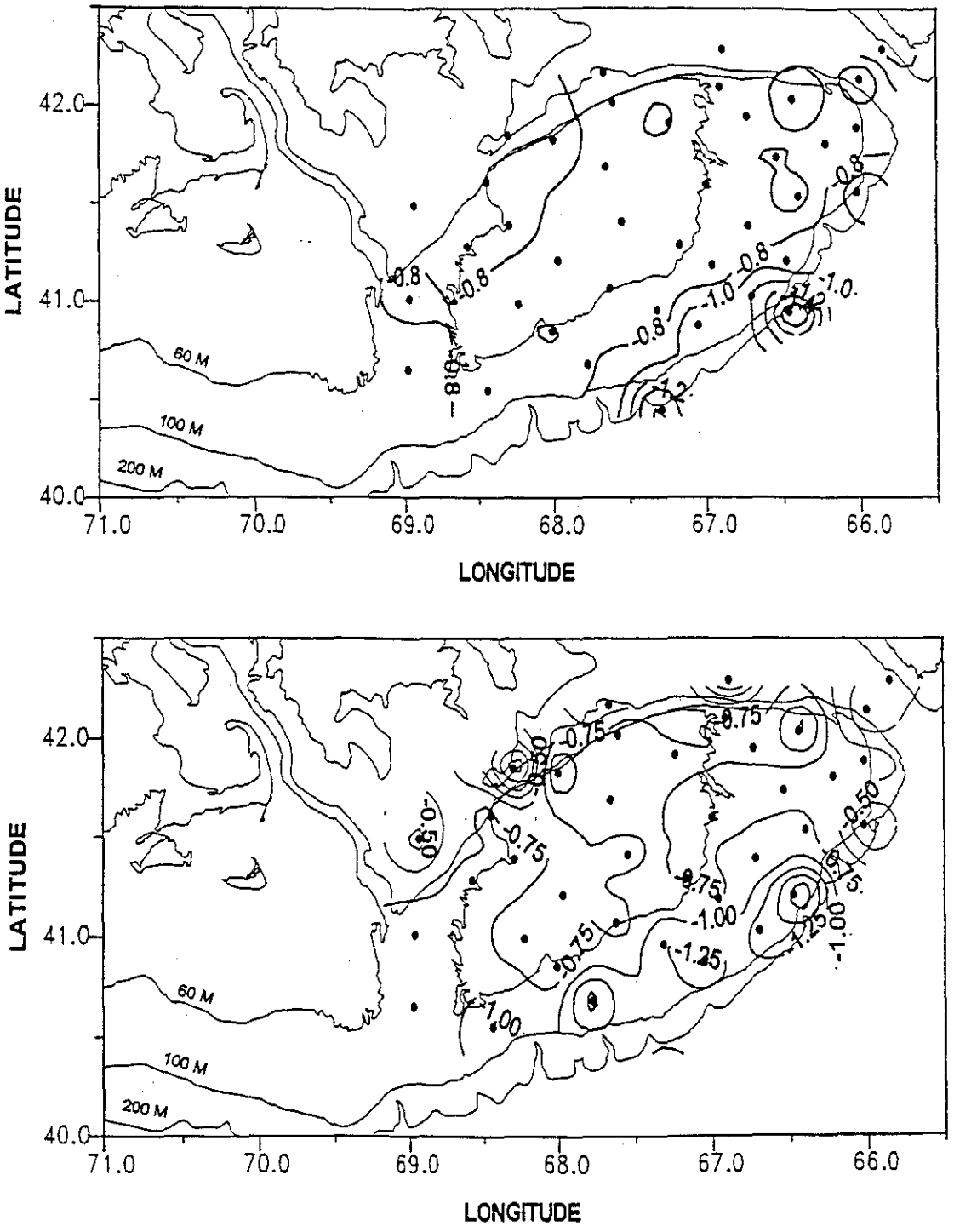

Figure 15. The surface and bottom salinity anomaly distribution for the U.S. GLOBEC Broad Scale Survey OCE9798.

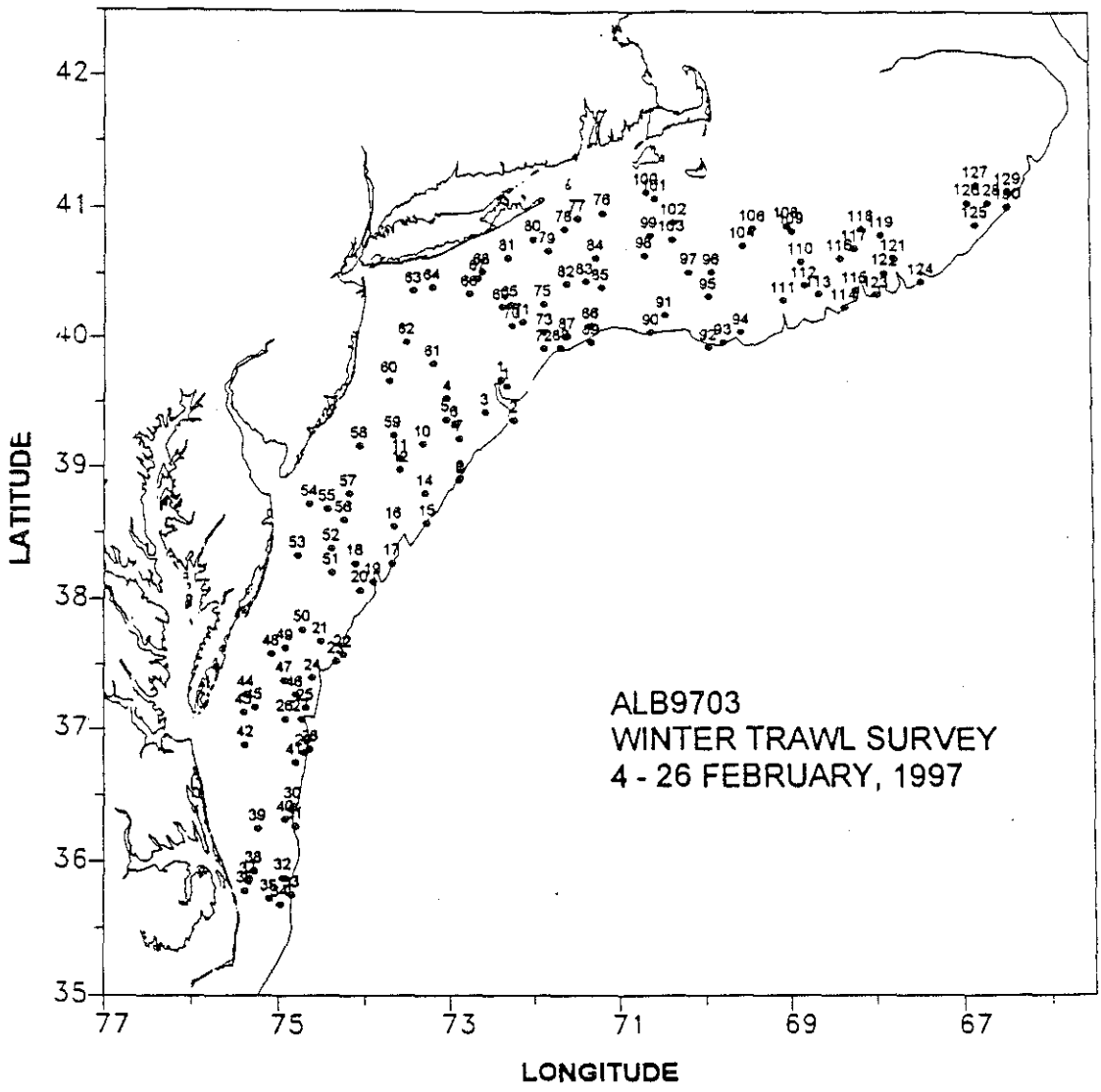

Figure 16. Hydrographic stations occupied during the Winter Bottom Trawl Survey ALB9703.

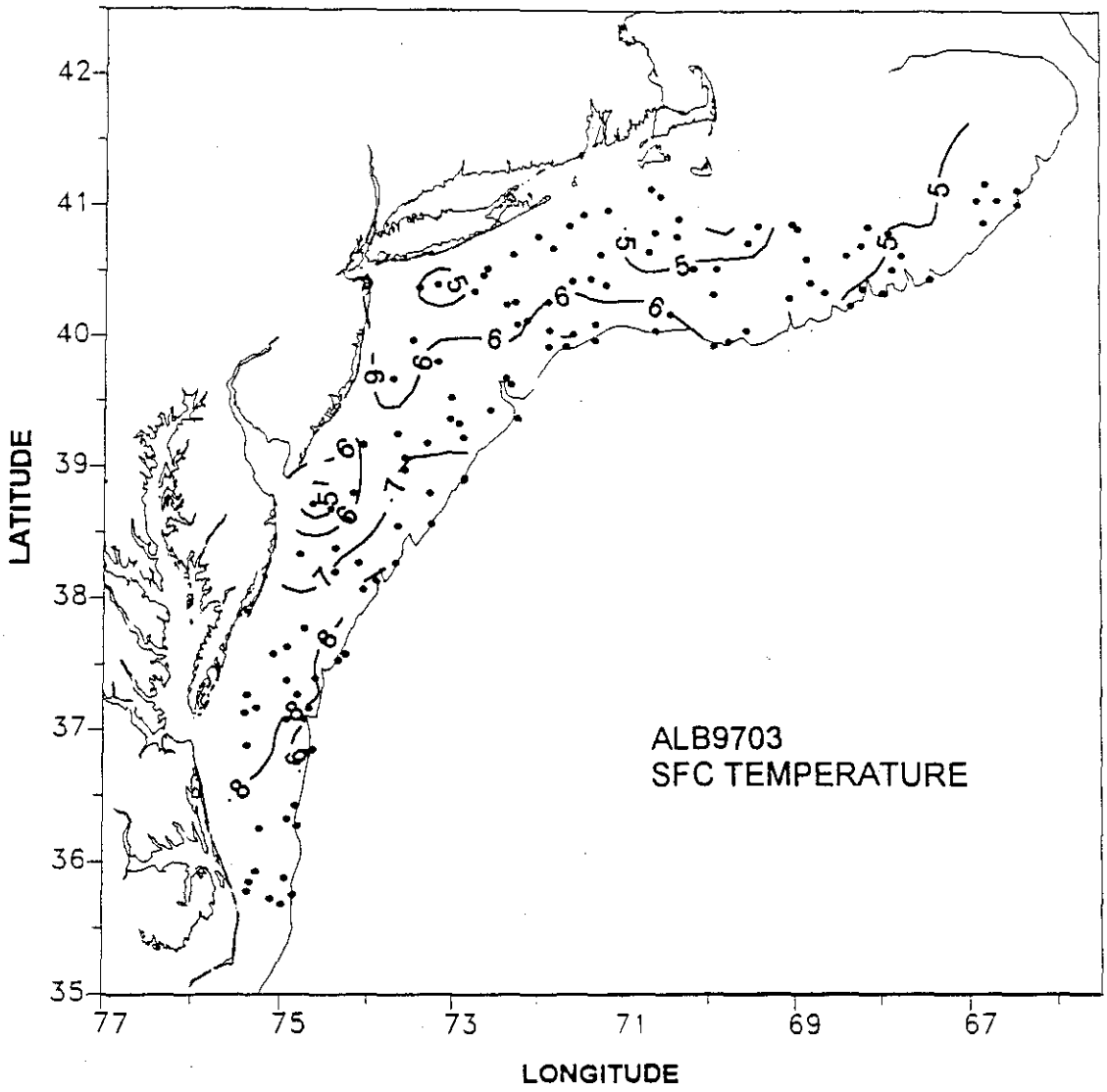

Figure 17. Surface temperature distribution for the Winter Bottom Trawl Survey AL9703.

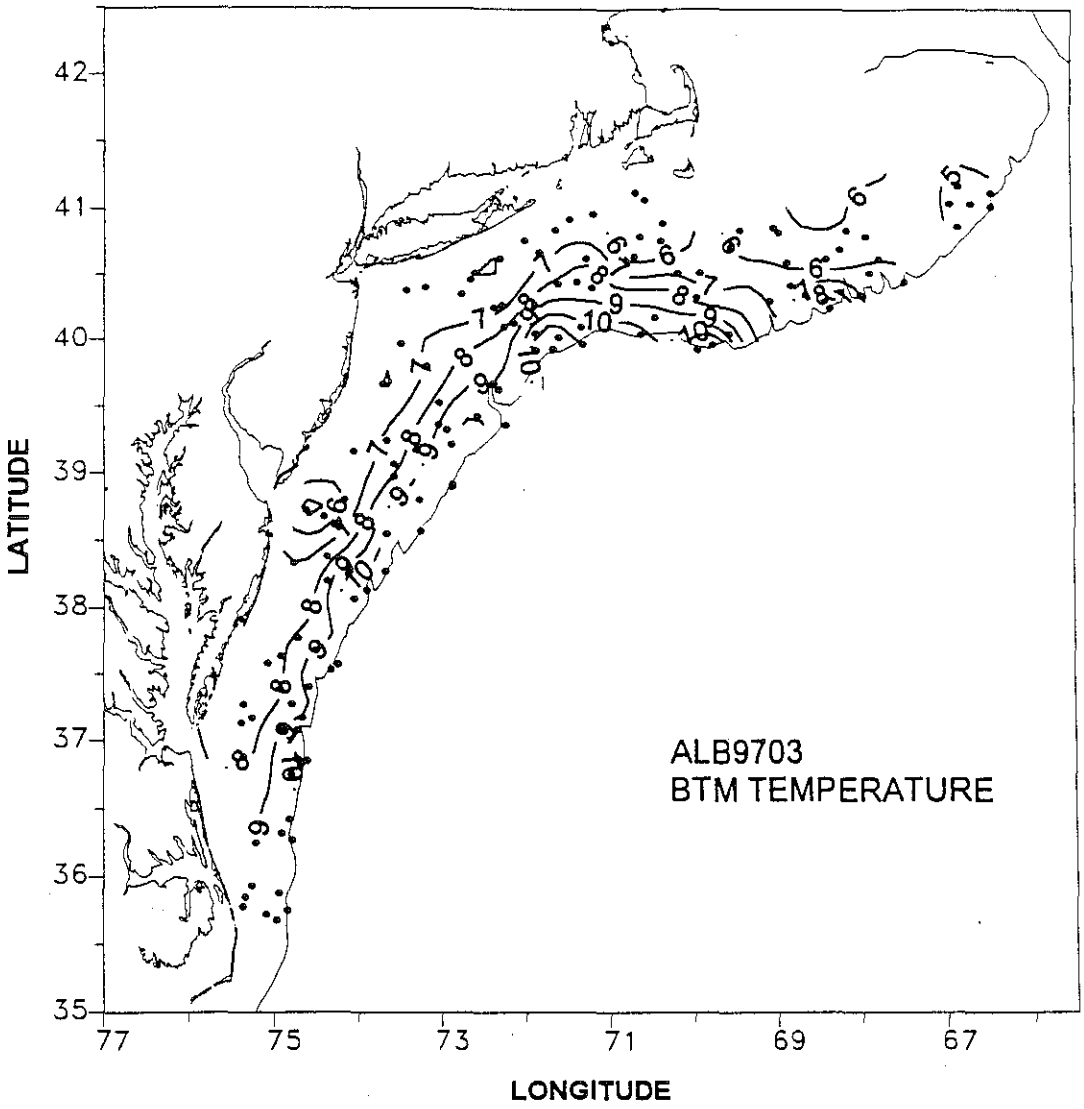

Figure 18. Bottom temperature distribution for the Winter Bottom Trawl Survey AL9703.

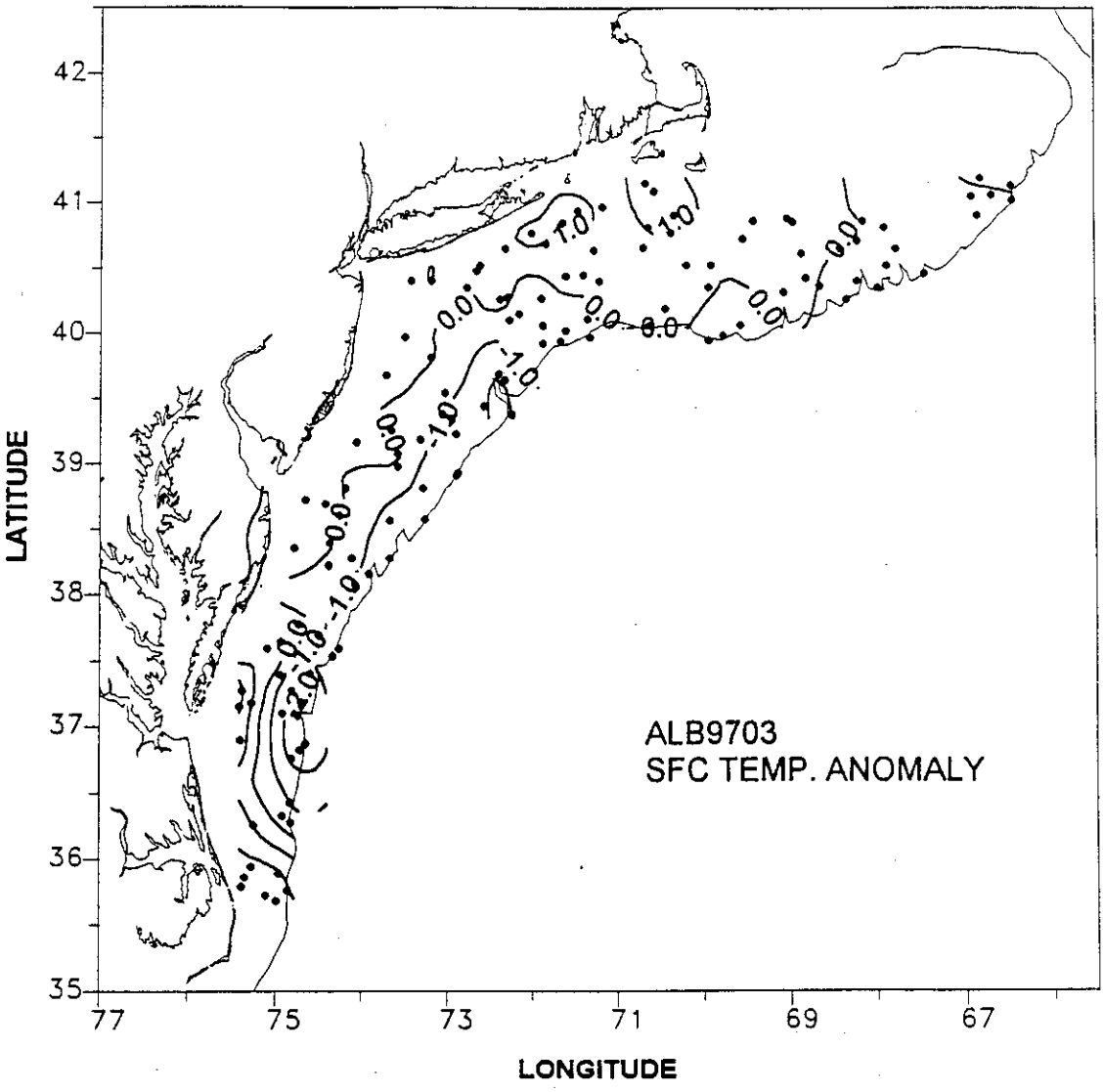

Figure 19. Surface temperature anomaly distribution for the Winter Bottom Trawl Survey AL9703.

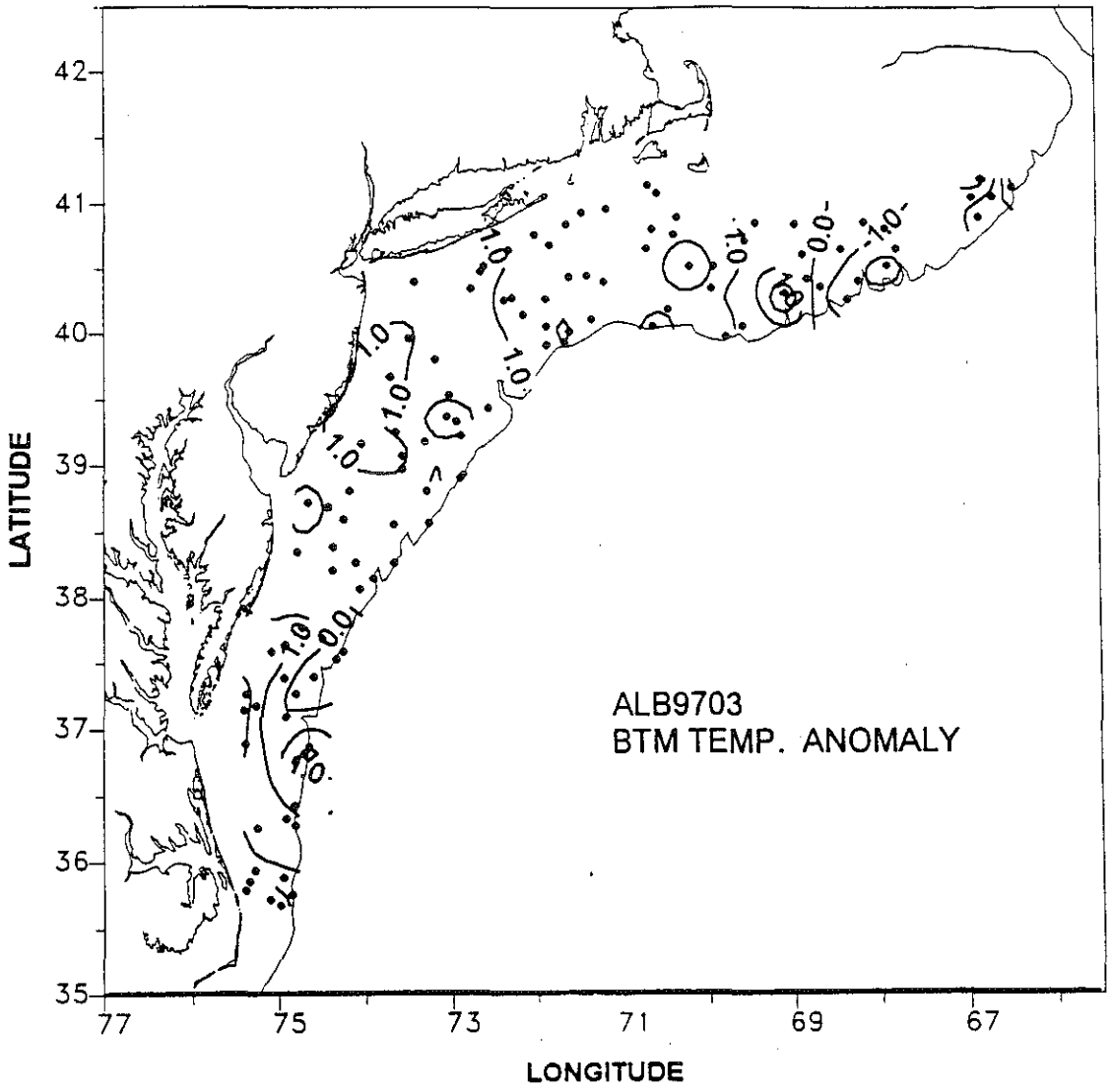

Figure 20. Bottom temperature anomaly distribution for the Winter Bottom Trawl Survey AL9703.

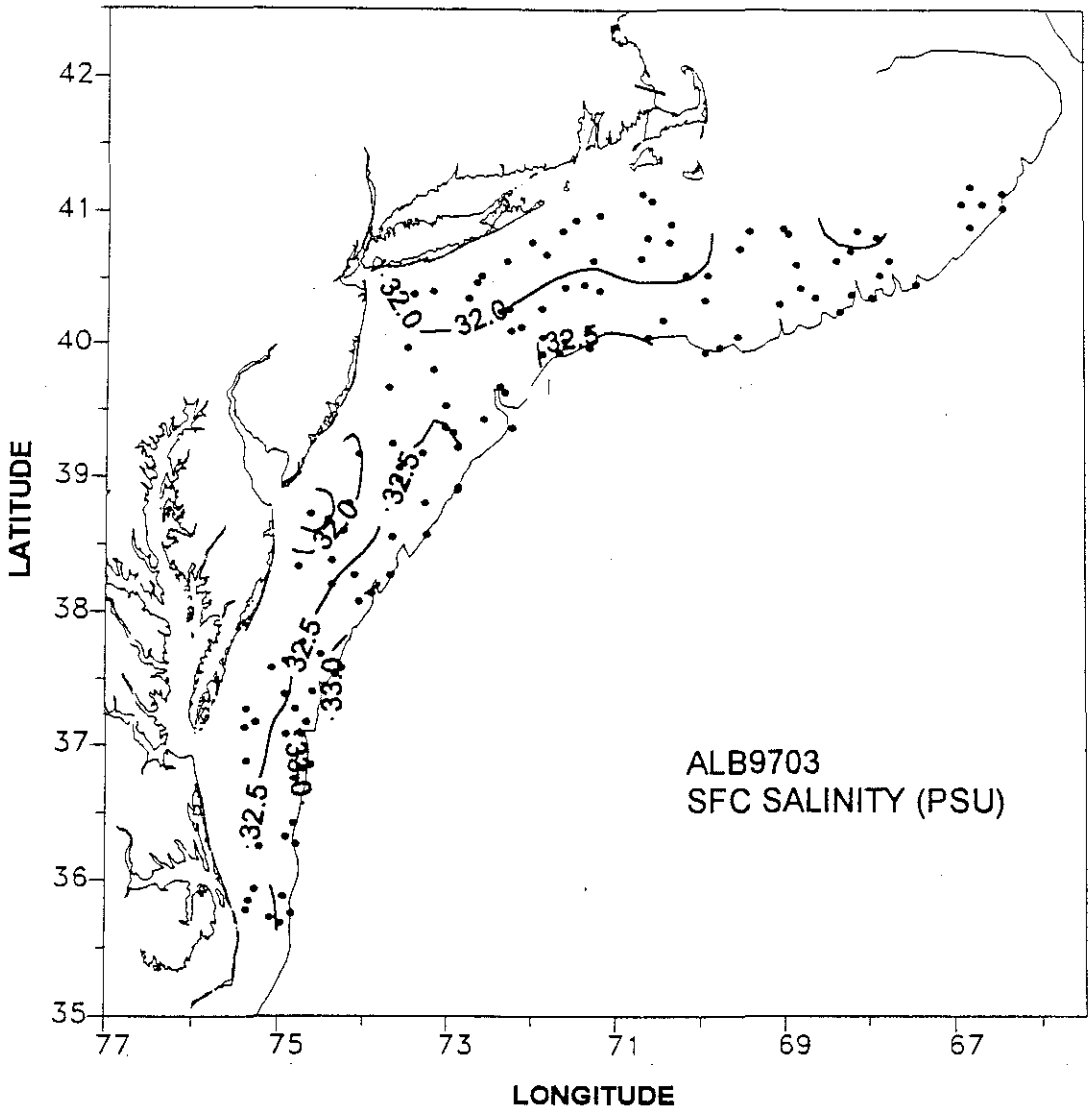

Figure 21. Surface salinity distribution for the Winter Bottom Trawl Survey AL9703.

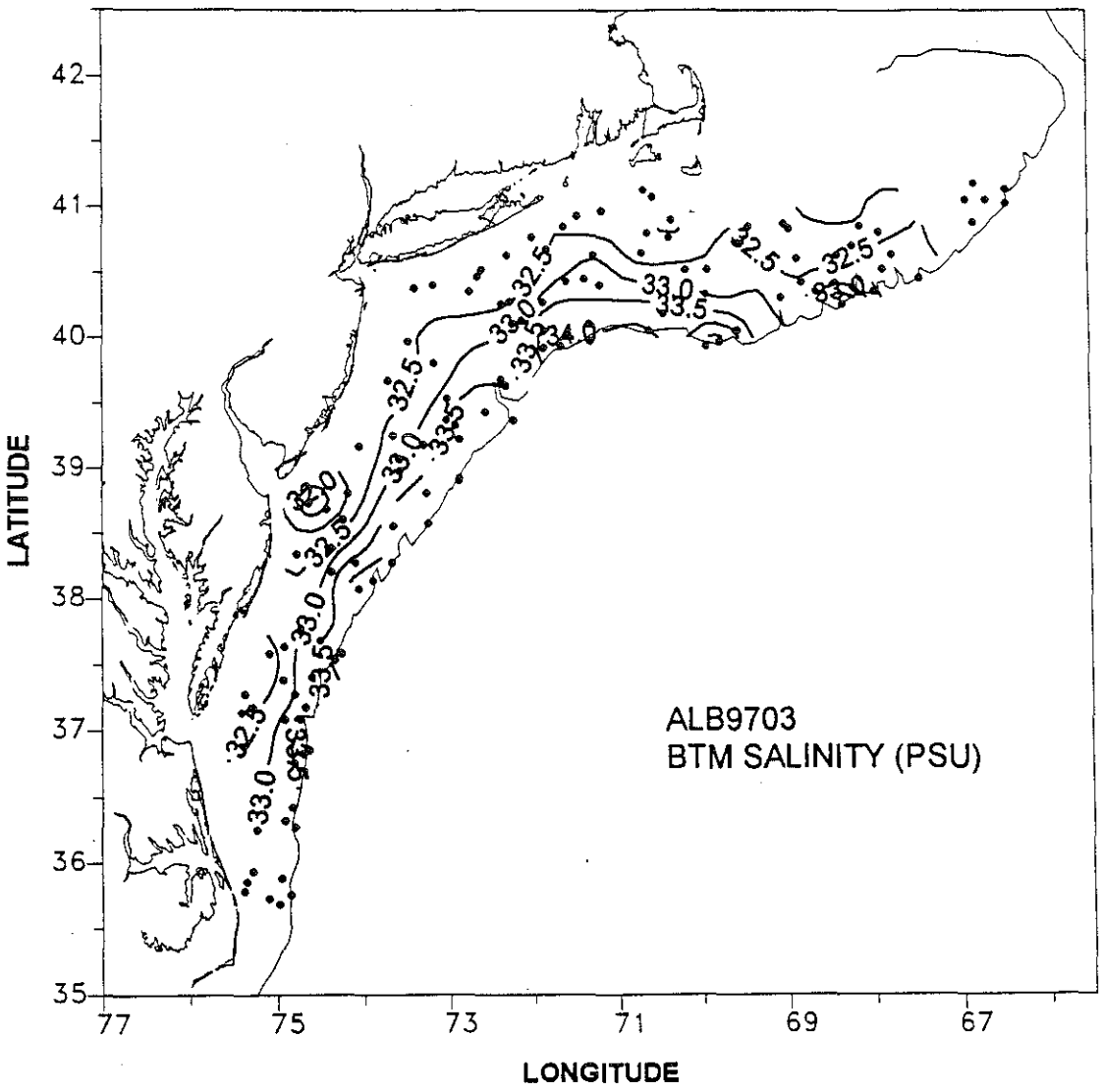

Figure 22. Bottom salinity distribution for the Winter Bottom Trawl Survey AL9703.

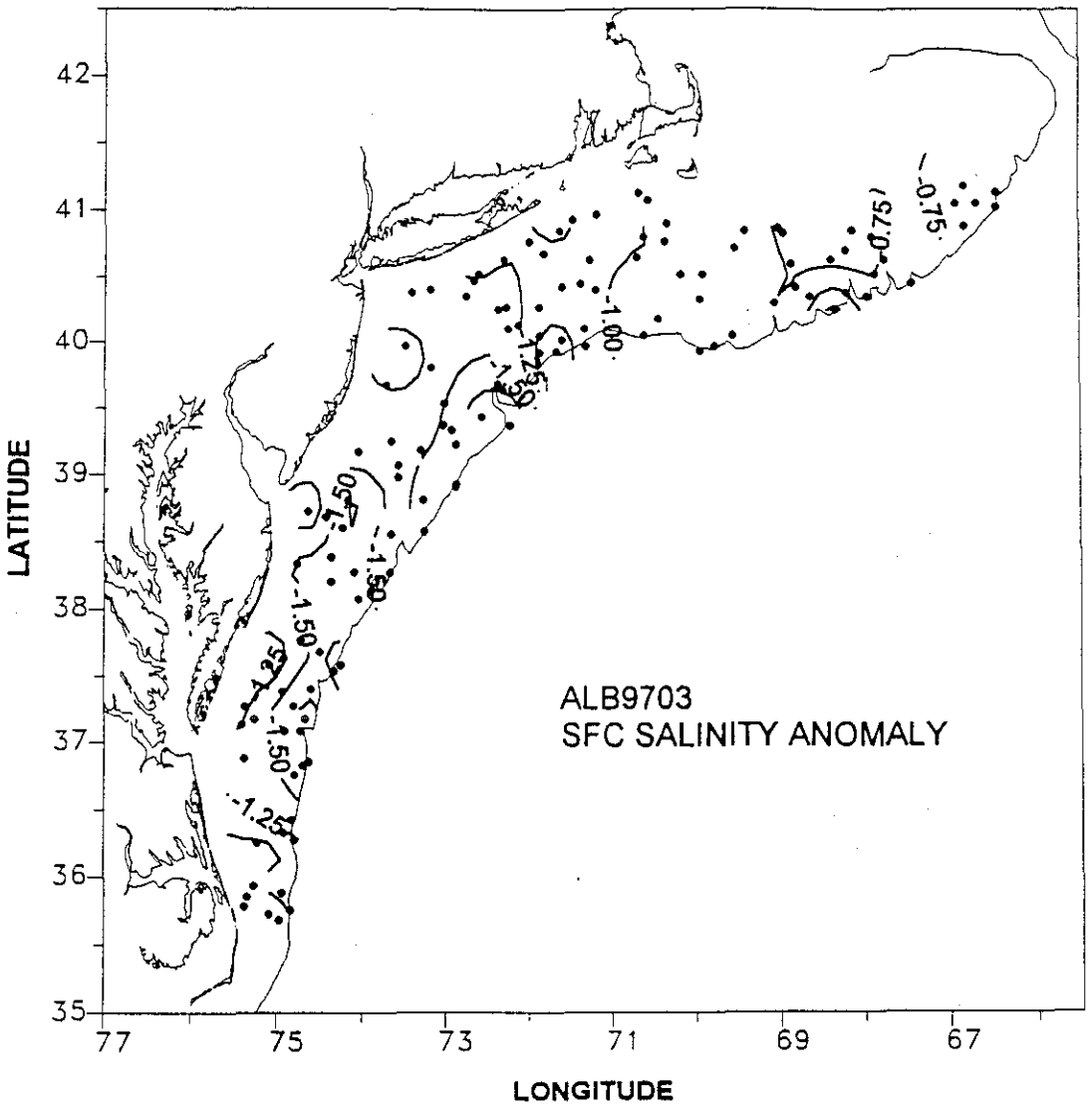

Figure 23. Surface salinity anomaly distribution for the Winter Bottom Trawl Survey AL9703.

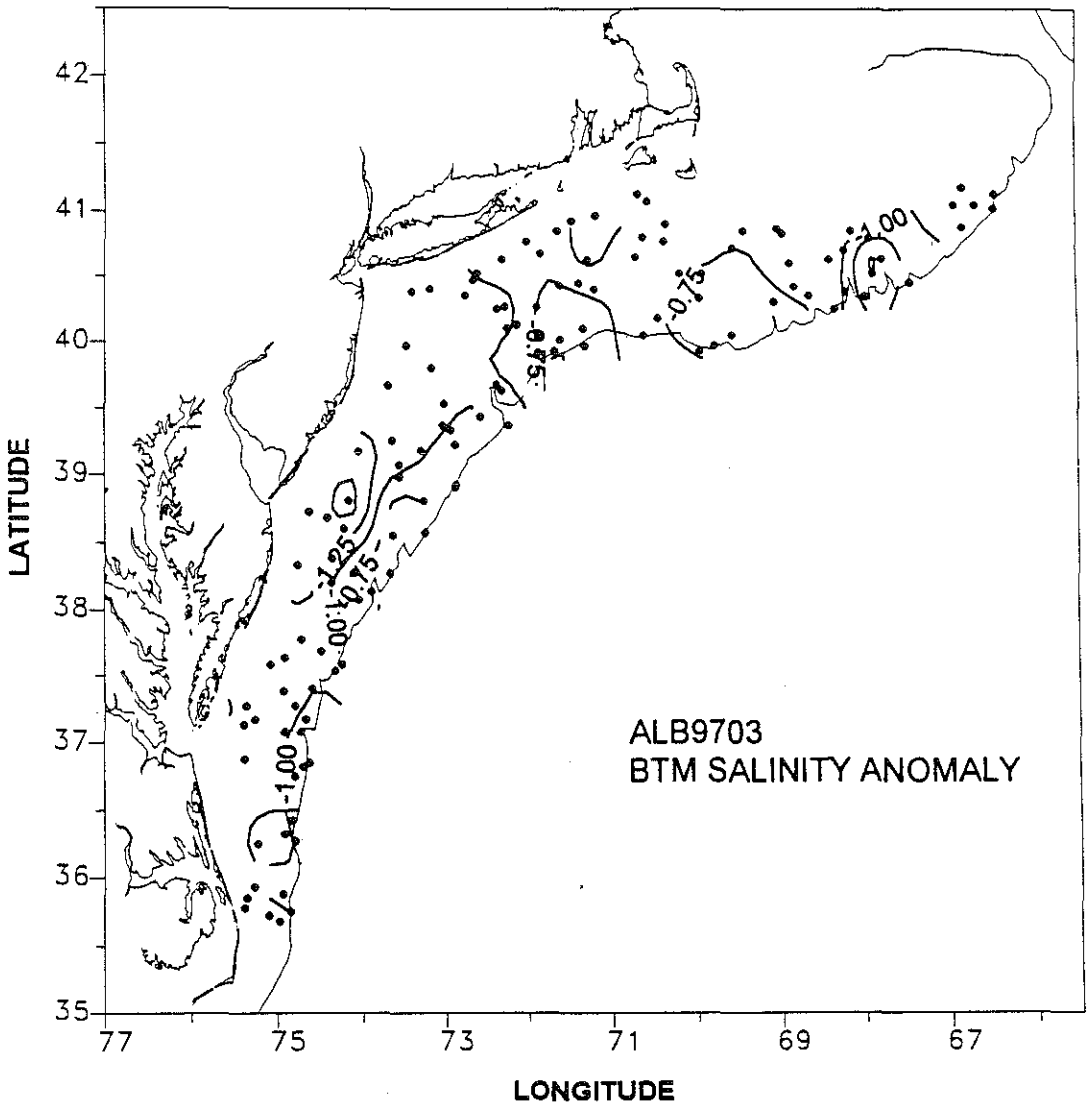

Figure 24. Bottom salinity anomaly distribution for the Winter Bottom Trawl Survey AL9703.

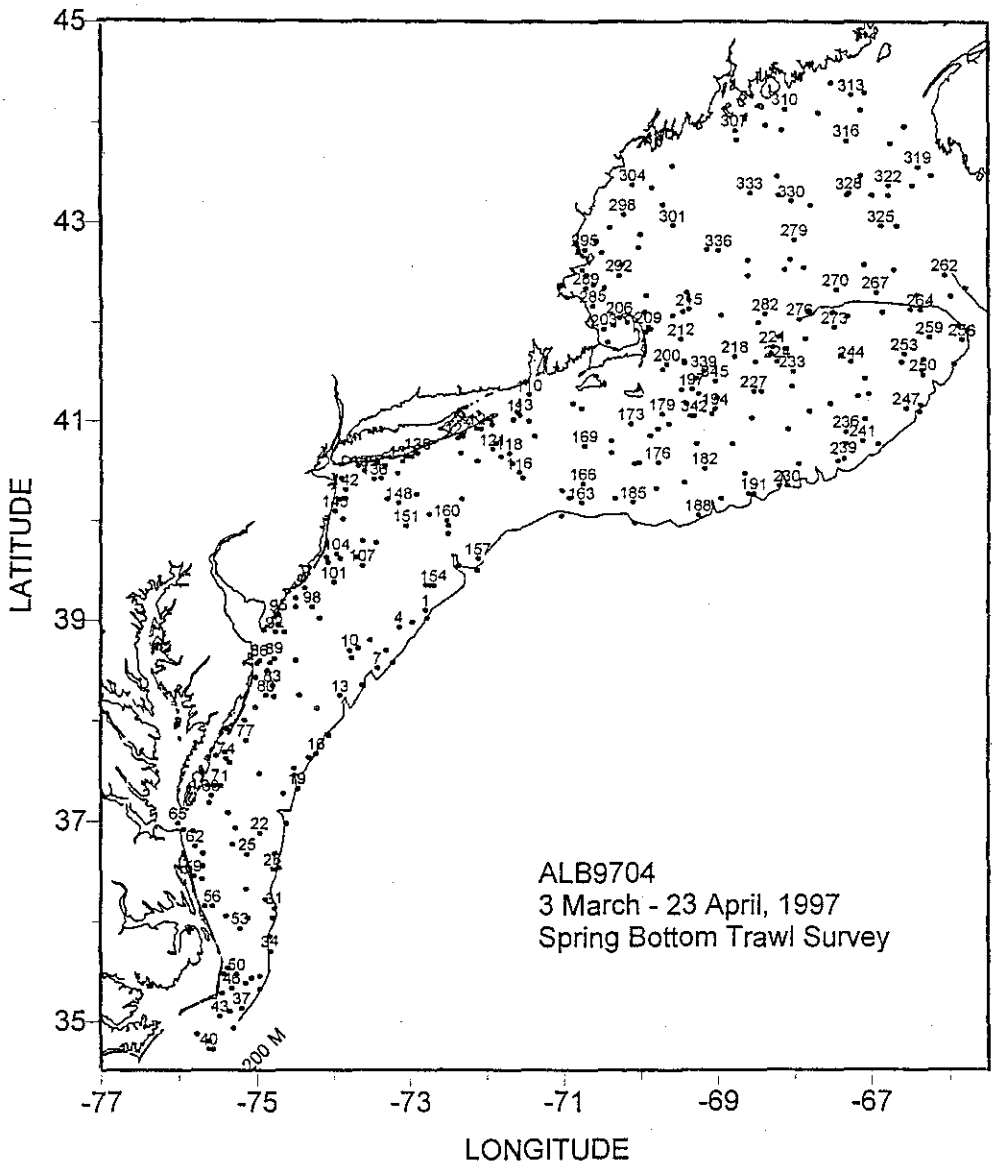

Figure 25. Hydrographic stations occupied during the spring bottom trawl survey ALB9704.

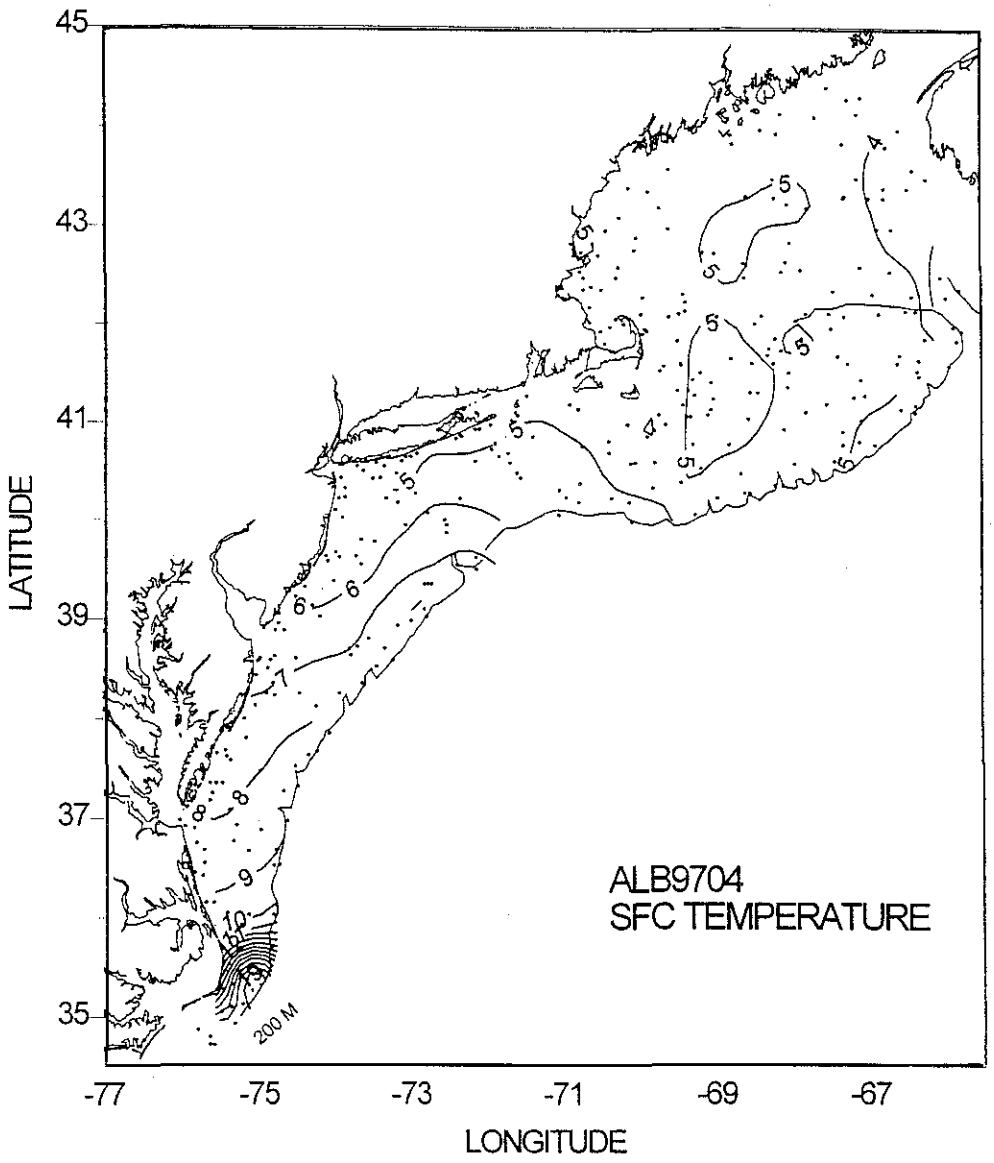

Figure 26. Surface temperature distribution for the Spring Bottom Trawl Survey ALB9704.

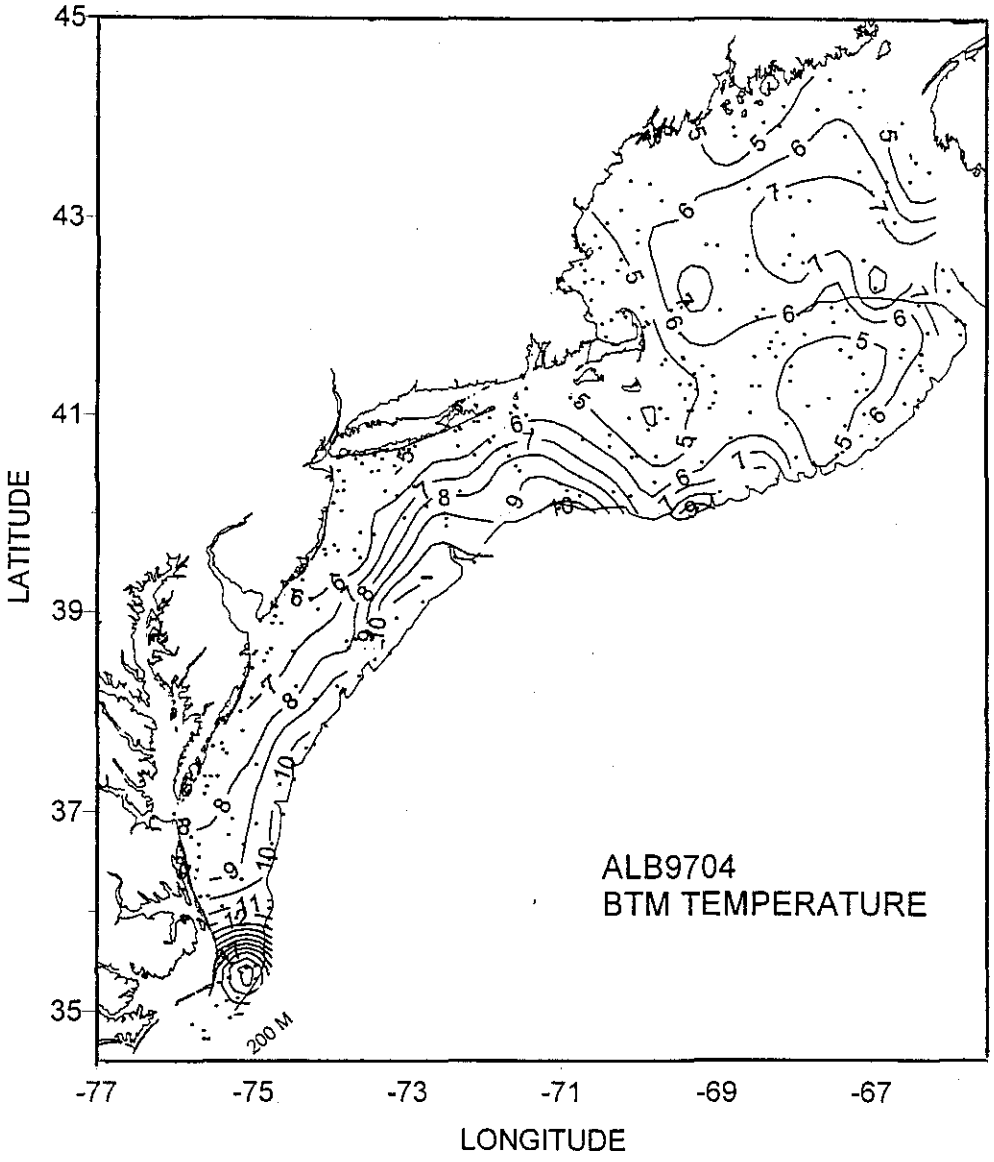

Figure 27. Bottom temperature distribution for the Spring Bottom Trawl Survey ALB9704.

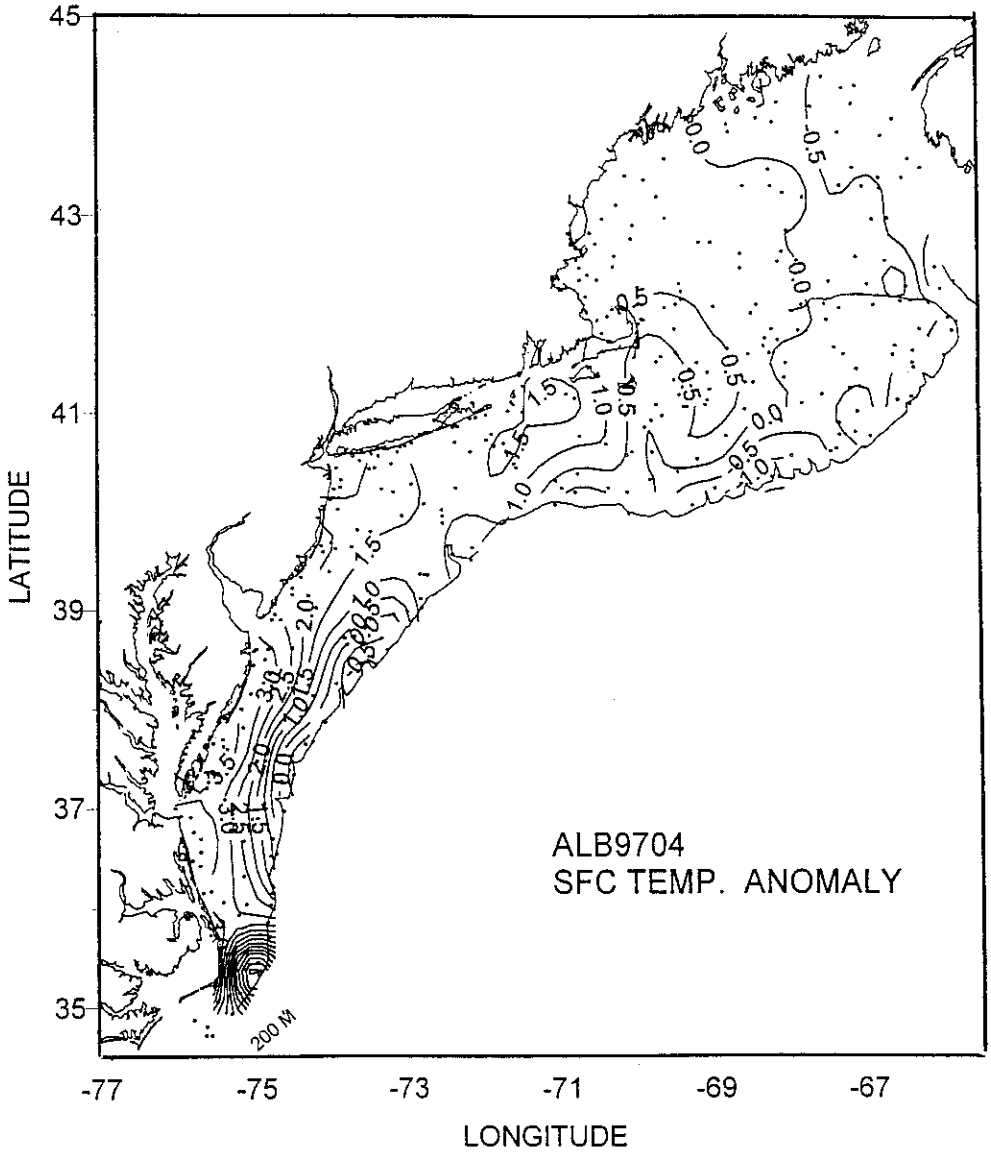

Figure 28. Surface temperature anomaly distribution for the Spring Bottom Trawl Survey ALB9704.

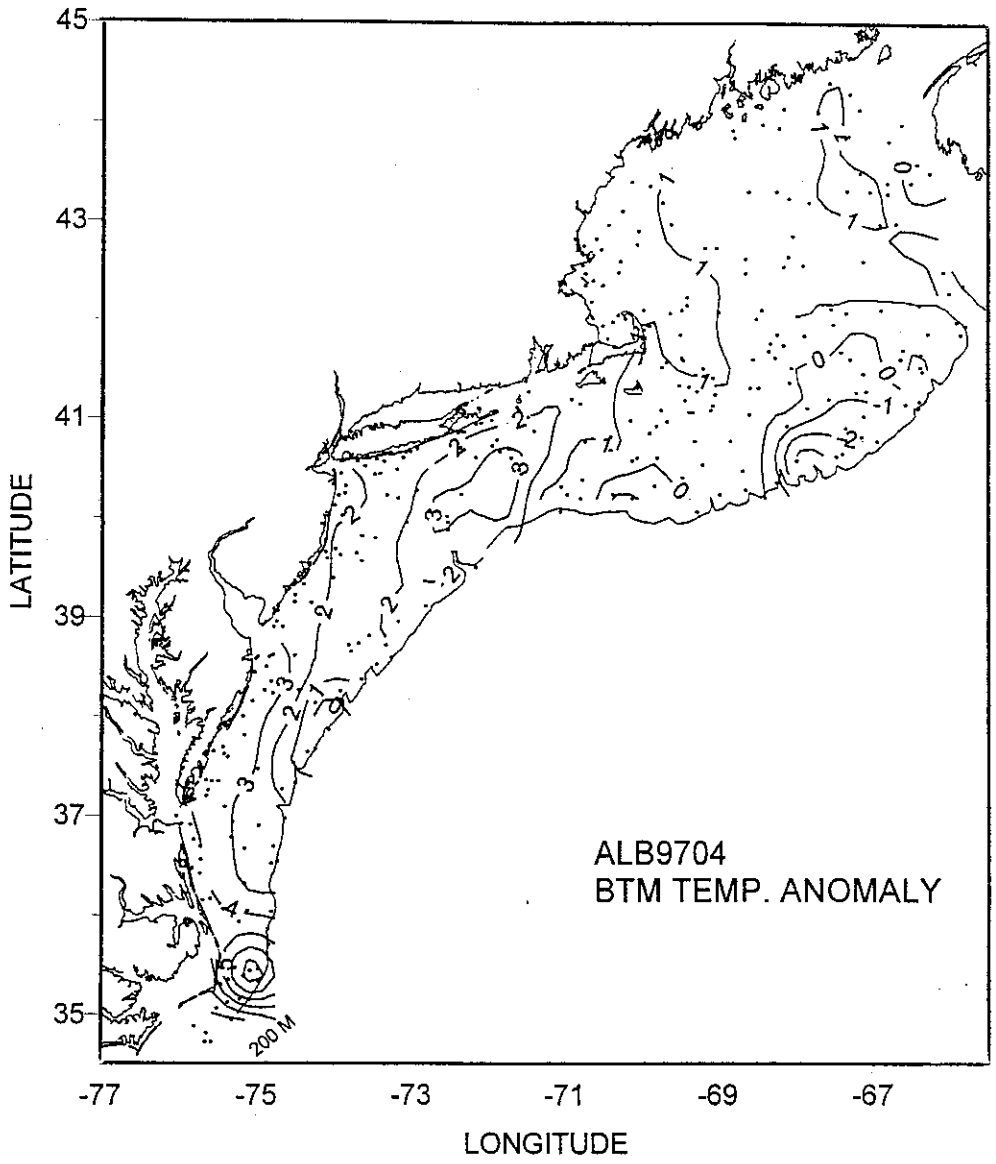

Figure 29. Bottom temperature anomaly distribution for the Spring Bottom Trawl Survey ALB9704.

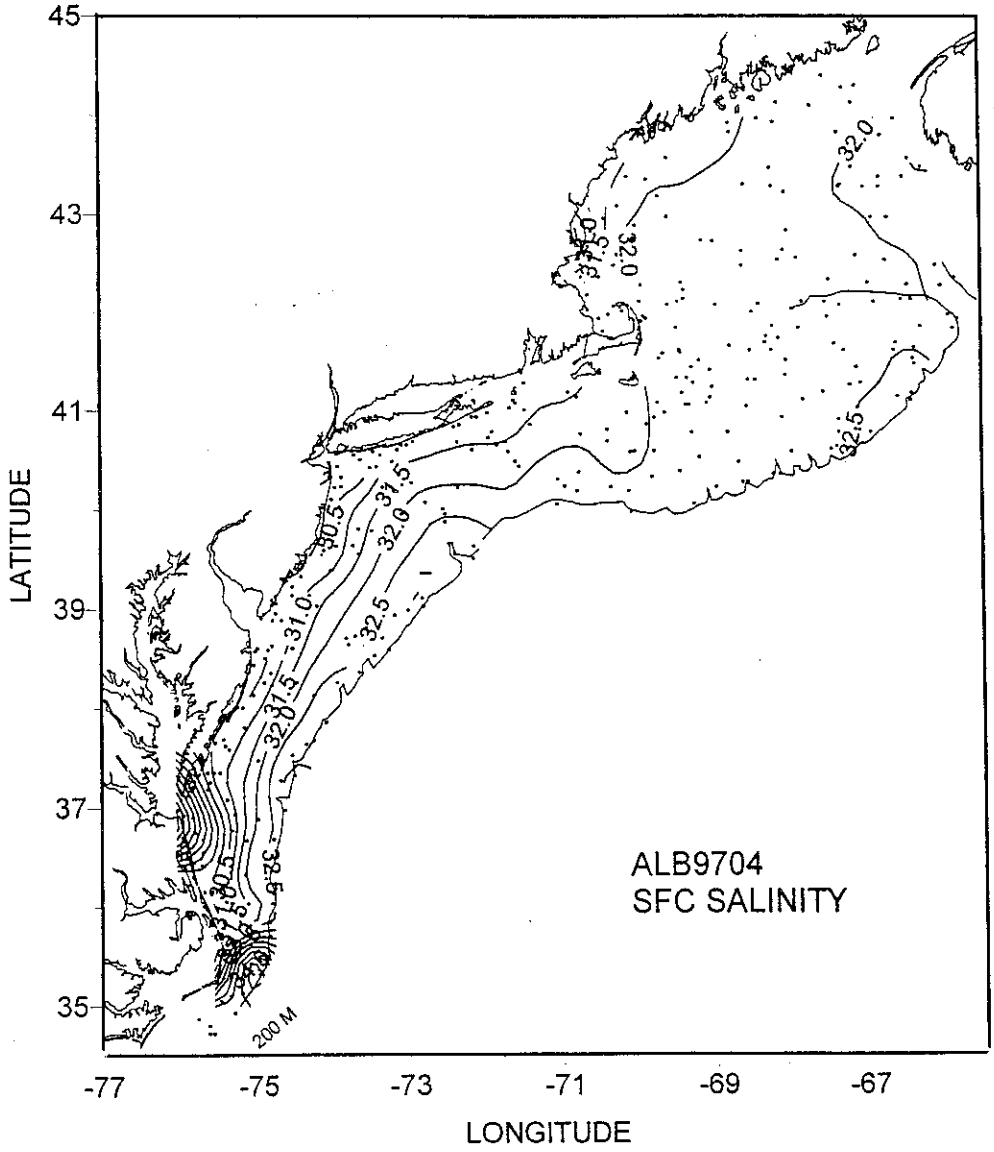

Figure 30. Surface salinity distribution for the Spring Bottom Trawl Survey ALB9704.

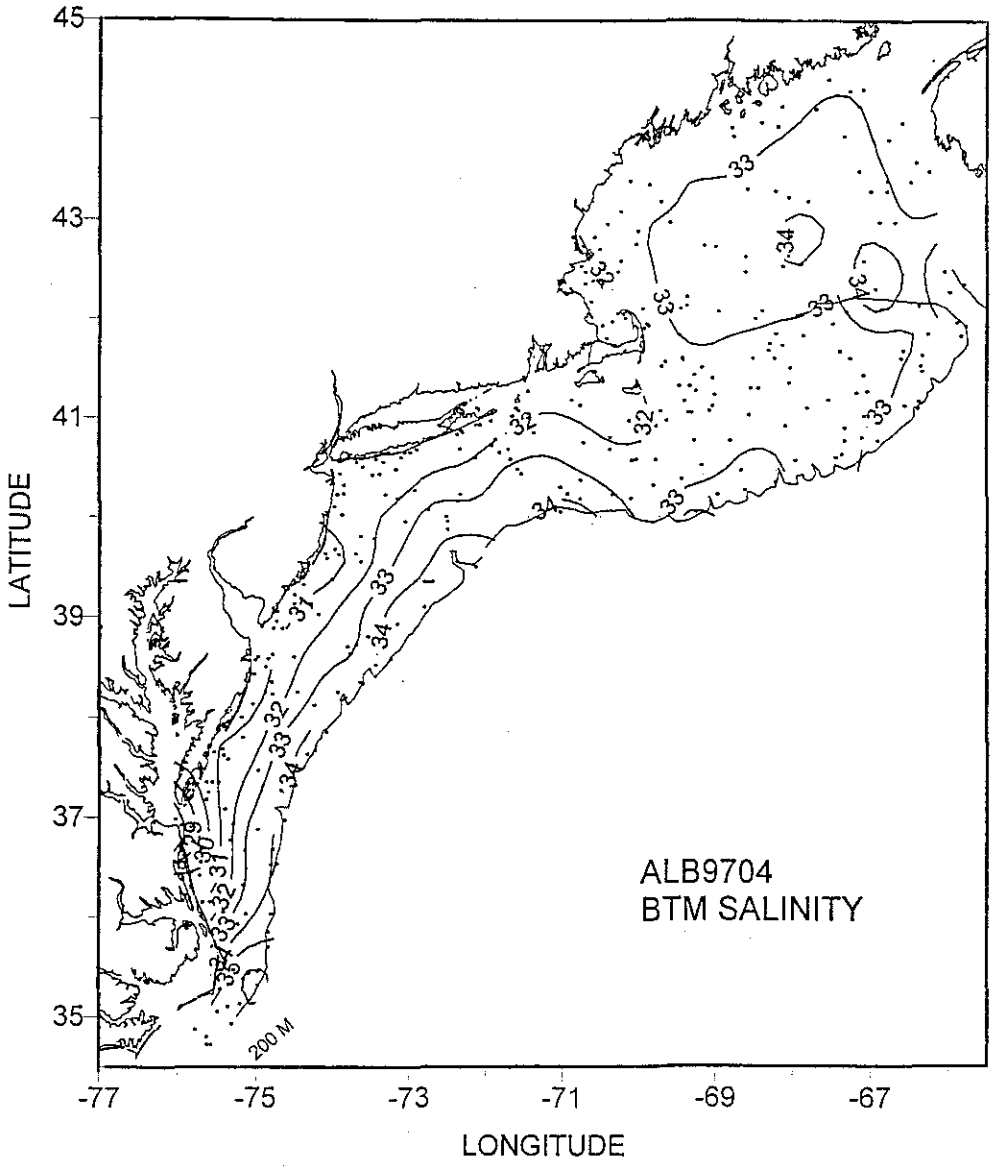

Figure 31. Bottom salinity distribution for the Spring Bottom Trawl Survey ALB9704.

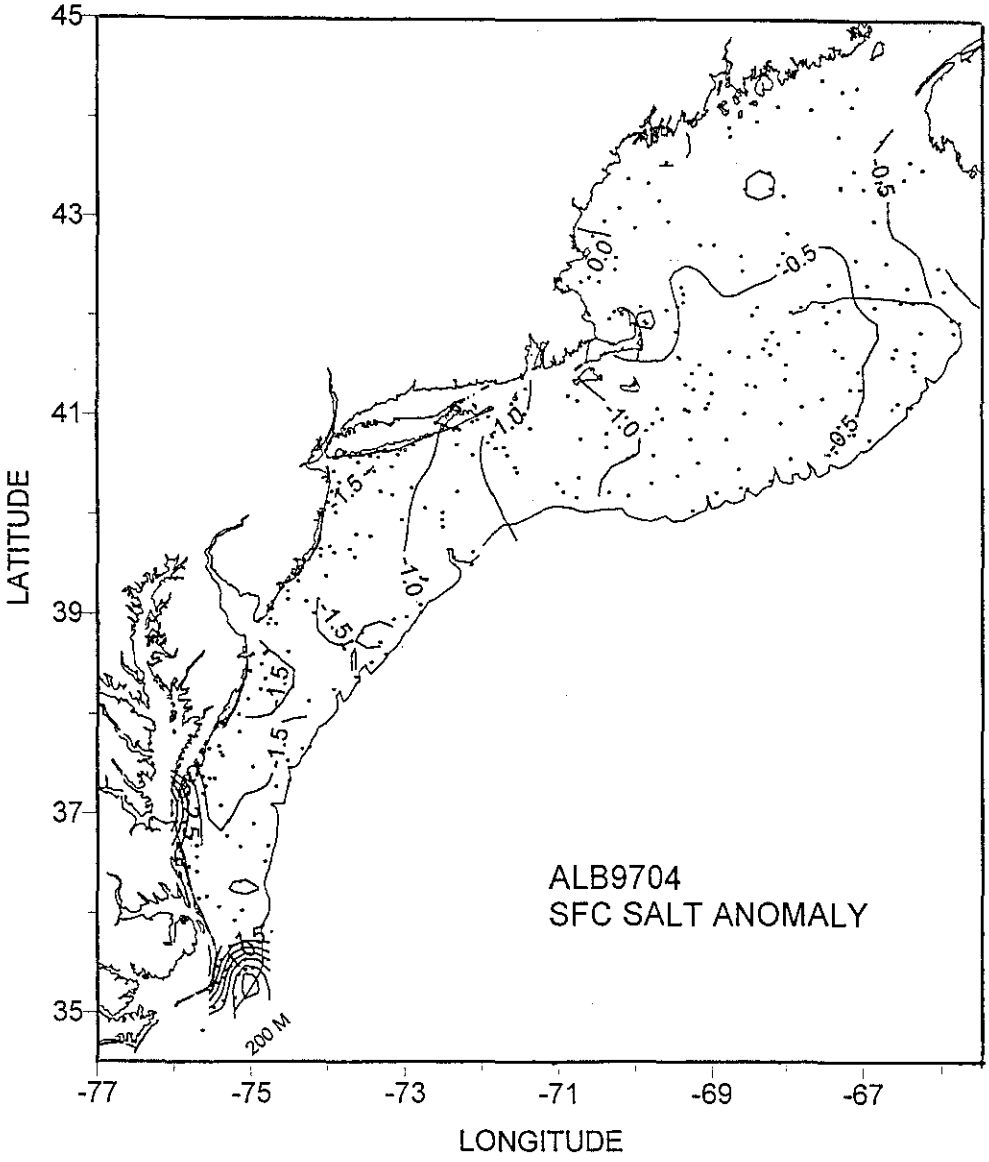

Figure 32. Surface salinity anomaly distribution for the Spring Bottom Trawl Survey ALB9704.

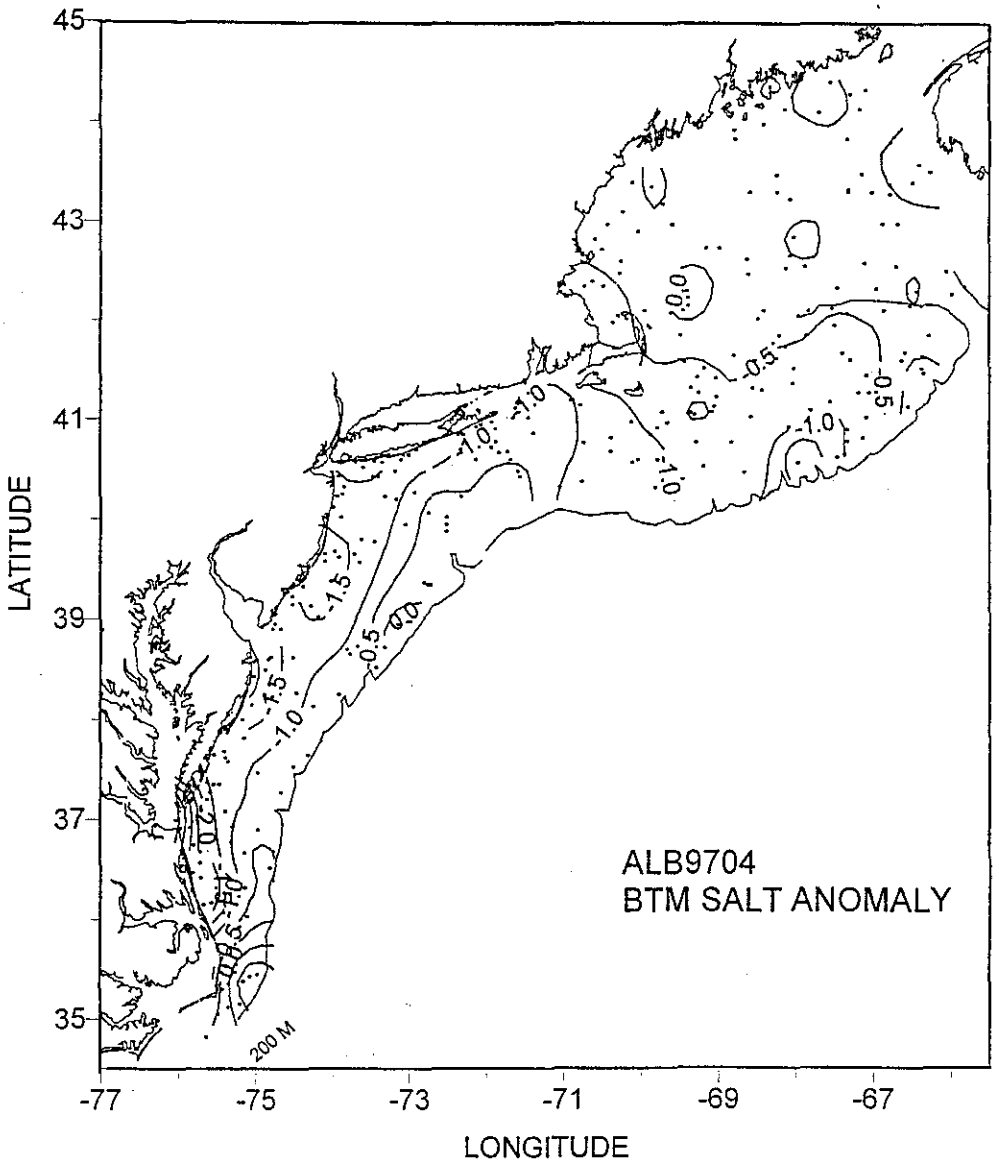

Figure 33. Bottom salinity anomaly distribution for the Spring Bottom Trawl Survey ALB9704.

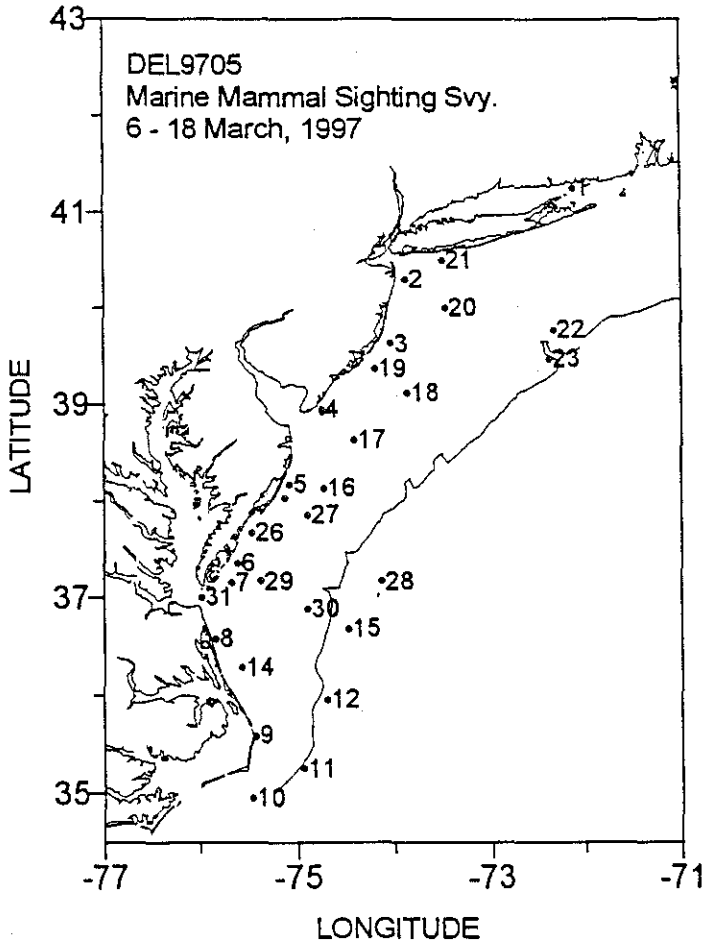

Figure 34. Hydrographic stations occupied during the Marine Mammal Survey DEL9705

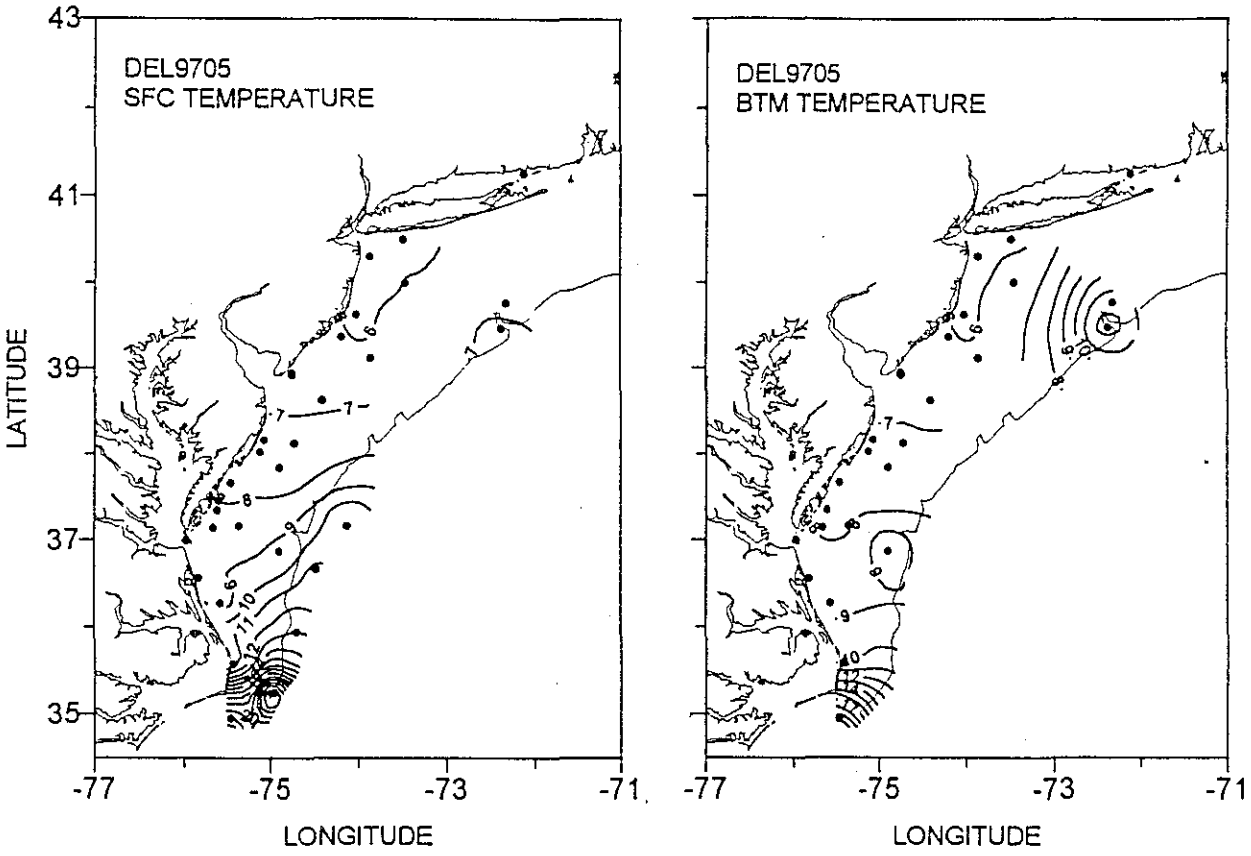

Figure 35. Surface and bottom temperature distributions during the Marine Mammal Survey DEL9705.

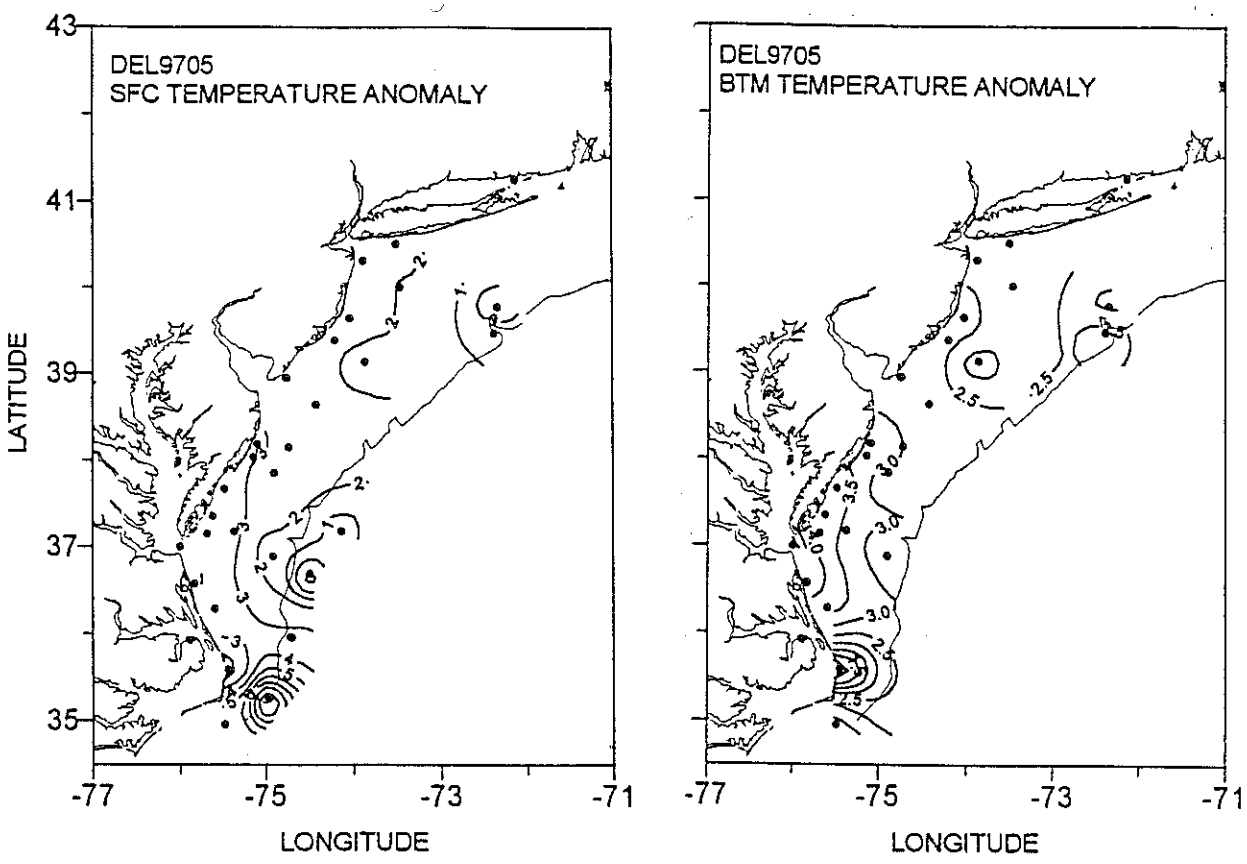

Figure 36. Surface and bottom temperature anomaly distributions during the Marine Mammal Survey DEL9705.

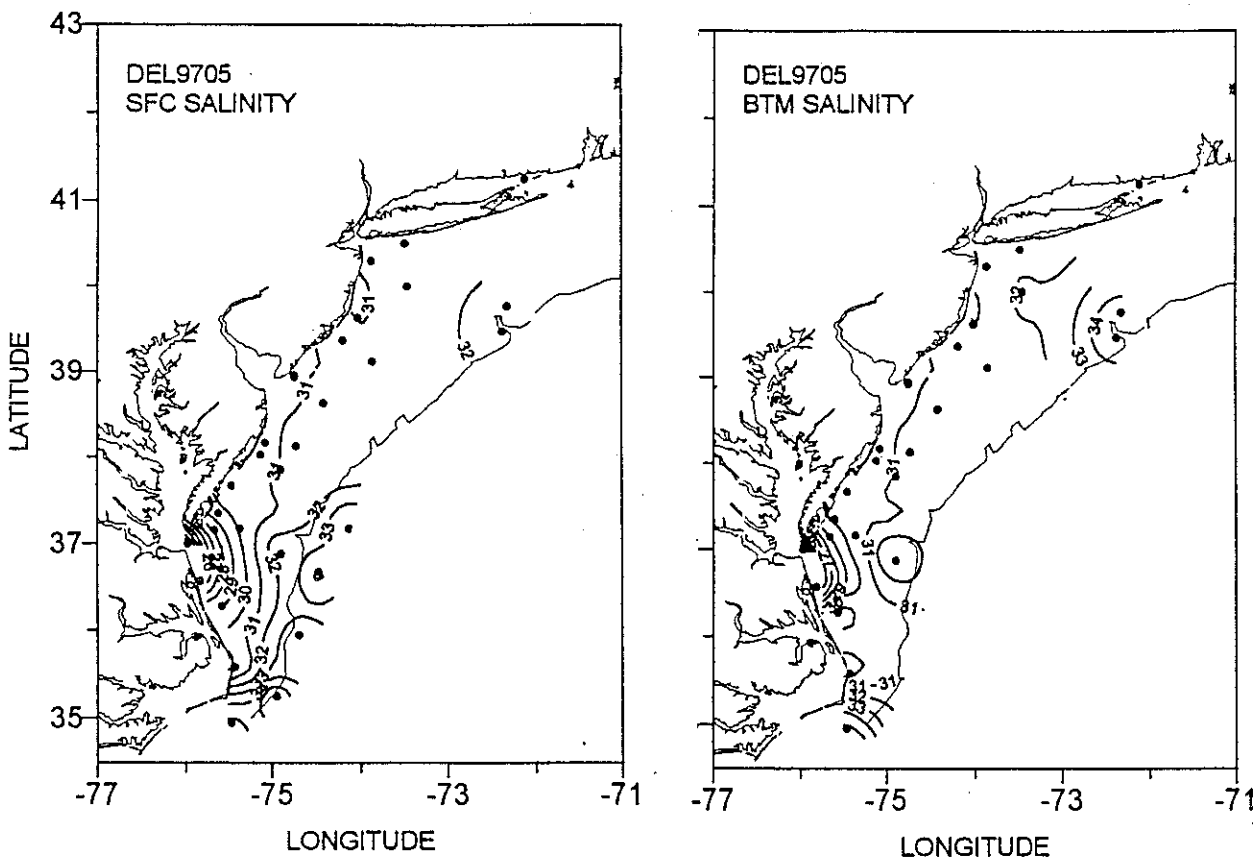

Figure 37. Surface and bottom salinity distributions during the Marine Mammal Survey DEL9705.

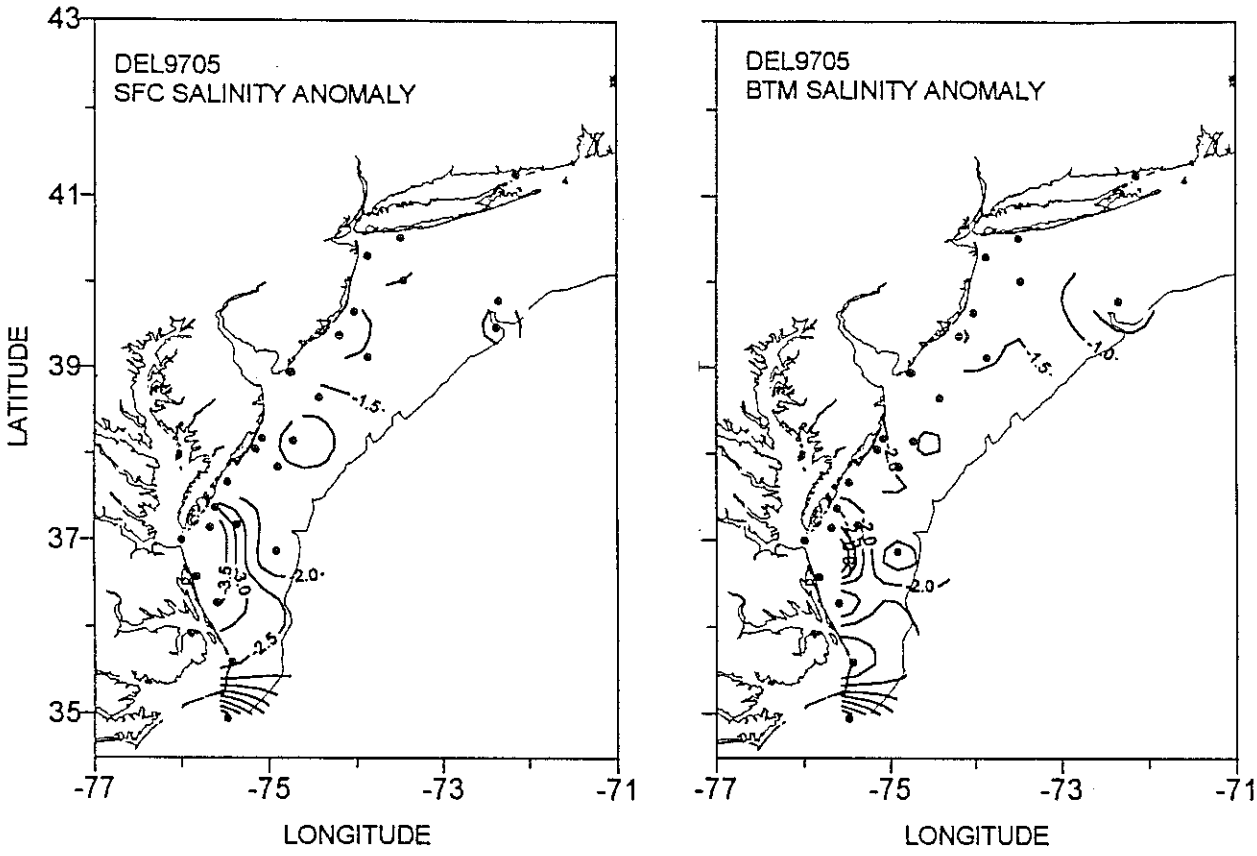

Figure 38. Surface and bottom salinity anomaly distributions during the Marine Mammal Survey DEL9705.

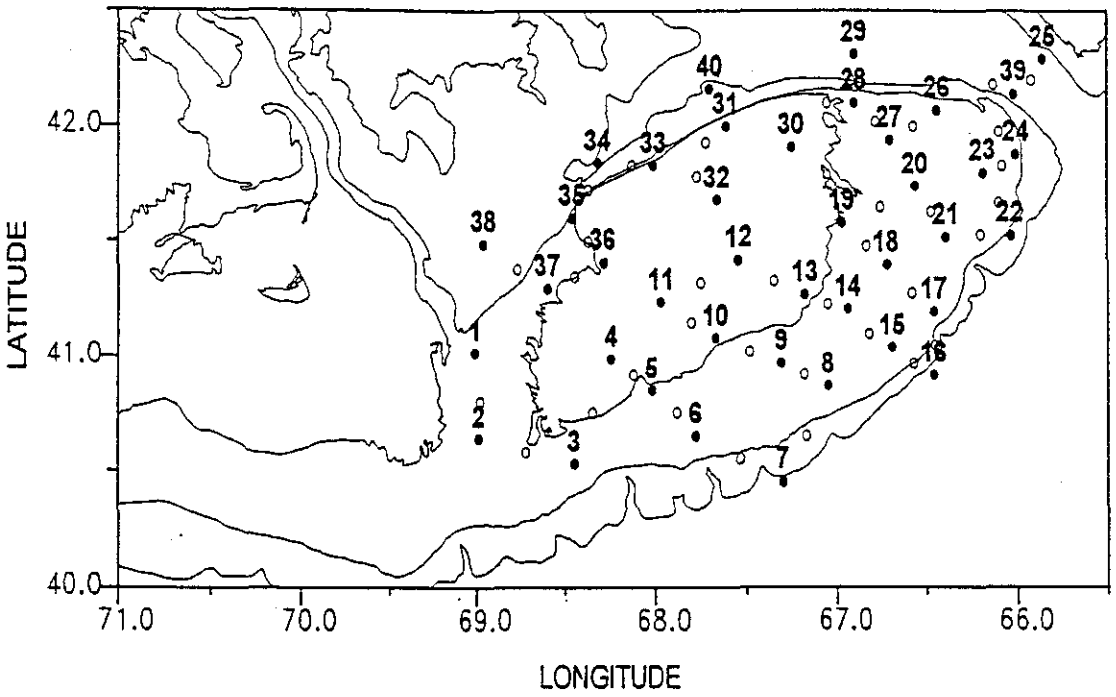

Figure 39. Hydrographic stations occupied during the U.S. GLOBEC Broad Scale Survey OCE9730.

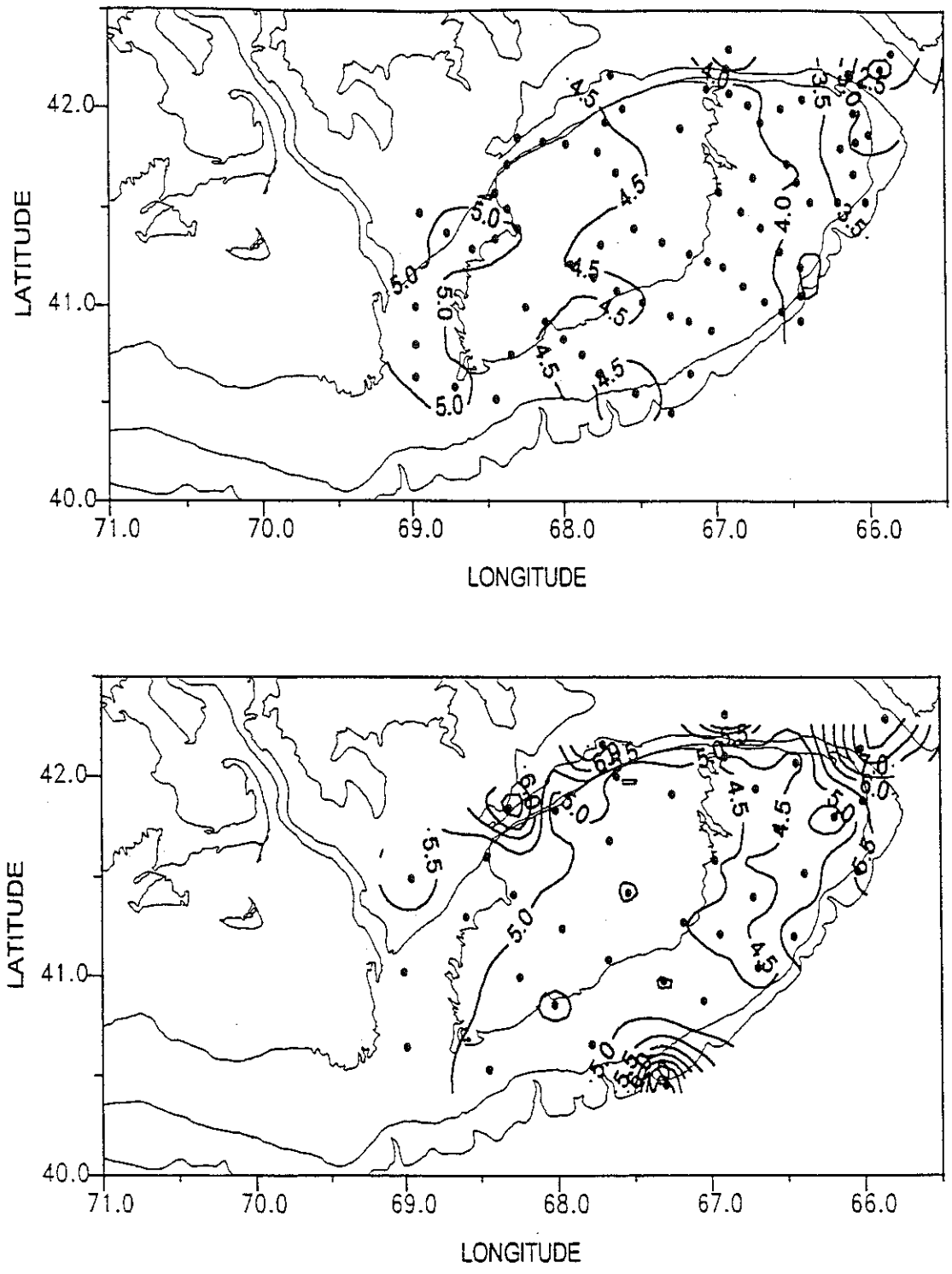

Figure 40. Surface and bottom temperature distributions during the U.S. GLOBEC Broad Scale Survey OCE9730.

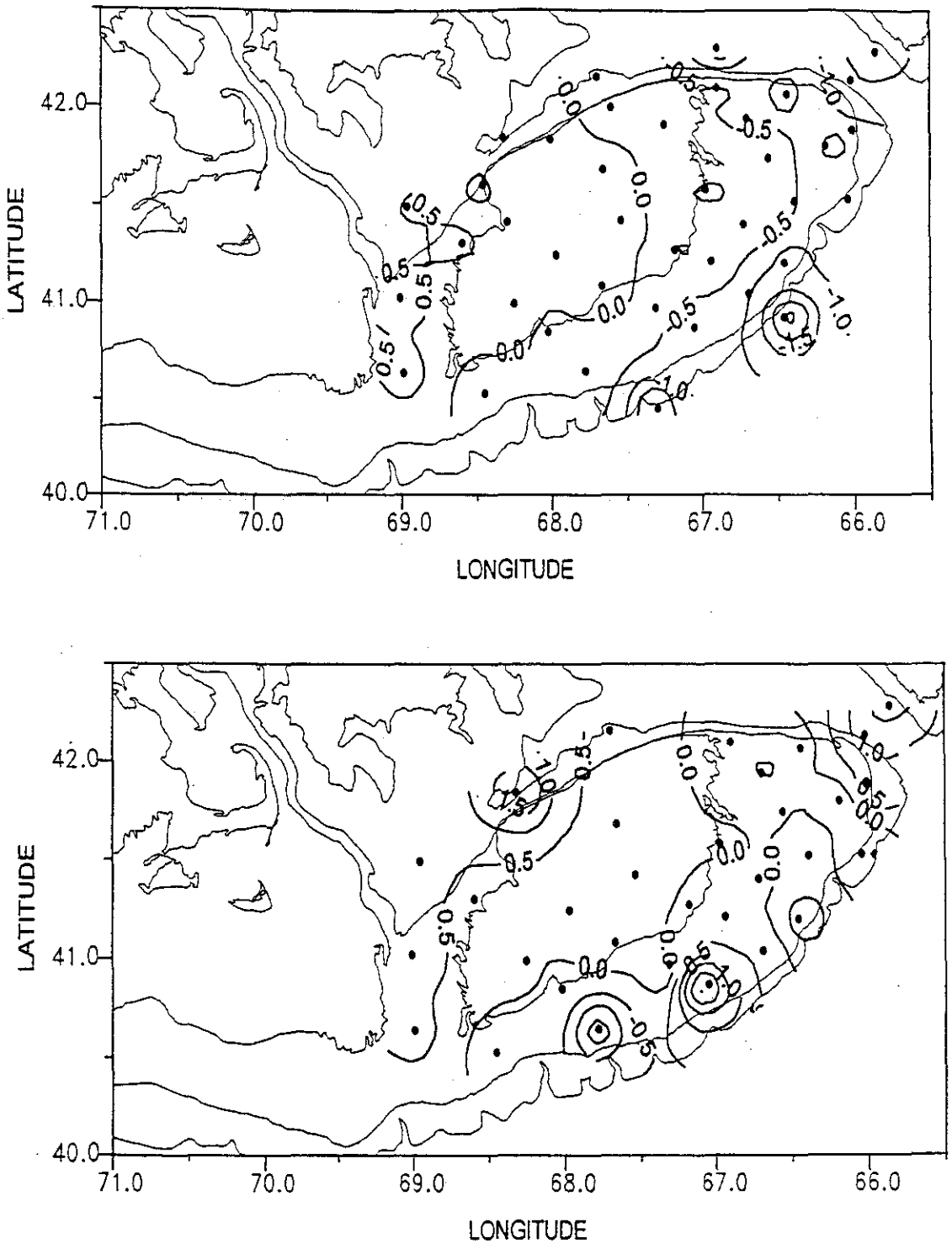

Figure 41. Surface and bottom temperature anomaly distributions during the U.S. GLOBEC Broad Scale Survey OCE9730.

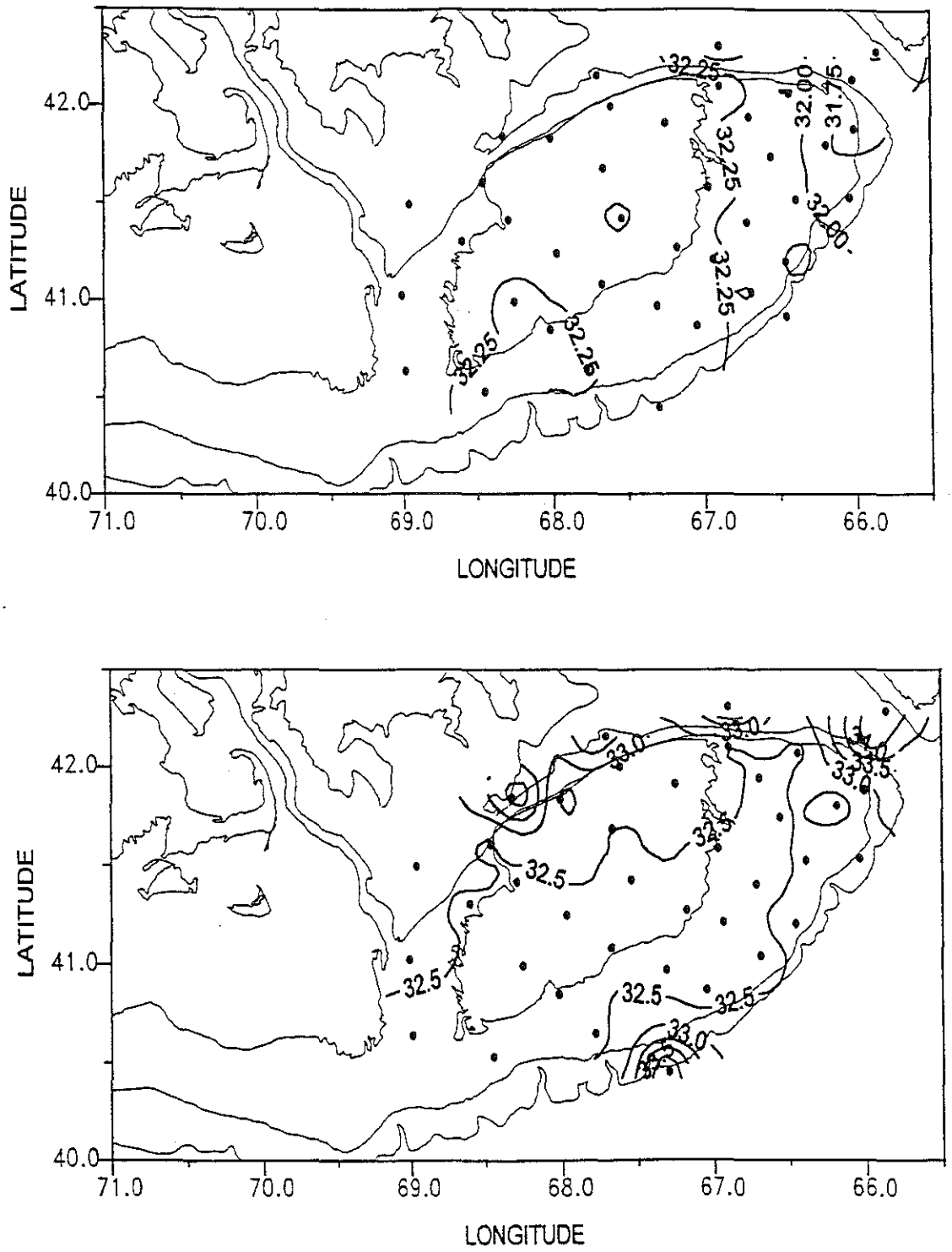

Figure 42. Surface and bottom salinity distributions during the U.S. GLOBEC Broad Scale Survey OCE9730.

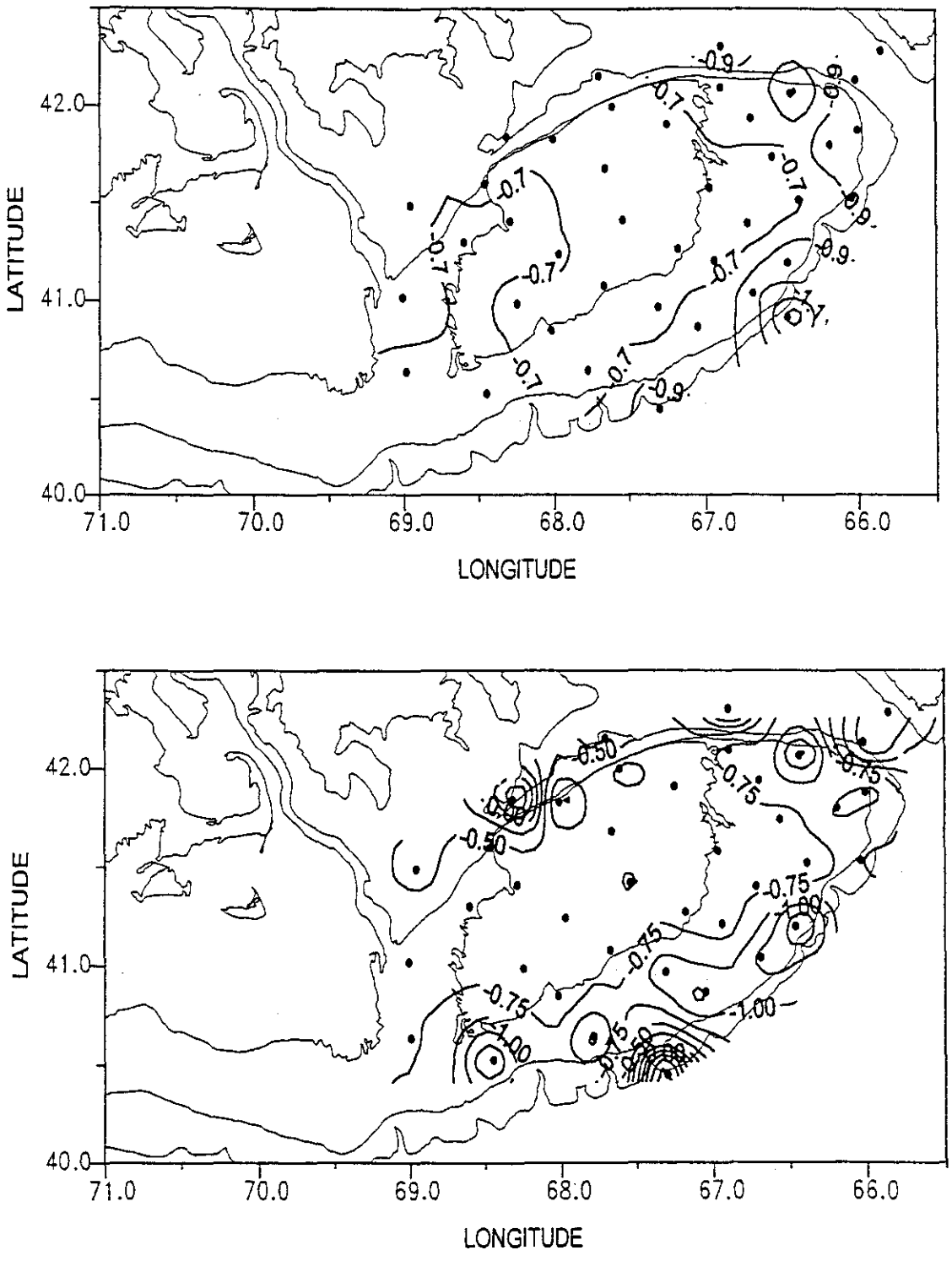

Figure 43. Surface and bottom salinity anomaly distributions during the U.S. GLOBEC Broad Scale Survey OCE9730.

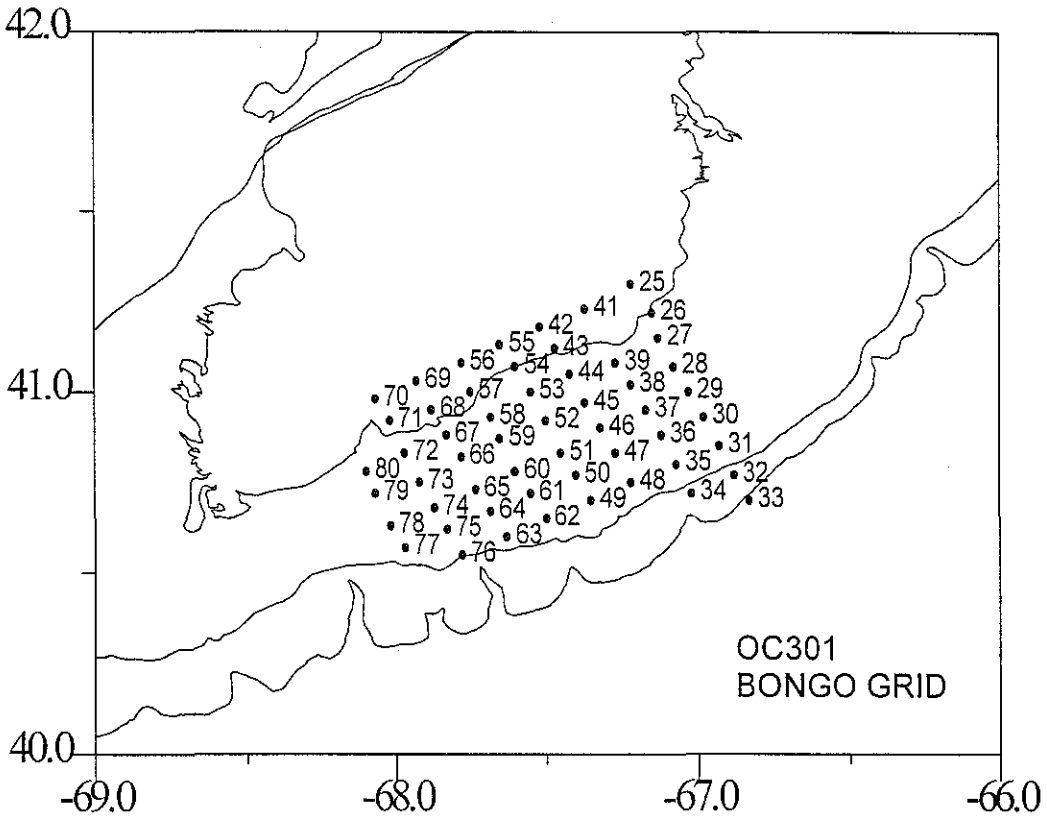

Figure 44. Hydrographic stations occupied during the U.S. GLOBEC Process study OCE9701.

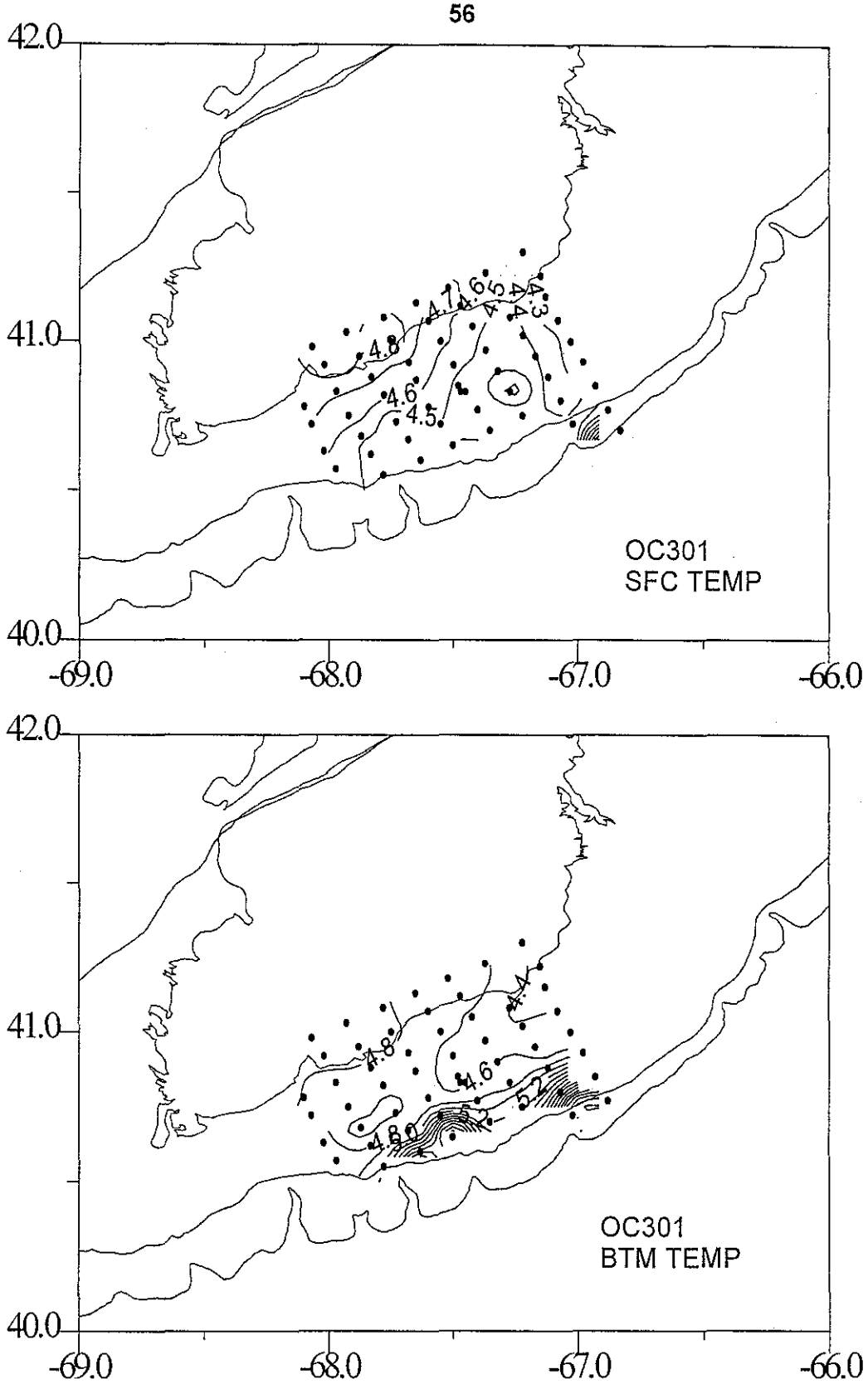

Figure 45. Surface and bottom temperature distributions during the U.S. GLOBEC Process study OCE9701.

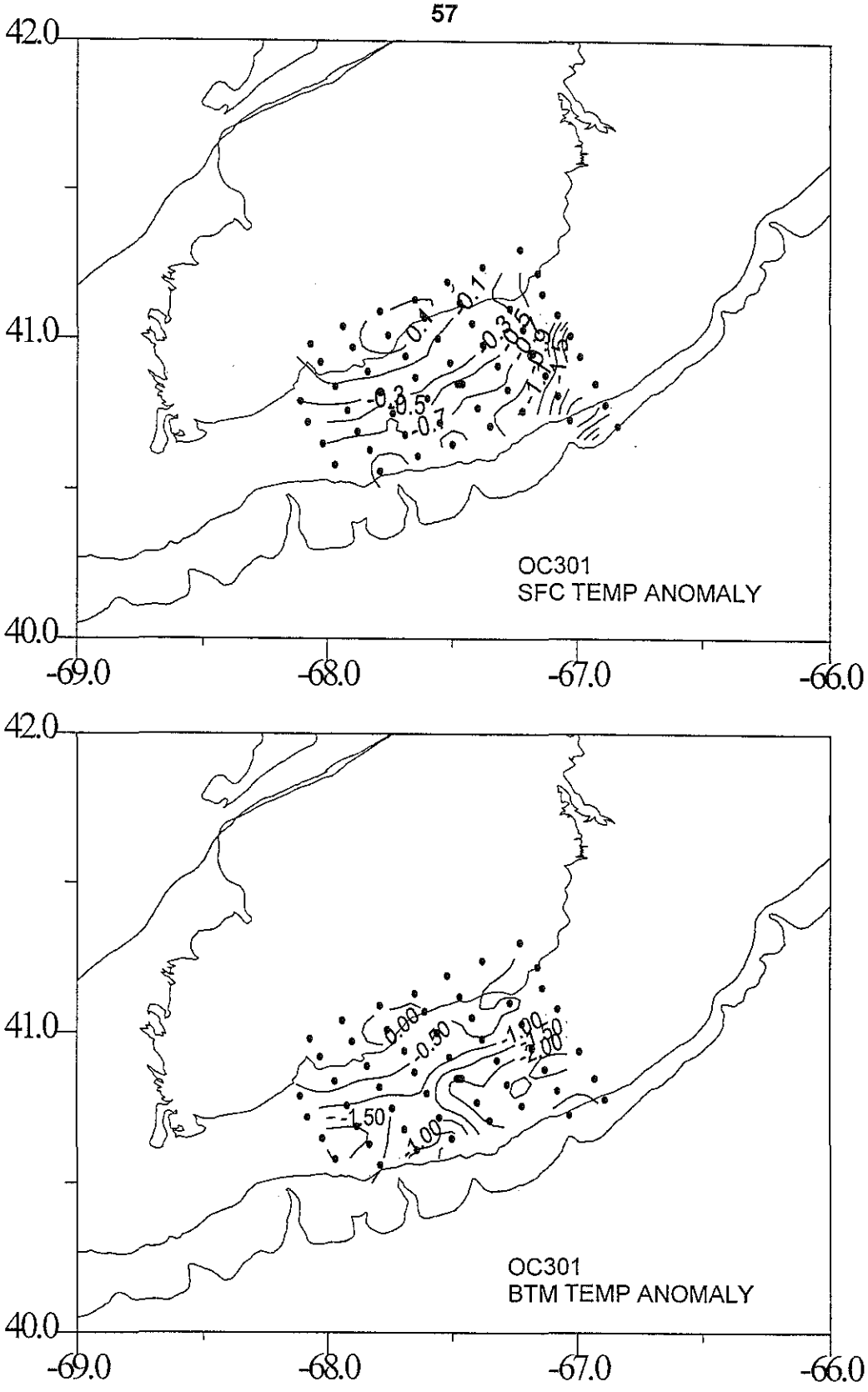

Figure 46. Surface and bottom temperature anomaly distributions during the U.S. GLOBEC Process study OCE9701.

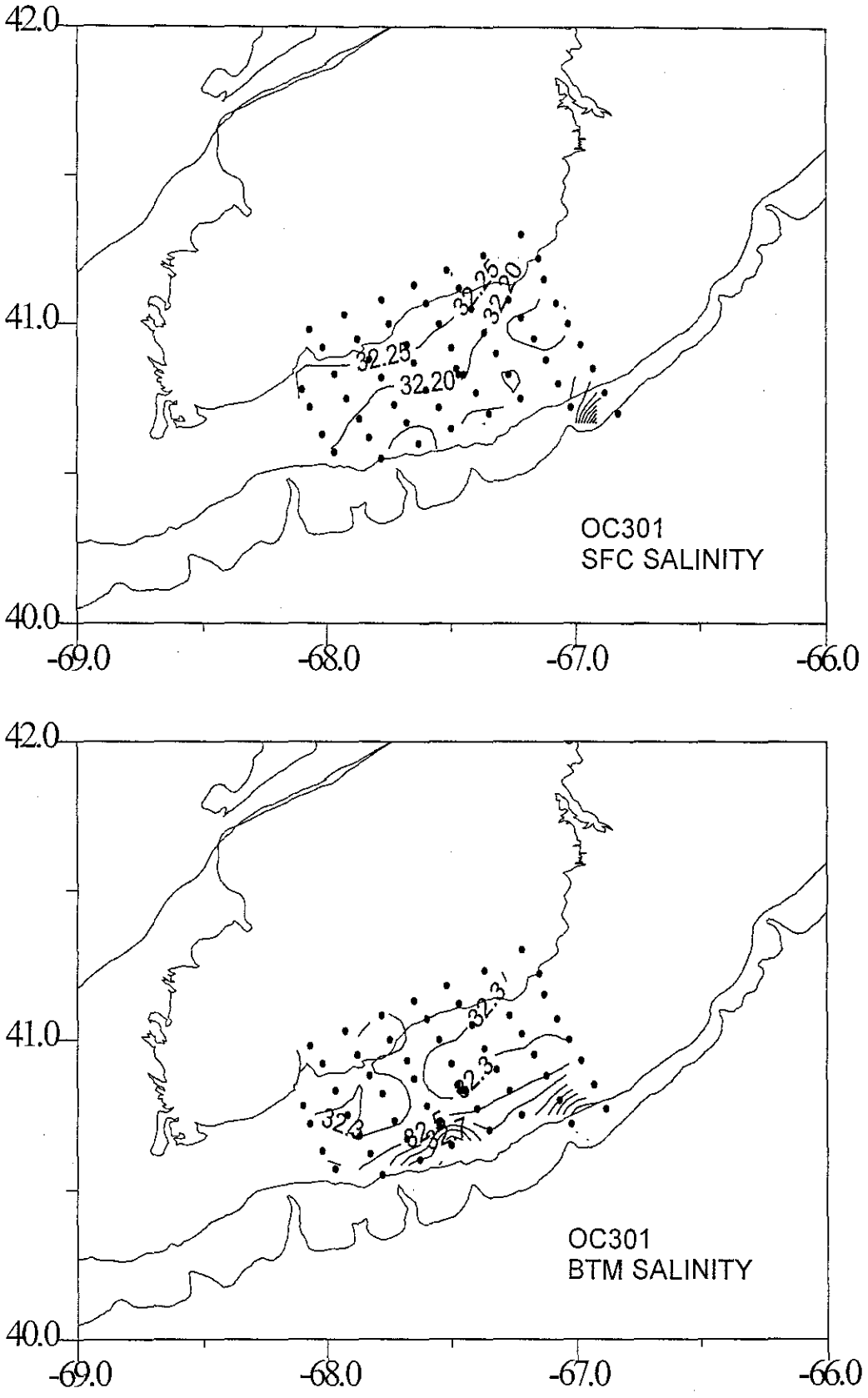

Figure 47. Surface and bottom salinity distributions during the U.S. GLOBEC Process study OCE9701.

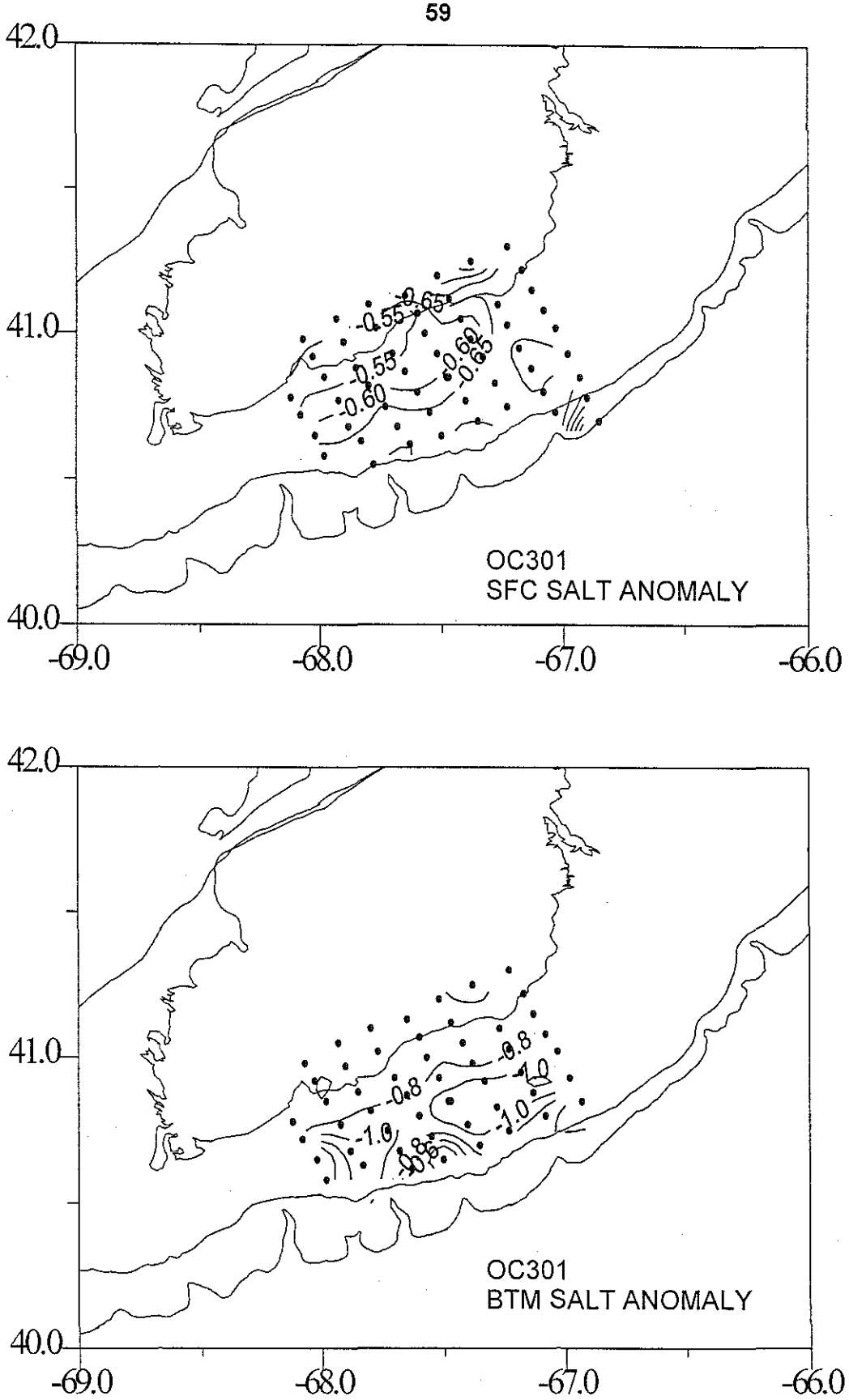

Figure 48. Surface and bottom salinity anomaly distributions during the U.S. GLOBEC Process study OCE9701.

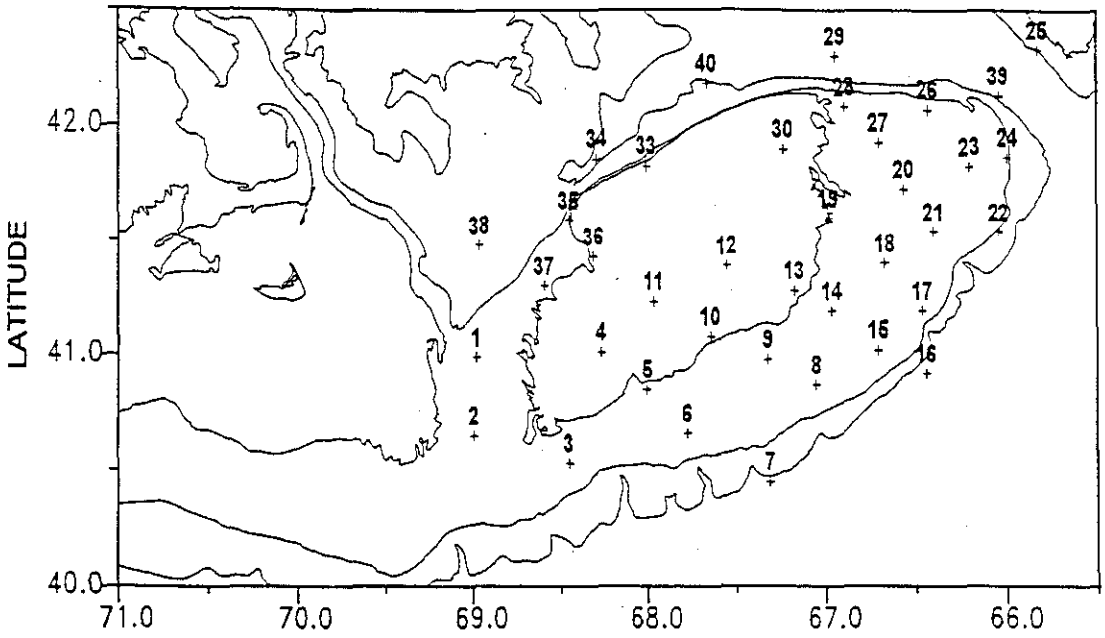

Figure 49. Hydrographic stations occupied during the U.S. GLOBEC Broad Scale survey OCE9702.

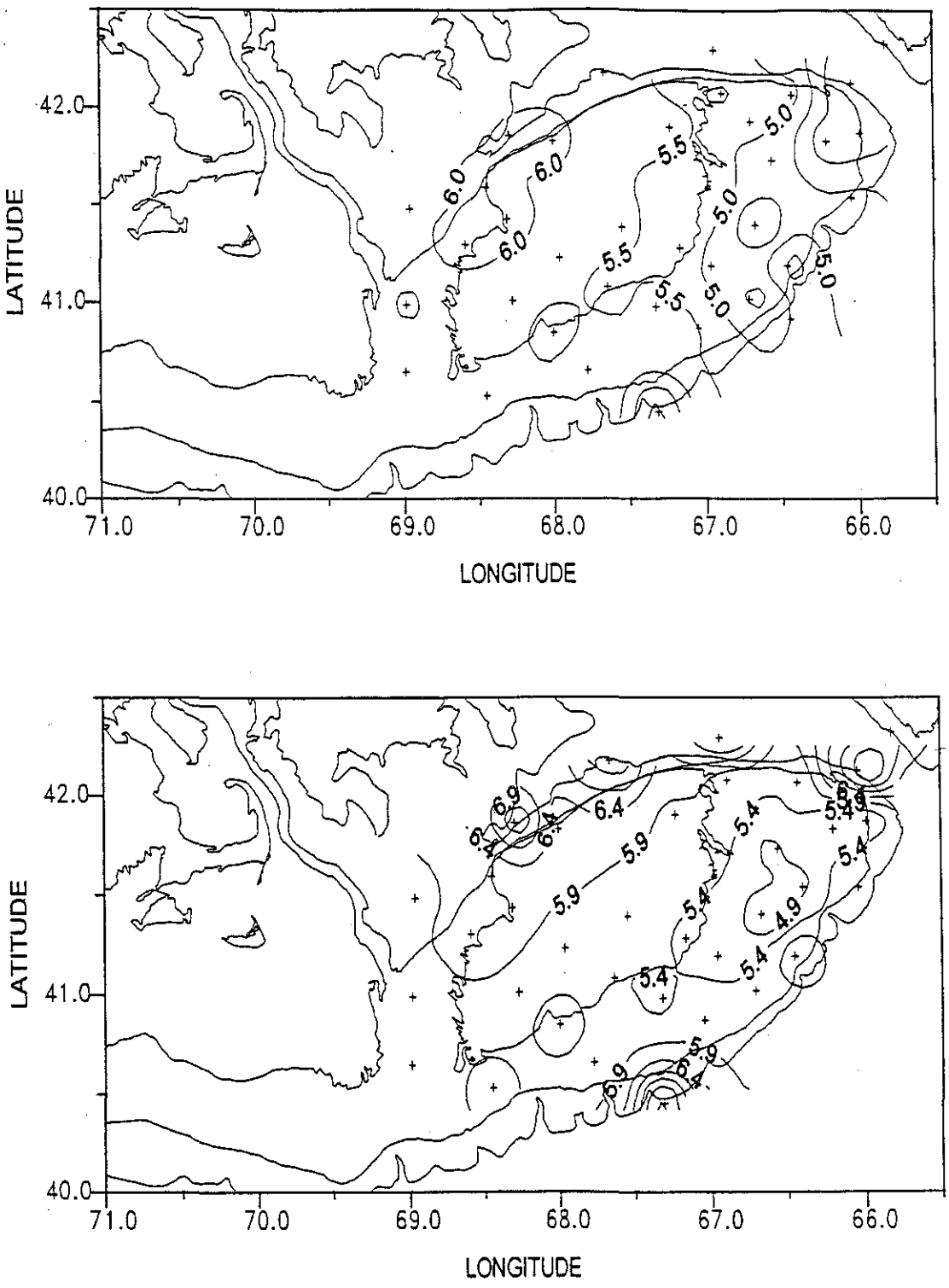

Figure 50. Surface and bottom temperature distributions during the U.S. GLOBEC Broad Scale survey OCE9702.

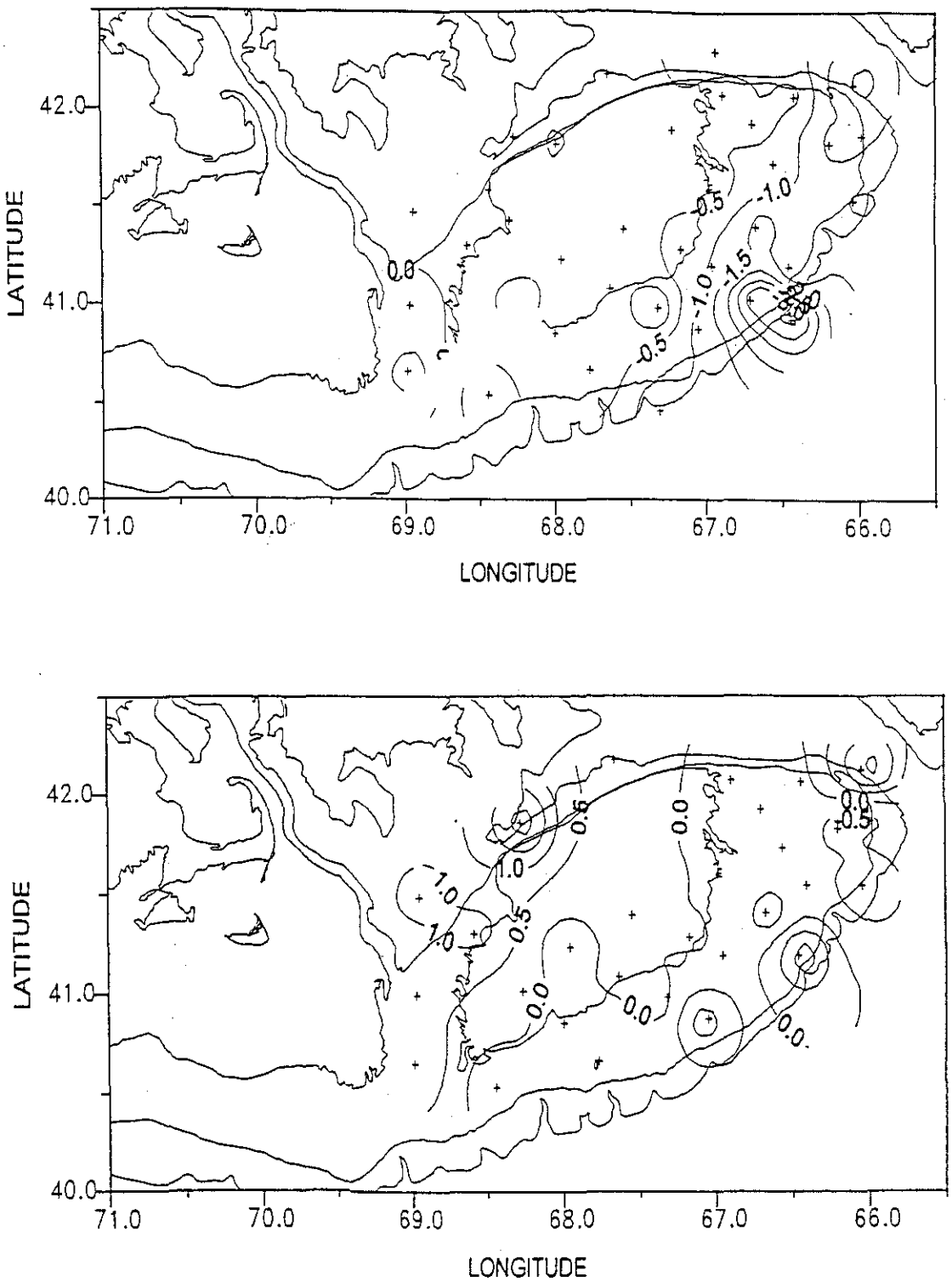

Figure 51. Surface and bottom temperature anomaly distributions during the U.S. GLOBEC Broad Scale survey OCE9702.

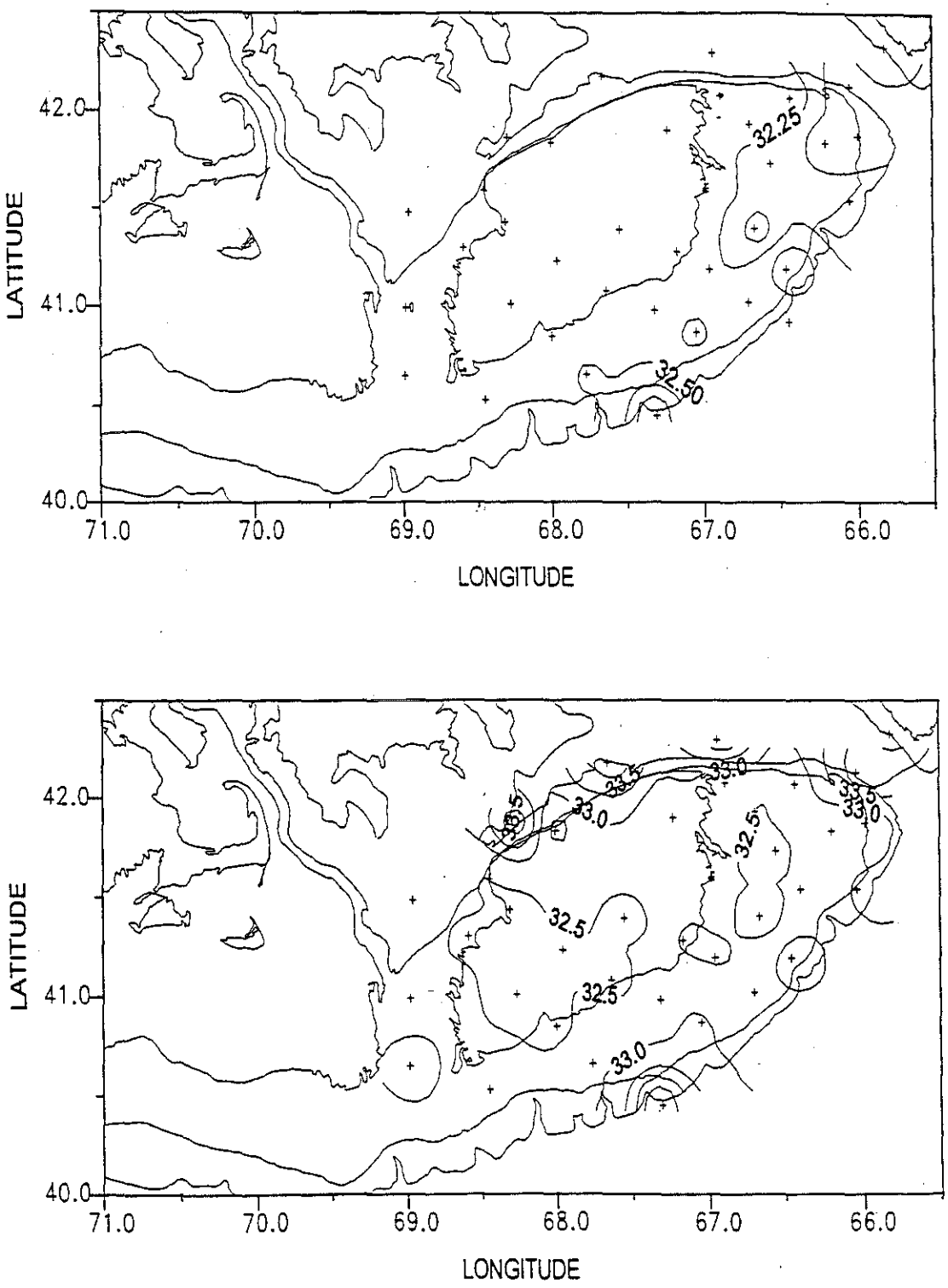

Figure 52. Surface and bottom salinity distributions during the U.S. GLOBEC Broad Scale survey OCE9702.

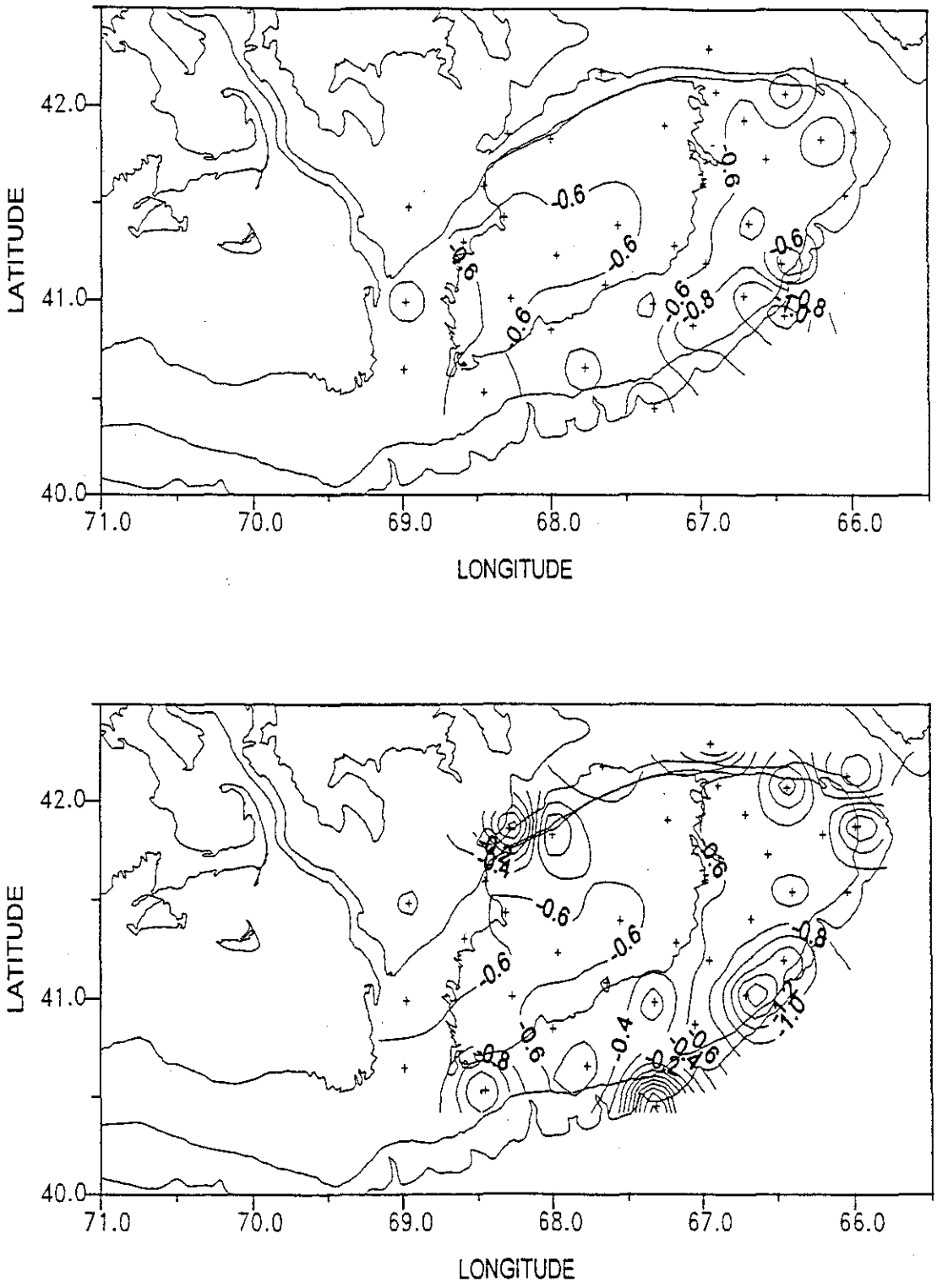

Figure 53. Surface and bottom salinity anomaly distributions during the U.S. GLOBEC Broad Scale survey OCE9702.

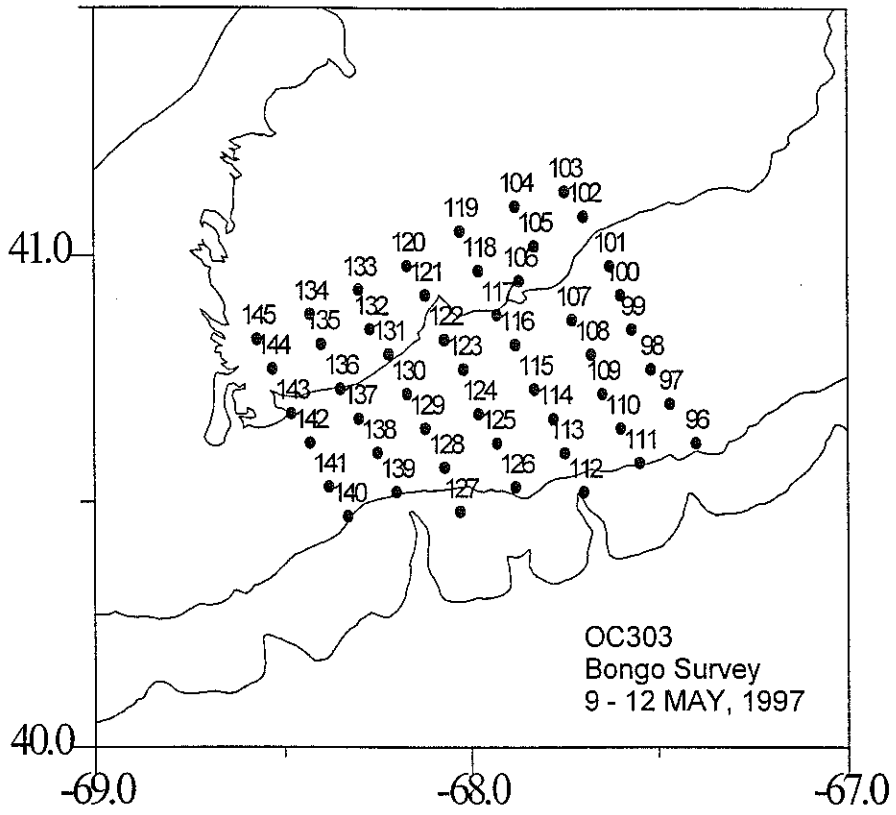

Figure 54. Hydrographic stations occupied during the U.S. GLOBEC Process study OCE9703.

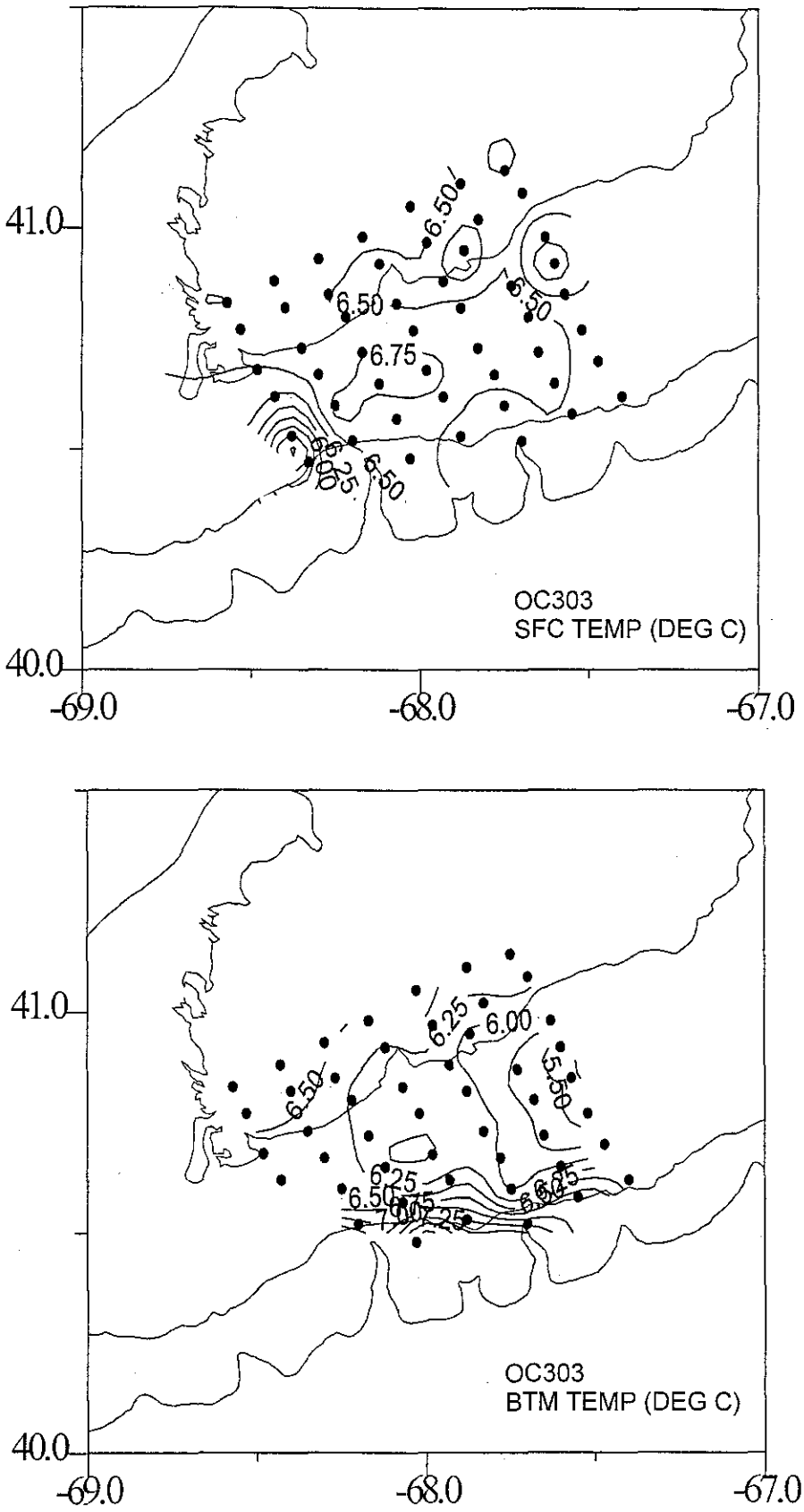

Figure 55. Surface and bottom temperature distributions during the U.S. GLOBEC Process study OCE9703.

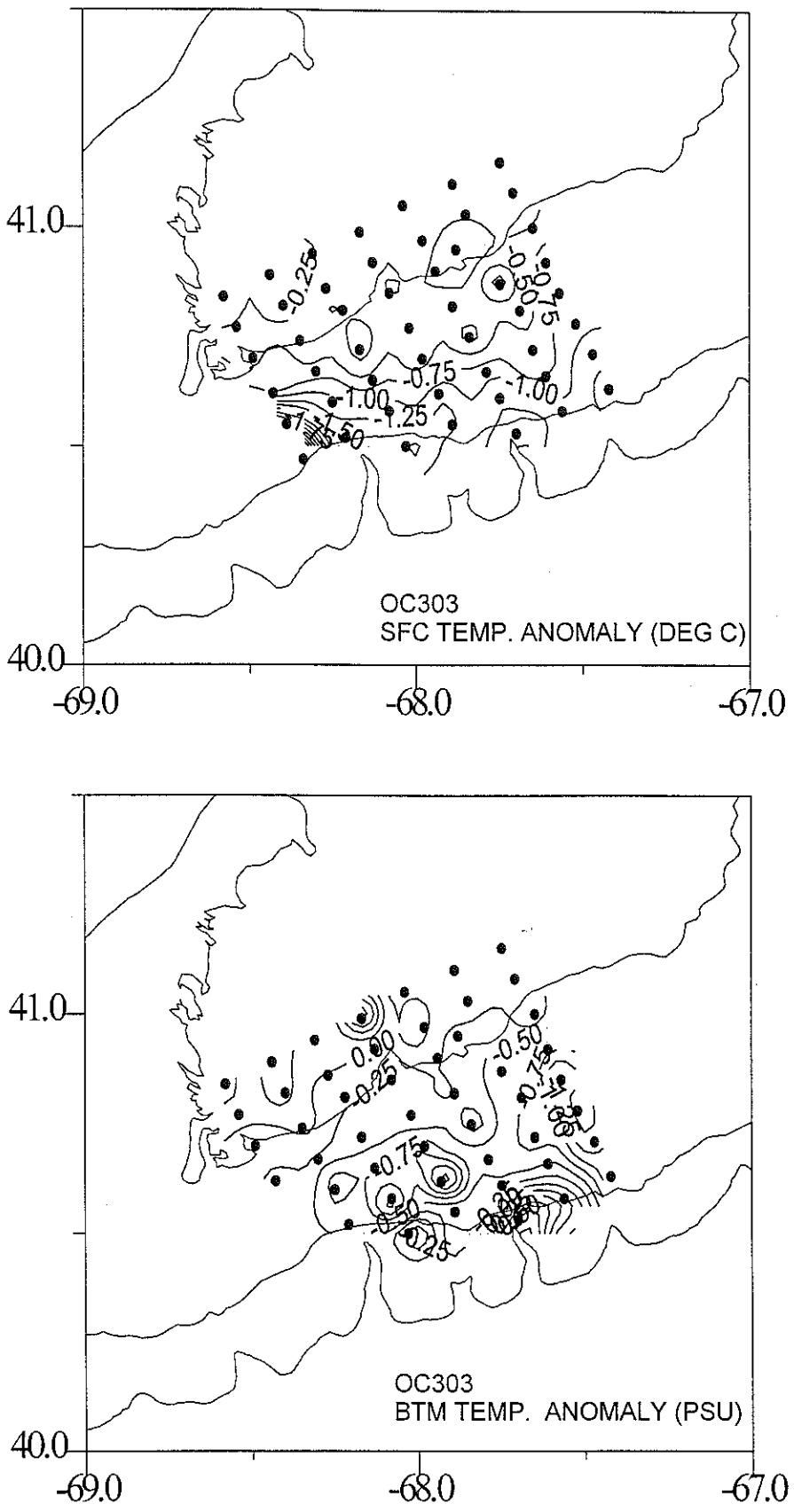

Figure 56. Surface and bottom temperature anomaly distributions during the U.S. GLOBEC Process study OCE9703.

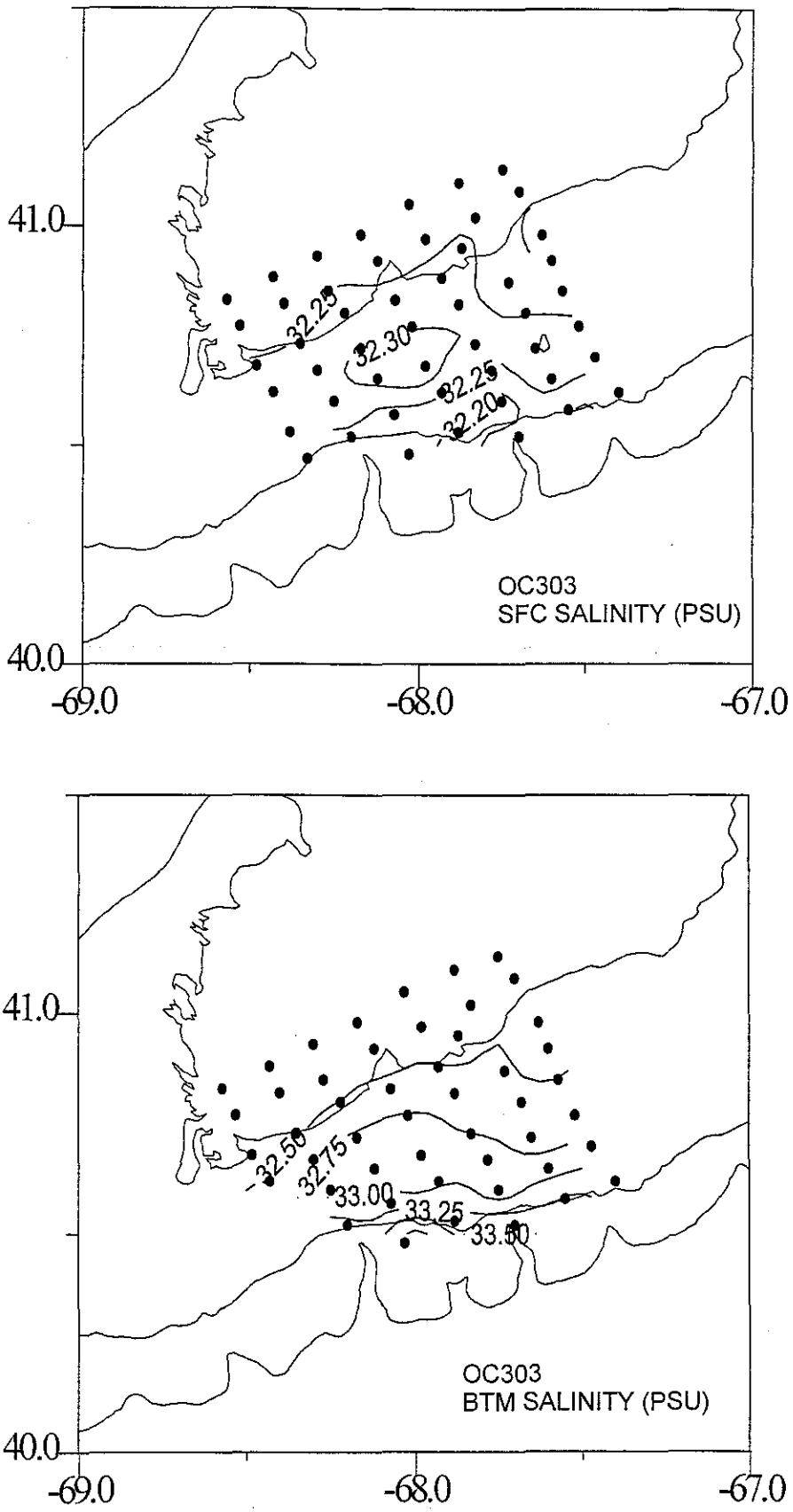

Figure 57. Surface and bottom salinity distributions during the U.S. GLOBEC Process study OCE9703.

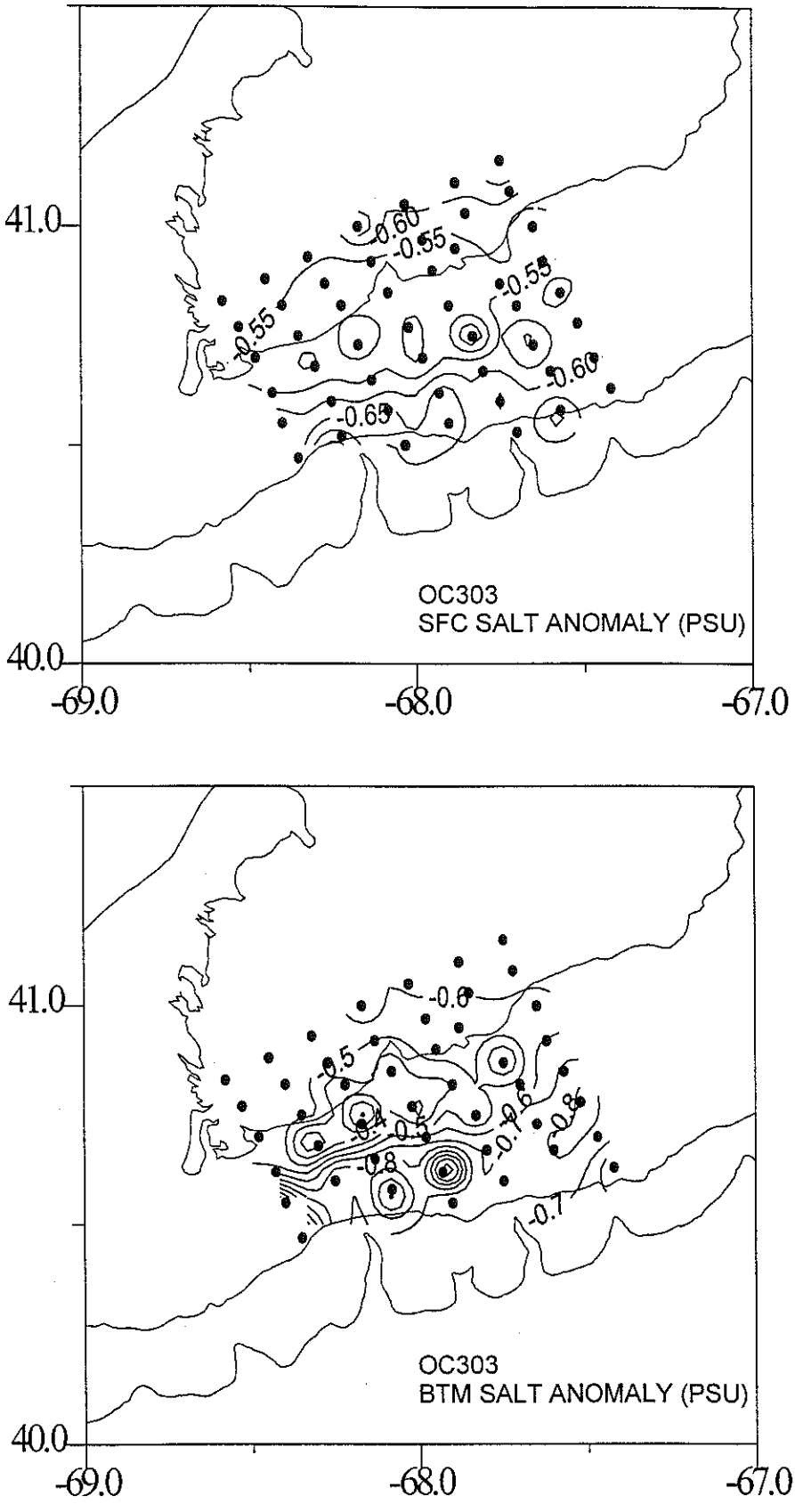

Figure 58. Surface and bottom salinity anomaly distributions during the U.S. GLOBEC Process study OCE9703.

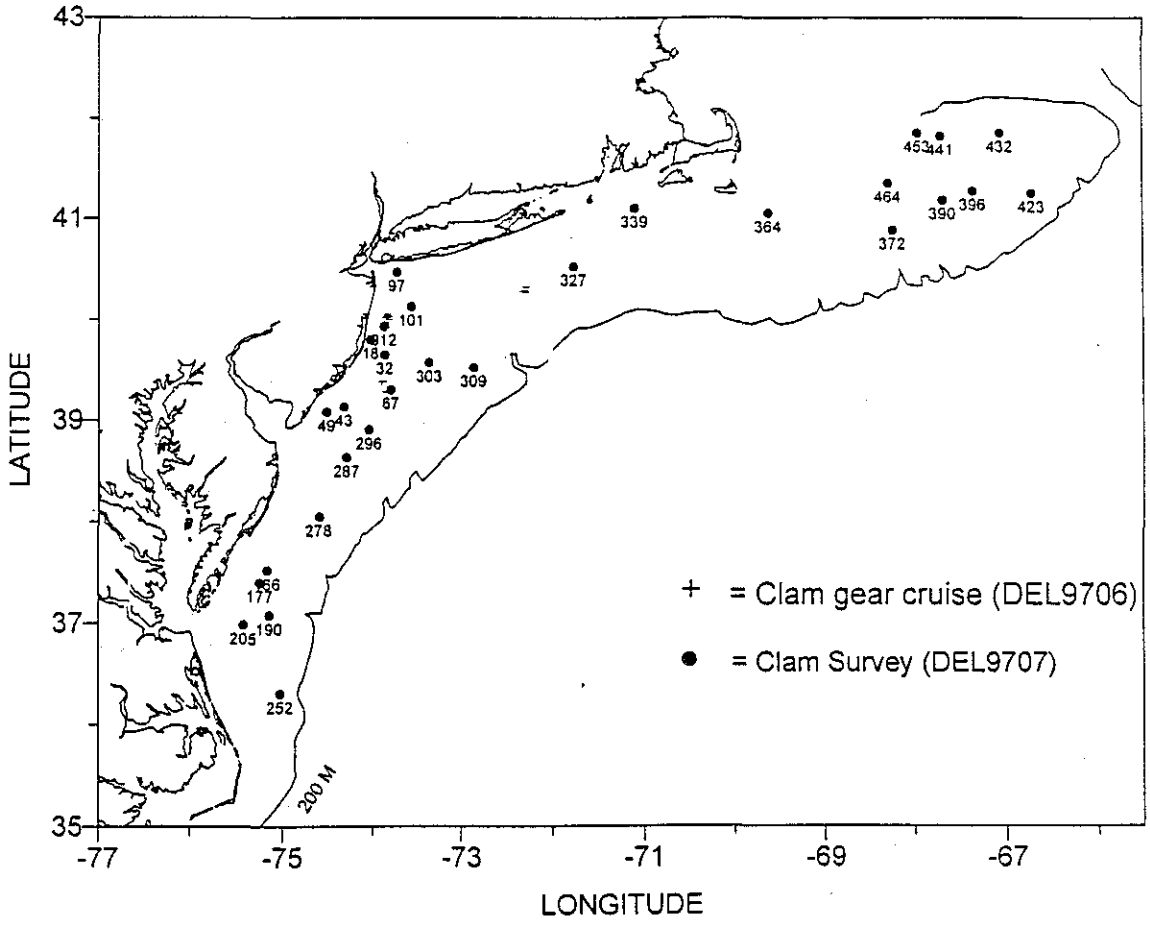

Figure 59. Hydrographic stations occupied during the Clam gear cruise (DEL9706) and the Clam Survey (DEL9707).

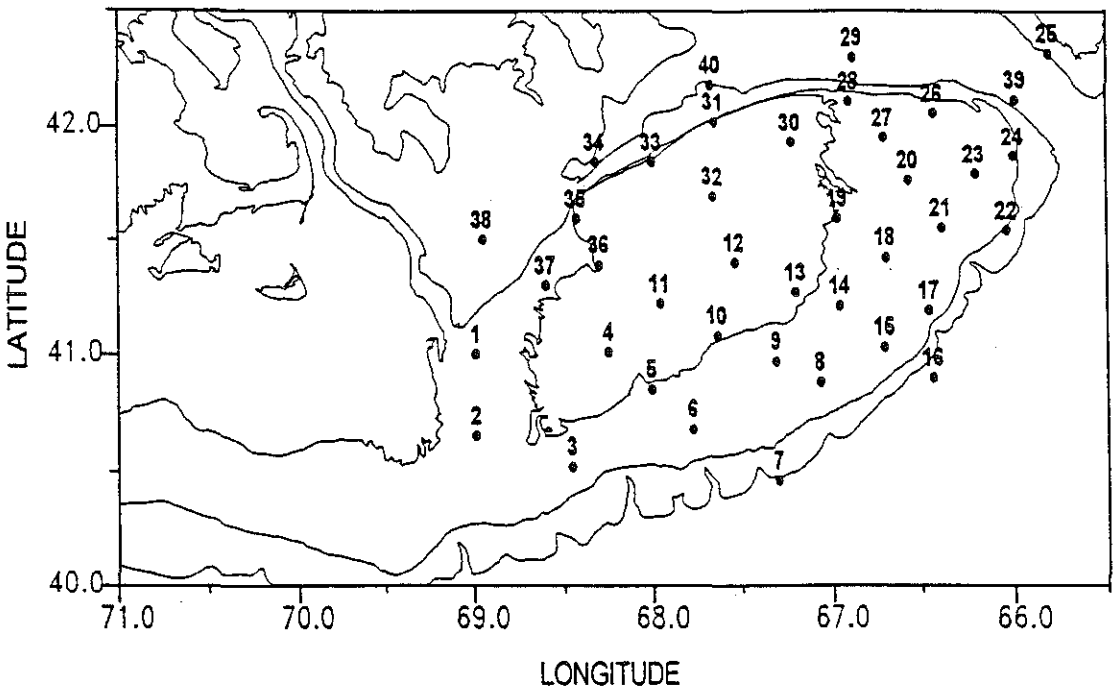

Figure 60. Hydrographic stations occupied during the U.S. GLOBEC Broad Scale survey ALB9705.

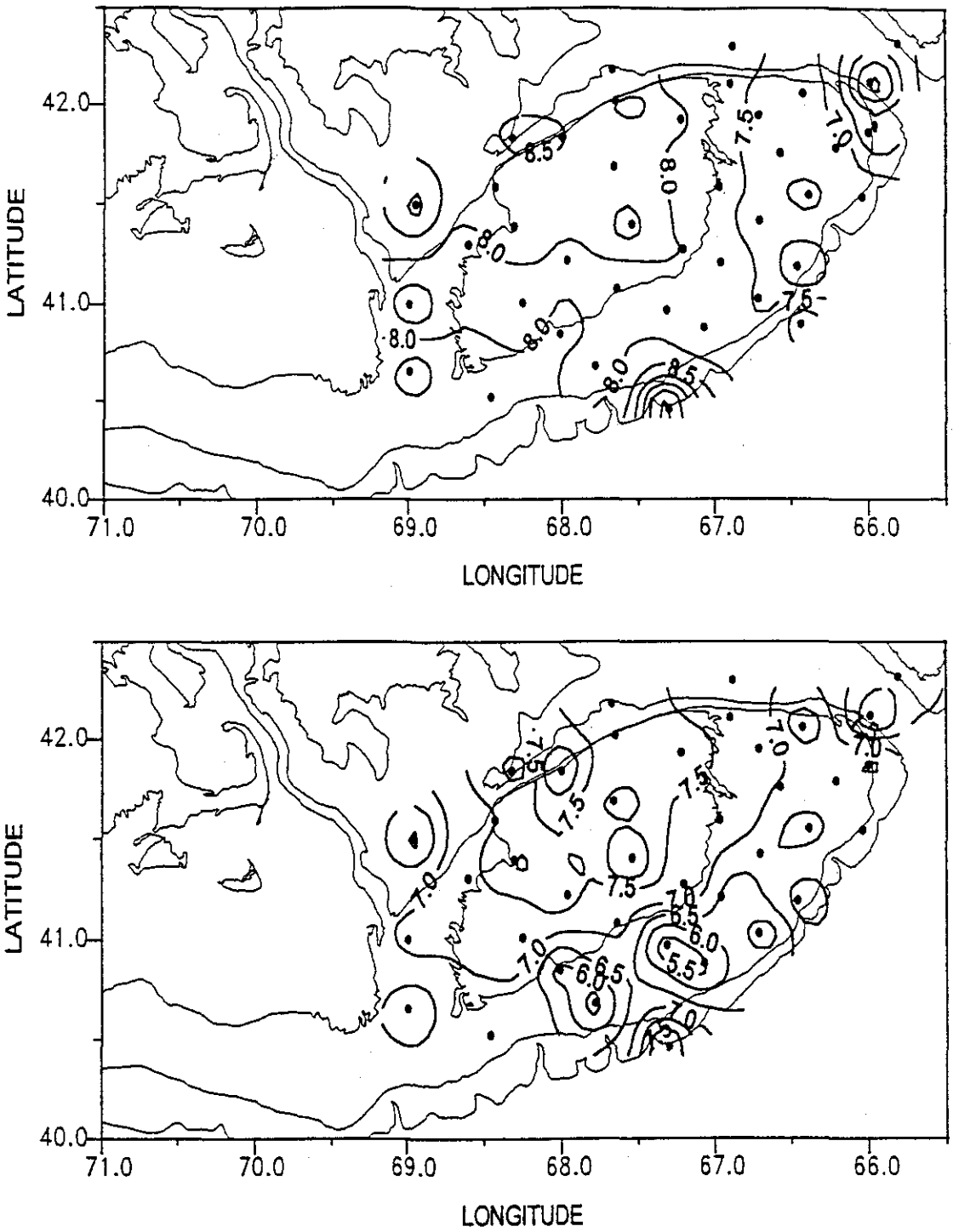

Figure 61. Surface and bottom temperature distributions during the U.S. GLOBEC Broad Scale survey ALB9705.

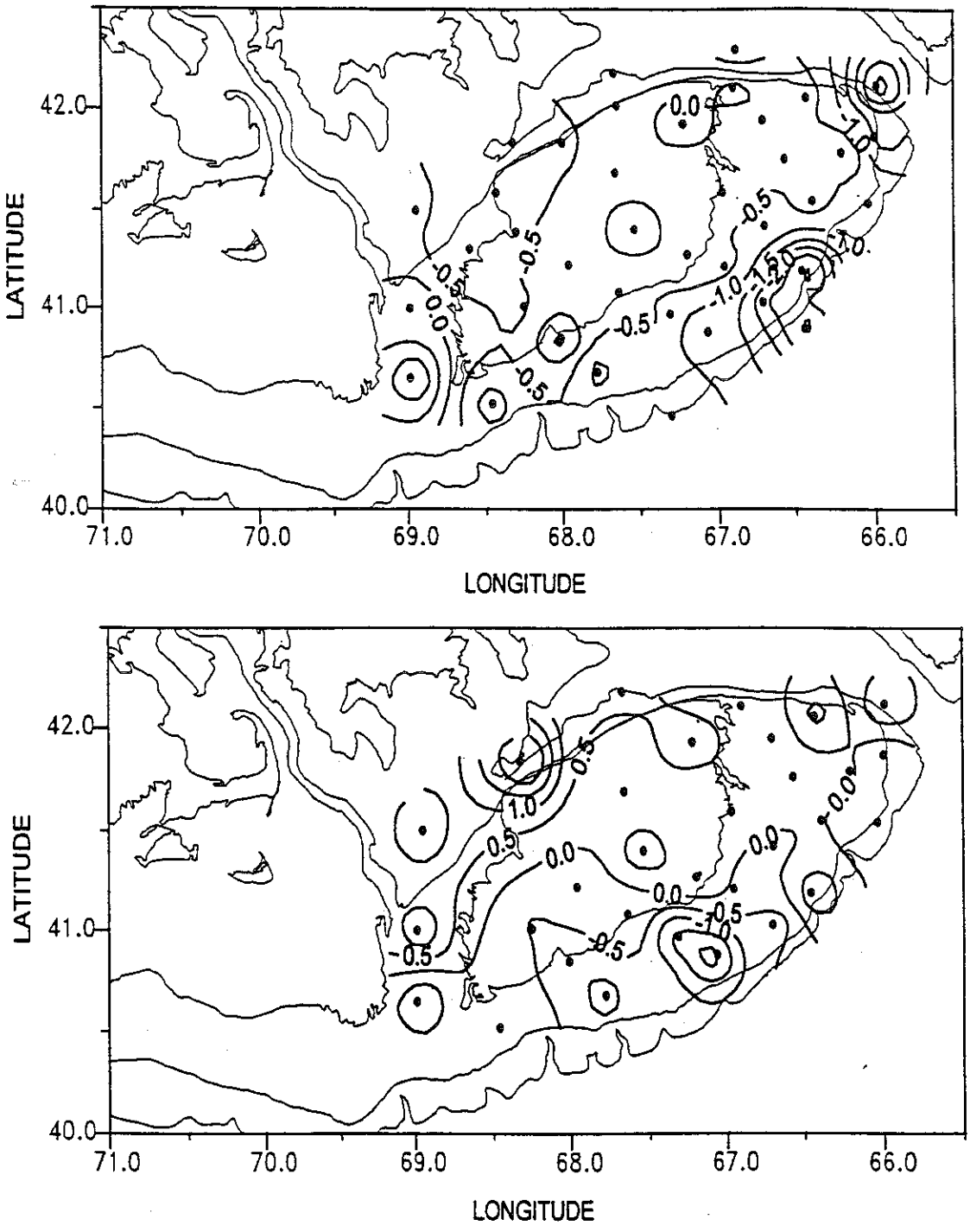

Figure 62. Surface and bottom temperature anomaly distributions during the U.S. GLOBEC Broad Scale survey ALB9705.

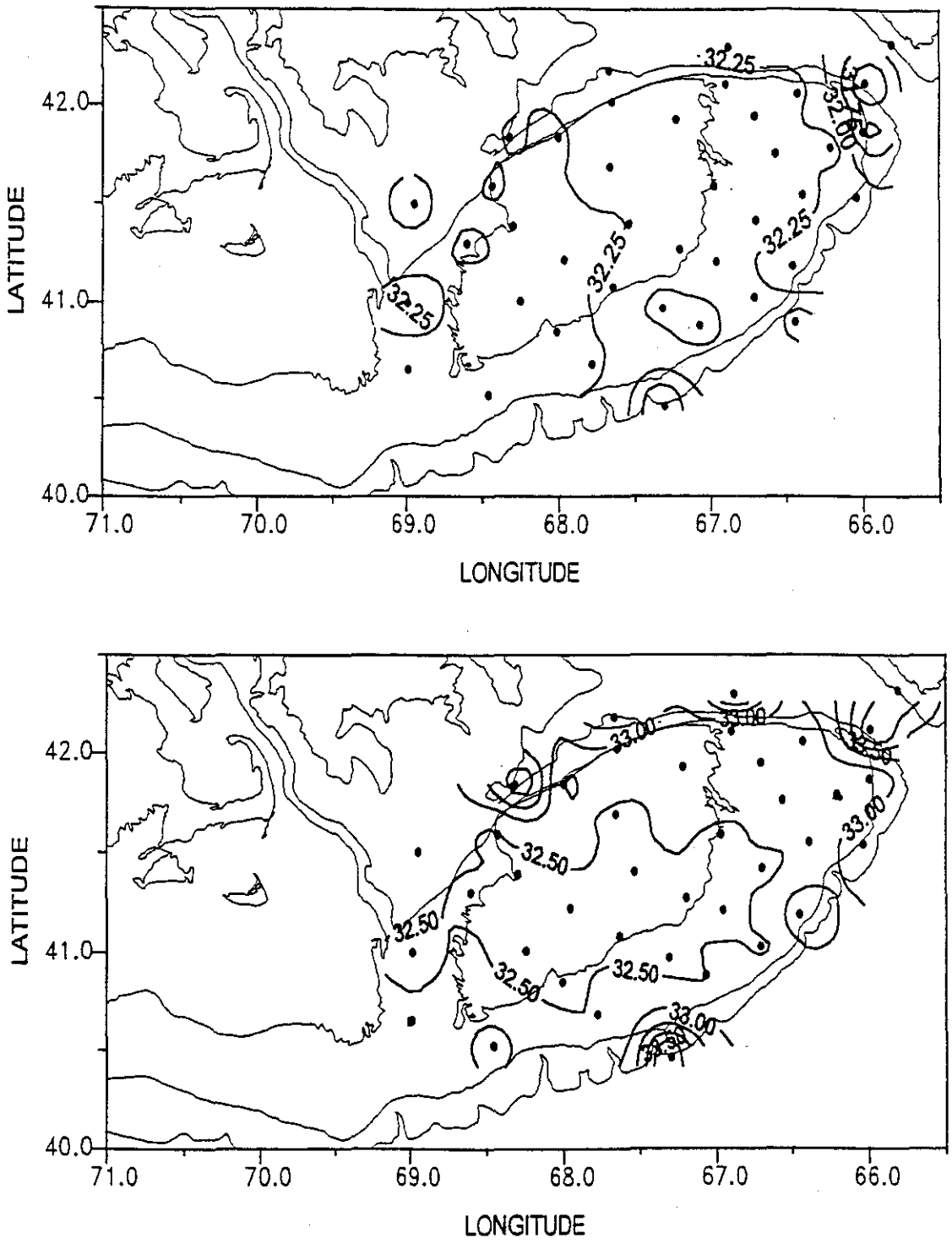

Figure 63. Surface and bottom salinity distributions during the U.S. GLOBEC Broad Scale survey ALB9705.

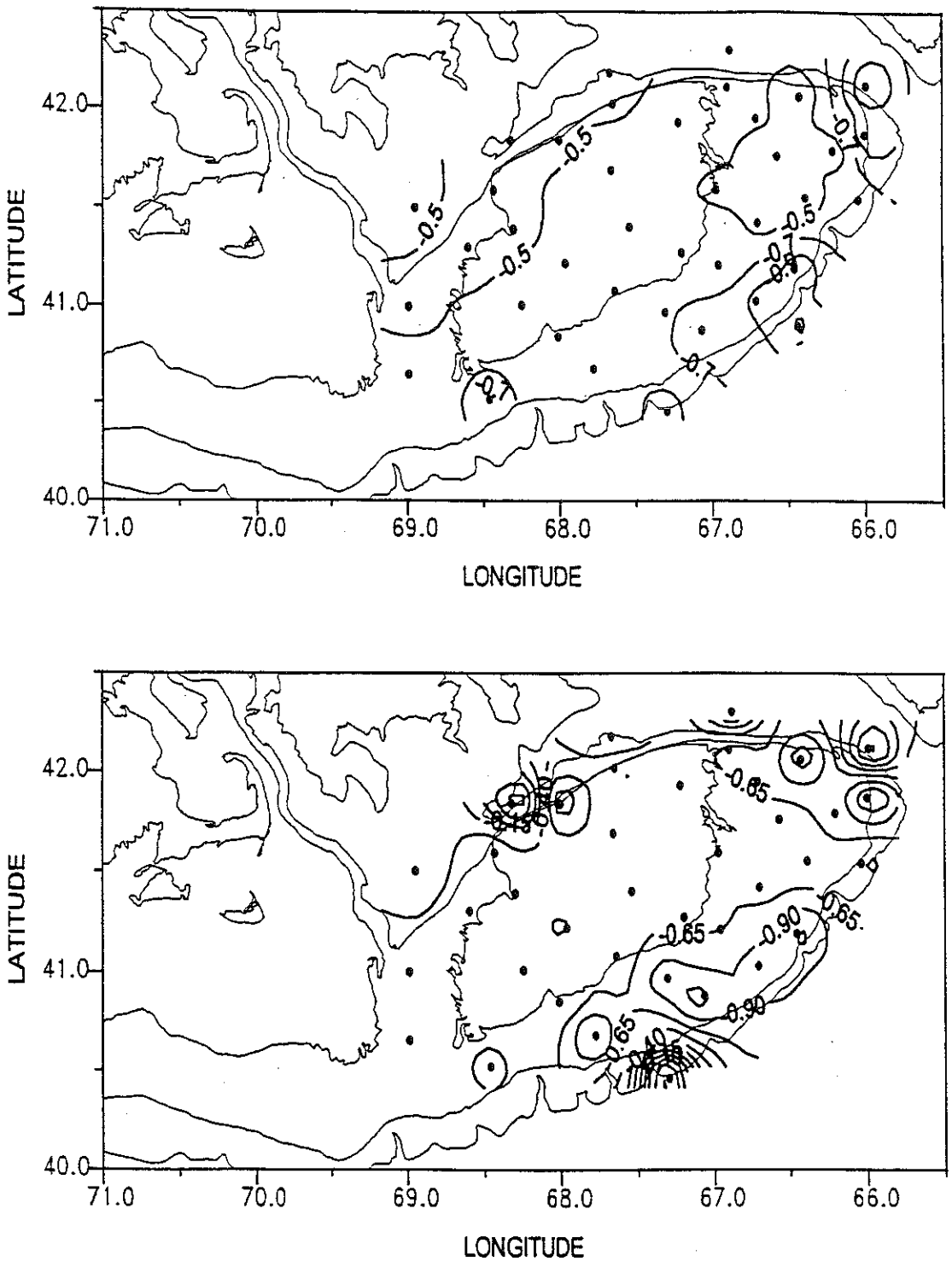

Figure 64. Surface and bottom salinity anomaly distributions during the U.S. GLOBEC Broad Scale survey ALB9705.

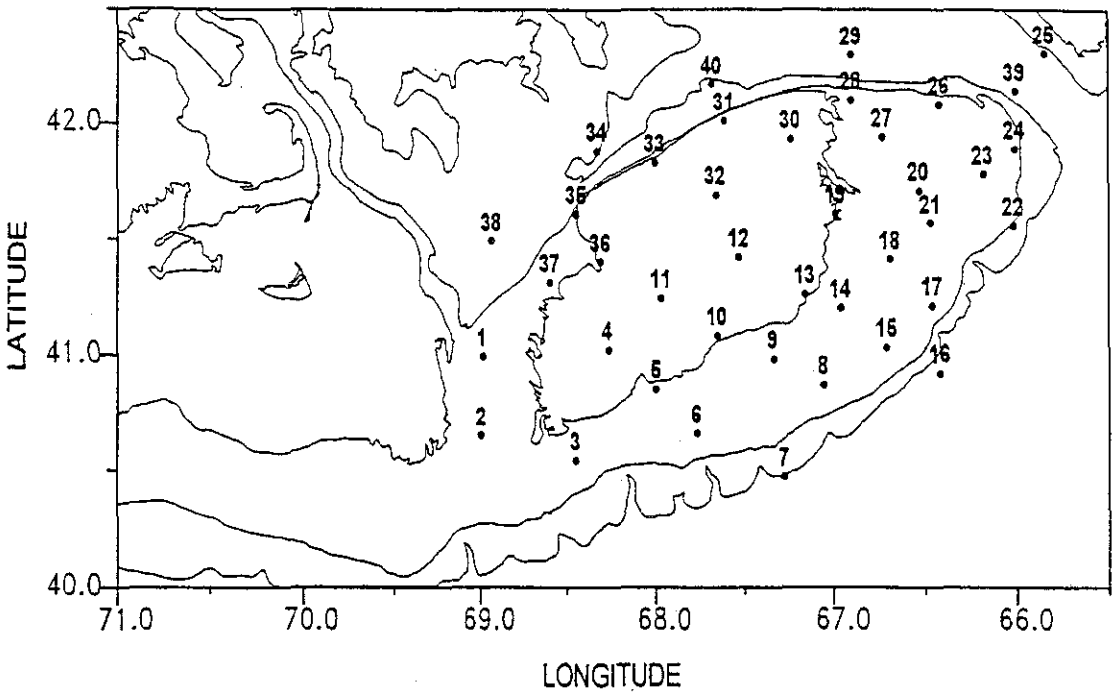

Figure 65. Hydrographic stations occupied during the U.S. GLOBEC Broad Scale survey ALB9707.

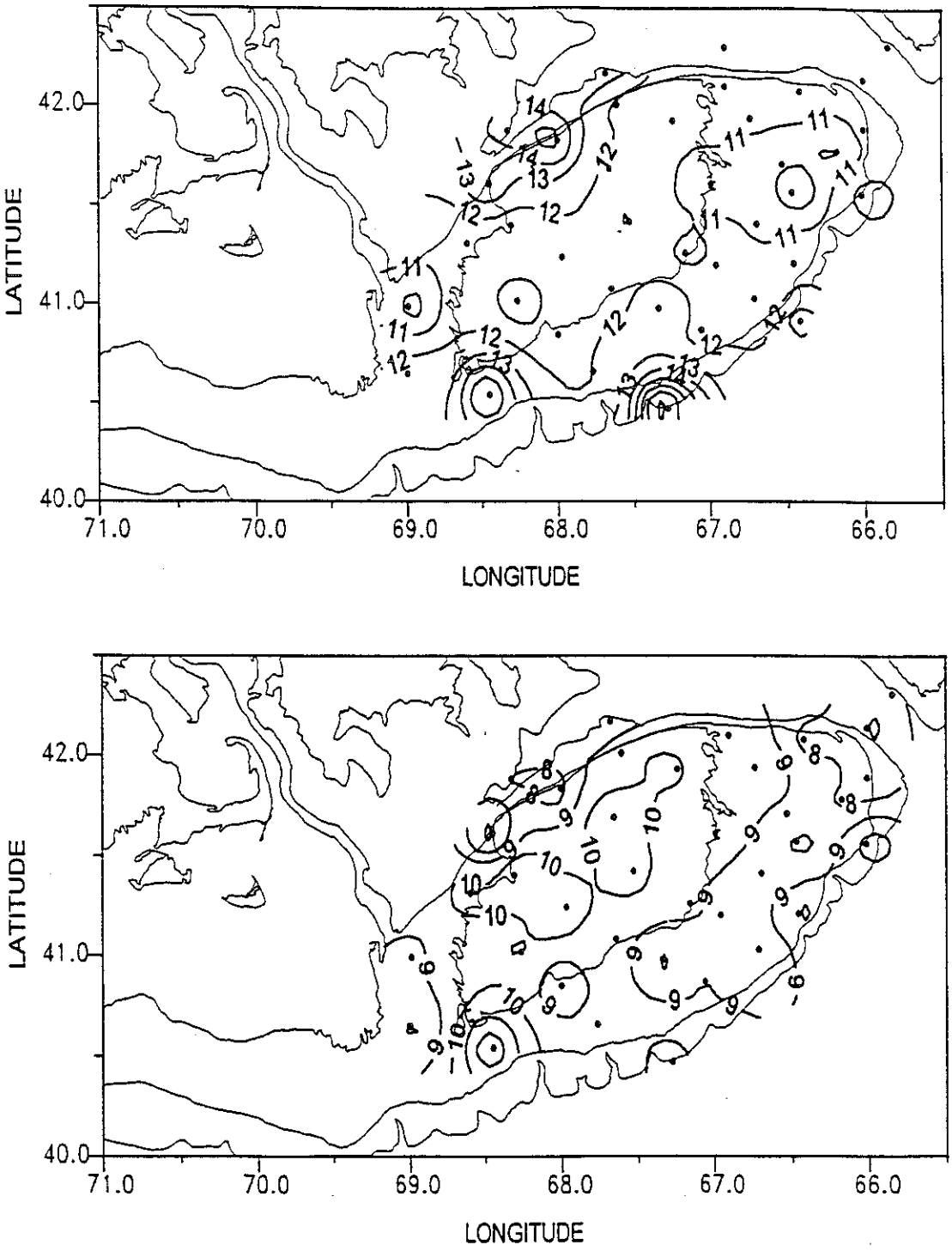

Figure 66. Surface and bottom temperature distributions during the U.S. GLOBEC Broad Scale survey ALB9707.

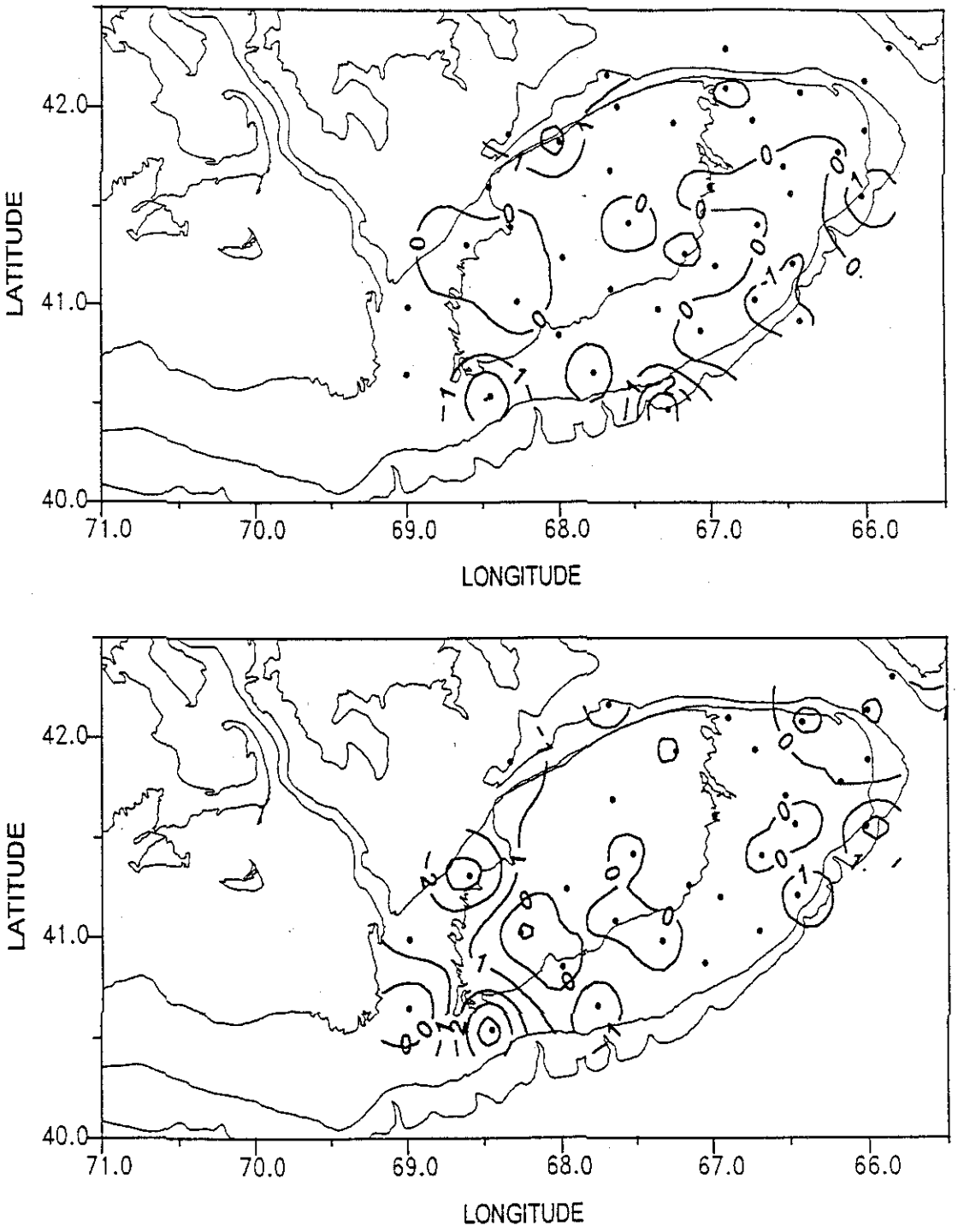

Figure 67. Surface and bottom temperature anomaly distributions during the U.S. GLOBEC Broad Scale survey ALB9707.

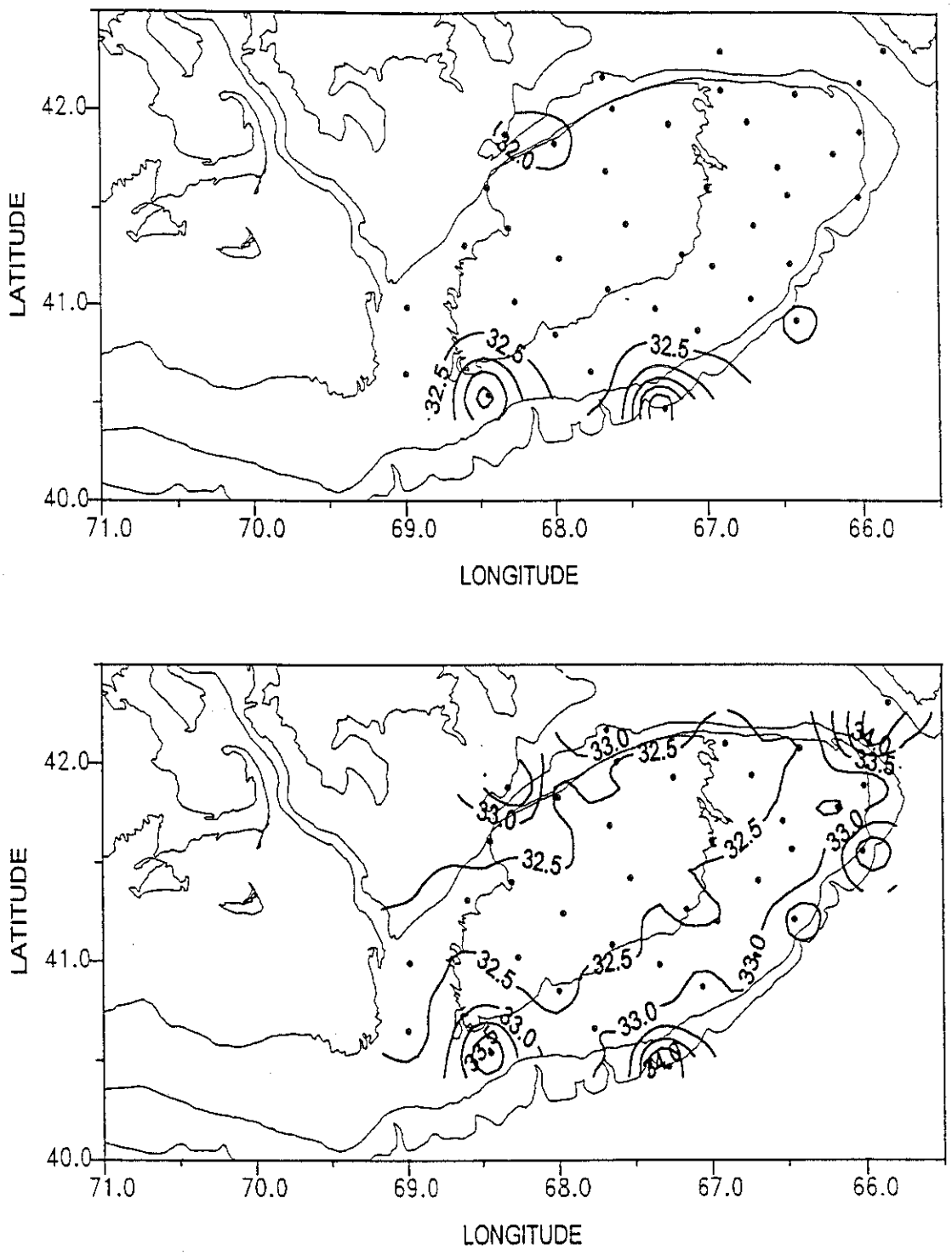

Figure 68. Surface and bottom salinity distributions during the U.S. GLOBEC Broad Scale survey ALB9707.

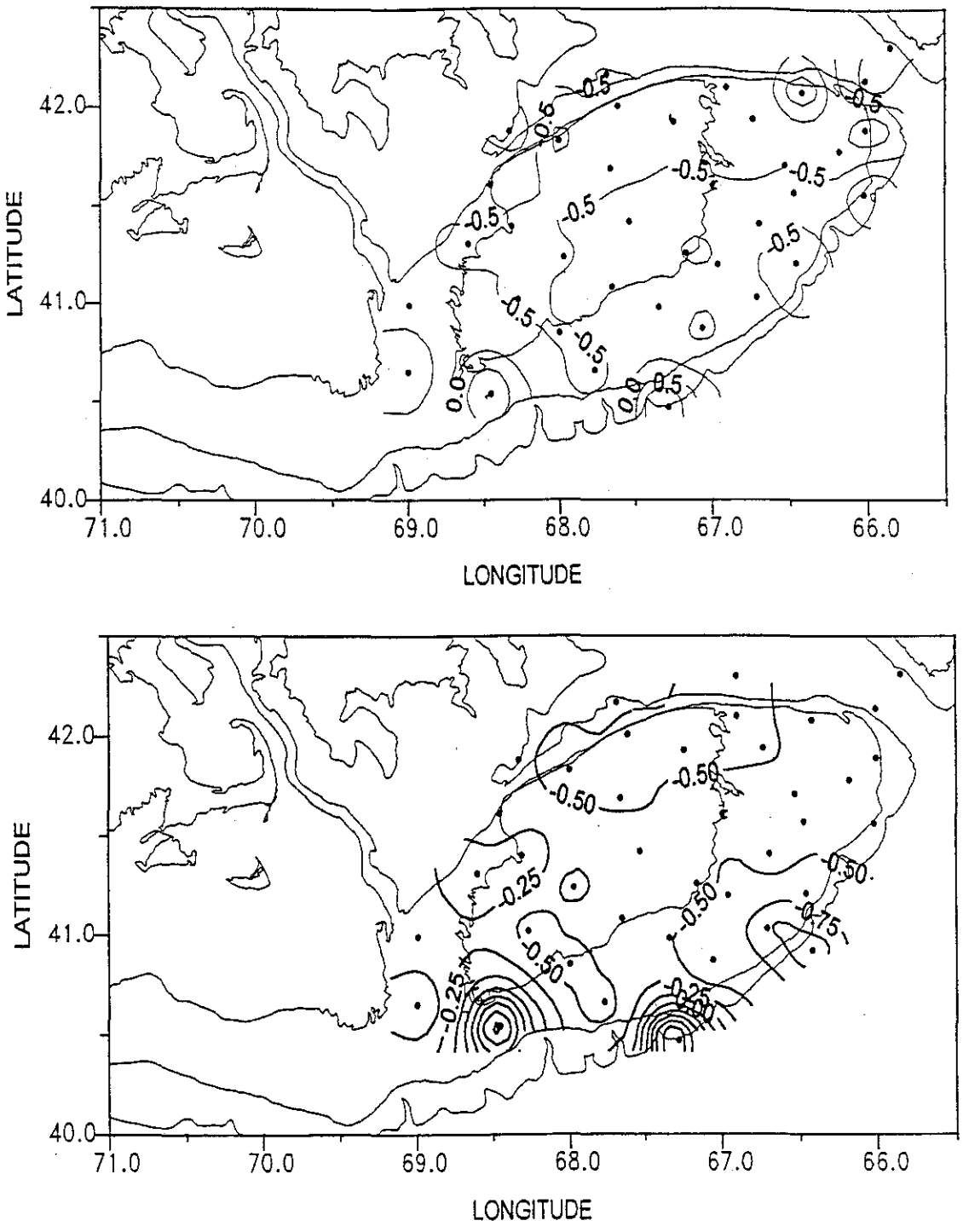

Figure 69. Surface and bottom salinity anomaly distributions during the U.S. GLOBEC Broad Scale survey ALB9707.

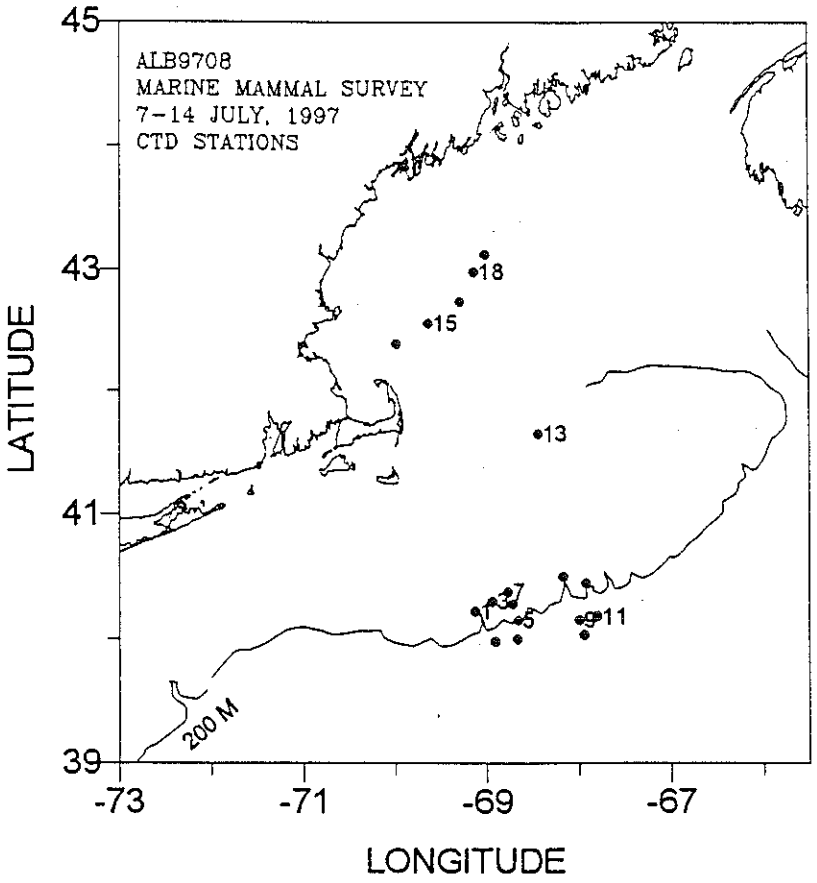

Figure 70. Hydrographic stations occupied during the Marine Mammal survey ALB9708.

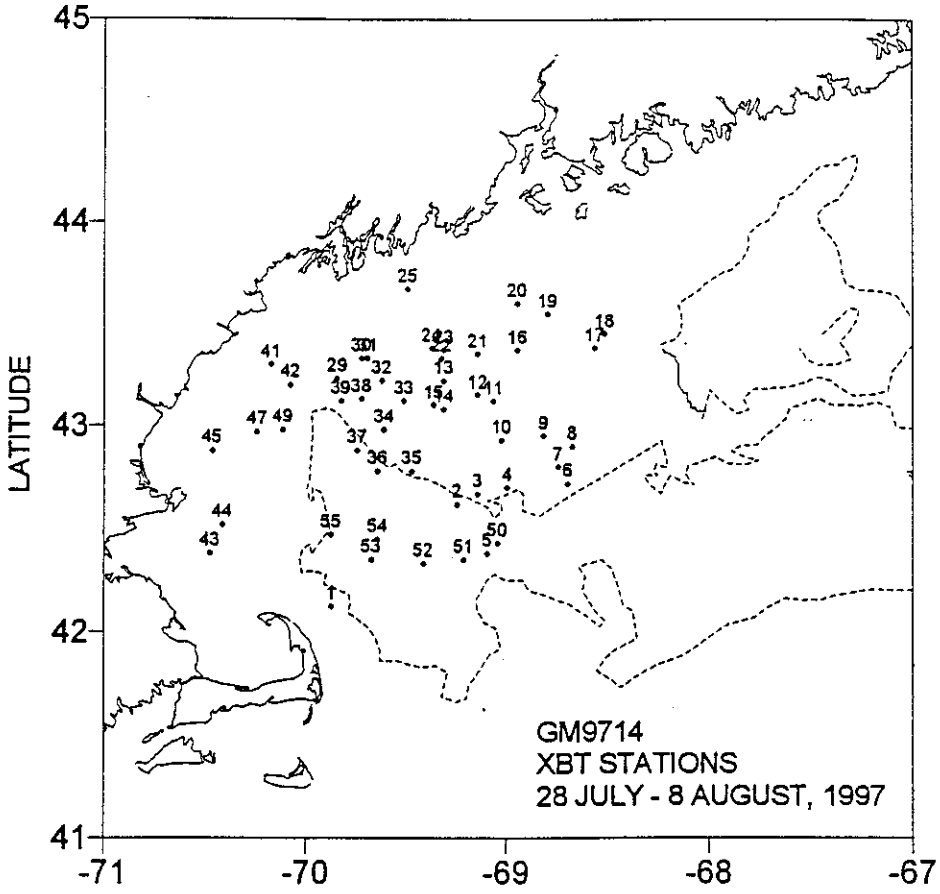

Figure 71. XBT drop locations during the Gulf of Maine Shrimp survey GLM9714.

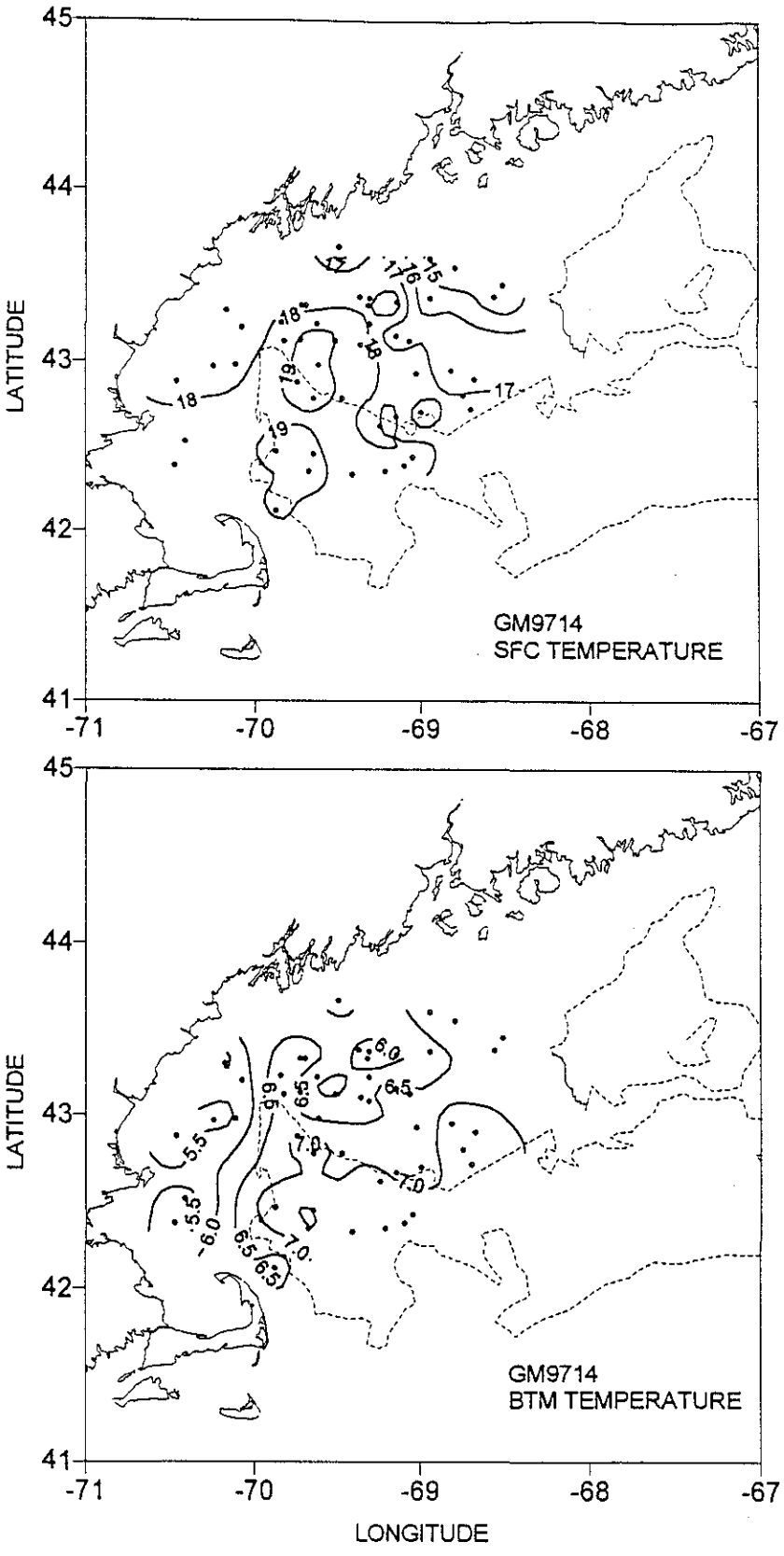

Figure 72. Surface and bottom temperature distributions during the Gulf of Maine Shrimp survey GLM9714.

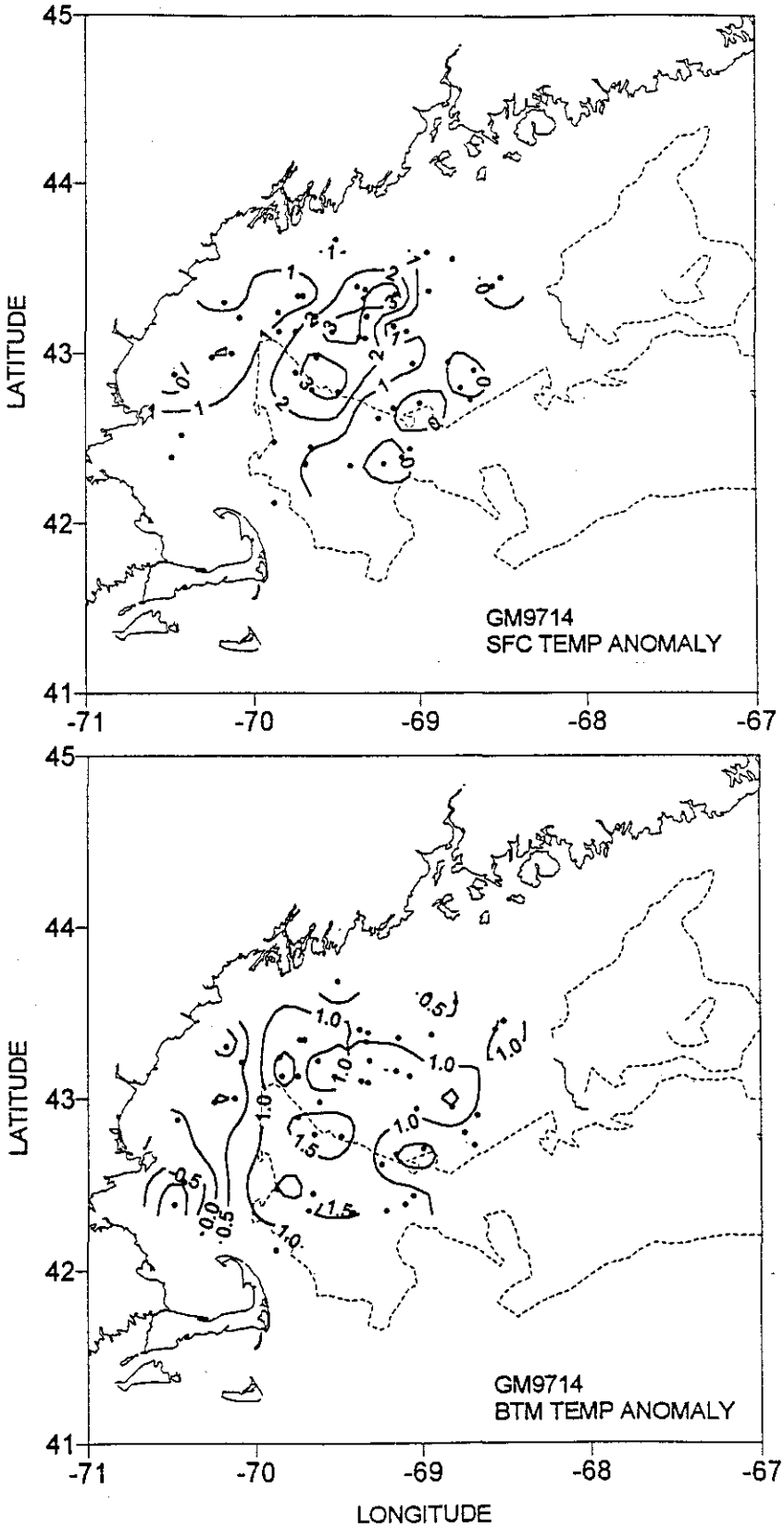

Figure 73. Surface and bottom temperature anomaly distributions during the Gulf of Maine Shrimp survey GLM9714.

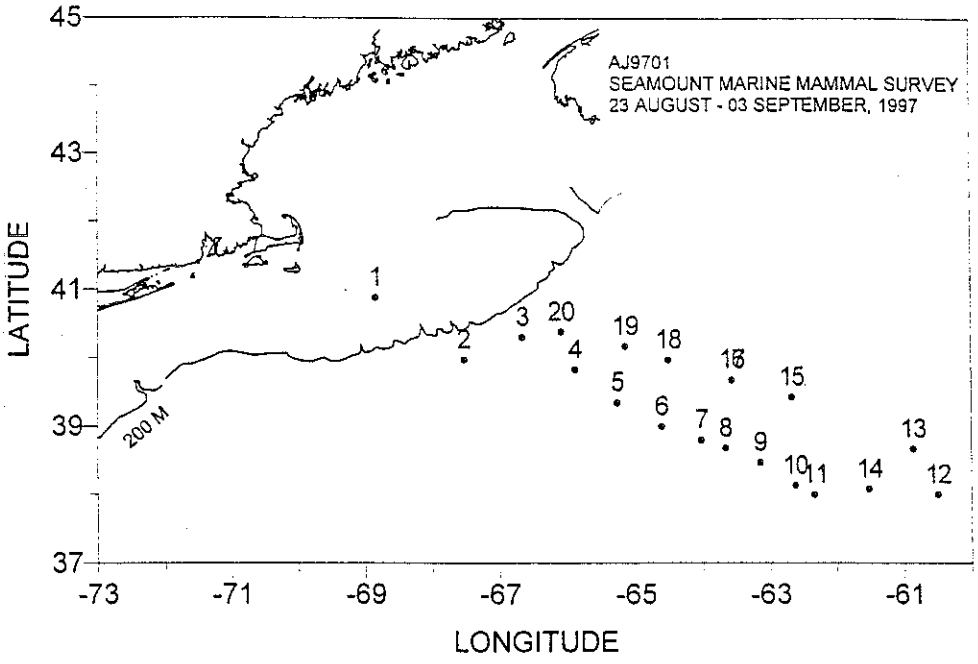

Figure 74. Hydrographic stations occupied during the Marine Mammal survey AJ9701.

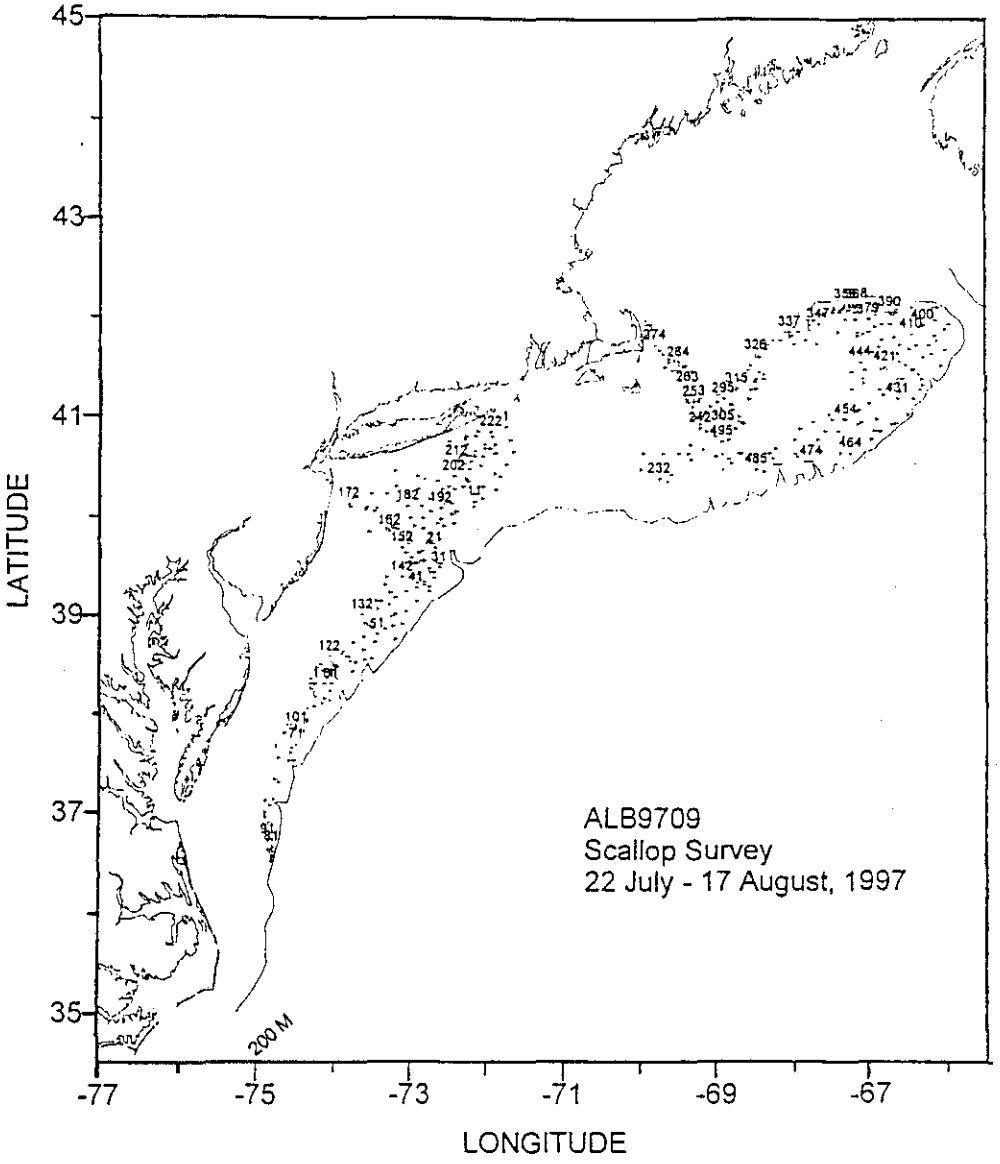

Figure 75. Hydrographic stations occupied during the Scallop survey ALB9709.

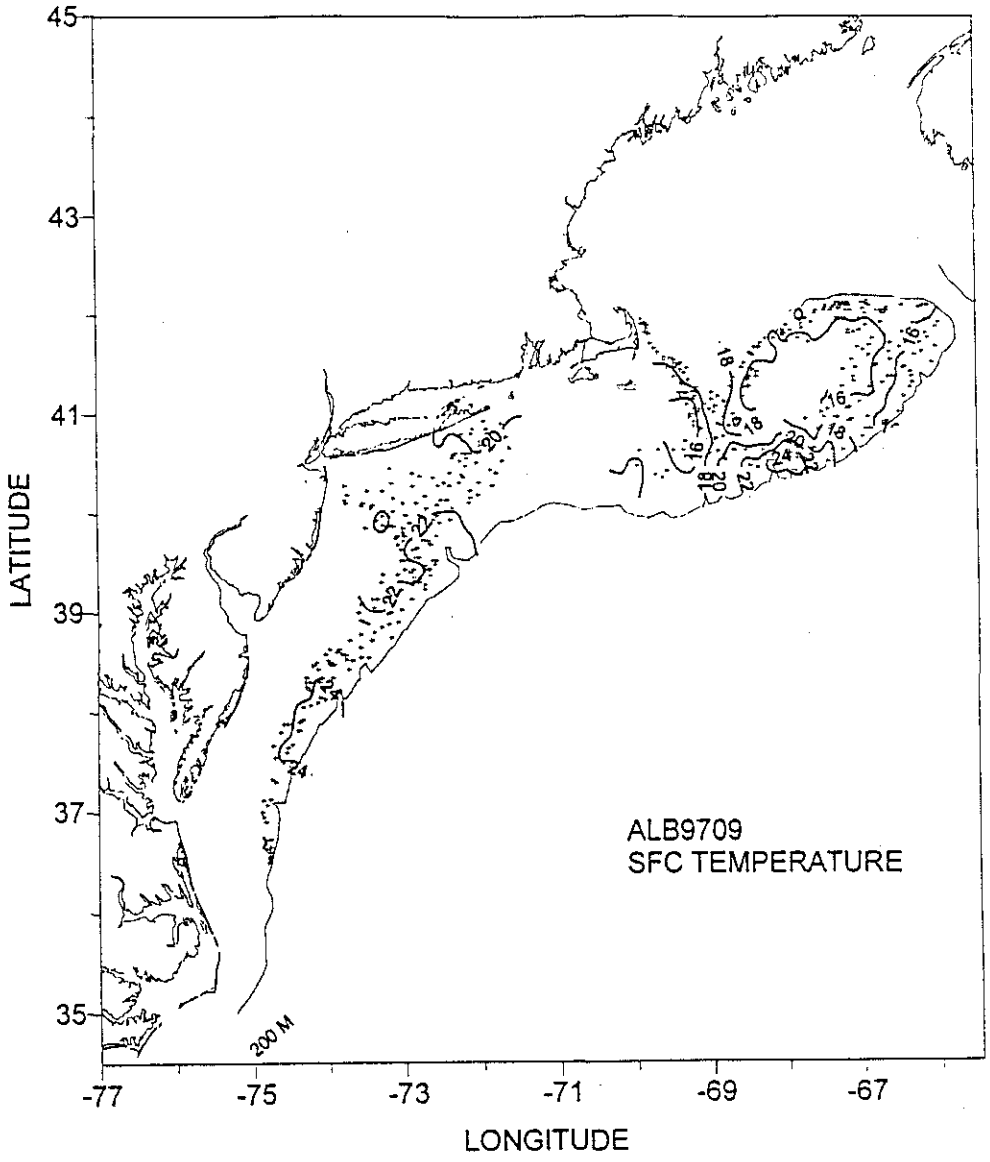

Figure 76. Surface temperature distribution during the Scallop survey ALB9709.

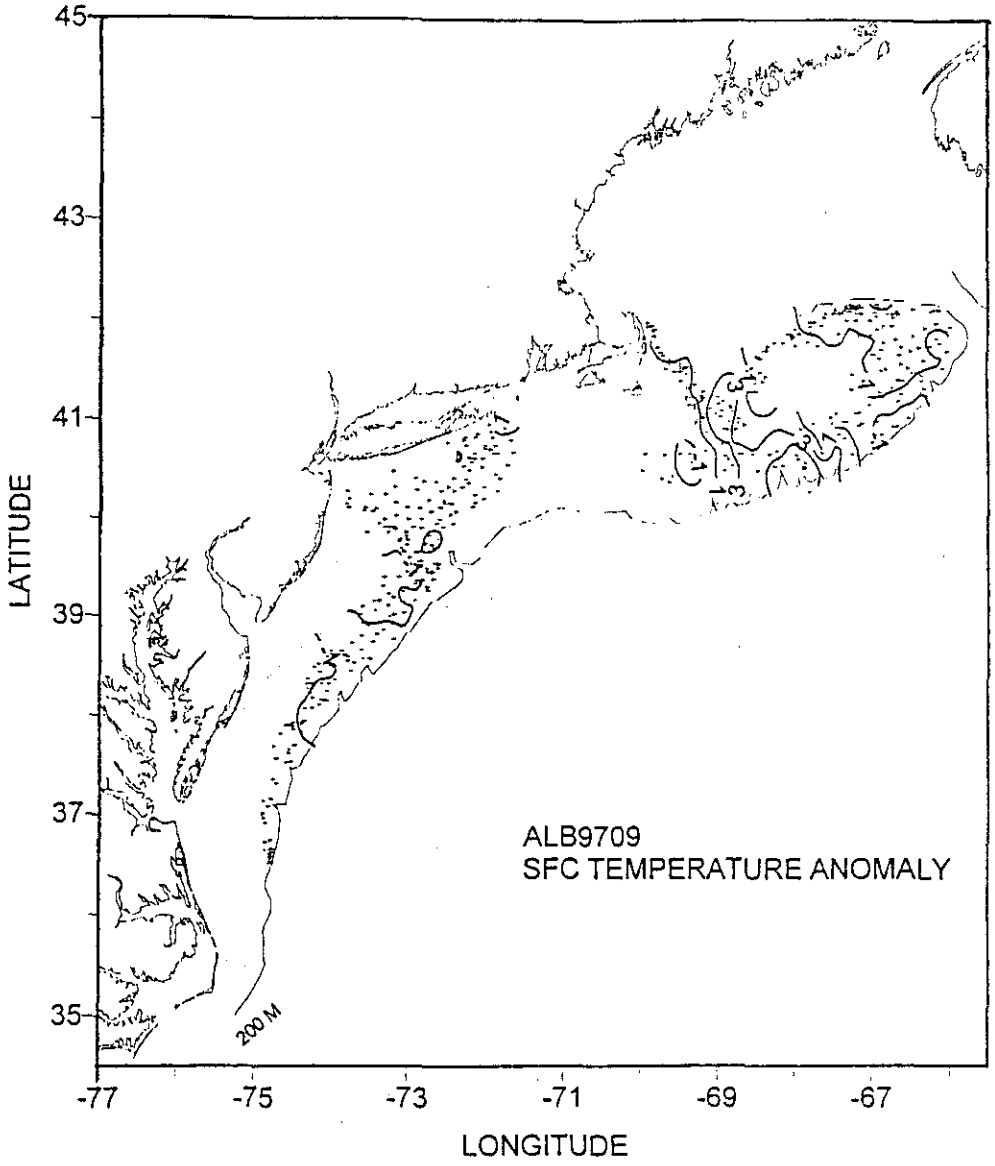

Figure 77. Surface temperature anomaly distribution during the Scallop survey ALB9709.

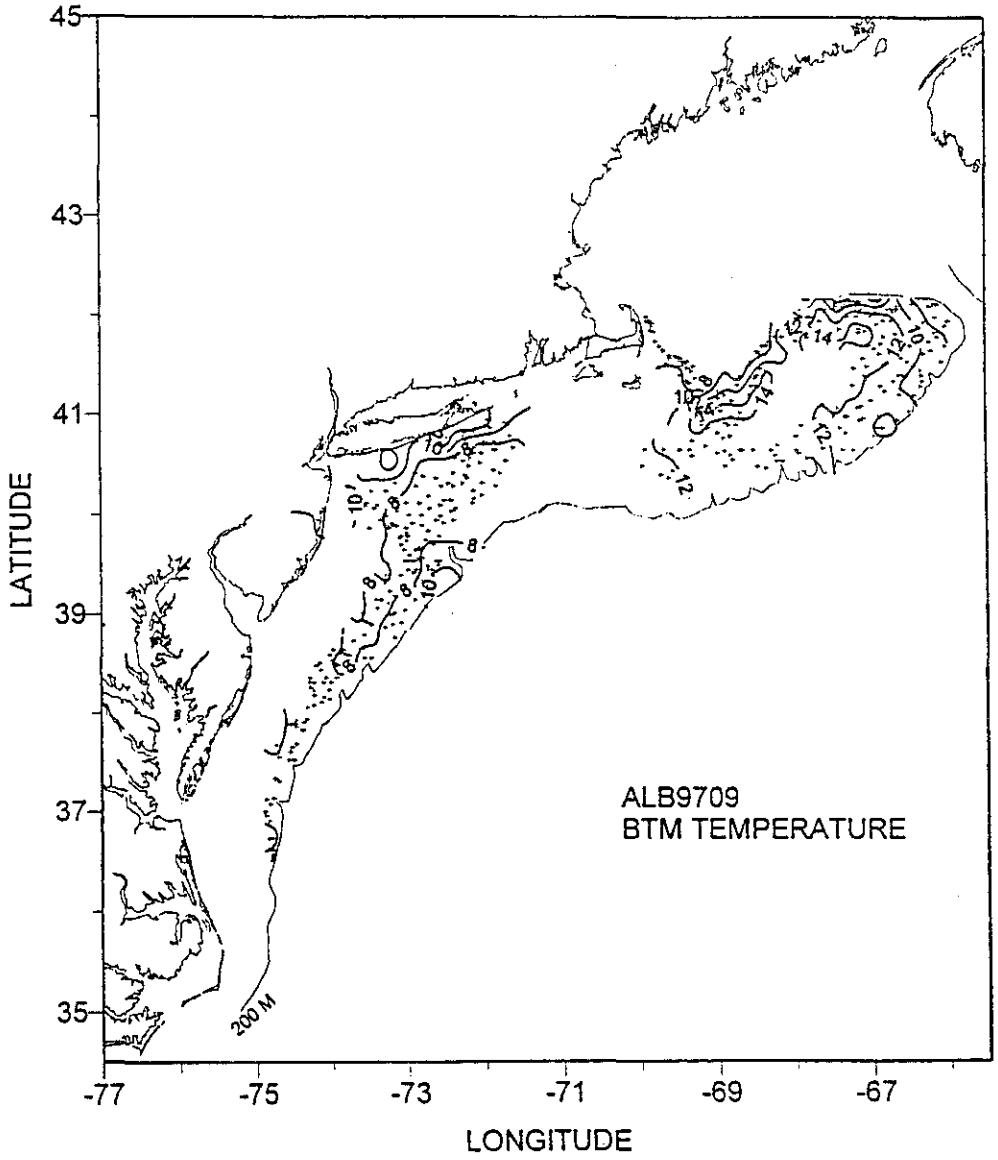

Figure 78. Bottom temperature distribution during the Scallop survey ALB9709.

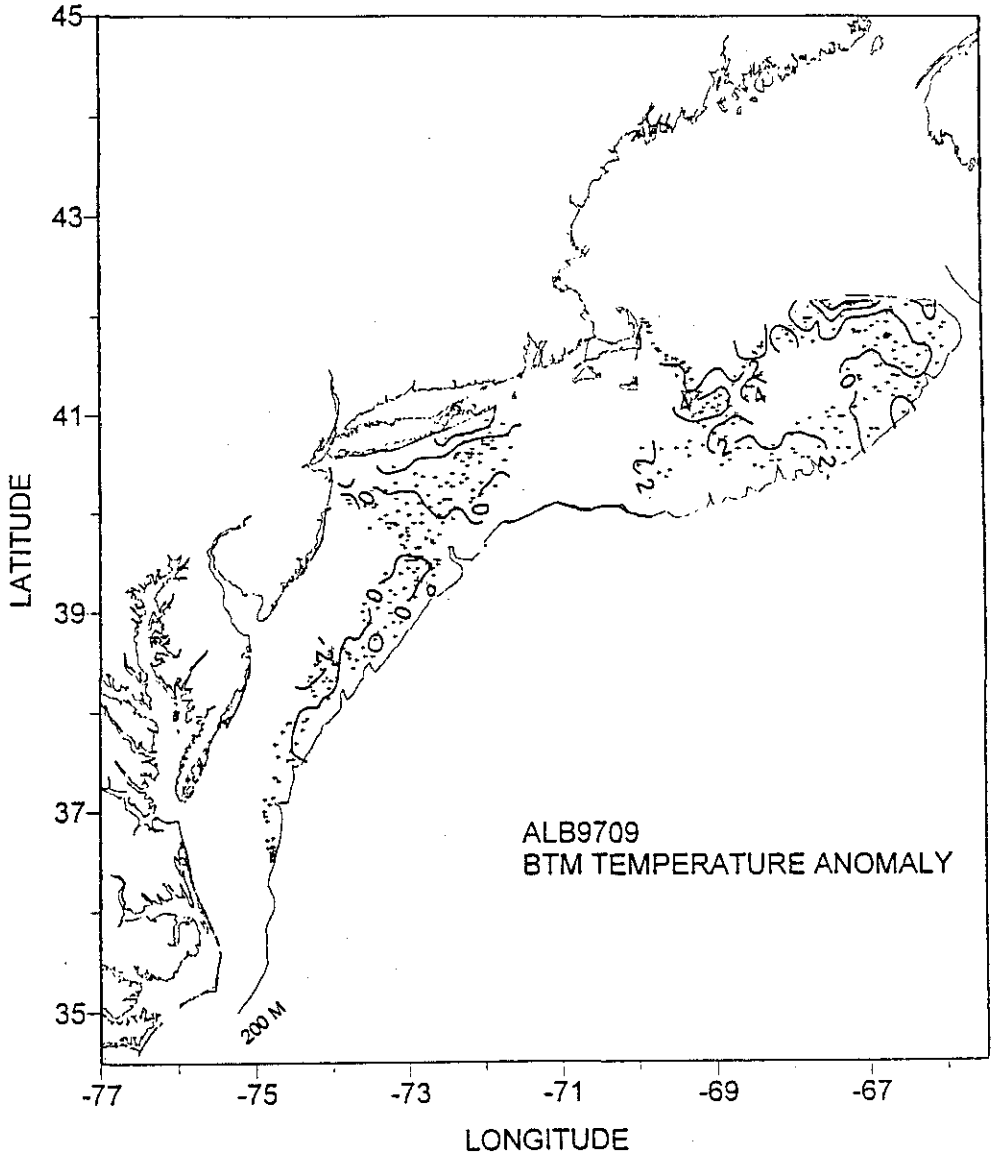

Figure 79. Bottom temperature anomaly distribution during the Scallop survey ALB9709.

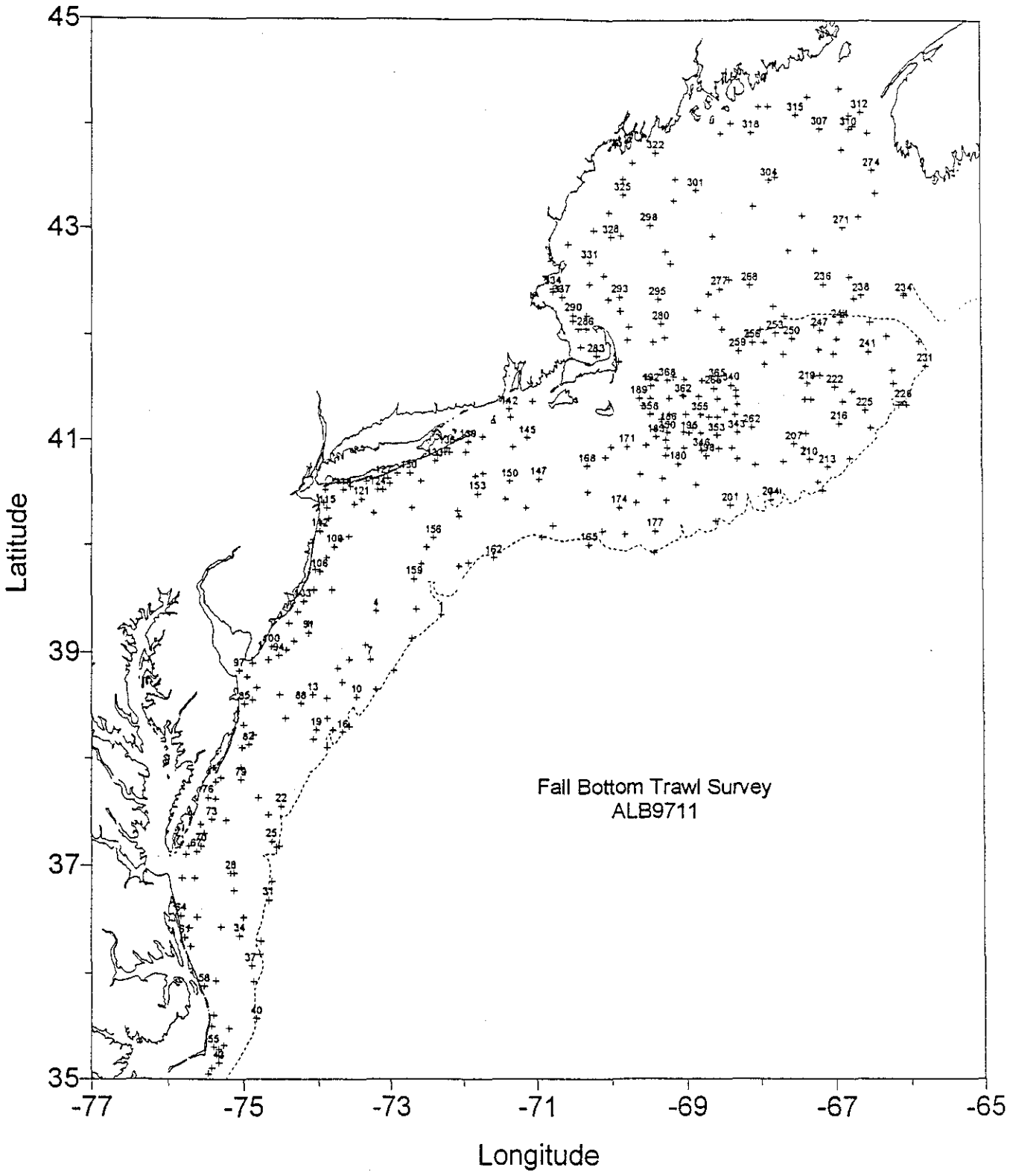

Figure 80. Hydrographic stations occupied during the Fall Bottom Trawl survey ALB9711.

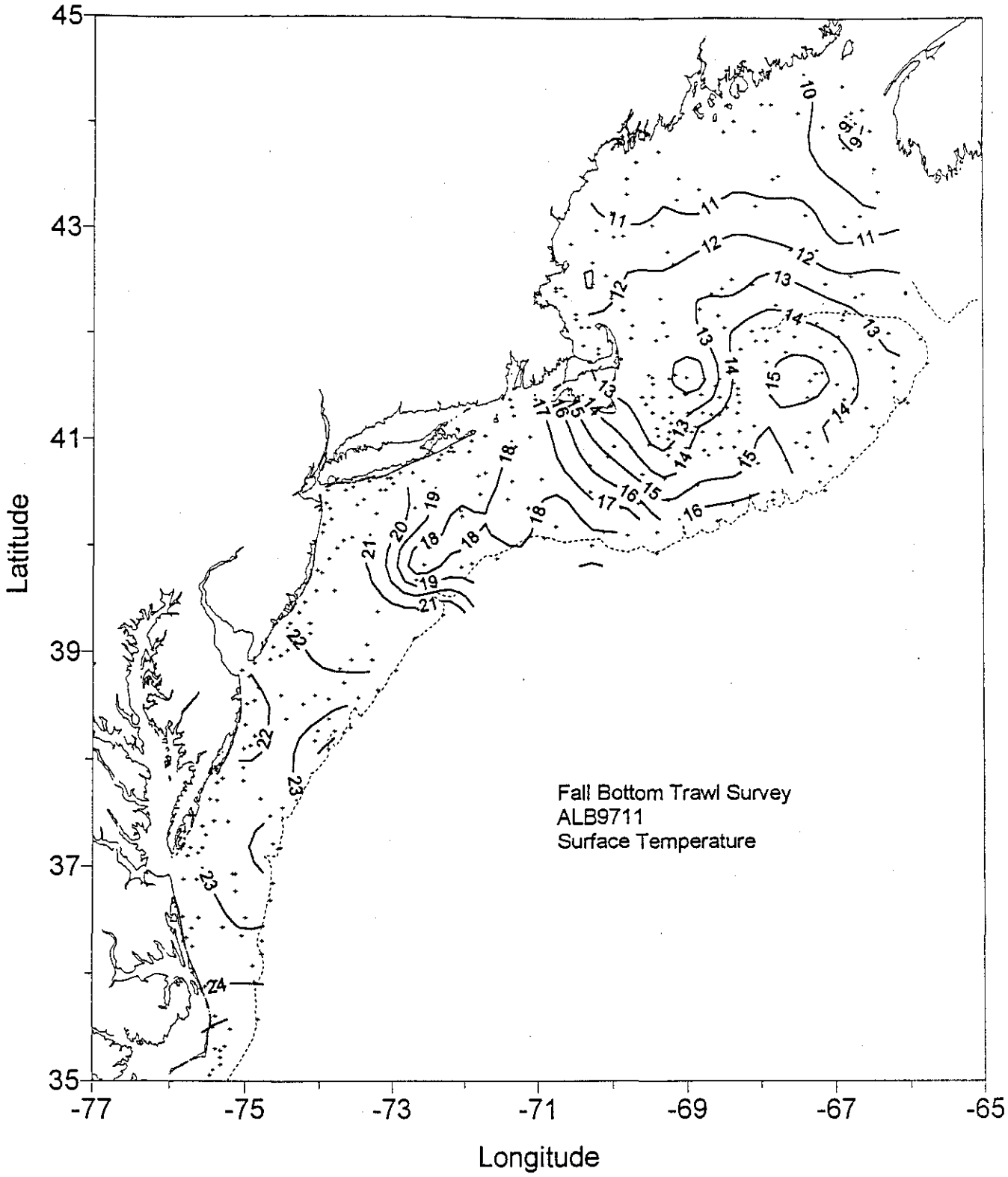

Figure 81. Surface temperature distribution during the Fall Bottom Trawl survey ALB9711.

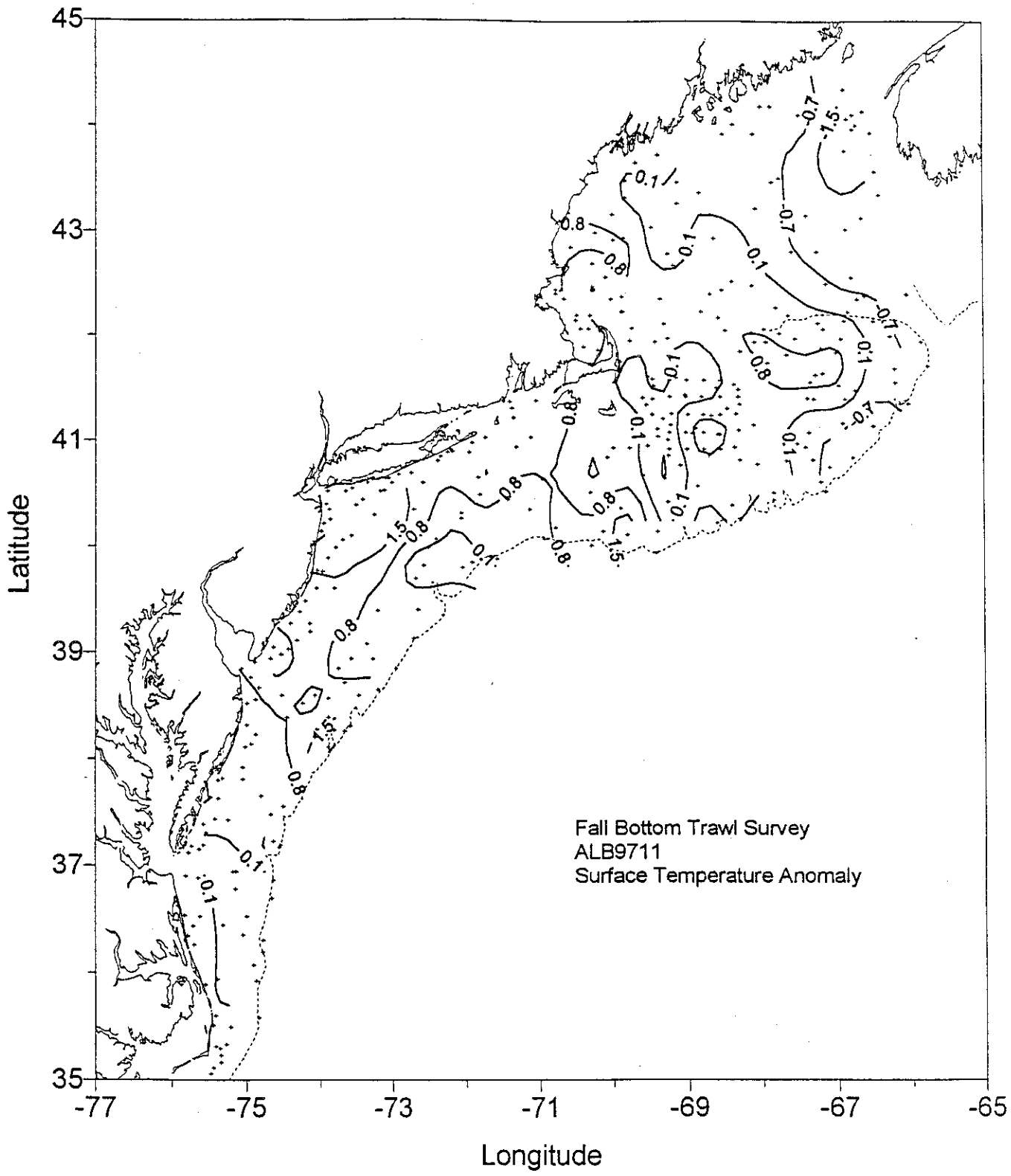

Figure 82. Surface temperature anomaly distribution during the Fall Bottom Trawl survey ALB9711.

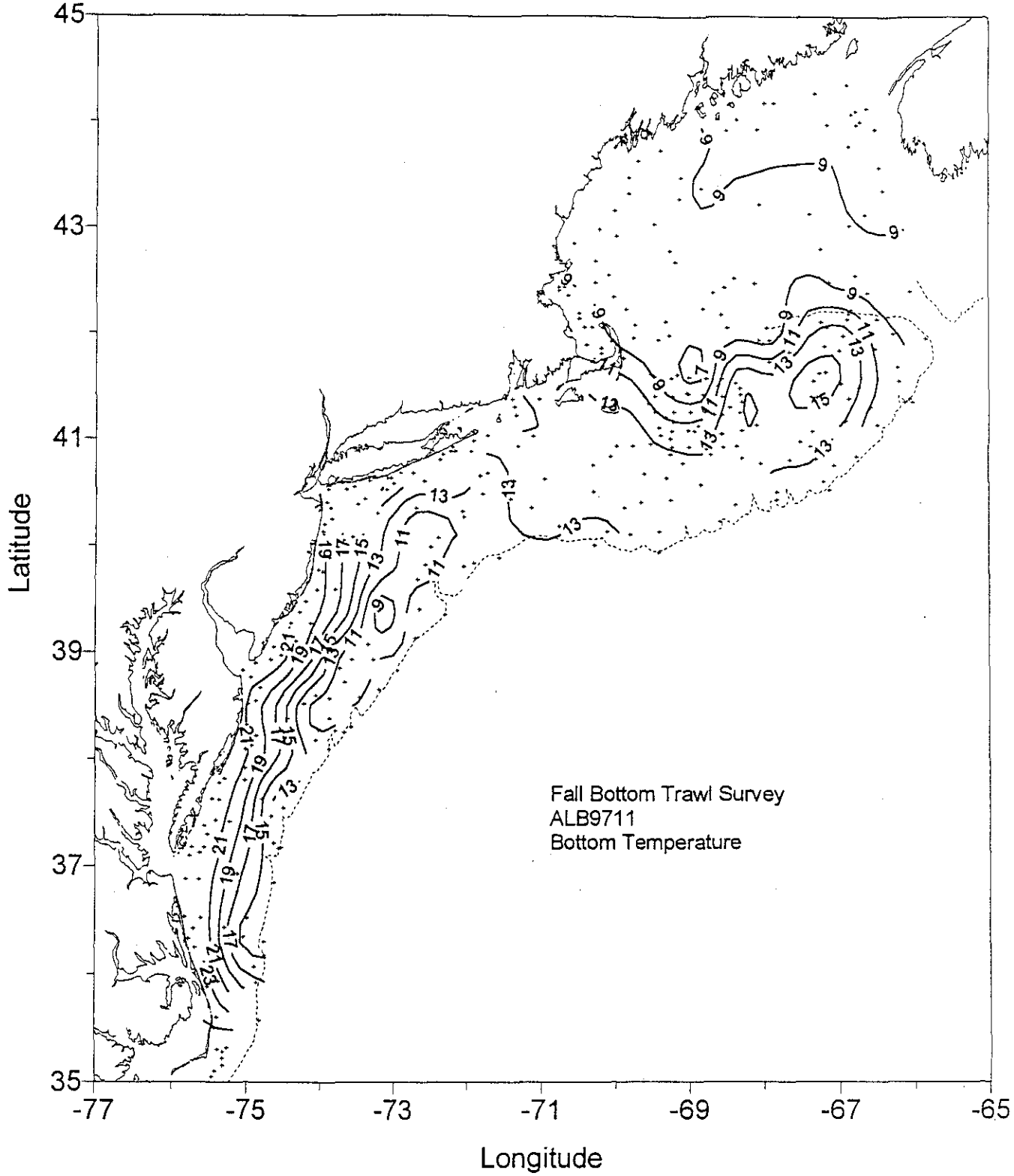

Figure 83. Bottom temperature distribution during the Fall Bottom Trawl survey ALB9711.

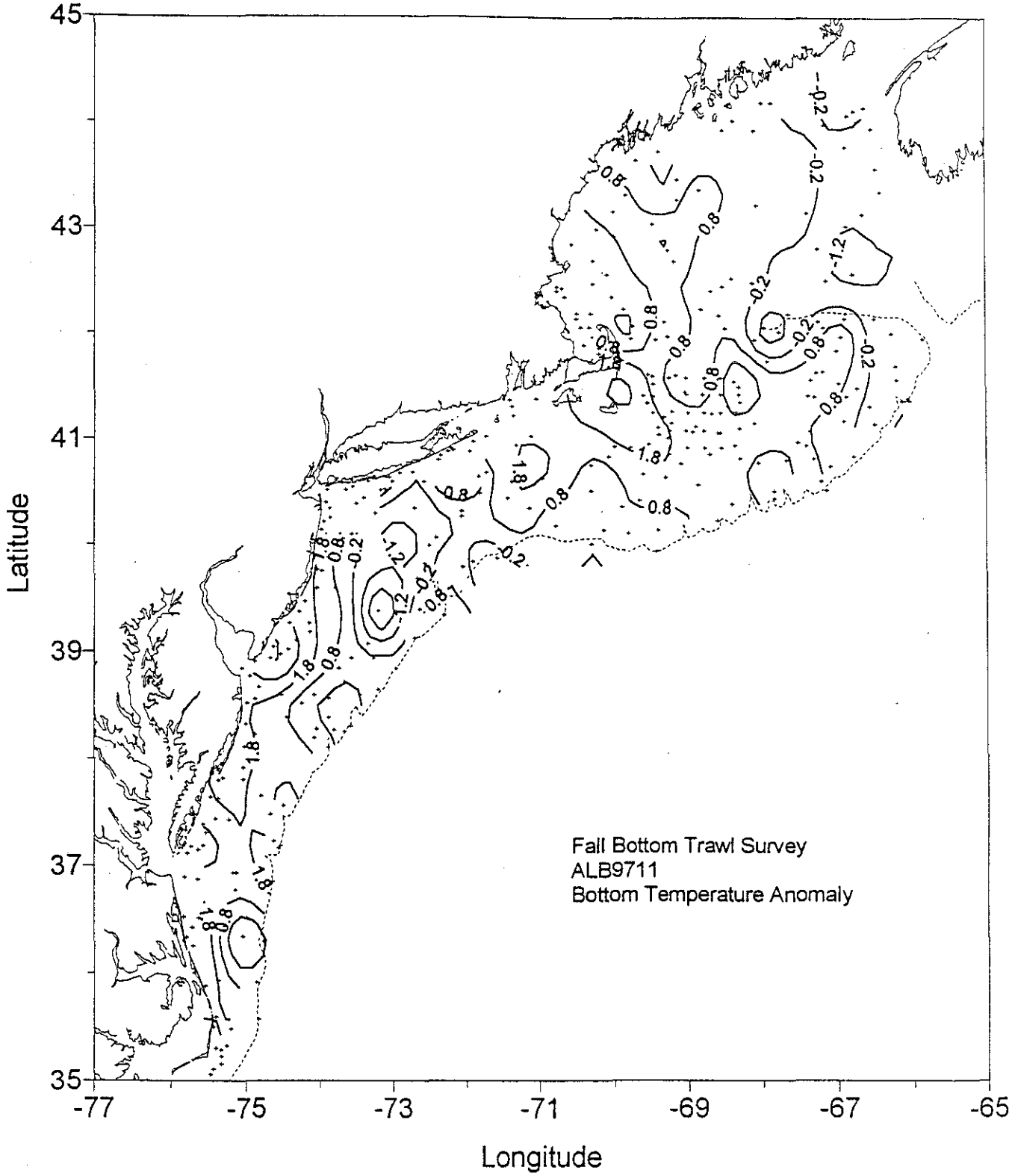

Figure 84. Bottom temperature anomaly distribution during the Fall Bottom Trawl survey ALB9711.

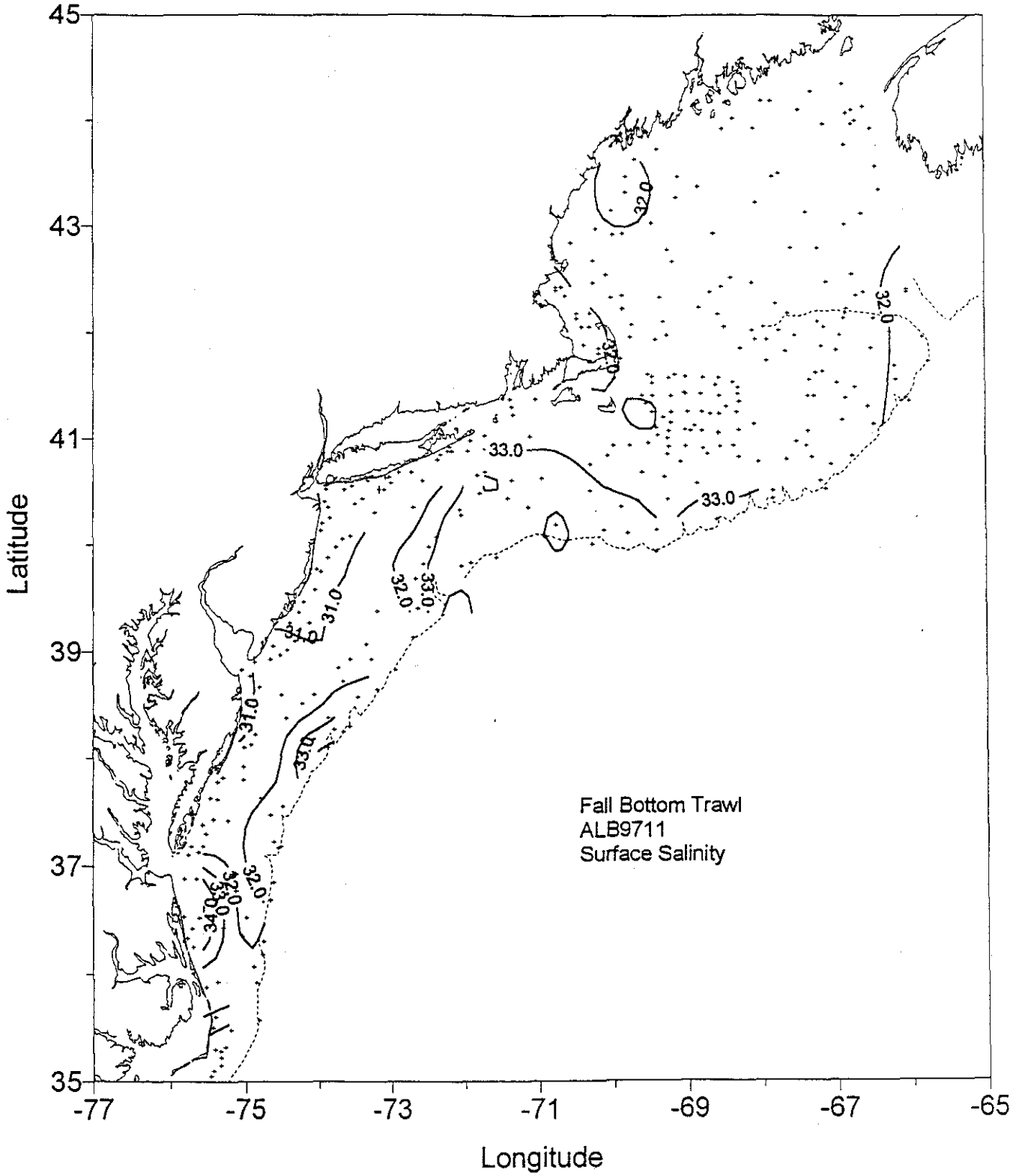

Figure 85. Surface salinity distribution during the Fall Bottom Trawl survey ALB9711.

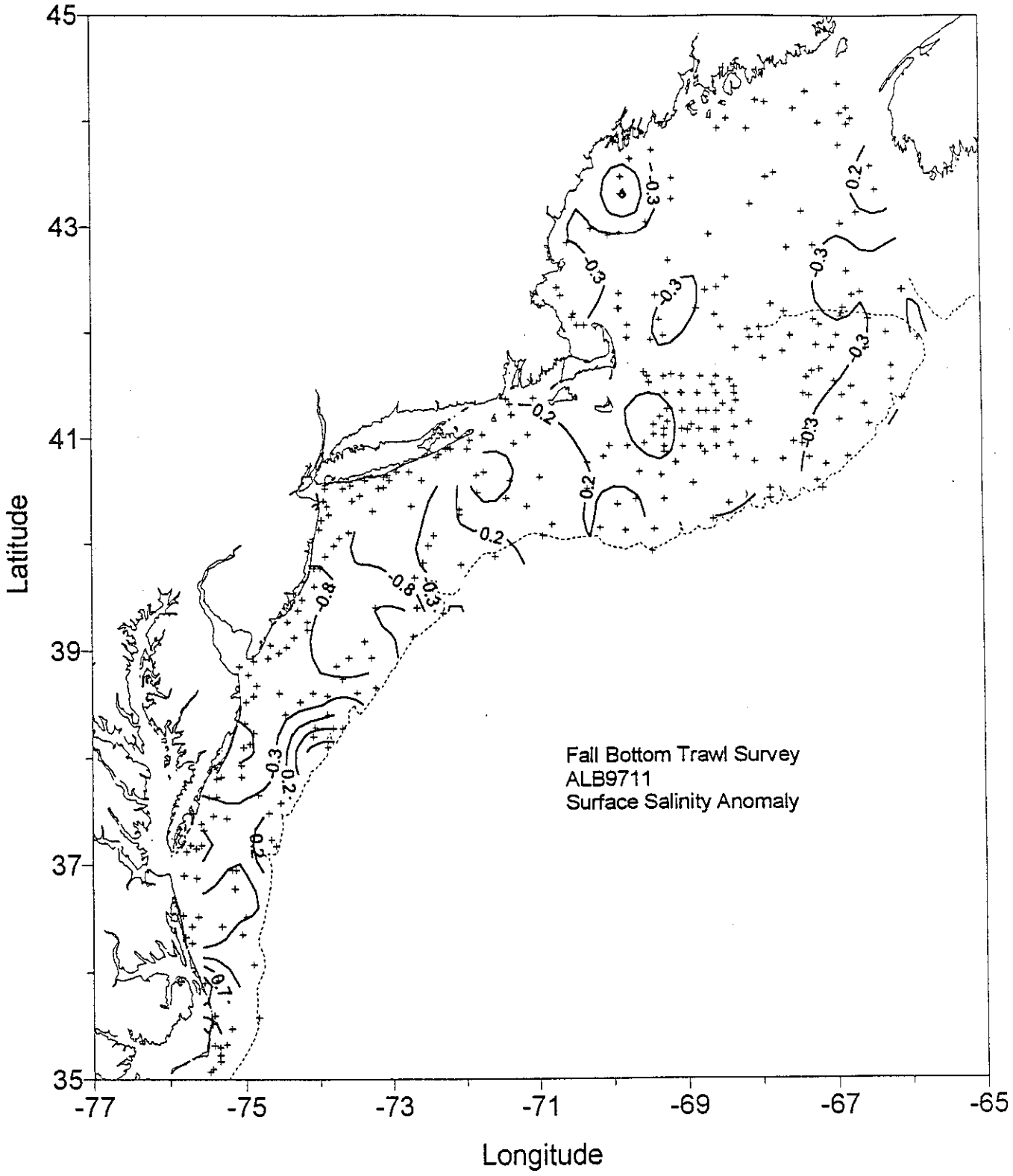

Figure 86. Surface salinity anomaly distribution during the Fall Bottom Trawl survey ALB9711.

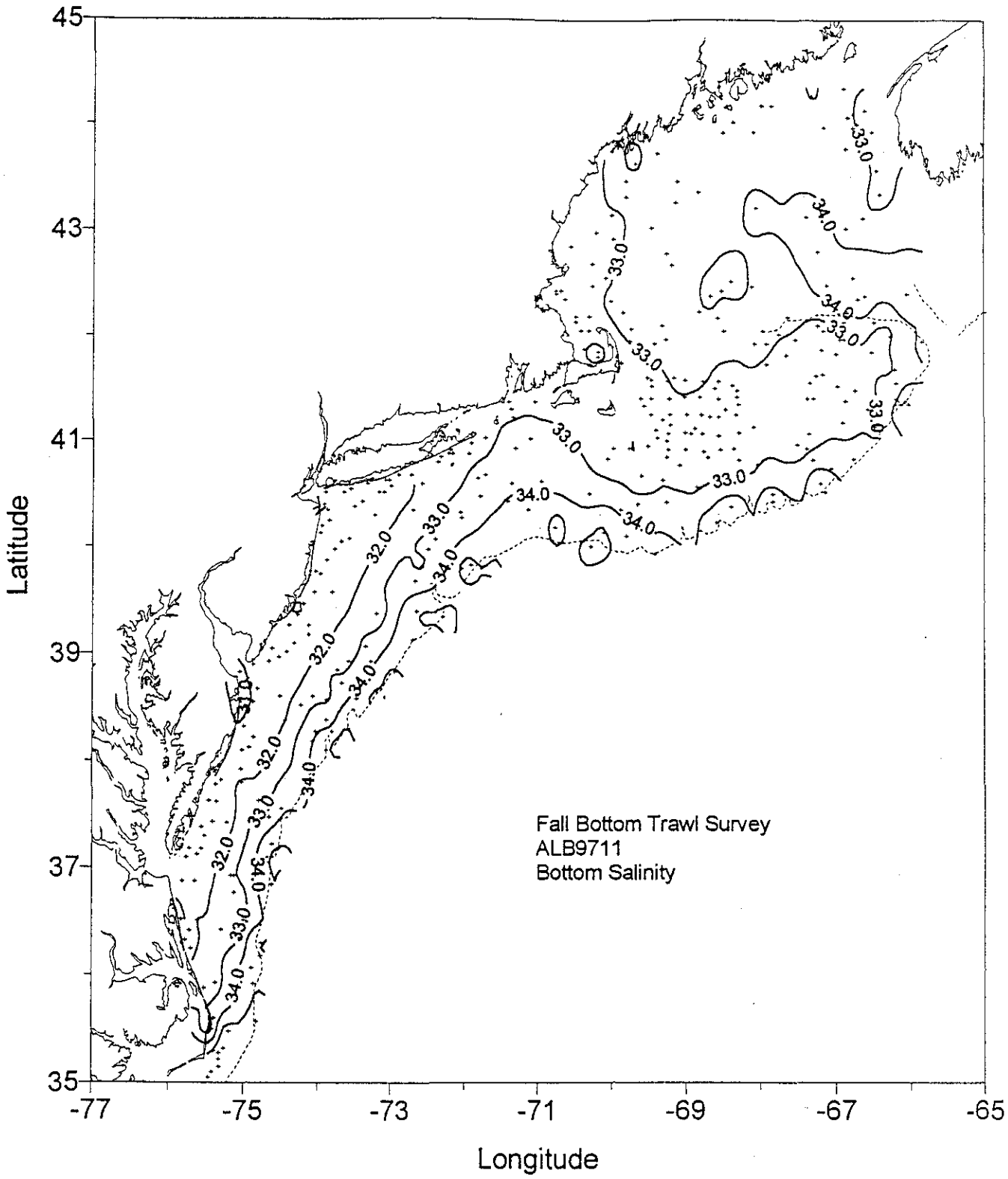

Figure 87. Bottom salinity distribution during the Fall Bottom Trawl survey ALB9711.

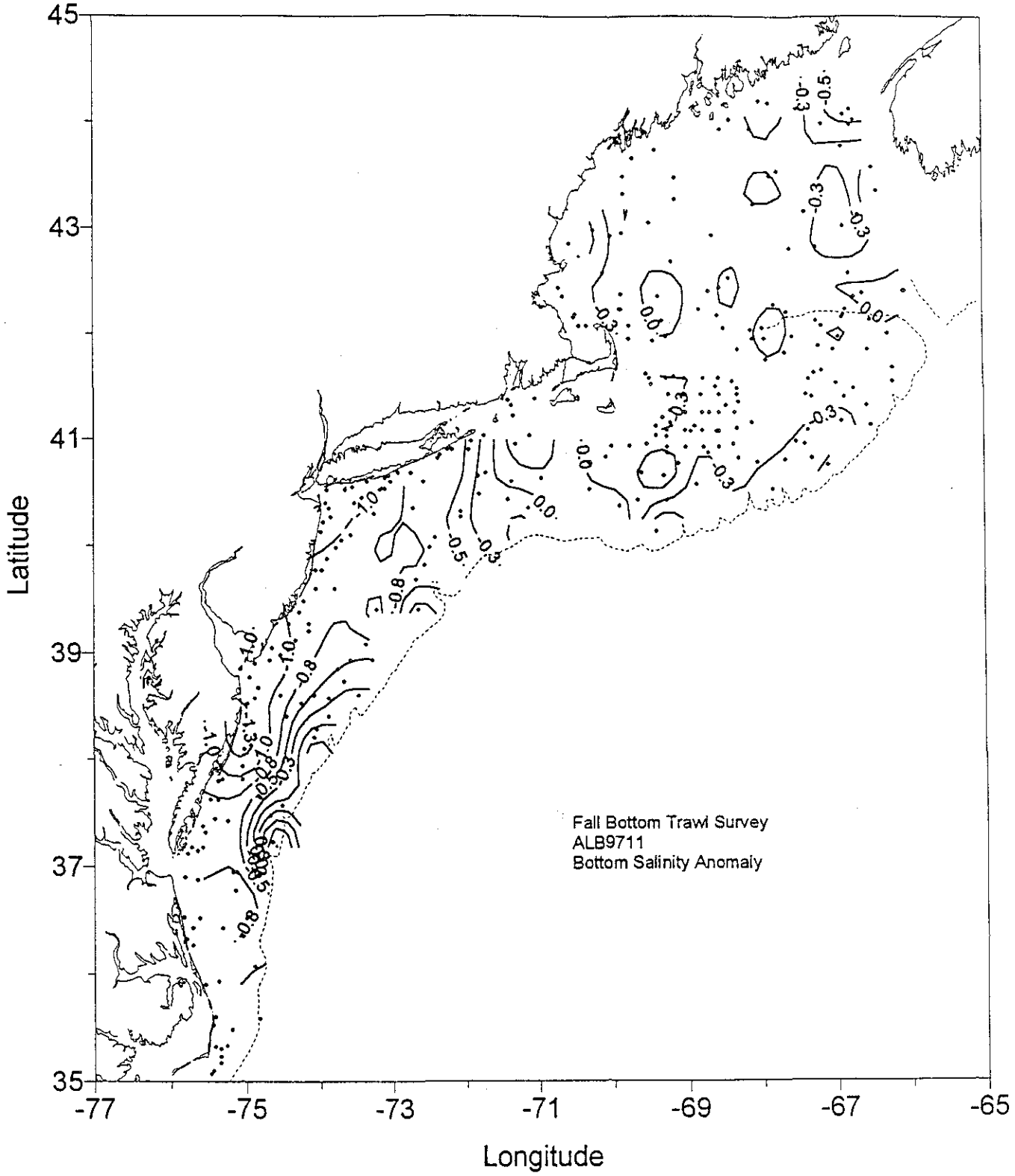

Figure 88. Bottom salinity anomaly distribution during the Fall Bottom Trawl survey ALB9711.

Appendix A. Summary of cruise information and hydrographic work completed.

Vessel: R/V Albatross IV	**Cruise:** 9701

Program: GLOBEC Broad Scale Survey #1
Dates: 14 - 19 January
Sea Days: 6
Instrument(s): Profiler 1468

Cruise Objectives: To (1) determine the distribution and abundance of target species of ichthyoplankton (eggs, larvae, and juveniles of cod and haddock); zooplankton (all stages of copepods, *Calanus finmarchicus* and *Pseudocalanus spp.*) and their predators and prey on Georges Bank and in the adjacent Gulf of Maine and slope waters; (2) provide systematic collections of larval and juvenile cod and haddock for age and growth estimates; (3) conduct a hydrographic survey of the Bank; (4) map the Bank wide velocity field using an Acoustic Doppler Current Profiler; (5) deploy Lagrangian-type drifters to make current measurements.

Total # of stations: 19
 # Of vertical CTD/Profiler casts: 3
 # Of double oblique Profiler casts: 19
 # Salinity samples: 3
Salt correction: -0.0092

Special Notes: Primary hydrographic data on this cruise were collected with a Neil Brown Mark V CTD.

****

Vessel: R/V Oceanus	**Cruise:** 298

Program: GLOBEC Broad Scale Survey #2
Dates: 11 - 23 February
Sea Days: 13
Instrument(s): Profiler 1468

Cruise Objectives: To (1) determine the distribution and abundance of target species of ichthyoplankton (eggs, larvae, and juveniles of cod and haddock), zooplankton (all stages of copepods, *Calanus finmarchicus* and *Pseudocalanus spp.*) and their predators and prey on Georges Bank and in the adjacent Gulf of Maine and slope waters, (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) map the Bank wide velocity field using an Acoustic Doppler Current Profiler; (6) deploy four shallow and one deep expendable drifter; (7) redeploy two long-term moorings.

Total # of stations: 76
 # Of vertical CTD/Profiler casts: 6
 # Of double oblique Profiler casts: 103
 # Salinity samples: 6
Salt correction: + 0.021

Special Notes: Primary hydrographic data on this cruise were collected with a Neil Brown Mark V CTD.

****

Vessel: R/V Albatross IV **Cruise:** 9703

Program: Winter Bottom Trawl Survey
Dates: 4 - 26 February
Sea Days: 13
Instrument(s): Profilers 1495, 1496

Cruise objectives: To (1) determine the winter distribution and relative abundance of fish and selected invertebrate species; (2) collect biological samples for studies of age and growth relationships, fecundity, maturity, and food habits; (3) collect hydrographic and meteorological data; (4) collect samples of ichthyoplankton and zooplankton; (5) make data and sample collections for cooperative researchers and programs.

Total # of stations: 127
 # Of vertical CTD/Profiler casts: 55
 # Of double oblique Profiler casts: 52
 # Salinity samples: 6 (1495), 11(1496)
Salt correction: NA / + 0.0234

****

Vessel: R/V Delaware II **Cruise:** 9705

Program: Marine Mammal Survey

Dates: 6 - 18 March
Sea Days: 13
Instrument(s): Profilers 0851, 0853

Cruise Objectives: To (1) determine the spatial distribution and relative abundance of harbor porpoises and bottlenose dolphins in the mid-Atlantic region; (2) obtain biopsy samples of bottlenose dolphins to determine stock boundaries of the coastal bottlenose dolphin species.

Total # of stations: 31
 # Of vertical CTD/Profiler casts: 31
 # Of double oblique Profiler casts: 0
 # Salinity samples: 8 (0851), 1 (0853)
Salt correction: + 0.0194 / NA

****

Vessel: R/V Oceanus	**Cruise:** 300

Program: GLOBEC Broad Scale Survey #3
Dates: 17 - 28 March
Sea Days: 12
Instrument(s): Profiler 1468

Cruise Objectives: To (1) conduct a broad-scale survey of U.S. GLOBEC Georges Bank Program target fish and copepod species with their predators and prey to determine their distribution and abundance, (2) conduct a hydrographic survey of the Bank, (3) conduct acoustic mapping of the plankton along the track lines between stations using a high frequency echo sounder deployed in a towed body, (4) map the Bank-wide velocity field using an Acoustic Doppler Current Profiler, (5) collect individuals of *Calanus* and the euphausiid *Meganyctiphanes norvegica* for population genetics studies and (6) deploy drifting buoys to make Lagrangian measurements of the region's currents.

Total # of stations: 77
 # Of vertical CTD/Profiler casts: 9
 # Of double oblique Profiler casts: 80
 # Salinity samples: 9
Salt correction: + 0.0203

Special Notes: Primary hydrographic data on this cruise were collected with a Neil Brown Mark V CTD.

****

Vessel: R/V Oceanus **Cruise:** 301

Program: GLOBEC Process #1
Dates: 5 - 16 April
Sea Days: 12
Instrument(s): Profiler 0360

Cruise Objectives: To (1)determine the distribution and abundance of larval and juvenile cod and haddock on the eastern flank of Georges Bank in relation to water column conditions, and (2) conduct site studies to determine juvenile fish vertical distribution, diel variability, predator-prey relations and biochemical content.

Total # of stations: 85
 # Of vertical CTD/Profiler casts: 5
 # Of double oblique Profiler casts: 121
 # Salinity samples: 5
Salt correction: +0.009

****

Vessel: Oceanus **Cruise:** 302

Program: GLOBEC Broad Scale Survey #4
Dates: 22 April - 1 May
Sea Days: 10
Instrument(s): Profiler 1468

Cruise Objectives: To (1) determine the distribution and abundance on target ichthyoplankton (eggs, larval, and juvenile cod and haddock) and copepod species (all stages of *Calanus finmarchicus* and *Pseudocalanus spp.*) and their predators and prey; (2) provide systematic collections of larval and juvenile cod and haddock for age and growth estimates; (3) collect individuals of Calanus and the euphausiid, *Meganyctiphanes norvegica*, for population genetics studies; (4) conduct a hydrographic survey of the Bank; (5) map the Bank wide velocity using an Acoustic Doppler Current Profiler ; (6) deploy drifting buoys to make Lagrangian measurements

of the currents.

Total # of stations: 69
 # Of vertical CTD/Profiler casts: 6
 # Of double oblique Profiler casts: 67
 # Salinity samples: 6
Salt correction: + 0.0131

Special Notes: Primary hydrographic data on this cruise were collected with a Neil Brown Mark V CTD.

****

Vessel: R/V Albatross IV **Cruise:** 9704

Program: Spring Bottom Trawl Survey
Dates: 3 March - 23 April
Sea Days: 37
Instrument(s): Profiler 1495

Cruise Objectives: To (1)determine the spring distribution and relative abundance of fish and invertebrate species; (2) collect biological samples for studies of age and growth relationships, fecundity, maturity and food habits; (3) collect hydrographic and meteorological data; (4) make collections of data and samples for cooperative researchers and programs.

Total # of stations: 345
 # Of vertical CTD/Profiler casts: 176
 # Of double oblique Profiler casts: 118
 # Salinity samples: 50
Salt correction: +0.029

****

Vessel: R/V Oceanus **Cruise:** 303

Program: GLOBEC Process #2
Dates: 8 - 22 May
Sea Days: 15
Instrument(s): Profiler 0360

Cruise Objectives: To (1)determine the distribution and abundance of larval and juvenile cod and haddock on the eastern flank of Georges Bank in relation to water column conditions, and (2) conduct site studies to determine juvenile fish vertical distribution, diel variability, predator-prey relations and biochemical content.

Total # of stations: 110
 # Of vertical CTD/Profiler casts: 11
 # Of double oblique Profiler casts: 132
 # Salinity samples: 3
Salt correction: +0.007

Special Note: Salt samples were mixed up on this cruise with those for another CTD. There were only 3 "known" samples.

****

Vessel: R/V Albatross IV **Cruise:** 9705

Program: GLOBEC Broad Scale Survey #5
Dates: 20 - 28 May
Sea Days: 9
Instrument(s): Profiler 1468

Cruise Objectives: To (1) conduct a broad-scale survey of U.S. GLOBEC Georges Bank Program target fish and copepod species with their predators and prey to determine their distribution and abundance, (2) conduct a hydrographic survey of the Bank, (3) collect individuals of *Calanus* and the euphausiid *Meganyctiphanes norvegica* for population genetics studies, (4) deploy drifting buoys to make Lagrangian measurement of the currents and (5) gather acoustic Doppler current profiler data.

Total # of stations: 78
 # Of vertical CTD/Profiler casts: 7
 # Of double oblique Profiler casts: 86
 # Salinity samples: 7
Salt correction: +0.0077

Special Note: Primary hydrographic data on this cruise was collected using a Neil Brown Mark V CTD.

****

Vessel: R/V Albatross IV **Cruise:** 9707

Program: GLOBEC Broad Scale Survey #6
Dates: 19 - 27 June
Sea Days: 9
Instrument(s): Profiler 1468

Cruise Objectives: To (1) conduct a broad-scale survey of U.S. GLOBEC Georges Bank Program target fish and copepod species with their predators and prey to determine their distribution and abundance, (2) conduct a hydrographic survey of the Bank, (3) collect individuals of *Calanus* and the euphausiid *Meganyctiphanes norvegica* for population genetics studies, (4) deploy drifting buoys to make Lagrangian measurement of the currents and (5) gather acoustic Doppler current profiler data.

Total # of stations: 41
 # Of vertical CTD/Profiler casts: 5
 # Of double oblique Profiler casts: 40
 # Salinity samples: 5
Salt correction: +0.0032

Special Note: Primary hydrographic data on this cruise was collected using a Neil brown Mark V CTD.

****

Vessel: R/V Albatross IV **Cruise:** 9708

Program: Marine Mammal Survey
Dates: 7 - 14 July
Sea Days: 8
Instrument(s): Profiler 1495

Cruise Objectives: To (1) collect marine mammal biopsy samples; (2) conduct marine mammal

photographic and video identification methodology studies; (3) conduct line transect sampling to determine cetacean density in study sites.

Total # of stations: 31
 # Of vertical CTD/Profiler casts: 9
 # Of double oblique Profiler casts: 0
 # Salinity samples: 9
Salt correction: +0.0046

****

Vessel: R/V Delaware II **Cruise:** 9708

Program: Bio Acoustic Survey
Dates: 02 - 08 August
Sea Days: 7
Instrument(s): Profiler 2277

Cruise Objectives: To (1) test and evaluate a recently purchased mid water trawl; (2) tune the mid water trawl performance using new trawl monitoring systems; (3) provide training for officers, crew, and scientists in mid water trawling operations; (4) modify and evaluate new Furuno omni-directional scanning sonar for quantitative fish survey applications; (5) obtain training on soar operations for survey near surface herring; (6) locate herring aggregations for an in-situ TS experiment; (7) calibrate the 12 kHz single-beam transducer of the EK - 500; (8) conduct EK - 500 noise tests to define optimal survey speeds and potential acoustical interference; (9) continue the pelagic fish survey operations using sonar, echo-integration, and mid water trawling to locate herring aggregations in srudy area; (10) conduct an in-situ multifrequency TS experiment using the EK - 500 echo-integrator, mid water trawling, Methot sampler, CTD, and underwater camera to receive training.

Total # of stations: 13
 # Of vertical CTD/Profiler casts: 13
 # Of double oblique Profiler casts: 0
 # Salinity samples: 0
Salt correction: NA

****

Vessel: Gloria Michelle **Cruise:** 9714

Program: Shrimp Survey
Dates: 31 July - 08 August
Sea Days: 9
Instrument(s): XBT

Cruise Objectives: To (1)determine the seasonal distribution and relative abundance of Northern shrimp found in the Gulf of Maine; (2) collect biological specimens and data relating to the age and size composition of Gulf of Maine Northern shrimp stock.

Total # of stations: 55
 # Of vertical CTD/Profiler casts: 0
 # Of double oblique Profiler casts: 0
 # Salinity samples: 0
Salt correction: NA

****

Vessel: R/V Delaware II **Cruise:** 9706

Program: Clam / Gear Cruise
Dates: 18 May - 08 June
Sea Days: 8
Instrument(s): Profiler 2277

Cruise Objectives: To (1) determine the most efficient and safe dredge and catch handling procedures considering the new deck machinery arrangement; (2) train crew and scientists in these procedures; (3) test the effect of scope and velocity on catch per tow; (4) estimate efficiency of the dredge.

Total # of stations: 18
 # Of vertical CTD/Profiler casts: 8
 # Of double oblique Profiler casts: 0
 # Salinity samples: 9

Salt correction: NA

Special Note: See note for cruise DEL9707.

****

Vessel: R/V Delaware II	**Cruise:** 9707

Program: Clam Survey
Dates: 09 June - 14 July
Sea Days: 29
Instrument(s): Profiler 2277

Cruise Objectives: To (1) investigate the distribution and relative abundance of the surf clam (*Spisula solidissima*), ocean quahog *(Arctica islandica),* and other mollusks; (2) collect biological samples and data relative to assessment needs; (3) monitor hydrographic and meteorological condition; (4) make collections for interested scientists from other instituions and NMFS laboratories..

Total # of stations: 32
 # Of vertical CTD/Profiler casts: 15
 # Of double oblique Profiler casts: 0
 # Salinity samples: 16
Salt correction: NA

Special Note: The salt samples were mixed and some were accidentally discarded during the previous gear cruise and the clam survey. There were no corrections applied to DEL9706 and DEL9707.

****

Vessel: Abel J	**Cruise:** 9701

Program: Marine Mammal Survey
Dates: 22 August - 05 September
Sea Days: 15
Instrument(s): Profiler 0851

Cruise Objectives: To (1)determine the spatial distribution and relative abundance of all marine mammals that inhabit the sea mount habitat; (2) obtain biopsy samples of marine mammals, in particular strategic species, to determine stock structure relationship between animals taken in coastal fisheries and those in the sea mount region.

Total # of stations: 20
 # Of vertical CTD/Profiler casts: 20
 # Of double oblique Profiler casts: 0
 # Salinity samples: 0
Salt correction: NA

Special Note: No salt calibration samples were taken during this cruise.

****

Vessel: R/V Albatross IV **Cruise:** 9709

Program: Scallop Survey
Dates: 22 July - 17 August
Sea Days: 22
Instrument(s): Profilers 1495, 1496

Cruise Objectives: To (1) determine the distribution and relative abundance of the sea scallop (*Placopecten magellanicus*) and Iceland scallop (*Chlamys islandica*); (2) collect biological samples and data relative to assessment needs; (3) monitor hydrograpic and meteorological conditions; and (4) make collections for interested scientists at other institutions and laboratoiries.

Total # of stations: 487
 # Of vertical CTD/Profiler casts: 381
 # Of double oblique Profiler casts: 161
 # Salinity samples: 13 (1496), 29 (1495)
Salt correction: NA / +0.0265

Special Note: Salinity samples from Profiler 1495 were not used because of instrument damage. Conductivity cell on intrument 1496 was broken. Salinity data not available for all stations occupied during the scallop survey because of damage to both CTD units.

****

Vessel: R/V Albatross IV	**Cruise:** 9711

Program: Fall Bottom Trawl Survey
Dates: 09 September - 30 October
Sea Days: 38
Instrument(s): Profiler 2277

Cruise Objectives: To (1)determine the autumn distribution and relative abundance of fish and invertebrate species; (2) collect biological samples for studies of age and growth relationships, fecundity, maturity and food habits; (3) collect hydrographic and meteorological data; (4) make collections of data and samples for cooperative researchers and programs.

Total # of stations: 369
 # Of vertical CTD/Profiler casts: 192
 # Of double oblique Profiler casts: 110
 # Salinity samples: 64
Salt correction: +0.0177

****