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Description of the 1996 Oceanographic Conditions on the Northeast Continental Shelf

by

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TABLE OF CONTENTS

List of Tables

List of Figures

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Abstract

A summary of hydrographic observations for 22 surveys on the northeast continental shelf during 1996 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).

The 1996 regional distributions show that nearly the entire northeast shelf region experienced fresher surface and bottom salinities relative to the MARMAP reference period. A trend of cooler surface and bottom temperatures was observed during the latter part of the year for the Georges Bank region.

This report is the 5th in a series of yearly compilations of hydrographic data collected on NEFSC cruises (Holzwarth and Taylor 1992-1994, Taylor and Almgren 1996).

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) only occurs during the spring and fall bottom trawl surveys. Station coverage on other cruises throughout the year varies. 1996 marked the second sampling year of the U.S. GLOBEC northwest Atlantic field program. 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 22 NEFSC surveys conducted during 1996 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, and a double oblique tow was made. If no plankton haul was done, the Profiler was deployed vertically down and up through the water column. 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. 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. No salinity correction was applied to the cruise data if the mean salinity offset was less than +/- 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 94. Contour distribution figures were not prepared for some of the cruises because of poor station coverage.

Discussion

The areal average salinity distributions for the five regions of the northeast continental shelf under study reveal that the shelf waters were consistently fresher than the MARMAP reference, with the exception of two cruises in the Gulf of Maine. There were no significant intrusions of Scotian Shelf water observed on Georges Bank during the 1996 GLOBEC field season (January - June), unlike what has been documented in 1992 and 1995. The cause of the fresher conditions on the NE shelf is not evident at this time and may require analysis of river discharge data.

The relatively high variablility observed in the temperature and salinity anomaly distributions for eastern Gulf of Maine region (GLOBEC Broad-Scale surveys and Predator/Prey cruises) are most likely the result of limited station coverage (< 10) in this region and probably are not representative of the region as a whole. Relatively cooler conditions were present in the

Middle Atlantic Bight region throughout much of the year. A trend toward cooler temperatures on Georges Bank was shown toward the latter part of the year.

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

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

Holzwarth-Davis, T.J. and M. H. Taylor. 1992. Description of the 1991 oceanographic conditions on the northeast continental shelf. Woods Hole, MA: Northeast Fisheries Science Center. Reference Document 92-08. Available from: Information Services Section, NMFS/Northeast Fisheries Science Center, Woods Hole, MA; 02543

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Taylor, M. H. and D. W. Almgren. 1996. Description of the 1994 oceanographic conditions on the northeast continental shelf. Woods Hole, MA: Northeast Fisheries Science Center. Reference Document 96-07. Available from: Information Services Section, NMFS/ Northeast Fisheries Science Center, Woods Hole, MA; 02543.

Taylor, M. H. and D. W. Almgren. 1996. Description of the 1995 oceanographic conditions on the northeast continental shelf. Woods Hole, MA: Northeast Fisheries Science Center. Reference Document 96-07. Available from: Information Services Section, NMFS/ Northeast Fisheries Science Center, Woods Hole, MA; 02543.

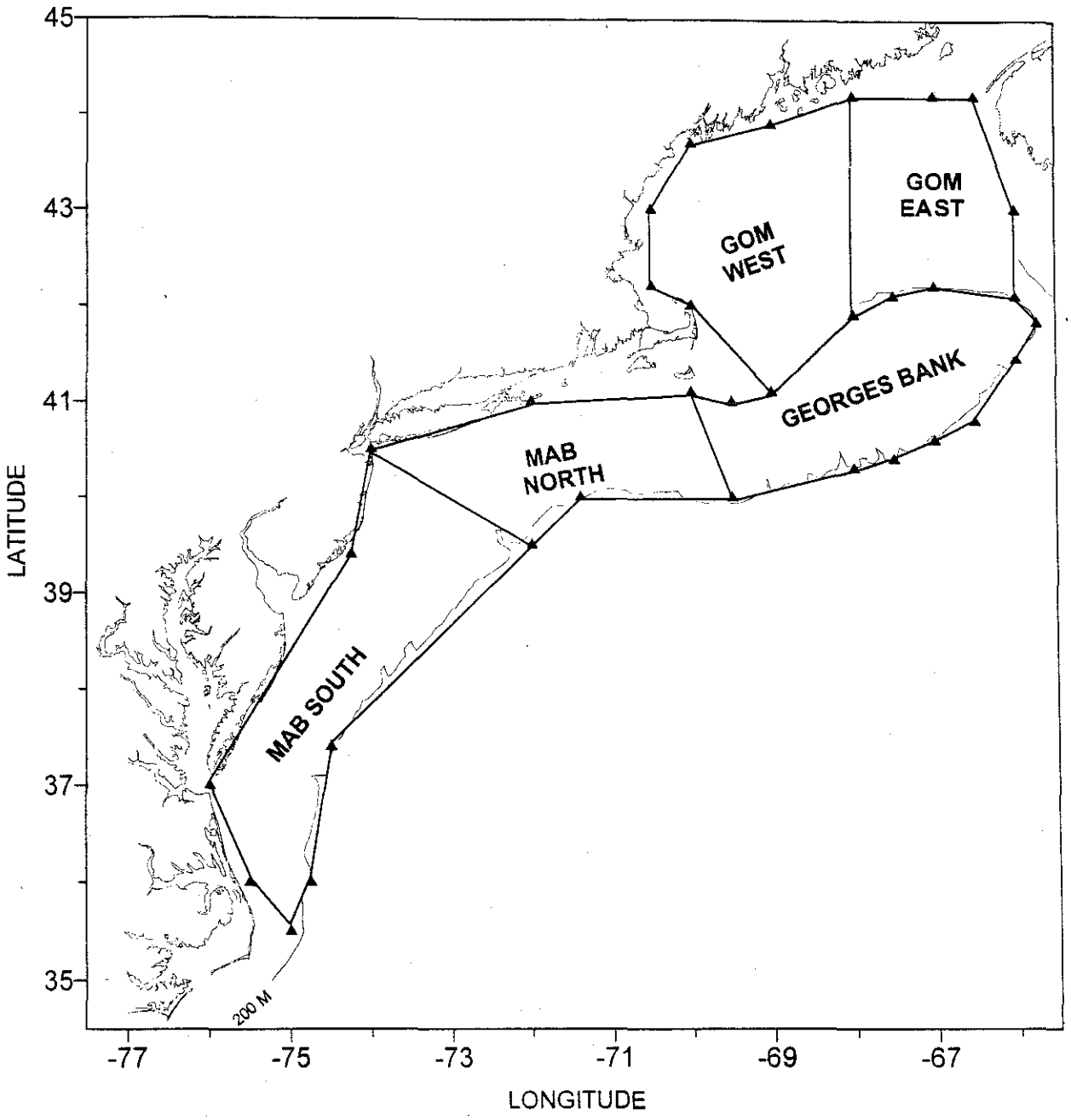


Figure 1. The regions of the northeast continental shelf covered by the Northeast Fisheries Science Center cruises during 1996.

Table 1. Summary of 1996 Cruises.

Cruise	Program	Dates	Region(s) [1]
END9676	GLOBEC Broad Scale Survey #1	12-22 January	GB
ALB9601	Coastal Monitoring	23-26 January	R.I. Sound
ALB9602	Coastal Monitoring	30 - 31 January	R.I. Sound
ALB9603	Winter Bottom Trawl Survey	6 - 28 February	MAB, GB
END9678	GLOBEC Broad Scale Survey #2	14-24 February	GB
OCE9675	GLOBEC Broad Scale Survey #3	12-22 March	GB
END9682	GLOBEC Broad Scale Survey #4	8-20 April	GB
ALB9604	Spring Bottom Trawl Survey	6 March - 29 April	MAB, GB, GOB
ALB9605	GLOBEC Process Cruise #5	7 - 16 May	GB
ALB9605	Predator / Prey	21 - 30 May	GB
ALB9607	GLOBEC Broad Scale Survey #6	4 - 12 June	GB
ALB9608	Predator / Prey	18 - 25 June	GB
GLM9611	Shrimp Survey	29 July - 9 August	GOM
AJ9601	Marine Mammal Survey	20-28 June	GB
AJ9602	Marine Mammal Survey	1 - 9 July	GB
AJ9603	Marine Mammal Survey	17 - 29 July	GB
AJ9604	Marine Mammal Survey	8 - 27 August	GOM
IS9601	Marine Mammal Survey	20 - 28 August	GOM
ALB9609	Scallop Survey	31 July - 26 August	MAB, GB
ALB9610	Predator / Prey	29 August - 5 September	GB
ALB9611	Fall Bottom Trawl Survey	10 September - 31 October	MAB, GB, GOM
ALB9612	GLOBEC / Marine Mammal Survey	5 - 13 November	GB, GOM

[1] Regional Abbreviations

GB = Georges Bank
GOM = Gulf of Maine
MAB = Middle Atlantic Bight

Table 2. Areal average surface and bottom temperatures and temperature anomalies for the NEFSC 1996 cruises in the five regions of the northeast continental shelf as shown in Figure 1[1].

CRUISE	CD	SURFACE #Obs	Temp	Anomaly	SDV1	SDV2		BOTTOM #Obs	Temp	Anomaly	SDV1	SDV2	
Gulf of Maine West													
AL9604	96	24	4.45	-.73	.21	.90		20	7.34	.65	.27	1.10	
GM9611	216	44	17.00	.34	.19	1.43	*	44	6.76	1.16	.14	.90	*
AL9611	300	30	11.50	-.99	.24	.55		26	8.24	-.57	.20	1.94	
AL9612	313	19	10.20	.47	.31	.72	*	19	7.71	.88	.31	.61	*
Gulf of Maine East													
EN9676	17	5	6.07	-.09	.35	.29	*	5	6.11	-.17	.37	.52	*
EN9678	50	7	4.02	-.55	.34	1.02	*	6	6.81	1.31	.34	1.31	*
OC9675	76	9	4.15	-.20	.30	.51	*	8	5.93	.90	.31	.79	*
EN9682	104	9	4.23	-.65	.31	.57	*	7	6.01	.28	.30	.68	*
AL9604	112	38	5.08	-.16	.19	.71		38	6.04	1.06	.14	.70	
AL9605	132	12	6.44	-.40	.28	1.10	*	10	6.43	-.31	.28	1.12	*
AL9606	146	4	8.60	1.02	.42	.53	*	4	6.12	-1.24	.42	.41	*
AL9607	159	5	10.42	1.12	.42	1.52	*	4	7.51	-1.07	.41	1.67	*
AL9608	173	5	10.15	.72	.36	.72	*	5	6.38	-1.99	.36	1.46	*
AL9611	286	40	11.41	-.46	.19	.93		40	7.93	.61	.13	1.30	
AL9612	310	3	10.51	-.83	.57	.79	*	3	9.01	-.25	.54	1.87	*
Georges Bank													
EN9676	17	58	6.11	-.66	.20	1.31		52	6.22	-1.02	.22	1.06	
EN9678	50	63	4.64	-.26	.19	.82		57	4.94	-.46	.21	1.18	
AL9603	56	23	5.16	.03	.33	.44	*	13	5.08	-.99	.45	1.32	*
OC9675	76	67	4.41	.00	.20	.40		63	4.72	-.19	.22	1.19	
EN9682	104	83	4.89	-.16	.16	.48		78	5.17	.02	.18	.55	
AL9604	112	50	5.20	-.25	.18	.53		43	5.36	-.18	.22	.75	
AL9605	132	118	6.79	-.16	.15	.74		107	6.32	-.01	.16	.71	
AL9606	146	77	8.23	-.11	.17	.67		74	6.97	-.26	.20	.71	
AL9607	159	34	9.30	-.30	.28	1.48		33	7.79	-.20	.31	1.02	
AL9608	173	61	11.47	.13	.17	1.07		57	8.29	-.68	.21	1.02	
AL9609	233	162	15.78	-.23	.13	1.42		159	9.95	-1.33	.15	2.30	
AL9610	245	46	14.95	-1.20	.20	1.17		44	12.20	-1.30	.15	1.73	*
AL9611	286	72	13.00	-1.90	.17	1.06		65	10.56	-2.05	.21	1.83	
AL9612	313	7	10.91	-1.54	.41	.32	*	7	10.08	-1.00	.40	1.66	*
MAB North													
AL9603	42	32	4.58	-.41	.30	.91		27	5.09	-.70	.37	1.17	
AL9604	84	59	4.51	-.29	.28	.66		54	4.43	-.57	.33	.99	
AL9609	216	73	20.35	-.11	.17	1.40	*	73	7.97	-.68	.17	1.10	*
AL9611	271	58	15.80	-2.08	.27	1.67		49	11.74	-.86	.35	2.63	

MAB South

AL9603	42	68	5.38	-1.09	.26	1.77	60	6.63	.00	.29	1.82
AL9604	70	109	5.86	-.34	.22	1.29	100	6.20	.14	.25	1.25
AL9609	216	132	21.83	-2.14	.15	1.18 *	132	6.51	-1.17	.17	.99*
AL9611	258	85	21.92	.15	.23	1.57	75	13.80	-.53	.29	3.17

[1] "Cruise", the code name for a cruise: "CD", the calendar mid-date 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 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.

Table 3. Areal average surface and bottom salinity and salinity anomalies for the NEFSC 1996 cruises in the five regions of the northeast continental shelf as shown in Figure 1[1].

CRUISE	CD	SURFACE #Obs	Salt	Anomaly	SDV1	SDV2		BOTTOM #Obs	Salt	Anomaly	SDV1	SDV2	
Gulf of Maine West													
AL9604	96	24	32.02	-.46	.11	.20		24	33.96	-.09	.07	.52	
AL9611	300	30	31.77	-.77	.13	.31		30	34.21	.15	.08	.36	
AL9612	313	19	31.69	-.90	.13	.27	*	19	33.45	-.10	.07	.26	*
Gulf of Maine East													
EN9676	17	5	32.86	-.13	.13	.10	*	5	32.89	-.06	.11	.10	*
EN9678	50	7	32.27	-.63	.14	.47	*	7	33.83	.08	.11	.74	*
OC9675	76	9	32.37	-.58	.12	.24	*	9	33.50	-.12	.10	.58	*
EN9682	104	9	32.29	-.51	.13	.24	*	9	33.34	-.55	.08	.71	*
AL9604	112	38	31.84	-.58	.08	.50		38	33.17	-.21	.05	.34	
AL9605	132	12	32.08	-.63	.12	.29	*	12	33.42	-.59	.09	.68	*
AL9606	146	4	32.17	-.70	.15	.07	*	4	32.58	-.40	.13	.28	*
AL9607	159	5	31.87	-.78	.17	.43	*	5	33.45	-.23	.12	.34	*
AL9608	173	4	32.08	-.65	.15	.12	*	4	32.62	-.31	.12	.39	*
AL9611	286	40	31.87	-.69	.08	.25		40	33.45	-.12	.06	.45	
AL9612	313	3	32.03	-.62	.23	.06	*	3	33.97	-.11	.16	.17	*
Georges Bank													
EN9676	17	54	32.87	.00	.07	.42		48	32.90	-.13	.08	.22	
EN9678	50	63	32.73	-.19	.07	.41		57	32.87	-.24	.07	.38	
AL9603	56	23	32.83	-.12	.11	.16	*	13	32.89	-.49	.16	.34	*
OC9675	76	65	32.63	-.30	.07	.27		61	32.77	-.39	.08	.43	
EN9682	104	83	32.52	-.40	.05	.20		78	32.70	-.41	.06	.35	
AL9604	112	50	32.52	-.37	.07	.21		44	32.70	-.43	.08	.31	
AL9605	132	117	32.44	-.42	.05	.21		106	32.58	-.52	.06	.36	
AL9606	146	77	32.36	-.46	.06	.15		74	32.50	-.52	.08	.21	
AL9607	159	33	32.27	-.49	.09	.33		32	32.52	-.51	.10	.31	
AL9608	173	60	32.06	-.70	.07	.33		56	32.47	-.51	.07	.25	
AL9609	233	162	31.80	-.88	.05	.34		159	32.43	-.58	.05	.33	
AL9610	245	46	31.92	-.75	.07	.26		45	32.34	-.57	.09	.35	
AL9611	300	72	31.97	-.78	.07	.33		65	32.44	-.54	.07	.38	
AL9612	313	7	31.87	-.84	.13	.25	*	7	32.22	-.54	.11	.19	*
MAB North													
AL9603	42	31	32.76	-.29	.14	.43		26	32.99	-.55	.13	.38	
AL9604	84	59	32.25	-.52	.13	.42		54	32.45	-.79	.11	.50	
AL9609	216	72	30.92	-.90	.08	.56	*	72	32.29	-.66	.06	.21	*
AL9611	271	56	31.76	-.98	.12	.51		48	32.38	-1.06	.12	.49	

MAB South

AL9603	42	68	32.82	-.89	.14	.77		60	33.59	-.20	.11	.61
AL9604	70	106	32.88	-.25	.12	.89		97	33.17	-.34	.09	.65
AL9609	216	129	30.64	-1.24	.07	.40	*	129	32.48	-.79	.06	.40*
AL9611	258	85	30.69	-1.51	.13	1.38		75	31.82	-1.35	.10	.69

[1] "Cruise", the code name for a cruise: "CD", the calendar mid-date 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 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.

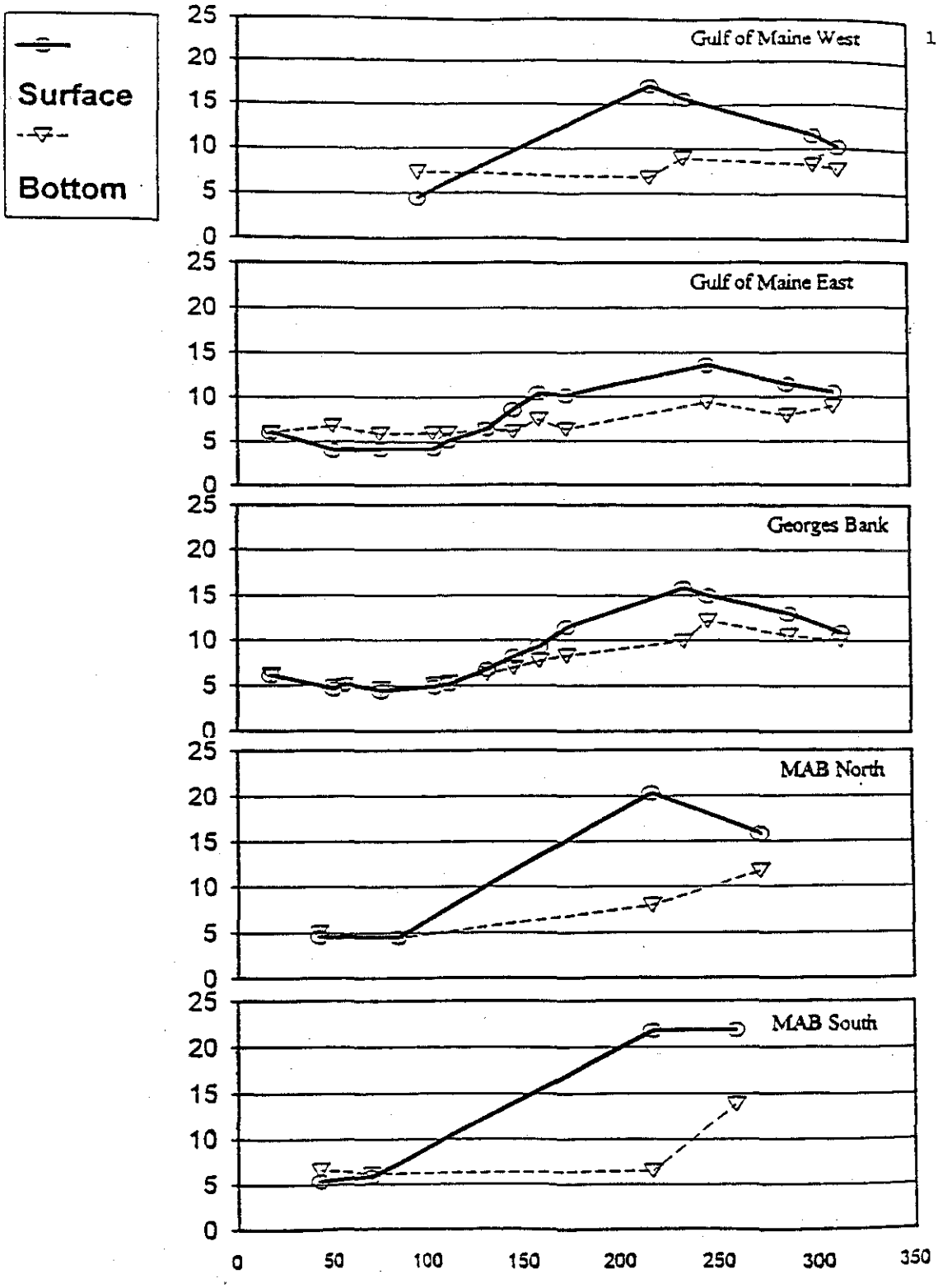


Figure 2. The 1996 areal average surface and bottom temperature values from Table 2

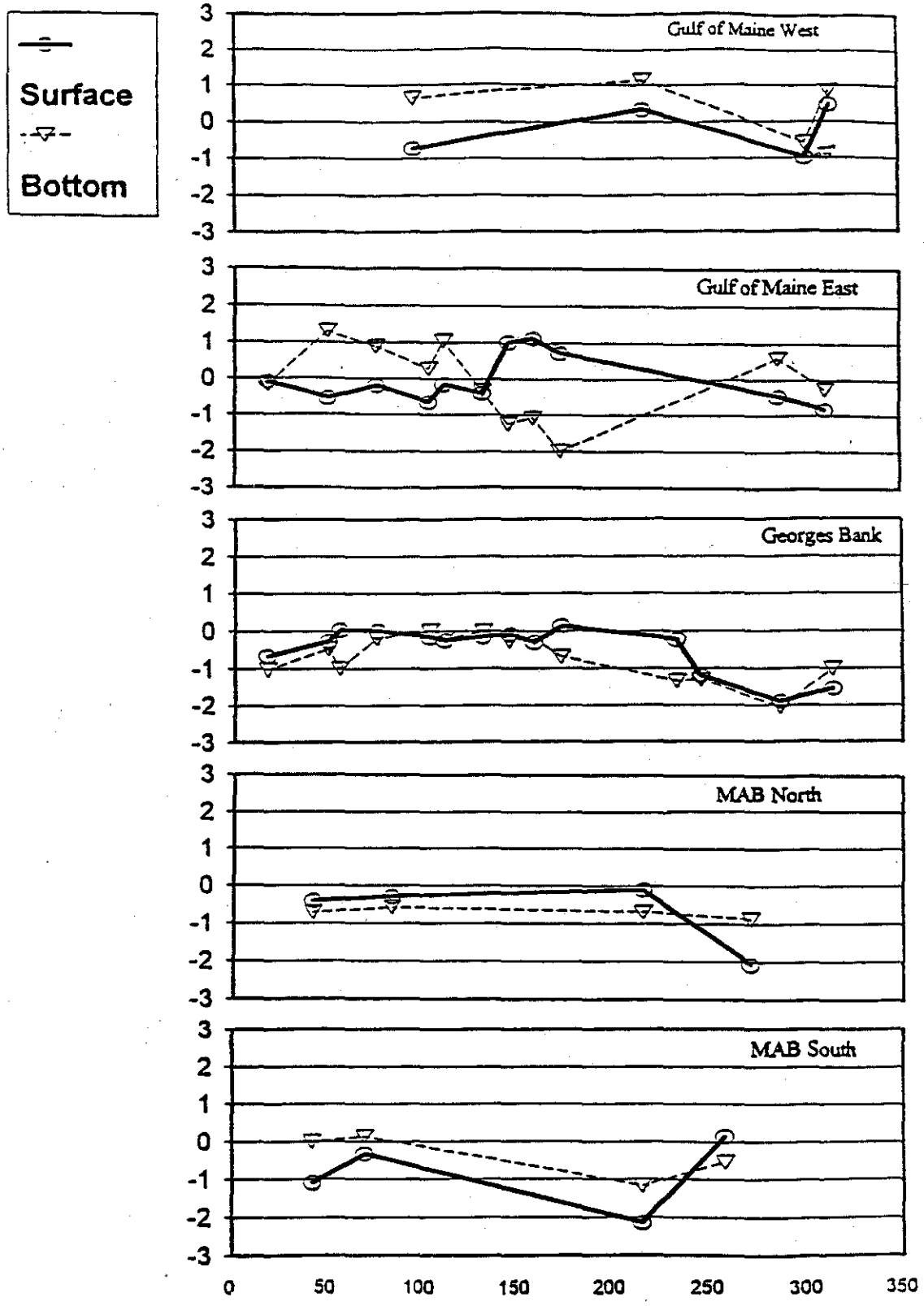


Figure 3. The 1996 areal average surface and bottom temperature anomalies from Table 2

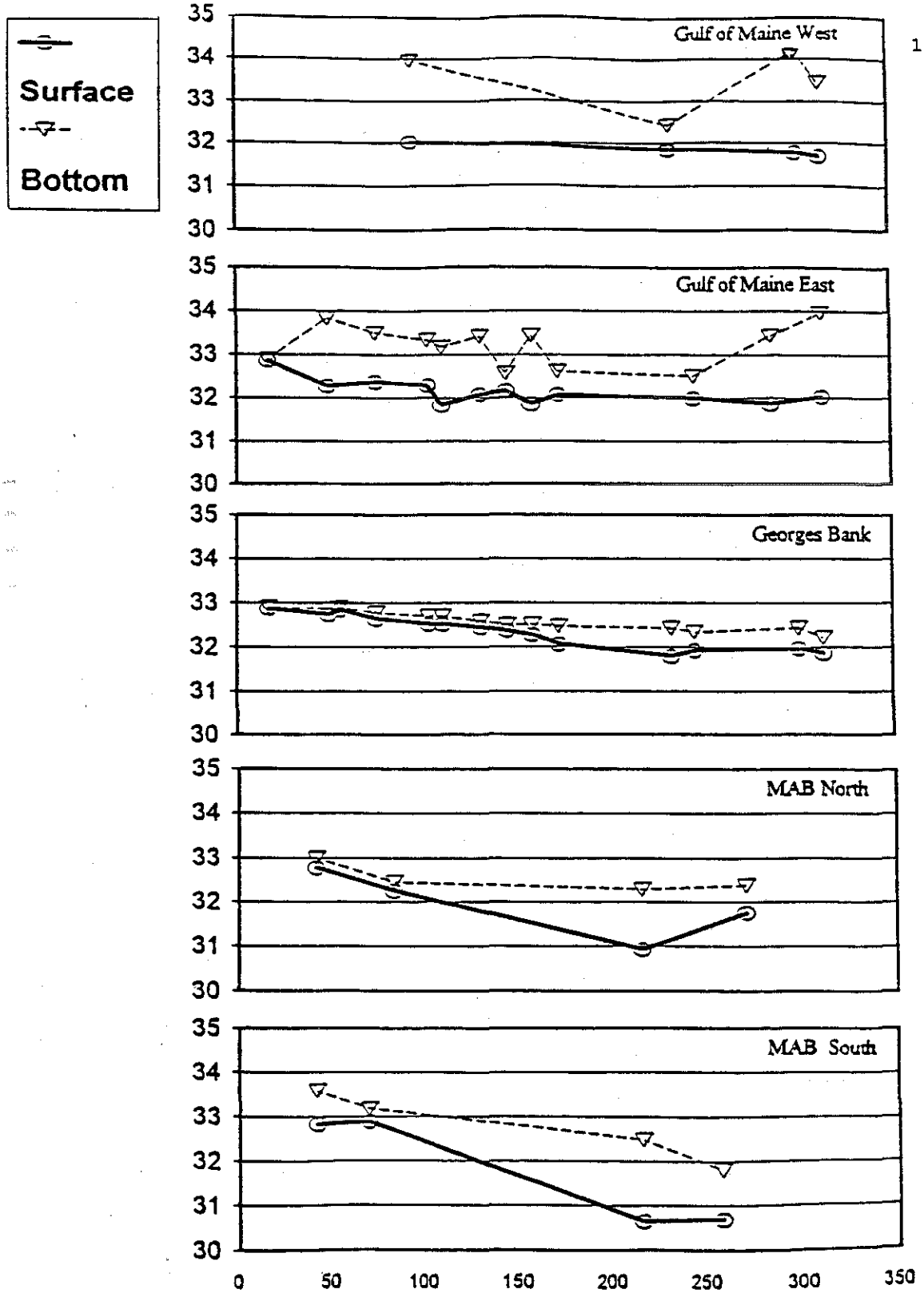


Figure 4. The 1996 areal average surface and bottom salinity values from Table 3.

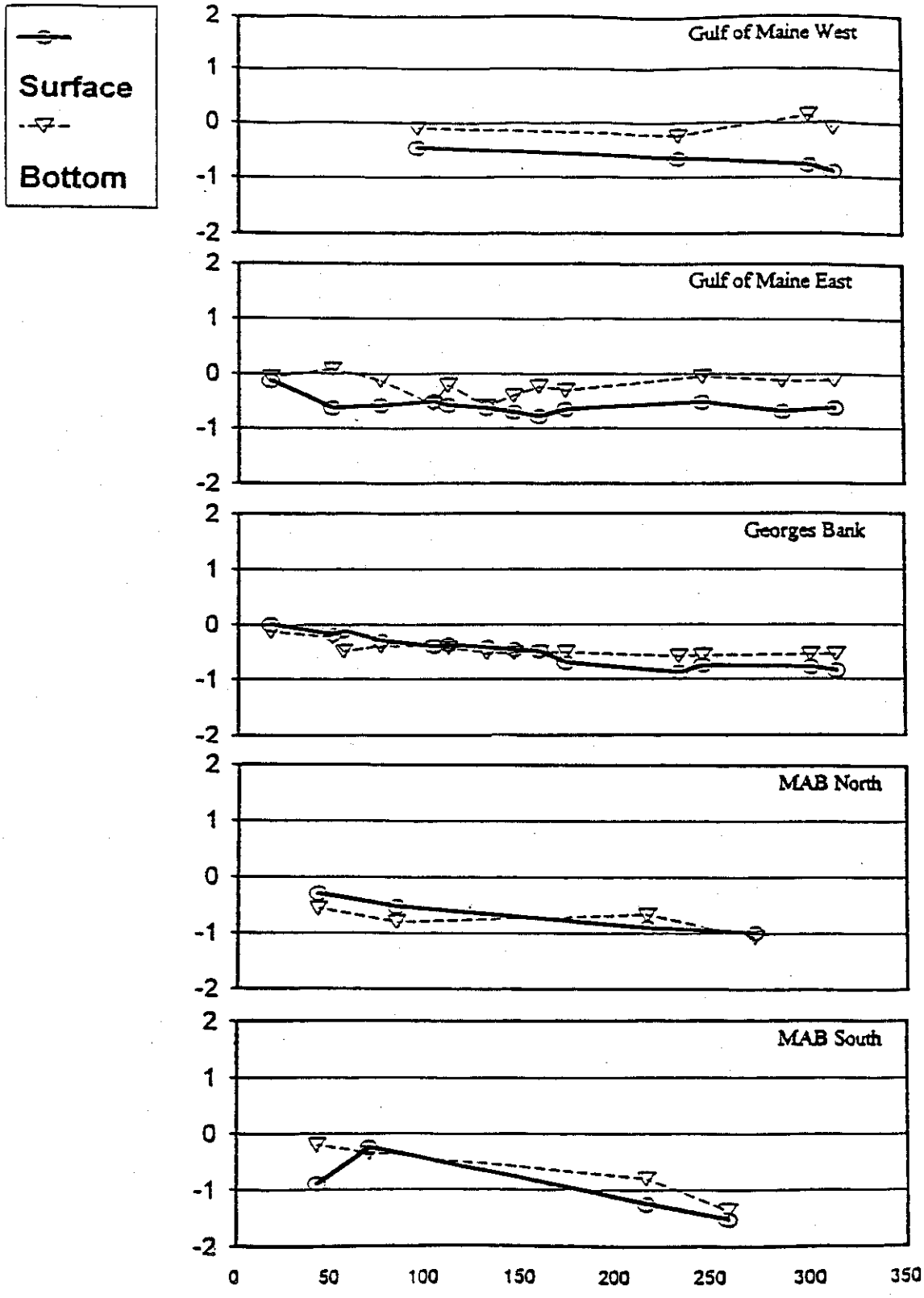


Figure 5. The 1996 areal average surface and bottom salinity anomalies from Table 3.

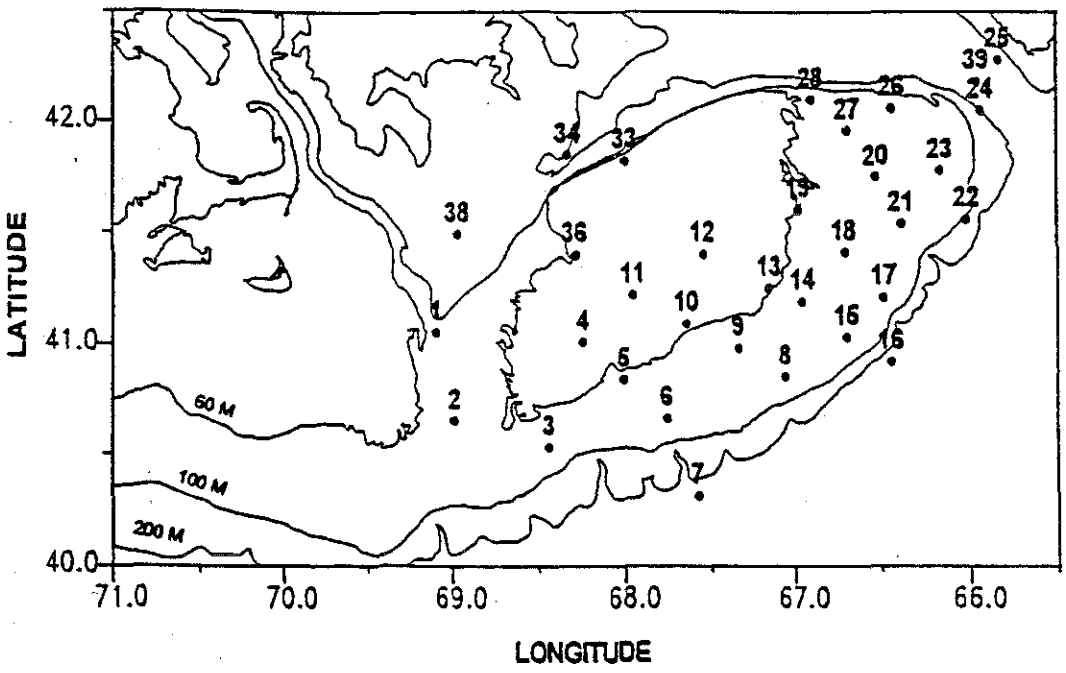


Figure 6. Hydrographic stations occupied during the GLOBEC broadscale survey END9676.

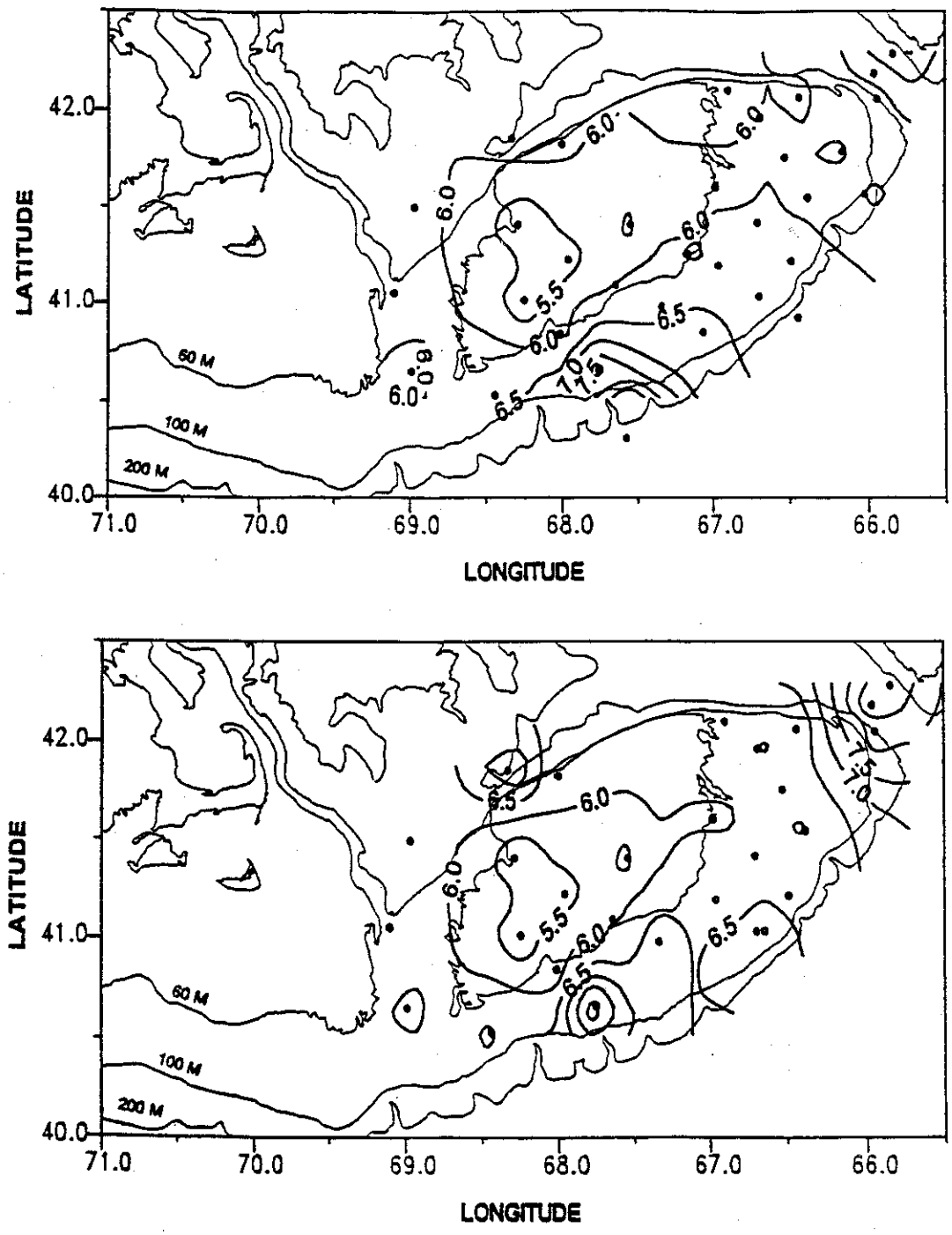


Figure 7. The surface and bottom temperature distribution for the GLOBEC broadscale survey END9676.

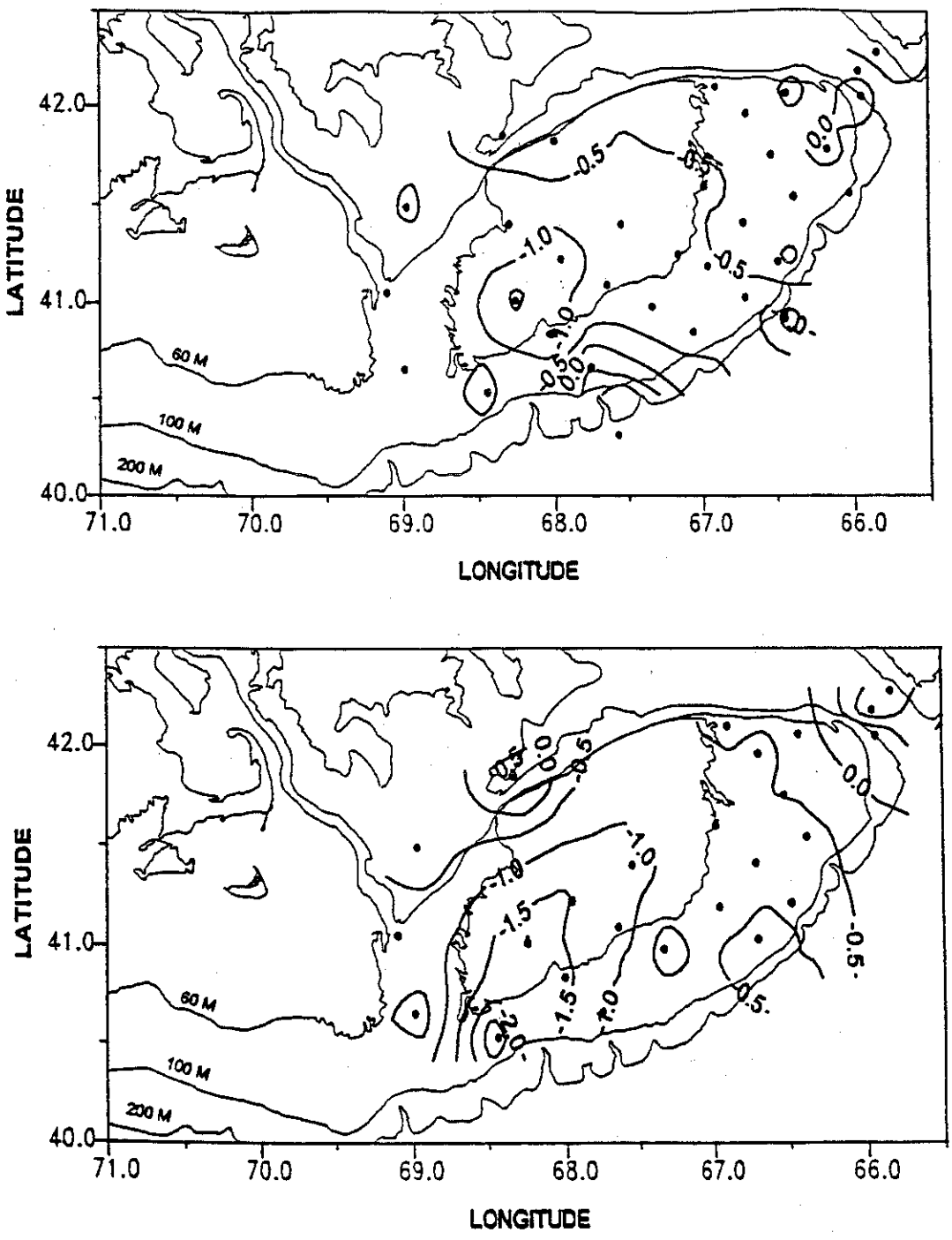


Figure 8. The surface and bottom temperature anomaly distribution for the GLOBEC broadscale survey END9676.

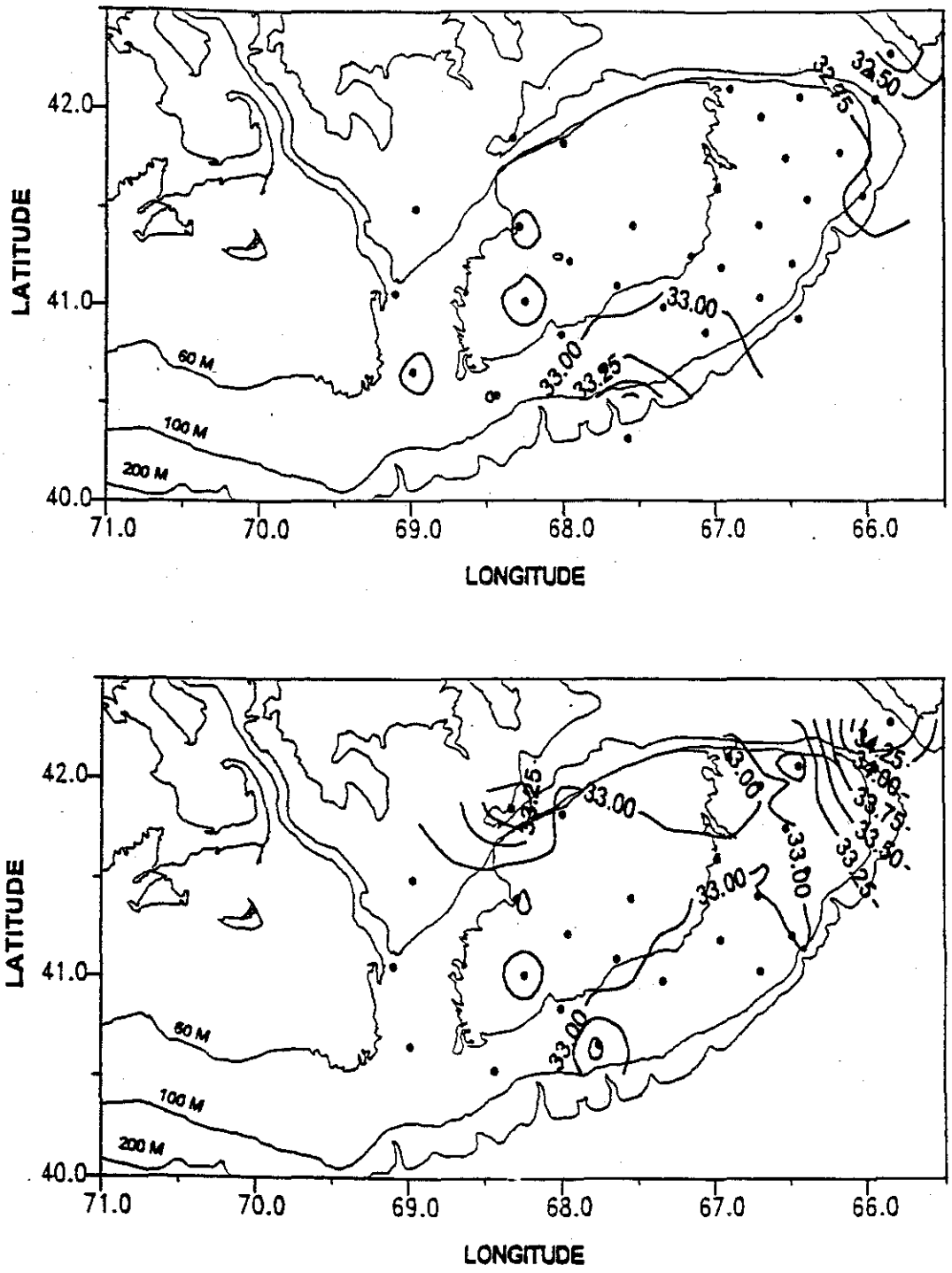


Figure 9. The surface and bottom salinity distribution for the GLOBEC broadscale survey END9676.

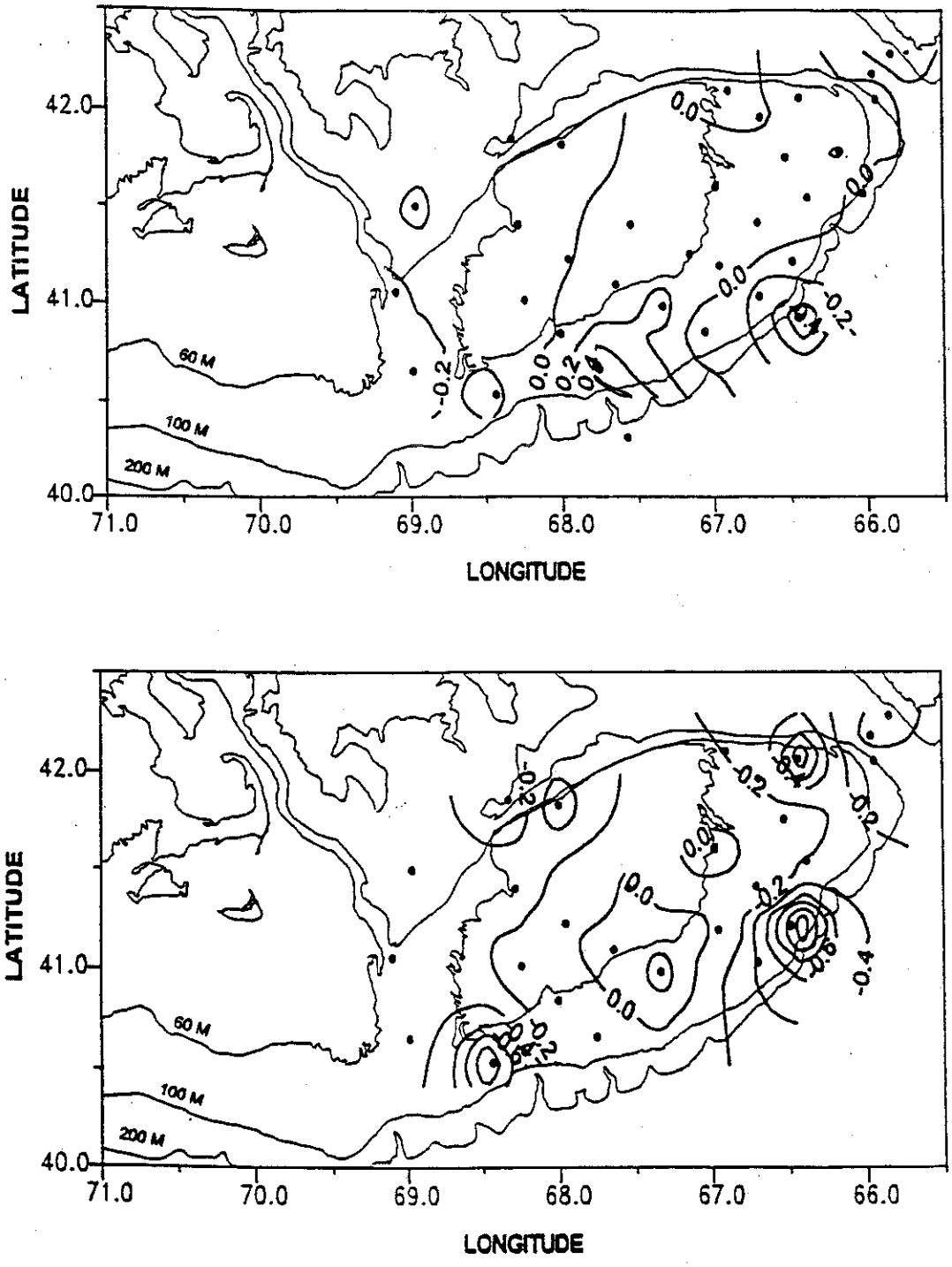


Figure 10. The surface and bottom salinity anomaly distributions for the GLOBEC broadscale survey END9676.

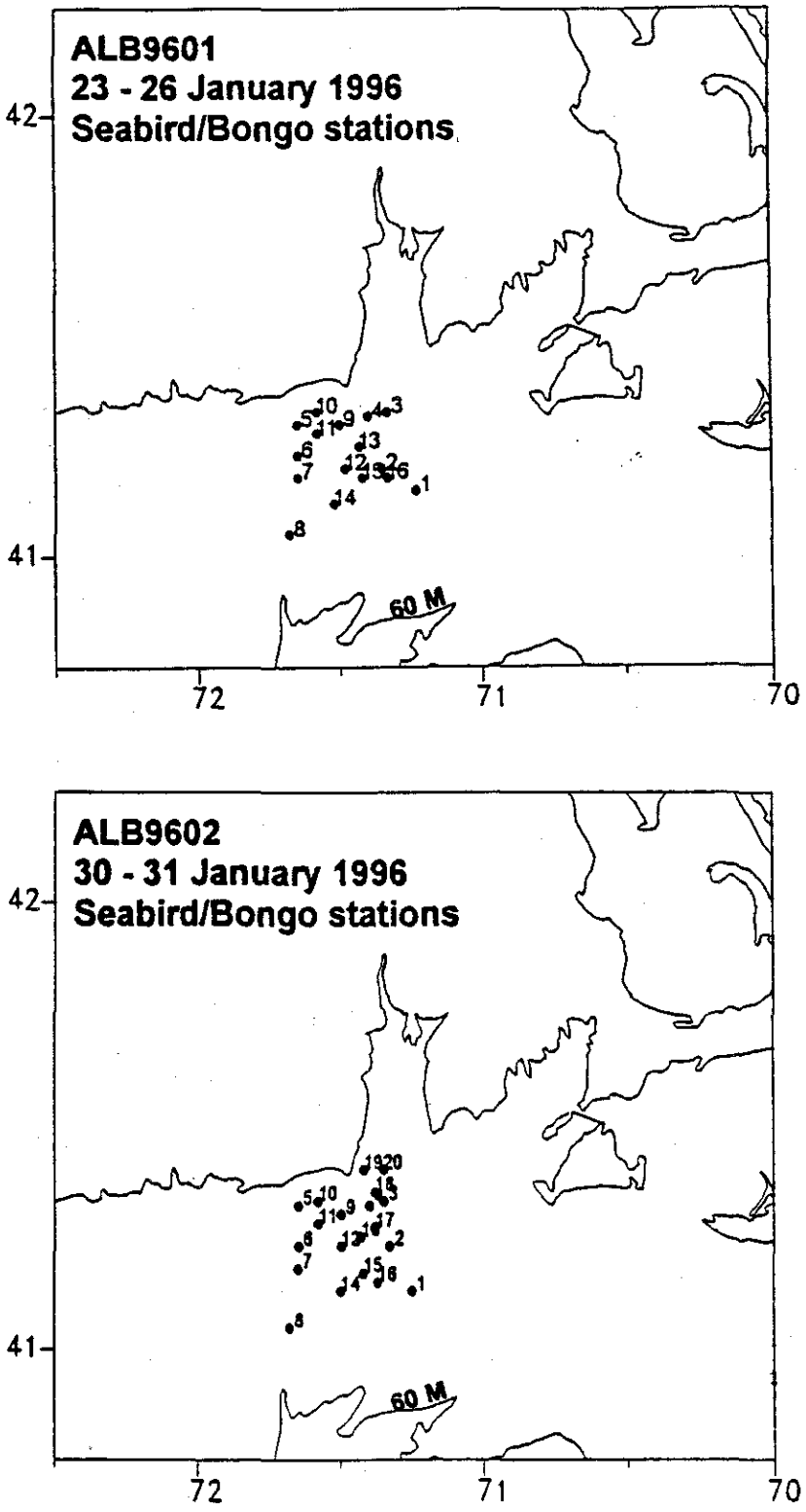


Figure 11. Hydrographic stations occupied during the coastal monitoring cruises ALB9601 and ALB9602.

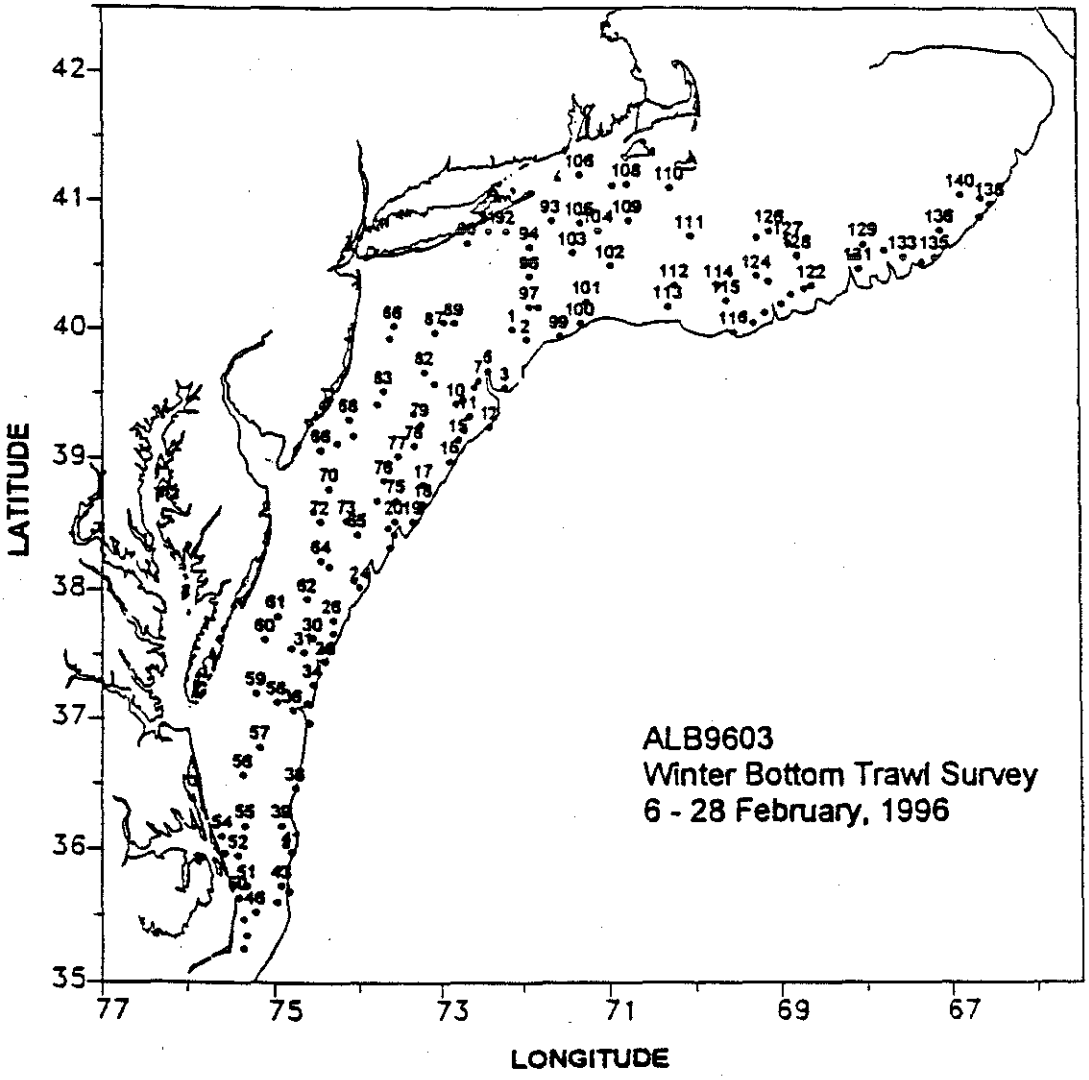


Figure 12. Hydrographic stations occupied during the winter bottom trawl survey ALB9603.

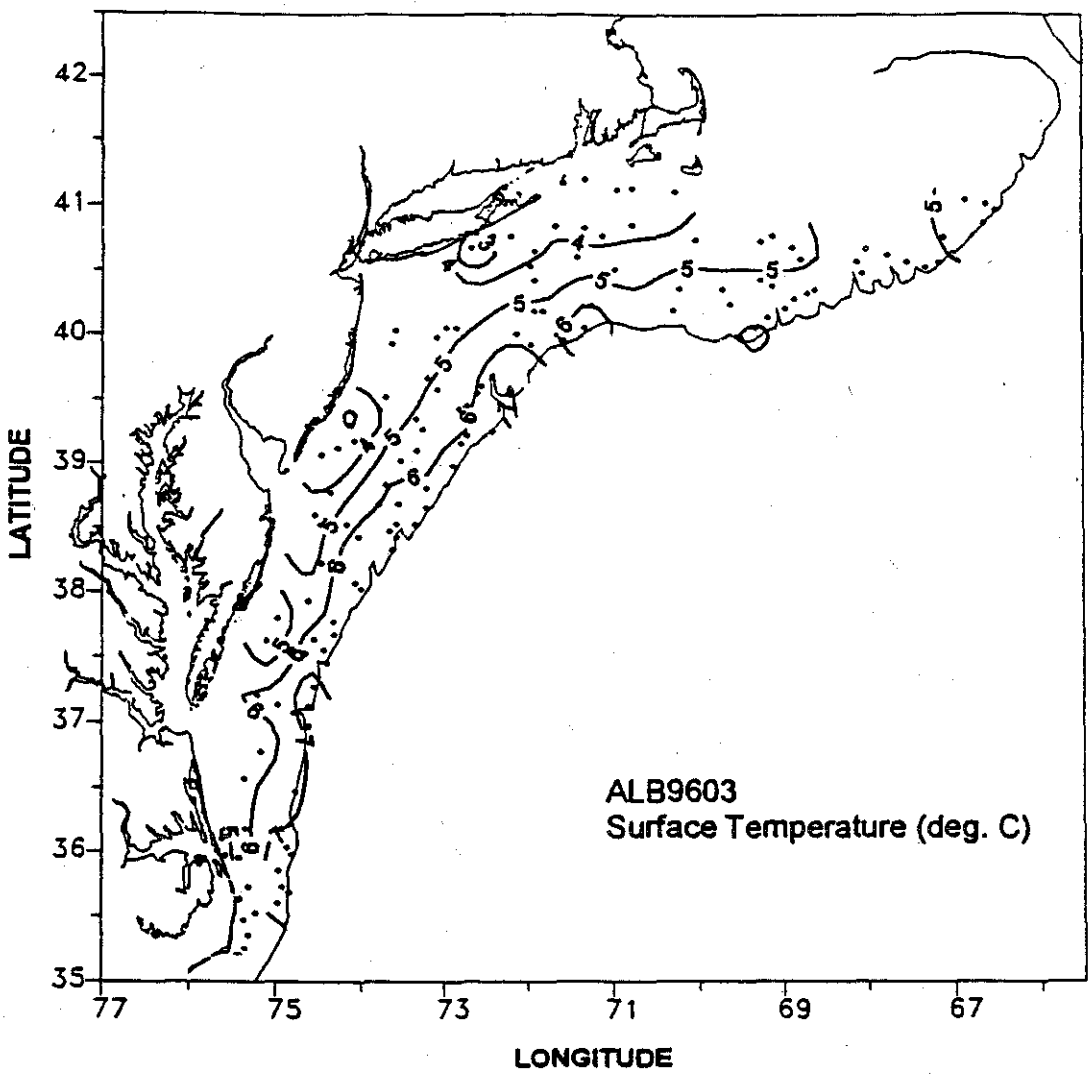


Figure 13. The surface temperature distribution for the winter bottom trawl survey ALB9603.

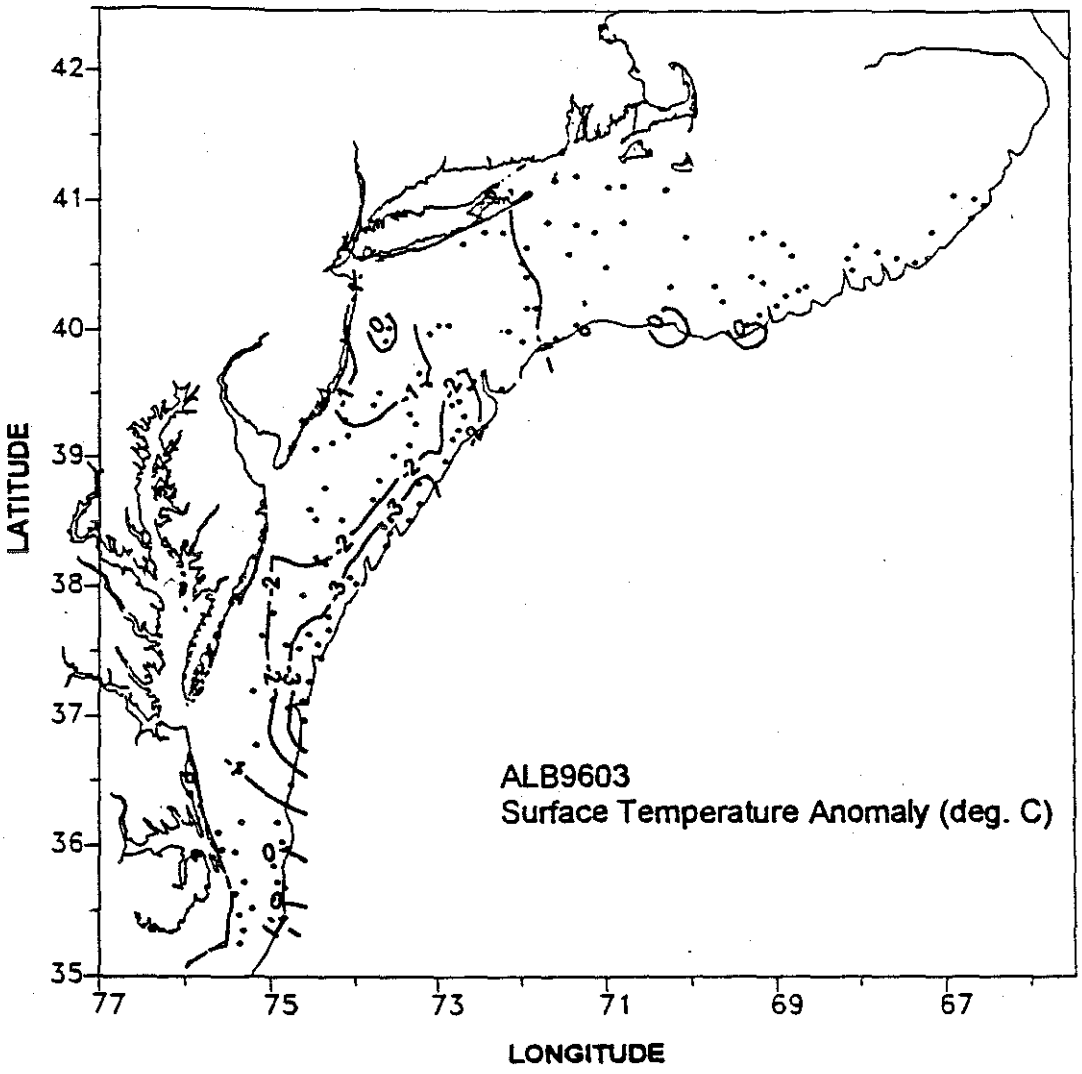


Figure 14. The surface temperature anomaly distribution for the winter bottom trawl survey ALB9603.

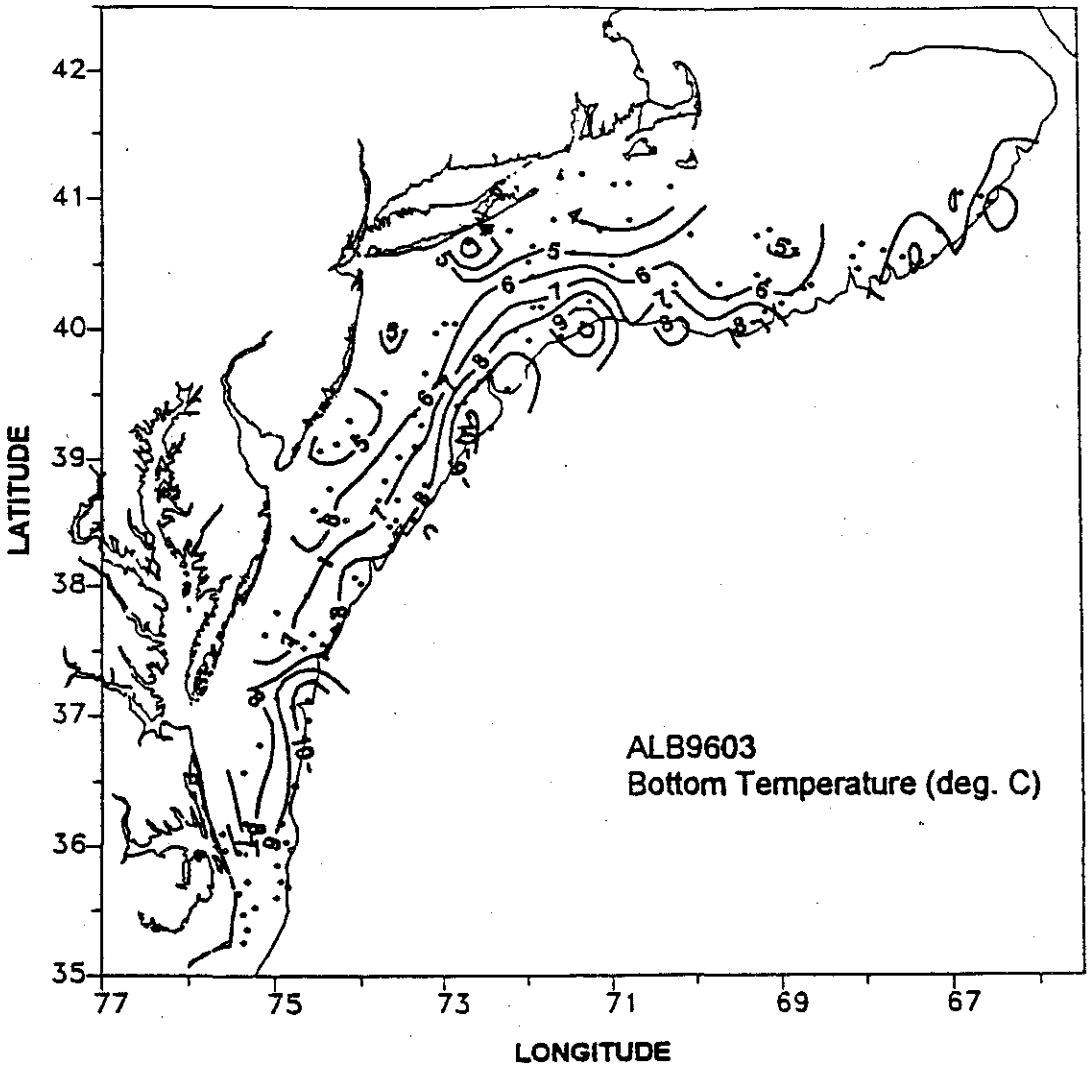


Figure 15. The bottom temperature distribution for the winter bottom trawl survey ALB9603.

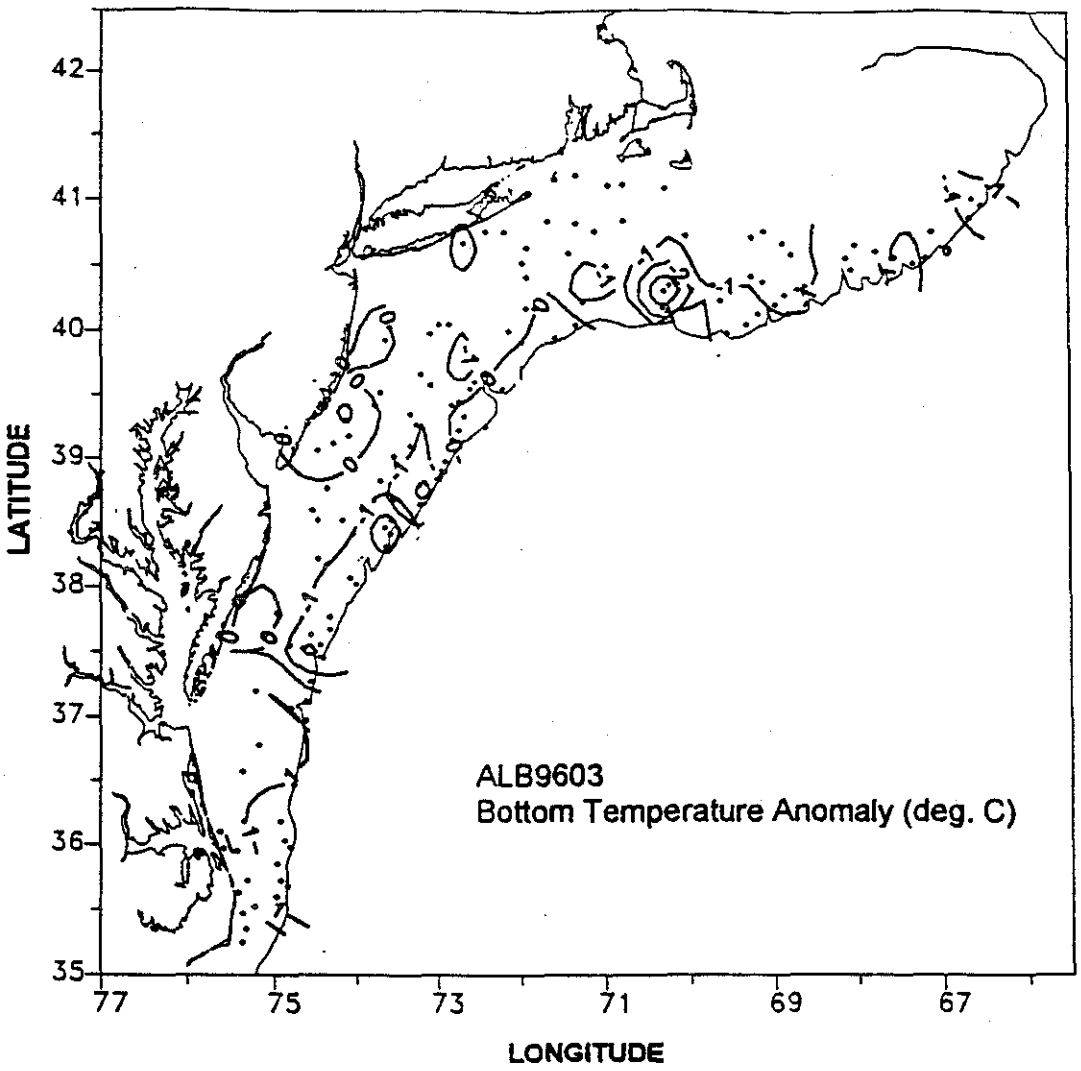


Figure 16. The bottom temperature anomaly distribution for the winter bottom trawl survey ALB9603.

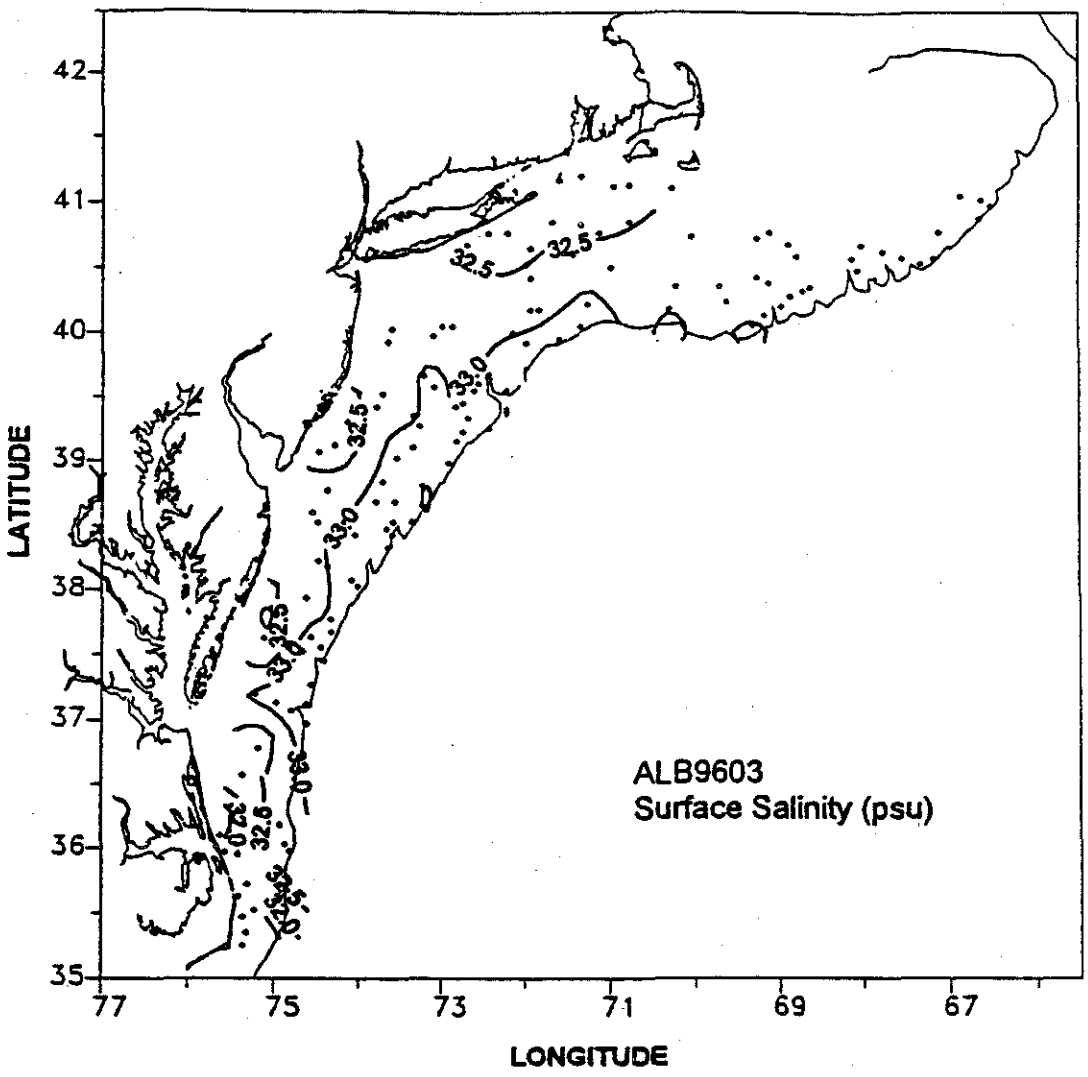


Figure 17. The surface salinity distribution for the winter bottom trawl survey ALB9603.

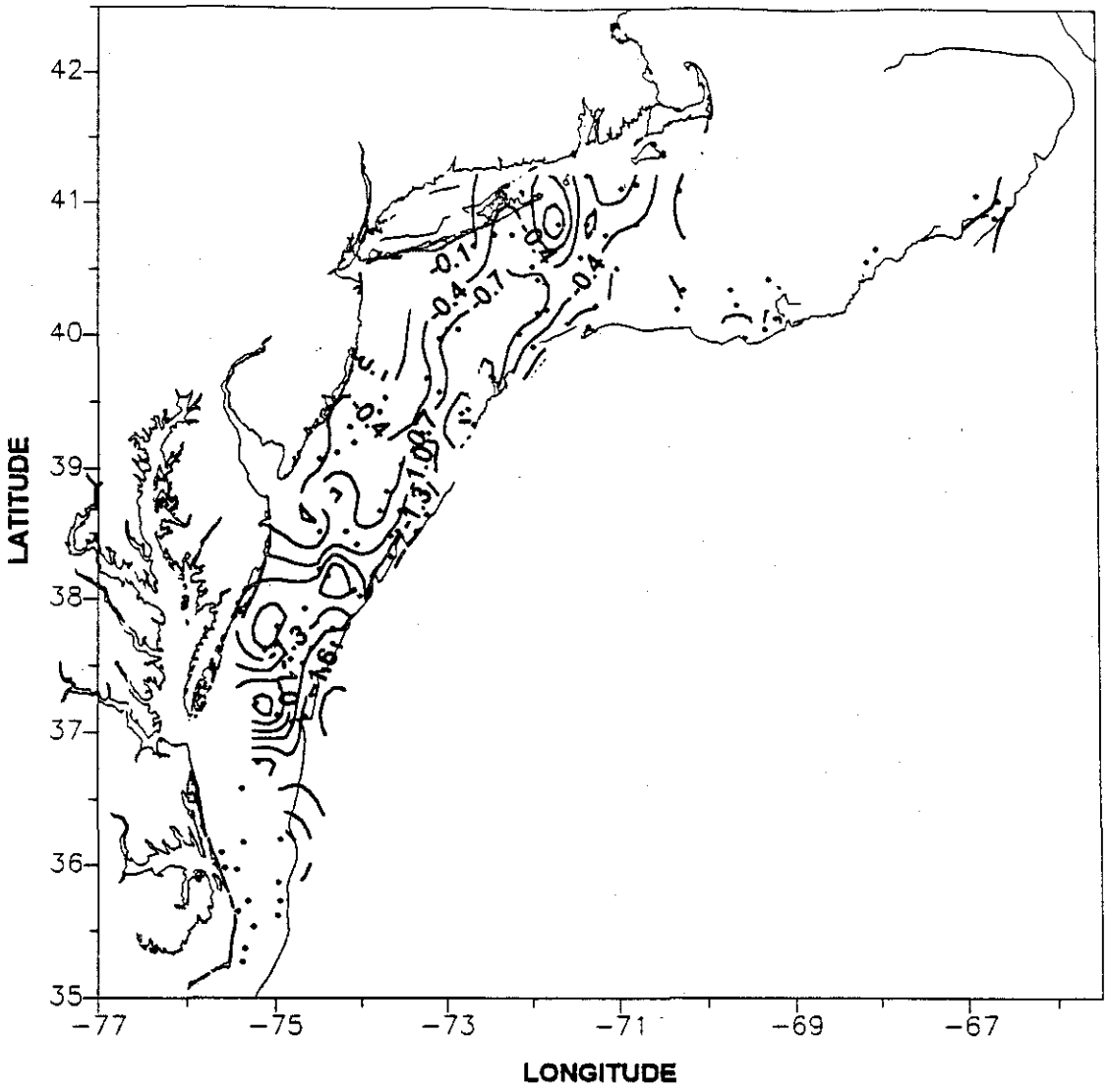


Figure 18. The surface salinity anomaly distribution for the winter bottom trawl survey ALB9603.

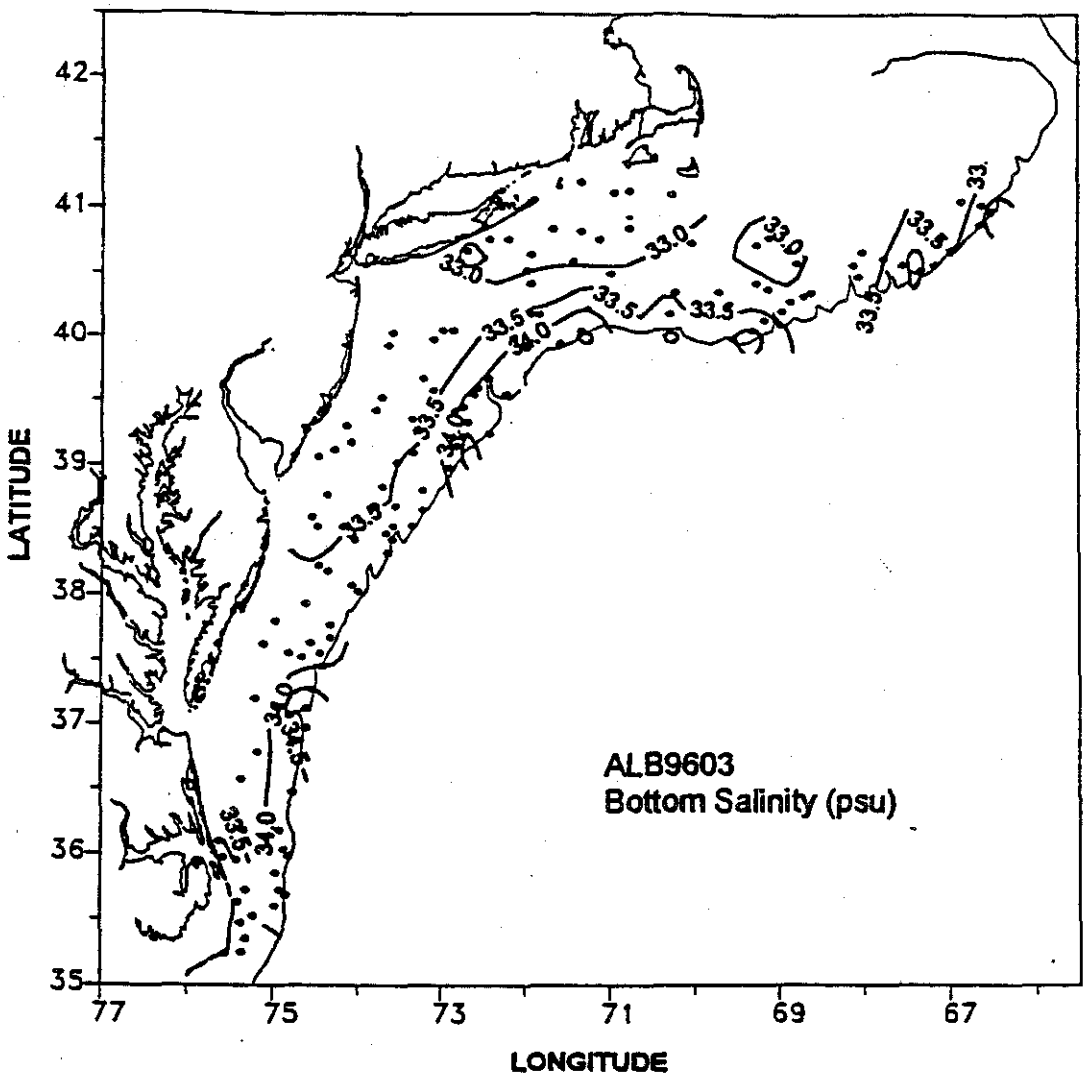


Figure 19. The bottom salinity distribution for the winter bottom trawl survey ALB9603.

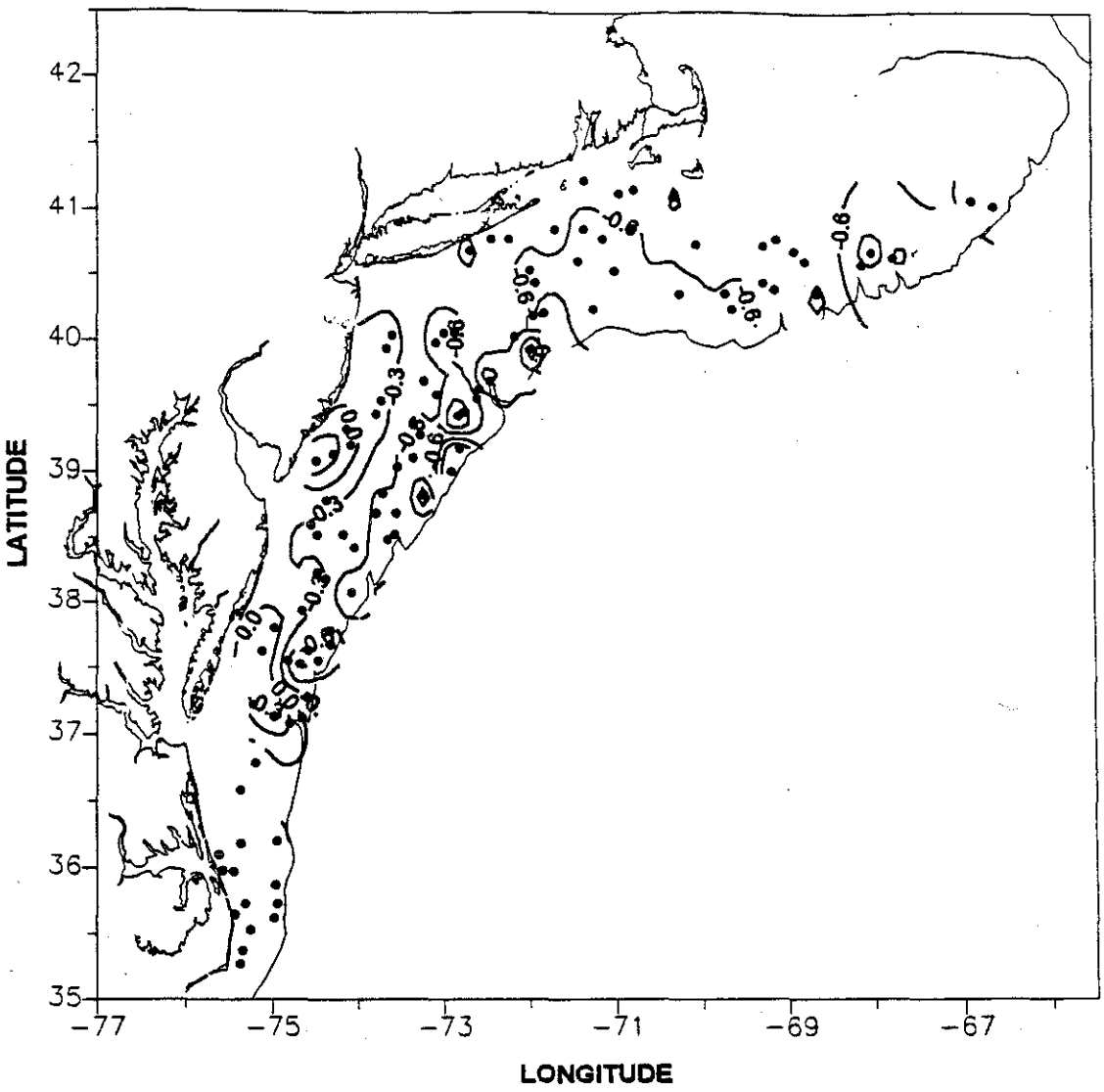


Figure 20. The bottom salinity anomaly distribution for the winter bottom trawl survey ALB9603.

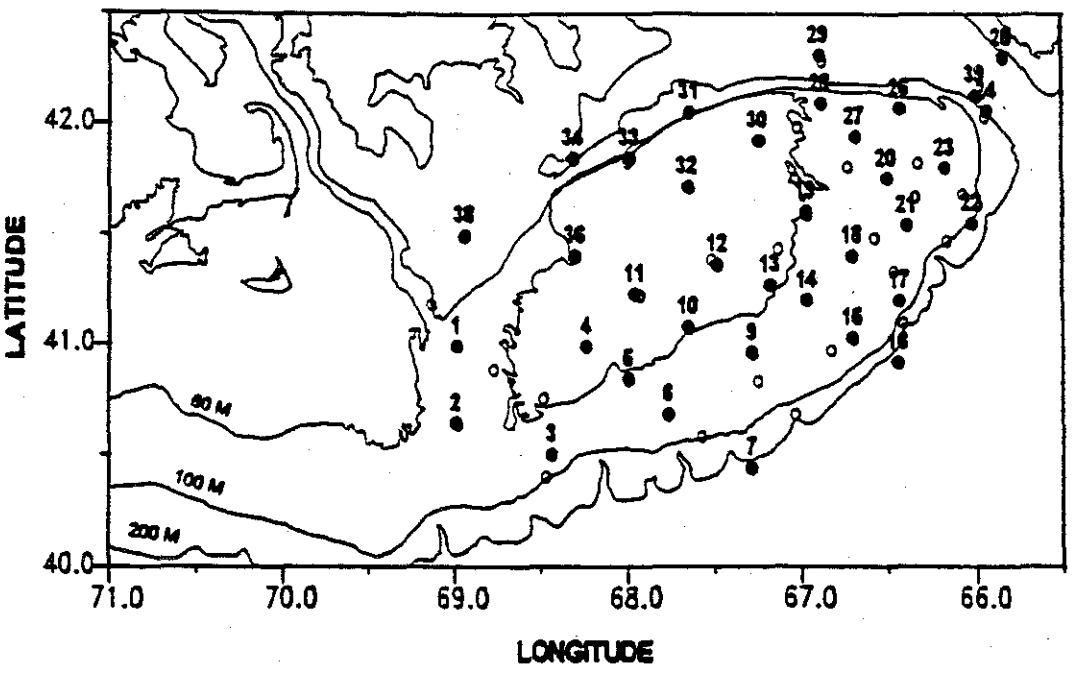


Figure 21. Hydrographic stations occupied durint the GLOBEC broadscale survey END9678.

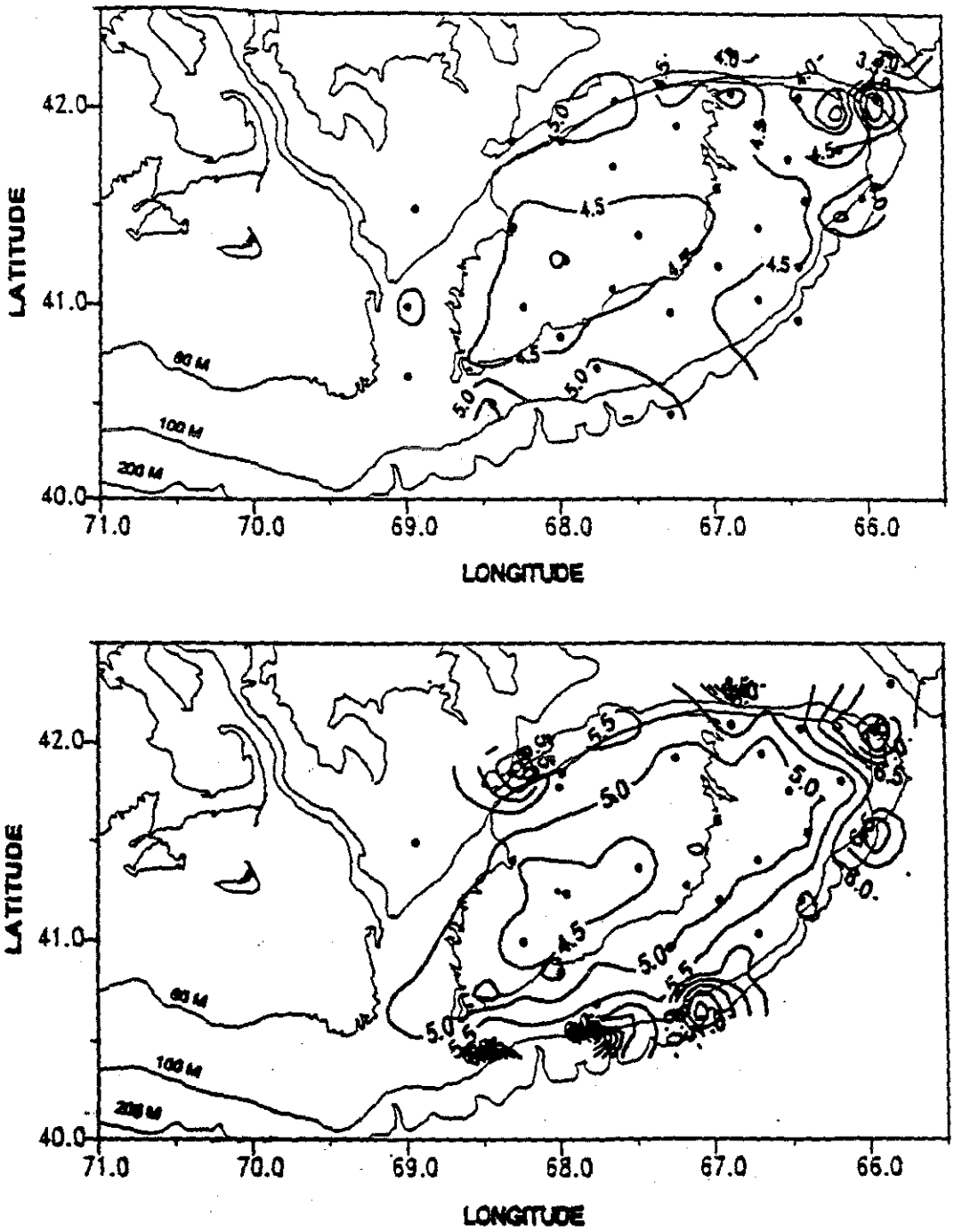


Figure 22. The surface and bottom temperature distributions during the GLOBEC broadscale survey END9678.

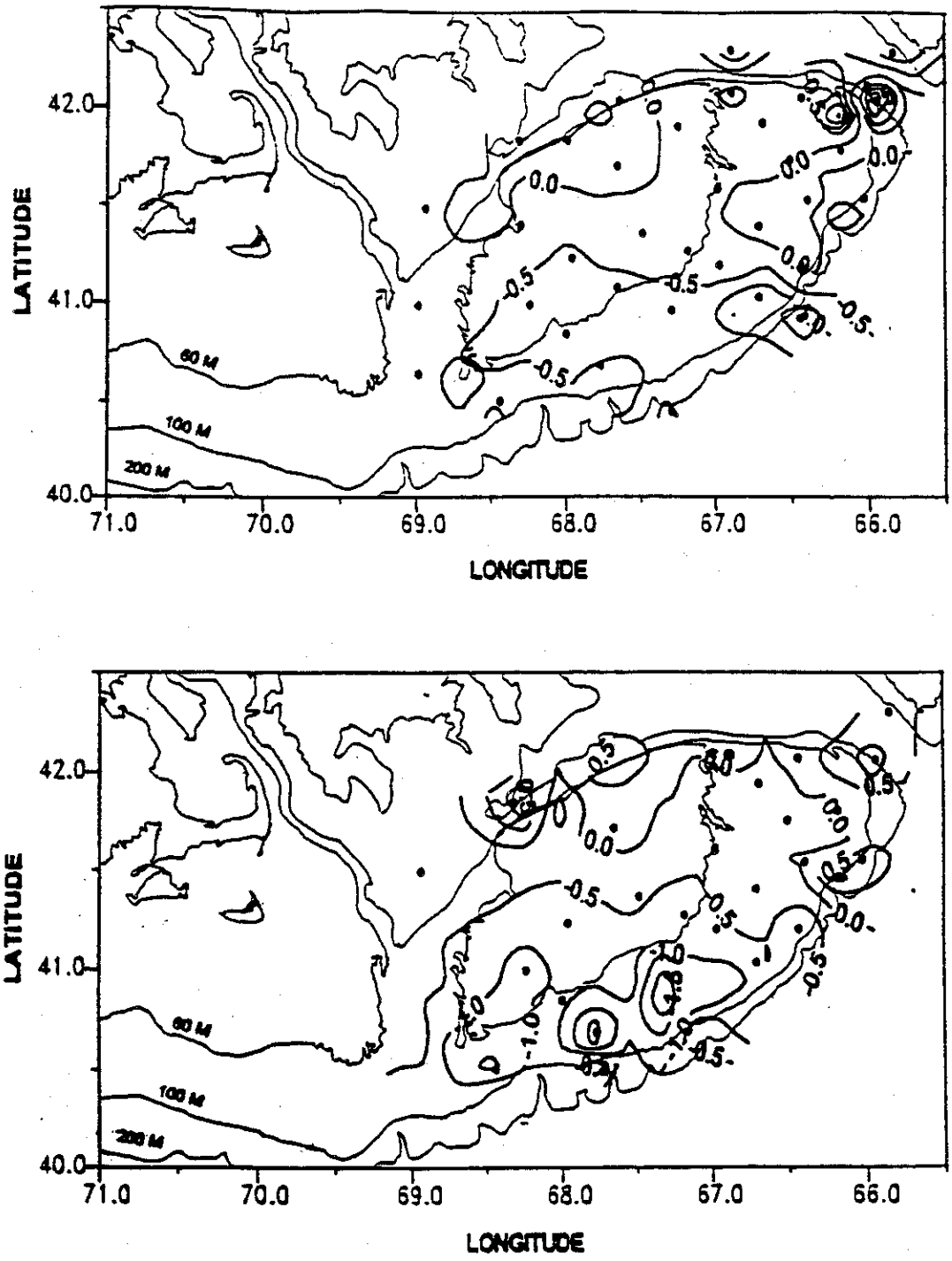


Figure 23. The surface and bottom temperature anomaly distributions for GLOBEC broadscale survey END9678.

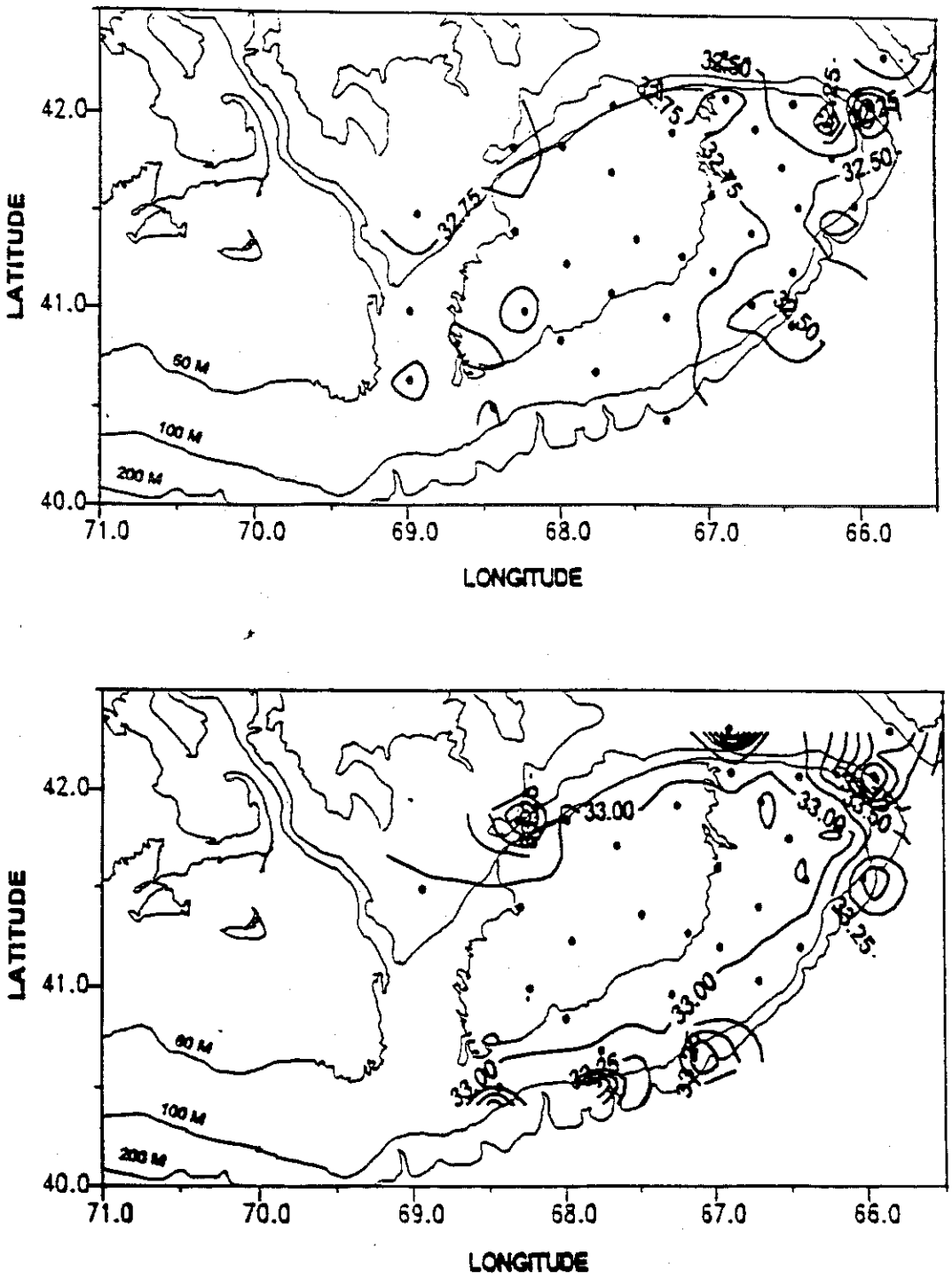


Figure 24. The surface and bottom salinity distributions during GLOBEC broadscale survey END9678.

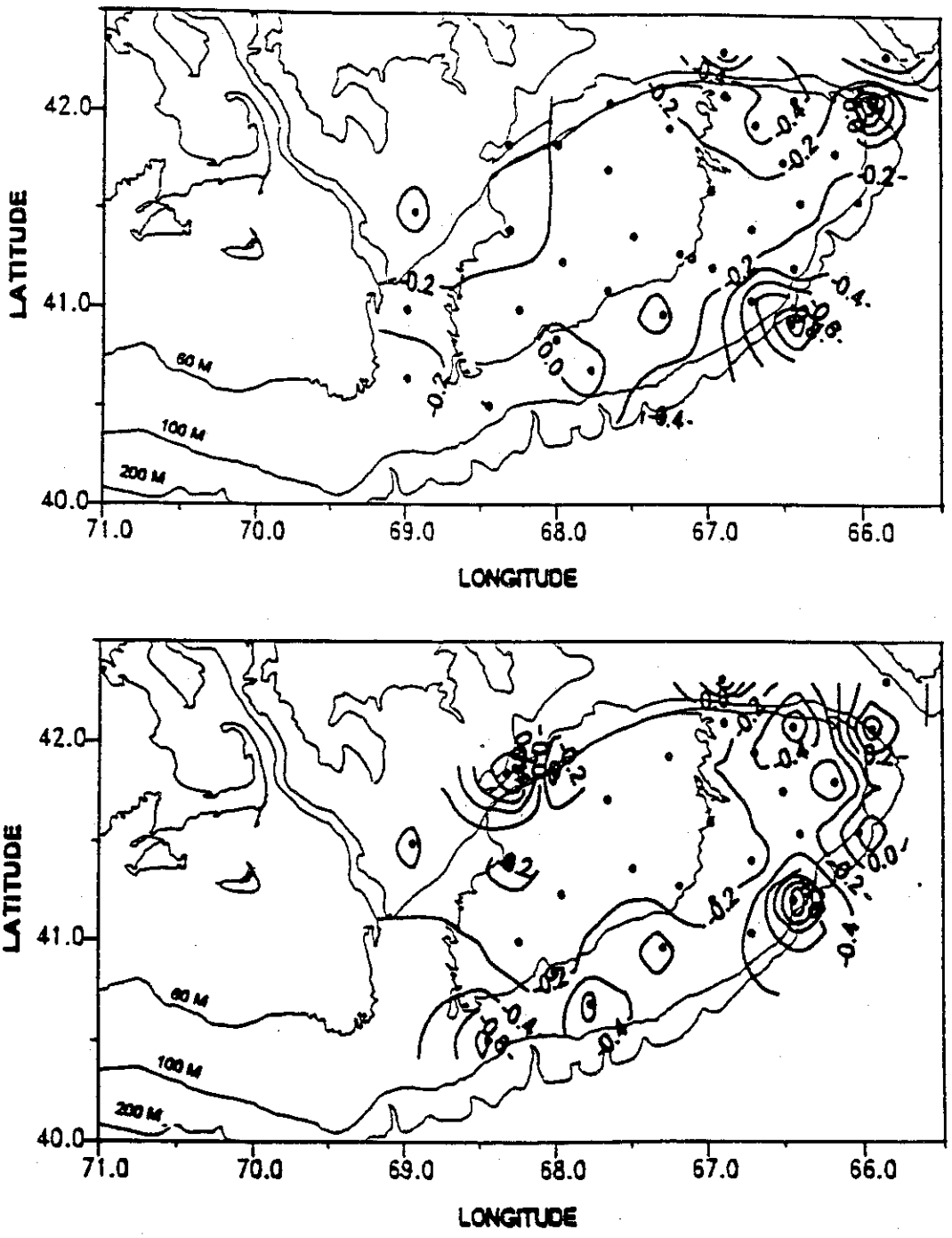


Figure 25. The surface and bottom salinity anomaly distributions during GLOBEC broadscale survey END9678.

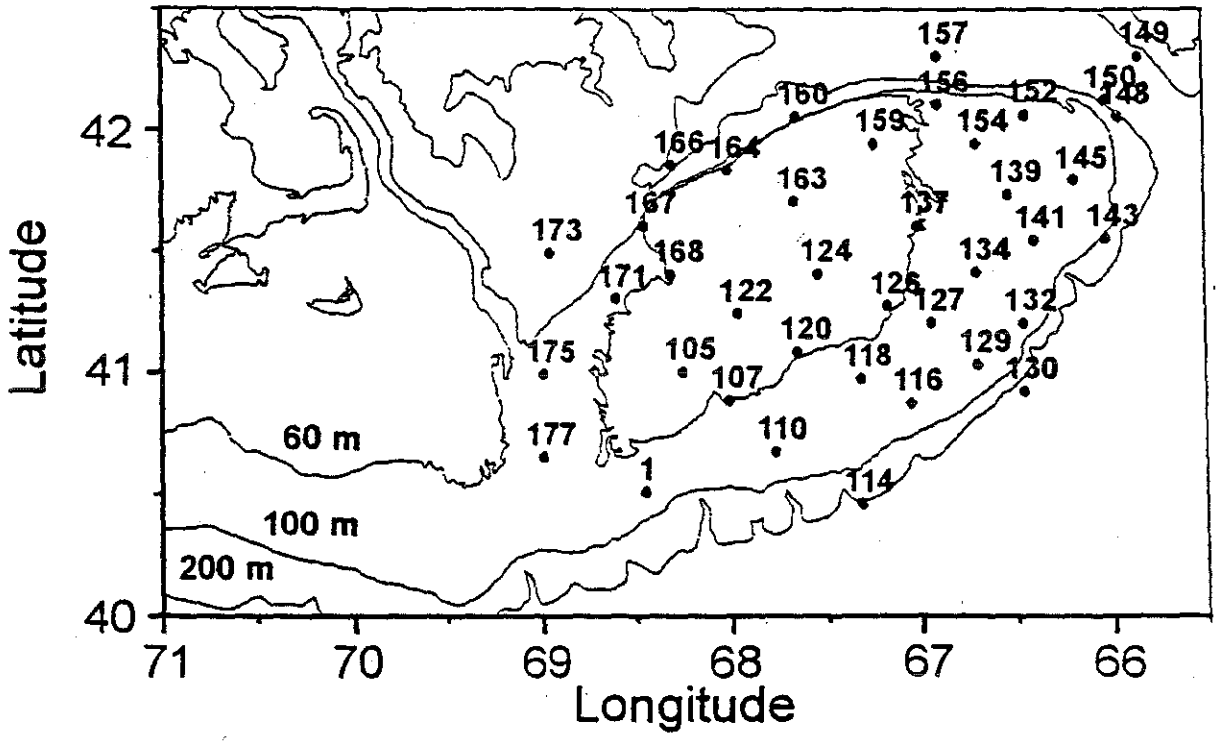


Figure 26. Hydrographic stations occupied during the GLOBEC broadscale survey OCE9675.

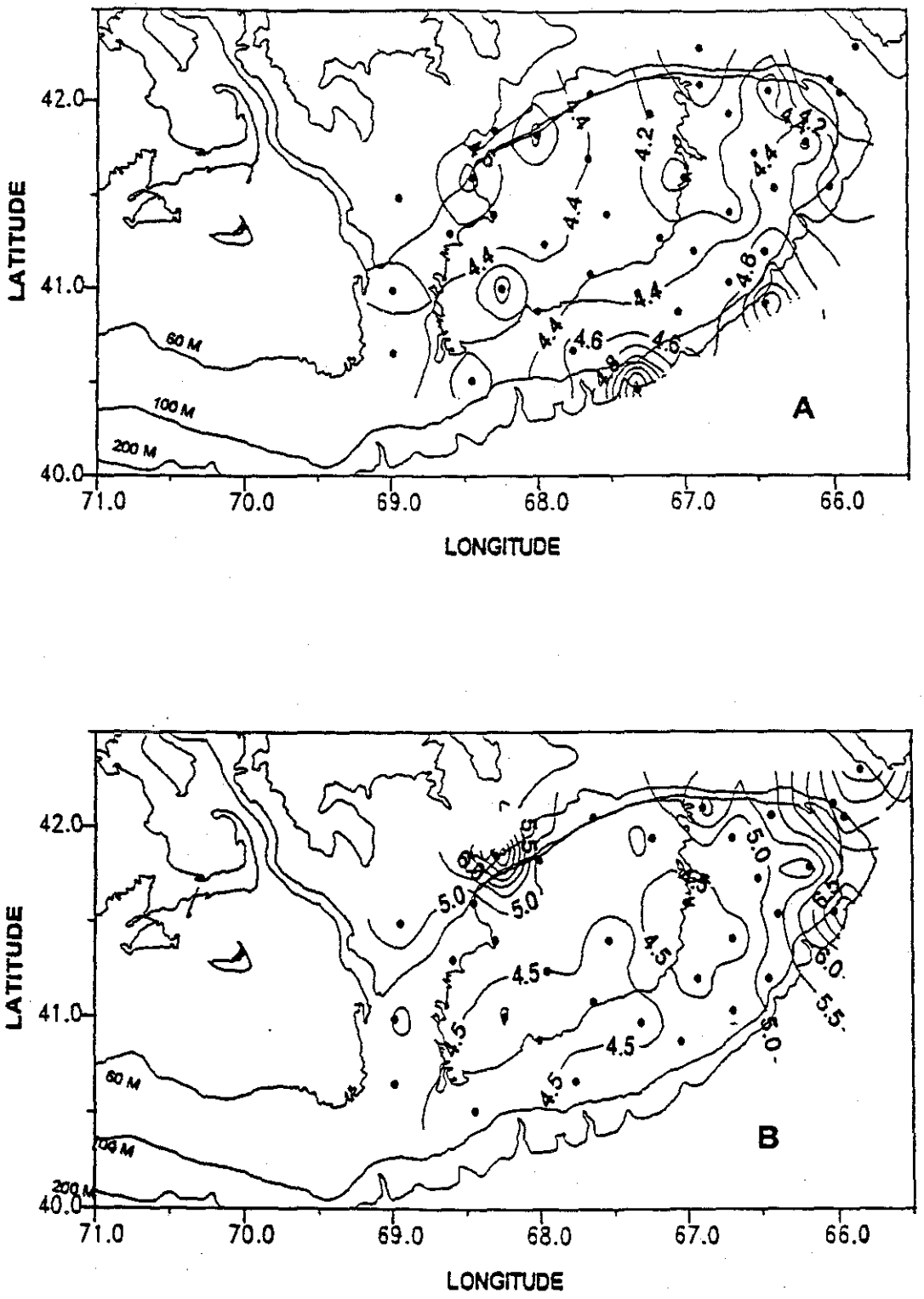


Figure 27. The surface and bottom temperature distributions during the GLOBEC broadscale survey OCE9675.

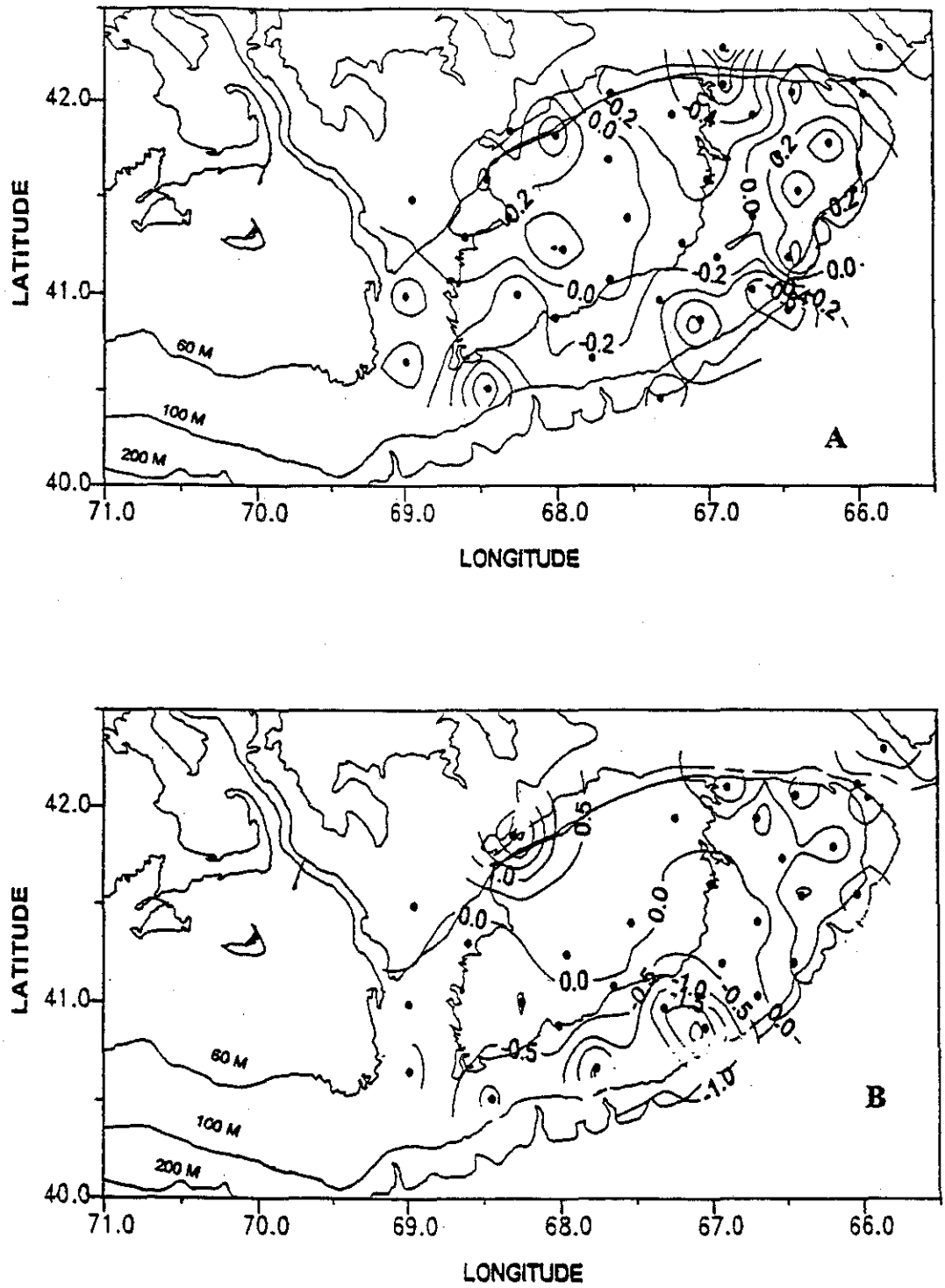


Figure 28. The surface and bottom temperature anomaly distributions for GLOBEC broadscale survey OCE9675.

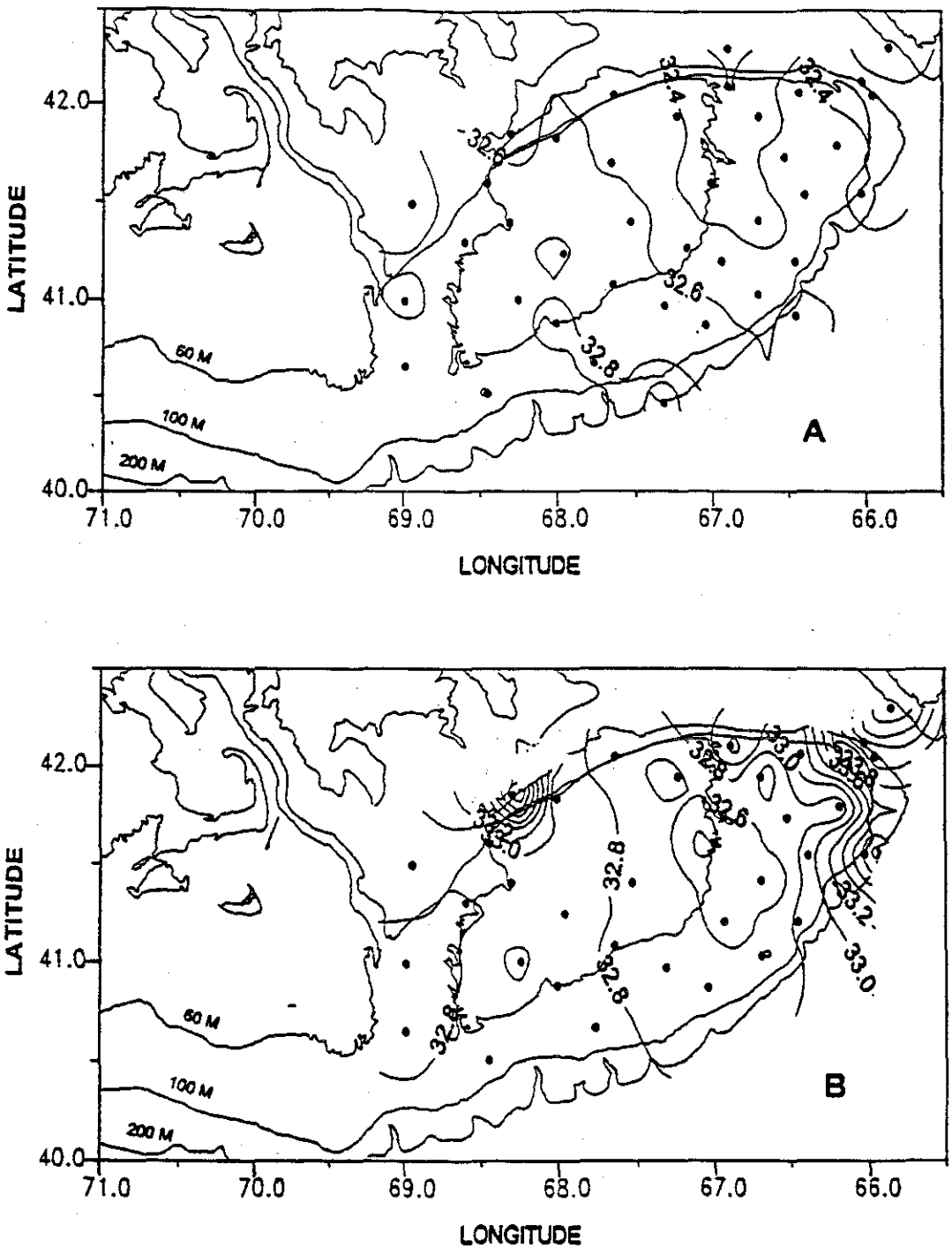


Figure 29. The surface and bottom salinity distributions during GLOBEC broadscale survey OCE9675.

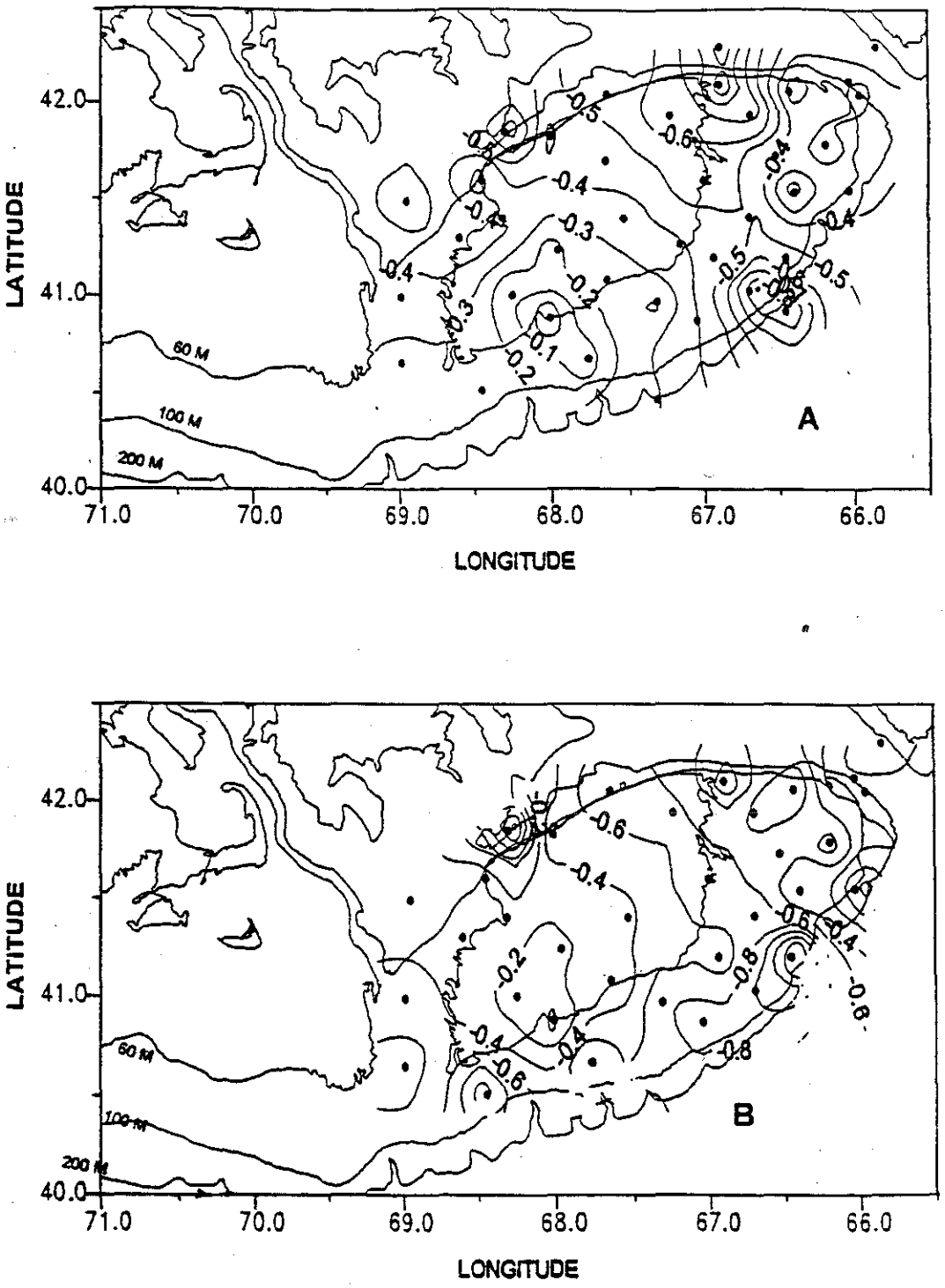


Figure 30. The surface and bottom salinity anomaly distributions during GLOBEC broadscale survey OCE9675.

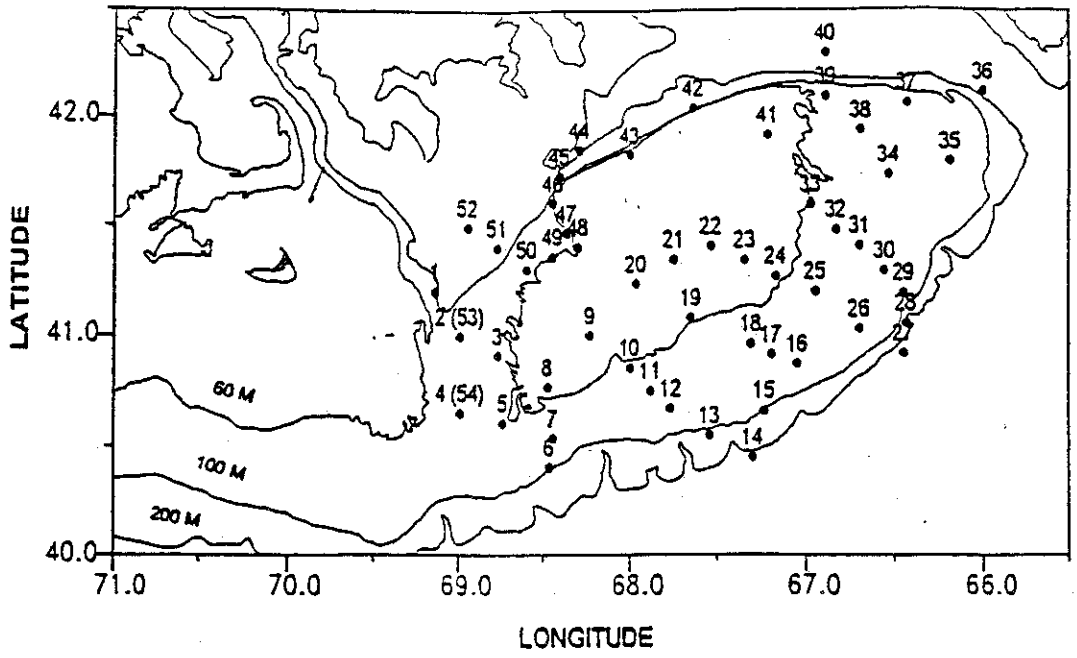


Figure 31. Hydrographic stations occupied during the GLOBEC broadscale survey END9682.

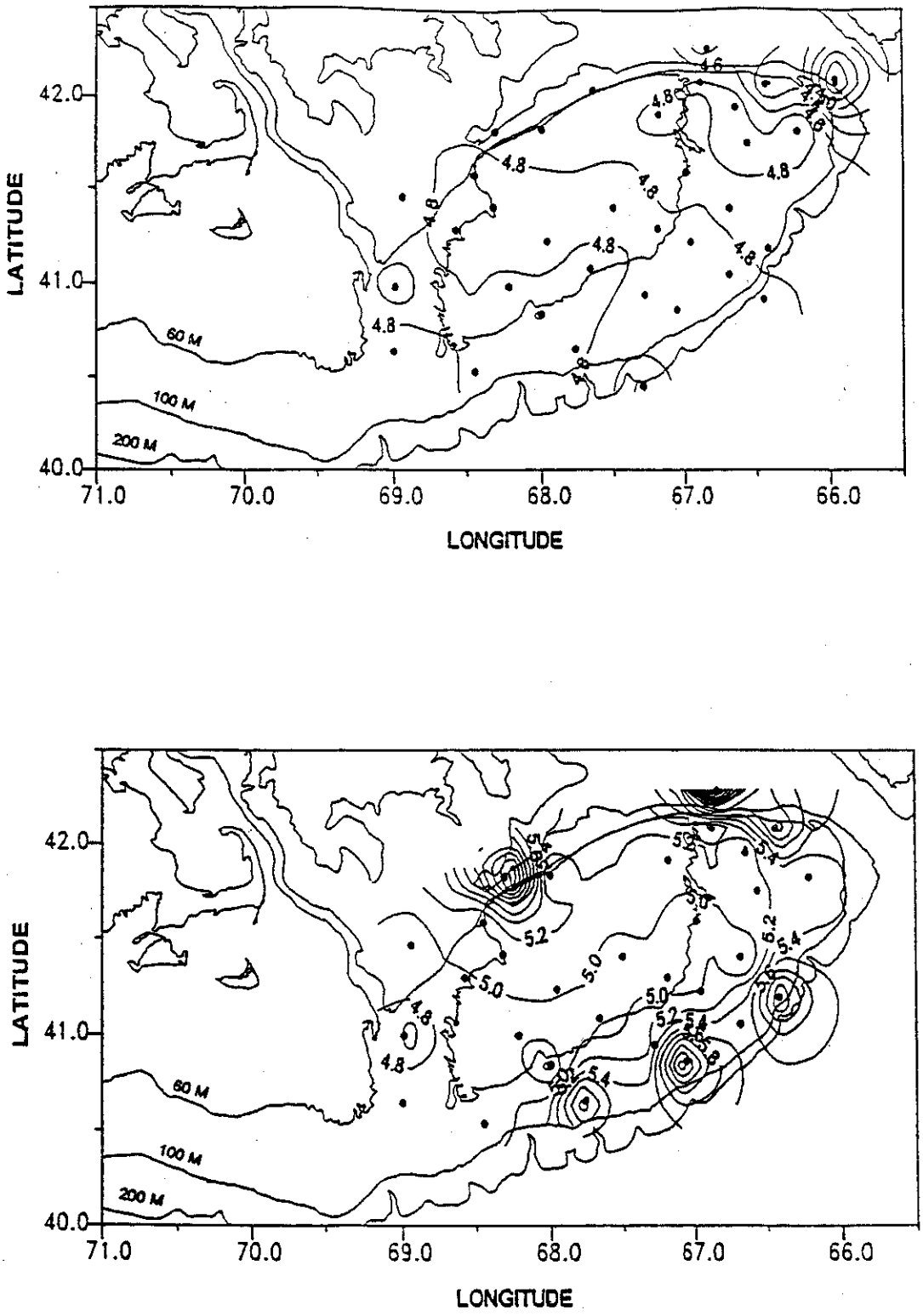


Figure 32. The surface and bottom temperature distributions during the GLOBEC broadscale survey END9682.

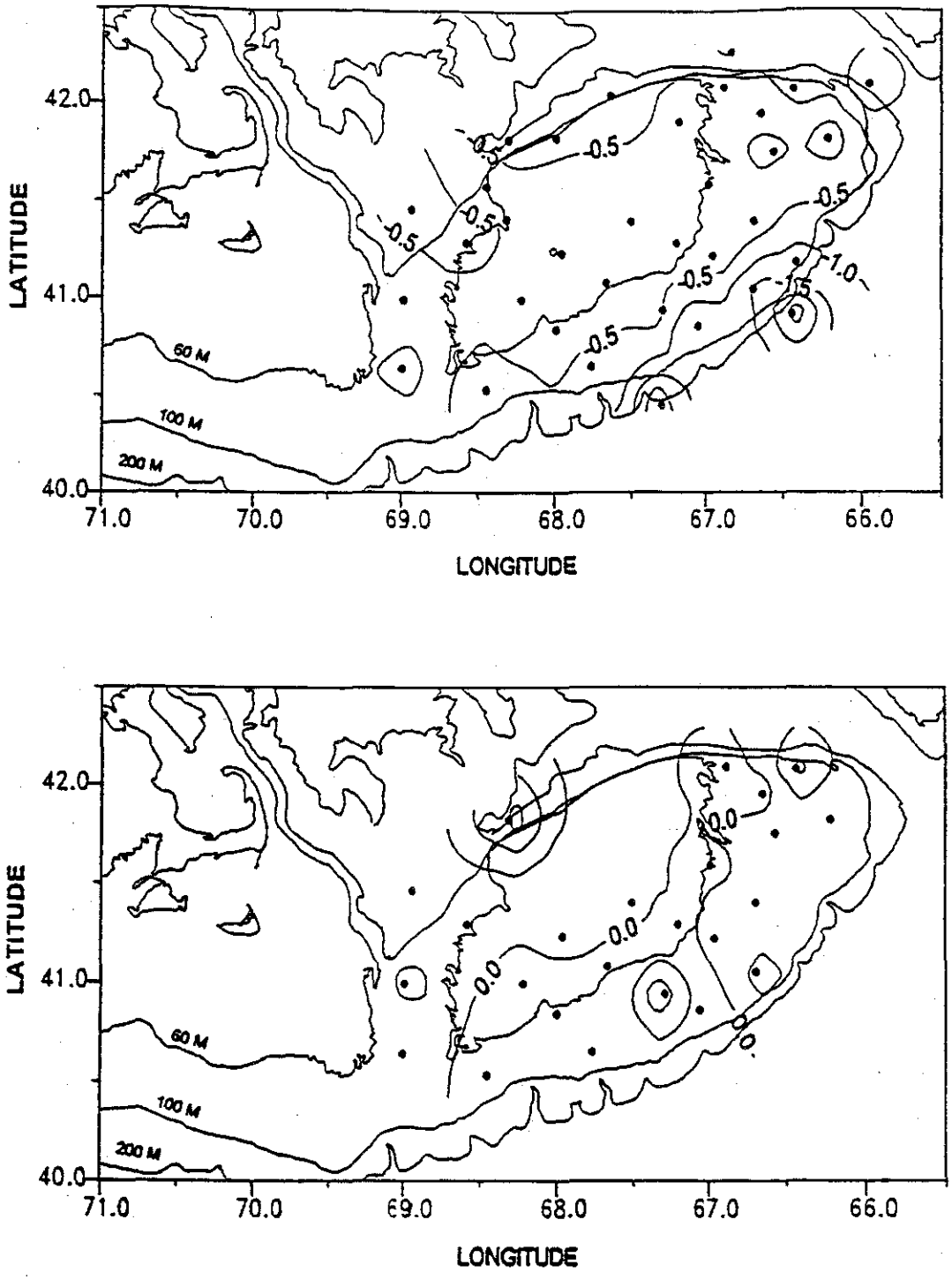


Figure 33. The surface and bottom temperature anomaly distributions for GLOBEC broadscale survey END9682.

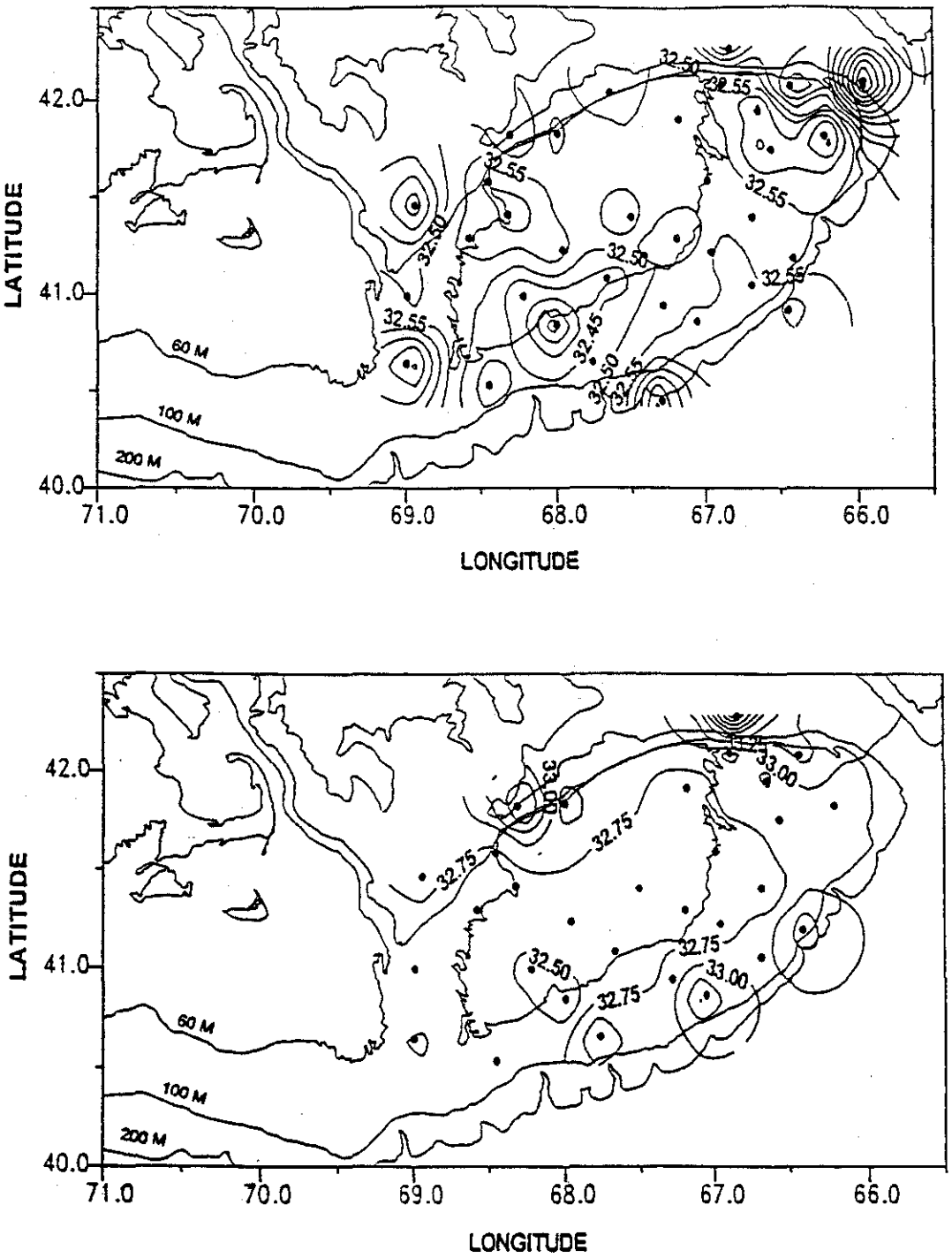


Figure 34. The surface and bottom salinity distributions during GLOBEC broadscale survey END9682.

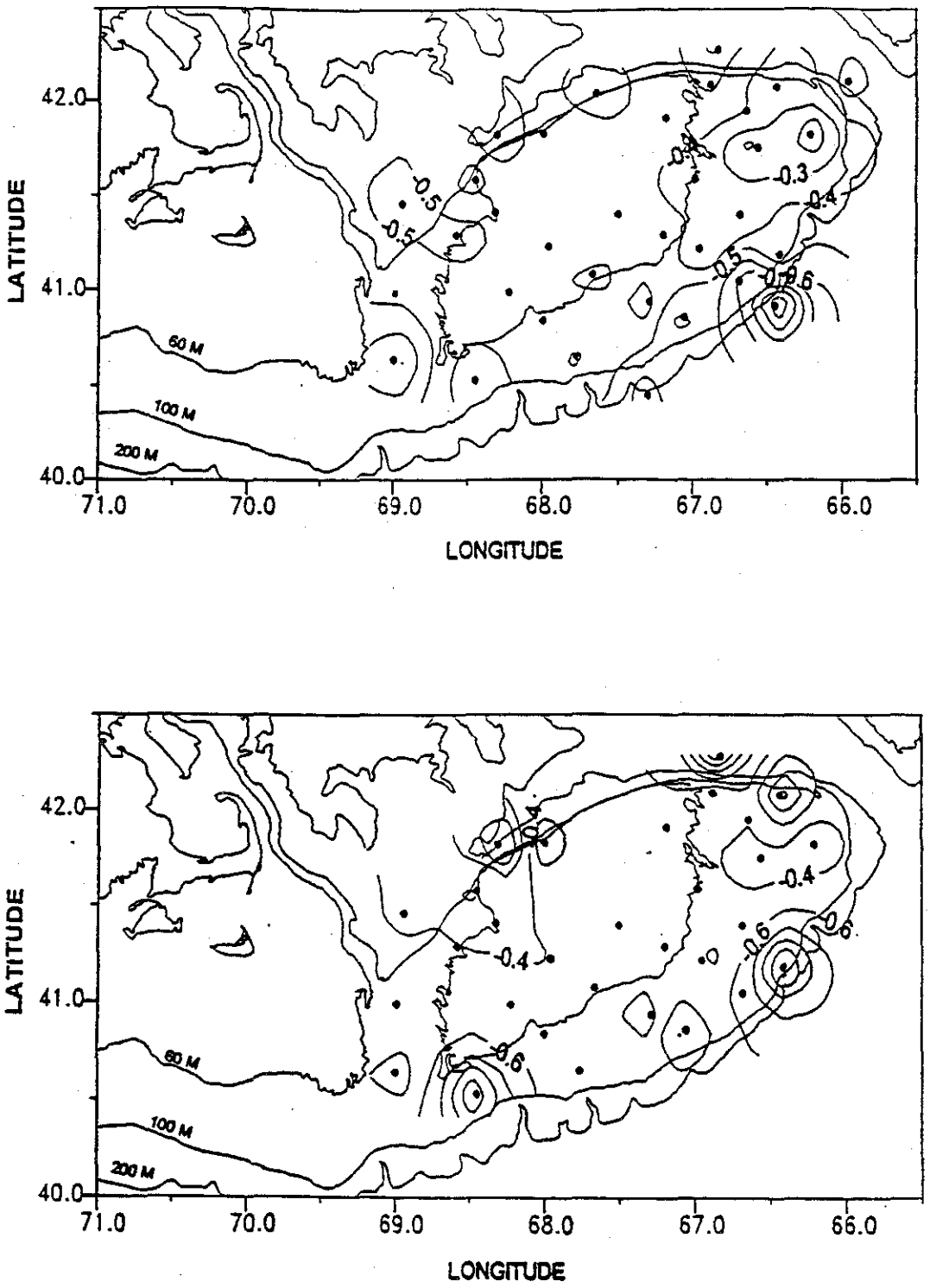


Figure 35. The surface and bottom salinity anomaly distributions during GLOBEC broadscale survey END9682.

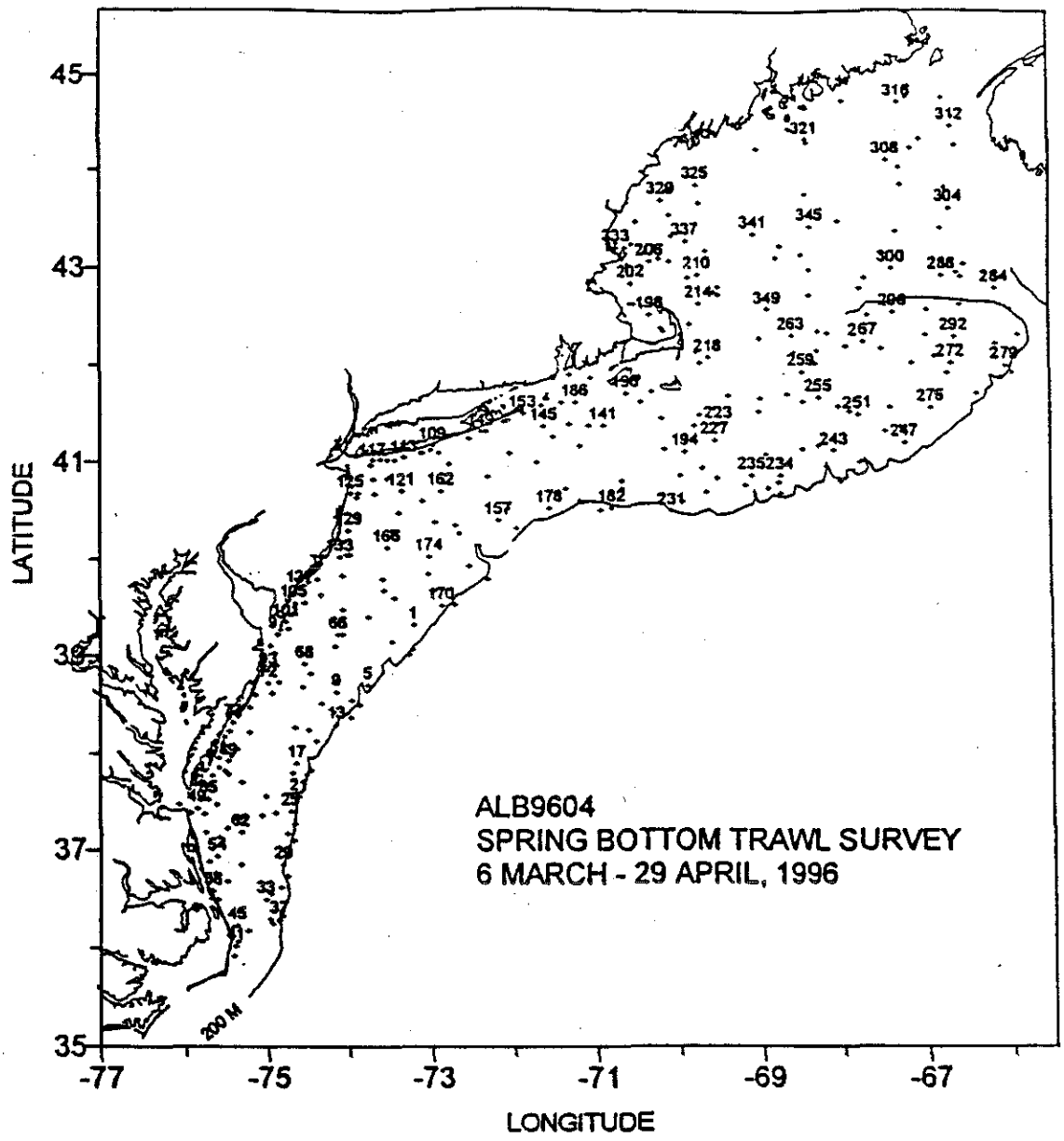


Figure 36. Stations occupied during the spring bottom trawl survey ALB9604.

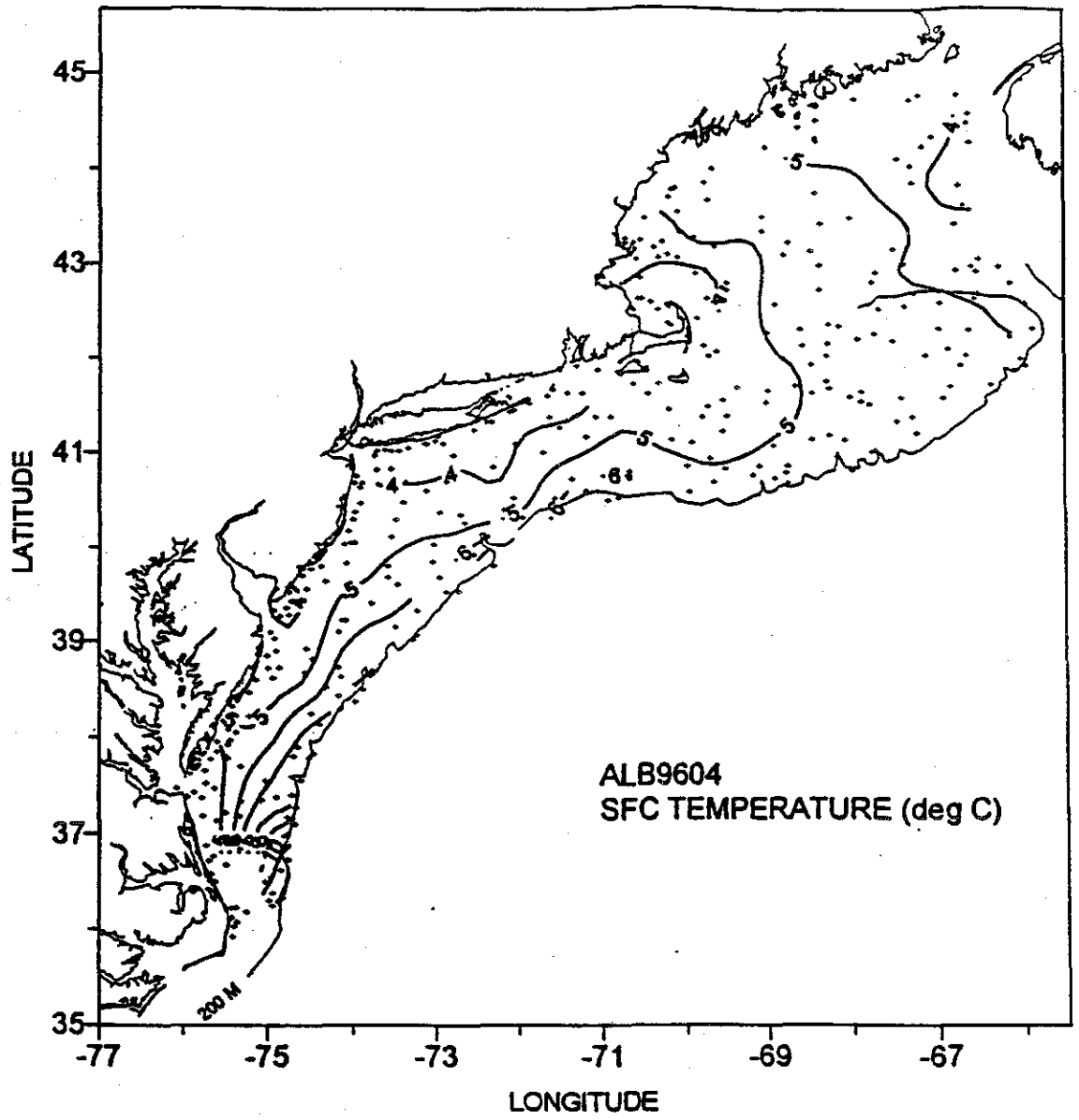


Figure 37. The surface temperature distribution during the spring bottom trawl survey ALB9604.

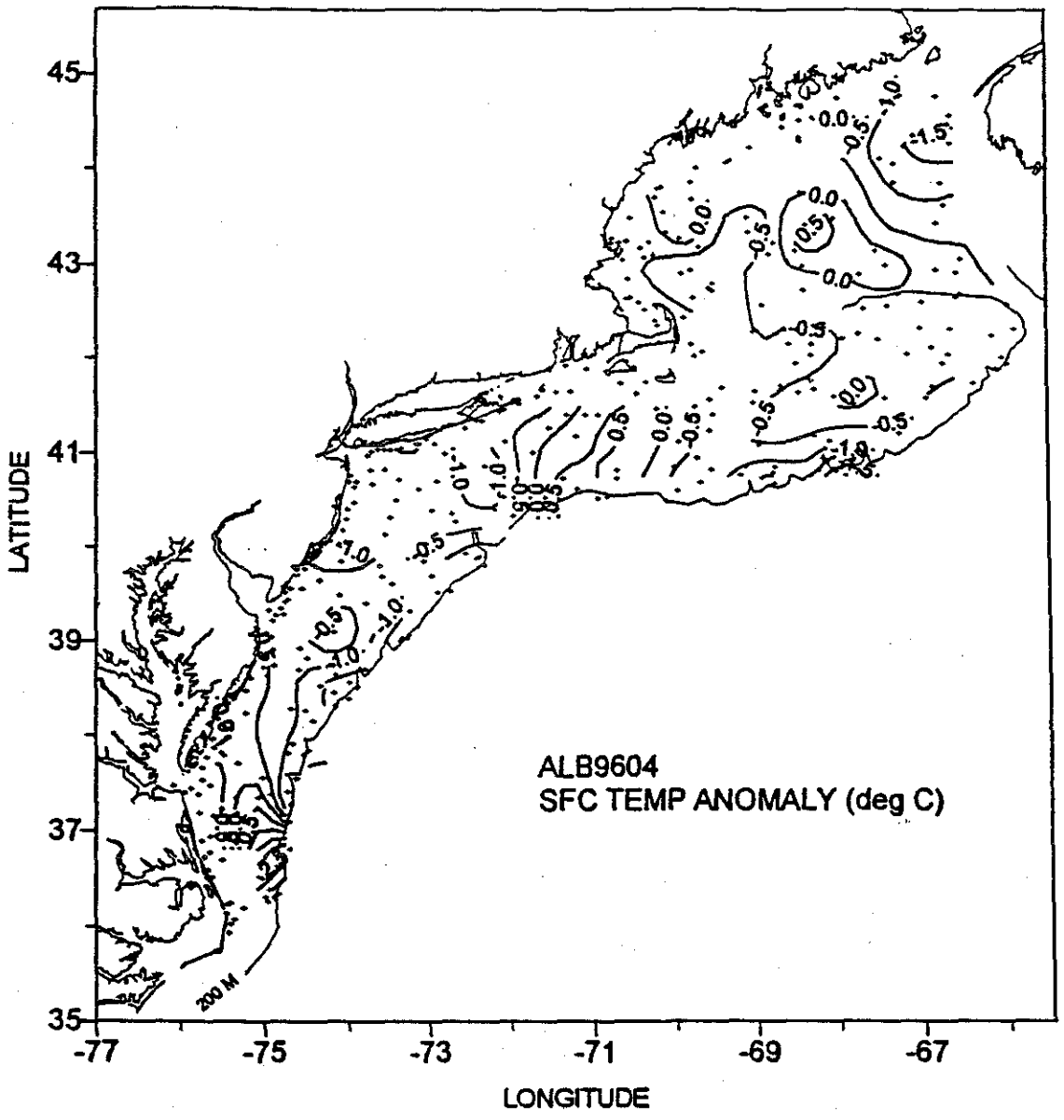


Figure 38. The surface temperature anomaly distribution during the spring bottom trawl survey ALB9604.

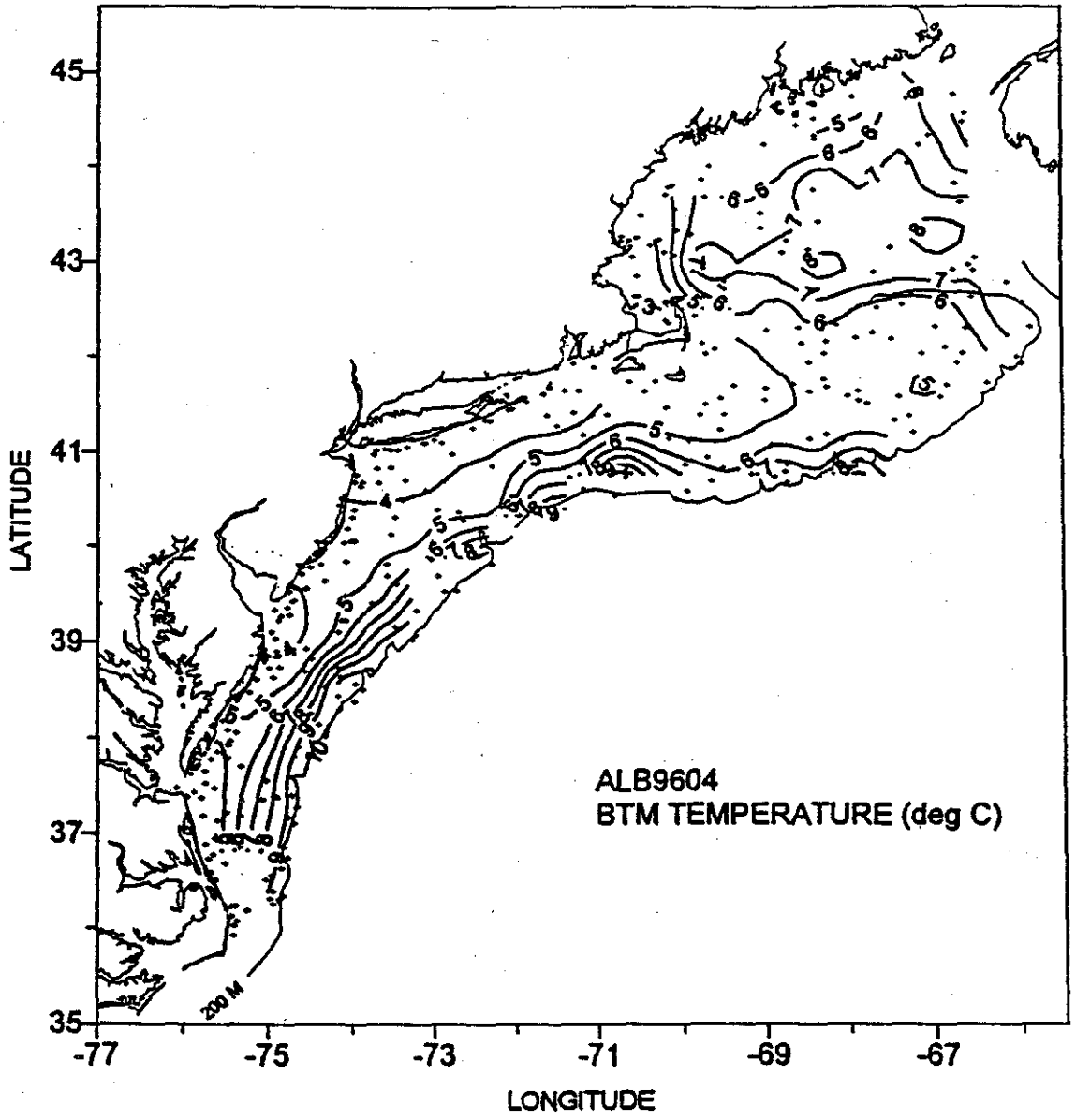


Figure 39. The bottom temperature distribution during the spring bottom trawl survey ALB9604.

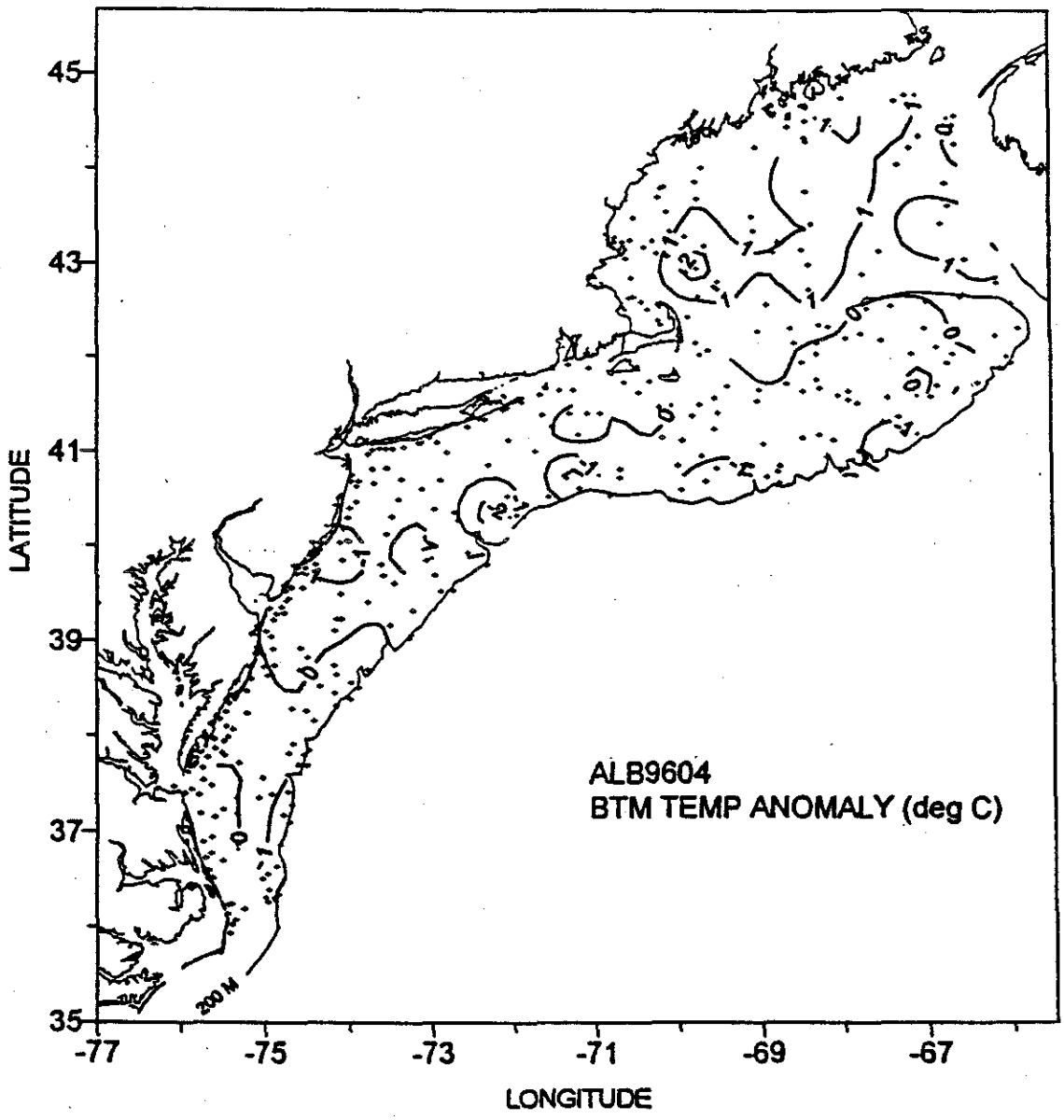


Figure 40. The bottom temperature anomaly distribution during the spring bottom trawl survey ALB9604.

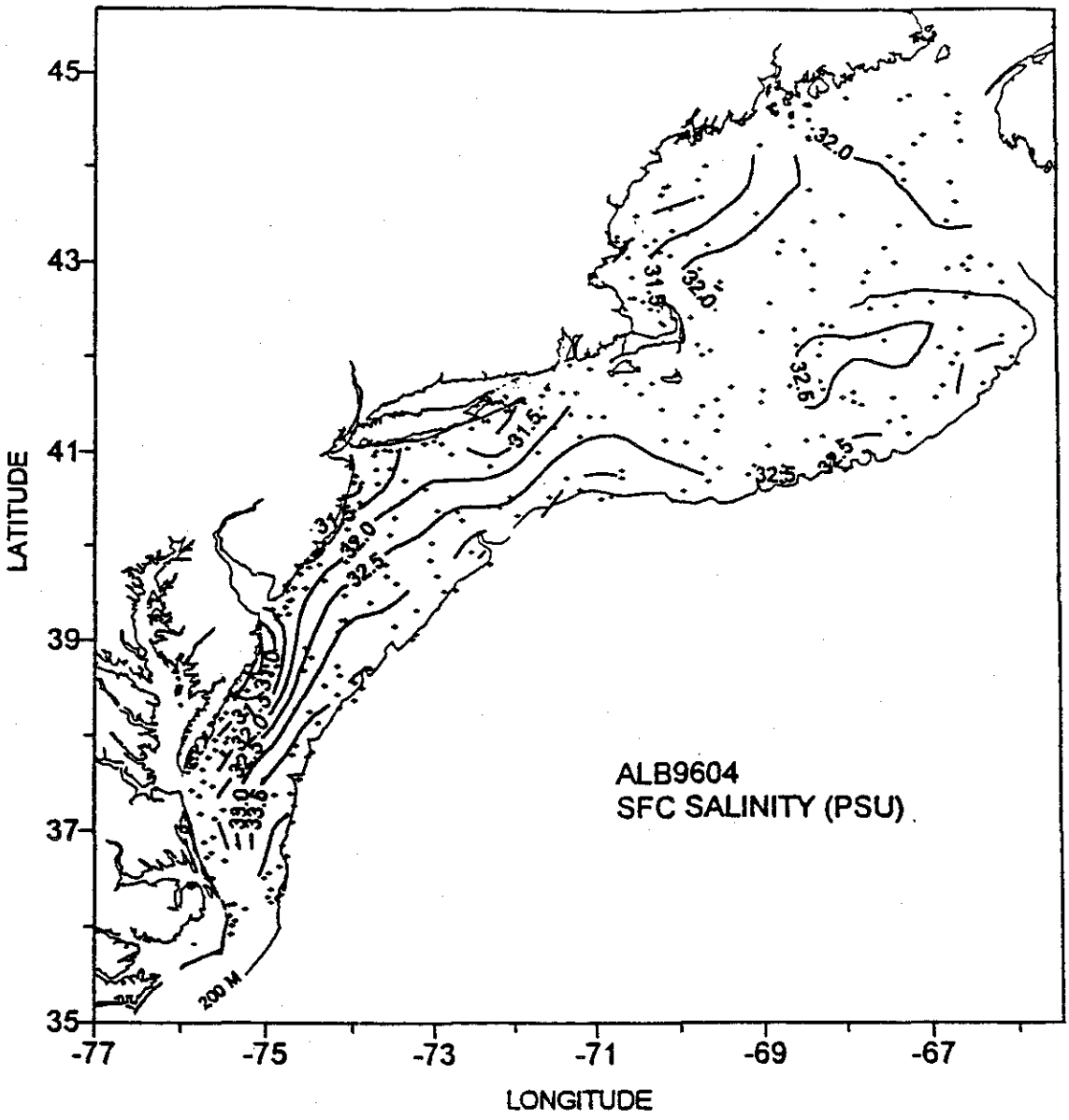


Figure 41. The surface salinity distribution during the spring bottom trawl survey ALB9604.

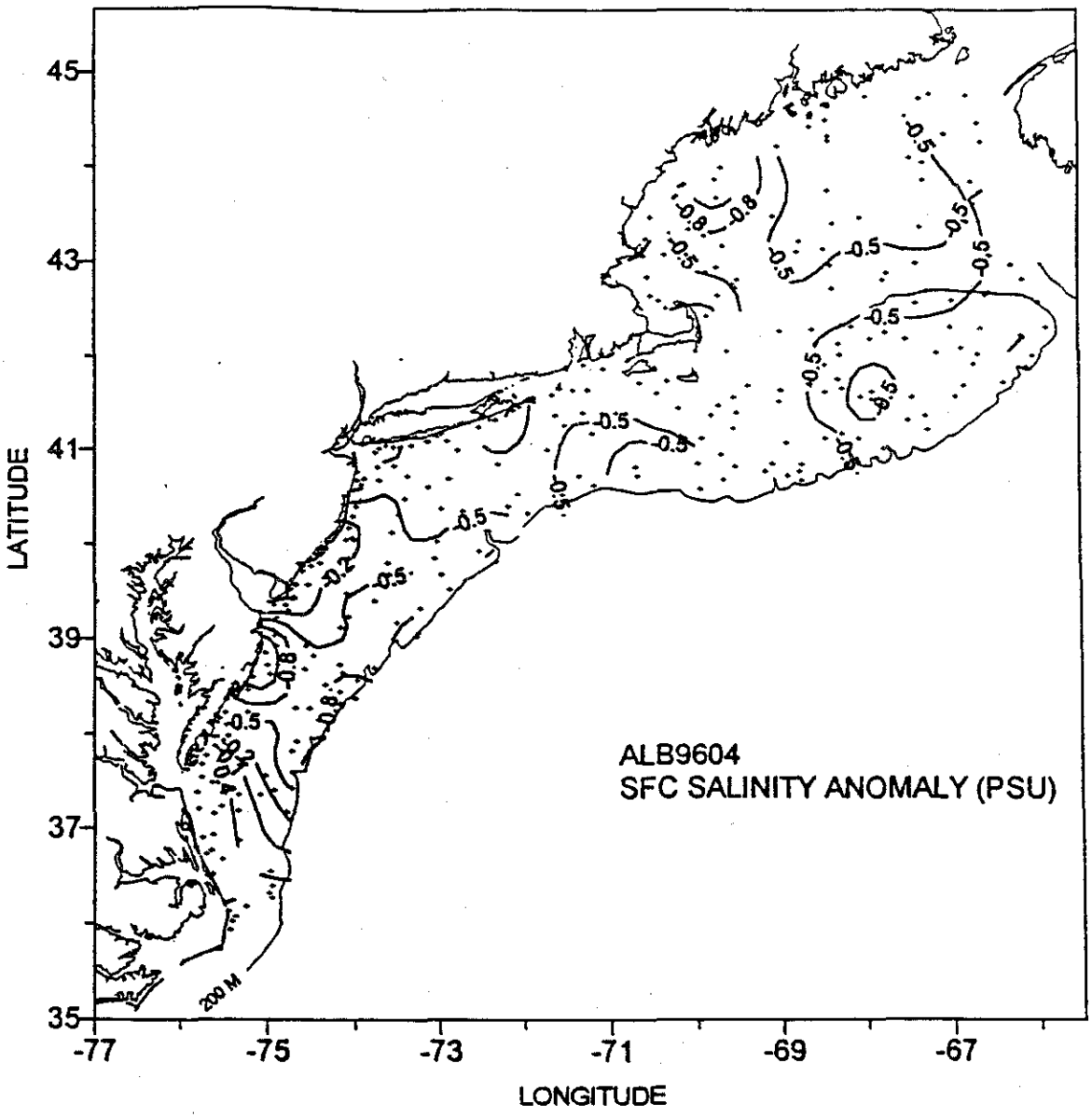


Figure 42. The surface salinity anomaly distribution during the spring bottom trawl survey ALB9604.

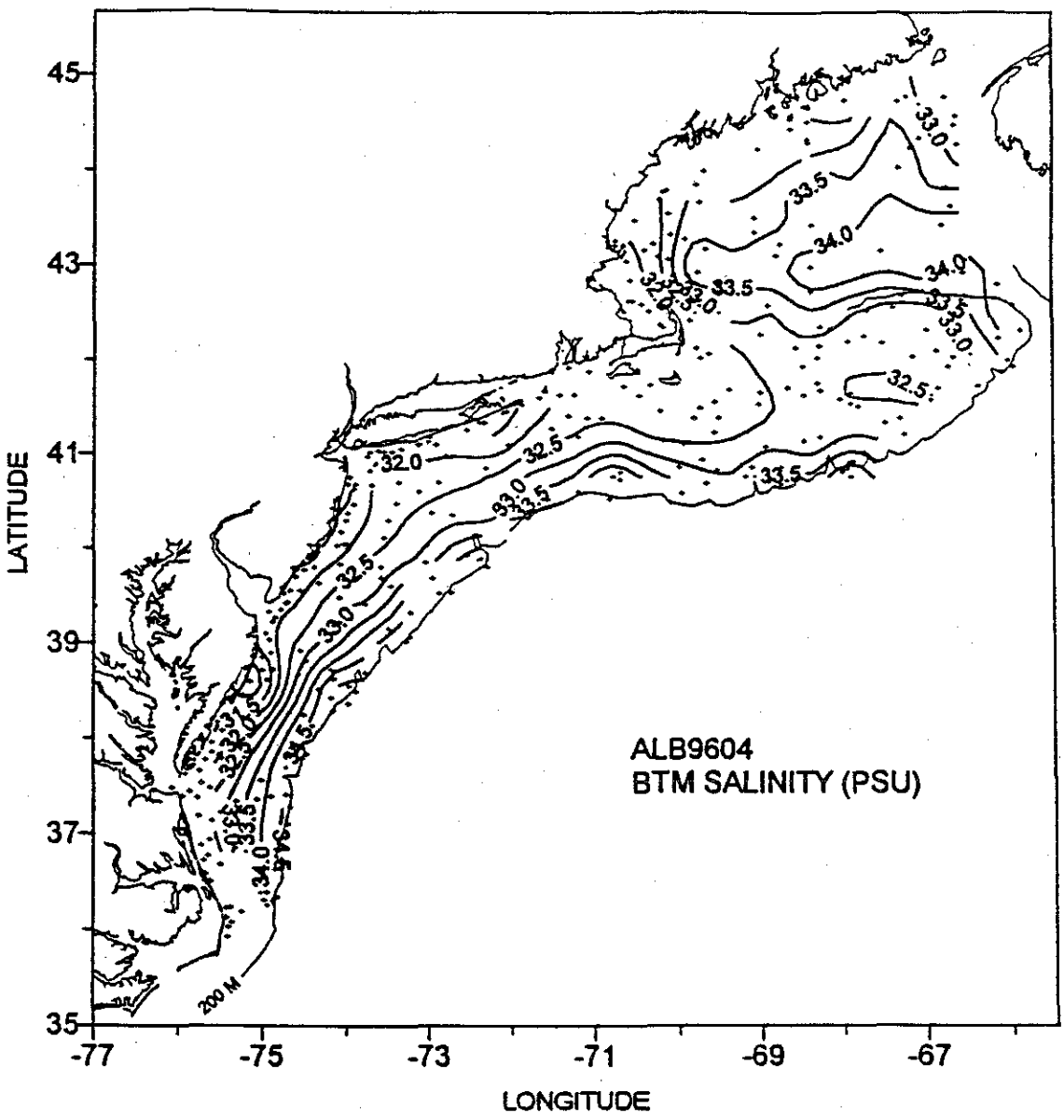


Figure 43. The bottom salinity distribution during the spring bottom trawl survey ALB9604.

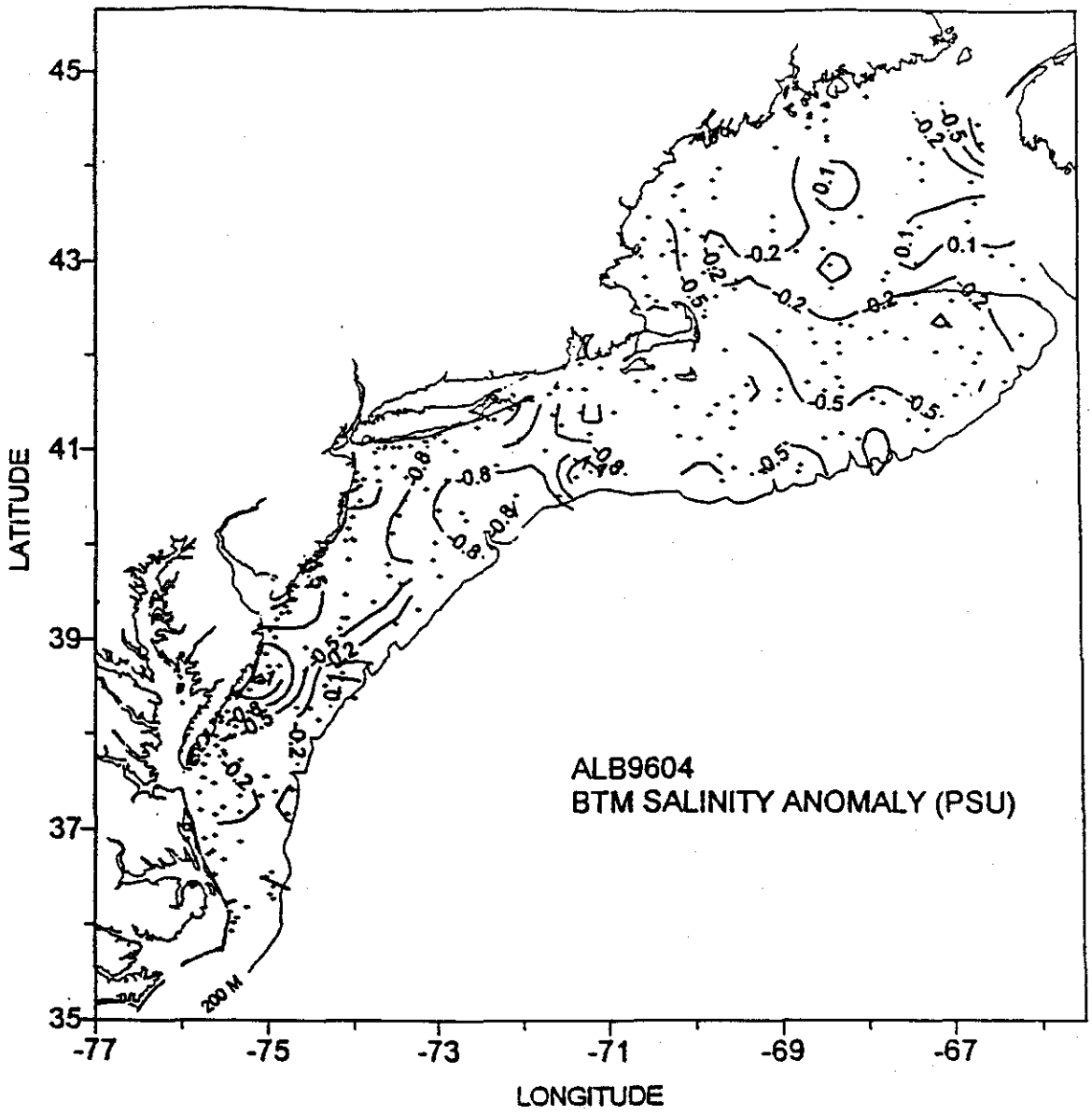


Figure 44. The bottom salinity anomaly distribution for the spring bottom trawl survey ALB9604.

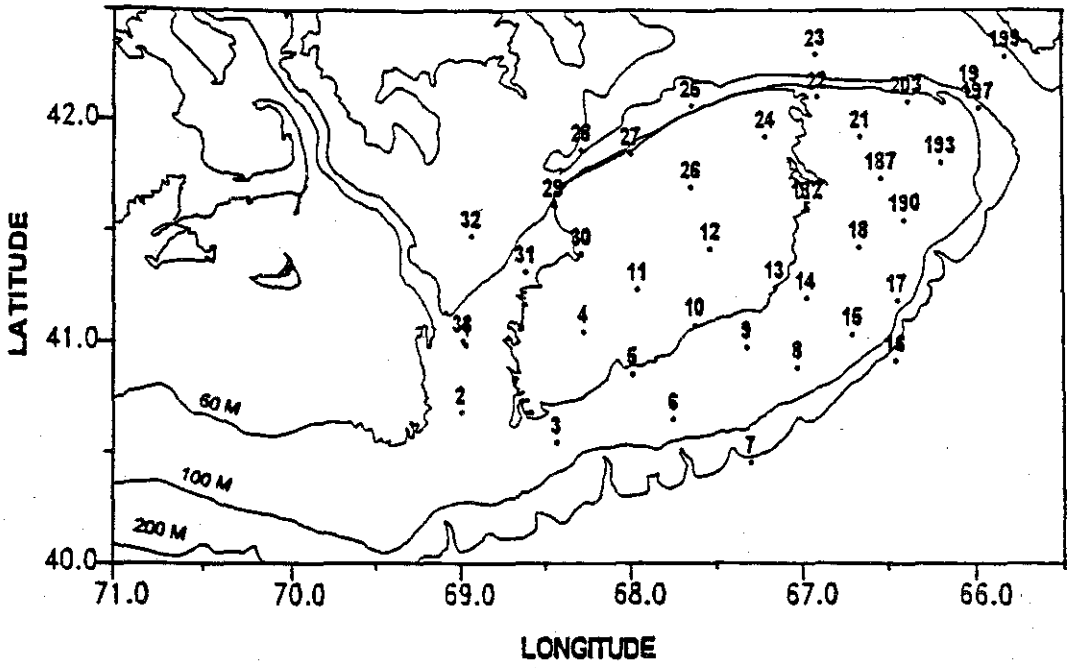


Figure 45. Hydrographic stations occupied during the GLOBEC broadscale survey ALB9605.

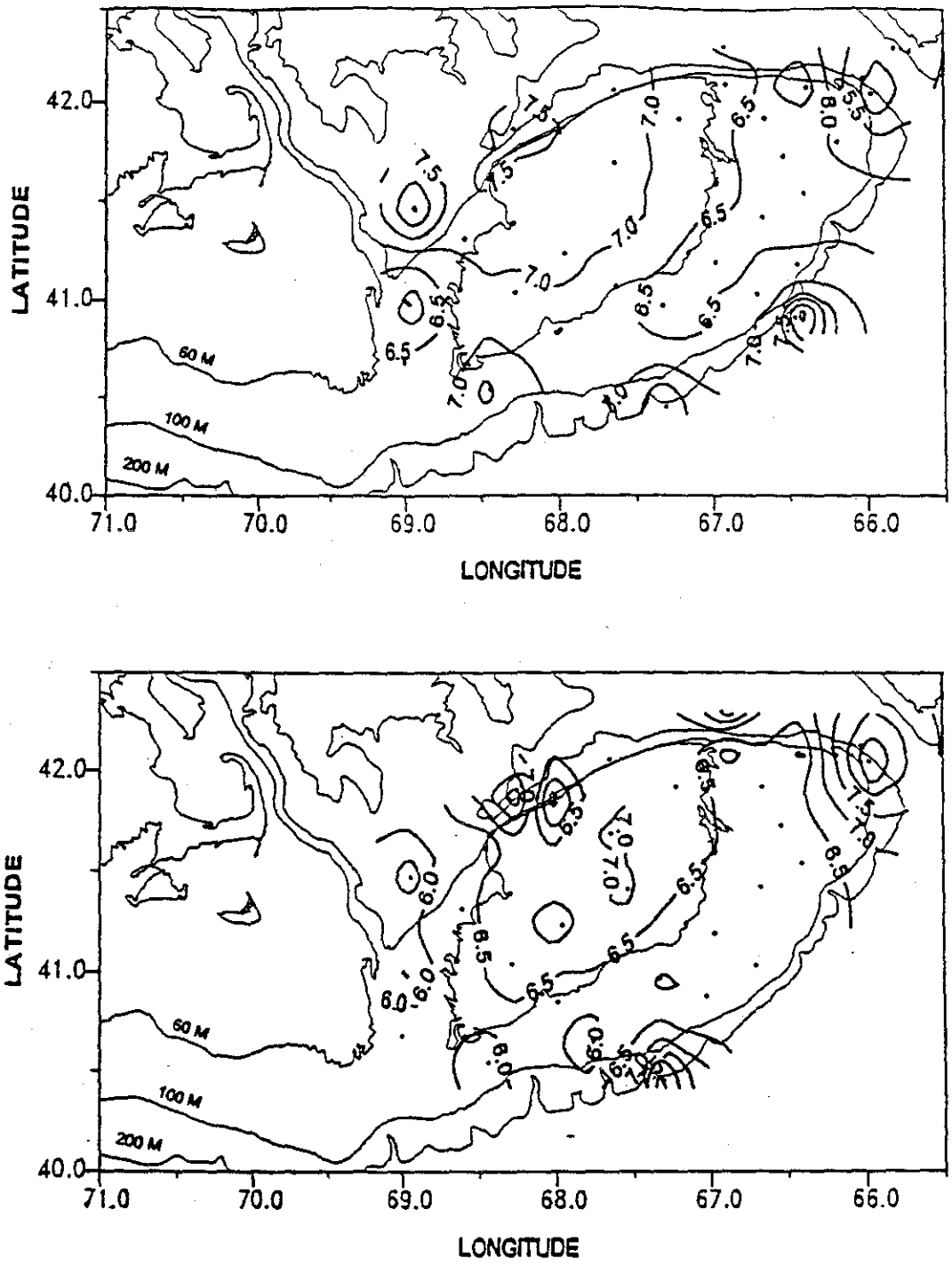


Figure 46. The surface and bottom temperature distributions during the GLOBEC broadscale survey ALB9605.

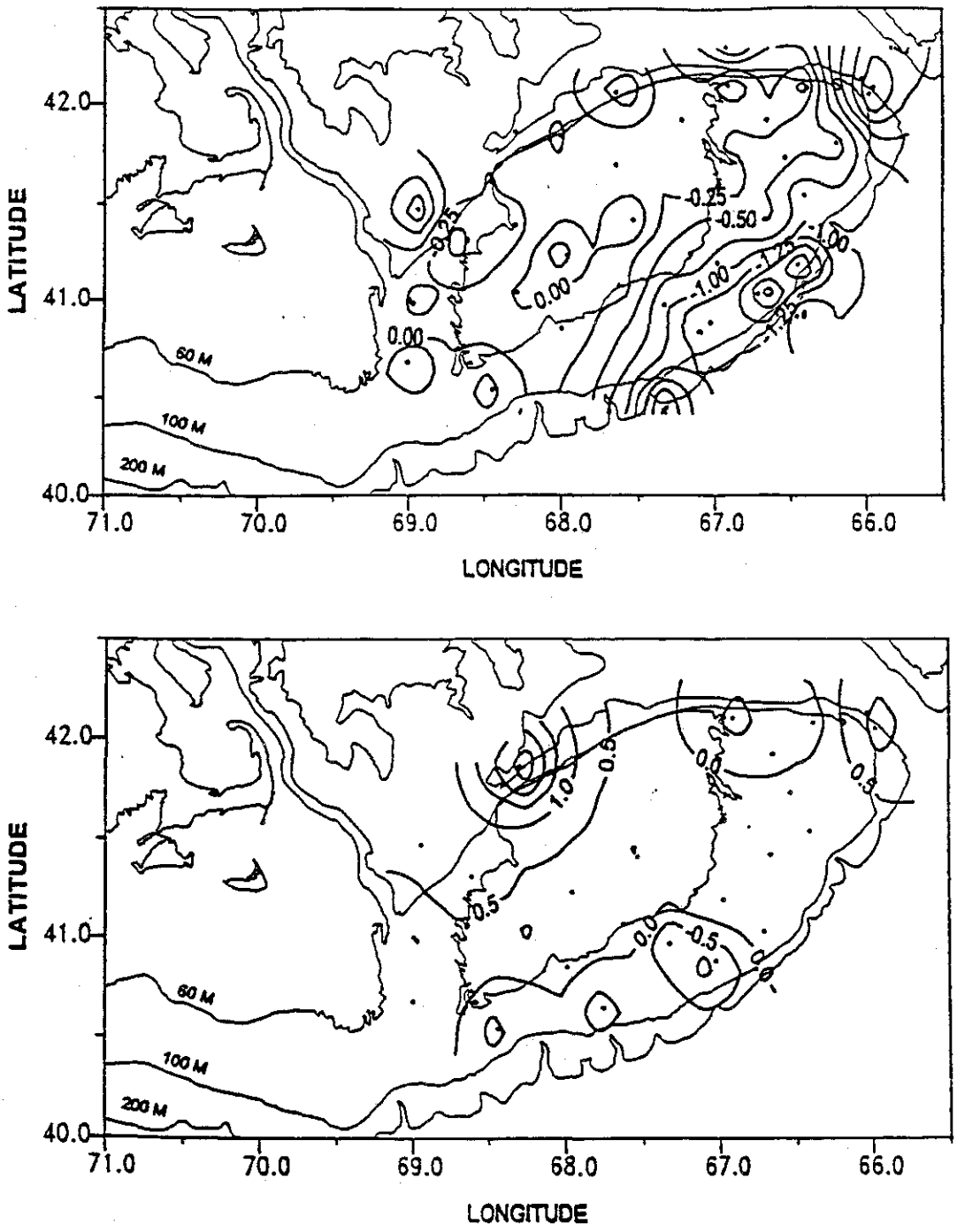


Figure 47. The surface and bottom temperature anomaly distributions for GLOBEC broadscale survey ALB9605.

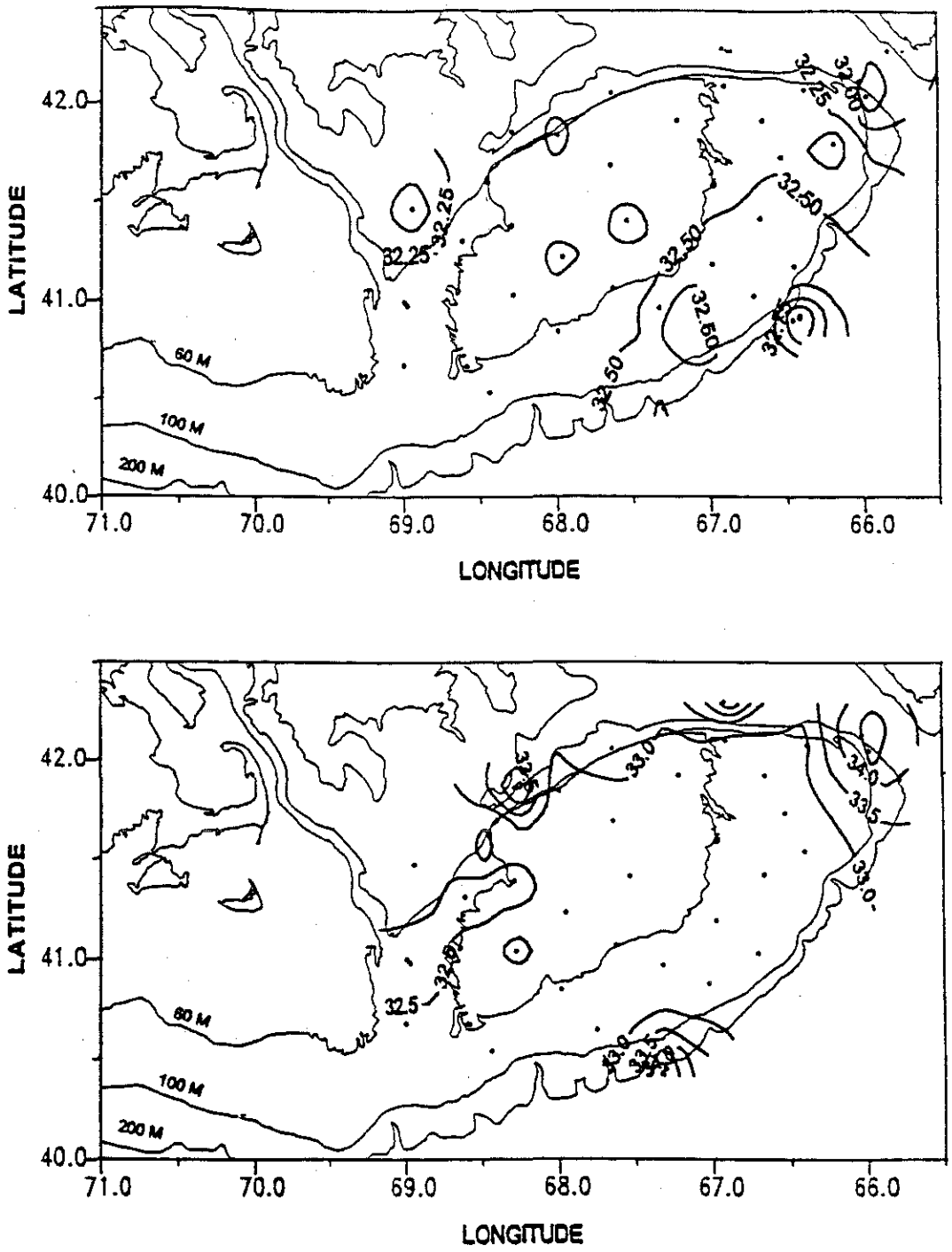


Figure 48. The surface and bottom salinity distributions during GLOBEC broadscale survey ALB9605.

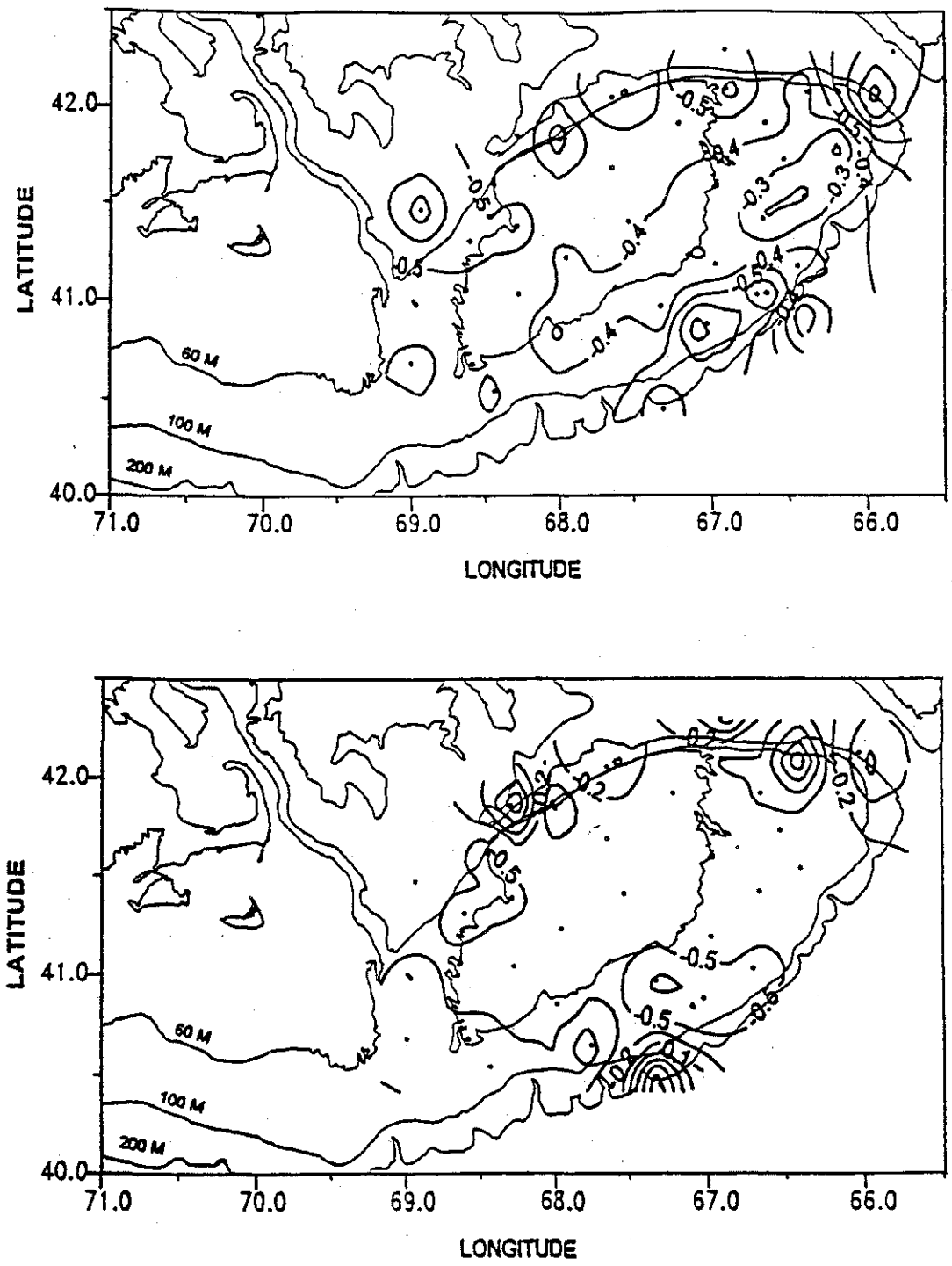


Figure 49. The surface and bottom salinity anomaly distributions during GLOBEC broadscale survey ALB9605.

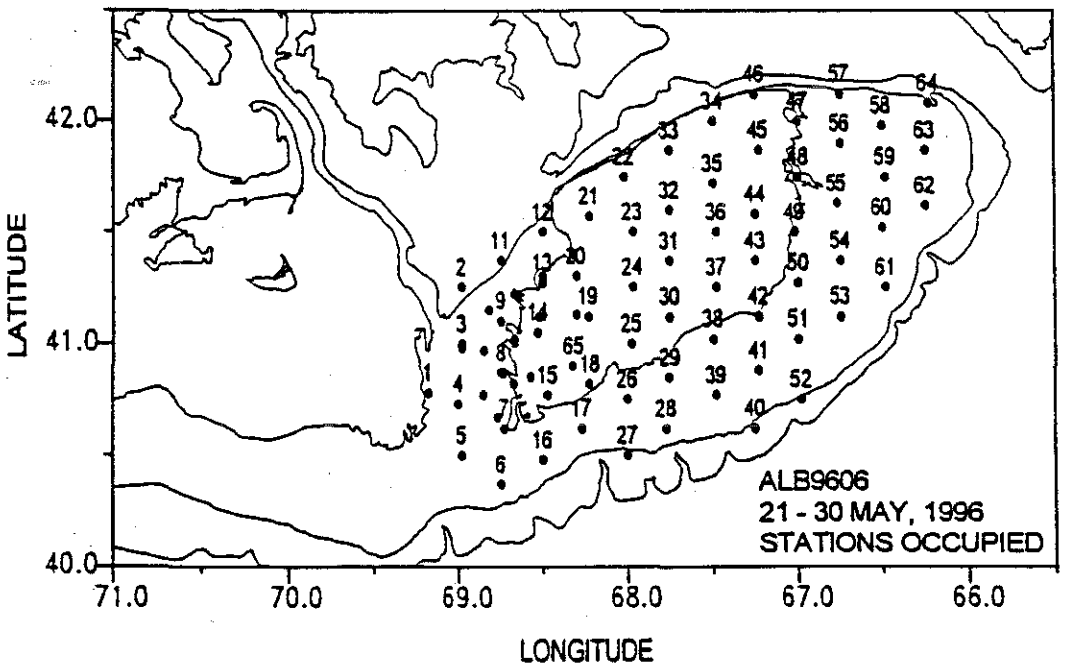
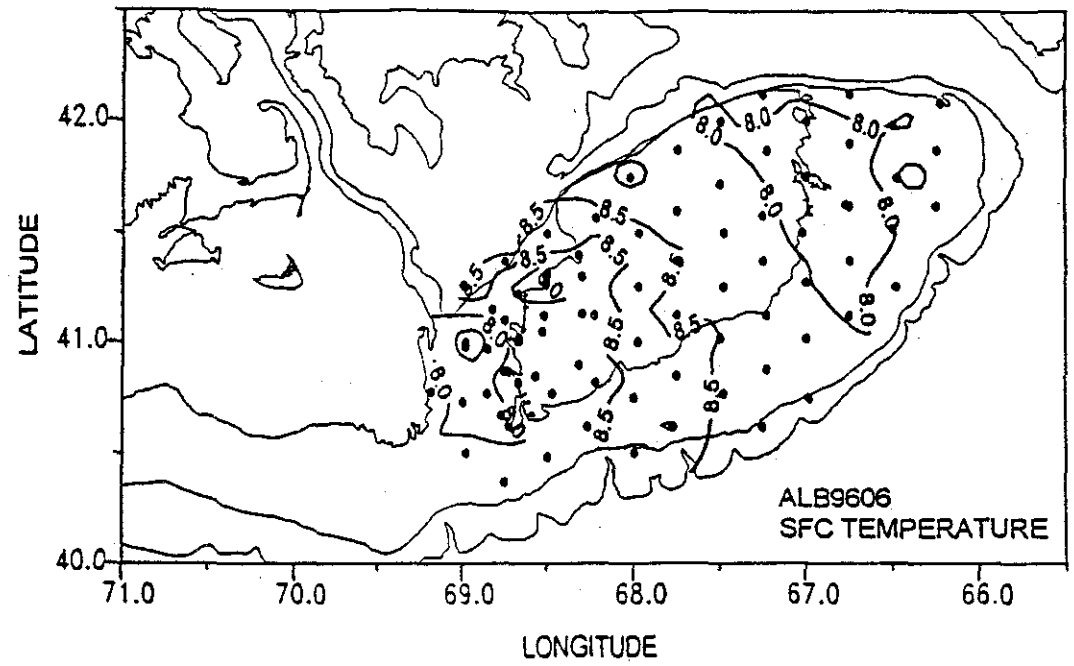


Figure 50. Hydrographic stations occupied during the predator / Prey survey ALB9606.



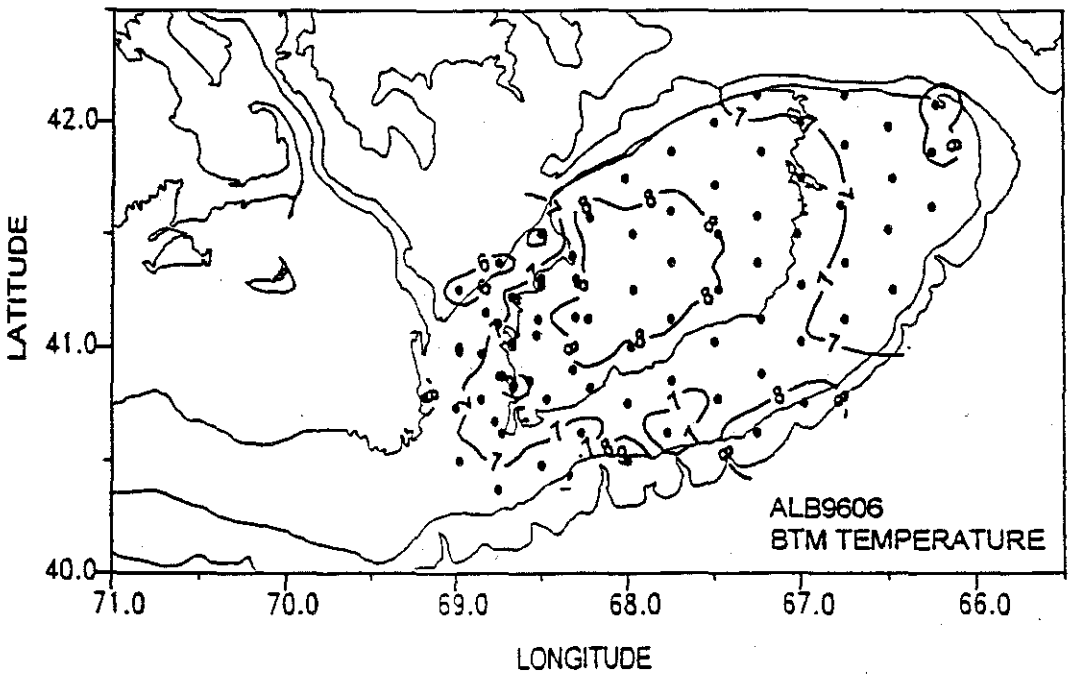


Figure 51. The surface and bottom temperature distributions during the predator / prey cruise ALB9606.

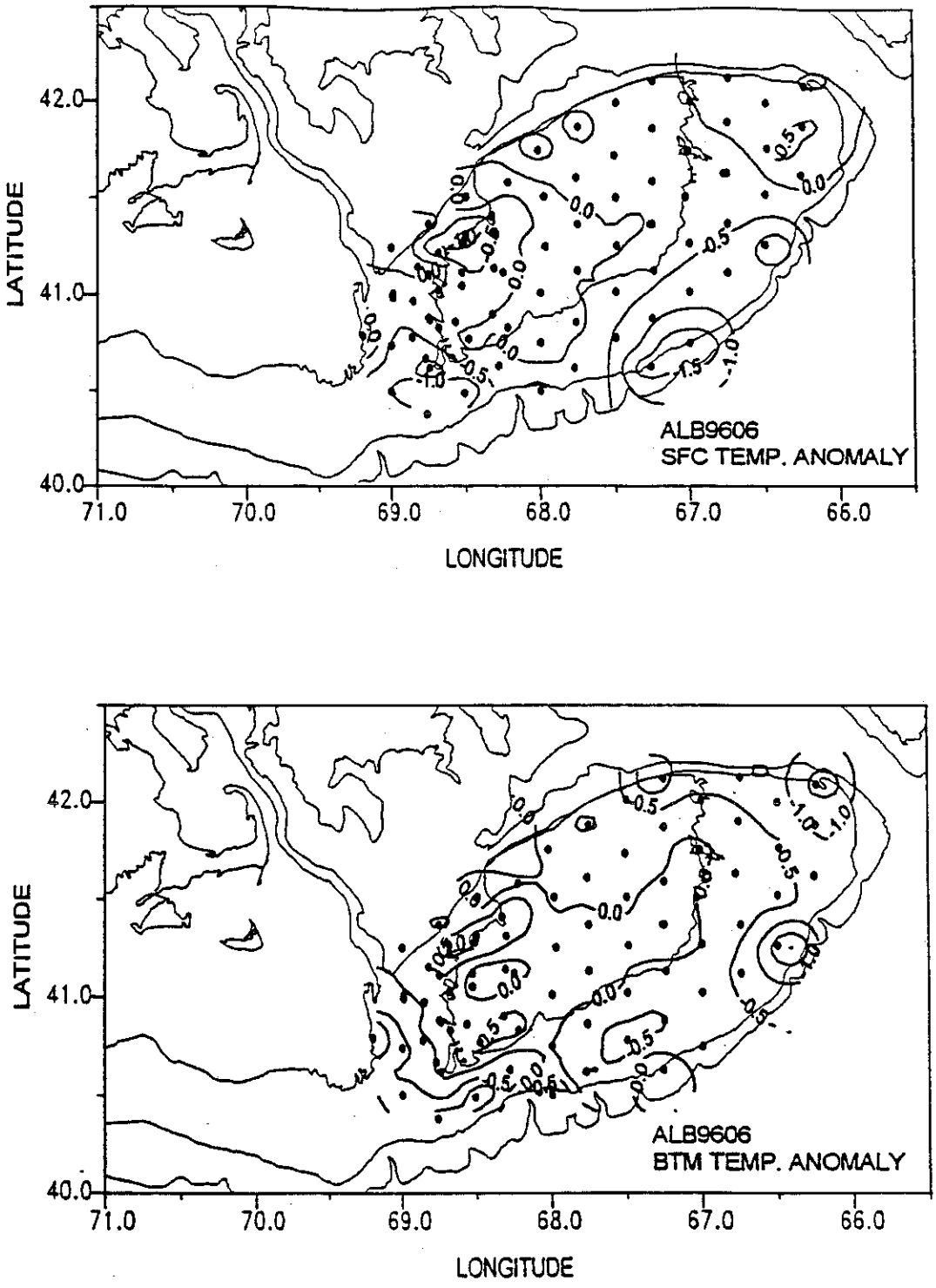


Figure 52. The surface and bottom temperature anomaly distributions during the predator / prey cruise ALB9606.

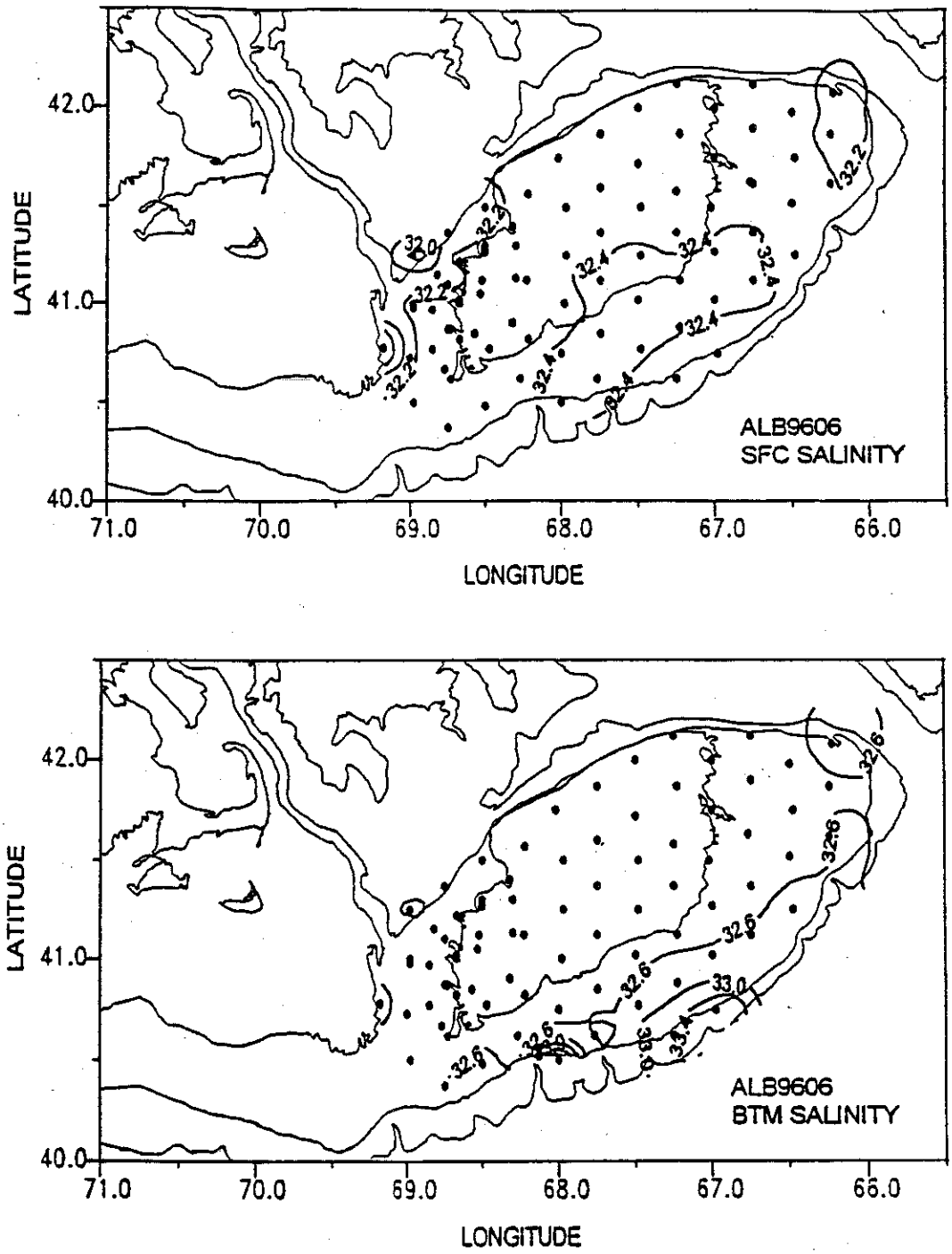


Figure 53. The surface and bottom salinity distributions during the predator / prey cruise ALB9606.

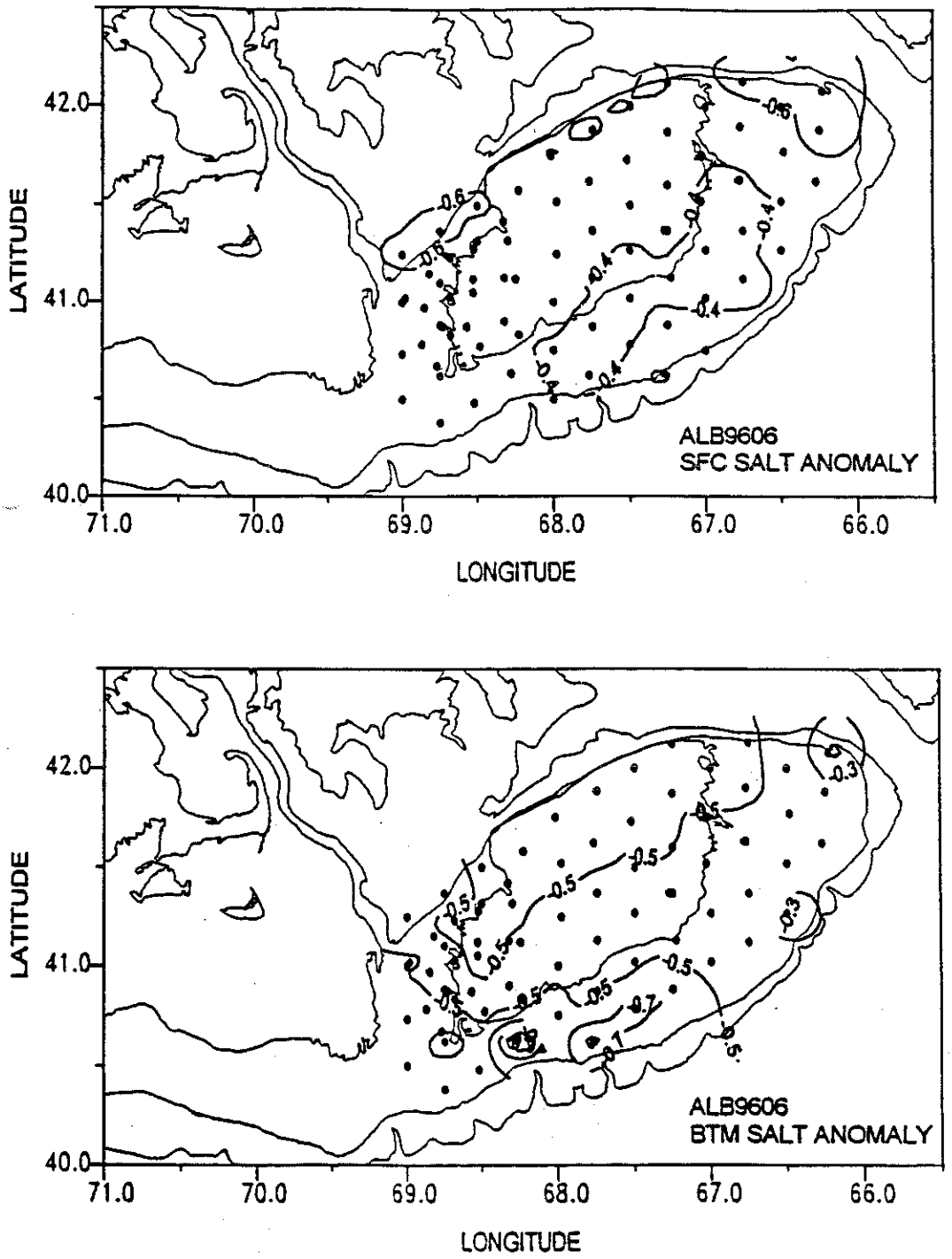


Figure 54. The surface and bottom salinity anomaly distributions during the predator / prey cruise ALB9606.

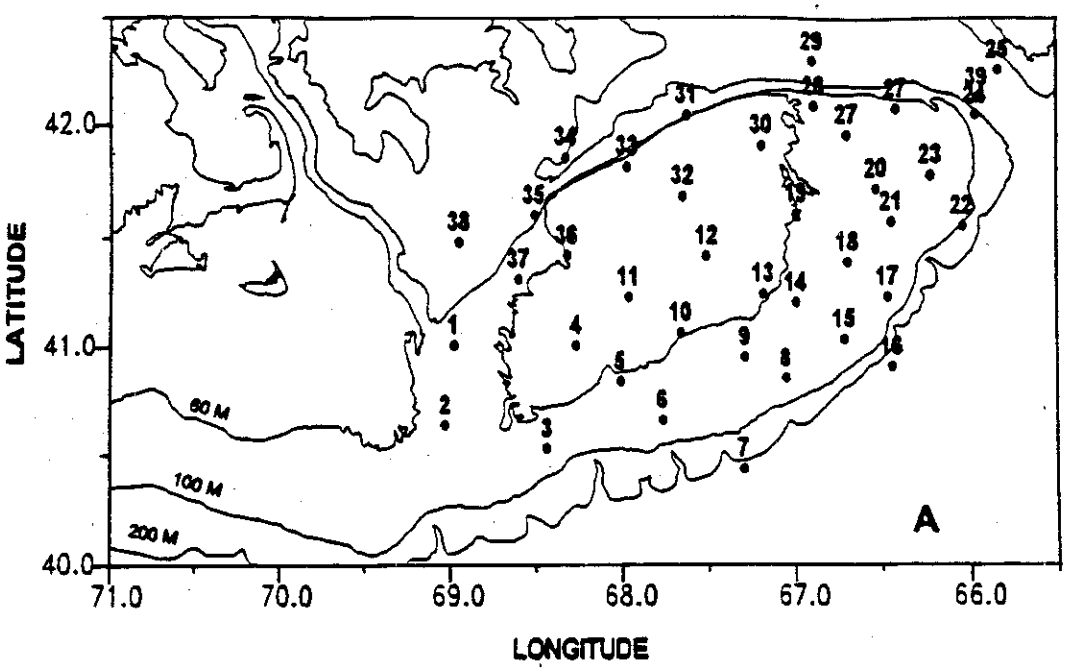


Figure 55. Hydrographic stations occupied during the GLOBEC broadscale survey ALB9607.

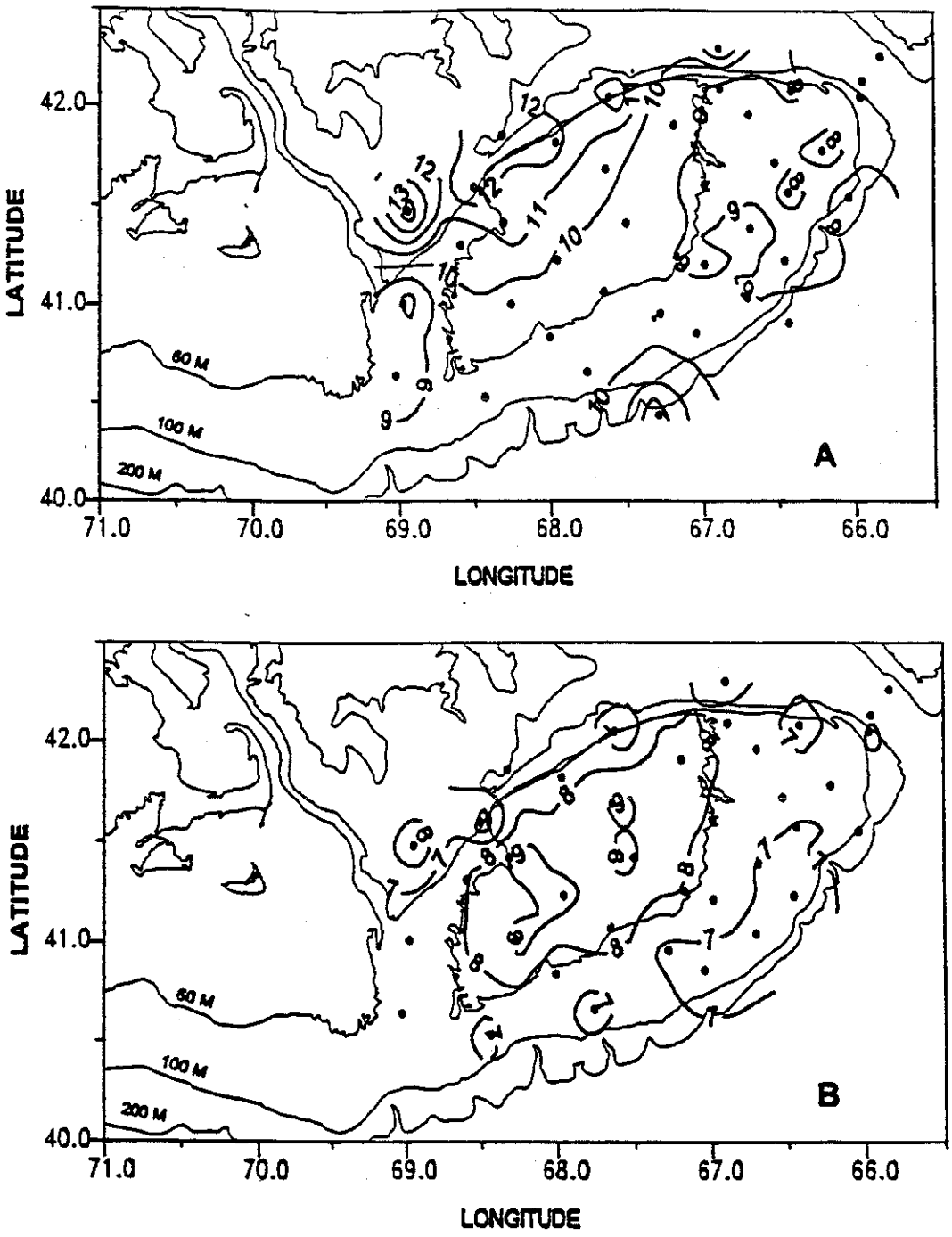


Figure 56. The surface and bottom temperature distributions during the GLOBEC broadscale survey ALB9607.

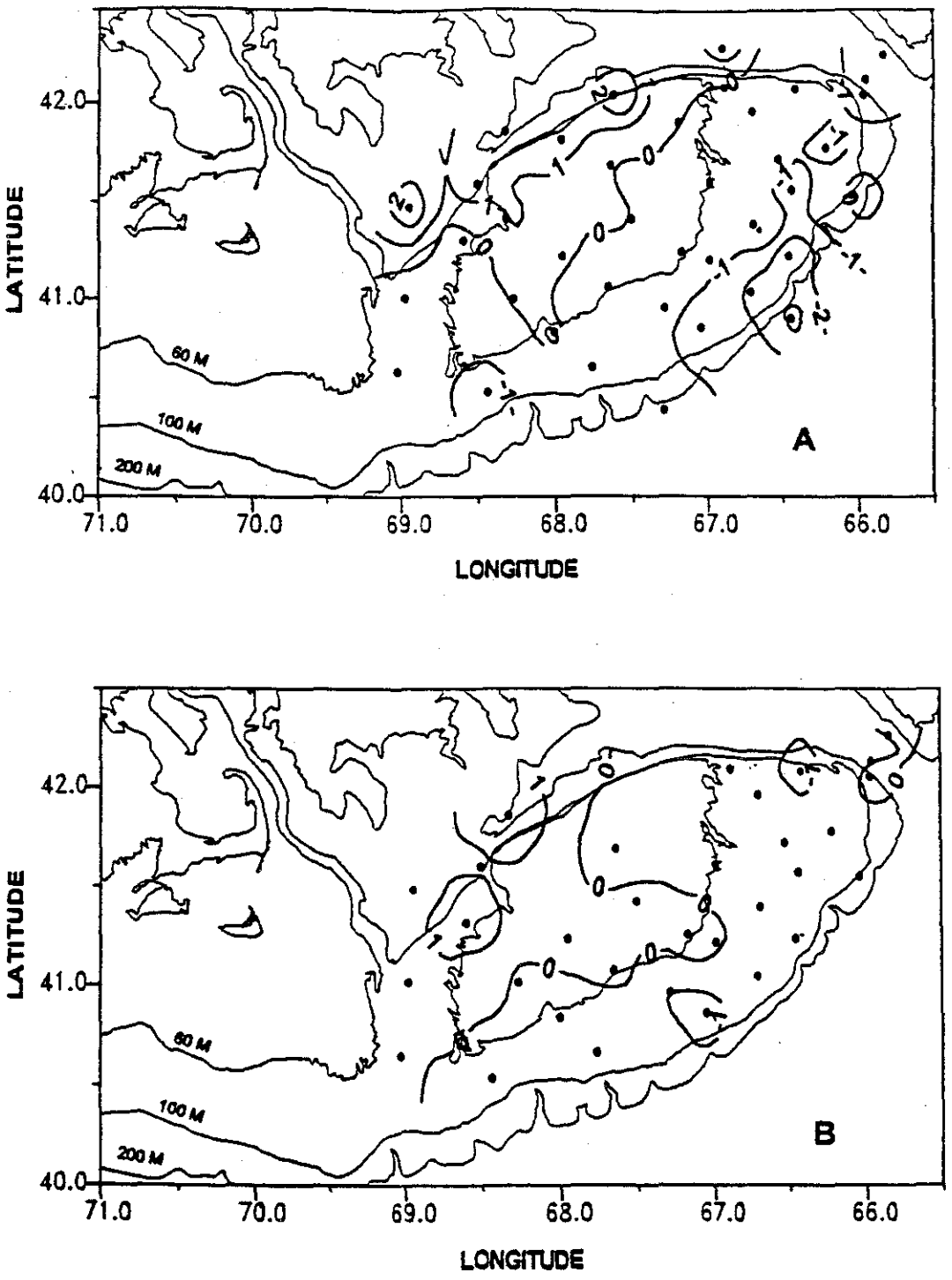


Figure 57. The surface and bottom temperature anomaly distributions for GLOBEC broadscale survey ALB9607.

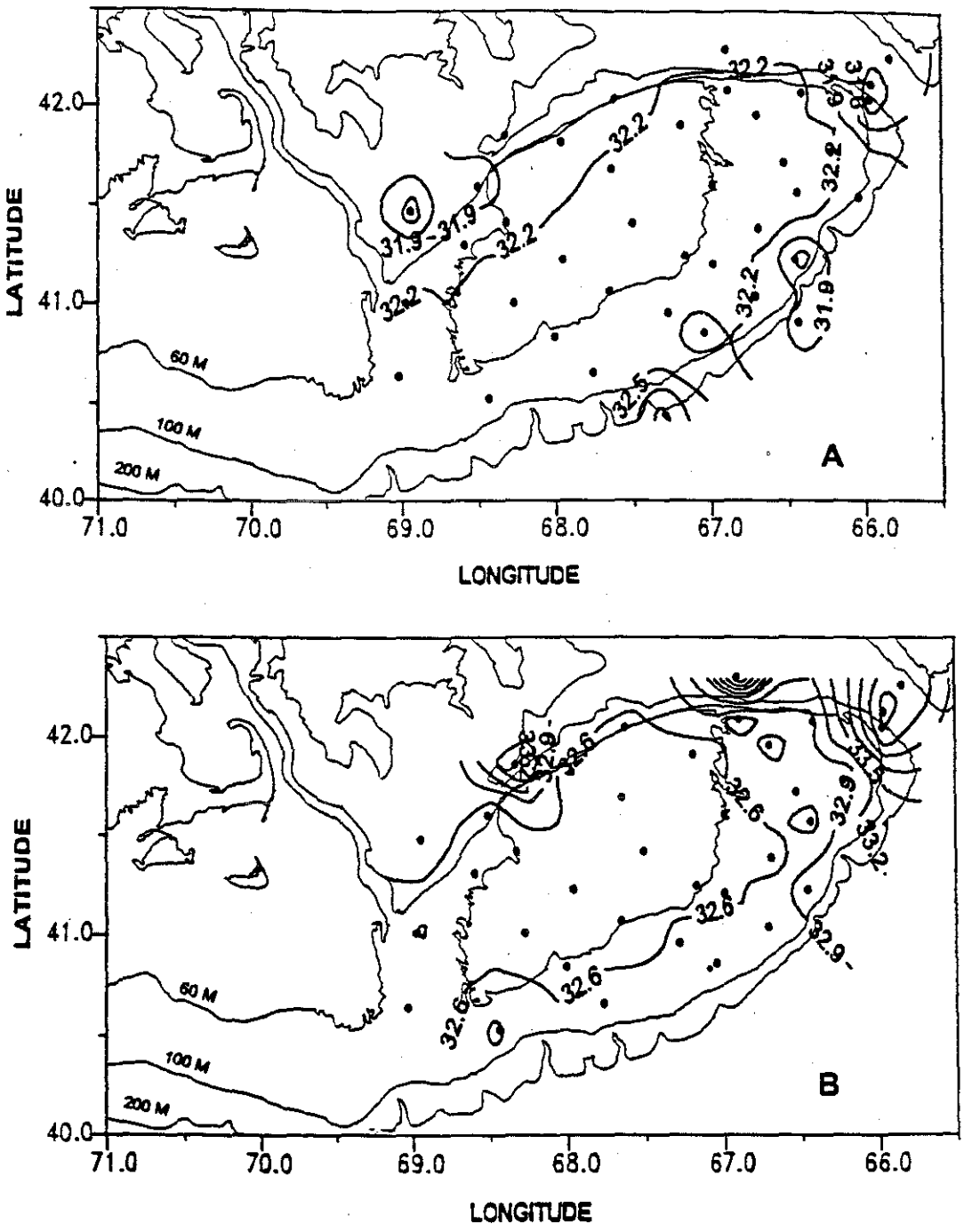


Figure 58. The surface and bottom salinity distributions during GLOBEC broadscale survey ALB9607.

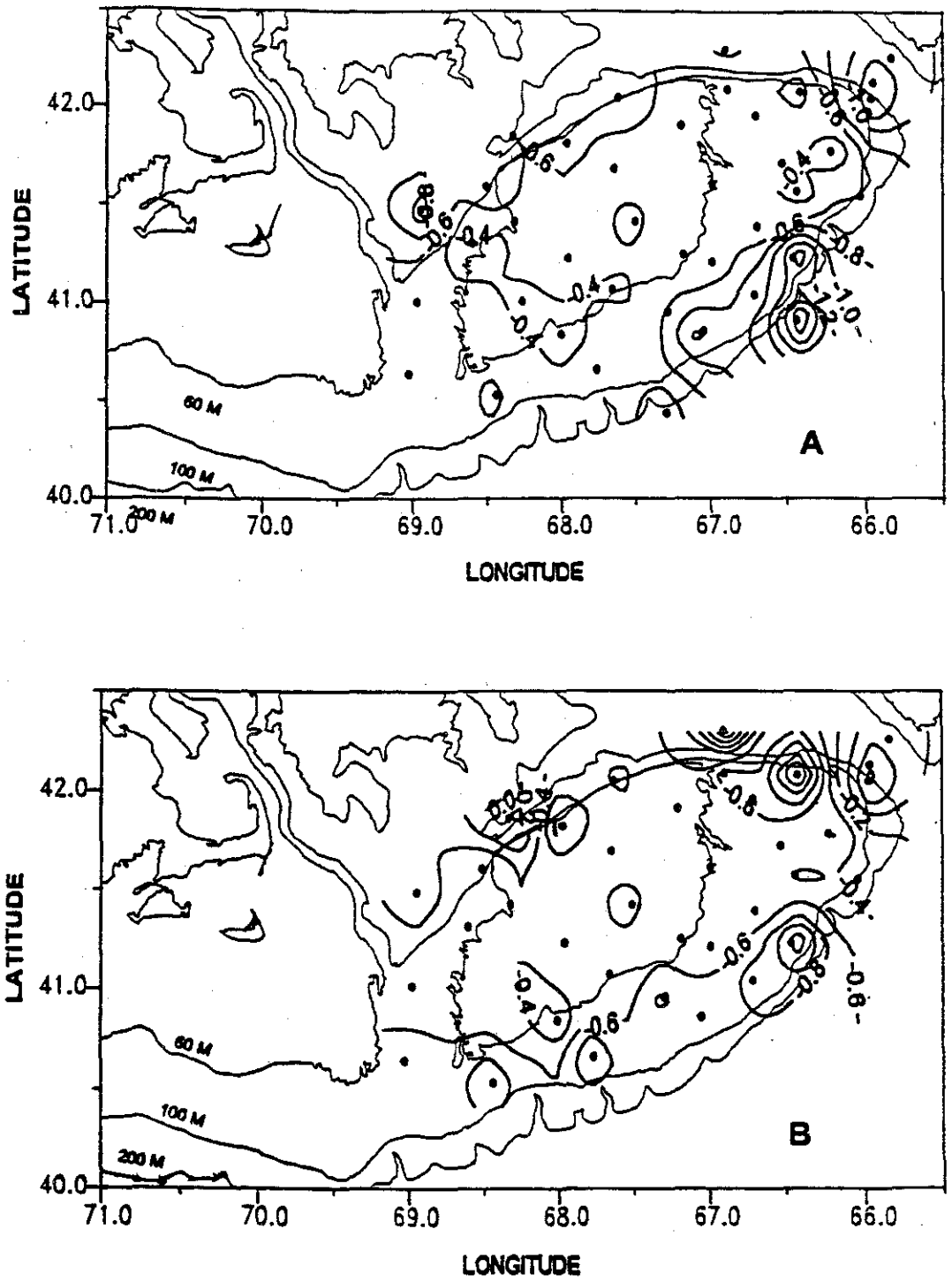


Figure 59. The surface and bottom salinity anomaly distributions during GLOBEC broadscale survey ALB9607.

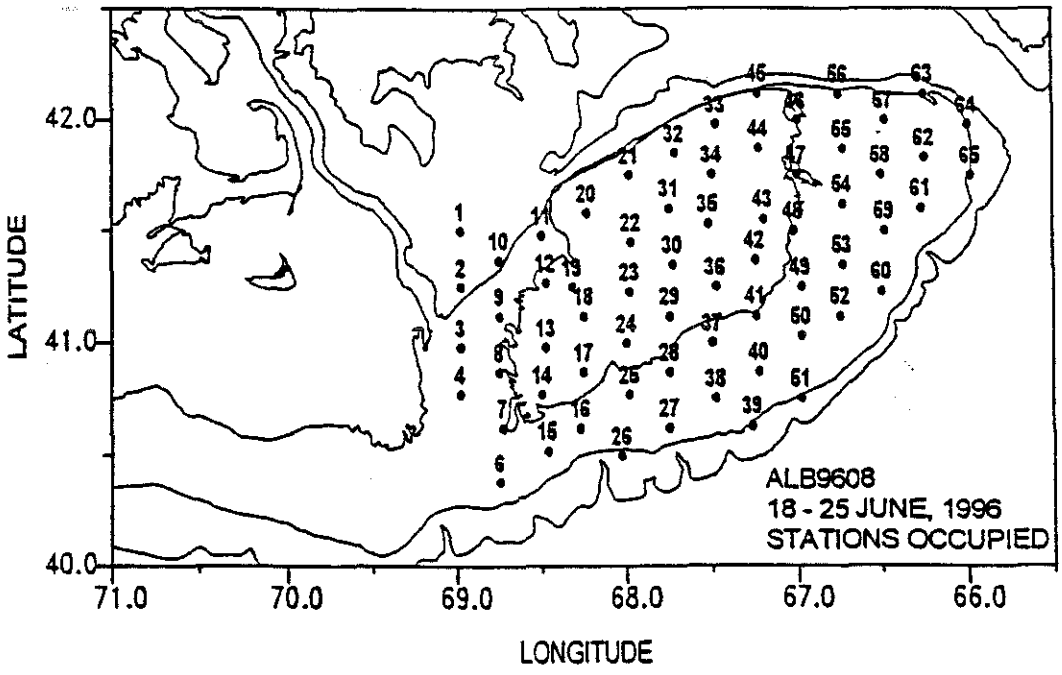


Figure 60. Hydrographic stations occupied during the predator / Prey survey ALB9608.

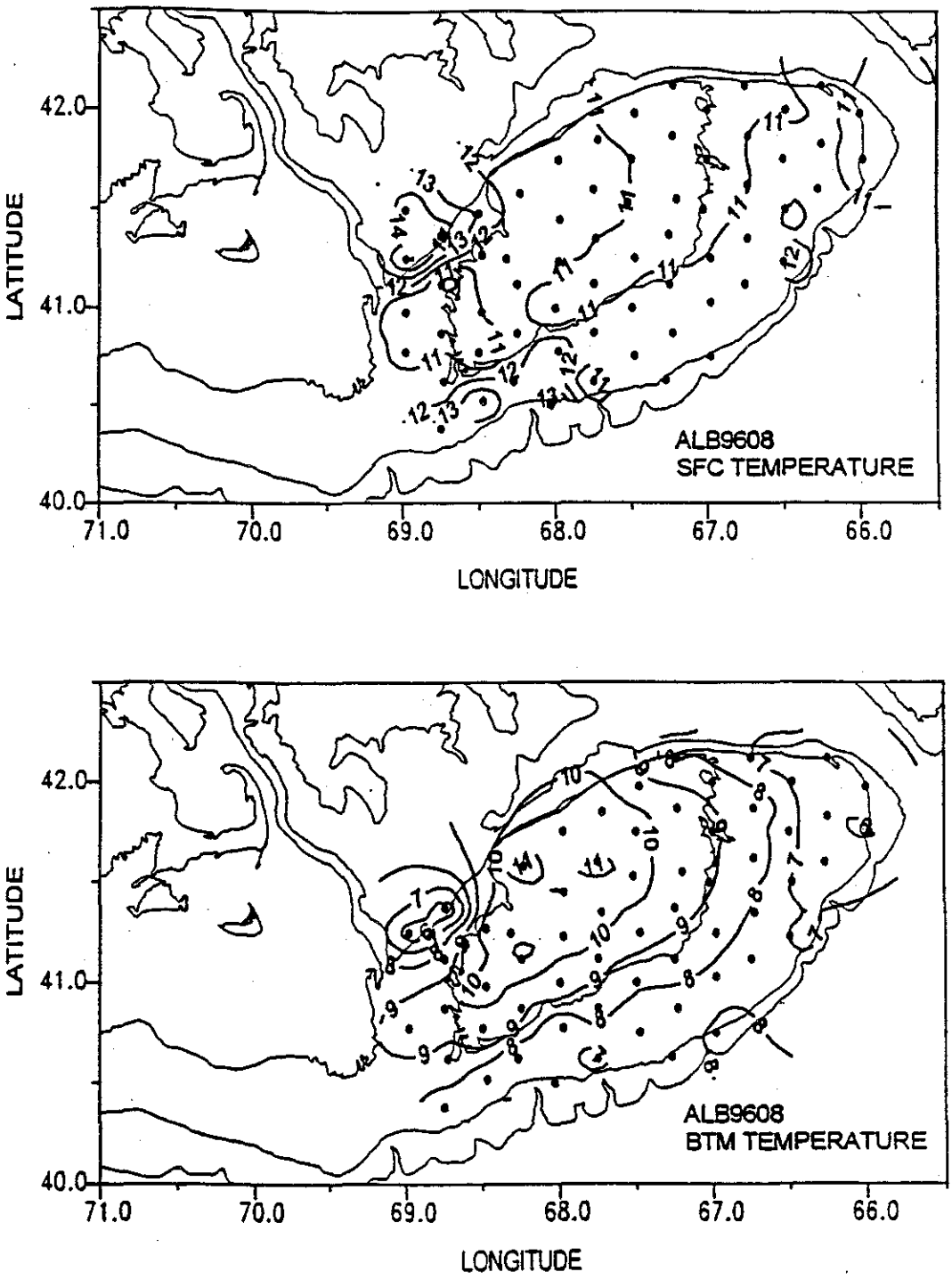


Figure 61. The surface and bottom temperature distributions during the predator / prey cruise ALB9608.

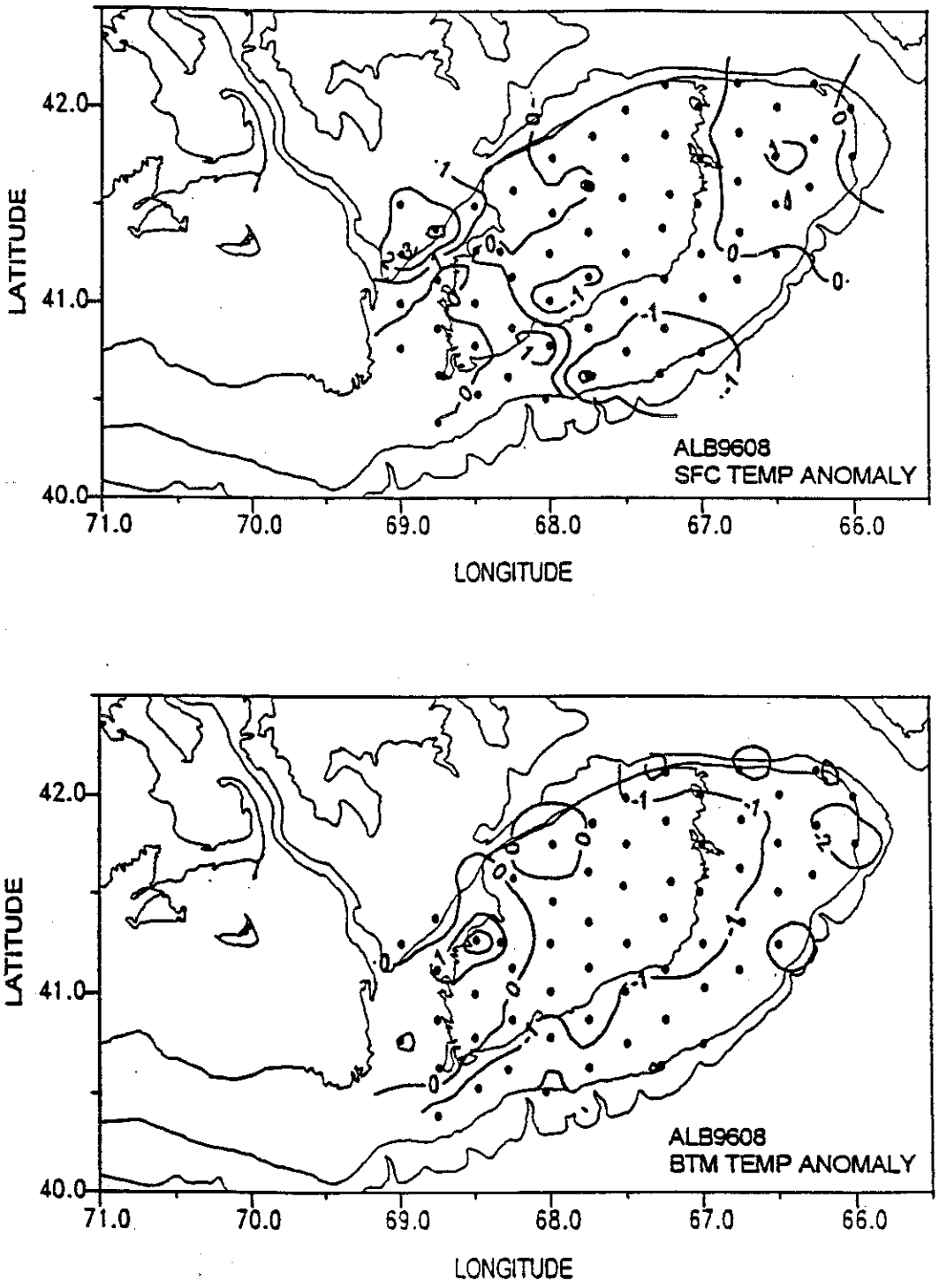


Figure 62. The surface and bottom temperature anomaly distributions during the predator / prey cruise ALB9608.

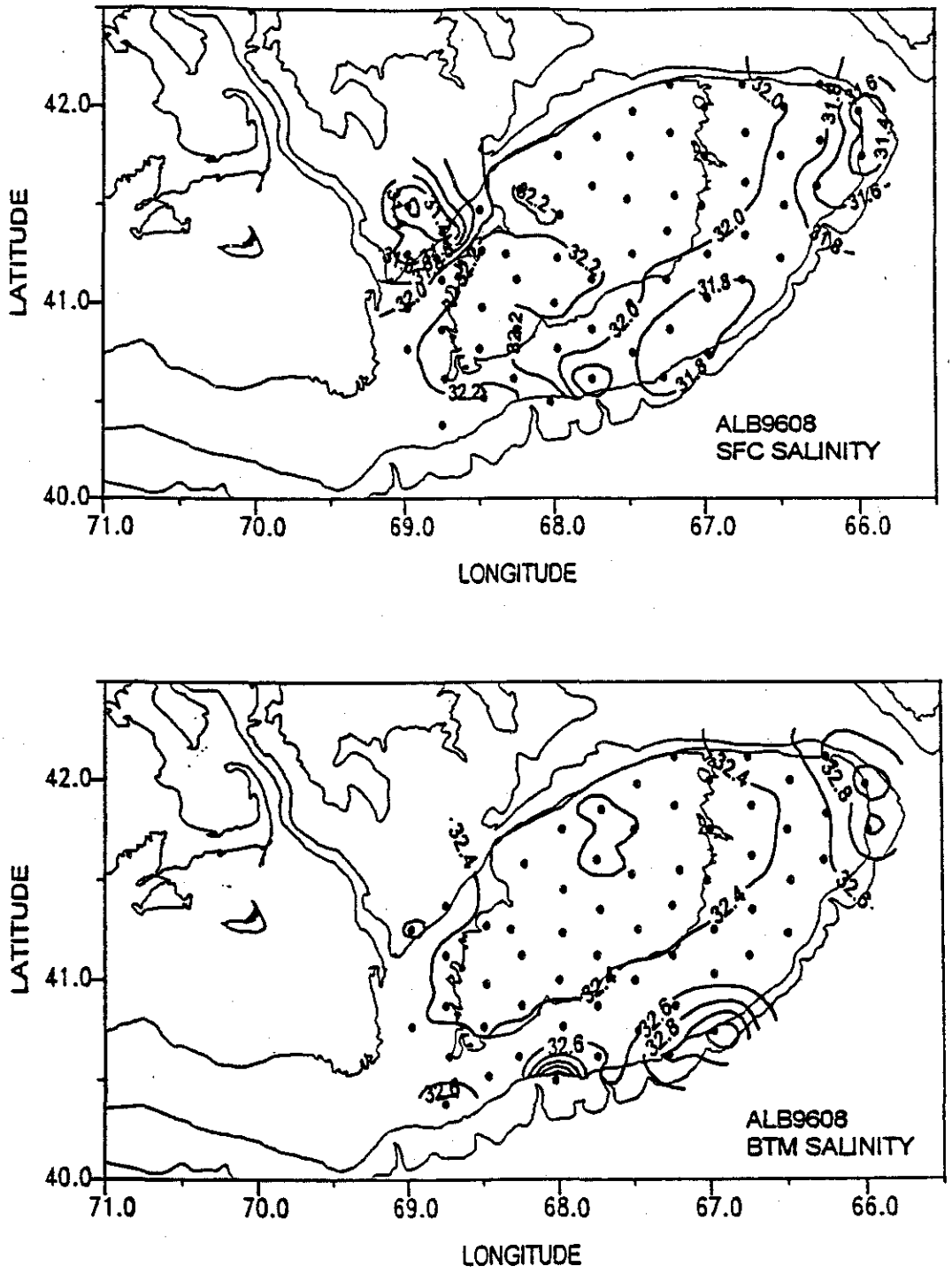


Figure 63. The surface and bottom salinity distributions during the predator / prey cruise ALB9608.

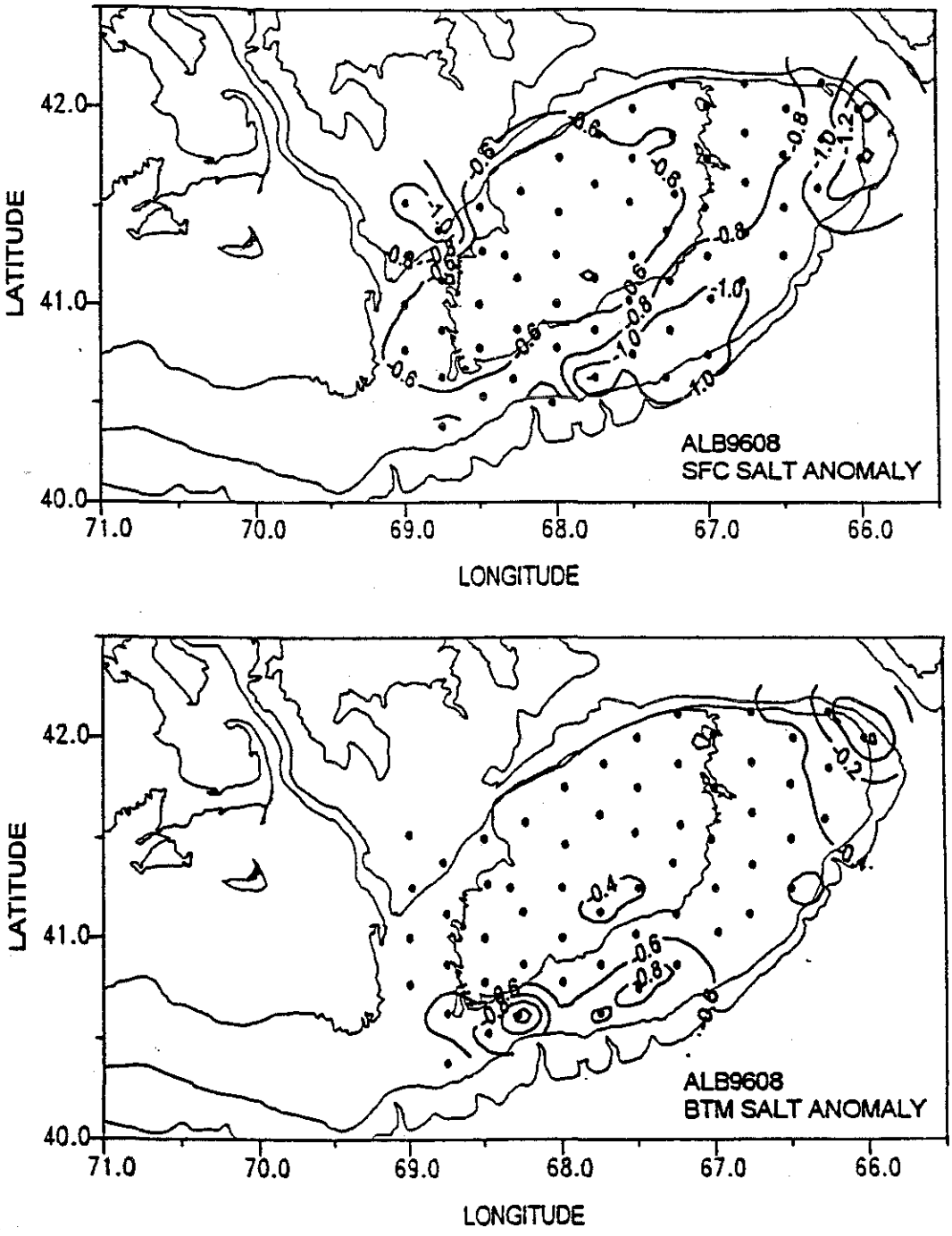


Figure 64. The surface and bottom salinity anomaly distributions during the predator / prey cruise ALB9608.

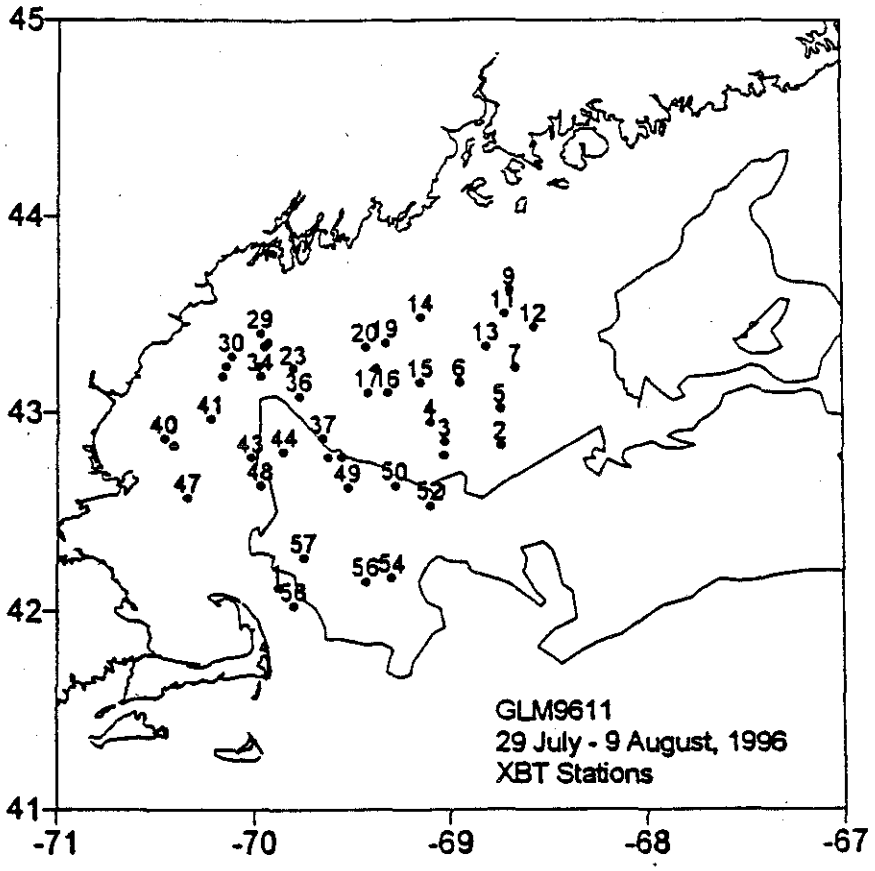
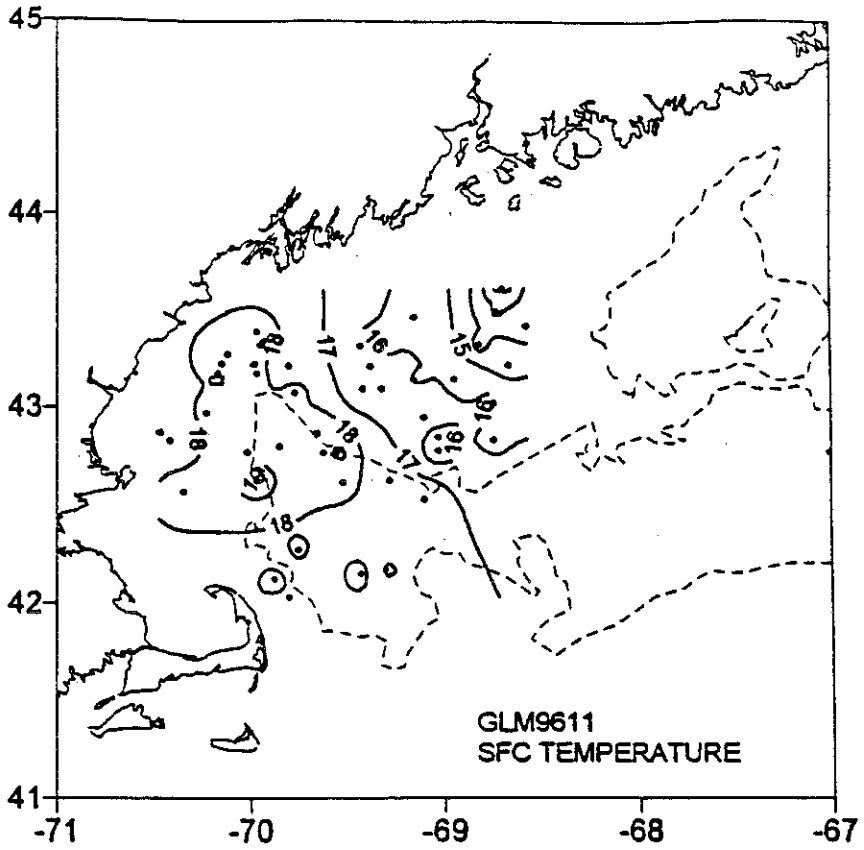


Figure 65. Stations occupied during the Gulf of Maine shrimp survey GLM9611.



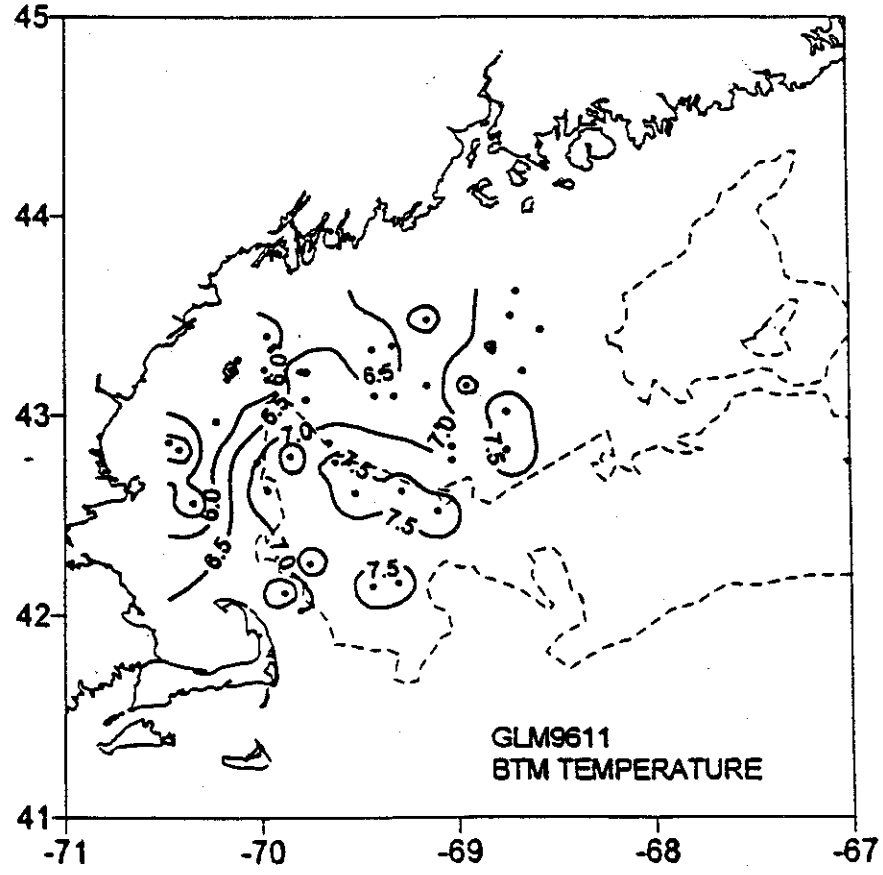
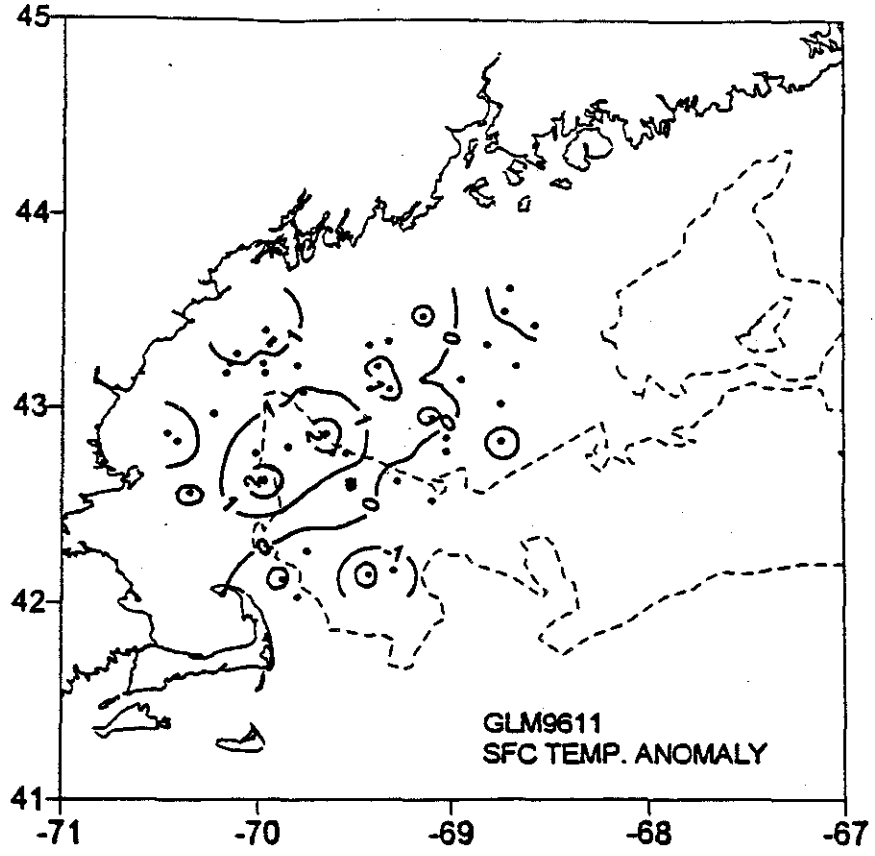


Figure 66. The surface and bottom temperature distributions during the Gulf of Maine shrimp survey GLM9611.



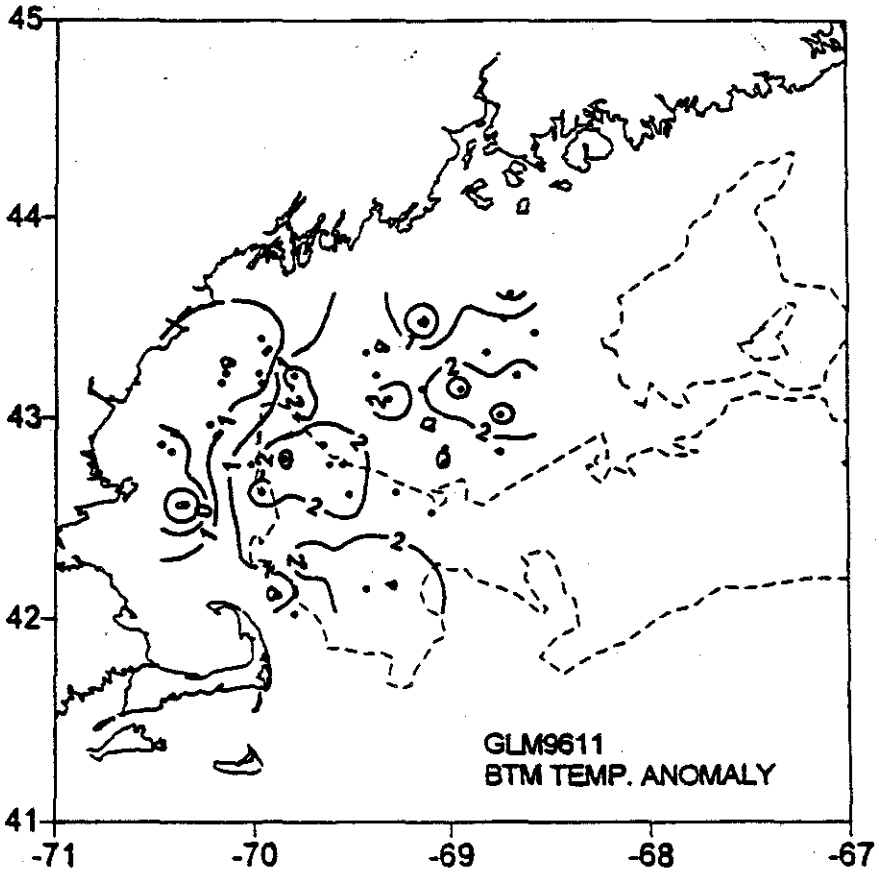


Figure 67. The surface and bottom temperature anomaly distributions during the Gulf of Maine shrimp survey GLM9611.

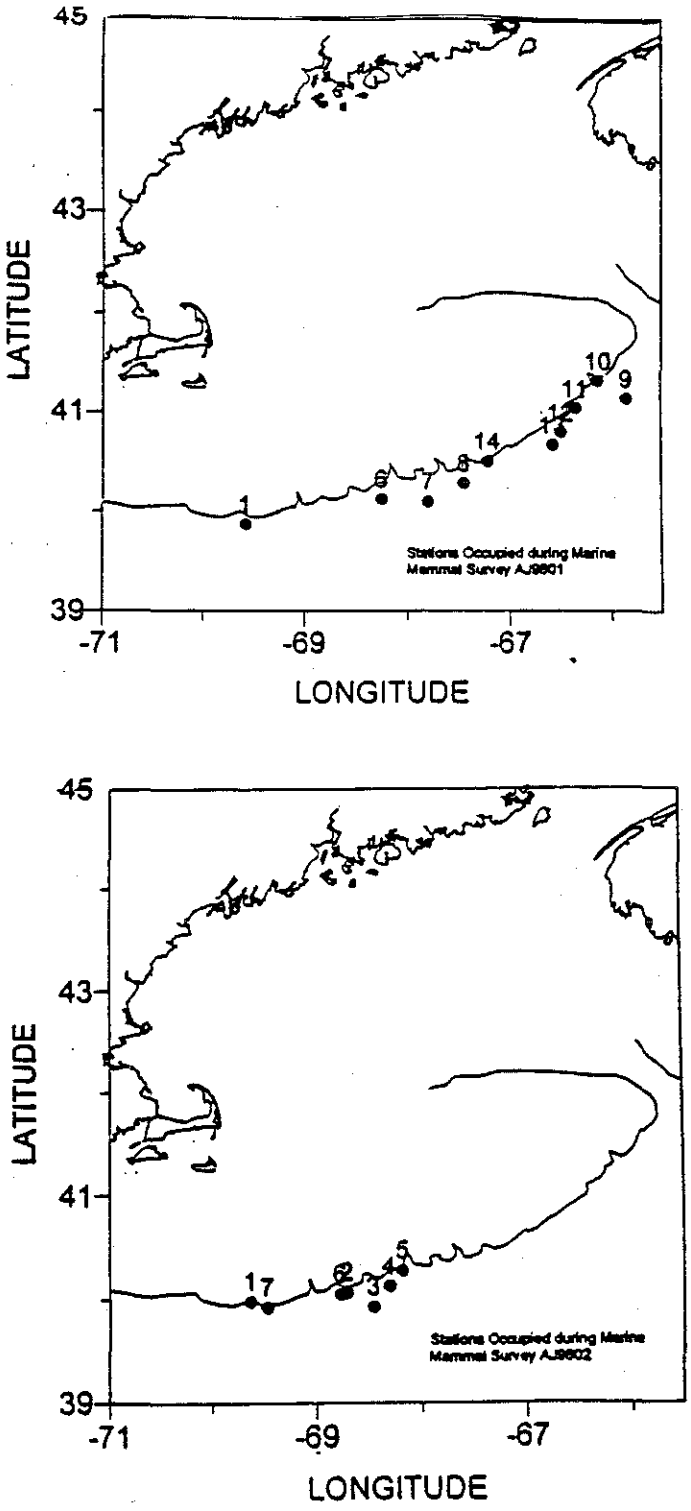


Figure 68. Hydrographic stations occupied during the marine mammal surveys AJ9601 and AJ9602.

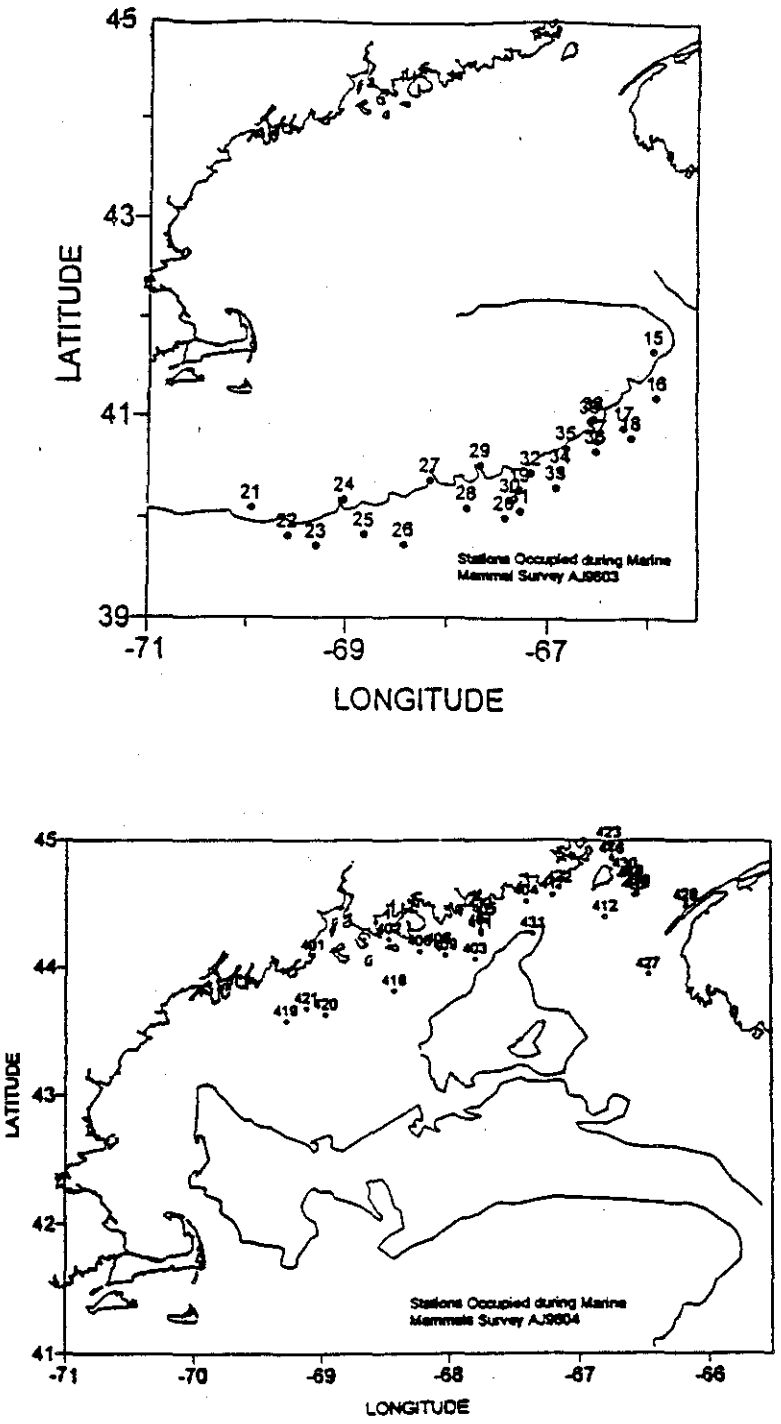


Figure 69. Hydrographic stations occupied during the marine mammal survey AJ9603 and AJ9604.

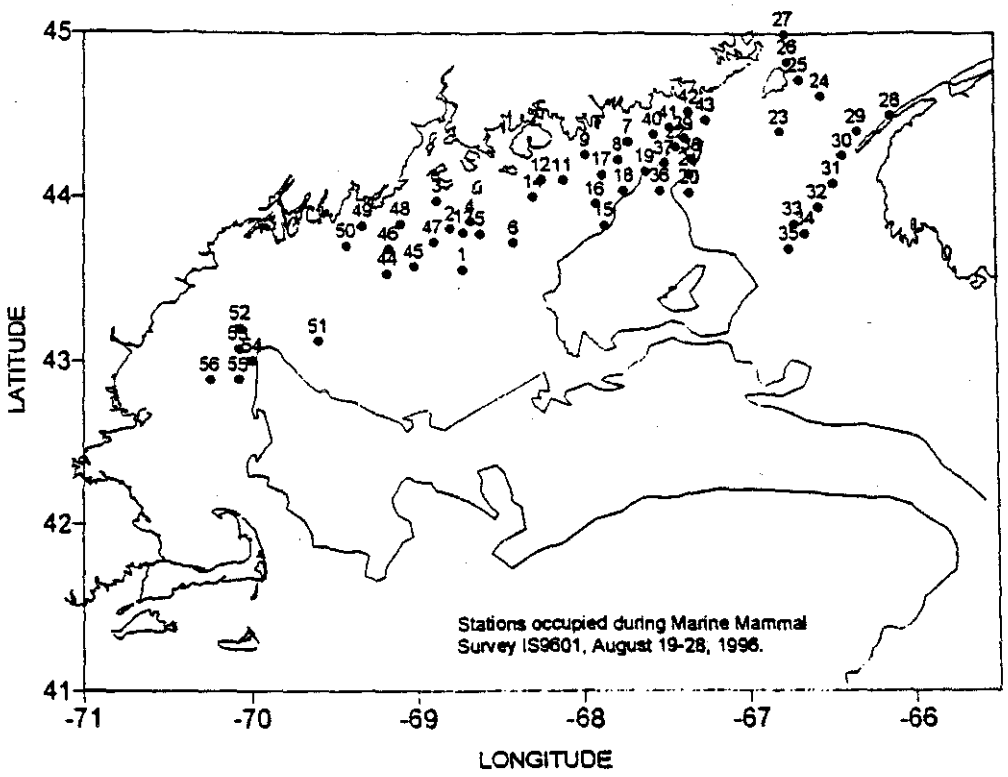


Figure 70. Hydrographic stations occupied during the marine mammal survey IS9601.

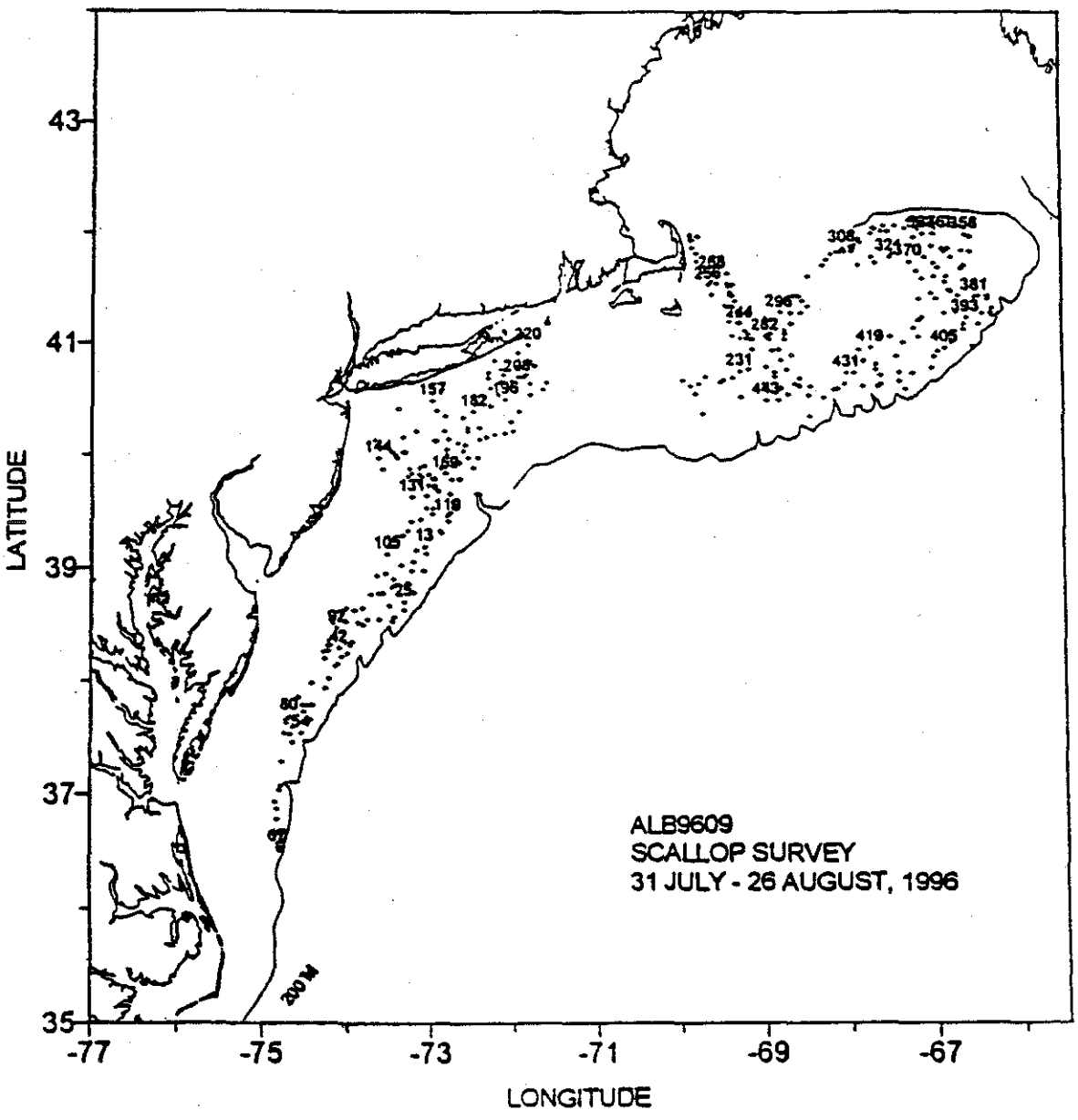


Figure 71. Hydrographic stations occupied during the scallop survey ALB9609.

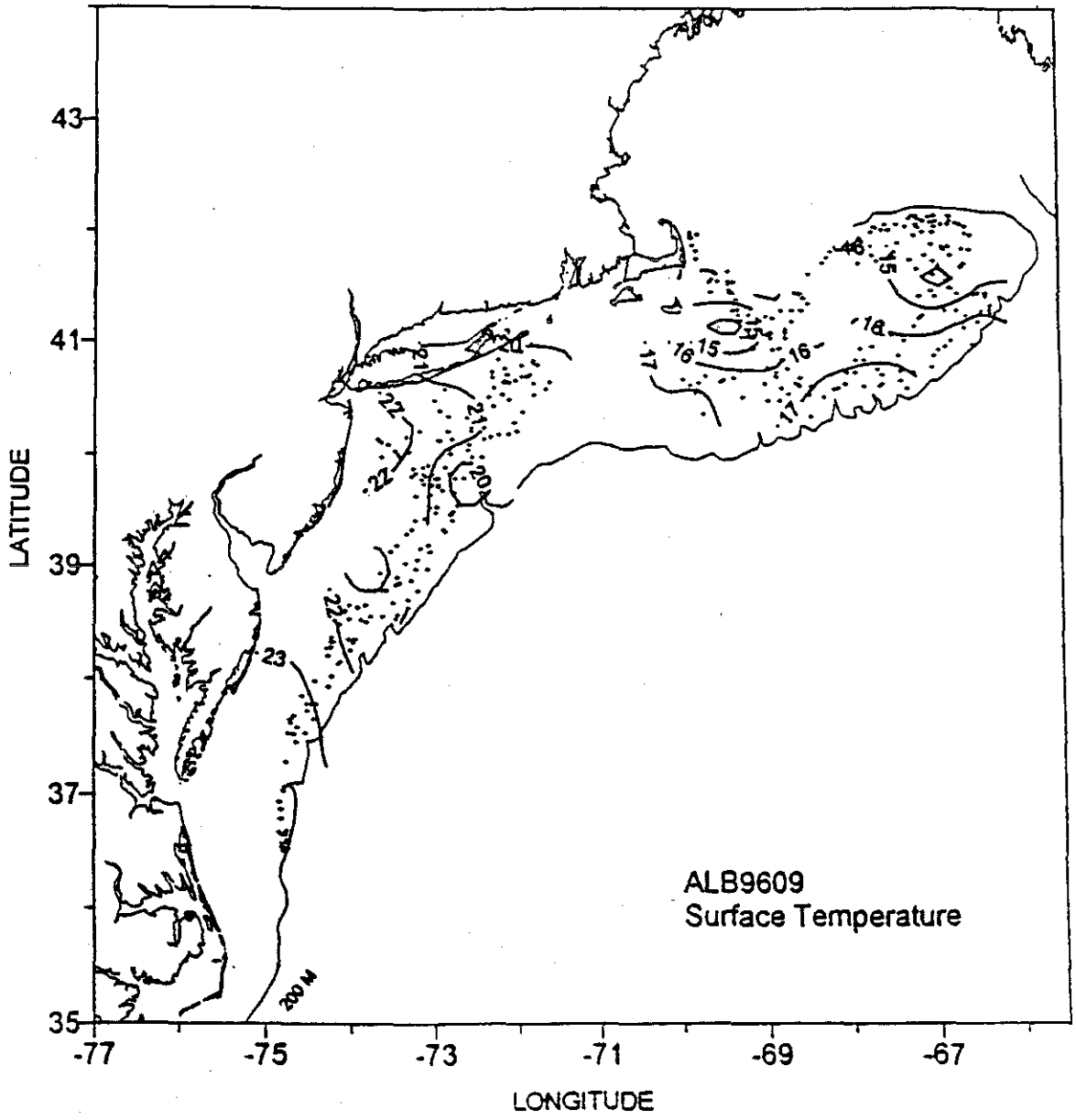


Figure 72. The surface temperature distribution for the scallop survey ALB9609.

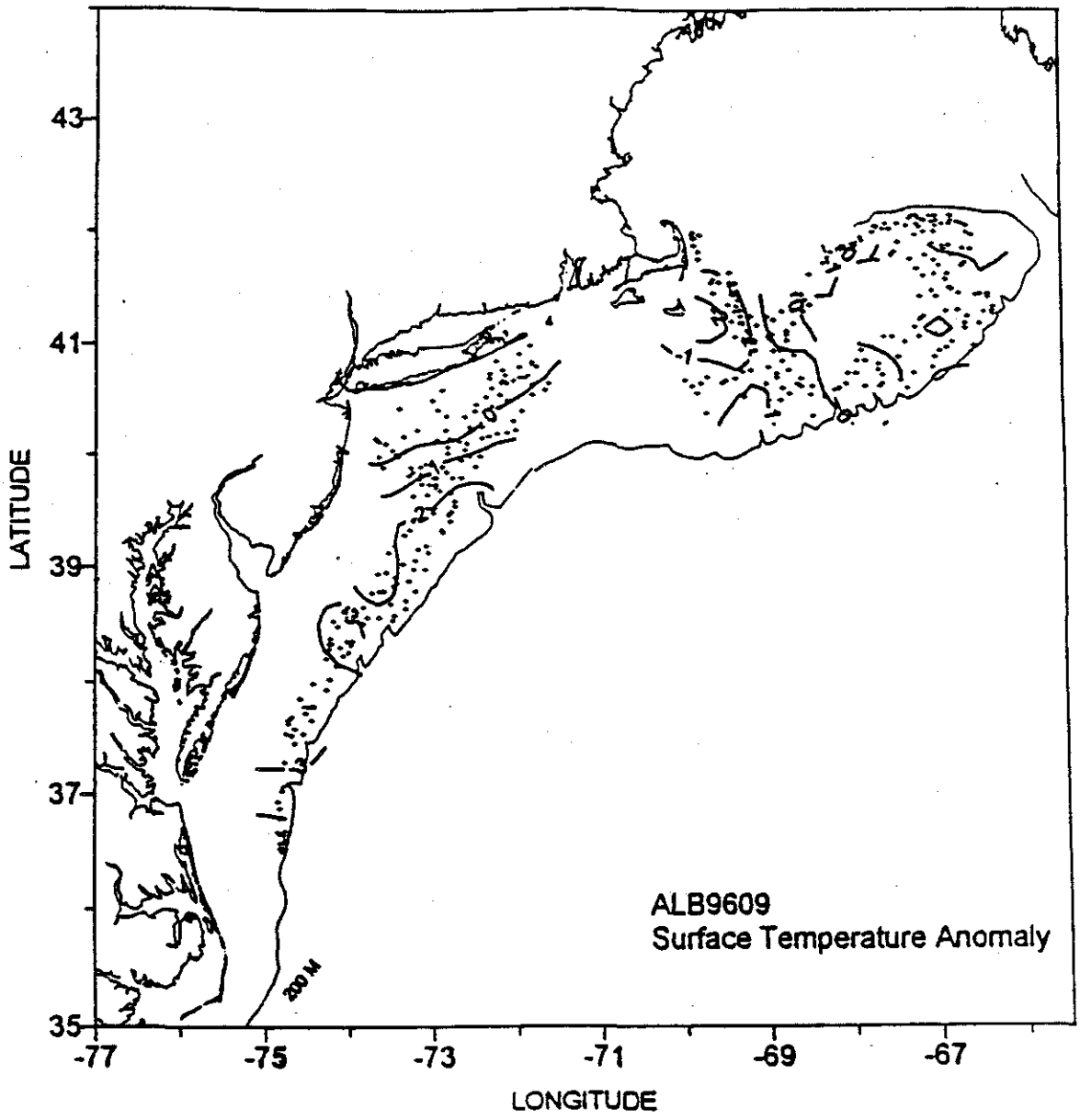


Figure 73. The surface temperature anomaly distribution for the scallop survey ALB9609.

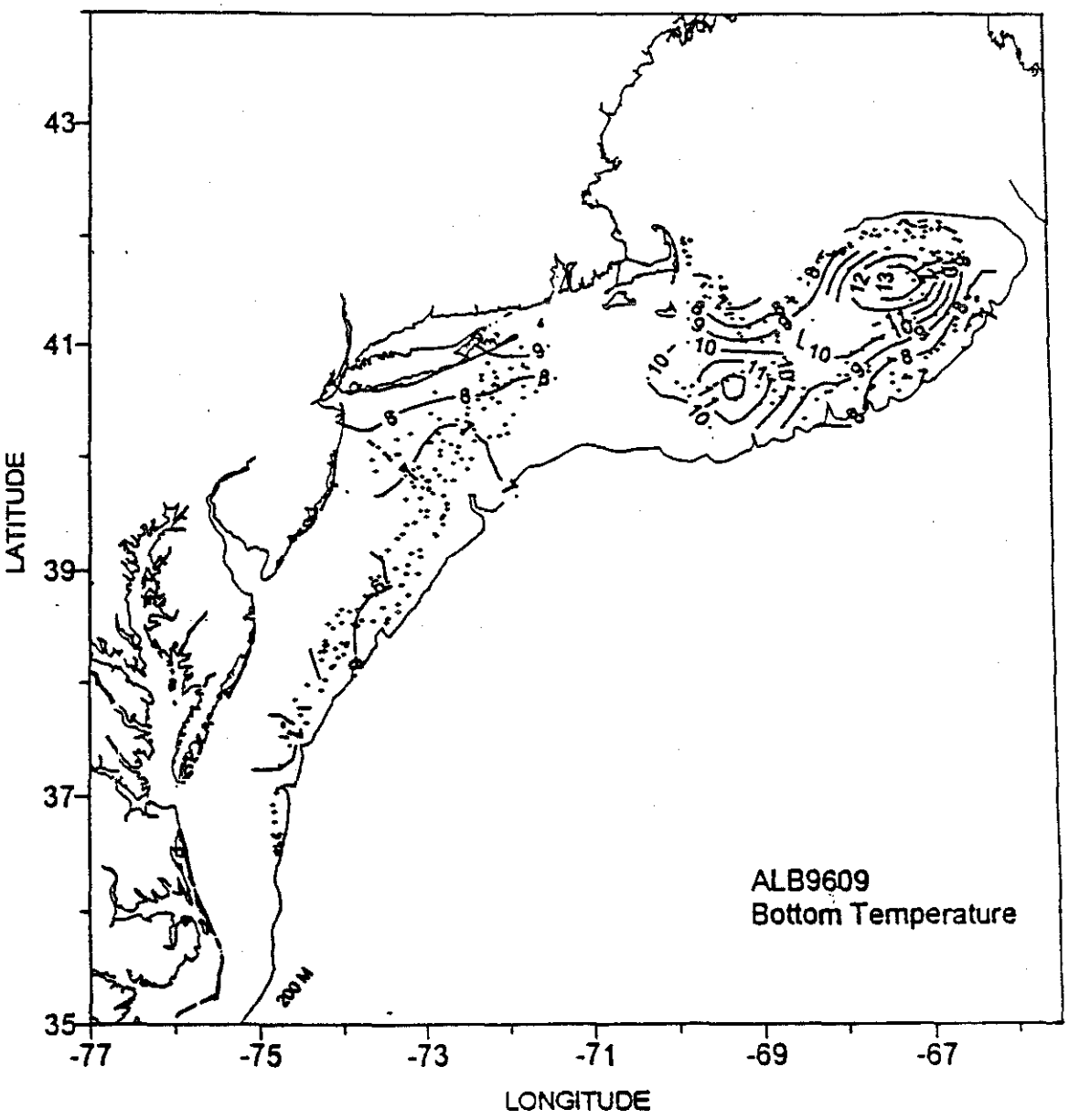


Figure 74. The bottom temperature distribution for the scallop survey ALB9609.

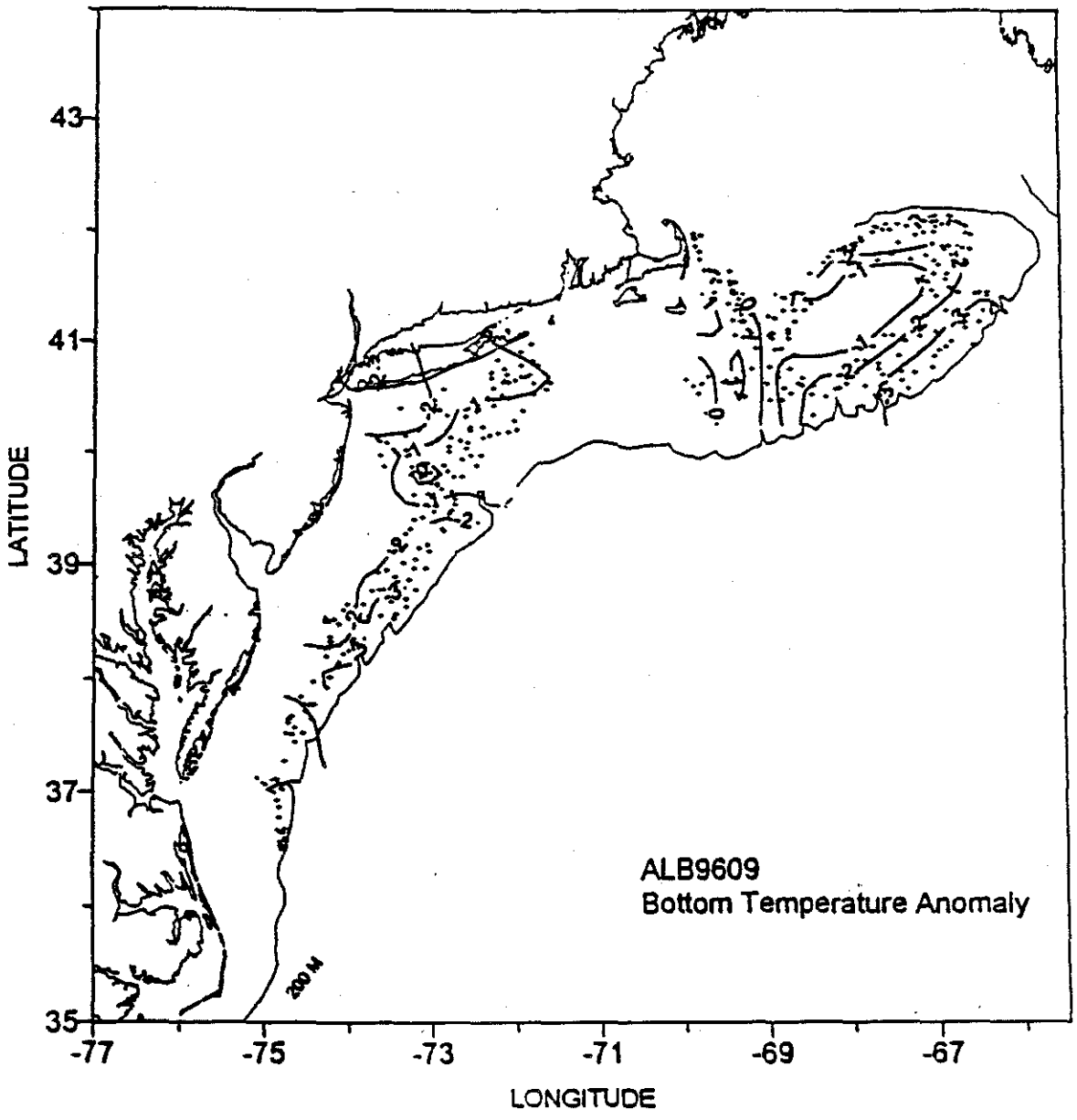


Figure 75. The bottom temperature anomaly distribution for the scallop survey ALB9609.

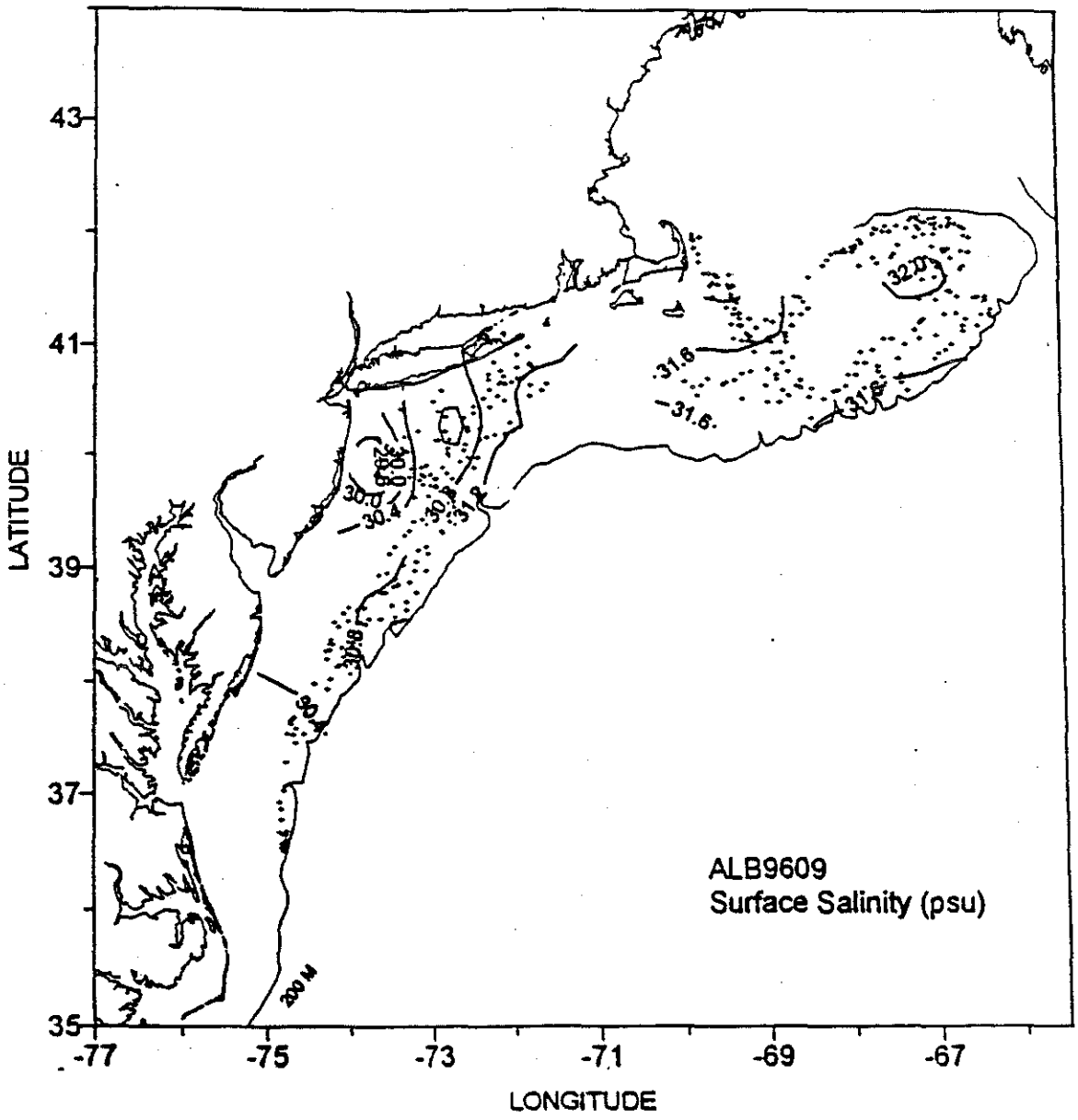


Figure 76. The surface salinity distribution for the scallop survey ALB9609.

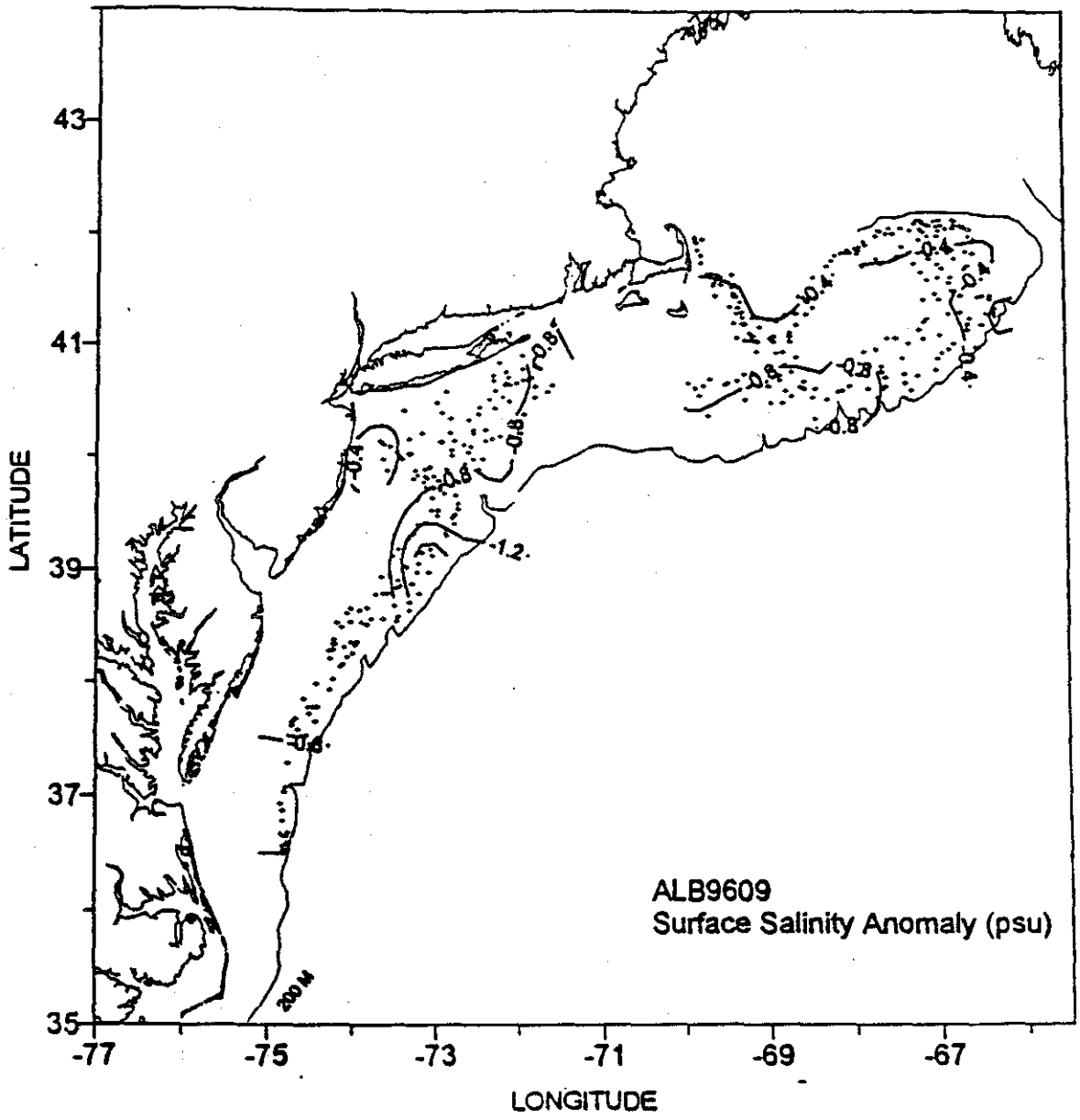


Figure 77. The surface salinity anomaly distribution for the scallop survey ALB9609.

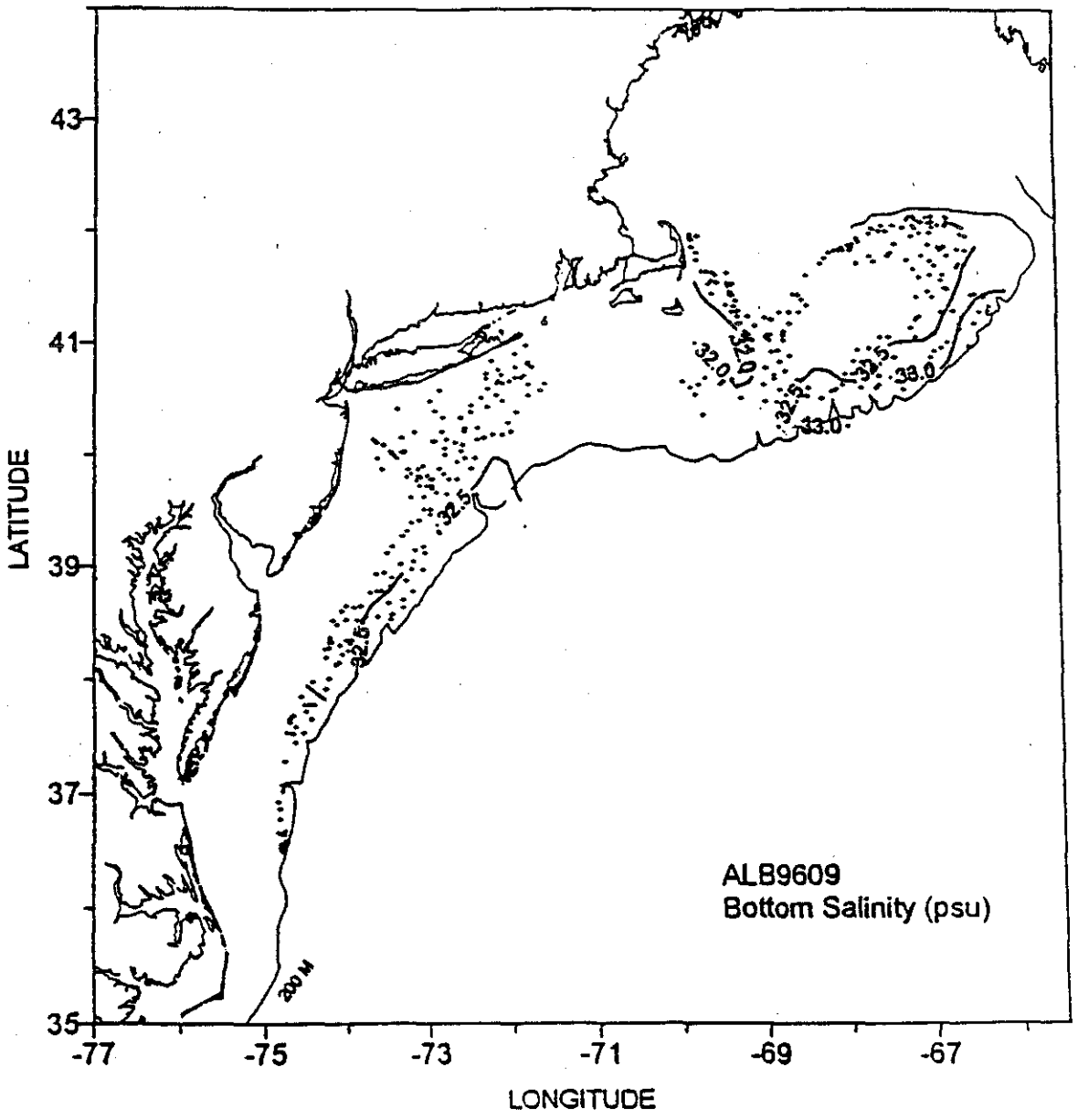


Figure 78. The bottom salinity distribution for the scallop survey ALB9609.

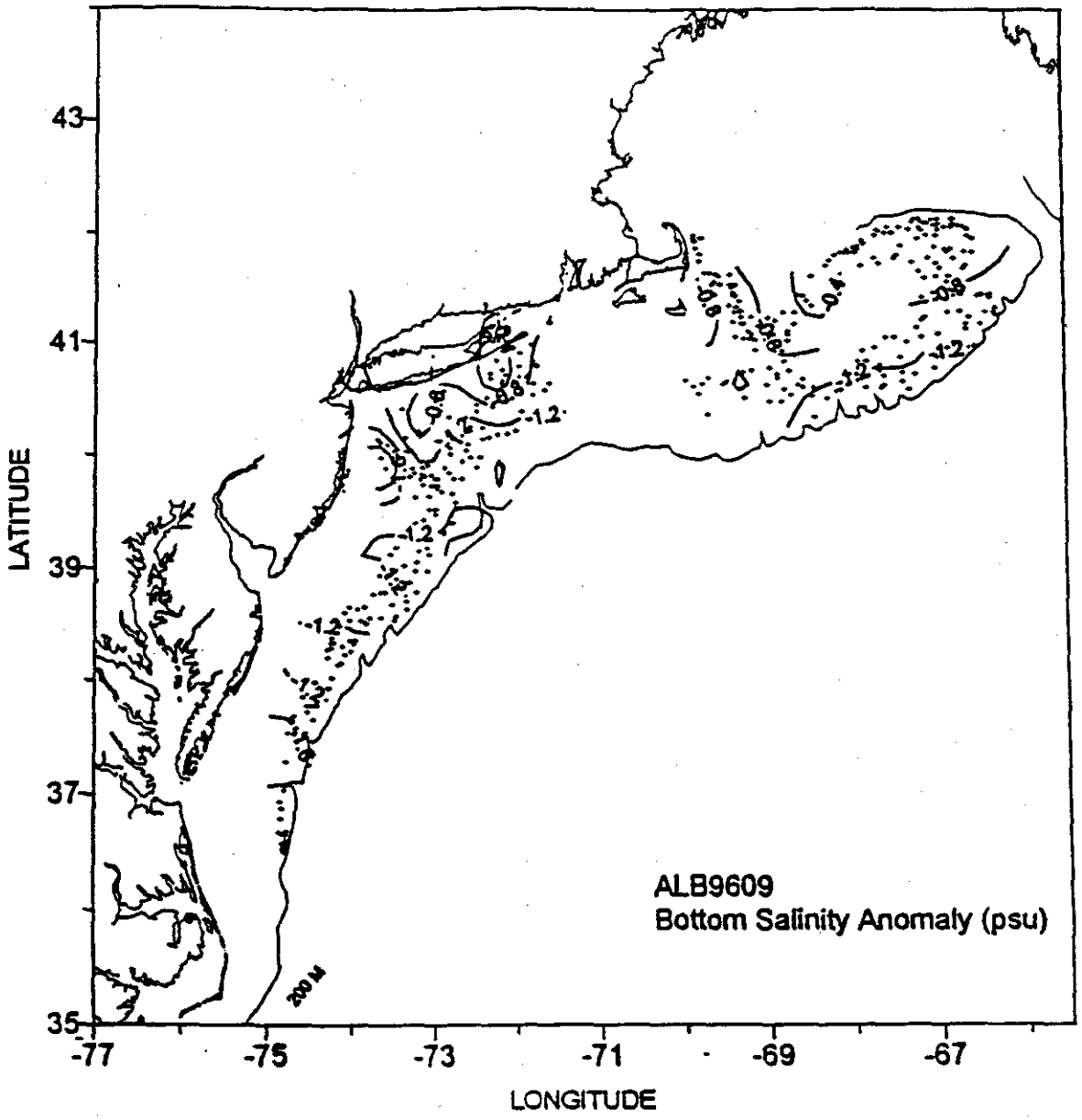


Figure 79. The bottom salinity anomaly distribution for the scallop survey ALB9609.

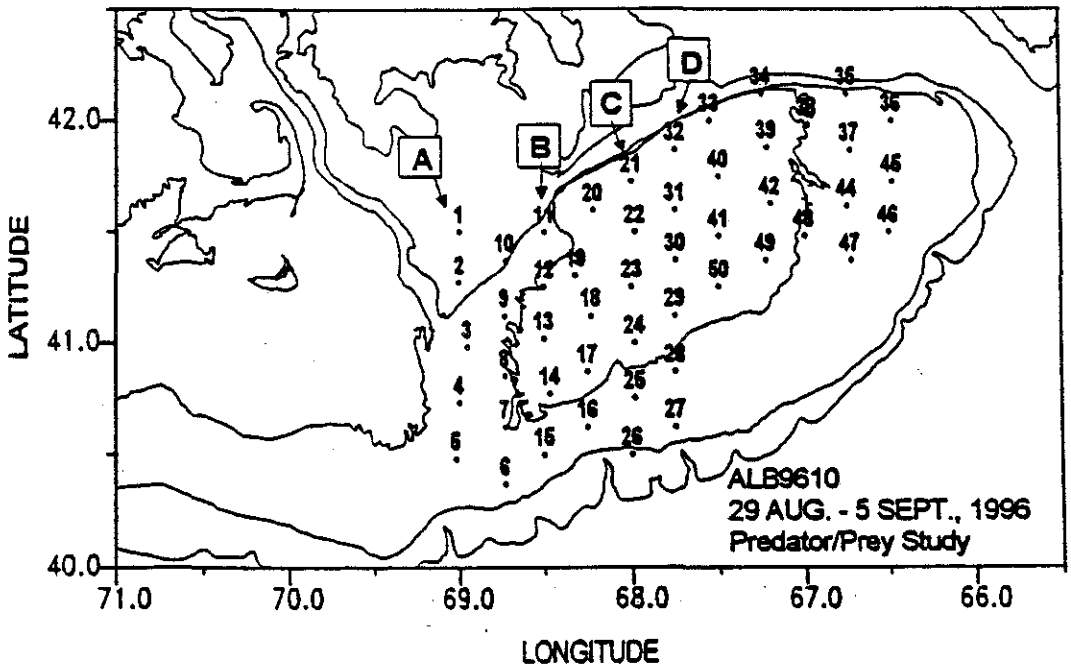


Figure 80. Hydrographic stations occupied during the predator / prey survey ALB9610.

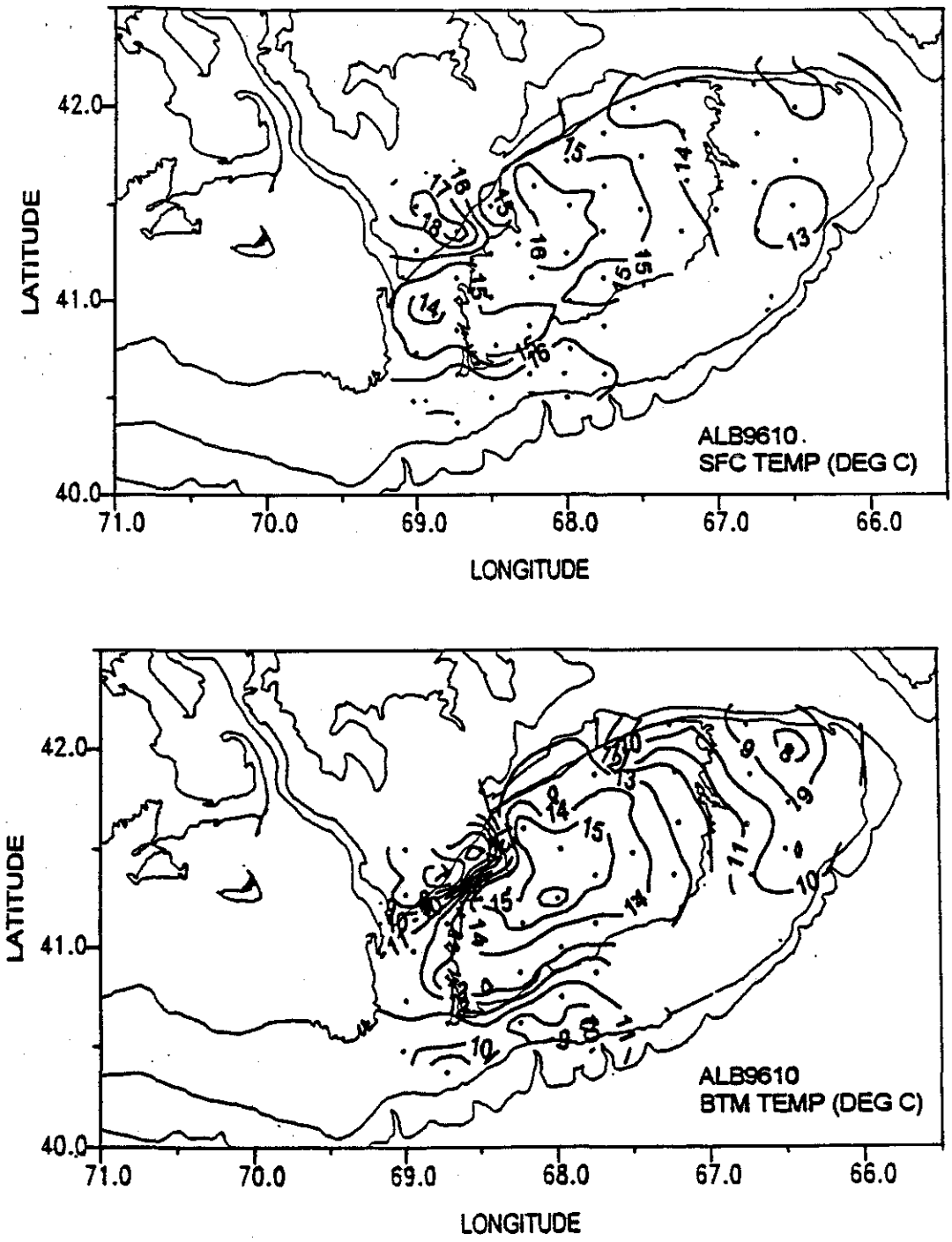


Figure 81. The surface and bottom temperature distributions during the predator / prey cruise ALB9610.

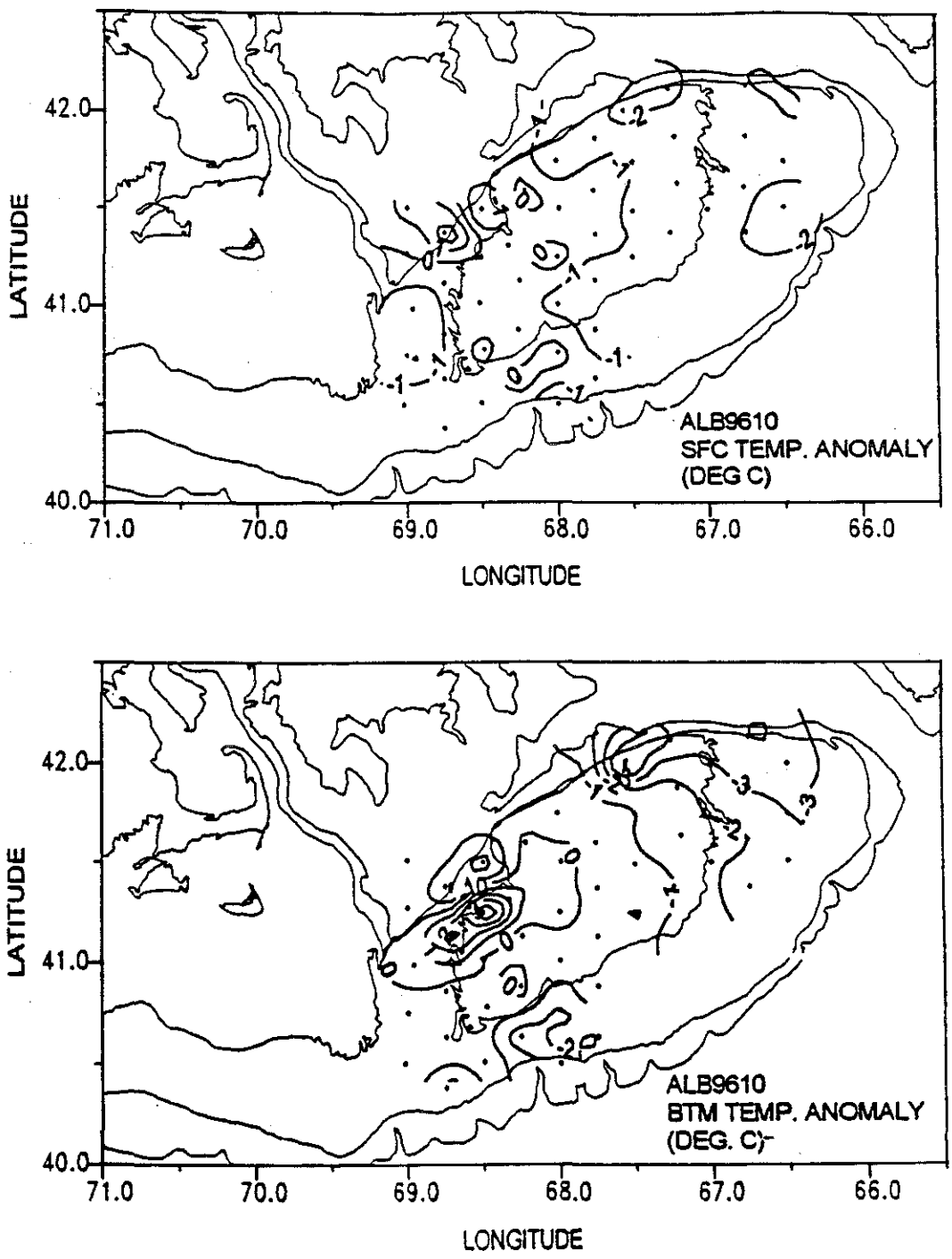


Figure 82. The surface and bottom temperature anomaly distributions during the predator / prey cruise ALB9610.

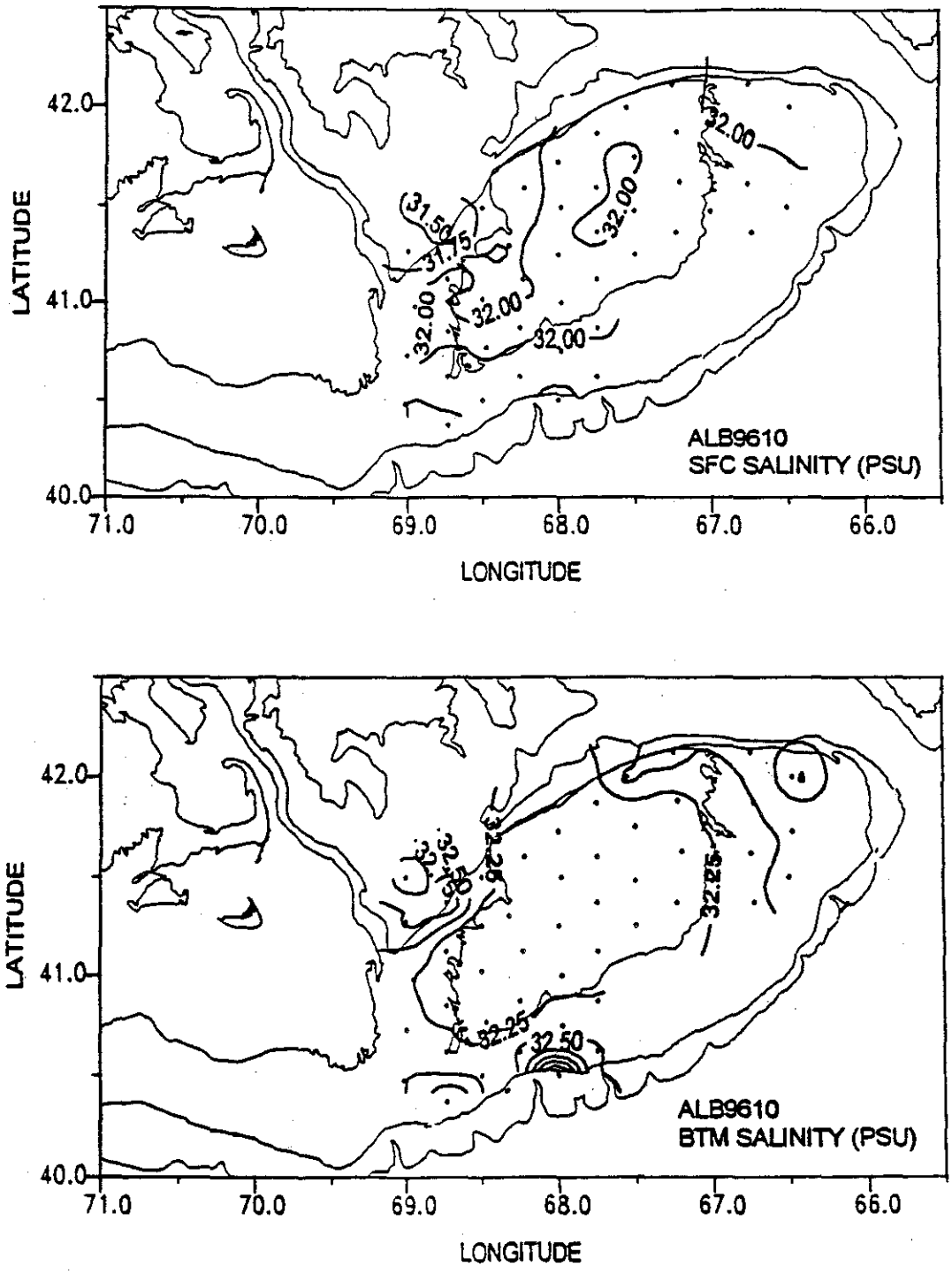


Figure 83. The surface and bottom salinity distributions during the predator / prey cruise ALB9610.

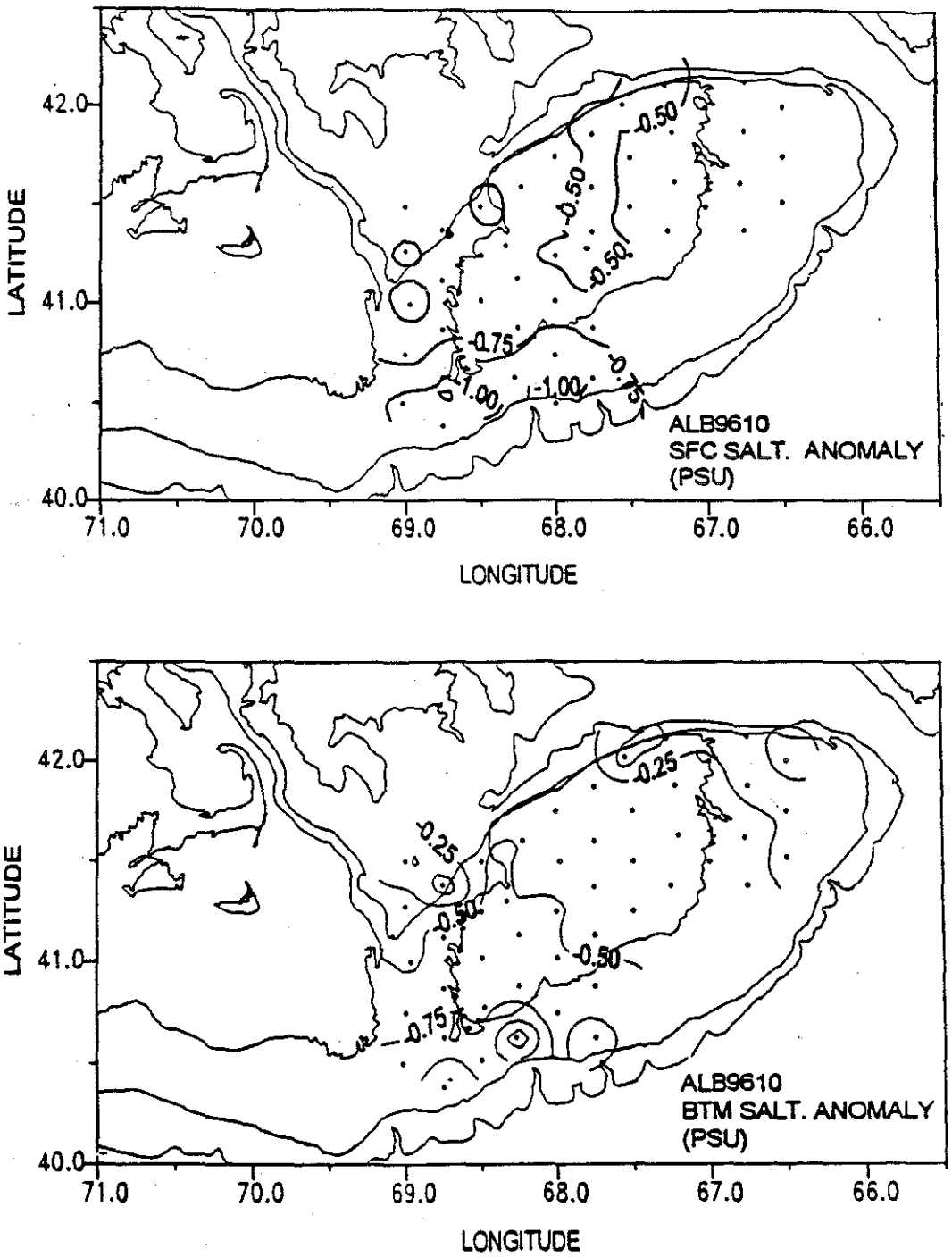


Figure 84. The surface and bottom salinity anomaly distributions during the predator / prey cruise ALB9610.

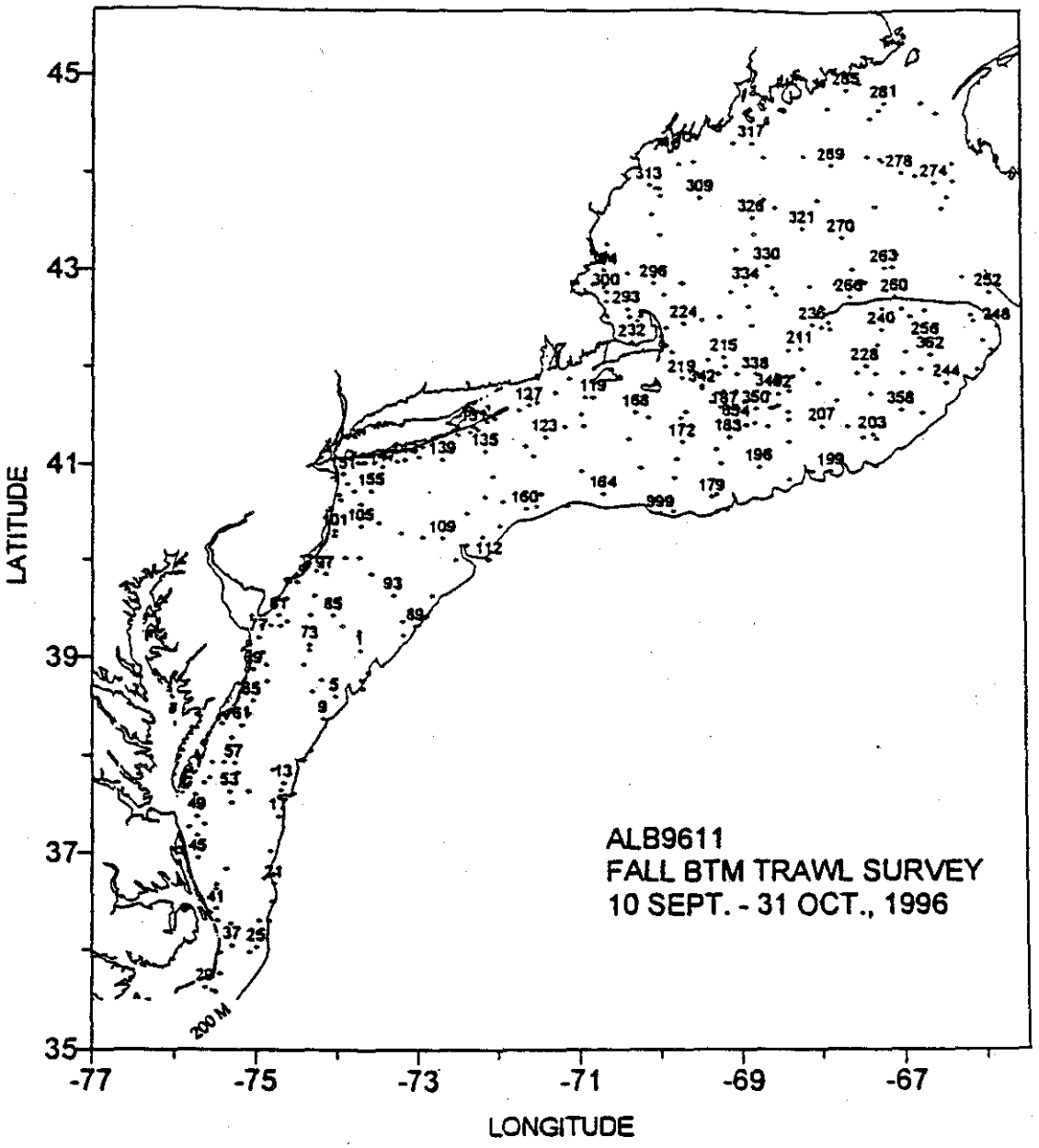


Figure 85. Stations occupied during the spring bottom trawl survey ALB9611.

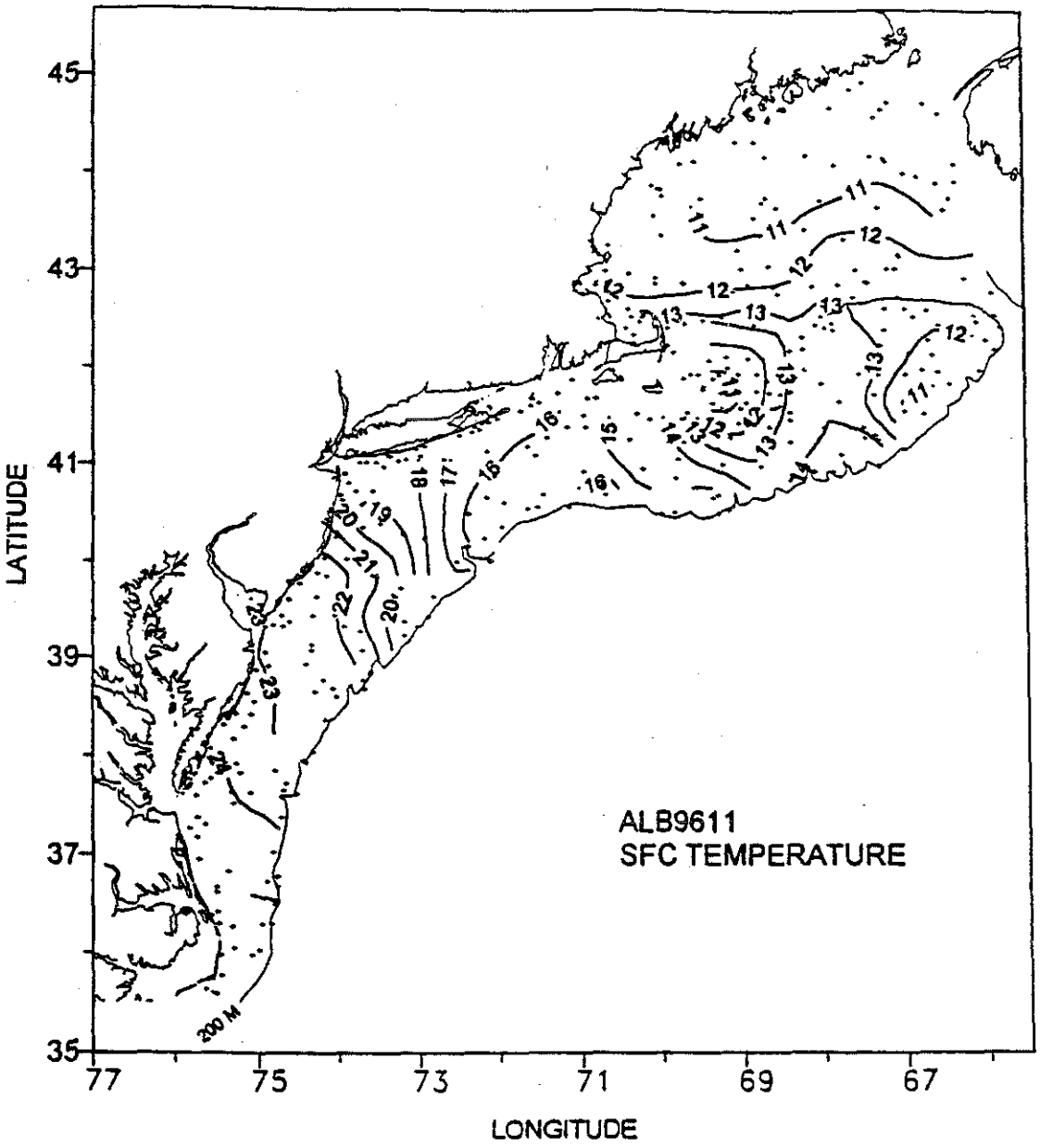


Figure 86. The surface temperature distribution during the spring bottom trawl survey ALB9611.

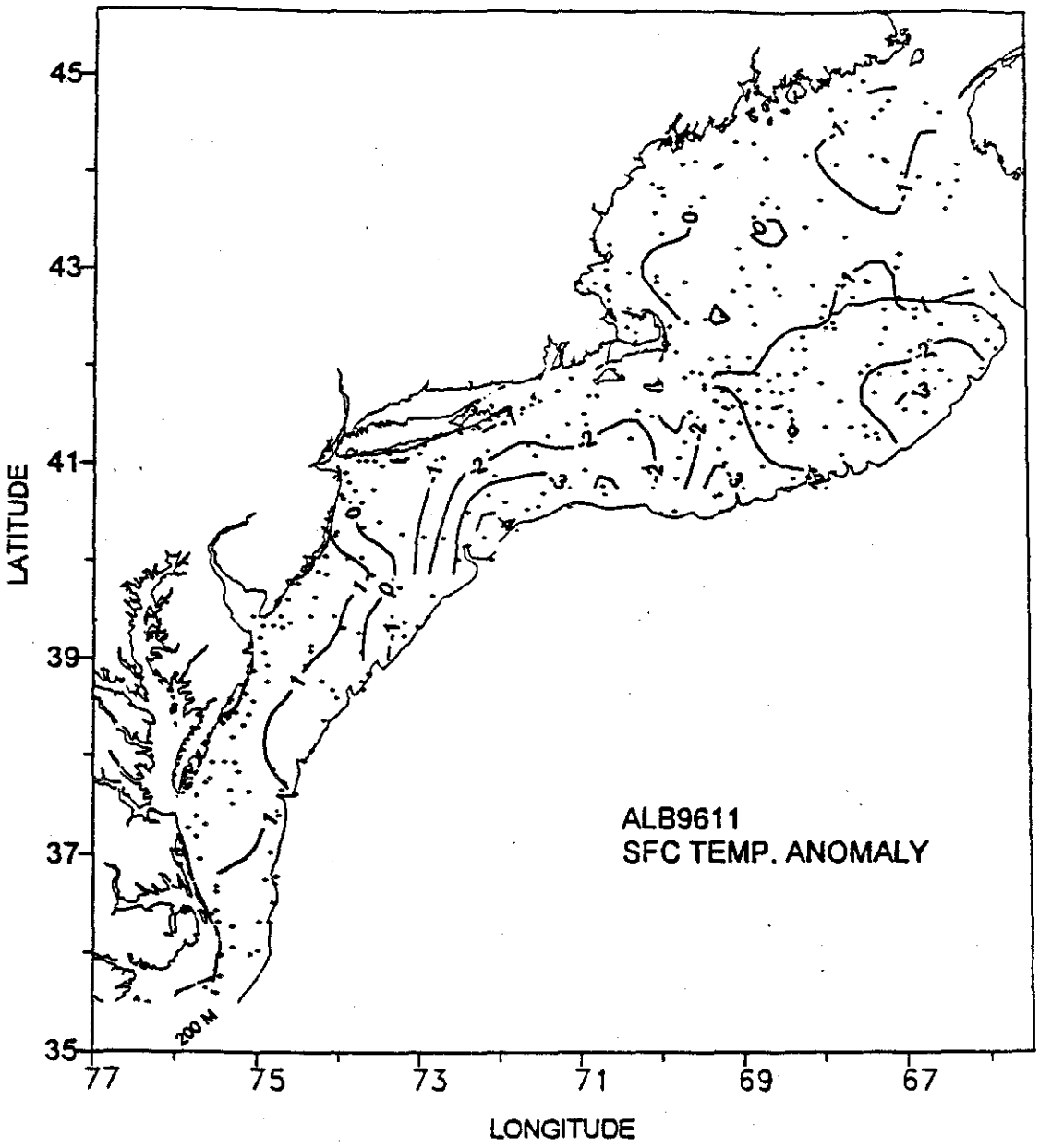


Figure 87. The surface temperature anomaly distribution during the spring bottom trawl survey ALB9611.

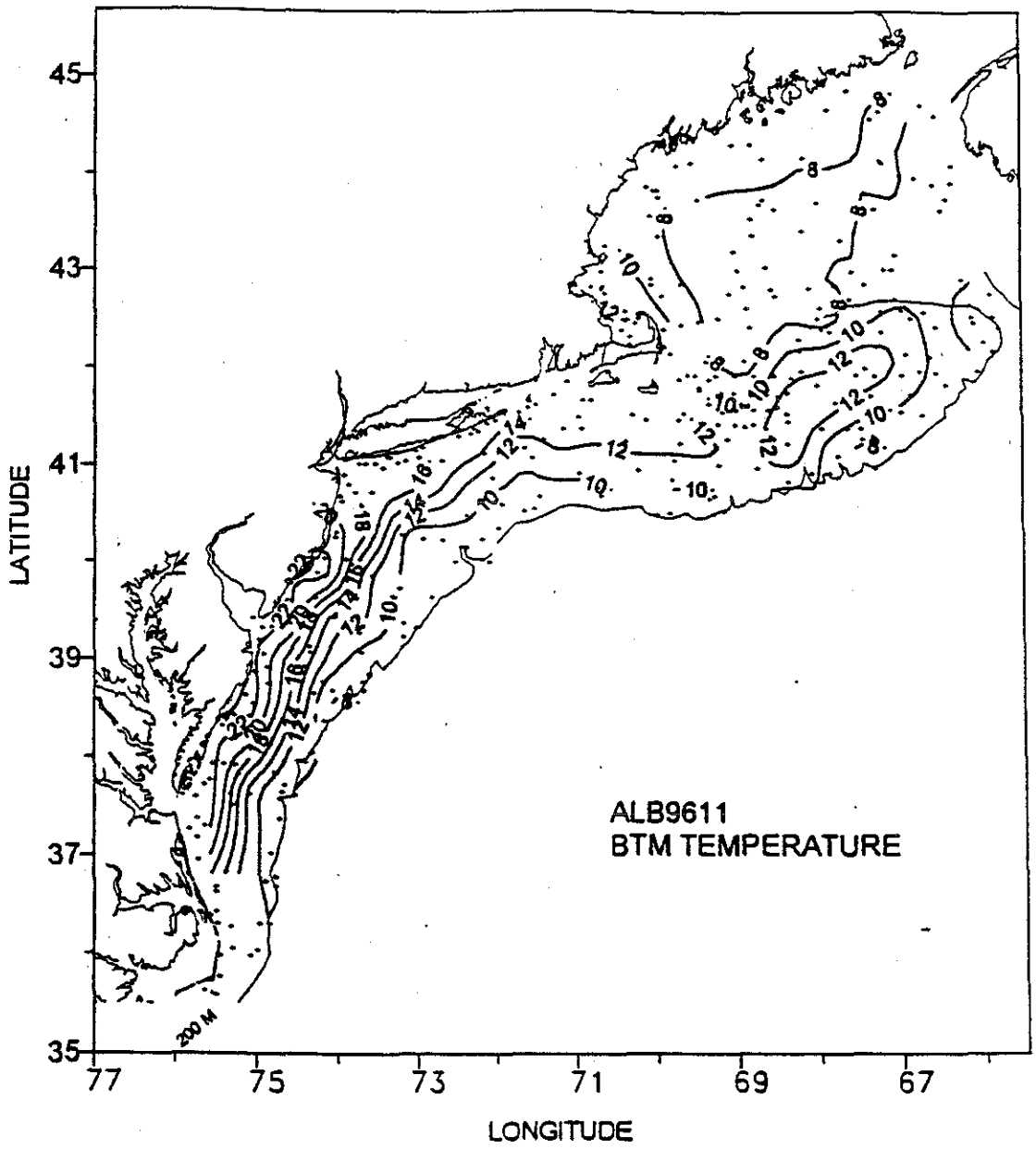


Figure 88. The bottom temperature distribution during the spring bottom trawl survey ALB9611.

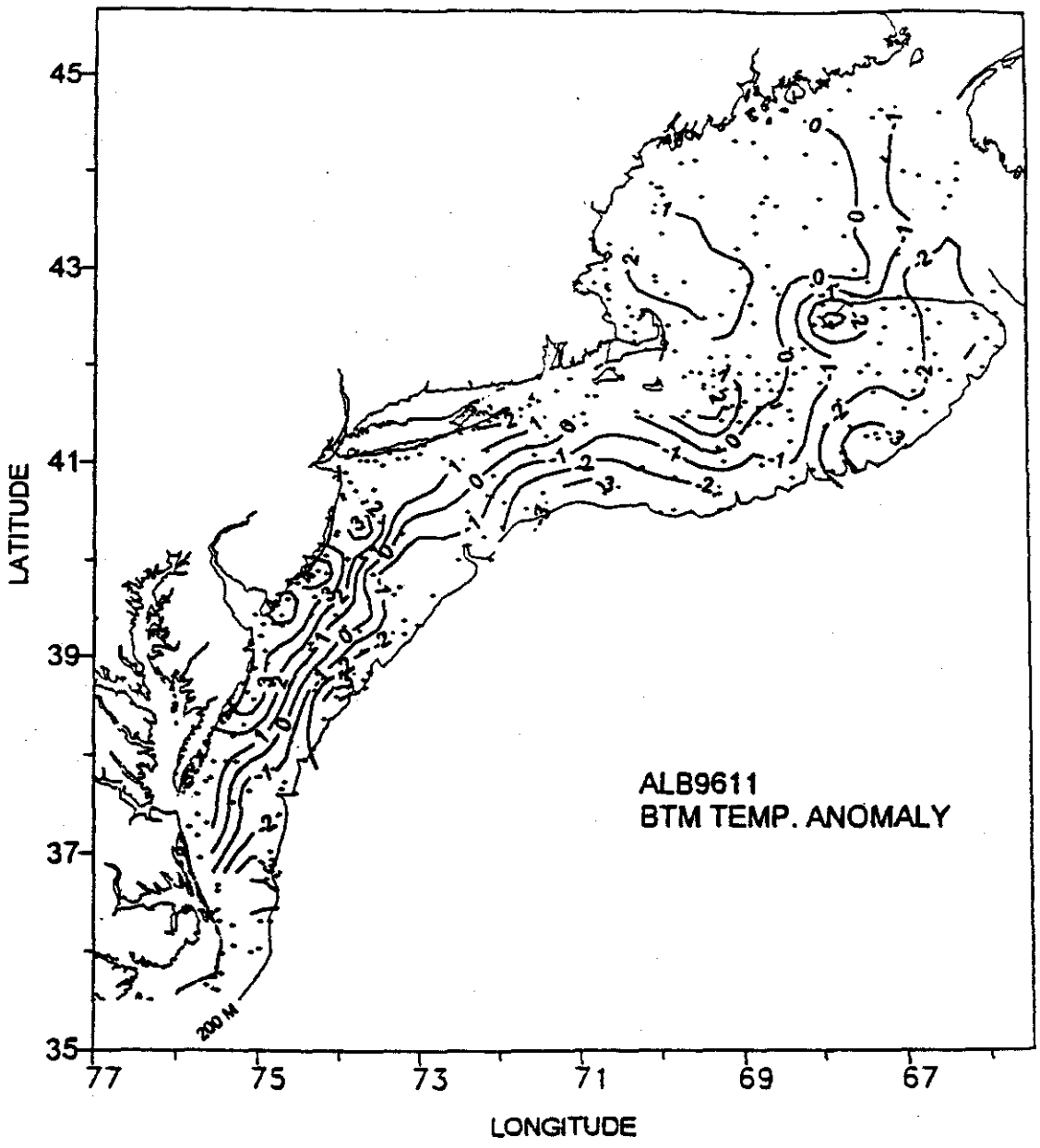


Figure 89. The bottom temperature anomaly distribution during the spring bottom trawl survey ALB9611.

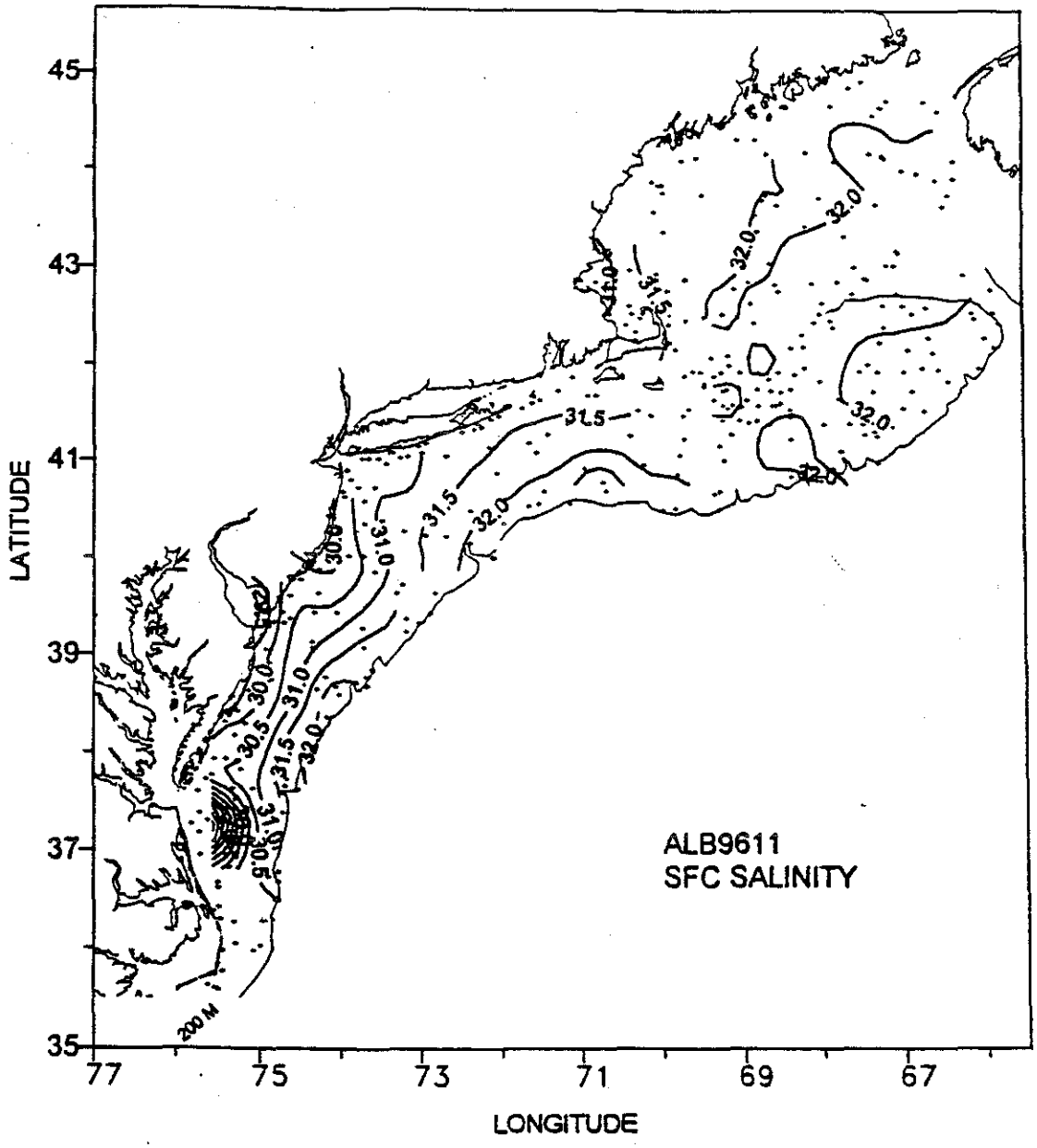


Figure 90. The surface salinity distribution during the spring bottom trawl survey ALB9611.

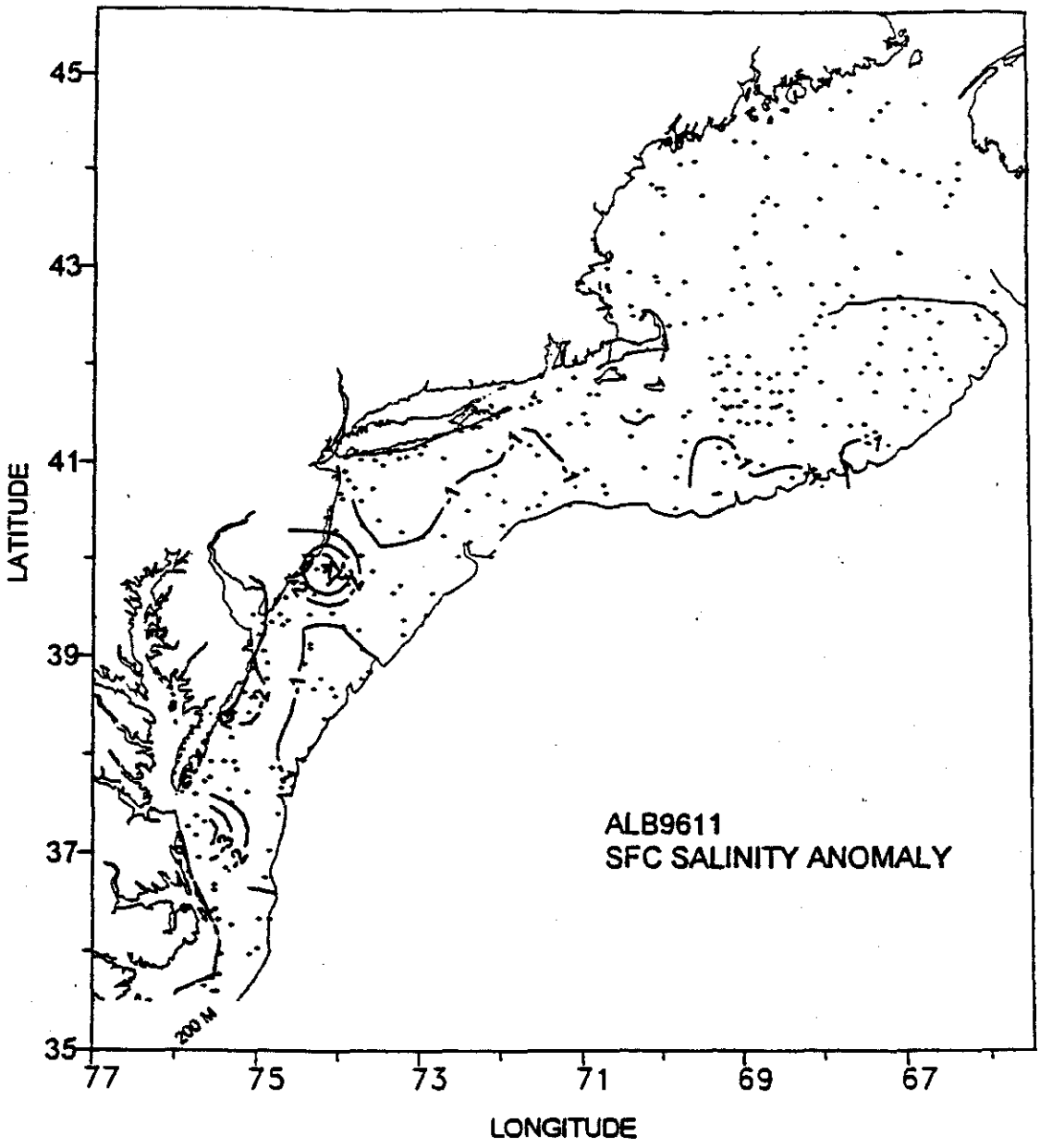


Figure 91. The surface salinity anomaly distribution during the spring bottom trawl survey ALB9611.

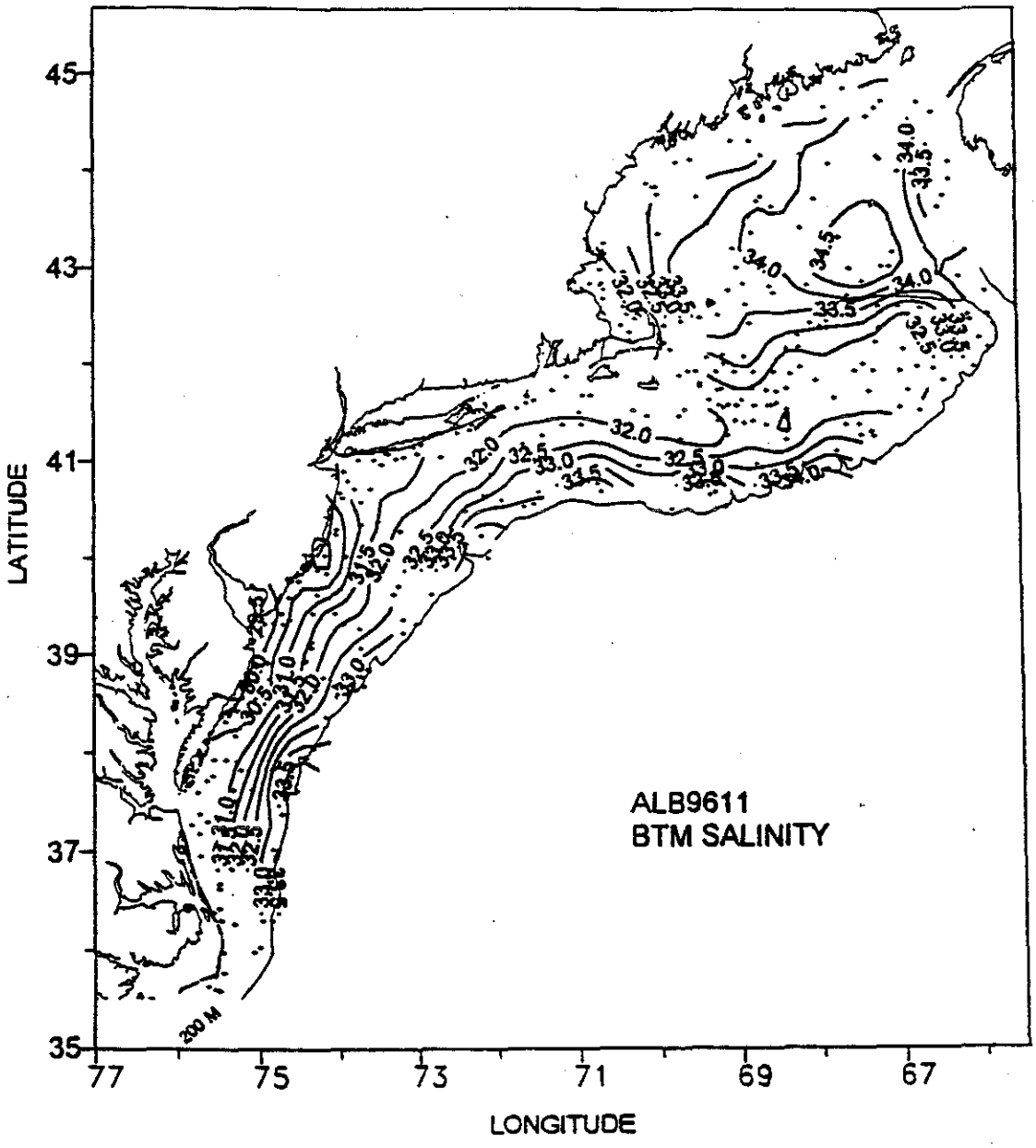


Figure 92. The bottom salinity distribution during the spring bottom trawl survey ALB9611.

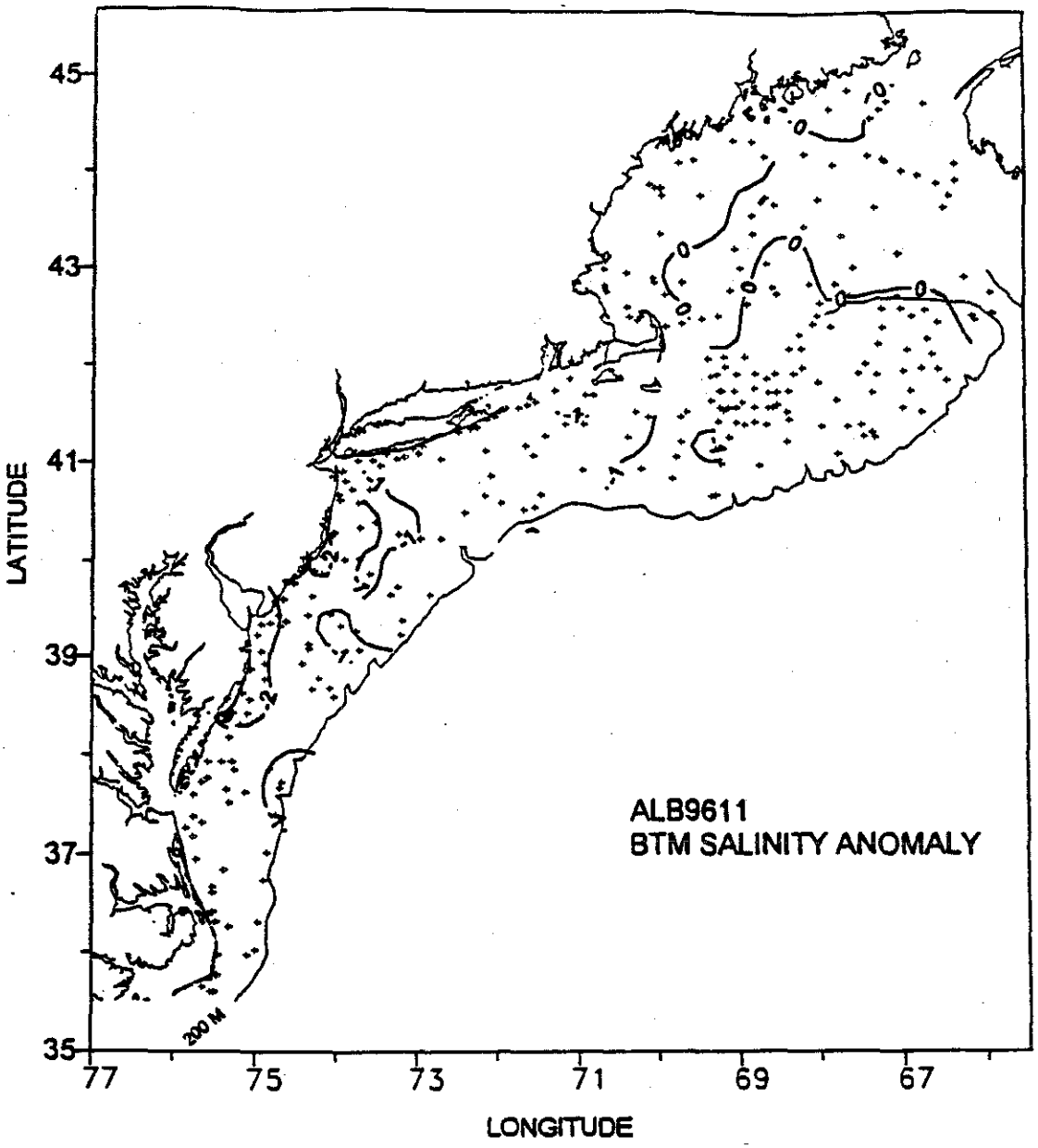


Figure 93. The bottom salinity anomaly distribution for the spring bottom trawl survey ALB9611.

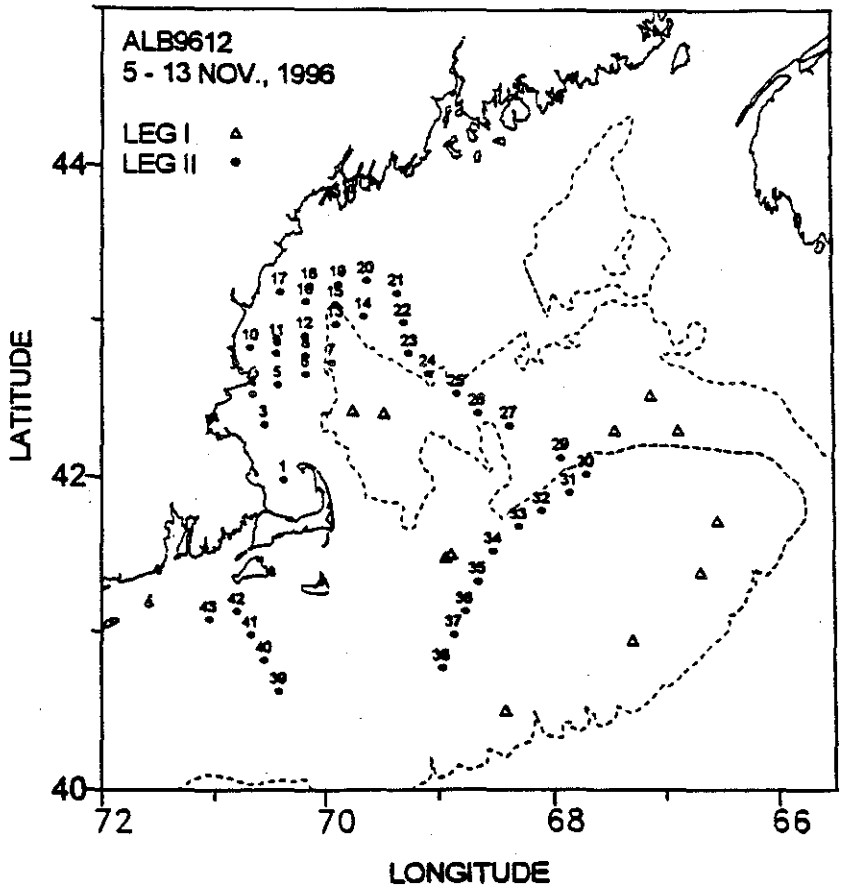


Figure 94. Hydrographic stations occupied during the GLOBEC process study (leg I) and the marine mammal survey (leg II).

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

Summary of 1996 Cruise Information and Hydrographic Work Completed

Vessel: R/V Endeavor **Cruise:** 276

Program: GLOBEC Broad Scale Survey #1
Dates: 12 - 22 January
Sea days: 9
Instrument(s): Profilers 0851, 0360, 0456

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) conduct a hydrographic survey of Georges Bank, (3) collect samples of zooplankton for genetic population studies, (4) conduct lipid biochemical and morphological studies of *C. finmarchicus*, and (5) deploy Lagrangian-type drifters to make current measurements.

Total # of stations: 60
# of vertical CTD/Profiler casts: 3
# of double oblique profiler casts: 73
 # salinity samples: 3/0/0
salt correction: .0062/NA/NA

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

****

Vessel: R/V Albatross IV **Cruise:** 9601

Program: Coastal Monitoring
Dates: 23 - 26 January
Sea days: 4
Instrument(s): Profiler 0456

Cruise Objectives: To assess the impacts of the spill of 800,000 gallons of fuel oil into the costal and offshore waters of Block Island Sound. (1) To collect fish and examine for the presence of petroleum residues. (2) To examine the extent of mortality of larval fish and their zooplankton prey. (3) To provide information on the extent of mortality among other renewable living resources important to the fisheries of the area including clams and lobsters.

Total # of stations: 16
# of vertical CTD/Profiler casts: 16

# of double oblique profiler casts: 16
 # salinity samples: 0
salt correction: NA

****

Vessel: R/V Albatross IV **Cruise:** 9602

Program: Coastal Monitoring
Dates: 30 - 31 January
Sea days: 2
Instrument(s): Profiler 0456

Cruise Objectives: To collect biological and hydrographic samples in the vicinity of the 'North Cape' barge oil spill in order to assess the ecological impact on fishery resources and productivity in the area.

Total # of stations: 40
# of vertical CTD/Profiler casts: 16
# of double oblique profiler casts: 16
 # salinity samples: 0
salt correction: NA

****

Vessel: R/V Albatross IV **Cruise:** 9603

Program: Winter Bottom Trawl Survey
Dates: 6 - 28 February
Sea days: 16
Instrument(s): Profiler 0456

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, and (4) collect ichthyoplankton and zooplankton, and (5) make data and sample collections for cooperative researchers and programs.

Total # of stations: 140
# of vertical CTD/Profiler casts: 86
# of double oblique profiler casts: 58
 # salinity samples: 21
salt correction: 0.0236

****

Vessel: R/V Endeavor **Cruise:** 278

Program: GLOBEC Broad Scale Survey #2
Dates: 14 - 24 February
Sea days: 12
Instrument(s): Profiler 0851

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) conduct a hydrographic survey of Georges Bank, (3) collect samples of zooplankton for genetic population studies, (4) conduct lipid biochemical and morphological studies of *C. finmarchicus*, and (5) deploy drifting buoys to make Lagrangian measurements of the currents.

Total # of stations: 68
# of vertical CTD/Profiler casts: 5
# of double oblique profiler casts: 78
 # salinity samples: 5
salt correction: .015

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

****

Vessel: R/V Oceanus **Cruise:** 275

Program: GLOBEC Broad Scale Survey #3
Dates: 12 - 22 March
Sea days: 11
Instrument(s): Profilers 0851, 1447

Cruise Objectives: To (1) conduct a broad-scale survey of the U.S. GLOBEC Georges Bank Program of target fish (larval and juvenile cod and haddock) and copepod species (*Calanus finmarchicus* and *Pseudocalanus spp*) and their predators and prey to determine their distribution and abundance, (2) conduct a hydrographic survey of Georges Bank, (3) conduct acoustic mapping of the plankton along the track lines between stations using a high frequency echo sounder, (4) map the Bank wide velocity field suing an Acoustic Doppler Current Profiler, collect samples of zooplankton for genetic population studies, (5) collect infividuals of C. finmarchicus, Pseudocalanus spp, and the euphausiid Meganyctiphanes norvegica, for population genetics studies, (6) conduct lipid biochemical and morphological studies of *C. finmarchicus*, and (7) deploy drifting buoys to make Lagrangian measurements of the

currents.

Total # of stations: 72
# of vertical CTD/Profiler casts: 10
# of double oblique profiler casts: 78
 # salinity samples: 0/10
salt correction: NA/.0004

****

Vessel: R/V Endeavor **Cruise:** 282

Program: GLOBEC Broad Scale Survey #4
Dates: 8 - 20 April
Sea days: 11
Instrument(s): Profiler 1447

Cruise Objectives: To (1) conduct a broad-scale survey of the U.S. GLOBEC Georges Bank Program of target fish (larval and juvenile cod and haddock) and copepod species (*Calanus finmarchicus* and *Pseudocalanus spp*) and their predators and prey to determine their distribution and abundance, (2) conduct a hydrographic survey of Georges Bank, (3) provide systematic collections of larval and juvenile cod and haddock for age and growth estimates and feeding habits, (4) collect individuals of *Calanus* and the euphausiid, *Meganyctiphanes norvegica*, for population genetics studies, (5) map the Bank wide velocity field using an Acoustic Doppler Current Profiler and (6) deploy drifting buoys to make Lagrangian measurements of currents.

Total # of stations: 54
# of vertical CTD/Profiler casts: 10
# of double oblique profiler casts: 100
 # salinity samples: 10
salt correction: .0067

Special Notes: The principal hydrographic data during this cruise were collected with a Neil Brown Mark V CTD.

****

Vessel: R/V Albatross IV **Cruise:** 9604

Program: Spring Bottom Trawl Survey
Dates: 6 March - 29 April
Sea days: 40
Instrument(s): Profiler 0456

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, and (4) make collections of data and samples for cooperative researchers and programs.

Total # of stations: 350
# of vertical CTD/Profiler casts: 248
# of double oblique profiler casts: 107
 # salinity samples: 37
salt correction: 0.0355

****

Vessel: R/V Albatross IV **Cruise:** 9605

Program: GLOBEC Broad Scale Survey #5
Dates: 7 - 16 May
Sea days: 10
Instrument(s): Profiler 1447

Cruise Objectives: To (1) determine the distribution and abundance of the ichthyoplankton and zooplankton community on Georges Bank and in 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 and (6) deploy drifting buoys to make Lagrangian measurements of currents.

Total # of stations: 66
# of vertical CTD/Profiler casts: 10
# of double oblique profiler casts: 136
 # salinity samples: 8
salt correction: .0029

Special Notes: The principal hydrographic data for this cruise was collected using a Neil Brown Mark V CTD.

****

Vessel: R/V Albatross IV **Cruise:** 9606

Program: Predator/Prey Study
Dates: 21 - 30 May
Sea days: 10

Instrument(s): Profilers 0360, 0456

Cruise Objectives: To (1) investigate the impact of predation on the survival of age-zero fish (primarily *Gadus morhua* and *Melanogrammus aeglefinus*) by pelagic fish (*Scomber scombrus* and *Clupea harengus*) and (2) collect biological samples for use in the development of polyclonal immunoassays and DNA probes for identification of well-digested fish larvae in stomach contents.

Total # of stations: 79
# of vertical CTD/Profiler casts: 16
# of double oblique profiler casts: 96
 # salinity samples: 16
salt correction: NA /+.039

****

Vessel: R/V Albatross IV **Cruise:** 9607

Program: GLOBEC Broad Scale Survey #6
Dates: 4 - 12 June
Sea days: 9
Instrument(s): Profilers 1447, 0456

Cruise Objectives: To (1) determine the distribution and abundance of the ichthyoplankton and zooplankton community on Georges Bank and in 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 estimates, (3) collect individuals of *Calanus* and the euphausiid, *Meganyctiphanes norvegica* for population genetic studies, (4) conduct a hydrographic survey of the Bank, and (5) map the Bank-wide velocity field using an Acoustic Doppler Current Profiler.

Total # of stations: 41
# of vertical CTD/Profiler casts: 8
# of double oblique profiler casts: 49
 # salinity samples: 4/4
salt correction: .0005 / .0125

Special Notes: Primary hydrographic data for this cruise were collected using a Neil Brown Mark 5 CTD.

****

Vessel: R/V Albatross IV **Cruise:** 9608

Program: Predator / Prey Study
Dates: 18 - 25 June
Sea days: 8
Instrument(s): Profiler 0456

Cruise Objectives: To (1) determine the distribution and abundance of larval and juvenile cod and haddock on the southern flank of Georges Bank in relation to water column conditions, (2) conduct site studies to determine larval fish distribution, diel variability, predator-prey relations, and biochemical content, (3) document the abundance, distribution, and behavior of hydroids and other gelatinous predators in the same area, and (4) measure the horizontal shear and vorticity of water parcels through small scale drifter deployments.

Total # of stations: 95
# of vertical CTD/Profiler casts: 14
# of double oblique profiler casts: 65
 # salinity samples: 14
salt correction: +.039

****

Vessel: R/V Gloria Michelle **Cruise:** 9611

Program: Shrimp Survey
Dates: 29 July - 9 August
Sea Days: 12
Instrument(s): XBT, Minilog

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

Total # of stations: 45
# of vertical CTD/Profiler casts: 0
# of double oblique profiler casts: 0
 # salinity samples: 0
salt correction: NA

Special Notes: No salt samples were taken during this cruise. There were 48 XBT drops and 6 Minilog casts completed during the cruise.

****

Vessel: R/V Abel-J **Cruise:** 9601

Program: Marine Mammal Survey
Dates: 20 - 28 June
Sea Days: 9
Instrument(s): Profiler 1495

Cruise Objectives: To (1) conduct line-transect population surveys within the study area, (2) determine if the distribution of cetaceans is continuous between shelf edge and slope water habitats, (3) conduct marine mammal photographic and video identification methodology studies using a rigid bottom inflatible boat, (4) collect biopsy samples, (5) collect information on the relationship between cetaceans and oceanographic features and (6) collect CTD data.

Total # of stations: 10
# of vertical CTD/Profiler casts: 10
# of double oblique profiler casts: 0
 # salinity samples: 0
salt correction: NA

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Vessel: R/V Abel-J **Cruise:** 9602

Program: Marine Mammal Survey
Dates: 1 - 9 July
Sea Days: 4
Instrument(s): Profiler 1495

Cruise Objectives: To (1) collect and necropsy marine mammals incidentally killed in pelagic driftnet fisheries conducted in U.S. waters, (2) conduct marine mammal photographic and video identification methodology studies using a rigid bottom inflatible boat, (3) collect biopsy samples from free living animals in the vicinity of fishing operations, (4) collect information on the relationship between fishing operations, cetaceans and oceanographic features, (5) collect CTD data and (6) collect plankton samples.

Total # of stations: 7
# of vertical CTD/Profiler casts: 7
# of double oblique profiler casts: 0
salinity samples: 0
salt correction: NA

****

Vessel: R/V Abel-J **Cruise:** 9603

Program: Marine Mammal Survey
Dates: 8 - 27 August
Sea days: 10
Instrument(s): Profiler 1495

Cruise Objectives: To (1) conduct line-transect population surveys within the study area, (2) determine if the distribution of cetaceans is continuous between shelf edge and slope water habitats, (3) conduct marine mammal photographic and video identification methodology studies using a rigid bottom inflatible boat, (4) collect biopsy samples, (5) collect information on the relationship between cetaceans and oceanographic features and (6) collect CTD data.

Total # of stations: 25
# of vertical CTD/Profiler casts: 25
# of double oblique profiler casts: 0
 # salinity samples: 0
salt correction: NA

****

Vessel: R/V Abel-J **Cruise:** 9604

Program: Marine Mammal Survey
Dates: 20 - 28 August
Sea days: 14
Instrument(s): Profiler 1495

Cruise Objectives: To (1) determine the spatial distribution and estimate the abundance of marine mammals found in the study area and (2) determine if spatial distribution patterns of marine mammals are correlated with hydrographic features or with biological features.

Total # of stations: 31
# of vertical CTD/Profiler casts: 30
# of double oblique profiler casts: 1
 # salinity samples: 0
salt correction: NA

****

Vessel: Isabelle-S **Cruise:** 9601

Program: Marine Mammal Survey
Dates: 20 - 28 August
Sea days: 9
Instrument(s): Profiler 1496

Cruise Objectives: To (1) determine the spatial distribution and estimate the abundance of marine mammals found in the study area and (2) determine if spatial distribution patterns of marine mammals are correlated with hydrographic features or with biological features.

Total # of stations: 56
# of vertical CTD/Profiler casts: 54
# of double oblique profiler casts: 0
 # salinity samples: 0
salt correction: NA

****

Vessel: R/V Albatross IV **Cruise:** 9609

Program: Sea Scallop Survey
Dates: 31 July - 26 August
Sea days: 22
Instrument(s): Profilers 0853, 0851

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 hydrographic and meteorological conditions; and, (4) make collections for interested scientists at other institutions and laboratories.

Total # of stations: 453
# of vertical CTD/Profiler casts: 387
# of double oblique profiler casts: 66
 # salinity samples: 39
salt correction: 0.016, 0.022

****

Vessel: R/V Albatross IV **Cruise:** 9610

Program: Predator/Prey Study
Dates: 29 August - 5 September

Sea days: 5
Instrument(s): Profiler 1447

Cruise Objectives: To investigate fish predation on age-0 cod and haddock during their transition from pelagic to early demersal phase of life history.

Total # of stations: 50
# of vertical CTD/Profiler casts: 10
# of double oblique profiler casts: 41
 # salinity samples: 10
salt correction: -0.0277

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Vessel: R/V Albatross IV **Cruise:** 9611

Program: Fall Groundfish Survey
Dates: 9 Sepetember - 1 November
Sea days: 48
Instrument(s): Profilers 1447, 1468

Cruise Objectives: To determine the seasonal distribution and relative abundance of fish and invertebrate species found on the continental shelf.

Total # of stations: 364
# of vertical CTD/Profiler casts: 301
# of double oblique profiler casts: 84
 # salinity samples: 18/19
salt correction: -0.019, 0.019

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Vessel: R/V Albatross IV **Cruise:** 9612

Program: GLOBEC/Marine Mammal Survey
Dates: 5 - 13 November
Sea days: 9
Instrument(s): Profilers 1468, 1495

Cruise Objectives: GLOBEC: (1)Conduct a survey of U.S. GLOBEC Georges Bank Program target species (*Calanus finmarchicus* and *Pseudocalanus spp.*) and their predators and prey to determine their distribution and abundance; and (2) test and evaluate a new Video Plankton Recorder instrument system.

Marine Mammal: To document the spatial patterns of harbor

porpoises, its potentail prey species (Atlantic herring and Silver hake), its potential competitors (Atlantic cod and pollock), a lower trophic level (plankton), and environmental factors (water temperature, salinity, and depth). Secondary objectives include: collecting biopsy samples from bow riding or surface active cetaceans and conducting photographic and video identification studies.

Total # of stations: 56
# of vertical CTD/Profiler casts: 56
# of double oblique profiler casts: 0
 # salinity samples: 0/6
salt correction: NA /+.0224

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