Northeast Fisheries Science Center Reference Document 99-01

Description of the 1998 Oceanographic Conditions on the Northeast Continental Shelf

by

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region
Northeast Fisheries Science Center
Woods Hole, Massachusetts

February 1999

Northeast Fisheries Science Center Reference Documents

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This report's publication history is as follows: manuscript submitted for review--December 21, 1998; manuscript accepted through technical review--January 15, 1999; manuscript accepted through policy review--January 29, 1999; and camera-ready copy submitted for publication--February 5, 1999. This report may be cited as:

Taylor, M.H.; Bascunan, C. 1999. Description of the 1998 oceanographic conditions on the Northeast Continental Shelf. *Northeast Fish. Sci. Cent. Ref. Doc.* 99-01; 91 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

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Abstract

A summary of hydrographic observations for 21 surveys on the northeast continental shelf during 1998 is presented. Distributions of station position, surface and bottom temperature, salinity, and anomalies are portrayed. The average surface and bottom temperatures and salinities 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 entire northeast continental shelf experienced fresher salinity conditions during the 1998 field season. This trend in lower salinity anomalies (relative to the MARMAP reference period) also had been observed during 1996 and 1997. The temperature distributions for all five regions show a fairly typical seasonal pattern. Surface temperatures during the summer and fall were warmer than expected for nearly all regions, although observations from the last two cruises of the field season show a trend of cooler surface and bottom temperatures.

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 and the Ecosystem Monitoring cruises. 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. Station coverage on other cruises throughout the year varies.

Temperature and salinity observations from 21 NEFSC surveys conducted during 1998 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 affects 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, generally once per day, 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. OC317 was renamed OCE9817). 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 - 3 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 4 - 66. Contour distribution figures were not prepared for some of the cruises because of poor station coverage. We were not able to resolve small scale, localized events because of the regional averaging method used in this report.

Discussion

The dominant trend over the entire northeast continental shelf was of fresher salinity conditions relative to the MARMAP reference period, similar to what has been observed during the last two years. (Taylor and Kiladis 1997, Taylor and Bascuñán 1998). The colder, fresher anomalies observed in the eastern Gulf of Maine during the Ecosystem Monitoring cruise (ALB9802) can probably be attributed to a greater inflow of Scotian Shelf water into the Gulf,

although this signal was not as evident in the western Gulf or on Georges Bank. Warmer surface temperatures occurred during the summer in all regions but to a lesser extent in the western Gulf of Maine (see observations for mid - late August). Observations from the fall cruises show a consistent cooling trend for both surface and bottom temperatures.

Some of the high variability observed in the 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 136 ctd casts but spatial coverage within the middle Atlantic bight regions was poor (figure 45). Simple regional averages were computed for this cruise and all others listed with an asterisk in Tables 2 and 3.

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.

Taylor, M. H. and C. Bascuñán 1998. Description of the 1997 oceanographic conditions on the northeast continental shelf. Woods Hole, MA: Northeast Fisheries Science Center. Reference Document 98-01. Available from: Information Services Section, NMFS/ Northeast Fisheries Science Center, Woods Hole, MA; 02543.

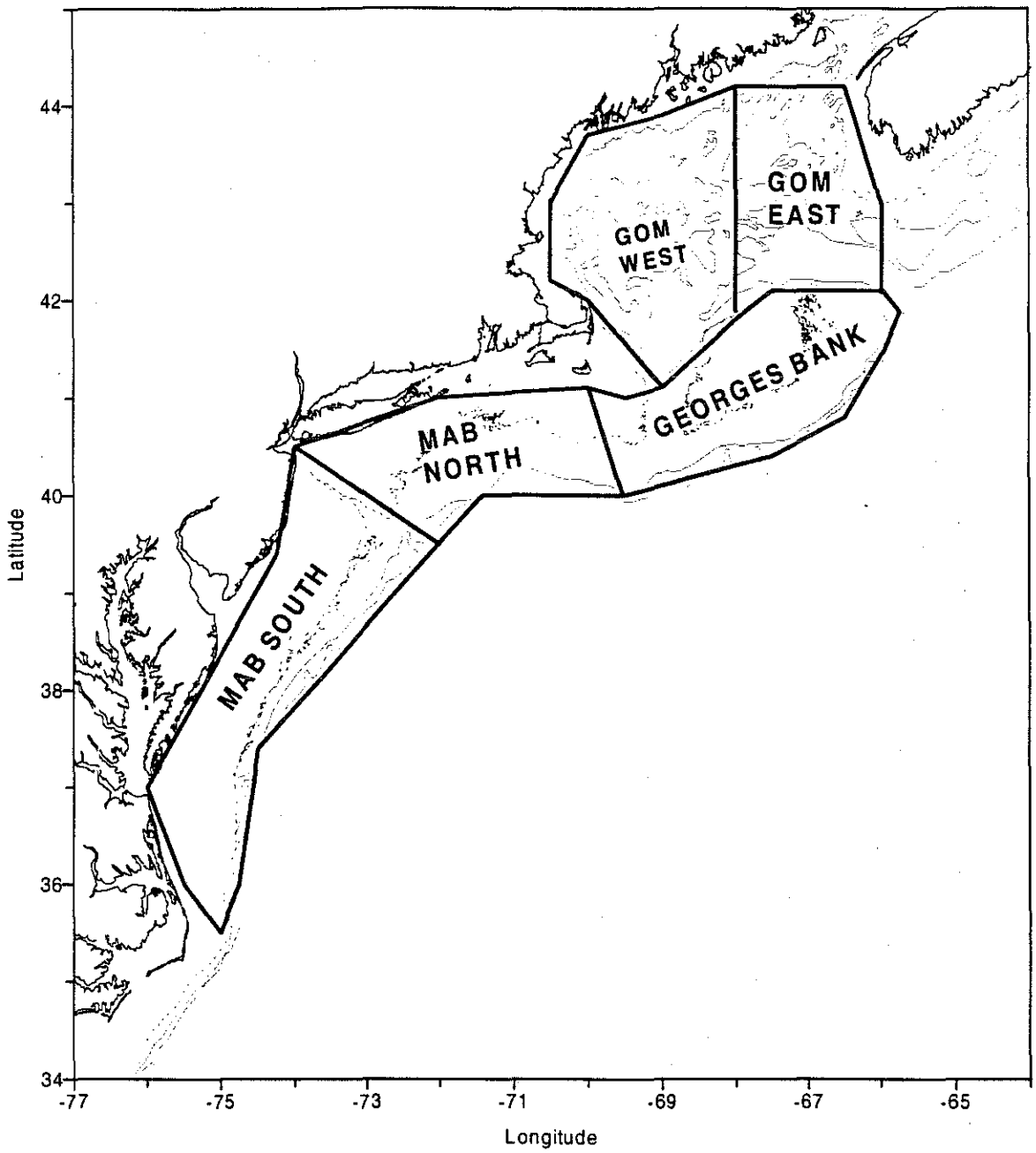

Figure 1. The regions of the northeast continental shelf covered by the Northeast Fisheries Science Center cruises during 1998.

Table 1. Summary of 1998 Cruises.

Cruise	Program	Dates	Region(s) [1]
ALB9801	GLOBEC Broadscale #1	8-18 January	GB
ALB9802	Ecosystem Monitoring	24-28 January	GOM, GB
OCE9817	GLOBEC Broadscale #2	7-17 February	GB
ALB9803	Winter Bottom Trawl	8-27 February	MAB, GB
DEL9803	Marine Mammal Survey	23 Feb - 6 March	GOM
ALB9804	Spring Bottom Trawl	3 March - 20 Apr	MAB, GB, GOM
DEL9804	Marine Mammal Survey	13-26 March	MAB, GB
OCE9819	GLOBEC Broadscale #3	16-26 March	GB
DEL9806	Apex Predator Survey	13 Apr - 29 May	U.S. East Coast
OCE9822	GLOBEC Broadscale #4	15-27 April	GB
ALB9806	GLOBEC Broadscale #5	13-22 May	GB
ALB9807	Ecosystem Monitoring	26 May - 12 June	MAB, GB, GOM
ALB9808	GLOBEC Broadscale #6	17-26 June	GB
DEL9808	Marine Mammals Survey	7-19 August	GOM
AJ9801	Marine Mammals Survey	8 July – 1 Sept.	GB, MAB
ALB9809	Scallop Survey	22 July – 16 August	MAB, GB
GLM9815	GOM Shrimp Survey	27 July – 7 August	GOM
IS9801	Ecosystem Monitoring	22 August – 1 Sept.	GOM, GB
DEL9810	Hydroacoustic Survey	8 Sept. – 1 October	GB, GOM
ALB9811	Fall Bottom Trawl	21 Sept. – 9 Nov.	MAB, GB, GOM
DEL9813	Ecosystem Monitoring	4 – 19 November	MAB, GB, GOM

[1] Regional Abbreviations

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

Table 2. Areal average surface and bottom temperature and temperature anomalies for the 1998 NEFSC cruises in the five regions of the northeast continental shelf as shown in Figure 1

		SURFACE					BOTTOM				
CRUISE	CD	#obs	Temp	Anomaly	SDV1	SDV2	#obs	Temp	Anomaly	SDV1	SDV2
Gulf of Maine West											
AL9802	26	9	5.36	-0.72	0.38	0.61*	9	6.77	0.94	0.28	0.86*
AL9804	107	56	5.21	0.56	0.16	0.78	56	6.06	1.10	0.12	0.77
AL9807	161	16	10.98	-0.36	0.30	0.94	16	6.23	0.76	0.21	1.16
IS9801	241	22	17.67	0.99	0.28	1.58*	22	6.24	-0.14	0.23	1.29*
AL9811	301	46	11.02	-0.16	0.17	0.99	46	7.08	-0.25	0.13	1.33
DE9813	322	18	9.07	-0.65	0.26	0.60	18	7.40	0.04	0.20	1.31
Gulf of Maine East											
AL9801	12	11	6.76	0.52	0.27	0.31*	10	6.89	0.13	0.26	0.67*
AL9802	26	10	3.42	-1.64	0.44	0.98	10	5.78	-1.16	0.43	2.15
OC9817	43	12	4.83	0.1	0.26	0.72*	11	6.05	0.41	0.26	0.89*
0C9819	79	9	4.81	0.41	0.3	0.50*	8	5.48	0.27	0.29	0.90*
AL9804	104	39	4.24	-0.24	0.18	0.75	28	5.73	-0.52	0.22	1.23
OC9822	110	12	5.85	0.43	0.26	0.98*	11	5.88	-0.07	0.26	0.63*
AL9806	137	15	7.49	0.19	0.23	0.35*	14	6.25	-0.62	0.23	0.63*
AL9807	159	15	8.86	-0.27	0.28	1.40	13	6.24	-1.03	0.33	1.44
AL9808	172	7	12.52	1.6	0.36	1.52*	6	7.75	-1.22	0.37	0.97*
IS9801	238	16	15.21	1.1	0.23	1.31	15	7.36	-1.18	0.32	1.62
AL9811	297	34	10.54	-1.14	0.19	1.16	32	7.40	-1.62	0.2	1.27
DE9813	319	16	8.25	-1.76	0.29	0.55	15	7.22	-1.38	0.23	1.15
Georges Bank											
AL9801	12	63	6.96	-0.14	0.18	0.81	60	7.45	-0.22	0.23	0.90
OC9817	43	70	4.77	-0.47	0.16	0.91	66	4.91	-0.85	0.21	1.36
AL9803	54	35	4.28	-0.77	0.28	1.09*	20	4.85	-0.70	0.31	1.65*
OC9819	79	69	4.74	0.31	0.18	0.73	64	4.93	0.09	0.22	1.13
AL9804	94	58	5.26	0.56	0.19	1.00	49	5.32	0.44	0.23	1.21
OC9822	110	67	5.77	0.41	0.18	0.72	63	5.60	0.23	0.22	0.87
AL9806	137	69	7.34	-0.16	0.18	0.79	66	6.64	-0.06	0.22	1.02
AL9807	155	31	9.93	0.27	0.23	1.18	28	8.01	0.06	0.26	1.28
AL9808	172	36	12.03	0.74	0.24	1.21	35	8.56	-0.20	0.28	1.48
AL9809	207	65	17.88	2.17	0.19	2.15	64	10.47	-0.68	0.22	2.14
IS9801	235	35	17.99	1.64	0.25	1.47	31	12.31	-0.17	0.18	2.34*
AL9811	292	71	13.61	-0.66	0.18	1.15	65	11.57	-0.84	0.19	1.67
DE9813	316	33	11.04	-1.16	0.23	0.83	30	10.83	-1.06	0.30	1.13

MAB North

AL9803	48	38	5.6	0.62	0.29	1.46	31	5.62	-0.02	0.35	2.04
DE9804	78	8	5.11	1.26	0.51	0.95*	7	5.22	1.51	0.58	0.64*
AL9804	83	61	5.11	0.78	0.25	0.94	55	5.18	-0.17	0.28	1.94
AL9807	152	24	13.19	0.63	0.37	1.15	22	7.88	0.26	0.41	1.11
AL9809	215	20	22.58	2.61	0.33	1.45*	20	7.86	-0.14	0.34	1.07*
AL9811	284	60	17.41	0.55	0.25	1.36	56	11.14	-1.72	0.30	1.84
DE9813	313	25	12.45	-1.44	0.32	0.56	23	11.04	-2.28	0.37	1.08

MAB South

AL9803	41	52	7.35	0.7	0.27	2.36	46	7.68	0.90	0.31	2.46
DE9804	74	9	5.96	0.92	0.5	1.65*	8	6.07	1.57	0.57	1.16*
AL9804	68	81	6.79	1.11	0.24	2.16	72	6.90	2.00	0.24	2.15*
DE9806	130	19	15.73	-0.74	0.44	1.18*	19	10.94	-0.27	0.54	1.67*
AL9807	149	40	15.36	-0.41	0.3	1.49	37	9.39	0.44	0.33	0.73
AL9809	222	41	25.18	1.31	0.28	1.09*	40	8.48	0.84	0.33	0.92*
AL9811	274	79	22.44	1.91	0.27	1.22	72	14.40	-0.44	0.29	2.53
DE9813	310	47	15.13	-0.34	0.28	0.92	43	12.89	-1.50	0.33	1.68

(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 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 1998 NEFSC cruises in the five regions of the northeast continental shelf as shown in Figure 1

		SURFACE					BOTTOM				
CRUISE	CD	#obs	Salt	Anomaly	SDV1	SDV2	#obs	Salt	Anomaly	SDV1	SDV2
Gulf of Maine West											
AL9802	26	9	32.30	-0.74	0.15	0.30*	9	33.32	-0.37	0.11	.56*
AL9804	107	56	31.36	-1.18	0.07	0.47	56	32.97	-0.44	0.05	0.45
AL9807	161	16	31.20	-0.85	0.13	0.24	16	33.11	-0.26	0.09	0.54
IS9801	241	22	31.03	-0.84	0.12	0.44*	22	32.80	-0.49	0.08	0.53*
AL9811	301	46	31.96	-0.65	0.07	0.25	46	33.4	-0.24	0.05	0.33
DE9813	322	18	32.18	-0.59	0.11	0.22	18	33.40	-0.24	0.08	0.66
Gulf of Maine East											
AL9801	12	11	32.67	-0.24	0.10	0.10*	11	33.13	-0.18	0.08	0.11*
AL9802	26	10	31.26	-1.35	0.20	0.53	10	32.96	-1.04	0.14	1.11
OC9817	43	11	32.37	-0.54	0.11	0.34*	11	33.29	-0.48	0.09	0.38*
0C9819	79	9	32.13	-0.82	0.12	0.28*	9	32.88	-0.75	0.09	0.31*
AL9804	104	39	31.64	-0.84	0.10	0.28	28	33.51	-0.45	0.08	0.39
OC9822	110	12	31.89	-0.99	0.11	0.16*	12	33.12	-0.58	0.09	0.41*
AL9806	137	15	31.92	-0.88	0.09	0.17*	15	32.79	-0.72	0.08	0.32*
AL9807	159	15	31.78	-0.68	0.16	0.20	13	33.59	-0.50	0.10	0.51
AL9808	172	7	31.64	-0.96	0.14	0.13*	7	33.13	-0.48	0.12	0.33*
IS9801	238	16	31.79	-0.69	0.13	0.35	15	33.75	-0.30	0.09	0.52
AL9811	297	34	31.89	-0.68	0.11	0.35	34	33.74	-0.22	0.08	0.41
DE9813	319	16	32.03	-0.63	0.16	0.47	16	33.61	-0.40	0.11	0.79
Georges Bank											
AL9801	12	63	32.41	-0.44	0.07	0.38	60	32.74	-0.34	0.08	0.31
OC9817	43	69	32.31	-0.58	0.06	0.21	65	32.41	-0.71	0.08	0.32
AL9803	54	35	32.21	-0.81	0.11	0.43*	20	32.46	-0.70	0.10	0.30*
OC9819	79	68	32.22	-0.70	0.07	0.26	63	32.35	-0.78	0.08	0.40
AL9804	94	58	32.11	-0.81	0.07	0.33	49	32.30	-0.79	0.08	0.36
OC9822	110	67	32.12	-0.77	0.06	0.20	63	32.30	-0.80	0.08	0.35
AL9806	137	69	32.07	-0.76	0.06	0.18	66	32.18	-0.89	0.08	0.36
AL9807	155	31	31.93	-0.87	0.08	0.25	28	32.21	-0.80	0.10	0.30
AL9808	172	36	31.91	-0.83	0.09	0.22	35	32.21	-0.80	0.10	0.40
AL9809	207	65	31.69	-1.01	0.07	0.45	64	32.15	-0.83	0.08	0.45
IS9801	235	35	31.88	-0.87	0.10	0.65	31	32.22	-0.60	0.06	0.45*
AL9811	292	68	32.07	-1.12	0.09	1.71	63	32.33	-0.67	0.07	0.39
DE9813	316	33	31.99	-0.77	0.09	0.17	30	32.26	-0.74	0.10	0.52

MAB North

AL9803	48	38	32.35	-0.75	0.13	0.42	31	32.47	-1.03	0.12	0.54
DE9804	78	8	31.97	-0.64	0.34	0.63*	7	31.98	-1.06	0.23	0.70*
AL9804	83	61	32.04	-0.85	0.12	0.47	55	32.17	-1.28	0.10	0.65
AL9807	152	24	31.00	-1.41	0.17	0.62	22	32.17	-1.10	0.14	0.41
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AL9811	284	60	31.54	-1.27	0.11	0.63	56	32.41	-1.13	0.1	0.45
DE9813	313	25	31.90	-1.12	0.15	0.37	23	32.27	-1.37	0.13	0.43

MAB South

AL9803	41	52	32.74	-1.02	0.16	0.80	46	33.04	-0.81	0.11	0.77
DE9804	74	9	31.08	-1.41	0.41	2.20*	8	31.62	-1.40	0.23	1.36*
AL9804	68	81	32.04	-1.05	0.14	1.03	72	32.24	-0.88	0.09	0.73*
DE9806	130	19	29.75	-2.22	0.33	2.35*	19	31.38	-1.85	0.20	0.69*
AL9807	149	40	31.05	-1.04	0.17	0.92	37	31.97	-1.29	0.12	0.54
AL9809	222	41	30.12	-1.80	0.13	0.55*	40	32.53	-0.81	0.11	0.48*
AL9811	274	78	31.24	-1.08	0.14	0.69	72	32.00	-1.17	0.11	0.58
DE9813	310	47	31.83	-1.09	0.18	0.41	43	32.06	-1.30	0.13	0.49

(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: "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.

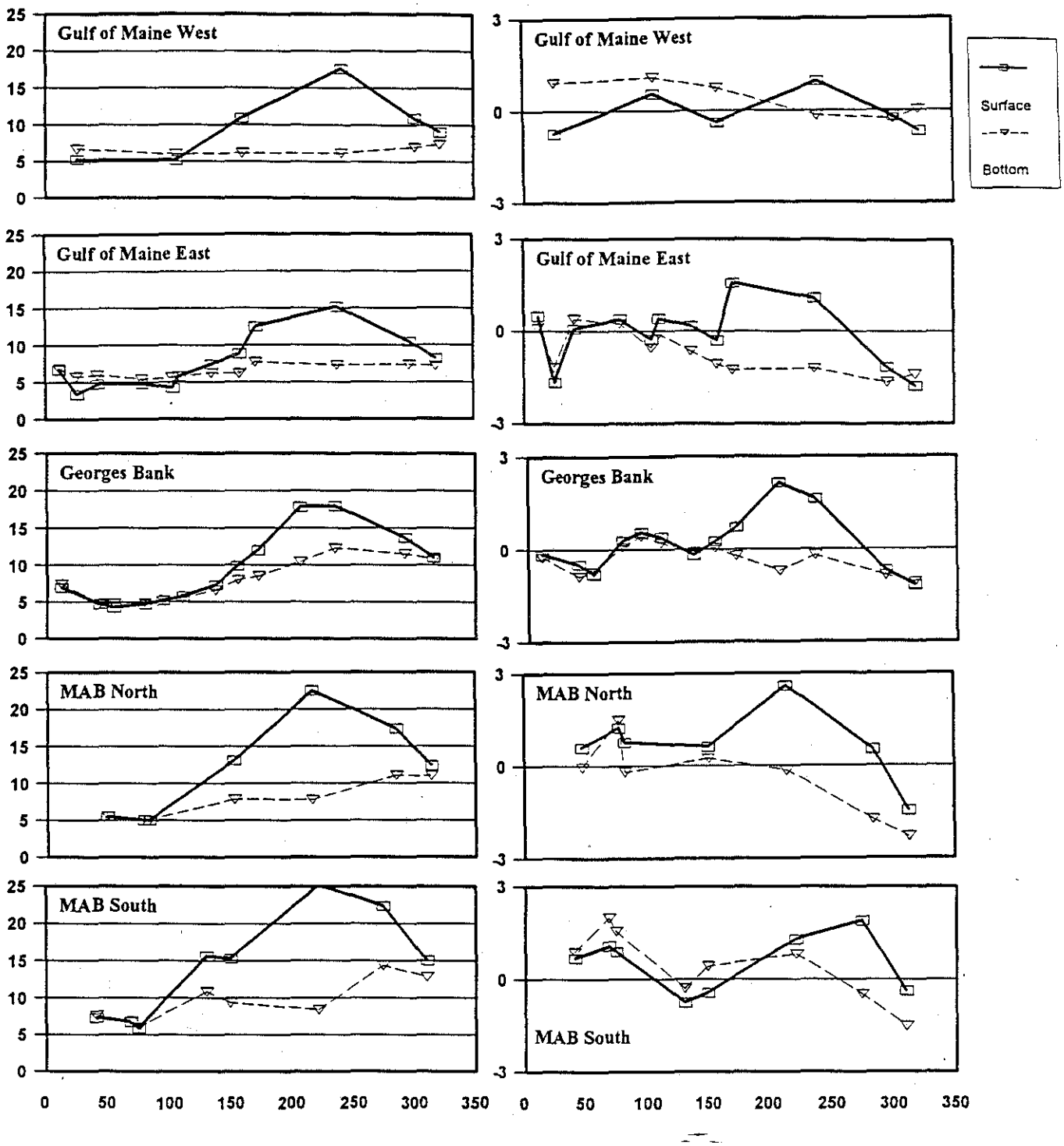


Figure 2. The 1998 areal average surface and bottom temperatures (left) and anomalies (right) from Table 2.

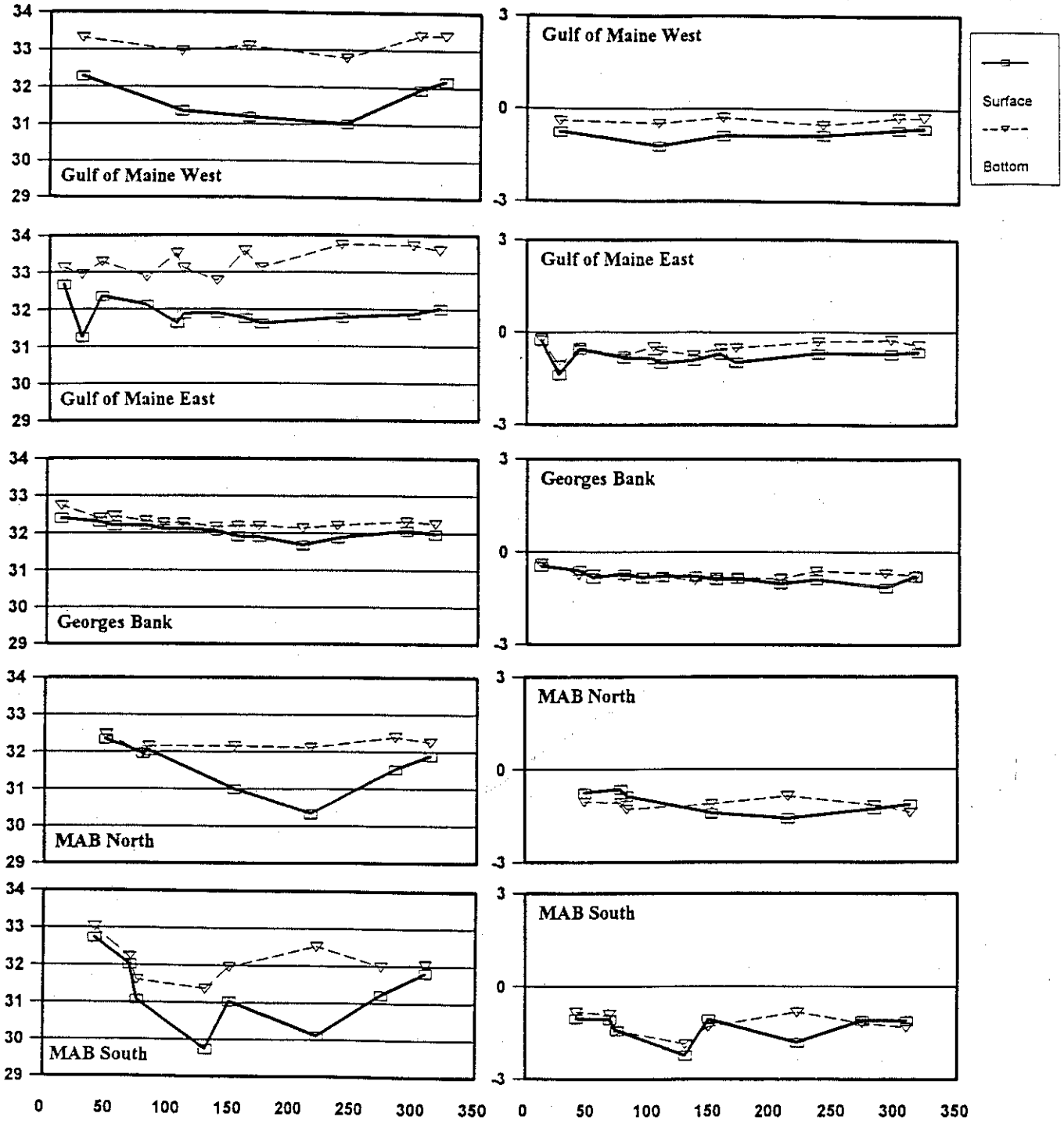


Figure 3. The 1998 areal average surface and bottom salinities (left) and anomalies (right) from Table 3.

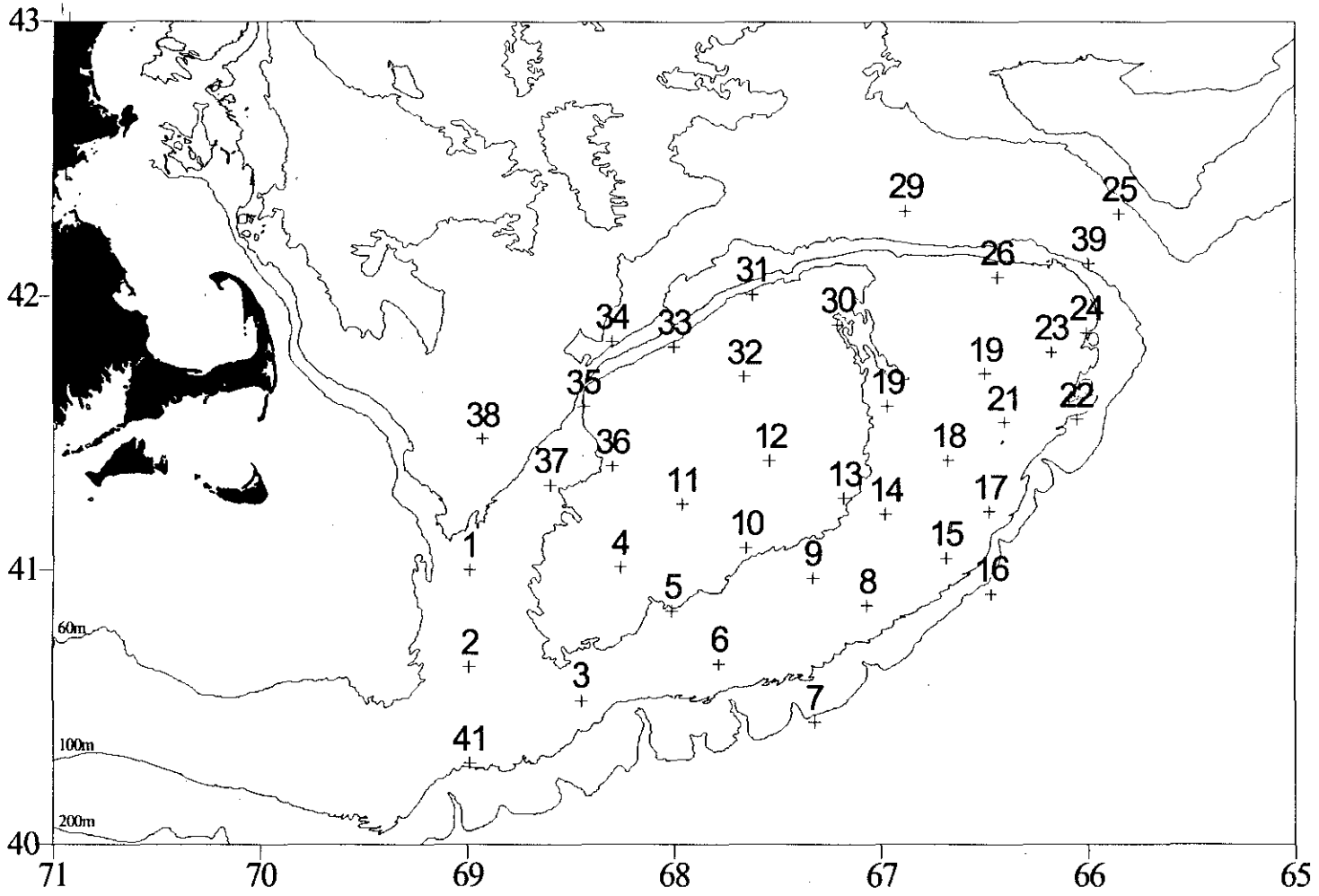


Figure 4. Hydrographic stations occupied during the GLOBEC Broad Scale survey ALB9801.

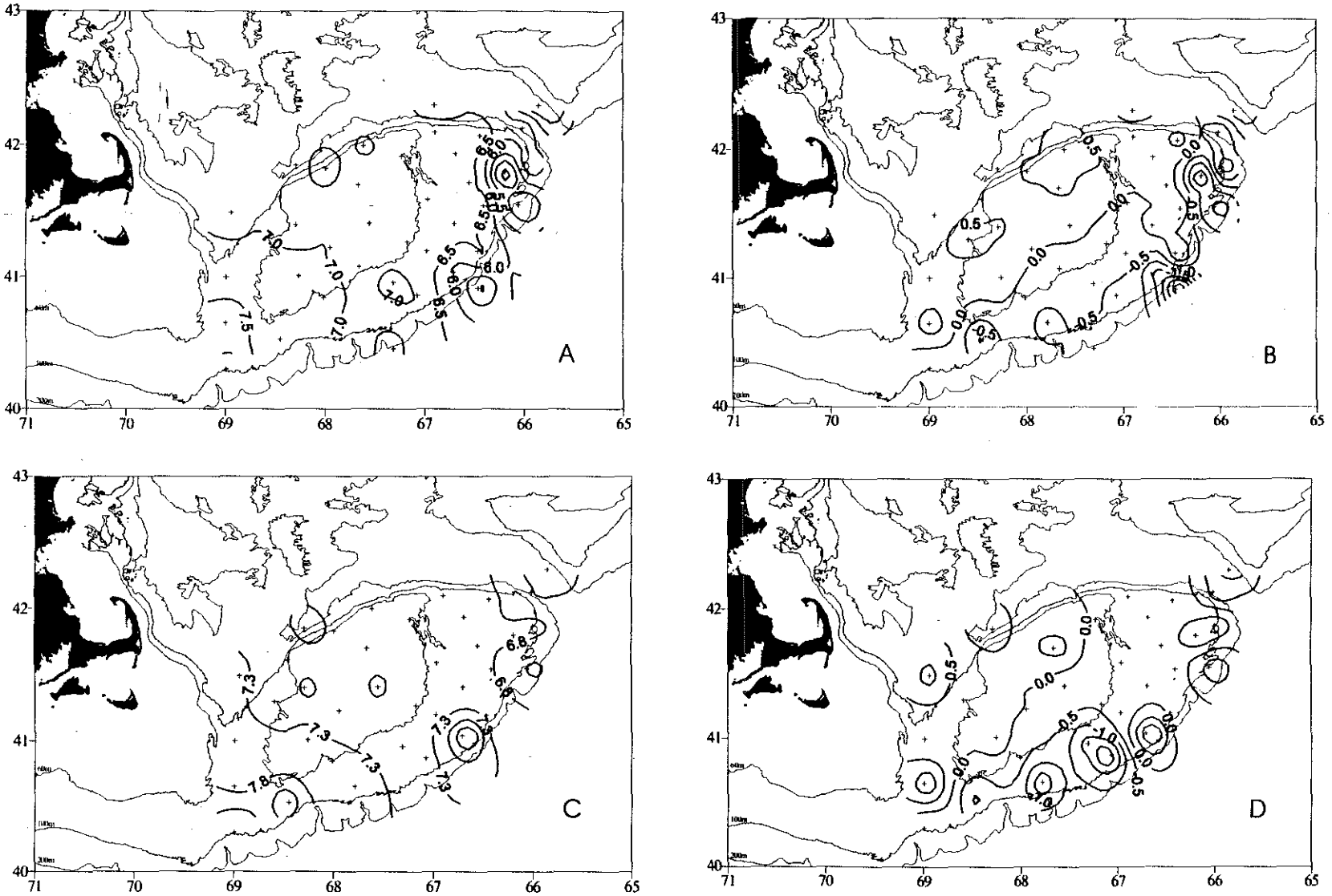


Figure 5. Distribution figures for GLOBEC Broad Scale survey ALB9801. Surface temperature (A), surface temperature anomaly (B), bottom temperature (C), and bottom temperature anomaly (D).

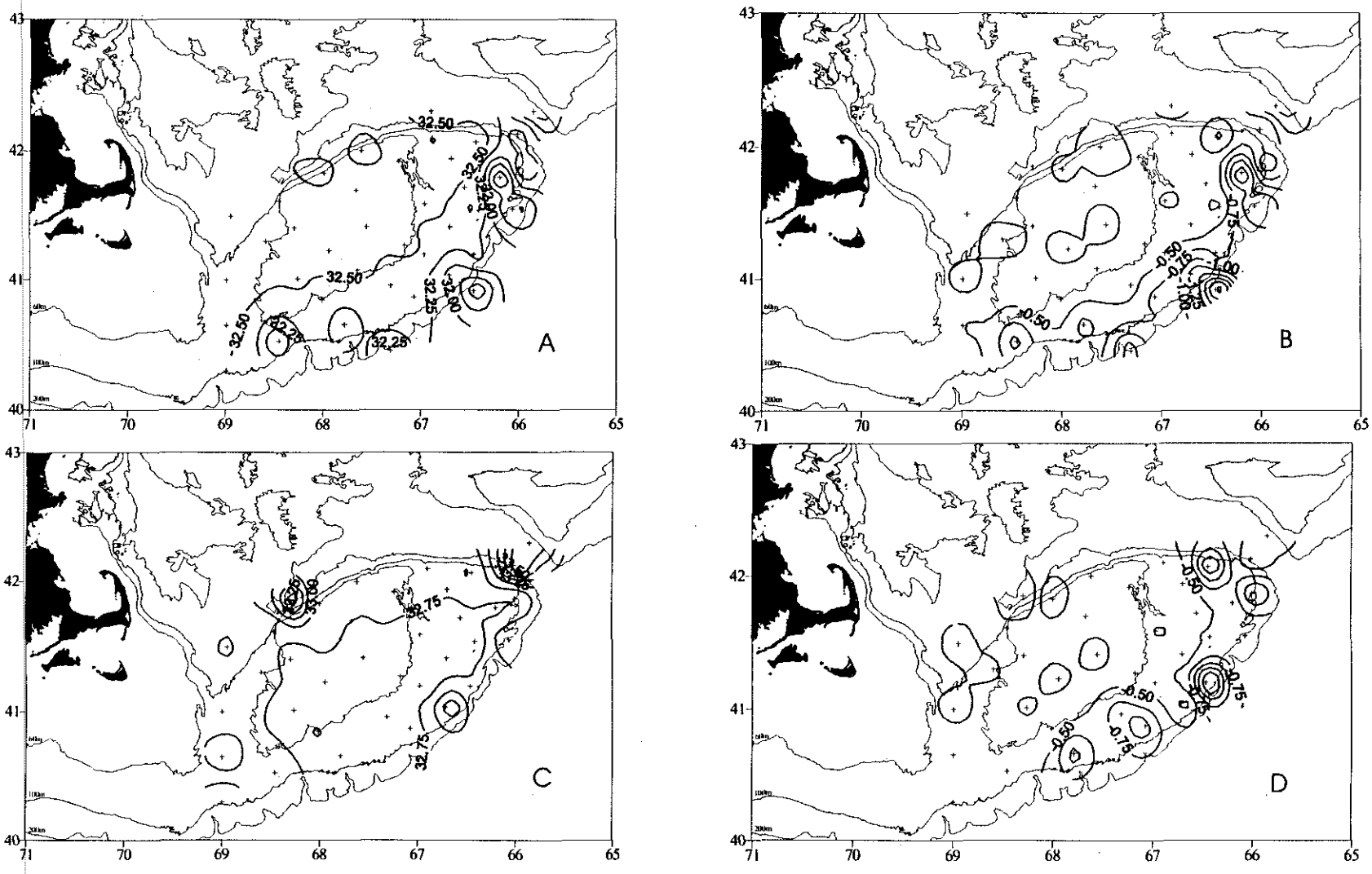


Figure 6. Distribution figures for GLOBEC Broad Scale survey ALB9801. Surface salinity (A), surface salinity anomaly (B), bottom salinity (C), and bottom salinity anomaly (D).

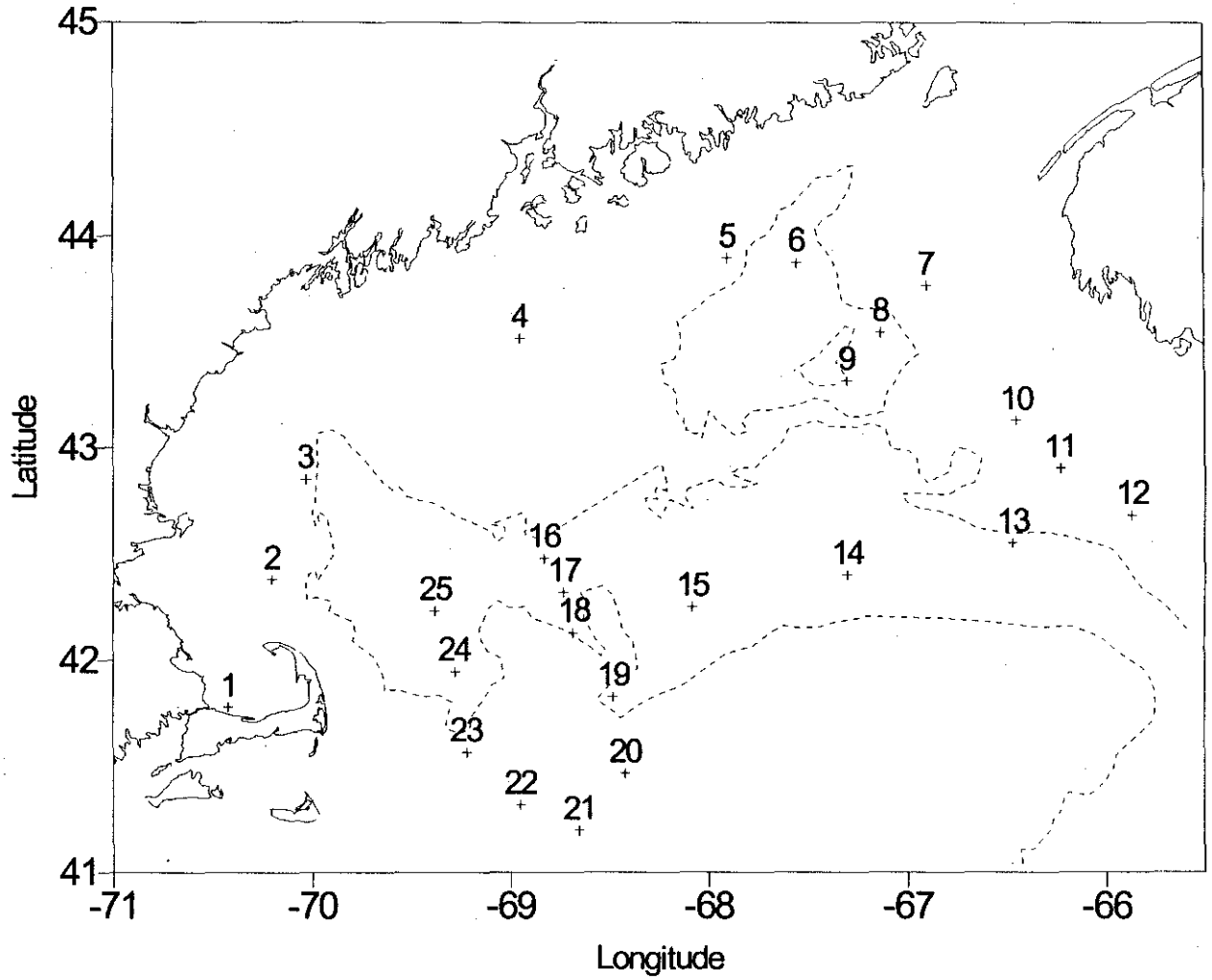


Figure 7. Stations occupied during Ecosystem Monitoring survey ALB9802.

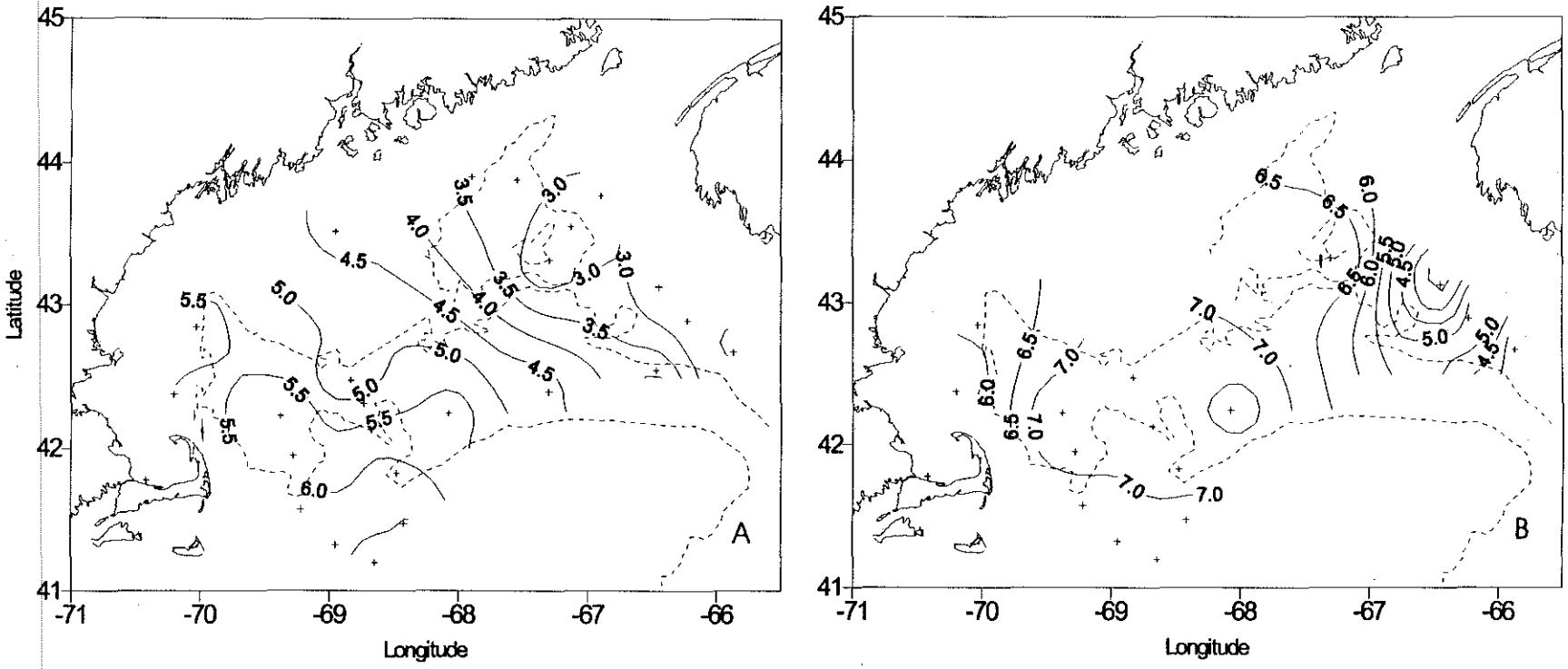


Figure 8. Surface (A) and bottom (B) temperature distributions during Ecosystem Monitoring survey ALB9802.

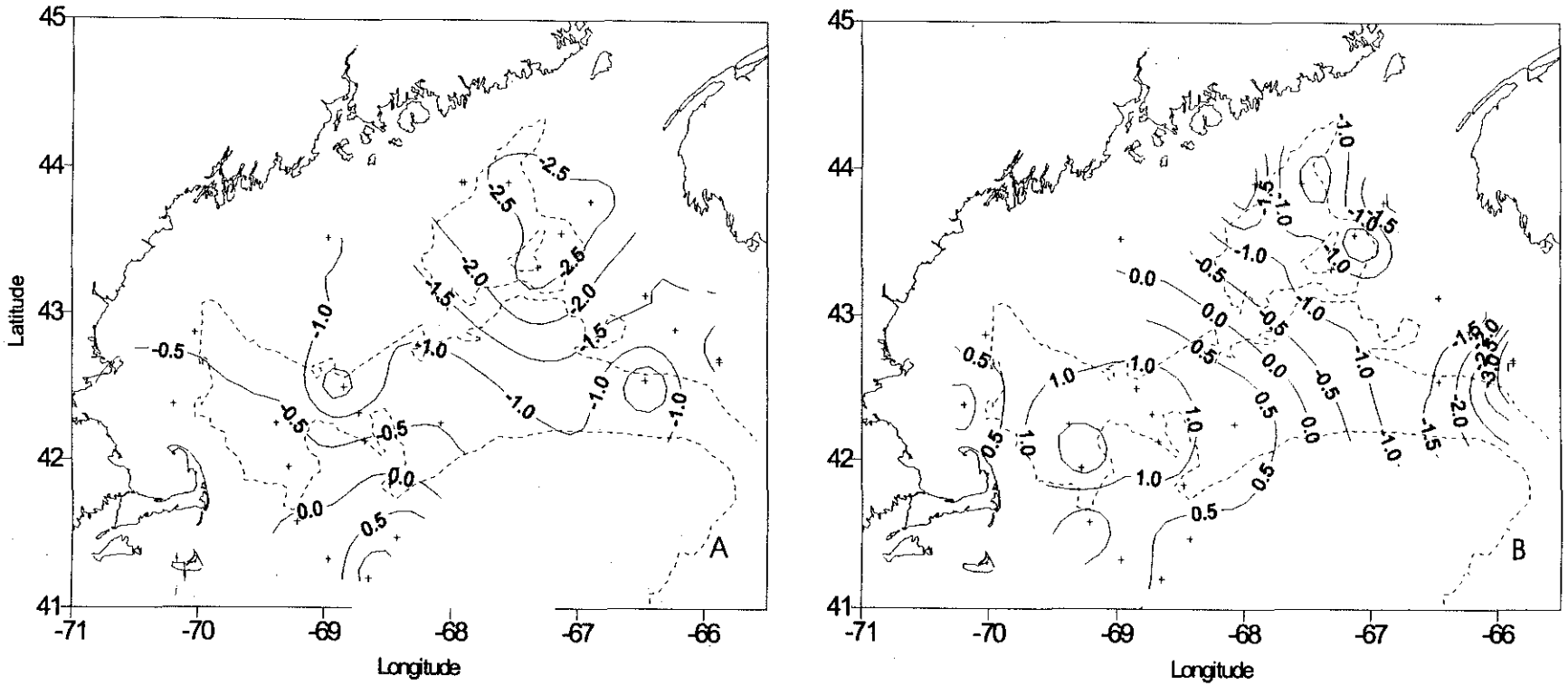


Figure 9. Surface (A) and bottom (B) temperature anomaly distributions for Ecosystem Monitoring survey ALB9802.

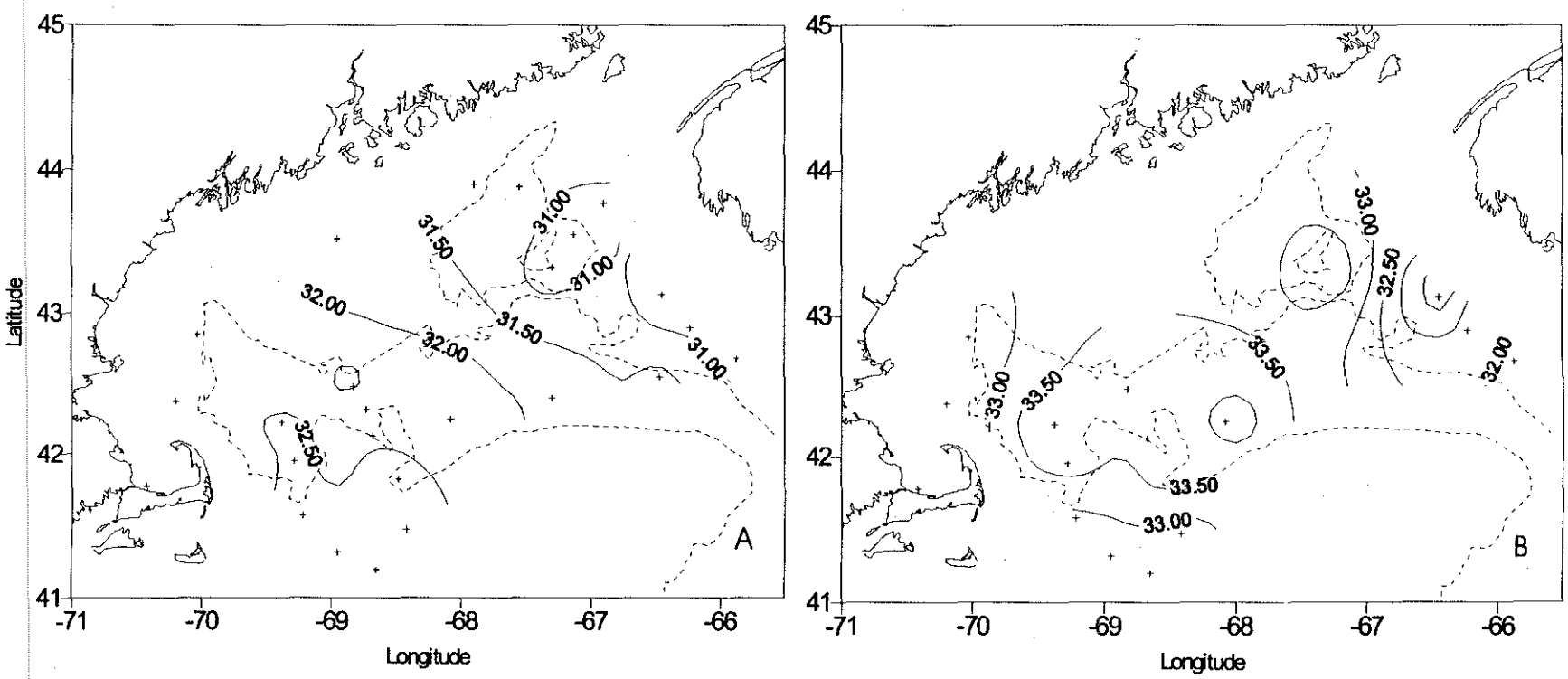


Figure 10. Surface (A) and bottom (B) salinity distributions for Ecosystem Monitoring survey ALB9802.

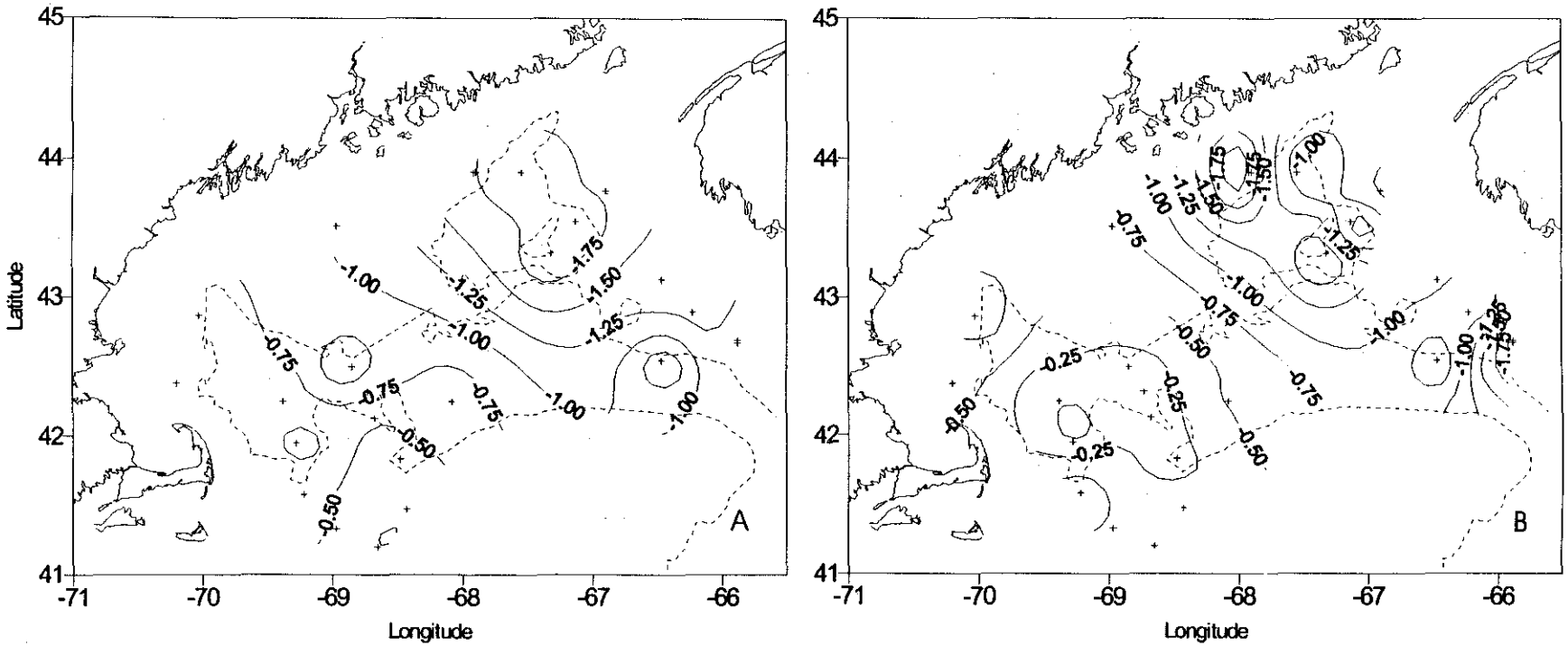


Figure 11. Surface (A) and bottom (B) salinity anomaly distributions for Ecosystem Monitoring survey ALB9802.

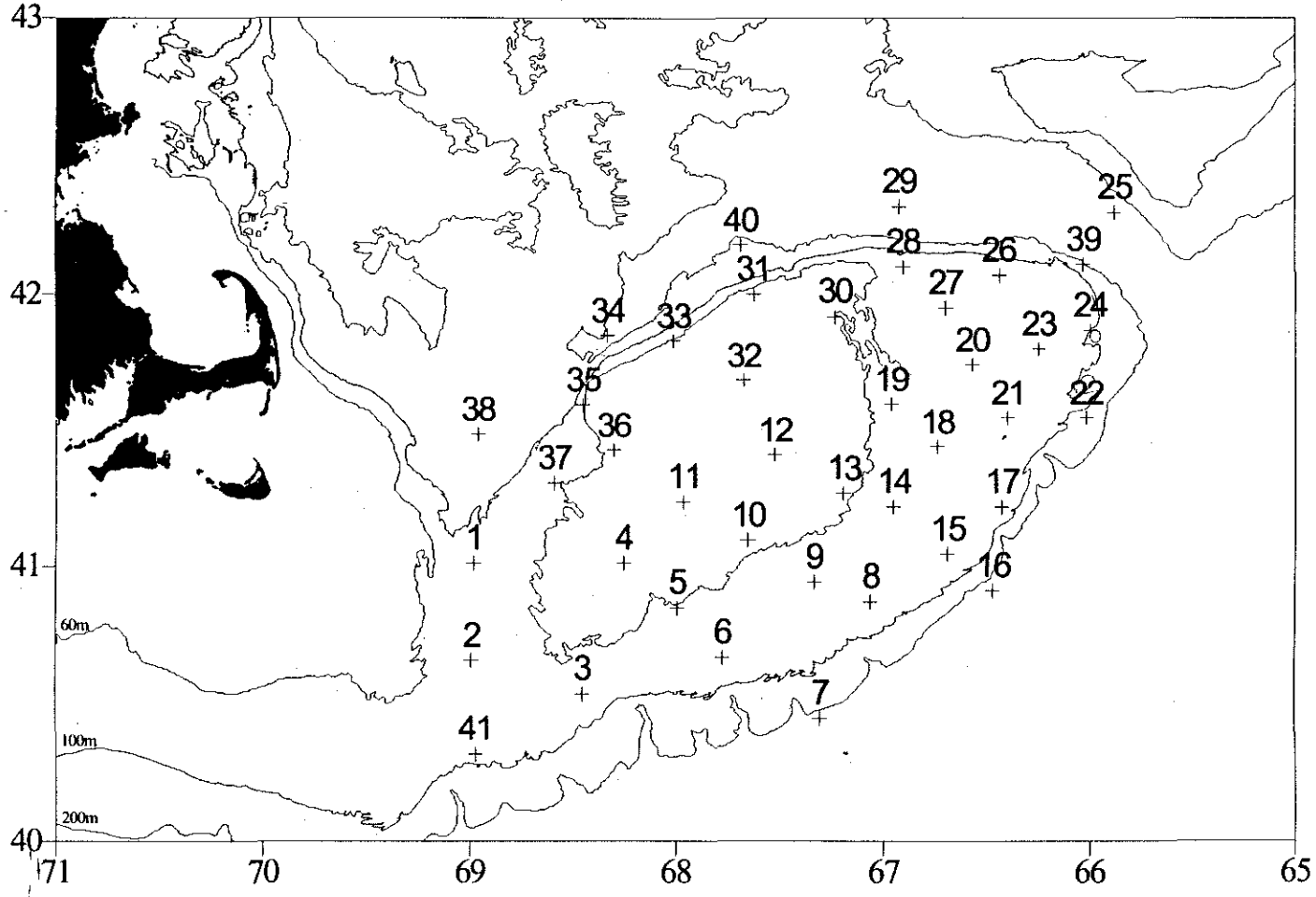


Figure 12. Hydrographic stations for GLOBEC Broad Scale survey OCE9817.

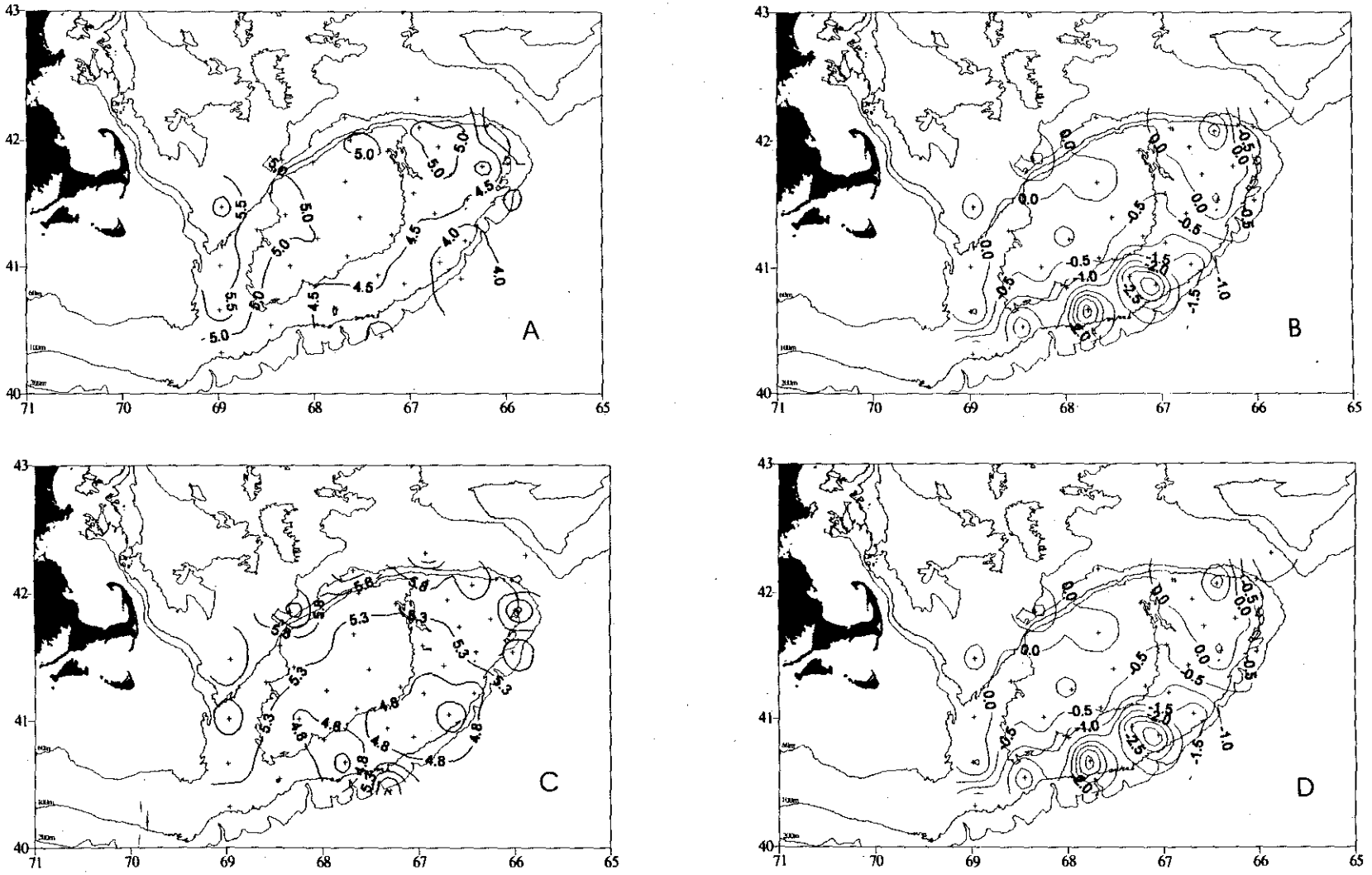


Figure 13. Distribution figures for GLOBEC Broad Scale survey OCE9817. Surface temperature (A), surface temperature anomaly (B), bottom temperature (C) , bottom temperature anomaly (D).

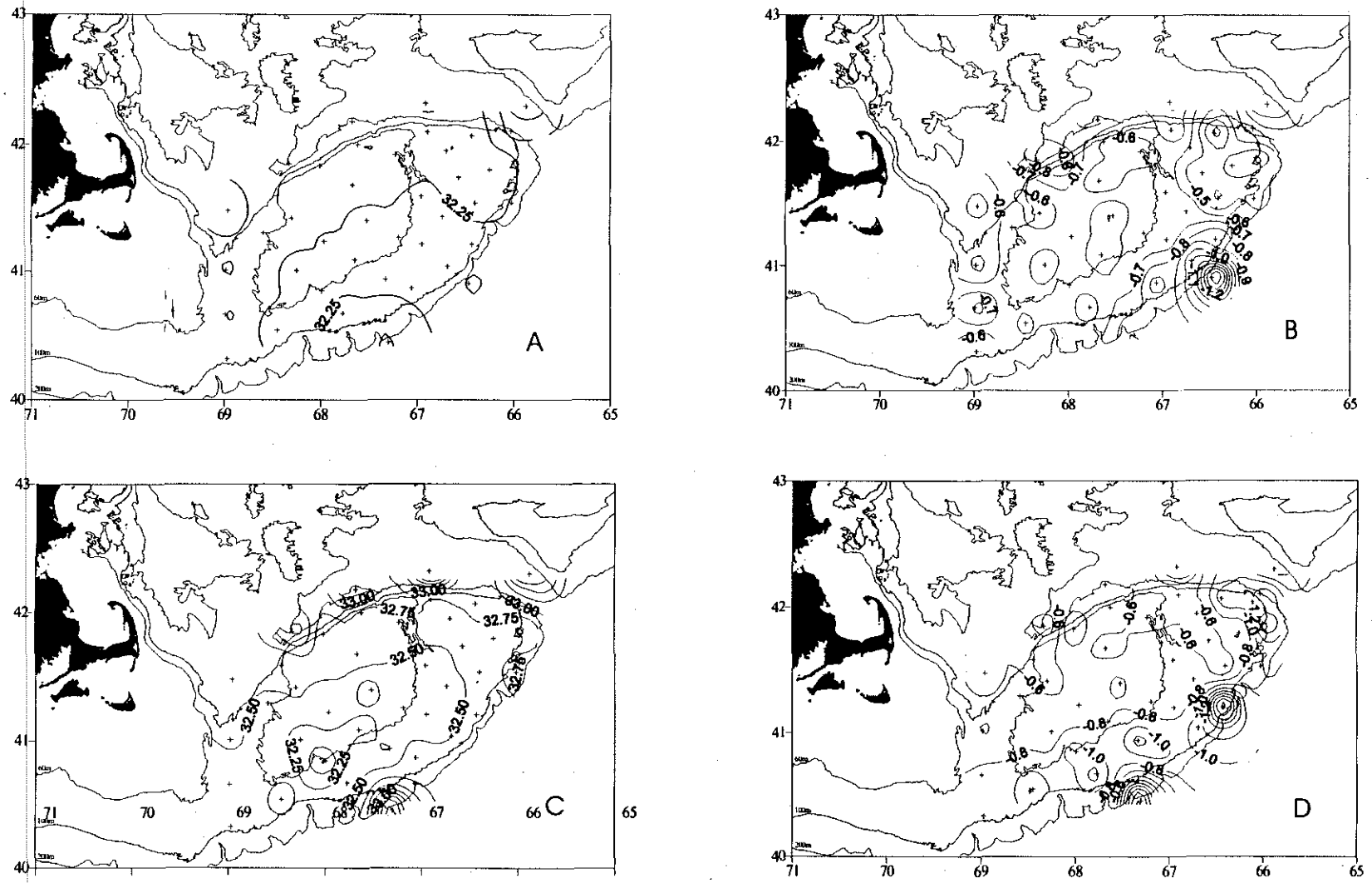


Figure 14. Distribution figures for GLOBEC Broad Scale survey OCE9817. Surface salinity (A), surface salinity anomaly (B), bottom salinity (C), bottom salinity anomaly (D).

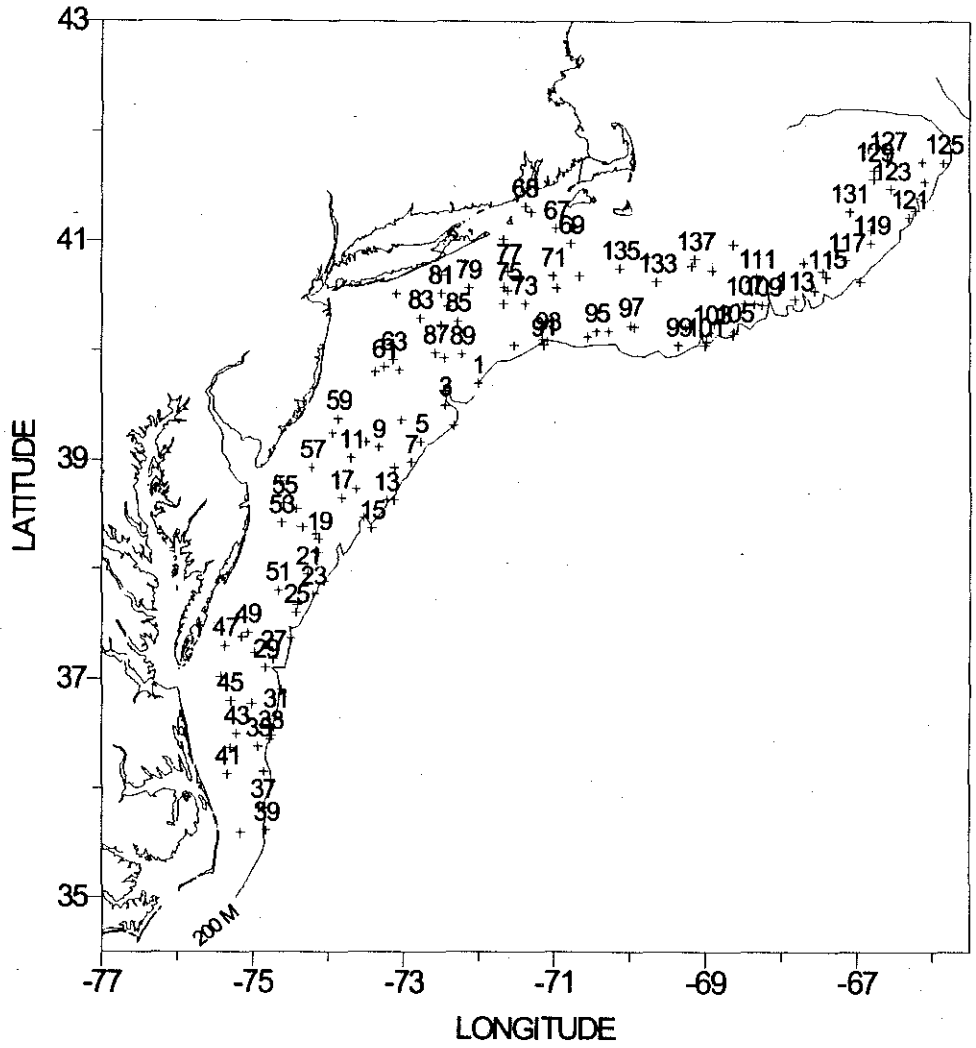


Figure 15. Stations occupied during the Winter Bottom Trawl survey ALB9803.

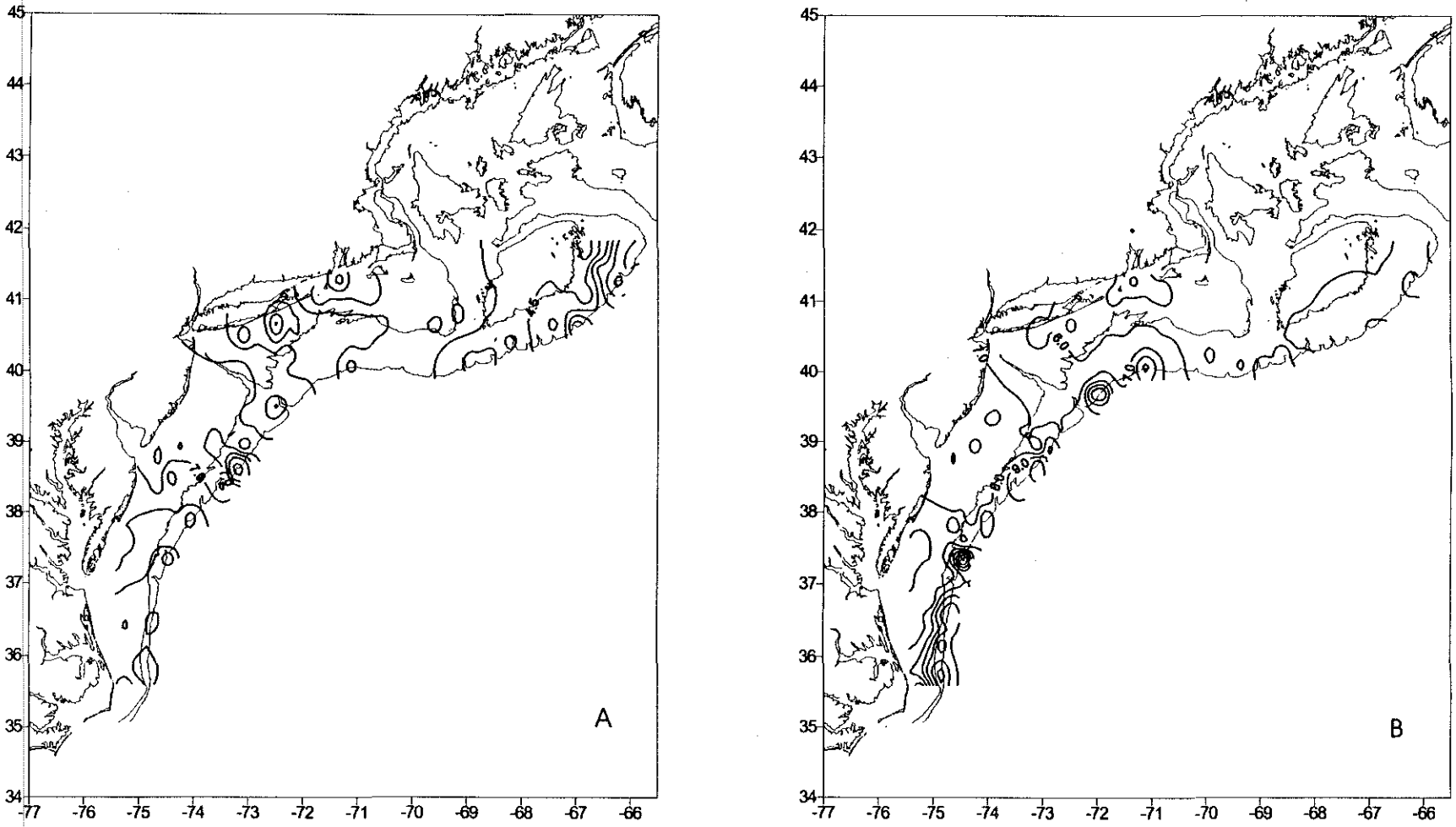


Figure 16. Surface (A) and bottom (B) temperature distributions for the Winter Bottom Trawl survey ALB9803.

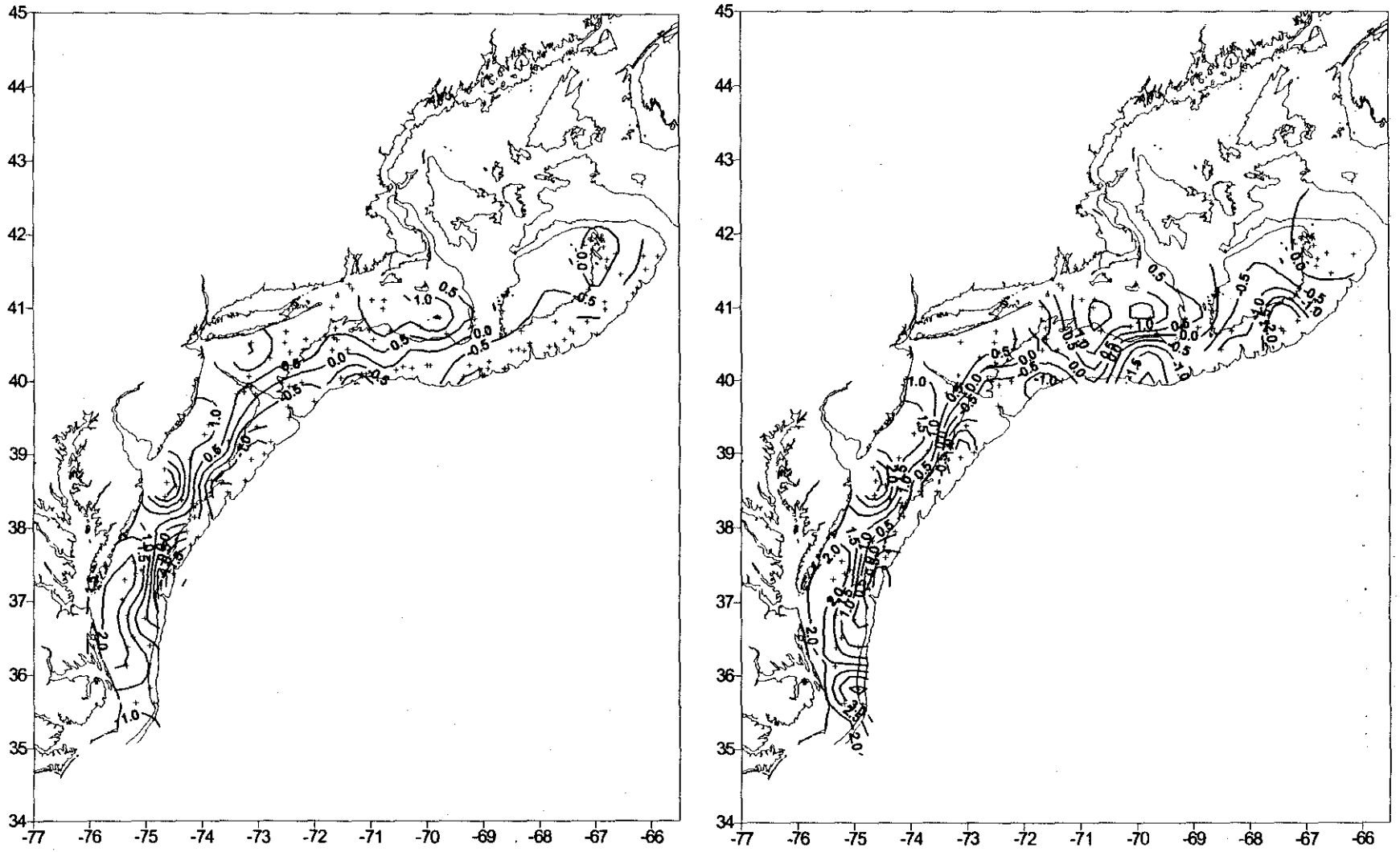


Figure 17. Surface (A) and bottom (B) temperature anomaly distributions for the Winter Bottom Trawl survey ALB9803.

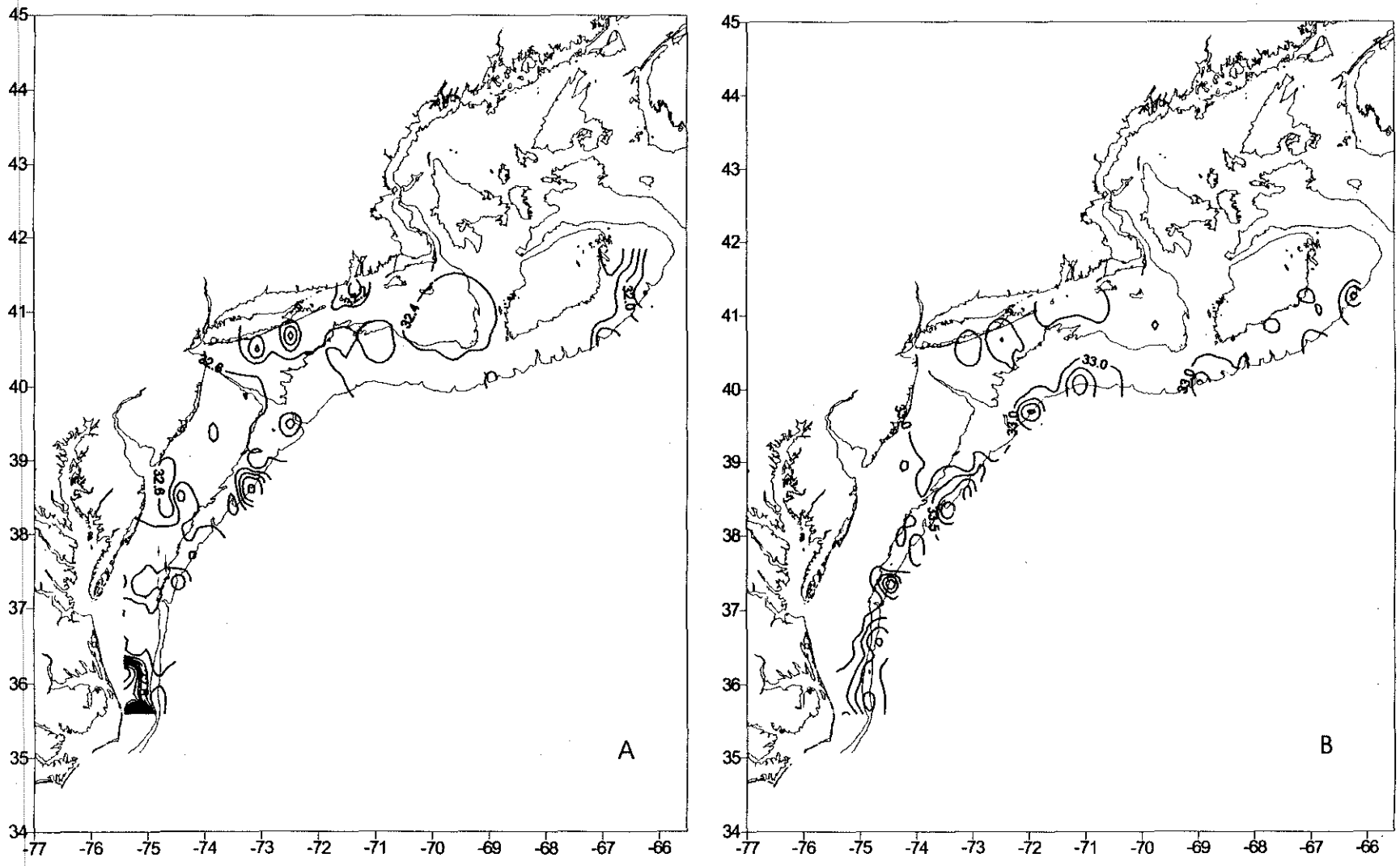


Figure 18. Surface (A) and bottom (B) salinity distributions for the Winter Bottom Trawl survey ALB9803.

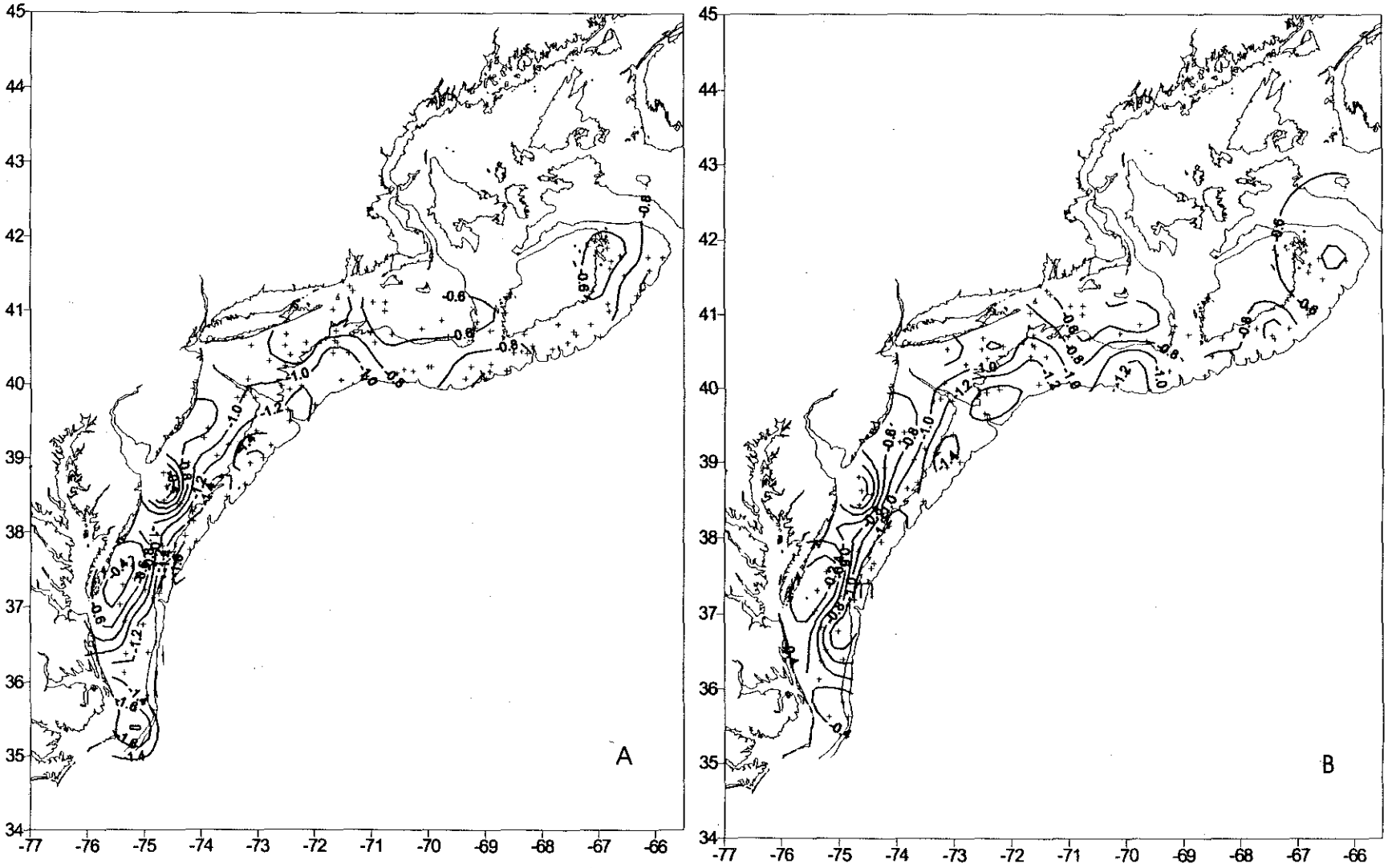


Figure 19. Surface (A) and bottom (B) salinity anomaly distributions for the Winter Bottom Trawl survey ALB9803.

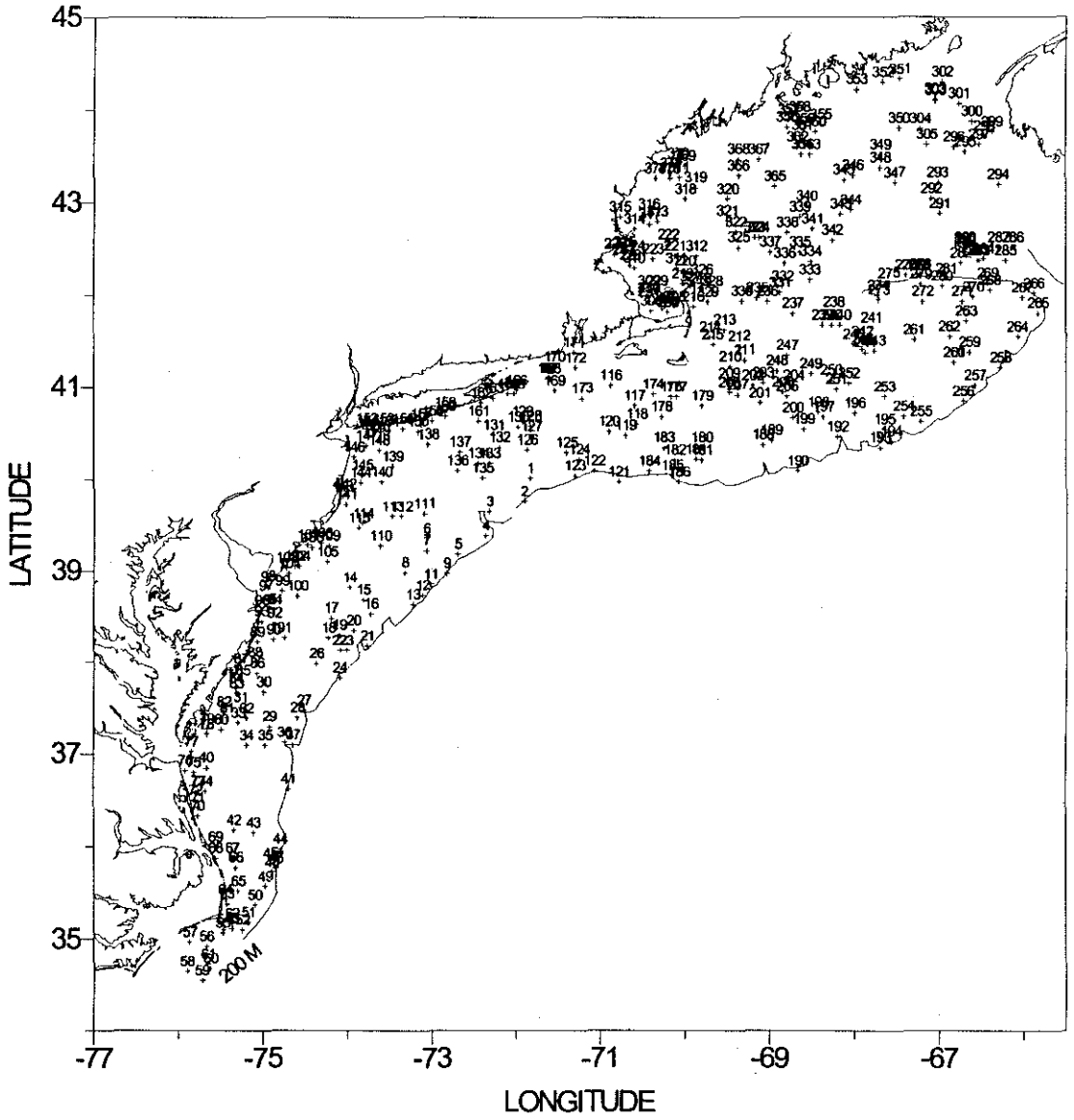
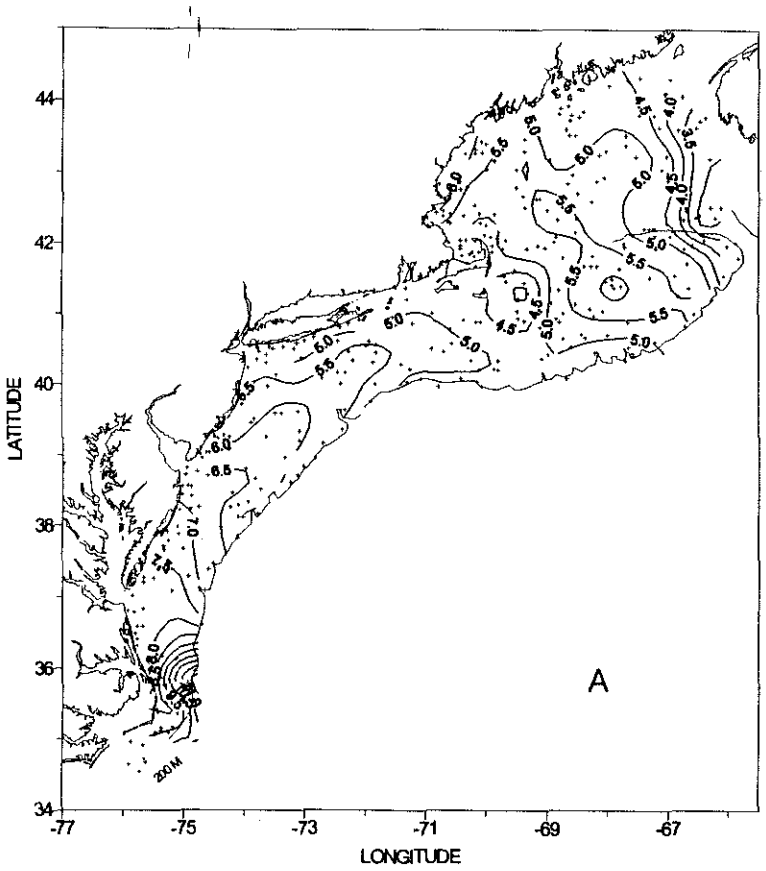


Figure 20. Stations occupied during the Spring Bottom Trawl Survey ALB9804



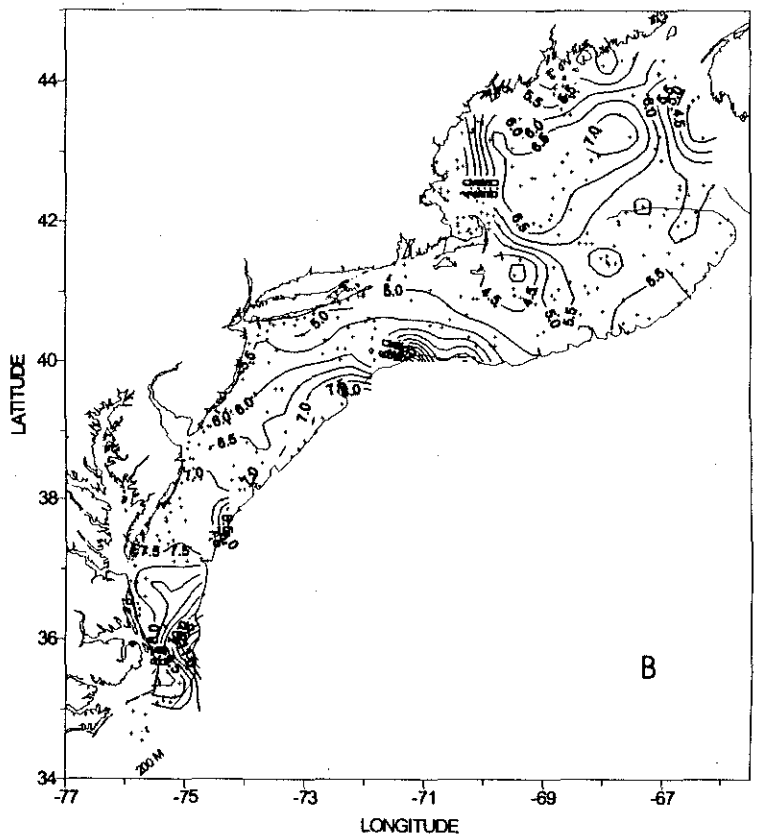
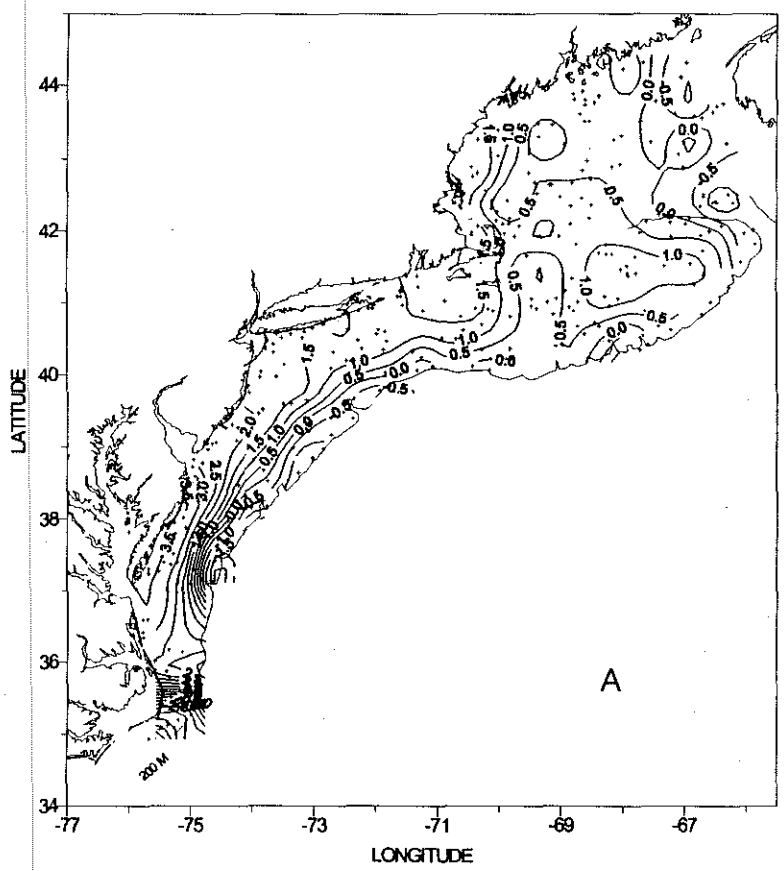


Figure 21. Surface (A) and bottom (B) temperature distribution figures for the Spring Bottom Trawl survey ALB9804.



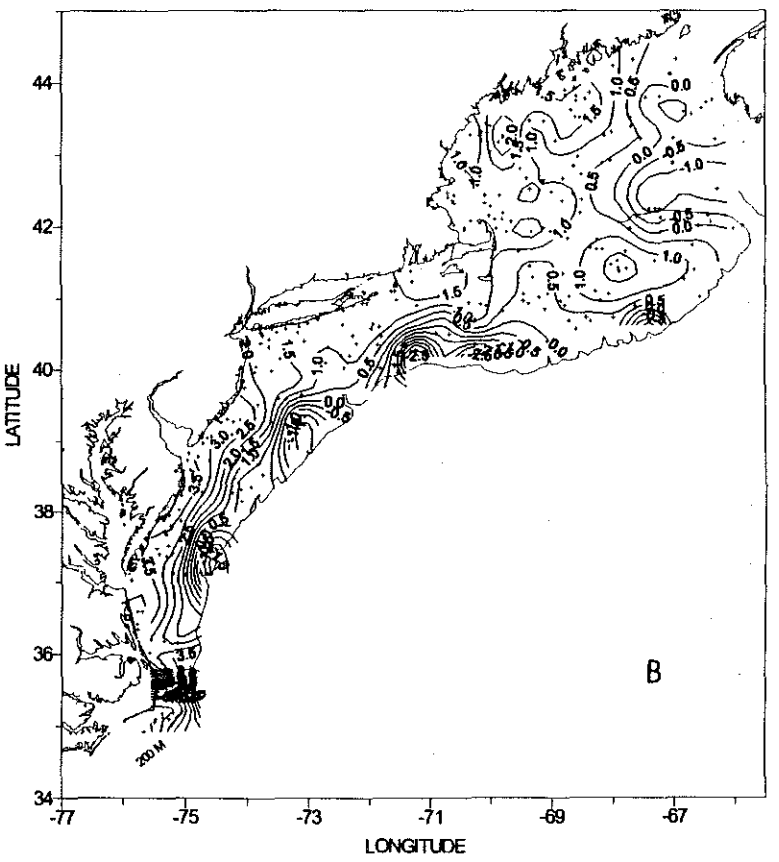


Figure 22. Surface (A) and bottom (B) temperature anomaly distributions for the Spring Bottom Trawl Survey ALB9804.

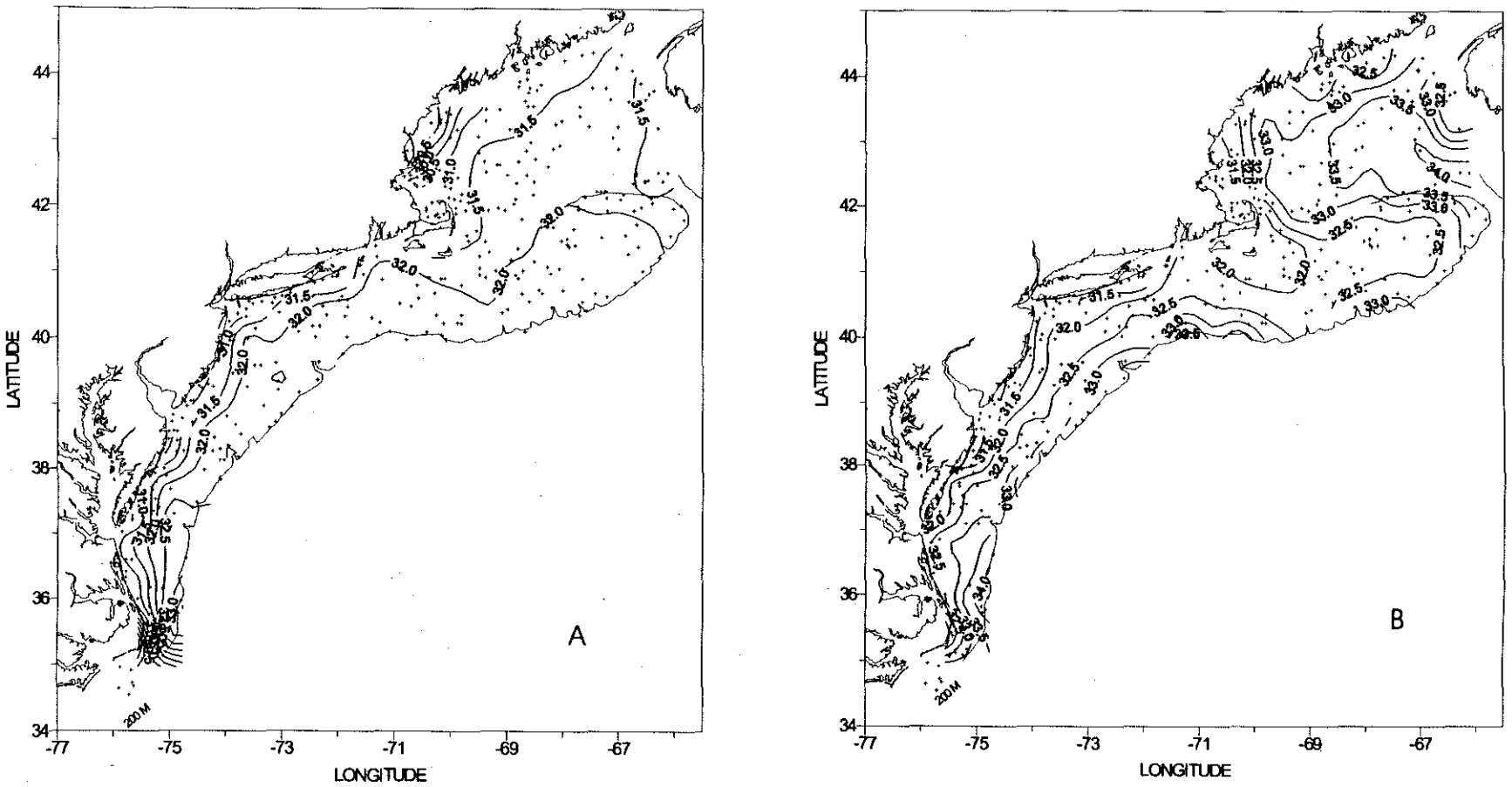


Figure 23. Surface (A) and bottom (B) salinity distributions for the Spring Bottom Trawl survey ALB9804.

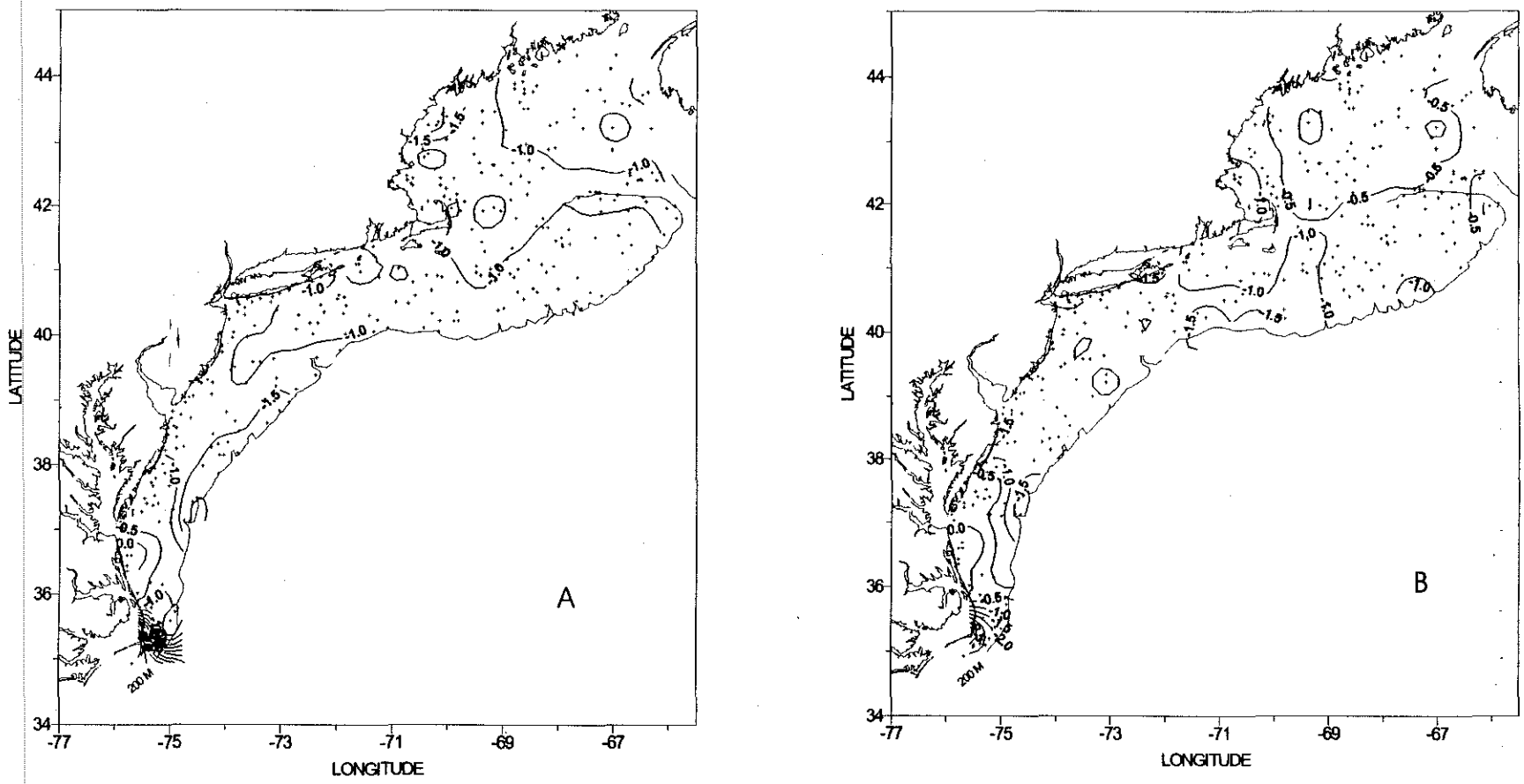


Figure 24. Surface (A) and bottom (B) salinity anomaly distributions for the Spring Bottom Trawl Survey ALB9804.

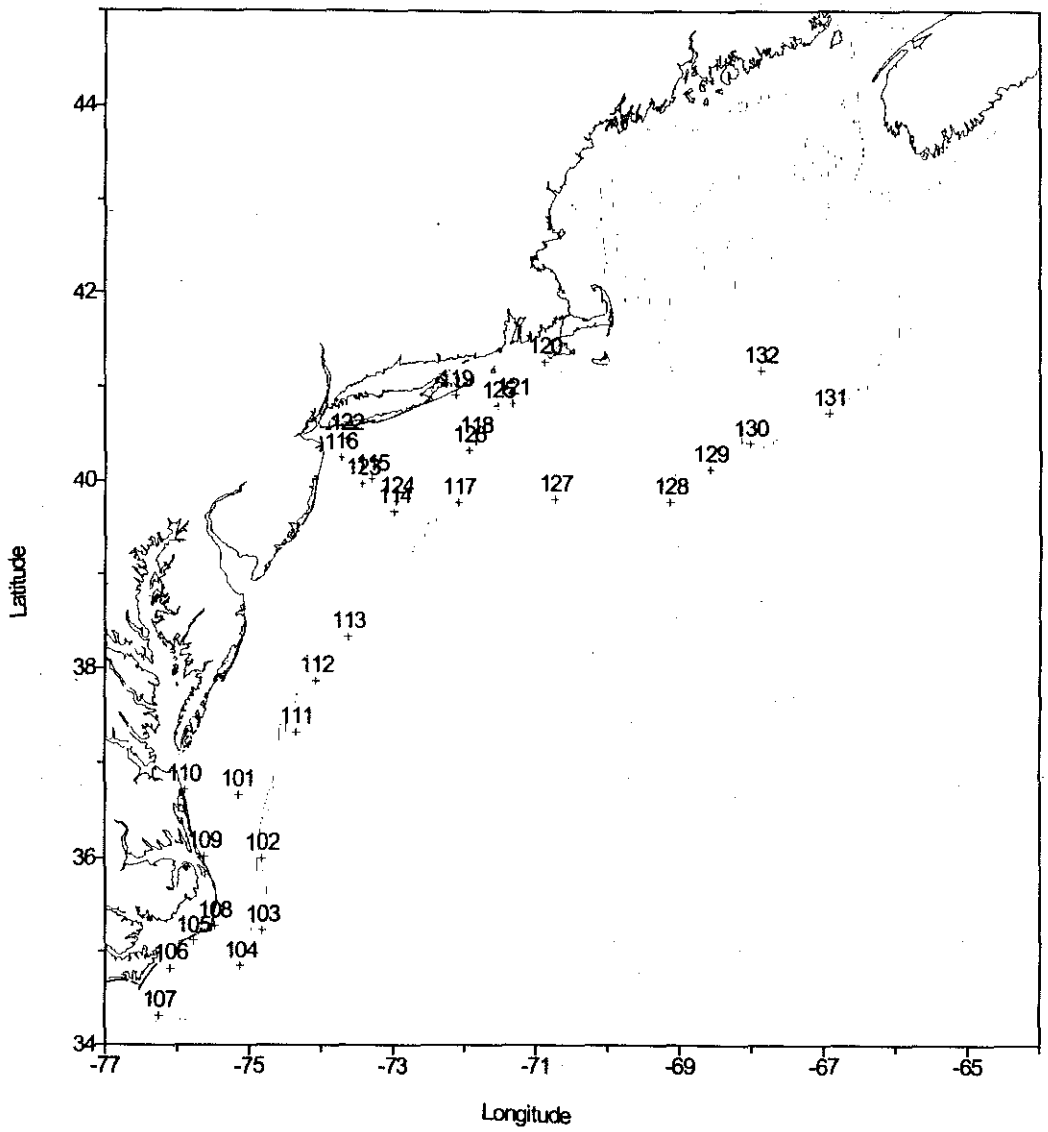


Figure 25. Stations occupied during Marine Mammal Survey DEL9804.

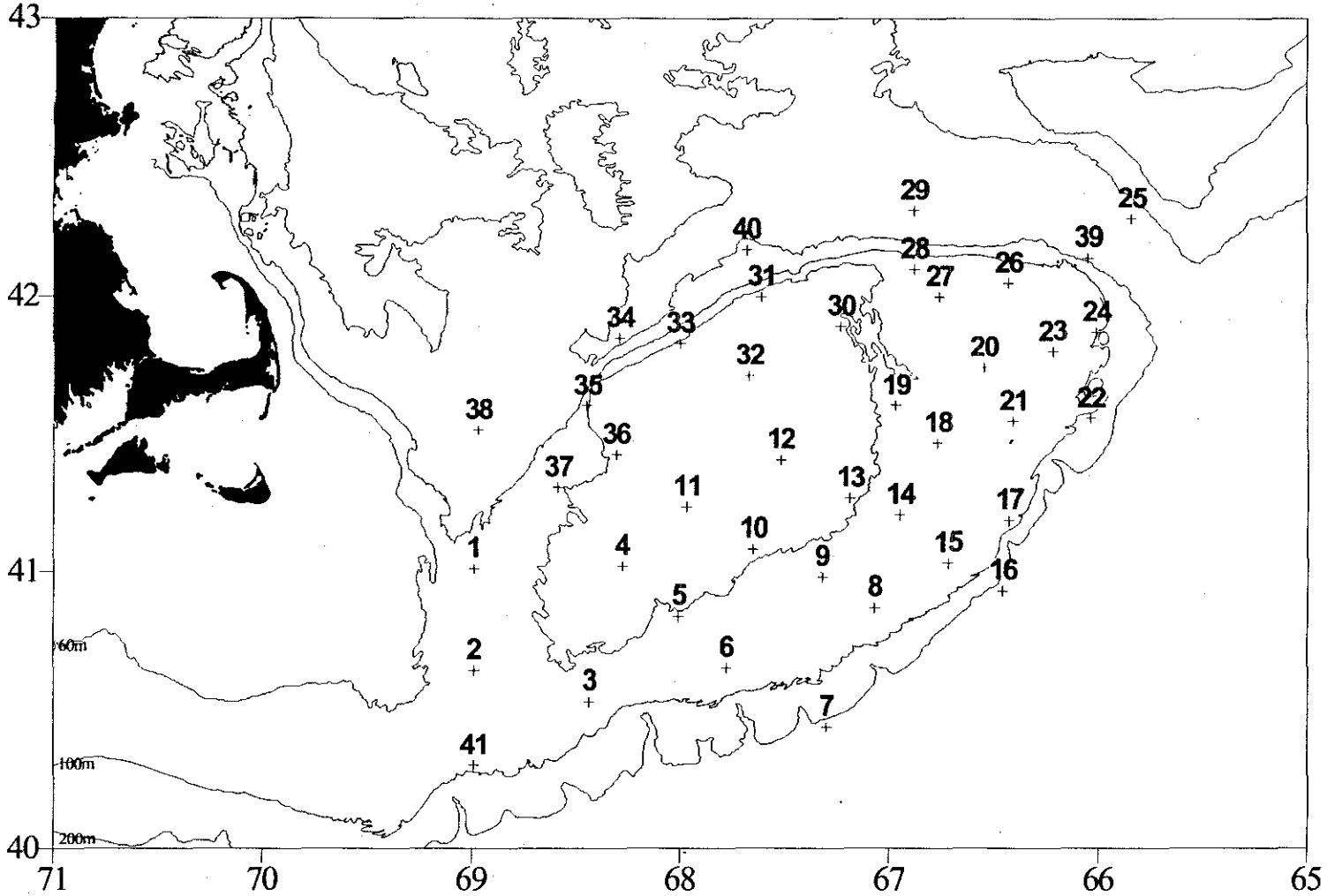


Figure 26. Hydrographic stations for GLOBEC Broad Scale survey OCE9819.

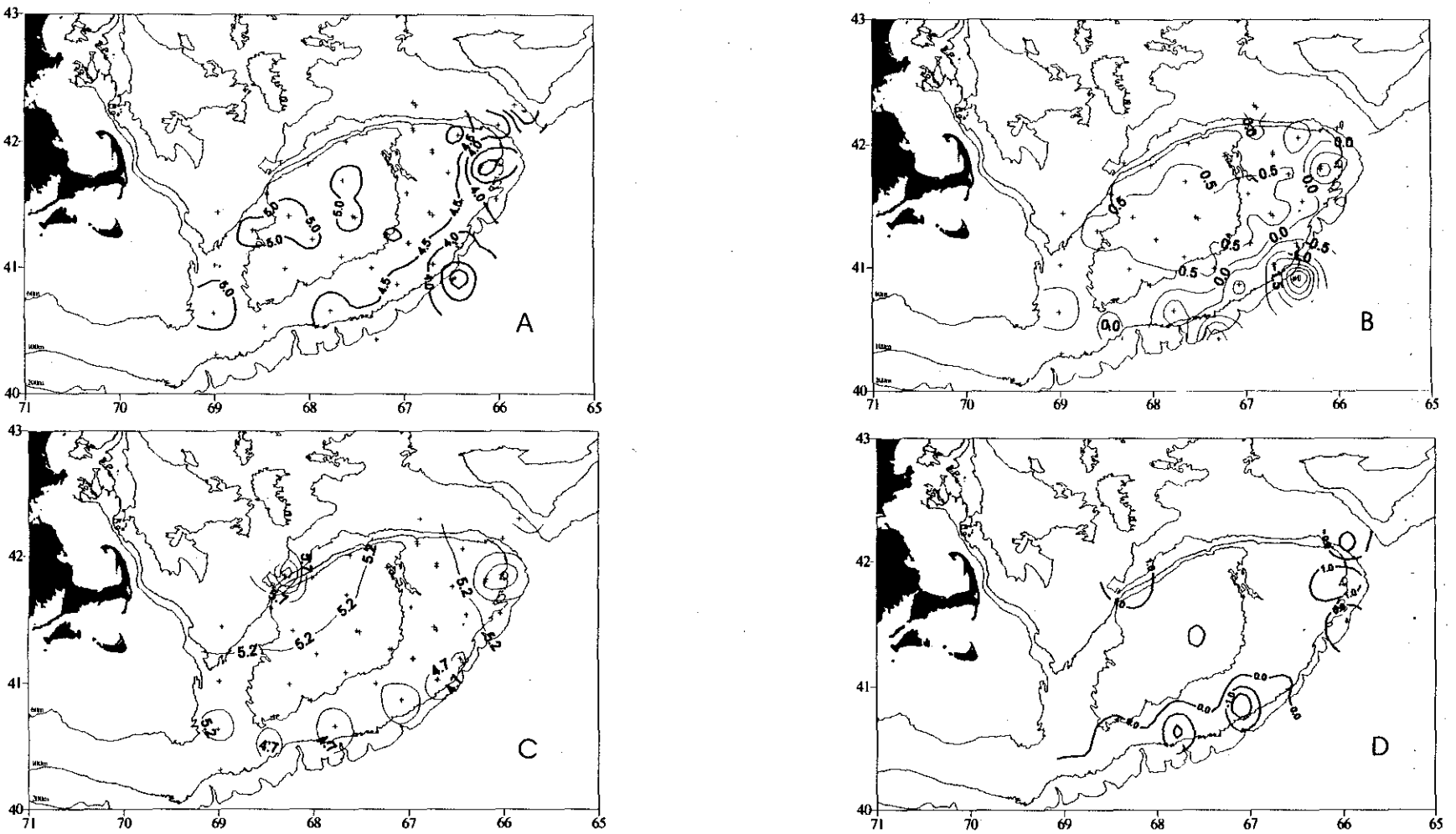


Figure 27. Distribution figures for GLOBEC Broad Scale survey OCE9819. Surface temperature (A), surface temperature anomaly ((B), bottom temperature (C), and bottom temperature anomaly (D).

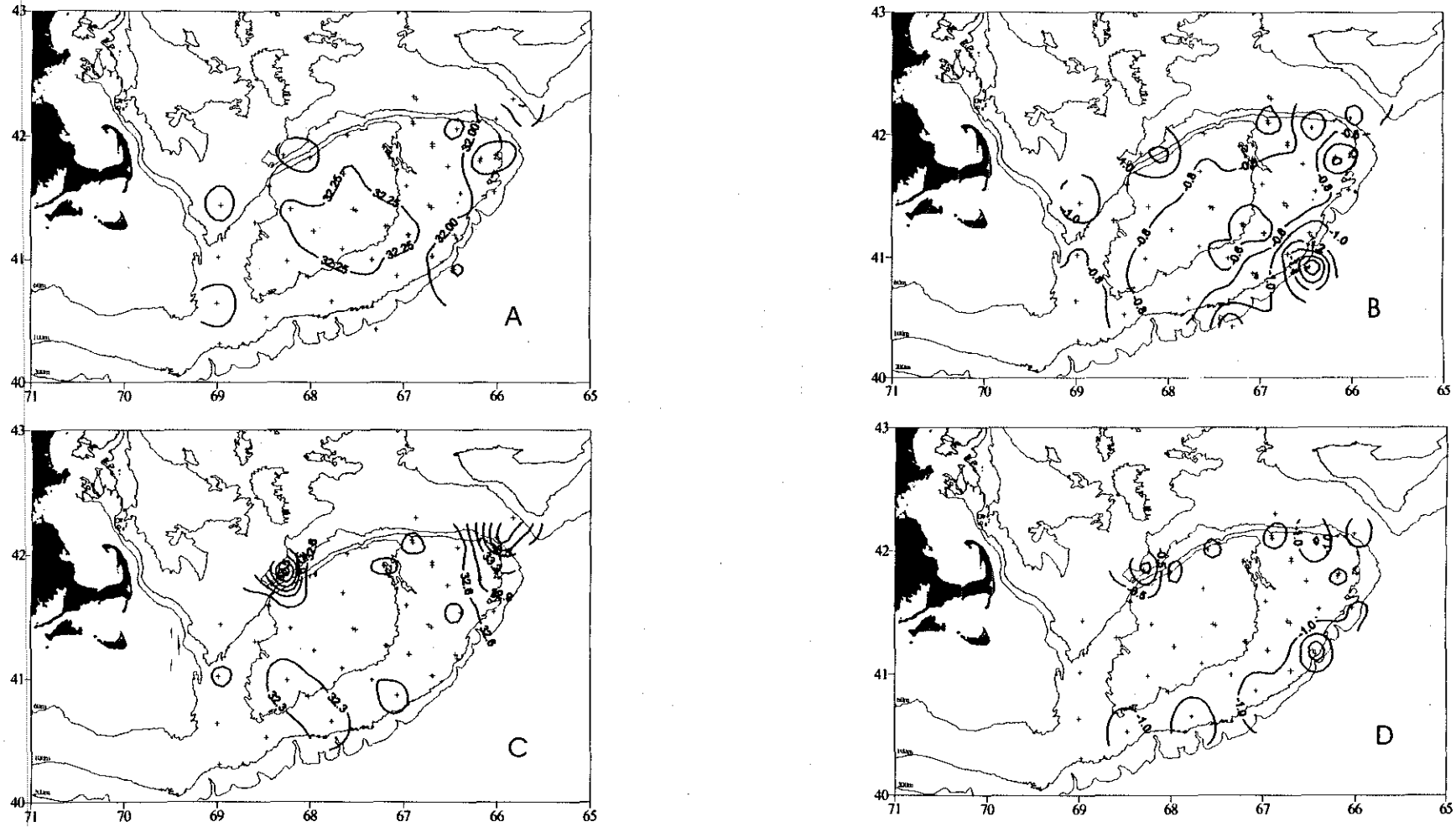


Figure 28. Distribution figures for GLOBEC Broad Scale survey OCE9819. Surface salinity (A), surface salinity anomaly (B), bottom salinity (C), and bottom salinity anomaly (D).

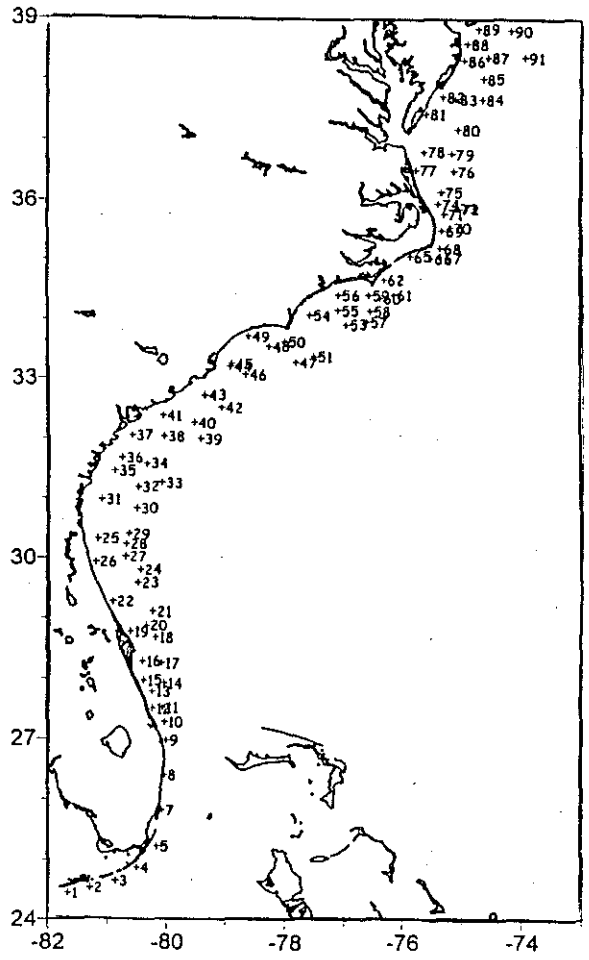


Figure 29. Stations occupied during the Apex Predator survey DEL9806.

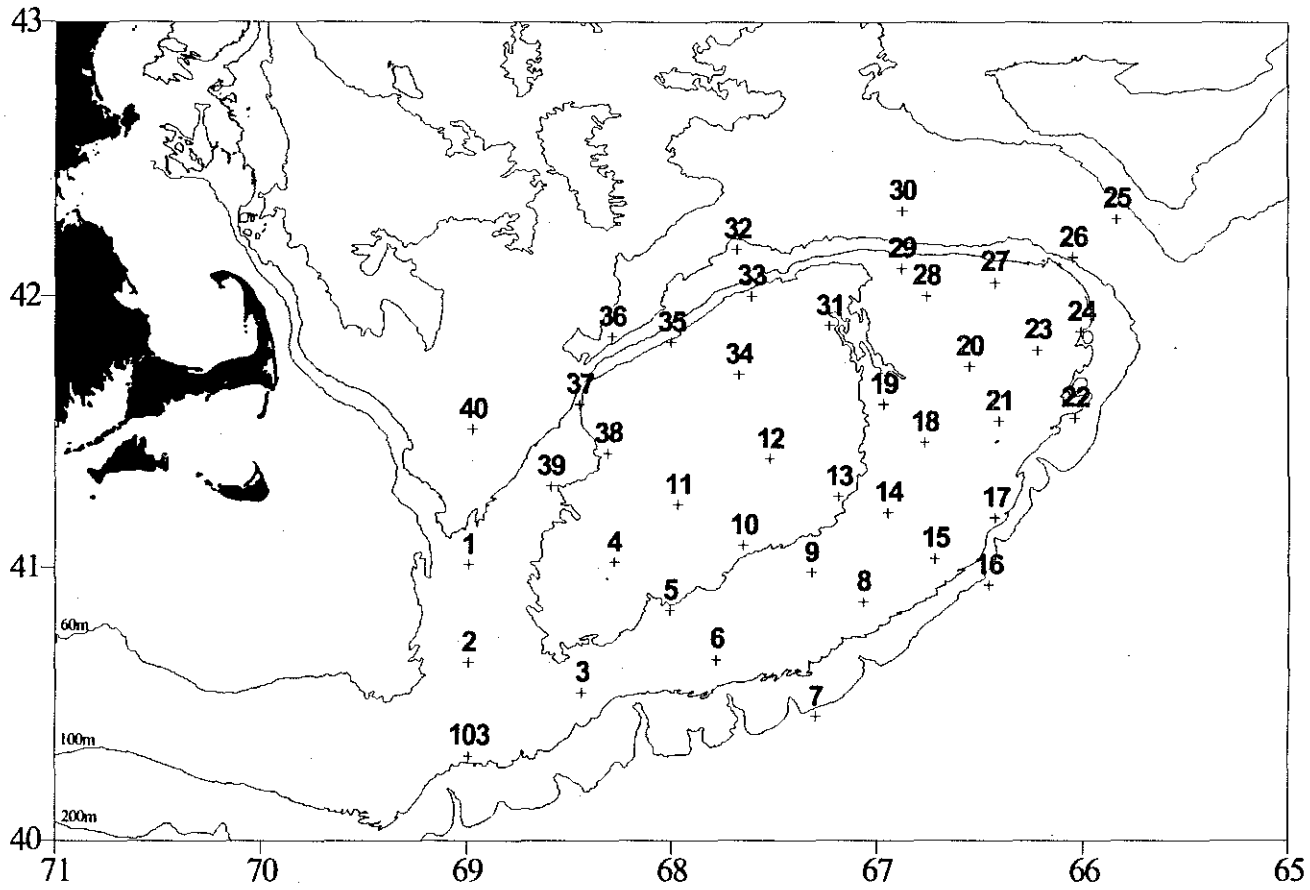


Figure 30. Hydrographic stations occupied during GLOBEC Broad Scale survey OCE9822.

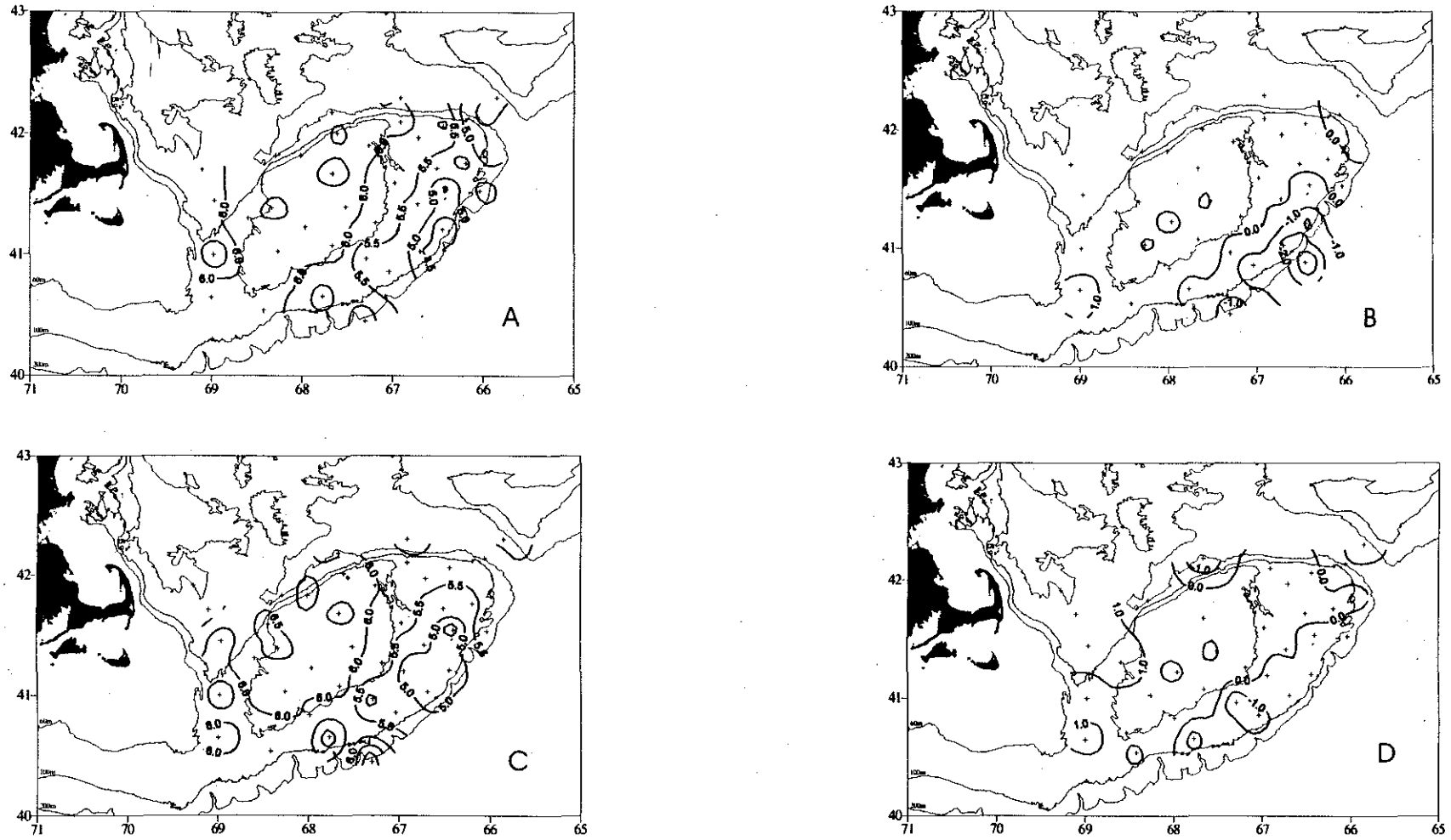


Figure 31. Distribution figures for GLOBEC Broad Scale survey OCE9822. Surface temperature (A), surface temperature anomaly (B), bottom temperature (C), and bottom temperature anomaly (D).

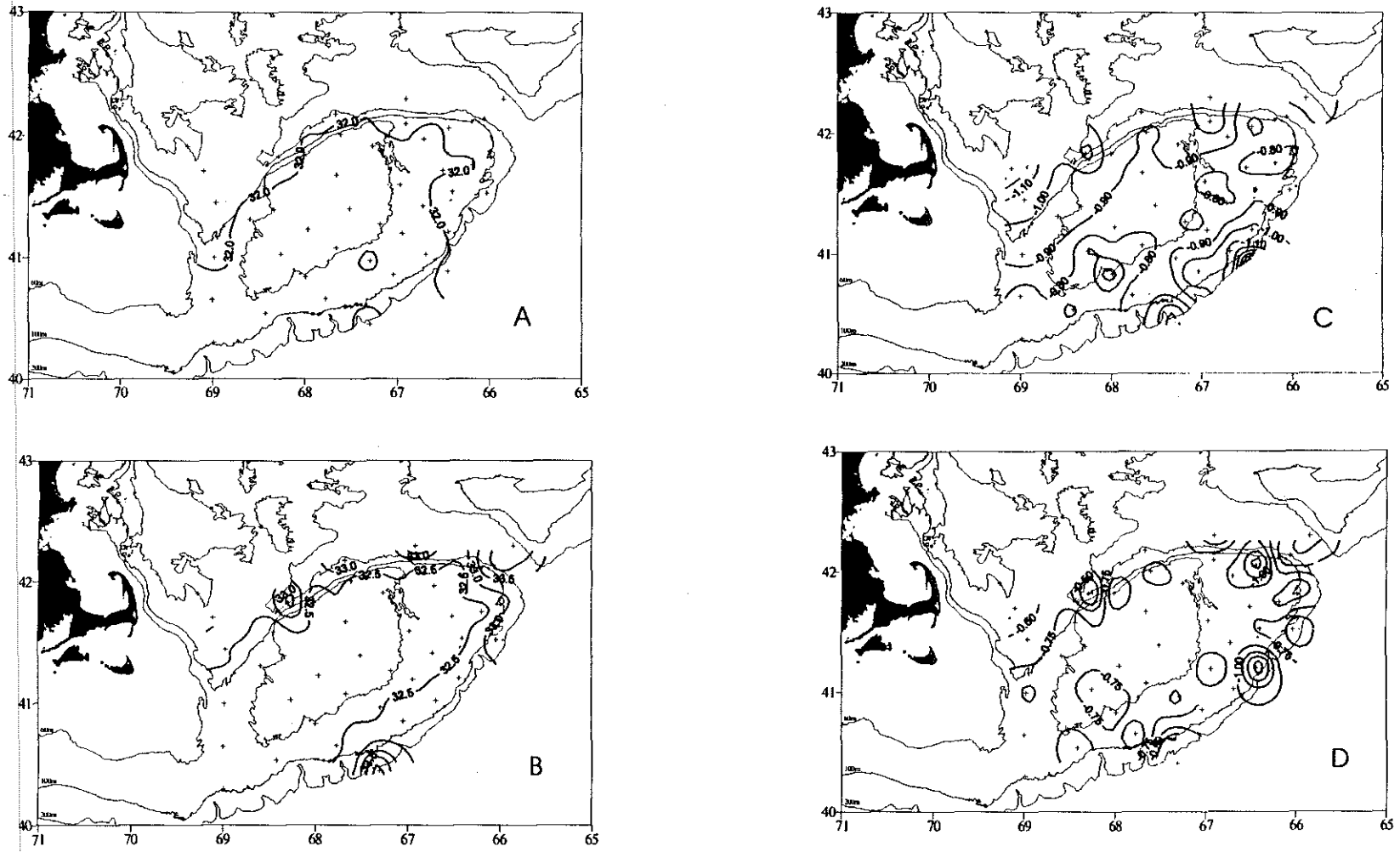


Figure 32. Distribution figures for GLOBEC Broad Scale survey OCE9822. Surface salinity (A), surface salinity anomaly (B), bottom salinity (C), and bottom salinity anomaly (D).

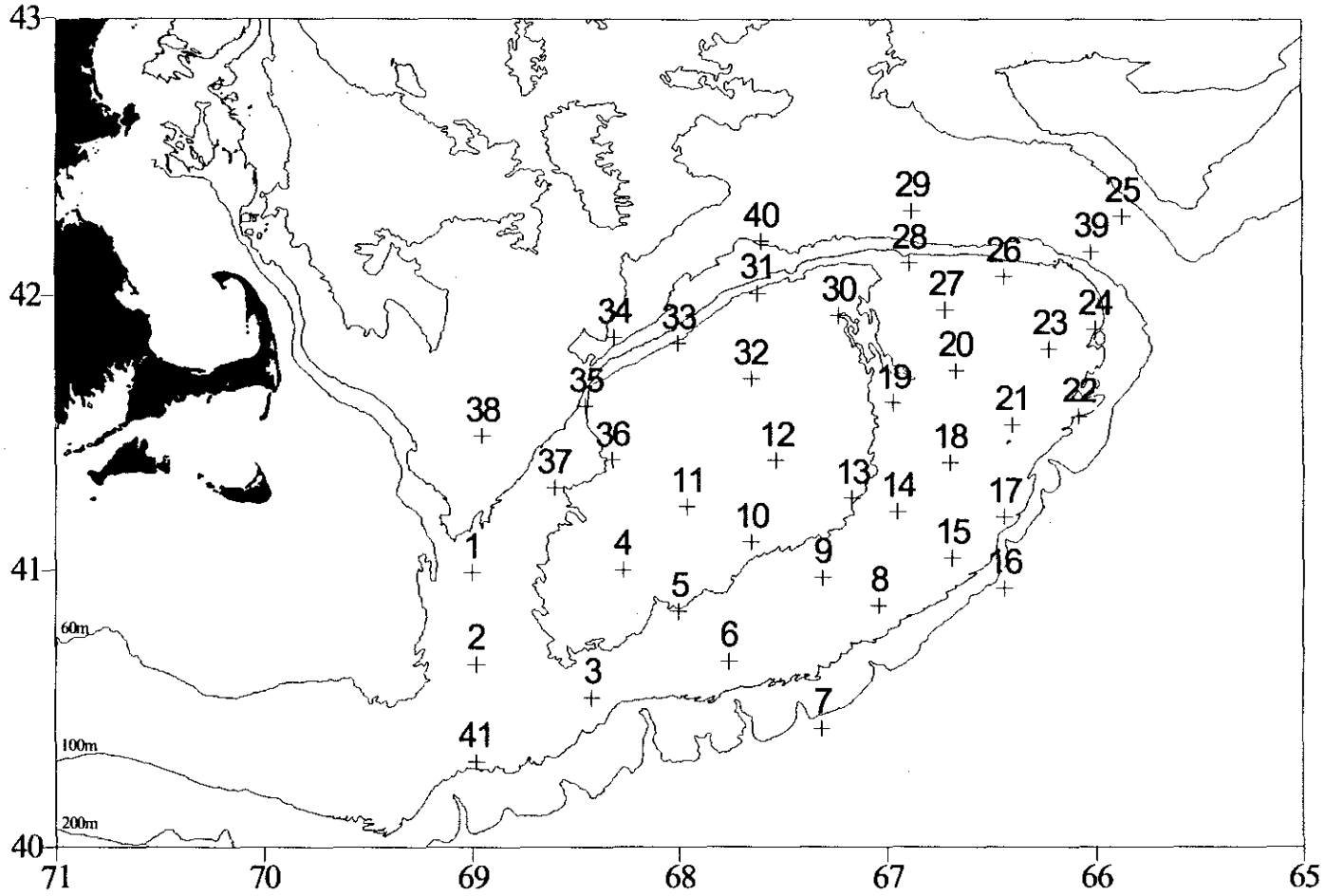


Figure 33. Hydrographic stations occupied during GLOBEC Broad Scale survey ALB9806.

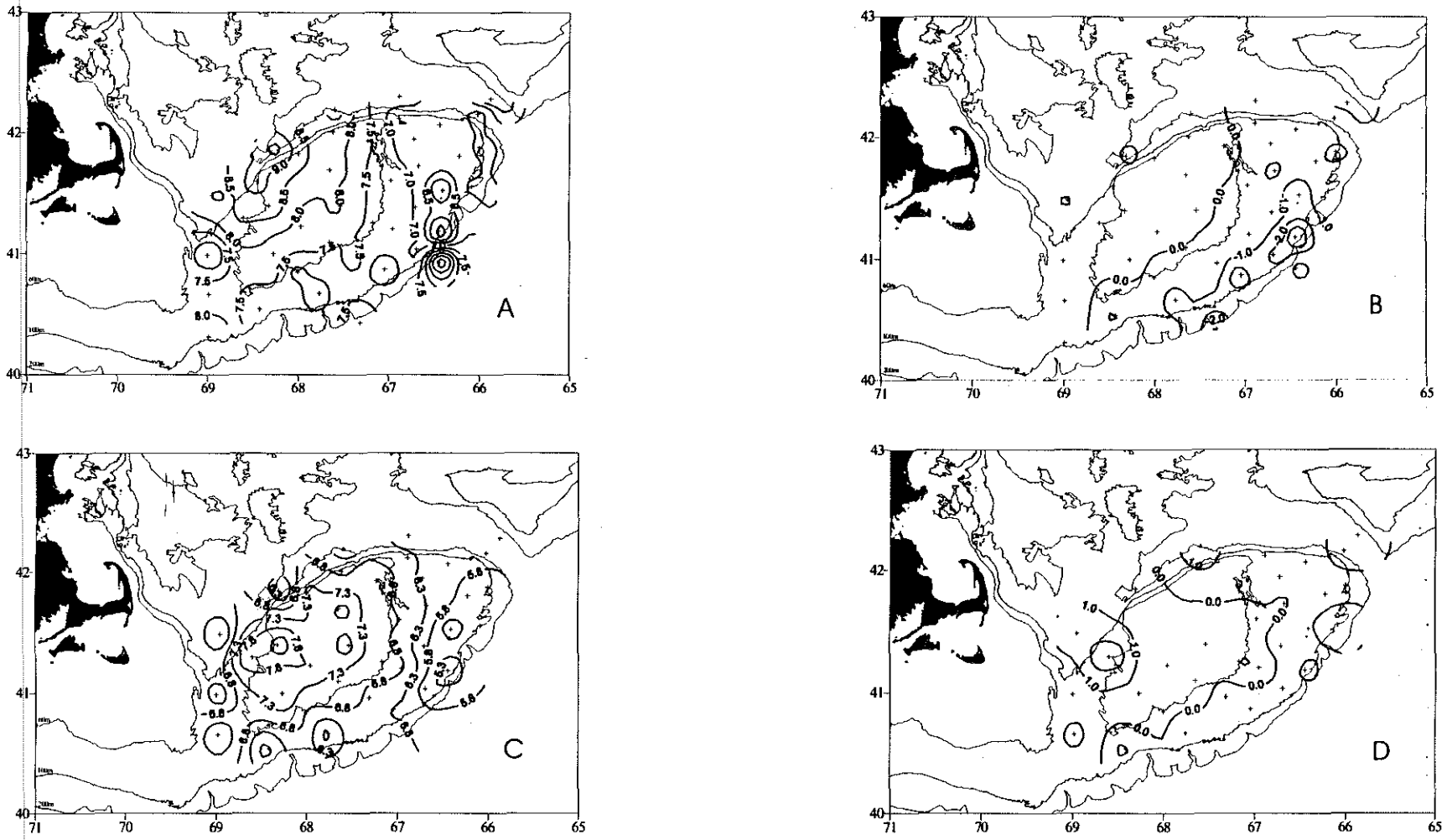


Figure 34. Distribution figures for GLOBEC Broad Scale survey ALB9806. Surface temperature (A), surface temperature anomaly (B), bottom temperature (C), and bottom temperature anomaly (D).

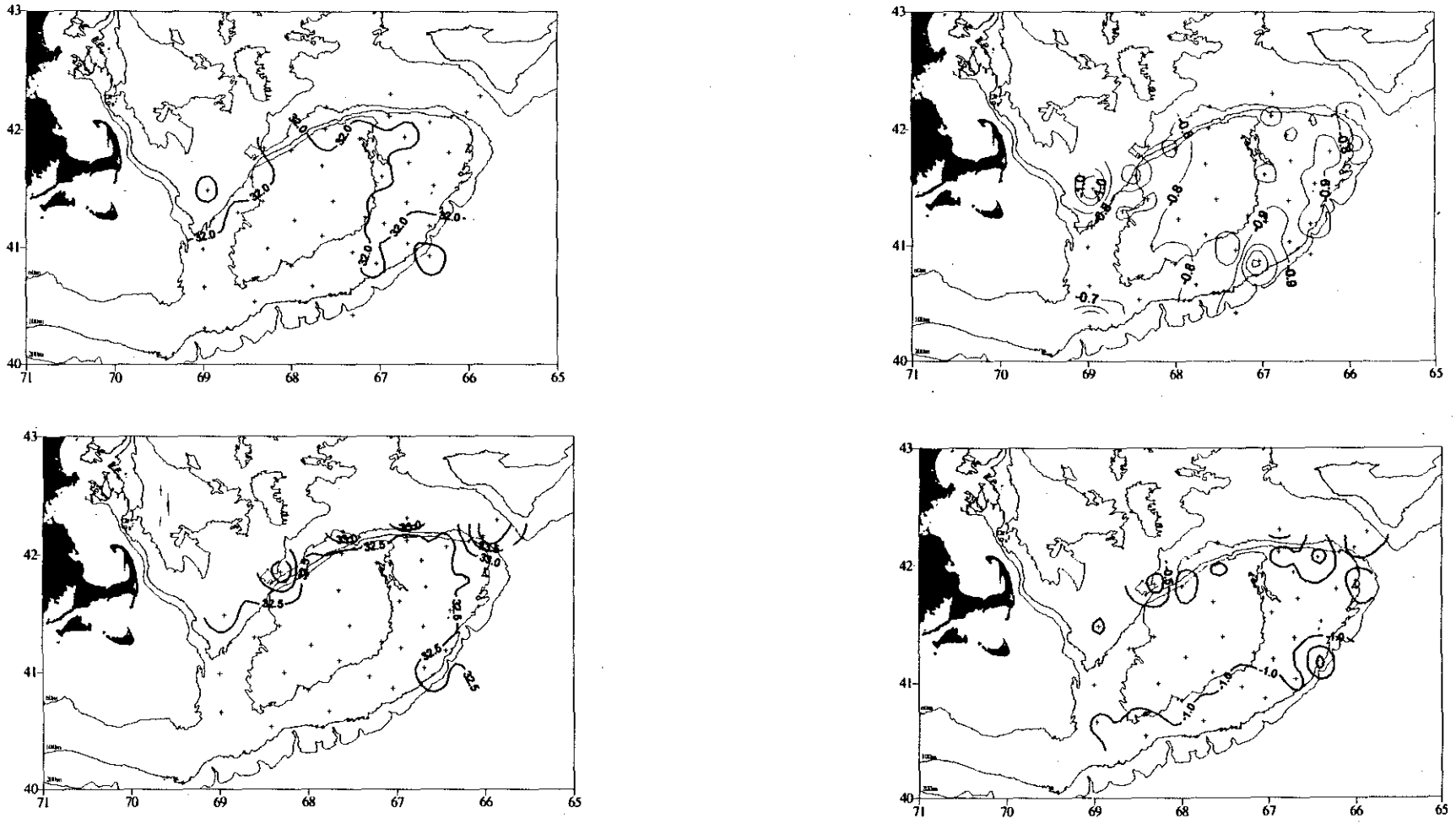


Figure 35. Distribution figures for GLOBEC Broad Scale survey ALB9806. Surface salinity (A), surface salinity anomaly (B), bottom salinity (C), and bottom salinity anomaly (D).

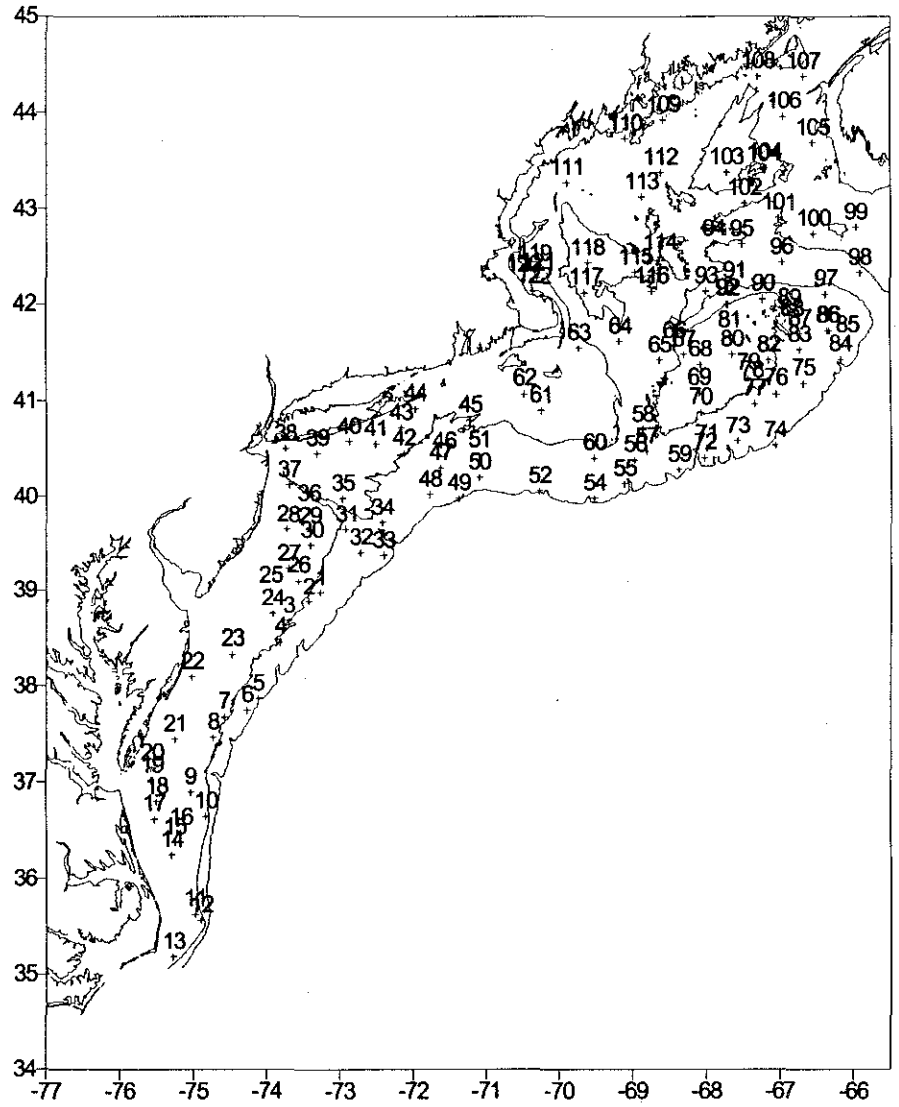


Figure 36. Stations occupied during Ecosystem Monitoring survey ALB9807.

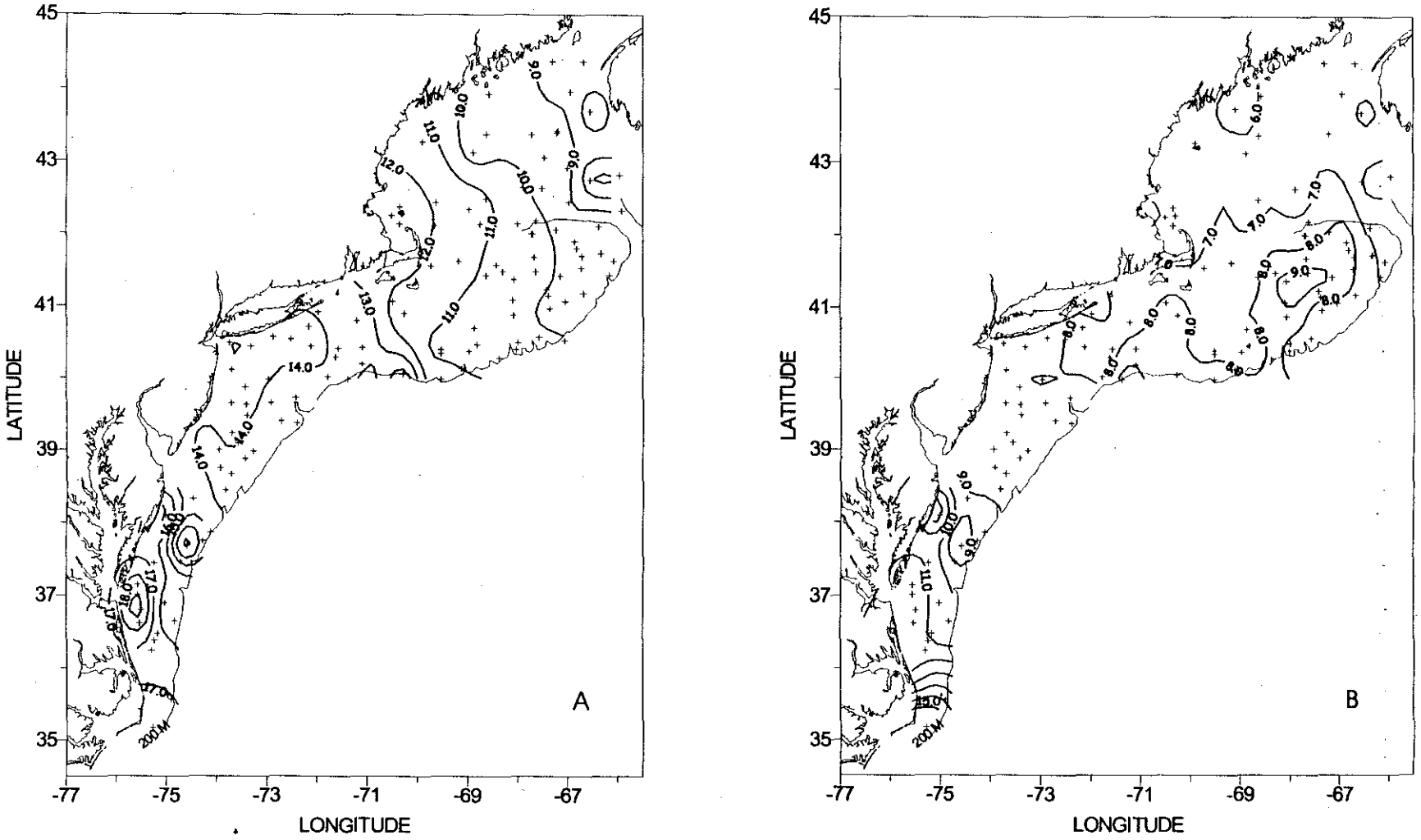
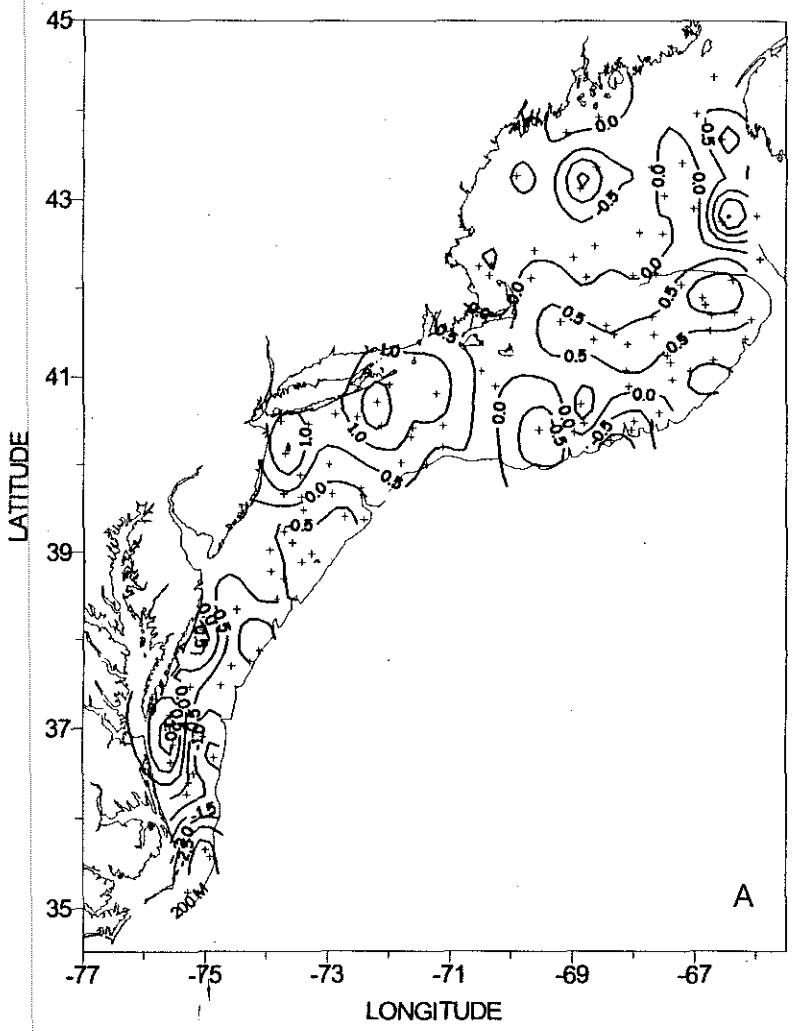


Figure 37. Surface (A) and bottom (B) temperature distributions for Ecosystem Monitoring survey ALB9807.



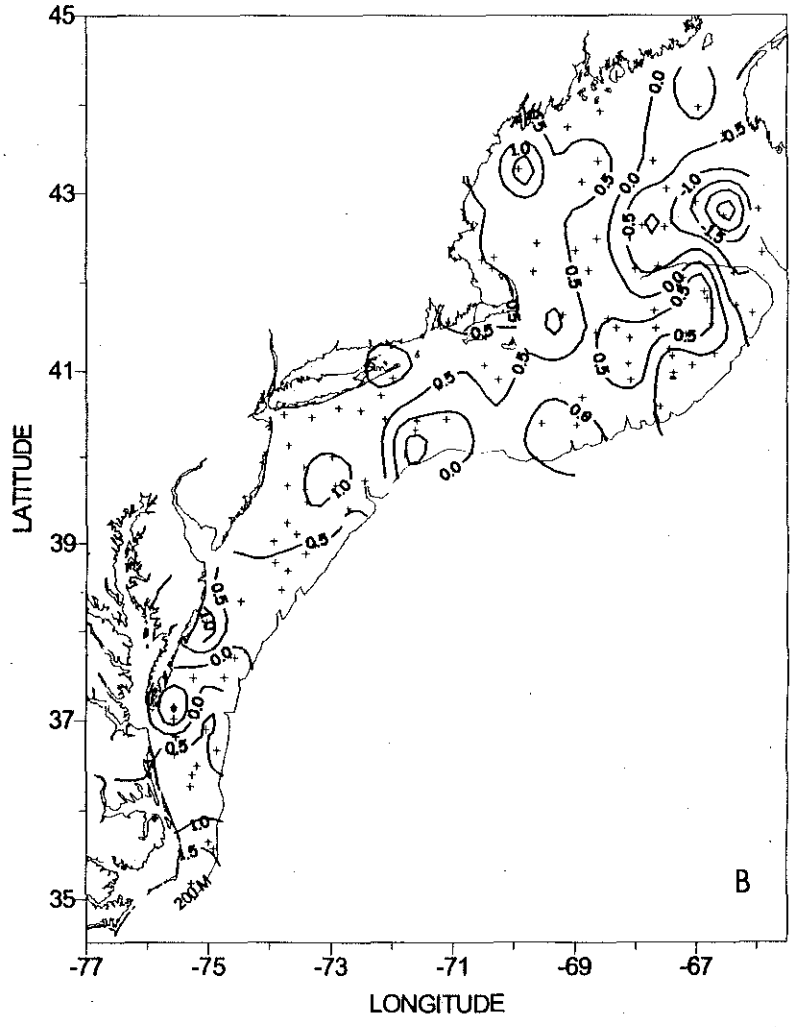


Figure 38. Surface (A) and bottom (B) temperature anomaly distributions for Ecosystem Monitoring survey ALB9807.

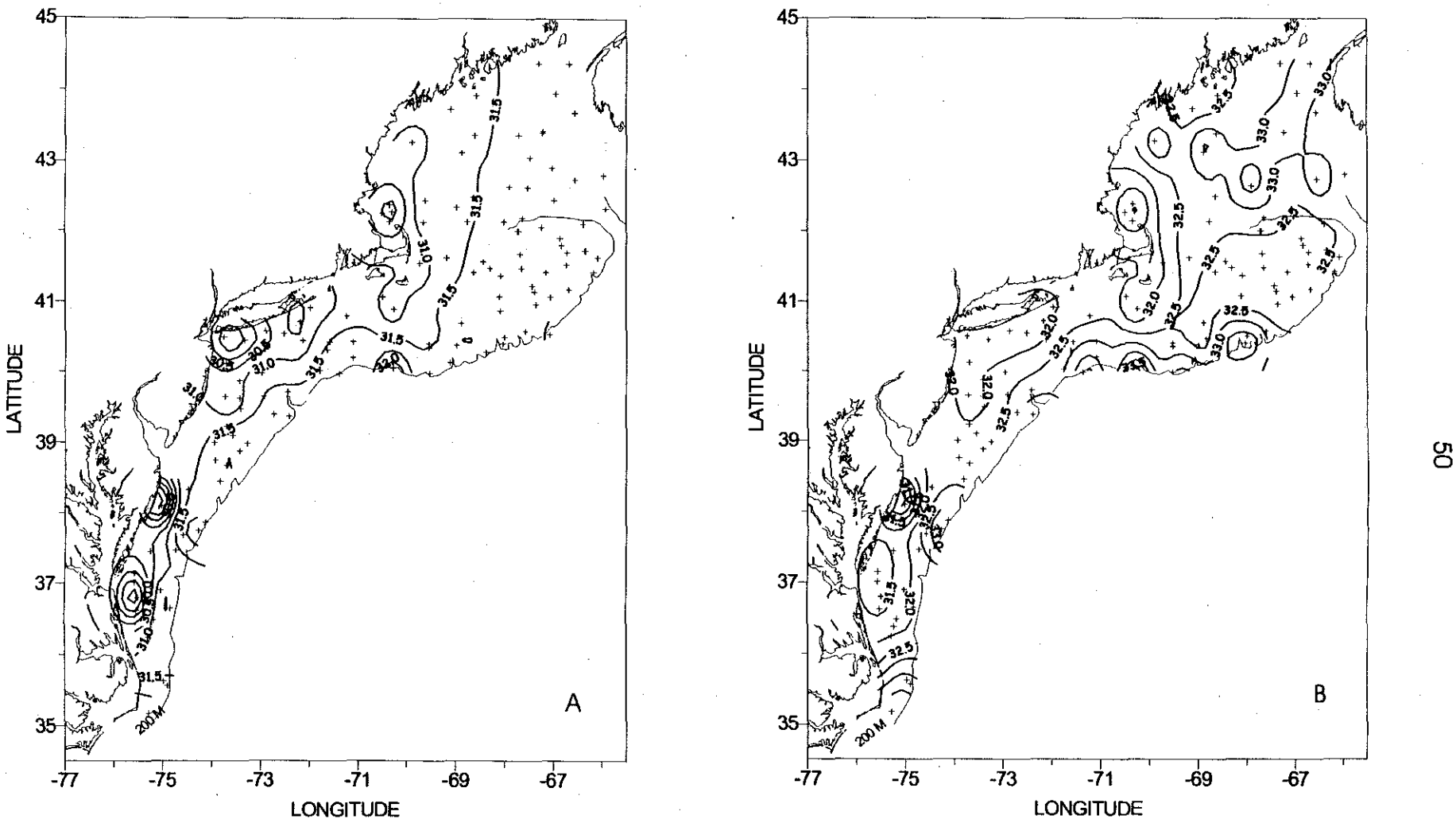


Figure 39. Surface (A) and bottom (B) salinity distributions for Ecosystem Monitoring survey ALB9807.

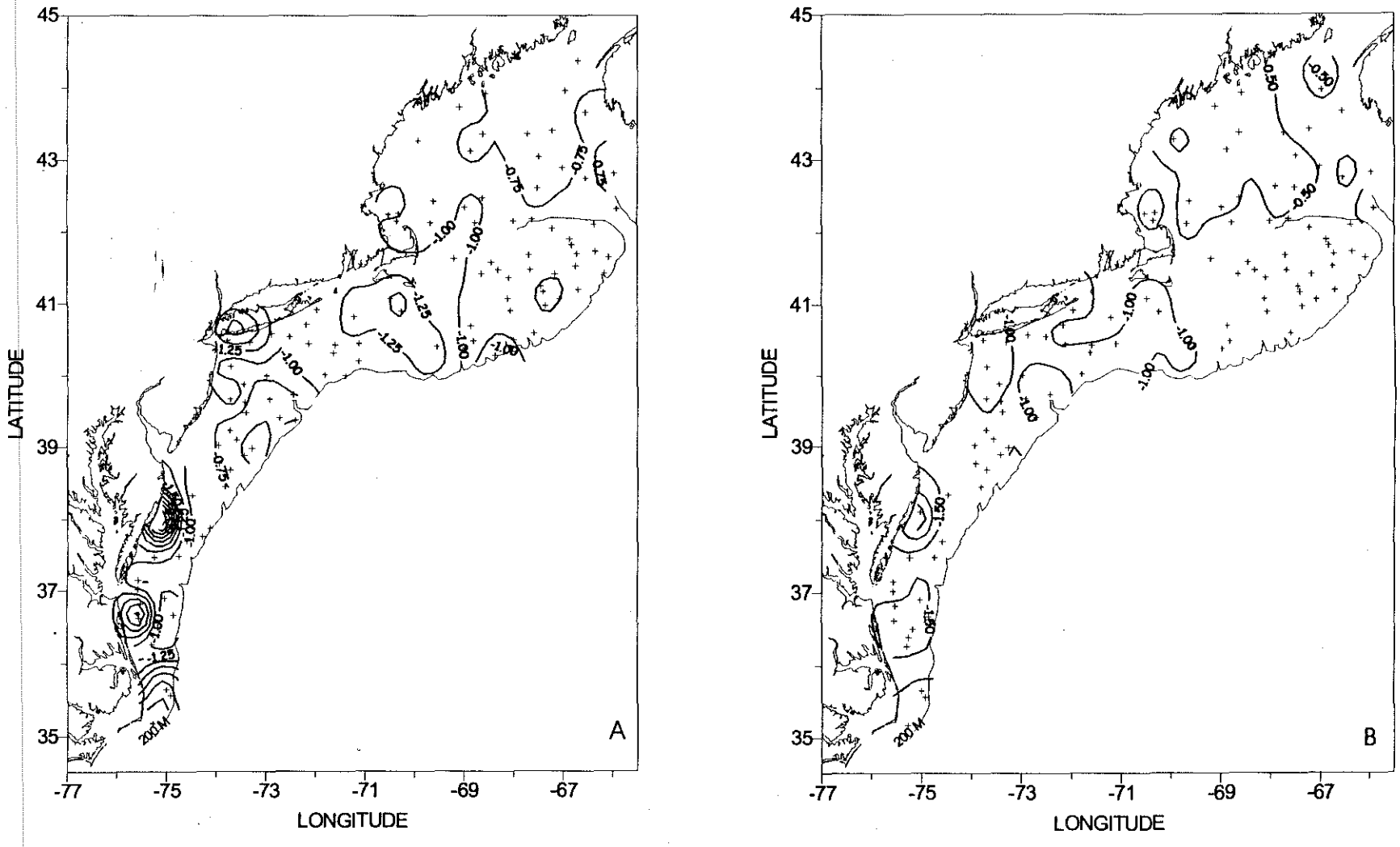


Figure 40. Surface (A) and bottom (B) salinity anomaly distributions for Ecosystem Monitoring survey ALB9807.

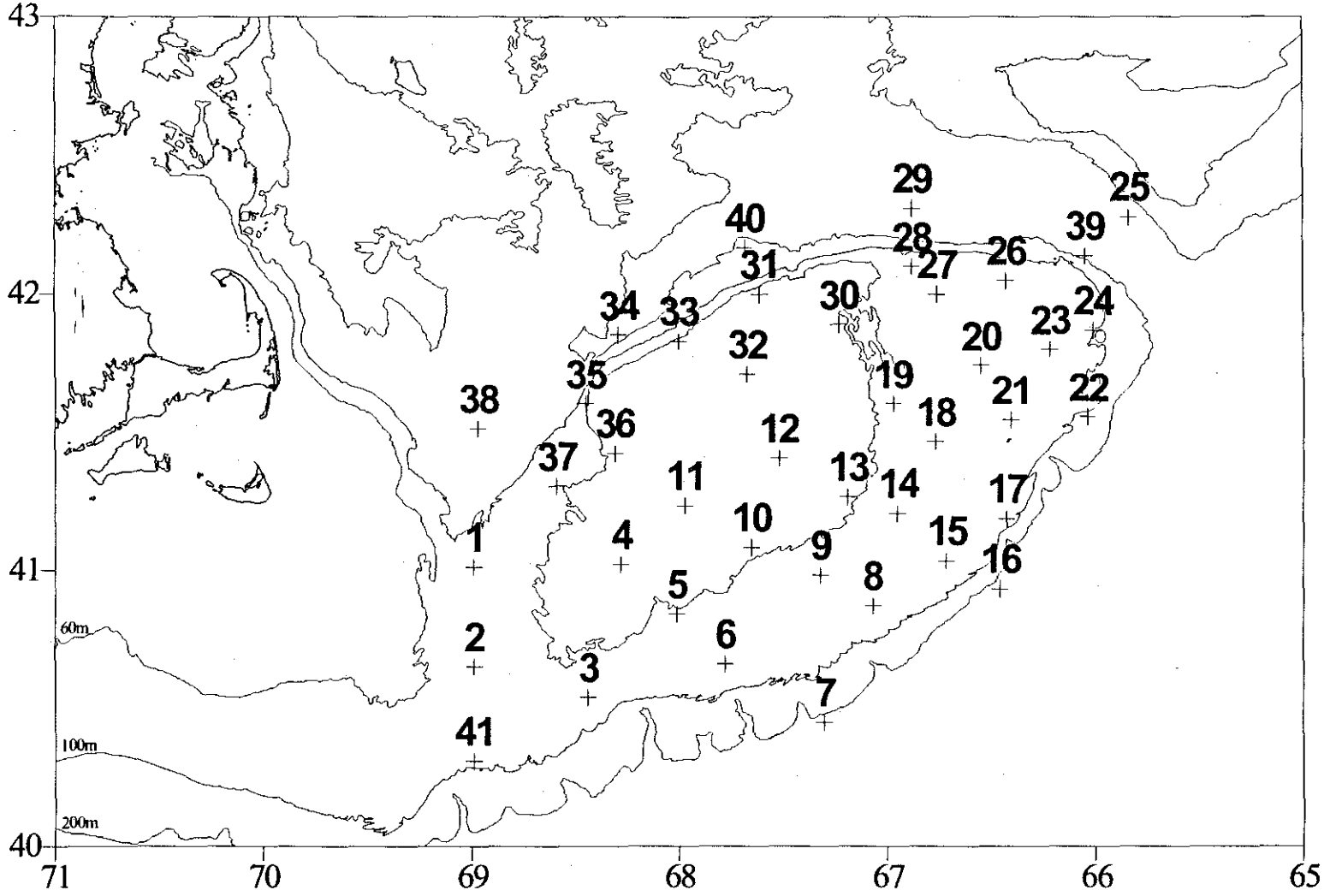


Figure 41. Hydrographic stations for GLOBEC Broad Scale survey ALB9808.

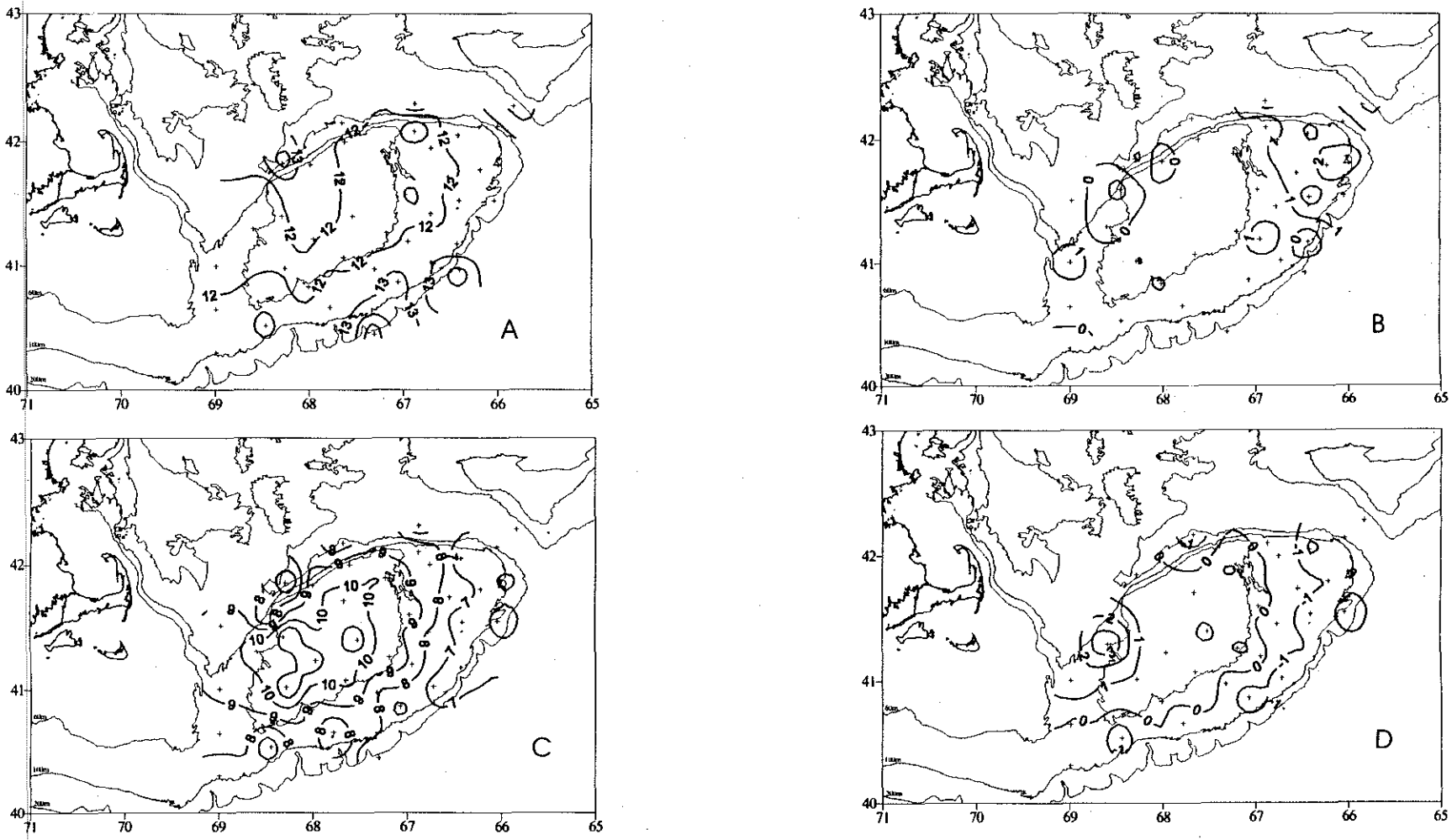


Figure 42. Distribution figures for GLOBEC Broad Scale survey ALB9808. Surface temperature (A), surface temperature anomaly (B), bottom temperature (C), and bottom temperature anomaly (D)

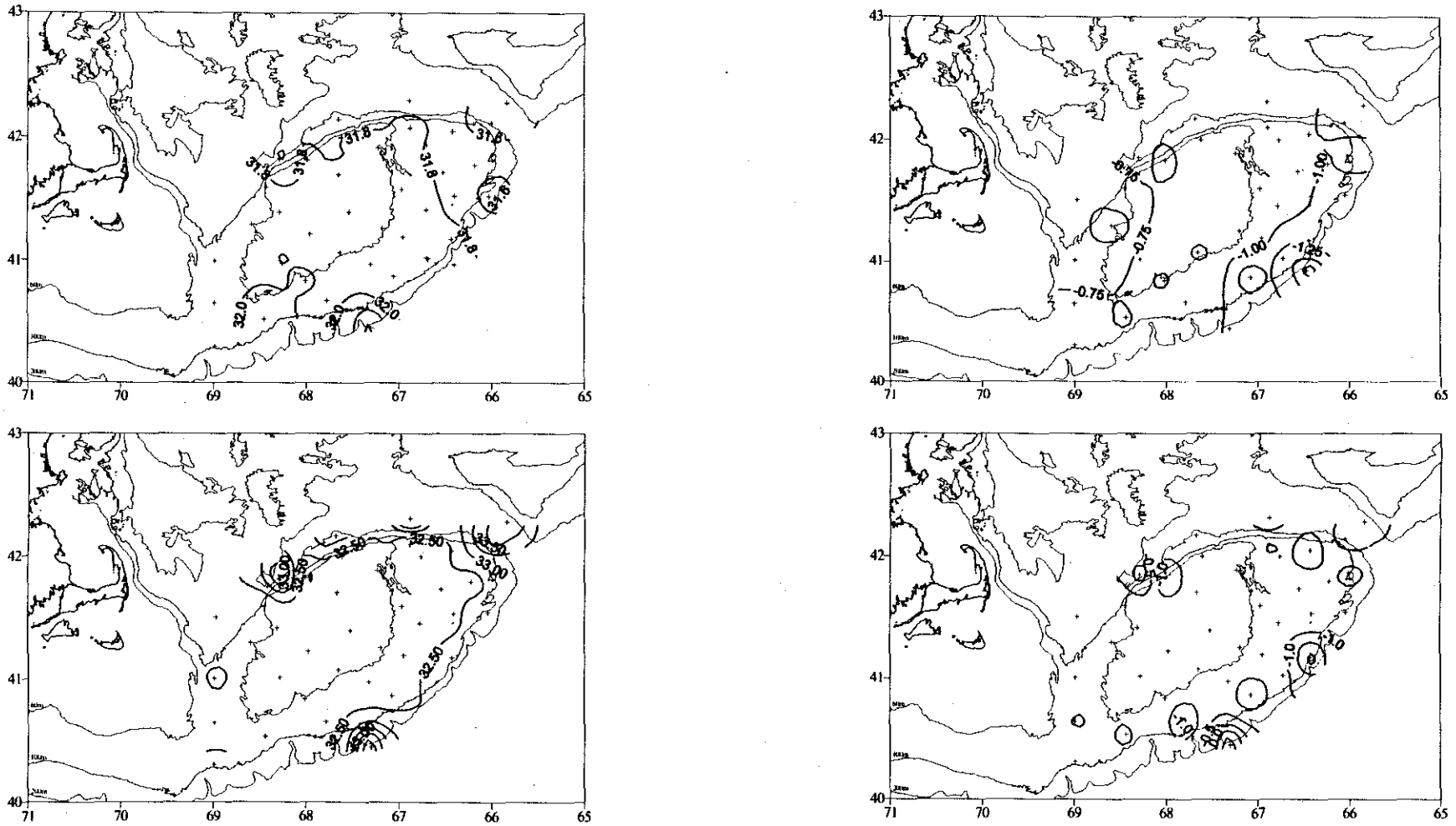


Figure 43. Distribution figures for GLOBEC Broad Scale survey ALB9808. Surface salinity (A), surface salinity anomaly (B), bottom salinity (C), and bottom salinity anomaly (D).

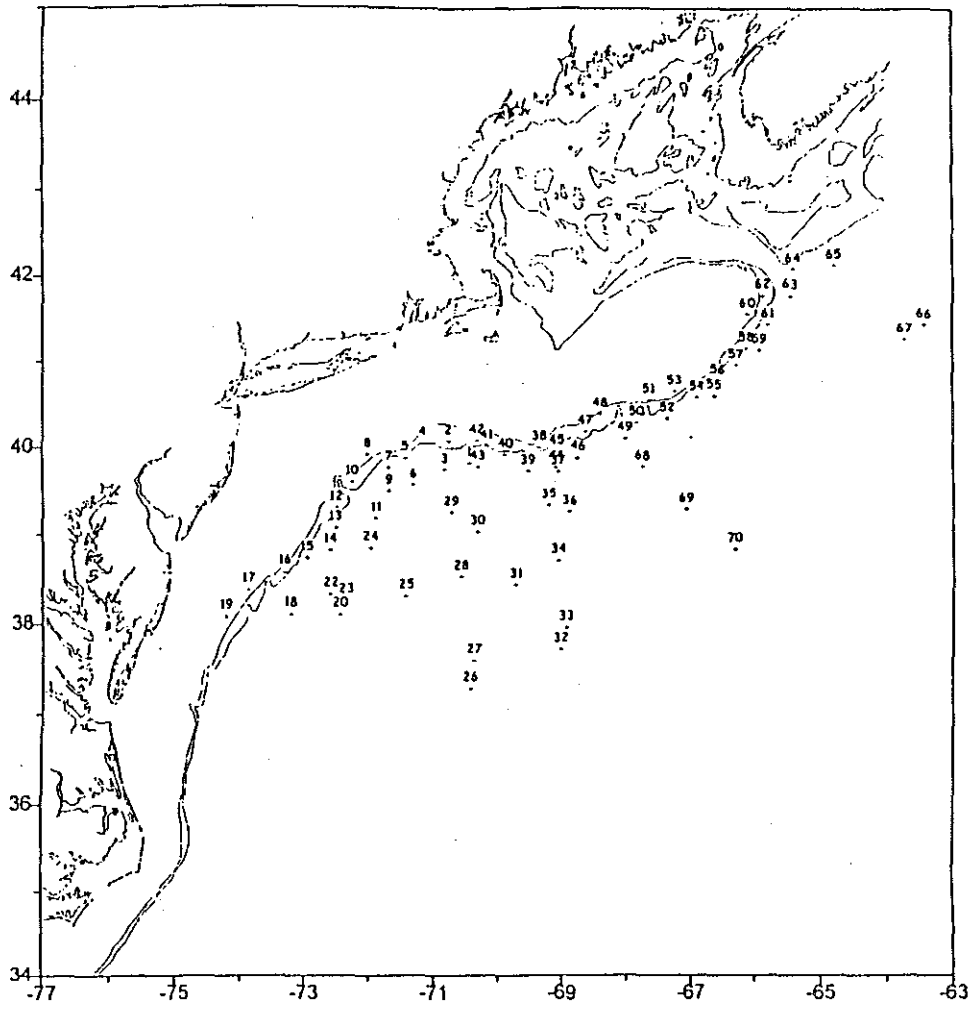


Figure 44 Stations occupied during Marine Mammal survey AJ9801.

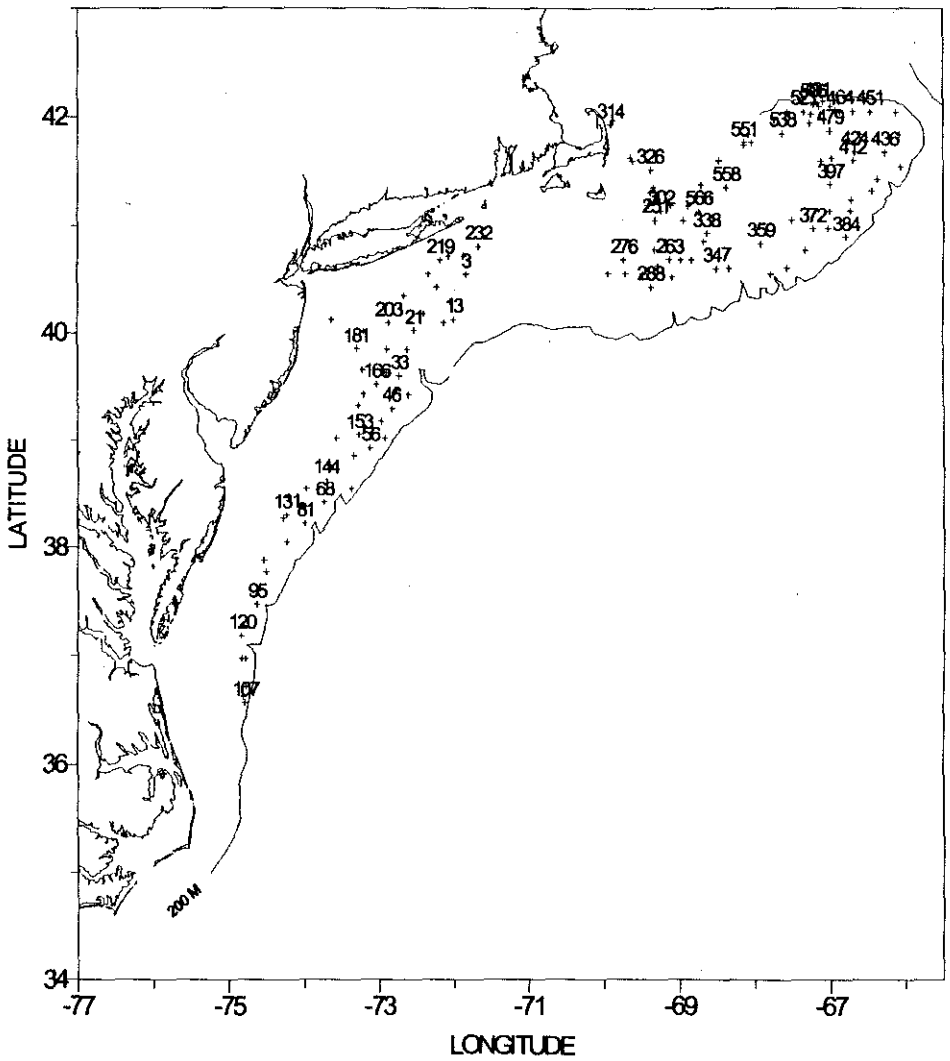


Figure 45. Stations occupied during Scallop Survey ALB9809.

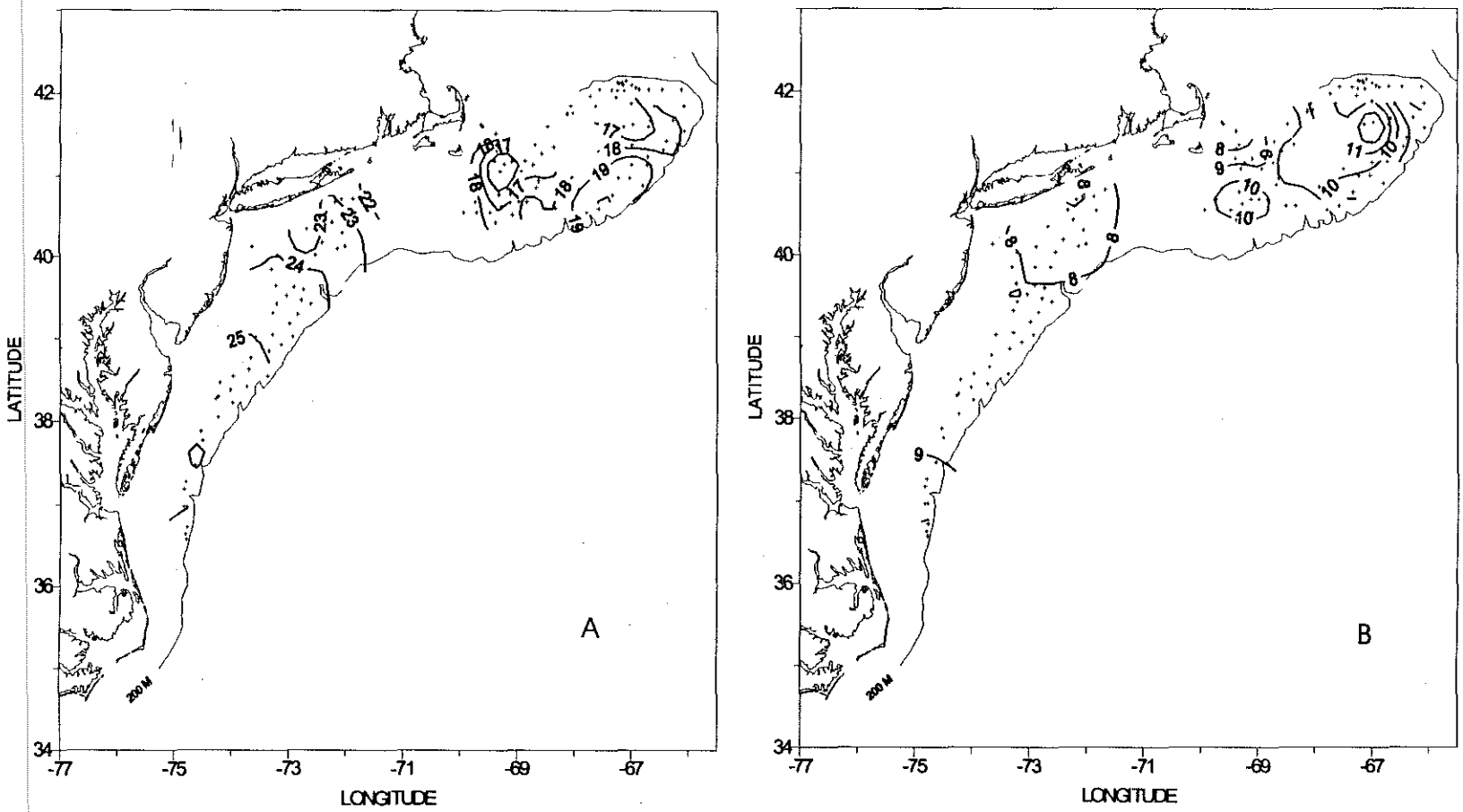


Figure 46. Surface (A) and bottom (B) temperature distributions for Scallop Survey ALB9809.

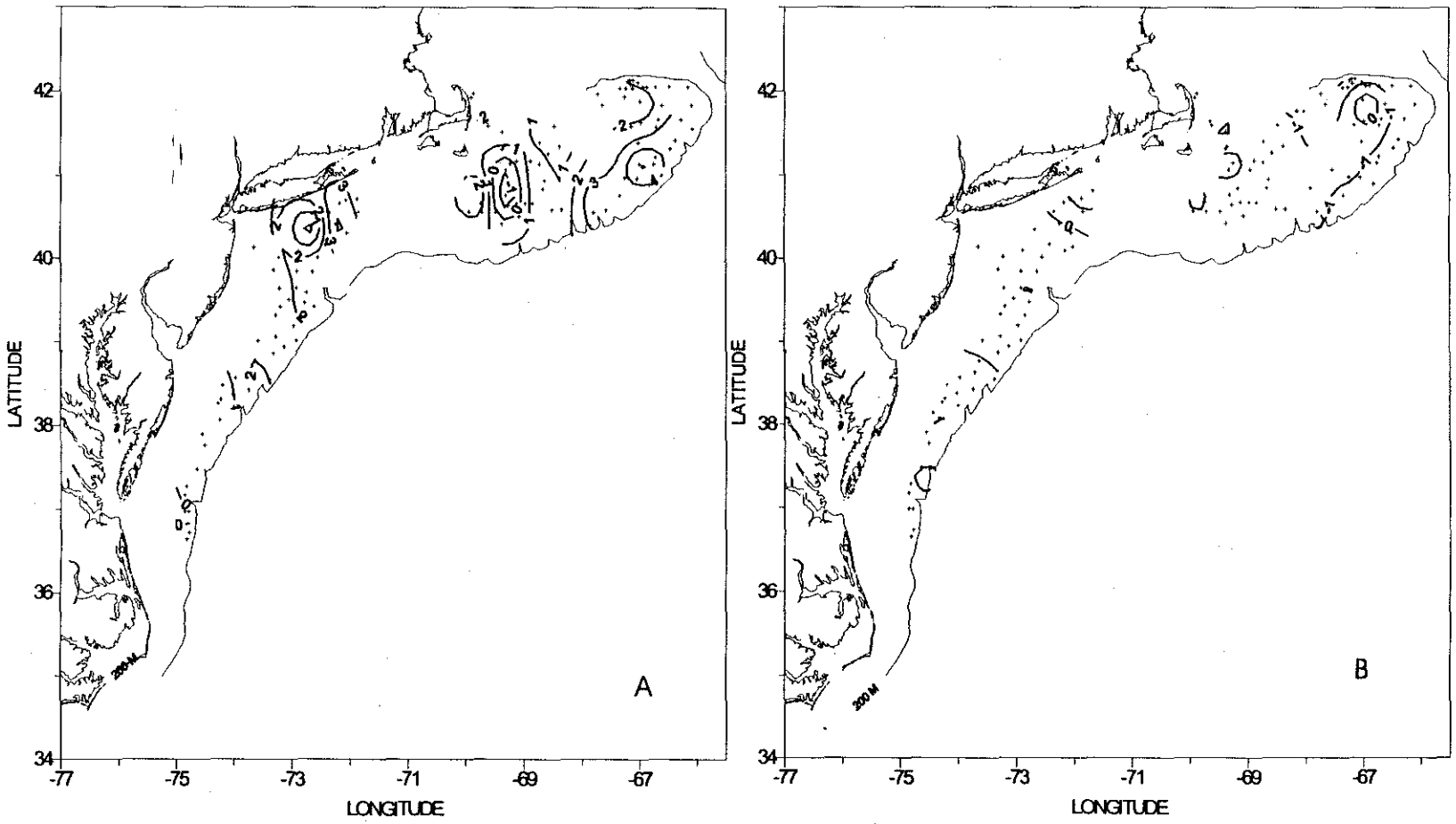


Figure 47. Surface (A) and bottom (B) temperature anomaly distributions for Scallop Survey ALB9809.

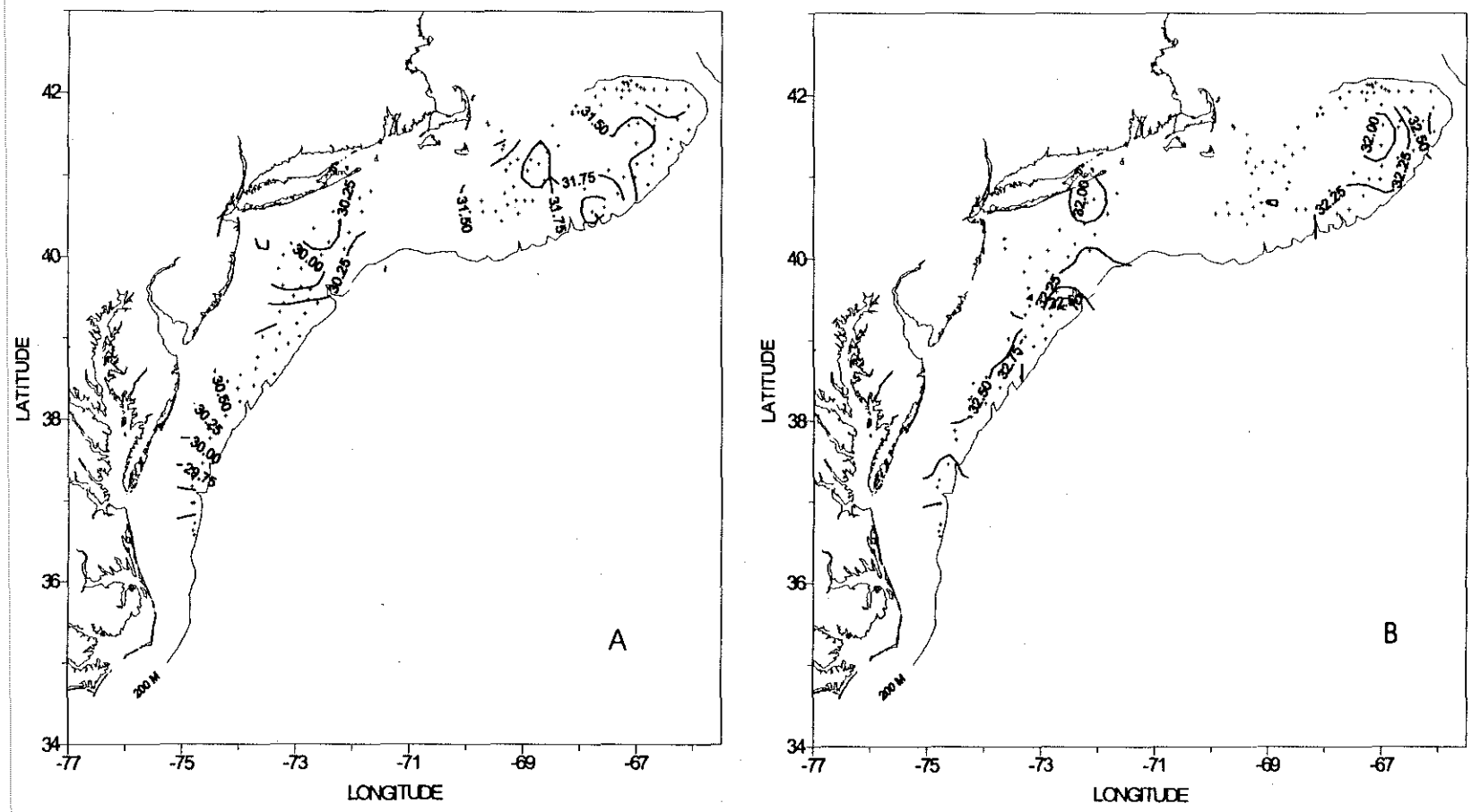


Figure 48. Surface (A) and bottom (B) salinity distributions for Scallop Survey ALB9809.

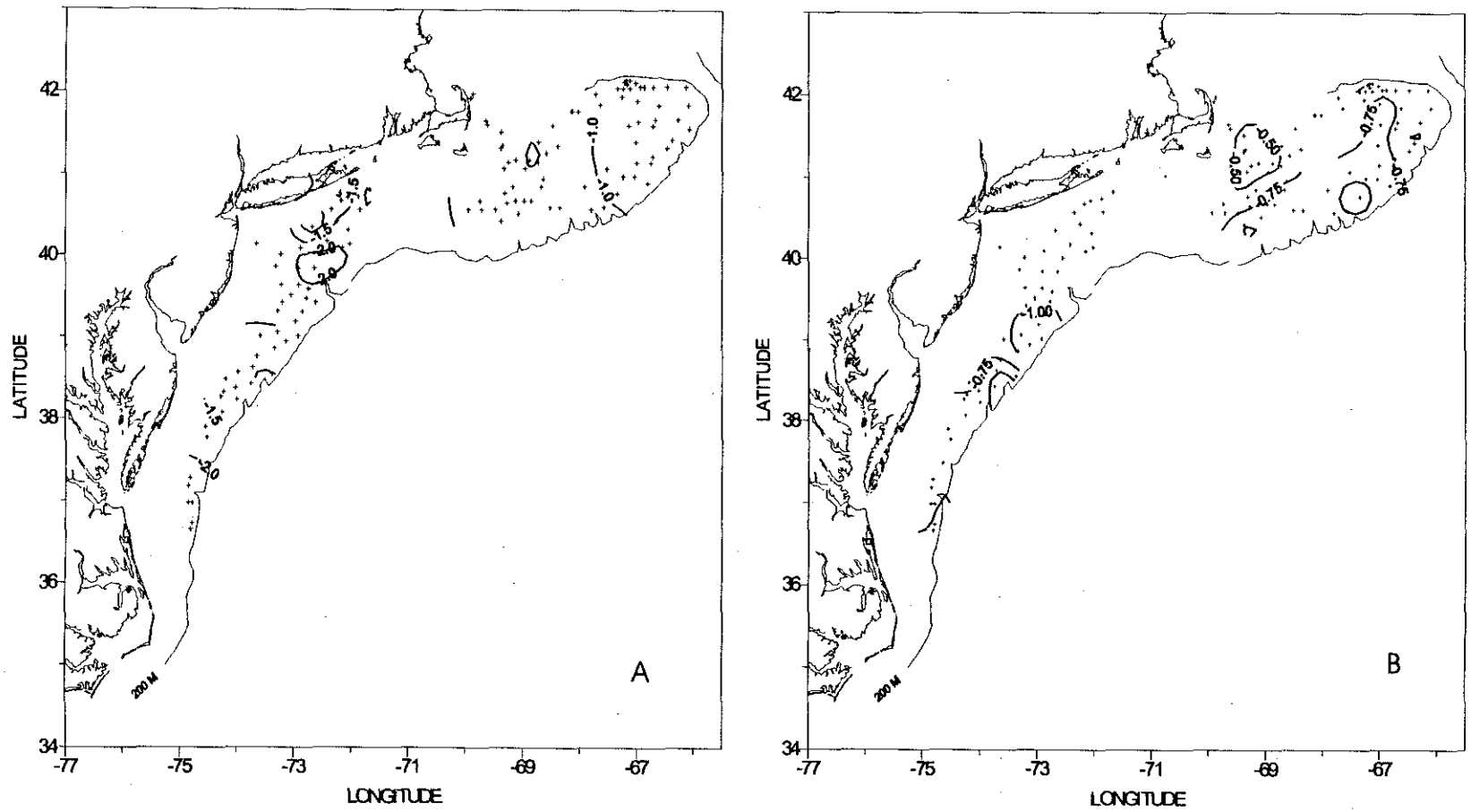


Figure 49. Surface (A) and bottom (B) salinity anomaly distributions for Scallop Survey ALB9809.

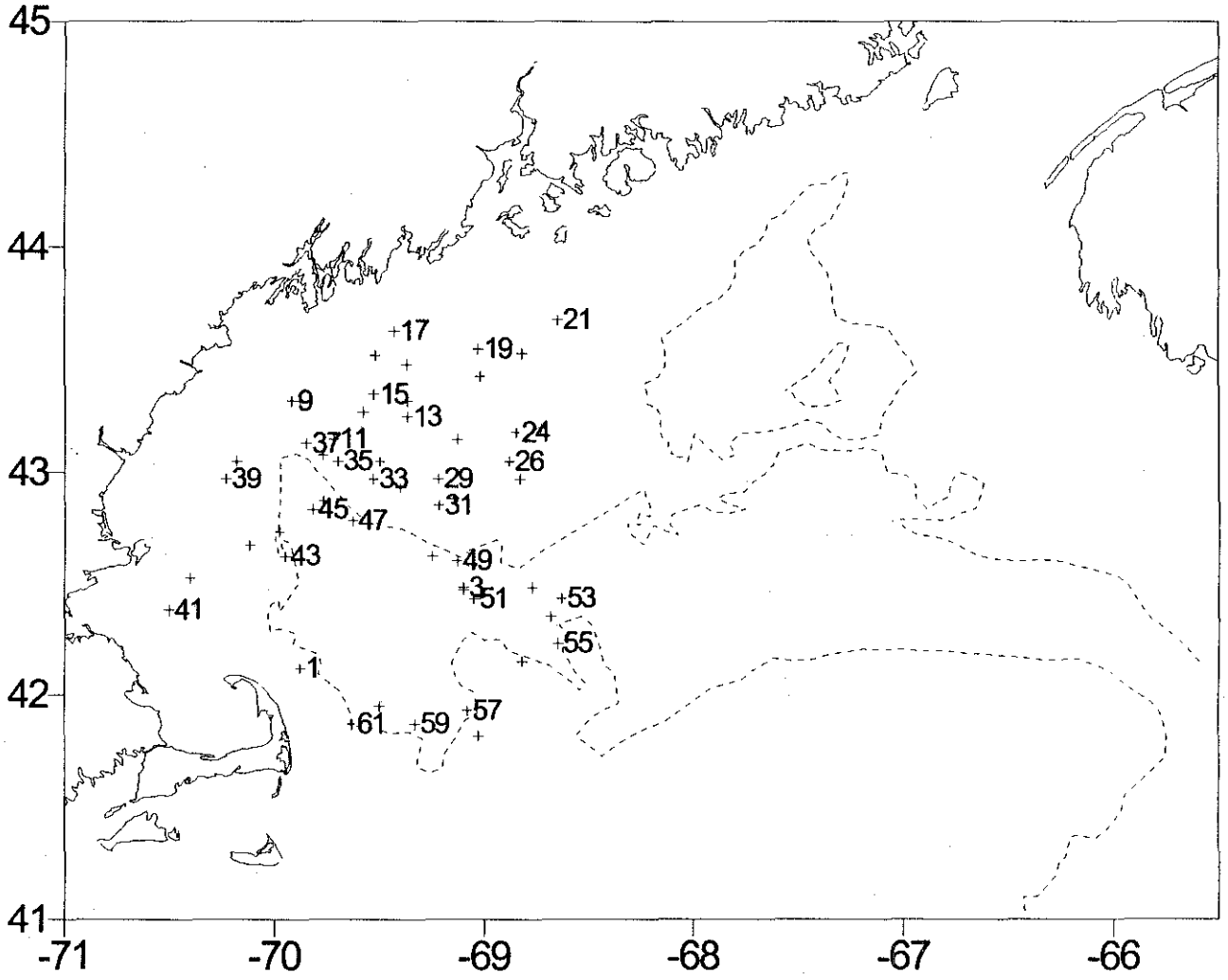


Figure 50. Stations occupied during the Gulf of Maine shrimp survey GLM9815.

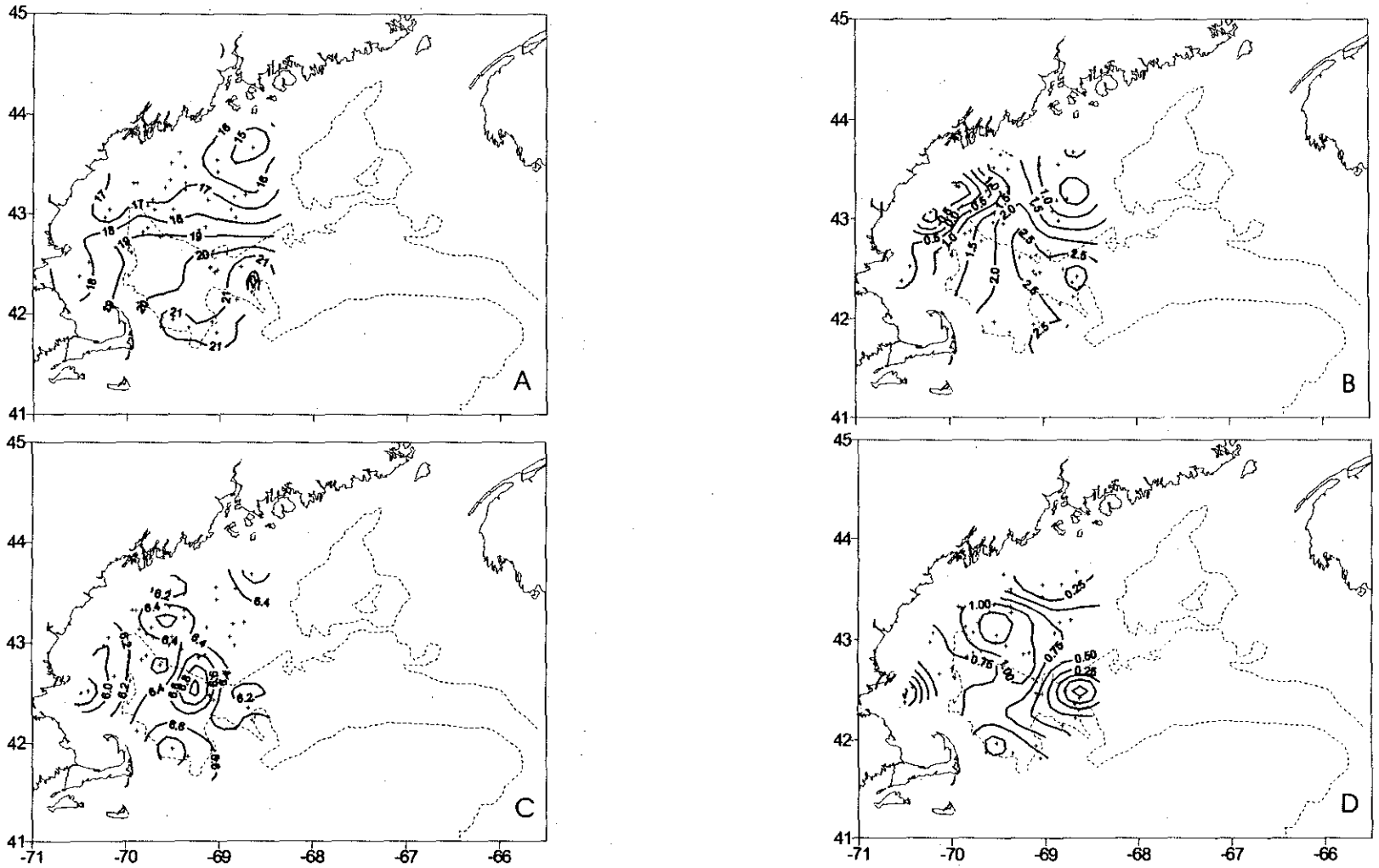


Figure 51. Distribution figures for the Gulf of Maine shrimp survey GLM9815. Surface temperature (A), surface temperature anomaly (B), bottom temperature (C), and bottom temperature anomaly (D).

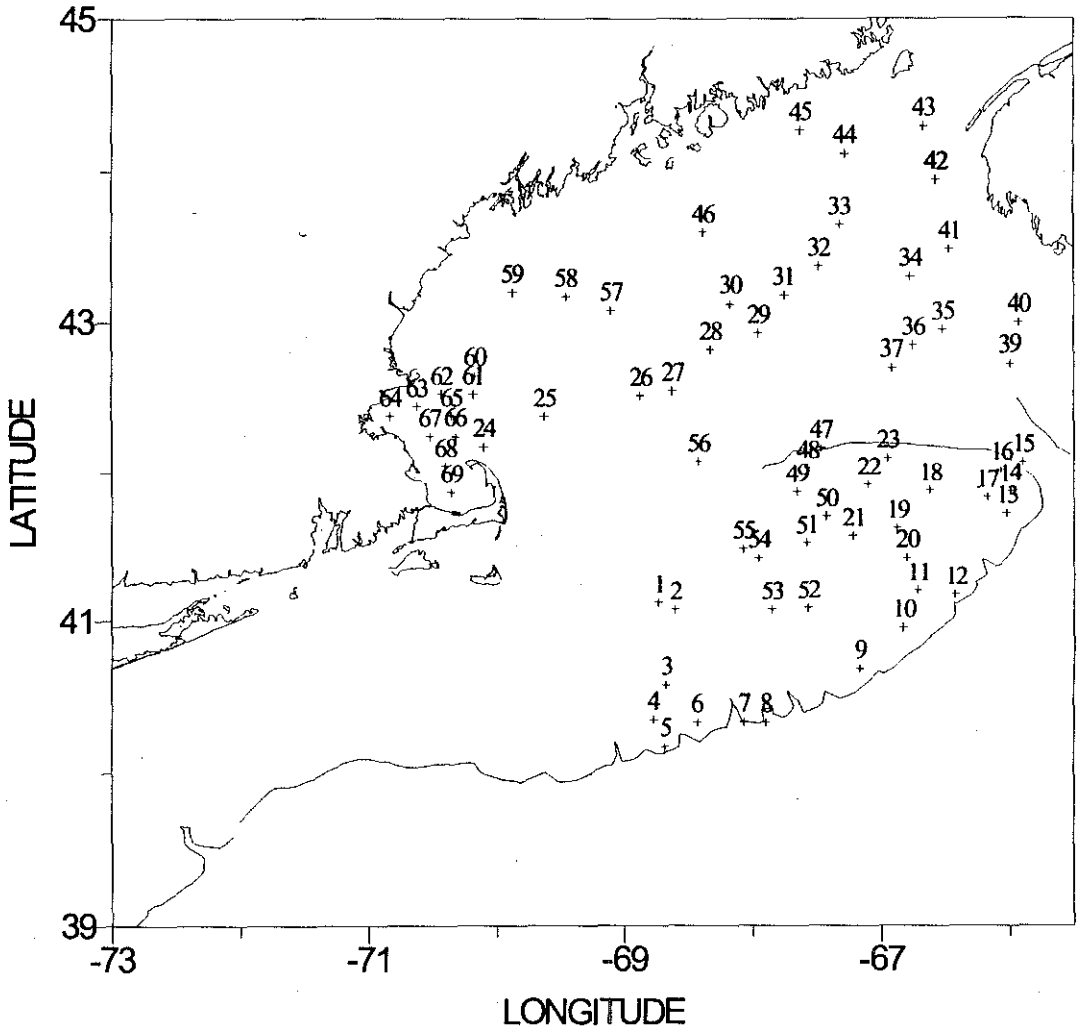


Figure 52. Stations occupied during the Ecosystem Monitoring survey IS9801.

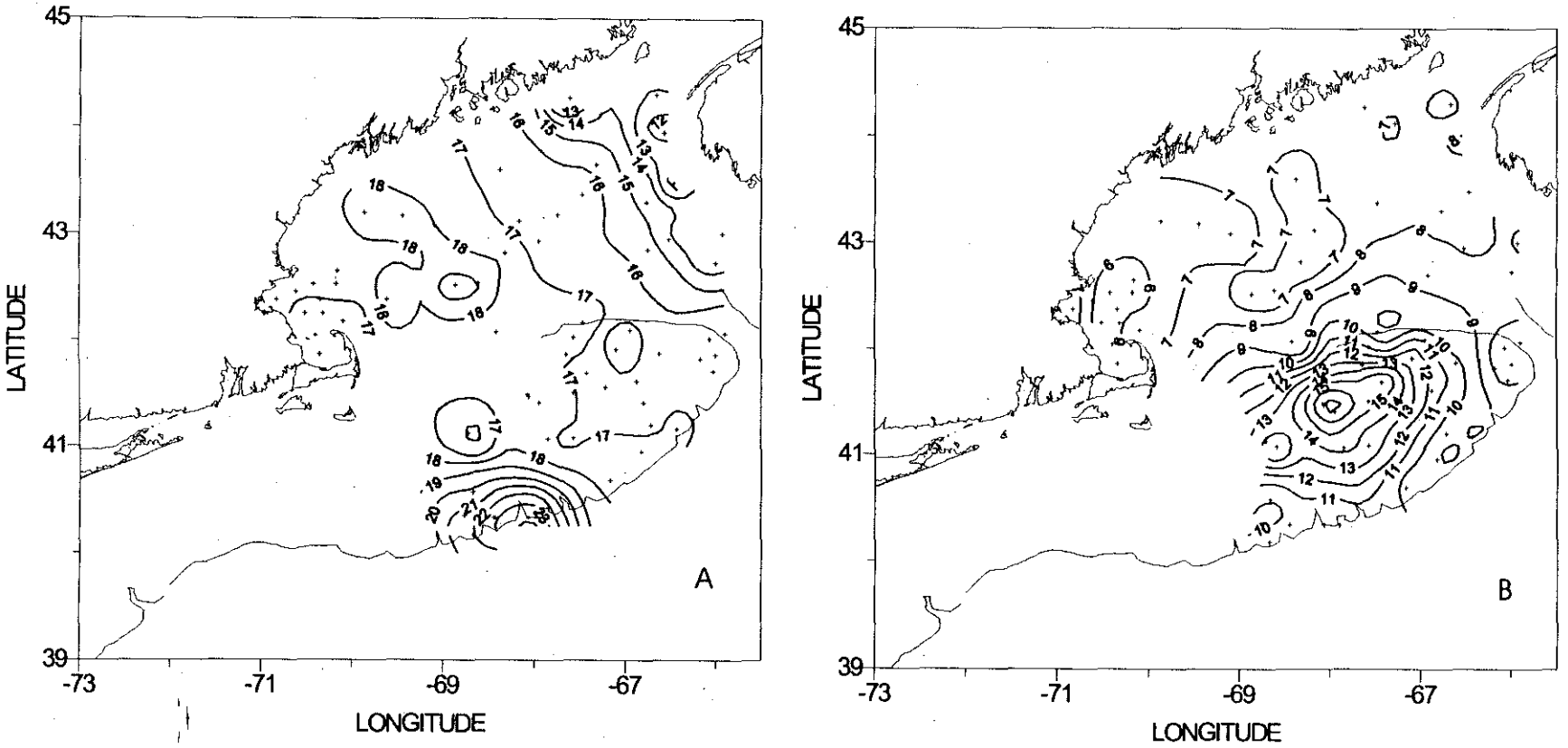


Figure 53. Surface (A) and bottom (B) temperature distributions for Ecosystem Monitoring survey IS9801.

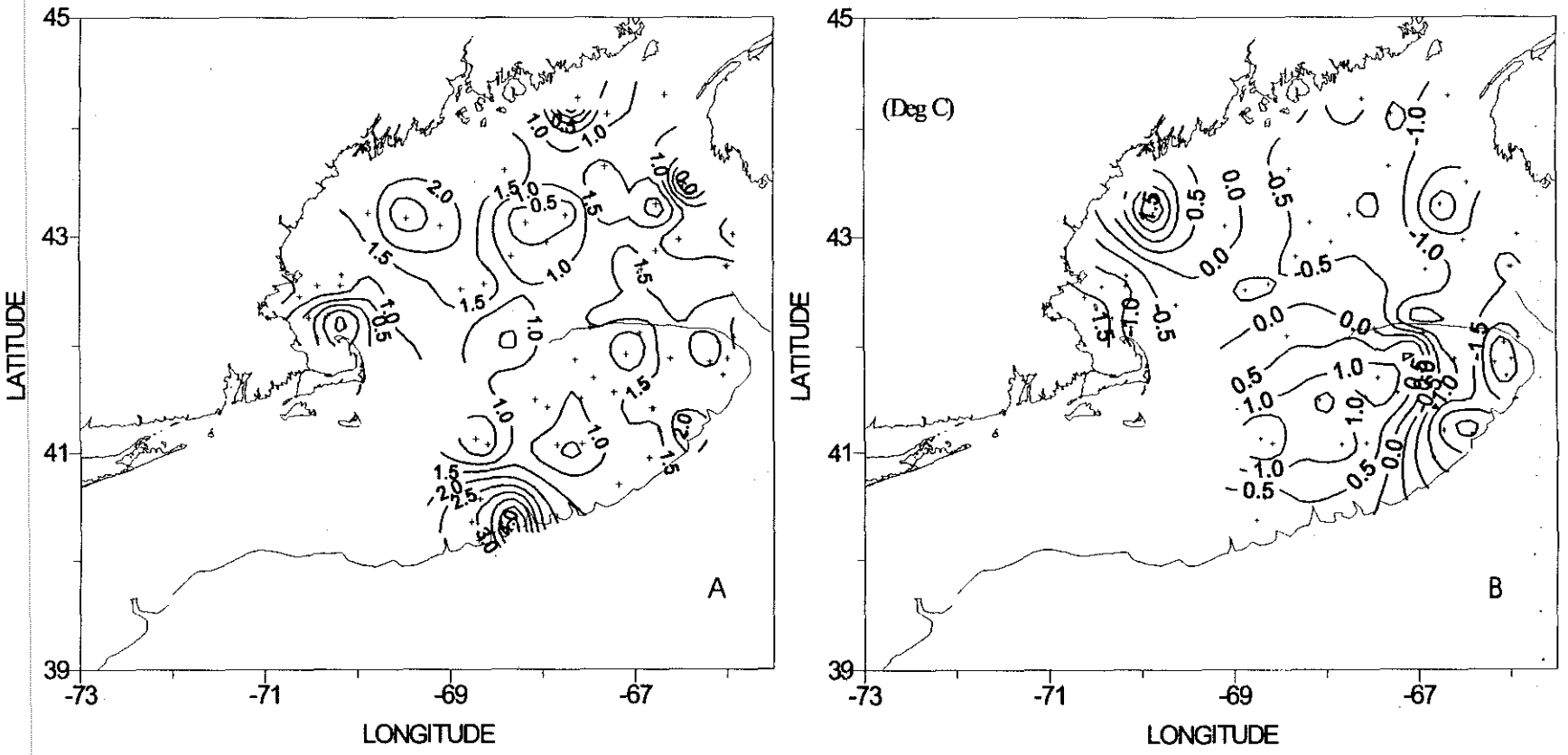


Figure 54. Surface (A) and bottom (B) temperature anomaly distributions for Ecosystem Monitoring survey IS9801.

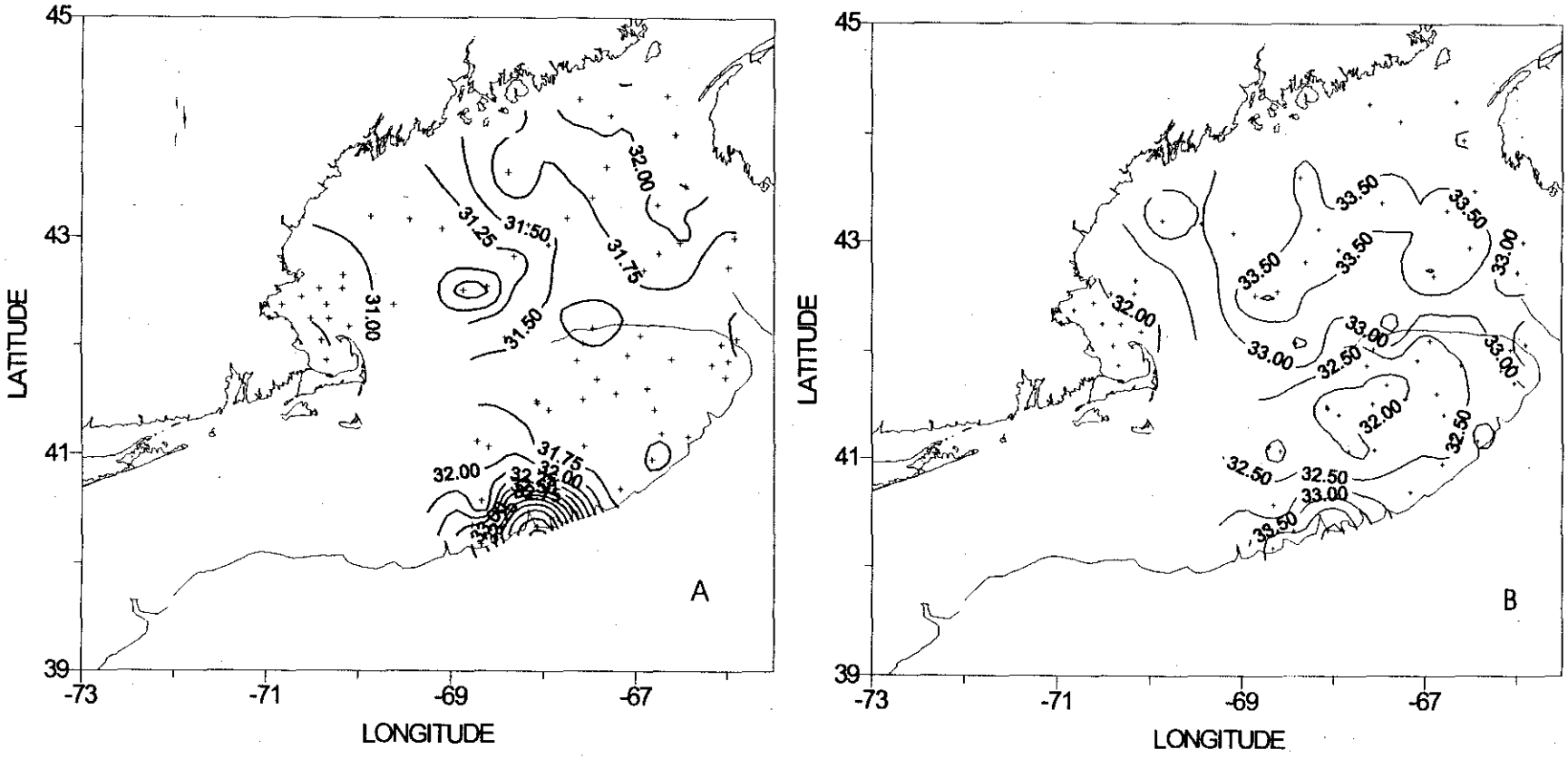


Figure 55. Surface (A) and bottom (B) salinity distributions for Ecosystem Monitoring survey IS9801.

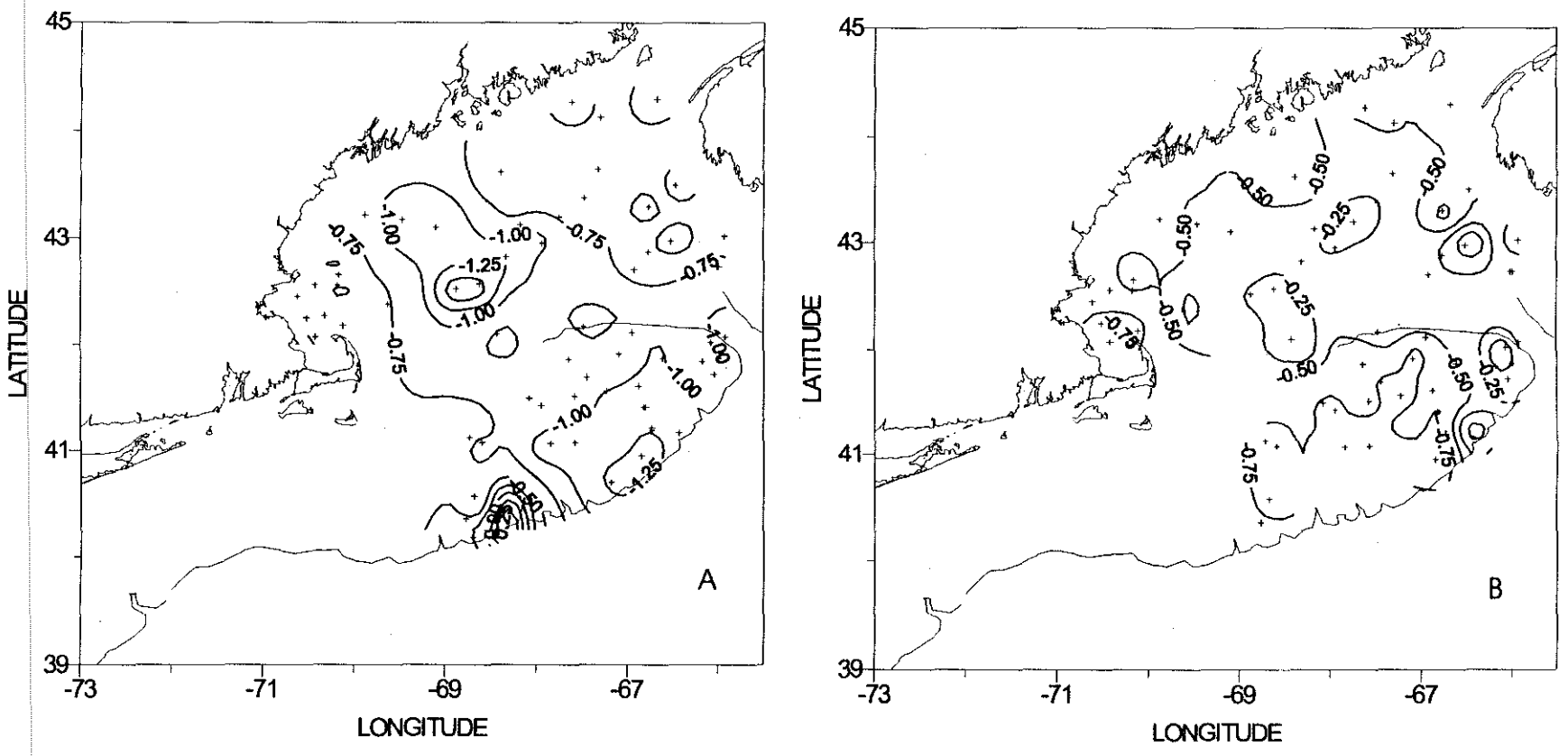


Figure 56. Surface (A) and bottom (B) salinity anomaly distributions for Ecosystem Monitoring survey IS9801.

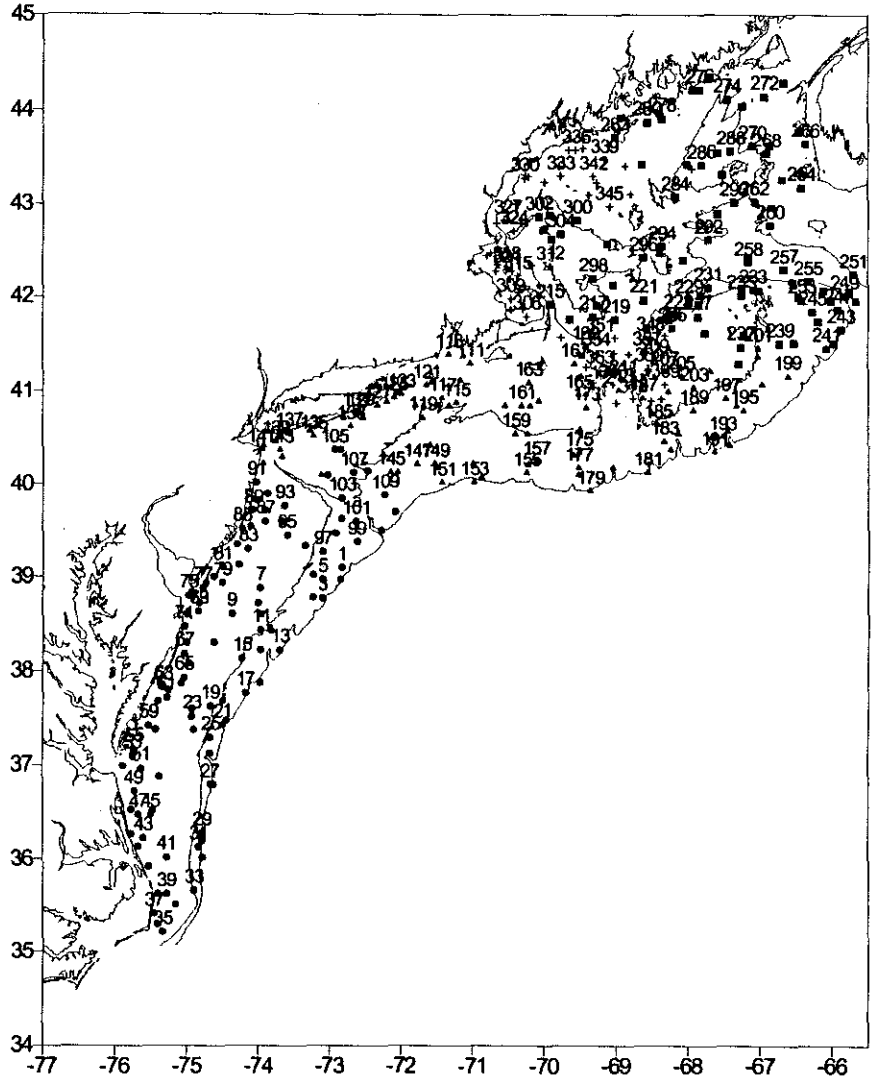


Figure 57. Stations occupied during the Fall Bottom Trawl survey ALB9811.

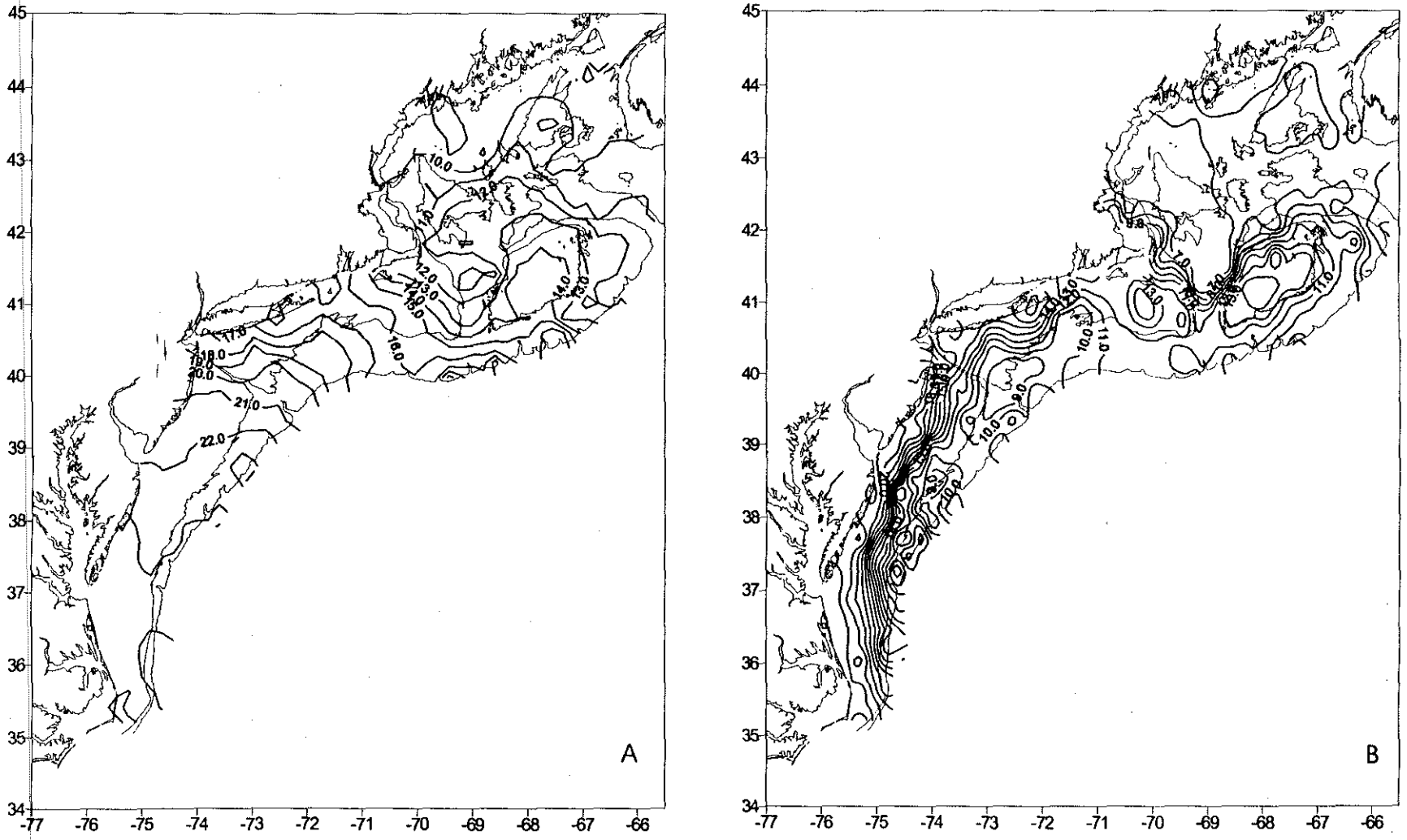


Figure 58. Surface (A) and bottom (B) temperature distributions for the Fall Bottom Trawl survey ALB9811.

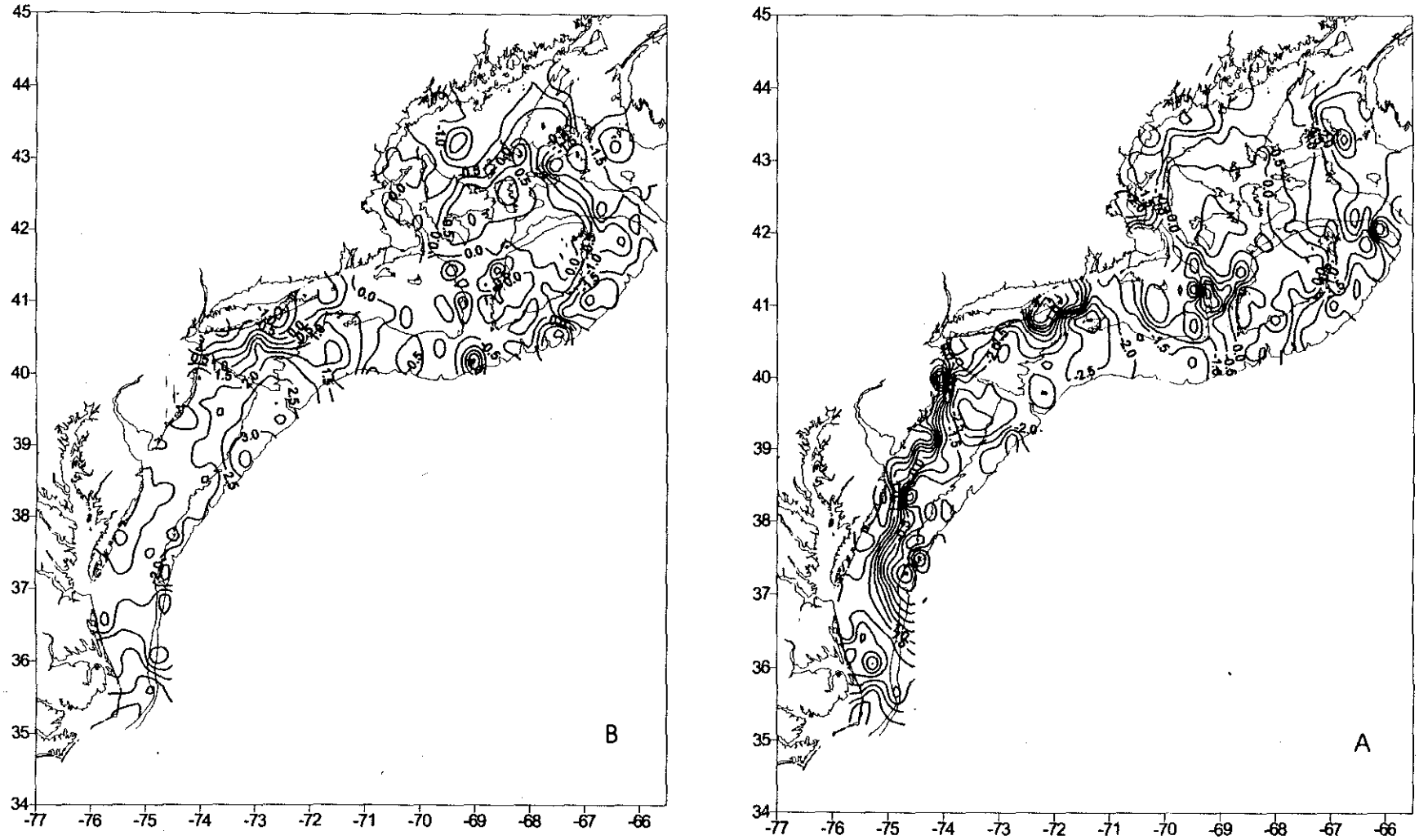


Figure 59. Surface (A) and bottom (B) temperature anomaly distributions for the Fall Bottom Trawl survey ALB9811.

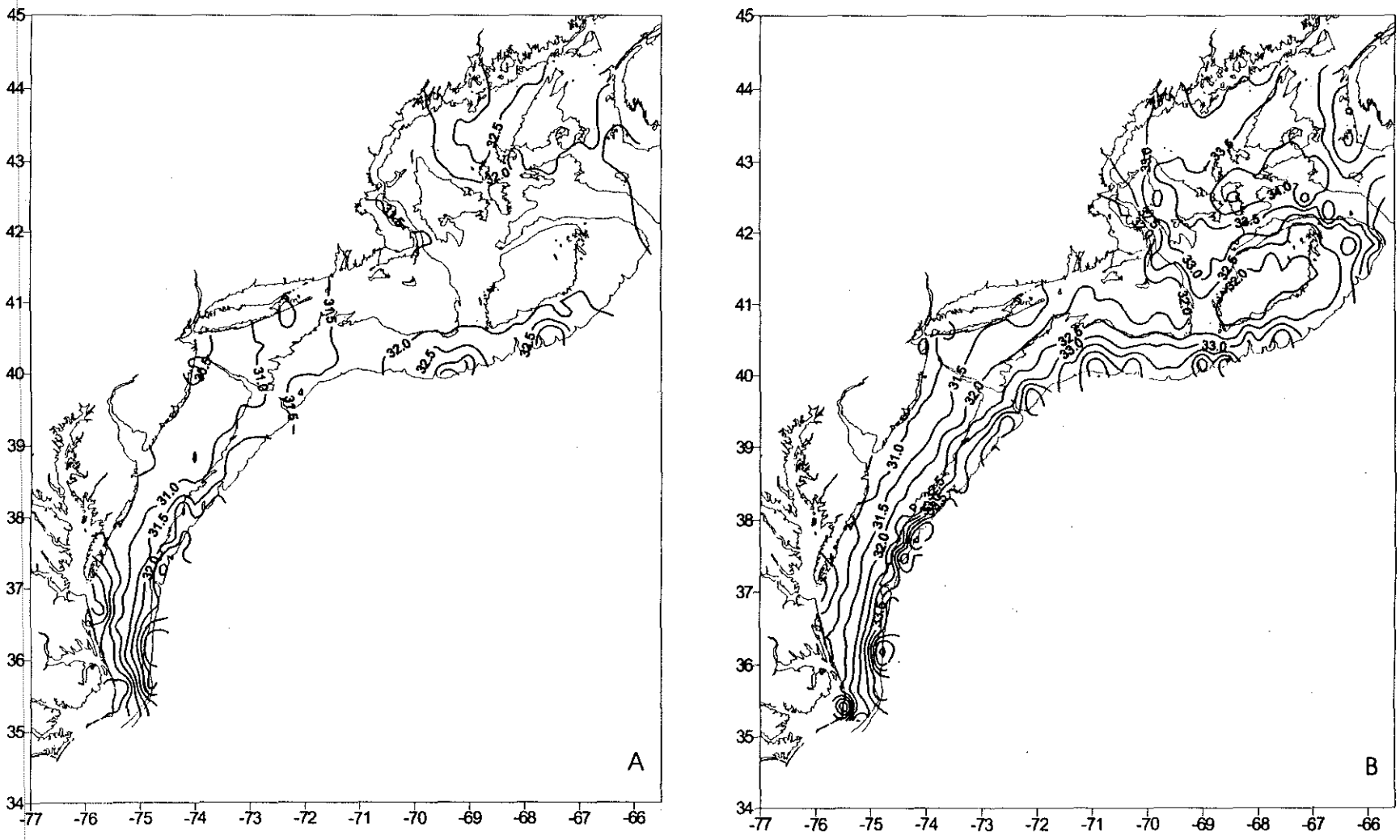


Figure 60. Surface (A) and bottom (B) salinity distributions for the Fall Bottom Trawl survey ALB9811.

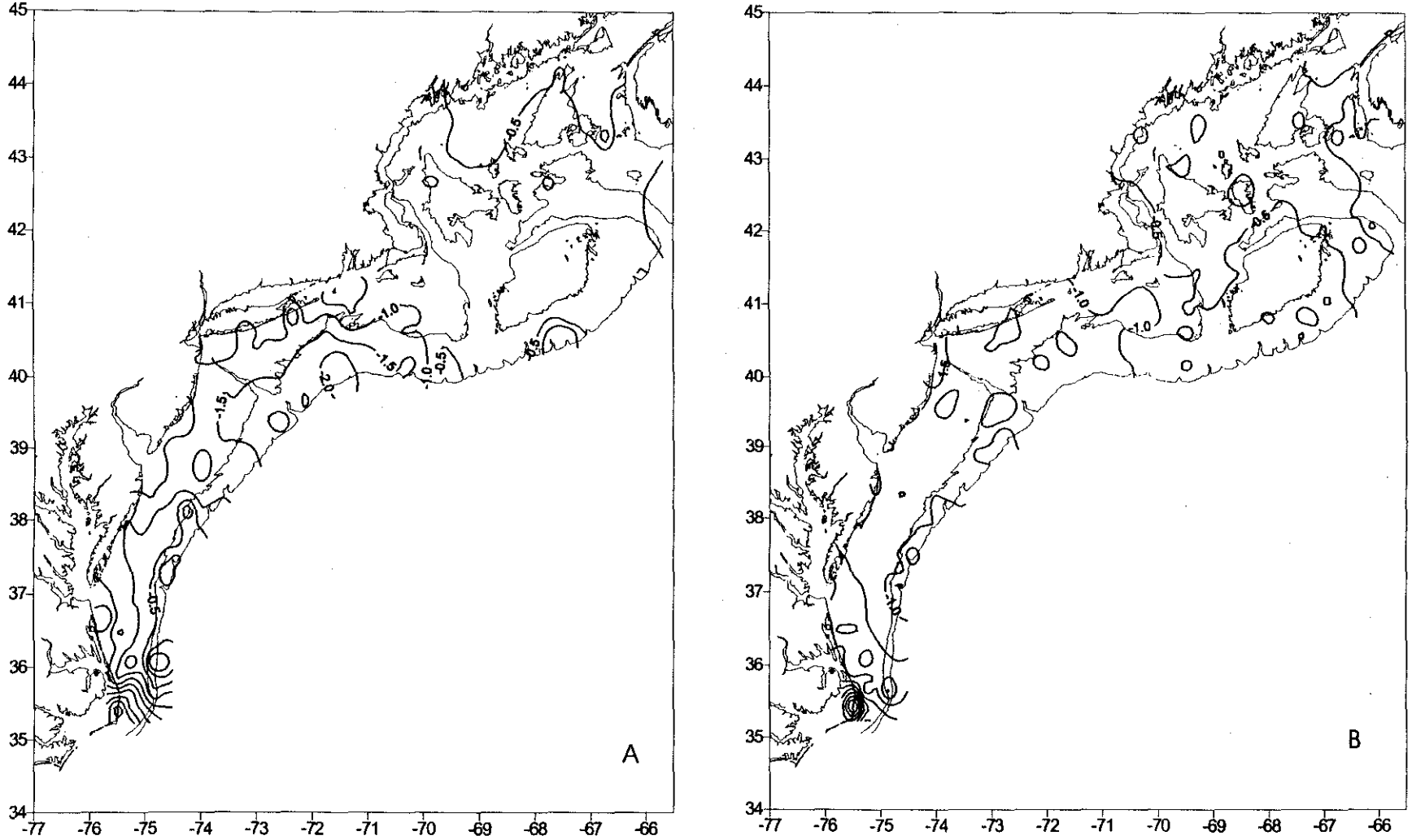


Figure 61. Surface (A) and bottom (B) salinity anomaly distributions for the Fall Bottom Trawl survey ALB9811.

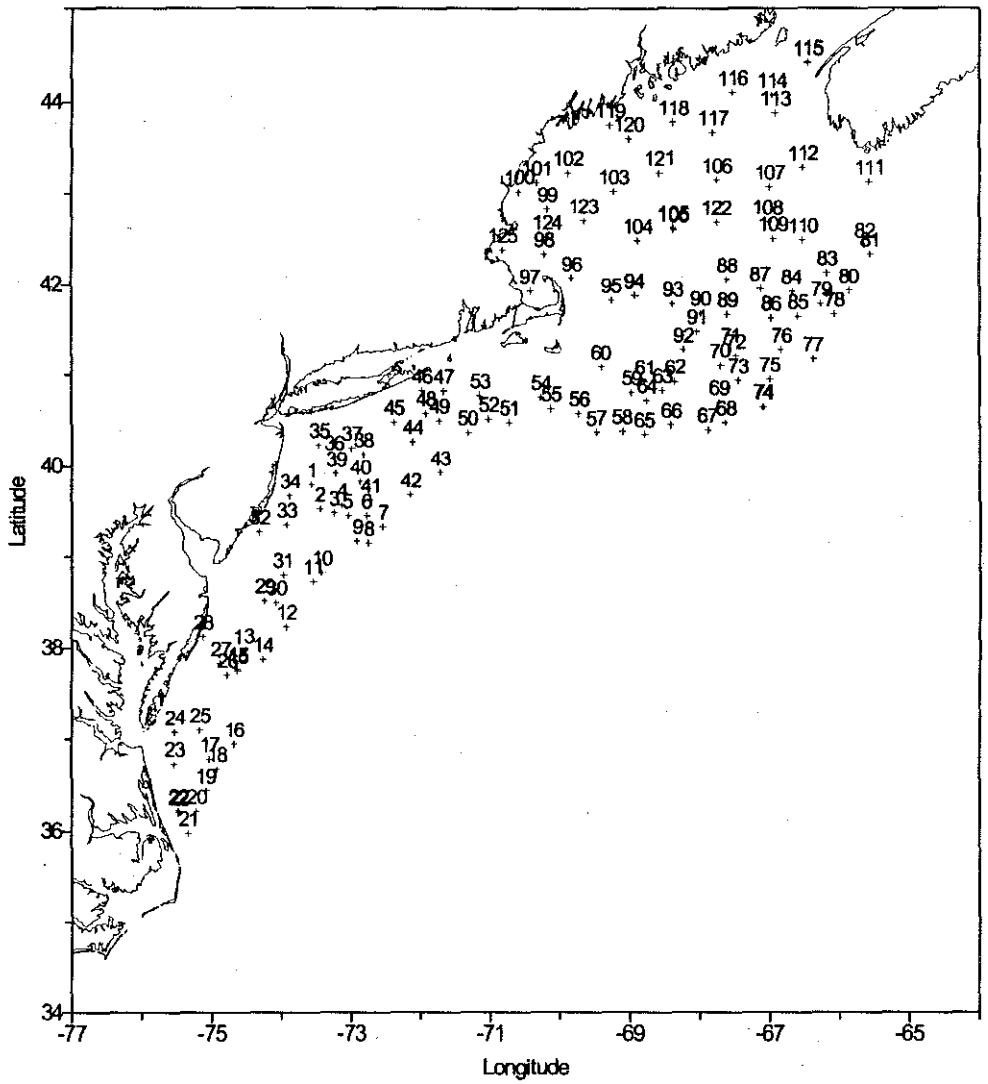


Figure 62. Stations occupied during the Ecosystem Monitoring survey DEL9813.

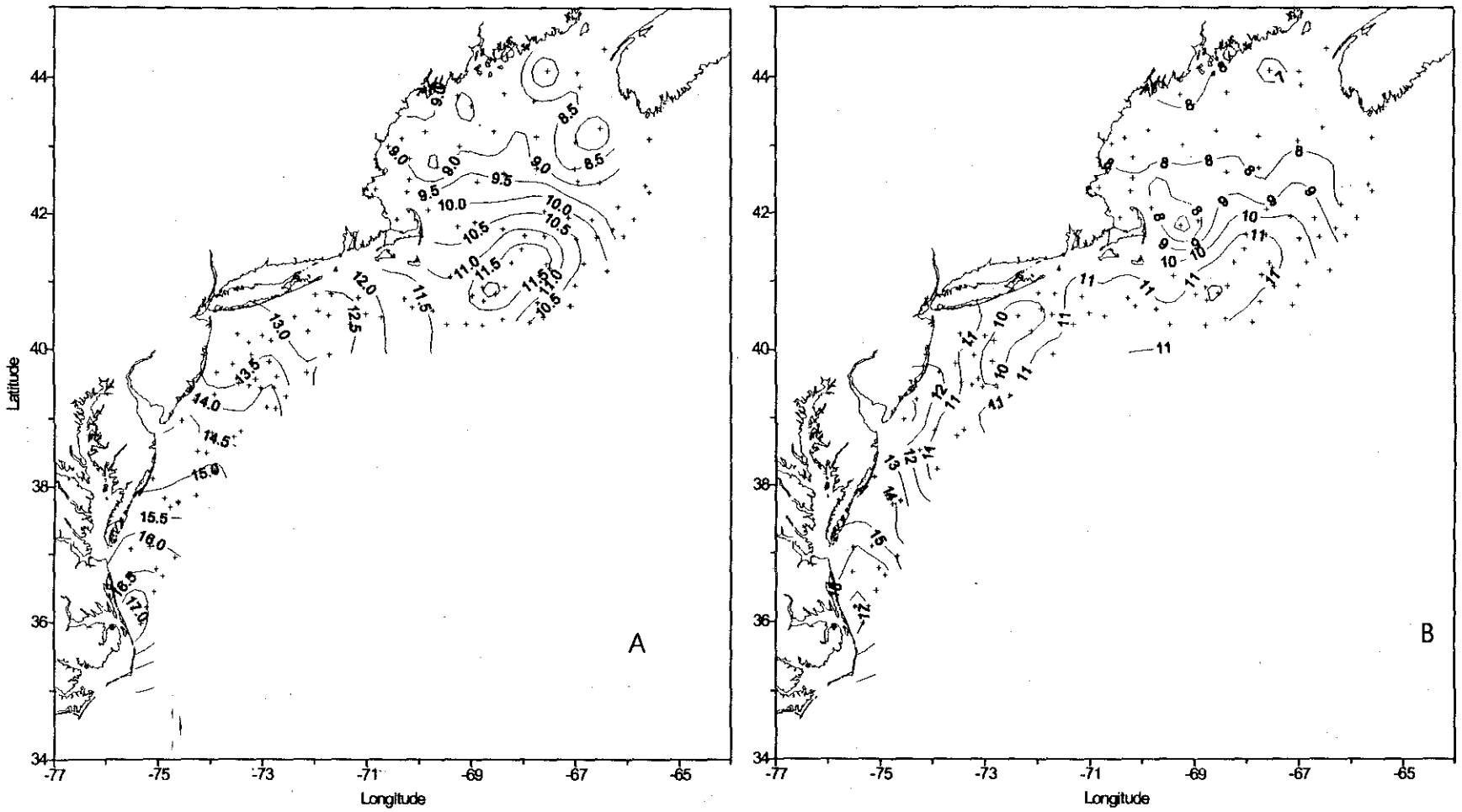


Figure 63. Surface (A) and bottom (B) temperature distributions for the Ecosystem Monitoring survey DEL9813.

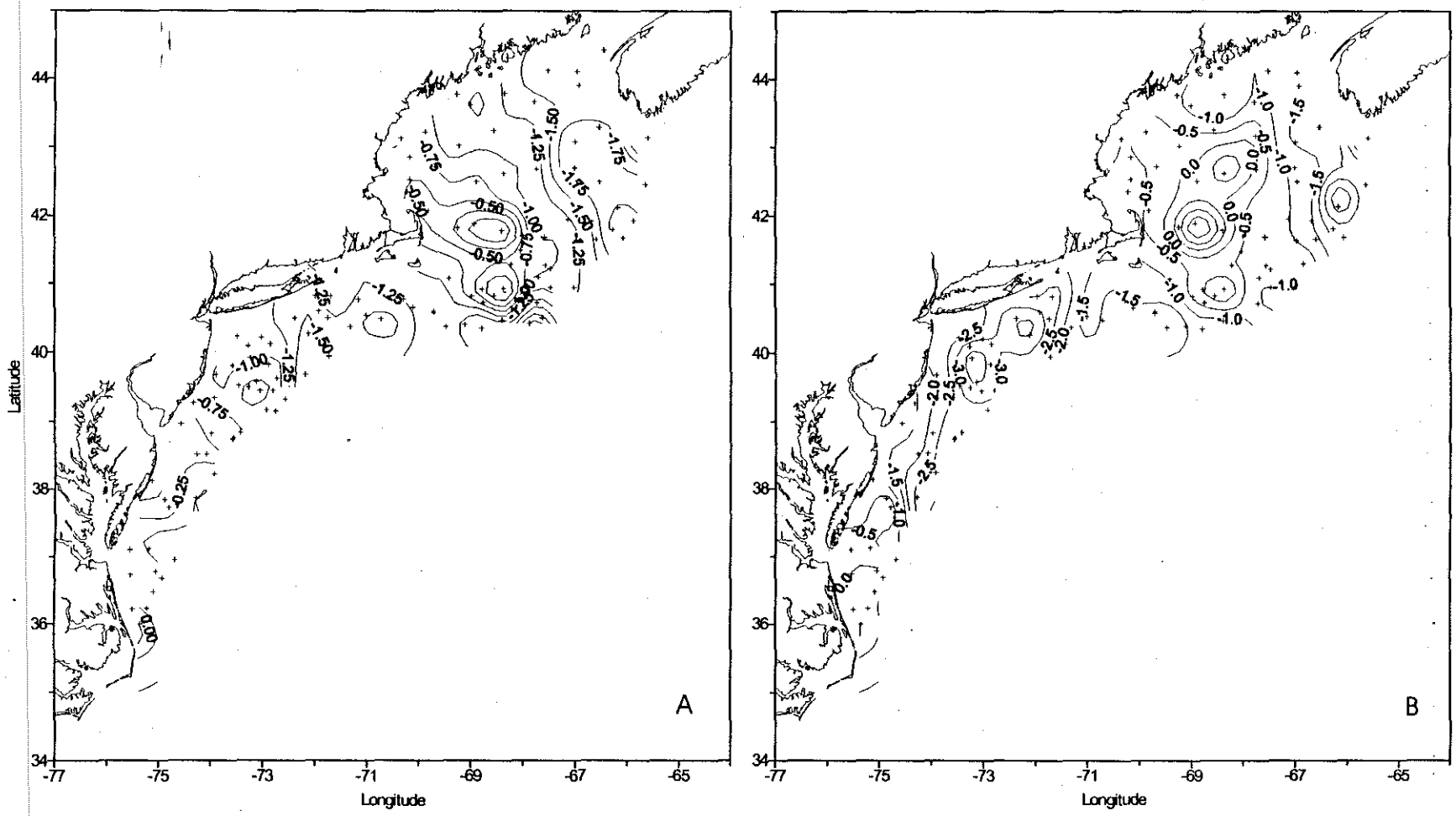


Figure 64. Surface (A) and bottom (B) temperature anomaly distributions for the Ecosystem Monitoring survey DEL9813.

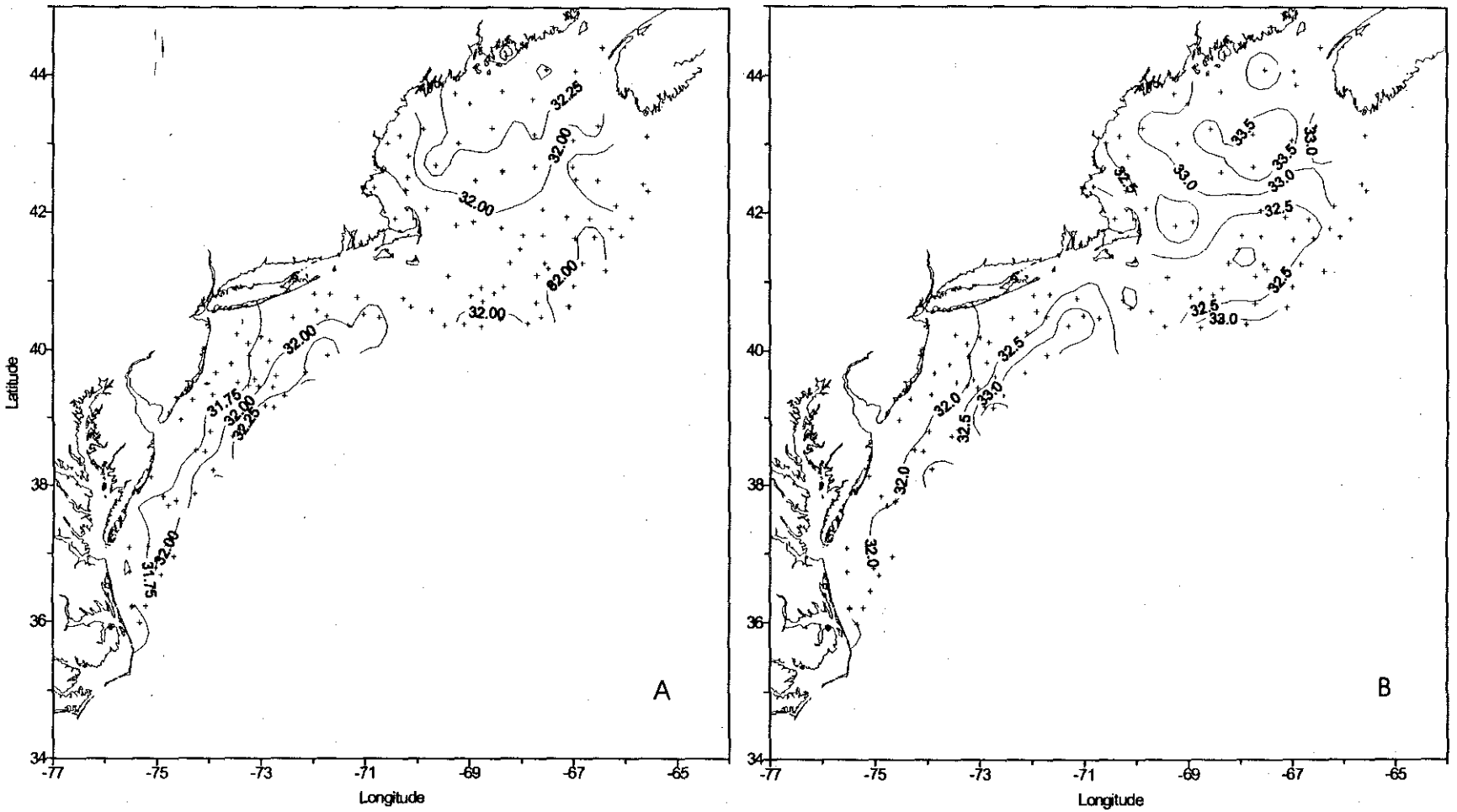


Figure 65. Surface (A) and bottom (B) salinity distributions for the Ecosystem Monitoring survey DEL9813.

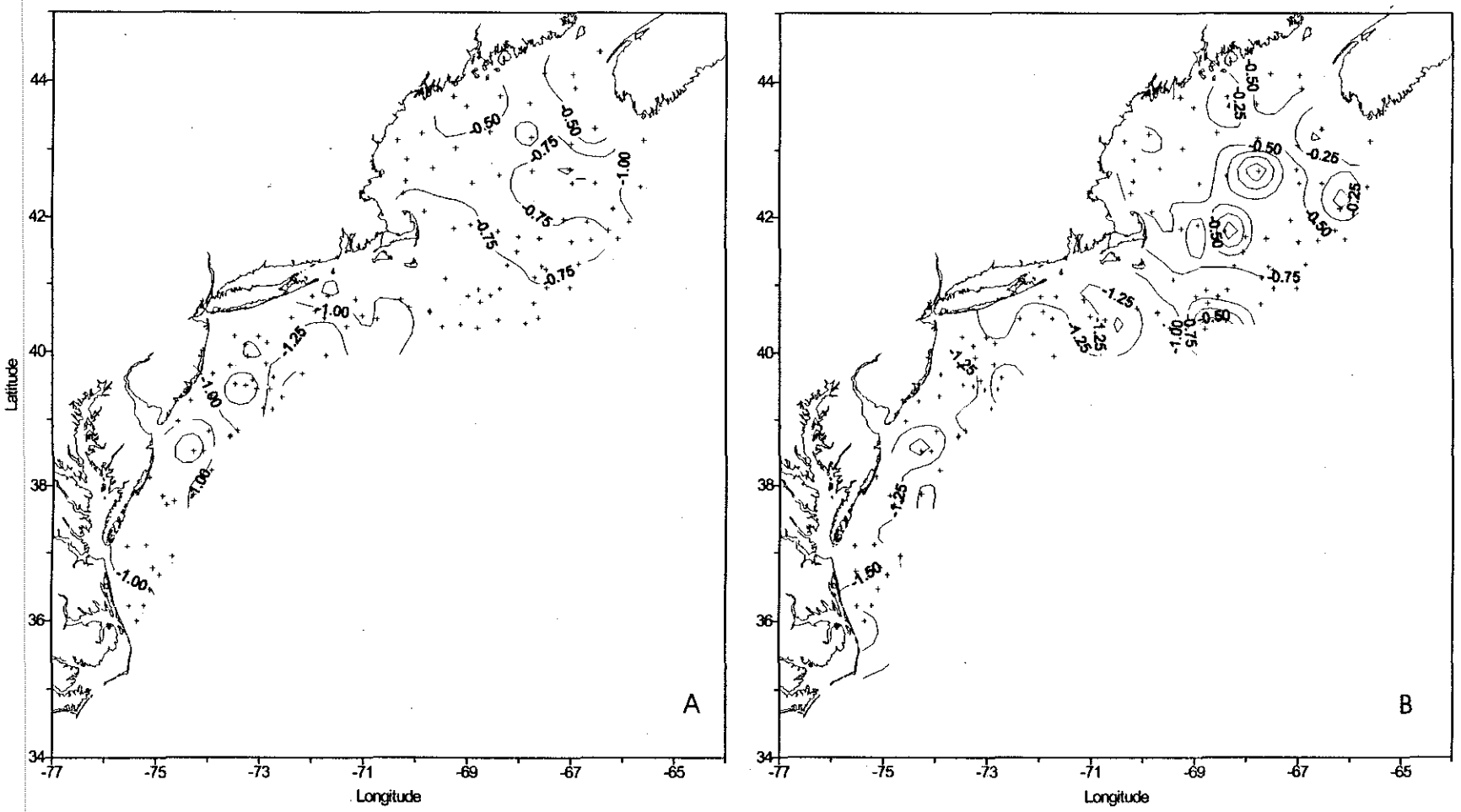


Figure 66. Surface (A) and bottom (B) salinity anomaly distributions for the Ecosystem Monitoring survey DEL9813.

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

Vessel: R/V Albatross IV **Cruise:** ALB9801

Program: GLOBEC Broadscale Survey #1
Dates: 8 - 18 January
Sea Days: 11
Instrument(s): 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 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: 77
# of vertical CTD/Profiler casts: 11
# of double oblique Profiler casts: 76
#Salinity samples: 11
Salt correction: +.002

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

****

Vessel: R/V Albatross IV **Cruise:** ALB9802

Program: Ecosystem Monitoring Survey
Dates: 24 - 28 January
Sea Days: 5
Instrument(s): 1495

Cruise Objectives: To assess the impact of changing biological and physical properties of the Northeast Continental Shelf ecosystem which influence the sustainable productivity of the living marine resources

Total # of Stations: 30
# of vertical CTD/Profiler casts: 5
# of double oblique Profiler casts: 25
 # Salinity samples: 5
Salt correction: -0.001

****

Vessel: R/V Oceanus **Cruise:** OCE9817

Program: GLOBEC Broadscale Survey #2
Dates: 7 -17 February
Sea Days: 11
Instrument(s): 1468

Cruise Objectives: To (1) determine the distribution and abundance of the ichthyoplankton and zooplankton community on the Bank and in adjacent Gulf of Maine and slope waters, with emphasis on target fish (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 and feeding habits; (3) conduct a hydrographic survey of the Bank; (4) conduct a survey of chlorophyll and nutrient levels on the Bank; (5) map the Bank-wide velocity field using an Acoustic Doppler Current Profiler ; (6) compare two plankton pumping systems in their sampling of N1 stage copepods; (7) collect samples for population genetic studies of *Pseudocalanus* spp.; (8) deploy satellite tracked drifters for the study of the currents on the Bank.

Total # of Stations: 80
# of vertical CTD/Profiler casts: 8
# of double oblique Profiler casts: 83
 # Salinity samples: 82
Salt correction: +.011

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

****

Vessel: R/V Delaware II **Cruise:** DEL9803

Program: Marine Mammal Survey
Dates: 23 February - 6 March
Sea Days: 12
Instrument(s): 2277

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: 6
# of vertical CTD/Profiler casts: 6
# of double oblique Profiler casts: 0
 # Salinity samples: 3
Salt correction: N/A -samples mixed up

****

Vessel: R/V Albatross IV **Cruise:** ALB9803

Program: Winter Bottom Trawl Survey
Dates: 8 - 27 February
Sea Days: 20
Instrument(s): 1496, 1495

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; (30 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: 138
# of vertical CTD/Profiler casts: 94
# of double oblique Profiler casts: 17
 # Salinity samples: 27
Salt correction: +.015

****

Vessel: R/V Oceanus **Cruise:** OCE9819

Program: GLOBEC Broadscale Survey #3
Dates: 16 - 26 March
Sea Days: 11
Instrument(s): 1468, 0456

Cruise Objectives: To (1) conduct a broadscale survey of Georges Bank to determine the abundance and distribution of target species of ichthyoplankton (eggs, larvae, and juveniles of cod and haddock), zooplankton (all stages of the copepods *Calanus finmarchicus* and *Pseudocalanus* spp.) and their predators and prey on the Bank and in the adjacent Gulf of Maine and slope waters; (2) conduct a hydrographic survey of the Bank; (3) map the Bank-wide velocity field using an Acoustic Doppler Current Profiler; (4) collect individuals of *C. finmarchicus*, *Pseudocalanus* spp., and the euphausiid *Meganyticphanes norvegica*, for population genetics studies; (5) conduct lipid biochemical and morphological studies of *C. finmarchicus*; (6) conduct acoustic mapping of the plankton along the tracklines between stations using a high frequency echo sounder deployed in a towed body; (7) deploy drifting buoys to make Lagrangian measurements of the currents.

Total # of Stations: 77

# of vertical CTD/Profiler casts: 13
# of double oblique Profiler casts: 77
 # Salinity samples: 13
Salt correction: +.012

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

****

Vessel: R/V Delaware II **Cruise:** DEL9804

Program: Marine Mammal Survey
Dates: 13 –26 March
Sea Days: 17
Instrument(s): 2277

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: 32
# of vertical CTD/Profiler casts: 32
# of double oblique Profiler casts: 0
 # Salinity samples: 12
Salt correction: +.019

****

Vessel: R/V Oceanus **Cruise:** OCE9822

Program: GLOBEC Broadscale Survey #4
Dates: 15 - 27 April
Sea Days: 12
Instrument(s): 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.

Total # of Stations:	80
# of vertical CTD/Profiler casts:	8
# of double oblique Profiler casts:	80
# Salinity samples:	8
Salt correction:	+.013

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

****

Vessel: R/V Albatross IV **Cruise:** ALB9804

Program:	Spring Bottom Trawl Survey
Dates:	3 March - 20 April
Sea Days:	40
Instrument(s):	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:	378
# of vertical CTD/Profiler casts:	199

# of double oblique Profiler casts: 130
 # Salinity samples: 46
Salt correction: +.008

*****

Vessel: R/V Delaware II **Cruise:** DEL9806

Program: Marine Mammal Survey
Dates: 13 –29 May
Sea Days: 17
Instrument(s): 0853, 0851

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: 91
# of vertical CTD/Profiler casts: 87
# of double oblique Profiler casts: 0
 # Salinity samples: 28
Salt correction: +.009 (0853), +.007 (0851)

****

Vessel: R/V Albatross IV **Cruise:** ALB9806

Program: GLOBEC Broadscale Survey #5
Dates: 13 - 22 May
Sea Days: 10
Instrument(s): 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.

Total # of Stations:	81
# of vertical CTD/Profiler casts:	8
# of double oblique Profiler casts:	82
# Salinity samples:	8
Salt correction:	+.007

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

****

Vessel: R/V Albatross IV **Cruise:** ALB9807

Program:	Ecosystem Monitoring Survey
Dates:	26 May - 12 June
Sea Days:	18
Instrument(s):	1495

Cruise Objectives: To assess the impact of changing biological and physical properties of the Northeast Continental Shelf ecosystem which influence the sustainable productivity of the living marine resources.

Total # of Stations:	145
# of vertical CTD/Profiler casts:	22
# of double oblique Profiler casts:	123
# Salinity samples:	22
Salt correction:	-.002

****

Vessel: R/V Albatross IV **Cruise:** ALB9808

Program: GLOBEC Broadscale #5
Dates: 17 - 25 June
Sea Days: 9
Instrument(s): 1468

Cruise Objectives: To (1) conduct a broadscale survey of 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 measurements of the currents and (5) to gather acoustic Doppler current profiler data.

Total # of Stations: 41
# of vertical CTD/Profiler casts: 7
# of double oblique Profiler casts: 42
 # Salinity samples: 7
Salt correction: +.004

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

****

Vessel: R/V Abel J **Cruise:** AJ9801

Program: Marine Mammal Survey
Dates: 8 July – 1 September
Sea Days: 50
Instrument(s): 2277

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: 70
# of vertical CTD/Profiler casts: 70
# of double oblique Profiler casts: 0
 # Salinity samples: 0
Salt correction: N/A

Vessel: R/V Albatross IV **Cruise:** ALB9809

Program: Sea Scallop Survey
Dates: 22 July – 16 August
Sea Days: 22
Instrument(s): 1495

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: 569
# of vertical CTD/Profiler casts: 91
# of double oblique Profiler casts: 2
 # Salinity samples: 43
Salt correction: +.013

****

Vessel: Isabel S **Cruise:** IS9801

Program: Ecosystem Monitoring
Dates: 22 August – 1 September
Sea Days: 11
Instrument(s): 1447

Cruise Objectives: To assess the impact of changing biological and physical properties of the Northeast Continental Shelf ecosystem which influence the sustainable productivity of the living marine resources.

Total # of Stations: 69
# of vertical CTD/Profiler casts: 0
# of double oblique Profiler casts: 70
 # Salinity samples: 17
Salt correction: +.008

****

Vessel: R/V Delaware II **Cruise:** DEL9808

Program: Marine Mammal Survey
Dates: 22 August – 1 September
Sea Days: 11
Instrument(s): 1447

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: 48
# of vertical CTD/Profiler casts: 0
# of double oblique Profiler casts: 22
 # Salinity samples: 0
Salt correction: N/A

Vessel: R/V Albatross IV **Cruise:** ALB9811

Program: Fall Bottom Trawl Survey
Dates: 21 September – 9 November
Sea Days: 43
Instrument(s): 1496, 1495

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: 374
# of vertical CTD/Profiler casts: 270
# of double oblique Profiler casts: 72
 # Salinity samples: 51
Salt correction: +.018 (1496), +.022 (1495)

****

Vessel: R/V Delaware II **Cruise:** DEL9813

Program: Ecosystem Monitoring Survey
Dates: 4 – 19 November
Sea Days: 16
Instrument(s): 0851, 0853

Cruise Objectives: To assess the impact of changing biological and physical properties of the Northeast Continental Shelf ecosystem which influence the sustainable productivity of the living marine resources.

Total # of Stations: 151
# of vertical CTD/Profiler casts: 0
# of double oblique Profiler casts: 125
 # Salinity samples: 26

Salt correction: .005 (0851), .003 (0853)

****