

CRUISE RESULTS

NOAA Fisheries Research Vessel DELAWARE II

Cruise No. DE 07-11

Northeast Shelf Ecosystem Monitoring Late Autumn Survey

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CRUISE PERIOD AND AREA

The cruise period was 29 October to 16 November 2007. The NOAA fisheries research vessel DELAWARE II sampled at a total of 97 stations. Of these, 35 were located in the Gulf of Maine (GOM), 31 were in the Southern New England (SNE) area and 25 in the Mid-Atlantic Bight (MAB). The Gulf of Maine (GOM) stations included 4 fixed stations: the Wilkinson, and Georges basins, the site of a proposed liquefied natural gas (LNG) terminal east of Boston Harbor and the Northeast Channel (Figure 1).

OBJECTIVES

The primary objective of the cruise was to assess changing biological and physical properties which influence the sustainable productivity of the living marine resources of the northeast continental shelf ecosystem. Key parameters measured for the Ecosystem Monitoring Program included ichthyoplankton and zooplankton composition, abundance and distribution, plus water column temperature and salinity. Near-surface along-track chlorophyll-*a* fluorescence, water temperature and salinity were measured while underway with the vessel's flow-through sampling system. Secondary objectives of this cruise included the following:

- Vertical CTD casts to within 5 meters of the bottom in Gulf of Maine deep basin areas to provide hydrographic data detailing the incursion of Labrador Current water into this region.
- Sampling at the site of a proposed liquefied natural gas (LNG) terminal east of Boston Harbor, to collect baseline data.
- Collection of zooplankton for the Census of Marine Zooplankton Project (formerly called the Zooplankton Genome Project) based at University of Connecticut, Avery Point.
- Collection of near-surface water samples for detection of *Pseudonitzschia* diatoms and *Alexandrium* dinoflagellates as part of the Harmful Algal Bloom Project (HAB) of the Woods Hole Oceanographic Institution (WHOI).
- Note presence and volume of *Calanus finmarchicus* in samples upon return of cruise to shore.
- Collection of phytoplankton samples from the ship's flow-through seawater system for nitrogen isotope ratio analysis.
- A series of 9 plankton samples was collected for Jon Hare at the mouth of the Chesapeake Bay to be used for ichthyoplankton otolith analysis.

METHODS

The survey consisted of 97 stations at which the vessel stopped to lower instruments over the side (Figure 1). All stations sampled were at randomly stratified locations except for 5 fixed-position stations in the GOM visited on all Ecosystem Monitoring cruises: Wilkinson Basin, Georges Basin, Jordan Basin, a proposed Liquefied Natural Gas terminal site east of Boston and the Northeast Channel. The other non-random stations on this cruise were located at positions between randomly selected stations done to improve areal coverage on transits greater than four hours and a series of 9 stations placed at the mouth of the Chesapeake Bay for ichthyoplankton otolith analysis.

Plankton and hydrographic sampling was conducted at all stations by making double oblique tows using the 61-cm bongo sampler and a Seabird CTD. The tows were made to approximately 5 m above the bottom, or to a maximum depth of 200 m. All plankton tows were conducted at a ship speed of 1.5 – 2.0 knots. Plankton sampling gear consisted of a 61-cm diameter aluminum bongo frame with two 335-micron nylon mesh nets. At the randomly designated zoogen stations a 20-cm diameter PVC bongo frame fitted with paired 165-micron nylon mesh nets was put on the towing wire one half meter above the Seabird CTD with a wire stop (Figure 2.). A 45-kg lead weight in the shape of a flat-bottomed pear was attached by an 80-cm length of 3/8-inch diameter chain below the aluminum bongo frame to depress the sampler. The flat bottomed configuration of the depressor weight made for safer deployment and retrieval of the sampling gear when the boat was rolling in rough seas. A digital flowmeter was suspended within the mouth of each sampler to determine the amount of water filtered by each net. No flowmeters were used in the 20-cm bongos. The plankton sampling gear was deployed off the starboard stern quarter of the vessel using an A-frame and a Sea-Mac winch which was placed on the aft deck specifically for this operation. After retrieval, the bongo frames were carried into a covered work area on the port side of the aft deck and placed on tables for wash down of the nets to obtain the plankton samples. This work space allowed for much easier removal of the samples, particularly during inclement weather. The 61-cm bongo plankton samples were preserved in a 5% solution of formalin in seawater. The zooplankton genetics samples from the 20-cm diameter bongos were preserved in 95% ethanol, which was changed once at 24 hours after the initial preservation. Tow depth was monitored in real time with a Seabird CTD profiler. The Seabird CTD profiler was hard-wired to the conductive towing cable, providing simultaneous depth, temperature, and salinity for each plankton tow. A CTD cast to within 5 m of the bottom was made in the Wilkinson and Georges basins to provide hydrographic data from below the 200 m limit set for bongo tows.

Continuous monitoring of the seawater salinity, temperature and chlorophyll-*a* level, from a depth of 3.7 meters along the entire cruise track was done by means of a thermosalinograph, and a flow-through fluorometer hooked up to the ship's flow-through seawater system. The Scientific Computer System (SCS) recorded the output from both the thermosalinograph, and the fluorometer at 10-second intervals. The data records were given a time-date stamp by the GPS unit.

Samples for Seabird CTD salinity data calibration were obtained twice a day using a 1.7 liter Niskin bottle taking a water sample from 25 or more meters depth in an isohaline portion of the water column. Calibration of the CTD salinities and chlorophyll-*a* from the surface flow-through system was undertaken twice daily while the ship was underway. Sample analysis for these calibrations followed the protocol outlined in the Ecosystem Monitoring Program Operations Manual.

Zooplankton genetics (zoogen) samples were collected using the 20-cm diameter bongos described above

at 5 randomly designated stations in each of the three regions sampled: Mid-Atlantic Bight, Southern New England, and Gulf of Maine.

Seawater sample collections were made at random stations in the Gulf of Maine to test for the presence of *Pseudonitzschia*, a pennate diatom, and *Alexandrium*, an armored dinoflagellate, both of which cause paralytic shellfish poisoning. The *Pseudonitzschia* samples were collected by filling a small 50 ml container containing some growth medium with seawater from the flow-through system discharge, and placing them in a small refrigerator set to an approximation of the ambient seawater temperature. The *Alexandrium* samples were collected by filtering two liters of the seawater from the flow-through system discharge through a 20 micron mesh and then placing the filtered material into a 15 ml centrifuge tube with 0.75 ml of concentrated formaldehyde as a preservative into a cooler.

Nitrogen isotope samples were collected from 16 stations along the entire cruise track by filtering 600 – 1000 ml of seawater from the discharge of the ship's flow-through seawater system. The seawater was filtered through 25 mm diameter Whatman glass fiber filters (GFF) and the filters were subsequently frozen for analysis ashore.

Presence and volume of *Calanus finmarchicus* was noted in the samples after completion of the cruise by measuring the settled height of the samples in mm, and then converting it to ccs by using the algorithm: $\text{volume} = (-26.43) + (6.19)(\text{sample height})$. From "A Method for Rapid Assessment of Plankton Volumes from Settled Height Measurements of Zooplankton Samples" Prezioso and Kane (in prep).

RESULTS

A summary of routine survey activities is presented in Table 1. Areal coverage for the cruise is shown in Figure 1. The DELAWARE II sailed at 1330 hours EDT on Monday, 29 October 2007, under calm conditions and proceeded southeast to sample the offshore stations until Wednesday, 31 October, when the cruise track was altered to start working towards inshore stations in anticipation of Tropical Storm Noel, which was heading north. On Thursday, 12 noon EDT, 1 November, the DELAWARE II docked in Norfolk Virginia where it remained until Sunday, 0800 EDT, 4 November, when sea conditions had improved to the point where the vessel could safely resume working. Due to the loss of time, 7 stations in the southern part of the Middle Atlantic Bight were not sampled. Instead, the vessel worked its way back north, and continued sampling through 5 November, after which the vessel proceeded to Woods Hole where it docked at 1400 EDT on Tuesday, 7 November. Three of the four scientists disembarked, and were replaced the next day by another three scientists, after which the DELAWARE II sailed at 1400 hours EST, on Wednesday, 8 November. The second leg of the cruise was started by the vessel heading towards Long Island and New Jersey, picking up all the Southern New England and northern Mid-Atlantic Bight stations that had been missed on the first leg. After completing a counter-clockwise track loop, a course was set for the Cape Cod Canal. Normally at this point in the cruise, the vessel would have headed to Georges Bank, but a very large storm system precluded any sampling operations in that region at that time. By heading into the western Gulf of Maine, sampling was able to continue, starting late on Friday, 9 November. Subsequent sampling was carried out in a great clockwise loop around the Gulf of Maine. No sampling was done in the Georges Bank region since there was only enough time left in the vessel schedule to finish the Gulf of Maine area, which was done completely with the exception of one station northeast of Grand Manan Island in the Bay of Fundy. There was enough time left after completion of the Gulf of Maine area to sample 6 eastern Southern New England Area stations which had been missed due to the large storm system that had prevented sampling on Georges Bank.

All sampling was completed on Thursday, 15 November. The DELAWARE II returned to Woods Hole and docked at the NMFS concrete pier at 0745 EST on Friday, 16 November 2007.

DISPOSITION OF SAMPLES AND DATA

All samples and data, except for the zooplankton genetics samples, the HAB samples, and the Seabird CTD data, were delivered to the Ecosystem Monitoring Group of the NEFSC, Narragansett, RI, for quality control processing and further analysis. Nancy Copley and Dave Kulis of the Woods Hole Oceanographic Institute took the zooplankton genetics and HAB samples from the vessel. The Ecosystems Monitoring Group in Narragansett retained copies of the CTD logs. The nitrogen isotope samples were delivered to the EPA laboratory in Narragansett, RI. Calanus volume information was forwarded to Tim Cole after the cruise report was completed.

SCIENTIFIC PERSONNEL

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Table 1. STATION OPERATION REPORT FOR CRUISE DE0711

CAST	STA.	Date (GMT)		TIME (GMT)		LAT	LONG	DEPTH	OPERATION	
		mm	dd	yy	hr	min		m	B=bongo W=water Z=zoogen V=vertical cast (CTD only) CO=Calanus observed / vol HAB=WHOI HAB sample N=nitrogen isotope	
1	1	10	29	2007	20	14	4111.2	7102.5	31	B
2	2	10	29	2007	21	36	4111.1	7118.4	41	B, N1
3	3	10	29	2007	23	26	4106.1	7138.3	32	B, Z1
4	4	10	30	2007	1	28	4051.5	7121.3	59	B
5	5	10	30	2007	4	33	4043.9	7200	45	B, Z2
6	6	10	30	2007	10	21	4006.4	7101	159	W1
7	6	10	30	2007	10	29	4006.3	7101.9	165	B, N2
8	7	10	30	2007	15	24	3953.7	7200.4	98	B
9	8	10	30	2007	17	17	3953.9	7220.7	77	B, Z3
10	9	10	30	2007	19	36	4003.6	7242.6	57	W2
11	9	10	30	2007	19	41	4003.4	7242.5	57	B, N3
12	9	10	30	2007	19	51	4003.2	7242.3	57	V
13	9	10	30	2007	20	7	4003.2	7242.3	57	V
14	10	10	30	2007	20	43	3958.8	7240.9	57	B
15	11	10	30	2007	22	6	3948.8	7250.7	63	B
16	12	10	31	2007	1	37	3923.8	7219	155	B
17	13	10	31	2007	7	15	3858.9	7324.4	61	B
18	14	10	31	2007	9	21	3846.2	7302.7	192	B
19	15	10	31	2007	10	19	3843.7	7308.8	122	W3
20	15	10	31	2007	10	25	3843.6	7308.8	123	B
21	16	10	31	2007	13	50	3826	7346.1	68	B, Z4, CO/ 203cc
22	17	10	31	2007	17	17	3758.7	7410.8	86	B, N4, CO/ 190cc
23	18	10	31	2007	19	14	3741.5	7414.9	126	W4
24	18	10	31	2007	19	19	3741.6	7414.8	128	B
25	19	10	31	2007	22	26	3728.8	7448.5	48	B
26	20	10	31	2007	23	31	3726.2	7500.6	33	B
27	21	11	1	2007	0	27	3718.9	7458.7	42	B
28	22	11	1	2007	1	15	3718.7	7506.4	31	B, CO/ 500cc
29	23	11	1	2007	2	59	3718.4	7525.2	25	B
30	24	11	1	2007	3	54	3718.9	7534.1	17	B
31	25	11	1	2007	4	36	3718.1	7539.7	13	B
32	26	11	1	2007	5	42	3710.5	7542.7	14	B
33	27	11	1	2007	7	39	3700.4	7552	11	B
34	28	11	1	2007	8	3	3701	7549.1	13	B
35	29	11	1	2007	8	39	3701.3	7543.2	17	B
36	29	11	1	2007	8	56	3701.3	7542.6	17	B
37	30	11	1	2007	10	1	3653.9	7548	15	B
38	31	11	4	2007	16	28	3646.5	7553.1	15	B
39	32	11	4	2007	17	17	3646.3	7546.8	19	B
40	33	11	4	2007	18	2	3646.3	7540.7	21	B

Table 1. (cont.) STATION OPERATION REPORT FOR CRUISE DE0711

CAST	STA.	Date(GMT)		TIME(GMT)		LAT	LONG	DEPTH	OPERATION
		mm	dd	yy	hr min				
								m	B=bongo W=water Z=zoogen V=vertical cast (CTD only) CO=Calanus observed/vol HAB=WHOI HAB sample N=nitrogen isotope
41	33	11	4	2007	18 12	3646.1	7540.9	21	B, N5
42	34	11	5	2007	1 49	3753.7	7456.9	25	B, Z5
43	35	11	5	2007	4 42	3813.8	7432.8	41	B, Z6
44	36	11	5	2007	6 18	3813.8	7451	27	B
45	37	11	5	2007	7 37	3823.9	7458.6	20	B, N6
46	38	11	5	2007	9 33	3826.4	7436.9	30	B
47	39	11	5	2007	12 36	3855.6	7445.9	15	W5
48	39	11	5	2007	12 43	3855.5	7445.9	14	B
49	40	11	5	2007	16 6	3912.9	7410.9	27	B
50	41	11	5	2007	18 46	3913.7	7338.7	45	W6
51	41	11	5	2007	18 53	3913.6	7338.7	46	B
52	42	11	5	2007	20 16	3918.7	7324.6	48	B, Z7
53	43	11	5	2007	22 38	3936.3	7304.8	46	B, Z8
54	44	11	8	2007	6 1	4035.8	7242.4	37	B
55	45	11	8	2007	9 23	4026.4	7324.4	29	B, N7
56	46	11	8	2007	10 41	4016.5	7319	37	B
57	47	11	8	2007	11 33	4011.3	7324.6	38	W7
58	47	11	8	2007	11 39	4011.3	7324.7	39	B
59	48	11	8	2007	14 30	3956.4	7346.5	28	B
60	49	11	8	2007	16 11	3941.3	7352.7	28	B
61	50	11	8	2007	18 4	3936.2	7332.7	38	W8
62	50	11	8	2007	18 10	3936.1	7332.7	38	B
63	51	11	9	2007	2 49	4021.2	7200.6	63	B
64	52	11	9	2007	3 59	4016.8	7148.5	75	B
65	53	11	9	2007	9 10	4026.2	7045.1	82	B, Z9, CO/ 190cc
66	54	11	9	2007	10 56	4033.8	7028.9	64	W9
67	54	11	9	2007	11 2	4033.9	7028.8	64	B
68	55	11	9	2007	14 35	4106.5	7012.8	26	B
69	56	11	9	2007	17 29	4053.8	7044.8	52	W10
70	56	11	9	2007	17 33	4053.9	7044.9	52	B, Z10
71	57	11	10	2007	2 37	4203.7	7020.8	57	B, CO/ 190cc
72	58	11	10	2007	5 46	4225	7037	85	B, N8, CO/ 190cc
73	59	11	10	2007	8 18	4236.1	7018.9	122	B, CO/ 221cc
74	60	11	10	2007	14 46	4317.3	7025.6	28	B, N9
75	61	11	10	2007	20 25	4228.1	6955.9	174	B, CO/ 450cc
76	62	11	11	2007	0 9	4230.4	6939.9	245	B, CO/ 494cc
77	63	11	11	2007	8 31	4313.7	6940.8	107	B, CO/ 227cc
78	64	11	11	2007	12 23	4313.8	6905.3	136	B, HAB1, CO/ 97cc
79	65	11	11	2007	19 48	4351.3	6830.9	114	B, HAB2
80	66	11	11	2007	21 26	4338.9	6821.2	186	B, CO/ 512cc

Table 1. (cont.) STATION OPERATION REPORT FOR CRUISE DE0711

CAST	STA.	Date(GMT)		TIME(GMT)		LAT	LONG	DEPTH	m	OPERATION B=bongo W=water Z=zoogen V=vertical cast (CTD only) CO=Calanus observed / vol HAB=WHOI HAB sample N=nitrogen isotope
		mm	dd	yy	hr min					
81	67	11	11	2007	22 38	4333.7	6814.7	182		B, CO/ 388cc
82	68	11	12	2007	1 46	4319	6744.8	263		B, CO/ 376cc
83	69	11	12	2007	3 2	4323.9	6742.1	249		V
84	69	11	12	2007	3 19	4323.7	6742.1	251		B, N10, CO/196cc
85	70	11	12	2007	9 27	4348.6	6653.3	145		B, HAB3, CO/ 159cc
86	71	11	12	2007	13 3	4415.9	6642.8	186		B, N11,Z11,HAB4,CO/146cc
87	72	11	12	2007	17 48	4338.5	6630.7	114		W11
88	72	11	12	2007	17 52	4338.5	6630.7	113		B, N12, HAB5
89	73	11	12	2007	20 44	4310.4	6616.1	98		B
90	74	11	12	2007	23 55	4241.4	6601.3	76		B, HAB6
91	75	11	13	2007	3 48	4231.2	6517.1	105		B
92	76	11	13	2007	7 0	4213.5	6546	224		V
93	76	11	13	2007	7 12	4213.3	6545.7	224		B, N13, HAB7
94	77	11	13	2007	9 35	4228.3	6548.7	102		B
95	78	11	13	2007	12 45	4233.7	6628.6	208		W12
96	78	11	13	2007	12 51	4233.7	6628.4	208		B, Z12,HAB8,CO/ 110cc
97	79	11	13	2007	16 22	4224.8	6659.8	361		B, N14, HAB9, CO/ 444cc
98	80	11	13	2007	20 14	4251.3	6712.4	240		V
99	80	11	13	2007	20 30	4250.9	6712.1	234		B, CO/ 265cc
100	81	11	13	2007	23 24	4226.5	6726.6	312		V
101	81	11	13	2007	23 43	4226.1	6726.6	313		B, HAB10, CO/ 234cc
102	82	11	14	2007	3 47	4258.6	6752.7	191		B, HAB11, CO/ 425cc
103	83	11	14	2007	5 20	4251.2	6756.8	193		B, HAB12, CO/ 70cc
104	84	11	14	2007	8 5	4236.2	6816.8	183		B, Z13, CO/ 172cc
105	85	11	14	2007	11 34	4208.8	6752.7	213		W13
106	85	11	14	2007	11 48	4208.7	6752.4	209		B, HAB13, N15, CO/500cc
107	86	11	14	2007	15 33	4203.6	6838.4	171		B,Z14,HAB14,CO/ 128cc
108	87	11	14	2007	17 28	4214	6856.6	178		B, CO/ 178cc
109	88	11	14	2007	18 17	4218.6	6854.9	213		B, CO/ 617cc
110	89	11	14	2007	20 53	4233.5	6914.5	225		V
111	89	11	14	2007	21 6	4233.6	6914.2	224		B,N16,Z15,HAB15,CO/ 252cc
112	90	11	15	2007	3 47	4141.4	6948.3	41		B, HAB16
113	91	11	15	2007	6 41	4136.4	6913.1	171		B, HAB17, CO/ 438cc
114	92	11	15	2007	9 39	4111.5	6920.9	54		B
115	93	11	15	2007	13 15	4041.5	6917.2	63		W14
116	93	11	15	2007	13 21	4041.5	6917.1	53		B
117	94	11	15	2007	15 40	4041.7	6944.3	51		B
118	95	11	15	2007	18 48	4016.2	6952.6	86		B
119	96	11	15	2007	19 51	4023.7	6954.7	78		B
120	97	11	15	2007	21 24	4033.4	7004.5	60		B

Table 1. (cont.) STATION OPERATION REPORT FOR CRUISE DE0711

TOTALS: Bongo Casts	= 099
Bongo 6B3Z Samples	= 098
Bongo 6B3I Samples	= 099
Water Samples	= 14
Vertical Casts	= 4
CTD Casts	= 120
Zoogen samples	= 15
HAB samples	= 17
Nitrogen isotope samples	= 16
<u>Calanus</u> observations	= 30

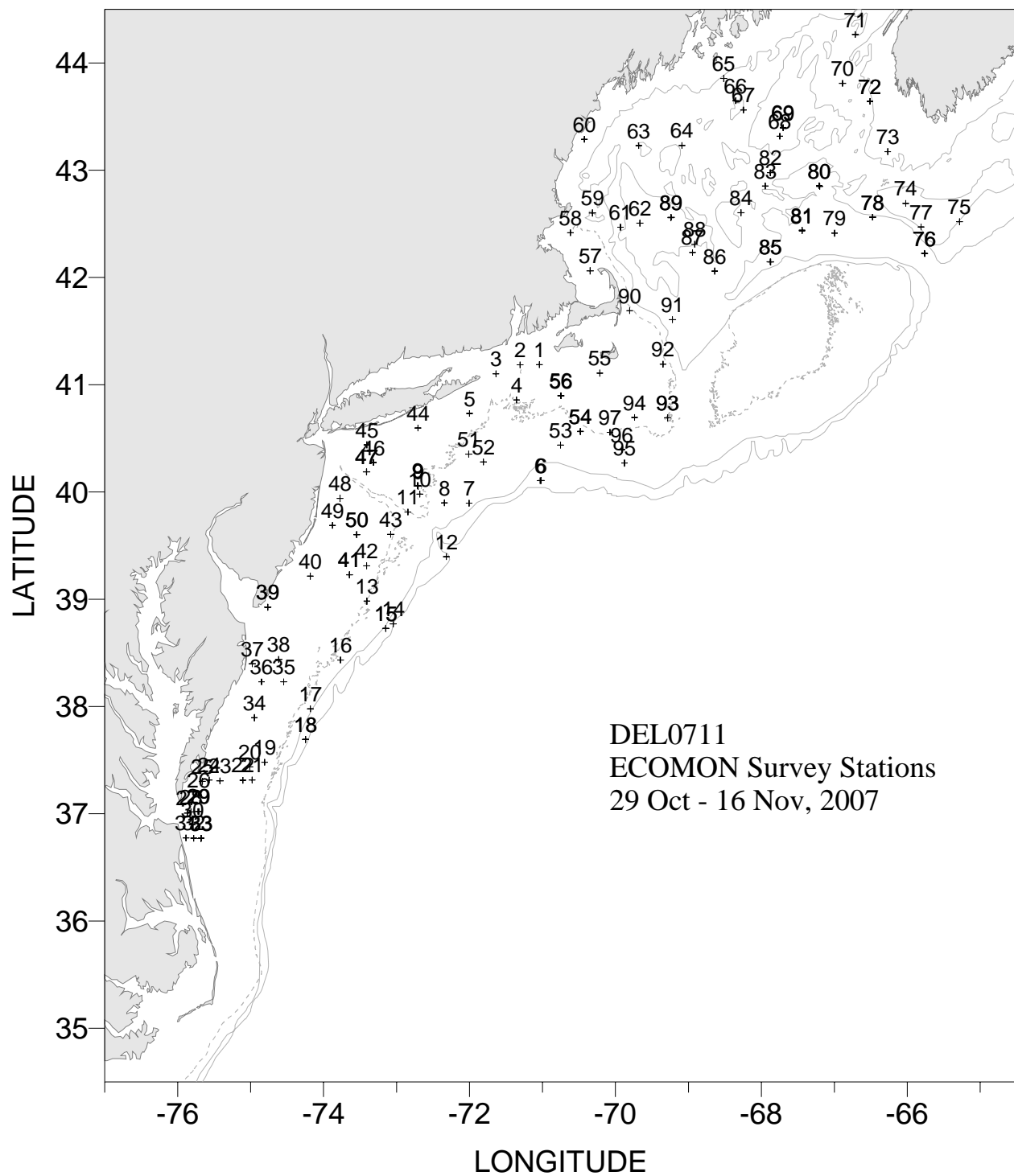


Figure 1. Station locations numbered consecutively for Late Autumn Ecosystem Monitoring Cruise DE 07-11, 29 October - 16 November 2007.

Appendix A.

Regional average surface and bottom temperature / salinity and anomalies for the Fall ECOMON survey DEL0711.

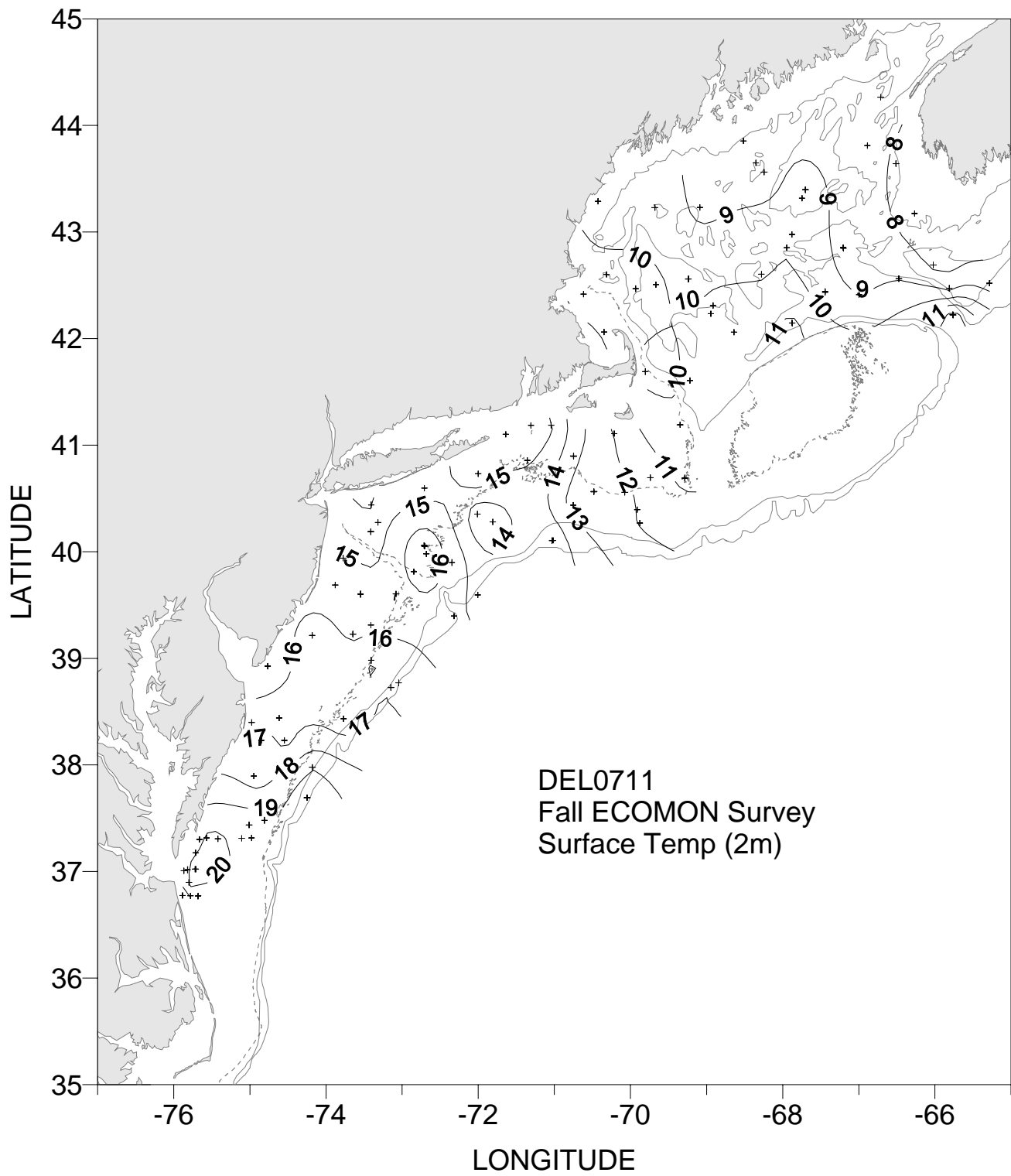
Decimal Year Day	Number of Surface obs	Surface Temp/Salt	Surface T/S Anomaly	SDV1	SDV2	Surface Flag*	Number of Bottom obs.	Bottom Temp/Salt	Bottom T/S Anomaly	SDV1	SDV2	Bottom Flag*
ast												
2007.87	18	8.92	-1.53	0.24	1.24	0	12	7.49	-0.77	0.3	0.82	0
2007.87	18	32.46	-0.22	0.17	0.41	0	12	34.13	-0.12	0.16	0.23	0
2007.87	15	9.72	-0.29	0.28	2.06	1	12	6.62	-0.13	0.28	2.9	1
2007.87	15	32.65	-0.12	0.18	0.62	1	12	33.67	-0.1	0.15	0.71	1
Gulf of Maine E												
2007.85	25	13.94	-0.11	0.25	1.19	0	20	11.58	-1.56	0.31	1.74	0
2007.85	25	32.39	-0.53	0.17	0.37	0	20	32.79	-0.76	0.18	0.42	0
Gulf of Maine West												
2007.84	43	17.71	2.07	0.2	1.25	1	34	17.06	1.79	0.23	2.36	1
2007.84	43	32.42	-0.06	0.17	0.76	1	34	32.57	-0.14	0.15	0.45	1
MAB-North												

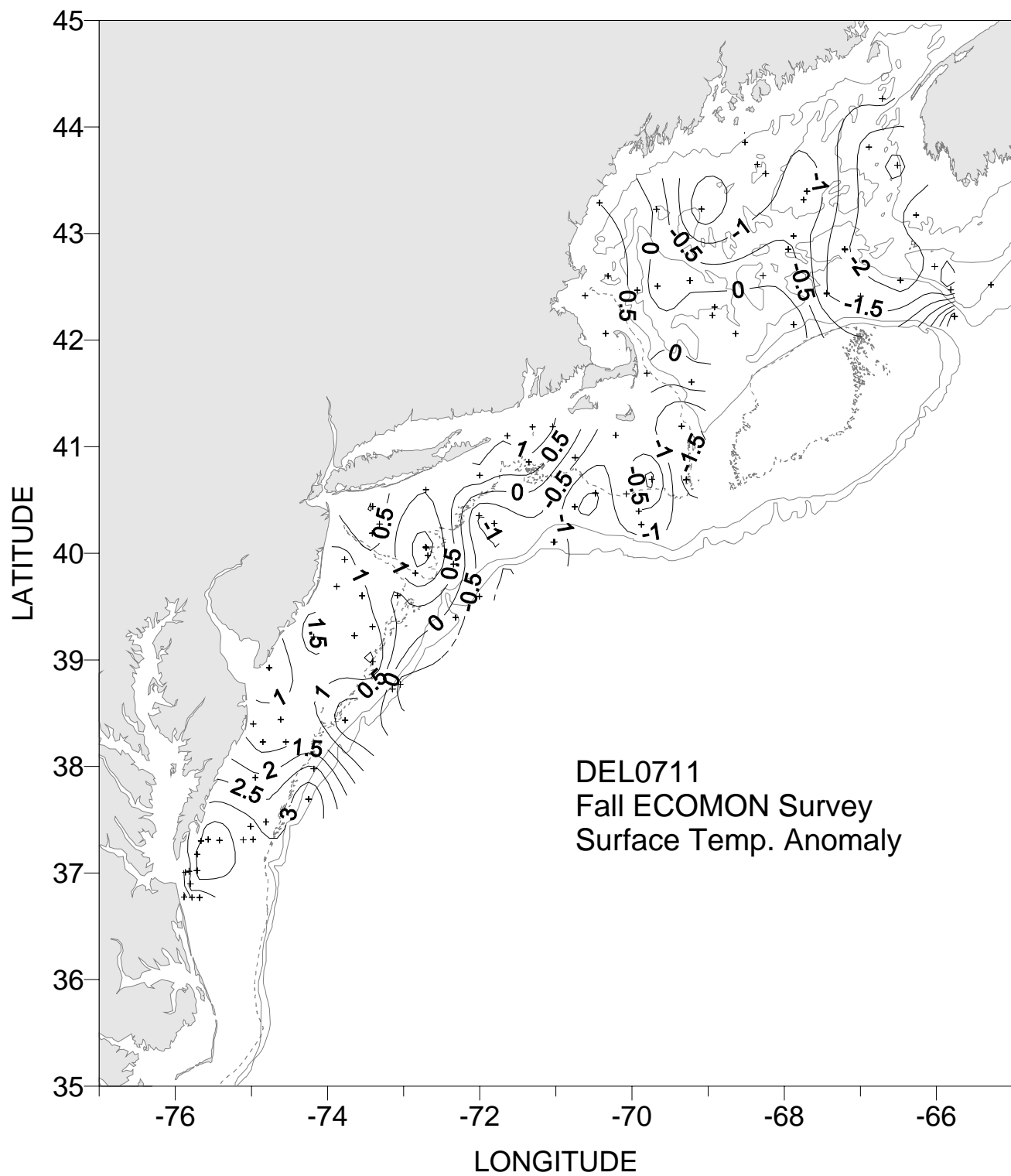
* A Flag value of 0 indicates that there were enough observations to calculate an area weighted value for the region.

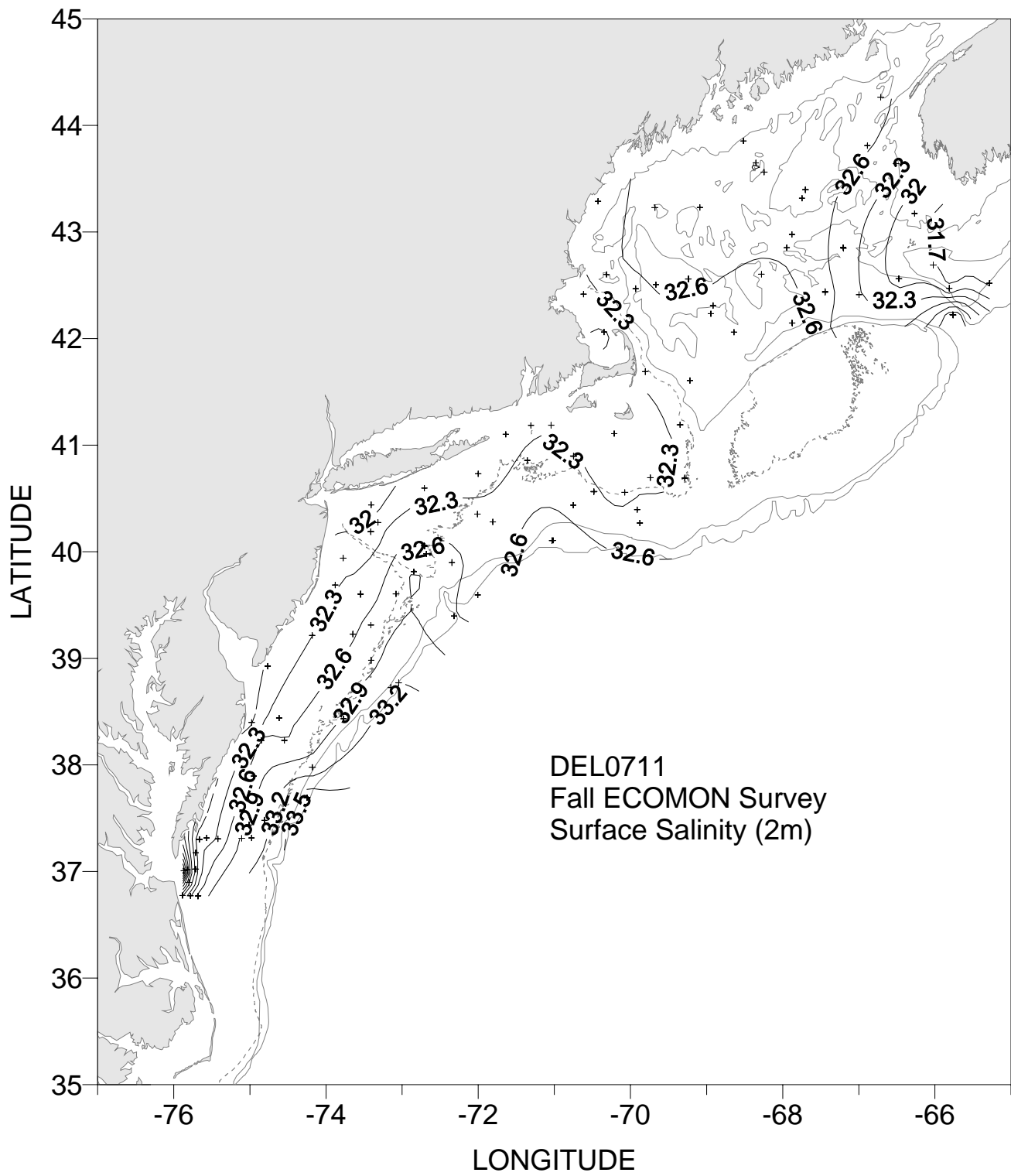
A Flag value of 1 indicates that the spatial distribution of the observations was not sufficient to calculate an area weighted average for the region, and instead a simple average of the observations was calculated.

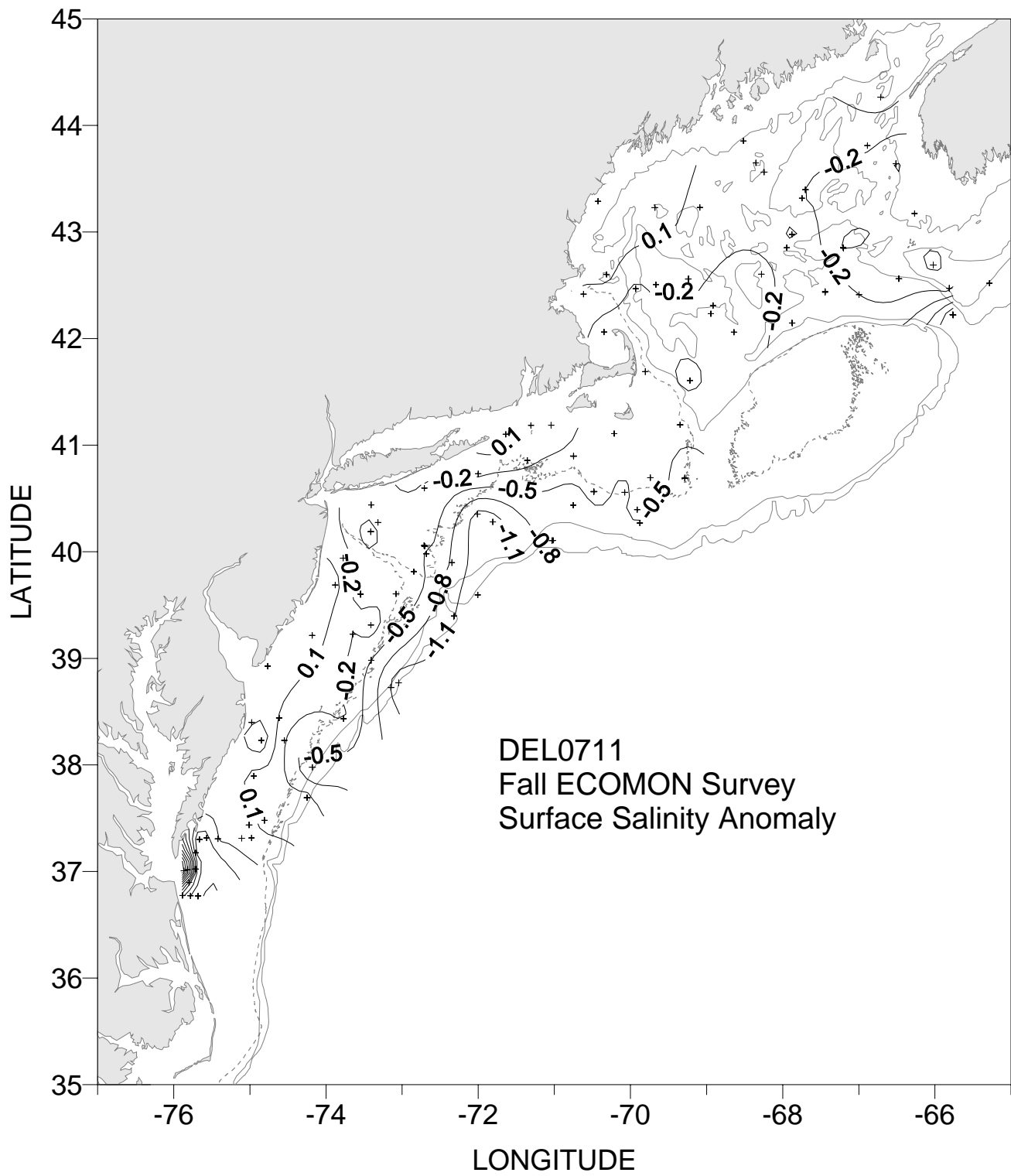
** SDV1 = the standard deviation associated with the average temperature / salinity
the standard deviation of the individual anomalies from which the average anomaly was derived

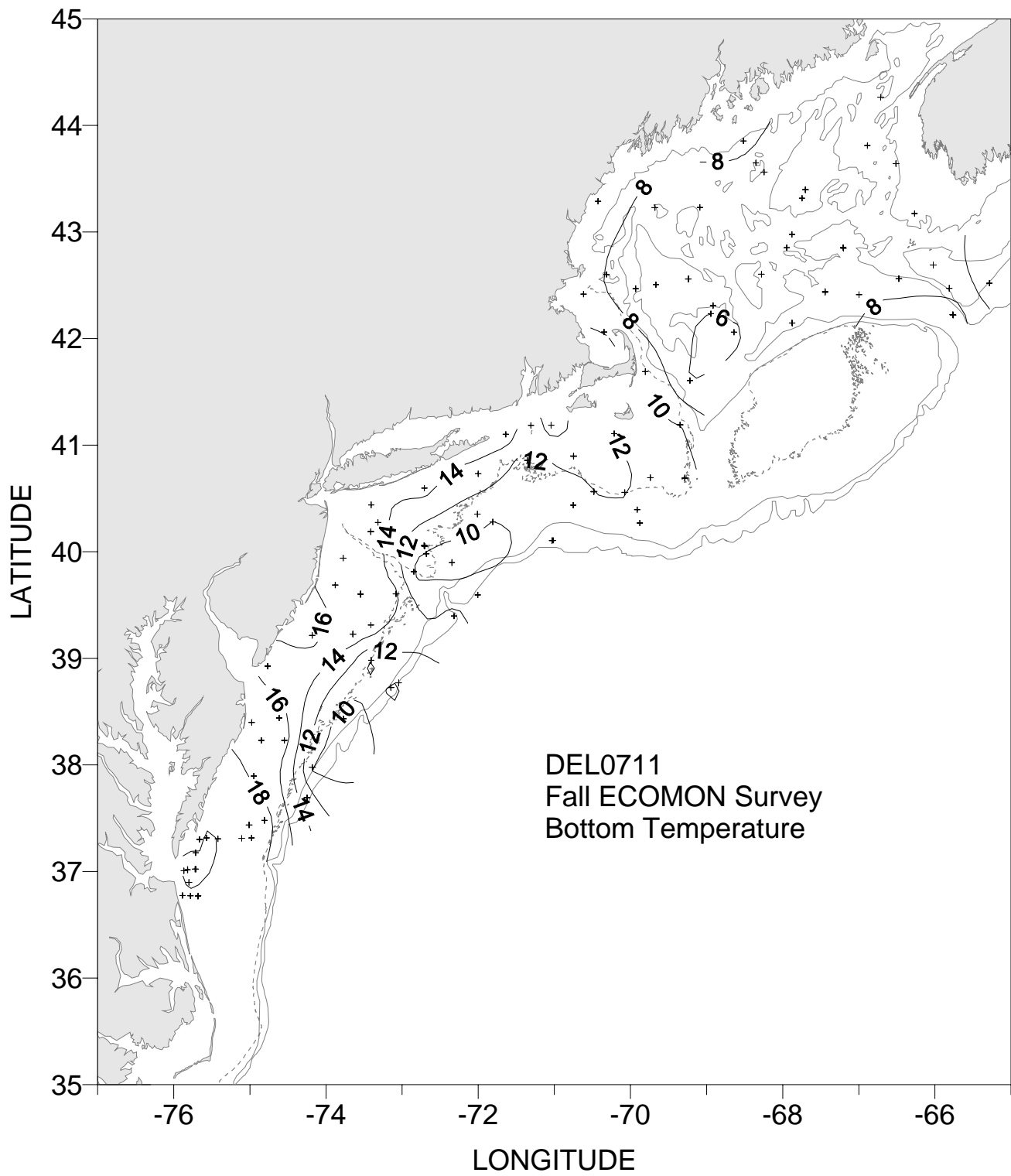
SDV2 =

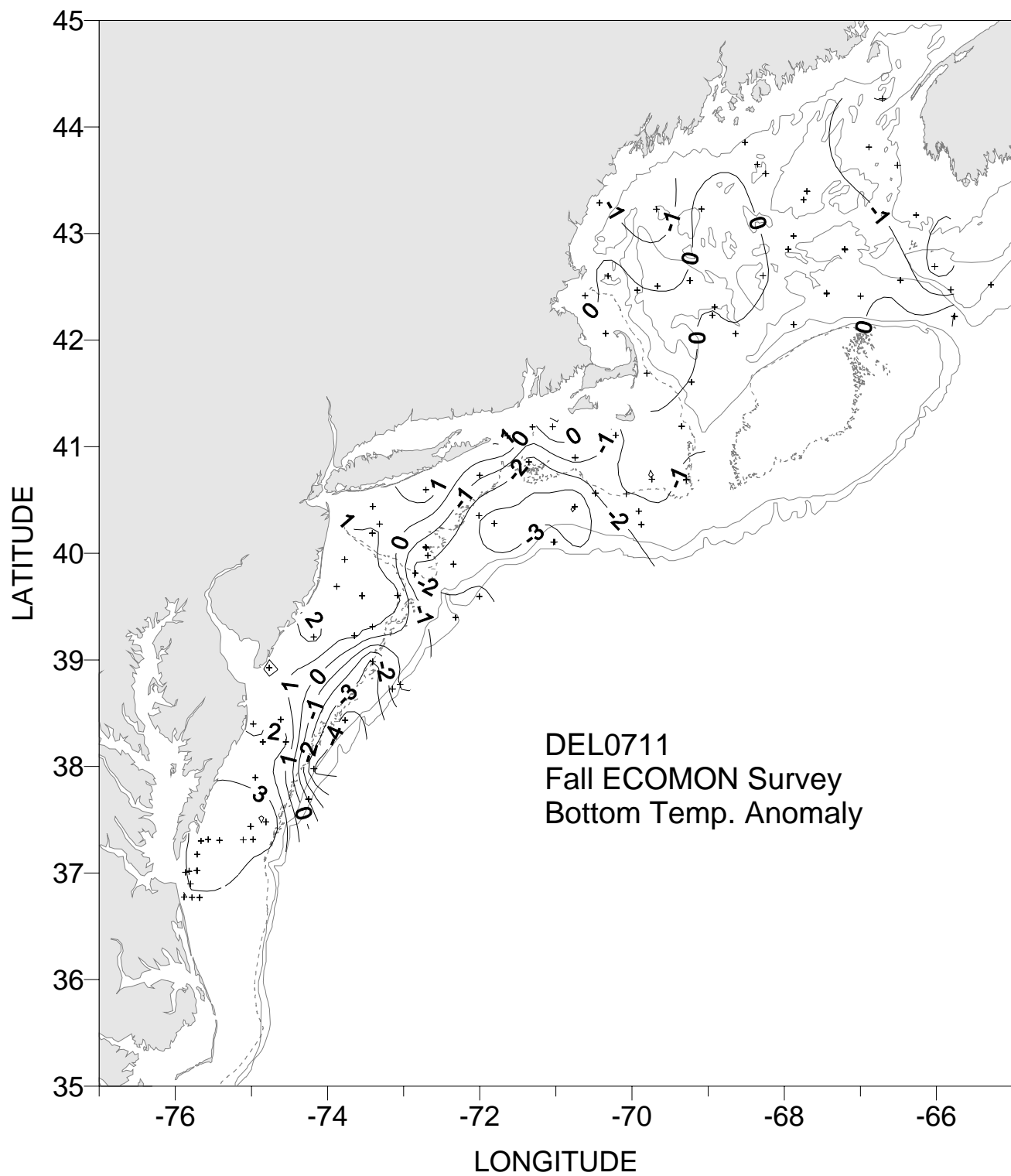


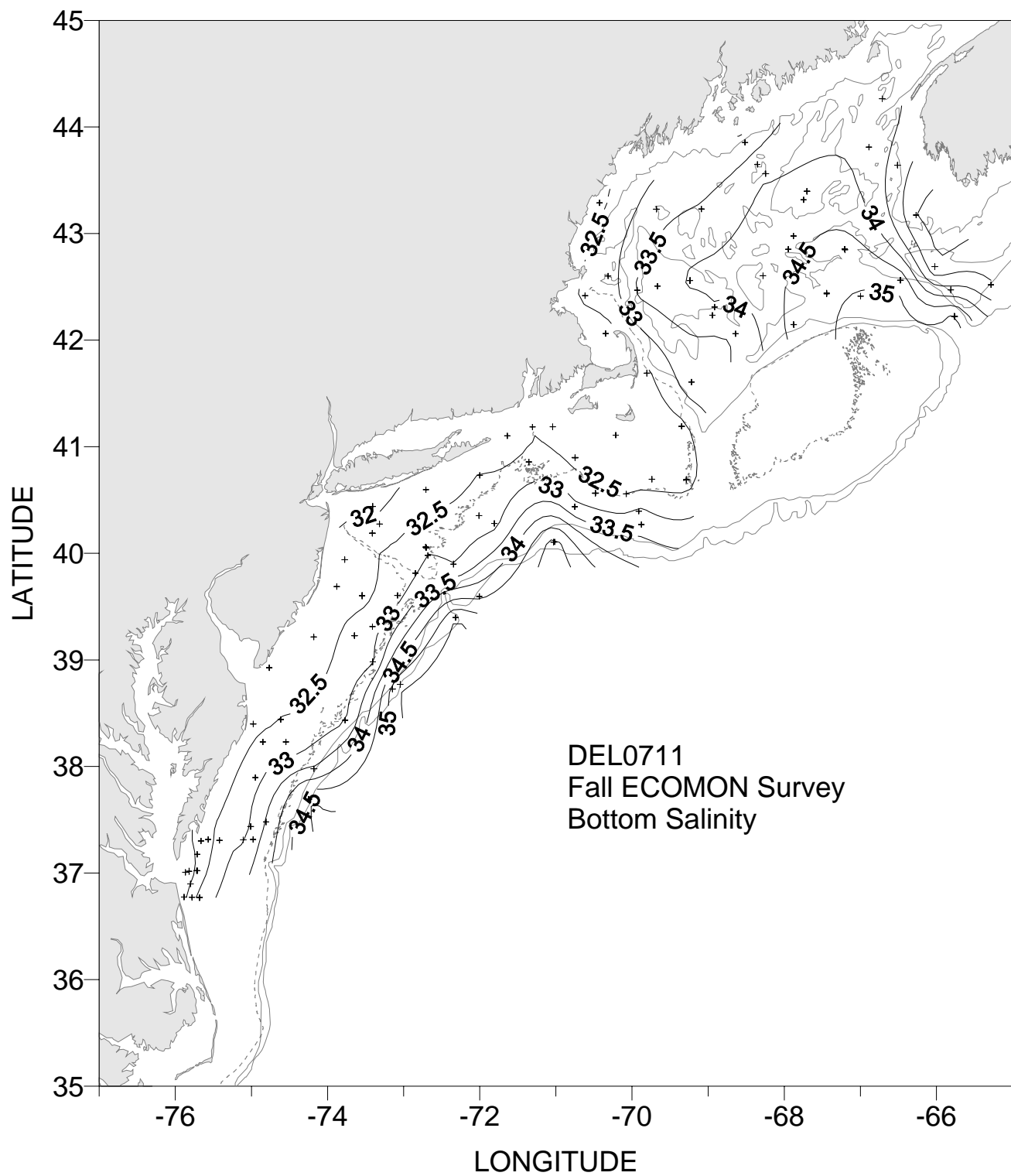


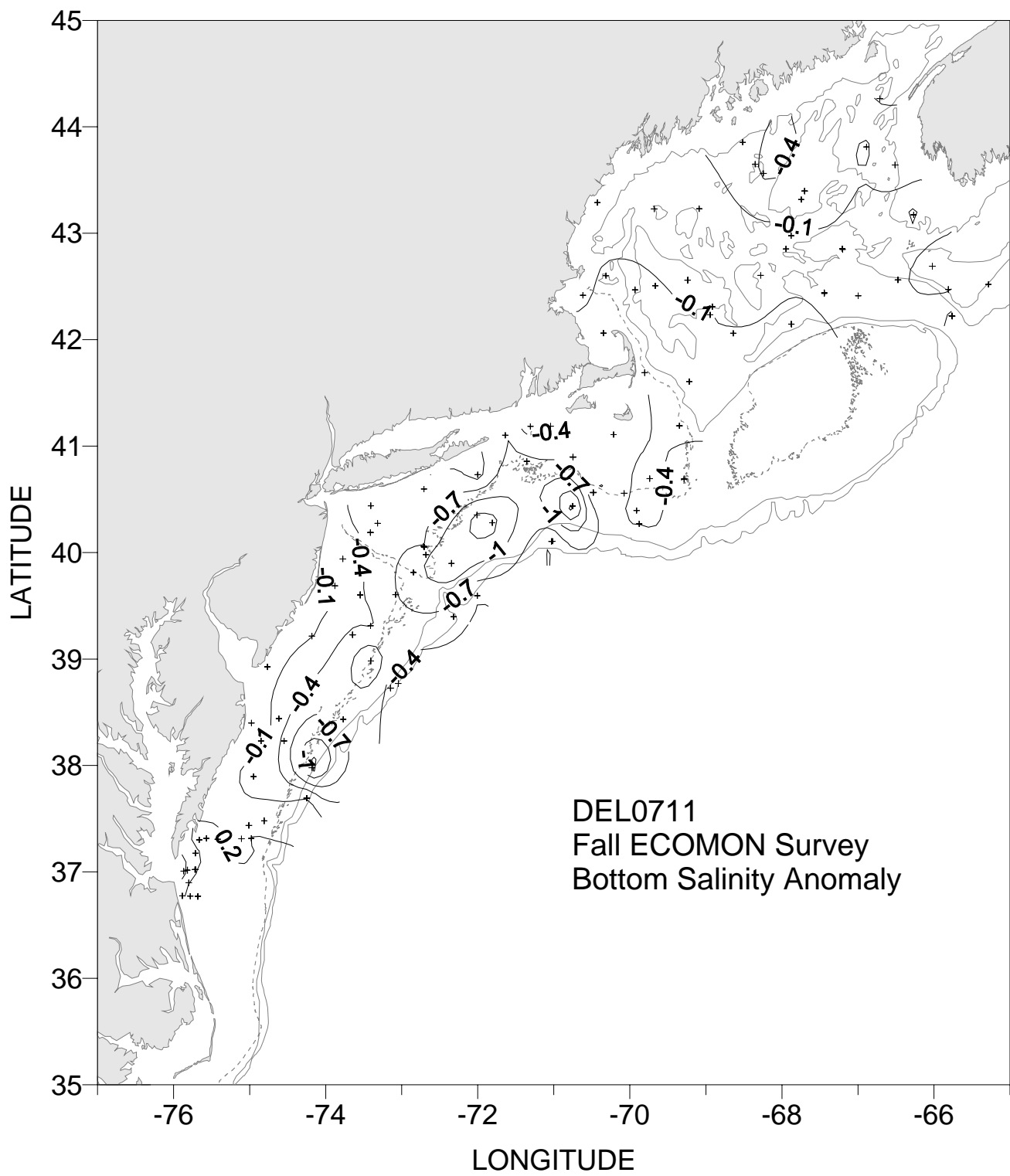












DEL0711 Fall Ecomon Survey
29 October - 15 November, 2007

Cast #	Sta #	Lat	Long	Day	Mo	Yr	Time (GMT)	Btm Depth	Sfc Temp	Sfc Salt	Btm Temp	Btm Salt	Meters from Bottom
1	1	4111.2	7102.5	29	10	2007	20:13	31	15.12	32.27	14.96	32.29	3
2	2	4111.1	7118.4	29	10	2007	21:36	41	15.58	32.23	13.09	32.49	5
3	3	4106.1	7138.3	29	10	2007	23:25	32	15.11	32.05	15.12	32.06	5
4	4	4051.5	7121.3	30	10	2007	1:28	59	15.11	32.41	10.64	32.68	5
5	5	4043.9	7200.0	30	10	2007	4:33	45	15.85	32.14	13.33	32.54	4
6	6	4006.4	7101.0	30	10	2007	10:21	159	14.91	32.86	14.92	32.86	144
7	6	4006.3	7101.9	30	10	2007	10:28	165	14.93	32.87	10.71	35.25	4
8	7	3953.7	7200.4	30	10	2007	15:23	98	14.69	32.44	10.75	34.45	5
9	8	3953.9	7220.7	30	10	2007	17:16	77	15.78	32.68	9.16	33.00	6
10	9	4003.6	7242.6	30	10	2007	19:36	57	16.86	32.73	16.74	32.73	31
11	9	4003.4	7242.5	30	10	2007	19:40	57	16.85	32.73	10.06	32.97	5
12	9	4003.2	7242.3	30	10	2007	19:51	57	16.82	32.73	10.05	32.97	3
13	9	4003.2	7242.3	30	10	2007	20:07	57	16.82	32.72	10.02	32.97	8
14	10	3958.8	7240.9	30	10	2007	20:43	57	16.55	32.66	9.90	33.02	4
15	11	3948.8	7250.7	30	10	2007	22:06	63	16.55	32.95	9.40	32.98	4
16	12	3923.8	7219.0	31	10	2007	1:37	155	15.16	32.61	12.73	35.53	5
17	13	3858.9	7324.4	31	10	2007	7:15	61	17.09	32.79	9.27	32.90	4
18	14	3846.2	7302.7	31	10	2007	9:21	192	16.73	33.20	11.21	35.39	5
19	15	3843.7	7308.8	31	10	2007	10:19	122	16.94	33.28	17.28	33.40	103
20	15	3843.6	7308.8	31	10	2007	10:25	123	16.96	33.29	12.94	35.34	5
21	16	3826.0	7346.1	31	10	2007	13:49	68	16.34	32.92	9.00	32.95	4
22	17	3758.7	7410.8	31	10	2007	17:16	86	18.99	33.01	9.69	33.55	4
23	18	3741.5	7414.9	31	10	2007	19:13	126	19.82	33.76	19.80	33.83	102
24	18	3741.6	7414.8	31	10	2007	19:19	128	19.96	33.80	12.95	35.06	6
25	19	3728.8	7448.5	31	10	2007	22:25	48	18.89	33.13	18.88	33.57	4
26	20	3726.2	7500.6	31	10	2007	23:31	33	19.86	32.91	19.51	33.04	4
27	21	3718.9	7458.7	1	11	2007	0:26	42	19.80	32.92	19.13	33.33	6
28	22	3718.7	7506.4	1	11	2007	1:15	31	19.46	32.96	19.35	32.96	4
29	23	3718.4	7525.2	1	11	2007	2:58	25	20.26	32.33	19.95	32.87	3
30	24	3718.9	7534.1	1	11	2007	3:54	17	20.25	32.16	20.25	32.17	4
31	25	3718.1	7539.7	1	11	2007	4:35	13	19.69	32.35	19.70	32.34	2
32	26	3710.5	7542.7	1	11	2007	5:41	14	20.01	32.06	20.00	32.07	4

Cast #	Sta #	Lat	Long	Day	Mo	Yr	Time (GMT)	Btm Depth	Sfc Temp	Sfc Salt	Btm Temp	Btm Salt	Meters from Bottom
33	27	3700.4	7552.0	1	11	2007	7:39	11	19.15	28.59	20.13	31.51	3
34	28	3701.0	7549.1	1	11	2007	8:03	13	19.24	29.11	20.50	31.80	4
35	29	3701.3	7543.2	1	11	2007	8:38	17	20.48	31.94	20.58	32.04	5
36	29	3701.3	7542.6	1	11	2007	8:55	17	20.47	31.95	20.62	32.18	5
37	30	3653.9	7548.0	1	11	2007	10:01	15	20.18	31.32	20.66	32.04	4
38	31	3646.5	7553.1	4	11	2007	16:28	15	18.16	31.69	18.25	31.91	4
39	32	3646.3	7546.8	4	11	2007	17:16	19	19.22	32.32	19.10	32.33	5
40	33	3646.3	7540.7	4	11	2007	18:01	21	19.21	32.71	19.04	32.73	4
41	33	3646.1	7540.9	4	11	2007	18:12	21	19.24	32.68	19.02	32.73	4
42	34	3753.7	7456.9	5	11	2007	1:49	25	17.50	32.79	17.64	32.89	4
43	35	3813.8	7432.8	5	11	2007	4:41	41	16.64	32.58	16.68	32.58	5
44	36	3813.8	7451.0	5	11	2007	6:18	27	17.38	32.70	17.39	32.70	3
45	37	3823.9	7458.6	5	11	2007	7:37	20	16.50	31.93	16.90	32.28	4
46	38	3826.4	7436.9	5	11	2007	9:33	30	16.92	32.54	16.82	32.54	5
47	39	3855.6	7445.9	5	11	2007	12:36	15	15.12	32.05	15.42	32.20	4
48	39	3855.5	7445.9	5	11	2007	12:43	14	14.75	31.68	15.39	32.17	3
49	40	3912.9	7410.9	5	11	2007	16:06	27	16.67	32.31	16.61	32.32	4
50	41	3913.7	7338.7	5	11	2007	18:46	45	15.79	32.59	15.59	32.64	22
51	41	3913.6	7338.7	5	11	2007	18:52	46	15.85	32.57	15.36	32.73	4
52	42	3918.7	7324.6	5	11	2007	20:16	48	15.73	32.76	15.33	32.84	3
53	43	3936.3	7304.8	5	11	2007	22:37	46	14.85	32.82	14.47	32.82	3
54	44	4035.8	7242.4	8	11	2007	6:01	37	14.57	32.21	14.60	32.27	5
55	45	4026.4	7324.4	8	11	2007	9:22	29	13.91	31.79	14.03	31.85	6
56	46	4016.5	7319.0	8	11	2007	10:40	37	14.76	32.21	14.77	32.21	5
57	47	4011.3	7324.6	8	11	2007	11:33	38	14.25	32.05	14.26	32.05	21
58	47	4011.3	7324.7	8	11	2007	11:38	39	14.27	32.06	15.03	32.49	6
59	48	3956.4	7346.5	8	11	2007	14:30	28	15.32	32.28	15.32	32.28	3
60	49	3941.3	7352.7	8	11	2007	16:10	28	15.30	32.29	15.30	32.29	5
61	50	3936.2	7332.7	8	11	2007	18:04	38	15.33	32.33	15.19	32.37	10
62	50	3936.1	7332.7	8	11	2007	18:10	38	15.32	32.34	15.12	32.40	3
63	51	4021.2	7200.6	9	11	2007	2:49	63	13.24	32.41	10.55	32.77	3
64	52	4016.8	7148.5	9	11	2007	3:58	75	13.30	32.42	9.89	32.86	5
65	53	4026.2	7045.1	9	11	2007	9:10	82	12.42	32.47	10.00	33.11	5
66	54	4033.8	7028.9	9	11	2007	10:55	64	12.36	32.35	12.36	32.35	47
67	54	4033.9	7028.8	9	11	2007	11:01	64	12.37	32.35	12.07	32.64	4
68	55	4106.5	7012.8	9	11	2007	14:34	26	11.95	32.10	11.88	32.10	5

Cast #	Sta #	Lat	Long	Day	Mo	Yr	Time (GMT)	Btm Depth	Sfc Temp	Sfc Salt	Btm Temp	Btm Salt	Meters from Bottom
69	56	4053.8	7044.8	9	11	2007	17:28	52	13.17	32.33	12.92	32.37	21
70	56	4053.9	7044.9	9	11	2007	17:32	52	13.13	32.33	12.93	32.37	1
71	57	4203.7	7020.8	10	11	2007	2:37	57	10.85	31.95	10.04	32.25	3
72	58	4225.0	7037.0	10	11	2007	5:46	85	10.32	32.16	8.26	32.59	4
73	59	4236.1	7018.9	10	11	2007	8:18	122	10.24	32.56	7.94	32.76	3
74	60	4317.3	7025.6	10	11	2007	14:46	28	9.57	32.38	9.58	32.39	5
75	61	4228.1	6955.9	10	11	2007	20:25	174	10.50	32.52	6.16	33.62	3
76	62	4230.4	6939.9	11	11	2007	0:09	245	10.23	32.63	6.57	34.05	43
77	63	4313.7	6940.8	11	11	2007	8:31	107	9.49	32.78	7.17	33.29	6
78	64	4313.8	6905.3	11	11	2007	12:22	136	8.83	32.86	7.14	33.56	9
79	65	4351.3	6830.9	11	11	2007	19:47	114	8.99	32.84	8.84	33.02	14
80	66	4338.9	6821.2	11	11	2007	21:25	186	8.71	32.91	6.79	33.99	5
81	67	4333.7	6814.7	11	11	2007	22:37	182	8.58	32.89	6.58	33.94	4
82	68	4319.0	6744.8	12	11	2007	1:46	263	9.55	32.76	6.92	34.19	64
83	69	4323.9	6742.1	12	11	2007	3:01	249	9.46	32.75	6.95	34.20	5
84	69	4323.7	6742.1	12	11	2007	3:19	251	9.47	32.75	6.93	34.18	50
85	70	4348.6	6653.3	12	11	2007	9:26	145	8.17	32.62	7.44	33.86	4
86	71	4415.9	6642.8	12	11	2007	13:03	186	8.37	32.68	7.21	33.83	5
87	72	4338.5	6630.7	12	11	2007	17:47	114	7.92	32.40	7.94	32.50	74
88	72	4338.5	6630.7	12	11	2007	17:52	113	7.90	32.44	8.00	33.24	6
89	73	4310.4	6616.1	12	11	2007	20:43	98	7.65	31.79	7.82	32.51	5
90	74	4241.4	6601.3	12	11	2007	23:55	76	7.87	31.71	6.99	32.56	5
91	75	4231.2	6517.1	13	11	2007	3:47	105	8.50	31.60	4.70	33.05	3
92	76	4213.5	6546.0	13	11	2007	7:00	224	12.59	33.54	9.24	35.13	4
93	76	4213.3	6545.7	13	11	2007	7:11	224	12.55	33.53	9.31	35.13	23
94	77	4228.3	6548.7	13	11	2007	9:34	102	8.57	31.67	7.27	33.66	4
95	78	4233.7	6628.6	13	11	2007	12:45	208	9.00	31.88	8.97	31.88	190
96	78	4233.7	6628.4	13	11	2007	12:51	208	8.80	31.93	7.75	34.93	5
97	79	4224.8	6659.8	13	11	2007	16:22	361	8.96	32.31	7.57	34.88	161
98	80	4251.3	6712.4	13	11	2007	20:13	240	8.76	32.46	7.80	34.72	5
99	80	4250.9	6712.1	13	11	2007	20:30	234	8.75	32.47	7.79	34.72	31
100	81	4226.5	6726.6	13	11	2007	23:23	312	9.41	32.69	7.56	34.88	5
101	81	4226.1	6726.6	13	11	2007	23:43	313	9.39	32.68	8.24	34.86	114
102	82	4258.6	6752.7	14	11	2007	3:46	191	9.25	32.87	7.19	34.31	5
103	83	4251.2	6756.8	14	11	2007	5:19	193	9.95	32.65	7.26	34.44	5
104	84	4236.2	6816.8	14	11	2007	8:04	183	9.88	32.51	6.91	34.27	5

Cast #	Sta #	Lat	Long	Day	Mo	Yr	Time (GMT)	Btm Depth	Sfc Temp	Sfc Salt	Btm Temp	Btm Salt	Meters from Bottom
105	85	4208.8	6752.7	14	11	2007	11:34	213	11.23	32.52	7.51	34.67	4
106	85	4208.7	6752.4	14	11	2007	11:48	209	11.34	32.53	7.47	34.64	8
107	86	4203.6	6838.4	14	11	2007	15:33	171	10.59	32.43	5.79	33.52	6
108	87	4214.0	6856.6	14	11	2007	17:28	178	10.44	32.43	5.93	33.60	4
109	88	4218.6	6854.9	14	11	2007	18:16	213	10.41	32.45	6.49	33.99	9
110	89	4233.5	6914.5	14	11	2007	20:52	225	9.40	32.77	6.61	34.07	3
111	89	4233.6	6914.2	14	11	2007	21:06	224	9.38	32.78	6.60	34.06	23
112	90	4141.4	6948.3	15	11	2007	3:46	41	9.64	32.37	9.70	32.40	4
113	91	4136.4	6913.1	15	11	2007	6:40	171	10.15	32.36	5.87	33.34	5
114	92	4111.5	6920.9	15	11	2007	9:38	54	10.08	32.38	10.07	32.38	4
115	93	4041.5	6917.2	15	11	2007	13:15	63	10.78	32.29	10.55	32.31	38
116	93	4041.5	6917.1	15	11	2007	13:21	53	10.78	32.29	10.47	32.31	1
117	94	4041.7	6944.3	15	11	2007	15:40	51	11.59	32.18	11.67	32.30	4
118	95	4016.2	6952.6	15	11	2007	18:47	86	11.92	32.46	11.17	33.31	5
119	96	4023.7	6954.7	15	11	2007	19:51	78	11.97	32.55	11.01	33.15	4
120	97	4033.4	7004.5	15	11	2007	21:23	60	12.16	32.11	12.14	32.46	4