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SHELF OBSERVATIONS - HYDROGRAPHY
CRUISE OF AUGUST 21-26, 1962

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1964

Virginia Institute of Marine Science
Gloucester Point, Virginia

SHELF OBSERVATIONS - HYDROGRAPHY
CRUISE OF AUGUST 21-26, 1962

M. M. Nichols and R. C. Barnes

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W. J. Hargis, Jr.
Director

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SHELF OBSERVATIONS HYDROGRAPHY

Cruise of August 21-26, 1962

Hydrographic observations were made on the continental shelf off Chesapeake Bay, August 21-26, 1962. The observations were part of a continuing study to investigate physical and chemical characteristics of shelf water.

METHODS

Stations were established at 10-mile intervals along traverses 20 miles apart (Fig. 1). On the outer shelf stations were made at 3 to 5 mile intervals to obtain greater detail. Station numbers (e.g. 720-20) are derived from the latitude with the first digit taken from the degrees north of 30°N (e.g. 37°) and subsequent two digits obtained from minutes of latitude (e.g. $37^{\circ} 20'$, or 720). The second group of numerals, following a hyphen is derived from the distance in miles east of the 76° meridian of longitude through the mouth of Chesapeake Bay.

Observations consisted of: (1) Vertical profiles at fixed stations and (2) track measurements of surface water. Temperature and salinity were obtained in situ with an ICTI unit (induction conductivity temperature indicator) calibrated and adjusted to give readings with an accuracy of $\pm 0.02^{\circ}\text{C}$ and ± 0.05 ‰. ICTI profiles were supplemented with bathythermograph lowerings to 200 feet. Surface and bottom water samples were obtained with Nansen bottles. Chlorinity was determined by standard silver nitrate titrations and converted to salinity by the Knudsen equation. The chlorinity titrations provided a constant check on the electronic units and these data were used where necessary to correct values of the depth profiles. Oxygen concentrations were determined by the Winkler method. Drift bottles and Woodhead bottom drifters were released in groups of six on stations at 10 mile intervals. Time is reported in Eastern Standard Time.

RESULTS

The distributions of measured parameters, temperature, salinity and dissolved oxygen concentration, are presented in Figures 2-10. Table 1 lists data of the vertical profiles; Table 2 gives drift bottle results.

Temperature.---Vertical distributions (Fig. 2) depict: (1) a warm relatively homogeneous surface layer, (2) a zone of pronounced temperature change between 40 and 70 feet and (3) a cool lower layer. Vertical gradients were greatest in section 710 at about the 50 foot depth. The thermocline shoals slightly in each section at about 50 miles offshore. A minimum temperature of 9.60°C occurred in moderately stratified water near the shelf edge in section 700. Cool water, defined by the 12°C isotherm, was closer to the surface in the north (section 720) than in the south (section 700) (Figs. 2, 3).

Salinity.---Freshened water of 28-29 ‰ extended about 25 miles off the Chesapeake entrance, traverse 700 (Fig. 4). Over most of the shelf salinity varied within narrow limits, from 31 to 33 ‰ both on the surface and at 80 foot depth (Figs. 4, 5). In section 700 near the shelf edge saltier water intrudes landward in a slightly stratified layer (Fig. 6).

Density.---Vertical variations of density (σ_t) conform to patterns of temperature over most of the shelf, but within 35 miles of the Chesapeake entrance, section 700, they reflect the influence of salinity gradients (Fig. 7). Vertical gradients of temperature and salinity in the lower layer near the shelf edge, section 700, combine to produce better vertical stability than corresponding water to the north.

Oxygen.---Surface water contained a relatively high concentration of oxygen, 6.93 mg/L, off the Chesapeake entrance (station 700-20) and reduced values, down to 3.00 mg/L, offshore to the north (Fig. 8). A minimal value, 2.96 mg/L, occurred in bottom water near the outer shelf, traverse 710 (Fig. 9). No close relation is apparent between patterns of oxygen and

temperature or salinity.

Circulation.--Sloping isocynals of the vertical density distribution (Fig. 7) suggest a weak southerly flow below the thermocline. Drift bottle recoveries, which reached 31 percent, suggest a southerly flow (Fig. 1) on the surface. Bottles released at offshore stations show greater dispersal than those of the inner shelf.

The cool water (12°C) near the shelf edge is apparently related to shelf water as evidenced by its relatively low salinity. Low temperature may have been inherited by cooling on the shelf during the previous winter season.

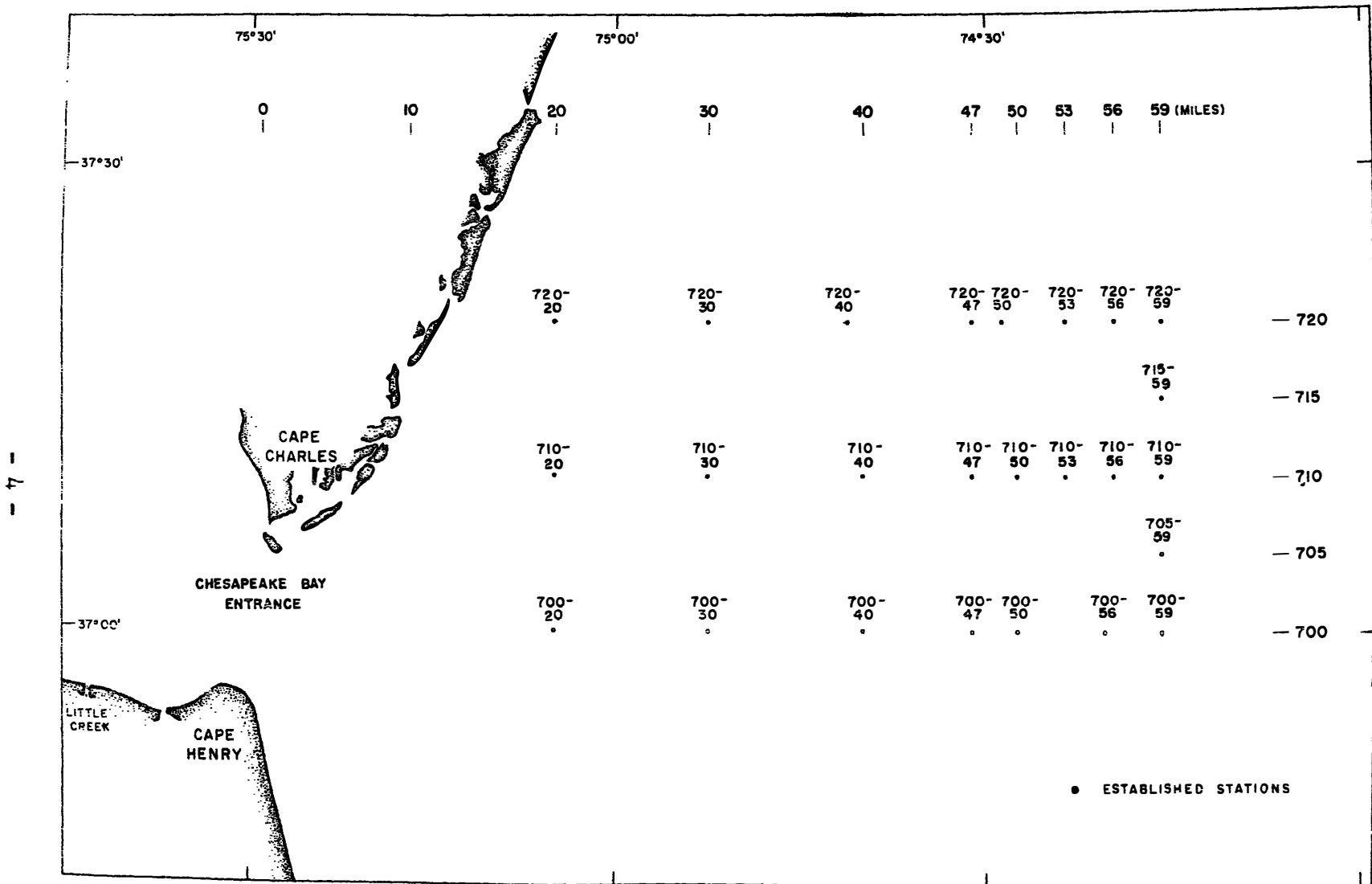


Fig. 1 Location of stations, cruise of Aug. 21-26, 1962.

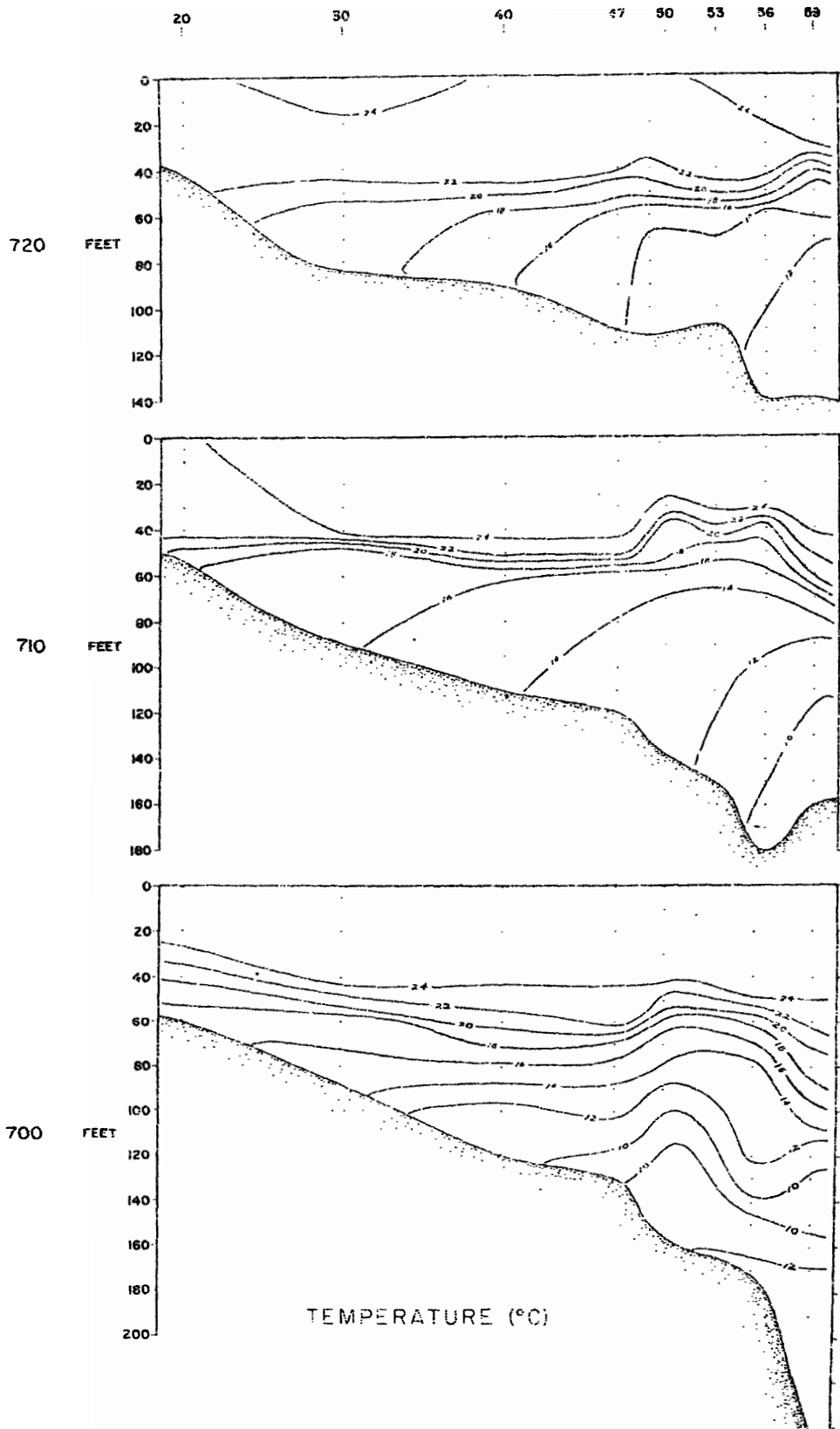


Fig. 2 Vertical distribution of temperature, °C, August 21-25, 1962.

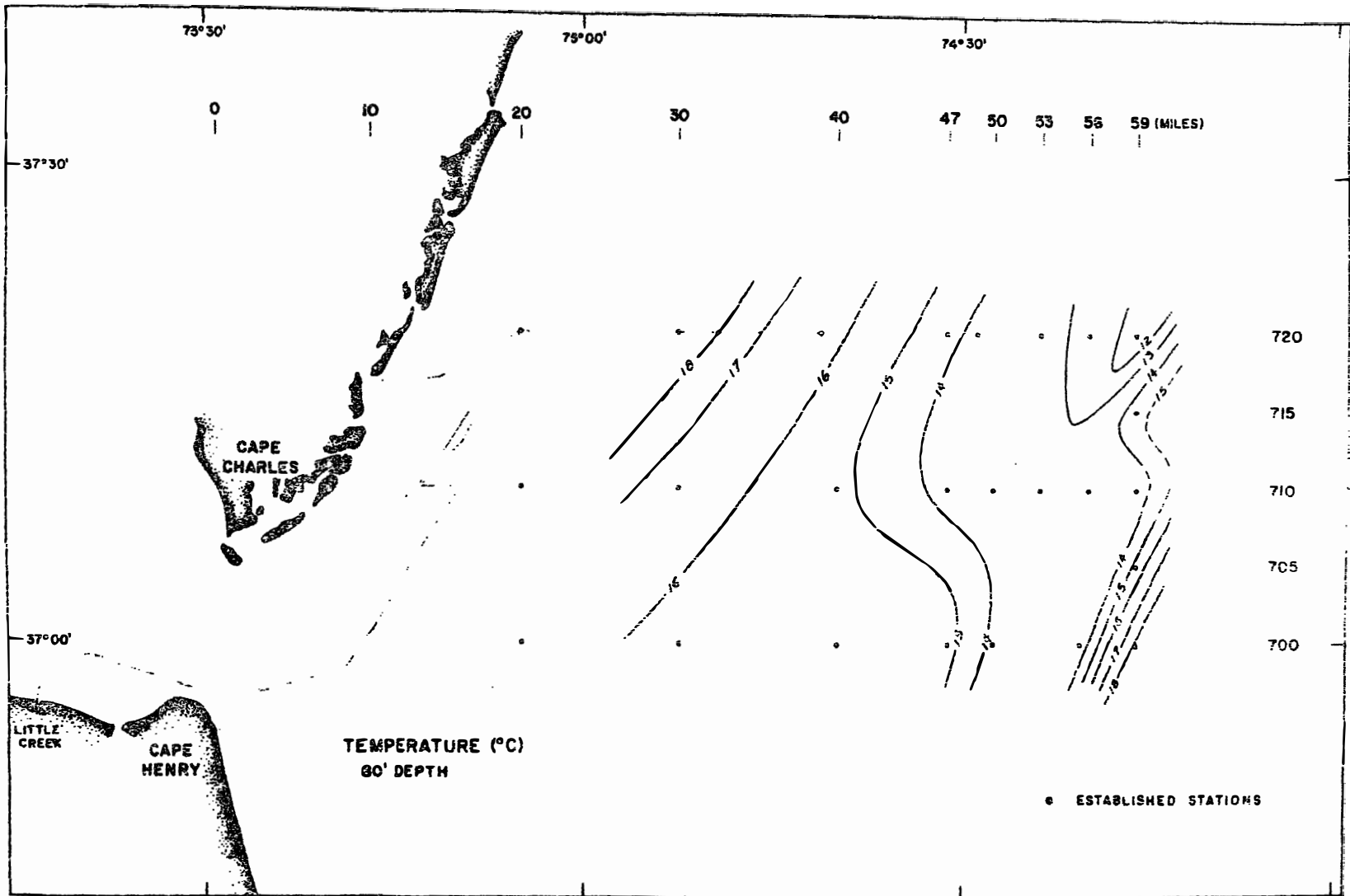


Fig. 3 Distribution of temperature at 80 feet, °C, August 21-25, 1962.

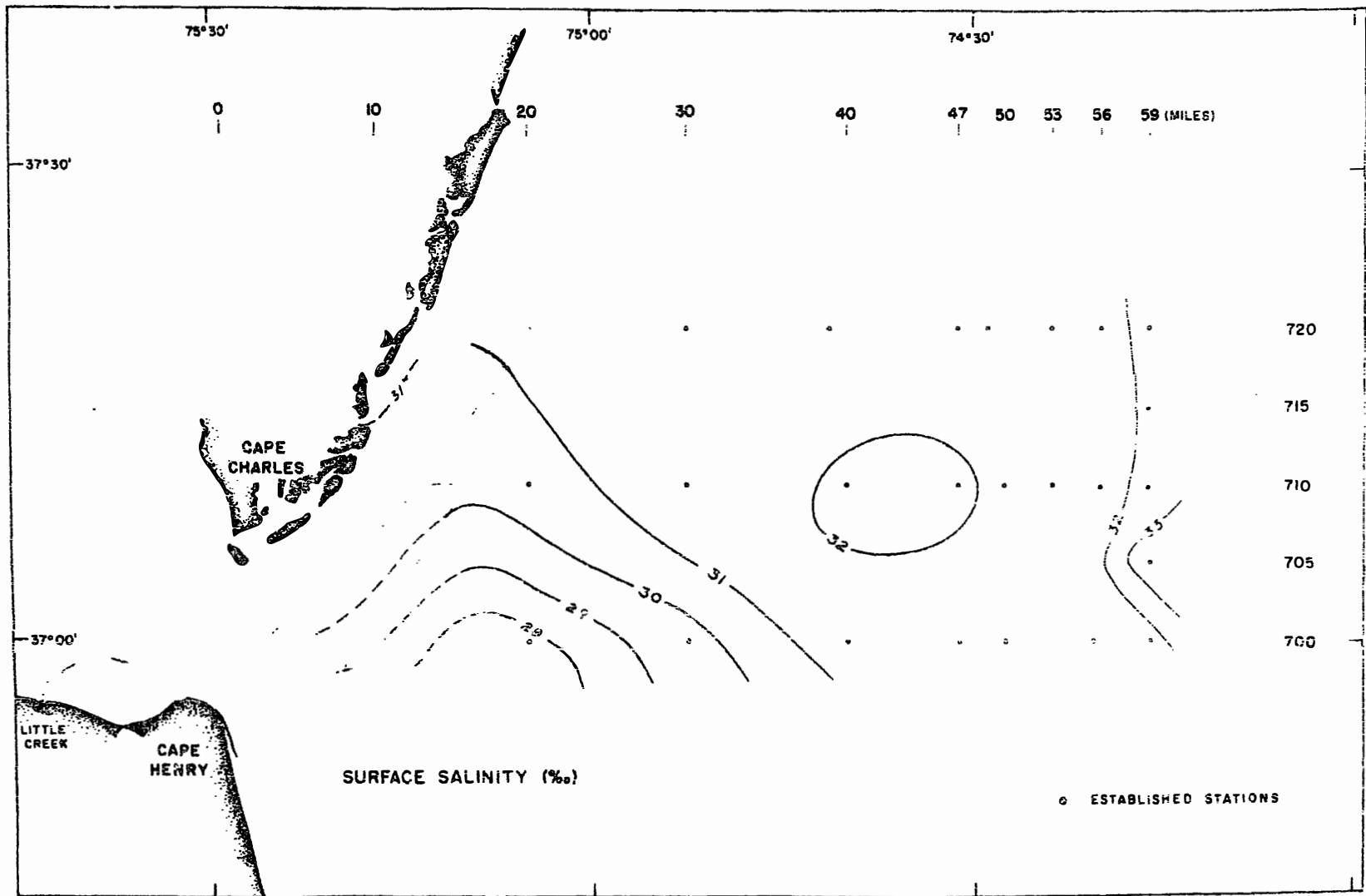


Fig. 4 Surface distribution of salinity, ‰, August 21-25, 1962.

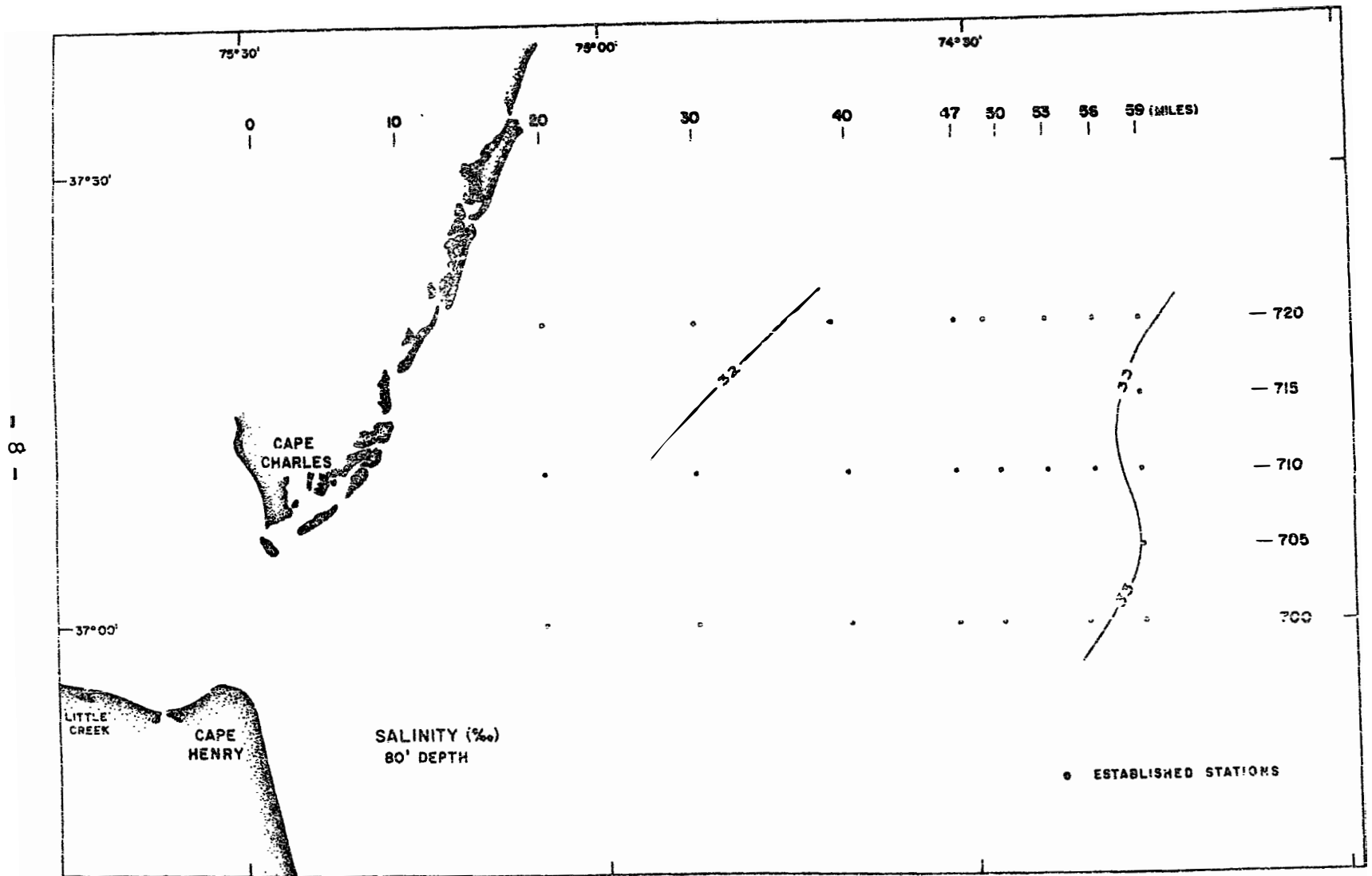


Fig. 5 Distribution of salinity at 80 feet, o/oo, August 21-25, 1962.

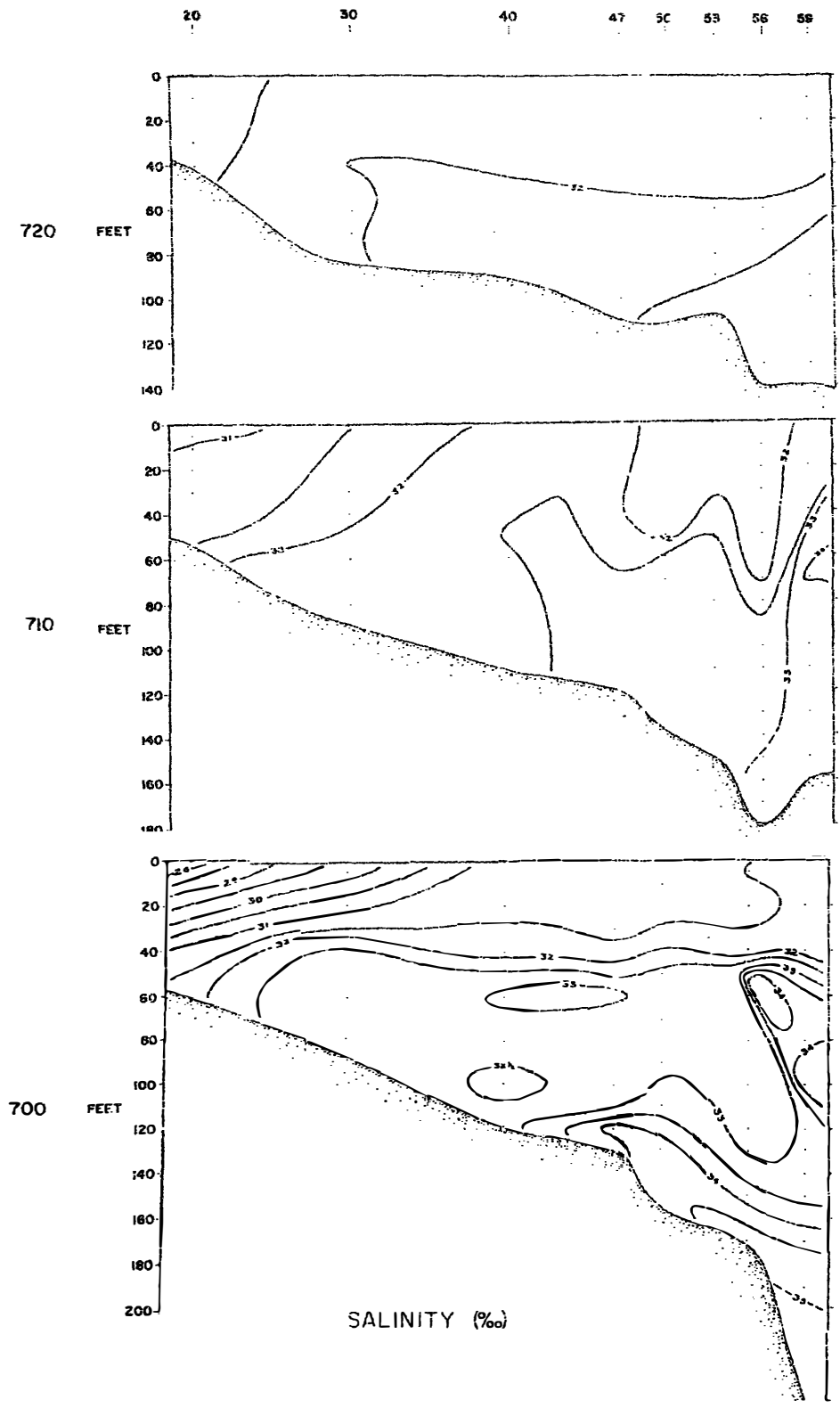


Fig. 6 Vertical distribution of salinity, ‰, August 21-25, 1962.

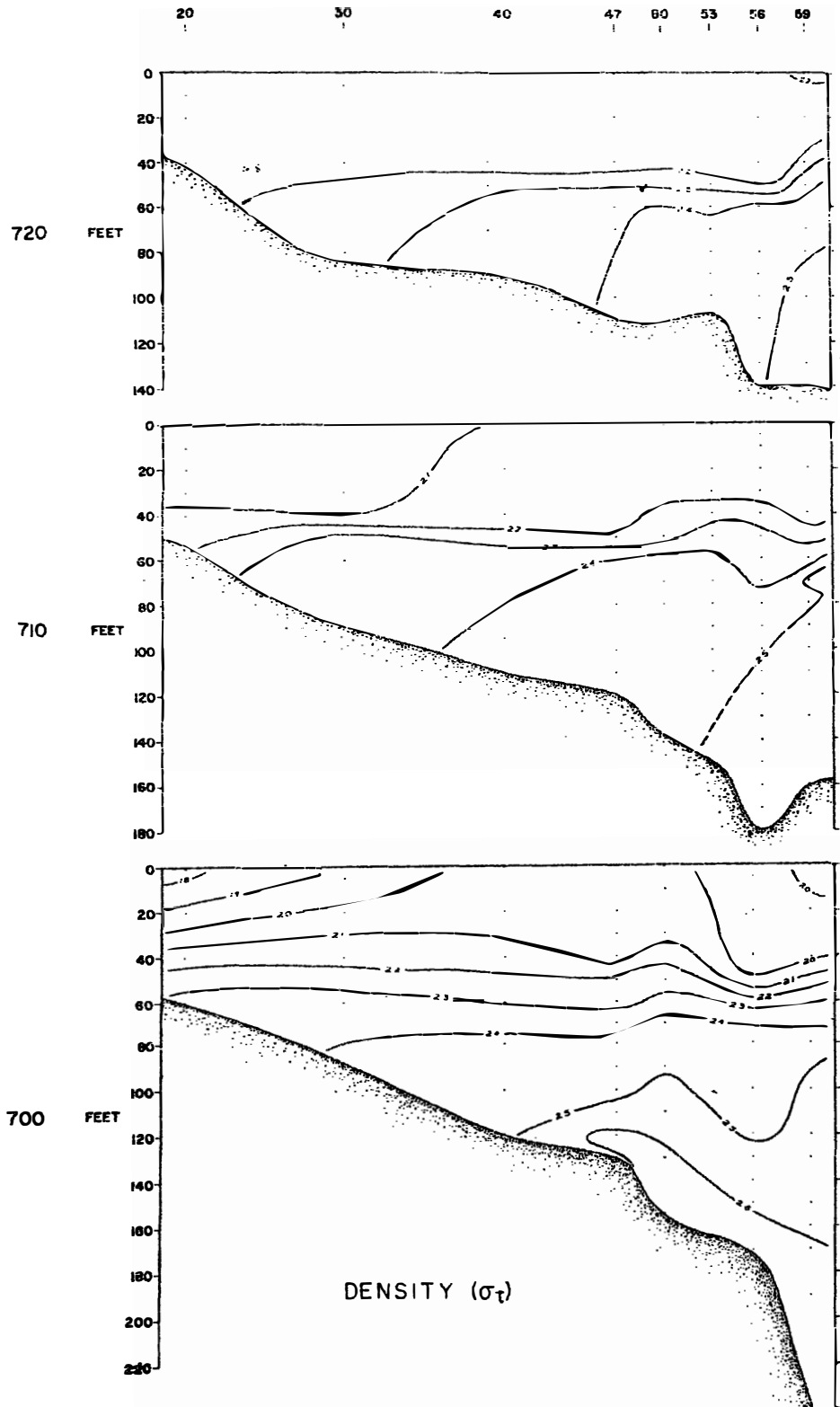


Fig. 7. Vertical distribution of density, Sigma t, August 21-25, 1962.

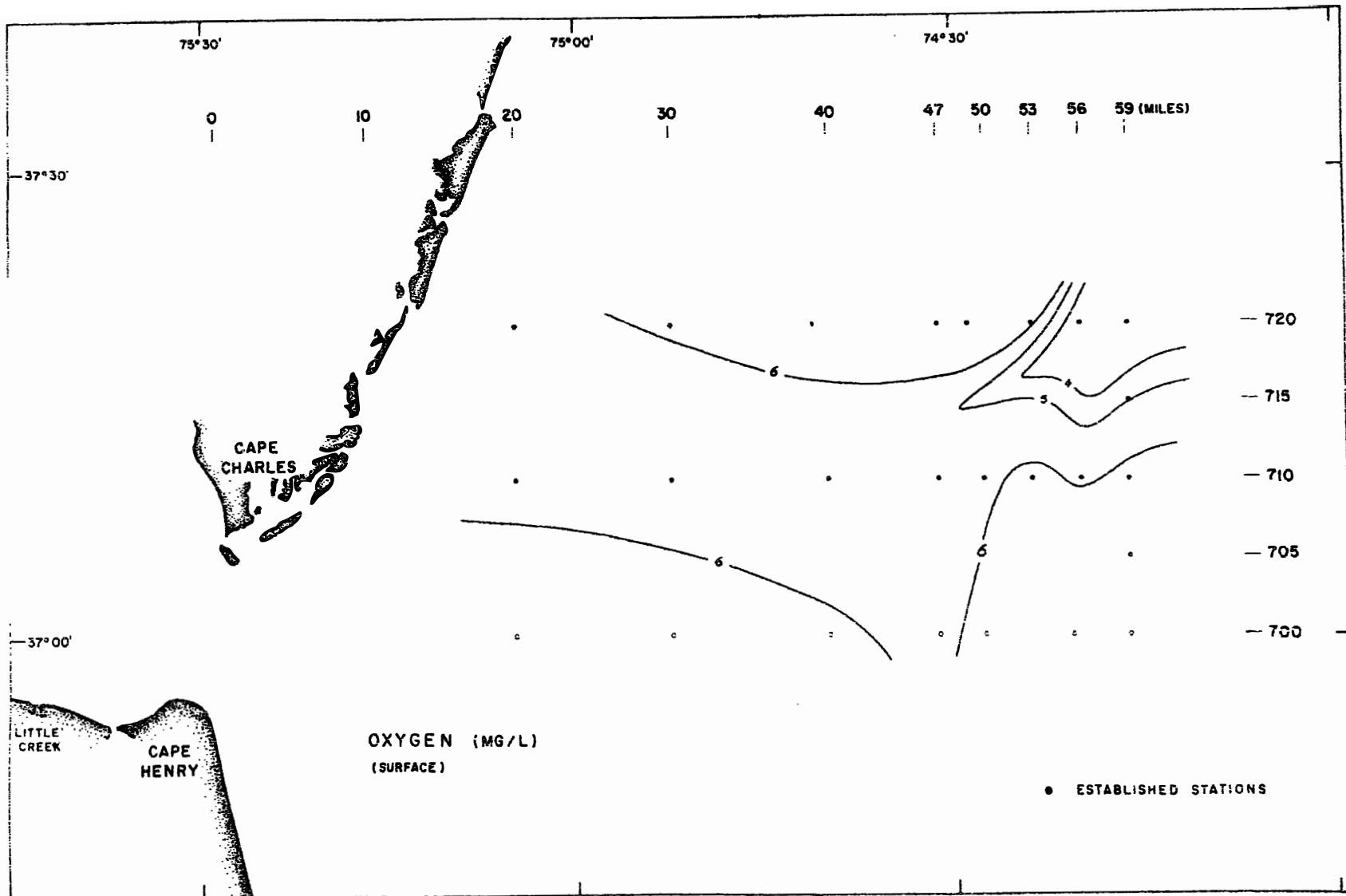


Fig. 8 Surface distribution of oxygen, mg/l; August 21-25, 1962.

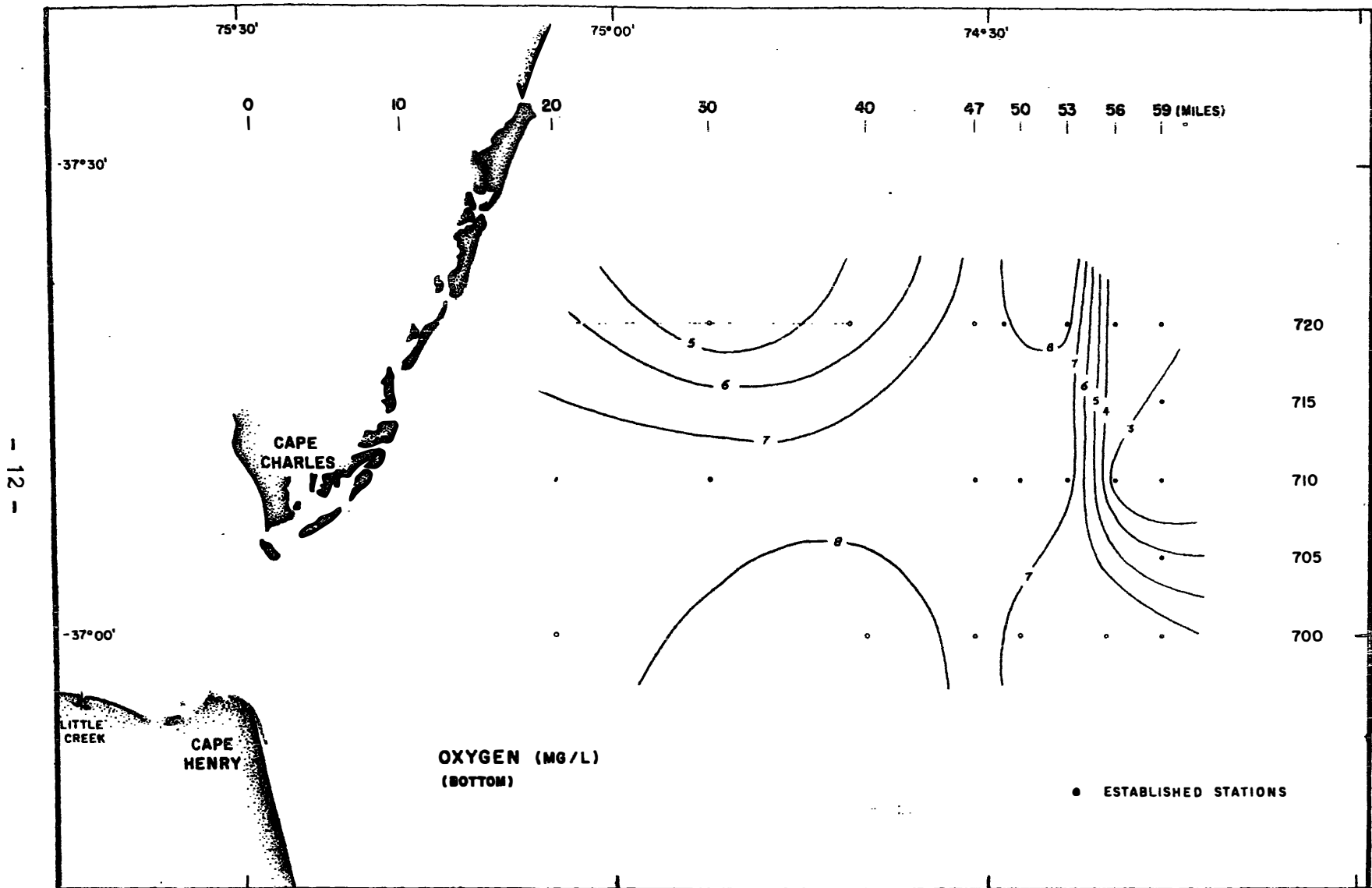


Fig. 9 Bottom distribution of oxygen, mg/l; August 21-23, 1962.

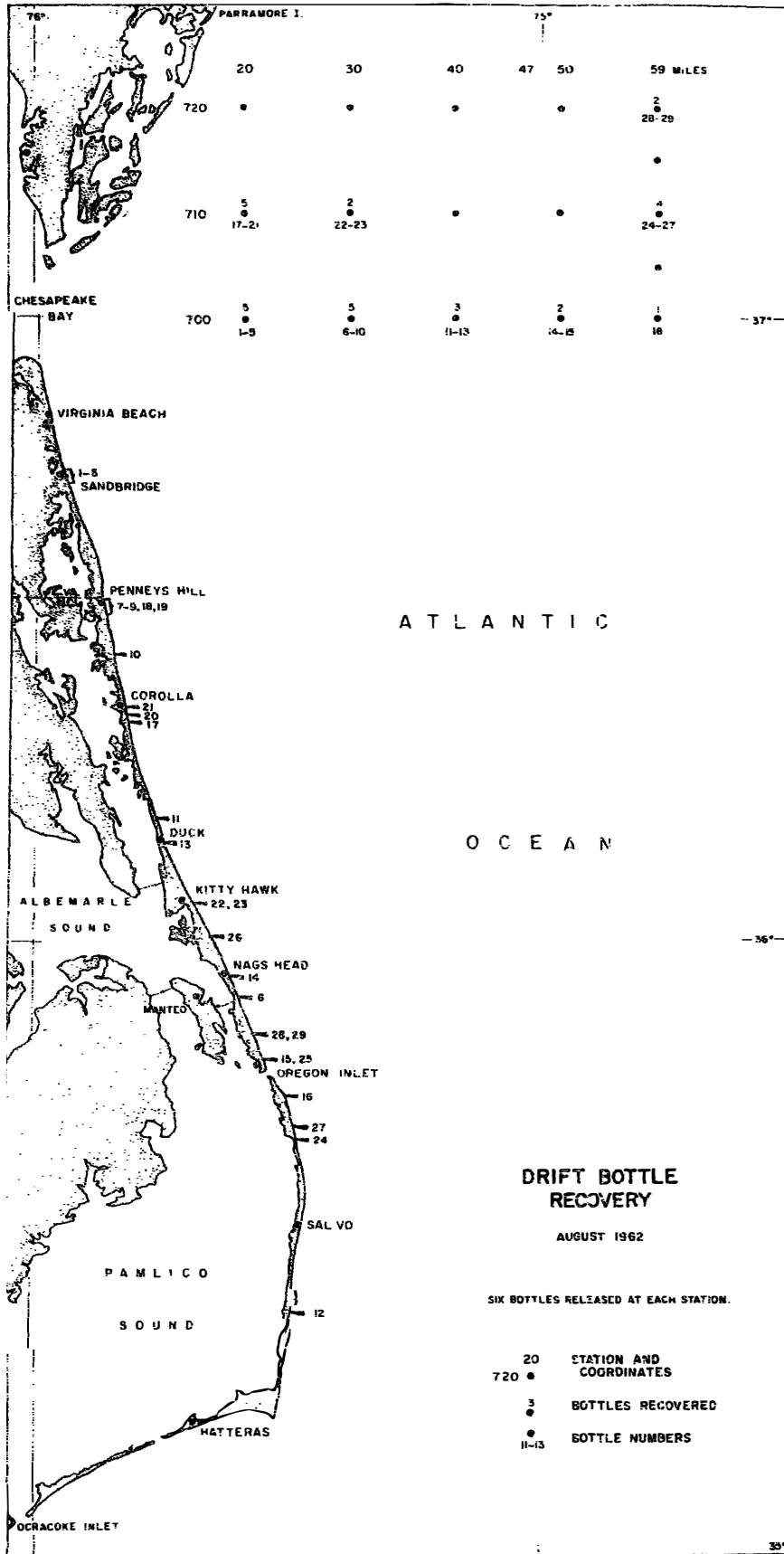


Fig. 10 Location of drift bottle releases and recovery, August 21-25, 1962.

TABLE I - DEPTH PROFILES

	DEPTH (Feet)	TEMPERATURE (°C)	SALINITY (‰)	DENSITY (σ_t)	OXYGEN (mg/L)
700-20 21 Aug 1145 SW 10-15 KT	0	25.15	27.83	17.93	6.93
	20	25.26	29.50	19.16	
	40	20.45	31.06	21.67	
	61	16.52	31.92	23.29	7.79
700-30 21 Aug 1259 SW 10-15 KT	0	25.74	29.81	19.24	
	20	25.42	30.86	20.12	
	40	24.54	32.68	21.75	
	60	17.76	32.58	23.50	
	80	15.82	32.62	23.98	8.05
700-40 21 Aug 1437 SW 10-15 KT	0	25.50	31.27	20.43	6.32
	20	25.36	31.31	20.71	
	40	24.55	31.88	21.16	
	60	21.00	33.05	23.00	
	80	15.14	32.74	24.22	
	100	11.50	32.43	24.71	
	120	10.96	32.63	24.94	8.66
700-47 21 Aug 1549 SW 10-15 KT	0	25.64	31.52	20.54	5.65
	20	25.55	31.31	20.41	
	30	25.36	31.38	20.54	
	40	24.96	31.58	20.80	
	50	22.20	32.34	22.14	
	60	22.22	33.03	22.67	
	70	17.20	32.53	23.60	
	80	15.32	32.71	24.16	
	90	13.50	32.57	24.43	
	100	12.58	32.79	24.79	
	110	11.00	32.97	25.24	
	120	9.44	34.13	26.39	
	130	9.84	33.52	25.83	7.54

TABLE I (cont.)

	DEPTH (Feet)	TEMPERATURE (°C)	SALINITY (‰)	DENSITY (σ_t)	OXYGEN (mg/L)	
700-50 21 Aug 1632 SW 10-15 KT	0	25.55	31.37	20.47	6.37	
	10	25.55	31.37	20.47		
	30	25.24	31.52	20.68		
	50	21.25	32.58	22.62		
	70	14.75	32.65	24.24		
	90	11.90	32.74	24.89		
	110	9.60	33.27	25.69		
	130	11.42	34.27	26.16		
	155	11.58	34.37	26.20	6.77	
700-55 21 Aug 1725 SW 15 KT	0	25.60	31.51	19.53	6.46	
	20	25.52	31.12	19.52		
	40	25.20	31.79	19.68		
	60	18.34	34.02	20.98		
	80	13.54	32.69	23.84		
	100	12.96	32.76	24.70		
	120	12.04	32.76	24.87		
	130	10.80	32.93	24.23		
	140	9.88	33.23	25.62		
	150	10.48	33.76	25.93		
	170	12.40	34.90	26.46	-	
	700-59 21 Aug 1830 S 15 KT	0	25.44	31.66	20.72	-
		20	25.38	31.67	19.61	
40		25.14	31.86	19.70		
60		22.85	33.66	22.99		
80		18.90	33.85	24.20		
100		15.10	34.27	25.41		
120		10.30	33.05	25.41		
130		9.94	33.29	25.66		
140		9.80	33.39	25.76		
150		9.78	33.41	25.79		
160		10.52	33.70	25.88		
170		12.28	34.43	26.12		
190		12.54	34.96	26.46	6.36	

TABLE I (cont.)

	DEPTH (feet)	TEMPERATURE (°C)	SALINITY (‰)	DENSITY (σ_t)	OXYGEN (mg/L)
705-59 21 Aug 1930 SW 15 KT	0	25.38	31.98	20.97	-
	20	25.38	32.09	21.06	
	40	25.14	32.08	21.13	
	60	19.58	33.46	23.73	
	70	18.46	34.15	24.54	
	80	15.80	33.01	24.29	
	90	17.48	34.72	25.22	
	100	14.68	35.10	26.15	
	120	11.34	33.36	25.47	
	140	10.02	33.43	25.76	
	160	10.24	33.27	25.59	
180	9.76	33.29	25.69		
200	10.36	33.31	25.60	-	
710-20 26 Aug 0117 E 5 KT	0	23.78	30.49	20.33	5.68
	10	23.78	31.04	20.75	
	20	23.79	31.03	20.73	
	30	23.40	31.02	20.83	
	40	23.00	31.21	21.10	-
710-30 25 Aug 2356 E 5 KT	0	24.54	31.49	20.85	5.42
	20	24.54	31.55	20.90	
	30	24.52	31.57	20.93	
	40	24.36	31.62	21.01	
	50	16.60	32.14	23.44	
	60	16.44	32.08	23.44	
	80	16.28	32.14	23.51	7.32

TABLE I (cont.)

	DEPTH (feet)	TEMPERATURE (°C)	SALINITY (‰)	DENSITY (σ_t)	OXYGEN (mg/L)
710-40 25 Aug 2236 E 5 KT	0	24.92	31.17	21.26	-
	20	24.92	32.06	21.18	
	40	24.86	32.22	21.32	
	50	22.08	32.67	22.45	
	60	16.06	32.33	23.71	
	80	15.14	32.47	24.02	
	95	14.98	32.42	24.01	7.21
710-47 25 Aug 2121 E 5 KT	0	24.72	32.24	21.37	5.37
	10	24.74	32.22	21.36	
	30	24.68	32.12	21.29	
	40	24.62	32.07	21.27	
	50	22.62	32.41	22.11	
	60	15.16	32.41	23.97	
	80	13.94	32.65	24.42	
	100	13.90	32.65	24.43	
	110	13.88	32.68	24.45	-
710-50 25 Aug 2038 E 5 KT	0	24.54	31.67	20.99	5.79
	20	24.38	31.68	21.05	
	30	23.86	31.60	21.14	
	40	18.00	31.76	22.83	
	50	18.14	31.84	22.85	
	60	15.20	32.54	24.06	
	70	13.94	32.58	24.36	
	80	13.72	32.65	24.46	
	90	13.72	32.60	24.42	7.21

TABLE I (cont.)

	DEPTH (feet)	TEMPERATURE (°C)	SALINITY (‰)	DENSITY (σ_t)	OXYGEN (mg/L)
710-53 25 Aug 2000 E 5 KT	0	24.42	31.70	21.06	6.74
	20	24.38	31.75	21.10	
	30	24.22	31.76	21.16	
	40	21.26	32.42	22.49	
	50	16.42	32.48	23.74	
	70	13.52	32.69	24.53	
	80	13.50	32.69	24.54	
	90	13.48	32.69	24.54	
	100	13.44	32.70	24.56	
	110	13.32	32.66	24.55	7.67
710-56 25 Aug 1920	0	24.71	31.74	20.99	5.91
	10	24.71	31.81	21.05	
	20	24.68	31.79	21.04	
	30	24.26	31.71	21.11	
	40	18.50	31.64	22.61	
	50	17.28	31.87	23.08	
	60	15.22	31.83	23.51	
	70	13.75	31.95	23.92	
	80	13.32	32.28	24.65	
	90	12.39	32.53	24.63	
	100	11.33	32.70	24.96	
	110	11.02	32.74	25.04	
	120	10.82	32.84	25.15	
	130	10.81	32.87	25.18	
140	10.80	32.95	25.25	2.96	

TABLE I (cont.)

	DEPTH (Feet)	TEMPERATURE (°C)	SALINITY (‰)	DENSITY (σ_t)	OXYGEN (mg/L)
710-59 21 Aug 2125	0	24.92	32.21	21.29	6.45
	20	24.94	32.18	21.27	
	40	24.86	32.24	21.33	
	60	20.18	33.52	23.62	
	70	15.56	34.08	25.16	
	80	13.84	33.33	24.96	
	90	11.12	33.51	25.62	
	100	10.72	33.16	25.42	
	110	10.42	33.15	25.46	
	130	9.24	33.25	25.74	
	150	8.98	33.29	25.82	
	160	9.20	33.31	25.79	

715-59 21 Aug 2150 S 10-12 KT	0	25.36	32.11	21.08	..
	20	25.16	32.30	21.29	
	40	25.08	32.35	21.34	
	50	22.40	32.99	22.61	
	70	19.76	33.51	23.71	
	80	14.72	33.40	24.83	
	90	12.76	33.01	24.93	
	100	12.76	33.01	24.93	
	110	12.72	32.98	24.92	
	120	12.66	32.96	24.91	
	130	12.52	33.05	25.00	
	140	11.16	32.91	25.15	
	150	10.72	32.34	24.78	
	160	10.64	33.35	25.59	
	180	11.18	33.48	25.58	-

TABLE I (cont.)

	DEPTH (feet)	TEMPERATURE (°C)	SALINITY (‰)	DENSITY (σ_t)	OXYGEN (mg/L)
720-20 25 Aug 1032 E 10-15 KT	0	23.37	31.31	21.06	-
	10	23.31	31.29	21.07	
	20	23.23	31.29	21.09	
	30	23.14	31.32	21.14	
	40	22.83	31.38	21.28	6.47
720-30 25 Aug 1158 E 10-15 KT	0	24.08	31.82	21.25	6.05
	20	23.98	31.85	21.30	
	30	23.91	31.87	21.33	
	40	23.23	32.01	21.63	
	50	20.35	31.78	22.24	
	60	19.33	31.73	22.47	
	70	18.91	31.87	22.69	
	80	18.93	31.74	22.58	4.32
720-40 25 Aug 1318 E 10-15 KT	0	23.90	31.56	21.10	6.74
	20	23.70	31.58	21.17	
	40	23.64	31.58	21.19	
	50	21.00	32.76	22.82	
	60	16.24	32.07	23.47	
	70	16.18	32.07	23.49	
	90	16.14	32.13	23.54	5.58
720-47 25 Aug 1422 E 15 KT	0	23.56	31.53	21.18	6.53
	20	23.24	31.55	21.28	
	40	22.50	31.59	21.53	
	60	15.02	32.19	23.84	
	70	14.78	32.21	23.90	
	80	14.56	32.28	24.00	
	90	14.48	32.29	24.03	
	100	14.36	31.42	23.37	
	110	14.36	32.35	24.09	7.53

TABLE I (cont.)

	DEPTH (feet)	TEMPERATURE (°C)	SALINITY (‰)	DENSITY (σ_t)	OXYGEN (mg/L)
720-50	0	23.54	31.51	21.16	6.58
25 Aug	20	23.24	31.58	21.31	
1456	40	21.86	31.57	21.68	
E 15 KT	50	18.02	31.86	22.89	
	60	14.26	32.20	24.00	
	70	13.82	32.29	24.16	
	80	13.46	32.43	24.34	
	90	13.42	32.46	24.37	
	100	13.38	32.42	24.35	
	112	13.42	32.60	24.48	-
720-53	0	24.08	31.77	21.21	6.47
25 Aug	20	23.82	31.68	21.22	
1547	40	23.58	31.60	21.22	
E 15 KT	50	20.34	31.78	22.25	
	60	14.65	32.09	23.83	
	70	14.00	32.45	24.25	
	80	13.42	32.44	24.36	
	90	12.66	32.45	24.52	
	100	12.60	32.54	24.60	
	110	12.52	32.59	24.64	8.53

TABLE I (cont.)

	DEPTH (feet)	TEMPERATURE (°C)	SALINITY (‰)	DENSITY (σ_t)	OXYGEN (mg/L)
720-56 25 Aug 1630 E 15 KT	0	24.45	31.64	21.00	3.11
	10	24.42	31.63	21.00	
	20	24.03	31.70	21.17	
	30	23.87	31.66	21.18	
	40	23.79	31.83	21.33	
	50	19.46	31.14	21.99	
	60	13.90	32.20	24.08	
	70	12.97	32.34	24.37	
	80	12.75	32.50	24.54	
	90	12.75	32.50	24.54	
	100	12.32	32.58	24.68	
	110	11.73	32.60	24.81	
	120	11.75	32.64	24.83	
	130	11.80	32.64	24.82	
	140	11.81	32.75	24.90	3.63
720-59 25 Aug 1723	0	22.30	33.17	22.77	3.00
	10	24.29	31.57	21.00	
	20	24.10	31.63	21.09	
	30	24.03	31.79	21.23	
	40	18.78	31.75	22.63	
	50	14.93	32.00	23.71	
	60	14.18	32.36	24.14	
	70	12.66	32.49	24.55	
	80	11.42	32.67	24.91	
	90	10.68	32.75	25.11	
	100	10.75	32.86	25.19	
	110	10.61	32.76	25.13	
	120	10.56	32.84	25.20	
	130	10.57	32.82	25.18	
	140	10.56	32.89	25.24	3.21

TABLE II

DRIFT BOTTLE DATA

Assigned Number	Date and Time of Release	Station	Recovery Date	Recovery Location Geographic Coordinates	
1	8/21/62 1145	700 - 20	8/25/62	36°46.5'N	75°57.0'W
2	8/21/62 1145	700 - 20	8/25/62	36°46.5'N	75°57.0'W
3	8/21/62 1145	700 - 20	8/25/62	36°46.5'N	75°57.0'W
4	8/21/62 1145	700 - 20	8/29/62	36°45.5'N	75°56.7'W
5	8/21/62 1145	700 - 20	8/25/62	36°46.5'N	75°57.0'W
6	8/21/62 1259	700 - 30	8/31/62	35°57.0'N	75°37.0'W
7	8/21/62 1259	700 - 30	8/26/62	36°33.5'N	75°52.0'W
8	8/21/62 1259	700 - 30	8/26/62	36°33.0'N	75°51.5'W
9	8/21/62 1259	700 - 30	9/3/62	36°33.0'N	75°51.5'W
10	8/21/62 1259	700 - 30	8/24/62	36°31.5'N	75°51.5'W
11	8/21/62 1437	700 - 40	9/1/62	36°12.5'N	75°45.5'W
12	8/21/62 1437	700 - 40	9/15/62	35°23.5'N	75°29.0'W
13	8/21/62 1437	700 - 40	9/6/62	36°12.0'N	75°45.5'W
14	8/21/62 1632	700 - 50	10/20/62	35°57.5'N	75°37.0'W
15	8/21/62 1632	700 - 50	8/24/62	35°48.5'N	75°33.0'W
16	8/21/62 1830	700 - 59	10/7/62	35°45.0'N	75°30.0'W
17	8/26/62 0117	710 - 20	9/10/62	36°21.0'N	75°49.0'W
18	8/26/62 0117	710 - 20	9/8/62	36°32.0'N	75°51.5'W
19	8/26/62 0117	710 - 20	9/8/62	36°32.0'N	75°51.5'W
20	8/26/62 0117	710 - 20	9/10/62	36°20.0'N	75°49.0'W
21	8/26/62 0117	710 - 20	9/9/62	36°20.5'N	75°49.0'W
22	8/25/62 2356	710 - 30	9/22/62	36°04.0'N	75°41.5'W
23	8/25/62 2356	710 - 30	9/9/62	36°04.0'N	75°41.5'W
24	8/21/62 2025	710 - 59	9/19/62	35°39.5'N	75°28.5'W
25	8/21/62 2025	710 - 59	9/11/62	35°49.5'N	75°33.0'W
26	8/21/62 2025	710 - 59	9/23/62	36°01.0'N	75°39.0'W
27	8/21/62 2025	710 - 59	9/6/62	35°41.0'N	75°29.0'W
28	8/25/62 1723	720 - 59	9/24/62	35°53.0'N	75°35.5'W
29	8/25/62 1723	720 - 59	9/24/62	35°49.0'N	75°32.5'W