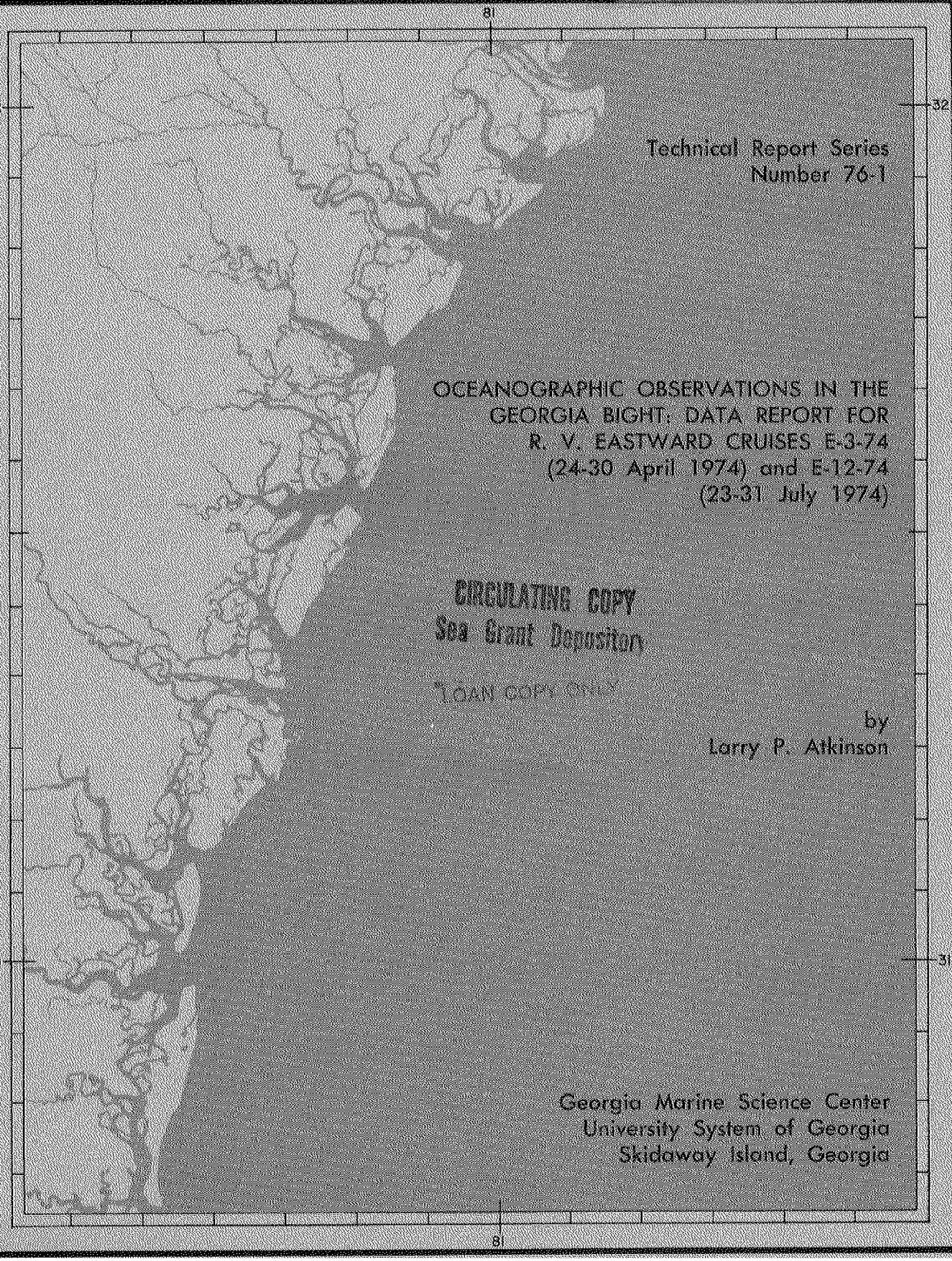

Technical Report Series
Number 76-1

OCEANOGRAPHIC OBSERVATIONS IN THE GEORGIA BIGHT: DATA REPORT FOR R. V. EASTWARD CRUISES E-3-74 (24-30 April 1974) and E-12-74 (23-31 July 1974)

by
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SRO-0639-19

MICROBIAL PROCESSES AND BIOMASS ON THE SOUTHEASTERN CONTINENTAL SHELF

Cruise Report, 1975-1976

U. S. Department of Energy Contract EY-76-S-09-0639

with The University of Georgia

Institute of Ecology
The University of Georgia
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June 1978

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INTRODUCTION

This report presents data collected on four reconnaisance cruises conducted in connection with study of the continental shelf ecosystem supported by U. S. Department of Energy Contract EY-76-5-09-0639. The purpose of the study is to understand the function of the microbial communities of continental shelf waters and the objectives of these cruises were:

1) to obtain preliminary data regarding the spatial distribution and condition of microorganisms in the continental shelf ecosystem of the Southeastern Atlantic bight, and

2) to provide field evaluation of methodologies and instrumentation.

Cruises 1 and 2 (June 11-17, 1975 and December 1-7, 1975) were conducted aboard the R/V EASTWARD and Cruises 3 and 4 (February 8-14, 1976 and June 7-11, 1976) were conducted aboard the R/V ADVANCE II. Salinity, temperature, and chlorophyll and pheo-pigment concentrations were determined for all stations on all cruises. Adenosine mono-, di-, and tri-phosphate (AMP, ADP, and ATP) concentrations and adenylate energy charge were determined for nearly all stations on all four cruises and are also reported here. Simulated *in situ* primary production was estimated less frequently. In general, two photosynthesis measurements were conducted each day. On Cruises 1, 2 and 3, samples were taken for scanning electron microscopy, and particle size spectra were determined using a Spectrex laser particle counter on Cruise 3. These latter data will be made available elsewhere and are not included in this report. Additional pigment samples were taken for HPLC analysis according to the method of Jacobsen 1977. These results, differ at times from the usual fluorometric chlorophyll measurement and will be discussed in a later report.

This report was prepared by A. Michelle Wood. Computer programs for mapping, salinity and adenylate calculations were prepared by A. Michelle Wood and Walton B. Campbell. Statistical analyses of the data were done by Alice G. Chalmers. Assistance in programming was provided by Thelma Richardson, statistical consultant at the Institute of Ecology and Charles R. Sticher, systems programmer at The University of Georgia Computer Center. Data processing was done with the assistance of Mary Catherine Chase and Richard Rabek. The cooperation and patience of the captains, port captains, and crews of R/V EASTWARD and R/V ADVANCE II is acknowledged with thanks. This report is published as a part of the Georgia Marine Science Center's Technical Report Series, issued by the Georgia Sea Grant Program. Publication costs were supported under NOAA Office of Sea Grant #04-7-158-44126.

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METHODS

Samples were collected with five-liter and thirty-liter PVC Niskin samplers. A sample was taken at the 3M depth at all stations and additional depths were included as time and total depth permitted. When data regarding the physical structure of the water column were available, at least one sample was taken on either side of the thermocline.

Hydrographic Data: On Cruises 1 and 2, salinity data were obtained with a precision salinometer using standard seawater for calibration. Conductivity ratios were convered to salinity (°/₀₀) using an interactive fortran program based on the polynomial equations published by the Joint Council on Oceanographic Standards and UNESCO (1966). This program is reproduced in Appendix Ia. Salinity measurements on Cruises 3 and 4 were made with a refractometer. Temperature was determined using a mercury-in-glass bucket thermometer. A bathythermograph (BT) was also used to measure water column temperature stratification on Cruises 3 and 4. BT traces from these cruises are on file at The University of Georgia Department of Zoology (c/o Dr. L. R. Pomeroy).

Biological Data: Chlorophyll and pheo-pigments were determined using standard fluorometric techniques (Strickland and Parsons 1972). The Turner Designs and Turner III fluorometers were used for these analyses and these were calibrated with pure chlorophyll a obtained by column chromatography (Jacobsen 1978). ATP, ADP, and AMP were determined using the luciferin-luciferase photometric assay as modified for energy charge measurements (Chapman, Fall and Atkinson 1971; Wiebe and Bancroft 1975). Energy charge was calculated from ATP, ADP, and AMP measurements determined on a JRB model 1000 photometer which was modified to provide both peak height and integral values. An interactive fortran program was used to calculate the standard curve for each photometer run and convert photometer readings to molar concentration prior to calculation. This program is reproduced in Appendix Ib.

Statistics and Contouring: Statistical analyses for all four cruises were done by Alice Chalmers using the SAS 76 statistical software package. The results of these analyses are presented and discussed in Appendix II. Contour maps describing the spatial distribution of chlorophyll, pheo-pigments, salinity, and temperature were generated by Michelle Wood using Calcomp software package GPCP-II (General Plotting and Contouring Program). The coastal outline for these maps was generated from NOAA nautical chart #11009 using a Numonics Electronics Graphics Calculator interfaced with a WANG model 2200 minicomputer.

CRUISE 1, JUNE 11-17, 1975 E-3-75

Most of the 59 stations on Cruise 1 were part of eight transects across the continental shelf.

Fernandina	Stations 26 - 31
St. Mary's	Stations 25 - 32
Doboy	Stations 16 - 33
St. Catherine's	Stations 34 - 37
Wassaw	Stations 8 - 12
Edisto	Stations 41 - 46
Charleston	Stations 3 - 7
Cape Fear	Stations 52 - 56

The Cape Fear transect was extended into the Sargasso Sea and the two deepest stations (58 and 59) are not included in Figure 1. These were located near the 3000M contour at 32°29'N and 75°27'W and 33°37'N and 75°24'W, respectively. Station 1, located off Beaufort, North Carolina, is somewhat north of the study area and is also omitted from Figure 1.

The principal hydrographic features of interest on this cruise are a plume of fresh water south of the mouth of the Savannah River, cool water in the vicinity of Cumberland Island (St. Mary's transect), and a patch of relatively fresh water located at the seaward edge of the shelf between 31.5°N and 32.5°N. This latter feature is associated with a shoreward intrusion of the 27° isotherm and a patch of high chlorophyll fluorescence (chlorophyll concentrations of 6 µg/L at station 45).

The two other regions of high chlorophyll concentration were coastal phenomena. One center of increased chlorophyll concentration is the aforementioned hydrographic region south of the Savannah River; in this region chlorophyll concentration ranged from 7 µg/L at Station 39 to 16 µg/L at Station 15. A plume-like zone of high pheo-pigment concentration was observed north of the Savannah River and may represent degradation products which have been moved northward.

A final feature of interest is the zone of relatively high chlorophyll and pheo-pigment concentration near the shelf-break at about 30.5°N. This has also been identified as a region of high chlorophyll concentration, and relatively low temperature and salinity on Cruise 2.

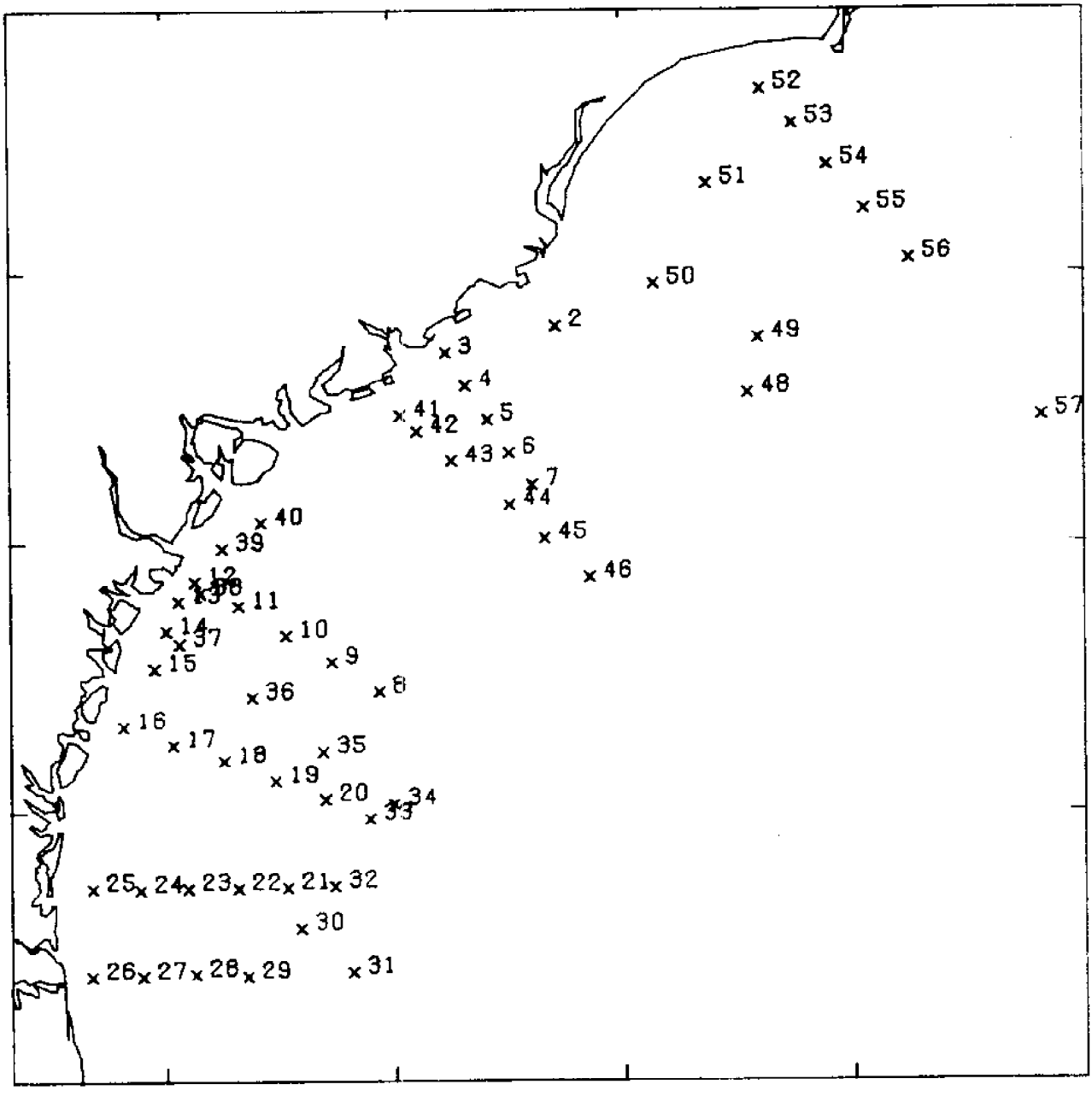

FIGURE 1. Station Locations for Cruise 1.

Table I. STATION DATA ** E-3-75 JUNE 11-17,1975 **

DATE	TIME	STA	LATITUDE	LONGITUDE	DEPTH	TEMP	NISKIN DEPTHS	SALINITY	CHLOROPHYLL IN MICROGRAMS PER LITRE	PHAEO-PIGMENTS IN MICROGRAMS PER LITRE	TOTAL ADEN.	ATP	ENERGY CHARGE
61075	1230	1	34.12.18N	77.04.30W	26	-9.00	2	0.0	99.99	99.99	-1.00	-1.00	-1.00
							24	0.0	99.99	99.99	-1.00	-1.00	-1.00
61175	500	2	32.48.12N	79.17.30W	16	24.50	1	34.8470	99.99	99.99	-1.00	-1.00	-1.00
							14	1.0000	99.99	99.99	-1.00	-1.00	-1.00
61175	750	3	32.42.18N	79.46.12W	12	24.40	3	34.7450	4.01	0.67	0.68	0.25	0.61
							9	34.8020	3.21	0.30	-1.00	-1.00	-1.00
61175	1010	4	32.35.00N	79.40.54W	14	25.20	3	33.7860	3.53	-0.93	-1.00	-1.00	-1.00
							11	34.7570	4.66	-0.23	-1.00	-1.00	-1.00
61175	1145	5	32.27.30N	79.35.18W	25	26.30	3	30.0970	99.99	99.99	0.05	0.18	0.63
							10	32.0920	3.86	0.83	-1.00	-1.00	-1.00
							22	35.5670	5.14	1.36	-1.00	-1.00	-1.00
61175	1330	6	32.20.06N	79.29.42W	28	26.60	3	32.9270	2.40	0.18	-1.00	-1.00	-1.00
							10	34.4690	99.99	99.99	-1.00	-1.00	-1.00
							22	35.7480	2.41	0.58	-1.00	-1.00	-1.00
61175	1508	7	32.13.00N	79.23.42W	31	26.60	3	33.5700	0.46	-0.04	0.90	0.27	0.54
							15	35.4320	1.03	-0.20	-1.00	-1.00	-1.00
							28	35.9620	99.99	99.99	0.43	0.25	0.68
61175	2230	8	31.27.00N	80.04.00W	36	27.20	3	33.4750	0.32	0.04	0.95	0.32	0.61
							21	34.4660	0.74	0.28	-1.00	-1.00	-1.00
							33	36.0540	1.29	0.43	-1.00	-1.00	-1.00
61275	100	9	31.33.30N	80.16.18W	17	27.20	3	33.8220	0.64	0.19	-1.00	-1.00	-1.00
							16	35.8270	0.02	0.04	-1.00	-1.00	-1.00
61275	255	10	31.39.30N	80.28.18W	20	26.40	3	33.4300	1.48	0.14	0.45	0.12	0.76
							10	33.5330	1.22	0.24	-1.00	-1.00	-1.00
							17	35.3100	4.18	0.77	1.27	0.37	0.65
61275	455	11	31.46.00N	80.40.30W	12	25.70	3	33.3450	1.48	0.98	-1.00	-1.00	-1.00
							8	34.3480	7.40	4.90	-1.00	-1.00	-1.00
							10	34.5060	99.99	99.99	-1.00	-1.00	-1.00
61275	655	12	31.51.30N	80.52.00W	8	25.80	3	1.0000	6.43	1.38	2.52	0.68	0.56
							7	32.4800	8.35	-0.81	-1.00	-1.00	-1.00
							10	33.5400	99.99	99.99	-1.00	-1.00	-1.00
61275	800	13	31.47.12N	80.56.12W	7	25.40	1	31.7770	16.06	0.07	-1.00	-1.00	-1.00
							7	32.1540	16.70	2.03	-1.00	-1.00	-1.00
61275	955	14	31.40.30N	80.59.30W	5	25.40	3	31.8610	9.00	-0.67	-1.00	-1.00	-1.00
61275	1135	15	31.32.00N	81.02.30W	8	25.90	3	33.2210	7.71	0.37	-1.00	-1.00	-1.00
61275	1325	16	31.19.18N	81.10.42W	-1	26.60	3	33.2880	1.93	-0.16	4.69	1.35	0.51
							6	33.7480	4.37	1.46	1.48	0.42	0.55
61275	1515	17	31.15.12N	80.57.48W	12	26.60	3	33.8390	1.80	0.39	-1.00	-1.00	-1.00
							9	34.5710	7.71	1.14	-1.00	-1.00	-1.00
61275	1705	18	31.11.30N	80.44.30W	24	26.60	3	34.2250	1.67	-0.21	0.92	0.48	0.66
							10	34.3230	1.67	0.41	-1.00	-1.00	-1.00
							20	1.0000	3.98	0.60	1.65	0.55	0.63
61275	1915	19	31.07.06N	80.31.00W	26	26.60	3	34.6630	1.41	0.25	-1.00	-1.00	-1.00
							12	35.2360	1.48	0.60	-1.00	-1.00	-1.00
							22	35.7550	4.18	1.03	-1.00	-1.00	-1.00
61275	2130	20	31.03.00N	80.18.00W	40	27.60	3	34.8610	1.41	0.61	2.12	0.37	0.59
							13	34.8580	1.29	0.17	-1.00	-1.00	-1.00
							20	35.8240	2.89	0.15	0.83	0.08	0.55
61375	45	21	30.43.12N	80.28.06W	35	27.20	3	35.2640	0.84	0.15	-1.00	-1.00	-1.00
							18	35.6270	1.93	0.52	-1.00	-1.00	-1.00
							30	36.1060	2.51	0.56	-1.00	-1.00	-1.00
61375	230	22	30.43.06N	80.41.00W	13	27.30	3	35.5110	0.45	0.07	-1.00	-1.00	-1.00
							10	35.4440	0.90	-0.12	-1.00	-1.00	-1.00
61375	445	23	30.43.06N	80.54.00W	9	27.40	3	34.9450	0.90	-0.01	-1.00	-1.00	-1.00

** In this, and all subsequent tables, the following codes were used for missing data or data not taken: -1 - time, station depth, and niskin depth; -9.0 - Surface temperature; 0.0 - salinity; 99.99 - chlorophyll and pheo-pigments; -1 - adenylate data

61375	625	24	30.42.42N	81.06.30W	13	25.40	7	34.9460	0.51	0.27	-1.00	-1.00	-1.00
							3	35.1580	1.54	0.12	-1.00	-1.00	-1.00
							13	1.0000	4.18	0.51	-1.00	-1.00	-1.00
61375	810	25	30.43.00N	81.19.00W	8	24.40	3	1.0000	5.80	0.98	-1.00	-1.00	-1.00
							6	35.1690	10.28	1.17	-1.00	-1.00	-1.00
61375	1035	26	30.23.30N	81.19.12W	16	26.80	3	35.4430	2.96	-1.60	4.20	1.25	0.47
							11	35.6990	9.64	0.25	-1.00	-1.00	-1.00
							16	35.7570	16.70	-9.42	-1.00	-1.00	-1.00
61375	1230	27	30.23.30N	81.05.54W	23	26.80	3	1.0000	1.29	-0.04	-1.00	-1.00	-1.00
							11	35.8240	1.41	-0.06	-1.00	-1.00	-1.00
							16	35.8670	2.06	0.23	-1.00	-1.00	-1.00
61375	1430	28	30.24.00N	80.52.06W	26	27.60	3	1.0000	0.84	0.10	-1.00	-1.00	-1.00
							16	1.0000	1.29	0.22	-1.00	-1.00	-1.00
							22	35.9340	1.93	1.20	1.48	0.65	0.70
61375	1627	29	30.23.30N	80.38.30W	32	28.10	3	36.0540	3.83	0.63	1.23	0.37	0.51
							17	35.9450	2.89	1.01	-1.00	-1.00	-1.00
							29	36.0890	3.53	0.89	1.00	0.38	0.59
61375	1827	30	30.34.12N	80.24.30W	37	28.30	3	36.2460	0.20	0.17	-1.00	-1.00	-1.00
							10	36.2360	0.28	0.18	-1.00	-1.00	-1.00
							30	1.0000	1.41	1.97	-1.00	-1.00	-1.00
61375	2030	31	30.24.30N	80.11.06W	90	28.60	3	36.2650	0.29	0.02	0.82	0.03	0.50
							12	36.2670	0.32	-0.01	-1.00	-1.00	-1.00
61375	2310	32	30.43.30N	80.15.36W	40	28.80	3	36.1140	0.32	-0.04	-1.00	-1.00	-1.00
							10	36.1530	0.22	0.01	-1.00	-1.00	-1.00
61475	45	33	30.58.30N	80.06.30W	36	28.20	3	36.1370	0.32	0.04	0.28	0.17	0.81
							22	36.1520	0.61	0.12	-1.00	-1.00	-1.00
							30	36.2160	0.32	0.35	-1.00	-1.00	-1.00
61475	200	34	31.02.00N	80.00.00W	45	28.80	3	1.0000	0.35	0.01	-1.00	-1.00	-1.00
							15	35.0140	99.99	99.99	-1.00	-1.00	-1.00
							40	36.1930	1.09	0.31	-1.00	-1.00	-1.00
61475	515	35	31.13.36N	80.18.30W	27	27.00	3	34.7490	0.27	-0.60	-1.00	-1.00	-1.00
							14	34.9590	1.03	0.64	-1.00	-1.00	-1.00
							22	35.9220	0.32	7.23	-1.00	-1.00	-1.00
61475	800	36	31.25.36N	80.37.12W	22	26.50	3	33.9770	1.48	0.14	-1.00	-1.00	-1.00
							6	34.1140	3.21	-0.07	-1.00	-1.00	-1.00
							10	34.6590	3.21	0.09	-1.00	-1.00	-1.00
							15	35.1560	4.82	0.72	-1.00	-1.00	-1.00
61475	1045	37	31.37.36N	80.56.00W	14	26.60	3	32.3010	6.75	-0.05	-1.00	-1.00	-1.00
							7	34.0490	13.70	-0.20	-1.00	-1.00	-1.00
							12	1.0000	14.46	-0.01	-1.00	-1.00	-1.00
61475	1320	38	31.49.00N	08.05.030	-1	-9.00	NO NISKINS						
61475	1437	39	31.58.54N	80.44.36W	9	26.70	3	33.7020	7.07	-0.53	-1.00	-1.00	-1.00
							5	1.0000	29.72	-1.74	-1.00	-1.00	-1.00
							7	33.7670	99.99	99.99	-1.00	-1.00	-1.00
61475	1628	40	32.04.36N	80.34.30W	14	25.40	3	33.8590	1.16	1.34	-1.00	-1.00	-1.00
							12	34.0560	6.43	0.86	-1.00	-1.00	-1.00
61475	2100	41	32.28.30N	79.58.00W	10	26.10	3	1.0000	2.18	0.31	1.90	0.80	0.67
							6	33.1400	3.08	0.04	-1.00	-1.00	-1.00
							9	33.9440	3.86	0.72	-1.00	-1.00	-1.00
61475	2200	42	32.24.48N	79.53.42W	14	26.10	3	34.8500	1.54	0.75	-1.00	-1.00	-1.00
							7	34.4010	8.35	1.54	-1.00	-1.00	-1.00
							32	34.4900	8.35	1.54	-1.00	-1.00	-1.00
61475	2355	43	32.18.18N	79.44.42W	21	27.00	3	32.2640	1.61	0.16	-1.00	-1.00	-1.00
							10	32.6440	3.53	-0.15	-1.00	-1.00	-1.00
							15	35.4950	7.39	0.68	-1.00	-1.00	-1.00
61575	200	44	32.08.30N	79.29.30W	36	27.60	3	32.9110	2.89	0.23	-1.00	-1.00	-1.00
							18	34.4940	1.35	0.16	-1.00	-1.00	-1.00
							24	36.2420	0.96	0.41	-1.00	-1.00	-1.00
61575	358	45	32.01.00N	79.20.30W	55	27.20	3	32.4580	6.10	-0.12	-1.00	-1.00	-1.00
							8	32.4540	6.10	-0.64	-1.00	-1.00	-1.00
							12	32.5780	5.78	-0.58	-1.00	-1.00	-1.00
61575	550	46	31.52.18N	79.08.42W	475	28.50	3	36.4780	0.51	0.01	-1.00	-1.00	-1.00
							20	36.3160	0.25	0.11	-1.00	-1.00	-1.00

DATE	TIME	STA	LATITUDE	LONGITUDE	DEPTH	TEMP	NISKIN DEPTHS	SALINITY	CHLOROPHYLL IN MICROGRAMS PER LITRE	PHAEO-PIGMENTS IN MICROGRAMS PER LITRE	TOTAL ADEN.	ATP	ENERGY CHARGE
							30	36.2960	0.39	0.06	-1.00	-1.00	-1.00
61575	1340	48	32.33.18N	78.27.24W	195	27.40	3	35.1620	0.59	0.02	0.48	0.15	0.67
							13	1.0000	0.57	-0.33	-1.00	-1.00	-1.00
61575	1610	49	32.45.30N	78.24.48W	21	27.20	25	36.3040	1.04	0.45	-1.00	-1.00	-1.00
							3	35.0000	0.51	-0.10	-1.00	-1.00	-1.00
61575	1845	50	32.57.30N	78.52.00W	20	26.20	6	35.0480	0.60	0.07	-1.00	-1.00	-1.00
							12	35.5480	0.64	0.09	-1.00	-1.00	-1.00
							3	34.5310	1.48	1.07	-1.00	-1.00	-1.00
							7	34.5740	1.93	1.20	-1.00	-1.00	-1.00
							10	1.0000	99.99	99.99	-1.00	-1.00	-1.00
61575	2200	51	33.19.48N	78.38.00W	16	27.60	15	1.0000	99.99	99.99	-1.00	-1.00	-1.00
61675	45	52	33.40.48N	78.24.00W	16	25.40	3	1.0000	0.96	0.08	-1.00	-1.00	-1.00
							10	35.2560	2.89	-0.29	-1.00	-1.00	-1.00
							3	35.3590	2.31	0.29	-1.00	-1.00	-1.00
							4	0.0	99.99	99.99	-1.00	-1.00	-1.00
							5	0.0	99.99	99.99	-1.00	-1.00	-1.00
61675	215	53	33.33.00N	78.15.42W	18	25.90	10	35.3530	1.03	0.22	-1.00	-1.00	-1.00
							3	35.1020	4.37	0.03	-1.00	-1.00	-1.00
61675	345	54	33.23.48N	78.06.36W	19	26.10	16	35.1880	1.41	0.15	-1.00	-1.00	-1.00
							3	34.9720	0.45	0.02	1.02	0.50	0.70
							5	0.0	99.99	99.99	-1.00	-1.00	-1.00
							7	0.0	99.99	99.99	-1.00	-1.00	-1.00
61675	520	55	33.14.00N	77.57.00W	27	26.30	16	35.2650	0.96	0.19	-1.00	-1.00	-1.00
							3	35.3310	0.64	0.40	-1.00	-1.00	-1.00
61675	720	56	33.03.00N	77.45.30W	120	27.10	20	36.0260	1.00	0.36	-1.00	-1.00	-1.00
							3	36.1830	0.57	0.01	-1.00	-1.00	-1.00
							30	36.2060	1.12	0.31	-1.00	-1.00	-1.00
61675	1325	57	32.28.00N	77.11.00W	675	26.20	60	36.2020	0.0	1.43	-1.00	-1.00	-1.00
							3	36.1510	0.29	0.05	0.27	0.07	0.40
							10	33.1370	0.32	-0.04	-1.00	-1.00	-1.00
61675	2335	58	33.29.12N	75.27.12W	3690	27.30	40	36.1250	0.42	0.0	-1.00	-1.00	-1.00
							3	0.0	0.58	0.15	2.69	1.10	0.66
							20	33.1370	0.29	0.05	-1.00	-1.00	-1.00
61775	600	59	33.37.48N	75.24.24W	3330	28.70	60	36.1510	0.90	0.12	0.77	0.32	0.66
							3	0.0	0.0	0.0	-1.00	-1.00	-1.00
							20	0.0	0.0	0.0	-1.00	-1.00	-1.00

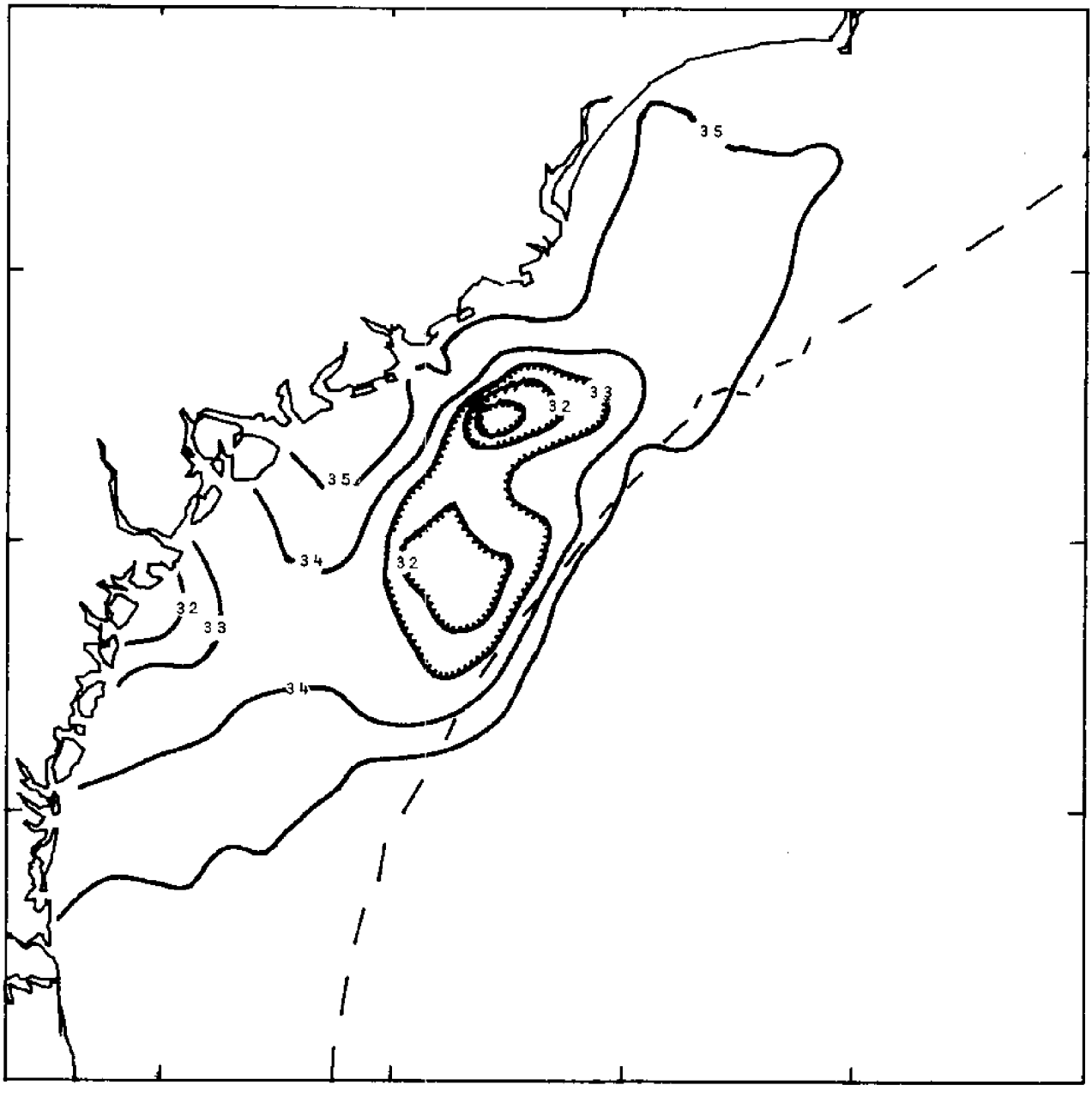

FIGURE 2. Isocline analysis of salinity data for Cruise 1.
(Contour interval = 1 °/₀₀)

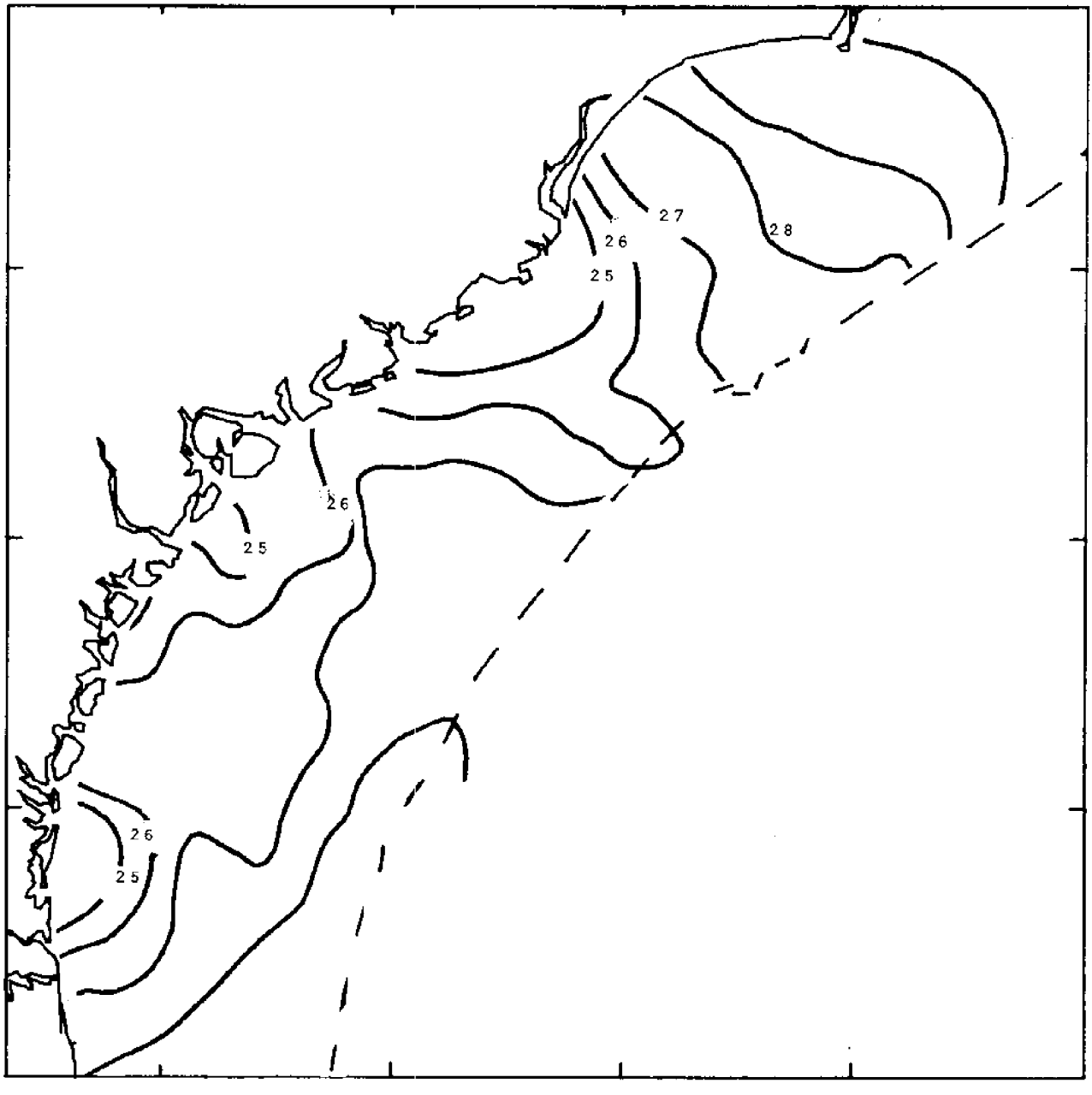

FIGURE 3. Isocline analysis of surface temperature data for Cruise 1. (Contour interval = 1 degree Centigrade)

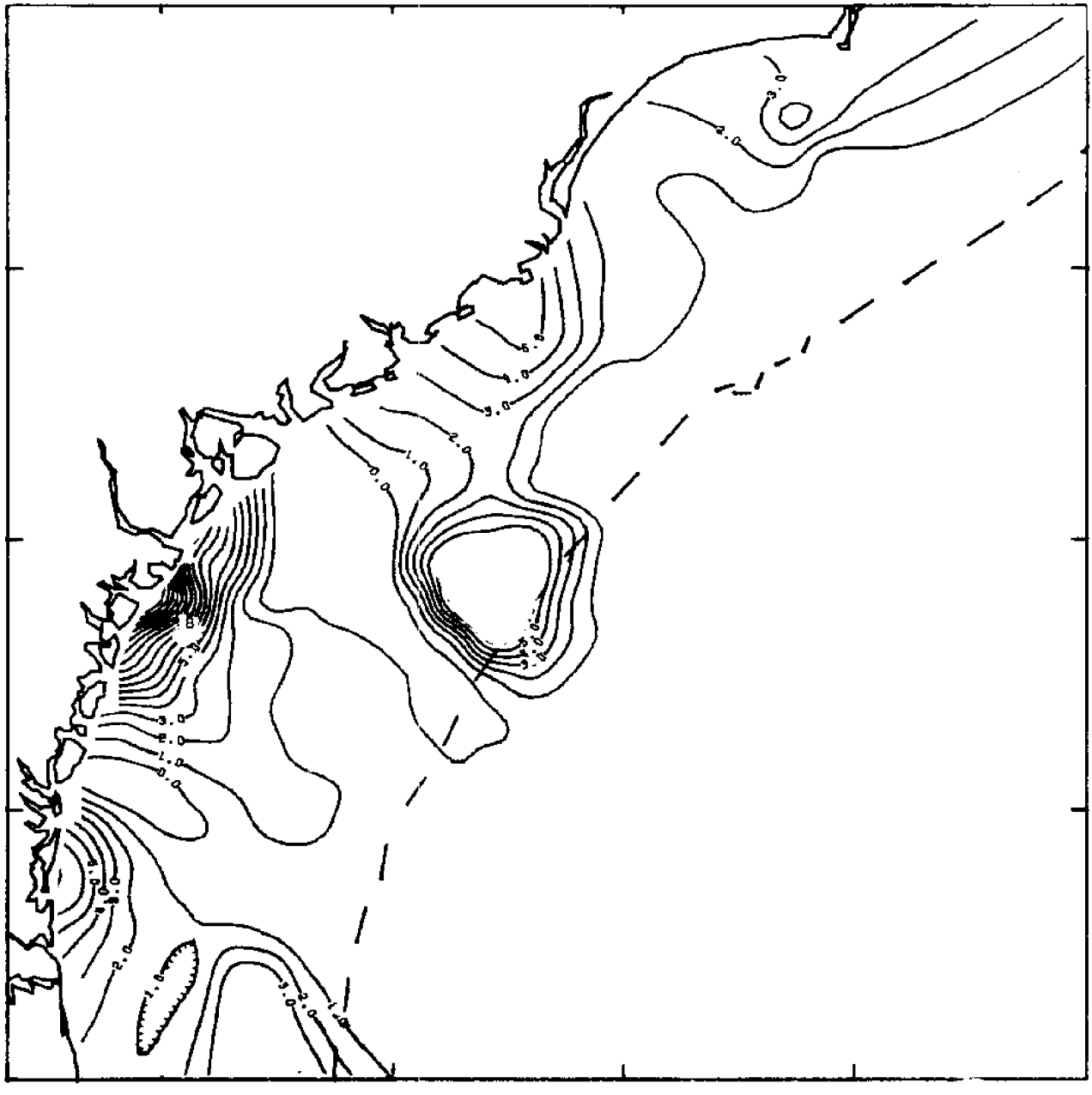

FIGURE 4. Isocline analysis of chlorophyll data for Cruise 1. (Contour interval = 1 µg/L)

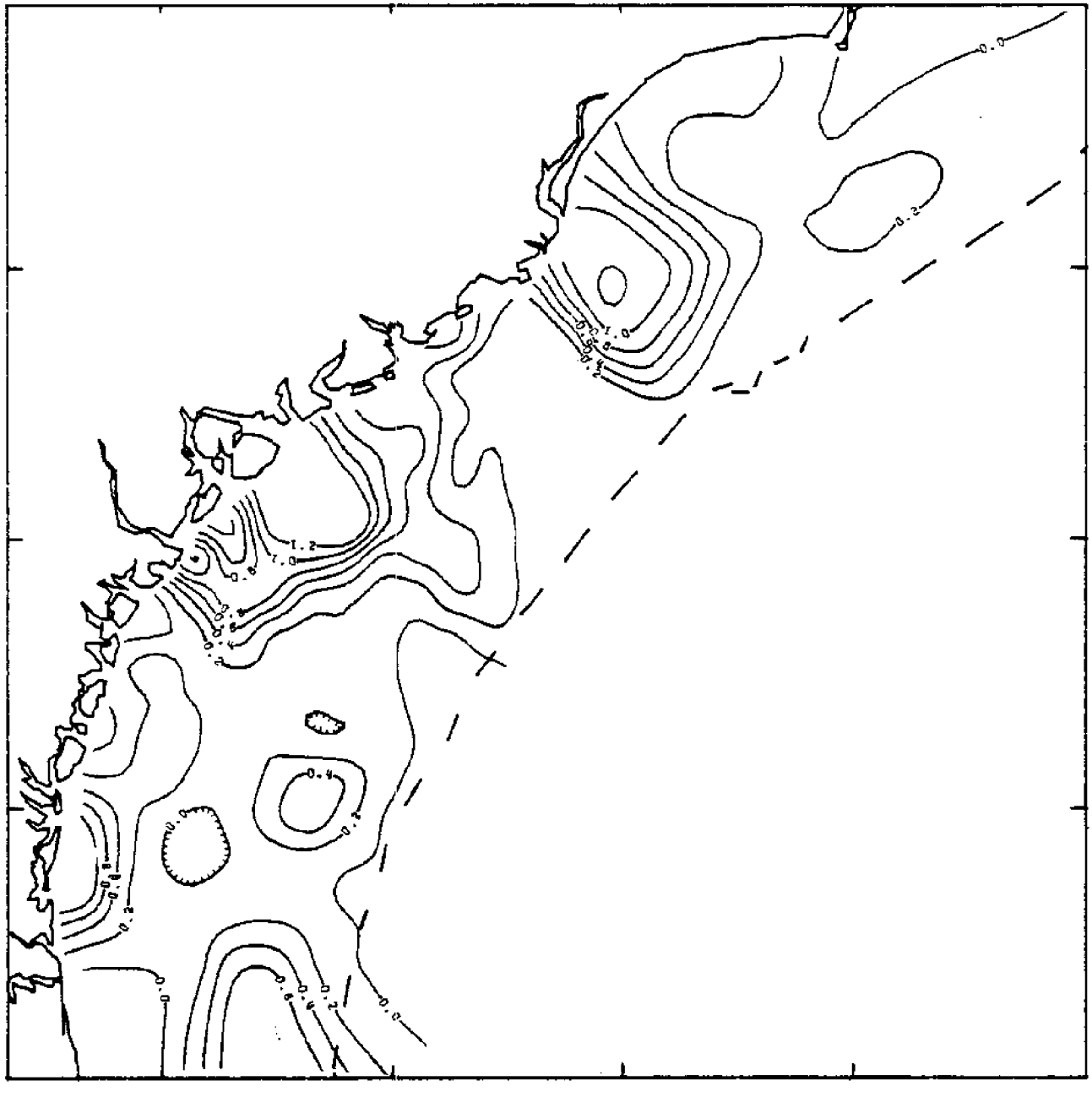

FIGURE 5. Isocline analysis of phéo-pigment data for Chrise 1. (Contour interval = .2 µg/L)

CRUISE 2, DECEMBER 1-7, 1975 E-15-75

The station locations and cruise track for this cruise were similar to those of Cruise 1. The St. Catherine's transect was omitted on this cruise and the "Edisto" transect (Stations 41 - 46) ran in a southeasterly direction from St. Helena Sound instead of Edisto Sound. Station 1, which was located south of Beaufort, North Carolina, was somewhat north of the principal study area and is not included in Figure 2.

An interesting feature of the hydrographic structure on this cruise is the patch-like zone of relatively low salinity and low temperature water located near the shelf-break at about 30.5°N. On Cruise 1, this phenomenon was also observed and found to be associated with relatively high concentrations of chlorophyll and pheo-pigments. On this cruise, the feature appears to be due to the influence of Station 24 where a salinity of 24 °/₀₀, temperature of 17C, and chlorophyll concentration of 2.46 µg/L were observed. Chlorophyll maxima were found as diffuse, plume-like formations in coastal waters off of Charleston and south of the Savannah River. Pheo-pigment concentration is low across the shelf with only two observable zones of activity. One appears as a region of high concentration off of Cumberland Island (St. Mary's transect) where concentration ranges from .59 µg/L at Station 23 to .04 µg/L at Station 32 and the other is located slightly west of the shelf break at approximately 31°N. The latter zone appears to be a patch defined by Station 19 (.49 µg/L) and 20 (.35 µg/L) and may represent the remains of an old phytoplankton bloom.

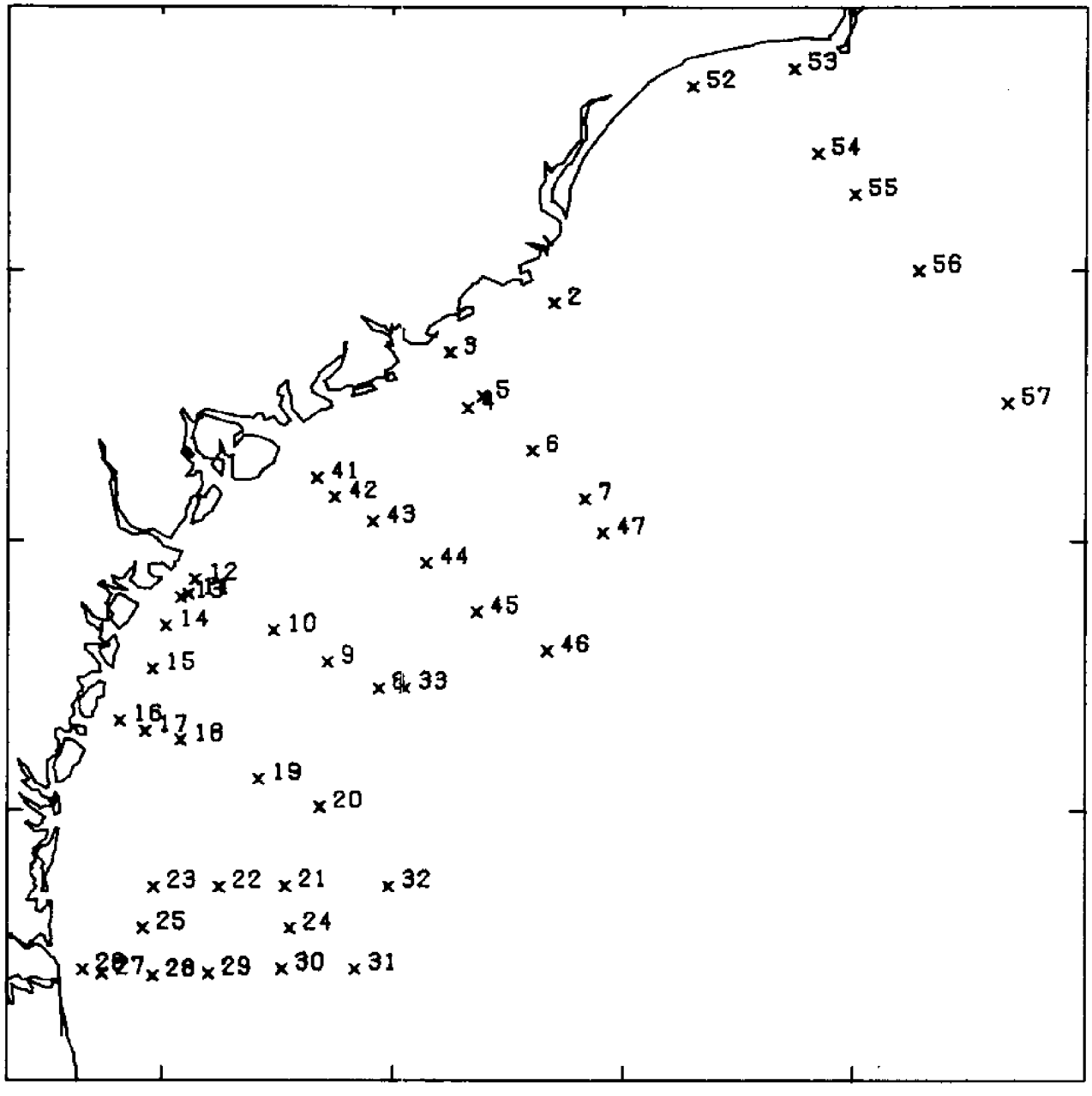

FIGURE 6. Station locations for Cruise 2.

Table II. STATION DATA ** E-15-75 DEC 1-7,1975

DATE	TIME	STA	LATITUDE	LONGITUDE	DEPTH	TEMP	NISKIN DEPTHS	SALINITY	CHLOROPHYLL IN MICROGRAMS PER LITRE	PHAEO-PIGMENTS IN MICROGRAMS PER LITRE	TOTAL ADEN.	ATP	ENERGY CHARGE
120175	1100	1	34.31.18N	07.64.600	17	18.40	NO NISKINS						
120275	845	2	32.53.42N	79.18.18W	17	17.33	3	34.9781	0.46	0.06	1.42	0.82	0.78
							15	34.9866	0.56	0.16	1.02	0.50	0.74
120275	1222	3	32.41.48N	79.45.30W	16	15.19	3	1.0000	2.46	0.01	1.92	0.70	0.63
							10	1.0000	3.09	-0.55	2.57	1.02	0.59
120275	1402	4	32.39.30N	79.40.48W	13	16.80	3	34.7746	1.04	-0.13	1.77	0.57	0.58
							9	34.7736	2.03	-0.12	1.85	0.78	0.67
120275	1600	5	32.32.00N	79.37.00W	21	18.35	3	1.0000	0.53	0.02	0.55	0.37	0.83
							15	35.9806	0.50	0.02	0.95	0.38	0.67
120275	1935	6	32.20.00N	79.23.54W	27	21.80	3	36.0984	0.0	0.0	0.82	0.35	0.57
							20	36.0791	0.47	0.03	0.70	0.35	0.69
120275	2230	7	32.09.18N	79.10.18W	85	22.60	3	36.1065	0.26	0.02	1.67	0.37	0.64
							20	36.0944	0.32	0.08	-1.00	-1.00	-1.00
							40	36.0900	0.23	0.0	1.27	0.95	0.86
120375	615	8	31.27.18N	80.03.48W	38	21.80	3	35.9917	0.32	0.01	0.45	0.27	0.72
							10	35.9979	0.50	-0.21	-1.00	-1.00	-1.00
							35	35.9941	0.32	0.08	-1.00	-1.00	-1.00
120375	855	9	31.33.00N	80.17.00W	35	20.20	3	35.8785	0.41	0.06	1.17	0.47	0.63
							30	35.8824	0.41	0.04	0.65	0.32	0.75
120375	1206	10	31.40.06N	80.31.00W	18	18.30	3	35.3876	0.47	0.01	1.92	0.62	0.48
							6	36.0055	99.99	99.99	-1.00	-1.00	-1.00
							12	35.0346	0.64	0.03	2.03	0.63	0.45
120375	1452	11	31.48.06N	80.45.24W	10	17.20	3	33.4863	0.70	0.04	1.95	0.77	0.55
							7	33.5578	0.88	-0.07	2.13	0.65	0.43
120375	1623	12	31.51.30N	80.51.24W	9	16.30	1	31.5807	1.88	0.02	1.83	0.78	0.66
							4	32.6222	1.76	-0.10	1.93	1.15	0.70
120375	1735	13	31.47.18N	80.55.00W	10	16.35	3	31.7235	1.11	-0.02	2.43	1.13	0.67
120375	1857	14	31.41.06N	80.59.00W	10	16.85	3	31.9625	1.64	-0.12	1.92	0.93	0.67
120375	2052	15	31.31.30N	81.02.18W	9	16.90	3	32.0658	0.94	-0.04	1.17	0.73	0.73
120375	2310	16	31.20.00N	81.10.48W	10	17.10	3	32.5717	99.99	99.99	1.37	0.60	0.66
120375	2352	17	31.17.48N	81.04.18W	10	17.34	3	33.3156	0.80	0.03	2.38	0.77	0.54
120475	120	18	31.15.48N	80.55.00W	17	18.20	3	34.5787	0.64	0.07	0.92	0.35	0.81
							14	34.7960	0.42	0.03	1.55	0.92	0.73
120475	345	19	31.07.06N	80.34.42W	25	19.60	3	35.7298	0.49	0.10	0.72	0.20	0.52
							20	35.7276	0.46	0.04	0.75	0.38	0.70
120475	643	20	31.00.48N	80.19.00W	-1	21.40	3	35.8449	0.35	0.17	2.07	1.10	0.75
							30	35.9928	0.29	0.05	2.42	2.10	0.88
120475	1000	21	30.43.12N	80.27.48W	33	22.60	3	36.0806	0.38	0.05	0.37	0.05	0.48
							10	36.0796	0.35	0.02	0.20	0.02	0.24
							25	36.0809	0.69	0.07	0.73	0.20	0.47
120475	1327	22	30.43.00N	80.45.00W	21	19.95	3	35.1439	0.53	-0.05	1.07	0.45	0.61
							18	35.1701	0.35	0.03	1.13	0.68	0.73
120475	1559	23	30.43.00N	81.02.00W	18	19.05	3	34.0461	0.59	-0.02	1.43	0.67	0.67
							15	34.2112	0.82	-0.06	1.03	0.52	0.64
120475	1730	24	30.33.48N	80.26.42W	10	17.80	3	32.5644	2.46	-0.42	-1.00	-1.00	-1.00
120475	1820	25	30.33.54N	81.04.42W	15	17.30	3	1.0000	1.88	0.45	2.67	1.28	0.67
120475	2102	26	30.24.42N	81.20.24W	20	18.60	3	32.3974	2.34	0.31	0.95	0.60	0.79
							15	33.5862	1.52	1.79	1.13	0.62	0.77
120475	2152	27	30.23.54N	81.15.24W	14	18.50	3	31.1605	1.93	-0.13	-1.00	-1.00	-1.00
120475	2326	28	30.23.24N	81.02.12W	27	19.90	3	1.0000	1.11	-0.12	2.43	1.53	0.76
							20	34.6556	1.64	-0.12	2.43	1.23	0.69
120575	140	29	30.23.48N	80.47.42W	30	20.90	3	35.3049	99.99	99.99	-1.00	-1.00	-1.00
							20	1.0000	99.99	99.99	-1.00	-1.00	-1.00
120575	415	30	30.24.48N	80.28.42W	37	22.40	3	1.0000	0.23	0.05	0.65	0.22	0.52

DATE	TIME	STA	LATITUDE	LONGITUDE	DEPTH	TEMP	NISKIN DEPTHS	SALINITY	CHLOROPHYLL IN MICROGRAMS PER LITRE	PHAEO-PIGMENTS IN MICROGRAMS PER LITRE	TOTAL ADEN.	ATP	ENERGY CHARGE
							15	36.1092	0.35	0.03	-1.00	-1.00	-1.00
							30	1.0000	0.59	0.03	-1.00	-1.00	-1.00
120575	655	31	30.24.48N	80.09.48W	120	24.80	3	35.9940	0.38	0.04	-1.00	-1.00	-1.00
							15	35.9242	0.24	0.08	-1.00	-1.00	-1.00
							30	35.0057	0.31	0.03	-1.00	-1.00	-1.00
							100	36.1167	0.10	0.04	-1.00	-1.00	-1.00
120575	955	32	30.43.12N	80.01.00W	150	24.60	3	36.0327	0.38	0.04	0.53	0.23	0.73
							40	36.0065	0.35	0.08	0.55	0.22	0.58
							100	36.0925	0.10	0.0	-1.00	-1.00	-1.00
120575	1155	33	31.27.24N	79.56.48W	145	24.10	3	36.0796	0.31	0.0	0.83	0.27	0.52
							40	36.0055	0.33	0.11	-1.00	-1.00	-1.00
							100	36.0697	99.99	99.99	-1.00	-1.00	-1.00
120575	2200	41	32.13.54N	80.19.42W	18	17.10	3	34.0302	0.38	0.11	1.23	0.90	0.80
120575	2355	42	32.09.42N	80.15.12W	17	17.30	3	34.3279	0.50	0.04	-1.00	-1.00	-1.00
120675	20	43	32.04.18N	80.05.12W	19	19.86	3	1.0000	0.31	0.03	1.85	0.93	0.75
							15	36.0620	0.01	0.05	-1.00	-1.00	-1.00
120675	221	44	31.55.00N	79.51.18W	32	21.30	3	36.1127	99.99	99.99	2.23	1.25	0.65
							25	36.1015	0.24	0.03	0.78	0.52	0.78
120675	420	45	31.44.18N	79.38.12W	58	-9.00	3	36.0390	0.18	0.02	0.98	0.45	0.69
							40	1.0000	0.13	0.15	0.55	0.18	0.66
120675	757	46	31.35.42N	79.20.00W	425	25.50	3	35.9689	0.11	0.05	0.48	0.23	0.65
							30	35.9852	99.99	99.99	-1.00	-1.00	-1.00
							100	36.0907	0.04	0.04	-1.00	-1.00	-1.00
120675	1220	47	32.01.54N	79.05.24W	250	24.60	6	36.0119	0.07	0.04	0.53	0.18	0.66
							40	36.0364	0.07	0.04	-1.00	-1.00	-1.00
							100	36.1048	0.07	0.04	0.22	0.08	0.53
							0	0.0	0.07	0.04	-1.00	-1.00	-1.00
120775	0	52	33.41.00N	78.42.18W	11	16.20	3	35.3703	0.33	0.10	1.88	1.02	0.71
120775	307	53	33.44.48N	78.15.48W	21	17.50	3	35.7079	0.40	0.03	2.00	1.02	0.73
							15	35.3116	0.38	0.07	1.65	0.81	0.74
120775	445	54	33.25.54N	78.09.42W	25	20.40	3	36.0617	0.18	0.04	0.93	0.48	0.68
							15	36.0537	99.99	99.99	0.47	0.22	0.61
120775	645	55	33.17.00N	78.00.00W	31	23.40	3	36.0274	0.11	0.03	-1.00	-1.00	-1.00
							6	0.0	99.99	99.99	-1.00	-1.00	-1.00
							15	36.0610	99.99	99.99	-1.00	-1.00	-1.00
120775	955	56	33.00.00N	77.43.24W	173	23.00	3	35.5847	0.27	0.04	0.48	0.20	0.63
							50	36.0539	0.20	0.05	-1.00	-1.00	-1.00
							100	36.4400	0.02	0.02	-1.00	-1.00	-1.00
120775	1505	57	32.30.30N	77.12.36W	625	25.80	3	35.9049	0.24	0.01	0.35	0.05	0.53
							50	35.9009	0.24	0.02	0.32	0.28	0.86
							100	35.9083	0.22	0.03	-1.00	-1.00	-1.00
							250	36.0908	99.99	99.99	-1.00	-1.00	-1.00

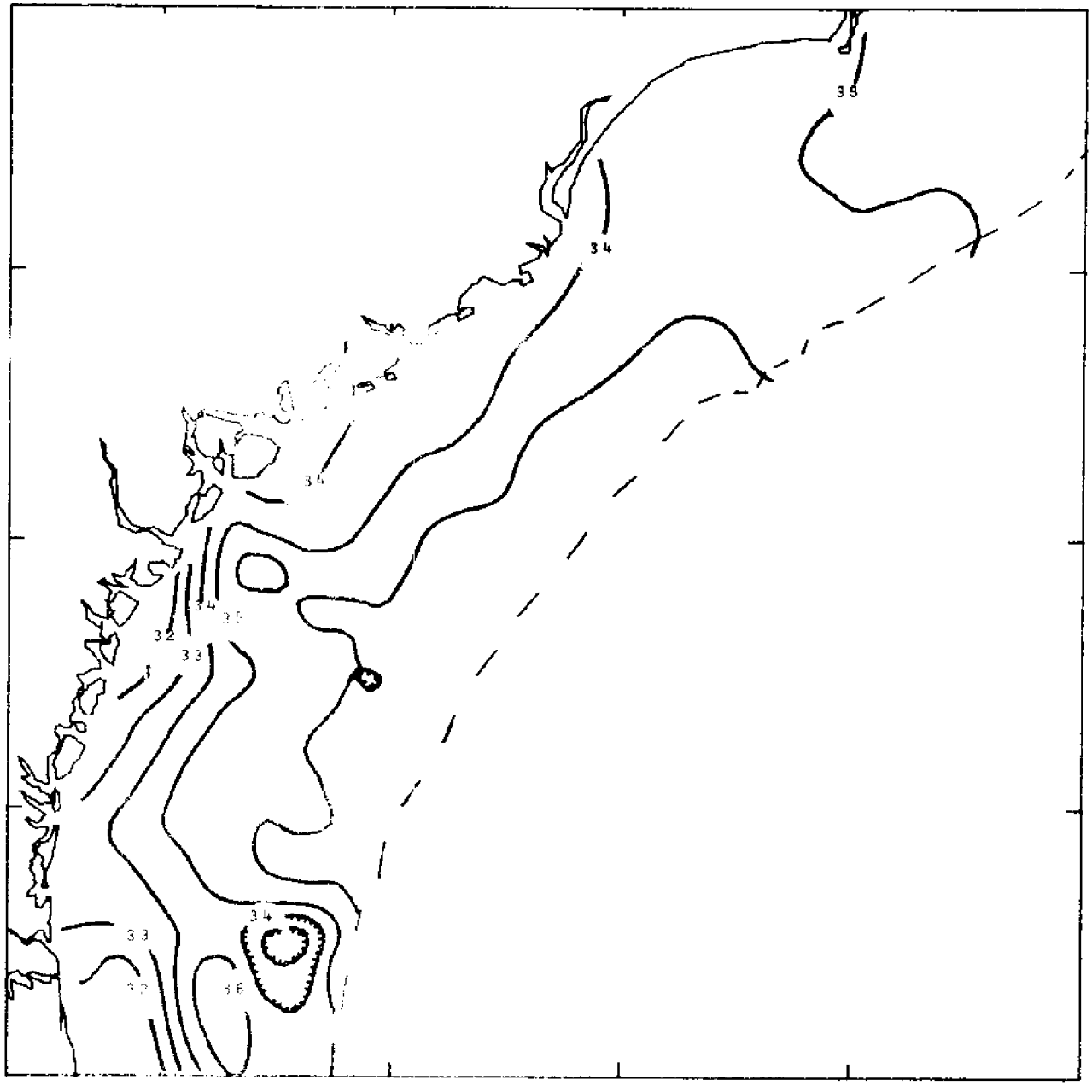

FIGURE 7. Isocline analysis of salinity data for Cruise 2.

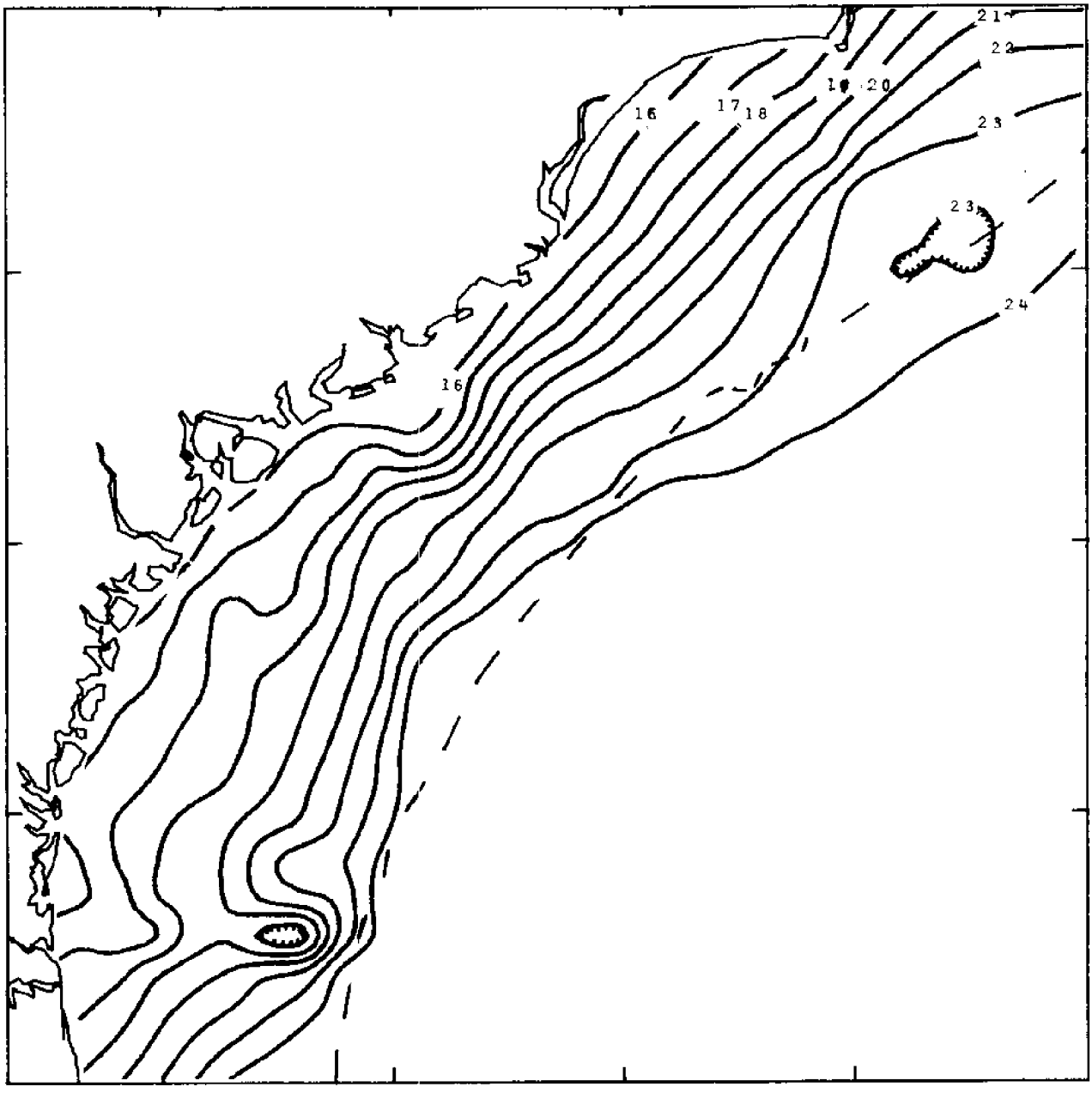

FIGURE 8. Isocline analysis of temperature data for Cruise 2.
(Contour interval = 1 degree Centegrade)

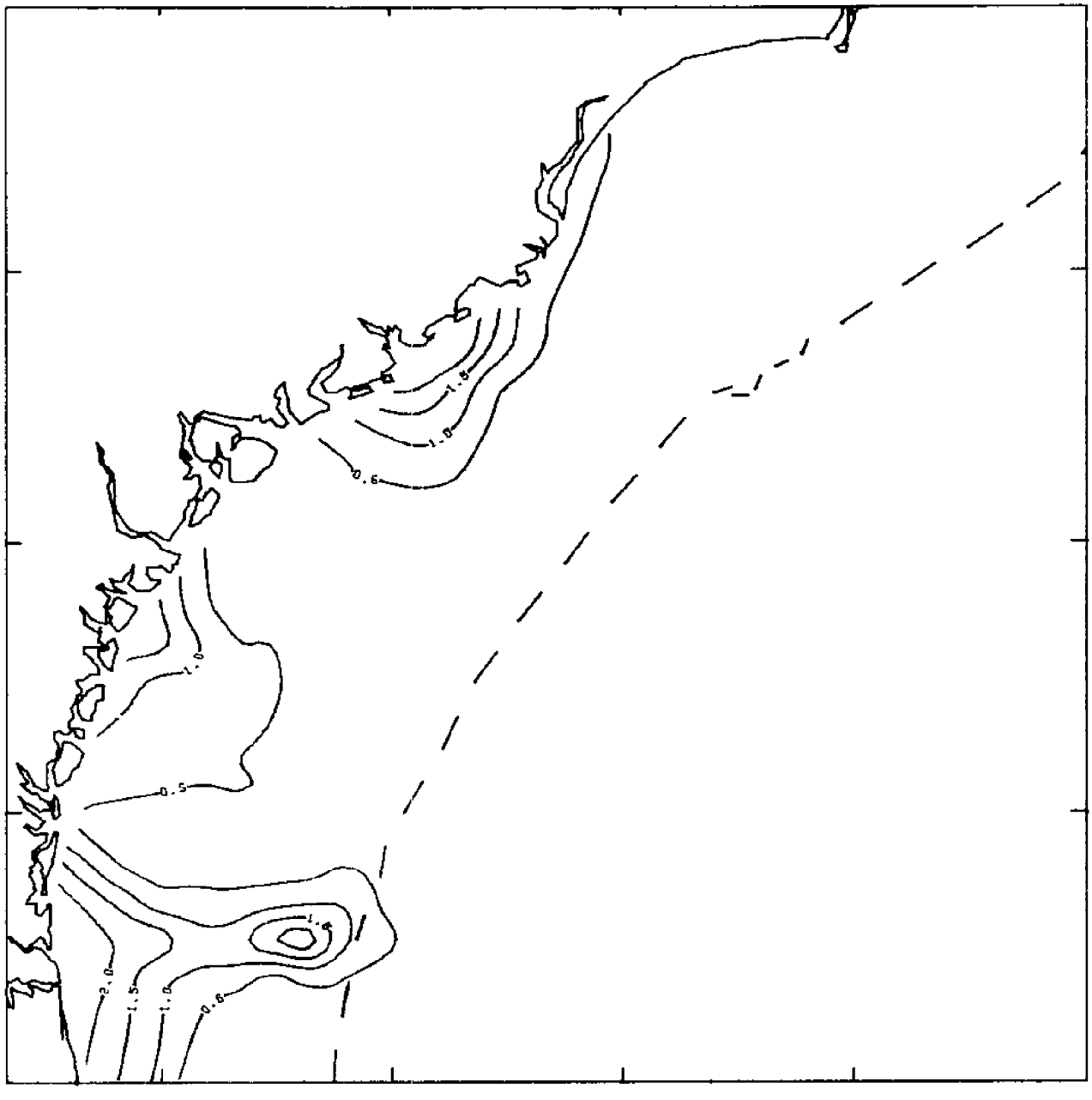

FIGURE 9. Isocline analysis of chlorophyll data for Cruise 2.
(Contour interval = 1.0 µg/L)

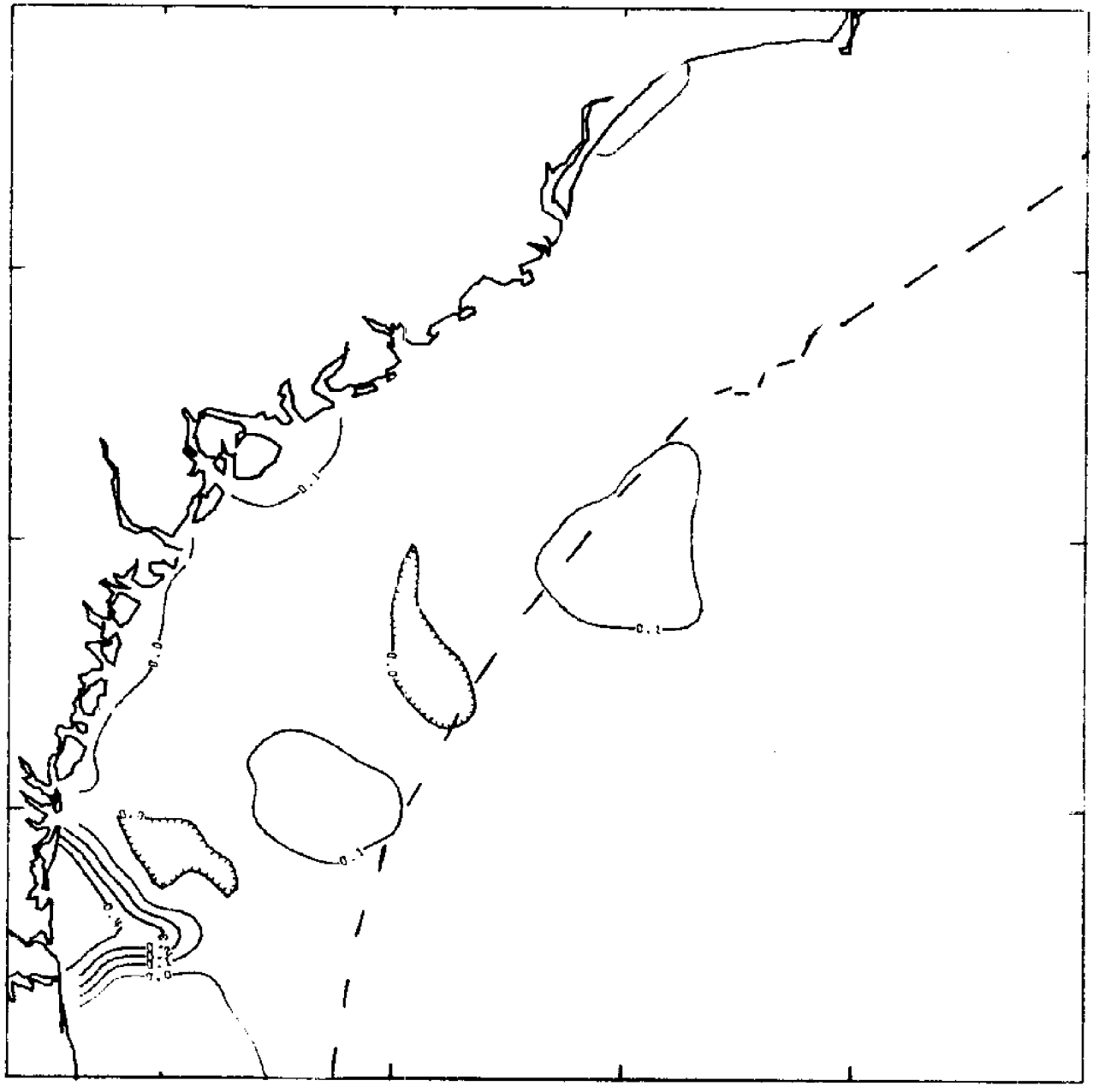

FIGURE 10. Isocline analysis of pheo-pigment data for Cruise 2.
(Contour interval = .2 µg/L)

CRUISE 3, FEBRUARY 8-15, 1976 R/V ADVANCE II

Four complete transects of the continental shelf were included in the track for Cruise 3:

St. Mary's	Stations 20 - 25
Doboy	Stations 19 - 26
Charleston	Stations 4 - 8
Cape Fear	Stations 28 - 34

The Cape Fear transect runs in an east-southeasterly direction from a point just south of the Little River Inlet and was continued to the 650M depth contour (Station 28). Station 29 (164M, 30°27'N, 76°55'W), which was on the return leg of the cruise, is not included in Figure 3.

Hydrographic data for this cruise exhibit little two-dimensional structure. Temperature tends to increase along a smooth gradient across the shelf. Salinity data indicate a zone where salinity is less than 30 °/₀₀ in the coastal region from the Savannah River to Jekyll Island. A zone of relatively fresh water (<31 °/₀₀) is also located near the coast off Charleston.

Biological data for this cruise differed from previously established patterns in several ways. While there was a significant decrease in chlorophyll as distance from shore increased, it was not as great as in Cruise 1, 2, and 4 (See Appendix II). Furthermore, nearly all of the pheo-pigment maxima were located in patch-like regions on the outer continental shelf (See Figure 15) instead of plume-like formations in the coastal zone. One of the two identified zones of relatively high chlorophyll concentrations is also an offshore phenomenon. This chlorophyll concentration in this region is .75 µg/L (Station 29) and 1.82 µg/L (Station 22). The other region of relatively high chlorophyll concentration was a coastal plume extending outward from the St. Mary's River. Chlorophyll concentrations in this region ranged from 2.29 µg/L at Station 20 to .06 µg/L at Station 25.

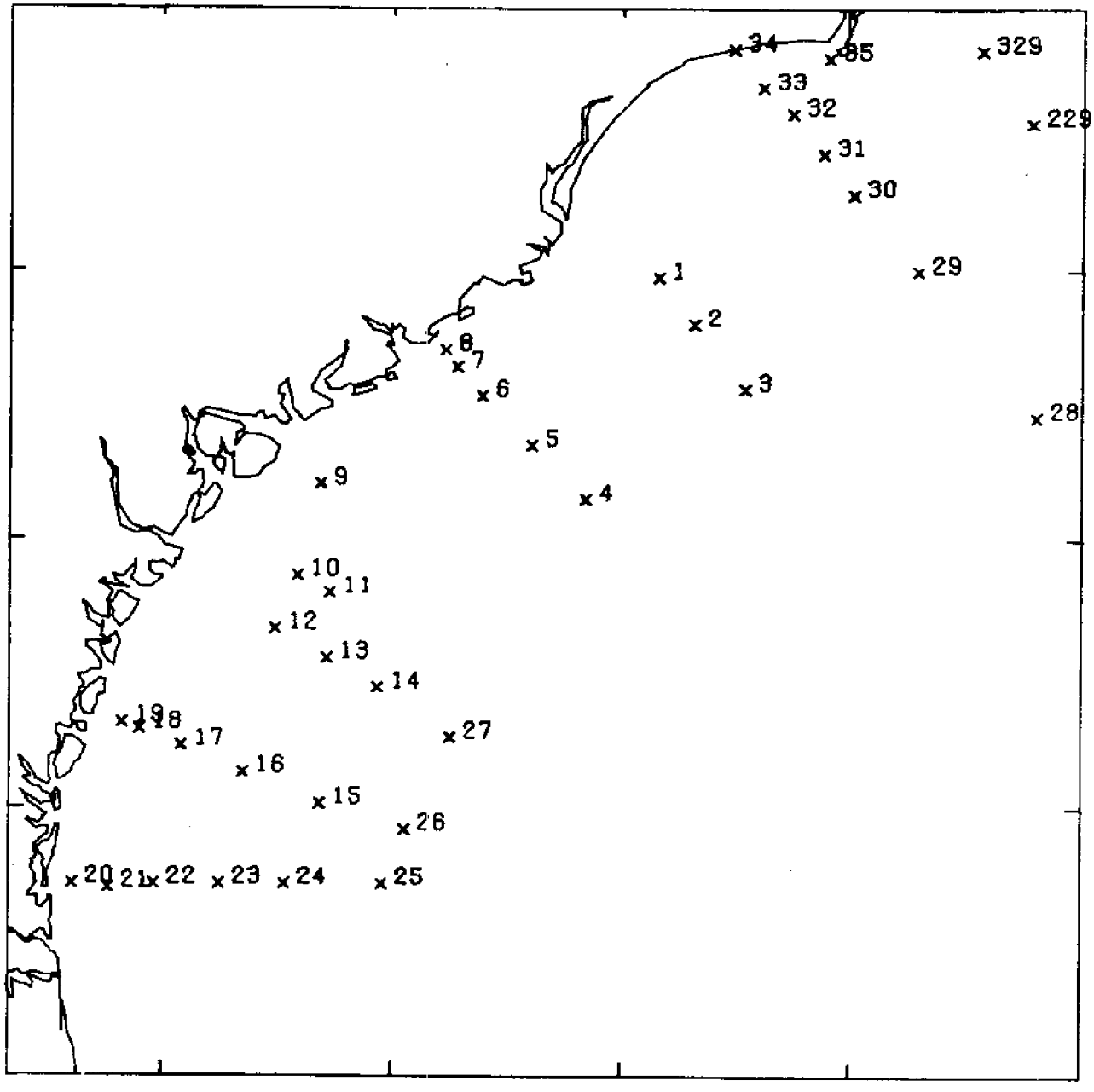

FIGURE 11. Station locations for Cruise 3.

Table III. STATION DATA ** ADV II FEB 8-13,1976

DATE	TIME	STA	LATITUDE	LONGITUDE	DEPTH	TEMP	NISKIN DEPTHS	SALINITY	CHLOROPHYLL IN MICROGRAMS PER LITRE	PHAEO-PIGMENTS IN MICROGRAMS PER LITRE	TOTAL ADEN.	ATP	ENERGY CHARGE
20976	1700	1	32.58.30N	78.51.00W	27	13.00	3	34.5000	0.09	0.14	1.32	1.02	0.83
							20	34.5000	0.02	-0.09	3.65	1.88	0.74
20976	1640	2	32.48.00N	78.41.30W	39	16.50	3	35.5000	0.16	-0.06	1.78	1.42	0.86
							30	35.5000	0.02	0.07	1.78	1.05	0.66
20976	2035	3	32.33.30N	78.28.12W	216	20.00	3	36.0000	1.34	0.01	1.95	1.08	0.78
							60	36.0000	99.99	99.99	1.15	0.68	0.65
21076	100	4	32.09.00N	79.10.00W	80	18.00	3	35.5000	0.38	0.03	5.30	2.87	0.64
							60	35.5000	0.42	0.37	2.94	2.00	0.79
21076	255	5	32.21.00N	79.24.00W	30	15.00	3	35.0000	1.03	0.59	4.59	3.08	0.73
							20	35.5000	1.34	0.04	5.35	3.24	0.70
21076	445	6	32.32.06N	79.37.00W	21	13.00	3	35.0000	0.33	0.22	3.50	2.22	0.82
							15	34.5000	0.33	0.14	2.80	1.82	0.84
21076	610	7	32.38.30N	79.43.30W	13	12.00	3	33.5000	0.61	0.18	1.58	0.63	0.56
							10	33.5000	0.63	-0.18	2.72	1.30	0.72
21076	705	8	32.42.12N	79.46.30W	11	10.00	3	27.5000	1.53	0.10	2.74	1.63	0.76
							7	29.5000	1.53	0.36	2.38	1.57	0.78
21076	1110	9	32.12.18N	80.18.54W	18	11.50	3	33.5000	0.11	0.05	1.60	0.62	0.76
							10	33.5000	0.51	-0.21	2.62	1.62	0.80
21076	1430	10	31.52.00N	80.25.00W	11	11.00	3	31.5000	1.01	-0.16	1.80	1.23	0.83
21076	1525	11	31.48.06N	80.16.30W	11	12.00	3	31.5000	0.42	0.17	2.15	0.97	0.52
21076	1705	12	31.40.06N	80.30.48W	24	12.00	3	34.0000	0.60	-0.38	0.42	0.28	0.71
							20	34.0000	0.38	0.16	0.98	0.93	0.94
21076	1840	13	31.33.30N	80.17.18W	34	15.00	3	35.5000	0.23	0.79	-1.00	-1.00	-1.00
							30	35.5000	0.74	-0.56	-1.00	-1.00	-1.00
21076	2000	14	31.27.00N	80.04.00W	41	18.50	3	36.5000	0.45	-0.03	0.75	0.32	0.63
							30	36.5000	-0.11	0.43	0.62	0.22	0.54
21076	2255	15	31.01.00N	80.19.00W	40	17.00	3	36.0000	0.23	0.13	2.87	1.43	0.62
							30	36.0000	0.27	0.09	3.14	1.60	0.70
21176	10	16	31.08.00N	81.39.00W	27	14.00	3	33.0000	0.38	0.16	0.48	0.27	0.75
							30	33.0000	0.25	0.30	0.95	0.55	0.76
21176	254	17	31.14.00N	80.55.00W	18	12.00	3	31.5000	0.42	0.15	0.75	0.55	0.81
							15	32.5000	0.54	-0.13	1.28	0.88	0.81
21176	350	18	31.17.48N	81.05.48W	12	12.00	3	30.5000	0.96	0.04	0.78	0.52	0.84
21176	435	19	31.19.00N	81.10.30W	11	12.00	3	29.5000	1.16	0.13	0.93	0.50	0.67
21176	900	20	30.43.00N	81.23.30W	10	13.00	3	32.5000	2.92	99.99	4.54	2.28	0.72
21176	1000	21	30.42.00N	81.14.00W	14	14.00	3	33.5000	0.51	0.23	1.05	0.65	0.73
21176	1100	22	30.43.00N	81.02.00W	24	14.50	3	34.5000	1.07	-0.57	0.53	0.45	0.93
							20	0.0	99.99	99.99	3.17	1.87	0.77
21176	1230	23	30.43.00N	80.45.00W	29	15.50	3	35.5000	0.38	-0.14	0.80	0.60	0.88
							25	0.0	-0.14	0.53	0.92	0.45	0.75
21176	1400	24	30.43.00N	80.28.00W	41	19.00	3	36.5000	99.99	99.99	1.93	0.82	0.67
							35	0.0	2.07	0.0	1.95	0.73	0.56
21176	1610	25	30.43.00N	80.02.36W	200	24.00	3	36.5000	0.06	0.05	0.92	0.48	0.55
							100	36.5000	0.11	-0.01	0.48	0.12	0.30
21176	1750	26	30.55.12N	79.54.42W	150	24.00	3	36.5000	0.08	-0.04	1.80	0.07	0.38
							100	36.5000	0.25	0.05	0.45	0.28	0.63
21176	1940	27	31.14.00N	79.45.00W	88	23.50	3	35.5000	-0.06	0.41	2.43	1.37	0.71
							60	35.5000	-0.33	1.81	2.74	1.55	0.78
21276	632	28	32.27.30N	77.12.00W	685	24.00	3	36.5000	0.33	0.11	-1.00	-1.00	-1.00
							100	0.0	0.63	0.22	-1.00	-1.00	-1.00
21276	1115	29	33.00.00N	77.43.00W	180	22.00	3	35.5000	0.79	-0.13	3.54	2.13	0.75
							100	36.5000	-0.05	0.30	2.05	1.48	0.82
21276	1545	129	33.27.30N	76.55.00W	164	23.00	3	36.5000	0.12	0.12	-1.00	-1.00	-1.00
							100	0.0	0.06	0.08	-1.00	-1.00	-1.00
21276	1755	229	33.32.40N	77.13.18W	37	20.00	3	36.5000	1.82	0.10	-1.00	-1.00	-1.00
							16	0.0	1.34	0.43	-1.00	-1.00	-1.00
21276	1940	329	33.49.00N	77.26.30W	32	15.00	3	0.0	0.23	0.14	-1.00	-1.00	-1.00
							25	0.0	0.28	0.22	-1.00	-1.00	-1.00
21376	40	30	33.17.00N	78.00.00W	34	16.00	3	35.5000	0.51	0.33	2.75	2.02	0.76
							25	35.5000	0.42	0.46	4.14	1.65	0.64
21376	152	31	33.26.00N	78.09.00W	27	13.50	3	35.5000	0.47	0.29	1.32	1.12	0.84
							20	35.5000	0.29	0.11	-1.00	-1.00	-1.00
21376	315	32	33.35.00N	78.16.00W	22	13.00	3	34.5000	0.49	0.32	1.02	0.97	0.94
							10	35.5000	0.33	0.55	0.73	0.65	0.91
21376	440	33	33.40.48N	78.23.42W	18	11.00	3	34.5000	0.18	0.20	1.42	1.17	0.89
21376	600	34	33.45.18N	78.31.30W	10	11.00	3	33.5000	0.29	0.40	1.40	1.08	0.77
21376	900	35	33.49.30N	78.04.00W	12	11.00	3	32.0000	1.01	0.31	2.10	1.03	0.68

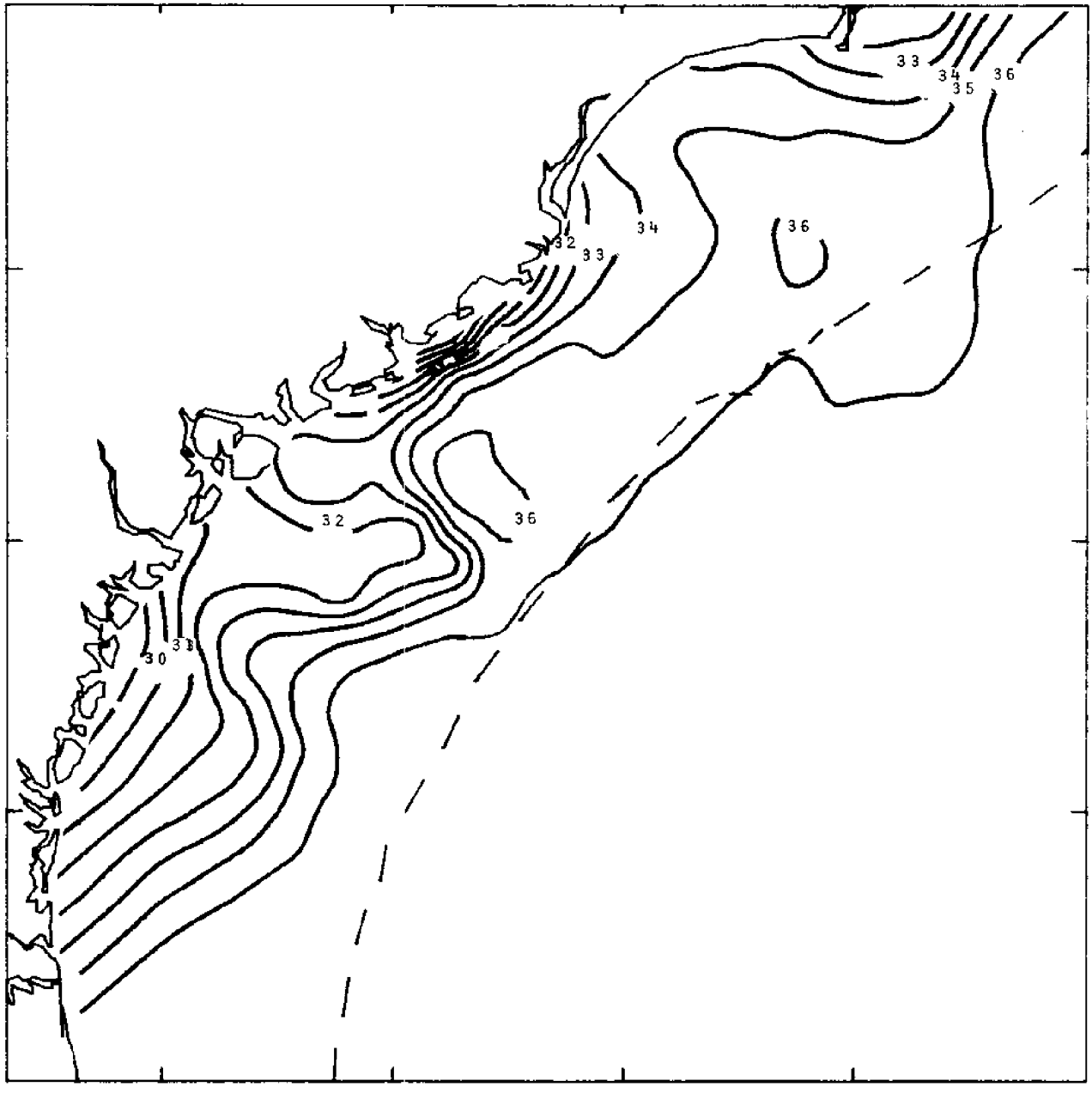

FIGURE 12. Isocline analysis of salinity data for Cruise 3.
(Contour interval = 1 °/₀₀)

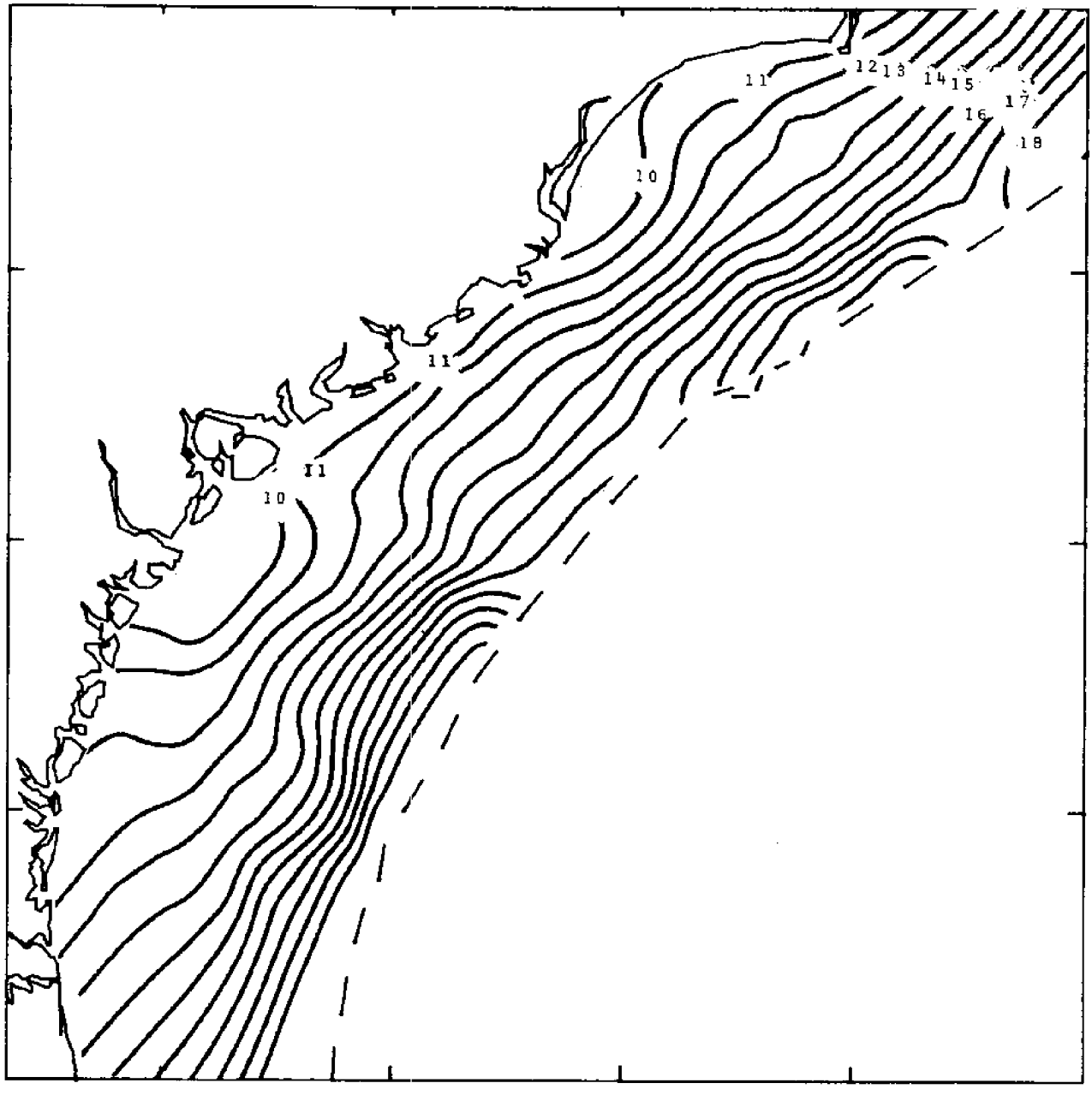

FIGURE 13. Isocline analysis of temperature data for Cruise 3.
(Contour interval = 1 degree Centegrade

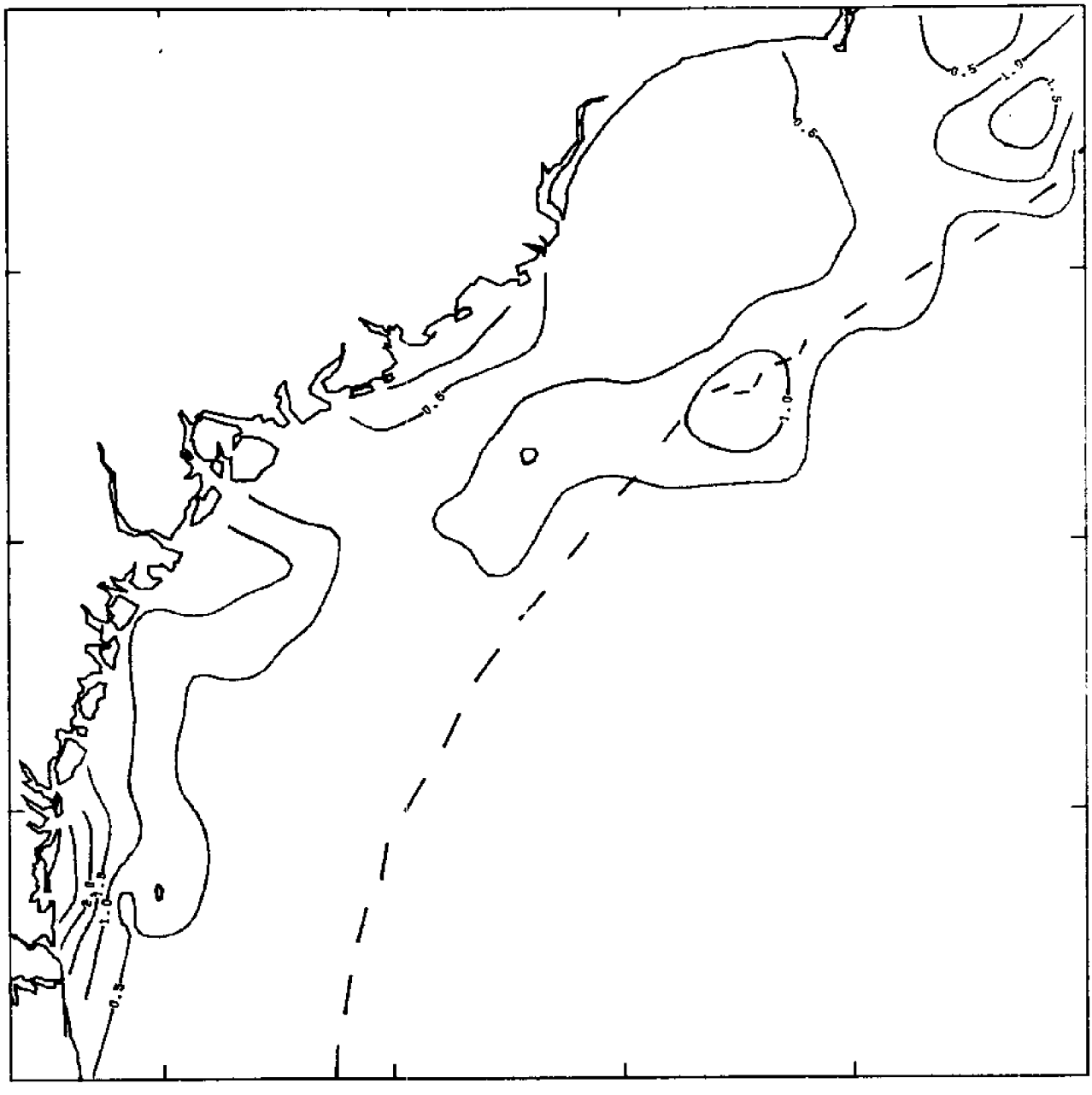

FIGURE 14. Isocline analysis of chlorophyll data for Cruise 3. (Contour interval = 1 µg/L)

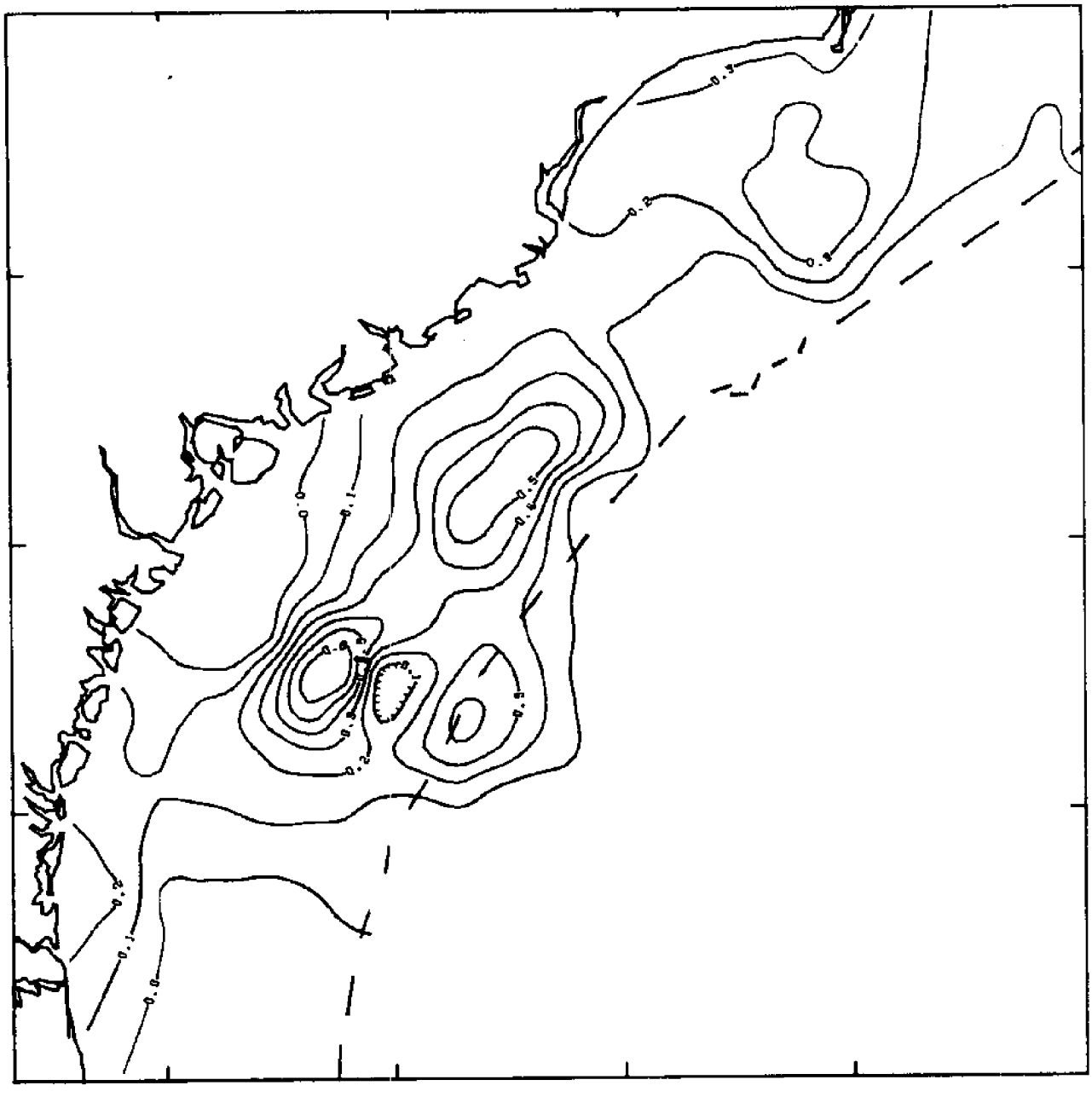

FIGURE 15. Isocline analysis of pheo-pigment data for Cruise 3. (Contour interval = .2 µg/L)

CRUISE 4, JUNE 7-11, 1976 R/V ADVANCE II

Nearly all 43 stations on this cruise were part of four transects across the continental shelf:

Doboy	Stations 10 - 16
Wassaw	Stations 5 - 9
Charleston	Stations 22 - 26
Cape Fear	Stations 28 - 39

On this cruise a special effort was made to study the same locations for an extended period of time. Stations 35, 135, 235, and 335 (Cape Fear transect) represent stations held at two-hour intervals on June 10. On the Doboy transect, a station located at 31°73'N and 80°54'W was sampled three times between 0031 and 0755 hours on June 9 (Station numbers 12, 16, and 116). During the Cape Fear series temperature, chlorophyll, and pheo-pigments remained fairly constant except at 1930 when a particularly high chlorophyll value was recoreded (.4 µg/L) and salinity increased by 1 °/₀₀. During the Doboy series, values for all parameters were essentially the same at 0402 and 0755 hours.

Analysis of the spatial distribution of hydrographic data reveals a region of relatively fresh water near the Savannah River. This area is also the focal point for a zone of high chlorophyll and pheo-pigment fluorescence. Chlorophyll concentrations in the region range from 5.8 µg/L at Station 5 to a value of .09 µg/L about 20 miles offshore (Station 9). The concentration of pheo-pigments in this zone ranged from .7 µg/L (Station 5) to .04 µg/L (Station 9). The sharp increase in chlorophyll concentration north of the Cape Fear transect is due to a chlorophyll concentration of 4 µg/L measured at Station 1.

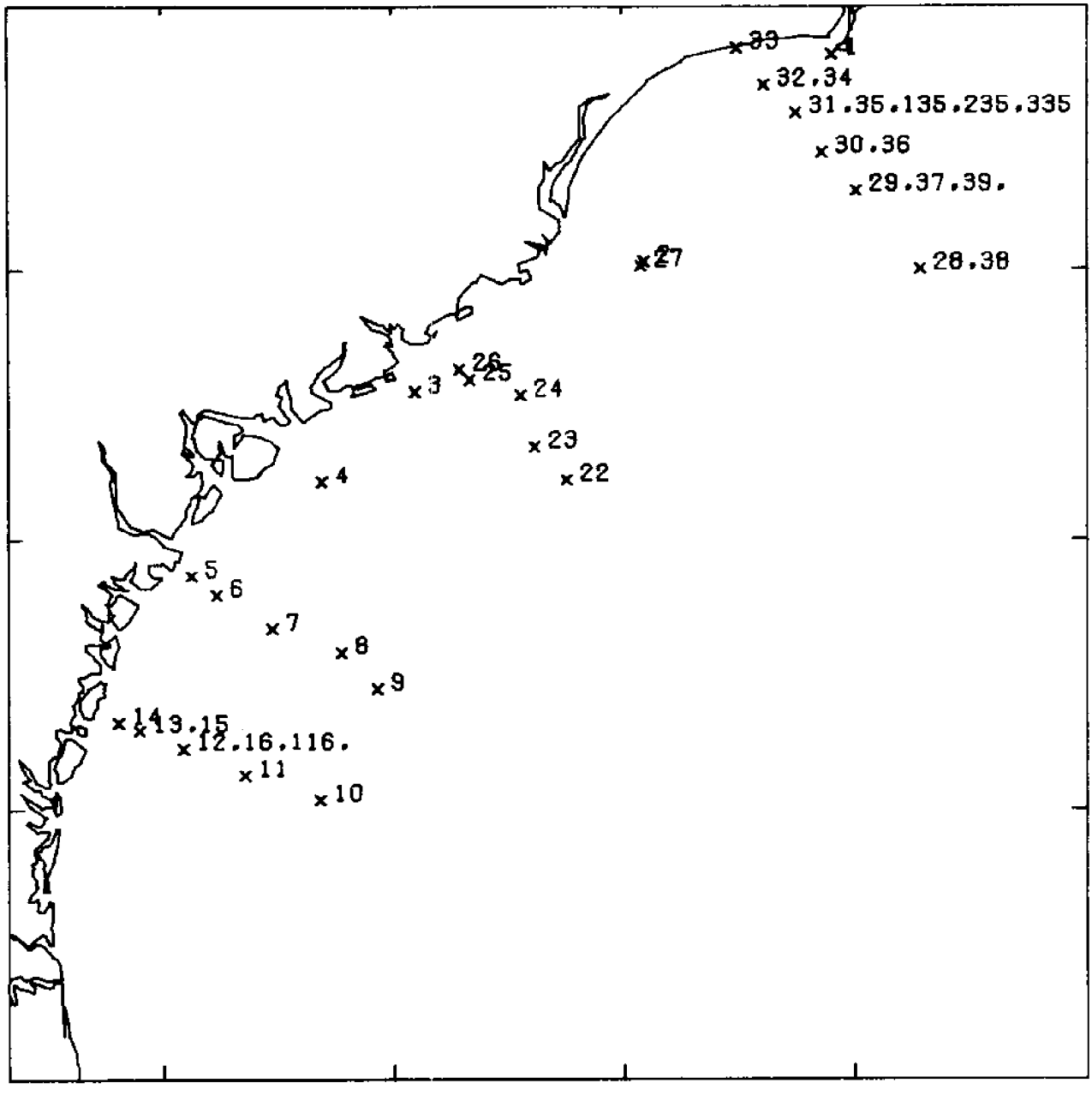

FIGURE 16. Station locations for Cruise 4.

Table IV. STATION DATA ** ADV II JUNE 7-11,1976

DATE	TIME	STA	LATITUDE	LONGITUDE	DEPTH	TEMP	NISKIN DEPTHS	SALINITY	CHLOROPHYLL IN MICROGRAMS PER LITRE	PHAEO-PIGMENTS IN MICROGRAMS PER LITRE	TOTAL ADEN.	ATP	ENERGY CHARGE
60776	1700	1	33.49.36N	78.03.42W	13	22.00	3	31.5000	4.00	-0.04	2.24	1.42	0.81
60776	2315	2	33.01.42N	78.55.06W	16	22.00	3	34.0000	0.53	0.19	2.89	1.41	0.60
60876	335	3	32.32.54N	79.54.36W	10	22.00	3	32.0000	99.99	99.99	2.00	0.87	0.72
60876	830	4	32.12.48N	80.18.48W	16	23.00	3	31.0000	0.27	0.09	1.69	1.08	0.82
60876	1205	5	31.52.00N	80.52.30W	10	23.50	3	26.0000	5.80	0.70	6.04	2.81	0.71
60876	1250	6	31.47.36N	80.46.00W	-1	23.50	3	32.0000	1.25	-0.20	1.41	0.81	0.79
60876	1430	7	31.40.12N	80.31.36W	20	23.50	3	34.0000	1.25	-0.09	1.21	0.69	0.79
60876	1635	8	31.35.00N	80.13.30W	33	24.00	3	34.5000	0.09	0.13	0.66	0.33	0.66
60876	1805	9	31.27.00N	80.04.18W	80	24.50	3	35.0000	0.09	0.04	0.73	0.38	0.71
60876	2055	10	31.07.06N	80.19.12W	48	24.00	3	34.0000	0.22	0.14	2.17	1.15	0.71
60876	2250	11	31.07.48N	80.36.42W	22	23.80	3	33.0000	0.09	0.09	1.27	0.76	0.73
60976	31	12	31.13.42N	80.54.42W	15	24.00	3	31.0000	0.67	0.09	0.97	0.69	0.80
60976	130	13	31.17.46N	81.06.00W	13	23.00	3	31.0000	3.57	-1.76	0.97	0.50	0.72
60976	204	14	31.19.30N	81.11.30W	11	23.50	3	31.5000	2.23	-0.42	1.51	0.90	0.76
60976	245	15	31.17.49N	81.06.00W	13	24.00	3	31.0000	0.98	0.07	0.0	0.0	0.0
60976	402	16	31.13.42N	80.54.42W	15	24.00	3	31.0000	2.05	-0.61	0.0	0.0	0.0
60976	755	116	31.13.42N	80.54.42W	15	24.00	3	33.0000	2.41	-1.25	0.0	0.0	0.0
60976	1700	22	32.13.18N	79.15.06W	49	25.50	3	35.0000	0.04	0.06	0.35	0.20	0.76
							30	0.0	0.22	0.03	-1.00	-1.00	-1.00
60976	1830	23	32.20.42N	79.23.24W	31	24.50	3	34.5000	0.13	0.05	0.68	0.34	0.67
60976	1946	24	32.32.18N	79.27.00W	19	24.50	3	32.0000	0.31	-0.06	1.63	0.81	0.73
							15	0.0	0.22	0.03	-1.00	-1.00	-1.00
60976	2030	25	32.35.36N	79.40.24W	18	23.50	3	34.0000	0.18	0.04	1.41	0.71	0.66
60976	2200	26	32.37.54N	79.43.00W	14	24.00	3	32.0000	0.36	0.0	1.05	0.72	0.84
61076	105	27	33.00.54N	78.55.48W	14	23.50	3	34.0000	0.67	0.06	0.83	0.46	0.72
61076	700	28	33.00.00N	77.43.18W	188	25.20	3	34.5000	0.22	-0.04	0.48	0.23	0.72
							20	0.0	0.09	0.06	-1.00	-1.00	-1.00
61076	940	29	33.17.24N	78.00.00W	34	24.00	3	34.0000	0.22	-0.08	0.80	0.31	0.61
61076	1056	30	33.26.00N	78.09.00W	24	23.50	3	34.0000	0.22	-0.08	1.10	0.52	0.67
61076	1216	31	33.34.48N	78.15.42W	18	23.50	3	34.0000	0.13	0.05	1.22	0.61	0.66
							10	0.0	0.31	0.12	-1.00	-1.00	-1.00
61076	1320	32	33.41.00N	78.24.00W	17	23.00	3	34.0000	0.27	-0.05	1.33	0.68	0.68
61076	1435	33	33.49.06N	78.31.00W	11	23.00	3	32.0000	0.75	-0.27	2.41	1.32	0.71
61076	1615	34	33.41.00N	78.24.00W	18	24.00	3	35.0000	0.31	0.12	1.33	0.72	0.70
61076	1720	35	33.34.48N	78.15.42W	20	24.00	3	33.0000	0.16	0.02	0.0	0.0	0.0
61076	1930	135	33.34.48N	78.15.42W	20	23.50	3	34.0000	0.40	-0.18	0.0	0.0	0.0
61076	2130	235	33.34.48N	78.15.42W	20	23.50	3	33.0000	0.13	0.05	0.0	0.0	0.0
61076	2230	335	33.34.48N	78.15.42W	20	23.50	3	33.0000	0.11	0.07	0.0	0.0	0.0

DATE	TIME	STA	LATITUDE	LONGITUDE	DEPTH	TEMP	NISKIN DEPTHS	SALINITY	CHLOROPHYLL IN MICROGRAMS PER LITRE	PHAEO-PIGMENTS IN MICROGRAMS PER LITRE	TOTAL ADEN.	ATP	ENERGY CHARGE
61076	2330	36	33.26.00N	78.09.00W	26	24.00	3	34.0000	0.04	0.06	0.82	0.53	0.81
							10	0.0	0.27	0.02	-1.00	-1.00	-1.00
61176	104	37	33.17.24N	78.00.00W	31	24.50	3	35.0000	0.11	0.01	1.07	0.66	0.76
							15	0.0	0.18	0.0	-1.00	-1.00	-1.00
61176	325	38	33.00.00N	77.43.18W	160	25.00	3	35.0000	0.20	-0.06	0.42	0.19	0.69
61176	534	39	33.17.24N	78.00.00W	-1	24.50	3	35.0000	0.07	0.06	0.50	0.28	0.76

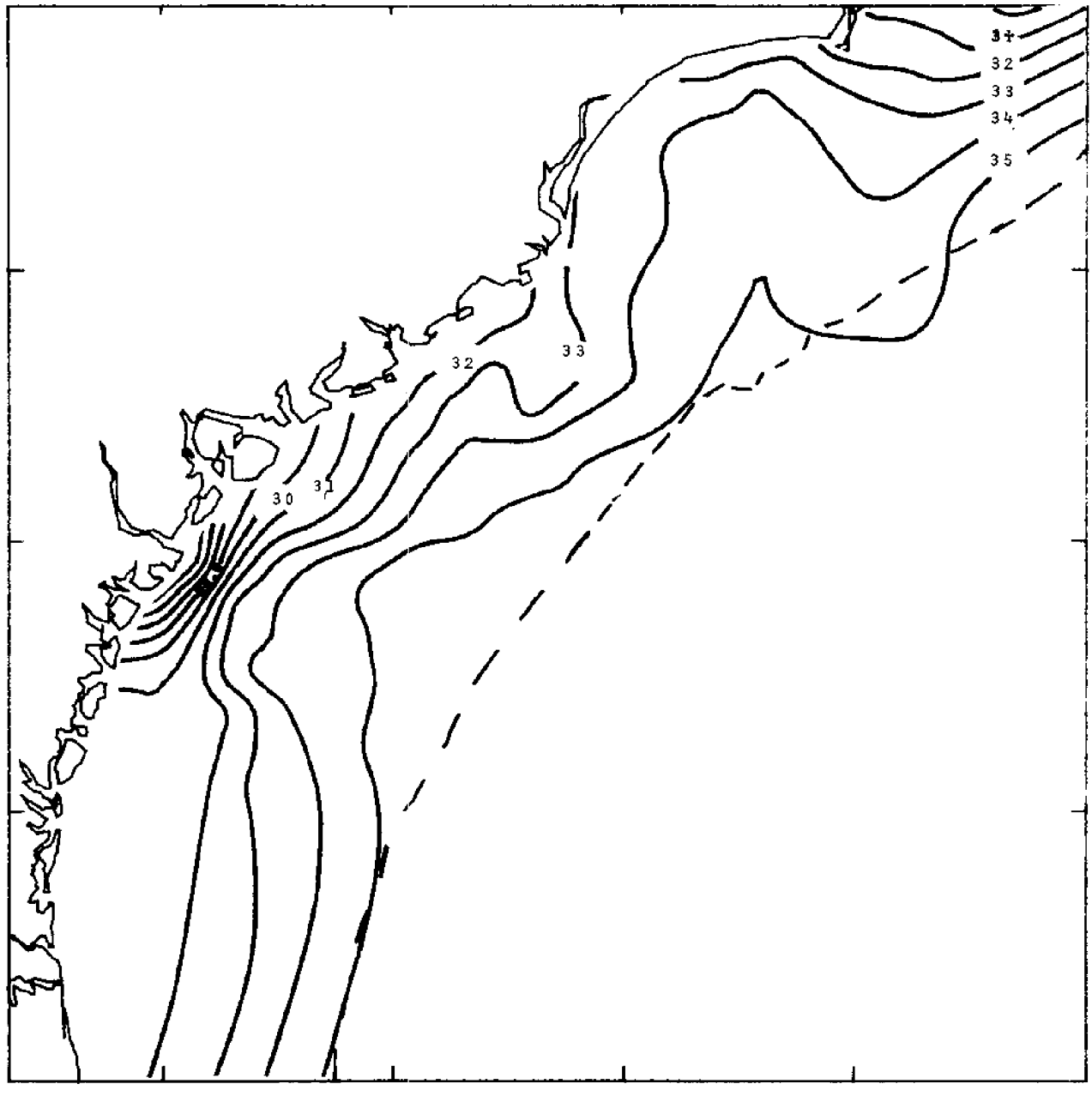

FIGURE 17. Isocline analysis of salinity data for Cruise 4.
(Contour interval = 1 °/₀₀)

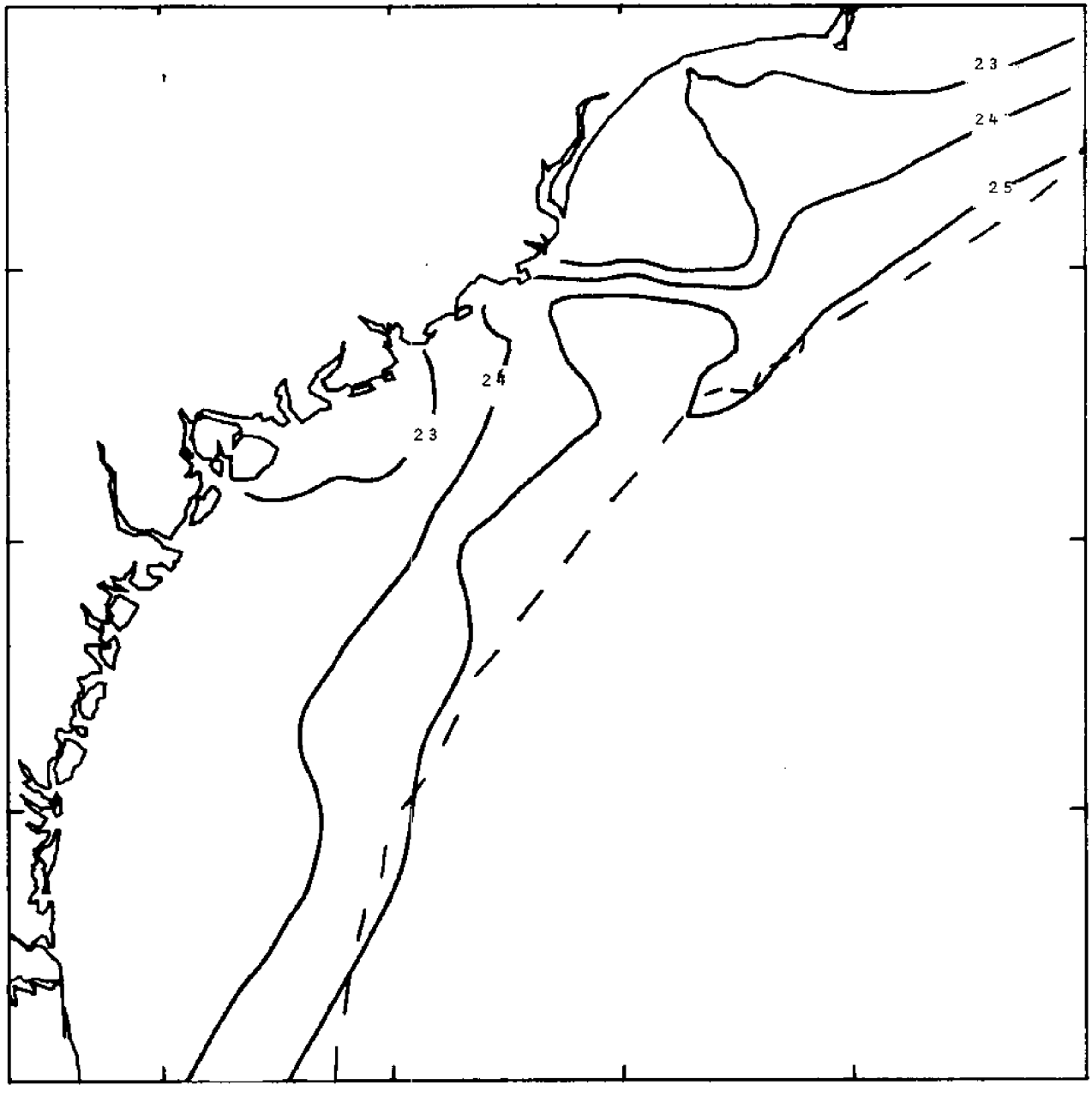

FIGURE 18. Isocline analysis of surface temperature data for Cruise 4. (Contour interval = 1 degree Centigrade)

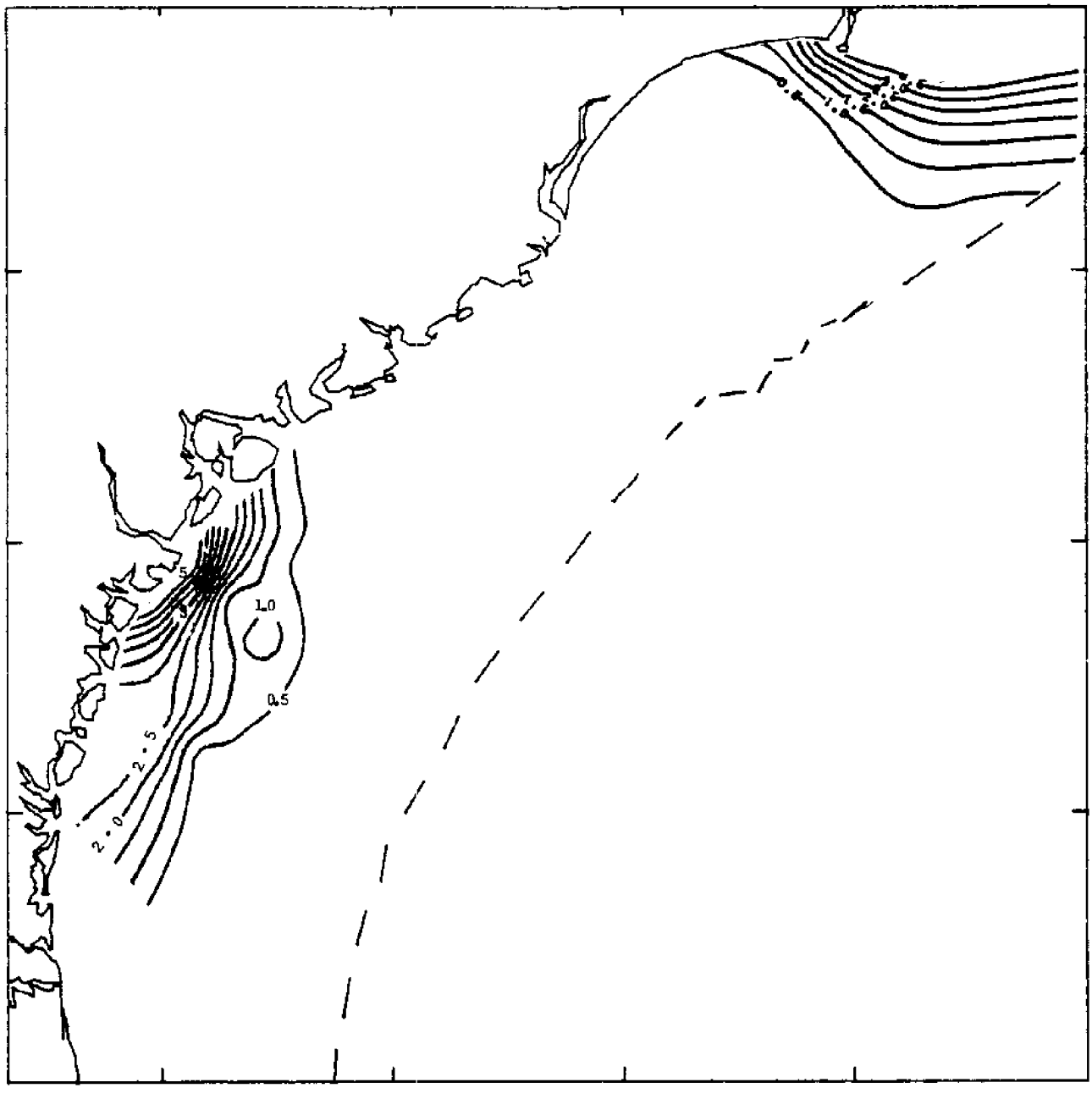

FIGURE 19. Isocline Analysis of chlorophyll data for Cruise 4.
(Contour interval = .5 µg/L)

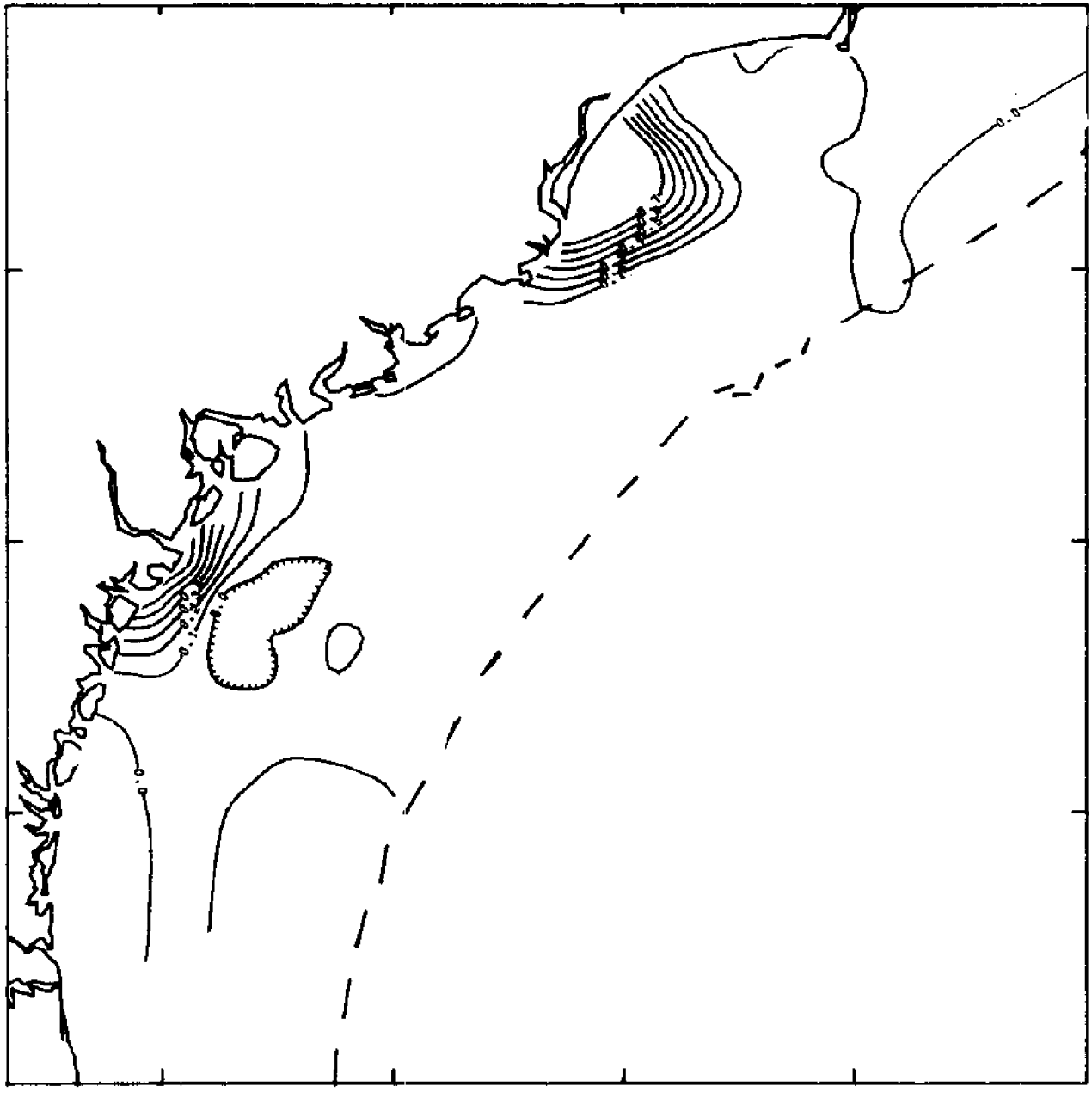

FIGURE 20. Isocline analysis of pheo-pigment data for Cruise 4.
(Contour interval = .1 µg/L)

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Wiebe, W. J. and K. Bancroft. 1975. Use of the adenylate energy charge ratio to measure growth state of natural microbial communities. Proc. Nat. Acad. Sci. 72: 2112-

Appendix IA. Salinity Program "SAL"

SAL is an interractive fortran program which was developed for use with an IBM 2741 hardcopy terminal. As a consequence, the format of some of the write statements, particularly those which give instructions to the user, would have to be re-formatted to fit the shorter line length of most erminals with a CRT-type display. The program is designed for use with data collected on a precision salinometer and the drift correction which this instrument requires is calculated by SAL and incorporated into the corrected conductivity ratio. Temperature correction to 15C is made according to procedures outlined by the International Council on Oceanographic Standards and Tables (1966) and the user may enter a standard temperature for use with all samples in a series or enter individual temperatures with each conductivity ratio. SAL has been fully documented with respect to accuracy, and questions regarding its implementation may be directed to Michelle Wood, Institute of Ecology, The University of Georgia, Athens, Georgia.

Joint Council on Oceanographic Standards and UNESCO. 1966. International Oceanographic Tables. National Institute of Oceanography of Great Britain (London). UNESCO, Paris 128 pp.

```
**** TSO FOREGROUND HARDCOPY ****
DSNAME=GGA.COOKIES                                        (SAL     )

      C    ** SALINITY PROGRAM BY A. MICHELLE GOOD *** JANUARY 1976 **      00000010
           DIMENSION OBOT(200),OTEMP(200),OSAL(200)                         00000020
           INTEGER COUNT, BOT,K,ANS,OBOT                                    00000030
           DATA Y/'Y'/                                                      00000040
           K=1                                                              00000050
           WRITE (6,5)                                                      00000054
         5 FORMAT (////+9X,'THIS IS AN INTERACTIVE FORTRAN PROGRAM WHICH CA00000055
          &LCULATES'/12X,'SALINITY (ERROR<.001 PPT) FOR UP TO 200 SAMPLES ACC00000056
          &ORDING TO CONVENTIONS'/9X,'PUBLISHED BY THE JOINT PANEL ON OCEANOG00000057
          &RAPHIC TABLES AND STANDARDS AND UNESCO IN 1966'/)                00000058
           WRITE (6,10)                                                     00000060
        10 FORMAT (//5X,'ENTER NUMBER OF SAMPLES BETWEEN STANDARDS AS XXX AND00000070
          & CONDUCTIVITY RATIO FOR EACH STANDARD AS X.XXXXX'/5X,'SKIP A SPACE00000080
          &E BETWEEN THESE ENTRIES'//)                                      00000090
        15 READ (5,20) NMSMP,STD1,STD2                                      00000100
        20 FORMAT (I3,1X,F7.5,1X,F7.5)                                      00000110
           DRIFT=(STD1-STD2)/(FLOAT(NMSMP)+1.)                              00000120
           WRITE (6,25) DRIFT                                               00000130
        25 FORMAT (5X,'DRIFT=',F6.5/5X,'PLEASE ENTER STANDARD TEMPERATURE AS 00000140
          & + OR -XX.XX')                                                   00000150
           READ (5,30) TTEMP                                                00000160
        30 FORMAT (F6.2)                                                    00000170
           WRITE (6,35)                                                     00000180
        35 FORMAT (5X,'THANK YOU'/5X,'DO YOU NEED INSTRUCTIONS?')           00000190
           READ (5,40) ANS                                                  00000200
        40 FORMAT (A1)                                                      00000210
           IF (ANS.EQ.N) GO TO +)                                           00000220
           WRITE (6,45) TTEMP                                               00000230
        45 FORMAT (5X,'ENTER SAMPLE NUMBER AND CONDUCTIVITY RATIO AS XXXX AN00000240
          &D X.XXXXX AND RETURN'/5X,'SKIP A SPACE BETWEEN THESE ENTRIES. IF TH00000250
          &E TEMPERATURE IS NOT',1X,F5.2/5X,'SKIP A SPACE, ENTER THE CORRECT 00000260
          &VALUE AS + OR -XX.XX BEFORE RETURN'/5X,'YOU MAY ENTER NEW DATA AS 00000270
          &SOON AS SALINITY IS DISPLAYED')                                  00000280
           COUNT=0                                                          00000290
           WRITE (6,46)                                                     00000291
        46 FORMAT (/5X,'ENTER FIRST SAMPLE DATA')                           00000292
        50 READ (5,56) BOT, RAT, TEMP                                       00000310
        55 FORMAT (2X,I4,F7.5,F7.2)                                         00000330
        56 FORMAT (I4,1X,F7.5,1X,F7.2)                                      00000331
           COUNT=COUNT+1                                                    00000340
           K=K+1                                                            00000350
           RTEMP=TTEMP                                                      00000360
           IF (TEMP.NE.0.0) RTEMP=TEMP                                      00000370
           CORRAT=(10.**(-5.)*RAT*(RAT-1.)*(RTEMP-15.)*(96.7-[72.0*RAT)+(37.300000380
          &*(RAT**2.))-((.63+(.21*(RAT**2.)))*(RTEMP-15.)))                 00000390
           CORRAT=(DRIFT*FLOAT(COUNT))+CORRAT                               00000420
           SAL=-.66956+(28.29720*CORRAT)+(12.80832*(CORRAT**2.))-(10.67869*(C00000450
          &ORRAT**3.))+(5.98624*(CORRAT**4.))-(1.32311*(CORRAT**5.))        00000460
           WRITE (6,44) SAL                                                 00000470
        44 FORMAT (2X,'SALINITY=',F7.4/)                                    00000480
           OBOT(K)=BOT                                                      00000490
           OTEMP(K)=RTEMP                                                   00000500
           OSAL(K)=SAL                                                      00000510
           IF (COUNT.NE.NMSMP) GO TO 50                                     00000520
           WRITE (6,60)                                                     00000530
        60 FORMAT (2X,'ANOTHER SET?')                                       00000540
           READ (5,40) ANS                                                  00000550
           IF (ANS.EQ.N) GO TO 70                                           00000560
           WRITE (6,65)                                                     00000570

        65 FORMAT (2X,'ENTER NUMBER OF SAMPLES AND STANDARDS')              00000580
           GO TO 15                                                         00000590
        70 WRITE (6,75)                                                     00000600
        75 FORMAT (2X,'DO YOU WANT THIS DATA SORTED BY SAMPLE NUMBER?')     00000610
           READ (5,40) ANS                                                  00000620
           IF (ANS.EQ.N) GO TO 100                                          00000630
           DO 80 I=1,K                                                      00000640
           DO 80 J=1,K                                                      00000650
           IF (OBOT(I).LE.OBOT(J)) GO TO 80                                 00000660
           TBOT=OBOT(J)                                                     00000670
           TSAL=OSAL(J)                                                     00000680
           TTEMP=OTEMP(J)                                                   00000690
           OBOT(J)=OBOT(I)                                                  00000700
           OSAL(J)=OSAL(I)                                                  00000710
           OTEMP(J)=OTEMP(I)                                                00000720
           OBOT(I)=TBOT                                                     00000730
           OSAL(I)=TSAL                                                     00000740
           OTEMP(I)=TTEMP                                                   00000750
        80 CONTINUE                                                         00000760
           WRITE (6,85)                                                     00000770
        85 FORMAT (/////10X,'SAMPLE',5X,'SALINITY',5X,'TEMPERATURE'///)     00000780
           DO 95 L=1,K                                                      00000790
           WRITE (6,90) OBOT(L),OSAL(L),OTEMP(L)                            00000800
        90 FORMAT (11X,I4,7X,F7.4,8X,F6.2)                                  00000810
        95 CONTINUE                                                         00000820
       100 STOP                                                             00000830
           END                                                              00000840
```

Appendix IB. Adenylate Programs "ATP" and "ATPEC"

Two adenylate programs are included in this appendix: ATPEC and ATP. Both are interactive fortran programs which are compatible with most hard-copy or CRT-type terminals. The program ATPEC was created to automate data processing for Cruises 1, 2, 3, and 4 according to methods used by Bancroft (Thesis 1977; Wiebe and Bancroft, ms.). The use of the one-point standard curve for ATP has since been found to be unreliable (Campbell and Wiebe 1978). All adenylate assays are now accompanied by multiple-point standard curves run at the beginning and end of each series of samples. This provides a better approximation of the ATP standard curve and allows a correction to be made for drift which arises from enzyme deterioration during the analytical session. Parties interested in implementing either of these programs should contact Walton B. Campbell, Institute of Ecology, The University of Georgia, Athens, Georgia.

Campbell, W. B. and W. J. Wiebe. 1978. ATP standard curves: a precautionary note. Abstracts. 78th Annual Meeting American Society for Microbiology. Las Vegas, Nevada.

Wiebe and Bancroft, ms.

```
**** TSO FOREGROUND HARDCOPY ****
DSNAME=UGA.TENNIES                                    (ATP     )

      C ** ADENYLATE DATA ANALYSIS ** WALT CAMPBELL ** DECEMBER 1975      00000005
        DATA Y/'Y'/                                                       00000010
     1  WRITE (6,2)                                                       00000020
     2  FORMAT (1H0,'INPUT'/' ATPST.BACKG.COUNT.')                        00000030
        SUMXSQ=0.0                                                        00000040
        SUMXY=0.0                                                         00000050
        SUMX=0.0                                                          00000060
        SUMY=0.0                                                          00000070
        N=0.0                                                             00000080
     3  READ (5,4) ATP,BCK,STD                                            00000090
     4  FORMAT (E6.0,2F6.0)                                               00000100
        IF (ATP .EQ. 0.0) GO TO 5                                         00000110
    50  L=ALOG10(ATP)                                                     00000120
        A=L                                                               00000130
        A=ALOG10(ATP)-A                                                   00000140
        L=L/10                                                            00000150
        IF (ATP .GT. 1.0E20) ATP=10.0**(A+L)                              00000160
        IF (ATP .GT. 1.0E20) GO TO 50                                     00000170
        IF (STD .LE. BCK) WRITE (6,16)                                    00000180
        IF (STD .LE. BCK) GO TO 3                                         00000190
        STD=ALOG10(STD-BCK)                                               00000200
        ATP=ALOG10(ATP)                                                   00000210
        SUMXSQ=(STD**2)+SUMXSQ                                            00000220
        SUMXY=(STD*ATP)+SUMXY                                             00000230
        SUMX=STD+SUMX                                                     00000240
        SUMY=ATP+SUMY                                                     00000250
        N=N+1                                                             00000260
        GO TO 3                                                           00000270
     5  XBAR=SUMX/FLOAT(N)                                                00000280
        WRITE (6,14)                                                      00000290
        READ (5,15) DIL                                                   00000300
        YBAR=SUMY/FLOAT(N)                                                00000310
        TOP=SUMXY-((SUMX*SUMY)/FLOAT(N))                                  00000320
        BOT=SUMXSQ-((SUMX**2)/FLOAT(N))                                   00000330
        SLOPE=TOP/BOT                                                     00000340
        XINTER=YBAR-(SLOPE*XBAR)                                          00000350
        WRITE (6,17) SLOPE,XINTER                                         00000360
        WRITE (6,7)                                                       00000370
        D=1.0                                                             00000380
     7  FORMAT (1H0,'ENTER'/' BACKG.COUNT.DRYWT.')                        00000390
     8  READ (5,9) BCK,STD,DRY                                            00000400
     9  FORMAT (3F6.0)                                                    00000410
        IF (BCK.EQ. 0.0) GO TO 11                                         00000420
        IF (DRY .EQ. 0.0) DRY=D                                           00000421
        D=DRY                                                             00000422
        IF (DIL .EQ. 0.0) DIL=30.0                                        00000423
        IF (STD .LE. BCK) WRITE (6,16)                                    00000430
        IF (STD .LE. BCK) GO TO 8                                         00000440
        STD=ALOG10(STD-BCK)                                               00000450
        ATP=(10.0**((SLOPE*STD)+XINTER))*DIL                              00000460
        DRY=ATP/DRY                                                       00000470
        WRITE (6,10) ATP,DRY                                              00000480
    10  FORMAT (1H ,14X,2E10.4)                                           00000490
        GO TO 8                                                           00000500
    11  WRITE (6,12)                                                      00000510
    12  FORMAT (1H0,'ANOTHER?')                                           00000520
        READ (5,13) ANS                                                   00000530
    13  FORMAT (A1)                                                       00000540
    14  FORMAT (' DILUTN')                                                00000550

    15  FORMAT (F10.1)                                                    00000560
    16  FORMAT (' BACKG > COUNTS ? ')                                     00000570
    17  FORMAT (/' LOG ATP (Y) VS LOG COUNTS (X)'/' SLOPE=',E10.4,' INTERC00000580
       *EPT=',E10.4)                                                      00000590
        IF (ANS .EQ. Y) GO TO 1                                           00000600
        STOP                                                              00000610
        END                                                               00000620
```

```
      C  *** ADENYLATE PROGRAM ** WALT CAMPBELL ** DECEMBER 1975          00000005
       REAL I,D,M,EPFACT,MPFACT,CONST,AT,AD,AM                           00000010
       REAL ATP,ADP,AMP,STD,ATPBLK,ADPBLK,AMPBLK,NAME                    00000020
       DATA YES/'Y'/                                                     00000030
    10 WRITE (6,1)                                                       00000040
     1 FORMAT (1H1//' INPUT'/' ATPBLK.ADPBLK.AMPBLK.STDCNT.DILN.STDCON.')00000050
       READ (5,2) ATPBLK,ADPBLK,AMPBLK,STD,DILN,STDCON                   00000060
     2 FORMAT (4F7.0,F5.0,E6.2)                                          00000070
       IF (STDCON .EQ. 0.0) STDCON=1.0E-7                                00000080
       WRITE (6,75) ATPBLK,ADPBLK,AMPBLK,STD,DILN,STDCON                 00000090
    75 FORMAT (4F7.0,F5.0,E7.2)                                          00000091
       WRITE (6,12)                                                      00000100
    12 FORMAT(1H //26X,'NAME',6X,'ATP',9X,'ADP',9X,'AMP',8X,'TOTAL',10X,'00000110
      *EC'/)                                                             00000120
       WRITE (6,3)                                                       00000130
     3 FORMAT (1H ,'INPUT'/' NAME.ATPNUM.ADPNUM.AMPNUM.')                00000140
     4 READ (5,5) NAME,ATP,ADP,AMP                                       00000150
     5 FORMAT (A4,1X,3F7.0)                                              00000160
       WRITE (6,5) NAME,ATP,ADP,AMP                                      00000170
       IF (ATP .EQ. 0.0) GO TO 9                                         00000180
       IF (ATP .LE. ATPBLK) GO TO 7                                      00000190
       IF (ADP .LE. ADPBLK) GO TO 7                                      00000200
       IF (AMP .LE. AMPBLK) GO TO 7                                      00000210
       CONST=((DILN*5.*1.2*STDCON)/(STD-ATPBLK)                          00000220
       AT=(ATP-ATPBLK)*CONST                                             00000230
       AD=(ADP-ADPBLK)*CONST                                             00000240
       AM=(AMP-AMPBLK)*CONST                                             00000250
       T=AT                                                              00000260
       D=AD-AT                                                           00000270
       M=AM-AD                                                           00000280
       IF (M .LT. 0.0) M=0.0                                             00000290
       EC=(T+(0.5*D))/(M+D+T)                                            00000300
       ATP=T                                                             00000310
       ADP=D                                                             00000320
       AMP=M                                                             00000330
       TOTADE=T+D+M                                                      00000340
       WRITE (6,6) NAME,ATP,ADP,AMP,TOTADE,EC                            00000350
     6 FORMAT (1H ,25X,A4,1X,4E12.4,F12.6)                               00000360
       GO TO 4                                                           00000370
     7 WRITE (6,8)                                                       00000380
     8 FORMAT (1H ,'BLANK MORE THAN SAMPLE? TRY AGAIN.!')                00000390
       WRITE (6,3)                                                       00000400
       GO TO 4                                                           00000410
     9 WRITE (6,10)                                                      00000420
    10 FORMAT (1H ,' RUN ANOTHER STD CURVE & SAMPLS?!')                  00000430
       READ (5,11) ANS                                                   00000440
    11 FORMAT (A1)                                                       00000450
       WRITE (6,11) ANS                                                  00000460
       IF (ANS .EQ. YES) GO TO 20                                        00000470
       ENDFILE 8                                                         00000471
       STOP                                                              00000480
       END                                                               00000490
```

APPENDIX III. STATISTICAL ANALYSIS. Alice G. Chalmers

All statistical analysis was done with the SAS 76 statistical program package. Descriptive statistics (Table 1) used all data points. For further analysis, all negative values for chlorophyll a were omitted, and all negative values for phaeopigments were equated to zero. Log transformations were used in analyses of chlorophyll a, total adenylates, ATP and energy charge. When there was a significant interaction effect in a two-way analysis of variance, one-way analyses were used.

Correlation analyses were carried out to determine what relationships, if any, existed between the variables. There was a significant negative correlation between chlorophyll and both salinity and miles from shore on all cruises. There was a significant positive correlation between chlorophyll and ATP on all cruises. There was also a significant positive correlation between chlorophyll and total adenylates on all cruises but Cruise 3. Chlorophyll and phaeopigments were significantly correlated only for Cruise 4, when there was a negative relationship. Besides its correlation with chlorophyll, ATP correlated positively with total adenylates on all 4 cruises, positively with energy charge on Cruises 2 and 3, negatively with miles from shore on all but Cruise 1, and negatively with salinity on Cruises 2 and 4. There was a significant positive correlation between total adenylates and energy charge on Cruise 2 and significant negative correlations between total adenylates and both salinity and miles from shore on Cruises 2 and 4. There was a significant negative correlation between energy charge and miles from shore on Cruise 3. Miles from shore and salinity were positively correlated on all cruises.

Since miles from shore was so highly correlated with some of the variables, a multivariate partial correlation analysis was used to eliminate its effect on the other variables. When the effect of miles from shore was held constant, the significant correlation between ATP and total adenylates was still present for all cruises (Tables 6-9). Chlorophyll was significantly correlated only with total adenylates and ATP on Cruise 1. Phaeopigments were significantly correlated with total adenylates and ATP on Cruise 4. ATP and energy charge were significantly correlated on Cruises 2 and 3.

Regression analysis also revealed a significant relationship between several of the variables and distance from shore (Table 10). Regressions were significant for surface chlorophyll on all cruises, for below surface chlorophyll on all but Cruise 1, for total adenylates on Cruises 2 and 4 and for energy charge on Cruise 3. Analysis of covariance showed that the slopes of the regression lines were statistically the same on all cruises for phaeopigments and below surface chlorophyll, meaning that the relationship with distance from shore was the same on all cruises. There were differences between cruises for surface chlorophyll, total adenylates, ATP and energy

charge. All slopes were negative except for energy charge on Cruise 1 and for phaeopigments on Cruises 1, 3, and 4, so that both correlation and regression analysis have shown that there was an inverse relationship between distance from shore and concentrations of chlorophyll a, total adenylates, ATP and energy charge ratios.

Analysis of variance showed that there was no difference with depth in values of total adenylates, ATP, energy charge or phaeopigments (Tables 23, 28, 34 and 20, respecitvely), so both surface and below surface (>3m) observations were utilized in analyses of these variables. There was a significant difference with depth for chlorophyll (Table 11) and salinity (Table 52), so separate analyses were carried out for surface and below surface observations.

Analysis of variance was used to determine whether there were differences between cruises in concentrations of chlorophyll, phaeopigments, total adenylates, ATP energy charge and salinity. There were differences for each variable, although the groupings of cruises were different for all variables but chlorophyll and phaeopigments. For these two variables, cocentrations were significantly higher for Cruise 1 than for the other three, which had statistically equal concentrations of chlorophyll and phaeopigments (Tables 11 and 20). Total adenylates were higher on Cruise 3 than on the other cruises (Table 23). ATP concentrations were higher on Cruise 3 than on any of the others and lower on Cruise 1 than on the other three; concentrations on Cruises 2 and 4 were the same (Table 28). Energy charge values were higher on the last 2 cruises than on the first two (Table 34). Salinities were highest on Cruise 2 and lowest on Cruise 4. For all subsequent analyses of variance, cruise data was grouped according to these results.

To further investigate the relationship between the variables of interest and distance from shore, observations were grouped into on-shore and off-shore by distance and salinity. The dividing points were 20 miles and 33% salinity. Chlorophyll, both at the surface and below, ATP, and total adenylates were significantly higher closer to shore than off-shore (Tables 12, 13, 24 and 29, respectively). Surface and below surface chlorophyll and total adenylates were higher in lower salinity on-shore water than in off-shore water (Tables 14, 15 and 25, respectively). Phaeopigments and energy charge were the same in on-shore and off-shore waters when divided either by distance or by salinity (Tables 21, 22, 35 and 36). There was no difference in ATP when observations were separated on the basis of salinity (Table 30).

To determine whether there might be other break points other than 20 miles, observations were divided into groups based on distance from shore using 10 mile increments out to 60 miles and combining all observations taken further out than 60 miles into the seventh group. These analyses did not reveal any distant division points

except perhaps for chlorophyll (Tables 16-19), but showed that values for all variables but phaeopigments and energy charge tend to be higher close to shore and gradually decrease as distance from shore increases, just as was shown by the regression analysis.

When salinity was analyzed for differences with distance from shore, surface salinities inside 10 miles were significantly lower than those further out. Another breakpoint in surface salinity was found at 30 miles (Table 55). A distance of 20 miles from shore was the most appropriate dividing point for below-surface salinities (Table 56).

The other variables (chlorophyll, phaeopigments, total adenylates, ATP and energy charge) were analyzed according to salinity. Phaeopigment was the only variable for which there were no differences (Table 59). There was a strong relationship between surface chlorophyll concentrations and salinity, with the highest concentrations occurring at salinities of 33 °/₀₀ and lower (Table 57). Lowest surface chlorophyll concentrations occurred at salinities greater than 34 °/₀₀. More than 85% of the surface observations with salinities of 34 °/₀₀ or less occurred less than 20 miles from shore; 95% of them occurred less than 30 miles from shore. Below-surface chlorophyll concentration was not so closely related to salinity (Table 58), although lowest concentrations were found at the highest salinities.

The relationship between total adenylates and salinity was different for Cruise 3 than for the other cruises (Tables 61 and 62). ATP and energy charge showed little difference with increasing salinities, although 36 °/₀₀ was a significant break-point for both variables.

Four transects--Cape Fear, Charleston, Wassaw and Sapelo--which were sampled on each of the four cruises were analyzed for differences in the variables from cruise to cruise. The only variables for which there were differences between transects were below surface chlorophyll a and total adenylates and ATP on Cruise 3 (Tables 40, 42 and 43, respectively). ATP concentrations were higher in the two more northern transects. In the case of both ATP and total adenylates, concentrations were highest on the Charleston transect.

Explanation of symbols

For Analysis of Variance Tables 11, 20, 23, 18, 34, and 52.

1 = Cruise 1, R/V Eastward, E-3-75, June 11-17, 1975
2 = Cruise 2, R/V Eastward, E-15-75, Dec. 1-7, 1975
3 = Cruise 3, R/V Advance II, Feb. 8-13, 1976
4 = Cruise 4, R/V Advance II, June 7-11, 1976

For Analysis of Variance Tables 16-19, 26, 27, 31-33, 37, 38, 55, and 56.

1 = 10.1 miles from shore
2 = 10.1-20.0 miles from shore
3 = 20.1-30.0 " " "
4 = 30.1-40.0 " " "
5 = 40.1-50.0 " " "
6 = 50.1-60.0 " " "
7 = 60.0 miles from shore

For Analysis of Variance Tables 39-51.

CF = Cape Fear Transect
C = Charleston Transect
W = Wassaw Transect
S = Sapelo Transect

For Analysis of Variance Tables 57-64.

1 = salinity $\leq$ 33 $^{o}/_{oo}$
2 = salinity > 33 $^{o}/_{oo}$ and $\leq$ 34 $^{o}/_{oo}$
3 = 34 $^{o}/_{oo}$ < salinity $\leq$ 35 $^{o}/_{oo}$
4 = 35 $^{o}/_{oo}$ < salinity $\leq$ 36 $^{o}/_{oo}$
5 = salinity > 36 $^{o}/_{oo}$

* = PR>F .05
** = PR>F .01
*** = PR>F .001

Table 1. Summary of the Data.

VARIABLE	CRUISE	N	MEAN	STD. DEV.	MIN.	MAX.
Chlorophyll A Surface	1	53	2.40	2.92	0.20	16.06
	2	41	0.74	0.68	0.11	2.46
	3	36	0.63	0.59	0.06	2.92
	4	37	0.84	1.27	0.04	5.80
Chlorophyll A Below Surface	1	79	3.83	4.80	0.02	29.72
	2	41	0.54	0.62	0.01	3.09
	3	22	0.58	0.53	0.02	2.07
	4	6	0.22	0.08	0.09	0.31
Phaeopigments	1	135	0.36	1.47	- 9.42	9.43
	2	83	0.04	0.23	- 0.55	1.79
	3	63	0.16	0.32	- 0.57	1.81
	4	43	- 0.06	0.38	- 1.76	0.70
Total Adenylates	1	26	0.81	0.67	0.11	2.81
	2	68	0.75	0.42	0.12	1.60
	3	56	1.16	0.75	0.25	3.21
	4	31	0.83	0.63	0.21	3.62
ATP	1	26	0.27	0.21	0.02	0.81
	2	68	0.36	0.23	0.01	1.26
	3	56	0.69	0.42	0.04	1.94
	4	31	0.44	0.31	0.12	1.68
Energy Charge	1	26	0.61	0.09	0.40	0.81
	2	68	0.65	0.12	0.24	0.88
	3	56	0.73	0.13	0.30	0.94
	4	31	0.72	0.06	0.60	0.83
Salinity	1	126	34.67	1.51	25.82	36.48
	2	83	35.19	1.32	31.16	36.44
	3	59	34.47	2.02	27.50	36.50
	4	44	33.40	1.87	26.00	35.50

Table 2. Correlation Matrix, R/V Eastward, E-3-75, June 11-17, 1975.

	Salinity	Chl. A	Phaeo.	Tot. Ad.	ATP	E. Charge	Miles
Salinity	1.00						
Chlorophyll A	-0.35***	1.00					
Phaeopigments	0.08	0.03	1.00				
Total Adenylates	0.12	0.51**	-0.01	1.00			
ATP	0.06	0.48*	0.03	0.81***	1.00		
Energy Charge	-0.09	-0.08	0.18	-0.24	0.09	1.00	
Miles from Shore	0.36***	-0.62***	0.03	-0.21	-0.23	0.01	1.00

Table 3. Correlation Matrix, R/V Eastward, E-15-75, Dec. 1-7, 1975.

	Salinity	Chl. A	Phaeo.	Tot. Ad.	ATP	E. Charge	Miles
Salinity	1.00						
Chlorophyll A	-0.71***	1.00					
Phaeopigments	0.02	-0.04	1.00				
Total Adenylates	-0.50***	0.60***	-0.10	1.00			
ATP	-0.46***	0.49***	-0.03	0.89***	1.00		
Energy Charge	-0.15	0.07	0.13	0.26*	0.60***	1.00	
Miles from Shore	0.70***	-0.62***	-0.04	-0.63***	-0.59***	-0.20	1.00

Table 4. Correlation Matrix, Advance II, Feb. 8-13, 1976.

	Salinity	Chl. A	Phaeo.	Tot. Ad.	ATP	E. Charge	Miles
Salinity	1.00						
Chlorophyll A	-0.43**	1.00					
Phaeopigments	0.07	-0.02	1.00				
Total Adenylates	0.02	0.16	0.23	1.00			
ATP	-0.10	0.28*	0.19	0.79***	1.00		
Energy Charge	-0.24	0.25	0.07	0.05	0.52***	1.00	
Miles from Shore	0.74	-0.29*	0.15	-0.04	-0.30*	-0.48***	1.00

Table 5. Correlation Matrix, Advance II, June 7-11, 1976.

	Salinity	Chl. A	Phaeo.	Tot. Ad.	ATP	E. Charge	Miles
Salinity	1.00						
Chlorophyll A	-0.66***	1.00					
Phaeopigments	0.09	-0.42**	1.00				
Total Adenylates	-0.68***	0.59***	0.19	1.00			
ATP	-0.70***	0.57***	0.19	0.97***	1.00		
Energy Charge	-0.32	0.12	-0.04	0.04	0.24	1.00	
Miles from Shore	0.65***	-0.62***	0.17	-0.65***	-0.69***	-0.29	1.00

Table 6. Partial Correlation Matrix, Cruise 1. (effect of miles from shore held constant)

	Chl. A	Phaeo.	Tot. Ad.	ATP	E. Charge
Chlorophyll A	1.00				
Phaeopigments	0.07	1.00			
Total Adenylates	0.44*	-0.06	1.00		
ATP	0.39	-0.01	0.76***	1.00	
Energy Charge	-0.08	0.18	-0.21	0.15	1.00

Table 7. Partial Correlation Matrix, Cruise 2. (effect of miles from shore held constant)

	Chl. A	Phaeo.	Tot. Ad.	ATP	E. Charge
Chlorophyll A	1.00				
Phaeopigments	-0.08	1.00			
Total Adenylates	0.18	-0.22	1.00		
ATP	0.03	-0.11	0.81***	1.00	
Energy Charge	-0.12	0.12	0.19	0.43***	1.00

Table 8. Partial Correlation Matrix, Cruise 3. (effect of miles from shore held constant)

	Chl. A	Phaeo.	Tot. Ad.	ATP	E. Charge
Chlorophyll A	1.00				
Phaeopigments	-0.02	1.00			
Total Adenylates	0.09	0.27	1.00		
ATP	0.15	0.23	0.79***	1.00	
Energy Charge	0.11	0.01	-0.02	0.31*	1.00

Table 9. Partial Correlation Matrix, Cruise 4. (effect of miles from shore held constant)

	Chl. A	Phaeo.	Tot. Ad.	ATP	E. Charge
Chlorophyll A	1.00				
Phaeopigments	-0.28	1.00			
Total Adenylates	0.31	0.40*	1.00		
ATP	0.24	0.42*	0.96***	1.00	
Energy Charge	-0.09	0.01	-0.20	0.05	1.00

Table 10. Regression against miles from shore.

Variable	Cruise	Slope	Intercept	F	R^2
Chlorophyll A, Surface	1	-0.030	1.247	42.28***	0.453
	2	-0.024	0.065	35.27***	0.475
	3	-0.017	-0.358	6.51*	0.161
	4	-0.058	0.285	21.12***	0.376
Chlorophyll A, Below Surface	1	-0.031	1.767	48.00***	0.384
	2	-0.026	-0.032	15.45***	0.284
	3	-0.006	-0.759	0.29	0.015
	4	-0.032	-0.552	8.56*	0.681
Phaeopigments	1	0.002	0.292	0.16	0.001
	2	-0.0003	0.052	0.11	0.001
	3	0.002	0.085	1.40	0.022
	4	0.005	-0.172	1.26	0.030
Total Adenylates	1	-0.005	-0.311	1.08	0.043
	2	-0.018	0.079	42.74***	0.393
	3	-0.001	-0.019	0.10	0.002
	4	-0.026	0.226	21.56***	0.426
ATP	1	-0.007	-1.425	1.39	0.055
	2	-0.023	-0.612	35.97***	0.353
	3	-0.011	-0.267	5.27*	0.089
	4	-0.027	-0.353	25.85***	0.471
Energy Charge	1	0.000	-0.506	0.00	0.000
	2	-0.002	-0.385	2.82	0.041
	3	-0.005	-0.187	16.58***	0.235
	4	-0.002	-0.292	2.67	0.084

Table 11. Analysis of Variance, Chlorophyll A, Cruise x Depth.

Source	Partial SS	df	F	Mult. Range Test
Cruise	149.13	3	40.34***	
Depth	1.73	1	1.41	
Interaction	11.19	3	3.03*	
Error	378.30	307		

Source	SS	df	F	
Cruise	167.93	3	44.69***	
Error	389.56	311		
				1 2 3 4

Source	SS	df	F
Depth	8.14	1	4.64*
Error	549.35	313	

Table 12. Analysis of Variance, Chlorophyll A, Surface, Distance x Cruise
(on-shore <20 miles < off-shore)

Source	Partial SS	df	F
Cruise	54.63	1	72.39***
Distance	55.92	1	74.09***
Interaction	0.68	1	0.91
Error	123.03	163	

Table 13. Analysis of Variance, Chlorophyll A, Below Surface, Distance x Cruise.
(on-shore < 20 miles < off-shore)

Source	Partial SS	df	F
Cruise	82.48	1	84.44***
Distance	53.89	1	55.17***
Interaction	0.67	1	0.69
Error	140.66	144	

Table 14. Analysis of Variance, Chlorophyll A, Surface, Salinity x Cruise. (on-shore < 33‰ < off-shore)

Source	Partial SS	df	F
Cruise	41.37	1	46.27***
Salinity	29.16	1	32.60***
Interaction	0.30	1	0.34
Error	145.76	163	

Table 15. Analysis of Variance, Chlorophyll A, Below Surface, Salinity x Cruise. (on-shore <33‰ < off-shore)

Source	Partial SS	df	F
Cruise	73.59	1	57.76***
Salinity	15.08	1	11.83***
Interaction	0.19	1	0.15
Error	183.48	144	

Table 16. Analysis of Variance, Chlorophyll A, Surface, Distance in 10 mile increments, Cruise 1.

Source	SS	df	F	Mult. Range Test
Distance	35.997	6	11.06***	
Error	24.946	46		1 2 3 4 5 6 7

Table 17. Analysis of Variance, Chlorophyll A, Below surface, distance in 10 mile increments, Cruise 1.

Source	SS	df	F	Mult. Range Test
Distance	60.801	6	11.73***	
Error	62.207	107		1 2 3 4 5 6 7

Table 18. Analysis of Variance, Chlorophyll A, Surface, Distance in 10 mile increments, Cruises 2, 3, and 4.

Source	SS	df	F	Mult. Range Test
Distance	43.412	6	9.69***	
Error	79.927	107		1 2 3 5 6 4 7

Table 19. Analysis of Variance, Chlorophyll A, Below Surface, Distance in 10 mile increments, Cruises 2, 3, and 4.

Source	SS	df	F	Mult. Range Test
Distance	28.412	6	6.16***	
Error	47.672	62		1 2 5 4 3 7 6

Table 20. Analysis of Variance, Phaeopigments, Cruise x Depth.

Source	Partial SS	df	F	Mult. Range Test
Cruise	3.93	3	2.48*	
Depth	0.63	1	1.19	
Interaction	1.96	3	1.24	
Error	185.97	352		1 3 2 4

Table 21. Analysis of Variance, Phaeopigments, Distance x Cruise (on-shore < 20 miles < off-shore)

Source	Partial SS	df	F
Cruise	5.96	1	11.15***
Distance	0.16	1	0.30
Interaction	0.08	1	0.15
Error	190.33	356	

Table 22. Analysis of Variance, Phaeopigments, Salinity x Cruise (on-shore < 33‰ < off-shore)

Source	Partial SS	df	F
Cruise	3.54	1	6.66*
Salinity	1.02	1	1.91
Interaction	0.64	1	1.21
Error	189.11	356	

Table 23. Analysis of Variance, Total Adenylates, Cruise x Depth.

Source	Partial SS	df	F	Mult. Range Test
Cruise	3.00	3	2.21*	
Depth	0.06	1	0.13	
Interaction	0.41	2	0.46	
Error	78.73	174		3 4 2 1

Table 24. Analysis of Variance, Total Adenylates, Cruise x Distance (on-shore< 20 miles < off-shore)

Source	Partial SS	df	F
Cruise	3.63	1	9.76**
Distance	4.69	1	12.58***
Interaction	3.47	1	9.30**
Error	65.93	177	

Source	SS	df	F
Distance	9.454	1	22.29***
Error	75.932	179	

Table 25. Analysis of Variance, Total Adenylates, Cruise x Salinity (on-shore< 33‰ < off-shore)

Source	Partial SS	df	F
Cruise	2.31	1	5.44*
Salinity	1.00	1	2.36
Interaction	1.77	1	4.17*
Error	75.17	177	

Source	SS	df	F
Salinity	2.66	1	5.75*
Error	82.73	179	

Table 26. Analysis of Variance, Total Adenylates, Distance in 10 mile increments, Cruise 3.

Source	SS	df	F
Distance	3.607	6	1.39
Error	21.178	49	

Table 27. Analysis of Variance, Total Adenylates, Distance in 10 mile increments, Cruises 1, 2, and 4.

Source	SS	df	F	Mult. Range Test#
Distance	20.887	6	12.10***	
Error	33.960	118		1 2 3 6 4 7 5

Table 28. Analysis of Variance, ATP, Cruise x Depth.

Source	Partial SS	df	F	Mult. Range Test
Cruise	14.62	3	7.14***	
Depth	0.05	1	0.79	
Interaction	0.41	2	0.74	
Error	118.83	174		3 4 2 1

Table 29. Analysis of Variance, ATP, Cruise x Distance (on-shore< 20 miles < off-shore

Source	Partial SS	df	F
Cruise	14.18	2	12.46***
Distance	13.65	1	23.99***
Interaction	3.85	2	3.38
Error	99.58	175	

Table 30. Analysis of Variance, ATP, Cruise x Salinity (on-shore < 33‰ < off-shore)

Source	Partial SS	df	F
Cruise	11.46	2	8.87***
Salinity	2.33	1	3.61
Interaction	3.46	2	2.68
Error	113.04	175	

Table 31. Analysis of Variance, ATP, Distance in 10 mile increments, Cruise 3.

Source	SS	df	F	Mult. Range Test
Distance	7.589	6	2.35	
Error	26.364	49		5 4 1 2 3 6 7

Table 32. Analysis of Variance, ATP, Distance in 10 mile increments, Cruises 2 and 4.

Source	SS	df	F	Mult. Range Test
Distance	30.875	6	14.20***	
Error	33.337	92		1 2 3 4 6 7 5

Table 33. Analysis of Variance, ATP, Distance in 10 mile increments, Cruise 1.

Source	SS	df	F
Distance	6.99	4	2.27
Error	16.170	21	

Table 34. Analysis of Variance, Energy Charge, Cruise x Depth.

Source	Partial SS	df	F	Mult. Range Test
Cruise	0.293	3	7.67***	
Depth	0.002	1	0.18	
Interaction	0.005	2	0.82	
Error	2.217	174		3 4 2 1

Table 35. Analysis of Variance, Energy Charge, Cruise x Distance (on-shore < 20 miles < off-shore)

Source	Partial SS	df	F
Cruise	0.300	1	23.83***
Distance	0.040	1	3.56
Interaction	0.0004	1	0.03
Error	2.210	177	

Table 36. Analysis of Variance, Energy Charge, Cruise x Salinity (on-shore < 33% < off-shore)

Source	Partial SS	df	F
Cruise	0.223	1	17.83***
Salinity	0.042	1	3.37
Interaction	0.002	1	0.16
Error	2.217	177	

Table 37. Analysis of Variance, Energy Charge, Distance in 10 mile increments, Cruises 3 and 4.

Source	SS	df	F	Mult. Range Test
Distance	0.824	6	6.58***	
Error	1.670	80		3 1 2 4 5 6 7

Table 38. Analysis of Variance, Energy Charge, Distance in 10 mile increments, Cruises 1 and 2.

Source	SS	df	F	Mult. Range Test
Distance	0.827	6	3.54**	
Error	3.393	87		2 1 3 4 6 7 5

Table 39. Analysis of Variance, Chlorophyll A, Surface, Cruise x Transect.

Source	Partial SS	df	F
Cruise	19.741	1	21.22***
Transect	3.969	3	1.42
Interaction	1.149	3	0.41
Error	78.145	84	

Table 40. Analysis of Variance, Chlorophyll A, Below Surface, Cruise x Transect.

Source	Partial SS	df	F	Mult. Range Test
Cruise	31.220	1	33.86***	
Transect	11.929	3	4.31	
Interaction	2.478	3	0.89	
Error	59.016	64		C S W CF

Table 41. Analysis of Variance, Phaeopigments, Cruise x Transect.

Source	Partial SS	df	F
Cruise	8.243	1	14.06***
Transect	8.984	3	5.11*
Interaction	6.299	3	3.58*
Error	104.909	179	

Table 42. Analysis of Variance, Phaeopigments, Cruise 1, Cruise x Transect.

Source	SS	df	F
Transect	11.403	3	2.18
Error	99.464	57	

Table 43. Analysis of Variance, Phaeopigments, Cruises 2, 3, and 4. Cruise x Transect.

Source	SS	df	F
Transect	0.216	3	1.61
Error	5.446	122	

Table 44. Analysis of Variance, Total Adenylates, Cruise x Transect.

Source	Partial SS	df	F
Cruise	3.401	1	8.25**
Transect	1.584	3	1.28
Interaction	6.981	3	5.65*
Error	44.913	109	

Table 45. Analysis of Variance, Total Adenylates, Cruise 3, Cruise x Transect.

Source	SS	df	F	Mult. Range Test
Transect	4.859	3	4.01*	
Error	13.328	33		C CF W S

Table 46. Analysis of Variance, Total Adenylates, Cruises 1, 2, and 4, Cruise x Transect.

Source	SS	df	F
Transect	3.157	3	2.53
Error	31.585	76	

Table 47. Analysis of Variance, ATP, Cruise x Transect.

Source	Partial SS	df	F
Cruise	17.427	2	18.21***
Transect	0.506	3	0.35
Interaction	12.455	6	4.34***
Error	50.246	105	

Table 48. Analysis of Variance, ATP, Cruise 3, Cruise x Transect.

Source	SS	df	F	Mult. Range Test
Transect	10.355	3	7.79***	
Error	14.626	33		C CF W S

Table 49. Analysis of Variance, ATP, Cruises 2 and 4, Cruise x Transect.

Source	SS	df	F
Transect	1.902	3	1.52
Error	24.624	59	

Table 50. Analysis of Variance, ATP, Cruise 1, Cruise x Transect.

Source	SS	df	F
Transect	1.386	3	0.55
Error	10.996	13	

Table 51. Analysis of Variance, Energy Charge, Cruise x Transect.

Source	Partial SS	df	F
Cruise	0.418	1	16.02***
Transect	0.070	3	0.89
Interaction	0.014	3	0.18
Error	2.847	109	

52. Salinity CRUISE X DEPTH

Source	SS	df	F	
Cruise	23.06	3	3.10	*
Depth	57.35	1	23.15	***
Cruise X Depth	16.71	3	2.25	
Error	753.03	304		

2 1 3 4

53. Salinity, Surface CRUISE X DIST (20>MILES>)

Source	SS	df	F	
Cruise	43.86	2	3.01	*
Dist	164.46	1	83.73	***
Cruise X Dist	2.88	2	0.73	
Error	304.45	155		

54. Salinity, Below Surface CRUISE X DIST (20>MILES>20)

Source	SS	df	F	
Cruise	8.53	2	3.01	*
Dist	48.38	1	34.16	***
Cruise X Dist	0.01	1	0.01	
Error	206.76	146		

55. Salinity, Surface Cruise x Distance (10 mile incre)

Source	SS	df	F	
Cruise	25.59	2	7.95	***
Distance	167.40	6	17.35	***
Cruise x Distance	11.03	11	0.62	
Error	227.03	141		

7 6 5 4 3 2 1

56. Salinity, Below Surface Cruise x Distance

Source	SS	df	F	
Cruise	4.31	2	1.49	
Distance	59.23	6	6.84	***
Cruise x Distance	2.10	8	0.18	
Error	193.48	134		

6 7 4 5 3 2 1

57. Chlorophyll A, Surface Cruise x Salinity

Source	SS	df	F	
Cruise	42.18	1	50.78	***
Water	40.46	4	12.18	***
Cruise x Salinity	3.84	4	1.16	
Error	130.43	157		

1 2 3 4 5

58. Chlorophyll A, Below Surface CRUISE X SALINITY

Source	SS	df	F	
Cruise	67.57	1	61.92	***
Water	43.81	4	10.04	***
Cruise X Salinity	4.12	4	0.94	
Error	150.61			

1 3 2 4 5

59. Phaeopigments CRUISE X SALINITY

Source	SS	df	F	
Cruise	9.23	1	17.52	***
Water	1.90	4	0.90	
Cruise X Salinity	2.87	4	1.36	
Error	184.38	350		

60. Total Adenylates CRUISE X SALINITY

Source	SS	df	F	
Cruise	6.94	4	4.68	**
Water	3.15	1	8.48	**
Cruise X Salinity	7.62	4	5.14	***
Error	63.43	171		

61. Total Adenylates, Cruise 3 X SALINITY

Source	SS	df	F	
Salinity	5.67	4	3.79	**
Error	19.11	51		

4 1 5 2 3

62. Total Adenylates — Cruises 1, 2 and 4

Source	SS	df	F	
Salinity	10.53	4	7.13	***
Error	44.32	120		

1 2 3 4 5

63. ATP — Cruise x Salinity

Source	SS	df	F	
Cruise	17.36	4	8.00	***
Salinity	18.71	2	17.23	***
Cruise x Salinity	7.72	8	1.78	
Error	90.11	166		

1 3 4 2 5

64. Energy Charge — Cruise x Salinity

Source	SS	df	F	
Cruise	0.55	1	16.85	***
Salinity	1.09	4	8.42	***
Cruise x Salinity	0.14	4	1.09	
Error	5.55	171		

3 1 4 2 5