Revised Copy
February 16, 1979

Report Submitted to MESA New York Bight Project

Synoptic Investigations in Nutrient Cycling

1) Dissolved oxygen concentrations

2) Percent oxygen saturation in water column

3) Dissolved organic carbon concentrations

4) Incident radiation, light extinction, alkalinity, and pH

5) Release of dissolved organic matter from phytoplankton

6) Total (net- plus nanno-particulate plus dissolved) phytoplankton primary productivity

7) Total plankton respiration

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Report No. SHL 79-05 (January, 1979)

2.2.1 pH and Total Alkalinity

The pH and Total Alkalinity of sea water samples were measured according to methods given by Strickland and Parsons (1972). A Corning pH 130 meter, calibrated against pH 4 and 7 buffers, was used for sea water pH and alkalinity pH measurements.

2.2.3 Dissolved Oxygen

Water for determining dissolved oxygen concentrations in the water column was collected at all but the mid-morning (MM) stations using Niskin bottles. Water samples from these Niskins were drawn within minutes of their arrival on deck and were, in fact, the first samples drawn. The initial samples for total plankton respiration (Oxygen Uptake, 2.6.1) were used to determine dissolved oxygen concentrations for the noon (N) and midnight (MN) stations. A bottom tripping Niskin bottle was used to collect water 20 to 50 cm above the bottom during SINC II through IV.

In drawing the samples care was taken to remove air in the drawing tube to prevent bubbles in the sample. This was done by displacing the air in the drawing tube with flowing water from the Niskin bottle while holding the drawing tube qbove the Niskin outlet valve with the opening of the drawing tube pointing upward. With sample water in the drawing tube the tube was inserted in and to the bottom of an acid-cleaned 300 ml BOD bottle. Two BOD bottle-volumes of sample water were flushed through a BOD bottle while the bottle was checked for bubbles. The drawing tube was then withdrawn from BOD bottle and inserted into next BOD bottle. The filled BOD bottle was stoppered at this time. These samples were fixed immediately with 2 ml each of manganous sulfate and alkaline iodide azide (APHA, 1975). Each sample,

after mixing and settling twice, was acidified with 2 ml of concentrated sulfuric acid (APHA, 1975). The entire contents of the bottle were titrated using a Brinkman E415 Multi-Dosimat Titrator with 0.0375 N Phenylarsine oxide (PAO) as the titrant and amylose starch as the indicator (Kroner, 1964; U. S. EPA, 1974). The number of milliliters of PAO used in the titration was equivalent to the dissolved oxygen concentration in mg O_2/liter. *In situ* percent saturation of oxygen was computed from the equations of Weiss (1970).

2.2.4 Incident Radiation and Light Extinction

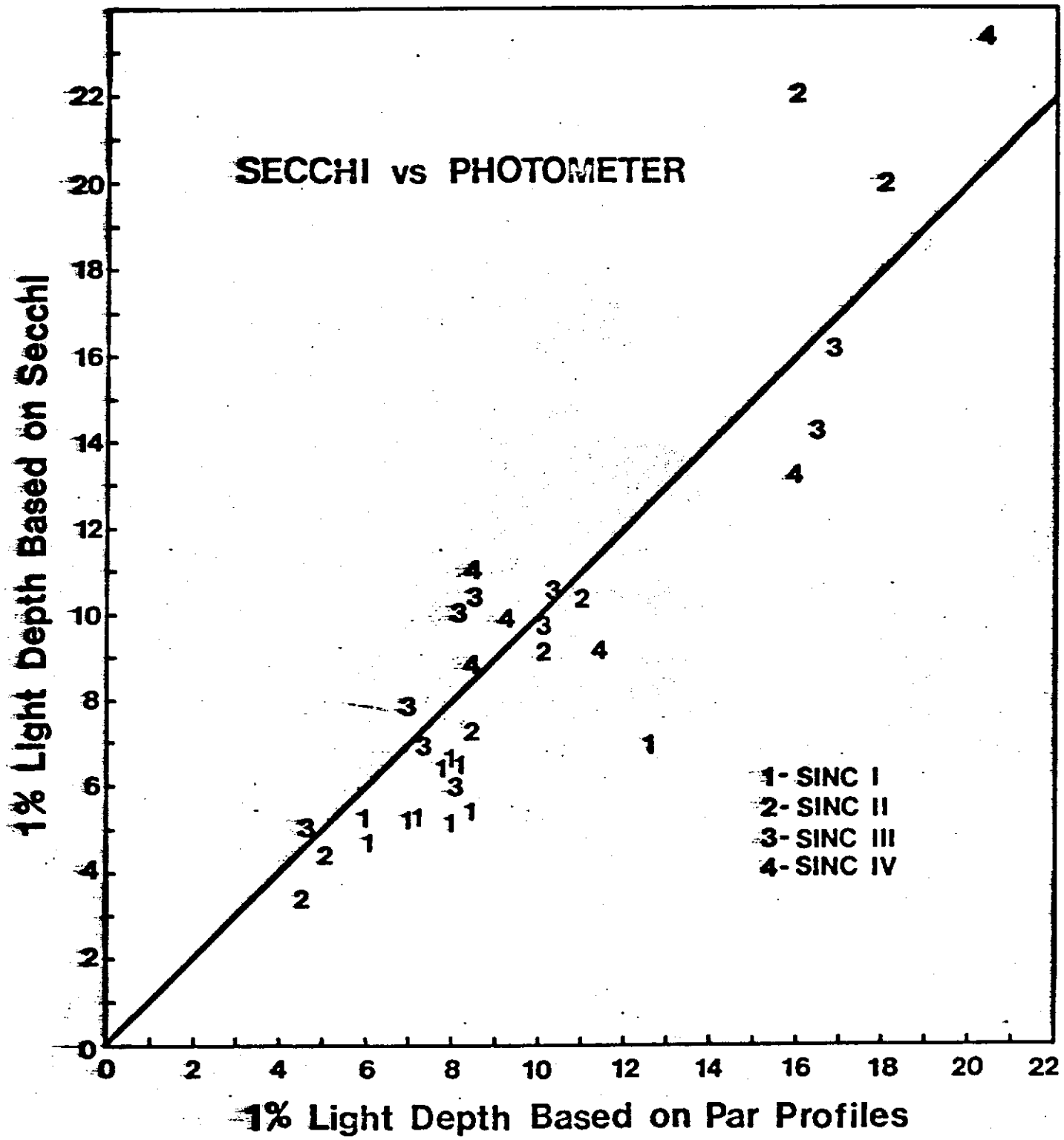
(a) Photosynthetically Active Radiation (by definition between 400-700 nanometers) was measured using a Lambda quantum-response sensor Li-190S and Li-500 digital integrator. The same photocell and integrator were used during the four SINC studies. The photocell constant was and the integrator constant was . Consequently, 249 counts were equivalent to one Einstein/m^2 PAR. The photocell was gimbal-mounted and located on deck adjacent to the SIS-sunlight ^{14}C incubator.

The integrator was read each day at sea sunrise and sunset to generate daily PAR (Einst/m^2/d). The integrator was also read at the beginning and termination of 24 hr ^{14}C-sunlight incubations.

(b) The extinction of Photosynthetically Active Radiation throughout the water column was measured using a submersible quantum-response underwater Li-192S sensor connected to a Lambda Li-185 photometer and strip-chart recorder. Readings were quickly made above surface, immediately below the water surface (=100%) and at 2-meter intervals until zero readings were obtained or the seabed was reached. The resulting readings (uEi/m^2/s) from the recorder were plotted on 4-cycle semi-log graph paper against depth (m). Sampling depths (60%, 20%, 10%, 2%) for ^{14}C-SIS sunlight incubations were determined from the PAR extinction profile.

(c) The disappearance-depth of a 30 cm diam. white Secchi disc was measured each day in conjunction with submersible photometry.

(d) It is apparent from Fig. that in a very general way the 1% light depth predicted from the secchi depth and the formula K = 1.77/secchi (m) (Strickland 1960) approximates the 1% light depth measured with the quantum sensor. The secchi predicted depths from SINC I and II are generally less than the measured 1% depths (Figure).


SECCHI vs PHOTOMETER
1% Light Depth Based on Secchi
1% Light Depth Based on Par Profiles
1- SINC I
2- SINC II
3- SINC III
4- SINC IV
0
2
4
6
8
10
12
14
16
18
20
22

2.4 Dissolved Organic Matter

2.4.1 Carbon

(a) Field collection and processing

Samples were collected from each Niskin sampled depth, in 250 ml Polyethylene bottles that had been rinsed twice with small quantities of the water to be sampled. The samples were then filtered through Whatman glass fiber filters, that had been combusted at 450°C for at least 2 hours. Prior to filtration these filters were rinsed twice with small amounts of the sample. This same water, after passing through the filter, was used also to rinse the 100 ml acid washed glass bottles in which the filtered sample would be stored. The remaining portion of the sample was then passed through the filter and collected directly into the 100 ml glass bottle allowing the excess to overflow. The glass bottle containing the filtered sample was then removed from the filtration unit. A small amount of sample was discarded, to allow for expansion during freezing. Aluminum foil which had been combusted was placed over the mouth of the glass bottle (now containing approximately 80 ml of sample), the bottle capped, and frozen upright until analysis.

(b) Laboratory analysis

In the laboratory the samples were allowed to thaw to room temperature and then 0.1 ml of phosphoric acid was added to each of the samples to lower the pH. The samples were then bubbled with oxygen for 10 minutes to remove inorganic carbonate. Three 5 ml aliquots were taken from each sample after

bubbling and placed into 10 ml ampules, previously combusted at 450°C for 2 hours, containing 200 mg potassium persulfate. Each aliquot was bubbled for 10 seconds with oxygen and then sealed. The ampules were then autoclaved at 130°C for 45 minutes. They were then connected, by a silicone sheath, to a Beckman Model 865 Infrared Analyzer, interfaced to a Hewlett-Packard Model 3380 S integrator, the ampule tips crushed and bubbling needle inserted through the silicone sheath into the open ampule to its bottom. The aliquot was bubbled with oxygen gas and the peak recorded and integrated. Standards were run after every 5 or 7 samples. The integrated peak areas were used to calculate the dissolved organic carbon concentrations.

collection depth. SIS samples were then placed in a plexiglass tube incubator (Kahlisco, Calif.) and kept at sea surface temperature using the ship's salt water system.

Following incubation, both PC and SIS samples were serially filter-fractionated using Nylon-Nitex 20 um and Millipore 0.45 um filter discs (25 mm diameter). A 60 ml aliquot from each light and dark bottle was filter-fractionated at a vacuum less than 55 mm Hg. Greater vacuum can lyse phytoplankton and artificially elevate the dissolved organic matter proportion of total photosynthesis at the expense of the particulate fraction (Herbland, 1974). Sixty ml of filtrate passing the Millipore 0.45 um filter were collected in large test tubes contained within small plexiglass cylindrical vacuum chambers. During filtration, 10 ml of prefiltered sea water (previously filtered through GF/F filters) were used to rinse the netplankton funnel walls and filter. When a few ml of sample remained above the Millipore-nannoplankton filter, an additional 10 ml of prefiltered sea water were used to rinse the nannoplankton filter. The 20 ml rinse was collected in the test tube with the 60 ml DOM filtrate. The 80 ml filtrate was acidified to a pH between 2.6 and 3 using 3 ml of 0.1 N HCl. The sample was mixed and a 10 ml subsample placed in a glass liquid scintillation vial. The acidified 10 ml aliquots were bubbled with air for 30 minutes at 100 cc/min/vial in a specially constructed bubbling manifold which sparges up to 20 samples simultaneously (O'Reilly and Thomas, 1979). During bubbling, inorganic ^{14}C is

removed as $^{14}CO_2$, leaving behind non-volatile ^{14}C-labeled dissolved organic matter.

Adsorption of ^{14}C-dissolved organics onto the walls of the bubbling chamber will cause underestimates of the DOM fraction (Theodorsson and Bjarnason, 1975). Sparging 10 ml of DOM-filtrates directly in the liquid scintillation vials eliminates these losses.

Figure indicates that after 15 minutes of bubbling at 100 cc/min/vial, 0.002% of the initial inorganic activity/ml filtrate remains when using the bubbling manifold and this method. Low "residual" inorganic ^{14}C activities or blanks are predicated upon thorough and vigorous sparging methods. Sharp (1977) has indicated that residual activity should be less than 0.02%, otherwise the ratio of sample activity to background activity will be low and the results questionable.

Using this bubbling manifold, and samples collected during SINC II and III, and coefficient of variability of replicate sparged filtrates from single and pooled productivity bottles averages 2.6%.

Immediately following bubbling, 9 ml of Insta-Gel (Packard Instrument Co.) is added to the 10 ml DOM filtrate. DOM samples were counted on a Packard 3330 tri-carb spectrometer for 100 minutes or 10,000 counts. Counting efficiencies are typically 60%. The counts per minute of each sample were corrected to disintegrations per minute using the "internal channels ratio method of quench correction" (Herberg, 1965). The surface dark bottle activity was subtracted from each light bottle DOM-activity and the equations

in Strickland and Parsons (1972), a FORTRAN program (MS174, LeBaron-O'Reilly) and measurements of sea water pH, temperature, salinity and alkalinity were used to calculate rates of DOM release by the phytoplankton community ($mgC/m^3/h$).

The DOM release rates were arithmetically integrated with depth to generate integral euphotic DOM release rates ($mgC/m^2/h$-PC, $mgC/m^2/day$-SIS). These euphotic integral rates were divided by integral total production (described later) to yield estimates of Euphotic PER (Percent Extracellular Release) or the percent of total euphotic carbon production released as DOM.

2.5.3 Measurements of Total Productivity

In addition to measurements of DOM release rates, measurements were made of total productivity using a modification of the method proposed by Schindler et al. (1972). The unused 80 ml aliquot from each light and dark productivity bottle was acidified to a pH between 2.6-3 with 3 ml 0.1 N HCl. A 10 ml subsample was placed in a liquid scintillation vial and bubbled with air at 100 cc/min/vial for 30 minutes. Nine ml of Insta-Gel were added to the bubbled sample and activity and rate of total productivity were measured in the same way DOM was measured as described above. Following bubbling, ^{14}C-labeled phytoplankton as well as DOM activity remained in the liquid scintillation vial.

The coefficient of variability among replicate sparged total productivity samples collected during SINC I and III was 2.1% (see Table).

During an earlier study (O'Reilly et al., 1976) we found excellent agreement between the sum of netplankton, nannoplankton and DOM activities (= Total Production) and estimates of total production using our adaptation of Schindler et al.'s method (r = 0.97, 1236 cases).

Average ^{14}C-activity (DPM) and coefficient of variation of replicates after sparging[1] acidified[2] 10ml samples in liquid scintillation vials

Date	Sta.	Sample Origin	Number of Replicates Bubbled from Bottle	Average DPM/10ml	Coefficient of Variation, %
7705	195	PC[3], total productivity, dark bottle	8	1821	1.67
7705	195	PC, dissolved organic matter, dark bottle	8	1076	1.55
7705	195	PC, dissolved organic matter, pooled duplicate 100%-light bottles	15	4016	1.43
7705	202	PC, total productivity, pooled duplicate 20%- light bottles	9	12390	1.98
7705	202	PC, total productivity, pooled duplicate 10%-light bottles	9	4896	2.54
7705	185	SIS[4], total productivity, 100%-light bottle	6	118798	3.09
7705	185	SIS, total productivity, 60%-light bottle	7	97034	2.31
7705	185	SIS, total productivity, 20%-light bottle	8	70230	1.93
7705	185	SIS, total productivity, 10%-light bottle	6	32583	1.77
7705	185	SIS, total productivity, dark bottle	6	1045	0.89
7705	185	SIS, dissolved organic matter, 100%-light bottle	7	6193	2.19
7705	185	SIS, dissolved organic matter, 60%-light bottle	7	6559	0.85
7705	185	SIS, dissolved organic matter, 20%-light bottle	7	3242	1.76
7705	185	SIS, dissolved organic matter, 10%-light bottle	7	1358	2.38
7705	185	SIS, dissolved organic matter, 2%-light bottle	6	227	3.36
7705	210	PC, dissolved organic matter, 10%-light bottle	4	1391	2.95
7705	210	PC, dissolved organic matter, 2%-light bottle	7	1212	2.28
7705	210	PC, dissolved organic matter, dark bottle	8	666	4.44
7711	129	SIS, total productivity, dark bottle	8	1514	2.50
7711	129	SIS, dissolved organic matter, dark bottle	8	869	5.20

1) Sparging was done using air at 100 cc/min/vial using 20 gauge needles.

2) Acidified to pH~3 with 0.1 N HCl.

3) Photosynthetic capacity, fluorescent illumination, attenuating nylon screens over productivity bottles.

4) Simulated *in situ*, sunlight, attenuating nylon screens over productivity bottles.

AVG = 2.35%

2.6 Microbial Respiration

2.6.1 Oxygen Uptake

Water for determining oxygen consumption in the water column (total plankton respiration) was collected at the noon (N) and midnight (MN) stations using Niskin bottles. Unconcentrated whole water samples from these Niskins were drawn within minutes of their arrival on deck and were, in fact, the first samples drawn. They included samples for the determination of dissolved oxygen concentrations as well (see section 2.2.3). A bottom tripping Niskin bottle was used to collect water 20 to 50 cm above the bottom during SINC II through IV.

Ten acid-washed and baked (232°C for 1 hour) 300 ml BOD bottles were filled with sample water (see section 2.2.3) from each depth, resulting in five replicate pairs of samples. The drawing tube used to fill these BOD bottles was placed in 30% HCl acid between stations to prevent microbial build-up in and on the tube. Half (five) of these replicate samples were fixed immediately with 2 ml each of manganous sulfate and alkaline iodide azide (APHA, 1975). The remaining five samples for a given depth were incubated in the dark at ±1°C of *in situ* temperature for a period of 12 hours during the July cruise and 24 hours during the May, November, and March cruises. Beginning with SINC II (July 1977) the glass stoppers of these bottled samples were rubber banded to hold them tightly and securely in the neck of the BOD bottle. Additionally, water was placed

on top of the stoppers to further insure against leakage of oxygen into or out of the samples. At the end of the incubation period these samples also were fixed with manganous sulfate and alkaline iodide azide. Each sample, after mixing and settling twice, was acidified with 2 ml of concentrated sulfuric acid (APHA, 1975). The entire contents of the bottle were then titrated on a Brinkman E415 Multi-Dosimat Titrator with 0.0375 N Phenylarsine oxide as titrant and amylose starch as an indicator (Kroner, 1965; U. S. EPA, 1974). The rate of oxygen consumption was calculated from the difference between initial (fixed immediately) and incubated replicate titrations for each depth. The average coefficient of variability for the five initial determinations was 1.25%.

3.1.2 Hydrography

The data for incident radiation, light extinction, alkalinity and pH are listed in Tables .

Percent Saturation of Dissolved Oxygen

Dissolved oxygen concentrations were converted to percent saturation (Table) using the equations of Weiss (1970.

SINC I

During the May 1977 cruise percent saturation of dissolved oxygen in surface waters increased during the cruise ranging from 95 to 108% at the start of the cruise to 112 to 164% by the end of the cruise. Concurrent with this increase in the surface waters was a slight but general decrease in bottom waters. This meant that the vertical stratification of dissolved oxygen percent saturation intensitied during the cruise. Generally, percent saturation decreased with depth. Subsurface maxima occurred at many stations. Most surface samples were supersaturated. Overall range of saturation for the cruise was 76 to 183%.

SINC II

During the July 1977 cruise percent saturation in surface water ranged from 110 to 145% at the start of the cruise to 80 to 112% at the end. As with the previous cruise most surface samples (except stations 74, 137, 165, and 171) were supersaturated. Bottom water ranged from 44 to 67% saturated at the start of the cruise. At the end of the cruise bottom water ranged from 47 to 69% saturated.

Supersaturation occurred only in the upper half of the water column compared with the previous cruise where much of the water column was supersaturated. The highest percents of supersaturation were not as high in July as they were at the end of the cruise in May. The lowest percents, however, were lower in July than in May. Overall percents saturation in July ranged from 44% to 145%.

SINC III

During the November 1977 cruise percent saturation of dissolved oxygen in surface water ranged from 89 to 104% at the start of the cruise to 88 to 101% at the end of the cruise. Bottom water ranged from 86 to 94% at the start of the cruise and from 92 to 96% at the finish of the cruise. Oxygen percent saturation was nearly vertically homogeneous at all stations. Slight subsurface maxima occurred at many of the stations. Few samples (those at stations 28 and 170) were in excess of 100% saturation in contrast to the cruises of May and July. All stations and depths had oxygen percent saturation values of 85% or greater.

SINC IV

During the March 1978 cruise percent saturation of dissolved oxygen in surface water ranged from about 96 to 114% at the start of the cruise to 93 to 113% at the end of the cruise. Most samples were saturated or slightly supersaturated. Percent saturation changed little or decreased slightly with depth. No demonstrable subsurface maxima occurred. Overall range for oxygen saturation percents in March was 93 to 124%.

Oxygen Saturation Summary

Dissolved oxygen percent saturation values in the surface and near surface water were generally high to supersaturated. The highest values (183%) occurred in surface water during May 1977. The lowest values (44%) occurred in bottom water in July 1977. Surface water was generally supersaturated in March, May, and July. Maximum stratification of percent saturation values occurred in July (maximum differences 63%) and minimum stratification occurred in November 1977 (maximum difference of 9%) and March 1978 (maximum difference of 10%). Few supersaturated values occurred in November. The November and March water columns were generally near saturation.

Table . SINC I.

Date	Station	Depth	pH at 20°C	Alkalinity pH*	Einst/m²/day	Einst/m²/Sis Δ Time
May 9, '77	9	0	8.162	3.810,3.820		
10	31	0	7.970	3.676,3.649	30.00	
11	34	0	7.916	3.631,3.668	45.96	
11	38	0	8.000	3.635,3.628		45.93/#38
11	38	2	8.050			
11	38	4	8.100			
11	38	6	8.105			
11	43	0	7.945	3.600,3.557		
11	48	0	8.002	3.668		
12	68	0	8.064	3.598,3.605	43.89	
13	81	0	7.988	3.536,3.529	43.86	47.26/#81
13	87	0	8.101	3.686,3.674		
14	95	0	8.074	3.692,3.728	48.69	
14	101	0	8.010	3.596,3.614		48.37/#101
14	107	0	8.112	3.605,3.616		
May 14, '77	110	0	8.173	3.599,3.597		
15	117	0		3.573,3.571	47.79	
15	121	0	8.130	3.709,3.718		48.56/#121
15	127	0	8.096	3.580,3.583		
15	133	0	8.143	3.532,3.539		
16	141	0	8.145	3.767,3.767	40.68	
16	144	0	8.200	3.556,3.551		40.28/#144
16	153	0	8.234	3.594,3.608		
16	156	0	8.191	3.546,3.563		
17	163	0	8.031	3.556,3.545	43.75	
17	170	0	8.285	3.542,3.537		37.67/#170
17	174	0	8.387	3.552,3.595		
18	181	0	8.146	3.539,3.582	34.99	
18	185	0	8.165	3.604,3.629		33.84/#185
18	191	0	8.343	3.553,3.576		
18	195	0	8.407	3.560,3.560		
19	202	0	8.129	3.527,3.548	24.78	
19	205	0	8.197	3.575,3.566		
May 19, '77	210	0	8.393	3.584,3.592		

* 100 ml seawater added to 25 ml 0.01 N HCl, duplicates

TABLE SINC II

Date	Station	Depth	pH at 20°C	Alkalinity pH*	Einst/m^2/day	Einst/m^2/Sis & Time
July 18, '77					49.45	
19					42.79	
20	32	0	8.113	3.633	33.97	
20	36	0	8.207	3.618		35.43/#36
20	42	0	8.276	3.608		
20	50	0	8.240	3.609		
21	53	0	8.043	3.570	40.32	
21	57	0	8.130	3.633		40.59/#57
21	63	0	8.206	3.509		
21	67	0	8.139	3.591		
22	74	0	8.013	3.637	45.69	
22	80	0	8.244	3.684		
22	85	0	8.234	3.665		
23	92	0	8.249	3.688	49.21	
23	96	0	8.228	3.715		47.28/#96
23	102	0	8.194	3.680		
23	106	0	8.251	3.678		
24	113	0	8.234	-	42.69	
24	117	0	8.237	3.709		38.77/#117
24	123	0	8.275	3.709		
25					8.52	
26	128	0	8.132	3.713	49.82	
27	137	0	8.136	3.732	48.27	
27	141	0	8.134	3.739		46.86/#141 or 139
27	147	0	8.078	3.734		
27	151	0	8.184	3.727		
28	158	0	8.121	3.710	42.70	
28	162	0	8.058	3.716		

* 100 ml seawater added to 25 ml 0.01 N HCl

Table . SIMC III

Date	Station	Depth	pH at 20°	Alkalinity pH*	Einst/ m^2/day	Einst/m^2/Sis Δ time
771110	39	0	7.894	3.565		
10	42	0	7.883	3.479	8.12	
11	49	0	7.996	3.668		
11	53	0	8.012	3.652		12.46/53
11	59	0	7.989	3.690	12.54	
12					13.11	
13					10.42	
14					16.19	
15					16.23	
16	63	0	7.903	3.453		
16	67	0	7.888	3.497		13.33/57
16	74	0	7.951	3.553		
16	77	0	8.012	3.562	15.37	
17	84	0	7.977	3.588		
17	88	0	7.975	3.591		7.55/88
17	95	0	8.000	3.628		
17	98	0	8.017	3.651	7.70	
18	105	0	8.003	3.654		
18	110	0	7.980	3.665		
18	118	0	7.962	3.672	8.40	12.04/118
19	125	0	8.000	3.691		
19	129	0	8.010	3.874		11.72/129
19	136	0	8.002	3.757		
19	139	0	7.988	3.784	12.45	
771120					10.97	

*100 ml seawater and 25 ml 0.01 N HCl

SINC IV

Date	Station	Depth	pH at 20°	Alkalinity, pH*	Einst/m^2/day	Einst/m^2/Sis Δ time
78/03/05					32.82	
78/03/06					30.43	
78/03/07	031	0	8.125	3.729		
78/03/07	034	0	8.135	3.755		28.55
78/03/07	041	0	8.100	3.755		
78/03/07	044	0	8.055	3.781	32.10	
78/03/08	050	0	8.001	3.783		
78/03/08	053	0	8.040	3.794		8.72
78/03/08	059		8.037	3.790		
78/03/08	062		7.993	3.790	7.72	
78/03/09	068	0	8.038	3.763		
78/03/09	071	0	8.080	3.767		14.13
78/03/09	078	0	8.072	3.793	16.03	
78/03/10	084	0	8.104	3.759		
78/03/10	087	0	8.171	3.706		7.34
78/03/10	094	0	8.083	3.745		
78/03/10	097	0	8.097	3.742	3.91	
78/03/11	108	0	8.090	3.719		
78/03/11	104	0	8.078	3.727		20.13
78/03/11	111	0	8.166	3.709		
78/03/11	115	0	8.296	3.681	21.01	
78/03/12	123		8.179	3.712		
78/03/12	126		8.234	3.686	20.56	
78/03/13	132	0	8.155	3.705	28.30	
78/03/13	133	0	8.186	3.710		25.49
78/03/13	133	2		3.694		
78/03/13	141	0	8.182	3.695		
78/03/13	144	0	8.145	3.707		
78/03/14	150	0	8.048	3.745	4.27	
78/03/14	153		8.084	3.764		10.63
78/03/15					31.35	

* 100 ml sea water and 25 ml 0.01 N HCl

Table . SINC I % light-depths and Secchi

Date	Station	% Light-Depths 60	20	10	2	1	Secchi (m)	Extinction Coefficient (base e) m^{1}
77/05/11	37	1.0	2.4	3.6	6.0	8.0	2.0	-0.58
77/05/12	57	0.6	2.0	3.2	5.5	8.4	2.1	-0.55
77/05/13	83	0.8	2.0	3.0	5.0	6.0	2.0	-0.77
77/05/14	100	1.0	2.0	3.0	6.8	8.0	2.5	-0.58
77/05/15	120	1.0	2.0	3.0	6.0	8.0	2.5	-0.58
77/05/15	129	0.6	1.4	2.0	6.0	8.0	-	-0.58
77/05/15	130	8.0	2.8	4.0	6.8	8.0	2.5	-0.58
77/05/16	145	0.7	2.0	3.0	5.6	7.0	2.0	-0.66
77/05/17	168	1.0	2.4	3.6	9.0	12.6	2.7	-0.37
77/05/18	184	0.6	2.0	3.0	5.2	7.2	2.0	-0.64
77/05/19	206	0.5	2.0	3.0	5.0	6.0	1.8	-0.77

Table . SIEC II % light-depths and Secchi

Date	Station	% Light-Depths 60	20	10	2	1	Secchi (m)	Extinction Coefficient (base e) m^{-1}
77/07/20	36	0.4	1.5	2.2	4.0	5.0	1.7	-0.92
77/07/21	55	0.4	1.4	2.0	3.6	4.5	1.3	-1.02
77/07/23	95	1.6	5.6	8.0	13.6	16.0	8.5	-0.29
77/07/24	115	1.6	5.0	8.0	16.0	18.0	7.7	-0.26
77/07/26	129	0.6	2.2	3.4	7.0	8.4	2.8	-0.55
77/07/27	139	1.0	3.6	5.4	9.2	11.0	4.0	-0.42
77/07/28	160	1.0	3.0	4.4	8.4	10.0	3.5	-0.46
77/07/28	166						1.5	
77/07/28	171						1.8	
77/07/28	177						2.0	
77/07/28	181						1.8	
77/07/28	187						7.0	

Table . SINC III % light-depths and Secchi

Date	Station	% Light-Depths 60	20	10	2	1	Secchi (m)	Extinction Coefficient (base e) m^{-1}
77/11/09	10						1.0	
77/11/09	13						1.0	
77/11/09	18						1.7	
77/11/10	31	0.5	1.6	2.5	4.3	4.7	1.9	-0.98
77/11/11	51	0.5	2.0	3.2	6.0	7.3	2.7	-0.63
77/11/16	65	0.5	1.8	2.9	6.4	8.0	2.4	-0.58
77/11/17	86	0.9	2.9	4.1	7.0	8.3	3.9	-0.55
77/11/18	108	1.0	3.2	4.8	8.8	10.5	4.0	-0.44
77/11/18	112	1.0	3.2	4.5	7.2	8.5	4.0	-0.54
77/11/19	127	0.8	2.5	3.4	5.8	7.0	3.0	-0.66
77/11/20	149	1.0	3.2	4.5	8.5	9.9	3.8	-0.47
77/11/20	154						6.0	
77/11/20	159						3.0	
77/11/20	164						2.0	
77/11/20	169						4.7	

SINC IV - % Light-Depths and Secchi.

Date Yr/Mo/Da	Sta.	% Light-Depths (m) 60%	20%	10%	2%	1%	Secchi (m)	Extinction Coefficient (base e) m^{-1}
780306	17						1.0	
780306	20						2.0	
780307	33	1.0	3.4	4.9	9.2	11.3	3.5	-0.41
780308	52	1.8	5.6	8.0	14.0	16.4	5.5	-0.28
780309	70	1.4	5.0	8.6	16.6	20.4	9.0	-0.23
780310	86	0.8	2.6	4.0	8.2	9.2	3.8	-0.50
780311	105	1.6	5.2	7.6	14.4	16.8	6.3	-0.27
780312	121	0.8	2.6	4.0	7.4	8.4	3.3	-0.55
780313	134	1.6	4.0	6.0	13.0	16.0	5.1	-0.29
780314	152	1.5	4.0	5.5	7.5	8.5	4.3	-0.54
780315	156						4.8	
780315	161						2.8	
780315	167						4.2	
780315	174						3.5	
780315	179						7.5	

Table . Percent oxygen saturation using the equations of Weiss (1970) during SINC cruises I-IV. (R = reference stations).

Cruise	Drogue	Date	Time	Sta. No.	Depth (m)	% O_2 Sat.
I	R-1	5/ 9/77	1720	003	0	98
					2	99
					5	99
					10	86
	R-2	5/ 9/77	1820	005	0	100
					2	101
					5	101
					10	100
	R-3	5/ 9/77	2000	007	0	107
					5	108
					15	84
	R-4	5/ 9/77	2330	009	0	103
					5	103
					10	103
					15	103
					25	85
	R-5	5/10/77	0125	011	0	101
					5	102
					10	103
					20	101
					30	91
					50	88
	R-6	5/10/77	0410	013	0	101
					5	102
					10	102
					15	101
	R-7	5/10/77	0620	015	0	101
					5	102
					10	102
					15	102
					25	78
	R-8	5/10/77	0930	017	0	108
					5	102
					10	101
					15	102
					25	84
	R-9	5/10/77	1200	020	0	93
					5	93
					10	91
					15	83
	1	5/10/77	1855	027	0	100
					2	101
					6	101
					10	100
					14	102
					18	85
			2325	031	0	97
					3	97
					6	102
					10	104
					15	89
	1	5/11/77	0615	034	0	95
					3	97
					7	100
					11	99
					17	84
			0850	038	0	96
					2	97
					4	99
					6	100
			1315	044	0	98
					2	97
					5	102
					10	95
					15	96
			1855	048	0	105
					2	103
					5	105
					9	95
					14	97
			2300	051	0	101
					4	103
					6	96
					11	92
	None	5/12/77	1030	058	0	102
					2	102
					4	104
					10	101
					15	98
			1200	061	0	97
					2	100
					4	104
					10	104
					15	102
			1445	065	0	101
					2	108
					4	108
					10	100
					15	101
	2	5/12/77	1840	068	0	106
					3	113
					7	101
					12	98
					18	90
			2255	071	0	111
					5	111
					10	109
					15	104
	3	5/12/77	1240	081	0	102
					2	104
					5	110
					9	108
					15	98

Table (continued)

Cruise	Drogue	Date	Time	Sta. No.	Depth (m)	% O_2 Sat.
I	3	5/13/77	1900	087	0	111
					4	109
					9	104
					14	100
					20	95
			2330	091	0	109
					5	109
					10	99
					20	85
		5/14/77	0605	095	0	107
					3	107
					7	100
					15	82
					21	77
	4	5/14/77	1250	107	0	112
					3	111
					6	111
					12	102
					17	83
			1845	110	0	120
					3	121
					7	118
					12	89
					18	79
			2305	114	0	118
					3	118
					6	118
					12	94
					17	83
		5/15/77	0610	117	0	104
					3	108
					7	105
					11	94
					16	81
			1235	127	0	116
					3	114
					7	100
					11	101
					15	83
			1850	133	0	118
					3	127
					7	89
					11	86
					15	76
			2240	137	0	120
					3	123
					7	113
					12	100
					16	81
		5/16/77	0550	141	0	114
					2	119
					6	104
					10	94
					16	77
	4	5/16/77	1225	153	0	133
					3	127
					7	92
					11	90
					14	78
	5		1850	156	0	126
					2	133
					4	127
					8	114
					14	89
					22	78
			2305	160	0	126
					4	116
					8	103
					14	89
					20	80
		5/17/77	0600	163	0	105
					2	110
					5	113
					8	110
					14	80
	6	5/17/77	1240	170	0	147
					2	135
					4	122
					10	106
					18	89
			1900	174	0	170
					2	156
					6	117
					10	109
					16	102
					24	79
			2245	178	0	148
					4	110
					8	106
					14	101
					20	80
		5/18/77	0600	181	0	123
					2	121
					5	126
					10	105
					18	78
			1230	191	0	164
					2	132
					5	118
					9	104
					14	85
			1840	195	0	183
					2	176
					5	139
					9	107
					14	87
			2250	199	0	129
					3	124
					9	114
					15	92
					20	78

Table (continued)

Cruise	Drogue	Date	Time	Sta. No.	Depth (m)	% O_2 Sat.
	6	5/19/77	0600	202	0	124
					2	134
					5	144
					9	111
					14	91
			1215	210	0	160
					2	156
					5	140
					10	99
					18	77
	R-1	5/19/77	1430	214	0	121
					2	147
					4	137
					8	100
					13	79
	R-6	5/19/77	1630	217	0	132
					3	122
					8	106
					15	83
					23	91
	R-3	5/19/77	1830	220	0	127
					2	127
					5	130
					10	95
					15	78
	R-4	5/19/77	1950	223	0	121
					3	121
					8	113
					13	105
					20	84
	R-5	5/19/77	2120	226	0	112
					3	112
					8	108
					18	100
	R-2	5/19/77	2335	229	0	135
					4	138
					8	127
					13	77
					18	76
	R-7	5/20/77	0115	232	0	139
					7	117
					14	102
					21	80
					28	78
II	R-3	7/19/77	0150	003	0	124
					4	122
					8	77
					18	49
	R-4	7/19/77	0420	008	0	115
					4	112
					10	97
					27	67
	R-2	7/19/77	0645	012	0	145
					4	106
					16	49
	R-5	7/19/77	0845	016	0	137
					5	113
					10	86
					15	59
					28	47
	R-1	7/19/77	1050	020	0	117
					4	94
					9	65
					14	58
	R-6	7/19/77	1250	024	0	131
					4	108
					9	78
					15	63
					25	48
	1	7/19/77	2305	029	0	139
					6	97
					12	67
					20	55
		7/20/77	0545	032	0	110
					5	92
					10	49
					17	46
			0835	036	0	124
					2	119
					5	113
			1205	042	0	140
					8	115
					13	84
	None	7/20/77	1838	046	0	137
					3	120
					6	98
					12	66
					26	44
	2	7/20/77	2300	050	0	105
					4	95
					8	86
					12	66
					26	45
		7/21/77	0540	053	0	102
					12	61
					24	49
			0840	057	0	109
					2	104
					4	91
			1220	063	0	142
					3	121
					6	91
					12	62
					22	52

Table (continued)

Cruise	Drogue	Date	Time	Sta. No.	Depth (m)	% O_2 Sat.
II	2	7/21/77	1845	067	0	123
					4	100
					8	70
					19	50
		7/21/77	2300	071	0	128
					4	87
					8	72
					18	53
		7/22/77	0540	074	0	96
					3	97
					8	84
					13	44
	3	7/22/77	1225	080	0	110
					5	115
					12	99
					28	64
					29	63
			1855	085	0	111
					5	111
					10	109
					15	69
					28	56
			2330	089	0	108
					8	112
					14	97
					20	73
					35	55
		7/23/77	0545	092	0	106
					5	103
					12	89
					18	49
					24	49
			0840	096	0	105
					2	104
					6	104
					8	103
			1230	102	0	105
					6	106
					20	54
					27	53
					29	53
			1845	106	0	106
					4	106
					11	93
					18	55
					28	52
			2250	110	0	105
					6	106
					18	60
					28	52
		7/24/77	0600	113	0	106
					8	109
					16	83
					25	69
					50	49
	3	7/24/77	0905	117	0	108
					2	108
					5	107
					8	108
					16	81
			1235	123	0	108
					7	107
					15	88
					25	67
					50	45
					53	45
	4	7/26/77	1840	128	0	107
					5	92
					10	66
					15	62
					27	70
			2300	134	0	106
					10	70
					20	72
					30	69
		7/27/77	0600	137	0	100
					5	99
					11	73
					20	68
					28	67
			0845	141	0	101
					1	101
					4	99
					6	97
			1205	147	0	104
					3	104
					8	92
					15	49
					22	65
					23	68
			1830	151	0	108
					3	108
					8	99
					13	58
					22.5	66
			2252	155	0	109
					4	103
					10	57
					14	49
					18	63
		7/28/77	0550	158	0	105
					7	74
					12	50
			0835	162	3	106
					7	83
					12	52
	R-2	7/28/77	1030	165	0	100
					5	84
					10	50
					17	48

Table (continued)

Cruise	Drogue	Date	Time	Sta. No.	Depth (m)	% O_2 Sat.
II	R-1	7/28/77	1215	171	0	80
					5	79
					10	72
					15	55
	R-6		1320	176	0	109
					4	78
					10	59
					15	60
					25	66
	R-5		1520	182	0	110
					10	60
					15	63
					25	69
	R-4		1835	186	0	105
					6	105
					12	91
					18	65
					27	62
	R-3		2025	191	0	112
					5	119
					10	73
					15	48
					22	47
III	R-6	11/ 9/77	0935	004	0	99
					3	99
					6	99
					12	98
					25	94
	R-2		1210	009	0	98
					2	92
					6	93
	R-1		1350	015	0	89
					2	88
					6	91
					14	91
	R-5		1550	020	0	95
					26	90
	R-4		1850	024	0	99
					5	98
					10	93
					27	93
	R-3		2030	028	0	104
					3	102
					6	97
					18	.86
	1	11/10/77	1440	039	0	95
					5	95
					10	96
					15	96
					20	92
			1855	042	0	94
					4	96
					7	96
					13	93
					21	90
	1	11/10/77	2310	046	0	94
					5	94
					10	92
					20	85
		11/11/77	0700	049	0	97
					5	97
					10	97
					23	97
			1225	059	0	100
					5	99
					10	98
					15	98
					20	99
	2	11/16/77	0710	063	0	91
					3	93
					6	93
					14	98
			1010	067	0	95
					3	94
					6	96
					14	96
					36	88
			1445	074	0	96
					4	97
					8	96
					16	97
					29	86
			1850	077	0	95
					4	98
					8	95
					16	96
					28	87
			2320	081	0	96
					5	96
					10	96
					14	93
					17	91
		11/17/77	0645	084	0	98
					4	98
					10	95
					19	91
	3	11/17/77	1900	098	0	99
					5	98
					10	99
					20	97
			2310	102	0	95
					5	98
					10	98
					20	91
		11/18/77	0645	105	0	97
					4	97
					8	97
					14	98
					23	96

Table (continued)

Cruise	Drogue	Date	Time	Sta. No.	Depth (m)	% O_2 Sat.
III	3	11/18/77	1005	110	0	99
					4	99
					9	99
					15	99
					22	97
	4	11/18/77	1340	118	0	96
					3	97
					7	96
					13	100
			2325	122	0	97
					7	97
					13	99
					20	96
	24 hrs	11/19/77	1045	129	0	95
					3	94
					6	94
					12	95
					22	95
			1415	136	0	97
					5	97
			1840	139	0	95
					5	97
					10	100
					15	100
					23	93
			2300	143	0	94
					7	96
					13	97
					20	95
	R-5	11/20/77	1100	155	0	99
					5	99
					10	99
					15	95
					27	94
	R-2	11/20/77	1225	160	0	94
					5	95
					10	92
					17	92
	R-1	11/20/77	1350	165	0	88
					5	92
					10	89
					14	90
	R-6	11/20/77	1550	170	0	101
					5	101
					10	97
					15	94
					26	90
IV	R-3	3/ 6/78	0315	004	0	109
					5	109
					10	107
					15	106
					19	107
	R-4	3/ 6/78	0540	007	0	106
					5	103
					10	104
					20	103
	R-2	3/ 6/78	0812	009	0	106
					3	107
					8	107
					13	106
	R-5	3/ 6/78	0951	013	0	110
					5	110
					10	107
					15	106
					28	96
	R-1	3/ 6/78	1141	016	0	109
					5	109
					10	109
					14	109
	R-6	3/ 6/78	1323	021	0	113
					5	114
					10	111
					20	104
	1	3/ 6/78	1901	025	5	109
					10	110
					20	104
					27	96
			2309	029	0	105
					5	106
					10	107
					20	102
					30	101
		3/ 7/78	1918	044	0	107
					7	107
					19	106
					29	99
					35	100
			2323	047	0	106
					10	104
					17	103
					27	102
		3/ 8/78	0718	050	0	104
					5	103
					10	104
					20	104
			1400	059	0	107
					7	107
					15	107
					22	105
			1911	062	0	104
					5	104
					10	104
					20	104
					31	103

Table (continued)

Cruise	Drogue	Date	Time	Sta. No.	Depth (m)	% O_2 Sat.
IV	1	3/ 8/78	2253	065	0	106
					5	105
					10	104
					20	104
					30	104
		3/ 9/78	0658	068	0	103
					5	104
					10	104
					20	104
					27	104
			1417	078	0	106
					5	107
					10	106
					15	105
	2	3/ 9/78	2251	081	0	107
					5	109
					10	108
					20	97
		3/10/78	0710	084	0	113
					5	109
					20	107
					35	99
			1405	094	0	110
					5	110
					10	109
					15	108
			1903	097	0	106
					5	107
					10	106
					15	106
					25	100
			2250	100	0	110
					5	110
					10	109
					17	104
					22	108
		3/11/78	0651	103	0	106
					5	106
					15	106
			1840	115	0	124
					5	119
					10	113
	3	3/12/78	1413	123	0	117
					5	112
					10	107
			1845	126	0	120
					5	121
					10	113
					15	110
			2229	129	0	121
					5	110
					10	107
					15	104
					23	99

Cruise	Drogue	Date	Time	Sta. No.	Depth (m)	% O_2 Sat.
IV	3	3/13/78	0647	132	0	114
					5	114
					10	107
					14	101
	4	3/13/78	1510	141	0	113
					5	115
					10	109
					15	106
			1832	144	0	113
					5	114
					10	111
					18	99
			2240	147	0	116
					5	116
					10	113
	24 hrs	3/14/78	0735	150	0	104
					5	107
					10	107
					15	104
					27	96
	R-6	3/15/78	0900	158	0	107
					5	107
					10	104
					20	100
					28	99
	R-1	3/15/78	1030	163	0	113
					5	111
					10	110
					16	101
	R-5	3/15/78	1245	169	0	107
					7	106
					15	103
					22	100
					28	97
	R-2	3/15/78	1420	174	0	110
					5	110
					10	104
					15	99
					19	96
	R-4	3/15/78	1731	178	0	104
					5	101
					10	103
					17	101
					30	96
					49	93
	R-3	3/15/78	1956	183	0	104
					5	103
					10	104

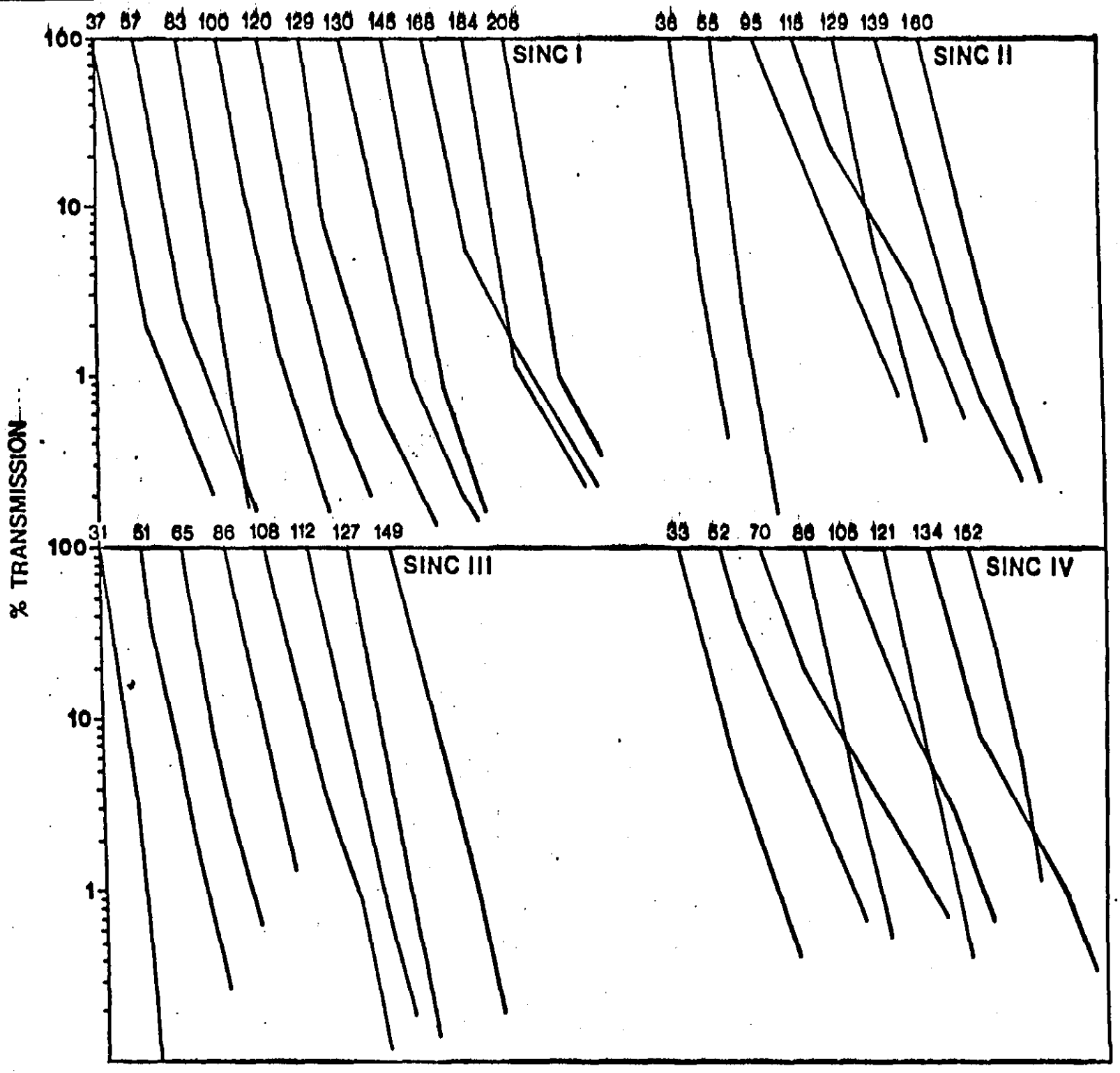
3.1.4 Vertical Stratification and Downwelling Radiation

a) Percent of transmission of photosynthetically active radiation (PAR) through the water column

The interval between stations plotted on the x-axis of Figure represents 5 meters' depth. During SINC I, most of the PAR transmission profiles indicated a relatively more transparent layer below 7 meters. In part these profiles may reflect the lower concentrations of chlorophyll observed in the relatively more saline water below 7 meters during SINC I.

The majority of PAR profiles from SINC II and III are linear and indicate a more homogeneous water column.

The PAR profiles measured during SINC IV are noticaeably less steep than those for SINC I-III, indicating a more transparent wqter column and a relatively deeper 1% light-depth.


% TRANSMISSION
100
10
1
37 57 83 100 120 129 130 145 168 184 208
SINC I
38 55 95 118 129 139 160
SINC II
31 51 65 86 108 112 127 149
SINC III
33 52 70 86 106 121 134 152
SINC IV

3.1.5 Dissolved Organic Carbon

SINC I

During May 1977 dissolved organic carbon (DOC) concentrations generally ranged between 1 and 2 mg C/liter (0.99 to 2.65 mg C/liter). Concentrations were usually highest at the surface and decreased with depth. Surface maxima between 2 and 3 mg C/liter occurred at stations 51, 81, 160, 170, 185, 191, 202, 205 and 210. A subsurface maximum of 2.64 mg C/liter occurred at 2 m depth at station 210. Otherwise DOC concentrations were nearly homogeneous vertically. The highest concentrations appeared to be at the surface when sigma-t was lowest, suggesting an estuarine source for DOC (Figures). Concentrations were also highest at reference station 1, further suggesting an estuarine source (Figure).

SINC II

During July 1977 DOC concentrations generally ranged between 1 and 2 mg C/liter (0.84 to 3.07 mg C/liter). As with the previous cruise concentrations usually decreased slightly with depth. DOC concentrations were between 2 and 3 mg C/liter at the surface at stations 24, 29, 42, 63, and 123. DOC concentrations were between 2 and 3 mg C/liter throughout the water column at station 42; concentrations were highest at the surface and decreased with depth. These high concentrations occurred early in the cruise (drogues 1 and 2 except for station 123) when surface sigma-t were low suggesting an estuarine source for DOC (Figures). These were also the stations with the highest rates of total plankton respiration yet DOC did not

appear to be related to respiration. Also average water column concentrations of DOC were highest at reference station 1, closest to the estuary (Figures and).

SINC III

During November 1977 DOC concentrations generally ranged between 1 and 2 mg C/liter (0.93 to 3.15 mg C/liter)(Figures). Concentrations were nearly homogeneous vertically except for a maximum value of 3.15 mg C/liter at 15 m at station 39. This was the highest value measured along the drogue tracks during the SINC study. The higher DOC concentrations (near 2 mg C/l) occurred during drogues 1 and 2 when surface sigma-t values were lowest. As with the previous cruises the highest concentrations were associated with the reference stations closest to the estuary (Figures).

SINC IV

During March 1978 DOC concentrations ranged from 0.45 to 1.82 mg C/liter. At the beginning of the cruise concentrations were closer to 1 than 2 mg C/liter and were vertically homogeneous (drogue 1). These were some of the lowest concentrations measured during the SINC study). Values from drogues 2, 3 and 4 were slightly higher but still vertically homogeneous and relatively unchanging temporally during the drogue. Again the higher concentrations were found closer to the estuary (Figures and).

DOC Summary

Dissolved organic carbon concentrations varied amazingly little both vertically and temporally during the drogue studies. In general concentrations did decrease with depth except for the March 1978 cruise. The highest concentrations (2-3 mg C/liter) occurred during May, July and November 1977. The lowest concentrations (0.45 to 1.82 mg C/liter) occurred during March 1978. DOC concentrations appeared to be highest when sigma-t values were lowest, suggesting an estuarine source for DOC. This, however, is not well tested. DOC concentrations generally were also highest at the reference stations nearest and most under the influence of the estuary (Refs. 1 and 2)(Figures).

Several possibilities for interpretation of this data exist. First, if the concentrations are considered to be relatively constant over the year than what enters the DOC pool must equal what leaves the pool, either by physical mixing and dilution or by oxidation. Second, if concentrations are considered to vary during the year than excess production over utilization or dilution of DOC occurs in the late spring, summer and fall and excess utilization or dilution over production occurs in the winter and early spring based on slight variations in standing stock concentrations. Sources entering the SINC study area DOC pool include Metropolitan New York sewage and other organic waste disposal into the estuary, phytoplankton production of DOC in the estuary and in the apex, excretion of organic substances by heterotrophic organisms, and other ambient refractory and labile

DOC advected into the area from other coastal and offshore areas. Certain of these sources would be expected to be relatively more refractory and others more labile, perhaps highly labile. The highly labile portions of the DOC pool might be expected to come from *in situ* phytoplankton production. However, no determination has been made as to what portion of the DOC pool is relatively labile and which is relatively refractory. Thus our understanding of the meaning of the DOC concentrations occurring in the New York Bight is relatively poor.

Figure [illegible]. Sine 1 pre-survey concentration of dissolved organic carbon in mg/liter at reference station 4, 9 May 1977 at 2330 hrs (EST). Surface concentrations are in brackets [ ].

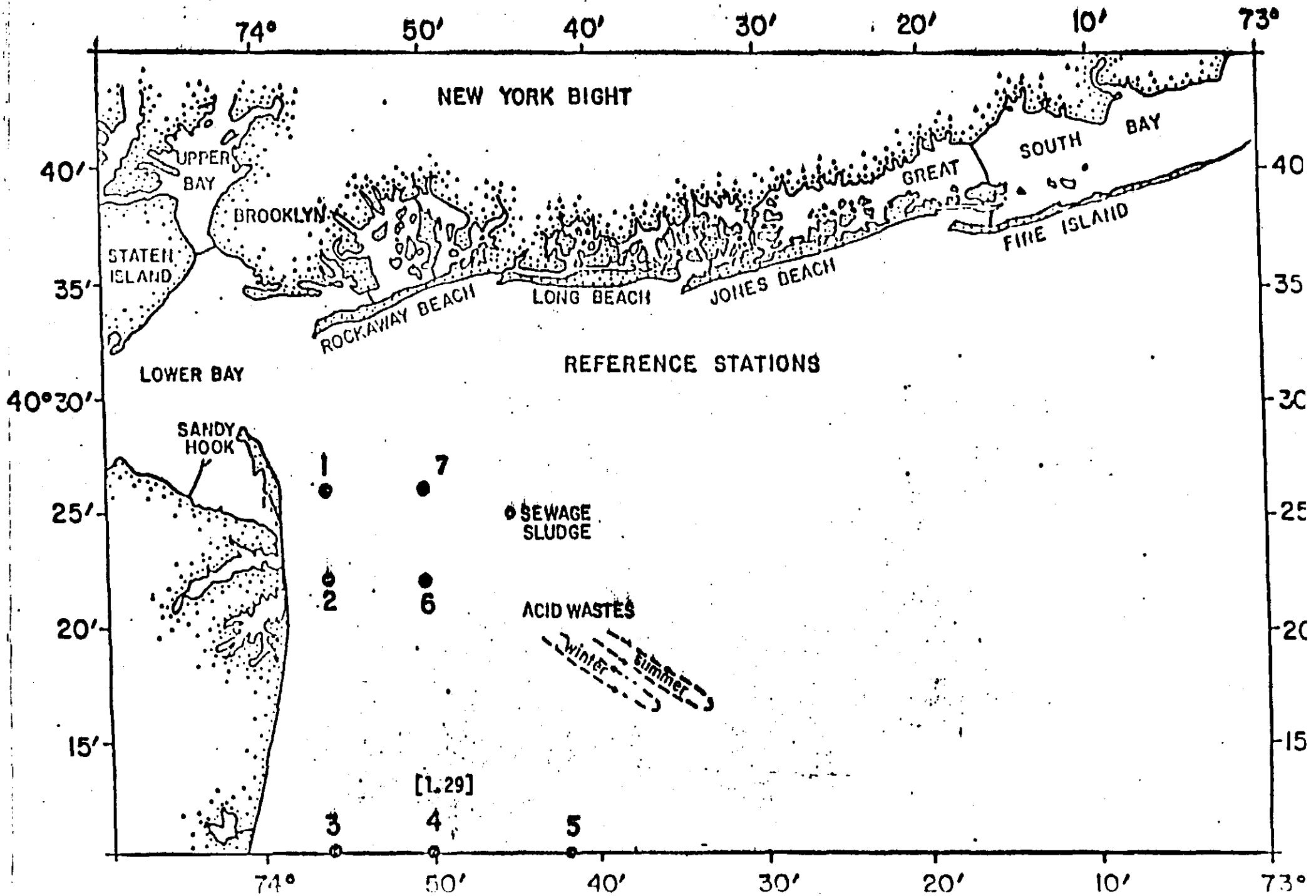
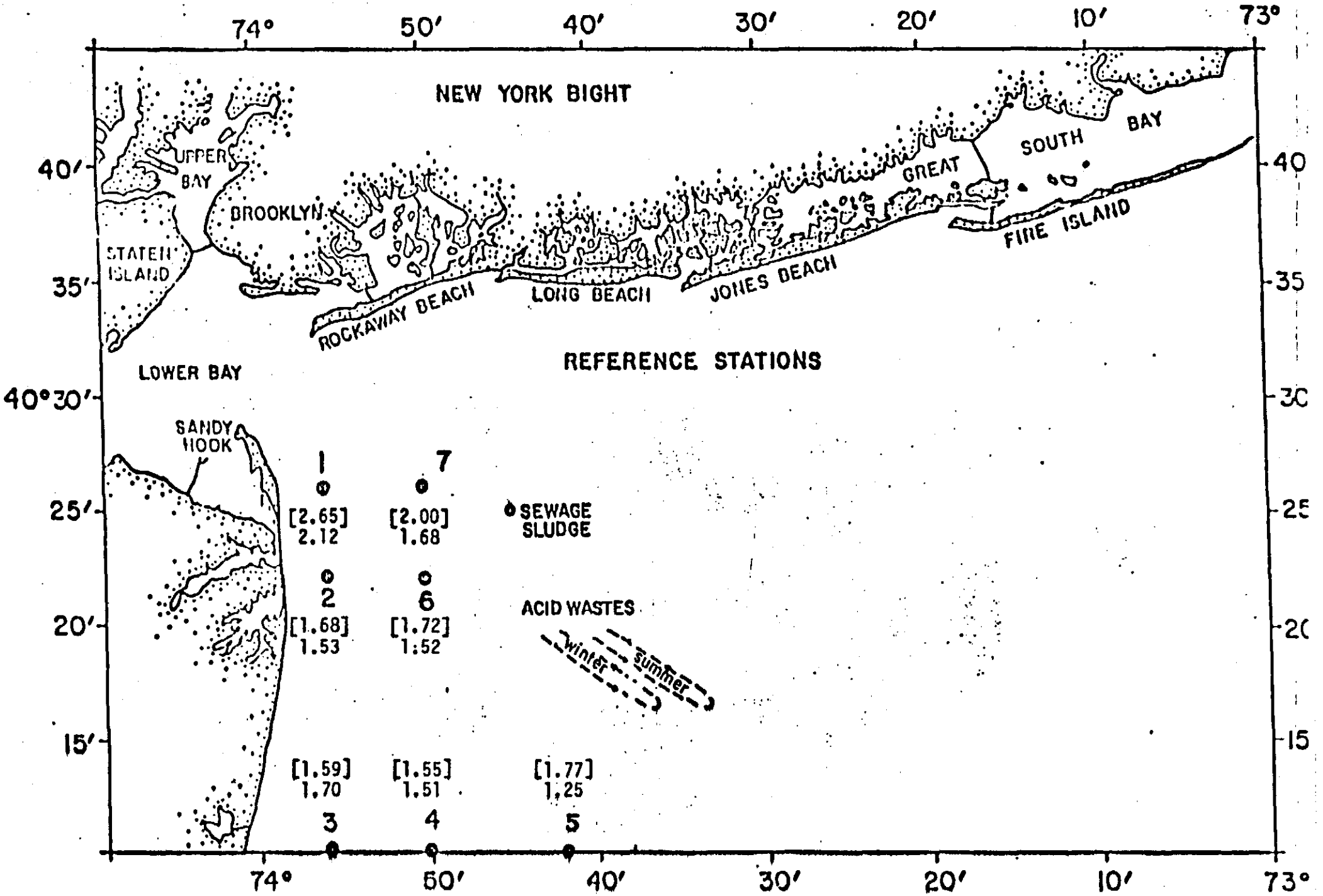


Figure . SINC I post-survey surface concentrations of dissolved organic carbon in mg/liter and average water column concentrations of dissolved organic carbon in mg/liter at reference stations 1 (1430 hrs), 6 (1630), 3 (1830), 4 (1950), 5 (2120), and 2 (2335) on 19 May 1977 and 7 (0115) on 20 May 1977. Surface concentrations are in brackets [ ].



water column concentrations of dissolved organic carbon in mg/liter at reference stations 3 (0150 hrs), 4 (0420), 2 (0645), 5 (0845), 1 (1050) and 6 (1250) on 19 July 1977. Surface concentrations are in brackets [ ].

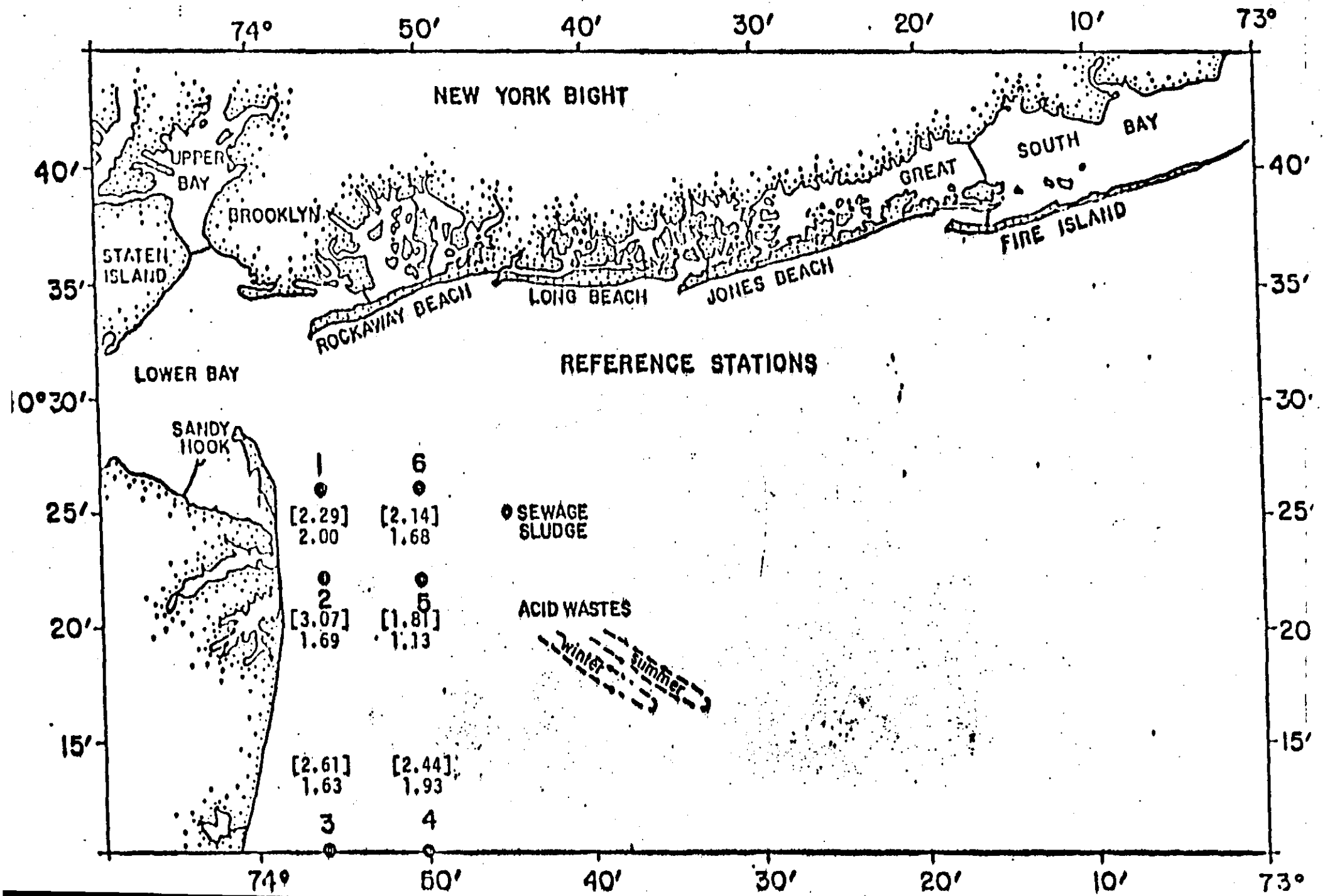
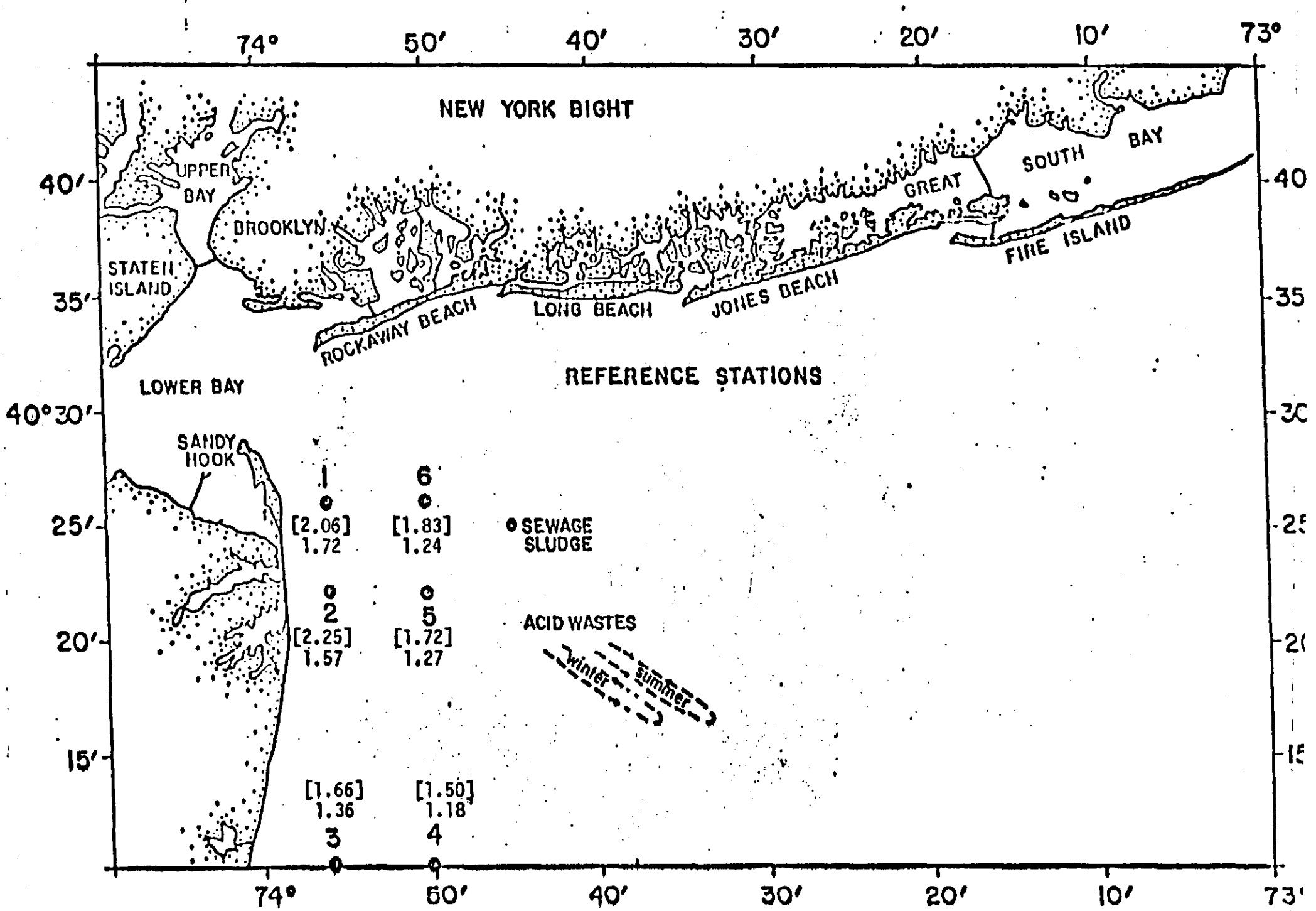
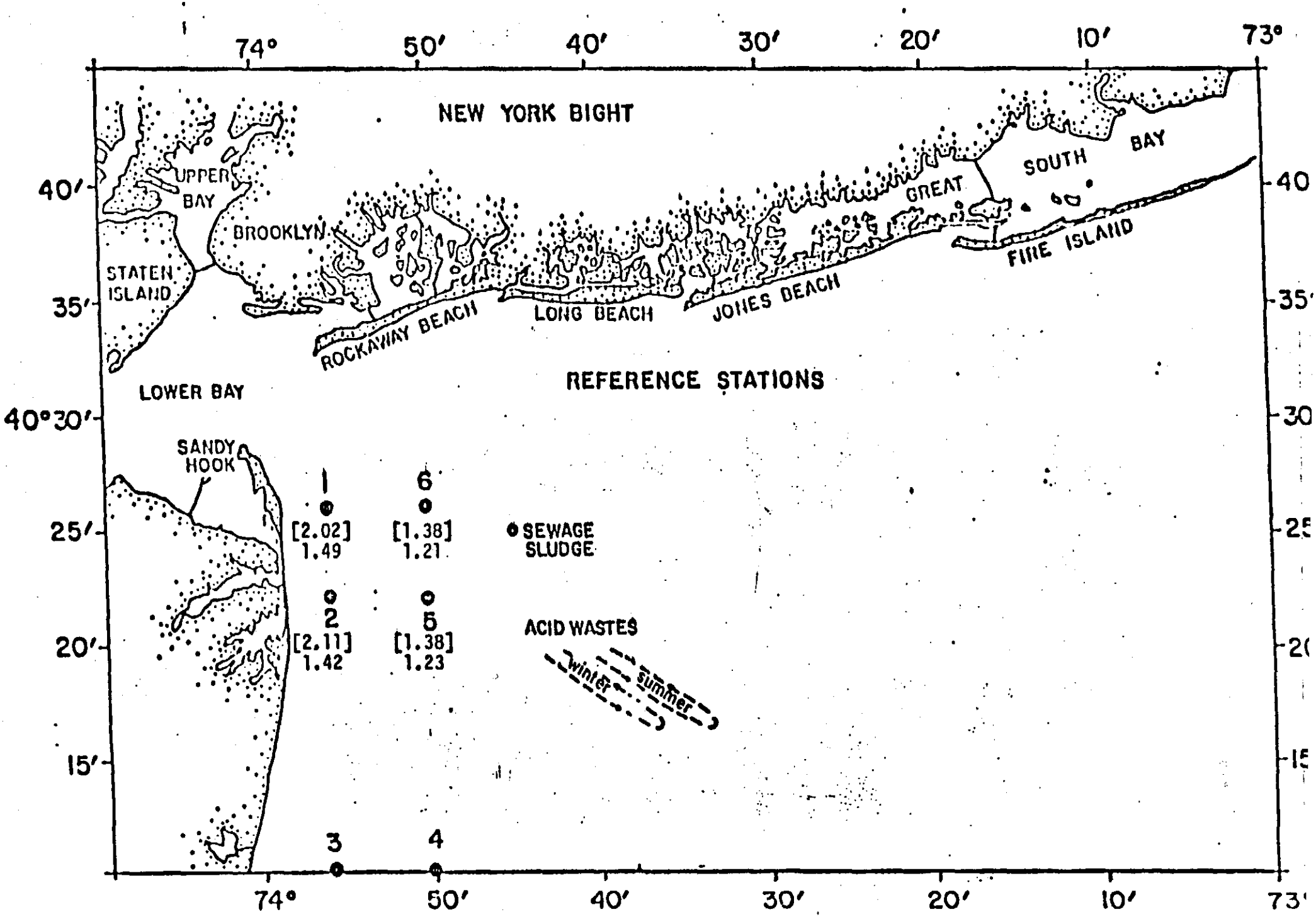


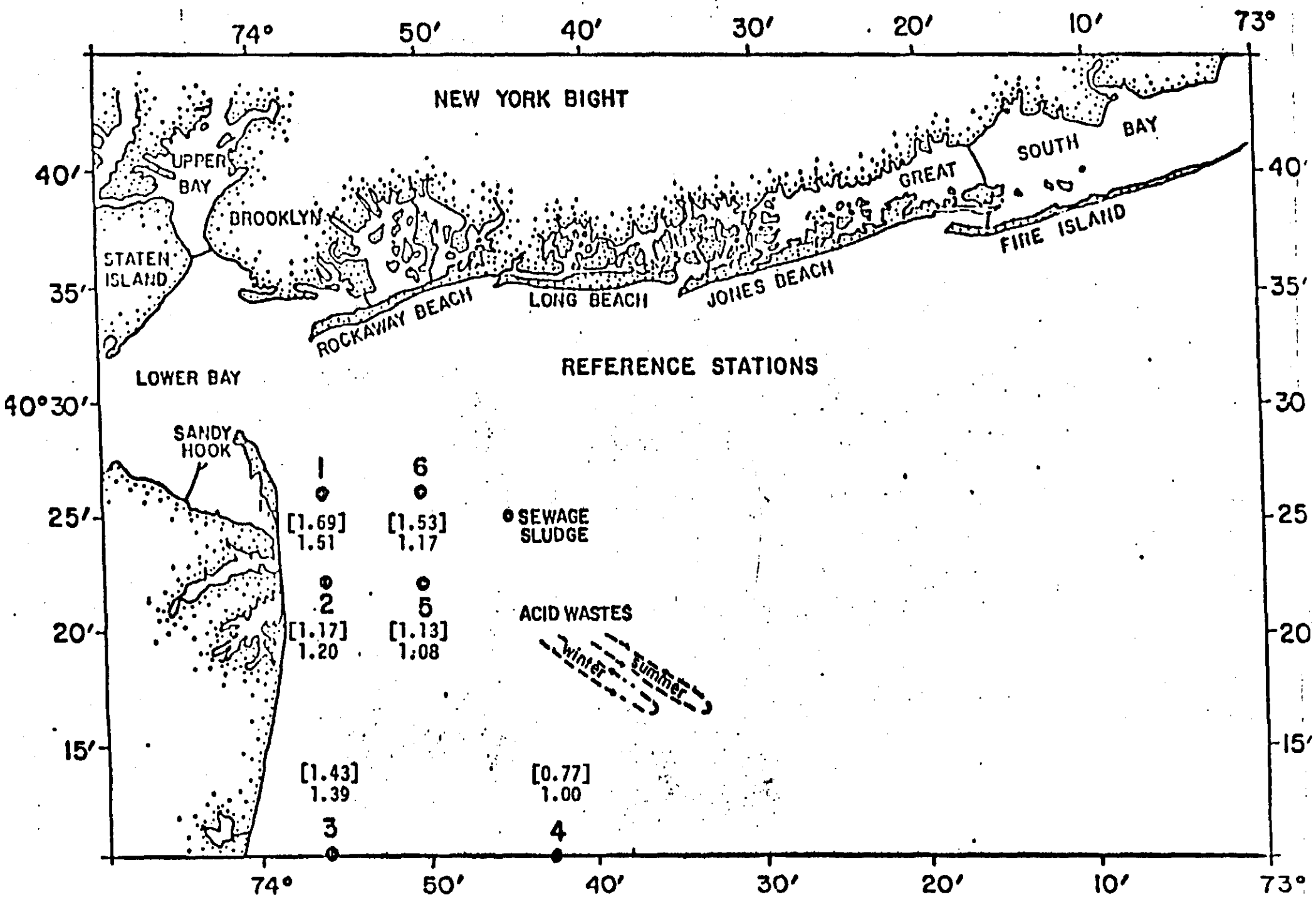
Figure . [illegible]
water column concentrations of dissolved organic carbon in mg/liter at reference stations 2 (1030 hrs), 1 (1215), 6 (1320), 5 (1520), 4 (1835) and 3 (2025) on 28 July 1977. Surface concentrations are in brackets [ ].



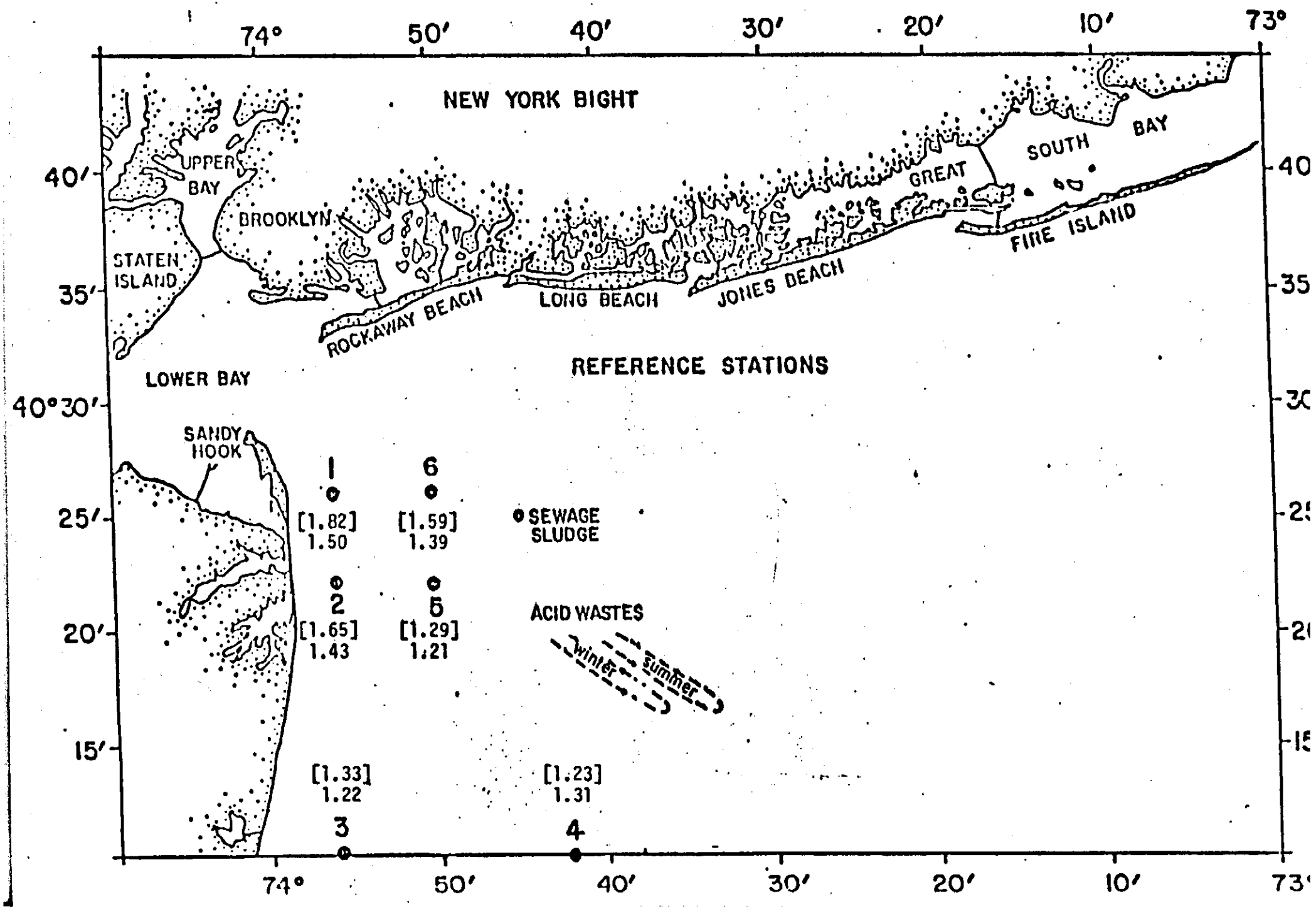
water column concentrations of dissolved organic carbon in mg/liter at reference stations 5 (1100 hrs), 2 (1225), 1 (1350) and 6 (1550) on 20 November 1977. Surface concentrations are in brackets [ ].



Water column concentrations of dissolved organic carbon in mg/liter at reference stations 3 (0315 hrs), 4 (0540), 2 (0812), 5 (0921), 1 (1141), and 6 (1323) on 6 March 1978. Surface concentrations are in brackets [ ].



Water column concentrations of dissolved organic carbon in mg/liter at reference stations-
6 (0900 hrs), 1 (1030), 5 (1245), 2 (1420), 4 (1731) and 3 (1956) on 15 March 1978. Surface concentrations are in brackets [ ].



3.4 Release of DOC by phytoplankton: Photosynthetic Capacity (DOM + Total)

Rates of release of ^{14}C-labeled dissolved organic matter (DOM) by the phytoplankton community ranged from 0-80 $mgC/m^3/hr$ in measurements of photosynthetic capacity (PC) made during SINC I (Table). During SINC II, III, IV, DOM release rates in PC experiments ranged (respectively) 0-19, 0-7, and 0-5 $mgC/m^3/hour$ (Tables).

Total Photosynthetic capacity (using method of Schindler et al. 972) ranged from 0-260 $mgC/m^3/hr$ (SINC I), 0-173 (SINC II), 0-26 (SINC III) and 0-38 (SINC IV)(Tables).

Generally, during all four SINC studies the percent extracellular release of DOM by phytoplankton increased with decreasing light intensities in photosynthetic capacity experiments. Generally, percent extracellular release (PER) was consistent at 10, 60, and 20% light intensities and variable at the lower light intensities (10, 2%) where total capacity was low. Consequently, the euphotic percent extracellular release, EPER (Integral DOM release rate divided by the Integral Total Productivity), should provide a fair representation of the proportion of total carbon assimilation released as DOM by the phytoplankton community. These EPER's are given according to drogue stations during SINC I-IV in Tables

The range of euphotic integral release of DOM in PC measurements during SINC I-IV was (25-122 $mgDOM\text{-}C/m^2/h$), (6-29), (3-16) and (9-44 $mgDOM\text{-}C/m^2/h$) respectively.

Total euphotic integral photosynthetic capacity (particulate + DOM) ranged between 74-763 $mgC/m^2/h$ (SINC I), 26-300 (SINC II), 14-47 (SINC III), and 15-432 $mgC/m^2/h$ (SINC IV).

In Photosynthetic capacity experiments, euphotic percent extracellular release (EPER) ranged between 13% and 69% and averaged 30% (n = 22) during SINC I studies. EPER ranged between 4% and 69% and averaged 24% (n = 19) during SINC II. EPER ranged between 20% and 69% and averaged 36% (n = 15) during SINC III. EPER ranged between 10% and 60% and averaged 24% (n = 19) in photosynthetic capacity measurements conducted during SINC IV.

Table . SINC I Euphotic integral release of D.O.M. and total primary productivity.

Date Yr/Mo/Da	Station* #	Euphotic Depth (2%)	Integral Release of D.O.M. PC = $mgC/m^2/h$ SIS = $mgC/m^2/d$	Integral Total Primary Productivity PC = $mgC/m^2/h$ SIS = $mgC/m^2/d$	Euphotic Percent Extracellular Release, %
770510	27 PC	6.0	52.41	ND	ND
11	34 PC	6.0	30.48	100.30	30.4
11	38 SIS	6.0	152.64	1698.96	9.0
11	44 PC	6.0	30.67	150.13	20.4
11	48 PC	6.0	36.08	74.04	48.7
12	68 PC	6.6	52.97	76.46	69.3
13	81 PC	5.0	25.24	128.51	19.6
13	81 SIS	5.0	209.28	2228.64	9.4
13	87 PC	5.0	42.51	123.17	34.5
14	95 PC	5.0	34.82	121.57	28.6
14	101 SIS	6.8	241.92	2183.52	11.1
14	107 PC	6.8	92.92	159.80	58.2
14	110 PC	6.8	50.22	127.00	39.5
15	117 PC	6.0	41.66	201.09	20.7
15	121 SIS	6.0	204.48	2567.76	8.0
15	127 PC	6.0	52.54	158.72	33.1
15	133 PC	6.8	61.73	204.24	30.2
16	145 SIS	5.6	298.56	4227.60	7.1
16	153 PC	5.6	86.42	261.21	33.1
16	156 PC	9.0	55.91	294.77	19.0
17	163 PC	9.0	47.69	320.02	14.9
17	170 PC	9.0	115.40	463.33	24.9
17	170 SIS	9.0	152.16	3756.72	4.1
17	174 PC	9.0	90.91	413.43	22.0
18	181 PC	5.2	64.21	452.87	14.2
18	185 SIS	5.2	335.04	5273.04	6.4
18	191 PC	5.2	121.77	435.13	28.0
18	195 PC	5.2	59.63	329.05	18.1
19	202 PC	5.0	47.61	369.77	12.9
770519	210 PC	5.0	90.85	211.86	42.9

Avg. SIS P.E.R. = 7.9%, Avg. PC P.E.R. = 30.1%

* Drogue 1 = stations 25-51; Drogue 2 = stations 66-72; Drogue 3 = stations 76-95; Drogue 4 = stations 98-153; Drogue 5 = stations 154-163; Drogue 6 = stations 164-211

Table . SINC II Euphotic integral release of D.O.M. and total primary productivity.

Date Yr/Mo/Da	Station * #	Euphotic Depth (2%)	Integral Release of D.O.M. PC = $mgC/m^2/h$ SIS = $mgC/m^2/d$	Integral Total Primary Productivity PC = $mgC/m^2/h$ SIS = $mgC/m^2/d$	Euphotic Percent Extracellular Release, %
770720	32 PC	4.0	27.35	97.51	23.9
20	36 SIS	4.0	108.24	1500.72	7.2
20	42 PC	4.0	18.74	167.71	11.2
20	50 PC	3.6	23.98	78.16	30.7
21	53 PC	3.6	15.67	225.54	6.9
21	57 SIS	3.6	154.80	1819.92	8.5
21	63 PC	3.6	16.46	218.47	7.5
21	67 PC	3.6	22.16	139.46	15.9
22	74 PC	3.6	28.80	129.65	22.2
22	80 PC	13.6	12.29	42.03	29.2
22	85 PC	13.6	15.73	26.39	59.6
23	92 PC	13.6	6.32	44.30	14.3
23	96 SIS	13.6	58.32	792.96	7.4
23	102 PC	13.6	11.71	49.02	23.9
23	106 PC	16.0	5.99	25.84	23.2
24	113 PC	16.0	9.32	28.15	33.1
24	117 SIS	16.0	60.00	515.28	11.6
24	123 PC	16.0	13.27	300.26	4.4
26	128 PC	7.0	9.62	90.68	10.6
27	137 PC	9.2	16.49	59.03	27.9
27	141 SIS	9.2	111.84	1451.04	7.7
27	147 PC	9.2	13.86	69.44	20.0
27	151 PC	9.2	25.87	37.54	68.9
770728	158 PC	8.4	7.60	53.85	14.1

Avg. SIS P.E.R. = 8.5%, Avg. PC P.E.R. = 23.6%

* Drogue 1 = stations 26-43; Drogue 2 = stations 47-74; Drogue 3 = stations 75-124; Drogue 4 = stations 126-162.

Table . SINC III euphotic integral release of D.O.M. and total primary productivity.

Date Yr/Mo/Da	Station* #	Euphotic Depth (2%)	Integral Release of D.O.M. PC = mgC/m²/h SIS = mgC/m²/d	Integral Total Primary Productivity PC = mgC/m²/h SIS = mgC/m²/d	Euphotic Percent Extracellular Release, %
771110	39 PC	4.3	9.49	39.47	24.0
10	42 PC	4.3	9.64	30.67	31.4
10	49 PC	6.0	7.15	22.87	31.3
11	53 SIS	6.0	58.08	202.56	28.7
11	59 PC	6.0	6.57	23.14	28.4
16	63 PC	6.4	13.02	14.38	58.6
16	67 SIS	6.4	14.64	182.40	8.0
16	74 PC	6.4	8.21	24.33	33.7
16	77 PC	6.4	9.54	19.73	48.4
17	84 PC	7.0	16.18	35.24	45.9
17	88 SIS	7.0	17.28	174.24	9.9
17	95 PC	8.8	12.68	34.58	36.7
17	98 PC	8.8	7.12	18.12	39.3
18	105 PC	8.8	5.82	29.65	19.6
18	118 PC	7.2	15.88	36.19	43.9
18	118 SIS	7.2	19.68	188.64	10.4
19	125 PC	7.2	15.70	46.77	33.6
19	129 SIS	5.8	27.60	130.08	21.2
19	136 PC	5.8	6.09	21.07	28.9
771119	139 PC	5.8	3.44	15.90	21.6

Avg. SIS P.E.R. = 15.6%, Avg. PC P.E.R. = 30.1%

* Drogue 1 = stations 29-60; Drogue 2 = stations 61-88; Drogue 3 = stations 89-110; Drogue 4 = stations 111-125; 24 hr station - No Drogue

Table . SINC IV euphotic integral release of D.O.M. and total primary productivity.

Date Yr/Mo/Da	Station* #	Euphotic Depth (2%)	Integral Release of D.O.M. PC = $mgC/m^2/h$ SIS = $mgC/m^2/d$	Integral Total Primary Productivity PC = $mgC/m^2/h$ SIS = $mgC/m^2/d$	Euphotic Percent Extracellular Release, %
720207	31 PC	11.3	30.01	221.89	13.52
07	34 SIS	11.3	80.16	1347.60	5.95
07	41 PC	11.3	20.86	131.32	15.88
07	44 PC	11.3	25.64	131.69	19.47
08	50 PC	16.4	39.40	186.13	21.17
08	53 SIS	16.4	120.00	1214.16	9.88
08	59 PC	16.4	39.13	150.47	26.01
08	62 PC	16.4	44.46	130.22	34.14
09	68 PC	20.4	29.08	95.64	30.41
09	71 SIS	20.4	113.76	443.04	25.68
09	78 PC	20.4	38.03	42.70	89.06
10	84 PC	9.2	12.46	44.87	27.77
10	87 SIS	9.2	45.60	950.88	4.80
10	94 PC	9.2	14.57	82.13	17.74
10	97 PC	9.2	11.94	34.11	35.00
11	103 PC	16.8	27.63	70.24	39.34
11	104 SIS	16.8	87.60	437.28	20.03
11	111 PC	16.8	30.42	266.45	11.42
11	115 PC	16.8	43.38	431.91	10.04
12	123 PC	8.4	20.79	109.44	19.00
12	126 PC	8.4	17.68	87.33	20.25
13	132 PC	8.4	12.49	128.90	9.69
13	133 SIS	16.0	150.96	557.52	27.08
13	141 PC	16.0	18.54	81.85	22.65
13	144 PC	16.0	23.39	120.77	19.37
14	150 PC	8.5	8.89	14.84	59.91
14	153 SIS	8.5	41.76	92.88	44.96

Avg. SIS P.E.R. = 19.3%, Avg. PC P.E.R. = 27.1%

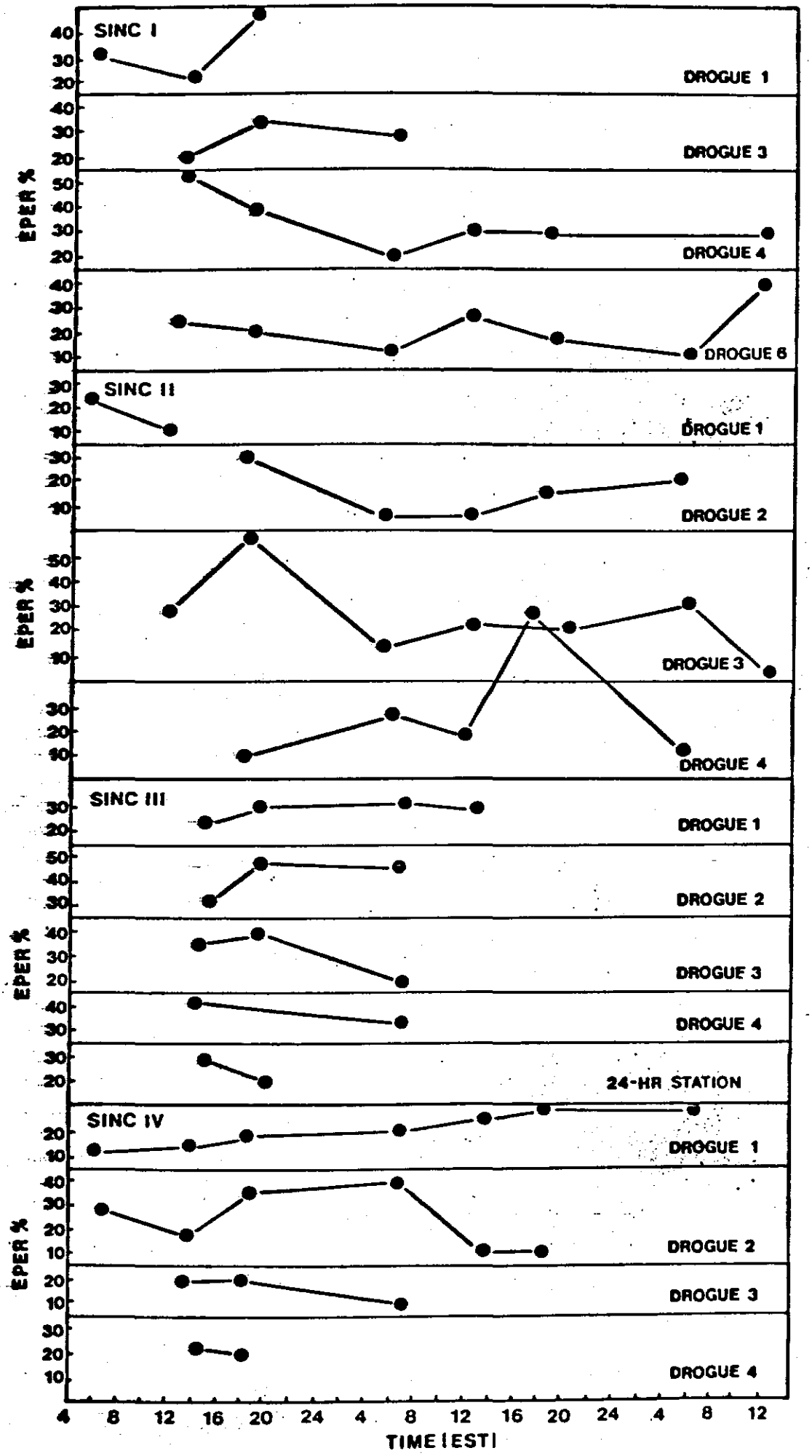
*Drogue 1 = stations 23-78; Drogue 2 = stations 79-115; Drogue 3 = stations 116-132; Drogue 4 = stations 133-147.

3.4.2 Simulated *In Situ* Measurements of DOM Release and Total Production

During SINC I the euphotic integral rates of DOM release by phytoplankton during sunlight SIS measurements ranged between 152 and 335 mg $C/m^2/day$ and averaged 228 mg $C/m^2/day$ (N = 7). Euphotic integral rates of DOM release (SIS) ranged between 58 and 155 mg $C/m^2/day$ ($\bar{x}$ = 99, N = 5) during SINC II, between 15 and 58 ($\bar{x}$ = 27, N = 5) during SINC III, and between 42 and 151 ($\bar{x}$ = 91, N = 7) mg $C/m^2/day$ during SINC IV. Average euphotic PER for sunlight SIS incubations were 8% (SINC I), 8% (SINC II), 16% (SINC III), and 20% (SINC IV). Throughout the four SINC studies, euphotic PER in samples incubated under sunlight 24 hr SIS conditions was consistently lower than EPER in samples incubated under fluorescent lighting for 2 hrs (photosynthetic capacity).

Measurements of DOM release by phytoplankton represent the net between actual phytoplankton release of DOM and heterotrophic utilization of DOM (Derenbach and Williams, 1974; Iturriaga and Hoppe, 1977; Williams and Yentsch, 1976). Possibly, the difference in euphotic percent extracellular release measured in the 2 hr photosynthetic capacity and the 24 hr simulated *in situ* results from the potentially relatively larger balance of heterotrophic uptake of DOM possible during the dark period of 24 hr SIS incubations. A proportion of the DOM compounds synthesized and released during the light period are subsequently assimilated heterotrophically during the dark period.

Examining graphs of euphotic PER according to drogue number (Figure), it is clear that EPER (PC) can change by as much as 10-20% between adjacent measurements separated by as little as 6 hours. However, several of the graphs (#4 SINC I, #2 SINC II, #1 SINC III, #1 SINC IV) reveal definite progressive changes in EPER over the course of the drogue path.


SINC I
DROGUE 1
DROGUE 3
DROGUE 4
DROGUE 6
SINC II
DROGUE 1
DROGUE 2
DROGUE 3
DROGUE 4
SINC III
DROGUE 1
DROGUE 2
DROGUE 3
DROGUE 4
24-HR STATION
SINC IV
DROGUE 1
DROGUE 2
DROGUE 3
DROGUE 4
EPER %
TIME (EST)

Given the rates of release of DOM (DOC) by phytoplankton in Table (SIS), we estimate that the time it would take to replace the measured euphotic standing stocks of dissolved organic carbon with newly released phytoplankton DOC is 55 days in May (29-72d), 218 days in July (69-455d), 522 days in November (159-779d) and 203 days in March (128-300d). Comparing the DOM release rates with euphotic standing stocks of DOC in this way provides a relative index of the potential distribution of phytoplankton released DOM to the DOC pool.

4.3

Based on our measurements of DOM release by phytoplankton during SINC I-IV (May, July, November and March) and other data, estimates of total carbon production (particulate plus dissolved) for the New York Bight apex can be made. Malone (1977) estimated 480 grams carbon/m^2/year for particulate phytoplankton carbon production in the apex. Our measurements of percent extracellular release during the four SINC studies averaged approximately 27% for two hour photosynthetic capacity experiments. The percent extracellular release determined in the SIS experiments were generally lower, approximately 13%. Studies by Thomas et al. (1979) in the apex during August-September 1976 indicated that 20% of total photoassimilated carbon was released as DOM. Studies by Thomas et al. (ms. in preparation) indicated that euphotic PER was 3% and 36% respectively in March and June 1977 in the apex.

Obviously, individual particulate measurements should be corrected using the appropriate PER before an accurate estimate of yearly total production (particulate and dissolved carbon) can be made for the apex. Nevertheless, from the above studies, 13 to 27% of the total carbon photoassimilated is released as DOM. Therefore, total phytoplankton production in the apex is probably between 552 and 658 g C/m^2/yr. Earlier studies over the annual cycle in Raritan Bay, Lower Bay, and Sandy Hook Bay, and between Sandy Hook and Rockaway indicated that annual PER was about 13% (O'Reilly et al., 1976).

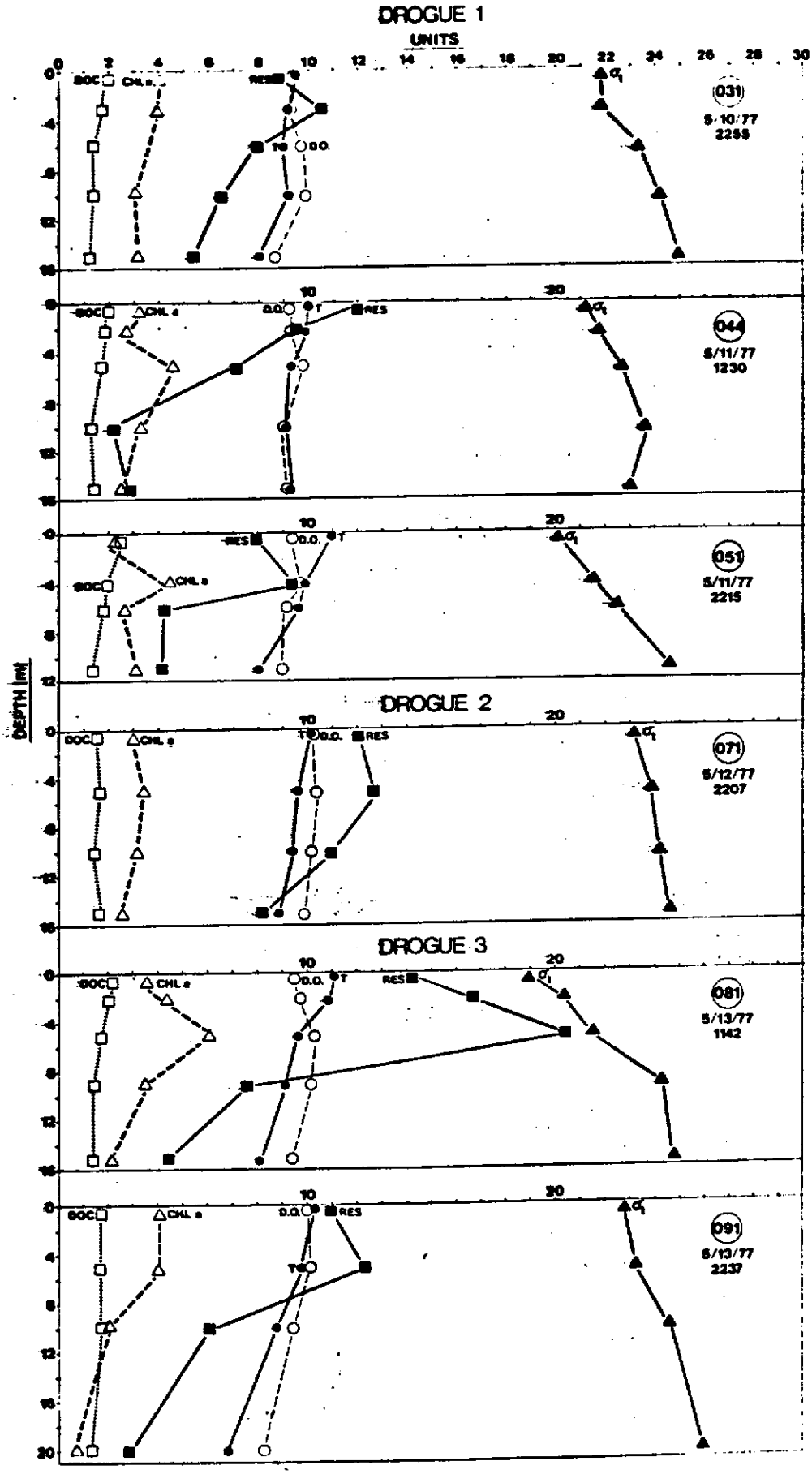
3.6 Microbial Respiration (Total Plankton Respiration)

a) Drogue Studies
SINC I - May 1977

Drogue 1 - total plankton respiration, determined by measuring oxygen change in whole water, unconcentrated samples held at in situ temperature, ranged from 2 to 12 ml O_2 m^{-3} hr^{-1} and was highest in the upper half of the water column. Bottom water generally ranged from 3 to 5 ml O_2 m^{-3} hr^{-1} while the top six meters of water ranged from 8 to 12 ml O_2 m^{-3} hr^{-1}. A subsurface maximum between 3 and 5 m was observed during the near midnight stations. The maximum was at the surface during the noon station.

Drogue 2 - only a single station near midnight was taken. Overall the rates appeared to be higher than those at stations on the first drogue track even though the range (8 to 12 ml O_2 m^{-3} hr^{-1}) overlapped those along the first drogue track. Again oxygen consumption was greatest in the upper half of the water column. Generally, as with oxygen uptake along the first drogue track, rates decreased with depth.

Drogue 3 - the highest oxygen uptake rates as with the previous two drogues, were observed in the upper half of the water column. A subsurface maximum was observed consistently at 5 m during this drogue. This subsurface maximum was also observed on the previous drogues between 3 and 5 m. As with the previous drogues, this maximum seemed to be associated with the top of the pycnocline and in some cases with a definite total

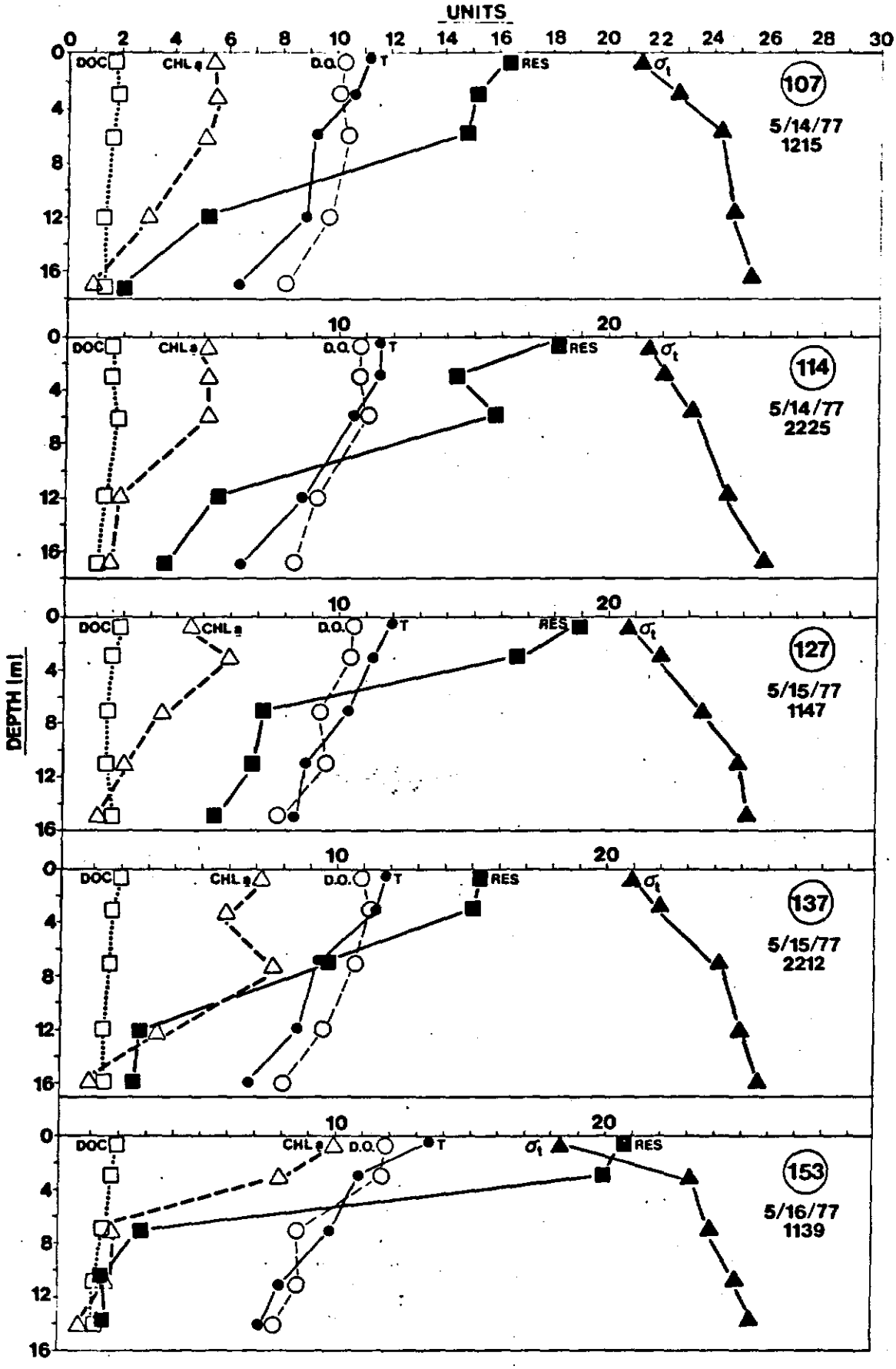

DROGUE 1
UNITS
DEPTH (m)
SOC
CHL a
RES
T
D.O.
σt
031
5/10/77
2255
044
5/11/77
1230
051
5/11/77
2215
DROGUE 2
071
5/12/77
2207
DROGUE 3
081
5/13/77
1142
091
5/13/77
2237

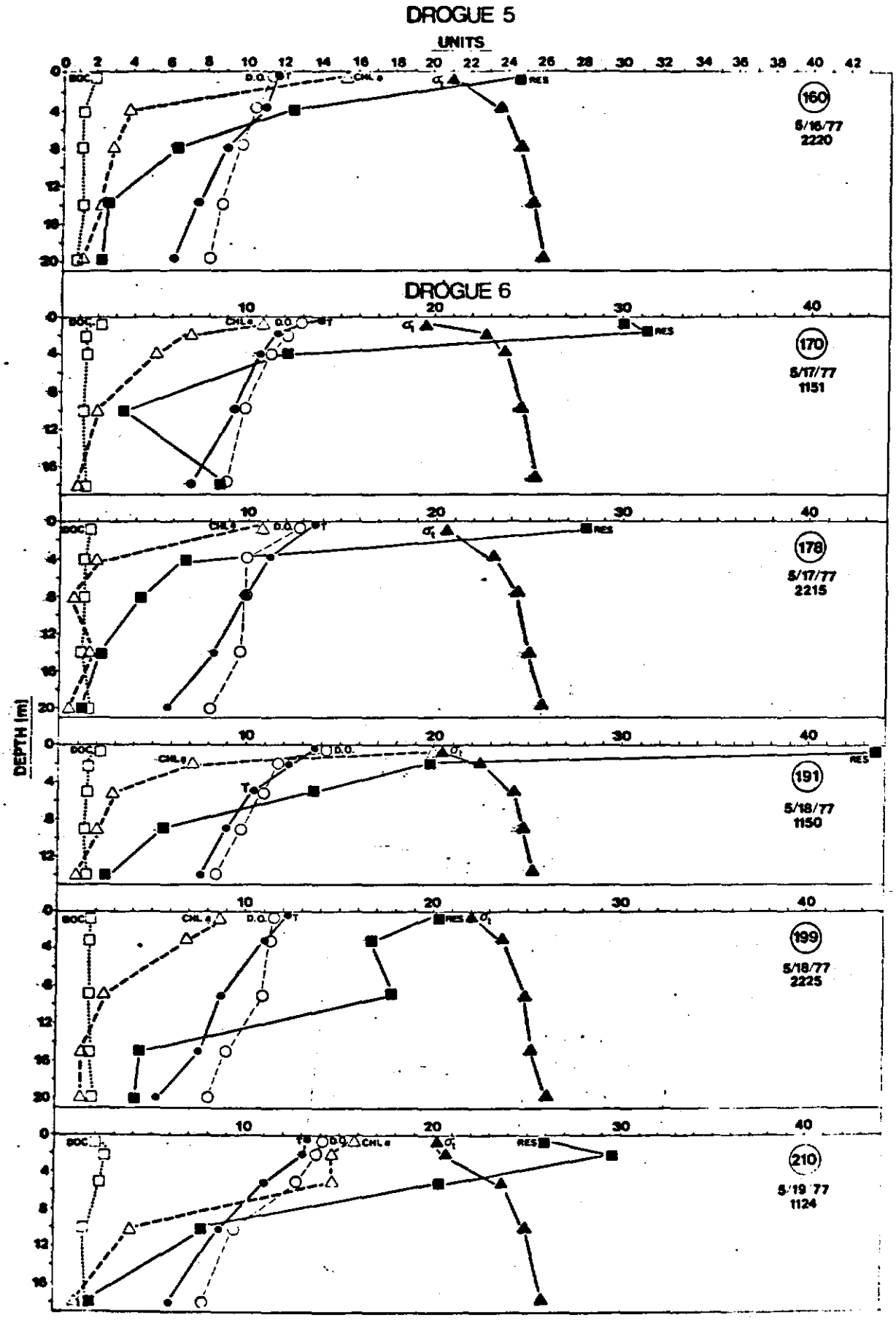
total chlorophyll a maximum which also resided there. At station 81 near noon on this drogue track the water column was strongly stratified. Yet by that night (station 91) stratification of the water column was relatively much weaker and oxygen uptake rates were lower. The suggestion is that total plankton respiration increased with stratification and decreased with a weakening of stratification.

Drogue 4 - oxygen uptake by plankton ranged from 2 to almost 21 ml O_2 m^{-3} hr^{-1}. In all cases the maximum was at the surface. Rates decreased precipitously from the surface to the bottom of the pycnocline. Below the pycnocline rates were relatively low and uniform. Thus as with the previous drogues, the major activity occurred above the pycnocline. During this drogue total plankton respiration increased along with surface water temperature, water column stratification, and total chlorophyll a above the pycnocline. Dissolved oxygen concentrations above the pycnocline also increased and together with the chlorophyll increase suggest considerable photosynthesis. In fact total primary productivity did increase from 2.5 g C m^{-2} d^{-1} at station 137 to over 4 g C m^{-2} d^{-1} at station 153 (Table).

Drogue 5 - only one station for total plankton respiration was taken along this drogue track. However, here as with the previous drogue, the highest rate of total plankton respiration (24 ml O_2 m^{-3} hr^{-1}) occurred in the surface water above the pycnocline. Oxygen uptake rates decreased with depth down to about 2 ml O_2 m^{-3} hr^{-1} in bottom water. Relative to previous drogue stations both total chlorophyll a concentrations

DROGUE 4


UNITS
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
DEPTH (m)
DOC
CHL a
D.O.
T
RES
σt
107
5/14/77
1215
114
5/14/77
2225
127
5/15/77
1147
137
5/15/77
2212
153
5/16/77
1139


DROGUE 5
UNITS
DEPTH (m)
160
5/16/77
2220
DROGUE 6
170
5/17/77
1151
178
5/17/77
2215
191
5/18/77
1150
199
5/18/77
2225
210
5/19/77
1124
BOC
D.O.
T
CHL a
RES

and total plankton respiration rates were higher except for water below the pycnocline.

Drogue 6 - total plankton respiration rates were highest at or near the surface (within 2 m) and decreased with depth to between 1 and 9 ml O_2 m^{-3} hr^{-1}. Surface rates ranged from 20 to 43 ml O_2 m^{-3} hr^{-1} and were the highest rates measured during the SINC I cruise in May 1977.

SINC I - Summary

During the SINC I cruise in May 1977 water column stratification became established. Surface water temperature increased from almost 10°C to almost 14°C. Surface water total chlorophyll a increased from about 4 ug/liter to between 9 and 20 ug/liter. Surface water dissolved oxygen concentrations increased to 11 to 14 mg O_2/liter. Surface water total plankton respiration generally increased throughout the cruise from 8 to 12 ml O_2 m^{-3} hr^{-1} to 20 to 43 ml O_2 m^{-3} hr^{-1}.

In bottom water temperature generally decreased during the cruise from 8 to 10°C and isothermal to 5 to 6°C and stratified at the end of the cruise. Total chlorophyll a also tended to decrease in bottom water during the cruise from about 4 ug/liter and nearly vertically homogeneous to about 1 ug/liter and highly stratified. Concentrations of dissolved oxygen in bottom water remained relatively unchanged. Total plankton respiration rates in bottom water except for station 170 were about the same throughout the cruise. The suggestion

is that during the SINC I cruise in May 1977 the major metabolic (biological) activity in the water column occurred above the pycnocline and generally near the surface. Of interest is that samples collected near noon generally exhibited higher respiration rates than those samples collected near midnight.

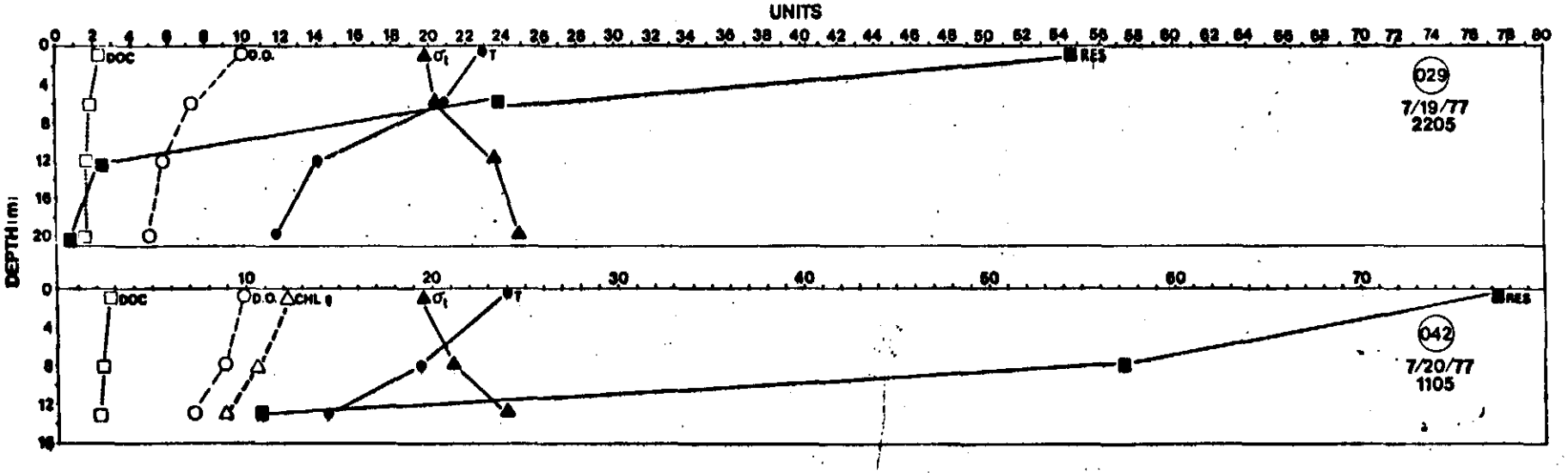
SINC II - July 1977

Drogue 1 - total plankton respiration ranged from less than 1 to 77 ml O_2 m^{-3} hr^{-1} and was always highest at the surface. As with the previous cruise respiration decreased with depth. Also, as with the previous cruise, higher respiration was observed with the surface samples collected near noon than those collected near midnight. Again the highest metabolic activities occurred above the pycnocline.

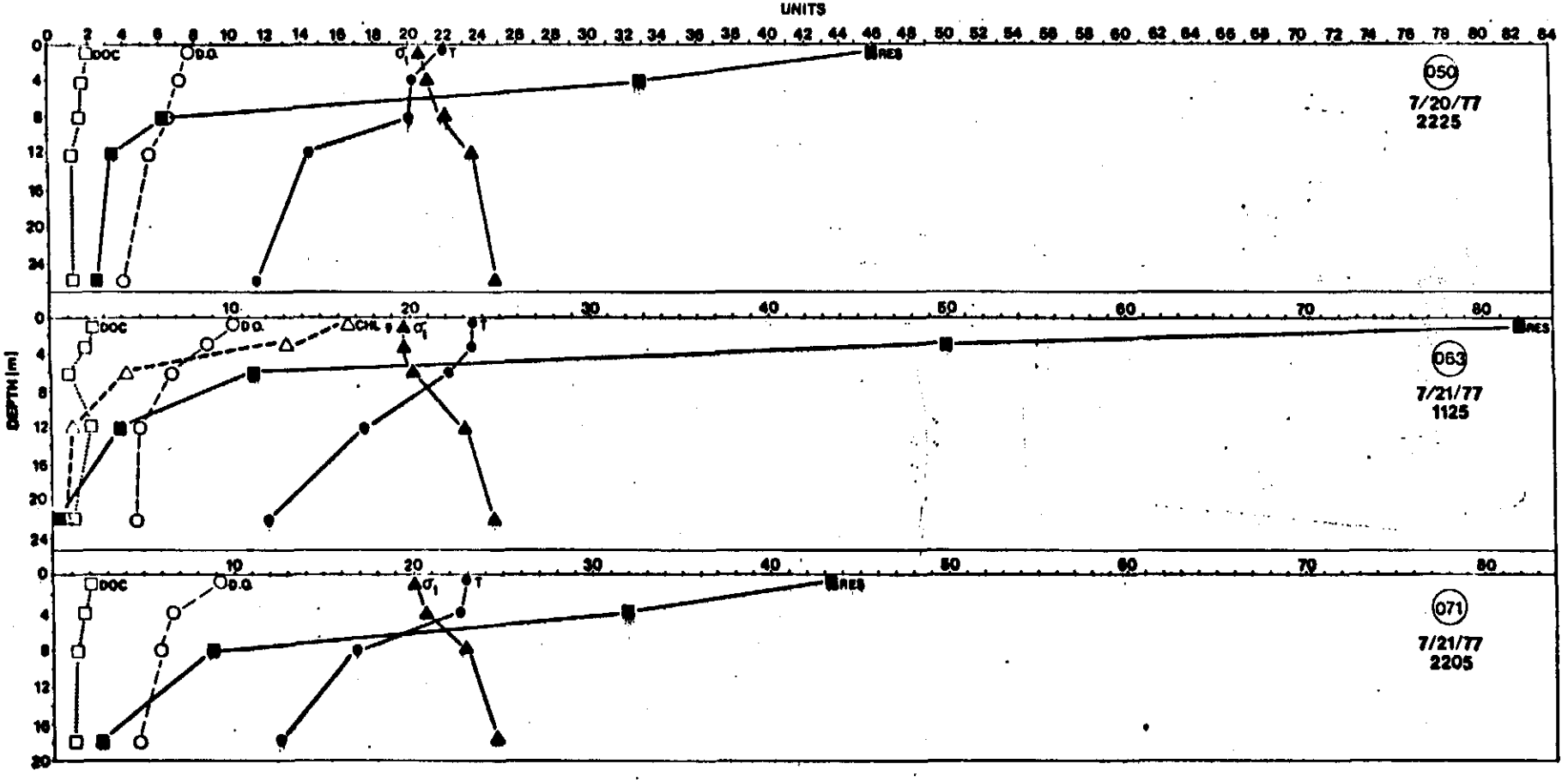
Drogue 2 - diurnal variation was most striking during this drogue with the highest respiration occurring in samples collected near noon. Total plankton respiration rates ranged from near zero in bottom water to 43 to 82 ml O_2 m^{-3} hr^{-1} in surface water. These were among the highest rates measured during the study. Again the major activity was above the pycnocline (at the surface).

Drogue 3 - total plankton respiration rates ranged from 1 to 5 ml O_2 m^{-3} hr^{-1} in bottom water to 8 to 9 ml O_2 m^{-3} hr^{-1} in surface water. No diurnal variation was apparent. Most striking is that respiration rates above the pycnocline were much lower than on the previous drogue. Total chlorophyll a

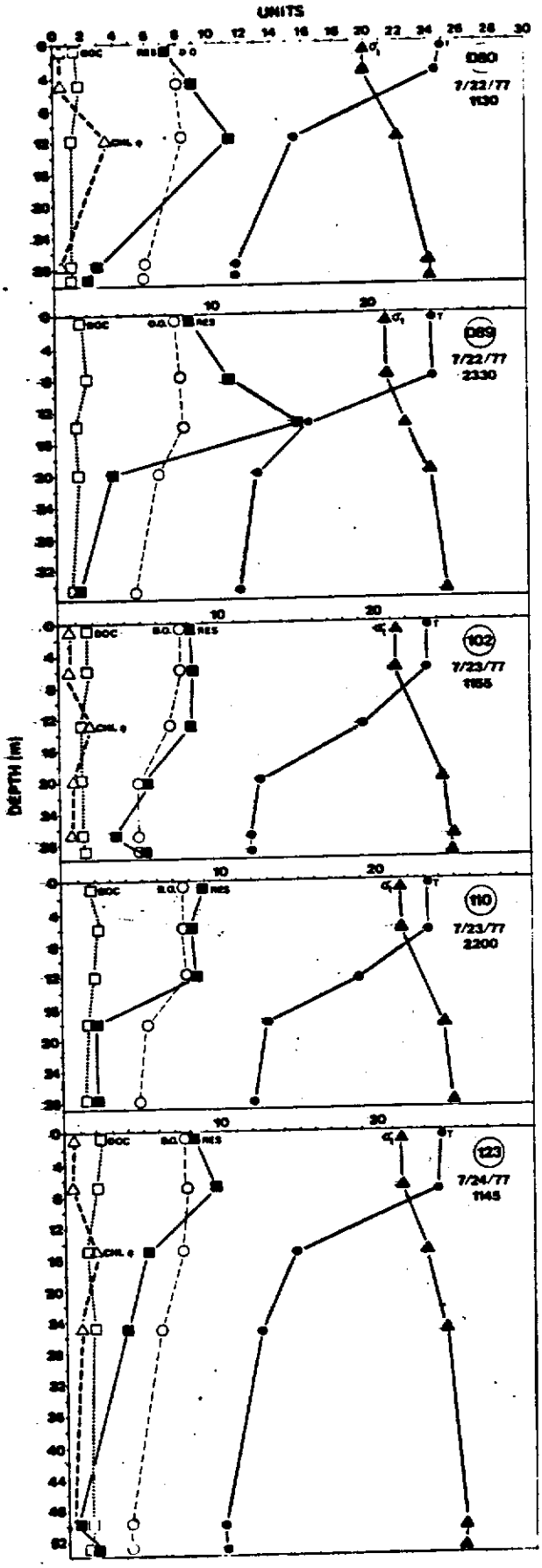
DROGUE 1



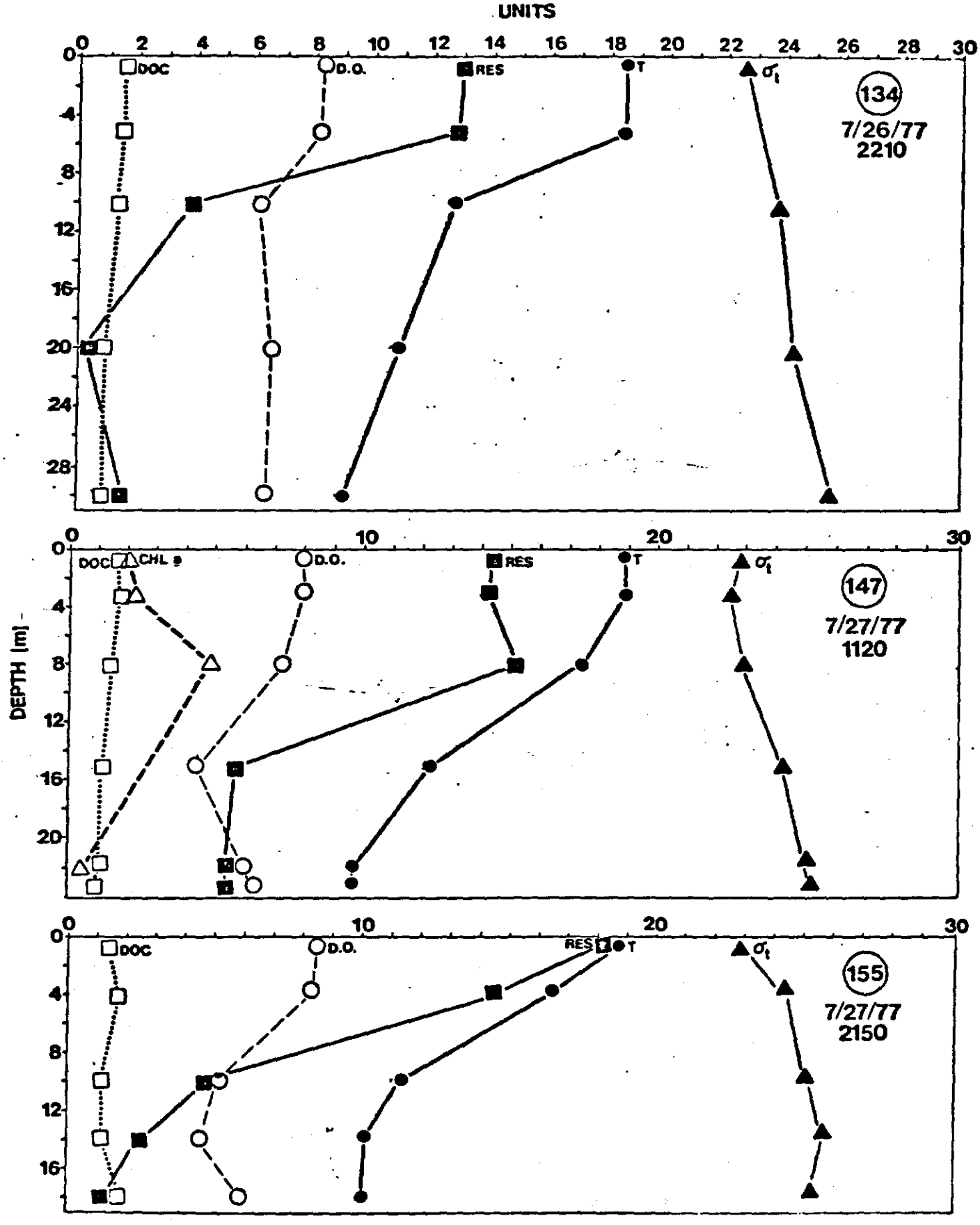
DROGUE 2


UNITS
DEPTH [m]
DOC
D.O.
CHL
σ1
T
RES
050
7/20/77
2225
063
7/21/77
1125
071
7/21/77
2205

DROGUE 3


UNITS
DEPTH (m)
DOC
RES
D.O.
CHL. a
σt
T
080
7/22/77
1130
089
7/22/77
2330
102
7/23/77
1155
110
7/23/77
2200
123
7/24/77
1145

DROGUE 4


UNITS
DEPTH (m)
DOC
D.O.
RES
T
σ_t
CHL a
134
7/26/77
2210
147
7/27/77
1120
155
7/27/77
2150

concentrations were also much lower. For the first time during the cruise a subsurface maximum for total plankton respiration, total chlorophyll a, and generally for dissolved oxygen was observed between 4 and 14 meter depths. These maxima seemed to be associated with the thermocline and the depth to which an approximate sigma-t of 22 extended.

Drogue 4 - total plankton respiration rates ranged from near zero to 5 ml O_2 m^{-3} hr^{-1} in water below the pycnocline to rates of 13 to 18 ml O_2 m^{-3} hr^{-1} above the pycnocline. These rates were a little higher than the previous drogue waters for the portion of the water column above the pycnocline. No diurnal variation was evident. Respiration and temperature profiles appeared to nearly parallel one another. A subsurface maximum was observed at station 147 for both respiration and chlorophyll a. Stratification of the water column appeared to be weaker (only 3 sigma-t units) than on the first drogue (approximately 4 sigma-t units).

SINC II - Summary

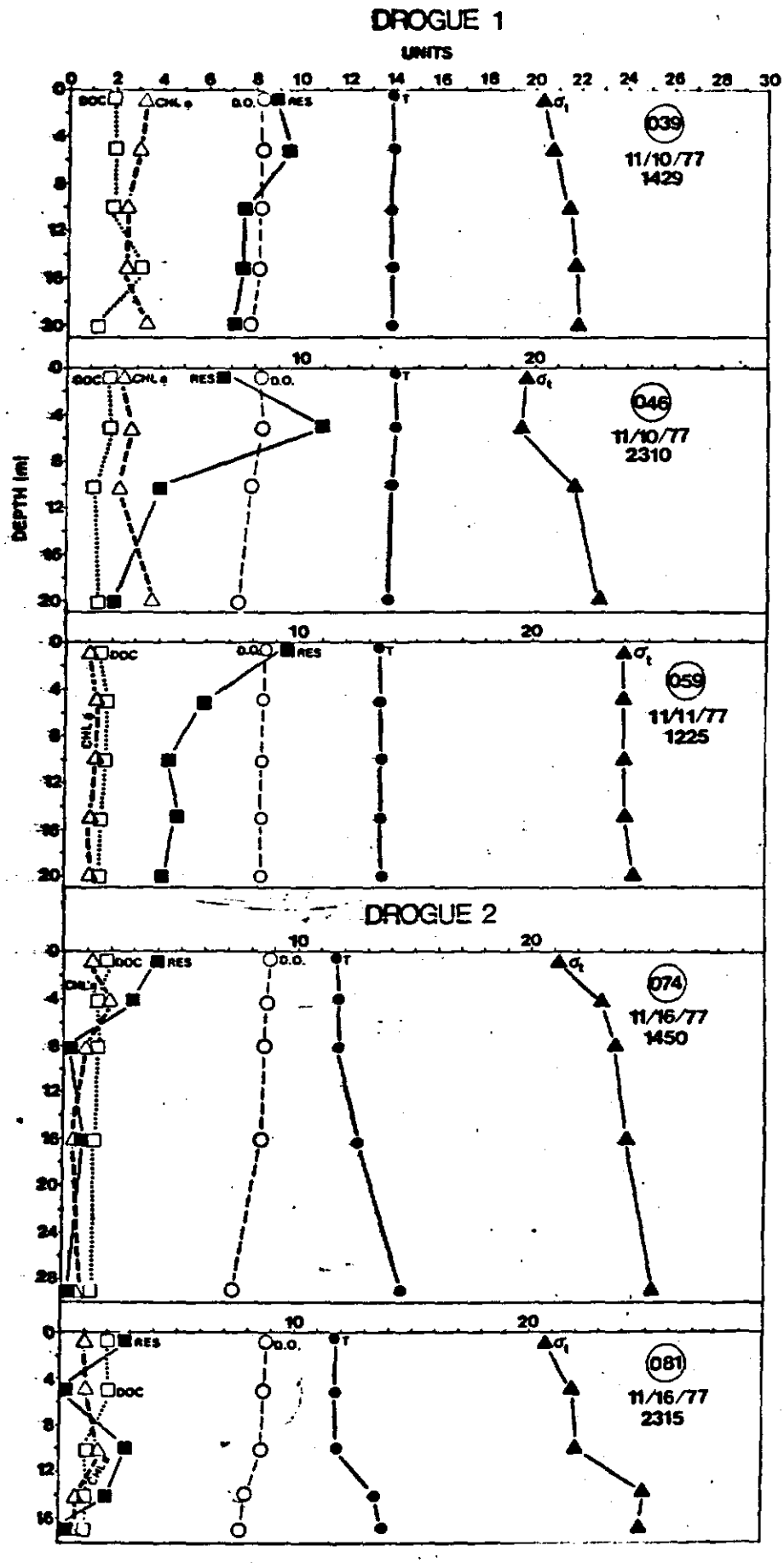
The highest rates (up to 82 ml O_2 m^{-3} hr^{-1}) of total plankton respiration for the SINC investigations were measured during this cruise. Stratification of the water column was most intense (4 sigma-t units) at the start of the cruise. Later only 3 sigma-t units separated surface and bottom waters. The highest rates of respiration were also measured at the start of the cruise. The suggestion is that the highest rates were associated with the strongest stratification of the water column.

The highest rates also occurred above the pycnocline. Dissolved oxygen concentrations remained reasonably stable about 8 mg O_2/liter at the surface and 5 or 6 mg O_2/liter at the bottom except for stations 63 and 71. Chlorophyll a was also at a maximum along with dissolved oxygen at the surface of station 63, suggesting a possible relationship between dissolved oxygen and chlorophyll a concentrations.

SINC III - November 1977

Drogue 1 - total plankton respiration ranged from 6 to 9 ml O_2 m^{-3} hr^{-1} in surface water and from 2 to 7 ml O_2 m^{-3} hr^{-1} in bottom water. The higher rates were still at or near the surface even in the absence of a pycnocline (station 59) compared with previous cruises (May and July 1977). A subsurface respiration maximum occurred at 5 m at stations 39 and 46. The subsurface maximum at station 46 was at the top of the pycnocline, which was principally a halocline; the water column was isothermal. Chlorophyll a and dissolved oxygen concentrations were relatively uniform throughout the water column and neither appeared to have any relationship to oxygen uptake in the water column. Overall respiration rates were less and stratification of the rates in the water column was less than that observed on the previous cruises (May and July).

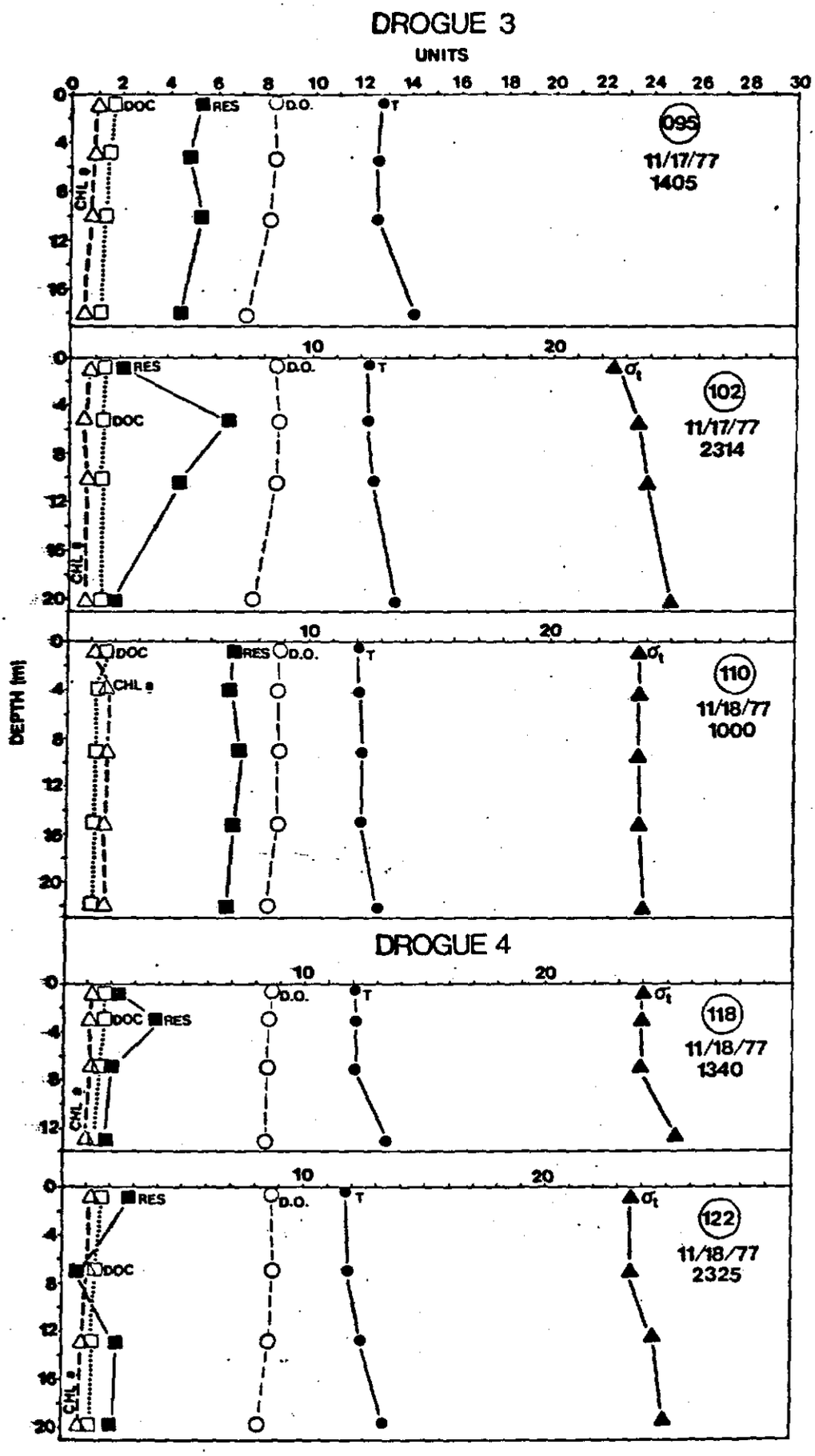
Drogue 2 - total plankton respiration rates ranged from near zero to 4 ml O_2 m^{-3} hr^{-1}. These rates were lower than those during the previous drogue and were some of the lowest

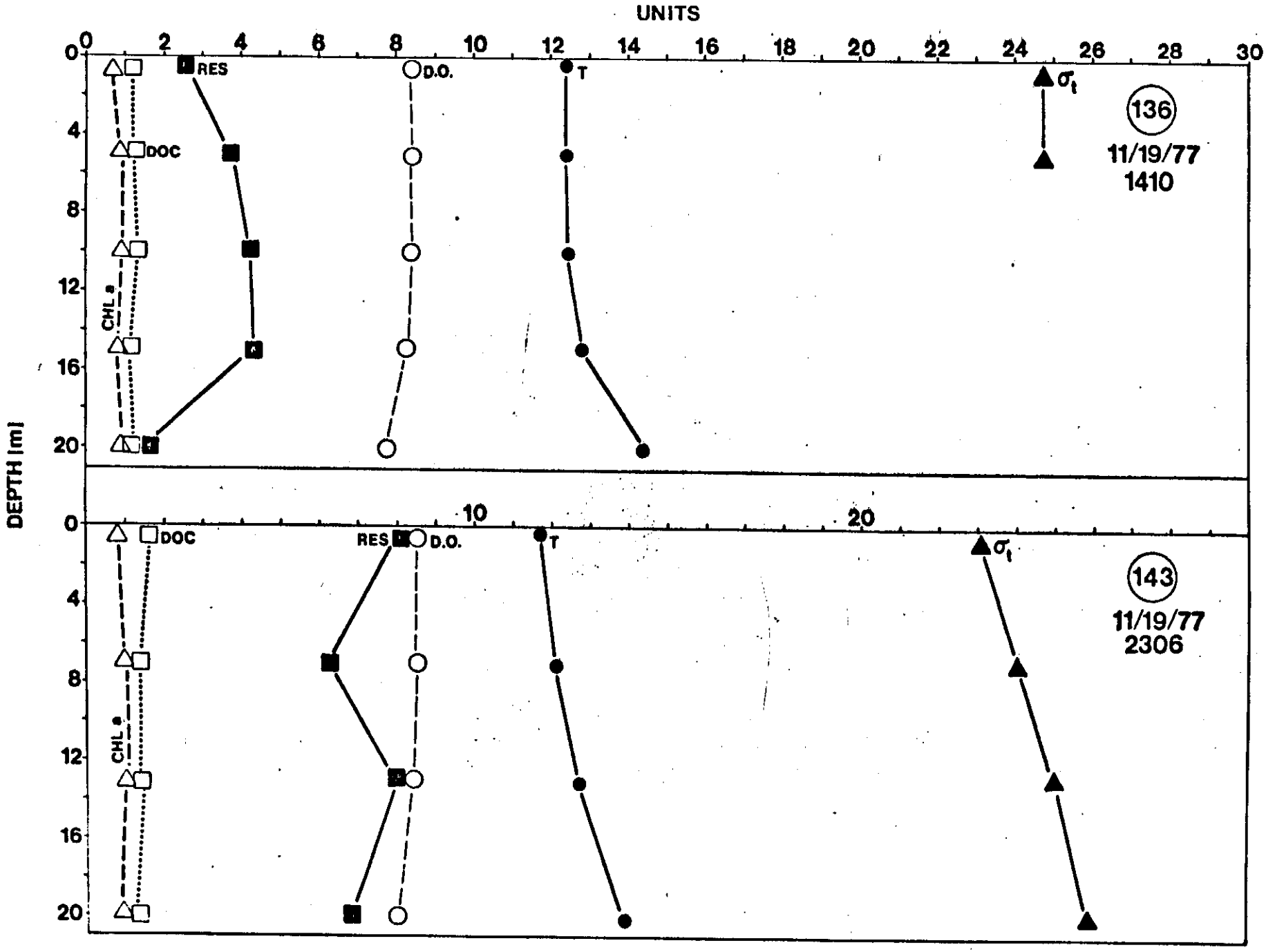

DROGUE 1
UNITS
DEPTH (m)
DOC
CHL a
D.O.
RES
T
σt
039
11/10/77
1429
046
11/10/77
2310
059
11/11/77
1225
DROGUE 2
074
11/16/77
1450
081
11/16/77
2315

rates measured during the SINC study. The higher rates, however, were associated with breaks or increases in the density structure of the water column. At station 74 the highest rate was at the surface and was associated with the less dense water of lower salinity. At station 81 both surface and subsurface maxima were observed. The surface maximum was associated with fresher, less dense water. The subsurface maximum was associated with the warmer, less dense water at the top of the thermocline. Again neither dissolved oxygen nor chlorophyll a appeared to be associated with oxygen consumption in the water column.

Drogue 3 - total plankton respiration ranged from 2 to 7 ml O_2 m^{-3} hr^{-1} and except for station 102 was relatively uniform with depth. No maximum occurred at the surface. At station 102 a subsurface maximum occurred at 5 m which did not appear to be related to chlorophyll a, dissolved oxygen, temperature, or sigma-t. Chlorophyll a, dissolved oxygen, temperature and sigma-t were all relatively uniform with depth.

Drogue 4 - total plankton respiration ranged from less than 1 to 4 ml O_2 m^{-3} hr^{-1}. No clear maximum occurred at the surface. A subsurface maximum in oxygen uptake occurred at 3 m at station 118. This maximum was not relatable to chlorophyll, temperature, dissolved oxygen, or density structure of the water column. These and those of the second drogue were some of the lowest rates of respiration measured during the SINC study.


DROGUE 3
UNITS
DEPTH (m)
DOC
RES
D.O.
T
CHL a
095
11/17/77
1405
102
11/17/77
2314
110
11/18/77
1000
DROGUE 4
118
11/18/77
1340
122
11/18/77
2325


UNITS
DEPTH (m)
RES
D.O.
T
σ_t
DOC
CHL a
136
11/19/77
1410
143
11/19/77
2306

Twenty-four hour station - at the end of the November cruise a single geographical location was maintained and sampled over a 24 hour period. No drogue was deployed. Thus the samples do not represent change with time while drifting with a water mass, but rather change at a particular geographical location over a 24 hour period. In this particular case the location is where all of the drogues for this cruise were first deployed. Total plankton respiration rates ranged from 1 to 8 ml O_2 m^{-3} hr^{-1} and were relatively unstratified with depth. Slightly warmer but more dense bottom water appeared to have a slightly lower activity at station 136. Station 143 had somewhat higher respiration rates than station 136, but neither chlorophyll, nor temperature, nor dissolved oxygen explained the difference. Sigma-t is slightly lower at station 143 and the higher rates may have been associated with the slightly cooler, fresher river-estuarine water.

SINC III - Summary

During this cruise in November 1977 the water column was alternately stratified and unstratified. Temperature, dissolved oxygen, and chlorophyll were relatively uniform vertically. The pycnocline appeared to be principally a halocline. Total plankton respiration ranged from near zero to 11 ml O_2 m^{-3} hr^{-1}. Some of the lowest rates measured during the SINC study occurred during this cruise. Maximum respiration rates

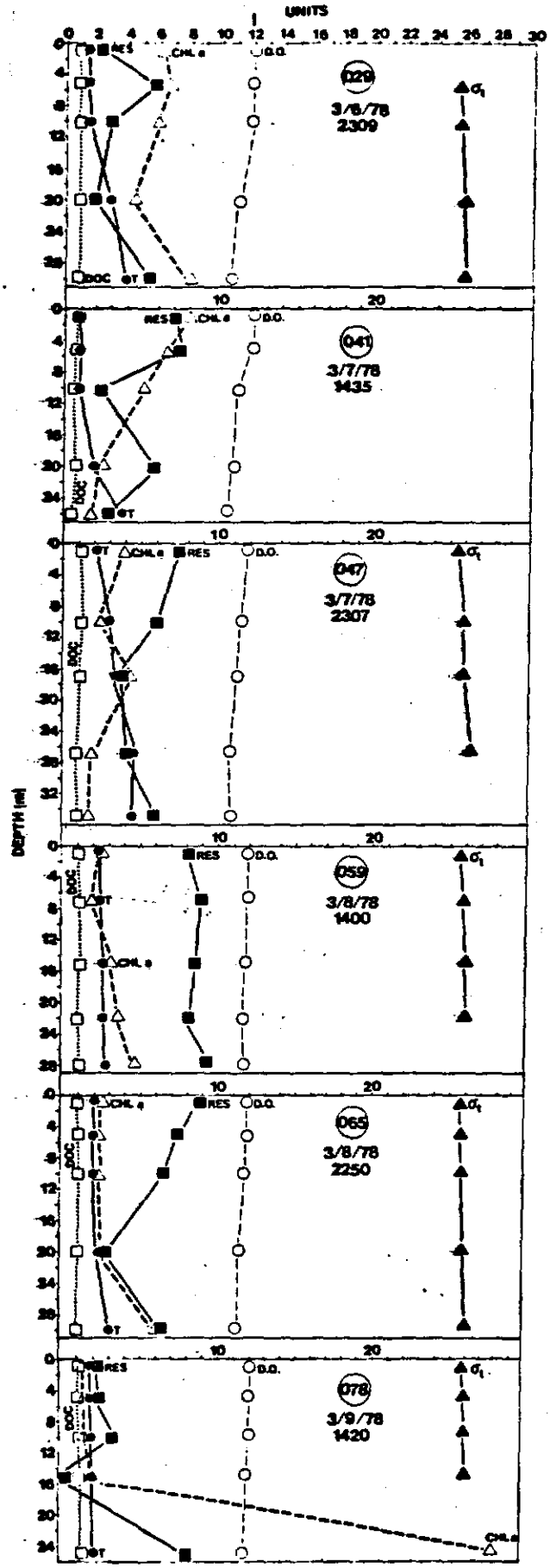
occurred at the surface of only stations 59 and 74. However, oxygen uptake was highest in the upper half of the water column along drogue track 1 and at the first station (station 74) of drogue 2. Subsurface maxima occurred at the density boundaries. At station 110 respiration rates were vertically homogeneous as was sigma-t.

SINC IV - March 1978

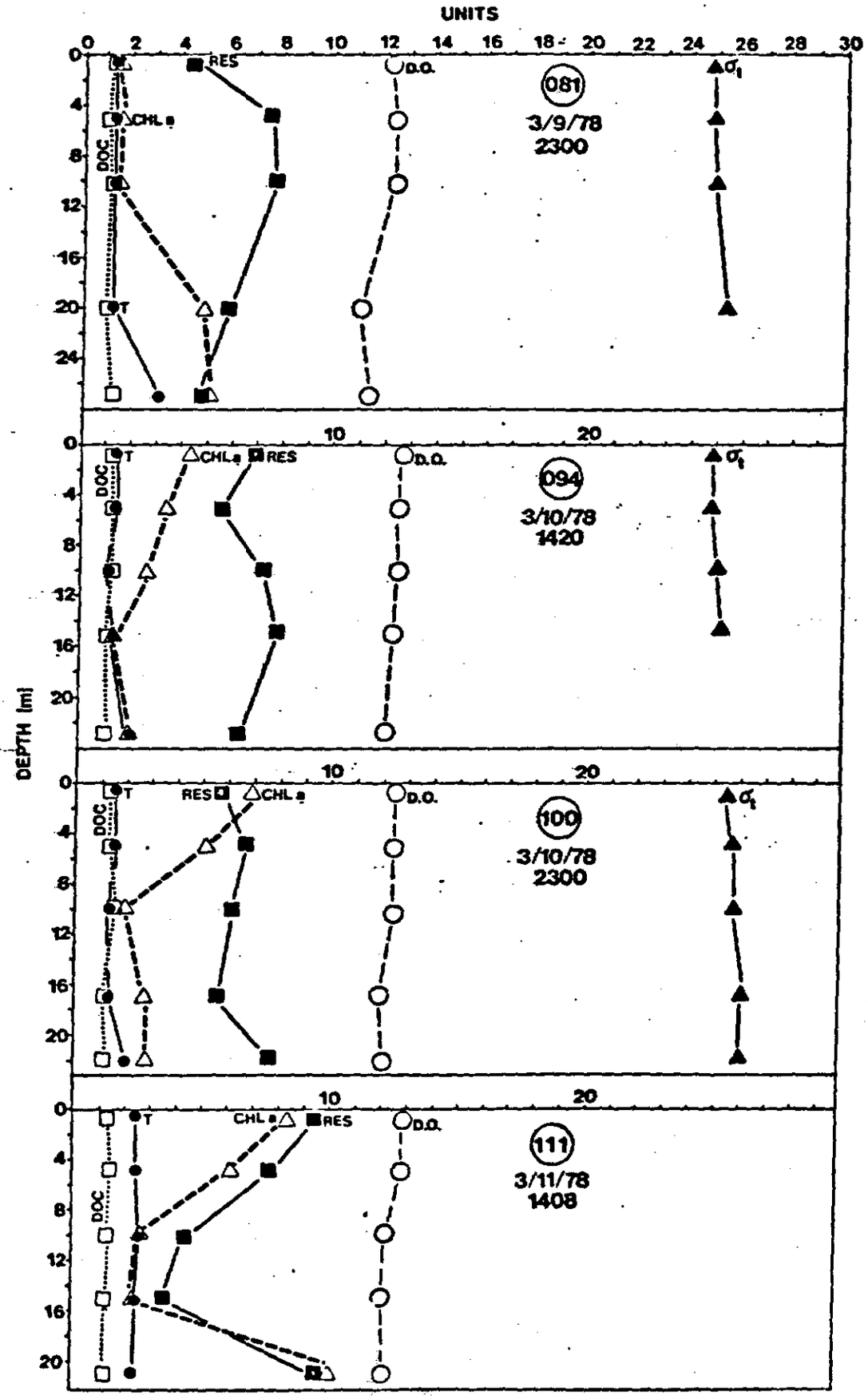
Drogue 1 - this was the longest drogue of the entire SINC study. Total plankton respiration rates ranged from near zero to 9 ml $O_2 m^{-3} hr^{-1}$. Sigma-t was vertically homogeneous and therefore not relatable to respiration. Temperature was low and nearly homogeneous. Bottom water, however, was generally slightly warmer than surface water. Total chlorophyll a was higher than the November cruise and was not vertically homoheneous. Frequently (stations 29, 59, 65 and 78) chlorophyll a was maximum at the bottom of the water column. Concurrent with this chlorophyll increase in bottom water was an increase in respiration. Otherwise no specific pattern was evidenced for total plankton respiration.

Drogue 2 - total plankton respiration rates ranged from 3 to 9 ml $O_2 m^3 hr^{-1}$. The water column was unstratified. Temperature was low and nearly uniform with depth. Bottom water was slightly warmer than the rest of the water column. Total chlorophyll a concentrations were variable at depth,

DROGUE 1


UNITS
DEPTH (m)
029
3/6/78
2309
041
3/7/78
1435
047
3/7/78
2307
059
3/8/78
1400
065
3/8/78
2250
078
3/9/78
1420
RES
CHL a
D.O.
DOC
T
σt

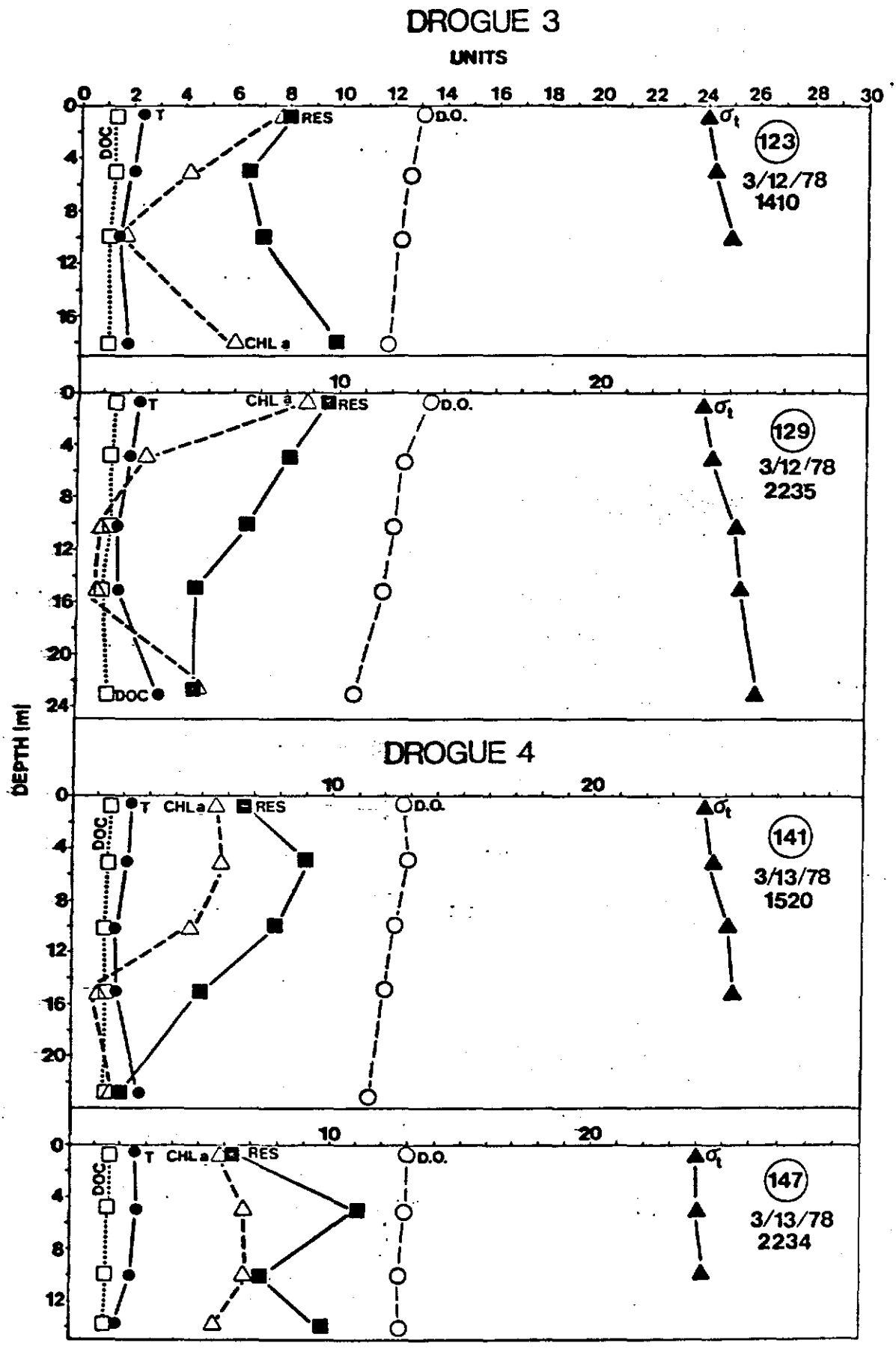
DROGUE 2


UNITS
DEPTH (m)
RES
D.O.
CHL a
DOC
T
σt
081
3/9/78
2300
094
3/10/78
1420
100
3/10/78
2300
111
3/11/78
1408

sometimes being high at the surface (stations 94, 100 and 111) and sometimes being high at the bottom (stations 81 and 111). Respiration and chlorophyll a showed little relationship except at station 111 (r^2 = .967). Other variables were not relatable with respiration. No easily definable pattern for respiration existed vertically.

Drogue 3 - the water column was only slightly stratified. Water temperature, total chlorophyll a, and respiration were higher at the surface and at the bottom than at mid-depth. Total plankton respiration rates ranged from 4 to 10 ml O_2 m^{-3} hr^{-1} and were highest at the bottom at station 123 and higher at the surface at station 129.

Drogue 4 - total plankton respiration rates ranged from 2 to 11 $O_2 m^{-3} hr^{-1}$ and were highest at 5 m. The water column was still only slightly stratified. Temperature was nearly homogeneous vertically and thus not relatable to respiration. In one case temperature increased in bottom water (station 141) and in another (station 147) temperature decreased. Chlorophyll a concentrations were not high at the surface and bottom, as with the previous drogue, but were high at 5 m with the respiration maximum. It appears that total chlorophyll a and respiration were starting to become related (Table).

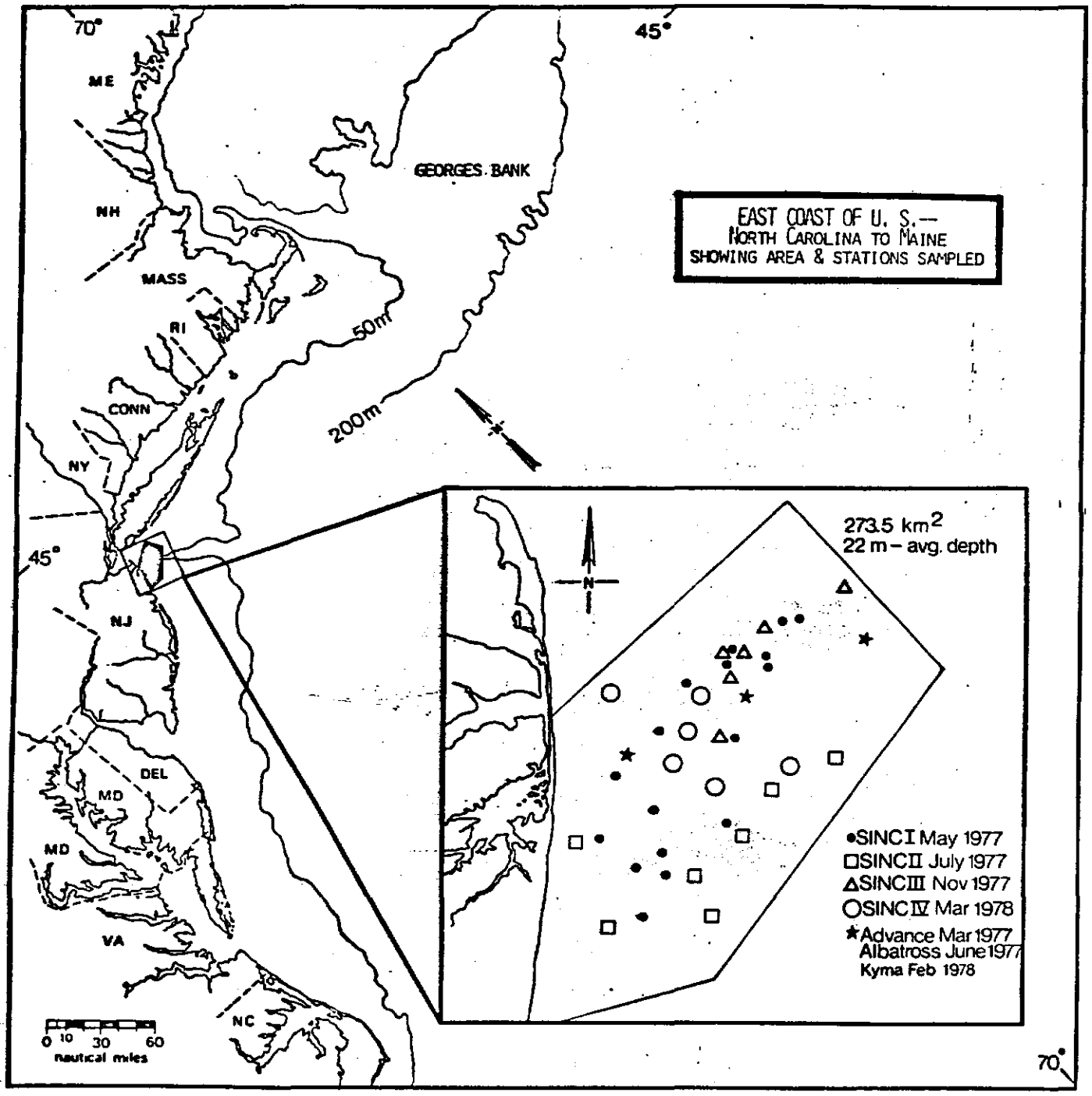

DROGUE 3
UNITS
DEPTH (m)
DOC
T
RES
D.O.
σt
CHL a
123
3/12/78
1410
129
3/12/78
2235
DROGUE 4
141
3/13/78
1520
147
3/13/78
2234

SINC IV - Summary

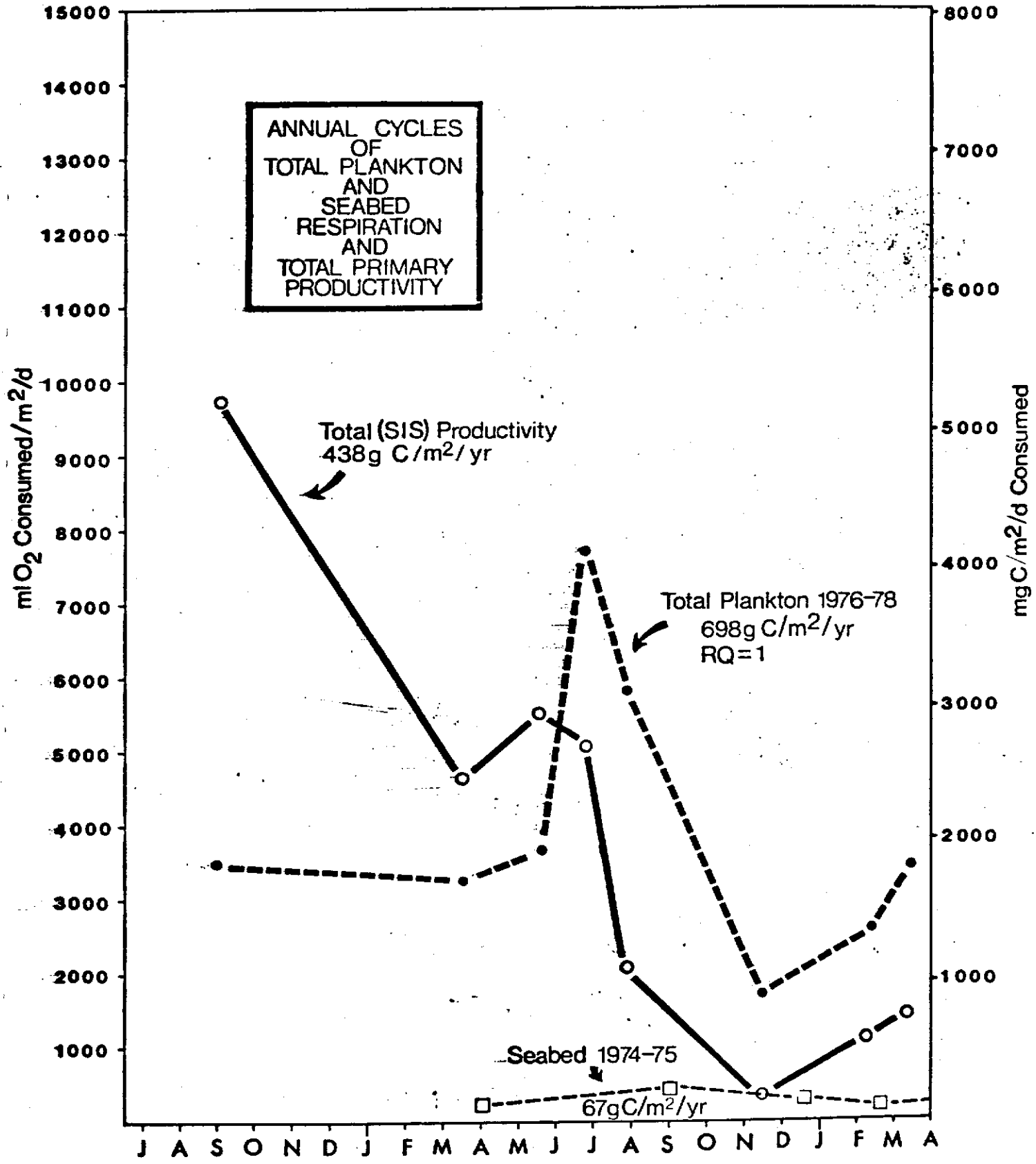
The system is cold and unstratified. Total chlorophyll a concentrations appeared to be variable but did show relatable maxima with total plankton respiration at the surface (stations 111, 123 and 129), at the bottom (stations 29, 59, 65, 78, 111 and 123) and at mid-depth (stations 141 and 147). Compared with the November cruise when no relationships occurred, chlorophyll and respiration during March 1978 appeared to be weakly related (Table).

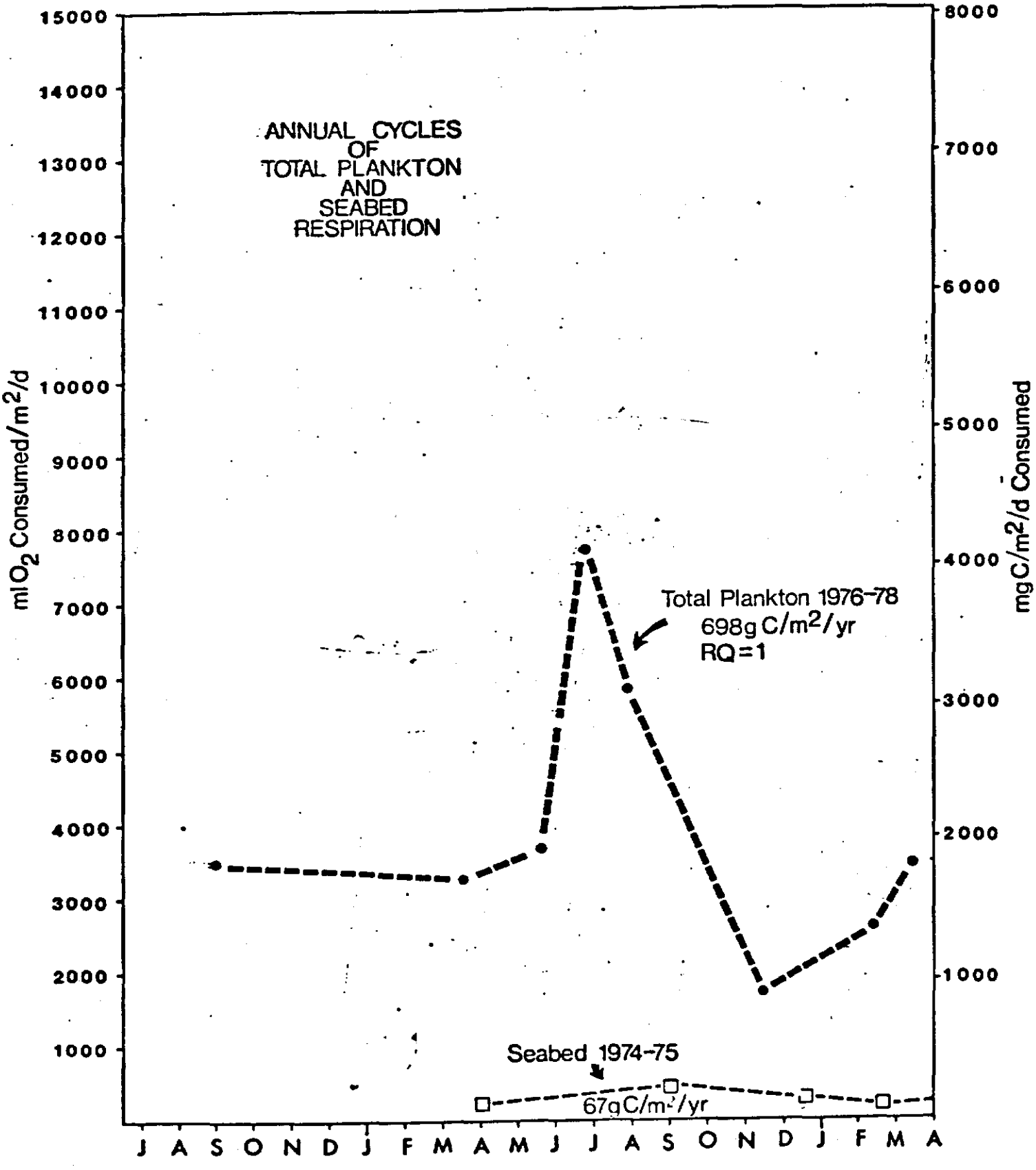
b) Annual Curve of Total Plankton Respiration

An annual curve for total plankton respiration (R_T) (Figure) was constructed using all available data (MESA/SINC plus NMFS cruises) within an arbitrarily defined SINC area (Figure) which had good representative coverage during the year. Total plankton respiration in the SINC area ranged from 2 to 7.5 liters $O_2 m^{-2} d^{-1}$ (1 to 4.5 $gCm^{-2}d^{-1}$, assuming an RQ = 1). The maximum (based on geometric means) occurred inthe summer (June cruise) and the minimum in the late fall (November cruise). However, individual stations can range from 0.4$gCm^{-2}d^{-1}$ (November) to 9.2 $gCm^{-2}d^{-1}$ (July) (Tables). Annually 698 gCm^{-2} are consumed (Figure). This is about ten times the amount of carbon consumed by the seabed annually in the SINC area (Figure). Data for the seabed were derived from data presented in Thomas et al. (1976). Computations were accomplished using a planimeter for each level of seabed oxygen consumption within the defined SINC area.


EAST COAST OF U. S.—
NORTH CAROLINA TO MAINE
SHOWING AREA & STATIONS SAMPLED
70°
45°
ME
NH
MASS
RI
CONN
NY
NJ
DEL
MD
MD
VA
NC
GEORGES BANK
50m
200m
N
273.5 km2
22 m – avg. depth
•SINC I May 1977
□SINC II July 1977
△SINC III Nov 1977
○SINC IV Mar 1978
★Advance Mar 1977
Albatross June 1977
Kyma Feb 1978
0 10 30 60
nautical miles

The annual oxidation by plankton of 698 g C m^{-2} seems high when compared to Malone's (1977) range of 370 to 480 g C m^{-2} yr^{-1} for primary productivity in the New York Bight apex. These values can be increased to between 552 and 658 g C m^{-2} yr^{-1} by adding to them the dissolved organic carbon released by the phytoplankton in the SINC study area. Ordinarily one would not expect respiration to exceed primary production except for short periods of time. However, primary productivity in the SINC study area (in the Hudson Plume) is probably greater than in the apex as a whole. Additionally estuarine outwelling of organic materials from the New York Metropolitan area (principally sewage) and primary production from Lower New York Bay (800-1000 g C m^{-2} yr^{-1}) with maximum production in June-July (O'Reilly et al., 1976) add to the load of oxidizable organic carbon in the SINC study area. Thus 698 g C m^{-2} yr^{-1} oxidized by the plankton community plus 67 g C m^{-2} yr^{-1} oxidized by the seabed (765 g C m^{-2} yr^{-1} total) does not seem to be an unreasonable number.


ANNUAL CYCLES OF TOTAL PLANKTON AND SEABED RESPIRATION AND TOTAL PRIMARY PRODUCTIVITY
Total (SIS) Productivity 438g C/m2/yr
Total Plankton 1976-78 698g C/m2/yr RQ=1
Seabed 1974-75 67gC/m2/yr
ml O2 Consumed/m2/d
mgC/m2/d Consumed
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
8000
7000
6000
5000
4000
3000
2000
1000
J A S O N D J F M A M J J A S O N D J F M A


ANNUAL CYCLES
OF
TOTAL PLANKTON
AND
SEABED
RESPIRATION
ml O2 Consumed/m2/d
mgC/m2/d Consumed
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
8000
7000
6000
5000
4000
3000
2000
1000
Total Plankton 1976-78
698g C/m2/yr
RQ=1
Seabed 1974-75
67gC/m2/yr
J A S O N D J F M A M J J A S O N D J F M A

c) Productivity and Respiration

Estimated Gross Primary Productivity to Total Plankton Respiration

Gross primary productivity (P_G) to total (autotrophic plus heterotrophic) respiration (R_T) ratios indicate whether net community production (NCP) was positive, negative, or neither (Odum, 1971). Positive NCP would be a P gross/ R_{total} ratio greater than 1 and would indicate that more organic material is being produced by the community via primary production than is being oxidized. Negative NCP, ratios less than 1, would indicate the reverse. Positive net community production represents the organic matter or energy available to the next trophic level.

Our measurements of total phytoplankton primary productivity are based on 24 hour simulated in situ deck incubations at sea surface temperature under natural sunlight with neutral density screens. Values derived from these incubations represent net photosynthesis (P_N) (Steemann-Nielsen, 1963), which means that they include autotrophic and heterotrophic respiration. To obtain estimates of integral gross total primary productivity (P_G) we added 20% of P_G to P_N. P_G/R_T ratios calculated this was showed that NCP was greater than respiration only during the SINC I cruise in May 1977.

Table . Integral estimated gross productivity (P_G) to integral total (autotrophic plus heterotrophic) respiration (R_T) for the entire water column (exclusive of seabed) was based on integrated 24 hour incubations of total net simulated *in situ* (SIS) phytoplankton primary productivity (particulate plus dissolved) corrected to estimate gross photosynthesis (P_G) by adding 20% of P_G to P_N, and total plankton respiration at nearest station in time within same drogue track for SINC I, 9-20 May 1977.

Productivity Station #	Net Primary Productivity mg C m^{-2} d^{-1} (P_N)	Estimated Gross Primary Productivity mg C m^{-2} d^{-1} (Est. P_G)	Respiration Station #	Total Plankton Respiration mg C m^{-2} d^{-1}* (R_T)	Estimated P_G/R_T Ratio
38	1699	2123	31	1476	1.44
38	1699	2123	43	1073	1.98
38	1699	2123	51	893	2.38
81	2229	2785	81	2297	1.21
81	2229	2785	91	1938	1.44
101	2184	2729	107	2202	1.24
101	2184	2729	114	2355	1.16
121	2568	3210	127	1995	1.61
121	2568	3210	137	1760	1.82
145	4228	5285	153	1536	3.44
170	3757	4696	170	2575	1.82
170	3757	4696	178	1706	2.75
185	5273	6591	191	2372	2.78
185	5273	6591	199	3214	2.05
185	5273	6591	210	3033	2.17
	G.M.=2913	G.M.=3640		G.M.=1921	$\bar{x}$=1.95

G.M. = geometric mean

* (mg C m^{-2} d^{-1}) (1.866) = ml O_2 m^{-2} d^{-1}

Table . Integral estimated gross productivity (P_G) to integral total (autotrophic and heterotrophic) respiration (R_T) for the entire water column (exclusive of seabed) was based on integrated 24 hour incubations of total net simulated in situ (SIS) phytoplankton primary productivity (particulate plus dissolved) corrected to estimate gross photosynthesis (P_G) by adding 20% of P_G to P_N, and total plankton respiration at nearest station in time within same drogue track for SINC II, 18-29 July 1977.

Productivity Station #	Net Primary Productivity mg C m^{-2} d^{-1} (P_N)	Estimated Gross Primary Productivity mg C m^{-2} d^{-1} (Est. P_G)	Respiration Station #	Total Plankton Respiration mg C m^{-2} d^{-1}* (R_T)	Estimated P_G/R_T Ratio
36	1501	1876	29	4396	.43
36	1501	1876	42	9235	.20
57	1820	2275	50	3875	.59
57	1820	2275	63	4832	.59
57	1820	2275	71	3783	.60
96	793	991	80	2710	.37
96	793	991	96	3153	.31
96	793	991	102	2422	.41
96	793	991	110	1893	.52
117	515	644	123	2808	.23
141	1451	1814	134	1752	1.04
141	1451	1814	147	3021	.60
141	1451	1814	155	1894	.96
	G.M.=1101	G.M.=1377		G.M.=3163	$\bar{x}$=0.53

G.M. = geometric mean

* (mg C m^{-2} d^{-1}) (1.866) = ml O_2 m^{-2} d^{-1}

Table . Integral estimated gross productivity (P_G) to integral total (autotrophic and heterotrophic) respiration (R_T) for the entire water column (exclusive of seabed) was based on integrated 24 hour incubations of total net simulated *in situ* (SIS) phytoplankton primary productivity (particulate plus dissolved) corrected to estimate gross photosynthesis (P_G) by adding 20% of PG to P_N, and total plankton respiration at nearest station in time within same drogue track for SINC III, 7-21 November 1977.

Productivity Station #	Net Primary Productivity mg C m^{-2} d^{-1} (P_N)	Estimated Gross Primary Productivity mg C m^{-2} d^{-1} Est. P_G)	Respiration Station #	Total Plankton Respiration mg C m^{-2} d^{-1}* (R_T)	Estimated P_G/R_T Ratio
67	182	228	39	2100	.11
67	182	228	46	1404	.16
67	182	228	59	1441	.16
67	182	228	74	377	.60
67	182	228	81	561	.41
88	174	218	95	1167	.19
88	174	218	102	1039	.21
88	174	218	110	1959	.11
118	189	236	118	392	.60
118	189	236	122	485	.49
	G.M.=182	G.M.=227		G.M.=914	$\bar{x}$=0.30

G.M. = geometric mean

* (mg C m^{-2} d^{-1}) (1.866) = ml O_2 m^{-2} d^{-1}

Table . Integral estimated gross productivity (P_G) to integral total (autotrophic and heterotrophic) respiration (R_T) for the entire water column (exclusive of seabed) was based on integrated 24 hour incubations of total net simulated *in situ* (SIS) phytoplankton primary productivity (particulate plus dissolved) corrected to estimate gross photosynthesis (P_G) by adding 20% of P_G to P_N, and total plankton respiration at nearest station in time within same drogue track for SINC IV, 5-16 March 1978.

Productivity Station #	Net Primary Productivity mg C m^{-2} d^{-1} (P_N)	Estimated Gross Primary Productivity mg C m^{-2} d^{-1} (Est. P_G)	Respiration Station #	Total Plankton Respiration mg C m^{-2} d^{-1}* (R_T)	Estimated P_G/R_T Ratio
34	1348	1685	29	1337	1.26
34	1348	1685	41	1662	1.01
34	1348	1685	47	2295	.73
53	1214	1518	59	3054	.50
53	1214	1518	65	2185	.69
71	443	554	78	956	.58
71	443	554	81	2221	.25
87	951	1189	94	2041	.58
87	951	1189	100	1749	.68
104	437	546	111	1716	.32
133	558	698	123	1759	.40
133	558	698	129	1886	.37
133	558	698	141	1798	.39
133	558	698	147	1538	.45
	G.M.=743	G.M.=929		G.M.=1810	$\bar{x}$=0.59

G.M. = geometric mean

* (mg C m^{-2} d^{-1}) (1.866) = ml O_2 m^{-2} d^{-1}

d) Stepwise Regressions

Stepwise linear regressions were calculated using total chlorophyll a and temperature against total plankton respiration (Tables and). For the entire SINC study as well as by cruise chlorophyll is more closely related to changes in total plankton respiration. Much of the total plankton respiration in May and July can be explained based on the

distribution of total chlorophyll a during those cruises. However, in November and March the relationship is so weak that respiration cannot be explained on the basis of chlorophyll distributions. Thus total chlorophyll a seems to be a good biomass indicator from which to estimate total plankton respiration in May and July, but not in November or March. This is illustrated in Figure which shows the changes in slope and coefficients of determination associated with the regressions. Data is also included in Figure for other cruises in the SINC study to improve understanding of the relationship between chlorophyll a and total plankton respiration over an annual cycle. The relationship is poor during both March 1977 and March 1978. However, March 1978 was subdivided based on a visual relationship seen during the last half of the cruise (Figures and). Subsequently stepwise regressions by drogue for each cruise were run (Table). Figure as well as the stepwise regressions demonstrate a developing relationship progressively increasing toward the end of the SINC IV March 1978 cruise. The best relationships were observed during the July, May, and June cruises in descending order (Figure).

Additional stepwise regressions were run using temperature, total chlorophyll a, and particulate organic carbon on total plankton respiration by cruise and by drogue (Table). Stepwise regressions of temperature, total chlorophyll a, and particulate organic carbon on total plankton respiration were also run by cruise, by drogue and for samples above and below the pycnocline (Table).

Table Stepwise linear regression of temperature and total chlorophyll a on total plankton respiration for the entire SINC study and by cruise.

Cruise	N of Cases	First Variable Used	Correlation Coefficient	Slope	Second Variable Used	Multiple Correlation Coefficient
All SINC	232	Chla	0.657	1.904	Temp.	0.776
May	80	Chla	0.856	1.802	Temp.	0.900
July	33	Chla	0.927	4.305	Temp.	0.940
November	53	Chla	0.337	0.946	Temp.	0.352
March	66	Chla	0.304	0.192	Temp.	0.318

Table Stepwise linear regression of temperature and total chlorophyll a on total plankton respiration by cruise and by drogue.

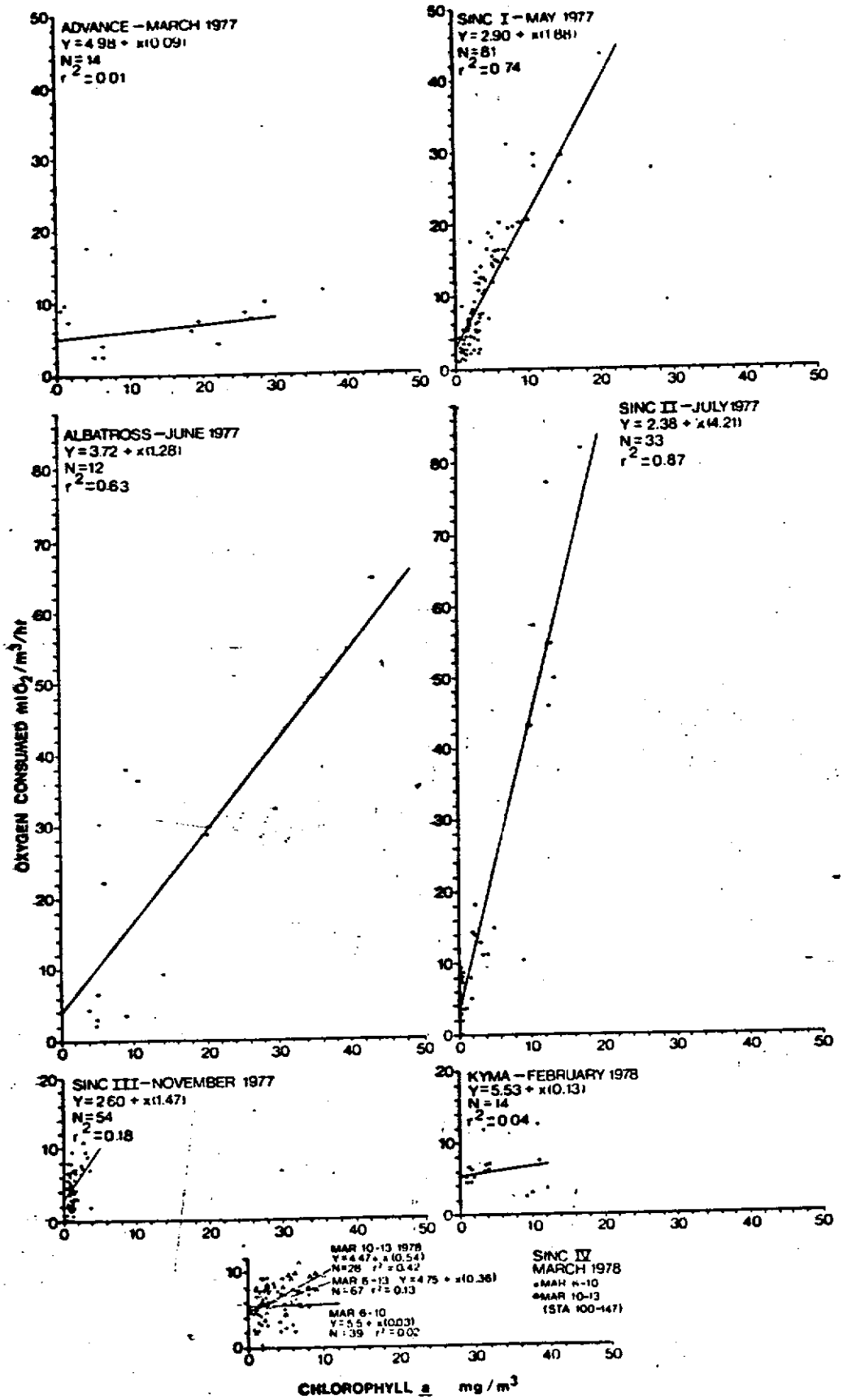
SINC	Drogue	N of Cases	First Variable Used	Correlation Coefficient	Slope	Second Variable Used	Multiple Correlation Coefficient
I	1	11	Chla	.489	1.040	Temp.	.612
I	2	4	Temp.	.831	2.943	Chla	.894
I	3	9	Chla	.924	3.389	Temp.	.936
I	4	25	Temp.	.882	3.260	Chla	.887
I	5	5	Chla	.949	1.498	Temp.	.987
I	6	25	Chla	.894	1.854	Temp.	.918
II	1	4	Temp.	.926	5.872	Chla	.977
II	2	7	Chla	.981	4.621	Temp.	.983
II	3	16	Temp.	.780	.405	Chla	.941
II	4	6	Temp.	.897	1.083	Chla	.904
III	1	14	Temp.	.337	4.740	Chla	.343
III	2	10	Chla	.677	2.362	Temp.	.677
III	3	13	Chla	.610	2.790	Temp.	.651
III	4	8	Temp.	.133	-.203	Chla	.252
III	24 hrs	6	Chla	.436	9.487	Temp.	.451
IV	1	28	Chla	.246	.129	Temp.	.256
IV	2	20	Chla	.446	.287	Temp.	.510
IV	3	9	Chla	.582	.357	Temp.	.790
IV	4	9	Chla	.774	.993	Temp.	.872

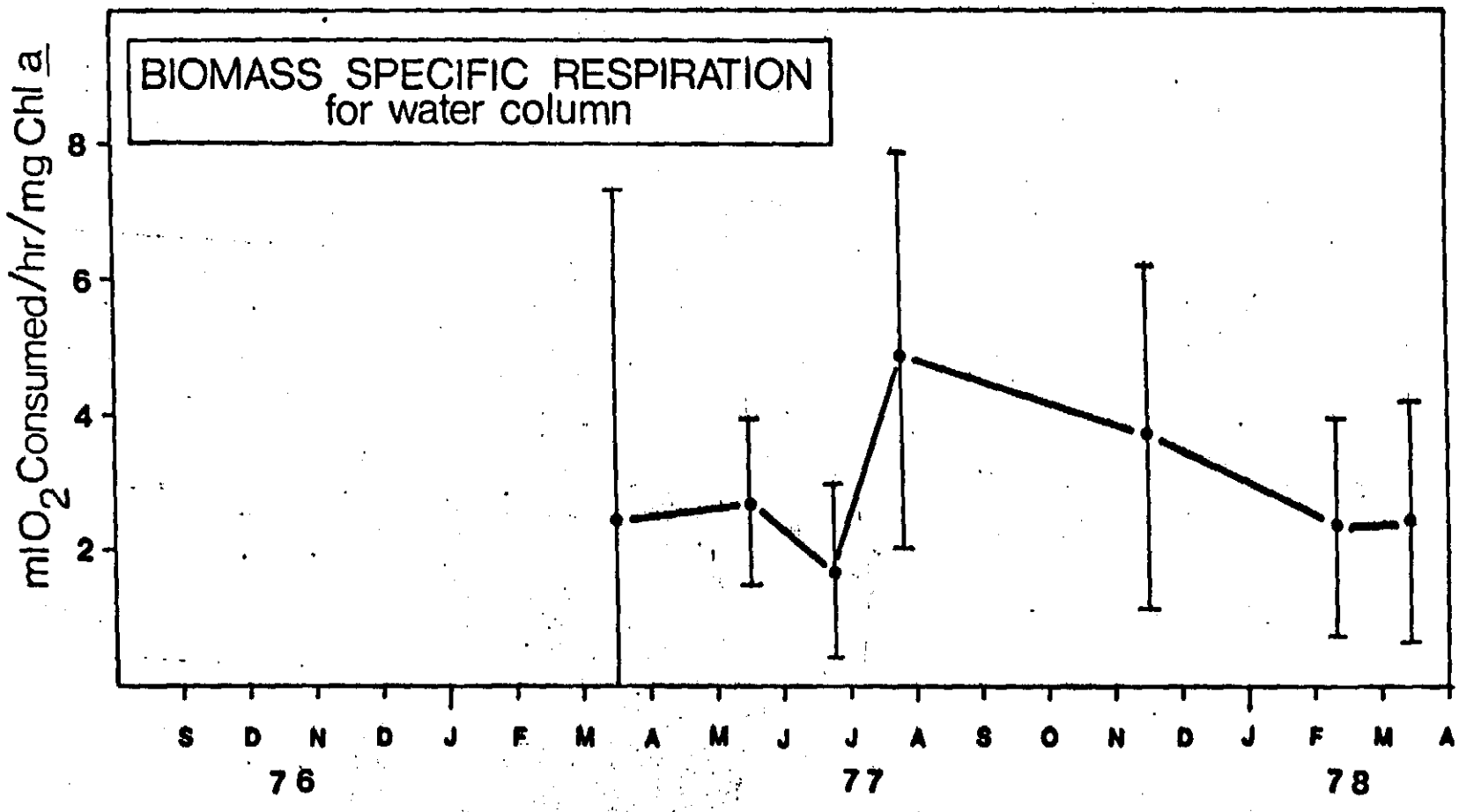
Table . Stepwise linear regression of temperature (Temp.), total chlorophyll a (Chl*a*), and particular organic carbon (POC) on total plankton respiration for SINC cruises I through IV by drogue.

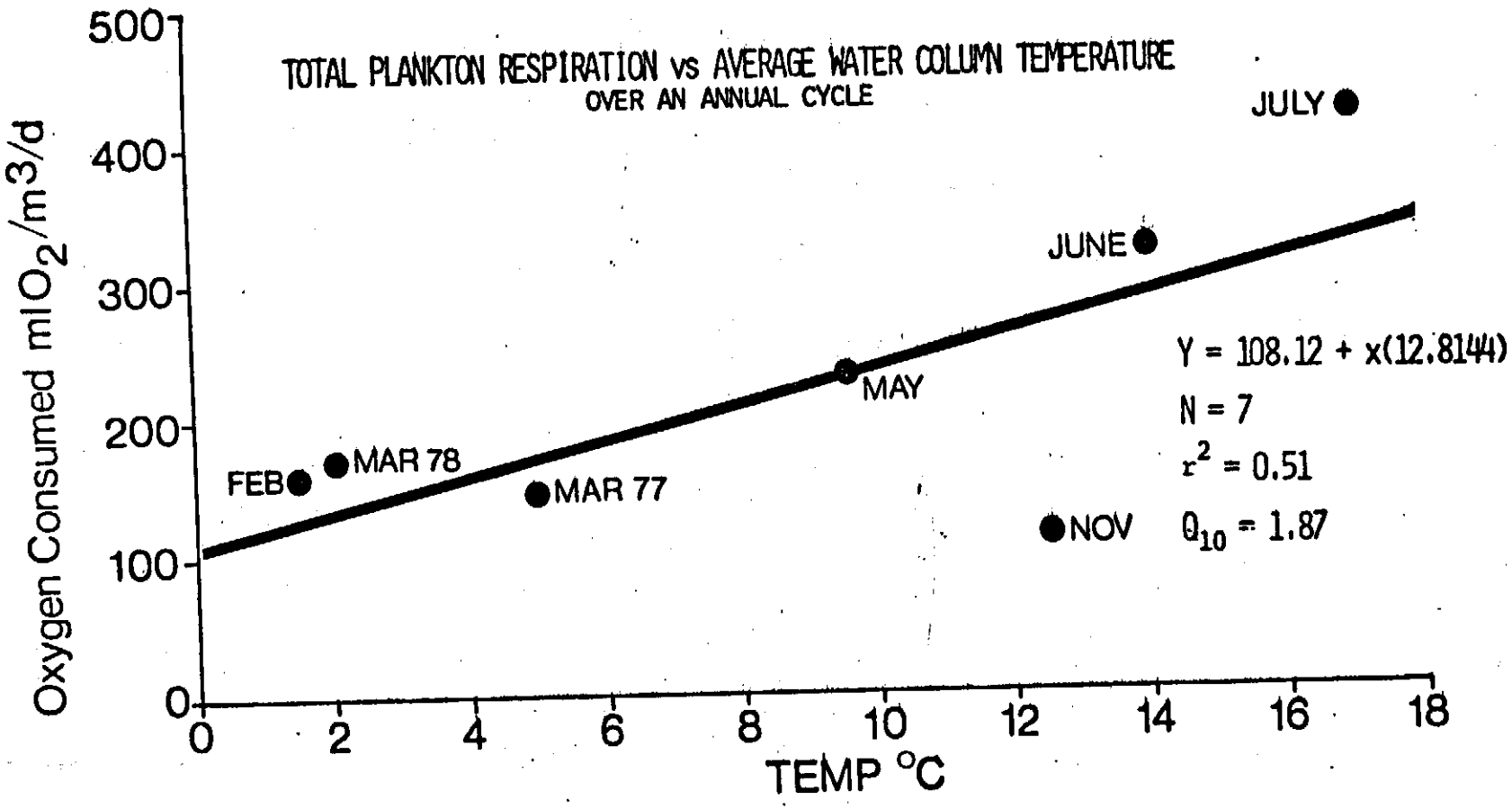
SINC	Drogue	No. of Cases	First Variable Used	Correlation Coefficient	Slope	Second Variable Used	Multiple Correlation Coefficient	Third Variable Used	Multiple Correlation Coefficent
I	1	13	Temp.	.489	2.268	Chl*a*	.608	POC	.612
I	2	4	Temp.	.831	2.942	POC	.932	-	-
I	3	8	Temp.	.947	3.200	POC	.949	Chl*a*	.953
I	4	25	Temp.	.882	3.260	Chl*a*	.887	POC	.887
I	5	5	Chl*a*	.949	1.498	Temp.	.987	POC	.999
I	6	25	Chl*a*	.849	1.854	Temp.	.918	POC	.921
II	1	4	Temp.	.926	5.872	Chl*a*	.977	-	-
II	2	7	POC	.998	40.163	Chl*a*	.999	Temp.	.999
II	3	16	Temp.	.780	0.405	Chl*a*	.941	POC	.945
II	4	6	Temp.	.897	1.083	Chl*a*	.904	POC	.906
III	1	14	Temp.	.337	4.740	Chl*a*	.343	POC	.381
III	2	10	Chl*a*	.677	2.362	POC	.706	-	-
III	3	13	Chl*a*	.610	2.790	Temp.	.651	POC	.737
III	4	8	POC	.259	1.967	Temp.	.358	Chl*a*	.422
III	24 hrs	9	POC	-.849	-19.754	Temp.	-.866	Chl*a*	-.881
IV	1	29	Chl*a*	.240	0.125	POC	.268	Temp.	.281
IV	2	20	Chl*a*	.446	0.287	Temp.	.510	POC	.553
IV	3	9	Chl*a*	.582	0.357	Temp.	.790	POC	.864
IV	4	9	Chl*a*	.774	0.993	Temp.	.872	POC	.877

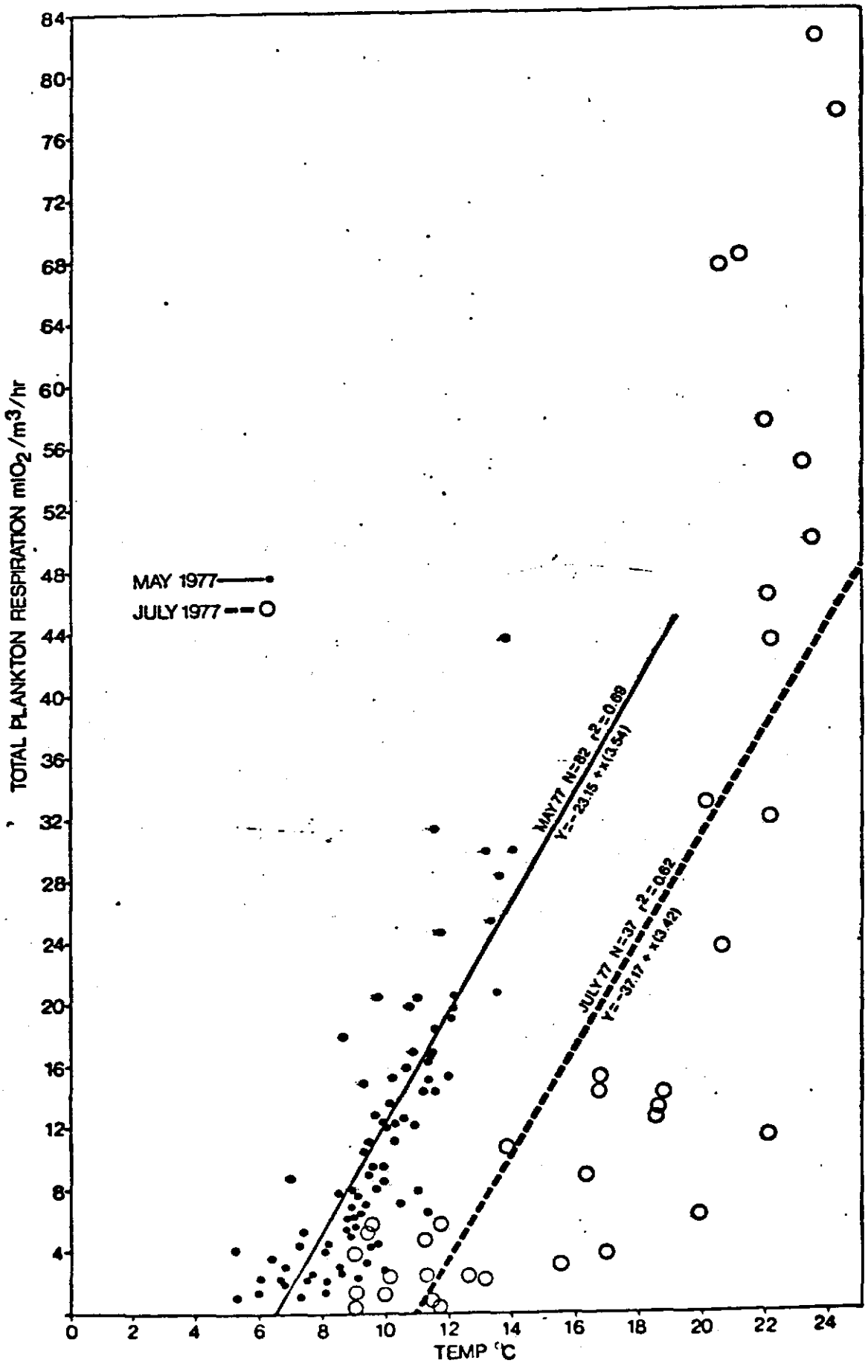
Table . Stepwise linear regression of temperature (Temp.), total chlorophyll a (Chl*a*), and particular organic carbon (POC) on total plankton respiration for SINC cruises I through IV by drogue and above and below pycnocline when one exists.

SINC	Drogue	Above Pycnocline	Below Pycnocline	No. of Cases	First Variable Used	Correlation Coefficient	Slope	Second Variable Used	Multiple Correlation Coefficient	Third Variable Used	Multiple Correlation Coefficient
I	1	*		7	POC	.358	6.181	Temp.	.387	Chl*a*	.494
I	1		*	6	POC	-.389	-3.351	Chl*a*	-.505	-	-
I	2	*		2	-	-	-	-	-	-	-
I	2		*	2	-	-	-	-	-	-	-
I	3	*		4	POC	.826	12.106	Temp.	1.00	-	-
I	3		*	4	Temp.	.939	1.839	Chl*a*	.953	-	-
I	4	*		14	Temp.	.653	2.270	POC	.655	Chl*a*	.656
I	4		*	11	Temp.	.401	.729	POC	.428	-	-
I	5	*		2		-	-	-	-	-	-
I	5		*	3	Temp.	.840	1.394	-	-	-	-
I	6	*		13	Chl*a*	.808	1.480	Temp.	.862	POC	.864
I	6		*	12	Chl*a*	.497	2.488	Temp.	.513	POC	.529
II	1	*		3	POC	.993	-	-	-	-	-
II	1		*	1	-	-	-	-	-	-	-
II	2	*		5	POC	.996	39.349	Chl*a*	.999	Temp.	.999
II	2		*	2	-	-	-	-	-	-	-
II	3	*		11	Chl*a*	.265	.396	Temp.	.772	POC	.825
II	3		*	5	Temp.	.966	1.744	Chl*a*.	.972	POC	.990
II	4	*		5	POC	-.122	-1.245	Chl*a*	-.177	Temp.	-.659
II	4		*	1	-	-	-	-	-	-	-
III	1	*		6	POC	.574	7.950	Temp.	.583	-	-
III	1		*	8	Temp.	.305	4.025	Chl*a*	.367	POC	.781
III	2	*		4	POC	.822	12.570	Temp.	.978	-	-
III	2		*	6	Chl*a*	.700	2.282	POC	.745	Temp.	.753
III	3	*		6	Chl*a*	.378	1.886	Temp.	.413	POC	.653
III	3		*	7	Chl*a*	.775	3.353	Temp.	.802	POC	.922
III	4	*		5	Chl*a*	-.400	-4.919	Temp.	-.450	POC	-.487
III	4		*	3	Chl*a*	-.887	-1.873	-	-	-	-
III	24 hrs	*		4	Temp.	-.963	-7.893	Chl*a*	-.9999	-	-
III	24 hrs		*	5	POC	-.828	-18.413	Temp.	-.952	Chl*a*	-.972
IV	3	*		4	Temp.	.762	5.965	Chl*a*	.780	-	-
IV	3		*	5	POC	.461	5.024	Temp.	.985	Chl*a*	.998
IV	4	*		4	Chl*a*	.842	3.751	Temp.	.996	-	-
IV	4		*	5	Chl*a*	.812	.946	Temp.	.993	-	-


ADVANCE – MARCH 1977
Y = 4.98 + x(0.09)
N = 14
r² = 0.01
SINC I – MAY 1977
Y = 2.90 + x(1.88)
N = 81
r² = 0.74
ALBATROSS – JUNE 1977
Y = 3.72 + x(1.28)
N = 12
r² = 0.63
SINC II – JULY 1977
Y = 2.38 + x(4.21)
N = 33
r² = 0.87
SINC III – NOVEMBER 1977
Y = 2.60 + x(1.47)
N = 54
r² = 0.18
KYMA – FEBRUARY 1978
Y = 5.53 + x(0.13)
N = 14
r² = 0.04
MAR 10-13 1978
Y = 4.47 + x(0.54)
N = 26 r² = 0.42
MAR 6-13 Y = 4.75 + x(0.36)
N = 67 r² = 0.13
MAR 6-10
Y = 5.5 + x(0.03)
N = 39 r² = 0.02
SINC IV
MARCH 1978
MAR 6-10
MAR 10-13
(STA 100-147)
OXYGEN CONSUMED ml O₂/m³/hr
CHLOROPHYLL a mg/m³


BIOMASS SPECIFIC RESPIRATION
for water column
ml O_2 Consumed/hr/mg Chl a
8
6
4
2
S D N D J F M A M J J A S O N D J F M A
76
77
78


TOTAL PLANKTON RESPIRATION vs AVERAGE WATER COLUMN TEMPERATURE
OVER AN ANNUAL CYCLE
Oxygen Consumed mlO_2/m^3/d
TEMP °C
0
100
200
300
400
500
0
2
4
6
8
10
12
14
16
18
FEB
MAR 78
MAR 77
MAY
JUNE
JULY
NOV
Y = 108.12 + x(12.8144)
N = 7
r^2 = 0.51
Q_{10} = 1.87


TOTAL PLANKTON RESPIRATION mlO2/m3/hr
TEMP °C
MAY 1977
JULY 1977
MAY 77 N=82 r2=0.69
Y=-23.15 + x(3.54)
JULY 77 N=37 r2=0.62
Y=-37.17 + x(3.42)
0
2
4
6
8
10
12
14
16
18
20
22
24
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
72
76
80
84

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