TURKEY POINT UNITS 3 & 4

SEMIANNUAL ENVIRONMENTAL REPORT NO. 7

JANUARY 1, 1976

through

JUNE 30, 1976

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I. INTRODUCTION

This report is submitted in accordance with Turkey Point Plant Environmental Technical Specifications, Appendix B, Section 5.4.a. This report covers the period January 1, 1976 through June 30, 1976.

Please refer to the Plant's Semiannual Operating Report for the same period, for operational information.

II. RECORDS OF MONITORING REQUIREMENT SURVEYS AND SAMPLES

The results of the chemical analyses conducted at the outlet of Lake Warren are shown on pages 3, 4 and 5 of this report. Page 6 contains the amounts of chemicals added from Units 3 and 4 to the closed circulating water system. Results of the various biological programs are given in sections III.C through III.H.

III. ANALYSIS OF ENVIRONMENTAL DATA

A. Chemical

Analysis of chemical parameters data shows the same trends that have been observed for the last three years, and reported in previous semiannual reports. The pH ranged from a low of 7.60 to a high of 7.98. Dissolved Oxygen ranged between 5 and 6 ppm during the cooler months, and between 4 and 5 during the warmer months. Salinity concentrations ranged from 30.5 ppt during the rainy season, to a high of 41.5 ppt during the dry season.

Residual chlorine analyses were conducted sporadically during this period, because no chlorination of the circulating water system was conducted. It was not required to conduct the test if no chlorination took place, nonetheless, some tests were conducted to check out the hardware. Once again, Ammonia and Biological Oxygen Demand (BOD) level remained at or below the detection limits. Chemical Oxygen Demand (COD) levels averaged 480 mg/l for the period, with a min/max of 184/856. No definite trend can be observed with the DO levels, except that these oscillated more than in the previous period.

TURKEY POINT PLANT UNITS 3 & 4
pH, DISSOLVED OXYGEN AND SALINITY
LAKE WARREN DISCHARGE

YEAR 1976

MO.	JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
DAY	pH	D.O.	Sal.	pH	D.O.	Sal.	pH	D.O.	Sal.	pH	D.O.	Sal.	pH	D.O.	Sal.	pH	D.O.	Sal.
1	7.90	5.1	38.0	7.90	5.7	38.0	7.83	4.60	36.0	7.85	4.70	40.0	7.78	4.8	40.0	7.83	4.40	35.0
2	7.85	5.0	38.0	7.90	5.2	36.5	7.80	4.60	37.5	7.85	4.60	40.0	7.82	5.5	38.5	7.82	4.40	36.5
3	7.80	5.6	38.0	7.90	5.0	36.5	7.85	4.60	37.0	7.85	4.60	40.0	7.95	5.4	38.0	7.85	4.80	35.5
4	7.85	5.3	38.0	7.86	5.2	37.0	7.85	4.60	37.0	7.77	4.50	40.0	7.85	5.6	38.5	7.88	4.60	35.0
5	7.80	4.8	37.0	7.90	5.2	38.0	7.90	4.80	36.5	7.79	4.30	40.0	7.90	5.5	38.5	7.85	4.65	36.0
6	7.80	5.1	37.5	7.89	5.0	38.0	7.80	4.90	37.5	7.80	4.4	39.5	7.92	5.3	38.0	7.88	4.95	35.5
7	7.80	5.0	37.5	7.85	5.5	38.0	7.85	5.05	38.0	7.78	4.5	37.0	7.88	5.2	38.0	7.88	4.6	36.5
8	7.80	4.6	37.0	7.90	5.35	38.0	7.60	4.20	38.0	7.85	4.4	38.0	7.85	4.4	38.0	7.90	4.4	36.5
9	7.80	4.8	37.0	7.90	5.2	38.0	7.75	4.10	37.0	7.84	4.55	38.0	7.98	4.2	37.5	7.85	3.8	36.5
10	7.82	6.0	38.0	7.90	5.2	38.0	7.70	4.40	38.5	7.86	4.9	38.0	7.85	3.6	38.0	7.84	3.8	34.5
11	7.84	6.25	38.5	7.90	5.4	39.0	7.71	4.20	37.5	7.84	5.0	38.5	7.85	4.0	38.5	7.82	4.5	32.5
12	7.85	5.7	37.5	7.85	5.2	39.0	7.75	4.50	39.0	7.80	4.95	38.5	7.90	4.1	39.0	7.85	4.75	32.0
13	7.85	5.0	37.5	7.90	5.1	38.0	7.85	4.50	38.0	7.75	4.8	38.5	7.80	4.0	39.0	7.83	4.5	31.0
14	7.90	5.0	38.0	7.81	4.9	38.5	7.71	4.40	38.0	7.7	5.0	40.0	7.85	3.8	39.0	7.85	4.4	31.5
15	7.90	4.6	37.0	7.85	4.95	38.0	7.70	4.60	38.0	7.8	4.4	38.0	7.85	4.2	39.0	7.88	4.4	32
16	7.89	4.6	37.5	7.85	5.05	38.0	7.78	4.40	38.0	7.82	5.2	39.0	7.90	4.25	37.0	7.90	4.65	32.5
17	7.81	6.1	37.5	7.95	4.80	38.0	7.78	4.40	38.0	7.83	5.4	38.5	7.88	4.45	38.0	7.91	4.4	33.5
18	7.85	5.9	37.5	7.90	4.80	38.0	7.80	4.90	38.0	7.83	5.25	39.5	7.85	4.6	38.5	7.92	4.35	33.5
19	7.90	6.2	38.0	7.90	4.60	38.0	7.80	5.20	39.5	7.78	5.1	39.5	7.92	4.75	38.5	7.80	4.25	33.0
20	7.89	5.9	37.0	7.90	4.40	38.0	7.75	5.10	40.0	7.85	4.6	40.0	7.91	4.2	38.5	7.87	4.45	34.0
21	7.90	5.6	38.0	7.88	4.70	38.0	7.80	5.05	39.5	7.90	4.6	38.5	7.92	4.6	39.5	7.90	4.60	34.5
22	7.88	5.6	38.0	7.86	4.80	38.0	7.85	4.30	39.0	7.85	4.3	39.5	7.85	4.45	38.5	7.90	4.30	34.5
23	7.89	6.0	37.0	7.80	4.80	37.0	7.85	4.25	39.0	7.85	3.9	39.5	7.90	5.0	38.5	7.88	4.45	33.0
24	7.85	6.3	38.0	7.80	5.40	38.0	7.82	4.50	38.5	7.84	4.5	39.0	7.88	4.6	38.5	7.95	4.90	32.0
25	7.88	5.95	38.0	7.85	6.20	39.0	7.80	4.80	40.0	7.80	4.3	40.0	7.90	5.2	38.5	7.92	4.95	31.0
26	7.90	5.3	37.5	7.85	6.00	37.5	7.82	4.80	39.0	7.85	4.3	40.0	7.92	4.5	38.5	7.90	4.80	31.5
27	7.95	5.8	38.0	7.85	5.40	36.5	7.75	4.90	41.5	7.90	4.6	39.5	7.88	4.4	38.5	7.92	3.5	32.0
28	7.80	4.9	37.0	7.80	5.00	37.5	7.80	4.80	39.0	7.83	4.2	39.5	7.88	3.8	39.5	7.90	4.0	30.5
29	7.75	5.1	37.0	7.83	4.85	37.5	7.85	4.60	40.0	7.85	5.0	39.0	7.85	4.25	38.0	7.92	3.95	31.5
30	7.9	5.4	37.0	-	-	-	7.85	4.60	39.5	7.85	5.2	40.0	7.85	4.5	37.0	7.90	3.90	31.5
31	7.80	5.8	37.5	-	-	-	7.85	4.70	40.0	-	-	-	7.85	4.90	36.5	-	-	-

FIG. 1

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANTS UNITS 3 & 4
LAKE WARREN DISCHARGE

NOTE: All Results in mg/L YEAR 1976

DATE	T. RES. CHLOR.	AMMONIA	B.O.D.	C.O.D.	Cu	Zn	Co	As	Hg	OIL	Cr	Pb	Cd
1/2/76		<0.2	1	480					<0.0002	<1			
1/9/76		<0.2	1	370	0.03	0.06	<0.02	<0.001	<0.0002	<1	<0.02	<0.05	---
1/19/76		<0.2	1	380					<0.0002	2			
1/23/76		<0.2	<1	665					<0.0002	<1			
1/30/76		<0.2	<1	665					<0.0002	5			
2/6/76		<0.2	1	511	<0.02	<0.02	<0.02	<0.001	0.0005	<1	0.05	<0.05	---
2/13/76		0.2	<1	832					<0.0002	<1			
2/20/76		<0.2	<1	515					<0.0002	2			
2/27/76		<0.2	2	620					<0.0002	<1			
3/5/76		<0.2	<1	572	<0.02	0.09	<0.02	<0.001	<0.0002	2	<0.02	<0.05	---
3/12/76		<0.2	<1	184					<0.0002	1			
3/19/76	<.01												
3/19/76		0.2	<1	264					<0.0002	1			
3/26/76		0.2	<1	192					<0.0002	1			
3/27/76	<.01												
4/2/76	<.01												
4/2/76		<0.2	<1	856	0.03	0.05	<0.02	<0.001	0.0002	<1	<0.02	<0.05	0.02
4/9/76	<.01												
4/9/76		<0.2	<1	520					<0.0002	1			
4/16/76		<0.2	<1	405					<0.0002	<1			
4/23/76	<.01												
4/23/76		<0.2	1	420					<0.0002	<1			
4/30/76		<0.2	<1	310					<0.0002	<1			
5/7/76		<0.2	<1	330	0.05	0.07	<0.02	<0.001	<0.0002	1	<0.02	<0.05	<0.02
5/14/76		<0.2	<1	310					0.0003	<1			

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANTS UNITS 3 & 4
LAKE WARREN DISCHARGE

NOTE: All Results in mg/L YEAR 1976

DATE	T. RES. CHLOR.	AMMONIA	B.O.D.	C.O.D.	Cu	Zn	Co	As.	Hg	OIL	Cr	Pb	Cd
5/21/76		0.2	<1	396					<0.0002	1			
5/21/76	<.01												
5/27/76	<.01												
5/28/76		<0.2	<1	359					<0.0002	1			
6/3/76	<.01												
6/4/76		<0.2	<1	555	<0.02	0.06	<0.02	<0.001	<0.0002	<1	<0.02	<0.05	<0.02
6/11/76		<0.2	<1	494					0.0002	<1			
6/18/76		0.2	<1	696					<0.0002	1			
6/25/76		<0.2	<1	588					<0.0002	<1			

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNITS 3 & 4
CHEMICAL DISCHARGES TO LAKE WARREN

NOTE: ALL RESULTS IN POUNDS

YEAR 1976

CHEMICAL \ MONTH	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
BENTONITE CLAY	2,015	1,857	1,961	1,822	1,698	1,759
POTASSIUM DICHROMATE	27	20	17	10	36	22
POTASSIUM CHROMATE	0	0	0	0	0	0
SODIUM HEXAMETA-PHOSPHATE	14	5	12	6.5	22	18
BORIC ACID	878	933	570	492	400	1,435
HYDRATED LIME	30,750	27,994	29,769	27,810	26,219	26,668
POLYELECTROLYTE	35	44	76	62	53	23
CONCENTRATED (50% SODIUM HYDROXIDE	75,769	79,839	109,647	75,450	75,169	94,207
CONCENTRATED SULFURIC ACID	99,576	102,102	127,639	102,562	87,910	122,373
HTH - CALCIUM HYPOCHLORITE	0	0	0	0	0	0
LIQUID CHLORINE	0	0	0	0	0	0
SALT	0	0	0	0	0	0

* COAGULANT AID

Heavy metals maintained their previous levels. We began monitoring for Cadmium in April, 1976.

The amounts of chemicals released to the circulating water system remained fairly constant. After treatment of these chemicals in the plant's waste treatment facilities, and mixing with the circulating water system waters, these chemicals are undetectable.

Thermal data collected have been summarized in temperature time duration curves by month, for both the inlet and outlet temperatures. These are shown on Tables III.B-1 through III.B-6.

No major differences were observed between this six-month period and the same periods in 1974 and 1975. Listed below are the maximum inlet and outlet temperatures for 1974, 1975 and 1976, in degrees Farenheit.

	Max. Inlet Temp.			Max. Outlet Temp.		
	1974	1975	1976	1974	1975	1976
January	81	86	80	94	99	96
February	81	89	83	97	101	98
March	85	92	86	101	102	102
April	86	90	86	101	101	102
May	90	92	87	105	105	105
June	91	96	90	108	110	106

TABLE III.B.1

TIME DURATION CURVES - TEMPERATURE

JANUARY 1976

UNITS 3 & 4 INTAKE

NUMBER OF HOURS	TEMPERATURE	ACCUMULATED TIME - %
16	80	2.2
30	79	6.2
58	78	14.0
58	77	21.8
64	76	30.4
77	75	40.8
88	74	52.6
27	73	56.3
25	72	59.6
21	71	62.4
65	70	71.2
30	69	75.2
30	68	79.3
37	67	84.3
40	66	89.6
21	65	92.5
28	64	96.2
5	63	96.9
12	62	98.5
4	61	99.1
7	60	100.0

LAKE WARREN OUTLET

NUMBER OF HOURS	TEMPERATURE	ACCUMULATED TIME - %
2	96	0.3
10	95	1.6
34	94	6.2
28	93	10.0
47	92	16.3
46	91	22.5
42	90	28.1
53	89	35.3
56	88	42.8
35	87	47.5
33	86	52.0
38	85	57.1
48	84	63.5
33	83	68.0
33	82	72.4
35	81	77.1
35	80	81.8
51	79	88.7
24	78	91.9
21	77	94.8
22	76	97.7
9	75	98.9
4	74	99.5
3	73	99.9
0	72	99.9
0	71	99.9
0	70	99.9
0	69	99.9
0	68	99.9
0	67	99.9
0	66	99.9
1	65	100.0

TABLE III.B.2

TIME DURATION CURVES - TEMPERATURE

FEBRUARY 1976

UNITS 3 & 4 INTAKE

NUMBER OF HOURS	TEMPERATURE	ACCUMULATED TIME - %
10	83	1.4
21	82	4.5
36	81	9.6
52	80	17.1
88	79	29.7
79	78	41.1
71	77	51.3
43	76	57.5
32	75	62.1
37	74	67.4
46	73	74.0
53	72	81.6
24	71	85.1
30	70	89.4
17	69	91.8
18	68	94.4
33	67	99.1
6	66	100.0

LAKE WARREN OUTLET

NUMBER OF HOURS	TEMPERATURE	ACCUMULATED TIME - %
1	98	0.1
10	97	1.6
28	96	5.6
42	95	11.6
35	94	16.7
65	93	26.0
72	92	36.4
66	91	45.8
54	90	53.6
30	89	57.9
41	88	63.8
57	87	72.0
39	86	77.6
38	85	83.0
32	84	87.6
34	83	92.5
13	82	94.4
18	81	97.0
6	80	97.8
3	79	98.3
7	78	99.3
5	77	100.0

TABLE III.B.3

TIME DURATION CURVES - TEMPERATURE

MARCH 1976

UNITS 3 & 4 INTAKE

NUMBER OF HOURS	TEMPERATURE	ACCUMULATED TIME - %
1	86	0.1
25	85	3.5
28	84	7.3
65	83	16.0
123	82	32.5
123	81	49.1
117	80	64.8
75	79	74.9
48	78	81.3
30	77	85.3
29	76	89.2
37	75	94.2
21	74	97.0
16	73	99.2
6	72	100.0

LAKE WARREN OUTLET

NUMBER OF HOURS	TEMPERATURE	ACCUMULATED TIME - %
5	102	0.7
2	101	0.9
28	100	4.7
42	99	10.3
49	98	16.9
83	97	28.1
90	96	40.2
83	95	51.3
91	94	63.6
71	93	73.1
73	92	82.9
36	91	87.8
39	90	93.0
29	89	96.9
17	88	99.2
5	87	99.9
1	86	100.0

TABLE III.B.4

TIME DURATION CURVES - TEMPERATURE

APRIL 1976

UNITS 3 & 4 INTAKE

NUMBER OF HOURS	TEMPERATURE	ACCUMULATED TIME - %
42	86	5.8
38	85	11.1
79	84	22.1
75	83	32.5
82	82	43.9
78	81	54.8
71	80	64.7
46	79	71.1
33	78	75.7
85	77	87.5
51	76	94.6
31	75	98.9
8	74	100.0

LAKE WARREN OUTLET

NUMBER OF HOURS	TEMPERATURE	ACCUMULATED TIME - %
2	102	0.3
46	101	6.7
35	100	11.5
58	99	19.6
62	98	28.2
85	97	40.1
55	96	47.7
81	95	59.0
58	94	67.0
42	93	72.9
54	92	80.4
49	91	87.2
25	90	90.7
32	89	95.1
15	88	97.2
9	87	98.5
5	86	99.2
4	85	99.7
0	84	99.7
2	83	100.0

TABLE III.B.5

TIME DURATION CURVES - TEMPERATURE

MAY 1976

UNITS 3 & 4 INTAKE

NUMBER OF HOURS	TEMPERATURE	ACCUMULATED TIME - %
59	87	7.9
98	86	21.1
78	85	31.6
130	84	49.1
120	83	65.2
84	82	76.5
55	81	83.9
43	80	89.7
44	79	95.6
28	78	99.3
5	77	100.0

LAKE WARREN OUTLET

NUMBER OF HOURS	TEMPERATURE	ACCUMULATED TIME - %
4	105	0.5
23	104	3.6
48	103	10.1
44	102	16.0
63	101	24.5
84	100	35.8
74	99	45.7
85	98	57.1
63	97	65.6
59	96	73.5
45	95	79.6
46	94	85.8
17	93	88.0
8	92	89.1
13	91	90.9
3	90	91.3
1	89	91.4
21	88	94.2
15	87	96.2
4	86	96.8
16	85	98.9
8	84	100.0

TABLE III.B.6

TIME DURATION CURVES - TEMPERATURE

JUNE 1976

UNITS 3 & 4 INTAKE

NUMBER OF HOURS	TEMPERATURE	ACCUMULATED TIME - %
30	90	4.2
33	89	8.7
37	88	13.9
73	87	24.0
144	86	44.0
131	85	62.2
94	84	75.3
59	83	83.5
28	82	87.4
19	81	90.0
47	80	96.5
25	79	100.0

LAKE WARREN OUTLET

NUMBER OF HOURS	TEMPERATURE	ACCUMULATED TIME - %
11	106	1.5
21	105	4.4
20	104	7.2
22	103	10.3
31	102	14.6
29	101	18.6
71	100	28.5
64	99	37.4
95	98	50.6
65	97	59.6
71	96	69.4
67	95	78.7
44	94	84.9
35	93	89.7
37	92	94.9
16	91	97.1
11	90	98.6
6	89	99.4
4	88	100.0

III.C. FISH AND SHELLFISH

Introduction

The purpose of this study was to sample the fish and shellfish populations in the Turkey Point cooling canal system to determine species presence, relative abundance and size. Observations on life history stages were taken which would identify species with reproducing populations. Species which demonstrated a variety of life history stages may be considered established in the canals.

Methods and Materials

Fishes were collected monthly from January through June 1976, the period covered by this report. Sampling was done at the ten stations (Figure C.1) which were surveyed and reported in 1974 and 1975.

Collections were made by gill net and minnow trap. The gill nets were designed for experimental fishing by combining 2, 3 and 4 inch stretch mesh panels sewn end-to-end. These monofilament nylon nets measured 6 by 100 feet. The minnow traps were constructed of galvanized steel, measured 9 by 18 inches and had a mesh size one-quarter inch square. The minnow traps were baited with soy cake.

The sampling method at each station was determined by the configuration and characteristics of the canal at the sampling site. Gill nets were fished at Stations 1, 2, 4 and 8; minnow traps at Stations 2 through 10. Preliminary studies at Station 1 had revealed absence of the small

fishes which could be collected by minnow traps. One gill net and/or two minnow traps were fished for one 24 hour period per station per month.

All specimens collected were identified to species, counted, measured to the nearest millimeter and weighed to the nearest gram. Fishes were measured from the tip of the snout to the base of the tail (standard length). Crabs were measured across the shell (carapace); lobster and shrimp along the carapace and tail. Fish nomenclature was in accordance with the American Fisheries Society (Bailey, et al., 1970).

Results and Discussion

Twenty-three species of fishes and five species of shellfishes were collected during this sampling period (Table C.1). Collections by month and station number are presented in Tables C.2 - C.7.

The killifish family (Cyprinodontidae) and livebearer family (Poeciliidae) comprised 86.0 and 9.5%, respectively, of the 2371 total fishes collected.

The goldspotted killifish (Floridichthys carpio) and the sheepshead minnow (Cyprinodon variegatus) were the predominant species collected with 1070 and 959 individuals, respectively. The goldspotted killifish was the dominant species at Stations 2-7, based on the number of individuals collected. The sheepshead minnow was the dominant species at Stations 8-10. The largest numbers of individuals of these two species were collected

in June (Table C.7).

The sailfin molly (Poecilia latipinna) was the only other species in which more than 36 individuals were obtained during all sampling periods combined. Approximately 70% of the 226 individuals collected were obtained at Station 9. The largest number of sailfin mollies were found during January (Table C.2).

Since juvenile and adult fishes were captured, it may be assumed that reproducing populations of goldspotted killifish, sheepshead minnow, and sailfin molly are established within the canal system.

Other killfishes collected were the marsh killifish (4 individuals), Gulf killifish (3), and rainwater killifish (2). Continuing studies should indicate whether there are enough indiviudals of these species to maintain populations. The pike killifish (Belonesox belizanus) is established in the vicinity of Station 9, based on visual observations.

The crested goby also appears to be established, although only 13 individuals were collected. Two juvenile striped mojarras and one juvenile Atlantic needlefish were collected but no adults were found. The establishment of these two species appears doubtful.

The balance of the fishes listed in Table C.1 were represented. only by adult individuals. These include the bonefish, tidewater silverside, lined seahorse, sharksucker, the snappers, the mojarras (with the

the exception of the spotfin mojarra), Atlantic spadefish, striped mullet, the grunts and great barracuda. As these fishes mature and die off, the species may be expected to disappear from the canal system unless recruitment occurs from outside the system. This attrition apparently has already occurred for ladyfish, sea catfish, hardhead silverside, pipefish, blue runner, crevalle jack, lookdown, Gulf kingfish, two gobies and the checkered puffer. These species were collected from December 1974 to December 1975. and not found during recent sampling periods.

With the exception of one stone crab (36 mm carapace width), no juvenile shellfishes were collected (Table C.1). Without outside recruitment, the crabs, shrimp and spiny lobster may also be expected to disappear from the system.

Summary

The Turkey Point cooling canals are a closed system containing a decreasingly diverse assemblage of marine and estuarine species of fish. The chance for outside recruitment of marine species is low, with only extreme spring tides and hurricane associated floods potentially able to bring water into the canals. Reproducing populations, as evidenced by the occurrence of both juveniles and adults, is confined primarily within the killifish and livebearer families of fishes. The goldspotted killifish and the sheepshead minnow are the dominant fishes, based on number of individuals collected. The majority of fish and shellfish species may be expected to disappear from the canal system as natural attrition occurs.

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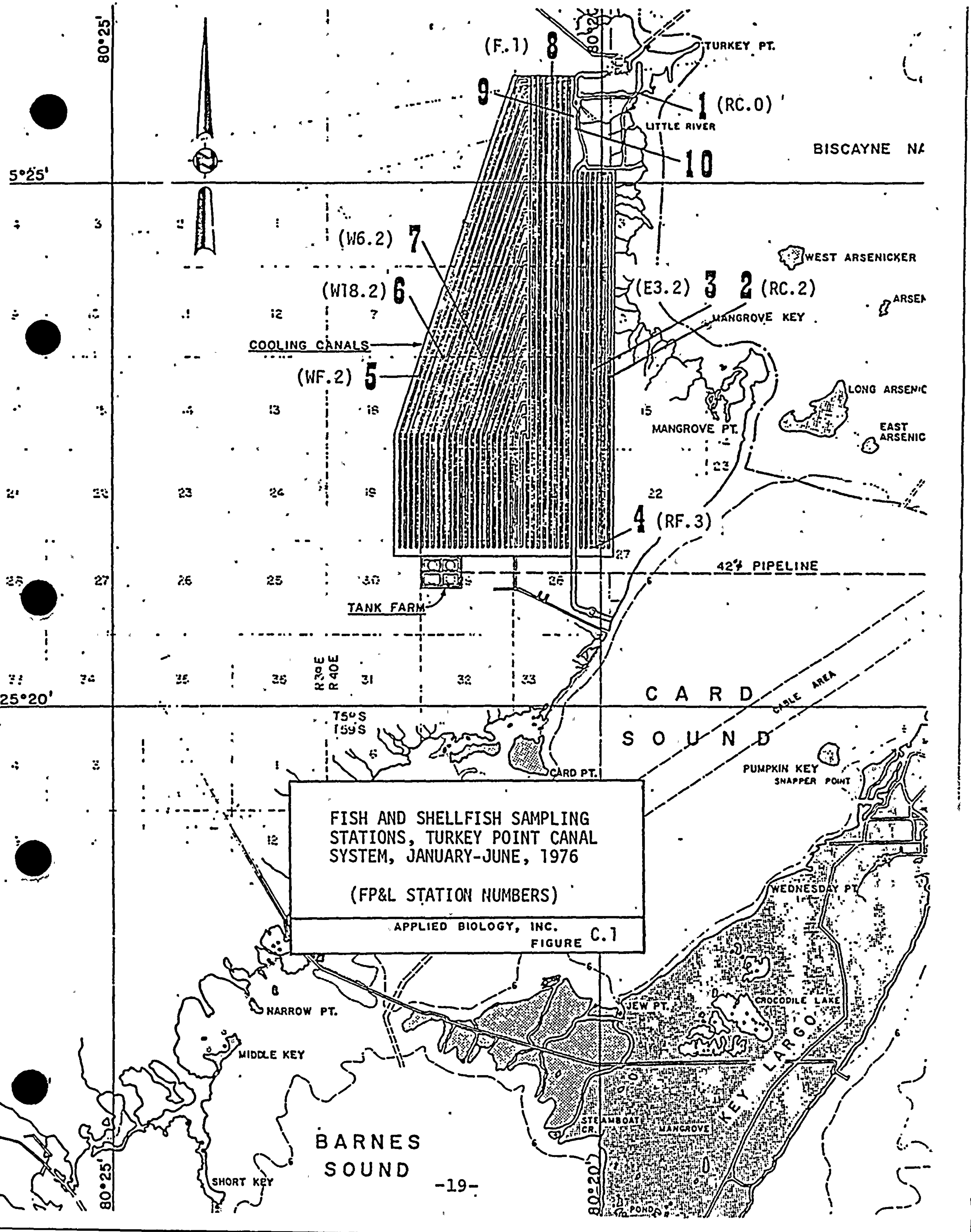

FISH AND SHELLFISH SAMPLING STATIONS, TURKEY POINT CANAL SYSTEM, JANUARY-JUNE, 1976

(FP&L STATION NUMBERS)

APPLIED BIOLOGY, INC.

FIGURE C.1

TABLE C.1
SHELLFISHES AND FISHES COLLECTED
TURKEY POINT COOLING CANALS
JANUARY-JUNE 1976

Scientific Name	Common Name	Number of Individuals	Range of Standard Lengths (mm)
Limulus polyphemus	horseshoe crab	1	240
Penaeus sp.	edible shrimp	3	70-108
Panulirus argus	spiny lobster	5	250-320
Minippe mercenaria	stone crab	14	36-112
Callinectes sp.	blue crab	2	106-160
Family Albulidae			
Albula vulpes	bonefish	5	229-432
Family Belonidae			
Strongylura marina	Atlantic needlefish	1	50
Family Cyprinodontidae			
Cyprinodon variegatus	sheepshead minnow	959	18-51
Floridichthys carpio	goldspotted killifish	1070	22-49
Fundulus confluentus	marsh killifish	4	37-55
Fundulus grandis	Gulf killifish	3	62-90
Lucania parva	rainwater killifish	2	26-29
Family Poeciliidae			
Poecilia latipinna	sailfin molly	226	23-74
Family Atherinidae			
Menidia beryllina	tidewater silverside	1	52
Family Syngnathidae			
Hippocampus erectus	lined seahorse	1	80
Family Echeneidae			
Echeneis naucrates	sharksucker	1	458
Family Lutjanidae			
Lutjanus apodus	schoolmaster	4	174-255
Lutjanus griseus	gray snapper	13	178-444
Family Gerreidae			
Diapterus plumieri	striped mojarra	2	140-241
Eucinostomus argenteus	spotfin mojarra	2	29-45
Eucinostomus gula	silver jenny	1	113
Gerres cinereus	yellowfin mojarra	36	165-256
Family Ephippidae			
Chaetodipterus faber	Atlantic spadefish	3	280-359

(Continued)

TABLE C.1
(Continued)
SHELLFISHES AND FISHES COLLECTED
TURKEY POINT COOLING CANALS
JANUARY-JUNE 1976

Scientific Name	Common Name	Number of Individuals	Range of Standard Lengths (mm)
Family Mugilidae			
Mugil cephalus	striped mullet	9	305-381
Family Pomadasyidae			
Haemulon parrai	sailors choice	5	234-295
Haemulon sciurus	bluestriped grunt	7	210-267
Family Sphyraenidae			
Sphyraena barracuda	great barracuda	3	457-522
Family Gobiidae			
Lophogobius cyprinoides	crested goby	13	25-71

TABLE C.2
FISH AND SHELLFISH SURVEY
TURKEY POINT COOLING CANALS
13-14 JANUARY 1976

STATION NUMBER	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF STANDARD LENGTHS (mm)	TOTAL WEIGHT (gms)	RANGE OF TEMPERATURES (°C)
1	spiny lobster	2	279-300	2500	22.0-23.0
2	bluestriped grunt	4	210-267	1760	22.0-22.5
	yellowfin mojarra	2	178-222	499	
	striped mullet	2	356-381	2010	
	gray snapper	7	178-279	2160	
	bonefish	1	432	1009	
	crested goby	2	38-57	10	
3	crested goby	2	44-54	18	21.5-22.0
	goldspotted killifish	2	25-29	2	
4	bluestriped grunt	1	216	375	22.0-22.5
	yellowfin mojarra	4	203-229	1112	
	gray snapper	1	305	800	
	crested goby	1	57	10	
	goldspotted killifish	28	25-44	26	
5	goldspotted killifish	19	32-44	19	21.0-22.5
	sheepshead minnow	2	19-25	2	
6	goldspotted killifish	16	25-38	16	22.0-26.0
	sheepshead minnow	6	19-35	6	
7	nothing	0	-	-	22.0-25.0
8	stone crab	2	83-89	450	22.0-29.0
	great barracuda	1	457	710	
	sharksucker	1	458	450	
	silver jenny	1	113	46	
	striped mojarra	2	140-241	458	
	yellowfin mojarra	2	165	265	
	bonefish	1	229	170	
	goldspotted killifish	15	17-38	14	
	sheepshead minnow	16	19-25	14	
	edible shrimp	2	70-76	13	
9	goldspotted killifish	10	28-47	13	22.0
	sailfin molly	111	27-74	143	
	sheepshead minnow	17	22-45	16	
10	goldspotted killifish	16	25-37	16	22.0-25.0
	sailfin molly	23	28-62	33	
	sheepshead minnow	10	23-31	9	

TABLE C.3
FISH AND SHELLFISH SURVEY
TURKEY POINT COOLING CANALS
18-19 FEBRUARY 1976

STATION NUMBER	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF STANDARD LENGTHS (mm)	TOTAL WEIGHT (gms)	RANGE OF TEMPERATURES (°C)
1	stone crab	3	80-112	1000	27.0-27.5
	spiny lobster	2	260-320	1800	
	horseshoe crab	1	240	360	
	great barracuda	1	490	800	
	Atlantic needlefish	1	50	1	
2	yellowfin mojarra	4	175-188	736	27.0-27.5
	bonefish	1	335	750	
	crested goby	4	44-62	28	
3	goldspotted killifish	1	29	1	25.5-28.0
4	stone crab	2	60-88	335	26.5
	blue crab	1	160	250	
	yellowfin mojarra	9	184-230	2477	
	striped mullet	2	305-353	1100	
5	goldspotted killifish	39	24-46	34	25.5-29.0
	sheepshead minnow	23	17-26	17	
6	goldspotted killifish	2	23-25	2	26.5-28.5
7	goldspotted killifish	23	23-26	18	27.5-29.0
	sheepshead minnow	5	18-21	4	
8	stone crab	1	106	530	27.0-36.0
	great barracuda	1	522	800	
	gray snapper	1	232	360	
	goldspotted killifish	18	24-33	15	
	sheepshead minnow	2	23-27	2	
9	sheepshead minnow	9	19-41	10	28.0-28.5
	sailfin molly	5	35-41	7	
	goldspotted killifish	4	42-48	5	
10	goldspotted killifish	24	25-43	21	28.5-33.0
	sheepshead minnow	5	29-32	4	

TABLE C.4

FISH AND SHELLFISH SURVEY
TURKEY POINT COOLING CANALS
30-31 MARCH 1976

STATION NUMBER	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF STANDARD LENGTHS (mm)	TOTAL WEIGHT (gms)	RANGE OF TEMPERATURES (°C)
1	schoolmaster	2	174-199	377	28.0
	Atlantic spadefish	1	280	1330	
	lined seahorse	1	80	3	
2	bonefish	2	362-373	1211	27.5-28.5
	bluestriped grunt	2	219-241	785	
	gray snapper	1	234	358	
	goldspotted killifish	5	23-34	5	
	sailfin molly	1	26	1	
3	goldspotted killifish	1	29	1	26.5-27.5
4	yellowfin mojarra	4	208-256	1554	27.0
	goldspotted killifish	9	22-40	9	
	sailfin molly	3	29-38	3	
5	goldspotted killifish	7	24-40	7	25.5-30.0
	sheepshead minnow	3	24-26	3	
	sailfin molly	1	28	2	
6	goldspotted killifish	15	30-44	22	27.0-30.0
	sheepshead minnow	1	26	1	
7	goldspotted killifish	44	24-48	66	27.0-29.5
	sailfin molly	7	25-49	9	
	sheepshead minnow	2	23-27	2	
8	goldspotted killifish	3	24-28	2	26.5-36.0
	rainwater killifish	1	29	1	
	sheepshead minnow	1	20	1	
9	sheepshead minnow	97	22-32	77	29.0-32.0
	sailfin molly	12	29-52	18	
	Gulf killifish	2	89-90	37	
	marsh killifish	2	37-48	4	
10	goldspotted killifish	16	26-44	16	28.5-33.5
	sailfin molly	1	38	2	
	sheepshead minnow	1	28	1	
	spotfin mojarra	1	45	4	

TABLE C.5
FISH AND SHELLFISH SURVEY
TURKEY POINT COOLING CANALS
27-28 APRIL 1976

STATION NUMBER	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF STANDARD LENGTHS (mm)	TOTAL WEIGHT (gms)	RANGE OF TEMPERATURES (°C)
1	stone crab	4	36-108	594	28.0-30.5
	blue crab	1	106	82	
2	Atlantic spadefish	2	289-359	3191	28.0-31.0
	sailors choice	2	284-295	1269	
	yellowfin mojarra	1	176	143	
	goldspotted killifish	8	24-44	10	
	sailfin molly	1	36	1	
3	goldspotted killifish	23	29-38	24	29.0
4	yellowfin mojarra	5	200-246	1769	29.0-29.5
	schoolmaster	1	255	527	
	crested goby	2	53-59	10	
	goldspotted killifish	1	27	1	
5	sheepshead minnow	9	23-26	7	29.5-31.0
	goldspotted killifish	3	27-37	3	
6	goldspotted killifish	84	26-44	94	29.0-31.0
	sheepshead minnow	9	24-26	7	
7	goldspotted killifish	27	29-45	37	29.5-31.0
	sheepshead minnow	10	25-29	9	
	sailfin molly	2	25-31	2	
8	striped mullet	2	334-354	1033	33.0-37.5
	sheepshead minnow	74	24-36	56	
	goldspotted killifish	5	29-34	6	
9	sheepshead minnow	70	29-40	81	31.0-34.0
	sailfin molly	8	34-49	15	
	marsh killifish	2	51-55	6	
	Gulf killifish	1	62	6	
10	goldspotted killifish	3	32-34	3	29.0-33.5
	spotfin mojarra	1	29	1	

TABLE C.6
FISH AND SHELLFISH SURVEY
TURKEY POINT COOLING CANALS
27-28 MAY 1976

STATION NUMBER	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF STANDARD LENGTHS (mm)	TOTAL WEIGHT (gms)	RANGE OF TEMPERATURES (°C)
1	stone crab	1	81	192	28.0-32.0
	spiny lobster	1	250	525	
	sailors choice	1	238	342	
2	gray snapper	2	332-444	1832	28.0-32.5
	sailors choice	1	275	508	
	goldspotted killifish	24	25-39	17	
3	goldspotted killifish	15	22-35	9	29.5-30.5
4	stone crab	1	101	305	31.0-32.0
	yellowfin mojarra	4	220-230	1276	
	schoolmaster	1	234	459	
	goldspotted killifish	14	28-45	17	
5	sailfin molly	36	23-43	35	31.0-31.5
	goldspotted killifish	23	24-49	38	
	sheepshead minnow	4	27-31	4	
6	goldspotted killifish	32	27-49	54	30.5-32.0
	sheepshead minnow	21	23-26	10	
7	goldspotted killifish	93	25-41	120	31.0-32.0
	sheepshead minnow	11	23-28	9	
8	edible shrimp	1	108	12	31.5-35.0
	striped mullet	3	311-345	1674	
	gray snapper	1	261	515	
	sheepshead minnow	42	24-35	13	
9	sheepshead minnow	57	27-39	58	29.5-34.0
	sailfin molly	1	29	1	
	rainwater killifish	1	26	1	
10	goldspotted killifish	29	25-44	34	28.5

TABLE C.7
FISH AND SHELLFISH SURVEY
TURKEY POINT COOLING CANALS
24-25 JUNE 1976

STATION NUMBER	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF STANDARD LENGTHS (mm)	TOTAL WEIGHT (gms)	RANGE OF TEMPERATURES (°C)
1	stone crab	2	74-88	220	26.0-27.0
	sailors choice	1	234	388	
2	yellowfin mojarra	1	203	232	25.0
	goldspotted killifish	57	22-42	56	
	sheepshead minnow	21	22-30	15	
	tidewater silverside	1	52	1	
3	goldspotted killifish	84	22-43	75	24.0-25.0
4	goldspotted killifish	4	28-41	6	24.0-25.5
	crested goby	1	51	3	
5	goldspotted killifish	27	27-44	31	24.5-26.0
	sheepshead minnow	24	23-40	16	
6	goldspotted killifish	75	24-45	97	25.0
	sheepshead minnow	51	22-29	39	
7	goldspotted killifish	82	22-43	73	24.0-26.0
	sheepshead minnow	13	23-27	8	
8	sheepshead minnow	112	26-35	93	26.5-36.0
	goldspotted killifish	22	26-40	23	
9	sheepshead minnow	99	23-49	117	25.0-26.5
	sailfin molly	12	26-47	13	
10	sheepshead minnow	132	23-51	143	26.5-29.0
	goldspotted killifish	18	25-44	26	
	sailfin molly	2	32-38	4	
	crested goby	1	71	9	

III. D. BENTHOS

D.1. MACROINVERTEBRATES

INTRODUCTION

Macroinvertebrates are animals large enough to be seen by the unaided eye and can be retained by a U.S. Standard No. 30 sieve (28 meshes per inch^2, 0.595 mm openings; EPA, 1973). They live at least part of their life cycles within or upon available substrate in a body of water or water transport system.

The major taxonomic groups of marine macroinvertebrates are polychaete worms, molluscs, crustaceans, echinoderms, and bryozoans. Benthic macroinvertebrates occupy all levels of the trophic structure of a marine community, and as such, are important members of the food web. They represent a very diverse aggregate which exhibits the complete range of feeding types and habitat preferences.

A community of macroinvertebrates in an aquatic ecosystem is very sensitive to environmental stress. Because of the limited mobility and relatively long life span of benthic invertebrates, their community characteristics are a function of environmental conditions during the recent past. Thus they serve as useful indicators of environmental perturbation.

MATERIALS AND METHODS

The collection and analysis of benthic macroinvertebrates was accomplished through the use of methods and materials recommended by the United States Environmental Protection Agency (EPA, 1973); Holme and McIntyre (1971); Standard Methods (APHA, 1971) and NESP (1975).

Benthic sampling in the Turkey Point cooling canal system was accomplished by direct sampling of the bottom substrata by using an Ekman grab. This device is a 6" X 6" metal box equipped with spring-loaded jaws which are closed when tripped with a messenger weight. The enclosed substratum was then raised to the surface and washed through a No. 30 mesh sieve to remove fine sediment and detritus particles. All material retained on the sieve was preserved in a 1:1 mixture of Eosin B and Biebrich Scarlet stains in a 1:1000 concentration of 5% formalin (Williams, 1974). These stains color animal tissue red and enable faster, more accurate hand sorting or benthic samples.

Three replicate grab samples were taken in May of 1976 at each of eight sampling stations (Figure D.1.1). Replication is necessary for valid statistical analysis because of variation in distribution patterns of benthic fauna (EPA, 1973). Sampling at Station RC.0 was hindered by the fact that the substratum was very rocky thus allowing the grab to shut without enclosing a sample. No reliable data could be obtained at this station.

Biomass analyses of the grab samples were made on a dry weight basis, exclusive of molluscan shells. This was accomplished by drying whole samples at 105°C for four hours, then weighing them on a Mettler H32 analytical balance (EPA, 1973). Biomass was reported as the mean biomass per replicate per month and also as biomass per square meter per month. Biomass per square meter, as well as density per square meter, were calculated by taking a mean of the results of the three replicate samples and multiplying by the appropriate factor.

The Shannon-Weaver Index of Diversity and the equitability component was also computed and applied to the data (see section entitled Diversity and Equitability.

RESULTS AND DISCUSSION

Benthic macroinvertebrates at Turkey Point were of four main groups: polychaete marine worms, molluscs (snails and bivalves), crustaceans and a miscellaneous group of diverse animals which were present irregularly and in small numbers (Tables D.1.1 through D.1.7). Polychaetes were the most abundant group. Additional invertebrates were collected during fish surveys (see Section C). These included species of commercially important decapod crustaceans; namely, stone crabs, blue crabs, lobsters, and shrimp.

Density of benthic macroinvertebrates in the canal system was dependent on sample site and ranged from 1106 individuals per square meter at Station F.1 to 14,483 at Station E3.2. The latter

density was the highest ever recorded at Turkey Point. Most of the stations showed reduced density since December, 1975, but showed generally increased density since May, 1975 (Figure D.1.2). All stations were numerically dominated by polychaete worms.

Coincident with the increase in density, biomass in May, 1976, was generally greater than in December, 1975, and less variable than in May, 1975. Station E.3.2 had the greatest biomass (8.08 g/m^2) while Station W18.2 had the least biomass (2.66 g/m^2).

Diversity of the benthic community was generally low and continued the trend of decreased diversity which started in August, 1975 (Figure D.1.2). Dominance of the benthic community by polychaete worms was the main reason for this trend. These burrowing deposit-feeding animals are best suited for life in the soft, mud and fibrous peat substratum of the canal system. The only station where this type of substratum did not occur was Station F.1 where the bottom was harder and suited for other species. Because this station was located nearest the plant discharge, water temperatures there would be expected to be highest and probably high enough to preclude recruitment from other areas of the canal system. This was evidenced by the fact that Station F.1 had the lowest density and diversity of all the stations. Biomass there was comparable with other stations due to the presence of the relatively larger and heavier bodied snail *Batillaria minima*.

Diversity was highest in the canal system in May, 1975, when 38 species were recorded from all stations. There were 22 species in May, 1976, 12 of which were polychaete worm species. The number of crustacean and mollusc species and individuals had declined considerably from earlier sampling periods. Future sampling will determine if the reduction of crustacean and molluscan species continues.

The trend of increasing dominance by polychaetes has been previously reported (Applied Biology, 1976). Should it continue, community stability, in the classic sense of high diversity and community complexity, will never be realized in the Turkey Point Canal system. Instead, a community of polychaete worms will evolve.

Polychaete worms are known to tolerate wider variances in environmental conditions than most other organisms. The tissue heat-resistance of _Nereïs diversicolor_ has been shown to change during seasonal fluctuations in temperature (Ivleva, 1967). This species has also been reported by Markovski (1960) and Warinner and Brehmer (1966) to occur in the vicinity of thermal outfalls from steam electric plants during summer months. In a study of thermal pollution, Warinner and Brehmer (1965) found that, in August, two polychaetes, _Heteromastus_ and _Nereis succinea_, were the only surviving species at a point 100 yards from the outfall of a power plant, Several studies in southern California

have reported polychaetes to survive in heavily polluted areas with restricted circulation (Reish 1956 and 1959). Bandy et al. (1965) reported polychaetes to outnumber other groups 8:1 at an ocean sewage outfall.

Conclusions

The general trend of the benthic macroinvertebrate community continued toward increased density and biomass and greatly reduced diversity and number of species. Polychaete worms continued and increased their dominance of the benthic community. Due to the apparent lack of recruitment of species to the canal system, it appears likely that polychaete worms will eventually replace the crustacean and mollusc populations reported earlier. These latter organisms do not appear to have sufficient reproductive success in the canals.

Diversity and Equitability (EPA, 1973)

Diversity indices are an additional tool for measuring the quality of the environment and the effect of induced stress on th structure of a community of macroinvertebrates. Their use is based on the generally observed phenomenon that undisturbed environments support communities having large numbers of species with no individual species present in overwhelming abundance. If the species in such a community are ranked on the basis of their numerical abundance, there will be relatively few species with large numbers of individuals and large numbers of species represented by only a few individuals. Many forms of stress tend to reduce diversity by making the environment unsuitable for some species or by giving other species a competitive advantage.

There are two components of species diversity: the number of species (species richness) and the distribution of individuals among the species (species eveness). The inclusion of this latter component renders the diversity index independent of sample size.

The Shannon-Weaver index of diversity ($\bar{d}$) (Lloyd, Zar, and Karr, 1968) calculates mean diversity and is recommended by the EPA (1973).

$$\bar{d} = \frac{C}{N} (N \log_{10} N - \Sigma\, n_i \log_{10} n_i)$$

C = 3.321928 (converts base 10 log to base 2)

N = total number of individuals

n_i = total number of individuals of the i^{th} species.

Mean diversity as calculated above is affected by both species richness and eveness and may range from 0 to 3.321928 log N.

To evaluate the component of diversity due to the distribution of individuals among the species (equitability), compare the calculated $\bar{d}$ with a hypothetical maximum $\bar{d}$ based on an arbitrarily selected distribution. This hypothetical maximum would occur when all species are equally abundant. Since this phenomenon is quite unlikely in nature, Lloyd and Ghelardi (1964) proposed the term "equitability" and compared $\bar{d}$ with a maximum based on the distribution obtained from MacArthur's (1957) "broken stick" model. The MacArthur model results in distribution quite frequently observed in nature -- one with a few abundant species and increasing numbers of species represented by only a few individuals. Sample data are not expected to conform to the MacArthur model, since it is only being used as a measure against which the distribution of abundances is compared. Equitability values may range from zero to one except in rare cases where the distribution in the sample is more equitable than in the MacArthur model.

Equitability is computed by:

$$e = \frac{S'}{S}$$

where:

S = number of taxa in the sample

S'= hypothetical maximum number of taxa in the sample based on a table devised by Lloyd and Ghelardi (1964).

When Wilhm (1970) evaluated diversity indices calculated from data collected by numerous authors, he found that in unpolluted water $\bar{d}$ was generally between 3 and 4, whereas in polluted waters, $\bar{d}$ was generally less than 1. However, data collected from southeastern United States waters by EPA biologists has shown that where degradation is at slight to moderate levels, $\bar{d}$ lacks the sensitivity to demonstrate differences. Equitability, on the contrary, is very sensitive to demonstrate differences. Equitability levels below 0.5 have not been encountered in southeastern waters known to be unaffected by oxygen-demanding wastes, and in such waters, e generally ranged from 0.6 to 0.8. Even slight levels of degradation have been found to reduce equitability below 0.5 and generally to a range of 0.0 to 0.3.

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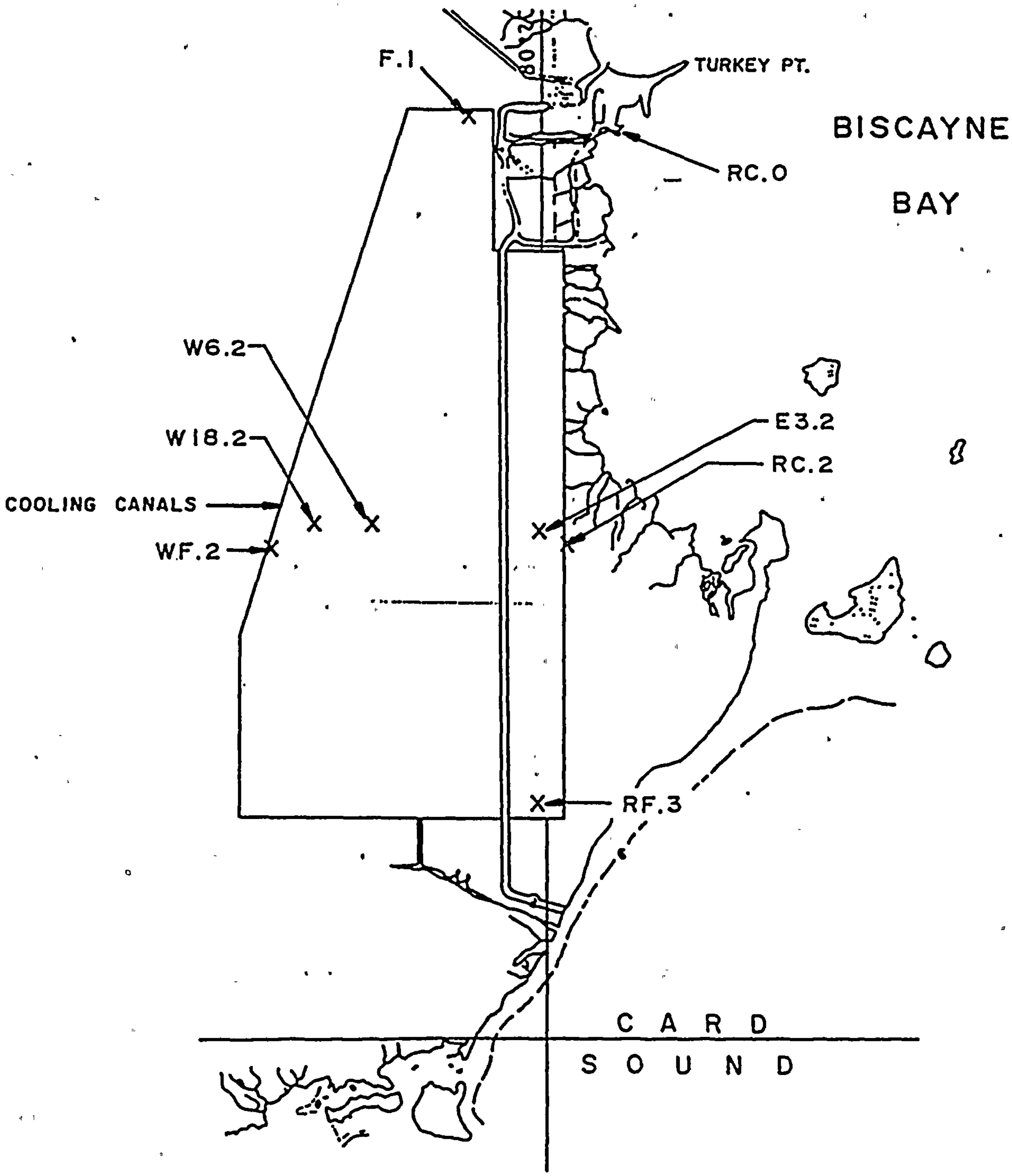
FIGURE D.1.1

LOCATION OF BENTHIC MACROINVERTEBRATE SAMPLING STATIONS-TURKEY POINT PLANT



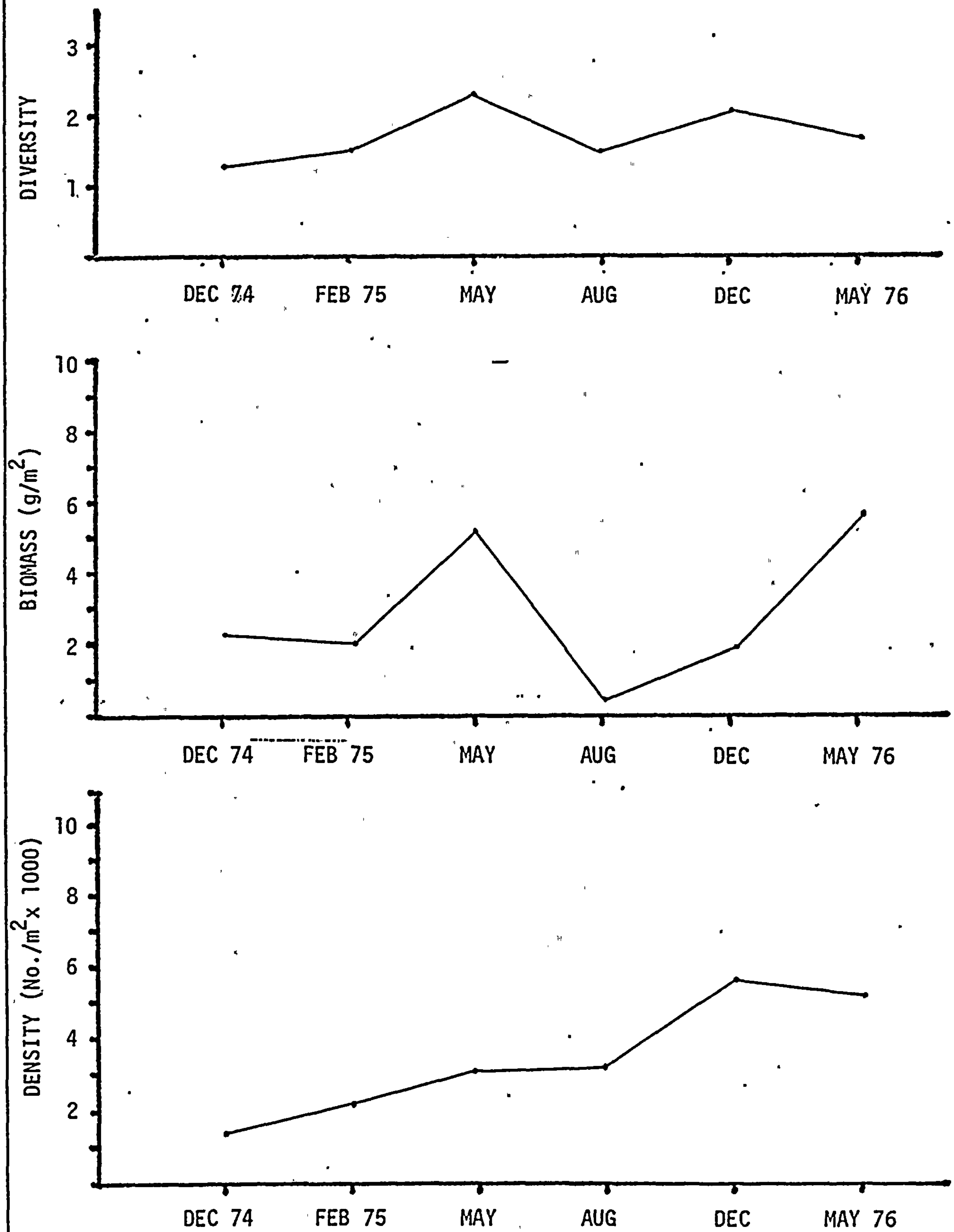


FIGURE D.1.2

MEAN DIVERSITY, BIOMASS AND DENSITY PER STATION
TURKEY POINT PLANT, 1974-1976

TABLE D.1.1

RESULTS OF BENTHIC MACROINVERTEBRATE SAMPLING
AT STATION RC. 2 - TURKEY POINT PLANT-MAY, 1976

Species	Specimens/Replicate 1	2	3
Class Polychaeta			
worms *Autolytus brevicirrata*	50	21	64
Cirriformia filigera	7		
Dorvillea sociabilis	7	7	
Odontosyllis enopla			7
Nereis succinea			21
Podarke obscura	21		28
Class Crustacea			
ostracods *Cylindroleberis mariae*		14	14
Sarsiella americana			7
amphipods *Microdeutopus gryllotalpa*		7	
Phylum Echiurida			
echiurid worms *Thalassema hartmani*	14	7	
Individuals/Replicate	99	56	141
Biomass (g)/Replicate	0.101	0.105	0.081
Index of Diversity	1.92	2.16	2.16
Equitability	0.98	1.18	0.98
Individuals/m^2	4253		
Biomass(g)/m^2	4.124		

TABLE D.1.2

RESULTS OF BENTHIC MACROINVERTEBRATE SAMPLING AT STATION E3.2 -TURKEY POINT PLANT-MAY, 1976

Species	Specimens/Replicate 1	2	3
Class Polychaeta			
worms *Amphicteis gunneri floridus*	7		
Autolytus brevicirrata	92	14	78
Cirriformia filigera	114	43	14
Dorvillea sociabilis	36	43	14
Haploscoloplos fragilis	14	14	
Hydroides sp.		7	
Odontosyllis enopla		14	
Nereis succinea	14		
Podarke obscura	114	64	28
Polyophthalamus pictus			7
Class Pelecypoda			
bivalves *Gouldia cerina*	78	71	21
Class Crustacea			
ostracods *Cylindroleberis mariae*	43	43	7
amphipods *Microdeutopus gryllotalpa*			7
Phylum Echiurida			
echiurid worms *Thalassema hartmani*	7		
Individuals/Replicate	519	313	176
Biomass (g)/Replicate	0.199	0.150	0.213
Index of Diversity	2.83	2.86	2.45
Equitability	0.99	1.13	0.94
Individuals/m^2	14,483		
Biomass (g)/m^2	8.075		

TABLE D.1.3

RESULTS OF BENTHIC MACROINVERTEBRATE SAMPLING AT STATION WF. 2 - TURKEY POINT PLANT-MAY, 1976

Species	Specimens/Replicate 1	2	3
Class Polychaeta			
worms *Autolytus brevicirrata*	7	21	
Cirriformia filigera	14		14
Odontosyllis enopla		7	
Nereis succinea	14	21	
Podarke obscura	28	21	—
Class Pelecypoda			
bivalves *Gouldia cerina*	7		
Lyonsia floridana	7		
Class Gastropoda			
snails *Batillaria minima*		7	
Individuals/Replicate	77	77	14
Biomass (g)/Replicate	0.070	0.199	0.160
Index of Diversity	2.37	2.16	0.00
Equitability	1.17	1.19	1.00
Individuals/m^2	2414		
Biomass (g)/m^2	6.164		

TABLE D.1.4

RESULTS OF BENTHIC MACROINVERTEBRATE SAMPLING AT STATIONW18.2 -TURKEY POINT PLANT-MAY, 1976

Species	Specimens/Replicate 1	2	3
Class Polychaeta			
worms *Autolytus brevicirrata*	7		7
Cirriformia filigera	21		
Nereis succinea	7	7	
Podarke obscura	50	28	
Class Crustacea			
amphipods *Elasmopus rapax*		21	
Individuals/Replicate	85	56	7
Biomass (g)/Replicate	0.115	0.044	0.026
Index of Diversity	1.55	1.41	0.00
Equitability	0.93	1.12	1.00
Individuals/m^2	2126		
Biomass (g)/m^2	2.658		

TABLE D.1.5

RESULTS OF BENTHIC MACROINVERTEBRATE SAMPLING
AT STATION W6.2 - TURKEY POINT PLANT-MAY, 1976

Species	Specimens/Replicate 1	2	3
Class Polychaeta			
worms *Autolytus brevicirrata*	64	64	92
Cirriformia filigera		28	28
Nereis succinea	14	28	14
Podarke obscura	21	14	99
Class Gastropoda			
snails *Bulla occidentalis*	21		
Class Pelecypoda			
bivalves *Gouldia cerina*			7
Class Crustacea			
ostracods *Cylindroleberis mariae*			7
amphipods *Hemiaegina minuta*		7	
Individuals/Replicate	120	141	247
Biomass (g)/Replicate	0.201	0.103	0.172
Index of Diversity	1.73	2.00	1.95
Equitability	1.08	1.06	0.85
Individuals/m^2	7299		
Biomass (g)/m^2	6.839		

TABLE D.1.6

RESULTS OF BENTHIC MACROINVERTEBRATE SAMPLING
AT STATION F.1 -TURKEY POINT PLANT-MAY, 1976

Species	Specimens/Replicate 1	2	3
Class Polychaeta			
worms *Nereis succinea*	14	7	
Podarke obscura			7
Class Gastropoda			
snails *Batillaria minima*	21	7	21
Individuals/Replicate	35	14	28
Biomass (g)/Replicate	0.191	0.059	0.184
Index of Diversity	0.97	1.59	0.81
Equitability	1.15	1.27	1.00
Individuals/m^2	1106		
Biomass (g)/m^2	6.236		

TABLE D.1.7

RESULTS OF BENTHIC MACROINVERTEBRATE SAMPLING AT STATION RF.3 -TURKEY POINT PLANT-MAY, 1976

Species	Specimens/Replicate 1	2	3
Class Polychaeta			
worms *Amphicteis gunneri floridus*	14	21	
Autolytus brevicirrata		128	7
Cirriformia filigera		7	
Marphysa sanguinea			14
Pista cristata	14		
Nereis succinea		21	7
Podarke obscura		14	
Class Pelecypoda			
bivalves *Gouldia cerina*		14	7
Class Crustacea			
ostracods *Cylindroleberis mariae*		114	7
amphipods *Elasmopus rapax*		14	
Microdeutopus gryllotalpa		7	
Individuals/Replicate	28	340	42
Biomass (g)/Replicate	0.121	0.262	0.100
Index of Diversity	1.00	2.36	2.25
Equitability	1.22	0.77	1.28
Individuals/m^2	5891		
Biomass (g)/Replicate	6.940		

D.2 MICROBIOLOGY

INTRODUCTION

The microbiological study of the Turkey Point canal sediments was conducted to provide an understanding of bacterial isolates present in the substrates. These isolates were characterized according to their ability to utilize various organic (carbohydrate, lipid, protein) and inorganic (nitrate, nitrite, sulfate, sulfite and ammonia) substrates. Bacterial cycling of nutrients as energy food sources is essential for the growth and diversity of organisms living in the canal environment.

A. Chitin

Chitin is a major complex carbohydrate found in the marine environment. This material is composed of repeating units of N-acetyl-glucosamine, a derivative of glucose, which contains the elements carbon, hyrdrogen, nitrogen and oxygen. Chitin is the basic structural compound found in the exoskeleton of crustaceans, insects, and other arthropods. Insufficient degradation of chitin could result in depletion of fundamental elements from the carbon and nitrogen cycles.

B. Cellulose

Another complex carbohydrate found in the estuarine environment is cellulose from the cell walls of plants. Cellulose is believed to make up more than 50% of the total organic carbon in the biosphere.

Very similar to chitin, cellulose is composed of repeating units of glucose molecules instead of glucosamine, so that nitrogen is not a component. Insufficient bacterial degradation of cellulose would make carbon less available for use by other organisms.

C. Sugars

Utilization of small carbohydrates as energy or food sources was also included in the characterization of isolates. Lactose, glucose, mannitol and saccharose were used as the test sugars. Lactose and saccharose are disaccharides with lactose being composed of galactose and glucose, while saccharose is composed of fructose and glucose, Glucose and mannitol are simple sugars called monosaccharides.

D. Proteins

Proteins occurring free in the marine environment are products of degradation of dead plants and animals. Degradation of free protein contributes to the carbon, nitrogen and sulfur pools. Casein (milk protein) hydrolysis by marine bacteria shows good correlation with hydrolysis of naturally occurring marine protein (Sizemore and Stevenson, 1970). The test for casein hydrolysis was performed on all bacterial isolates.

E. Nitrogen and Sulfur

The role of the bacterial isolates in specific steps of the

nitrogen and sulfur cycles was investigated. Nitrogen exists in the environment in several forms, including: molecular nitrogen, ammonia, amines, nitrites, nitrates and protein. The production of ammonia from proteins (ammonification), ammonia oxidation to nitrite and then nitrate and the reduction of nitrates are all normal phenomena in a healthy environment and were used as indicators of utilization of nitrogen compounds by the bacterial isolates.

Sulfur is the sixth most abundant element in the sea (Stevenson and Colwell, 1973). It may exist in an oxidized form as sulfate or sulfite, or in a reduced form as sulfide.

Materials and Methods

Sediment samples were taken asceptically with a gravity type core sampler (Wildco Supply Company) or a clean polypropylene wide mouth jar at eight stations within the canal system and three in Biscayne Bay that were used as controls (Figure D.2.1). Sterile screw-capped bottles were filled with the mud-water mixture at the sampling location. They were then placed on ice until the analyses were begun in the laboratory.

Immediately after arriving in the laboratory, each bottle containing a sample was weighed. The mud-sea water mixture was shaken vigorously. An aliquot (approximately one ml) of this slurry was removed with a sterile pipet and placed in a dilution bottle containing 99 ml of sterile artificial sea water. After the aliquot of sample was

removed from each bottle, the sample bottle was once again weighed. The difference in the two weights is equal to the weight of the sample removed from each bottle. This sample weight was used in calculating the number of bacteria per gram of sediment.

Serial dilutions were then made from the bottles containing the measured aliquot. A most-probable-number (MPN) was determined from triplicate inoculations into broth of the three most dilute samples (APHA, 1974).

An inoculum from each of the sediment samples was streaked onto an agar plate (Marine Agar 2216, Difco Laboratories, Inc.). Isolated colonies of these plates were randomly picked for study.

The majority of tests used to characterize and identify the isolates has been summarized (Table D.2.1). These tests follow standard microbiological procedures (Frobisher, 1968; Salle, 1961; Benson, 1967).

Sulfate reduction was examined in more detail during the May and June analyses. A sulfate-reducing medium composed of sodium lactate, dipotassium phosphate, sodium chloride and varying concentrations of ammonium and iron sulfate was used. The formulas for the five different concentrations of sulfate used in this study are as follows:

GRAMS OF NUTRIENTS ADDED TO 100 ML OF DEONIZED WATER

PARTS PER MILLION	2100	2625	3150	3675	4200
Ammonium sulfate	0.2	0.25	0.3	0.35	0.4
Iron sulfate	0.01	0.0125	0.015	0.0175	0.02
Sodium lactate	0.5	0.5	0.5	0.5	0.5
Dipotassium phosphate	0.05	0.05	0.05	0.05	0.05
Sodium chloride	3.0	3.0	3.0	3.0	3.0

An inoculum from an undiluted sample was added to each of these concentrations of sulfate medium and cultured for three weeks. Sulfate reduction to sulfide is detected by the formation of a black precipitate. This precipitate is due to the reaction between the reduced form of sulfate, hydrogen sulfide, and iron. This reaction results in the formation of iron sulfide which is a black precipitate.

Results and Discussion

The number of bacteria per gram of sediment was highest in January, 1976, in the canals as well as in Biscayne Bay (Table D.2-2). The average number of bacteria for the eight canal stations was 383.5 X 10^4 bacteria/gram compared to 210.0 X 10^4 bacteria/gram of sediment taken from the three bay stations. The average bacterial counts of samples taken in the canal system in June was also high (373.0 X10^4 bacteria/gram of sediment). However, results obtained from the

control stations were low. Bacterial densities in the canal do not seem to vary according to seasonal changes alone. Other factors, such as chemical, probably also have an effect on the density of microorganisms in the canal system.

Stations W18-2 and WF-2 were found to have the highest average bacterial counts for the six month period (433.4×10^4 and 406.5×10^4 bacteria/gram of sediment, respectively). Both of these stations are located on the western part of the canal system (Figure D.2.1). The lowest six month average bacterial count was found near the intake canal, Station RC-0 (14.7×10^4 bacteria/gram of sediment). The diversity of bacteria is greatest during the month of March (Table D.2.3).

Laboratory tests performed on the bacteria isolated from the Turkey Point canal system indicated that organisms found there have a wide range of metabolic potentials.

Carbohydrates and proteins are readily degraded. Saccharolytic activity is usually not considered a major attribute of aquatic bacteria (Rheinheimer, 1974). However, since it is important as an aid in taxonomic identification of bacteria, tests for this biochemical characteristic were conducted (Table D.2.4). Protein hydrolysis has an impact on cycling of important nutrients. A significant proportion of the isolates were capable of protein hydrolysis (Table D.2.5). By-products

of this hydrolysis include carbon compounds that will go into the food chain and nitrogen. The nitrogen is initially in the reduced form of ammonia (Rehinheimer, 1974; Stevenson and Colwell, 1974) which may be oxidized to nitrite and nitrate by the action of bacteria (Frobisher, 1967). A small percentage of the isolates were capable of oxidizing ammonia under proper conditions (Table D.2.6). A greater percentage of the bacterial isolates performed nitrite reduction (36.1% of the isolates), which indicated anaerobic conditions; i.e., reduced oxygen in the canal sediments.

Chromogenicity, the ability of bacteria to produce a pigment, was noted during the months of February, March, April, May and June (Table D.2.7). The highest percentage of bacteria demonstrating chromogenicity was during the month of June, 1976. This coincided with the highest number of Pseudomonas sp. isolated from the canal system during the same month. Pseudomonads produce a diffusable water soluble pigment whereas Aeromonas sp., Vibrio sp., and Achromobacter sp. generally do not produce pigment. Pigmentation is thought to be a trait that can be induced in many bacteria by exposure to light (Rheinheimer, 1974).

Chitin, a major constituent of marine environments, was found to be hydrolyzed by a majority of the bacterial isolates. There were significant reductions in the numbers of chitinoclasts during March and May (Table D.2.8). However, in both cases the numbers increased the following month.

Analysis for cellulose degradation has given negative results. The current methodology for determining cellulose degradation may not be adequate for measuring the breakdown of this material in marine bacteria which require a medium containing a number of complex ions that interfere with the detection of cellulose breakdown. Another method for detecting cellulose hyrdolysis should be developed.

The results of chemical analyses show considerable quantities of sulfate in the Turkey Point canal system. For this reason, an in-depth analysis of sulfate reduction was performed. Sulfate reducers were found to be very active at sulfate concentrations up to and including 3,150 ppm (Table D.2.9). Sulfate reduction by the same aliquots of sediments samples at concentrations of 3,675 ppm and 4,200 ppm was minimal, if detected at all. This would indicate a nearly complete inhibition of sulfate reduction by the substrate itself at concentrations of 3,675 ppm and above.

Sulfate reducing bacteria are present in the sediments of the canal system. However, they may not be actively reducing sulfate under all conditions. Addition of sulfate ion producing materials in toxic quantities a result of power plant operations is thus contraindicated.

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SAMPLING LOCATIONS FOR MICROBIOLOGICAL STUDIES

FIGURE D.2.1

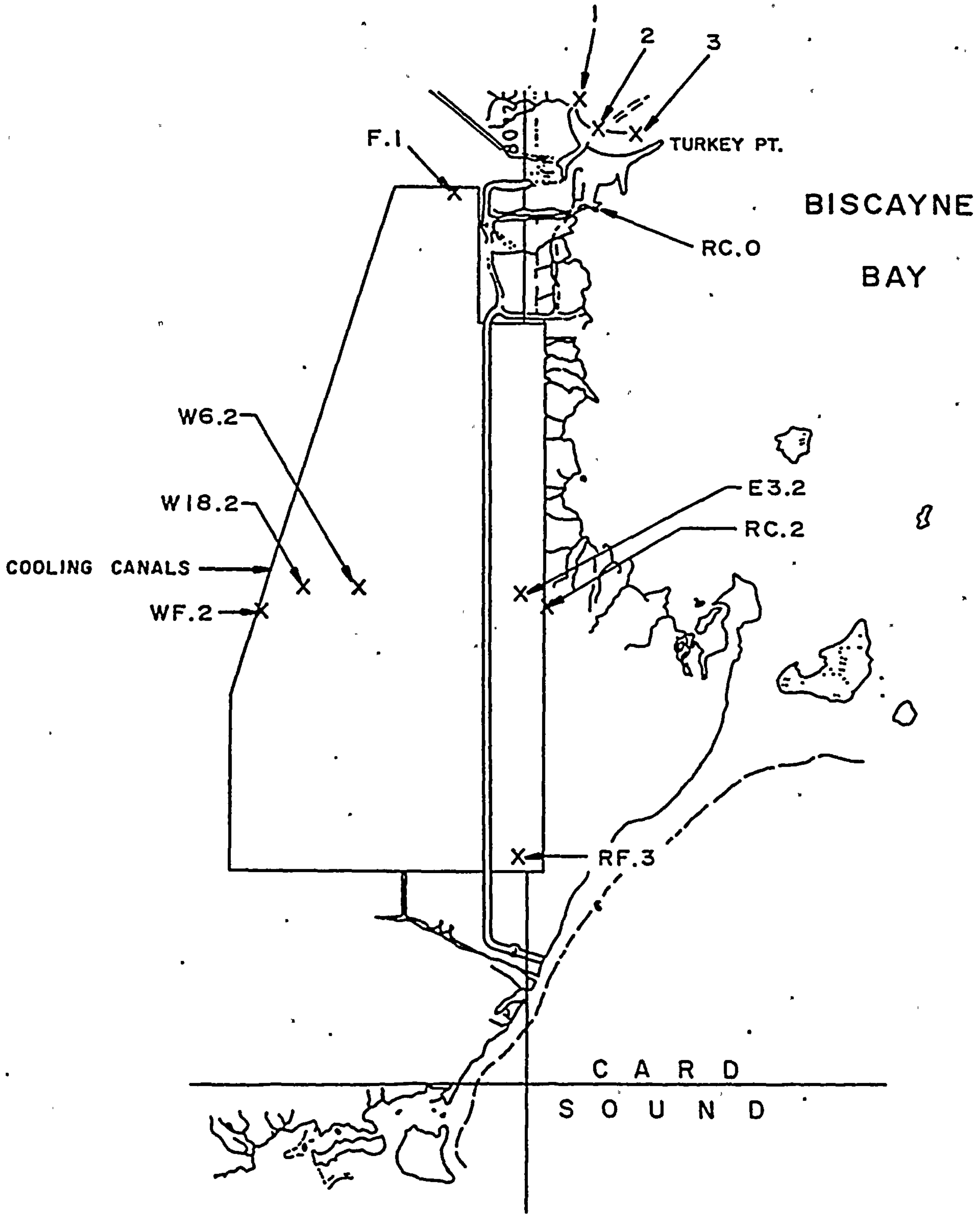


TABLE D.2.1

DETERMINATIVE TESTS USED FOR THE IDENTIFICATION OF BACTERIAL ISOLATES

TEST	SUMMARY OF METHODOLOGY
Gram Stain	(1) Air dry smear, heat fix (2) Crystal violet stain, rinse with H_2O (3) Apply mordant (iodine), rinse with H_2O (4) Decolorize with Gram's alcohol, rinse with H_2O (5) Safranin stain, rinse with H_2O
Spore Stain	(1) Air dry smear, heat fix (2) Apply 1% methylene blue stain, rinse with H_2O
Catalase Test	(1) Apply a drop of 3% H_2O_2 to an isolated colony
Oxygen Dependency	(1) An agar-shake is made in a culture tube with each isolate to be tested
Oxidase Test	(1) A drop of oxidase reagent (1% tetramethyl-p-phenylene-diamine dihydrochloride) is applied to each isolated colony to be tested
Penicillin Sensitivity	(1) A Difco penicillin disk (5 units) is applied to each plate streaked with bacteria
Methyl-Red/Voges-Proskauer Test	<u>Methyl Red</u> (1) Add methyl red solution to a 24-48 hour culture of the bacteria to be tested. <u>Voges-Proskauer</u> (1) Add 18 drops of Barritt's solution A to one ml of a 24-48 hour culture (2) Add 18 drops of Barritt's solution B to the above and shake
Indole	(1) Grow each bacterial isolate in 1% tryptone broth (Difco) for 24 hours (2) After 24 hours add 10-12 drops of Kovac's reagent
Citrate Utilization	(1) Streak each isolate on a slat of Simmon's Citrate Agar and incubate for 24 hours

TABLE D.2.1 (continued)

DETERMINATIVE TESTS USED FOR THE IDENTIFICATION OF BACTERIAL ISOLATES

TEST	SUMMARY OF METHODOLOGY
Urea Hydrolysis	(1) Inoculate each isolate into 1% Difco urea broth containing phenol red indicator
Motility	(1) Inoculate Difco motility medium with each isolate
Ammonification of Chitin	(1) Add a drop of a 4, 7, 10, 14, or 21 day culture grown in selective medium to a spot plate well (2) Test for production of ammonia from chitin with Nessler's reagent (3) Confirm by observing culture for an additional 1-2 weeks for visual evidence of chitin degradation in the tube
Ammonification of Peptone	(1) Inoculate peptone broth with each isolate to be tested (2) Test for presence of ammonia after 4, 7, 10, 14, and 21 days with Nessler's reagent.
Metabolism of Carbohydrates	(1) Culture isolated bacteria in specific sugar broths (2) Observe for change in color of phenol red indicator from red to yellow as evidence of sugar metabolism
Nitrate Reduction	(1) Inoculate isolate to be tested into BBl trypticase nitrate broth (2) After incubation, test for production of nitrite by adding a drop of the culture to a spot well containing 3 drops of Trommsdorf's reagent and one drop of dilute (1 part acid: 3 parts distilled H_2O) sulfuric acid (3) Observe for development of an intense blue-black color.
Sulfate Reduction	(1) Bacterial isolates grown on triple sugar iron agar and sulfate reducer API agar
Sulfite Reduction	(1) Bacterial isolates grown on BBL sulfite agar for 48 hours and examined for appearnace of blackened areas, indicating formation of sulfide

TABLE D.2.2

MOST PROBABLE NUMBER OF BACTERIA ($x10^{-4}$) PER GRAM OF SEDIMENT

STATION LOCATION	BISCAYNE BAY				TURKEY POINT CANAL SYSTEM								
STATION NUMBER	1	2	3	MEAN	F-1	W6-2	W18-2	WF-2	RF-3	E3-2	RC-2	RC-0	MEAN
MONTH: January	210	210	210	210	240	93	150	1100	1100	210	150	23	383.5
February	74.4	171.4	12.0	85.9	45.7	280.0	368.0	160.0	450.0	83.3	214.3	4.2	201.9
March	17.2	7.7	2.8	9.2	15.0	4.3	57.7	23.1	100.0	18.2	17.0	5.2	30.1
April	91.4	8.5	15.9	38.6	52.3	47.4	441.2	97.9	14.3	*	62.5	22.5	105.5
May	18.2	18.5	20.2	19.0	571.4	82.8	1263.2	452.8	153.3	32.9	46.2	9.6	326.5
June	17.2	13.5	25.8	18.8	345.5	400.2	320.5	605.0	387.5	75.4	826.4	23.8	373.0
SIX MONTH AVERAGE	71.4	71.6	47.8		211.7	151.3	433.4	406.5	369.2	87.9	219.4	14.7	

*The microbiological analysis for MPN was not done in April at Station E3-2

TABLE D.2.3

PERCENTAGE OF EACH MONTH'S BACTERIAL ISOLATES IDENTIFIED TO GENUS

Percentage Distribution by Month

Type of Organism	January	February	March	April	May	June
Pseudomonas	30.00	41.20	26.30	9.10	23.50	63.60
Xanthomonas						
Aeromonas vibrio group			21.05	27.27	29.40	
Achromobacter Alcaligenes group	30.00	58.80	21.05	54.55	47.10	36.40
Flavobacter	20.00		5.30	9.09		
Cyctophaga			21.05			
Bacillaceae						
Micrococcaceae						
Coliforms						
Unidentified	20.00		5.30			

TABLE D.2.4

SACCAROLYTIC ACTIVITY OF THE BACTERIAL ISOLATES

MONTH	% of Isolates Metabolizing the Sugars			
	Glucose	Saccharose	Mannitol	Lactose
January	40.0	30.0	30.0	0
February	6.2	6.2	6.2	0
March	77.8	72.2	55.6	0
April	45.4	36.4	27.3	0
May	64.7	52.9	41.2	0
June	54.6	27.3	27.3	0

TABLE D.2.5

PROTEIN HYDROLYSIS

MONTH	% of Bacterial Isolates Hydrolyzing Protein
January	60.0
February	31.2
March	33.9
April	90.9
May	58.8
June	72.7

TABLE D.2.6

PERCENT OF BACTERIAL ISOLATES OXIDIZING AMMONIA AS COMPARED TO THOSE REDUCING NITRATE AND NITRITE

% of Isolates Oxidizing Ammonia	% of Isolates Reducing Nitrate or Nitrite
11.1	36.1

TABLE D.2.7

CHROMOGENICITY IN TURKEY POINT BACTERIAL ISOLATES
1976

MONTH	% Bacterial Isolates Showing Chromogenicity (in canal)
January	*
February	25.0
March	16.7
April	18.2
May	25.1
June	54.6

*Not determined in January

TABLE D.2.8

CHITIN HYDROLYSIS

MONTH	% Hydrolysis
January	60.0
February	56.2
March	38.9
April	90.9
May	29.4
June	63.7

TABLE D.2.9

SULFATE REDUCTION

	CONCENTRATION OF SULFATE IN THE MEDIUM (PPM)				
Replicate	2,100	2,625	3,150	3,675	4,200
1	++	++	+++	+	-
2	++	++	+++	-	-
3	++	++	+++	-	
4	++	++	+++	-	+
5	-	-	-	-	-
6	++	++	+++	-	-
7	++	++	+++	+	+
8	++	+	+	+	-
9	++	++	+++	-	-
10	++	++	+++	-	-
11	++	+++	+++	-	-

* + indicates minimum sulfate reduction occurred
++ indicates a significant amount of sulfate reduction has occurred
+++ indicates a large amount of sulfate hs occurred
\- indicates no sulfate reduction was noted

III.E PHYSICAL AND NUTRIENT DATA

A. PHYSICAL DATA

PURPOSE

The purpose of this section is to provide basic physical data to help in the interpretation of plankton reports which follow. This report deals with data collected on a monthly basis during plankton sampling. More detailed temperature, salinity, and dissolved oxygen data can be found in another section of this report.

METHOD AND PROCEDURES

1. Temperature was measured by a Y.S.I. Thermistemp Telethermometer. Accuracies were $\pm$ 0.5°C.

2. Salinities were determined with an American Optical Refractometer. Accuracies were $\pm$ 0.5 PPT.

3. Dissolved oxygen was measured with a Y.S.I. Probe type oxygen meter. Accuracies were $\pm$ 0.4 PPM.

All instruments were calibrated before each sampling date. All measurements were made in the top meter of water.

DISCUSSION AND CONCLUSIONS

1. Temperature (°C)

The maximum temperature measured in the cooling canal system was 37°C but 30.4°C in Biscayne Bay and Card Sound. The maximum temperatures both within the cooling system and the bay were lower than in the same period of last year.

The minimum temperature measured in the system was 18.5°C recorded in February, and 18.0°C in the bay recorded the same month.

The average temperature of the bay continued to be lower by 2.0°C than the power plant's intake.

There is an average range of 10°C between the maximum and the minimum temperature in the cooling canal system for this period.

2. SALINITY (PPT)

The maximum salinity in the cooling canals was 40.0 (PPT) or 1.0 (PPT) higher than the maximum in the bay. Most of this period of the year is known as the dry season. There is no evidence of salinity buildup in the system. That will be observed in the yearly report. The lowest salinity in the system, reported at the westernmost canal, is due to the operation of the interceptor ditch pump for salt water intrusion control.

Salinity average range in the system despite the station in the westernmost canal was 1.5 (PPT) and in the bay 1.0 (PPT). Salinities in the cooling canal system as in the bay are within the tolerable limits of the marine organisms of this area.

3. DISSOLVED OXYGEN (PPM)

Due to the elevated temperatures in the cooling canal system is dissolved oxygen is lower than in Biscayne Bay.

The lowest value of dissolved oxygen recorded in the system was above 4.2 PPM. This is a sufficient oxygen supply for the organisms living therein.

B. NUTRIENT DATA

METHODS AND PROCEDURES

Samples were collected monthly from 12 sample points within the canal system and three control sample points in Biscayne Bay and Card Sound.

Acid washed, ground glass, stoppered, clear containers were used for the ammonia samples with Phenol Alcohol added as the preservative. Dark containers were used for the other nutrient samples with Mercuric Chloride added as the preservative.

All analyses were performed on a Technicon (cs M 6) Autoanalyzer. Data is recorded as (PPM).

DISCUSSION AND CONCLUSIONS

The 1976 nutrient levels in the cooling canal system are marginally higher than in 1975. The average level of ammonia, nitrites, nitrate, organic and total phosphate are 3 to 4 times the average level at the three bay control stations.

The apparent cycling of the ammonia, nitrite, and nitrate seen in the cooling canal system in previous years has been repeated this period.

The absence of April nutrient data was due to sample loss. The purpose of these analysis are to provide a more complete picture of the various parameteres correlated with the plankton in the system.

PLANKTON

1. ZOOPLANKTON

A. SAMPLING METHODS AND PROCEDURES

Methods and procedures were as previously reported using a standard 5" Clarke-Bumpus Sampler with a #10 mesh net and bucket.

Sampling was made at the top meter of the water at 1 to 3 mph speed. Tows were approximately 5 minutes long in the canals and three minutes long in the bay.

The methods of counting Zooplankton in the laboratory were the same as previously reported.

Zooplankton organisms were divided into six categories as following:

1. COPEPODS
   Includes cyclopoid, harpacticoid, and monstrilloid copepods.
2. GASTROPODS
   All gastropod veligers.
3. BIVALVE LARVAE
   All bivalve veligers.

4. COPEPOD NAUPLII
   All crustacean nauplii similar in appearance to copepod nauplii (with the exception of cirripeds).
5. CIRRIPED NAUPLII
   As distinguished from other nauplii.
6. OTHER ORGANISMS
   All other Zooplankton not included in the first five categories.

The data is given as number per liter for each of the groups of Zooplankton.

B. DISCUSSION AND CONCLUSIONS

A lower level population of Zooplankton continues to exist in the cooling canal system. However, the level for this period showed higher concentrations than those that were recorded for the same period last year.

In Biscayne Bay and Card Sound the Zooplankton concentrations are approximately 8 - 10 times of those found in the cooling system.

In the bay the higher levels of Zooplankton are recorded in the winter. They decline toward the summer. The lowest level for this period is recorded in June.

More observations on Zooplankton will be made at the end of this year.

C. COPEPODS

The low levels of last year have continued through the first half of 1976 in the cooling system. The highest concentration was .6 per liter while the average was .2 copepods per liter.

In the bay the average maximum recorded for this period was 5.5 per liter and lower than 1975.

Copepod concentration in the bay was at its highest in February and at its lowest in June.

In both the bay and cooling system copepods constitute over 75 % of the organisms counted.

D. GASTROPOD AND BIVALVE LARVAE

Both gastropod and bivalve larvae continued to be almost totally absent in the cooling system. However, for the gastropods, a level of .2 per liter was recorded in the month of June. This is similar to 1975. Bivalve larvae continued at 0 per liter.

In Biscayne Bay and Card Sound gastropods are the second only to copepods in total number. They follow a cycle with highest levels in the winter time.

The highest concentration level for gastropods was above 2 per liter in February and April. The level declined to less than .8 per liter for May and June.

Bivalve are always at a low level. The highest concentration was .06 per liter reported in January. This is lower than the level reported in 1975 at 0.23 per liter.

E. COPEPOD AND CIRRIPED NAUPLII

Both nauplii are too small to be adequately sampled by a # 10 mesh net.

In the cooling canal the copepod nauplii level is essentially zero. The highest concentration for cirriped nauplii in the system was .2 per liter while the average maximum was below .02 per liter. In general both nauplii are at very low levels in the system.

In Biscayne Bay and Card Sound both recorded maximum levels in the month of April, .3 per liter. The average maximum was the same for both at below .1 per liter.

There is no significant change in both concentrations between the first half of this year and the last half of last year.

F. OTHER ZOOPLANKTON

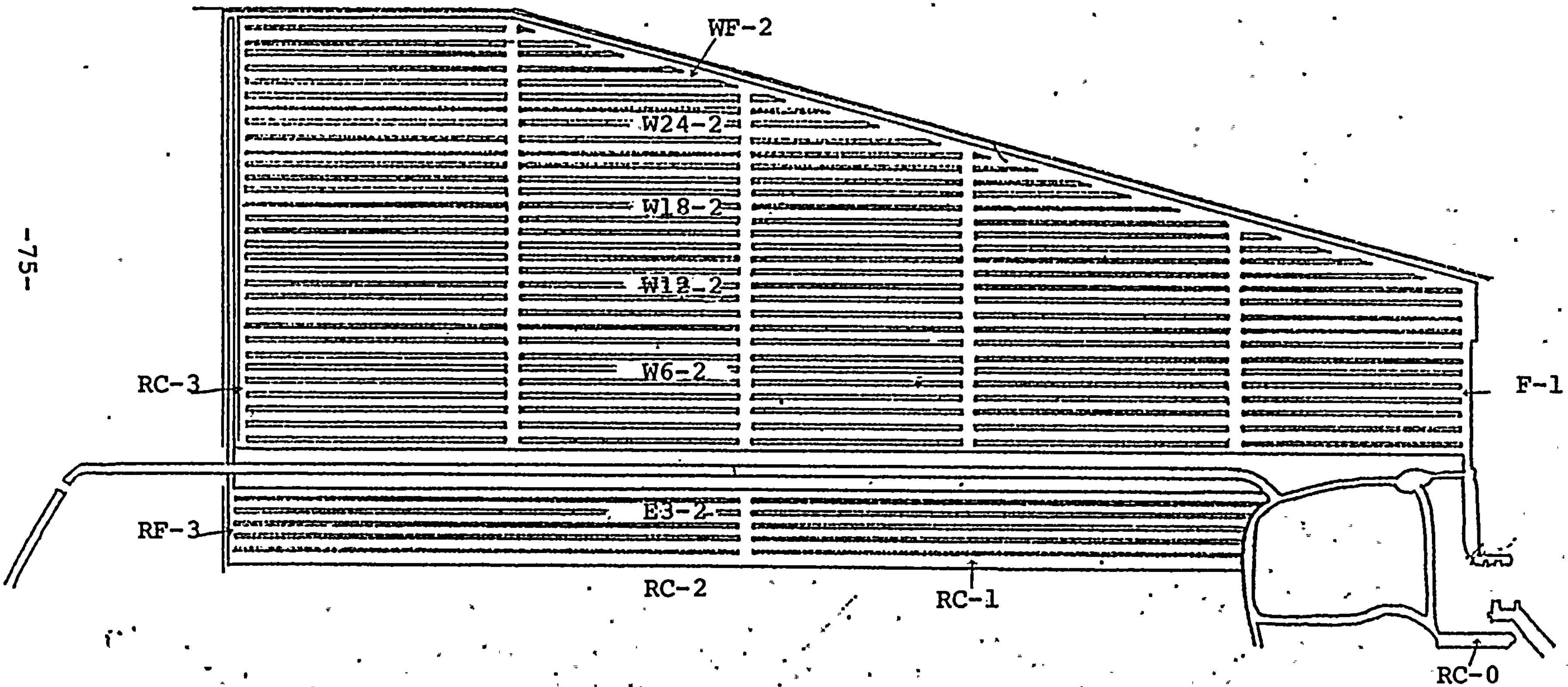
The average level continued to decline both in the bay and in Card Sound for the first half of 1976 and was below the level recorded for 1975 at 0.5 per liter.

The highest concentration was 1.0 per liter in the bay and .8 per liter in the cooling system. The average level for the bay was 0.3 per liter and 0.1 in the system.

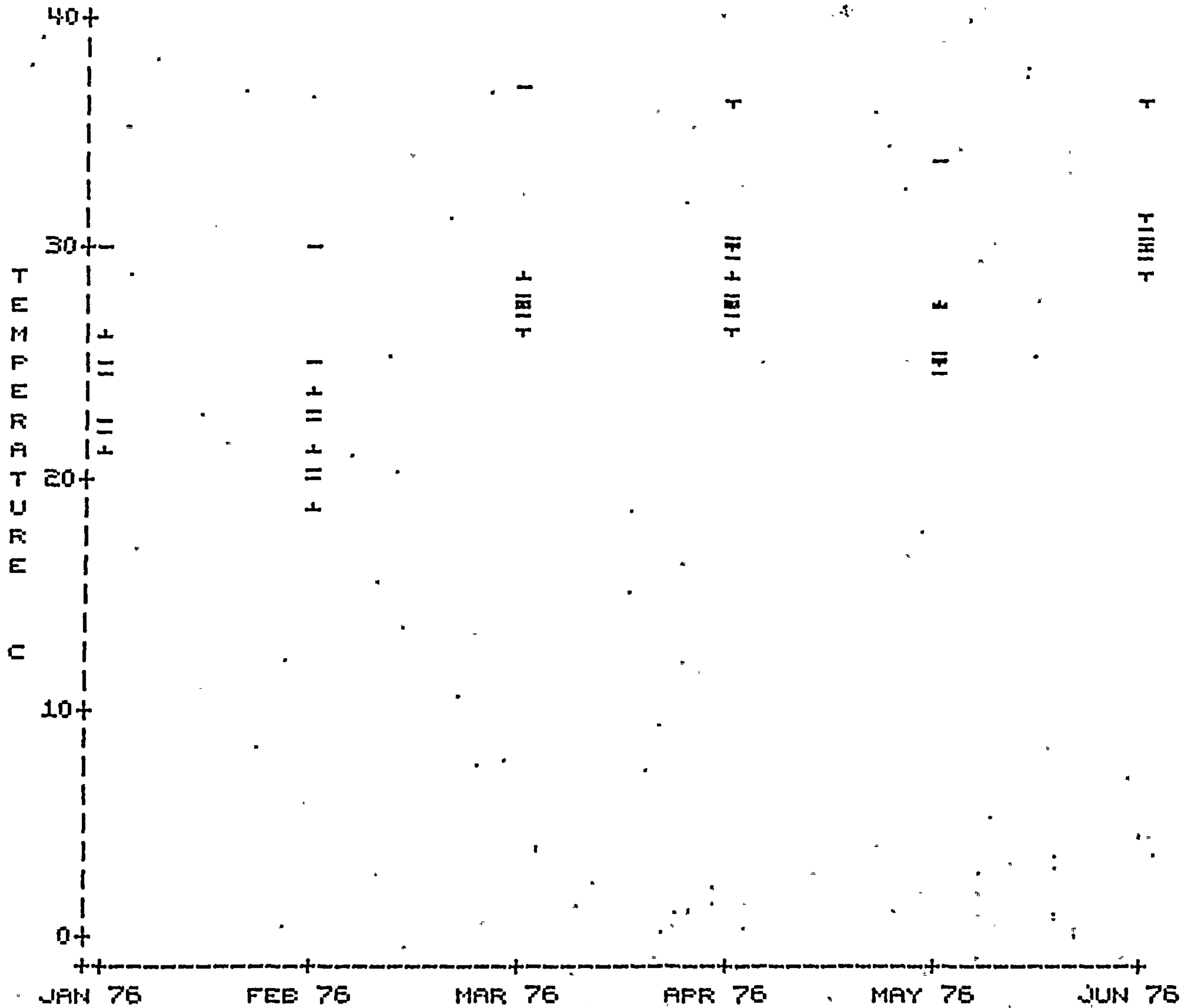
Other Zooplankton organisms normally found in the cooling canals are fish eggs, fish larvae, shrimp larvae, zoea larvae, chaetognaths, polychae larvae, and tunicate larvae.

In Biscayne Bay and Card Sound in addition to the previous groups, nematodes, amphipods, cladocerans, and medusae are found.

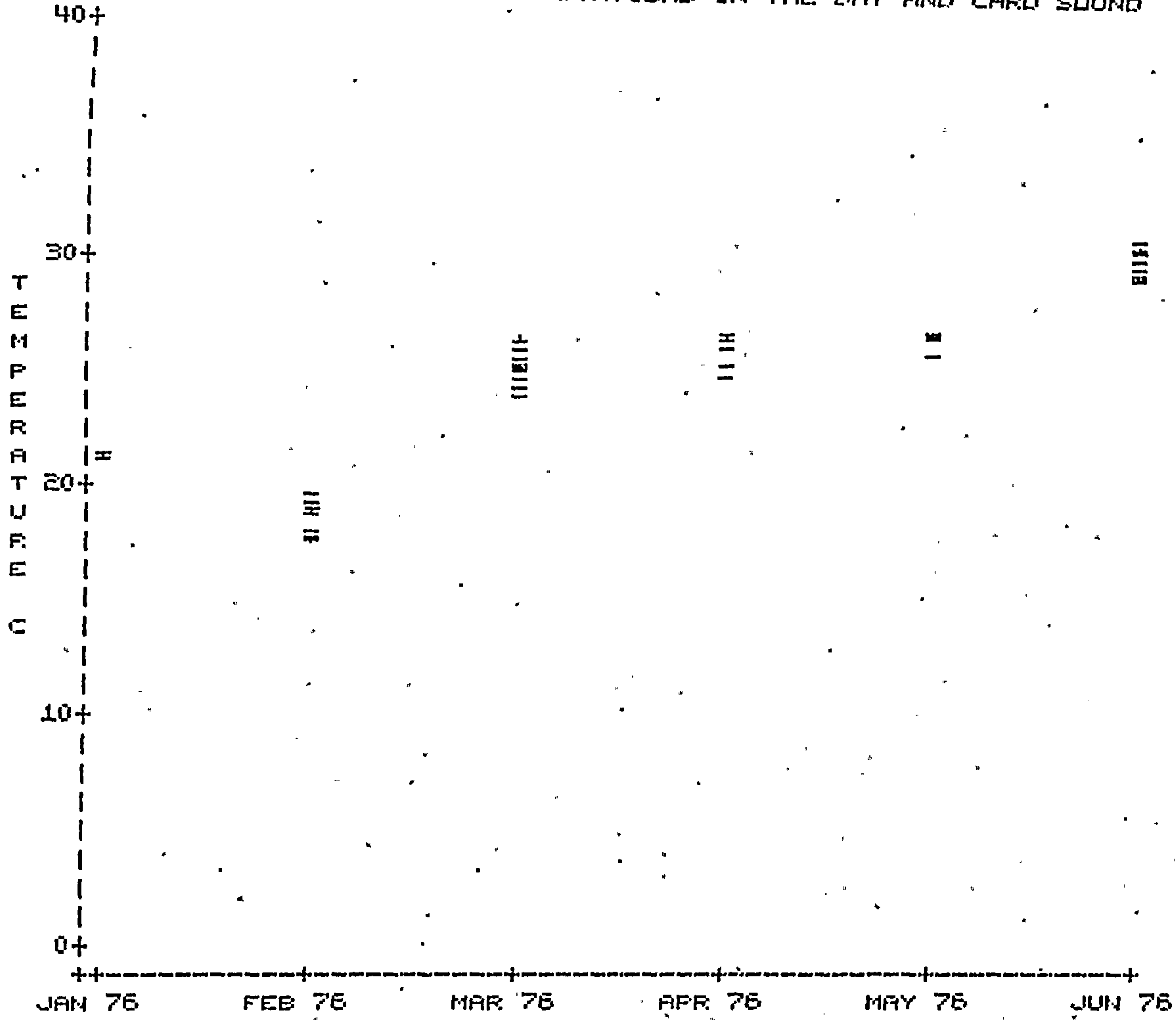
TWELVE PHYTOPLANKTON, NUTRIENT AND HYDROGRAPHY SAMPLING STATIONS



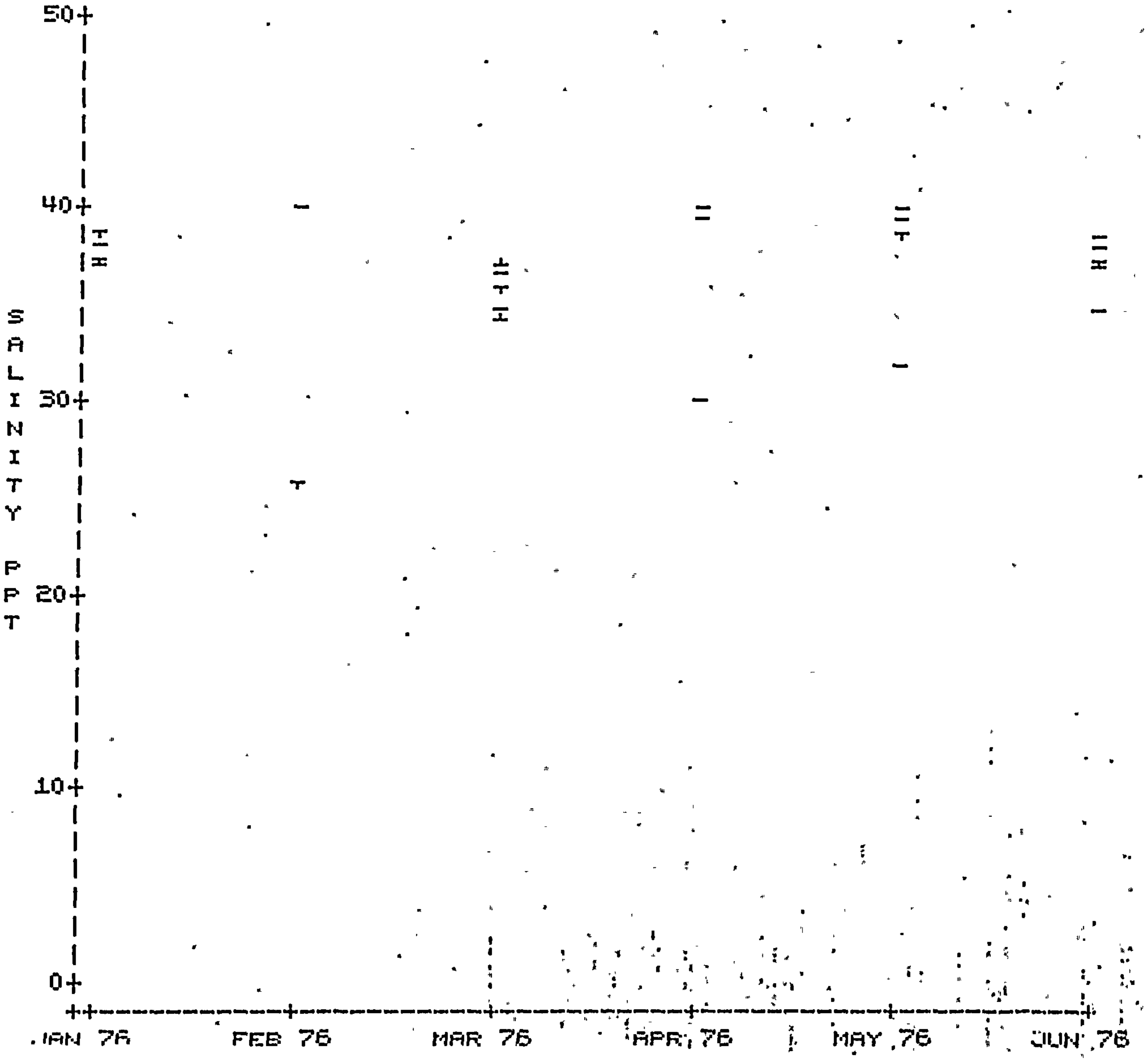
TEMPERATURE AT ALL PLANKTON SAMPLING STATIONS WITHIN THE COOLING CANALS

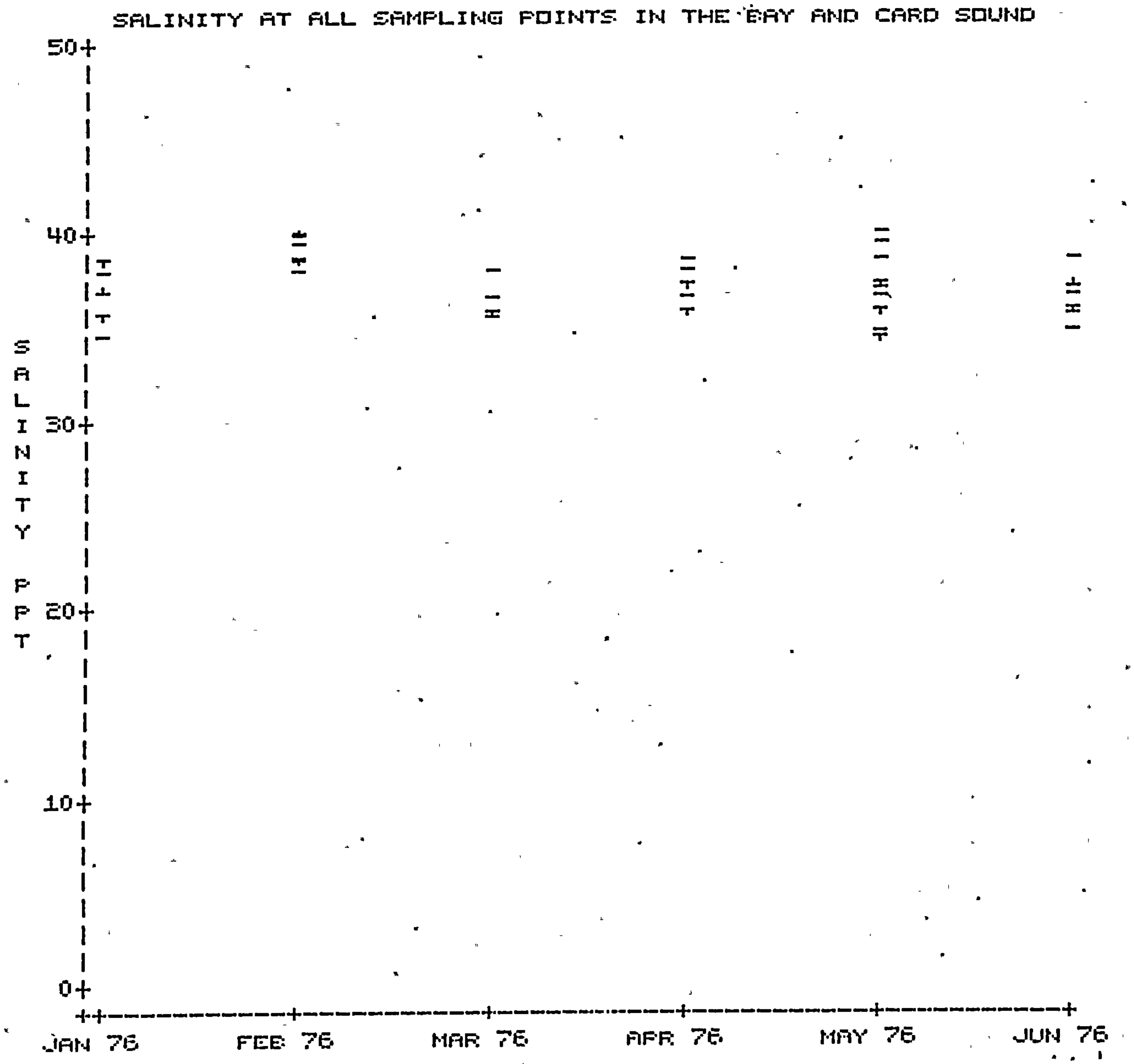


TEMPERATURE AT ALL SAMPLING STATIONS IN THE BAY AND CARD SOUND

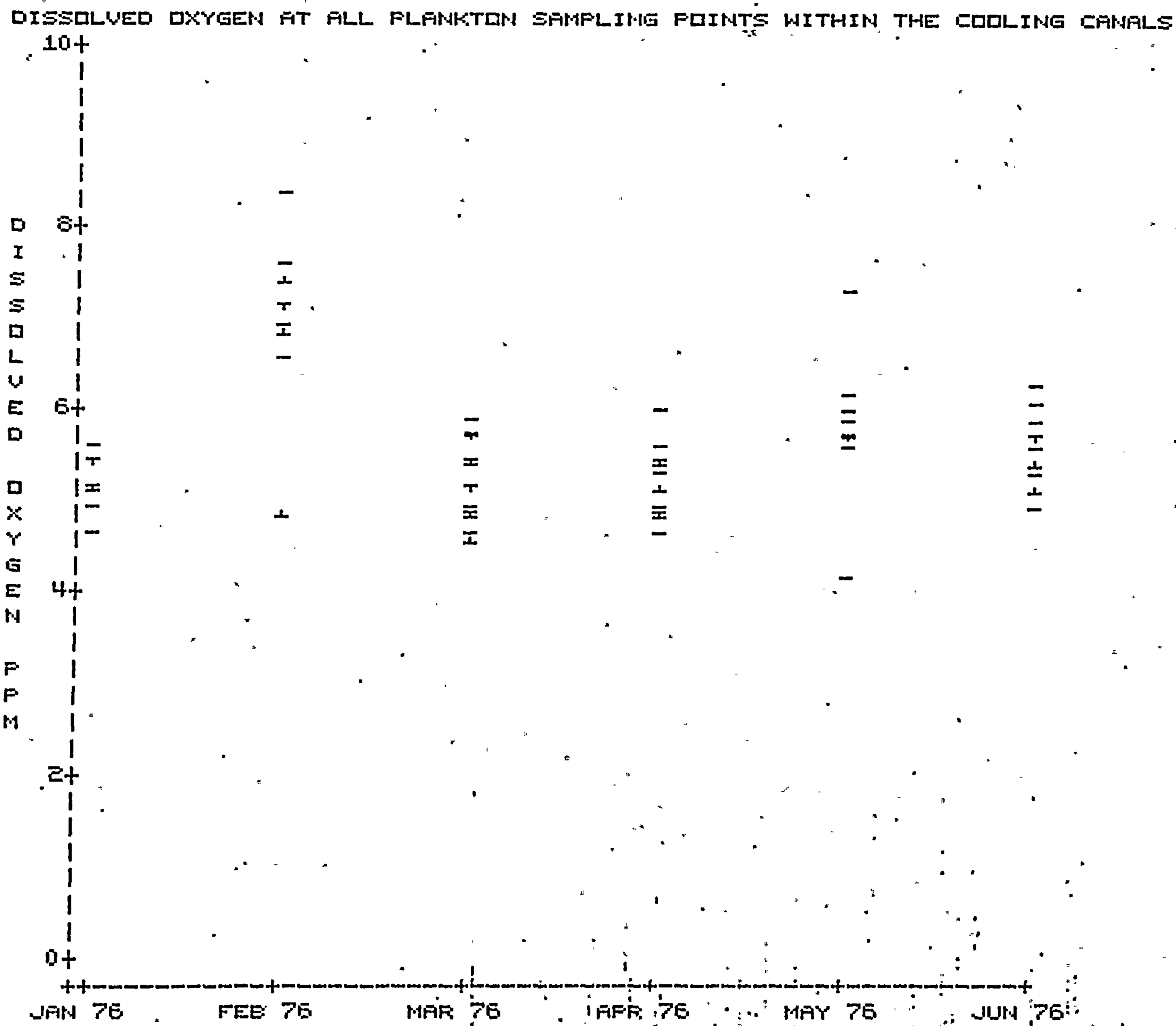


SALINITY AT ALL PLANKTON SAMPLING STATIONS WITHIN THE COOLING CANALS

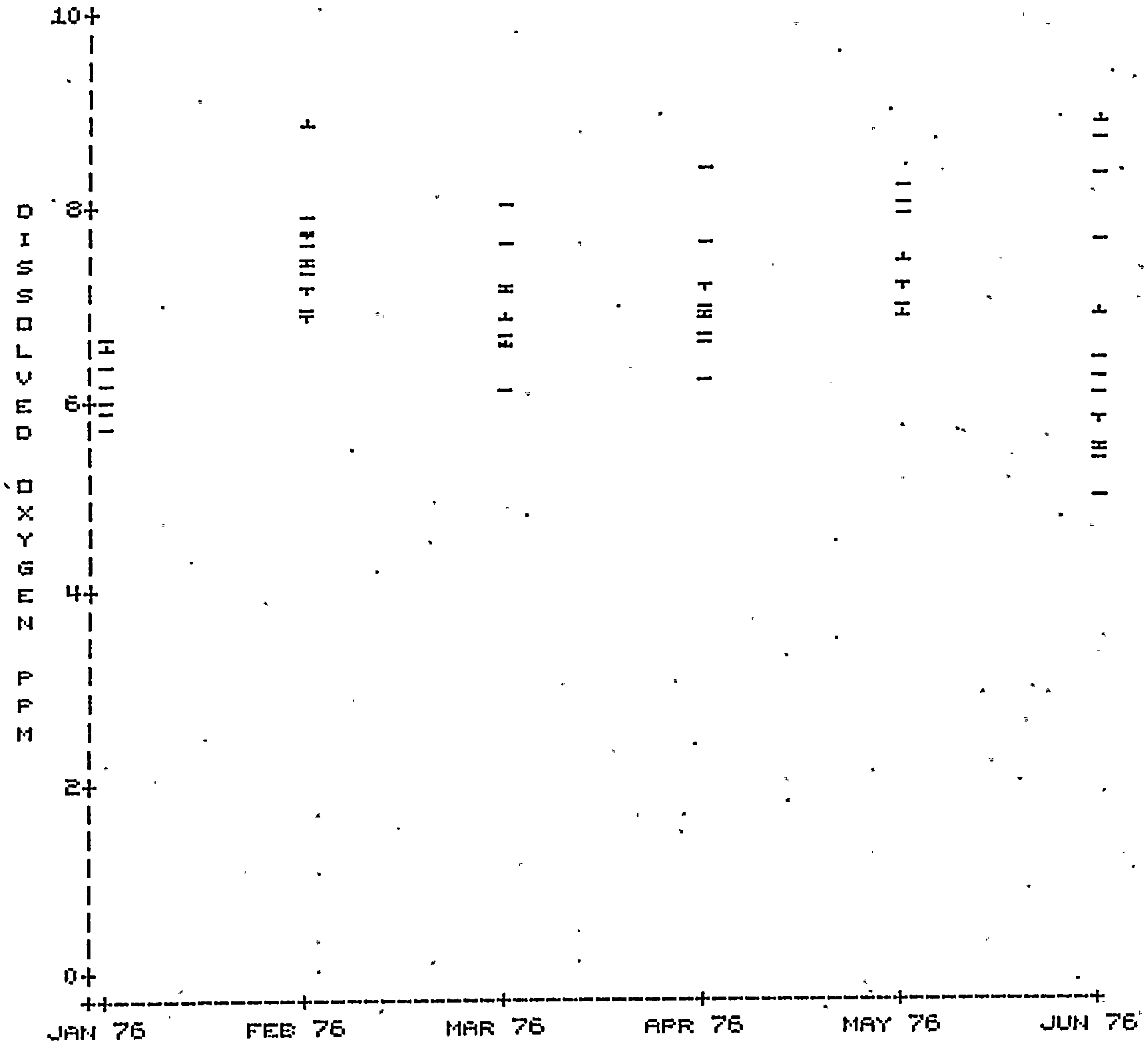




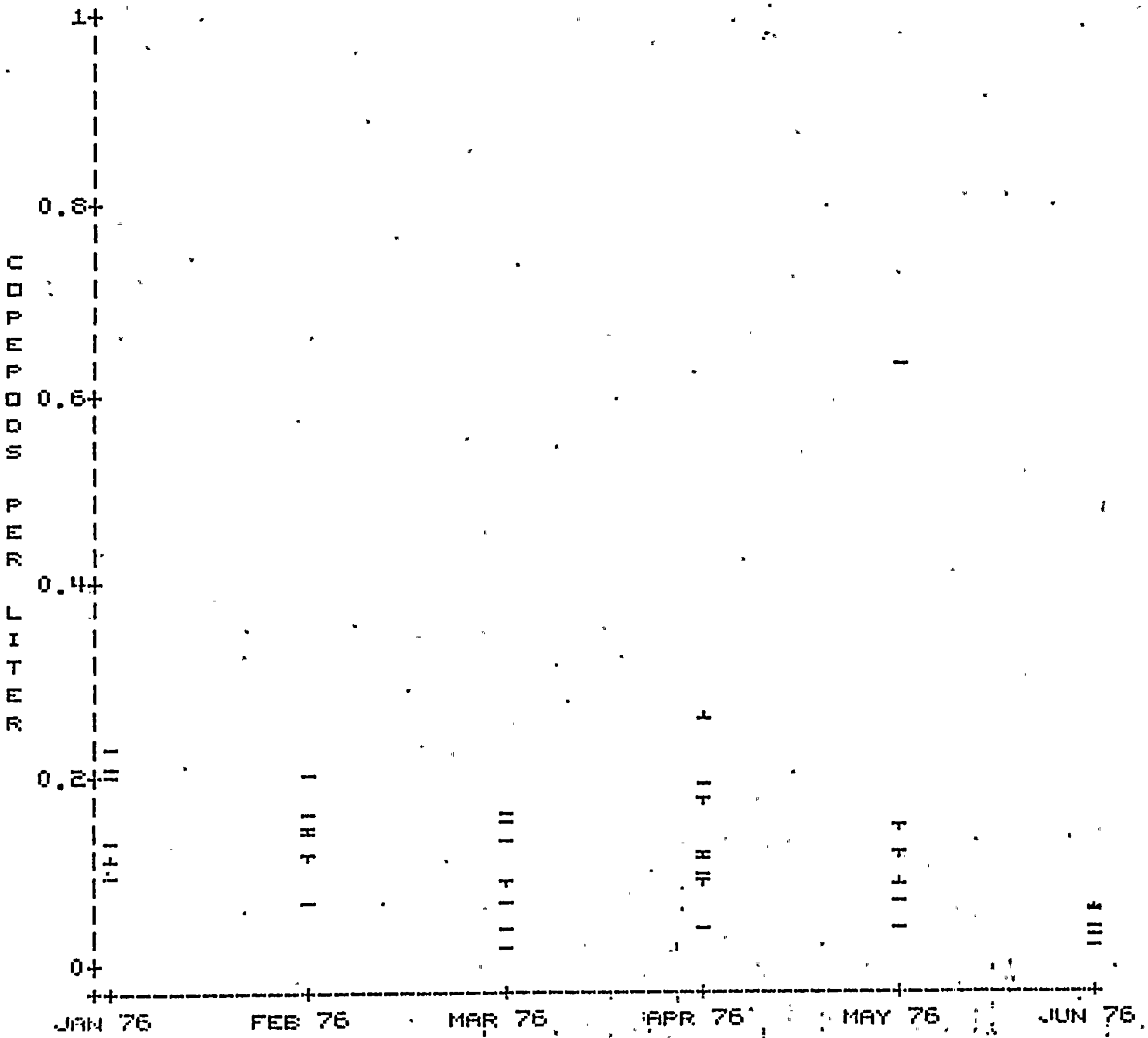
SALINITY AT ALL SAMPLING POINTS IN THE BAY AND CARD SOUND
SALINITY PPT
50
40
30
20
10
0
JAN 76
FEB 76
MAR 76
APR 76
MAY 76
JUN 76

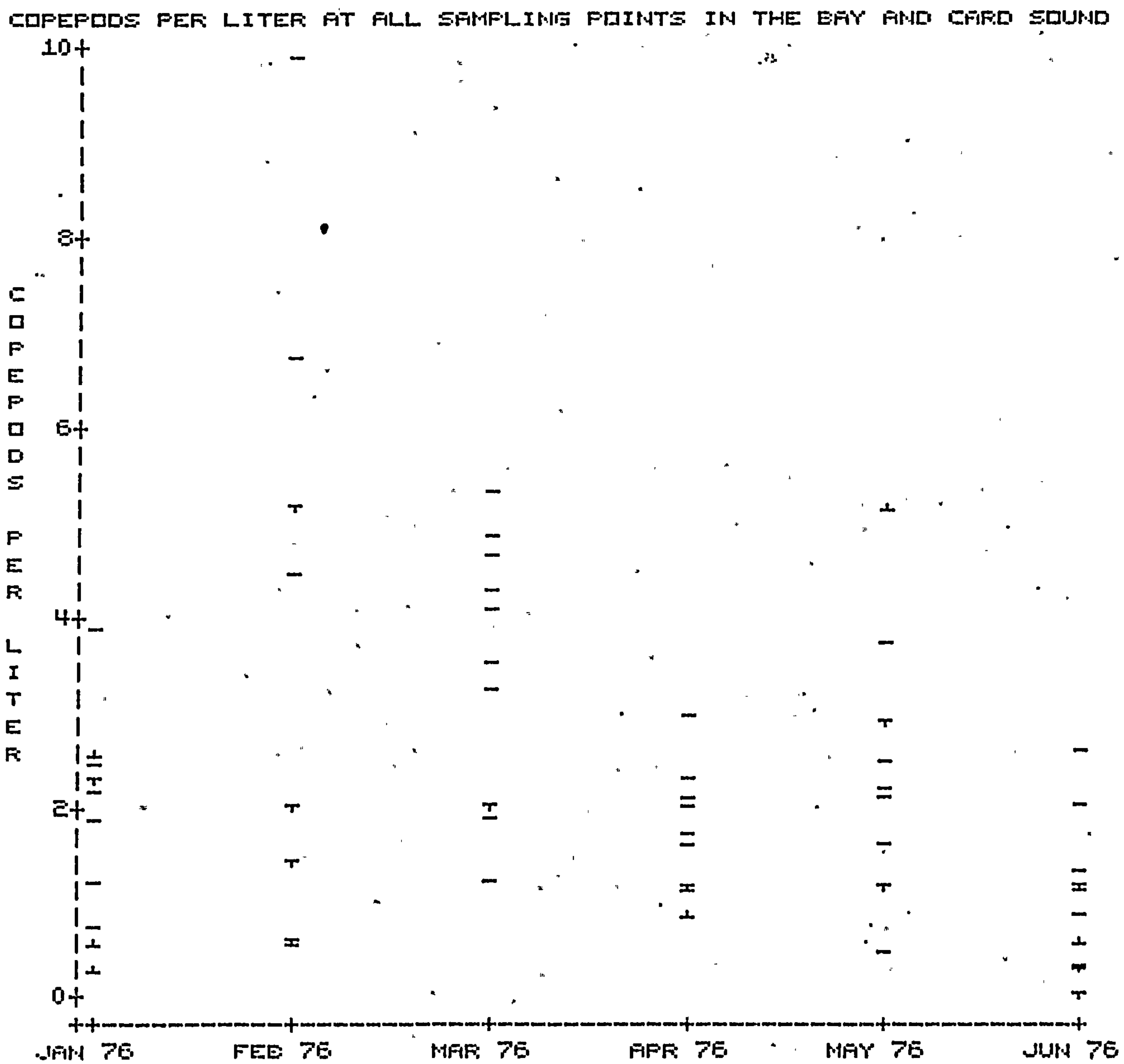

DISSOLVED OXYGEN AT ALL PLANKTON SAMPLING POINTS WITHIN THE COOLING CANALS
DISSOLVED OXYGEN PPM
10
8
6
4
2
0
JAN 76
FEB 76
MAR 76
APR 76
MAY 76
JUN 76

DISSOLVED OXYGEN AT ALL SAMPLING POINTS IN THE BAY AND CARD SOUND

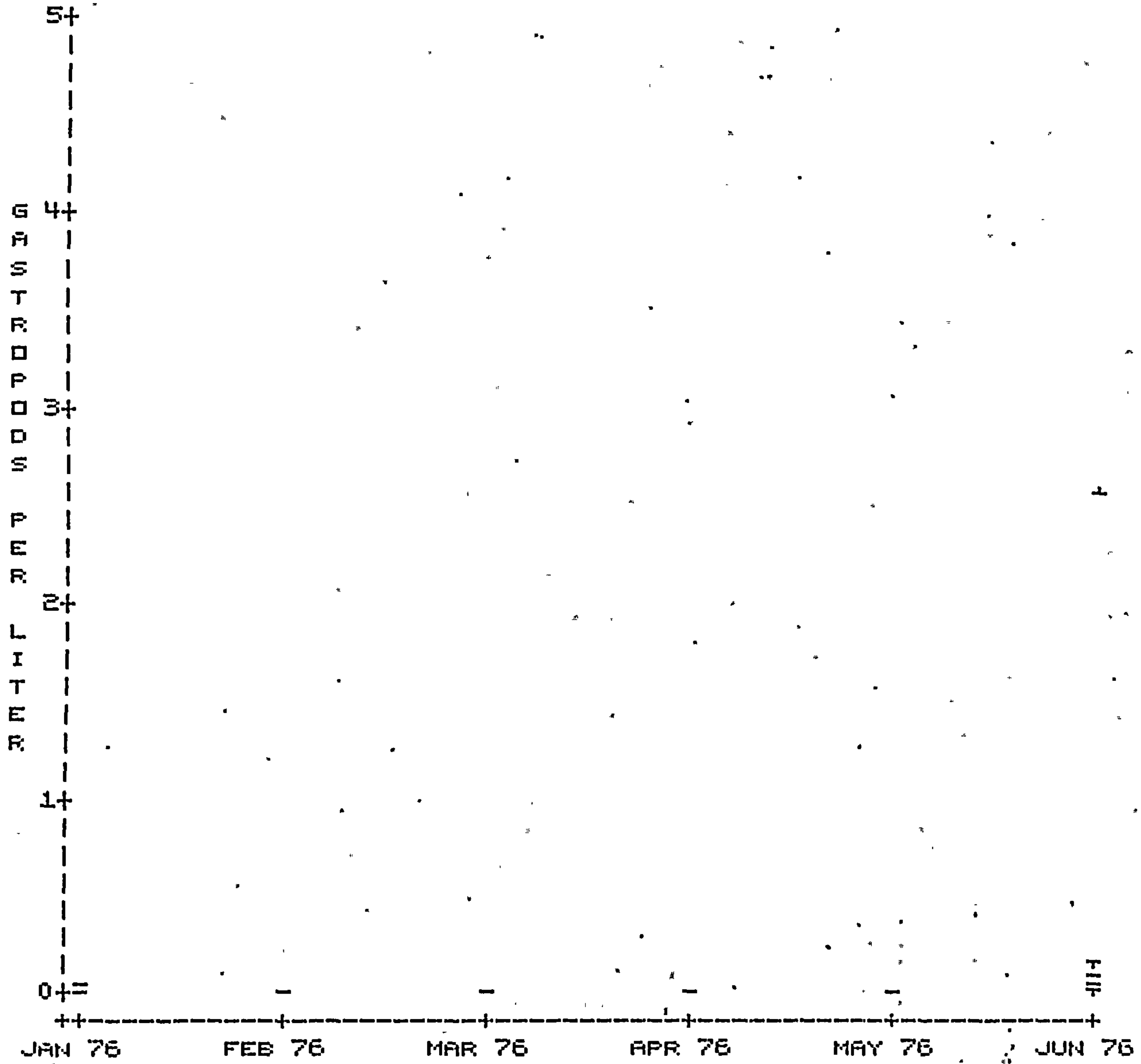


COPEPODS PER LITER AT ALL PLANKTON SAMPLING POINTS WITHIN THE COOLING CANALS

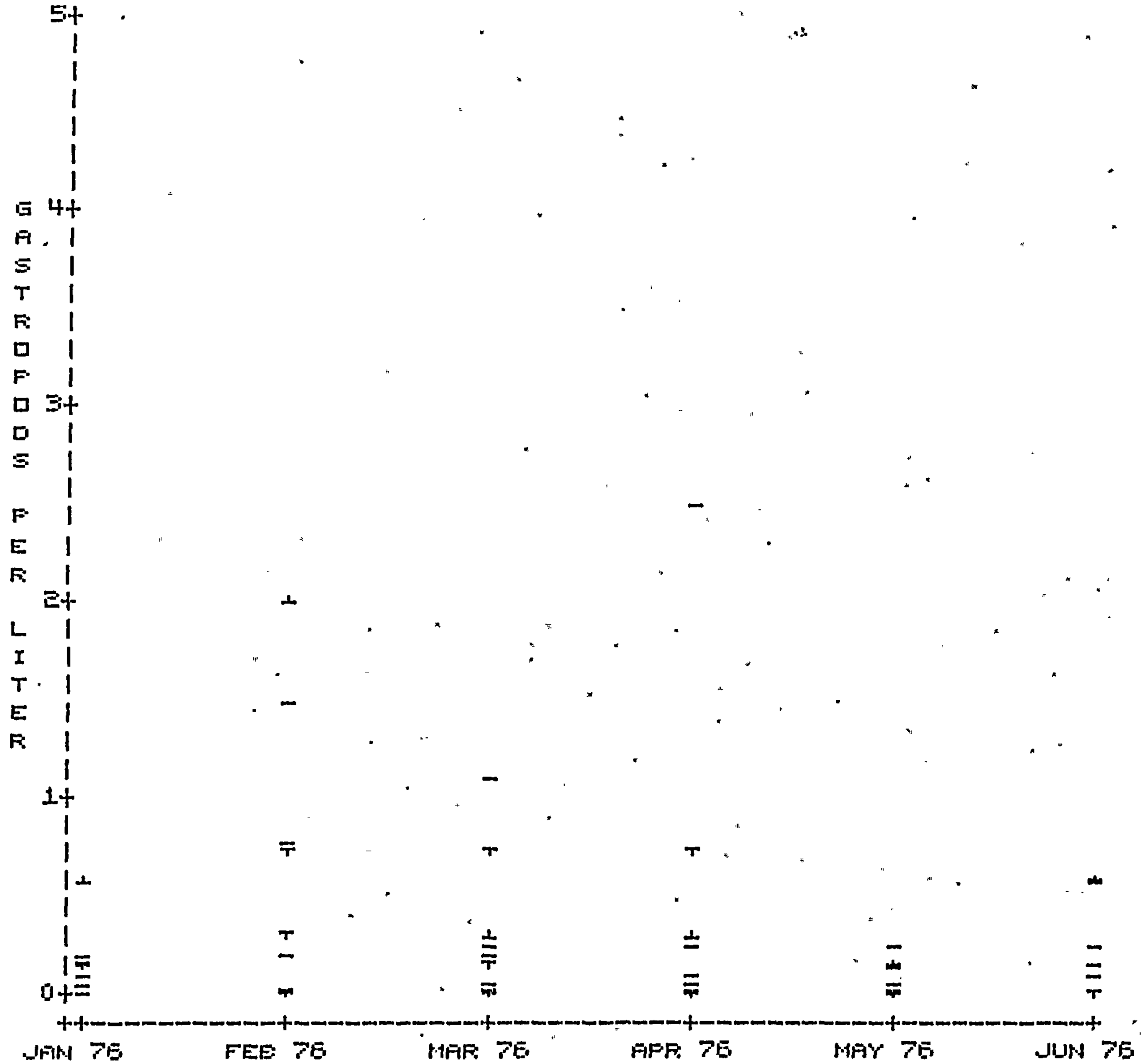


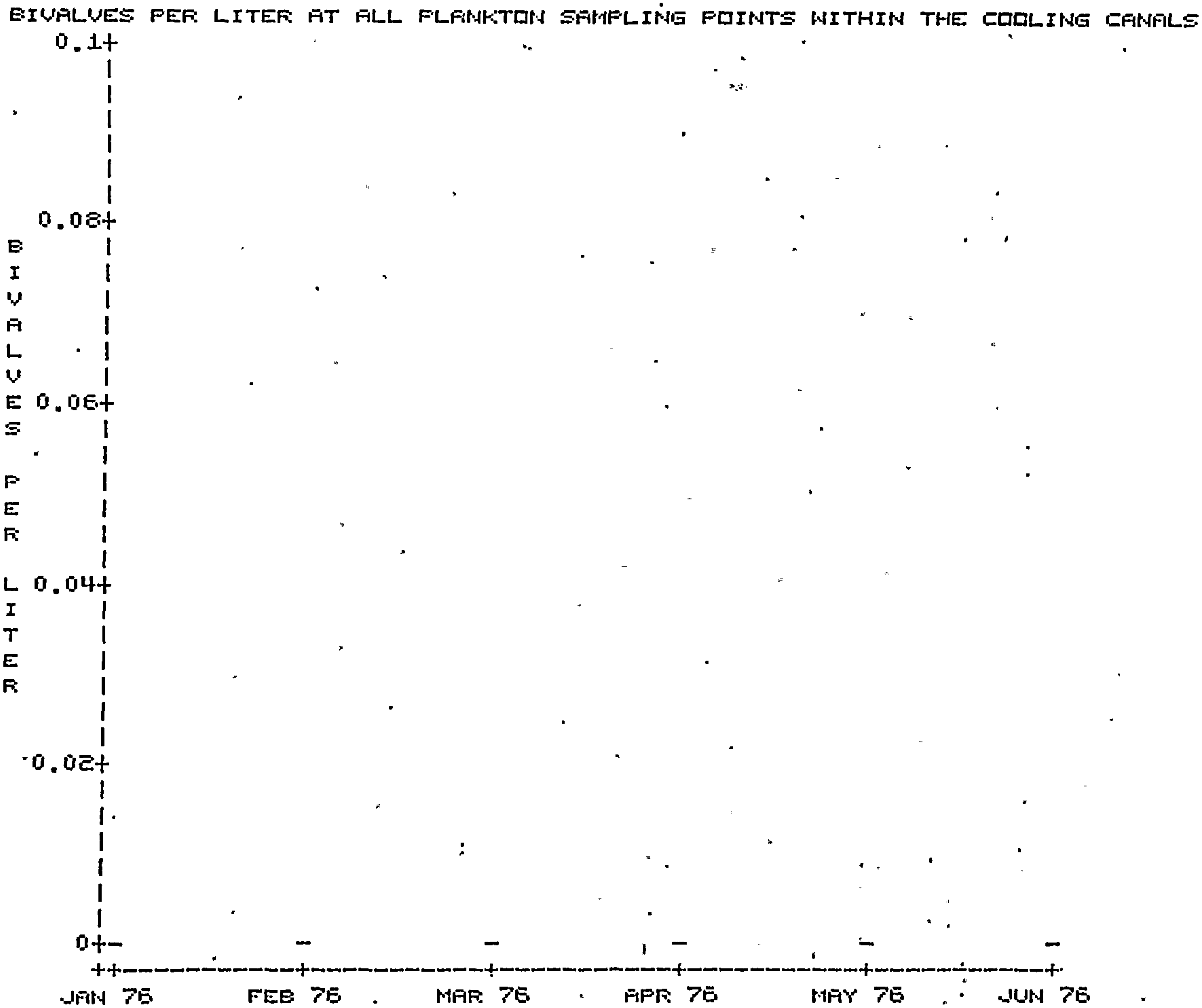

COPEPODS PER LITER AT ALL SAMPLING POINTS IN THE BAY AND CARD SOUND
COPEPODS PER LITER
10
8
6
4
2
0
JAN 76
FEB 76
MAR 76
APR 76
MAY 76
JUN 76

GASTROPODS PER LITER AT ALL PLANKTON SAMPLING POINTS WITHIN THE COOLING CANALS



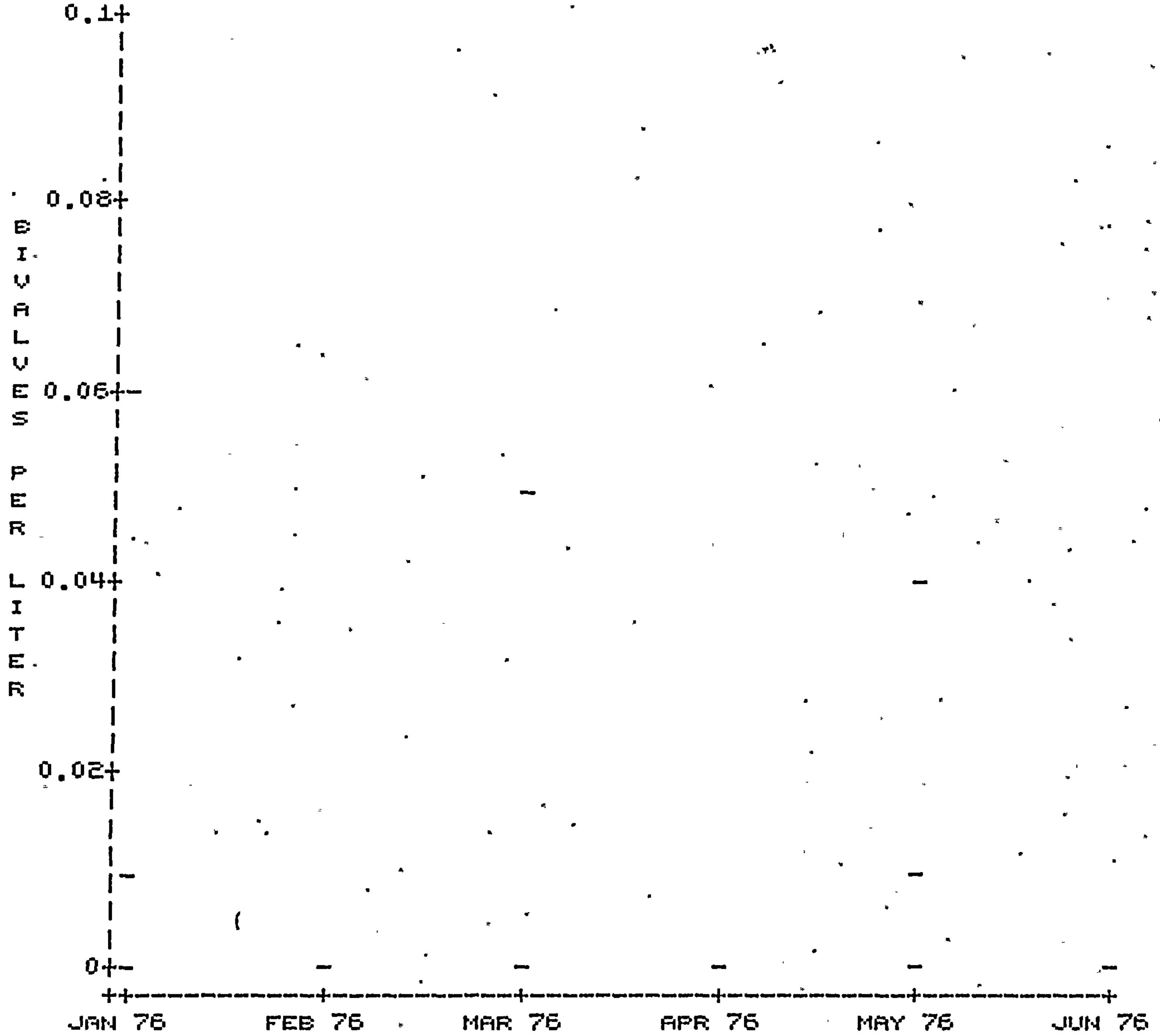
GASTROPODS PER LITER AT ALL SAMPLING POINTS IN THE BAY AND CARD SOUND

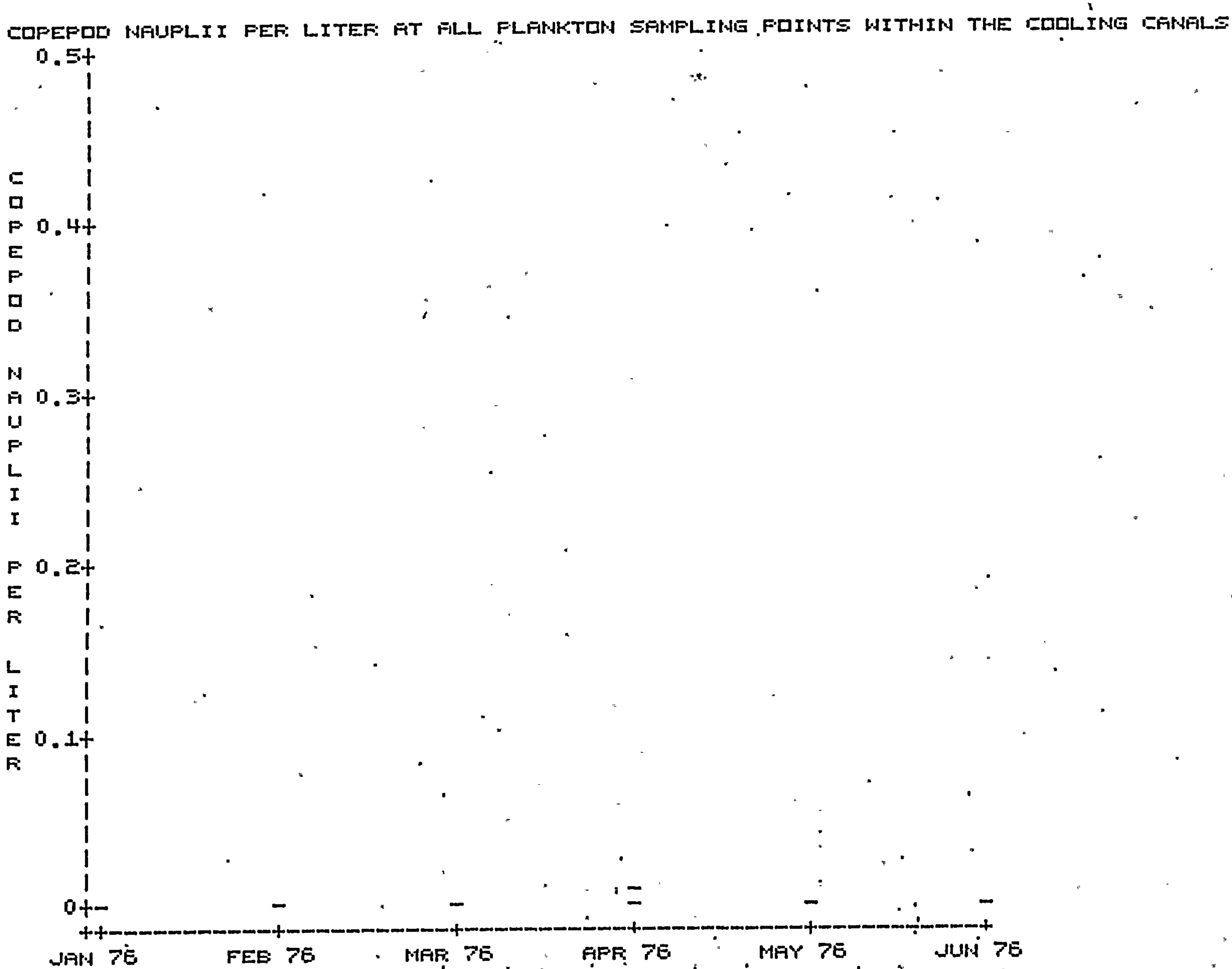




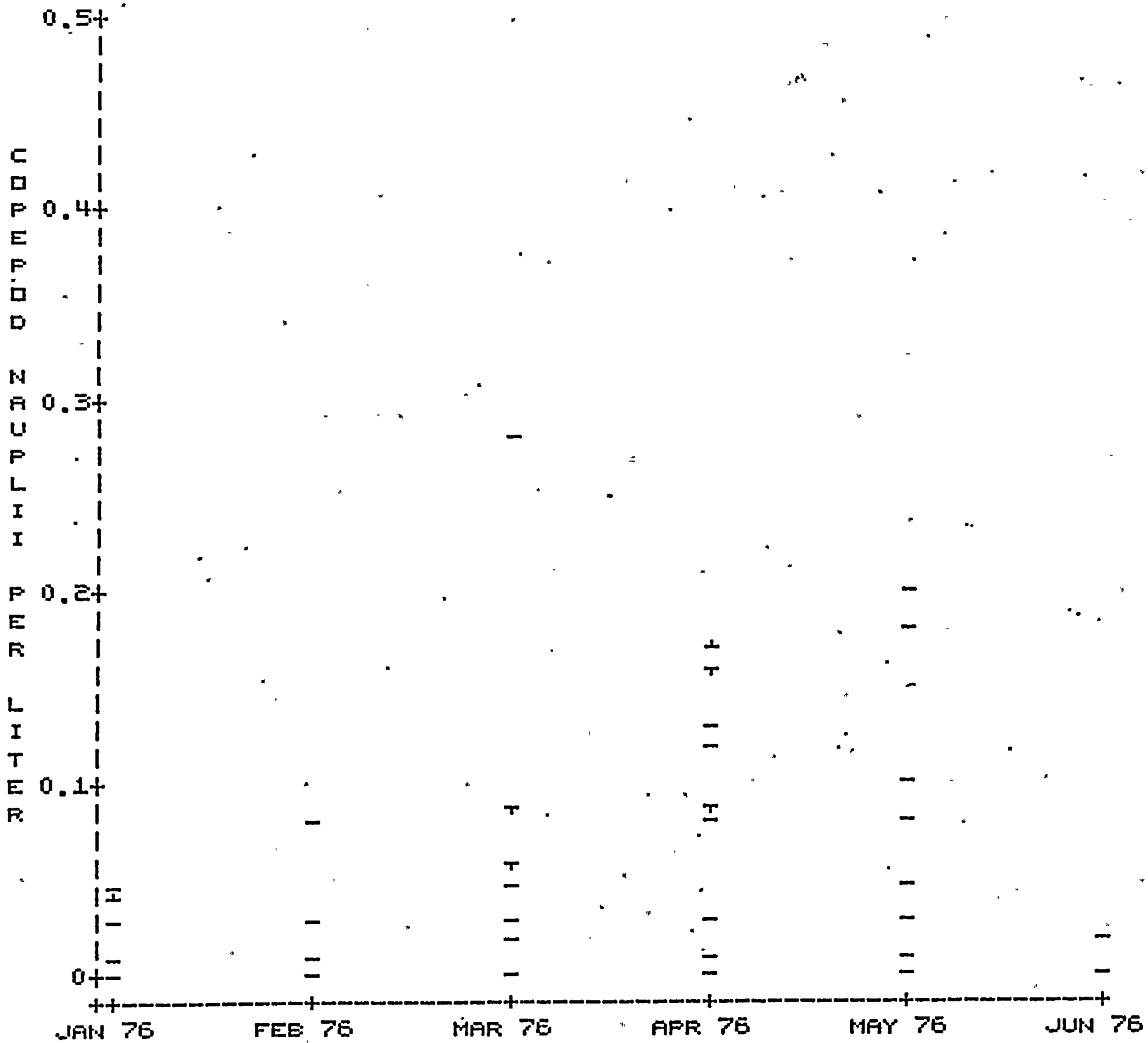
BIVALVES PER LITER AT ALL PLANKTON SAMPLING POINTS WITHIN THE COOLING CANALS
0.1
0.08
0.06
0.04
0.02
0
BIVALVES PER LITER
JAN 76
FEB 76
MAR 76
APR 76
MAY 76
JUN 76

BIVALVES PER LITER AT ALL SAMPLING POINTS IN THE BAY AND CARD SOUND

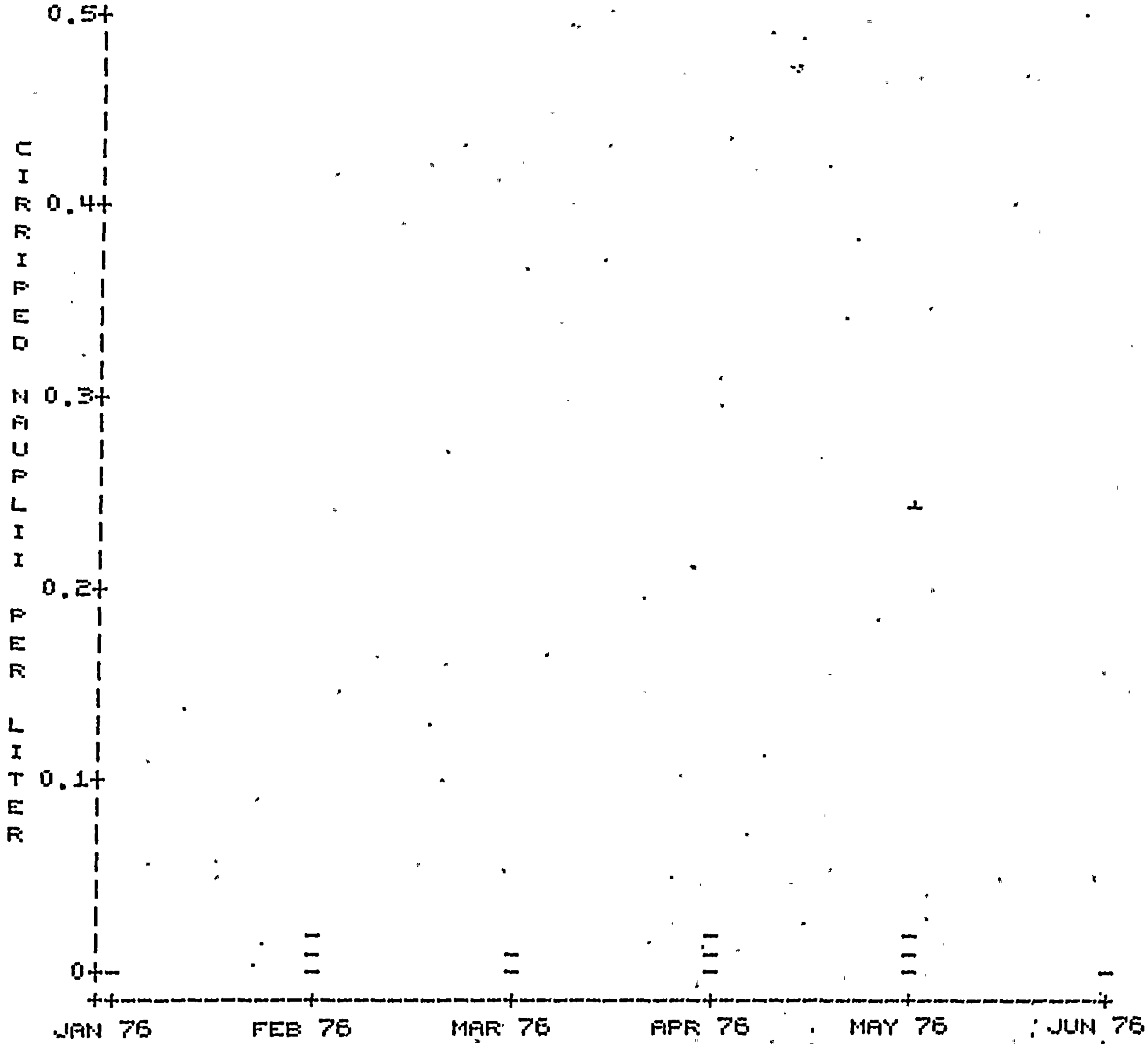



COPEPOD NAUPLII PER LITER AT ALL PLANKTON SAMPLING POINTS WITHIN THE COOLING CANALS
COPEPOD NAUPLII PER LITER
0.5
0.4
0.3
0.2
0.1
0
JAN 76
FEB 76
MAR 76
APR 76
MAY 76
JUN 76

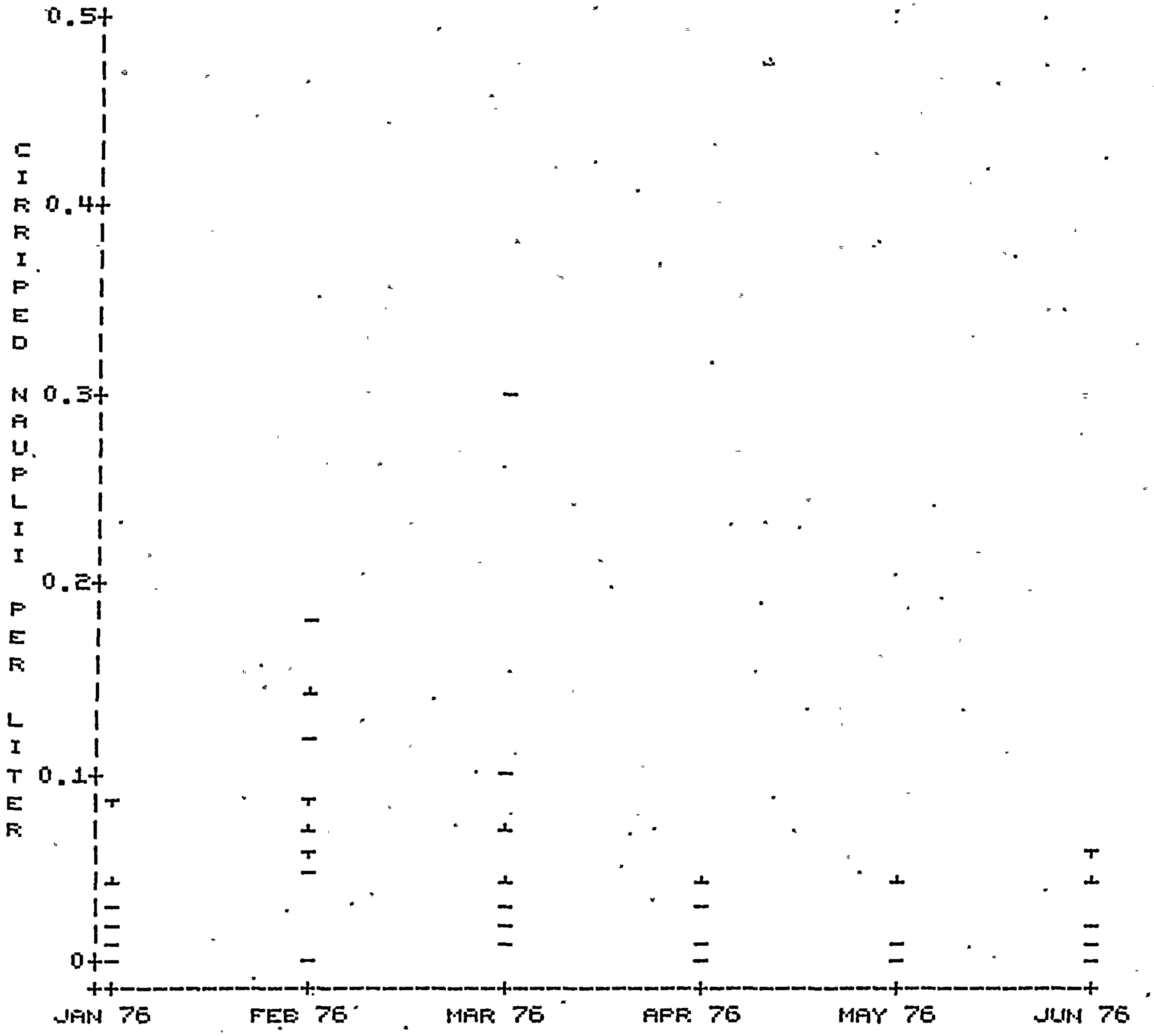
COPEPOD NAUPLII PER LITER AT ALL SAMPLING POINTS IN THE BAY AND CARD SOUND



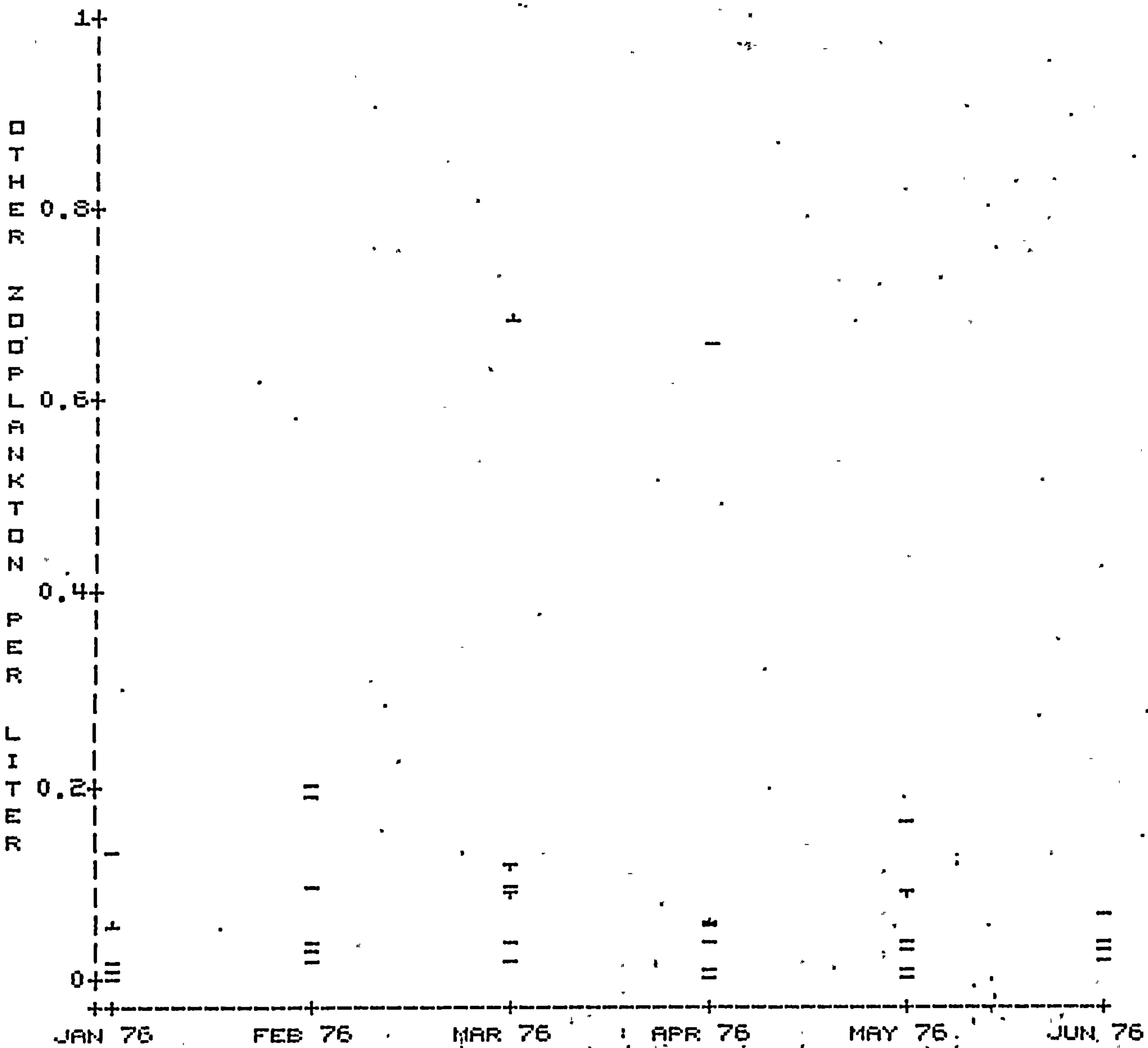
CIRRIPED NAUPLII PER LITER AT ALL PLANKTON SAMPLING POINTS WITHIN THE COOLING CANALS



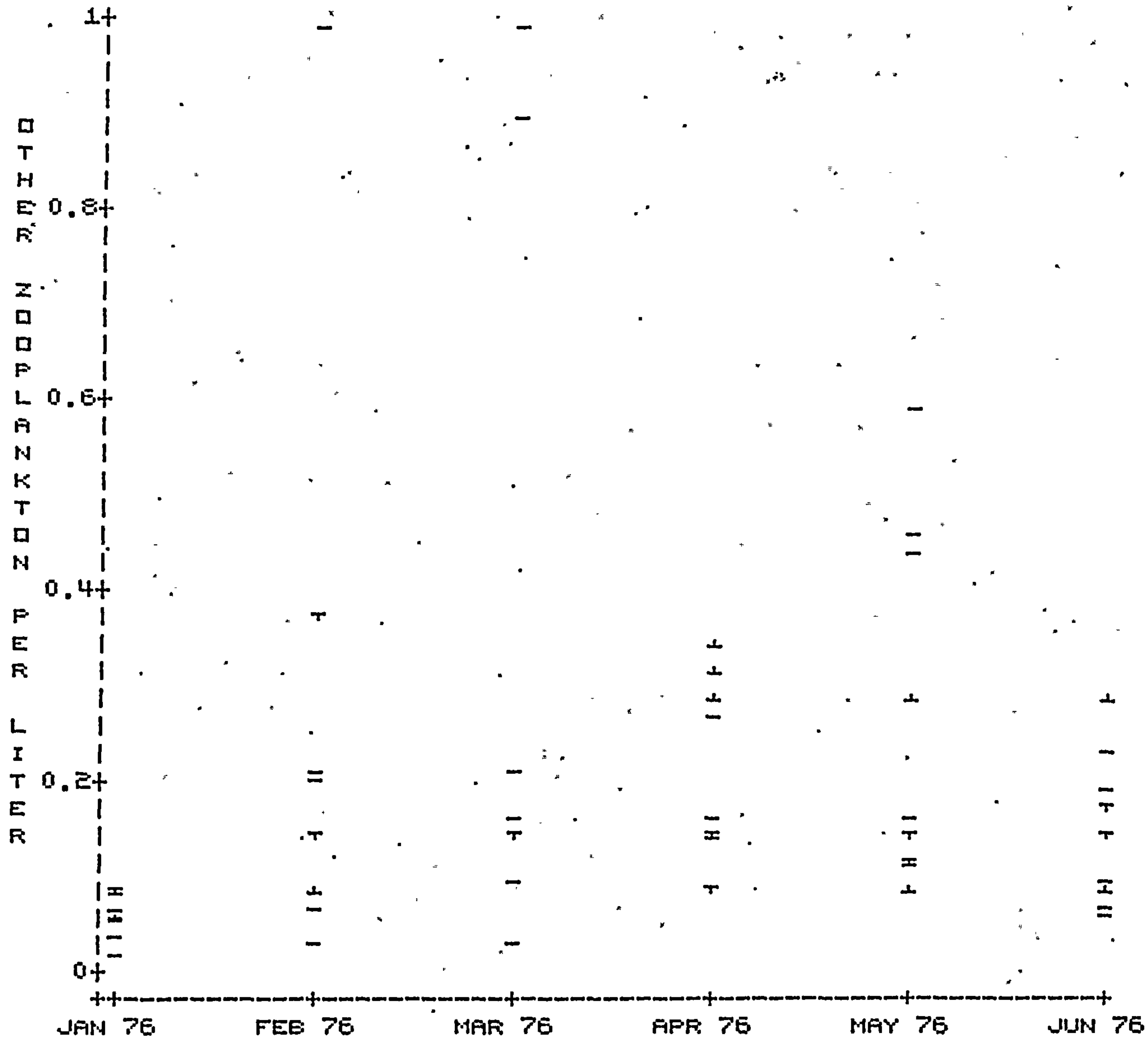
CIRRIPED NAUPLII PER LITER AT ALL SAMPLING POINTS IN THE BAY AND CARD SOUND

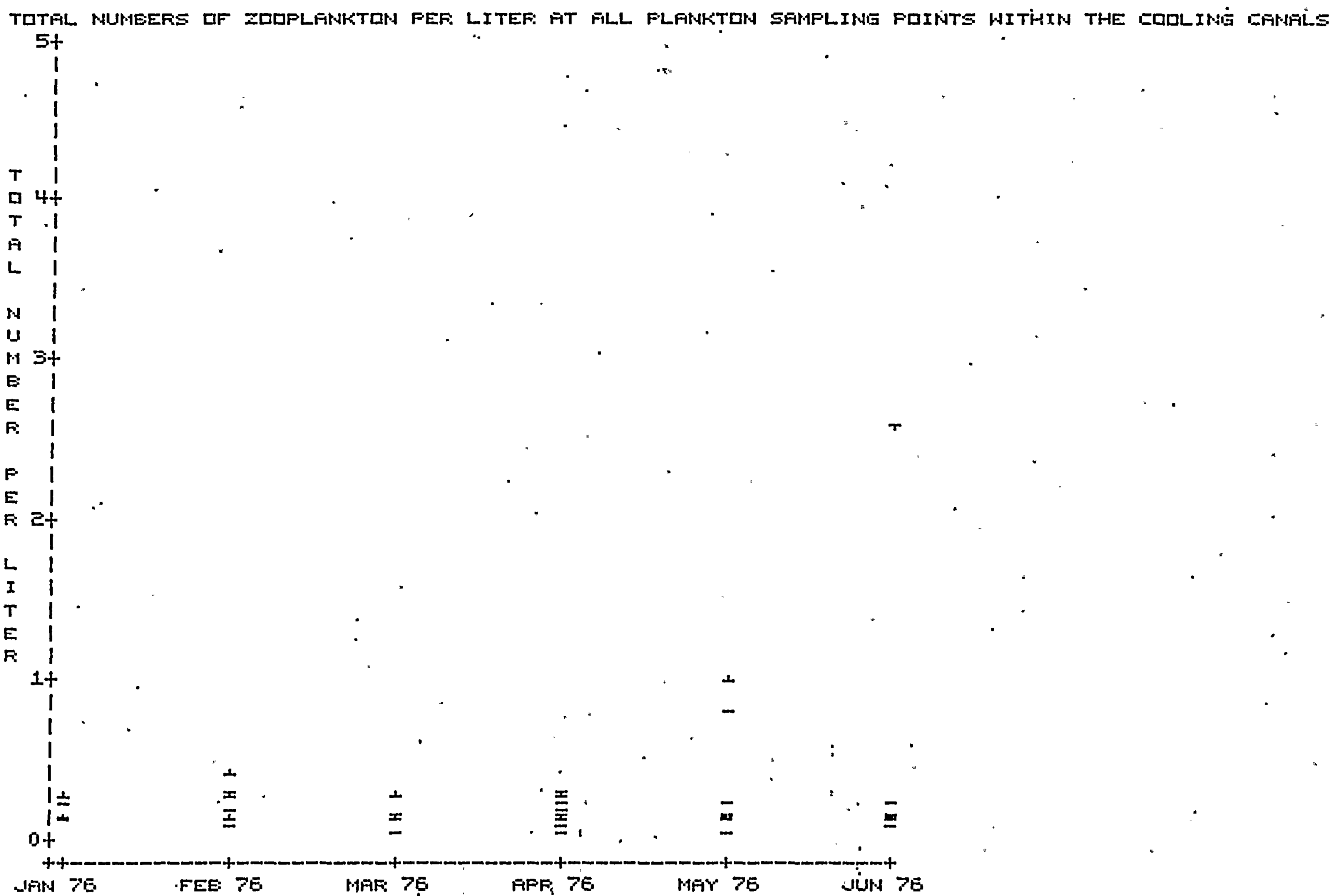


OTHER ZOOPLANKTON PER LITER AT ALL PLANKTON SAMPLING POINTS WITHIN THE COOLING CANALS

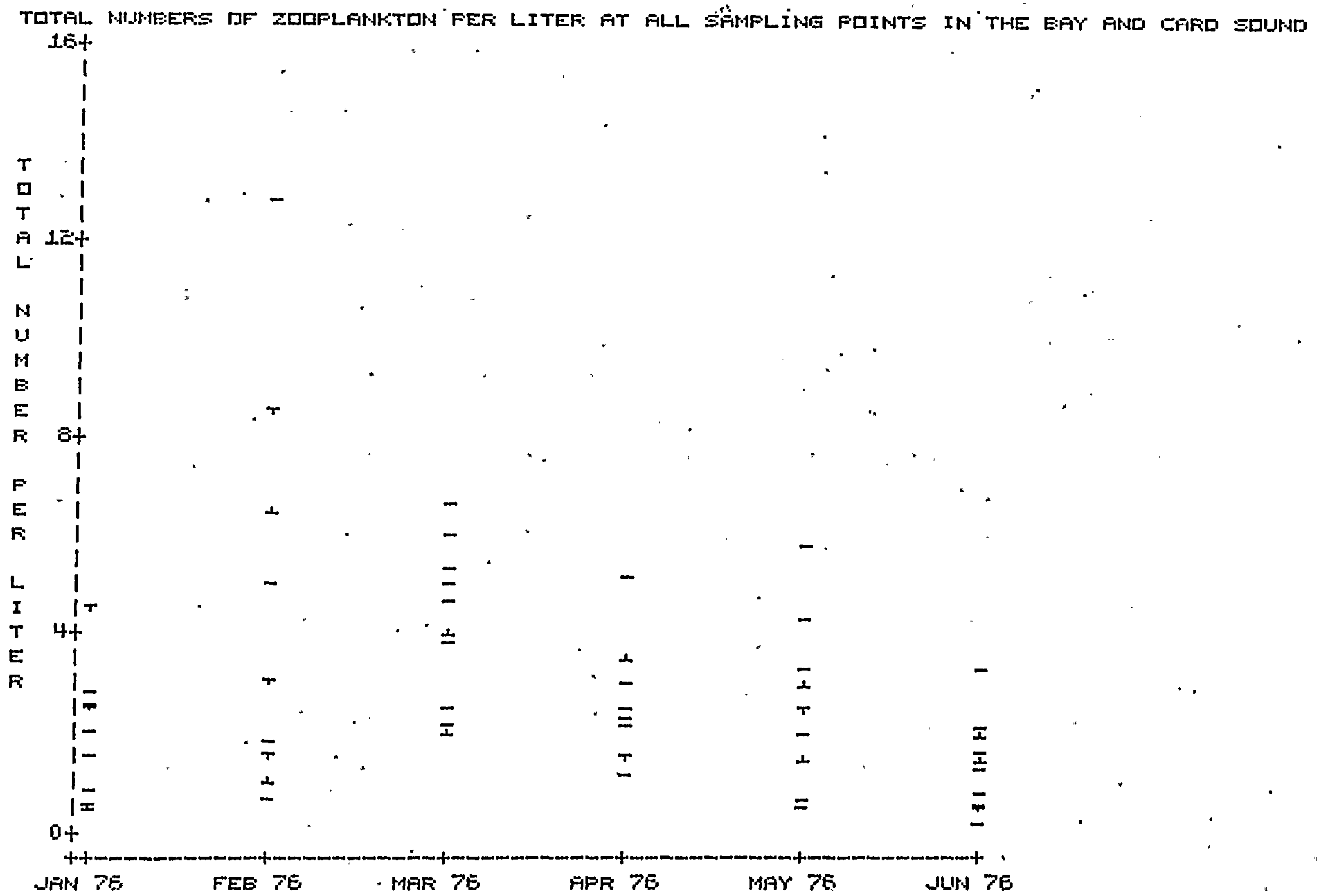


OTHER ZOOPLANKTON PER LITER AT ALL SAMPLING POINTS IN THE BAY AND CARD SOUND




TOTAL NUMBERS OF ZOOPLANKTON PER LITER AT ALL PLANKTON SAMPLING POINTS WITHIN THE COOLING CANALS
TOTAL NUMBER PER LITER
5
4
3
2
1
0
JAN 76
FEB 76
MAR 76
APR 76
MAY 76
JUN 76

-94-



TOTAL NUMBERS OF ZOOPLANKTON PER LITER AT ALL SAMPLING POINTS IN THE BAY AND CARD SOUND
TOTAL NUMBER PER LITER
16
12
8
4
0
JAN 76
FEB 76
MAR 76
APR 76
MAY 76
JUN 76

III.F PLANKTON

Report on the Genera and Species of Algae and protozoa in the Turkey Point Cooling Water Canals and Adjacent Biscayne Bay Waters, January to June, 1976.

Introduction

The present report shows the number of times an organism occurred in the canals, and in adjacent Bay waters. Quantitative numbers are not given here, but the data are on file, if requested. All samples were preserved with Lugols solution when taken. Three groups of microorganisms are not shown in this report - small zooflagellates, small blue greens such as Coccochloris and minute green cells. With any debris at all, the error in counting such small forms is too great.

It is felt that the number of occurrences of a species is more important, in showing whether or not it is endemic, than in numbers per liter. In these six months no blooms of 500 or more per ml were noted, and in fact most of the species present were so few, that numbers per liter were counted.

Groups Present

Sulfur Bacteria.

Table 1 shows five species of Beggiatoa - - - five occurrences in Bay samples, 25 in canal samples. Generally it would seem the Canals are a better environment. But the best way to sample for these bacteria is to take cores, and examine the sediment-water interface. Under such a program, coring the Bay in a sandy area, would yield very few Beggiatoa, while silted areas would be more fruitful. As pointed out in Report III these are not normally plankton, but crawl in the cellulosic debris of the canals and successful coring or other bottom sampling should yield high populations. Such large numbers are of little importance, but do tend to minimize H_2S production. They are not important in the food chain.

Blue Green algae.

Only 17 species of these are recorded in January - June, 1976. Coccochloris was purposely omitted, despite its known, but uncountable presence. In addition, Anabaena microscopiea recorded as A. minuta in IV; Arthrospira sp.' Borzia tricularis; Lyngbya majuscula; Nodularia spumigena and Pleurocapsa sp. were not noted. Both the number and kinds of species have fluctuated to only a limited extent in the past reports so it may be concluded that whatever environmental factors favor the species of blue green algae, have become stabilized, at least for occurrence. None of those identified occurred in abundance. Few are plankton forms, although Gomphosphaeria aponina can be so termed. It occurred frequently in the Bay, was almost lacking in the canals, and while frequently present, was never abundant.

Blue greens were about twice as frequent - - 107 occurrences vs. 61 - - in the Bay as in the canals. Since numbers per liter were always low, it must be assumed that conditions favor only limited growth. This is despite the fact that mats of Oscillatoria and Lyngbya have been observed on rocks and debris in the canals, and on macroscopic plants, in the Bay. All of the 18 species shown are common, except the very small filamentous form given the name Anabaena minuta (microscopica) which has been a species for previous comment. None seem to have any particular indicator value here.

Volvocida.

In estaurine situations Volvocida are sometimes numerous, and may be represented by a number of genera which are determined by the salinity is high in both Bay and Canals, and is probably the governing factor keeping their numbers very low. Pyramidomonas grossi sp. was the only one found in the Bay, occurring 8 times, and twice in the canals. In July - December, 1974, it occurred 14 times, but in July - December, 1975, only 4 times. With a scarcity of rainfall, there has probably been a continuing scarcity of available nitrogen. Volvocida are not important in the ecological picture for these two situations except by their absence.

Euglenida.

These also were few in number, and have consistently been in 1974 and 1975. Eutreptia and Eutreptiella are typically salt water species, and there are about five species of Euglena common to salt water. These are primarily plankton species, and in large numbers, they indicate recent organic pollution. No such numbers were found in January - June, 1976, and in fact comments on the excellent quality of South Biscayne Bay have been heard. So, blooms of green Euglenida have not been expected, nor have they been noted. Nineteen occurrences in the canals against 3 in the Bay is hardly significant beyond the presence of some, probably soluble, organic matter. However, non-plankton euglenids, which are colorless, saprophytic are abundant in the bottom interface. A few, Astasia sp. for example, often show up in plankton. They probably came from debris or litter from macroscopic plants, carried into suspension.

Euglinids cannot be said to have indicator value, in the Turkey Point area.

Cryptomonadida.

This is another group which is frequently abundant in estuaries. In past reports it has shown only a very few species in this area. The same is true for January - June, 1976. Generally cryptomonads, if abundant, are indicative of good quality water. Their small numbers here, both as to species present and low population, indicate restrictive, but presently unidentified, factors.

Dinoflagellida.

This group, while well represented in fresh water, is most abundant in salt water. Many species, especially gymnodinia, are typically inshore species. Since all modes of nutrition are present in dinoflagellates it follows that inorganic substrates, dissolved organic matter and particulate matter all favor their presence. Either the canals lack enough of this nutrient material, or else other restrictive factors are present, for both species and frequency of occurrence are most abundant in the Bay.

	Bay	Canals
Species present	33.	25
Number of occurrences	616	326

Three species, Exuviaella marina, Gymnodinium sp. (large), and Peridinium trochoideum, occurred more frequently in the canals.

Since dinoflagellates at times bloom at high temperatures or at much lower ones, it is not considered that the higher canal temperatures were effective here. A species of economic importance which has bloomed repeatedly in the Gulf and in 1974 invaded Atlantic coastal waters in sufficient abundance to cause a fish kill, Gymnodinium breve, was not recorded at Turkey Point. Of course, one sampling per month may have missed it.

Four species (Table 1) which were noted in the canals but not in the Bay are hardly significant. Various other species which favored the Bay were noted:

Occurrences in	Bay	Canals
Ceratium furca	14	0
Ceratium fusus	39	4
Gyrodinium pingue	25	3
Peridinopsis rotunda	13	0
Peridinium divergens	13	1
Prorocentrum micans	49	4
Prorocератium recticulatum	19	1
Proroceratium triangulatum	10	2
Pyrodinium bahamience	25	0

Presumably these species were originally present in the Canals when closed off, so some adverse factor eliminated them. Other species, less numerous in occurrence (Table 1) can be cited, but those of frequent occurrence, are believed significant.

All together dinoflagellates show rather sharply that there is a difference between Bay and Canal water. Temperature is the major

one, and turbidity may be another factor. A third may be turbulence in passage thru the condenser, and a fourth may be gradual diminution of nutrients in recirculation of the water mass. None of these can be surely identified at present.

Diatoms.

Forty-eight species 32 genera of diatoms are recorded in Table 1. Only four - - Chaetoceras sp., Cyclotella spp., Milosira monlilata and Nitzschia closterium are regarded as primarily planctonic. Forms such as Rhizosolenia and Chactoceras spp. simply are missing from these waters during this study. Again there is no answer as to why the planctonic species are largely absent except those advanced for dinoflagellates above.

The remaining forty-four kinds of diatoms for the most part slide about on a solid substrate and some can float. So, not being anchored, they may be swept into suspension by the circulation current, and probably present an accurate picture of kinds and frequency of occurrence. The study indicates that both Bay and Canals are rich in their diatom flora, distributed as follows:

	Bay	Canals
Species found	44	32
Species occurrence	572	352
Total diatom species or genera	47	

First inspection indicates the Bay is richer in diatoms. However counts per liter indicate the two areas are close in total numbers, but the canals have large numbers of very small naviculoid diatoms, while the larger species are primarily Bay species. Amphiprora, Cyclotella, Cymatopleura and Gyrosigma are dominant in occurrence in the Canals; Cocconeis, Cosinodiscus, Mastogloia and Tropidoneis dominate in the Bay. Navicula occurred in all but one sample in the Canals and in all but 7 in the Bay. But the numbers of naviculoid diatoms were very large, compared to other species.

Evidently conditions are suitable for large diatom populations in both canals and the Bay. Since they are autotrophic, nutrients and silicon are probably in ample supply.

It is probable that a much larger number of diatom species could be included in Table 1, if all were identified. An inordinate amount of time would be required,. which is not believed necessary because of similar physiology.

Rhizopodea.

This group was practically lacking in the plankton of both Bay and canals. In all studies of the area to date Rhizopodea have been important only in sediment-water interface material.

Zoomastigophorea.

This group is almost lacking. Only Phanerobia pelophila has shown a tendency to recur in sampling over the last two years. It seems probable that the genera Monas, Oicomonas, Bodo and some other kinds of small zooflagellates occur in numbers, but cannot be counted because of debris, and because they preserve poorly.

Ciliophorea.

Thirty-one genera or species were recorded in the six months' samples..
Distribution was as follows:

Species in	Bay	27	Canals	12
Number occurrences in		253		67

Three species: Cyclidium sp., Dysteria (aculeata?) and Euplotes (bisulcatus?) were peculiar to the canals, but 19 were dound only in the Bay. These figures, and the occurrence record, indicate that the canals are not nearly as suitable for ciliates as in the Bay.

The ciliates are primarily feeders on bacteria. The canals may be either low in bacterial numbers, or perhaps variety of bacteria is

limited. Presumably this is the case, since the Canal organic matter is largely derived from mangrove debris. Such an origin would tend to produce a paucity of species, and probably a lowered population. The Bay, in contrast, is only swept by tidal circulation, has a variety of sources of nutrients. It seems likely that nutrients are the determinants in the ciliate number and distribution.

It should be pointed out however, that all the Bay species are planctonic, and most are known from the high seas. Species of Metacylis are distinctly offshore forms, and while many of the other species are inshore forms, they are planctonic.

Missing groups.
Green algae were completely absent. So were Chrysophysida, Coccolithophora and many scattered species known from the high seas. No particular importance is attached to these missing ones.

Discussion

The species list for the Bay has fluctuated to some extent during two years. Numbers of individuals have dropped from a per ml count, to a per liter count, but this is in an area, where the human element has gradually declined because of a drop in construction. There have also been modifications in drainage into the Bay and Sound. None the less, the Bay population remains abundant and varied and shows no sign of severe stress, or even moderate stress. Its dominant forms are dinoflagellates, diatoms and ciliates.

The canals do show signs of stress. Most of the dinoflagellates and ciliates are gone, and the variety of diatoms have declined, although to what extent is difficult to say because of lack of identification of naviculoid, or at least pennate species.

However, in point of population density, the canals present a favorable climate. Numbers, believed derived from bottom species are high.

Blue green algae, and smaller groups give little indication for their population levels.

The two areas support good biotas, but the canals show a gradually declining variety, and except for diatoms, a gradually declining density.

Table 1.

Genera and species of algae and protozoa, and the number of occurrences in the Bay and Canals at Turkey Point, January - June, 1976.

	Bay	Canals
Sulfur Bacteria		
Beggiatoa alba	1	10
Beggiatoa arachnoidea	2	5
Beggiatoa gigantea	1	5
Beggiatoa minima	1	
Beggiatoa mirabilis		5
Blue green Algae		
Anabaena minuta	2	2
Aphanocapsa sp.	2	
Chroococus gigantea		2
Chroococus plactonica	9	3
Chroococus turgidus	2	8
Gomphosphaeria aponina	35	
Johannesbaptistia pellucida	28	3
Lyngbya aestuarii		1
Lyngbya sp.	2	6
Merismopedia glauca	3	1
Merismopedia punctata	7	3
Microcystis aeruginosa	3	
Oscillatoria tenuis	1	
Oscillatoria sp.	3	19
Schizothrix calcicola	1	11
Spirulina minor	2	1
Trichodesmium sp.	5	1
Unid.	2	
Volvocida		
Carteria sp.		1
Chlamydomonas sp.		1
Pryamidomonas grossi	8	2
Euglenida		
Astasia sp.	8	

Euglenida (Continued)	Bay	Canals
Eutreptia sp.	3	15
Eutreptiella sp.		4
Unid. colorless euglenids	3	12
Cryptomonadida		
Chilomonas marina	7	
Rhodomonas sp.	12	21
Hillea sp.	1	
Silicoflagellida		
Dictyocha fibula	3	
Distephanus speculum	2	
Dinoflagellata		
Amphidinium operculata		2
Amphidinium spp.		3
Ceratium fusus	14	
Ceratium furca	39	4
Ceratium hirca	1	
Dinophysis acuminata	1	
Dinophysis tripos	1	
Diplopsalis lentieularis	13	
Exuviaella apora +	14	3
Exuviaella marina	41	48
Gonyaulax diegensis	2	
Gonyaulaz digitale	1	
Gonyaulax polyedra	1	1
Gonyaulax triacantha	2	
Gonyaulax spp.	3	
Gymnodinium foliaceum	3	
Gymnodinium large	34	35
Gymnodinium small	74	62
Gymnodinium splendens	36	33
Gyrodinium lachryma	2	
Gyrodinium pingue	25	3
Hemidinium sp.		2

+ Possibly a new species other than apora.

Dinoflagellata (Continued)	Bay	Canals
Peridiniopsis rotundata	13	
Peridinium (divergens?)	13	1
Peridinium leonis	1	
Peridinium monacanthus		9
Peridinium obtusum	4	
Peridinium pentagonum	8	1
Peridinium triangulatum	10	2
Peridinium trochoideum	36	43
Peridinium tuba	20	13
Peridinium spp.	56	18
Prorocentrum gracile	5	
Prorocentrum micans	49	4
Protoceratium reticulatum	19	1
Protodinium sp.	1	
Pyrodinium bahamiense	25	
Pyrophacus horologicum	2	
Unid.	58	38
Diatoms - Bacillariophyceae		
Amphora ovalis	34	28
Amphiprora sp.	7	24
Auricula sp.	2	
Caloneis sp.	2	
Campylosira sp.	5	
Cerataulina bergonii	1	
Chaetoceras sp.	6	
Cocconeis sp.	35	11
Coscinodiscus spp.	10	1
Cyclotella spp.	24	55
Cymatopleura solea	29	35
Cymbella sp.	4	3
Diploneis sp.	8	1
Eunotia sp.	3	15
Grammatophora spp.	2	
Gyrosigma augusta	18	13

Diatoms - Bacillariophyceae (Continued)	Bay	Canals
Gyrosigma elongata		2
Gyrosigma sp. large	3	14
Gyrosigma sp. small	4	2
Licmophora abbreviata	12	2
Licmophora campanula ++	27	14
Licmophora curvata ++	1	10
Licmophora longa ++	29	18
Mastogloia sp.	20	
Melosira monilata		1
Navicula ostrea		1
Navicula spp.	71	71
Neidium sp.	1	
Nitzschia acicularis	8	1
Nitzschia closterium	25	32
Nitzschia longa	15	11
Nitzschia paradoxa	1	1
Nitzschia seriata	1	1
Nitzschia sigmoidea	9	1
Pleurosigma nicobarium	10	25
Rhopelodia arcuatum	4	
Striatella unipunctata	10	
Striatella sp. (Rhabdonema arcuatum?)	9	
Surirella robusta	14	25
Surirella spp.	3	
Synedra actinastroides	3	
Tabellaria fenestrata	7	
Thalassionema nitschoides	2	
Thalassiosira sp.	8	28
Thalassiothrix sp.	6	
Tropidoneis lepidoptera	12	
Tropidoneis minor	3	9
Unid. spp.	30	32
Zoomastigophorea		
Bicoeca mediterranea	1	

++ Tentative species name

Zoomastigophorea (Continued)	Bay	Canals
Phanerobia pelophila	5	
Spirochaeta sp.		1
Rhizopodea		
Amoeba arachnula spp.	1	
Amoeba radiosa	1	
Shelled testate rhizopod #1		2
Ciliophorea		
Askenasia volvox	2	
Chilodonella sp.	1	
Codonellopsis sp.	1	
Cyclidium sp.		1
Cyclotrichium menunrei	3	
Dysteria (aculeata?)		2
Euplotes (Bisulcatus?)		1
Favella panaminsis	4	10
Metacylis angulata	28	1
Metacylis jurgensis	18	
Metacylis lucasensis	8	
Metacylis pontica	2	
Salpingella miutissima	1	
Steenstrupiella robusta	3	
Strobilidium spp.	20	15
Strombidium strobilus	18	
Strombidium spp.	53	3
Tintinnopsis beroides	24	9
Tintinnopsis brandti	8	1
Tintinnopsis minuta	14	7
Tintinnopsis platensis	2	
Tintinnopsis prowazeki	6	
Tintinnopsis rotundata	5	
Tintinnopsis tocantinnus	4	
Tintinnopsis spp.	4	
Tintinnus angustatus	6	
Tintinnus pingue	1	

Ciliophorea (Continued)	Bay	Canals
Tintinnus procurrens	9	
Tintinnus tubiformis	1	
Trachelocerca sp.		1
Unid. spp.	17	16

III.G Assessment of Recovery in the Turkey Point Plant Discharge Area

Purpose

This report is to assess revegetation of grasses and benthic macrophyton in areas affected by the Turkey Point power plant discharge. Effects and recovery prior to June, 1976 are given in previous Semiannual Environmental Monitoring Reports.

Methodology

Method 1

To measure the overall revegetation quantitatively, aerial photographs were taken from 2,000 feet. Using reference points in the photographs to determine the scale of the photo, sizes of areas were measured by tracing specific areas onto a grid and determining their relative areas. The tracing is included in this report.

Method 2

Qualitative and quantitative measurements of the algae were made by counting and identifying the vegetation in the six one-meter-square areas permanently located on the bottom.

Method 3

To identify and quantify the less abundant species not represented in the square meter areas, a survey was made by transects across the previously affected area. Species identifications, quantities present and general conditions were noted.

Method 1: Aerial Survey

The entire area is revegetated. The amount of *Syringodium* growth is continuing to increase. The darkened areas shown in Figure 1 show the distinct patches of *Syringodium*.

I have previously discussed possible hypotheses to explain why the *Syringodium* growth is found in the old affected area but not in surrounding unaffected area. The hypothesis that the *Syringodium* is there because of unique characteristics of the sediment remains tenable. See the discussion section.

There are two patches of *Syringodium* within 300 feet of the mouth of the canal. This is new growth and will be commented on later.

GRAND CANAL DISCHARGE AREA

JUNE, 1976

AFFECTED AREA: 0 ACRES

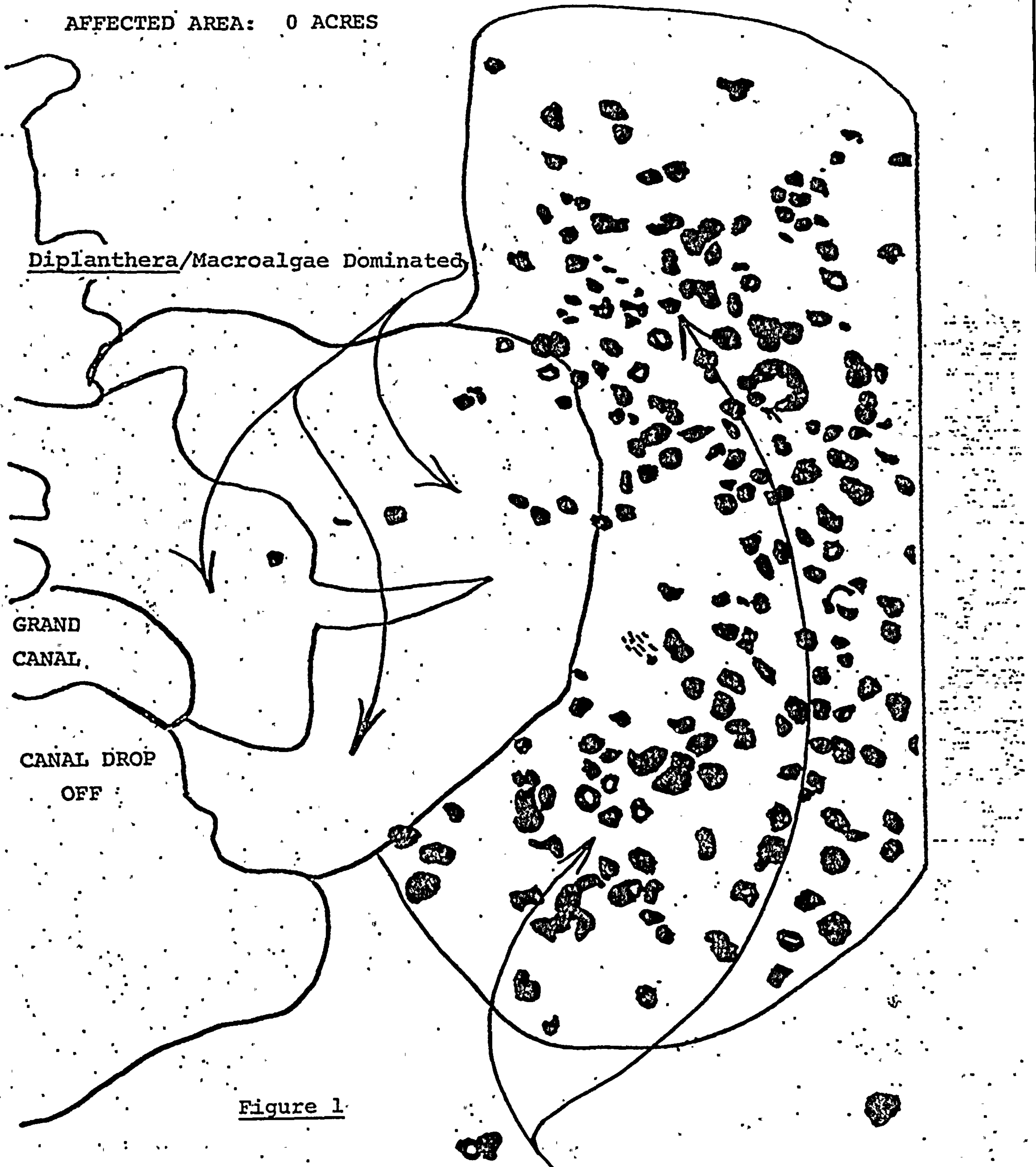


Figure 1

SCALE: 1" = 146'

Method 2: Square Meter Surveys

The following table is data from square meter areas permanently staked out on the bottom. The counts and identifications were made *in situ*. The sample points X-1, X-2, X-3, and X-4 are located approximately 100, 200, 400, and 600 feet east of the mouth of the canal respectively. Station X-2N is approximately 200 feet NNE of X-2. X-2S is approximately 200 feet SSE of X-2. Data reported as less than (<) or greater than (>) is based on extrapolation of counts of plants in 1/16 of a square meter. The counts on the grasses are counts of the fasicles (sheaths of leaves). The counts of the *Dictyota* are of the number of distinct but unattached clumps of the alga. These numbers are not volumetrically quantitative.

TABLE 1

GRAND CANAL DISCHARGE REVEGETATION

		X-1	X-2	X-3	X-4	X-2N	X-2S
GRASSES:	Diplanthera wrightii	140	>1400	>2700	>1500	>2200	>1000
	Thalassia testudinum	32	25	74	53	19	25
CHLOROPHYTA:	Acetabularia crenulata	0	0	**	**	0	**
	Avrainvillea nigricans	5	0	48	18	0	6
	Batophora oerstedii	0	0	0	0	0	**
	Caulerpa Mexicana	**	*	0	0	0	0
	Caulerpa prolifera	0	0	0	0	0	*
	Halimeda species	0	4	10	22	0	3
	Penicillus species	0	0	20	12	4	76
PHAEOPHYTA:	Laurencia poitei	0	0	0	0	12	0

Sampling Date: July 1976

* Present

** Common

Method 3: Transects

Between X-1 and X-2 there is a solid growth of Thalassia and Diplanthera with the latter dominating. The blades are typically 12" to 20" long. There continues to be a solid covering of dead blades of Diplanthera throughout the area.

The sediment coating seen previously on the blades is no longer present.

Between X-2 and X-3 the same general pattern was found. The grasses were shorter, between 6" and 12". Occasional Halimeda and Penicillus species were noted. Acetabularia was common in the area. It was growing almost exclusively on dead Halimeda.

Just west of X-3 there was a patch of Thalassia with densities of around 100 per square meter.

The area between X-3 and X-4 was similar to that between X-2 and X-3 with the addition of Caulerpa prolifera being found in several areas.

The rest of the area is similar with the following noteworthy observations.

The Diplanthera blade debris is thickest shoreward. This is probably due to the onshore wind and wave action causing it to accumulate there.

The macroalgae, Avrainvillea nigricans, continues to be most abundant around and shoreward of X-25.

Discussions and Conclusions:

The entire area previously affected has revegetated. The growth has proceeded from barren to macroalgae dominated to macroalgae and *Diplanthera* which is being colonized by *Thalassia* and *Syringodium*. It is speculated that the *Syringodium* growth will increase and then decrease under the influence of micronutrient depletion while the amount of *Thalassia* growth will increase and eventually become the dominant vegetation.

The *Syringodium* growth has definitely increased in all areas. The aerial photogrpahs have shown that in some of the older patches of *Syringodium* the diameter of these approximately spherical patches has continued to increase while the original centers have died. This configuration is similar in appearance to a doughnut.

I have proposed that the *Syringodium* that is found in the previously affected area but not in the unaffected area has been due to some as yet unidentified sediment characteristic.

There are four general observations that must be explained in order for any hypothesis can be tenable. These four are:

1) The growth of *Syringodium* in the previously affected area but not in adjacent areas.
2) The demise of the center of a patch of *Syringodium* with the continued vitality of the outer portions of the same patch.

3) The absence of the *Syringodium* (with the exception of three isolated patches) within 300' of the mouth of the canal.

4) The depression of *Diplanthera* densities within the patches of *Syringodium*.

These four observations can be divided into two categories. The first three are most probably related directly to the edaphic characters of the area and their relationship to *Syringodium*. The last observation may well be due to the interrelationship between *Syringodium* and *Diplanthera*.

III.H SEDIMENT CHEMISTRY

MATERIALS AND METHODS

Sediment samples were taken at eight stations (Figure D.2.1) located within the Turkey Point canal system and three in Biscayne Bay. These samples were collected with a gravity type core sampler (Wildco Supply Company) and placed in a one liter screw-capped polypropylene container. Each container contained $HgCl_2$ (40 mg) as a preservative. Immediately after the samples were taken, they were iced at 4°C until the chemical analysis could be performed.

Samples were analyzed for soluble ammonia, NO_3, NO_2, SO_4, SO_3, and S, total phosphate, ortho-phosphate and insoluble sulfate, SO_3, and S. Standard APHA analytical methods were used (Table E-1). The results of these analyses were compiled monthly for each station (Tables E-2 through E-12).

TABLE E-1

METHODS AND ANALYSIS FOR WATER CHEMISTRY PARAMETERS

PARAMETER	METHOD	REFERENCE
Ammonia-nitrogen	Nesslerization	APHA, 1974, p. 412
Nitrate-nitrogen	Brucime	APHA, 1974, p. 427
Nitrite-nitrogen	Colorimetric	APHA, 1974, p. 434
Phosphate	Vanadomolybdophophoric-acid	APHA, 1974, p. 476
Ortho-phosphate	Stannous chloride	APHA, 1974, p. 479
Sulfate	Turbidimetric	APHA, 1974, p. 496
Sulfite	Colorimetric	APHA, 1974, p. 508
Sulfide	Colorimetric	APHA, 1974, p. 499

TABLE E-2
SOLUBLE ANALYSIS-AMMONIA
(PARTS PER MILLION)

MONTH	AVG OF 3 CONTROLS	F-1	W18-2	W6-2	WF-2	RF-3	E3-2	RC-2	RC-0
		STATION NUMBER							
JAN	5.9	N.D.	2.4	1.8	N.D.	2.4	6.1	0.3	N.D.
FEB	3.6	1.9	11.0	1.9	N.D.	N.D.	N.D.	N.D.	N.D.
MAR	4.6	5.5	3.1	3.7	4.9	4.9	1.9	N.D.	4.3
APR	2.1	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
MAY	6.9	4.3	4.4	7.8	4.1	3.3	4.2	4.6	3.3
JUN	4.2	12.0	11.7	9.3	90.5	14.8	15.1	164.3	N.D.

N.D.: None detected

TABLE E-3
SOLUBLE ANALYSIS-NITRATE
(PARTS PER MILLION)

MONTH	AVG OF 3 CONTROLS	STATION NUMBER F-1	W18-2	W6-2	WF-2	RF-3	E3-2	RC-2	RC-0
JAN	165.7	132	242	308	242	154	374	132	242
FEB	88.0	88.0	88.0	66.0	88.0	132.0	132.0	132.0	132.0
MAR	110	132.0	176.0	132.0	154.0	154.0	154.0	N.D.	132.0
APR	85.7	132.0	44.0	44.0	110.0	66.0	66.0	88.0	110.0
MAY	111.9	132.0	64.0	118.9	115.6	67.5	128.6	125.7	101.8
JUN	104.9	19.9	21.5	19.2	45.9	16.7	15.4	56.9	98.1

TABLE E-4
SOLUBLE ANALYSIS-NITRITE
(PARTS PER MILLION)

MONTH	AVG OF 3 CONTROLS	STATION NUMBER							
		F-1	W18-2	W6-2	WF-2	RF-3	E3-2	RC-2	RC-0
JAN	1.1	0.7	1.0	1.8	0.7	1.0	0.8	1.0	1.0
FEB	1.1	1.0	1.0	0.8	1.0	0.8	0.8	1.2	0.8
MAR	0.9	0.7	1.0	1.2	0.6	0.5	1.2	N.D.	0.5
APR	1.3	0.7	1.0	1.0	1.5	0.7	1.0	1.3	1.0
MAY	0.8	1.0	0.8	0.8	0.5	0.8	1.0	0.6	1.0
JUN	N.D.	0.004	0.04	0.03	0.12	0.05	0.03	0.08	0.004

N.D.: None detected

TABLE E-5
SOLUBLE ANALYSIS SULFATE (SO_4)
(PARTS PER MILLION)

MONTH	AVG OF 3 CONTROLS	STATION NUMBER								CANAL AVG.
		F-1	W18-2	W6-2	WF-2	RF-3	E3-2	RC-2	RC-0	
JAN	2328.3	2165	1860	2300	2545	2280	2040	2235	2140	2195.6
FEB	2543.3	2820	2595	2255	2545	3165	3425	3335	2300	2805.0
MAR	2415	2507	2120	2450	2595	2623	2495	N.D.	2425	2459.3
APR	1672	1766	2060	2293	2000	1880	2000	2112	1225	1917.0
MAY	2505.7	1965	2425	2338	2436	2374	2388	2678	2415	2377.4

N.D.: None detected

TABLE E-6
SOLUBLE ANALYSIS-SULFITE (SO_3)
(PARTS PER MILLION)

MONTH	AVG OF 3 CONTROLS	STATION NUMBER							
		F-1	W18-2	W6-2	WF-2	RF-3	E3-2	RC-2	RC-0
JAN	41.7	50	50	50	25	50	50	50	50
FEB	41.7	25	25	50	25	50	50	50	50
MAR	216.7	150	125	200	175	200	300	N.D.	200
APR	73.7	50.0	25.0	50.0	60.0	50.0	50.0	65.0	50.0
MAY	61.2	75.0	36.4	45.02	56.3	38.3	48.7	47.4	38.6
JUN	13.5	49.0	47.0	49.0	48.0	47.0	96.0	48.0	4.0

N.D.: None detected

TABLE E-7
SOLUBLE ANALYSIS-SULFIDE ($S^{=}$)
(PARTS PER MILLION)

MONTH	AVG OF 3 CONTROLS	STATION NUMBER F-1	W18-2	W6-2	WF-2	RF-3	E3-2	RC-2	RC-0
JAN	0.83	0.85	0.75	0.75	0.85	1.0	0.65	0.85	1.0
FEB	1.07	0.90	0.60	0.75	1.55	0.90	0.90	0.75	0.90
MAR	1.8	1.6	1.8	1.6	1.6	1.8	1.8	N.D.	1.8
APR	0.97	0.75	0.50	0.63	1.0	1.0	0.63	1.0	0.75
MAY	1.2	1.25	1.13	1.40	0.75	0.96	0.97	0.71	0.58
JUN	0.087	1.22	1.04	1.08	0.97	1.03	1.35	1.06	0.025

N.D.: None detected

TABLE E-8
TOTAL SOLUBLE PHOSPHATE - PHOSPHORUS
OF TURKEY POINT AND CONTROL SEDIMENTS (IN PPM)
1976

MONTH	$\overline{X}$ OF 3 CONTROLS	STATION NUMBERS							
		F-1	W18-2	W6-2	WF-2	RF-3	E3-2	RC-2	RC-0
JAN	25.0	23.0	23.0	14.0	14.0	10.0	14.0	14.0	14.0
FEB	18.1	7.2	14.3	7.2	7.2	21.4	7.2	10.0	10.0
MAR	25.7	22.8	32.8	32.8	34.3	35.7	27.2	32.8	N.D.
APR	80.0	30.0	53.0	57.0	40.0	26.0	36.0	23.0	23.0
MAY	29.7	57.1	51.9	20.7	42.8	23.0	29.2	37.9	23.2
JUN	1.5	9.8	9.5	9.8	9.7	9.3	9.6	17.8	0.5

N.D.: None detected

TABLE E-9
SOLUBLE ORTHO-PHOSPHATE PHOSPHORUS CONTENT IN PPM
OF TURKEY POINT AND CONTROL SEDIMENTS
1976

MONTH	$\bar{X}$ OF 3 CONTROLS	STATION NUMBERS F-1	W18-2	W6-2	WF-2	RF-3	E3-2	RC-2	RC-0
JAN	11.0	7.0	10.0	7.0	7.0	7.0	7.0	7.0	9.0
FEB	6.2	7.2	10.0	7.2	4.3	7.2	7.2	7.2	10.0
MAR	8.1	7.2	7.2	7.2	7.2	2.9	7.2	N.D.	2.9
APR	N.D.	5.7	7.0	4.5	4.5	4.5	4.5	N.D.	N.D.
MAY	17.9	57.1	51.9	13.1	26.7	17.6	24.4	9.5	14.3
JUN	0.4	6.8	N.D.	N.D.	9.7	6.5	6.7	13.9	0.3

N.D.: None detected

TABLE E-10
INSOLUBLE ANALYSIS - SULFATE (SO_4)
(PARTS PER MILLION)

MONTH	AVG OF 3 CONTROLS	STATION NUMBER							
		F-1	W18-2	W6-2	WF-2	RF-3	E3-2	RC-2	RC-0
JAN	180.	204	396	196	223	203	264	87	100
FEB	368.3	806	235	343	136	201	219	233	N.D.
MAR	283	286	481	500	259	N.D.	N.D.	--	N.D.
APR	922.3	1,856	351.0	197.0	391	708	N.D.	375	N.D.
MAY	621.5	493.1	239.0	420.4	127.3	290.8	513.2	415.3	117.5
JUN	N.D.	N.D.	402.	N.D.	192	351	176	209	N.D.

N.D.: None detected

TABLE E-11
INSOLUBLE ANALYSIS - SULFITE (SO_3)
(PARTS PER MILLION)

MONTH	AVG OF 3 CONTROLS	STATION NUMBER F-1	W18-2	W6-2	WF-2	RF-3	E3-2	RC-2	RC-0
JAN	25.7	14	383	113	551	884	914	379	32
FEB	69.2	711	414	614	127	214	29.2	835	N.D.
MAR	111.7	561	999	417	568	N.D.	N.D.	--	N.D.
APR	287.3	758	530	46.0	910	625	325	1,374	N.D.
MAY	52.7	1376.1	1156.5	98.9	414.4	1313.3	745.0	775.2	382.5
JUN	N.D.	333	492	374	399	980	398	640	N.D.

N.D.: None detected

TABLE E-12
INSOLUBLE ANALYSIS - SULFIDE ($S^{=}$)
(PARTS PER MILLION)

MONTH	AVG OF 3 CONTROLS	STATION NUMBER F-1	W18-2	W6-2	WF-2	RF-3	E3-2	RC-2	RC-0
JAN	2.1	72	67	9.1	218	172	436	98	3.8
FEB	0.83	282	85	190	53.1	77.4	23.1	230.0	N.D.
MAR	1.73	219	607	215	239	N.D.	N.D.	N.D.	N.D.
APR	4.8	50	106	2.4	338	231	116	593	N.D.
MAY	3.25	424	387.4	9.45	118.41	562.85	69.39	184.94	93.99
JUN	N.D.	26.0	26.0	46.0	5.0	77.0	5.0	33.0	N.D.

N.D.: None detected

IV. RECORDS OF CHANGES IN SURVEY PROCEDURES

No changes in survey procedures were made this period. The following administrative Environmental Procedures were revised:

Company Environmental Review Group Charter

A-1 , Document Control

A-2, Changes to Environmental Technical Specifications

A-3, Changes or modifications to plant systems or equipment which have an environmental impact

A-4, Telemetry Equipment Periodic Checks

A-5, Preparation and Revision of Procedures

A-6, Deviation from and Temporary Changes to Approved Procedures

A-8, Chemical Additions to Water Pumped Through the Licensed Facilities

A-9, Environmental Tech Specs Non-Radiological Limits Exceeded and Investigation and Reporting of the Event

A-11, Responsibilities for Maintenance and Monitoring Requirements of the Cooling Canal System

A-12, Implementation of Environmental Technical Specifications

A-13, Environmental Technical Specifications Reporting Requirements .

A-14, Data Review and Retention of Documents and Records

V. SPECIAL ENVIRONMENTAL STUDIES RELATED TO THE LICENSED FACILITIES NOT REQUIRED BY THE ENVIRONMENTAL TECHNICAL SPECIFICATIONS

Section III.E of this report analyzes data collected which were not required by the Environmental Technical Specifications.

VI. RECORDS OF ANY VIOLATIONS OF THE ENVIRONMENTAL TECHNICAL SPECIFICATIONS

1. FPL Quality Assurance Department Audit No. QAA-ENV-76-1 had two unsatisfactory conditions concerning the implementation of the Environmental Tech Specs.

a) Quality Assurance Indoctrination and Training

Finding: "The Environmental Department does not have a formal, documented Quality Assurance training program"

Action: A procedure was written and implemented to develop a Quality Assurance training program.

b) Quarterly Status Report for Controlled Document

Finding: "Contrary to Environmental Procedure A-1, status reports have not been issued every three months as required"

Action: Environmental Procedure A-1 was revised requiring that a new status report be issued only when procedures are added, revised, or deleted.

2. IE Inspection Report Nos. 50-250/76-8 and 50-251/76-8

Deficiency: Contrary to Appendix B, Tech Spec 5.1.g., documentation that the required review of noncompliance identified in June 1975 with the ETS was not accomplished in accordance with the Company Environmental Review Group's Charter.

Action: The CERG Charter was revised to insure timely review of noncompliance items.

3. IE Inspection Report Nos. 50-250/76-9 and 50-251/76-8

Deficiency: Contrary to Tech Spec 5.1, Appendix B-Environmental, independent auditors failed during their 1975 audit to identify and followup items of noncompliance

cited by NRC in IE Reports 50-250/75-9 and 50-251/75-9.

Action: Procedures will be written to insure identification and followup of noncompliance items.

VII. RECORDS OF UNUSUAL EVENTS, CHANGES TO THE PLANT, CHANGES TO THE ENVIRONMENTAL TECHNICAL SPECIFICATIONS, AND CHANGES TO PERMITS OR CERTIFICATES

None

VIII. STUDIES REQUIRED BY THE ENVIRONMENTAL TECHNICAL SPECIFICATIONS NOT INCLUDED IN THIS REPORT

None