

INVESTIGATIONS OF THE EFFECTS OF
ELECTRICAL POWER GENERATION ON
MARINE RESOURCES IN SALEM HARBOR

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1.0 INTRODUCTION

The following is the seventh quarterly progress report of research performed by personnel of the Division of Marine Fisheries operating under contract DMF-2-72 with the New England Power Company. Included are data collected from 1 April through 30 June 1973.

Project staff was increased on 11 June by the employment of Assistant Marine Fisheries Biologist Elaine Sawin, Fisheries Manager Paul Knox, and Laboratory Technician Mary Patterson. The services of Laboratory Technician Patricia Rule were increased to full time.

Preliminary current data was collected as personnel familiarized themselves with new equipment and techniques. Surveys were interrupted due to mechanical failure of our current meter.

Procedures for ^{14}C and ATP analyses were demonstrated for laboratory personnel at the EPA Water Quality Laboratory, West Kingston, Rhode Island.

Benthic sampling during April included three new stations off Winter Island, in the vicinity of the proposed Unit 5 discharge. Bi-weekly sampling for ichthyoplankton was initiated at the Unit 4 intake and discharge water boxes. Analyses of benthos, plankton, and fish egg and larvae collected since September 1972 are incomplete. The final report of work

completed under sub-contract at the William F. Clapp Laboratories is expected by 1 August and will be included in Quarterly Progress Report No. 8.

Sampling at Station 17, Chappel Ledge, with the 49-ft trawl was discontinued due to excessive accumulations of kelp and unavoidable obstructions by lobster buoys.

Our 1973 lobster tagging study and sport finfish survey commenced on 1 April.

2.0 PHYSICAL INVESTIGATIONS

2.1 Temperature

Routine temperature monitoring continues throughout Salem Harbor (Figure 2.1). Average surface temperatures for the quarter rose 9° to 13°C. Figure 2.2 displays the average weekly surface water temperatures at Stations A - D.

Continuous data is now collected from the plant intake basin in compliance with Environmental Protection Agency permit requirements. Project personnel are maintaining Endeco 109 recorders bi-weekly for the New England Power Company. Similar instruments are maintained monthly at Stations C and D.

Figure 2.1. Locations of water quality and finfish sampling stations in Salem Harbor.

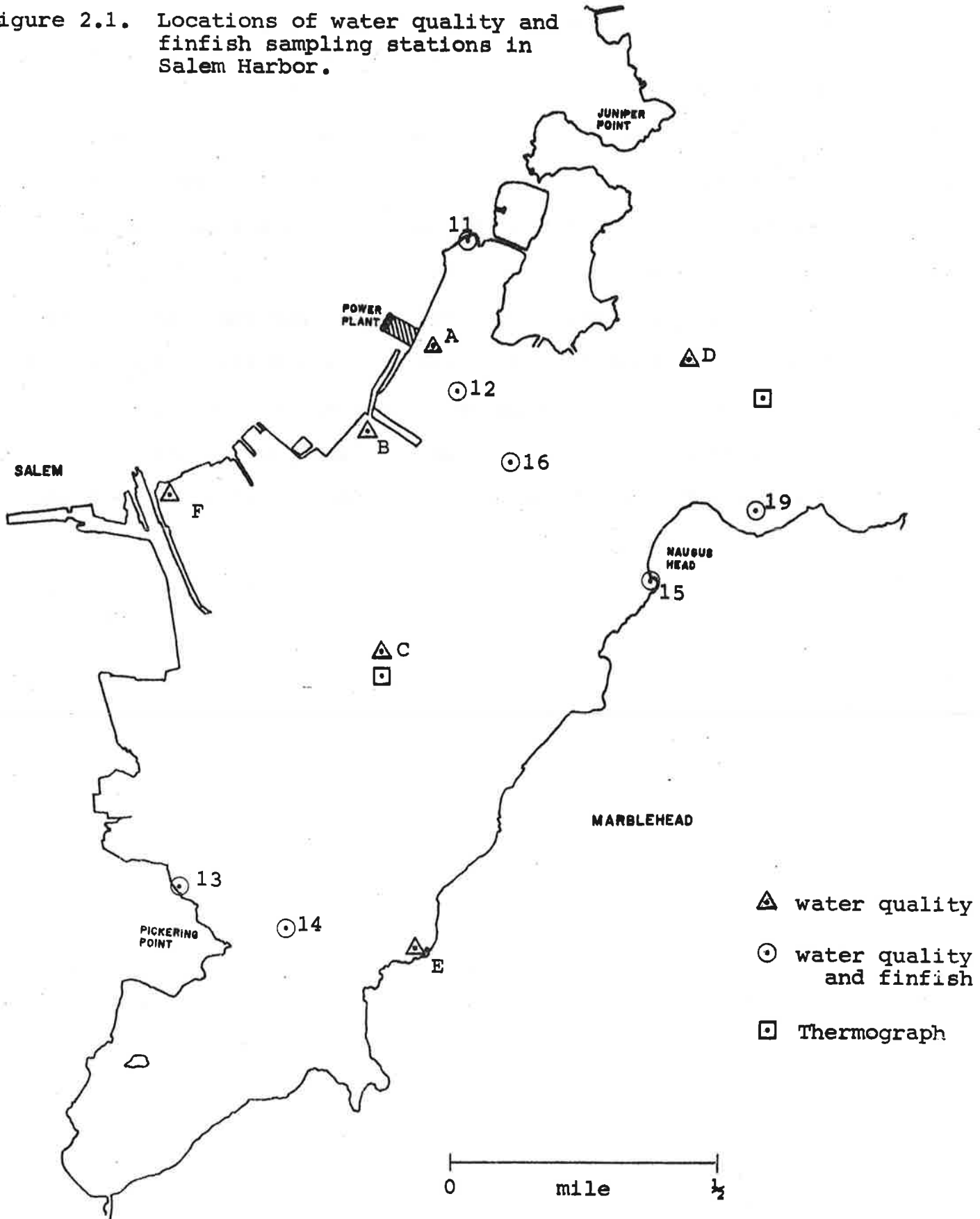
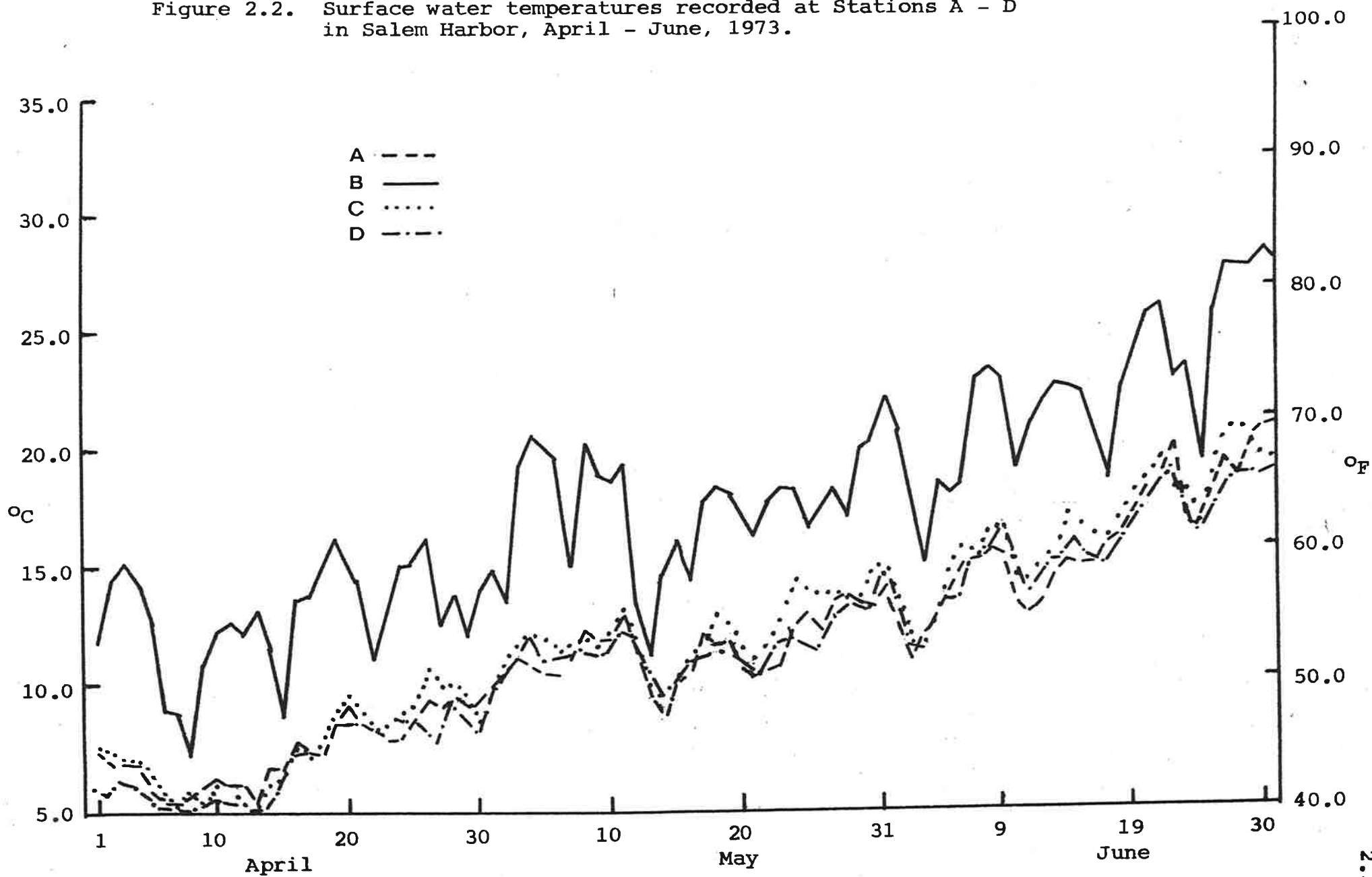


Figure 2.2. Surface water temperatures recorded at Stations A - D in Salem Harbor, April - June, 1973.



3.0 CHEMICAL INVESTIGATIONS

3.1 Water Quality

Surface water quality measurements throughout the study area exhibited the following ranges: water temperature, 3.5 - 29.0 C; salinity, 25.5 - 31.5 ‰; pH, 8.0 - 8.5; carbon dioxide, 5.0 - 10.0 ppm; dissolved oxygen, 6.9 - 14.4 ppm; biological oxygen demand, 0.2 - 10.4 ppm; nitrite-N, 0.1 - 2.9 µg-atom/l; nitrate-N, 3.6 - 102.9 µg-atom/l; and phosphate-P, 2.3 - 25.4 µg-atom/l (Table 3.1).

Compared to data collected during the Spring of 1972 little variance was noted, except for a 1.3°C increase in average surface water temperature.

Table 3.2 from Quarterly Report #6 is reproduced in the attached appendix and reflects corrected values for nitrate, nitrite, and phosphate, consistent with Section 3.1 narrative.

3.2 Heavy Metals

Copper concentrations in soft shell clams, Mya arenaria, varied from 2.1 - 5.8 ppm; northern lobsters, Homarus americanus, 6.9 - 44.9 ppm; and in water, .001 - .006 ppm (Table 3.2). Sediment analyses from Stations 11 and 13 will be initiated in July to fulfill Environmental Protection Agency permit requirements.

Table 3.1. Water quality data for Salem Harbor, April - June, 1973.

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL	WIND DIR/VEL (MPH)	CLOUD COVER (%)	DEPTH (FEET)	TEMP °C		SALINITY (0/00)	CO ₂ pH	O ₂ (ppm)	BOD (ppm)	NO ₂ -N µg-atom/L	NO ₃ -N	PO ₄ -P
			STAGE (HOURS)				AIR	WATER							
Station A															
4/4	000698	1205	high + ½		100	S	4.0	6.5	27.3	8.5	5.0	11.0	3.5	0.48	28.6 5.7
4/13	000712	1055	high +3	0	0	S	5.5	3.5	30.4	8.5	5.0	11.2	3.4	0.73	3.6 17.0
4/19	000730	1020	low +4	0	100	S	17.5	9.5	30.6	8.5	5.0	12.5	3.9	0.28	28.6 3.9
4/25	000789	0845	high +4½	N/5	30	S	15.0	8.0	29.3	8.5	10.0	11.0	3.1	0.32	32.1 3.2
5/2	000745	1020	high	0	80	S	13.0	11.0	30.8	8.5	10.0	9.2	2.6	0.68	32.1 7.8
5/10	000936	0725	high +2	0	100	S	12.0	12.0	29.0	8.5	10.0	9.0	3.1	0.23	33.6 8.5
5/17	000952	1230	high +1	SW/5	0	S	12.0	12.0	28.8	8.5	10.0	9.8	1.7	0.29	35.7 12.8
5/22	000960	1230	low +4	E/5	90	S	19.0	11.5	29.2	8.5	10.0	9.5	4.1	0.27	40.7 10.1
5/30	000969	0830	low +5½	0	0	S	25.0	13.0	28.5	8.5	10.0	8.8	1.5	0.28	56.4 13.0
6/4	000980	1135	low +4	S/10	100	S	18.0	13.0	29.0	8.5	5.0	10.3	2.1	0.27	14.3 1.6
6/12	000991	0915	high + ½	SW/5	10	S	30.5	15.0	30.2	8.5	5.0		0.37	14.3 19.7	
6/18	001000	1130	low +5	SW/5	100	S	18.5	15.5	29.5	8.5	10.0	8.6	4.1	0.52	34.3 4.8
6/26	000983	0530	low +4½	0	100	S	18.0	20.0	29.2	8.5	5.0	9.1	4.6	0.43	102.9 3.7
Station B															
4/4	000697	1125	high		100	S	4.5	13.5	28.7	8.5	5.0	10.6	3.7	0.36	22.1 2.3
4/13	000715	1030	high +3	0	0	S	3.5	13.5	30.8	8.5	5.0	8.8	0.2	0.29	7.1 17.9
4/19	000733	1200	high	0	50	S	17.0	17.0	30.6	8.5	10.0	11.5	4.3	0.39	27.1 4.9
4/25	000742	0920	high +5	NW/5	70	S	15.0	14.0	29.2	8.5	5.0	9.8	4.0	0.32	34.3 3.2
5/2	000746	0935	low +5	0	90	S	13.0	16.0	31.0	8.5	10.0	9.1	3.5	0.57	41.4 6.7
5/10	000937	0735	high +2	0	100	S	16.0	26.0	29.0	8.5	5.0	8.8	2.2	0.23	36.4 7.4
5/17	000953	1255	high +1½	0	0	S	12.0	21.5	30.0	8.5	10.0	9.2	2.0	0.29	34.3 14.0
5/22	000963	1305	low +4½	E/5	100	S	19.0	22.0	29.4	8.5	10.0	9.4	3.1	0.27	28.6 8.7
5/30	000970	1015	high +1	0	0	S	24.0	20.0	29.3	8.5	10.0	8.6	1.6	0.45	50.0 10.8
6/4	000979	1120	low +4	0	100	S	20.0	25.0	29.2	8.5	10.0	9.1	2.1	0.27	10.7 0.7
6/12	000990	0950	high +1	SW/5	10	S	32.0	23.0	30.4	8.5	10.0	9.0	3.3	0.37	14.3 14.2
6/18	001001	1210	low +5½	SW/5	100	S	18.0	24.5	29.5	8.5	5.0	8.4	2.7	0.21	8.9 3.2
6/26	001013	0700	high	0	100	S	19.0	29.0	29.6	8.5	5.0	9.4	6.5	0.28	22.9 4.5

Table 3.1. Continued

			TIDAL	WIND		CLOUD			TEMP °C		SALINITY		CO ₂	O ₂	BOD	NO ₂ -N	NO ₃ -N	PO ₄ -P
DATE	SAMPLE NUMBER	TIME (EST)	STAGE (HOURS)	DIR/VEL (MPH)	COVER (%)	DEPTH (FEET)	AIR	WATER	(0/00)	pH	(ppm)	(ppm)	(ppm)	µg-atom/L				
Station C																		
4/4	000700	1325	high +1½		100	S	4.0	6.5	27.9	8.5	10.0	11.4	3.8	0.60	87.9	3.4		
4/13	000714	1015	high +2½	W/10	0	S	2.5	4.5	30.7	8.5	5.0	10.2	3.2	0.58	3.6	14.3		
4/19	000732	1130	low +5½	0	50	S	18.0	9.5	31.5	8.5	5.0	12.4	3.6	0.19	28.6	4.9		
4/25	000741	0910	high +5	N/10	60	S	15.0	8.5	29.5	8.5	5.0	10.9	3.6	0.40	34.3	4.9		
5/2	000747	0915	low +5	0	90	S	11.0	11.0	29.4	8.5	10.0	9.5	2.9	0.48	28.6	5.6		
5/10	000938	0745	high +2½	0	100	S	12.0	12.0	29.0	8.5	5.0	8.8	1.2	0.17	33.6	6.4		
5/17	000950	1120	high	S/10	0	S	11.0	10.5	29.6	8.5	5.0	10.0	3.0	0.29	35.0	10.7		
5/22	000962	1250	low +4½	E/5	100	S	15.5	12.0	29.2	8.5	10.0	9.4	3.2	0.41	42.9	8.6		
5/30	000971	0925	high	0	0	S	21.0	15.5	28.4	8.5	10.0	9.8	2.3	0.17	38.6	13.0		
6/4	000976	1050	low +3½	S/5	100	S	18.0	12.5	29.2	8.5	10.0	9.9	1.7	0.27	7.9	1.7		
6/12	000992	0800	low +5½	S/10	10	S	27.0	17.0	29.8	8.5	5.0	9.0	3.4	0.45	9.3	14.2		
6/18	001002	1250	high	SW/10	100	S	17.0	18.0	29.7	8.5	5.0	8.6		0.31	38.2	7.3		
6/26	001010	0615	low +5½	NE/5	100	S	18.5	20.5	29.8	8.5	5.0	9.0	3.1	0.14	25.0	9.0		
Station D																		
4/4	000699	1250	high +1		100	S	3.0	5.0	29.2	8.5	5.0	11.6	1.4	0.48	25.0	6.8		
4/13	000713	1005	high +2½	NW/10	0	S	2.5	3.5	31.2	8.5	5.0	10.8	3.4	0.58	17.9	17.9		
4/19	000731	1050	low +4½	0	90	S	16.0	9.5	30.4	8.5	10.0	12.0	3.1	0.47	30.0	3.9		
4/25	000740	0900	high +4½	N/10	50	S	15.0	8.0	29.2	8.5	10.0	11.8	3.7	0.16	35.7	6.5		
5/2	000748	1040	high	0	70	S	11.0	10.0	29.4	8.5	10.0	9.6	2.7	0.48	33.6	6.7		
5/10	000939	0750	high +2½	0	100	S	12.0	11.0	31.2	8.5	5.0	9.3	2.3	0.34	33.6	7.9		
5/17	000951	1150	high + ½	0	10	S	12.0	10.0	29.7	8.5	10.0	10.1	2.7	0.26	41.4	10.7		
5/22	000961	1240	low +4	E/10	100	S	18.0	10.5	28.7	8.5	10.0	9.6	2.9	0.20	27.1	11.1		
5/30	000972	0910	high	0	0	S	21.0	13.5	28.5	8.5	10.0	9.0	2.2	0.22	45.0	11.6		
6/4	000975	1030	low +3	S/5	100	S	18.0	12.0	28.9	8.5	5.0	10.4	2.1	0.27	10.7	1.6		
6/12	000988	0930	high + ½	SW/10	10	S	30.0	15.0	30.1	8.5	10.0	9.7	2.9	0.30	5.0	9.5		
6/18	001003	1145	low +5	SW/10	100	S	17.5	15.5	29.5	8.5	5.0	9.3	4.0	0.31	20.7	3.2		
6/26	001009	0550	low +5	0	100	S	18.5	18.5	29.8	8.5	8.5	10.2	3.9	0.24	42.9	5.0		

Table 3.1. Continued

		TIDAL		WIND		CLOUD		TEMP °C		SALINITY (0/00)	CO2 pH (ppm)	O2 (ppm)	BOD (ppm)	NO2-N µg-atom/L	NO3-N	PO4-P	
DATE	SAMPLE NUMBER	TIME (EST)	STAGE (HOURS)	DIR/VEL (MPH)	COVER (%)	DEPTH (FEET)	AIR	WATER									
Station E																	
4/2	000691	1110	high +1	0	100	S	7.0	7.5	27.6	8.5	5.0	10.6	4.3	1.07	37.1	16.1	
4/10	000710	0920	high +5	0	100	S	6.0	4.0	29.2	8.5	5.0	11.3	3.2	0.39	32.1	7.1	
4/17	000722	1100	high	0	100	S	15.0	10.0	27.9	8.5	5.0	12.4	4.0	0.39	54.3	25.4	
4/25	000743	1050	low	0	0	S	15.0	12.5	28.8	8.5	10.0	9.0	2.8	0.41	42.1	13.0	
5/2	000749	1235	high +2	0	10	S	13.0	12.0	29.4	8.5	10.0	9.2	0.7	0.54	33.6	11.6	
5/10	000940	0930	high +4	0	100	S	17.0	13.0	28.5	8.5	10.0	8.7	2.6	0.46	42.8	14.8	
5/15	000945	1000	high	0	100	S	14.5	9.5	30.0	8.5	10.0	9.7	2.3	0.41	45.7	12.3	
5/25	000967	1330	low +2½	0	100	S	13.0	14.5	28.2	8.5	10.0	9.9	1.6	0.30	23.6	11.2	
5/30	000973	1315	high +4	0	20	S	28.0	15.0	28.3	8.5	10.0	9.0	2.3	0.56	37.9	5.8	
6/4	000977	1100	low +3½	0	90	S	19.0	13.0	29.6	8.5	10.0	10.2	2.0	0.33	21.4	6.5	
6/12	000993	0830	high	S/5	10	S	26.0	17.0	30.1	8.5	10.0	8.0	3.1	0.30	9.3	15.8	
6/18	001004	1155	low +5	SW/5	100	S	17.0	17.0	29.8	8.5	10.0	8.8	3.4	0.21	6.1	8.1	
6/26	001011	0635	high	0	100	S	18.5	19.0	29.8	8.5	10.0	8.6	3.7	0.29	33.6	11.2	
Station F																	
4/2	000693	1210	high +2	0	100	S	6.5	8.5	28.8	8.5	5.0	9.5	7.8	2.86	30.0	16.1	
4/10	000711	0920	high +5	SE/10	100	S	4.5	5.5	27.0	8.5	10.0	9.7	6.6	1.14	28.6	14.1	
4/17	000723	1150	high +1	0	100	S	16.5	8.5	30.6	8.5	5.0	14.1	5.2	0.20	28.6	8.5	
4/25	000744	1120	low + ½	0	0	S	16.0	12.0	29.6	8.5	10.0	10.5	4.2	0.31	32.9	4.9	
5/2	000750	1250	high +2½	0	10	S	12.0	14.0	29.4	8.5	10.0	9.6	2.4	0.18	31.4	14.0	
5/10	000941	1000	high +4½	0	100	S	14.0	12.0	29.2	8.5	5.0	11.0	1.8	0.29	36.4	9.5	
5/15	000949	1050	high +1	0	100	S	13.5	12.0	30.1	8.5	10.0	9.2	3.3	0.41	42.9	7.8	
5/25	000968	1350	low +3	0	100	S	13.0	15.5	28.5	8.5	10.0	11.5	2.4	0.90	21.4	23.9	
5/30	000974	1335	high +4½	0	0	S	19.0	18.5	28.7	8.5	10.0	10.5	10.4	0.45	35.7	11.6	
6/4	000978	1115	low +4	0	100	S	19.0	14.0	29.6	8.5	5.0	9.6	2.1	0.33	7.1	5.9	
6/12	000989	0835	high	SW/5	10	S	28.5	15.0	30.2	8.5	10.0	9.8	3.0	0.33	14.3	14.2	
6/18	001005	1205	low +5½	SW/5	100	S	16.5	17.0	29.7	8.5	5.0	9.7	3.7	0.26	34.3	6.5	
6/26	001012	0650	high	0	100	S	18.5	21.0	29.8	8.5	10.0	9.0	2.9	0.21	50.0	5.2	

0.0 30.6 9.2

Table 3.1. Continued

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL STAGE (HOURS)	WIND DIR/VEL (MPH)	CLOUD COVER (%)	DEPTH (FEET)	TEMP °C AIR WATER	SALINITY (0/00)	pH	CO ₂ (ppm)	O ₂ (ppm)	BOD (ppm)
<u>Station 5</u>												
4/9	000707	1015	low + $\frac{1}{2}$	0	0	S	4.5 3.5	30.0	8.5	10.0	12.4	4.0
4/23	000736	0915	low	SW/20	10	S	16.5 8.0	31.5	8.5	10.0	12.4	4.9
5/8	000933	0820	high +4 $\frac{1}{2}$	0	0	S	10.0 10.0	28.5	8.5	10.0	10.0	2.8
5/23	000964	0815	high +5 $\frac{1}{2}$	0	20	S	15.5 8.5	30.5	8.5	10.0	10.5	3.6
6/11	000984	0830	high + $\frac{1}{2}$	0	40	S	22.0 14.0	28.0	8.5	10.0	9.0	6.2
6/28	001017	1000	high +1	S/5	50	S	23.0 18.0	27.0	8.5	10.0	9.8	6.2
<u>Station 11</u>												
4/2	000689	0950	high	0	100	S	7.0 6.5	28.5	8.5	5.0	11.0	3.2
4/3	000694	1000	low +5	0	100	S	6.0 7.5	29.0	8.5	5.0	10.7	2.7
4/17	000716	0920	low +4 $\frac{1}{2}$	S/5	100	S	19.5 9.5	30.0	8.5	10.0	12.1	3.4
4/17	000719	1305	high +2	S/5	100	S	17.5 9.5	30.0	8.5	5.0		
5/3	000927	0825	low +3 $\frac{1}{2}$	0	100	S	12.0 12.0	28.5	8.5	10.0	8.6	2.7
5/3	000921	1145	high + $\frac{1}{2}$	0	50	S	19.5 13.0	28.0	8.5	10.0		
5/14	000944	0830	low +5 $\frac{1}{2}$	0	0	S	14.0 9.5	30.0	8.5	10.0	9.0	2.4
5/15	000947	0845	low +5	0	100	S	14.5 10.5	29.5	8.5	10.0	9.8	2.5
6/11	000982	1000	high +2	0	70	S	30.0 16.0	29.0			9.1	2.6
6/12	000986	0920	high +1 $\frac{1}{2}$	0	0	S	29.5 18.0	27.0	8.5		8.9	1.6
6/25	001006	0730	high +1 $\frac{1}{2}$	0	100	S	18.0 17.5	27.5	8.5	5.0	8.0	1.9
6/26	001014	0805	high +2	0	100	S	20.0 19.0	27.0	8.5	10.0	6.9	2.0
<u>Station 12</u>												
4/5	000701	1100	low +5		80	S	5.0 6.0	28.0	8.5	10.0	10.9	3.4
4/18	000725	1215	high + $\frac{1}{2}$	0	90	S	18.0 8.0	31.5	8.5	5.0	9.3	0.5
5/7	000929	1245	low +4	0	20	S	9.5 12.0	29.0	8.5	10.0	9.4	2.3
5/21	000955	1215	low +4 $\frac{1}{2}$	S/5	100	S	16.0 10.5	28.5	8.5	10.0	10.7	3.6
6/15	000995	1000	low +5 $\frac{1}{2}$	W/10	80	S	13.0 15.0	29.5	8.5	5.0	9.4	5.1
6/28	001020	0715	low +5	S/5	60	S	20.5 18.5	27.0	8.0	5.0	9.2	3.2

Table 3.1. Continued

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL STAGE (HOURS)	WIND DIR/VEL (MPH)	CLOUD COVER (%)	DEPTH (FEET)	TEMP °C		SALINITY (0/00)	pH	CO ₂ (ppm)	O ₂ (ppm)	BOD (ppm)		
							AIR	WATER							
Station 13															
4/2	000692	1150	high +1½	0	100	S	7.5	8.0	23.5	8.5	5.0	9.5	4.2		
4/3	000696	1230	high +1½	0	100	S	4.5	8.0	26.0	8.5	5.0	10.7	4.2		
4/17	000718	1125	high + ½	0	100	S	18.0	8.5	30.5	8.5	5.0	13.1	4.7		
5/3	000922	1025	low +5½	0	60	S	15.5	13.0	28.0	8.5	10.0	9.0	1.7		
5/3	000751	1245	high +1½	0	30	S	19.5	14.5	27.5	8.5	10.0				
5/14	000942	1025	high +1	0	10	S	19.0	10.0	30.0	8.5	10.0	9.5	3.1		
5/15	000948	1030	high + ½	0	100	S	14.5	9.5	29.5	8.5	10.0	10.0	2.5		
6/25	001008	0900	high +3	0	100	S	16.5	18.5	27.0	8.5	10.0	8.1	2.9		
6/26	001016	1025	high +4	0	100	S	19.5	20.0	25.5	8.5	5.0	8.4	3.7		
Station 14															
4/5	000702	1140	low +5½	E/20	90	S	5.0	6.5	29.0	8.5	5.0	10.8	3.2		
4/18	000724	1140	high	W/5	70	S	19.5	9.0	30.0	8.5	10.0	12.0	4.2		
5/7	000928	1150	low +3	SE/5	70	S	10.5	13.0	29.5	8.5	10.0	9.1	3.2		
5/21	000954	1125	low +3½	S/5	100	S	13.0	12.0	28.5	8.5	10.0	9.3	2.2		
6/15	000994	0900	low +4½	W/10	40	S	13.0	15.0	28.0	8.5	10.0	7.8	4.6		
6/28	001021	0630	low +4	S/5	70	S	20.0	19.5	26.5	8.5	5.0	8.7	2.6		
Station 15															
4/2	000690	1045	high + ½	0	100	S	7.5	7.0	28.5	8.5	5.0	11.0	3.8		
4/3	000695	1135	high + ½	0	100	S	5.0	7.0	26.5	8.5	5.0	10.7	3.9		
4/17	000717	1025	low +5½	W/5	100	S	13.0	10.5	28.5	8.5	5.0	10.8	3.9		
4/17	000720	1415	high +3	SW/10	100	S	14.5	9.0	30.0	8.5	5.0				
5/3	000926	0930	low +4½	0	60	S	15.5	12.5	28.0	8.5	10.0	9.5	2.1		
5/3	000920	1215	high +1	0	40	S	19.5	12.0	29.0	8.5	10.0				
5/14	000943	0940	high + ½	SW/15	20	S	15.0	12.0	27.0	8.5	10.0	9.1	2.3		
5/15	000946	0940	high	0	100	S	15.5	10.5	29.5	8.5	10.0	10.2	2.7		
6/11	000981	0830	high +1	0	80	S	25.0	17.5	27.0	8.5		8.6	2.9		
6/12	000987	0840	high + ½	0	0	S	25.5	16.5	27.5	8.5		8.6	3.9		
6/25	001007	0820	high +2½	0	100	S	16.5	17.0	27.0	8.5	10.0	8.3	1.8		
6/26	001015	0950	high +3	0	100	S	19.0	18.5	26.0	8.5	5.0	8.2	1.9		

Table 3.1. Continued

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL STAGE (HOURS)	WIND DIR/VEL (MPH)	CLOUD COVER (%)	DEPTH (FEET)	TEMP °C AIR WATER	SALINITY (0/00)	pH	CO ₂ (ppm)	O ₂ (ppm)	BOD (ppm)
<u>Station 16</u>												
4/9	000708	1250	low +3	SE/5	20	S	3.0 5.0	30.0	8.5	10.0	11.3	3.5
4/23	000739	1200	low +3	SW/20	50	S	17.0 9.0	30.5	8.5	5.0	12.3	4.9
5/8	000934	1035	low +1	0	20	S	14.0 13.0	29.0	8.5	10.0	9.3	2.1
5/23	000965	1100	low +2	0	40	S	19.0 12.0	28.0	8.5	10.0	8.9	2.1
6/11	000985	1030	high +2½	S/5	70	S	27.0 17.5	29.5	8.5	10.0	8.6	4.3
6/28	001018	1210	high +3	S/5	30	S	24.0 20.0	27.0	8.5	5.0	9.7	6.3
<u>Station 17</u>												
4/9	000709	1430	low +5	NE/10	60	S	3.0 4.0	30.0	8.5	10.0	14.4	5.7
4/23	000738	1315	low +4			S	17.0 9.0	30.0	8.5	10.0	12.0	4.7
5/8	000935	1300	low +3½	SE/10	90	S	10.0 10.0	29.5	8.5	10.0	10.4	3.9
<u>Station 19</u>												
4/18	000726	1240	high +1	E/10	50	S	18.0 8.5	30.0	8.5	5.0	12.0	3.3
5/7	000931	1325	low +5	0	0	S	9.0 10.0	29.5	8.5	10.0	10.0	2.2
5/21	000956	1245	low +5	S/5	100	S	14.0 9.5	28.5	8.5	10.0		
6/15	000996	1045	high	NW/10	60	S	15.5 14.5	28.0	8.5	10.0	9.2	5.4
6/28	001019	0800	high	0	80	S	21.0 19.5	27.5	8.5	5.0	9.8	3.6

ave 12.9 29.0 8.5 7.9 10.0 3.2

Table 3.2. Copper concentrations (ppm) in soft shell clams (Mya arenaria), lobsters (Homarus americanus), and water from Salem Harbor, April - June, 1973.

Date	Station	Soft shell clam	Lobster	Water
4/4	A	4.4	26.8	0.002
	B	2.1	17.6	0.001
	C	3.7	29.1	0.006
	11	3.9		
	13	3.3		
5/2	A	3.3	33.1	0.001
	B			0.001
	C - surface		44.9	0.002
	C - midwater		25.1	
	C - bottom	4.4	20.0	
5/4	11	5.8		
	13	5.0		
5/29	11	3.1		
	13	3.9		
5/30	A	3.1	8.8	
	B	3.3	9.1	
	C - midwater		6.9	
	C - bottom	3.3	21.5	
	20		14.1	
	21		34.6	
6/25	11	4.0		
	13	5.1		
6/26	A	3.6	25.5	0.004
	B	4.0		0.004
	C - surface		26.8	0.003
	C - midwater		38.0	
	C - bottom	4.5	19.1	

4.0 BIOLOGICAL INVESTIGATIONS

4.1 Primary Production

Chlorophyll levels increased during the quarter (Table 4.1).
Respective ranges were:

Chlorophyll A	2.06 - 9.74	mg/m ³
B	0.25 - 2.84	mg/m ³
C	0.90 - 10.56	mg/m ³
Carotenoids	0.89 - 7.70	mg/m ³

Figure 4.1 displays bi-weekly Chlorophyll A levels at Stations A - D.

4.2 Bioassays

Thermal bioassays increased during the quarter despite difficulty in collecting large numbers of selected finfish. Determined by availability, assays are underway utilizing winter flounder, Pseudopleuronectes americanus, mummichogs, Fundulus heteroclitus; Atlantic silverside, Menidia menidia; threespine stickleback, Gasterosteus aculeatus and fourspine stickleback, Apeltes quadracus. Experiment procedures are outlined in the Appendix.

Preliminary data suggests that juvenile winter flounder and threespine sticklebacks can tolerate water temperatures of 26 - 28°C; fourspine sticklebacks will survive in waters of 28 - 29°C; and mummichogs succumb in waters from 34 - 36°C. Data is inconclusive at this time for tolerances by Atlantic silversides. Upon completion of all bioassays a complete synopsis will be prepared.

Table 4.1. Chlorophyll counts (mg/m³) in Salem Harbor, April - June, 1973.

Date	Station	Chlorophyll a	Chlorophyll b	Chlorophyll c	Carotenoids
4/4	A	7.28	1.62	3.66	3.24
	B	8.84	0.53	3.31	2.83
	C	7.88	0.39	4.99	2.31
	D	7.50	0.43	2.97	3.73
4/19	A	6.42	0.78	4.40	2.27
	B	6.43	0.80	3.18	2.70
	C	2.32	0.55	0.93	0.90
	D	2.06	0.25	1.20	0.89
5/17	A	3.88	0.87	3.20	2.77
	B	2.99	1.41	1.82	1.27
	C	4.85	1.59	3.20	2.94
	D	4.64	0.92	3.55	2.58
5/30	A	5.78	1.33	3.67	2.80
	B	4.03	1.43	2.97	2.53
	C	7.38	1.41	4.35	5.03
	D	4.66	1.42	3.15	2.77
6/12	A	4.44	2.84	2.84	1.78
	B	6.72	1.66	4.32	2.09
	C	5.65	1.18	4.85	2.99
	D	3.70	1.74	5.54	1.31
6/26	A	8.37	0.55	1.29	4.74
	B	9.49	1.27	0.90	7.70
	C	8.56	0.38	3.80	4.99
	D	9.74	1.92	10.56	7.08

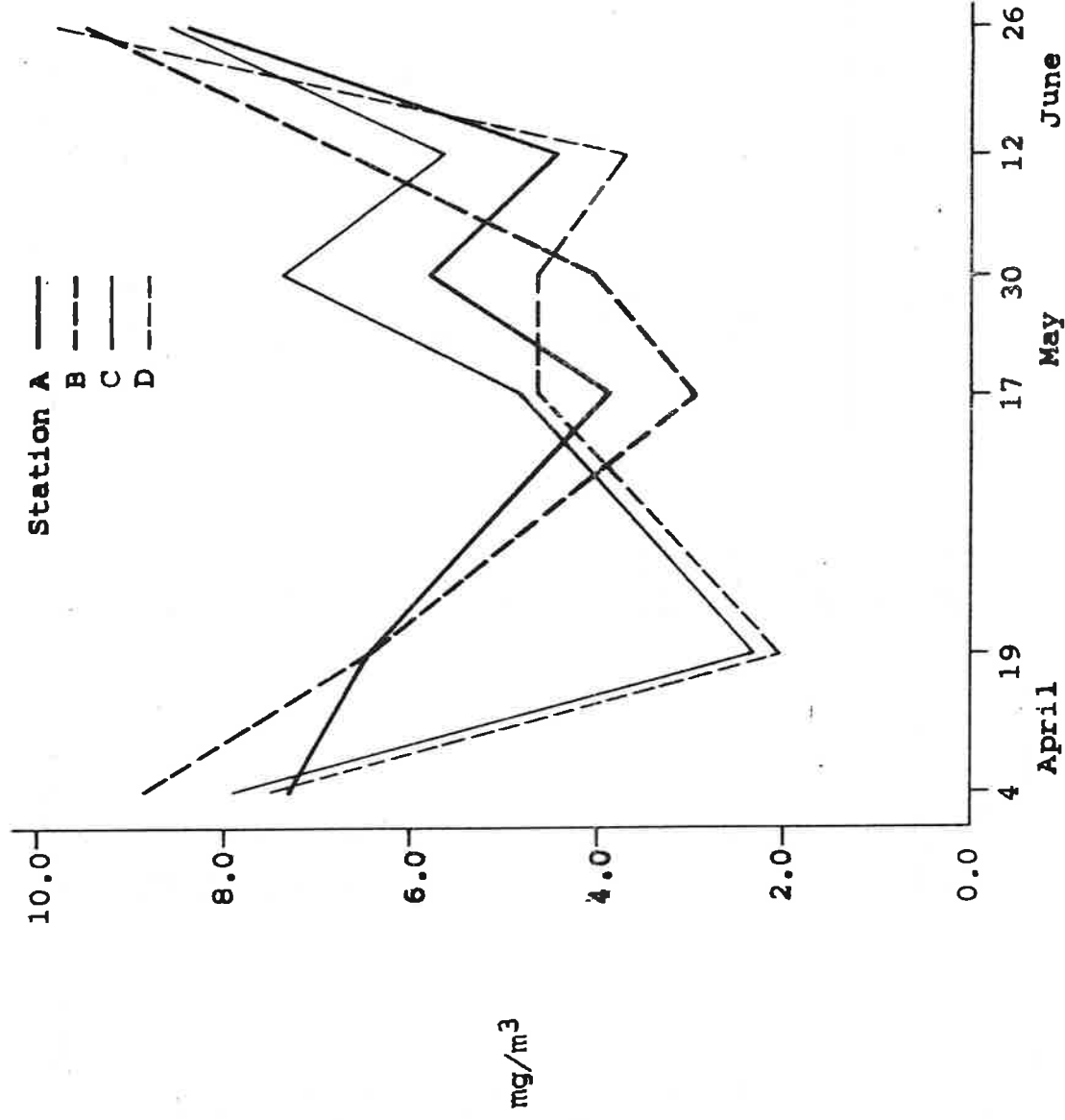


Figure 4.1. Chlorophyll a counts in Salem Harbor, April - June, 1973.

4.3 Finfish

Finfish collections from Salem Harbor totaled 4,409 individuals (Table 4.2) and were dominated by winter flounder (66%). Of 2,905 flounder sampled 79.3% were captured with the 49-ft trawl; 11.4% by gill nets; 5.3% with the 120-ft haul seine; and 4.0% at the 30-ft trawl stations (Tables 4.3 - 4.6). Atlantic silverside dominated finfish catches at the 50-ft haul seine stations (Table 4.7). Forty-eight pollock, Pollachius virens, were collected during one 5-minute tow with the 30-ft midwater trawl (Table 4.8).

Figure 4.2 displays length frequency histograms for the most abundant finfish species sampled: winter flounder; Atlantic cod, Gadus morhua; Atlantic silverside; and pollock. Species diversity was greatest with the 30-ft trawl and gill nets (Table 4.9).

Winter flounder; yellowtail flounder, Limanda ferruginea; and Atlantic cod dominated finfish catches outside Salem Harbor (Table 4.10). A conger eel, Conger oceanicus, collected this quarter brings our finfish checklist to 51 species.

4.4 Entrainment and Entrapment

Random monitoring of intake waters was performed for 66 hours. Threespine sticklebacks (19), and juvenile winter flounder (9) were most susceptible to impingement upon unit travel screens (Table 4.11).

Of 47 finfish sampled (12 species), 57% were collected from Unit 3 and 43% were taken from Unit 4 wash water. Mortality totaled 40%, remaining greatest at Unit 4; 85 and 7%, respectively.

Table 4.2. Rank of finfish collected in Salem Harbor, April - June, 1973.

Species	Method of Capture					Gill Net	Totals
	50-ft Seine	120-ft Seine	30-ft Trawl	Mid-water Trawl	49-ft Trawl		
1. winter flounder		153	110	8	2,303	331	2,905
2. Atlantic cod			14	1	80	128	223
3. Atlantic silverside	54	96	1				151
4. pollock			2	48	1	99	150
5. fourspine stickleback	14	3	115				132
6. Atlantic herring	1					124	125
7. mummichog	17	103					120
8. skate*					100	7	107
9. threespine stickleback	2	18	72	1			93
10. Atlantic tomcod		1	70			5	76
11. yellowtail flounder					70		70
12. windowpane					45	1	46
13. Atlantic menhaden						34	34
14. northern pipefish	1	3	25	1			30
15. ocean pout					25		25
16. rainbow smelt	1	6	2		1	14	24
17. Atlantic mackerel			1			20	21
18. American eel			14				14
19. ninespine stickleback	1	6	6				13
striped bass						13	13
20. white hake		1	8				9
21. <u>Urophycis</u> sp.			5			2	7
22. striped killifish		5					5
23. alewife		1	1	2			4
grubby			4				4
sea raven					2	2	4
24. longhorn sculpin					1	1	2
25. conger eel						1	1
cunner			1				1
Total	91	396	451	61	2,628	782	4,409

*Not separated by species

Table 4.3. Dominant finfish species collected in Salem Harbor with the 49-ft trawl, April - June, 1973.

winter flounder (<u>Pseudopleuronectes americanus</u>)					Atlantic cod (<u>Gadus morhua</u>)		
Date	Set No.	Total Collected	Size Range (mm)	Mean (mm)	Total Collected	Size Range (mm)	Mean (mm)
Station 16							
4/9	1	148	195-484	317	8	300-769	488
	2	172	115-524	301	2	520-529	524
4/23	1	375	180-464	305	7	405-734	493
	2	414	170-924	315	7	430-674	512
5/8	1	324	200-424	309	3	420-434	427
5/23	1	159	170-464	275	14	330-685	442
	2	156	190-514	285	25	300-589	412
6/11	1	224	172-462	265	2	427-477	452
	2	237	147-482	263	12	302-407	356
6/28	1	94	140-389	264			

Table 4.4. Dominant finfish species collected in Salem Harbor with gill nets, April - June, 1973.

winter flounder (<u>Pseudopleuronectes americanus</u>)				Atlantic cod (<u>Gadus morhua</u>)			Atlantic herring (<u>Clupea harengus harengus</u>)		
Date	Total Collected	Size Range (mm)	Mean (mm)	Total Collected	Size Range (mm)	Mean (mm)	Total Collected	Size Range (mm)	Mean (mm)
<u>Station 20</u>									
4/18	7	125-344	251				78	205-354	286
5/30	232	130-314	222	26	300-414	355			
6/28	43	170-344	235						
<u>Station 21</u>									
4/18	5	105-289	183	31	230-735	386	46	240-349	302
5/30	44	170-374	245	71	300-469	367			

Table 4.5. Dominant finfish species collected in Salem Harbor with the 120-ft seine, April - June, 1973.

winter flounder (<u>Pseudopleuronectes americanus</u>)					mummichog (<u>Fundulus heteroclitus</u>)		
Date	Set No.	Total Collected	Size Range (mm)	Mean (mm)	Total Collected	Size Range (mm)	Mean (mm)
<u>Station 11</u>							
4/3	1	2	210-344	277	2	55-84	69
4/17	2	1	-	70	1	-	70
5/3	1				2	50-89	69
5/14	1	10	85-219	140			
	2	13	75-254	142	4	50-94	78
6/11	1	2	57-82	70			
	2	7	107-147	122	9	47-67	58
6/25	1	3	75-114	96	49	50-114	87
	2	6	32-107	56			
<u>Station 13</u>							
4/3	1	8	60-229	135	1	-	52
	2	2	90-114	102			
5/3	1	26	65-129	93	2	-	62
	2	6	75-94	88	3	55-89	75
5/14	1	6	70-184	99			
5/25	1	8	32-127	48	5	62-82	75
	2	5	32-42	36	15	67-122	95
<u>Station 15</u>							
4/3	1	9	80-274	160			
	2	4	80-304	191			
4/17	1	4	50-89	71			
	2	2	165-210	189			
5/3	1	10	85-124	108			
	2	1	-	182			
5/14	1				1	-	67
	2	5	80-109	100			
6/11	1	3	105-235	150			
	2	8	75-159	111			
6/25	1	1	-	147			
	2	1	-	117	9	62-102	80

Table 4.6. Dominant finfish species collected in Salem Harbor with the 30-ft trawl, April - June, 1973.

winter flounder (<u>Pseudopleuronectes americanus</u>)					fourspine stickleback (<u>Apeltes quadracus</u>)		
Date	Set No.	Total Collected	Size Range (mm)	Mean (mm)	Total Collected	Size Range (mm)	Mean (mm)
<u>Station 12</u>							
4/5	2	1	-	27			
5/7	1	5	80-379	209			
	2	6	85-224	142			
5/21	2	4	90-274	147	1	-	47
6/15	1	5	97-327	217	1	-	47
	2	6	107-342	170	3	42-47	46
6/28	1	1	-	212	4	45-59	50
	2	17	90-284	140			
<u>Station 14</u>							
4/18	1				1	-	47
5/7	1	5	100-304	252	6	30-64	46
	2	11	85-399	182	49	35-64	47
5/21	1	1	-	272	3	40-59	50
	2	32	85-349	242	1	-	62
6/15	1	4	112-235	177			
	2	4	212-352	288	9	42-57	47
6/28	1	4	190-299	224	9	30-59	46
	2	3	110-234	122	28	35-64	50
<u>Station 19</u>							
5/7	2	1	-	92			

Table 4.7. Dominant finfish species collected in Salem Harbor with the 50-ft seine, April - June, 1973.

Atlantic silverside
(Menidia menidia)

Date	Set No.	Total Collected	Size Range (mm)	Mean (mm)
<u>Station 11</u>				
4/17	2	1	-	92
6/26	1	13	15-24	21
	2	4	15-24	21
<u>Station 13</u>				
4/2	2	2	90-99	94
4/17	1	2	85-110	97
5/3	2	16	90-129	108
6/26	1	1	-	22
<u>Station 15</u>				
4/17	1	15	80-119	102

Table 4.8. Dominant finfish species collected in Salem Harbor with the 30-ft midwater trawl, April - June, 1973.

pollock (<u>Pollachius virens</u>)				
<u>Date</u>	<u>Set No.</u>	<u>Total Collected</u>	<u>Size Range (mm)</u>	<u>Mean (mm)</u>
<u>Station 14</u>				
5/7	2	48	185-234	211

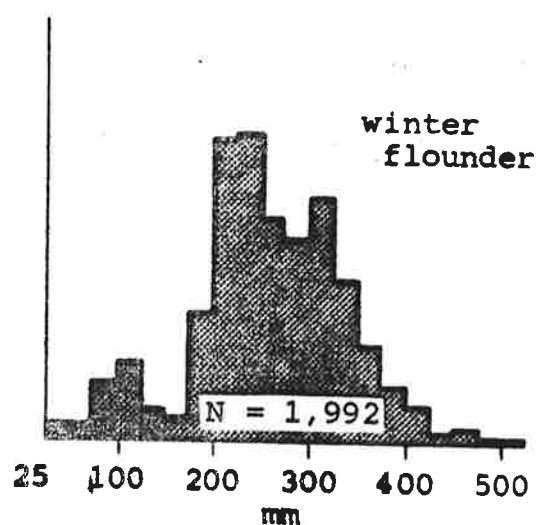
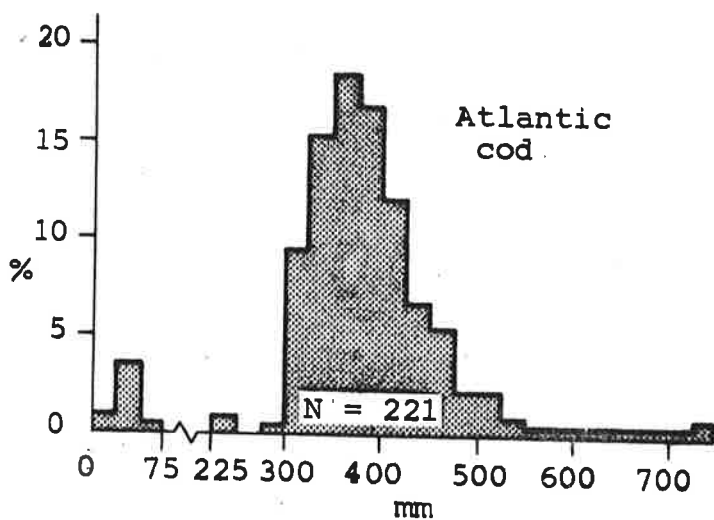
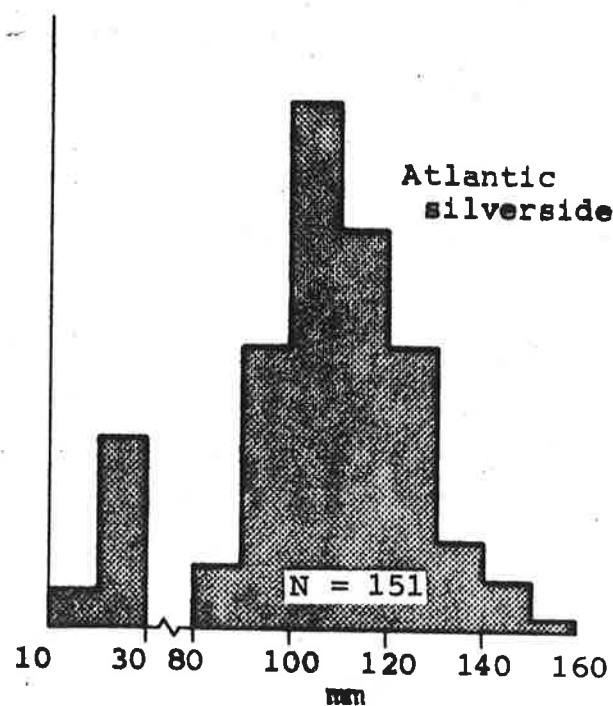
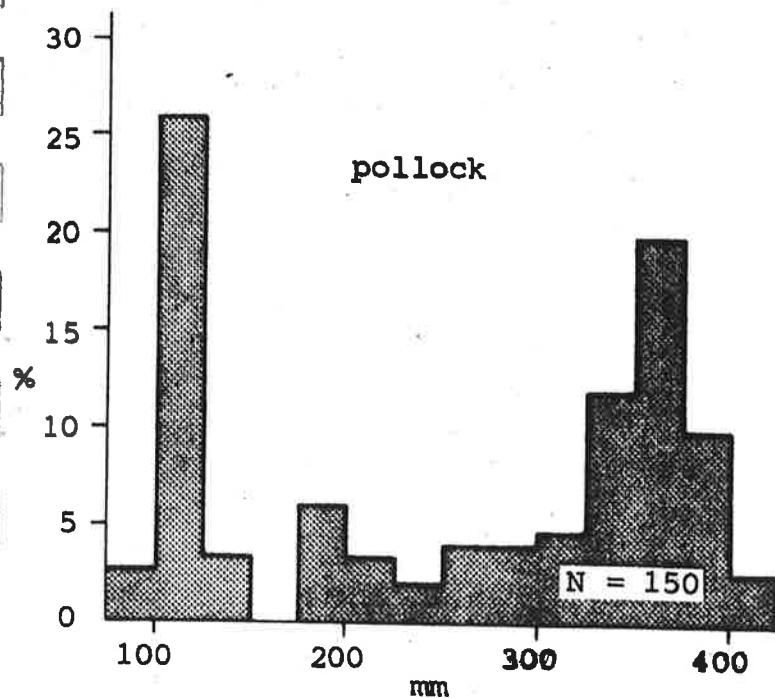


Figure 4.2. Length frequency histograms for dominant finfish species collected in Salem Harbor, April - June, 1973.

Table 4.9. Diversification index of finfish species by method of capture, Salem Harbor, April - June, 1973.

Date	50-ft Seine	120-ft Seine	30-ft Trawl	Midwater Trawl	49-ft Trawl	Gill Net
4/2	5					
4/3		10				
4/5			3			
4/9						
4/17	3	4			7	
4/18			2	1		
4/23						8
5/3	4	4			7	
5/7			7	5		
5/8						
5/14		4			6	
5/15	1					
5/21			10	1		
5/23						
5/30					7	
6/11		4				11
6/12	2				4	
6/15			11	1		
6/25		8				
6/26	2					
6/28			11		2	8

Table 4.10. Rank of finfish collected outside Salem Harbor with the 49-ft trawl, April - June, 1973.

Species	Total
1. winter flounder	3,332
2. yellowtail flounder	271
3. Atlantic cod	253
4. ocean pout	84
windowpane	84
5. rainbow smelt	8
6. longhorn sculpin	5
7. sea raven	3
pollock	3
8. American plaice	1
white hake	1
goosefish	1
Total	3,946

Table 4.11. Finfish species collected in the Unit 3 and 4 sluiceways, Salem Harbor, April - June, 1973.

Species	(EST)	4/4	4/4	4/5	4/6	4/10	4/11	4/11	4/12	4/25	4/25	4/26	TOTALS*
		0900	1500	1100	1100	0900	0800	1500	0900	0700	1300	1300	
		1100	1600	1300	1300	1100	0900	1700	1100	0900	1500	1500	
	Tidal Stage (Hrs)	L+4½	H+2½	H	L+5	L+5½	H+3	L+4	H+3	H+3½	L+3	L+2½	
<u>Unit 3</u>													
Atlantic silverside						1	1						2 (1)
Atlantic tomcod												1	1
rainbow smelt									1			1	2 (1)
sea raven				1									1
threespine stickleback		1	1			15						1	18
winter flounder								1	1	1			3
<u>Unit 4</u>													
alewife											1		1 (1)

Table 4.11. Continued

Species	(EST)	5/14	5/14	5/16	5/25	6/11	6/12	6/14	6/19	6/27	6/29	6/29	TOTALS*
		0600	0700	1400	0600	0800	0800	0800	1000	0700	1000	1400	
	Tidal Stage (Hrs)	L+3½	L+4½	L+4	H+2½	H+1	H	L+5	L+3½	H	H+1	H+5	
Atlantic silverside													
northern pipefish													1 (1)
threespine stickleback		1											1
white hake													1 (1)
winter flounder								1					1 (1)
													2 (2)

Table 4.11. Continued

Species	(EST) Tidal Stage	June 6										June 7			TOTALS*
		0500	0700	0900	1100	1300	1500	1700	1900	2100	2300	0100	0300		
		0700	0900	1100	1300	1500	1700	1900	2100	2300	0100	0300	0500		
		Low					High					Low			
<u>Unit 4</u>															
Atlantic cod						1								1 (1)	
cunner							1		1					2 (2)	
lumpfish							1							1 (1)	
northern pipefish						1	3							4 (3)	
white hake											1			1 (1)	
winter flounder							4							4 (3)	

*Number of dead finfish shown in parenthesis.

Unit 3 was shut down for annual maintenance from 5 May - 1 June.

4.5 Lobster Tagging

1973 tagging commenced April 13. To date, 344 lobsters have been released in Salem Harbor (1972 - 144, 1973 - 200) and 533 liberated at Bowditch Ledge in Salem Sound (1972 - 302, 1973 - 231). Of 446 sub-legal sized lobsters tagged and released in 1972, 139 (31%) were recaptured prior to 1973 tagging operations. 21 tags (5%) have been returned from the 431 lobsters liberated in 1973 (Figures 4.3 - 4.6). A total of 6 molted lobsters have been recovered. Growth of the molted lobsters ranged from 8.8 to 11.9 mm, and averaged 10.7 mm.

Figure 4.3. Recapture locations of 1972 tagged lobsters, Homarus americanus, liberated in Salem Harbor.

1 July 1972 - March 1973

① April 1973 - June 1973

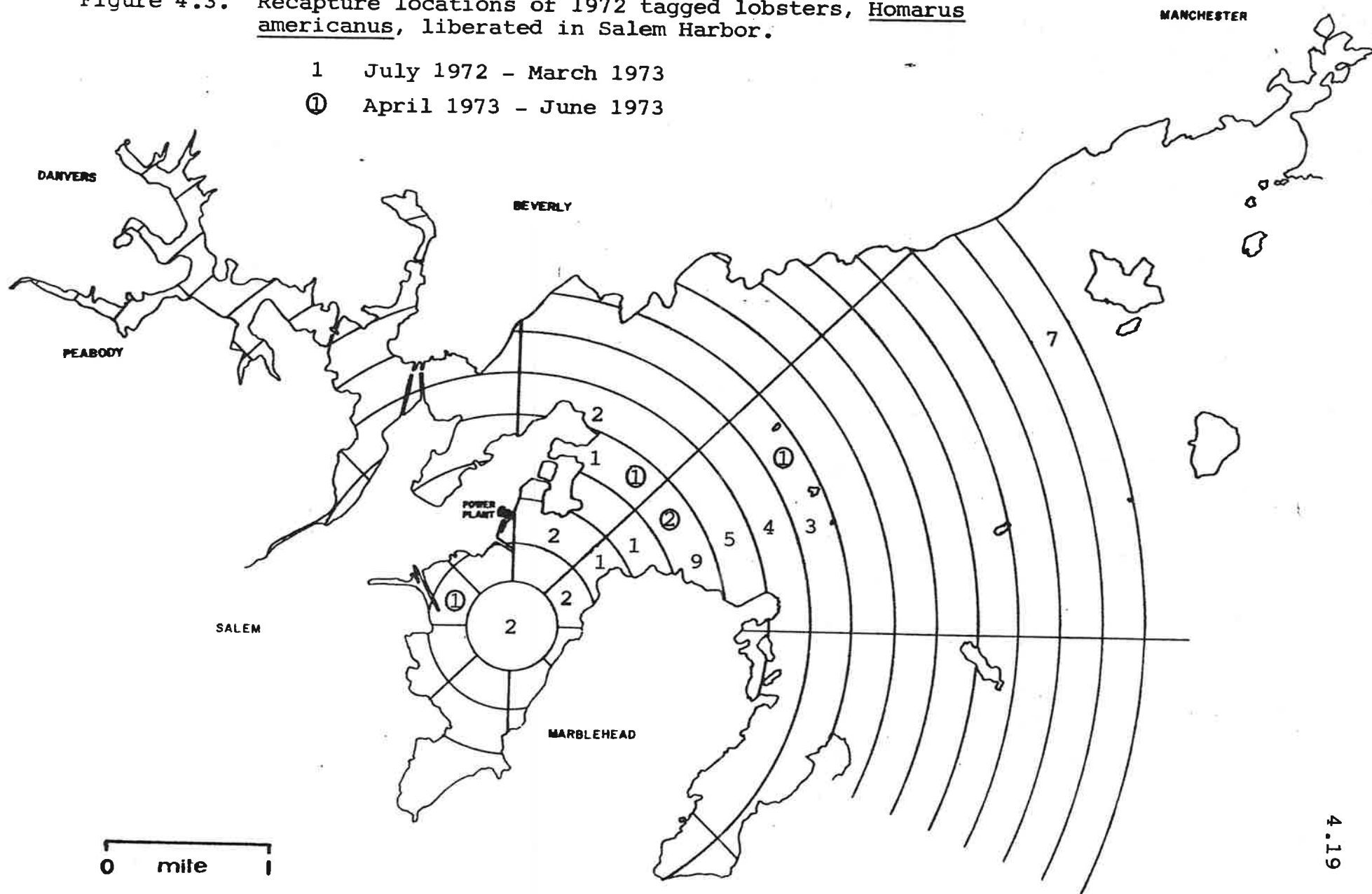
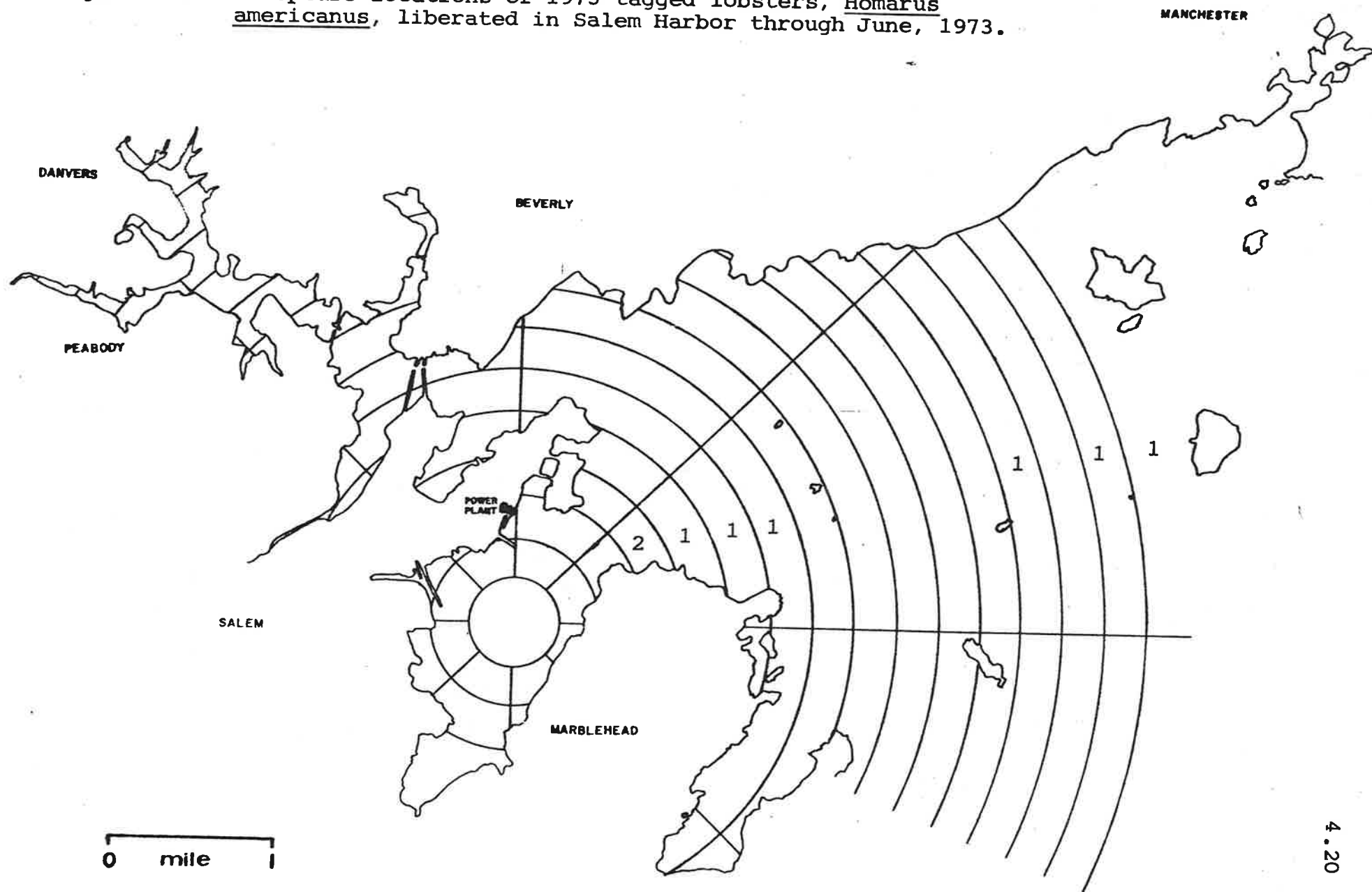


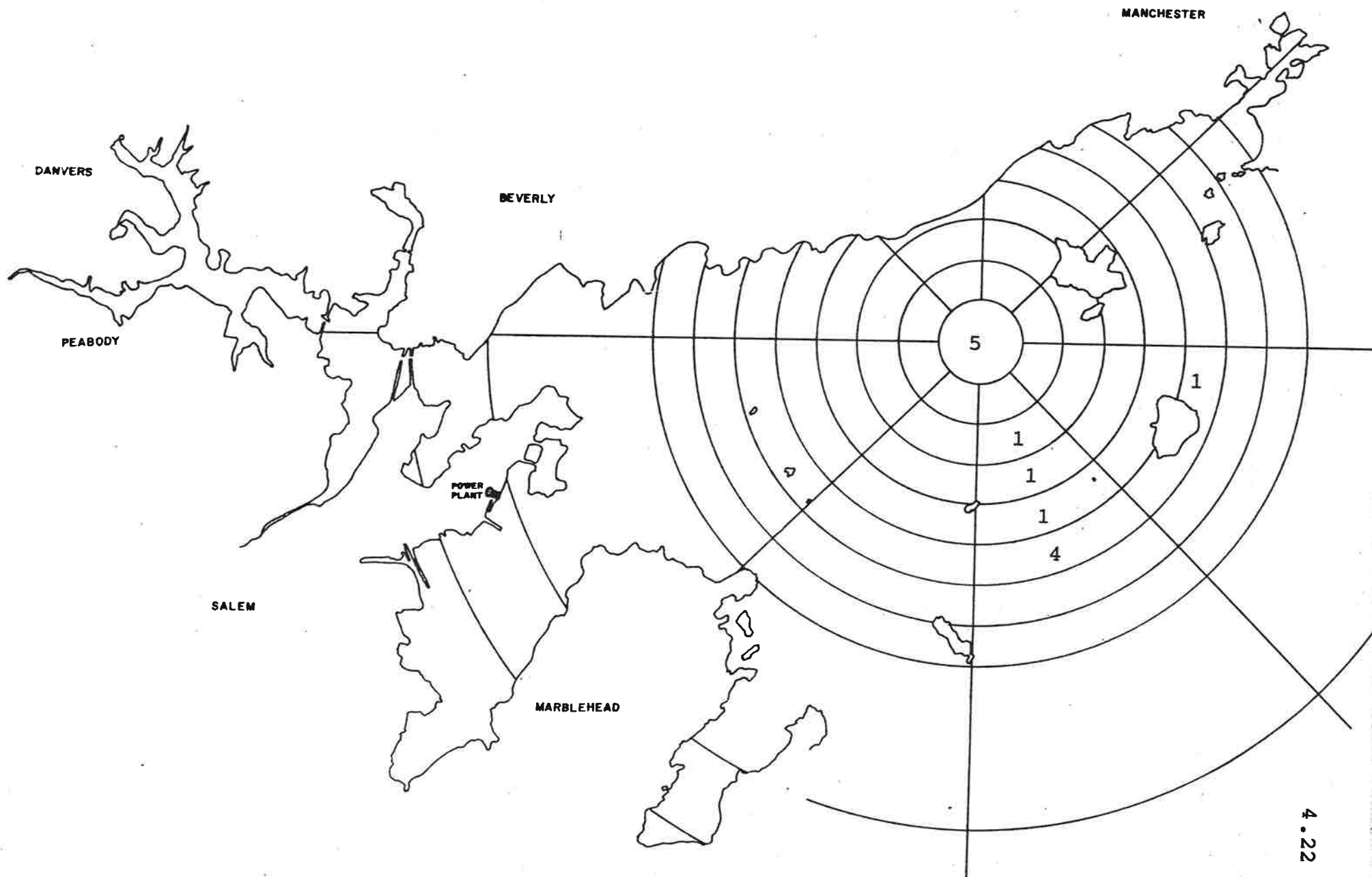
Figure 4.4. Recapture locations of 1973 tagged lobsters, Homarus americanus, liberated in Salem Harbor through June, 1973.



1 July 1972 - March 1973
① April 1973 - June 1973



Figure 4.6. Recapture locations of 1973 tagged lobsters, Homarus americanus, liberated in Salem Sound through June, 1973.



5.0 SUMMARY

Project staff was increased to nine. Preliminary current data for Salem Harbor was compiled. A continuous recording thermograph is maintained in compliance with EPA discharge permit requirements.

Except for a 1.3°C increase in average surface water temperatures over the Spring of 1972, water quality throughout Salem Harbor is unchanged. This increase, however, does not appear to have an adverse affect upon the marine resources of the Harbor. Laboratory personnel received instruction on ^{14}C and ATP analyses.

Laboratory thermal bioassays were intensified, and preliminary tolerance levels identified. Winter flounder continues to dominate field collections. Finfish impingement upon units 3 and 4 travel screens averaged less than one/hour.

Bi-weekly ichthyoplankton sampling was resumed. Benthic sampling was initiated in the vicinity of the proposed Unit 5 discharge. 1973 lobster tagging commenced with the liberation of 431 sub-legal sized lobsters.

6.0 APPENDIX

SAMPLING PROCEDURES

CHLORINITY

Field Collection: 300 ml/sample of seawater.

Laboratory Analysis: Modified Knudsen method, from Strickland and Parson (1968).

SALINITY

Field Analysis: Direct reading from a G.M. hydrometer, calibrated from 0 - 45 ‰.

HYDROGEN ION

Field Analysis: Hach Chemical Company test kit, Model 17-N.

Samples collected from May 15 - December 1, 1972 were analyzed with a Hach test kit, Model CA-10. Prior to May 15 a Kontes mini-pH meter was employed.

CARBON DIOXIDE

Field Analysis: Hach Chemical Company test kit, Model CA-10.

DISSOLVED OXYGEN

Field Collection: 300 ml/sample of seawater fixed with 1 ml manganous sulfate reagent and 1 ml alkaline iodide reagent.

Laboratory Analysis: Titration by Winkler method.

BIOLOGICAL OXYGEN DEMAND

Field Collection: 300 ml/sample of seawater.

Laboratory Analysis: Titration by Winkler method following 7-day incubation.

COPPERField Collection:

Water - 1 liter/sample collected in a nalgene bottle.

Soft shell clam - 6/sample, approximately 2" in length.

Lobster - 1/sample, approximately 3" in carapace length.

Laboratory Analysis: Utilizing a modified Strickland and Parsons (1968) method, the soft portions of clams and 6 grams of lobster gills are digested and analyzed.

NITRATE

Field Collection: 300 ml/sample of seawater.

Laboratory Analysis: Ultraviolet spectrophotometric method from Standard Methods (1971).

NITRITE

Field Collection: 300 ml/sample of seawater.

Laboratory Analysis: Modified Griess Diazo reaction from Griess (1858).

INORGANIC PHOSPHATES

Field Collection: 300 ml/sample of seawater.

Laboratory Analysis: Colorimetric determination of reduced phosphomolybdate complex from Fiske and Subba Row (1925).

BENTHIC

Field Collection: Benthic algae and invertebrates are sampled at sites selected at various depth contours. Quadrats are established by attaching a 12-ft line to the site marker and swinging a circle of 10-ft radius. The first quadrat is located 2 ft from the marker, and subsequent quadrats are located 2 ft and 70° counter-clockwise from the former. This procedure is repeated until 5-1/4m² samples are collected within each circle. Samples are stored and frozen in plastic bags until analyses.

PLANKTON

Field Collection: Phytoplankton is collected in a water sample bottle (Van Dorn or Nanson). Zooplankton is collected in an 80 micron mesh nytex plankton net. Tows are made for 1 minute at selected sites and strained water volume is recorded on an 8.5 cm T.S. flow meter attached to a one meter ring. Samples are transferred to 250 ml nalgene bottles containing a 5% glutaraldehyde solution, and refrigerated until analyses.

CHLOROPHYLL

Field Collection: Surface seawater is filtered through a 316 micron mesh nytex cloth into a one gallon nalgene bottle and stored in a light-proof box for transport to the laboratory.

Laboratory Analysis: Samples are stored in a cool dark place not exceeding eight hours from collection. Estimation of extracted algae cell pigments is made spectrophotometrically using the SCOR/UNESCO method outlined by Strickland and Parsons (1968).

FINFISH

Field Collection: Duplicate sets are made at selected sites with gear of the following desing:

50 x 4 ft seine, with 1/8 in mesh;

120 x 8 ft seine, with 1-1/2 in mesh wings and 3/4 in mesh bag;

30 x 25 ft trawl with 1-1/2 in mesh wings and 1 in mesh cod end;

49 x 38 ft trawl with 5 in mesh wings and 4 in mesh cod end.

Seines are set parallel to shore with the aid of a skiff and drawn to the shore by lines of approximately 75 ft. Trawl cruises are along a fixed course. Where obstructions occur, cruise lines are altered. Fishing time is five minutes with the 30 ft trawl and 20 minutes with the 49-ft trawl.

Gill nets are set at selected sites for 24 hours. All gill nets are constructed of monofilament and measure 100 x 10 ft. Stretched mesh size range from 1-1/2 to 3-1/2 in.

Finfish collected are separated by species, enumerated, and measured for total length in millimeters.

SPORT FISH SURVEY

Starting Date: mid-April

Ending Date: mid-October

Area: Salem Harbor, inside or west of a line drawn between Fort Pickering Light on Winter Island to Naugus Head in Marblehead; and the easterly shorelines of Winter Island and Salem Neck from the Fort Pickering Light to, and including, the public pier at the north end of Salem Neck.

Procedure: Instantaneous fishermen counts are conducted three times during each survey day at randomly selected hours.

Fishermen interviews are conducted throughout the survey day. Survey data is recorded on forms provided for a minimum of 10 percent of all shore and boat fishermen.

Children who are fishing are included in the instantaneous counts, and a separate tally noted. Children are not interviewed when fishing in the accompaniment of an adult.

Schedule: One weekday and one weekend day is surveyed each week. All holidays are surveyed. Selection of day, and 8-hour shift (6 - 2 or 10 - 6), is made at random. Changes in routine are made only at time of schedule selections.

FISH EGG AND LARVAE

Field Collection: Procedures employed in collecting and handling fish egg and larvae are identical to zooplankton except for use of a 153 micron mesh nytex net.

SLUICeway INVESTIGATIONS

Field Collection: Finfish, invertebrates and marine vegetation are sampled in the intake sluiceways to Units 3 and 4. Traps, constructed of 1/2 in welded steel rod and covered with 3/16 in stretched mesh nylon net, are periodically placed in the respective sluiceways for one hour intervals. All organisms are identified, enumerated and measured. Water temperature and salinity is recorded during each sampling interval.

LOBSTER TAGGING

Field Collection: Division personnel, aboard commercial vessels, collect sub-legal sized lobsters (3 - 3-1/8 in) from Beverly and Salem Harbors. Lobsters are then transferred to a Division boat or returned to our Cat Cove Laboratory for tagging with a fluorescent orange spherion tag.

Tagging Procedure: Tags are attached by securing a stainless steel anchor (.014 dia.) in the body muscle beneath the abdomen with the aid of a #20 hypodermic needle. Each tag is imprinted with a number and the legend "Div. Mar. Fish., Salem, Mass." Tagged lobsters are then released at selected sites in Beverly and Salem Harbors. Sex, carapace length (in millimeters), date, and release point are recorded.

Return Procedure: Through a public awareness program, including personal letters to commercial lobstermen known to fish Beverly - Salem Harbors; distribution of posters and tag reporting forms; and articles in the local news media; individuals are requested to return lobster tags to our laboratory or to a cooperating fish dealer. All returns are acknowledged in writing, and tags are placed on a map designating the point of capture. Records are updated on growth and movements of each recapture.

THERMAL BIOASSAY

Field Collection: Finfish species are collected by seines and trawls and transported to the laboratory in aerated containers of seawater.

Laboratory Experiment: Following acclimation to room temperature (about 18°C), 96 hour tolerance levels for each species are determined for abrupt and gradual changes in water temperature. Effects are noted for each 2.8°C gradient over the range -1.0 to 32.0 °C.

HYDROGRAPHIC SURVEYS

Tidal direction and velocity are recorded with an Endeco 110 remote current meter. Direct readout data is collected at varied depths along prescribed transects bisecting Salem Harbor. Attempts are made to monitor seasonal current patterns at varied tidal stages. Data interpretation is performed by project personnel.

TEMPERATURE MONITORING

In situ monitoring is conducted with Endeco 109 continuous recording thermographs. Thermographs are installed at prescribed locations and depths by personnel utilizing SCUBA. Temperature data is retrieved at approximately 30-day intervals and delivered to Environmental Devices Corporation for reduction and verification.

ADENOSINE TRIPHOSPHATE

Field Collection: Following removal of zooplankton with an 80 micron mesh net, water is filtered through a 2.4 GF/A millipore filter retained in a Swinex 25 filter holder locked between two 50ml disposable syringes. After filtration the filter pad is removed, quick frozen on dry ice, and placed in a labeled glass vial for transport to the laboratory. All samples remain frozen until analyzed. Triplicate samples are collected at each sampling site.

Laboratory Analysis: ATP is assayed enzymatically using the luciferin-luciferinose bioluminescence system outlined by Strehler (1968).

¹⁴C

Field Collection: At depths determined by a portable photometer (100, 50, 25, 12 and 0% relative light intensity) unfiltered water is incubated for 4 hours in 300 ml BOD bottles containing a solution of radioactive carbon. Duplicate samples are collected in light and dark bottles. Immediately following incubation all samples are placed in a light proof container for transport to the laboratory.

Laboratory Analysis: Following filtration of phytoplankton from seawater samples, the uptake of fixed radioactive carbon is determined by the liquid scintillation technique outlined by Strickland and Parsons (1968).

Table 3.2. Comparative water quality data for Salem Harbor, July 1971 - March 1973.

		1971	1972				1973
		July- Dec	Jan- Mar	Apr- June	July- Sept	Oct- Dec	Jan- Mar
Temperature (°C)	Min	4.5	0.0	4.5	11.5	4.5	-2.0
	Max	24.0	16.0	21.5	23.0	22.5	16.0
	Ave	13.1	4.7	11.5	19.0	11.2	4.4
Salinity (0/00)	Min	29.3	31.1	26.6	29.6	29.1	17.4
	Max	32.9	35.0	32.9	31.4	32.5	33.0
	Ave	30.8	32.7	30.0	29.8	30.3	30.8
pH	Min	8.0	8.0	8.0	8.0	8.0	8.0
	Max	8.0	9.0	8.0	8.0	8.5	8.5
	Ave	8.0	8.3	8.0	8.0	8.1	8.5
CO ₂ (ppm)	Min	5.0	5.0	5.0	5.0	5.0	5.0
	Max	10.0	10.0	10.0	10.0	10.0	10.0
	Ave	7.5	8.2	7.5	5.8	7.9	8.8
O ₂ (ppm)	Min	6.4	8.7	8.5	7.0	7.6	9.2
	Max	9.7	11.3	13.2	9.6	12.5	13.1
	Ave	8.1	10.5	9.8	8.3	8.8	10.9
BOD (ppm)	Min		1.4	1.2	1.0	0.8	0.5
	Max		4.7	5.1	3.3	4.0	7.8
	Ave		2.5	2.5	2.2	1.9	2.9
Nitrite - N (µg-atom/l)	Min						0.1
	Max						3.4
	Ave						0.8
Nitrate - N (µg/atom/l)	Min						6.5
	Max						129.0
	Ave						38.3
Phosphate - P (µg-atom/l)	Min						2.2
	Max						59.2
	Ave						19.8

The above table supersedes Table 3.2 of Quarterly Report #6, and reflects corrected nitrite, nitrate and phosphate values for January - March, 1973.

Project expenditures as of June 30, 1973 were:

	<u>Total Allotted</u>	<u>Total Expended</u>	<u>Balance</u>
Salaries	\$ 86,675.00	\$ 78,358.89	\$ 8,316.11
Travel	3,375.00	1,303.65	2,071.35
Office & Laboratory Supplies	8,875.00	3,881.99	4,993.01
Equipment	23,500.00	18,023.53	5,476.47
Maintenance	6,100.00	2,095.99	4,004.01
Overhead	<u>33,045.00</u>	<u>15,261.18</u>	<u>17,783.82</u>
Subtotal	\$161,570.00	\$118,925.23	\$42,644.77
Contracts	<u>79,280.00</u>	<u>24,000.00</u>	<u>55,280.00</u>
TOTAL	<u>\$240,850.00</u>	<u>\$142,925.23</u>	<u>\$97,924.77</u>