

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

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July, 1972

Progress Report No. 3
April - June, 1972

Division of Marine Fisheries
Department of Natural Resources
The Commonwealth of Massachusetts

Publication of this Document Approved by Alfred C.
Holland, State Purchasing Agent No. 6267.

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INTRODUCTION

The following is the third quarterly progress report of research performed by personnel of the Division of Marine Fisheries operating under contract Project DMF-2-72 with the New England Power Company. Included are data collected from 1 April through 30 June 1972.

PHYSICAL INVESTIGATIONS

Temperature Monitoring

Bathythermograph (BT) casts are continuing at all offshore finfish sampling stations. In addition, a series of BT casts were taken June 29 along 5 transects east of Winter Island, in the area proposed for future intake and discharge cooling water (Fig. 1). Figure 2 displays isotherms along transect A at a tidal stage of low + 5 hrs.

Horizontal and vertical temperature and salinity characteristics of the discharge channel were monitored for one tidal cycle. Units I, II and III maintained an average total output of 282 MW while circulating 183,500 gpm of cooling water.

Average surface water temperature for the quarter rose approximately 7° to 12°C. Surface water temperatures recorded at Stations A and B are plotted in Figure 3.

CHEMICAL INVESTIGATIONS

Water Quality

Monitoring of water quality continued with little variance from previous data. Ranges for parameters sampled at Stations 1 - 18 (Figs. 4 and 5) were: surface water temperature, 3.0 - 19.0°C; surface salinity, 17.0 - 32.0 0/00; pH, 8.0; carbon dioxide,

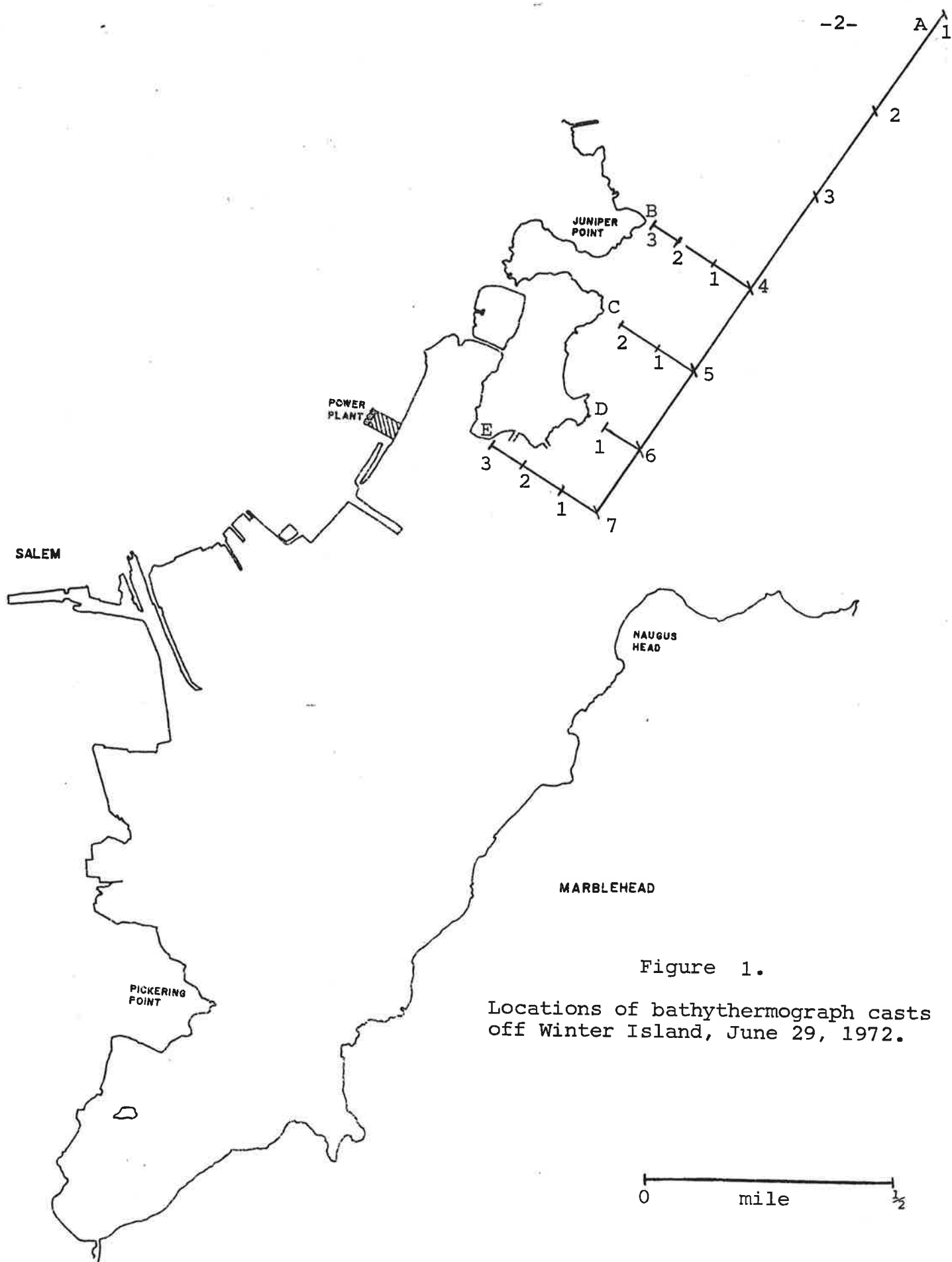


Figure 2. Temperature isotherms ($^{\circ}\text{C}$) along transect A off Winter Island, Salem, June 29, 1972.

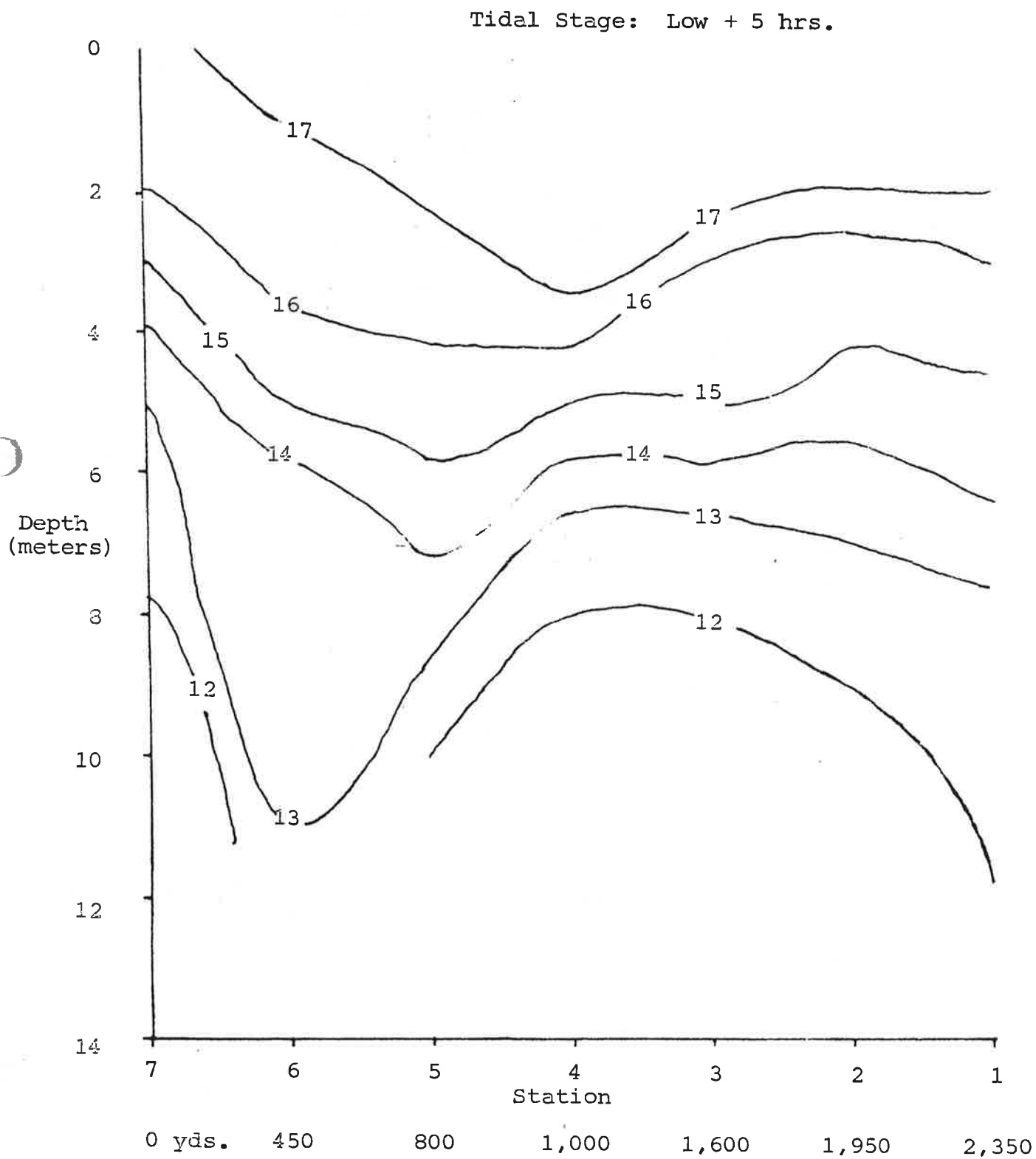


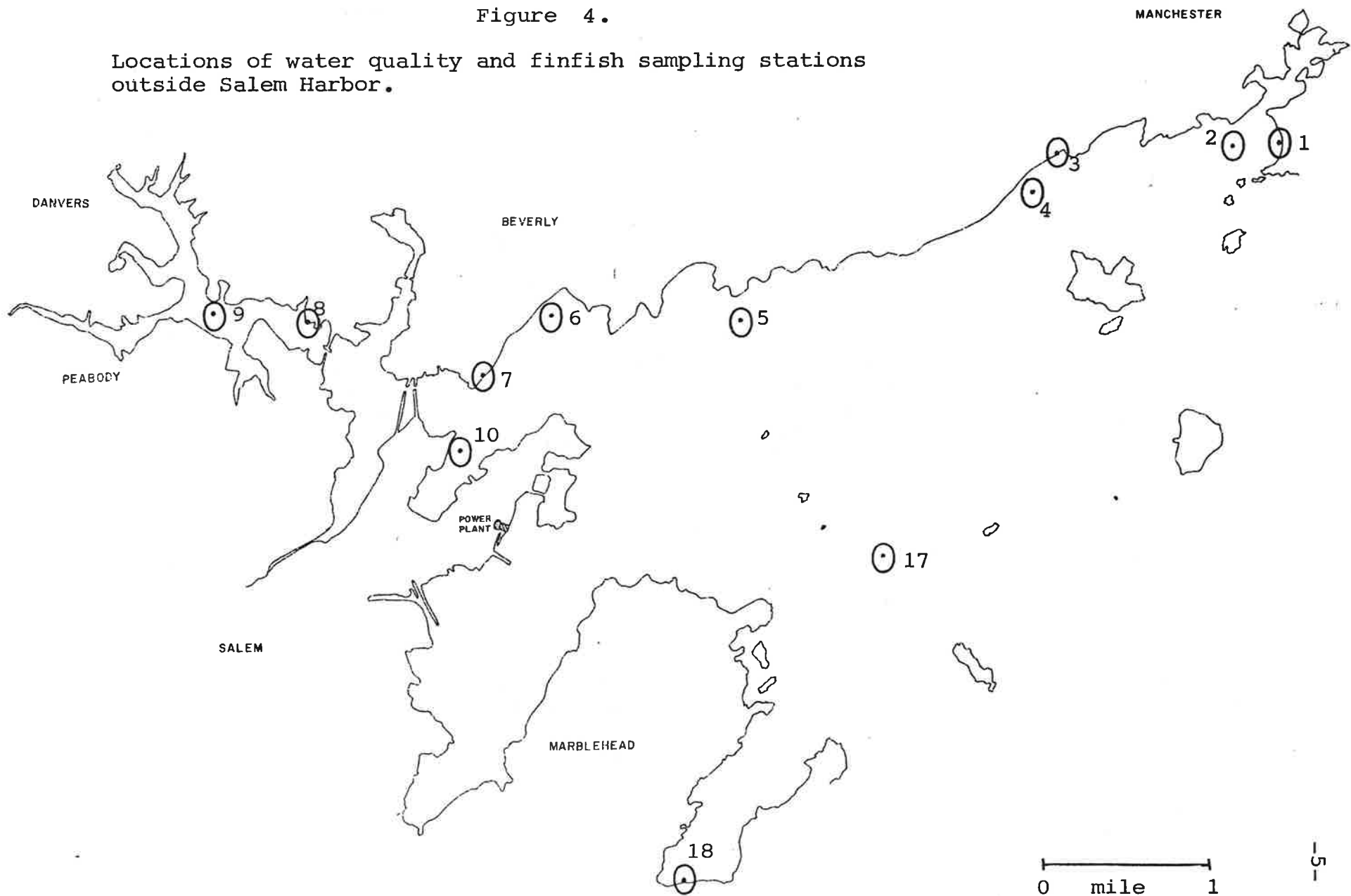
Figure 3.

Surface water temperatures recorded at Stations
A and B in Salem Harbor, April - June, 1972.



Figure 4.

Locations of water quality and finfish sampling stations
outside Salem Harbor.



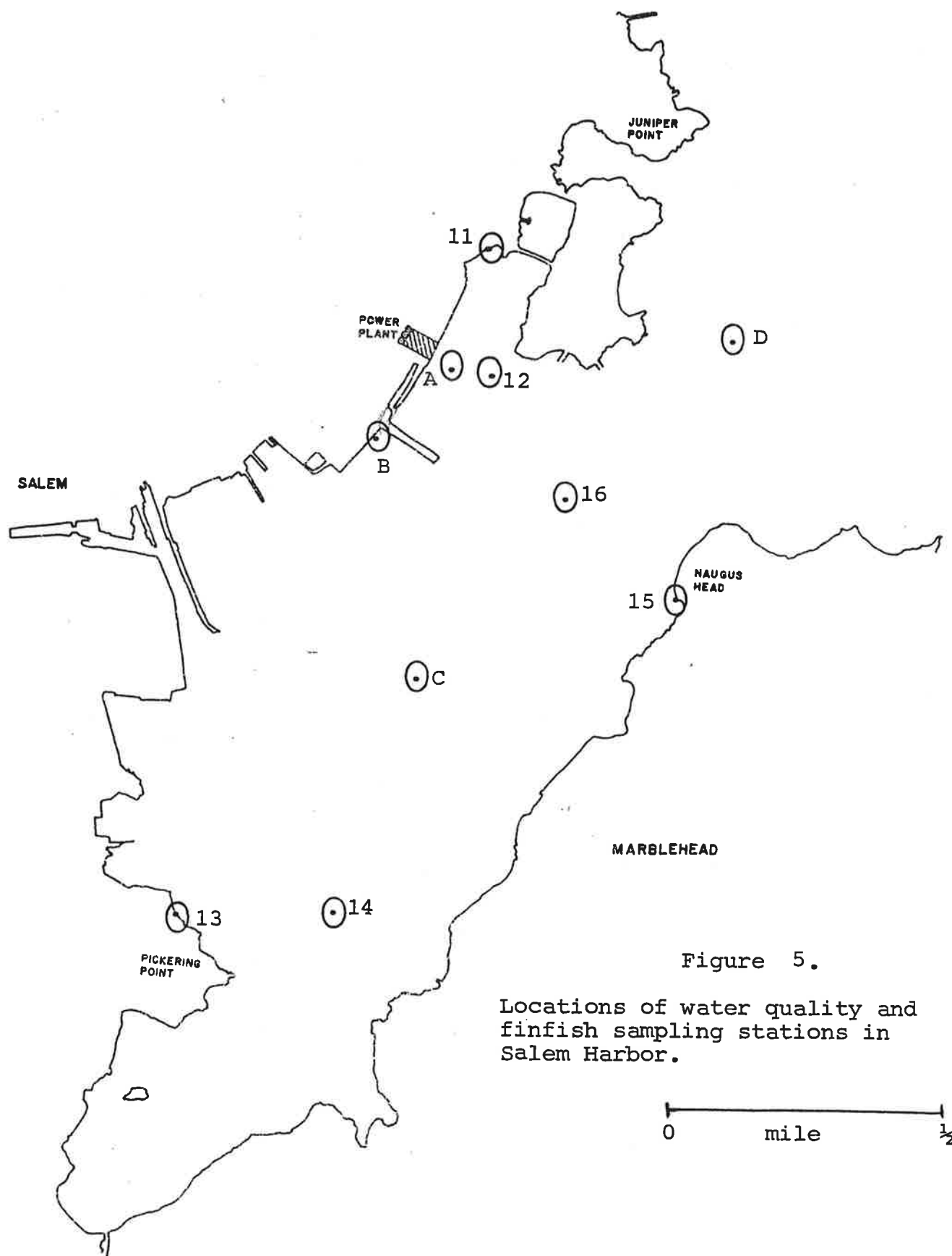


Figure 5.

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

5.0 - 10.0 ppm; and dissolved oxygen, 7.7 - 12.5 ppm (Table 1).

Ranges for parameters sampled at Stations A - D were: surface water temperature, 4.5 - 21.5 °C; surface salinity, 26.6 - 32.9 ‰; pH, 8.0; carbon dioxide, 5.0 - 10.0 ppm; dissolved oxygen, 8.5 - 13.2 ppm; and biological oxygen demand, 1.2 - 5.1 ppm (Table 2).

Heavy Metal Analyses

Copper concentrations in lobsters, Homarus americanus, and soft shell clams, Mya arenaria are assessed monthly. Levels varied from 2.0 to 16.0 ppm in clams and from 10.0 to 44.2 ppm in lobsters (Table 3).

Samples of sediment, winter flounder, Pseudopleuronectes americanus, and soft shell clams were also analyzed at the Massachusetts Department of Public Health's Lawrence Experiment Station for concentrations of mercury, cadmium, lead, zinc, nickel, copper, and chromium (Table 4).

To be used only as a guide, Table 4 contains "alert levels" for trace metals in soft shell clams as proposed by the U.S. Food and Drug Administration to the delegates at the 1971 National Shellfish Workshop. Action on establishing "alert levels" was postponed until the next scheduled Workshop in 1973.

BIOLOGICAL INVESTIGATIONS

Plankton and Primary Productivity Studies

Chlorophyll levels are assessed bi-^{weekly}monthly, and concurrently with surface plankton analyses. Twenty-eight samples collected this quarter (Table 5) reflect the following ranges:

Table 1. Water quality data for Beverly - Salem Harbor, April - June, 1972.

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL STAGE (HOURS)	WIND DIR/VEL (MPH)	CLOUD COVER (%)	DEPTH	TEMP °C		SALINITY (0/00)	pH	CO ₂ (ppm)	O ₂ (ppm)
AIR	WATER											
Station 1												
4/10	000348	1100	high +3	W/6	60	S	6.0	5.0	28.0	8.0	10.0	11.6
5/10	000394	1100	high +2½	W/7	90	S	11.0	14.0	17.0	8.0	5.0	7.7
6/22	000454	0920	high +1½	0	100	S	14.5	19.0	29.0	8.0	5.0	9.2
Station 2												
4/11	000361	1125	high +2½	0	100	S	3.0	4.5	31.0	8.0	5.0	11.5
5/1	000380	0927	low +3	S/6		S	17.5	10.0	28.0	8.0	10.0	11.1
6/7	000422	0845	high +2	0	80	S	15.5	12.0	26.5	8.0	10.0	9.4
Station 3												
4/10	000347	0920	high +2½	E/6	30	S	5.5	4.0	30.5	8.0	10.0	11.3
5/11	000393	0900	high	W/5	70	S	14.0	8.5	28.5	8.0	10.0	10.1
6/21	000445	0545	low +5	0	100	S	17.0	14.0				
6/22	000453	0900	high +1	0	100	S	18.0	14.5				
Station 4												
4/11	000362	1220	high +3	0	100	S	4.5	3.0	32.0	8.0	5.0	11.8
5/1	000381	0958	low +3	SE/5	40	S	12.0	9.0	30.0	8.0	10.0	11.2
6/7	000423	0930	high +2½	0	80	S	14.5	12.0	30.0	8.0	5.0	10.4
Station 5												
4/14	000358	0925	low +4	N/19	90	S	6.5	4.0	32.0	8.0	10.0	
5/23	000433	0845	low +1	0	0	S	16.0	12.0	28.0	8.0	10.0	9.6
6/12	000430	0830	low +3	0	10	S	12.5	11.0	29.0	8.0	10.0	
Station 6												
4/11	000363	1240	high +4	0	100	S	3.5	4.0	31.5	8.0	10.0	12.5
5/1	000382	1040	low +4	0	40	S	17.5	9.5	29.5	8.0	10.0	10.8
6/7	000424	1100	high +4		50	S	20.0	12.0	29.0	8.0	5.0	9.3

Table 1. Continued

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL STAGE (HOURS)	WIND DIR/VEL (MPH)	CLOUD COVER (%)	DEPTH	TEMP °C		SALINITY (0/00)	pH	CO ₂ (ppm)	O ₂ (ppm)
							AIR	WATER				
Station 7												
4/3	000346	1500	high +1	0	100	S	3.0	4.0	31.5	8.0	10.0	
5/10	000392	1025	high +2	NE/9	80	S	9.0	8.5	29.5	8.0	10.0	9.3
6/22	000455	1010	high +2	NE/20	100	S	16.5	16.0				
Station 8												
4/3	000345	1420	high + ½	W/20	100	S	3.5	6.5	30.0	8.0	10.0	10.0
4/12	000353	1120	high +1½	0	10	S	6.5	5.5	28.0	8.0	10.0	11.5
5/10	000391	1040	high +2	0	90	S	10.0	8.5	27.0	8.0	10.0	9.0
5/11	000401	1120	high +2	NW/15	100	S	9.0	10.0	27.0	8.0	5.0	9.0
6/21	000446	0700	high	0	100	S	17.0	13.5	28.5	8.0	10.0	8.7
6/22	000456	1045	high +5	NE/6	100	S	17.5	15.0	28.5			8.0
Station 9												
4/11	000364	1340	high +5	0	100	S	5.5	5.0	28.5	8.0	10.0	10.5
5/1	000383	1124	low +4			S	17.0	10.5	28.5	8.0	10.0	10.1
6/7	000425	1200	high +5	W/6	80	S	19.5	14.0	24.0	8.0	10.0	8.4
Station 10												
4/11	000365	0950	high +1	SW/5	100	S	3.0	4.5	30.5	8.0	10.0	10.7
5/1	000386	1300	high			S	15.0	11.0	28.0	8.0	10.0	10.4
6/7	000421	0800	high +1	0	100	S	15.0	12.0	29.0	8.0	10.0	8.4
Station 11												
4/3	000349	1130	low +3½	W/6	90	S	7.5	7.0	30.0	8.0	10.0	10.3
4/4	000351	1230	low +4	0	100	S	4.0	7.0	30.0	8.0	10.0	10.2
5/10	000390	0700	low +5	NW/5	80	S	6.0	8.0	29.5	8.0	5.0	9.3
5/11	000400	0820	low +5	0	80	S	12.0	10.0	29.0	8.0	5.0	9.2
6/21	000447	0815	high +1	0	100	S	23.0	17.0	28.0	8.0	10.0	8.6
6/22	000452	0825	high + ½	NE/6	100	S	16.0	17.0	28.0	8.0	10.0	8.0

Table 1. Continued

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL STAGE (HOURS)	WIND DIR/VEL (MPH)	CLOUD COVER (%)	DEPTH	TEMP °C		SALINITY (0/00)	pH	CO ₂ (ppm)	O ₂ (ppm)
AIR	WATER											
<u>Station 12</u>												
4/11	000366	0942	high +1	SE/6	100	S	4.5	5.0	32.0	8.0	10.0	11.0
5/1	000384	1240	high	S/6		S	15.0	10.0	29.5	8.0	10.0	11.2
6/7	000419	0600	low +5½	0		S	14.0	13.5	27.5	8.0	10.0	9.3
<u>Station 13</u>												
4/3	000344	1330	low +5½	W/12	90	S	4.5	4.0	31.0	8.0	10.0	10.4
4/11	000367	1030	high +1½	0	100	S	4.0	5.5	31.0	8.0	5.0	10.7
5/10	000388	0715	low +4	NW/7	100	S	6.0	8.5	27.5	8.0	5.0	9.4
5/11	000399	0630	low +4	W/5	90	S	10.0	8.5	28.5	8.0	10.0	8.6
6/21	000448	1000	high +3	0	90	S	21.0	18.0	28.0	8.0	10.0	9.8
6/22	000449	0600	low +4	NE/10	100	S	15.0	16.5	29.0	8.0	5.0	7.7
<u>Station 14</u>												
4/11	000367	1030	high +1½	0	100	S	5.5	4.0	31.0	8.0	5.0	10.7
5/1	000385	1228	high +1		90	S	15.0	10.0	29.0	8.0	10.0	10.6
6/7	000420	0715	high +1½	0	90	S	14.5	13.0	24.5	8.0	10.0	8.8
<u>Station 15</u>												
4/3	000342	1220	low +4½	W/14	90	S	4.5	6.5	30.0	8.0	10.0	
5/10	000389	0600	low +4	0	100	S	6.0	6.5	29.0	8.0	10.0	9.6
6/22	000451	0715	low +5½	0	100	S	15.0	15.0	28.5	8.0	5.0	8.5
<u>Station 16</u>												
4/14	000359	1205	high +1	NW/12	90	S	6.5	4.8	31.0	8.0	10.0	
5/23	000434	1030	high +3	S/6	0	S	19.0	14.0	28.0	8.0	10.0	10.3
6/12	000432	1100	low +5½		10	S	12.5	11.0	29.5	8.0	10.0	

Table 1. Continued

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL STAGE (HOURS)	WIND DIR/VEL (MPH)	CLOUD COVER (%)	DEPTH	TEMP °C		SALINITY (0/00)	pH	CO ₂ (ppm)	O ₂ (ppm)
							AIR	WATER				
Station 17												
4/14	000360	1450	high +4½	N/8	90	S	7.0	4.0	31.0	8.0	5.0	10.5
5/23	000435	1230	high +5	S/7	0	S	13.5	12.5	28.0	8.0	10.0	
6/12	000431	1315	high +1½		80	S	14.5	11.5	29.0	8.0	5.0	
Station 18												
4/3	000343	1300	low +5	W/10	90	S	5.0	6.5	31.5	8.0	5.0	9.6
5/10	000387	0620	low +4	0	100	S	4.0	7.0	27.0	8.0	10.0	
6/22	000450	0645	low +5	NE/11	100	S	14.5	15.0	18.5	8.0	5.0	

Table 2. Water quality data for Salem Harbor, April - June, 1972.

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL STAGE (HOURS)	WIND DIR/VEL (MPH)	CLOUD COVER (%)	DEPTH	TEMP °C AIR WATER	SALINITY (0/00)	pH	CO ₂ (ppm)	O ₂ (ppm)	7-DAY BOD (ppm)
<u>Station A</u>												
4/5	000354	1435	low +5	W/11	40	S	3.5 5.5	31.4	8.0	5.0	10.2	2.1
4/12	000368	1300	high +4	SW/3	50	S	8.0 6.5	31.6	8.0	5.0	11.3	
4/19	000375	1315	low +3½	NE/3	70	S	8.0 7.5	31.3	8.0	5.0	12.7	4.0
4/26	000376	0930	high	S/15	0	S	3.5 6.0	29.6	8.0	5.0	10.7	2.9
5/5	000395	1020	low	0	100	S	11.0 9.0		8.0	10.0	10.0	~~2.1~~ *
5/12	000406	1035	high +1	0	30	S	8.5 13.0	29.6			9.2	2.3
5/17	000409	1255	low +5	0	100	S	10.0 13.0	27.0	8.0	10.0	9.2	2.1
5/25	000414	1025	high +1	NE/14	0	S	17.0 11.5	29.2	8.0	5.0	10.0	3.8
6/1	000416	1310	low +5	0	100	S	16.0 14.0	31.2	8.0	10.0	9.7	2.5
6/8	000429	0810	high	0	100	S	13.0 12.5	29.7	8.0	5.0	9.4	~~2.7~~ **
6/14	000438	0940	low +2½		0	S	19.0 14.5	32.6	8.0	5.0	9.6	2.8
6/20	000444	0850	high +3		100	S	16.5 15.0	31.0	8.0	5.0	8.8	
6/28	000460	1305	high + ½	0	20	S	19.5 21.5	30.8		5.0	9.4	3.5
<u>Station B</u>												
4/5	000357	1415	low +4½	0	30	S	3.0 13.5	31.4	8.0	5.0	9.9	1.6
4/12	000369	1320	high +4½	W/6	80	S	6.5 12.5	31.6	8.0	5.0	10.5	
4/19	000374	1224	low +3	N/1	70	S	10.5 15.0	31.4	8.0	5.0	11.0	3.2
4/26	000378	0945	high	SW/3	0	S	7.0 15.0	30.0	8.0	10.0	10.8	3.3
5/5	000396	1440	high +4½	0	100	S	13.0 16.0	30.0	8.0	10.0	9.4	~~2.4~~ *
5/12	000405	1003	high +1	N/8	3	S	12.0 16.0	29.6	8.0	10.0	9.0	2.1
5/17	000410	1330	low +4½	0	100	S	17.0 16.5	27.0	8.0	10.0	9.1	1.2
5/25	000411	1020	high +1	NE/10	0	S	14.0 20.0	29.5	8.0	5.0	9.5	2.6
6/1	000418	1410	high	0	100	S	18.0 15.5	31.5	8.0	10.0	9.6	2.3
6/8	000428	0800	high	0	100	S	14.5 14.5	31.0	8.0	10.0	9.2	~~2.4~~ **
6/14	000439	1050	low +4		0	S	23.0 20.5	30.4	8.0	10.0	8.7	1.5
6/20	000441	0815	high +2	0	100	S	16.0 18.0	30.8	8.0	10.0	8.5	
6/28	000459	1320	high +1		80	S		31.2	8.0	5.0	9.1	4.3

Table 2. Continued

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL STAGE (HOURS)	WIND DIR/VEL (MPH)	CLOUD COVER (%)	DEPTH	TEMP °C AIR WATER	SALINITY (0/00)	pH	CO ₂ (ppm)	O ₂ (ppm)	7-DAY BOD (ppm)
<u>Station C</u>												
4/5	000355	1400	low +4½	W/12	30	S	3.0 5.5	31.0	8.0	10.0	10.6	2.4
4/12	000370	1340	high +4½	S/10	70	S	7.0 6.0	31.8	8.0	5.0	11.3	
4/19	000373	1223	low +3	NE/4	70	S	10.0 7.0	31.3	8.0	5.0	13.2	5.1
4/26	000377	0940	high	SW/9	0	S	4.5 6.0	26.6	8.0	5.0	10.6	2.8
5/5	000397	1000	low	W/10	90	S	11.0 10.0	30.0	8.0	10.0	9.4	~~2.3*~~
5/12	000404	0942	high	N/8	30	S	10.0 8.5	29.2	8.0	10.0	9.3	2.3
5/17	000407	1212	low +4	0	100	S	15.0 12.0	28.5	8.0	10.0	9.1	2.4
5/25	000412	1005	high +½	NE/17	0	S	16.0 12.0	29.5	8.0	5.0	10.0	3.7
6/1	000417	1335	low +5½	0	100	S	17.0 14.0	30.9	8.0	5.0	9.0	1.7
6/8	000427	0750	high	0	100	S	13.5 12.0	29.7	8.0	5.0	9.2	~~2.1**~~
6/14	000437	0915	low +2	0	0	S	20.5 15.0	32.9	8.0	5.0	8.9	1.7
6/20	000442	0825	high +2½	0	100	S	16.5 15.0	30.5	8.0	10.0	8.6	
6/28	000458	1340	high +1	0	60	S	20.5 19.5	30.5	8.0	5.0	9.0	2.5
<u>Station D</u>												
4/5	000356	1330	low +4	W/17	30	S	4.5 5.5	31.4	8.0	10.0	10.3	2.1
4/12	000371	1355	high +5	SE/10	70	S	6.0 6.0	31.8	8.0	5.0	11.3	
4/19	000372	1200	low +2½	N/11	70	S	6.5 6.5	31.4	8.0	5.0	12.4	3.3
4/26	000379	1010	high	SW/8	0	S	4.5 4.5	29.6	8.0	5.0	10.6	3.7
5/5	000398	1030	low +½	W/10	70	S	11.5 11.5	29.9	8.0	5.0	9.8	~~2.8*~~
5/12	000403	0935	low +5½	N/7	30	S	11.0 11.0	28.9	8.0	10.0	9.2	1.9
5/17	000408	1225	low +4½	0	100	S	12.0 12.0	29.0	8.0	10.0	9.2	1.6
5/25	000413	0950	high +½	NE/15	0	S	15.0 15.0	29.5	8.0	5.0	9.8	3.4
6/1	000415	1235	low +4½	0	100	S	17.0 17.0	31.1	8.0	5.0	9.5	2.0
6/8	000426	0745	high	0	100	S	13.0 13.0	30.0	8.0	10.0	9.4	~~2.3**~~
6/14	000436	0850	low +1	0	0	S	18.0 18.0	30.0	8.0	5.0	9.2	1.9
6/20	000443	0835	high +2½	0	0	S	16.0 16.0	30.8	8.0	5.0	9.0	
6/28	000457	1355	high +1½	SE/7	70	S	18.0 18.5	31.2	8.0		9.4	3.0

* 5-day B.O.D.

** 13-day B.O.D.

Table 3. Copper concentrations (ppm) in soft shell clams (Mya arenaria) and lobsters (Homarus americanus) from Salem Harbor, April - June, 1972.

Date	Station	Soft shell clam	Lobster
4/12	A	2.0	*
	B	6.2	*
	C	2.2	*
5/12	A	7.0	36.0
	B	14.0	32.0
	C	16.0	10.0
6/14	A	3.9	44.2
	B	-	27.9
	C	5.2	17.3

*Analyses suggested technique modification.

Table 4. Concentrations (ppm) of trace metals in sediment, winter flounder (Pseudopleuronectes americanus) and soft shell clams (Mya arenaria) from Salem Harbor, April 12, 1972.

	Sediment	Winter flounder	Soft shell clams	Proposed F. D. A. "alert level" for soft shell clams
mercury	0.3	0.1	0.2	0.2
cadmium	0.6	0.0	0.3	0.5
lead	52.0	1.1	4.3	5.0
zinc	61.0	9.3	22.0	30.0
nickel	12.0	0.3	2.4	
copper	23.0	1.3	21.0	25.0
chromium	260.0	0.4	6.6	5.0

Table 5. Chlorophyll counts (mg/m³) in Salem Harbor, April - June, 1972.

Date	Station	Chlorophyll a	Chlorophyll b	Chlorophyll c	Carotenoids
4/5	A	3.35	0.69	1.78	1.63
	B	1.54	1.52	4.00	0.22
	C	1.37	1.02	1.95	0.44
	D	1.54	0.83	1.98	0.85
4/19	A	6.62	2.76	5.28	2.61
	B	7.50	3.73	4.18	2.42
	C	14.17	2.44	11.09	4.97
	D	7.40	0.82	4.16	2.36
5/5	A	2.27	0.43	1.68	1.14
	B	2.84	0.53	2.10	1.33
	C	2.51	0.44	2.42	1.54
	D	2.27	0.40	2.12	1.41
5/17	A	1.06	0.47	1.42	0.05
	B	6.68	0.23	2.58	4.51
	C	6.18	0.15	2.24	3.86
	D	4.55	0.29	2.06	1.96
6/1	A	3.29	0.55	2.28	1.88
	B	2.35	0.86	2.72	1.16
	C	1.95	0.50	1.76	1.27
	D	1.95	0.50	1.76	1.12
6/14	A	2.94	0.67	2.44	1.95
	B	1.51	0.49	1.59	0.81
	C	5.16	0.75	3.30	2.88
	D	2.24	0.90	2.78	1.19
6/28	A	8.48	4.65	6.36	4.34
	B	10.16	2.65	8.07	4.28
	C	4.37	2.66	5.93	1.20
	D	6.24	2.17	6.53	2.92

Chlorophyll A	1.06 - 14.17 mg/m ³
B	0.15 - 4.65 mg/m ³
C	1.42 - 11.09 mg/m ³
Carotenoids	0.05 - 4.97 mg/m ³

Finfish

Routine sampling was supplemented by use of gill nets. Finfish species and abundance increased during the spring. Of 6,073 finfish sampled by all methods, 2,735 (45%) were captured within Salem Harbor and 3,338 (55%) were captured outside Salem Harbor (Tables 6 and 7).

Winter flounder comprised 55% of catches within Salem Harbor and 65% outside the harbor. Atlantic silverside comprised 27% of catches within Salem Harbor and 15% outside the harbor. Species diversification remained greatest at the trawl stations (Table 8).

Table 9 classifies the 26 finfish species collected.

One hundred eighty-four hours were devoted to a sport fish survey in Salem Harbor. Sport fishing effort and harvest is greatest for winter flounder. Statistical results will be compiled upon completion of the six-month survey in October.

Table 10 lists marine organisms observed during sluiceway investigations at Unit 3. Due to observed avoidance of intake travel screens by finfish species, monitoring terminated on June 30. Resumption of these investigations will coincide with operation of Unit 4.

Table 6. Numerical rank of finfish species collected in Salem Harbor, April - June, 1972.

Species	Method of Capture				Gill Net	Totals
	50-ft Seine	120-ft Seine	30-ft Trawl	49-ft Trawl		
1. winter flounder		48	96	1,317	45	1,506
2. Atlantic silverside	31	708				739
3. threespine stickleback	163	14	39			216
4. fourspine stickleback		6	70			76
5. mummichog	10	41				51
6. Atlantic cod			3	26		29
7. windowpane				25		25
8. skate*				16		16
9. striped bass					11	11
10. pollock					8	8
rainbow smelt		5	1	1	1	8
yellowtail flounder				8		8
11. ninespine stickleback	5	2				7
12. alewife		1			5	6
Atlantic menhaden					6	6
13. northern pipefish		3	2			5
14. Atlantic mackerel					4	4
15. Atlantic tomcod			3			3
grubby			3			3
ocean pout			1	2		3
16. blueback herring					2	2
17. Atlantic herring	1					1
sea raven					1	1
white hake			1			1
Totals	210	828	219	1,395	83	2,735

*Not separated by species

Table 7. Numerical rank of finfish species collected outside Salem Harbor, April - June, 1972.

Species	Method of Capture				Totals
	50-ft Seine	120-ft Seine	30-ft Trawl	49-ft Trawl	
1. winter flounder	2	25	207	1,935	2,169
2. Atlantic silverside	259	190	65		514
3. yellowtail flounder			1	195	196
4. mummichog	91	85			176
5. Atlantic cod	6	1	64	36	107
6. windowpane		3	1	35	39
7. ocean pout			1	29	30
8. threespine stickleback	7	11	7		25
9. white hake			19		19
10. Atlantic tomcod		1	13		14
11. rainbow smelt		2	5	3	10
12. fourspine stickleback			8		8
13. American eel		1	6		7
14. sea raven			1	5	6
15. cunner			4	1	5
16. northern pipefish			5		5
17. longhorn sculpin				2	2
skate*				2	2
18. alewife	1				1
blueback herring			1		1
lumpfish			1		1
seasnail			1		1
Totals	366	319	410	2,243	3,338

*Not separated by species

Table 8. Diversification index of finfish species by method of capture, Beverly - Salem Harbor, April - June, 1972.

Date	50-ft Seine	120-ft Seine	30-ft Trawl	49-ft Trawl	Gill Net
4/3	3				
4/4		2			
4/10	1	1			
4/11			9		
4/12		4			
4/14				7	
5/1			10		
5/10	6				
5/11		8			
5/23				8	
6/7			13		
6/12				8	
6/14					9
6/21		8			
6/22	5				

Table 9. Classification of finfish species collected in
Beverly - Salem Harbor, April - June, 1972.

Class: CHONDRICHTHYES

Order: RAJIFORMES

Family: Rajidae - skates

Class: OSTEICHTHYES

Order: ANGUILLIFORMES

Family: Anguillidae - freshwater eels

Anquilla rostrata (LeSueur) - American eel

Order: CLUPEIFORMES

Family: Clupeidae - herrings

Alosa aestivalis (Mitchill) - blueback herring

Alosa pseudoharengus (Wilson) - alewife

Brevoortia tyrannus (Latrobe) - Atlantic menhaden

Clupea harengus harengus Linnaeus - Atlantic herring

Order: SALMONIFORMES

Family: Osmeridae - smelts

Osmerus mordax (Mitchill) - rainbow smelt

Order: GADIFORMES

Family: Gadidae - codfishes

Gadus morhua Linnaeus - Atlantic cod

Microgadus tomcod (Walbaum) - Atlantic tomcod

Pollachius virens (Linnaeus) - pollock

Urophycis tenuis (Mitchill) - white hake

Family: Zoarcidae - eelpouts

Macrozoarces americanus (Bloch and Schneider) - ocean pout

Order: ATHERINIFORMES

Family: Cyprinodontidae - killifishes

Fundulus heteroclitus (Linnaeus) - mummichog

Family: Atherinidae - silversides

Menidia menidia (Linnaeus) - Atlantic silverside

Order: GASTEROSTEIFORMES

Family: Gasterosteidae - sticklebacks

Apeltes quadracus (Mitchill) - fourspine stickleback

Gasterosteus aculeatus Linnaeus - threespine stickleback

Pungitius pungitius (Linnaeus) - ninespine stickleback

Family: Syngnathidae - pipefishes

Syngnathus fuscus Storer - northern pipefish

Table 9. Continued

Order: PERCIFORMES

Family: Percichthyidae - temperate basses

Morone saxatilis (Walbaum) - striped bass

Family: Labridae - wrasses

Tautogolabrus adspersus (Walbaum) - cunner

Family: Scombridae - mackerels

Scomber scombrus Linnaeus - Atlantic mackerel

Family: Cottidae - sculpins

Hemitripterus americanus (Gmelin) - sea raven

Myoxocephalus aeneus (Mitchill) - grubby

Myoxocephalus octodecemspinosus (Mitchill) - longhorn sculpin

Family: Cyclopteridae - lumpfishes and seasnails

Cyclopterus lumpus Linnaeus - lumpfish

Liparis atlanticus (Jordan and Evermann) - seasnail

Order: PLEURONECTIFORMES

Family: Bothidae - lefteye flounders

Scophthalmus aquosus (Mitchill) - windowpane

Family: Pleuronectidae - righteye flounders

Limanda ferruginea (Storer) - yellowtail flounder

Pseudopleuronectes americanus (Walbaum) - winter flounder

Table 10. Marine organisms and marine vegetation observed in the Power Plant sluiceways, April - June, 1972.

FINFISH

<u>Raja</u> sp.	skate
<u>Alosa</u> <u>aestivalis</u>	blueback herring
<u>Alosa</u> <u>pseudoharengus</u>	alewife
<u>Osmerus</u> <u>mordax</u>	rainbow smelt
<u>Merluccius</u> <u>bilinearis</u>	silver hake
<u>Urophycis</u> <u>tenuis</u>	white hake
<u>Fundulus</u> <u>heteroclitus</u>	mummichog
<u>Menidia</u> <u>menidia</u>	Atlantic silverside
<u>Gasterosteus</u> <u>aculeatus</u>	threespine stickleback
<u>Syngnathus</u> <u>fuscus</u>	northern pipefish
<u>Myoxocephalus</u> <u>octodecemspinosus</u>	longhorn sculpin
<u>Pseudopleuronectes</u> <u>americanus</u>	winter flounder

INVERTEBRATES

<u>Tubularia</u> <u>crocea</u>	
<u>Metridium</u> <u>senile</u>	
<u>Limulus</u> <u>polyphemus</u>	sea anemone
<u>Balanus</u> sp.	horseshoe crab
<u>Idotea</u> <u>baltica</u>	barnacle
<u>Gammarus</u> sp.	
<u>Crangon</u> <u>septemspinosus</u>	sand shrimp
<u>Homarus</u> <u>americanus</u>	lobster
<u>Cancer</u> <u>irroratus</u>	rock crab
<u>Carcinus</u> <u>maenus</u>	green crab
<u>Littorina</u> <u>saxatilis</u>	periwinkle
<u>Nassarius</u> <u>obsoletus</u>	mud snail
<u>Aeolidia</u> <u>papillosa</u>	sea slug
<u>Mytilus</u> <u>edulis</u>	blue mussel
<u>Mya</u> <u>arenaria</u>	soft shell clam
<u>Loligo</u> <u>pealii</u>	squid
<u>Asterias</u> <u>forbesi</u>	sea star
<u>Asterias</u> <u>vulgaris</u>	purple sea star
<u>Strongylocentrotus</u> <u>drobachiensis</u>	sea urchin

VEGETATION

<u>Ulva</u> <u>lactuca</u>	sea lettuce
<u>Ascophyllum</u> <u>nodosum</u>	rock weed
<u>Fucus</u> <u>spiralis</u>	rock weed
<u>Fucus</u> <u>vesiculosus</u>	rock weed
<u>Laminaria</u> sp.	kelp
<u>Ceramium</u> <u>rubrum</u>	
<u>Chondrus</u> <u>crispus</u>	Irish moss
<u>Phyllophora</u> <u>brodiaei</u>	
<u>Spartina</u> <u>alterniflora</u>	salt water cord grass
<u>Zostera</u> <u>marina</u>	eel grass

APPENDIX

SAMPLING PROCEDURES

FINFISH

Field Collection: 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 $1\frac{1}{2}$ - $3\frac{1}{2}$ in.

Project expenditures as of June 30, 1972 were:

	<u>Total Allotted</u>	<u>Total Expended</u>	<u>Balance</u>
Salaries	\$36,750.00	\$24,436.87	\$12,313.13
Travel	1,200.00	79.80	1,120.20
Office and Lab. Supplies	3,500.00	2,212.23	1,287.77
Equipment	20,500.00	15,973.91	4,526.09
Maintenance	1,300.00	975.58	324.42
Overhead	<u>12,000.00</u>	<u>4,638.30</u>	<u>7,361.70</u>
TOTALS	\$75,250.00	\$48,316.69	\$26,933.31