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

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INTRODUCTION

The following is the second in a series of quarterly progress reports covering work 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 January through 31 March 1972.

METHODS AND MATERIALS

Procedure and material descriptions employed are outlined in the attached appendix. Subsequent reports will include procedure changes and identification of new methods and materials.

PHYSICAL INVESTIGATIONS

Current Studies

Hydrographic studies will be performed utilizing current meters and drogues. Amplitude at the entrance to Salem Harbor is 9.0 ft, with a mean tidal exchange in water volume of 44.8%. At mean high water (MHW) Salem Harbor contains approximately 5.4 billion gallons of water.

Temperature Monitoring

Intake (A) water is monitored hourly by power company personnel, and discharge (B) water is monitored on a 7-day Hagen continuous recorder (Fig. 1). Malfunctioning of the

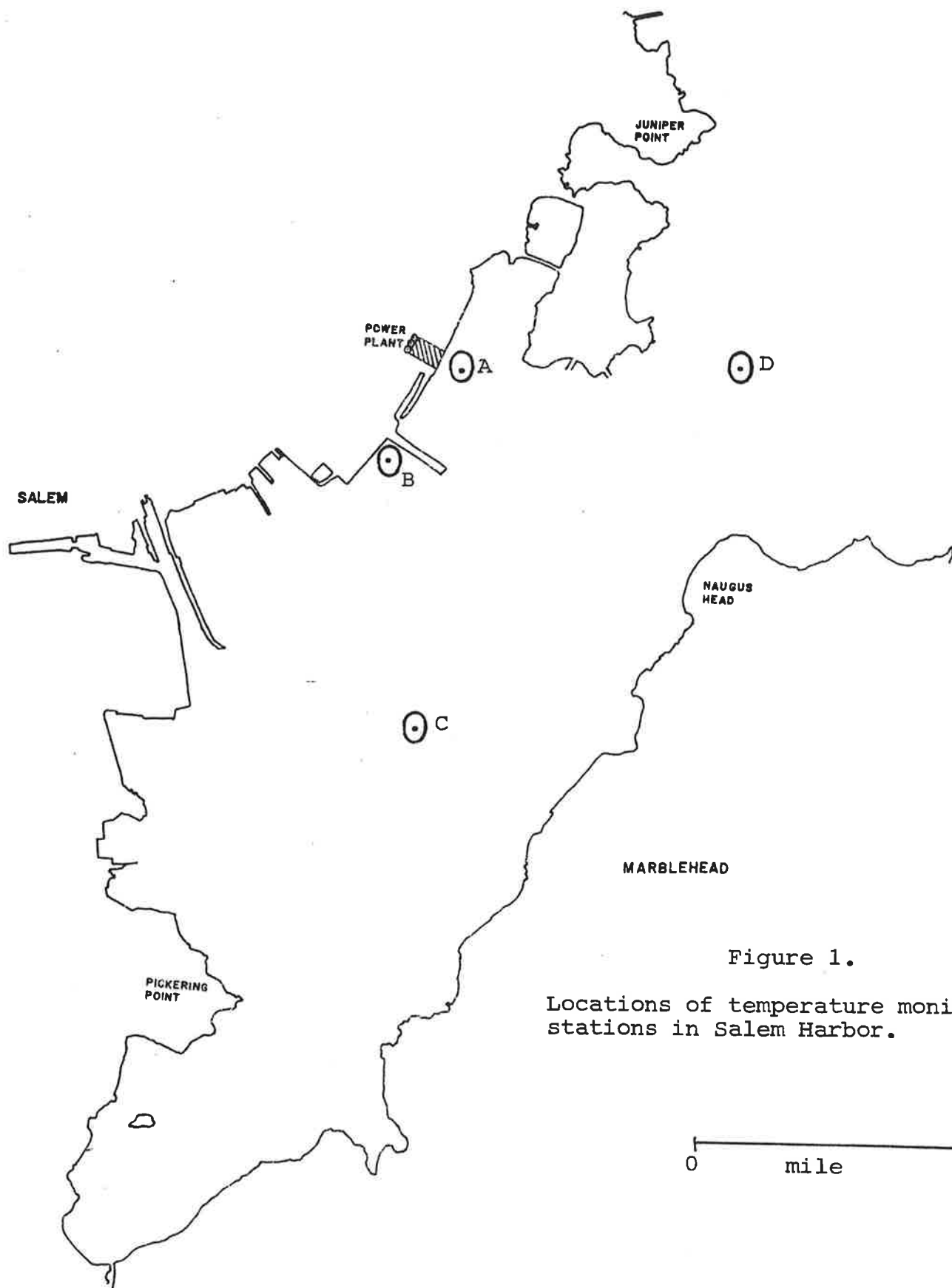


Figure 1.

Locations of temperature monitoring stations in Salem Harbor.

0 mile 1/2

recorder caused a gap in data collection from 8 December through 12 March. Purchase requisitions were submitted for two additional continuous recording thermographs. These instruments will be installed at Stations C and D. Figure 2 displays mean daily water temperatures at Stations A and B.

Thermal characteristics in the water column were taken with a bathythermograph (BT) at Stations 2, 4, 5, 6, 9, 10, 12, 14, 16, and 17 during finfish sampling procedures (Fig. 3). Stratification during March was not evident. Horizontal and vertical characteristics of the thermal plume will be defined during third quarter operations.

CHEMICAL INVESTIGATIONS

Water Quality

Surface temperature, salinity, hydrogen ion (pH), carbon dioxide, and dissolved oxygen is monitored monthly at Stations 1 - 18 (Fig. 4), and weekly at Stations A - D (Fig. 5). Prior to February, sampling at Stations A - D did not include all parameters mentioned. Biological oxygen demand (BOD) determinations were initiated in February at Stations A - D.

Ranges for parameters sampled at Stations 1 - 18 were: surface water temperature, 0.0 - 7.1 °C; surface salinity, 16.5 - 34.0 ‰; pH, 8.0 - 9.0; carbon dioxide, 5.0 - 10.0 ppm; and dissolved oxygen, 9.0 - 12.0 ppm (Table 1). Hydrogen ion (pH) values were recorded with a Hach field test kit. The reliability of this colormetric test is questionable, and a portable pH meter has been purchased. Harvey (1969) reports

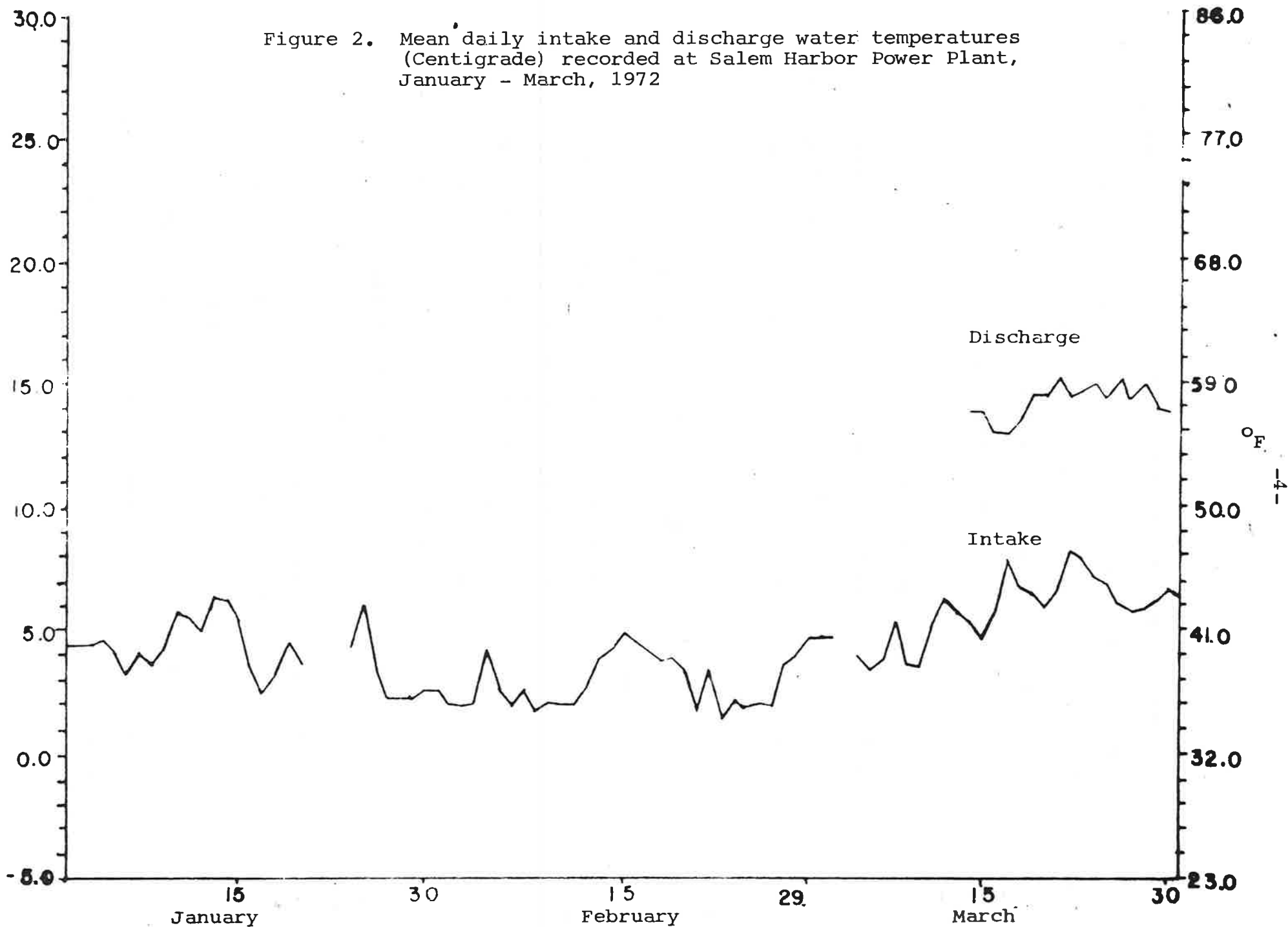


Figure 3.

Locations of bathythermograph sampling stations
in Beverly - Salem Harbors.

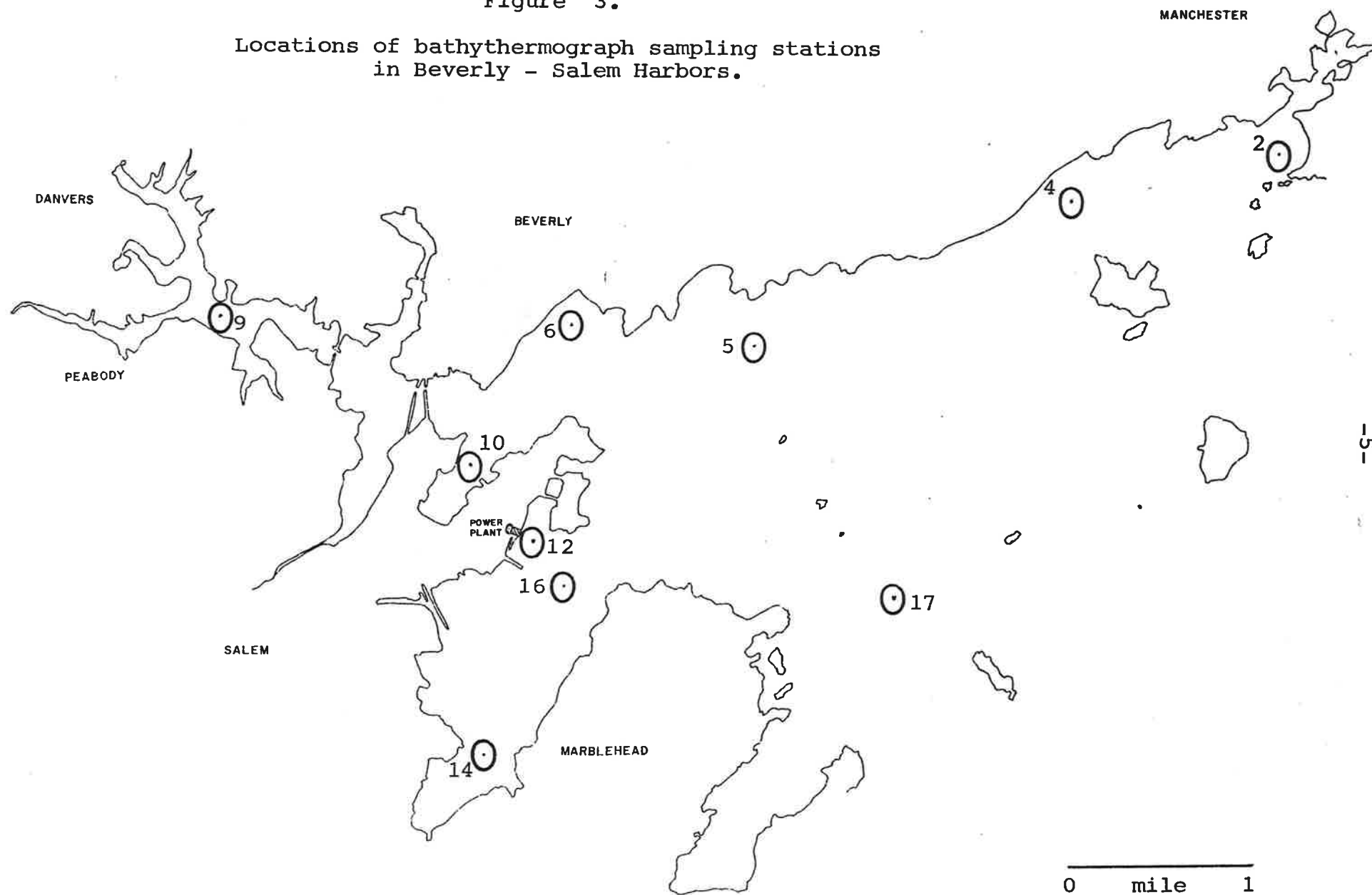
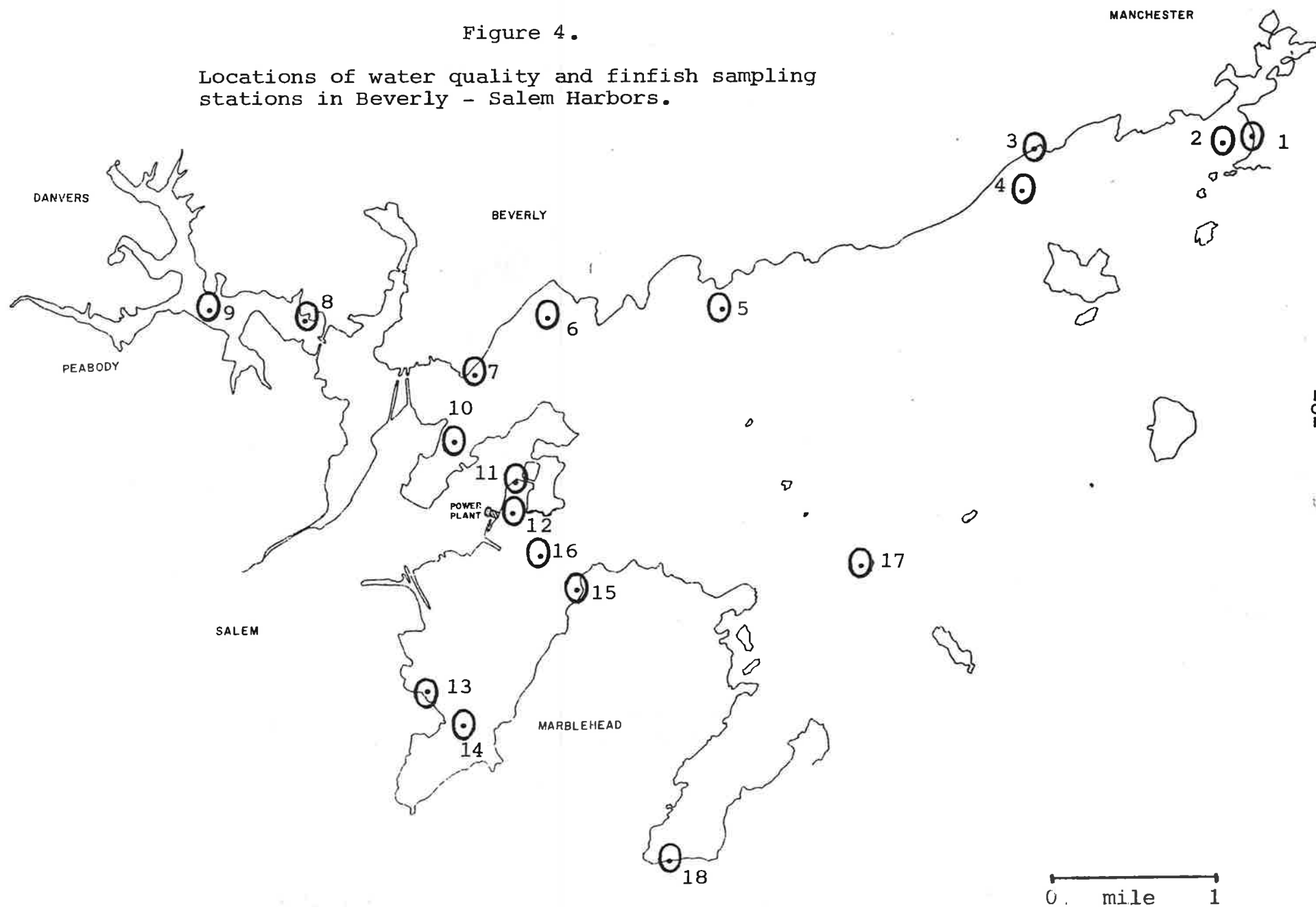


Figure 4.

Locations of water quality and finfish sampling stations in Beverly - Salem Harbors.



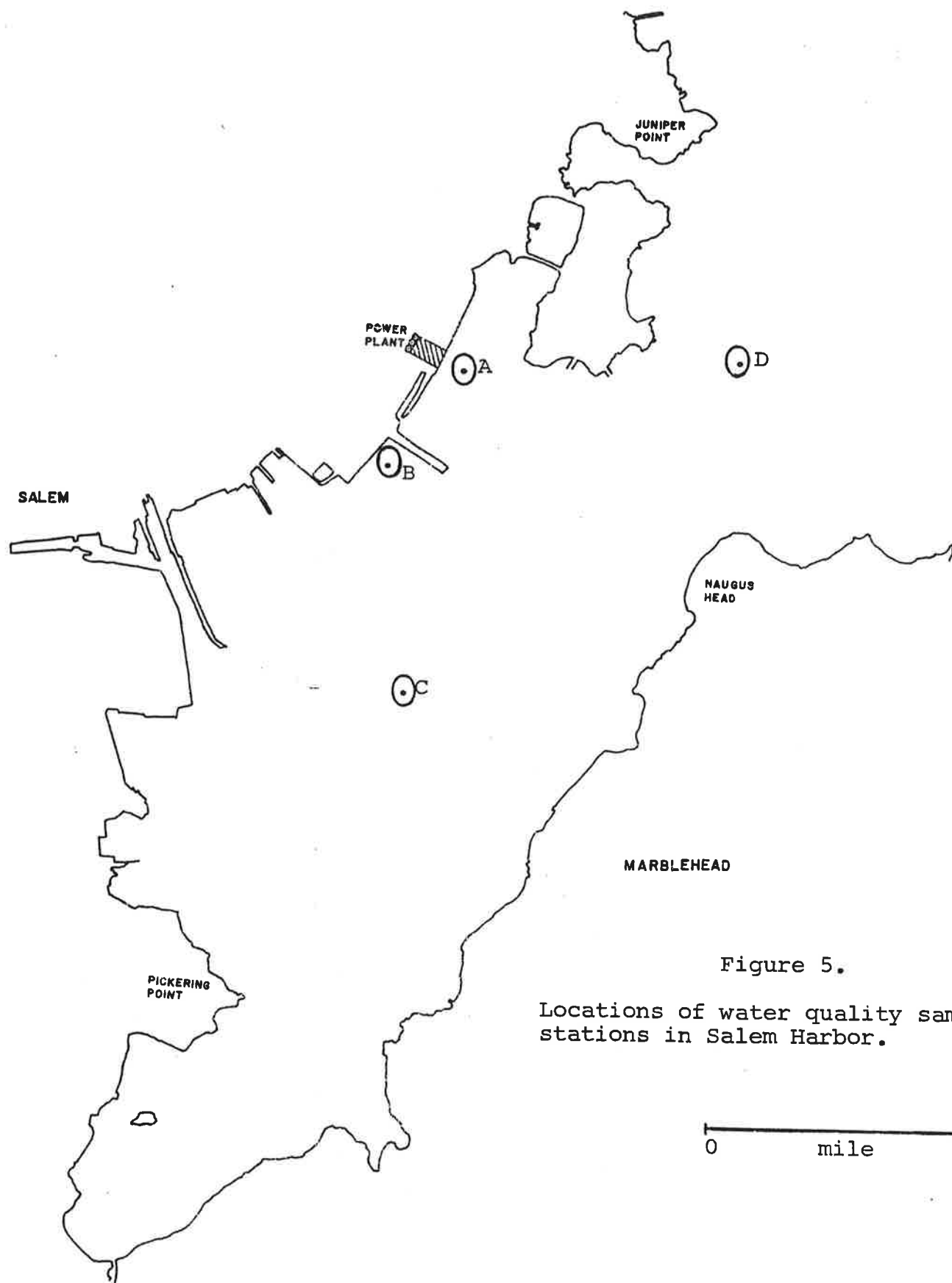


Figure 5.
Locations of water quality sampling
stations in Salem Harbor.

0 mile 1/2

Table 1. Water quality data for Beverly - Salem Harbor, January - March, 1972.

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL STAGE (HOURS)	WIND DIR/VEL	DEPTH	TEMP °C AIR WATER	SALINITY 0/00	pH	CO ₂ (ppm)	O ₂ (ppm)
<u>Station 1</u>										
1/3	000062	1425	high +1		S	3.5 3.5	20.0	8.0	5.0	11.7
2/2	000245	1340	high +1	NE/6	S	-1.0 0.0	31.0	8.0	5.0	11.5
2/14	000269	1200	high + $\frac{1}{2}$	0	S	7.0 3.0	31.5	9.0	10.0	10.7
3/13	000322	1140	high +2 $\frac{1}{2}$	0	S	5.0 4.0	32.0	8.0	10.0	10.9
<u>Station 2</u>										
1/18	000219	1042	low +4 $\frac{1}{2}$	N/16	S	3.0 3.5	33.0			
2/1	000238	1055	low +4 $\frac{1}{2}$	SW/6	S	-2.0 2.5	34.0	8.0	10.0	10.6
3/8	000286	1445	low +4	0	S	3.5 2.5	16.5	8.0	5.0	12.0
<u>Station 3</u>										
1/3	000086	1345	high +1		S	3.0 5.0	32.0	8.0	5.0	9.7
1/4	000087	1250	low +5 $\frac{1}{2}$		S	7.0 4.0	30.5			
2/2	000246	1310	high +1	NE/6	S	0.5 2.5	34.0	8.0	5.0	11.2
2/14	000268	1110	high +1	0	S	6.0 3.5	33.5	9.0	10.0	10.1
3/1	000287	1035	low +5	0	S	9.5 4.5	32.0	8.0	5.0	10.9
3/13	000320	1045	high +1 $\frac{1}{2}$	0	S	4.0 4.5	33.0	8.0	5.0	10.7
<u>Station 4</u>										
1/14	000220	1110	low +5	SE/13	S	2.0 3.5	33.5			
2/1	000239	1130	high +5 $\frac{1}{2}$	NW/10	S	-0.5 2.5	34.0	8.0	10.0	11.1
3/8	000295	1530	low +4 $\frac{1}{2}$	0	S	2.0 2.5	31.0	8.0	5.0	10.8
<u>Station 5</u>										
1/7	000096	1020	low + $\frac{1}{2}$		S	-4.0 2.5	34.0			
2/10	000262	1100	high +4	NW/11	S	-3.0 1.5	34.0	9.0	10.0	
3/20	000298	1030	low +1 $\frac{1}{2}$	E/7	S	-1.5 3.0		8.0	10.0	10.6

Table 1. Continued

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL STAGE (HOURS)	WIND DIR/VEL	DEPTH	TEMP °C AIR WATER	SALINITY 0/00	pH	CO ₂ (ppm)	O ₂ (ppm)
<u>Station 6</u>										
1/18	000221	1150	high	S/12	S	3.5 3.5	33.5			
2/1	000240	1200	low +6	NW/15	S	-1.5 1.5	34.0	8.0	5.0	10.9
3/8	000297	1620	low +5½	0	S	3.0 2.5	31.0	8.0	5.0	10.7
<u>Station 7</u>										
1/3	000113	1505	high +2½		S	2.5 4.0	32.0	8.0	5.0	10.5
2/14	000247	1245	high +2½	NW/6	S	8.0 3.5	33.0	9.0	5.0	10.5
3/10	000317	1025	high +4	NW/5	S	-5.0 3.5		8.0	5.0	10.7
<u>Station 8</u>										
1/3	000131	1545	high +3	NE/6	S	2.5 3.5	31.0	9.0	5.0	10.3
1/4	000132	1335	high		S	4.0 3.0	30.5			
2/2	000248	1445	high +2½	NE/6	S	-0.5 1.0	34.0	9.0	5.0	11.0
2/14	000267	1025	high	0	S	5.0 2.5	33.0	9.0	5.0	10.5
3/1	000288	1150	low +6	SW/8	S	11.0 4.0	32.0	8.0	10.0	10.6
3/13	000319	1000	high +1	N/6	S	1.5 3.5	32.0	8.0	5.0	10.2
<u>Station 9</u>										
1/18	000222	1330	high +1½	W/8	S	5.0 2.5				
2/1	000244	1350	high +1½	NW/12	S	-1.5 2.0	34.0	9.0	10.0	10.9
3/2	000307	1100	low +4	NW/4	S	2.0 3.5	30.5	9.0	10.0	10.5
<u>Station 10</u>										
1/18	000223	1310	high +1	SW/12	S	4.5 2.0				
2/1	000243	1330	high +1	NW/12	S	0.0 1.5	33.5	8.0	5.0	11.6
3/2	000303	1155	low +5	NE/6	S	2.0 3.5	30.5	9.0	5.0	9.0

Table 1. Continued

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL STAGE (HOURS)	WIND DIR/VEL	DEPTH	TEMP °C AIR WATER	SALINITY 0/00	pH	CO ₂ (ppm)	O ₂ (ppm)
<u>Station 11</u>										
1/3	000158	1630	high +3½		S	4.0 3.5	32.0	9.0	5.0	10.4
1/4	000159	1210	low +4½		S	5.0 3.5	32.0			
2/2	000245	1025	low +3½	NE/12	S	-1.5 0.0	34.0	8.0	5.0	11.0
2/14	000265	0855	low +4½	0	S	5.0 3.0	33.5	8.0	10.0	10.5
3/1	000289	1355	high +2	SW/9	S	12.0 7.1	30.5	9.0	10.0	10.9
3/10	000314	0830	high +2	0	S	-1.5 1.5	33.0	8.0	10.0	10.8
<u>Station 12</u>										
1/18	000224	1225	high	SW/15	S	3.5 3.0				
2/1	000241	1230	high	NW/12	S	-1.5 2.0	33.5	8.0	5.0	11.0
3/2	000301	1425	high +1½	E/5	S	0.5 3.5	33.5	9.0	10.0	10.5
<u>Station 13</u>										
1/3	000182	1110	low +4½		S	3.5 3.5	33.0	8.0	10.0	10.1
1/4	000180	1405	high +½		S	5.0 4.0	30.5			
2/2	000250	1055	low +4	NE/16	S	0.0 1.0	34.0	8.0	10.0	11.2
2/14	000266	0940	low +5½	NW/5	S	4.0 3.0	31.5	9.0	10.0	10.5
3/1	000290	1245	high +½	0	S	12.0 4.0	31.5	8.0	10.0	11.1
3/10	000316	0950	high +3½	0	S	-2.0 3.0		8.0	10.0	10.7
<u>Station 14</u>										
1/18	000225	1245	high +½	E/8	S	6.5 3.5				
2/1	000242	1300	high +½	NW/13	S	-1.0 2.5	33.5	8.0	5.0	10.9
3/2	000299	1250	high	SW/12	S	2.0 4.0	32.5	9.0	5.0	10.6
<u>Station 15</u>										
1/3	000195	1200	low +5½		S	2.0 3.5	26.5	8.0	10.0	10.8
2/2	000251	1135	low +4½	0	S	-0.5 1.0	32.5	9.0	5.0	11.0
3/13	000318	1020	high +1	0	S	5.0 4.0	32.0	8.0	10.0	10.5
<u>Station 16</u>										
1/7	000200	1150	low +1½		S	-0.5 0.5	33.0			
2/10	000264	1225	high +5½	0	S	-1.0 3.0	33.5	9.0	10.0	11.3
3/20	000296	1250	low +3	0	S	-2.0 4.0		8.0	10.0	10.6

Table 1. Continued

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL STAGE (HOURS)	WIND DIR/VEL	DEPTH	TEMP °C AIR WATER	SALINITY 0/00	pH	CO ₂ (ppm)	O ₂ (ppm)
1/7	000205	1305	low +3		Station 17					
2/10	000263	1340	high + $\frac{1}{2}$	N/2	S	0.0 3.5	33.0			
3/20	000294	1413	low +5 $\frac{1}{2}$	0	S	0.0 3.5	34.0	9.0	10.0	11.0
					S	-3.0 3.5		8.0	5.0	10.8
1/13	000218	1230	high		Station 18					
2/2	000252	1210	low +5	NW/15	S	3.0 4.0	33.0	9.0	10.0	10.1
3/10	000315	0910	high +2 $\frac{1}{2}$	0	S	-1.0 1.0	32.0	9.0	10.0	11.7
					S	-5.0 2.0	26.0	8.0	10.0	10.9

a narrow range, 8.0 - 8.3, for pH in upper layers of the open ocean. While shallow waters and tide pools display a greater range, pH seldom exceeds 8.4.

Ranges for parameters sampled at Stations A - D were: surface water temperature, 0.0 - 16.0 °C; surface salinity, 31.1 - 35.0 ‰; pH, 8.0 - 9.0; carbon dioxide, 5.0 - 10.0 ppm; dissolved oxygen, 8.7 - 11.3 ppm; and biological oxygen demand, 1.4 - 4.7 ppm (Table 2). Stations A and B surface water temperatures are plotted in Figure 6.

Heavy Metal Analyses

Assessment of heavy metal concentrations in lobsters, Homarus americanus, and soft shell clams, Mya arenaria, was initiated in February. Copper concentrations in soft shell clams varied from 2.5 to 6.0 ppm (Table 3). Preliminary analyses of copper in lobsters suggests technique modification. In an effort to determine uptake by certain marine organisms, copper levels will be assessed in the waters of Salem Harbor.

Table 3. Copper uptake (ppm) in soft shell clams (Mya arenaria) from Salem Harbor, February - March, 1972.

Date	Station	Soft shell clam
2/16	A	2.5
	B	3.4
	C	3.8
3/16	A	3.8
	B	6.0
	C	3.4

Table 2. Water quality data for Salem Harbor, January - March, 1972.

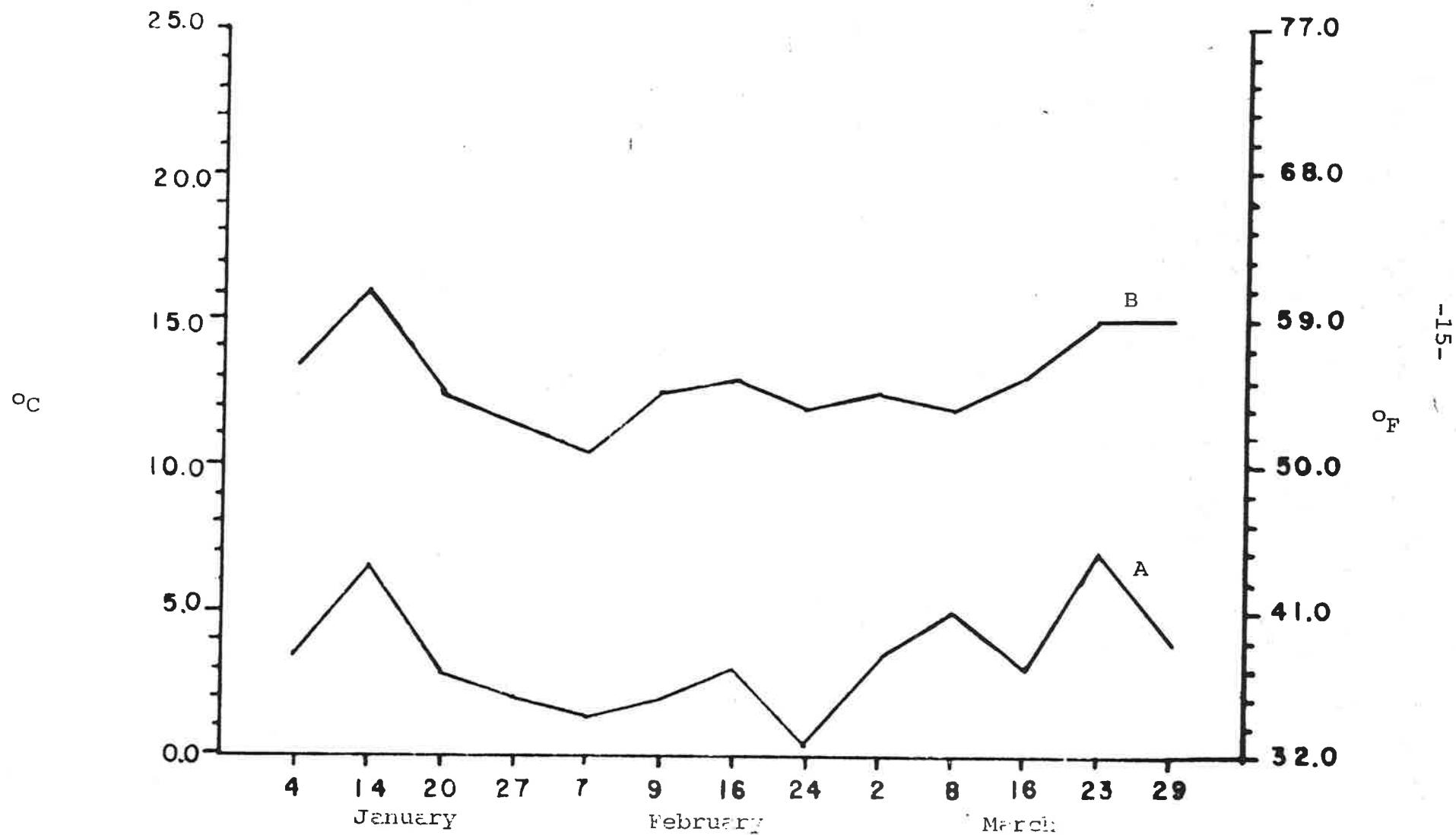
DATE	SAMPLE NUMBER	TIME (EST)	TIDAL		WIND DIR/VEL	DEPTH	TEMP °C		SALINITY 0/00	pH	CO2 (ppm)	O2 (ppm)	BOD (ppm)
			STAGE (HOURS)				AIR	WATER					
Station A													
1/4	000012	1032	low	+3		S	3.5	3.5				9.5	
1/14	000226	1410	high	+5		S	-0.5	6.5	33.3			10.0	
1/20	000232	1355	high	+½		S	2.5	3.0	33.5			10.9	
1/27	000234	0830	high	+½	N/1	S	-8.0	2.0	33.8	8.0	5.0	10.7	
2/7	000255	1545	low	+5	N/1	S	-5.0	1.5	33.5	8.0	5.0	10.9	
2/9	000259	1310	low	+½	0	S	3.5	2.0	34.0	9.0	10.0	11.3	
2/16	000276	1320	high	+1½	0	S	5.0	3.0	33.2	9.0	10.0	10.5	
2/24	000278	1105	low	+4	0	S	-3.5	0.5	33.1	9.0	10.0	11.0	2.0
3/2	000282	1335	high	+1	0	S	1.5	3.5	32.6	8.0	10.0	10.6	2.3
3/8	000327	1035	~~high~~ +6 ~~low~~		S/6	S	9.5	5.0	31.5	8.0	10.0	10.3	2.5
3/16	000323	1005	low	+4½	0	S	2.0	3.0	32.4	8.0	5.0	10.6	2.8
3/23	000331	0950	high	+4½	S/12	S	6.0	7.0	31.4	8.0	10.0	10.4	2.8
3/29	000340	1410	high	+3	0	S	5.0	4.0	32.6	8.0	10.0	10.9	2.4
Station B													
1/4	000023	1055	low	+3½		S	4.0	13.5				8.8	
1/14	000227	1430	high	+5		S	0.0	16.0	35.0			9.1	
1/20	000229	1345	high			S	2.5	12.5	33.0			10.4	
1/27	000235	0840	high	+½	0	S	-8.0	11.5	33.1	8.0	5.0	10.5	
2/7	000254	1530	low	+4½	NW/6	S	-1.5	10.5	33.0	9.0	10.0	10.1	
2/9	000260	1320	low	+½	0	S	3.0	12.5	33.8	8.0	10.0	9.7	
2/16	000274	1240	high	+½	NW/6	S	7.0	13.0	33.2	8.0	5.0	10.1	
2/24	000279	1055	low	+4	0	S	-3.5	12.0	33.2	9.0	5.0	9.6	2.5
3/2	000283	1330	high	+1	NE/4	S	2.0	12.5	33.6	8.0	10.0	10.1	1.7
3/8	000328	1050	~~high~~ +6 ~~low~~		S/6	S	9.5	12.0	31.1	8.0	10.0	9.1	4.7
3/16	000324	0945	low	+4	0	S	2.5	13.0	33.1	8.0	10.0	10.1	1.8
3/23	000332	1020	high	+5	S/6	S	6.0	15.0	31.5	8.0	10.0	8.7	1.4
3/29	000341	1420	high	+3½	0	S	6.0	15.0	32.6	8.0	10.0	9.5	1.5

Table 2. Continued

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL STAGE (HOURS)	WIND DIR/VEL	DEPTH	TEMP °C		SALINITY 0/00	pH	CO ₂ (ppm)	O ₂ (ppm)	BOD (ppm)
						Station C						
1/4	000037	1040	low +3½		S	3.0	5.0				9.7	
1/20	000228	1340	high		S	3.5	3.5	34.5			10.8	
1/27	000236	0850	high +½	N/18	S	-8.5	2.0	34.0	8.0	5.0	10.9	
2/7	000253	1515	low +4½	NW/12	S	-4.0	2.0	33.0	8.0	10.0	11.0	
2/9	000261	1330	low +1	SW/12	S	0.0	2.0	33.7	8.0	5.0	11.0	
2/16	000275	1300	high +1	NW/13	S	5.0	3.0	32.3	9.0	10.0	10.5	
2/24	000280	1045	low +4	NW/8	S	-4.0	0.0	32.3	9.0	10.0	11.0	2.2
3/2	000284	1230	~~low +6½~~ high	E/8	S	1.5	3.5	32.6	8.0	5.0	10.7	2.3
3/8	000329	1120	low +½	NW/24	S	5.0	3.5	32.4	8.0	5.0	10.6	3.3
3/16	000326	0930	low +4	N/6	S	1.5	2.0	33.8	8.0	5.0	10.6	2.6
3/23	000333	1030	high +5	S/13	S	4.5	4.0	31.7	8.0	10.0	9.9	1.9
3/29	000338	1345	high +3	E/8	S	5.0	5.0	32.7	8.0	10.0	10.6	2.5
						Station D						
1/4	000048	1022	low +3		S	3.5	3.5				9.7	
1/20	000233	1330	high		S	3.0	3.0	34.5			10.8	
1/27	000237	0915	high +1	N/4	S	-8.0	2.0	33.1	8.0	5.0	10.9	
2/7	000256	1555	low +5	NW/20	S	-5.0	1.5	33.5	8.0	5.0	10.7	
2/9	000258	1300	low +½	SW/11	S	0.5	2.0	33.7	9.0	5.0	10.8	
2/16	000277	1330	high +1½	NW/13	S	3.0	2.5	32.3	9.0	10.0	10.5	
2/24	000281	1110	low +4	0	S	-4.5	1.0	33.2	9.0	10.0	10.9	1.7
3/2	000285	1220	~~low +6½~~ high	NE/8	S	2.0	4.0	32.5	9.0	10.0		
3/8	000330	1210	low +1	W/8	S	3.5	3.5	32.1	8.0	5.0	10.5	3.9
3/16	000323	0915	low +4	0	S	1.5	2.0	31.9	8.0	10.0	10.6	3.1
3/23	000334	0930	high +4	S/18	S	5.0	4.5	31.4	8.0	10.0	10.1	2.0
3/29	000339	1355	high +4	E/10	S	4.0	3.5		8.0	10.0	10.6	2.5

Figure 6.

Surface water temperatures (Centigrade) recorded at
Stations A and B in Salem Harbor, January - March, 1972.



BIOLOGICAL INVESTIGATIONS

Benthic Survey

Eleven benthic sampling stations are established along three parallel transects within Salem Harbor (Fig. 7). Each station is marked by a 100 lb concrete anchor and attached flotation buoy. Five $1/4\text{m}^2$ quadrat samples will be collected seasonally at each station by Division personnel employing SCUBA. Laboratory analyses will be performed under contract by personnel of the William F. Clapp Laboratories, Inc. in Duxbury, Massachusetts. Quarterly and final reports summarizing work performed, and all data collected will be submitted by the contractor. Winter samples were collected in March.

Plankton and Primary Productivity Studies

Surface plankton is collected bi-weekly at Stations A - D (Fig. 8). Quantitative identification, to the lowest taxon possible, will be performed under contract at Clapp Laboratories. Eight samples collected during March are being analyzed.

Concurrent water samples are taken for chlorophyll analysis at the Cat Cove Laboratory. Twenty samples collected since January (Table 4) reflect the following ranges:

Chlorophyll A	0.04-6.33 mg/m^3
B	0.14-3.03 mg/m^3
C	0.23-11.45 mg/m^3
Carotenoids	0.10-2.17 mg/m^3

Figure 9 displays levels of chlorophyll on five sampling dates.

Bioassays

Bioassays will be initiated on Atlantic herring, Clupea harengus harengus; Atlantic tomcod, Microgadus tomcod;

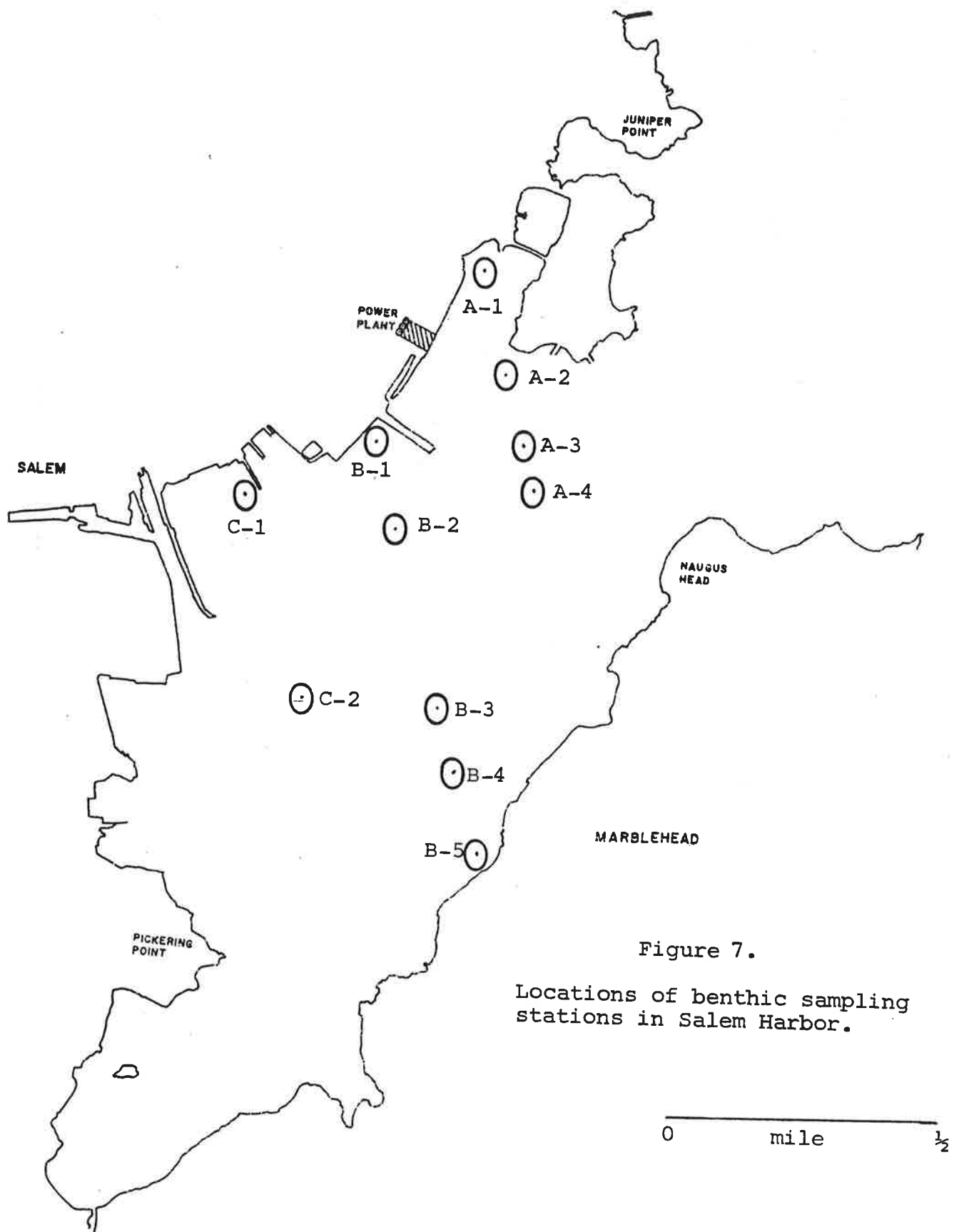


Figure 7.
Locations of benthic sampling
stations in Salem Harbor.

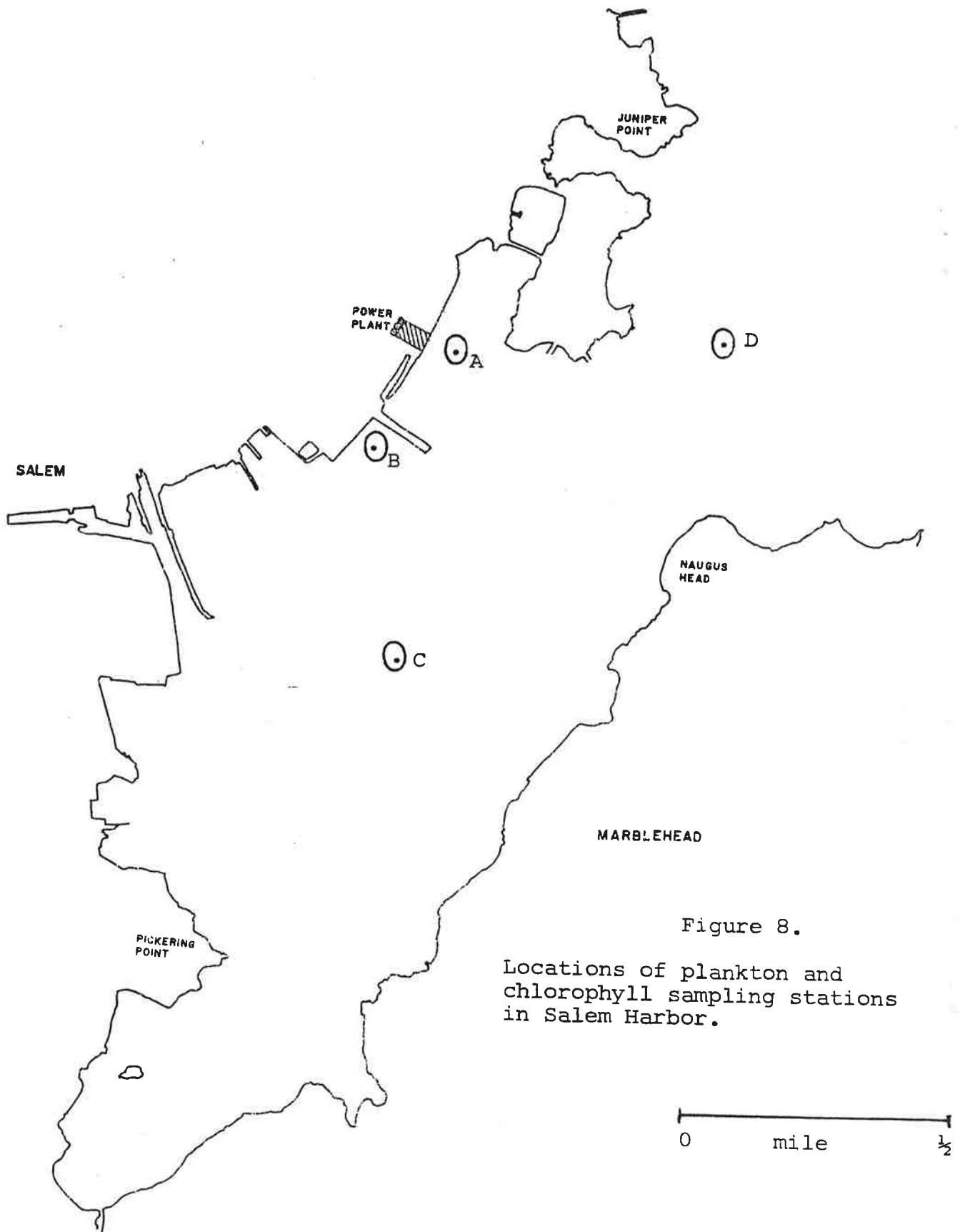


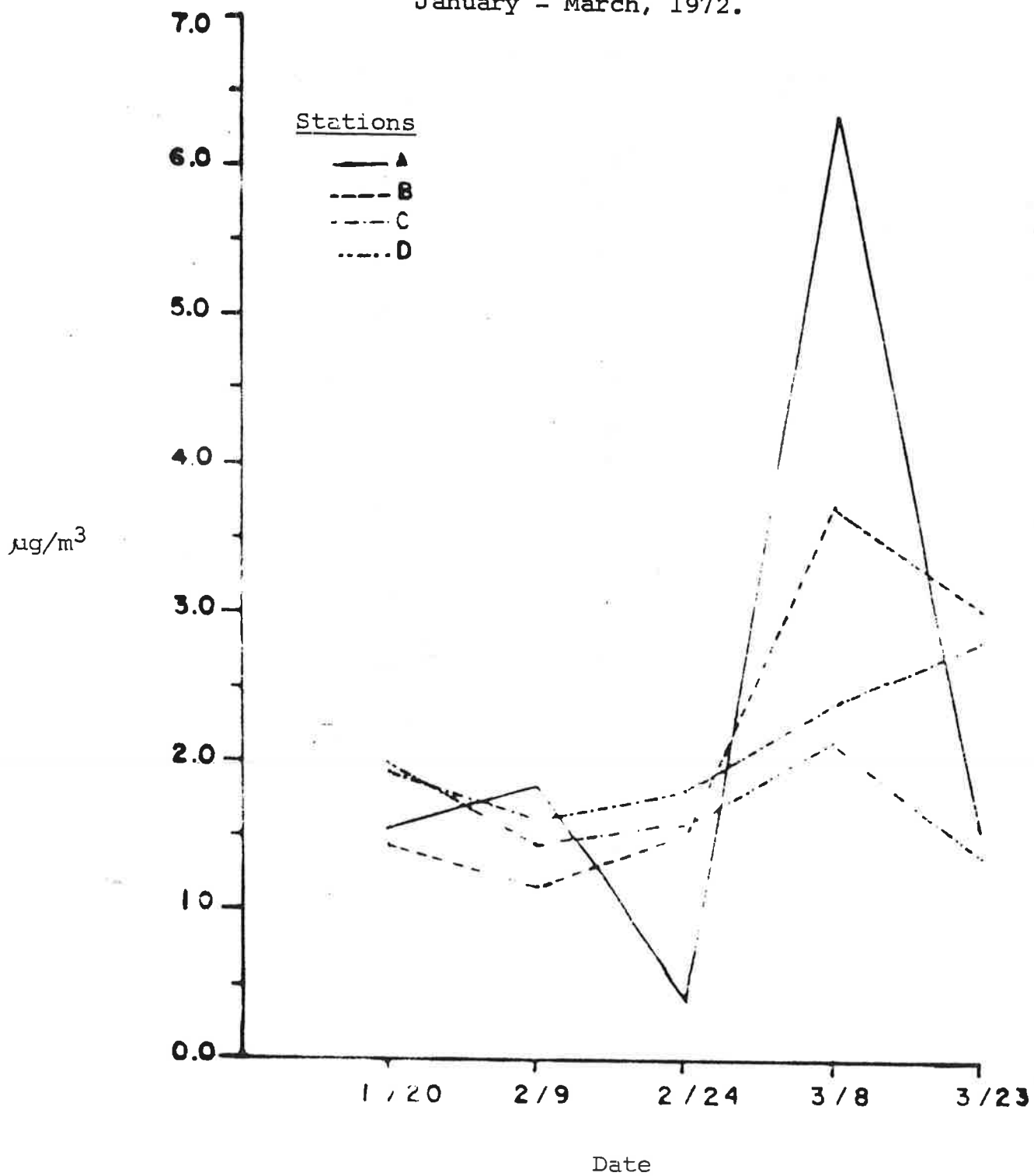
Figure 8.
Locations of plankton and
chlorophyll sampling stations
in Salem Harbor.

Table 4. Chlorophyll counts in Salem Harbor,
January - March, 1972.

Date	Station	Chlorophyll a ($\mu\text{g}/\text{m}^3$)	Chlorophyll b ($\mu\text{g}/\text{m}^3$)	Chlorophyll c ($\mu\text{g}/\text{m}^3$)	Carotenoids ($\mu\text{g}/\text{m}^3$)
1/20	A	1.56	1.28	4.30	
	B	1.44	1.16	4.00	0.51
	C	1.93	1.83	5.99	0.41
	D	1.99	2.13	6.99	0.84
2/9	A	1.83			1.29
	B	1.18	1.00	3.51	
	C	1.60	0.59	1.90	0.10
	D	1.46	0.58	2.47	0.12
2/24	A		0.90	2.84	0.15
	B	0.04	0.40		0.12
	C	1.51	0.49	0.23	
	D	1.82	0.68	1.59	0.52
3/8	A	1.55	0.14	2.75	0.93
	B	6.33	3.03	0.80	0.59
	C	3.75	2.00	11.45	0.67
	D	2.40	1.06	6.67	2.17
3/23	A	2.14	0.38	3.14	1.34
	B	1.52	0.37	1.21	0.79
	C	3.03	0.84		0.69
	D	2.81	0.16	1.33	0.37
	A	1.34	0.46	2.24	0.78
	B			1.22	1.22
	C			1.47	0.50
	D				

Figure 9.

Chlorophyll a counts in Salem Harbor,
January - March, 1972.



mummichog, Fundulus heteroclitus; rainbow smelt, Osmerus mordax; and yellowtail flounder, Limanda ferruginea to determine effects of heat and chlorine. Published data on alewife, Alosa pseudoharengus; Atlantic mackerel, Scomber scombrus; Atlantic silverside, Menidia menidia; and winter flounder, Pseudopleuronectes americanus, will be reviewed, and if necessary, additional bioassays will be conducted.

Finfish

Finfish catches decreased substantially during the winter period. Of 481 finfish sampled by all methods, 353 were captured outside Salem Harbor, and 128 were captured within Salem Harbor (Tables 5 and 6). Winter flounder dominated catches from both areas and were captured only by trawl. Atlantic silversides (144) remained most abundant at the shore stations.

Species diversification was greatest at the trawl stations (Table 7).

Table 8 classifies the 14 finfish species collected during this quarter.

A six-month sport fish survey commenced in April. The study will be conducted within Salem Harbor, inside or west of a line drawn between Fort Pickering Light on Winter Island to Naugus Head in Marblehead; and along 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. The cooperation of Dr. James C. McCann, Leader, Cooperative

Table 5. Numerical rank of finfish species collected in Salem Harbor, January - March, 1972.

Species	50-ft Seine	Method of Capture			Totals
		120-ft Seine	30-ft Trawl	49-ft Trawl	
1. winter flounder					
2. fourspine stickleback			2	97	99
3. Atlantic silverside			15		15
4. Atlantic tomcod	1	10			11
ninespine stickleback		1	1		1
rainbow smelt		1			1
Totals	1	12	18	97	128

Table 6. Numerical rank of finfish species collected outside Salem Harbor, January - March, 1972.

Species	50-ft Seine	Method of Capture			Totals
		120-ft Seine	30-ft Trawl	49-ft Trawl	
1. winter flounder					
2. Atlantic silverside	101	32	11	158	169
3. yellowtail flounder					133
4. Atlantic cod				30	30
5. ocean pout				13	13
6. rainbow smelt				4	4
7. skate*		1	1		2
threespine stickleback				1	1
Totals	101	33	13	206	353

*Not separated by species.

Table 7. Diversification index of finfish species by method of capture, Beverly - Salem Harbors, January - March, 1972.

Date	50-ft Seine Total Species	120-ft Seine Total Species	30-ft Trawl Total Species	49-ft Trawl Total Species
1/3	1			
1/4		3		
1/7				
1/18				4
2/1			1	
2/10			2	
2/14				2
3/1		1		
3/2		1		
3/13	1		4	
3/20				5

Table 8. Classification of finfish species collected in
Beverly - Salem Harbor, January - March, 1972.

Class: CHONDRICHTHYES

Order: RAJIFORMES

Family: Rajidae - Skate

Class: OSTEICHTHYES

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

Family: Zoarcidae - eelpouts

Macrozoarces americanus (Bloch and Schneider) ocean pout

Order: ATHERINIFORMES

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

Order: PERCIFORMES

Family: Labridae - wrasses

Tautoglabrus adspersus (Walbaum) - cunner

Family: Cottidae - sculpins

Hemitripterus americanus (Gmelin) - sea raven

Order: PLEURONECTIFORMES

Family: Bothidae - lefteye flounders

Scophthalmus aquosus (Mitchill) - windowpane

Family: Pleuronectidae - righteye flounders

Limanda ferruginea (Storer) - yellowtail flounder

Pseudopleuronectes americanus (Walbaum) - winter flounder

Fisheries Unit, University of Massachusetts, was received. Dr. McCann outlined our survey procedure and will assist in compiling statistical results.

Seven fish egg and larvae samples collected at Stations A - D are being analyzed at Clapp Laboratory.

Daily monitoring of intake sluiceways for juvenile and adult finfish continues. Traps have been constructed and became operable in the Unit 3 sluiceway on April 1. Marine organisms and marine vegetation observed are listed in Table 9.

Annual maintenance required shut down of Unit 2 from February 12 to March 13, and Unit 1 from March 18 to April 18. Project personnel inspected the intake tunnel of Unit 2 noting heavy encrustation by blue mussels, Mytilus edulis, and barnacles, Balanus balanoides.

Assessment of the local lobster fishery and population will commence in May. Tags have been assembled and cooperation of local lobster fishermen is expected. A similar study is under consideration for winter flounder.

ADMINISTRATION

Contract agreements were drafted for use of a research vessel and laboratory analysis of plankton, fish egg and larvae, and benthic samples. Mr. Charles W. Sibley will provide the Division with his vessel, Peggybell, for a total of 38 days during the one-year contract period commencing March 14, 1972. The William F. Clapp Laboratories will analyze 96 plankton, 64 fish egg and larvae, and 220 benthic samples during its one-year contract.

Table 9. Marine organisms and marine vegetation observed
in the Power Plant sluiceways, January - March, 1972.

FINFISH

<u>Raja erinacea</u> Mitchill	little skate
<u>Anquilla rostrata</u> (Lesueur)	American eel
<u>Osmerus mordax</u> (Mitchill)	rainbow smelt
<u>Fundulus heteroclitus</u> (Linnaeus)	mummichog
<u>Fundulus majalis</u> (Walbaum)	striped killifish
<u>Menidia menidia</u> (Linnaeus)	Atlantic silverside
<u>Gasterosteus aculeatus</u> Linnaeus	threespine stickleback
<u>Myoxocephalus octodecemspinosus</u> (Mitchill)	longhorn sculpin
<u>Myoxocephalus scorpius</u> (Linnaeus)	shorthorn sculpin
<u>Scophthalmus aquosus</u> (Mitchill)	windowpane
<u>Pseudopleuronectes americanus</u> (Walbaum)	winter flounder

INVERTEBRATES

<u>Metridium senile</u>	sea anemonae
<u>Cerebratulus lacteus</u>	ribbon worm
<u>Aphrodite aculeata</u>	scale worm
<u>Nereis virens</u>	clam worm
<u>Glycera dibranchiata</u>	blood worm
<u>Caprella linearis</u>	
<u>Cancer irroratus</u>	common rock crab
<u>Aeolidia papillosa</u>	sea slug
<u>Asterias forbesii</u>	common starfish
<u>Asterias vulgaris</u>	northern starfish

VEGETATION

<u>Ulva lactuca</u>	sea lettuce
<u>Agarum cribosum</u>	holed kelp
<u>Ascophyllum nodosum</u>	rock weed
<u>Fucus spiralis</u>	rock weed
<u>Chondrus crispus</u>	Irish moss
<u>Rhodomenia palmata</u>	red kale
<u>Spartina alterniflora</u>	salt water cord grass
<u>Zostera marina</u>	eel grass

Additional purchase requisitions were initiated and previously ordered equipment was received.

LITERATURE CITED

Harvey, H. W. 1969. The chemistry and fertility of sea waters.
The University Press. Cambridge. 240 pp.

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 CA-10.

Samples collected since May 15, 1972 were analyzed with a Kontes mini-pH meter.

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.

COPPER

Field 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.

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 and zooplankton are collected in an 80 micron mesh nytex plankton net. Tows are made for 2 minutes 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).

Project expenditures as of March 31, 1972 were:

	<u>Total Allotted</u>	<u>Total Expended</u>	<u>Balance</u>
Salaries	\$24,500.00	\$ 9,993.28	\$14,506.72
Travel	800.00	12.10	787.90
Office and Laboratory Supplies	3,500.00	1,524.32	1,975.68
Equipment	20,500.00	14,460.94	6,039.06
Maintenance	700.00	679.67	20.33
Overhead	<u>7,000.00</u>	<u>1,894.91</u>	<u>5,105.09</u>
TOTALS:	\$57,000.00	\$28,565.22	\$28,434.78