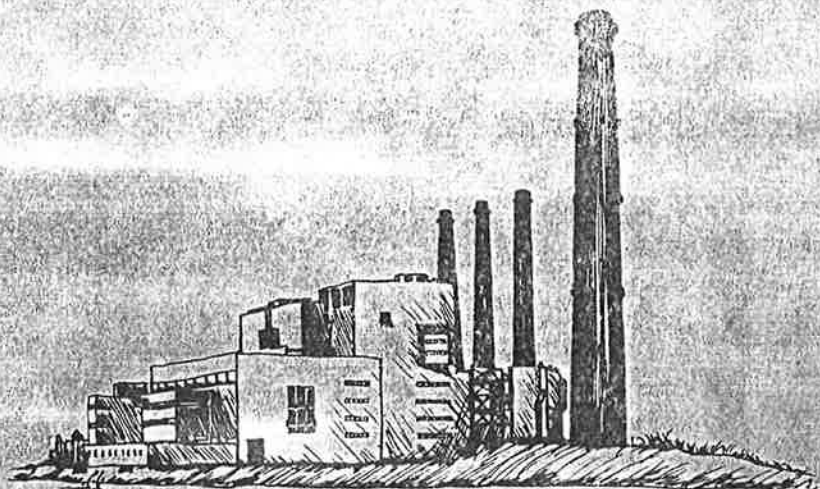


ARTHUR P. CHESMORE

PROGRESS REPORT NO. 8

JULY - SEPTEMBER, 1973



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

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The Commonwealth of Massachusetts



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1.0 INTRODUCTION

The following is the eighth 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 July through 30 September 1973.

Thermal and current surveys highlighted field operations. ^{14}C and ATP sampling and analyses were initiated. Lobster harvest statistics for 1968 - 1972 were compiled. Check-lists of algae, vascular plants, and invertebrates were prepared. Benthos, phytoplankton, zooplankton and ichthyoplankton populations are identified and discussed.

2.0 PHYSICAL INVESTIGATIONS

2.1 Morphometry

Salem Harbor contains 929.2 surface acres at MHW and decreases 21.6% to 728.5 acres at MLW (Table 2.1). Water depths range to 40.0 ft with a mean of 15.8 ft at MHW (Figure 2.1). Tidal amplitude is 8.8 ft and volume exchange is 50.8% (Figure 2.2).

In comparison to the Beverly - Salem Harbor complex (Figure 2.3), Salem Harbor exhibits greater tidal exchange (28.5 : 50.8%) and is capable of more rapid dispersion of waterborne pollutants (i.e., thermal effluent). Beverly - Salem Harbor totals 8,051 surface acres (MHW), or approximately tenfold Salem Harbor (Jerome, et al, 1967).

Beverly - Salem Harbor is flanked by low, gently sloping shores, except on the west side of Marblehead where steep rocky slopes rise to 70 feet above sea level. The shore at Marblehead, Salem Neck, and northeastern Beverly is predominately rocky, with small pocket beaches between rock headlands. The beaches are mostly gravel on the south shore and sandy on the north shore (Kaye, personal communication).

Table 2.1. Morphometric measurements for Beverly and Salem Harbors.

	Salem Harbor		Beverly - Salem* Harbor	
	MHW	MLW	MHW	MLW
Maximum Length (stat. m)	2.3	1.9	8.1	8.1
Maximum Effective Length (stat. m)	2.2	2.0	7.2	7.0
Maximum Width (stat. m)	1.1	0.9	3.4	3.3
Maximum Effective Width (stat. m)	1.1	0.9	3.1	2.9
Mean Width (stat. m)	0.62	0.57	1.7	1.6
Maximum Depth (feet)	40.0	31.0	73.0	64.0
Mean Depth (feet)	15.8	9.8	29.7	24.0
Mean Depth - Maximum Depth Relation	0.39	0.31	0.41	0.38
Maximum Depth - Surface Area Relation	0.0063	0.0055	0.004	0.003
Total Surface Area (acres)	929.2	728.5	9,051	8,031
Length of Shoreline (stat. m)	7.3	6.3	47.7	41.0
Shore Development Index	1.69	1.65	3.6	3.3
Volume (gallons)	4,770,973,853	2,346,189,347	87,735,598,000	62,694,346,000
Mean Tidal Amplitude (feet)	8.8		9.0	

U.S. Coast and Geodetic Survey Chart #240 was used for all morphometric measurements.

Methods for calculating morphometric data were obtained from Welch (1948).

*Jerome, et al (1967).

Figure 2.1. Cross-sectional profile of Salem Harbor at mean high water.

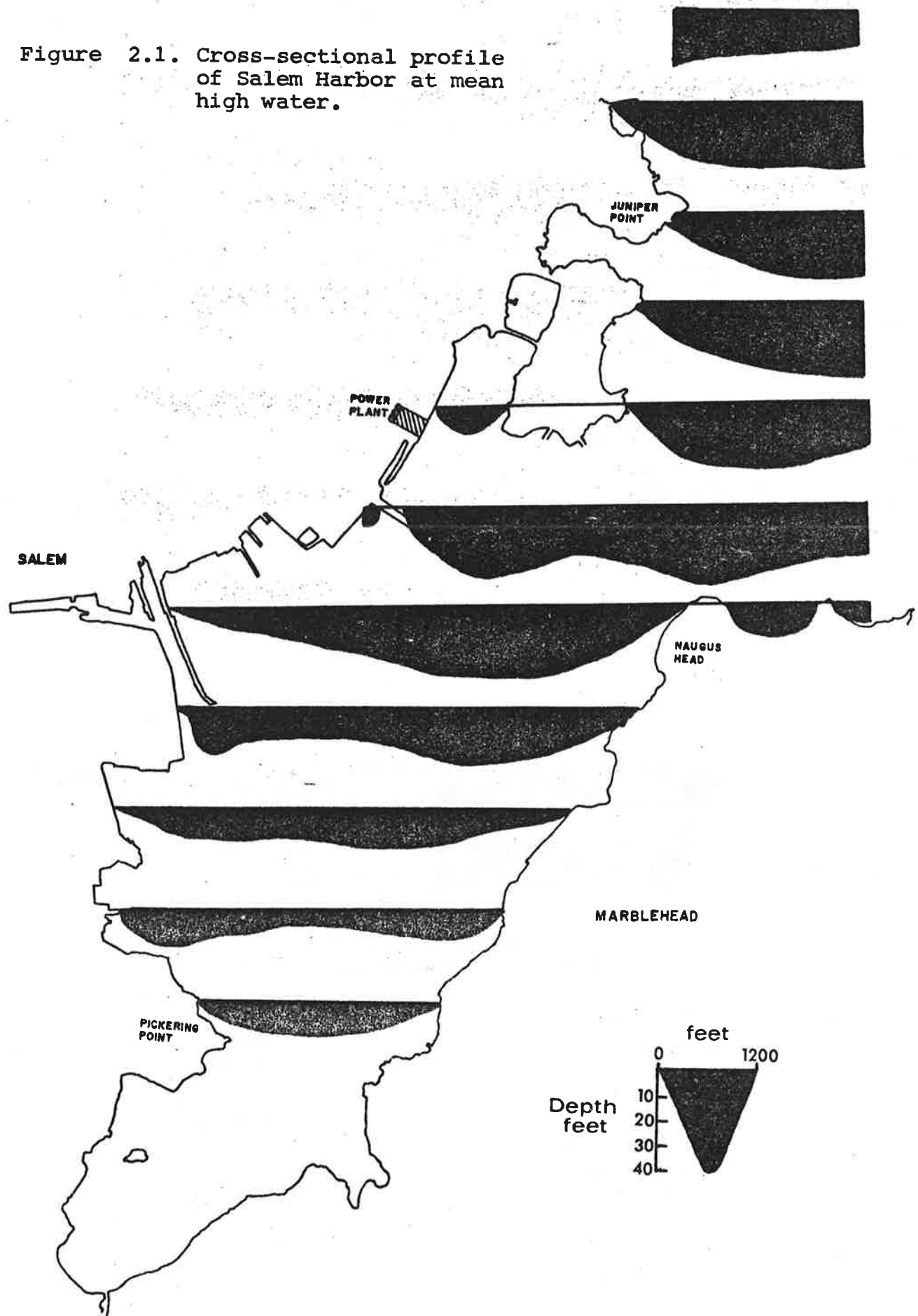


Figure 2.2. Percent of area, and percent of volume, at each depth contour for Salem Harbor.

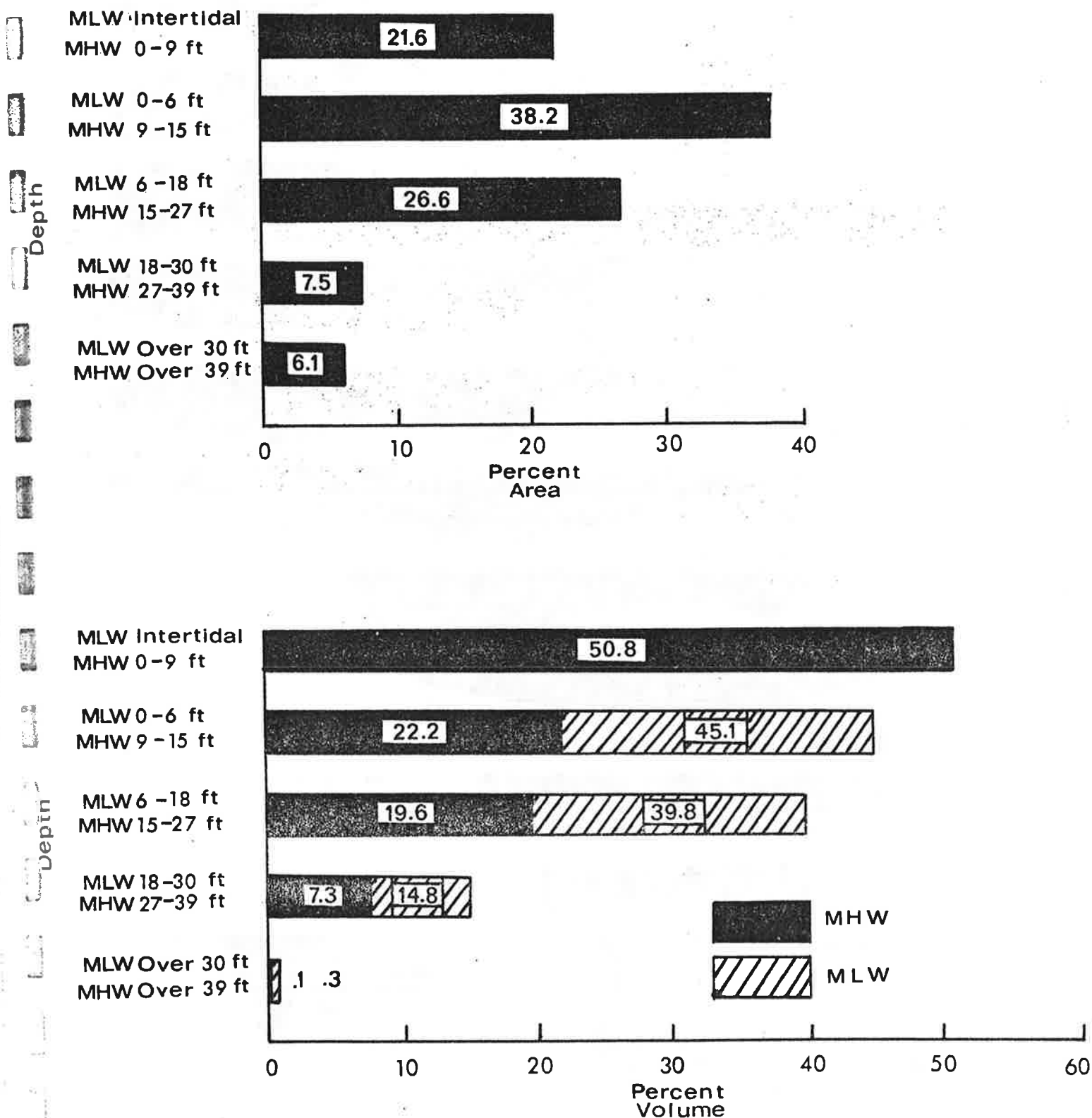
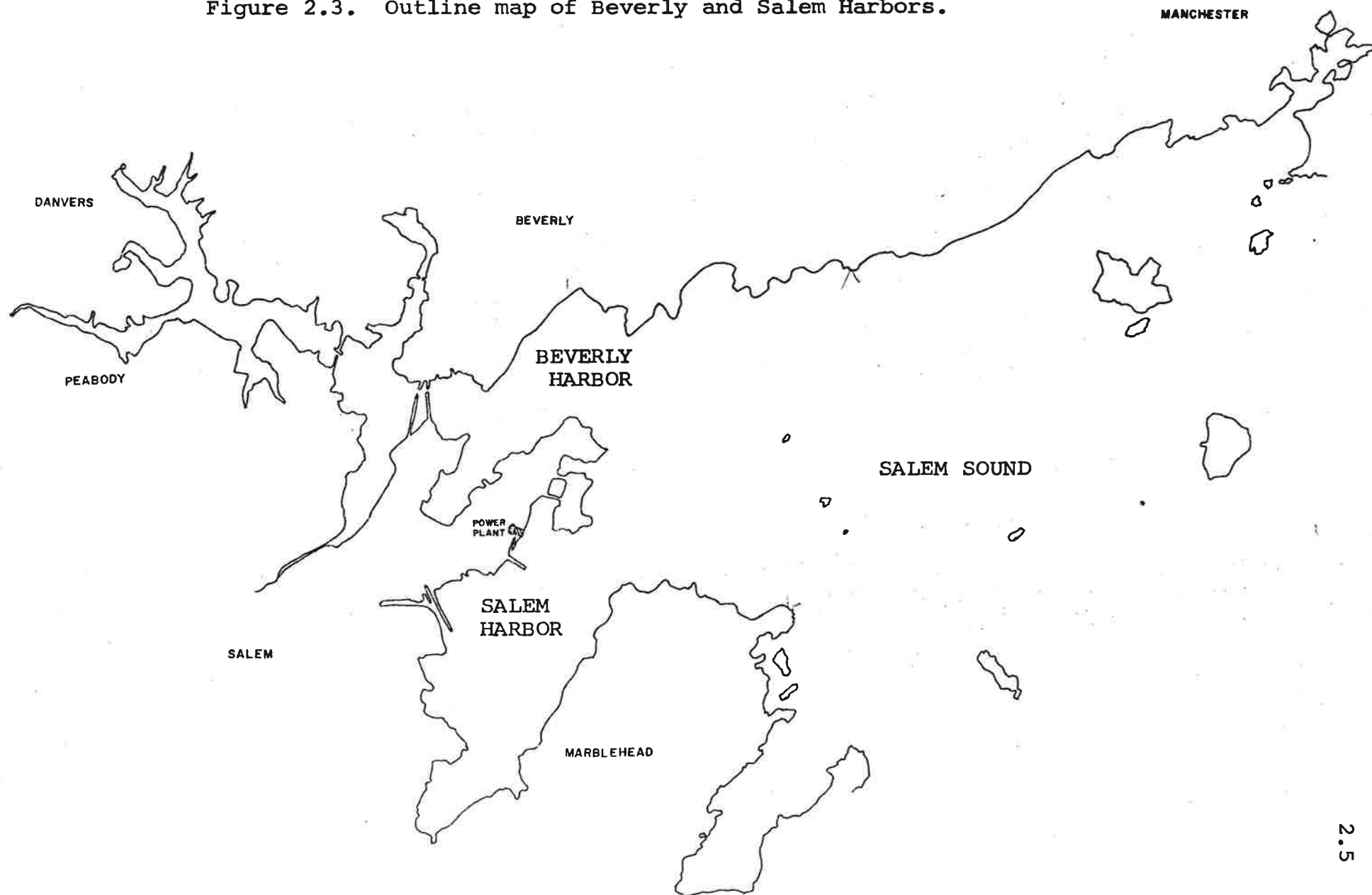


Figure 2.3. Outline map of Beverly and Salem Harbors.



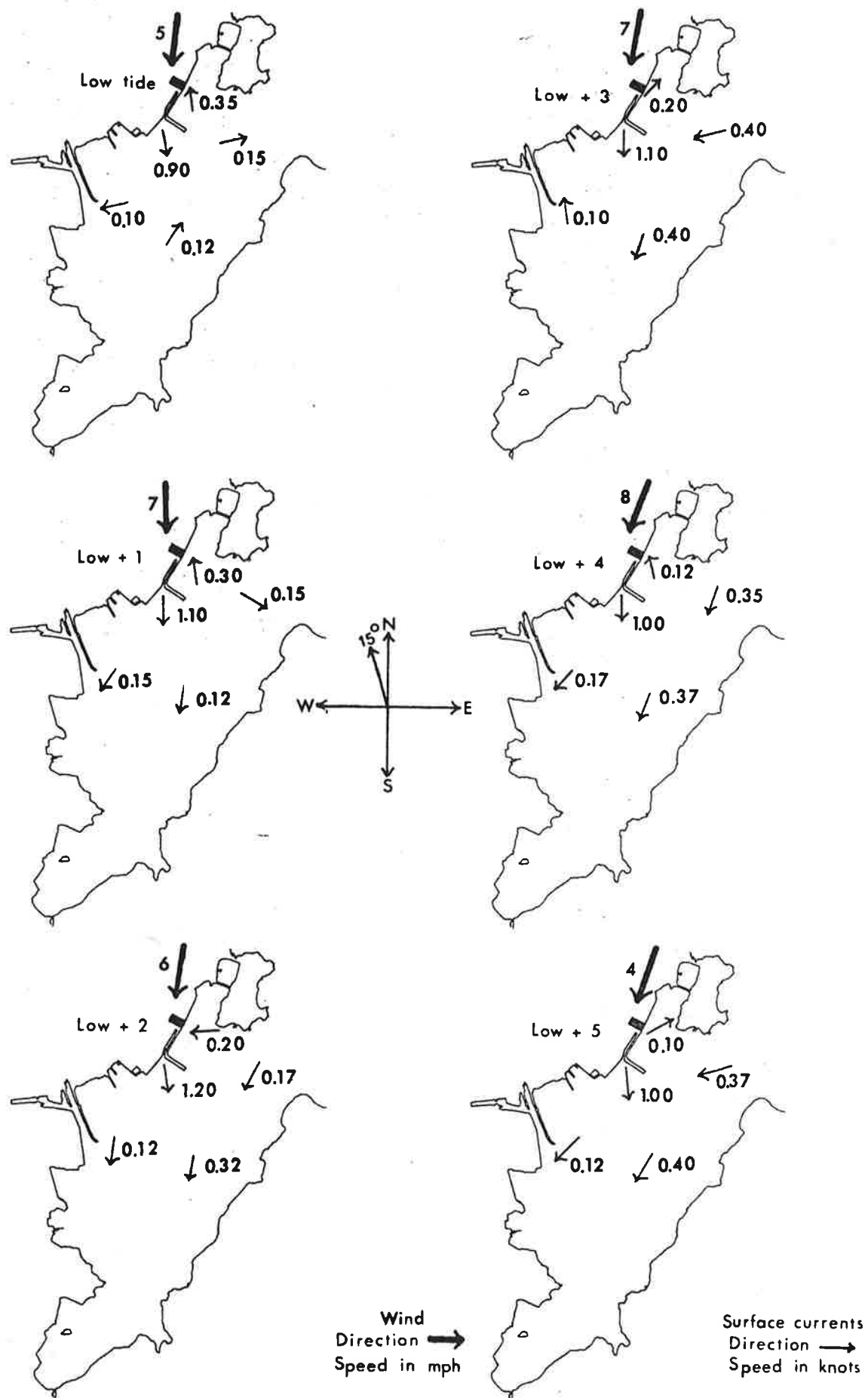
2.2 Hydrology

Current patterns were monitored at 5 locations on 17 July and 19 September (Figures 2.4 and 2.5). Velocities ranging to 1.1 knots were recorded with an Endeco 110 remote reading current meter.

Surface current patterns at various tidal stages generally conformed to an influx and efflux of water during low and high tide periods, respectively. Current direction at the discharge was generally southerly regardless of tidal stage and wind influence. The influence of wind was evident on 17 July. Efflux of water from Salem Harbor was masked by a northerly wind ranging from 8 to 10 mph during the first two hours after high tide. The wind diminished to 4 mph three hours after high and the expected tidal currents were noted. Moderate winds (8 to 10 mph) on 19 September shifted from northeasterly to southerly during the tidal cycle (low to high). The influence of a variable wind is difficult to isolate from surface tidal current patterns and theoretical predictions based on present data are not possible. More vigorous sampling of current patterns and an attempt to correlate concomitant wind patterns are planned.

Figure 2.4. Surface current patterns for Salem Harbor, July 17, 1973.

2.7



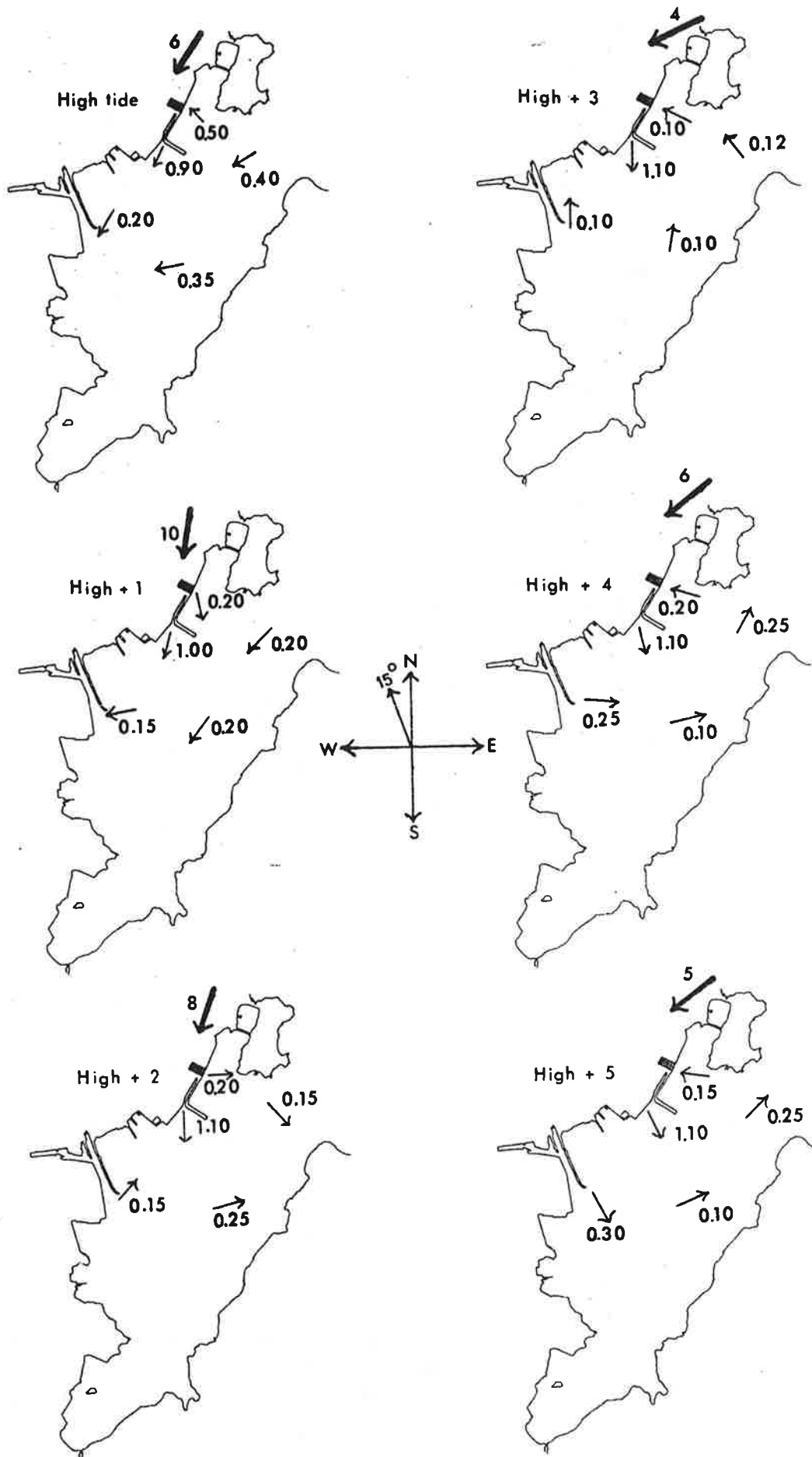
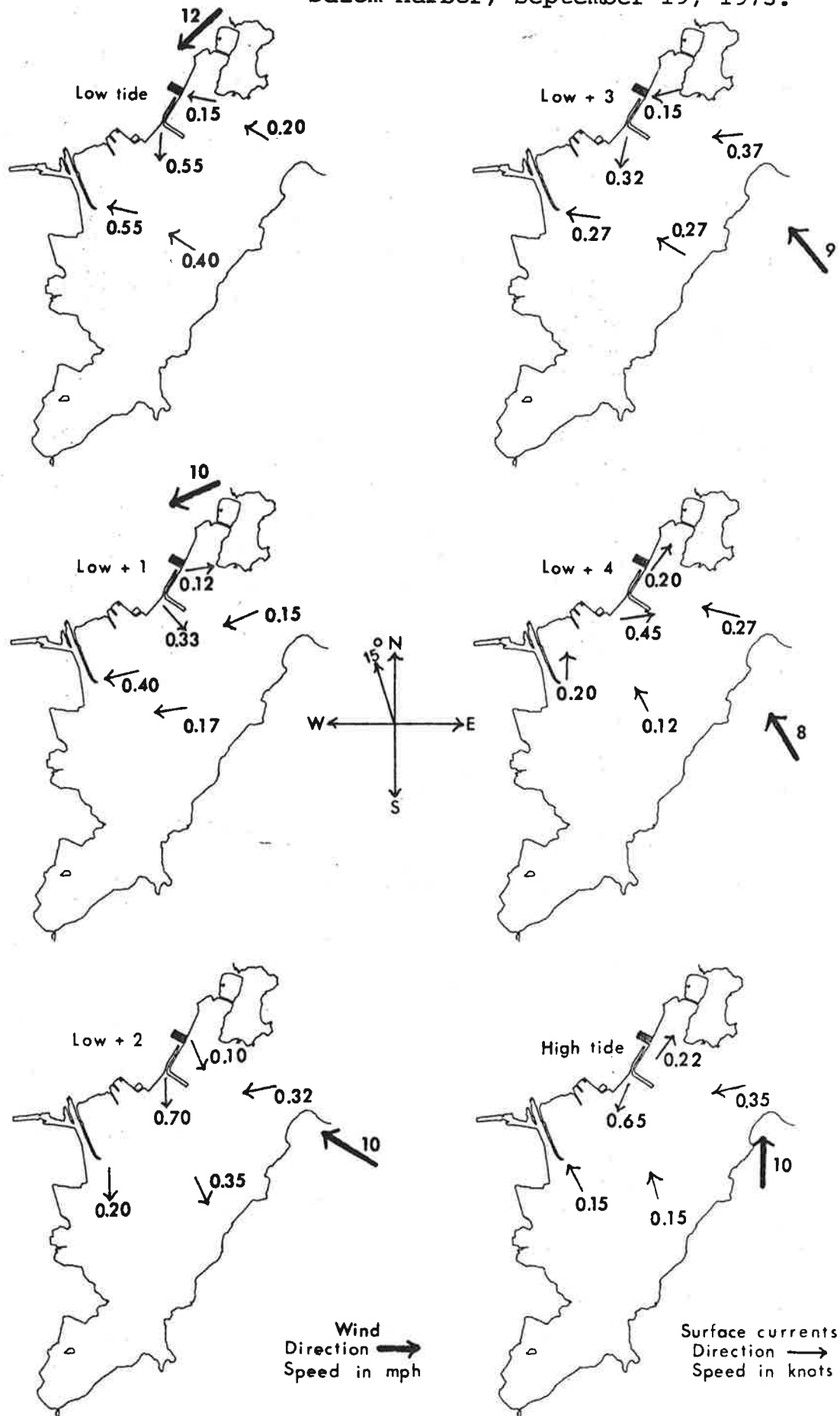


Figure 2.5. Surface current patterns for Salem Harbor, September 19, 1973.



2.3 Temperature

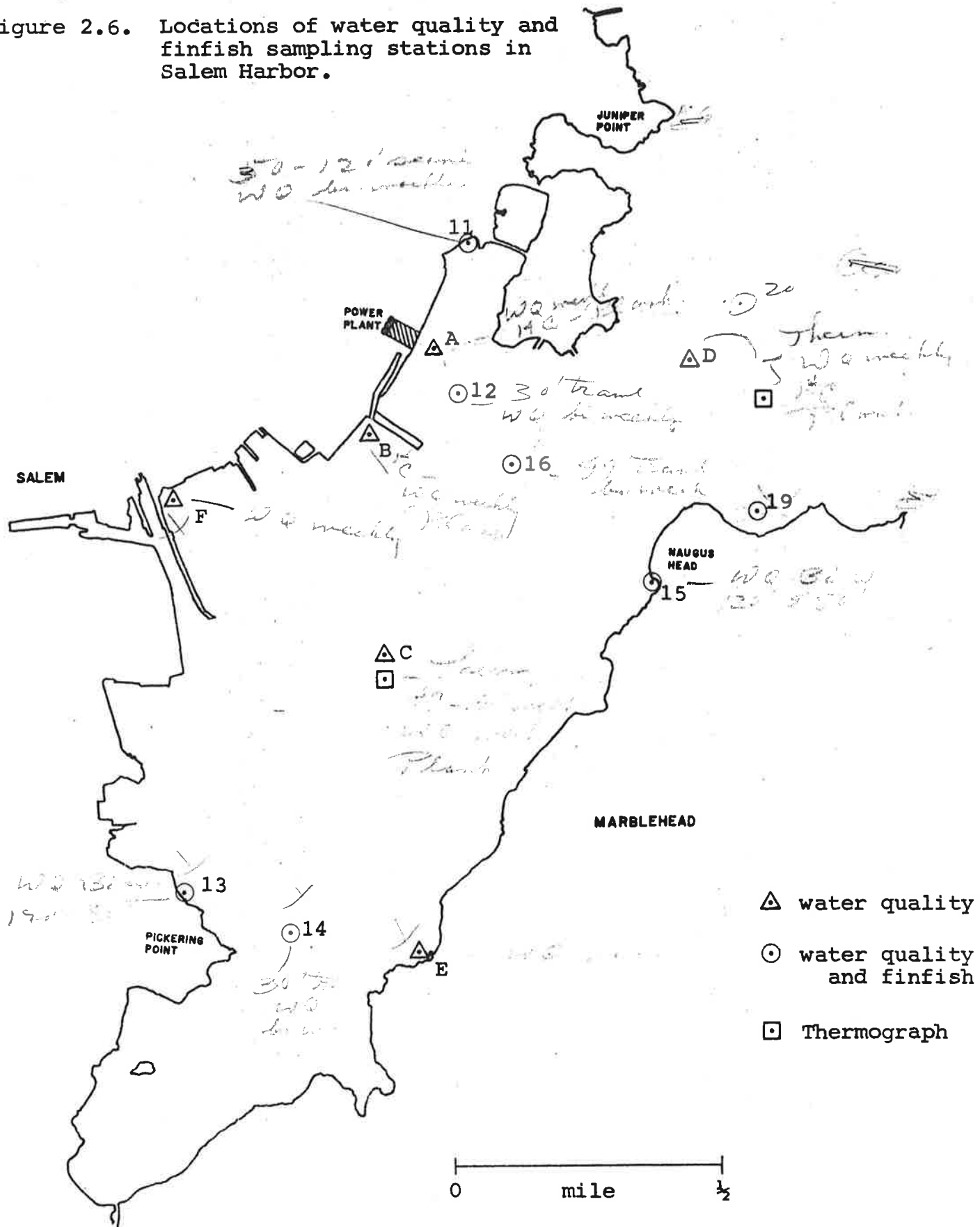
Average surface water temperature for the quarter rose 5.5°C to 18.5°C . Although recordings were higher than usual (33.4°C at Station B), the overall average approximated the July - September 1972 mean of 18°C .

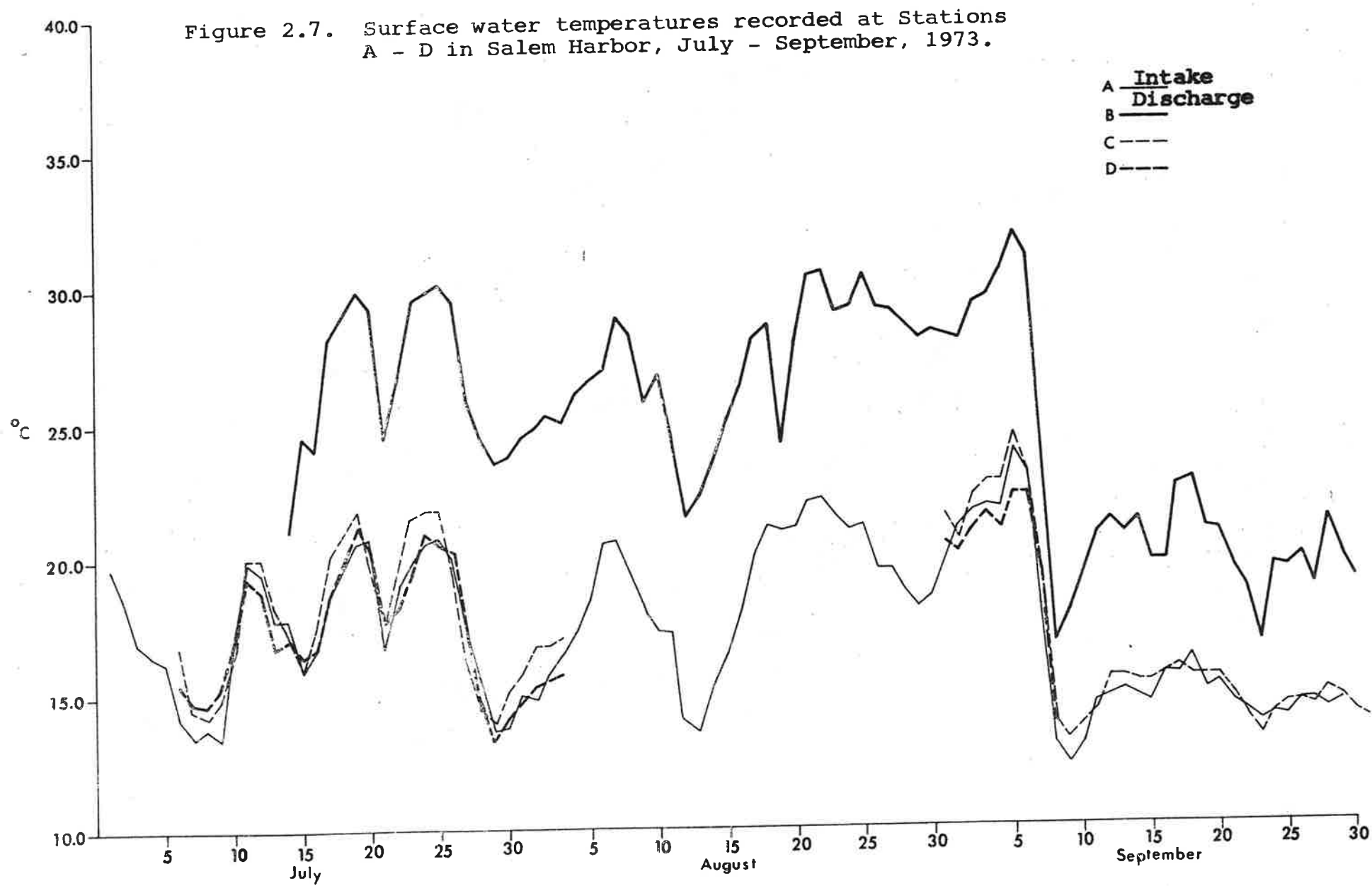
Daily surface water temperatures are recorded at Stations A - D (Figure 2.6). Figure 2.7 indicates minimal temperature variation among Stations A, C and D. Sharp temperature reductions occurred at all Stations on 6 and 7 September preceding the 8 September shutdown of Unit 4. The drop in water temperature was directly related to sharply reduced air temperatures. Midday air temperatures prior to 5 September generally reached 32.2°C (90°F), while maximum midday air temperature on 5, 6, and 7 September were 21.1°C , 26.1°C and 23.9°C , respectively. Early morning minimum temperatures during the same period showed little variation indicating a reduction of radiant energy during the day affecting both air and water temperatures. Reduced ΔT levels after 8 September are indicative of decreased discharge of thermal effluent.

Equipment malfunctions resulted in loss of data at Stations C and D from August 4 - 29.

Bi-weekly monitoring of the plant intake basin (2 ft below surface) terminated on 30 September following fulfillment of Environmental Protection Agency permit requirements. Data collected at the -2' surface level and at -8' MLW, as suggested in Progress Report No. 5, indicates similar temperature patterns (Figure 2.8). However, lower minimum values

Figure 2.6. Locations of water quality and finfish sampling stations in Salem Harbor.





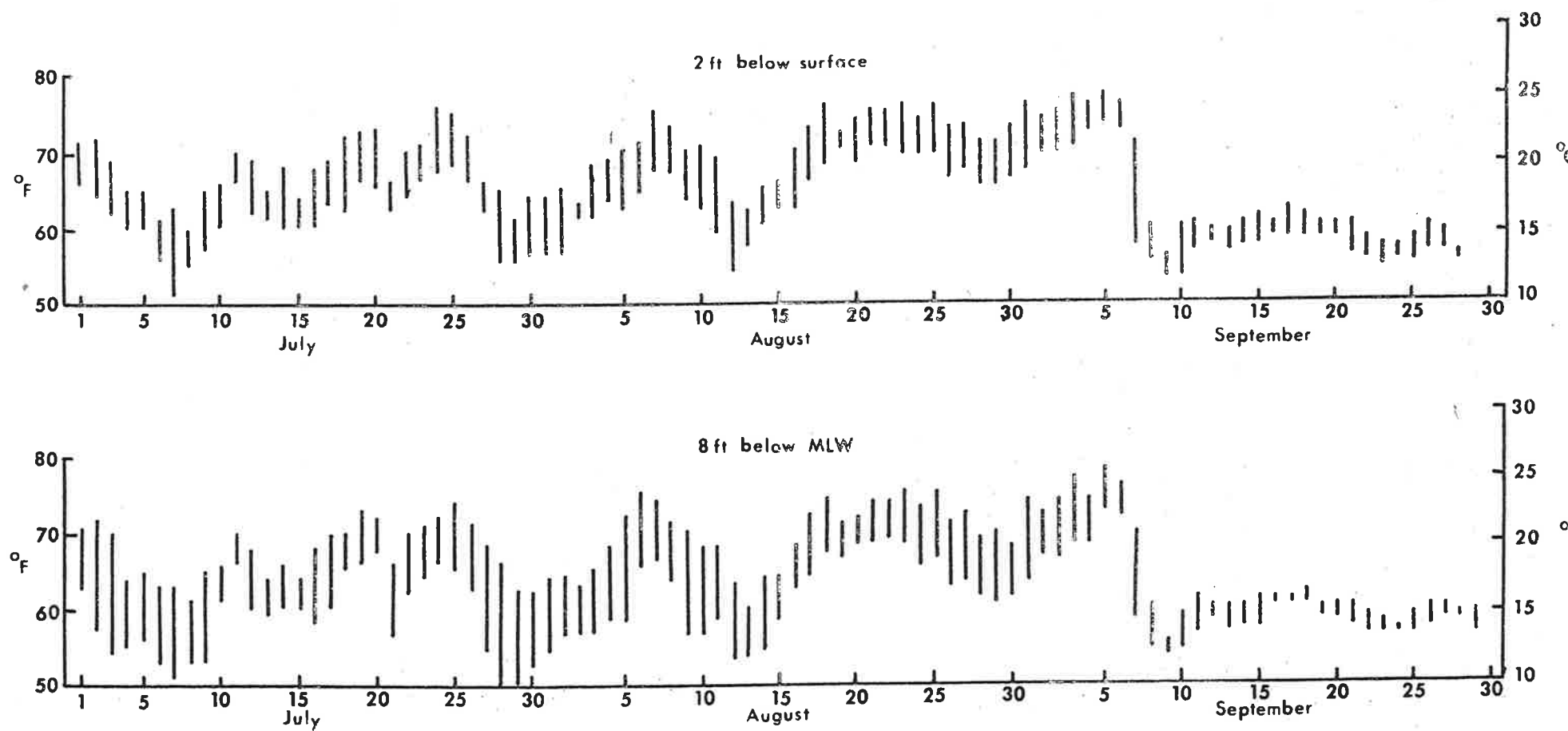


Figure 2.8. Daily minimum and maximum water temperatures recorded at Station A, Salem Harbor, July - September, 1973.

were recorded daily at the deep water thermistor, located in close proximity to intake water tunnels. Combined effects of seasonal change and Unit 4 shutdown is again demonstrated between September 5 and 8. Interestingly, daily minimum and maximum temperatures have been greatly reduced since September 7. A similar phenomenon occurred in 1972. In early September, temperature ranges were reduced as the effect of midday warming diminished.

Thermal surveys were conducted on July 18, 19 and 20; August 9 and 17; and September 26.

For the July 18 and 19 surveys, 86 stations were established along 17 parallel east-west transects in Salem Harbor (Figures 2.9 and 2.10). Profiling was achieved with two G.M. RS5-3 salinometers and a W&T FA-190 bathythermograph. Figures 2.11 and 2.12 display surface isotherms for high and low tide, respectively; while Figures 2.13 and 2.14 show profile cross sections along each transect.

Although sampling was performed on succeeding days, intake water temperatures were similar (20°C), and circulating water volumes averaged 421,000 gpm. Generation was maintained between 730 and 740 MW. Discharge water recorded at high and low tide was 23°C and 24°C , respectively. As expected, thermal effects penetrate further into Salem Harbor at high tide, and push seaward at low tide. During both surveys surface temperature was reduced to 19°C before reaching the Marblehead shore, approximately $3/4$ mile from the plant discharge.

Figure 2.9. Locations of temperature profile stations, Salem Harbor, July 18 - 19, 1973.

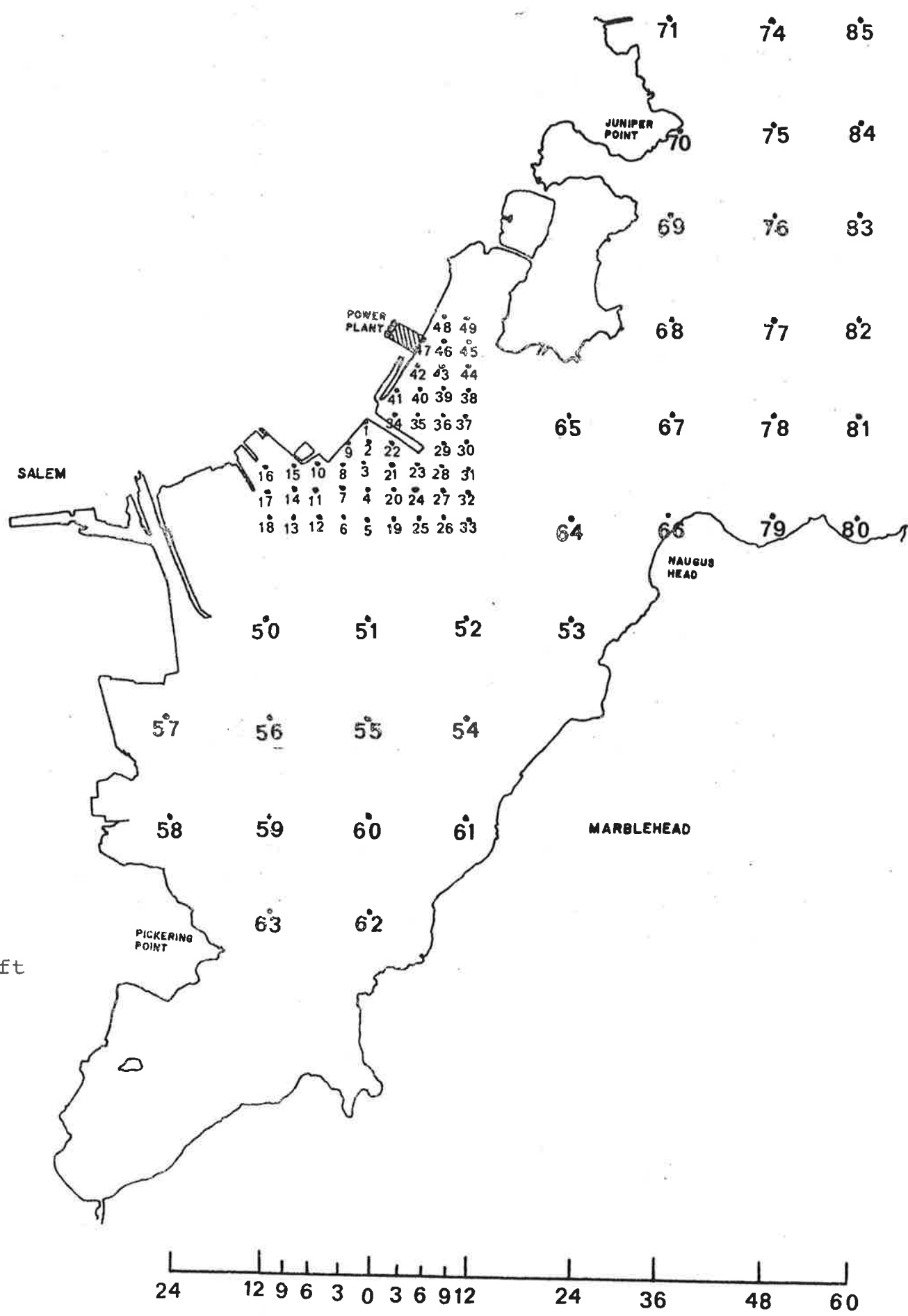


Figure 2.10. Locations of temperature profile transects, Salem Harbor, July 18 - 19, 1973.

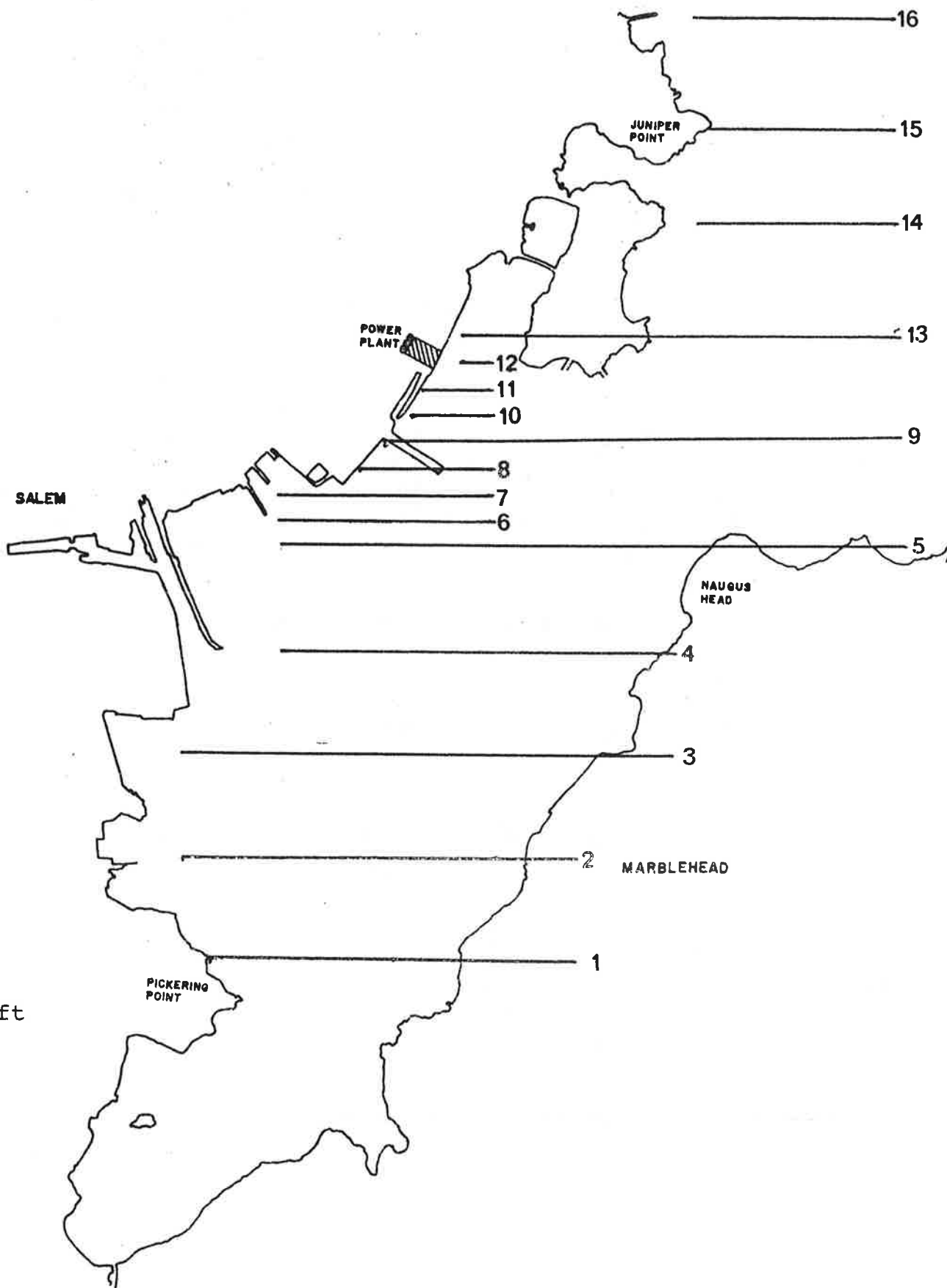


Figure 2.11. Surface isotherms ($^{\circ}\text{C}$) in Salem Harbor, July 18, 1973.

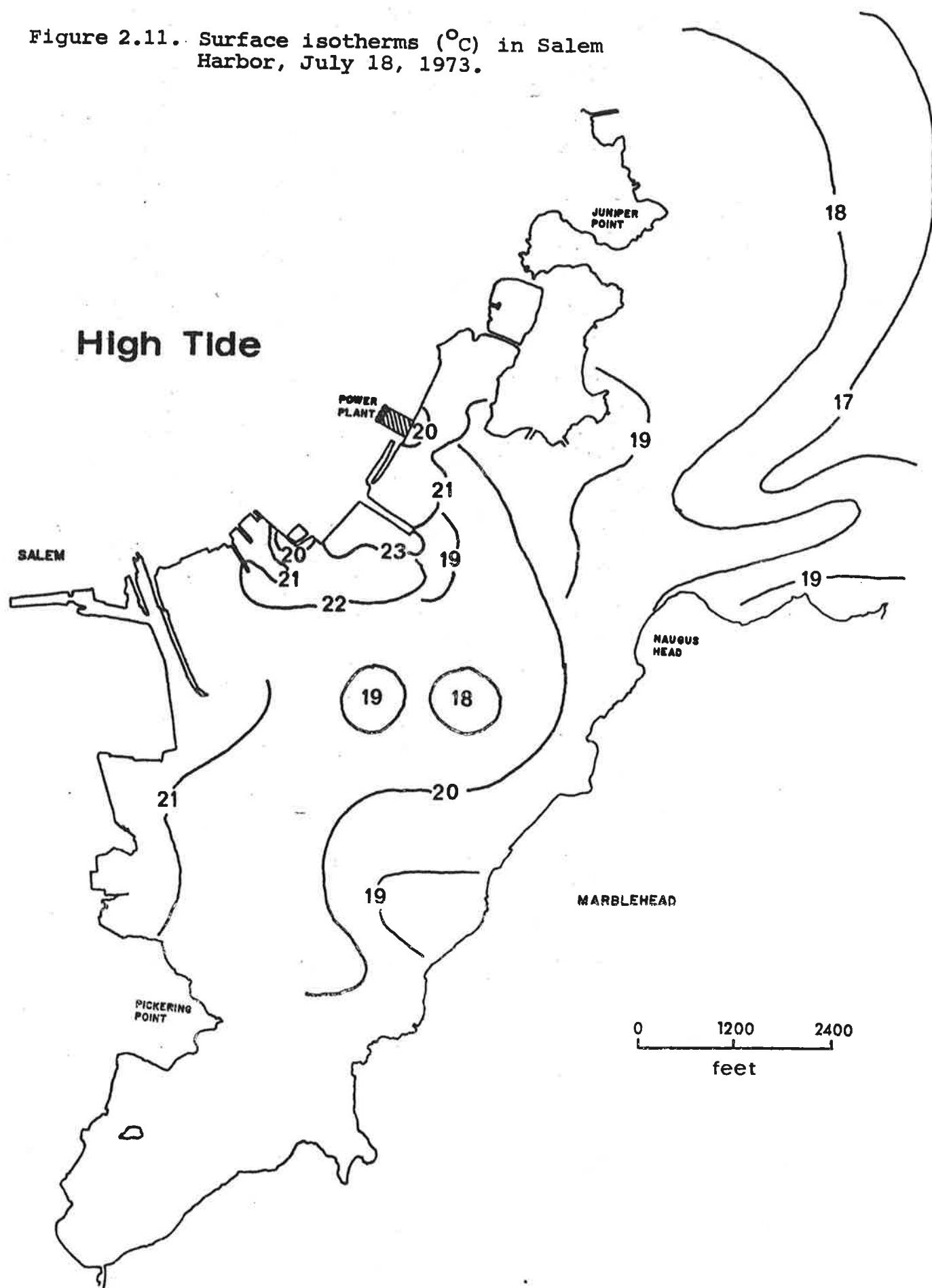


Figure 2.12. Surface isotherms ($^{\circ}\text{C}$) in Salem Harbor, July 19, 1973.

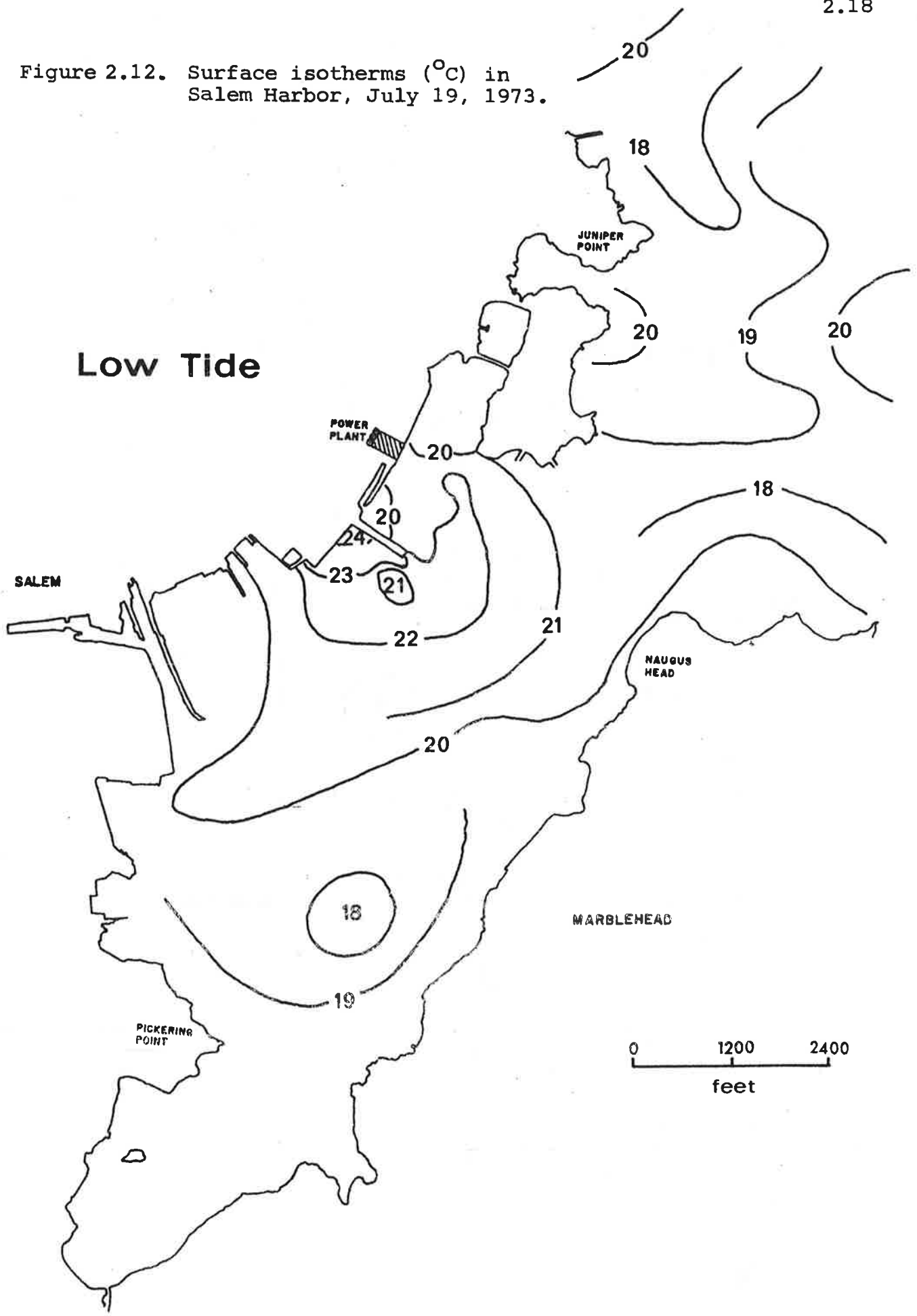


Figure 2.13. Vertical isotherms in Salem Harbor, July 18, 1973.

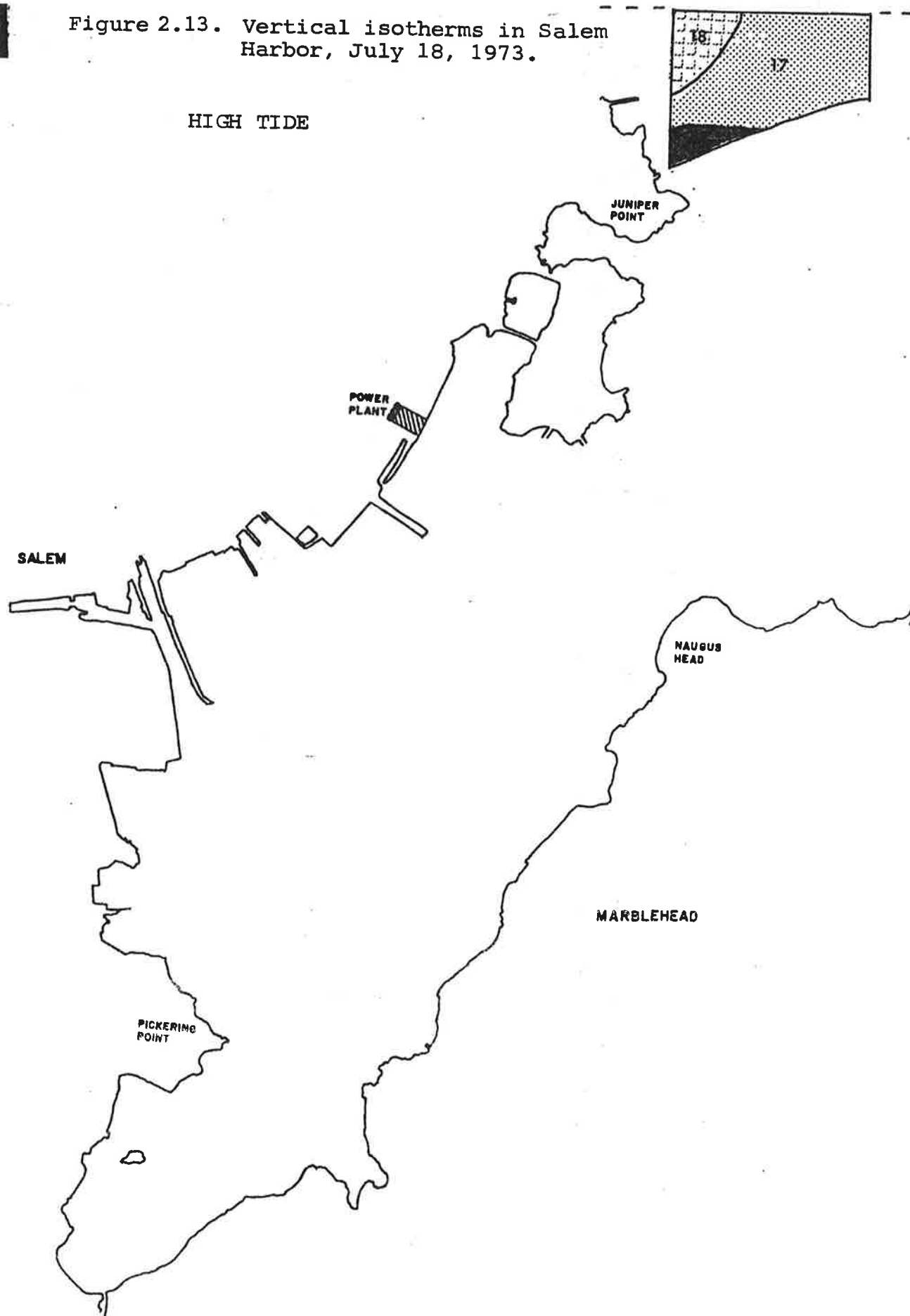


Figure 2.19. Wind occurrence in Salem Harbor, January 1973.

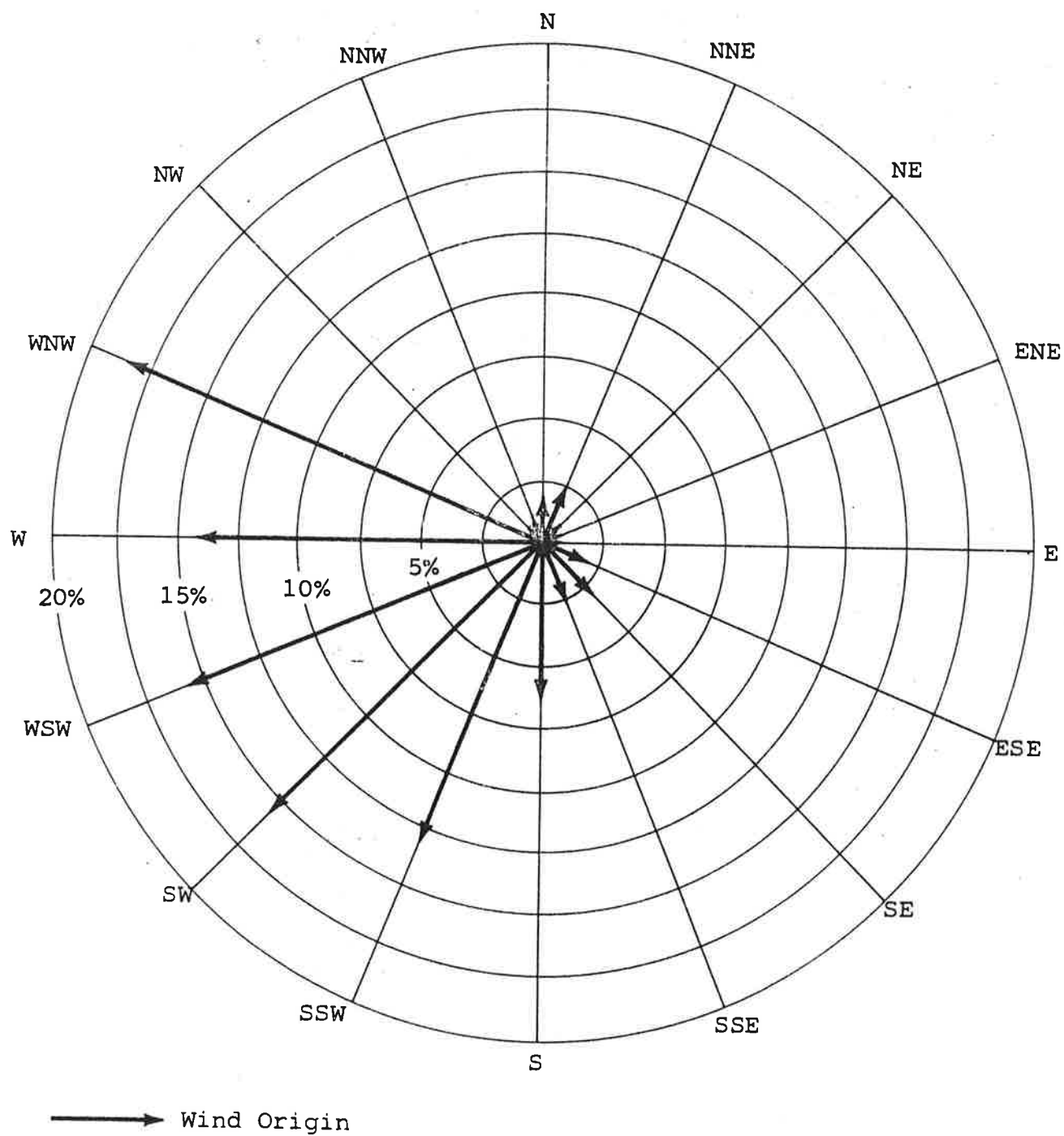


Figure 2.20. Wind occurrence in Salem Harbor, February, 1973.

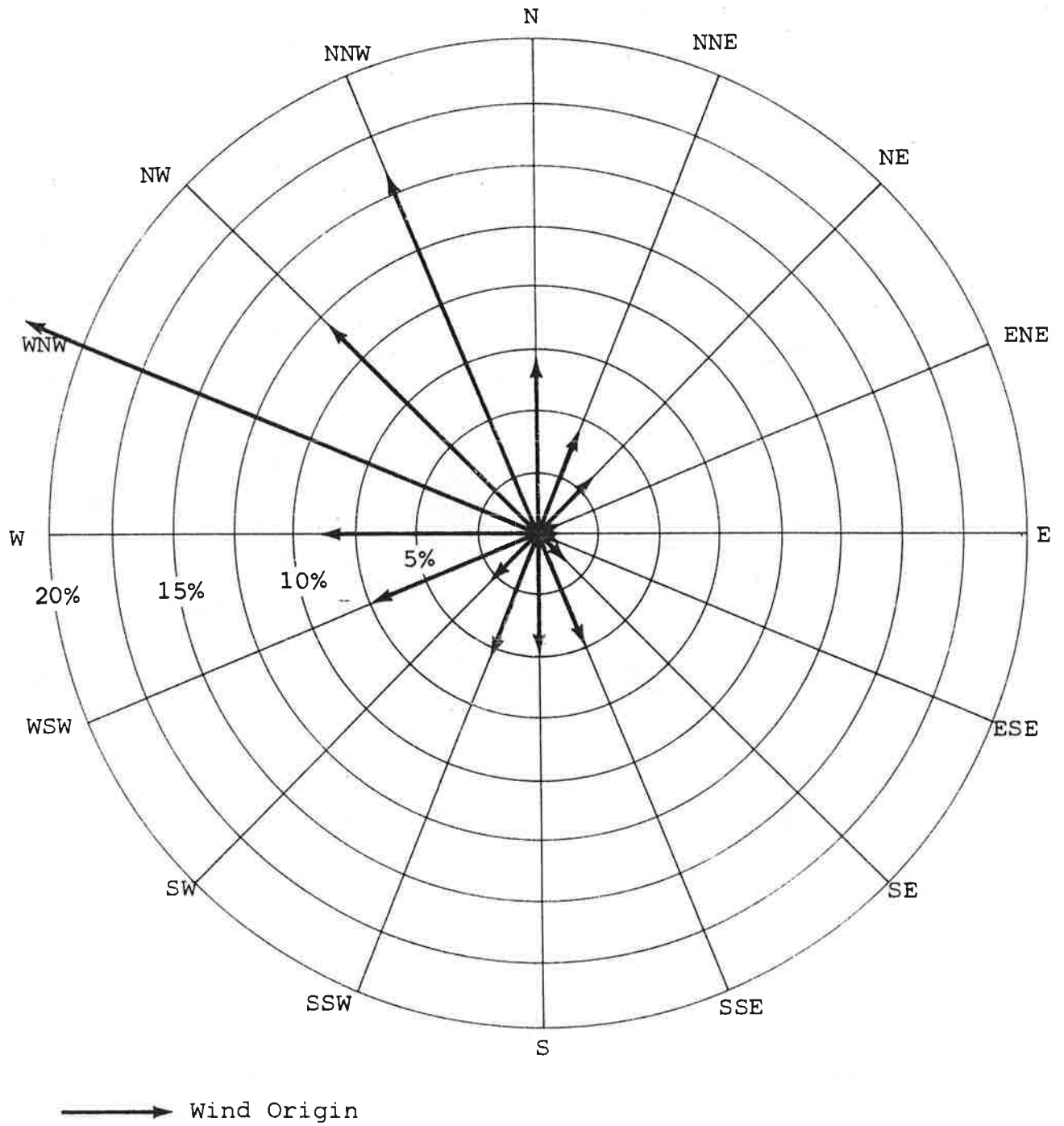


Figure 2.21. Wind occurrence in Salem Harbor, March, 1973.

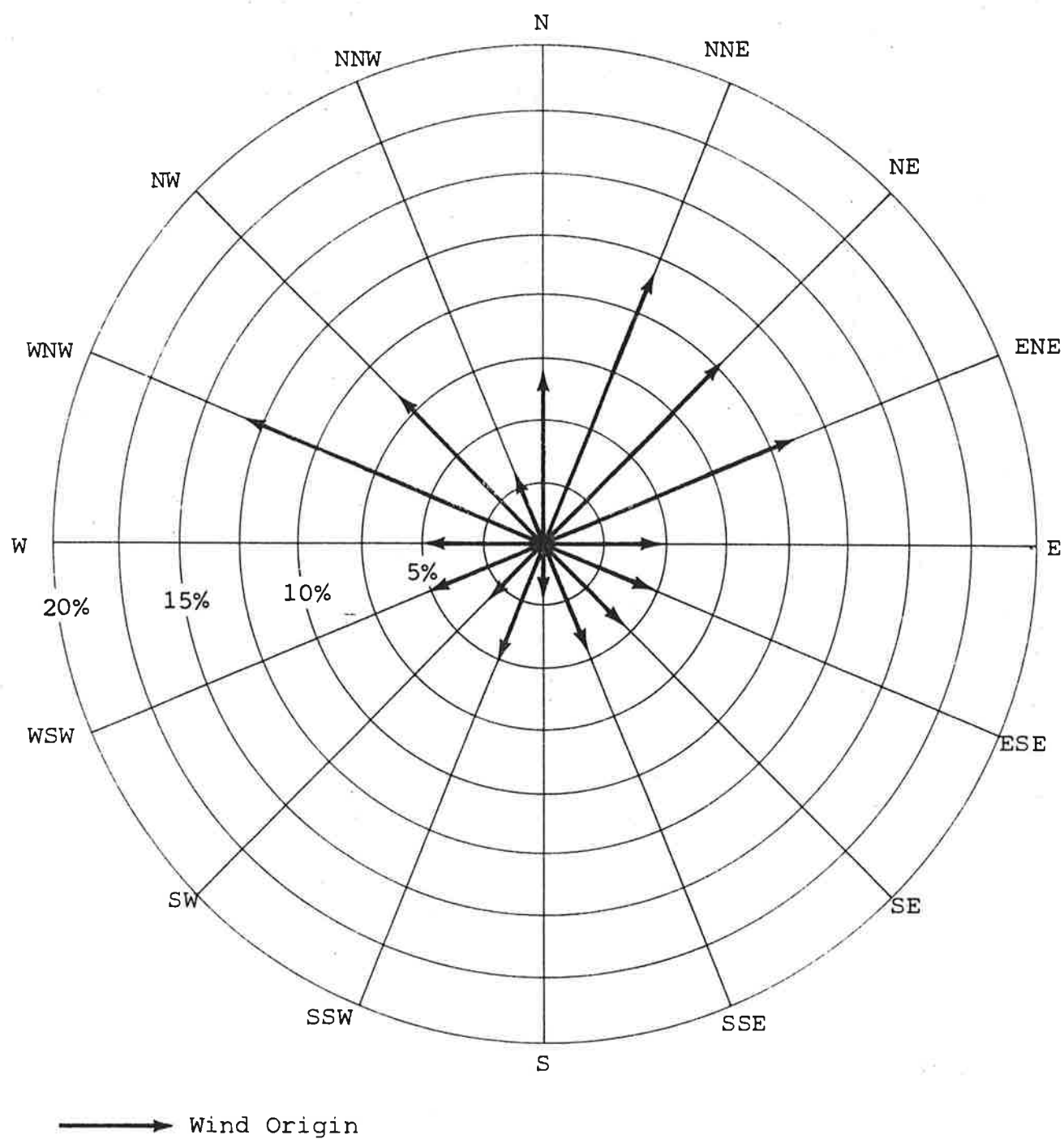


Figure 2.22. Wind occurrence in Salem Harbor, April, 1973.

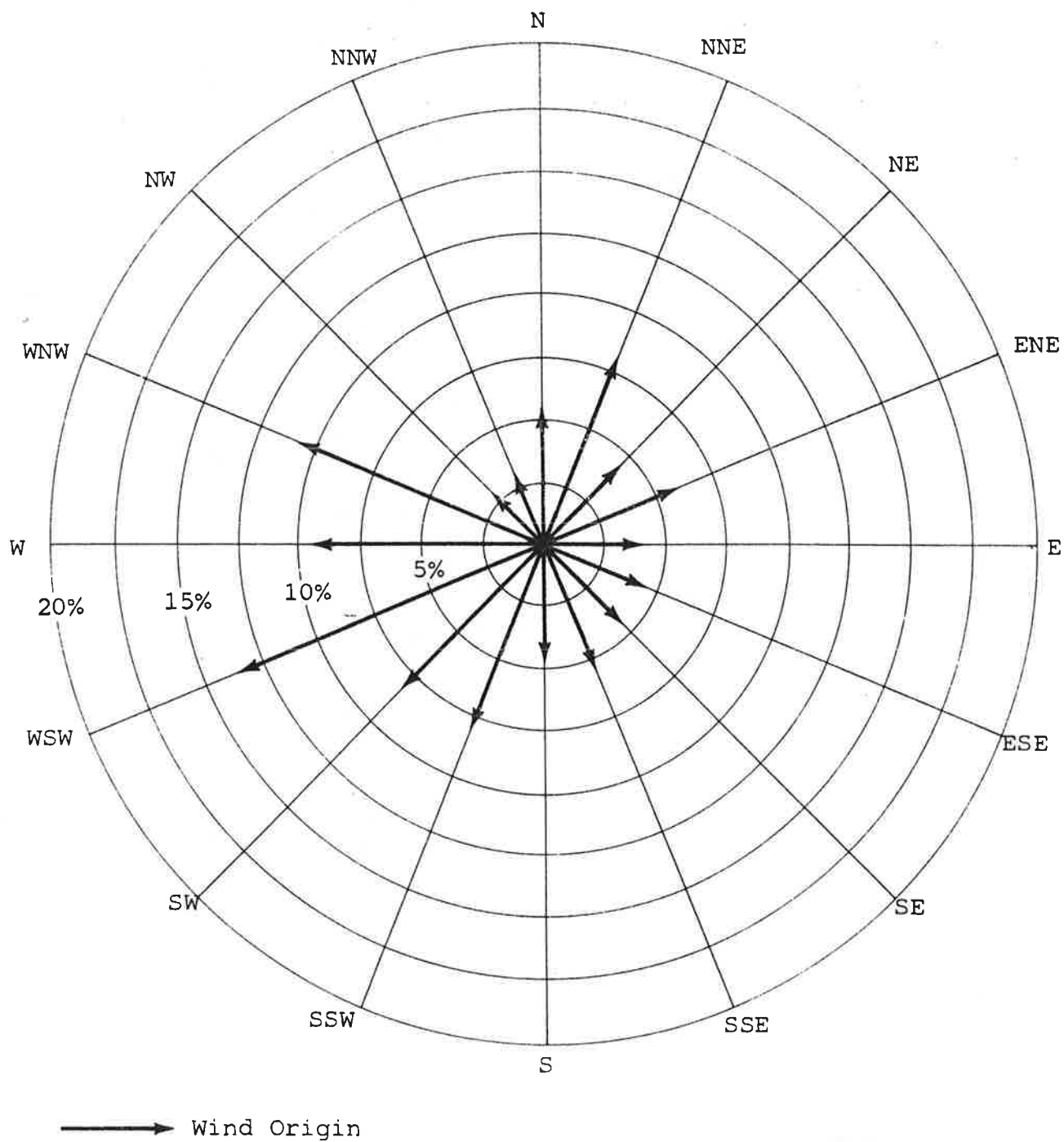


Figure 2.23. Wind occurrence in Salem Harbor, May, 1973.

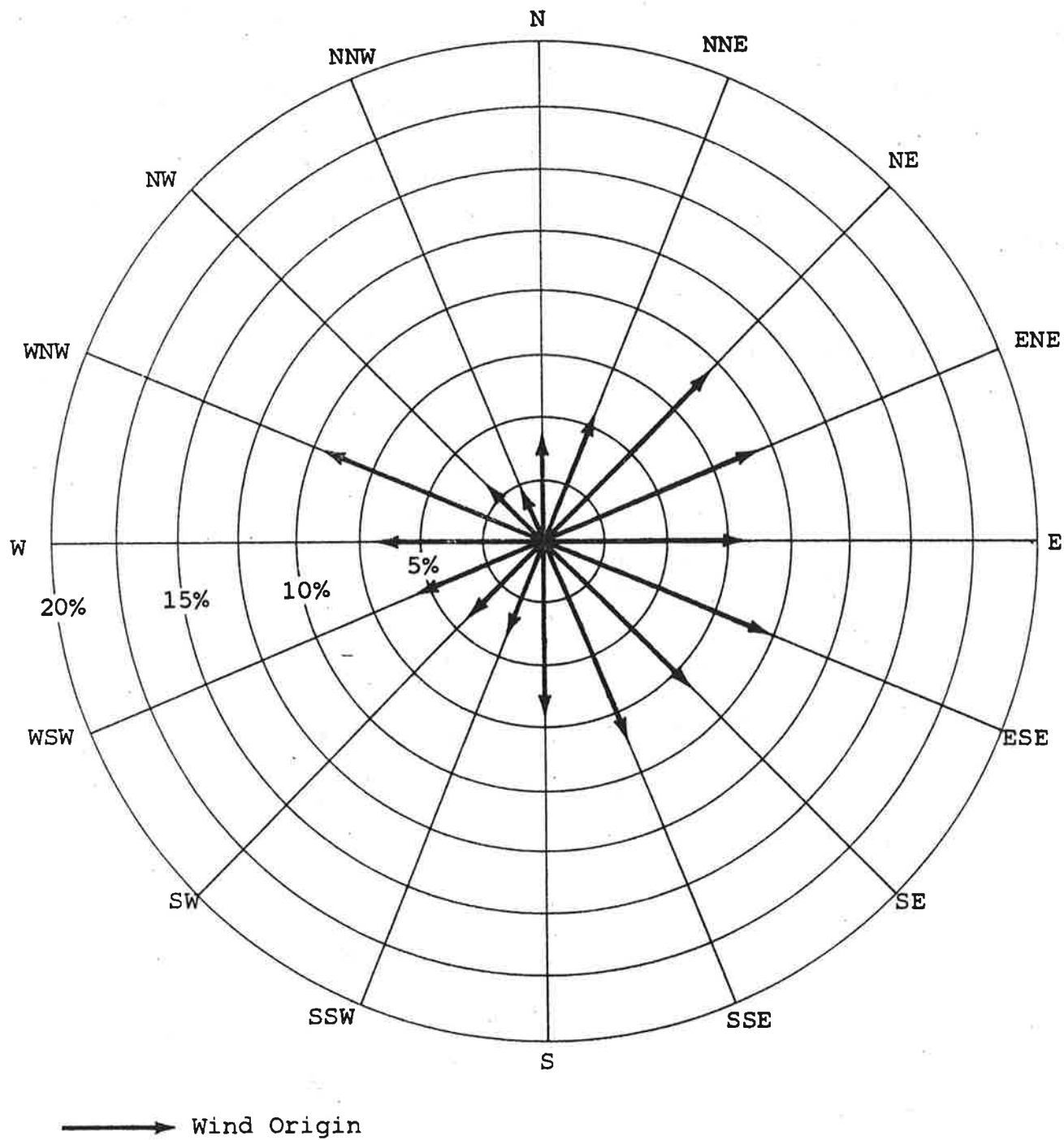


Figure 2.24. Wind occurrence in Salem Harbor, June, 1973.

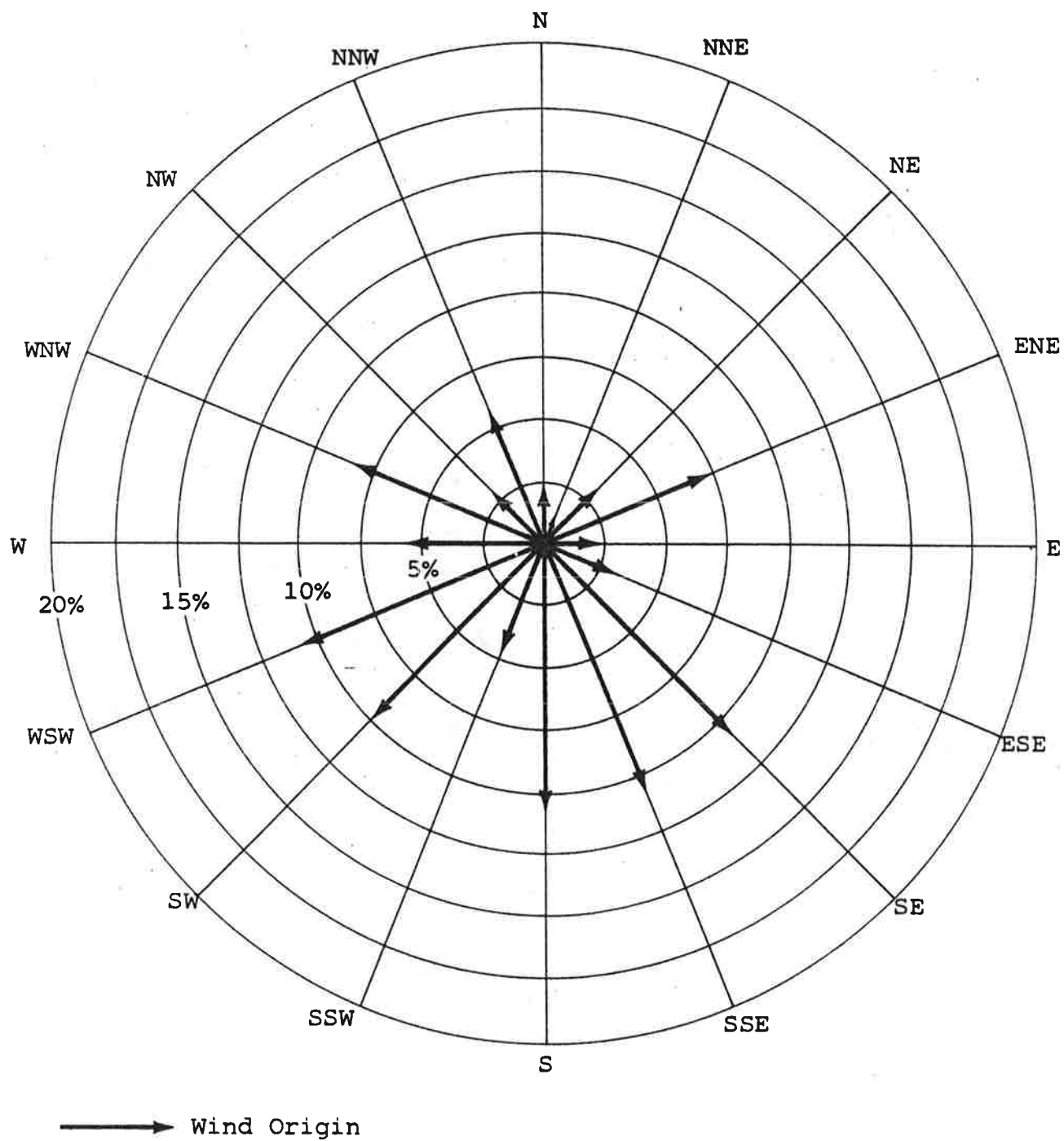


Figure 2.25. Wind occurrence in Salem Harbor, July, 1973.

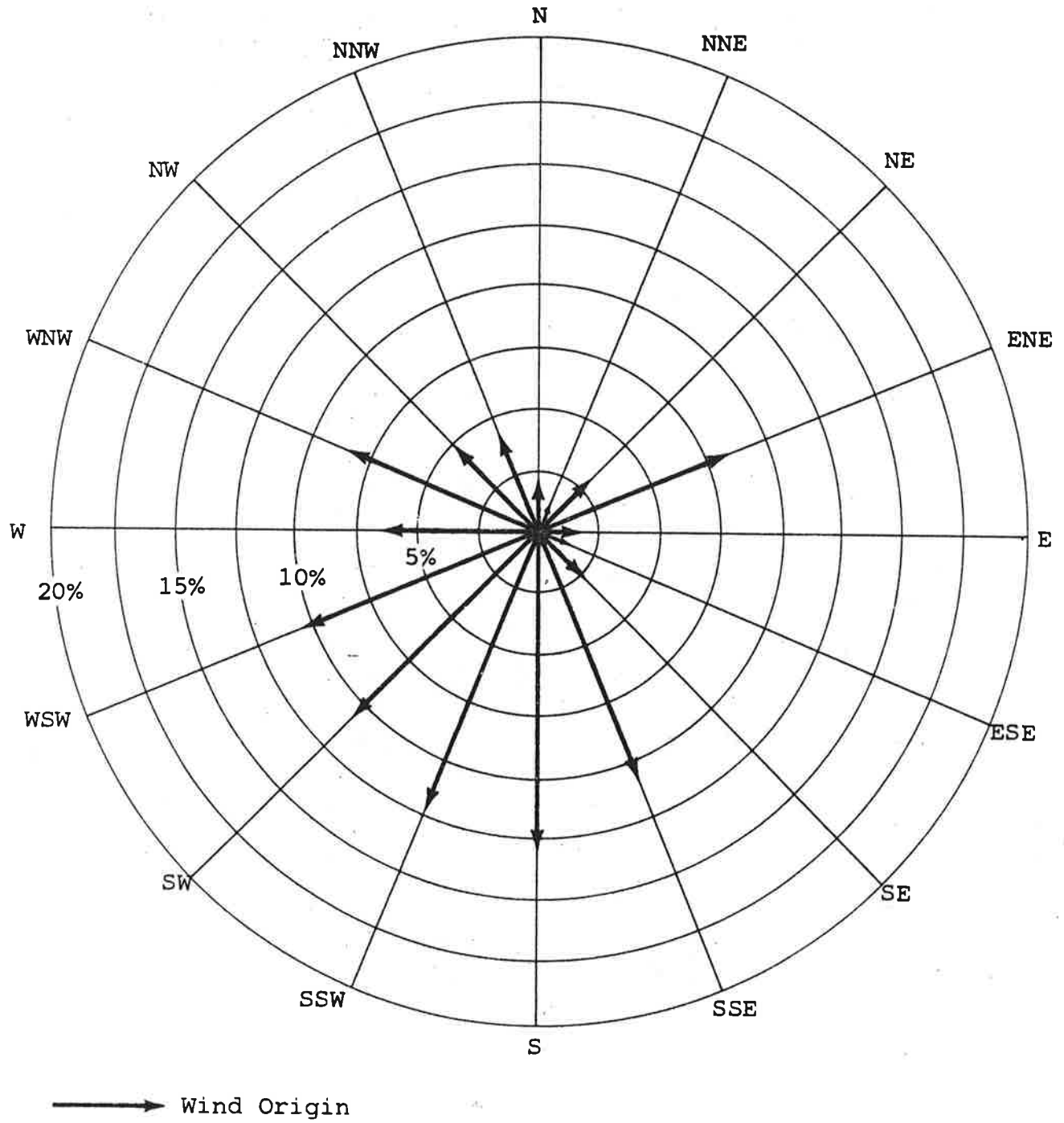


Figure 2.26. Wind occurrence in Salem Harbor, August, 1973.

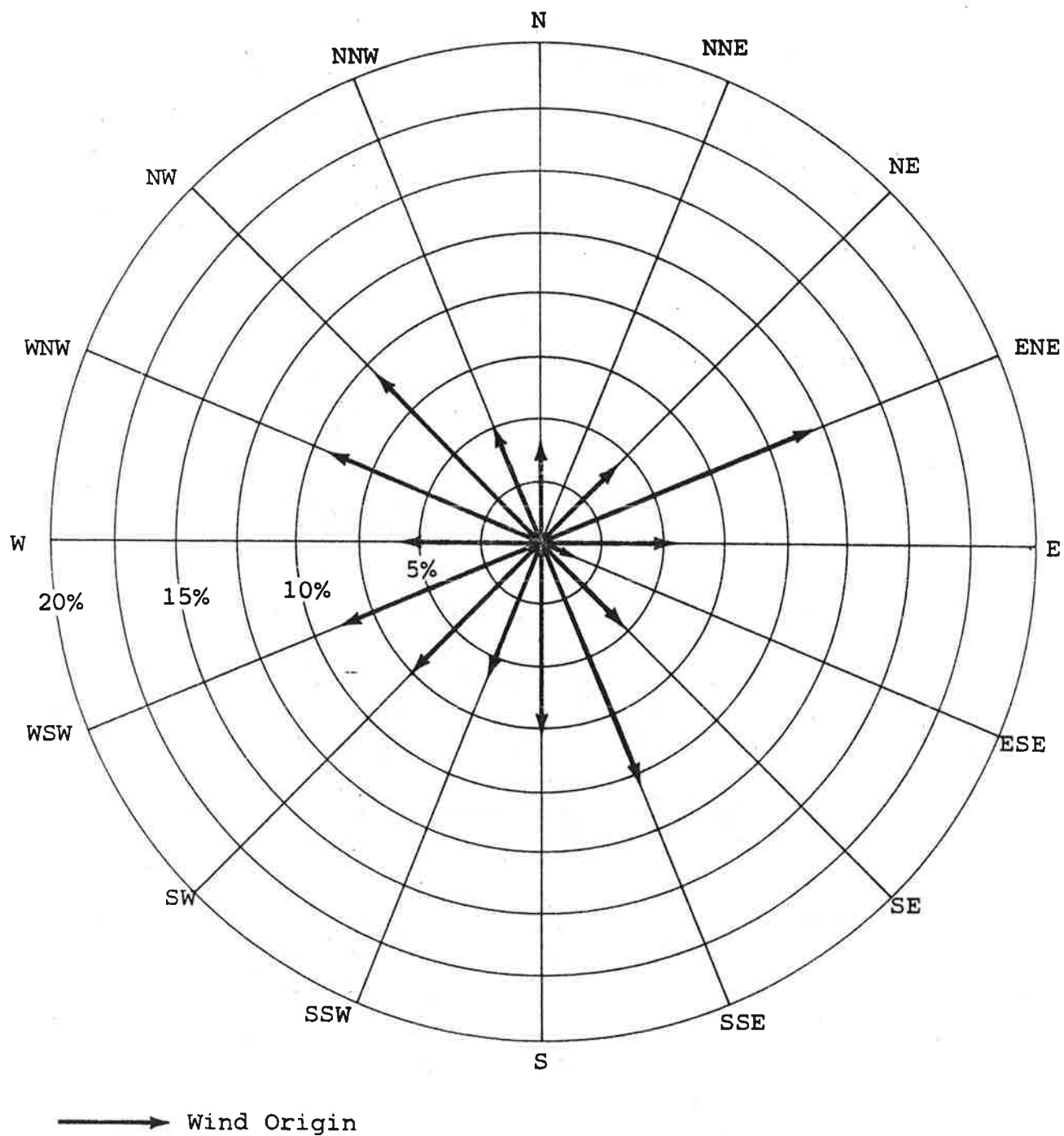
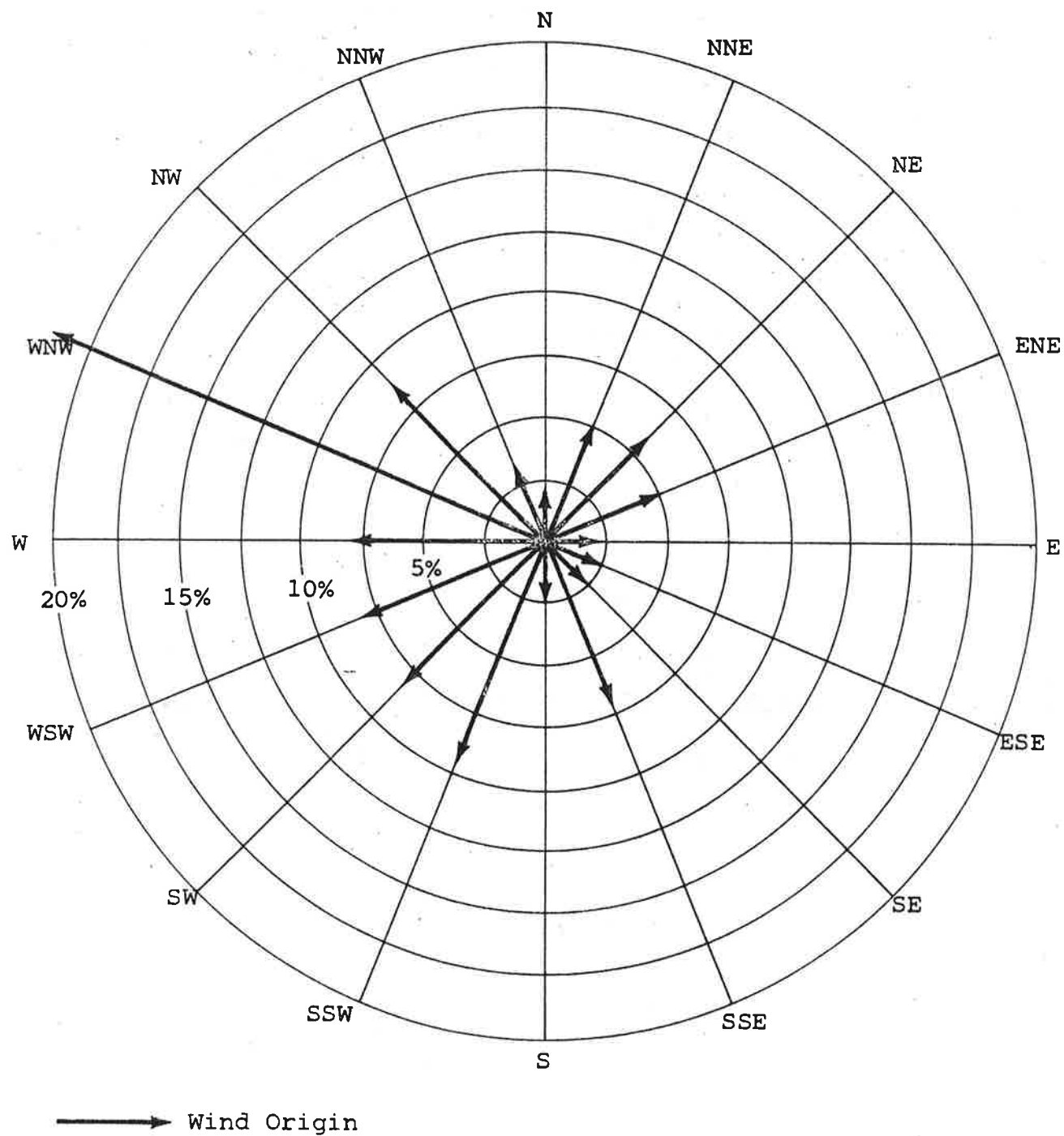


Figure 2.27. Wind occurrence in Salem Harbor, September, 1973.



3.0 CHEMICAL INVESTIGATIONS

3.1 Water Quality

Surface water quality varied as follows: temperature, 12.0 - 30.0°C; salinity, 24.0 - 31.5 ‰; pH, 8.0 - 9.0; carbon dioxide, 5.0 - 10.0 ppm; dissolved oxygen, 5.3 - 15.5 ppm; biochemical oxygen demand, 1.2 - 6.7 ppm, nitrite-N, 0.0 - 0.8 µg-atom/l; nitrate-N, 10.7 - 360.3 µg-atom/l; and phosphate-P, 0.0 - 42.4 µg-atom/l (Table 3.1).

The most pronounced change in water quality was reflected by increased surface water temperatures. Recordings up to 30.0°C were noted at Station B (power plant discharge) during August when the ambient temperature reached 20.0°C. Correspondingly, salinities in Salem Harbor increased slightly during the last few weeks of the quarter.

Nitrate values were generally 35.0 µg-atom/l; however, a tenfold increase on 7 September at Station E was noted. The source of the high nitrate recording was unknown; however a surface drain is located on the station.

Table 3.1. Water quality data for Salem Harbor, July - September, 1973.

DATE	SAMPLE NUMBER	TIME (EST)	TIDAL STAGE (HOURS)	WIND DIR/VEL (MPH)	CLOUD COVER (%)	DEPTH (FEET)	TEMP °C AIR WATER	SALINITY (0/00)	CO ₂ pH	O ₂ (ppm)	BOD (ppm)	NO ₂ -N (ug-atom/L)	NO ₃ -N (ug-atom/L)	PO ₄ -P (ug-atom/L)
<u>Station A</u>														
7/6	001031	1020	low + ½		0	S	22.0 16.0	29.3	8.5	5.0	9.0	2.4	0.2	25.0 10.5
7/10	001032	0750	high + ½	NE/5	30	S	23.5 15.5	29.7	8.5	5.0	9.8	5.8	0.3	38.9 13.1
7/16	001052	0950	low +4	0	90	S	22.0 16.5	29.7	8.5	10.0	9.4	6.3	0.1	47.9 11.3
7/24	001059	1200	low + ½	SW/5	0	S	24.0 21.5	29.2	8.5	10.0	9.5	3.8	0.2	19.3 9.8
8/1	001076	1215	low +5½	0	100	S	20.0 14.5	30.5	8.5	5.0	8.1	1.8	0.2	58.5 14.7
8/8	001089	1315	low + ½	SW/5	90	S	27.5 21.5		8.5	10.0				
8/13	001109	1255	high +2	N/5	50	S	22.5 15.0	30.3	8.5	5.0	9.3	2.2	0.0	33.9 10.4
8/22	001111	1605	low +5	0	100	S	18.0 21.5	30.0	8.5	5.0	8.0	3.2	0.0	28.4 5.2
8/28	001134	1215	high +1	NW/5	100	S	28.5 20.5	30.3	8.5	10.0	7.9	6.7	0.1	32.9 12.3
9/7	001145	1235	low	0	50	S	24.0 19.0	30.5	8.5	10.0	5.9	2.2	0.1	33.5 8.1
9/11	001164	0840	low +4½	SW/5	0	S	19.0 13.5	31.2	8.5	5.0	7.8	2.6	0.7	33.6 16.8
9/20	001191	1015	high +5½	SE/20	70	S	15.0 14.5	30.5	8.5	10.0	7.9	2.0	0.0	31.1 17.0
9/25	001205	1135	high +1½	E/5	10	S	14.5 13.5	30.8	8.5	10.0	7.7	4.4	0.2	29.3 1.6
<u>Station B</u>														
7/6	001029	1000	low		0	S	24.0 22.5	29.4	8.5	5.0	8.1	1.9	0.2	50.0 10.3
7/10	001033	0840	high +1½	NE/5	20	S	24.0 19.5	29.6	8.5	5.0	9.4	4.8	0.3	43.9 14.4
7/16	001053	1050	low +5	0	90	S	24.0 25.0	29.8	8.5	5.0	8.6	3.1	0.1	64.3 10.2
7/24	001060	1415	low +2½	SW/5	0	S	24.5 29.5	29.2	8.5	5.0	8.8	3.9	0.3	65.0 12.9
8/1	001077	1230	low +5½	0	100	S	20.5 22.0	30.5	8.5	5.0	7.9		0.3	37.9 15.9
8/8	001088	1450	low +2	W/5	100	S	27.0 23.0	30.4	8.5	10.0	8.2	3.8	0.1	42.1 7.2
8/13	001107	1215	high +1½	0	70	S	23.5 22.0	30.6	8.5	10.0	8.5	1.8	0.1	32.5 12.8
8/22	001112	1630	low +5½	0	100	S	19.0 30.0	30.1	8.5	5.0	7.9	3.1	0.0	29.0 21.4
8/28	001135	1245	high +2	W/15	100	S	20.0 25.0	29.8	8.5	5.0	6.8	2.9	0.2	37.8 16.6
9/7	001148	1050	high +3½	SW/10	60	S	18.5 26.0	30.6	8.5	5.0	6.0	1.4	0.3	35.3 10.6
9/11	001165	0852	low +5	SW/5	0	S	19.0 19.0	31.2	8.5	10.0	7.4	1.5	0.4	34.0 16.8
9/20	001194	1140	low +1	S/15	20	S	18.0 23.0	30.5	8.5	5.0	7.3	1.6	0.1	35.6 3.9
9/25	001206	1150	high +2	E/5	0	S	13.5 20.0	30.8	8.5	10.0	8.5	4.8	0.2	30.2 1.2

Table 3.1. Continued

		TIDAL		WIND		CLOUD											
SAMPLE		TIME	STAGE	DIR/VEL	COVER	DEPTH	TEMP °C	SALINITY	CO ₂	O ₂	BOD	NO ₂ -N	NO ₃ -N	PO ₄ -P			
DATE	NUMBER	(EST)	(HOURS)	(MPH)	(%)	(FEET)	AIR WATER	(0/00)	pH	(ppm)	(ppm)	(ppm)	ug-atom/L				
Station C																	
7/6	001030	0930	low		0	S	20.5 17.0	29.1	8.5	5.0	8.5	2.6	0.2	34.3	13.6		
7/10	001034	0910	high +2	E/5	80	S	22.0 15.5	29.8	8.5	5.0	10.0	3.3	0.3	33.2	13.6		
7/16	001054	1015	low +4½	0	90	S	23.0 17.0	29.4	8.5	5.0	9.0	3.8	0.0	39.3	10.6		
7/24	001061	1312	low +1½		0	S	29.5 25.0	29.2	8.5	5.0	7.1	1.3	0.2	28.2	5.7		
8/1	001078	1240	high	N/5	100	S	19.0 17.0	30.4	8.5	5.0	7.9		0.8	39.3	12.8		
8/8	001090	1430	low +1½	SW/5	100	S	29.5 22.5	30.1	8.5	5.0	9.5	3.4	0.0	39.3	11.2		
8/13	001105	1200	high +1½	NW/5	90	S	22.0 15.5	30.4	8.5	10.0	9.2	2.0	0.0	32.5	8.8		
8/22	001113	1655	low +5½	0	100	S	19.0 23.0	30.1	8.5	5.0	8.0	2.8	0.0	29.3	6.0		
8/28	001136	1230	high +1½	NW/10	100	S	24.5 20.5	30.4	8.5	5.0	7.7	3.4	0.2	31.7	13.4		
9/7	001147	1145	high +4½	SW/15	50	S	21.0 20.0	30.1	8.5	10.0	5.7	1.6	0.2	31.1	8.1		
9/11	001166	0906	low +5	SW/5	0	S	17.0 13.5	31.1	8.5	5.0	7.8	1.5	0.4	34.3	17.6		
9/20	001193	1125	low + ½	S/15	30	S	14.5 14.5	30.7	8.5	10.0	8.1	1.7	0.1	34.7	12.9		
9/25	001203	1245	high +3	E/5	0	S	13.0 14.0	30.8	8.5	10.0	8.4	3.6	0.2	31.4	6.4		
Station D																	
7/6	001026	0900	high +5½		0	S	27.5 16.5	29.0	8.5	5.0	8.4	1.7	0.2	46.4	9.8		
7/10	001035	0940	high +2½	E/5	80	S	21.5 16.5	29.7	8.5	5.0	9.7	2.2	0.3	36.8	16.8		
7/16	001055	1000	low +4½	0	90	S	20.0 17.0	29.8	8.5	5.0	9.3	3.5	0.0	37.1	10.0		
7/24	001062	1245	low +1		0	S	23.0 22.0	29.2	8.5	5.0	9.4	4.1	0.2	10.7	8.5		
8/1	001079	1205	low +5	0	100	S	17.4 14.5	30.4	8.5	10.0	8.1		0.2	38.2	14.0		
8/8	001091	1400	low +1½	SW/5	100	S	27.5 21.5	30.2	8.5	10.0	9.5	3.6	0.0	31.1	6.3		
8/13	001108	1226	high +1½	NW/5	70	S	22.5 14.0	30.4	8.5	5.0	9.4	2.0	0.0	30.4	5.1		
8/22	001114	1745	high + ½	0	100	S	17.0 20.0	30.0	8.5	5.0	8.5	3.6	0.0	29.8	0.0		
8/28	001137	1225	high +1½	NW/10	100	S	23.0 19.5	30.3	8.5	5.0	7.7	5.1	0.1	35.4	12.7		
9/7	001146	1215	high +5½	W/10	50	S	22.5 20.0	30.4	8.5	10.0	6.2	1.2	0.1	30.0	7.7		
9/11	001167	0925	low +5½	SW/5	0	S	17.0 13.5	30.9	8.5	5.0	8.0	2.3	0.2	31.3	11.8		
9/20	001192	1045	low	S/20	50	S	18.5 15.0	30.5	8.5	10.0	8.4	2.1	0.2	31.9	12.3		
9/25	001204	1250	high +3	E/10	0	S	14.0 13.5	30.8	8.5	10.0	8.7	4.6	0.2	31.9	1.6		

Table 3.1. Continued

		TIDAL		WIND		CLOUD													
SAMPLE TIME		STAGE	DIR/VEL	COVER	DEPTH	TEMP °C	SALINITY	CO2	O2	BOD	NO2-N	NO3-N	PO4-P						
DATE	NUMBER	(EST)	(HOURS)	(MPH)	(%)	(FEET)	AIR WATER	(0/00)	pH	(ppm)	(ppm)	(ppm)	ug-atom/L						
Station E																			
7/6	001027	0920	low		0	S	27.5 17.5	25.6	8.5	10.0	8.5	2.7	0.6	32.9	42.4				
7/10	001036	0920	high +2	E/5	80	S	22.0 16.5	30.1	8.5	5.0	8.7	2.4	0.2	37.9	18.0				
7/16	001056	1025	low +5	0	90	S	22.0 17.5	29.4	8.5	5.0	7.5	3.0	0.1	62.1	17.4				
7/24	001063	1325	low +2		0	S	24.0 23.0	28.2	8.5	5.0	8.4	2.8	0.2	21.9	18.0				
8/1	001080	1250	high	N/5	100	S	19.5 17.0	30.1	8.5	5.0	7.7		0.8	37.9	16.9				
8/10	001092	0840	high	0	0	S	24.0 20.0	29.9	8.5	5.0	7.4	2.2	0.1	40.4	6.5				
8/13	001096	1155	high +1	NW/5	80	S	24.5 18.5	29.9	8.5	5.0	8.7	2.2	0.0	30.0	12.7				
8/22	001115	1715	high	0	100	S	17.0 21.0	29.8	8.5	5.0	7.7	3.0	0.0	29.4	6.4				
8/28	001138	1235	high +1½	NW/10	100	S	24.5 21.0	30.0	8.5	5.0	7.2	3.0	0.1	32.0	16.8				
9/7	001149	1425	low +1½	SW/5	50	S	20.0 22.0	28.8	8.5	5.0	7.3	2.8	0.3	360.3	24.4				
9/11	001168	0913	low +5	SW/5	0	S	16.0 13.5	31.1	8.5	10.0	7.0	1.3	0.2	33.4	21.8				
9/20	001188	1330	low +2½	SW/5	90	S	14.0 16.0	30.7	8.5	10.0	8.2	1.3	0.2	35.3	25.4				
9/25	001208	1230	high +2½	0	0	S	14.5 14.0	30.5	8.5	10.0	7.5	2.4	0.2	36.7	8.9				
Station F																			
7/6	001028	0940	low		0	S	23.0 14.0	30.0	8.5	5.0	8.4	2.2	0.4	35.7	12.9				
7/10	001037	0825	high +1		80	S	21.5 17.5	29.8	8.5	10.0	9.8	3.1	0.3	40.4	17.8				
7/16	001057	1035	low +5	0	80	S	20.0 18.0	29.8	8.5	5.0	8.6	2.6	0.0	59.3	12.8				
7/24	001064	1340	low +2		0	S	24.0 25.5	28.9	8.5	5.0	9.4	4.5	0.2	14.3	6.5				
8/1	001081	1235	high	0	100	S	21.5 19.0	30.7	8.5	5.0	7.7	2.1	0.3	37.1	18.0				
8/10	001093	0900	high + ½	0	0	S	28.0 17.5	30.5	8.5	5.0	8.3	2.3	0.0	36.8	3.5				
8/13	001106	1210	high +1½	NW/5	90	S	21.5 14.0	30.6	8.5	5.0	8.9	2.6	0.0	30.4	10.8				
8/22	001116	1720	high	0	100	S	18.0 23.5	30.0	8.5	5.0	8.1	3.6	0.0	26.6	4.8				
8/28	001139	1240	high +2	W/10	100	S	23.5 19.0	29.8	8.5	5.0	7.3	3.3	0.1	34.0	15.8				
9/7	001150	1450	low +2	SW/5	50	S	19.0 18.5	30.5	8.5	5.0	7.7	2.5	0.2	29.1	13.0				
9/11	001169	0900	high	0	0	S	20.0 13.5	31.1	8.5	5.0	7.3	1.5	0.5	34.4	18.5				
9/20	001190	1343	low +3	SW/5	100	S	15.0 16.5	30.8	8.5	10.0	8.5	1.5	0.1	37.4	13.5				
9/25	001207	1210	high +2½	E/5	0	S	14.0 14.5	30.5	8.5	10.0	7.9	1.8	0.2	31.2	1.2				

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>												
7/11	001038	1130	high +3½	0	100	S	22.5 19.0	25.0	8.5	5.0	9.0	3.6
7/23	001058	0800	high +4½	N/10	0	S	17.5 17.0	28.0	8.5	5.0	9.6	
8/7	001086	0900	high +3	0	50	S	22.0 19.5	30.1	8.5	5.0	9.8	4.4
8/21	001104	1000	low	0	10	S	23.5 20.0	27.5	8.5	5.0	8.9	7.8
9/12	001143	0835	low +4	SW/5	0	S	14.0 13.5	30.0	8.5	10.0	7.6	3.2
9/25	001198	0810	low +4½	NE/5	0	S	10.0 13.0	31.0	8.5	5.0	8.5	3.0
<u>Station 11</u>												
7/12	001040	0815	low +5½	0	100	S	17.5 19.0	27.7	8.5	5.0	5.7	1.8
7/13	001051	0950	high	SW/5	0	S	17.0 16.5	26.0	8.5	5.0	5.3	2.2
7/25	001065	0750	high +1½	W/5	0	S	24.0 21.5	27.0	8.5	5.0	7.7	2.4
7/26	001068	0600	low +4½	SW/5	100	S	20.0 21.0	27.0	8.5	10.0	6.2	2.6
8/6	001082	1010	low +1	SW/5	0	S	23.5 22.5	26.0	9.0	5.0	15.5	1.3
8/7	001085	0630	high +1	0	0	S	20.5 22.0	26.0	8.0	5.0	9.6	2.5
8/21	001101	0530	high +1½	0	100	S	17.0 21.5	28.0	8.5	5.0	7.6	2.4
8/24	001127	0730	high	0	100	S	17.0 20.5	27.0	8.5	5.0	6.7	2.2
9/5	001140	0920	high +2	0	100	S	21.0 22.5	27.0	8.5	5.0	7.5	3.0
9/10	001161	0750	low +4½	SW/5	0	S	13.5 12.0	31.0	8.5	5.0	6.0	1.6
9/24	001195	0825	low +5	0	100	S	12.5 13.5	30.5	8.5	5.0	6.8	1.8
9/25	001200	0815	low +4½	N/5	0	S	13.5 13.0	31.5	8.5			
<u>Station 12</u>												
7/12	001047	0900	high	NW/5	50	S	16.0 18.5	26.0	8.5	5.0	9.1	2.3
7/27	001072	0925	high +1	SW/10	100	S	22.0 18.0	28.0	8.5	5.0	7.7	2.4
8/13	001094	0925	low +5	NW/5	10	S	25.0 13.5	30.0	8.5	5.0	8.9	5.4
8/27	001130	0945	high	E/5	100	S	23.0 19.5	27.5	8.5	10.0	7.8	3.2
9/13	001174	1220	high +1	0	30	S	18.0 13.5	30.5	8.5	10.0	8.4	2.3
9/27	001210	1235	high +1	S/5	0	S	20.0 14.5	31.5	8.5	10.0	9.2	4.0

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 13</u>												
7/12	001041	0630	low +3½	0	100	S	15.0 18.5	27.5	8.5	5.0	6.7	1.8
7/13	001049	0730	low +4	NW/5	10	S	16.5 17.5	27.0	8.5	5.0	7.5	1.9
7/25	001067	0920	high +3	0	0	S	27.0 23.0	26.5	8.5	5.0	7.2	2.7
7/26	001069	1100	high +3½	0	100	S	21.0 18.0	27.0	8.5	10.0	7.9	2.4
8/6	001044	0830	high +4	0	0	S	20.5 21.0	26.5	8.5	5.0	8.1	3.1
8/7	001084	0830	high +3	0	0	S	28.5 22.0	26.5	8.5	10.0	9.6	2.4
8/21	001103	0700	high +3	0	50	S	17.0 22.0	26.5	8.5	5.0	7.3	2.3
8/24	001128	0910	high +2	NW/10	10	S	18.5 21.0	26.5	8.5	5.0	6.7	2.4
9/5	001141	0825	high +3	E/5	100	S	21.0 24.0	26.0	8.5	5.0	6.2	1.9
9/10	001162	1230	high +3	SW/5	0	S	17.5 14.0	30.0	8.5	10.0	7.8	1.5
9/24	001196	1110	high +2½	SW/10	100	S	12.5 13.5	31.0	8.5	5.0	7.9	2.0
9/25	001202	0950	high	N/5	40	S	13.0 14.0	31.0	8.5			
<u>Station 14</u>												
7/12	001048	0800	low +5	W/5	100	S	15.0 19.0	27.0	8.5	10.0	8.4	5.3
7/27	001071	0830	high	SW/5	100	S	22.0 17.0	29.5	8.5	10.0	7.2	2.3
8/13	001095	1025	high	NW/10	10	S	22.0 13.5	31.0	8.5	5.0	8.4	2.7
8/27	001131	0830	low +4½	0	100	S	23.5 20.0	27.0	8.5	10.0	7.2	3.5
9/13	001173	1110	high	SW/5	30	S	18.0 14.5	31.5	8.5	5.0	8.1	2.9
9/27	001209	1030	low +5½	S/5	0	S	17.5 14.5	31.5	8.5	10.0	8.8	4.5
<u>Station 15</u>												
7/12	001042	0730	low +4½	0	100	S	15.0 17.0	26.6	8.5	5.0	7.8	3.2
7/13	001050	0815	low +5	NW/10	10	S	18.0 17.5	24.0	8.5	10.0	6.4	5.9
7/25	001066	0830	high +2	0	0	S	28.0 27.0	24.0	8.5	5.0	8.1	2.6
7/26	001070	0710	high	0	100	S	22.0 21.0	25.5	8.5	5.0	6.3	2.5
8/6	001043	0915	high +4½	0	0	S	21.5 22.0	26.0	8.5	5.0	9.4	2.7
8/7	001083	0925	high +4	0	0	S	28.0 22.5	26.0	8.5	5.0	9.9	2.7
8/21	001102	0615	high +2	0	100	S	17.5 21.5	26.0	8.5	5.0	6.8	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 15 (Cont.)</u>												
8/24	001129	0830	high +1	W/5	80	S	18.5 20.5	27.0	8.5	10.0	6.8	2.5
9/5	001142	0750	high +2½	0	100	S	21.5 23.5	26.5	8.5	5.0	7.0	1.9
9/10	001163	0845	low +5½	SW/10	0	S	12.0 12.5	29.5	8.5	5.0	6.9	1.5
9/24	001197	1010	high +1½	0	100	S	12.5 13.5	31.0	8.5	5.0	7.0	2.1
9/25	001201	0905	low +5½	0	40	S	12.5 13.0	31.0	8.5			
<u>Station 16</u>												
7/11	001039	1325	high +5	SW/5	60	S	22.0 20.0	24.5	8.5	5.0	9.8	3.8
8/7	001087	1045	high +5	N/5	50	S	23.5 24.0	30.1	8.5	5.0	9.8	5.6
8/21	001110	1200	low +2	NE/5	0	S	22.5 23.0	28.0	8.5	5.0	8.6	5.8
9/12	001144	1030	high	SW/5	10	S	17.0 15.0	30.0	8.5	5.0	8.2	2.2
9/25	001199	1100	high +1½	NE/5	40	S	14.5 13.0	31.5	8.5	5.0	8.0	2.4

3.2 Heavy Metals

Analyses of sediments from Stations 11 and 13 were initiated in compliance with EPA permit requirements. Table 3.2 reflects copper concentrations which varied from 2.3 - 7.9 ppm in soft shell clams, Mya arenaria; 11.5 - 43.6 ppm in northern lobsters, Homarus americanus; 0.002 - 0.008 ppm in water; and 9.6 - 16.0 ppm in sediment. Correlation of copper uptake by lobsters at varied levels in the water column has been inconclusive, therefore, sampling has been terminated.

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

Date	Station	Soft shell clam	Lobster	Water	Mud
7/27	A	3.1	18.1	0.004	
	B	3.6	30.9	0.003	
	C - surface			0.002	
	C - midwater		18.2		
	C - bottom	2.3	25.9		
8/22	A	3.5	23.2	0.004	
	B	3.9		0.005	
	C - surface		36.6	0.004	
	C - midwater		22.7		
	C - bottom	5.4	11.5		
8/23	11	4.9		0.004	14.5
	13	7.9		0.004	9.6
9/21	A	4.2	43.6		
	B	4.6	16.1		
	C - surface		32.6		
	C - midwater		17.4		
	C - bottom	6.6	16.3		
9/24	11	3.2		0.005	16.0
	13	4.6		0.008	9.3

4.1 Benthos

Figure 4.1 locates benthic sampling stations in Salem Harbor. Mollusca, Annelida and Arthropoda were dominant invertebrates (Table 4.1). The periwinkle, Littorina littorea, was dominant intertidally; while the amphipods, Leptocheirus pinquus, Leptocheirus sp. and Phoxocephalus holbolli were most abundant subtidally. The bivalve, Nucula delphinodonta, contributed significantly to the subtidal population.

Table 4.2 ranks benthos by percent of abundance at each station seasonally. Comparison of faunal diversity among stations is presented in Table 4.3. Community overlap procedures of Ruddiman, et al (1970) and Sanders (1968) were employed.

Stations B₅ and C₁ showed the greatest and most consistent percent overlap among intertidal stations. Overlap between stations A₁ and B₅ and between A₁ and C₁ never exceeded 38%. The ecological variation responsible for the dissimilarity of station A₁ is unknown.

Physical characteristics are similar at all intertidal stations. Hard packed mud, medium to coarse grain sand, and rocks characterized the substrate. Shell fragments from Mytilus edulis and Mya arenaria littered the bottom. The substrate at station C₁ was softer and less rocky than stations B₅ and A₁. A stronger current generally persisted at station B₅. Bottles and glass fragments at stations C₁ and B₅ provided favorable habitat for Crepidula fornicata.

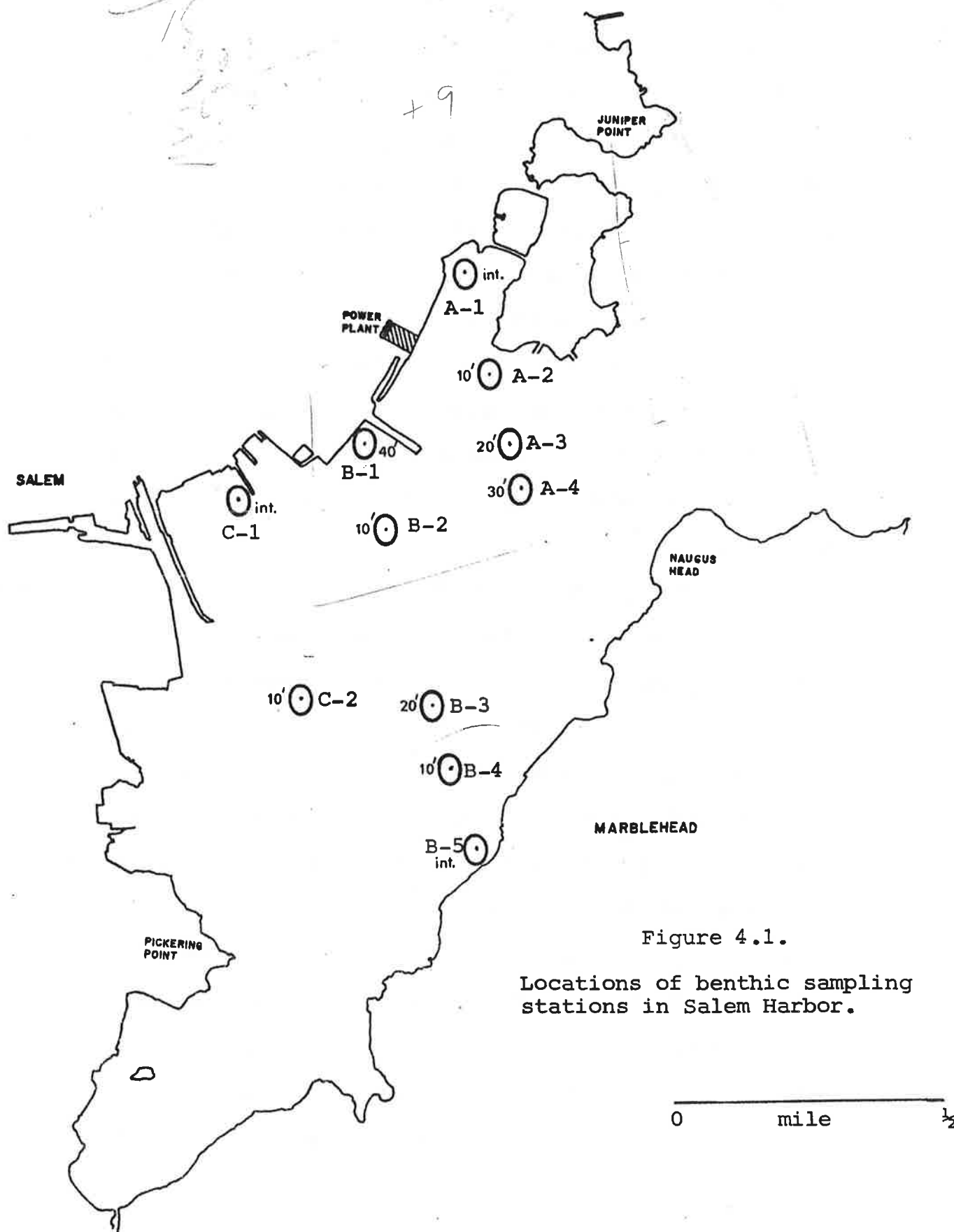


Figure 4.1.

Locations of benthic sampling
stations in Salem Harbor.

Subtidally, species overlap among Stations A₃, A₄, B₃, and B₄ was consistently greater than 60%. Substrates at Stations A₃, A₄, B₁, B₂, B₃, B₄, and C₂ are similar. Fine silt of varying depth, covered with decaying organic matter, overlaid clay. Station A₂ had substrate similar to intertidal stations. Stations A₂, B₁, and C₂ appeared dissimilar to other subtidal sites and to each other.

Table 4.1. Mean weight (g), mean number and percent composition of organisms (to 5cm depth) at benthic stations, Salem Harbor, March 1972 - March 1973.

- = less than .5 percent of total weight and/or less than 10^{-3} grams

STATION A-1

Depth: intertidal	April 6, 1972			July 27, 1972			November 3, 1972			March 2, 1973		
SPECIES	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
RHYNCHOCOELA												
Cerebratulus sp.												
Nemertea												
MOLLUSCA												
Acmaea testudinalis												
Boreotrophon clathratus												
Cerastoderma pinnulatum												
Columbellidae												
Crepidula fornicata												
Crepidula plana												
Fossarus elegans												
Hiatella arctica												
Hydrobia minuta	0.23	179	26							0.91	758	39
Ischnochiton ruber												
Lacuna vincta												
Lacuna sp.												
Littorina littorea	7.98	6	1	119.16	102	26	51.67	88	12	50.72	115	6
Littorina obsoleta										2.82	10	1
Littorina sp.												
Lunatia heros												
Lyonsia hyalina							0.14	4	1			
Macoma sp.	4.83	10	1									
Margarites helicina												
Mercenaria mercenaria												

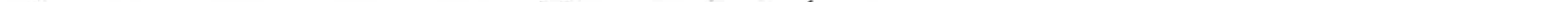
Table 4.1. Continued

STATION A-1												
SPECIES	April 6, 1972			July 27, 1972			November 3, 1972			March 2, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
MOLLUSCA (continued)												
Mesodesma artica												
Moelleria costulata												
Modiolus modiolus												
Mya arenaria	6.04	317	45	2.05	125	32	0.89	88	12	2.72	384	20
Mytilus edulis				95.33	45	11	2.78	40	6	10.18	147	7
Nassarius obsoleta	43.40	54	8	31.53	48	12						
Nassarius trivittatus				1.28	3	1	0.29	4	1	0.10	10	1
Nucula delphinodonta							0.07	32	4			
Nucula tenuis												
Nucula sp.												
Nuculana sp.												
Pandora gouldiana										-	3	-
Petricola pholadiformis										-	3	-
Pyramidella fusca												
Polinices sp.												
Retusa canaliculata												
Retusa obtusa												
Tellina agilis							0.78	52	7	2.03	163	8
Mysella planulata										-	6	-
Odostomia trifidia										-	6	-
Macoma balthica										-	13	1
ANNELIDA												
Aricidea jeffreysii												
Aricidea sp.												
Capittelidae				< 0.01	22	6						
Cirratulidae												
Eunicidae												
Eteone sp.	-	16	2	0.01	22	6	0.01	4	1			
Flabelligeridae												
Glycera dibranchiata												

Table 4.1. Continued

STATION A-1

[illegible]



STATION A-1

4.7

Table 4.1. Continued

STATION A-1												
SPECIES	April 6, 1972			July 27, 1972			November 3, 1972			March 2, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ECHINODERMATA Amphipholis squamata Asterias vulgaris Asterias sp. Ophiuroidea sp. Strongylocentrotus droebachiensis												
Total Number		700			396			713			1,921	
Total Dry Weight Biomass (grams)		62.480			249.390			57.612			69.658	

Table 4.1. Continued

STATION A-2												
Depth: 10' MLW	March 28, 1972			July 27, 1972			November 1, 1972			March 5, 1973		
SPECIES	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
RHYNCHOCOELA												
Cerebratulus sp.												
Nemertea												
MOLLUSCA												
Acmaea testudinalis							0.06	19	4			
Admete couthouyi										5.52	3	-
Cerastoderma pinnulatum							0.14	3	1			
Columbellidae												
Crepidula fornicata												
Crepidula plana												
Fossarus elegans				-	3	1						
Hiatella arctica												
Hydrobia minuta												
Ischnochiton ruber				-	3	1				-	6	1
Lacuna vincta	0.02	19	6									
Lacuna sp.				0.05	45	12						
Littorina littorea	96.43	54	16	370.15	230	60	208.43	138	29	129.32	208	28
Littorina obsoleta												
Littorina sp.	0.47	48	<1									
Lunatia heros												
Lyonsia hyalina												
Macoma sp.												
Margarites helicina												
Mercenaria mercenaria												

Table 4.1. Continued

SPECIES	STATION A-2											
	March 28, 1972			July 27, 1972			November 1, 1972			March 5, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
MOLLUSCA (continued)												
Mesodesma artica												
Moelleria costulata												
Modiolus modiolus												
Mya arenaria	0.16	64	19							0.01	13	1
Mytilus edulis												
Nassarius obsoleta												
Nassarius trivittatus	4.31	96	28	1.49	38	10	2.17	35	7	4.17	112	15
Nucula delphinodonta										0.13	29	4
Nucula tenuis												
Nucula sp.												
Nuculana sp.												
Pandora gouldiana	8.10	6	2				5.60	10	2	4.33	10	1
Pitar morrhuana												
Polinices heros												
Polinices sp.												
Retusa canaliculata												
Retusa obtusa												
Tellina agilis												
Tellina sp.				0.06	3	1	1.26	192	40	0.40	125	17
Thais lapillus												
ANNELIDA												
Aricidea jeffreysii												
Aricidea sp.												
Capittelidae												
Cirratulidae	-	3	1									
Eunicidae												
Eteone sp.	-	6	2									
Flabelligeridae				0.09	6	2	0.01	6	1			
Glycera dibranchiata												

Table 4.1. Continued

STATION A-2												
SPECIES	March 28, 1972			July 27, 1972			November 1, 1972			March 5, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ANNELIDA (continued)												
Harmothoe sp.							-	3	1	0.05	74	10
Lumbrinereidae												
Nephtyidae				0.30	45	12	0.16	16	3	0.24	6	1
Nephtys bucera	-	29	9									
Nephtys sp.												
Nereis virens				-	3	1						
Nereis sp.												
Ninoe nigripes												
Notomastus sp.							<0.01	10	2			
Orbiniidae												
Paraonidae										0.31	3	-
Pectinaria gouldii				0.09	3	1	0.03	10	2	0.02	6	1
Pherusa affinis										0.01	6	1
Pherusa sp.										0.02	3	-
Phyllodoce sp.												
Phyllodocidae												
Polynoidae												
Scoloplos sp.												
Serpulidae tubes												
Sigalionidae												
Spionidae	-	3	1									
Syllidae	-	13	4	0.04			0.04			0.14		
Fragments										0.01	19	3
Unidentified												
SIPUNCULA												
Phascolian strombi												
Phascolopsis gouldi												

4.11

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1

STATION A-2

[illegible]

Table 4.1. Continued

STATION A-2												
SPECIES	March 28, 1972			July 27, 1972			November 1, 1972			March 5, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ECHINODERMATA												
Amphipholis squamata												
Asterias vulgaris												
Asterias sp.				-	3	1						
Ophiuroidea sp.												
Strongylocentrotus droebachiensis							2.92	3	1	0.88	16	2
Total Number		341			382			476			743	
Total Dry Weight Biomass (grams)		109.490			372.270			220.886			146.773	

Table 4.1. Continued

STATION A-3											
Depth: 20' MLW			March 29, 1972			July 27, 1972			November 1, 1972		
SPECIES			Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
RHYNCHOCOELA											
Cerebratulus sp.			-	32	20						
Nemertea										0.57	6
MOLLUSCA											
Acmaea testudinalis											
Boreotrophon clathratus											
Cerastoderma pinnulatum									0.04	8	-
Columbellidae											
Crepidula fornicata											
Crepidula plana											
Fossarus elegans											
Hiatella arctica											
Hydrobia minuta			<0.01	10	6						
Ischnochiton ruber											
Lacuna vincta											
Lacuna sp.											
Littorina littorea						11.92	6	-			
Littorina obsoleta											
Littorina sp.											
Lunatia heros											
Lyonsia hyalina											
Macoma sp.											
Margarites helicina											
Mercenaria mercenaria											

Table 4.1. Continued

STATION A-3

SPECIES	March 29, 1972			July 27, 1972			November 1, 1972			March 5, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
MOLLUSCA (continued)												
Mesodesma artica												
Moelleria costulata												
Modiolus modiolus												
Mya arenaria	0.07	35	22	0.11	26	1	0.02	4	-	0.01	10	-
Mytilus edulis					3	-						
Nassarius obsoleta				-			1.45	44	2	1.11	74	2
Nassarius trivittatus	1.31	26	16				0.10	72	3	0.44	304	9
Nucula delphinodonta					3	-						
Nucula tenuis	-	13	8	0.02	3	-						
Nucula sp.				-	3	-						
Nuculana sp.												
Pandora gouldiana							3.47	4	-			
Pitar morrhuana												
Polinices heros												
Polinices sp.												
Retusa canaliculata												
Retusa obtusa							0.02	12	-	-	3	-
Tellina agilis							1.12	312	12	0.56	189	5
Tellina sp.				-	3	-						
Thais lapillus												
ANNELIDA												
Aricidea jeffreysii										0.01	13	-
Aricidea sp.												
Capittelidae										0.01	3	-
Cirratulidae	-	16	10									
Eunicidae							-	4	-			
Eteone sp.	-	3	2	0.01	22	1	0.32	148	5	<0.01	3	-
Flabelligeridae												
Glycera dibranchiata				0.29	6	-						

Table 4.1. Continued

STATION A-3

[illegible]

STATION A-3

[illegible]

Table 4.1. Continued

STATION A-3												
SPECIES	March 29, 1972			July 27, 1972			November 1, 1972			March 5, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ECHINODERMATA												
Amphipholis squamata												
Asterias vulgaris	26.50	3	2									
Asterias sp.				0.66	3	-						
Ophiuroidea sp.												
Strongylocentrotus droebachiensis												
Total Number		161			2,228			2,681			3,497	
Total Dry Weight Biomass (grams)		27.890			21.20			9.562			6.770	

Table 4.1. Continued

STATION A-4

Depth: 30' MLW	March 29, 1972			July 27, 1972			November 1, 1972			March 5, 1973		
SPECIES	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
RHYNCHOCOELA												
Cerebratulus sp.	-	13	1				0.13	6	-	0.45	26	-
Nemertea												
MOLLUSCA												
Acmaea testudinalis										0.01	3	-
Admete couthouyi							0.13	35	-	-	3	-
Cerastoderma pinnulatum	0.08	26	2									
Columbellidae												
Crepidula fornicata												
Crepidula plana												
Fossarus elegans												
Hiatella arctica												
Hydrobia minuta												
Ischnochiton ruber												
Lacuna vincta												
Lacuna sp.							<0.01	3	-	0.01	3	-
Littorina littorea										0.05	19	-
Littorina obsoleta												
Littorina sp.	0.01	3	-									
Lunatia heros	0.17	10	1									
Lyonsia hyalina												
Macoma sp.												
Margarites helicina							0.02	6	-			
Mercenaria mercenaria												

Table 4.1. Continued

SPECIES	STATION A-4											
	March 29, 1972			July 27, 1972			November 1, 1972			March 5, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
MOLLUSCA (continued)												
Mesodesma artica	<0.01	3	-									
Moelleria costulata												
Modiolus modiolus												
Mya arenaria	0.05	26	2	-	3	-	0.05	19	-	0.14	19	-
Mytilus edulis										-	3	-
Nassarius obsoleta												
Nassarius trivittatus	0.11	6	-				0.15	19	-	0.01	10	-
Nucula delphinodonta							8.30	4,297	43	9.48	5,475	45
Nucula tenuis	0.28	141	9									
Nucula sp.				0.06	13	-						
Nuculana sp.												
Pandora gouldiana												
Pitar morrhuana												
Polinices heros				98.05	3	-						
Polinices sp.												
Retusa canaliculata	0.01	13	1				0.11	64	1	0.18	125	1
Retusa obtusa	0.02	13	1									
Tellina agilis	0.02	10	1				0.18	70	1	0.17	90	1
Tellina sp.												
Thais lapillus												
ANNELIDA												
Aricidea jeffreysii				-	3	-						
Aricidea sp.												
Capittelidae				0.01	3	-						
Cirratulidae												
Eunicidae												
Eteone sp.	-	102	6	0.01	32	1	0.09	42	-			
Flabelligeridae												
Glycera dibranchiata												

Table 4.1. Continued

STATION A-4

STATION A-4												
SPECIES	March 29, 1972			July 27, 1972			November 1, 1972			March 5, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ANNELIDA (continued)												
Harmothoe sp.	-	3	-	0.02	29	1				0.01	22	-
Lumbrinereidae	-	10	1									
Nephtyidae												
Nephtys bucera												
Nephtys sp.												
Nereis virens												
Nereis sp.												
Ninoe nigripes										0.08	3	-
Notomastus sp.												
Orbiniidae												
Paraonidae												
Pectinaria gouldii				0.03	3	-				0.03	10	-
Pherusa affinis												
Pherusa sp.	-	51	3									
Phyllodoce sp.												
Phyllodocidae										0.02	13	-
Polynoidae												
Scoloplos sp.	-	3	-									
Serpulidae tubes												
Sigalionidae												
Spionidae												
Syllidae												
Fragments				<0.01			0.03			0.36		
SIPUNCULA												
Phascolian strombi				0.09	-	-						
Phascolopsis gouldi				0.23	10	-						
4.21												

STATION A-4

SPECIES	March 29, 1972			July 27, 1972			November 1, 1972			March 5, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ECHINODERMATA												
Amphipholis squamata												
Asterias vulgaris												
Asterias sp.				0.28	3	-						
Ophiuroidea sp.												
Strongylocentrotus droebachiensis												
Total Number		1,630			4,088			9,451			12,202	
Total Dry Weight Biomass (grams)		5.280			206.120			17.086			19.915	

Table 4.1. Continued

STATION B-1												
Depth: 40' MLW												
SPECIES	April 6, 1972			July 28, 1972			November 1, 1972			March 6, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
RHYNCHOCOELA												
Cerebratulus sp.												
Nemertea												
MOLLUSCA												
Acmaea testudinalis												
Boreotrophon clathratus												
Cerastoderma pinnulatum	0.01	6	3									
Columbellidae												
Crepidula fornicata												
Crepidula plana												
Fossarus elegans												
Hiatella arctica												
Hydrobia minuta	<0.01	13	8									
Ischnochiton ruber										0.02	13	4
Lacuna vineta												
Lacuna sp.												
Littorina littorea												
Littorina obsoleta												
Littorina sp.												
Lunatia heros												
Lyonsia hyalina										0.04	3	1
Macoma calcaria												
Margarites helicina	0.05	6	3									
Mercenaria mercenaria												

Table 4.1. Continued

STATION B-1												
SPECIES	April 6, 1972			July 28, 1972			November 1, 1972			March 6, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
MOLLUSCA (continued)												
Mesodesma artica												
Moelleria costulata												
Modiolus modiolus												
Mya arenaria	0.01	6	3				0.02	20	5	0.01	3	1
Mytilus edulis							<0.01	4	1	0.19	96	31
Nassarius obsoleta	0.63	42	24									
Nassarius trivittatus	0.03	13	8	-	10	40	2.06	28	8	1.48	70	23
Nucula delphinodonta												
Nucula tenuis												
Nucula sp.												
Nuculana sp.												
Pandora gouldiana												
Pitar morrhuana												
Polinices heros												
Polinices sp.												
Solenidae							0.02	12	3			
Retusa obtusa												
Tellina agilis	0.58	54	31				0.75	124	34	0.10	35	11
Tellina sp.				0.14	6	24						
Thais lapillus												
ANNELIDA												
Aricidea jeffreysii												
Aricidea sp.												
Capittelidae												
Cirratulidae												
Eunicidae												
Eteone lactea							0.18	88	24			
Flabelligeridae												
Glycera dibranchiata												

Table 4.1. Continued

[illegible]

[illegible]

4.27

Table 4.1. Continued

STATION B-1												
SPECIES	April 6, 1972			July 28, 1972			November 1, 1972			March 6, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ECHINODERMATA Amphipholis squamata Asterias vulgaris Henricia sanguinolenta Ophiuroidea sp. Strongylocentrotus droebachiensis										1.44	6	2
Total Number		172			25			262			292	
Total Dry Weight Biomass (grams)		1.67			.78			3.26			3.57	

Table 4.1. Continued

STATION B-2												
Depth: 10' MLW	April 5, 1972			July 27, 1972			November 1, 1972			March 5, 1973		
SPECIES	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
RHYNCHOCOELA												
Cerebratulus sp.										0.07	19	-
Nemertea												
MOLLUSCA												
Acmaea testudinalis												
Boreotrophon clathratus												
Cerastoderma pinnulatum	0.01	10	1				0.21	38	-	0.04	3	-
Columbellidae												
Crepidula fornicata												
Ensis directus							0.03	3	-			
Fossarus elegans										0.04	22	1
Haminoea solitaria												
Hydrobia minuta												
Ischnochiton ruber												
Lacuna vincta												
Lacuna sp.												
Littorina littorea										0.01	3	-
Littorina obsoleta												
Littorina sp.												
Lunatia heros												
Lyonsia hyalina				0.03	3	-	0.01	3	-			
Macoma balthica							0.62	19	-	<0.01	3	-
Margarites helicina							0.02	3	-	0.01	6	-
Mactridae							<0.01	3	-			

Table 4.1. Continued

STATION B-2												
SPECIES	April 5, 1972			July 27, 1972			November 1, 1972			March 5, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
MOLLUSCA (continued)												
Mesodesma artica												
Moelleria costulata							0.07	16	-			
Myrella planulata							0.46	118	1	0.03	22	1
Mya arenaria					3	-	0.02	10	-			
Mytilus edulis												
Nassarius obsoleta	2.24	74	10		6	-	0.40	26	-	1.71	166	4
Nassarius trivittatus							0.65	346	4	1.79	1133	26
Nucula delphinodonta												
Nucula tenuis	0.12	58	8									
Nucula sp.				4.60	189	6						
Nuculana sp.												
Pandora gouldiana							0.05	3	-			
Petricola pholadiformis												
Polinices heros												
Polinices sp.												
Retusa canaliculata							0.06	32	-			
Retusa obtusa	0.01	3	-	0.04	32	1	1.41	538	6	0.40	198	5
Tellina agilis	0.87	118	16									
Tellina sp.				1.03	134	4						
Thais lapillus												
ANNELIDA												
Aricidea jeffreysii												
Aricidea sp.												
Capittelidae												
Cirratulidae												
Eteone lactea							0.61	292	3	<0.01	16	-
Eteone sp.												
Flabelligeridae												
Glycera dibranchiata												

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	5
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STATION B-2

4.31

Table 4.1. Continued

STATION B-2

[illegible]

Table 4.1. Continued

STATION B-2												
SPECIES	April 5, 1972			July 27, 1972			November 1, 1972			March 5, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ECHINODERMATA Amphipholis squamata Asterias vulgaris Asterias sp. Ophiuroidea sp. Strongylocentrotus droebachiensis												
Total Number		727			2,937			8,393			4,365	
Total Dry Weight Biomass (grams)		4.22			10.98			13.20			6.68	

Table 4.1. Continued

STATION B-3												
Depth: 20' MLW	April 5, 1972			July 28, 1972			November 1, 1972			March 6, 1973		
SPECIES	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
RHYNCHOCOELA												
Cerebratulus sp.												
Nemertea												
MOLLUSCA												
Admete couthouyi							0.06	3	-			
Boreotrophon clathratus												
Cerastoderma pinnulatum				0.03	6	-	0.28	10	-			
Columbellidae												
Crepidula fornicata												
Crepidula plana							0.08	10	-			
Ensis directus										0.07	35	1
Haminoea solitaria												
Hydrobia minuta												
Ischnochiton ruber												
Lacuna vincta												
Lacuna sp.												
Littorina littorea				-	6	-	0.05	6	-	0.20	6	-
Littorina obsoleta												
Littorina sp.												
Lunatia heros												
Lyonsia hyalina												
Macoma sp.												
Margarites helicina												
Mercenaria mercenaria												

Table 4.1. Continued

STATION B-3												
SPECIES	April 5, 1972			July 28, 1972			November 1, 1972			March 6, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
MOLLUSCA (continued)												
Mesodesma artica												
Moelleria costulata												
Mysella planulata							0.01	3	-			
Mya arenaria				0.13	29	-				0.55	80	2
Mytilus edulis												
Nassarius obsoleta	0.87	22	-	-	3	-				1.76	29	1
Nassarius trivittatus				0.02	3	-	0.51	22	-	1.15	595	17
Nucula delphinodonta							2.58	1030	20			
Nucula tenuis	4.20	2320	57	0.35	269	3						
Nucula sp.				5.25	3030	34						
Nuculana sp.												
Pandora gouldiana							2.86	3	-			
Pitar morrhuana												
Polinices heros												
Polinices sp.												
Retusa canaliculata												
Retusa obtusa				0.07	35	-	0.12	90	2	0.02	19	1
Tellina agilis	<0.01	3	-				0.07	26	-	0.10	42	1
Tellina sp.												
Thais lapillus												
Yolida myalis										-	3	1
ANNELIDA												
Aricidea jeffreysii												
Aricidea sp.												
Capittelidae				0.01	16	-						
Cirratulidae												
Eteone lactea							0.01	6	-			
Eteone sp.				<0.01	13	-				0.04	3	-
Flabelligeridae												
Glycera dibranchiata												

Table 4.1. Continued

STATION B-3												
SPECIES	April 5, 1972			July 28, 1972			November 1, 1972			March 6, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ANNELIDA (continued)												
Harmothoe sp.				0.01	26	-	<0.01	6	-	0.02	26	1
Lumbrinereidae												
Nephtyidae												
Nephtys buccera												
Nephtys sp.												
Nereis virens												
Nereis sp.				0.05	3	-						
Ninoe nigripes				-	3	-						
Notomastus sp.												
Orbiniidae												
Paraonidae												
Pectinaria gouldii												
Pherusa affinis												
Pherusa sp.												
Phyllodoce sp.							<0.01	3	-	0.01	3	-
Phyllodocidae												
Polynoidae												
Scoloplos sp.												
Serpulidae tubes												
Sigalionidae												
Spionidae												
Syllidae							0.09			0.02		
Fragments												
SIPUNCULA												
Phascolian strombi												
Phascolopsis gouldi												

4.36

Table 4.1. Continued

STATION B-3

[illegible]

Table 4.1. Continued

STATION B-3												
SPECIES	April 5, 1972			July 28, 1972			November 1, 1972			March 6, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ECHINODERMATA Amphipholis squamata Asterias vulgaris Asterias sp. Ophiuroidea sp. Strongylocentrotus droebachiensis	2.77	3	-									
Total Number		4,079			8,881			5,198			3,506	
Total Dry Weight Biomass (grams)		11.12			11.42			13.45			6.65	

Table 4.1. Continued

STATION B-4												
Depth: 10' MLW	April 5, 1972			July 27, 1972			November 1, 1972			March 6, 1973		
SPECIES	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
RHYNCHOCOELA												
Cerebratulus sp.												
Nemertea										0.02	3	-
MOLLUSCA												
Acmaea testudinalis												
Boreotrophon clathratus												
Cerastoderma pinnulatum	0.02	3	-				0.02	3	-			
Columbellidae												
Crepidula fornicata												
Crepidula plana												
Fossarus elegans												
Hiatella arctica												
Hydrobia ulvae												
Ischnochiton ruber												
Lacuna vincta	0.27	154	30				0.02	3	-	<0.01	6	-
Lacuna sp.												
Littorina littorea	71.4	54	11							12.52	6	-
Littorina obsoleta							1.60	3	-	<0.01	3	-
Littorina sp.	0.34	48	10									
Lunatia heros	1.76	3	-									
Lyonsia hyalina				0.13	6	-						
Macoma sp.												
Margarites helicina												
Mercenaria mercenaria												

Table 4.1. Continued

SPECIES	STATION B-4											
	April 5, 1972			July 27, 1972			November 1, 1972			March 6, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
MOLLUSCA (continued)												
Mesodesma artica												
Moelleria costulata										0.02	3	-
Mysella planulata												
Mya arenaria	0.01	6	1	0.30	45	1	-	6	-			
Mytilus edulis							0.02	3	-			
Nassarius obsoleta	2.91	77	15									
Nassarius trivittatus				4.66	74	1	5.13	83	1	3.39	58	1
Nucula delphinodonta							4.84	2762	34	2.91	2016	34
Nucula tenuis	1.09	86	17									
Nucula sp.				3.52	2259	33						
Nuculana sp.				0.03	3	-						
Pandora gouldiana												
Pitar morrhuana	3.29	3	-	0.02	3	-						
Polinices heros												
Polinices sp.				-	3	-						
Retusa canaliculata												
Retusa obtusa	<0.01	3	-	0.03	10	-	0.05	16	-	0.06	26	-
Tellina agilis	0.06	35	7				0.55	35	-	0.02	10	-
Tellina sp.				1.00	3	-						
Spisula poynyma										0.02	3	-
ANNELIDA												
Aricidea jeffreysii												
Aricidea sp.												
Capittelidae												
Cirratulidae												
Eteone lactea												
Eteone sp.				0.01	10	-	0.05	26	-			
Flabelligeridae												
Glycera dibranchiata												

Table 4.1. Continued

STATION B-4												
SPECIES	April 5, 1972			July 27, 1972			November 1, 1972			March 6, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ANNELIDA (continued)												
Harmothoe sp.												
Lumbrinereidae				0.20	774	11	0.01	16	-	0.03	118	2
Nephtyidae												
Nephtys bucera				0.72	3	-						
Nephtys sp.												
Nereis virens												
Nereis sp.				<0.01	3	-						
Ninoe nigripes				0.17	3	-						
Notomastus sp.												
Orbiniidae												
Paraonidae												
Pectinaria gouldii												
Pherusa affinis										0.02	3	-
Pherusa sp.												
Phyllodoce sp.												
Phyllodocidae							0.01	19	-			
Polynoidae												
Scoloplos sp.												
Serpulidae tubes												
Sigalionidae												
Spionidae												
Syllidae												
Fragments				0.17			0.11			0.05		
SIPUNCULA												
Phascolian strombi												
Phascolopsis gouldi				0.40	6	-						
				</								

Table 4.1. Continued

[illegible]

Table 4.1. Continued

SPECIES	STATION B-4											
	April 5, 1972			July 27, 1972			November 1, 1972			March 6, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ECHINODERMATA												
Amphipholis squamata	0.07	6	1									
Asterias vulgaris												
Asterias sp.							1.58	3	-			
Ophiuroidea sp.												
Strongylocentrotus droebachiensis												
Total Number		504			6,907			8,100			5,967	
Total Dry Weight Biomass (grams)		81.34			19.29			20.86			22.31	

Table 4.1. Continued

STATION B-5												
Depth: intertidal	April 29, 1972			July 28, 1972			November 3, 1972			March 2, 1973		
SPECIES	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
RHYNCHOCOELA												
Cerebratulus sp.												
Nemertea												
MOLLUSCA												
Acmaea testudinalis	0.27	10	2				0.16	24	3	0.07	10	1
Boreotrophon clathratus							0.05	4	-			
Cerastoderma pinnulatum										0.04	3	-
Cingula aculeus							153.43	12	1	131.60	16	2
Crepidula fornicata										0.04	3	-
Cumingia tellinoides				0.41	35	6						
Fossarus elegans				0.01	10	2						
Hiatella arctica												
Hydrobia minuta												
Ischnochiton ruber												
Lacuna vineta							0.02	4	-			
Lacuna sp.				0.06	22	4						
Littorina littorea	54.57	454	83	2916.57	419	67	142.57	444	53	83.41	512	62
Littorina obsoleta										-	6	1
Littorina sp.												
Lunatia heros							0.02	4	-			
Lyonsia hyalina												
Macoma sp.												
Margarites helicina										50.97	3	-
Mercenaria mercenaria												

Table 4.1. Continued

STATION B-5

SPECIES	April 29, 1972			July 28, 1972			November 3, 1972			March 2, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
MOLLUSCA (continued)												
Mesodesma artica												
Moelleria costulata												
Mysella planulata							0.04	4	-	0.02	3	-
Mya arenaria	0.02	45	8	0.42	32	5	0.23	96	11	0.07	45	5
Mytilus edulis	25.06	16	3	34.15	6	1	0.09	20	2	18.73	51	6
Nassarius obsoleta	1.83	10	2									
Nassarius trivittatus				1.37	26	4	7.08	64	8	6.85	109	13
Nucula delphinodonta										0.01	10	1
Nucula tenuis												
Nucula sp.												
Nuculana sp.												
Odostomia bisutiralis							0.01	4	-			
Pitar morrhuana												
Polinices heros												
Polinices sp.												
Retusa canaliculata												
Retusa obtusa												
Tellina agilis							3.83	92	11	0.01	3	-
Tellina sp.				0.01	10	2						
Thais lapillus	1.09	3	-									
ANNELIDA												
Aricidea jeffreysii												
Aricidea sp.												
Capittelidae				0.09	6	1						
Cirratulidae												
Eunicidae												
Eteone sp.				0.01	3	-						
Flabelligeridae												
Glycera dibranchiata												

Table 4.1. Continued

SPECIES	STATION B-5											
	April 29, 1972			July 28, 1972			November 3, 1972			March 2, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ANNELIDA (continued)												
Harmothoe sp.												
Lumbrinereidae										0.07	13	2
Nephtyidae				0.02	3	-	0.25	28	3			
Nephtys buccera							0.02	4	-	0.03	6	1
Nereidae							0.05	8	1			
Nereis virens				0.38	10	2						
Nereis sp.												
Ninoe nigripes												
Notomastus sp.												
Orbiniidae												
Paraonidae				0.02	3	-						
Pectinaria gouldii				0.03	3	-						
Pherusa affinis												
Pherusa sp.												
Phyllodoce sp.												
Phyllodocidae												
Polynoidae							0.04	8	1			
Scoloplos sp.												
Serpulidae tubes												
Sigalionidae												
Spionidae												
Syllidae							0.11			0.18		
Fragments												
SIPUNCULA												
Phascolian strombi												
Phascolopsis gouldi												

Table 4.1. Continued

STATION B-5

[illegible]

Table 4.1. Continued

SPECIES	STATION B-5											
	April 29, 1972			July 28, 1972			November 3, 1972			March 2, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ECHINODERMATA												
Amphipholis squamata	<0.01	3	-									
Asterias vulgaris												
Asterias sp.				3.36	3	-						
Ophiuroidea sp.												
Strongylocentrotus droebachiensis				1.48	3	-						
Total Number		544			625			820			800	
Total Dry Weight Biomass (grams)		82.85			2958.45			308.15			307.26	

Table 4.1. Continued

STATION C-1												
Depth: intertidal	April 29, 1972			July 27, 1972			November 3, 1972			March 2, 1973		
SPECIES	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
RHYNCHOCOELA												
Cerebratulus sp.												
Nemertea												
MOLLUSCA												
Acmaea testudinalis	0.11	10	4	-	3	-				12.08	35	7
Boreotrophon clathratus												
Cerastoderma pinnulatum												
Columbellidae												
Crepidula fornicata							1.73	12	2	6.83	3	1
Crepidula plana				0.28	51	5						
Fossarus elegans												
Hiatella arctica												
Hydrobia minuta												
Ischnochiton ruber												
Lacuna vincta							0.03	24	4			
Lacuna sp.												
Littorina littorea	101.48	122	46	566.40	816	84	358.12	372	57	291.38	317	59
Littorina obsoleta												
Littorina sp.												
Lunatia heros												
Lyonsia hyalina												
Macoma sp.												
Margarites helicina												
Mercenaria mercenaria				0.19	3	-						

Table 4.1. Continued

STATION C-1												
SPECIES	April 29, 1972			July 27, 1972			November 3, 1972			March 2, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
MOLLUSCA (continued)												
Mesodesma artica				-	3	-						
Moelleria costulata												
Modiolus modiolus												
Mya arenaria	1.01	90	34	13.81	35	4	0.10	48	7	0.09	42	8
Mytilus edulis	11.05	38	14	27.15	16	2	0.36	92	14	94.51	45	8
Nassarius obsoleta				0.46	6	1						
Nassarius trivittatus												
Nucula delphinodonta										0.01	3	1
Nucula tenuis												
Nucula sp.												
Nuculana sp.												
Pandora gouldiana												
Pitar morrhuana												
Polinices heros												
Polinices sp.												
Retusa canaliculata												
Retusa obtusa												
Tellina agilis							0.02	4	1	0.07	29	5
Tellina sp.												
Thais lapillus	3.49	3	1									
ANNELIDA												
Aricidea jeffreysii												
Aricidea sp.												
Capittelidae												
Cirratulidae												
Eunicidae												
Eteone sp.										0.01	3	1
Flabelligeridae												
Glycera dibranchiata												

Table 4.1. Continued

SPECIES	STATION C-1											
	April 29, 1972			July 27, 1972			November 3, 1972			March 2, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ANNELIDA (continued)												
Harmothoe sp.												
Lumbrinereidae												
Nephtyidae												
Nephtys bucera				0.50	29	3	0.04	4	1			
Nephtys sp.										0.12	19	4
Nereis virens												
Nereis sp.												
Ninoe nigripes												
Notomastus sp.												
Orbiniidae												
Paraonidae												
Pectinaria gouldii												
Pherusa affinis												
Pherusa sp.							0.02	8	1			
Phyllodoce sp.												
Phyllodocidae												
Polynoidae												
Scoloplos sp.							0.06	12	2			
Serpulidae tubes												
Sigalionidae												
Spionidae												
Syllidae												
Fragments							-			0.04		
SIPUNCULA												
Phascolian strombi												
Phascolopsis gouldi												

Table 4.1. Continued

STATION C-1

	April 29, 1972			July 27, 1972			November 3, 1972			March 2, 1973		
SPECIES	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ARTHROPODA												
Aeginella sp.												
Ampelisca abdita							0.01	8	1	-	6	1
Balanus balanus										0.19	3	1
Brachyura zoea												
Cancer sp.										0.71	10	2
Caprellidae												
Carcinides maenas												
Carcinus moenas												
Chiridotea												
Crangon septemspinosa							<0.01	4	1			
Diastylis polita												
Diastylis sculpta												
Edotea triloba												
Edotea sp.				<0.01	3	-						
Eudorella hispida												
Gammaridea												
Harpinia propinqua												
Idotea baltica												
Leptocheirus pinquis							0.08	56	8	-	6	1
Leptocheirus sp.												
Lysianopsis alba							<0.01	4	1	-	6	1
Lysianopsis sp.												
Orchomonella minuta												
Orchomonella sp.												
Pagurus pubescens												
Photis reinhardi												
Photis macrocoxa												
Phoxocephalus holbolli							0.01	8	1	<0.01	10	2
Unciola irrorata												
												4.52

Table 4.1. Continued

SPECIES	STATION C-1											
	April 29, 1972			July 27, 1972			November 3, 1972			March 2, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ECHINODERMATA												
Amphipholis squamata												
Asterias vulgaris												
Asterias sp.												
Ophiuroidea sp.												
Strongylocentrotus droebachiensis												
Total Number		263			965			656			524	
Total Dry Weight Biomass (grams)		117.14			608.80			360.60			406.05	

Table 4.1. Continued

STATION C-2												
Depth: 10' MLW	April 5, 1972			July 27, 1972			November 3, 1972			March 5, 1973		
SPECIES	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
RHYNCHOCOELA												
Cerebratulus sp.												
Nemertea												
MOLLUSCA												
Acmaea testudinalis												
Boreotrophon clathratus												
Cerastoderma pinnulatum												
Columbellidae												
Crepidula fornicata												
Crepidula plana												
Fossarus elegans												
Hiatella arctica												
Hydrobia minuta												
Ischnochiton ruber												
Lacuna vincta							0.01	3	-			
Lacuna sp.												
Littorina littorea	51.55	61	69	104.65	45	2	184.35	93	4	192.84	80	19
Littorina obsoleta												
Littorina sp.												
Lunatia heros	78.98	3	3									
Lyonsia hyalina												
Macoma sp.												
Margarites helicina												
Mercenaria mercenaria												

Table 4.1. Continued

STATION C-2												
SPECIES	April 5, 1972			July 27, 1972			November 3, 1972			March 5, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
MOLLUSCA (continued)												
Mesodesma artica												
Moelleria costulata												
Mysella planulata							0.01	3	-			
Mya arenaria	0.02	6	7	8.14	40	2						
Mytilus edulis							3.72	6	-			
Nassarius obsoleta	0.13	6	7									
Nassarius trivittatus				0.76	22	1	0.59	10	-	0.75	11	3
Nucula delphinodonta										0.08	5	1
Nucula tenuis												
Nucula sp.				-	3	-						
Nuculana sp.												
Pandora gouldiana												
Pitar morrhuana												
Polinices heros												
Polinices sp.												
Retusa canaliculata												
Retusa obtusa												
Tellina agilis	0.03	6	7				0.37	51	2	0.22	48	11
Tellina sp.				0.52	138	5						
Thais lapillus												
ANNELIDA												
Aricidea jeffreysii												
Aricidea sp.												
Capittelidae												
Cirratulidae							0.03	13	-			
Eunicidae												
Eteone sp.				0.07	326	12						
Eteone lactea							0.36	170	7			
Glycera dibranchiata												

Table 4.1. Continued

STATION C-2

[illegible]

Table 4.1. Continued

STATION C-2

[illegible]

Table 4.1. Continued

STATION C-2												
SPECIES	April 5, 1972			July 27, 1972			November 3, 1972			March 5, 1973		
	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%	Ave wt/m ²	Ave no/m ²	%
ECHINODERMATA												
Amphipholis squamata										0.03	5	1
Asterias vulgaris												
Asterias sp.	1.77	3	3				4.46	6	-			
Ophiuroidea sp.												
Strongylocentrotus droebachiensis												
Total Number		88			2,655			2,396			421	
Total Dry Weight Biomass (grams)		132.50			116.25			196.57			194.23	

Table 4.2. Rank of organisms collected at Salem Harbor
benthic stations, March 1972 - March 1973.

SAMPLING PERIOD March 1972

Data Includes: Tot.# and Tot.Wt./M² (to a depth of 5 cm.), # of Species encountered per 5/16 M², % of Tot. # for each species, and a Cumulative of sample %.

A-1	Tot.#/M ² 774	# Sp. 10
	Tot.Wt./M ² 59	
Species	%	Cum. %
Mya arenaria	41	41
Hydrobia minuta	23	64
Ampelisca abdita	10	74
Scoloplos sp.	9	83
Nassarius obsoleta	7	90
Nephtys buccera	6	96

A-2	Tot.#/M ² 442	# Sp. 19
	Tot.Wt./M ² 110	
Species	%	Cum. %
Littorina littorea	23	23
Nassarius trivittatus	22	45
Mya arenaria	14	59
Phoxocephalus holbolli	8	67
Ampelisca abdita	8	75
Nephtys sp.	7	82
Lacuna vincta	4	86
Syllidae	3	89
Leptocheirus pinguis	2	91

A-3	Tot.#/M ² 2670	# Sp. 18
	Tot.Wt./M ² 5	
Species	%	Cum. %
Leptocheirus pinguis	32	32
Lysianopsis alba	31	63
Phoxocephalus holbolli	18	81
Photis macrocoxa	9	90
Eudorella hispida	2	92

A-4	Tot.#/M ² 4562	# Sp. 24
	Tot.Wt./M ² 7	
Species	%	Cum. %
Leptocheirus pinguis	54	54
Phoxocephalus holbolli	14	68
Lysianopsis alba	14	82
Eudorella hispida	3	85
Nucula delphinodonta	3	88
Eteone sp.	2	90
Unciola irrorata	2	92
Photis macrocoxa	2	94

B-1	Tot.#/M ² 266	# Sp. 15
	Tot.Wt./M ² 3	
Species	%	Cum. %
Nephtys buccera	26	26
Tellina agilis	20	46
Nassarius obsoleta	16	62
Leptocheirus pinguis	11	73
Hydrobia minuta	5	78
Nassarius trivittatus	5	83
Lysianopsis alba	4	87
Margarites helicina	2	89
Cerastoderma pinnulatum	2	91
Mya arenaria	2	93
Cirratulidae	2	95

B-2	Tot.#/M ² 1230	# Sp. 20
	Tot.Wt./M ² 5	
Species	%	Cum. %
Leptocheirus pinguis	38	38
Paraonidae	11	49
Tellina agilis	10	59
Cirratulidae	7	66
Nassarius obsoleta	6	72
Nucula delphinodonta	5	77
Phoxocephalus holbolli	5	82
Lumbrineridae	3	85
Aricidea jeffreysii	3	88
Phyllodoce sp.	3	91
Ampelisca abdita	2	93
Lysianopsis alba	2	95

Table 4.2. Continued

SAMPLING PERIOD March 1972

B-3	Tot. #/M ² 7401	# Sp. 22
	Tot. Wt./M ² 10	
Species	%	Cum. %
<i>Nucula delphinodonta</i>	31	31
<i>Leptocheirus pinguis</i>	24	55
<i>Lysianopsis alba</i>	18	73
<i>Phoxocephalus holbolli</i>	11	84
<i>Lumbrinereidae</i>	6	90
<i>Unciola irrorata</i>	3	93
<i>Ampelisca abdita</i>	3	96

B-4	Tot. #/M ² 1122	# Sp. 24
	Tot. Wt./M ² 82	
Species	%	Cum. %
<i>Phoxocephalus holbolli</i>	35	35
<i>Lacuna vineta</i>	14	49
<i>Littorina littorea</i>	9	58
<i>Nucula delphinodonta</i>	8	66
<i>Nassarius obsoleta</i>	7	73
<i>Polynoidae</i>	6	79
<i>Lumbrinereidae</i>	4	83
<i>Lysianopsis alba</i>	4	87
<i>Tellina agilis</i>	3	90
<i>Leptocheirus pinguis</i>	2	92
<i>Eteone</i> sp.	2	94

B-5	Tot. #/M ² 595	# Sp. 14
	Tot. Wt./M ² 83	
Species	%	Cum. %
<i>Littorina littorea</i>	76	76
<i>Mya arenaria</i>	8	84
<i>Mytilus edulis</i>	3	87
<i>Cirratulidae</i>	3	90
<i>Acmaea testudinalis</i>	2	92
<i>Nassarius obsoleta</i>	2	94
<i>Nereis virens</i>	2	96
<i>Scoloplos</i> sp.	2	98

C-1	Tot. #/M ² 440	# Sp. 11
	Tot. Wt./M ² 145	
Species	%	Cum. %
<i>Scoloplos</i> sp.	33	33
<i>Littorina littorea</i>	28	61
<i>Mya arenaria</i>	20	81
<i>Mytilus edulis</i>	9	90
<i>Nephtys bucera</i>	4	94
<i>Acmaea testudinalis</i>	2	96

C-2	Tot. #/M ² 253	# Sp. 13
	Tot. Wt./M ² 246	
Species	%	Cum. %
<i>Phoxocephalus holbolli</i>	26	26
<i>Littorina littorea</i>	24	50
<i>Lysianopsis alba</i>	11	61
<i>Ampelisca abdita</i>	9	70
<i>Lumbrinereidae</i>	9	79
<i>Nephtys bucera</i>	9	88
<i>Nassarius obsoleta</i>	2	90
<i>Mya arenaria</i>	2	92
<i>Tellina agilis</i>	2	94

Table 4.2. Continued

SAMPLING PERIOD July 1972

A-1	Tot. #/M ² 396	# Sp. 11
	Tot. Wt./M ² 249	
Species	%	Cum. %
<i>Mya arenaria</i>	32	32
<i>Littorina littorea</i>	26	58
<i>Nassarius obsoleta</i>	12	70
<i>Mytilus edulis</i>	11	81
Capitellidae	6	87
<i>Eteone</i> sp.	6	93
<i>Scoloplos</i> sp.	3	96
Gammaridea	3	99

A-2	Tot. #/M ² 398	# Sp. 11
	Tot. Wt./M ² 273	
Species	%	Cum. %
<i>Littorina littorea</i>	58	58
<i>Nephtys bucera</i>	15	73
<i>Lacuna</i> sp.	11	84
<i>Nassarius trivittatus</i>	10	94
Flabelligeridae	2	96

A-3	Tot. #/M ² 2728	# Sp. 18
	Tot. Wt./M ² 21	
Species	%	Cum. %
<i>Leptocheirus pinguis</i>	64	64
<i>Orchomonella minuta</i>	31	95

A-4	Tot. #/M ²	# Sp.
	Tot. Wt./M ²	
Species	%	Cum. %
<i>Leptocheirus pinguis</i>	58	58
<i>Orchomonella minuta</i>	38	96
<i>Diastylis polita</i>	4	100

B-1	Tot. #/M ² 67	# Sp. 5
	Tot. Wt./M ² 2	
Species	%	Cum. %
<i>Nephtys bucera</i>	67	67
<i>Nassarius trivittatus</i>	15	82
<i>Tellina agilis</i>	9	91
<i>Crangon septemspinosa</i>	4	95
<i>Edotea triloba</i>	4	99

B-2	Tot. #/M ² 3154	# Sp. 15
	Tot. Wt./M ² 11	
Species	%	Cum. %
<i>Leptocheirus pinguis</i>	66	66
<i>Orchomonella minuta</i>	14	80
<i>Nucula delphinodonta</i>	6	86
<i>Eteone</i> sp.	5	91
<i>Tellina agilis</i>	4	95
Lumbrineridae	2	97

Table 4.2. Continued

SAMPLING PERIOD July 1972

B-3	Tot. #/M ² 8881	# Sp. 17
	Tot. Wt./M ² 11	
Species	%	Cum. %
Leptocheirus pinguis	39	39
Nucula delphinodonta	37	76
Orchomonella minuta	22	98

B-4	Tot. #/M ² 6907	# Sp. 17
	Tot. Wt./M ² 19	
Species	%	Cum. %
Leptocheirus pinguis	39	39
Nucula delphinodonta	33	72
Orchomonella minuta	14	86
Lumbrinereidae	11	97

B-5	Tot. #/M ² 645	# Sp. 22
	Tot. Wt./M ² 171	
Species	%	Cum. %
Littorina littorea	65	65
Fossarus elegans	5	70
Mya arenaria	5	75
Nassarius trivittatus	4	79
Lacuna vineta	3	82
Hydrobia minuta	2	84
Tellina agilis	2	86
Capitellidae	2	88
Nephtys bucera	2	90
Nereis sp.	2	92
Aeginella abdita	2	94

C-1	Tot. #/M ² 965	# Sp. 10
	Tot. Wt./M ² 609	
Species	%	Cum. %
Littorina littorea	85	85
Fossarus elegans	5	90
Mya arenaria	4	94
Nephtys bucera	3	97
Mytilus edulis	2	99

C-2	Tot. #/M ² 2708	# Sp. 14
	Tot. Wt./M ² 108	
Species	%	Cum. %
Gammaridea	37	37
Leptocheirus pinguis	22	59
Orchomonella minuta	18	77
Eteone sp.	12	89
Tellina agilis	5	94
Littorina littorea	2	96
Mya arenaria	2	98

Table 4.2. Continued

SAMPLING PERIOD November 1972

A-1	Tot. #/M ² 713	# Sp. 17
	Tot. Wt./M ² 58	
Species	%	Cum. %
Leptocheirus pinguis	38	38
Mya arenaria	12	50
Littorina littorea	12	62
Tellina agilis	7	69
Mytilus edulis	6	75
Orbiniidae	6	81
Ampelisca abdita	5	86
Nereis virens	4	90
Nucula delphinodonta	4	94
Phoxocephalus holbolli	2	96

A-2	Tot. #/M ² 476	# Sp. 17
	Tot. Wt./M ² 221	
Species	%	Cum. %
Tellina agilis	40	40
Littorina littorea	29	69
Nassarius trivittatus	7	76
Acmaea testudinalis	4	80
Nephtys bucera	3	83
Leptocheirus pinguis	3	86
Pherusa affinis	2	88
Orbiniidae	2	90
Pandora gouldiana	2	92

A-3	Tot. #/M ² 2681	# Sp. 20
	Tot. Wt./M ² 10	
Species	%	Cum. %
Leptocheirus pinguis	33	33
Lysianopsis alba	26	59
Phoxocephalus holbolli	14	73
Tellina agilis	12	85
Eteone sp.	5	90
Nucula delphinodonta	3	93
Nassarius trivittatus	2	95
Unciola irrorata	2	97

A-4	Tot. #/M ² 9451	# Sp. 20
	Tot. Wt./M ² 17	
Species	%	Cum. %
Nucula delphinodonta	45	45
Leptocheirus pinguis	31	76
Lysianopsis alba	9	85
Phoxocephalus holbolli	8	93

B-1	Tot. #/M ² 366	# Sp. 13
	Tot. Wt./M ² 3	
Species	%	Cum. %
Tellina agilis	34	34
Eteone lactea	24	58
Leptocheirus pinguis	11	69
Nassarius trivittatus	8	77
Lysianopsis alba	6	83
Mya arenaria	5	88
Solenidae	3	91
Nephtyidae	2	93

B-2	Tot. #/M ² 8732	# Sp. 31
	Tot. Wt./M ² 13	
Species	%	Cum. %
Leptocheirus pinguis	40	40
Lysianopsis alba	17	57
Phoxocephalus holbolli	16	73
Tellina agilis	6	79
Nucula delphinodonta	4	83
Ampelisca abdita	4	87
Eteone lactea	3	90
Lumbrinereidae	2	92
Unciola irrorata	2	94
Eudorella hispida	2	96

Table 4.2. Continued

SAMPLING PERIOD November 1972

B-3	Tot. #/M ² 5220	# Sp. 22
	Tot. Wt./M ² 13	
Species	%	Cum. %
Leptocheirus pinguis	46	46
Nucula delphinodonta	20	66
Lysianopsis alba	12	78
Phoxocephalus holbolli	9	87
Ampelisca abdita	9	96
Retusa obtusa	2	98

B-4	Tot. #/M ² 8129	# Sp. 22
	Tot. Wt./M ² 21	
Species	%	Cum. %
Leptocheirus pinguis	35	35
Nucula delphinodonta	34	69
Lysianopsis alba	13	82
Phoxocephalus holbolli	9	91
Ampelisca abdita	4	95

B-5	Tot. #/M ² 844	# Sp. 21
	Tot. Wt./M ² 308	
Species	%	Cum. %
Littorina littorea	53	53
Mya arenaria	11	64
Tellina agilis	11	75
Nassarius trivittatus	8	83
Acmaea testudinalis	3	86
Nephtys bucera	3	89
Mytilus edulis	2	91

C-1	Tot. #/M ² 656	# Sp. 14
	Tot. Wt./M ² 361	
Species	%	Cum. %
Littorina littorea	57	57
Mytilus edulis	14	71
Leptocheirus pinguis	9	80
Mya arenaria	7	87
Lacuna vineta	4	91
Crepidula fornicata	2	93
Scoloplos sp.	2	95

C-2	Tot. #/M ² 2578	# Sp. 25
	Tot. Wt./M ² 197	
Species	%	Cum. %
Ampelisca abdita	43	43
Leptocheirus pinguis	16	59
Lysianopsis alba	14	73
Phoxocephalus holbolli	9	82
Eteone lactea	7	89
Littorina littorea	4	93
Tellina agilis	2	95

Table 4.2. Continued

SAMPLING PERIOD March 1973

A-1	Tot. #/M ² 1921	# Sp. 20
	Tot. Wt./M ² 70	
Species	%	Cum. %
Hydrobia minuta	39	39
Mya arenaria	20	59
Ampelisca abdita	9	68
Tellina agilis	8	76
Mytilus edulis	7	83
Littorina littorea	6	89
Orbiniidae	5	94

A-2	Tot. #/M ² 743	# Sp. 26
	Tot. Wt./M ² 147	
Species	%	Cum. %
Littorina littorea	28	28
Tellina agilis	17	45
Nassarius trivittatus	15	60
Lumbrinereidae	10	70
Phoxocephalus holbolli	7	77
Nucula delphinodonta	4	81
Unciola irrorata	2	83
Strongylocentrotus drobachiensis	2	85
Ampelisca abdita	2	87
Unidentified	3	90

A-3	Tot. #/M ² 3497	# Sp. 24
	Tot. Wt./M ² 7	
Species	%	Cum. %
Leptocheirus pinguis	29	29
Phoxocephalus holbolli	20	49
Lysianopsis alba	18	67
Nucula delphinodonta	9	76
Eudorella hispida	5	81
Tellina agilis	5	86
Lysianopsis alba	3	89
Nassarius trivittatus	2	91
Photis macrocoxa	2	93
Photis reinhardi	2	95

A-4	Tot. #/M ² 12202	# Sp. 26
	Tot. Wt./M ² 20	
Species	%	Cum. %
Nucula delphinodonta	45	45
Leptocheirus pinguis	20	65
Lysianopsis alba	12	77
Phoxocephalus holbolli	9	86
Photis macrocoxa	5	91
Photis reinhardi	4	95
Eudorella hispida	2	97

B-1	Tot. #/M ² 310	# Sp. 19
	Tot. Wt./M ² 3	
Species	%	Cum. %
Mytilus edulis	31	31
Nassarius trivittatus	23	54
Tellina agilis	11	65
Serpulidae	6	71
Lysianopsis alba	5	76
Leptocheirus pinguis	5	81
Lacuna vineta	4	85
Henricia sanguinolenta	2	87
Ampelisca abdita	2	89
Lumbrinereidae	2	91

B-2	Tot. #/M ² 4390	# Sp. 25
	Tot. Wt./M ² 7	
Species	%	Cum. %
Nucula delphinodonta	26	26
Phoxocephalus holbolli	20	46
Leptocheirus pinguis	17	63
Lysianopsis alba	9	72
Eudorella hispida	9	81
Tellina agilis	5	86
Nassarius trivittatus	4	90
Lumbrinereidae	3	93
Ampelisca abdita	3	96

Table 4.2. Continued

4.66

SAMPLING PERIOD March 1973

B-3	Tot. #/M ² 3547	# Sp. 22
	Tot. Wt./M ² 7	
Species	%	Cum. %
Leptocheirus pinguis	31	31
Lysianopsis alba	19	50
Nucula delphinodonta	17	67
Phoxocephalus holbolli	13	80
Ampelisca abdita	4	84
Photis macrocoxa	3	87
Eudorella hispida	3	90
Mytilus edulis	2	92
Unciola irrorata	2	94

B-4	Tot. #/M ² 5976	# Sp. 21
	Tot. Wt./M ² 22	
Species	%	Cum. %
Nucula delphinodonta	34	34
Leptocheirus pinguis	22	56
Lysianopsis alba	14	70
Ampelisca abdita	12	82
Phoxocephalus holbolli	10	92
Lumbrinereidae	2	94
Photis macrocoxa	2	96

B-5	Tot. #/M ² 821	# Sp. 21
	Tot. Wt./M ² 307	
Species	%	Cum. %
Littorina littorea	62	62
Nassarius trivittatus	13	75
Mytilus edulis	6	81
Mya arenaria	5	86
Crepidula fornicata	2	88
Nephtyidae	2	90

C-1	Tot. #/M ² 537	# Sp. 15
	Tot. Wt./M ² 406	
Species	%	Cum. %
Littorina littorea	59	59
Mytilus edulis	8	67
Mya arenaria	8	75
Acmeae testudinalis	7	82
Tellina agilis	5	87
Nephtys sp.	4	91
Phoxocephalus holbolli	2	93
Cancer sp.	2	95

C-2	Tot. #/M ² 421	# Sp. 12
	Tot. Wt./M ² 194	
Species	%	Cum. %
Phoxocephalus holbolli	21	21
Littorina littorea	19	40
Lumbrinereidae	15	55
Tellina agilis	11	66
Ampelisca abdita	11	77
Nephtys sp.	8	85
Leptocheirus pinguis	4	89
Eudorella hispida	4	93
Nassarius trivittatus	3	96

Table 4.3. Overlap of organisms, by percent and number (in parentheses), collected at Salem Harbor benthic stations, March 1972 - March 1973.

FOR SAMPLING PERIOD March 1972

Data includes for each station: total number of individuals per square meter to a depth of 5 cm. (# IND.), total number of species encountered per 5/16* square meter to a depth of 5 cm. (# SP.), total dry weight biomass (to nearest gram) of organisms collected per square meter to a depth of 5 cm. (WT.)

A-1	A-2	A-3	A-4	B-1	B-2	B-3	B-4	B-5	C-1	C-2		# IND. WT.	# SP.
	24 (4)	2 (5)	4 (5)	20 (4)	10 (4)	4 (5)	12 (5)	15 (6)	35 (5)	20 (5)	A-1	774 59	10
		17 (11)	16 (10)	12 (6)	13 (7)	16 (8)	27 (9)	33 (4)	39 (4)	44 (7)	A-2	442 110	19
			67 (14)	18 (6)	43 (10)	56 (10)	26 (10)	3 (5)	2 (4)	33 (7)	A-3	2670 5	18
				18 (7)	53 (14)	57 (13)	28 (15)	2 (5)	2 (4)	29 (10)	A-4	4562 7	24
					35 (9)	15 (8)	19 (8)	8 (5)	7 (3)	20 (6)	B-1	266 3	15
						42 (14)	30 (14)	8 (5)	3 (3)	19 (9)	B-2	1230 5	20
							31 (13)	2 (5)	1 (2)	32 (9)	B-3	7401 10	22
								14 (6)	11 (3)	50 (11)	B-4	1122 82	24
									47 (9)	31 (6)	B-5	595 83	14
										30 (3)	C-1	440 145	11
											C-2	253 246	13

Table 4.3. Continued

FOR SAMPLING PERIOD JULY 1972

Data includes for each station: total number of individuals per square meter to a depth of 5 cm. (# IND.), total number of species encountered per 5/16* square meter to a depth of 5 cm. (# SP.), total dry weight biomass (to nearest gram) of organisms collected per square meter to a depth of 5 cm. (WT.)

A-1	A-2	A-3	A-4	B-1	B-2	B-3	B-4	B-5	C-1	C-2		# IND. WT.	# SP.
	28 (3)	2 (6)	1 (4)	1 (1)	5 (4)	0 (7)	2 (4)	38 (8)	33 (4)	14 (6)	A-1	396 249	11
		0 (4)	0 (2)	26 (3)	1 (3)	0 (2)	1 (4)	71 (10)	63 (4)	5 (6)	A-2	398 373	11
			33 (11)	0 (3)	80 (10)	61 (10)	55 (10)	2 (8)	1 (3)	42 (11)	A-3	2728 21	18
				0 (1)	17 (6)	22 (9)	15 (8)	2 (8)	0 (1)	19 (8)	A-4	4088 105	18
					4 (3)	0 (1)	1 (3)	8 (3)	4 (2)	7 (3)	B-1	67 2	5
						59 (8)	61 (12)	3 (6)	0 (3)	45 (10)	B-2	3154 11	15
							86 (10)	0 (7)	0 (3)	40 (10)	B-3	8881 11	17
								2 (7)	2 (3)	38 (11)	B-4	6907 19	17
									78 (7)	9 (10)	B-5	645 171	22
										6 (4)	C-1	965 609	10
											C-2	2708 108	14

FOR SAMPLING PERIOD NOVEMBER 1972

Data includes for each station: total number of individuals per square meter to a depth of 5 cm. (# IND.), total number of species encountered per 5/16* square meter to a depth of 5 cm. (# SP.), total dry weight biomass (to nearest gram) of organisms collected per square meter to a depth of 5 cm. (WT.)

A-1	A-2	A-3	A-4	B-1	B-2	B-3	B-4	B-5	C-1	C-2		# IND. WT.	# SP.
	29 (9)	50 (11)	41 (11)	28 (9)	58 (13)	51 (10)	47 (12)	34 (9)	38 (8)	32 (13)	A-1	713 58	17
		22 (10)	7 (8)	48 (7)	14 (10)	6 (9)	7 (8)	53 (7)	38 (8)	14 (11)	A-2	476 221	17
			55 (15)	38 (10)	81 (17)	60 (16)	61 (14)	13 (6)	13 (7)	50 (11)	A-3	2681 10	20
				20 (9)	56 (17)	72 (16)	84 (15)	1 (7)	12 (7)	37 (10)	A-4	9451 17	20
					29 (10)	19 (8)	20 (9)	25 (6)	19 (7)	28 (9)	B-1	366 3	13
						71 (18)	66 (17)	7 (11)	14 (9)	51 (14)	B-2	8732 13	31
							81 (16)	0 (7)	12 (6)	48 (12)	B-3	5220 13	22
								1 (9)	12 (8)	43 (13)	B-4	8129 21	22
									66 (10)	6 (11)	B-5	844 308	21
										17 (11)	C-1	656 361	14
											C-2	2578 197	25

Table 4.3. Continued

FOR SAMPLING PERIOD MARCH 1973

Data includes for each station: total number of individuals per square meter to a depth of 5 cm. (# IND.), total number of species encountered per 5/16* square meter to a depth of 5 cm. (# SP.), total dry weight biomass (to nearest gram) of organisms collected per square meter to a depth of 5 cm. (WT.)

A-1	A-2	A-3	A-4	B-1	B-2	B-3	B-4	B-5	C-1	C-2		# IND. WT.	# SP.
	18 (9)	8 (8)	3 (13)	20 (8)	11 (10)	9 (8)	11 (10)	20 (11)	28 (8)	25 (6)	A-1	1921 70	20
		21 (13)	12 (16)	33 (11)	27 (14)	18 (13)	16 (14)	45 (12)	39 (10)	53 (10)	A-2	743 147	26
			57 (18)	21 (11)	70 (19)	80 (14)	60 (13)	4 (10)	11 (8)	37 (8)	A-3	3497 7	24
				13 (12)	65 (20)	66 (17)	78 (16)	2 (14)	6 (10)	17 (9)	A-4	12202 20	26
					27 (11)	20 (12)	17 (11)	22 (10)	19 (8)	24 (7)	B-1	310 3	19
						68 (15)	70 (13)	7 (10)	12 (7)	43 (8)	B-2	4390 7	25
							72 (15)	5 (10)	9 (9)	28 (9)	B-3	3547 7	22
								3 (12)	6 (8)	30 (9)	B-4	5976 22	21
									75 (11)	24 (8)	B-5	821 307	21
										33 (7)	C-1	537 406	15
											C-2	421 194	12

4.2 Primary Production

Chlorophyll a levels decreased from the previous quarter (Table 4.4) and corresponded to ^{14}C values (Figure 4.2). In general, the fluctuations in chlorophyll a were similar to those recorded from July - September, 1972. Ranges for chlorophyll a and other accessory pigments were:

Chlorophyll a	2.80	-	13.74	mg/m ³
b	0.00	-	2.32	mg/m ³
c	0.00	-	7.72	mg/m ³
Carotenoids	1.92	-	8.78	mg/m ³

Primary productivity (^{14}C assimilation by phytoplankton) was monitored at Stations A - D on 22 August, 7 and 20 September. An 8" seechi disc, used to determine light penetration, will be replaced by a photometer. Surface, mid-depth, and bottom (zero light penetration) water samples were collected, inoculated, and incubated as outlined in the appendix.

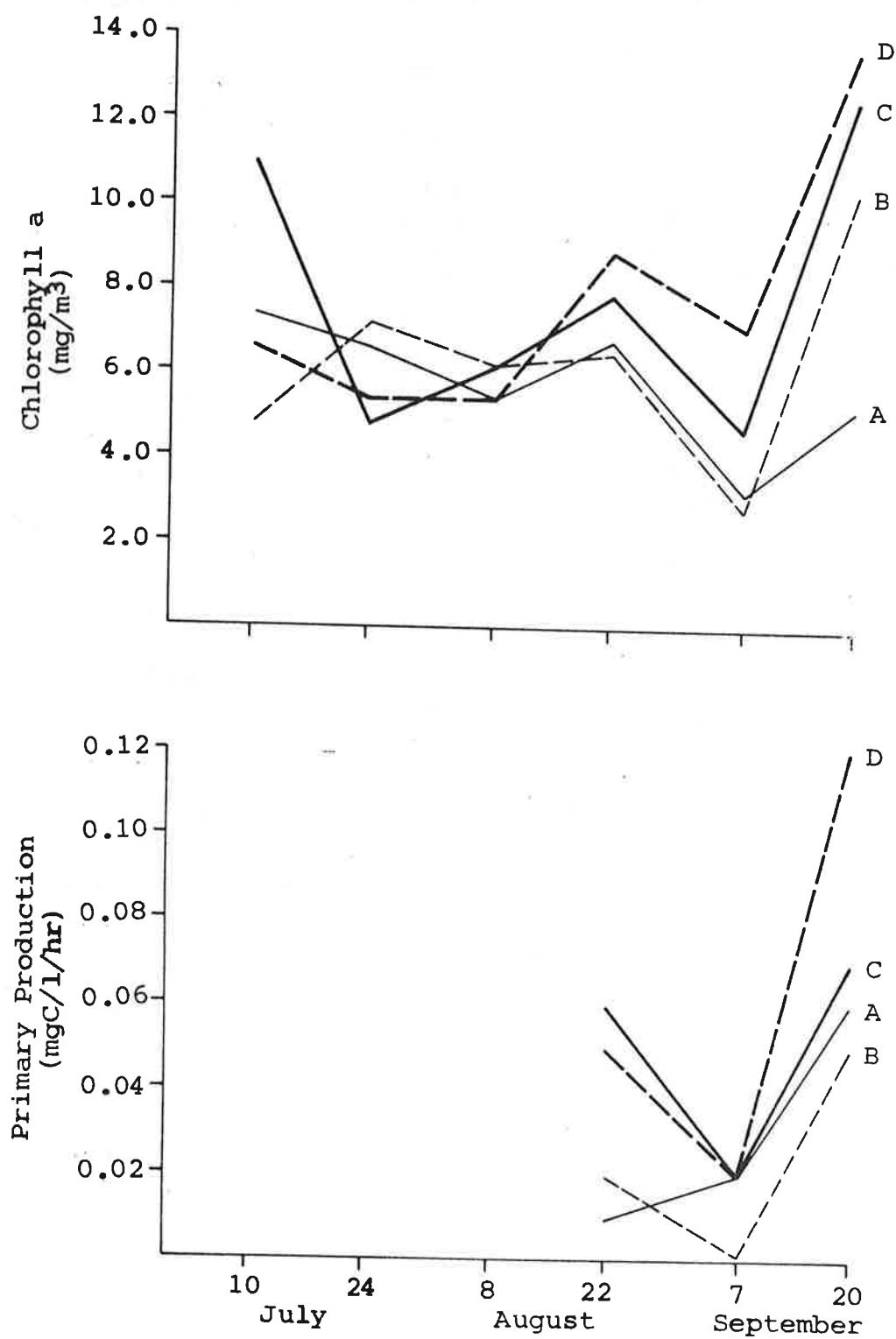
Production was cyclic, with assimilation minimal on 7 September. ^{14}C values ranged from <0.01 - 0.12 mgC/l/hr, and averaged 0.05 mgC/l/hr to approximately 5 ft below the surface (Table 4.5). Light penetration varied from 7.5 to 12.0 ft with corresponding reductions in production capabilities. Bottom samples averaged 0.03 mgC/l/hr. Highest readings, noted on 20 September, indicated a fall phytoplankton bloom within the Harbor.

Adenosine triphosphate (ATP) sampling was initiated on 24 July and is conducted at 10 locations in Salem Harbor concurrently with plankton and related primary production studies (Figure 4.3). ATP is an energy yielding compound

Table 4.4. Chlorophyll counts (mg/m³) in Salem Harbor, July - September, 1973.

Date	Station	Chlorophyll a	Chlorophyll b	Chlorophyll c	Carotenoids
7/10	A	7.35	0.42	3.22	5.53
	B	4.83	0.46	2.16	3.32
	C	11.02	1.41	3.90	8.78
	D	6.55	0.06	4.10	4.96
7/24	A	6.63	1.66	6.29	3.52
	B	7.21	0.63	2.82	4.78
	C	4.76	0.74	1.72	3.70
	D	5.38	0.16	2.31	3.86
8/8	A	5.40	0.47	0.77	2.39
	B	6.17	0.68	1.11	2.56
	C	6.09	0.12	1.61	2.67
	D	5.44	0.00	2.63	2.62
8/22	A	6.84	0.12	1.43	3.57
	B	6.49	0.00	1.49	4.30
	C	7.92	0.05	4.21	3.60
	D	8.89	0.41	3.89	4.29
9/7	A	3.17	0.00	0.00	3.01
	B	2.80	0.27	0.45	2.36
	C	4.71	0.79	3.26	1.92
	D	7.06	1.50	2.40	3.48
9/20	A	5.20	2.32	7.72	4.17
	B	10.33	0.50	5.15	5.11
	C	12.51	0.31	4.54	6.47
	D	13.74	0.28	4.85	6.39

Figure 4.2. Chlorophyll a (mg/m^3) and primary production ($\text{mgC}/\text{l}/\text{hr}$) taken at the surface for Stations A - D in Salem Harbor, July - August, 1973.*



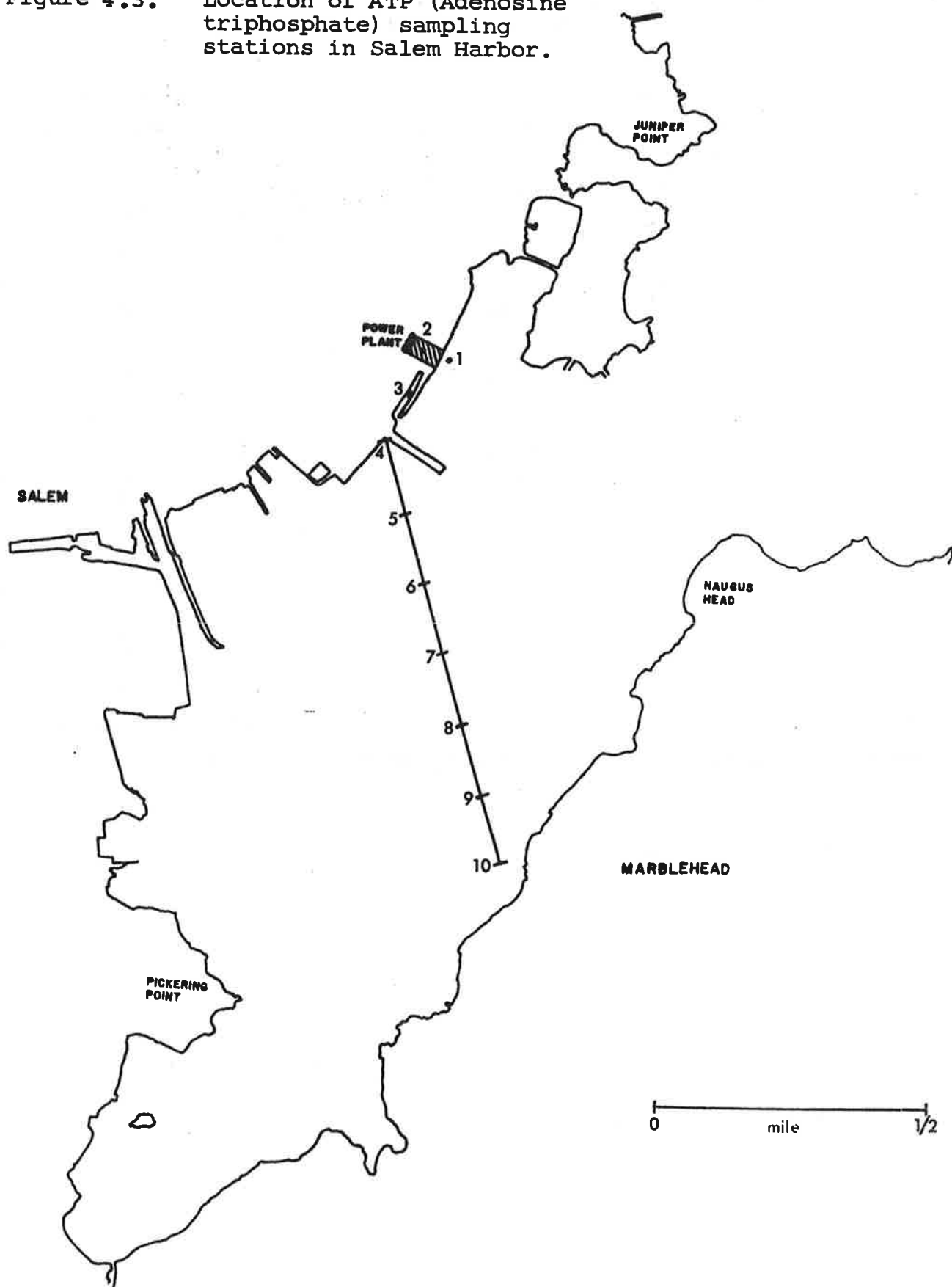
* ^{14}C sampling initiated August 22, 1973

Table 4.5. Primary production (^{14}C) in Salem Harbor,
August - September, 1973.

Date	Station	Depth (ft)	mgC/l/hr	Date	Station	Depth (ft)	mgC/l/hr
8/22	A	S	0.10	9/7 (Cont.)	C	S	0.02
		4	0.06			5	0.02
		8*	0.02			10	0.01
	B	S	0.02		D	S	0.02
		4	0.03			5	0.03
		8	0.01			10	0.01
	C	S	0.06	9/20	A	S	0.06
		4	0.03			4	0.08
		8	0.02			8	0.05
	D	S	0.05		B	S	0.05
		4	0.03			4	0.10
		8	0.01			8.5	0.01
9/7	A	S	0.02		C	S	0.07
		5.25	0.02			4	0.11
		10.5	0.02			7.5	0.11
	B	S	<0.01		D	S	0.12
		6	0.01			4	0.08
		12	0.01			7.5	0.07

*Maximum transparency determined by an 8" seechi disc.

Figure 4.3. Location of ATP (Adenosine triphosphate) sampling stations in Salem Harbor.



essential for metabolic activity in living organisms. ATP levels decrease rapidly to zero with the onset of death.

Figure 4.4 displays ATP levels at the power plant intake, Unit 4 discharge water box (Station 2), discharge canal, and at 825 ft intervals on a line drawn 165° from the point of discharge. Phytoplankton mortality is evident at Station 2. Rapid increase in cooling water temperature appears responsible for the 100% mortality rate. ATP levels recover at Station 3 (approximately 600 ft from the power plant) and peaked on 4 sampling days in the vicinity of Station 6 (450 yds north of Station C). Excluding Station 2, ATP levels in Salem Harbor ranged from 20 - 3120 $\mu\text{gATP/l}$ (Table 4.7). Although no conclusions are drawn at this time, ATP analyses support indications of the previously mentioned fall bloom.

Figure 4.4. Adenosine triphosphate (ATP) in phytoplankton, Salem Harbor, July - September, 1973.

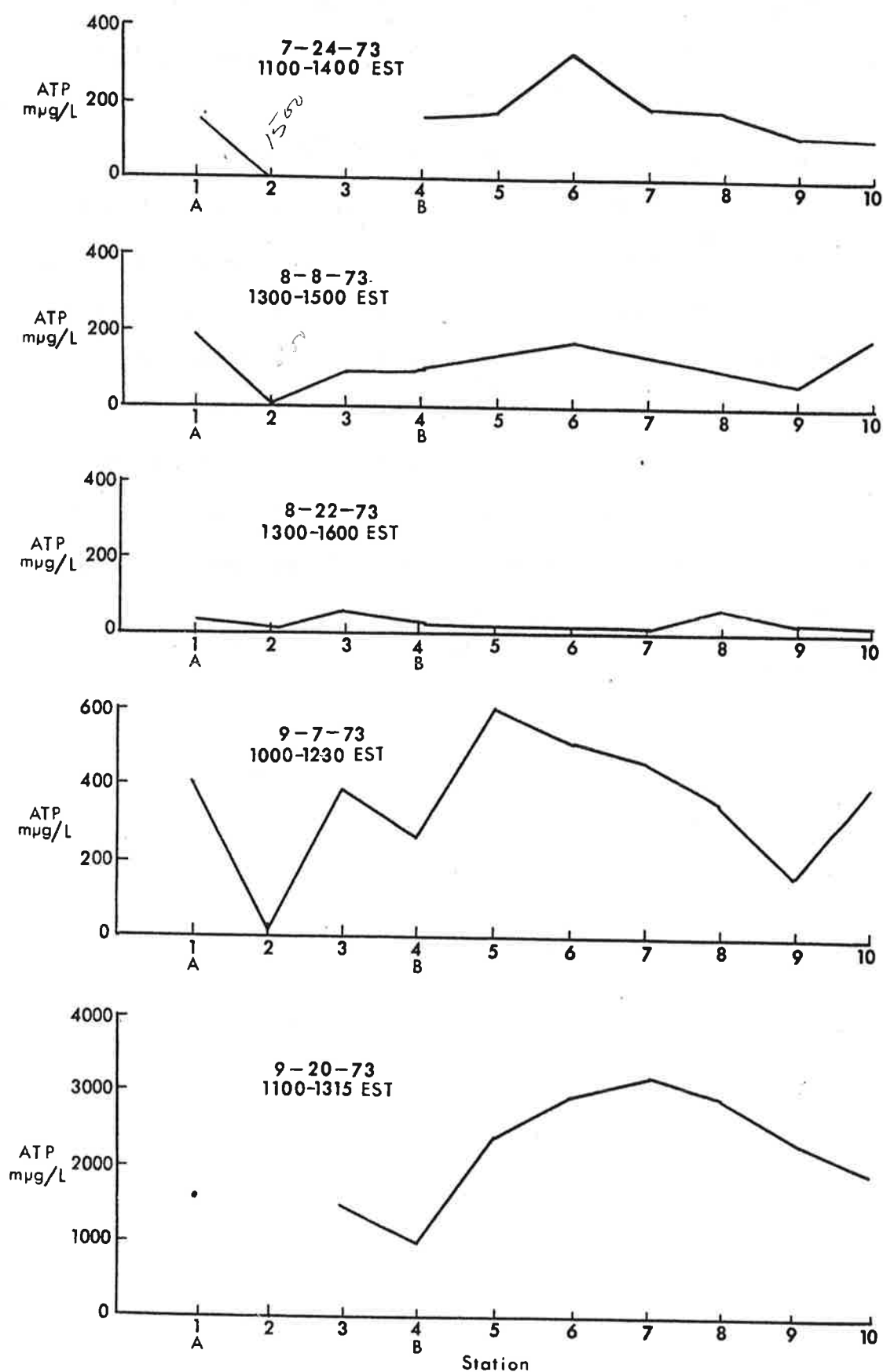


Table 4.6. Adenosine triphosphate ($\mu\text{gATP/l}$) levels in Salem Harbor, July - September, 1973.

Station	July 24	Aug 8	Aug 22	Sept 7	Sept 20
1	150	190	30	410	1610
2	<1	<1	<1	<1	**
3	*	90	50	390	1480
4	170	100	30	260	970
5	180	140	20	610	2350
6	330	170	20	510	2880
7	190	140	20	460	3120
8	180	100	70	350	2850
9	110	60	30	160	2320
10	110	180	20	400	1920

* Station inaccessible

** Unit 4 shut down

NOTE: All samples collected at surface except at Station 2 (dis-charge water box)

4.3 Phytoplankton

Nine families of phytoplankton were identified (Table 4.7). Subsequent identifications will be carried to species or lowest taxon possible.

Chaetoceraceae, Coscinodiscaceae, Fragilariaceae, and Naviculaceae were observed monthly from April 1972 through January 1973. Chaetoceraceae and Coscinodiscaceae were found monthly at all stations. Fragilariaceae was not identified in April at Station C, nor in January at Stations A and D. Naviculaceae was not reported in November at Station D.

Leptocylindraceae occurred at all stations from October - January, except Station D in December, and Stations A and B in January. Rhizosoleniaceae was not identified during April and June.

Biddulphiaceae was identified at all stations in April; re-identified in August and December at Station B; and again present at all stations in January. Bacteriastreae was found only at Station B during August and September; and Bacillariaceae was identified only in January, and at all stations.

Coscinodiscaceae dominated sampling with more than 2.5 billion organisms/m³ (Table 4.8). Less dominant families included: Chaetoceraceae, 442 million; Fragilariaceae, 12.8 million; and Leptocylindraceae, 12.2 million.

Incomplete identification prohibits discussion of seasonally abundant species during 1972.

Table 4.7. Occurrence of phytoplankton in Salem Harbor,
April 1972 - January 1973.

	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sept</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Jan</u>
Bacillariaceae										X
Bacteriastaceae					X	X				
Biddulphiaceae	X				X				X	X
Chaetoceraceae	X	X	X	X	X	X	X	X	X	X
Coscinodiscaceae	X	X	X	X	X	X	X	X	X	X
Fragilariaceae	X	X	X	X	X	X	X	X	X	X
Leptocylindraceae							X	X	X	X
Naviculaceae	X	X	X	X	X	X	X	X	X	X
Rhizosoleniaceae		X		X	X	X	X	X	X	X

Table 4.8. Phytoplankton (organisms/m³) collected
in Salem Harbor, April 1972 - January 1973.

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	4/5	4/19		4/5	4/19		4/5	4/19		4/5	4/19	
<i>Achnantheaceae</i>												
<i>Actinodiscaceae</i>												
<i>Anaulaceae</i>												
<i>Auliscaceae</i>												
<i>Auriculaceae</i>												
<i>Bacillariaceae</i>												
<i>Bacteriastreae</i>												
<i>Biddulphiaceae</i>	12066		12066	13514		13514	45277		45277	76230		76230
<i>Chaetoceraceae</i>	317728	44763514	45081242	814189	23310811	24125000	322165	33361487	33683652	246015	59856052	60102063
<i>Coscinodiscaceae</i>	132722	4117399	4250121	74324	1131757	1206081	167178	791807	958985	91823	5361340	5453163
<i>Corethronaceae</i>												
<i>Cymbellaceae</i>												
<i>Epithemiaceae</i>												
<i>Eupodiscaceae</i>												
<i>Fragilariaceae</i>		739020	739020	3378	185811	189189					146886	146886
<i>Gomphonemaceae</i>												
<i>Hemidiscaceae</i>												
<i>Leptocylindraceae</i>												
<i>Naviculaceae</i>	8044		8044	3378	16892	20270	3483	105574	110057		73443	73444
<i>Rhizosoleniaceae</i>												
<i>Surirellaceae</i>												
<i>Cyanophyta</i>												
<i>Chlorophyta</i>	8044		8044	594595		594595				5198		519
<i>Phaeophyta</i>												
<i>Pyrrhophyta</i>												
<i>Rhodophyta</i>												
TOTALS - SAMPLE	478604	49619933		1503378	24645271		538103	34258868		419266	65437721	
GRAND TOTALS / STATION	50098537			26148649			34796971			65856987		

Table 4.8. Continued

4.82

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	5/5	5/17		5/5	5/17		5/5	5/17		5/5	5/17	
<i>Achnanthaceae</i>												
<i>Actinodiscaceae</i>												
<i>Anaulaceae</i>												
<i>Auliscaceae</i>												
<i>Auriculaceae</i>												
<i>Bacillariaceae</i>												
<i>Bacteriastreae</i>												
<i>Biddulphiaceae</i>												
<i>Chaetoceraeae</i>	428418	3185328	3613746	98879	3233591	3332470	145885	323485	469370	137874	318242	456116
<i>Coscinodiscaceae</i>				1030	48263	49293				2739	23515	26254
<i>Corethronaceae</i>												
<i>Cymbellaceae</i>												
<i>Epithemiaceae</i>												
<i>Eupodiscaceae</i>												
<i>Fragilariaceae</i>		72394	72394	3090	1978765	1981855		1104	1104		784	784
<i>Gomphonemaceae</i>												
<i>Hemidiscaceae</i>												
<i>Leptocylindraceae</i>												
<i>Naviculaceae</i>		16088	16088	1030	193050	194080	960	3312	4272			
<i>Rhizosoleniaceae</i>	2448		2448								784	784
<i>Surirellaceae</i>												
<i>Cyanophyta</i>												
<i>Chlorophyta</i>								8832	8832			
<i>Phaeophyta</i>												
<i>Pyrrophyta</i>	2448		2448	1030		1030	1920		1920	913		913
<i>Rhodophyta</i>												
TOTALS/SAMPLE	433314	3273810		105059	5453669		148765	336733		141528	343325	
GRAND TOTALS /STATION		3707124			5558728			485498			484851	

STATIONS	A			B			C			D		
	6/1	6/14	6/28	6/1	6/14	6/28	6/1	6/14	6/28	6/1	6/14	6/28
<i>Achnanthaceae</i>												
<i>Actinodiscaceae</i>												
<i>Anaulaceae</i>												
<i>Auliscaceae</i>												
<i>Auriculaceae</i>												
<i>Bacillariaceae</i>												
<i>Bacteriastreae</i>												
<i>Biddulphiaceae</i>												
<i>Chaetoceraeae</i>	95728	8490991	36373874	736487	12528450	24155405	826961	2591216	78108108	198004	11418919	21325075
<i>Coscinodiscaceae</i>			1463964		462304	548987			540541			4294294
<i>Corethronaceae</i>												
<i>Cymbellaceae</i>												
<i>Epithemiaceae</i>												
<i>Eupodiscaceae</i>												
<i>Fragilariaceae</i>	17883	608108		304054	924609	878378	179960	456757	540541			48799
<i>Gomphonemaceae</i>												
<i>Hemidiscaceae</i>												
<i>Leptocylindraceae</i>												
<i>Naviculaceae</i>	1052			47297	46230	329392				1119		48799
<i>Rhizosoleniaceae</i>												
<i>Surirellaceae</i>												
<i>Cyanophyta</i>							214239					
<i>Chlorophyta</i>	2104			277027			205669					
<i>Phaeophyta</i>												
<i>Pyrrhophyta</i>	2104	67568	225225	13514	46230	329392		17568		4475	38190	48799
<i>Rhodophyta</i>												
TOTALS/SAMPLE	118871	9166667	38063063	1378379	14007823	26241554	1426829	3065541	79189190	203598	11457109	25765766
GRAND TOTALS /STATION		47348601			41627756			83681560			37426473	

Table 4.8. Continued

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	7/12	7/26		7/12	7/26		7/12	7/26		7/12	7/26	
<i>Achnantheaceae</i>												
<i>Actinodiscaceae</i>												
<i>Anaulaceae</i>												
<i>Auliscaceae</i>												
<i>Auriculaceae</i>												
<i>Bacillariaceae</i>												
<i>Bacteriastreae</i>												
<i>Biddulphiaceae</i>												
<i>Chaetoceraeae</i>	6237006	45964	6282970	2086646	586045	2672691	17736487	67568	17804055	9290541	103531	9394072
<i>Coscinodiscaceae</i>	130457381	45964	130503345	42130366	1689189	43819555	1131756757		1131756757	312288851	174368	312463219
<i>Corethronaceae</i>												
<i>Cymbellaceae</i>												
<i>Epithemiaceae</i>												
<i>Eupodiscaceae</i>												
<i>Fragilariaceae</i>		919287	919287	298092		298092	844595		844595		136225	136225
<i>Gomphonemaceae</i>												
<i>Hemidiscaceae</i>												
<i>Leptocylindraceae</i>												
<i>Naviculaceae</i>		34473	34473	198728		198728	1689189		1689189	211149	5449	216563
<i>Rhizosoleniaceae</i>								2413	2413			
<i>Surirellaceae</i>												
<i>Cyanophyta</i>												
<i>Chlorophyta</i>								14479	14479	10557432		10557432
<i>Phaeophyta</i>												
<i>Pyrrhophyta</i>	129938	22982	152920	298092	172366	470458		28958	28958	1478041	16347	1494388
<i>Rhodophyta</i>												
TOTALS/SAMPLE	136824325	1068670		45011924	2447600		1152027028	113418		333826014	435920	
GRAND TOTALS / STATION		137892995			47459524			1152140446			334261934	

Table 4.8. Continued

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	8/10	8/23		8/10	8/23		8/10	8/23		8/10	8/23	
<i>Achnanthaceae</i>												
<i>Actinodiscaceae</i>				.								
<i>Anaulaceae</i>												
<i>Auliscaceae</i>												
<i>Auriculaceae</i>												
<i>Bacillariaceae</i>												
<i>Bacteriastreae</i>				70270	70270	140540						
<i>Biddulphiaceae</i>					632432	632432						
<i>Chaetoceraeae</i>	1756757	2163389	3920146	2740541	12929730	15670271	1650287	4611487	6261774	2927928	1737452	4665380
<i>Coscinodiscaceae</i>	50862291	72768533	123630824	19956757		19956757	3283374	499797277	534080671	37310167	140444015	177754182
<i>Corethronaceae</i>												
<i>Cymbellaceae</i>												
<i>Epithemiaceae</i>												
<i>Eupodiscaceae</i>												
<i>Fragilariaceae</i>		196672	196672	70270	70270	140540	106470	219595	326065	167310	96525	263835
<i>Gomphonemaceae</i>												
<i>Hemidiscaceae</i>												
<i>Leptocylindraceae</i>												
<i>Naviculaceae</i>					70270	70270				41828		41828
<i>Rhizosoleniaceae</i>		590015	590015	70270	70270	70270	53235	439189	492424	41828	96525	138355
<i>Surirellaceae</i>												
<i>Cyanophyta</i>												
<i>Chlorophyta</i>												
<i>Phaeophyta</i>												
<i>Pyrrophyta</i>	669241	196672	865913	421622	140541	562163	532351	219595	751946	209138	193050	402188
<i>Rhodophyta</i>												
TOTALS/SAMPLE	53288289	75915281		23259460	13983783		36625717	505287163		40698199	142507567	
GRAND TOTALS/STATION	129203570			37243243			541912880			183265766		

Table 4.8. Continued

4.86

STATIONS	A			B			C			D		
	9/6	9/20	TOTAL PER SPECIES	9/6	9/20	TOTAL PER SPECIES	9/6	9/20	TOTAL PER SPECIES	9/6	9/20	TOTAL PER SPECIES
<i>Achnanthaceae</i>												
<i>Actinodiscaceae</i>												
<i>Anaulaceae</i>												
<i>Auliscaceae</i>												
<i>Auriculaceae</i>												
<i>Bacillariaceae</i>												
<i>Bacteriastreae</i>				70748		70748						
<i>Biddulphiaceae</i>												
<i>Chaetoceraeae</i>	16667	1722222	1738889	70748	1734737	1805485	13072	742857	755929	10753	1208333	1219086
<i>Coscinodiscaceae</i>	797222	2611111	3408333	3042177	3324912	6367089	480392	990476	1470868	358423	1208333	1564756
<i>Corethronaceae</i>												
<i>Cymbellaceae</i>												
<i>Epithemiaceae</i>												
<i>Eupodiscaceae</i>												
<i>Fragilariaceae</i>				141497		141497						
<i>Gomphonemaceae</i>												
<i>Hemidiscaceae</i>												
<i>Leptocylindraceae</i>												
<i>Naviculaceae</i>		277778	277778	212245	180702	392947		198095	198095	3584	41667	45251
<i>Rhizosoleniaceae</i>	5556		5556	70748		70748					208333	208333
<i>Surirellaceae</i>												
<i>Cyanophyta</i>					144561	144561						
<i>Chlorophyta</i>		333333	333333		144561	144561						
<i>Phaeophyta</i>												
<i>Pyrrhophyta</i>	11111	55556	66667	778231	72281	850512	13072		13072	21505	41667	63172
<i>Rhodophyta</i>												
TOTALS/SAMPLE	830556	5000000		4386394	5601754		506536	1931428		394265	200333	
GRAND TOTALS /STATION		5830556			9988148			2437964			3102598	

Table 4.8. Continued

4.87

STATIONS	A			B			C			D		
	10/5	10/18	TOTAL PER SPECIES	10/5	10/18	TOTAL PER SPECIES	10/5	10/18	TOTAL PER SPECIES	10/5	10/18	TOTAL PER SPECIES
<i>Achnanthaceae</i>												
<i>Actinodiscaceae</i>												
<i>Anaulaceae</i>												
<i>Auliscaceae</i>												
<i>Auriculaceae</i>												
<i>Bacillariaceae</i>												
<i>Bacteriastreae</i>												
<i>Biddulphiaceae</i>												
<i>Chaetoceraeae</i>	359048	28,889	387,937	740741	173,333	914074	50000	171,717	221,717	126061	123810	249871
<i>Coscinodiscaceae</i>		8254	8254	666,667	86,667	753,334	12,500	10101	22,601	110303	41,270	151,573
<i>Corethronaceae</i>												
<i>Cymbellaceae</i>												
<i>Epithemiaceae</i>												
<i>Eupodiscaceae</i>												
<i>Fragilariaceae</i>		90794	90794		650,000	650,000	8333	383838	392171	267879	866,667	1,134,546
<i>Gomphonemaceae</i>												
<i>Hemidiscaceae</i>												
<i>Leptocylindraceae</i>	1646,667	231,111	1,877,778	4037,037	2,166,667	6,203,704	383,333	666,667	1,050,000	1,339,394	1,650,794	2,990,188
<i>Naviculaceae</i>		12381	12381	37037	43333	80,370	12,500	10101	22,601	15,758		15,758
<i>Rhizosoleniaceae</i>	37143	4127	41,270	148,148		148,148		20202	20,202			
<i>Surirellaceae</i>												
<i>Cyanophyta</i>		16508	16,508									
<i>Chlorophyta</i>		4127	4,127	185,185		185,185	4167		4,167	63030		63,030
<i>Phaeophyta</i>												
<i>Pyrrhophyta</i>		8254	8,254	148,148		148,148	8333	50505	58,838	47,273	206,349	253,622
<i>Rhodophyta</i>												
TOTALS/SAMPLE	2042858	393302		5962963	3120000		479166	1313131		1969698	2888890	
GRAND TOTALS/STATION		2436160			9082963			1792297			4858588	

Table 4.8. Continued

4.88

STATIONS	A			B			C			D		
	11/2	11/17	11/28	11/2	11/17	11/28	11/2	11/17	11/28	11/2	11/17	11/28
<i>Achnantheaceae</i>												
<i>Actinodiscaceae</i>												
<i>Anaulaceae</i>												
<i>Auliscaceae</i>												
<i>Auriculaceae</i>												
<i>Bacillariaceae</i>												
<i>Bacteriastreae</i>												
<i>Biddulphiaceae</i>												
<i>Chaetoceraceae</i>		17,600	14,228	3,546				21,818		2,165		29,851
<i>Coscinodiscaceae</i>	2,451	76,267	163,624	3,546	38,389	134,228	5,128	90,909	142,550	2,165	38,278	98,508
<i>Corethronaceae</i>												
<i>Cymbellaceae</i>												
<i>Epithemiaceae</i>												
<i>Eupodiscaceae</i>												
<i>Fragilariaceae</i>	12,255	46,933	14,228		17,450	53,691	12,821	18,182	3,624	21,645	7,656	
<i>Gomphonemaceae</i>												
<i>Hemidiscaceae</i>												
<i>Leptocylindraceae</i>	22,059	17,600	7,114	24,823	6,980		15,385	10,909		17,316	15,311	
<i>Naviculaceae</i>		23,467	14,228	14,184	10,470	40,269		10,909				
<i>Rhizosoleniaceae</i>	492,647	264,000	3,557	492,908	136,107	26,846	330,769	229,091	2,416	227,273	95,694	1,493
<i>Surirellaceae</i>												
<i>Cyanophyta</i>		35,200				80,537						1,493
<i>Chlorophyta</i>		58,667	10,671									
<i>Phaeophyta</i>												
<i>Pyrrophyta</i>	4,902	23,467	14,228	7,092	6,980	13,423		3,636	6,040	4,329	22,967	8,955
<i>Rhodophyta</i>												
TOTALS - SAMPLE	534,314	563,201	241,878	546,099	216,376	348,994	364,103	385,454	154,630	274,893	179,906	113,434
GRAND TOTALS / STATION	1,339,393			1,111,469			904,187			568,233		

Table 4.8. Continued

4.89

STATIONS	A			B			C			D		
	12/15	12/26	TOTAL PER SPECIES	12/15	12/26	TOTAL PER SPECIES	12/15	12/26	TOTAL PER SPECIES	12/15	12/26	TOTAL PER SPECIES
<i>Achnanthaceae</i>												
<i>Actinodiscaceae</i>												
<i>Anaulaceae</i>												
<i>Auliscaceae</i>												
<i>Auriculaceae</i>												
<i>Bacillariaceae</i>												
<i>Bacteriastreae</i>												
<i>Biddulphiaceae</i>					15,348	15,348						
<i>Chaetoceraceae</i>	11,679	12,268	23,947		9,592	9,592	8,729	50,488	59,217	36,510	21,488	57,998
<i>Coscinodiscaceae</i>	10,511	6,134	16,645	14,925	13,429	28,354	18,705	15,366	34,071	9,664	9,917	19,581
<i>Corethronaceae</i>												
<i>Cymbellaceae</i>												
<i>Epithemiaceae</i>												
<i>Eupodiscaceae</i>												
<i>Fragilariaceae</i>	9,343		9,343	14,925	8,633	23,558	2,494	4,390	6,884	3,222	1,653	4,875
<i>Gomphonemaceae</i>												
<i>Hemidiscaceae</i>												
<i>Leptocylindraceae</i>	5,839	1,534	7,373		2,878	2,878	3,741	4,390	8,131			
<i>Naviculaceae</i>	3,504	3,834	7,338	22,388	4,796	27,184	9,976	4,390	14,366	4,295	827	5,122
<i>Rhizosoleniaceae</i>					959	959					827	827
<i>Surirellaceae</i>												
<i>Cyanophyta</i>												
<i>Chlorophyta</i>		5,367	5,367		4,796	4,796					6,612	6,612
<i>Phaeophyta</i>												
<i>Pyrrhophyta</i>	2,336	2,300	4,636	7,463	6,715	14,178	2,494	4,390	6,884	5,369	3,306	8,675
<i>Rhodophyta</i>												
TOTALS/SAMPLE	43,212	31,437		59,701	67,146		46,139	83,414		59,060	44,630	
GRAND TOTALS/STATION		74,649			126,847			129,553			103,690	

Table 4.8. Continued

STATIONS	A			B			C			D		
	1/10	1/23	TOTAL PER SPECIES	1/10	1/23	TOTAL PER SPECIES	1/10	1/23	TOTAL PER SPECIES	1/10	1/23	TOTAL PER SPECIES
<i>Achnanthaceae</i>												
<i>Actinodiscaceae</i>												
<i>Anaulaceae</i>												
<i>Auliscaceae</i>												
<i>Auriculaceae</i>												
<i>Bacillariaceae</i>		2650	2650	2151		2151	1342	1119	2461	879	2797	3676
<i>Bacteriastaceae</i>												
<i>Biddulphiaceae</i>		1767	1767	4301	2581	6882		3356	3356	1318	27972	29290
<i>Chaetoceraeae</i>	5830	10601	16431	30108	15484	45592	20134	31320	51454	7907	34965	42872
<i>Coscinodiscaceae</i>	4770	16785	21555	15054	7742	22796	14765	20134	34899	2441	57343	59784
<i>Corethronaceae</i>												
<i>Cymbellaceae</i>												
<i>Epithemiaceae</i>												
<i>Eupodiscaceae</i>												
<i>Fragilariaceae</i>				2151		2151	2685		2685			
<i>Gomphonemaceae</i>												
<i>Hemidiscaceae</i>												
<i>Leptocylindraceae</i>								2237	2237		2797	2797
<i>Naviculaceae</i>	1590	1767	3357	6452	6452	12904	2685	3356	6041		5594	5594
<i>Rhizosoleniaceae</i>	530		530							439	1399	1838
<i>Suriellaceae</i>												
<i>Cyanophyta</i>								3356	3356			
<i>Chlorophyta</i>	5300	5300	10600		5161	5161	6711		6711	3514	9790	13304
<i>Phaeophyta</i>												
<i>Pyrrhophyta</i>				2151		2151	1342		1342	439		439
<i>Rhodophyta</i>												
TOTALS - SAMPLE	18020	38870		62368	37420		49664	64878		16937	142657	
GRAND TOTALS / STATION		56890			99788			114542			159594	

4.4 Zooplankton

Twenty-four species, and nine developmental stages of zooplankton were identified from March 1972 through January 1973 (Table 4.9). Zooplankton occurrence and abundance from March - August 1973 was reported in Quarterly Progress Report No. 6.

Acartia clausi, copepod nauplii, copepod immature, Cirripedia nauplii and Polychaeta were most commonly identified. Copepod nauplii, copepod immature, Acartia clausi and Eurytemora herdmani were most abundant, respectively (Figure 4.5).

Eighteen organisms were identified during September. Copepod nauplii abundance ranged from 93,898 - 298,762/m³; copepod immature and Acartia clausi ranked second and third (12,541 - 60,410/m³ and 5,487 - 31,820/m³, respectively) (Table 4.10). Oithona sp. was identified for the first time in September.

Sixteen identifications were made during October. Copepod nauplii ranged from 73,302 - 393,519/m³. Polychaeta replaced copepod immature as the second most abundant organism (6,580 - 127,785/m³); and A. clausi varied from 3,981 - 103,946/m³. Centropages typicus was identified for the first time.

Sixteen organisms were sampled during November. Copepod nauplii ranged from 1,129 - 49,031/m³. Copepod immature reached peak abundance (5,000 - 51,072/m³) and A. clausi ranked third (4,838 - 33,390/m³).

Diversity was lowest in December (10 organism identifications). Copepod nauplii concentrations varied from

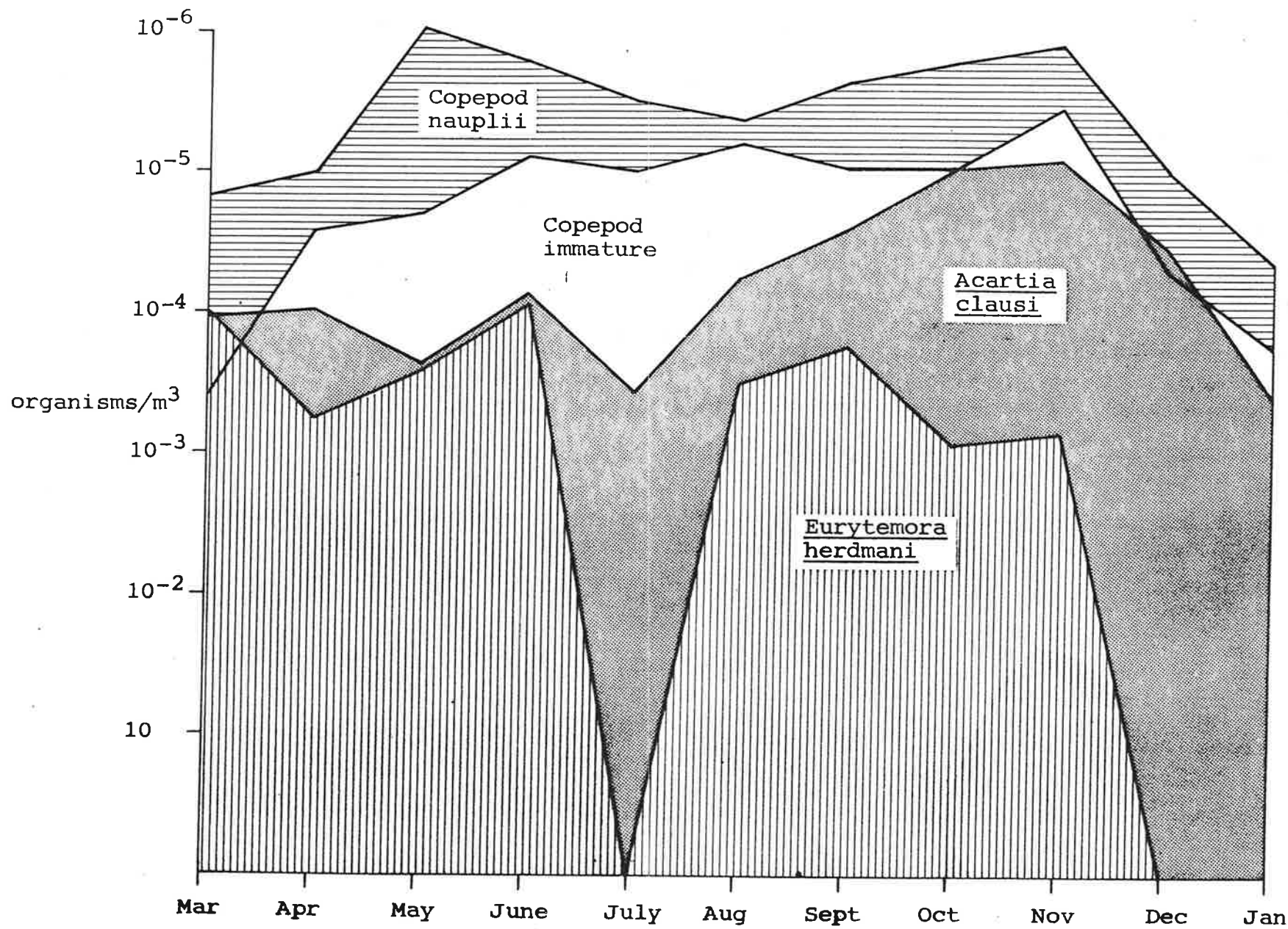


Figure 4.5. Abundance of dominant copepods sampled in Salem Harbor, March 1972 - January 1973.

13,055 to 44,762/m³. A.clausii and Copepod immature reversed order of abundance ranging from 5,868 - 23,722/m³ and 7,711 to 10,922/m³, respectively.

Eleven organisms were identified in January. Copepod nauplii ranged from 5,483 - 17,237/m³. Harpactius sp. ranked second in abundance (1,577 - 3,256/m³); and Copepod immature ranged from 1,185 - 2,985/m³.

Table 4.10. Zooplankton (organisms/m³) collected in Salem Harbor, March 1972 - January 1973.

STATIONS	A			B			C			D		
	3/8	3/23	TOTAL PER SPECIES	3/8	3/23	TOTAL PER SPECIES	3/8	3/23	TOTAL PER SPECIES	3/8	3/23	TOTAL PER SPECIES
<i>Acartia tonsa</i>												
<i>Acartia clausi</i>	5395	245	5640	267	49	316	1418	990	2408	1005	239	1244
<i>Temora longicornis</i>	101		101				112		112	41		41
<i>Eurytemora</i> sp.												
<i>Eurytemora herdmanni</i>	8320	490	8810	391	82	473	2072	2287	4359	972	151	1123
<i>Centropages typicus</i>												
<i>Centropages hamatus</i>												
<i>Paracalanus parvus</i>												
<i>Paracalanus</i> sp.												
<i>Diaptomus</i> sp.												
<i>Labidocera acutifrons</i>												
<i>Calanus finmarchicus</i>												
<i>Tortanus</i> sp.												
<i>Tortanus discaudatus</i>	50		50				96		96			
<i>Harpacticus gracilis</i>												
<i>Harpacticus</i> sp.	50	17	67	196	136	332	64		64	8		
<i>Cyclopoida</i>	4336	177	4513	18	27	45	27	528	555	107	163	270
<i>Oithona</i> sp.												
<i>Copepod</i> unidentified	1160	76	1236	36	22	58	414	990	1404	190	151	341
<i>Copepod</i> naupii	30607	12069	42676	622	1689	2311	5609	27361	32970	2546	4537	7083
<i>Copepod</i> immature	2597	152	2749	36	98	134	765	528	1293	264	144	408
<i>Cirripedia</i> naupii	8169	76	8245	338	33	371	2054	22	2076	1978	212	2190
<i>Cirripedia</i> cypris												
<i>Cirripedia</i> sp.												
<i>Malacostraca</i> naupii												
<i>Malacostraca</i> immature												
<i>Decapod</i> larvae												
<i>Echinoderm</i> larvae												
<i>Tunicate</i> larvae												
<i>Nematoda</i>				18	5	23						
<i>Polychaeta</i>	101	25	126				32	22	54	25		2
<i>Chaetognatha</i>												
<i>Medusoids</i>												
<i>Polyps</i>												
<i>Gastropod</i> larvae		42	42				48		48	25		
<i>Gastropod</i> eggs												
<i>Tintinid</i>												
<i>Ostracoda</i>												
<i>Cladocera</i>												
<i>Podon</i> sp.												
<i>Evadne</i> sp.												
<i>Bivalvae</i> larvae												
<i>Crassostrea virginica</i>												
<i>Mya arenaria</i>												
<i>Mercenaria mercenaria</i>												
<i>Modiolus demissus</i>												
<i>Mytilus edulis</i>												
TOTALS/SAMPLE	60886	13369		1922	2141		12713	32728		7151	5597	
GRAND TOTALS/STATION		74255		4063			45441			12758		

Table 4.10. Continued

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	4/5	4/19		4/5	4/19		4/5	4/19		4/5	4/19	
<i>Acartia tonsa</i>												
<i>Acartia clausi</i>	1860	2323	4183	676	2787	3463	435	1848	2283	736	698	1434
<i>Temora longicornis</i>	25		25									
<i>Eurytemora</i> sp.								2903	2903			
<i>Eurytemora herdmanni</i>	226	53	279	169	169	338	240	1848	2088	173	404	577
<i>Centropages typicus</i>												
<i>Centropages hamatus</i>												
<i>Paracalanus parvus</i>	50		50									
<i>Paracalanus</i> sp.												
<i>Diaptomus</i> sp.	50	317	367								110	110
<i>Labidocera acutifrons</i>												
<i>Calanus finmarchicus</i>												
<i>Tortanus</i> sp.												
<i>Tortanus discaudatus</i>												
<i>Harpacticus gracilis</i>				296		296						
<i>Harpacticus</i> sp.												
<i>Cyclopoida</i>	327	211	538	169	253	422	283	132	415	260		260
<i>Oithona</i> sp.												
<i>Copepod</i> unidentified	101	211	312	85	169	254	109	396	505	22	110	132
<i>Copepod</i> naupii	11590	11402	22992	15076	13936	29012	14585	20455	35040	9399	9695	19094
<i>Copepod</i> immature	13551	7126	20677	6630	6926	13556	2003	11217	13220	11478	3819	15297
<i>Cirripedia</i> naupii	1131		1131	887	9	896						
<i>Cirripedia</i> cypris		53	53	85		85						
<i>Cirripedia</i> sp.												
<i>Malacostraca</i> naupii												
<i>Malacostraca</i> immature	25		25									
<i>Decapod</i> larvae												
<i>Echinoderm</i> larvae												
<i>Tunicate</i> larvae												
<i>Nematoda</i>												
<i>Polychaeta</i>	25		25				305	1056	1361	65	184	249
<i>Chaetognatha</i>												
<i>Medusoids</i>												
<i>Polyps</i>												
<i>Gastropod</i> larvae	25	106	131	42		42	392	264	656	22		22
<i>Gastropod</i> eggs												
<i>Tintinid</i>												
<i>Ostracoda</i>												
<i>Cladocera</i>							44		44			
<i>Podon</i> sp.												
<i>Evadne</i> sp.												
<i>Bivalvae</i> larvae												
<i>Crassostrea virginica</i>												
<i>Mya arenaria</i>												
<i>Mercenaria mercenaria</i>												
<i>Modiolus demissus</i>												
<i>Mytilus edulis</i>												
TOTALS/SAMPLE	28986	21802		24115	24249		18396	40119		22155	15020	
GRAND TOTALS/STATION	50788			48364			58515			37175		

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	5/5	5/17		5/5	5/17		5/5	5/17		5/5	5/17	
<i>Acartia tonsa</i>												
<i>Acartia clausi</i>	4284		4284	644	181	825	180	69	249	1256	98	1354
<i>Temora longicornis</i>												
<i>Eurytemora</i> sp.												
<i>Eurytemora herdmanni</i>	2448		2448	103	2413	2516	552		552	685	49	734
<i>Centropages typicus</i>												
<i>Centropages hamatus</i>												
<i>Paracalanus parvus</i>												
<i>Paracalanus</i> sp.												
<i>Diaptomus</i> sp.												
<i>Labidocera acutirostris</i>												
<i>Calanus finmarchicus</i>	61		61	52		52				228		228
<i>Tortanus</i> sp.												
<i>Tortanus discaudalus</i>												
<i>Harpacticus gracilis</i>												
<i>Harpacticus</i> sp.	153	503	656									
<i>Cyclopoida</i>	612	1006	1618	26	1207	1233	138		138	114		114
<i>Oithona</i> sp.												
Copepod unidentified				52		52	138		138	114		114
Copepod naupii	160045	811414	971459	14703	199083	213786	58169	120755	178924	2922	58103	61025
Copepod immature	14383	23126	37509	2472	22321	24793	4554	2622	7176	3766	1470	5236
<i>Cirripedia naupii</i>				52		52	138	69	207			
<i>Cirripedia cypris</i>				52		52						
<i>Cirripedia</i> sp.												
<i>Malacostraca naupii</i>												
<i>Malacostraca immature</i>											49	49
Decapod larvae												
Echinoderm larvae												
Tunicate larvae	12853	6033	18886	2987		2987	2139		2139	3196	147	3343
Nematoda												
Polychaeta	918	6033	6951	618	1810	2428	345	2691	3036	228	980	1208
Chaetognatha												
Medusoids											49	49
Polyps												
Gastropod larvae	4437	2011	6448	165	1207	1372		345	345		49	49
Gastropod eggs							207		207			
Tintinid												
Ostracoda												
Cladocera	153		153	77	1207	1284		69	69		98	98
Podon sp.												
Evadne sp.												
Bivalvae larvae				77	603	680		69	69			
<i>Crassostrea virginica</i>												
<i>Mya arenaria</i>												
<i>Mercenaria mercenaria</i>												
<i>Modiolus demissus</i>												
<i>Mytilus edulis</i>												
TOTALS/SAMPLE	200347	850126		22080	230032		66560	126689		12509	61092	
GRAND TOTALS/STATION		1050473			252112			193249			73601	

STATIONS	A			B			C			D		
	6/1	6/14	6/28	6/1	6/14	6/28	6/1	6/14	6/28	6/1	6/14	6/28
<i>Acartia tonsa</i>												
<i>Acartia clausi</i>	127	3790	282	1299	6446	1584	206	2428	4223	56	11	1
<i>Temora longicornis</i>												
<i>Eurytemora</i> sp.												
<i>Eurytemora herdmanni</i>	63		845	812	2889	3167	1854	4117	650	811	5	1
<i>Centropages typicus</i>										28		
<i>Centropages hamatus</i>												
<i>Paracalanus parvus</i>										252	1	
<i>Paracalanus</i> sp.	885	1354		325				106				
<i>Diaptomus</i> sp.								211				
<i>Labidocera acutifrons</i>												
<i>Calanus finmarchicus</i>	127						206					
<i>Tortanus</i> sp.												
<i>Tortanus discaudatus</i>												
<i>Harpacticus gracilis</i>												
<i>Harpacticus</i> sp.				812	2567							
<i>Cyclopoida</i>	190	1624	4505			1056		634	1299	28	4	2
<i>Oithona</i> sp.												
<i>Copepod unidentified</i>					222		103			28		
<i>Copepod naupii</i>	55585	175687	60811	34434	191812	42758	68186	83193	102001	10599	378	92
<i>Copepod immature</i>	5121	20574	21960	20140	32450	33784	5562	20165	35733	411	57	17
<i>Cirripedia naupii</i>							103			28	1	
<i>Cirripedia cypris</i>	63						412			28		
<i>Cirripedia</i> sp.												
<i>Malacostraca naupii</i>												
<i>Malacostraca immature</i>	63									28		
<i>Decapod larvae</i>												
<i>Echinoderm larvae</i>												
<i>Tunicate larvae</i>							103		56			
<i>Nematoda</i>				162		2375						
<i>Polychaeta</i>	632	271					618	845	325	196		
<i>Chaetognatha</i>												
<i>Medusoids</i>										28		
<i>Polyps</i>												
<i>Gastropod larvae</i>	316	3248		162	222		721	106	325	112	3	
<i>Gastropod eggs</i>	63	271		4061								
<i>Tintinid</i>												
<i>Ostracoda</i>												
<i>Cladocera</i>	63		1689		222		412	2333			6	
<i>Podon</i> sp.												
<i>Evadne</i> sp.												
<i>Bivalvae larvae</i>	1075	271	5349	487	667	7654		211	10070	28	1	3
<i>Crassostrea virginica</i>												
<i>Mya arenaria</i>												
<i>Mercenaria mercenaria</i>												
<i>Modiolus demissus</i>												
<i>Mytilus edulis</i>												
TOTALS/SAMPLE	64,373	207090	95441	62,694	237,597	92,378	78,486	114,349	154,682	12661	467	116
GRAND TOTALS/STATION		336904			392669			347517			13244	

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	7/12	7/26		7/12	7/26		7/12	7/26		7/12	7/26	
<i>Acartia tonsa</i>												
<i>Acartia clausi</i>	325	144	469	1242	1293	2535	528		528	1056	341	1397
<i>Temora longicornis</i>												
<i>Eurytemora</i> sp.												
<i>Eurytemora herdmanni</i>												
<i>Centropages typicus</i>												
<i>Centropages hamatus</i>												
<i>Paracalanus parvus</i>												
<i>Paracalanus</i> sp.												
<i>Diaptomus</i> sp.												
<i>Labidocera acutilfrons</i>												
<i>Calanus finmarchicus</i>												
<i>Tortanus</i> sp.												
<i>Tortanus discaudatus</i>												
<i>Harpacticus gracilis</i>												
<i>Harpacticus</i> sp.												
<i>Cyclopoida</i>					1987	1987	2112	1508	3620	3167	1362	4529
<i>Orithona</i> sp.												
Copepod unidentified												
Copepod naupii	15268	81725	96993	110543	80150	190693	20059	39961	60020	191090	38484	229574
Copepod immature	4548	15938	20486	52166	11635	63801	500	3167	3667	20059	7152	27211
<i>Cirripedia naupii</i>		287	287					151	151			
<i>Cirripedia cypris</i>												
<i>Cirripedia</i> sp.												
<i>Malacostraca naupii</i>												
<i>Malacostraca immature</i>												
Decapod larvae												
Echinoderm larvae												
Tunicate larvae												
Nematoda												
<i>Polychaeta</i>		8331	8331	994	9911	10905		2413	2413	2112	170	2,282
<i>Chaetognatha</i>												
Medusoids								302	302		170	170
Polyps												
Gastropod larvae	325	1574	1899	1739	431	2170		302	302	1056	341	1,397
Gastropod eggs				248	431	679						
Tintinid	13644	45103	58747	36765	361969	398734	26816	63646	90462	51731	20938	72661
Ostracoda												
Cladocera	1949	18236	20185	4223	9049	13272	528	905	1433	3167	1866	503
Podon sp.												
<i>Evadne</i> sp.												
Bivalvae larvae	975	4160	5135	20370	14,651	35021	1584	1810	3394	8446	4250	1269
<i>Crassostrea virginica</i>												
<i>Mya arenaria</i>												
<i>Mercenaria mercenaria</i>												
<i>Modiolus demissus</i>												
<i>Mytilus edulis</i>												
Fish eggs	325		325					302	302			
TOTALS/SAMPLE	37359	175498		228290	491507		52127	114467		281884	75074	
GRAND TOTALS/STATION	212857			719797			166594			356958		

Table 4.10. Continued

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	8/10	8/23		8/10	8/23		8/10	8/23		8/10	8/23	
<i>Acartia tonsa</i>										265		265
<i>Acartia clausi</i>	2014	1007	3021	3710	4293	8003	8613	12265	20878	806	48	854
<i>Temora longicornis</i>	106		106	464	358	832				806		806
<i>Eurytemora</i> sp.												
<i>Eurytemora hermani</i>	530		530	928		928	663	3339	4002			
<i>Centropages typicus</i>												
<i>Centropages hamatus</i>												
<i>Paracalanus parvus</i>												
<i>Paracalanus</i> sp.					358	358						
<i>Diaptomus</i> sp.	530		530									
<i>Labidocera acutifrons</i>												
<i>Calanus finmarchicus</i>												
<i>Tortanus</i> sp.												
<i>Tortanus discaudatus</i>												
<i>Harpacticus gracilis</i>												
<i>Harpacticus</i> sp.												
<i>Cyclopoida</i>	106	1007	1113	5565	1073	6638	663		663	1060		1060
<i>Oithona</i> sp.												
<i>Copepod</i> unidentified												
<i>Copepod naupii</i>	94340	59917	154257	137270	60460	197730	37100	40140	77240	25186	3943	29129
<i>Copepod</i> immature	78440	13595	92035	91377	17172	108549	44732	22300	67032	26246	1473	27719
<i>Cirripedia naupii</i>					358	358						
<i>Cirripedia cypris</i>												
<i>Cirripedia</i> sp.												
<i>Malacostraca naupii</i>												
<i>Malacostraca</i> immature												
<i>Decapod</i> larvae												
<i>Echinoderm</i> larvae												
<i>Tunicate</i> larvae												
<i>Nematoda</i>												
<i>Polychaeta</i>	22811	4028	26839	12058	6082	18140	6625	1115	7740	6106	95	6201
<i>Chaetognatha</i>												
<i>Medusoids</i>												
<i>Polyps</i>												
<i>Gastropod</i> larvae	3180	504	3684	6493	358	6851	663		663	265	24	289
<i>Gastropod</i> eggs												
<i>Tintinid</i>	23871	9567	33438	16695	11090	27785	3657		3657	3392	570	3962
<i>Ostracoda</i>												
<i>Cladocera</i>												
<i>Podon</i> sp.	40280	33735	74015	36655	22538	59193	3313	21185	24498	3986	451	4437
<i>Eradne</i> sp.	2671		2671	1410	1431	2841	331	1115	1446	265		265
<i>Bivalvae</i> larvae	92771	1511	94282	34800	7871	42671	2995		2995	5046	48	5094
<i>Crassostrea virginica</i>												
<i>Mya arenaria</i>												
<i>Mercenaria mercenaria</i>												
<i>Modiolus demissus</i>												
<i>Mytilus edulis</i>												
TOTALS/SAMPLE	361650	124871		347425	133442		109355	101459		73429	6652	
GRAND TOTALS/STATION		486521			480867			210814			80081	

Table 4.10. Continued

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	9/6	9/20		9/6	9/20		9/6	9/20		9/6	9/20	
<i>Acartia tonsa</i>	134		134	1081		1081		504	504	230	267	497
<i>Acartia clausi</i>	1075	4412	5487	18380	4095	22475	2113	29707	31820	1728	4008	5736
<i>Temora longicornis</i>											267	267
<i>Eurytemora</i> sp.												
<i>Eurytemora herdmanni</i>		1177	1177	721		721		4532	4532	230	1336	1566
<i>Centropages typicus</i>												
<i>Centropages hamatus</i>	67		67								267	267
<i>Paracalanus parvus</i>												
<i>Paracalanus</i> sp.												
<i>Diaptomus</i> sp.												
<i>Libidocera acutifrons</i>												
<i>Calanus finmarchicus</i>												
<i>Tortanus</i> sp.												
<i>Tortanus discaudatus</i>												
<i>Harpacticus gracilis</i>												
<i>Harpacticus</i> sp.		294	294					504	504	115		115
<i>Cyclopoida</i>												
<i>Oithona</i> sp.	941	3530	4471	3244	1593	4837	1138	6546	7684	115	1069	1184
Copepod unidentified												
Copepod nauplii	35213	86186	121399	135150	47775	182925	51543	247219	298762	37786	56112	93898
Copepod immature	1949	14119	16068	51537	8873	60410	8613	32224	40832	3456	9085	12541
<i>Cirripedia nauplii</i>				360		360						
<i>Cirripedia cypris</i>												
<i>Cirripedia</i> sp.												
<i>Malacostraca nauplii</i>												
<i>Malacostraca immature</i>												
Decapod larvae												
Echinoderm larvae												
Tunicate larvae	403	883	1286		228	228		1511	1511		2138	2138
Nematoda					228	228						
Polychaeta	336	5295	5631	2523	4323	6846	8288	3021	11309	346	3741	4087
Chaetognatha												
Medusoids					455	455		504	504		267	267
Polyps												
Gastropod larvae	269	883	1152	360	683	1043	650	1511	2161		267	267
Gastropod eggs												
Tintinid	538	1177	1715	721	1138	1859	325	8560	8885	230		231
Ostracoda												
Cladocera	2352	4706	7058	11533	5460	16993	163	22154	22317	2074	2138	4212
Podon sp.												
Evadne sp.												
Bivalvae larvae	202		202	3964	228	4192	163		163	576	534	1110
<i>Crassostrea virginica</i>												
<i>Mya arenaria</i>												
<i>Mercenaria mercenaria</i>												
<i>Modiolus demissus</i>												
<i>Mytilus edulis</i>												
TOTALS SAMPLE	43479	122662		229574	75079		72996	358497		46886	81496	
GRAND TOTALS/STATION		166141			304653			431493			128382	

Table 4.10. Continued

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	10/6	10/18		10/6	10/18		10/6	10/18		10/6	10/18	
<i>Acartia tonsa</i>		419	419				52		52	803	795	1,598
<i>Acartia clausi</i>	631	3,350	3,981	8,336	22,075	30,411	830	8,030	8,860	60,221	43,725	103,946
<i>Temora longicoris</i>	63	837	900		6,622	6,622				1,606		1,606
<i>Eurytemora</i> sp.												
<i>Eurytemora herdmanni</i>		837	837								795	795
<i>Centropages typicus</i>		419	419									
<i>Centropages hamatus</i>		628	628		2,208	2,208	52	3,747	3,799	7,227	1,590	8,817
<i>Paracalanus parvus</i>												
<i>Paracalanus</i> sp.										3,212		3,212
<i>Diaptomus</i> sp.												
<i>Labidocera acutifrons</i>												
<i>Calanus finmarchicus</i>												
<i>Tortanus</i> sp.												
<i>Tortanus discaudatus</i>												
<i>Harpacticus gracilis</i>												
<i>Harpacticus</i> sp.												
<i>Cyclopoida</i>												
<i>Oithona</i> sp.	2,838	6,490	9,328	7,503	39,734	47,237	2,386	8,565	10,951	8,030	11,130	19,160
<i>Copepod unidentified</i>												
<i>Copepod nauplii</i>	16,777	56,525	73,302	128,210	269,309	393,519	18,779	185,214	203,993	20,074	125,610	145,684
<i>Copepod immature</i>	2,144	7,955	10,099	23,342	26,489	49,831	2,386	18,736	21,122	20,074	31,800	51,874
<i>Cirripedia nauplii</i>				834		834		1,071	1,071			
<i>Cirripedia cypris</i>												
<i>Cirripedia</i> sp.												
<i>Malacostraca nauplii</i>												
<i>Malacostraca immature</i>												
<i>Decapod larvae</i>												
<i>Echinoderm larvae</i>												
<i>Tunicate larvae</i>	5,992		5,992	2,501		2,501	1,349	535	1,884	10,438		10,438
<i>Nematoda</i>												
<i>Polychaeta</i>	189	24,494	24,683	4,168	123,617	127,785	156	6,424	6,580		8,745	8,745
<i>Chaetognatha</i>												
<i>Medusoids</i>												
<i>Polyps</i>												
<i>Gastropod larvae</i>		1,047	1,047	834		834					1,590	1,590
<i>Gastropod eggs</i>												
<i>Tintinid</i>												
<i>Ostracoda</i>												
<i>Cladocera</i>	189	209	398	834		834	571		571	3,212		3,212
<i>Poison</i> sp.												
<i>Evadne</i> sp.												
<i>Bivalvae larvae</i>		3,140	3,140	834	6,622	7,456	52		52		7,155	7,155
<i>Crassostrea virginica</i>												
<i>Mya arenaria</i>												
<i>Mercenaria mercenaria</i>												
<i>Modiolus demissus</i>												
<i>Mytilus edulis</i>												
TOTALS/SAMPLE	28,823	106,350		173,396	496,676		26,613	232,322		134,897	232,935	
GRAND TOTALS/STATION		135,173			670,072			258,935			367,832	

Table 4.10. Continued

STATIONS	A			B			C			D		
	11/2	11/17	11/28	11/2	11/17	11/28	11/2	11/17	11/28	11/2	11/17	11/28
<i>Acartia tonsa</i>							265			228		
<i>Acartia clausi</i>	5351	4802	33390	7526	1,781	4,838	8354	6214	30,240	7,635	48,995	26,881
<i>Temora longicornis</i>				376								
<i>Eurytemora</i> sp.		800							336		1,195	
<i>Eurytemora herdmanni</i>					445							
<i>Centropages typicus</i>												
<i>Centropages hamatus</i>	127		445			645						430
<i>Paracalanus parvus</i>												
<i>Paracalanus</i> sp.						161						
<i>Diaptomus</i> sp.		800					133					
<i>Labidocera acutifrons</i>												
<i>Calanus finmarchicus</i>												
<i>Tortanus</i> sp.												
<i>Tortanus discaudatus</i>												
<i>Harpacticus gracilis</i>												
<i>Harpacticus</i> sp.												
<i>Cyclopoida</i>												
<i>Orithona</i> sp.	2421	2401	1336	2070	1336		2122	5258	336	1595	1,195	215
Copepod unidentified												
Copepod nauplii	57,203	148,874	24,931	56,257	24,486	1,129	46,410	184,030	43,008	57,545	234,220	49,031
Copepod immature	21,276	42,021	21,815	27,282	18,698	5,000	39,647	24,856	51,072	29,513	236,610	21,505
<i>Cirripedia</i> nauplii	127			376				478		114		
<i>Cirripedia</i> cypris												
<i>Cirripedia</i> sp.												
<i>Malacostraca</i> nauplii												
<i>Malacostraca</i> immature												
Decapod larvae												
Echinoderm larvae												
Tunicate larvae												
Nemaloda					445							
Polychaeta	2,548	1601		1,317	890	323	3,448	956		2,849	1,195	
Chaetognatha												
Medusoids												
Polyps												
Gastropod larvae		400		188			265					
Gastropod eggs												
Tintinid												
Ostracoda												
Cladocera												
Podon sp.												
Evadne sp.												
Bivalvae larvae							265					
<i>Crassostrea virginica</i>												
<i>Mya arenaria</i>												
<i>Mercenaria mercenaria</i>												
<i>Modiolus demissus</i>												
<i>Mytilus edulis</i>												
TOTALS/SAMPLE	89053	201699	81917	95392	48081	12096	100909	221,792	124,992	99,479	523,410	98,062
GRAND TOTALS/STATION		372669			155569			447,693			720,951	

Table 4.10. Continued

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	12/15	12/26		12/15	12/26		12/15	12/26		12/15	12/26	
<i>Acartia tonsa</i>												
<i>Acartia clausi</i>	6,424	6,720	13,144	4,068	1,800	5,868	2,067	21,655	23,722	8,141	1,391	9,532
<i>Temora longicornis</i>												
<i>Eurytemora</i> sp.												
<i>Eurytemora herdmani</i>												
<i>Centropages typicus</i>												
<i>Centropages hamatus</i>				194		194						
<i>Paracalanus parvus</i>												
<i>Paracalanus</i> sp.										302		302
<i>Diaptomus</i> sp.												
<i>Labidocera acutifrons</i>												
<i>Calanus finmarchicus</i>												
<i>Tortanus</i> sp.												
<i>Tortanus discaudatus</i>												
<i>Harpacticus gracilis</i>												
<i>Harpacticus</i> sp.					300	300						
<i>Cyclopoida</i>												
<i>Oithona</i> sp.	1,314	840	2,154	1,162	750	1,912	1,272	305	1,577	452	116	568
Copepod unidentified												
Copepod nauplii	12,702	32,060	44,762	6,005	7050	13,055	7,632	35,685	43,317	12,663	8,691	21,354
Copepod immature	6,862	4,060	10,922	4,261	3,450	7,711	3,339	6,100	9,439	7,688	232	7,920
<i>Cirripedia</i> nauplii										151		151
<i>Cirripedia</i> cypris												
<i>Cirripedia</i> sp.												
<i>Malacostraca</i> nauplii												
<i>Malacostraca</i> immature												
Decapod larvae												
Echinoderm larvae												
Tunicate larvae												
Nematoda												
Polychaeta					150	150						
<i>Chaetognath</i>							159		159			
Medusoids												
Polyps												
Gastropod larvae												
Gastropod eggs												
Tintinid												
<i>Ostracoda</i>												
<i>Cladocera</i>												
<i>Podon</i> sp.												
<i>Evadne</i> sp.												
<i>Bivalvae</i> larvae												
<i>Crassostrea virginica</i>												
<i>Mya arenaria</i>												
<i>Mercenaria mercenaria</i>												
<i>Modiolus demissus</i>												
<i>Mytilus edulis</i>												
TOTALS/SAMPLE	27,302	43,680		15,690	13,500		14,469	63,745		29,397	10,430	
GRAND TOTALS/STATION		70,982			29,190			78,214			39,827	

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	1/10	1/23		1/10	1/23		1/10	1/23		1/10	1/23	
<i>Acartia tonsa</i>												
<i>Acartia clausi</i>	331	702	1033	807	1290	2097	546	890	1436	76	140	216
<i>Temora longicornis</i>		234	234	135		135						
<i>Eurytemora</i> sp.												
<i>Eurytemora herdmanni</i>												
<i>Centropages typicus</i>												
<i>Centropages hamatus</i>												
<i>Paracalanus parvus</i>												
<i>Paracalanus</i> sp.	55	293	348	269	968	1237		742	742	46	315	361
<i>Diaptomus</i> sp.												
<i>Labidocera acutifrons</i>												
<i>Calanus finmarchicus</i>												
<i>Tortanus</i> sp.												
<i>Tortanus discaudatus</i>	110	59	169		161	161					35	35
<i>Harpacticus gracilis</i>												
<i>Harpacticus</i> sp.	1325	1931	3256	1480	484	1964	756	2078	2834	107	1470	1577
Cyclopoida												
<i>Oithona</i> sp.	221	410	631	135	806	941	546	890	1436	214	455	669
Copepod unidentified												
Copepod nauplii	3256	4738	7994	4035	9030	13065	4326	12911	17237	1388	4095	5483
Copepod immature	993	936	1929	1211	1774	2985	672	1039	1711	275	910	1185
<i>Cirripedia nauplii</i>												
<i>Cirripedia cypris</i>												
<i>Cirripedia</i> sp.												
<i>Malacostraca nauplii</i>												
<i>Malacostraca immature</i>												
Decapod larvae												
Echinoderm larvae												
Tunicate larvae												
Nematoda				135		135						
Polychaeta		59	59	135		135	42		42			
<i>Chaetognatha</i>												
Medusoids												
Polyps												
Gastropod larvae											35	35
Gastropod eggs												
Tintinid												
Ostracoda												
Cladocera												
Podon sp.												
Evdne sp.												
Bivalvae larvae												
<i>Crassostrea virginica</i>												
<i>Mya arenaria</i>												
<i>Mercenaria mercenaria</i>												
<i>Modiolus demissus</i>												
<i>Mytilus edulis</i>												
TOTALS/SAMPLE	6291	9362		8342	14513		6888	18550		2106	7455	
GRAND TOTALS/STATION		15653			22855			25438			9561	

4.5 Ichthyoplankton

Nine species of fish eggs and seven species of fish larvae were identified from March - October, 1972. One species of egg and two species of larvae were re-identified during February and March, 1973 (Table 4.11). Eggs from the cod and wrasses families were also identified. Sand lance larvae was keyed to genus.

Cunner, Tautogolabrus adspersus, eggs were identified most frequently and observed from May through August. Sand lance, Ammodytes, dominated larval identifications and were sampled from March - May, 1972 and again in February and March 1973.

In general, concentrations of eggs and larvae were low and interpretation on species abundance was difficult (Table 4.12). The greatest diversity was observed in June; March and May ranked highest in diversity of larval species.

Neither juvenile, nor adult, American plaice, Hippoglossoides platessoides; haddock, Melanogrammus aeglefinus; rock gunnel, Pholis gunnellus; snake blenny, Lumpenus lumpretaeformis; witch flounder, Glyptocephalus cynoglossus; have been sampled in Salem Harbor. The lack of winter flounder eggs and larvae can be attributed to our sampling technique. Winter flounder eggs are demersal and larvae remain near the bottom after hatching, and are not taken in our sampling survey gear. Use of additional sampling methods (i.e., bongo net and bottom sled) when ichthyoplankton sampling resumes in March 1974 is under consideration.

Table 4.11. Occurrence of ichthyoplankton in Salem Harbor,
March 1972 - March 1973.

	1972								1973	
	Mar	Apr	May	June	July	Aug	Sept	Oct	Feb	Mar
American plaice			OX							
Atlantic herring							X			
Atlantic mackerel				O						
cod (family)	O		O							O
cunner			OX	O	O	OX				
haddock		O								O
longhorn sculpin	X	X							X	X
pollock				O						
rock gunnel	X									
sand lance (genus)	X	X	X						X	X
snake blenny			X	X	X					
tautog			O	O	O					
windowpane				O	O	O		O		
witch flounder		O		O						
wrasses (family)				O						
yellowtail flounder	X			OX	OX					

O - eggs
X - larvae

Table 4.12. Ichthyoplankton (organisms/m³) collected in Salem Harbor, March - October, 1972 and February - March, 1973.

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	3/23			3/23			3/23			3/23		
Tautoglabrus adspereus												
Limanda ferruginea				.03		.03						
Tautoga onitis												
Scophthalmus aquosus												
Glyptocephalus cynoglossus												
Scomber scombrus												
Gadidae				(.03)		(.03)						
Pollachius virens												
Labridae												
Melanogrammus aeglefinus												
Lumpenus lumpetiaeformis												
Pholis gunnellus										.04		.04
Ammodytes				.2		.2				.1		.1
Myxocephalus octodecemspinosus										.3		.3
Hippoglossoides platessoides												
Clupea harengus												
Unidentified												
TOTALS / SAMPLE				(.03)	.23					.44		
GRAND TOTALS / STATION				(.03)	.23					.44		

○ = FISH EGGS

Table 4.12. Continued

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	4/5	4/19		4/5	4/19		4/5	4/19		4/5	4/19	
<i>Tautoglabrus adspersus</i>												
<i>Limanda ferruginea</i>												
<i>Tautoga onitis</i>												
<i>Scophthalmus aquosus</i>												
<i>Glyptocephalus cynoglossus</i>							(.02)		(.02)			
<i>Scomber scombrus</i>												
Gadidae												
<i>Pollachius virens</i>												
Labridae												
<i>Melanogrammus aeglefinus</i>				(.04)		(.04)						
<i>Lumpenus lumpretaeformis</i>												
<i>Pholis gunnellus</i>												
<i>Ammodytes</i>								.2		.1	.3	.4
<i>Myxocephalus octodecemspinosus</i>				.04		.04				.03		.03
<i>Hippoglossoides platessoides</i>												
<i>Clupea harengus</i>												
Undentified		.6										
TOTALS / SAMPLE		.6		(.04)	.04		(.02)	.2		.13	.3	
GRAND TOTALS / STATION		.6		(.04)	.04		(.02)	.2			.4	.3

○ = FISH EGGS

Table 4.12. Continued

4.110

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	5/5	5/17		5/5	5/17		5/5	5/17		5/5	5/17	
<i>Tautogolabrus adspersus</i>	.1		.1	1.0	4.6	1.0 4.6		.04	.04		.1	.1
<i>Limanda ferruginea</i>												
<i>Tautoga onitis</i>	.02		.02									
<i>Scophthalmus aquosus</i>												
<i>Glyptocephalus cynoglossus</i>												
<i>Scomber scombrus</i>												
Gadidae											.1	.1
<i>Pollachius virens</i>												
Labridae												
<i>Melanogrammus aeglefinus</i>												
<i>Lumpenus lumpretaeformis</i>								.1	.1	.1	.1	.2
<i>Pholis gunnellus</i>												
<i>Ammodytes</i>	.1		.1									
<i>Myxocephalus octodecemspinosus</i>												
<i>Hippoglossoides platessoides</i>	.1 1		.1 .1	.1	.1		.04 .02			.1		.1
<i>Clupea harengus</i>												
Unidentified	.1		.1	.1		.1	.02		.02			
TOTALS / SAMPLE	.32 .3			1.2	4.7		.04 .04	.04 .1		.1 1	.2 .1	
GRAND TOTALS / STATION		.32 .3		1.2	4.7		.08 .14			.3	.2	

○ = Fish Eggs

Table 4.12. Continued

STATIONS	A			B			C			D		
	6/1	6/14	6/28	6/1	6/14	6/28	6/1	6/14	6/28	6/1	6/14	6/28
<i>Tautoglabrus adspersus</i>	.5	.6	3.2	3.6	1.3					.3	3.4	
<i>Limanda ferruginea</i>		.6	.3		.06					.2	5.2	.05
<i>Tautoga onitis</i>	.1		.5		.1					.03		
<i>Scophthalmus aquosus</i>	.3				.2						.3	
<i>Glyptocephalus cynoglossus</i>		.04		.08	.06							
<i>Scomber scombrus</i>					.02							
Gadidae												
<i>Pollachius virens</i>		.08										
Labridae				.08			.08					
<i>Melanogrammus aeglefinus</i>						no data			no data			
<i>Lumpenus lumpetæformis</i>										.1		
<i>Pholis gunnellus</i>												
<i>Ammodytes</i>												
<i>Myxocephalus octodecemspinosus</i>												
<i>Hippoglossoides platessoides</i>												
<i>Clupea harengus</i>												
Unidentified												
TOTALS / SAMPLE	.9	1.32	4.0	3.76	1.74		.08			5.3	.1	8.9 .05
GRAND TOTALS / STATION		6.22			5.48		.08				14.2	.15

○ = FISH EGGS

Table 4.12. Continued

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	7/12	7/26		7/12	7/26		7/12	7/26		7/12	7/26	
<i>Tautoglabrus adspersus</i>	(15.2)		(152)	(2.3)	(.3)	(2.6)	(1.7)	(.03)	(173)	(2.6)		(26)
<i>Limanda ferruginea</i>	(11.8)		(118)	(.2)	(.04)	(24)	(1.8)	(.1 .03)	(1.9 .03)			
<i>Tautoga onitis</i>	(.9)		(9)				(.1)		(.1)			
<i>Scophthalmus aquosus</i>	(.3)		(.3)									
<i>Glyptocephalus cynoglossus</i>												
<i>Scomber scombrus</i>												
Gadidae												
<i>Pollachius virens</i>												
Labridae												
<i>Melanogrammus aeglefinus</i>												
<i>Lumpenus lumpretaeformis</i>										.1		.1
<i>Pholis gunnellus</i>												
<i>Ammodytes</i>												
<i>Myxocephalus octodecemspinosus</i>												
<i>Hippoglossoides platessoides</i>												
<i>Clupea harengus</i>												
Unidentified					.3							
TOTALS / SAMPLE	(28.2)			(2.5)	(.34)	.3	(3.6)	(.13)	.03	(2.6)	.1	
GRAND TOTALS / STATION		(282)		(284)	.3		(373)	.03		(2.6)	.1	

○ = FISH EGGS

Table 4.12. Continued

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	8/10	8/23		8/10	8/23		8/10	8/23		8/10	8/23	
<i>Tautoglabrus adspersus</i>								(.06)	(.06)		(.06)	(.06)
<i>Limanda ferruginea</i>												
<i>Tautoga onitis</i>												
<i>Scophthalmus aquosus</i>							(.06)		(.06)			
<i>Glyptocephalus cynoglossus</i>												
<i>Scomber scombrus</i>												
Gadidae												
<i>Pollachius virens</i>												
Labridae												
<i>Melanogrammus aeglefinus</i>												
<i>Lumpenus lumpretaeformis</i>												
<i>Pholis gunnellus</i>												
<i>Ammodytes</i>												
<i>Myoxocephalus octodecemspinosus</i>												
<i>Hippoglossoides platessoides</i>												
<i>Clupea harengus</i>												
Unidentified												
TOTALS / SAMPLE							(.06)	(.06)			(.06)	(.06)
GRAND TOTALS / STATION								(.12)			(.06)	(.06)

○ = FISH EGGS

Table 4.12. Continued

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	9/6	9/20		9/6	9/20		9/6	9/20		9/6	9/20	
Tautoglabrus adspersus												
Limanda ferruginea												
Tautoga onitis												
Scophthalmus aquosus												
Glyptocephalus cynoglossus												
Scomber scombrus												
Gadidae												
Pollachius virens												
Labridae												
Melanogrammus aeglefinus												
Lumpenus lumpretaeformis												
Pholis gunnellus												
Ammodytes												
Myxocephalus octodecemspinosus												
Hippoglossoides platessoides												
Clupea harengus					.02	.02						
• Unidentified												
TOTALS / SAMPLE					.02							
GRAND TOTALS / STATION					.02							

 = FISH EGGS

Table 4.12. Continued

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	10/5			10/5			10/5			10/5		
Tautoglabrus adspersus												
Limanda ferruginea												
Tautoga onitis												
Scophthalmus aquosus	(.09)		(.09)									
Glyptocephalus cynoglossus												
Scomber scombrus												
Gadidae												
Pollachius virens												
Labridae												
Melanogrammus aeglefinus												
Lumpenus lumpretaeformis												
Pholis gunnellus												
Ammodytes												
Myxocephalus octodecemspinosus												
Hippoglossoides platessoides												
Clupea harengus												
Unidentified												
TOTALS / SAMPLE	(.09)											
GRAND TOTALS / STATION		(.09)										

○ = FISH EGGS

Table 4.12. Continued

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	2/21/73			2/21/73			2/21/73			2/21/73		
<i>Tautopolabrus adspersus</i>												
<i>Limanda ferruginea</i>												
<i>Tautoga onitis</i>												
<i>Scoenothalmus aquosus</i>												
<i>Glyptocephalus cynoglossus</i>												
<i>Scomber scombrus</i>												
Gadidae												
<i>Pollachius virens</i>												
Labridae												
<i>Melanogrammus aeglefinus</i>												
<i>Lumpenus lumorettaeformis</i>												
<i>Pholis gunnellus</i>												
<i>Ammodytes</i>	1		1	2		2	1		1			
<i>Myoxocephalus octodecemspinosus</i>				1		1						
<i>Hippoglossoides platessoides</i>												
<i>Clupea harengus</i>												
Unidentified												
TOTALS / SAMPLE	1			3			1					
GRAND TOTALS / STATION	1			3			1					

 = FISH EGGS

Table 4.12. Continued

4.117

STATIONS	A			B			C			D		
			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES			TOTAL PER SPECIES
	3/7,8/73	3/19/73		3/7,8/73	3/19/73		3/7,8/73	3/19/73		3/7,8/73	3/19/73	
<i>Tautoglabrus adspersus</i>												
<i>Limanda ferruginea</i>												
<i>Tautoga onitis</i>												
<i>Scoenthalmus aequosus</i>												
<i>Glyptocephalus cynoglossus</i>												
<i>Scomber scombrus</i>												
Gadidae							①		①	①		①
<i>Pollachius virens</i>												
Labridae												
<i>Melanogrammus aeglefinus</i>		①	①									
<i>Lumpenus lumorettaeformis</i>												
<i>Pholis gunnellus</i>												
<i>Ammodytes</i>	4		4									
<i>Myoxocephalus octodecemspinosus</i>	4		4									
<i>Hippoglossoides platessoides</i>		①	①									
<i>Clupea harengus</i>												
Unidentified				1								
TOTALS / SAMPLE	8	②		1			①			①		
GRAND TOTALS / STATION		8 ②			1			①			①	

○ = FISH EGGS

4.6 Finfish

Atlantic silverside, Menidia menidia; winter flounder, Pseudopleuronectes americanus; and mummichog, Fundulus heteroclitus, dominated finfish collections in Salem Harbor and comprised 45, 22 and 17% of the total catch, respectively (Table 4.13).

Of 9,439 silversides collected, 88% were sampled by 50-ft seine; 9% by 120-ft seine; 3% by 30-ft trawl; and <1% by mid-water trawl.

Winter flounder were taken with all types of sampling gear, but the majority (80%) were captured with the 49-ft trawl (Table 4.14). Mummichogs were taken only at shore stations (Table 4.16). A school of juvenile blueback herring, Alosa aestivalis, sampled on September 24, dominated catches by 120-ft seine (Table 4.17). Sticklebacks--fourspine, Apeltes quadracus; threespine, Gasterosteus aculeatus; and ninespine, Pungitius pungitius--dominated catches by 30-ft trawl (Table 4.18), particularly at Station 14 where extensive growth of eel grass, Zostera marina, exists subtidally. Atlantic menhaden, Brevoortia tyrannus, were taken only by gill net and were the dominant species captured with this gear (Table 4.15).

Finfish data was supplemented on 12 September by sampling at night with the 120-ft seine. Atlantic silverside dominated catches at Stations 13 and 15 (2,224 and 1,918, respectively). Less abundant species included winter flounder and mummichogs.

Length frequency histograms for the most abundant finfish species sampled are displayed in Figure 4.6. Species diversity was greatest at the 30-ft trawl stations (Table 4.19).

Table 4.13. Rank of finfish collected in Salem Harbor, July - September, 1973.

Species	Method of Capture						Totals
	50-ft Seine	120-ft Seine	30-ft Trawl	Mid-water Trawl	49-ft Trawl	Gill Net	
1. Atlantic silverside	8,324	840	253	22			9,439
2. winter flounder	21	517	284	7	3,638	93	4,560
3. mummichog	3,305	219	1				3,525
4. blueback herring		879		1			880
5. fourspine stickleback		1	765	7			773
6. threespine stickleback			397	1			398
7. ninespine stickleback		1	318	4			323
8. Atlantic tomcod		1	207	6			214
9. striped killifish	136	29					165
10. Atlantic menhaden						142	142
11. skate*			1		113	4	118
12. rainbow smelt			68	1	1	18	88
13. northern pipefish	1		82				83
14. Atlantic cod			1			62	63
15. windowpane			1		44		45
16. cunner			33	1			34
17. Atlantic herring			31				31
18. American eel		5	19	4			28
19. Atlantic mackerel						24	24
20. pollock						23	23
21. white hake		1	12		2		15
22. striped bass		1			1	10	12
23. grubby			6				6
24. lumpfish			2				2
25. shorthorn sculpin			1				1
Totals	11,787	2,494	2,195	54	3,799	359	20,992

* Not separated by species.

Table 4.14. Dominant finfish species collected in Salem Harbor with the 49-ft trawl, July - September, 1973.

winter flounder (<u>Pseudopleuronectes americanus</u>)				
Date	Set No.	Total Collected	Size Range (mm)	Mean (mm)
<u>Station 16</u>				
7/11	1	285	195-459	283
8/7	1	384	195-414	279
8/21	1	609	210-434	283
	2	644	205-454	274
9/12	1	672	225-479	287
	2	602	210-499	286
9/25	1	840	205-499	302
	2	738	185-459	287

Table 4.15. Dominant finfish species collected in Salem Harbor with gill nets, July - September, 1973.

Atlantic menhaden (<u>Brevoortia tyrannus</u>)			
Date	Total Collected	Size Range (mm)	Mean (mm)
<u>Station 20</u>			
7/30	13	280-384	341
8/13	23	335-414	379
9/13	31	305-394	360
<u>Station 21</u>			
9/13	75	300-399	356

Table 4.16. Dominant finfish species collected in Salem Harbor with the 50-ft seine, July - September, 1973.

Atlantic silverside (<u>Menidia menidia</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>							
7/13	1	54	10-54	33	11	15-34	23
	2	15	15-44	22	14	15-29	21
7/25	1	408	15-79	30	157	15-74	28
	2	2,780	15-59	30	12	15-44	29
8/6	1	3,160	20-64	34	724	15-89	32
8/21	1	232	25-69	47	84	25-59	42
	2	628	30-74	43	6	30-39	35
9/5	1	5	45-79	55	174	25-89	49
	2	2	50-59	55	23	30-54	40
9/25	1				15	25-44	36
	2	1	-	62	2	-	37
<u>Station 13</u>							
7/13	1	9	15-29	20	322	20-59	30
	2				850	15-44	30
7/25	1	174	25-84	49	31	30-104	74
	2	3	15-49	35	8	30-79	57
8/6	1	165	10-69	40	182	15-94	47
	2	46	15-69	44	35	25-84	54
8/21	1	303	25-149	77	12	25-54	36
	2	1	-	52	32	30-69	45
9/5	1	16	45-149	91	2	55-59	57
	2	33	35-89	60	61	30-74	45
9/25	1	12	60-104	77	1	-	52
	2				9	35-54	46
<u>Station 15</u>							
7/13	1				12	20-89	51
	2				14	15-29	26
7/25	1	103	10-64	24	406	20-44	30
	2	28	10-24	19	22	25-39	31
8/6	1	74	15-79	36	29	30-64	41
	2	45	15-54	29	26	25-49	39
8/21	1	1	-	32	2	27-44	35
	2				5	40-64	50
9/5	1	6	35-59	46			
	2	7	45-69	59	1	-	52
9/25	2	13	60-94	75			

Table 4.17. Dominant finfish species collected in Salem Harbor
with the 120-ft seine, July - September, 1973.

blueback herring (<u>Alosa aestivalis</u>)					Atlantic silverside (<u>Menidia menidia</u>)			winter flounder (<u>Pseudopleuronectes americanus</u>)		
Date	Set No.	Total Collected	Size Range (mm)	Mean (mm)	Total Collected	Size Range (mm)	Mean (mm)	Total Collected	Size Range (mm)	Mean (mm)
<u>Station 11</u>										
7/12	1				3	25-39	29	17	30-49	40
	2				36	25-44	35	30	25-59	37
7/26	1				253	15-124	35	28	30-124	53
	2				44	25-49	35	26	25-49	39
8/7	1				59	20-39	31	15	25-154	56
	2				200	20-74	35	18	30-174	68
8/24	1							5	30-124	62
	2				4	35-64	46	16	35-64	52
9/10	1				1	-	122	9	40-69	52
	2							1	-	67
9/24	1	5	70-84	75	2	50-64	60	20	40-64	54
	2							27	35-74	51
<u>Station 13</u>										
7/12	1				6	110-149	123			
	2				3	105-144	120	6	30-154	78
7/26	1				23	105-134	118	7	30-149	68
	2				1	-	122	5	30-179	69
8/7	1				118	15-74	48	8	30-174	74
	2				4	40-54	48	10	30-59	42
8/24	1							15	30-69	52
	2				1	-	42	36	35-65	53
9/10	1				30	70-159	87	4	50-89	63
	2				7	65-144	86	44	40-74	51
9/24	1	870	45-179	83	3	65-129	102	6	45-64	54
	2	3	45-84	62	2	60-74	67	11	50-79	66

Table 4.17. Continued

blueback herring (<u>Alosa aestivalis</u>)					Atlantic silverside (<u>Menidia menidia</u>)			winter flounder (<u>Pseudopleuronectes americanus</u>)		
Date	Set No.	Total Collected	Size Range (mm)	Mean (mm)	Total Collected	Size Range (mm)	Mean (mm)	Total Collected	Size Range (mm)	Mean (mm)
<u>Station 15</u>										
7/12	1							14	30-159	83
7/26	1							39	25-134	49
	2				2	15-34	24	10	35-59	44
8/7	1				2	120-154	137	1	-	47
	2							5	35-54	43
8/24	1				6	60-134	111	32	35-99	62
	2				1	-	132	17	40-84	55
9/10	1				9	45-134	72	10	45-99	76
	2				14	55-94	78	4	50-94	74
9/24	1	1	-	47	6	60-114	82	11	50-94	74
	2							10	50-169	78

Table 4.18. Dominant finfish species collected in Salem Harbor
with the 30-ft trawl, July - September, 1973.

fourspine stickleback (<u>Apeltes quadracus</u>)					threespine stickleback (<u>Gasterosteus aculeatus</u>)			ninespine stickleback (<u>Pungitius pungitius</u>)		
Date	Set No.	Total Collected	Size Range (mm)	Mean (mm)	Total Collected	Size Range (mm)	Mean (mm)	Total Collected	Size Range (mm)	Mean (mm)
Station 12										
7/12	1	4	40-59	48	1	-	62	4	40-54	46
	2	3	40-54	45	5	25-74	38	1	-	42
7/27	1	2	35-44	40						
	2	7	25-54	42	6	30-74	51	3	40-54	47
8/27	1	13	25-59	52	1	-	37	3	45-64	55
	2	9	30-59	40	16	20-49	35	3	50-64	59
9/13	1	15	30-49	37	8	30-49	37	2	50-64	57
	2	2	25-34	30						
9/27	1	1	-	47	20	30-54	42	1	-	67
	2	12	25-54	39	5	30-49	41			
Station 14										
7/12	1	14	35-59	48	8	40-74	63	13	30-69	46
	2	67	35-64	50	21	25-74	60	40	35-69	47
7/27	1	62	20-64	42	29	20-74	51	73	30-69	48
	2	2	40-49	44	2	30-34	32	1	-	52
8/13	1	253	20-59	38	41	20-69	40	26	45-69	54
	2	39	30-54	39	1	-	32	1	-	52
8/27	1	96	20-59	37	167	20-79	34	80	45-74	55
	2	105	20-59	38	37	20-74	38	48	40-74	52
9/13	1	34	20-59	37	32	20-44	34	18	50-69	56
9/27	1	24	30-59	44	14	25-54	41	1	-	57

Figure 4.6. Length frequency histograms for dominant finfish species collected in Salem Harbor, July - September, 1973.

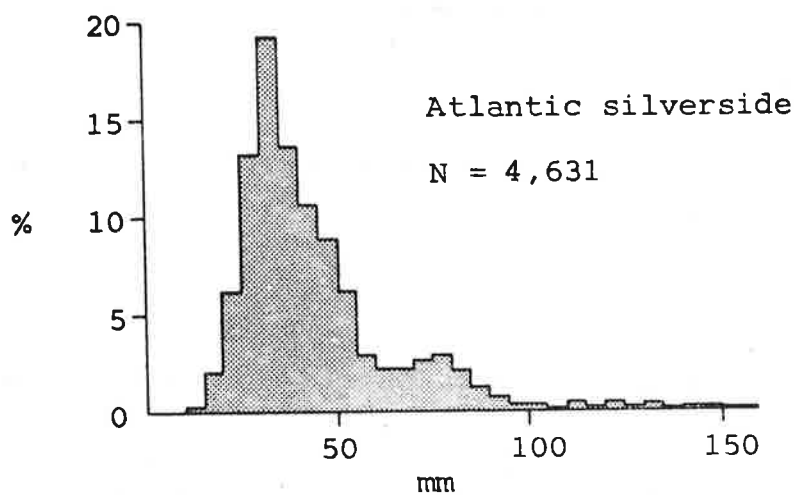
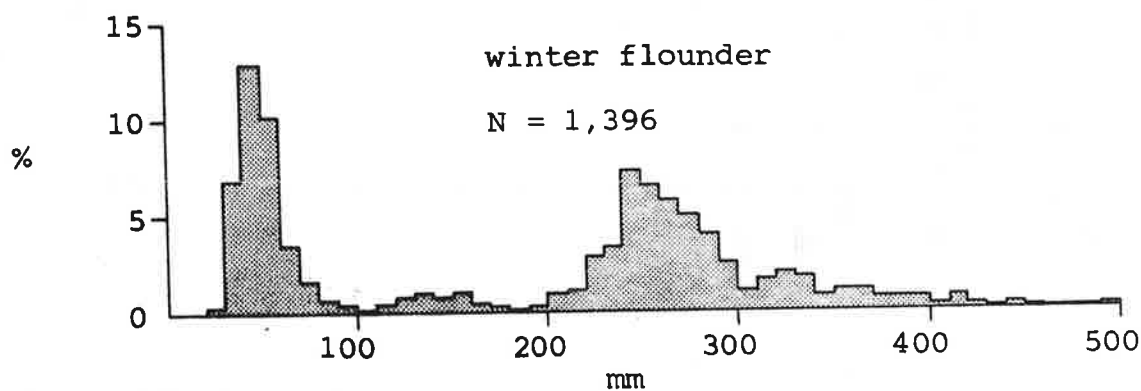
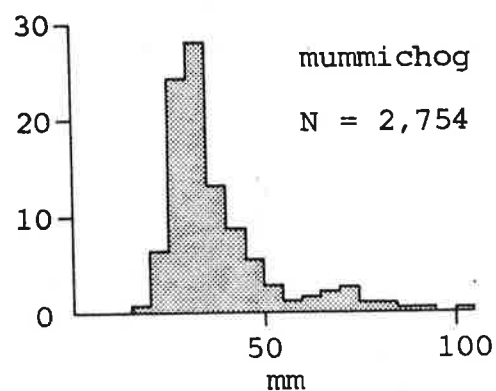
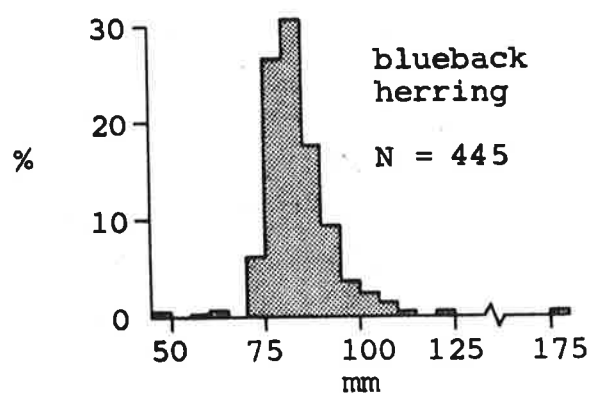


Table 4.19. Diversification index of finfish species by method of capture, Salem Harbor, July - September, 1973.

Date	50-ft Seine	120-ft Seine	30-ft Trawl	Midwater Trawl	49-ft Trawl	Gill Net
7/11					4	
7/12		6		2		
7/13	3		14			
7/25	3		11			
7/26		3				
7/27				6		
7/30						8
8/6	4					
8/7		5			3	
8/13			12	5		6
8/21	4				3	
8/24		4				
8/27			12	3		
9/5	4					
9/10		4				
9/12					3	
9/13			7	3		6
9/24		6				
9/25	4				6	
9/27			9	4		

Large schools of adult menhaden and juvenile blueback herring were frequently observed in Salem Harbor during the quarter. Occasionally, commercial purse seining operations for menhaden were seen within the Harbor.

Winter flounder constituted 90% of finfish catches outside Salem Harbor (Table 4.20). Two fourspot flounders, Paralichthys oblongus, collected at Station 5 brought our species checklist to 52.

Quarterly Report No. 9 will include detailed catch/effort and length statistics for 1965 and 1971 - 1973. 1973 sport finfish data will also be summarized.

Table 4.20. Rank of finfish collected outside Salem Harbor with the 49-ft trawl, July - September, 1973.

Species	Totals
1. winter flounder	2,373
2. yellowtail flounder	115
3. windowpane	101
4. goosefish	10
5. Atlantic cod	5
silver hake	5
skate*	5
6. sea raven	4
7. ocean pout	3
8. fourspot flounder	2
9. red hake	1
white hake	1
Total	2,625

*Not separated by species.

4.7 Entrainment

Power plant traveling screens continue to exhibit only minimal impact upon finfish populations in Salem Harbor. Random monitoring was conducted for 55 hours at Unit 3, and for 32 hours at Unit 4 intake travel screens (Table 4.21).

Of 17 finfish sampled (6 species), 82% were collected from Unit 3 and 18% were taken from Unit 4 cooling waters. Juvenile winter flounder were most common (47%) and were captured only during September. Mortality totaled 35% of finfish entrained.

Unit 4 shut down September 9 for annual maintenance and is expected to resume generation about December 1.

4.8 Bioassays

Upper thermal tolerance bioassays were continued. Procedures are being refined for determining lethal residual chlorine levels. Finfish are being retained for winter experiments on lower thermal tolerance limits.

Table 4.21. Finfish species collected in the Unit 3 and 4
sluiceways, Salem Harbor, July - September, 1973.

Species	Tidal Stage (Hrs)	7/3	7/4	7/6	7/6	7/9	7/9	7/17	7/19	7/20	7/26	TOTALS*
		(EST)										
		1000 1200	1200 1400	0800 1000	1000 1200	0500 0700	0700 0800	0600 0800	1200 1400	1000 1200	0600 0800	
		L+4	L+5	H+5½	L+1½	H	H+1	L+½	L+5½	L+3	L+5	
northern pipefish		1		<u>Unit 3</u>		1						2 (1)
northern pipefish				<u>Unit 4</u>				1				1 (1)
threespine stickleback								1				1

Table 4.21. Continued

Species	(EST) Tidal Stage (Hrs)	8/2	8/6	8/8	8/16	8/17	8/20	8/20	8/24	8/27	8/29	8/31	TOTALS*
		1200	0800	0800	1000	0700	1200	1400	0800	0800	0600	1000	
		1400	1000	1000	1200	0900	1400	1600	1000	1000	0800	1200	
		L+5½	H+4½	H+2½	L+4½	L+1	L+4	L+5½	H+2	L+5	L+½	L+4	
blueback herring										1			1
threespine stickleback		1											1 (1)

Table 4.21. Continued

Species	Tidal Stage (Hrs)	(EST)	9/3	9/10	9/11	9/12	9/17	9/20	9/25	TOTALS*
			1000 1200	1200 1400	0600 0800	0800 1000	1200 1400	0800 1000	1200 1400	
			L+1½	H+3½	L+3	L+4½	L+5	H+4	H+3	
<u>Unit 3</u>										
Atlantic silverside						1				1 (1)
grubby						1				1
northern pipefish						1				1 (1)
winter flounder				1		2	2		3	8 (1)

*Number of dead finfish shown in parenthesis.

4.9 Lobsters

Tagging was completed for 1973. Tags from 1972 and 1973 releases continue to be returned.

To supplement tagging data, 1963 - 1965 and 1968 - 1972 effort and harvest statistics for Beverly - Salem Harbors were compiled from annual reports on file with the Division of Marine Fisheries. Table 4.22 lists statistics for the three groupings of lobster fishermen; commercial, casual, and other. Figure 4.7 displays combined statistics since 1968.

Statistically, total pots fished is a better indicator of fishing pressure than number of individuals active in the fishery. Thus, the 14,542 pots fished during 1972 represents a decrease of 9% (1,447 pots) from the 1968 effort. This decrease was accompanied by an 18% (72,781 lobsters) reduction in harvest and a 14% (65,854 lbs) decrease in weight of lobsters landed. Despite reductions in effort and harvest, a 20% (\$80,420) increase was realized in wholesale value over the 5-year period.

Review of commercial landings reveals that average annual harvest/pot decreased significantly: 1963, 44.2 lbs; 1964, 47.5 lbs; 1965, 34.7 lbs; 1968, 30.5 lbs; 1969, 28.5 lbs; 1970, 30.5 lbs; 1971, 30.0 lbs; and 1972, 29.9 lbs.

The average weight of individual lobsters harvested in 1972 (1.16 lbs) approximates findings of Jerome, et al (1967), indicating that most lobsters are harvested soon after reaching legal size (3-3/16" carapace length). No correlation has been

Table 4.22. Lobster effort and harvest statistics for
Beverly - Salem Harbors, 1963 - 1965 and
1968 - 1972.

	No. of Fishermen	No. of Pots	No. Harvested	Pounds Harvested	Value of Harvest * (dollars)
COMMERCIAL **					
1972	47	11,470	295,663	342,432	419,236
1971	51	12,597	332,684	378,132	436,437
1970	70	11,970	303,272	365,161	393,430
1969	75	12,187	316,517	347,485	342,516
1968	83	13,115	363,084	399,607	348,233
1965	45	8,415	263,451	292,337	244,303
1964	47	7,550	290,448	358,867	224,695
1963	37	4,817	170,146	212,978	125,123
CASUAL					
1972	58	1,885	22,997	26,633	32,704
1971	36	1,780	22,181	25,507	29,333
1970	76	2,135	25,677	28,770	31,072
1969	79	1,979	29,189	32,315	31,878
1968	99	2,073	34,184	41,096	35,754
OTHER					
1972	264	1,187	16,894	21,243	25,916
1971	407	1,465	19,997	25,108	28,874
1970	385	1,862	25,745	35,286	38,109
1969	332	1,501	22,886	29,962	29,662
1968	225	801	11,067	15,459	13,449

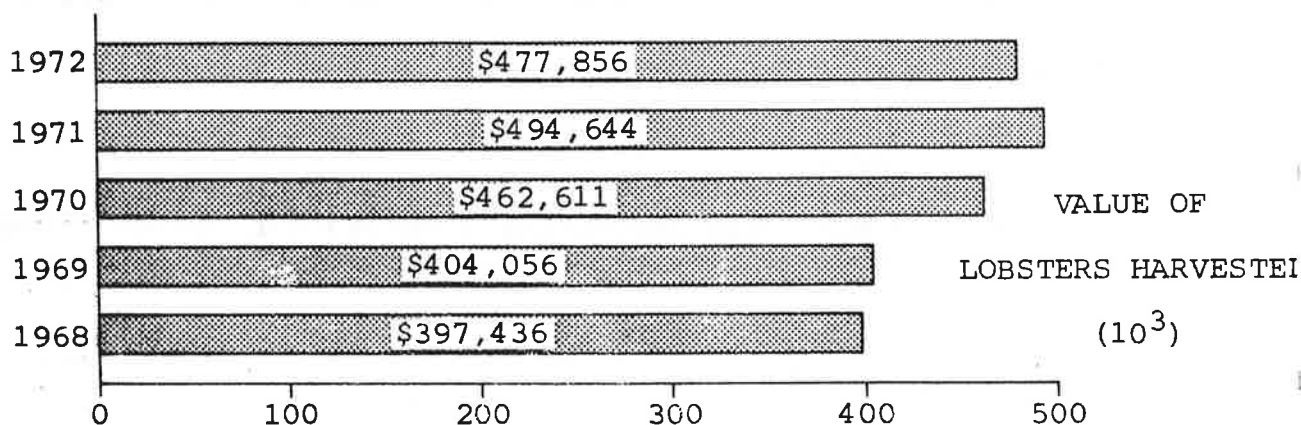
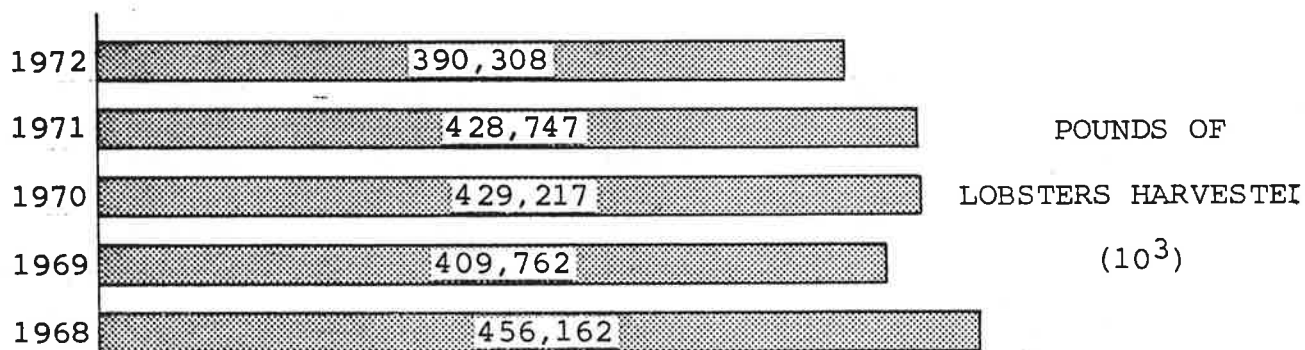
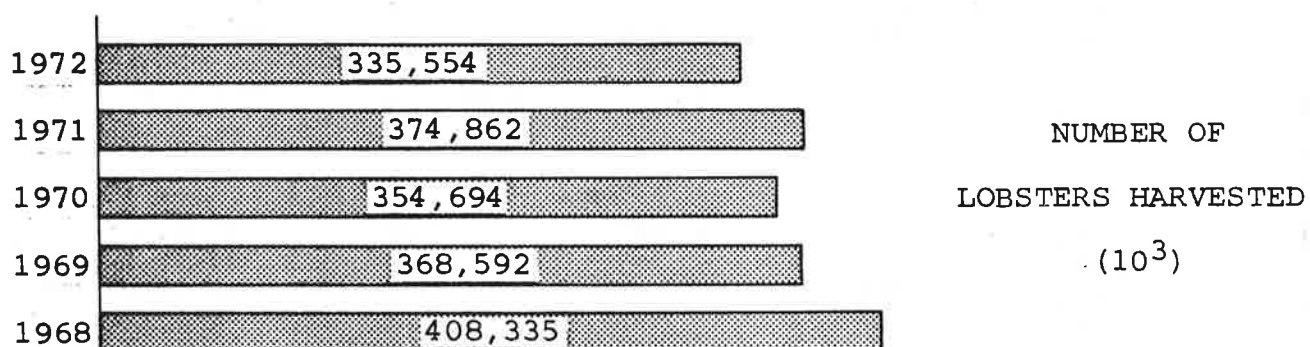
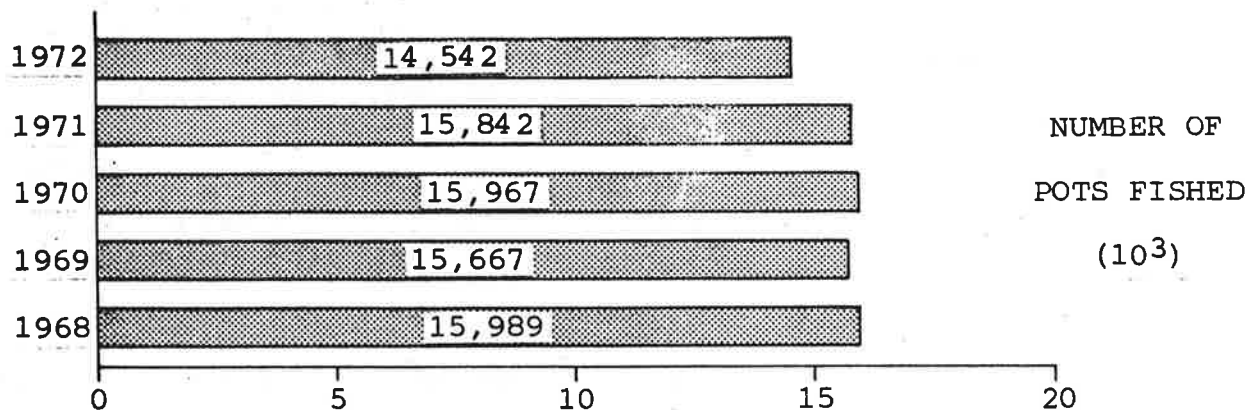
* Based on the average wholesale price/lb. to the commercial fishermen
(1972 - \$1.22; 1971 - \$1.15; 1970 - \$1.08; 1969 - \$0.99;
1968 - \$0.87; 1965 - \$0.84; 1964 - \$0.63; 1963 - \$0.59)

** Commercial - full-time fishermen, usually fishing >100 pots;

Casual - part-time fishermen, usually fishing >25 but <100
pots;

Other - individuals harvesting lobsters for personal use,
usually fishing <25 pots and/or using SCUBA.

Figure 4.7. Lobster effort and harvest statistics for
Beverly - Salem Harbors, 1968 - 1972.



drawn to suggest that power plant operation influenced the lobster harvest in the Beverly and Salem Harbors. Ichthyoplankton sampling has failed to show presence of lobster larvae in Salem Harbor.

4.10 Marine Vegetation

A list of marine algae and vascular plants collected in Salem Harbor during late summer is presented in Table 4.23. This checklist is supplemental to project sampling and should be considered incomplete and preliminary. Periodic updating will be performed as time permits.

Seventeen species have been identified, including 5 green algae; 5 brown algae; 5 red algae; and 2 vascular plants. Salem Harbor is devoid of salt marsh acreage with the exception of small patches at Cat Cove, Naugus Head and Forest River.

Eel grass, Zostera marina, once considered an endangered species on the North Shore, thrives in shallow waters south of Cat Cove, southeast of Pickering Point, northeast of Derby Wharf, and west of Folger Point.

Mats of rock weed (Ascophyllum sp. and Fucus sp.) characterize the rock and ledge shoreline of Salem Harbor.

Green and red algae are commonly found washed upon shore sampling stations, while species of each classification have been collected in the power plant intake sluiceways. Sea lettuce, Ulva lactuca, poses severe problems to plant operations, particularly following hours of onshore winds.

Table 4.23. Marine vegetation collected in Salem Harbor.*

Scientific Name	Common Name
ALGAE	
Class: CHLOROPHYCEAE	
<u>Enteromorpha erecta</u>	
<u>Enteromorpha</u> sp.	
<u>Ulva lactuca</u>	sea lettuce
<u>Chaetomorpha linum</u>	
<u>Rhizoclonium</u> sp.	
Class: PHAEOPHYCEAE	
<u>Ectocarpus tomentosus</u>	
<u>Elachistea fucicola</u>	
<u>Laminaria</u> sp.	kelp
<u>Ascophyllum nodosum</u>	rock weed
<u>Fucus vesiculosus</u>	rock weed
Class: RHODOPHYCEAE	
<u>Goniotrichum alsidii</u>	
<u>Hildenbrandia</u> sp.	
<u>Chondrus crispus</u>	Irish moss
<u>Ceramium</u> sp.	
<u>Polysiphonia harveyi</u> v. <u>olneyi</u>	
VASCULAR PLANTS	
<u>Spartina alterniflora</u>	salt water cord grass
<u>Zostera marina</u>	eel grass

* As identified by Taylor (1969)

5.0 SUMMARY

Physical and biological surveys were intensified. Current patterns in Salem Harbor generally conformed to inflow and outflow of water at various tidal stages. Current velocities ranged to 1.1 knots. Winds ranging from 8 - 10 mph imposed influence on current direction. Current direction at the discharge was generally southerly regardless of tidal stage and wind influence.

Average surface water temperature for the quarter rose to 18.5°C, approximating the July - September 1972 mean of 18.0°C. Minimal temperature variation was noted among Stations A, C and D. Sharp temperature reductions at all stations was directly related to sharply reduced air temperatures.

Bi-weekly monitoring of the plant intake basin (2 ft below surface) terminated following fulfillment of EPA permit requirements. Lower minimum water temperatures were recorded at -8' MLW in the intake basin.

As expected, thermal effects penetrate further into Salem Harbor at high tide, and push seaward at low tide. On two succeeding days, when intake water temperature was 20°C, thermal discharge was reduced to 19°C before reaching the Marblehead shore, approximately 3/4 mile from the plant discharge. Thermoclines existed at all deep water stations.

In general, thermal effects prevail horizontally to 2,400 ft from the discharge and vertically to 6 ft. Homogeneous

temperatures and salinities were recorded throughout the water column in the discharge canal. Generation at the Salem Harbor Station was reduced on several days when discharge water temperatures exceeded the 90°F thermal limitation prescribed in the operation permit. No visible adverse effects were noted during, or after, each incident.

Bi-weekly ^{14}C and ATP sampling was initiated in conjunction with plankton surveys.

Chlorophyll a levels decreased from the previous quarter and corresponded to ^{14}C values. Primary production was cyclic, with assimilation minimal on 7 September. Recordings on 20 September indicated occurrence of a fall phytoplankton bloom within the Harbor.

Measurements of ATP showed evidence of 100% phytoplankton mortality within the Unit 4 discharge water box. ATP levels recover stature approximately 600 ft from the discharge, and peaked approximately 3,600 ft from the power plant.

Nine families of phytoplankton have been identified. Dominant families were Coscinodiscaceae, Chaetoceraceae, Fragilariaceae, and Leptocylindraceae.

Twenty-four species, and nine developmental stages of zooplankton have been identified. Acartia clausi, copepod nauplii, copepod immature, Cirripedia nauplii, and polychaeta were most frequently observed. Copepod nauplii, copepod immature, Acartia clausi and Eurytemora herdmani were most abundant.

6.0 APPENDIX

6.1

7.0 LITERATURE CITED

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Project expenditures as of September 30, 1973 were:

	<u>Total Allotted</u>	<u>Total Expended</u>	<u>Balance</u>
Salaries	\$107,800.00	\$ 99,943.87	\$ 7,856.13
Travel	3,375.00	1,394.50	1,980.50
Office & Laboratory Supplies	8,875.00	4,912.45	3,962.55
Equipment	23,500.00	19,417.31	4,082.69
Maintenance	6,100.00	2,638.02	3,461.98
Overhead	<u>39,920.00</u>	<u>19,543.09</u>	<u>20,376.91</u>
Subtotal	\$189,570.00	\$147,849.24	\$41,720.76
Contracts	<u>79,280.00</u>	<u>24,600.00</u>	<u>54,680.00</u>
TOTAL	<u>\$268,850.00</u>	<u>\$172,449.24</u>	<u>\$96,400.76</u>

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 sphyron 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).