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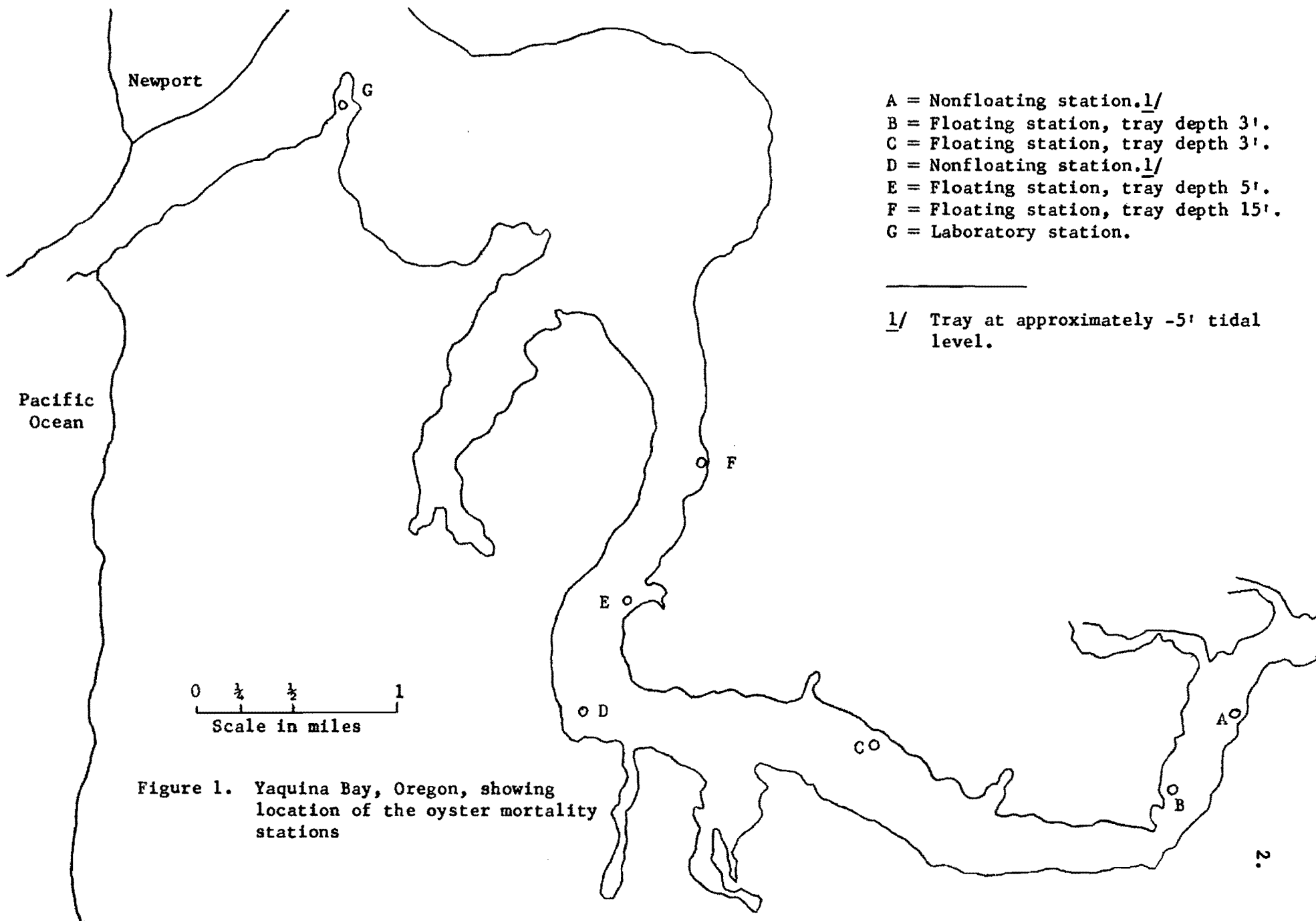
INTRODUCTION

Objectives of Oregon's Oyster Mortality Study from July 1, 1967-March 31, 1968, were: (1) to monitor oyster mortalities to detect a possible increase in mortality rate, (2) to collect hydrographic data for comparison with data from areas where high oyster mortalities occur, and (3) to furnish oysters from a relatively mortality-free area to the University of Washington for histological examination and comparison to oysters from high-mortality areas.

METHODS AND MATERIALS

Description of stations

Mortality and hydrographic data were collected at six subtidal stations in Yaquina Bay (Figure 1), a laboratory station, and at intertidal stations in Coos and Tillamook bays. Equal numbers of oysters were retained in a sacrifice and a control tray at each station. The Yaquina stations each initially contained in total 200 Pacific oysters (Crassostrea gigas) and 400 native oysters (Ostrea lurida). Yaquina stations were checked every other week for mortality. Four native and three Pacific oysters were collected monthly from the sacrifice tray at each station for condition index determination and preparation for histological examination. The laboratory station contained 100 Pacific and 100 native oysters which were checked daily for mortalities. No samples were taken from this station. In December 1967 all oysters at the Yaquina Bay stations were replaced with younger animals. In November 1967 a tray containing 500 native



oysters of the 1967 set was suspended at a depth of 4 feet at Station C. These oysters were checked monthly for mortalities and shell growth. Stations at Coos and Tillamook bays each began with 100 Pacific oysters. Monthly samples included three oysters from the sacrifice tray and four oysters from the surrounding beds.

Shell growth

The mean product of shell length times width was used for determining growth of Pacific oysters. Native oyster growth was calculated from mean shell length only. During the first 6 months of this reporting period a random sample of Pacific and native oysters was measured monthly from the control tray at each station. In order to obtain more accurate growth data, all control tray oysters are now measured at the end of each quarter.

Condition index

Condition index is obtained by the formula:

$$\text{C.I.} = \frac{\text{dry weight of oyster tissue}}{\text{volume of shell cavity}} \times 100$$

The dry weights were obtained by drying the oyster meat in an oven at 90 C for 1 week. The water displacement method was used to obtain the shell cavity volumes.

Histological samples

Oyster samples collected monthly at Yaquina, Coos, and Tillamook bays, and dying oysters ("gapers") were fixed in Davidson's solution and sent to the University of Washington for histological analysis.

Hydrographic data

Salinity, temperature, pH, dissolved oxygen, and turbidity information were collected twice monthly at all Yaquina Bay stations

(Appendix Tables A-E)^{1/}. Continuous temperature data were obtained on the commercial oyster beds (Station D) in Yaquina Bay with a Ryan recording thermometer. At the Coos and Tillamook Bay stations, surface temperatures and salinities were obtained monthly at low tide (Appendix Table F).

RESULTS

Mortality

Yaquina Bay. Pacific oyster mortality was very low in Yaquina Bay: 0.8% during July-September 1967; 0.4% in October-November 1967; and 0.3% during February-March 1968. Native oyster mortality in the same periods was 3.5%, 1%, and 5.1%. Mortality was not recorded in Yaquina Bay in December 1967-January 1968, because of the initially high handling mortality in the young replacement oysters. Mortality of native oysters of the 1967 set was 8.2% in November 1967-March 1968, which is a lower than expected mortality for oysters of this age.

Coos and Tillamook bays. Mortality was low in both bays. Meaningful mortality percentages cannot be reported due to the small size of the experimental populations (100 Pacific oysters in each bay), but mass mortality would have been detected had it occurred.

Shell growth

Yaquina Bay. Mean shell size of Pacific oysters in trays increased 24% from July 1967 through September 1967 and 6.4% during the 2-month period October-November. Shell growth averaged 16.1% from January 1968 through March 1968 after replacement of oysters in trays with younger

^{1/} Hydrographic data for June 1966-November 1967 was reported in "Hydrographic Data for Yaquina, Coos, and Tillamook Bays," Fish Commission of Oregon mimeographed report, 1967. C. Dale Snow and Gary G. Gibson.

animals. The best growth in this period was recorded at Station D (38.6%). Native oyster growth was negligible during July-November 1967 due to the maturity of the experimental animals. Shell growth was also negligible for the younger replacement native oysters during January-March 1968.

Coos and Tillamook bays. Shell growth was slow during July-December 1967 in Coos Bay (16%) and at the Tillamook Bay station (10%) due to the mature size of the experimental oysters. Growth was not monitored after December 1967.

Condition index

Yaquina Bay. Pacific oyster mean condition index (Table 1) remained fairly high in July-August 1967, but dropped slightly during September-November because some oysters had partially spawned. Native oyster condition was low during July-September 1967, due to spawning, but most native oysters had regained their "fatness" by October. Condition indexes for the young Pacific and native oysters which replaced the mature oysters in the experimental trays were low during January-March 1968 as is expected for immature oysters.

Tillamook and Coos bays. Pacific oyster mean condition index remained at a constant level during the entire study period at the Tillamook station. Coos Bay oysters were variable in "fatness," but generally exhibited lower condition indexes than oysters in Yaquina and Tillamook bays.

Histological samples

Ninety-six native and 137 Pacific oysters were prepared during the study period and sent to the University of Washington for histological examination.

Table 1. Mean condition index for native and Pacific oysters in Yaquina Bay and for Pacific oysters in Tillamook and Coos bays, July 1967 to March 1968

Month	Yaquina Bay		Coos Bay	Tillamook Bay
	Native	Pacific	Pacific 1/	Pacific 1/
July 1967	9.3	16.8	-	-
August	9.6	16.8	-	-
September	10.2	15.5	12.0	14.4
October	18.5	14.6	7.6	15.7
November	15.0	13.9	11.2	-
December	-	-	13.2	12.9
January 1968	11.9	7.2	10.7	12.8
February	10.1	10.0	8.9	14.2
March	9.3	10.2	9.4	-

1/ Includes oysters from tray and surrounding beds.

Hydrographic data

Hydrographic information (Appendix Tables A-E) from Yaquina Bay reveals expected seasonal patterns. The area changes from an essentially salt-water bay in the summer to an area heavily influenced by fresh water in the winter, with layering of fresh water over salt water common during the rainy season. Temperatures were uniformly low throughout the study area during the winter (49 F average) and at the lower bay station (F) in the summer (55 F average); while temperatures near 70 F were common at the upper bay stations (A and B) during the summer. Average daily high temperatures near bottom within the commercial oyster grounds (Station D) ranged from 68 F in July-August 1967 to 48 F in January-February 1968. Average daily low temperatures during the same periods were 54 F and 48 F. Dissolved oxygen concentrations were generally high throughout the study area. Values at high tide ranged from 5.2 ppm in August at Station A to 10.3 ppm in January at Station C. Secchi disc readings ranged from

1.5 feet at Station A (heavily influenced by fresh water) to 7.5 feet at Station F (nearest the ocean). Hydrogen ion (pH) concentrations averaged slightly under 8 at Station A, and slightly over 8 at Station F.

SUMMARY

Pacific and native oysters were retained in "control" and "sacrifice" trays at six subtidal stations in Yaquina Bay and at single intertidal stations in Coos and Tillamook bays. In addition a group of each species was retained at the laboratory.

Observed mortality continued at a low level in Oregon from July 1, 1967-March 31, 1968, as indicated by the samples. Pacific oyster mortality in Yaquina Bay was less than 1% by quarterly period, while native oyster mortality averaged 3.2% quarterly. Mortality of Pacific oysters was also low in Tillamook and Coos bays. Expected seasonal patterns of shell growth, condition index and hydrographic data were recorded in Yaquina, Tillamook, and Coos bays.

APPENDIX

Table A. Salinities (o/oo) from Yaquina Bay, December 1967-
March 1968 (values at high tide unless noted)

Date	Station						Seaward →
	A	B	C	D	E	F	
12-19-67	13.6	14.6	17.1	18.8	26.3	27.8	Surface
	14.9	15.7	25.1	22.6	31.2	31.6	Mid-depth
	22.0	21.4	29.4	31.1	31.4	32.0	Bottom
1-4-68	7.6	14.0	16.1	18.3	19.7	25.4	
	17.8	22.6	24.3	28.4	29.0	29.9	
	20.4	23.8	25.9	29.0	29.8	29.9	
1-18-68	-	7.2	6.4	-	19.2	20.1	
	-	13.6	18.2	-	21.4	23.3	
	-	20.4	25.6	-	26.3	28.4	
2-5-68 ^{1/}	0.7	3.3	2.8	3.9	8.5	5.4	
	0.7	3.2	2.8	4.7	9.7	6.4	
	1.2	3.3	2.8	4.8	9.9	28.0	
2-26-68	3.4	4.7	10.6	18.6	16.7	10.7	
	7.9	5.5	14.1	20.1	21.7	25.5	
	20.4	22.5	22.0	23.5	24.7	26.1	
3-14-68	19.7	20.5	20.6	24.2	27.3	27.7	
	21.4	22.4	23.0	26.8	27.6	28.2	
	21.7	22.5	23.3	27.2	27.6	28.2	

^{1/} Readings at low tide during heavy runoff.

Table B. Temperatures (F) from Yaquina Bay, December 1967-
March 1968 (values at high tide unless noted)

Date	Station						Seaward →
	A	B	C	D	E	F	
12-19-67	43	43	44	44	47	47	
	44	44	46	45	48	49	
	45	45	47	47	48	49	
1-4-68	47	47	47	48	48	48	
	48	48	48	49	49	49	
	48	48	48	49	49	49	
1-18-68	-	48	48	-	48	48	
	-	49	49	-	48	48	
	-	49	49	-	48	49	
2-5-68 ^{1/}	48	48	48	48	48	48	
	47	48	48	48	48	49	
	47	48	48	48	48	49	
2-26-68	53	53	53	53	53	53	
	53	53	53	53	54	54	
	54	54	53	53	54	54	
3-14-68	51	51	51	51	50	50	
	51	51	51	50	50	50	
	51	51	51	50	50	50	

^{1/} Readings at low tide during heavy runoff.

Table C. Dissolved oxygen (ppm at tray level) from Yaquina Bay, December 1967-March 1968 (values at high tide unless noted)

Date	Station						Seaward →
	A	B	C	D	E	F	
12-19-67	9.2	9.9	9.7	8.8	8.9	8.8	
1-4-68	8.4	8.6	8.8	8.6	8.6	8.6	
1-18-68	-	10.2	10.3	-	9.6	9.6	
2-5-68 ^{1/}	10.2	10.2	10.0	10.2	9.9	9.4	
2-26-68	9.0	9.6	9.4	8.9	9.0	9.2	
3-14-68	8.3	8.6	8.5	8.6	8.8	9.0	

^{1/} Readings at low tide during heavy runoff.

Table D. Secchi disc readings (ft) from Yaquina Bay, December 1967-March 1968 (values at high tide unless noted)

Date	Stations						Seaward →
	A	B	C	D	E	F	
12-19-67	6.0	6.0	6.0	6.5	5.0	6.0	
1-4-68	7.0	6.0	6.5	7.5	7.5	7.5	
1-18-68	-	3.0	3.5	-	4.0	4.5	
2-5-68 ^{1/}	1.5	2.0	2.0	2.0	2.0	2.0	
2-26-68	3.0	3.5	4.5	5.0	5.0	4.0	
3-14-68	3.5	3.5	3.5	3.5	3.5	3.5	

^{1/} Readings at low tide during heavy runoff.

Table E. Hydrogen ion (pH) values from Yaquina Bay, December 1967-March 1968 (values at high tide unless noted)

Date	Station			Seaward →
	A	C	F	
12-19-67	7.4	7.8	8.3	Surface
	8.0	8.3	8.3	Bottom
1-4-68	7.3	7.9	8.2	
	8.1	8.2	8.3	
1-18-68	-	7.2	8.3	
	-	8.3	8.4	
2-5-68 ^{1/}	6.6	6.7	7.0	
	6.6	6.9	8.4	
2-26-68	7.0	7.5	7.6	
	8.2	8.2	8.4	
3-14-68	8.0	8.0	8.2	
	8.1	8.1	8.2	

^{1/} Readings at low tide during heavy runoff.

Table F. Surface temperatures and salinities from the Tillamook and Coos Bay stations, December 1967-March 1968 (values at low tide)

Month	Tillamook Bay ^{1/}		Coos Bay ^{2/}	
	Temperature	Salinity	Temperature	Salinity
	F	o/oo	F	o/oo
December 1967	52	14.1	51	18.8
January 1968	52	19.2	50	10.6
February	51	1.6	51	1.8
March	-	-	49	.1.3

^{1/} Station located on intertidal oyster bed in the southwest section of the bay.

^{2/} Station located on intertidal oyster bed in Joe Ney Slough.