OYSTER MORTALITY STUDY

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OYSTER MORTALITY STUDY

ABSTRACT

Oyster mortality data collected from suspended trays at four subtidal locations in Yaquina Bay revealed an 8.6% Pacific oyster mortality (Crassostrea gigas) and 26.5% mortality of native oysters (Ostrea lurida) during the study year. Low salinity stress caused about one-third of the Pacific oyster mortality and about three-fourths of the mortality of native oysters.

A 2.1 and 6.9% Pacific oyster mortality occurred at the intertidal stations in Tillamook and Coos bays, respectively.

A shell growth of yearling Pacific oysters in Yaquina Bay occurred almost entirely during the 6-month periods, April - September 1968 and 1969. Oysters at one upper bay location grew significantly better than the oysters in the other areas tested.

We prepared a total of 711 oysters for histological examination.

Hydrographic data collected from Yaquina Bay reflect expected tidal and seasonal patterns.

Since the identification of a neoplastic disease in native oysters and mussels in Yaquina Bay, we have collected and sent live shellfish to the Bureau of Commercial Fisheries laboratory in Oxford, Maryland, for analysis. An October 1969 native oyster sample disclosed a 40% incidence of the disease; however, monthly samples from the native oyster beds in Yaquina Bay reveal generally low mortality rates.

Pacific oysters are being maintained in Yaquina Bay from seed plantings of 1962 (8 years old), 1963, 1964, and 1965 to gain information on the longevity of this species.

INTRODUCTION

Objectives of Oregon's oyster mortality study for the past year included monitoring oyster mortality in Yaquina, Tillamook, and Coos bays, obtaining hydrographic data in Yaquina Bay; and furnishing oysters to the University of Washington and the Bureau of Commercial Fisheries (BCF) in Oxford, Maryland, for histological examination. Other activities included (1) determining seasonal growth of Pacific oysters in Yaquina

Bay, (2) cooperating with the BCF Oxford laboratory on a study of the neoplastic disease in native oysters, Ostrea lurida, and (3) obtaining information on the longevity of Pacific oysters, Crassostrea gigas.

MATERIALS AND METHODS

Mortality Stations

Mortality data were obtained at four subtidal stations in Yaquina Bay (Figure 1) and at single intertidal locations in Tillamook and Coos bays.

Suspended trays at each Yaquina Bay station initially contained 300 Pacific oysters, and 300 native oysters except station D (lower bay station), which contained 300 Pacific oysters only. I checked these stations every 2 weeks for mortalities and collected 10 Pacific and 10 native oysters every 4 weeks from each upper bay station (A, B, and C) for histological examination.

Stations in Tillamook and Coos bays each initially contained 150 Pacific oysters. I checked these stations monthly for mortalities, and at the same time collected 5 tray animals and 10 oysters from the surrounding commercial beds for histological examination.

Shell Growth

I measured the same 100 yearling Pacific oysters at each upper Yaquina Bay station every 3 months from April 1968 through March 1970. The mean product of height (commonly called length) times width determined relative shell size.

Histological Samples

Oysters from Yaquina, Tillamook, and Coos bays were fixed in Davidson's solution, preserved in alcohol, and sent to the University of Washington and the BCF Oxford laboratory for histological examination.

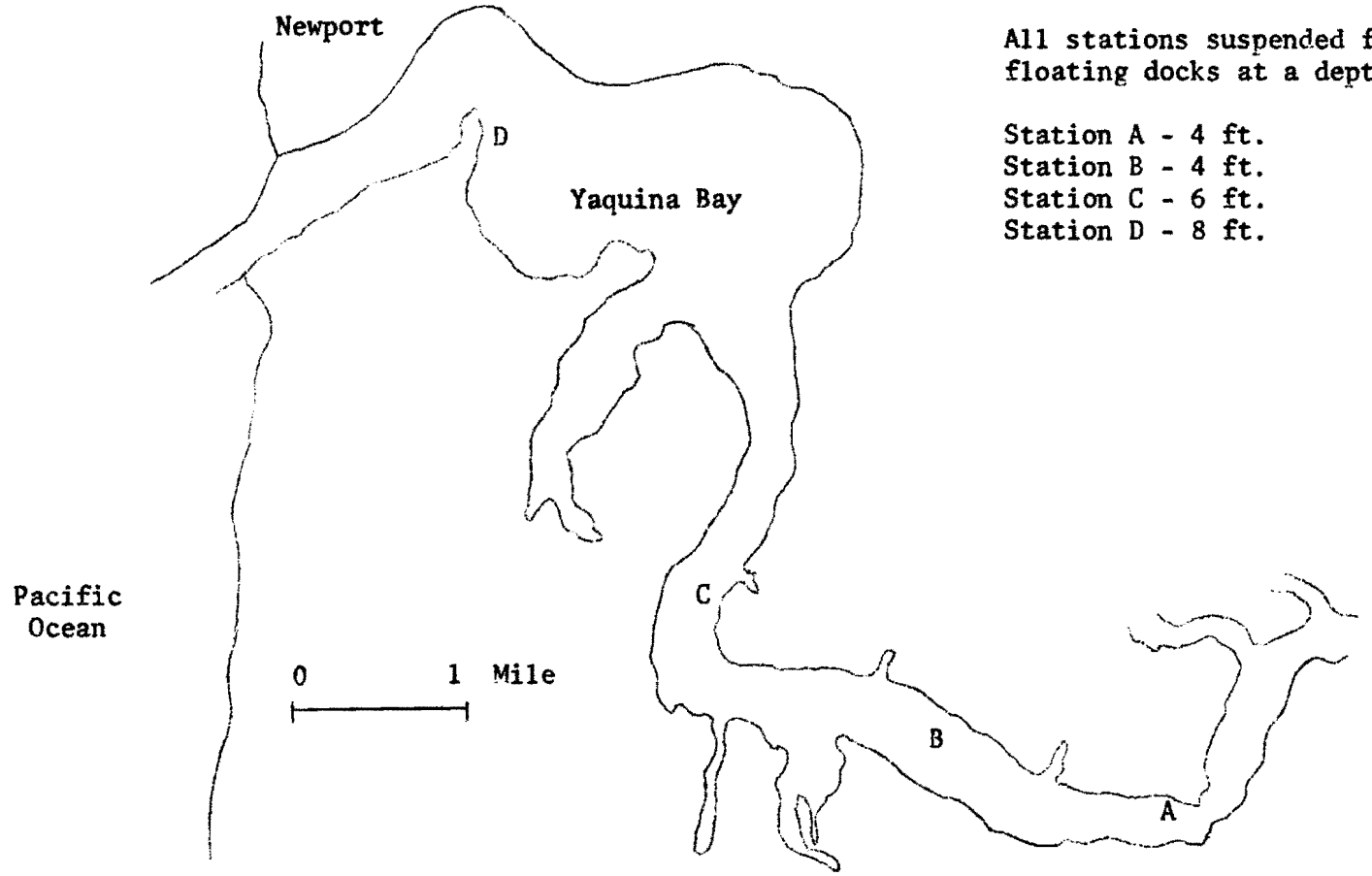

Figure 1. Locations of the Oyster Mortality Stations in Yaquina Bay

Hydrographic Data

Salinity, temperature, dissolved oxygen and turbidity data were collected every 2 weeks during a daily high and low slack tide at all Yaquina Bay stations (Appendix Tables A-D).

Native Oyster Disease Study

Since the identification of a neoplastic disease of native oysters and bay mussels (Mytilis edulis) from Yaquina Bay, I have been cooperating in a study to determine the cause and significance of the disease. During 1969 I collected samples of oysters, mussels, and clams at irregular intervals from Yaquina Bay, and sent these live to the BCF Oxford laboratory for histological examination. Since January 1970, monthly samples of shipped animals included: (1) 50-100 native oysters from the natural beds, (2) 25 native oysters introduced from Puget Sound, (3) 25-50 bay mussels, and (4) 50 Pacific oysters quarterly.

In January 1970, I obtained 2,500 native oysters from Puget Sound and introduced them into Yaquina Bay. I suspended three trays containing 500 oysters each within the major native oyster producing grounds. We maintain about 1,000 of these oysters in our laboratory. Before introduction, a sample of the Puget Sound oysters was sent to the Oxford laboratory for examination to establish that these animals did not contain the neoplastic disease. From this introduction we expect to obtain information about the time and rate of transmission of the disease.

Since May 1969, I have sampled the native oyster grounds monthly in Yaquina Bay for mortality. From one tongful of oysters (125-350 animals)

I count the number of live oysters, gapers;[1/] fresh, unfouled boxes[2/] (Class I); and lightly fouled boxes[3/] (Class II), and calculate mortality rates using the ratio: $\frac{\text{gapers + Class I boxes}}{\text{gapers + Class I boxes + live oysters}}$

This information is sent to the Oxford Laboratory for further evaluation and possible correlation with histological findings.

Pacific Oyster Longevity Study

In 1967, Dr. Kenneth Chew of the University of Washington terminated a study in Yaquina Bay on the effects of the parasitic copepod Mytilicola orientalis on Pacific oysters. Dr. Chew gave me the remaining experimental oysters, some of which were 4 years old. This provided an opportunity to find out how long oysters live, so I initiated a study to determine the longevity of these animals.

Mortality and growth data from these oysters were collected in March 1970.

RESULTS

Mortality Stations

I recorded an 8.6% mortality of Pacific oysters at the Yaquina Bay stations (Table 1). About one-third of this mortality occurred during August 1969, in one tray at the upper bay station (A). There was no mortality in an adjacent tray less than 3 feet away. I recorded another one-third of the total Pacific oyster mortality in February - March 1970, at the two uppermost Yaquina Bay stations (A and B). Hydrographic data indicate that these animals probably died from low salinity stress. We reported lower Pacific oyster mortalities for the previous three study periods: 1.1% during 1968-69, 1.5% for 1967-68, and 1.8% during 1966-67.

1/ Entire or part of animal remaining in shell.
2/ No part of animal remaining in a clean shell.
3/ Shell fouled with bryozoa but still showing clean areas.

Table 1. Pacific Oyster Mortality in Yaquina Bay by Station and Quarterly Period, April 1969 - March 1970

Date	Number Dead Oysters Station A	B	C	D	Total	Total % Mortality
1969						
April - June	3	1	2	1	7	0.7
July - September	23	10	1	1	35	3.9
October - December	3	8	0	0	11	1.4
1970						
January - March	16	4	0	0	20	2.9
Total	45	23	3	2	73	8.6 1/

1/ Total mortality equals 100 minus the product of monthly survival percentages.

A 26.5% mortality of native oysters occurred at the Yaquina Bay stations during the past year (Table 2).

About three-fourths of this mortality occurred at the uppermost bay station (A) during February-March 1970, following a 4-week period of extremely low salinities at this station. We reported the following mortalities for the previous study periods: 28.2% during 1968-69, 9.6% for 1967-68, and 18.2% during 1966-67.

A 2.1% Pacific oyster mortality occurred at the Tillamook Bay station during the past year (Table 3), as compared to 4.6% mortality for 1968-69.

At the Coos Bay station, 6.9% of the tray animals died, compared to a 27.1% mortality during the previous year (Table 3).

Shell Growth

Shell growth of Pacific oysters in Yaquina Bay occurred almost entirely during the 6-month period April - September in 1968 and 1969 (Figure 2). After 2 years in suspended trays, the oysters at station C have grown 41.5% larger than those at station A and 28.4% more than the oysters at station B. Higher salinities during winter months and more intense algal blooms during spring and summer months probably contribute to better growth in the vicinity of station C than in areas farther up bay.

Histological Samples

I prepared 256 native and 455 Pacific oysters during the study period, and sent them to the University of Washington and the BCF Oxford Laboratory for histological examination.

Hydrographic Data

Hydrographic data obtained from Yaquina Bay reflect expected characteristic tidal and seasonal patterns (Appendix Tables A-D). An explanation

Table 2. Native Oyster Mortality in Yaquina Bay by Station and Quarterly Period, April 1969 - March 1970

Date	Number Dead Oysters: Station A	B	C	Total	Total % Mortality
1969					
April - June	7	5	3	15	1.7
July - September	3	9	6	18	2.3
October - December	9	2	6	17	2.5
1970					
January - March	113	12	3	128	21.1
Total	132	28	18	178	26.5[1/]

1/ Total mortality equals 100 minus the product of monthly survival percentages.

Table 3. Pacific Oyster Mortality[1/] in Tillamook and Coos Bays by Quarterly Period, April 1969 - March 1970

Date	Station: Tillamook Bay No. Dead	Tillamook Bay %[1/]	Coos Bay No. Dead	Coos Bay %
1969				
April - June	1	0.7	3	2.1
July - September	2	1.5	3	2.3
October - December	0	0	2	1.7
1970				
January - March	0	0	1	1.0
Total	3	2.1	9	6.9

1/ Total mortality equals 100 minus the product of monthly survival percentages.

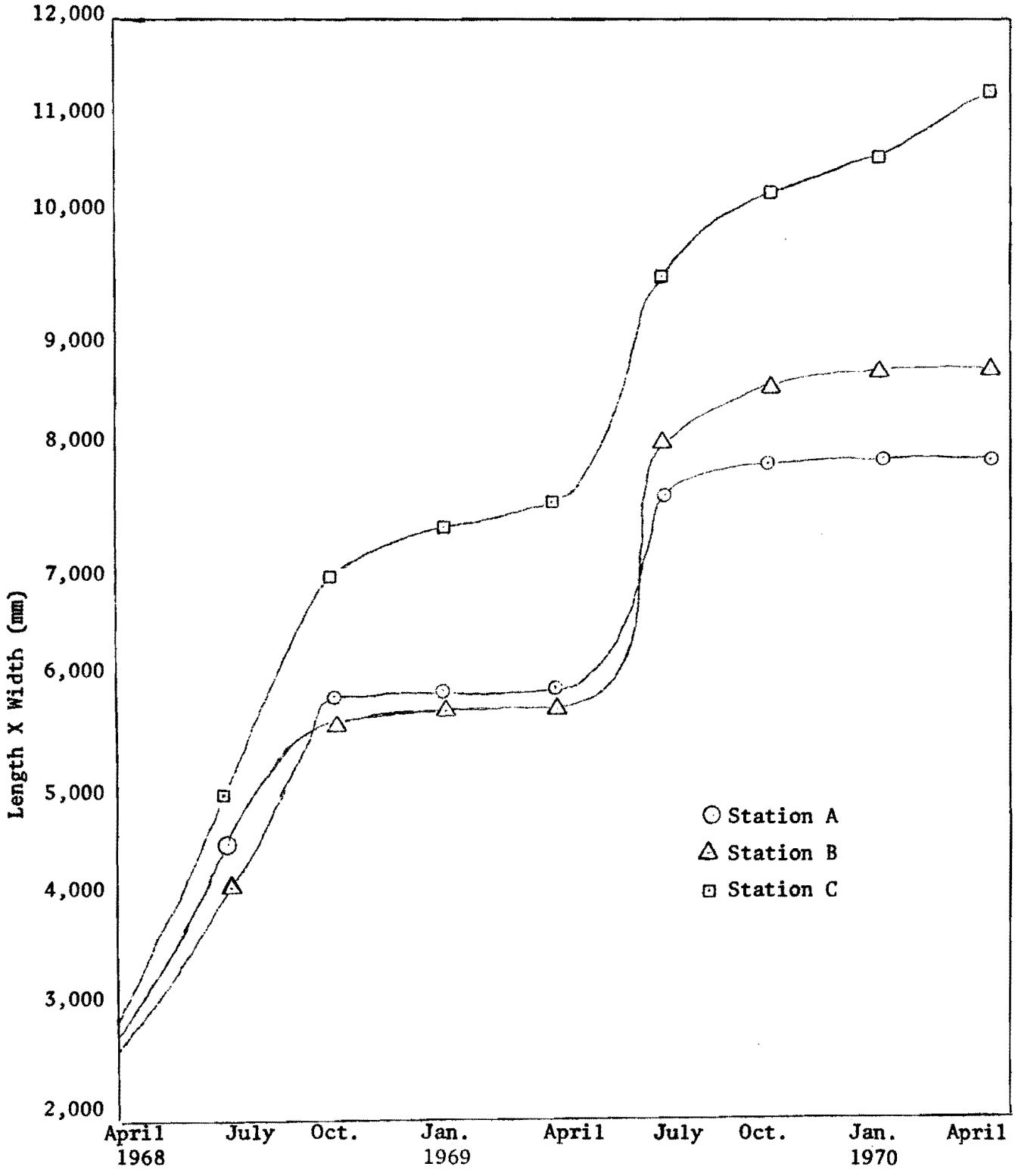

Figure 2. Average Shell Growth of 300 Yearling Pacific Oysters in Suspended Trays at Three Yaquina Bay Stations, April 1968-March 1970

of these patterns appeared in the oyster mortality annual report for April 1968 - March 1969.

Native Oyster Disease Study

We have not received the pathology reports from Oxford concerning our shellfish samples; however, a project proposal prepared by the Oxford Laboratory to study the neoplasm disease stated that histological examination disclosed a 40% incidence of the disorder in native oysters collected from Yaquina Bay during October 1969.

I noted generally low mortality in the monthly samples which I collected on the native oyster beds in Yaquina Bay from May 1969 - March 1970 (Table 4). The 10% mortality recorded in February 1970 is believed to have resulted from extremely low salinities which occurred over the native oyster beds for several weeks.

Table 4. Native Oyster Mortality (%) on a Natural Oyster Bed in Yaquina Bay from May 1969 - March 1970

Date	Mortality %	Date	Mortality %
May 1969	2.6	November	0.6
June	6.7	January 1970	0.0
July	3.0	February	10.1
September	1.1	March	1.2
October	0.0		

Pacific Oyster Longevity Study

Oysters of the 1964 planting (1963 year class) from Japan have shown the best survival of the four year classes monitored since 1965 (Table 5). Low salinity stress probably caused the generally poor survival, since I noted and removed most of the mortalities just after periods of low salinity each year. To increase survival, I plan to move these oysters from their near-surface positions in the upper bay area to deeper water in a higher salinity area.

Growth data reveals only small differences in size among the four year classes (Table 5).

Table 5. Survival and Growth of Four Plantings of Pacific Oyster Seed in Yaquina Bay Since April 1965

Year of Planting	Survival %	Size (mm)	
		Mean Length	Mean Width
1965	36	150	89
1964	47	148	81
1963	37	161	92
1962	13	154	100

APPENDIX TABLES

Table A. Salinities (ppt) from Four Locations in Yaquina Bay, April 1969-March 1970[1/]

Date	Station A	B	C	D	Date	Station A	B	C	D
4-7-69	9.3	10.8	10.7	25.5	7-25-69	23.1	25.1	28.4	31.2
Low Tide	10.8	10.7	17.4	26.7	Low Tide	23.0	24.7	29.4	31.5
	11.6	10.7	23.8	27.2		23.3	25.9	30.3	32.7
4-7-69	20.6	23.5	26.3	28.8	7-25-69	25.9	29.3	30.7	32.4
High Tide	20.1	23.9	27.1	30.3	High Tide	26.7	29.9	31.4	33.7
	21.6	25.6	28.8	30.7		26.9	29.5	32.3	33.6
4-21-69	10.2	11.6	16.0	24.0	8-15-69	20.9	21.1	28.6	31.2
Low Tide	10.5	11.9	17.0	25.2	Low Tide	21.3	22.2	28.2	31.6
	10.6	12.2	22.2	27.2		21.2	22.2	29.4	31.8
4-21-69	20.5	22.5	25.5	29.8	8-15-69	30.3	30.4	32.4	32.8
High Tide	21.2	24.0	27.6	30.6	High Tide	30.3	31.4	32.8	33.0
	21.8	24.8	28.2	30.7		30.8	31.5	32.8	33.2
5-12-69	15.4	17.0	21.7	29.4	8-29-69	22.7	23.8	28.5	31.4
Low Tide	15.4	17.0	23.4	32.4	Low Tide	22.9	23.8	28.5	31.6
	15.6	17.0	25.9	32.9		23.0	24.0	28.8	31.8
5-12-69	23.5	25.2	28.4	31.9	8-29-69	31.2	31.5	32.3	32.0
High Tide	23.9	27.4	31.8	34.1	High Tide	31.4	31.9	32.1	32.3
	24.4	28.2	32.5	34.5		31.4	31.9	32.3	32.3
5-28-69	19.4	21.6	25.9	29.4	9-16-69	25.6	27.2	31.5	32.8
Low Tide	19.1	21.3	25.9	29.1	Low Tide	25.6	27.2	32.0	32.8
	20.9	22.6	28.0	29.1		26.1	28.2	32.1	32.8
5-28-69	24.7	26.4	28.1	31.1	9-16-69	31.0	31.1	32.3	32.8
High Tide	24.8	27.2	28.9	31.6	High Tide	31.0	31.6	32.5	32.8
	25.6	27.4	30.8	31.5		31.5	32.1	32.9	32.8
6-10-69	18.7	20.6	25.8	31.0	10-6-69	25.0	25.8	29.1	30.6
Low Tide	19.0	20.5	26.5	30.7	Low Tide	2/	25.6	28.9	30.7
	21.7	23.4	29.0	31.4		25.1	26.7	29.5	31.1
6-10-69	24.6	26.0	28.1	29.3	10-6-69	27.3	27.8	29.1	30.4
High Tide	24.6	26.7	29.1	31.2	High Tide	26.9	28.4	29.3	31.4
	25.6	27.6	29.5	31.6		27.1	28.9	30.2	31.9
6-26-69	17.0	19.0	23.5	31.1	10-21-69	20.3	22.1	25.9	28.5
Low Tide	17.3	19.0	25.6	31.5	Low Tide	20.4	22.2	26.9	30.7
	18.2	22.0	27.6	31.6		20.6	27.2	28.9	31.2
6-26-69	23.1	23.4	28.2	28.2	10-21-69	27.3	28.9	30.2	31.2
High Tide	23.7	25.4	28.9	30.7	High Tide	27.6	29.5	31.0	31.6
	25.2	26.4	29.5	30.6		28.0	28.0	31.4	31.8

Table A. (Continued)

Date	Station A	B	C	D	Date	Station A	B	C	D
11-18-69	12.6	15.6	20.8	27.8	3-10-70	19.7	23.7	26.1	30.3
Low Tide	2/	16.1	21.0	28.9	High Tide	21.3	25.8	29.5	30.4
	2/	16.7	24.6	29.3		22.5	26.0	29.7	30.4
11-18-69	24.0	24.6	28.9	29.0					
High Tide	24.0	25.1	29.1	31.2					
	24.6	27.6	29.4	31.4					
12-5-69	18.4	18.4	23.4	28.6					
Low Tide	2/	18.3	24.7	28.6					
	2/	18.3	26.0	29.0					
12-5-69	25.2	27.2	28.9	30.4					
High Tide	25.2	27.1	29.1	30.4					
	25.6	27.2	29.4	31.2					
12-30-69	5.6	7.2	11.2	14.9					
Low Tide	2/	7.2	13.2	19.1					
	2/	7.5	23.9	26.0					
12-30-69	5.5	5.6	12.0	16.1					
High Tide	5.9	8.1	21.3	24.8					
	7.9	22.0	25.4	30.8					
1-28-70	0.0	0.0	1.6	3.3					
High Tide	0.0	0.0	16.0	21.4					
	0.0	6.0	18.4	27.6					
2-9-70	0.9	0.3	5.5	16.9					
Low Tide	2/	0.4	6.3	18.2					
	2/	0.4	11.0	19.6					
2-9-70	11.6	12.6	20.0	23.8					
High Tide	12.8	21.8	25.5	29.0					
	14.8	22.0	27.3	29.4					
2-24-70	6.4	7.1	12.7	21.2					
Low Tide	2/	7.3	14.6	22.4					
	6.3	11.5	17.1	24.2					
2-24-70	14.5	15.4	23.5	25.8					
High Tide	16.7	21.6	26.3	29.5					
	17.8	24.8	24.0	31.1					
3-10-70	4.5	6.0	14.4	24.6					
Low Tide	2/	6.4	15.2	25.5					
	2/	7.7	19.7	26.1					

1/ Measurements are for surface, mid-depth, and bottom positions, respectively.
2/ Insufficient depth to make a difference in values.

Table B. Temperatures (F) from Four Locations in Yaquina Bay, April 1969-March 1970 1/

Date	Station A	B	C	D	Date	Station A	B	C	D
4-7-69	55	54	54	53	7-25-69	70	69	65	58
Low Tide	55	54	54	53	Low Tide	69	68	63	57
	56	55	53	53		69	67	59	51
4-7-69	54	54	54	54	7-25-69	67	66	59	54
High Tide	54	53	52	52	High Tide	66	64	58	50
	54	53	52	52		65	62	57	50
4-21-69	57	57	56	55	8-15-69	68	68	64	58
Low Tide	57	57	56	55	Low Tide	68	68	64	57
	57	57	55	54		68	68	62	56
4-21-69	57	57	56	54	8-15-69	62	62	55	55
High Tide	56	56	54	54	High Tide	62	59	54	54
	56	55	54	54		61	59	54	52
5-12-69	64	64	62	57	8-29-69	66	65	63	58
Low Tide	64	64	60	55	Low Tide	66	65	63	58
	64	64	60	54		66	65	62	57
5-12-69	60	59	56	53	8-29-69	60	60	56	58
High Tide	60	58	54	49	High Tide	59	57	56	56
	60	57	54	49		59	57	55	55
5-28-69	63	63	60	58	9-16-69	62	61	56	51
Low Tide	63	63	60	58	Low Tide	62	61	55	50
	62	62	59	57		62	60	54	50
5-28-69	61	60	59	58	9-16-69	58	58	54	50
High Tide	61	60	58	56	High Tide	58	56	52	50
	60	59	58	56		56	55	52	50
6-10-69	66	65	63	58	10-6-69	61	61	59	57
Low Tide	65	65	62	57	Low Tide	2/	61	59	57
	64	64	60	56		61	61	59	56
6-10-69	63	62	60	58	10-6-69	60	59	58	56
High Tide	63	61	59	53	High Tide	60	59	57	55
	62	60	58	52		60	58	57	55
6-26-69	65	65	63	60	10-21-69	57	56	55	54
Low Tide	65	64	62	59	Low Tide	57	57	56	55
	64	63	60	58		58	56	56	55
6-26-69	63	63	60	59	10-21-69	55	55	54	53
High Tide	62	62	59	56	High Tide	55	55	54	53
	61	61	59	56		55	55	53	53

Table B. (Continued)

Date	Station A	B	C	D	Date	Station A	B	C	D
11-18-69	50	50	51	51	3-10-69	53	53	53	53
Low Tide	2/	50	51	51	High Tide	52	52	53	53
	2/	50	51	51		52	52	53	53
11-18-69	50	51	51	50					
High Tide	51	50	51	52					
	51	51	52	52					
12-5-69	45	45	46	48					
Low Tide	2/	45	46	48					
	2/	46	47	49					
12-5-69	47	47	48	49					
High Tide	47	47	48	50					
	47	47	49	50					
12-30-69	49	49	48	47					
Low Tide	2/	49	49	49					
	2/	50	50	51					
12-30-69	49	49	49	50					
High Tide	49	49	50	51					
	49	50	50	51					
1-28-70	49	49	48	50					
High Tide	47	47	50	52					
	48	48	50	52					
2-9-70	50	50	50	50					
Low Tide	2/	50	50	50					
	2/	50	50	50					
2-9-70	52	52	52	53					
High Tide	52	52	53	53					
	52	52	53	53					
2-24-70	49	49	50	50					
Low Tide	2/	49	50	50					
	50	50	50	50					
2-24-70	52	53	52	53					
High Tide	52	53	52	53					
	52	53	53	53					
3-10-70	51	50	51	52					
Low Tide	2/	50	51	51					
	2/	50	51	51					

1/ Measurements are for surface, mid-depth, and bottom positions, respectively.
2/ Insufficient depth to make a difference in values.

Table C. Dissolved Oxygen Values (ppm at oyster tray level) from Four Stations in Yaquina Bay, April 1969-March 1970 1/

Date	Station A	B	C	D	Date	Station A	B	C	D
4-7-69 Low Tide	8.9	9.0	9.4	9.2	8-29-69 Low Tide	5.4	5.5	6.4	8.0
4-7-69 High Tide	9.4	9.3	9.5	9.8	8-29-69 High Tide	8.0	8.2	8.4	8.8
4-21-69 Low Tide	9.0	9.1	8.7	8.6	9-16-69 Low Tide	6.4	6.6	7.1	6.0
4-21-69 High Tide	9.1	8.6	8.9	9.6	9-16-69 High Tide	7.6	7.4	6.9	7.0
5-12-69 Low Tide	8.9	9.0	8.6	7.4	10-6-69 Low Tide	8.2	8.0	8.4	9.6
5-12-69 High Tide	8.2	7.6	6.8	5.3	10-6-69 High Tide	7.6	7.9	8.3	8.7
5-28-69 Low Tide	7.4	7.5	8.1	8.8	10-21-69 Low Tide	8.2	8.0	8.4	9.0
5-28-69 High Tide	8.2	8.0	7.7	9.0	10-21-69 High Tide	8.1	8.6	8.8	8.9
6-10-69 Low Tide	7.6	7.6	7.4	8.0	11-18-69 Low Tide	9.2	9.2	9.0	9.2
6-10-69 High Tide	7.0	6.7	7.2	7.8	11-18-69 High Tide	8.3	8.8	9.2	9.1
6-26-69 Low Tide	8.9	10.2	9.1	9.0	12-5-69 Low Tide	9.6	9.4	9.0	9.2
6-26-69 High Tide	8.9	8.0	8.3	8.8	12-5-69 High Tide	8.5	8.8	8.9	9.0
7-25-69 Low Tide	8.6	9.4	9.0	9.2	12-30-69 Low Tide	10.2	9.9	9.4	9.1
7-25-69 High Tide	8.5	8.6	8.0	6.2	12-30-69 High Tide	10.0	10.1	8.9	8.8
8-15-69 Low Tide	5.9	5.8	6.8	6.4	1-28-70 High Tide	10.4	10.4	9.6	9.2
8-15-69 High Tide	7.2	6.7	6.4	6.2	2-9-70 Low Tide	10.0	10.1	9.7	9.4

Table C. (Continued)

Date	Station A	B	C	D
2-9-70 High Tide	9.6	9.2	9.1	9.0
2-24-70 Low Tide	10.2	10.2	9.4	9.0
2-24-70 High Tide	9.3	9.0	9.3	9.0
3-10-70 Low Tide	9.7	8.9	9.4	8.6
3-10-70 High Tide	8.9	8.7	9.0	9.4

Table D. Secchi Disc Reading (ft.) from Four Stations in Yaquina Bay, April 1969-March 1970

Date	Station A	B	C	D	Date	Station A	B	C	D
4-7-69 Low Tide	1/	1/	6.0	5.5	8-29-69 Low Tide	3.0	3.5	3.5	4.0
4-7-69 High Tide	7.0	7.0	3.5	8.0	8-29-69 High Tide	4.0	4.0	6.5	6.5
4-21-69 Low Tide	1/	4.0	5.5	6.0	9-16-69 Low Tide	4.5	5.0	4.5	7.5
4-21-69 High Tide	4.5	5.0	6.5	8.0	9-16-69 High Tide	5.5	5.5	7.0	11.0
5-12-69 Low Tide	4.0	4.0	4.0	8.0	10-6-69 Low Tide	1/	6.0	5.5	8.5
5-12-69 High Tide	5.0	5.5	7.0	9.5	10-6-69 High Tide	5.0	6.0	6.0	8.0
5-28-69 Low Tide	4.0	4.5	5.0	6.5	10-21-69 Low Tide	5.0	6.5	6.5	10.0
5-28-69 High Tide	4.0	4.0	4.5	6.5	10-21-69 High Tide	5.0	6.5	7.5	8.5
6-10-69 Low Tide	4.0	4.5	5.0	8.0	11-18-69 Low Tide	1/	6.0	6.0	6.5
6-10-69 High Tide	5.0	5.0	7.5	11.0	11-18-69 High Tide	5.0	5.0	5.0	7.0
6-26-69 Low Tide	4.5	4.0	5.5	7.0	12-5-69 Low Tide	1/	5.0	7.0	5.0
6-26-69 High Tide	4.0	5.0	5.5	7.0	12-5-69 High Tide	6.0	7.0	8.5	10.0
7-25-69 Low Tide	4.0	4.5	5.5	9.0	12-30-69 Low Tide	1/	5.0	5.0	5.0
7-25-69 High Tide	4.5	5.0	5.0	11.0	12-30-69 High Tide	1/	5.0	5.0	6.0
8-15-69 Low Tide	3.0	3.5	4.0	6.0	1-28-70 High Tide	1.5	1.5	1.5	1.5
8-15-69 High Tide	4.0	4.5	7.0	8.0	2-9-70 Low Tide	1.5	2.0	2.0	2.0

Table D. (Continued)

Date	Station A	B	C	D
2-9-70 High Tide	3.0	3.5	3.5	6.0
2-24-70 Low Tide	1/	4.5	5.0	4.0
2-24-70 High Tide	4.0	4.0	5.0	8.5
3-10-70 Low Tide	1/	4.0	5.0	5.0
3-10-70 High Tide	4.0	6.0	6.0	9.0

1/ Insufficient depth to obtain reading.