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OYSTER MORTALITY STUDY

ANNUAL REPORT
April 1, 1968-March 31, 1969

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDIX TABLES

Annual Progress Report

Oyster Mortality Study

INTRODUCTION

Objectives of Oregon's Oyster Mortality study for the year ending March 1969 were similar to those of the first 2 years of the program: (1) to monitor oyster mortality in Yaquina, Tillamook and Coos bays, (2) to collect hydrographic data in Yaquina Bay and (3) to furnish oysters to the University of Washington for comparative histological examination.

Additional work was done on the seasonal growth of Pacific oysters, the survival and growth of native oysters from spat and low salinity tolerance of adult native oysters.

MATERIALS AND METHODS

Mortality stations

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

Three hundred Pacific oysters (*Crassostrea gigas*) and an equal number of native oysters (*Ostrea lurida*) were held in suspended trays at each Yaquina Bay station (2,400 animals). These stations were checked every other week for mortality and 10 oysters of each species were collected monthly at the upper bay stations (A, B and C) for histological preparation.

An additional tray containing 500 native oyster spat of the 1967-year class was placed in Yaquina Bay at Station B in November 1967 and was checked at irregular intervals for mortality.

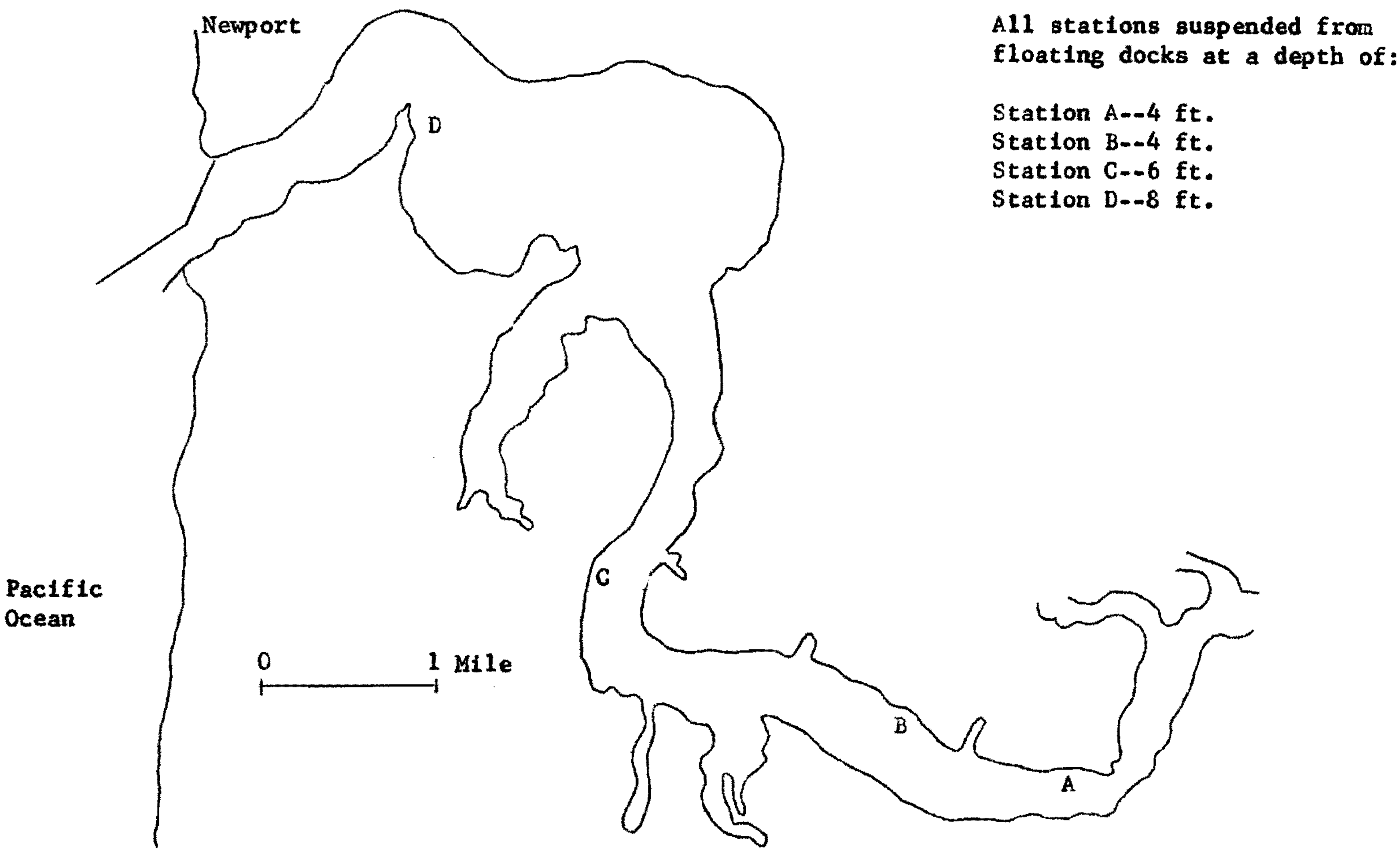

Figure 1. Location of the oyster mortality stations in Yaquina Bay

Stations at Tillamook and Coos bays each initially contained 100 Pacific oysters. These stations were checked monthly for mortality, and at the same time five tray animals and 10 oysters from the surrounding commercial beds were collected for histological examination.

Shell growth

One hundred 1-year-old Pacific oysters were measured every 3 months at each upper Yaquina Bay station with the same animals being used in succeeding quarters. The mean product of height (length) times width was used to determine shell size.

One hundred native oysters of the 1967 set were measured every 3 months at Station B since November 1967. Native oyster growth was calculated from mean shell length only because of their more uniform shape.

Histological samples

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

Hydrographic data

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

Salinity tolerance experiment

Laboratory experiments were conducted to determine the low salinity tolerance of native oysters and the extent of delayed mortality from reduced salinity. Adult Yaquina Bay native oysters were brought into the laboratory in December 1968, and conditioned for 2 weeks with a constant temperature of 59 F. While conditioning, the oysters were fed a mixture of unicellular algae (Monochrysis sp and Isochrysis sp) totaling from 200-800 million cells per day. Five groups of 40 oysters each were then placed in 1 gallon containers of water at salinities of 0, 5, 10, 15 and 30 ppt. Filtered sea water was mixed with distilled fresh water to obtain the required salinities. The water in the containers was continuously aerated and changed every other day. After 2 weeks, half of the oysters from each salinity group were placed in 30 ppm salt water, and monitored for delayed mortality. The remaining animals were left in the original salinities and were checked daily for mortality. Oysters were considered dead when they gaped and were unable to hold their valves closed. All dead oysters were prepared for sectioning and sent to the University of Washington for analysis of any internal changes caused by low salinity stress.

RESULTS

Mortality stations

Pacific oyster mortality was 1.1% during the past year for Yaquina Bay stations with most of it occurring at Stations A and B (Table 1). Similar low mortalities were reported for the two previous study periods: 1.5% during July 1967-March 1968 and 1.8% during June 1966-June 1967.

Native oyster mortality was 28.2% at the Yaquina Bay stations during the study year (Table 2). About three-fourths of this mortality occurred at the upper bay station (A) during January-March 1969, when hydrographic data indicated that the salinity was near zero for extended periods. Another one-seventh of the total annual mortality was recorded at the lower bay station (D) immediately following transfer of the oysters from

Table 1. Pacific oyster mortality in Yaquina Bay by station and quarterly period, April 1968-March 1969

Date	Station A	Station B	Station C	Station D	Total number	Total %
1968						
April-June	0	2	0	1	3	0.3
July-September	0	1	0	0	1	0.1
October-December	2	0	1	-1/	3	0.4
1969						
January-March	2	0	0	-	2	0.3
Total No.	4	3	1	1	9	1.1 2/

1/ Station lost October 18, 1968.

2/ Total mortality is equal to 1--the product of the quarterly survival rates.

Table 2. Native oyster mortality in Yaquina Bay by station and quarterly period, April 1968-March 1969

Date	Station A	Station B	Station C	Station D	Total number	Total %
1968						
April-June	5	12	9	45	71	6.0
July-September	3	1	1	2	7	0.7
October-December	3	2	2	-1/	7	0.9
1969						
January-March	118	3	3	-	124	21.3
Total No.	129	18	15	47	209	28.2 2/

1/ Station lost October 18, 1968.

2/ Total mortality is equal to 1--the product of the quarterly survival rates.

the upper bay near Station A. Total mortalities during the previous study periods were 9.6% from July 1967-March 1968 and 18.2% during June 1966-June 1967. Mortality of the 1967-year class native oysters, established at Station B in November 1967, was 53.2% through March 1969. Mortality rate was highest during the spring of 1968, coinciding with the usual high adult mortality period in Yaquina Bay.

Mortality of Pacific oysters at the Tillamook station was 4.6% during the study period (Table 3). No mortality was noted at this station from October 1968-March 1969.

At the Coos Bay station 27.1% of the 100 additional experimental animals died. About 17% of this mortality occurred during July-September 1968. No unusual mortality was noted during this time in younger oysters being cultured on racks and sticks. This area will be monitored more intensively in the coming year to determine if a significant mortality actually occurs and if there is a differential mortality between young and older oysters.

Shell growth

Shell growth of Pacific oysters in Yaquina Bay occurred almost entirely during the 6 months period April-September (Figure 2). The best growth during the study year was recorded at Station C, with a 161% increase in size. Some growth took place at this station during October-March, while little or no growth was noted at the other upper bay stations. Total shell growth was 127% and 110% at Stations A and B, respectively.

Table 3. Pacific oyster mortality in Tillamook and Coos bays by quarterly period, April 1968-March 1969

Station / Date	Tillamook Bay		Coos Bay	
	Number	%	Number	%
1968				
April-June	1	1.0	3	3.2
July-September	3	3.6	13	17.6
October-December	0	0.0	3	5.6
1969				
January-March	0	0.0	1	3.2
Total	4	4.6 1/	20	27.1 1/

1/ Total mortality is equal to 1--the product of the quarterly survival rates.

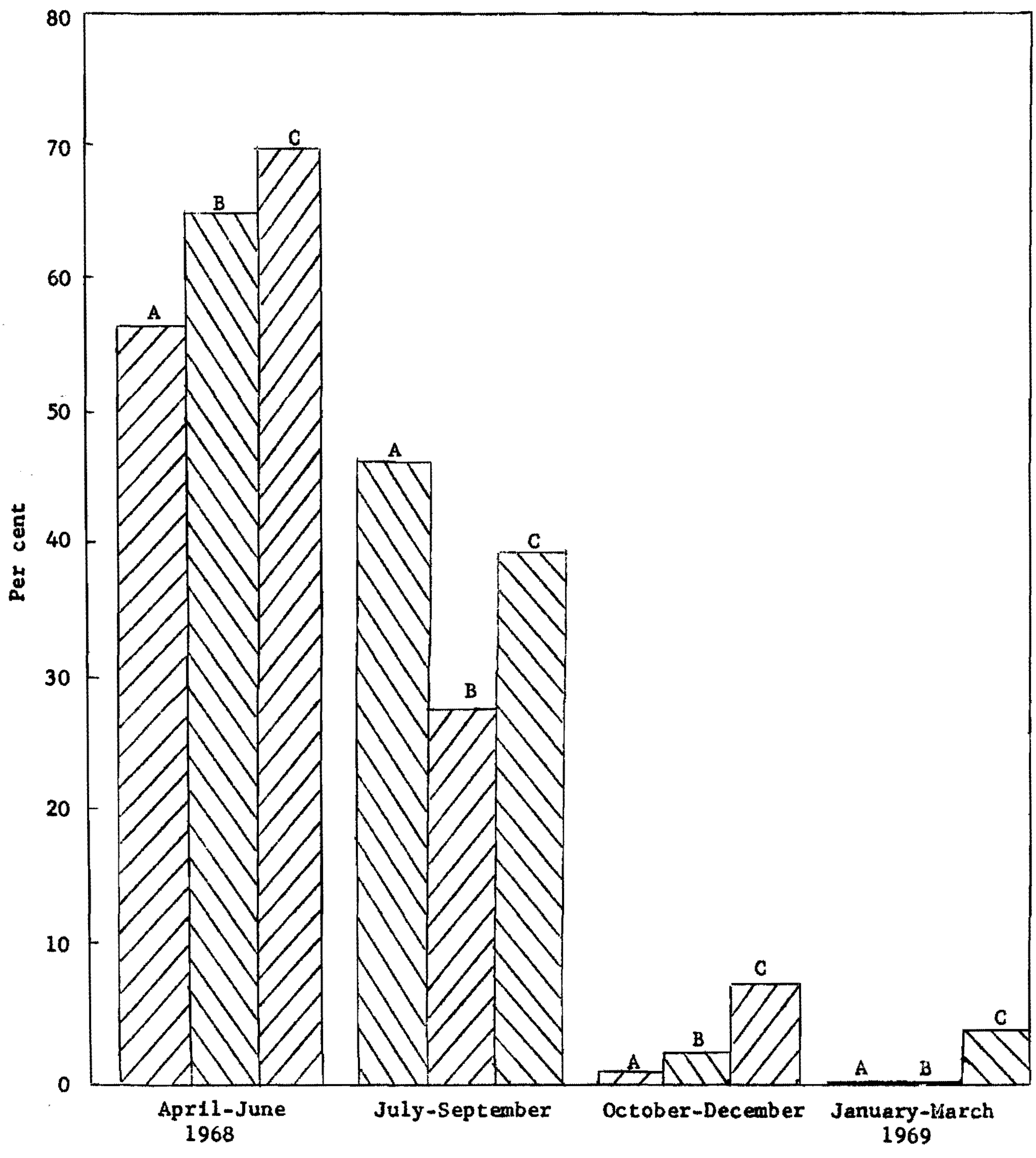

Figure 2. Quarterly mean percentage increase in shell size (length x width) of Pacific oysters at three Yaquina Bay stations (A, B and C), April 1968-March 1969

Mean increase in shell length of the 1967 set native oysters was only 1.8 millimeters (12.4%) during November 1967-May 1968, while rapid growth occurred during June-August 1968 (86.5%). No further increase was noted through March 1969.

Histological samples

A total of 462 native oysters and 614 Pacific oysters was prepared during the study period and sent to the University of Washington for histological examination.

Hydrographic data

Hydrographic data collected in Yaquina Bay reflect characteristic changes which occur in this estuary between tides and seasons (Appendix Tables A-D).

Salinity is generally high within the area of oyster production, between Station A and C, during the summer, but is often very low for several weeks at a time during the winter. Layering of fresh water over salt water occurs frequently during periods of high stream flow, an example being January 8, 1969, at high tide when the surface salinity was zero at Station B; while a salinity of 19.2 ppt was recorded on the bottom.

A high native oyster mortality occurred at Station A during January-February 1969, while mortality was small at Station B less than a mile down bay. Salinity information reveals that winter conditions were severe at both stations at low tide, but high-tide salinities were usually substantially higher beneath the fresh-water layer at Station B than at Station A.

Temperature, like salinity, varies considerably as to area, season and tidal cycle. Yearly temperature extremes are greater at the upper bay stations than in the lower bay area. Maximum summer temperatures at high and low tide at Station A were 67 and 70 F, while at Station D, comparable temperatures were 61 and 60 F. Winter minimum temperatures at Station A were 44 F at high tide and 43 F at low tide; Station D readings were 46 F and 44 F. Large differences in temperature occasionally occur during the summer between Station A and D due to oceanic upwelling, an example being July 22, 1968, when the bottom temperature at Station D was 52 F, while 70 F was recorded at Station A.

Dissolved oxygen concentrations were generally high throughout the study area, but in August 1968, at the upper bay stations, high temperatures forced readings down to 5-6 ppm. Dissolved oxygen was also low in July 1968, at Station D, when values fell below 6 ppm due to upwelling. In March 1969 supersaturation was recorded at the upper bay stations during a heavy algal bloom.

Secchi disc readings ranged from 1 foot at Station A during the winter to 11 feet at Station D during the summer. These extremes resulted from the heavy influx of silt-laden fresh water into the head of the bay during winter freshets and the intrusion of cold, clear sea water into the lower bay during summer upwelling.

Salinity tolerance experiment

Adult native oysters were found to be quite tolerant to reduced salinity during the winter. Survival was slightly better in distilled water than in 5 ppt salinity, indicating that low salinity (5 ppt or less) may be just as lethal as fresh water (Table 4). The threshold of minimum survival appears to be somewhere between 5 and 10 ppt salinity for 2-3

Table 4. Survival of adult native oysters in different salinities at 15 C

Salinity (ppm)	Per cent survival after: 7 days	14 days	21 1/ days	28 days	35 days	42 days	49 days
0	100	95	68	21	0	0	0
5	98	85	59	18	0	0	0
10	100	93	94	89	67	11	0
15	98	98	100	90	90	85	85
30	100	97	100	100	100	100	100

1/ Percentages determined using new base number after removal of half of the original oysters at 14 days.

weeks. These conditions occur frequently during winter freshet on native oyster grounds. A preliminary experiment indicated that tolerance to reduced salinity is even lower during the summer.

No significant delayed mortality was experienced by oysters held at low salinities for 2 weeks, then maintained in 30 ppt salt water and fed (Table 5).

Table 5. Survival of native oysters after being held in reduced salinities for 14 days, then held at 30 ppm salinity and fed

Initial salinity (ppm) for 14 days	Per cent survival in 30 ppt salt water after: 7 days	14 days	21 days
0	78	78	78
5	100	94	94
10	100	89	89
15	95	95	95
30	100	100	100

Results of studies by other workers on the Eastern oyster (*Crassostrea virginica*) indicated no significant difference in the survival rate at low salinities between oyster spat and adult oysters, but young native oysters which were set on the adult oysters in our experiment died much sooner at low salinities than the older animals. Further study is needed to determine the extent of this differential mortality.

SUMMARY

Oyster mortality data were collected from tray held animals at four subtidal locations in Yaquina Bay and at single intertidal stations in Tillamook and Coos bays. Pacific oyster annual mortality continued low (1.1%) in Yaquina Bay, while native oyster mortality was 28.2%. Most of this mortality occurred at the upper bay station during strong fresh water inflow. Pacific oyster mortality in Tillamook Bay was minimal (4.6%) but a 27% mortality was observed at the Coos Bay station.

Shell growth of Pacific oysters in Yaquina Bay was excellent; animals at one of the upper bay stations increased 161% in size during the year.

A total of 1,076 oysters was prepared and sent to the University of Washington for histological examination.

Hydrographic data collected in Yaquina Bay reflected characteristic seasonal patterns of salinity, temperature, dissolved oxygen, and turbidity during tidal cycles and in different areas.

A laboratory experiment with adult native oysters to determine low salinity tolerance and delayed mortality from reduced salinity revealed that these animals can resist low salinities during the winter. The threshold of survival appears to be between 5 and 10 ppt, at 59 F, for at least 2 weeks which approximates natural conditions during winter freshets. No significant delayed mortality was observed.

APPENDIX

Table A. Salinities (o/oo) from Yaquina Bay,
April 1968-March 1969

	Station					Station			
Date	A	B	C	D	Date	A	B	C	D
4-16-68	4.2	5.2	12.6	23.1	7-8-68	28.0	29.3	31.2	32.4
Low tide	1/	5.6	14.1	23.5	High tide	28.4	30.6	32.9	33.7
	4.8	5.8	20.9	25.2		28.9	30.8	33.7	33.8
4-16-68	18.8	24.6	25.8	31.4	7-22-68	24.6	26.4	30.3	34.2
High tide	18.7	24.3	30.7	32.3	Low tide	24.6	26.3	31.9	34.4
	22.0	24.6	31.0	31.9		25.2	26.7	32.3	34.6
4-30-68	10.3	11.4	17.9	26.0	7-22-68	27.2	26.8	30.2	32.8
Low tide	10.3	11.2	18.3	27.6	High tide	27.2	27.4	31.6	34.2
	9.9	11.0	27.3	28.8		27.3	27.3	32.3	34.4
4-30-68	22.2	23.9	24.4	32.4	8-5-68	26.3	27.8	30.4	33.6
High tide	22.9	25.9	30.0	33.4	Low tide	26.1	27.8	31.5	33.4
	25.0	26.3	31.4	32.5		27.2	29.4	32.8	34.0
5-13-68	24.8	25.9	17.9	27.7	8-5-68	29.4	32.0	33.0	34.9
Low tide	1/	1/	1/	28.1	High tide	29.7	32.5	34.9	35.1
	1/	26.7	21.7	29.1		30.3	33.3	35.1	35.4
5-13-68	28.0	29.0	29.1	32.8	8-28-68	17.4	19.7	25.9	33.0
High tide	28.6	31.0	32.1	33.2	Low tide	17.3	19.6	25.8	33.2
	29.0	31.1	32.4	33.2		18.2	20.6	28.2	33.4
5-31-68	8.9	10.2	16.1	21.7	8-28-68	28.0	29.0	32.7	32.7
Low tide	1/	10.3	17.1	23.9	High tide	28.6	30.0	32.8	33.0
	8.9	10.5	22.6	24.0		29.4	32.0	32.9	33.2
5-31-68	17.5	19.9	19.9	27.3	9-11-68	20.6	23.1	27.7	33.6
High tide	19.0	20.0	25.0	27.4	Low tide	21.0	23.5	28.4	34.0
	20.6	21.7	25.9	27.7		22.1	25.0	32.7	33.6
6-19-68	16.0	17.0	19.7	26.5	9-25-68	17.8	19.6	24.6	32.8
Low tide	16.0	17.1	24.3	27.2	Low tide	18.3	20.1	25.5	33.0
	16.5	21.7	28.1	30.7		18.6	21.4	28.2	33.2
6-19-68	16.6	18.0	22.1	29.5	9-25-68	27.7	31.9	33.3	33.2
High tide	19.6	21.7	28.4	32.5	High tide	31.2	32.7	33.7	33.8
	25.8	26.4	30.0	33.0		32.4	32.5	34.0	34.0
7-8-68	22.5	24.6	29.0	31.9	10-9-68	21.4	23.3	26.8	33.6
Low tide	22.2	25.0	30.3	33.4	Low tide	21.7	23.5	29.7	33.2
	22.9	26.5	31.5	33.6		24.2	23.9	31.9	33.2

Table A (cont'd)

Date	Station A	B	C	D	Date	Station A	B	C	D
10-9-68	29.1	31.4	32.3	33.4	2-7-69	3.2	4.7	9.4	18.4
High tide	29.9	32.4	33.8	33.8	Low tide	3.0	4.8	11.2	20.9
	31.8	32.7	33.7	34.0		3.5	5.2	15.3	25.1
10-31-68	9.8	11.9	18.6	24.6	2-7-69	6.3	10.1	17.5	24.0
Low tide	9.6	11.6	19.9	25.4	High tide	17.8	18.0	23.9	31.2
	9.7	13.7	21.3	27.6		22.2	22.2	26.0	31.1
10-31-68	16.6	20.5	22.6	31.1	2-21-69	2.5	4.5	9.4	18.4
High tide	20.1	24.3	29.8	32.7	Low tide	2.6	4.5	11.4	18.4
	22.7	25.5	31.2	32.7		2.9	4.6	15.8	24.4
11-14-68	2.1	4.8	6.0	9.2	2-21-69	12.8	16.2	19.4	20.9
Low tide	2.1	5.1	7.3	11.9	High tide	17.1	20.3	25.4	32.3
	3.9	11.1	26.3	27.8		18.2	22.1	26.3	32.1
11-14-68	6.2	5.4	6.7	9.9	3-21-69	3.8	5.8	12.0	20.5
High tide	8.4	8.1	25.4	30.7	Low tide	3.2	5.8	12.6	22.6
	19.6	23.7	27.3	31.1		5.0	7.5	17.6	25.5
12-12-68	0.0	0.0	2.9	4.6	3-21-69	18.4	22.1	24.8	29.8
Low tide	0.0	0.0	3.3	5.8	High tide	18.7	22.6	27.3	32.5
	0.4	0.1	8.6	19.6		19.6	23.3	30.6	33.0
12-12-68	0.5	0.5	1.1	3.9					
High tide	0.0	0.8	8.5	20.8					
	0.9	12.4	24.6	27.8					
1-8-69	0.0	0.0	0.8	6.6					
Low tide	0.0	0.0	3.2	8.1					
	0.0	0.0	5.2	14.2					
1-8-69	0.0	0.0	18.2	21.4					
High tide	0.0	0.4	18.0	28.4					
	9.4	19.2	25.4	30.8					
1-21-69	2.1	4.5	8.0	20.6					
Low tide	2.5	4.6	11.5	23.9					
	5.0	5.2	19.1	26.9					
1-21-69	12.8	16.2	19.4	20.9					
High tide	17.1	20.3	25.4	32.3					
	18.2	22.1	26.3	32.1					

1/ Insufficient depth to make a difference in values.

2/ All measurements are for surface, mid-depth and bottom positions, respectively.

Table B. Temperatures (°F) from Yaquina Bay, April 1968-March 1969

	Station					Station			
Date	A	B	C	D	Date	A	B	C	D
4-16-68	53	52	52	51	7-8-68	64	62	60	58
Low tide	1/	52	51	52	High tide	64	60	55	50
	52	52	50	52		63	60	52	50
4-16-68	53	53	53	52	7-22-68	70	69	63	54
High tide	53	52	51	51	Low tide	70	69	62	53
	53	52	50	50		70	68	62	52
4-30-68	58	58	58	55	7-22-68	67	67	62	60
Low tide	58	58	57	55	High tide	67	66	61	52
	58	58	55	54		67	66	61	51
4-30-68	59	58	58	54	8-5-68	68	68	65	60
High tide	58	57	54	53	Low tide	68	67	62	57
	57	57	54	53		67	65	61	55
5-13-68	57	57	57	54	8-5-68	65	63	62	58
Low tide	1/	1/	1/	54	High tide	64	62	58	55
	1/	57	56	53		64	61	56	54
5-13-68	56	55	53	53	8-28-68	64	64	63	60
High tide	55	54	53	53	Low tide	64	64	62	60
	54	54	56	53		64	64	62	60
5-31-68	64	64	63	61	8-28-68	64	63	61	61
Low tide	1/	64	62	60	High tide	64	62	61	61
	64	64	61	60		62	62	61	60
5-31-68	62	60	60	56	9-11-68	65	64	62	58
High tide	60	60	57	55	Low tide	65	64	62	58
	60	59	56	55		64	63	60	58
6-19-68	67	67	66	61	9-25-68	63	63	62	58
Low tide	67	66	62	61	Low tide	63	63	61	57
	66	65	59	55		63	62	60	56
6-19-68	66	65	63	56	9-25-68	64	60	58	58
High tide	65	64	58	52	High tide	62	59	57	55
	62	61	57	50		60	59	56	54
7-8-68	70	69	62	57					
Low tide	70	69	60	55					
	69	67	59	51					

Table B (cont'd)

Date	Station A	B	C	D	Date	Station A	B	C	D
10-9-68	57	56	56	52	1-21-69	43	43	44	45
Low tide	56	56	55	51	Low tide	43	43	44	45
	56	56	54	51		44	44	46	47
10-9-68	56	55	54	52	1-21-69	45	46	47	48
High tide	55	54	52	51	High tide	46	47	48	49
	54	53	52	51		47	47	48	49
10-31-68	54	54	55	55	2-7-69	43	43	43	44
Low tide	54	54	55	55	Low tide	43	43	44	45
	54	55	55	54		43	43	44	45
10-31-68	53	53	53	53	2-7-69	44	44	44	46
High tide	54	54	53	53	High tide	44	44	45	46
	54	54	53	53		45	45	46	46
11-14-68	50	50	50	49	2-21-69	47	47	47	47
Low tide	50	50	50	50	Low tide	47	47	47	47
	50	51	53	53		47	47	47	48
11-14-68	50	50	49	48	2-21-69	47	48	48	48
High tide	50	50	53	52	High tide	47	48	48	48
	52	53	53	53		47	48	48	49
12-12-68	49	49	49	48	3-21-69	51	51	50	50
Low tide	49	49	49	48	Low tide	51	51	50	50
	49	49	49	50		51	51	50	50
12-12-68	48	48	49	49	3-21-69	52	52	51	51
High tide	48	48	49	50	High tide	52	52	51	51
	48	49	50	51		52	51	50	50
1-8-69	47	47	47	48					
Low tide	47	47	47	48					
	47	47	48	48					
1-8-69	47	47	48	48					
High tide	47	47	48	49					
	48	49	49	50					

1/ Insufficient depth to make a difference in values.

2/ All measurements are for surface, mid-depth and bottom positions, respectively.

Table C. Dissolved oxygen values (ppm at tray level) from Yaquina Bay, April 1968-March 1969

Date	Station A	Station B	Station C	Station D	Date	Station A	Station B	Station C	Station D
4-16-68 Low tide	10.0	10.4	9.5	8.8	8-5-68 Low tide	6.2	6.6	7.6	10.7
4-16-68 High tide	10.2	8.9	9.0	9.0	8-5-68 High tide	6.3	6.5	9.0	9.7
4-30-68 Low tide	9.4	9.4	8.3	8.3	8-28-68 Low tide	5.4	5.4	6.0	7.0
4-30-68 High tide	8.8	8.2	9.1	10.0	8-28-68 High tide	6.4	6.5	8.2	8.5
5-13-68 Low tide	6.9	6.9	7.0	7.8	9-25-68 Low tide	6.4	6.4	6.8	7.0
5-13-68 High tide	8.0	8.0	10.2	10.8	9-25-68 High tide	7.0	7.5	7.4	7.3
5-31-68 Low tide	7.5	7.4	7.0	7.6	10-9-68 Low tide	7.3	7.5	8.0	7.8
5-31-68 High tide	8.2	8.2	8.0	8.2	10-9-68 High tide	8.2	8.4	8.4	8.8
6-19-68 Low tide	8.2	8.8	9.1	9.6	10-31-68 Low tide	8.5	8.6	8.7	9.2
6-19-68 High tide	7.5	7.5	6.6	6.0	10-31-68 High tide	8.4	8.4	8.5	8.6
7-8-68 Low tide	7.5	7.8	6.5	6.5	11-14-68 Low tide	9.6	9.4	9.4	9.3
7-8-68 High tide	6.9	6.4	5.6	5.0	11-14-68 High tide	9.2	9.3	8.6	8.9
7-22-68 Low tide	7.9	8.1	7.1	6.2	12-12-68 Low tide	10.2	10.3	10.0	10.2
7-22-68 High tide	6.8	6.4	6.7	5.4	12-12-68 High tide	10.3	10.5	10.0	9.9

Table C (cont'd)

Date	Station A	B	C	D
1-8-69 Low tide	10.6	10.6	10.3	10.2
1-8-69 High tide	10.7	10.7	10.0	9.6
1-21-69 Low tide	10.7	10.7	10.1	9.5
1-21-69 High tide	10.2	9.9	9.2	9.0
2-7-69 Low tide	11.1	11.2	10.7	10.2
2-7-69 High tide	10.8	10.9	10.1	10.2
2-21-69 Low tide	10.6	10.7	10.2	9.6
2-21-69 High tide	10.4	10.3	9.8	9.8
3-21-69 Low tide	10.9	11.2	11.1	10.1

Table D. Secchi disc readings (ft) from Yaquina Bay, April 1968-March 1969

Date	Station A	B	C	D	Date	Station A	B	C	D
4-16-68 Low tide	1/	2.0	2.5	4.0	8-5-68 Low tide	4.0	4.0	5.0	7.0
4-16-68 High tide	4.0	4.5	4.5	5.5	8-5-68 High tide	4.0	5.0	5.0	7.5
4-30-68 Low tide	3.5	3.5	4.5	4.5	8-28-68 Low tide	3.5	3.5	4.0	6.0
4-30-68 High tide	4.5	5.0	5.0	6.5	8-28-68 High tide	4.5	5.0	7.0	10.0
5-13-68 Low tide	1/	2.5	2.5	2.5	9-11-68 Low tide	5.0	5.0	5.0	8.0
5-13-68 High tide	2.5	3.0	3.5	5.5	9-25-68 Low tide	4.0	3.5	4.0	5.5
5-31-68 Low tide	3.0	3.0	3.5	4.0	9-25-68 High tide	5.0	5.5	7.0	7.5
5-31-68 High tide	3.5	4.0	4.5	10.0	10-9-68 Low tide	4.5	4.5	6.0	8.5
6-19-68 Low tide	3.5	4.0	4.0	5.0	10-9-68 High tide	5.5	6.0	6.5	10.0
6-19-68 High tide	4.0	4.0	4.5	7.0	10-31-68 Low tide	5.0	5.0	6.0	7.0
7-8-68 Low tide	3.5	3.5	4.0	8.0	10-31-68 High tide	6.0	6.0	5.5	6.5
7-8-68 High tide	3.5	4.0	4.0	11.0	11-14-68 Low tide	3.0	3.0	3.5	3.0
7-22-68 Low tide	3.0	3.5	4.5	10.0	11-14-68 High tide	3.0	3.0	3.0	4.5
7-22-68 High tide	3.5	4.0	4.5	6.0					

Table D (cont'd)

Date	Station A	B	C	D
12-12-68 Low tide	1.0	1.0	1.0	1.5
12-12-68 High tide	1.0	1.0	1.0	1.5
1-8-69 Low tide	1.0	1.0	1.5	2.5
1-8-69 High tide	1.5	1.5	2.0	3.5
1-21-69 Low tide	3.0	3.0	3.5	6.0
1-21-69 High tide	5.0	5.5	5.5	8.0
2-7-69 Low tide	4.0	4.5	5.0	7.5
2-7-69 High tide	5.0	5.0	6.5	8.5
2-21-69 Low tide	4.0	4.5	4.5	6.5
2-21-69 High tide	6.0	6.0	7.5	8.5
3-21-69 Low tide	3.5	3.5	3.0	7.0
3-21-69 High tide	5.0	6.0	7.0	9.5

1/ Insufficient depth to obtain reading.