Oysters

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INTRODUCTION

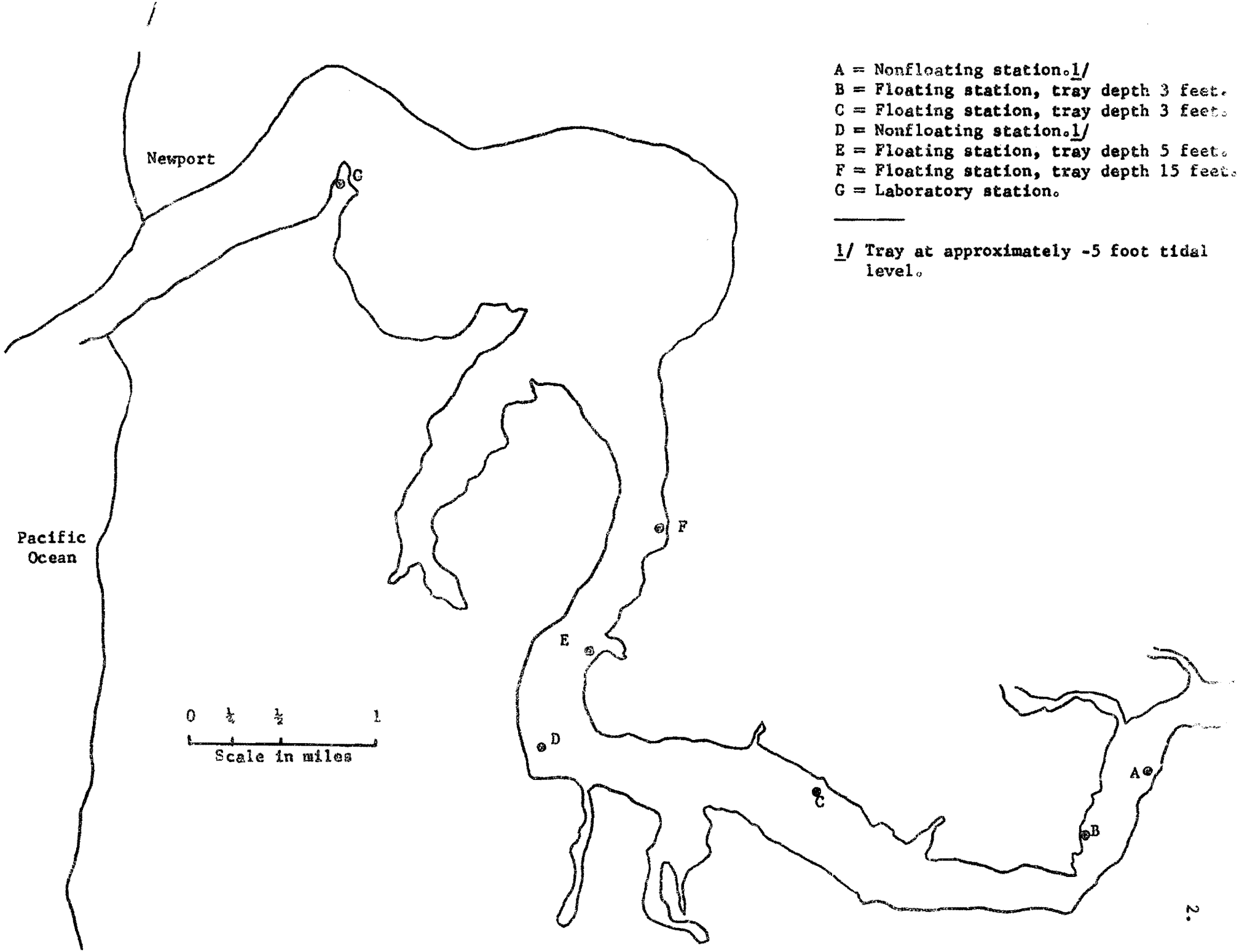
Although Oregon has been relatively free from any major oyster mortality a monitoring program has been established with the basic objectives being to: (1) monitor mortalities; (2) collect environmental data; and (3) furnish oysters from a disease-free area for histological examination.

METHODS AND MATERIALS

Field stations were established at Yaquina, Tillamook, and Coos bays. Figure 1 shows the depth and location of the Yaquina Bay stations. The Tillamook and Coos bay stations are located on intertidal oyster beds. The Yaquina Bay station trays are metal baskets 42 x 24 x 6 inches with a lid and a partition down the center. These trays were dipped in a nontoxic plastic to make them corrosion resistant. Half of each tray contains Pacific oysters (Crassostrea gigas) and the other half contains native oysters (Ostrea lurida). The section containing native oysters is lined with 3/8-inch mesh galvanized hardware cloth to prevent small oysters from falling through the larger mesh of the basket. The Coos and Tillamook bay station trays are plastic "igloo" lobster traps and contain only Pacific oysters. In the laboratory, two wooden trays are maintained with running sea water and contain both native and Pacific oysters.

Each station has a sacrifice tray and a control tray. The Yaquina control trays each contained 100 Pacific and 200 native oysters, however, these numbers are gradually reduced by mortalities. Each month four native and three Pacific oysters are taken from the sacrifice tray at each Yaquina station.

The Tillamook and Coos bay trays started with 55 and 50 Pacific oysters, respectively, and are checked each month. Three Pacific oysters are taken from the sacrifice tray and four are collected from the surrounding beds.



A = Nonfloating station.1/
B = Floating station, tray depth 3 feet.
C = Floating station, tray depth 3 feet.
D = Nonfloating station.1/
E = Floating station, tray depth 5 feet.
F = Floating station, tray depth 15 feet.
G = Laboratory station.

1/ Tray at approximately -5 foot tidal level.

Figure 1. Yaquina Bay, Oregon, showing location of the oyster mortality stations.

The laboratory station contained 100 native and 100 Pacific oysters and is checked daily for mortalities and for oysters showing distress. No regular sacrifice is made from it. A random length-frequency sample is taken at each station each month. The oysters taken monthly from the sacrifice trays are used as control histological specimens or for determining a condition index. All dying oysters ("gapers") and control histological specimens are fixed in Davidson's fixative and sent to the University of Washington for preparation and analysis. The university makes three slides of each oyster with one being sent to the Bureau of Commercial Fisheries Laboratory at Oxford, Maryland, and one to the Fish Commission. The third is kept at the university where it is read. The slides are reread at Oxford, Maryland, for confirmation.

The condition index is established by the formula:

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

To get the dry weight, the oyster meat is dried in an oven at 90 C for 1 week after which it is weighed.

Environmental (hydrographic) data are taken twice a month at the Yaquina Bay stations. Salinities and temperatures are taken at the surface, mid, and bottom levels at all stations and pH is measured at surface and bottom levels of stations A, C, and F (Figure 1) using a colorimetric pH kit. Dissolved oxygen is measured from samples collected at tray level and turbidity is measured with a Secchi disc. Additional temperature data are obtained at station D with a Ryan Model D recording thermometer. At Coos and Tillamook bays, surface temperatures and salinities are taken each sampling period.

DISCUSSION

Mortalities

No heavy mortalities were noted in the Yaquina Bay during the study period. Native oyster mortality was 18.2% (402 oysters) while Pacific oyster

mortality was an insignificant 1.8% (19 oysters). Death rates among O. lurida were similar from June 1966 through March 1967, but went up considerably from April through June 1967. Almost half of the dead native oysters from this period came from the upper two stations (Table 1). The 19 dead C. gigas represent a very minimal natural mortality.

Two deaths (0.04%) were recorded at the Tillamook station between December 1966 and April 1967, and six oysters (0.18%) died at Coos Bay between February and June 1967, neither of which can be considered significant.

Condition index

Pacific oyster condition index followed a seasonal pattern with the lowest values occurring during December through April. A similar pattern was not observed with native oysters, however they showed a decline in condition index in July as a result of spawning. The Tillamook Bay condition index values were similar to those for Yaquina Bay and the Pacific oysters at Coos Bay have shown a lower condition index than those at the other bays (Table 2).

Growth

Trends indicate that in Yaquina Bay both C. gigas and O. lurida grew best at station D and poorest at the upper stations, A and B. A marked increase in size was evident in Pacific oysters from April through June (Table 3). Native oysters did not show any such change during the same period (Table 4). Growth trends of Pacific oysters in Tillamook and Coos bays were similar to those in Yaquina Bay (Table 5). To better demonstrate growth rates, during the coming year individual oysters will be measured each month instead of a random sample.

Table 1. Oyster mortalities in Yaquina Bay, by station and quarterly period, June 1966-June 1967.

Station	A		B		C		D.		E		F		G		TOTAL			
Date	C. gigas	O. lurida	C. gigas	O. lurida	C. gigas	O. lurida	C. gigas	O lurida	C. gigas	O. lurida	C. gigas	O. lurida	C. gigas	O. lurida	C. gigas	%	O. lurida	%
June-September 1966	0	23	1	11	0	10	2	15	0	8	1	11	0	3	4	0.3	81	3.8
October-December	1	14	0	14	2	11	0	7	2	8	2	11	0	0	7	0.6	65	2.9
January-March 1967	0	9	1	22	0	10	1	8	0	8	0	13	0	3	2	0.2	73	3.4
April-June	0	39	0	68	2	27	0	14	3	17	0	11	1	7	6	0.6	183	9.2
Total	1	85	2	115	4	58	3	44	5	41	3	46	1	13	19	1.8	402	18.9

Table 2. Mean condition index, June 1966-June 1967.

Month	Yaquina Bay		Coos Bay	Tillamook Bay
	O. lurida	C. gigas	C. gigas 2/	C. gigas 2/
June 1966	12.1 1/	19.7 1/	-	-
July	9.6	14.7	-	-
August	13.6	16.2	-	-
September	17.4	16.2	-	16.9
October 26-November 7	15.5	15.3	-	-
December	14.3	14.4	9.6	14.0
January 1967	15.5	14.1	7.3	13.0
February	14.9	12.2	9.4	14.1
March	13.8	13.3	8.1	13.3
April	14.9	13.8	-	-
May	13.5	17.1	-	12.9
June	-	-	14.7	-

1/ Experimental oysters before being placed in trays.

2/ Includes specimens from tray and surrounding beds.

Table 3. Mean value of length times width in millimeters for Pacific oysters, Yaquina Bay, July 1966-June 1967.

Date	Station					
	A	B	C	D	E	F
July 20-Aug. 1, 1966	5,231	4,564	4,762	5,509	4,450	4,138
Aug. 19-Sept. 1	5,089	4,735	5,110	6,281	4,814	4,759
Sept. 26-Oct. 15	5,865	5,110	6,163	7,611	5,444	5,284
Oct. 25-Nov. 7	5,922	5,158	5,504	7,444	5,649	5,442
Dec. 1-12	5,808	4,592	5,903	7,499	5,801	6,051
Jan. 3-4, 1967	5,888	5,032	5,841	7,104	5,652	5,881
Jan. 31-Feb. 7	5,582	5,071	5,843	7,233	5,942	5,854
Mar. 2-21	5,416	4,592	5,814	7,165	5,878	6,958
Apr. 24-May 2	6,390	4,999	6,178	8,391	-	6,910
June 1-2	6,461	5,782	7,018	9,043	7,445	7,212
Mean for total time period	5,765	4,963	5,813	7,328	5,677	5,848

Table 4. Mean length in millimeters of native oysters, Yaquina Bay, July 1966-June 1967.

Date	Station					
	A	B	C	D	E	F
July 25, 1966	38.5	40.2	38.5	40.2	38.5	38.3
Aug. 24	39.6	41.6	42.2	42.1	41.6	40.9
Oct. 5	41.3	41.1	42.6	43.7	41.9	42.0
Nov. 7	39.3	41.7	42.2	42.9	40.7	42.3
Dec. 6	40.2	41.6	42.0	43.1	39.9	42.5
Jan. 4, 1967	39.3	40.3	41.5	42.7	40.4	41.1
Jan. 31	41.5	41.5	41.9	44.3	41.5	41.7
Mar. 2	39.1	40.7	41.5	42.2	39.8	40.4
May 2	38.7	41.1	42.0	41.1	-	40.9
June 2	38.9	39.9	41.5	42.6	39.7	39.8
Mean for total time period	39.6	41.0	41.6	42.5	40.4	41.0

Table 5. Mean value of length times width in millimeters for Pacific oysters, Tillamook and Coos bays, October 1966-June 1967.

Date	Tillamook Bay	Coos Bay
Oct. 14, 1966	8,811	-
Dec. 8	8,779	-
Jan. 5-6, 1967	8,520	10,067
Feb. 2	8,234	10,044
March 1-6	8,409	10,500
April 30	8,142	10,188
June 12	-	11,289
Mean for total time period	8,482	10,417

Hydrographic data

Hydrographic data from Yaquina Bay (Table 6) show that the study area changes character during the year from an essentially salt-water bay in the summer to an area heavily influenced by fresh water in the winter. Yaquina River, Elk River, smaller tributaries, and cooling water from a pulp mill at Toledo all add fresh water to the bay. As a result, a layering of fresh water over salt water is common during high tide in the rainy season. Salinity at the surface at high tide has gone as low as 0.3 0/00 during December at station A. At station F, 4 miles from the mouth of the bay, the lowest surface reading was 4.0 0/00 during the same period. Corresponding values for bottom salinities were 5.9 0/00 and 25.9 0/00, respectively. During the winter, temperatures stayed uniformly low, averaging 49.6 F at mid-depth at both stations A and F. During June through October mid-water salinities at high tide were relatively stable at all stations. In August 1966 an upwelling of cold, oyxgen-poor ocean water entered the bay and a distinct temperature stratification was observed with differences as great as 18 F between the bottom and mid-water layers.

Table 7 shows surface temperatures and salinities taken at Tillamook and Coos bays at low tide.

Turbidity readings at high tide ranged from 1 foot to 7 feet at station A and to 11 feet at station F. Station A, heavily influenced by fresh water, had a yearly average turbidity reading of 4.2 at high tide as compared to 5.5 for station F nearest the ocean (Table 6). Dissolved oxygen concentrations, measured at tray level, were generally high throughout the study period. Mean readings, at high tide, were 6.8 mg/l at station A and 7.9 mg/l at station F. The extreme ranges at the upper station were 9.6 and 4.8 mg/l. Station F varied from 10.6 to 4.0 mg/l. The low values were probably caused by oceanic upwelling.

Table 6. Hydrographic data for Yaquina Bay, June 1966-June 1967.

Station	A	F	A	F	A	F	A	F	A	F
Date	Salinity[1] 0/00		Temp.[1] F		pH[2]		Turbidity feet		Dissolved oxygen[3] ppm	
					June 1966-September 1966					
6-28-66	25.3	31.2	69	65	7.7	8.0	4.0	3.5	5.8	8.2
7-15-66	27.8	33.3	67	58	8.0	8.7	5.0	6.0	6.8	10.6
8-1-66	30.2	34.1	68	50	7.8	7.7	3.0	11.0	6.8	4.0
8-15-66	32.3	34.4	64	50	8.0	7.7	4.0	6.5	6.8	5.2
8-31-66	29.0	32.4	66	62	7.5	8.0	3.5	4.0	4.8	6.5
9-14-66	30.0	32.3	64	61	7.6	7.9	2.5	3.5	4.6	6.2
					October 1966-December 1966					
10-4-66	29.9	32.3	63	58	7.7	8.3	4.0	4.5	5.3	6.6
10-18-66	29.6	33.0	54	50	8.0	8.0	3.5	6.5	6.5	7.8
11-1-66	26.1	32.8	56	53	8.2	8.2	5.0	11.0	7.9	8.5
11-18-66	17.0	26.1	51	51	8.0	8.3	4.5	5.0	8.3	8.8
12-5-66	2.1	17.7	48	50	6.8	8.2	1.0	1.0	9.2	9.0
12-22-66	11.1	18.7	50	50	7.3	8.8	7.0	6.0	8.4	8.6
					January 1967-March 1967					
1-11-67	10.6	28.5	48	50	7.4	8.2	4.0	6.0	9.2	9.3
1-30-67[4]	0.0	8.2	48	49	6.7	8.0	1.0	1.0	10.2	9.6
2-15-67	12.2	23.8	48	48	8.0	8.8	4.5	6.0	8.6	9.2
3-27-67[4]	3.8	19.3	49	50	7.1	7.8	1.0	4.0	9.6	9.0
					April 1967-June 1967					
4-5-67	21.8	29.1	50	50	8.2	8.0	7.0	5.0	8.2	8.9
5-4-67	11.0	29.9	55	52	8.5	8.2	6.0	6.0	8.2	8.6
5-16-67[4]	13.2	26.9	64	58	8.3	8.4	3.0	5.0	8.2	7.6
6-5-67	25.9	33.6	62	54	8.3	8.2	3.5	4.0	7.1	6.3
6-22-67	23.4	30.4	62	52	8.2	8.2	3.5	4.0	6.7	9.1

1/ Mid-depth reading.

2/ Bottom depth reading.

3/ Tray level reading.

4/ Readings at low tide.

Table 7. Surface salinities and temperatures, Tillamook and Coos bays, December 1966-June 1967.

Month	Tillamook Bay		Coos Bay	
	Temperature F	Salinity 0/00	Temperature F	Salinity 0/00
Dec. 1966	46	8.8	48	3.5
Jan. 1967	43	15.8	49	0.5
Feb.	50	11.1	54	0.9
March	52	20.6	54	1.8
April	70	20.1	52	1.6
May	-	-	-	-
June	-	-	60	-

Stations A and F differed in pH values. The readings at station F averaged slightly over 8, at station A slightly less than 8. Only in April-June 1967 did the pH values at station A exceed 8. Maximum-minimum pH values for station A were 8.3 and 6.7; station F had a pH range from 8.8 to 7.7.

SUMMARY

At the end of the first contract year we find no evidence of major oyster mortality. The 1.8% annual mortality (less than 1% by quarterly period) observed in Pacific oysters can be regarded as a minimal natural mortality. The 3-4% mortality in native oysters by quarterly period (except during April-June 1967 when trauma from spawning increased the percentage to 9%) is considerably less than expected or observed in the past by workers from Oregon State University and the University of Washington. Further study is needed to see if the downward mortality trend in this latter species continues.