LABORATORY HATCHING AND REARING OF PACIFIC COAST CLAMS AND OYSTERS

Public Law 88-309 Projects

ANNUAL REPORT
July 1, 1968-June 30, 1969

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Fish Commission of Oregon

U. S. Department of Interior
Fish and Wildlife Service
Bureau of Commercial Fisheries
Commercial Fisheries Research and Development Act
Subproject 1-27-R-2
Contract No. 14-17-0001-1905

October 1969

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LABORATORY HATCHING AND REARING OF PACIFIC COAST CLAMS AND OYSTERS

INTRODUCTION

The first year of the project was devoted to developing laboratory spawning and larval rearing techniques for Pacific Coast clams and oysters. The objectives of the past year were to: (1) refine these spawning and rearing techniques to achieve higher larval survival to the adult form and (2) initiate growth and survival studies in the field using laboratory-raised juvenile clams and oysters.

An experimental oyster rearing raft was designed and constructed for use in oyster studies in Yaquina Bay.

A habitat study was initiated in Yaquina Bay to determine growth and survival of laboratory-reared butter clams.

MATERIALS AND METHODS

Spawning and larval rearing of oysters

Pacific and Kumamoto oysters (Crassostrea gigas) were spawned and the larvae were reared through metamorphosis using the same techniques as previously reported (Phibbs, 1968). Spat were collected on shell and samples of six broods were held in the laboratory for growth studies.

Oyster growth and survival studies

Plastic pipe containing European oyster spat were placed in oyster growing areas of Yaquina, Netarts and Coos bays to monitor oyster growth and survival. Studies were initiated to compare growth and survival of imported and laboratory-reared oyster spat of approximately the same age. Imported Japanese oyster spat set in the summer of 1968 was used in the

experiments. This seed underwent a hardening process in which it was exposed to the air for increasing periods of time prior to shipment to the Pacific Northwest. The Japanese spat was received in March and April 1969 and held in the laboratory for 2 to 4 weeks prior to planting to observe any shipping mortality. Imported and laboratory-raised Pacific and Kumamoto oyster spat were then measured, placed in trays and suspended from an oyster rearing raft at a depth of 3 feet. Samples were measured monthly to determine growth.

Experimental oyster raft

An experimental oyster raft was designed and built to study off-bottom oyster culture in Yaquina Bay (Figure 1). The raft is 32 feet long, 20 feet wide and consists of a framework supported by eight fiberglas floatation tanks (Figure 2). The framework is made of planks bolted together and reinforced by 1/4-inch steel angle supports. The floatation units consist of fiberglas tanks (56 inches x 32 inches x 25 inches deep) bonded to a 3/4-inch plywood deck which serves as a work area (Figure 3). Two 20-foot shear logs at each end of the raft protect it from floating debris. The raft is held in position by two Danforth No. 22-S anchors attached to each end by 100 feet of 1/2-inch wire rope.

Oyster trays (3 feet x 6 feet), (Figure 4) were suspended in the center spaces of the framework. The capacity of the raft is 27 trays arranged in three tiers. The raft is stationed at the mouth of McCaffery's Slough in Yaquina Bay.

Spawning and larval rearing of clams

Butter clams (Saxidomus gigantous) were conditioned and induced to spawn by adding 2.0 gm of KC per liter of water (Phibbs, 1968). Larvae

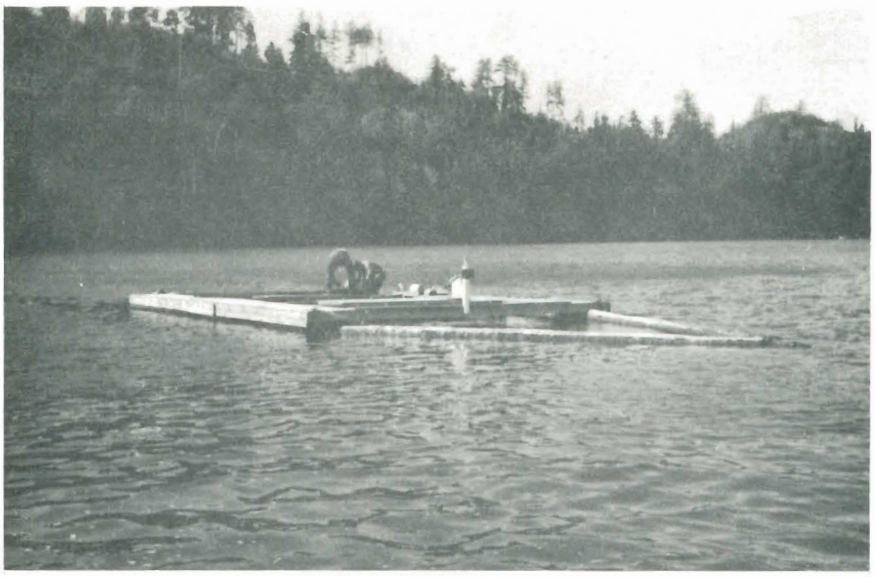

Figure 1. Experimental oyster rearing raft

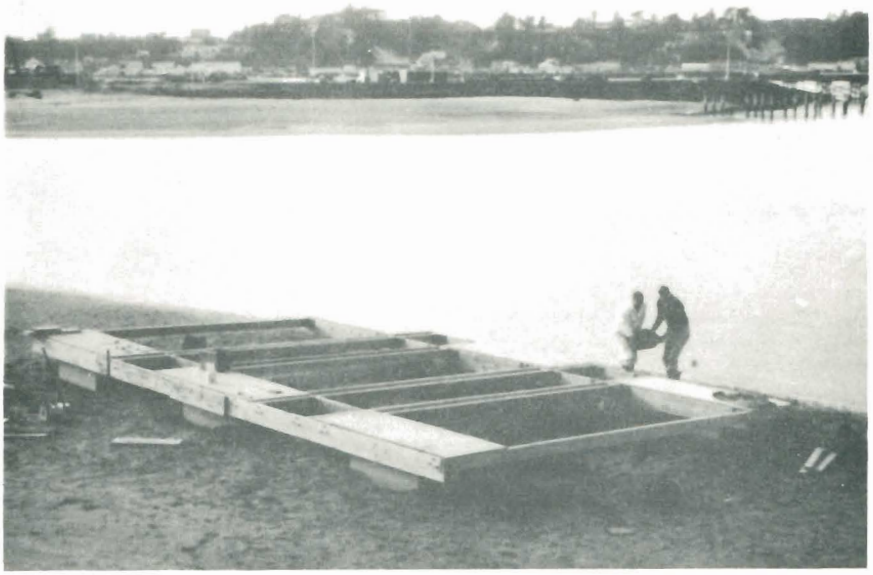

Figure 2. Oyster raft showing wood framework and fiberglas floatation units

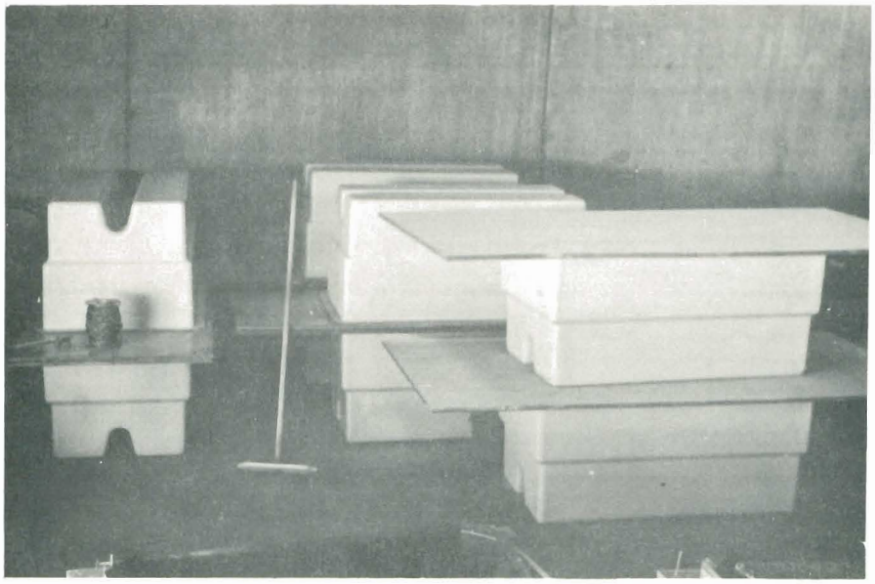

Figure 3. Fiberglas floatation units used in supporting the oyster raft

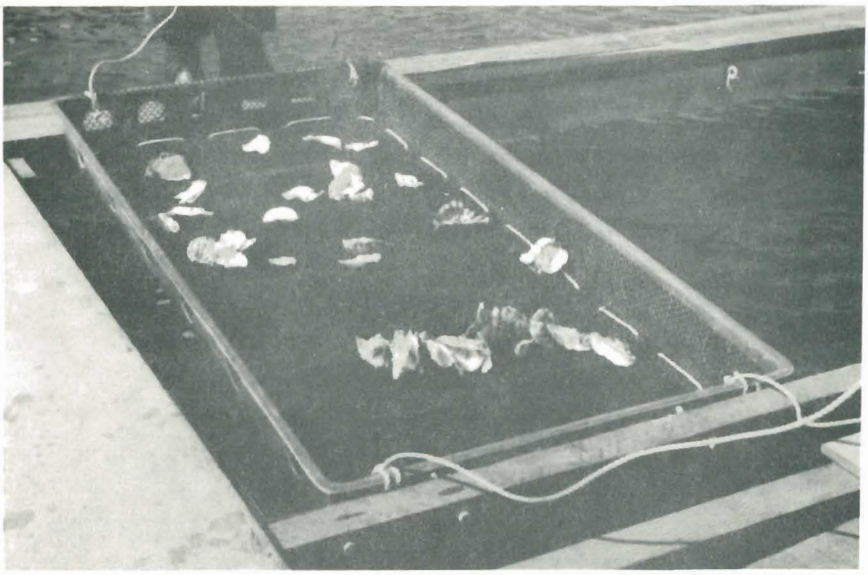

Figure 4. Oyster trays used in suspended oyster culture in Yaquina Bay

were reared through metamorphosis and juveniles were held for use in field studies.

Adult gaper clams (Tresus capax) were "stripped" and the gametes mixed to obtain fertilized eggs. The larvae were reared through metamorphosis. Larval survival through metamorphosis was increased by renewing the rearing water periodically.

Attempts were also made to spawn razor (Siliqua patula), cockle (Clinocardium nuttalli) and little neck (Protothaca staminea) clams.

Clam marking experiments

Two different broods of clams (15,000 clams each) were placed in 25 liters of sea water containing 8 ppm sodium alizarin monosulfonate for marking as described by Hidu and Hanks (1968). The clams were fed 100,000 cells per ml of Monochrysis and Isochrysis algae daily. The staining solution was renewed every 2 days for the first 2 weeks and daily for the second 2 weeks when the experiment terminated. One hundred juvenile gaper clams were also marked with alizarin stain in a preliminary experiment.

Clam field studies

A habitat study was initiated in Yaquina Bay to determine the effects of various substrate types upon the survival of laboratory-raised juvenile butter clams.

Gravel of various types and sizes were mixed into the substrate of 8x8-foot plots to a depth of 6 inches. The plots were established at a tide level of +1.0 feet. A control plot was left undisturbed. After allowing the plots to settle for 1 week, juvenile butter clams were placed in a 4x4-foot portion of each plot at a density of 100 clams per square

foot. The clams were 8 months old and averaged 2.9 mm in shell length. Part of the clams were marked with sodium alizarin monosulfonate (3.5 unmarked clamsto 1 marked).

Survival and growth of the clams will be measured by screening two random samples of 1 square foot (1 to 2 inches deep) from each plot every 6 months (Figures 5 and 6).

Additional plots of natural substrate were planted with butter clams in December, March and May to compare clam growth and survival by period of planting (Table 1). Every 2 months, 6 random samples (1 square foot each) were screened, clams counted, measured and returned to the plots.

An 8x8-foot plot was planted with unmarked gaper clam juveniles. Planting density was 25 clams per square foot. Samples taken before planting revealed a natural set of four gaper clams per square foot. Six random samples were taken 1 month after planting for growth and survival data.

RESULTS

Spawning and larval rearing of oysters

Prolonged low salinities in Yaquina Bay due to the extreme rainfall occurred from November through February (mean salinities were below 15 ppt throughout the period in the areas where the brood oysters were held, Gibson (1969). Attempts to spawn Pacific and Kumanoto oysters or to obtain viable sex products by stripping were unsuccessful with the exception of one group of oysters from a deep water area which was spawned in December. The adult oysters were in such poor condition that holding the oysters in the laboratory resulted in weakening the oysters further and high mortalities occurred. Some brood oysters will be held in deeper waters of Yaquina Bay next winter in an attempt to alleviate this problem.

Figure 5. Taking square-foot samples from butter clam habitat study plots

Figure 6. Screening square-foot samples from butter clam plots

Table 1. Juvenile butter clams planted in Yaquina Bay

Plot	Plot size (sq. ft.)	Date planted	Planting density (per sq. ft.)	Ratio unmarked:marked
A	64	Dec. 16, 1968	100	3.5:1
B	80	Dec. 16, 1968	80	3.5:1
C	64	Mar. 12, 1969	25	6.4:1
D	64	May 7, 1969	25	All unmarked
E	64	May 7, 1969	25	All marked

Oyster growth and survival studies

European oyster spat, set on plastic pipe and planted in oyster producing areas of Yaquina, Netarts and Coos bays, failed to survive the winter. Mortality was attributed to prolonged periods of low salinities.

Only 1 month's growth data were available on laboratory reared and imported Pacific oyster spat (Table 2). Growth during this period was comparable for both groups (Table 2). Growth in shell length of laboratory-reared Kumamoto spat spawned in September was better than imported spat during the first 2 months of the study (Table 3). Growth of spat spawned in December nearly equaled the growth of the imported seed. No mortality has been observed.

Spawning and larval rearing of clams

Butter clams were conditioned and spawned successfully in November, February and May. Fertilized eggs from clams spawned in May did not develop due to fouling of the holding water by excess sperm and body fluids. Juveniles from spawnings in November and February will be used in field plantings.

A paper entitled "Some Observations on the Spawning and Early Development of the Butter Clam, Saxidomus gigantens, (Deshayes)" coauthored with W. P. Breese [1/] was submitted for publication.

1/ W. P. Breese is an associate professor on the staff at the Oregon State University Marine Science Center, Newport, Oregon.

Table 2. Growth (mm) of imported and laboratory-reared Pacific oyster spat

	Spawning date			
	6/5/68	7/29/68	8/13/68	Summer 1968 2/
Date sampled \ Source	Laboratory	Laboratory	Laboratory	Imported
May 7, 1969 1/	8.2-6.7 3/	7.3-5.4	5.2-4.4	6.9-5.2
June 11, 1969	18.2-15.3	19.0-16.5	11.9-11.5	17.9-14.2

1/ Beginning date and size.

2/ Spawning date unknown (set in Japan in summer of 1968).

3/ Length-width.

Table 3. Growth (mm) of imported and laboratory-reared Kumamoto oyster spat

	Spawning date		
	9/23/68	12/17/68	Summer 1968 2/
Date sampled \ Source	Laboratory	Laboratory	Imported
April 16, 1969 1/	3.2-2.9 3/	8.1-6.5	4.6-3.8
May 16, 1969	11.3-9.8	13.3-11.5	10.1-8.3
June 11, 1969	22.0-19.2	24.3-20.2	17.3-14.7

1/ Beginning date and size.

2/ Spawning date unknown (set in Japan in summer of 1968).

3/ Length-width.

Survival of gaper clam larvae through metamorphosis was increased from previous experiments by renewing the rearing water regularly. Renewal of the rearing water every 4 days resulted in 9.8 to 12.0% completing metamorphosis. Larvae reared without renewal of rearing water died before metamorphosis was completed. Metabolites and uneaten algae

accumulate on the bottom of the rearing tanks when the water is not renewed. This fouls the water and causes mortality. Mortality occurs as the larvae settle to the bottom and begin to metamorphose under these conditions.

Attempts to spawn razor, cockle and little neck clams in the past year were unsuccessful. Use of potassium chloride to stimulate spawning in razor clams induced small releases of eggs. "Stripping" of razor clams yielded low numbers of malformed larvae that died after 1 week. The problem is believed to be due to the late maturing of razor clams this year. Few clams had spawned naturally by June this year whereas during previous years spawning was completed by the last of May.

Clam marking experiments

Marking juvenile butter clams with the vital stain, sodium alizarin monosulfonate, was successful. The stain was incorporated into the new shell growth leaving a red band (Figure 7).

Marking juvenile gaper clams was unsuccessful. The clams (6 to 8 mm in shell length) grew slowly and did not incorporate the stain. Nearly 50% mortality occurred during the experiment. The staining experiments will be repeated using smaller clams.

Clam field studies

Survival of butter clams for the first 6 months of the habitat study appears to have been better in the areas containing introduced crushed gravel (3.5, 6.0 and 9.0% vs. 1.5 and 2.0%, Table 4). Growth was also better in areas containing crushed gravel (8.6, 9.2 and 9.7 mm in crushed gravel vs. 7.4 and 7.9 mm in river gravel).

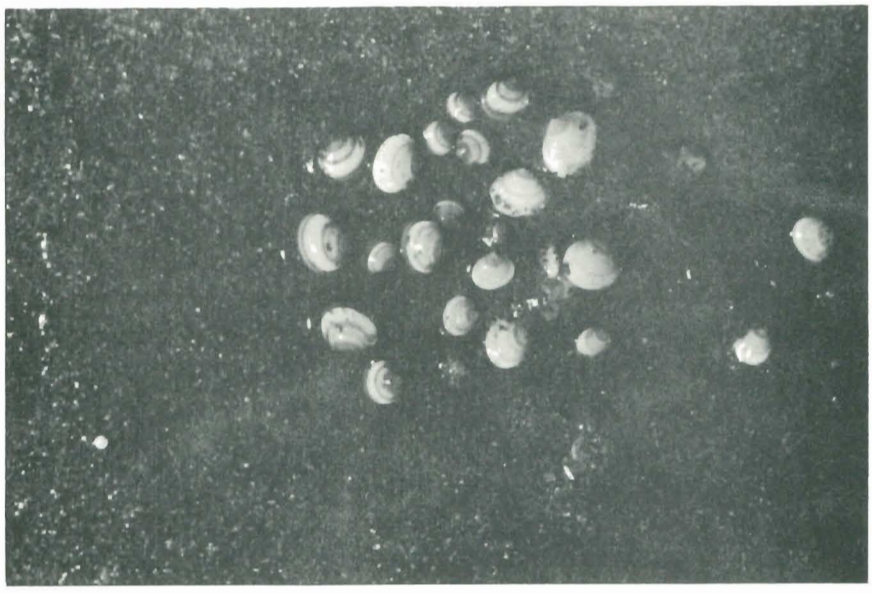

Figure 7. Juvenile butter clams marked with sodium alizarin monosulfonate stain. Dark areas stain

Table 4. Growth and survival of butter clams planted in prepared experimental plots after 6 months

Plot number	Gravel type and size	Per cent survival	Average shell length (mm)
1	Control (Unchanged)	1.0	8.3
2	Crushed 3/4"-1 1/2"	3.5	9.7
3	River 3/4" minus	2.0	7.9
4	Crushed 3/4" minus	6.0	9.2
5	River 3/4"-1 1/2"	1.5	7.4
6	Crushed 1 1/2"-3"	9.0	8.6

After 2 months, survival of butter clams planted in March was significantly higher (28.7%) than those planted in December (7.0 and 5.0%, Table 5). No shell growth was apparent on clams planted in December at the end of 2 months. By April the survival was 7.0 and 2.9% and the clams were beginning to grow (3.9 and 4.3 mm). Survival after 6 months (1.3%) was comparable to the control plot of the habitat study (1.0%, Table 4) and average shell length had tripled from planting (2.9 to 8.1 and 9.4 mm). Clams planted in March increased in shell lengths from 3.9 to 5.5 mm in 2 months.

Six random samples were taken from the gaper clam plot 1 month after planting. No live clams and only two empty clam shells were found. The fact that naturally set clams (4 per square foot) did not survive indicates that the area was not desirable for gaper clams even though there was a limited number of adult clams in the area. Mortality is assumed to be due to exposure during the low summer tides.

Table 5. Growth and survival of butter clams planted in December 1968 and March 1969

Plot A			Plot B			Plot C		
Date	Per cent survival	Average shell length (mm)	Date	Per cent survival	Average shell length (mm)	Date	Per cent survival	Average shell length (mm)
12/16/68 1/	—	2.9	12/16/68 1/	—	2.9	3/12/69 1/	—	3.9
2/12/69	7.0	2.7	2/12/69	5.0	2.8	5/6/69	28.7	5.5
4/3/69	7.0	3.9	4/7/69	2.9	4.3			
6/16/69	1.3	9.4	6/16/69	1.3	8.1			

1/ Date clams were planted.

SUMMARY

Poor success was experienced in spawning Pacific and Kumamoto oysters during the winter and spring.

An oyster raft was designed and constructed to study off-bottom oyster culture in Yaquina Bay. Studies comparing growth and survival of Pacific and Kumamoto imported and laboratory-reared oyster spat was initiated. Early results indicate laboratory-reared Kumamoto oyster spat grew faster than imported oyster seed of similar age

European oysters set on plastic pipe failed to survive the winter in Yaquina, Netarts and Coos bays.

Larvae of butter and gaper clams were successfully reared through metamorphosis. Juvenile butter clams were marked with sodium alizarin monosulfonate prior to planting in Yaquina Bay.

A butter clam habitat study using various gravel sizes and types was initiated in Yaquina Bay to study clam growth and survival. After 6 months growth and survival were better in plots containing introduced crushed gravel than the control plot (natural substrate) and the plots containing introduced river gravel. Additional plots of butter clams on natural substrate were planted in December and March to compare clam survival and growth with period of planting. Survival 2 months after planting was better for clams planted in March than those planted in December. Clams planted in December showed no shell growth in 2 months whereas clams planted in March grew considerably.

One plot was planted with gaper clam juveniles. All clams died during the first month.

LITERATURE CITED

Gibson, Gary G. Oyster Mortality Study. Annual Report, April 1, 1968, to March 31, 1969. Fish Comm. of Ore. 20p.

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