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COMMERCIAL CLAM PRODUCTION

COMPLETION REPORT
October 1, 1979 to December 31, 1981

by
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ABSTRACT

We completed our assessment of commercial clam harvest potential in Tillamook, Yaquina and Coos bays. All three bays contained commercial quantities of clams. Detailed studies in Yaquina Bay in 1981 revealed a biomass estimate of 2.6 million pounds (1,179.1 mt) of gaper clams (*Tresus capax*) in the study tract.

Our studies showed strong recruitment and survival of gaper set in 1975. Since then survival of set has been negligible.

Estimates of instantaneous rates of natural mortality for eight gaper clam cohorts ranged from 0.12 to 0.89.

The experimental commercial clam harvest in Oregon was entirely in Coos Bay during 1980 and 1981. Poor market conditions eliminated the fishery from Yaquina Bay.

Pump harvesters reported a catch per hour of effort of 432 pounds/hr (196 kg/hr), nearly twice the harvest rate of jet harvesters.

The effects of harvest on recruitment and habitat were evaluated. Analysis of variance revealed that densities of only two species of clams (littlenecks and macomas), and amphipods and anemones were significantly different in the treatment and control sites at the 95% confidence level.

Sediments in post-harvested areas showed a significantly higher percentage of coarse material at the 95% confidence level.

INTRODUCTION

This report summarizes the results of the final two years of our contract studies on the bay clam resources in Oregon's major estuaries. A completion report documenting the first three years of our work was submitted in 1976 (Gaumer, 1976). The report described laboratory clam rearing studies, clam planting work, and clam surveys performed from 1973 to 1976. The second phase of our studies was summarized and further reported distribution and commercial potential of Oregon bay clams (Hancock, et al. 1979). Three annual progress reports have been prepared since 1979 which reported assessment of harvest potential and effects of harvest upon recruitment (Gaumer, et al. 1979; Gaumer and Robart, 1980; Gaumer and Starr, 1982).

The objectives of all report periods have been: (1) to refine techniques for assessing the potential for a commercial clam fishery in several of Oregon's estuaries and in offshore locations along the southern Oregon coast and (2) to develop a scientifically sound clam management data base.

ASSESSMENT OF HARVEST POTENTIAL

As a result of our clam distribution studies conducted between 1973 and 1979, several areas within Tillamook, Yaquina and Coos bays were found to contain what appeared to be commercial quantities of subtidal clams (Gaumer and Lukas, 1975; Gaumer and Robart, 1980). Studies conducted in 1976 (Gaumer and Halstead, 1976) revealed that commercial quantities of subtidal clams existed in certain portions of these three bays.

Although we originally planned to inventory subtidal clams off the southern Oregon coast, the studies did not materialize during the contract period. The commercial fishermen that expressed an interest in a joint exploratory survey with our Department were unable to obtain the state and federal fill and removal permits necessary to conduct the surveys.

This section summarizes the results of our studies in Yaquina and Coos bays. The Yaquina test plot encompassed 18.4 acres (7.4 ha) (Figure 1), whereas the Coos Bay site covered 48.0 acres (19.4 ha) (Figure 2).

Results and Discussion

Yaquina Bay

Table 1 shows the population and biomass estimates of clams collected from Area 2 of Yaquina Bay since 1975. Gaper clams (*Tresus capax*) and macoma clams (*Macoma inquinata*) were the two principal species encountered. Other species included the cockle (*Clinocardium nuttallii*), native littleneck (*Venerupis staminea*), butter (*Saxidomus giganteus*) and piddock (*Zirfaea pilsbryi*) clams.

Gaper clams, the target species for the commercial fishery, had an estimated peak population of 36.3 million clams in 1975 and decreased in numbers to a population low of 6.2 million clams in 1981. A corresponding decrease in

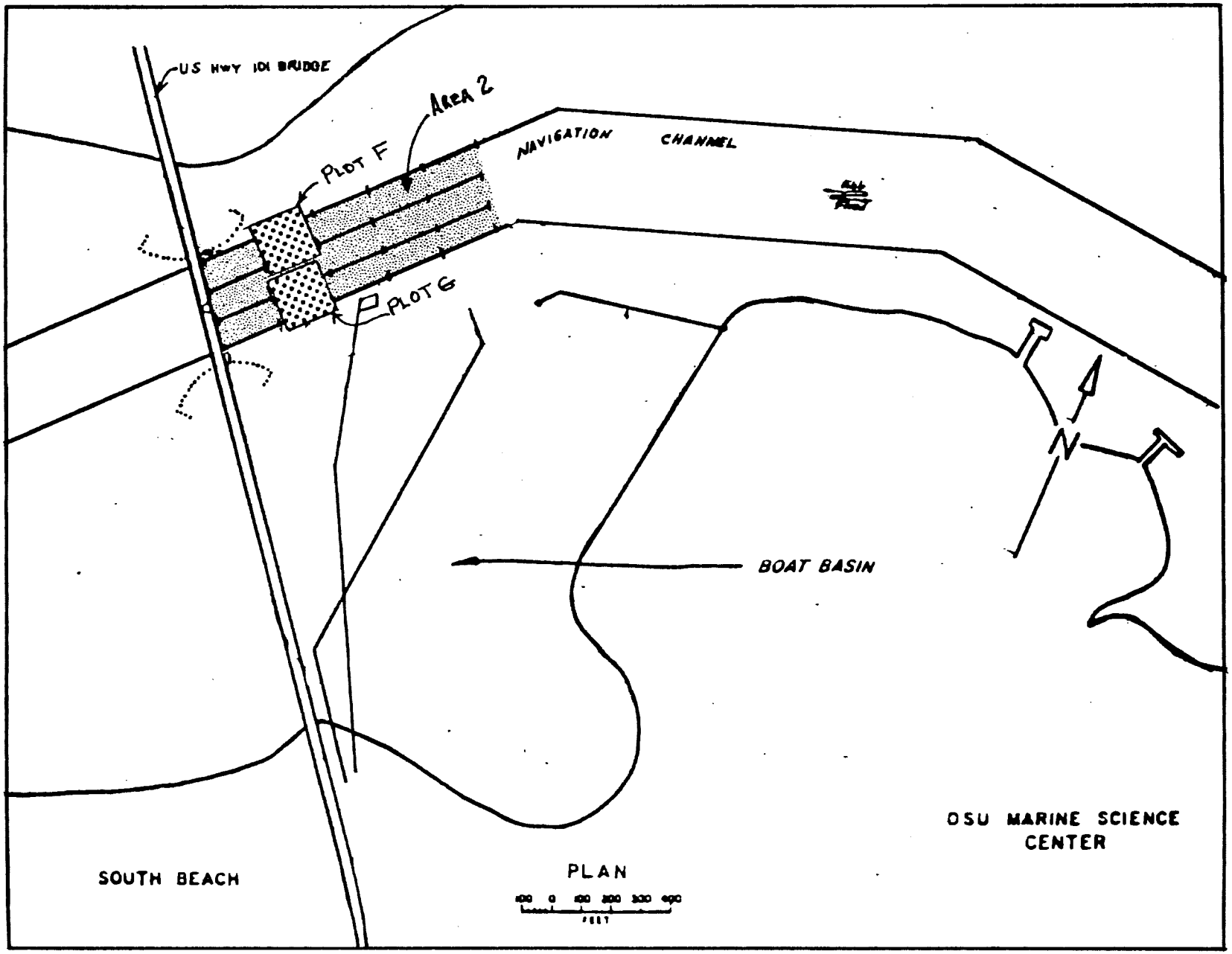

Figure 1. Map of Yaquina Bay, Showing Areas Approved for Commercial Clam Harvest.

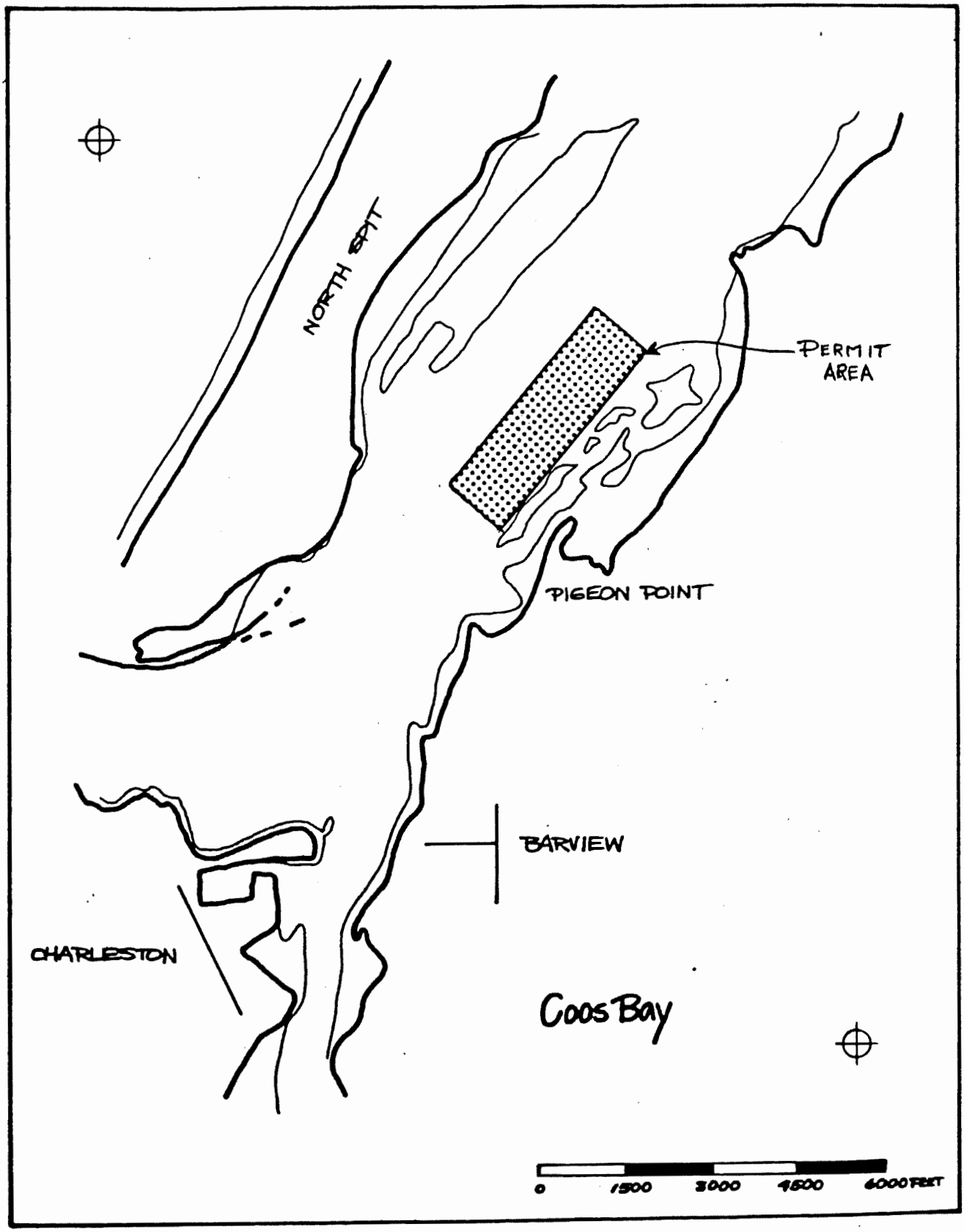

Figure 2. Map of Lower Coos Bay, Showing Area Approved for Commercial Clam Harvest.

estimated biomass was also recorded. Gaper clam biomass decreased from over 5.1 million pounds (2,267.6 mt) in 1975 to 2.6 million pounds (1,179.1 mt) in 1981.

The principal reason for this decline was the nearly complete lack of annual recruitment since a very successful set in 1975 (Table 2). No recruitment has been realized from the 1978 to 1981 year-classes. Spawning and juvenile settlement occurred each year, but survival was negligible. Mean gaper clam densities ranged from a high of 45.4/ft^2 (488.7/m^2) in 1975 to a low of 7.7/ft^2 (82.9/m^2) in 1981. Several of the individual samples collected in 1975 contained gaper set in excess of 200.0/ft^2 (2,153.0/m^2).

Table 1. Population and Biomass Estimates of Subtidal Clams in Area 2, Yaquina Bay, 1975-81.

	Numbers						
Species	1975	1976	1977	1978	1979	1980	1981
Gaper	36,300,000	25,566,400	29,316,000	10,560,000	11,116,700	11,050,000	6,160,000
Cockle	183,200	16,800	0	32,000	16,700	0	0
Littleneck	366,400	216,800	116,000	48,000	133,300	66,700	120,000
Butter	416,000	333,600	200,000	240,000	200,000	366,700	200,000
Macoma	13,532,800	20,566,400	12,049,600	11,200,000	10,100,000	10,100,000	5,968,000
Piddock	1,700,000	0	0	0	0	0	0
Total	52,498,400	46,700,000	41,681,600	22,080,000	21,566,700	21,583,400	12,448,000

	Biomass (lbs)						
Species	1975	1976	1977	1978	1979	1980	1981
Gaper	5,084,200	5,217,200	4,968,991	4,136,800	3,461,100	4,265,600	2,569,700

Table 2. Recruitment Estimates by Year-Class, of Subtidal Gaper Clams in Area 2, Yaquina Bay, 1975-81.

Year-	Numbers						
Class	1975	1976	1977	1978	1979	1980	1981
1975	28,894,800	18,995,800	24,742,700	5,786,900	9,666,700	9,414,600	5,427,000
1976	-	25,500	351,800	570,200	150,000	165,800	18,500
1977	-	-	29,300	211,200	16,700	0	18,500
1978	-	-	-	0	0	0	0
1979	-	-	-	-	0	0	0
1980	-	-	-	-	-	0	0
1981	-	-	-	-	-	-	0

Mean age composition of clams sampled from Area 2 is shown in Table 3. The steady increase in age, since 1975, for gaper, butter and littleneck clams reflects the impact of strong recruitment from the 1974 and 1975 year-classes and weak recruitment since then. From 1975 to 1981 gaper clams increased in mean age from 0.6 years to 6.3 years, butter clams increased from 3.2 years to 10.5 years and littleneck clams increased from 1.5 years to 6.1 years. Too few cockle clams were collected to show a trend.

Table 3. Mean Age (yrs) of Clams Sampled from Area 2, Yaquina Bay, 1975-81.

Species	Year 1975	1976	1977	1978	1979	1980	1981
Gaper	0.6	3.1	4.5	4.1	4.4	5.3	6.3
Cockle	0.9	-	-	3.0	-	-	-
Butter	3.2	7.9	7.8	7.9	11.3	9.1	10.5
Littleneck	1.5	5.1	3.9	5.3	5.3	4.8	6.1

Table 4 displays the mean length composition for the same four species of clams. Mean lengths of gaper clams increased from 36.9 mm in 1975 to 91.7 mm in 1981. Butter and littleneck clams exhibited similar increases in mean sizes.

Table 4. Mean Length (mm) of Clams Sampled from Area 2, Yaquina Bay, 1975-81.

Species	Year 1975	1976	1977	1978	1979	1980	1981
Gaper	36.9	76.0	65.9	90.8	83.2	88.7	91.7
Cockle	20.5	13.0	-	47.5	-	-	-
Butter	35.4	63.4	86.1	75.3	83.2	76.0	75.3
Littleneck	24.4	45.3	46.3	57.3	56.3	44.0	50.0

We regressed estimated abundance with time to obtain estimates of natural mortality for eight gaper clam cohorts. Estimated instantaneous rates of natural mortality (M) ranged from 0.12 to 0.89 (Table 5). This wide range may be partially due to the fact that the estimates of M are only as reliable as the estimates of abundance. The most reliable abundance estimates are those which came from large samples and are for clams younger than 5 years (because of the difficulty in aging clams older than 5 years). Therefore, the 1972, 1975, and 1976 year-class abundance estimates are the most reliable for the 1975 to 1981 time period. Estimated M for those year-classes exhibited a narrower range from 0.33 to 0.50.

Table 5. Estimated Abundance of Various Cohorts of Gaper Clam, Area 2, Yaquina Bay, Oregon, 1975-81

Year Class	YEAR Sept. 1975	Oct. 1976	May 1977	Feb. 1978	March 1979	March 1980	March 1981	M
1967	395,800	151,200	89,379	45,815	17,502	-	-	0.89
1968	1,193,200	295,750	138,040	53,080	12,988	-	-	0.12
1969	1,627,700	617,150	366,610	185,280	70,249	-	-	0.89
1970	981,720	470,080	314,380	188,520	90,272	45,649	23,084	0.68
1971	250,600	218,960	203,400	185,210	161,830	142,820	126,050	0.12
1972	2,031,300	1,180,900	878,090	602,500	350,270	211,980	128,290	0.50
1975	42,663,000	29,851,000	24,560,000	19,166,000	13,410,000	9,634,700	6,922,000	0.33
1976	-	611,020	494,110	364,620	245,530	170,250	118,050	0.36

Coos Bay

Analysis of our data showed the 48-acre (19.4 ha) clam bed in Coos Bay contained an estimated 3.7 million clams in 1980 (Table 6). This represented a net loss of approximately 22.7 million clams since our 1975 survey. The only species not realizing a dramatic decrease in numbers was the piddock clam. The dredging of the nearby main ship channel during the 1975-80 time period may have contributed to the reduction of clams in the harvest bed. Post dredge observations revealed what appeared to be more fluid sand over much of the area. Whatever the reason for the population decline, we believe that the commercial fishery in the area had little impact on the availability of harvestable clams. Less than 300,000 clams, mainly gapers, were removed from the area from 1975 to 1980, and only a small portion of the plot was worked.

As in 1975, gaper and macoma clams were the principal species recorded. Mean gaper clam densities ranged from a high of $2.7/ft^2$ ($29.1/m^2$) in 1975 to $0.3/ft^2$ ($3.2/m^2$) in 1980. Biomass estimates during that same time period decreased from 484 mt to 210 mt.

Table 6. Population and Biomass Estimates of Subtidal Clams in Pigeon Point Area, Coos Bay, 1975 and 1980.

	1975		1980	
Species	Number	Biomass (lbs)	Number	Biomass (lbs)
Gaper	5,648,700	1,530,800	606,400	464,400
Cockle	202,200	23,000	16,900	Not Calculated
Littleneck	843,000	71,600	151,800	" "
Butter	809,200	248,200	236,100	" "
Irus	16,018,600	Not Calculated	2,428,100	" "
Piddock	0	" "	252,900	" "
Petricola	101,000	" "	0	" "
Bentnose	2,647,300	" "	0	" "
Cryptomya	67,300	" "	0	" "
Bodega	101,000	" "	0	" "
Total	26,438,300	1,873,600	3,692,200	464,400

Gaper clams in the Coos Bay survey area had a mean age of 2.6 years in 1976 and 5.7 years in 1980. Similar to Yaquina Bay, recruitment was sporadic with a near total failure of the 1975-1979 year-classes. The loss of the 1975 year-class is particularly disturbing since this year-class is dominant in Yaquina, Netarts, and Tillamook bays.

Mean length of gapers was 65.7 mm in 1975 and 102.8 mm in 1980.

COMMERCIAL CLAM HARVEST

As a result of our clam assessment surveys, selected areas within Yaquina and Coos bays were approved for an experimental commercial clam fishery (Figures 1 and 2). The fishery was designed to study the effects of mechanical clam harvesting equipment on the clam resources and benthic environment. Two types of harvest equipment were permitted: a high pressure hand-held water jet and a suction pump. Specific areas were designated within Yaquina Bay for jet or pump harvest. The entire unit in Coos Bay was open to either jet or pump. A quota of 10% of the available gaper clam biomass was arbitrarily selected for harvest from each permit area. The season started July 1 and ended December 31 for each year. Monthly accounts reporting pounds and numbers of clams harvested and hours of effort were required of each harvester.

Table 7 is a summary of the number of clam diggers we issued permits to mechanically remove clams from Yaquina and Coos bays from 1976-1981. To date, most interest has been towards the use of a high pressure water jet in Coos Bay.

Table 7. Summary of Numbers of Permits Issued to Commercial Clam Harvesters, 1976-81.

	Yaquina Bay		Coos Bay	
	Jet	Pump	Jet	Pump
1976	1	1	2	0
1977	2	3	1	0
1978	2	2	1	1
1979	0	2	3	1
1980	1	1	4	1
1981	2	1	4	1
Total	8	10	15	4

Results and Discussion

The experimental clam fisheries in Yaquina and Coos bays produced 291,088 pounds (132 mt) and 290,867 pounds (132 mt), respectively (Table 8). The harvest peaked in 1978 when 199,162 pounds (90.3 mt) were landed and steadily declined to a low of 61,955 pounds (28.1 mt) in 1981. In 1980 and 1981, only Coos Bay fishermen produced clams. Poor market conditions and the availability of cheap east coast clams contributed to this lower harvest.

Although harvest permits were issued to both jet and pump harvesters for most years in each bay, a number of harvesters reported no take. Several of these fishermen confided in us that they reapply every year with no intention of fishing, but want to be ready if a market develops.

Catch per hour of effort was highest for pump operators in Yaquina Bay where they took 432 pounds/hr (196 kg/hr). Surprisingly, jet operators in Yaquina and Coos bays harvested clams at nearly the same rate; 243 pounds/hr (110 kg/hr) vs. 239 pounds/hr (109 kg/hr), respectively.

Table 8. Summary of Harvest (lbs) and Catch/Effort (lbs/hr) for Commercially Harvested Subtidal Clams, 1975-81.

	Yaquina Bay				Coos Bay			
	Jet	C/Hr	Pump	C/Hr	Jet	C/Hr	Pump	C/Hr
1976	0	0	0	0	103,584	226	0	0
1977	38,505	307	15,600	129	11,931	157	0	0
1978	9,103	128	153,315	486	36,744	250	0	0
1979	0	0	74,565	593	13,901	287	0	0
1980	0	0	0	0	62,752	282	0	0
1981	0	0	0	0	61,955	235	0	0
Total	47,608	243	243,480	432	290,867	239	0	0

Table 9 exhibits the year-class composition of commercially harvested subtidal gaper clams taken from Yaquina and Coos bays from 1976-1981. Yaquina Bay data revealed that the 1970-1972 year-classes were the principal age groups taken in 1977 and 1978. In 1979 the 1975 year-class became important in the take, producing over 67% of the harvest. No harvest was reported for 1980 and 1981. Mean ages of harvested clams were 5.7, 7.4 and 4.8 years in 1977, 1978 and 1979, respectively.

It was difficult to determine if pump and jet operators were selectively harvesting gaper clams by size. Table 10 shows that in 1977 gaper clams taken by jet operators in Yaquina Bay averaged 116.0 mm in length, whereas pump harvested gapers averaged 109.1 mm. In 1978, the mean length of pump harvested clams was 26.6 mm larger than those taken by jet.

Data collected from Coos Bay harvested gaper clams showed a wide range of year-classes represented in the take. In contrast to Yaquina Bay, the 1975 year-class has never been a large contributor to the harvest. The mean age of clams ranged from 6.2 years in 1978 to 8.9 years in 1980. Jet harvested gapers were generally larger in Coos Bay than in Yaquina Bay (Table 10).

Table 9. Summary of Year-Class Composition (in Percentage) of Commercially Harvested Gaper Clams, 1976-81.

Year-Class	Yaquina Bay						Coos Bay					
	1976	1977	1978	1979	1980	1981	1976	1977	1978	1979	1980	1981
					1/	1/						
1964	--	--	--	--	--	--	1.7	--	--	--	--	--
1965	--	--	0.1	--	--	--	5.9	--	--	--	--	--
1966	--	<0.1	0.2	--	--	--	50.0	--	--	--	0.3	--
1967	--	0.7	1.0	0.4	--	--	3.4	0.9	--	--	0.3	--
1968	--	1.8	5.9	0.4	--	--	0.0	7.2	--	0.6	4.7	--
1969	--	8.5	12.3	0.0	--	--	0.4	27.0	4.9	9.0	9.4	--
1970	--	17.2	25.8	1.6	--	--	3.4	28.8	14.0	5.8	14.5	--
1971	--	29.8	31.0	4.3	--	--	5.0	18.0	20.7	26.9	25.6	2.1
1972	--	25.4	16.7	7.8	--	--	27.7	15.3	15.8	37.5	33.7	12.8
1973	--	6.7	5.2	8.3	--	--	2.1	0.9	43.5	9.0	10.4	42.6
1974	--	2.0	0.7	8.8	--	--	0.4	1.8	1.1	8.7	0.7	29.8
1975	--	7.8	1.1	67.2	--	--	--	--	--	2.6	0.3	12.8
1976	--	--	--	1.2	--	--	--	--	--	--	--	--
1977	--	--	--	--	--	--	--	--	--	--	--	--
1978	--	--	--	--	--	--	--	--	--	--	--	--
Mean Age (Yrs)	--	5.7	7.4	4.8	--	--	7.8	6.9	6.2	7.3	8.9	7.6

1/ No commercial harvest during these years.

Table 10. Summary of Mean Lengths (mm) of Commercially Harvested Gaper Clams, 1976-81.

Year	Yaquina Bay		Coos Bay	
	Pump	Jet	Pump	Jet
1976	--	--	--	133.1
1977	109.1	116.0	--	132.6
1978	123.5	96.9	--	121.2
1979	101.6	--	--	126.4
1980	--	--	--	133.7
1981	--	--	--	132.3

EFFECTS OF HARVEST ON RECRUITMENT AND HABITAT

One of our primary concerns with a new commercial clam fishery was the effect the harvest might have on recruitment. This is especially important in Oregon since our estuaries are small in size and few in number. Ideally, a commercial fishery can harvest a portion of the existing clams without affecting recruitment from surrounding brood stock.

Due to the location of our research facilities most of our field activities were limited to Yaquina Bay. This segment reports the results of our findings from Yaquina Bay.

Results and Discussion

Although we originally planned to evaluate the relative effects of a water jet vs. a suction pump on clam recruitment and surrounding habitat, little measurable effort by jet harvesters precluded a comparison. As a result, we were only able to measure the impacts caused by a suction pump in Plot C of Area 2 in Yaquina Bay (Figure 1).

Plot C was originally surveyed in 1978 and contained 1.3 million clams, of which 0.4 million were gapers weighing 358,900 pounds (162.7 mt). Gapers in the plot averaged 118.8 mm in length and 397.2 gms in weight. Preharvest sampling revealed a clam density of 21.6/ft^2 (232.5/m^2). Mean age was 6.4 years. A harvest quota of 200,000 pounds (90.7 mt) was approved for the site.

A control test plot was established near the treatment area. Gaper clams in the control plot averaged 120.3 mm in length and 411.8 gms in weight. Mean age was 6.4 years. Our sampling revealed a clam density of 64.4 clams/ft^2 (695.5/m^2) for the control area.

Two suction pump operators, working side by side removed 153,315 pounds (69.5 mt) or 43% of the gapers from Plot C in the fall of 1978. The harvested clams averaged 123.5 mm in length and 420.2 gms in weight. Mean age was 7.4 years. Post harvest sampling in the fished area showed a clam density of 1.3/ft^2 (14.0/m^2), indicating a nearly complete removal of clams. Approximately 60% of the test plot was harvested.

Post harvest samples were taken twice a year, spring and fall, from 1978 to 1981 (Table 11). Results of this sampling revealed a disturbing fact that we have had poor survival of set of gaper and cockle clams in Yaquina Bay in both the treatment and control sites. Some recruitment was evident for butter and littleneck clams in both the harvest and control plots. Although we made no effort to age the macoma clams, populations appeared to remain constant for this species throughout the test period.

In the post harvest samples we found that 64 different species of marine organisms reestablished themselves in Plot C, whereas 46 species were observed in the control (Gaumer et al, 1979). Mollusca, annelida and arthropoda were all well represented in the samples.

A two-way analysis of variance was applied to test for possible variation due to temporal separation of sampling periods. Since our data showed no

variation due to sampling in different time periods, a one-way analysis of variance was utilized as a more powerful test for evaluating differences in number of taxonomic groups between treatment and control.

Analysis of variance for our 1981 data showed that densities of two species of clams (littlenecks and macomas), and amphipods and anemones were significantly different in the treatment and control sites at the 95% confidence level. Our 1980 data revealed no significant differences for the five species of clams and 17 other taxa of benthic invertebrates.

The impact of the commercial clam harvest on habitat was initially assessed by visual observations. Post-harvest surveys revealed little physical evidence of the harvest. Strong tidal currents in the area removed nearly all evidence of the fishery.

Sediment analysis of the pre- and post-harvest samples showed the percentages of coarse materials were generally higher in the post-harvest samples. We found percentages of gravel, shell and coarse sand significantly higher at the 95% confidence level following harvest, whereas the percentage of fine sands was significantly lower. These data suggest that a portion of the fine sand was carried away from the area during harvest.

MANAGEMENT CONSIDERATIONS

The primary purpose of this study was to develop a scientifically sound clam management data base. The years of data collection and analysis, accomplished with PL 88-309 funding, provided our Department with considerable insight into the status and basic biology of several species of bay clams. Our commercial bay clam management program was aided by our research which had the following findings and considerations:

1. A resource inventory of both the intertidal and subtidal clam stocks in 11 of Oregon's major estuaries was completed and provided a wealth of information on species composition, distribution, relative densities, and habitat requirements. Data were also collected on sand shrimp and vegetation. Our distributional surveys were extensive; we examined over 518,000 meters of transect which included over 9,200 stations.

2. Although a large volume of data were collected, analyzed and reported, considerable knowledge of basic Oregon clam life history is still needed.

3. The subtidal surveys provided new information on the location of clam beds having commercial harvest potential in Tillamook, Yaquina and Coos bays. Biomass estimates in these bays revealed a total of 18.4 million pounds (8,345 mt) of clams. Yaquina Bay contributed 10.4 million pounds (4,717 mt), or 57%, of this total. For the three bays combined, gaper clams comprised 74.5% of the total biomass.

4. Gaper clams were found associated with eelgrass beds in many instances. Few clams were observed in areas having dense concentrations of sand and mud shrimp. These results tend to indicate the importance of substrate stability to the settling and/or survival of bay clams.

5. In 1975 an experimental commercial gaper clam fishery was initiated in Yaquina Bay. Our primary objective was to evaluate the impact of harvest on clam recruitment and habitat. Two types of harvesting gear were permitted--a high pressure water jet and a suction pump. Due to the lack of effort by jet harvesters, only the impact caused by the suction pump was evaluated. Little long term impact by the suction pump on recruitment or habitat was noted for the treatment area.

6. Recruitment of subtidal clams in Yaquina Bay was found to be annual but survival was sporadic; 1975 was the last year for high survival of gaper clams. This precluded us from fully understanding the impact of the fishery on recruitment. This also suggests that careful consideration must be given to the allowable acreage for subtidal harvest.

7. Species diversity in the treatment plot returned to preharvest levels within months of harvest.

8. Suction pump harvesting was considerably more efficient than water jet harvesting. Pump operators were able to harvest 432 lbs/hr (196 kg/hr), nearly double what the jet operators could take.

9. Growth data suggest that the optimum age to harvest gaper clams in Yaquina Bay is about five years.

10. Meat recovery for gaper clams was highest during the winter and averaged 21% of live wet weight.

11. Market conditions more than anything else affected the commercial clamming activity in Yaquina and Coos bays.

12. Gaper clams, the principal target species in Oregon, are not easily marketed. The high cost of processing, and their bland flavor reduces their value as a chowder base clam. Because of this, few Oregon processors were willing to try processing gaper clams.

13. Most of the gaper clams taken in 1979 went into the fish bait market.

14. Certain factors restricted the profitable harvest of gaper clams in Oregon from 1975 to 1981:

    a. Harvesting equipment was expensive to operate and maintain,

    b. Labor costs were high,

c. Tidal currents restricted the hours/day of effective harvest,

d. Harvest was conducted in deep water which limited down time for divers,

e. Harvest was in areas of heavy boat traffic which produced dangerous waves,

f. Visibilities were generally poor due to plankton blooms or suspended sediments from river runoff,

g. The seasons were short, July 1-December 31 annually,

h. State Board of Health requirements limited areas of potential harvest, and in Yaquina Bay, allowed only gaper clams to be taken; and

i. Processors required a dependable daily supply to hire and keep crew; a constant supply could not be guaranteed by the harvesters.

Table 11. Summary of Clam Densities (No./ft^2) in Treatment and Control Sites, Plot C of Area 2, Yaquina Bay, 1978-81.

Sample Period	Gaper		Cockle		Butter		Littleneck		Macoma	
	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control
Spring 1978	6.4	12.6	0.3	0.0	0.6	0.8	0.3	0.0	14.1	20.6
Fall 1978	0.2	12.0	0.3	0.6	0.1	2.0	0.2	1.8	0.5	48.0
Spring 1979	12.3	6.0	0.3	0.5	0.9	1.0	0.8	0.5	3.3	102.5
Fall 1979	0.0	9.6	0.0	0.4	3.6	3.5	1.1	0.5	3.7	33.3
Spring 1980	42.0	5.3	1.8	0.3	1.9	1.6	4.1	0.4	5.4	60.3
Fall 1980	5.1	2.8	0.3	0.2	3.8	1.0	1.6	0.3	9.3	16.7
Spring 1981	2.6	9.2	0.1	0.2	4.8	1.3	2.9	0.3	7.4	24.3
Fall 1981	1.2	6.1	0.9	1.5	4.7	5.4	2.8	0.8	4.6	39.3

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