Tillamook

COMMERCIAL CLAM PRODUCTION

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by

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COMMERCIAL CLAM PRODUCTION

ABSTRACT

Studies on the assessment of harvest potential in Yaquina Bay continued. Population and biomass estimates, age and size of clams were calculated for an area in Yaquina Bay having commercial harvest potential. Our data revealed that the 1975 year-class continued strong with over 88% of the gapers sampled of this age. Approximately 2.5 million pounds (1,165.4 mt) of gapers were estimated for the area and a harvest quota of 250,000 pounds (113.4 mt) was established.

We calculated estimates of natural mortality for eight year-classes of gaper clams in Yaquina Bay and they ranged from 0.12 to 0.89.

Due to poor markets, none of the three Yaquina Bay commercial clam fishermen landed clams in 1981. This was the second consecutive year of no harvest. In 1979, 74,565 pounds (33.8 mt) were taken.

In Coos Bay 61,955 pounds (28.1 mt) of clams were harvested. Of this total, 59,751 pounds (27.1 mt) or 96.4% were gaper clams. Production figures showed that 272 pounds (0.1 mt) were taken/hour.

Post harvest surveys revealed significant differences in population densities, at the 95% confidence level, for recruitment of macoma and littleneck clams in the treatment and control sites. Amphipods and anemones were also similarly impacted. In general, all species of clams have revealed poor survival of recruitment in Yaquina Bay since 1975.

INTRODUCTION

During the year we continued our studies on the clam resources in Oregon's estuaries. Our objectives were: to collect data for developing a scientifically sound clam management data base and to refine techniques for assessing the potential for a commercial clam fishery in several of Oregon's estuaries. In addition we continued to monitor the growth of laboratory reared Manila littleneck clams *(Tapes japonica)* released in Netarts Bay.

ASSESSMENT OF HARVEST POTENTIAL

We continued our survey of Area 2 in Yaquina Bay to determine the commercial clam harvest potential (Figure 1). This area has been surveyed and clam resources inventoried every year since 1975. The experimental commercial clam harvesting area in Coos Bay surveyed in 1975 and 1980 was not resurveyed in 1981 (Figure 2).

Methods

Yaquina Bay

Using techniques developed by the Washington Department of Fisheries (Goodwin, 1973) and the Oregon Department of Fish and Wildlife (Gaumer and Halstead, 1976) we collected data on the subtidal clam populations in Yaquina Bay. We removed 24 samples from the 18.4 acre (7.4 ha) site. Data collected provided estimates of population and biomass, size, weight, age and species composition, recruitment and natural mortality.

Following our assessment of clam stocks in Area 2, we selected two 0.9 acre (0.4 ha) sites for the 1981 commercial clam fishery. Plot F was restricted to the use of a suction pump for harvest and Plot G was designated for harvest with a high pressure water jet (Figure 1). Data similar to that collected from Area 2 were obtained from Plots F and G.

Coos Bay

The same 48-acre (19.4 ha) site that was approved in 1975 for commercial harvest of clams was again opened for the 1981 season. Due to limitations in manpower and the fact that this area was surveyed in 1980, we did not resurvey the harvest area in 1981.

Results and Discussion

Yaquina Bay

Population and Biomass Estimates, Area 2. From our samples we estimated that 12.4 million clams inhabited Area 2 (Table 1). This was about one-half the number estimated in 1980. Gaper clams *(Tresus capax)*, the target species for the commercial fishery, represented over 6.1 million of this total with a biomass estimated at over 2.5 million pounds (1,165.4 mt). Decreases in availability of gaper and macoma *(Macoma inquinata)* clams were responsible for the lower total number of clams in the population.

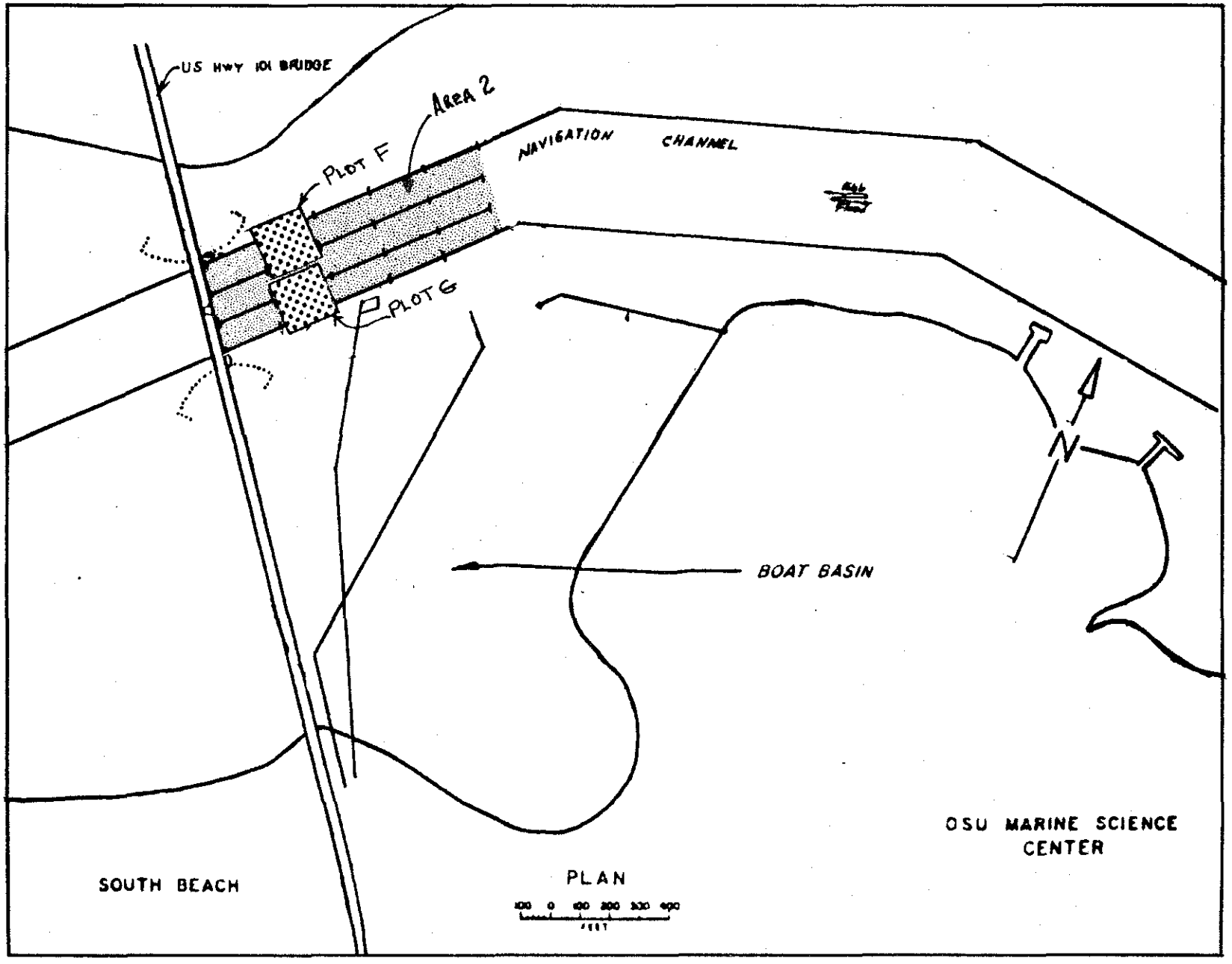

Figure 1. Map of Yaquina Bay, Showing Areas Approved for Commercial Clam Harvest.

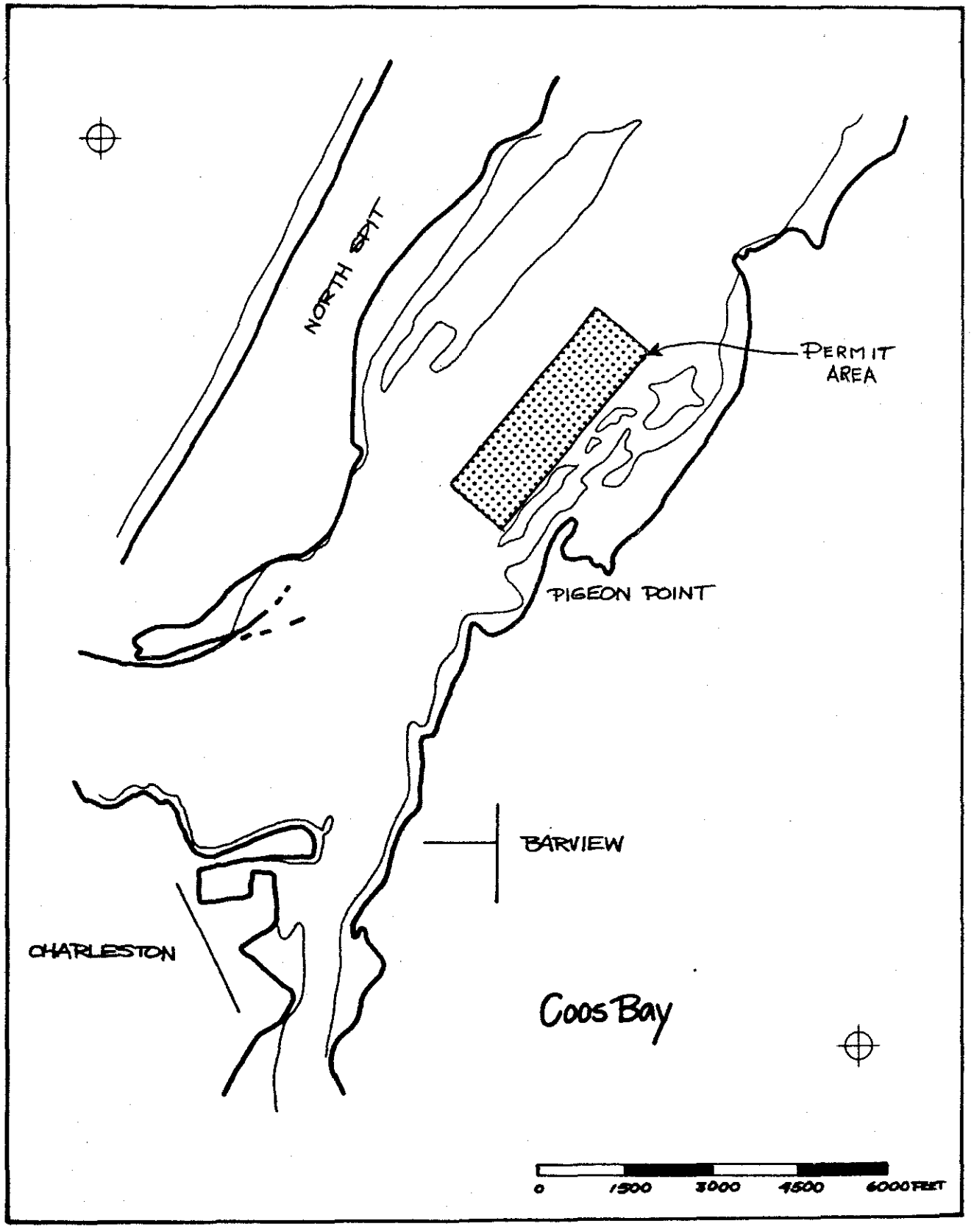

Figure 2. Map of Lower Coos Bay, Showing Area Approved for Commercial Clam Harvest.

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

The year-class composition of gaper clams in Area 2 is shown in Figure 3. The 1975 year-class continues to represent a majority of the clams (88.1%) in the population. Mean age of the gapers was 6.3 years, an exact increase of 1.0 years since 1980 illustrating the lack of recruitment or mortality of the older clams in the population. Our data reveal no survival of gaper set since 1978 and very little in 1976 and 1977. Surveys in 1981 were taken too early to expect that year-class to show in the samples. Age composition data for butter, cockle and littleneck clams are not presented due to the few clams collected. The length-class distribution of gaper clams from Area 2 is shown in Figure 4. Mean size was 91.7 mm, an increase of 3.0 mm since 1980.

Gaper clams in Area 2 exhibited a patchy distribution. The wide range in numbers of individuals observed created a large sample variance which resulted in a large coefficient of variation for our population estimates. To minimize the effect of the large variance we applied an iterative numerical fitting routine involving the least squares technique (Snedecor and Cochran 1978) to gaper clam population estimates.

We utilized the CURFIT program in Oregon State University's CDC CYBER 170/720 computer to plot a "best fit" regression line for eight gaper clam cohorts. Observed numbers of clams were too small or inconsistent to obtain realistic regression lines for the 1963-66, 1973, 1974, and 1977-80 year-classes. From the eight plausible regression lines we obtained estimates of natural mortality (M) and cohort abundance through time (Table 2).

Estimated M values ranged from 0.12 to 0.89 which indicates vastly different rates of natural mortality between year-classes. These data may be

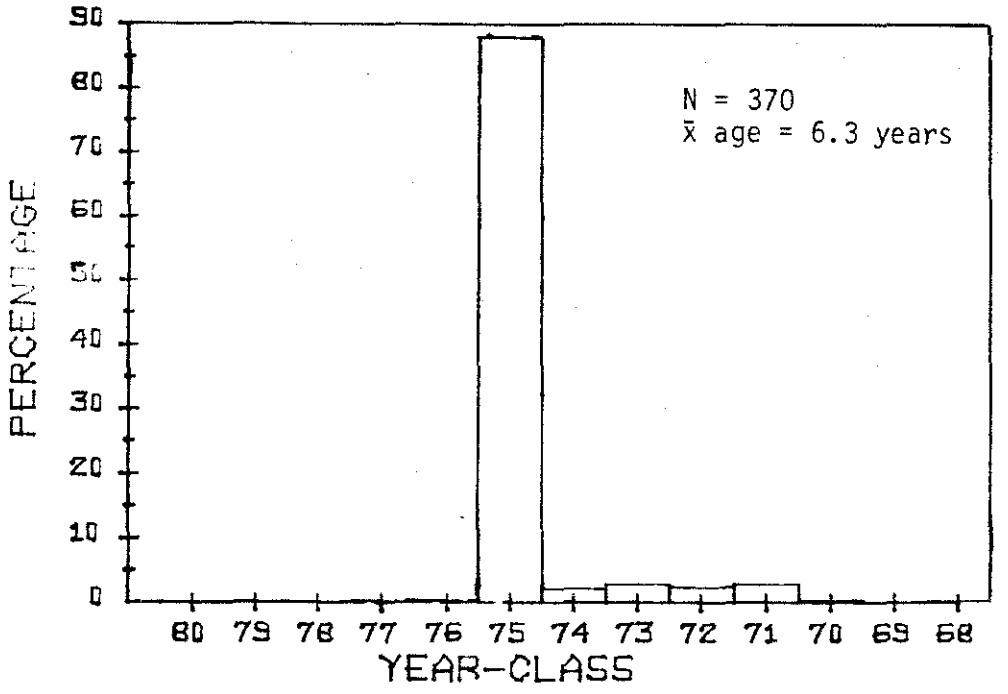

Figure 3 . Year-Class Composition of Subtidal Gaper Clams Collected from Area 2, Yaquina Bay, Oregon, 1981.

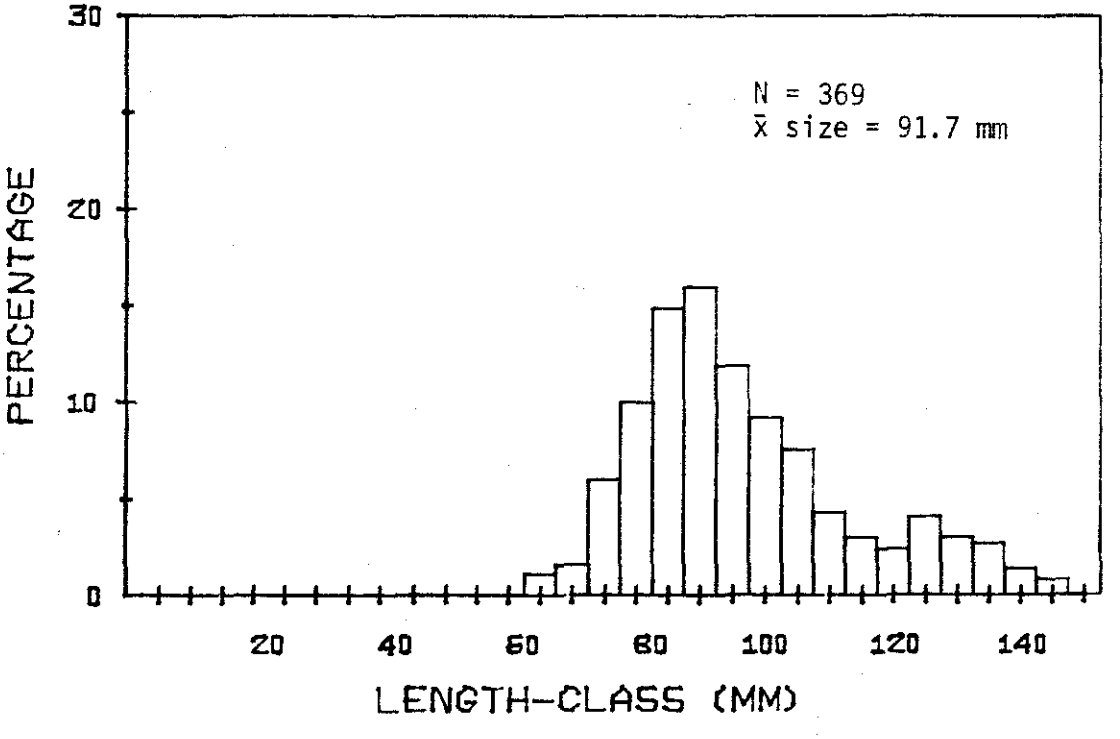

Figure 4 . Length-Class Composition of Subtidal Gaper Clams Collected from Area 2, Yaquina Bay, Oregon, 1981.

Table 2. 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

misleading; however, because the low sample numbers of old clams and difficulty in accurately aging clams older than 5 years may bias the abundance estimates. Our abundance estimates of clams less than 5 years old are probably more accurate because of greater aging reliability and larger sample numbers. Consequently, the M value range of 0.33 to 0.50 may be more representative of gaper clam cohorts in Yaquina Bay.

Population and Biomass Estimates, Area 2, Plots F and G. We estimated that 720,000 clams inhabited Plot F and 950,000 occurred in Plot G (Table 3). Of the total number of clams in Plot F, 492,000 were gaper clams weighing an estimated 152,200 pounds (69.0 mt). Of the total clams in Plot G, 370,000 were gapers weighing an estimated 207,500 pounds (94.1 mt). In excess of 95% of the gapers in Plot F were the 1975 year-class, whereas 76% of the gapers in Plot G were the 1975 year-class (Figures 5 and 7). In neither plot did we observe any gapers from the 1976 through 1981 year-classes. Mean age of gapers from Plots F and G was 6.2 and 6.5 years, respectively.

Length frequency of gaper clams in Plots F and G is shown in Figures 6 and 8. In Plot F, mean size of the clams in the preharvest sample was 84.1 mm, whereas gapers in Plot G averaged 101.2 mm. Gapers sampled in Area 2 averaged 91.7 mm. Mean size of 1975 year-class gapers in Plots F and G was 82.3 mm and 93.9 mm, respectively. This size difference reflects the possible impact of crowding on the two populations of clams since densities in Plot F were considerably higher.

COMMERCIAL HARVEST OF CLAMS

In 1981, we issued eight permits to commercial clam fishermen to mechanically harvest subtidal clams in experimental test plots. Permits were required because the use of mechanical means to harvest clams is unlawful. The permits specified the pounds of clams that could be harvested, season, harvest area and harvest equipment. Additionally, monthly reports giving pounds and numbers of clams harvested and hours of effort were required of each operator. The season started July 1, 1981, and ended December 31, 1981.

Methods

Yaquina Bay

Three commercial clam harvesting permits were issued for Yaquina Bay in 1981. One permit was issued for Plot F (suction pump site) and a quota of 125,000 pounds (56.7 mt) of gapers was set. The other two permits were issued for Plot G (water jet site); an additional quota of 125,000 pounds (56.7 mt) was placed on this plot. The 250,000 pounds (113.4 mt) allocated for harvest was 10% of the available biomass of gaper clams in Area 2.

Coos Bay

Five commercial clam harvesting permits were issued for Coos Bay. Four of the permits allowed the use of a water jet to harvest clams while the remaining permit was issued for a suction pump with a subsurface discharge. A quota of 100,000 pounds (45.4 mt) was set for the area. Both pump and jet operators worked in the same area adjacent to Pigeon Point in Coos Bay (Figure 2). We sampled the commercially harvested clams for size, age and species composition.

Results and Discussion

Yaquina Bay

No clams were commercially harvested in the experimental fishery in Yaquina Bay during 1981. This was the second consecutive year that no harvest occurred in Yaquina Bay (Table 4). A lack of markets plus a carry-over of frozen clams from the 1979 season constrained the commercial fishery.

Coos Bay

The commercial harvest in Coos Bay produced 61,955 pounds (28.1 mt) of clams of which 59,751 pounds (27.1 mt) or 96.4% were gaper clams (Table 5). The remainder were butter clams (*Saxidomus giganteus*). The fishery extended from August through December 1981. Divers averaged 2.8 hours of dive time each trip. Harvest figures revealed that in 1981, clam catch per unit effort was 272 pounds/hour (124 kg/hr) or 608 pounds/trip (276 kg/trip) (Table 6). Clams harvested in 1981 were delivered to different buyers than in previous years due to the effects of a soft market. Most clams harvested between 1975 and 1980 were processed and then shipped out-of-state. The bulk of the 1981 harvest was sold through local Coos Bay markets.

Gaper clams averaged 7.6 years of age with the 1973 year-class producing over 42% of the harvest (Figure 9). The clams averaged 133.7 mm which was exactly the same mean size as clams harvested in 1980 (Figure 10).

ASSESSMENT OF EFFECTS OF COMMERCIAL CLAM HARVEST ON RECRUITMENT

One of the primary concerns with a new commercial clam fishery is the effect the harvest might have on future recruitment. Ideally, a portion of the existing stocks are available for harvest and the remaining clams serve as brood stock capable of reseeding the harvest areas. One basic objective of our studies was to determine if the harvested areas were being reseeded by adjacent brood stock.

Methods

The area selected for evaluation was commercially harvested by suction pump in 1978 (Gaumer et al. 1978). Sampling methods were the same as reported in 1979 (Gaumer et al. 1979), with slight modification as reported in 1980 (Gaumer and Robart 1980). Twelve individual samples of 1 ft^2 (0.09 m^2) were collected from the treatment area in both June and September 1981. Similar numbers of samples were taken from an adjacent control area during the same time periods.

All benthic samples were bagged, labeled and returned to the laboratory, and all invertebrates were sorted into taxonomic groups. Invertebrates easily identified were separated into species while all others were grouped by family, order, or phyla. A two-way analysis of variance was applied to representative species or groups of invertebrates 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.

Table 3. Population and Biomass Estimates of Subtidal Clams in Area 2, Plots F and G, Yaquina Bay, Oregon, 1981.

Species	Plot F Number	Plot F Biomass (lbs)	Plot G Number	Plot G Biomass (lbs)
Gaper	492,000	152,200	370,000	207,500
Cockle	0		0	
Butter	4,000	Not calculated	15,000	Not calculated
Littleneck	4,000	" "	5,000	" "
Macoma	220,000	" "	560,000	" "
TOTAL	720,000	152,200	950,000	207,500

Table 4. Pounds of Clams Mechanically Harvested in Experimental Fishery, Yaquina Bay, Oregon, 1975-81.

Species	Year 1975	1976	1977	1978	1979	1980	1981	Total
Gaper	1,478	0	68,074	162,351	73,959	0	0	305,862
Cockle	24	0	10	0	0	0	0	34
Littleneck	0	0	49	1	0	0	0	50
Butter	0	0	590	22	606	0	0	1,218
Irus	0	0	334	44	0	0	0	378
TOTAL	1,502	0	69,057	162,418	74,565	0	0	307,542

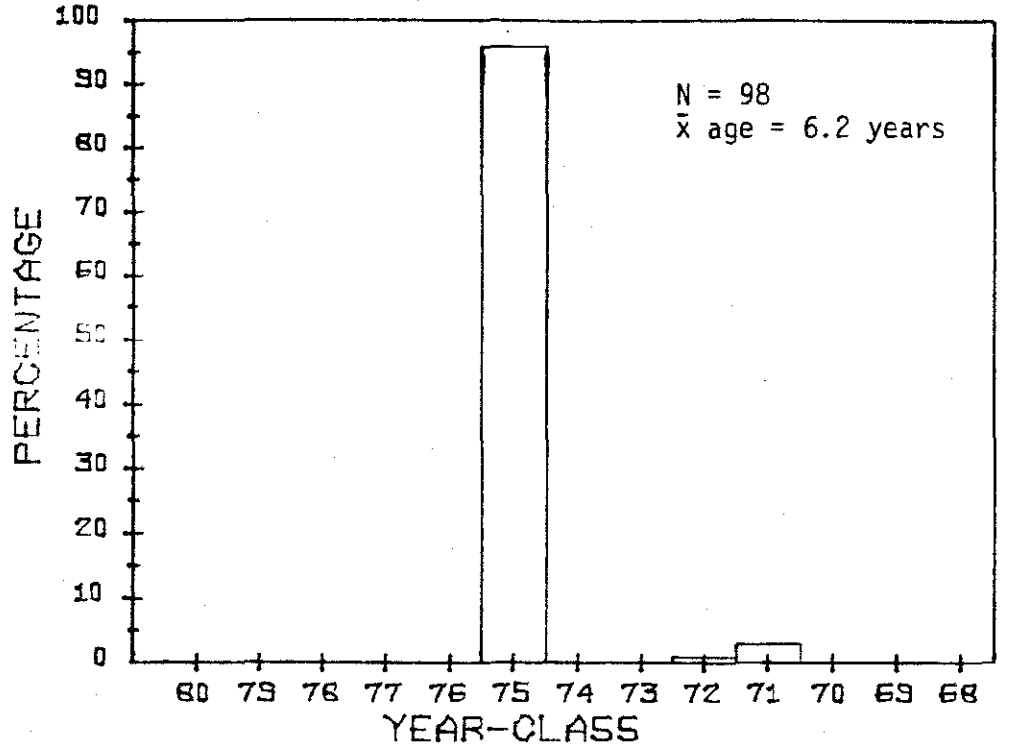

Figure 5. Year-Class Composition of Subtidal Gaper Clams Collected from Plot F of Area 2, Yaquina Bay, Oregon, 1981.

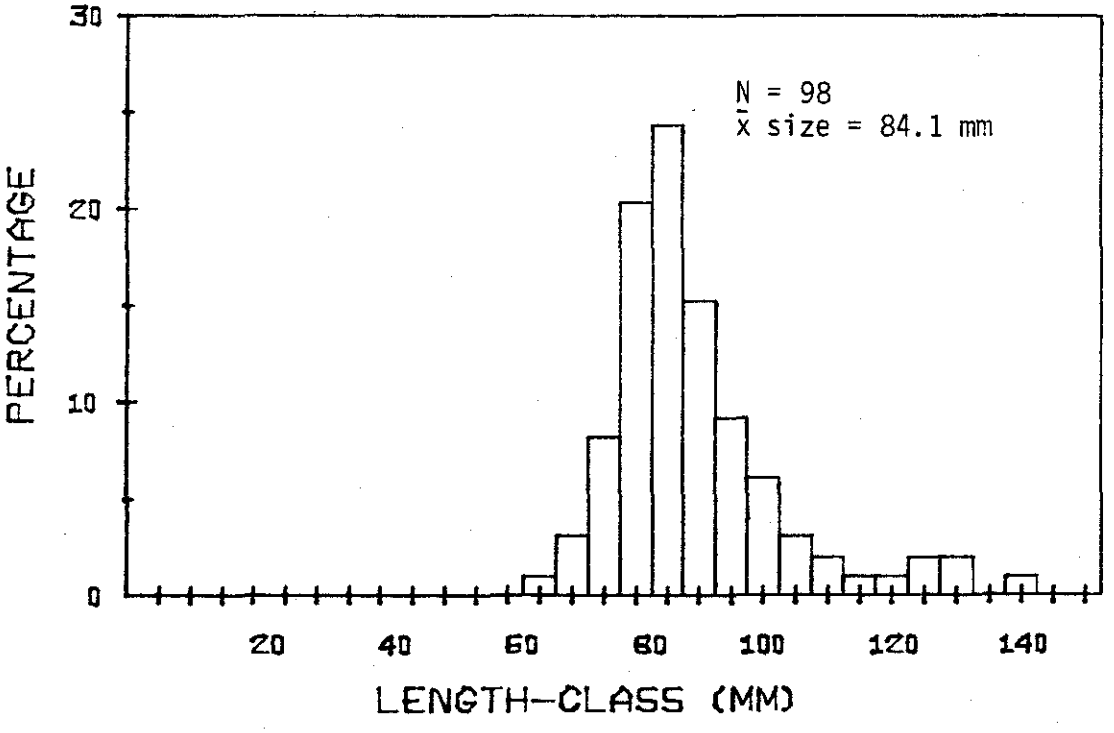

Figure 6. Length-Class Composition of Subtidal Gaper Clams Collected from Plot F of Area 2, Yaquina Bay, Oregon, 1981.

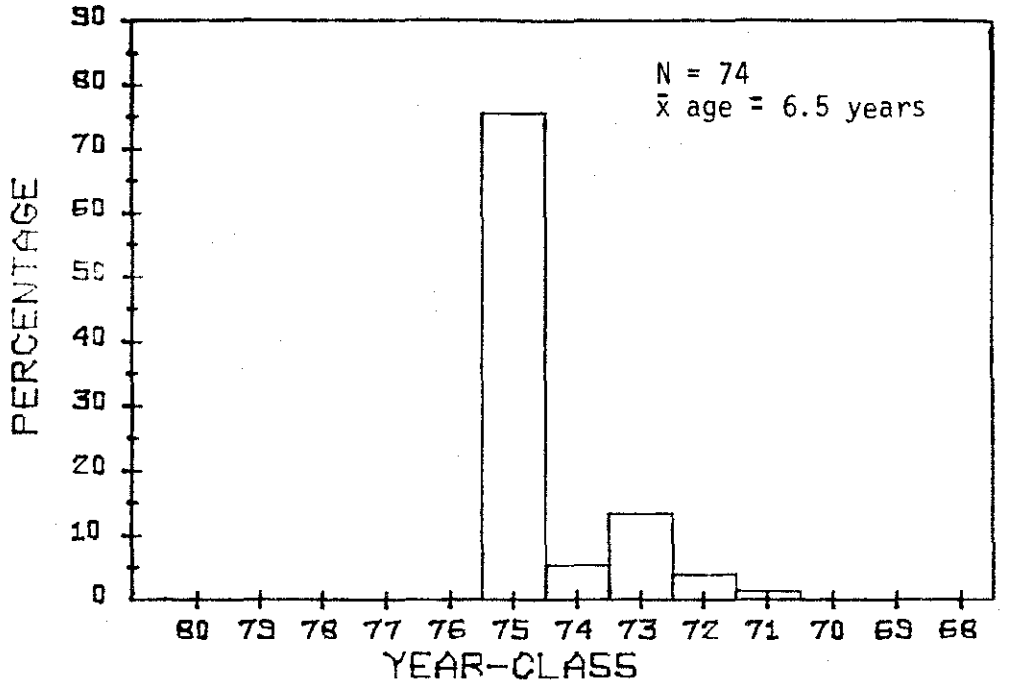

Figure 7. Year-Class Composition of Subtidal Gaper Clams Collected from Plot G of Area 2, Yaquina Bay, Oregon, 1981.

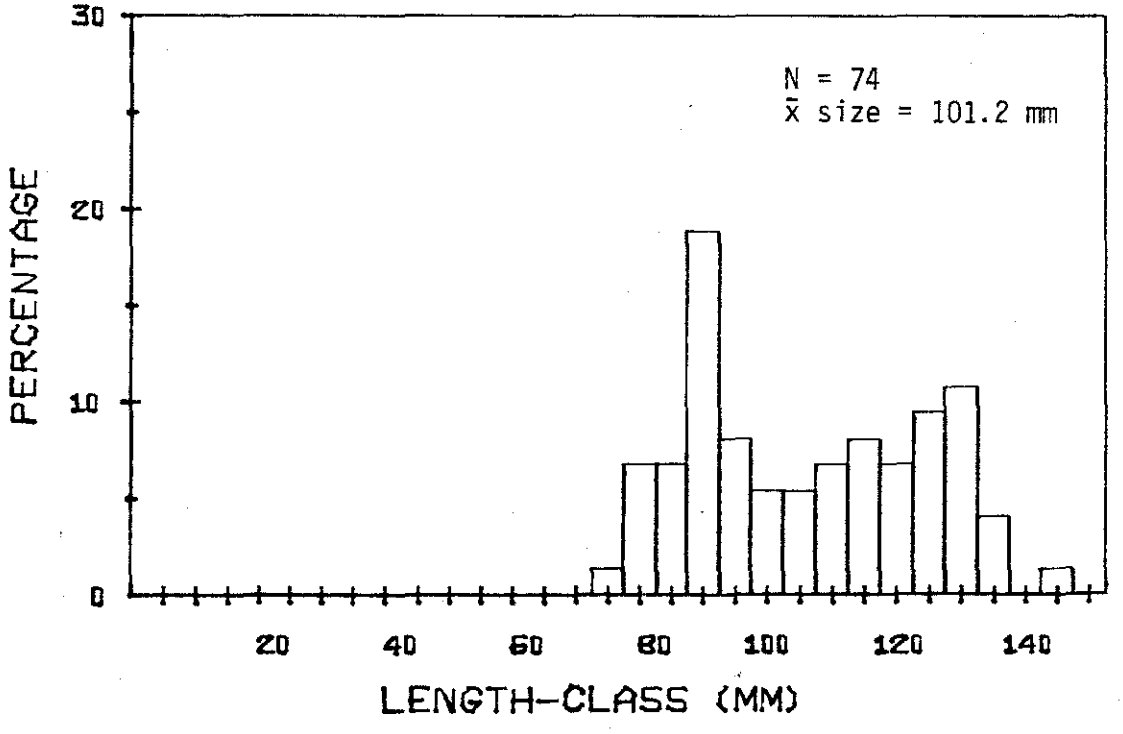

Figure 8. Length-Class Composition of Subtidal Gaper Clams Collected from Plot G of Area 2, Yaquina Bay, Oregon, 1981.

Table 5. Summary of Pounds of Clams Mechanically Harvested in Experimental Fishery, Coos Bay, Oregon, 1975-81.

	Year						
Species	1975	1976	1977	1978	1979	1980	1981
Gaper	14,467	102,442	11,931	36,744	13,351	60,616	59,751
Butter	735	1,142	0	0	39	125	2,204
Littleneck	0	0	0	0	511	0	0
Total	15,202	103,584	11,931	36,744	13,901	60,741	61,955

Table 6. Catch/Effort for Gaper Clams Harvested Subtidally from Coos Bay, Oregon, 1981.

	Year						
Effort	1975	1976	1977	1978	1979	1980	1981
Pounds/trip	761	1,078	852	1,225	1,214	1,174	608
Pounds/hour	193	223	157	250	275	283	272

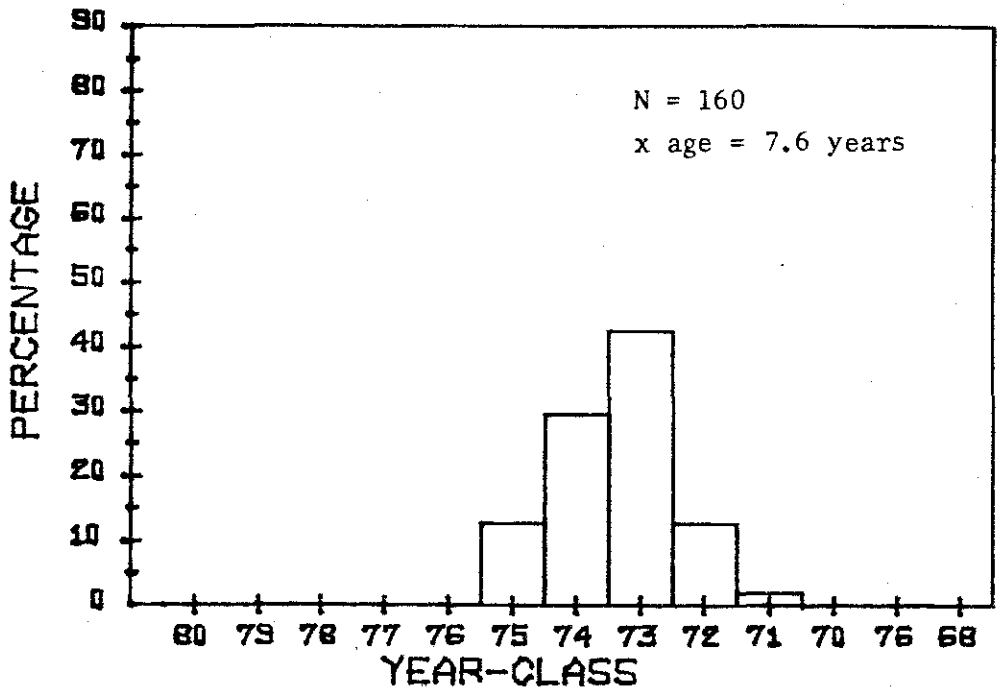

Figure 9. Year-Class Composition of Subtidal Gaper Clams Commercially Harvested from Pigeon Point Area of Coos Bay, Oregon, 1981.

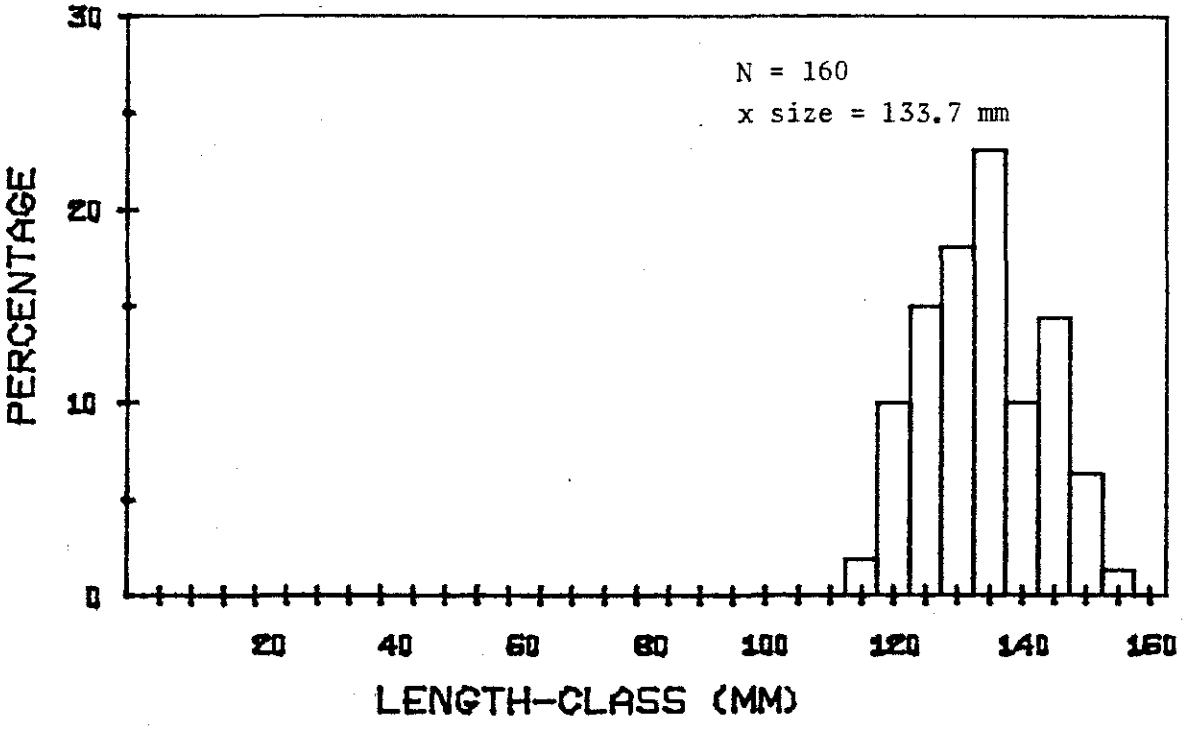

Figure 10. Length-Class Composition of Subtidal Gaper Clams Commercially Harvested from Pigeon Point Area of Coos Bay, Oregon, 1981.

Results and Discussion

Table 7 presents the macrobenthic data collected in 1981 from the treatment and control plots of Area 2, Plot C, Yaquina Bay. Six species of clams and 48 other taxa of benthic invertebrates were recorded. Macoma (*Macoma sp.*) and butter clams were the principal species of clams collected. Densities of benthic organisms were nearly the same for the May treatment and control, and September treatment samples. On the other hand, a considerable increase in density occurred for the September control sample. Some of this increase was attributed to successful recruitment of macoma clams.

A one way analysis of variance was performed to compare the numbers of selected benthic invertebrates inhabiting the treatment and control plots since 1979 (Table 8). Fourteen of the 18 taxa compared showed no significant differences in population densities at the 95% confidence level. Significant differences were recorded for macoma and littleneck clams, amphipods and anemones.

Analysis of variance also showed that taxonomic diversity between the treatment and control plots did not differ significantly either in numbers of taxa represented or in densities (Figures 11 and 12). Both figures show that benthic invertebrates in both treatment and control plots reached equilibrium within a year after harvest.

Figure 13 shows the post harvest density of gaper, butter, and littleneck clams in both control and harvest areas. Clam densities for each species remained nearly constant throughout the study period in the control plots and for butter and littleneck clams in the harvested area. Gaper clams, on the other hand, exhibited considerable recruitment in the treatment area. May samples in 1979 and 1980 revealed strong evidence of new recruitment, whereas fall samples during these years showed poor survival for these brood years. The June 1981 sample revealed no evidence of successful set from the 1981 year-class.

Studies performed at the School of Fisheries, Oregon State University Marine Science Center, have revealed considerable differences in the reproductive condition of gaper clams in Yaquina and Coos bays. Observations during the winter spawning seasons of 1980 and 1981 revealed that adult gapers did not come into spawning condition in Yaquina Bay. On the other hand, gapers collected from Coos Bay came into condition both years and contained full ripe gonads (Wilbur Breese, pers. comm.). To date no explanation has been offered.

LABORATORY CLAM STUDIES

Our laboratory clam studies were terminated in 1975. Since then we have annually monitored the growth of clams planted in Netarts Bay.

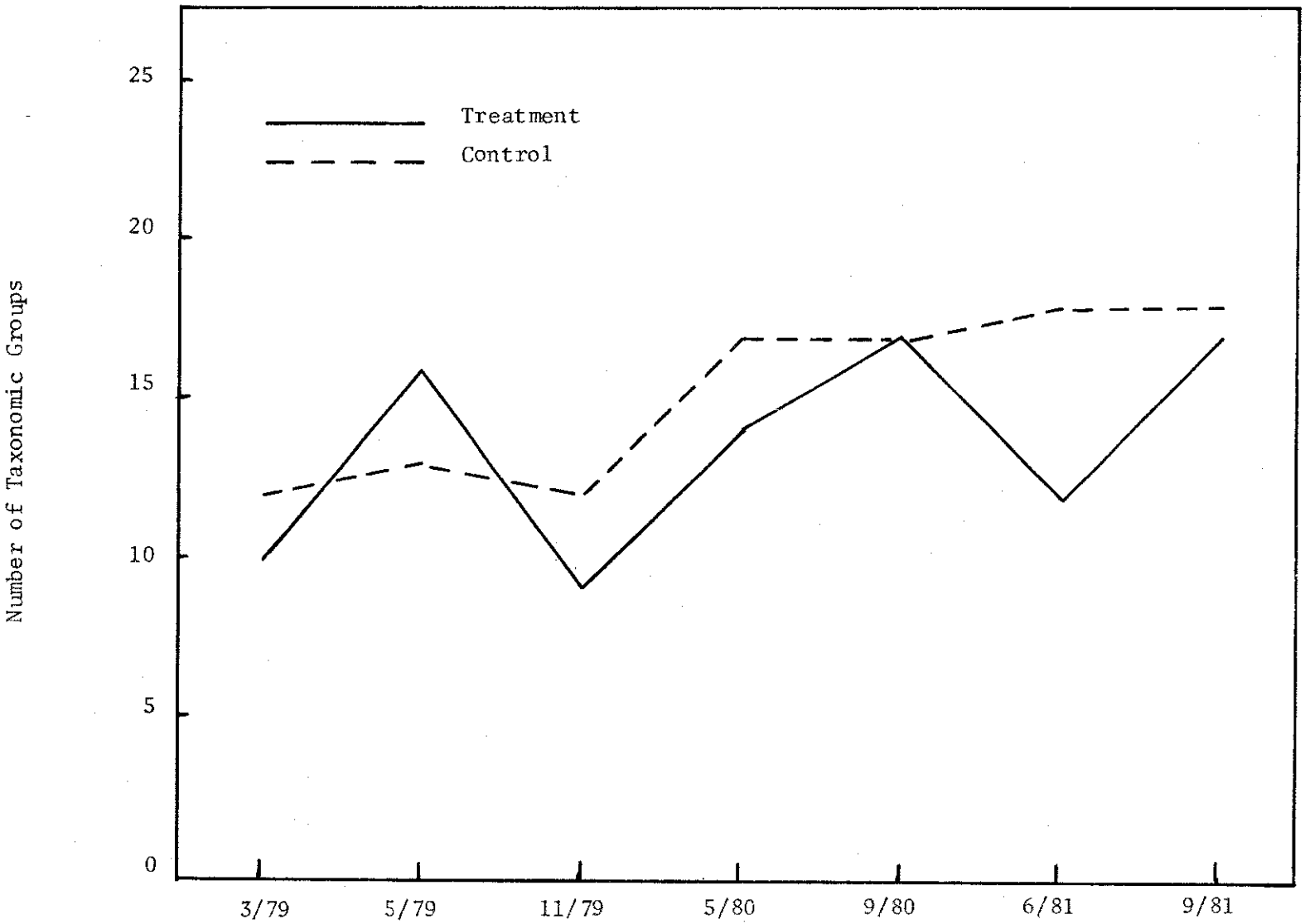

Figure 11. Number of Taxonomic Groups of Macrofaunal Benthos in Area 2, Treatment and Control, Yaquina Bay, 1979-81.

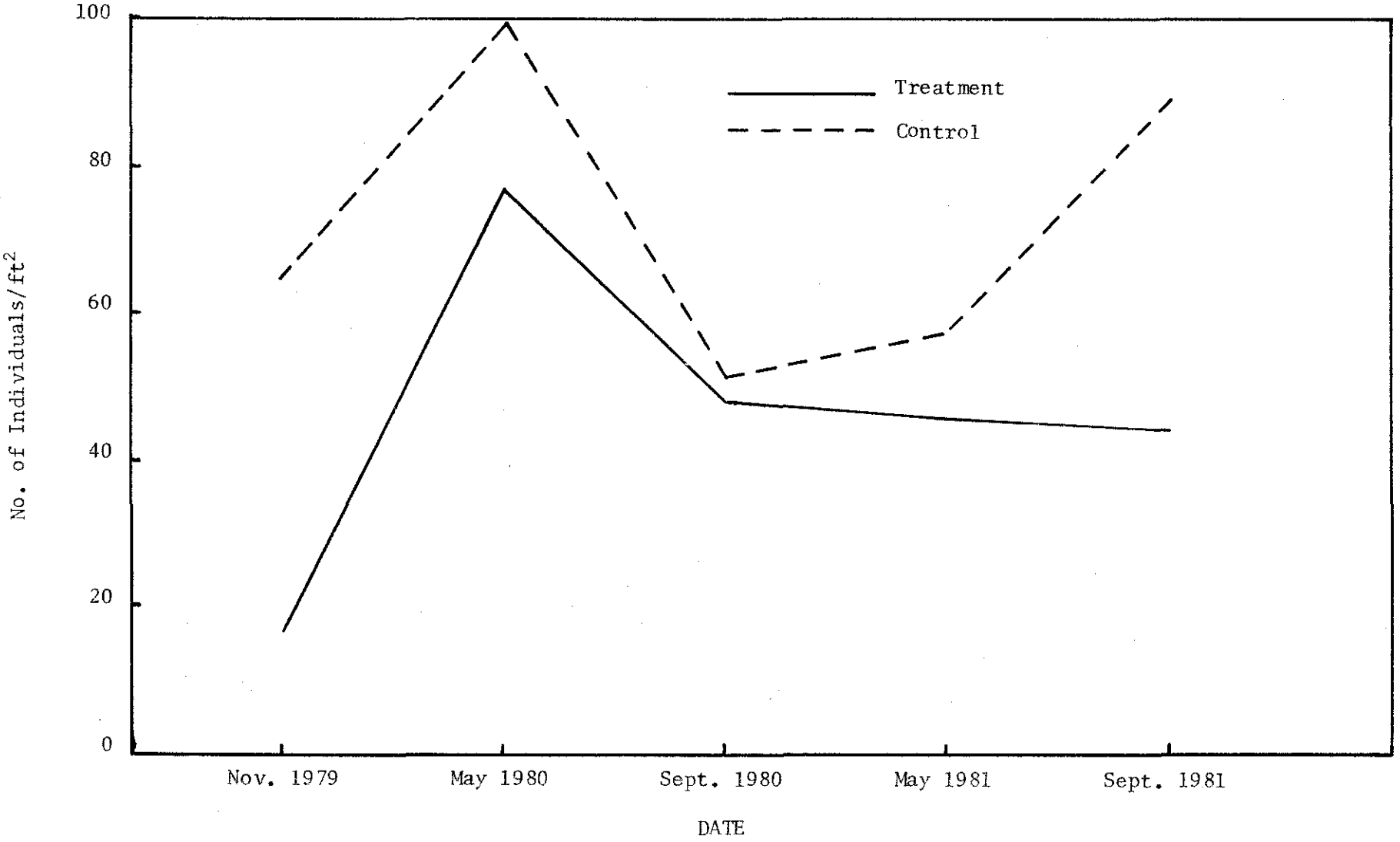

Figure 12. Total Number of Benthic Invertebrates per ft^2, Area 2, Treatment and Control, Yaquina Bay, Oregon, 1979-81.

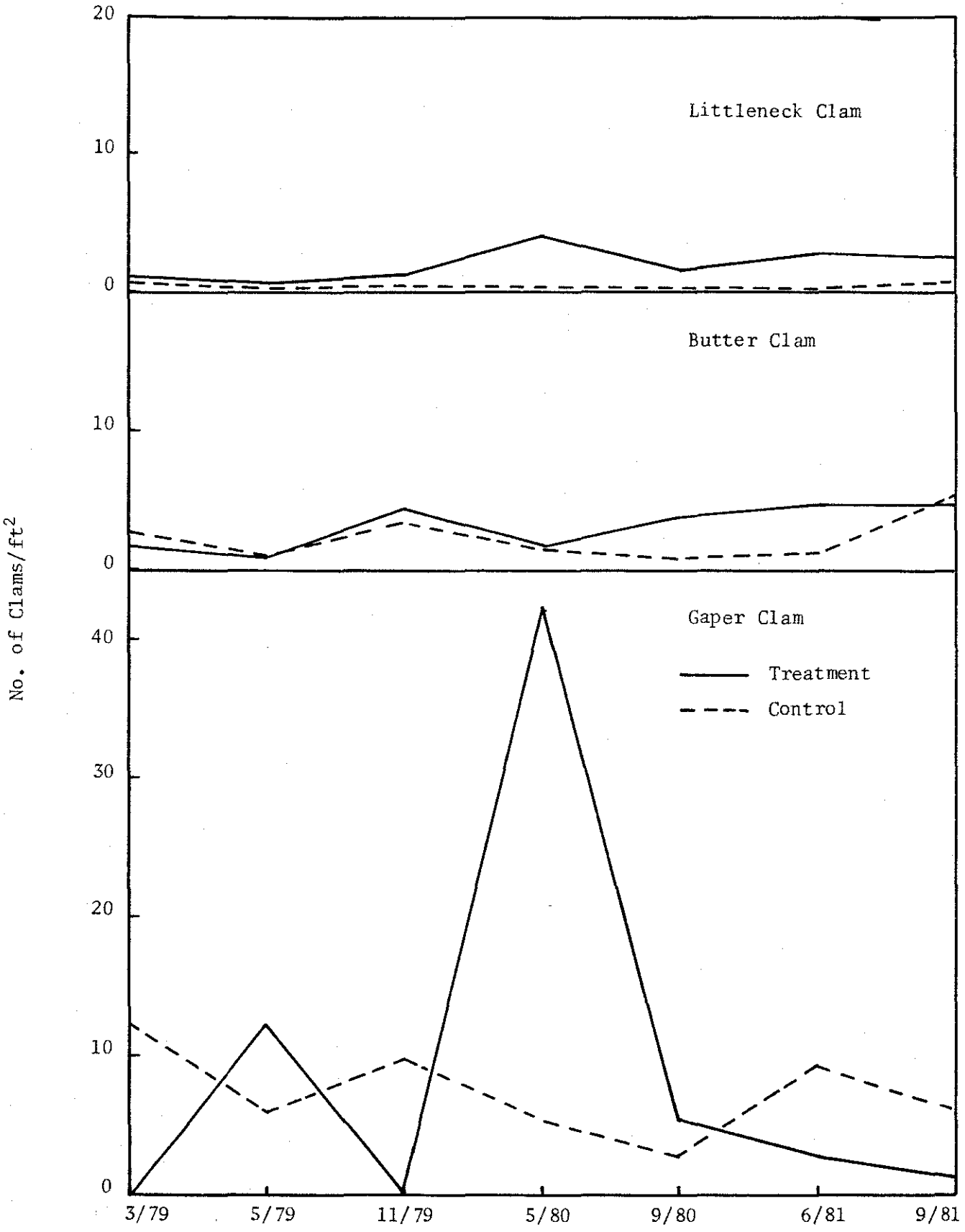

Figure 13. Number of Clams/ft.^{2} Area 2, Treatment and Control, Yaquina Bay, Oregon, 1979-81.

Methods

Two studies were continued in Netarts Bay. One compared the growth characteristics of Manila littleneck clams that were selected for their fast growing ability vs. normal growing clams (Gaumer and Lukas, 1975); the other compared growth of clams in a screened enclosure vs. unscreened areas.

Results and Discussion

Manila littleneck clams spawned in August 1974 from fast growing parent stock grew 1.2 mm from June 1980 to June 1981 and averaged 40.4 mm in length, whereas progeny from the "normal" clams grew 1.1 mm and averaged 38.4 mm (Figure 14).

Manila clams planted in the screened test plot averaged 40.2 mm, an increase of 1.6 mm since 1980, whereas clams planted in an adjacent unscreened test plot averaged 41.5 mm, an increase of 1.5 mm. Manilas planted adjacent to an eelgrass bed and at slightly lower elevation were 43.8 mm in mean length, a decrease of 1.1 mm since 1980 (Figure 15). The small sample size probably created this decrease. Clams in all three test plots averaged 13.1 mm when released.

Several dozen adult Manila clams, collected adjacent to the test plots, were brought back to the Oregon State University Marine Science Center laboratory where Wilbur Breese conditioned and spawned them with success. This effort produced to date an uncounted number of juvenile clams which will be released back into Netarts Bay in June 1982.

ACKNOWLEDGMENTS

We wish to thank Laimons Osis, Jean McCrae, Jim Golden and Steve Johnson of the Oregon Department of Fish and Wildlife, and Marian Asche for their assistance in the study.

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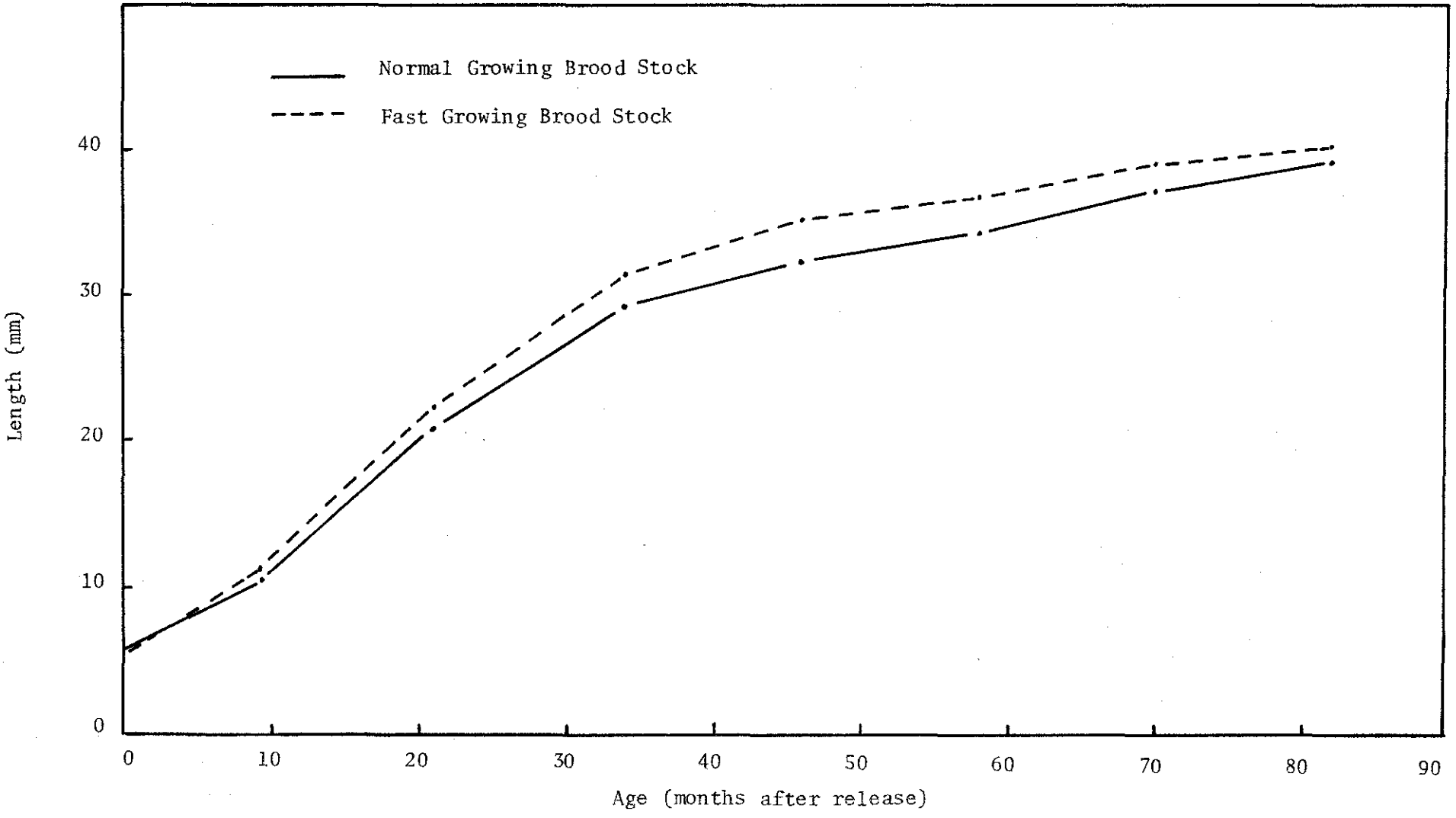

Figure 14. Growth Curve of Manila Littleneck Clams Spawned and Planted from Normal and Fast Growing Brood Stock in Netarts Bay, 1974-81.

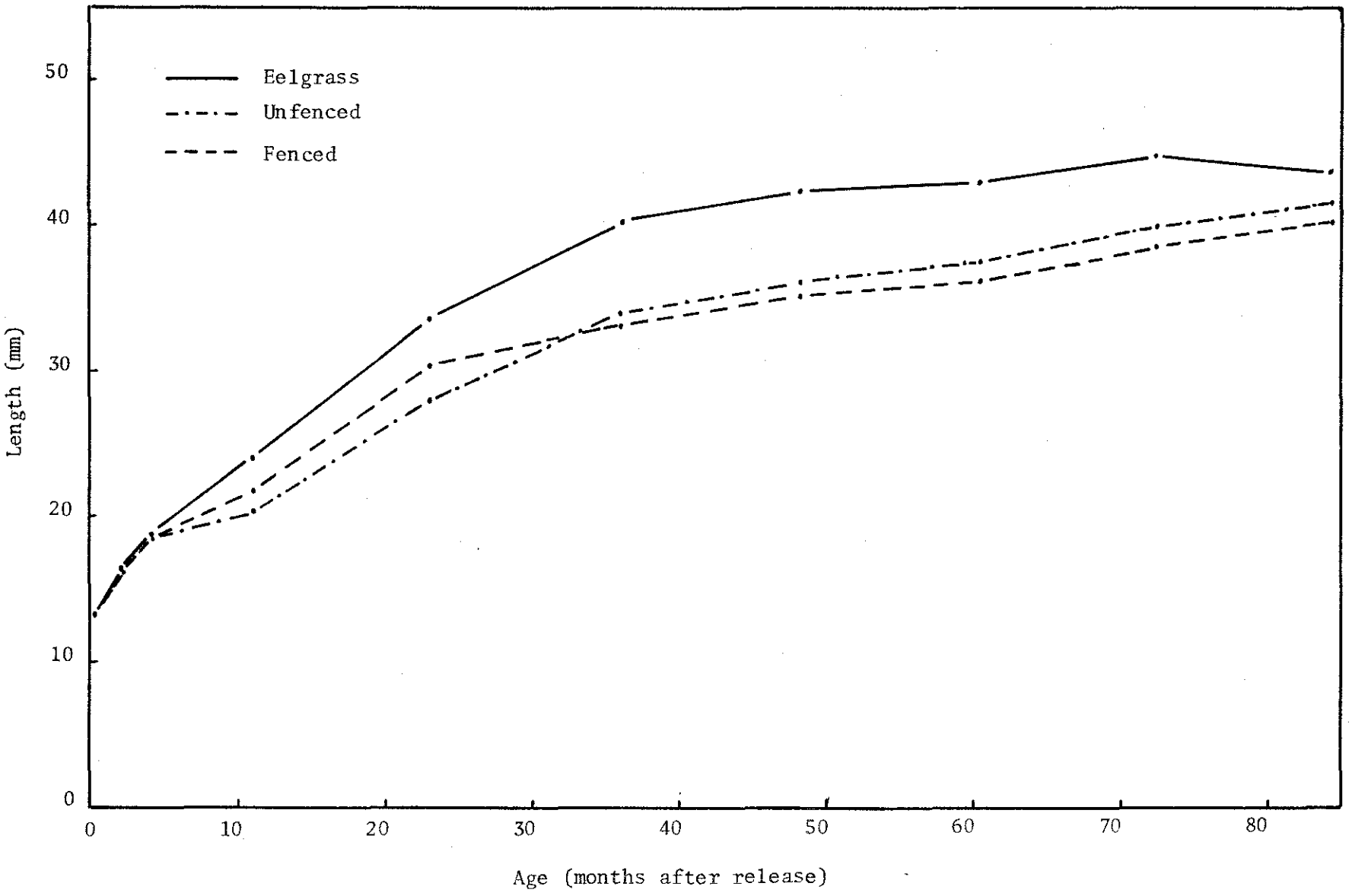

Figure 15. Growth Curve of Manila Littleneck Clams Planted in Fenced, Unfenced and Eelgrass Covered Areas of Netarts Bay, 1974-81.

Table 7. Summary of Total Numbers[1/] of Marine Organisms Occurring in Commercially Harvested Plot C and Control of Area 2, Yaquina Bay, 1981.

	5/11/81		9/30/81	
	Plot C	Control	Plot C	Control
MOLLUSCA				
Clinocardium nuttallii	0.1	0.2	0.9	1.5
Cryptomya californica	0.0	0.3	0.0	0.0
Macoma inquinata	7.4	24.3	4.6	39.3
Saxidomus giganteus	4.8	1.3	4.7	5.4
Tresus capax	2.6	9.2	1.2	6.1
Venerupis staminea	2.9	0.3	2.8	0.8
Pododesmus macroschisma	0.0	0.0	0.0	0.1
Chiton	0.0	0.0	0.0	0.1
Hermissenda crassicornis	0.0	0.1	0.0	0.0
Nucella lamellosa	0.0	0.0	0.0	0.1
Nudibranchi	0.0	0.0	0.5	1.3
Onchidella borealis	0.0	0.0	0.0	0.1
Hinnites multirugosus	0.0	0.0	0.0	0.1
Triopha sp	0.0	0.1	0.0	0.0
Anaula pacifica	0.0	0.1	0.0	0.0
Onchidoris bilamellata	0.0	0.4	0.0	0.0
ANNELIDA				
Glyceridae	0.5	0.0	0.1	0.0
Lumbrineridae	11.1	1.0	9.4	2.5
Nereidae	0.0	0.1	0.0	0.2
Ophelliidae	0.0	0.1	0.2	0.1
Orbiniidae	6.3	2.7	4.6	4.3
Pectinariidae	0.1	0.0	0.1	0.0
Phyllodocidae	0.2	0.4	1.1	5.8
Polynoidae	0.0	0.1	0.0	0.0
Terebellidae	0.0	0.0	3.4	0.2
Capitellidae	0.0	1.0	1.6	1.3
Cirratulidae	4.4	0.1	4.4	0.0
Nemertian worm	0.3	0.7	0.9	0.4
ARTHROPODA				
Cancer magister	3.4	0.2	0.0	0.1
Cancer oregonensis	0.0	0.0	0.1	0.0
Cancer productus	0.9	1.8	3.8	7.1
Callianassa californiensis	0.1	0.0	0.0	0.0
Caprellidae	0.0	0.0	0.0	0.3
Caridean shrimp	0.2	1.8	0.6	4.9
Gammaridean amphipods	0.0	7.2	4.1	4.2
Hemigrapsus oregonensis	0.0	1.2	0.5	0.3
Lophopanopeus sp	0.0	0.0	0.0	0.3
Loxorhynchus sp	0.0	0.0	0.2	0.2
Pagurus sp	0.1	0.1	0.3	0.3
Petrolisthes cinctipes	0.0	0.2	0.0	0.4
Pinnixa sp	0.1	1.0	0.1	0.2
Upogebia pugettensis	0.0	0.1	0.0	0.1
ECHINODERMATA				
Amphiodia occidentalis	6.6	6.3	0.0	0.0
Evasterias sp	0.0	0.1	0.0	0.3
Ophiuroidae	0.0	0.0	2.1	8.3
Pycnopodia helianthoides	0.0	0.1	0.3	1.4
	0.0	0.1	0.3	1.4
COELENTERATA				
Anthozoa	2.3	0.2	2.7	0.3
BRYOZOA	0.0	0.0	0.0	0.7
HYDROZOA	0.0	0.0	0.1	0.0
ECHIUROIDEA				
Urechis caupo	0.0	0.0	0.1	0.0
VERTEBRATA				
Citharichthys stigmaeus	0.0	0.2	0.0	0.0
Pholidae (gunnels)	0.1	0.0	0.0	1.1
Stichaeidae (blenny)	0.0	0.1	0.0	0.0
Cottidae (sculpins)	0.0	0.1	0.0	0.1
Total number of organisms	653	750	664	1195
Number/ft^2	54.5	62.5	55.3	99.6

1/ Numbers are organisms/ft^2

Table 8. Summary of Numbers[1/] of Representative Marine Organisms Occurring in Commercially Harvested Plot C and Control of Area 2, Yaquina Bay, Oregon, 1979-81.

	DATE														F Oneway Anova	Degrees of Freedom
	3/13/79		5/24/79		11/6/79		5/1/80		9/17/80		6/9/81		9/30/81			
	Plot C	Control	Plot C	Control	Plot C	Control	Plot C	Control	Plot C	Control	Plot C	Control	Plot C	Control		
MOLLUSCA																
Clinocardium nuttallii	0.4	0.0	0.3	0.5	0.0	0.4	1.8	0.3	0.3	0.2	0.1	0.2	0.9	1.5	0.11	(1,12)
Macoma inquinata	4.3	56.6	3.3	102.5	3.7	33.3	5.4	60.3	9.3	16.7	7.4	24.3	4.6	39.3	14.67	(1,12)
Saxidomus giganteus	1.9	2.8	0.9	1.0	4.4	3.5	1.8	1.6	3.8	1.0	4.8	1.3	4.7	5.4	0.88	(1,12)
Tresus capax	0.0	12.2	12.3	6.0	0.0	9.6	42.0	5.3	5.1	2.8	2.6	9.2	1.2	6.1	0.86	(1,12)
Venerupis staminea	1.2	0.8	0.8	0.5	1.3	0.5	4.1	0.4	1.6	0.3	2.9	0.3	2.8	0.8	12.02	(1,12)
ANNELIDA																
Capitellidae	0.0	0.0	>10.0	>10.0	0.0	0.0	0.0	1.4	1.3	1.0	0.0	1.0	1.6	1.3	0.18	(1,12)
Lumbrineridae	0.4	>10.0	0.3	0.0	0.0	0.0	0.0	5.0	11.8	1.3	11.1	1.0	9.4	2.5	0.55	(1,12)
Opheliidae	0.0	0.0	>10.0	0.0	0.0	11.8	0.0	4.2	0.8	1.7	0.0	0.1	0.2	0.1	0.21	(1,12)
Orbiniidae	0.0	>10.0	>10.0	4.5	0.0	0.0	15.6	3.0	1.8	5.4	6.3	2.7	4.6	4.3	0.24	(1,12)
Phyllodocidae	0.0	>10.0	>10.0	>10.0	0.0	0.2	1.4	0.4	1.0	1.2	0.2	0.4	1.1	5.8	0.87	(1,12)
ARTHROPODA																
Cancer productus	1.5	4.4	1.8	0.5	0.0	0.0	0.2	1.9	0.5	1.8	0.9	1.8	3.8	7.1	1.43	(1,12)
Gammeridean amphipods	0.0	>10.0	0.5	>10.0	1.3	1.9	0.9	5.4	1.0	3.5	0.0	7.2	4.1	4.2	14.09	(1,12)
Hemigrapsus oregonensis	0.0	0.2	0.3	0.5	0.5	0.2	0.2	4.2	0.2	0.7	0.0	1.2	0.5	0.3	2.13	(1,12)
Pagurus sp	0.1	0.0	1.9	2.0	0.2	0.3	0.1	0.4	0.3	0.1	0.1	0.1	0.3	0.3	0.01	(1,12)
Upogebia pugettensis	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.38	(1,12)
COELENTERATA																
Anthozoa anemone	0.5	0.0	0.3	0.0	1.8	0.0	0.4	0.3	0.4	0.1	2.3	0.2	2.7	0.3	7.40	(1,12)
ECHINODERMATA																
Ophiuroidea	0.8	1.4	1.6	3.0	2.3	2.8	2.1	5.1	8.6	13.2	6.6	6.3	2.1	8.3	1.47	(1,12)
Pycnopodia helianthoides	0.0	1.6	0.0	0.0	0.3	0.2	0.3	0.4	0.2	0.3	0.0	0.1	0.3	1.4	2.70	(1,12)
Total Number/ft^2	Not calculated		Not calculated		16.7	64.7	76.3	99.6	48.0	51.3	45.3	57.4	44.9	89.1		

[1/] Numbers are organisms/ft^2/

Critical F value = 4.75