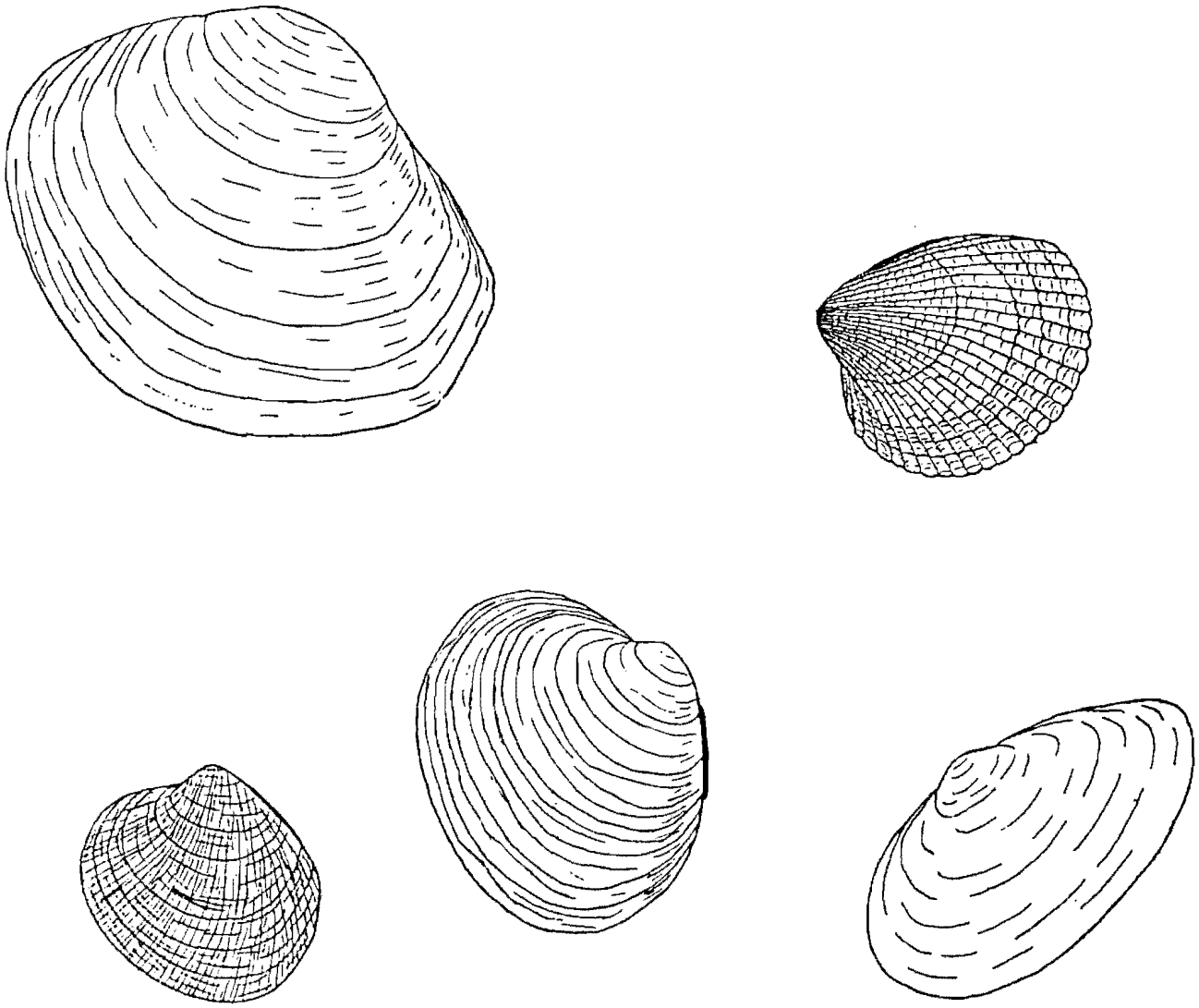
OREGON DEPARTMENT OF FISH AND WILDLIFE

STATUS OF BAY CLAMS IN OREGON
1975-88



STATUS OF BAY CLAMS IN OREGON, 1975-88

by

Thomas F. Gaumer

Jean E. McCrae

Marine Region

Oregon Department of Fish and Wildlife

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STATUS OF BAY CLAM STOCKS IN OREGON, 1975-88

INTRODUCTION

This report presents an overview of the status of bay clams in Oregon. Our observations will focus on the status of the major clam species that are taken by recreational and commercial harvesters. In 1975, the Oregon Department of Fish and Wildlife (ODFW) started collecting routine biological data from each of the major clam beds. This report covers the collection of these data for the 1975-88 time period. Comments on conditions before this period will only be made to illustrate a specific point. The status of clam stocks within each of the major clam producing bays comes from data collected by interviewing recreational and commercial clam diggers, compiling and analyzing commercial catch statistics, and conducting stock assessment studies on both intertidal and subtidal clam populations. The unit of measurement we used to evaluate the status or condition of clam stocks was catch per unit of effort (CPUE), and age and size composition for each species of clam.

BRIEF HISTORY

Species of clams found within the mouth of an estuary are commonly called bay clams, although in some instances they also inhabit the outer coast. Of the five species of clams described in this report, only the softshell clam is non-native; it was introduced from the east coast with shipments of Atlantic oysters in the late 1800's.

Bay clams are found in nearly all of Oregon's major estuaries. Although our estuaries are quite small, most have historically supported a small recreational and commercial clam fishery. Today, the main production comes from Nehalem, Tillamook, Netarts, Nestucca, Yaquina, Alsea, Siuslaw, Umpqua, Coos, and Coquille estuaries (from north to south).

The principal species having commercial and recreational importance are:

Clinocardium nuttallii- cockle, cockerel, basket cockle
Mya arenaria- eastern softshell, mud clam
Protothaca staminea- native littleneck, butter, steamer, rock clam
Saxidomus giganteus- butter, quahog, beefsteak, Martha Washington, Coney Island, great Oregon clam
Tresus capax- gaper, horse, horseneck, blue, blueneck, Empire

Although a fairly large number of other bay clams are found in Oregon's estuaries, they represent a small part of the recreational and commercial clam harvest.

Stock Status

The early history of bay clams in Oregon is rather sketchy. Edmondson (1922) collected considerable biological data in 1918-19 on the distribution and abundance of bay clams in Oregon. References are made to his report and to

old ODFW records for a historical overview of the status of clams in our estuaries.

The first recorded studies by the ODFW (then the Fish Commission of Oregon) on the status of bay clam stocks in Oregon was in 1947. Tollefson (1948) gave a bay-by-bay status report and although his comments were subjective, it gave a basis for comparison to present conditions. His evaluation showed the following conditions for each bay:

Nehalem - softshell clam stocks stable
Tillamook - clams fairly abundant
Netarts - clams quite abundant
Nestucca - softshell clams being depleted
Siletz - softshell clams scarce
Yaquina - gaper and softshell clams declining, accessible areas dug out
Alsea - most clam beds dug out
Siuslaw - nothing known about the clam stocks
Umpqua - clams scarce
Coos - clams fairly abundant but cockle and gaper clams declining
Coquille - nothing known about the clam stocks

In summary, Tollefson stated:

1. "There are comparatively few areas in Oregon where clams are present in any real concentrations, those that are, are localized within a bay."
2. "All known areas that do have "normal" numbers of clams are comparatively inaccessable to the average

sport or private digger, while in every known area that is readily reached, the clams are reduced in numbers, virtually to the extent of non-existence in some places."

3. "To date, in their suitable areas the cockle is maintaining itself at least semi-successfully whereas the horse clam and eastern clam seem to be on the decline."

A review of other ODFW reports since 1947 revealed the following information on stock status:

1952 - Bay Ocean Spit in Tillamook Bay breached, covering clam and oyster beds with tons of sand. One third of oyster beds destroyed.

1953 - Softshell clam stocks in Siuslaw in poor shape. Logging practices have contributed thick layers of silt on tideflats.

1957 - Softshell clam surveys showed overall stocks, except for the Siuslaw, to be in good shape. Siuslaw closed east of Highway 101 bridge, June 1957 to June 1959. In addition, 17,000 adult clams from Nehalem Bay were transplanted to the Siuslaw to provide brood stock.

1959 - Siuslaw survey revealed substantial numbers of young softshell clams.

1960 - Netarts Bay survey revealed a peak digger count of 540 diggers; the diggers averaged 18.0 clams/digger.

1960 - Yaquina Bay survey on Sally's Bend and Idaho Flat revealed diggers averaged 27.0 clams/ digger; 83% were cockles and 16% were gapers. Sally's Bend produced 53% (88,000 clams) of the total commercial and recreational harvest from Sally's Bend and Idaho Flat.

1961 - Tillamook County constructed a boat basin at Netarts Bay destroying one of the most productive and accessible clam beds in the state.

1963 - Garibaldi Flat survey revealed diggers averaged 25.1 clams/digger of which 45% were cockles, 27% butters, 21% littlenecks, and 7% gapers.

1964 - Record floods killed many cockles in Tillamook and Yaquina bays.

1964 - The Alaska earthquake and resulting tsunami caused extensive mortalities of subtidal gaper clams in Yaquina Bay and intertidal softshell beds in Siuslaw Bay. Windrows of gapers were reported by SCUBA divers. Similar mortalities probably occurred in other bays.

1965 - Garibaldi Flat survey revealed diggers averaged 22.9 clams/digger. All species are abundant except cockle clam.

1966 - Softshell clam abundance in Umpqua has declined 60% since 1961. The 1964 floods placed heavy accumulations of wood chips, sticks, and bark on tideflats.

1971 - A Resource use survey was conducted on all major estuaries. Results are discussed later in this report.

1971 - Flooding killed significant numbers of clams in Garibaldi Flat.

1982 - Heavy rains in Coos Bay area in April killed large numbers of cockles on North Spit.

Commercial Harvest

ODFW commercial clam landing records started in 1928 and revealed a combined harvest of 110,000 lb of bay and razor clams (Table 1). Starting in 1941, bay and razor clams were listed separately and showed 338,000 lb of razor clams and 214,000 lb of bay clams taken. It was not until 1944 that bay clams were listed by species and in that year 204,000 lb of bay clams were reported harvested. As evidenced by these landing records, Oregon's commercial harvest was never large. The peak production in the 1930's was reported to be in response to the economic depression.

Table 1. Oregon commercial clam harvest in pounds, 1928-88.

Year	Harvest All Clams	Harvest Bay Clams	No. Diggers	No. Landings	Ave. lb/ Landing	No. Permits Issued
1928	110,000	-	-	-	-	-
1929	57,000	-	-	-	-	-
1930	163,000	-	-	-	-	-
1931	143,000	-	-	-	-	-
1932	132,000	-	-	-	-	-
1933	128,000	-	-	-	-	-
1934	224,000	-	-	-	-	-
1935	469,000	-	-	-	-	-
1936	448,000	-	-	-	-	-
1937	472,000	-	-	-	-	-
1938	664,000	-	-	-	-	-
1939	608,000	-	-	-	-	-
1940	659,000	-	-	-	-	-
1941	-	214,000	131	-	-	-
1942	-	121,000	-	-	-	-
1943	-	178,000	59	-	-	-
1944	-	204,000	77	-	-	-
1945	-	306,000	110	-	-	-
1946	-	265,000	115	-	-	-
1947	-	178,000	90	-	-	-
1948	-	122,000	106	-	-	-
1949	-	135,000	202	-	-	-
1950	-	149,000	-	-	-	-
1951	-	155,000	-	-	-	-
1952	-	149,000	-	-	-	-
1953	-	135,000	-	-	-	-
1954	-	134,000	-	-	-	-
1955	-	113,000	-	-	-	-
1956	-	124,000	-	-	-	-
1957	-	96,000	-	-	-	-
1958	-	77,000	-	-	-	-
1959	-	65,000	-	-	-	-
1960	-	76,000	-	-	-	-
1961	-	68,000	-	-	-	-
1962	-	109,000	-	-	-	-
1963	-	71,000	-	-	-	-
1964	-	61,000	-	-	-	-
1965	-	48,000	-	-	-	-
1966	-	40,000	-	-	-	-
1967	-	27,605	-	-	-	-
1968	-	27,866	-	-	-	-
1969	-	20,860	41	264	79.0	-
1970	-	25,884	40	258	100.3	-
1971	-	28,526	50	230	124.0	-
1972	-	61,505	37	354	173.7	-
1973	-	17,156	19	187	91.7	-
1974	-	16,315	23	182	39.6	-
1975	-	26,550	19	116	228.9	-
1976	-	88,054	7	97	946.8	-
1977	-	85,733	29	155	304.0	-
1978	-	216,962	15	218	995.2	-
1979	-	94,912	19	128	741.5	-
1980	-	81,467	36	176	462.9	-
1981	-	81,138	30	336	222.5	-
1982	-	134,090	46	538	249.2	-
1983	-	136,185	41	811	168.0	-
1984	-	120,567	30	704	171.3	-
1985	-	99,254	44	614	161.7	65
1986	-	82,609	36	664	124.4	65
1987	-	46,283	34	385	120.2	121
1988	-	44,696	28	258	173.2	136

Since the mid 1940's, clam production gradually decreased until it reached an all time low of 16,315 lb in 1974.

It was during the 1970's that we completed a comprehensive clam stock assessment study in most of the coastal estuaries. Several bays were found to contain large beds of subtidal clams. Using these data, commercial clammers developed a renewed interest in the fishery and production increased to nearly 217,000 lb in 1978. Yaquina Bay produced 172,047 lb or 79.3% of the total harvest (Table 2). Since then, production has declined to 44,696 lb in 1988 with Tillamook Bay providing 34,450 lb or 77.1% of the total harvest. Several factors have contributed to this decline. Poor recruitment of the gaper clam in Yaquina and Coos bays since 1975 has caused our Department considerable concern. In 1985, we discontinued issuing permits to commercial clam diggers to mechanically harvest subtidal

Table 2. Annual commercial harvest (lb) of bay clams, by bay, in Oregon, 1975-88.

Year	Nehalem	Tillamook	Netarts	Yaquina	Alsea	Siuslaw	Umpqua	Coos	Bandon	Total
1975	0	4,637	0	0	13	0	309	21,553	38	26,550
1976	0	998	0	0	480	0	0	86,576	0	88,054
1977	0	2,619	0	71,013	0	0	35	12,066	0	85,733
1978	0	3,111	0	172,047	0	0	0	41,804	0	216,962
1979	174	433	0	74,565	0	3,432	0	16,308	0	94,912
1980	373	5,320	486	244	0	9,109	0	65,935	0	81,467
1981	65	4,259	0	128	0	684	0	76,002	0	81,138
1982	10,862	11,501	37	15	0	223	25	111,427	0	134,090
1983	31,856	3,144	200	5,253	0	15	0	95,717	0	136,185
1984	23,069	42,663	0	22	0	50	0	54,763	0	120,567
1985	40,349	34,148	240	0	0	895	268	23,030	324	99,254
1986	30,545	28,737	480	6	0	1,206	0	19,557	2,078	82,609
1987	10,723	22,936	0	1,114	250	654	0	10,214	392	46,283
1988	0	34,450	0	1,153	230	1,200	28	7,086	549	44,696

clams in these two bays. As a result, today all harvest is restricted to hand removal and the contribution of gaper clams to the total harvest is significantly less, 207,685 lb (95.7%) in 1978 and 3,816 lb (8.5%) in 1988 (Table 3). The other major factor impacting the commercial harvest has come from restrictions placed by the Oregon State Health Division (OSHD) on commercial clam harvest in several key estuaries because of water quality problems. During the past several years, OSHD has developed shellfish harvest management plans for each estuary and several major clam beds are now available for harvest because of this work.

The quality of our commercial clam harvesting data was enhanced considerably in 1985 when the Oregon Fish and Wildlife Commission approved Oregon Administrative Rule (OAR) 635-05-016 which requires all commercial clam diggers to have a permit to take clams. They also required all

Table 3. Annual commercial harvest (lb) of bay clams, by species, in Oregon, 1975-88.

Year	Butter	Cockle	Gaper	Littleneck	Softshell	Macoma	Total
1975	0	6,855	15,024	4,311	360	0	26,550
1976	816	322	85,831	455	630	0	88,054
1977	607	859	81,775	232	1366	894	85,733
1978	1,452	6,717	207,685	1,056	52	0	216,962
1979	606	2,299	91,028	0	979	0	94,912
1980	40	2,244	74,459	4,268	456	0	81,467
1981	2,409	4,580	68,508	4,892	749	0	81,138
1982	3,654	10,517	106,440	13,231	248	0	134,090
1983	4,035	2,579	95,091	34,444	36	0	136,185
1984	4,842	17,912	50,573	46,874	366	0	120,567
1985	1,646	29,412	20,121	46,266	1,809	0	99,254
1986	2,862	31,681	17,021	27,487	3,558	0	82,609
1987	3,046	20,202	6,368	14,140	2,527	0	46,283
1988	2,492	30,068	3,816	6,884	1,436	0	44,696

landings to be reported on a monthly log book. The permit gave us the opportunity to learn about individual commercial clam diggers, where their harvest occurred, and their CPUE by species. In addition, the log book provided a means to reconcile differences on the fish ticket summaries.

Regulations

The history of recreational and commercial clam digging regulations is summarized below:

1948 - Prior to 1948, coastal counties regulated the harvest of bay clams. In 1948, a statewide bag limit of 36 bay clams was approved; only 18 of the 36 could be gaper clams and no sorting was allowed. There was no recreational or commercial harvest January 1-June 30 for gaper clams.

1960 - Gaper bag limit changed; only 12 of the 36 bay clams could be gaper clams. The recreational season on gaper clams was also removed.

1963 - The use of mechanical equipment to commercially harvest intertidal clams was made unlawful and a permit was required to harvest subtidal clams.

1977 - Bag limit changed to 20 bay clams, of which 12 could be gaper clams. In addition, 36 of the incidental species, including the softshell clam, could be taken. Sorting of unbroken butter, cockle, and littleneck clams allowed.

SOURCES OF STOCK ASSESSMENT DATA

Intertidal Clam Surveys

Intertidal clams inhabit the tideflats that are exposed to the air during low tide. During the past several decades ODFW has conducted numerous studies that provide an insight into the status of these clam stocks. A comprehensive coastwide study documenting the recreational fisheries in 15 estuaries was completed in 1971 (Gaumer et al. 1973-74). Results of this survey revealed the recreational clam fishery in Oregon was an important component of the total sport use of our estuaries. Recreational harvesters dug clams in 11 estuaries in 1971. We estimated that in excess of 103,000 clam diggers expended nearly 152,000 hours of effort to harvest 1.8 million clams (Table 4). This represented a harvest rate of 17.5 clams/trip or 11.9 clams/hour. The cockle clam was the principal species harvested, comprising over 35% of the total clam harvest (Table 5). Table 5 also shows Tillamook Bay provided the most production, nearly 614,000 clams. Unfortunately, none of the clams observed in the harvest were aged or measured for size which would have provided us with a much clearer understanding of the status of the intertidal stocks at that time.

In 1975, the ODFW started conducting annual surveys of recreational clam diggers in Tillamook, Netarts, Nestucca, Yaquina, and Siuslaw estuaries. We added Alsea Bay to our

Table 4. Summary of 1971 recreational clam fishery, by bay.

	Trips		Hours		Clams				
	No.	%	No.	%	No.	%	Clams/Trip	Clams/Hour	Hours/Trip
Nehalem	438	0.4	540	0.4	4,353	0.2	9.9	8.1	1.2
Tillamook	24,472	23.7	38,252	25.2	613,836	34.0	25.1	16.0	1.6
Netarts	14,633	14.2	19,304	12.7	232,935	12.9	15.9	12.1	1.3
Sand Lake	3,562	3.4	2,468	1.6	34	0.1	0.1	0.1	0.7
Nestucca	1,466	1.4	1,584	1.0	23,211	1.3	15.8	14.7	1.1
Yaquina	24,347	23.5	36,332	24.0	402,314	22.3	16.5	11.1	1.5
Alsea	3,615	3.5	4,982	3.3	23,422	1.3	6.5	4.7	1.4
Siuslaw	5,890	5.7	8,665	5.7	143,073	7.9	24.3	16.5	1.5
Umpqua	3,218	3.1	5,898	3.9	84,680	4.7	26.3	14.3	1.8
Coos	19,286	18.7	31,383	20.7	277,532	15.4	14.4	8.8	1.6
Coquille	169	0.2	211	0.1	2,622	0.1	15.5	12.4	1.3
Total	103,387		151,642		1,808,012		17.5	11.9	1.5

surveys in 1982 and in 1983 Coos Bay was added. Today, we interview clam diggers on 22 clam beds. Nearly 1,400 clam diggers are interviewed each year. These surveys provide data on CPUE, digger origin, and species, age, and size composition (Gaumer 1990).

Results of our 1975-88 intertidal surveys show digging success remained similar to 1971 as diggers averaged 16.6 clams/trip or 11.7 clams/hour (Figure 1). This is especially meaningful considering the bag limit was reduced in 1977 from 36 to 20 clams/person. Size composition data for 1975-88 also revealed little change in average size for each species harvested by the recreational digger (Figure 2).

In addition to these interview studies, we also completed stock assessment surveys on the distribution and relative abundance of clams in each of our major estuaries.

Table 5. Summary of 1971 recreational clam fishery, number of clams by bay, by species.

Species	Nehalem	Tillamook	Netarts	Sand Lake	Nestucca	Yaquina	Alsea	Siuslaw	Umpqua	Coos	Coquille	Total	Percent
Cockle	0	251,902	74,830	34	0	246,275	13,834	0	0	53,520	0	640,395	35.4
Softshell	4,353	9,458	1,823	0	23,211	78,402	8,797	128,326	84,680	45,101	2,617	386,768	21.4
Gaper	0	41,448	97,768	0	0	71,914	94	0	0	107,907	5	319,136	17.7
N. Littleneck	0	243,916	10,486	0	0	1,719	79	7	0	15,482	0	271,689	15.0
Butter	0	65,675	47,360	0	0	1,451	40	0	0	53,288	0	167,814	9.3
Piddock	0	0	61	0	0	0	531	14,740	0	134	0	15,466	0.9
Bentnose	0	996	56	0	0	2,531	0	0	0	2,100	0	5,683	0.3
Razor	0	223	435	0	0	0	0	0	0	0	0	658	<0.1
Sand	0	206	61	0	0	22	0	0	0	0	0	289	<0.1
Bodega	0	9	21	0	0	0	47	0	0	0	0	77	<0.1
M. Littleneck	0	3	34	0	0	0	0	0	0	0	0	37	<0.1
Total	4,353	613,836	232,935	34	23,211	402,314	23,422	143,073	84,680	277,532	2,622	1,808,012	
Percent	0.2	34.0	12.9	<0.1	1.3	22.3	1.3	5.9	4.7	15.4	0.1		

1/ Columbia, Salmon, Siletz, Rogue, and Chetco bays not shown due to zero harvest observed for these bays.

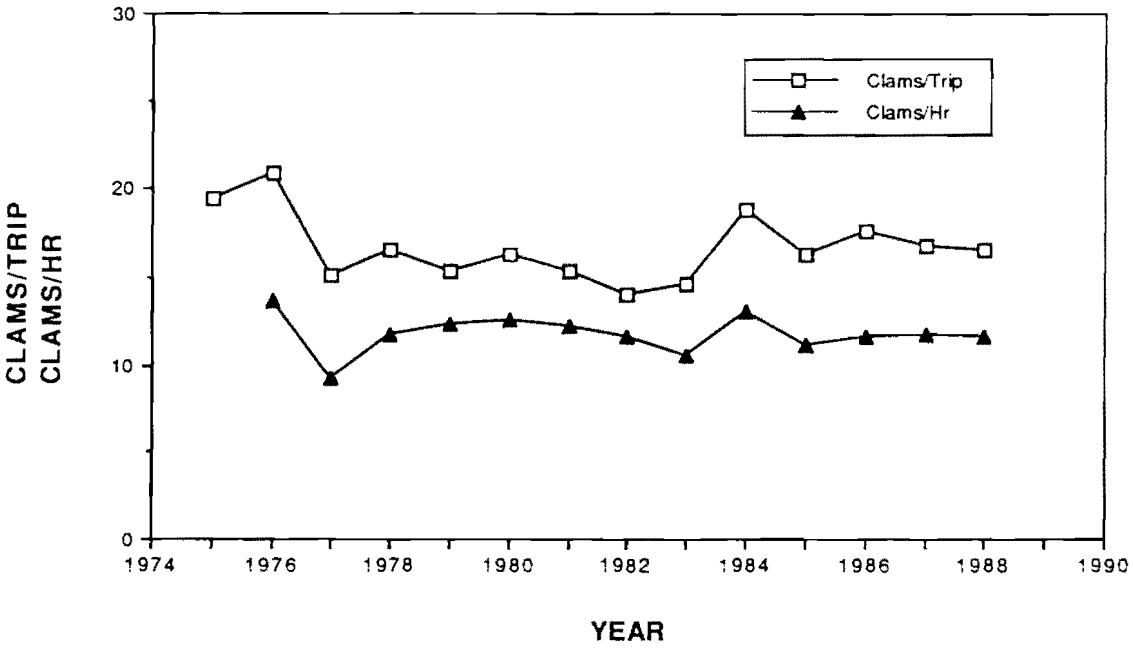

Figure 1. Average catch per unit of effort for recreational harvest in Oregon (all species combined), 1975-88.

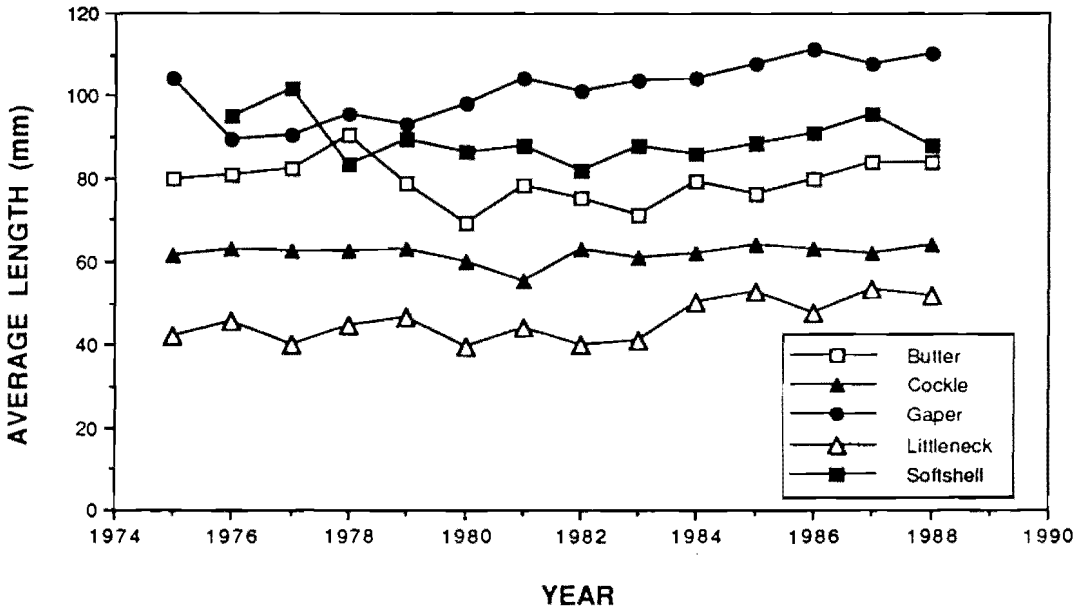

Figure 2. Size composition of recreationally harvested clams in Oregon (all bays combined), 1975-88.

Data from these surveys were summarized and presented in map form in Hancock et al. 1979.

Subtidal Clam Surveys

Subtidal clams inhabit those portions of our estuaries that are never exposed to the air, even at low tide. Nearly all of the commercial harvest of clams comes from subtidal stocks; very little recreational harvest occurs subtidally. The status of these subtidal stocks came from comprehensive surveys conducted in the mid 1970's. Using SCUBA and transect lines, the subtidal clam stocks of 10 estuaries were systematically surveyed and the distribution and abundance of each species was mapped (Hancock et al. 1979). Additional surveys, in those areas appearing to have commercial clam harvest potential (Tillamook, Yaquina, and Coos bays), were inventoried with the the use of a venturi suction pump and sampling grid. This gave us detailed data for population and biomass estimates, and size and age composition.

Data collected during our subtidal stock assessment surveys provided the most complete picture of the status of our clam stocks. All year-classes are taken in the samples, including new recruits. As might be expected, recreational and commercial harvesters are selective to the larger clams which creates a bias against incoming year-classes. These stock assessment surveys were conducted in Tillamook Bay (1974-76 and 1984-85), Yaquina Bay (1975-88), and Coos Bay (1975 and 1980).

In addition to our subtidal stock assessment surveys, we collected biological data from the commercial clam fishery. These data included species composition, CPUE, and size and age composition for several species of the commercially important clams.

The results of our intertidal and subtidal surveys conducted since 1975 provide the basis for the following discussion on the status of Oregon's bay clam stocks.

CURRENT STATUS OF CLAM STOCKS

Butter Clam

The butter clam is found primarily in Tillamook, Netarts, and Coos bays (Table 6). These bays support an active recreational fishery but very little commercial

Table 6. Summary of occurrence of intertidal and subtidal clams in Oregon's major clam producing bays.

	Species									
	Butter		Cockle		Gaper		Littleneck		Softshell	
Bay	Int.	Sub.	Int.	Sub.	Int.	Sub.	Int.	Sub.	Int.	Sub.
Nehalem	-	-	-	-	-	-	-	A	A	-
Tillamook	C	A	A	A	A	A	A	A	A	-
Netarts	C	A	A	A	A	A	C	C	C	-
Nestucca	-	-	-	-	-	-	-	-	C	-
Yaquina	S	S	C	S	A	A	S	S	A	-
Alsea	-	-	S	S	S	S	S	-	C	-
Siuslaw	-	-	-	-	S	C	-	-	A	-
Umpqua	-	-	-	S	S	S	-	-	A	-
Coos	A	A	A	A	A	A	A	C	A	-
Coquille	-	-	-	-	-	S	-	-	C	-

S = sparse
C = common
A = abundant
- = unusual or rare

harvest of this species. The clam has a thick shell with pronounced concentric rings. It is found in the mid-intertidal zone and subtidally to depths of 60 ft in substrates of mixtures of sand, shell, and gravel. The clam prefers protected bays with good current flow. Butter clams will burrow to a depth of 8 to 14 inches and may reach a size of 4 to 6 inches. The clam is the slowest growing of our bay clams and lives to 20 years of age. They are dioecious (separate sexes) and are summer spawners. A single female clam can release nearly a million eggs. The clam is usually dug with a shovel.

Recreational Fishery: The butter clam historically has contributed between 5.2 and 16.5% of the recreational harvest in Oregon (Figure 3). This figure also shows that since 1975 the harvest has been cyclic with 1978 and 1984 being the years of low contribution. Both low years were followed by periods of similar rates of increase in the harvest. CPUE data collected from recreational diggers also reflects this cyclic pattern (Figure 4). This figure shows a range of 0.9 to 2.7 clams/trip or 0.6 to 1.9 clams/hour taken during 1975-88. The regulation change in 1977, reducing the bag limit from 36 to 20 clams/person, had an immediate impact on the harvest of butter clams. The catch of clams/trip declined from 2.3 to 1.0 the first year of the new bag limit. By 1980, CPUE had nearly returned to the pre-regulation change level. A portion of this cyclic nature can also be attributed to the declines in abundance of butter clams on several tideflats in Netarts and Coos

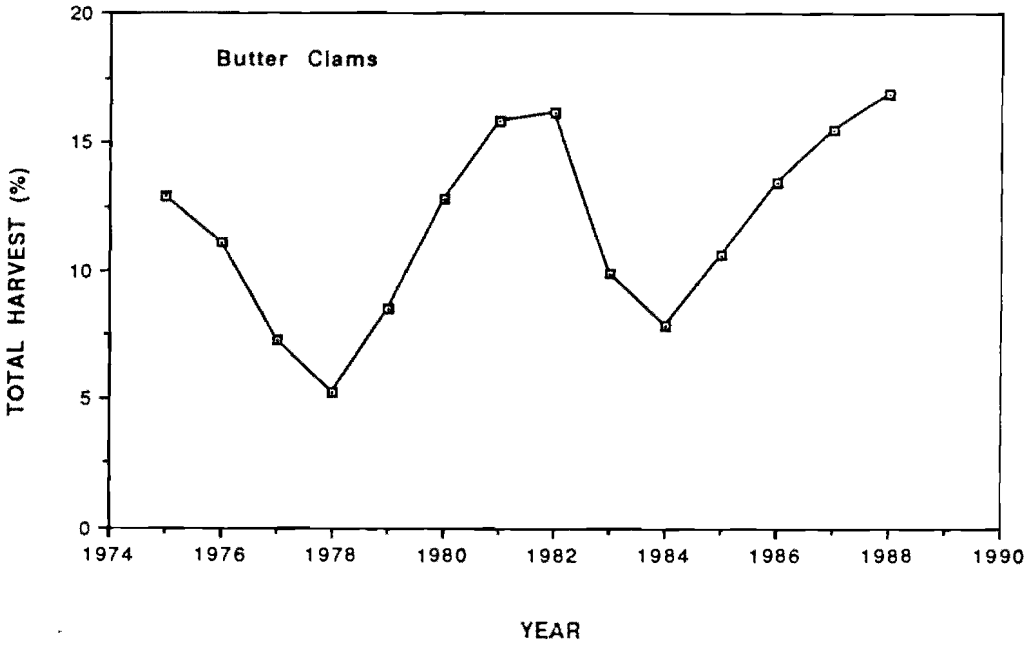

Figure 3. Recreational harvest of butter clams (percent of total harvest) in Oregon, 1975-88.

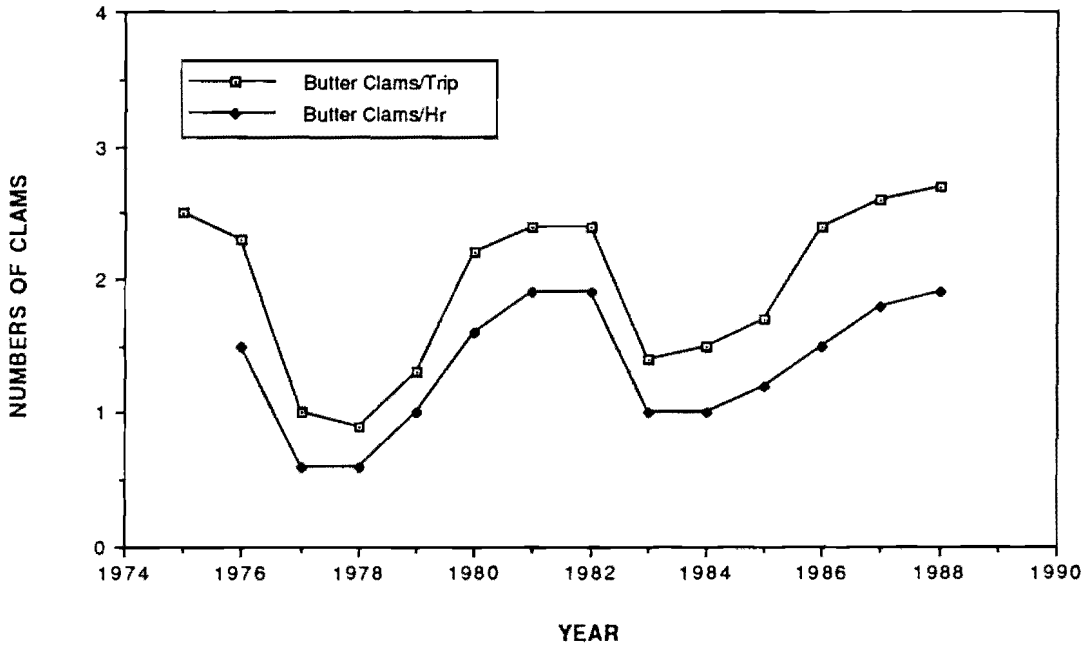

Figure 4. Average catch per unit of effort for recreational harvest of butter clams in Oregon, 1975-88.

bays. For both bays, strong 1978, 1979, and 1980 year-classes have contributed to the recent recovery of this species in the recreational harvest.

Size composition data collected from the recreational clam digger show butter clams averaged between 69.2 and 90.7 mm between 1975 and 1988 (Figure 5). The pronounced increase in average size from 82.4 mm in 1977, to 90.7 mm in 1978, was partially the result of clam diggers targeting on large butter clams (average size 103 mm) at Happy Camp in Netarts Bay. By 1980, the overall statewide average size had declined to 69.2 mm due primarily to increased digging pressure on young incoming year-classes on Garibaldi Flat in Tillamook Bay. Since 1980, the average size of butter clams

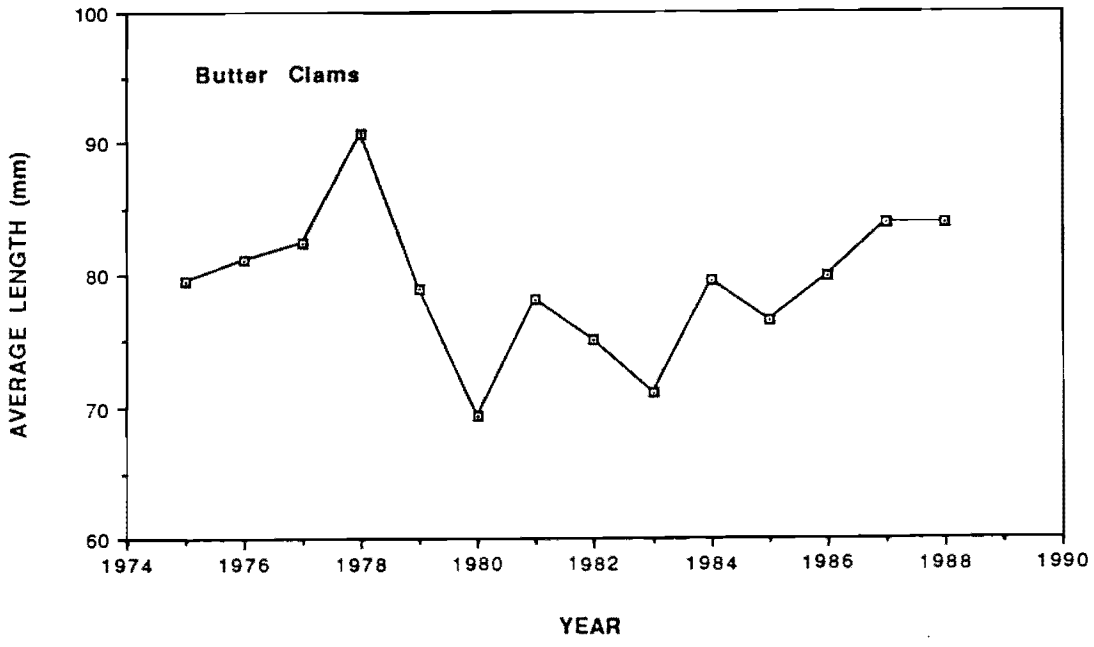

Figure 5. Size composition of butter clams in recreational harvest in Oregon, 1975-88.

has steadily increased to 83.9 mm, second only to the 90.7 mm recorded in 1978.

Commercial Fishery: The contribution of the butter clam to the total commercial harvest is shown in Table 3. Of the 2,492 lb landed in 1988, 59.8% were from Coos Bay and 40.2% came from Tillamook Bay. In general, the butter clam is harvested as an incidental species as fishermen are digging other species of clams. Several fishermen in the past have targeted on butters for market testing but discontinued the fishery due to poor consumer acceptance. Of all the bay clams, the butter is reported to have the shortest shelf life. A short shelf life, difficulties in harvesting by hand (i.e., it occurs deeper in the substrate than most other bay clams, and frequently inhabits rocky habitat), and several of the more productive areas located in restricted shellfish harvest areas, will probably keep the butter clam from becoming an important commercial species in Oregon. Because of the limited occurrence of this species in the commercial fishery, little information is available from these data to provide insight into the status of our subtidal stocks of butter clams.

Stock Assessment: Results of our subtidal surveys revealed there was annual recruitment of butter clams in Tillamook Bay (Figure 6). The population was not dominated by a single year-class, and all samples revealed at least 14 year-classes were represented in the population. Our sampling in Yaquina and Coos bays suggest that recruitment was not annual for all bays (Figure 7). Our 1975 samples

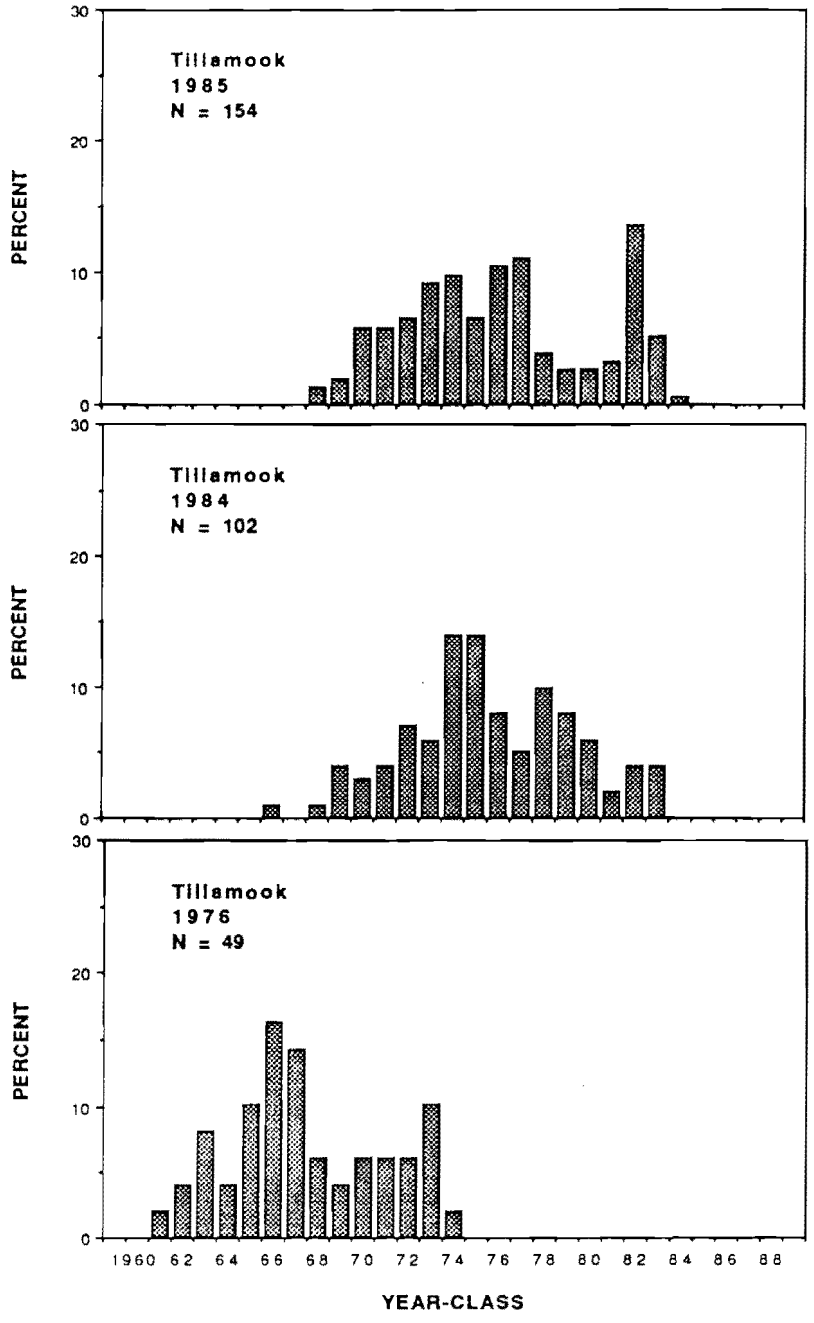

Figure 6. Age composition of subtidal butter clams in Tillamook Bay,1976, 1984-85.

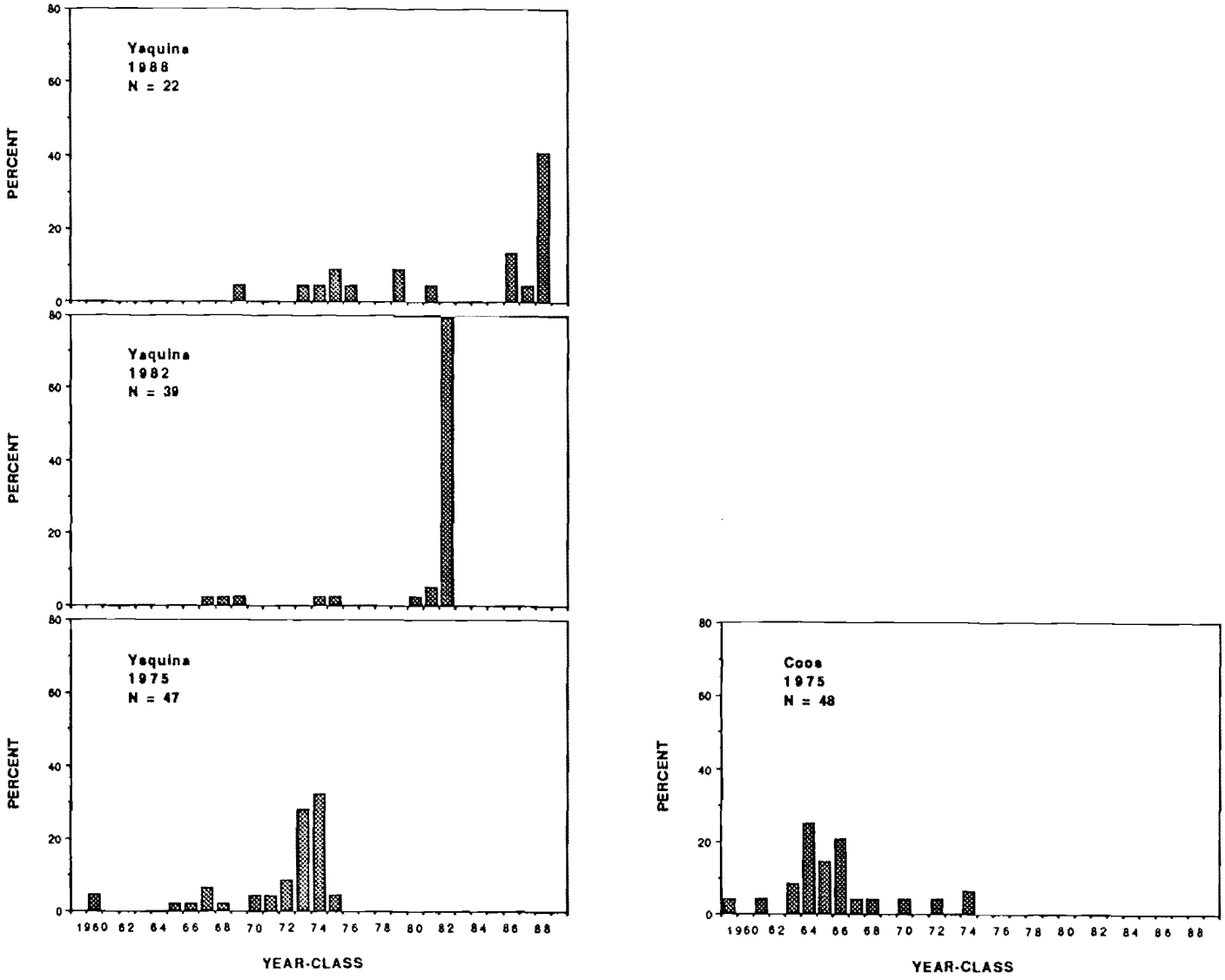

Figure 7. Age composition of butter clams in Yaquina and Coos bays, 1975-88.

showed for both of these bays, the 1962 and 1969 year-classes were not represented. It should be noted sample sizes were considerably smaller for Yaquina and Coos bays than for Tillamook Bay. In 1982 and 1988, new recruits dominated the Yaquina Bay samples. Unfortunately, our 1988 survey revealed none of the 1982 year-class clams had survived. This was not unique to butter clams in Yaquina Bay. Both native littleneck and gaper clams have had successful settlement of new recruits but within a year most young clams had died.

Cockle Clam

The cockle clam is the species most sought after by the recreational and commercial clam digger. The clam is found in nearly all of our larger estuaries (Table 6) with Tillamook, Netarts, Yaquina, and Coos bays providing most of the digging effort.

The clam is easily identified by the many prominent, evenly spaced ridges on the exterior of the shell that radiate in a fan-like pattern from the umbo. The clam is found primarily in a sandy substrate and burrows to a depth of 1 to 3 inches This shallow depth makes the clam especially vulnerable to freezing and heavy mortality on low tides during the winter. It occurs both high in the intertidal zone and at considerable depths in the subtidal zone. The clams are fast growing, reaching sexual maturity in 2 years at a size of 25 to 40 mm. They can reach 15 years of age but seldom are seen over 7 years of age. They

can reach 145 mm in size but usually average less then 70 mm. The clams are hermaphroditic (both sexes in same individual) and are summer spawners. The clam is usually harvested with a clam rake.

Recreational Fishery: Since 1975, the cockle clam has contributed between 22.7 and 58.7% of the total annual recreational harvest (Figure 8). Unlike the butter clam that has shown a steady increase in contribution to the total harvest since 1984, the contribution of cockles has leveled off between 1986 and 1988, providing between 37.7 and 41.7% of the total production.

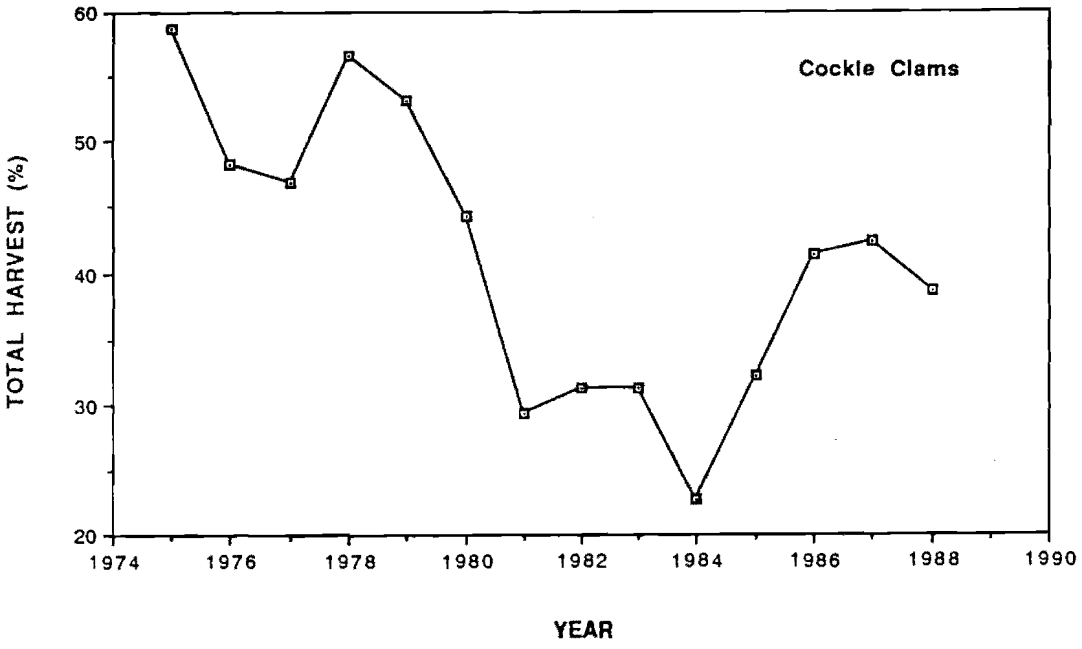

Figure 8. Recreational harvest of cockle clams (percent of total harvest) in Oregon, 1975-88.

Figure 9 shows cockle clams, in contrast to butter clams, are becoming more difficult to find. In 1975, cockles were taken at a rate of 11.3 clams/trip. By 1977, the catch rate had declined to 6.6 clams/trip. Part of this reduction can be explained by the change in bag limit from 36 to 20 clams in 1977. Since 1977, CPUE for cockles has fluctuated between 4.3 and 9.3 clams/trip. The low part of the cycle occurred in 1984. From 1984 to 1986, CPUE improved somewhat to 7.2 clams/trip but since then, has shown a gradual decline to 6.3 clams/trip in 1988.

The overall decline in cockle production can also be shown by changes in digging activity on popular cockle beds. For example, during the early 1970's, Bay Ocean Spit in Tillamook Bay produced some of the best cockle digging in

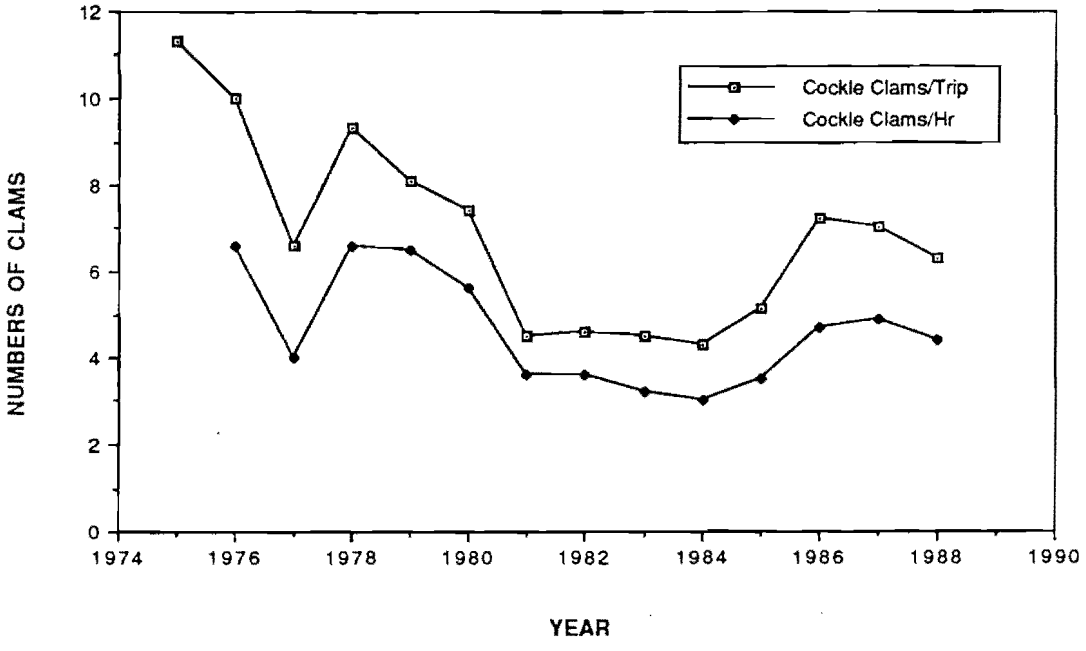

Figure 9. Average catch per unit of effort for recreational harvest of cockle clams in Oregon, 1975-88.

the state (CPUE as high as 20.5 clams/trip in 1976). That year, we made a peak count of 280 diggers on this clam bed. In 1987, only three clam diggers were counted on the tideflat (Table 7). Another example of rapid changes in cockle availability was observed at the Gas Plant clam bed in Yaquina Bay. In 1978, diggers enjoyed a CPUE of 11.5 clams/trip, but by 1981 the production had fallen to 0.4 clams/trip. Since then, several strong year-classes helped to bring CPUE back up to nearly 14 clams/trip in 1988.

Table 7. Peak clam digger counts, by tideflat, 1975-88.

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Tillamook														
Garibaldi	425	350	131	225	256	300	460	516	487	350	118	380	400	257
Bay Ocean	-	280	122	39	107	-	33	13	10	4	0	17	3	-
Netarts														
Happy Camp	-	175	73	-	150	160	425	500	478	200	191	314	265	116
Yaquina														
Bridge Bed	-	245	138	30	91	84	225	625	275	84	107	204	225	110
Breakwater	-	127	120	62	23	20	27	63	26	28	25	30	46	17
Idaho Flat	-	110	98	45	66	61	38	176	46	35	31	50	56	39
Gas Plant	-	-	-	-	24	26	41	16	12	10	11	34	20	10
Coquille Point	-	-	-	-	17	18	5	41	20	5	9	14	7	4
Sally's Bend (*)	-	159	67	14	41	44	46	57	32	15	20	48	27	14
Alsea														
Breakwater	-	-	-	-	-	-	-	12	9	0	22	22	4	45
Bay Shore	-	-	-	-	-	-	-	49	31	14	20	10	15	44
North Bank	-	-	-	-	-	-	-	4	3	0	5	0	13	18
Siuslaw														
North Fork	-	55	-	-	109	57	146	33	22	43	41	44	56	45
Coos														
Charleston Triangle	-	-	76	-	-	-	-	-	31	24	41	39	87	82
Charleston Flat	-	-	138	-	-	-	-	-	64	30	26	27	66	103
Peterson's Flat	-	-	35	-	-	-	-	-	5	-	2	15	14	4
Pigeon Point	-	-	112	-	-	-	-	-	62	50	42	67	97	52
North Spit	-	-	322	-	-	-	-	-	-	37	-	83	158	102
Clam Island	-	-	-	-	-	-	-	-	-	58	-	86	119	93

(*) Sally's Bend is a combination of Gas Plant and Coquille Point.

Several factors contribute to the cyclic nature of the cockle clam population. In addition to periodic freezing mortalities, annual variability in recruitment and digging pressure also play a role in clam availability. Another factor that has played a major roll in recent years, is the proliferation of mud and ghost shrimp on a number of our more productive clam beds. Mud shrimp have all but destroyed much of the Bay Ocean Spit on Tillamook Bay for clam production. Our intertidal surveys of this tideflat in 1975 revealed cockle clams at most sample stations where clam diggers were routinely observed. Shrimp were also inventoried on this tideflat with sparse to moderately dense concentrations observed at most stations. In 1986, we resurveyed a 67 acre portion of this tideflat in response to an oyster lease application. Only one clam was located in this survey but shrimp concentrations were dense at nearly all stations. Other tideflats including Sally's Bend in Yaquina Bay have also been severely impacted by the encroachment of mud shrimp since the 1970's.

Figure 10 shows the size composition of cockles taken in the recreational harvest since 1975. Cockles harvested in 1988 had a mean size of 63.9 mm. Only in 1985 did they have a larger mean size (64.2 mm). The decrease in average size observed in 1980 and 1981 was influenced by the smaller size of clams taken in Tillamook and Yaquina bays. Strong incoming 1977 and 1978 year-classes depressed the mean size down to 55.3 mm in 1981, by far the smallest average size

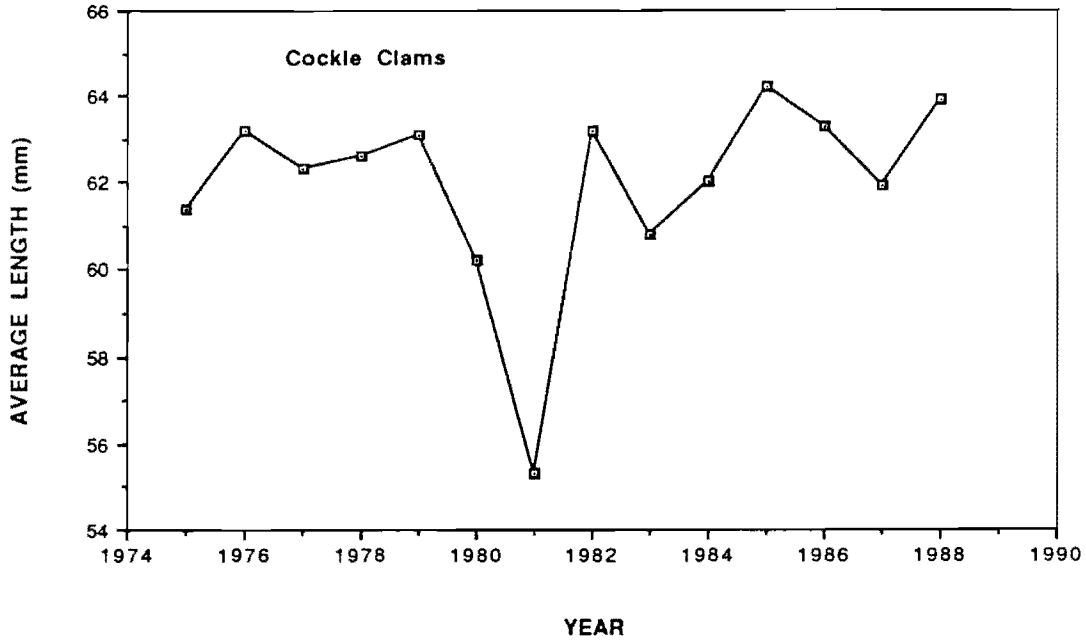

Figure 10. Size composition of cockle clams in recreational harvest in Oregon, 1975-88.

observed during the report period. By 1982, cockle clams were again similar in size to those observed in 1979.

Commercial Fishery: Since 1986, the cockle clam has been the principal species taken in the commercial harvest. In 1988, over 67% (30,068 lb) of the harvest was cockle clams (Table 3). Nearly all of this harvest was from subtidal stocks in Tillamook Bay and nearly all of the clams were used for crab bait.

In 1984, commercially harvested cockle clams from Tillamook Bay averaged 60.8 mm in size. Cockles taken from the same general area in 1985 and 1987, averaged 68.7 and 62.8 mm, respectively. CPUE for cockles commercially harvested in Tillamook Bay during 1985, 1986, 1987, and 1988 was 88.8, 140.4, 131.6, and 139.2 lb/hour, respectively.

Stock Assessment: Data collected for cockle clams during our stock assessment surveys revealed good annual recruitment occurred in Tillamook Bay. Too few cockles were collected in Yaquina and Coos bays to assess annual recruitment. In Tillamook Bay, a minimum of eight year-classes were represented in each of our 1976, 1984, and 1985 samples (Figure 11). In general, individual year-classes did not dominate the age composition; although, in 1984, 42.1% of the clams were of the 1983 year-class. None of the samples revealed a total year-class failure.

Cockle clams sampled in 1976, 1984, and 1985 averaged 59.2, 46.9, and 49.5 mm in size, respectively. The smaller average in 1984 reflects the influence the strong 1983 year-class had on reducing the average size.

Gaper Clam

Two species of gaper clams occur in Oregon. Tresus nuttallii, the southern gaper clam, is occasionally taken in Netarts and Coos bays. This species is more elongated in shape and has thick bony plates on it's siphon. Tresus capax, the more commonly taken of the two, is more oval in shape, has a leathery tipped siphon, and is the species discussed in this report.

The gaper clam is the largest of the bay clams discussed in this report, occasionally reaching 7 or 8 inches in size and a weight in excess of 3 lb. The clam is easily identified by the large gape where the neck (siphon) protrudes. Historically both the recreational and

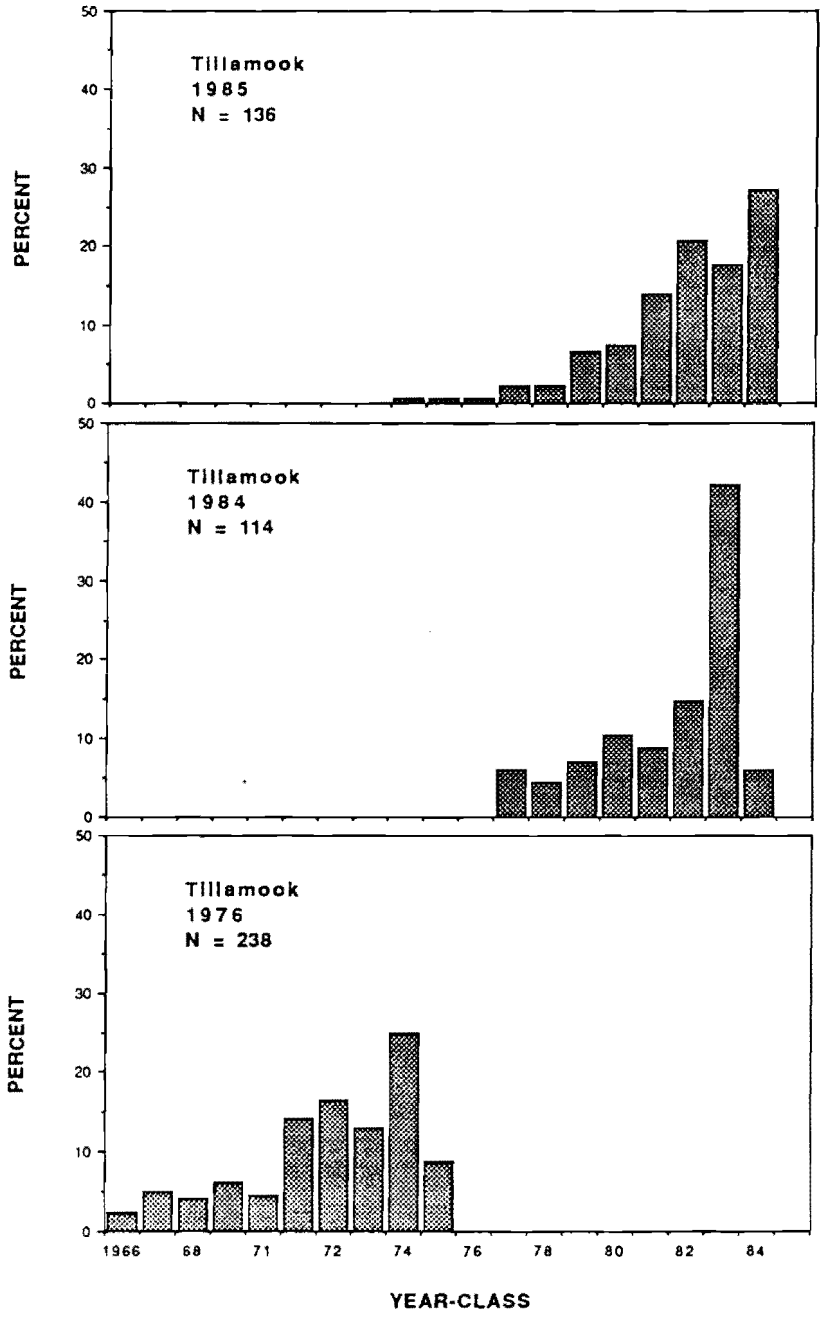

Figure 11. Age composition of subtidal cockle clams in Tillamook Bay, 1976, 1984-85.

commercial clam digger have actively pursued this species. The clam is commonly found both intertidally and subtidally in Tillamook, Netarts, Yaquina, and Coos bays (Table 6). The gaper is frequently found in the same areas as the butter clam, preferring a substrate of gravel, sand, and shell mixture. The clam burrows to a depth of 14 to 16 inches beneath the substrate surface but this depth varies considerably. Gaper clams are frequently found near eelgrass beds. The clam is a plankton feeder and is fast growing, reaching 100 mm in five years. The female reaches sexual maturity in 3 to 4 years at an average size of 3 inches. A female clam can contain several million eggs and the gaper is the only winter spawner in Oregon. Gapers have been found to reach 15 years of age. The clam is normally harvested with a shovel.

The gaper clam, unlike the other species of bay clams, has presented our shellfish management program with an ongoing challenge. In 1975, our studies revealed a massive set of newly recruited clams. During that year intertidal surveys at Happy Camp in Netarts Bay produced clam densities of 133 gaper set/sq ft (Figure 12). Surveys of subtidal clam beds in Yaquina Bay revealed densities of 27.8 clams/sq ft. Both of these clam beds have historically been some of our most productive. Since 1975, recruitment at both areas has generally been less then 1 clam/sq ft and nearly all set since 1975 have failed to survive beyond one year after settlement. Figure 13 also shows the 1975 year-class has remained the dominant age group since 1975. To illustrate

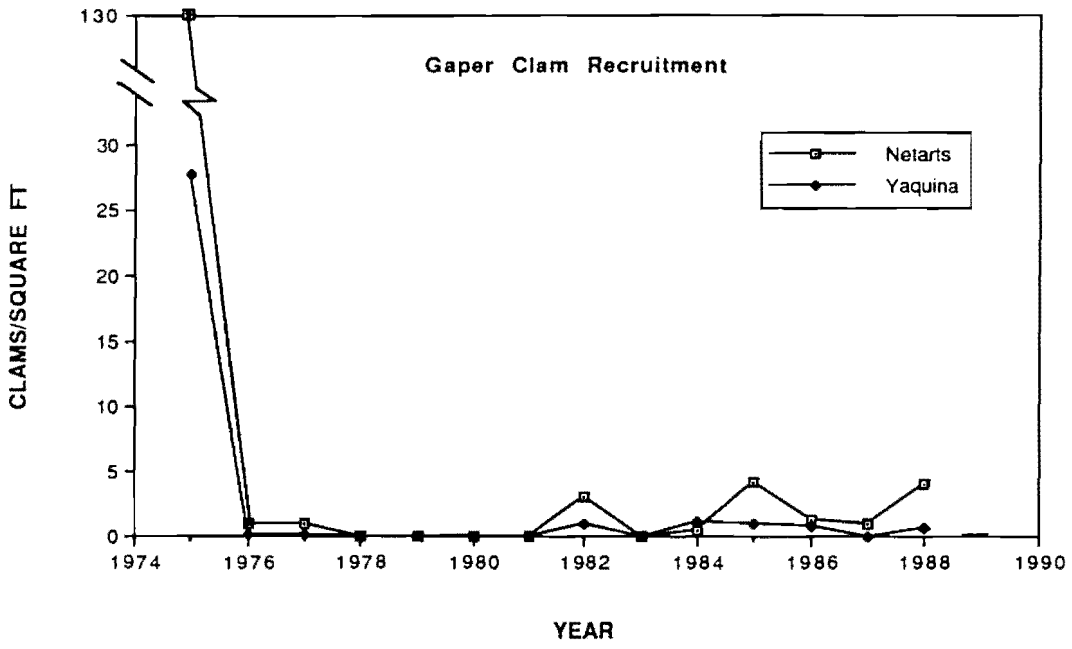

Figure 12. Density of gaper clams in Netarts and Yaquina bays,1975-88.

the complexity of this issue, a number of clam beds adjacent to these two areas have shown consistent annual recruitment since 1975. Also, the North spit in Coos Bay has had excellent gaper clam recruitment in several years since 1975.

Recreational Fishery: As with both the butter and cockle clam, gapers have been cyclic in the recreational harvest. During the 1975-88 report period, gapers comprised between 17.9 and 35.6% of the total harvest (Figure 14). In 1975, gapers comprised only 19.1% of the harvest. By 1977, this had increased to 32.5% due primarily to the presence of the exceptionally strong showing of the 1975 year-class. Following the peak in 1977, the presence of gapers in the bag has fluctuated rather radically and reached the low of

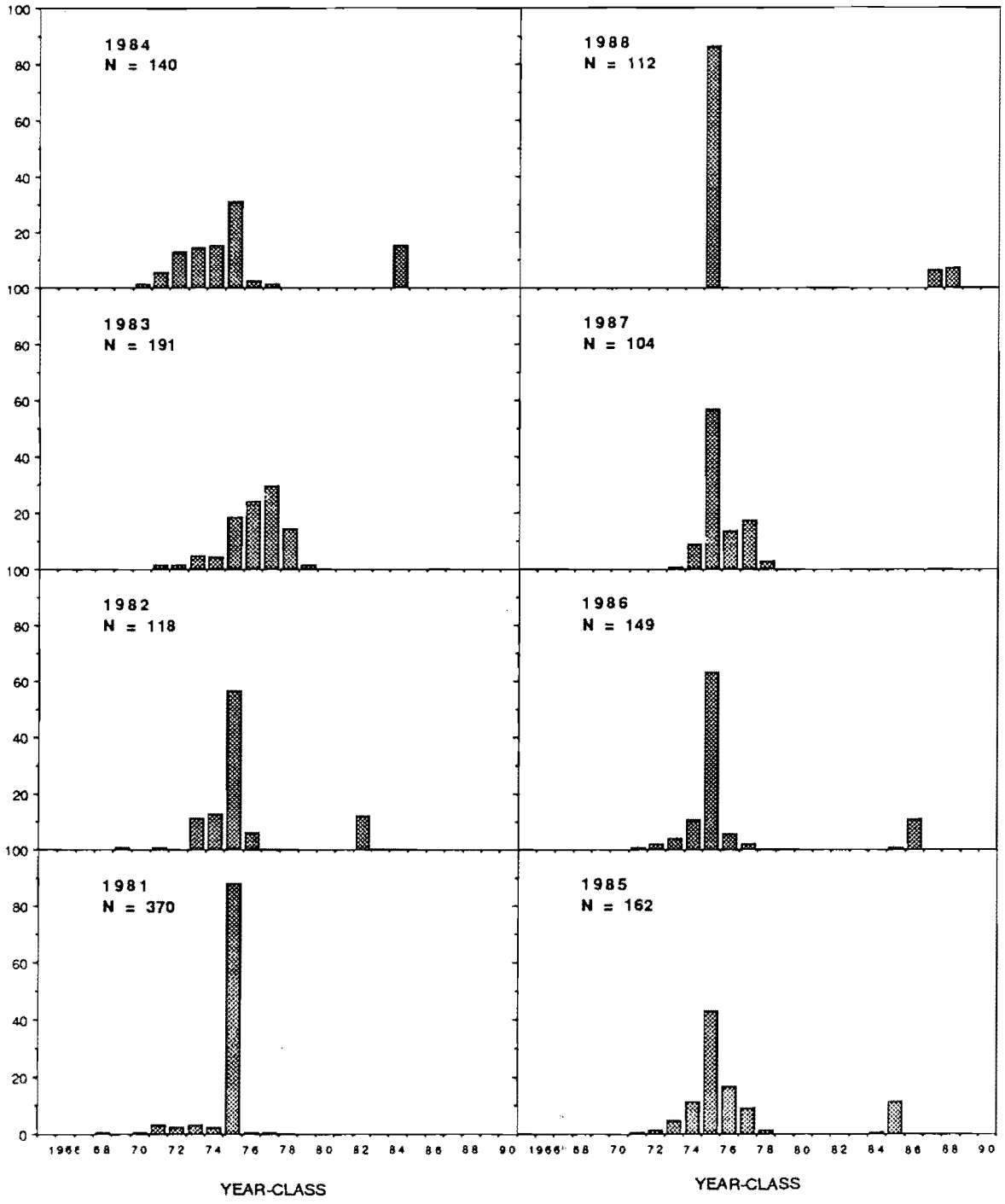

Figure 13. Age composition of subtidal gaper clams, Area 2, Yaquina Bay, 1981-1988.

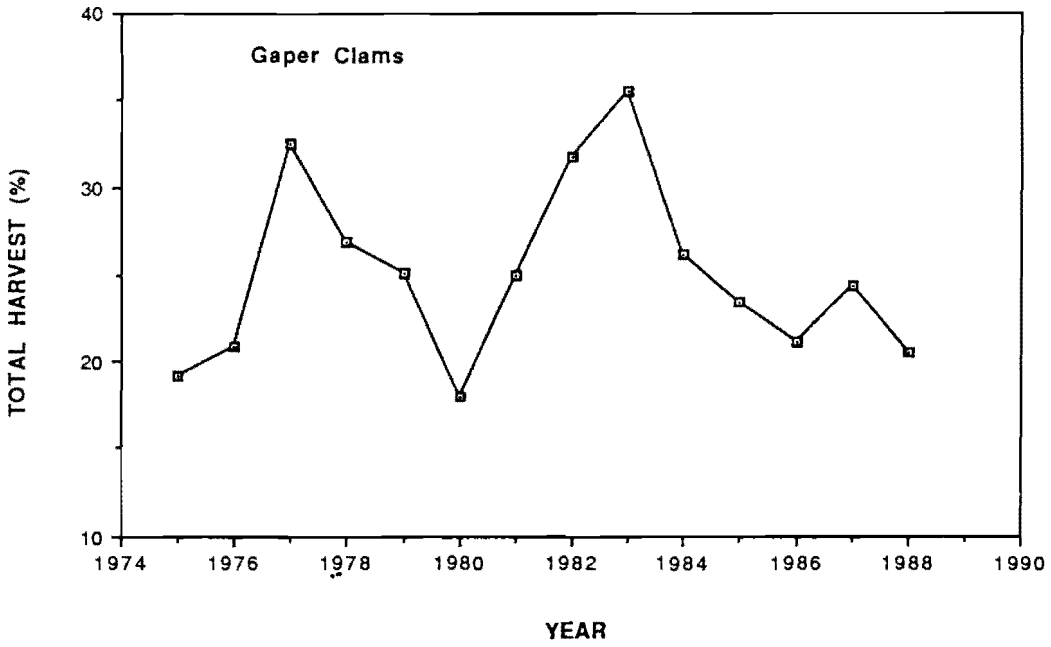

Figure 14. Recreational harvest of gaper clams (percent of total harvest) in Oregon, 1975-88.

17.9% in 1980. This low resulted partially from reduced numbers of gapers in the Tillamook Bay harvest. Following 1980, the contribution of gaper clams in the recreational harvest increased rapidly to an all time high of 35.6% in 1983, due primarily to an increase in gaper harvest in Coos and Netarts bays. Since 1983, there has been a general decline in the harvest. In 1988, gaper clams comprised only 20% of the recreational clam harvest.

The peak harvest rate of gaper clams for the recreational clam digger occurred in 1983 when diggers averaged 5.1 clams/trip (Figure 15). Since 1983, there has been a general decline in CPUE and in 1988 diggers averaged only 3.3 clams/trip. Only in 1980 did we observe a CPUE value lower than in 1988 (3.0 clams/trip). The cyclic

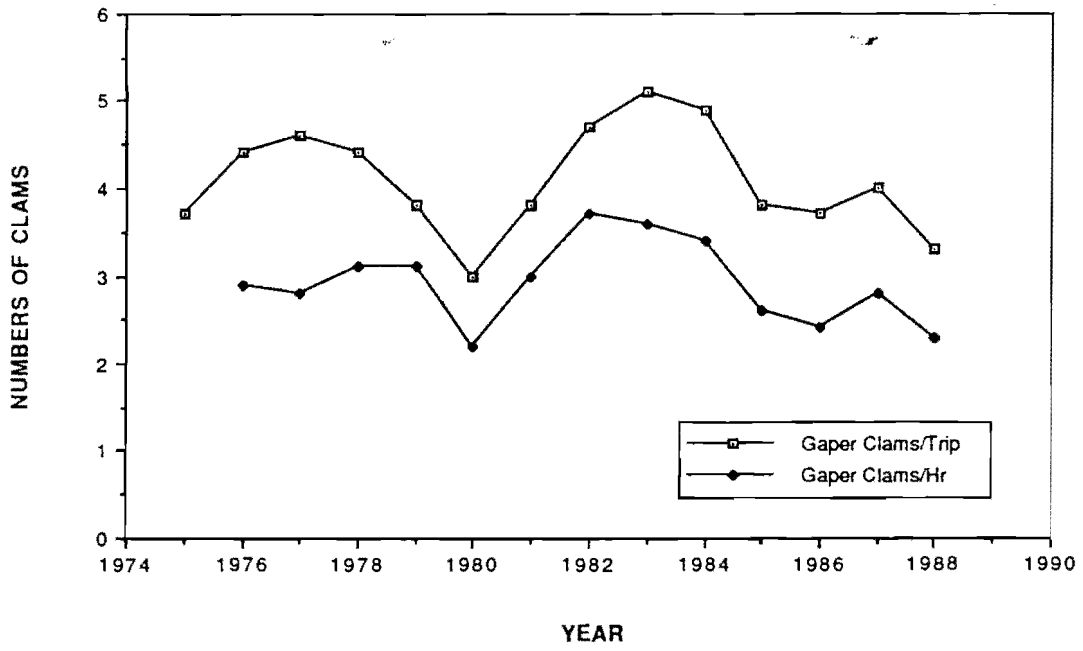

Figure 15. Average catch per unit of effort for recreational harvest of gaper clams in Oregon, 1975-88.

pattern observed for CPUE follows very closely to the pattern seen for percent of species composition in the annual recreational harvest (Figure 14). This suggests stongly that species composition of the catch and harvest rates are both a function of clam availability and abundance.

Figure 16 shows the importance of the 1975 year-class to the digger. The catch rate for gaper clams at Happy Camp went from 6.5 clams/hour in 1975 to 17.7 clams/hour in 1980 (over 87% were of the 1975 year-class). Since then, digging success has declined to 3.5 clams/hour in 1988. A similar pattern was observed for a popular gaper clam bed under the Yaquina Bay bridge. On the other hand, the breakwater in Yaquina Bay has experienced some recruitment nearly every

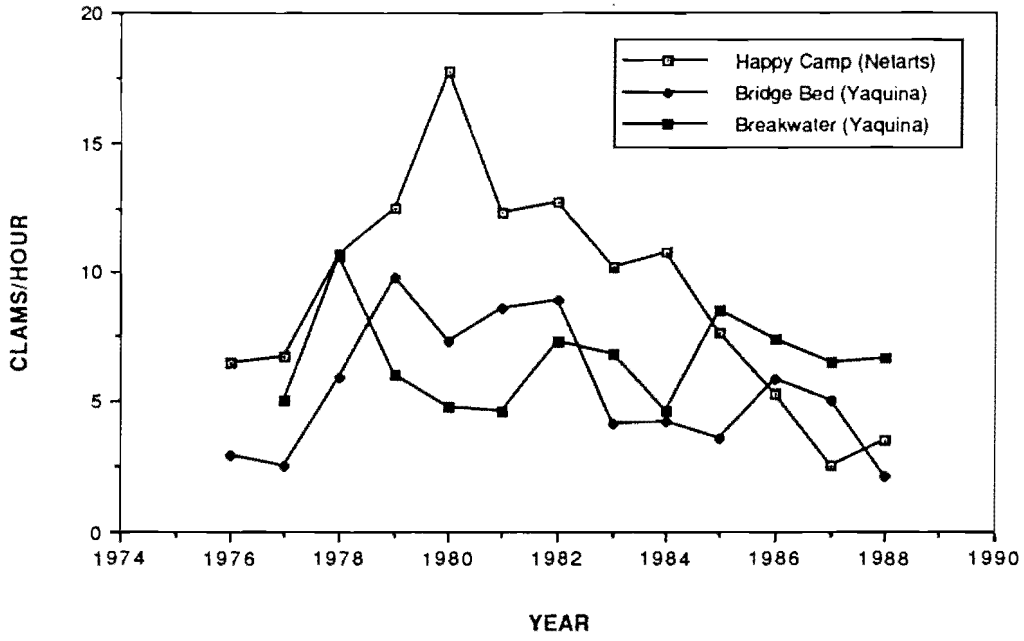

Figure 16. Average catch per unit of effort for recreational harvest of gaper clams on three major clam beds, 1976-88.

year. As a result, the catch rate on the breakwater in 1988 was nearly double the rate found at Happy Camp and under the Yaquina Bay bridge.

The average size of gaper clams in the annual recreational clam harvest also reflects the impact the strong 1975 year-class had. Since all gaper clams must be kept as part of the bag limit, large numbers of small 1975 year-class clams were retained in the 1976 harvest. Mean size of the clams decreased from 104.1 mm in 1975 to 89.5 mm in 1976 (Figure 17). Since then, as the clams continued to grow, mean size has increased to 110.3 mm in 1988, the second largest mean size observed during the report period.

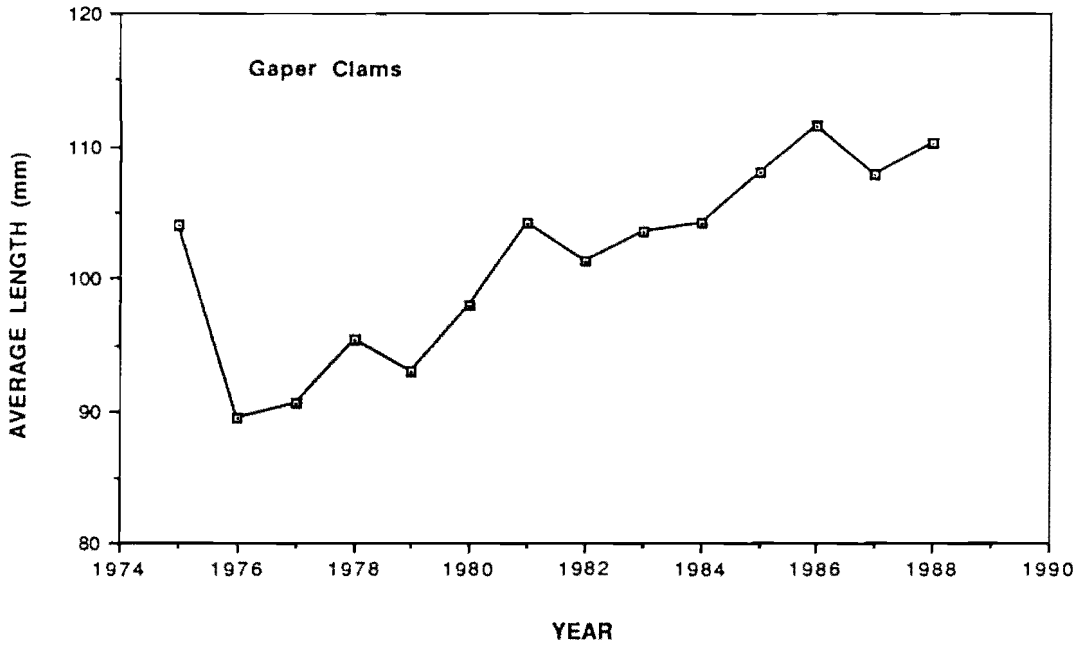

Figure 17. Size composition of gaper clams in recreational harvest in Oregon, 1975-88.

Commercial Fishery: The gaper clam historically has been the main species harvested by the commercial clam digger. In 1975, 57% of the total bay clam harvest (15,024 lb) were gaper clams (Table 3). The commercial harvest peaked in 1978 when 216,962 lb were reported; 207,685 lb or 95.7% were gaper clams, of which 171,898 lb or 82.8% came from Yaquina Bay. As mentioned earlier, the increased harvest came as a result of our clam surveys where we located and inventoried a number of subtidal clam beds. By 1980, two years after the peak harvest, the Yaquina Bay gaper fishery collapsed with no landings reported. A number of factors led to the collapse. The completion of the South Beach Marina jetty narrowed the main channel resulting in considerably higher current velocities and more difficult harvest conditions. This, coupled with increased boat

traffic from the new marina, and low prices offered by the processors, interfered with the steady supply of clams needed by the processors. At the same time, the processors found they could purchase processed clams from the east coast cheaper than they could process local clams. By 1988, only 3,816 lb of gaper clams were harvested statewide in Oregon. This statewide decline can be attributed to several major factors; the sporadic recruitment already discussed, which eventually led to a cessation of ODFW issuing mechanical harvest permits in 1985; the harvest problems in Yaquina Bay; and the classification by OSHD of the major clam bed in Yaquina Bay as restricted to the commercial harvest of shellfish because water quality standards could not be met.

Nearly all the 1988 commercial harvest of gaper clams was taken by SCUBA divers; 1,481 lb (38.8%) were taken from Coos Bay, and 1,010 lb (26.5%) were taken from the Siuslaw. Most of the clams were sold to local restaurants or live to the public. Some were used as crab or fish bait.

Only in Coos Bay have we been able to collect annual size and age composition data for commercially harvested gapers. During the 1976-87 period, annual mean sizes have ranged between 121.2 mm in 1978 to 139.9 mm in 1984 (Figure 18). The small average size in 1978 reflects again the impact that the strong 1975 year-class had in both the recreational and commercial harvest. In general, the overall increase in average size suggests young clams are not being recruited into the subtidal stocks.

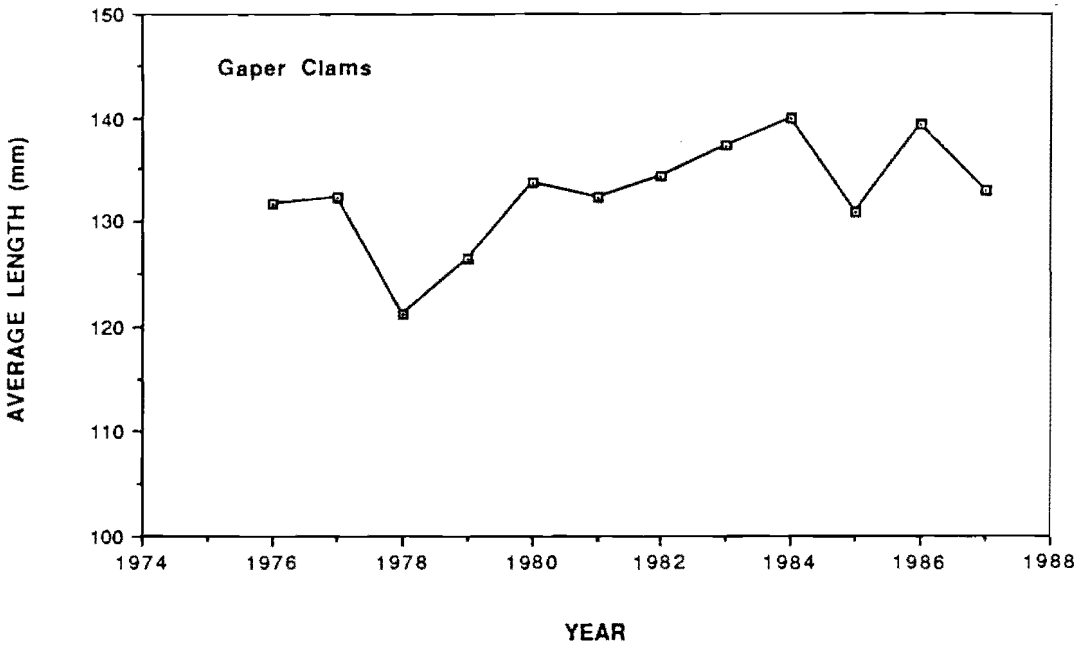

Figure 18. Size composition of gaper clams in commercial harvest, Coos Bay, 1976-87.

CPUE data for gaper clams harvested by mechanical means (high pressure water jet) were collected from the same commercial clam digger from 1975 to 1984 (Figure 19). Since 1984, the last year mechanical harvesting was permitted, CPUE data were collected from another commercial fisherman, a hand harvester. The mechanical harvest data revealed catch/trip declined from a peak of 1,225 lb in 1978 to 238 lb in 1984. This harvester claimed he needed 300 lb/day to stay in business. In 1984, he went out of business. Since 1985, CPUE for hand harvest has remained relatively constant, producing 246 lb/trip in 1988; although the digger had to work considerably longer to obtain the clams (catch/hour declined from 47 lb in 1987 to 26 lb in 1988). CPUE data were not collected from commercial clam diggers harvesting gapers in other bays.

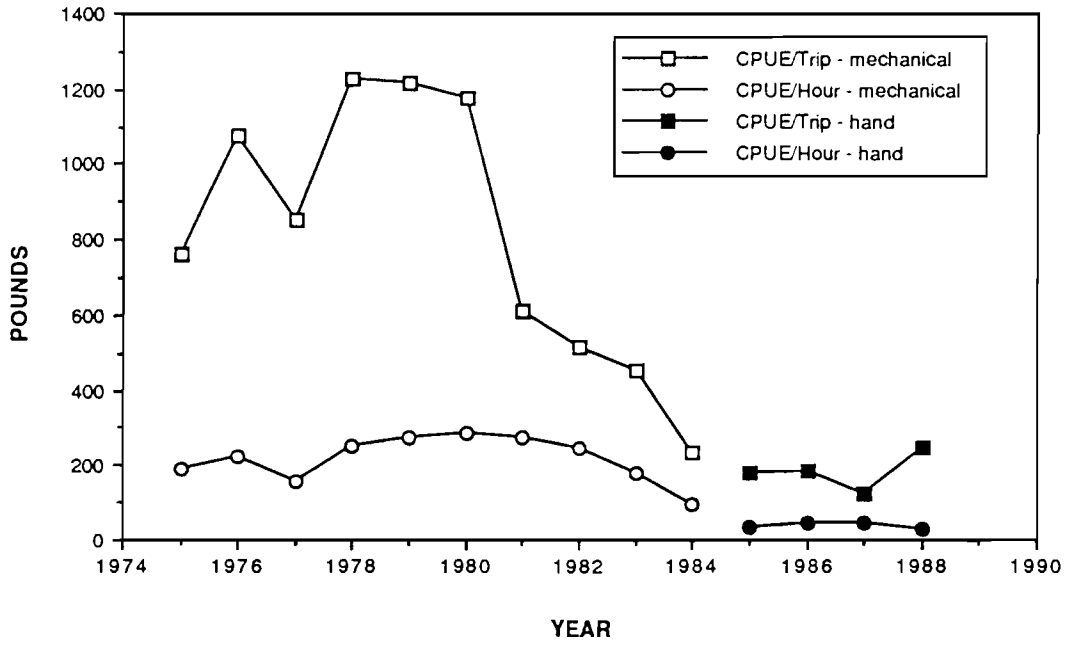

Figure 19. Average catch per unit of effort for commercial gaper clam harvest, Coos Bay, 1975-88.

Stock Assessment: As in Yaquina Bay, age composition data for gaper clams collected subtidally from Tillamook and Coos bays revealed the 1975 year-class was exceptional (Figure 20). Recruitment since then has been sporadic. Our 1980 survey of Coos Bay showed the 1975-79 year-classes entirely missing from our samples. The 1980 year-class was relatively prominent but it appears this year-class has contributed very little to the subtidal stocks or harvest (Figure 21). Our 1984 survey of Tillamook Bay also revealed substantial recruitment failures with the 1981-84 year-classes (Figure 20).

Considerable discussion has taken place, between ODFW and other agencies, as to the possible reasons for the sporadic recruitment of gaper clams. Several possibilities

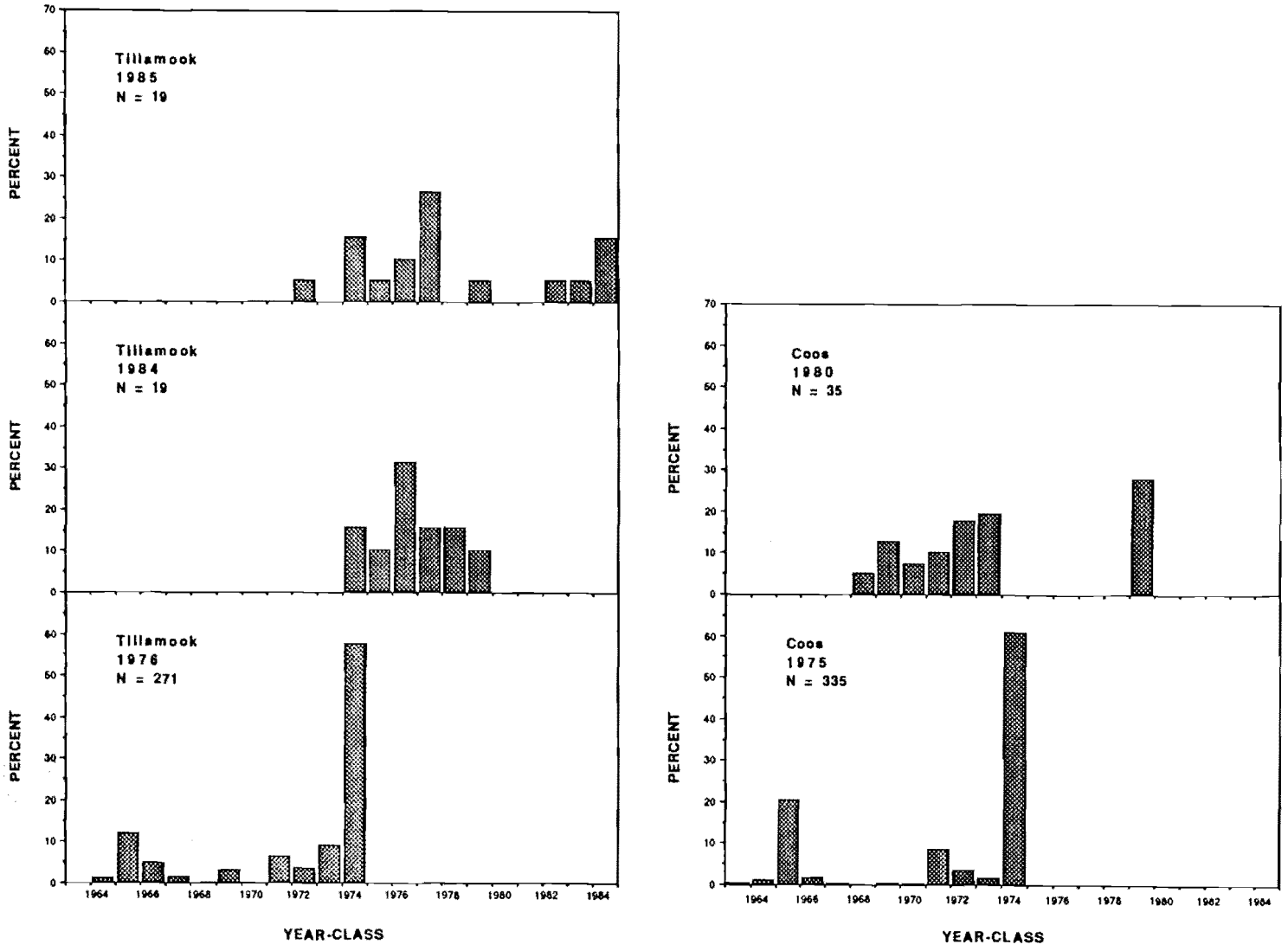

Figure 20. Age composition of subtidal gaper clams, Tillamook and Coos bays.

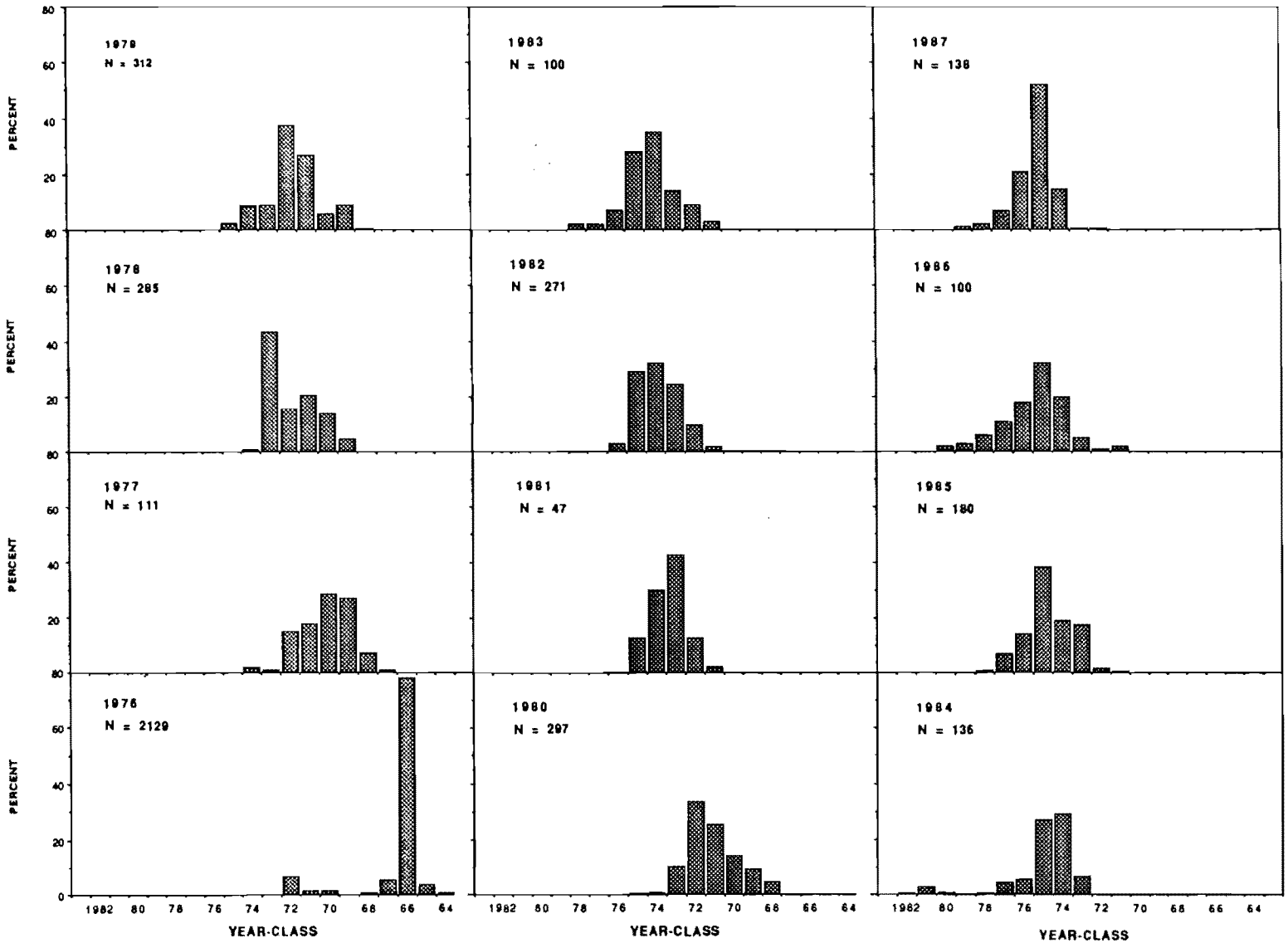

Figure 21. Age composition of commercially harvested gaper clams in Coos Bay, 1976-87.

exist. On the east coast several predator species have periodically invaded productive clam beds and have produced a cyclic pattern in clam survival (Glude 1955, Sutterlin et al. 1981). Field tests have also shown predation substantially reduces soft clam abundance (Dow and Wallace 1952, Smith and Chin 1953, MacPhail et al. 1955, Smith et al. 1955, Medcof and Thurber 1959, Hanks 1963, Edwards and Huebner 1977). Our studies to date have not revealed elevated numbers of predator species. Other biologists have also suggested the high densities of adult clams in these two areas precluded successful settlement and survival of newly recruited clams. Beal (1983), however, found no relationship between recruitment rate and adult density for Mercenaria mercenaria on the east coast. Our investigations have also shown we have had good survival of young clams in late spring but by fall these clams had all died. It is also possible other factors have played a roll in the survival of juvenile gaper clams in Oregon. Armstrong and Armstrong (1974) reported on a haplosporidian infection in gaper clams in Yaquina Bay. Their studies revealed 43% of the tested clams were infected by the parasite. Unfortunately, we have no data on its effect on clams less than one year of age.

Of particular concern to us is the impact natural and fishing mortality might have on future spawning potential with the reduced brood stock. Already, we are seeing some evidence of declining populations in our surveys of subtidal stocks in Yaquina Bay. Table 8 shows the population of

gapers in an 18.4 acre area just above the Hwy 101 bridge has declined from an estimated 36.3 million in 1975 to 7.5 million in 1988. Nearly all of these clams are now 14 years of age or older, which is about as old as we expect these clams will live.

Table 8. Population and biomass estimates (95% CI) for gaper clams in an 18.4 acre area in lower Yaquina Bay, 1975-88.

	Population Estimates		Biomass Estimates	
Year	No.	CI (%)	No.	CI (%)
1975	36,302,000	±56.1	5,084,200	N/A
1976	25,566,400	±51.5	5,217,200	N/A
1977	29,316,000	±44.5	4,969,000	N/A
1978	10,560,000	±48.9	4,136,800	N/A
1979	11,116,700	±51.7	3,459,900	±39.0
1980	11,050,000	±51.6	4,252,500	±33.2
1981	6,160,000	±49.4	2,569,700	±36.9
1982	6,320,000	±42.6	4,424,900	±30.4
1983	7,680,000	±40.3	5,042,100	±29.7
1984	5,600,000	±59.2	3,528,700	±54.2
1985	6,480,000	±32.6	4,708,200	±32.7
1986	5,920,000	±48.8	4,350,600	±50.3
1987	7,563,600	±66.1	6,507,400	±58.6
1988	7,467,000	±35.5	7,430,500	±31.1

Native Littleneck Clam

The littleneck clam is rather scarce in Oregon's estuaries. The clam is found primarily in Nehalem, Tillamook, and Coos bays (Table 6). The littleneck prefers a habitat similar to the butter and gaper clam; fine gravel with broken shell and sand. Littlenecks occupy a depth of 1 to 6 inches in the substrate. The clam is easily identified with fine cross-hatched ribs radiating from the umbo. The clam lacks the deeply scalloped edge of the cockle clam. Littlenecks are plankton feeders. They spawn in the summer

and reach sexual maturity in two years at an average of 1 inch in size. The littleneck is relatively slow growing, reaching 1.5 inches in 3 to 4 years. Occasionally, littlenecks in excess of 3 inches occur in the harvest. Rarely are littlenecks over 8 years of age observed. Littlenecks are found both intertidally and subtidally and are taken by recreational and commercial diggers. Of the five species of bay clams, this species is one of the most preferred by recreational clam diggers. Unfortunately, suitable intertidal habitat is rather limited in Oregon for the littleneck clam. The clam is usually harvested with a garden fork or shovel.

Recreational Fishery: Of the five species of bay clams frequently taken by the recreational digger, the littleneck generally provides the fewest clams. Species composition data for the recreational digger showed the littleneck clam comprised between 5.0 and 14.1% of the total annual harvest (Figure 22). The rather abrupt change in digger preference observed between 1987 and 1988 reflects, at least partially, the difficulty diggers had in locating gaper and cockle clams in 1988. For example, on Garibaldi Flat we recorded nearly a four fold increase for littlenecks between 1987 and 1988; a two fold increase was observed at Charleston Flat in Coos Bay.

Clam diggers in 1988 enjoyed some of the best littleneck digging since 1976. Catch rates of 2.3 clams/trip or 1.7 clams/hour were second only to the 1976 values of 2.6 clams/trip or 1.7 clams/hour (Figure 23). As

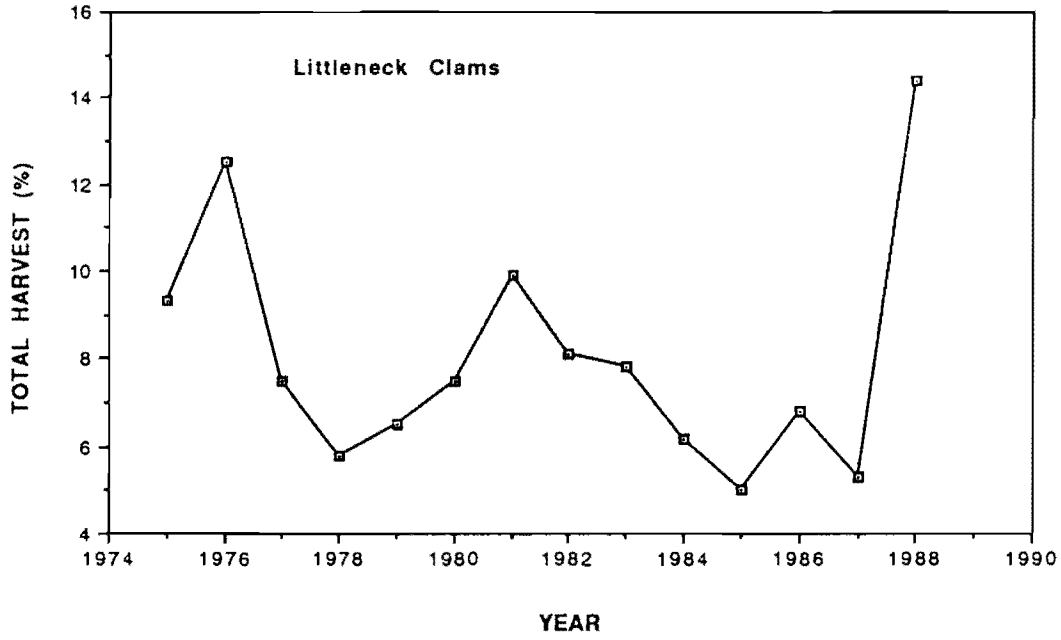

Figure 22. Recreational harvest of native littleneck clams (percent of total harvest) in Oregon, 1975-88.

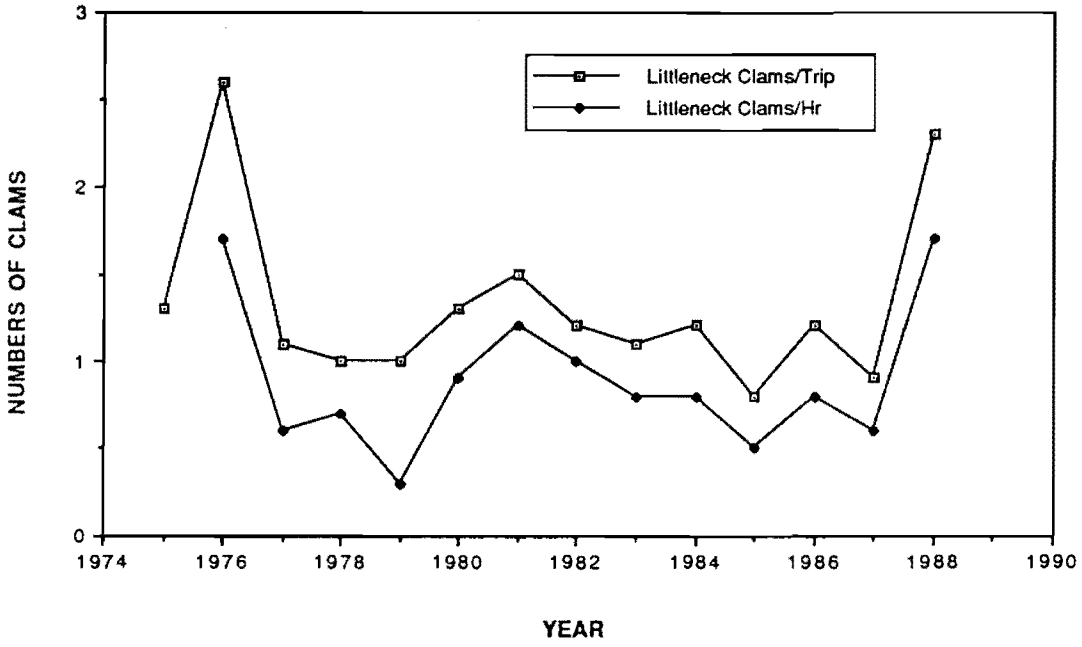

Figure 23. Average catch per unit of effort for recreational harvest of native littleneck clams in Oregon, 1975-88.

with the other species of bay clams, the changes in clam regulations in 1977, reducing the limit from 36 to 20 clams, had an immediate impact on the harvest rates. Following 1977 and through 1987, harvest rates remained rather consistent ranging between 0.8 and 1.5 clams/trip or 0.3 and 1.2 clams/hour.

Each year since 1984, the mean size of the recreationaly harvested littleneck has been considerably larger, ranging between 47.7 mm and 66.5 mm. Prior to 1984, the mean sizes ranged between 39.8 mm and 47.0 mm (Figure 24). This increase in mean size suggests digging pressure has had little overall impact on the status of the littleneck stocks.

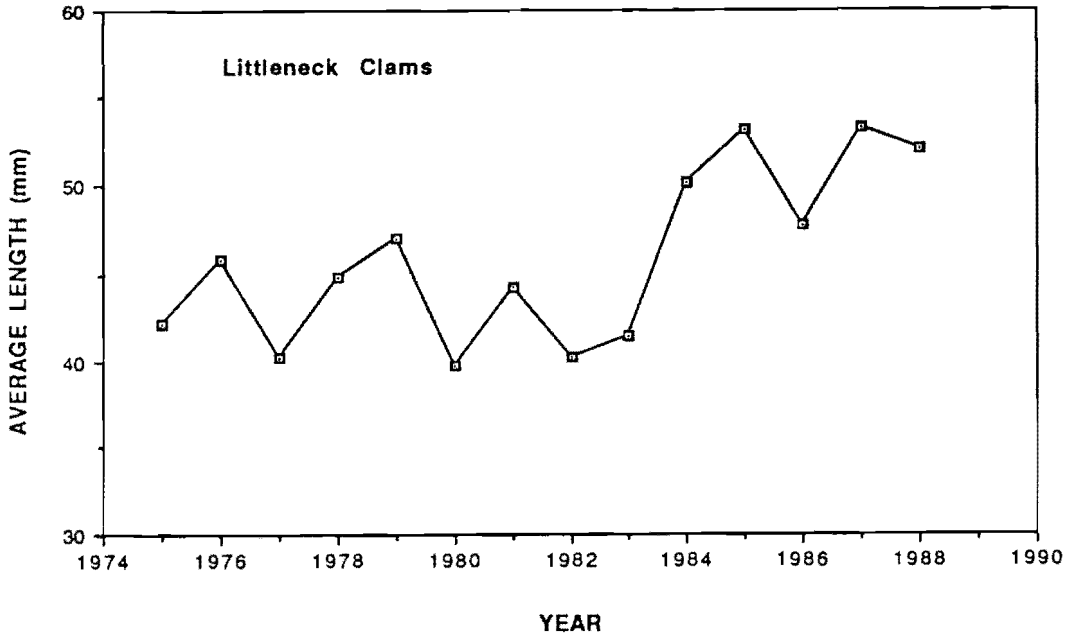

Figure 24. Size composition of native littleneck clams in recreational harvest in Oregon,1975-88.

Commercial Fishery: The commercial harvest of littleneck clams has been primarily from a 14.7 acre subtidal clam bed in Nehalem Bay. In 1983, we inventoried the clams in this bed and our results showed an estimated 5.1 million littlenecks weighing 268,000 lb inhabited the area. These clams averaged 36.9 mm in size. Since the discovery of this subtidal bed, statewide production of littlenecks jumped from 4,892 lb in 1981, to 13,231 lb in 1982; 10,862 lb (82.1%) were from Nehalem Bay (Tables 2-3). In 1987, the OSHD closed Nehalem Bay to the commercial harvest of shellfish pending completion of a shellfish harvest management plan. As a result, no harvest of littlenecks occurred in Nehalem Bay in 1988 and most digging effort switched to Tillamook Bay where 6,637 lb or 96.4% of the 1988 harvest occurred.

Figure 25 shows the age composition of littleneck clams commercially harvested in Nehalem Bay from 1984-87. These data revealed a minimum of five year-classes represented in the harvest and some recruitment occurred every year. The 1979-81 year-classes were especially well represented in the commercial harvest.

Our size frequency data revealed littlenecks commercially harvested in Nehalem Bay in 1984 averaged 44.6 mm in size. Since then, mean sizes have decreased each year and in 1987 mean littleneck size was 40.6 mm. This reduction in size reflects the impact of an intensive fishery on a rather limited area and population of clams.

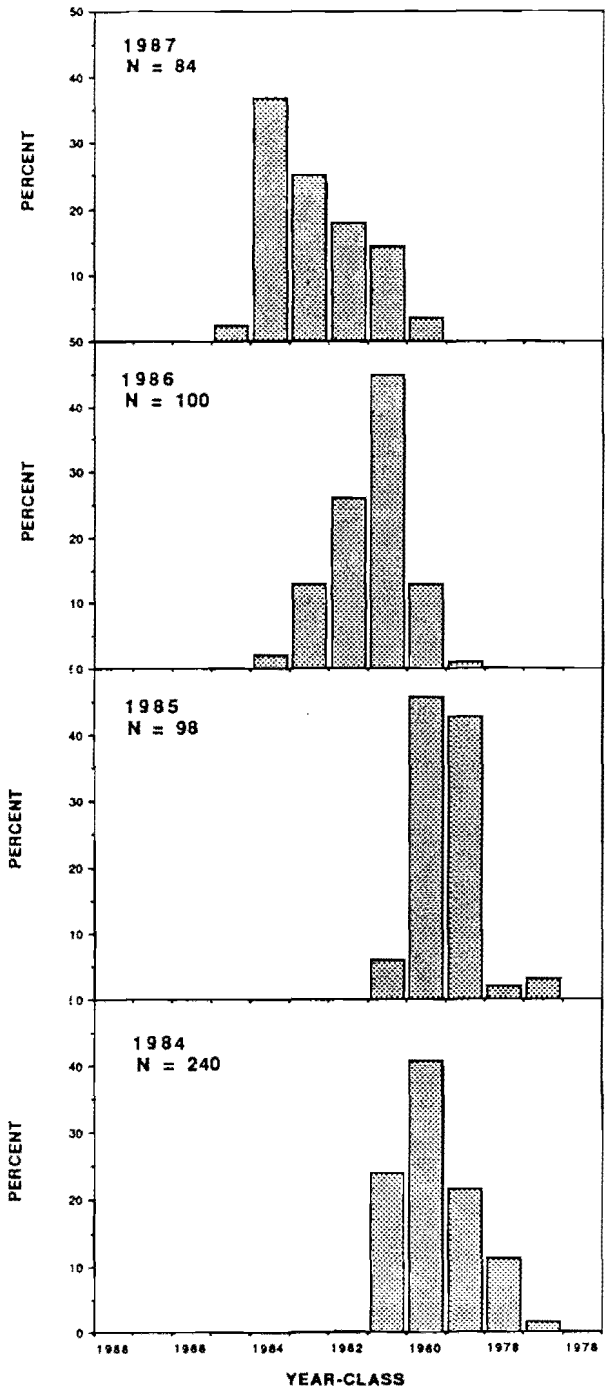

Figure 25. Age composition of commercially harvested native littleneck clams in Nehalem Bay,1984-87.

Data collected from the same commercial digger's logbooks revealed CPUE increased from 41.5 lb/hour in 1985 to 48.6 lb/hour in 1986, then declined to 43.2 lb/hour in 1987. These data suggest that the commercial digger became more efficient in harvesting clams and by 1987, digging was having an impact on the subtidal clam population.

Stock Assessment: In 1984 and 1985, we resurveyed the Nehalem Bay clam bed and our population estimates revealed 4.3 and 4.0 million clams, respectively, inhabited the area. Biomass estimates for the two years revealed 215,000 lb and 189,000 lb, respectively, remained in the area. At the same time, mean sizes of clams also decreased from 36.5 mm to 23.9 mm. These biomass estimates showed the impact the commercial fishery had on the population by removing 31,856 lb in 1983, and 23,019 lb in 1984.

Figure 26 shows the year-classes of littleneck clams from our stock assessment surveys in Nehalem and Tillamook bays. A minimum of 10 year-classes were represented each year. In none of the sample periods did a single year-class dominate the age structure.

Softshell Clam

As mentioned earlier, the eastern softshell clam is an introduced species. The softshell differs somewhat from our other species of bay clams as it inhabits those portions of estuaries with lower salinities. Nearly all of our estuaries have populations of softshells with Nehalem, Tillamook, Yaquina, Siuslaw, Umpqua, and Coos bays our major

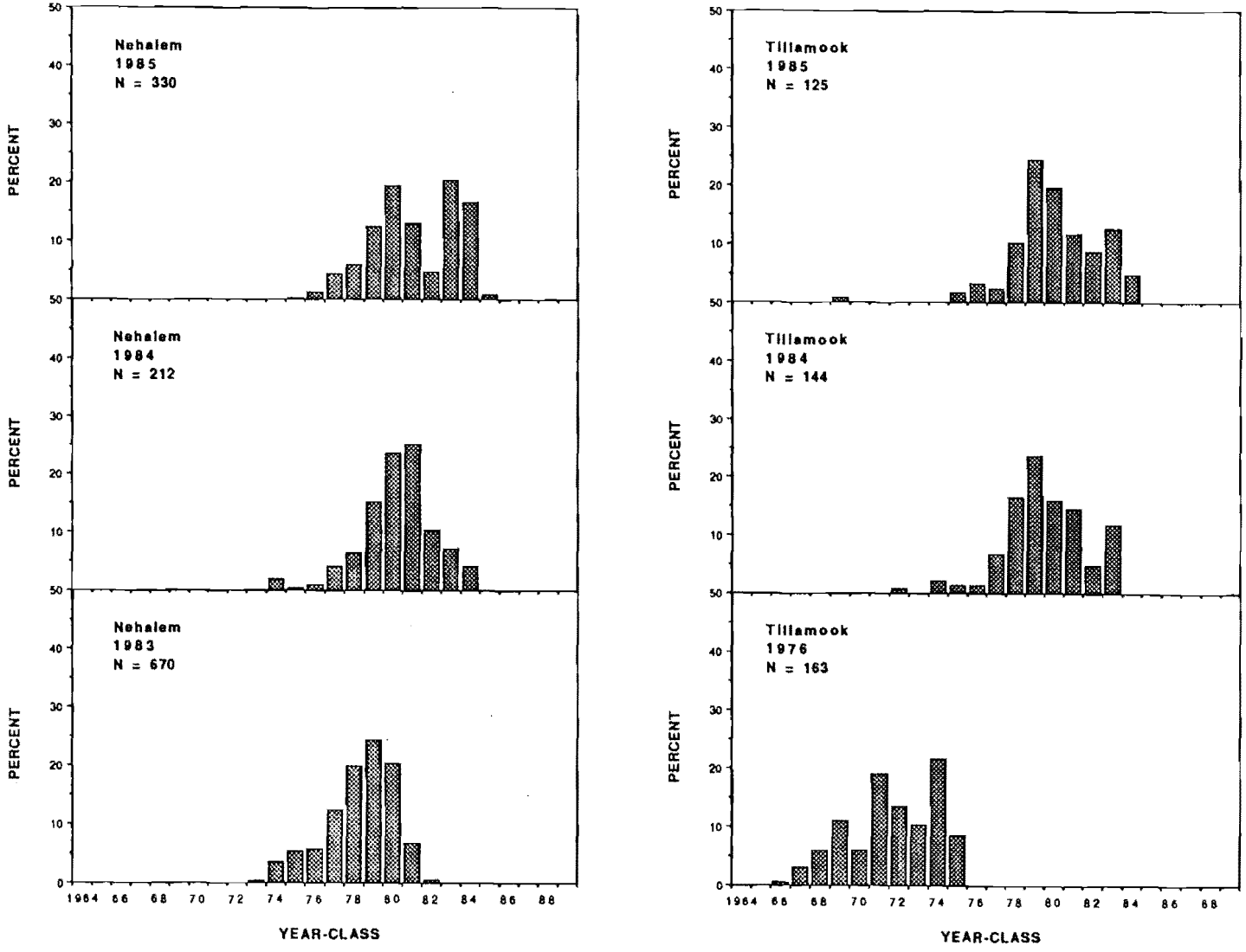

Figure 26. Age composition of subtidal native littleneck ckams, Tillamook and Nehalem bays, 1976, 1983-85.

producers (Table 6). All of these bays support an active recreational fishery. A limited commercial interest is primarily for fish and crab bait.

As their name implies, softshell clams have a thin, brittle, chaulky white shell. The clams are primarily found in the intertidal zone and prefer a mud-sand substrate. They are usually found farther up bay than the other clam species and live at a depth of 6 to 12 inches in the substrate. The softshell is a plankton feeder. They reach sexual maturity at about 1 inch long and are summer spawners. The softshell can reach nearly 6 inches in length and 10-year-old clams have been observed in the recreational harvest.

Recreational Fishery: As with the other species of bay clams, the softshell has exhibited considerable variability in the species composition of the recreational harvest (Figure 27). Coastwide, the softshell has contributed between 5.5 and 37.2% of the annual harvest of bay clams. In general, the clam has provided less than 20% of the annual harvest of bay clams although excellent digging in 1984-85 in the Nestucca, Siuslaw, and Umpqua changed the species composition fairly dramatically. Since 1985, the percentage of softshell clams in the species composition has returned to pre 1984 levels. CPUE data (Figure 28) provide evidence of the excellent softshell digging in 1984-85. In 1983, clam diggers averaged 2.2 clams/trip or 1.6 clams/hour. The next year, digging success jumped to 6.9 clams/trip or 4.8 clams/hour. Overall, the softshell

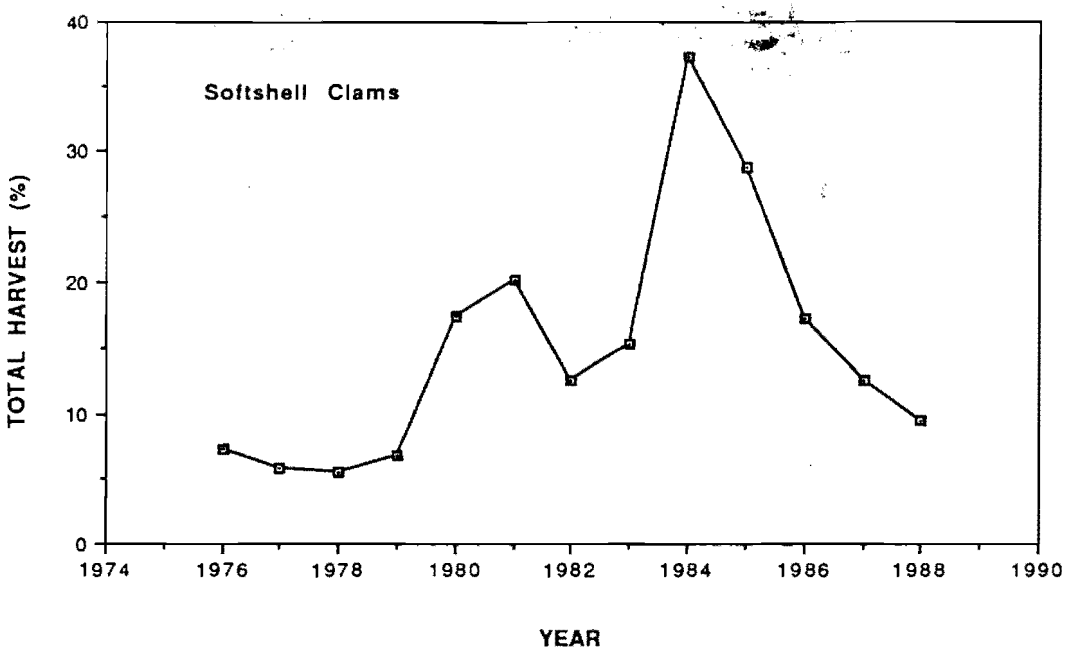

Figure 27. Recreational harvest of softshell clams (percent of total) in Oregon, 1976-88.

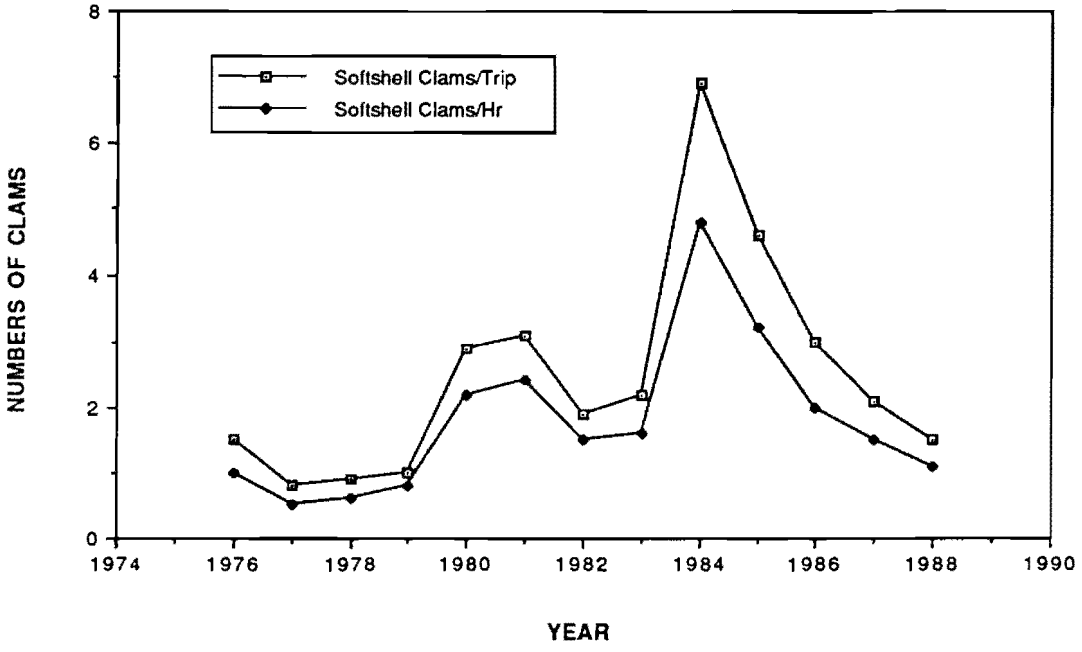

Figure 28. Average catch per unit of effort for recreational harvest of softshell clams in Oregon, 1976-88.

species composition in the recreational harvest tracked very closely the digging success of the clam digger.

Of all the bay clams, the softshell showed the least variation in annual mean sizes (Figure 29). Mean sizes ranged from 81.8 mm to 101.9 mm and no apparent trends in size were observed.

Commercial Fishery: In recent years, the softshell has not been a major part of the commercial harvest, generally contributing less than 2% of the total harvest (Table 3). A slight increase in landings since 1986 was primarily in response to a demand for bait clams. The low landings of the late 1970's and 1980's are in contrast to the 1960's and early 1970's when softshells comprised over 40% of the total

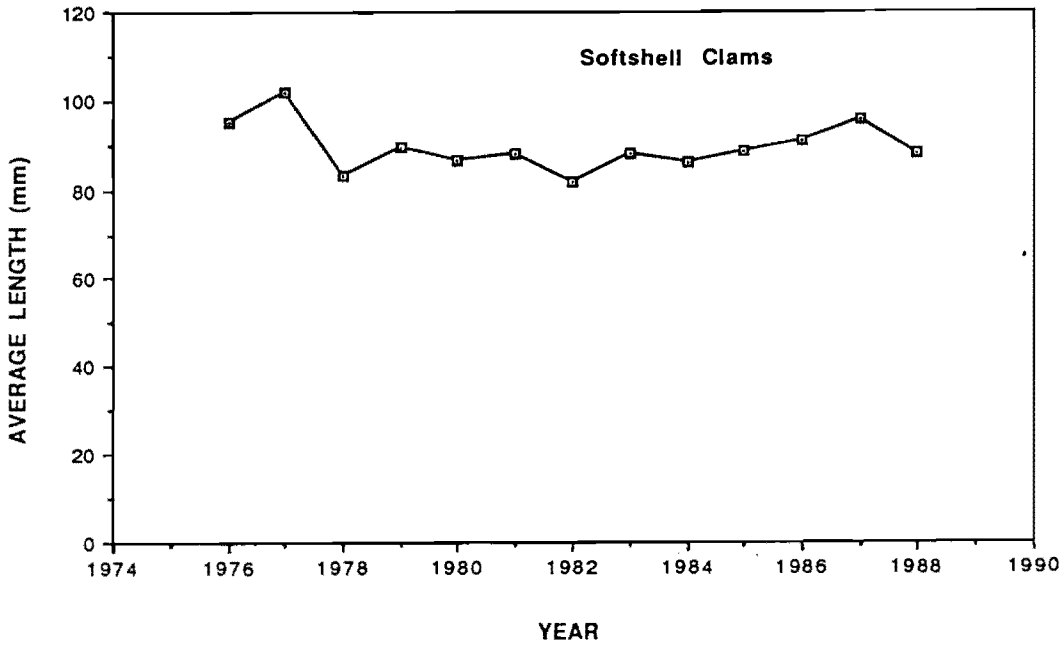

Figure 29. Size composition of softshell clams in recreational harvest in Oregon, 1976-88.

commercial bay clam landings. Of the 1988 harvest, Coquille and Yaquina bays provided 38.2% and 29.6% of the landings, respectively. CPUE for softshells from the Coquille in 1986 and 1987 averaged 26.5 and 26.2 lb/hour, respectively. These data were collected from the same commercial digger. The clams were all hand harvested and all commercial harvest was from intertidal stocks.

Stock Assessment: During our subtidal stock assessment surveys we failed to locate any softshell clams. As a result, we have no data available comparable to that collected for the other species of clams. In general, the softshell clam is considered an intertidal species in Oregon's estuaries. Perhaps the most notable point that can be made about the status of the softshell was the remarkable recovery this species has made in the Siuslaw Estuary. For some unknown reason (logging and sawmill practices were suspected) the softshell clam populations declined rather abruptly in the Siuslaw prior to 1953. In 1957, the Commission closed the Siuslaw and the shellfish staff transplanted 18,200 adult clams from the Nehalem and Tillamook bays. A year after the transplant, 75% of the clams were still alive. In 1959, the Commission reopened the bay to digging and today it is probably the best softshell clam producing bay in Oregon; in 1988, diggers harvested 33.9 clams/trip averaging 97.1 mm in size.

GENERAL COMMENTS

From a staff perspective, the general condition or status of bay clams in Oregon is relatively good shape. Data collected from the recreational and commercial clam fisheries, and from our stock assessment surveys have provided staff with an excellent data base to monitor and evaluate changes in stock status. Not withstanding a natural catastrophic occurrence, it appears bay clams have considerable resiliency towards day-by-day or year-to-year events. Even when large scale disruptions occur, such as the tsunami in 1964, it appears clams recover to pre-disruption status in a relatively short time.

One should keep in mind Oregon's estuaries are quite small, totaling only 41,448 acres, of which 18,280 acres are tideflats. Considering 1,913 acres (10.5%) of our tideflats have already been filled, the health of our clam stocks depends to a large degree on how well we protect those acres remaining.

As a final point, if one were to compare the status of our clam stocks today with the observations made by Tollefson in 1947, it would appear our management program has certainly been adequate to insure a healthy clam resource for the public to enjoy.

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