AN ABSTRACT OF THE THESIS OF

MARY J. LEWIS for the degree of MASTER OF ARTS IN INTERDISCIPLINARY STUDIES in Fisheries, Anthropology, Education presented on May 25, 1982

Title: CONDITIONS IN THE OREGON COMMERCIAL FISHERY BASED ON THE SALMON, CRAB AND SHRIMP INDUSTRIES FROM 1967 TO 1980

Abstract approved by: Redacted for Privacy
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Changes in the Oregon salmon, crab and shrimp fisheries were documented from 1967 to 1980. The related socio-economic conditions in fishing communities were described. Trends indicated that the overall importance of fisheries to port communities has declined and ports are not planning for an increase in the fishing industry. Chinook and coho salmon have accounted for a major part of the salmon fishery and both show downward trends. The shrimp fishery has replaced salmon in 1979 and 1980 as the most important commercial fishery, but shrimp fishing will probably not be permitted to increase until stocks can be more accurately determined. The crab fishery remained relatively stable and responded to a long term biological cycle of abundance of crabs. Fishermen are attempting to increase their economic position by forming cooperatives and working within commodity commissions that promote seafoods.

Conditions In The Oregon Commercial Fishery Based On The Salmon, Crab And Shrimp Industries From 1967 To 1980

by

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A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Arts in Interdisciplinary Studies

Completed May 25, 1982

Commencement June, 1983

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Date thesis is presented May 25, 1982

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ACKNOWLEDGEMENTS

I wish to express my gratitude to Dr. Richard A. Tubb for assuming the role of major professor and helping to direct this study. Appreciation is also given to Dr. Courtland L. Smith, Dr. Bruce Rettig and Dr. Tom Grigsby for their help and comments.

A special word of thanks is also due to the many people who helped with various aspects of this study: especially, Jeanne Mandville, Pacific Fishery Management Council; Marilyn Guin, Marine Science Center Librarian; Kirk T. Beiningen and Christopher Carter, Oregon Department of Fish and Wildlife.

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I. INTRODUCTION

Commercial fishing has always been a part of the Oregon economy. The Columbia River was the site of a large salmon fishery. The canning of salmon changed the fishery from a subsistence activity which fed settlers and Indians to one of world-wide significance. Fishermen adapted quickly by developing new gear and fishing patterns. Hand operated beach seines and gillnets were replaced by fishwheels and traps. By the early 1900's marine gasoline engines replaced sail power making offshore fishing more attractive.

Until 1935, salmon was the most important commercial fishery. The revised codes of 1935 made possible the reduction of pilchards or sardines. Reduction plants were established in Coos Bay and Astoria. Otter trawl fisheries, started in 1937, began to exploit bottom fish and shrimp. By 1940, Astoria had become the most impcrtant port in Oregon with 20 trawlers landing 2 million lb (907,200 kg). In the early 1940's fathometers were added to trawlers, then radios. By the late 1940's Loran, a directional device, was used to fix positions at sea. The 1950's brought stabilizers and echosounders. The commercial fishermen were of three general types: full-time, part-time, and sport-commercial fishermen. By 1951, a study showed that fewer than one-third of the Oregon commercial fishermen earned their family income by fishing (Smith 1977). Since 1945, several ocean fisheries have gone through rapid growth and decline cycles.

Fishermen have organized from time to time to meet challenges,

Smith's (1974b) study of the fish fights on the Columbia is one example. In 1965, fishermen obtained a 12-mile (19.2 km) fishing zone in response to Soviet trawlers off the Oregon coast. By 1974, factory ships from communist-bloc nations observed close to U. S. coasts contributed to another organized effort which resulted in the Fishery Conservation and Management Act (FCMA) or the 200 mile (320 km) limit.

The FCMA or Public Law 94-265 did more than establish a 200 mile zone to restrict foreign fishing. Conservation of all renewable resources is the key principle of the law. Eight regional councils acting under the authority of the Secretary of Commerce set standards, develop plans and prepare regulations for management of the fisheries in the respective regions. The Pacific Fishery Management Council (PFMC) consists of the states of California, Oregon, Washington and Idaho and has authority over the fisheries beyond 3 miles seaward of these states. The Council has 13 voting members including 8 appointed by the Secretary of Commerce. Those voting members not appointed by the Secretary are: the principal state official with marine fishery management responsibility in each constituent state and the regional director of the National Marine Fisheries Service. Non-voting members are the regional director of the U. S. Fish and Wildlife Service, Commander of the Coast Guard district concerned, the executive director of the Marine Fisheries Commission for the area, one representative of the Department of State and one non-voting member appointed by the Governor of Alaska.

The regional council recommends fishery management plans to the Secretary of Commerce. The plans are written using the best available scientific information. An advisory panel represents the interests of commercial and recreational fishermen, industry and the consumer. Seven

national standards also must be met by each council including the prevention of overfishing, nondiscrimination among U. S. fishermen and the concept of optimum rather than maximum sustainable yield. Management plans are approved and implemented by the U. S. Department of Commerce, acting for the federal government.

The optimum yield (OY) is a basic concept of the management plan which is designed to provide benefit to the nation as to food production and recreation and is based on maximum sustainable yield (MSY) modified by economic, social and ecological factors. This concept is used by the councils even though OY is not completely defined. Councils also review applications which foreign vessels submit and continually review "the total allowable level of foreign fishing" within their areas. The U. S. Coast Guard is the primary agency charged with enforcement.

Purpose of the Study

This study attempts to discern trends in the Oregon commercial fisheries from 1967 to 1980 based on selected characteristics of the salmon, crab and pink shrimp industries. Identification of trends can be used to aid administration in developing future management objectives. It is also the purpose to describe the effects of these trends on the coastal communities.

Some characteristics of the fishery are changing. Modifications in the environment, the fish stocks, fishing methods and management tactics appear to have been major factors causing the fishery to change. It is important to accurately and objectively document what has been the long term response of the Oregon fishery to fluctuations or decreases in the fish resource. Analysis of the major trends in an economic and social

context can be used to describe the basis for the conflicts between fish managers and fishermen. The conflicts develop between the fishermen's and management's perception of the status of the fishery. Fishermen insist the fish are plentiful and their problems result from unnecessary restrictions imposed by management. Management contends that fish stocks have declined and fishermen, if not restricted, could reduce fish stocks still further. The trends documented in this study are an attempt to objectively record the data used in management decision-making and to trace developments in management of the salmon, crab and pink shrimp fisheries.

The Resource and the Setting

In 1980, salmon, crab and pink shrimp accounted for 45% of the total Oregon commercial landings and 71% of the total value. Both salmon and pink shrimp are managed outside 3 miles (4.8 km) by the Pacific Fishery Management Council. Life histories of the species present unique problems to management and may ultimately affect other characteristics of the study. The groundfish and tuna fisheries are related fisheries not directly considered in the study. Both fisheries remained relatively static with regard to weight landed from 1969 to 1977 (Table 14, 15 appendix). Tuna is an auxillary fishery to salmon. In contrast, the groundfish fishery is more closely related to the pink shrimp fishery. The crab fishery is related to both fisheries, but requires much different fishing gear.

Groundfish landings began to increase in 1977. In 1979, the PFMC drafted a management plan for groundfish. Tuna were treated separately in the FCMA and did not come under the jurisdiction of the management

councils. Though both fisheries contributed to the total Oregon fishery, I considered the salmon, crab and pink shrimp industries to best characterize the Oregon fisheries since groundfish industry is centered in Newport and Seattle and tuna has international characteristics.

Chinook (Oncorhynchus tshawytscha) and coho (O. kisutch) salmon are the major salmon species landed in the Oregon commercial salmon fishery. Most chinook are caught in the open ocean troll fishery while coho are usually caught nearer to the coast. More coho than chinook are caught each year but due to the difference in size and value, the total landed values are similar (Montagne-Bierly Associates 1979)

Different stocks of chinook salmon enter rivers to spawn during most of the year. Some spawn immediately above the tidal limit, but most go up stream, some as much as 600 miles (960 km). Eggs are buried in gravel nests in river bottoms. Usually young chinook go to sea soon after hatching, but some remain in fresh water for a year. Growth is most rapid in the year preceeding their return to fresh water, therefore delaying capture increases production from the resource. Chinook return to spawn in their fourth or fifth year (Hart 1973).

Most coho salmon begin spawning migrations in early fall for spawning in October and November. Spawning takes place in large rivers and their headwaters as well as many smaller streams. Fry emerge from the gravel spawning beds in April and remain in fresh water at least a year. Most coho spend about 18 months (two summer seasons) in the sea and return to spawn in the fall usually at age 3 or 4 (Scott and Crossman 1973).

Salmon landings and values fluctuate from year to year due to a variety of factors. Reduced production and increased sophistication of

fishing methods has led to management imposed limitations on both commercial and recreational harvest. The fishery that began in the 1920's as a fleet of small craft making daily fishing runs has developed with the help of electronic gear to the troll fishery of today. There are still many small boats, but also larger boats fish for other species during different seasons.

The Dungeness crab (Cancer magister) also known as the Pacific edible crab is one of the largest crustaceans on the west coast of North America and supports an extensive fishery from Alaska to California (MacKay 1942). The principal landing ports are San Francisco and Eureka, California, Coos Bay, Newport, and Astoria, Oregon, Grays Harbor, Willapa Harbor, and Seattle, Washington (Hipkins 1957).

The Dungeness crab range is from the intertidal zone to depths of 93 fathoms (170 m). The Dungeness crab is found on almost any type of bottom, though showing a preference for sandy or sandy-mud bottom, and is present within bays and estuaries as well as on the ocean floor (Waldron 1958).

Regulation of the fishery is based upon the life cycle of the Dungeness crab and the growth rates of the crabs. Dungeness crabs grow rapidly during the 1 or 2 day period when the shell is soft from molting. During the first year, a crab may molt as many as six times. Thereafter crabs molt only once per year. Both sexes grow at the same rate for 2 years. The female then begins to grow more slowly, rarely if ever attaining the legal minimum size of 6.5 in (16.5 cm). Males attain a width of 6 in (15.2 cm) after 3 years and almost 7 in (17.8 cm) after 4 years.

Crabs are harvested with traps called "pots". Crab pots are

circular, steel-framed covered with stainless steel wire mesh and are generally 3-3.5 ft (91 cm) in diameter and weigh 60-120 lb (27.2-54.4 kg). Crab vessels are usually 25-85 ft (7.6-25.9 m) in length and are combination boats equipped to fish salmon and albacore as well (Montagne-Bierly Associates 1979).

The smooth pink shrimp (Pandalus jordani), also known as ocean shrimp and ocean pink shrimp, is the target species of a recently developed Oregon fishery. This species is small in comparison to the shrimp and prawns caught in the warmer waters of the southeastern United States and coasts of Latin America. Adult pink shrimp have an average length between 7.5 and 12.0 cm. Counts per pound on a weight basis vary with the size of the shrimp in the catch (Magill and Erho 1963).

Pink shrimp are found in depths of 40 to 140 fathoms (73 to 256 m) on mud or mixed sand and mud bottom. Off Oregon, the shrimp, especially young, migrate vertically at night, and eat euphausiids and copepods. On sunny days, shrimp rest on the bottom but, during cloudy days they swim up to 2.5 m off the bottom. The species is distributed over the continental shelf from Alaska to San Diego, California with commercially important concentrations present from Vancouver Island to the area off Morro Bay on the south-central coast of California (Butler 1980). Most commercial catches off the Oregon coast are made from 2 to 25 miles (4 to 40 km) off shore. Along the Oregon Coast the active shrimp grounds include: Columbia River to Cape Foulweather, a central bed from Heceta Head to north of Cape Blanco, a smaller bed south of Cape Blanco and a southern bed extending from Brookings to Cresent City, California (Zirges and Robinson 1980).

Larval shrimp, or zoea, are nearly transparent and drift with ocean currents for the first 2 to 4 months of life. Pink shrimp undergo 11 or 12 molts before reaching the adult stage. Normally maturing first as males at about 1.5 years, they mate and begin changing to females the following spring. By the age of 2.5 years the transition to female is complete, mating again occurs and 1,500 to 3,000 eggs are extruded. The eggs are carried on the pleopods or swimmerettes until the following spring when they hatch. Some pink shrimp develop directly into one year old females. Shrimp may live for 4 years and function three times as a female (Robinson 1976).

Boats from Astoria, Coos Bay and Newport take about 70% of the Oregon commercial landings. Trends in the fishery affect the port, the city and county in which the port is located. The economic and social conditions in the county affect the port as does the condition of the port affect the stability of the community and the county. Documentation of this interaction is fundamental to any general study of the fishing industry.

Clatsop County is located in the northwestern corner of the state covering 843 sq miles (2183.3 km^2) and 515,200 acres. Astoria, the county seat and largest city is located on Young's Bay, 10 miles (16 km) from the mouth of the Columbia River and 100 miles (160 km) northwest of Portland. Fish constitute a major natural resource; the Columbia River salmon giving way to other ocean fish as the basis of the Astoria fishing industry.

Coos County lies between the crest of the coast range and the Pacific Ocean. It contains about 1,627 sq miles (4213.3 km^2) or about 1,041,280 acres. The economy of the county depends primarily on timber

with shipping, commercial and sport fishing and agriculture playing significant roles. North Bend and Coos Bay are the cities best served by water transportation and, therefore, have grown faster.

Lincoln County is located on the central Oregon coast. The county seat, Newport, is about 83 miles (133 km) southwest of Salem, 114 miles (182 km) southwest of Portland, and 94 miles (150 km) northwest of Eugene. Lumbering, fishing, agriculture and recreation are the major industries in Lincoln County.

Method of Study

The time period selected for the study was 1967 to 1980. The year 1967 was selected because previous Oregon commercial fishery data has some inconsistancies. At about that time inflation and rapid changes occurred in the U. S. The wholesale and retail price indexes use 1967 as a base year from which to measure price changes. All value data in this study have been subjected to this method of deflation (1967=100). Over the 13 years analyzed several significant events occurred that affected the commercial fishery. The energy crisis of 1974 and subsequent shortages and fuel cost hikes have encroached on fishermen's profits. Implementation of the FCMA in 1977 affected season length, fishing areas, and by 1980 experimentation with limited entry had begun. The closing year of 1980 was chosen because more recent data, if obtainable, are preliminary.

Data were obtained from several sources. Though data are available from the management plans, I used original data sources when possible to reduce the possibility of accepting another interpretation of the data. The Oregon Department of Fish and Wildlife provided unpublished data for

1969 to 1980 on landings and values and for 1967 to 1980 on licensing and seasons. Statistics on landings and values as well as unpublished information regarding obligation guarantees and Capital Construction Fund were obtained from the U. S. National Marine Fisheries Service. Information on aquatic loans to Oregon fishermen was obtained from annual reports of the Production Credit Association (PCA) to the Farm Credit Administration. County employment and labor force data were obtained from published material by the Oregon State Employment Division. The Oregon Agricultural Extension Service provided statistics on marine extension audience contacts.

Several characteristics were used to describe the Oregon fishery. Weight of fish landed was used to indicate the amount of fish coming into selected ports relative to total catch. English rather than metric weight was used as the primary measure because economic information is more readily identified in price-per-pound terms. "Dock-side" value or price was used to indicate the real value of the catch, gross returns per fisherman and vessel, and economic condition of ports relative to the fishing industry. Numbers of boat and fishing licenses sold were used to estimate the number of fishermen and vessels. This provided an overall view of the fishery but it did not take into account that a large portion of the catch is taken by a small number of fishermen. Averages from aggregated data were used for comparisons. Most distributions of catch, effort, and value are lognormally distributed, and not adequately described with an average (Smith 1974a). Due to the aggregated nature of these data no other alternative was available. In addition, the data were interpreted on the basis of the Oregon fishery. However, fishermen often operate on a regional basis, purchasing licenses

in several states and landing the catch in any one of the states in which they are licensed. The data available from Washington and California were considered but not analyzed in the study.

Length of seasons were used to show the total number of possible fishing days as well as to indicate management restrictions. Loans and obligations provided an indication as to the number of fishermen needing financial assistance as well as how much assistance was needed. County employment was used to describe the economic conditions of the areas in which fishing is important and vocational education, both formal and informal, was used to indicate fishermen's desire or need for marine related information.

II. THE SALMON FISHERY

Background

The commercial ocean salmon fishery, primarily a troll fishery, began by dragging lures at various depths behind a boat, in the Columbia River area in 1912. These early trollers were gillnetters by night. Trolling was conducted mainly off the mouth of the Columbia River. Boats had only small engines and lacked storage facilities so trollers returned to port each evening to deliver catches. As engines and gear were improved, trollers became increasingly mobile and better adapted to ocean fishing. They ranged as far as 25 miles (40 km) out to sea and 40 to 50 miles (64-80 km) up and down the coast. As a result, coastal ports along Oregon and Washington began developing as troll centers. The increased mobility allowed trollers to catch more salmon, but the degree of immaturity of the salmon was more pronounced. Present troll regulations have size restrictions helping to minimize the loss to the industry (Hatley 1975).

Basic Economic Indicators for Salmon, 1947-1972 (U. S. National Marine Fisheries Service 1973a) provided a statistical background for the current study. From 1962 to 1967 the Washington salmon troller averaged a gross return of $7,510. Demand indicators showed U. S. aggregate consumption in 1947 at 234.9 million lb (106.5 million kg), reached a low of 152.6 million lb (69.2 million kg) in 1959 and recovered to 211.3 million lb (95.8 million kg) in 1971.

Domestic production indicators showed Oregon Pacific salmon landings averaging 11,675,000 lb (5,295,780 kg) for 1947 to 1972. Landings fluctuated widely. Landings in 1947 totaled at 20,631,000 lb

(9,358,221 kg). A low of 5,329,000 lb (2,417,234 kg) was reached in 1959. Landings remained between 5 and 9 million lb (2.2-4 million kg) until 1965. By 1970, landings nearly reached the 20 million lb (9 million kg) mark. Landings for the states of Alaska, Washington, and California showed the same fluctuations but Washington and California did not record a recovery in the late 1960's as did Alaska and Oregon.

Employment, vessel and effort indicators showed the number of Pacific salmon fishermen and boats increased steadily from 1950 to 1968. In 1950 the total salmon fleet consisted of 2,718 vessels and by 1968 there were 6,247 vessels. Numbers of fishermen nearly tripled with 11,082 listed in 1950 and 32,111 in 1969. Yield indicators listed estimates of MSY from world stocks of salmon. Chinook salmon was estimated at 22.5 thousand metric tons and coho at 35.0 thousand metric tons in the North Pacific. An estimate of MSY for salmon in waters fished by U. S. fishermen was 406.7 thousand metric tons.

Ecology

Young chinook salmon migrate predominantly northward on their feeding migrations and southward as maturing fish. Chinook from the Sacramento-San Joaquin River system of California contribute largely to ocean fisheries off Oregon and southern Washington. Northern California coastal chinook also contribute to these areas. Columbia River stocks contribute primarily to the ocean fisheries of Washington and British Columbia. Some Columbia River chinook salmon also move southward on feeding migrations and enter the Oregon ocean salmon fishery. Therefore, the Oregon ocean chinook fishery operates mainly on Oregon coastal stocks, California stocks, and some from the Columbia River. Adult coho tend to

be available both northward and southward from their parent streams and usually are captured by the local fisheries. Columbia River and Oregon coastal stocks contribute mainly to the Oregon and California fisheries. The Oregon troll catch is composed primarily of Columbia River, Oregon coastal, Washington coastal, and Puget Sound stocks (Pacific Fishery Management Council 1978).

Adverse environmental conditions is a major reason for generally lower levels of abundance in California and Oregon salmon stocks. The Sacramento-San Joaquin River system salmon production has declined largely due to degraded environmental conditions in the upper rivers and water diversion projects. Logging, fires, dams and pollution have decreased recruitment from Oregon spawning streams. Many Columbia River stocks are reduced and a few upriver stocks have been lost completely due to dam construction. Oregon coastal coho stocks which declined as a result of early deterioration of watersheds, are considered by many biologists to have stabilized. Due to annual salmon stock variability, MSY for salmon is expressed as an average for a number of years. Preseason run size predictions for each area are usually based on an analysis of catch and effort during the early part of the run, dam counts, and early escapement indices. The large number of interacting variables that affect stock abundance put achievement of MSY and OY out of reach in any single year (Pacific Fishery Management Council 1978).

Exploitation

Landings of coastal chinook and coho salmon have fluctuated from 1967 to 1980. In 1967, 1,078,000 lb (488,980 kg) of chinook and 6,930,000 lb (3,143,448 kg) of coho were landed in Oregon ports. In

1980, 2,497,912 lb (1,133,052 kg) of chinook and 2,519,380 lb (1,142,790 kg) of coho were landed (Fig. 1). In 1967, troll caught chinook comprised 6% of the total Oregon salmon catch and troll caught coho made up 40%. In 1970, the total catch peaked at 19,600,000 lb (8,890,560 kg) and coho accounted for 40% of the catch and chinook 6.5%. By 1973, chinook reached a peak of 23% while coho dropped to 33%. Coho catches in 1977 dropped drastically due to drought conditions. For the study period, the total salmon catch averaged 14,191,615 lb (6,437,316 kg); chinook averaged 2,153,307 lb (976, 740 kg); and, coho averaged 5,940,384 lb (2,694,558 kg). Fluctuations in the total catch averaged 3,438,461 lb (1,559,685 kg). Coho fluctuations averaged 2,421,153 lb (1,098,235 kg) and chinook averaged 791,538 lb (359,041 kg).

From 1967 to 1971, the salmon fishery accounted for the largest percent of the total round weight of the Oregon commercial catch (Fig.2). In 1972, the pink shrimp fishery rose 10 percentage points above salmon and continued well above salmon through 1980. Salmon catch continued to decrease in the late 1970's to a low of 6%. This gradual drop and low years followed a trend similar to the pattern shown during 1958 and 1963 and to a lesser extent in 1968 and 1969 (U. S. National Marine Fisheries Service 1973a).

Salmon no longer comprises the largest percentage of Oregon commercial catch, but it was the highest of the three fisheries studied with regard to percent of total commercial value until 1980 (Fig.3). Determining the value of a fishery assists managers in assigning priorities to the time spent managing the resource and its value in relation to water projects which affect it. Fry (1962) stated that fisheries must be appraised by methods comparable to those used on other

Fig. 1 OREGON TROLL AND TOTAL SALMON PRODUCTION

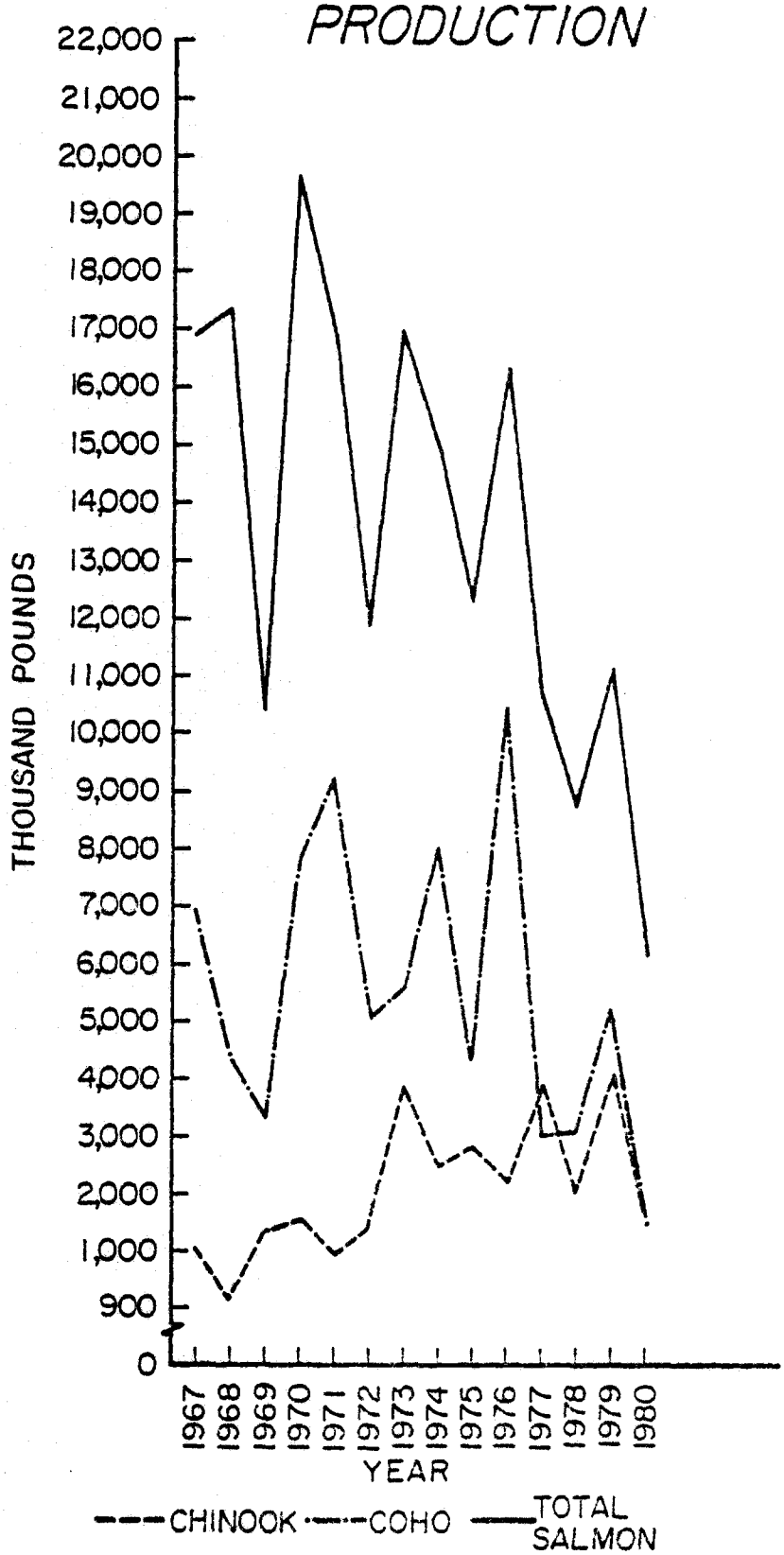


Fig. 2 PERCENT OF TOTAL OREGON COMMERCIAL CATCH BY WEIGHT

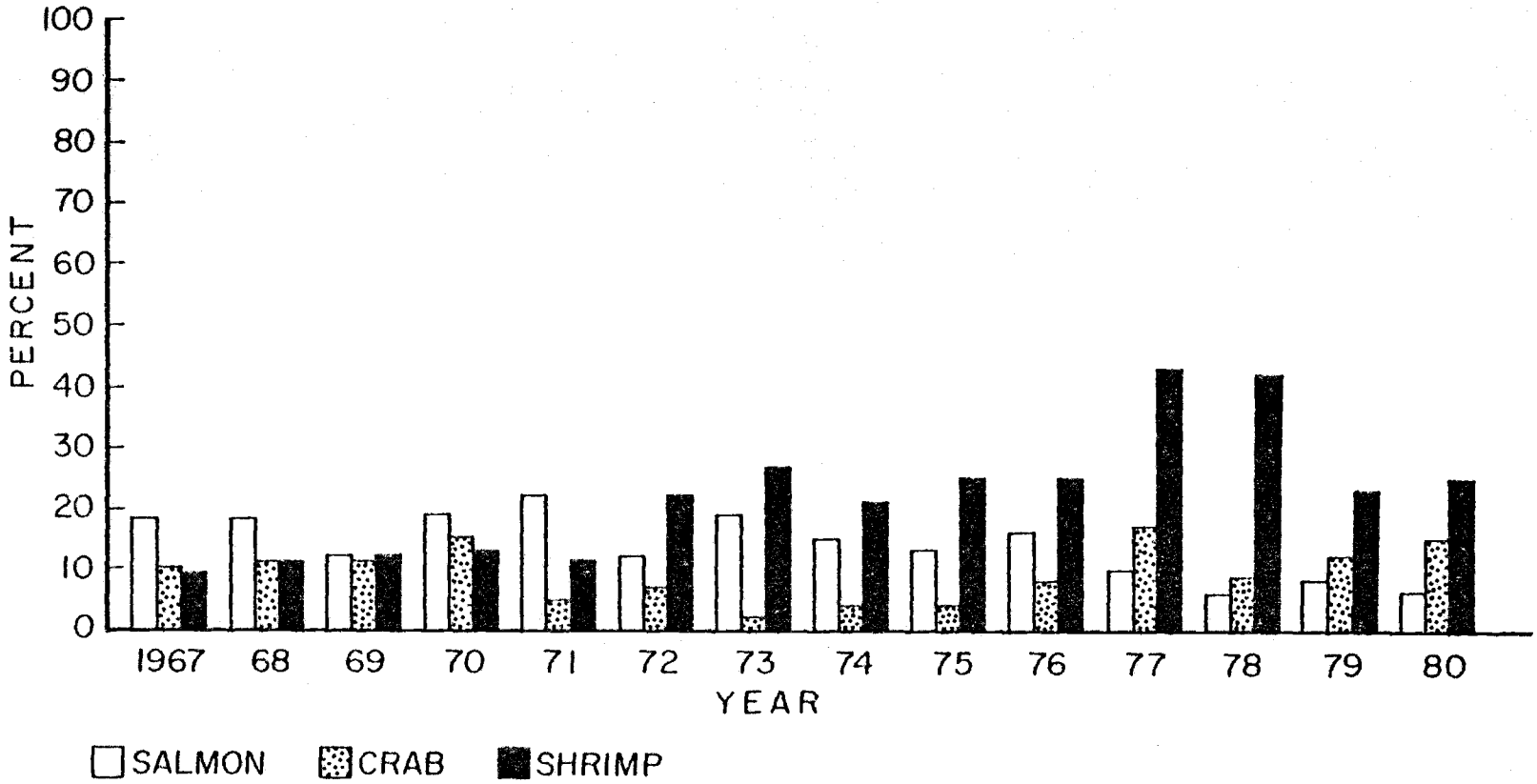
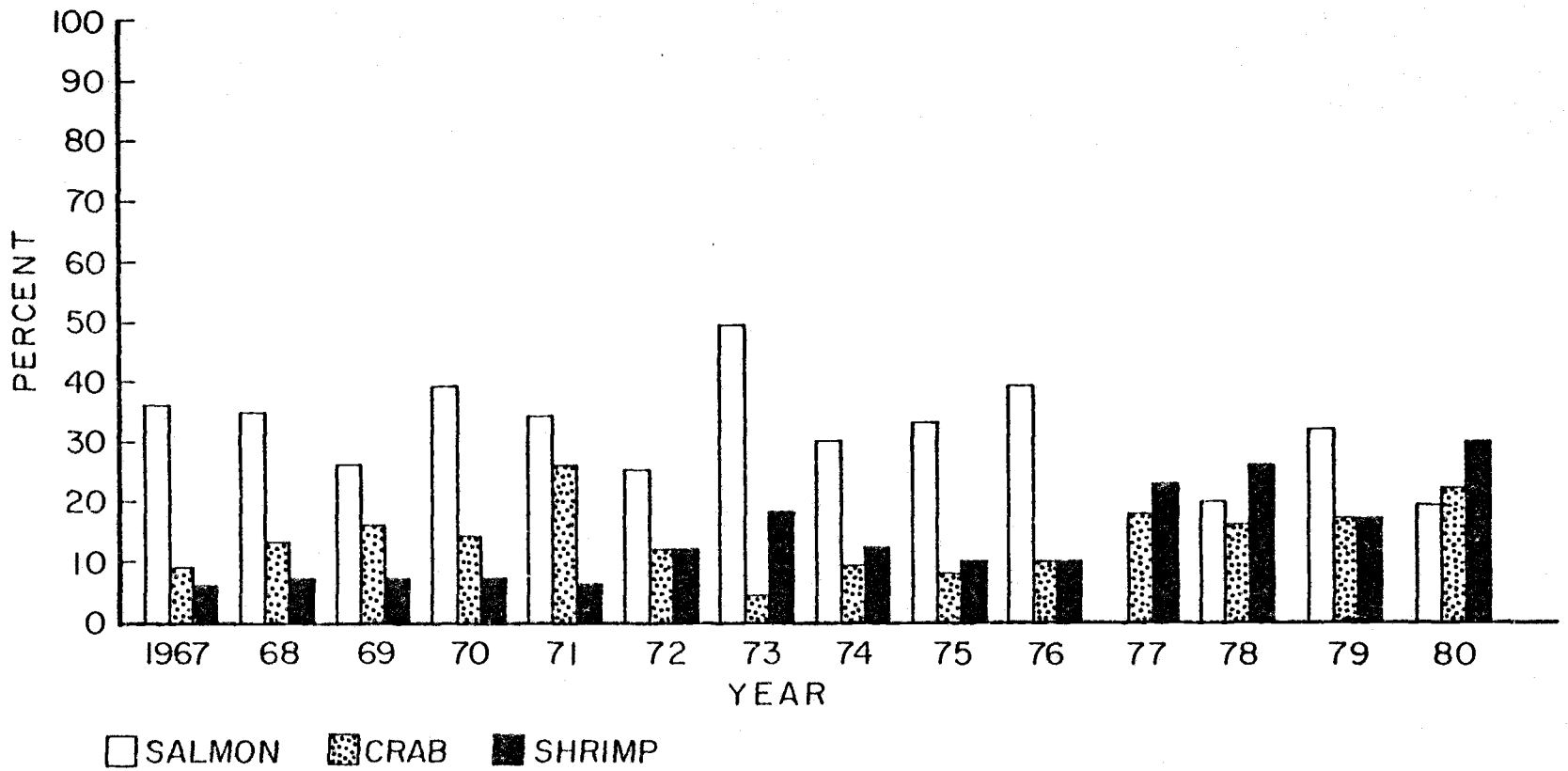


Fig. 3 PERCENT OF TOTAL OREGON COMMERCIAL VALUE



parts of a project. Smith (1978) gives several reasons for undertaking salmon value studies such as assistance to managers allocating salmon between several interest groups and among gear-specific commercial fishermen, justification for various water projects such as dam construction, and salmon enhancement programs including stream improvement and hatcheries.

Fluctuations in salmon values have been as dynamic as those of catch. However, since value is in part determined by world economic conditions at the time of landing, the fluctuations do not necessarily coincide. The salmon catch has comprised as much as 49% of the total Oregon commercial catch value and as little as 20%. Values for 1967 through 1972 appear more stable than those after 1973. The growth rate of the Oregon commercial fishery based on total values for 1967 to 1980 was 4.95%. The salmon fishery showed a rate of growth of 4.6% based on total values for the same time period. The salmon fishery has grown but the growth rate has not been sufficiently high to produce an increase in the percent of total commercial value. The impact of this slow growth on the economics of the salmon fishery can best be described by considering the characteristics of a common property resource and its effect on the fishermen involved.

From 1967 to 1976, the salmon troll fishery fluctuated as much in the number of fishermen and boats as in the total catch and value (Table 1). Based on the number of fishermen each year from 1967 to 1976, the fishery increased at the rate of 5.6%. The number of boats, however, grew at a rate of 4.6%. The best measure of troll fishing effort over time presently available is the total number of boats landing troll caught salmon in Oregon ports (Pacific Fishery Management Council 1981a).

Table 1 Oregon Troll Salmon Catch/Effort and Gross Returns, 1967-1980

Year	Number of Fishermen	Number of Boats	Catch (Pounds)	Pounds Per Fishermen	Pounds Per Boat	Value of Catch (1967=100)	Gross Return Per Fisherman	Gross Return Per Boat
1967[a]	2,939	2,124	8,685,900	2,955.5	4,089.4	$3,380,001	$1,150.05	$1,591.33
1968	3,294	1,859	13,187,000	4,003.3	7,093.5	4,379,808	1,329.63	2,356.00
1969[b]	3,048	2,283	5,327,514	1,747.8	2,333.5	2,156,881	707.63	944.75
1970	2,997	2,219	10,752,397	3,587.7	4,845.6	5,057,759	1,687.60	2,279.29
1971	2,694	2,082	11,241,086	4,172.6	5,399.1	3,095,041	1,044.21	1,486.57
1972	2,470	762	7,084,498	2,868.2	9,297.2	3,025,600	1,224.93	3,970.60
1973	5,175	964	9,905,673	1,914.1	10,275.5	5,662,407	1,094.18	5,873.86
1974	3,199	2,177	10,943,611	3,420.9	5,026.9	5,399,319	1,687.81	2,480.16
1975	3,148	2,340	7,673,373	2,437.5	3,279.2	3,585,185	1,138.87	1,532.13
1976	5,097	3,394	12,636,530	2,479.2	3,723.1	8,698,245	1,706.54	2,562.82
1977[b]	--- [d]	3,108[c]	7,477,245	---	2,405.8	---	---	---
1978	---	3,158	5,451,651	---	1,726.2	3,767,612	---	1,193.06
1979	---	3,114	8,363,489	---	2,685.7	8,870,512	---	2,848.59
1980	---	3,860	5,019,097	---	1,300.2	3,317,004	---	1,859.32

[a] U.S. National Marine Fisheries Service. Fishery Statistics.

[b] unpublished data. Oregon Dept. of Fish and Wildlife

[c] unpublished data. Carter, C.

[d] data not available.

The rate of return per unit of effort is determined by the average productivity of the fishery and the number of boats being used (Anderson 1977). Weight harvested per fisherman in 1967 was 2955.3 lb (1340.5 kg). The pounds per fisherman fluctuated from 1747.8 lb (792.8 kg) to 4003.3 lb (1815.8 kg) during the study period. Fluctuations of 1,174 lb (532.5 kg) were average. Rate of return per unit showed even greater fluctuations than catch per fisherman. This was true because the number of boats varied more widely from year to year than did the number of fishermen. Pounds landed per boat ranged from 1,733 lb (786.0 kg) with 3,158 boats licensed to 10,275 lb (4660.9 kg) when 964 boats fished. Anderson (1977) addressed this situation pointing out that in open access the number of boats will increase until average revenue falls to the minimum cost of producing effort per boat.

In addition to catch/effort, gross returns can also provide insight into the condition of the fishery. Gross returns show the gross income a fisherman made on his catch for the year in "real" dollars (Table 1). In 1969, the number of fishermen was high, catch was down 40% from 1968, and value remained the same as 1968. All of these factors produced the lowest gross return per fisherman of the study period. A comparable situation occurred in 1975, but value also dropped that year. The highest year, 1976, showed a high number of fishermen, high catch and a dramatic rise in value. The rise in value along with the large catch supported the large number of fishermen. The overall rise in gross returns was 4.1% for the 10 years for which data were available. Gross returns per boat exhibited the same low years as did the gross returns per fisherman. An interesting exception was 1973. At that time there was an average of 5.3 fishermen per boat. Catch was

not high, but value was stabilized and the number of boats was greatly reduced. This made the gross return per boat exceptionally high while the gross return per fisherman was quite low. The overall rate of increase for the entire study period for gross return per boat was 4%.

An investigation of landings of chinook and coho catch and values by major port as well as the total Oregon commercial salmon fishery showed, from a slightly different perspective, the trend of value and catch, the relationship of value to catch and how this relationship affects the fisherman. Fishery economists consider this final relationship an important indicator. It is often referred to as "dockside price" which measures the economic value that salmon buyers place on salmon. It has been used in allocating public resources between salmon and non-salmon fisheries. This is a conservative estimate, but it can be used to justify enhancement and other conservation projects (Smith 1978).

Data were available for the three Oregon ports chosen for the study for 1969 to 1980 (Table 2). Astoria chinook landings averaged 167,773 lb (76,101 kg) compared to the total Oregon chinook catch average of 5,569,769 lb (2,526,447 kg), an average of 3% of all Oregon troll chinook landings. "Dockside price" averaged $0.63 for the study period at the port of Astoria compared to the average of $0.58 for all Oregon ports. At Newport the chinook landings averaged 437,607 lb (198,498 kg), or 7% of the total Oregon chinook catch. Price at Newport averaged $0.69 or $0.11 over the total Oregon average. Weight of the catch landed at Coos Bay averaged 743,252 lb (337,139 kg) or 13% of the total Oregon catch. Price-per-pound at Coos Bay averaged $0.65, $0.07 over the total Oregon average.

The coho salmon fishery can be delineated in the same way as the

Table 2

Oregon Chinook Salmon Fishery

Area	1967[a]	1968	1969[b]	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Astoria														
Lbs Landed	c/		108,148	244,034	162,631	88,724	87,311	183,430	122,139	308,484	230,099	193,990	116,521	123,347
Value			52,293	136,206	61,983	44,000	49,624	97,278	58,641	254,385		185,128	130,054	90,688
Price/Lb.			.48	.55	.38	.49	.56	.53	.48	.82		.95	1.12	.73
Newport														
Lbs Landed			150,224	285,503	104,876	193,783	952,493	448,820	342,126	384,781	771,014	629,863	550,202	563,234
Value			79,816	181,896	52,066	109,600	643,609	289,795	194,444	353,801		547,179	586,194	479,757
Price/Lb.			.53	.63	.49	.56	.67	.64	.57	.92		.86	1.06	.85
Coos Bay														
Lbs Landed			523,373	568,642	128,945	336,591	1,580,838	1,127,186	1,047,535	610,196	1,053,361	453,906	740,208	740,404
Value			246,788	355,172	54,545	179,200	1,054,135	704,761	576,543	553,216		355,384	755,718	634,412
Price/Lb.			.47	.62	.42	.53	.66	.62	.55	.90		.78	1.02	.85
Columbia River														
Lbs Landed	3,577,000	2,857,000	3,853,641	4,373,706	3,862,733	3,586,105	5,614,019	2,281,225	3,563,921	2,610,189	2,968,840	2,362,327	1,837,990	1,456,415
Value	1,220,000	957,773	1,767,841	1,177,685	1,509,600	4,089,473	1,103,401	1,837,037	1,910,526	1,442,051		1,105,641	591,093	
Price/Lb.	.34	.33	.34	.40	.30	.42	.72	.48	.52	.73		.61	.60	.40
Total Oregon														
Lbs Landed	4,655,000	3,780,000	5,235,332	6,311,491	5,013,000	5,085,474	9,595,654	4,911,284	6,534,955	4,820,004	6,953,526	4,543,434	4,804,950	3,954,327
Value	1,769,000	1,435,700	1,998,165	2,850,862	1,662,809	2,319,200	6,736,030	2,771,428	3,491,358	3,904,678		3,284,102	4,168,158	2,721,862
Price/Lb.	.38	.37	.38	.45	.33	.49	.70	.56	.53	.81		.72	.86	.69

a/ U.S. National Marine Fish. Service. Fishery Statistics

b/ Unpublished data. Oregon Dept. Fish and Wildlife.

c/ Data not available

chinook fishery (Table 3). Astoria averaged 481,193 lb (218,269 kg) landed as compared to the total Oregon coho landings average of 7,819,230 lb (3,546,802 kg). Astoria landings accounted for 6% of the total Oregon coho catch. The "dockside price" averaged $0.50 per pound in Astoria compared to the average of $0.48 generally paid Oregon coho fishermen. The port of Newport averaged 1,475,973 lb (669,501 kg) of coho landed or 18% of the total coho catch for the state. Newport fishermen were paid an average of $0.49 per pound. Coos Bay fishermen landed an average of 1,565,673 lb (710,189 kg) or 20% of the total catch for an average of $0.49 per pound.

Both chinook and coho fisheries have fluctuated widely throughout the study period. The Oregon troll chinook fishery has shown a growth rate of 6.5% based on the price-per-pound or "dockside price". The coho fishery has shown a somewhat stronger growth rate of 7.6%. The improvements noted in the coastal spawning stream environments could be partially responsible for this increase as well as an increased interest in the fishery because of several low chinook landing years. Over the period of the study, more pounds of coho were landed, but the price remained lower. Coho has been considered a less desirable food fish than chinook by processors and consumers. There was less fluctuation in price paid at the three ports for coho than for chinook. More fresh chinook than coho is sold in local markets, therefore, the price is less stable than the more widely marketed coho.

The Oregon salmon troll fishery showed an overall growth rate for the period 1967 to 1976, for which data were available for both number of fishermen and pounds caught, of 4.85%. Value increased at a rate of 10%, while the number of fishermen increased at a rate of 5.6% and that

Table 3

Oregon Coho Salmon Fishery

Area	1967[a]	1698	1969[b]	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Astoria														
Lbs Landed	c/		320,895	775,496	788,509	402,791	217,448	300,359	276,785	868,830	424,905	266,887	432,777	213,385
Value			125,688	345,689	204,132	149,600	103,759	134,013	113,580	549,707	c/	177,435	408,815	105,668
Price/Lb.			.39	.44	.25	.37	.47	.44	.41	.63		.66	.94	.50
Newport														
Lbs Landed			718,469	2,869,829	1,695,469	1,095,714	1,712,495	2,301,323	1,010,606	2,079,597	591,373	817,939	1,342,888	769,202
Value			280,733	1,280,172	438,842	406,400	933,082	1,018,367	416,049	134,152		491,794	1,212,804	372,064
Price/Lb.			.39	.44	.25	.37	.54	.44	.41	.64		.60	.90	.48
Coos Bay														
Lbs Landed			979,203	1,908,440	2,119,332	1,709,860	1,432,607	2,148,789	1,183,151	3,393,572	597,508	718,292	1,031,660	423,614
Value			382,568	850,862	547,933	777,600	697,744	996,598	483,950	218,771		425,641	927,510	197,165
Price/Lb.			.39	.44	.25	.45	.48	.46	.41	.64		.59	.90	.47
Columbia River														
Lbs Landed	4,426,000	1,262,000	1,293,762	4,417,972	1,694,796	897,935	1,050,938	1,741,270	1,122,190	993,371	254,354	951,778	886,086	736,279
Value	1,296,000	374,280	379,816	1,207,547	350,413	467,000	715,037	606,122	643,827	694,152		747,179	644,985	342,105
Price/Lb.	.29	.29	.29	.27	.20	.52	.68	.34	.57	.70		.78	.73	.46
Total Oregon														
Lbs Landed	11,356,000	5,781,000	4,941,033	13,084,479	11,774,660	6,482,926	7,305,423	10,054,741	5,823,540	11,413,708	3,291,276	4,148,041	6,160,328	3,255,659
Value	3,954,000	1,375,047	1,804,587	5,433,962	2,957,851	2,589,600	3,725,563	4,364,625	2,574,691	7,394,736		2,672,820	5,415,859	1,527,935
Price/Lb.	.34	.23	.36	.41	.25	.39	.50	.43	.44	.65		.64	.87	.47

a/ U.S. National Marine Fisheries Service.Fishery Statistics

b/ Unpublished data. Oregon Dept. of Fish and Wildlife.

c/ data not available

of boats at 4.6%. This is another illustration of the point made earlier; if there is any profit shown new entries will be made into the fishery. Anderson (1977) addressed this problem recommending that for a maximum economic yield (MEY) the number of boats should be reduced until revenue is equal to minimum average cost of producing effort per boat. Though achievement of MEY is not presently a management goal, some plans to stabilize the economics of the fishery are already in existance.

Limited Entry

Soon after the passage of the FCMA, the Pacific Fishery Management Council and the Oregon Department of Fish and Wildlife studied alternative forms of limited entry, especially in terms of the commercial salmon fishery. Alaska, Washington, California, and British Columbia all have some form of limited entry (Porter 1978). All concern salmon except California. Alaska's limited entry system made an initial allocation of entry permits to individuals based on a complex system of ranking that balanced several economic aspects of an individual as well as past participation in the fishery. Permits were issued only to people, not to groups or corporations, and were freely transferable. Fishermen were allowed to hold only one permit per fishery. Social considerations played a large role in decisions to issue entry permits to individuals rather than vessels. Native villages and cultures were a primary concern. Many aspects of the 1973 law are still being debated in the state legislature. It is not yet understood whether increased gross returns are attributable in some part to limited entry or an increased price of fish (Adasiak 1979). Rogers (1979) stated that very little has been said within Alaska on the subject of economic efficiency as an objective

of management in Alaska. He sees the plan as primarily a political objective using social considerations to mask it and, at the same time, to gain local support.

Campbell (1972) and Fraser (1979) outlined the limited entry program implemented in British Columbia in 1969. The Salmon Vessel License Control Program was implemented in three phases. The emphasis of Phase I was to bring to a halt increases in the actual number of fishing units in the salmon fleet unless a vessel had fished in 1967 or by September 6, 1968 or it was under construction by that date or that it replaced a vessel with certain standards of production. Phase II increased fees for salmon vessels in 1970. Ten year maximum licenses were sold for category "B" vessels. Category "A" and "B" vessels were defined during Phase I. Fish processing company vessels were frozen to a fixed percentage of the total fleet and money from increased license fees were used to "buy back" category "A" vessels out of industry. The third phase called for quality standards on salmon vessels. The extreme opposition to Phase III by industry involved the rationale that this was not a matter to be included in the licensing program.

In 1967, a special government program was begun for Indian fishermen; this had to be reconciled with the license control program in 1969. By 1979, Fraser (1979) concluded that although the program had several significant failings, evidence of continued positive license values indicated that some long run break was shown between fishing revenues and costs. Limited entry is not a control that will prevent the destructive pattern of competition among fishermen for a share of a limited resource. Pearse and Wilen (1979) studied the impact of the program and concluded that the program restricted only one dimension of fishing

effort, therefore distorting but not limiting the employment of capital, and since all incentives to dissipate rent were left intact, it has not contained fleet capitalization. They advocated instead a plan whereby a license gives a right to land a specified quantity of fish.

Higgs (1978) has done background work on a license moratorium for the PFMC. Higgs forecasted possible effects for Oregon and California fishermen to include: no significant change in troll fishermen's income, no significant change in prices of troll caught salmon, small increase in troll fishery effort, market value of licenses would increase to several thousand dollars, great increases in expected rents of the fishery, and a slight increase in social conflict among fishermen.

A vessel permit system was adopted by the 1979 Oregon legislature for troll and gillnet. This permit was in addition to the regular license. Qualifications to be met for a permit were: 1) at least one salmon must have been landed during the period 1974 to 1978; gillnet permit requires a landing during 1977 to 1978 only; or, 2) a new boat must have been under construction or contracted during that time. It has been extended by the legislature through 1983 for troll and indefinitely for gillnetters.

Based on a sketch by Carter (1981), the Oregon system is actually more of a ceiling than limited entry. The system has almost nothing in common with the programs previously mentioned but has been compared to more recent programs in Washington and California. Generally, California limits people engaging in the fishery while Oregon and Washington limit vessels. Permits are non-transferable in California, provisionally transferable in Oregon and freely transferable in Washington. In Oregon, unclaimed permits are distributed by lottery, California's permits are

non-transferable, therefore will decrease over time, Washington has a "buy back" plan. Neither California nor Oregon's programs have been in existence long enough to be analyzed in depth (Davis 1980).

None of the limited entry programs now in effect appear to be aiding in the approach to MEY, although this was one of the initial reasons for adopting these programs. Social considerations that must be made very often seem to be in direct conflict with measures which need to be taken to attain MEY. Optimum yield called for in the FCMA is to be somewhat of a combination of or, perhaps, a compromise between the two, however, it is also yet to be achieved.

Fishing Seasons

Length of season provides a measure of the maximum possible number of fishing days. Such factors as foul weather, mechanical breakdown, and illness can further limit the number of days fished by any fisherman. Length of season is different for each species and has been changed several times over the study period. Season length was, until 1977, set only by the Oregon Department of Fish and Wildlife. Since the implementation of the FCMA, the Pacific Fishery Management Council has determined the length of the salmon season outside three miles as well as boundaries as part of the Salmon Management Plan. The Columbia River salmon seasons are considered separately. Oregon Department of Fish and Wildlife has jurisdiction inside three miles and ruling may differ slightly from Management Council declared seasons.

The Oregon troll season was stable at 200 days, April 15 to October 31 for chinook and 139 days, June 15 to October 31 for coho through 1975. From 1967 to 1975, landings averaged 5,698,333 lb

(2,584,763 kg) of chinook and 8,515,444 lb (3,862,605 kg) of coho. Pounds landed fluctuated widely for both species although length of seasons (Fig. 4) and season dates (Fig. 5) remained the same. The 1976 and 1977 seasons were changed as to date and boundary to protect maturing upper Columbia River spring chinook present in the ocean until May 1. North of Tillamook Head chinook season lasted 168 days and south of the Head, 184 days. Coho season lasted 123 days north of Tillamook Head and 139 days south. Catch statistics showed large fluctuations between 1975 and 1977. From 1976 to 1977 chinook catch increased by about 1,100,000 lb (498,960 kg), but coho dropped from 11,413,000 lb (5,176,936 kg) to 3,292,000 lb (1,493,251 kg). In 1978, the number of days for both species remained the same, but the boundary was changed to Cape Falcon. Pounds caught fluctuated only slightly from those of 1977 and even less between species. In 1979, fishing days were greatly reduced, 84 and 154 respectively for chinook, and 53 and 65 respectively for coho. During this period, the number of fishermen and boats fluctuated but generally increased.

The changes in boundaries and numbers of fishing days did not appear to slow interest in fishing. Although boundaries were laid out in 1976, and fewer days were available on each side of the boundary, any one fisherman could, by fishing both species on both sides of the boundary fish more days than could have been fished prior to 1976. Though length of the fishing season seems to arouse strong disagreements between fishermen and managers, the data do no appear to bear out any direct correlation between pounds caught and number of season days.

Fig. 4 OREGON COMMERCIAL FISHING DAYS

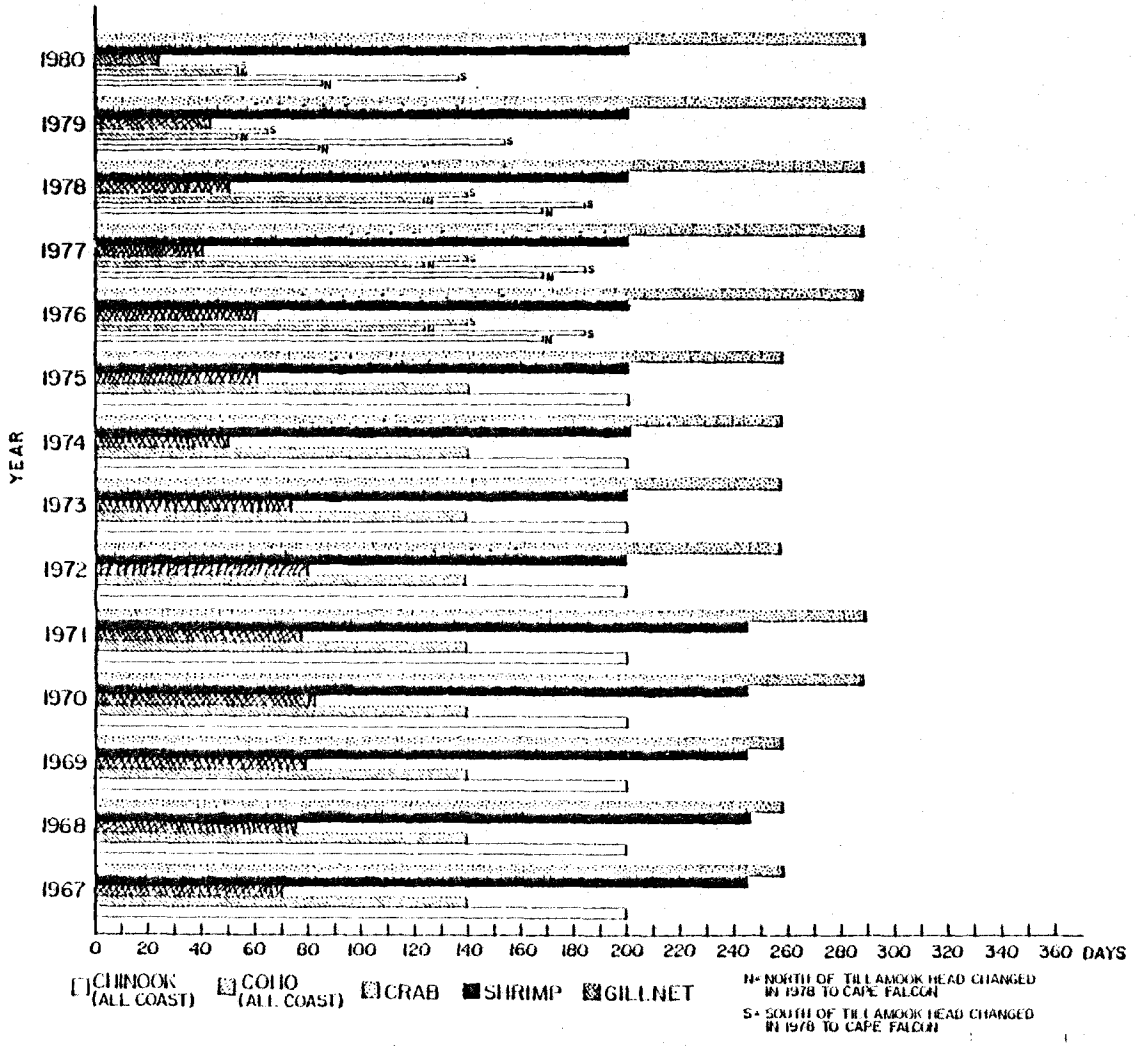
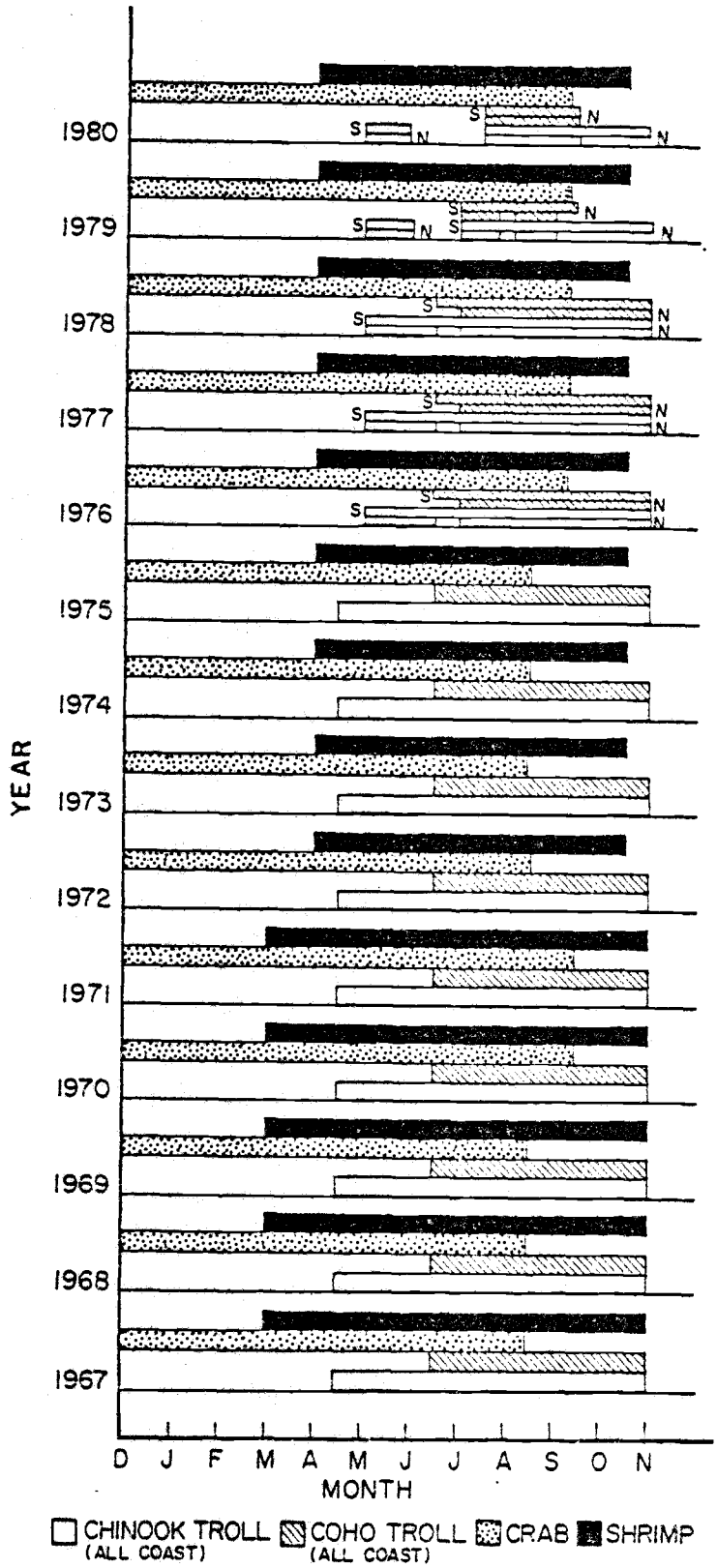


Fig. 5 OREGON COMMERCIAL FISHERY SEASONS



N = NORTH OF TILLAMOOK HEAD CHANGED IN 1978 TO CAPE FALCON
S = SOUTH OF TILLAMOOK HEAD CHANGED IN 1978 TO CAPE FALCON

Columbia River Gillnet Fishery

The Columbia River system is one of the most exploited watersheds for production of anadromous fish. Before the white man's influence, 163,200 sq mile (422,688 km^2) of watershed contained ideal salmonid habitat. Today less than 72,800 sq miles (186,480 km^2) remain. Dams, pollution, waterflow manipulation and flow depletions, various watershed management practices, urbanization, industrialization, and development of transportation networks have caused severe problems for aquatic organisms. The effects of large hydroelectric dams and related water quality have adversely affected Columbia River salmon more than all other environmental changes combined. More than 55% of the Columbia River system formerly accessible to salmon has now been blocked for electrical power generation (Thompson 1976).

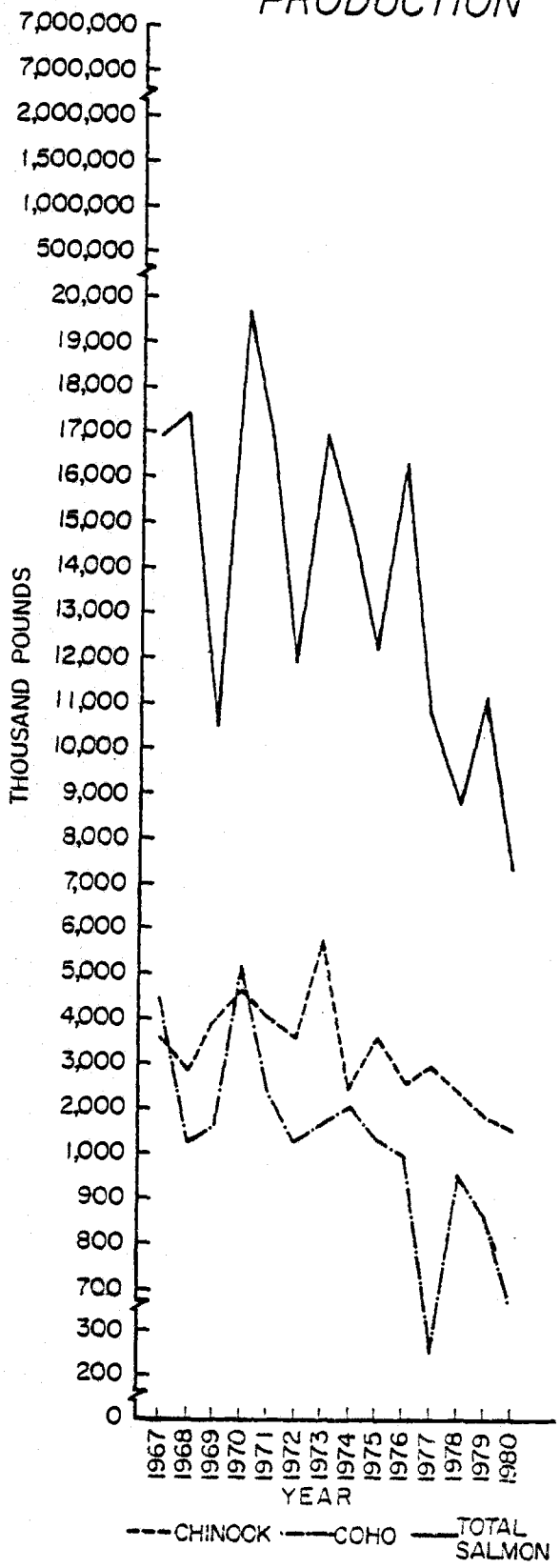
The Columbia River and its tributaries have been a source of fish for Pacific Northwest Indians for hundreds of years. Salmon and steelhead were used for food, ceremonies, and trading purposes. A few decades after white explorers reached the Columbia River region, U. S. territorial expansion was accelerated by gold discoveries. Authority to negotiate with the Indians was granted by Congress under the Indian Treaty Act of 1850. Most important in terms of fishing rights involving Columbia River Indians was the Treaty of 1855 (Beiningen 1976). Current fishing disputes tend to create the illusion that Indians in general retain fishing rights on the Columbia. Actually, only treaty Indians retain these rights on the Columbia River. The treaty groups who retain fishing rights are: The Confederated tribes of Warm Springs, the Yakima Confederation, the Umatillas, and the Nez Perce Confederations. In 1855, treaties were signed by these four Confederations in which they gave up

possession of thousands of acres of land, but retained some rights, one of which was "right to fish at usual and accustomed grounds and stations in common with all citizens" (Balagna 1979). At the time of the treaty and before, Indian fishing effort was concentrated at natural barriers such as Kettle Falls, Celilo Falls or in tributaries that were easily accessible. Groups of Indian fishermen were noted by early explorers fishing at points along the San Poil, Okanogan, Spokane, Yakima, Grand Ronde, Umatilla, Deschutes, Klickitat and Willamette Rivers. These were the "usual and accustomed grounds".

In 1853, two years before the Indian Treaty was signed, the first gillnet was used by settlers on the Columbia River. Its impact was not immediately felt. Many groups of fishermen, seiners, trapmen, fishwheel operators and dipnetters were important for a time, but changes in river conditions and fishery laws forced them out of business. Their leaving was not voluntary, but forced by regulations meant to limit fishing effort on declining salmon runs. But the gillnetters stayed on, adapted by modifying their nets and redesigning their boats. Hatley's (1975) account of the development of the gillnet fishery clearly shows the adaptability of the fishermen including the accompanying fish fights.

The catch and value statistics for 1967 to 1980 provided insight into the effects of regulation and declining salmon runs on a fishery. Chinook landings fluctuated over the 13 years but showed a general decline (Fig. 6). In 1967, gillnet caught chinook comprised 21% of the total salmon catch and coho made up 26% of the total catch. In 1973, chinook peaked at 5,700,000 lb (2,585,520 kg) accounting for 33% of the total Oregon catch that year. Coho peaked in 1970 at 5,194,000 lb (2,344,998 kg) comprising 26% of the total catch. Drought conditions in 1977 which

Fig. 6 COLUMBIA RIVER GILLNET AND TOTAL SALMON PRODUCTION



adversely affected the troll catch also affected the coho gillnet catch. Though chinook is in the midst of a downward trend, catch statistics do not show a similar drop. By 1980, the chinook catch reached a low for the study period of 1,456,415 lb (660,629 kg) or 20% of the total Oregon salmon catch. Coho finished the study period at 736,279 lb (333,976 kg) comprising 10%. For the same period, chinook catch averaged 3,416,461 lb (481,513 kg). Coho catch averaged 1,879,000 lb (852,314 kg) and fluctuations averaged 1,176,923 lb (533,852 kg). This pattern was similar to the troll fishery, chinook catches were more stable than coho catches, and the average catch in weight landed was higher for chinook than for coho.

From 1967 to 1979, the number of gillnetters fluctuated from 316 to 893 and the number of nets from 283 to 1,091 (Table 4). The rate of growth of the fishery based on the number of gillnetters was 1%. The number of nets fluctuated so widely that no growth could be discerned. Columbia River salmon catch was 8,246,000 lb (3,740,430 kg) in 1967. It continued to fluctuate until 1973 when catch was recorded at 7,034,499 lb (3,190,848 kg). From 1974 to 1980, the downward trend was steady from 4,025,788 lb (1,825,870 kg) to 2,194,581 lb (995,461 kg). Pounds harvested per gillnet fluctuated widely but not in the same pattern as catch. In 1968, for instance, catch dropped about 4 million lb (1,814,400 kg) from 1967. The number of gillnetters dropped from 737 to 316 making the pounds per gillnetter rise in 1968 2,000 lb (907.2 kg), although total catch dropped sharply. This pattern was again visible in 1975. Pounds per net showed the same effect. In 1972, the number of nets reached a low of 4,259 lb (1,932 kg). Value of the catch and gross returns to the gillnetters will help clarify the effect of the fluctuations in

Table 4

Columbia River Gillnet Catch/Effort and Gross Returns.

Year	No. of Gillnets	No. of Nets	Catch (Pounds)	Pounds Per Gillnetter	Pounds Per Net	Value of Catch (1967=100)	Gross Return Per Gillnetter	Gross Return Per Net
1967[a]	737	670	8,246,100	11,188.7	12,307.6	$2,581,004	$3,502.04	$3,852.00
1968	316	283	4,184,000	13,240.5	14,784.4	1,357,692	4,296.49	4,797.49
1969[b]	709	625	5,221,566	7,364.6	8,354.5	1,731,192	2,441.73	2,769.90
1970	565	512	8,837,236	15,641.1	17,260.2	2,773,275	4,908.45	5,416.55
1971	815	576	5,724,019	7,023.3	9,937.5	1,581,818	1,940.88	2,746.21
1972	713	1091	4,647,716	6,518.5	4,260.0	1,941,600	2,723.14	1,779.65
1973	891	931	7,034,499	7,895.0	7,555.8	4,812,781	4,501.54	5,169.47
1974	676	674	4,025,788	5,955.3	5,972.9	1,738,095	2,571.14	2,578.77
1975	329	329	4,690,795	14,257.7	14,257.7	2,482.16	7,546.24	7,546.24
1976	618	539	3,614,070	5,848.0	6,705.1	2,609,356	4,222.25	4,841.10
1977	- [c]	-	3,224,143	-	-	-	-	-
1978	730[d]	-	3,327,167	4,557.7	-	2,195,384	3,007.37	-
1979	815	-	2,724,461	3,342.8	-	1,750,805	2,148.22	-
1980	-	-	2,194,581	-	-	933,198	-	-

[a] U.S. National Marine Fisheries Service. Fishery Statistics

[b] Unpublished data. Oregon Dept. of Fish and Wildlife

[c] data not available

[d] unpublished data, Carter, C.

catch and numbers of gillnetters and nets.

Value of the gillnet fishery has fluctuated widely, but generally declined. The weight landed declined faster than general prices increased and the total value of the fishery declined even with price increases. In 1967, 8,246,100 lb (3,740,430 kg) were valued at $2,581,004 while in 1980, 2,194,581 lb (995,461 kg) valued at $933,198. In 1967, there were an estimated 737 gillnetters and the gross return per gillnetter was $3,502.05 while in 1979, there were 815 gillnetters whose gross return averaged $2,148.22. The highest value of the year of the study was 1973 but the number of fishermen depressed the return per fisherman. In 1975, the number of gillnetters dropped to 329, catch was slightly improved over 1974 and the return per fisherman rose. The rise in number of gillnetters and a drop of nearly 1 million lb (453,600 kg) in catch caused a serious drop in gross returns after the 1975 high. Gross returns per net matched closely, or followed the same trend as the gross returns per gillnetter.

Price-per-pound paid Columbia River gillnetters compared to that paid trollers at three major Oregon ports was usually lower (Table 2, 3). Though no data were available from individual ports for 1967 and 1968, price-per-pound for Columbia River chinook was lower than the total Oregon price. From 1969 to 1980 chinook averaged $0.49 per pound. This figure was $0.14 less than Astoria's price paid to trollers, $0.20 less than the price paid at Newport and $0.16 less than that paid to Coos Bay fishermen. Prices paid gillnetters for coho were also less than those paid to trollers landing fish in Oregon's major ports. Average price-per-pound paid gillnetters was $0.47. This means gillnetters received $0.02 less than trollers landing coho in Astoria, Newport and Coos Bay.

The price difference is less for coho than for chinook because there is less variability in market price, thus less variance from port to port. Gillnet caught fish are considered by some processors to be of slightly lower quality because the catching process can leave marks on the fish which detract from its appearance and the fish have already entered fresh water indicating that the flesh may have already begun the deterioration process.

The number of season days as a descriptor of the Oregon fishery leads to some enlightening comparisons (Fig. 4). Troll seasons for coho and chinook were unchanged from 1967 through 1975 at 139 and 200 days respectively. Gillnet seasons below Bonneville Dam began at 70 days in 1967, fluctuated to a high in 1970 of 82, reduced to 49 in 1974 and back to 59 in 1975. Pounds caught for the given number of season days gives a rough measure of efficiency. First of all in 1967, gillnetters were able to fish 35% of the time that chinook trollers could fish and almost 50% of the length of time of the coho season. However, for the same year gillnetters caught three times as many pounds of chinook and about two-thirds as much coho as the trollers. By 1980, salmon troll seasons had been shortened and a north-south boundary introduced. Gillnet season was now reduced to 43 days. By this time, the extreme reduction in days was quite visible in the landing statistics. Declines in the Columbia River catch correlate with the reduction in fishing days. In 1974, fishing days were cut back by 24 days; catch dropped 3,200,000 lb (1,451,520 kg), regained slightly in 1975 and 10 days were added to the fishing season. By 1977, the downward trend in both was obvious. If the current trend continues the commercial gillnet fishery on the Columbia River will cease to exist in the near future. While season closures are

an attempt to insure escapement, a commercial fishery may also be destroyed.

Present managemnt of Columbia River salmon takes into account allocation of fish to gillnetters, sports fishermen, Indian fishermen and escapement requirements. Ocean trollers are not included since only those fish that return to the river can be allocated. However, a 1975 court ruling granting Indians the right to 50% of all salmon that normally reach their fishing grounds indicates that the allocation process will also be applied to ocean trollers (Hatley 1975). This court ruling, known as the Boldt Decision, has had a tremendous impact on the management of fisheries in Washington and Oregon and merits some explanation.

The suit began in 1970 when several Indian tribes claimed they were not receiving the rights to fish that had been granted in the treaty. After extensive finding of fact, Judge Boldt declared in 1974 that Indian fishermen should be given the opportunity to harvest up to 50% of the fish which would normally return to tribal fishing grounds. At this time the state of Washington was directed to reduce non-Indian fishing on runs so that more fish would be available to the Indians on their non-reservation fishing areas. This decision generated a great deal of controversy among other fishing groups, especially gillnetters (Balagna 1979). The reduction of fishing days and the landings by gillnetters correlate with this 1974 court decision timing. A major decision for management now seems to be whether to let the gillnet fishery on the Columbia River continue until it dies completely, for all its past adaptability, this problem may be beyond its ability to adapt, or to step up research to find ways to increase fish runs so that

there will be enough to support all the fisheries, perhaps on a limited scale.

In late 1982 the Oregon Department of Fish and Wildlife started a buy-back program for gillnet licenses in an attempt to help the fishermen avoid economic disaster and to decrease the number of gillnetters on the Columbia. Hatcheries and private salmon ranching ventures, though not answers to all the problems of the salmon fishery may help to maintain salmon populations in the coastal streams. The augmentation, or in some cases, replacement of wild salmon stocks by hatchery reared stock is an issue of debate by biologists, fishermen and politicians. Examination of that debate is outside the scope of this paper, but the future policy regarding salmon ranching will have a profound effect on the Oregon salmon fishery.

III. THE DUNGENESS CRAB FISHERY

Background

The Dungeness crab fishery is considered to be the oldest and largest shellfish fishery of the North Pacific coast. Indians trapped crabs on the shores of the Strait of Juan de Fuca well before the arrival of the white man. In California, the crab fishery began between 1860 and 1870 in the San Francisco Bay area (Hipkins 1957). The U. S. Bureau of Fisheries first recorded crab landings in Oregon in 1889. The State of Oregon first recorded crab landings in 1903. Increase in production up to 1931 was gradual but fluctuating. From 1931 to 1943, production increased sharply from one-half million pounds (266,800 kg) to almost 11 million lb (4.9 million kg). In 1933, the variable bag limit on commercial crabbing was repealed, allowing an increase in the number of licenses sold and, perhaps, in the amount of gear fished by individual crabbers. During the 12 years from 1944 to 1955, landings fluctuated between 6 and 11 million lb (2.7-4.9 million kg) and Columbia River landings followed a downward trend while catches at Yaquina Bay and Coos Bay increased. Over this 11 year period, Oregon crab landings usually reached a seasonal peak in May. This is probably a function of the type of boats available at the time and weather. Bays produced the bulk of the crab catch for several years until in 1915 crabs were taken in substantial numbers from the open ocean. The ocean fishery continued to develop until in 1952 almost 95% of the crabs were taken from the open ocean (Waldron 1958).

Traps, hoopnets, forked sticks, spears and dipnets have been used to fish crabs on the Pacific coast. Traps and hoopnets account for

about 99% of the catch (MacKay 1942). The type of gear used in the majority of offshore fishing at present is the pot or trap. In a detailed description of the crab pot, Waldron (1958) states that the original crab pot was adopted from the east coast lobster fishery and was constructed from wood. The pot in use today is cylindrical with a diameter varying between 30 and 42 in (76.6-106.6 cm) and about 14 in high (35.5 cm). It is constructed of five-eighths inch mesh, with two funnel-like entrances to the pot with loosely projecting wires at the inner edges to prevent the crabs' escape. Undersized crabs can escape through a hole, about 4 1/8 in (10.4 cm) in the top. Bait consists of razor clams, squid or herring. Bait is hung in small wooden, stainless steel or plastic boxes in the pot. Pots are set in strings of 30 to 60 with a bouy marking the first and last pot. Strings are usually set parallel to shoreline in 5 to 20 fm (9.1-36.5 m). In good weather a crew can pick and reset 60 pots in an hour or over 300 in a 10-hr day (Hoopes 1973).

The other type of gear in use is the crab ring or hoop which is a cotton mesh basket attached to two iron hoops, the larger hoop on the top, the smaller hoop on the bottom. Bait usually consisting of dead fish or clams is attached to the inside of the basket. When the basket reaches the ocean floor, it collapses and both rings rest on the bottom. Crabs can then easily reach the bait. When the ring is raised, it again forms a basket trapping the crabs (Waldron 1958). This method requires almost constant tending since the nets must be hauled to the surface often, about once every half hour. The success of the method depends on the hunger of the crab and upon the fact that crabs tend to cling to the nets as they are hauled to the surface (MacKay 1942).

The Basic Economic Indicators for King and Dungeness Crabs, 1947-1972 (U.S. National Marine Fisheries Service 1973b) provided a statistical history of this fishery. Landings per Pacific coast Dungeness crab fisherman averaged 20,527 lb (9,311 kg) from 1947 to 1969. Landings per boat averaged 41,342 lb (18,752 kg) for the same period. Landings per fisherman and per boat/vessel fluctuated with no measureable gain per fisherman but an increase of 2.8% per craft. Domestic production showed the Oregon crab fishery landings fluctuating, but growing at a rate of 1%, compared to growth of the Washington fishery at 2.3% and the growth of the Alaska fishery at 4% for the years 1947 to 1969. Demand indicators showed exvessel, wholesale, and retail price increases from 1947 to 1971. Exvessel and wholesale prices fluctuated slightly, but increased 4% for the period. Retail prices fluctuated, but increased slightly slower, at a rate of 3.9% for 1947 to 1971.

The number of vessels (craft in excess of 5 net tons) and boats (craft less than 5 net tons) in the Oregon crab fishery totaled 269 in 1947 and 199 in 1969. The number of vessels increased steadily over the time period; from 75 in 1947, the fleet increased to 156 by 1969. On the other hand, the number of boats decreased steadily from 194 in 1947 to 43 in 1969. This could, in part, account for the increase in landings per vessel and/or boat while the pounds landed per fisherman showed no gain for the time period. Vessels are larger, more efficient and can range greater distances than boats. Slightly fewer fishermen may be employed. The number of fishermen on vessels increased from 206 in 1947 to 388 in 1969 while the number of fishermen on boats decreased from 237 in 1947 to 68 in 1969. The number of crab pots used by Oregon fishermen between these dates increased from 26,200 to 44,900 for a

2.3% rate of growth. Estimates of MSY from world stock of Dungeness crab is 65 thousand metric tons. U. S. fishermen fish for Dungeness crab only in the North Pacific, the MSY for this area has been estimated at 50 thousand metric tons (U. S. National Marine Fisheries Service 1973b).

Ecology

Tagging studies have provided information on movements of crabs as well as other aspects of the stock which are of interest to managers. Though locally crabs tend to move in one direction, there is no definite pattern coastwide to crab movement; nor have crabs been observed to move in significant numbers between major fishing areas. Crabs tend to move inshore in the spring and offshore in the fall. Crabs tend to move freely in waters of the Oregon-California border area indicating a single population occurs in the area (Pacific Marine Fisheries Commission 1978). The only California population of commercial importance extends from Eureka north into Oregon. These stock units are not thought to be reproductively discrete and the extent of larval drift is unknown. Though the fishing grounds off Oregon and Washington appear continuous with the exceptions of an area near Cascade Head, Oregon and Destruction Island, Washington where length/width ratios and crab condition differs significantly from other areas. Studies also showed a wide diversity of food items found in crab stomachs indicating Dungeness crabs are opportunistic feeders. Cottids, flatfish, surfperch, skates,croakers, rockfish, salmon, sturgeon, greenling, sharks, cod and hake feed on crab larvae and adults. Coho salmon have the potential to cause significant mortality during the megalops stage (Pacific Fishery

Management Council 1979a).

Management Considerations

The Pacific Marine Fisheries Commission (1978) estimated MSY based on three different models and effort based on total crab pot estimates for the states of Oregon, Washington and California. The Simple Schaefer Curve estimates the Oregon crab MSY at 11,042,319 lb (5,008,795 kg) while the number of pots at MSY could be 39,718. According to the Schaefer Peak Years estimation, MSY is estimated to be 12,836,355 lb (5,822,570 kg) and the number of pots at MSY is estimated at 30,125. The Generalized Production Model produced an MSY estimate from 8,600,000 lb (3,900,600 kg) to 10,360,000 lb (4,699,296 kg). The pot estimate ranges from 25,000 to 32,500. Optimum Yield is all of the crabs that are harvested under existing harvesting restrictions. The Pacific Fishery Management Council is not currently managing the Dungeness crab; responsibility for managing the Oregon crab fishery rests with the Oregon Department of Fish and Wildlife.

Exploitation

Landings of Dungeness crab fluctuated from 1967 to 1979, ranging from 9,630,000 lb (4,368,168 kg) in 1967 to 15,632,000 lb (7,090,675 kg) in 1979 (Table 5). In 1970 and 1971, about 14,900,000 lb (6,758,640 kg) were harvested, followed by 5 years of low landing records before a peak for the study period was reached in 1977 with 19,185,000 lb (8,702,316 kg). A similar trend can be seen in the basic economic indicators of Oregon Dungeness crab production for the years 1962 through 1965 (U. S. National Marine Fisheries Service 1973b). The trend was not visible during the

Table 5 Oregon Dungeness Crab Catch/Effort and Gross Returns

Year	No. of Fishermen	No. of Boats/Vessel	Catch (Pounds)	Pounds Per Fisherman	Pounds Per Boat/Vessel	Value of Catch (1967=100)	Gross Return Per Fisherman	Gross Return Per Boat/Vessel	
1967[a]	340	107	9,630,000	28,323.5	90,000.0	$1,560,000	$4,588.23	$14,579.43	.16
1968	366	170	11,351,000	31,013.6	66,770.5	2,207,293	6,030.85	12,984.07	.19
1969	431	190	9,783,998	22,700.6	51,494.7	2,691,743	6,245.34	14,167.06	.28
1970	463	205	14,929,347	32,244.8	72,826.0	3,217,241	6,948.66	15,693.85	.22
1971	596	266	14,875,849	24,959.5	55,924.2	3,508,264	5,886.34	13,188.36	.24
1972	678	217	6,762,259	9,973.8	31,164.2	2,292,800	3,381.71	10,695.89	.34
1973	625	202	2,349,645	3,759.4	11,631.9	1,007,518	1,612.82	4,987.71	.42
1974	525	200	3,917,625	7,462.1	19,588.1	1,878,231	3,577.58	9,391.15	.42
1975	557	271	4,026,937	7,229.6	14,859.5	1,988,271	3,569.60	7,336.75	.44
1976	563	247	8,134,065	14,447.7	32,931.4	3,092,397	5,492.71	12,519.82	.38
1977	---[b]	383	19,902,419	---	51,964.5	5,284,848	---	13,798.55	.27
1978	---	468	12,502,137	---	26,713.9	4,922.564	---	10,518.29	.34
1979	---	587	15,631,877	---	26,630.1	5,357,660	---	9,127.18	.34
1980	---	627	18,652,423	---	29,748.6	5,010,121	---	7,990.62	.27

[a] U.S. National Marine Fisheries Services. Fishery Statistics

[b] data not available

1950's in Oregon, though it was in Washington. At this time Oregon had less than half as many boats and vessels fishing crab as did Washington, therefore the Oregon fishery effort was not high enough to produce a trend for that time period. Crab landings accounted for an average of 8% of the total weight of the Oregon commercial fishery catch from 1967 to 1980 (Fig. 2). The low landings years 1971 to 1976 were reflected in the low percentage figures for those years.

Though the crab fishery accounted for a small portion of the total commercial catch in pounds landed, it made a larger contribution to the commercial fishery in value. Crab landings accounted for approximately 13% of the total value of the Oregon commercial fishery. Though salmon consistantly remained the most valuable species studied in the fishery, crab remained well above pink shrimp until the drop in crab landings during the early 1970's (Fig. 3). Since the recovery of the crab catch in 1977, it remained competitive with other fisheries in total value, although many more pounds of pink shrimp were landed per year.

Fishermen sell most of the Dungeness crab catch to processors. More than 75% of the Oregon catch is exported to surrounding states as fresh frozen, frozen or canned crab meat, with 66% of the total production sold in California markets. In contrast to the extensive marketing program conducted by Alaska king crab processors, very little advertising or product promotion is used by Dungeness crab processors. Several factors appear to threaten the stability and growth of the Dungeness crab industry. Production has fluctuated widely from highs of 11.8 million lb (5,352,480 kg) in 1957, 11.3 million lb (5,125,680 kg) in 1968 and 19.1 million lb (8,663,760 kg) in 1977 to lows of 5.4 million lb (2,449,440 kg) in 1952, 3.1 million lb (1,406,160 kg) in 1964 and

2.3 million lb (1,043,280 kg) in 1973.

Introduction of large quantities of Alaska king crab into traditional Dungeness crab markets affected the market for crab. King crab prices have not fluctuated as have Dungeness crab prices (Youde and Wix 1967). Wix (1967) stated that over 67% of Oregon's Dungeness crab was sold to California markets. Therefore, it could be expected that the total quantity of Dungeness crab caught in all states would influence the Oregon price to fishermen. He concluded that Dungeness crab prices showed a definite seasonal trend; however, cyclical fluctuations in price had a greater impact on the fisherman's revenue than did the seasonal fluctuation. During the 1960's, prices varied inversely to the quasi-cyclical variations in total supply of Dungeness crab.

Extreme fluctuations in catch limited the rate of growth of the crab fishery in Oregon to 4%. The rate of growth based on the increased value, on the other hand, was 13%. Value showed little of the fluctuation observed in the weight landed data (Table 5). Though the fishery has grown slowly when total landings were considered, steady price-per-pound increases showed a more substantial growth rate. Data were available for 1969 to 1980 for the three Oregon ports chosen for closer study (Table 6). Astoria crab landings averaged 5,598,175 lb (2,539,332 kg) compared to the average total Oregon crab catch of 133,197,000 lb (60,418,159 kg). Therefore, 4% of the state's crab catch was landed in Astoria. Price-per-pound, the "dockside price", averaged $0.34 for the study period compared to the average of $0.31 for the general Oregon price paid. The port of Newport averaged 1,344,429 lb (609,833 kg) of crab landed or 1% of the total Oregon catch. The average price paid the fisherman per pound was $0.35. Coos Bay

Table 6

Oregon Dungeness Crab Fishery

Area	1967[a]	1968	1969[b]	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Astoria														
Lbs Landed	c/		3,941,459	3,809,343	5,148,741	3,872,563	992,973	1,398,220	1,090,333	1,353,092	3,476,836	2,542,671	2,662,197	2,287,636
Value			1,084,403	820,689	978,512	1,313,600	425,563	661,904	538,271	514,619	c/	987,179	932,234	593,927
Price/Lb.			.27	.21	.19	.33	.42	.47	.49	.38		.38	.35	.26
Newport														
Lbs Landed			1,274,377	3,150,766	3,624,105	1,263,913	327,355	912,618	525,516	1,117,154	4,632,961	2,679,577	4,584,232	5,813,455
Value			50,458	679,310	898,347	428,800	140,601	390,476	259,259	424,561		1,047,692	1,612,455	1,616,599
Price/Lb.			.27	.21	.24	.33	.42	.42	.49	.38		.39	.35	.27
Coos Bay														
Lbs Landed			1,581,711	2,716,861	1,898,998	468,683	245,662	782,518	774,489	1,427,844	2,376,249	2,556,926	2,873,732	3,671,889
Value			35,779	585,344	549,586	158,400	105,263	374,149	382,716	542,690		1,008,205	1,022,995	1,017,813
Price/Lb.			.27	.21	.28	.33	.42	.47	.49	.38		.39	.35	.27
Total Oregon														
Lbs Landed	9,630,000	11,351,000	9,783,998	14,929,347	14,875,000	6,762,259	2,349,645	3,917,625	4,026,937	8,134,065	19,185,000[a]	12,502,137	15,587,797	18,652,23
Value	1,560,000	2,207,293	2,691,743	3,217,241	3,508,264	2,292,800	1,007,518	1,878,231	1,988,271	3,092,397	2,903,762	4,522,564	5,340,907	5,010,121
Price/Lb.	.16	.19	.27	.21	.23	.34	.42	.47	.49	.38	.27	.39	.34	.27

a/ U.S. National Marine Fisheries Service. Fishery Statistics.

b/ Unpublished data. Oregon Dept. of Fish and Wildlife

c/ data not available

fishermen landed an average of 1,608,727 lb (729,718 kg) comprising 1% of the total Oregon crab landings. Fishermen were paid an average of $0.35 per pound. The sale of most crab to out-of-state markets stabilized the price between ports.

The study of gross returns to crab fishermen showed a lack of growth from 1967 to 1976 (Table 5). There were 223 more fishermen in 1976 than 1967; 1,496,000 lb (678,585 kg) less were landed than in 1967; and, the value increased from an average of $0.16 per pound in 1967 to $0.38 per pound in 1976. The number of fishermen increased at a rate of 5.1%. Total catch fluctuated widely as the number of fishermen increased steadily. "Dockside price" of the catch increased by 9%. Gross returns per fisherman increased at a rate of 2%. Though the value increased steadily and the number of fishermen entering the fishery was gradual, wide fluctuations in pounds caught kept the rate of increase in gross return per fisherman low. Gross returns per boat/vessel varied more widely than gross returns per fisherman because the number of boats/vessels fluctuated from year to year, the number of fishermen did not. The number of craft increased at a rate of 3.7%. No growth could be discerned based on gross returns per craft. Liao and Stevens (1975) in a study of profitability of fishing enterprises found no correlations between profit from crabbing and physical characteristics of the boat. Only gross returns and gross returns per day were significantly correlated with profits from crabbing. Youde and Wix (1967) found that total quantity of Dungeness crab caught by year in Oregon, Washington, California, and Alaska, and the average price paid fishermen for Alaska king crab were significant in explaining variations in Oregon Dungeness crab prices.

Limited Entry

License or effort limitation has been considered since the formation of the Dungeness Crab Project of the State-Federal Fisheries Management Program (SFP) study team. This team was developed in response to the sharp decrease in crab landings in 1972 and was directed to "evaluate and recommend options for both research and management of the crab fishery". In 1977, the Ad hoc Dungeness Crab Management Review Team (1977) reported that there existed the possibility of "considerable error in the estimate of the potential benefits due to effort management". There was a lack of information regarding estimates of stocks and the extent to which these stocks should be landed during peak years. Therefore, if effort level was to be controlled near the optimum amount to achieve economic efficiency, techniques for the estimation of harvestable stock and landing statistics needed to be improved.

The Pacific Marine Fisheries Commission (1978) also considered other management procedures such as taxes, license fee and buy back plans. However, the study team recommended that any such limitation be investigated in the context of a multi-species fishery because a plan directed at a single species fishery when the fishery was, in fact a multi-species fishery may have adversely affected the other fisheries. The Pacific Fishery Management Council (1979a) concurred with a recommendation by the Dungeness Crab Development Team and Advisory Subpanel not to investigate effort limitation directed only at the crab fishery.

Various forms of regulation exist in all commercial fisheries being managed. Closed areas, closed seasons and quotas, limitations on

technology, limited entry including taxes and licenses are some of the most often used measures (Scott 1962). The Dungeness crab fishery has been under some form of regulation since about 1900. In Oregon, laws regulating fisheries during the first 45 years of the century were promulgated entirely by legislative action. A license required for commercial crab fishing was one of the first regulations in the Oregon crab fishery. In 1909, the minimum size limit was 6.5 in (16.5 cm) measured across the back. The taking of female crabs was not prohibited until 1948. The method of measuring crabs has been revised several times. The commercial bag limit of 50 crabs per day per fisherman in 1909 was increased to 60 dozen per week by 1933 and repealed during that year. Beginning in 1911, crabbing became unlawful during the months of July, August and September for canning and shipping. In 1948, this law was replaced by a closed season during these months to prevent taking of crabs in poor condition (Waldron 1958).

Miller (1976) outlines modern West Coast Dungeness crab fishing regulations. Many of the initial regulations or amendments of them still exist. There are differences between regulations of various states involved in the fishery, but they are relatively minor. In several areas regulations differ between sport and commercial catches. Salmon trollers and crab fishermen have an informal agreement to divide the grounds at the 15 fm (27.4 m) contour to resolve some grounds and gear conflicts. Females may be retained in British Columbia if they exceed the minimum size. Protection of females in Washington and Oregon includes, in addition to their reproductive role, a consideration that meat yield and quality are lower than for males. A specific fishing license for crab is required in Alaska and Washington, but only a general commercial

license is required in British Columbia, Oregon and California.

Fishing Season

Seasonal fluctuations in shell hardness and meat yield follow the molting cycle of the crabs. Meat yield, handling mortality as well as seasonal changes in costs of crab harvesting and processing must be considered when determining an optimal crab season. Crab condition is not cnstant from year to year. Theoretically it would be possible to have a season each year dependent upon the determined condition that year. Another major problem in season determination results from the fact that crabs tend to molt earlier in the southern part of the range than they do in the north. Therefore, seasons in California and Oregon open earlier than desired by Washington. However, Washington fishery managers fear a later opening would cause an influx of vessels from the south.

Crab seasons in Oregon have varied from 258 to 289 days between 1967 and 1980 (Fig. 4). Seasons have opened on December 1 and closed between August 16 and September 16 depending on the year (Demory 1981). Length of season has remained stable while landings have fluctuated widely. Therefore, the number of available fishing days has not affected the catch by Oregon fishermen. Liao and Stevens (1975) found that about half of Oregon's resident crabbers fished for salmon and/or tuna in addition to crab in 1972. From December 1 through April 31, there is no overlap of crab and salmon seasons. Only in November is there no season for commercial crab, salmon or shrimp (Fig. 5). Since Oregon fishermen fish in California and Washington waters, this affords them the opportunity to move as the condition of the crab changes from south to north. A

coast wide common opening date is in effect, with Washington opening early by emergency declaration. The closing date is staggered, earlier in California, latest in Washington based on crab condition.

The Oregon Dungeness crab fishery can be considered a stable fishery. Season length (Fig. 4,5) indicates that the fishery is being utilized over a substantial part of the year. While salmon troll and gillnet seasons are open shorter times, Dungeness crab and pink shrimp seasons have been cut less. The number of fishermen has gradually increased and gross returns per fisherman has been fairly stable when fluctuations in the catch are taken into account. The trend from smaller boats to larger vessels also indicates stabilization of the crab fishery. Stabilization is based on the demand and prices associated with that demand. With the trend to larger vessels, and more capital invested, a decrease in demand will cause sudden drop in price and bankruptcy for many fishermen.

IV. THE PINK SHRIMP FISHERY

Background

The pink shrimp was known to be abundant off the Washington coast as early as 1904 and has sustained a commercial fishery in Puget Sound since 1888. A developed shrimp fishery off the coasts of California, Oregon and Washington did not begin until the late 1950's. The difficulties of capturing and processing small shrimp were prime factors in the late development of the fishery (Magill and Erho 1963). In 1951 the California Department of Fish and Game found several shrimp beds off the coast of central and northern California. In 1952, regulations governing a potential fishery were established and the first commercial landings were made in California (Geibel and Heimann 1976).

In 1951 and 1952, the Oregon Fish Commission chartered commercial boats to make exploratory tows using a 10 ft beam trawl to find concentrations of shrimp. As a result, research studies were initiated to assess the magnitude and locate boundaries of the shrimp areas (Magill and Erho 1963). Explorations by the John N. Cobb took place between 1955 and 1960. Shrimp were found over a wide area between 50 and 100 fm in depth. Both beam trawls and otter trawls were used. Beam trawls brought up 150 lb (68.4 kg) per hour of only shrimp, while otter trawls brought up 600 lb (272.16 kg) per hour but contained significant quantities of bottom fish. During 1958 the Bureau of Commercial Fisheries made 157 drags from the Yaquina River to the mouth of the Columbia River. Gulf-of-Mexico type shrimp trawls and semi-balloon trawls were used to bring up shrimp at a rate of 400 lb (181.44 kg) per hour (Ronholt and Magill 1961).

The Oregon shrimp fishery began in 1957 and continued with small landings due to low effort and processing limitations. After 1966, catch levels increased with the introduction of the pre-steam blanch peeling machine. The restaurant market then opened to volume production (Zirges and Robinson 1980). Gear restrictions hampered development of the fishery. In late 1957, the regulation requiring use of the beam trawl only was recinded allowing use of Gulf-of-Mexico-type trawls. Also, in 1957 the poundage tax was reduced from $0.75 to $0.01 per pound. No season restrictions were placed on the pink shrimp fishery (Pacific Fishery Management Council 1981b).

The Basic Economic Indicators-Shrimp, 1947-1972 were concerned with the Gulf of Mexico and Atlantic coast industry (U. S. National Marine Fisheries Service 1973c). However, the growth of the Pacific coast shrimp fishery is included in the domestic production indicators. From 1947 to 1957, growth was slow, increasing from 2,543,000 lb (1,153,504 kg) in 1947 to 6,811,000 lb (3,089,469 kg) in 1957. Most of the commercial pink shrimp landings during this period were from California. In 1958, the catch increased sharply to 17,891,000 lb (8,115,357 kg) reflecting the beginning of the Oregon and Washington shrimp fishery. Catch fluctuated but continued to increase, reaching a high of 105,515,000 lb (47,861,000 kg) in 1971. The Oregon and Washington shrimp fishery accounts for the major portion of the total landings since California has only one defined shrimp bed. Biological stock assessment placed the MSY for the North Pacific at 130.0 thousand metric tons of shrimp. This number includes *Pandalopsis despar*, *Pandalus borealis*, *Pandalus danae*, *Pandalus gomiurus*, *Pandalus hysinotus*, *Pandalus jordani*, *Pandalus platyceros*, and *Panaeus latisulcatus*. Maximum sustainable yield data

for pink shrimp only was not available. All of the area included in the MSY estimate can be fished by U. S. fishermen.

A total of 400,000 lb (18,440 kg) was landed by seven vessels during 1957, the first year of the Oregon shrimp fishery. Landings were made at Astoria, Winchester Bay, and Coos Bay. Two mechanical peelers were in use at Astoria while shrimp were handpicked at the other two ports. Participation continued to increase during the next two years. By 1959, landings at Astoria peaked at 24 million lb (1,088,640 kg) then declined and remained low through 1966. Processors lost interest and the fishermen involved returned to bottomfish trawling. A renewal of interest in the shrimp fishery was visible in Coos Bay in 1959 where production increased through the early 1960's. A peak of 4.3 million lb (1,814,400 kg) was reached in 1964. Processing of shrimp began in 1959 and peaked in 1962 at Brookings. Most of the shrimp catch landed in Brookings came from California waters. In response to a 1964 Oregon Fish Commission regulation prohibiting landing of shrimp caught south of the 42nd parallel from October 1 to May 1, effort in California waters by vessels, landings in Brookings declined. Effort was then directed to the southern Oregon shrimp grounds.

The 1964 peak year for the Oregon shrimp fishery was brought about by several factors. An abundance of large shrimp and good market resulted in an increased demand. This encouraged an increase in industry effort. Shrimp were landed for the first time in Newport during this same year. Crab landings had been poor for 2 years prior to 1964 encouraging increased effort in shrimp fishing.

In October, 1964, the Oregon Fish Commission passed a regulation establishing a shrimp fishing season from March 1 to October 31 with

specific interest in protecting gravid females. The period of season closure was intended to coincide with the egg bearing period of the female shrimp.

By 1965, total Oregon shrimp landings had dropped to 1.8 million lb (816,480 kg). The 1966 landings improved rapidly based on the abundant 1964 year class; landings totaled 4.8 million lb (2,177,280 kg), the second highest record to that date (Pacific Fishery Management Council 1981b). Though 1964 was a peak year for the Oregon shrimp fishery, the total catch for the Pacific coast shrimp fishery was 6,800,000 lb (3,084,480 kg) less in 1964 than the previous year. In 1965, the total Pacific coast catch recovered to within one million lb (453,600 kg) of the 1963 catch, though the Oregon fishery dropped sharply. From 1947 to 1966, the Pacific coast shrimp landings had increased at the rate of 15%. The total Oregon shrimp catch increased at a rate of 28% while the total Pacific coast catch increased at a rate of 18.8% for the years 1957 to 1966 (U. S. National Marine Fisheries Service 1973c).

Ecology

Pink shrimp feed on detritus material while on the bottom, primarily small invertebrates and euphausiids and copepods while in mid-water. Such fish as Pacific whiting (*Merluccium productus*), blackcod (*Anaplopoma fimbria*), arrowtooth flounder (*Atheresthes stomias*), petrale sole (*Epssetta jordani*), spiny dogfish (*Squalus acanthias*)and skates (*Raja* spp.) are prey species on the pink shrimp. The pink shrimp population consists of a single stock. There are no apparent genetic differences between the various subunits; although, shrimp found north of Port Orford, Oregon have a normal life span of four years while the

southerly sub-population span is three years. The states and the Pacific Marine Fisheries Commission have named subunits by geographical areas or prominant landmark to facilitate data organization (Pacific Fishery Management Council 1979b).

Management Considerations

California, Washington, and Oregon obtain catch data from landing tickets and effort data from trawl logbooks. Data summaries are collected from each state by the Pacific Marine Fisheries Commission and compiled into the Data Series (Crab and Shrimp). Catch-per-unit-of-effort (CPUE) for the years 1959 to 1977 were compiled by the Commission from the state catch records and showed a small upward trend. Cohort analysis estimates were calculated for 5 of the 10 stock areas. Biomass estimates for the 5 areas totaled 77.7 million lb (35,244,720 kg) and 1976 maximum monthly estimates totaled 101.2 million lb (45,800,000 kg). By fitting a Schaefer-type production model to the state catch and effort data for the years 1959 to 1977, a MSY estimate of 77 million lb (34,000,000 kg) was obtained (Pacific Fishery Management Council 1979b).

Several research studies were undertaken to aid management of the pink shrimp in Oregon. In 1966 and 1967, a series of shrimp cruises were undertaken to study shrimp distribution in the Coquille River and the California-Oregon border. The biomass was estimated at 111 million lb (50,349,000 kg) in spring, 1967. In 1969, studies on life history and behavior were initiated off Tillamook Head. Data from these studies indicated that shrimp were not dispersed in a random pattern, but were grouped by sex or age in certain areas. There was an apparent offshore migration in the fall and a return from the south in the spring. In 1971,

a shrimp tagging feasibility study was conducted, but was abandoned because of the need to mark very large numbers to obtain a reasonable recovery and difficulties in obtaining and maintaining live shrimp under laboratory conditions. More recently, commercial shrimp vessels have been chartered and supplied with trawl nets for surveys to better understand effects of gear changes on catch (Zirges and Robinson 1980).

Exploitation

Landings of pink shrimp showed a steady increase with only minor fluctuations from 1967 to 1976. During the next two years, pounds landed doubled, then dropped sharply during 1979 and 1980 (Table 7). From 1967 to 1971, landings averaged 10,796,600 lb (4,897,300 kg). In 1972, landings rose sharply, averaging 22,982,000 lb (10,424,600 kg) for the 5 years ending in 1976. Landings in 1977 rose sharply again nearly doubling the 1976 poundage. By the end of 1979 the landings for that year were slightly more than half those of the previous year. High availability and abundance of shrimp along nearly all areas of the coast, a strong market and favorable weather combined to make 1977 and 1978 record total landing years. The fishery has not existed long enough to make long-term trends visible. However, in 1976, the MSY was estimated at 77 million pounds (34.9 million kg) for five major fishing areas along the coast. In 1977 and 1978, the Oregon fishery landed over 48 and 56 million lb (21.7 and 25.4 million kg) respectively. These landings were closer to the MSY estimate than any other years. The drop in 1979 landings to just over 29 million lb (13.15 million kg) may be a response of the population to fishing pressure. The MSY estimate has since been reduced to 60 million lb (27.2 million kg) as a result of the 1979 low

Table 7

Oregon Pink Shrimp Fishery

Area	1967[a]	1968	1969[b]	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Astoria														
Lbs Landed	c/		2,682,059	2,609,461	1,797,242	2,359,920	2,777,298	6,708,831	5,075,528	5,700,549	11,697,000	7,528,946	7,647,169	9,224,939
Value			70,642	269,827	171,900	226,400	459,398	834,693	420,987	666,666	c/	1,007,179	1,442,342	2,089,878
Price/Lb.			.10	.10	.09	.09	.16	.12	.08	.11		.13	.19	.23
Newport														
Lbs Landed			1,483,224	3,171,867	3,601,879	7,333,133	6,500,542	4,386,054	5,017,210	7,779,329	15,361,000	20,730,187	7,123,743	6,311,543
Value			49,541	328,448	356,198	792,000	1,075,187	661,904	416,049	909,941		2,791,794	1,199,268	1,435,222
Price/Lb.			.10	.10	.09	.10	.16	.15	.08	.11		.13	.17	.23
Coos Bay														
Lbs Landed			3,551,949	4,711,216	1,521,483	5,409,721	8,825,822	4,834,286	7,431,766	6,214,827	12,056,000	17,280,004	9,131,294	10,465,749
Value			58,715	487,068	162,809	648,800	1,460,150	853,741	616,666	726,315		2,334,358	1,587,337	2,317,004
Price/Lb.			.10	.10	.10	.11	.16	.17	.08	.11		.13	.17	.23
Total Oregon														
Lbs Landed	10,160,000	10,900,000	10,268,433	13,572,174	9,075,006	20,731,151	24,517,194	20,313,760	24,083,568	25,456,007	48,580,070	56,666,109	29,586,586	30,152,030
Value	1,040,000	1,151,631	1,036,697	1,404,310	917,355	2,296,000	4,055,639	3,006,802	1,998,148	2,977,192	6,155,922	7,643,076	5,225,614	6,753,846
Price/Lb.	.10	.10	.10	.10	.10	.11	.11	.14	.08	.11	.12	.13	.17	.22

a/ U.S. National Marine Fisheries Service. Fishery Statistics.

b/ Unpublished data. Oregon Dept. of Fish and Wildlife

c/ data not available

catch (Pacific Fishery Management Council 1981b).

Since 1972 pink shrimp have contributed the highest percentage of pounds landed of the three fisheries studied to the total Oregon fishery (Fig. 2). Between 1972 and 1979, the shrimp fishery contribution averaged 28.5% of the total commercial fishery. Though shrimp contributed the most pounds landed, only in 1978 and 1980 did the shrimp fishery lead in percent of total value (Fig. 3). In every other year, except 1977, where salmon values were not available, salmon contributed the most value to the Oregon fishery. Value of the smaller Oregon pink shrimp at $0.10 per pound was significantly lower than the Atlantic coast or Gulf of Mexico shrimp which was valued at $0.59 per pound in 1971. By 1975, Gulf coast pink shrimp prices had risen to $0.94 while Oregon shrimp reached a low of $0.07 per pound. Increases in landings of northern shrimp has brought about a shift in relative importance of producing areas. The south Atlantic states' share of total production has declined while the Pacific states, including Alaska, has increased from 1.2% in 1950 to 1952 to 13.5% in 1967 to 1969. Shrimp price increases are directly related to shrimp size. Prices for smaller shrimp have remained steady while medium sized shrimp has increased 4 to 5% per year while the largest shrimp has increased 7 to 8%. Price spreads have caused buyers to shift purchases to smaller sizes. Northern shrimp fishermen usually receive one price for their entire catch while southern fishermen's catches are graded and priced differently by size (Whitaker 1973).

Many fishermen now sell their product directly to retailers and institutions at major shipping points. The growth of supermarkets, expanded geographic production and improved transportation have

contributed to the shift to direct marketing. Consumption shifts from fresh to processed frozen shrimp have required changes in processing and marketing. Fishermen must maintain quality and insure a dependable supply. Use of imports has helped eliminate some of the seasonality of processing and helped to maintain a more even price. Increased demand for fast foods has impacted the structure of shrimp marketing and processing. The number of plants freezing shrimp increased while the number of canning plants decreased, but the volume process increased (Whitaker 1973).

The extreme fluctuations which characterized the other two fisheries studied has not been visible in the shrimp fishery data. The rate of growth for the total Oregon pink shrimp fishery is 8.5% for the study period 1967 to 1980. The rate of growth for the period 1967 to 1977 was 9.0% based on pounds landed. However, based on value, the rate of growth was 12.25%. Though slightly more fluctuation occurred in value than in pounds landed, growth was strong and occurred in at least two fairly large peaks rather than a gradual rise. Table 8 shows the two years in which dynamic increases in catch took place, 1972 and 1978. The increases in prices were larger in 1973 and 1979 than during the years when catch increased sharply. Between 1971 and 1972, the price rose only $0.01 per pound while catch increased 10 million lb (4.5 million kg). In 1978, a record catch of 56,666,000 lb (25,703,697 kg) was landed at $0.13 per pound; in 1979 a total of 29,633,000 lb (13,441,528 kg) were landed at $0.17 per pound. Though the catch has fluctuated during the last three years, fishermen are receiving more per pound indicating market conditions are good and there is a continuing demand for the product.

Table 8

Oregon Pink Shrimp Catch/Effort and Gross Returns

Year	Number of Fishermen	Number of Vessels	Number of Trawls	Catch (Pounds)	Pounds Per Fisherman	Pounds Per Vessel	Pounds Per Trawl	Value of Catch	Gross Return Per Fisherman	Gross Return Per Vessel	Gross Return/ Trawl
1967[a]	151	45	45	10,160,000	67,284.7	225,777.7	225,777.7	$1,040,000	$6,887.41	$23,111.11	$23,111.11
1968	135	41	32	10,900,000	80,740.7	265,853.6	340,625.0	1,151,632	8,530.60	28,088.58	35,988.50
1969	179	55	56	10,268,433	57,365.5	186,698.7	183,364.8	1,132,058	6,324.34	20,582.87	20,215.32
1970	194	58	62	13,572,174	69,959.6	234,003.0	218,906.0	1,629,000	8,396.90	28,086.20	26,274.19
1971	173	52	[b]	9,075,006	52,456.6	174,519.0	-	917,355	5,302.63	17,641.44	-
1972	230	73	80	20,731,151	90,135.4	283,988.3	259,137.5	2,296,000	9,982.60	31,452.05	28,700.00
1973	266	85	104	24,517,194	92,169.9	288,437.5	235,742.2	4,055,639	15,246.76	47,713.40	38,996.52
1974	353	115	161	20,313,760	57,546.1	176,641.3	126,172.4	3,006,802	8,517.85	26,146.10	18,675.78
1975	365	115	189	24,083,568	65,982.3	209,422.3	127,426.2	1,998,148	5,474.37	17,375.20	10,572.21
1976	359	111	192	25,456,007	70,906.1	229,333.4	132,583.3	2,977,192	8,293.01	26,821.54	15,506.20
1977	--	103[c]	--	48,580,070	-	471,651.1	-	6,155,922	-	59,766.23	-
1978	--	187	--	56,666,109	-	303,027.3	-	7,643,076	-	40,872.06	-
1979	--	203	--	29,586,586	-	145,746.7	-	5,225,614	-	25,741.94	-
1980	--	270	--	30,152,030	-	111,674.1	-	6,754,251	-	25,015.74	-

[a] U.S. National Marine Fisheries Service. Fishery Statistics

[b] data not available

[c] unpublished data; Carter, C.

Data were available for 1969 to 1980 for the ports of Astoria, Newport, and Coos Bay (Table 7). Astoria landings averaged 5,144,200 lb (2,333,318 kg) compared to the average total Oregon catch of 25,701,009 lb (11,658,014 kg) showing that 20% of the total Oregon catch was landed in Astoria. The "dockside price" averaged $0.11 per pound in Astoria compared to the total Oregon average of $0.12. The Port of Newport averaged 7,498,922 lb (3,401,511 kg) of shrimp landed or 29% of the total Oregon catch. Newport fishermen were also paid $0.11 per pound. An average of 6,751,034 lb (3,062,296 kg) of shrimp were landed by Coos Bay fishermen, 26% of the total Oregon catch. Coos Bay fishermen were paid an average of $0.12 per pound. The nearly common price in all ports demonstrates the effect of the nationwide market as compared to a predominately local market such as salmon.

Gross returns per fisherman showed a modest growth of 2% for the period 1967 to 1976. In 1967, 151 fishermen landed 10,160,000 lb (4,608,576 kg) valued at $1,040,000; by 1976, 359 fishermen had harvested 25,456,000 lb (11,546,841 kg) of shrimp valued at $2,977,192 (Table 8). Though pounds landed per fisherman increased less than 1%, value increased at a rate of over 12%. The number of fishermen and the number of vessels increased at the same rate, 9%, as did the pounds landed for the same period. However, the pounds per trawl dropped by 93,000 lb (42,184 kg) for the period because the number of trawls increased at a faster rate, 15%, than did the catch rate. No growth could be discerned in the gross returns per trawl. The rate of increase in the number of trawls was greater than the rate of increase in value.

High catch rates for 1977 and 1978 brought further increases in the number of fishermen and vessels. Since 1979 the catch rate has fallen

and this will reduce effort unless the price for shrimp increases. Since this reduction often lags behind changes in abundance, more immediate steps are being considered to prevent further increase in the number of fishermen and vessels. In 1979, Oregon enacted a shrimp license moratorium. However due to several features of the moratorium, more vessels are landing shrimp than in 1979. The base period for qualifying is not short enough, and attrition rates are lower than expected (Pacific Fishery Management Council 1981b). Generally, the Oregon shrimp fishery is the least restricted of the three fisheries studied. There are no mesh size restrictions in Oregon, though there are in California and Washington. A coastwide mesh size restriction is currently being considered by the PFMC. Logbooks are required in all three states. Oregon is the only state where a form of limited entry existed in 1981.

Fishing Season

The length of the fishing season has undergone one change during the study period (Fig. 4). In 1972, the number of fishing days was reduced from 245 to 200 days. Prior to 1972, the season opened on March 1 and continued to November 1. In 1972, the season began on April 1 and closed on October 15 (Fig. 5). There are no season closures in Washington; however, catches off Oregon may not be landed from October 16 to March 31. The California season is closed November 1 to April 15. Though there is not a coastwide season opening and closing date, restrictions as to landings based on where the shrimp are caught are in effect.

Though season length has not been subject to frequent change and there are few other restrictions on the Oregon shrimp fishery, the drop

in pounds caught shows the possibility of over-exploitation. Over the period of the study the fishing fleet has become more efficient. MSY was estimated at 77 million lb (34.9 million kg) in 1976. By 1979, MSY was adjusted downward to 60 million lb (27.2 million kg) in an attempt to prevent overfishing. This is the only one of the three fisheries studied in which landings have very closely approached MSY. The fishery may already be over-exploited. Discouraging entry into the fishery by a stronger limited entry program and larger mesh size to allow escapement of one-year olds are two management alternatives. Declines in the salmon fishery encouraged entry into the shrimp fishery. This placed demands on the stocks and the total catch has now dropped to the point where fishermen are now leaving the shrimp fishery. This will help the problem of over-exploitation. Recovery of the stock should become apparent within 5 years with reduced fishing pressure.

V. THE OREGON COMMERCIAL FISHERMAN

Background

The human or social factor in fisheries management received new status when it was identified as part of the concept of optimum yield in the FCMA. Mayer's (1966) study of quasi-groups in complex societies helps to explain the difficulties in considering the human dimension in fisheries management described by Orbach (1981). Mayer defines quasi-groups as "entities without a recognizable structure, but whose members have certain interests or modes of behavior in common which may at anytime lead them to form themselves into definite groups". Action-sets within the group are loosely ordered, composed of cliques. Linkages between action-sets are based on the convergence of interests.

Considering the Pacific coast commercial fishermen as a quasi-group, fisheries managers interact primarily with action-set leaders. Through such linkages as large catches, high income and advanced technology, leaders have been unofficially chosen by the group to represent them in communication with managers. The diversity and complexity of the group is characterized by differences in national, racial, and ethnic background; social and economic strata; and, cultural preferences, beliefs, and lifestyles. Beyond the fisherman, the network expands to include family; social, political and business contacts including distributers, marketers and consumers. To begin to assess the possible impact of management decisions on the Oregon commercial fishing group, several economic and social aspects of the occupation must be considered.

Surveys conducted by Smith (1972) and Liao and Stevens (1975) identified such characteristics of Oregon commercial fishermen as age,

years of formal education, months of vocational training, years of non-fishing employment, family size, years of fishing experience and place of residence. The average age of the salmon fisherman was 45, while the average crab fisherman was 55. Nearly 12% of all Oregon license holders were aged 17-21, with the average age being 41. The salmon fisherman had an average of 11 years of formal education, about 7 months of vocational training and 6.5 months of non-fishery job training. The average salmon fisherman had 7 years fishing experience and 17 years non-fishing employment experience. Average family size was 3 members. The crab fisherman had an average of 10 years formal education, 2 months of vocational training and 5 months of non-fishery job training. He had an average of 24 years fishery experience and 12 years non-fishing employment experience. The crab fisherman's family averaged 2.9 members. Resident license holders lived an average of 45 miles from the Pacific coast. More than 21% of all licenses issued were to non-residents.

Economic Aspects

The Oregon commercial fishery provides employment in several parts of the industry. The number of fishermen based on numbers of licenses sold has ranged from 4,553 to 8,383 for the study period. The number of licensed boats has ranged from 2,433 in 1967 to 4,928 in 1980 (Table 9). The number of Oregon licensed fishermen has increased at a rate of 5% for the 13 year period ending 1980. The number of Oregon licensed commercial fishing boats increased at a rate of 4.4% for the same period. The average number of fishermen per boat illustrated a more rapid increase in the number of fishermen than in the number of boats. There was an

Table 9 Oregon Commercial Fishery Employment[a/]

Date	Number of Fishermen (Licenses)	Number of Commercial Boat (Licenses)	Employed Fishermen		Commercial Wholesalers	Commercial Buyers	Processing and Wholesale Employment		Number of Plants
			Full-time	Part-Time			Seasonal	Year	
1980	8,383	4,928	-- [c/]	--	243				
1979	8,258	4,263	--	--	187	93	3,134	2,214	69
1978	8,566	4,359	--	--	170	96	3,309	2,178	74
1977	7,980	4,095	--	--	200	102	3,122	2,039	69
1976	5,990	3,452	--	--	185	101	2,647	1,786	72
1975	5,540	3,067	1,081	3,570	164	85	2,418	1,551	84
1974	5,556	2,978	1,080	3,550	162	103	2,907	2,113	82
1973	6,668	3,567	1,070	3,520	151	121	2,725	1,984	44
1972	5,989	3,314	1,030	3,510	163	135	2,813	1,987	46
1971	6,428	3,487	4,140	860	165	118	3,119	2,229	50
1970	5,584	3,025	--	--	154	102	3,203	2,279	60
1969	5,663	3,042	--	--	152	95	3,314	2,344	60
1968	5,923	3,048	--	--	142	91	3,279	2,248	59
1967	4,553	2,433	--	--	138	88	3,455	2,275	61

a/ U.S. National Marine Fisheries Service. Fishery Statistics

b/ Unpublished data. Oregon Dept. of Fish and Wildlife

c/ data not available

average of 1.87 fishermen per boat in 1967 and by 1980 the average had increased to 1.96. During the same time period the total commercial catch increased by only 2.6% and the value of that catch increased at a rate of 5%. Both the number of licensed fishermen and boats increased more rapidly than the catch; however, the value increased at approximately the same rate. Therefore, the individual fisherman received slightly more for his catch in 1980 than he did in 1967, but there were more fishermen catching less fish. A result of this trend was the shift from full- to part-time fishing. In 1971, 64% of the licensed fishermen were full-time. By 1975, the situation reversed and 64% considered themselves part-time fishermen (Table 9).

Other parts of the industry, buyers, wholesalers, and processors, did not show a steady increase (Table 9). Commercial wholesalers varied from 138 to 200 and buyers from 88 to 135. Seasonal employment in the fish processing industry varied from 2,418 to 3,455 and year-round processing employment has fluctuated between 1,551 and 2,344. The total number of fish processing plants in Oregon has varied from 44 in 1973 to 84 in 1975. Seasonal and year-round processing employment figures do not immediately reflect increased or decreased landings. For instance, total landings of just over 98 million lb (44.4 million kg) in 1970 were 16 million lb (7.2 million kg) more than 1969; processors employed approximately 100 fewer seasonal and 70 fewer year-round people in 1970 than in 1969. In 1971, the catch dropped to 25 million lb (11.3 million kg) less than in 1970 and the industry hired about 80 fewer seasonal employees than in 1970.

The gross return is used as a basis for calculating a profit in the fishing business. Other costs such as repair and maintenance of the boat,

bait, gear, fuel, insurance, license fees, and depreciation must be subtracted from the gross return (Smith 1973). Based on the catch/value figures for 1967 to 1980, the gross return per licensed fisherman averaged $3,000.00 (Table 10). Since not all licensed fishermen fished, the average is a conservative estimate. Average gross return increased at a rate of less than 0.25% because the rate of increase in the number of fishermen and that of value of landings were approximately equal for the period.

Loans help fishermen survive economic difficulties. Until 1972, the local bank was the lending insitution available to fishermen. Fishermen still use banks for both personal loans and business loans. In 1972, the Farm Credit Act was extended to include aquatic harvesters. Loans are made to producers or harvesters of aquatic products by PCA with terms up to seven years in length. Oregon PCA members have borrowed a total of $128 million in aquatic loans from 1973 to 1980. By the end of 1973, 61 loans were outstanding, by 1980, 345 loans were outstanding. While the number of loans outstanding has increased steadily, the amount of money loaned fluctuated between 1973 and 1977, then tripled between 1977 and 1978. The implementation of the FCMA in 1978 was the cause for optimism and it opened the opportunity for joint ventures.

The opportunity for joint ventures was partially responsible for renewed interest in two financial programs administered by the U. S. National Marine Fisheries Service. The Fishing Vessel Obligation Guarantee is issued by National Marine Fisheries Service on behalf of a fisherman, guaranteeing to his lender that a loan will be repaid. It is available for financing or refinancing up to 87.5% of the cost of constructing, reconstructing, or reconditioning U. S. commercial fishing

Table 10

Financial Status of the Oregon Commercial Fishery

	Production Credit Association[a]			NMFS Obligation Guarantee[b]			
Date	Amount of New Loans	Number of Outstanding Loans	Amount of Outstanding Loans	Number of Cases	Amount of Guarantees	Gross Return Per Fisherman	Gross Return Per Boat
1980	$42,049,000	345	$75,683,000	14	$4,761,908	$2,660	$4,525
1979	35,263,000	428	51,370,000	6	1,427,643	3,632	7,037
1978	22,943,000	357	28,488,000	9	1,560,600	3,381	6,642
1977	7,583,000	293	12,110,000	1	120,000	3,350	7,746
1976	4,782,000	263	11,470,000			4,771	8,278
1975	7,081,000	219	10,770,000			3,225	5,825
1974	6,190,000	182	6,416,000			4,198	7,832
1973	2,526,000	61	2,329,000			3,201	5,983
1972						3,201	5,785
1971						2,080	3,834
1970						3,510	6,480
1969						2,573	4,790
1968						2,722	5,289
1967						3,576	6,692

a/ Production Credit Association. Annual Report

b/ Unpublished data. National Marine Fisheries Service

vessels of at least 5 net tons. There is no upper limit on the amount of any one guarantee. Records of guarantees for Oregon fishermen were available for 1977 to 1980 (Table 10). The number of guarantees has risen steadily, but represents a very small number of fishermen, because of conservative management by the National Marine Fisheries Service.

The other loan program available is the Capital Construction Fund (CCF). This program enables fishermen to construct, re-construct or sometimes acquire fishing vessels with before-tax rather than after-tax dollars. Payments of federal taxes are deferred which they would otherwise have paid on taxable income from the operation of their fishing vessels. Fishermen must agree to use some portion of their taxable income, and the federal taxes associated with that portion, to pay for constructing or reconstructing fishing vessels. In 1970, when the program began, 18 agreements were signed. By 1980, there were 210; Oregon fishermen make up about 28% of the national total. The total amount of the agreements is about $37.5 million (Goosen 1981). Both of these programs require more collateral and more working capital than is available to small fishing operators. The PCA loans make borrowing easier for small scale operators.

Social Aspects

Before the Oregon State Univesity was designated as a Sea Grant College in 1971, the Marine Advisory Program made Marine Extension Agents available to coastal communities following the traditional role of the County Extension Agent. Marine Extension Agents relate findings of research and improved methods to the solution of problems in the fishing community. The marine agent consults with fishermen, conducts workshops,

short courses and demonstrations, being the closest and primary source of vocational education to the commercial fisherman.

Audience contacts and total number of hours spent in marine related activities gave some indication of the need for and utilization of Marine Extension Agents by fishing communities (Table 11). In the Clatsop Planning Unit, audience contacts dropped substantially during the four year period, although more time was spent by the agent on marine related work in 1980-1981 than in previous years. This indicates an increase in individual contacts where more time is spent with fewer contacts. In the Coos Planning Unit, the number of audience contacts increased for the same period while the actual number of hours reported related to marine work decreased slightly. More help was given to the fishing communities in the Coos Unit, but less time in hours was being used indicating that the trend in this unit could be toward group contacts. The Lincoln Planning Unit showed an increase in total hours devoted to marine related contacts (Oester 1981). In Coos and Lincoln Units, more professional advice to individuals appeared to be given in 1980-1981 than in previous years. As depression in the industry continues or deepens, more fishermen may receive advice regarding their vocation.

Navratil, Provan and Strong (1968) recommended organized training for fishermen as in other trades and professions. The fishing industry needs highly skilled technicians trained in principles of business and use of complex fishing equipment. Practical courses of short duration were recommended for practicing fishermen. An Oregon Marine Advisory Program vocation education survey found that a majority of fishermen surveyed agreed that major items of interest were boat maintenance, navigation, care of the catch and equipment operation as well as business

TABLE 11 Marine Extension Contacts[a]

	Extension Planning Units						
	Clatsop		Coos		Lincoln		Total
Date	Time (hr)	Number	Time (hr)	Number	Time (hr)	Number	Oregon
1980-81	2027	1641	1958	2323	1964		27,284
1979-80	2161	1895	1936	1605	1864		6,806
1978-79	1635	5039	2009	1769	1450	2314	11,386

[a] Unpublished data. Oregon State University Agricultural Extension Service.

management and record keeping. Occupational workshop training was the perferred method (Sea Grant Marine Advisory Program 1971).

Formal vocational education available to Oregon fishermen exists in two major forms. Workshops varying in length from one evening to one week are offered by the Sea Grant Marine Advisory Program at the OSU Marine Science Center and selected places on the coast. Seminars such as computer applications in fishing, health insurance for fishermen, and marine meteorology are given by the local Marine Extension Agent and tend to be based on suggestions in the previously discussed survey.

An associate degree program is available at Clatsop Community College. The College has a fishing boat and all facilities available to teach the program to potential fishermen. An advisory committee consisting of representatives from fishing and other marine related industries assists the college in program planning. For the past 12 years approximately 20 students per year have received degrees. Since 1979, enrollment has dropped to approximately 15 students. Depression in the industry was probably responsible for enrollment decline. Southwestern Community College offers a 1 year fishery program where students gain practical experience by working under the guidance of local fishermen. In the 2 years of its existence about 20 individuals have completed the course (Lodge 1982).

Common interest and a need to unite economically and socially have prompted fishermen to join formal organizations. Fishermen are considered "independent", but the need to communicate with management and to cope with economic pressures has brought about two major types of organizations. One type of organization is a semi-social, local group drawing fishermen together to exchange views on local matters of the community, port, and

regulations. Representatives from these groups speak for the group at public hearings and other meetings held by fishery managers. These people then report such encounters with management to their peers. Management's philosphies and rationale are received by the majority of the fishermen through these representatives.

The fishery cooperatives are the formal organizations formed by fishermen. A cooperative consists of a group of fishermen acting together to accomplish group objectives. Members own the cooperative by owning capital stock or paying membership fees. A board of directors is the planning and policy making body of the cooperative. Cooperatives can perform several functions such as marketing products, negotiating prices with buyers, purchasing supplies and equipment and operation of vessel repair stations (Smith 1970). Until 1979, the Oregon commercial fishery had only one cooperative. In 1980, the number of cooperatives in Oregon increased to 5. The economic conditions in the industry are probably responsible for the increased interest in the formation of these mutually beneficial organizations.

General Characterization

Based on the foregoing description, the Oregon commercial fisherman is a member of a local clique or action-set and has informally chosen a leader or become a leader based on his economic place in the clique. This fisherman is middle aged, has about 11 years of formal education and less than 1 year of vocation education. His gross return is about $3,632 and is probably a part-time fisherman. There is likely to be at least one other fisherman on his boat and the gross return for the boat is about $7,037. He has probably borrowed from a local bank or PCA and

is optimistic that this money will take him through to better times next season. He has also sought some information or advice from a local Marine Extension Agent probably regarding new electronic gear. He has either joined a cooperative or is considering doing so.

VI. THE GROWTH AND DEVELOPMENT OF COASTAL PORTS

Background

The economy of the coastal communities of Oregon has depended upon the exploitation and management of renewable natural resources since the 19th century. Forestry and fisheries have been the dominate industries in the coastal counties of Clatsop, Coos and Lincoln; but agriculture, recreation and shipping are increasing in importance. All of the ports are some distance from population centers. Port development requires adequate rail, road, and airport links. Except for the Port of Astoria, adequate incentives are not present for developing the ports without support facilities. Fishing and fish processing will probably continue to have a major impact on the basic economy of the ports. A review of the history of each port is important because it indicates some of the major problems facing Oregon's coastal ports and the factors that have caused the ports to prosper or decline.

Clatsop County was one of the earliest settled regions in Oregon. Growth accelerated after 1870 when salmon canning and timber industries expanded. Growth increased rapidly from 1930 to 1950 after a drop in population caused by a fire in Astoria in 1922. Another drop in population occurred in the 1960's due to reduction in fishing, logging and military activities (Ruttle 1973). Until 1853, Coos County was settled mostly by trappers. The County has grown steadily as lumbering, fishing, shipping, and recreational industries have developed (Tam 1973). Lincoln County grew rapidly during the 1920's, the rate of growth slowed from 1930 to 1950 and population declined from 1960 to 1965. Renewed growth activity began in 1967. Lumbering, tourism, fishing and agriculture are the

major components of the county's economy (Valde 1973).

Port of Astoria (Clatsop County)

The Port of Astoria is located in Clatsop County on the south side of the Columbia River 13 to 15 miles (20 to 24 km) from the mouth and on the east side of Youngs Bay at the mouth of the Youngs River. Clatsop County population has increased slowly during the period for which data were available, 1970-1980. The rate of increase was 0.08% while the rate of growth for the State of Oregon was just over 1% (Table 12). Astoria's population reached a peak of 14,300 in 1960 but by 1970 dropped to 10,244. In 1960, 55% of the county's population was urban, by 1970 that had dropped to 51.4% (Oregon Department of Economic Development 1979a). Change in percent of urban dwellers coincided with the drop in Astoria's population between 1960 and 1970.

In 1970, Clatsop County's labor force represented 43% of its total population (Table 12). About 94% of the labor force was employed and about 12% of the labor force was employed in the food processing and production industry. These were predominately fish processing employees. By 1978, the labor force included 47% of the county population. The employed number dropped to 85% and 9% were employed in food processing. Unemployment figures fluctuated for the period but exhibited a general trend upward (Fig. 7).

Both the Columbia River estuary and the Youngs Bay estuary are important to the Port of Astoria. Physical and hydraulic characteristics are considered in port development. The diurnal range of tides for Youngs Bay is about 8.6 ft (2.62 m). Tides at the mouth of the Columbia River show typical Pacific Coast diurnal inequality. Highest

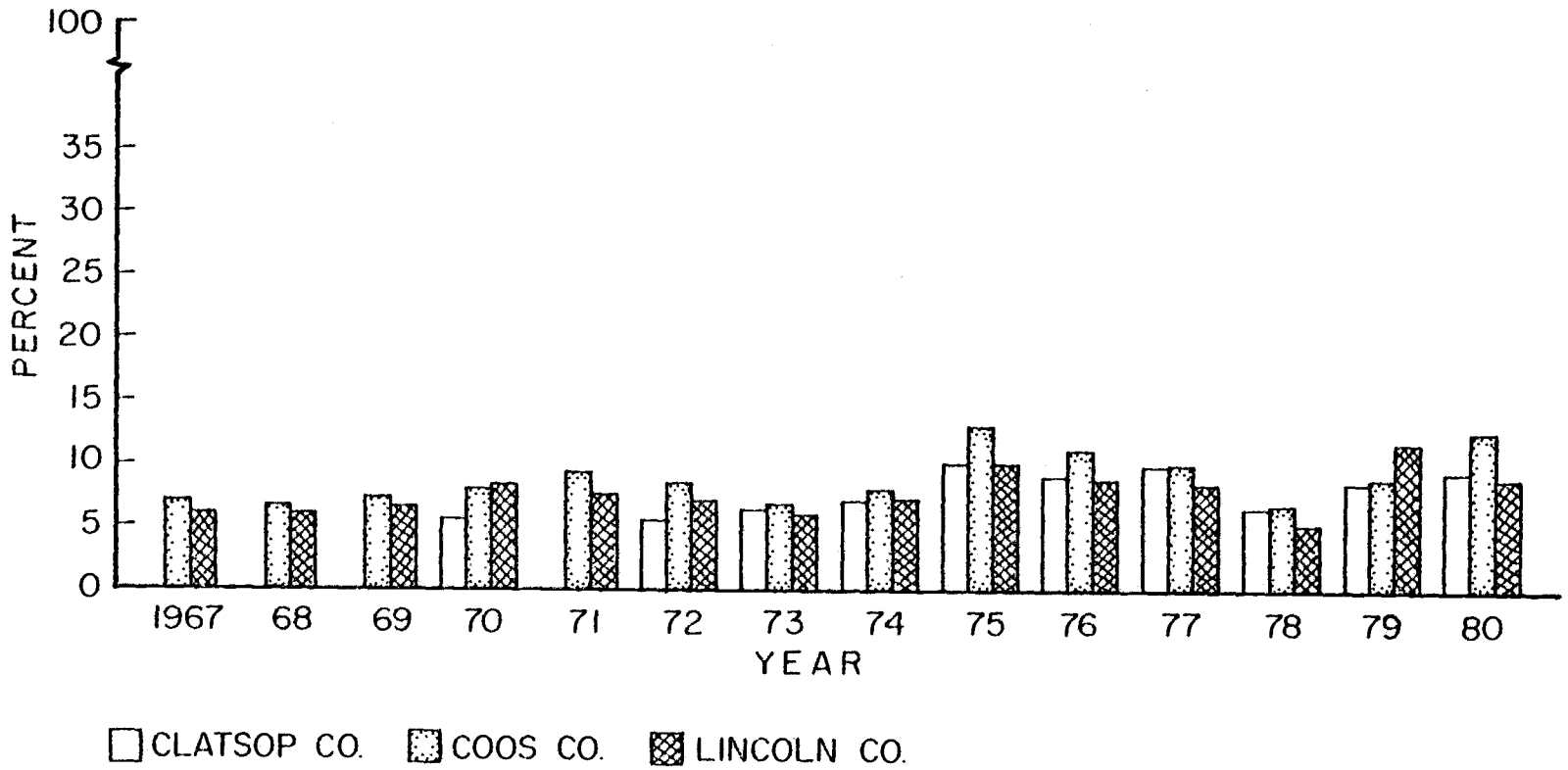
Table 12

County Growth and Development[a/]

Date	Clatsop County				Coos County				Lincoln County				Total Oregon Population	Total U.S. Population
	Labor Force	Total Employed	Food Prod. Employed	Total Co. Popul.	Labor Force	Food Prod. Employment	Food Products Employ.	Total County Population	Labor Force	Total Employed	Food Prod. Employment	Total County Population		
1967	-	-	-	-	22,181	20,435	588	-	8,602	8,057	897	-	-	-
1968	-	-	-	-	22,081	20,658	644	-	9,380	9,025	645	-	-	-
1969	-	-	-	-	22,600	19,333	721	-	9,125	8,515	422	-	-	-
1970	12,276	11,600	1,535	28,473	22,865	20,966	632	56,515	9,347	8,597	282	25,755	2,091,533	203,235,298
1971	12,670	-	-	28,700	23,035	20,859	510	58,600	9,584	8,835	245	27,000	2,158,000	207,053,000
1972	12,671	11,976	1,566	28,900	23,710	21,669	435	58,700	9,760	9,068	223	27,400	2,182,000	208,846,000
1973	12,887	12,086	1,236	28,711	23,852	22,279	458	59,337	10,445	9,811	208	26,782	2,217,375	210,410,000
1974	13,010	12,118	11,390	29,100	24,873	22,878	390	59,200	12,162	11,287	187	27,400	2,266,000	211,901,000
1975	13,283	11,911	1,052	29,100	24,355	20,987	311	59,000	12,320	11,026	191	27,800	2,284,335	213,559,000
1976	13,350	12,143	1,241	28,879	24,744	21,940	420	59,932	13,160	11,979	245	28,630	2,325,895	215,152,000
1977	13,880	12,490	1,251	29,600	24,830	22,330	352	60,800	13,471	12,350	348	30,200	2,384,501	216,880,000
1978	14,370	12,319	1,372	30,500	26,822	25,013	403	62,400	15,170	14,390	338	31,300	2,444,000	218,717,000
1979	14,433	13,075	1,452	-	27,332	24,876	447	-	15,547	14,373	510	31,200	-	226,234,000
1980	14,161	12,910	889	-	27,315	23,896	439	-	16,889	15,395	410	33,000	-	228,666,000

a/ Oregon Employment Division, Labor Force Trends.

Fig. 7 TOTAL WORK FORCE - PERCENT UNEMPLOYED



turbidity values have been recorded between mile 9 and 10 on the Columbia River; Youngs Bay is at mile 12. The water quality of Youngs Bay improved as a result of two new sewage treatment plants in Astoria. Though several are being planned, no recent alterations have been made in Youngs Bay. There is a channel from the Columbia River, across Youngs Bay and about four miles in the Youngs River authorized in 1935. Five bridges cross the bay. There are about 28 manufacturers using Youngs Bay; of those, eight are fish processing plants (Percy, et al. 1974).

A total of 22 piers, wharves and docks comprise the commercial part of the Port of Astoria. Twenty-one are located on the south bank of the Columbia River and one on the north bank of the Youngs River. General cargo in foreign trade is received and shipped over terminals, Pier No. 1 and Pier No. 3. Pier No. 1 provides 620 ft of berthing space at the face and 1,100 ft on the slip side. A grain elevator with a storage capacity of 1,250,000 bushels at the rear of the transit shed is used by Bunge Corporation for the shipment of grain. The elevator is equipped to receive grain by rail and to ship by vessel, rail and truck. The vessel loading spouts have a maximum loading rate of 317.4 metric tons per hour. Pier No. 3 is a 1,155 ft long timber pile warf and is used primarily for shipping logs and wood products.

Three other waterfront facilities are equipped to receive petroleum products by barge or small tanker. Open storage is available on a 23 acre unpaved area. There is very little warehouse storage area except the transit at Pier No. 1 and 3. No floating cranes or derricks for heavy lifting are available at the port. Water front marine repair plants equipped to do limited work on small vessels are maintained by Bumble Bee Shipyard and Machine Shop and the Astoria Marine Construction Company.

Major repairs must be accomplished at the Port of Portland (Board of Engineers for Rivers and Harbors 1976).

Total pounds of commercial fish landed and accompanying values at each port is a means of describing the fishery as well as showing one aspect of growth or decline of the port. The Port of Astoria has the largest payroll in the state port system, and 49.1% of that payroll is generated from the fish-processing activity (Gabriel and Lee 1977). Astoria showed increases in landings of all species studied. Landings of coho increased 8.06%, chinook 7.9%, crab 2.3% and pink shrimp 10.2%. Although these rates of growth indicate a strong port, the total pounds landed for all species from 1968 to 1980 showed a decrease of 3.2%. Though total landings fluctuated, the general trend is downward (Table 13). The prime reason for the drop in pounds landed is the decrease in tuna landings over the same period. In 1969, 22,157,884 lb (10,050,816 kg) of tuna were landed, by 1980, the tuna landings had declined to 2,626,626 lb (1,191,437 kg). During this period the Bumble Bee Seafoods Company initiated large lay-offs of employees and Union Seafoods closed. The drop in tuna landings added to the already existing problems of an outdated plant away from major transport system.

The future of the Port of Astoria will depend to a large degee on the success of a current plan to ship coal and wheat to countries in Asia. The package was compiled by NERCO Inc. a subsidiary of Pacific Power and Light Company, Burlington Northern Railroad, Pan Ocean Bulk Carriers, a Korean ship line; and the Port of Astoria. The plan includes a coal handling terminal with a 4 million ton annual capacity to be built between Pier No. 1 and 3, supplied via the Burlington Northern rebuilt lower Columbia River tracks, with NERCO coal from Montana and Wyoming.

Table 13 Commercial Fishery Landings and Values by Port[a/]

	Astoria		Coos Bay		Newport	
Date	Pounds Landed	Value (1967=100)	Pounds Landed	Value (1967=100)	Pounds Landed	Value (1967=100)
1968	55,968,000	$9,436,666	19,868,000	$4,011,516	17,137,000	$1,830,134
1969	41,704,000	6,985,428	13,089,000	2,253,187	10,066,000	1,918,943
1970	42,973,000	7,559,759	13,183,000	2,565,778	13,824,000	3,155,631
1971	29,750,000	4,685,078	8,809,000	1,594,394	12,447,000	2,219,291
1972	39,733,000	7,972,865	16,205,000	2,895,450	16,101,000	2,985,634
1973	32,650,000	6,776,108	18,303,000	4,358,377	15,756,000	4,058,602
1974	45,230,000	9,481,381	15,720,000	4,150,304	13,038,000	3,382,532
1975	32,580,000	5,118,486	18,276,000	3,209,057	13,705,000	2,343,052
1976	37,164,000	6,160,117	18,589,000	4,791,202	17,003,000	3,741,348
1977	36,611,000	5,509,641	20,487,000	5,179,063	27,679,000	5,123,966
1978	37,856,000	6,993,858	30,589,000	6,050,665	38,478,000	6,978,505
1979	37,538,000	7,078,656	28,550,000	6,137,534	35,461,000	7,305,887
1980[b/]	39,893,349	5,521,457	27,391,714	5,302,834	36,807,109	5,700,809

a/ U.S. National Marine Fisheries Service. Fishery Statistics

b/ Unpublished data. Oregon Dept. of Fish and Wildlife

First shipments would begin by 1983 and achieve full capacity by 1985. Also under the plan, the port grain capacity would be quadrupled to nearly 3.6 million metric tons for expanded shipping to Asia. The entire plan could generate a five million dollar payroll for the port by the end of the decade; additionally would be employment generated by necessary construction of facilities, upgrading of railroad lines and roads (Williams 1982). If this plan is accepted and contracts are signed, the Port of Astoria will become redirected from a fishing port to a major export shipping facility. Fishing will continue, but existing docks are small and in poor condition; and likely to remain so. They will be placed on a low maintenance priority.

Port of Coos Bay (Coos County)

The Port of Coos Bay is located in Coos County on the south central Oregon coast. The county has grown steadily reaching a total population of 56,515 in 1970. The median age of the county residents was 28.8 years (Tam 1973). The population of Coos County gained almost 2.5 times the number of people gained by Clatsop County. The increases between 1940, 1950 and 1960 amounted to about 1,000 persons per decade. Between 1960 and 1970 the rate of increase was 6%. The growth rate of the City of Coos Bay was just over 3%. In 1960, the urban population was 47%; by 1970 it had risen to 51.3% (Oregon Department of Economic Development 1979b). This shift corresponded to the rise in population in the largest urban area, Coos Bay, for the same time period. The labor force represented 40% of the total county population in 1970 of which 91% were actually employed. The food products industry employed 3% of all employed persons. By 1978, 42% of the population was part of the work

force. Unemployment stood at about 12%. Unemployment in Coos County has generally been highest of the three counties studied (Fig. 7). The 1979 and 1980 unemployment rates rose higher. The largest industry employing in Coos County was lumber and wood products. The depression in this industry was responsible for the steady rise in unemployment. This trend could encourage part-time fishermen who work in the lumber industry to return to full-time fishing; showing a reversal again of the trend away from full-time fishing in the early 1970's.

Coos Bay is a large U-shaped estuary with more than 25 tributaries, the major one being the Coos River. Tidelands consist of sandbars in the lower reaches and mud, salt, and marsh-pastures in the upper reaches. The tidal range is 5.2 ft (1.5 m) with a diurnal range of 7.0 ft (2.1 m). Littoral drift is to the south in the summer and to the north in the winter. Sediments transported from the drainage basin to the estuary average 72 tons annually. Commercial and domestic wastes and ground water seepage from a coal field covering 250 sq miles (647.5 km^2) are the primary factors affecting water quality. Alterations to Coos Bay have been extensive including two jetties, numerous channels and five basins. There are 16 major manufacturers located on Coos Bay, three are fish product and 11 deal with wood products (Percy, et al. 1974).

More than 35 piers, wharves and docks are located at the Port of Coos Bay. Five located in Charleston handle fish, two in Empire and one in Coos Bay. The Port exports about 3.6 million metric tons of wood and paper products annually. Six of the waterfront facilities are equipped to receive petroleum products by barge and small tanker. There is a limited amount of warehouse and open storage available at the port. Three companies own and operate waterfront marine repair plants. The

cities of Coos Bay and North Bend are served by the Southern Pacific Transportation Company (Board of Engineers for Rivers and Harbors 1976).

The Port of Coos Bay ranks second among Oregon ports in payrolls generated and tonnages handled. The commercial fishermen at Coos Bay contribute over $7 million in direct payrolls (Gabriel and Lee 1977). Rates of increase in pounds landed at Coos Bay for the four species studied were: chinook 7.5%, coho 8.04%, crab 2.05%, and shrimp 9.0%. The total pounds landed and the value increased at a rate of 3.4% for the 12 year period (Table 13). Growth of the Coos Bay fishery has been steady, though of the three ports studied fewer pounds of fish were landed there than in either of the two other ports. Pounds landed and value increased at the same rate, therefore fishermen's income at this port has not increased over the study period. In 1969, bottom fish made up a major part of the pounds landed 3,649,811 lb (1,655,554 kg); by 1979, pink shrimp and bottom fish were major components of the total catch.

In the past, the Port of Coos Bay has been developed without an overall plan. Proliferation of single purpose docks and underutilized land around the estuary resulted. In 1980 Coos County undertook a land use planning study. The resulting plan attempted to establish standards for the development of the limited remaining marine industrial parcels. Current unemployment levels are the result of long time dependence on one industry. Fish processing facilities at Charleston are designed for more traditional species and off-loading facilities are relatively inefficient. The North Bay Marine Industrial Park is planned to provide an area and plan for future development; encourage investment in Coos Bay, and provide job opportunities and long term economic stability

to the area. The plan is expected to expand the number of basic jobs in fisheries significantly. Additional road and rail extensions are planned in the future. Total estimated costs for the petroleum terminal will be $7.5 million and the trawler basin $26.5 million (Coos-Curry Council of Governments 1981).

Port of Newport (Lincoln County)

The Port of Newport is located in Lincoln County on the central Oregon coast. Lincoln County population has increased at a rate of 3% for 1970 to 1980. Lincoln and Coos Counties each gained 6,000 people while Clatsop gained 2,000 for the same time period. Lincoln County grew 2.5 times that of the state. In 1960, the county population was 34% urban, by 1970 it had risen to 47.4% (Oregon Department of Economic Development 1979c). Lincoln, like Coos County, showed a trend toward more urban dwelling. In 1970, the labor force represented 36% of the total county population. The number of employed persons was 91% and the food products industry employees made up 2% of that total (Table 13). Though consistently the lowest number of unemployed; in 1979, unemployment was the highest recorded and higher than any other of the three counties (Fig. 7). This was a result of rapid increase in gasoline prices which adversely affected the tourism industry.

The Yaquina Bay estuary is composed primarily of the Yaquina River which has its zero mile at the mouth of the bay. Newport lies about one river mile from the mouth of the estuary on the north side of Yaquina Bay. The mean tide range is 5.9 ft (1.79 m) with a diurnal range of 7.9 ft (2.4 m). Currents off Newport are variable and have characteristics of a large eddy. Littoral drift in this area is northward in winter and

southward in summer. Sediments deposited are estimated at 30,000 tons (Bourke, et al. 1971). Alterations to the bay consist of two jetties, channels, and turning and small boat basins. Five industries use the bay at Newport, three of these industries are fish processors. All of the Toledo manufacturers are wood product oriented (Percy, et al. 1974).

The Port of Newport ranks fifth among Oregon ports in total payroll with 80% of its total coming from commercial fishing and fish processing industries (Gabriel and Lee 1977). The recreation industry is of major importance to the economy of the area. In a study prepared by Friedman, et al. (1979) need for additional moorage facilities was reiterated. The completion of the South Beach marina for recreational craft has helped this situation. The Yaquina facility is congested and accomodates 100 boats over the design capacity of the harbor. Berth structures are deteriorating and need to be totally rebuilt. A big problem for the commercial fishing fleet is the lack of adequate berthing facilities for larger vessels.

During the fishing year, up to 1,200 commercial fishing vessels use moorage facilities at Newport. Rates of increase in landings of individual species have been comparable to the other two ports. Landings of coho have increased 8.1%, chinook 6.7%, crab 2.05% and pink shrimp 15.9%. Landings of pink shrimp in all three ports showed a high rate of increase because it was a new, developing fishery during the study period. The Port of Newport recorded a much higher rate of increase than did either of the other ports. In total pounds landed the rate of increase was 6% and value increased at a rate of 12.5% (Table 13). During the study period, Newport's major catch changed from tuna to bottomfish and pink shrimp.

A harbor redevelopment plan focuses on improving the harbor and landside areas of the existing commercial fishing harbor. The existing timber floats, ramps, berth utilities and steel guide piling would be removed. New berthing facilities capable of accomodating the larger vessels used in the fishery is expected to be of long term benefit to the industry and the Port of Newport.

General Observations

All three of the ports studied are making some type of development plan with different emphasis. The Port of Astoria's emphasis is on the development of foreign trade. The building of new coal docks and improved wheat and other grain facilities are intended to attract foreign investment. Though these plans have been suggested in the past and rejected, they appear to be more realistic now than ever before. Asian countries are interested in coal now because of the difficulties in obtaining sufficient foreign oil. The governments and private industries seem ready to invest. The plan also has U. S. Government support as evidenced by recent trade missions. The Port of Astoria has not included the commercial fishery directly in its redevelopment plan.

The Port of Coos Bay's redevelopment plan is not as concerned with foreign trade as domestic land-use planning. They have realized the problem of relying heavily on a single industry and are attempting to overcome that deficiency. The commercial fishery seems to be an active part of their plan for development.

The Port of Newport is planning for the escalation of the recreation industry, but is also attempting to upgrade facilities for commercial fishing vessels. It is the only Oregon port currently engaged in any

joint venture activity.

The commercial fisheries studied will probably continue as they have with fluctuations and some further declines. It has not contributed significantly enough to any of the ports to be placed as a high priority for future development. Only at the Port of Coos Bay might it develop further, and then only if the wood products industry remains depressed and the wharves at Charleston can be upgraded.

VII. DISCUSSION

There have been no perceptible increases in either the ocean troll or gillnet catch during the 14 year study period; but rather, fluctuations about a mean of 8,500,000 lb (3,855,600 kg). The chinook fishery reached a peak of 9,598,000 lb (4,353,652 kg) in 1973 and dropped to 3,954,327 lb (1,793,682 kg) in 1980. Coho catch peaked at 13,085,000 lb (5,935,356 kg) in 1970 and decreased to 3,255,659 lb (1,476,766 kg) by 1980. Although there have been wide fluctuations in values, increases in catch were visible until 1980. The number of fishermen and vessels are increasing despite the decreasing catch. This indicates that the pending moratorium may not be effective.

Real values of chinook and coho increased 6.5% and 7.6%, respectively through 1979. This encouraged fishermen to enter the fishery. In 1980, the real value for chinook dropped $0.18 per pound and the coho value dropped $0.40 per pound. The lack of increase in catch, the sudden large drop in value and the steady increases in the number of fishermen and vessels indicates a declining economic situation in the troll fishery.

A common statement made by gillnetters is, "the trollers are fishing too long a season, and therefore catching too many fish. Not enough fish are allowed to return to the spawning river." The statement is true, in part. Troll seasons are longer than gillnet seasons, but the troll catch is not proportionally increasing. More fishermen and vessels with more elaborate gear are catching fewer fish. Concurrently, the gillnetters are also catching fewer fish. There has not been an increase in the number of gillnetters and the catch has decreased steadily. In 1980, the total value of the gillnet catch was less than $1,000,000. If trends continue, the gillnet fishery will probably cease to exist in the near

future. Overall, trends show fewer salmon being landed by any method. Ocean catches for 1980 were the lowest of any year since the study began, except for the 1969 chinook catch. It was also the lowest year for gillnet catches, indicating a decline in salmon populations.

The salmon fishery is complex. It includes multiple managment agencies and active recreational and aquacultural components. The movement of salmon and fishermen along the coast increases the complexity. Some troll vessels are completely dependent on salmon, while others operating from California to Alaska may fish other species such as albacore, crab, sablefish and halibut in addition to salmon. Management recognizes that a large number of salmon fishermen operating small boats on a narrow profit margin influences the behavior and political actions of the fishermen. The Pacific Fishery Management Council (1981a) summarized the situation in these words: "More and more participants with greater econimic and social needs are putting more pressure on smaller salmon populations

No decision has been made regarding private aquaculture. Private aquaculture could pose a threat to the future of the troll fishery. Managemant is committed to preservation of the wild stock which mixes with hatchery stock in the ocean. Furthermore, a wild stock alone will not support the increasing fishery. Private aquaculture may be able to produce evidence of economic benefits in the near future. If large stocks of salmon can be produced by ocean ranching and the fishing pressure is increased according to population size, there is a real danger of eliminating a wild stock in the ocean by troll fishing. A situation where small wild stocks are mixed with hatchery produced salmon might tempt management to curtail troll fishing to protect the wild stocks.

An effective management plan has been developed but not yet implemented to satisfy the Indian fishing rights requirements while maintaining a satisfactory escapement quota. If the gillnet fishery is to be saved in any form, studies of the salmon stocks, spawnig areas and other environmental factors must be increased. Ocean ranching may be the only economical means of increasing stocks to continue the fishery. A tighter moratorium should be imposed; a well planned buy-back system would prevent total economic collapse.

The Dungeness crab fishery has also shown wide fluctuations in catches, but changes have been cyclic, therefore more predictable. The adjusted price per pound peaked in 1974 and has steadily declined. A lack of organization has caused declines in demand for the product in out-of-state markets. Production is carried out by several small firms with no large firm willing to extensively advertise the product. The Crab Commission is working for better marketing practices and advertisement which will help stabilize prices in the fishery.

The sporadic development of the pink shrimp fishery continued over the 13 year analysis in this study. Catch and value increased and pink shrimp replaced salmon in catch by weight and value. Catch rose sharply in 1977 and 1978 approaching an estimated MSY of 77 million pounds then dropped drastically in 1979 and 1980. In 1980, the PFMC lowered MSY estimates to 60 million pounds as a result of the lower 1979 landings. Wise use of the resource requires that the MSY be flexible to take advantage of strong year classes as well as to protect weak year classes (Pacific Fishery Management Council 1981b). The 1980 landing record did not recover showing characteristics of over-exploitation. There is only a slight possibility that management will permit the MSY to exceed

the annual amount of 60 million pounds. The Pacific Fishery Management Council (1981b) acknowledged that they did not know the effect of such high effort on the health of the shrimp stock and stated that the potential for over-fishing exists.

The MSY are estimates and subject to all the inherent problems of estimates. Therefore, an MSY does not protect a population, but it indicates the level of management capability and sensitivity. If population cycles are responsible in part for the lower catch figure, then closer relationships between research and management must exist to prevent potential over-exploitation. The number of vessels licensed in the pink shrimp fishery continued to rise after the moratorium was placed on vessel entry. The moratorium needs to be stronger and, perhaps other managemnt techniques, such as larger mesh size, or assigned quotas of fish for each license need to be imposed. Management occurs "after the fact" for political reasons. This management style will not insure a healthy pink shrimp fishery.

The Pink Shrimp Management Plan Development Team cited several specific areas where information is needed to develop future management plans (Pacific Fishery Management Plan 1981b). A bioeconomic model is needed to help managers predict impact of various management strategies. A deep water survey is needed to determine distribution and abundance of pink shrimp outside regular fishing areas. Mesh size experiments will give information on escapement rates. Other needs include biometric research, shrimp and shrimp bed observations and quota determination methods. These research needs indicate that the information needed to manage pink shrimp is not yet available.

Although catches are declining in all but one of the fisheries

studied and the price-per-pound has decreased, more fishermen entered the fishery each year. The number of fishermen and boats has doubled over the period surveyed.

The impact of limited entry on the fishery and the fishermen is also not fully known. Fishermen see limited entry as it exists now, as a system which may limit their ability to move from one fishery to another. The limited number of licenses available to be bought and sold could become concentrated in the hands of a few large processors. Fisheries economists point out that license limitation itself does not prevent overcapitalization or over-fishing (Pacific Fishery Management Council 1981b). Limited entry programs are also expensive to direct.

Employment in the fish processing industry has not increased nor has the number of processing plants (Table 9). There remains a high level of optimism among fishermen. They continue to enter the fishery and continue to voice optimism about the fish populations. A feeling that management is keeping them from making a good living at fishing with over-restriction, insufficient information, and political game-playing is frequently voiced at public hearings and other gatherings of fishermen. Conversely, management must have close cooperation of fishermen in order to project annual quotas. The FCMA can only be wisely implemented with close cooperation and understanding of both management and the fishermen. The FCMA, so long sought by fishermen, implies that the fishermen will be willing to live with quotas and restrictions on their fishing operations in order to have the resource conserved and available to them over time.

The social impact of management on the fishermen is best seen in terms of indebtedness. Most banks are not lending to individual fishermen, but recommend that they apply through the PCA indicating that

local banks consider fishermen poor credit risks. All loans to fishermen are not made through PCA, however, the increasing number of outstanding loans through that agency ($75,600,000 in 1980) further substantiates the conclusion that more fishermen are under financial stress. The increased number of loans to an industry probably already over-capitalized is sure to draw more criticism to government lending processes. The total value of the Oregon fishery has been calculated to be about $40,000,000.

The formation of fishermen's cooperatives in response to these events and attitudes is a positive step which can benefit fishermen. The cooperatives provide the best avenue for further economic development of the fishery. In the fisheries studied, the methods of fishing have probably developed as far as possible. Cooperatives can help develop fisheries in the areas of marketing, processing, and increased efficiency of the existing industry. Though fewer fish are being caught, those fish can be caught, processed, and marketed more effectively keeping member fishermen in business.

All three ports studied are planning for future development. All have a different emphasis; Astoria is planning for foreign trade in areas of raw energy material such as coal and grain commodities, especially sought by Asian countries. Coos Bay, recognizing the problem of long-time dependence on a single industry, wood products, is attempting to make the port more attractive to a variety of industries. Newport appears to be attempting to further capitalize on the industry for which it is best known, recreation. The impact of fishing on the already declining economy of the coastal communities is limited. Declines in landings have had a negative impact on associated industries such as

processing and gear suppliers. The accompanying decline in values has affected businesses and lending institutions. Shorter fishing seasons have caused longer periods of unemployment. Depression in other coastal industries has made it more difficult for fishermen to find jobs when they are not fishing.

None of the ports have given the commercial fishery a high priority in their future development plans. Astoria plans did not mention fishery development. Coos Bay considered it important but wanted to avoid remaining a one industry port. Newport also has some plans to develop areas for commercial fishing boats, but the processing industry is not providing guarantees for future development. It appears that the port authorities have determined that the cost of economic survival is diversity and that traditional coastal industries such as wood products and fishing will not sustain an economy for the region in the next decade.

REFERENCES CITED

Ad hoc Dungeness Crab Management Review Team. 1977. Preparation for background information for management planning based on the requirements of P.L. 94-265. State/Federal Dungeness Crab Fisheries Management Program, Pacific Marine Fisheries Commission, Portland, Oregon.

Adasiak, A. 1979. Alaska's experience with limited entry. Journal of the Fisheries Research Board of Canada 36:770-782.

Anderson, L. G. 1977. The economics of fisheries management. The Johns Hopkins University Press, Baltimore, Maryland.

Balagna, S. D. 1979. U. S. Supreme Court to rule on northwest Indian fishing rights. Ocean Law Memo 13:1-4.

Beiningen, K. T. 1976. Indian fishery. Pages P1-P21 in: Investigative reports of Columbia River Fisheries Project, Pacific Northwest Regional Commission, Vancouver, Washington.

Board of Engineers for Rivers and Harbors. 1976. The ports of Coos Bay and Astoria, Oregon, Longview and Vancouver, Washington, and ports on Columbia River. U. S. Army Corps of Engineers. Port Series No. 33.

Bourke, R. H., B. Glenne, and B. W. Adams. 1971. The nearshore physical oceanographic environment of the Pacific Northwest coast. Oregon State University, Department of Oceanography Reference 71-45, Corvallis, Oregon.

Butler, T. H. 1980. Shrimps of the Pacific Coast of Canada. Canadian Bulletin of Fisheries and Aquatic Sciences No. 202.

Campbell, B. A. 1972. A review of salmon vessel license control program in British Columbia. Paper presented at the meeting of Northwest Washington District American Institute of Fisheries Research Biologists.

Carter, C. 1981. Personal communication.

Coos-Curry Council of Governments. 1981. North Bay marine industrial park. U. S. Army Corps of Engineers, Portland District, Portland, Oregon.

Davis, D. Q. 1980. How to get a salmon troll permit and how to keep it. Ocean Law Memo 17:1-4.

Demory, D. 1981. Personal communication.

Fraser, G. A. 1979. Limited entry: experience of the British Columbia salmon fishery. Journal of the Fisheries Research Board of Canada 36:754-763.

Friedman, J. M., E. G. Niemi, P. K. Watt, W. E. Whitelow, and S. L. Zaklan. 1979. Commercial and recreational boating facilities in Oregon estuaries: inventory and demand analysis. Oregon Department of Land Conservation and Development, Salem, Oregon.

Fry, D. H. 1962. Potential profits in the California salmon fishery. California Fish and Game 48:256-267.

Gabriel, S. R. and C. E. Lee. 1977. Oregon port districts; an economic profile. Oregon Department of Economic Development, Portland, Oregon.

Geibel, J. J. and R. F. H. Heimann. 1976. Assessment of ocean shrimp management in California resulting from widely fluctuating recruitment. California Fish and Game 62:255-273.

Goosen, D. 1981. Personal communication.

Hart, J. L. 1973. Pacific fishes of Canada. Fisheries Research Board of Canada Bulletin 180.

Hatley, T. A. 1975. Efficiency in Oregon's commercial salmon fisheries: a historical perspective. Master's Thesis, Oregon State University, Corvallis, Oregon.

Higgs, R. 1978. Preliminary report on the probable socio-economic effects of a moratorium on the issuance of new vessel licenses in the Pacific Ocean commercial salmon fishery. Pacific Fishery Management Council, Portland, Oregon.

Hipkins, F. W. 1957. The Dungeness crab industry. Fishery Leaflet 439.

Hoopes, D. T. 1973. Alaska's fishery resource--the Dungeness crab. Fishery Facts 6.

Liao, D. S. and J. B. Stevens. 1975. Oregon's commercial fishermen: characteristics, profits and incomes in 1972. Oregon State University Sea Grant College Program Publication ORESU-T1-75-001.

Lodge, D. 1982. Personal communication.

McKay, D. C. 1942. The Pacific edible crab, Cancer magister. Fisheries Research Board of Canada Bulletin 62.

Magill, A. R. and M. Erho. 1963. The development and status of the pink shrimp fishery of Washington and Oregon. Pacific Marine Fisheries Commission Bulletin 6:62-80.

Mayer, A. C. 1966. The significance of quasi-groups in the study of complex societies. Pages 97-122 in: M. Banton, editor. The social anthropology of complex societies. Frederick A. Praeger, New York, New York.

Miller, R. J. 1976. North American crab fisheries regulations and their rationales. Fishery Bulletin 74:626-627.

Montagne-Bierly Associates, Inc. 1979. Oregon coastal zone fishery management analysis. Oregon Department of Land Conservation and Development, Salem, Oregon.

Navratil, Z. A., A. J. Provan, and J. J. Strong. 1968. Education of technical personnel and fishermen. Pages 279-284 in: D. W. Gilbert, editor. The future of the fishing industry of the United States. University of Washington. Publications in Fisheries. New Series Volume IV.

Oester, L. 1981. Personal communication.

Orbach, M. K. 1981. The human dimension. Pages 149-163 in: R. I. Lackey and L. A. Nielson, editors. Fisheries Management. John Wiley and Sons, New York, New York.

Oregon Department of Economic Development. 1979a. Clatsop County economic information. Economic Information Clearinghouse, Portland, Oregon.

Oregon Department of Economic Development. 1979b. Coos County economic information. Economic Information Clearinghouse, Portland, Oregon.

Oregon Department of Economic Development. 1979c. Lincoln County economic information. Economic Information Clearinghouse, Portland, Oregon.

Pacific Fishery Management Council. 1978. Final environmental impact statement and fishery management plan for commercial and recreational salmon fisheries off the coasts of Washington, Oregon, and California commencing in 1978. Pacific Fishery Management Council, Portland, Oregon.

Pacific Fishery Management Council. 1979a. Draft fishery management plan for the Dungeness crab fishery off Washington, Oregon, and California. Pacific Fishery Management Council, Portland, Oregon.

Pacific Fishery Management Council. 1979b. Draft fishery management plan and environmental impact statement for the pink shrimp fishery off Washington, Oregon, and California. Pacific Fishery Management Council, Portland, Oregon.

Pacific Fishery Management Council. 1981a. Proposed plan for managing the 1981 salmon fisheries off the coast of California, Oregon, and Washington. Pacific Fishery Management Council, Portland, Oregon.

Pacific Fishery Management Council. 1981b. Discussion draft of the fishery management plan for the pink shrimp fishery off Washington, Oregon, and California. Pacific Fishery Management Council, Portland, Oregon.

Pacific Marine Fisheries Commission. 1978. Dungeness crab project of the state-federal fisheries management program. Pacific Marine Fisheries Commission, Portland, Oregon.

Pearse, P. H. and J. E. Wilen. 1979. Impact of Canada's Pacific salmon fleet control program. Journal of the Fisheries Research Board of Canada 36:764-769.

Percy, K. L., C. Sutterlin, D. A. Bella, and P. C. Klingeman. 1974. Oregon's estuaries. Sea Grant College Program, Oregon State University, Corvallis, Oregon.

Porter, R. G. 1978. Review of limited entry alternatives for commercial salmon fisheries. Pacific Marine Fisheries Commission, Portland, Oregon.

Rogers, G. W. 1979. Alaska's limited entry: another view. Journal of the Fisheries Research Board of Canada 36:783-788.

Robinson, J. G. 1976. The pink shrimp. Oregon Department of Fish and Wildlife. Marine Region. Informational Report. 76-4.

Ronholt, L. L. and A. R. Magill. 1961. Biological observations and results of the 1960 John N. Cobb exploratory shrimp cruise off the central Oregon coast. Oregon Fish Commission Research Briefs 8(1):31-52.

Ruttle, M. 1973. Clatsop County Oregon resource atlas. Oregon State University Extension Service, Corvallis, Oregon.

Scott, A. D. 1962. The economics of regulating fisheries. Pages 25-61 in: R. Hamlisch, editor. The economic effects of fishery regulation. FAO Fisheries Report No. 5. Rome, Italy.

Scott, W. B. and E. J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada Bulletin 184.

Sea Grant Marine Advisory Program. 1971. Fisheries-related marine career training needs on the Oregon coast, 1971-1975. Oregon State University, Corvallis, Oregon.

Smith, C. L. 1974a. Fishing success in a regulated commons. Ocean Development and International Law Journal 1:369-381.

Smith, C. L. 1974b. Oregon fish fights. Oregon State University, Sea Grant College Program ORESU-T-74-004.

Smith, C. L. 1977. Fish or cut bait. Oregon State University, Sea Grant College Program ORESU-T-77-006.

Smith, F. J. 1970. Organizing and operating a fishery cooperative Pt. 1. Oregon State University. Extension Marine Advisory Program SG No. 19, Corvallis, Oregon.

Smith, F. J. 1972. Some characteristics of Oregon fishermen. Extension Marine Advisory Program Commercial Fishing Publication No. 12.

Smith, F. J. 1973. How to calculate profit in a fishing business. Extension Marine Advisory Program SG No. 29, Corvallis, Oregon.

Smith, F. J. 1978. What are salmon worth? Oregon State University Extension Marine Advisory Program SG No. 48, Corvallis, Oregon.

Tam, M. 1973. Coos County, Oregon resource atlas. Oregon State University, Extension Service, Corvallis, Oregon.

Thompson, K. 1976. Columbia basin fisheries past, present, and future. Pages A1-A41 in: Investigative reports of Columbia River Fisheries Project, Pacific Northwest Regional Commission, Vancouver, Washington.

U. S. National Marine Fisheries Service. 1973a. Basic economic indicators-salmon 1947-1972. Current Fishery Statistics No. 6129.

U. S. National Marine Fisheries Service. 1973b. Basic economic indicators-king and Dungeness crabs 1947-1972. Current Fishery Statistics No. 6133.

U. S. National Marine Fisheries Service. 1973c. Basic economic indicators-shrimp 1947-1972. Current Fishery Statistics No. 6131.

Valde, G. 1973. Lincoln County, Oregon resource atlas. Oregon State University Extension Service, Corvallis, Oregon.

Waldron, K. D. 1958. The fishery and biology of the Dungeness crab (*Cancer magister* Dana) in Oregon waters. Fish Commission of Oregon. Contribution No. 24.

Williams, L. Hatfield says Koreans "warm". The Oregonian. 1982 Feb. 18:B3 (Col. 2).

Witaker, D. R. 1973. The U. S. shrimp industry: past trends and prospects for the 1970's. Marine Fisheries Review 35(5-6):23-30.

Wix, J. R. 1967. Some economic considerations in Dungeness crab marketing. Master's Thesis, Oregon State University, Corvallis, Oregon.

Youde, J. G. and J. R. Wix. 1967. Economics of the Dungeness crab industry. Agricultural Experiment Station Circular of Information 627, Oregon State University, Corvallis, Oregon.

Zirges, M. H. and J. G. Robinson. 1980. The Oregon pink shrimp fishery, management history and research activities. Oregon Department of Fish and Wildlife. Marine Region. Informational Report 80-1.

APPENDIX

Table 14 Oregon Groundfish Landings and Values a/

Year	Catch (Pounds)	Value (1967=100)
1969	23,243,151	$1,704,587
1970	21,392,381	1,383,620
1971	22,039,881	1,497,520
1972	22,801,367	1,732,800
1973	21,944,140	1,972,180
1974	22,097,723	2,200,000
1975	21,023,739	1,835,802
1976	26,929,976	2,515,789
1977	23,365,634	b/
1978	37,056,208	4,115,897
1979	45,208,027	4,352,761
1980	63,661,111	4,696,761

a/ Oregon Department of Fish and Wildlife unpublished statistics.

b/ Data not available.

Table 15 Oregon Tuna Landings and Values[a]

Year	Catch(Pounds)	Value (1967=100)
1969	29,827,549	$6,157,798
1970	26,936,875	5,968,965
1971	13,092,167	2,998,347
1972	29,233,715	7,308,800
1973	24,425,485	6,539,849
1974	33,039,926	8,551,700
1975	23,584,409	4,629,629
1976	17,349,410	3,310,526
1977	9,898,921	b/
1978	18,397,673	5,292,307
1979	8,820,586	2,145,518
1980	3,505,721	1,111,740

a/ Oregon Department of Fish and Wildlife unpublished statistics.

b/ Data not available