Prospects for Aquaculture Diversification in Alaska

By Brad Pierce 1/

Aquaculture is a general term which can be defined as the cultivation of finfish, shellfish and aquatic plants in fresh or saltwater. Mariculture is a more specific term which refers to the cultivation of plants and animals in saltwater. Aquaculture in Alaska is presently centered around a highly successful salmon hatchery program where juveniles are reared in a protected freshwater environment and released to migrate to sea and return as adults. During the past few years, attention has turned to the possibilities offered by adapting techniques used in other parts of the world to utilize Alaska's clean, nutrient-rich marine waters and vast areas of suitable habitat for mariculture development. Two species—Pacific oysters and blue mussels—are currently being farmed in commercial quantity and salmon, giant kelp and scallops are being studied for their feasibility in Alaska.

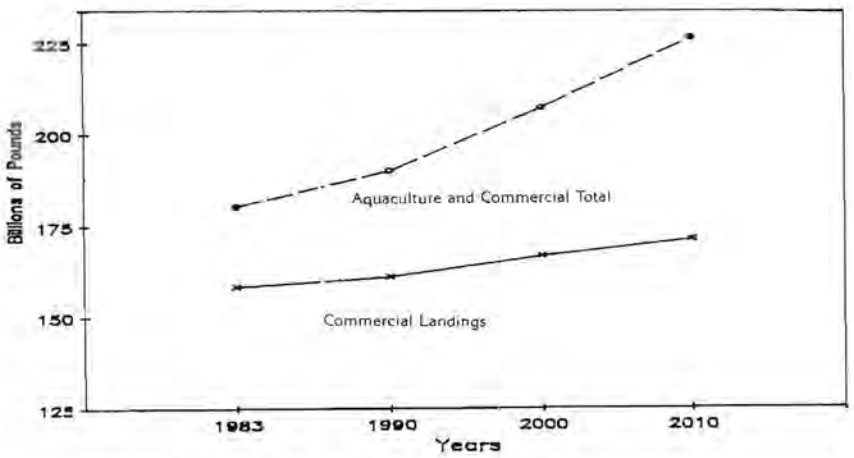
The Big Picture

Annual world per capita consumption of fish and shellfish is presently 28.6 lbs.

World commercial landings of fish and shellfish have remained rather static at 70-75 million metric tons (mt) during the past 15 years. This suggests that naturally occurring stocks are being harvested at or near their upper level of capacity. An annual average increase in commercial landings of just 0.3 percent is forecast by the National Marine Fisheries Service (NMFS) through 2010. World commercial fisheries landings accounted for about 88 percent of total world production of fish and shellfish, while aquaculture production accounted for the remaining 12 percent by 1983. As portrayed in Figure 1, the NMFS expects the commercial fisheries component to slip to 76 percent of current levels and aquaculture production to increase at a 5.5 percent annual rate by 2010.

Annual world per capita consumption of fish and shellfish is presently 28.6 lbs., which is expected to increase to 34 lbs. by the turn of the century. Over the same period, population is forecast to increase from 5.0 billion to 6.1 billion. These global factors combine to portend a 15 million mt annual market for aquaculture products by the turn of the century. Many experts argue that we are in the beginning stages of a worldwide "blue revolution" in aquaculture development similar to the "green revolution" in agriculture of the 1960s, which had profound social and economic consequences worldwide and transformed many food-importing countries of the third world into net food exporters.

Figure 1
World Production of Fish and Shellfish



Source: "Future of Aquaculture: Profile of a Growth Industry." International Aquaculture Foundation, February 1985, pg. 8.

The United States as a major market for fish and shellfish and Alaska as a major producer of seafood can be expected to experience substantial economic impacts as the worldwide protein production potential of aquaculture is realized. Domestic seafood markets are among the fastest growing in the world and have been dramatically affected by aquaculture production. United States per capita consumption of fish and shellfish has increased 13 percent since 1980, while total domestic annual consumption of seafood increased by 19 percent. This trend is expected to continue as American consumers be-

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come more knowledgeable about the health benefits of eating seafood and increasingly sophisticated about different species and methods of preparation. Most of the increase in domestic demand for seafood is being met by imports. Fresh salmon imports increased from 1.1 million pounds in 1982 to 13.8 million pounds in 1984. In fact, imports of foreign fish and shellfish grew by 14 percent in 1985 alone and the U.S. fisheries trade deficit amounted to $5.6 billion that year.

Alaska's Place in the Blue Revolution

Alaska's competitive position as a producer of aquaculture products will depend on the economics of production and distribution as well as worldwide conditions of supply and demand for seafood. The state's physical potential for aquaculture development is quite large. Major physical advantages include enormous natural salmon runs (which are being supplemented by public and private hatchery production), clean nutrient-rich waters and many undeveloped areas that are suitable for mariculture sites. For species other than salmon, however, cold water temperatures limit the number of varieties that can be cultivated economically.

Aquaculture development in Alaska has the economic advantages of a well developed fisheries infrastructure and barrier-free access at reasonable cost to rapidly growing domestic seafood markets. The classic economic development triad of cooperation between government, the university system and private industry already exists in Alaska and has been proven in the salmon hatchery systems. The major disadvantage of further aquaculture diversification in Alaska is generally high operating costs. Since the State and federal government own most of the coastal lands in Alaska and the State has jurisdiction over waters to three miles offshore, government policies (particularly as they affect operating costs) will play a substantial role in future development.

Major obstacles to diversification of the aquaculture industry are legal and political. Aquatic farming legislation (HB 108, SB 106) would have established an administrative and regulatory framework allowing further aquaculture development. Several significant issues need to be resolved including potential user conflicts over mariculture sites; the dangers of disease transmission or genetic degradation of wild stocks; environmental hazards of fish waste accumulation or effects of antibiotics in feed being diluted into the water; and impacts to the existing fishing industry, especially on fish prices and access to State loan programs.

While salmon farming is the most controversial form of development, other aquaculture activities such as the rearing of mussels, oysters, scallops and sea vegetables are not perceived as a direct threat to the traditional fishing industry. All of the other aquaculture products mentioned above which could be developed in the near term (next five years) are likely to be of minor economic importance, however, when compared to the potential of salmon farming.

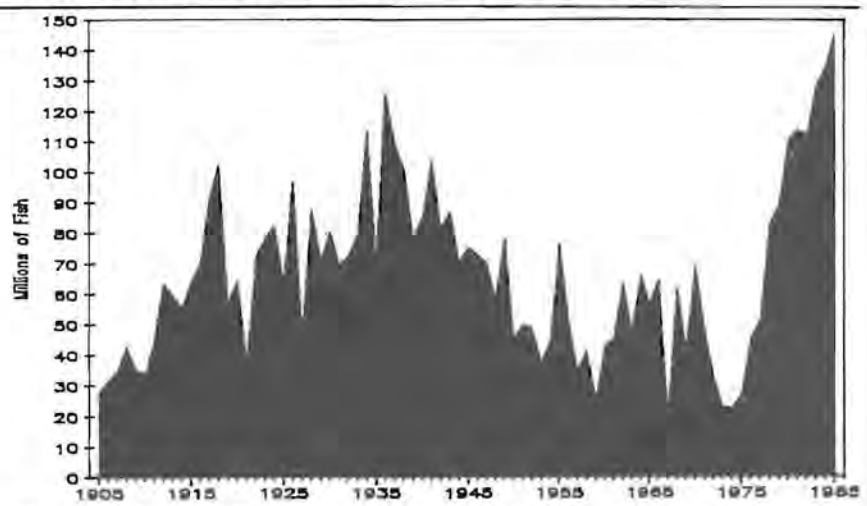
Salmon Farming

The new form of aquaculture development with the most economic potential is salmon farming. The pen rearing (farming) of salmon, where smolts are held captive in pens and fed until they reach harvester size is a relatively new industry that has largely developed since 1970. Norway is the leading producer of farmed salmon, but twelve other countries are rapidly developing their own salmon farming industries.

In 1986 approximately 59,200 metric tons (mt) of farmed salmon were produced worldwide, compared to a 657,000 mt wild harvest. By 1990, production of farmed salmon is forecast to increase to 107,000 mt while the wild harvest is expected to stabilize at about 677,000 mt. By comparison, the 1986 Alaska salmon harvest was 268,000 mt. The proportion of farmed to wild salmon in world markets is expected to increase from 8.3 percent (1986) to 13.7 percent by 1990. Figure 2 gives a historical perspective on Alaska's wild salmon production and Figure 3 provides a graphic representation of proportionate world salmon production (farmed and wild) by major producing countries.

Since about 43 percent of world salmon production and 90 percent of U.S. salmon come from the commercial harvest in Alaska, the enormous influx of farmed salmon into world markets (particularly domestic markets for premium species) expected in the early 1990s will have major implications for the value of Alaska's market share. Farmed salmon compete most directly with premium wild species—chinook, cohos and sockeye. The combined 1986 Alaska harvest of chinook (5,070 mt) and cohos (18,771 mt) was about half the 48,600 mt Atlantic farmed salmon produc-

Figure 2
Alaska Commercial Salmon Catch 1904-1985



Source: Alaska Commercial Salmon Catches 1878-1984, Alaska Department of Fish and Game, Division of Commercial Fisheries, February 1985.

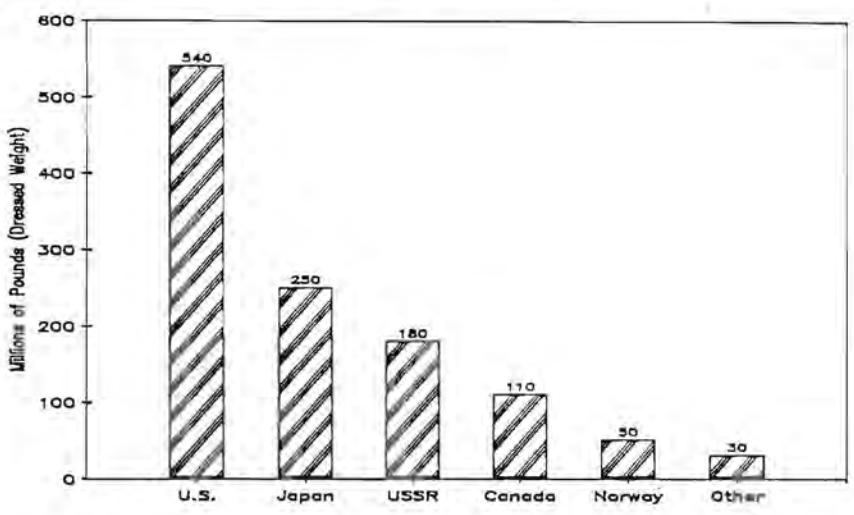
tion. The 1986 Alaska sockeye harvest was 88,575 mt. Sockeye are primarily sold on the Japanese market and thus are not expected to be a major factor in the fierce domestic market competition of the 1990s.

Recently British Columbia has become the focal point for farmed Pacific salmon development, with Chilean, Japanese and New Zealand production also expanding rapidly.

maintaining a frozen inventory of wild fish in the off season.

The next major challenge to producers of farmed salmon is to move into the mass retail market (i.e., supermarkets) and win acceptance with the great bulk of domestic consumers. This market segment is where wild fish from Alaska will likely face their greatest competition in the near future. Farmed production

Figure 3
World Salmon Production, 1984



Source: *Seafood Business Report*, Volume 4, Number 2, March/April 1985.

British Columbia is likely to be Alaska's major competitor in premium domestic markets as further pen rearing development in Puget Sound and Maine has been slowed by opposition (primarily on aesthetic grounds) from waterfront homeowners and real estate interests.

Fresh Atlantic farmed salmon have been targeted at the top of the domestic market and have enjoyed their greatest acceptance with fine restaurants and specialty fish shops, where quality and continuity of supply are prime considerations. Farmed Atlantics have also captured a large portion of the European smoker market, once dominated by wild fish from Alaska. Even though the characteristics of wild Pacific species are superior (flesh color, oil content), many smokers have switched to farmed Atlantics because they can order them fresh as needed and do not have to bear the energy and interest costs of

fits in with the ability of these stores to plan, schedule and market large fresh product volumes of consistent quality and price over long periods each year. Farmed salmon of specific quality and size can be purchased via long-term fixed price contracts. The key to mass markets will be lower prices for farmed products.

Ninety-seven percent of Alaska's production of premium salmon species is sold in frozen form. Salmon farmers only marginally compete with fisherman in Alaska in today's markets but this situation is beginning to change. As can be seen in Figure 4, the year-round volume of imports of farmed salmon is increasing rapidly as producers begin to compete more directly with domestically produced fish. By the early 1990s, large volumes of farmed fish are likely to saturate the fresh salmon market and begin to spill over to frozen markets where they will compete directly with wild fish from Alaska.

New entrants to the salmon farming industry are likely to face stiff price competition from established producers within the next five years. Those with unamortized development costs or improperly scaled operations could be very vulnerable to price undercutting by producers such as Chile, which has very low labor and feed costs, and new Alaska fish farmers may have difficulty surviving the anticipated industry shakeout. Interestingly, salmon farming operations do not appear to benefit from significant economies of scale. In Norway, the most profitable operations appear to be medium-sized (140 mt) farms which have average annual costs of about $400,000 and revenues of approximately $640,000. Larger and smaller scaled operations tend to have lower rates of return.

According to the British Columbia Salmon Farmers Association, a properly scaled operation requires a capital outlay of about $1 million in the first two years of operation before any fish are ready for harvest. About 40 percent of the capital investment (estimated at slightly over $75 million) for the 75 salmon farms currently operating in British Columbia came from foreign investors, mainly Norwegian banks. It is likely that an influx of foreign capital would occur if Alaska were to allow salmon farming, since domestic banks have no experience with aquaculture and State loan programs are generally being reduced.

Salmon farming is a capital intensive business. Labor costs amount to about 15 % of total annual operating costs. The average 108 mt farm in British Columbia employs 5.5 persons and has a payroll of $98,920. Salmon farm employees are not highly paid—the average salary in British Columbia is about $18,000 per year. In this respect, salmon farming employment is similar to the fish processing industry, however, unlike the seafood processing industry which relies heavily on nonresident and seasonal employees—fish farming provides year-round jobs to residents and could become an important source of income to coastal communities.

It is estimated that a fully developed 20,000 mt salmon farming industry in Alaska would directly employ in excess of 1,000 persons and have gross sales on the order of $130 million. A 20,000 mt salmon farming industry in Alaska is many years in the future, although a 4,000 mt industry may be possible four to five years after enabling legislation is adopted.

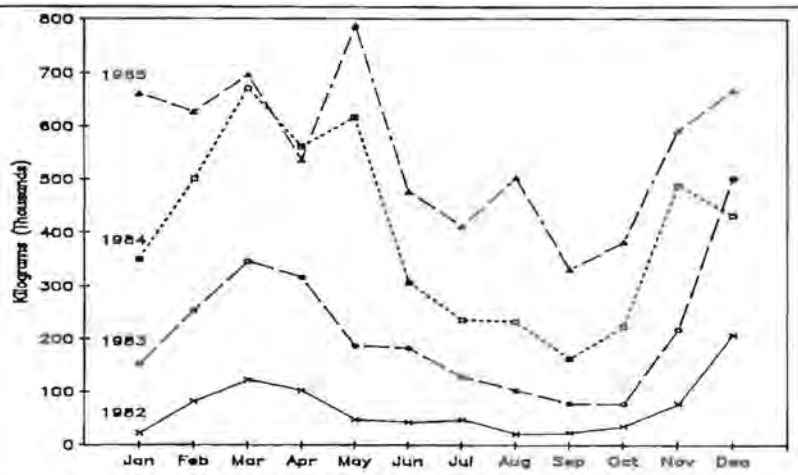
The market impacts of a 20,000 mt Alaska salmon farming industry are small compared to the impact of the expected increase in the supply of farmed salmon worldwide. Preliminary estimates indicate that increased supplies of non-Alaska farmed salmon will cause a $5 million to $36 million loss in revenue to the Alaska fishing industry by 1990. A fully developed Alaska salmon farming industry could result in an additional 10-15 percent ($500,000 to $4 million) revenue loss. In relative terms, prices for Alaska salmon are expected to fall by about nine percent as a result of world farmed salmon production and an additional one percent if Alaska were to develop a 20,000 mt industry.

The domestic seafood market is very dynamic; there appears to be considerable room for expansion of fresh salmon sales. Significant substitution effects between wild and farmed salmon have not shown up in domestic sales data which suggests that the fresh market is not close to the saturation level. There is a window of opportunity for Alaska to enter the salmon farming business that will close as existing producers establish their share of the domestic market for premium salmon products. At this point, we can only guess that real price competition between wild and farmed salmon in frozen markets will occur sometime in the early to mid-1990s.

Oysters

Oysters are the only mariculture product in Alaska that are specifically addressed in State law and regulated by the Board of Fisheries. Oysters were farmed for a brief period in Southeast Alaska prior to statehood using beach culture methods. Experimental production using raft culture techniques began in 1978, with the first commercial sales occurring in 1983. Today there are 20 permitted oyster farms in Alaska, with seven actually growing oysters and two farms with commercial sales. Half-shell oysters take two growing seasons to produce and sell for about 50 cents each or $3/lb. The Department of Fish and Game does not compile statistics on oyster production, but from conversations with producers it appears that 1986 sales amounted to 30,000-32,000 oysters.

Figure 4
U.S. Imports of Norwegian Salmon 1982-1985



Source: Ronald V. Rogness and Dr. Biing-Hwan Lin, "The Marketing Relationship Between Pacific and Pen-Raised Salmon: A Survey of U.S. Seafood Wholesalers, University of Alaska, Fairbanks.

Oysters only rarely spawn in Alaska because they require a sustained water temperature of 68 to 72 degrees for approximately one month. This biological fact has both good and bad implications for oyster farmers in Alaska. On the positive side, because oysters do not spawn, they remain fat and succulent during the summer when Puget Sound oysters get mushy and bitter. This gives Alaska producers a foothold in fresh half-shell markets during the summer months. Actually oyster farmers in Alaska have little trouble selling all they can produce. Demand for oysters is high and domestic production is declining because of water quality problems in Puget Sound and New England.

On the negative side, juveniles (spat) must be imported from outside the state. Nonindigenous spat is very hearty and has a high (90 percent plus) survival rate but is not genetically adapted to Alaska. Therefore growth rates are fairly uneven among juveniles. A selective breeding program could develop an Alaska strain within a few generations that would grow uniformly well.

A major priority for oyster farmers is to establish a hatchery in the state. At their present scale of production, it would not be feasible to generate enough from an assessment tax on gross sales to pay for a hatchery. Thus a State-funded facility appears to be the most realistic option at present.

Each shipment of oysters (or other farmed shellfish) that is sold, must be tested for paralytic shellfish poisoning (PSP) by the Department of Environmental Conservation as a condition of their shucker/shipper permit. The DEC testing lab is located in Palmer. Oyster farmers, most of whom are located in Southeast, must remove their oysters from the water and send off a sample to be tested before they can ship their product. It often takes three days to receive results back from the lab by phone. Even though the oysters can easily survive the interval out of the water, they lose some of their shelf life because of the delay. Oyster and other shellfish farmers are selling a gourmet product and freshness is of paramount importance, so the testing delay is bothersome. Thus shellfish

farmers of all types in Alaska are lobbying the legislature for regional PSP testing facilities.

It takes two years for an oyster farm to produce a harvest. During the winter, the oyster rafts only require custodial care, but during the intense April to October growing season, oyster farming is a fairly labor intensive operation. The screens in the rafts must be cleaned and the oysters must be turned and sorted regularly to assure maximum growth. It is estimated to take a capital investment of about $110,000 during the first two years of operation to raise enough oysters to have an economically viable business and earn a living wage. Oyster farms are generally sited in remote locations. Because the farmer must remain on site for most of the year, it is difficult to hold down another job.

All shellfish farmers in Alaska operate under a complicated site permitting situation. The Department of Natural Resources (DNR) administers the leasing of sites for shellfish farms. The terms of shellfish site leases were originally drafted for log transfer sites and do not give an operator enough security to obtain long-term financing. The DNR is in the process of drafting new site regulations, specifically designed for mariculture operations. The idea is to have a screening procedure for new applicants that does not allow for site speculation and a prove out period to keep sites from being tied up and not developed. Operators who establish a viable business would be allowed long-term leases.

Mussels

Blue mussels are the only indigenous shellfish species that is currently being farmed in commercial quantities in Alaska. Mussels are a rich food source and can produce more protein per acre than any other farm crop. Although considered to be a gourmet item in North America, mussels are a primary food source in many parts of the world. The domestic market for mussels is quite large and growing rapidly. Some of the U.S. market for mussels is supplied by farms in Puget Sound, the Santa Barbara Channel (mussels grown on oil rigs) and New England, while imports from Europe, Chile, New Zealand and Asian countries account for most of the rest.

Because of water quality problems, no new mussel farms are likely to be permitted in Puget Sound in the near future. Another problem faced by shellfish growers in Puget Sound is plankton blooms (red tide) in late summer which nearly shut down sales for about two months each year. In many areas of New England, harvested mussels must go through a depuration process, where they are flushed with clean saltwater for a certain time period before they can be sold. European mussel farmers are also facing severe water quality problems. These factors add up to a very promising domestic and export market situation for mussel farmers in Alaska. Freight rates from Alaska to both the U.S. and Europe are cheaper than they are for several of the exporting countries cited above.

There are currently five permitted mussel farms in Alaska—three in Kachemak Bay and one each in Prince William Sound and Kodiak. Mussel farmers benefit from the same market situation as oyster farmers. Thus far, only one farm is producing mussels in commercial quantities (10,000 lbs. in 1986).

Mussel farming is a moderately labor intensive business. The larvae can be collected at the free floating stage on lines suspended in the water or juveniles can be scraped off rocks or cliff faces and contained in sock nets around a hanging line. When the mussels become attached to the line, the containment sock is removed. The hanging lines are then suspended from rafts. Periodically the lines must be inverted and sediment and debris scraped off. Mussels take from 12-18 months to mature and can be harvested at any time of the year.

Mussels are sold live, in the shell for about $1.45/lb. wholesale and $2.99/lb. retail. Based on the economics of present operations, six rafts yielding an average of 5,000 lbs. each would generate sufficient returns for a family living at the farm site, once initial investment costs have been recovered. We do not have an adequate information base to discuss investment costs in detail but it appears that mussel farming could be an ideal family-type operation that can be practiced in many suitable coastal regions of the state. Combined with the cultivation of other species, it can allow a small operator to make a comfortable living and enjoy a remote life-style. In some other areas of the world, mussel rafts have been placed around salmon pens to feed off the fines from salmon food suspended in the water.

Scallops

The stable price of scallops over the years (about $4/lb.) and a growing domestic shellfish market makes it a very attractive species for mariculture. There are several scallop larvae collection efforts underway in the waters around Kodiak Island and other areas of Prince William Sound and Southeast. The Kodiak efforts are being coordinated under a joint Alaska-Japan development project to adapt techniques used to grow the Japanese scallop, which has been under cultivation for over twenty years in that country. Japan has a very large scallop culture industry, located mainly on Hokkaido, that produces about 200,000 mt of scallops annually. Kodiak has some of the richest scallop-growing conditions in the world and the species that is being targeted is the weathervane scallop, which is the largest of ten separate species found in the area.

Weathervane larvae drift in the water and seek a place to attach themselves. Spat are collected by suspending onion bags full of monofilament line from anchored and buoyed lines near known scallop beds. The larvae attach themselves to the monofilament in the bags until they become mature enough to drop off and continue their life cycle on the bottom. By this time they are too big to fit through the onion bag mesh and are captured. To date, many other kinds of shellfish have been collected but weathervane have proven elusive. A large-scale effort is planned for this summer.

In the initial grow-out phase, small scallops are placed in pearl nets to filter feed from the water as it is moved by tides and currents through the mesh of the net. Scallop culture is fairly labor intensive. Periodically the scallops must be removed to be cleaned, checked and sorted. After approximately one year, the scallops

are moved to final grow-out nets of larger mesh or alternatively strung on lines through holes drilled in their shells. Within two to three years the scallops reach harvester size of about five inches in diameter. Maricultured scallops are generally sold on the gourmet half-shell market.

If current larvae collection efforts are successful and a reliable source of spat is developed either through wild capture or hatchery techniques, scallop mariculture could become a viable industry, suitable to many of the coastal areas of Alaska. Based on the experience of the Japanese industry, there could be potential for cultivating scallops in Alaska.

Giant Kelp

Herring roe-on-kelp is the highest priced fisheries product harvested in Alaska. Roe-on-kelp is known as kazunoko kombu in Japan where it is a traditional delicacy. The Japanese market is expected to provide the impetus for development of a sea vegetable industry involving the cultivation of giant kelp in Alaska. The roe-on-kelp pound fishery, which would serve as the basis for giant kelp mariculture, occurs in Prince William Sound for a few days each spring. In 1987, herring roe-on-kelp sold for $10 - $14/lb. (depending on the grade of product) and the pound fishery grossed approximately $1.2 million on a harvest of 60.26 tons.

In the pound fishery, giant kelp is harvested in Southeast (where it grows wild) and is transported to Prince William Sound (where it is not native). The kelp is suspended in net-enclosed rafts or pounds. Ripe schools of herring are caught by fishing vessels in seine nets and transferred to the pound, where they are held until spawning occurs on the enclosed kelp. The roe-laden kelp is then harvested at the optimum time for the highest quality roe and the herring are released to return and spawn again in future years.

In the traditional sac roe fisheries, the spawning herring are caught in nets, frozen in blocks and generally shipped to Japan to be stripped of their roe. Because the adult herring are not killed and a much higher valued product is produced, the pound fishery is an attractive alternative to the traditional sac roe fisheries.

A major concern in the management of the existing roe-on-kelp fishery is the potential for overharvesting the wild giant kelp resource. One way to avoid this would be to artificially cultivate kelp on farms to enhance existing beds. Sheldon Jackson College in Sitka is conducting an experimental project to test the feasibility of kelp mariculture in Southeast under the same Alaska-Japan cooperation agreement as the scallop project in Kodiak. A smaller kelp project will also be conducted in Kodiak over the next year.

Giant kelp is cultivated by collecting sporofites from wild plants. At the appropriate stage of development, juvenile plants are started on strings, which are then threaded through a groundline that is suspended just off the seabed. When the plants reach maturity, the groundline is retrieved and the kelp fronds are harvested.

Herring roe-on-kelp is the highest priced fisheries product harvested in Alaska.

In recent years the pound fishery has become so popular that the Board of Fisheries limited entry to the pound fishery at 125 permits in February of this year. The 1987 fishery quota was set at 85 tons. The Board of Fisheries has been petitioned by many groups wishing to start pounding operations in other areas of the state, but has turned them down because available roe herring stocks are being fully exploited by traditional net fisheries.

The Department of Fish and Game is in the process of surveying widely scattered herring stocks to see if there are any which are currently unexploited by existing sac roe fisheries that could support further pound fisheries. Thus it appears that while kelp farmers could have a good roe-on-kelp fishery market, the ultimate feasibility of giant kelp mariculture will probably depend on locating an adequate roe herring resource.

Conclusion

Aquaculture diversification is proceeding along several paths in Alaska and holds great promise for the economies of coastal communities. Two recent developments have conspired to make the articulation of a State policy for mariculture development take on a sense of urgency. First the Attorney General's Office has issued an opinion that says that salmon farming is legal under existing statutes. Second, a lawsuit has been filed against the State by Wilderness Acquisitions, Inc. for denial of the permits necessary to start a hatchery and salmon farm at Warm Springs Bay on Baranof Island. If the State loses this case in court, it could open the way for further litigation and potentially allow salmon farming under very loose regulatory guidelines.

In response to these developments, the legislature has passed a bill (Chapter 70, SLA 1987) that places a one-year moratorium on the issuance of licenses, permits, leases or authorizations for commercial finfish farming but allows the experimental scallop and giant kelp projects to proceed. Oyster and mussel farmers will continue to operate under the current permit situation until an agreeable regulatory structure can be worked out. This legislation is designed to allow an interim committee of representatives of the various regulatory agencies and interest groups to design a comprehensive policy for further mariculture development.

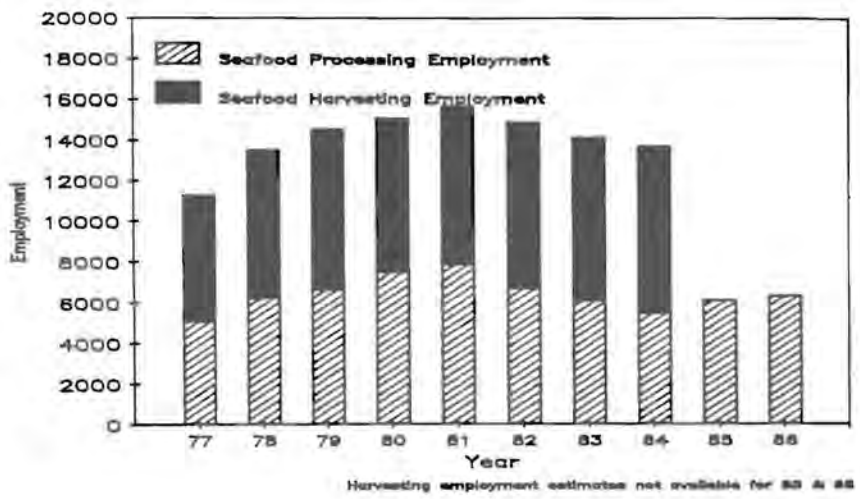
All parties concerned feel that aquaculture diversification is too important to proceed haphazardly and should be undertaken within a policy framework that is clearly laid out in State law.

Employment in Alaska's Seafood Industry

By Neal Fried and John Boucher

The seafood industry has been a major contributor to Alaska's overall economy since the late 1800s. Commercial fish canning began in 1878 in Southeast Alaska and the number of canneries in Alaska increased steadily for the next fifty years. The number of canneries reached their peak in 1929 at 160. Although the number of canneries has declined since, the seafood industry remains an important economic activity in Alaska. Canneries and fishing fleets provide economic activity around which coastal communities from Ketchikan to Kotzebue sprang up and prospered.

Figure 1
Seafood Industry Employment 1977-1986



In recent years oil has been such a dominant force in Alaska's economy that strong growth in Alaska's seafood industry has gone unnoticed. Now, with lower oil prices and reduced state government spending, Alaska's seafood industry is reemerging as a leader in employment and industry growth. Today, employment is more than double the levels of the 1960s and early 1970s. The development of new seafood products, the recovery in the salmon fishery, and expanding shellfish and bottomfish harvests have made this growth possible.

This article examines employment and trends in the seafood industry. Seafood industry employment is broken into two components; seafood harvesters (fishermen) and seafood processors (manufacturing). This method is used for several reasons.

First seafood processing and harvesting employment estimates are obtained by separate methodologies. Seafood processing employment is covered by unemployment insurance and therefore included in the nonagricultural wage and salary employment figures published monthly. Seafood harvesting employment is not covered by unemployment insurance, unless the number of the crew is ten or more and they receive a wage or salary.

Since most crew members work for a share of the catch they are considered self-employed and not included in the nonagricultural employment numbers. Data from the Commercial Fisheries Entry Commission and crew factors for various types of fisheries are used to estimate seafood harvesting employment. (For an explanation of methodology see *Alaska Seafood Industry Employment*, Alaska Department of Labor, June 1987)

In addition to methodological considerations, seafood processing and harvesting are different occupations. Seafood harvesting attracts independent individuals who are willing to take high risks for potential big gains. Processing work on the other hand is manufacturing factory work at relatively low pay. The levels of employment are related, however, and estimates of seafood processing employment give an indication of the level and trend of seafood harvesting employment (Figure 1 and Table 1).

Seafood Harvesting Employment

Since seafood harvesting employment is classified as self-employed and not collected by an ongoing survey such as that used to collect nonagricultural wage and salary employment an alternative method to estimate seafood harvesting employment was developed. This data was first estimated for 1977 through 1981 and was recently updated through 1984. (See *Alaska Seafood Industry Employment*, Alaska Department of Labor, June, 1987.)

From 1977 to 1984 the number of seafood harvesters in Alaska increased by one-third, with most of the increase occurring prior to 1980. In 1977, annual average employment in all fisheries was 6,164. By 1979, seafood harvesting employment was 7,919 and it has remained around 8,000 since. In 1984, seafood harvesting employment recorded its highest level of employment since 1977 with an annual average employment of 8,202.

Seafood Processing Employment

The seafood processing component is the other major employment generator in Alaska's seafood industry and is Alaska's leading manufacturer. Over the past decade annual average seafood processing employment has been relatively stable. The low point was 5,463 annual average employment in 1977. At that time salmon harvests were just beginning to recover after a number of lean years. Employment in the industry peaked in 1981 when a very healthy salmon season pushed annual average employment in seafood processing to 7,957, a record. Ironically, this was also the year the collapse of the king crab fishery began.

No other industry in the state is as seasonal as the seafood industry. In 1986 seafood processing employment peaked at 15,007 in July; with an annual average 6,813 jobs. This represents 41-45% of the jobs in the seafood industry and 3% of the states total wage and salary employment. During the past three years the peak month's employment in seafood processing is seven times the low month's employment. The peak month traditionally occurs during the salmon harvest in July or August and the low point is in January. (Figure 2)

Table 1
Seafood Industry Employment by Major Category
1977-1984 Annual Averages

Year	Seafood Processing	Seafood Harvesting	Total Seafood Industry
1977	5,122	6,164	11,286
1978	6,274	7,278	13,352
1979	6,657	7,919	14,576
1980	7,510	7,590	15,100
1981	7,884	7,821	15,705
1982	6,730	8,194	14,924
1983	6,132	8,029	14,161
1984	5,521	8,202	13,723
1985	6,149	*	
1986	6,366	*	

* Estimate not available

Trends in the Seafood Industry

Through 1984, three fisheries were responsible for most of the growth in seafood employment; the salmon fishery, the halibut fishery and the herring fishery. Of the 2,000 seafood harvesters added from 1977 to 1984, over half were in the salmon fishery, 400 in the halibut fishery, and 300 in the herring fishery. The bottomfish and sablefish fisheries account for most of the balance of seafood harvesting employment growth since 1977.

Seafood harvesting employment and other available data show that salmon is the most important species for Alaska seafood harvesters (Figure 3). In 1984 the salmon fishery provided 65% of all seafood harvesting employment. After salmon, the nearest fishery was shellfish which accounted for 14% of the total employment. Halibut was third at 11%.

Since 1977, the mix of employment by species has changed because of the collapse in the shellfish fishery. In 1977, the shellfish fishery accounted for 18% of all seafood harvesting employment and it maintained that level through 1983. By 1984, harvesting employment in the shellfish fishery dropped off dramatically because of disappearing shellfish stocks. From 1977-1980 the annual shellfish catch

Figure 2
Seasonality of Fishing Industry Employment 1984

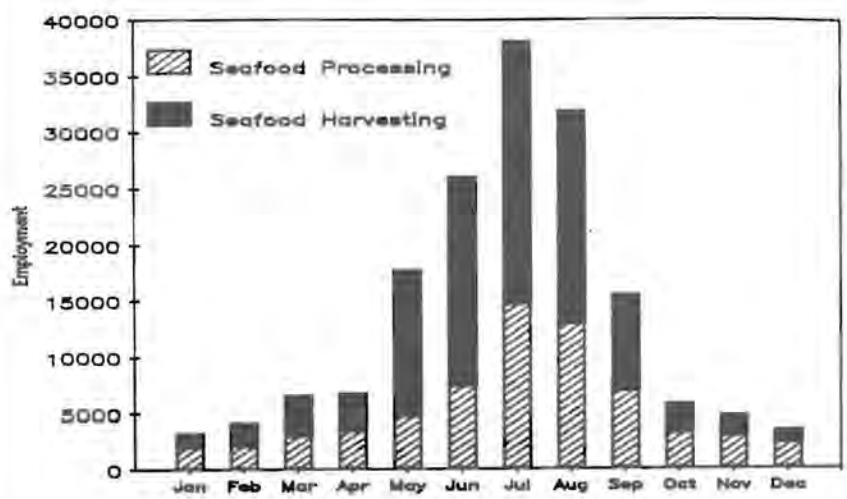


Figure 3
Seafood Harvesting Employment by Species
1984 Annual Average

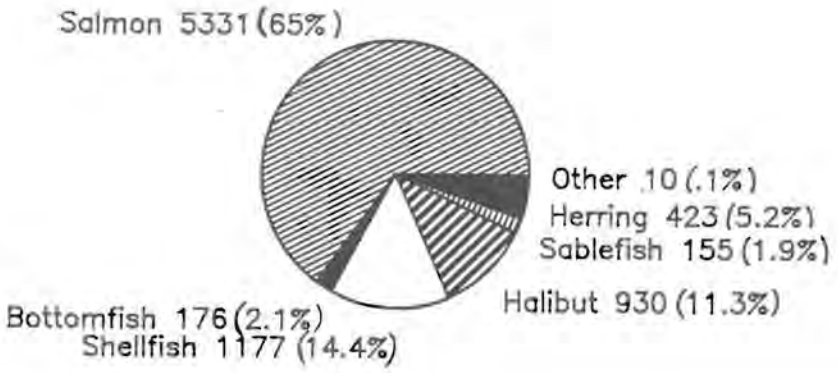
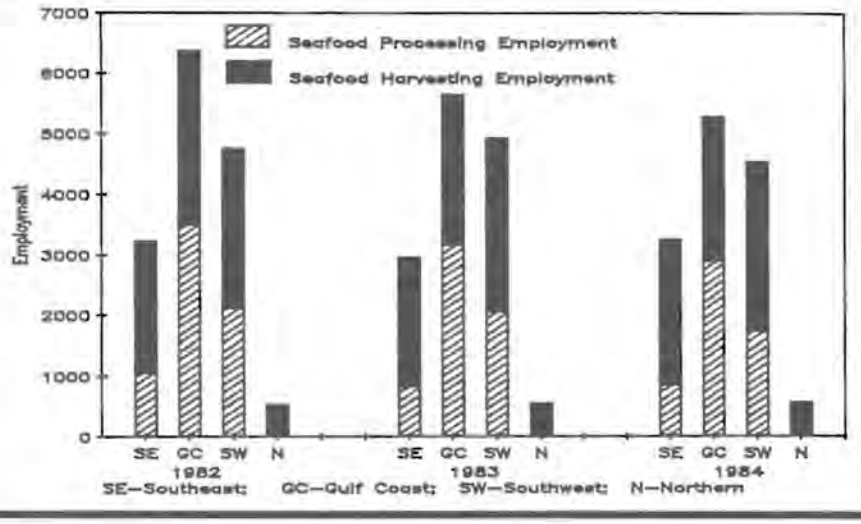


Figure 4
Fishing Employment by Region 1982-1984



was over 300 million pounds, but by 1984 the shellfish catch was down to 91 million pounds, little more than one-quarter of the total harvested in the late 1970s.

In contrast to the decline in employment in the shellfish fishery, the halibut fishery has seen its share of total harvesting employment steadily increase since 1977. In 1978 the halibut fishery accounted for 7% of total seafood harvesting employment. By 1984 it had climbed to 11% of the total seafood harvesting employment.

Unlike Alaska's economy as a whole, seasonality has increased in the seafood processing industry over the past decade. During the late 1970s and early 1980s the difference between high and low months was three-fold unlike the seven-fold it has been during the past three years. Seasonality of the industry has increased because: 1) the collapse of the king crab fishery which provided significant employment during the non-salmon season, 2) other shellfish harvests such as shrimp and tanner crab suffered declines, 3) the volume of salmon processed increased, and 4) certain fishing seasons, such as halibut and herring were shortened so that an increasingly concentrated effort during a shorter period of time now takes place, causing more dramatic swings in employment.

In the future there could be some smoothing out in the seasonality if the bottomfish fishery continues to grow. Fishing activity in bottomfishing is not limited to three or four months out of the year, but instead is a year-round activity. This year a number of processors in Kodiak plan on operating both bottomfish and salmon lines simultaneously for the first time. A return to a healthy shellfish fishery could also temper the fluctuations in employment. The less seasonal the industry becomes, the more Alaskan residents could depend on it as source of their livelihood.

Geographic Distribution

Not surprisingly, seafood industry employment is concentrated in Alaska's coastal communities and is an important contributor to employment in all the coastal regions of Alaska (Figure 4). In rural areas seafood harvesting's stature as a source of employment is greater than urban areas where local economies are not as dependent upon this single resource. In 1985, 95% of the seafood processing employment was concentrated in three regions—the Gulf Coast (including Anchorage/MatSu) (48%), Southwest (32%) and in Southeast (16%). Interior Alaska is the only region where there is no significant seafood employment.1/

Southwest Alaska has the largest amount of seafood harvesters and its economy relies more heavily on harvesting employment than any other region in Alaska. On an annual average basis, seafood harvesting employment in the Southwest region was

1/ Because of the way harvesting data is aggregated, Anchorage/MatSu is included with the Gulf Coast Region's data. Seafood harvesting employment is not available separately for the Anchorage/MatSu Region. In addition the processing data for the Southwest Region falls in areas that are included in the Northern Region for fish harvesting.

nearly 2,800 in 1984. If seafood harvesting employment were compared to nonagricultural wage and salary employment, seafood harvesting would be the largest employer except local government. If seafood harvesting and seafood processing employment are added together they surpass local government's total annual employment. In June, July, and August, seafood harvesting and seafood processing employment combine to create over 10,000 jobs in the region. A recent report by the University of Alaska's Institute of Social and Economic Research (ISER) on the commercial seafood industry in Alaska estimated that the fisheries industry generated 47% of all income earned in the Southwest region. If just private sector basic industry income is considered, fishing generated 98% of all private sector basic industry income in Southwest Alaska.

The Gulf Coast and Southeast regions of Alaska are not as dependent upon seafood harvesting employment as Southwest Alaska, but seafood harvesters do play a significant role in their economies. Processors in the Gulf Coast and Southeast often benefit from fish harvested in other region's waters. The Southwest region produced the largest harvests—almost twice as large as the Gulf Coast's but its processing employment is significantly smaller. It is not unusual for a share of the large Bristol Bay salmon catch to be processed in the Gulf Coast.

In 1984, seafood harvesting employment in the Gulf Coast and Southeast Alaska was comparable, slightly under 2,400 in both regions. Although Southeast Alaska had slightly more harvesting employment in 1984 than the Gulf Coast, historically the Gulf Coast has had more seafood harvesting employment. The flip-flop is due to the collapse in the Gulf Coast's crab fishery. The Gulf Coast region has historically relied on the shellfish fishery for about 25% of its total harvesting employment. On the other hand, Southeast Alaska's shellfish fisheries share of total employment only recently topped 10% of total harvesting employment.

Gulf Coast seafood processing is dominated by Kodiak and Cook Inlet processors. Kodiak is Alaska's number one fish port for value of fish landed and second only to New Bedford, Maine nationwide. Kodiak presently has 13 active fish processors, the largest number in any one community in the state. The Southwest region is dominated by Dutch Harbor and Bristol Bay processors.

The Northern region's seafood harvesting employment is rather small when compared to the other regions. The fishing industry's importance is minimal when compared to the oil industry, but it does provide employment and income primarily to the northwest coastal communities of the state.

Floating Processors Increase in Number

One change occuring in the processing arena is an increase in the number of floating fish processors. Floating processors provide flexibility by moving with ease from one fishery to the next. According to the Alaska Department of Environmental Conservation's records there are approximately 3-times as many floating processors permitted in 1987 than there were in 1980.

There is some concern regarding this trend because many floating processors are based out-of-state, and therefore may more readily buy their supplies and bring in their crews from elsewhere. This would mean little economic activity generated in Alaska's economy, and would make the goal to improve resident hire much more difficult. The growth in the number of floating processors does not necessarily mean Alaska will accrue less economic benefit from floating processors than shore based operations. It will depend on whether these floating processors dock in Alaska's ports for repairs, supplies and workers.

Product Changes

The biggest change occurring presently is the growing bottomfishery in Alaska. Though we are unable to accurately break down seafood processing employment by species we know this fishery has made measurable inroads into Alaska's processing industry. The bottomfish harvest has increased dramatically for domestic fisherman. The areas most active in bottomfish processing have been Kodiak and Dutch Harbor. During the past year, processors in Kodiak and in Dutch Harbor have processed bottomfish for filets, surimi, and blocks.

Some Cook Inlet processors and others in the state also began to process bottomfish during the past two years, and others are considering expanding to process bottomfish. The potential is great, and if Alaskan based processors succeed in capturing a large portion of the harvest, it could provide the biggest boost to the seafood industry since the growth in the King Crab harvests of the late 1970s and early 1980s. An additional benefit to a growing bottomfishery is the smoothing of the seasonality of this industry.

An increasing amount of salmon are being processed for the fresh/frozen market as opposed to canning. In 1977 32% of the salmon processed were fresh or frozen while 64% were canned. By 1985 the proportions had reversed themselves; 66% were processed for the fresh/frozen market and 32% were canned. These proportions fluctuate each year but with a trend towards a greater percentage of fresh and frozen salmon. For example in 1982, the year after the botulism scare, 70% of the salmon were fresh/frozen. The effects a shift to a fresh/frozen product has had on processing employment is not clear. Some claim it utilizes more labor and other say less.

In addition to a growing fresh/frozen product, Hormel, Bumble Bee and others are introducing a new method to can skinless and boneless pink salmon. The project is an attempt to broaden the appeal of canned pink salmon. If it proves to be successful it could help insure a permanent market for Alaska's largest salmon fishery.

Employment of Residents

Few residents work in Alaska's seafood processing plants. As a low paying and uncertain source of employment it is difficult to sustain a person in areas with a high cost of living.

In 1985, 69% of all seafood processing workers were nonresidents. The migration of thousands of college

students and others from the lower 48 is an annual ritual. They are Alaska's 'migrant' workers. A majority come for three to four months during the summer season and then leave. Some begin with the herring fishery in Togiak in April and work their way down the coast to Ketchikan in September to process salmon. The seasonality of the fishery partially explains why so few residents choose to work in this industry.

Wages paid in this industry make work less attractive to residents. The average entry hourly wage is $5.66 per hour and the average hourly wage for a person with a two years of experience is $6.67. Long working hours can boost earnings, but in spite of this, the average monthly wage in this industry remains low. In 1985 the average monthly earnings was $1,443 in seafood processing, only 61% of the monthly average of $2,369 for all industries. The highest wages are paid during the salmon season because of longer hours worked. The average monthly earnings climb to $1,600 during the third quarter of the year.

Over time, seafood processing earnings have increased little, and if they are adjusted for inflation they have actually lost purchasing power. The average monthly earnings would have fallen further if salmon's relative importance hadn't increased over the past six years because of the poor shellfish fishery. The combination of low wages, seasonality, a long tradition for many fish processors to hire their crews outside of Alaska, and possibly working conditions have all tended to make the percentage of nonresidents high in this industry.

In the future the number of residents represented in the processing industry could grow for two reasons. Presently there are far fewer employment opportunities in the state than in past years and therefore more state residents may choose to work in this industry. Also, the Department of Labor and a group of fish processors are making greater efforts to facilitate and encourage state residents to work in this industry.

Resource Management and Seafood Harvesting Employment

Any discussion of seafood harvesting employment must acknowledge the enormous effect that resource managers have on seafood harvesting employment. Since so few variables affecting the availability of the fisheries resource can be controlled, resource managers control the number of fishermen, the type of gear used, and the time that fishing can take place. In short, resource managers can be one of the most important variables in the amount of seafood harvesting employment.

Alaska's salmon fishery is an example of how resource managers have affected salmon harvesting employment. Since 1975, Alaska's salmon fishery has been managed through limited entry. Permits are issued that limit the number of seafood harvesters that have access to the fishery. The result has been that except for a jump in salmon harvesting employment that occurred from 1977 to 1978, salmon harvesting employment has remained stable at around 5,000 harvesters.

Limited entry is not the only way that resource managers can affect harvesting employment in a fishery. Halibut harvesting employment has been made more seasonal since 1977 because the halibut fishery is not limited. Since fishermen are allowed free access to the fishing grounds, the length of halibut openings have been dramatically shortened. In 1977 the halibut season lasted five months and monthly employment never exceeded 1,800. By 1984 halibut was a one month fishery with employment during that month of over 9,000.

Resource managers do not always act as a limiting factor to seafood harvesting employment. In the case of the bottomfish industry, Congress mandated with the Magnuson Act of 1980 that resource managers act to expand seafood harvesting employment by "Americanizing" the bottomfish industry. The growth of bottomfish harvesting employment, at least through 1984, has been slow but it has been accelerating. From 1983 to 1984, the total number of employees involved in bottomfish grew 47% compared to the usual 20 to 25% growth. Bottomfish harvesting employment has grown 450% from 1977 to 1984.

Projections of the American take of bottomfish for 1987 indicate that volume processed will be double the volume processed in 1984. In Japan, retraining programs are being instituted for Japanese bottomfishermen who have been laid off due to Americanization of the industry. All of these point to increasing bottomfish harvesting employment for the immediate future.

Another way resource managers affect seafood harvesting employment is by increasing the available supply of fish through hatchery programs. By enhancing the supply of salmon through state owned and private nonprofit hatcheries, the salmon fishery has increase from 304 million pounds harvested in 1977 to 650 million pounds in 1984.

Conclusion

The seafood industry provides many benefits to Alaska's economy including direct jobs. In 1985 the value of Alaska's fish harvest was $565 million but the wholesale value to the processors was $1.1 billion. The processing of the fish provides an "added value" to the fish product. In other words the fish becomes a more valuable product after it is processed and some of the "added value" accrues to the state's economy in the form of direct jobs, taxes, and indirect jobs in the transportation and services industries. In 1986 $115 million was paid out in wages. Processors purchase supplies and other services and pay taxes in the communities they are located. And last but not least they provide the necessary infrastructure to operate one of Alaska's largest industries—fishing.