

ALASKA LEGISLATURE SPECIAL COMMITTEE / SUBJECT F
1864 SCOMM 75: MARICULTURE (FISH FARMING),

TABLE 4 (Continued)

Region/Corporation (Number of Permits)	State Loans		Cumulative Enhancement Funds	Grants* and Contracts	Estimated Revenue 1985 Sales of Fish
	Capital Construction	Operations			
<u>Northern Southeast (Continued)</u>					
Kake Nonprofit Fisheries Corp.-- KNFC (1)	731,087	823,526	N/A		0
Sheldon Jackson College--SJC (1)	362,254	61,370	N/A		98,583
Tlingit and Haida Central Council-- THCC (1)	1,464,000	89,860	N/A		0
<u>Prince William Sound</u>					
Prince William Sound Aquaculture Corp.-- PWSAC (2)	16,052,539	1,085,500	3,845,816 (Note 2)	1,088,500	911,673
Valdez Fisheries Development Corp.-- VFDC (1)	3,433,830	2,211,879	N/A		157,717
<u>Cook Inlet</u>					
Cook Inlet Regional Aquaculture Corp.-- CIRAA (1)	1,348,881	444,755	2,428,882 (Note 3)	756,621	0
Lower Yukon/ Kuskokwim--LYK				308,000	

TABLE 4 (Continued)

Region/Corporation (Number of Permits)	State Loans		Cumulative Enhancement Funds	Grants* and Contracts	Estimated Revenue 1985 Sales of Fish
	Capital Construction	Operations			
<u>Cook Inlet (Continued)</u>					
Imarpik				100,000	
Kodiak				118,520	
STATEWIDE TOTALS	\$39,571,926	\$12,753,555	\$15,438,460	\$4,262,652	\$1,905,256

*Grants and contacts include funds appropriated by the legislature and administered through the Alaska Department of Fish and Game Commissioner's Office for development of comprehensive regional salmon plans.

Note 1: Three percent mandatory assessment tax collected from commercial fisherman.

Note 2: Two percent voluntary assessment tax (through 1984) collected from commercial fishermen.

Note 3: Two percent mandatory assessment tax collected from commercial fishermen.

Source: "FRED 1985 Annual Report", p. 49; Update State Loan data (through June 30, 1986), Department of Commerce and Economic Development, Division of Investments, September 1986.

According to FRED personnel, it takes about two years to bring a new hatchery into operation. The permitting process from preliminary application through final approval takes approximately nine months (if everything goes smoothly). Building a new facility generally takes an entire construction season. By the time the facility is operational and ready to receive eggs, most PNP operators have already been receiving State loans for two years without ever incubating a fish egg. Once eggs have been purchased or taken (under FRED supervision), it generally requires at least two complete cycles of releases and returns before a hatchery can generate enough revenues from the sale of surplus fish, eggs and carcasses to become self-sufficient and begin repaying its loans. If wild stocks of the particular species to be raised are not locally available for taking and must be purchased, it may take three generations before a hatchery can become self-sufficient.

The extended payback period and the uncertainty of returns through the common property fisheries (risk factor) are the primary reasons for the State to be involved in financing PNP hatcheries. Operators of each hatchery facility must complete extensive pro forma cost and revenue projections for the species to be raised (based on survival assumptions developed through experience over several years by FRED) before taking out a State loan. Thus, the difference in interest rates between State and private financing is not critical, as it is already figured into projected operating costs. The deferred payment schedule and extended payback period offered in the State's Fisheries Enhancement Revolving Loan program are crucial to the viability of PNP hatcheries however.

Salmon Species in Alaska's Hatcheries

The economics of private salmon hatchery production in Alaska are highly variable and dependent on the species that are produced. We include this section explaining the life cycles of species produced in Alaska's hatcheries for clarification. Depending on the species to be produced, the type of hatchery facility, and management objective, the time span required for two complete cycles of releases and returns ranges from 4 to 12 years:

Chinook	8-12 years
Coho	6- 8 years
Sockeye	8-12 years
Chum	6-10 years
Pink	4 years

Figure 5 describes the life cycles of the five species of salmon native to Alaska and the amount of time required to produce hatchery-raised adult returns from each.

FIGURE 5

LIFE CYCLE OF 5 SPECIES OF PACIFIC SALMON
NATIVE TO ALASKA

YEAR	CHINOOK Natural	(King) Hatchery	COHO Natural	(Silver) Hatchery	SOCKEYE (Red)	CHUM (Dog)	PINK (Humpty)
1978	Brood Year	Brood Year	Brood Year	Brood Year	Brood Year		
						Brood Year	Brood Year
1979		Smolt Release		Smolt Release		Release	Release
				Jack Return *			
1980	Smolt Release	Jack Return *	Smolt Release Jack *	Adult Return	Smolt Release		Adult Return
			Return				
1981	Jack Return	Jack Return	Adult Return		Jack Return *		
1982	Jack Return	Adult Return			Adult Return	Adult Return	
1983	Adult Return	Adult Return			Adult Return	Adult Return	
1984	Adult Return	Adult Return			Adult Return		
1985	Adult Return						

*Jacks are sexually precocious males which return early.

SOURCE: Jeff Hansen, Alaska Department of Fish and Game. FRED.

Chinook and cohos can either be released into freshwater as fingerlings, from which they will migrate voluntarily to sea (as smolts) in one or two years, or they can be reared to smolt size in raceways at the hatchery and released as smolts in one year. FRED has recently experimented with so-called "age-zero" chinook.⁴² These are juveniles whose natural behavior of overwintering in freshwater before going to sea has been modified (by rearing in warmer water with an accelerated feeding schedule) so they can be released at sea in less than one year after hatching. Even though the survival rates of these fish are lower than regular yearling smolt releases, they are much more economical to raise.

The hatchery can produce three to four times as many age-zero juveniles as yearling smolts for release, since as smaller fish, they require much less freshwater rearing space at the hatchery site. There have been some small-scale adult returns of age-zero releases, so the technique has proven to be effective, though it has yet to be applied on a major scale. As we show in the next chapter, these new hatchery techniques could be important to the development of a salmon-farming industry in Alaska.

Sockeye fingerlings are generally released into lake systems (where the hatchery has no control over the timing of their migration) and migrate to sea as smolts in one, two or even three years. Chum and pink salmon migrate to sea as emergent fry after hatching in the spring and do not go through the same extended fingerling stage as other species in freshwater. This makes them much cheaper and easier to raise than other species.

Moratorium on Fisheries Enhancement Loans

In 1984, the Governor's fisheries mini-cabinet recommended a freeze on construction loans from the Fisheries Enhancement Revolving Loan Fund, pending a review of the costs and benefits of the State's investments in both private and public salmon rehabilitation and enhancement projects. This move was prompted by processors' complaints of unsold inventories of frozen and canned salmon (particularly pinks and chums) and fishermen's concerns over low ex-vessel prices following five consecutive years of near-record harvests. In a memorandum to the Governor, Greg Baker, then Director of the Office of Commercial Fisheries Development, stated the situation and the consensus of opinion within the Governor's Fisheries Mini-Cabinet at the time very succinctly:

Alaska's waters now produce an average wild stock harvest ranging from 66.2 to 86.3 million fish. The State has made a worthwhile investment exceeding \$100 million in PNP, Regional and FRED

⁴²Jeffrey A. Hansen, "FRED 1985 Annual Report to the Alaska Legislature," p. 39.

enhancement facilities. When these are completed, they will add 21 to 28 million salmon to the commercial harvest, producing net profits to resident Alaskan fishermen.

Conversely, when the total salmon harvest exceeds about 115 million fish, additional catches probably reduce net income to the fishermen, and until salmon consumption increases, an investment in any new increment of production is unlikely to produce a net benefit.

Consequently the cabinet recommends funding the completion of existing/permitted facilities but cannot at this time recommend investing in any new increments of production. The seafood industry in Alaska must view itself as being in the food business.

The State and industry must focus their efforts on the marketplace. We can increase consumption and add more value to our seafood products through marketing and product form development.⁴³

The moratorium affected loans for new hatchery production of all species not permitted prior to February 15, 1985. At the request of several regional aquaculture associations, fishermen's groups and one PNP operator, the Fisheries Mini-Cabinet reviewed its earlier analysis and changed its policy regarding the Fisheries Enhancement Revolving Loan Fund (as of July 31, 1986). Again Greg Baker wrote to the Governor on behalf of the mini-cabinet:

Existing data regarding the impact of Alaska salmon supplies on prices suggests that there is no clear correlation between the production of Alaskan coho, sockeye and chinook and ex-vessel prices paid to resident fishermen. Consequently we recommend that, subject to funds available to the loan fund, the policy restriction on loans for the incremental hatchery production of these species be removed.⁴⁴

⁴³Greg Baker, Memorandum from Richard Lyon, Commissioner, Department of Commerce and Economic Development, Richard Neve, Commissioner, Department of Environmental Conservation, and Don Collingsworth, Commissioner, Department of Fish and Game to Honorable Bill Sheffield, Governor, regarding benefit/cost analysis of State Enhancement Investments, December 20, 1984.

⁴⁴Fisheries Mini-Cabinet, July 31, 1985 memorandum to Honorable Bill Sheffield, regarding Fisheries Enhancement Revolving Loan Fund Policy.

Additionally, the mini-cabinet recommended that analytical tools for market impact forecasting of incremental increases in pink and chum production on a regional or sub-regional basis be developed. Feasibility studies at the preconstruction stage for all species remain eligible for loans. To date, no hatchery operator has actually been denied a loan because of the moratorium.

It is probable that some sort of pause in the construction of new hatchery production facilities was inevitable, given the rapid growth of the program and the magnitude of the State's investment. Some of the Mom and Pop operations have had difficulty generating enough cost recovery to pay off their State loans. Three operators have had serious financial difficulties, and of these, two appear to have been successfully resolved. Regional associations are under additional constraints. They must partially recover costs through sales of surplus fish without competing for markets with the fishermen whose assessments help pay for their operations. The major difficulty faced by both regional and nonassociation hatchery operations has been to work out a reasonable harvest management scheme with the ADF&G, Division of Commercial Fisheries, the Board of Fish and fishermen's groups, that allows adequate returns to the hatchery site for cost recovery.

Harvest management is a controversial subject. The ADF&G, Division of Commercial Fisheries (DCF) is charged with managing salmon harvests to separate natural and hatchery stocks and to assure adequate escapement for natural runs.⁴⁵ The DCF is not charged with managing to assure cost recovery to hatchery operators. FRED, on the other hand, as the regulator for PNP hatcheries, is in something of an advocacy position. Thus, there is often a basic philosophical conflict between the goals of the two divisions. Many biologists feel that managing mixed stock fisheries is an inexact art at best and adding an additional burden of trying to assure adequate cost recovery to hatchery operators is simply not realistic. On the other hand, there is the specter of a declining State revenue source behind enhancement loans, which implies that PNP hatcheries should become self-sufficient and independent of State financial support as quickly as possible.⁴⁶

⁴⁵Hatchery stocks have a higher juvenile survival rate than natural stocks. Thus, harvests of mixed stocks (assuming hatchery and natural fish are harvested at the same rate) will inevitably favor the return of hatchery fish over time. Since the purpose of hatchery production is to supplement, rather than supplant natural production, hatcheries are generally sited to allow terminal harvests near the hatchery that do not adversely affect natural runs in the region.

⁴⁶"North Pacific Fisheries Delphi Project Final Report," p. 39.

The partial cost recovery/assessment method for regional associations appears to be working fairly well. For nonassociation hatcheries, the present cost recovery situation is more difficult. It is probable that some other institutional arrangement will have to be made (e.g., allowing hatcheries to eventually obtain private, for-profit status, allowing them to pen rear salmon and/or sell eggs and smolts to salmon farms) to assure their long-term viability in the absence of continued State funding. A discussion of options for nonassociation hatcheries appears at the end of this chapter.

PRICE/VOLUME RELATIONSHIPS IN ALASKA'S SALMON FISHERIES

The benefit/cost analyses of Alaska's hatchery programs (discussed in the next section) on which the enhancement loan policy decisions cited above were based, are in turn based on assumptions about the factors that determine price and volume relationships for the species of salmon being produced in Alaska's hatcheries. An understanding of these factors and their relative importance is crucial to rational policy decisions about the future of the State's hatchery programs. Price and volume relationships for various salmon products and geographical markets are extremely complex and interrelated and do not lend themselves easily to economic modeling. Ex-vessel prices in Alaska are not set on a purely competitive basis (a standard assumption of most econometric models).⁴⁷ Generally, a negotiated contract price is set at the beginning of the harvest season for very early runs (e.g., Copper River sockeye), which serves as a benchmark for other areas with later returns. Ex-vessel and wholesale prices for individual species tend to be fairly volatile as the harvest season progresses and the strength or weakness of returns for particular species and areas become apparent.

Aside from the seasonal volatility of prices based on harvest levels, there are underlying structural changes relating to shifts in consumer tastes and preferences occurring in salmon markets worldwide. These factors are not picked up by economic models until after a particular trend has become apparent in available data. For example, there is a trend toward greater consumption of fresh and frozen products, as opposed to traditionally canned salmon. New products such as skinless and boneless canned salmon and frozen fillets are also entering the market place. (The effects of large volumes of farmed Atlantic salmon entering the market place on prices for premium species, i.e., chinook and coho, are discussed in the next chapter.) Another very important consideration is exchange rates (particularly the dollar/yen relationship in export markets) on the price of many salmon products.

⁴⁷ Ben Muse, "Ex-vessel Price Models for Alaska Salmon," Alaska Department of Commerce and Economic Development, Commercial Fisheries Entry Commission, CFEC Discussion Draft 84-6, September 1984.

A Brief Discussion of Export Trading Patterns

In the context of international trade patterns for salmon products, U.S. exports (357.9 million pounds valued at \$614 million in 1985) really mean Alaska exports, since landings in Alaska account for 90 percent of U.S. commercial salmon landings. Of the high-volume species (sockeye, chum and pinks), only sockeye has enjoyed a nearly insatiable Japanese market demand since they (the Japanese) were regulated out of many traditional high seas fishing areas in the mid-1970s. Sockeye are mainly exported in frozen whole or dressed form. Japan imported 227.3 million pounds of frozen U.S. salmon in 1985, worth \$384.9 million, or about 83 percent of total U.S. exports of frozen salmon.

Pink salmon has traditionally been canned, with the United Kingdom being the most important geographical market (50 percent of U.S. canned pink exports in 1985), followed by Australia (21 percent) and Canada (17 percent).⁴⁸ Japan, the U.S., Canada and Soviet Union are the main competitors for market share in world canned salmon markets.⁴⁹ Thus, the relationship between the value of the U.S. dollar, the yen, Canadian dollar and English pound directly affects the competitiveness of Alaska canned pink salmon in world markets, and indirectly influences wholesale and ex-vessel prices to producers in Alaska. (Soviet exports to Western countries are generally priced in dollars, as rubles are not hard currency in world trade.)

Most of the Alaska chum salmon harvest is sold in fresh or frozen form (76 percent in 1983) as opposed to canned. Japan is by far the most important export market for fresh and frozen chums, with France a distant second. As we mentioned earlier in this chapter, Japan produces large amounts of chums domestically, which obviously substitute for U.S. exports. Chum roe is preferred to that of other species. Thus the yen/dollar relationship has a direct effect on the price received for chum salmon in Alaska.

Benefits/Costs of Alaska's Hatchery Systems

The benefit/cost analysis of Alaska's enhancement projects which serves as the empirical basis for the State's current hatchery policy, was prepared by Jeff Hartman of the ADF&G, FRED for the Governor's Fisheries Mini-Cabinet and published in April 1986. This analysis represented over two man

⁴⁸ "Fisheries of the United States, 1985," U.S. Department of Commerce, National Marine Fisheries Services, Current Fisheries Statistics No. 8380, April 1986.

⁴⁹ Ben Muse, "Ex-Vessel Price Models for Alaska Salmon," p. 10.

years of research effort aimed at evaluating public and PNP hatcheries in the state. After examining a range of differing volume and value scenarios of the commercial catch resulting from hatchery production, the analysis concludes that, depending on the assumptions used for natural production (higher natural production = lower net benefits of hatcheries) and the price forecasting model employed, the net present value (NPV) of hatchery production ranges from well above (\$344.8 million) to well below (\$-178.6 million) zero. The midpoint NPV (\$96.5 million) from the most likely case results in a benefit/cost ratio over the useful life of all projects of 1.43:1. The profits (or consumer surplus in economic terms) from the sport fishery are only roughly estimated in this analysis (assumed to vary from a low end present value of \$25.2 million to a high of \$362 million). At the low value estimate, sportfishing adds little to the NPV of hatchery production, while at the high estimate, it makes all scenarios of natural plus hatchery production yield positive benefits.

After studying this analysis and the price forecasting models that it is based on, our judgment is that the conclusions reached (NPV estimates and benefit/cost ratios) are extremely conservative and probably underestimate the contribution of hatcheries to the state's economy. To err on the side of caution is prudent when investing public funds, but we think that the State has probably made a better investment than the most likely scenario indicates. Without getting bogged down in technical details, we present a few arguments for a higher NPV of the State's hatchery investment.

Estimates of the net benefits of commercially harvested salmon are very sensitive to the price forecasting model used. One of the key components of these models was exchange rates, the most important (i.e., statistically significant explanatory variable) being the dollar/yen ratio which has declined 40 percent since the models used in the benefit/cost analysis were estimated in 1984. (On a trade-weighted basis, the dollar has fallen 35 percent against all major currencies since its peak in February 1985.)⁵⁰ This factor alone makes hatchery investments look much more attractive today than they did two years ago.

Another benefit of hatchery production that is difficult to quantify is the smoothing effect of hatchery returns on major fluctuations in natural production. The 1986 fishing season could have been financially disastrous for many Prince William Sound fishermen without hatchery returns, which accounted for 60 to 70 percent of the total harvest for certain gear types. This turned many fishermen who were previously dubious about the efficacy of aquaculture assessments and hatchery investments into "true believers."

⁵⁰"The Outlook for Net Exports," Federal Reserve Bank of San Francisco Weekly Letter, September 26, 1986.

The sport fishery impact of hatchery production and its impact on the state's economy may be underestimated in the benefit/cost analysis as well, though we do not have data to prove it. Experience has shown that the benefits from increased hatchery production of sportfish species can be quite high, though not easily quantified. Witness the major increase in the charterboat fleet, fishing lodges and destination visitors to the Ketchikan area over the past few years since large numbers of hatchery-raised chinook have begun returning to hatcheries in the area. Fifty percent of the chinook caught in the 1985 Ketchikan Salmon Derby were hatchery-raised adults.⁵¹ The winning fish was a 53-pound chinook released by the Deer Mountain hatchery in 1981.⁵² The same growth in the sportfishing contribution to the local economy is likely to occur in the Juneau area in the next few years as the result of major releases of chinook smolts from the FRED facilities at Snettisham and Crystal Lake following the U.S. and Canada treaty settlement. Twelve percent of the chinook caught in the 1985 Golden North Salmon Derby in Juneau were adult returns to the Crystal Lake hatchery.

Product Development

The 1986 salmon season will mark the seventh consecutive year that the total Alaska harvest has exceeded 100 million fish (the 1986 harvest was 127.8 million fish valued at \$404 million).⁵³ If these harvest levels are sustainable through aquaculture and are accompanied by the development of new product forms for pink and chum salmon, then there is little reason why salmon cannot regain its pre-World War II position as a cheap staple commodity in the diet of domestic consumers. The key is to produce products that will appeal to changing consumer tastes.

Experience has shown that a hypothetical 100-million-fish total harvest level will contain perhaps 60 million pinks, 20 to 30 million sockeye and 10 to 15 million chums. As Greg Baker indicated in his memorandum to the Governor, this level of pink and chum harvest is about what the world market for traditional (mostly canned) products will buy at a price that translates into reasonable profits for processors and decent ex-vessel prices to fishermen. It has long been recognized by market analysts in the seafood industry that the demographics of consumers of traditionally canned

⁵¹Jeffrey A. Hansen, "FRED 1985 Annual Report to the Alaska Legislature," p. 6.

⁵²J. S. Holland and William Hauser, "Salmon and Trout for Sportfishermen in Alaska," Alaska Fish and Game, May/June 1986, p. 8.

⁵³Alaska Department of Fish and Game, Computer Services Division, September 1986.

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salmon (containing skin and bones) are not promising. A large share of these consumers are older adults who grew up eating canned salmon in the pre-World War II era. In other words the present market is aging and new products must be found to interest younger consumers.

The Office of Commercial Fisheries Development (OCFD) has been working for the past three years to develop new products from pink salmon using bottom-fish processing technology. Altogether, about \$400 thousand in General Fund appropriations (supplemented by \$30 thousand in program sales receipts) has been spent working with selected processors to develop and test market products that can be sold to major domestic food companies. Boneless and skinless fillets (in frozen blocks and vacuum packed logs) and minced salmon products (primarily skinless boneless canned salmon) are the main items that have been produced so far. The OCFD plans to publish a manual of processing techniques, least cost methods of handling specific products and quality control guidelines in early 1987.⁵⁴

This program has drawn considerable interest from processors and food companies. The Hormel Company, Ralston Purina and Bumble Bee Seafoods have contracted with processors in Alaska to produce skinless, boneless canned salmon. Other major domestic food companies (Van de Kamps, Gorton's, Certatech) are evaluating the fillet products.⁵⁵ Several processing companies around the state have indicated that they are going to invest in filleting and mincing machinery. Before major sales to domestic food companies can occur, Alaska processors will need to prove they can produce high quality products consistently. One of the main problems in Alaska is that the major salmon processors have had very little experience producing whitefish products (for which the technology was designed), which require much tighter quality control than traditional salmon products.

Quality

Another area of concern is the quality of the fish as they enter the processing plant. One of the reasons policymakers are concerned with maintaining fishermen's gross incomes at fairly high levels is to allow the fishing fleet to upgrade its holding facilities (e.g., through the addition of refrigerated seawater equipment) and thereby improve the overall quality of the catch. High quality products commanding premium prices require high quality fish. There are some encouraging signs in this area as well; refrigerated seawater (RSW) equipment has gone down in price nearly 50 percent over the past five years and many processors (particularly floaters) are paying substantial premiums for RSW fish.

⁵⁴Paul Peyton, Acting Director, Office of Commercial Fisheries Development, personal communication, September 1986.

⁵⁵Seafood Trends, Vol. III, No. 6, September 29, 1986.

To date, skinless and boneless fillet technology has not been applied to chum salmon. In the past few years, major terminal chum salmon harvests have occurred on adult returns to hatcheries. These fisheries are expected to continue to increase, as several hatcheries with major chum capacity are just getting up to full production. The main problem with terminal fisheries near the hatchery site is the dark color of the fish, which causes them to be graded and priced lower than brights.⁵⁶

Unattractive dark fish do not command high prices in frozen markets and often end up being canned, which makes them much less valuable. Chum salmon retain good flesh color and firmness even though their skin may be dark. If these fish could be sold as skinless and boneless frozen fillets, they would command a much higher price in the marketplace. Consequently, fishermen would realize substantially higher ex-vessel prices.

In sum, it appears as though a real breakthrough in the high-volume/low-value end of the Alaska salmon industry may be imminent. Sales of the new products mentioned above are likely to only marginally increase total revenues during the next few years until processors become proficient with the new technology, but current product development efforts are likely to pay off in the intermediate (five to ten-year) future.

Fleet Rationalization

We have shown how State policy has been oriented toward maintaining fishermen's incomes and processor profit margins by placing limits on the numbers of pink and chum salmon produced by PNP hatcheries. This has been accomplished by a limit on State loans for construction of new production facilities. The State has no control over exogenous factors such as exchange rate fluctuations (which are at least as important a determinant of product prices in forecasting models as volume) but can influence the long-term supply of pink and chum products in world markets and thus influence prices at the ex-vessel and wholesale levels. This is a fairly indirect policy tool.

⁵⁶ Dave Cantillon, Southeast Regional Supervisor, Alaska Department of Fish and Game, Division of Commercial Fisheries, personal communication, September 1986.

Another, more direct policy tool which would raise fishermen's gross incomes and improve harvesting efficiency (thereby cutting costs) is a buyback program. Buyback programs (commonly referred to as fleet rationalization strategies) have been used with varying degrees of success in several West Coast salmon fisheries but never in Alaska.⁵⁷ Under buyback, an agent enters the limited entry permit market, buys up permits and retires them from the fishery. For example, 50 permits may be bought in a fishery with 400 leaving 350 fishermen with the right to participate in that fishery. Thus, total gross revenues in the fishery would be shared among fewer participants.

In 1974, when Alaska's salmon fisheries were originally limited, permits were rationed among fishermen (no more than one in any fishery to a person) on the basis of a complex point system that sought to balance economic dependence on the fishery and the extent of past participation. Once issued, most permits became freely transferable (though they may be leased only under very restrictive circumstances). Alaska's limited entry statutes (AS 16.43.290-330) provide the Commercial Fisheries Entry Commission (CFEC) with the authority to set the optimal number of permits in a given salmon fishery (according to biological and market criteria) and to establish and administer a voluntary buyback program to reduce the number of participants to an optimum level.

The CFEC staff has prepared an extensive analysis of changes necessary to make the buyback statute workable.⁵⁸ One of the main problems with the statute as written is that it apparently violates Article IX Section 7 of the Alaska State Constitution which prohibits taxes collected by State agencies from being dedicated to special funds. The CFEC paper offers four alternatives for dealing with this problem and three different options for collecting taxes from participants in a given fishery [AS 16.43.310(b) allows the CFEC to tax up to seven percent of the gross value of annual landings for each permit to be put in a buyback fund]. The CFEC staff have written draft legislation to get a viable buy back program started. Note that the CFEC itself does not introduce legislation, rather it acts in support of legislative leadership. Thus, fleet rationalization awaits support in the legislature.

⁵⁷Ben Muse and Kurt Schelle, "Buyback of Fishing Rights in the U.S. and Canada: Implications for Alaska," paper presented at the 114th annual meeting of the American Fisheries Society, August 15, 1984, Ithaca, N.Y., Commercial Fisheries Entry Commission, Juneau, Alaska.

⁵⁸Ben Muse and Kurt Schelle, "Investments in Fleet Reductions: Suggestions for Revisions of Alaska's Buyback Statute," CFEC Policy Discussion Draft 86-2, June 17, 1986.

The CFEC staff have been developing a buyback simulation model that would forecast the effects of the proposed program on permit prices. There is some concern that a buyback program could lead to speculation in permits. The draft legislation is designed to avoid this. Another concern is that buyback might eliminate a considerable number of marginal fishermen without appreciably raising average gross incomes of the remaining permit holders. The CFEC staff are attempting to calculate the payback period for investments in improved fleet efficiency.

It should be noted that there are significant limits to what a mechanical computer simulation model can forecast about the effects of a buyback program. The actual effects of buyback cannot be known until it is actually tried. From the perspective of Alaska's overall competitive position in world salmon markets however, improvements in fleet efficiency result in lower production costs (fewer boats catching more fish spread costs over larger volumes) and are a very positive factor.

Several fishermen's groups have approached the CFEC informally for information on buyback programs, and there appears to be considerable interest throughout the limited salmon fisheries. There is some reluctance among fishermen's groups to come out publicly in favor of buyback however. As we mentioned in Chapter One, there have been bitter conflicts between competing gear types over area salmon allocation decisions by the Board of Fish in recent years. There is a fear that a buyback program started for one gear type (which reduced the number of fishermen) might be used by a competing gear type in the same geographical region to justify asking the Board of Fish for a larger allocation for its members.

Alaska's Hatcheries and Salmon Farming

At the present time, salmon farming (or pen rearing) is not allowed in Alaska. If and when a salmon-farming industry is begun, the availability of smolts will be a critical factor in how quickly development can proceed. The lack of smolts has proven to be a severe bottleneck in the growth of the British Columbia salmon-farming industry. Ripe adult female chinooks owned by private hatcheries in British Columbia are currently worth \$500 to \$1,000 each for their eggs. Imported Atlantic salmon smolts which are completely adapted to pen rearing sell for \$1.50 each. Norwegian fish farmers have had serious disease problems in several operations caused by importing Atlantic salmon smolts from Scotland, because they were unable to produce sufficient quantities domestically.

There are three basic alternatives for would-be salmon farmers in Alaska to obtain eggs and/or smolts. First would be an egg take from wild stocks. This is very expensive. Experience has shown that it may cost \$60 to \$70 thousand to run a remote weir and egg stripping site for a month.⁵⁹

⁵⁹Rick Harris, Vice-President, Natural Resources, Sealaska Corporation, personal communication, September 1986.

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Wild egg takes have to be conducted within the constraints of the Commercial Fisheries Division escapement goals for a particular stream system. This often means that considerably fewer eggs are taken from a given site than are needed.

Another alternative would be the importation of nonindigenous species (e.g., Atlantic salmon smolts or eggs) from other states or countries. There are serious difficulties with this approach. To properly quarantine nonindigenous species so that new diseases cannot be introduced to native stocks, the fish must be held in shoreside tanks (outside of public waters) for an entire generation until their progeny can be stocked in pens in public waters. A highly regulated quarantine system may be worthwhile over the long term (as explained further in the next chapter) but it is much too costly for an industry that is just getting started.

The final and most practical means of obtaining eggs or smolts for salmon farmers would be to purchase them from PNP and FRED hatcheries. By amending the private nonprofit statutes to allow PNPs to pen rear salmon and sell eggs and smolts to salmon farms, an important new source of revenues for nonassociation hatcheries could be developed. This could reduce some of their cost recovery problems, encourage further hatchery expansion (to produce more chinook and cohos) and increase the performance potential of the State's enhancement loan portfolio.

Private nonprofit hatcheries have a common property fishery obligation (expressed in the Regional Salmon Plan), and sales of eggs or smolts to salmon farms should come only after that obligation has been filled. The PNPs also have a financial commitment to pay off the State's investment in their operations. Thus, earnings from the sale of eggs, smolts or salmon farming could come under the private nonprofit cost recovery guidelines and excess profits could go toward facility development and debt retirement. One alternative would be to allow PNPs to change their private nonprofit status to become private for-profit enterprises (free of State support) after they have paid off their State loans.

Regional associations (through their boards of directors) could decide for themselves whether pen-rearing investments or sales of eggs and smolts to farmers are feasible and acceptable to their membership. Revenues from egg and smolt sales could supplement assessment and cost recovery revenues. Existing statutes [AS 16.10.420 (3)] concerning the sale of eggs and/or fry by hatcheries would have to be changed to allow direct sales to fish farms. An alternative would be to handle sales from hatcheries to farms through ADF&G so that proper documentation, genetic and disease control is maintained. In this case, AS 16.10.420(7) would have to be altered to allow FRED to sell eggs and/or fry to farms.

FRED hatcheries are expected to have a surplus of chinook and coho eggs over rearing capacity next year. (A six-million chinook egg surplus forecast for 1986 did not materialize, mainly due to lower than expected returns to the Crystal Lake hatchery.) Currently FRED uses relatively few

genetic strains of chinook eggs (i.e., from only five or six different stream systems) for its hatcheries. An attempt is being made to broaden the gene pool, through wild egg takes from other systems. Thus, as different strains of eggs are brought in and replace those of current strains of adult fish returning to the hatchery sites, surplus eggs (over the capacity of the hatchery to rear) become available. These would be ideal for sale to salmon farms, since they would otherwise be wasted and do not affect the chinook quota under the U.S.-Canada treaty.⁶⁰ Thus, egg sales to farmers could help finance expensive wild egg takes and genetic diversification of the State's salmon aquaculture programs.

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Under the terms of the treaty, any returning hatchery-raised adult chinook above the 1984 level (when the treaty was signed) are added to the Alaska harvest quota.

CHAPTER THREE

SALMON FARMING

The net pen culture of salmon is a very young industry that has largely developed since 1970. It began experimentally in Norway in the 1960s with rainbow trout raised in saltwater. Legend has it that the industry actually started by mistake.⁶¹ Freshwater trout farms had been a ubiquitous feature of the streamside landscape in Norway since the 1860s. One of these, the Wik brothers' farm, was located very close to the sea. In the mid-1960s, a fortuitous combination of high tides and waves caused several of their ponds to be flooded with saltwater. The brothers thought surely their crop of fish would die, but incredibly, the fish in the flooded ponds grew much faster and had better quality flesh than those in their freshwater ponds. This discovery was passed on to other trout farmers who experimented further by adding saltwater to their ponds with encouraging results.

Five or six years later, a family of fishermen, the Grontvedt brothers (who, like many other fishing families in Norwegian coastal communities, had been forced to sell their vessels because of depleted fish stocks and low incomes) used their knowledge of fishing techniques to build experimental net pens and successfully produced the first salmon reared in saltwater enclosures. Very soon after this, fish farming became a high-priority planned development in Norway. It was viewed by the Norwegian government as a way of utilizing the skills of people in coastal communities to bring economic development to depressed fishing economies.

WORLD SALMON FARMING PRODUCTION

From these humble beginnings, salmon farming has become a worldwide growth industry, especially during the past five years. The opening of the U.S. market through air freight around 1980 and the high value of the dollar relative to the kroner (Norwegian currency) were key factors which accelerated the growth of the industry. In 1985, about 44,000 metric tons (mt) of pen-reared salmon (34,301 mt of Atlantic and 9,693 mt of Pacific salmon)

⁶¹ Kjell Tommeras, President, Norwegian Fish Farming Equipment Association, "Norwegian Fish Farming--Equipment and Technology Experience and Future Trends," remarks to the Norway Fish Farming Seminar, Seattle, Washington, June 1986.

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were produced.^{62, 63} This total is expected to nearly triple by 1990 (103,160 mt Atlantic and 39,500 mt Pacific salmon).

Table 5 gives a breakdown of world farmed salmon production by country for the past five years and a projection for 1990.

⁶²One metric ton equals 2,200 pounds.

⁶³Curt Kerns, "World Salmon Farming: An Overview with Emphasis on Possibilities and Problems in Alaska," University of Alaska, Juneau, Marine Advisory Bulletin Number 26, April 1986.

TABLE 5

World Production of Pen-Reared Salmon 1981-85, With Projections for 1990

Atlantic Salmon (Metric Tons)						
Country	1981	1982	1983	1984	1985	1990e
Norway	8,907	10,226	17,016	22,196	27,200	80,000
United Kingdom	1,000	2,100	2,500	2,500	3,912	14,000
Finland	30	30	30	40	80	160
Ireland	80	103	256	NA	NA	2,000
Sweden	60e	80e	100e	NA	NA	NA
Canada	35	140	180e	NA	NA	1,000
Iceland*	20e	30	50	60e	100	5,000
Denmark	100e	130	160	NA	NA	1,000
Total**	10,232	12,839	20,292	26,148	34,301	103,160

Pacific Salmon (Metric Tons)						
Japan	1,150	2,112	2,900	4,600	7,000	14,000
United States	450e	680	900	1,400	2,450	5,000
Canada	176	424	129	110	NA	15,000
Chile	NA	NA	NA	32	145	3,000
New Zealand	2e	5e	10e	12	98	2,000
France	60	80	80	NA	NA	500
Total	1,838	3,301	4,019	6,154	9,693	39,500

e Estimated.

NA Not Available.

* Includes ocean ranching.

** Does not include the recent introduction of Atlantic salmon to Washington State farms.

Source: "World Salmon Farming: An Overview," p. 26.

SALMON FARMING

Farmed salmon provided slightly over six percent of the world salmon supply in 1985 and is expected to increase its total world market share to about 14 percent by 1990.⁶⁴ (This growth rate is comparable to the forecast for all aquaculture products given in Chapter One.) Norway is expected to continue to be the dominant producer of farmed Atlantic salmon, accounting for 75 to 80 percent of total production. British Columbia is becoming the main world focus of Pacific salmon farming, but Chilean, Japanese and New Zealand production is also rapidly expanding. There are many extravagant claims for future production of farmed salmon (e.g., that Norway could produce 200,000 mt by the turn of the century) but these are based on nonmarket and physical assumptions (i.e., the availability of feed or hatchery and rearing capacity). Forecasts of production beyond 1990 are very tenuous.

The consensus outlook among European farmed salmon producers appears to be that wild landings of premium species (Atlantic, chinook, coho and sockeye) will remain relatively constant, while farmed production is expected to continue to increase steadily, if at a slower rate than at present. By 1990, total farmed production is expected to dominate world trading in both fresh and frozen premium products. It is unlikely that the growth rate in production of farmed salmon seen over the past five years is sustainable in the long-term (beyond five years) because of market constraints. Thus far, the salmon-farming industry has avoided the typical growth industry scenario, where overproduction eventually causes prices to fall to unprofitable levels and the ensuing shakeout of marginal producers and late entrants (who have not amortized their fixed investment costs) leaves only the lowest cost producers remaining.

The carefully controlled market development of established producers such as Norway (described in detail later in the chapter) is likely to endure for the next few years. As new markets for farmed salmon are opened (described in the next chapter) and lower cost producers enter the supply picture, price competition is likely to escalate. New producers (e.g. British Columbia or Alaska), with unamortized development costs and have not gotten production costs under control, would be particularly vulnerable to price cutting by lesser developed countries such as Chile which has extremely low labor and feed costs.⁶⁵

⁶⁴The University of Stirling (Scotland) Institute for Retail Studies Market Reports, No. 2, p. 43.

⁶⁵United States, British, Scandinavian and Japanese companies are investing in salmon ranching and farming operations in Chile. Future investment is expected to be concentrated in farming production (particularly adult coho production) because the Chilean fishing fleet is not presently capable of harvesting major salmon returns.

There are several attempts underway to model the effects of salmon farming on traditional markets for salmon products and the economic impact of a salmon-farming industry in Alaska. While there is no doubt that farmed salmon has had broad and irreversible effects on premium salmon markets worldwide, the impact is fairly complex and interactions between market segments are difficult to sort out. Government subsidies and development policies, tariffs, relative exchange rates, changing consumer tastes and preferences, and rapid structural change in seafood markets complicate--and to a certain extent, defy--conventional economic analysis. Most economic models attempt to measure the relationship of explanatory variables over time (e.g., consumer income, wild landings, farmed production, exchange rates, etc.) and project trends from the past into the future.⁶⁶ Just as no one foresaw the incredible increase in demand and production of farmed salmon in the 1980s, it would be unrealistic to project current trends in sales and production through the 1990s. Thus, for a new and rapidly changing industry such as salmon farming, the accuracy of forecasts via mechanical models is questionable.

At least one fisherman's group has called for a detailed analysis of the economic impact of a salmon farming industry in Alaska as a precondition to allowing pen rearing in the state. To this end, the Office of Commercial Fisheries Development within the Department of Commerce and Economic Development (DCED) is preparing a market demand model that will test several different development scenarios to gauge the economic impact of a salmon-farming industry in Alaska. However, as we show in the next section, fishermen and processors (particularly cold storages) in Alaska have been experiencing the effects of farmed salmon production in the form of lower prices, narrower profit margins and displacement in traditional markets during the past several years. This trend will undoubtedly continue into the intermediate future for reasons given below. In this context, the question of whether or not pen rearing of salmon should be allowed in Alaska misses the crux of the issue. Rather, the basic question is whether or not Alaska will use its comparative advantages as a producer of farmed salmon to compete in growing domestic markets.

PREMIUM SALMON MARKETS

Farmed salmon (both Atlantic and Pacific species) has carved out a permanent niche in premium salmon markets. To put the effects of increased supplies of farmed salmon on premium markets in perspective, consider that in 1985, farmed production of Atlantic salmon (34,301 mt) was nearly equal to U.S. commercial landings of chinook (12,358 mt) and coho (23,656 mt) combined. Farmed Pacific species added another 9,693 mt to premium markets

⁶⁶Biing-Hwan Lin, "An Econometric Analysis of Salmon Markets," University of Alaska, Fairbanks, Economics Department, p. 9.

in 1985. By comparison, U.S. sockeye landings in 1985 were 107,308 mt and accounted for approximately 70 percent of the total ex-vessel value of the harvest.⁶⁷ On a value comparison basis, Norway earned an estimated \$180 million on sales of farmed salmon in 1985 (four percent of world salmon production), while the record 1985 Alaska salmon harvest (all species) of 144.6 million fish (43 percent of world salmon production) earned \$370 million.⁶⁸

Thus far, the increased supplies of fresh salmon from farm production have been primarily aimed at the "top of the market" and sold through traditional fresh fish channels to the catering sector, smokers and certain retail markets. The next major challenge for producers of farmed salmon will be to penetrate further into the mass retail segment of fresh and frozen fish markets and win acceptance with the great bulk of consumers. Even though the industry is comparatively young, markets for farmed salmon products are fairly complex. Below we offer a brief discussion of farmed salmon markets, the basis for product differentiation among end users of wild and farmed fish, and the marketing chain of distribution by which they are sold.

Farmed vs. Wild Salmon Market Niches

A recent survey of domestic seafood wholesalers who handle fresh farmed salmon estimated that 42 percent of their annual sales were to restaurants, 29 percent to other wholesalers (indicating brokering activity), 19 percent to retail outlets (i.e., specialty fish shops), six percent to supermarkets and four percent to others.⁶⁹ A majority of wholesalers handled farmed Atlantic salmon, primarily of Norwegian (43 percent) and Scottish origin (14 percent), while a substantial minority (22 percent) handled pan-sized cohos from the Pacific Northwest and British Columbia.

According to the survey, a large majority of firms that handled pan-sized cohos do not consider them to be a legitimate substitute for fresh or frozen wild Pacific salmon. Pan-sized salmon and trout appear to occupy a slightly different (lower-priced) market niche from adult farmed salmon as well.

⁶⁷Alaska Department of Fish and Game, Computer Services Division, September 1986.

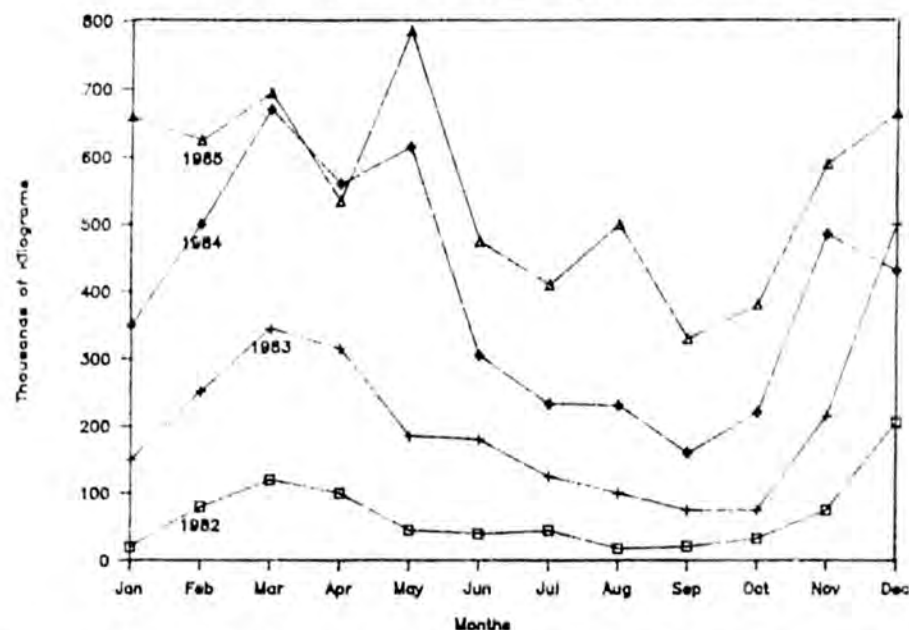
⁶⁸Computed from "Fisheries of the United States, 1985," U. S. Department of Commerce, National Marine Fisheries Service, Current Fisheries Statistics No. 8380, April 1986, p. 2.

⁶⁹Ronald V. Rogness and Biing-Hwan Lin, "The Marketing Relationship Between Pacific and Pen-Raised Salmon: A Survey of U.S. Seafood Wholesalers," University of Alaska, Alaska Sea Grant Program, Aquaculture Note No. 86-3.

A majority of firms that handle fresh farmed Atlantic salmon believe it to be a close substitute for fresh wild Pacific salmon and make their purchases independent of the availability of fresh wild fish. A significant number of domestic wholesalers purchase farmed Atlantics in place of fresh wild Pacifics for at least some customers (i.e., certain restaurants and retail seafood markets). Currently, fresh farmed Atlantic salmon can command a premium price because of the quality advantage it enjoys when the Pacific salmon season is closed and only frozen wild fish are available. Figure 6 shows monthly exports of fresh Norwegian pen-raised Atlantic salmon to the U.S. over the past four years. It is obvious from this graph that the marked seasonality of imports of pen-reared Atlantics (caused by the availability of fresh wild Pacific species) is becoming less of a factor over time.

FIGURE 6

U.S. Imports of Norwegian Salmon



Source: U.S. Bureau of Customs. Graph by R. Rogness, work in progress, University of Alaska, Fairbanks.

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A majority of domestic wholesalers appear to believe that frozen Atlantics are not regarded by their customers as a substitute for frozen Pacific salmon. (About 97 percent of the harvest of premium salmon species in Alaska is marketed in frozen form and only three percent fresh. A much larger percentage of premium species harvested by fishermen in the Pacific Northwest is sold fresh.) Because farmed Atlantic salmon is primarily sold in the fresh fish market, it appears to only marginally compete in the same domestic markets as wild Pacific fish from Alaska. The present situation is probably only temporary however, as the enormous increase in farmed production forecast by 1990 (Table 5) will almost inevitably drive down prices so that farmed Atlantics will compete directly with wild Pacific species in frozen markets.

The Catering Sector

The catering sector, where farmed salmon has enjoyed its greatest market penetration, is sometimes called the HRI trade (hotels, restaurants and institutions) and is fairly diverse in character, ranging from gourmet restaurants (commonly referred to in the trade as "white tablecloth restaurants") to canteens and fish and chip shops.⁷⁰ The relative importance of the catering sector in a given country appears to be primarily related to the national preference for eating out and the level of disposable personal income. For example, catering is by far the most important end user of farmed salmon in the U.S., while the catering sector in the United Kingdom (U.K.) ranks third behind the processing and retailing sectors. Gourmet restaurants are currently the most important market for farmed salmon. The most significant marketing criteria for the HRI trade appear to be high quality, freshness, uniform sizing, consistent pricing and continuity of supply.

The success of Norwegian farmed salmon in the catering sector of the U.S. market has been mainly with two to six-kilogram fresh fish. Pan-sized fresh and frozen farmed salmon and trout appear to be close substitutes for each other and occupy a significant market niche in the restaurant trades of the U.S., France and British Columbia. There appears to be major room for expansion of sales of farmed salmon to the domestic catering sector (both pan-sized and adult fish), particularly for prime quality frozen products in higher volume "family restaurant" outlets, where ease of preparation is a prime consideration.

⁷⁰ Much of this discussion is paraphrased from remarks by Karl Johan Ringstad, President of MOWI A/S, World Markets for Farmed Salmon to the Norway Fish Farming Seminar, Seattle, Washington in June 1986. MOWI is a large Norwegian aquaculture corporation.

Smoker Markets

The smoking market is very important for farmed salmon. Until about 1978, the European salmon-smoking industry was almost entirely based on the use of wild frozen fish. Traditionally, the raw material for premium smoked products was frozen Atlantic, chinook, coho and chum salmon. By 1980, European smokers began switching en masse to fresh farmed Atlantic salmon. There are two main reasons for this change. First is the ability to buy fresh product when it is needed and avoid or minimize risky inventory decisions with associated borrowing and energy costs. With wild fish, processors are dependent on seasonal raw material costs and have to absorb the risk and maintenance cost of operating substantial freezer capacity, as well as maintaining the quality of the fish from the time it is purchased until processed. Add to this the unpredictability of future prices, and there is a strong financial incentive to buy farmed fish.

Another reason some European smokers have switched to farmed Atlantic salmon is that their buyers noted a consistently higher average quality in farmed as opposed to wild fish, which translates into less wastage and a higher quality end product. Certain smoked specialty products require the specific properties of wild Pacific species, e.g., the high oil content in Yukon or Kuskokwim River chinook salmon, which gives them a relatively secure market niche. Indeed, if only the specific properties of the fish are compared, wild Pacific species are generally regarded as superior to farmed fish by smokers. When the price, risk and quality factors listed above are added, farmed Atlantic salmon is seen as a close substitute for Pacific species in most smoked product applications.

The availability of large volumes of high-quality farmed fish and resulting financial security has apparently contributed to the overall growth of the European smoking industry. The substitution of farmed Atlantic salmon for frozen Pacific salmon has been accompanied by a substantial increase in smoked production. In the U.K., for example, exports of smoked salmon products have increased from 284 mt in 1978 to 594 mt in 1984.⁷¹ Undoubtedly, a significant portion of this increase was also due to the strength of the dollar during this period. A breakdown of the sources of salmon used by smokers in the U.K. in 1984 is given below:

<u>Type of Fish</u>	<u>Metric Tons</u>
Wild Atlantic	700
Farmed Atlantic	2,500
Pacific Troll	1,700
Pacific Gillnet	1,600

⁷¹ "World Markets for Farmed Salmon," p. 10.

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On a worldwide basis, there appears to be a trend toward generic marketing of smoked salmon (i.e., British, Norwegian, Alaskan or Canadian smoked salmon) which will provide increased value added opportunities for the producer countries. Smoked salmon products have penetrated multiple retail outlets and the importance of large buyers with substantial market shares (who are very concerned with quality control, hygiene and product scheduling) has increased substantially. Thus there appears to be a significant opportunity for farmed salmon in domestic smoker markets.

Retail Markets

Multiple Retail Outlets (often referred to as hyperstores in Europe and supermarkets in the U.S.) are buying increasing quantities of farmed salmon in Europe and offer a potentially huge market in North America. Farmed production 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. For multiple retail buyers, the main drawbacks to purchasing fresh wild salmon are a lack of control over the supply of product, rising and/or fluctuating costs, a confusing variety of species, sizes and qualities of product and a generally long selling chain from producer to consumer.

The main successes to date with farmed fish in multiple retail outlets have been with packaged pan-sized salmon and trout (fresh and frozen) and two to six-kilogram fresh salmon on ice. Sales of vacuum-packed Atlantic salmon portions have reportedly been disappointing, probably due to higher unit pricing than pan-sized salmon and trout. There is a trend in the U.S. and Europe toward increasingly large stores that offer one-stop shopping to customers. Many of these outlets feature service seafood counters that offer fresh products of all types year-round. Multiple retailers are very price and margin conscious and the key to further growth in this market appears to be lower prices for adult farmed salmon, particularly relative to pan-sized fish.

Domestic Product Differentiation

When assessing the advantages of farmed Atlantic over wild Pacific salmon, wholesalers mention (in order of importance): year-round availability; freshness or quality; consistency; size; price and longer shelf life. Conversely, when wholesalers were asked to list the advantages of wild Pacifics over farmed Atlantics, the question yielded the following responses: price; flesh characteristics (i.e., color, firmness, less fat); volume available and ease of ordering.⁷²

⁷²"The Marketing Relationship Between Pacific and Pen-Raised Salmon," p. 12.

In general, there appears to be a geographic component to domestic product differentiation between fresh farmed Atlantic and wild Pacific salmon, with West Coast consumers preferring the larger size and deep red colored flesh of premium Pacific species. This is reflected in the fact that Seattle prices run \$0.40-\$0.60/lb. higher for fresh chinook than comparably sized Atlantic salmon (when both are available) and \$1.00/lb. over rainbow trout and pan-sized cohos.⁷³ East Coast consumers have greater familiarity with the lighter colored flesh of Atlantic salmon. Overall, the market penetration of farmed salmon has been fairly shallow and largely confined to the coastal regions of North America.⁷⁴ Aside from residents of a few of the larger cities, consumers in mid-America are unfamiliar with fresh salmon, and as greater supplies become available, demand for salmon products of all types is likely to increase. Consumers become exposed to fresh salmon in restaurants and then try preparing it at home, which leads them to experiment further with other product forms (e.g., frozen, smoked or canned salmon). The explosive growth of the domestic catfish industry in recent years began through consumer exposure in the restaurant trade in Southern and Midwestern states.

The Chain of Distribution from Producer to Consumer

From the mid-1970s (when Norway first began exporting significant volumes) until 1985, Norwegian and other Atlantic salmon farmers were in the enviable situation of rapidly increasing their production while their real product prices were also rising. Recently, farmed Atlantic salmon prices have stabilized and may in fact be falling. As the price of farmed salmon becomes more competitive with other prime value fresh seafood products, further market expansion and diversification will occur. In the future, the chain of distribution from producer to end user in North American markets could become a significant liability to foreign producers and create a bottleneck to further development, just as the availability of smolts has governed the growth in farmed production since the industry was in its infancy.

The marketing chain of distribution from producer to consumer is a prime area for cost reductions for both foreign and domestic producers. Because the salmon-farming industry is so young, it has not had time to develop stable relationships between buyers and producers. Traditional market systems for wild salmon usually involve the following components:

⁷³"World Salmon Farming: An Overview," p. 10.

⁷⁴Richard Bard, "Salmon, An Ever Changing Supply," Seafood Business Report, March/April 1985, p. 42.

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Fisherman/ Producer	Port Merchant or Exporter	Wholesale Broker	Caterer/Retailer	End User
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International sales of farmed salmon typically involve a longer (at least one additional link) and more complex chain of components:

Producer & Producer Organizations	Exporter	National Importer or Broker	Regional Wholesaler	Hotels Supermarkets Restaurants Catering	End User
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Generally, even large hotels and restaurants that are part of a chain buy their fresh fish from a local wholesale outlet, and do not deal directly with producers. This is likely to change in the future as producer organizations assume greater marketing responsibility and attempt to internalize the margins of middlemen.

Just how much room there is for reducing margins at each link in the marketing chain can be seen by examining the pricing components of a typical shipment of Norwegian farmed Atlantic salmon from the producer organization until it is sold to a restaurant in Chicago:

Price FOB Norway.....	\$ 6.56/kg.	\$2.98/lb.
Air Freight to the U.S.....	\$ 1.74/kg.	\$0.79/lb.
Margin of Importer (7-10 percent).....	\$ 0.83/kg.	\$0.38/lb.
Selling Price of Importer.....	\$ 9.13/kg.	\$4.15/lb.
Overland Freight.....	\$ 0.22/kg.	\$0.10/lb.
Margin of Wholesaler (20 percent).....	\$ 1.87/kg.	\$0.85/lb.
Selling Price to Restaurant.....	\$11.22/kg.	\$5.10/lb.

By eliminating the margins of the importer and wholesaler, the producer organization (all farmed salmon in Norway are sold through producer organizations) could reduce its price to the end user by \$2.70/kg (24 percent) and still maintain its original profit margin. Profit margins for Norwegian producers have averaged 50-60 percent over the past four years with an ex-farm break-even price of \$2.75-\$3.30/kg (\$1.25-\$1.50/lb) dressed and packaged.⁷⁵

Further reductions in price to end users will of necessity come from freight costs and producer margins. Of course, exchange rate fluctuations can play a substantial role in producers' profit margins as well. Shortening the length of the marketing distribution chain by eliminating middle men, reducing freight costs and managing exchange rate fluctuations are all

⁷⁵Computed from "World Salmon Farming: An Overview," p. 17 and "World Markets for Farmed Salmon," p. 7.

good reasons that established foreign (mostly Scandinavian and British) salmon-farming companies wish to invest in the U.S. and Canada.

Tariffs and Subsidies

In perfectly competitive markets, the basis of world trade in commodities such as salmon is a function of the distribution of comparative advantages among producers. In the real world of planned economies, tariffs and other trade barriers as well as government subsidies enter the picture. Thus, while comparative advantage should ultimately determine the long-term viability of salmon farming in Alaska, the actions (or inaction) of the U.S. State Department on international trade issues as well as financial assistance to entrepreneurs offered by State government will affect the course of development.

In general, U.S. exports of salmon products face higher trade barriers than foreign exports encounter entering the U.S. To date, there is no U.S. tariff on imports of fresh or frozen salmon. There is a five percent duty on smoked salmon imports, canned salmon in oil carries a 12.5 percent tariff and canned salmon not in oil carries a 4.7 percent duty.

Japan (\$385 million in 1985), France (\$24 million) and Canada (\$22 million) are the largest importers of U.S. fresh and frozen salmon products.⁷⁶ In Japan, the tariff on fresh and frozen salmon imports is five percent (5.6 percent for salmon roe). Canned salmon imports have a 12 percent tariff, and salted, dried, or smoked salmon carries a 15 percent duty.⁷⁷ Japanese salmon farmers produce almost entirely for their domestic market and are not directly subsidized by the government, although they are required to belong to a local cooperative which works closely with governmental authorities as described in Chapter Two.

European Economic Community (EEC) tariffs (2.8 percent for fresh and frozen salmon, 15 percent on salted, 13 percent on smoked and 6.1 percent on canned salmon) mainly affect sales of wild fish, since there is little comparative advantage to producing farmed salmon in the U.S. for sale in European markets. As member nations, Scottish and Irish farmed salmon enter the EEC duty free, while Norwegian salmon are taxed at a reduced rate because Norway is a member of the European Free Trade Association (EFTA). The Highlands and Islands Development Board offers loan programs to farmers in designated areas of Scotland.

⁷⁶"Fisheries of the U.S. 1985," p. 62.

⁷⁷"The Outlook for Salmon and Shrimp Aquaculture Products in World Markets," U.S. Department of Commerce, National Marine Fisheries Service, January 1985, p. 48. Japanese tariffs on salmon imports are being reduced over a multi-year period.

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The Norwegian government is an active partner with the salmon-farming industry. The Norwegian Export Committee for fresh fish serves as an advisory body to the Royal Norwegian Ministry of Fisheries and sets quality standards. All fish farmers are required to belong to a Fish Farmer's Sales Association which coordinates the flow of product between farmers and exporters. A two-price structure exists for farmers, with the maximum price being the market price and a minimum price based on the farmer's costs. If market prices fall below the minimum price, the government subsidizes farmers to recover their costs. Loans (for up to 35 percent of capital costs) and insurance for small farmers are guaranteed through various development funds.⁷⁸ The government funds several research institutes and until recently, paid a subsidy (\$0.25/lb.) to Scandanavian Airlines System (SAS) for air shipments of fresh farmed fish to the U.S. During the past two years, several other air freight companies have begun flying fish from Norway and competition has eliminated the need for subsidies.

Recently, the U.S. imposed a 6.85 percent duty on Canadian cod landed on the Atlantic seaboard, which was based on fisheries subsidies. Both the U.S. and Canada subsidize their wild salmon fisheries in a similar manner via vessel and permit loan programs and fisheries enhancement expenditures. The British Columbia Provincial Government offers an Aquaculture Incentive Loan Program to salmon farmers for up to \$100,000 (Canadian) for equipment purchase, with terms of deferred interest for three years and payback in five years. Recent trade negotiations between the U.S. and Canada have generally focused on lowering trade barriers (except for the specific instance cited above). Thus, it is unlikely that the British Columbia salmon-farming loan program would be viewed as an unfair subsidy. For a prospective British Columbia investor, the threat of a punitive tariff on farmed salmon exports to the U.S. is minimal.

Other salmon-farming countries that provide subsidies include Denmark (loans for up to 85 percent of project cost in the Faroe Islands) and New Zealand (special tax benefits for all new businesses).

STRUCTURE OF THE SALMON FARMING INDUSTRY

The structure of the salmon farming industry in its various forms around the world has evolved in response to physical constraints, i.e., the quality and quantity of available sites, and government objectives such as employment in coastal communities. In the U.K., where sheltered sites are limited, ocean pen-rearing facilities tend to be large and run by corporations, while freshwater trout and salmon farms tend to be smaller, family-type operations. In the following section, we examine the structure of the salmon-farming industries in those states and countries most likely to be the chief competitors with an Alaska salmon-farming program.

⁷⁸-----
"World Salmon Farming: An Overview," p. 8.

Washington State

The same type of corporate development pattern seen in the U.K. has occurred in Washington State and until recently in British Columbia, but for different reasons. Five of the nine saltwater farms operating in Puget Sound are owned by large companies (Cambell Soup owns Domsea and Scan-Am and Sea Farm of Norway, Inc. are subsidiaries of Norwegian firms). The Washington Department of Fisheries has an Aquaculture Coordinator to oversee the development of the salmon-farming industry and eight to ten marine farms are in the permitting/startup stage of development. Currently there are 11 to 12 successful freshwater pan-sized coho operations in Washington.⁷⁹

Marine pen-rearing operations in Washington have been strongly opposed by real estate developers and waterfront homeowners who object to their presence on aesthetic grounds (usually under the guise of "environmental concerns"). This is the main reason more pen rearing operations have not been started. County governments have been very reluctant to provide the required permits under pressure from constituent groups.

The University of Washington is in the process of conducting a comprehensive environmental impact study of mariculture in Puget Sound. According to a preliminary study (which is by no means comprehensive or conclusive), the present scale of floating mariculture (salmon and mussel farms) in Puget Sound does not cause long-term environmental degradation or pose any human health problems.⁸⁰ This study examined commonly cited environmental concerns over the accumulation of organic-rich sediments under floating mariculture sites, the introduction of diseases from farmed to wild species, effects of escapement on native gene pools and the release of toxicants (e.g., antibiotics in feed) to the surrounding waters. The study concluded that none of these factors appear to be major obstacles to further aquaculture development.

British Columbia

It is most likely that the rapidly expanding salmon-farming industry in British Columbia will become the main competitor for an Alaska salmon-farming industry, since British Columbia and Alaska share many of the same comparative advantages for North American markets. Thus, the progress of

⁷⁹ Bill James, Aquaculture Program Manager, Washington Department of Fisheries, personal communication, October 1986.

⁸⁰ Donald P. Weston, "The Environmental Effects of Floating Mariculture in Puget Sound," School of Oceanography, University of Washington, August 1986, p. viii, ix.

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industry development in British Columbia can offer some valuable lessons to Alaska. Below, we contrast the booming free market approach of development in British Columbia with the carefully regulated government-controlled approach to aquaculture development in Norway. These can be considered the extremes of the spectrum of salmon-farming development strategies as practiced around the world.

The British Columbia marine salmon farming industry began in the same way as Washington, when a subsidiary of Domsea, Apex Bio-Resources, started a pan-sized coho operation on Vancouver Island in 1975. The British Columbia government began supporting salmon-farming development in the early 1980s--as Norwegian imports of Atlantic salmon began entering U.S. markets--by providing a streamlined permitting process (several different permits are required from various provincial and federal agencies) for prospective entrepreneurs as well as government equipment loans to licensed farmers.

There are three stages for a prospective entrepreneur to pass through in the British Columbia permitting process. First, a management plan must be submitted to the Ministry of Agriculture and Fisheries, which is reviewed in conjunction with the Ministry of Forest and Lands. Upon approval, a Section 10 permit is granted which reserves a site for a period of one year for biological sampling and continuation of the permitting process. Since there is only a nominal fee charged and no restrictions on how many sites an entrepreneur can reserve, nor limitations on farm size, this has led to rampant speculation and attempts by individuals to tie up as many prime sites as possible. A kind of Klondike gold rush atmosphere pervades salmon-farming development in British Columbia. There are currently 700 sites reserved under Section 10 status.

The second stage of the permitting process allows entrepreneurs to actually begin farming and confers site tenure for 10 years. Currently, 150 sites have passed to the site occupation stage of the permitting process. The third and final stage of the permitting process gives farmers an actual foreshore lease for 20 years. There are presently 60 operating farms that have passed through the entire process; the number is expected to increase to 150 within the next year.⁸¹

Currently, there is no marketing coordination among independent salmon farmers in British Columbia, mainly because most farms are still in the start-up stages and do not have fish to sell. It generally takes about three years of planning and capital investment before sales of even pan-sized fish can occur. Existing operators have resisted any efforts to organize the flow of product to market. Many farmers are concentrating on

⁸¹ George Hunter, Aquaculture Coordinator, British Columbia Ministry of Fisheries and Oceans, personal communication, October 1986.

developing broodstocks due to the critical shortage of eggs and/or smolts. There is an attempt underway among farmers themselves to adopt Norwegian product quality standards.

A significant portion of the investment capital driving salmon-farming development in British Columbia is coming from foreign, mainly Scandinavian, banks with considerable experience in financing aquaculture projects. There are strings attached to this financial assistance, however, as most foreign banks want managerial control as well as a major equity share in the project.

The free-for-all atmosphere of salmon farm growth in British Columbia has all the appearances of the typical boom and bust cycle of uncontrolled development. In the rush to gain a foothold in the salmon-farming business, market considerations are being ignored. We spoke with several government officials involved in the development of the British Columbia salmon-farming industry who expressed concerns over the lack of technical expertise and business sense evident in the applicants for site permits. By most accounts, those few operators able to sell eggs and/or smolts to new entrants and the pioneer companies which produce pan-sized cohos are likely to be the most profitable operations for the next few years.⁸²

Salmon farmers who have an assured source of smolts and are tied into a marketing entity such as the Prince Rupert Fishermen's Cooperative (described below) or perhaps a Norwegian aquaculture company, will have a much better chance of survival than independent operators if product prices decline significantly. In this type of atmosphere, a painful shakeout of at least some independent farmers in the near future (next five years) seems almost inevitable.

The Prince Rupert Fishermen's Cooperative

One interesting development in the British Columbia salmon-farming scene has been the entry of the Prince Rupert Fishermen's Cooperative, which operates as a sort of North American version of the vertically integrated Hokkaido cooperative discussed in Chapter Two. Cooperative members include salmon fishermen of all gear types as well as other shellfish and finfish operators. Members of the cooperative currently have approximately 100 Section 10 permits⁸³ and 10 to 20 farms at the occupation stage of the permitting process. Typically, groups of six to eight fishermen have

⁸²Bill Heard, report of travel to British Columbia and Washington State salmon-farming operations, National Marine Fisheries Service, October 1985.

⁸³Bill Jones, Manager, Hywaze Seafarm (Prince Rupert Fishermen's Cooperative), personal communication, October 1986.

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formed partnerships with local entrepreneurs to acquire a farm site. To date, cooperative members have financed their farms internally, and have not gone into joint ventures with foreign investors. In most cases, the fishermen themselves plan to run the farms during their off season and hire a manager for the fishing season.

The cooperative operates a hatchery to produce smolts for member farmers as well as two marine salmon pens and two trout lakes. The federal government has provided wild eggs for broodstock development. Presently, chinook and coho salmon, rainbow trout and steelhead are being reared. Some other Washington and British Columbia salmon-farming companies have imported Atlantic salmon for broodstock development. The Prince Rupert Cooperative management is concentrating on domesticating Pacific species (which they feel are superior to Atlantics) and is adamantly against importing nonindigenous salmon species. Off-season fresh farmed Pacific salmon will be marketed supplementally to members' wild fish in season.

In addition to developing a salmon-farming capability, the cooperative has been operating a fish meal plant (which produces dried pellets from fish waste) for about six months and is in the process of expanding its feed production capacity. Experiments with oysters and mussels for possible farming application are also being conducted. The Prince Rupert Fishermen's Cooperative is a prime example of how traditional North American fishermen can take advantage of new developments in seafood markets. The combination of technical and research capability with managerial know how and vertically integrated operations makes the cooperative an extremely powerful and adaptive economic unit. In the highly competitive global seafood markets of the future, this type of organization could be essential for survival.

Norway

The Norwegian experience with salmon farm development stands in sharp contrast to the boom atmosphere of British Columbia. In the early days of salmon farming, the Norwegian government provided financial aid and research support as the industry developed. By 1973, legislation was passed which licensed the number of fish farms and set size limits (8,000 cubic meters) with the objective of maximizing employment opportunities in coastal communities. Currently, farms of 10,000 to 12,000 cubic meters are being approved. Size limitations were geared to be about the minimum scale for an economically viable family-run operation. In 1978, the average farming unit had a production of 30 mt and employed one and one-half persons. Today the average farm probably produces 50 to 80 mt annually.

In 1973, there were 300 farms and 200 hatcheries, though only a few operated on a large scale. Today, there are approximately 700 farms and 400 hatcheries, with another 1,000 farm permits awaiting approval. The availability of smolts has been the primary constraint on development, but smolt farm (hatchery) production capacity is expected to catch up with demand by 1990.

The Norwegian government carefully studied the economics of salmon-farming production and controlled the growth in the number of permitted farms to match the availability of feed and smolts. Simultaneous research efforts domesticated the Atlantic salmon. Over a 20-year period, the broodstock became genetically adapted in terms of disease resistance, feed conversion and survivability to the very high stocking densities required by pen rearing. It is estimated that each generation of selected broodstock has increased the average growth rate by three percent and improved hatchery techniques have cut the freshwater time period to produce a viable smolt from two years to one.⁸⁴ One of the keys to the growth of salmon farming in Norway has been the close relationship between government biologists and farmers. When the industry was in its infancy, there was almost daily contact between researchers and entrepreneurs.

Many of the pioneers in the Norwegian fish-farming industry were small businessmen and fishermen on the coast. Large corporations and banks played only a very minor role. Government surveys show that 90 percent of the operators in the salmon-farming industry in Norway are from the township where the farm is located. According to government criteria, 75 percent of the operations are located in economically underdeveloped areas. Of those operators who applied for farming permits between 1973 and 1978 (who were not already in the business), 55 percent came from a fishing background, 7 percent from agriculture and 10 percent from trade and industry (25 percent did not provide their occupational background).

In 1984, it is estimated that the salmon-farming industry in Norway directly employed 2,000 persons and another 2,000 in derived employment.⁸⁵ Thus, the Norwegian salmon-farming program has been highly successful at realizing the government's goals of promoting economic development and providing jobs and income for residents of coastal communities. The development of fish farming in coastal Norwegian communities has had profoundly beneficial social consequences as well. Salmon farming and related activities helped to reverse a trend of rural residents (particularly young people) migrating to the major cities to jobs created by Norway's new found oil wealth in the early 1970s. Thus, salmon farming has been instrumental in maintaining the traditional social fabric of rural communities.

⁸⁴Leiv Gronnevet, Secretary General, Association of Norwegian Fishing Vessel Owners, "Aquaculture in Norway: Development from a Cottage Industry to a Major Industrial Venture," remarks to the Norway Fish Farming Seminar, Seattle, Washington, June 1986.

⁸⁵Sven Eric Lindgren, "Sealaska Corporation Aquaculture: Opportunities and Constraints in Cultured Salmon Production--Phase II Feasibility and Profit Evaluation", August 30, 1985, p. 54.

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On the marketing side, all farm-raised fish since 1978 have been sold through a government-authorized marketing and sales organization (described previously). Membership is comprised of salmon farmers, licensed fish buyers and others in closely allied industries such as hatcheries and feed producers. A 2.5 percent levy on the first wholesale value of marketed fish is used to pay for operations (40 percent of revenues go to promotion, 10 to 15 percent to research and development and the remainder to other activities).⁸⁶ The government provides disease control services to all farmers and provides quality inspection during all stages of production and distribution from harvest to the point of departure at the airport in Norway.

As the salmon-farming industry has matured, a number of associated profit generating businesses have been spun off. Norwegian companies now export consulting services (biological, engineering, economic) and management techniques, financial and insurance services, salmon-farming equipment of all types, fish food and feed technology, smolts and eggs. Both public and private researchers in Norway have been working on developing techniques for farming other species such as Arctic char, halibut, cod, lobster, and turbot. The Norwegian government has identified aquaculture research as one of four top priority areas in the economy for planned growth in the 1986 to 1989 period. Thus, the university/government/private industry partnership that was formed during the development of the salmon-farming industry in Norway can be expected to be a major factor in global seafood markets of the future.

IMPLICATIONS FOR ALASKA

In the course of preparing this report, we have discussed the various aspects of salmon farming with a large number of industry and government officials from other states and countries. We have attempted to draw implications from their experiences and viewpoints for a potential Alaska salmon-farming industry. Below, we offer some general observations and then discuss specific issues in some detail.

Points most frequently mentioned by industry observers are that the major comparative advantages to farmed production in Alaska are site availability, the distance to domestic markets and the lack of international boundaries to cross. The main competition for farmed salmon from Alaska is likely to be British Columbia, as there is limited room for further increases in production in the Pacific Northwest states due to a lack of suitable sites, water quality problems, and opposition from environmental

⁸⁶James R. Brooker, "A Report on Aquaculture Activities in Norway," July 1984, p. 88.

and other resource user groups. British Columbia is even closer than Alaska to American markets and has a lower valued dollar, but is vulnerable to tariffs and other trade barriers. It may be that in the long-term (beyond ten years), neither British Columbia nor Alaska will be able to successfully compete with very low cost producers such as Chile.

A balanced approach somewhere between the free market excesses of British Columbia and the government-orchestrated Norwegian development strategies would seem to be in line with the Governor's Aquaculture Advisory Committee statement of philosophy for aquaculture development, which stressed compatibility with existing fisheries, economic self-sufficiency, and opportunities for family and small-scale business. The Klondike boom atmosphere in the permit process in British Columbia does not lend itself to these goals. Likewise, any creation of artificial wealth through granting of permits (as when limited entry permits have been granted in Alaska's fisheries) encourages speculation. If socioeconomic goals of providing jobs and income to residents of coastal communities are to be fulfilled, then dominance by a few large companies (e.g., Sealaska) or one particular industry segment (e.g., private nonprofit hatcheries) should be avoided.

The availability of smolts and locally produced feed are likely to be critical production constraints in Alaska (as they have been elsewhere) and the ability to obtain financing and insurance is likely to be crucial to the development of family-run operations. The hatchery capacity of FRED and PNP systems in Alaska is a distinct advantage over the situation in British Columbia whose smolts from private hatcheries are sold at premium prices. Much of the development of salmon-farming infrastructure in Norway involved construction of a large system of hatcheries, which is at least partially in place in Alaska. Under FRED supervision (and within their common property obligations), the PNP hatchery system could gear up to produce chinook and coho smolts for salmon farms fairly quickly. FRED and PNP hatcheries could also generate significant revenues from the sale of eggs and smolts.

Legal Questions

Fish farming is referred to obliquely in several different places in the Alaska Fish and Game statutes, but aside from setting fish and game farming license fees, the commercial farming of fish is not dealt with explicitly.⁸⁷ The Attorney General's Office has taken a stance on the legality of salmon pen rearing that essentially says that since it is not explicitly allowed in statute or regulation, you cannot do it.⁸⁸ While

⁸⁷Alaska Statute 16.05.340(15), AS 16.05.930 and AS 16.05.940(12).

⁸⁸Alaska Statute 16.05.340 and AS 16.05.920-940.

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this opinion may sound like an exercise in reverse legal logic, it highlights the nebulous area in State law into which mariculture falls. From an industry development standpoint, it is probably desirable that the legislature deal directly with the statutory bottlenecks in the way of salmon farming and other mariculture development to avoid legal problems in the future. The legislature could also clearly define the responsibilities of the various State agencies involved in permitting and regulating mariculture as well as the extent of State support and financial involvement in industry development.

Stripped of all the legal language, the present situation boils down to this: The ADF&G commissioner is given limited statutory authority to permit the collection of fish and game for scientific, propagative or educational purposes.⁸⁹ The commissioner is not given specific statutory authority to permit the commercial collection or sale of fish and game resources. Under AS 16.05.251, the Board of Fish is given fairly unlimited discretion to regulate the capture and holding of fish but it has not chosen to authorize any transfer or cultivation of fish for commercial purposes except for oysters.^{90, 91} The net effect of this situation is that the mariculture of a nonindigenous species (Pacific oysters) is allowed, while the commercial culture of indigenous species, such as salmon and scallops, is technically illegal.

There is a further legal snag in the Alaska Statutes that affects fish farming in particular. According to AS 16.10.420, hatchery operators in the state can sell eggs or fry only to ADF&G or--after FRED inspection--to other hatchery operators. This statute would have to be modified by the legislature to allow FRED and PNP hatcheries to sell eggs and/or smolts to salmon farmers. A lobbying group, the Alaska Mariculture Association, has drafted a bill to deal with the statutory impediments to mariculture development cited above. There appears to be a consensus among proponents that since all aspects of mariculture except oysters are in the same legal limbo, a comprehensive solution which addresses all components of the industry is more desirable than a piece-meal approach (e.g., which might allow the cultivation of shellfish but not salmon).

⁸⁹Memorandum to Don Collingsworth, Commissioner, Alaska Department of Fish and Game, from Larri Spengler, Assistant Attorney General, January 31, 1986, "Marine Net Pen Salmon Rearing," Department of Law file No. 366-187-84.

⁹⁰Alaska Statute 16.05.340(b).

⁹¹5 AAC 41.070 "Prohibitions on Imports and Release of Live Fish."

Permitting

The State controls tidal and submerged lands within its borders from the mean high water line to three miles offshore. Thus, the permitting process for a salmon farming industry in Alaska would involve the State Departments of Fish and Game (Title 16 permit), Environmental Conservation (Water Quality Certification), Natural Resources (Site Permit or Lease) and the Office of Governmental Coordination in the Governor's Office (Coastal Zone Management Consistency Determination). Federal involvement would include the U.S. Army Corps of Engineers (Section 10 Permit for Structures on Navigable Waters) and possibly the Forest Service (lease for onshore facilities on federal land).

Until the statutory problems cited in the previous section are resolved, the permitting process for salmon farms cannot be established or proceed. From our discussions with individuals in the resource agencies, it is apparent that clear policy guidelines need to be set forth before a permitting process can be developed. There is some feeling that a comprehensive permitting process which would be applicable to all forms of mariculture should be developed. The State agencies involved cannot draft regulations for public comment until they receive policy direction from the Governor's Office or the legislature.

In the absence of clear policy guidelines, the Department of Natural Resources is in the process of trying to refine its permitting process for oyster farms to avoid the problems cited previously in the "Implications for Alaska" section. There is some concern that individuals are applying for tideland permits ostensibly for oyster farms but actually to tie up potential sites for salmon farms (if and when they are allowed) or to obtain cabin sites.⁹² (Currently, less than half of the 20 permitted oyster sites in Southeast are actually being used to grow oysters.)

Policy decisions on the number, size and location of salmon farms are critical to development of the permitting process. One alternative that has been suggested by a number of persons interested in operating salmon farms in Alaska is to offer an initial number of permits, perhaps 300, with no individual or corporation controlling more than five. Each permit holder could control a site for a limited period (perhaps three years) and would have to show progress toward development of a viable operation within that period before he could apply for a longer term lease.

We do not know what size farms would prove to be economical in Alaska, though with the generally high cost of doing business, a family-run farm might have to be somewhat larger than those in Norway to generate the same

⁹²Letter to Roger Painter of the Alaska Mariculture Association from Paula Burgess, Southeast Regional Manager, Department of Natural Resources, October 22, 1986.

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returns. If State policy is to maximize local employment and small business income, then a size limitation on farms may be appropriate, but only after the economics of production in Alaska are understood. Another frequently mentioned idea would be to establish geographical areas or "aquaculture districts" where a certain number or size of farming operations are allowed.⁹³ An additional alternative could be to restrict the size of operations near coastal communities to encourage local employment and income, while larger operations could be relegated to less populated areas.

Financing

Scandinavian banks have become an important source of financing for salmon farms in several countries. In some cases, an entire turnkey farming operation including financing, insurance, construction, management, and marketing arrangements can be purchased as a package through a Norwegian export company (which represents a number of other companies). American banks and insurance companies have little or no experience with aquaculture, so at least some private financing would likely come from foreign investment. Outside investment in aquaculture in Alaska is a different prospect from traditional fishing industry investment noted in Chapter One, because it provides year-round employment for residents and promotes greater use of underutilized processing facilities. Outside investment also circulates money in local economies.

One means of encouraging family operated farms could be a State loan program with fairly rigorous application criteria, perhaps modeled after the loan requirements of Scandinavian banks. The Fisheries Enhancement Revolving Loan Fund will be receiving large payments in the next few years, as many of the original PNP hatcheries reach the end of their deferred payment period and begin repaying their capital construction loans. This income stream could be a means of financing the diversification of Alaska's aquaculture industry to include salmon farms and other forms of mariculture.

Any State loan program for salmon farming (or other aquaculture ventures) which attempts to encourage development in small coastal communities must be based on sound lending principles if it is to be self-sustaining. There are several examples of financially unsuccessful State loan programs which have been aimed at improving the economic conditions of specific geographic regions. For example, loans from the Commercial Fisheries Revolving Loan Fund (type B loans) were designed to enable residents of coastal communities to be able to afford limited entry permits and to participate in local fisheries. The program has very high (18.8 percent) delinquency and

⁹³Rick Harris, Vice-President of Natural Resources, Sealaska Corporation, personal communication, October 1986.

default rates and has had the effect of significantly inflating permit prices.^{94, 95} Both the success and long-term financial impact of a State loan program for aquaculture can be determined by the legislature.

Species, Genetics and Disease Control

FRED currently has a two-person genetic staff. If it is to support a salmon-farming industry and undertake a serious broodstock development program, this capability would need to be expanded. The same is true with disease control. By statute, FRED is responsible for disease control in Alaska's ocean-ranching program. FRED Pathology Lab provides support services to both FRED and PNP hatcheries. Either the pathology staff would have to be expanded to support a salmon-farming industry or FRED could be funded to certify a private lab and contract for the work.⁹⁶ FRED personnel are preparing a paper for the Mariculture Technical Work Group which will discuss disease control and broodstock development issues for salmon farms.

Water temperatures and climatic conditions from Southeast to the Aleutians are suitable for all species of salmon. North of the Alaska Peninsula, Arctic char (which has bright red flesh and sells for very high prices in European markets) might be feasible for pen culture. Currently, the most attractive Pacific species for prospective Alaska farmers are chinook, coho and, possibly, steelhead.

At the present time, wild adult Pacific salmon have not been adapted to pen rearing and cannot survive at the stocking densities of fully domesticated Atlantic salmon common in Norway (which approach 80 kilograms per cubic meter of pen volume). Pacific salmon stocks in Alaska require more room. Atlantic salmon are more sedentary fish to begin with (e.g., in the wild they do not migrate upriver nearly as far as Pacific species) and have been adapted over several generations for survivability in pen-rearing conditions and maximum dry feed conversion (domesticated Atlantics can convert at about a 1.2 to 1 feed to weight gain ratio as opposed to about a 2-to-1 ratio for wild fish). Thus, larger volume farms might be required to raise

⁹⁴"Division of Accounting and Collections Program Summary, February 1986," Department of Commerce and Economic Development, p. 7.

⁹⁵Jonathan M. Karpoff, "Limited Entry Permit Prices: A Study of the Causal Relationship Between Key Variables and Limited Entry Permit Prices," Commercial Fisheries Entry Commission Report No. 83-6, p. 3.

⁹⁶Tom Kron, Deputy Director, Alaska Department of Fish and Game, Fisheries Rehabilitation and Enhancement Division, personal communication October 1986.

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Pacific species for a few generations until they adapt to the pen environment. It is likely that a farmer in Alaska would raise a combination of cohos to pan-size (1 lb.) for cash flow while rearing chinook to grow-out size (7-12 lb. fish bring the highest price) for broodstock.⁹⁷

The question of whether or not to allow the importation of nonindigenous species such as Atlantic smolts or eggs is of momentous importance. There are numerous precedents for importing nonindigenous species to Alaska such as oysters and elk, though the Board of Fish has explicitly prohibited the importation of live fish or eggs from outside the state (5 AAC 41.070). Some have raised the fear that Atlantic salmon could possibly escape from farms and eventually supplant Pacific species. This fear is largely unfounded, as Washington State has attempted to develop Atlantic salmon runs in several rivers for 50 years with virtually no success. The real danger of bringing in Atlantic smolts or eggs is the importation of disease. Contaminated smolt imports from Scotland in 1985 forced Norwegian farmers to destroy 2,900 mt of farmed salmon.⁹⁸ Despite the experience, the Norwegian government has granted exemptions to restrictions on smolt imports to allow five million more smolts to be imported in 1986 because estimated domestic production of 24 million smolts is insufficient to meet the industry demand of 32 million.

British Columbia has allowed the importation of Atlantic eggs and smolts under very strict conditions. The fish are quarantined for their entire life cycle; and their progeny are allowed to be stocked in farms only after they have proven to be disease free. The enormous expense of this process may be justified for the development of broodstock; fully domesticated Atlantic salmon can convert dry feed to weight gain at nearly double the rate of wild fish. As explained below, feed accounts for 35 percent of operating costs. Thus, stocking fully domesticated fish could cut feed costs nearly in half and lower operating costs by about 15 percent compared to wild stocks.

There are many advantages to pen rearing Pacific salmon species aside from the market preference cited earlier in this chapter. Pan-sized cohos can be sold to bring in cash flow 18 months after hatching as opposed to three to four years for two to six-kilogram Atlantics or chinook.⁹⁹ Pan-sized

⁹⁷Rick Harris, "World-wide Aquaculture Industry Growing," Sealaska Shareholder, May/June 1986, p. 6.

⁹⁸Pacific Fishing, November 1986, p. 14.

⁹⁹Atlantic salmon have a life cycle similar to chinook or sockeye detailed in Chapter 2. Atlantics spend at least a year in fresh water before migrating to sea and mature and spawn in four, five, or six years. A unique trait of Atlantic salmon and Pacific steelhead is that they can spawn multiple times and can live up to ten years.

cohos can also be raised from smolt stage to market size in either fresh or saltwater. The zero-age chinook technique (explained in Chapter Two) can be used to introduce very small (five-gram) juveniles to saltwater.¹⁰⁰

Feed

The availability of high quality feed at a reasonable price will be an important factor in the development of an Alaska salmon-farming industry. Feed costs comprise the largest component of total operating costs. In Norway, the operating cost structure of an average salmon farm is composed of the following elements:¹⁰¹

Feed	35 percent
Smolts	20 percent
Labor	15 percent
Interest/Depreciation	15 percent
Maintenance	15 percent

An economically sound Norwegian dry fish food plant produces about 20,000 metric tons of feed per year which requires 5,000 to 10,000 metric tons of salmon farm production (and associated hatchery facilities) to support it. The Norwegian fish food industry is based on the harvest of a huge capelin resource which provides very cheap raw material for fish meal. The Norwegians have experimented with several types of dry and moist food diets and are currently feeding mostly dry, slow-sinking pellets because of their low cost and nonpolluting qualities. The Japanese and Chileans, on the other hand, have had considerable success raising cohos on a silage diet of chopped scrap and baitfish. Feeding of silage is probably not an option in Alaska, however, as silage-processing requires large amounts of labor as well as capital expense.

Alaska's hatcheries consume about two million pounds of fish food annually. Feed is purchased from two sources. Alaska Dry Pellets (ADP) are purchased from Seward Fisheries (a subsidiary of Icicle Seafoods) for between \$0.69 and \$0.75 per pound depending on volume. The other source of feed for Alaska's hatcheries is Oregon Moist Pellets (OMP) purchased from Moore Clark Company of La Conner, Washington for \$0.55 per pound.¹⁰²

¹⁰⁰One technique that has been developed for chinook is to rear fry in a saltwater pen lined with a plastic collar. Freshwater is pumped into the pen to form a lens on top of the saltwater. The fish can then be gradually adapted to saltwater without using valuable upland rearing ponds or raceways

¹⁰¹Finn Hallingstad, Marketing Manager, T. Skretting A/S, "Fish Feed Supply, Technology, Production and Quality Requirements," remarks to the Norwegian Fish Farming Seminar, Seattle, Washington, June 1986, p. 2.

¹⁰²Ken Leon, Chief Biologist, ADF&G-FRED, personal communication, October 1986.

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The differences between dry and moist pellets are that moist pellets have a lower conversion rate and must be kept frozen during shipment and storage. An operator can get the same amount of growth by using 78 percent as much dry feed as a moist food diet. Thus, on a cost comparison basis, the two feeds are very comparable. When shipping costs are added, it becomes cheaper for hatcheries in Southeast to use OMP while operators in South-central find ADP to be cheaper. Icicle Seafoods has expressed an interest to State officials in opening a fish meal processing facility at its Petersburg Fisheries plant to produce ADP if it could secure a contract to supply the total Alaska hatchery (FRED and PNP) feed requirements. This would lower feed prices slightly in Southeast.

Alaska's hatcheries can afford feed at the prices listed above because juvenile salmon at the hatchery site are fed for only a short time before being turned loose to forage on ocean feeding grounds and return many times larger than when they were released as smolts. Even though the economics of production for salmon farms in Alaska are not well known, it is very unlikely that a farmer could profitably pen rear salmon at prevailing feed prices. Dry pellet feed costs would probably need to drop to the \$0.30-\$0.40/lb. range for pen rearing to be profitable.

Thirty family-sized salmon farming operations of 50 metric tons each are estimated to require approximately 6.6 million pounds of feed annually, which is over three times as much as Alaska's hatchery systems presently consume.¹⁰³ Thus, even a small-scale salmon-farming industry could support more than one feed plant. We do not know what the economies of scale are with respect to feed production at the present time, or whether price reductions of the magnitude cited above are possible even with larger facilities.

The Economics of Production

The economics of salmon farming in Alaska are not well known at present. A breakdown of the investment and operating costs of a family-sized (50 mt) operation and a corporate-scale (200 mt) Atlantic salmon farm in the Seattle/Vancouver area are presented in Table 6. Production cost/revenue projections for the same two farms are presented in Table 7.

¹⁰³"Aquaculture: Opportunities and Constraints in Cultured Salmon Production," p. 110.

TABLE 6

INVESTMENT AND OPERATING COSTS

50 mt Atlantic salmon Farm		200 mt Atlantic Salmon Farm	
Investment Costs:			
Pens and nets	\$ 30,000	Pens (15)	\$125,000
Anchoring	2,000	Anchoring	8,000
Automatic Feeders	1,000	Automatic Feeders	2,000
Storage Facilities	4,000	Simple House and Storage	6,000
Slaughterhouse and Equip.	15,000	Slaughterhouse	22,000
Dock	3,000	Equipment	22,000
Transport Equipment	5,000	Boat and Motor	6,000
	<u>\$60,000</u>	Dock	11,000
		Truck	<u>20,000</u>
			\$222,000
Operating Costs:			
Smolts (\$1 each)	\$ 26,000	Smolts	\$103,000
Freight for smolts	2,000	Freight for smolts	10,000
Vaccination	500	Vaccination	1,000
Feed (\$600/tn.)	60,000	Feed	240,000
Labor (2 full-time+extra)	70,000	Labor (1 mgr.; 8 employees)	202,000
Energy Costs	1,000	Energy Costs	10,000
Miscellaneous	2,000	Miscellaneous	20,000
Maintenance	2,000	Maintenance	10,000
Insurance (facilities)	3,000	Insurance (facilities)	10,000
Insurance (fish)	3,500	Insurance (fish)	13,000
Containers (\$5.50 each)	<u>13,000</u>	Containers	<u>55,000</u>
Total	\$183,000		\$674,000
Gross Sales:			
91,300 lbs at \$3.50/lb.	\$320,000	365,143 lbs	\$1,278,000

Source: "Aquaculture: Opportunities and Constraints in Cultured Salmon Production," pp. 95, 105.

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TABLE 7

Production Costs/Returns (Thousands of 1985 Dollars)

50 mt Atlantic Salmon Farm

Year	1	2	3	4	5	6-11
Operating	76	159	183	183	183	183
Financing (15% for 10 yrs)	<u>0</u>	<u>97</u>	<u>171</u>	<u>71</u>	<u>12</u>	<u>29</u>
Subtotal	76	256	354	254	195	192
Transportation	<u>0</u>	<u>9</u>	<u>22</u>	<u>22</u>	<u>22</u>	<u>22</u>
Total	76	265	376	276	217	214
Sales	0	117	320	320	320	320
Gross Profit	(76)	(148)	(56)	44	103	106
Gross Profit Margin				13.7%	32%	33%

200 mt Atlantic Salmon Farm

Year	1	2	3	4	5	6-11
Operating	277	584	674	674	674	674
Financing	<u>0</u>	<u>353</u>	<u>553</u>	<u>144</u>	<u>45</u>	<u>34</u>
Subtotal	277	937	1,237	818	719	708
Transportation	<u>0</u>	<u>35</u>	<u>88</u>	<u>88</u>	<u>88</u>	<u>88</u>
Total	277	972	1,315	906	807	796
Sales	0	506	1,278	1,278	1,278	1,278
Gross Profit	(277)	(466)	(88)	372	471	482
Gross Profit Margin				29.7%	36.9%	37.7%

Source: "Aquaculture: Opportunities and Constraints in Cultured Salmon Production," pp. 98, 106.

The figures cited above should be used only as indicators of the order of magnitude of investment required to run a successful salmon-farming operation. The real costs of operating in Alaska are likely to be somewhat higher for labor (perhaps 20 percent) and feed (unknown), while costs for Pacific salmon smolts could be considerably lower. Small operators could save a substantial amount by constructing the pens and storage facilities themselves, hand feeding, and avoiding unnecessary purchases such as docks (the current trend in new farm construction is toward self-contained facilities without shoreside structures). Costs would also be lower for farms grouped near others that can share facilities and for those near processing facilities and/or transport links. Transport costs (i.e., \$0.28/lb. Juneau to Seattle air freight) will be higher in Alaska but comprise less than 10 percent of the selling price.¹⁰⁴ Small farmers can internalize labor costs and operate on a narrower profit margin, while large producers must hire their labor and may have greater profit expectations.

The Economic Impact of Salmon Farming in Alaska

The Sealaska Corporation commissioned a feasibility study of salmon farming in 1985, which included a cursory analysis of the economic impact (in terms of jobs and income) of a 20,000 mt salmon industry in Alaska by the turn of the century. In perspective, consider that the combined harvest of chinook (6,195 mt) and coho (18,379 mt) in Alaska in 1985 was 24,574 metric tons. The study uses assumptions on employment and income effects from the Norwegian salmon-farming industry structure to calculate a total employment effect (direct and derived employment) of 2,640 additional jobs and a payroll of \$67.8 million on total sales (\$3/lb.) of \$132 million.¹⁰⁵ In Norway, it is estimated that for each person directly employed in the salmon-farming industry, an additional job (derived employment) is created elsewhere in the economy (an employment multiplier of 2).

We believe that these estimates significantly overestimate the potential employment and resulting payroll effects of an Alaska salmon-farming industry. As discussed in Chapter One, the Alaska economy resembles that of a developing nation more than a mature industrialized economy like Norway. Much of the purchases of goods and services required by farmers would

¹⁰⁴Alaska Airlines Aircargo Office, October 1986 rate for shipments of fish greater than 250 pounds.

¹⁰⁵"Aquaculture: Opportunities and Constraints in Cultured Salmon Production," p. 124.

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be made out of state. Our experience with basic industry employment multipliers in Alaska is that they average about 1.5.^{106,107} The use of Norwegian employment multipliers probably overestimates total employment by at least one-third. Direct employment for a hypothetical 20,000 metric tons salmon-farming industry also includes 90 persons employed at 40 smolt hatcheries. Additional hatchery capacity would be required for a major salmon-farming industry, but it is unlikely that 40 new hatcheries would be needed to support a salmon-farming industry in Alaska, considering the magnitude of the State's existing hatchery investment.

Adjusting for these factors produces a total employment effect of about 1,920 jobs and a payroll of \$48.8 million. A salmon-farming industry of this magnitude would have an economic impact that is roughly comparable to the present Alaska logging industry in terms of resident employment (six percent greater resident employment and nearly double the resident payroll).¹⁰⁸ Note that these are very rough estimates and a 20,000 mt industry size is an arbitrary figure based on another rough calculation of the potential size of the domestic market.¹⁰⁹ In any case, an industry with \$132 million in gross sales would have a significant impact on the Alaska economy.

Salmon farming is a particularly appealing industry for Native and village corporations with large coastal landholdings and could become an important aspect of village economies. Shareholder employment is a prime concern to Native corporations. Salmon farming is not a labor intensive enterprise, but it does utilize the skills of local residents and brings in year-round income. At least two Indian tribes in the Puget Sound area have become involved in salmon pen-rearing projects. Vertically integrated companies such as the Sealaska Corporation (which is already involved in marketing Norwegian farmed salmon through its subsidiary, Ocean Beauty Seafoods) could become a nucleus of technical, financial and marketing support to a large number of satellite farming operations. There are many opportunities for this type of organization to develop the same profit centers we described previously for Norwegian companies.

¹⁰⁶Brad Pierce, "Statewide Budget Impact Indicators," House Research Agency Memorandum 86-032, November 26, 1985.

¹⁰⁷A basic industry is defined as one which brings in money from outside the state for goods and services produced within the state. In Alaska, the basic industries are mining (including oil and gas), timber, fishing, tourism and military employment.

¹⁰⁸"Nonresidents Working in Alaska," pp. 11, 14.

¹⁰⁹"Aquaculture: Opportunities and Constraints in Cultured Salmon Production," p. 27.

Negative Impacts

The conventional method of comparing two different investments is embodied in the concept of opportunity cost. The opportunity cost of investment is a measure of what opportunities are given up by choosing one investment over another. As commonly applied to fishermen, it is the other opportunities given up (e.g. buying a stock or security) by choosing to invest in the fishing business. This cost does not appear in a ledger, but, like depreciation, is a real cost of doing business.¹¹⁰

The State's investments in aquaculture also have an opportunity cost associated with them. The massive investment in hatcheries detailed in Chapter Two could have been spent for other public purposes or invested in securities (e.g. the Permanent Fund), but the State wisely chose to enhance its major comparative advantage among world salmon producers. Ocean ranching is the State's first aquacultural investment choice. As shown in Chapter Two, the investment in hatcheries is producing large economic benefits.

Salmon farming is the next logical State investment in salmon aquaculture. Failing to follow the trend to invest in salmon farming could result in: 1) a steady erosion of Alaska's market share in premium salmon markets; 2) underutilized processing facilities (and corresponding loss of jobs); and 3) a PNP hatchery system that may not be able to generate enough revenues (under current operating constraints) to repay its State loans and attain financial self-sufficiency.

Fishermen's organizations (particularly trollers) have argued that Alaska farmed salmon would compete with their wild fish in traditional markets. This is true, but market forces we analyzed earlier in this chapter are inexorable; Alaska fishermen will face competition from farmed salmon regardless of whether or not they come from Alaska farms. At the rate that worldwide production of farmed salmon is growing, domestic markets can be expected to become saturated in the intermediate (next five to ten years) future. This means that there is a limited "window of opportunity" for Alaska to enter salmon farming and gain a market share.

We have described fishermen's groups in other countries that have taken advantage of the opportunities offered by salmon farming. If traditional fishermen in Alaska can learn from their counterparts in other countries (which have successfully integrated salmon farming into their operations) and adopt some of the cooperative methods that have made others more competitive, then the greatest loss they suffer from farmed salmon may be some of their sense of autonomy and individual freedom.

¹¹⁰Doug Larsen, "1979 Fisherman's Income Survey: Herring and Salmon Fisheries," University of Alaska, Alaska Sea Grant Program Report 80-5, November 1980, p. 3.

CHAPTER FOUR

OTHER FORMS OF MARICULTURE

Several species other than salmon are currently being pursued and/or contemplated for mariculture development in Alaska. These are, in order of their present stage of development: oysters, mussels and scallops. This chapter also includes a brief section on the herring roe-on-kelp fishery, which could serve as the basis for sea vegetable (giant kelp) mariculture in the near future (within five years). Because of the fledgling status of these forms of mariculture, production could increase substantially before encountering the kind of market constraints, described in the previous two chapters, that will effect pen rearing salmon. Therefore, no detailed market analysis is offered in this chapter. The discussion focuses on the current status of these operations in Alaska and their potential for future development.

OYSTERS

Oysters only rarely spawn naturally in Alaska because they require a sustained water temperature of 68 to 72 degrees for approximately one month (water temperatures in Southeast do occasionally reach this level but not for a long enough period).¹¹¹ This biological fact has both good and bad implications for oyster farmers. Because they do not spawn, oysters grown in Alaska stay fat and succulent and do not become mushy and bitter during the summer spawning months as they do in regions where spawning occurs naturally. Oysters reared in Alaska direct all of their metabolized nutrition (glycogen) into growth rather than reproduction. Raft culture techniques (which allow oysters to feed twenty-four hours a day instead of between tides as in beach culture methods), a very intense April to October growing season, and most importantly, an abundance of sites with nutrient-rich clean water, are all important natural advantages to oyster farming in Alaska.

The lack of locally produced larvae (commonly known as spat) requires that juveniles be purchased from oyster hatcheries outside the state for grow-out on farms. Good quality imported spat (1/4-inch size) costs about \$14 per thousand (1.4 cents each). The importation of live oysters is specifically regulated by the Board of Fisheries, which allows only commercially cultured oysters from the Pacific Coast of North America to be

¹¹¹Robin Larsson, President, Alaska Shellfish Growers' Association, personal communication, November 1986.

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imported into Alaska.¹¹² Live oysters from Korea, the Gulf of Mexico, and the Atlantic Coast of North America are specifically prohibited from being released into the waters of the state unless the brood stock they come from has been cultured for three or more generations on the Pacific Coast of North America and they are proven free of diseases that are not indigenous to Alaska.

Oysters were farmed for a brief period in Southeast Alaska prior to statehood using beach culture methods and have enjoyed a revival of interest from rural residents in recent years. Experimental oyster production using raft culture techniques started in 1978, with the first commercial sales occurring in 1983. Today, there are 20 permitted oyster farms in Alaska, with seven actually producing oysters for commercial sale and two more ready to begin production next spring.¹¹³ Half-shell oysters take two growing seasons to produce and sell for 50 cents each or approximately \$3/lb. Currently, oyster farmers can easily sell all of the oysters they can produce and enjoy a domestic market situation where demand is increasing and production declining (because of water quality problems experienced by other producers). We do not have accurate production data (Alaska Department of Fish and Game does not publish production statistics for oysters), but from conversations with producers, it appears that 30,000 to 32,000 oysters from Alaska were sold in 1986.

The oyster farmers we contacted stress three things that they need from the State for orderly development of their industry to proceed. These are: an oyster hatchery; conveniently located paralytic shellfish poisoning (PSP) testing facilities; and a loan program. Ideally, an oyster hatchery should be located in Southeast near the center of present oyster farming activity. According to Robin Larsson, President of the Alaska Shellfish Grower's Association, his organization made a bulk purchase of two million spat in 1985, nearly all of which died en route to Alaska when the flight on which they were shipped overhauled Wrangell and arrived three days behind schedule. Another consideration is that nonindigenous oyster spat--which is very hardy and have a high (90 percent or better) survival rate once placed in rafts--are not genetically adapted to Alaska. Juveniles from a given order of spat tend to have very uneven growth rates. Perhaps 10 to 20 percent of juveniles grow very quickly, another 50 percent will grow moderately well and the remainder grow slowly. A selective breeding program could develop an Alaska strain that would grow uniformly well within a few generations. At current production levels, an assessment on sales by oyster farmers would probably not generate enough revenue to pay

¹¹²Alaska Administrative Code: 5 AAC 41.070 "Prohibitions on Imports and Release of Live Fish," Sections (a) and (b).

¹¹³Robin Larsson, "Oyster Farming in Alaska," Alaska Fish and Game, Alaska Department of Fish and Game, May/June 1986, p. 25.

for a hatchery operation. In the future, a hatchery assessment may be feasible.

PSP testing facilities are currently located in Palmer. When an oyster farmer wants to make a sale, he must remove all of his oysters from the water, take samples from the entire batch and send them to Palmer for testing. It generally takes about three days for Southeast farmers to get test results by phone, during which time the oysters must remain out of the water (under terms required by a shucker-shipper permit from the Department of Environmental Conservation). Oysters can easily stay alive out of the water for this period but it causes the quality of the product to deteriorate and reduces the shelf life of the oyster at the retail level. This is very important for Alaska oysters because they are generally grown for the gourmet half-shell market, where premium quality is the primary consideration. With a PSP testing lab in Southeast, oyster farmers could conceivably get their test results by phone on the same day samples were shipped (see the mussel section for a further discussion of PSP testing).

Oyster farmers point to the need for a State loan program because it takes two years from the time they are permitted until they get their first harvest and returns. Most oyster farms are located at remote sites so farmers are often unable to hold down regular jobs at the same time they are working their farms. Oyster farming is a moderately labor intensive business during the growing season, when the farmer must periodically clean debris from the screens in his rafts and prepare the oysters for sale. During the winter, only custodial care is required to maintain the rafts. The farmer may be able to leave his site for brief periods during the winter, but, for most of the year, he must be present. A State loan program would help prospective entrepreneurs survive their first two years.

Many of the primary developmental concerns of Alaska shellfish farmers (of all species) center around the present Department of Natural Resources (DNR) site permit procedures and stipulations. The time frame to go through the entire permit process (all State and federal permits described in Chapter Two) from start to finish is approximately 90 days, but site permits are valid for only one year and the farmer is required to reapply annually. Additionally, DNR has the power to revoke a permit without cause. Thus, the current site permit situation is full of uncertainties for the entrepreneur and is not something an operator can "take to the bank" and borrow money on or attract investors to expand an operation. Additionally, there is some fear that DNR will raise its leasing fees (currently \$50 per acre per year with a \$100 minimum) which would be a further investment deterrent.

The DNR is presently in the process of trying to refine its tideland site leasing permit regulations to better accommodate shellfish farms (which

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should at least result in longer-term leasing arrangements), but the basic problem is that the permits were originally designed for the logging industry (log transfer sites) and are difficult to adapt to shellfish farming. As we mentioned in Chapter Three, the current effort is being done in something of a policy vacuum, which makes it very difficult for resource managers to develop a fair and equitable leasing structure that meets the needs of shellfish farmers. Questions--such as should small or large farms be encouraged and how? Should districts be set aside for shellfish farming?; Can mariculture be limited to Alaska residents?--need to be answered before a workable leasing structure can be developed.¹¹⁴ From both an industry and a regulatory standpoint, it would be very desirable to have a separate mariculture (or at least shellfish) leasing procedure. In the future, the best way for family-run operations (of the type the Mariculture Advisory Committee felt should be encouraged) to make a good year-round income may be multispecies sea farms (which are not uncommon in other parts of the world).¹¹⁵

DNR has contacted shellfish growers and interested State officials about proposed changes in tideland permits for shellfish culture, which will be published (along with a discussion of their pros and cons) by the Mariculture Technical Work Group.¹¹⁶ The tideland permit changes under discussion for oyster farmers would provide for a permittee to be granted a three-year tideland permit. At the end of the permit period, the applicant would be required to prove that the site was being actively developed, with rafts in place and spat in the water or purchased, before a second three-year permit could be granted. At the end of the second three-year period, the applicant would be required to show proof of a DEC inspection and that he was licensed to sell the product. After this step is completed, the permittee could either apply for an additional three-year permit or for a longer-term lease. Permits would not be transferrable and could be revoked immediately with cause or after 30 days without cause. Fees are under review. Present DNR long-term tideland leases (up to 55 years) for log transfer sites have annual rates set at approximately 12 percent of the appraised value of the land (the lessee must have the site surveyed and appraised, but can apply the cost to rental fees).

¹¹⁴Paula Burgess, Southeast Regional Manager, Department of Natural Resources, letter to Roger Painter, Alaska Mariculture Association regarding changes to DNR shellfish site permitting procedures, October 22, 1986.

¹¹⁵James E. Hemming, "Blue Mussel Farming on Kachemak Bay," Alaska Fish and Game, May/June 1986, p. 27.

¹¹⁶Bob Palmer, Retained Lands Officer, Department of Natural Resources, memorandum to interested parties on the DNR Tideland Permit for Shellfish Culture, September 19, 1986.

The response of oyster growers to these permit proposals has been that they are somewhat premature, given the embryonic stage of development in their industry. From the farmer's perspective, there are some desirable provisions, such as a "prove out period" to discourage site speculation. Longer-term lease arrangements are also very desirable. The fact that permits would be nontransferrable (intended to avoid the artificial creation of wealth as in limited entry permits) and the ease with which DNR can revoke a permit are both factors which would tend to discourage investment.

MUSSELS

Blue mussels are indigenous species found throughout coastal Alaska. The larvae drift with the tides and settle on virtually anything to which they can anchor themselves. Mussels are an incredibly rich source of protein. According to Jim Hemming, who owns Alaska's first commercially viable blue mussel farm, more protein per acre can be produced with mussels than any other farm crop. Although considered to be something of a gourmet item in the U.S., mussels are a primary food source in many parts of the world. There is a very large and growing market in North America. 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.

Domestic mussel producers in New England and Puget Sound are experiencing increasing water quality problems. Mussels from New England have to go through a depuration process, where they are removed from the rafts or longlines on which they are grown and flushed in clean saltwater for a certain time period before they can be sold (mussels are generally sold live in the shell). Water quality problems in Puget Sound are becoming so severe that no new mussel farms are expected to be permitted in the future. It is likely that water quality problems may force many shellfish growers out of business in Puget Sound in the intermediate (five to ten-year) future. Another problem faced by Puget Sound shellfish growers is plankton blooms (red tide) in late summer which nearly shut off sales for about two months each year. This annual void in production from the Northwest can easily be filled by producers in Alaska and could serve as a foothold for long-term market penetration.

Given air freight costs, shellfish producers in Alaska should certainly be able to compete in domestic markets with imports from foreign countries. We do not have good information on the size of the market for mussels, but Vancouver, British Columbia and Seattle are reported to import several hundred thousand pounds of mussels annually. Another very large market for mussels exists in Europe which has also had substantial water quality problems with locally grown shellfish. Thus, the marketing situation appears to be excellent for Alaska mussel growers.

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Presently there are five permitted mussel farms in Alaska--three in Kachemak Bay, and one each in Kodiak and Prince William Sound. Thus far, only one farm is actually producing mussels in commercial quantities (10,000 lbs. in 1986). Blue mussels are grown on lines suspended from rafts. They require clean, nutrient-rich water with good tidal circulation and protection from strong wave action and ice. Good sites should also be close to economical transportation and have a low incidence of PSP. Mussel farmers are currently operating under Commercial Fisheries Entry Commission (CFEC) clam shovel licenses and the State and federal permits described previously (Chapter Three). According to the way the Attorney General's Office has interpreted the Fish and Game statutes, commercial mussel farming should be illegal. The operation of a mussel farm is nothing like the commercial clam fishery and the mussel farmers we spoke with consider themselves to be in business only because the Division of Commercial Fish has made a very liberal interpretation of the regulations. Thus, mussel farmers, while technically legal, actually operate in the same legal limbo as most other mariculture operators in the state.

Mussel farmers must obtain the same site permits from DNR as oyster farmers. An additional concern for the three mussel farmers in the Kachemak Bay area is the security of their permit arrangements with DNR. In addition to the problems with site permits discussed previously in the oyster section, Mr. Hemming's farm and two others are inholdings on State park land. The DNR policy in this case is to allow one-year site permits, but if there is greater demand for permits than available sites, DNR has the option to put the sites up for competitive bid. Thus, mussel farmers in the area are unwilling to increase the scale of their operations for fear that they might be rendered uneconomical by having the price of their site bid up in the future. Again the problem traces back to a lack of a coherent State policy to encourage mariculture development.

The State was instrumental in getting mussel farming started. The Office of Commercial Fisheries Development provided a small grant (\$5,000) to Mr. Hemming for experimental culture of mussels and was very supportive of his efforts to adapt techniques used in other countries and Puget Sound to the situation in Alaska. Mussel culture is an ideal family-type enterprise which could 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 lifestyle.

As with oyster farming, mussel culture is moderately labor intensive. The larvae can be collected at the free-floating stage on lines hung in the water or scraped (after they have attached themselves and grown into tiny mussels) from cliff faces or rocks at low tide. The tiny mussels are contained in sock nets around a hanging line until they have firmly attached themselves to the line, when the netting is removed. The hanging lines are

periodically inverted and sediment and debris are scraped off. Mussels can be harvested at any time of the year and may take anywhere from 12 to 18 months to mature, depending on the quality of the site. Under ideal controlled conditions, mussels may mature in as few as eight months. Other countries are experimenting with mussel rafts located near salmon pens where the mussels can feed off the fines from fish food suspended in the water.

Mussels are harvested by removing them from the growing lines. Then they are rinsed, graded according to size and shipped in 10 to 20-lb. onion bags. Mussels sell for approximately \$1.45/lb. in Anchorage at the wholesale level and \$2.99 at the retail level. Based on the economics of Mr. Hemming's mussel farm, 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 had been recovered.

Paralytic Shellfish Poisoning Testing (PSP)

The same PSP inspection requirements that apply to oysters also apply to mussels. Because shellfish farmers are selling freshness, the delays involved in transporting samples to the PSP testing lab are particularly troublesome. We contacted Richard Barrett, Lab Supervisor at the DEC, Palmer testing facility to get his views on the current PSP testing process. According to Mr. Barrett, his lab currently processes about 1,500 samples a year for PSP testing. The Palmer lab receives samples from ADF&G and razor clam fishermen as well as shellfish growers. The current bio-assay method used at the lab (which is certified by the FDA) involves injecting mice with a solution taken from samples. The capital expense for this procedure is minimal and total cost per assay is \$5 to \$10.

The DEC is testing a new high-pressure liquid chromatography (HPLC) machine, to be used for PSP analysis, which is reported to be more accurate and can process more samples per day than the bio-assay method. This equipment must be certified by the FDA and the Association of Analytical Chemists before it can be used. The capital cost for the HPLC machinery is \$25,000 to \$40,000, but operating costs are low, resulting in a total cost per assay of five to seven dollars. The State provides this testing service free of charge although the operator must pay to have his samples delivered. Apparently, there is a proposal before the FDA that would allow individual states to certify PSP testing labs, but it has yet to be approved. The transportation delay for shellfish operators in Alaska to get their samples tested for PSP is definitely a serious problem, but it is not clear at the present time that the solution is simply to build more testing labs.

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From DEC's budgetary perspective, the centralized laboratory is the most cost-effective means of providing PSP testing. According to Mr. Barrett, his lab could probably handle 2,000 to 2,500 samples annually with the new HPLC equipment. Because shellfish sales tend to be seasonal, it is possible to pull technicians away from other duties when there are large numbers of samples to be tested. If the facility were used to maximum capacity, further labs could be easily justified, but at the present scale of farmed shellfish production, the cost of providing regional service must be weighed against the amount of a handicap (in terms of economic loss) that centralized testing places on the industry in the marketplace. Presently, the Palmer lab can generally provide a 24-hour turnaround from the time it receives a sample. Transportation delays are problematic anywhere in Alaska during certain times of the year.

As the scale of shellfish production increases, satellite labs may become more viable (perhaps in the Homer-Kodiak area and Southeast). One idea would be to build or certify satellite labs to a certain threshold level of toxicity (FDA regulations say that 80 micrograms is the salable limit). The bio-assay method (which is the cheapest to set up) has a detection limit of approximately 31.5 micrograms.¹¹⁷ Thus, if samples tested over the detection limit at the satellite facility, they could be tested further at the central lab in Palmer to see if they were under FDA limits before sale. One option would be to assess the sales of shellfish growers in a particular region (e.g., Southeast) to set up a local satellite laboratory for PSP testing, similar to the way aquaculture associations assess their members for hatchery construction and operation.

SCALLOPS

There are presently four permitted scallop larvae collection efforts underway in the waters around Kodiak Island. All of these pilot projects are targeting on the weathervane scallop (*Pecten caurinus*), which is the largest of ten separate scallop species that are native to the area. Kodiak has some of the richest scallop-growing conditions in the world. 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. In recognition of these facts, a joint Alaska-Japanese development project is underway to adapt scallop culture techniques used to grow the Japanese scallop (*Pecten yessoensis*)-which has been under cultivation for over twenty years in Japan--to Alaska.¹¹⁸

¹¹⁷Dick Barret, Lab Supervisor, Department of Environmental Conservation, Palmer Testing Facility, personal communication, November 1986.

¹¹⁸Timothy C. Ward, "Central Kodiak Archipelago Scallop Farming Project (CKASFP)", Spring, Late Spring, Summer and Fall Reports, 1986.

A number of State and local agencies are involved in this enterprise including: the University of Alaska Marine Advisory Program; ADF&G; the Kodiak Area Native Association; the City of Port Lions; and Kodiak Community College.¹¹⁹ Financing of the spat collection effort has been via a Rural Development Agency grant (\$10,000) administered by the Department of Community and Regional Affairs and a \$5,000 grant provided by the Kodiak Island Borough and City of Port Lions. The Japanese Overseas Development Foundation has sent a scallop-farming instructor to help with spat collection and oversee the grow-out stages of the operation. (Scallop growers in Chile and New Zealand have also benefitted from the same Japanese program).

Weathervane scallops spawn directly into the water (unlike some shellfish, which are bisexual, weathervanes are either male or female) and fertilization occurs in midwater. Developing eggs lie on the bottom. After hatching, the larvae drift in the water and seek a place to attach themselves. Once a secure place is found, the larvae attach themselves with a filament. After several months of growing, the baby scallops drop off to the bottom, where they remain for the rest of their life cycle (scallops can propel themselves through the water by opening and closing their shells but they live at or near the bottom). Weathervane scallops from South-central Alaska reach sexual maturity between two and four years of age and, in unfished populations, can grow to the size of a dinner plate (weathervanes can live as long as 16 years).

The current spat collection effort has been underway for less than a year and has thus far been unsuccessful at capturing drifting weathervane larvae. Spat are collected by suspending onion bags full of monofilament line in the water column from anchored and buoyed lines near known scallop-fishing areas. The larvae attach themselves to the monofilament in the bags and when they become mature enough to drop off, they are too big to fit through the onion bag mesh and are captured in the bottom of the bag. Thus the larvae capture technique is very simple. The difficulty is in placing the capture bags in the right position at the right time to get weathervane larvae. To date, many species of clams and scallops have been collected, but so far, weathervane larvae have eluded capture. In 1987, a very large scallop spat collection effort is planned (it is believed that August is the optimum month for spat collection) as well as an artificial propagation attempt by the University of Alaska Institute of Marine Science in Seward.

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

¹¹⁹Mike Kaill, "Scallops," Alaska Fish and Game, May/June 1986, p. 22.

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mesh of the net. Scallop mariculture is fairly labor intensive. Periodically the scallops must be removed to be cleaned, checked and sorted. Of course, the net mesh must be cleaned of debris and algae build up to allow maximum water flow. 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 a harvestable size of about five inches in diameter. Maricultured scallops are generally sold on the gourmet half-shell market similar to oysters.

The commercial fishery for scallops in Alaska occurs mainly in the waters around Kodiak, Dutch Harbor and Yakutat, with a small fishery in Lower Cook Inlet. The commercial fishery is very cyclical, with a 1985 Alaska harvest of 299 mt.¹²⁰ By comparison, the Hokkaido maricultured scallop harvest is somewhere around 200,000 mt.¹²¹ There is some evidence that the Japanese have nearly maximized their scallop-growing potential. Clearly, they recognize the potential of scallop mariculture in Alaska and are willing to invest in research and development to further it.

The present scallop larvae collection effort comes under the auspices of the ADF&G, FRED in Kodiak and is authorized by a science and education permit. Commercial development faces the same legal and administrative bottlenecks as the other forms of shellfish mariculture mentioned previously in this chapter. A few entrepreneurs have expressed interest in capturing and selling weathervane spat to farmers. Under existing statutes and regulations, this would probably be illegal. It is possible that because there is a commercial scallop fishery which uses nets, scallop farming could be authorized through the same type of liberal interpretation of Fish and Game regulations under which mussel farmers are licensed.

GIANT KELP

The herring roe-on-kelp fishery, which could serve as the basis for giant kelp mariculture in Alaska, presently occurs in Prince William Sound and Togiak (Bristol Bay) for a few days each spring. The roe-on-kelp harvest quota in Prince William Sound is divided between a wild fishery (100 to 130-ton quota in 1987) and a pound fishery (42 to 60-ton quota).¹²² The

¹²⁰Mike Dean, Alaska Department of Fish and Game, Commercial Fisheries Division, personal communication, November 1986.

¹²¹Timothy Ward, President, CKASFP, personal communication, November 1986.

¹²²Mike Dean, Alaska Department of Fish and Game, Commercial Fisheries Division, personal communication, November 1986.

wild fishery involves divers cutting roe-laden indigenous ribbon and sieve kelp (an earlier roe-on-kelp fishery, using grappling hooks towed from skiffs, was outlawed in 1977 after several of the most productive native kelp beds were completely denuded). The harvest occurs in a very short period between the time the herring spawn has cemented itself securely to the kelp (usually about five days after spawning) and when the eggs begin to eye out (about 10 days after spawning). In 1986, 29 divers harvested 47.3 tons of roe-on-kelp worth \$117,200 (97 percent of the harvest was ribbon kelp priced at \$1.25/lb., while the price for sieve kelp was \$.88/lb.). The Togiak harvest is entirely hand-picked (no divers) rock fucus kelp, which amounted to 187 tons valued at \$187,000 in 1986 (this variety of roe-on-kelp sold for \$.50/lb.).

In the pound fishery, giant kelp (*macrocystis*) is harvested in Southeast (where it grows) and transported to Prince William Sound (where it is not native). Participants in the pound fishery must apply for an aquatic plant harvest permit from the Southeast Regional ADF&G Office prior to March 1 and have their pound constructed by April 1. The estimated total kelp available for harvest in a particular area of Southeast is divided by the number of permits, and participants are allowed to harvest these individual quotas of kelp. The 1986 kelp allotment was 300 pounds per harvest permit based on a 5-to-1 weight gain when eggs are added.¹²³ Once the kelp has been transported to Prince William Sound, it 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 and the spawned-out herring are released to return and spawn again in future years. Roe-on-kelp is graded by Japanese technicians on tenders near the fishing grounds and priced according to the evenness and thickness of the coating of eggs on both sides of the kelp fronds. "Ichiban Number One" is the highest grade and has full even-egg coverage of 1/2 to 3/4-inch on both sides of carefully trimmed *macrocystis* fronds that measure about 4 x 14 inches. In 1986, 82 participating pound permits accounted for a harvest of 71 tons of roe-on-kelp worth \$1.15 million (*macrocystis* roe-on-kelp was priced at an average of approximately \$8/lb.).

In the near future, the Japanese market for herring roe-on-kelp (known in Japan as *kazunoko kombu*, a traditional delicacy) is expected to provide the impetus for development of a sea vegetable industry involving the growing of *macrocystis* in Alaska.¹²⁴ A major concern in the management of the existing roe-on-kelp fishery is the potential for overharvesting the giant kelp resource. One way to avoid this would be to artificially propagate

¹²³Michael Stekoll, "Sea Vegetables," Alaska Fish and Game, May/June 1986, p. 20.

¹²⁴D. B. Pleschner, "Alaska Roe-On-Kelp, Part I," Pacific Fishing, September 1986, p. 35

OTHER FORMS OF MARICULTURE

kelp on farms.¹²⁵ An agreement between the State and the Overseas Fishery Cooperation Foundation of Japan has been reached which will involve a joint three-year study of the feasibility of giant kelp mariculture in the waters of Southeast Alaska. The Central Kodiak Archipelago Scallop Farming Project will be conducting a small macrocystis-growing project in Kodiak in 1987 in addition to the scallop project described in the previous section.

It is possible that widely scattered herring spawning locations in the state which are not currently being fished could be exploited by pounding, if greater amounts of kelp could be made available. One alternative would be to allow "open pounds" in these spawning areas, similar to those in British Columbia, which do not enclose the spawning herring (thereby eliminating stress to the fish caused by scaling and bruising in the containment net). Open pounding would require new regulatory guidelines from Fish and Game. Another possible use for farmed kelp would be to sell it for fertilizer, methane production or chemical products. Giant kelp is harvested in California by the Kelco Company to produce alginate.

The roe-on-kelp pound fishery in Prince William Sound has been growing rapidly, from 2 pound permits in 1979 to 82 permits in 1986 (unlike the closed pound fishery in British Columbia which has only 28 permits sharing a fixed herring quota, Alaska's pound fishery has open entry). Given the limitations on the giant kelp resource in Southeast and the size of the roe-on-kelp herring quota in Prince William Sound, this rate of growth in the number of pounding participants is not sustainable. Many of the current participants have switched from the diving fishery to pounding (some participate in both roe-on-kelp fisheries) because it offers greater control over product quality and higher returns. Classic gear type confrontations over quota allocations between pounders and divers have occurred for the last several years before the State Board of Fish, with the pounders gradually gaining an increasing share of the roe-on-kelp herring quota.

The roe-on-kelp fisheries described above account for only a small part of the state herring roe harvest, though the revenues they generate to participants are relatively high compared to the seine and gillnet sac-roe fisheries. This is due to the value added form of the roe-on-kelp product. Statewide, the herring sac-roe seine and gillnet fisheries harvested 48,730 tons of herring, worth \$35.5 million in 1986. (These fisheries harvest the spawning herring themselves, which are subsequently stripped of their eggs and the carcasses used for fish meal.) Because the spawning herring are not killed in the roe-on-kelp pound fishery and a very high valued product is produced, pounding offers an attractive alternative to traditional sac-roe fisheries.

¹²⁵Ibid., Part II, October 1986, p. 37.

The only area aside from Prince William Sound where a herring pound fishery is allowed is in the Eastern Aleutians. To date, no pound fishery has taken place in this area. There have been numerous proposals put before the Board of Fish to allow roe-on-kelp fisheries in other regions of the state (i.e., Southeast, Kodiak, Cook Inlet), but thus far, all have been rejected on the grounds that available herring stocks are being fully utilized by the existing sac-rope fisheries (most of which are limited and thus have substantial capital investments by permit holders). Thus, herring allocations for new pound fisheries would have to come from previously unexploited stocks. The Alaska Department of Fish and Game is in the process of surveying herring stocks to see if further pound fisheries could be supported.

Compared to the macrocystis harvest in British Columbia, management of the giant kelp harvest in Southeast is fairly conservative. At the last Board of Fish meeting in Southeast, even more restrictive kelp harvest guidelines were adopted.¹²⁶ Thus, it appears that while kelp farmers could have a good roe-on-kelp fishery market, the ultimate feasibility of giant kelp mariculture in Alaska will probably be dependent on locating an adequate roe-herring resource.

¹²⁶Elizabeth Stewart, Director of Boards, ADF&G, personal communication, November 1986.

APPENDIX

A Review of Recent Research on Alaska Aquaculture Issues

The Governor's Fisheries Mini-Cabinet was established in 1984 to review and coordinate fisheries programs and make policy and strategy recommendations to the administration on fisheries issues. The mini-cabinet (on its own and via the Mariculture Advisory Committee) has initiated a number of aquaculture-related studies by State agencies. Some of these special in-house reports produced by agency staff on aquaculture issues are listed below by department and division:

"An Analysis of the Net Benefits of Existing and Proposed Enhancement Projects for the State of Alaska", Jeff Hartmen, Alaska Department of Fish and Game, Fisheries Rehabilitation Enhancement Division, (FRED), Number 64, April 1986.

"Private Nonprofit Hatchery and Fisheries Impact Study", Paul Engleman, Department of Commerce and Economic Development (DCED), Office of Economic Analysis (OEA), October 1984.

"North Pacific Fisheries Delphi Project Final Report", Lynn Hutton, Brad Pierce, Department of Commerce and Economic Development, Office of Economic Analysis, September 1985.

"Ex-vessel Price Models for Alaska Salmon", Ben Muse, Alaska Department of Fish and Game, Commercial Fisheries Entry Commission, (CFEC) Discussion Draft 84-6, September 1984.

"Initial Performance of Chinook Salmon Cultured in Seapens in Southeastern Alaska", Frank P. Thrower, Alex C. Wertheimer, Roy M. Martin, and William R. Heard, Alaska Department of Fish and Game, Fisheries Rehabilitation Enhancement Division, National Marine Fisheries Service, Department of Commerce and Economic Development, Office of Commercial Fisheries Development, cooperatively funded effort.

There are at least two State-funded research projects in the development stages. As recommended by the Mariculture Advisory Committee, the Department of Commerce and Economic Development--Office of Commercial Fisheries Development, received a \$90,000 appropriation (FY 87) from the legislature to administer a study of the market effects of salmon pen rearing on the state's fishing industry using several different development scenarios. Part of the money is to be spent to send OCFD staff around the state to a series of public forums in various coastal communities to collect public testimony and provide information on pen rearing and other mariculture activities.

The governor recently signed a memorandum of agreement between the State of Alaska and the Overseas Fishery Cooperation Foundation of Japan to conduct a joint three-year study of the feasibility of developing scallop and giant kelp mariculture in the waters around Kodiak and Southeast respectively. The project will be jointly staffed and funded, with Alaska supplying \$249,320 and Japan contributing \$473,320.

The House Research Agency (HRA) has completed several memorandums for individual legislators on aquaculture issues. Those which have been publicly released are:

- 86-130 "State Appropriations to Aquaculture Associations"
- 85-086 "Fish Farming in Alaska"
- 84-074 "Description of Salmon Farming Operations in Other States and Countries and Impediments to Alaska Operations"
- 83-074 "Alaska Fisheries Plan for Salmon"
- 82-079 "Procedures for Disposing of State-Owned Fish Hatcheries"
- 81-004 "Alaska Fishing Industry: An Overview of State Expenditures and Economic Benefits"
- 80-173 "Voting Eligibility in Mandatory Aquaculture Assessment Elections"
- 80-104 "Aquaculture Tax for Cook Inlet"

In addition to the studies by State agencies listed above, there are several other important players conducting economic research on aquaculture related topics in Alaska, including the National Marine Fisheries Service (NMFS), University of Alaska and Alaska Sea Grant Program, and Sealaska Corporation. Bill Heard of NMFS has recently toured salmon-farming operations in Washington and British Columbia and published his observations for the Mariculture Advisory Committee. (A great deal of topical information on mariculture, including Mr. Heard's observations, has been compiled by Bill Paulick of the OCFD in a briefing notebook for the Mariculture Advisory Committee.)

The University of Alaska has sponsored several recent research projects related to aquaculture development. Curt Kerns, an aquaculture specialist with the UAJ--Marine Advisory Program recently completed an analysis of the status of salmon pen rearing in Alaska and its probable economic impacts titled "World Salmon Farming: An Overview With Emphasis on Possibilities and Problems in Alaska" (Marine Advisory Bulletin Number 26), as well as a very comprehensive bibliography, "Where to Get More Information on Farming Salmon and Trout in Net Pens", (Alaska Sea Grant Program, Aquaculture Note No. 8).

University staff are studying price/volume relationships for Pacific and Atlantic salmon. "An Econometric Analysis of Salmon Markets", (Biing-Hwan Lin, UAF--Economics Department) was funded in cooperation with the University of Oregon Sea Grant program, and is a first attempt at model specification in this area. Another Sea Grant publication is a survey of 700 seafood wholesalers, "The Marketing Relationship Between Pacific and Pen-Raised Salmon: A Survey of Seafood Wholesalers" (Ron Rogness, NPMC, Biing-Hwan Lin, University of Idaho, Department of Agricultural Economics, Alaska Sea Grant Program, Aquaculture Note No. 86-3) which focuses on market preference and the substitution of farmed salmon for premium wild species. This survey is expected to be incorporated in a larger econometric study of the price/volume relationships between farmed Atlantic and wild Pacific salmon in European markets.

The Sealaska Corporation, which has been very active in pursuing aquaculture development and identifies salmon farming as a high priority for future investment, commissioned a Swedish firm to do a feasibility study:

"Opportunities and Constraints in Cultured Salmon Production" (Sven Erik Lindgren, Kellus N. Sewell, Hans Peterson, VBB/SWECO, Nordic Alaska Co., August 8, 1985).

A lobbying group, the Alaska Mariculture Association (AMA), has organized an ad hoc Mariculture Technical Work Group composed of individuals from State and federal agencies interested in developing mariculture policy. The agencies involved are:

- Alaska Department of Fish and Game (ADF&G)
 - Fisheries Rehabilitation and Enhancement Division (FRED)
 - Division of Commercial Fisheries (DCF)
- Department of Natural Resources (DNR)
- Department of Environmental Conservation (DEC)
- Department of Commerce and Economic Development (DCED)
 - Office of Commercial Fisheries Development (OCFD)
 - Alaska Seafood Marketing Institute (ASMI)
- Office of the Governor
 - Office of Management and Budget (OMB)
 - Division of Governmental Coordination
- University of Alaska (U of A)
 - Marine Advisory Program
- U.S. Forest Service (USFS)
- National Marine Fisheries Service (NMFS)

The Mariculture Technical Work Group is developing an outline of nonpolitical regulatory issues related to mariculture and collecting discussion papers on research and development needs to present to the legislature and other interested parties (e.g., fisherman's groups).

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ALASKA STATE LEGISLATURE - SENATE

SENATOR RICHARD I. ELIASON

RULES COMMITTEE, CHAIRMAN
LABOR & COMMERCE COMMITTEE, VICE CHAIRMAN
LEGISLATIVE COUNCIL
RESOURCES COMMITTEE
FISHERIES SUBCOMMITTEE, CHAIRMAN



P.O. BOX 143
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May 11, 1987

Commissioner Don Collinsworth
Department of Fish and Game
P.O. Box 3-2000
Juneau, Alaska 99802

Dear Commissioner Collinsworth,

Recently hearings on Senate Bill 106, an act relating to aquatic farming, were conducted by the Senate Resources Subcommittee on Fisheries at five different locations -- Dillingham, Kodiak, Anchorage, Ketchikan, and Sitka. The individuals testifying at the hearings raised many concerns which must be addressed fully prior to the Legislature taking any formal action on permitting aquatic farming in Alaska.

Some of the unanswered questions asked are as follows:

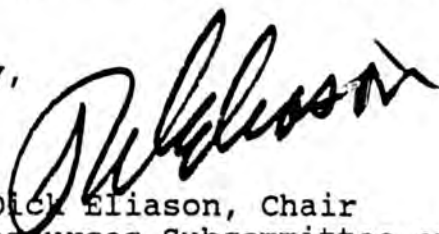
- 1) How will land use conflicts be resolved?
- 2) How can favoritism or the appearance of favoritism be avoided in the awarding of tide land permits?
- 3) What steps will be implemented to reduce tide land speculation?
- 4) What is the role of the non-profit hatcheries in the sea farming industry?
- 5) Will the role of a non-profit hatchery change if the hatchery chooses to rear pen salmon?
- 6) What will be the role of borough governments if a sea farm is within the borough's jurisdiction?
- 7) What will be the procedures in determining the monetary value for the tide land sites?

- 8) Will additional safeguards be established if the potential sea farm site is in a designated wilderness area?
- 9) How will the upland owners' concerns be resolved?
- 10) What exactly is known regarding any potential environmental danger in raising salmon in a concentrated area?

As these questions and other unresolved concerns regarding aquatic farming are reviewed and discussed during the interim by the Subcommittee on Fisheries, it will be most helpful if the various affected state agencies take an active role in the discussion. As chair of the interdepartmental work group on mariculture, the subcommittee looks forward to working with you and other members of the working group during the interim.

Commissioner Collinsworth, hopefully time will allow the subcommittee to meet with the agency representatives prior to adjournment in order to formalize plans for the next few months.

Sincerely,



Senator Dick Eliason, Chair
Senate Resources Subcommittee on Fisheries

cc: Senate Resources Committee Members
House Resources Committee Members



SENATOR FRED F. ZHAROFF ALASKA STATE LEGISLATURE

P.O. BOX 405, KODIAK, ALASKA 99615 (907) 486-5259

DURING SESSION:

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DISTRICT N

ALASKA PENINSULA • ALEUTIAN CHAIN • BRISTOL BAY • KODIAK ISLAND • LAKE CLARK/LAKE ILIAMNA • Pribilof Islands • Shumagin Islands

SECTIONAL ANALYSIS

SENATE BILL NO. 297

"An Act placing a moratorium on the issuance or granting of licenses, permits, leases, or authorizations for commercial finfish farming; and providing for a bivalve spat collection permit; and providing for an effective date."

SECTION 1 FINFISH FARMING MORATORIUM.

The state is prohibited from issuing the following licenses, permits, leases or authorizations for the construction or operation of a commercial finfish farm:

- (1) authorization for use of an interim-use permit for the experimental taking of a fishery resource.
- (2) fish farming license
- (3) collection permit
- (4) land use or tidelands permit
- (5) a land lease
- (6) fish transport permit
- (7) permit to appropriate water
- (8) temporary water use permit

This section means that a commercial finfish farm will not be able to obtain any of the licenses, permits, etc. that it needs to operate.

SECTION 2 NO PREFERENCE INTENDED.

Anyone who obtains any of the above listed permits for a purpose other than commercial finfish farming (shellfish farm, houseboat, floats, etc.) will receive no right or preference with regard to the "issuance, granting, or renewal of, or conditions or limitations placed on" any license, permit, etc., used to operate an aquatic farm.

This section is intended to discourage speculation. Everyone will be on notice that nothing they do now in regard to aquatic farming will give them any advantage if and when final aquatic farming legislation passes the legislature. Also, everyone will be on notice that their acquisition of a tidelands permit (renewable after one year) grants them no competitive or

speculative advantages if and when the legislature decides the state's official aquatic farming policy.

SECTION 3

Amendment to AS 16.05.340(b)

Allows the commissioner of fish and game to issue a discretionary permit for individuals to collect bivalve (two-shelled - scallops, mussels, clams, etc.) spat (seeds) to grow in aquatic farms. Fish and Game does not now have a permit that allows individuals to collect and possess bivalve spat for their private operations. Assists individuals now doing scallop and mussel mariculture.

SECTION 4

The Finfish Farming Moratorium is repealed July 1, 1988, on the expectation that the legislature will have developed and passed a final state aquatic farming policy.

SECTION 5

Immediate effective date.

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Aquatic Farming Projections*

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Figure 1

Anticipated Number of Proposed Aquatic Farm Projects,
After Legislative Action
(Annually, All Types)

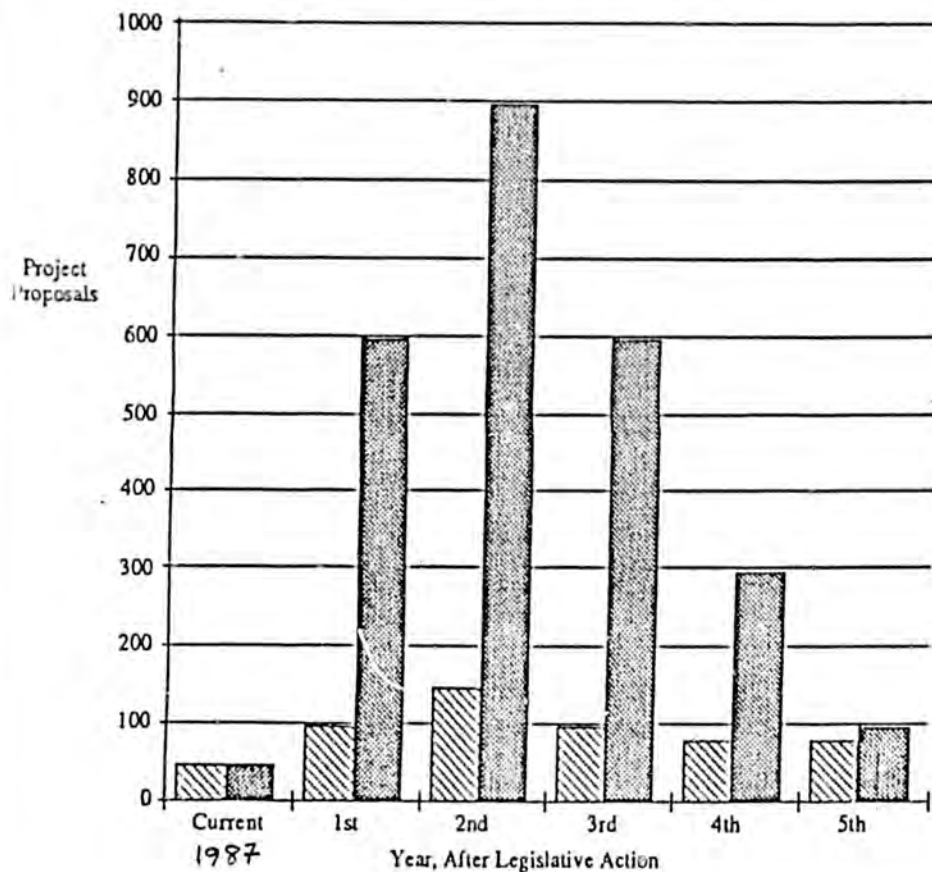
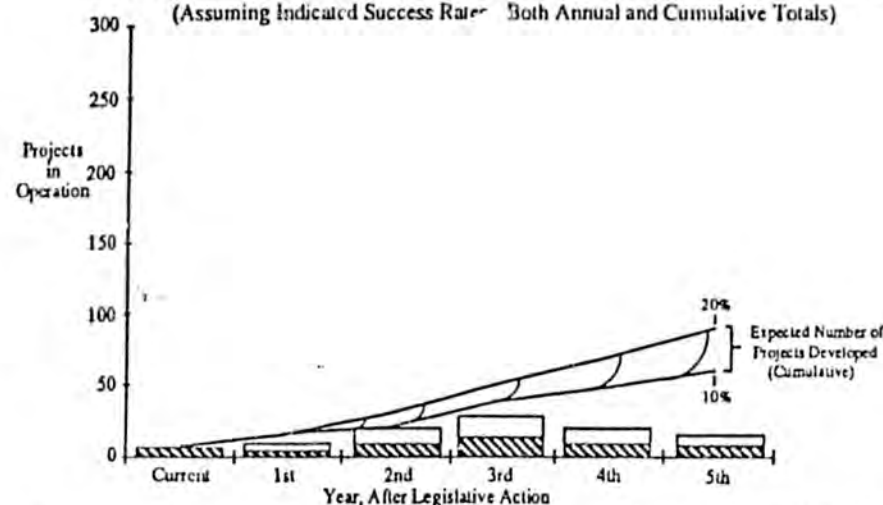


Figure 2A

Estimation of Operating Aquatic Farms After Legislative Action
(Assuming Indicated Success Rate - Both Annual and Cumulative Totals)



Assumptions: - Based on number of applications from Figure 1.
 - Range of 10% to 20% success rate.
 - No atlantic salmon.
 - Existing level of pathology.

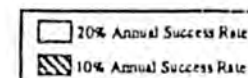
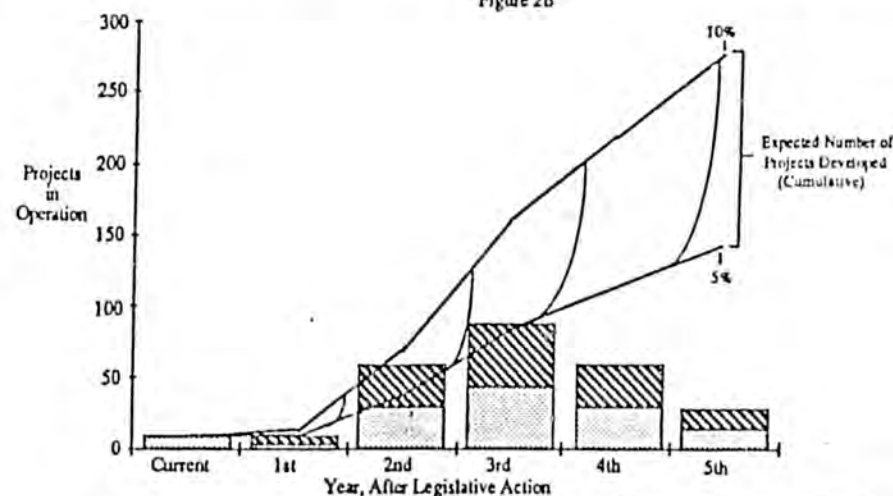
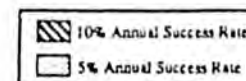


Figure 2B



Assumptions: - Based on number of applications from Figure 1.
 - Range of 5% to 10% success rate.
 - No atlantic salmon.
 - Existing level of pathology.



DRAFT

*All figures are based on resource projections jointly developed by OMB, DNR, DF&G, DEC, and the Marine Advisory Program (U of A).

1 IN THE SENATE

BY ZHAROFF, ELIASON AND DUNCAN

2

SENATE BILL NO. 297

3

IN THE LEGISLATURE OF THE STATE OF ALASKA

4

FIFTEENTH LEGISLATURE - FIRST SESSION

5

A BILL

6

For an Act entitled: "An Act placing a moratorium¹ on the issuance or
granting of licenses, permits, leases, or authoriza-
tions for commercial finfish farming; providing for a
bivalve spat collection permit; and providing for an
effective date."

11

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

12

* Section 1. FINFISH FARMING MORATORIUM. The following licenses, per-
mits, leases, or authorizations may not be issued or granted for the con-
struction or operation of a commercial finfish farm:

15

(1) authorization for use of an interim-use permit for the
experimental commercial taking of a fishery resource (AS 16.05.050(10));

17

(2) fish farming license (AS 16.05.340(a)(14));

18

(3) collection permit (AS 16.05.340(b));

19

(4) land use or tidelands permit (AS 38.05.035);

20

(5) a land lease (AS 38.05.070);

21

(6) fish transport permit (5 AAC 41.005);

22

(7) permit to appropriate water (11 AAC 93.120);

23

(8) temporary water use permit (11 AAC 93.210 - 11 AAC 93.220).

24

* Sec. 2. NO PREFERENCE INTENDED. A license, permit, lease, or au-
thorization described in sec. 1 of this Act that is issued or granted for a
purpose other than commercial finfish farming and that is in effect during
the period of the moratorium imposed by sec. 1 of this Act does not create
a right or preference with regard to the issuance, granting, or renewal of,
or conditions or limitations placed on, any license, permit, lease, or

1 authorization for aquatic farming after the period of the moratorium.

2 * Sec. 3. AS 16.05.340(b) is amended to read:

3 (b) The commissioner of fish and game may issue without cost a
4 permit to collect fish and game, including fur animals, subject to
5 limitations and provisions that are appropriate, for a scientific,
6 propagative, or educational purpose. The commissioner also may issue
7 a permit for the collection of bivalve spat for use in connection with
8 an aquatic farm. In addition, the commissioner shall issue a permit
9 for the collecting of wild fur animals for improving the genetic stock
10 of fur farm animals. Permits issued under this subsection shall be in
11 accordance with current sustained yield management practices for the
12 species of wild game for which the permit is requested. The annual
13 permit fee for an Alaska resident to collect wild fur animals for fur
14 farming purposes is the same as the fee for resident trappers.

15 * Sec. 4. Section 1 of this Act is repealed July 1, 1988.

16 * Sec. 5. This Act takes effect immediately under AS 01.10.070(c).

SCOMM

75:4

ALASKA STATE LEGISLATURE - SENATE

SENATOR RICHARD I. ELIASON

RULES COMMITTEE, CHAIRMAN
LABOR & COMMERCE COMMITTEE, VICE-CHAIRMAN
LEGISLATIVE COUNCIL
RESOURCES COMMITTEE
FISHERIES SUBCOMMITTEE, CHAIRMAN



P.O. BOX 143
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MEMORANDUM

TO: Senator Jack Coghill, Chair
Senate Resources Committee

FROM: Senator Dick Eliason, Chair
Fisheries Subcommittee *Dick Eliason*

DATE: February 23, 1988

RE: Proposed Mariculture Legislation

Last spring, the Fisheries Subcommittee of the Senate Resources Committee held several statewide hearings on S.B. 106, "An Act relating to aquatic farming". These well attended hearings were held in Dillingham, Kodiak, Anchorage, Sitka, and Ketchikan with residents from Petersburg and Wrangell connected by the teleconference system.

An overwhelming majority of those testifying were in opposition to the pen rearing of salmon. Concerns regarding possible water quality problems, increased conflict between users, competing markets, and potential disease contamination of the wild stock were voiced by those testifying at these hearings. Since that time many communities and organizations statewide have submitted resolutions opposing salmon farming. Because of this strong, broad-base opposition to permitting farming of fish in saltwater, it seems unrealistic at this time for the legislature to continue to pursue this concept.

The attached draft legislation, instead, encourages the growers of shellfish and aquatic plants as well as the farming of finfish in fresh water. This legislation sets the criteria for these economic ventures and provides for an

orderly development of the industry. Under this proposal farming of finfish in saltwater would not be allowed. Possibly at a later date when this concept gains more support, the legislature may wish to pursue this matter once again. However, until that happens, it appears most prudent to consider legislation involving the farming of shellfish, aquatic plants, and fresh water fish.

I respectfully request that this draft be introduced as a Senate Resources Committee bill and that hearings be scheduled as soon as possible to allow interested Alaskans an opportunity to respond to this proposal. Thank you very much for your thoughtful consideration of this request.

DOC 0062r

MEMO -- January 12, 1988

TO: Fisheries Cabinet

FROM: Paul Peyton

RE: Aquaculture socioeconomic studies

Legislators and others considering proposed regulation of aquaculture activities in Alaska have asked for additional information concerning the social and economic impacts of the various possible forms of development in Alaska. Central to most of the discussion is whether salmon can be profitably farmed in Alaska and compete in the marketplace with wild salmon and farmed fish from other areas. If farm production was to be permitted, what are the potential impacts to the existing common property fishery? What sort of commitment, in terms of time and dollars, would be required of the State to manage and support salmon farming activities?

The DCED has entered into a \$20,000 contract with the Sea Fare Group in Seattle to conduct a study of world salmon markets and evaluate the extent of market competition between wild and farmed salmon, including farmed salmon which potentially could be produced in Alaska. Principle investigator for this study will be Dr. James Anderson of the University of Rhode Island. Anderson is a recognized authority in the area and has authored several papers dealing with the market's response to increasing world supplies of farmed salmon. Market contacts, statistical research and report editing functions of the contract will be conducted by the Sea Fare Group which is a commercial consulting business operated by those people that put out the Seafood Leader magazine.

A second \$20,000 contract has been undertaken with the DPA group of Vancouver, B.C. DPA will evaluate the relative costs of farmed salmon production in major producing regions around the world, develop a proforma cost of production model for the Alaska situation and assess the sensitivity of major cost factors to overall costs of production. DPA has done similar work for the Government of British Columbia and others and has identified specific sources for the necessary data.

Both contracts call for an interim or progress report to be submitted about February 1st and the final report during the first week of March.

A third phase of the project, that of developing a policy options matrix will be postponed at least until preliminary results from the two contracted studies are reported. At that time we may elect to select a limited number of issues for policy option development and conduct the required work in-house or through an RSA agreement with ISER. There is about \$5,000 remaining in the project budget.

Studies by the Dept of Commerce