

SCOMM

75:2



Senate Rules Committee

Senator Richard L. (Dick) Eliason, Chairman

Greg
2664

- ATA ✓ 586-9400
- ✓UFA ✓
- ✓AMA ✓
- Date Young - 789-0740
- USAG - Gervon Bruce
- ~~John Reaburn & Somers~~
- SEACL(586 6942) ✓
- Sommerville
- Linda Freed
Planning Dir
Kodiak
- Paul Fuhs,

~~463~~

- ① identify issues to be pursued during the interim.
- ② Determine whether the committees will work on a joint C.S. covering basic issues in common to all forms of aquatic farming. Fully develop shellfish, plants, ~~fish~~ ^{fresh-water} trout.
- ③ Discuss whether the committees will work on development of a range of options for salmon farming.
- ④ Provide administration ^{& Legislative staff} with direction for work during coming months.
- ⑤ schedule for subsequent events and contact numbers for membership
- ⑥ ~~chair~~ designate ~~chair~~ coordinator to make things happen.

~~Education & information.~~

- ③ Discuss other forms of salt water fin fish farming, such as black cod, halibut, ~~salmon~~ steelhead.

Robert H. Blake

In Juneau
Mendenhall Apartments #1102
326 Fourth Street
Juneau, Alaska 99801
(907) 586-2986
463-3124

5/19/87

In Cordova
P.O. Box 94
Cordova, Alaska 99574
(907) 424-3682

Sen. Richard Ellison;
Alaska State Senate
Juneau, Alaska

Dear Dick;

I apologize for not being present at the Joint Committee Interim Committee on Marine Fisheries organizational meeting. Kate Graham, the exec director of the UFA is currently attending meetings in Washington DC, therefore he cannot be present also.

In conjunction with Roger Painter (CAMA) I delivered a outline sketch of how we would like to line out the committee's involvement around the middle of August. I stated so long and interfered with an original the meeting because it was certainly my intention to be there for it. As you know I make my mainstay living by fishing and with the major processors paying \$2.15/lb for both reds & kings on the Copper River I must succumb to financially practical aspects of my life.

I feel that the committee will be fair and practical in setting up goals and direction during this first meeting and am looking forward to being a very active participant this fall & winter.

Thank you
Sincerely
Bob
Blake

Mariculture file

May 1, 1987

Subcommittee-Senate Resource Committee

Senator Richard Eiliason:

We feel it is imperative that you do not allow House Bill 108 and Senate Bill 106 to pass, unless they are ammended for shellfish and plant mariculture only. This bill would only benifit a few people, mostly non Alaskakans, at the expense of Alaskan people. We strongly oppose this type of fish farming in Alaska.

We would hope you would better spend your time promoting State hatcheries, nonprofit aquaculture and wild natural Alaska salmon for the benifit of the vast majority of Alaskans.

Please review throughly in reference to mining or logging, which would adversely affect any salmon spawning streams and fisheries. Thank you.

Sincerely,

Antonina Hosick (37yr. resident)
Hugh C. Hosick (65yr. resident)

Hugh and Toni Hosick
Box 1060
Cordova, Alaska 99574

ALASKA STATE LEGISLATURE - SENATE

SENATOR RICHARD P. ELIASON

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



P.O. BOX 143
SITKA, ALASKA 99835

P.O. BOX V
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(907) 465-4916

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

STEVE COWPER
GOVERNOR



STATE OF ALASKA
OFFICE OF THE GOVERNOR
JUNEAU

May 12, 1987

The Honorable Jack Coghill
Chairman
Senate Resources Committee
Alaska State Legislature
P.O. Box V
Juneau, AK 99811

Dear Jack,

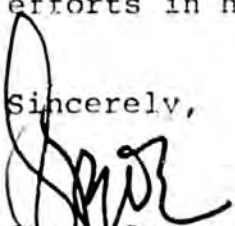
The prospect of mariculture development is generating considerable interest in Alaska this year. I believe that a mariculture industry can provide substantial economic benefits to our coastal communities and help diversify our economy. However, such an industry must be developed in an orderly fashion which provides the maximum benefit to Alaskans while ensuring protection for our existing fisheries resources, other resource users, and the environment. I have outlined for you the principles I believe must be satisfied to meet these goals. I believe that these principles and the other broad public policy questions that were raised during the public hearings process should be addressed.

I have already directed the state agencies to begin working on the technical issues affecting mariculture development. I believe that it would be beneficial to form a joint interim committee consisting of the Legislature, the administration, and the affected interest groups to resolve the conflicts surrounding mariculture development.

Mariculture holds promise for Alaska, but we must not repeat the mistakes made elsewhere. The development of a mariculture industry in Alaska must not be done piecemeal. We cannot allow a situation to develop here or proceed in the same way that occurred in British Columbia.

I appreciate your support and efforts in helping to resolve these issues.

Sincerely,


Steve Cowper
Governor

R. Painter and Bob Blake presented this list of suggested topics for mariculture meeting May 20.

- 1.) Identify issues to be pursued during the interim
- 2.) Determine whether the committees will work on a joint CS covering basic issues in common to all forms of aquatic farming. Fully develop shellfish, plants and fresh-water trout
- 3.) Discuss other forms of saltwater finfish farming such as black cod, halibut, steelhead
- 4.) Discuss whether the committees will work on development of a range of options for salmon farming
- 5.) Provide administration and legislative staff with direction for work during coming months
- 6.) Schedule for subsequent events and contact numbers for membership
- 7.) Designate coordinator to make things happen

To: Representative Sund
From: Nevette Bowen
Staff
Date: April 27, 1987
Subj: Mariculture - Interim Task Force
Moritorium

After reviewing the mariculture proposal over the past few weeks, it is apparent that the public policy issues need to be clarified and technical concerns clearly identified and addressed.

As we have discussed, the mariculture industry must be developed in a responsible manner to ensure that the resource is equitably distributed with appropriate environmental safeguards and monitoring. Alaska must avoid encouraging a haphazard mariculture industry with inadequate government oversight that creates land-use problems, causes pollution and displaces an existing fishery.

As I understand it, you would like to see the Legislature take the following action over the interim.

1. Prepare a committee report outlining the issues made available to us in various research documents and through public testimony.
2. Pass a legislative moratorium on all mariculture-related permits until a time certain. Grandfather in existing permit holders.
3. Establish a working group of approximately six - eight people supported by one or two full-time research staff to work through the issue and policy concerns and return to the legislature with specific policy recommendations for enabling legislation and regulations.

You have suggested that the make-up of such a task force include members from the House and Senate, members from the executive branch and several public members.

Under your proposed idea, the first meeting of the working group would be to discuss a scoping document compiled by committee reports and issues identified in other research. Additional concerns would be included at this time. In short, all the potential problems and public policy concerns would be outlined and identified. The working group would then proceed to address the issues by categorizing them into 4 or 5 major groups. Sub task forces would be established with agency resource people available to provide assistance.

The final recommendations from the task force would provide specific policy alternatives, draft legislation and regulations and the associated fiscal impact.

I have prepared a rough example of major categories of concern for your review:

I. Land Use Conflicts/Siting Problems/Public Hearing Process

- A. How can siting decisions consider mariculture proposals on an equal basis with all other commercial and noncommercial uses? What should the process be? Who decides? Should there be a priority of use system?
 - 1. Where in the process should public participation occur and to what extent?
- B. How many mariculture sites should there be? Where?
 - 1. How should sites be distributed among potential mariculture applicants? (This will be partially resolved by natural environmental constraints and siting criteria).
 - 2. How should sites be distributed among similar mariculture applicants? e.g. oyster
- C. What type of system should be developed so that cumulative land-use impacts can be considered in a comprehensive manner?
- D. What "fit, willing and able" provisions need to be implemented to prevent speculation and give the state a stronger right of refusal and authority to revoke permits from noncompliant permit holders?
- E. If a permit holder folds an operation, what happens to that site? Is it withdrawn? Can the permit be transferred?

II. Market - Economic Impact

- A. What are the potential economic benefits for Alaskans?
- B. Will pen rearing of salmon displace existing fisheries in Alaska? If so, to what extent? What would be the effect on the state's economy?
 - 1. Should production limits be considered as tool to avoid negative impacts on existing fisheries?
- C. Will the program place the current nonprofit aquaculture program at risk?
 - 1. A good site for a hatchery might also be a good mariculture site. How will these decisions be made? Who will make them. What is the state's priority policy on private non-profit vs private for profit?
- D. What is the cost of rechannelling Fish And Game budget resources? Studies show we have a high value fishery due to state financial commitment. Will this lower the value of the fisheries?
 - 1. Will financial resources be deflected from wild and hatchery programs?
- E. What is the impact and cost of rechannelling funds from other resource agencies?
- F. How valid is the concern that the world market will be glutted by salmon by the time Alaska is ready to get into the industry? What would be the effect on Alaska's new mariculture operations? Would they still be economically feasible?
- G. What support industries will be needed to provide feed and supplies to fish farms? Will Alaskans be able to participate in these support industries? What would operations have to pay for these supplies? (See transportation questions).
- H. What will the transportation needs be? Since many operations will be in remote locations, and since the product must reach the market quickly, will new transportation need to be developed?
- I. One of the high costs to operators will be transport of supplies to the remote sites? The product must then be priced higher to break even? Will this make our product less competitive?

III Government Involvement

- A. How much state commitment are we willing to make to responsibly protect the environment and ensure that the resource is equitably distributed?
 - 1. What should the state policy be regarding the number and size of mariculture operations?
 - a. Small locally owned and operated
 - b. Co-ops
 - c. Large corporation
 - d. Foreign and Outside ownership and investment
 - e. Combination of all of the above
 - 2. What are the fiscal impacts to the state based on different policy alternatives? What are the costs and benefits?
- B. To what extent should the state be involved in necessary monitoring/oversight. What is the state required to do? (i.e. Federal NSSP requirements).
- C. To what extent should the state be involved in providing technical assistance in site selection and necessary environmental analysis?
 - 1. How much should the industry contribute to offset administrative costs?
- D. To what extent should the industry be required to pay for the use of the public resources and the resulting effects such as pollution and landscape alterations?
- E. What role should the state play in market development?
- F. Given the fiscal and technical policy impacts of the different options - should we to encourage mariculture operations, and if so, in what areas?
- G. What criteria should be established to determine a whether or not a permit applicant is "fit, willing and able".
 - 1. How do we avoid excluding small, locally owned operations?
 - 2. Should bonding be required to discourage speculation and protect the state in the case of failure? (Clean-up costs). Will this create an extra hardship on small, locally-owned operations?

- H. How are permits going to be transferred? Who decides?
- I. To what extent should the state provide investment incentives? (State subsidization through loans, tax credits). Several sources say that tax credit incentives are necessary to attract venture capital.
- J. How much should the industry pay for necessary regulation, monitoring and oversight? What tax structure would be reasonable-that wouldn't hurt fledgling operations while still compensating the state.
- K. Because there are a limited number of adequate sites, are we creating a new form of limited entry fishing?
- L. The state is already providing some research & development? How much does this now cost us? How much more will the state have to provide to have a successful mariculture program? How much will it cost?

IV. Genetics/ Disease/ Environmental Concerns

- A. What are the long term and short term environmental impacts of mariculture operations.. How can the negative impacts be minimized or avoided?
- B. What siting and regulatory controls are necessary to avoid the potential problem of the accumulation of fish wastes and fish food?
- C. What provisions are necessary to prevent and control disease?
- D. Are there potential disease and genetic threats to wild stocks? What is the potential for escape given the unique weather conditions and predator situation in Alaska? What would the impact on wild stocks be if large numbers escape?
- E. What type of oversight should exist to monitor site selection and water quality, conduct health inspections and control any problems with disease.
- F. Given the potential genetic, disease and environmental considerations in various policy options, is it in the best interest of the state to proceed in developing fish farming, shellfish farming or kelp farming?
- G. Should a mandatory environmental monitoring system be required at each site?

Kodiak

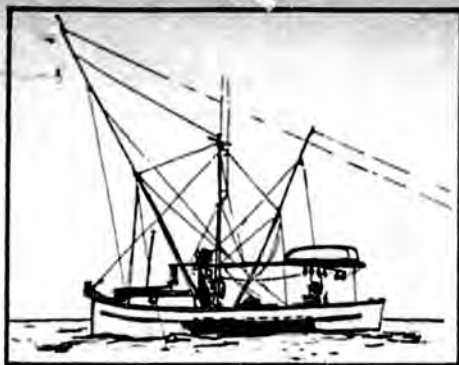
- ① DAVE SHRADER
- ② Ed Jack - old HARBOR people = DISGRACE
DONE BY INTRODUCING SALMON & SHELLFISH
TOGETHER = DEVELOPMENT PLAN FOR APPLICANTS
- ③ DAVE HERRNSTEEN - SHELL FISH PERSON =
GROUND PREEMPTION -
- ④ TOM LOEW - SCALLOP RESEARCH PROJECT -
ANY BILL WHICH WOULD CUT RED TAPE -
GO FORWARD WITH SHELLFISH = ADF&G FORMER
EMPLOYEE - COST MAY BE EXCESSIVE FOR SMALL
BUSINESS OPERATION =
- ⑤ TOM DOOLEY - 24 years fishing in Kodiak -
BIG MONEY TAKE OVER, LITTLE GUY IN VILLAGE
DEALT OUT -
- ⑥ BILL OSBORNE - MARICULTURE ASSN. -
RURAL ALASKA ? SCALLOP NEED IN STATE
PERMIT - ENVIRONMENTAL EFFECT OF SALMON
FARMING ^{U OF} WASHINGTON STATE -

THE ENVIRONMENTAL EFFECTS OF FLOATING MARICULTURE

(7) DONALD WESTON AUG. 1986

(8) NICK TROXELL = PERMIT PROCESS =
COMPREHENSIVE PLAN = LOCAL COMMUNITY
PLANNING EFFORT - APPLICATION PAPERS MUST
BE SCRUTINIZED CLOSELY - CLEAN UP BOND -
SPLIT OUT FIN FROM SHELLFISH - Pilot projects
TO GO FORWARD - HOUSE RESEARCH REPORT (?)

(9) MATTHEW DICK - NEED PERMIT PROCESS FOR SHELL
FISH - SEPERATE SHELL FISH FROM FIN FISH -



Alaska Trollers Association

REPRESENTING ALASKA POWER TROLLERS

130 Seward St., No. 213
Juneau, Alaska 99801
(907) 586-9400

Senator John B. Coghill, Chairman
Senate Resources Committee
Alaska State Legislature
Juneau, Alaska

Dear Senator Coghill:

Due to the amount of testimony presented to your committee, many local Juneau residents did not receive the opportunity to testify on the issue of mariculture. I am, therefore, submitting written testimony on the various subjects important for your deliberation. I have included a critical piece of testimony by Dr. Arthur H. Whiteley, made available to me by the United Fisherman of Alaska. Dr. Whiteley's testimony was presented to the Pacific Fisheries Legislative Task Force. It contains crucial information to aid you in your deliberation of the Mariculture Bill (HB108 and SB106).

I have previously testified as to my acute concern over the issue of disease in respect to salmon net pen farming and its effects on wild stock populations. Though the proponents of mariculture have tried to ridicule the problem of disease, mostly portraying it as the "Boogie Man" syndrome. I, myself a marine biologist, was pleased to find a specialist of Dr. Whiteley's stature who had expounded specifically on this topic of pathogens and salmon net pen cultures.

The key issue to understand in respect to net pen rearing of salmon is the eutrophication of the environment in and around the net pen. The result is a nutrient-rich medium where pathogens can proliferate. Growth of pathogenic populations is normally limited in the natural environment by the availability of nutrients. Sites which contain nutrients are diffuse in the natural environment and are normally not an attractant for fish, so exposure rates are low. Net pens, on the other hand, supply the ingredients needed to spread disease: a nutrient medium for pathogenic growth, attractants (fish attract other fish and unconsumed feed will keep wild fish and invertebrates in proximity to the pens), and exposure time.

Dr. Whiteley clearly demonstrates the need for caution and concern in respect to salmon farming. In Alaska, the gamble is against a few menial jobs in tending salmon farms - with the bulk of the monetary benefits accruing to out-of-State or out-of-country residents - versus our enormous wild stock salmon, and possibly shellfish, industries which support much of our economy.

Respectfully submitted,

Earl E. Krygier
Executive Director

TESTIMONY OF EARL E. KRYGIER (Alaska Trollers Association)

PREPARED BUT NOT GIVEN, FOR THE HOUSE RESOURCES COMMITTEE on
4/2/87

I've heard some promoters of aquaculture intimate that all you hear in fishermen's testimony is "emotionalism", and that they're obstructionists concerning this mariculture bill. Well, you can bet their testimony is emotionally charged - they have their livelihood at stake! But, "emotionalism" indicates a lack of substance, and if you just replay the tapes from Petersburg and elsewhere, you'll hear some real substance in the issues they raise. As a member of the past Governor's AdHoc Mariculture Committee, and as a representative of the fishing industry, I want you to clearly understand that fishermen have some very strong concerns with this bill. They are not against all forms of aquaculture, only against pen rearing of salmon. Fishermen believe the culture of shellfish and aquatic plants may offer beneficial opportunities to the economy and develop as true Alaskan industries, attracting local people and local interests, while they view the farming of fin fish to be attractive mostly to non-Alaskan corporate or foreign investment; possibly through the use of an Alaskan "front man" who supplies the tideland title to the farm. This is critical to fishing fleets like those I represent, where 87% of the Hand & Power Troll fleet are Alaskan residents. It is important to remember that the real benefit to rural Alaska is access and utilization of wild stocks. It is the

presence of wild stocks which maintains the existence of rural communities in Alaska. Anything which is done to reduce access or harm these stocks cannot be considered a boon to rural Alaska. The fishing community's opposition may yet change to support once this bill is written to address the fishing industry concerns.

As one of the present opponents of HB108 and SB106, I'd like to draw a little comparison of this legislation and another piece of legislation before you this session, SJR24, "Relating to the establishment of a domestic fishery zone for Unalaska". You heard Mr. Paul Fuhs' mariculture testimony, and though we believe he is sincere in his aspirations, we feel he has been mislead as to the benefits and social-economic costs to Alaska. As you know, Mr. Fuhs is the Mayor of Unalaska, and the initiator of SJR24. He is also President of the Alaska Mariculture Association, a strong promoter of the aquaculture bill before you. In one bill Mr. Fuhs is trying to protect local residents from outside non-resident large corporation interests. Yet, his support of the fish farming portion of the aquaculture bill makes him a promoter of these same interests. In SJR24, Mr. Fuhs is trying to promote small local fishermen and processors and keep foreign nationals from benefiting. Our stance against fish farming does this same thing. On one hand, Mr. Fuhs promotes domestic rather than foreign utilization of a finite resource. Yet, his own testimony before the House Labor & Commerce Committee indicates that only foreign capitol for salmon farming is presently available, which we feel is contradictory to the ideas he promotes in his exclusive fishing area proposal. Additionally, Mr. Fuhs recently

testified before Congress on the issue of reflagging of foreign processors. Again Mr. Fuhs used an argument contradictory to what he uses on the mariculture issue when he said: "this type of legislation attracts non-Alaskan financing which hurts the local economy". You can't have it both ways, if an argument is meaningful - it must be consistent. We would hope Mr. Fuhs and other Alaskans come to understand these contradictions.

Quite frankly, this bill leaves fishermen in a position where they do not believe that any aquaculture should occur until State policy is developed so that decisions can resolve the following critical issues which conflict with existing use and/or State policy:

- 1) This Bill defines a new State policy concerning the private use of public lands. You, the Legislature, must clearly define this policy for the bureaucracy, so that they can manage the resource. Bureaucrats must have a clear yard stick on who has priority claim rights for the coastal lands, bays, or protected harbors in Alaska. What policy will define site selection? First come, first serve? Or do we require prequalification by "fit, willing, and able" criteria. Certainly the prime sites will have more than one applicant. How will it be adjudicated? How do you stop speculative applicants?

- 2) We need a comprehensive plan, one which will include public input into this process. Since aquatic plants, shellfish and fin fish require the same sites as log storage sites, public use areas, commercial fishing, safe harbors, and PNP or FRED's ocean ranching hatcheries, there should be a moratorium on all further

aquaculture development until pre-site selection and inventories, with adequate prioritization, can be made.

3) What policy on Alaskan ownership? Should we address participation under the restrictions of Alaskan ownership, utilizing the tenets developed in the court-tested, nationally-implemented, "Jones Act" relating to fishing vessels? This act excludes "front men".

4) A policy decision as to which governmental agency will become the lead is critical. Most statute changes in HB108 relate to Title 16, which is Fish & Game. If all the protections under Title 16 must be modified to allow another agency, with no expertise in this area, to take the lead, what's the point? Safeguards are with Fish & Game and the Board of Fish - let's keep it that way!

5) It is essential that the Board of Fish be involved so that they can adjudicate such policy and allocation decisions as to priority rights to eggs, spat, and larvae. (ie. if eggs are needed by both PNP and a fish farmer, who gets them?) This bill suggests some very strong precedents of private access priority to wild stock and hatchery eggs. Is it really in the State's best interest that mariculture egg demand have priority? Such priority demands that fisherman forego harvest to put fish & eggs in the hatchery. This is an allocation of enhanced fish, and the Board of Fish is already addressing this issue.

6) What level of investment does the State plan to make? There are two models of pen rearing of salmon available; one from Norway and one from British Columbia. Each is reflective of the

amount of governmental support afforded these industries. Norway's model developed a plan, has strict regulations, controlled growth, advantages for the rural economy, but with large government subsidy and strong governmental controls. On the other hand, the B.C. model shows a lack of planning which unleashed a gold rush mentality, leading to a carnival-like atmosphere where land speculation, a lack of regard for long term commitment, and outside investment abounds. Few good impacts to the existing local economy are evident. If the State, because of reduced revenues, does not take an active part financially in the birth of this industry, then outside investors will expect return on investments to accrue principally to them. By relinquishing State control, we are giving away State resources (land, water and dollars for management) in a manner which won't clearly benefit the people of Alaska.

Of course, we feel the analogy of the Delta barley farms is pertinent if the State does become involved. Just as the barley farmers can raise barley, Alaska can pen rear fish, but can we raise them long-term without subsidies? Certainly this creates a quandary. I believe that Alaska needs to promote what we have, not copy others, but learn to do what we are doing better (- ie. more wild fish promotion, better quality, etc.).

Now I'd like to switch tacks and take a few moments to respond to some "expert testimony" before this Committee last week. Mr. Bill Paulick, of the Department of Commerce and Economic Development, made some remarks which we found very disconcerting. During that hearing, the question was raised about the promise of Governor Sheffield's Ad Hoc Committee on Mariculture - "that a detailed socio-economic study of salmon pen rearing, including careful analysis of effects on existing Alaska industry, would be performed prior to State promotion of pen rearing." Mr. Paulick told you that Commerce (as the lead agency on that Ad Hoc Committee) had decided that further study of the mariculture issue was not required because of the extensive literature already developed on this subject. He cited the existence of a number of reports including that done by the House Research Agency, and the Sea Grant market study authored by Ron Rogness. He further stated that the monies - \$50,000+ - appropriated to Commerce to deal with mariculture, had largely been used to fund what he described as "a road show" for "educating the public" on mariculture.

Let's start with the "road show". That's a pretty accurate description, because, in fact, this effort was a sales blitz. The public education aspect was rather like Proctor and Gamble "educating the public" about its latest laundry soap. The show is unabashedly pro-mariculture, including the pen rearing of salmon. It most certainly was not balanced by the concerns raised by those of us who could be seriously negatively impacted by pen rearing. The Alaska Trollers Association and the hundreds of fishermen we represent wish to register our extremely strong objection to a State agency actively

promoting developments which are the subject of great controversy, particularly when that agency knew full well that the issue would soon be a matter of extensive Legislative hearings. We recognize that Commerce sees itself as an advocacy agency, but such a stance is inappropriate when the Department is charged with balancing the pros and cons of a complex issue.

Next, we'd like to deal with Mr. Paulick's assertion that adequate studies have been performed. As you heard last week, numerous complex issues - from permitting to marketing to ensuring effective Alaskan participation - still cloud the mariculture picture. Mr. Paulick admitted that the promised socio-economic impact study had not been performed. Instead, we are asked to accept his assertion that existing literature is adequate, despite the fact that many important questions remain unanswered. And, what about those existing studies? Should we, the fishermen of Alaska, and the legislature trust the future of aquaculture policy to their bland assurances?

One much cited report is that by Ron Rogness and Biing-Hwan Lin titled The Marketing Relationship Between Pacific and Pen-Raised Salmon: A Survey of U.S. Seafood Wholesalers. In his testimony to you last week, Mr. Rogness stated that his other econometric study of the European market had numerous "weaknesses" and that the "results were not meaningful". Well, this study isn't any better in our view. We took this study to a well known Northwest consulting firm who has won national awards for their survey techniques and survey response rates. I have a five page synopsis of their analysis which I will

submit to this Committee in the next few days. In a nutshell, this paper has made simple computational errors and used inadequate survey techniques which result in highly questionable interpretation. For example, the author claims a 24% response rate, when, in fact, it was nearer 13% when computational errors were corrected. The actual effective response rate was closer to 7%, a sample size far below that which is acceptable for statistical analysis. The report stated that budget restraints did not allow follow-up letters. Yet, these follow-ups are critical in survey studies such as these, since they yield a "non-respondent analysis" which is critical to interpret results. The high non-response rate virtually insures that a non-response bias is "built into" the results. The most important survey question (No. 4) did not ask the critical question "had they ever sold Pacific salmon?" How buyers and sellers view substitution is dependent on this "missed" factor.

Another study which has received a lot of attention is the House Research Agency report entitled Aquaculture in Alaska. This report really gives us heartburn! While it purports to be unbiased and objective. In fact, it relies very heavily on input from pen rearing proponents, and is riddled with slams against the fishing industry. Indeed, Rodger Painter, the Executive Director of the Alaska Mariculture Association is even quoted as a "fishery industry observer" who doesn't think pen rearing of salmon will negatively impact existing industry. What a farce! What really irks us is that our very real concerns were not addressed. In fact, the researcher responsible for preparation of this report never even solicited the

Alaska Trollers Association's views, despite the fact that his office is literally just four doors down the hall from ours! Possible negative impacts of pen rearing of salmon were summarily dismissed in a single page of the most cursory analysis.

This report states that the State of Alaska is unbiased in its analysis of aquaculture. Yet, on page 103 of the report is a long list of State (or quasi-State) agencies which worked with the Alaska Mariculture Association in mariculture policy development. Many of these agencies are noted for the strong pro-pen rearing advocacy positions of key personnel. For example, former director of FRED, Stan Moberly; former director of the Office of Commercial Fisheries Development, DCED Greg Baker; Kurt Kerns of the Sea Grant/Marine Advisory Program; and Ole Mathisen, UAJ. Are all strong proponents of salmon farming.

It's reports such as these which Mr. Paulick cites as adequate socio-economic analysis on which it is suggested you can rely on for the formulation of policy on this highly controversial issue. The fishing industry does not consider these reports to fulfill the promise made to us last year. They do not constitute fair, unbiased analysis of the range of issues with which we are confronted. We urge you not to take legislative action on this bill until policy is drafted and concerns are met.

TESTIMONY OF ALASKA TROLLERS ASSOCIATION REGARDING
FISCAL NOTES ATTACHED TO HB 108 and SB 106 - APRIL 6, 1987

You have heard quite a number of comments regarding the fiscal notes attached to these companion mariculture measures - HB 108 and SB 106. We think much of the criticism is justified. At one point during the testimony last week it was asserted that permit and other user fees on mariculture licensees could be expected to largely defray the costs of regulating the new industry. We think this is extremely unlikely. Even a simplistic analysis of the existing fiscal notes indicates FY88 - FY92 program costs of some \$2.245 million against expected receipts of just \$247,000 - leaving a shortfall of some \$2 million over five years. Moreover, these cost estimates are optimistically low.

The Department of Environmental Conservation has already retrenched from its original \$0.00 fiscal note. Doug Donegon of DEC indicated that after listening to extensive testimony he would have to rethink their entire approach to the issue of regulating a new mariculture industry. Given the responsibilities of his agency I believe it is only prudent to expect a fairly significant fiscal note from DEC, which would add to the cost side of the fiscal estimates just cited.

The Department of Fish and Game submitted a fiscal note dealing with only one of its divisions - Fisheries Rehabilitation Enhancement and Development. While FRED will surely bear the brunt of responsibilities for mariculture within ADF&G, we think it is unrealistic to believe that additional costs will not be incurred in other areas too. Increased burdens for the Habitat Division come to mind most immediately. One criticism we have of FRED's fiscal note is that it anticipates 100 permit applications in FY88, resulting in 20 operational farms by 1992, but does not project an ongoing stream of applications in years subsequent to FY88. Still, FRED's projections work out to \$11,900 per application, or \$59,500 per successful farm over 5 years. Quite obviously, recovery of such costs through permit fees is unrealistic in the extreme, as the financial burden on applicants would be excessive. This is particularly so since at least some of these cost would be ongoing beyond the FY92 projection limit of the fiscal notes.

The Department of Natural Resources fiscal note also indicates a significant shortfall, although given the language of their note it is impossible to indicate per permit costs over the five year projection period. In gross terms DNR posits some \$989,400 in administrative costs against \$147,000 in revenues for an \$842,400 shortfall over the period.

Commerce and Economic Development's fiscal note is the most optimistic of all, projecting an actual surplus of revenues over costs of \$33,900 from FY88 through FY92. However, we believe that DCED's cost estimates are seriously flawed. As written these two bills would establish DCED as the lead agency for development of this industry in Alaska. As such

the cost estimates are hopelessly out of whack. It seems fairly clear to us that actual lead agency responsibility must ultimately rest with one of the agencies having the greatest regulatory responsibility. It appears that DCED envisions its role actually diminishing from its current "road show" responsibilities even as the industry grows! In our view this reflects a very unrealistic view of the complex set of issues that establishment of a new, technologically sophisticated industry would pose in such a large, diverse and difficult development environment as Alaska. Even the simplest of coordinative roles will impose a greater burden on DCED than that projected in its fiscal note. As "lead agency" precisely what sort of services does Commerce see itself providing - either to the public or other agencies - for a mere \$16,100 in 1992?

One of the most disconcerting things about these fiscal notes is that they are all based on entirely different assumptions about the number of potential applicants.

Commerce projects a straightline increase of 50 new permit applications per year through 1992. They apparently don't think any of those permits applications will be denied and/or abandoned, as revenues at the rate of \$100 per permit are projected through the entire period of the fiscal note, with a projected 300 active permits in FY 92.

Fish and Game calls for 100 permit applications in FY 88 resulting in 20 operational farms in FY 92. There is no mention of expected new permit applications subsequent to FY 88. Are we to assume that the projected costs through FY 92 are based solely on tracking those initial 100 applications through the period? If so can we expect an

additional increment of 100 new applications to be received in FY 89, and each year thereafter, with a similar additional cost increments over each subsequent five year period?

Natural Resources's fiscal note suffers from a similar discontinuity, as they too provide an estimate of the number of applications - some 70 - only in the first fiscal year of the projection period. How many additional applications do they expect through FY 92? What effect will those new applications have on their fiscal note?

This whole issue raises questions about lead agency responsibility once again. It seems only reasonable for the Administration to have come into these Legislative hearings with a set of agency fiscal notes based on a set of common assumptions. First year estimates of permit applications vary from 50, to 70, to 100. No two agency estimates are the same. Projections in subsequent years are completely muddled. The proper approach on this would be to develop a set of mutually agreed upon assumptions upon which every Department would base its fiscal projections. These assumptions should include low, mid and high range estimates of the number of permit applications and ultimate number of operators. Further, a careful analysis of all State government agencies expected to be involved in the regulatory processes of this new industry should have been completed well in advance. Each should have been provided with the basic assumptions and been directed to complete a timely and complete fiscal note. To us, that's what lead agency responsibility is all about. Unfortunately, Commerce's "road show" doesn't seem to have included much in the way of inter-agency coordination, and their projected fiscal note indicates no planning to take on that role.

Clearly, a great deal more fiscal analysis is required before the State leaps into this mariculture business. We need fiscal analyses from all effected agencies. We need analyses based on a set of clear, consistent assumptions about industry growth and regulatory requirements. Finally, we need some cogent analysis of the impacts of these new budgetary inputs on the conduct of vital existing management programs. This last point is absolutely crucial given sharply declining State revenues and already severely curtailed budgets in key resource management agencies. As so many others have already testified, the Alaska Trollers Association strongly believes that the State's limited funds would be far better spent in strengthening our existing fisheries.



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**Additional Testimony by the Alaska Trollers Association
to House Resources Committee 4/2/87**

**Discussion Of The Points Of Concern for CS For HB108 (L&C)
An Act Relating to Aquatic Farming**

Page 1, Lines 11 & 12: "Create new commercial fishing" - obviously, this is a mistake.

Page 1, Lines 19 thru 22: I do not believe that this a quid pro quo. That is, adding products from mariculture does not necessarily lead to a strengthening of Alaska's competitiveness on the seafood marketplace.

Page 1, Lines 23 & 24: Item 5 ignores the cost to government, especially in relation to the like similarity of Delta barley farmers and finfish farmers.

Page 2, Line 2: "Traditional high value industries" - this does not necessarily make sense in the context of item #3.

Page 2, Line 9: "Commissioner" - this relates to the Commissioner of Commerce & Economic Development, yet nearly all of the amended Alaska Statutes deal with Title 16 which is Fish & Game. Therefore, it only seems logical that the Commissioner of Fish & Game should be the "Commissioner".

Page 2, Line 16: "Sell stock" - these farms may pose a problem here, as far as how the State of Alaska keeps control of genetics and disease.

Page 2, Line 20: "May" - this is why Commerce & Economic Development should not be the lead agency. The word should be "shall" since the health of the wild stock are at stake.

Page 2, Line 29 and Page 3, Line 1: Indicates that an "inspection" by the Department of Fish & Game must occur. This is certainly an increase in the amount of fiscal note which should be addressed.

Page 3, Line 20: After the word "manner", it should include "and amount".

Page 3, Lines 24-28: Indicates that the Commissioner of Fish & Game "shall issue or deny a permit with within 30 days after receiving an application". Whether this time limit will require an additional staff member to handle this, may relate to an increased fiscal note.

Page 3, Line 29 thru Page 4, Line 7: Line 29 should read "shall" instead of "may", and Line 2, "substantially impair sustained yield" relates to the "shall". This section gives priority of wild stocks to fish farmers. Permits should be issued only if there is a demonstratable surplus. The sentence on Lines 3 & 4 indicates that the "decision of the Commissioner of Fish & Game must contain the factual basis for the findings". Whether this is always possible, or how "factual" the findings must be (ie the case of coho salmon), is difficult to say. Therefore, whether or not a denial of a permit is possible in all instances, even when it should occur, must be worked out and cleaned up. Lines 4 thru 7 indicates that again the priority rights go to fish farmers, not to the escapement. Not only that, but it appears that the Department of Fish & Game must manage the commercial fishery in such a manner as to give priority to the fish farmers in their needs for stock and inventory. That is, they must manage all fisheries (and I would guess subsistence also) to provide brood stocks for the fish farmers. This is crazy! Such a request is an allocation issue and should be relegated to the Board of Fish.

Page 4, Line 9: "Shall issue a permit" - it goes on to indicate that there should be no restrictions on egg take or on demand when fish farmers are involved. Substitute the word "may".

Page 4, Line 10, Item #1: Seems to me to be in direct conflict to chinook rebuilding under the U.S./Canada Salmon Treaty.

Page 4, Lines 12 & 13, Item #2: I'm unsure what this means at this time.

Page 4, Lines 14 & 15, Item #3: Seems to indicate that if a hatchery or wild stock needs to maintain a genetic pool, it will also be in a priority, since they "shall" issue a permit. Could be a problem.

Page 4, Lines 16 & 17, Item #4: May be trying to exclude the priority, but it is unclear. It probably should indicate commercial, sport, subsistence, and personal use harvest of the "species sought", etc.

Page 4, Line 21, Item h: "shall" should be "may". Otherwise, you are legislatively determining allocation of enhanced and wild stocks for consistency. Such allocation is best relegated to the Board of Fish where full public review can occur.

Page 5, Line 9 thru 11: "a report of a health inspection of the stock --- shall be conducted by the Department of Fish & Game". This is another fiscal note which the Department has to be aware of.

Page 5, Line 13, Item d: "may" should be "shall" restrict or disapprove a transfer of stock if it finds that the transfer would present a risk of spreading disease, and if it would impair production needs.

Page 5, Line 17 thru 19: This is unclear as to whose hatchery we are talking about; the whole sentence is rather vague.

Page 5, Line 27: Should read not only "intentionally", but "shall not be released into public waters".

Page 6, Lines 6 thru 8: "shall report" and add "or lose permit", after "holder".

Page 6, Line 9 thru 11, Item d: "upon reasonable notice" indicates that a spot-check to see if the farmer is actually in compliance will not be possible since you're going to notify them of your inspection. The additional item there is "the cost of inspection shall be borne by the Department of Fish & Game", and should be included in the fiscal note.

Page 6, Lines 13 & 14: "the Department of Fish & Game shall develop a disease management and control program for aquatic farms and hatcheries". This is certainly an addition in the fiscal note. Additionally, this Section reinforces the relevance of having Fish & Gam be the lead agency.

Page 6, Lines 19 thru 25: "commissioner" (of Commerce & Economic Development) shall submit a report to the legislature, which will, in part, discuss the affect of the salmon farming industry on the commercial fishing industry, with recommendations to the legislature. Such effects on the commercial fishing industry have not been discussed to date (ie the socio-economic impacts), and this has mostly been due to the lack of funds. This certainly must be included in the fiscal note, and I believe is not reflective of the present proportion of the fiscal note.

Page 6, Line 26: "the commissioner shall adopt regulations necessary to implement this chapter and to effect state policy concerning aquatic farming". The Department of Commerce & Economic Development, Fishery Development Section, is not, I don't believe, a regulatory body, though maybe they are.

Page 7, Lines 2 & 3: "guilty of a class B misdemeanor" - this certainly has to be more than a small "misdemeanor". We need to check this along with other types of infractions under the State law.

Page 7, Line 9: "fish parts that are propagated ---" - this is unclear; this is probably fish or shellfish which are propagated.

Page 7, Line 11: There again they are talking about the "commissioner", and, again, since the amendments are all amendments to Title 16, this should be the Commissioner of Fish & Game.

Page 7, Line 16: "fish" - We believe all reference to "fish" should be struck from this Bill.

Page 7, Lines 25 thru 29, Section a: amends AS 08.01.065(a) to include aquatic farms certainly must have a fiscal note to it when you refer to all the fees that are involved. The bureaucracy to institute and collect fees is not inexpensive.

Page 8, Lines 2 and 10: Because of the allocation issues, the Board of Fisheries overview must remain. Delete Lines 2 thru 10.

Page 8, Line 14: Should read <SHELLFISH, AND AQUATIC PLANTS>. "FISH" should not be included.

Page 8, Line 18: Same as above

Page 8, Line 23: Same as above

Page 9, Lines 2 thru 5: Same as above

Page 9, Line 14: "user group" - we're now including aquatic farms under Title 16.10.380(b)? If it is a "user group", then why are they trying to exclude it from Board of Fish activities??!!

Page 9, Line 22 thru Page 11: First, we believe that all reference to finfish or salmon in this Bill should be deleted. Notwithstanding, all of the issues starting on Page 9, Lines 22 thru 29, and Page 10, Lines 1 thru 24, require the Department to do and monitor many things that certainly must be included in the fiscal note, and must be checked as to their impact.

Page 10, Line 20: We need to check on what was <REPEALED>; did they repeal it, or had it been already repealed?

Page 11, Line 7: "must <SHALL>" - how does this actually occur in Alaska Statute 08.06.010?

Page 11, Lines 10 thru 12: We'll need to take a look at AS 16.43.140 and determine what the "amended" does here.

Page 11, Lines 13 thru 18: We'll have to take a look at AS 16.51.180(5) and see what the "amendment" does.

ASMI-GRAM

Vol. 3, No. 2

March, 1987

ASMI seeks federal dollars to market Alaska fish overseas

The Alaska Seafood Marketing Institute has applied for \$3.5 million in aid from a federal agency to be used in marketing frozen salmon, herring and pollock overseas.

In February ASMI submitted a proposal for federal assistance from the Foreign Agricultural Service (FAS). The agency controls disbursement of Targeted Export Assistance (TEA) grants to American businesses facing unfair foreign trade competition.

According to Merry Tuten, executive director of the Juneau-based state-private industry seafood marketing agency, ASMI is seeking federal funds to mount a marketing, promotion and advertising campaign to help Alaska salmon compete against Norwegian pen-reared salmon. The campaign also will focus on improving sales of herring and will serve as the forerunner for a promotion effort for Alaska pollock in Japan.

Tuten estimates that Alaska could sell \$36.2 million more fish overseas this year if ASMI receives the grant. In 1985, American fish exports totaled more than \$1 billion — Alaska accounts for 90 percent of the U.S. salmon catch, 87 percent of its Pacific herring catch and 100 percent of its pollock production.

~~Tuten said Alaska in recent years has watched its share of the foreign market in both Europe and Japan erode and depression. Norwegian farmed salmon is the Norwegian Ministry of Fisheries funded \$175 million in 1985 to support fish farms. In 1985 Alaska salmon was America's leading fish~~

export as 358 million pounds of salmon, valued at \$614 million, headed overseas.

But Norwegian pen-reared salmon is mounting a major assault on Alaska's market share. In 1975 Norway raised just 1.9 million pounds of salmon. By 1985 it had reached 74 million pounds worth \$186 million. ~~Worse yet, estimates are that unless Alaska undertakes a strong program to counter Norwegian sales efforts, Norway could capture the lion's share of the European market by 1990 — estimates being that Norway will capture 76 percent of sales in France — Alaska's best current customer for frozen salmon — and potentially 90 percent of the market in Great Britain.~~

According to the U.S. Department of Commerce, in 1983 the U.S. was the leading supplier of fresh salmon to Japan selling 1,275 tons of fresh fish to the country or 94 percent of its total imports. ~~In 1985 Norway replaced the United States as the leading fresh fish supplier in Japan.~~

"The threat to our markets is very serious. We really need to mount an aggressive campaign this summer and fall to stem the tide. Otherwise we could find ourselves increasingly shut out of major markets for Alaska seafood products," Tuten said.

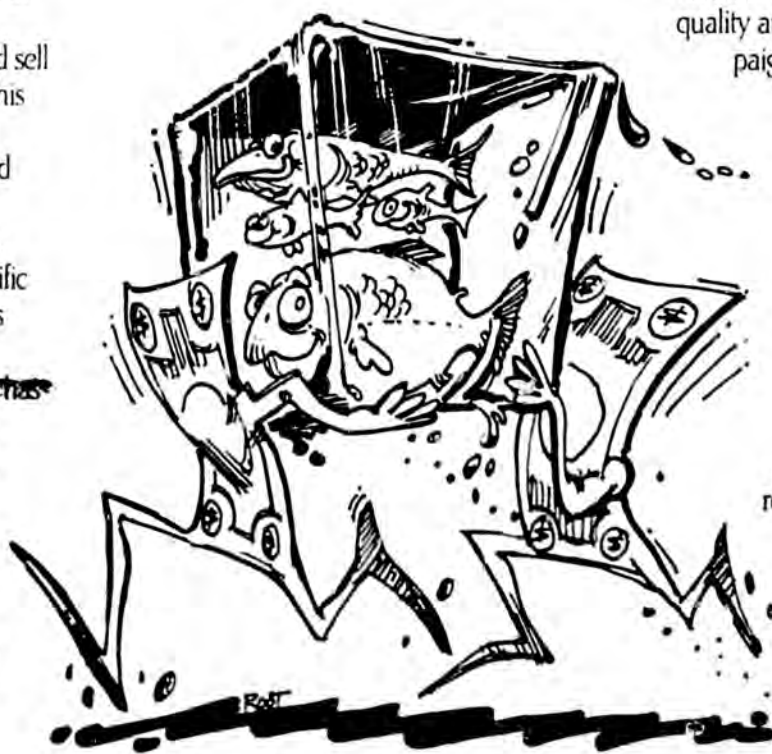
Noting that Alaska products already face a host of unfair trading handicaps, Tuten said ASMI wants to spend \$2.5 million in Western Europe and about \$1 million in Japan.

In Europe, the campaign will stress that Alaskan salmon are wild and natural with superior taste, of healthier quality and a deeper color — the campaign is specifically designed to

discount an attitude in Belgium that Alaska salmon are more red-pink in color because of artificial dyes. The campaign will stress that Alaska salmon have more natural color than the yellowish, paler pen-reared varieties.

The campaign also will include hiring merchandising representatives for Europe, running retail trade and consumer advertising, trade events, printing point-of-sale materials, providing

continued on page 2



Some relationships between pathogenic bacteria and
salmon net pen culture

Pacific Fisheries Legislative Task Force, State Capitol, Olympia,
Feb. 7, 1987

Dr. Arthur H. Whiteley, Professor, Department of Zoology,
University of Washington

I intend in these few minutes to comment on one aspect
only of pen rearing of salmon - the relationship to pathogenic
bacteria and other agents of disease.

The growth of bacterial populations in a natural environment is limited by the availability of nutrients. In a typical, natural marine environment the bacterial populations are relatively sparse. Given appropriate nutrients, either in the form of dissolved materials or sediments, the opportunity for growth in these populations will be much enhanced. It is generally agreed that salmon pen culture contributes substantially to the eutrophication of the environment of the pen - both in terms of soluble and finely suspended material, and in terms of larger particles that form heavy sediments on the bottom. In this way, the pens enrich the local environment for bacterial growth. Those bacteria already present in the water and substratum can increase. Any brought in with the introduced fish can increase as well. A variety of diseases can thereby be fostered by the pens. Some of these are of bacterial origin, some are viral, and some are due to organisms such as fish lice, parasitic worms, etc. The enhancement of the bacteria by nutritional enrichment works to the disadvantage of the penned fish. They are already stressed by the conditions in which they grow. They are therefore susceptible to bacterial invasion. Notably *Vibrio anguillarum* and *Renibacterium salmonarum* infect the penned fish and often kill them, and other vibrios and aeromonads are of major importance as salmon pathogens. *Vibrio anguillarum* produces disease in penned salmon in this State and in British Columbia. It also is ubiquitous in Norwegian waters, and is responsible for many of their fish farm diseases. With the advent of intensive fish farming in Norway, a new disease, the "hitra" disease, has appeared and now is responsible for 80% of the disease problems in the Norwegian fish farms. Its cause is uncertain, but vibrio species occur in connection with the disease

outbreaks (Håstein, 1986).

A significant question is whether these infections affect wild fish. Weston (1986) concludes that the evidence argues against such transmission. Others point out the difficulty of making such a determination because of the mobility of the wild fish and other complexities associated with working in a submerged, marine environment (Trust, 1986; Johnson, 1989; Staley, pers. com.). It takes only a few minutes exposure for a fish - penned or wild - to become infected. Often the route of transmission is through the gills. The infected fish often die, but if they survive, they frequently become carriers of the pathogenic organism. Both viruses and bacteria can be shed through the feces of the fish, thus spreading the focus of contamination in the natural environment. Moreover, in certain cases (*Renibacterium*) the bacteria can be passed from a female to her eggs, where it associates with the yolk, and transmits the disease to her offspring (Trust, 1986). It is too early to conclude that there is no transmission from a pen to the general environment and to the wild fish there. On the contrary, it is the opinion of microbial ecologists that an infected fish pen would in all likelihood serve as a focus for the infection of fish in the environment, and from them for the transmission of disease to their offspring (Staley, pers. com.)

In addition to pathogenic bacteria, the stressed salmon can serve as a focus for a number of serious viruses. These, too, may enter their host through the gills, and can be transmitted to other fish and to next generations (Trust, 1986). It is expected that they will be locally enhanced by the concentrations of wastes associated with fish pens (Staley, pers. com.), and this enhancement poses problems for the penned fish, and for wild fish as well. The danger that such viruses can be transmitted to wild fish is recognized by laws that prevent introduction of salmonids from the Columbia River system, which is infected by viruses, into any other river system in this State.

These pathogens and related ones that will multiply in the accumulated fish wastes, can serve as a reservoir of infection of marine invertebrate organisms as well. This, too, is a difficult field of inquiry because of the nature of the environment and the mobility of some of the organisms, and most information is derived from study of captive invertebrates. It is believed,

however, that animals living in degraded environments (which I assume would include under-pen locales) can be seriously disabled by such bacteria. Bacteria that degrade chitin, including *Vibrio*, *Beneckeia* and *Pseudomonas*, cause shell disease in a host of crustacea, including spiny lobsters, tanner crabs, king crabs, various shrimp, and others of economic importance (Johnson, 1983). The species of *Vibrio* bacteria that infect crabs and shrimp include those associated with salmon pens or are present in local waters: *V. anguillarum*, *V. parahaemolyticus*, *V. alginolyticus*. (Johnson, 1983). Laboratory experience indicates that animals kept in clean sea water are difficult to infect, but those in the presence of sewage sludge developed shell disease. In addition to causing shell diseases, bacteria invade shrimp, crabs and other crustacea and cause internal infections. Again, the total relation of these infections to stress, to polluted environments, to salmon pen sewage is not resolved (Johnson, 1983), but we believe this relationship needs analysis in relation to establishing fish pens in the vicinity of shrimp and crab populations.

There is a well documented literature demonstrating that molluscan embryos and larvae - some of commercial significance - are subject to serious infection by these same species of vibrio bacteria. Abalone embryos and Pacific oyster (*Crassostrea gigas*) embryos and veliger larvae in hatcheries suffer serious mortalities from vibriosis (Sparks, 1985; Jeffries, 1984; Tubiash and Elston, 1984). It would be prudent to determine carefully the potential damage that may be caused by juxtaposing salmon pens to oyster and abalone culture facilities, and to native bivalve beds.

It would be of interest, also, to determine if vibriosis similarly affects these same kinds of molluscan larvae and embryos in the natural plankton, thereby affecting natural populations. Beyond that, it is important to know if populations of these *Vibrio* species or other pathogens, enhanced by sewage or fish pen wastes, infect other forms of invertebrate larvae or adults. I am thinking of the sponges, sea urchins, starfish and the host of other invertebrates which, though not of direct commercial value, are absolutely fundamental to the ecosystems of these water and to their productivity. Their impairment would sound the death knell for these waters.

Some of these bacteria are pathogenic to man as well. Knowledge of the genus *Vibrio* is expanding rapidly. This genus, which includes *V. cholerae*, includes species that typically live in marine locales (Kelly et al., 1982). *V. anguillarum* appears not to infect humans. However, *V. vulnificus* and *V. parahaemolyticus* do infect humans. *V. vulnificus*, a recently recognized species, is a deadly pathogen that is carried in sea water. It is readily filtered and concentrated from sea water by oysters and clams and it is easily transmitted to humans when these bivalves are eaten. The results are often fatal. Other than through ingestion, humans can contract the disease through simple contact of sea water with open wounds or mucosal tissues. It is predominately a warm water organism, which suggests that our waters may be safe from it, but virulent strains of this species have been found in Oregon associated with fish, crabs and clams and in Japan associated with eels (Tison and Kelly, 1986; Kelly and McCormick, 1981; Tison and Kelly, 1984; Blake, Weaver and Hollis, 1980). A preliminary search for this species in the San Juan Islands has not revealed it, but its presence in warmer bays there, and in the Canadian Gulf Islands, or elsewhere in the Sound cannot yet be discounted (Kelly, pers. com.). *V. parahaemolyticus* is, by contrast, commonly found around the San Juan Islands and doubtless is ubiquitous here (Kelly, pers. com.). It causes acute gastroenteritis in humans (Tison and Kelly, 1984; Blake, Weaver and Hollis 1980). This form of gastroenteritis appears to be transmitted exclusively through food, usually seafood (Blake, Weaver and Hollis, 1980). It can be a very significant infectious agent: in Japan, over a 10 year span, 24% of reported cases of food poisoning were attributed to this bacterium.

V. parahaemolyticus, thus, is present here, is a known pathogen of humans, and is transmitted through filter feeders such as clams and oysters. *V. vulnificus* is found nearby, and with further searching may be found in the Sound and Gulf. Simple contact with infected sea water will lead to serious infection. The former species, and probably the latter as well, thrives in heavy, enriched sediments such as sewage sludge. It can also be expected to grow in salmon pen sludge (Staley, pers. com.; Kelly, pers. com.).

It has been argued by associates of the salmon pen aquaculture industry that human diseases associated with these vibrios have been rarely found in the Puget Sound region, and therefore no danger is posed by them. Thus fish pen aquaculture is justified. It is good that the base line now, before salmon pens are well established, is essentially zero. The water is relatively clean, now, and the populations of these pathogens are within tolerable limits, using customary screening methods for detecting these pathogens. But a further complication is introduced by a recent paper (Grimes, et al, 1986). They find that when such pathogens as I have been discussing are introduced into marine waters, they rather quickly lose their identity as measured by conventional culture methods. They enter into dormancy, but remain viable though not culturable by traditional methods. Failure to find them using these methods could lead to overlooking a substantial, but cryptic source of serious pathogens in the environment.

The important question, then, is not whether these organisms pose a present health threat, or ecological threat. The proper question is: can these organisms, and this ecosystem, and these humans tolerate the eutrophic burden that will be imposed by a full blown fish pen industry? It is our belief that there are many too many questions that need resolution, of a public health nature, and of an ecological nature, before we proceed further.

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SENATOR FRED F. ZHAROFF
ALASKA STATE LEGISLATURE

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DURING SESSION:

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DISTRICT N

ALASKA PENINSULA • ALEUTIAN CHAIN • BRISTOL BAY • KODIAK ISLAND • LAKE CLARK/LAKE ILIAMNA • PRIBILOF ISLANDS • SHUMAGIN ISLANDS

TO: All Senators

FROM: Senator Fred F. Zharoff

DATE: May 12, 1987

One of the biggest questions to arise this session during all the discussion over the aquatic farming legislation (SB 106) is: What will be the impact of salmon farming on Alaska's traditional salmon markets?

Attached is a copy of a study that provides information on this important issue.

In brief, the researchers have concluded that the worldwide production of farmed salmon will have a significant impact on Alaska's salmon industry. At the same time, they calculate that Alaskan farmed salmon production -- if we choose to enter this industry -- would only have a marginal impact on the traditional salmon fishery. The main competitive challenge will come from Outside. Alaska can choose to react, or do nothing.

Alaska's policy on aquatic farming is an issue the legislature must address next year. I recommend this study as one more source of information to consider in evaluating the overall issue.

Salmon Farming in Alaska

Economic Feasibility and Socioeconomic Impacts

Robert R. Logan

John Weddleton

University of Alaska - Fairbanks

April 1987

Salmon Farming in Alaska
Economic Feasibility and Socioeconomic Impacts

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Introduction

1) Overview

The dramatic increases in production of farmed Atlantic salmon has resulted in both optimism and fear for Alaskans. The optimism is expressed by those who believe salmon farming presents an alternative source of employment and income for the state. The fear is expressed by those who believe that farmed Atlantic salmon will compete with wild Pacific salmon in the marketplace, and cause reductions in employment and income for the traditional fishery.

The focal point for both groups is whether salmon farming should be legalized in the state of Alaska. (More precisely, whether the defacto restriction on production through the limitation on smolt acquisition is to be lifted.)¹ As with any public policy, the economic costs and benefits must be weighed in order to make a rational decision. The purpose of this piece is to aid in that process.

There would seem to be three important questions in this issue. The first is whether salmon farming is feasible in Alaska. If not, all arguments are moot because salmon farming wouldn't occur even if legal. If it is feasible, what kind of employment and income can we expect this industry to generate (both in terms of numbers and in terms

¹ See "Aquaculture in Alaska" for a discussion of the legal issues.

of demographics)? Finally, what affect will the development of this industry have on the traditional fishery?

The central focus of this piece is a comparison of two scenarios - one with and one without Alaskan salmon farming. It is necessary to make this comparison with the recognition that world output of farmed salmon is expected to be much higher in the future. Thus, an investigation of the impact worldwide production will have on the traditional fishery must be made first. A discussion of the incremental effects Alaskan salmon farming will have can then be made.

It would be a major error to confuse the two points above. There is nothing Alaska can do to prevent the affects worldwide production will have on the traditional fishery. That is, preventing salmon farming here will not change this. These effects should not be a part of the decision to legalize salmon farming. The main concern should be the incremental effects of Alaska's own production.

The last question may be the one with the most public controversy. There is argument about the degree to which Atlantic and Pacific (and fresh or frozen) salmon compete in the marketplace. This is a vital ingredient in discussing the effects of farmed salmon on the traditional fisheries. The view taken here is that it is better to be conservative and provide a margin of safety - to assume that the species do compete directly in order to estimate spillover affects.

Even with this conservative (pessimistic) approach, it appears that Alaskan salmon farming will largely complement, rather than displace the traditional fishery. The increases in world production are likely to have significant effects on the Alaskan traditional fishery. However, incremental Alaskan production is likely to have only marginal effects on the Alaskan traditional fishery.

Salmon farming is likely to generate thousands of jobs, and hundreds of millions in sales dollars when both direct and indirect effects are considered. The industry should earn high marks in terms opportunities for rural Alaskans. If the industry is developed properly, it will provide opportunities for family run operations as in Norway. Finally, it is an industry that provides year round employment and will result in wage dollars being spent in Alaska rather than elsewhere.

2) Putting Things Into Perspective

Before the technical analysis begins, a brief look at the relevant markets is warranted in order to put salmon farming into perspective. There has been an enormous increase in the production of farmed salmon. 1985 farmed salmon production (Atlantic and Pacific) was approximately 267% larger than 1981 production. Output increased from 12,000 metric tons to 44,000 metric tons over this period. However, as a fraction of total world salmon production, or even total world premium (Coho, Chinook, and Sockeye) salmon, the change is much less dramatic.

Table one indicates total wild, farmed, premium, and aggregated output numbers for various years. Note that even under the fairly dramatic forecasts of 142,000 metric tons of farmed salmon production by 1990, this represents only 17% of estimated world production. Currently, less than 10% of the world salmon supply is coming from farmed sources.

The above may underestimate the magnitude of farmed salmon relative to its particular market. Farmed production is sold as a fresh premium product. It may be appropriate to compare pen-raised output with wild Coho, Chinook, and Sockeye landings. Here, the comparison is more dramatic. If one thinks of these species as comprising a particular market segment, farmed production will rocket to over 40% of premium salmon production by 1990.

Thus, the dramatic increases in farmed salmon production do represent a substantial increase in the world supply of premium salmon species. The impact this will have on Alaska depends on how the demand for salmon changes through 1990. This topic is addressed after a brief discussion of salmon farming's feasibility in Alaska.

Relative Size of Salmon Farming

Year	Wild <u>Total</u>	Farmed <u>Total</u>	Farmed+Wild <u>Total</u>	% of <u>Total</u>	Premium <u>Wild</u>	Premium <u>Total</u>	% of <u>Prem</u>
1983	670.7	23.4	694.1	3.4%	196.4	219.8	10.6%
1986	657.0	59.2	716.2	8.3%	200.3	259.5	29.0%
1990	677.0	142.0	819.0	17.3%	200.0	342.0	41.5%

Table 1

Sources: 1983 and 1986 Wild and Farmed total figures reprinted from "World Markets for Farmed Salmon, p 2. 1990 farmed projections from "Aquaculture in Alaska" p 55. Premium wild species (Chinook, Coho, Sockeye) from "Statistical Yearbook - North Pacific Commission, 1986" p 15. (1986 estimates). Wild production of premium species assumed constant through 1990.

Profitability in Alaska

1) Overview

Atlantic salmon farming has proved to be an exceptionally profitable venture for the Norwegians. This does not guarantee the same for Alaska for two reasons. The first is that the Alaskan costs of production are not known with precision, and the second is that the enormous expected increases in production are bound to bring these rates of return down to "normal" rates of return.

There has been at least one study on the feasibility of Atlantic salmon farming in Alaska. This was a study for the Seaalaska Corporation undertaken by the VBB/Sweco and Nordic Alaska companies. In a word, the answer appears to be "yes". No such detailed study has been performed for Pacific salmon farming in Alaska, but the important features of Alaskan production costs seem to be the same for the Pacifics. The above report indicated that the Chilean and Japanese experience demonstrates the cost comparability between the two species.²

However, the state's posture towards salmon farming in Alaska has yet to be determined, and this will be an important feature of the profitability picture. If the start-up phase is elongated through an extensive permitting and site selection procedure, or if operational costs are

² Phase II, p 102.

increased through overly stringent environmental regulations, then Alaska's producers will be at a competitive disadvantage vis - a - vis foreign and other domestic producers.

Assuming that this is not the case, it appears, in short, that Alaska has a transportation cost advantage over European producers sufficient to outweigh higher feed and labor costs. This is extremely important feature for the long run viability of a salmon farming industry in Alaska. For if this were not the case, world output increases over time could result in price decreases sufficient to destroy a fledgling farming industry in Alaska.

2) The Norwegian Experience

A survey conducted in 1983 indicated that salmon farms in Norway were earning up to 39% rate of return on sales, with the least profitable farms reporting just over 20% rate of return on sales.³ Since that time, it appears that profitability has increased, and rates of return in excess of 100% for particular farms is not unheard of.⁴ Table 2 indicates the cost and profitability statistics by size of farm.

The numbers would appear to indicate that there are no dramatic economies of scale in salmon farming. The optimal sized farms seem to be above 100 metric tons of production a

³ These figures are lower than those reported in "Aquaculture in Alaska" p. 64.

⁴ "Opportunities and Constraints ..." (Phase II) p 42.

year, but not more than 200 metric tons per year. (7-15 M³ enclosure). It should be noted that there were only 8 Norwegian farms in the latter category, of which 6 responded to the survey. Thus, further scale economies cannot be ruled out absolutely.

These results should calm the fears of those worried about gigantic corporations taking over the salmon farming industry. In looking at the man-year inputs, it would seem that even "shoestring" operations are making substantial profits. The most profitable farms (the medium sized farms) are quite often family-run operations.⁵

It is important to understand the demographics of the typical salmon farm in Norway in evaluating the Alaskan potential. According to Braaten (1985), the typical Norwegian fish farm has been a small private enterprise of low technological standard operated by family members without a great deal of education. The typical farm is outlined as:

- small in size (50 tons production level)
- low investment
- high operating costs
- simple technology
- small degree of automation
- labor intensive
- low attention to working conditions
- risk of self pollution
- risk of wreckage in open site conditions
- dependence on natural conditions.

This would reaffirm the capability for small operators to compete in this marketplace. More importantly, however,

⁵ Anderson, p 11.

it indicates that there is plenty of room for an Alaskan industry if it is developed in a more efficient manner. The technology available for salmon farming has changed dramatically through the 1980's, and this should give an advantage to start-up operations in Alaska. Farms taking advantage of automated feeding systems, pumps for cleaning nets, mechanical harvesting systems, etc. will maintain higher profit margins through greater efficiency.

It is now possible to get a technical degree in salmon farming in Norway.⁶ There is no reason why the community college system in Alaska cannot offer the same type of training to rural Alaska residents. Indeed, this is a good part of the mission of the community college system. Sound technical training will ensure the future profitability of this industry in Alaska. The educational training can take place while implemental issues are worked out in the state legislature.

⁶ Personal communication: Jesper Nielsen, Aalborg University Center

Survey Results for Norwegian Salmon Farms

Enclosure Size (M ³)	<3	3-5	5-7	7-15	15+
Kg./Year	28,305	53,930	102,816	139,351	229,779
Income:	651,025	1,424,348	2,330,631	4,157,675	7,071,259
(\$)	(100,778)	(220,487)	(360,779)	(643,602)	(1,094,622)
Costs:					
Var:	344,671	776,634	1,191,192	1,794,949	3,666,233
Fixed:	57,455	133,186	237,482	291,083	991,435
Int./					
Depr.,					
Other:	63,857	177,166	272,140	444,486	956,239
Total:	465,893	1,086,986	1,700,814	2,530,518	5,613,907
(\$)	(72,133)	(168,264)	(263,283)	(391,721)	(869,026)
Profit:	185,042	337,362	629,817	1,627,157	1,457,352
(\$)	(28,644)	(52,223)	(97,495)	(251,882)	(225,596)
Man- Years	1.17	2.10	3.20	5.20	11.20
ROR	28.4%	23.6%	27%	39%	20.6%

Table 2

Source: Reprinted (ROR calculated) from Anderson, p 13.
During survey period, average exchange \$1 = 6.46 NOK

3) Cost Estimates for Alaska

As indicated earlier, the VBB/Sweco and Nordic Alaska companies produced a feasibility study for Atlantic salmon farming in Alaska. The relevant results of that study are summarized in table 3. Table 4 offers a comparison across input costs with the Norwegian case.

As can be seen from the tables, Alaska appears to be at a disadvantage on the basis of feed and labor costs. However, the transportation cost differential to U.S. markets appears to be sufficient to overcome this problem. It should be noted, however, that Alaskan farms will be at a distinct disadvantage relative to farms in the Seattle/Vancouver area. As the capacity of this region is limited due to site constraints, however, this is not likely to be a major concern in the future.

A discussion of the feed cost figures for Alaska is probably in order. Many are aware that Alaskan hatcheries are currently using either OMP or ADP feeds, which cost over \$.50 and \$.70 a pound, respectively. These both translate into costs of well over \$1.00 per pound of fish produced, despite feed conversion ratios comparable to Atlantic salmon. Cost estimations for "Zero Chinook" at the Osprey Bay facility were projected to be \$1.67 per lb. of fish produced, in fact.⁷

⁷ Memo, July 19, 1985 from Bill Heard, Auke Bay Laboratory Salmon Program Manager, to Stan Moberly, Director Fred Division. Feed costs assumed \$1.61/kg. FOB Juneau, and 2:1 feed to flesh conversion ratio.

These are premium feed products, and adequate feed can be purchased at substantially lower costs. Alternative feed products from the Moore Clark company (Which supplies OMP to Alaskan hatcheries) can be purchased for \$.25 to \$.30 per lb., and Surimi plants are producing feed products at prices as low as \$.16/lb.⁸ Commercial feed products can be mixed with silage to reduce costs per pound further.

In addition, it is likely that a regional feed industry will develop in Alaska as in British Columbia. Alaska has an abundance of fish byproducts that can be used for fish feed. For example, currently 200 tons of Kodiak and Unalaska/Dutch Harbor fish meal is exported to Taiwan for mariculture endeavors.⁹ Alaska's Herring, (currently dumped into the ocean) Capelin, and Krill resources can be utilized as Capelin and Herring are in Norway today.

It appears that even a small salmon farming industry in Alaska will require feed output consistent with the development of a regional feed industry. An economically sound Norwegian dry fish food plant produces about 20,000 metric tons of feed per year, which requires about 5,000 to 10,000 metric tons of salmon production with the associated

8 Personal communication, Kelles Sewel, Sea Star co.

9 Paul Fuhs, President of Alaska Mariculture Assn. Statement before House mariculture committee, April 3, 1987.

hatchery facilities.¹⁰ At least one firm (Ewas) has considered building feed plants in Alaska.¹¹

4 Summary

With 4 - 6 lb. Atlantic salmon currently selling for \$3.75 - \$3.95 landed in the U.S., Alaskan Atlantic salmon farming certainly appears to be a lucrative investment. While there will be tremendous growth in production of farmed salmon, prices would have to fall by over 35% to make it unprofitable to produce and deliver Alaskan farmed products to U.S. markets, assuming that technological innovations do not reduce the cost per lb. over time. Note that prices have remained strong despite the record harvests of Pacific salmon and the already dramatic increases in supply.

While no direct cost data was cited with regard to the production of Pacific salmon, indirect evidence seems to suggest that the costs are comperable. As a final note, one could add that if the private sector were not so convinced of Alaska's salmon farming potential, then one would not see so much interest in the issue. Indeed, if one is to guage profit expectations by the number of permit applications in British Columbia, then salmon farming must be the next Klondike.

¹⁰ "Aquaculture in Alaska, p 79

¹¹ Personal communication, Kelles Sewel, Sea Star co.

Delivered cost to Houston/Los Angeles (\$/lb.)

Item	Urban		Rural/Remote	
	(\$)	(%)	(\$)	(%)
Feed	.80	29%	.85	29%
Labor	.69	25%	.69	24%
Smolt	.31	11%	.31	11%
Containers	.15	5%	.15	5%
Other	.15	5%	.15	5%
Debt Service	.10	4%	.10	4%
Transportation	<u>.58</u>	<u>21%</u>	<u>.64</u>	<u>22%</u>
Total	2.78	100%	2.89	100%

Table 3

Reprinted from "Opportunities and Constraints..."
(Executive Summary) p 52

Salmon Production costs in Norway, 1982

<u>Item:</u>	<u>Range</u>
Smolt	.27 - .31
Feed	.41 - .59
Salary	.13 - .33
Interest/Deprec.	.22 - .24
Other	.22 - .28
Transportation	<u>1.21</u>
Total	2.47 - 2.59

Table 4

Reprinted From "Opportunities and Constraints..."
(Executive Summary) p 53

Positive Economic Impacts From a Salmon Farming Industry

1) Introduction

This section will present estimates of final increases in sales, income, and employment under three alternative development scenarios. The first scenario is a rather modest development of 10,000 metric tons, the second is a level of 20,000 tons, while the third is an optimistic 30,000 metric ton per year scenario. In each case, the final effects of these sales at \$3.00/lb. is calculated.

The 20,000 metric ton scenario was considered in the House Research Agency report: "Aquaculture in Alaska". This was a level based on projections of market potential in the VBB/Sweco - Nordic Alaska report: "Opportunities and Constraints...". This was a conservative estimate, and the explosive growth in the market bears this out. Therefore, the 10,000 metric ton estimates may be viewed as a sort of worst case (or very near term) scenario, while the 30,000 metric ton estimates may be viewed as an optimistic look at or near the turn of the century.

As noted in previous sections, salmon farms come in all sizes. The economic impacts associated with various levels of development also vary with the size of farms that predominate the industry. Furthermore, the location of the typical farm (urban vs. rural) affects the type of infrastructure required to support the industry. Thus, within each level of development an assumption must be made

about sizes and locations of farms. This leaves a total of twelve cases to consider.

2) Methodology

Given a change in direct sales by some industry in an economy, input - output modelling may be used to determine the final impact of such an event on sales, employment, and income for all industries in that economy. Essentially, this technique involves keeping track of how a dollar of direct sales in one industry is respent in other industries.

A dollar of direct sales translates into a particular distribution of expenditures across input factors. In turn, a dollar of expenditures on any input requires expenditures on other inputs, and so forth. If one sums all these secondary effects, one has a final effect on economy wide sales that is an order of magnitude greater than the initial effect. This magnitude is called the type one multiplier.

Type one multipliers do not exhaust the final increase in economy wide demand. For an industry to increase its output requires that all input industries increase their production. This requires increases in the use of labor, and therefore increases in household income. The latter effect causes a second round increase in demand for goods and services. When this induced demand is included in the analysis, the resulting multiplier is called a type two multiplier. Type two effects are reported here.

The accuracy of such forecasts depend on many factors, but chief among them are the level of detail acheived by the

model, the absence of structural change during the period of forecast, the absence of capacity constraints, and the absence of inter-regional linkage effects.

The "Alaska Input-Output Model" was used for this analysis.¹² This model is the most detailed and up-to-date attempt at an input-output modelling of the Alaskan economy. The model was restructured to mimic the economy of southeast Alaska in order to more accurately capture the economic effects of a fisheries related industry.

Inter-regional linkage effects are much less of a problem in Alaska because of its isolation, and this is a plus. Structural change in the economy is likely to occur, however, unless the oil economy stabilizes. While in the short run there may be bottlenecks in the infrastructure required for a salmon farming industry, there are no fundamental capacity constraints. In summary, input-output modelling is not an unreasonable tool in this case.

It is fairly well known that employment and income multipliers are low for basic industries in Alaska - on the order of 1.5 for employment multipliers, for example. There are two reasons for this. Type one multipliers are low because many inputs are imported. Type two multipliers are hampered additionally because a good deal of the wage income is spent elsewhere due to the seasonality of employment. That is, the induced demand from increases in household income is typically very minor.

¹² For a more detailed discussion see ch IV.

One should anticipate better results for a fish farming industry on both counts. The inputs are simple, and a larger proportion of these can be purchased within the state relative to other basic industries (e.g. oil). Secondly, the employment is year round, and therefore a much higher fraction of the wage income will be spent within the state.

The expenditure data reported in the VBB/Sweco Nordic Alaska report "Opportunities and Constraints..." was used to proxy expenditures by fish farms in Alaska. Note most importantly that it was assumed feed was imported. A more detailed study would have analyzed the expenditures of a fish food industry and incorporated this into the model as well. As indicated earlier, it is most likely that a regional feed industry will develop in Alaska. This will result in significant understatement of employment, sales and income effects, all else the same.

3) A Summary of the Results

Tables 5 through 16 indicate the input - output results for the twelve cases considered. Direct sales levels included \$60, \$132, and \$190 million. The impact of a rural industry was compared with a more urban industry. Finally, the sizes of farms considered included 50 and 200 metric tons of annual output. (Recall that 200 metric tons is considered "medium sized")

The industries affected are listed vertically. The change in that particular industries sales, and the change in that industries employment are listed to the right. A

summary appears at the bottom of each table. In all cases, the results in terms of impacts are as expected (e.g. packaged fish, air transport).

Note that the total employment figures do not include the direct employment on the farm itself. The direct employment in the farming industry will be approximately 600, 1200, and 1800 for 10, 20, and 30 thousand metric ton production levels, respectively. Adding these figures to the employment numbers in each table will yield the final change in employment.

Note most importantly that the employment effects include all jobs created - part-time as well as full time. This is because the input-output model relies on "County Business Patterns" data, which shows employment totals in the same manner. We therefore do not present employment multipliers, as the interpretation is not so straightforward. All that is presented is the total number of jobs created. A breakdown by full and part-time positions would take much more time.

Table 17 summarizes these cases compactly, and includes both direct and indirect employment. It is most interesting to compare the results for the \$132 million direct sales case to those reported in VBB/Sweco - Nordic Alaska.¹³ That report utilized a fairly informal procedure, and resulted in total employment of 2,640. The results here suggest full time plus part time employment of around 4,200, payroll

¹³ See phase II, p 124.

of around \$87 million, and final sales of around \$339 million.

FINAL IMPACT OF SALMON FARMING:
\$60 MILLION DIRECT SALES, RURAL 200 METRIC TONS

INDUSTRY	CHANGE IN SALES	CHANGE IN EMPLOYMENT
3 AG, FOR & FISHERY SERVICES	7.158	145.2
6 MAINTAINENCE AND REPAIR CONSTRCTN	3.216	46.2
7 SALMON FARMING	60	0
9 FRESH OR FROZEN PACKAGED FISH	18.678	192.6
13 PRINTING AND PUBLISHING	3.072	38.4
17 WATER TRANSPORT	2.982	34.2
18 AIR TRANSPORT	14.034	208.8
20 ARRANGEMENT FOR PASSENGER TRANSPORT	0.48	19.2
21 COMMUNICATIONS	1.284	24
23 ELECTRIC UTILITIES	0.84	13.2
26 WHOLESALE TRADE	1.896	42.6
27 RETAIL TRADE	5.118	243
28 BANKING	3.126	89.4
31 INSURANCE CARRIERS	2.058	48.6
32 INSURANCE AGENTS	0.54	10.8
33 REAL ESTATE	6.072	29.4
34 HOTELS AND LODGING PLACES	0.342	15.6
51 LEGAL SERVICES	0.51	9.6
54 EATING AND DRINKING PLACES	2.7	123
56 AUTOT REPAIR AND SERVICES	0.846	8.4
64 MEDICAL SERVICES	1.122	24
TOTAL CHANGE IN SALES	156	
TOTAL INCOME CHANGE	38.46	
TOTAL EMPLOYMENT CHANGE	1366.2	

Table 5

FINAL IMPACT OF SALMON FARMING
\$60 MILLION DIRECT SALES, RURAL 50 METRIC TONS

INDUSTRY	CHANGE IN SALES	CHANGE IN EMPLOYMENT
3 AG, FOR & FISHERY SERVICES	7.158	145.2
6 MAINTENANCE AND REPAIR CONSTRUCTION	2.238	32.4
7 SALMON FARMING	60	0
9 FRESH OR FROZEN PACKAGED FISH	18.69	192.6
13 PRINTING AND PUBLISHING	2.958	36.6
17 WATER TRANSPORT	2.994	34.2
18 AIR TRANSPORT	14.1	209.4
21 COMMUNICATIONS	1.416	26.4
23 ELECTRIC UTILITIES	0.93	14.4
26 WHOLESALE TRADE	1.944	43.8
27 RETAIL TRADE	5.802	275.4
28 BANKING	2.952	84.6
29 OTHER CREDIT AGENCIES	0.324	21
31 INSURANCE CARRIERS	2.88	67.8
32 INSURANCE AGENTS	0.75	15.6
33 REAL ESTATE	6.894	33
34 HOTELS AND LODGING PLACES	0.39	18
51 LEGAL SERVICES	0.57	10.8
54 EATING AND DRINKING PLACES	3.006	136.8
56 AUTO REPAIR SERVICES	0.948	9
64 MEDICAL SERVICES	1.602	27.6
TOTAL CHANGE IN SALES	159	
TOTAL INCOME CHANGE	44.136	
TOTAL EMPLOYMENT CHANGE	1434.6	

Table 6

FINAL IMPACT OF SALMON FARMING
\$60 MILLION DIRECT SALES, URBAN 200 METRIC TONS

INDUSTRY	CHANGE IN SALES	CHANGE IN EMPLOYMENT
3 AG, FOR & FISHERY SERVICES	7.11	144
6 MAINTAINENCE AND REPAIR CONSTRCTN	3.15	45
7 SALMON FARMING	60	0
9 FRESH OR FROZEN PACKAGED FISH	17.496	180
13 PRINTING AND PUBLISHING	3.048	37.8
17 WATER TRANSPORT	2.748	31.8
18 AIR TRANSPORT	12.684	188.4
21 COMMUNICATIONS	1.23	22.8
23 ELECTRIC SERVICES	0.81	12.6
26 WHOLESALE TRADE	1.77	39.6
27 RETAIL TRADE	4.944	234.6
28 BANKING	3.078	88.2
31 INSURANCE CARRIERS	2.004	46.8
32 INSURANCE AGENTS	0.522	10.8
33 REAL ESTATE	5.856	28.2
34 HOTELS AND LODGING PLACES	0.33	15
51 LEGAL SERVICES	0.492	9.6
54 EATING AND DRINKING PLACES	2.586	118.2
56 AUTOT REPAIR AND SERVICES	0.816	7.8
64 MEDICAL SERVICES	1.086	23.4
TOTAL CHANGE IN SALES	151.2	
TOTAL INCOME CHANGE	37.134	
TOTAL EMPLOYMENT CHANGE	1284.6	

Table 7

FINAL IMPACT OF SALMON FARMING
\$60 MILLION DIRECT SALES, URBAN 50 METRIC TONS

INDUSTRY	CHANGE IN SALES	CHANGE IN EMPLOYMENT
3 AG, FOR & FISHERY SERVICES	7.104	144
6 MAINTAINENCE AND REPAIR CONSTRCTN	2.178	31.2
7 SALMON FARMING	60	0
9 FRESH OR FROZEN PACKAGED FISH	17.43	179.4
13 PRINTING AND PUBLISHING	2.928	36.6
17 WATER TRANSPORT	2.76	31.8
18 AIR TRANSPORT	12.744	189.6
21 COMMUNICATIONS	1.356	25.2
23 ELECTRIC UTILITIES	0.9	14.4
26 WHOLESALE TRADE	1.812	40.8
27 RETAIL TRADE	5.616	267
28 BANKING	2.904	83.4
29 OTHER CREDIT AGENCIES	0.312	20.4
31 INSURANCE CARRIERS	2.82	66
32 INSURANCE AGENTS	0.738	15
33 REAL ESTATE	6.666	31.8
34 HOTELS AND LODGING PLACES	0.378	17.4
51 LEGAL SERVICES	0.552	10.8
54 EATING AND DRINKING PLACES	2.886	131.4
56 AUOT REPAIR AND SERVICES	0.912	9
64 MEDICAL SERIVICES	1.254	27
TOTAL CHANGE IN SALES	154.02	
TOTAL INCOME CHANGE	42.738	
TOTAL EMPLOYMENT CHANGE	1372.2	

Table 8

FINAL IMPACT OF SALMON FARMING:
\$132 MILLION DIRECT SALES, RURAL 200 METRIC TONS

INDUSTRY	CHANGE IN SALES	CHANGE IN EMPLOYMENT
3 AG, FOR & FISHERY SERVICES	15.7476	319.44
6 MAINTAINENCE AND REPAIR CONSTRCTN	7.0752	101.64
7 SALMON FARMING	132	0
9 FRESH OR FROZEN PACKAGED FISH	41.0916	423.72
13 PRINTING AND PUBLISHING	6.7584	84.48
17 WATER TRANSPORT	6.5604	75.24
18 AIR TRANSPORT	30.8748	459.36
20 ARRANGEMENT FOR PASSENGER TRANSPORT	1.056	42.24
21 COMMUNICATIONS	2.8248	52.8
23 ELECTRIC UTILITIES	1.848	29.04
26 WHOLESALE TRADE	4.1712	93.72
27 RETAIL TRADE	11.2596	534.6
28 BANKING	6.8772	196.68
31 INSURANCE CARRIERS	4.5276	106.92
32 INSURANCE AGENTS	1.188	23.76
33 REAL ESTATE	13.3584	64.68
34 HOTELS AND LODGING PLACES	0.7524	34.32
51 LEGAL SERVICES	1.122	21.12
54 EATING AND DRINKING PLACES	5.94	270.6
56 AUTOT REPAIR AND SERVICES	1.8612	18.48
64 MEDICAL SERVICES	2.4684	52.8
TOTAL CHANGE IN SALES	343.2	
TOTAL INCOME CHANGE	84.612	
TOTAL EMPLOYMENT CHANGE	3005.64	

Table 9

FINAL IMPACT OF SALMON FARMING:
\$132 MILLION DIRECT SALES, RURAL 50 METRIC TONS

INDUSTRY	CHANGE IN SALES	CHANGE IN EMPLOYMENT
3 AG, FOR & FISHERY SERVICES	15.7476	319.44
6 MAINTENANCE AND REPAIR CONSTRUCTION	4.9236	71.28
7 SALMON FARMING	132	0
9 FRESH OR FROZEN PACKAGED FISH	41.118	423.72
13 PRINTING AND PUBLISHING	6.5076	80.52
17 WATER TRANSPORT	6.5868	75.24
18 AIR TRANSPORT	31.02	460.68
21 COMMUNICATIONS	3.1152	58.08
23 ELECTRIC UTILITIES	2.046	31.68
26 WHOLESALE TRADE	4.2768	96.36
27 RETAIL TRADE	12.7644	605.88
28 BANKING	6.4944	186.12
29 OTHER CREDIT AGENCIES	0.7128	46.2
31 INSURANCE CARRIERS	6.336	149.16
32 INSURANCE AGENTS	1.65	34.32
33 REAL ESTATE	15.1668	72.6
34 HOTELS AND LODGING PLACES	0.858	39.6
51 LEGAL SERVICES	1.254	23.76
54 EATING AND DRINKING PLACES	6.6132	300.96
56 AUTO REPAIR SERVICES	2.0856	19.8
64 MEDICAL SERVICES	3.5244	60.72
TOTAL CHANGE IN SALES	349.8	
TOTAL INCOME CHANGE	97.0992	
TOTAL EMPLOYMENT CHANGE	3156.12	

Table 10

FINAL IMPACT OF SALMON FARMING:
\$132 MILLION IN DIRECT SALES, URBAN 200 METRIC TONS

INDUSTRY	CHANGE IN SALES	CHANGE IN EMPLOYMENT
3 AG, FOR & FISHERY SERVICES	15.642	316.8
6 MAINTAINENCE AND REPAIR CONSTRCTN	6.93	99
7 SALMON FARMING	132	0
9 FRESH OR FROZEN PACKAGED FISH	38.4912	396
13 PRINTING AND PUBLISHING	6.7056	83.16
17 WATER TRANSPORT	6.0456	69.96
18 AIR TRANSPORT	27.9048	414.48
21 COMMUNICATIONS	2.706	50.16
23 ELECTRIC SERVICES	1.782	27.72
26 WHOLESALE TRADE	3.894	87.12
27 RETAIL TRADE	10.8768	516.12
28 BANKING	6.7716	194.04
31 INSURANCE CARRIERS	4.4088	102.96
32 INSURANCE AGENTS	1.1484	23.76
33 REAL ESTATE	12.8832	62.04
34 HOTELS AND LODGING PLACES	0.726	33
51 LEGAL SERVICES	1.0824	21.12
54 EATING AND DRINKING PLACES	5.6892	260.04
56 AUTOT REPAIR AND SERVICES	1.7952	17.16
64 MEDICAL SERVICES	2.3892	51.48
TOTAL CHANGE IN SALES	332.64	
TOTAL INCOME CHANGE	81.6948	
TOTAL EMPLOYMENT CHANGE	2826.12	

Table 11

FINAL IMPACT OF SALMON FARMING:
\$132 MILLION DIRECT SALES, URBAN 50 METRIC TONS

INDUSTRY	CHANGE IN SALES	CHANGE IN EMPLOYMENT
3 AG, FOR & FISHERY SERVICES	15.6288	316.8
6 MAINTAINENCE AND REPAIR CONSTRCTN	4.7916	68.64
7 SALMON FARMING	132	0
9 FRESH OR FROZEN PACKAGED FISH	38.346	394.68
13 PRINTING AND PUBLISHING	6.4416	80.52
17 WATER TRANSPORT	6.072	69.96
18 AIR TRANSPORT	28.0368	417.12
21 COMMUNICATIONS	2.9832	55.44
23 ELECTRIC UTILITIES	1.98	31.68
26 WHOLESALE TRADE	3.9864	89.76
27 RETAIL TRADE	12.3552	587.4
28 BANKING	6.3888	183.48
29 OTHER CREDIT AGENCIES	0.6864	44.88
31 INSURANCE CARRIERS	6.204	145.2
32 INSURANCE AGENTS	1.6236	33
33 REAL ESTATE	14.6652	69.96
34 HOTELS AND LODGING PLACES	0.8316	38.28
51 LEGAL SERVICES	1.2144	23.76
54 EATING AND DRINKING PLACES	6.3492	289.08
56 AUTOT REPAIR AND SERVICES	2.0064	19.8
64 MEDICAL SERIVICES	2.7588	59.4
TOTAL CHANGE IN SALES	338.844	
TOTAL INCOME CHANGE	94.0236	
TOTAL EMPLOYMENT CHANGE	3018.84	

Table 12

FINAL IMPACT OF SALMON FARMING:
\$190 MILLION DIRECT SALES, RURAL 200 METRIC TONS

INDUSTRY	CHANGE IN SALES	CHANGE IN EMPLOYMENT
3 AG, FOR & FISHERY SERVICES	22.667	459.8
6 MAINTAINENCE AND REPAIR CONSTRCTN	10.184	146.3
7 SALMON FARMING	190	0
9 FRESH OR FROZEN PACKAGED FISH	59.147	609.9
13 PRINTING AND PUBLISHING	9.728	121.6
17 WATER TRANSPORT	9.443	108.3
18 AIR TRANSPORT	44.441	661.2
20 ARRANGEMENT FOR PASSENGER TRANSPORT	1.52	60.8
21 COMMUNICATIONS	4.066	76
23 ELECTRIC UTILITIES	2.66	41.8
26 WHOLESALE TRADE	6.004	134.9
27 RETAIL TRADE	16.207	769.5
28 BANKING	9.899	283.1
31 INSURANCE CARRIERS	6.517	153.9
32 INSURANCE AGENTS	1.71	34.2
33 REAL ESTATE	19.228	93.1
34 HOTELS AND LODGING PLACES	1.083	49.4
51 LEGAL SERVICES	1.615	30.4
54 EATING AND DRINKING PLACES	8.55	389.5
56 AUTOT REPAIR AND SERVICES	2.679	26.6
64 MEDICAL SERVICES	3.553	76
TOTAL CHANGE IN SALES	494	
TOTAL INCOME CHANGE	121.79	
TOTAL EMPLOYMENT CHANGE	4326.3	

Table 13

FINAL IMPACT OF SALMON FARMING:
\$190 MILLION DIRECT SALES, RURAL 50 METRIC TONS

INDUSTRY	CHANGE IN SALES	CHANGE IN EMPLOYMENT
3 AG, FOR & FISHERY SERVICES	22.667	459.8
6 MAINTENANCE AND REPAIR CONSTRUCTION	7.087	102.6
7 SALMON FARMING	190	0
9 FRESH OR FROZEN PACKAGED FISH	59.185	609.9
13 PRINTING AND PUBLISHING	9.367	115.9
17 WATER TRANSPORT	9.481	108.3
18 AIR TRANSPORT	44.65	663.1
21 COMMUNICATIONS	4.484	83.6
23 ELECTRIC UTILITIES	2.945	45.6
26 WHOLESALE TRADE	6.156	138.7
27 RETAIL TRADE	18.373	872.1
28 BANKING	9.348	267.9
29 OTHER CREDIT AGENCIES	1.026	66.5
31 INSURANCE CARRIERS	9.12	214.7
32 INSURANCE AGENTS	2.375	49.4
33 REAL ESTATE	21.831	104.5
34 HOTELS AND LODGING PLACES	1.235	57
51 LEGAL SERVICES	1.805	34.2
54 EATING AND DRINKING PLACES	9.519	433.2
56 AUTO REPAIR SERVICES	3.002	28.5
64 MEDICAL SERVICES	5.073	87.4
TOTAL CHANGE IN SALES	503.5	
TOTAL INCOME CHANGE	139.764	
TOTAL EMPLOYMENT CHANGE	4542.9	

Table 14

FINAL IMPACT OF SALMON FARMING:
\$192 MILLION DIRECT SALES, URBAN 200 METRIC TONS

INDUSTRY	CHANGE IN SALES	CHANGE IN EMPLOYMENT
3 AG, FOR & FISHERY SERVICES	22.515	456
6 MAINTAINENCE AND REPAIR CONSTRCTN	9.975	142.5
7 SALMON FARMING	190	0
9 FRESH OR FROZEN PACKAGED FISH	55.404	570
13 PRINTING AND PUBLISHING	9.652	119.7
17 WATER TRANSPORT	8.702	100.7
18 AIR TRANSPORT	40.166	596.6
21 COMMUNICATIONS	3.895	72.2
23 ELECTRIC SERVICES	2.565	39.9
26 WHOLESALE TRADE	5.605	125.4
27 RETAIL TRADE	15.656	742.9
28 BANKING	9.747	279.3
31 INSURANCE CARRIERS	6.346	148.2
32 INSURANCE AGENTS	1.653	34.2
33 REAL ESTATE	18.544	89.3
34 HOTELS AND LODGING PLACES	1.045	47.5
51 LEGAL SERVICES	1.558	30.4
54 EATING AND DRINKING PLACES	8.189	374.3
56 AUOT REPAIR AND SERVICES	2.584	24.7
64 MEDICAL SERVICES	3.439	74.1
TOTAL CHANGE IN SALES	478.8	
TOTAL INCOME CHANGE	117.591	
TOTAL EMPLOYMENT CHANGE	4067.9	

Table 15

FINAL IMPACT FROM SALMON FARMING
\$190 MILLION DIRECT SALES, URBAN 50 METRIC TONS

INDUSTRY	CHANGE IN SALES	CHANGE IN EMPLOYMENT
3 AG, FOR & FISHERY SERVICES	22.496	456
6 MAINTAINENCE AND REPAIR CONSTRCTN	6.897	98.8
7 SALMON FARMING	190	0
9 FRESH OR FROZEN PACKAGED FISH	55.195	568.1
13 PRINTING AND PUBLISHING	9.272	115.9
17 WATER TRANSPORT	8.74	100.7
18 AIR TRANSPORT	40.356	600.4
21 COMMUNICATIONS	4.294	79.8
23 ELECTRIC UTILITIES	2.85	45.6
26 WHOLESALE TRADE	5.738	129.2
27 RETAIL TRADE	17.784	845.5
28 BANKING	9.196	264.1
29 OTHER CREDIT AGENCIES	0.988	64.6
31 INSURANCE CARRIERS	8.93	209
32 INSURANCE AGENTS	2.337	47.5
33 REAL ESTATE	21.109	100.7
34 HOTELS AND LODGING PLACES	1.197	55.1
51 LEGAL SERVICES	1.748	34.2
54 EATING AND DRINKING PLACES	9.139	416.1
56 AUOT REPAIR AND SERVICES	2.888	28.5
64 MEDICAL SERIVICES	3.971	85.5
TOTAL CHANGE IN SALES	487.73	
TOTAL INCOME CHANGE	135.337	
TOTAL EMPLOYMENT CHANGE	4345.3	

Table 16

Summary of Economic Impacts

\$60 Million Direct Sales

		Employment	Income	Sales
Rural	200 MT	1966.2	38.5	156.0
	50 MT	2034.6	44.4	159.0
Urban	200 MT	1884.6	37.1	151.2
	50 MT	1972.2	42.7	154.0

\$132 Million Direct Sales

		Employment	Income	Sales
Rural	200 MT	4205.6	84.6	343.2
	50 MT	4356.1	97.1	349.8
Urban	200 MT	4026.1	81.7	332.6
	50 MT	4218.8	94.0	338.8

\$190 Million Direct Sales

		Employment	Income	Sales
Rural	200 MT	6126.3	121.8	494.0
	50 MT	6342.9	139.8	503.5
Urban	200 MT	5867.9	117.6	478.8
	50 MT	6145.3	135.3	487.7

Table 17

Displacement of Traditional Fishery

1) Introduction

It is crucial to distinguish between the potential effects of Alaskan salmon farming on the Alaskan traditional fishery versus the potential effects of world salmon farming on the Alaskan traditional fishery. It is important for the state of Alaska to keep abreast of developments in worldwide fisheries in making rational public policy decisions. However, the state must understand the difference between the consequences of actions taken by the state legislature, and the consequences of changes in world markets beyond the control of the legislature.

Thus, a full discussion of the effects of salmon farming should include an analysis of both impacts - that due strictly to worldwide salmon farming, and that due strictly to Alaskan salmon farming. The former allows the state to understand what will take place in the absence of Alaskan salmon farming, while the latter indicates the incremental effects of Alaskan salmon farming on top of this.

Nobody has a crystal ball that will tell how consumer tastes will change over time, how technological innovations will occur, etc. However, we can use past experience to develop reasonable best case/worst case scenarios for the impact of salmon farming on the traditional fishery. This study will take a pessimistic approach in the first

instance, and develop best case/worst case scenarios within that context. A total of four cases will be investigated.

The reason for this pessimistic approach is that the traditional fishery is quite concerned about displacement. The fear is that farmed salmon will compete with both fresh and frozen premium salmon and reduce prices (and also reduce prices of nonpremium fish indirectly). Then let us investigate the consequences under the most disastrous conditions. What additional effects will Alaskan salmon farming have in this case?

Indeed, the attitude of the previous state administration appeared to be that mariculture is acceptable under the condition that it complement, rather than compete with the traditional fishery.¹⁴ Rather than getting into a discussion about whether farmed salmon will compete or not, it would seem to make better sense to assume that it will for the sake of getting an idea of the maximum conceivable impact.

In part, this methodology is also a default. Ideally, the cross-price elasticity between pacific and pen-raised salmon should be used to calculate price effects on pacific species due to increases in production of pen-raised species. No reasearcher has estimated this cross-price elasticity because there isn't enough data to do so. Pen-raised salmon hasn't constituted a significant component of the market long enough to get significant results. By the

¹⁴ See "Aquaculture in Alaska", p 4,5

time enough data exists for this kind of estimation, the results will be inconsequential for state management decisions on an Alaskan salmon farming industry.

There has been one study on the demand for Atlantic Salmon that comes close to answering this question from a methodological standpoint. An econometric investigation indicated that the price of Pacific salmon was not a statistically significant explanatory variable in the demand for Atlantic salmon.¹⁵ Furthermore, the price of Atlantic salmon was not a statistically significant explanatory variable in the demand for Atlantic salmon.¹⁶

The above would imply that the quantity of Atlantic salmon consumed and both the prices of Atlantic and Pacific salmon are independent. If this is true, the expected increases in farmed salmon production will have no effect on the price of Atlantic salmon. This would seem to suggest that there would be no effect on Pacific salmon prices either. However, this cannot be guaranteed.

The problem with the study (besides the paucity of data) is that demand for Atlantic salmon has been shifting over the sample period, and the model assumes that it is not. A prediction based on the results of this model is a prediction based on the assumption that the demand for

¹⁵ That is, the author calculated the percentage change in the quantity of farmed Atlantic salmon demanded due to a percentage change in the price of pacifics. We wish to have the opposite.

¹⁶ "An Economic Analysis of the Market for Atlantic Salmon Aquaculture" p 164-166.

salmon will continue shifting just as fast as supply increases. This is a rather optimistic view, and will not be taken here.

2) The Assumptions

In order to isolate the effects of farmed salmon production on the traditional fishery, it is assumed that the current level and mix of the wild harvest remains roughly the same over the next several years. That is, the investigation is of salmon farming's incremental effects "all else the same".

This assumes that if marginal fishermen are displaced through bankruptcy as the price of wild salmon falls, the harvest of fish by the remaining fishermen increases by the same amount. This requires that either exit of fishermen increases catch per unit effort for the remaining fishermen, or that management rules are modified sufficiently to guarantee constant catch for the aggregate fishery.

This is not an unreasonable assumption in that maximum sustainable yield is a biological, as opposed to an economic constraint. Management tools such as gear and season length restrictions are a direct attempt to reduce efficiency in order to increase employment in the industry.¹⁷ Management rules can be modified such that traditional fishing still remains profitable for the remaining fishermen despite lower

¹⁷ Karpov (1987) argues that traditional regulations are designed to redistribute the catch to inefficient producers in the first place.

prices , and maximum sustainable yields are maintained. It would be foolish not to do so.

Assume that the fairly dramatic production forecasts hold true - that world farmed salmon production reaches the 143,000 metric ton level by 1990. While this level of production may not be met¹⁸, it sets a pessimistic stage for investigating the impact on the traditional fishery.

Assume also that there is no fundamental change in consumer tastes over the next several years. That is, there is no "shift" in demand for salmon and salmon products through changes in preferences and increases in income. In this case, the only way the market can absorb the increase in salmon production is through reductions in price. While this assumption runs counter to recent experience, it sets an even more pessimistic background for investigating the effects of salmon farming on the traditional fishery.

Given no change in consumer tastes, the next question is: what salmon products will the farmed salmon compete with? A survey commissioned by Sea Grant indicated that wholesalers perceived fresh farmed Atlantic salmon competes primarily with fresh wild salmon, and not with frozen salmon.¹⁹ It would appear on this basis that there is very little to worry about since less than 5% of Alaskan salmon

¹⁸ In discussions with wholesalers, it appears that Norwegian production for 1987 is behind forecasts.

¹⁹ See p15, "The Marketing Relationship Between Pacific and Pen-Raised Salmon", for example.

is marketed fresh.²⁰ Furthermore, it appeared that farmed pan-sized Pacifics occupied a separate (lower priced) market niche.²¹

Another important feature of the pen raised Atlantic marketing structure is the marked seasonality through the year. The importation of pen-raised Atlantics typically drops off dramatically when Pacific salmon hit the market in June through September. This would indicate an intertemporal market segmentation of pen-raised Atlantics and traditionally harvested Pacifics.

However, let us assume for the worst case scenario that both fresh and frozen wild Pacific premium fish are in direct competition with both Atlantic and Pacific farmed salmon. This is not to say that fresh Atlantics and frozen Pacifics should sell for the same price - fresh Atlantics sell for a substantial premium. It is to say that as farmed production increases, and the price of farmed salmon falls, the prices of wild fresh and frozen premium salmon must fall by the same proportion in order to remain competitive.

In the above scenario, it is assumed that there is no incidental effect on non-premium salmon prices. For example, the availability of more fresh salmon does not affect the canned salmon market, and thereby indirectly affect the ex-vessel prices of pink or chum salmon. It will become clear in a moment why it is a less troublesome

²⁰ Ibid, p 6.

²¹ Ibid., p 5.

situation when farmed salmon competes directly in all wild salmon markets.

The alternative assumption will be that farmed salmon merely represents an increase in aggregate production of salmon worldwide. While this implies a reduction in the price of all salmon products, it implies lower revenue losses for fishermen and the state for the following reason. Farmed salmon represents a large fraction of premium salmon markets, but a small fraction of total world salmon production. Thus, the percentage price decline is smaller in the latter case. Furthermore, it is distributed across both high value and low value products, rather than being concentrated on high value products.

While the above assumption is part of the "best case" scenario, it is far from a "best of all possible worlds" scenario. In the first place, it has been assumed that demand is not shifting over time. In the second place, we are assuming that the forecasts on farmed production come true. Finally, we are assuming that wild and pen-raised salmon compete head to head. The evidence suggests this is a significant overstatement.

It is further assumed that there will be no substantial change in relevant international trade conditions. This includes both exchange rates and trade agreements. A fall in the dollar both increases the attractiveness of our exports and decreases the propensity for the U.S. to import. A rise in the dollar does the opposite. The former

insulates Alaskan producers from increases in world production of farmed salmon to some degree, while the latter adds insult to injury.

The final component necessary for the development of the four cases is an elasticity of demand assumption. Many econometric studies have been done on salmon demand, and the estimates vary widely. The estimates of price elasticity of demand for the fresh/frozen product range between -3.94 and -9.68.²² While it is disturbing that such a large range exists, it is still best to consider the extremes.

This is again a rather conservative approach for the following reason: If the figures cited earlier are correct, and Alaska has a delivered cost advantage relative to Norwegian firms, the observed elasticity of demand for the Alaskan farmed product will be extremely high. This is because the production of the Alaskan farmed product will result primarily in the displacement of the more expensive Norwegian product in the U.S. marketplace. Thus, the displacement of revenue in the traditional fishery will be moderated.

While one might be tempted to argue that the reverse is true in European markets, the magnitude of our European trade is not significant enough to change the net result. The vast majority of the value of Alaskan salmon is sold in the U.S., Japan, and Canada. The only significant European market for U.S. salmon is in canned Pinks. Norwegian

²² See Anderson (1984) p 132, and Poon (1987) Chapter two.

exports are marketed primarily in the U.S. The net result is that the elasticity estimates used here probably overstate the incremental effects of Alaskan salmon farming on the traditional fishery.

Figures one and two indicate why elasticity of demand is so important in calculating revenue losses. Figure one indicates a relatively inelastic (low elasticity) demand schedule. Let Alaskan output of salmon be denoted Q_A , and total world output Q_W . Market price is denoted P . When world output increases to Q_W' , price falls to P' . If Alaskan output is constant, the revenue loss to the traditional fishery is the shaded area.

Figure two shows the same situation when demand is more elastic (higher elasticity). In this case, the market absorbs the increased world production with only a slight decline in price. The revenue loss to the traditional fishery is much less pronounced.

3) Revenue Impacts Under the Four Scenarios

In all four cases, an increase in annual world farmed production of 100,000 metric tons was used. This represents an increase of about 54% over the five year (1981-1985) average of world farmed plus Chinook, Coho, and Red salmon landings.²³ In terms of total average salmon production,

²³ Computed from North Pacific Commission Statistical Yearbook, various issues; World Markets for Farmed Salmon, p 2; Fisheries of the United States 1985 U.S. Department of Commerce, National Marine Fisheries Service, Current Fisheries Statistics No. 8380, April 1986, pl,2.

this represents an increase of about 14%. Incremental Alaskan production was assumed to be 20,000 metric tons annually.

The total value of the King, Coho, and Red salmon landings in Alaska in 1985 was approximately \$270 million, while the value of total salmon production was approximately \$370 million. These revenue figures were used as the base for calculating revenue losses. Table 18 summarizes the potential impacts on the traditional fishery.

The table indicates a worst case scenario of \$36 million in losses to the traditional fishery from the projected increases in world farmed salmon. An incremental Alaskan production of 20,000 metric tons causes an additional \$4 million in losses. This compares with a "best case" scenario of \$5 million in losses from world salmon farming, but in the absence of Alaskan salmon farming. The presence of Alaskan salmon farming causes an additional \$.6 million loss.

To put this into perspective, recall that the positive impact of a 20,000 metric ton salmon farming industry was in excess of \$100 million dollars in terms of direct sales. It would be difficult to argue that salmon farming is unjustified in Alaska on purely economic grounds. It would have to be on the grounds of social concerns such as environmental hazards.

It should be noted that a third set of cases was investigated where farmed salmon species competed strictly

with wild King and Coho salmon. The results were intermediate relative to the above in terms of revenue losses. However, the results implied price reductions logically impossible - below the costs of production, and far below the prices of competing salmon products. In other words, either these projected levels of production are economically unsustainable, or the impact is less focused (that is, the prices of other salmon species fall as well). The latter is most probably the case.

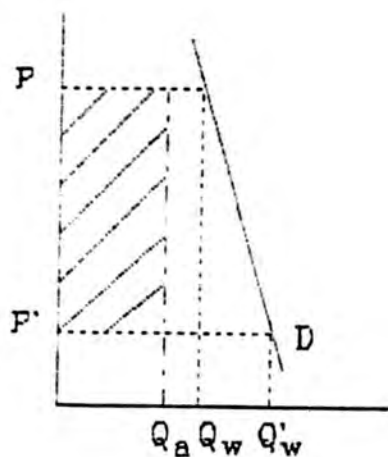


figure 1

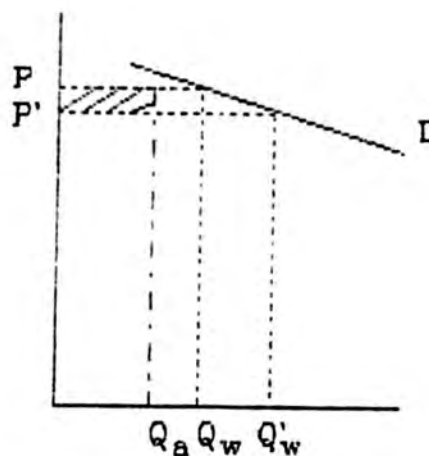


figure 2

The Impact of World and Alaskan Salmon Farming

Competes With	Elasticity	World Impact	Alaska Impact
King, Coho, Red	-3.94	-\$36,398	-\$4,720
	-9.68	-\$14,960	-\$1,974
All Species	-3.94	-\$13,115	-\$1,671
	-9.68	-\$ 5,138	-\$ 678

Table 18

4) Discussion

The results indicate that indeed, Alaskan fishermen should show concern over the production of pen-raised salmon throughout the world. They should show much less concern over the production of pen-raised salmon in Alaska. The incremental effects of Alaskan salmon farming are small, and this is for a very simple reason. The incremental production is small relative to the vast increases in farmed salmon production elsewhere in the world. Although 20,000 metric tons appears large relative to current King and Silver landings, the effect on price is determined by the size of the market when the extra production is sold, and not the size of the market today.

This is precisely why it is important for the state to distinguish between the effects of world salmon farming on the Alaskan traditional fishery and the incremental effects of an Alaskan salmon farming industry on the traditional fishery. If the state had a monopoly on the production of salmon, then the effects of changes in its own production would be much more pronounced. But it does not have a monopoly, and in fact world markets are becoming more competitive. The more competitive markets become, the less the impact each individual producer's production has on market price.

It is most likely that these estimates significantly overestimate the effects of farmed salmon production on the

traditional fishery. As discussed earlier, demand for salmon does indeed appear to be increasing. The farmed and traditionally harvested products do not occupy the same market niche. It is safe to say, therefore, that farmed salmon from Alaska will serve mostly to complement, rather than displace the traditional fishery.

5) Impact on Particular Fisheries

The previous sections investigated total revenue losses across the aggregate fishery, without discussion of the relative burdens across gear classes. To be more specific on this issue requires first a look at the market served by each gear class. This will indicate which gear classes are subject to the most competition from the farmed product. Secondly, a look at the profitability across gear classes will determine the extent to which this competition can be withstood.

On both counts, the troll fishery (hand and power) bears the brunt of the economic impacts described in the previous sections. The troll fishery produces almost exclusively a fresh and premium frozen product that would appear to compete with the pen raised Atlantics. In addition, it appears that the hand and power troll fisheries are not profitable enough to withstand significant reductions in price.

The following section will summarize a study of the economic profile of the southeast fisheries in 1982.

Although there are differences in profitability across regions of the state, as well as differences in profitability across time, the study is informative in its description of relative profitabilities. While there have been some changes such as an increase in use of at sea preservation, dramatic changes have been absent (in price or technology) since that time. It is expected that the profitability picture hasn't changed substantially.

6) Profitability in the Southeast Fisheries

An economic profile study of the Southeast Alaska salmon fishery was completed by Doug Larson in 1984. The hand troll fishery as a fleet had an average negative cash flow (-\$600) before debt service and living expenses, while the power troll fishery had positive cash flow (\$6,700). However, when a 10% opportunity cost of capital was incorporated, the power troll fishery earned a negative return as well.

The drift gillnet fishery earned an average positive cash flow of \$5,600, while the purse sein fishery earned an average \$24,400 cash flow. The drift gillnet fishery earned negative returns at 5% opportunity cost of capital, while the purse sein fishery return became negative at a 10% opportunity cost of capital.

As a rule, then, it appeared that if all of these fishermen had placed their capital into financial assets rather than fishing gear, their cash flow would have been higher. It is well known that the non-pecuniary benefits

associated with the fishery is sufficient to convince individuals to participate, despite the low or negative economic returns.²⁴ Individuals can use other income to offset the lack of sufficient earnings in the fishery. (Either by participating in other fisheries, or by earning non-fishing income.) The seasonality of these fisheries makes this both possible and practical.

It is no surprise that the hand troll fishery showed the largest dependence on non-fishing income. The negative cash flows necessitate this. The average operator earned about \$10,900 in nonfishing income, compared with only \$2,200 participating in other fisheries (either operating or crewing).

Bear in mind that at the same time handtrollers were earning negative cash flows, salmon farm operators were earning magnificent rates of return on sales. It is not hard to see that in an environment of declining prices, economic hardship will fall upon the traditional fishery much sooner than on the farming industry.

This suggests a rather straightforward natural evolutionary process in the Alaskan salmon fishery. The development of world salmon farming will probably displace labor in the traditional fishery, beginning with the troll fishery. Labor with expertise in the fishery will thus be available for the development of a salmon farming industry

²⁴ See Jon Karpov "Non-Pecuniary Benefits in Commercial Fishing" for example.

in Alaska. Most interestingly, a manager with a small crew is precisely the labor force required to operate a salmon farm. The incremental farmed production from these individuals will have only a marginal effect on the remainder of the traditional fishery.

The alternative is, of course, a permanently lower level of employment and income in the traditional fishery and in the state as a whole. Rural communities with an already depressed economy will sink lower, and depend further on the state government for support. That is, rather than increases in economic activity and a generation of tax dollars, there will be decreases in economic activity and increases in state support programs.

Conclusion

The already dramatic increases in the production of farmed Atlantic salmon force Alaska into a decision. Should salmon farming be legalized here? This project has attempted to answer the question through a socio-economic impact analysis. This is certainly not the only important point of view. Equally important are the biological issues that have been raised, and these should be considered as well.

It appears that salmon farming will be profitable in Alaska. A transportation cost advantage to Japanese, Canadian, and U.S. markets offsets higher feed and labor costs on the farm itself. Alaska has innumerable site possibilities. The infrastructure and labor force are already compatible with such an industry.

The industry does not appear to have dramatic scale economies. Rather, farms with one manager and a small crew seem to be the most profitable. The Norwegians have built a substantial fishery based on these small rural operations. There is no reason why Alaska should expect much difference. While much of the capital may initially come from outside, the same is true for virtually every significant industry this state has developed.

If this state does allow salmon farming, it appears that even a very modest development will result in thousands of jobs (part time plus full time), and over one hundred

million in sales dollars when both direct and indirect effects are considered. The 20,000 metric ton scenario resulted in well over \$300 million in final sales, around \$90 million in final payroll, and over 4,000 in final employment.

The numbers are promising largely because second round effects are substantial. This is an industry that provides stable employment and pays year round wages - much of which will be respent within the state rather than outside.

There has been argument about the degree to which wild Alaskan salmon (both fresh and frozen) compete with the farmed Atlantic and Pacific salmon product. This is indeed the key in calculating the spillover affects of salmon farming on the traditional fishery. This study took a rather pessimistic approach, and assumed direct competition between farmed and wild products. In this way, the maximum feasible impacts may be calculated.

It was shown that the traditional fishery has reason to be concerned with the increases in worldwide production. The worst case scenario indicated a \$36.4 million loss to the fishery through reduced revenues. However, incremental Alaskan production only added another \$4.7 million loss on top of this. The gain from the development of the industry here was \$132 million in direct sales, and the final effects listed above.

Note that these figures are the result of some very pessimistic assumptions - that demand for salmon fails to

increase over time (in conflict with recent experience); that farmed and wild salmon compete directly (also in conflict with recent experience); that the enormous projected increases in world production in fact occur. For these and other reasons discussed in the text, these numbers are substantial overestimates of the effects world and Alaskan salmon farming will have on the traditional fishery.

This is not to say that salmon farming will not affect the traditional fishery. World salmon farming probably does mean millions of dollars in reduced revenue to the traditional fishery over the long run. In particular, technological and genetic improvements will make salmon farming an ever more efficient enterprise. The crucial point Alaska policymakers must not miss is that as salmon markets become larger and more competitive, the effect of one's own production on market price becomes ever smaller.

Therefore, the issue of salmon farming in Alaska involves a choice between two futures: One is a future without salmon farming, but with a permanently lower level of employment and income in the fishery and the state as a whole. The other is a future with salmon farming, and with a higher level of employment and income in the fisheries sector as well as the state as a whole.

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University of Alaska

Statewide System of Higher Education

OFFICE FOR FISHERIES

ALASKA SEA GRANT COLLEGE PROGRAM

May 6, 1987

Senator Fred Zharoff

~~Senator Richard Eliason~~

Representative Adelheid Herrmann

Alaska State Legislature

P.O. Box V (MS 3100)

Juneau, AK 99811

RE: Aquaculture

Dear Legislators:

In the discussions on aquaculture at the Bristol Bay Fisheries Conference following your hearing on aquaculture in Dillingham, I pointed out that aquaculture sometimes aided traditional fisheries markets rather than competed with them. This seemed to surprise a number of people present. Recently I received from my colleagues in Maine discussion and documentation of this occurrence in their mussel fishery. I pass the report on to you as a matter of information.

Although I was aware that mussel aquaculture had actually stimulated the wild fishery rather than depress it, I did not know why. I believe that Dr. Wilson's conclusion that a leaseholder with product in the water has a great incentive to go out and develop markets is correct. In the fresh product market in the wild fishery the annual variability in catch makes it difficult to establish and maintain new markets. Although the markets for mussels and salmon are different from each other, I would not be surprised to see aquaculturists open new markets for Alaska fish of all kinds.

I hope the enclosed report is a help to you in your continued deliberation.

Cordially,

R. K. Dearborn
Director

RKD:lbd
Enclosure

Executive Summary

The Economics of the Maine Mussel Industry¹

In the early seventies the Maine mussel industry made a negligible contribution to the State's economy. Today it provides, directly and indirectly, approximately \$10 million income to about 600 Maine residents. The major cause of this economic growth appears to be the strong incentives for market development generated by leaseholds.

A lease has no value unless there is a market for its product. A leaseholder, consequently, has a strong incentive to develop new markets and, just as importantly, has the capability of planning production in order to meet contracts for delivery of product. These kinds of incentives do not exist in the wild fishery. A fisherman utilizing wild stocks can never be sure that he will be able to control the flow of product and, therefore, is rarely in the position where he might gain from his own development of new markets.

In the last ten years, the market development efforts of leaseholding companies appear to have been very successful. This market development has had very positive impacts on the wild fishery. In 1985 nearly 85% of the supply of mussels was from wild stocks.

The State can expect a continuation of both the wild and leasehold parts of the industry but we are not likely to see much, if any, further growth in volume from the wild fishery simply because the availability of high quality wild mussels has become very limited. Further growth is dependent upon a rapid shift to a much higher proportion of cultivated mussels.

If the industry can continue to meet the demands of the market, current growth rates would lead, directly and indirectly, to over \$20 million of annual income and 1200-1400 full time jobs by 1996. More than anything else, this growth is dependent upon the maintenance of the strong and secure incentives of the leasehold system.

¹ Professor James Wilson, Department of Economics and Douglas Fleming, graduate student, University of Maine, March, 1987.

The Economics of the Maine Mussel Industry

Dr. James Wilson and Douglas Fleming

Department of Economics

University of Maine

The biological potential for aquaculture on the coast of Maine appears to be extremely high. There are no adequate estimates of potential yields but by all accounts the biological and geographical characteristics of the coast are nearly ideal and extensive. Transforming this potential into an industry that generates income and employment for Maine citizens depends upon the ability to develop markets and resolve the problems of conflicting resource rights.

By and large, public debate about the development of aquaculture has centered on the resolution of the conflicting resource rights issue. There has been a strong tendency to view the problem in terms of absolute loss or gain to fishermen or aquaculturists. From the perspective of our experience to date, this characterization of the situation is very misleading. The major point of this paper is that, contrary to the usual assumptions, the aquaculture industry is likely to prove very beneficial to prices, income and employment in the State's wild fisheries.

The reason for expecting this outcome regarding further development of the cultured fisheries is drawn primarily from experience with the market and employment problems in the State's wild fisheries. The seasonal and highly variable supplies of wild fish (brought about by their migratory, spawning and other characteristics) severely constrain the ability to effectively market seafood products and at the same time create strong seasonal employment patterns. Cultured fisheries, on the other hand, offer considerable control over the volume, quality and timing of harvested product. This control makes market development much more feasible and can be translated into relatively stable seasonal employment patterns. At first glance, this capability would appear to give cultured fisheries a strong competitive advantage that would be detrimental to the interests of the wild fishery. It is much more likely however, that the cultured fisheries will create market opportunities that will very quickly benefit the State's wild fisheries and will provide employment opportunities for more stable seasonal employment or seasonal fill-in opportunities for the slack

seasons in wild fisheries.

The recent development of the mussel industry in Maine provides an instructive example of the complementary nature of wild and cultured fisheries. The the next few section of this paper explore the development of the mussel industry and report on preliminary measures of its direct and spin-off benefits to the Maine economy. The final section of the paper returns to and expands upon the basic idea that the wild and cultured fisheries complement one another.

A brief history of the Maine mussel fishery

In the late seventies and early eighties the Maine mussel industry made the transition from what might be called an incidental fishery supplying occasional ethnic markets to a high value industry supplying a broadly based and growing market. This transition involved both public and private efforts. Many of the early attempts at culturing and/or marketing appear to have been false starts or were attempts to implement technology that has not yet proven to be economical except in certain limited markets.

In the early 70's DMR embarked on mussel promotion campaign. Funded by Sea Grant, Reggie Bouchard of the Marketing Division of the Department conducted extensive in-store supermarket demonstrations of mussels and mussel preparation techniques. Anecdotal evidence suggests these demonstrations were very effective in raising consumer interest but were not closely tied-in with the ability to supply the newly stimulated demand. It is a matter of speculation whether these marketing efforts created a sustained demand that the industry was later able to build upon.

At about the same time the University, again funded through Sea Grant, began work on the development of rope culturing techniques and conducted basic scientific work that led to a more thorough understanding of the life history and basic biology of the mussel. The rope culturing technique produced a very high quality product on a very reliable basis, but, because of its labor intensive characteristics, proved to be uneconomical except for the most discriminating markets. Although rope culturing is not now the preferred method of cultivation,

it can be expected that this technique or similar methods will be used in the future as the market for mussels, especially the so-called 'white table cloth trade', develops further.

Bottom culture is an economical alternative to rope culturing and is now the dominant culturing method employed. The technique has apparently been used by several Maine fishermen since the mid-sixties or before. It is fairly common in Europe also. The 1972 passage of legislation allowing aquaculture leases gave a strong impetus to the establishment of mussel bottom culture leases.

The biology and technology of bottom culturing is very straightforward. In the wild, mussels tend to grow in dense clumps. The tight packing of the animals slows their growth and leads to a product of poor quality. If mussels by chance, or by deliberate act, are spaced out in less dense clumps their growth rate and product quality improve markedly. Bottom culturing is nothing more than the transplantation of wild spawned mussels, so-called seed, from the dense clumps they tend to form naturally to less dense aggregations on other parts of the ocean bottom. Because transplantation is costly fishermen do not normally have an incentive to undertake it unless they can be assured of exclusive rights to the results of their cultivation.¹ Once that right is established, however, the incentives for further cultivation are limited only by the extent of the market for the product. The other side of that same coin is that once lease rights are granted strong incentives for the development of markets are created. The stronger the market the more valuable the lease.

In the early eighties one company, Great Eastern Mussel, embarked on an extensive marketing campaign which laid a strong emphasis on the more consistent and higher quality product produced through bottom culture. According to the landings figures and anecdotal evidence from the industry the campaign was very successful.

The strong emphasis placed on product quality was intended to create a demand for the cultured product. Apparently, it also had the unintended effect

¹ Apparently several Maine fishermen did engage in transplantation as early as the sixties without having the protection of lease rights. Given the very limited markets for mussels at that time cultivation of this sort would not be overly risky because the lack of demand provided a form of protection for the cultivation effort.

of promoting mussels, in general, as a quality seafood product. The result was a strong surge in demand that the wild industry, through careful selection of product, was able to ride. In order to meet the demand GEM itself had to rely upon carefully selected wild product that it could market as cultivated quality.

The strong demand for quality product that began in the early eighties appears to be continuing and expectations in the industry are that expansion of the market will extend well into the nineties. If there is a problem in the industry right now, it is that demand for quality product has outstripped the ability to supply. The supply of cultivated quality product from wild stocks has apparently been diminished considerably and the production from leasehold is not yet sufficient to meet demand. Mussel harvesters have been forced to enter into extensive searches for a product that used to be available extensively in adequate quality. One harvester mentioned that he spent nearly a month searching for and surveying wild mussel beds.

The current scarcity of high quality wild product is not a biological problem in the sense that the reproductive capacity of the resource is threatened in any way. The problem is purely economic. The quality of wild mussels is not uniform. In fact, the locations where wild mussels grow under conditions that lead to a high quality product are relatively limited. These locations have been heavily harvested and it is only the mussels from these locations that are scarce.

This situation has arisen almost entirely as a result of the increased demand for and greater value of mussels. From the economic point of view, its resolution would appear to be found only in the artificial creation of sites capable of producing mussels of adequate quality for the market; i.e., greater efforts at cultivation. The alternative would appear to be a marginal industry incapable of meeting a strong demand for product and equally incapable of generating new income and employment along the Maine coast. Additionally, it is reasonable to expect that the strong demand that currently is felt for the product will lead to pressures to market marginal product so long as that is the only product available. Marketing product of that sort will effectively kill market demand within a short time.

Estimating the economic value of the fishery to the State

Estimation of the economic value of the mussel industry involves the measurement of:

(1) **direct effects** - the income and employment generated directly within the mussel industry,

(2) **indirect effects** - the income and employment generated indirectly in other industries that supply inputs or provide services to the mussel industry, and

(3) **induced effects** - the income and employment generated in other industries as a result of income earned and spent by people in the mussel industry.

Taken together indirect and induced effects are often referred to as spin-off effects. Measurements of spin-offs are based upon what might be called a typical or average firm for the industry². The costs, employment, income and other measures of a typical firm's activity are derived from data on the industry as a whole. Because this industry, especially, is evolving very rapidly and because the production methods and organizational form of the firms in the industry varies widely, estimates of the sort made here are best interpreted as broad indicators rather than precise measurements.

Direct economic effects

In 1985 the mussel industry landed approximately 609,000 bushels of mussels. It is estimated that 85 percent of this total was harvested from wild stocks, 15 percent from cultivated leaseholds³. The percent of mussels harvested from cultivated leaseholds has been rising from a negligible amount in the early eighties. Industry sources expect the percent coming from

² A preferable approach would be to obtain a complete accounting break-out for all the firms in the industry. This is not possible because of the costs and time involved and because it would require information that almost all firms would consider strictly confidential. Consequently, data for the industry as a whole is pieced together to create a statistical picture of the typical firm.

³ Source: Written communication from Robert Lewis, Maine Department of Marine Resources.

leaseholds to continue increasing over the next few years. What appears to have happened since about 1980-81 is that the marketing and promotion efforts of some of the larger leasehold companies have far out-stripped the ability to deliver truly cultivated product. Consequently, high quality wild product has been used to fill demand. In addition, the market development efforts of these companies appear to have created a demand for product that has been filled in part by companies that have not engaged in market development. The net result has been a very strong demand for product from the wild industry. This demand continues to be very strong even though a higher percent of all mussels is coming from cultivated areas.

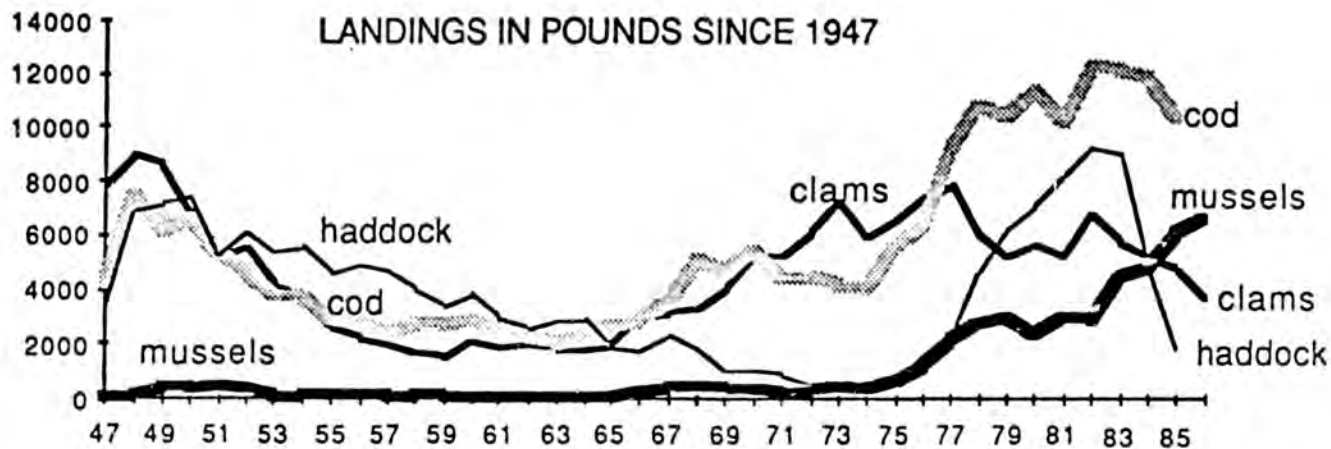
The landed price for mussels varies from a low of \$3.50 to a high of about \$6.50. Price differentials appear to be due primarily to product quality and/or special markets developed by the seller. The amount of cleaning, culling and other preparation done before the first sale make it difficult to arrive at a meaningful average price. DMR statistics for the industry put the average landed price at about \$4.20 per harvested bushel⁴. At a price of \$4.20/bu. the gross value of mussels at the dock was about \$2,079,000 in 1985. Trucked to the primary processor or distributor prices average about \$5.50 per bushel.

After processing, prices to wholesalers and/or retailers (i.e., prices received when the product leaves the industry) range from \$7.50 to highs of about \$30 per bushel. The considerable variation in these prices is due to equally large differences in product quality, preparation, marketing and contract effort, type of final market and a variety of other factors. Although an average final price for processed product when it leaves the industry may be something of a fiction, for purposes of estimation we will use \$17.00/bu. About 50% of all product sold falls in the category that we call processed. The remaining 50% is product that is sold after a simple cleaning, culling and bagging. Average price for this product is estimated at \$7.50 per bushel. At these prices final gross revenues (i.e., sales of processed product and direct sales) in 1985 were about \$8,245,125.

⁴ Source: Written communication from Robert Lewis, Maine Department of Marine Resources. DMR data is in terms of meat weights. The total value of landings in 1985 is taken from DMR statistics. Industry sources indicate that the landings and value figures from DMR may miss a large part of the landings, especially those landings coming from small independent harvesters and seafood dealers who handle mussels only occasionally.

When compared with the other major fisheries of the State, especially when similar estimates are made for past years, the growth and importance of this relatively new industry is very apparent. When a physical yield, pounds of meat, is used to gauge the size of the industry the rapid recent growth of the industry is readily apparent. For example, see figure 1 which compares mussel, clam, cod and haddock landings from 1947 to the present.

FIGURE 1*



*Weights are in thousands of pounds. Data since 1981 from Robert Lewis, DMR; from 1947 to 1981 data is DMR data compiled in Maine's Marine Fisheries, R. Townsend and H. Briggs, Univ. of Maine, Sea Grant Program, Orono, 1982.

Although landings weights and values give a good indication of the growth of the industry, neither gross revenues or physical yields are a good measure of the economic value of an industry. What is important economically is the income and employment generated by that activity directly within the industry itself and indirectly through the spin-off effects created in other industries. Measuring the direct employment and income effects within an industry is a rather straight forward problem of surveying.⁵

⁵ As mentioned above and in previous footnotes, problems of confidentiality, product quality differences, differences in the extent and type of processing at time of sale, differences in methods of production among the firms in the industry and a variety of other problems make a survey of the direct effects a little more difficult and not nearly so precise as merely counting heads, for instance.

Direct economic impacts - harvesting

The 609,000 bushels of mussels landed in 1985 are estimated to have resulted from the (direct and indirect) employment of about 80-85 man years⁶ of labor in harvesting of both wild and cultivated mussels and in the seeding of cultivated lease areas. Income⁷ to the harvesting sector only (including income earned while seeding cultivated leaseholds) is estimated at \$1,392,000. For a crew member working on a mussel boat employment tends to be fairly steady through the year although it does not have the regularity of office or factory work. Compared with other fisheries, musseling tends to have a much less marked seasonal employment pattern.⁸ This appears to be due in part to the ability (or need) to fill in the slack in harvesting times with seeding and other related work. While employed, crew members tend to do fairly well. Estimates for an equivalent hourly wage rate run from \$12 to \$15 per hour. Annual income might range from \$10,000 to \$18,000. It should be emphasized that there appears to be a wide range in these figures; most of that range is attributable to the unique characteristics of individual musseling firms and their harvest techniques and seasonal patterns. Another important aspect of the industry, one that is attributable to its protected location and, more importantly, to the existence of leaseholds, is the relatively low variability of output from season to season.

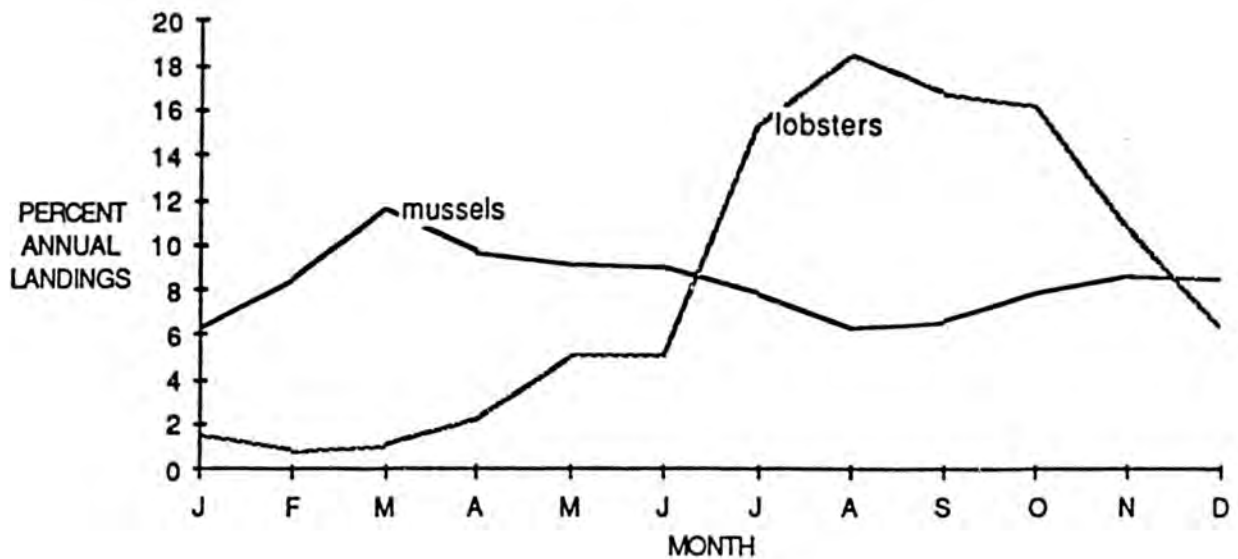
⁶ A man year of labor is simply the equivalent of one man working full time for a year. Twenty men working for six months equals ten man years.

⁷ Payment schemes in the mussel harvesting sector generally follow the share system employed in most fisheries. As is also usual, the shares to the crew, the captain and the boat vary according to the contract in effect on the boat. In some cases, payment to a boat's crew is based upon a flat rate (i.e., so much per crew per bushel harvested). Additionally, when boats are engaged in the practice of seeding a cultivated area payment is usually on a wage basis, although this may vary also.

⁸ The inshore nature of the fishery and the location of wild and cultivated mussel beds also means that boats are capable of working in weather which might shut down fisheries operating in more exposed locations.

FIGURE 2

MONTHLY LANDINGS PATTERN
MUSSELS AND LOBSTERS



The lobster fishery, for example, is probably one of the most stable wild fisheries in the world when it is considered from year to year. Yet seasonally, the lobster fishery shows a very marked variation. The mussel industry, although variable, tends to be relatively stable both seasonally and from year to year. One of the interesting things about the seasonality that does exist in the mussel fishery is its Spring peak. This is a time when other inshore fisheries, especially lobster, tend to be at a low ebb. Although an accurate count could not be obtained, anecdotal evidence from people in the industry tends to confirm the idea that many lobstermen are employed in one form or another in the Spring in musseling.

Direct economic effect – processing and distribution

The difference in the value of mussels at the time they are landed and at the time they are sold out of the industry is about \$6,166,125. About 74% of that difference is attributable to transportation,⁹ production, administrative,

⁹ The costs of transporting product (and the value added in the transport) from the site of landing to the processor or distributor is included in the processing sector.

equipment and building and financing costs. It is estimated that some 375 people are employed at one time or another during the year in the transportation, distribution, sales promotion, shucking, packaging and other preparation of mussels¹⁰. There appears to be the equivalent of about 110-115 man-years of labor and about \$1,896,000 of income generated in this part of the industry.

One point made forcefully by almost all the processors interviewed was the increasing amount of preparation going into the product before it leaves the industry. Until recently almost all product left the State after a simple cleaning, culling and bagging; today a large part of the product is subject to stringent culling, packaging and other measures designed to improve its consistency and saleability. This trend will lead to higher valued product and more value added (i.e., income) being retained within the State in the future.

Spin-off effects

Spin-off effects are the benefits that accrue to other industries because of activity in the mussel industry. They arise from the mussel industry's expenditures for materials and services used in its own production and from the expenditure of income earned. Measuring spin-off effects presents difficult problems of estimating the extent to which one industry, mussels in this case, interacts with the rest of the economy. The usual method of estimation, and the one used here, is called input/output economics. Input/output economics relies upon a large scale accounting scheme that records the sales and purchases of each industry from and to all other industries and sales to final demand.

The basic idea of an input/output table is this: when an industry purchases inputs from another industry it increases the demand for the second industry's product. In order to produce this new product the second industry must hire new workers, purchase new capital and obtain new material inputs from still other industries in the economy. This raises the demand for the output from

¹⁰ Part of the difficulty of making an employment estimate at this stage is the problem of allocating, for example, a trucker's time to mussels when his truck may be carrying mussels, lobsters and a variety of other items.

these other industries and leads to still more employment, income and purchase of other goods. The effect of these 'successive' rounds of spending is felt most strongly in industries closely related to the first. for example, the industries supplying boats and special mussel fishing gear would be impacted much more strongly than would their suppliers, the wood and steel industries. These effects are called **Indirect effects**. The same kind of rounds of spending' occur when the employees and owners of the mussel industry spend their income. These effects, **Induced effects**, start-off as consumption expenditures in the retail and service trades and then work their way through the remainder of the economy, setting off still more 'rounds of spending'.

A convenient mathematical manipulation of the input/output table (implemented on a computer) makes it possible to arrive at reasonable estimates of both indirect and induced effects.¹¹

Table 1 shows the mussel industry in comparison with other fisheries in the State. The numbers in the table have the following meaning: Under the column labeled "DIRECT" the number entered for the mussel harvesting sector is .67. This number means that for each dollar of landed value in the harvesting sector, 67¢ is take home income for someone working mussel harvesting. The number to its right in the "INDIRECT" column, .18, indicates an estimated income of 18¢ per dollar of landed value earned by someone in those parts of the economy that supply the mussel industry. the third figure for mussels, in the "INDUCED" column, .72, is an estimate of the income earned in industries where income from the mussel industry is spent. Finally, the figure in the "TOTAL" column, 1.57, represents all the income earned in the mussel industry and all other industries as a result of one dollar of landed value. In other words, every time a mussel fisherman lands a dollars worth of mussels \$1.57 of income is generated throughout the economy. This is the so-called spin-off or multiplier effect.

¹¹ The Maine State Planning Office uses an input/output table of the Maine economy. In 1980 this table was modified to include the major fisheries sectors in the State. The estimates of direct and indirect economic effects of the Maine mussel industry reported here, represent a modification and up-dating of the 1980 'fisheries' version of the State input/output table. See Briggs, Townsend and Wilson, "An Input-Output Analysis of Maine's Fisheries, Marine Fisheries Review, January 1982.

Table 1
In-State Income Multipliers

INDUSTRY	DIRECT	INDIRECT	INDUCED	TOTAL
harvesting				
clam	0.57	0.20	0.77	1.54
worm	0.72	0.10	0.83	1.65
groundfish	0.29	0.37	0.66	1.32
herring	0.51	0.22	0.74	1.47
lobster	0.35	0.34	0.69	1.38
mussel	0.67	0.18	0.72	1.57
processing				
clam/worm	0.24	0.58	0.83	1.65
groundfish	0.14	0.53	0.66	1.33
herring	0.28	0.31	0.59	1.18
lobster	0.17	0.42	0.58	1.17
mussel	0.23	0.46	0.69	1.38

In dollar terms for 1985, the harvesting sector alone is estimated to have generated about \$3,264,000 of income¹² within the State. About \$1,392,000 was earned within the industry itself, about \$1,871,000 was earned in the industries supplying the mussel industry. The processing sector generated approximately \$4,464,000 of additional¹³ income within the State; about \$1,896,000 was earned within the industry with the remainder going to other parts of the State's economy.

The total of all income generated within the State by both the harvesting and processing parts of the mussel industry was approximately \$10.3 million in 1985. Total employment within the industry is estimated at approximately 190-200 full time man years in the industry itself and (at \$17,000/yr.) approximately 414 full time jobs elsewhere in the economy.

¹² This use of the word income means that all costs have been accounted for.

¹³ This figure does not include the indirect income earned in the harvesting sector.

Table 2
1985 SALES AND DIRECT AND SPIN-OFF INCOME FROM MUSSELS

	gross output/sales	Income to mussel industry	spin-off Income	In state total income
harvesting	2,079,000	1,392,930	1,871,100	3,264,030
processing	3,882,375	892,946 +	4,464,731**	5,357,678
direct sales	2,283,750	1,004,850 *	703,395++	1,708,245
TOTAL	8,245,125	3,290,726	7,039,226	10,329,953

+ 50% of mussels were assumed subject to processing; the remainder were assumed to be sold directly with little or no processing.

* Transportation and other costs are included in the harvesting sector.

** This figure excludes the indirect income generated through the harvesting sector to avoid double counting.

++ this figure includes induced income only.

Table 3
DIRECT, SPIN-OFF AND TOTAL EMPLOYMENT FROM MUSSELS

	Mussel Industry		Other Industries	Total
	Total Engaged	Full Time Equivalent	Full Time Equivalent	Full Time Equivalent
Harvesting	260	80-85	104	190
Processing	375	110-115	310	430
TOTAL	635	190-200	414	620

Fishing industries as a whole tend to have relatively high income multiplier effects when compared with the rest of the economy; for example the total income multiplier for wood and paper products is .98. The reason for the strong multiplier effects in fisheries is traceable to the high proportion of labor involved in the industry and to the fact that a large part of the inputs to the fishing process involve the purchase of locally produced goods.

Compared with the other fisheries in the State, the harvesting part of the mussel industry produces multiplier income effects that are somewhat less than

the worm and clam industries (where the proportion of labor input is very high) but more than the groundfish industry which tends to be more capital intensive.

Cultured and wild fisheries

The principal marketing problem in the State's wild fisheries is the unpredictability of product supplies. The restaurant and institutional trade - the primary market for fresh seafood - has strong preferences for a steady and predictable supply of product. Because of the unpredictability of wild product supplies, Maine processors supplying these markets are relatively limited in their ability to arrange long term contracts promising delivery of specified product types at specified times¹⁴. Generally, they are only able to service the upper end of this trade with long term contracts. The large majority of sales must be made on the basis of daily product availability.

This uncertainty of the supply of wild seafood reduces the extent to which Maine sellers of wild fresh seafood can penetrate the nation's high quality, high priced food markets. The result, of course, is lower effective demand, prices and income for Maine's fishing industry.¹⁵ Aquaculture can have a strong positive effect upon this marketing picture.

The reason for the expected beneficial effect of aquaculture is that:

- (1) it provides significant controls over product harvest rates and volumes and product quality that are not present in the wild fisheries, and
- (2) the rights structure of aquaculture creates relatively stable long term expectations about the ability to actually deliver product.

¹⁴ Freezing product is one way to minimize the effects of unpredictable supplies of product. Doing so, however, reduces the quality and value of the product and places local processors in direct competition with low cost foreign suppliers.

¹⁵ There are a number of steps that can and have been taken to alleviate these problems in the wild fisheries. The new Portland Fish Exchange is designed to consolidate supplies for the purpose of creating greater predictability and to display the fish before sale in order to create strong incentives for careful handling and higher product quality. Over the first eight months of its operation the Exchange appeared to be fulfilling these objectives. Another way to attack the quality problem and ease the contracting problems of Maine processors is through quality assurance programs. For several years now, the Department of Marine Resources and the industry have jointly operated such a program under the label of Catch the Taste. This program also appears to have had very beneficial effects. Together the Exchange and the Catch the Taste Program have strongly complemented one another.

Both of these aspects of aquaculture allow a firm to contract with greater certainty in final markets and, consequently, to penetrate markets more deeply than is possible in wild fisheries where product control is subject to considerable uncertainty.

The market penetration made possible by aquaculture can be expected to enhance the marketing prospects of the wild fishery. Depending upon the nature of the product this benefit may spin-off to the wild fishery almost immediately or it may not develop until the cultured fishery is fairly mature. In the mussel fishery, for example, the marketing efforts of firms engaged in cultivation appears to have created an almost immediate and strong demand that was filled to a large extent by the wild fishery.

In other fisheries, especially those where there is no direct counterpart to the cultured animal, aquaculturists can be expected to capture most of the beneficial market effects in the early stages of the industry. As greater supplies of cultured product are developed, the difference between the price of cultured product and the prices of wild product substitutes can be expected to diminish and, in fact, aquaculturists will find that at certain times of the year, depending upon the product, prices in the traditional (spot) markets for wild product will exceed prices they are able to obtain through long term contract. At that time, cultured product will begin to enter the traditional market system and by so doing, will have a strong stabilizing effect on supplies and prices in those markets. To the extent that marketers of wild product are able to rely upon or tap into the supplies of cultured product they will be able to jointly market cultured and wild product with much more assurance of stable supplies and much more certainty about their contracting ability.

About the only circumstance in which one would expect cultured product to harm wild product in the market place would be in the hard to imagine instance of a small and restricted high quality market. In this kind of situation, the product control advantages of aquaculture might prove detrimental to the wild product, that is, would be expected to reduce the demand for the wild product. But it is hard to imagine much developmental effort being put into a culturing operation where the prospects for markets were limited in this way.

Summary

Leasehold operations in the Maine mussel industry have created a pronounced change in the business climate of the industry. The relative security of product supply and control of product quality have created strong incentives for the private development of new markets. The growth of the industry in recent years provides strong evidence of the social value of these incentives.

The benefits of the change in the rights structure brought about by leaseholding have accrued to the leaseholders and their employees, to people working in the wild fisheries and to a large number of people in supplying industries throughout the State. Although the mussel industry is at what is probably an early stage in its development, employment in the industry and its suppliers has risen from an almost negligible level in 1975 to about 600 people ten years later. Similarly, income rose to slightly over \$10 million dollars annually. If the growth rate of the last five years (1981-86) were to continue until 1996 - and people in the industry feel that that is entirely likely - the State might conservatively anticipate direct and spin-off employment in the range of 1200 to 1400 and income of over \$20 million. More optimistically, there will be a much higher proportion of product being sold only after cultivation and only after processing. This will mean proportionately more employment and income within the State.

The quality and location of these income and employment opportunities is also an important consideration since much of it occurs in coastal areas where the alternative opportunities are sometimes meager. Additionally, the work in the industry does not have the strong season swings often associated with the wild fisheries or tourism. In the mussel industry in particular, the seasonality that does exist, very nicely complements the slack periods in other fisheries.

In short, the leasehold arrangements in the mussel fishery have transformed the private incentives and abilities for the development of new seafood markets. The economic effects have been extremely positive for the industry and for the State as a whole. Discontinuation of the leasehold arrangement or even the

insertion of considerable uncertainty about its continuation would seriously undermine the positive incentives and the economic growth that have occurred to date.

A new and valuable industry has been created within the State. There are strong indications that its growth will continue well into the next decade or beyond.



Provided by
Brent - Rep.
Rieger's staff

Dear Sir/Madam:

Re: NORWEGIAN FISH FARMING INFRASTRUCTURE SEMINAR

Based on the outstanding success of last year's fish farming seminars in Seattle and Vancouver, the Trade Commission of Norway is sponsoring a one day Fish Farming Infrastructure Seminar in Juneau on June 22, 1987.

A series of speeches by well known members of the Norwegian fish farming community will be complemented by exhibits presented by 18 of the companies in the Norwegian delegation. The purpose is to present the latest in fish farming technology including present and future development in Norway, sea-based and land-based fish farming, the latest in feed technology and fish handling, along with packaging and transportation.

Participation cost for each seminar is \$120.00 and includes seminar materials, lunch, coffee, and reception.

We feel the information made available not only at the seminar sessions but also in the company exhibits will provide enhanced opportunities for those presently involved or planning to be involved in the Fish Farming Industry.

Please complete the attached Registration Form and forward, along with your cheque, to:

Trade Commission of Norway
Two Embarcadero Center
Suite 2910
San Francisco, California 94111

We would appreciate receiving your completed registration materials at least one (1) week prior to the opening of the seminar.

Sincerely,

Tor S. Andresen
Norwegian Trade Commissioner



Yes, I will be attending the Norwegian Fish Farming Infrastructure Seminar in:

____ Vancouver, British Columbia June 15, 1987

____ Prince Rupert, British Columbia June 18, 1987

____ Juneau, Alaska June 22, 1987

Cost per seminar is \$120.00 (includes Seminar, Lunch & Reception). Please make cheque payable to Norwegian Trade Commission Fish Farming Seminar.

NAME: _____

TITLE: _____

COMPANY: _____

ADDRESS: _____

CITY: _____ PROV/STATE: _____

POSTAL/ZIP CODE _____ TELEPHONE NO: _____

Please send completed form and cheque for Vancouver and Prince Rupert Seminar to:

Trade Commission of Norway
1200 Bay Street, Suite 702
Toronto, Ontario
M5A 2A5
(416) 920-0434

Please send completed form and cheque for Juneau Seminar to:

Trade Commission of Norway
Two Embarcadero Center
Suite 2910
San Francisco, California
94111
(415) 986-0770



Juneau, Alaska
Monday, June 22, 1987
Centennial Hall Convention Center
Sheffield Ballroom 3
Juneau, Alaska 99801

=====

8.00 am	Registration - Coffee and Danish
9.00 am	Seminar Commences Seminar Chairman, Mr. Jan Erik Hagen, President, Det Norske Veritas (Canada) Ltd. Opening of Seminar by an Alaskan Government Official
9.15 am	Introduction of Speakers by Seminar Chairman
9.20 am	Presentation of delegation members and participating companies Trade Commissioner, San Francisco
9.40 am	Aquaculture Status in Alaska Mr. Rodger Painter, Executive Director, Alaska Mariculture Association
10.20 am	Aquaculture in Norway - Present Situation and the Future Professor Harald Skjervold, Board Member, Interaqua A/S
11.00 am	Coffee
11.15 am	Farming in the Ocean - Conventional and New Technology Mr. Arne Vadseth, President, MARENOR A/S
11.45 am	Landbased Fish Farming Mr. Geir Mykletun, President, Aqua-division, SVACOM A/S
12.15 pm	LUNCH
2.00 pm	Research and Development within Fishfarming Technology Mr. Idar Schel, Program Director, SINTEF Group
2.30 pm	Norwegian Experience with Feed Formulas for Salmonides Mr. Egil Thomsen, International Marketing Manager, SKRETTING A/S
3.00 pm	Norwegian System for Handling, Packaging and Transportation of Fresh Fish Mr. Egil Budde, Marketing Manager, SAS CARGO, Norway
3.45	Exhibition by Norwegian Companies
7.00 - 9.00 pm	RECEPTION Baranof Hotel Treadwell Ballroom



PARTICIPATING COMPANIES

- =====
- AKVA A/S Computerized automatic feeding system for feeds based on USA and Canada patented water transportation systems.
- AQUA SERVICE INTERNATIONAL LTD. Competitive within areas of construction, biology, financing and administration, allowing complete project management capability.
- FACO A/S Marketer of fresh farmed salmon from B.C. to countries throughout the world, including Japan and the USA.
- HELGELAND PLAST Norway's largest producer of net pens in PEH plastic along with walkways, floats and boats. Helgeland Plast has established a company with production and storehouse in Sechell, B.C.
- HELLAND MEK. VERKSTED Experienced supplier of silos and transporters for gentle handling of pellets, bindermeal, and silage for the fishfarming industry.
- INTER-AQUA A/S Owned by major Norwegian financing, shipping and industrial companies. Inter-Aqua is involved in project development and production of fish.
- MA-BO A/S One of Scandinavia's leading manufacturers of plastic pipes and fittings including floating elements and waste pipelines along with feeding vessels and basins, hatch cylinders, fish turnstiles and other equipment.
- MARENOR A/S Offers facilities for research and full-scale testing in salt and fresh water along with development and participation in production.
- MONOPOL-HEMPEL A/S Developed antigrowth products for fish nets and is today's market leader in this field.
- NORDLANDS BANKEN Nordlandsbanken Bank provides financing and banking services to the fish farming industry.
- NORPLAN A/S Consulting engineers, architects, management consultants and economists serving the fish farming industry.
- RENA EMBALLASJE Pioneers in the field of packaging for airtransport of chilled fresh salmon. Rena Emballasje is the leading manufacturer of solid fiberboard packaging in Scandinavia.
- SALCOM AQUACULTURE PRODUCTS LTD. Markets its broad range of equipment, supplies, and services to fish farming operations and hatcheries.
- SAS CARGO Scandinavian Airline Systems Cargo Division, airline carrier, is a pioneer in the air transportation of fresh fish throughout the world.
- SCANMARIN AQUACULTURE A/S Offers a wide range of equipment and services for the fish farming industry including sea cargo systems, hydromed medical treatment equipment and mooring equipment.



PARTICIPATING COMPANIES

p.2

- SEAFARM TRADING A/S A turn-key supplier of equipment products for hatcheries, smolt facilities and growing facilities of salmon and trout at sea.
- SINTEF Scandinavia's largest R & D institution involved with the design and instrument development of new types of sea cages, land and sea based fish farming and farming of marine species.
- T. SKRETTING A/S Developer, producer and marketer of compound and dry feed along with equipment for hatcheries.
- SVACOM A/S Offers top quality stock organisms from cod, turbot, halibut, salmon -- complete sea and land-based plants, feeds, and research assistance.
- TEKNOTERM A/S Activities include marketing, mounting and service of heatpump and energy systems, oxygenizing and cleaning systems for the fish farming industry.
- UNDERTUN TRADING A/S Marketer of turn-key land-based farms, smolt production and hatcheries equipment.

Economic Benefits of Salmon Farms in the Sunshine Coast Regional District

Recently, several salmon farm proposals on the Sunshine Coast have encountered heavy public opposition, particularly where the public perceives the character of the areas in question as residential or recreational. To balance these negative views of fish farming, salmon farms statistics for the region were summarized to inform the public of economic benefits that will accrue from fish farming. This work was done by the Fisheries Branch along with the Ministry of Lands, Parks and Housing.

The following data were extracted from the 49 sites in the study area which had been approved by Fisheries Branch staff by May 20, 1986 or which existed prior to the advent of Management Plans. The Sunshine Coast Regional District boundaries defined the study area. Parameters 1, 2 and 3 relate specifically to economic benefits. Others are of general interest and provide information on the industry which was previously not available to the public:

<u>Parameter</u>	<u>Sample size</u>	<u>Average</u>	<u>Range</u>
1. Employment (No./farm) ¹	45	5.5	0.2 - 35.5
2. Wages (\$/farm) ²	45	98,920	3,600 - 639,000
3. Capital investment (\$/farm)	37	330,341	5,500 - 1,050,000
4. Foreshore area (ha/farm)	48	4.29	0.06 - 13.0
5. Total net pen volume (m ³ /farm)	45	18,704	648 - 236,476
6. Max. stocking density (kg/m ³)	39	8.2	5-12
7. Max. net pen capacity (t/farm)	45	161.27	10.8 - 1098.1
8. Percent survival estimate	37	68.4	54 - 80
9. Biomass at full production (t/farm) ³	45	108.74	3.37 - 709.68

¹ based on one person year per 20 tonnes of fish on hand

² based on \$18,000/per person year

³ maximum net pen capacity x % survival

By multiplying the average number of employees per farm by the 49 approved sites we find that the salmon farming industry in the study area would provide direct employment for 270 people, at full production. Similarly, the annual payroll could be as much as 4.9 million dollars and capital investment in net pens, accommodation, lab and feeding equipment, boats, etc. could exceed 16 million dollars. Much of this will be injected into the local economy. Salmon farmers will benefit by making known and consciously maintaining their positive influence on the local economy.

L. Michael Coon
Head: Finfish Management and
Development Unit

Provided by
Brent - Rep.
Reiger's staff



BC FERRIES

FARES

Fares are Canadian funds, One-Way.
Driver not included in vehicle rates.

• Mainland/
Vancouver Is.
• Sechart
Peninsula &
Jervis Inlet
(See Note)

• Vancouver/
Bowen Is.
(return)

• Saanich
Inlet

• Comox/
Powell River

Driver or Adult Passenger Child (5-11)	\$ 4.00 2.00	\$ 2.50 1.25	\$ 1.50 .75	\$ 4.00 2.00 (Child 6-14)
Vehicle (one unit up to 6'8" high)	\$15.00	\$ 9.00	\$ 4.50	\$15.00
Vehicle (over 6'8" high)	\$19.50	\$ 11.50	\$ 5.75	\$15.00
Vehicle with a trailer (two units up to 6'8" high)	\$30.00	\$18.00	\$ 9.00	\$ 30.00
Vehicle with a trailer (if either unit is over 6'8" high)	\$39.00	\$23.00	\$11.50	\$30.00
Motorcycle Bicycle	\$ 7.50 \$ 2.00	\$ 4.50 \$ 1.00	\$ 2.25 \$ 0.50	\$ 6.30 FREE

Extra Length

Note that the rates shown above are for vehicles or trailers up to 20' long. Vehicles or trailers, up to 6'8" high, which are over 20' long, are charged an additional \$1.45 per foot. Vehicles or trailers over 6'8" high and over 20' long are charged an additional \$1.70 per foot.

Any overhang or hitch is included when measuring overall length. Each vehicle or trailer is charged as a separate unit and the over 6'8" rate will apply to both units if either unit is over 6'8" high.

NOTE: Pets may be carried on board but must remain in your vehicle or on the car deck for the duration of the voyage.

NOTE: SECHART PENINSULA & JERVIS INLET

Ticketing: When you purchase a ticket at either Horseshoe Bay or Saltery Bay, it is valid for two crossings. You may, for instance, cross to the Sechart Peninsula and return, or cross both Howe Sound and Jervis Inlet (one way). In the latter case, you would purchase a second through ticket on your return.

Special commuter ticket books are available on Sechart Peninsula, Jervis Inlet, and Bowen Island routes.

SCHEDULES AND FARES SUBJECT TO CHANGE WITHOUT NOTICE.

SCHEDULE INFORMATION

For Mainland/Vancouver Island

24 hour recorded schedule information, phone:

Victoria
656-0757

Vancouver
685-1021

Nanaimo
753-6626

BC FERRIES, 818 Broughton St., Victoria, B.C.
Canada V8W 1E4

500M/01/86

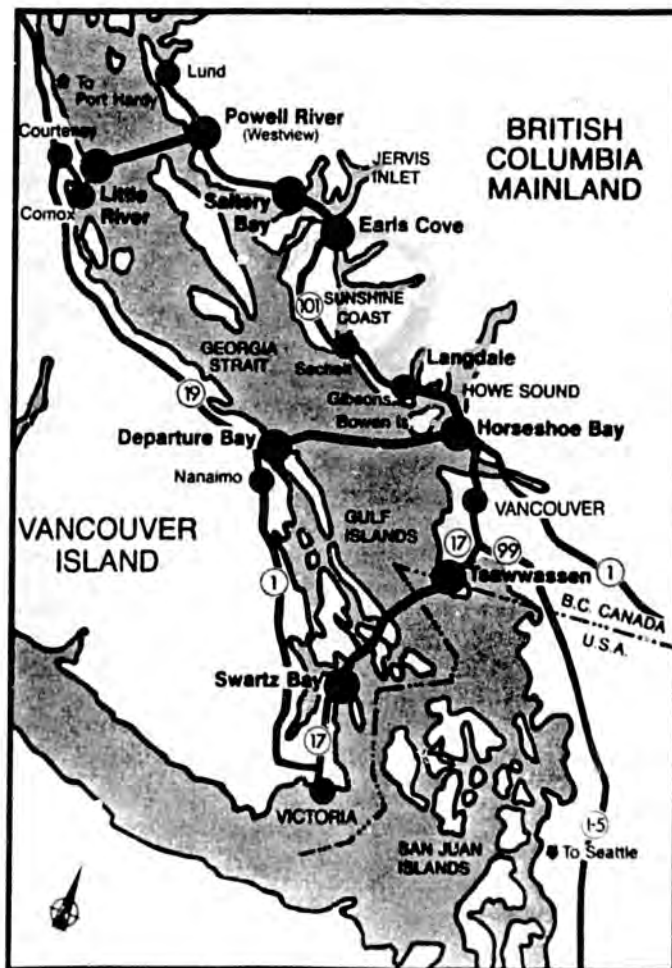
Printed in Canada



BC FERRIES

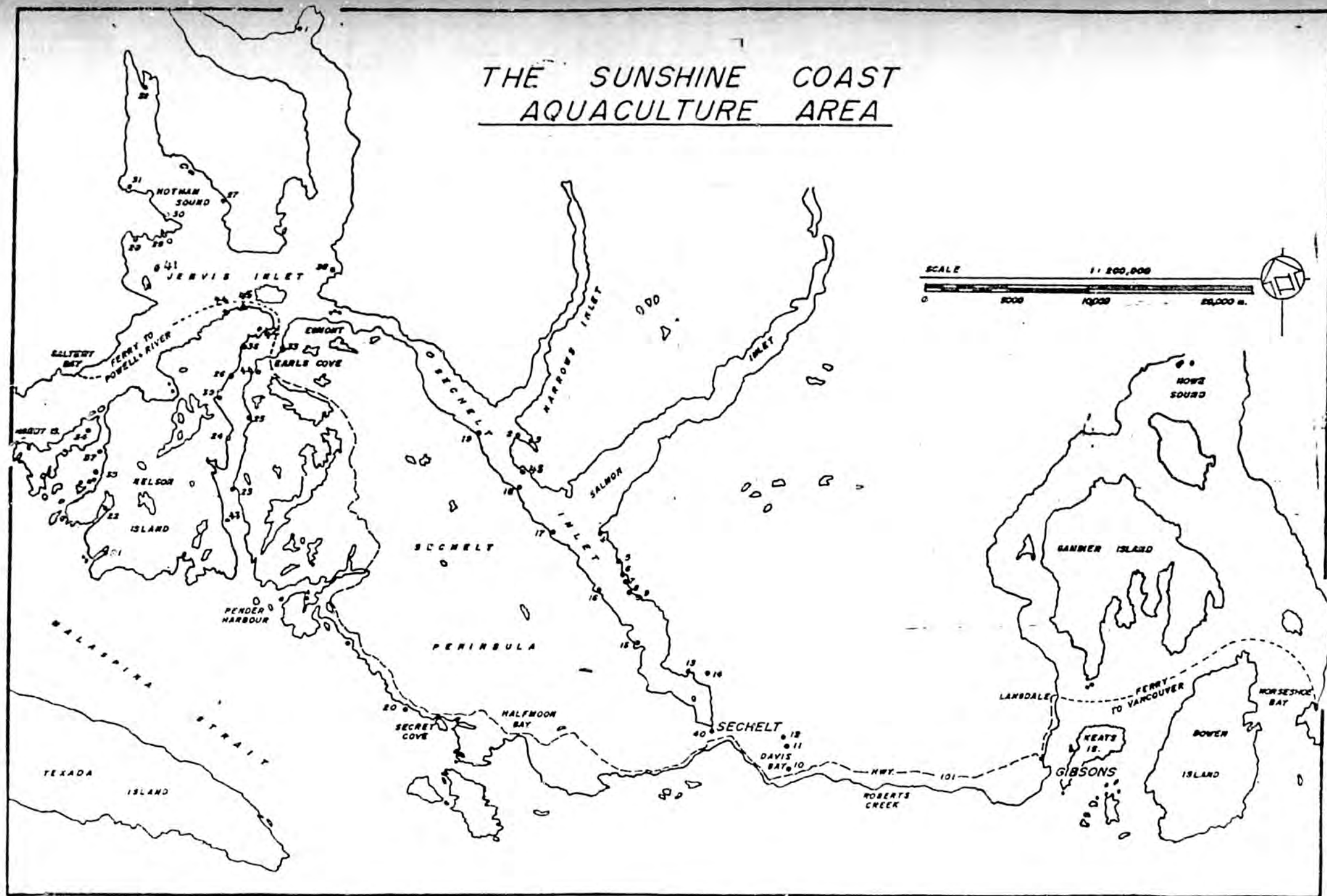
Expo 86 Season Schedule May 1—October 13, 1986

EXPLORE THE COAST OF BRITISH COLUMBIA WITH BC FERRIES



No reservations are required or accepted on any route detailed in this schedule.

THE SUNSHINE COAST AQUACULTURE AREA



- 01 Bay Fresh Sea Farms Ltd.
Box 2, Vancouver Bay,
Egmont, B.C. VON 1N0
- 02 Lynne Johnson (steelhead)
Box 804 Sechelt, B.C. VON 3A0
- 03 Storm Bay Shellfish Co. Ltd.
R.R. No. 1,
Halfmoon Bay, B.C. VON 1Y0
- 04 Seaforth Aquaculture Ltd.
Box 1545, Sechelt, B.C. VON 3A0
- 05 Porpoise Bay Shellfish Ltd.
R.R. No. 1,
Halfmoon Bay, B.C. VON 1Y0
- 06 Bruce Fraser Oysters
Box 1701, Sechelt, B.C. VON 3A0
- 07 Suncoast Salmon Ltd.
Box 1371, Sechelt, B.C. VON 1V0
- 08 Porpoise Bay Shellfish
- 09 Tonto Seafoods Ltd.
Box 993, Sechelt, B.C. VON 1V0
- 10 Cockburn Bay Seafarms Ltd.
Chapman Creek Hatchery,
Box 159, Garden Bay, B.C. VON 1S0
- 11 Scantech Resources Ltd.
Wilson Creek Warehouse,
Box 1964, Sechelt, B.C. VON 3A0
- 12 Trend Feed Inc. (Fish Food Plant),
Box 1039, Gibsons, B.C. VON 1V0
- 13 Sechelt Indian Band Hatchery
Indian Band Office,
Box 740, Sechelt, B.C. VON 1V0
- 14 Cron-Aqua Industries Ltd.
Cromarty Book Services,
Box 2149, Sechelt, B.C. VON 3A0
- 15 Jim Stockwell Oysters,
R.R. No. 1, Sechelt, B.C. VON 3A0

- 16 Suncoast Salmon Ltd.
- 17 Salten Sea Farms Ltd.
Box 1248, Sechelt, B.C. VON 3A0
- 18 Sechelt Salmon Farms
Box 1248, Sechelt, B.C. VON 3A0.
- 19 Salmo Pacific Sea Farm
Box 518, Sechelt, B.C. VON 3A0
- 20 Wood Bay Marine Farms Ltd.
Box 1946, Sechelt, B.C. VON 3A0
- 21 Cockburn Bay Seafarms Ltd.
- 22 Tidal Rush Marine Farms Ltd.
(Pacific Aquafarms Ltd.)
Box 263, Madeira Park, B.C. VON 2H0
- 23 Cedarbrook Salmon Farms Ltd.
Box 1339, Sechelt, B.C. VON 3A0
- 24 Ristol Sea Farms Ltd.
Box 785, Gibsons, B.C. VON 1V0
- 25 Skookumchuk Salmon Farms Ltd.
Box 2212, Sechelt, B.C. VON 1V0
- 26 Seascan Inc.
Box 1946, Sechelt, B.C. VON 3A0
- 27 Harmony Seafoods Ltd.
General Delivery,
Egmont, B.C. VON 1N0
- 28 Fruit of the Sea Marine Farms Ltd.
Box 1, Egmont, B.C. VON 1N0
- 29 Totem Oysters Ltd.
General Delivery,
Egmont, B.C. VON 1N0
- 30 Aquarius Sea Farms Ltd.
Box 1836, Sechelt, B.C. VON 1V0
- 31 Tidal Rush Marine Farms Ltd.
- 32 Tidal Rush Marine Farms Ltd.

- 33 Seastar Resources Corp.
614-850 West Hastings Street
Vancouver, B.C. V6C 1E1
- 34 Hardy Sea Farms Inc.
400-1055 West Hastings Street,
Vancouver, B.C. V6E 2E9
- 35 Aquarius Sea Farms Ltd.
- 36 Brumar Sea Farms Ltd.
R.R. No. 1,
Sechelt, B.C. VON 3A0
- 37 Killoram Salmon Farms,
Nelson Island
- 38 Seagrow Industries Inc.
Box 48266,
5959 Burrard Street
Vancouver, B.C. V7X 1A1
- 39 Jim Bagnall Oysters
558 West 25th Avenue
North Vancouver, B.C. V7N 2G3
- 40 Royal Reach Seafoods Western Inc.
Box 226, Sechelt, B.C. VON 3A0
- 41 Garden Bay Sea Farms
Box 99,
Granthams Landing, B.C. VON 1X0
- 42 Garden Bay Sea Farms
- 43 Moon Bay Sea Farms
Box 1555, Sechelt, B.C. VON 3A0
- 44 Troll Marine Farms
Box 419,
Madeira Park, B.C. VON 2H0
- 45 Aquarius Sea Farms Ltd.
- 46 Aquarius Sea Farms Ltd.
- 47 Nelson Island Marine Farms
- 48 Riscalt

REPRESENTATIVE
SAM COTTEN
DISTRICT 15



PO. BOX 296, EAGLE RIVER, AK 99577
PO. BOX V, JUNEAU, AK 99811

ALASKA STATE LEGISLATURE
HOUSE OF REPRESENTATIVES

TO: Resources Committee members
FROM: Rep. Sam Cotten, Co-Chair
SUBJECT: Tidelands leasing for mariculture (HB 108)
DATE: May 5, 1987

One of the most controversial issues in the Committee's hearings on the mariculture bill (HB 108) has been the leasing of state tidelands for mariculture sites.

My staff prepared draft tidelands leasing language that attempts to take into account most of the suggestions and concerns of committee members and the public. Of course this is only a very preliminary draft intended to focus discussion and provide a vehicle for future committee action, if appropriate. The draft is supplied for your consideration.

In a first review by some interested legislators, interest groups, and DNR, the following questions arose about the draft:

Does the legislation need to be so comprehensive?
Does it put things into statute that belong in regulation?

Should there be a distinct tidelands leasing procedure for aquatic farms, or should existing procedures be employed?

Are the proposed terms of the statute unfair?
(Proposed rentals, depth of planning and financing requirements)

I look forward to working on the bill with the committee and will appreciate any comments on this draft.

attachment

Sen. Eliason
could address some
issues in your May 11
letter to Collumworth

DRAFT fish farm/tidelands leasing language

May 6, 1987

* Section 1. AS 38.05.070(a) is amended to read:

(a) Land, including tide, submerged or shoreland, to which the state holds title or to which it may become entitled, may be leased, except for the extraction of natural resources, in the manner provided in AS 38.05.070-38.05.105. Leasing of land for aquatic farming sites may occur under AS 38.05.400-38.05.412.

* Sec. 2. AS 38.05 is amended by adding a new article to read:

Article ____ . Leasing of State Lands for Aquatic Farming.

Section

- 400. Generally
- 402. Application for a lease
- 404. Application processing
- 406. Review of applications
- 408. Leasing procedures and decisions
- 410. Lease terms
- 412. Regulations

AS 38.05.400. Generally. Under AS 38.05.400-AS 38.05.412, the commissioner may negotiate leases for land, including tide, submerged, and shoreland and adjacent uplands, for aquatic farm sites.

AS 38.05.402. Application for a lease. (a) An Alaska resident holding an Alaska business license who

is interested in obtaining a lease for aquatic farming operations must, by October 1 of the year, submit an application for a lease on forms issued by the commissioner. The commissioner shall require submittal of relevant information including at a minimum:

(1) a map at the most detailed scale generally available showing the proposed site;

(2) a farm operation plan, providing detailed information and drawings of the proposed operation, including

(A) the farm development schedule;

(B) biological and physical capabilities of the site;

(C) needs and sources for power, fresh water, fuel, and feed;

(D) waste disposal, including farm product wastes;

(E) production strategies and target levels;

(F) product processing and markets;

(G) cost estimates and financing; and

(H) special measures to mitigate environmental impact;

(3) an application fee of \$100;

(4) evidence that the applicant is fit, willing, and able to conduct the operation;

(5) photographs of the site.

(b) On receipt of an application for an aquatic farming lease, the commissioner shall evaluate the application for completeness and request more information, if necessary, within 15 days. If the commissioner does not request more information within 15 days, the application shall be considered complete, although the commissioner may request more information as the application is processed under AS 38.05.404-38.05.406.

AS 38.05.404. Application processing. (a) The commissioner shall begin to process an aquatic farm lease application after the application is complete.

(b) Between November 1 and December 31 of the year, the commissioner shall publish notice, in accordance with AS 38.05.945, of all aquatic farm site lease applications submitted by October 1 and completed before November 1 of the year. If warranted by public response to an aquatic farm application, the commissioner shall hold public hearings at a place and time to be announced at least fourteen days in advance.

(c) The commissioner shall issue final decisions on all aquatic farm lease applications submitted during the previous year by March 1.

AS 38.05.406. Review of applications. (a) Before issuing an aquatic farming lease under AS 38.05.400-38.05.412, the commissioner shall

(1) assure that the proposed use will conform with applicable land use plans adopted by the commissioner under AS 38.04.065 and land classifications under AS 38.05.300, with coastal management plans under AS 46.42.100, and with local planning and zoning in the municipalities;

(2) consider other land uses that exist or can reasonably be expected on the same site;

(3) assess and consider the cumulative impacts of aquatic farms already leased or proposed in the area;

(4) assure that adequate navigation and access can be maintained, including access to public and private uplands and to public waters;

(5) identify special operating conditions and mitigating measures that may be required of the applicant; and

(6) provide at least 30 days for public review of draft decisions and interest findings required by (c) of this section.

(b) In considering the aquatic farm application, the commissioner shall consult with local governments, local fish and game advisory committees, and other agencies, including the Department of Fish and Game.

With the cooperation of other departments, the commissioner may establish and coordinate regional review teams, composed of agency representatives, to work on aquatic farm applications in each region of the state.

(c) By January 15 of the year, the commissioner shall prepare and issue preliminary decisions, including draft lease terms and operating conditions, on all complete aquatic farm leasing applications received during the previous year. Notice of the preliminary decisions shall be provided in accordance with AS 38.05.945. The preliminary decision must include a draft finding of state's interests in accordance with AS 38.05.408(b).

AS 38.05.408. Leasing procedures and decisions.

(a) The commissioner may negotiate and issue an aquatic farm lease to a prequalified applicant under regulations adopted in accordance with AS 38.05.400-38.05.412.

(b) After determining that an aquatic farm lease application accords with AS 38.05.406(a), the commissioner shall consider the state's interests in the proposed lease of state lands, and may not issue any lease unless the commissioner determines that

issuance of the lease serves the best interests of the state.

AS 38.05.410. Lease terms. (a) An aquatic farm lease for tide, submerged, and shoreland and adjacent uplands may be issued for up to thirty years, at the discretion of the commissioner in consideration of the useful life of the improvements to be constructed.

(b) As a rental fee for the lease the commissioner shall provide for return of a portion of the gross receipts from the lease to be deposited in the general fund of the state. For an operation grossing less than \$500,000 per year, the commissioner shall require the return of two per cent of gross receipts. For an operation grossing between \$500,000 and \$1,000,000 per year, the commissioner shall require the return of three per cent of gross receipts. For an operation grossing over \$1,000,000 per year, the commissioner shall require the return of between three per cent and five per cent of gross receipts.

(c) A lease shall contain terms that

(1) prevent nonconforming uses of the leased property;

(2) provide for restoration of the site after termination of the lease;

(3) require investment and development on a specified schedule;

(4) allow transfer to another owner only with the commissioner's approval;

(5) permit regular inspection of the facilities and operations; and

(6) identify measures necessary to mitigate environmental impact.

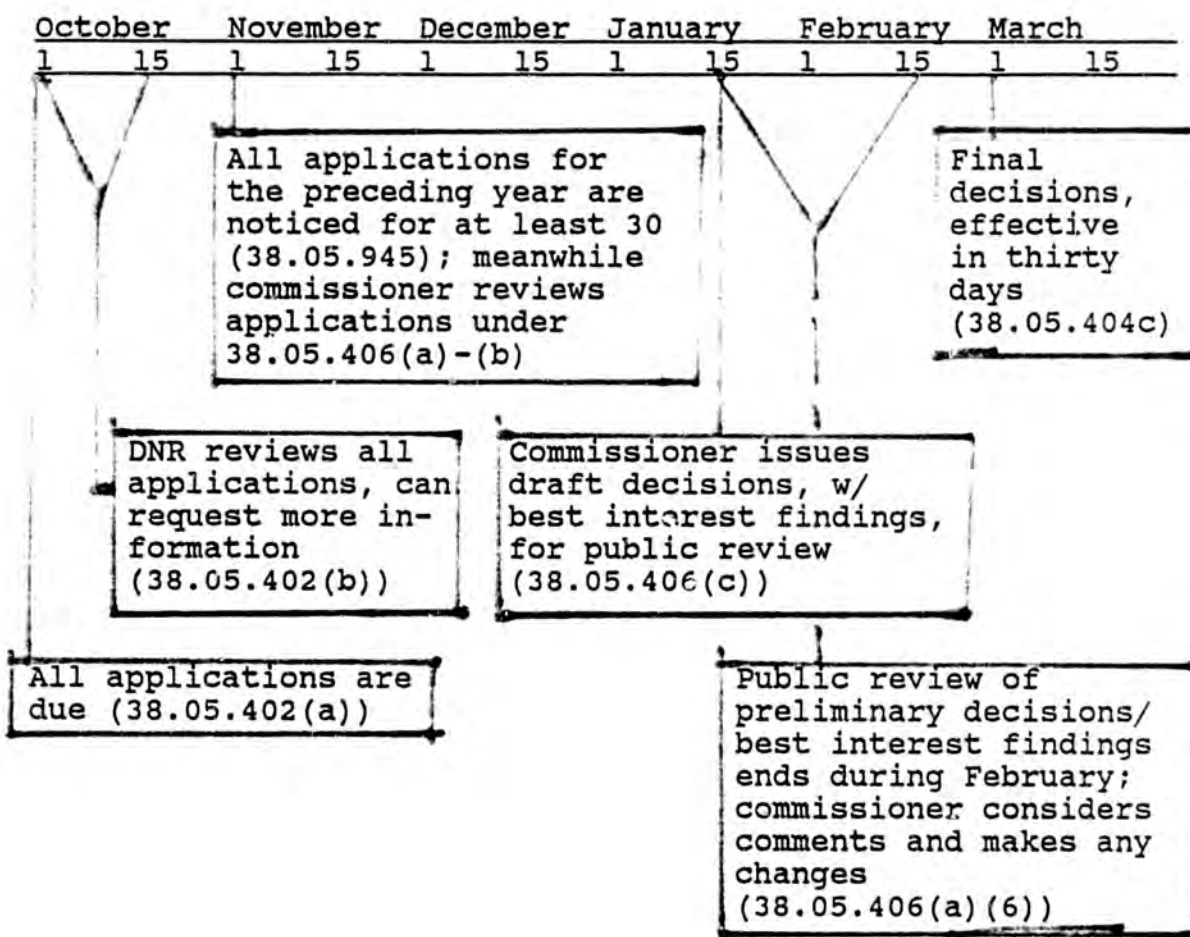
(d) The commissioner may require survey of the lease site at the applicant's expense prior to issuance of a lease or during the term of the lease.

(e) The commissioner may include other reasonable terms and conditions in the lease.

(f) The commissioner may not approve the transfer of any lease unless the commissioner determines that there has been substantial development and compliance with the terms of the lease.

AS 38.05.412. Regulations. The commissioner shall adopt regulations to implement AS 38.05.400-38.05.410.

This is a schedule for the annual applications and public review process for aquatic farm sites under proposed AS 38.05.400-412.



Alaska Mariculture Association

May 1, 1987

Representative Adelheid Herrmann
Representative Sam Cotten
Co-Chairs
House Resources Committee
P.O. Box V
Juneau, AK 99811

Dear Representatives Herrmann and Cotten:

The Alaska Mariculture Association (AMA) wishes to extend its thanks to the Resources Committee for the many long hours spent gathering public comment on House Bill 108.

In response to a request during committee hearings by Representative Davidson, I have prepared an assessment of the issues raised during public testimony.

AMA believes it is important that the committee identify the issues needing further work or clarification so the measure can be modified to ensure maximum benefits to Alaska from development of a diverse mariculture industry. This process will allow the committee to focus its efforts on responding to the concerns raised by the public and fashioning the best piece of legislation possible. We are pleased to be able to contribute to this effort.

Competing Uses in the Tidelands

The prospect of the creation of numerous sea farms in our coastal waters has focused attention on an issue of rising public concern: how to balance competing uses of state tidelands and public waters as Alaska's population expands and development extends to our more rural areas. AMA believes the concerns raised about the tidelands permitting process for mariculture extend to all activities in our coastal waters involving projects of long-term use, including floating lodges, industrial parks, log transfer facilities, mining terminals and private docks.

Members of the public have questioned whether the current permitting system provides adequate opportunities for public comment and protection of existing uses of our public waters. We believe the present tidelands permitting process and coastal management program provide the basic framework necessary to respond to these concerns.

We are convinced that notification of affected user groups such as commercial fishing groups and local fish and game advisory committees, could be improved at very little expense and would help ensure improved public review of all tidelands proposals.

The Department of Natural Resources also has suggested additional policy guidelines in statute would help the agency in balancing competing uses in the tidelands. AMA supports this goal, and suggests the committee approach the issue from the perspective of all tidelands uses. The planning director for the Kodiak Island Borough summed up the situation well at a recent coastal management conference when she suggested it doesn't make any sense to have two sets of rules for use of the tidelands--one for mariculture and one for everything else--when the impacts on competing uses are the same.

Tideland Permits and Leases

Aquatic farming proponents also have raised tidelands issues of great concern to existing and future sea farmers--the instability in mariculture operations created by the current one-year permitting system. Currently, DNR issues one-year permits which are revocable in 30 days without cause and require the tidelands user to reapply each year with no assurances of securing continued use of the site over competing applicants. The only existing alternative is a long-term lease which requires an appraisal and survey costing \$6,000-10,000.

This program should be revamped if the legislature is interested in creating stable mariculture businesses.

Siting Guidelines and Minimizing Environmental Impacts

The environmental impacts of floating mariculture facilities can be minimized by proper siting guidelines. Studies conducted in Washington State and British Columbia have indicated that environmental impacts of properly sited aquatic farms can be minimal. Testimony from the Alaska Department of Environmental Conservation has supported these conclusions.

AMA has provided the committee with siting guidelines for salmon farms which have been adopted by the State of Washington. We believe these guidelines could provide a good starting point for Alaska to develop its own guidelines. While it wouldn't be appropriate to put siting guidelines into statute, the document could provide the committee with some ideas for structuring policy language to guide state agencies in developing siting guidelines.

Ownership and Structure of Salmon Farms

Some members of the public have voiced concern that salmon farms would be owned or controlled by large corporations or foreign interests, and that few benefits would accumulate to Alaskans other than a few low paying jobs. This concern is based upon the perception that smaller salmon farms would not be competitive without massive state assistance.

While it is unclear just what are the economies of scale for salmon farms in Alaska, the existing structure of the fishing industry provides an excellent model for how small operations could be successful. Our fishing fleets are small-scale producers who have close economic relationships with processing corporations which provide the economy of scale for manufacturing and marketing.

Small "mom and pop" salmon farms could be independent "grow out" facilities serviced by existing processing companies providing smolts, feed and other supplies with tendering services. The processors could then purchase the marketable fish from the farmers for processing and marketing through existing infrastructure.

While it may also be difficult for medium-sized salmon farmers to achieve economy of scale through vertical integration, the larger farms could form cooperative arrangements for smolt and feed production, processing and marketing. These operations also could enter into agreements with existing processors to fulfill those functions.

The concern with corporate or foreign control can be dealt with through carefully conceived restrictions on the size of farms and number of permits held by individuals, companies and groups of investors. These restrictions could be combined with a tightening of the definition of Alaska-owned companies or corporations allowed to possess tideland permits.

Disease and Genetics

The Department of Fish and Game has testified that salmon farms and other mariculture operations pose no greater risk to wild stocks than existing enhancement programs, provided similar procedures are followed and the department has adequate resources. The existing disease and genetics policies should be examined in the context of mariculture to determine whether modifications are necessary or public policies should be clarified in enabling legislation.

Economic Impacts on Traditional Fisheries

Another concern raised during public hearings has been the potential for salmon farming in Alaska to adversely affect traditional markets for Alaska salmon. Information generated to date has shown that salmon farming in Alaska should have a minimal impact on traditional salmon markets. The latest report in the growing body of evidence was compiled by two University of Alaska economists who projected a range of adverse impacts of \$600,000 to \$4.7 million. This contrasted sharply with projections for positive economic benefits to Alaska of up to \$300 million.

Cost Recovery

Some have questioned whether mariculture will pay its own way. Mariculture proponents have expressed a willingness to support fair

taxation and licensing structures. To this end, AMA has testified that we are interested in helping the committee draft an aquatic farm product tax similar to the Fisheries Business Tax in effort to ensure the state's direct costs are covered and there is a fair return for the use of common property resources.

Acquisition of Brood Stock from Wild Sources

The present version of House Bill 108 does not provide the Department of Fish and Game adequate ability to balance the needs of existing uses with the needs of aquatic farmers. AMA believes HB 108 should be amended to allow ADFG to turn down wild stock brood stock requests when existing allocations would be affected, in addition to ADFG's authority under the current version to deny brood stock requests that impact the sustained yield. The new language should direct ADFG to refer brood stock requests affecting limited fisheries or in situations when allocations would be impaired to the Board of Fisheries for action.

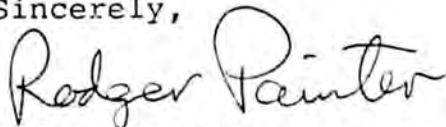
ADFG should grant the brood stock requests in situations where sustained yield or existing allocations would not be affected.

Surplus Salmon Eggs from State and Private Hatcheries

Concern has been expressed that salmon farming will result in the "stealing" of eggs from ocean ranching programs or reductions in catches by commercial fishermen. HB 108 should be amended to make it very clear that salmon farmers will not be allowed to purchase eggs unless they're truly surplus to the needs of ocean ranching programs and will not result in reductions of catches by commercial fishermen.

An April 10 letter from ADFG to Representative Ellis estimates that there were about 88.6 million such surplus eggs in 1986, including 23.2 million coho and 4.6 million chinook eggs. Even larger surpluses are envisioned in future years.

Sincerely,



Rodger Painter
Executive Director

c.c. Members of the House and Senate Resources Committees
 Senator Jan Faiks
 Representative Grussendorf



Dear Madam/Sir:

RE: NORWEGIAN FISH FARMING INFRASTRUCTURE SEMINAR

Based on the outstanding success of last years fish farming seminars in Seattle and Vancouver, the Trade Commission of Norway is sponsoring a one day Fish Farming Infrastructure Seminar in Juneau on June 22, 1987.

A series of speeches by well known members of the Norwegian fish farming community will be complemented by exhibits presented by 18 of the companies in the Norwegian delegation. The purpose is to present the latest in fish farming technology, especially as it relates to infrastructure. New technologies for sea- and land- based production will be covered along with feed formulas and feeding technologies, fish handling, packaging and transportation. These technologies are the results of the substantial, ongoing research and development efforts in Norway.

Participation cost for each seminar is \$ 120.00 and includes seminar materials, lunch, coffee and reception.

We feel the information made available not only at the seminar sessions but also in the company exhibits will provide enhanced opportunities for those presently involved or planning to be involved in the Fish Farming Industry.

Please complete the attached Registration Form and forward, along with your check to:

Trade Commission of Norway
Two Embarcadero Center, Suite 2910
San Francisco, CA 94111

We would appreciate receiving your completed registration material at least one (1) week prior to the opening of the seminar.

Sincerely,

Tor S. Andresen
Tor S. Andresen

Norwegian Trade Commissioner
San Francisco

NORWAY

**FISH FARMING
INFRASTRUCTURE
SEMINAR
JUNE 1987**

PARTICIPATING COMPANIES

AKVA A/S

Computerized automatic feeding system for feeds based on USA and Canada patented water transportation systems.

AQUA SERVICE INTERNATIONAL LTD.
Competitive within areas of construction, biology, financing and administration, allowing complete project management capability.

FACO A/S

Marketer of fresh farmed salmon from B.C. to countries throughout the world, including Japan and the U.S.A.

HELGELAND PLAST

Norway's largest producer of net pens in PEH plastic along with walkways, floats and boats. Helgeland Plast has established a company with production and storehouse in Sechart B.C.

HELLAND MEK. VERKSTED

Experienced supplier of silos and transporters for gentle handling of pellets, bindermeal and silage for the fish farming industry.

INTER-AQUA A/S

Owned by major Norwegian financing, shipping and industrial companies, Inter-Aqua is involved in project development and production of fish.

MA-BO A/S

One of Scandinavia's leading manufacturers of plastic pipes and fittings including floating elements and waste pipelines along with feeding vessels and basins, hatch cylinders, fish turnstiles and other equipment.

MARENOR A/S

Offers facilities for research and full-scale testing in salt and fresh water along with development and participation in production.

MONOPOL - HEMPEL A/S

Developed antigrowth products for fish nets and is today's market leader in this field.

NORDLANDSBANKEN

Nordlandsbanken Bank provides financing and banking services to the fish farming industry.

NORPLAN A/S

Consulting engineers, architects, management consultants and economists serving the fish farming industry.

RENA EMBALLASJE

Pioneers in the field of packaging for airtransport of chilled fresh salmon. Rena Emballasje is the leading manufacturer of solid fiberboard packaging in Scandinavia.

SALCOM AQUACULTURE PRODUCTS LTD.

Markets its broad range of equipment, supplies and services to fish farming operations and hatcheries.

SAS CARGO

Scandinavian Airline Systems Cargo Division, airline carrier, is a pioneer in the air transportation of fresh fish throughout the world.

SCANMARIN AQUACULTURE A/S

Offers a wide range of equipment and services for the fish farming industry including sea cage systems, hydromedical treatment equipment and mooring equipment.

SEA FARM TRADING A/S

A turn-key supplier of equipment products for hatcheries, smolt facilities and growing facilities of salmon and trout at sea.

SINTEF

Scandinavia's largest R & D institution involved with the design and instrument development of new types of sea cages, land and sea based fish farming and farming of marine species.

T. SKRETTEING A/S

Developer, producer and marketer of compound and dry feed along with equipment for hatcheries.

SVACOM A/S

Offers top quality stock organisms from cod, turbot, halibut, salmon - complete sea and land-based plants, feeds and research assistance.

TEKNOTERM A/S

Activities include marketing, mounting and service of heatpump and energy systems, oxygenizing and cleaning systems for the fish farming industry.

UNDERTUN TRADING A/S

Marketer of turn-key land based farms, smolt production and hatcheries equipment.

VANCOUVER B.C.
MONDAY JUNE 15, 1987
PLACE: THE PAN PACIFIC VANCOUVER HOTEL -
CRYSTAL PAVILLION
300-999 CANADA PLACE,
VANCOUVER, B.C. V6C 3B5

PRINCE RUPERT, B.C.
THURSDAY JUNE 18, 1987
PLACE: THE HIGHLINER INN -
THE BALLROOM,
815-1ST AVENUE WEST,
PRINCE RUPERT, B.C. V8J 1D3

JUNEAU, ALASKA
MONDAY JUNE 22, 1987
PLACE: CENTENNIAL HALL CONVENTION CENTER -
SHEFFIELD BALLROOM 3
JUNEAU, ALASKA 99801

8:00 a.m. Registration,
Coffee and Danish
9:00 a.m. Seminar commences
Seminar chairman,
Mr. Jan Erik Hagen, President
Det Norske Veritas
(Canada) Ltd.
Opening of seminar by
Mr. Per M. Olberg,
The Norwegian Ambassador
to Canada
9:15 a.m. Introduction of speakers
by seminar chairman
9:20 a.m. Presentation of delegation
members and participating
companies.
Trade Commissioner
Canada
9:40 a.m. Aquaculture status in B.C.
Mr. Jim Franck, Ministry of
Agriculture and Food, the
Province of British Columbia
Mr. Tom Bruusgaard,
Manager, Noredco
10:20 a.m. Aquaculture in Norway.
Present situation and
the future.
Professor Harald Skjerve,
Board Member
Interaqua A/S
11:00 a.m. Coffee

11:15 a.m. Farming in the ocean,
conventional and
new technology
Mr. Arne Vadseth, President
MARENOR A/S
11:45 a.m. Landbased fishfarming,
Mr. Geir Mykletun, President,
Aqua-division, SVACOM A/S
LUNCH
12:15 p.m. Research and development
trends within fishfarming
technology
Mr. Idar Schei, program
director SINTEF Group
2:00 p.m. Norwegian Experience
with feed formulas
for salmonides
Mr. Egil Thomsen,
International Marketing
Manager, SKRETTEING A/S
2:30 p.m. Norwegian system for
handling, packaging
and transportation of
fresh fish, Mr. Egil Budde,
Marketing Manager,
SAS CARGO, Norway
3:00 p.m. Exhibition by Norwegian
companies
3:45 p.m. RECEPTION
Vancouver
Pan Pacific Hotel
Pavilion A
Prince Rupert
Crest Motor Hotel
Ballroom

8:00 a.m. Registration,
Coffee and Danish
9:00 a.m. Seminar commences
Seminar chairman
Mr. Jan Erik Hagen, President
Det Norske Veritas
(Canada) Ltd.
Opening of seminar by an
Alaskan Government Official
9:15 a.m. Introduction of speakers
by seminar chairman
9:20 a.m. Presentation of delegation
members and participating
companies.
Trade Commissioner,
San Francisco
9:40 a.m. Aquaculture status in Alaska
Mr. Rodger Painter, Executive
Director Alaska Mariculture
Association
10:20 a.m. Aquaculture in Norway.
Present situation and
the future.
Professor Harald Skjerve,
Board Member
Interaqua A/S
11:00 a.m. Coffee
11:15 a.m. Farming in the ocean,
conventional and
new technology
Mr. Arne Vadseth, President
MARENOR A/S

11:45 a.m. Landbased fishfarming
Mr. Geir Mykletun, President,
Aqua-division, SVACOM A/S
12:15 p.m. LUNCH
2:00 p.m. Research and development
trends within fishfarming
technology
Mr. Idar Schei, program
director SINTEF Group
2:30 p.m. Norwegian Experience
with feed formulas
for salmonides
Mr. Egil Thomsen,
International Marketing
Manager, SKRETTEING A/S
3:00 p.m. Norwegian system for
handling, packaging
and transportation of
fresh fish, Mr. Egil Budde,
Marketing Manager,
SAS CARGO, Norway
3:45 p.m. Exhibition by Norwegian
companies
7:00 p.m. RECEPTION
Juneau
Baranof Hotel
Treadwell Ballroom

Yes, I will be attending the Norwegian Fish Farming Infrastructure Seminar in:

☐ Vancouver, British Columbia June 15, 1987 ☐ Prince Rupert, British Columbia June 18, 1987 ☐ Juneau, Alaska June 22, 1987

Cost per seminar is \$120.00 (includes Seminar, Lunch & Reception). Please make cheque payable to Norwegian Trade Commission Fish Farming Seminar.

NAME:

TITLE:

COMPANY:

ADDRESS:

CITY:

POSTAL/ZIP CODE:

Please send completed form and cheque
for Vancouver and Prince Rupert Seminar
to
Trade Commission of Norway
1200 Bay Street, Suite 702
Toronto, Ontario
M5R 2A5
(416) 920-0434

PROV/STATE

TELEPHONE NO.:

Please send completed form and cheque
for Juneau Seminar to
Trade Commission of Norway
Two Embarcadero Center
Suite 2910
San Francisco, California
94111
(415) 986-0770

NORWAY

**FISH FARMING
INFRASTRUCTURE
SEMINAR
JUNE 1987**

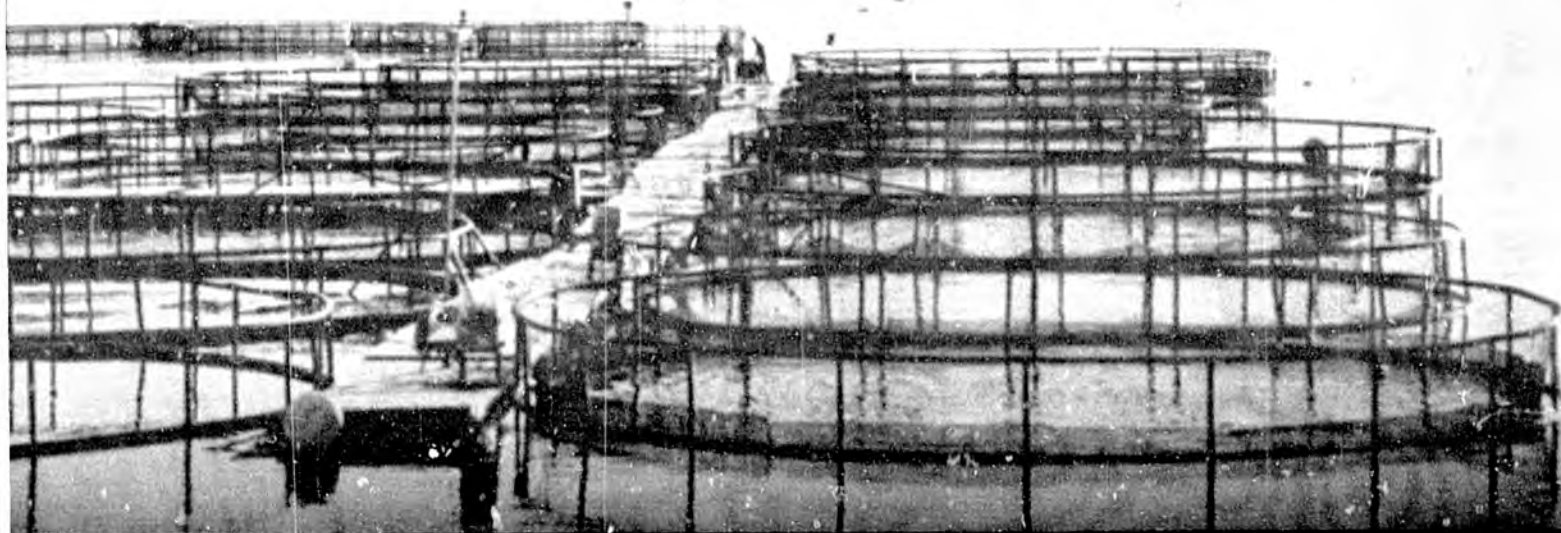


FISH FARMING
INFRASTRUCTURE
SEMINAR
JUNE 1987

PRINTED IN CANADA



FISH FARMING
INFRASTRUCTURE
SEMINAR
JUNE 1987



DRAFT

Aquatic Farming Projections*

DRAFT

Figure 1

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

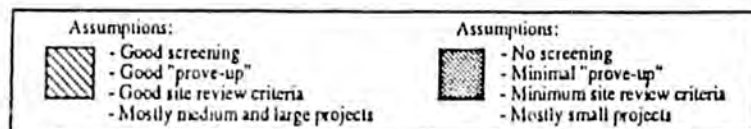
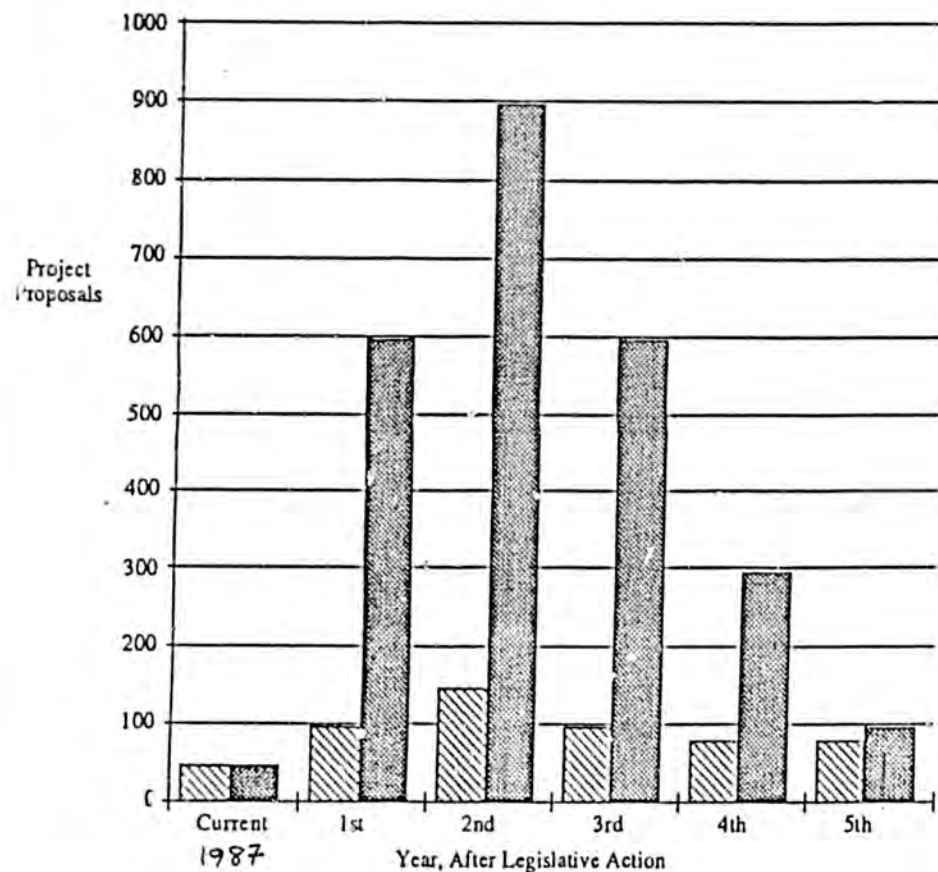
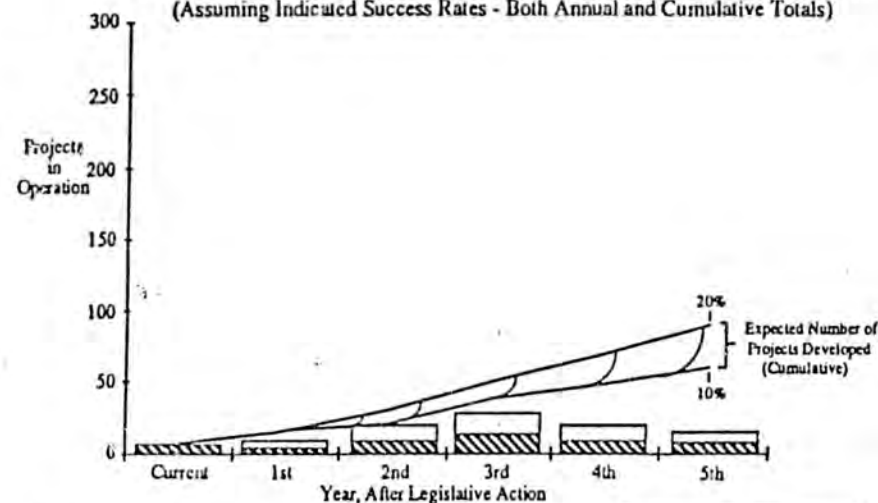


Figure 2A

Estimation of Operating Aquatic Farms After Legislative Action
(Assuming Indicated Success Rates - 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.

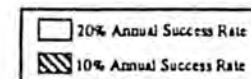
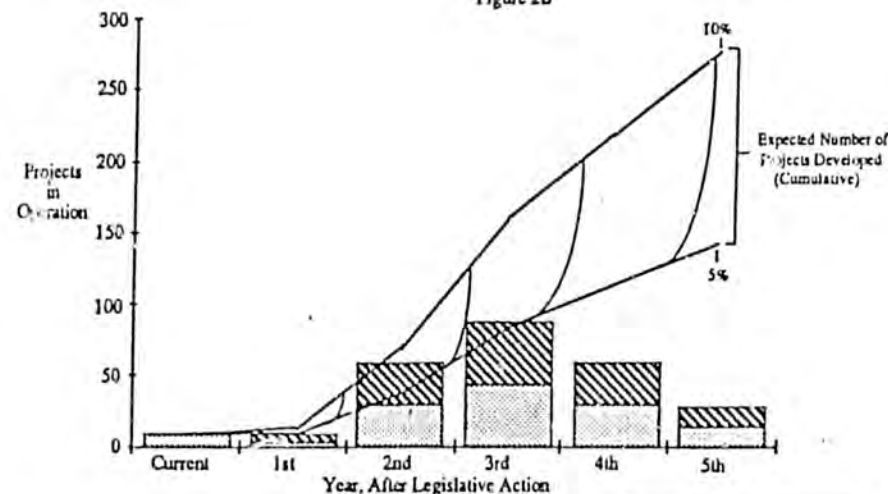
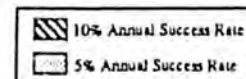


Figure 2B



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).

Call Dutton by end
of next week on
this.

April 27, 1987

Mariculture
Issues Discussion Paper

Governor's
Criteria #1

The mariculture industry must benefit Alaskans.

The mariculture industry must be developed in a manner which does not result in unfair competition with existing fisheries or cause undue economic displacement in our coastal communities. Legislation should, to the extent possible under the law, provide for local hire at mariculture facilities and give preferential access to mariculture permits and mariculture related tidelands leases to Alaskans.

Issue 1: Can the state legally give Alaskans either exclusive or preferential access to mariculture permits? Can legislation have provisions to give priority to Alaskan residents or Alaska-owned businesses or corporations?

Option: a) Have the Department of Law analyze our options, including:

1) Restricting mariculture leases to Alaskan residents or corporations.

2) Give priority for aquatic farm and broodstock permits to Alaska residents or businesses.

Governor's
Criteria #2

The mariculture industry must pay for itself and the state should get a fair return for the use of state resources.

Legislation should contain provisions for recovering administrative and other state costs associated with managing the industry. The legislation should also ensure that the state gets a fair return for the use of tidelands and other resources.

Issue 2: How can the state recover all or part of the administrative and other state costs associated with managing a mariculture program and get fair return for use of state resources (i.e., tidelands)?

Options: a) User fees charged as part of the permitting process to cover administrative costs, the cost of inspections, etc.

b) Fees or "rents" for use of state tidelands and water resources to ensure fair return to the state.

- c) Need to determine reasonable amounts for
a) and/or b) above.

Governor's
Criteria #3

The development of the mariculture industry in Alaska should be done in an orderly fashion which encourages a stable, dependable industry.

Legislation should provide general criteria which will lead to the development of a regulatory program which discourages speculation on permits and tidelands leases, encourages sound financial planning, and provides for a diverse industry ranging from "mom and pop" ventures to larger corporate operations.

Governor's
Criteria #7

Mariculture facilities must be sited to minimize land-use conflicts, maintain navigation and ensure access to upland areas.

Legislation should provide guidance for siting facilities to minimize conflicts with other tidelands users, reducing visual and aesthetic impacts, maintaining navigation and ensuring access across state tidelands.

Issue 3: There needs to be a vehicle to focus the permitting process for mariculture operations. There will be a wide variety of mariculture ventures. Most will require multiple permits and multi-agency review. We need to develop a vehicle to consolidate the various aspects of the application and promote efficient review of each operation. In addition, we need a way to gauge the commitment the applicant is willing to make to seriously develop the project.

Option: Require the applicant to submit a mariculture plan of operations and prospectus. This plan would be prepared by the applicant and used by DGC and agencies in the permit process. It would be the document used to make a initial fit, willing, and able determination (see Issue #4 below) to screen out speculators. The plan would describe the measures used to ensure compliance with water quality standards, disease control measures, etc. Specific elements in the plan could include the location, type of operation, species involved, size and scale of the operation, a financial plan, and a project development schedule to provide milestones to measure the project's progress as part of any "prove-up" requirements.

Issue 4: There is concern that there needs to be an initial screening of applicants to prevent rampant

time review the status of the project. If it is a viable operation then grant a 25-year operational permit/lease.

Issue 6: There needs to be criteria for resolving space-use conflicts. Many excellent sites for mariculture facilities are also highly prized for other uses including log storage, commercial fishing, anchorages, subsistence, and recreation.

Options: a) Use DNR tidelands planning process to resolve space-use conflicts. Land-use plans could address many of these issues, but DNR budgets may need to be adjusted accordingly.

b) Develop standards in the legislation which would provide general guidance to the agencies when reviewing these projects. These criteria would include provisions so that mariculture facilities will be sited to minimize land use conflicts; provide environmental safeguards; maintain navigation and access channels; and reduce visual and aesthetic impacts.

Issue 7: Tidelands leases could be locked up by individuals or businesses which are not actively operating facilities or following through on their commitments.

Options: a) Ensure that tidelands leases are non-transferable from one company or individual to another.

b) Ensure that there are provisions for revocation of the permit and tidelands lease

speculation and to encourage serious mariculture operations. At the same time there is a concern that this "test" not present an insurmountable barrier to small-scale, mom and pop adventures.

Options: a) Perform a "fit, willing, and able" test. This would be an initial determination that the operator is fit, willing and able to successfully conduct operations as described in the mariculture plan of operations and prospects. By tying the fit, willing, and able determination to the operations described in the plan, there should be latitude to allow for mom and pop operations as well as larger corporate ventures. The Department of Commerce and Economic Development would make the determination in consultation with other state agencies, and specific criteria would be developed through

- Option: a) Ask the Department of Law whether or not current statutes authorize DEC inspections.
- b) Develop language authorizing DEC product wholesomeness inspections of mariculture facilities.

Governor's
Criteria #5

Mariculture activities must be managed to ensure protection of the biological integrity of natural plant and animal stocks.

Legislation must address the issues of pathological and genetic protections for natural sea vegetable and fish stocks.

Issue: Ensure that legislation authorizes ADF&G regulation of mariculture activities affecting pathology and genetic protection of natural stocks.

Governor's
Criteria #6

Mariculture activities must be managed in a manner which ensures adequate environmental safeguards and habitat protection.

Legislation must ensure that mariculture facilities are sited, designed and operated to protect air and water quality, to provide for proper disposal of wastes, and to minimize adverse effects to important fish and wildlife habitat.

Issue: Are current statutory authorities sufficient to ensure adequate air/water/habitat protection? What regulatory changes need to be done, if any?

Governor's
Criteria #8

Broodstock acquisition for mariculture purposes should be carefully regulated, especially for species subject to limited entry fisheries.

Legislation should contain provisions limiting the acquisition of broodstock for species subject to limited entry fisheries. Legislation should grant the Department of Fish and Game the authority to regulate the acquisition, transport, and propagation of mariculture broodstock, and provide the Board of Fisheries the ability to resolve allocation decisions regarding broodstock acquisition if necessary.

Issue: The current pending legislation probably satisfies this criteria.

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
SITKA, ALASKA 99835

P.O. BOX V
JUNEAU, ALASKA 99811
(907) 465-4916

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

STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

OFFICE OF THE COMMISSIONER

STEVE COWPER, GOVERNOR

400 WILLOUGHBY AVE.
JUNEAU, ALASKA 99801-1796
PHONE: (907) 465-2400

May 5, 1987

The Honorable Richard Eliason
Alaska State Legislature
P.O. Box V
Juneau, AK 99811

Dear Senator Eliason:

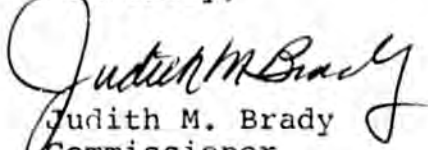
Thank you for your letter of April 2, 1986 regarding a moratorium on mariculture tideland permits. I share your concern that the program proceed in an orderly manner.

As you are aware, an interdepartmental work group has been formed to study the issues and concerns surrounding the potential development of a mariculture industry in Alaska. A moratorium is among the issues under discussion, although a final decision on this issue awaits further study of the legal ramifications of such a moratorium as well as administrative and developmental concerns.

The administration is committed to working with and keeping the Legislature informed of its progress on these issues, and members of the various resource agencies have appeared before the Senate Fisheries Subcommittee to apprise the Legislature of its work on these topics. Please rest assured that your views will play an integral part in any decision.

As always, my staff and I are available to discuss these issues further with you or your staff.

Sincerely,


Judith M. Brady
Commissioner

cc: Commissioner Collinsworth
Commissioner Smith
Commissioner Kelso

MEMORANDUM

State of Alaska

DEPARTMENT OF FISH AND GAME

TO: Grace Schaible
Attorney General
Department of Law

DATE: March 26, 1987

FILE NO.:

TELEPHONE NO.: 465-4100

SUBJECT: Pen-Reared Salmon
Farming

FROM: Don W. Collinsworth
Commissioner
Department of Fish and Game

Thank you for the work you have been doing to research and clarify the authorities presently available to the department to permit mariculture activities in Alaska. The recent hearings in House Resources highlight the interest in this issue. The March 10 memorandum from Sarah McCracken to Commissioner Collinsworth (enclosed) indicated that there may need to be clarification from the Board of Fisheries regarding the use of the Fish Transport Permit to govern the possession and transportation of live fish for farming purposes.

In your opinion, can the department under the current regulation issue permits for these fish farming purposes without action by the Board of Fisheries?

cc: Larri Spengler

Enclosure

DWC/DB/rlc

This was discussed in House Resources this morning. Rep. Herrmann expressed concern that NO answer has been received

Not yet intro-
just thinking about
it

5-1201A
Hein
5/7/87

SewZharoff is
also drafting a
resolution —

1 IN THE HOUSE

BY

2 HOUSE CONCURRENT RESOLUTION NO.

3 IN THE LEGISLATURE OF THE STATE OF ALASKA

4 FIFTEENTH LEGISLATURE - FIRST SESSION

5 Establishing a Joint Committee on
6 Aquatic Farming.

7 BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

8 WHEREAS aquatic farming has taken place in the state on a small scale
9 since the early 1920s and is a clean industry for which the state's south-
10 ern coast is suited; and

11 WHEREAS aquatic farmers have shown an interest in expanding their
12 operations and range of products in response to worldwide consumer trends;
13 and

14 WHEREAS the possibility of the expansion of aquatic farming in the
15 state has generated many questions with regard to potential coastal and
16 resource-user conflicts, the socioeconomic effects on the coastal communi-
17 ties of the state and existing sea harvesting industry, and the effects on
18 the environment and on the biological integrity of Alaska's wild aquatic
19 species; and

20 WHEREAS public testimony overwhelmingly indicates a desire for the
21 development of environmental and biological safeguards before an expansion
22 of the existing industry is allowed in the state; and

23 WHEREAS pending litigation involving the state may result in the
24 state's inability to legally halt the expansion of aquatic farming; and
25 WHEREAS Norway, Japan, British Columbia, and Chile have experience
26 with regulating aquatic farming from which we can learn;

27 BE IT RESOLVED by the Alaska State Legislature that a Joint Committee
28 on Aquatic Farming is established consisting of two members of the Senate
29 and two members of the House of Representatives; and be it

1 FURTHER RESOLVED that the Joint Committee on Aquatic Farming, after
2 holding public hearings, shall develop proposals for the state's policy on
3 aquatic farming, taking into account the experiences of other countries and
4 the socioeconomic effects of worldwide aquatic farming on existing Alaska
5 sea harvesting industries; the committee shall report its recommendations
6 and findings to the Legislature on the first day of the Second Session of
7 the Fifteenth Alaska State Legislature; and be it

8 FURTHER RESOLVED that the committee may hire staff to assist in the
9 duties of the committee and may appoint advisory committees; and be it

10 FURTHER RESOLVED that the committee may meet during and between
11 sessions of the Fifteenth Alaska State Legislature and shall terminate at
12 the end of the 10th day of the Second Session of the Fifteenth Alaska State
13 Legislature.
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STATE OF ALASKA

DEPARTMENT OF COMMERCE & ECONOMIC DEVELOPMENT

OFFICE OF THE COMMISSIONER

BILL SHEFFIELD, GOVERNOR

POUCH D
JUNEAU, ALASKA 99811
PHONE: 465-2500

April 16, 1987

Honorable Richard I. Eliason
Alaska State Senate
P.O. Box V
Juneau, AK 99811

Dear Senator Eliason:

I have reviewed your March 30 letter regarding department plans for a mariculture socioeconomic study in the event that funding becomes available in the near future.

While a number of studies have been released, I would agree that those currently available address areas other than the impact on the Alaska fisheries industry. I understand that Mr. Robert R. Logan, Assistant Professor of Economics at the University of Alaska-Fairbanks, is nearly finished with a report detailing the impacts of salmon farming in Alaska. His results should be available soon; however, I have not had the opportunity to review his assumptions or evaluate the validity of his work. His office indicates that the work should be completed within the month.

In addition, the Department of Commerce and Economic Development is currently working on a supply/demand study for all salmon species that is aimed at pacing increases in production (primarily through hatcheries) to demand. While focused on pink and chum salmon, the data base is the most extensive and complete in the country and includes all salmon species. We undertook this study in-house, with the Office of Research, Analysis and Support doing the economic analysis. Due to difficulties in obtaining a data base adequate to do projections and due to other demands on the staff's time, the project is still several months from completion. While the modeling and data analysis are incomplete, several conclusions concerning the data and the ability to predict future events can be made.

First, the data is most complete for king salmon. The coho price data available is not as thorough. Atlantic salmon price data only go back four years in a useable format. Production and consumption data for Atlantic salmon show major increases each year -- a steeply increasing

demand curve, with little change in price. This indicates expansion into a new market. It is not clear yet whether there is a statistically valid correlation between Atlantic salmon production and price for kings and cohos. The decline of the dollar, the rapidly expanding market for fresh salmon and other factors complicate the relationships.

In order to project the effects of increased pen reared production, it is necessary to either have adequate historical data to define the demand curve or to make a number of assumptions that will shape the demand curve. The shape of the demand curve is fundamental to determining the impact of increased production on price. As the projected production is two to three times the current level, any projections must be based on assumptions rather than hard numbers.

Another consideration is that the Alaskan increment of production is expected to be quite small in comparison to projected worldwide production. To measure its impact with any degree of confidence would require a very good data set or very accurate assumptions. At this macro level of analysis, it seems unlikely to have much impact on price, though the worldwide production impact is likely to be significant.

To demonstrate the problem, the projected worldwide production of pen reared salmon by 1995 is roughly 250,000 metric tons. The entire west coast production of king and coho salmon from common property fisheries, including British Columbia, has averaged 70-80,000 metric tons over the last 10 years. The highest realistic Alaskan production figure is 10,000 metric tons, which is unlikely to occur before 1995. In 1995, the Alaska increment of production would be 3% of the worldwide total. That increment would be added to a rapidly increasing total, if supply projections are accurate.

Clearly there are many assumptions necessary to construct demand and supply curves. Any study would require projections of production, estimates of various market sizes and price levels, and estimates of production costs in various producing areas. Much of the discussion by pen rearing opponents seems centered on the assumption that the studies available to date were conducted by pen rearing proponents and are by definition based on biased assumptions. A similar charge could be leveled at opponents' assumptions. Unfortunately, there is no way to deal with the issue without making assumptions.

I believe the best way to deal with the dilemma is a Delphi study of 25 or so marketers and producers of Pacific and Atlantic salmon, academicians, and government analysts. Care would be taken in the selection of the panelists to get a balanced group. By asking the group to make the necessary projections and by working to achieve consensus, the resulting assumptions should be the best available. The range in responses and the difficulty in reaching consensus should

April 16, 1987

provide a measure of the confidence in the results. The resulting "assumptions" would be used to build beyond the range of existing data, to predict market price through time as production increases and the market matures.

The amount of time required would likely be six to nine months, and if done in-house could be done for less than \$50,000 if there are economists available. We are, however, faced with the probability of transfer of the analysis staff to the Office of the Governor. In the event of transfer, the study would have to be contracted out, though the models already done should be of some use, and the department has a macroeconomic model which can be used to predict the overall economic effects. In the case of a Delphi-type study, bias is not as much a consideration as the contractor's ability to perform, as the result is a consensus decision by expert panelists.

I hope that I have answered your questions. While I have serious reservations about whether we can get definitive answers to the questions you ask, and whether any crystal ball gazing can be free of bias charges, we would perform the study in a professional and competent manner whether in-house or under contract.

In my absence, I would ask that you direct your comments and inquiries to John Williams. Please do not hesitate to ask if we may be of further assistance.

Sincerely,



J. Anthony Smith
Commissioner

JAS/cw5168c
41687a

cc: William G. Paulick
Office of Commercial Fisheries Development



MOSS LANDING MARINE LABORATORIES

CALIFORNIA STATE UNIVERSITY FRESNO, HAYWARD, SACRAMENTO, SAN FRANCISCO, SAN JOSE, STANISLAUS

P. O. BOX 450
MOSS LANDING CA USA
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APR 17 1987

April 10, 1987

Dear Senator Cochill,

I moved to Alaska in 1981 and fell in love with the State. Later I graduated from U.A.A. with a degree in Natural Science. Currently I'm in California attending graduate school as a Marine Biology/Ichthyology student with the intention of returning to Alaska when my course work is completed.

While I was in undergraduate in Alaska I worked as a seasonal wide creel censusing salmon for the Department of Fish and Game Sportfish Division. I am very proud of the Alaskan salmon runs and the progressive management by the State of Alaska that has ensured the continuation of healthy wild salmon stocks.

I am not proud that the Alaskan lawmakers are apparently conforming to reactionary, uninformed, and grossly induced tactics being used by special interest groups to stymie the development of mariculture. Just last week I attended a meeting of the Pacific Fisheries Biologists in Portland, Oregon where the strongest sentiments expressed were of regret for failing to develop mariculture for the fish export market. Oregon is now importing more salmon annually than their commercial fishery produces.

Commercial fishermen work very hard for their living and I would not deny them the opportunity to earn their livelihood. But I do object to a select, self-interested group overriding the best interests of Alaska. It should be kept in perspective that the ocean and the fish that the commercial fishermen are exploiting are public resources.

Compared to the world development of mariculture, the United States is a laggard country. The countries that have committed to mariculture have been very successful (Chile, Norway, Japan, Italy for example) and are exporting fish around the world.

Because of heavy exploitation, Alaskan salmon stocks are now carefully regulated. Similarly the quality of mariculture operations can be regulated through the permitting processes and revenues generated by licensing.

The time is right for Alaska to diversify it's economic base. Mariculture, like commercial fishing, is hard, honest work. If Alaska continues to block the efforts of would-be maricultural

entrepreneurs, the development will happen elsewhere where the political climate is more receptive. As a consequence, the fish will still be produced and exported worldwide, at no benefit to Alaska.

I will be finishing my Master's Degree in 1988 and I hope to be able to return to Alaska to develop my own mariculture business. If I'm faced with an uphill battle all the way and denied the opportunity to earn a living in the manner I choose, I'll be forced to go elsewhere. That's the cold, hard reality for Alaska. Alaska can't afford to lose creative, forward thinking people that care about the State and its future.

Sincerely,

Lucy Wold

Lucy Wold



Desk of Sheila

COOPERATIVE EXTENSION SERVICE

UNIVERSITY OF ALASKA, USDA & SEA GRANT COOPERATING

MARINE ADVISORY PROGRAM
2221 E. Northern Lights Blvd., Suite 220
Anchorage, Alaska 99508-4131
(907) 274-9691

April 24, 1987

Senator Richard Eliason
Chair, Senate Rules Committee
Alaska State Senate
P. O. Box V
Juneau, Alaska 99811

Dear Senator Eliason:

Enclosed are two recent reports on aquaculture. One is a general review of aquaculture in Japan. In particular, note Professor Fuji's concerns with overcrowding and disease. This has been a particular problem with growing seaweeds in areas of high pollution.

I have attended conferences on aquaculture in Japan where disease was discussed. It appeared to affect the cultivated stocks, but I heard no reports of the same thing happening in wild stocks. Overcrowding and man caused pollution from city and industry were the cause.

I hope this is of use to you.

Sincerely,

John P. Doyle
Professor of Fisheries

enclosures

Im



Marine Fisheries REVIEW



On the cover: An adult male northern fur seal, *Callorhinus ursinus*. Photograph by Charles Fowler, NMFS National Marine Mammal Laboratory, NWAFC, Seattle, WA 98115.



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Editor: W. Hobart

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Pen Rearing Pacific Salmon, *Oncorhynchus* spp., in San Francisco Bay

WILLIAM S. LEET, ROGER E. GREEN, and DANIEL RALPH

Introduction

Saltwater net-pen culture of Pacific salmon, *Oncorhynchus* spp., is a recent development in salmonid management. The technique consists of transferring smolts directly from fresh water into saltwater net pens. The salmon are reared in salt water, where their growth rate is accelerated, and at the appropriate time or size of fish, they are released or harvested for marketing.

Research on saltwater pen rearing on the U.S. west coast was initiated in 1969 by the National Marine Fisheries Service's (NMFS) Northwest and Alaska Fisheries Center at its Manchester Field Station on Clam Bay in Puget Sound, Wash. (Novotny, 1975). Coho, *O. kisutch*, and chinook, *O. tshawytscha*, salmon held in saltwater net pens in Puget Sound beyond the time of their normal migration into the sea tended to remain in the Sound and were more accessible to recreational fishermen (Novotny, 1975; Moring, 1976). In addition, chinook salmon were found to

Figure 1.—Pacific salmon pen-rearing study area.



ABSTRACT—Chinook, *Oncorhynchus tshawytscha*, and coho, *O. kisutch*, salmon were pen-reared in San Francisco Bay from 1974 to 1979 at the NMFS Southwest Fisheries Center's Tiburon Laboratory, Tiburon, Calif. Environmental and experimental conditions varied from year to year and tag returns indicated an inconsistent contribution of the different pen-reared groups to the local sport fishery and ocean harvest. The best results were from chinook salmon reared in 1976. Although commercial applications of pen rearing in San Francisco Bay might succeed, we do not see the release of pen-reared fish as an effective management technique for increasing the ocean catch in California.

return to streams closest to the pen-rearing site rather than to their natal or hatchery streams (Novotny, 1975). Such delayed release of pen-reared salmon resulted in improved returns to the fishery as well as better spawning escapement (Mahnken and Joyner, 1973).

The authors are with the Tiburon Laboratory, Southwest Fisheries Center, National Marine Fisheries Service, NOAA, 3150 Paradise Drive, Tiburon, CA 94920. The current address of R. E. Green is Tin Cup Road, Darby, MT 59829. The current address of D. Ralph is 8 Fifth Street, West Keansburg, NJ 07734.

The Squaxin Indian tribe, Shelton, Wash., has pen-reared coho salmon since 1976 and is currently releasing over 1 million fish annually. This program has increased the tribal catch dramatically. Consistent returns of 15-20 percent are being achieved¹.

In 1974, the NMFS Southwest Fisheries Center's Tiburon Laboratory, Tiburon, Calif. (Fig. 1), in cooperation with the San Francisco Tyee Club (a

¹Tim Tynan, Squaxin Indian Tribe, Shelton, Wash. Unpubl. data.

recreational fishermen's association), the California Department of Fish and Game (CDFG) and the University of California Cooperative Extension Service—Sea Grant (UCSG) began a series of salmon pen-rearing and release experiments to investigate the feasibility of pen rearing in San Francisco Bay. The primary objectives were to learn if seawater pen rearing of Pacific salmon would be possible in San Francisco Bay and if a recreational coho fishery could be established inside the Bay. As the study progressed, we added the ancillary objectives of measuring the contribution of pen-reared salmon to the ocean harvest and determining if pen rearing salmon in San Francisco Bay would be a cost-effective technique for augmenting the ocean harvest of Pacific salmon.

Rearing Environment

The pen-rearing site at the Tiburon Laboratory was on the northeast shore of the Tiburon Peninsula on San Francisco Bay (Fig. 1). The pens were fastened alongside a concrete quay where the depth was 3.2 m at mean lower low tide and the mean daily tidal range was 1.75 m. Tidal currents typically reached 1 km/hour. The pens were exposed to wave action from wakes of passing ships and from wind waves ranging up to 1.6 m. Annual ranges in salinity and temperature recorded at the pen-rearing site were 9-31‰ and 9.5°-21.0°C, respectively.

Net-pen enclosures, constructed of nylon mesh in the form of topless rectangular boxes, were hung from floats which also served as walkways (Fig. 2, 3). Mesh sizes were 22-32 mm stretched measure. To prevent deformation of the net in tidal currents, plastic gallon jugs filled with sand were suspended from lines inside each corner, and at about 1.8 m intervals along the sides and ends.

Predaceous seabirds were excluded from the open tops of the net pens by nylon nets stretched over the pens about 1 m high on pipe stanchions and polypropylene rope crisscrossed over the pen structure.

Pen-Rearing Procedures

Table 1 summarizes information on

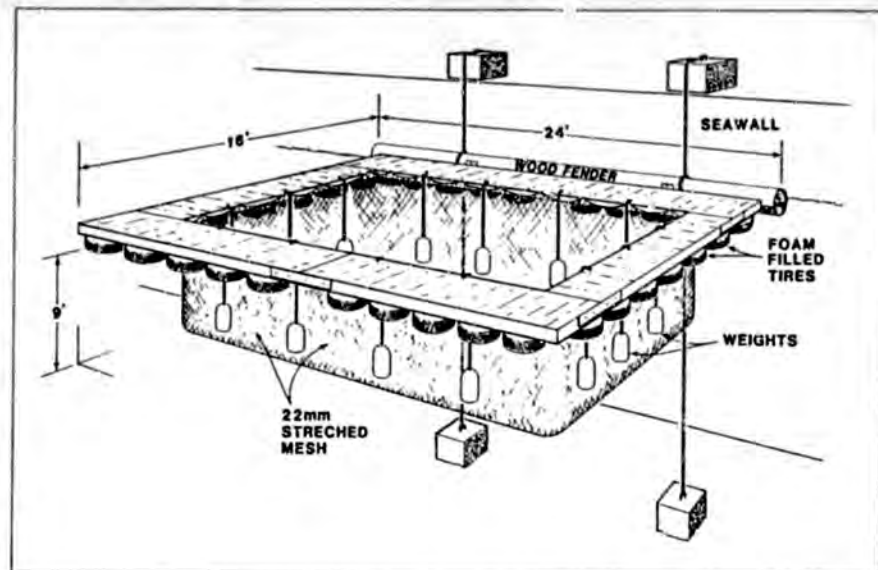


Figure 2.—Diagram of rearing pen.

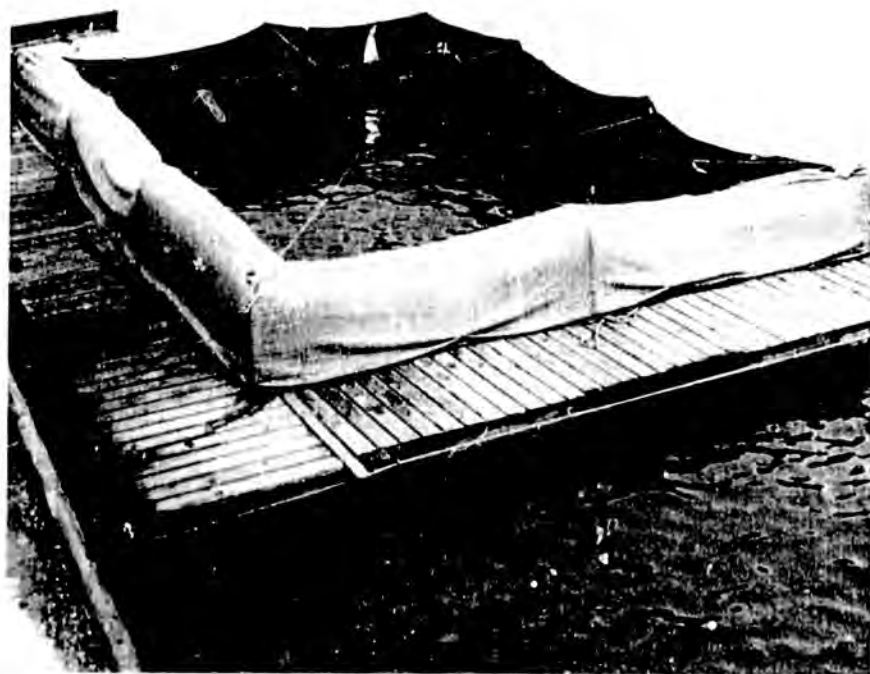


Figure 3.—Rearing pen in place.

the nine groups of salmon reared during the study. Coho salmon were initially selected for the pen-rearing ex-

periments on the basis of the NMFS Manchester Field Station reports and the evaluation guidelines given by Novotny

Table 1.—Summary of details pertaining to Pacific salmon pen-reared and released at the Tiburon Laboratory, 1974-79.

Group no.	Species	Brood stock	Last hatchery	No. fish delivered	Release date	Days in pen	No. fish released	Mean size (g/fish)	
								at delivery	at release
1	Coho	Noyo R., Calif.	Mad R., Calif.	10,000	11/06/74	119	4,000	15	200
2	Coho	Kalama R., Wash.	Mariculture N.W., Wash.	40,000	11/24/75	116	30,320	19	220
3	Coho	Alsea R., Oreg.	San Joaquin, Calif.	30,000	3/31/76	74	5,700	62	90
4	Chinook	Fall run Feather R., Calif.	Feather R., Calif.	20,250	12/17/76	78	6,900	34	103
5	Coho	Skagit R., Wash.	Mad R., Calif.	30,000	7/14/77	128	3,430	23	131
6	Coho	Toutle R., Wash.	Aqua Dell, Oreg.	28,250	9/12/77-11/08/77	53-110	9,220	22	86 206 233
7	Chinook	Fall run Feather R., Calif.	Feather R., Calif.	100,480	6/13/78	53	24,700	3.2 3.5	7.9
8	Chinook	Fall run Feather R., Calif.	Feather R., Calif.	100,000	10/26/78, 11/03/78	129-136	19,900	6.7 8.5	68 85
9	Chinook	Fall run Feather R., Calif.	Feather R., Calif.	76,050	11/20/79, 11/21/79	92-93	12,720	14	75

(1975). These reports indicated that cohos are more resistant to disease and handling mortality during saltwater culture than chinook salmon, and exhibit good first-year growth in salt water. Also, since coho salmon are not normally found in either the Sacramento-San Joaquin River system or the San Francisco Bay-Delta system (Hallock and Fry, 1967) we could assume that most cohos found near the rearing site or upstream had originated at our net pens.

Smolts (young fish physiologically capable of osmoregulating in seawater) were provided by State or Federal hatcheries in California or were purchased from commercial hatcheries in Oregon or Washington. The fish were delivered to Tiburon by hatchery trucks usually equipped with refrigeration and recirculating pumps.

Several factors led to our decision to use chinook salmon for the final three rearing experiments. They were readily available from California State hatcheries free of charge, whereas cohos were not, and funds were not available to purchase cohos from commercial hatcheries. In addition, we had successful results with the chinooks reared in the Group 4 experiment.

Groups 1, 2, and 5 (Table 1) were

inoculated against *Vibrio anguillarum* by vaccine injection at least 2 weeks before transport. Group 9 was inoculated against *V. anguillarum* by immersion in vaccine. The other groups were not inoculated.

In 1974, the first year of the pen-rearing experiments, the fish were fed Oregon Moist Pellets² (OMP). Thereafter, rearing capacity was quadrupled and dry-pellet salmon diets were substituted because sufficient refrigerated storage capacity for the OMP was not available.

Feeding rates of 3-5 percent body weight per day were used, dividing daily rations into four feedings. For groups with a large size range, the daily ration was divided into three feedings so that toward the end of each feeding period there was food left for the smaller, less aggressive fish after the larger ones had fed to satiation.

Pen stocking did not exceed the recommended density of 16 kg/m³ (Novotny, 1975). As the salmon grew, fish were transferred to avoid exceeding this capacity.

After release of the salmon, nets were

²Mention of trade names or commercial firms does not imply endorsement by the authors or the National Marine Fisheries Service, NOAA.

Table 2.—Summary of tag release and return details for groups of salmon pen-reared at the Tiburon Laboratory, 1974-79.

Group no.	Tagged ¹ fish released (no.)	Tag ¹ returns (no.)	Percent return	Adjusted ² return rate (%)
1	4,000 N	16 N	0.4 N	— ³
2	300 F	2 F	0.3 F	— ³
3	7,631 C	67 C	0.9	3.9
4	4,717 C	42 C	0.9	3.9
5	2,645 C	144 C	5.4	23.5
6	2,417 C	2 C	0.1	0.4
7	6,433 C, B	13 C	0.2 C	0.8 C
8	16,300 N	275 N	1.7	— ³
9	18,500 N	2,461 N	13.3 N	— ³
	1,400 C	20 C	1.4 C	5.9 C
	12,720 n	1,435 N	12.8	— ³

¹Tag types: B = Freeze brand, C = Carlin, F = Floy dart, and N = nose.

²Adjusted for tagging mortality/tag shedding.

³The tagging mortality/tag shedding adjustment factor of 4.32 demonstrated for Carlin tags only.

removed from the Bay and hung to dry. The nets were cleaned of fouling growth, inspected, and mended. At the end of the rearing year, pen sections were disassembled in the water, lifted out, and inverted for drying. When the sections were dry, the fouling organisms were scraped away and repairs were made. The work was usually accomplished in less than 100 worker-days.

Tagging

All 10,000 coho salmon of Group 1 (1974) and many chinook salmon in Groups 7, 8, and 9 were internally nose-tagged with binary-coded magnetic wire tags (Jefferts et al., 1963) and adipose-fin-clipped for field recognition (Table 2). Additionally, 600 fish from the 1974 rearing were double tagged with plastic dart tags (Dell, 1968). Carlin tags (Saunders, 1968) were used from 1975 through 1978. Tagged fish were held in recovery pens until normal feeding behavior resumed—usually 1-2 days. Mass releases into the Bay were timed for an ebbing tide when the water was turbid to help conceal them from predators.

In addition to being Carlin-tagged, one group (Group 6) was also freeze-branded (Mighell, 1969) to test the effectiveness of this less expensive marking procedure. For this test, a 6.35 mm dual brand (symbol IH) was applied under the dorsal fin. When fish were not

marked and therefore not counted, the number released was estimated by weighing and counting random samples of the fish as they were dipnetted from the pens.

Pen-Rearing Experience by Year

Between July 1974 and November 1979, nine groups of salmon were reared and released at the Tiburon Laboratory saltwater pen site. Tables 1 and 2 summarize details of rearing and tag returns. Because of the great experimental dissimilarity among the rearing groups, we present here notes, by group, on our experiences in rearing these fish. Group numbers match those used in Tables 1 and 2.

Group 1, 1974

In the first year of the project, 10,000 coho salmon were reared in one pen as a pilot study. The fish, from Noyo River brood stock, were hatched and reared by CDFG at the Mad River Fish Hatchery, Arcata, Calif. They were injected with vibrio vaccine when they were nose-tagged at the hatchery. They were delivered to the Tiburon Laboratory and placed in a floating pen on 10 July 1974 at an average size of 15 g.

Observed mortalities in this group of fish during pen rearing were 2,845, of which about 10 percent were found on the surface. The release of an estimated 4,000 fish revealed an inventory discrepancy of 3,000 fish. The problem of unaccountable inventory losses was also prevalent in each succeeding rearing throughout the later years, and has been reported by other workers who have reared salmon in pens³.

Group 2, 1975

This group of coho salmon was obtained from a commercial salmon grower in Washington. They had already been injection-immunized for vibriosis. On 1 August, 40,000 fish were delivered to Tiburon and placed in one net pen.

For several days, the salmon were fed a mixture of OMP and dry pellet feed

prayed with fish oil. After this adjustment period, they were fed a straight diet of dry pellets. As the salmon grew, they were transferred to other net pens until they were about equally divided among four pens. This group experienced fewer problems and greater survival during rearing than any other group. On 24 November, the 30,320 fish remaining were released; 7,631 of these were tagged.

Group 3, 1976

Yearling coho salmon were the first of two groups reared in 1976. Because the fish were delivered on short notice, the pens and nets were not ready; however, two above-ground plastic swimming pools were available for use. These pools were supplied with Bay water by a submersible pump.

On 16 January the salmon were delivered and stocked in the two pools. One net pen was made ready, and 7,500 fish were transferred to it on 4 February. That night the pump supplying the pools failed and the 22,000 fish still in the pools suffocated by the next morning.

The salmon placed in the net pen were the largest received during the entire project and had a large size range (20-270 g), as they had never been graded during their year of hatchery rearing. This presented feeding problems due to the dominance of the larger fish.

Pen rearing lasted through March, and the fish were released on 31 March. Of the 5,700 released, 4,717 had been Carlin-tagged the week before.

Group 4, 1976

Cohos were not available but 20,250 fall-run chinook salmon were obtained from the CDFG Feather River Hatchery in Oroville, Calif. These fish were just under 1 year old, and upon delivery on 1 October they averaged 34 g. They had not been vaccinated against vibriosis.

On 14 November waves broke the first pen loose from its moorings and about 12,000 salmon escaped before the net was repaired and the pen returned to its mooring. The remaining fish were unharmed.

This group, the first chinook salmon reared in the project, was healthier than

most others. Size range was small and all fish appeared to feed well throughout the rearing period. They were hand-fed dry pellets four times per day at a daily ration of 4 percent of their weight. No disease problems were encountered. We were impressed by the ease of rearing and the good growth rate for this first group of chinooks, both being contrary to reports that chinook salmon were more difficult to rear than cohos. On 17 December, after 78 days of rearing, the surviving 6,900 chinooks were released, 2,645 of which were Carlin-tagged.

Group 5, 1977

These coho salmon from the Mad River Hatchery were delivered to Tiburon on 3 March. At delivery, the 30,800 fish had a mean weight of 23 g (range 10-199 g). A high incidence of cannibalism was anticipated, and was verified by observation. The cohos appeared to be in poor health at delivery and suffered heavy mortality during their confinement. At release on 14 July, only 3,430 fish remained, of which 2,417 were Carlin-tagged.

Group 6, 1977

This group consisted of coho salmon from Toutle River (Washington) brood stock reared in fresh water at Aqua Dell Farms in Oregon. A total of 28,250 salmon, averaging 22 g, was delivered to Tiburon on 21 July. Initial mortality in this group was high: 33.1 percent of the number delivered died within the first 5 days.

Freeze-branding and Carlin-tagging began on 7 September, about 1½ months after the fish were introduced into the net pen. The number of marked fish released was 6,433. These were the last coho salmon reared and released during the project.

Group 7, 1978

Chinook salmon for the 1978 and 1979 rearings were obtained from fall-run Feather River brood stock spawned and reared by CDFG at the Feather River Hatchery, Oroville, Calif. The first 1978 group was delivered to Tiburon on 21 April and consisted of about 100,480 fish, of which 38,160 were nose-tagged.

³A. Novotny, NMFS Northwest and Alaska Fisheries Center, Seattle, Wash. Personal commun.

We planned to rear tagged and untagged fish in adjacent pens. However, the net pen into which the untagged fish were being stocked was of a slightly larger mesh size which allowed some of the fish to escape. After the problem was discovered, the remaining untagged fish were put into the smaller mesh pen with the tagged fish. On the third day after delivery, nose-tagged fish averaged 3.5 g and untagged fish averaged 3.2 g; these were the smallest salmon received during the project.

The fish were reared for 53 days and the 24,700 remaining after disease mortality and escape were released on 13 June. At an average weight of 7.9 g, these fish were smaller than those of any other release group. Indeed, they were smaller at release than the mean size of any other group at delivery.

Group 8, 1978

The second group of chinook salmon in 1978 was composed of 50,000 nose-tagged and 50,000 untagged fish, reared in separate pens. The nose-tagged fish were delivered on 19 June, and the untagged fish the following day. The same problem of fish escaping the pens occurred with these untagged fish as had occurred in the spring delivery; there were two distinct size modes of fish, and the smaller ones easily passed through the net. Weight samples were taken 2 days after delivery. Nose-tagged fish averaged 8.5 g and untagged fish 6.7 g.

For prophylactic treatment, Terramycin was administered in the food for 10 days, starting with the initial feeding. When the Terramycin was discontinued on 29 June, tagged fish began to die in increasing numbers, and heavy mortality occurred on 5 July. The dying fish exhibited whirling behavior, external lesions, and hemorrhaging fins.

On 7 July, live samples of tagged and untagged fish were examined at the State Fish Disease Laboratory. Preliminary diagnosis for the tagged fish was vibriosis. No disease organisms were detected in the untagged fish; however, a vitamin deficiency was found. Thereafter, Terramycin and vitamin supplements were added to the feed.

The untagged fish suffered a negligible mortality rate, but many had

escaped. On 17 August the net pen with untagged fish was inventoried and at least 35,000 fish were unaccounted for. The counting process killed 25 percent of those remaining. Several factors, in particular heavy scale loss and high water temperature, may have been responsible.

The nose-tagged fish were released on 26 October. On the release date a tag-retention check was performed which indicated 98 percent retention of the coded-wire nose tag.

The remaining untagged fish were Carlin-tagged 30 October-1 November. Only 2,000 of the expected 9,600 were present in the net pen. These fish, the last to be Carlin-tagged in the project, were released on 3 November 1978.

Group 9, 1979

In the final rearing experiment, two separate groups of chinook salmon were used—one reared in net pens as in previous years and the other released at the pen site upon delivery. Each group was nose-tagged. The second group served as a control to learn the effects of saltwater rearing and delayed release on survival. Both groups received identical treatment during freshwater residence, including immersion vaccination against vibriosis. Fish were delivered on 20-22 August. Average weight of both groups at delivery was 14 g. The pen-reared group numbered 76,050 fish and the release group numbered 24,800.

Feed rations were maintained at 3 percent throughout the rearing period, and Terramycin and vitamins were added at regularly scheduled intervals. Sulfamethazine was administered for 5 days immediately following the removal of a few dead fish from two of the net pens; however, no epidemic problems were encountered as in the previous year's two rearings.

The fish were released 20-21 November. The number released, adjusted for tag recognition percentages provided by CDFG, was 11,223 at an average weight of 75 g. The total number released was 12 percent higher. The adjusted figure for the control group was 21,730. The adjustment for tag recognition purposes is an estimate based on the size of fish, the experience of the tagging crew, and

other factors which might affect tag retention and recognition of the adipose-fin clip.

Results and Discussion

Growth

The average weight of salmon in all groups increased exponentially with time during the rearing period. Growth curves fit to average weight at delivery and release for all nine groups of salmon are presented in Figure 4. The mean weight of each rearing group (except 3, 4 and 5) doubled during each 30- to 32-day period they were in the pens.

Group 3 cohos, yearling fish delivered in January 1976, grew more slowly than any other group. Their mean size was large at delivery and the size range was extreme. Both factors, together with cool winter water temperatures, probably accounted for the slow growth.

Somewhat slower growth was noted in Groups 4 and 5 than in the remaining six groups. For Group 4, the likely cause was cool water; for Group 5 the range of size at delivery was so extreme that the growth curve based on mean size was of little significance.

Tagging Mortality, Tag Shedding, and Tag Recognition

The returning coho salmon from the 1975 and 1976 releases provided an opportunity to estimate the combined tag shedding and tagging mortality of these Carlin-tagged fish during their time spent at sea. The releases consisted of the 1975 fall and 1976 spring Tiburon releases, and a 1975 UCSG release which had been held at Tiburon for a week before transfer to and rearing in Tomales Bay. The Tomales Bay salmon apparently imprinted to the Tiburon site, as returns for this group were recorded only at Tiburon.

The estimation of tagging mortality and/or tag shedding involved comparing numbers of tagged and untagged salmon released with the numbers of tagged and untagged returning salmon captured in a gill net set at the pen site in 1976. All returning cohos were assumed to be returns from the 1975 and 1976 releases rather than wild stock, as

wild cohos were not normally found in the San Francisco Bay-Delta system. None of the adipose-fin-clipped cohos released in 1974 were caught in the gill net. The gill net was assumed to be an unbiased sampling gear with respect to untagged and tagged fish. A *t*-test was used to determine if the length of tagged and untagged fish had the same mean. Mean length was equal at the 0.01 significance level so the assumption seemed justified.

Given these circumstances, the percent tagging mortality and/or tag shedding while at liberty is:

$$M = \left[1 - \left(\frac{C_t}{R_t} \right) \div \left(\frac{C_u}{R_u} \right) \right] \times 100,$$

where *M* = tagging mortality and/or tag shedding,

C_t = number of tagged salmon recaptured by gill net,

R_t = number of tagged salmon released,

C_u = number of untagged salmon recaptured by gill net, and

R_u = number of untagged salmon released.

It was not possible to distinguish between tag shedding and tagging mortality, as only tagged vs. untagged fish were discernible after return to the gill net. The tagging mortality/tag shedding rates in these releases were very high. Only 20 tagged salmon were among the 159 caught in the gill net. Of the total of 43,118 salmon released, 16,552 were tagged. This would indicate a tagging mortality and/or tag shedding rate of 77 percent.

It follows that, in the absence of such tagging mortality/tag shedding, 4.3 times as many tagged fish would have been recaptured. This adjustment was used in estimating return rates (Table 2). An assumption has been made that the tagging mortality/tag shedding rates were the same for all groups of Carlin-tagged fish and has been used in estimating the percentage of tag recoveries for all groups released with Carlin tags.

In the case of nose-tagged fish, re-

coveries from the sport and commercial ocean catch are made by samplers at each port where the fish are landed. Total nose-tagged fish returns are then estimated by the CDFG by dividing the number of actual recoveries by the percentage of the landings sampled. This calculation estimates the number of nose tags that would be recovered if all the landings were censused.

Our freeze-branding trial produced no

returns. It can be concluded that the marks faded, because Carlin-tagged fish that were recaptured from group 6 showed no evidence of having been freeze-branded.

Tag Returns

Tag returns are important because they measure the contribution of each group to the fishery. Several factors in this study make it difficult to analyze the

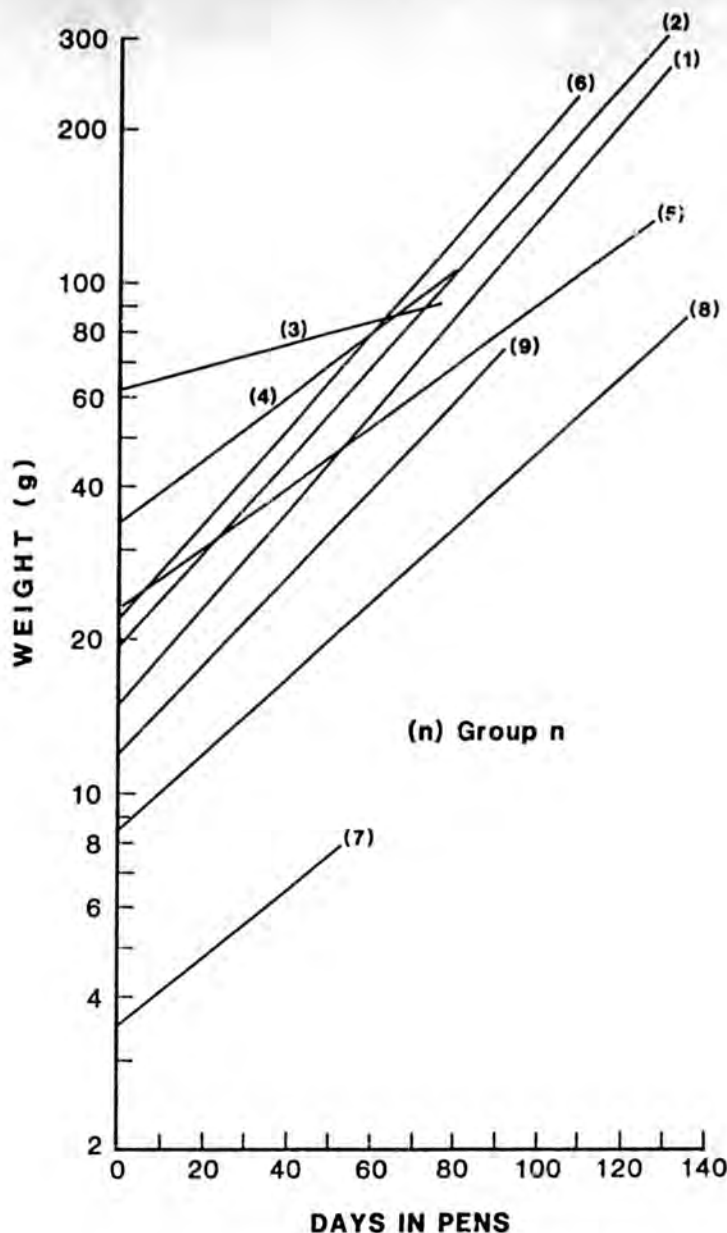


Figure 4.—Growth curves for pen-reared salmon by group.

tag return information and therefore to draw conclusions from it. There was a high degree of variability in the rearing experience from year to year. Changes in species, brood stock, hatchery, date, size, and uniformity of size at delivery were usually dictated by factors that were beyond the control of the experimenters. Varied environmental conditions, such as the drought in 1975 and 1976, not only affected rearing conditions but also caused some regulatory changes (season and size) that may have influenced tag return rates. It is also likely that the adipose fin clip identifying nose-tagged fish escaped observation in some groups more than others. For example, many cohos from Group 1 were caught by sportfishermen fishing along the shoreline of the Bay, where their catches were not censused. Group 1 returns therefore are probably underestimated.

Because a minimum mesh size of 22 mm was found to be necessary to assure adequate circulation and prevent the attendant problems of fouling and reduction of dissolved oxygen, many fish escaped soon after delivery and throughout the rearing period. Unfortunately this problem occurred in all the batches of nose-tagged fish that were received. To whatever extent such fish survived after their escape, the return rates are overestimated because the pool of tagged fish from which recoveries were drawn would have been larger than the number used to calculate the percentage or rate of recoveries. The groups most affected were 8 and 9. There also was a mass escape from Group 7, but it is unlikely that many of these pre-smolt fish survived⁴.

As would be expected from the preceding discussion, the tag return rates varied greatly from group to group. Nonetheless, certain trends appear and we believe that despite the various dissimilarities and uncertainties from year to year, certain conclusions become apparent from a subjective analysis of the tag returns.

The best return rate was from Group

4, the first batch of chinooks reared. As stated, this group was healthy throughout the rearing period. Although more than half of the fish escaped, those fish had not been tagged and would not affect the return rate calculation. The mean weight at delivery was the second largest of all the groups, and the size variation was small. Also, these fish were reared in the autumn when the water temperature was cool. As noted, this was one of the groups that grew somewhat more slowly than most others. Whatever the reason, the tag return rate of 23.5 percent (adjusted) was four times as good as from any other of the externally tagged groups.

The worst return rate for external tags was from Group 5, the first group of 1977 cohos. Only two tags were recovered, for an adjusted rate of 0.4 percent. Apparently the extreme size range (10-199 g) and poor health at delivery were contributing factors.

The next lowest return rate for Carlin-tagged fish was from the second batch of 1977 cohos, Group 6. This group suffered a high initial mortality—about one-third—and the fish were much handled, having undergone freeze-branding as well as Carlin-tagging.

The Group 7 experiment, which was fraught with problems from start to finish, produced the lowest return rate of nose-tagged fish. The critical factor in this group probably was the small size of the fish at delivery and release.

Earlier in this section we suggested that nose-tag return rates for Groups 8 and 9 are overestimated. The release of Carlin-tagged fish as well as nose-tagged fish in Group 8 provides an opportunity to gauge the magnitude of the over-

estimate by comparing the return rates for the two types of tags. The 13.3 percent return rate estimate for the nose tags is about 2.25 times as high as the 5.9 percent return estimate for the Carlin tags. This "overestimate factor" is subject to some degree of uncertainty because the Carlin-tagged and nose-tagged fish had slightly different histories. Nonetheless, it is probably realistic to assume that at least as many nose-tagged fish escaped and survived as were released and counted at the end of the rearing period.

The Group 9 experiment compared the return rate from pen-reared fish with those from a control group released at the pen site at the beginning of the rearing period. Table 3 summarizes the tag recovery data from Group 9. The return rate for the control subgroup was 2.6 percent. The return rate for the pen-reared subgroup is given first as a percentage of the fish that were counted out of the pen after the rearing period. The 12.8 percent figure neglects the more than 55,000 fish (adjusted for tag recognition) that were not accounted for in the release, most of which escaped. The second tag recovery rate is given as a percentage of all the fish that were delivered to the pens for rearing. Even though only one-sixth of the fish that were delivered for pen rearing were actually pen-reared, the 2.1 percent return in this comparison suggests that pen rearing was not advantageous.

Cost Effectiveness of Pen Rearing

One problem with the preceding analysis of tag returns from Group 9 deliveries of chinook salmon is that the

Table 3.—Nose-tag returns from Group 9.

Years recovered	Subgroup				
	Control		Pen-reared		
	Number recovered	Percent of release (21,730)	Number recovered	Percent of release (11,223)	Percent of delivery (67,900)
1980	0	0	14	0.1	0.0
1981	503	2.3	1,243	11.1	1.8
1982	69	0.3	178	1.6	0.3
Total	572	2.6	1,435	12.8	2.1

⁴Fred Meyer, California Department of Fish and Game, Region 2, Rancho Cordova, Calif. Personal communication.

Table 4.—Annual pen-rearing costs for 40,000 fish for 3 months; labor = \$50/worker-day

Item	Cost (dollars)	
	Materials	Labor
Nets and pens		
amortized at 12% over 10 years	\$2,650	
maintenance and repair	400	\$1,800
Medications	800	300
Feed	3,000	4,500
Miscellaneous supplies	1,700	
Subtotal	\$8,550	\$6,600
Grand total, materials and labor	\$15,150	

experience with Group 9 was not a best-case episode. The fact that a 23.5 percent return of tagged fish was achieved once suggests that under a certain set of circumstances pen rearing might be a cost-effective management technique for augmenting ocean harvest.

Critical to determining the benefits of pen rearing is the cost involved—specifically, the cost in producing the incremental increase in returns that can be attributed to the pen rearing. To deal with this question, it is necessary first to accept a return rate that might be expected from fish released directly into San Francisco Bay, as was the control portion of Group 9. Recent CDFG studies have led to their adopting a policy of releasing chinook smolts (45/pound or 10 g/fish), instead of yearlings, directly into San Francisco Bay. Return rates have been as good or better (up to 4 percent) than for yearlings and cost per fish is lower⁴.

If we assume a cost of \$0.06/fish to rear salmon to 45 fish/pound (an approximation using data from McCormack et al., 1984, which does not include an amortization of capital costs) and a 4 percent return, then each fish caught represents an operational investment of \$1.50.

The annual costs of pen rearing 40,000 fish for 3 months are shown in

Table 4. Capital expenditures are amortized over 10 years at 12 percent interest, and labor costs valued at \$50 per worker-day. If we assume that good pen-rearing techniques will bring about an ocean harvest of 25 percent of those fish released, then the cost of adding 10,000 fish to the catch would be \$15,150, or roughly \$1.50 for each fish. This cost does not include fixed costs, lease fees, management salary, or the cost of hatching and rearing the 40,000 fish to the size at which they would be introduced into the pens.

The objective of establishing a sport fishery for coho inside the Bay was best met by Group 1. Sufficient numbers returned to and remained in the vicinity of the rearing site that a fairly extensive fishing effort developed. The local fishery was less evident in subsequent rearings, possibly because we were no longer able to obtain fish from the Noyo River brood stock. Further testing with Noyo River fish would be required to determine if a sport fishery for coho could be consistently established inside San Francisco Bay.

Summary

Our successful experience with the Group 4 chinooks demonstrated that pen rearing is, indeed, possible in San Francisco Bay, and that chinook salmon have excellent potential for the various forms of net-pen salmon ranching. On the other hand, we know that the hatchery production cost of 40,000 fish that can be either directly released or released after pen rearing is roughly \$2,400. If we assume that the respective return rates for the two procedures would be 4 and 25 percent, then we can choose between getting 1,600 returns at a cost of \$2,400, or an additional 8,400 returns for an additional cost of \$15,050. The additional cost per additional return then, is about \$1.80 for each fish. To the extent that our assumed return rates are valid, this project did not demonstrate

that pen rearing would be a cost-effective management technique for adding to the ocean harvest in California. However, cost efficiency probably would improve if the project were scaled up.

Acknowledgments

Members of the San Francisco Tyee Club participated in pen construction and maintenance, tagging, and feeding. We are especially grateful to Jean Les-tanguet for his efforts on behalf of the Tyee Club. Tag rewards were paid from Tyee's treasury. Seventy different people spent long hours at the tedious task of tagging and we thank them all. We wish also to thank Sus Kato of the Tiburon Laboratory for his guidance and manuscript review and reviewers Earl Prentice of the NMFS and Fred Meyer of the CDFG. Valuable contributions were also made by CDFG hatchery personnel and State Fish Disease Laboratory staff.

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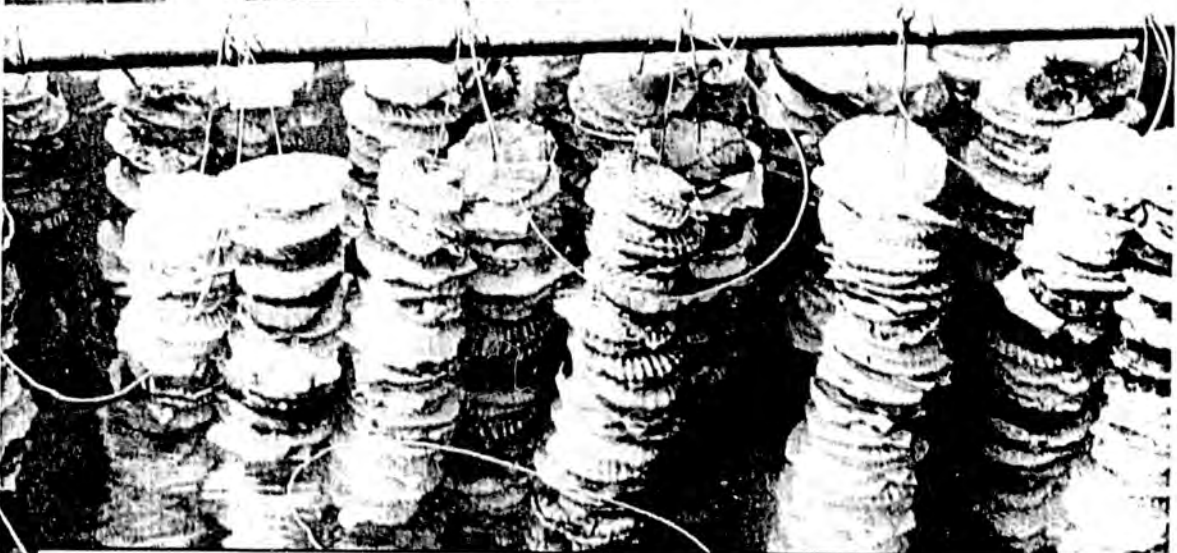
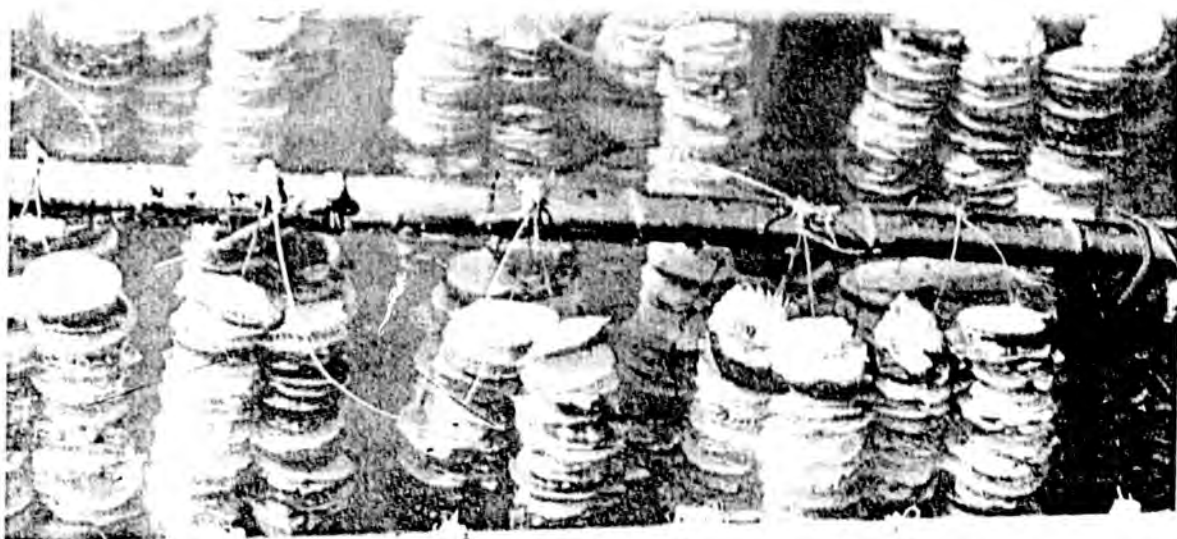
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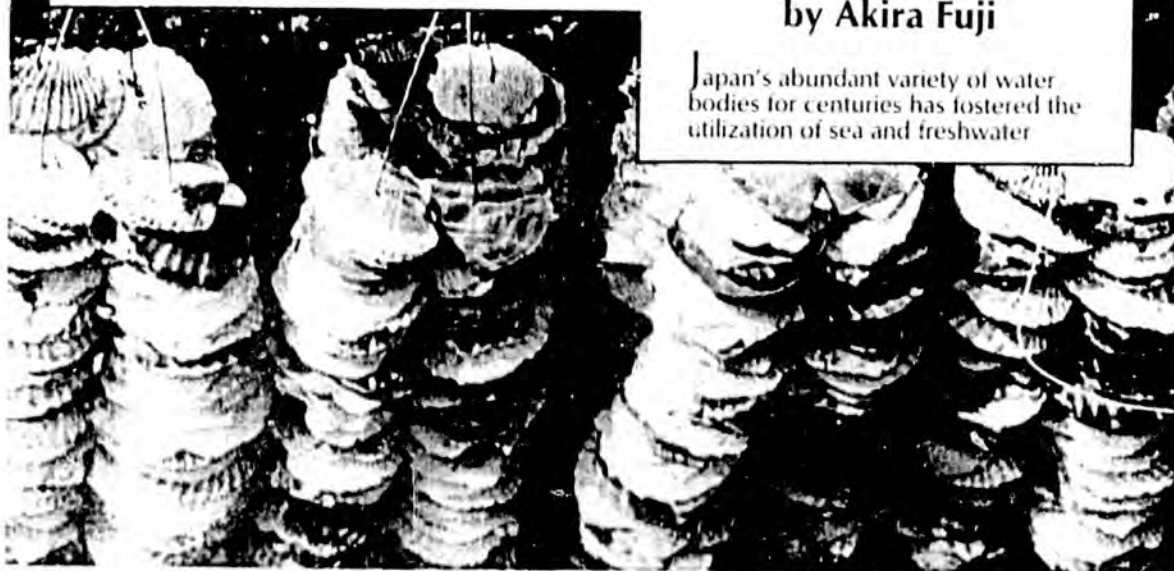
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Aquaculture and Mariculture

by Akira Fuji

Japan's abundant variety of water bodies for centuries has fostered the utilization of sea and freshwater



food supplies. Aquaculture, the farming and husbandry of such supplies, has developed over the years from a side activity of farmers into an industry in its own right. In the last 30 years, innovations in techniques and facilities have transformed it into a successful and productive enterprise. It now accounts for 10 percent of the total fisheries yield, and in 1984 it netted an income of 676.6 billion yen (US\$4.2 billion) (Figure 1).

Aquaculture aims to optimize the number of individuals of a given species that can grow to a commercial product within a defined aquatic area. It achieves this by controlling environmental elements and the life history of the organisms. In Japan, three categories of aquaculture—stocking, feeding, and sowing—represent different approaches to this final goal.

Aquaculture without feeding (stocking type), requires the establishment of a settling area for the spores or seeds of the organism to be grown, but demands no food input from the culturist. The organism drifts or is introduced to the settling area, and attaches itself to the supports provided—nets, empty shells, or bamboo stalks, depending on the species. It then feeds on nutrients and plankton in the water flowing through the area, and thus grows to harvestable size. This culture method is used for seaweed as well as scallops and oysters.

Aquaculture with feeding, the second major category, applies to the cultivation of all fresh water and marine bony fish. The organisms are confined in ponds or specifically-designed nets, and fed formulated preparations until they reach commercial size. Aquaculture by this second method requires artificial "seeding": fingerlings or fry collected in the wild are used as the starting stock in the holding areas. Although culturists have been able to rear seeds for certain species, many fish still require field collection of larval stages.

Culture-based fisheries ("sowing type") is a compromise between the first two methods. Natural fishing grounds are artificially seeded with field-collected or hatchery-reared seedlings, but the organisms are not fed by the culturist. Also, no special substrates are provided to promote growth. This method is successfully employed in scallop culture, and is still common for oysters in some areas.

All three techniques have been applied to the culture of both marine and fresh water species in Japan.

Mariculture

Both mariculture, the culture of marine species, and freshwater aquaculture are practiced in Japan, but mariculture is by far the more productive of the two industries. Its yield has increased about seven fold over the last 30 years. In 1984, it accounted for 92 percent of the total aquaculture yield. Mariculture employs all three categories of aquacultural techniques, since it involves shellfish and algae as well as finfish.

A shellfish, the Japanese oyster *Crassostrea gigas*, and a red alga called "Nori" (*Porphyra* species) have been cultivated in Japan since the

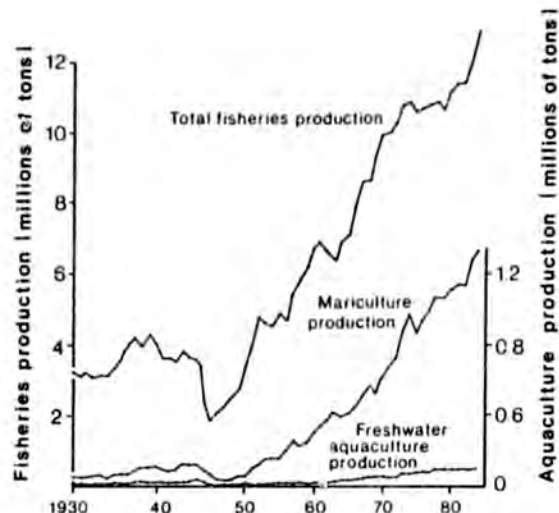


Figure 1. Annual production of total fisheries and aquaculture.

1700s, and have been the major products of mariculture up to the present. New species introduced in 1960–70 account for the recent marked increase in maricultural yield. The species include two fish, the yellowtail jack (*Seriola quinqueradiata*) and the red sea bream (*Pagrus major*); two types of brown algae, "Wakame," (*Undaria pinnatifida*), and "Konbu," (*Laminaria* species); and the scallop, (*Patinopecten yessoensis*). Money earned by mariculture of these seven organisms contributed about 77 percent of the entire income from Japanese mariculture production in 1984.

Innovations in all three aquaculture categories for marine species have been key in increasing harvest and income. The establishment of techniques for the production of large amounts of artificial hatchlings in 1975 resulted in a rapid increase in red sea bream yield; similarly, the development of the floating net cage culture method in 1965 markedly incremented the yield of yellowtail; and hanging methods in oyster farming have made it one of the most successful examples of aquaculture.

Aquaculture with feeding is used to grow yellowtail and bream. Fingerlings, hatchery-reared for bream but collected in the wild for yellowtail, are cultured to an initial stage in holding tanks. They are then released into net cages until they reach commercial size. A floating net cage (Figure 2) permits water flow through all of its surfaces. The resulting aeration and oxygen availability allows the stocking of larger numbers of fish per unit area than would be possible in embayments or holding ponds. Higher productivity is thus obtained. The technique is now the primary method of yellowtail cultivation, and in 1984 yielded a catch 3.7 times that of the wild fish.

Scallop culture can involve stocking or sowing aquaculture. Either category requires three basic operations: collection of larvae (spat) in the wild; intermediate culture of spat; and finally,

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Figure 3. The B) collected to market s

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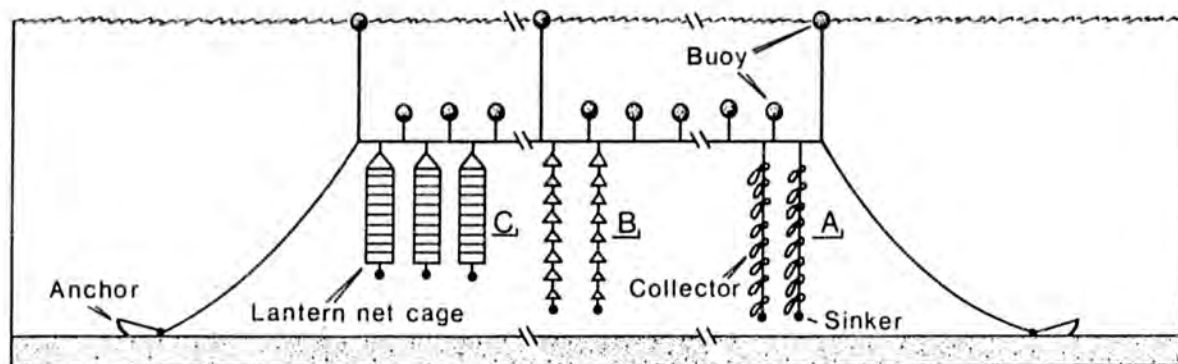


Figure 3. The three stages of scallop culture: A) spat are gathered in seed collectors—net bags filled with cedar twigs, B) collected spat grow to intermediate size inside pearl nets, and C) scallops are hung in lantern net cages where they grow to market size.

the scallop to the commercial product by growing. Figure 3 shows how the three stages are operated simultaneously in a culture system. Stage A, seed collectors, are placed in special "lantern nets," which are suspended from a long-line set in the water. In the growing culture method, the spat are literally sown on selected harvesting bottoms, from which they are collected 2 to 4 years later. Annual yield from both types of cultivation has been 200,000 tons in recent years.

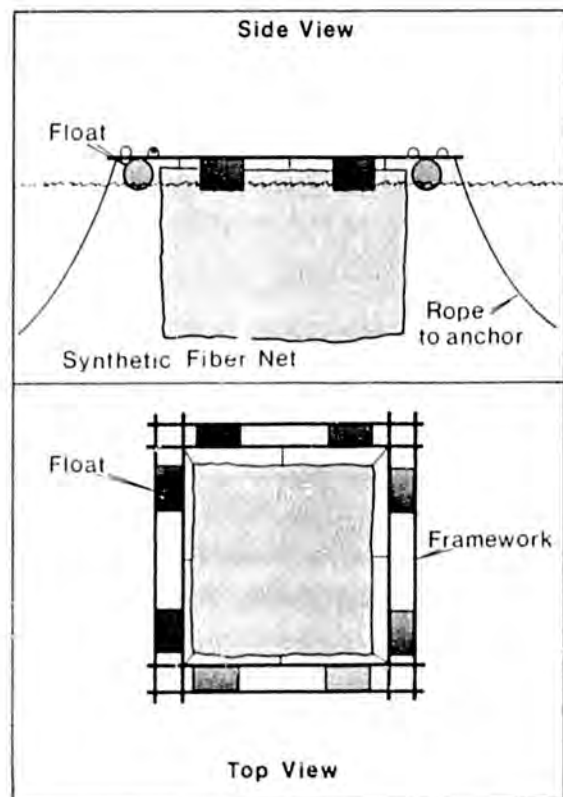


Figure 2. A floating net cage for yellowtail culture. Aeration and oxygen flow through all sides of the cage permit stocking of large numbers of fish in a limited area.

Oyster cultivation follows a pattern similar to that of the scallop. Seeds are obtained from the wild through the use of collectors. These consist of oyster or scallop shells ("culches") strung on a metal wire and hung vertically in the water. Seeds attach to these, and are grown to market size by further hanging of the strings of culches off racks, rafts, or long-lines (see Figure 4). The three-dimensional nature of the hanging method has permitted a remarkable increase in oyster productivity per unit area. The present industry has become stable at a yield of 250,000 tons per year in live weight.

Nori, which provides the most abundant seaweed harvest, is cultured through the use of several recently-developed techniques. Nets laid horizontally in the sea are sown with artificially-grown spores. These attach to the twine, develop into germlings, and eventually grow into fronds. The harvested fronds are dried and processed mechanically for market. Artificial spore cultivation and mechanization of the processing operation have permitted a rapid increase in nori production. Annual yield in 1984 reached as high as 400,000 tons in wet weight.

Freshwater Culture

The development of freshwater aquaculture has been quite slow compared to that of mariculture, due perhaps to the Japanese preference for marine fish over freshwater fish. Nonetheless, freshwater culture yields have similarly benefited from culturing improvements and introduction of new species, and income from the industry was 123.3 billion yen in 1984 (US\$780 million). Four types of fish—rainbow trout, (*Salmo gairdneri*); a salmonoid fish called ayu, (*Plecoglossus altivelis*); common carp, (*Cyprinus carpio*); and eel, (*Anguilla* species)—accounted for 91 percent of the entire earnings from freshwater culture in 1984. All are grown by variations on feeding aquaculture.

Eel, the most commonly eaten freshwater fish, is the species yielding the largest income. Its traditional consumption on special Japanese holidays accounts for its popularity and its extraordinarily high market price. The high value of

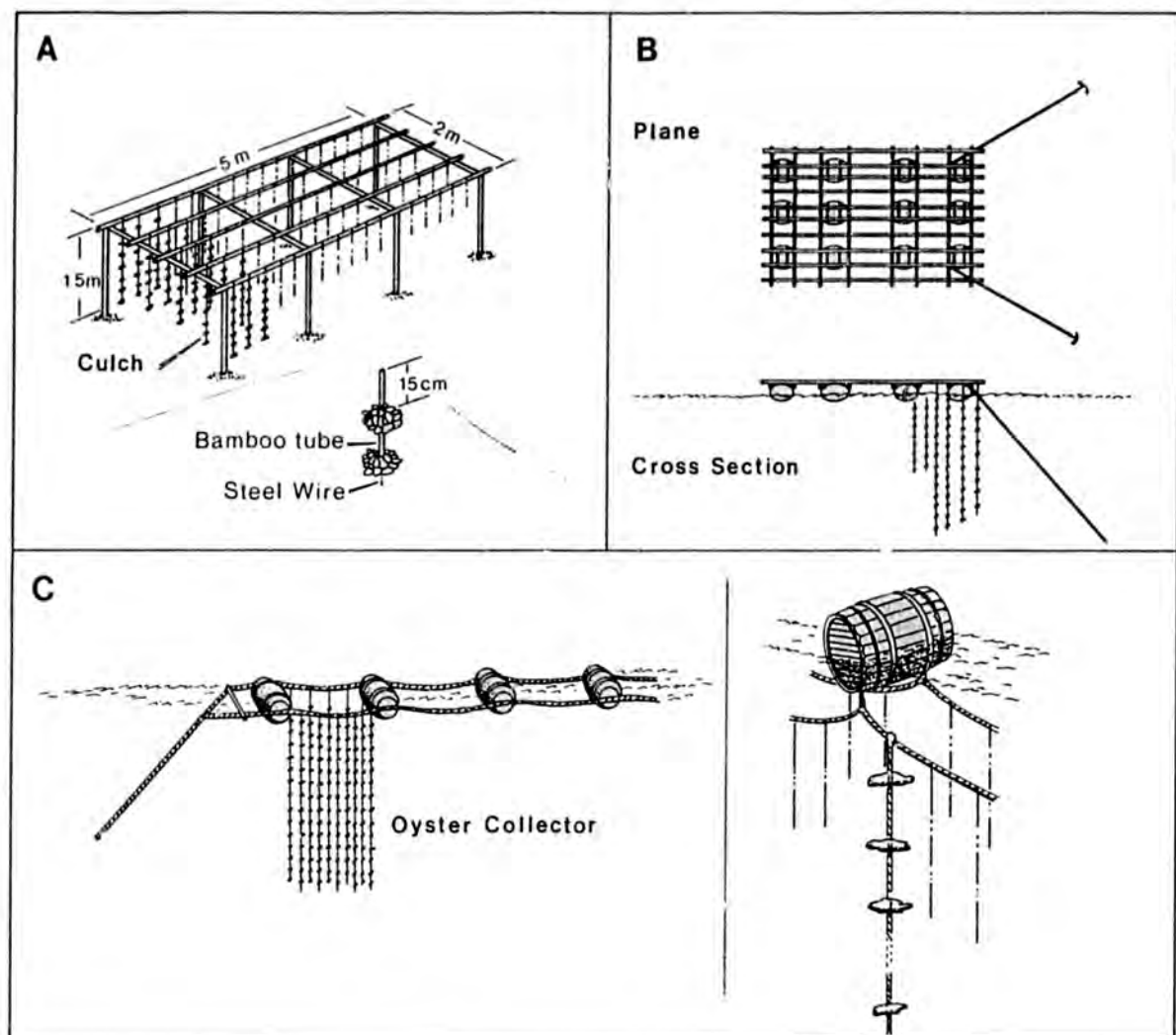


Figure 4. Different hanging methods for oyster culture: A) rack method—culches with attached oyster seeds are hung on a rack fixed to the seabed, B) raft method (the most employed)—strings of culches are hung on a cedar or bamboo raft, C) long-line method (can be used in open and deep waters)—the culches are hung on long lines kept afloat by buoys.

the fish has encouraged improvements in rearing facilities. In recent years, the outdoor still-water ponds that were used for eel culture have been replaced by indoor tanks supplied with heating and water circulating systems. Elvers for seeding the tanks, however, must still be collected in the wild.

Several other fish species are commonly grown. Like the eel culture, carp culture has progressed from the use of ordinary ponds or rice paddies as holding tanks to the employment of more sophisticated running-water ponds. In 1984, 21,071 tons were produced by culture. Rainbow trout culture began in 1877, when 10 000 eggs were imported from California. After the war, culture was sustained by a U.S. market that encouraged export, and which has permitted its steady increase to the present. The most recent addition to freshwater aquaculture is ayu. Commercial culture of this fish began after the war, and recent catches have yielded some 15,000 tons

per year. It is now distributed from central to southern Japan.

Future Research

Many problems hinder further expansion of the aquaculture industry in Japan. First, culture of major species, with the exception of seaweeds, still depends on natural seeds collected from the wild. A stable, reliable supply of larvae and fries is the basis for stabilizing culture. Preparation of suitable feed for rearing fish fry is therefore important. In Japan, successful techniques now exist for mass production of the rotifer *Brachionus plicatilis*, the most efficient and essential food for the early larval stage of marine fish. Next, it is necessary to grow natural food and to formulate artificial preparations for post-larval stages of fish.

Diseases and epidemics are another concern of aquaculturists. Fungal, viral, and bacterial diseases have been diagnosed in several cultured

An aerial view of cages used for oyster culture.

organisms, and mortality even prevention and identification of therapeutic use of aquaculture.

Finally, the use of aquaculture for the production of products necessary to carrying capacity of organisms.

Finally, the use of aquaculture for the production of products necessary to carrying capacity of organisms.

Akira Fuji is a researcher in Aquaculture, Hakodate, Japan.



An aerial view of Suzakinomi Bay in the Kochi Prefecture. The rows of square rafts in the center of the bay support the net cages used for yellowtail culture. (Photo courtesy of Japan Information Center)

organisms, and have repeatedly resulted in mass mortality events. High priority must go to the prevention and control of diseases, and to the identification of causes of epidemics. Establishment of therapeutics on each disease is essential.

Environmental hazards caused by intensive use of aquatic areas also can result in declines in the productivity of culturing grounds. It is necessary to establish, for each culture area, the carrying capacity that will permit the normal life of organisms.

Finally, efforts must concentrate on cultivating new species to meet demands for seafood and fish. Selection and inbreeding promise rapid establishment and subsequent conservation of successful genetic lines. Induction of artificial gynogenesis (resulting embryo contains only maternal chromosomes) by irradiation of sperm and cold-shocking uploid (having the basic chromosome number doubled) eggs may result in the development of induced organisms with new and desirable biological characteristics. Parallel improvements in biological and technological methods will continue fostering aquacultural development.

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Whaling and Research

—Commercial whaling has come to its final season.

by Akito Kawamura

In June 1972, when the United Nations Conference on the Human Environment was held in Stockholm, Sweden, great whales suddenly became important symbols of the conservation movement. As a result, there was a vigorous new campaign to seek an end to whaling. Although the adopted resolution calling for a 10-year moratorium



UNITED FISHERMEN OF ALASKA

907-586-2820
1-800-478-FISH

MORATORIUM POSITION

United Fishermen of Alaska believes a moratorium on permits allowing mariculture operations must be instituted immediately.

This moratorium should be established by the legislature since it created the statutes under which these permits are now being issued. It is seriously questionable whether the governor has the legal authority to suspend this program.

This moratorium should be in effect until statutes and regulations are adopted that explain how the State wants these operations to be conducted.

This moratorium should include permit applications for both shellfish and finfish mariculture. We are also concerned about applications that ostensibly are for siting of docks, float homes and similar projects on state tidelands but in reality are attempts to establish space for mariculture operations. We want to address these without bringing a halt to legitimate projects. The Department of Natural Resources should be consulted for a list of activities that may fall into this category.

This moratorium should include a provision for grandfather rights for activities legally operating before the effective date of the moratorium. Those who began their operations in good faith should not be penalized while the legislature deliberates on the policy it wishes to establish.

UFA believes the need for this moratorium is clearly indicated by the record built in testimony before House and Senate Resources and Labor & Commerce committees. The many unanswered questions presented to legislators indicate concerns that need to be researched and resolved before lawmakers can determine whether mariculture operations will benefit the state. In the meantime it is urgent that a de facto policy not be established by allowing the State to continue issuing permits while the legislature considers the question.

STATE OF ALASKA THE LEGISLATURE

LEGISLATIVE AFFAIRS AGENCY

POUCH Y. STATE CAPITOL
JUNEAU, ALASKA 99811
907 465 3800

MEMORANDUM

April 30, 1987

SUBJECT: Fish farming moratorium
TO: Senator Dick Eliason
FROM: Edward H. Hein *EHA*
Legislative Counsel

The following licenses, permits, and authorizations are, or may be, required to operate a fish farm:

1. authorization for use of an interim-use permit for the experimental commercial taking of a fishery resource (AS 16.05.050(10)); granting is discretionary by commissioner of fish and game;
2. fish farming license (AS 16.05.340(a)(14); 16.05.330(a)); issuance by Department of Revenue is mandatory if applicant pays \$200 biennial fee;
3. collection permit (AS 16.05.340(b)); issuance is discretionary by commissioner of fish and game;
4. land use or tidelands permit (AS 38.05.035); issuance discretionary by commissioner of natural resources;
5. land lease (AS 38.05.070); discretionary by commissioner of natural resources;
6. fish transport permit (5 AAC 41.005); issuance mandatory if commissioner of fish and game makes determinations specified under 5 AAC 41.030;
7. permit to appropriate water (11 AAC 93.120); issuance mandatory if commissioner of natural resources finds that requirements of AS 46.15.080 have been met;

Senator Ellason
April 30, 1987
Page 2

8. temporary water use permit (11 AAC 93.210 - 11 AAC 93.220); issuance discretionary by commissioner of natural resources;

9. certification under Sec. 401 of the Federal Water Pollution Control Act (18 AAC 15.180); certification by commissioner of environmental conservation according to federal requirements.

EHH:csh
c8/018

PRIVATE NONPROFIT HATCHERY PROGRAM

STATUS SHEET

Attached is a listing of Private Nonprofit (PNP) Salmon Hatchery Permits issued and applications that are currently in process. Also included are the Scientific/Educational Permits for PNP research projects and school district aquaculture programs that have been issued in 1986. This list is organized according to region and contains information regarding location, production status, and number of eggs or fish permitted.

To date, 24 PNP Salmon Hatchery Permits have been issued and one permit was given up. Sixteen of the permitted hatcheries are currently in operation. Thirteen of the permitted hatcheries had adult returns in 1985. Currently, there is one application for a permit under active consideration.

Regional comprehensive salmon plans have been approved by the Commissioner of Fish and Game for the Northern and Southern Southeast, Cook Inlet, Prince William Sound, Kodiak, and Yakutat Regions.

This status sheet will be updated quarterly.

DECEMBER 1986

PRIVATE NONPROFIT HATCHERY PROGRAM
ORGANIZED BY REGION

REGION

Southern Southeast

	<u>STATUS</u>	<u>LOCATION</u>	<u># OF EGGS OR FISH PERMITTED</u>
1. Southern Southeast Regional Aquaculture Association 1649 Tongass Ave. Ketchikan, Alaska 99901 Office - 225-9605 Whitman Lake Hatchery - 225-2635 Neets Bay Hatchery - 247-8790 Attn: Don Amend, General Manager Keith Johnson, Operations Manager Mike Blanchard, Special Proj. Mgr. Bill Halloran, Whitman Lake Hatchery Manager George Carnes, Neets Bay Hatchery Manager	Regional Association PNP Permit #8, Operational Issued 3/9/78 PNP Preliminary Application Submitted 1/27/82 Accepted 5/10/82 Inactive PNP Permit #19, Operational Issued 6/17/83 PNP Preliminary Application Submitted 2/18/83 Review Suspended PNP Permit #24, Operational Issued 7/1/86 Sci/Ed Permit #86-114 Sci/Ed Permit #86-115	Ketchikan Whitman Lake, Ketchikan Tyee Lake, Wrangell Neets Bay, Revillagigedo Island Virginia Lake, Wrangell Beaver Falls, Ketchikan Orchard Lake, off Shrimp Bay Virginia Lake	31.8 million chum 3.4 million coho 1.5 million chinook 2.5 million sockeye Requested at capacity: 40 million pink & chum 4 million coho 2 million chinook 60 million chum 5 million coho 4 million chinook Requested at capacity: 40 million chum 4 million coho 2 million chinook 4 million sockeye .3 million sockeye Take tissue and ovarian fluid samples from 60 kokanee and 60 cutthroat in spawning condition in order to determine the pathological status of the salmonid populations. 60 cutthroat juveniles/adults and 60 sockeye fry/smolt/adults for pathological examination to determine presence of disease in the water source.
2. Alaska Aquaculture, Inc. P.O. Box 1288 Wrangell, Alaska 99929 Office - 874-2250 Hatchery - 874-2441 Attn: Tod A. Jones - 874-2013 Jim Pace - 874-3521	PNP Permit #5, Operational Issued 4/28/76	Burnett Inlet, Etolin Island, Wrangell	10 million pink 20 million chum .25 million coho .75 million chinook

<u>Southern Southeast (continued)</u>	<u>STATUS</u>	<u>LOCATION</u>	<u># OF EGGS OR FISH PERMITTED</u>
3. Meyers Chuck Aquaculture Association 5001 Nottingham Way Anchorage, Alaska 99501 Attn: Robert M. Meyer - 261-4625	PNP Permit #10, Operational Issued 7/22/79	Meyers Creek, Meyers Chuck	5 million pink 1 million coho 5 million chum
	Sci/Ed Permit #86-133	Lake Helen Creek, Black Bear Creek, Karta River, and Meyers Stream	35 adult pink salmon, 35 adult coho salmon, 60 adult chum salmon, and 30 spawned-out adult coho salmon will be taken for disease-testing purposes.
4. Aquaculture, Inc. P.O. Box 1499 Wrangell, Alaska 99929 Attn: Robin Larsson - 874-3458	PNP Permit #22, Not Operational Issued 4/17/83	Crittenden Creek, Wrangell	12 million chum 3 million pink
5. Gro-Fish, Inc. P.O. Box 8 Juneau, Alaska 99802 Attn: Robert M. Meyer - 261-4625 Jodi Hilton - 586-7441 Steve Johnson - 789-3171	PNP Permit #21, Not Operational Issued 2/2/84	Santa Anna Creek, Ernest Sound	3 million pink 10 million chum
6. Twin Creek Salmon Ranch, Inc. P.O. Box 90 Petersburg, Alaska 99833 Attn: Darline M. Clausen - 772-3282	PNP Preliminary Application Submitted 11/1/78 Accepted 12/14/81 Inactive	Twin Creek, Wrangell Narrows, Petersburg	Requested at start-up: .5 million pink
7. Petersburg High School P.O. Box 289 Petersburg, Alaska 99833	Sci/Ed Permit #86-124	Five-Mile Creek, Petersburg	50 adult pink salmon for use in the high school aquaculture program.
8. Hollis Junior/Senior High School P.O. Box 101 Klawock, Alaska 99925 Attn: Jim Daly	Sci/Ed Permit #86-131	Harris River, east coast of Prince of Wales Island, near Hollis	20 adult pink salmon for initiation of an in-stream incubation project and school aquaculture program.
9. Houghtaling Elementary School 2940 Baranof Street Ketchikan, Alaska 99901 Attn: Anne Germain	Sci/Ed Permit #86-140	Houghtaling Elementary School	Up to 2,000 chum eggs from Beaver Falls Hatchery for school salmon-rearing project.
10. Bob Campbell Rediscovery Lodge Bell Island, Alaska 99950	Sci/Ed Permit #86-145	Bell Island Lakes, Behm Canal Narrows	60 adult kokanee, 60 adult Dolly Varden char, and 60 adult cutthroat trout for disease-testing purposes.
11. University of Alaska - AEIDC 707 A Street Anchorage, Alaska 99501 Attn: Michael D. Kelly	Sci/Ed Permit #86-138	Tyee Creek, near Wrangell	2 adult pink salmon and 2 adult chum salmon for study of incubation in tailrace of Tyee hydroelectric powerhouse.

Northern Southeast1. Northern Southeast Regional
Aquaculture Association103 Monastery
Sitka, Alaska 99835
Office - 747-6850

Medvejie Creek Hatchery - 747-5863

Attn: Peter Esquiro, General Manager
Bruce Bachen, Operations Manager
Dail Hurdlow, Mgr., Medvejie Ck.STATUS

Regional Association

PNP Permit #14, Not Operational
Issued 4/17/81PNP Permit #16, Operational
Issued 8/17/81PNP Permit #23, Operational
Issued 12/19/85

Sci/Ed Permit #86-103

Sci/Ed Permit #86-116

Sci/Ed Permit #86-118

LOCATION

Sitka

Salmon Creek, Juneau

Medvejie Creek, Sitka

Port Camden, Kuiu Island

Baranof Island, Chichagof
Island, Kruzof Island, and
Kuiu Island, to include:

Virginia Lake

Chilkat River, NSRAA
spawning channel,
26-mile Haines Highway# OF EGGS OR
FISH PERMITTED30 million pink & chum
.8 million coho28 million chum
3.3 million coho
.3 million chinook
.1 million pink

10 million chum

Preliminary Lake Surveys-
To assess the potential of
previously unstudied lakes for
the rearing of coho salmon
fry to smolts;
Detailed Lake Surveys-
Study of selected barrier lakes
which have been chosen for
stocking with coho salmon fry to
determine the proper number of
coho to plant; and
Adult Return-Enumeration of
coho returns to determine and
assess the success or failure
of lake stocking as an enhancement
technique.Capture, measure, weigh, and
release up to 500 kokanee
juveniles/adults, up to 500 Dolly
Varden juveniles/adults, and up
to 100 samples of other species
to determine what species reside
in the lake and inlet/outlet
streams.125 adult female chum salmon
and 125 adult male chum salmon
(250,000 eggs) will be taken
for 2 incubation boxes in an
attempt to increase fry
production and to test the
effectiveness of this
incubation box design.

Northern Southeast (continued)

	<u>STATUS</u>	<u>LOCATION</u>	<u># OF EGGS OR FISH PERMITTED</u>
	Sci/Ed Permit #86-119	Klehini River, at 31 mile Haines Highway	460 adult female chum salmon and 460 adult male chum salmon (a maximum of 1,000,000 eggs) for testing of an expanded version of the incubator box studies initiated in 1984.
	Sci/Ed Permit #86-121	Turner Lake, off Taku Inlet	3 hydroacoustic and trawl surveys will be conducted during the 1986 field season. Up to 500 Kokanees juveniles/adults, 10 cutthroat trout, 10 Dolly Varden char, and 10 three-spine stickleback will be collected, sampled for age, weight, and length, and released. 100 Kokanee adults will be retained for stomach analysis. The purpose is to quantify the abundance and distribution of kokanee salmon in the lake.
2. Sheldon Jackson College Aquaculture Program P.O. Box 479 Sitka, Alaska 99835 Office - 747-5254, Hatchery - 747-5209 Attn: Mel Seifert Bill Davidson, Manager Message - 747-5231	PNP Permit #3, Operational Issued 4/29/75	Indian River, Sitka	16 million pink & chum .15 million coho .1 million chinook
3. Tlingit & Haida Fisheries Development Corp. 320 W. Willoughby Ave., Suite 300 Juneau, Alaska 99801 Office - 586-1432, ext. 249 Attn: Ed Thomas	PNP Permit #4, Not Operational Issued 12/18/75	Maksoutof River, Sandy Bay, Baranof Island	25 million pink & chum
4. Douglas Island Pink and Chum, Inc. P.O. Box 168 Juneau, Alaska 99802 Attn: Ladd Macaulay Sheep Creek Hatchery - 586-3663 Kowee Creek Hatchery - 586-4041 Net Pen Site - 586-4833	PNP Permit #6, Operational Issued 7/30/76 PNP Permit #11, Operational Issued 9/18/79 PNP Preliminary Application Accepted 8/11/83 Inactive PNP Hatchery Application Submitted 11/25/85	Kowee Creek, Juneau Sheep Creek, Juneau Fish Creek, Juneau Gastineau Channel, Juneau	10 million pink & chum 40 million pink & chum .05 million coho Requested at Capacity: 60 million pink 10 million chum undetermined trout 50 million pink 111 million chum 1 million coho .2 million chinook

<u>Northern Southeast (continued)</u>	<u>STATUS</u>	<u>LOCATION</u>	<u># OF EGGS OR FISH PERMITTED</u>
	Sci/Ed Permit #86-134	King Salmon River, Limestone Creek	Collection of age, weight, and length data for identification of potential chum, pink, and coho broodstocks. Efforts will will be coordinated with ADF&G efforts at these locations.
5. Kake Nonprofit Fisheries Corporation c/o City of Kake P.O. Box 500 Kake, Alaska 99830 Gunnuk Creek Hatchery - 785-6460 Attn: Steve Andison	PNP Permit #7, Operational Issued 4/1/77	Gunnuk Creek, Kake	18 million pink and chum
6. Burro Creek Farms P.O. Box 455 Skagway, Alaska 99840 Hatchery - 983-2355 Attn: Eugene W. Richards	PNP Permit #12, Operational Issued 5/23/80	Burro Creek, Skagway	10 million pink & chum 15,000 coho
7. Armstrong-Keta, Inc. P.O. Box 39 Juneau, Alaska 99802 Office - 586-3443 Attn: Joe Smatlan - 789-9363 Bob Lium - 586-1164 Wm. Ritchie Phillips, Hatchery Manager	PNP Permit #13, Operational Issued 2/23/81 Sci/Ed Permit #86-142	Port Armstrong, Baranof Island Port Armstrong, Baranof Island	16 million pink 4 million chum .08 million chinook 18 adult female coho salmon and 18 adult male coho salmon (50,000 eggs) to determine feasibility of rearing coho salmon at Port Armstrong.
8. Angoon Aquaculture Association, Inc. P.O. Box 138 Angoon, Alaska 99820 Office - 788-3411 Attn: Martha Jack	PNP Permit #18, Not Operational Issued 8/5/82	Favorite Bay, Angoon	7.5 million pink 20 million chum 1.5 million coho
9. Pelican Cold Storage P.O. Box 5538 653 NE Northlake Way Seattle, Washington 98105 Office - (206) 632-9000 Attn: Cavin Philbin	Preliminary Application Accepted 11/25/81 Public Hearing scheduled 10/10/82 Postponed indefinitely	Pelican Creek, Pelican	Requested at capacity: 2.2 million chum
10. Skagway High School Skagway, Alaska 99840 Attn: Jerry Meyers 983-2960	Sci/Ed Permit #86-110	Pullen Creek, Skagway	70 adult pink salmon, 12 adult coho salmon, and 2 adult king salmon for use in the high school aquaculture program.

Northern Southeast (continued)

11. Angoon Schools
P.O. Box 209
Angoon, Alaska 99820
Attn: John Anderson

STATUS

Sci/Ed Permit #86-139

LOCATION

Kanalku Creek, Thayer
Creek, or Favorite Creek

OF EGGS OR
FISH PERMITTED

120 adult pink salmon for disease-
testing purposes.

12. Kake City Schools
P.O. Box 450
Kake, Alaska 99830
Attn: Charles Larson

Sci/Ed Permit #86-141

Gunnuk Creek

10 adult pink salmon and 10 adult
chum salmon for high school fish
husbandry class.

Prince William Sound

1. Prince William Sound
Aquaculture Corporation
P.O. Box 1110
Cordova, Alaska 99574
Office - 424-7511 or 424-7512
Attn: Brian Allee, President
Bruce Suzumoto, Vice President

Regional Association

PNP Permit #2, Operational
Issued 7/1/76

PNP Permit #20, Operational
Issued 6/17/83

Cordova

Port San Juan, Evans Island

Esther Lake

150 million pink
13 million chum

211 million pink
111 million chum
1 million chinook
1 million coho
31 million sockeye

Sci/Ed #86-117

Eyak River, Aleganik River,
Mile 18 Creek, Mile 25
Creek, and Salmon Creek, all
in the Copper River Delta

Conduct qualitative evaluations
of the coho and sockeye salmon
smolts being produced in these
Copper River Delta systems.

Sci/Ed #86-120

Esther Lake, Lake #344 in
Shoestring Bay, Prince
William Sound

Dolly Varden char, three-spine
stickleback, and sockeye salmon
will be captured to determine the
size, age structure, and dynamics
of the Sound resident Dolly
Varden char population and to
examine the resident fish for
disease, parasites, and heavy
metal accumulation.

Sci/Ed Permit #86-130

Eyak Lake at the north end
of Power Creek Arm, Cordova

60 adult sockeye salmon
(approximately 100,000 eggs) will
be used for initiation of a
streamside incubation project.

Sci/Ed Permit #86-144

Eyak Lake

1.2 million coho salmon eggs to allow
on-site incubation until eye-up.

<u>Prince William Sound (continued)</u>	<u>STATUS</u>	<u>LOCATION</u>	<u># OF EGGS AND FISH PERMITTED</u>
2. NERKA, Inc. P.O. Box 80165 Fairbanks, Alaska 99708 Attn: Dr. Jack M. Van Hyning - 479-2476	PNP Permit #1, Not Operational Issued 9/19/75	Perry Island	10 million pink 10 million chum
3. Valdez Fisheries Development Assoc. P.O. Box 125 Valdez, Alaska 99686 Office - 835-4874 Attn: Jason Wells, Project Director Paul McCollum, Manager	PNP Permit #15, Operational Issued 6/26/81	Solomon Gulch, Valdez	136 million pink 18 million chum 1 million coho .05 million chinook
	Sci/Ed Permit #86-104	Hell's Hole Creek	60 adult coho salmon will be taken for pathological examination.
	Sci/Ed Permit #86-159	Hatchery Special Harvest Area	Tag/recovery program with 5,000 pink, 1,000 chum, and 100 coho salmon.
4. McClure Bay Hatchery, Inc. 121 West 11th Anchorage, Alaska 99501 Office - 272-2679 Attn: Jerry McCutcheon	PNP Preliminary Application Accepted 12/23/83 Inactive	Port Nellie Juan, McClure Bay	30 million pink undetermined chum
5. Prince William Sound Community College P.O. Box 97 Valdez, Alaska 99686 Attn: Robert S. Benda 835-2681 (Ext. 131)	Sci/Ed Permit #86-132	Crooked Creek, Corbin Creek	70 adult pink salmon, 50 adult chum salmon, and 20 adult coho salmon for use in the school aquaculture program.
<u>Cook Inlet</u>			
1. Cook Inlet Aquaculture Association Route 2, Box 849 Soldotna, Alaska 99669 Office - 283-5761 Hatchery - 745-5692 Attn: Tom Mears, Exec. Director Loran Waldron, Hatchery Manager	Regional Association	Soldotna	
	PNP Permit #17, Operational Issued 2/8/82	Eklutna Hydroelectric project, Matanuska Valley	20 million pink & chum 1.1 million coho .1 million chinook
	Sci/Ed Permit #86-105	Fisher Lake, west side Cook Inlet	In-lake egg incubation experiment with sockeye salmon (50 adult females) to determine the capability of rearing juvenile sockeye salmon.
	Sci/Ed Permit #86-106	Grant Creek, near Moose Pass	To take, count, mark, and release 4,000 coho salmon adults to evaluate coho salmon stocking by ADF&G. Cooperators include CIAA, ADF&G, and U.S. Forest Service.

Cook Inlet (continued)

STATUS

LOCATION

OF EGGS AND
FISH PERMITTED

Sci/Ed Permit #86-107

Larson Lake, Chelatna
Lake, Shell Lake,
Stephan Lake

To assess densities of juvenile
salmon in four lakes as part of
a feasibility study for lake
fertilization.

Sci/Ed Permit #86-108

Larson Lake, near Talkeetna

To hold alive, subsample, and
release 10,000 sockeye salmon
adults, 65,000 sockeye salmon
smolts, and 4,000 coho salmon
smolts and adults as part of a
prefertilization study.

Sci/Ed Permit #86-109

Shell Lake, near Skwentna

To hold alive, subsample, and
release 10,000 sockeye salmon
adults, 100,000 sockeye salmon
smolts, and 4,000 coho salmon
smolts and adults as part of
a prefertilization study.

Sci/Ed Permit #86-111

Chunilna River, Birch
Creek, Talkeetna River,
and Susitna River, near
Talkeetna

Collection of 60 chum salmon
adults at each location for
disease screening of potential
broodstocks for the Eklutna
hatchery.

Sci/Ed Permit #86-112

Packers Lake, Kalgin Island

Enumeration of $\pm$ 20,000 sockeye
salmon adults, $\pm$ unestimated
number of coho salmon adults,
and $\pm$ 500,000 sockeye salmon
smolts as part of a continuing
lake fertilization study in
cooperation with ADF&G.

Sci/Ed Permit #86-113

Polley Creek, Cottonwood
Creek, Ursus Creek, Little
Kamishak River, Kamishak
River, and Iniskin Creek,
on the lower west side of
Cook Inlet

Collection of tissue samples
from 60 female chum salmon in
post-spawn condition at each
location. Purpose is to add
to the fish health history of
Cook Inlet salmon stocks and
to identify stock suitable for
seeding the Paint River.

2. Irreantum, Inc.
P.O. Box 1656
Homer, Alaska 99603
Attn: Lawrence McCubbins - 728-1315
c/o OMS/Tatalina
McGrath, AK 99627
728-1262

Preliminary Application
Submitted 3/22/82
Inactive

Tonsina Bay

Requested at capacity:
2 million pink
9 million chum

Preliminary Application
Accepted 3/9/84
Inactive

Chugach Bay,
Kenai Peninsula

Requested at capacity:
11 million pink & chum
.1 million coho

<u>Cook Inlet (continued)</u>	<u>STATUS</u>	<u>LOCATION</u>	<u># OF EGGS AND FISH PERMITTED</u>
3. Port Graham Elementary/High School General Delivery Port Graham, Alaska 99603 Attn: Ralph A. Hensley	Sci/Ed Permit #86-146	Port Graham River	Take up to 47 spawned-out adult coho salmon (kidney samples) for disease testing.
<u>Bristol Bay</u>			
1. Imapik Regional Aquaculture Association c/o General Delivery Dillingham, Alaska 99576	Inactive Regional Association	Dillingham	No hatcheries
<u>Alaska Peninsula</u>			
1. Sand Point JOM Aquaculture Program Sand Point City Schools P. O. Box 158 Sand Point, Alaska 99661	Sci/Ed Permit 86-143	Humboldt Creek	20 adult male and 15 adult female coho salmon and 20 adult male and 20 adult female coho salmon for school aquaculture program.
<u>Arctic/Yukon/Kuskokwim</u>			
1. Lower Yukon/Kuskokwim Regional Aquaculture Association General Delivery Russian Mission, Alaska 99657 Attn: John Massey	Inactive Regional Association	Bethel	No hatcheries
2. Takotna Community Association Box 86 Takotna, Alaska 99675 Attn: Dick Newton	Sci/Ed Permit 86-#101	Takotna	60 adult chum salmon will be taken for pathological examination.
	Sci/Ed Permit #86-102	Mouth of Takotna River to 5 miles above Waldron's Rock	Collect, measure, weigh, and release unharmed resident species in an attempt to determine which species are present in the Takotna River.
<u>Kodiak</u>			
1. Kodiak Regional Aquaculture Association P.O. Box 3407 Kodiak, Alaska 99615 Office - 486-3453 Attn: Nick Troxell, President	Regional Association	Kodiak	No hatcheries
2. Kodiak Borough Schools 722 Mill Bay Road Kodiak, Alaska 99615 Attn: Jack Witteveen	Sci/Ed Permit #86-137	Katmai Creek or Little Kitoi	10 adult male and 20 adult female coho salmon for initiation of a scientific-education facility at Ouzinkie School.

<u>Kodiak (continued)</u>	<u>STATUS</u>	<u>LOCATION</u>	<u># OF EGGS OR FISH PERMITTED</u>
Mariculture Pilot Projects (under auspices of ADF&G FRED Division, Kodiak)			
3. Jeffrey P. Barnhart P.O. Box 3170 Kodiak, Alaska 99615	Sci/Ed Permit #86-122	Anton Larsen Bay	Collection and possession of blue mussel seed.
4. Timothy Coffin Ward c/o City of Port Lions P.O. Box 278 Port Lions, Alaska 99550	Sci/Ed Permit #86-123	Raspberry Strait, Port Bailey, Whale Pass, and Port Lions boat harbor	Collection and possession of weathervane scallop.
5. Ann Barker 3880 Woodland Drive Kodiak, Alaska 99615	Sci/Ed Permit #86-125	Olga Bay, south end of Kodiak Island	Collection and possession of blue mussel seed.
6. Don Dumm Box 1723 Kodiak, Alaska 99615	Sci/Ed Permit #86-126	Anton Larsen Bay	Collection and possession of blue mussel seed.
7. William Osborne c/o Kodiak Area Native Association 402 Center Avenue Kodiak, Alaska 99615	Sci/Ed Permit #86-127	Kemoff Bay and southeast of Akhiok Island	Collection and possession of scallop spat.
8. Jerry Johnson Box 85 Larsen Bay, Alaska 99624	Sci/Ed Permit #86-128	Amook Bay near Amook Island, Uyak Bay	Collection and possession of weathervane scallop.
9. Peter Danelski Box 2333 Kodiak, Alaska 99615	Sci/Ed Permit #86-129	North end of Amook Island in Uyak Bay, and in Zachar Bay	Collection and possession of weathervane scallop.
10. Robin Barefield-Munsey c/o Munsey's Bear Camp Amook Pass Kodiak, Alaska 99615	Sci-Ed Permit #86-135	Amook Bay and Uyak Bay	Collection and possession of weathervane scallop spat and blue mussel seed.
11. Jack Alexander 2730 West 80th Anchorage, Alaska 99502	Sci/Ed Permit #86-136	Vikoda Bay, West Point, and Village Islands	Collection and possession of weathervane scallop spat.
12. Dan Ogg Box 2754 Kodiak, Alaska 99615	Sci/Ed Permit #86-147	Uganik Bay	Collection and possession of weathervane scallop spat, blue mussel seed, and clam spat.
13. Sue Klemzak Box 3363 Kodiak, Alaska 99615	Sci/Ed Permit #86-148	Uganik Passage	Collection and possession of weathervane scallop spat, blue mussel seed, and clam spat.

STATE OF ALASKA

DEPARTMENT OF COMMERCE & ECONOMIC DEVELOPMENT

DIVISION OF INVESTMENTS

STEVE COWPER, GOVERNOR

P. O. BOX D
JUNEAU, ALASKA 99811-0800
PHONE: (907) 465-2510

April 23, 1987

Honorable Dick Eliason
Alaska State Senate
P.O. Box V
Juneau, AK 99811

Dear Senator Eliason:

In accordance with your request, enclosed is a list of the Fisheries Enhancement loans made through this division.

If you have any questions, do not hesitate to contact me at 465-2510.

Sincerely,



Martin J. Richard
Director

MJR/ss0587Z
042287a
Enclosure

Dick -
Here is the
list you wanted
of state loans
to PNP hatcheries

<u>NAME</u>	<u>DOLLAR AMOUNT</u>
ALASKA AQUACULTURE, INC.	390,000
ALASKA AQUACULTURE, INC.	10,000
ALASKA AQUACULTURE, INC.	145,700
ALASKA AQUACULTURE, INC.	102,600
ALASKA AQUACULTURE, INC.	25,100
ALASKA AQUACULTURE, INC.	31,130
ALASKA AQUACULTURE, INC.	275,270
ALASKA AQUACULTURE, INC.	39,735
ALASKA AQUACULTURE, INC.	33,750
ALASKA AQUACULTURE, INC.	290,000
ALASKA AQUACULTURE, INC.	180,000
ALASKA AQUACULTURE, INC.	47,500
ALASKA AQUACULTURE, INC.	113,125
ALASKA AQUACULTURE, INC.	63,700
ALASKA AQUACULTURE, INC.	117,700
ALASKA AQUACULTURE, INC.	121,630
ALASKA AQUACULTURE, INC.	127,270
ALASKA AQUACULTURE, INC.	83,700
ALASKA AQUACULTURE, INC.	55,650
ARMSTRONG-KETA, INC.	474,045
ARMSTRONG-KETA, INC.	421,000
ARMSTRONG-KETA, INC.	75,000
ARMSTRONG-KETA, INC.	182,100
ARMSTRONG-KETA, INC.	252,500
ARMSTRONG-KETA, INC.	200,000
ARMSTRONG-KETA, INC.	30,000
ARMSTRONG-KETA, INC.	200,000
ARMSTRONG-KETA, INC.	193,000
ARMSTRONG-KETA, INC.	42,000
ARMSTRONG-KETA, INC.	273,000
BURRO CREEK FARMS, INC.	92,000
BURRO CREEK FARMS, INC.	36,200
BURRO CREEK FARMS, INC.	58,700
BURRO CREEK FARMS, INC.	68,975
BURRO CREEK FARMS, INC.	27,500
COOK INLET AQUACULTURE ASSN	113,310
COOK INLET AQUACULTURE ASSN	331,445
COOK INLET AQUACULTURE ASSN	1,348,881
DOUGLAS ISLAND PINK & CHUM	125,000
DOUGLAS ISLAND PINK & CHUM	50,000
DOUGLAS ISLAND PINK & CHUM	44,000
DOUGLAS ISLAND PINK & CHUM	37,000
DOUGLAS ISLAND PINK & CHUM	15,500
DOUGLAS ISLAND PINK & CHUM	75,000
DOUGLAS ISLAND PINK & CHUM	50,000
DOUGLAS ISLAND PINK & CHUM	163,000
DOUGLAS ISLAND PINK & CHUM	40,000
DOUGLAS ISLAND PINK & CHUM	30,000
DOUGLAS ISLAND PINK & CHUM	118,000
DOUGLAS ISLAND PINK & CHUM	42,000

<u>NAME</u>	<u>DOLLAR AMOUNT</u>
DOUGLAS ISLAND PINK & CHUM	67,700
DOUGLAS ISLAND PINK & CHUM	57,300
DOUGLAS ISLAND PINK & CHUM	67,500
DOUGLAS ISLAND PINK & CHUM	150,000
DOUGLAS ISLAND PINK & CHUM	162,000
DOUGLAS ISLAND PINK & CHUM	195,500
DOUGLAS ISLAND PINK & CHUM	198,000
DOUGLAS ISLAND PINK & CHUM	51,000
DOUGLAS ISLAND PINK & CHUM	263,000
DOUGLAS ISLAND PINK & CHUM	196,000
DOUGLAS ISLAND PINK & CHUM	95,000
DOUGLAS ISLAND PINK & CHUM	55,000
KAKE NONPROFIT FISHERY CORP	346,900
KAKE NONPROFIT FISHERY CORP	196,187
KAKE NONPROFIT FISHERY CORP	188,000
KAKE NONPROFIT FISHERY CORP	104,500
KAKE NONPROFIT FISHERY CORP	184,000
KAKE NONPROFIT FISHERY CORP	66,780
KAKE NONPROFIT FISHERY CORP	195,383
KAKE NONPROFIT FISHERY CORP	272,863
MEYERS CHUCK AQUACUL ASSN, INC.	10,000
NORTHERN SE REG AQUACULTURE ASSN	270,196
NORTHERN SE REG AQUACULTURE ASSN	1,500,000
NORTHERN SE REG AQUACULTURE ASSN	15,000
NORTHERN SE REG AQUACULTURE ASSN	260,000
NORTHERN SE REG AQUACULTURE ASSN	224,715
NORTHERN SE REG AQUACULTURE ASSN	288,989
NORTHERN SE REG AQUACULTURE ASSN	494,084
NORTHERN SE REG AQUACULTURE ASSN	450,125
NORTHERN SE REG AQUACULTURE ASSN	100,000
NORTHERN SE REG AQUACULTURE ASSN	201,369
NORTHERN SE REG AQUACULTURE ASSN	261,500
PRINCE WM SOUND AQUACULTURE CORP	329,000
PRINCE WM SOUND AQUACULTURE CORP	1,388,000
PRINCE WM SOUND AQUACULTURE CORP	7,692,000
PRINCE WM SOUND AQUACULTURE CORP	1,786,000
PRINCE WM SOUND AQUACULTURE CORP	585,500
PRINCE WM SOUND AQUACULTURE CORP	1,000,000
PRINCE WM SOUND AQUACULTURE CORP	1,400,000
PRINCE WM SOUND AQUACULTURE CORP	650,000
PRINCE WM SOUND AQUACULTURE CORP	204,000
PRINCE WM SOUND AQUACULTURE CORP	265,000
PRINCE WM SOUND AQUACULTURE CORP	62,000
PRINCE WM SOUND AQUACULTURE CORP	1,345,500
PRINCE WM SOUND AQUACULTURE CORP	1,217,039
PRINCE WM SOUND AQUACULTURE CORP	500,000
SHELDON JACKSON COLLEGE	177,254
SHELDON JACKSON COLLEGE	185,000
SHELDON JACKSON COLLEGE	61,370
SOUTHERN SE REG AQUACULTURE ASSN	1,100,000

<u>NAME</u>	<u>DOLLAR AMOUNT</u>
SOUTHERN SE REG AQUACULTURE ASSN	3,783,000
SOUTHERN SE REG AQUACULTURE ASSN	900,000
SOUTHERN SE REG AQUACULTURE ASSN	351,000
SOUTHERN SE REG AQUACULTURE ASSN	538,342
SOUTHERN SE REG AQUACULTURE ASSN	2,700,000
SOUTHERN SE REG AQUACULTURE ASSN	410,000
SOUTHERN SE REG AQUACULTURE ASSN	200,000
SOUTHERN SE REG AQUACULTURE ASSN	300,000
SOUTHERN SE REG AQUACULTURE ASSN	211,600
SOUTHERN SE REG AQUACULTURE ASSN	525,000
SOUTHERN SE REG AQUACULTURE ASSN	406,000
SOUTHERN SE REG AQUACULTURE ASSN	517,000
TLINGIT-HAIDA FISHERIES DEV CORP	89,860
TLINGIT-HAIDA FISHERIES DEV CORP	1,464,000
VALDEZ FISHERIES DEV'T ASSN	188,000
VALDEZ FISHERIES DEV'T ASSN	406,530
VALDEZ FISHERIES DEV'T ASSN	38,000
VALDEZ FISHERIES DEV'T ASSN	1,950,000
VALDEZ FISHERIES DEV'T ASSN	240,000
VALDEZ FISHERIES DEV'T ASSN	266,300
VALDEZ FISHERIES DEV'T ASSN	240,000
VALDEZ FISHERIES DEV'T ASSN	105,000
VALDEZ FISHERIES DEV'T ASSN	147,000
VALDEZ FISHERIES DEV'T ASSN	240,000
VALDEZ FISHERIES DEV'T ASSN	371,000
VALDEZ FISHERIES DEV'T ASSN	25,000
VALDEZ FISHERIES DEV'T ASSN	407,000
VALDEZ FISHERIES DEV'T ASSN	511,879
VALDEZ FISHERIES DEV'T ASSN	380,000
VALDEZ FISHERIES DEV'T ASSN	130,000
VALDEZ FISHERIES DEV'T ASSN	538,664



STATE OF ALASKA
LEGISLATIVE INFORMATION OFFICE

TESTIMONIES GIVEN
4/24/87 FROM PETERSBURG
ON S.B. 106. TELconference

We are pleased to enclose this
material for your information.

LEGISLATIVE INFORMATION
OFFICE

..... P.O. BOX 1470
PETERSBURG, AK 99833

W. W. W.

TESTIMONY ON SB 106 4-24-87

My name is Debra Carpenter, I live on the west side of Prince of Wales Island in Sea Otter Sound. I used to live at Edna Bay and now reside in Tokeen and fish with Dave Lyons on the KRAKEN out of Petersburg.

I make my living commercial fishing and contracting from the Forest Service. About three years ago Dave and I became interested in oyster culture and began researching the idea of raising oysters and began looking for private land with adjacent tidelands suitable for aquaculture. Well, I discovered that other than the native corporations there is no private land available. The Trillium Corporation, which is also called Lynn Canal Investment Corporation, does have some land for sale. It's \$5000 per acre, minimum purchase 20 acres. The state land disposal program has created communities whose populations and resulting pollution problems prohibit the location of adjacent aquaculture sites. There are a few old cannery sites available. They are in the hands of real estate speculators from Juneau who already have them subdivided.

Very reluctantly, we have pursued the course of applying for a tidelands permit and hoping that at some later date we will be able to obtain an uplands lease from the Forest Service.

I think that I have a valuable point of view because I am involved both with the fishing industry and the aquaculture field.

First, I must say I'm dismayed and confused by the terms aquaculture and mariculture. Why don't we just say that we have a bill here that calls for pen reared salmon for profit by the private sector.

I attended the Southeast Conference and heard Fred Harris, a lobbyist for Sealaska, speak. He stated flatly that pen reared salmon would not compete with troll fish and that salmon farming would be a mom-and-pop style business. We've received phone calls from salesmen who want to sell nets, floating docks, collapsible portable tanks, vinyl coated wire mesh, etc. It's incredible the amount of money these people are ready for us to make and give them.

I think the psychology that is motivating the pen-reared salmon proponents is, "How quickly can I invest 60 to 100,000 bucks and make my 150 to 200,000 dollars a year on my salmon farm?" That kind of thinking is buying the lobbyists who composed this misbegotten bill of dubious percentage. The pen reared salmon proponents have made a prostitute of an honest, struggling, fledgling shellfish industry by marrying the interests, the welfare and the future of the shellfish industry to the short-sighted and selfish interests of a few by corporations and investors who smell money!

The future shellfish industry and economy needs a rational and well-thought out plan and support from the State of Alaska.

We need a PSP lab in southeast.

We need a coherent criteria for evaluating sites for shellfish culture with respect to other area uses.

We need a position, in writing, from the Forest Service. A firm and fair policy on the leasing of uplands for support facilities for shellfish culture. It would be great to have a lab for culturing oyster spat and abalone spat. But a lab must be located on the uplands. Presently a person has to locate their aquaculture site in a floathouse; and floathouses and the resulting contamination of the water aren't compatible with shellfish culture.

Many other issues seek to discourage the private sector from venturing into shellfish farming. Marketing out-of-state requires a processors license. That means bonding and prepayment of estimated taxes. This increases the initial capital investment. With changes in the tax laws, you can now write off only as much in losses as your small business generates in sales of product. Well, with shellfish farming there is no product for the first three years. There is only investment, investment, investment...and the gamble that on some bright future day you will be able to make living, growing and selling shellfish on Forest Service and DNR leases, which won't unexpectedly terminate.

Personally, we don't expect to select our site, move through the permitting process, get the oysters into production, go through more permitting for uplands and long term lease of the tidelands if the oysters do produce, clear the land, install the generators, get the floathouse onto the beach, etc. and etc. in any less than 10 years. But we are willing to make that 10-year commitment of the days of our lives and the dollars that, by the way, wild and hatchery salmon have produced.

I ask you to support the shellfish industry by NOT supporting any bill that suggests we pen rear salmon at the expense of our existing fishing industry.

Also, I absolutely despair at seeing all the argument and wasted time and effort this bill has generated.

Shellfish farms desperately need a well-constructed and well-thought out plan and guidelines and support for their industry. Quick return, big profit for big investment salmon farming under the guise of mariculture has only clouded the issues and muddied the water.

Thank-you for your time and attention.

Gerry Merrigan
Box 1069
Petersburg, AK 99633

TESTIMONY ON SB 106 4/24/87

I realize there is a great need in Alaska for a comprehensive mariculture program. However, this bill is a poor step in formulating such a program. It raises many questions and provides very few answers. It does not provide for a speculation-free permitting process; it does not provide for public input on siting on public lands and waters; it does not provide for adequate biologic and genetic safeguards. What it does provide is accelerated licensing of a private industry that involves public resources along with very few safeguards for those same resources. The attitude is "Trust us."

In addition, the bill specifically excludes the public and the Board of Fish--hence the fishermen--from the licensing process.

Advocates of the pen-rearing of salmon would have you believe that aquatic farming would create more jobs and stabilize the economy with no threat to commercial fishermen. This simplistic view could not be further from the truth. Salmon pen rearing--within Alaska and outside Alaska--directly competes with existing Alaskan fishermen in fresh and frozen markets. It also poses critical environmental and genetic hazards for our present resources. The bill does not address these problems but instead paves the way for swift licensing of highly capital intensive farms which would be quite out of reach of most Alaskans. Who would benefit from this bill? Clearly not Alaskan fishermen or the average Alaskan resident and especially not the natural resources from which we derive our livelihood.

Salmon pen rearing is portrayed as a long term economically viable industry... the jury is still out. It can only grow as much as the market will bear.

Most of my objections to this bill are in regards to finfish with particular emphasis on gambling with our wild stocks in regards to viral and genetic contamination. As for other forms of mariculture--shellfish, mussels, kelp--the previous problems of physical siting criteria and speculation-free permitting still exist. As this bill has more holes than substance and since it raises more questions than it answers, I would hope to see this bill fail.

Rather than have a haphazard mariculture policy result from legislative time constraints, a moratorium will allow an unbiased study to be conducted. I'm not talking about studies like the House Research report on the effects of mariculture--a document over 100 pages in length with all of one page on negative effects.

I would like an honest look at the net benefit of pen rearing with the cost of displaced fisheries, the cost to the state pocketbook, and the cost in natural resource degradation. In short, the net benefit to all Alaskans, especially in jobs lost versus jobs created.

Since any type of mariculture is private resource consumption of public natural resources, the public should be included in the permitting process. One avenue for this is the inclusion of the Board of Fish, thus the local Fish & Game Advisory Boards. The public has the right to be included in any process which changes multiple use to single use.

Thank-you.

Julie Hursey
Box 213
Petersburg, Alaska
F/V Thunder

Senate Bill 106

I am opposed to the passage of House Bill 108, but before outlining the arguments I have with this bill, I will say that I am not opposed to mariculture ever being developed in Alaska. In particular, I think that shellfish mariculture could coexist well with the existing fisheries. However, the development of any kind of mariculture must follow a careful management plan to minimize adverse effects to the marine environment and our existing fisheries resources. My main argument with this bill is that it does not outline any such specific management plan, and too many crucial issues are left unresolved. Some of these issues include possible environmental degradation and adverse impacts on wild stocks of fish, realistic costs to the state, and conflicts over area use by different groups. I will address each of these in turn.

In order to ensure that development of the mariculture industry does not damage the environment, it is essential that a thorough monitoring plan is in place PRIOR to development. This program would oversee site selection, monitor water quality, conduct inspections of sites to maintain health standards and control any problems with disease. However, BEFORE such a monitoring program can be designed, and BEFORE the costs to state agencies can be assessed, there must be some sort of policy on the development of mariculture which would delineate the ultimate size and direction of industry growth. This bill fails to address controls over size and rate of growth of the mariculture industry.

Without knowing the ultimate number of farms, what size they will be or even where they will be, it is impossible to design an adequate environmental monitoring program, or to ensure environmental protection. According to the Gillespie Report "An Inquiry Into Finfish Aquaculture in British Columbia", environmental monitoring represents a major deficiency in the regulation of fish farms. In fact, this report mentions that site inspections have become infrequent because "approval agencies were too busy with the backlog of plans to conduct field inspections". To jeopardize environmental health because of such poor planning is inexcusable. We can learn from Canada's mistakes.

My particular concern is the effects that the uncontrolled development of salmon farming could have on environmental quality and the health of our wild stocks. It is a fact that if salmon farms are not carefully sited, fish wastes and excess feed can cause a pollution problem. Also, if a site is not properly located, penned salmon populations can become stressed and subject to disease. Canada is already having problems with farms that are improperly sited, and this in part led to the moratorium on new permits.

Julie Hursey
Box 213
Petersburg, Ak.
F/V Thunder

SB 106 The probability of disease transmission from farmed salmon to wild salmon is unknown at this time. In Norway, where most of the research has been done, there were few natural stocks to worry about. Eventually, however, even they are planning to develop "green zones" or areas that are aquaculture free to protect what wild stocks they do have. ~~House Bill 108~~ does not adequately address the question of protecting the health of the wild stocks. Perhaps these "green zones" should be considered. In any case, no industry should be allowed to develop at the expense of our healthy marine environment, and our wild stocks of fish.

If mariculture is to benefit state revenues, then we must have an accurate assessment of its costs to state agencies. Questions raised last week during testimony indicate that this is an area which needs to be addressed more carefully.

The number of farms that will be developed will determine the costs in part. According to Bryan Alle, the Fish and Game fiscal note is predicated on 100 permits being issued the first year, and an actual 20 farms being operational by 1992. What if this prediction falls short? Alle says that then costs will go up. But how much would they increase, and does the state have the resources to cope with a greater than expected increase in the numbers of farms? It is obvious that a range of fiscal scenarios must be presented by each agency, in order to have a more realistic picture of the probable costs, and to be able to plan accordingly.

In Canada, staff and funding levels have not kept pace with industry growth. According to Bryan Alle, there is a critical lack of pathologists in British Columbia, and we could face the same problem here if the mariculture industry grows beyond present predictions. Do these agencies have a contingency plan to deal with such a problem if it arises? What will happen if there are not adequate funds to cover the costs? Diverting funds from existing fisheries management programs is not an option. I must admit, the zero fiscal note submitted by the Department of Environmental Conservation mystifies me. Now they are reassessing that note. Good idea. I think this entire area needs more thorough investigation.

Another issue that is not addressed in this bill is how disputes over use of an area will be resolved between conflicting user groups, and the possible pre-emptive use of areas by the mariculture industry. Fish farms could be located in areas that have been traditionally used for anchorages, fishing grounds, gear storage areas, recreational uses, and even marine transportation corridors. Another source of conflict would arise if fish farms were placed in areas that are already used as spawning or nursery grounds for wild stocks. Canada is already having problems with these kinds of conflicts now, and it has reached serious proportions, according to Vince Goboyan, a Canadian delegate from the Canadian Standing Senate Committee on Fisheries.

Julie Hursey
Box 213
Petersburg, Alaska
F/V Thunder

A coastal zone management plan is urgently needed, to take inventory of our coastal resources, and to designate areas for specific uses. At this time, no such plan exists in the areas where mariculture could occur. It is essential to acknowledge the multiple uses of coastal waters and tidelands, and the diversity of user groups in order to minimize conflicts.

This brings to mind the question of how decisions will be made on area designations. Will this be made on a site by site basis, or will there be a comprehensive plan with public hearings? How much will it cost? Will the user groups have any input into this process, and what avenues will be available? The bill specifically precludes the Board of Fish from participating in site selection, but does not address the question of public participation in the process. This hardly seems fair.

In summary, I will say that I strongly object to the passage of this vaguely worded bill. I do not believe that enough planning and research has gone into determining an adequate environmental monitoring program to protect the marine environment, or our wild stocks of fish. I don't think that the costs to the state have been adequately assessed. I think the great potential for conflicts over area use could create a miasma of problems. I do not believe that we should start this industry, then develop the management plan as we go along. This would be extremely short-sighted, and could offer only band-aid solutions to the major problems which could arise. I think we can learn from the mistakes that Canada has been making.

~~SB 106~~
~~House Bill 108~~ does not adequately address the problems that could arise from the development of mariculture. Until we have a better plan for avoiding problems, and until we know that we have the resources to deal with these problems as they occur, I am opposed to the passage of ~~House SB 106~~ ~~Bill 108~~. Thank you very much for taking the time to consider this.

AS A FISHERMAN IN SOUTHEAST ALASKA, I HAVE AN INTEREST
IN MARICULTURE AND HAVE PUT SOME TIME INTO GATHERING INFORMA-
TION ON THE SUBJECT. I'VE BARELY SCRATCHED THE SURFACE OF
SUCH A COMPLEX ISSUE BUT AM AWARE ENOUGH TO REALIZE THAT
MARICULTURE IN ALASKA DESERVES MORE CAREFUL SCRUTINY THAN
SENATE BILL 106
WHAT ~~HOUSE BILL 108~~ SUGGESTS.

BESIDES HAVING OBVIOUS FLAWS WITH ADMINISTRATIVE CONCERNS
SUCH AS FUNDING AND MANAGEMENT, ~~HOUSE BILL 108~~ ^{SENATE BILL 106} IS CONTENT
TO RUBBER STAMP AN APPROVAL AS IF THERE WERE NOTHING AT RISK
IN THE BIOLOGICAL AND SOCIO-ECONOMIC RESULTS OF MARICULTURE.

MARICULTURE NEED NOT BE TREATED AS AN INEXORABLE
CONDITION OF ALASKA'S FUTURE SIMPLY BECAUSE SOMEONE SAID
THERE'S MONEY TO BE MADE IN IT. THE ECONOMICS OF MARICULTURE
DEPEND ON AN UNDERSTANDING OF COMPLEX BIOLOGICAL CONSIDER-
ATIONS WHICH MUST BE UNDERSTOOD TO BE SUCCESSFULLY
IMPLEMENTED. THIS UNDERSTANDING COULD BE COSTLY ON A
TRIAL AND ERROR BASIS.

+ ~~PROBABLY~~
RISK/REWARD
DO WE HAVE TO LOSE
SOMETHING TO GET
WHAT WE WANT

Daniel M. Bock

Box 148
Petersburg, AK
99833

106 - Senator Ellason

mariculture

I came to Alaska in 1946 and lived thru the time of fish traps. I sat thru the presentation at the SE Conference and the Sitka Marine Trade Fair in March. I can see Alaska being carved up into special harvest areas ^{for} ~~in~~ the mariculture lease areas. I like the proposal that a special committee be appointed to look into site selection before any leases permits are issued. I feel there should be a good representation of fishermen, conservationists, including their associations, industry, ADF&G and US Forest Service, and NMFS, who has done the preliminary work on pen-rearing. I also favor a moratorium until this group can report back. I understand there has already been 30-40 lease application for oyster farms in the Wrangell-Petersburg areas alone. As the pen-reared salmon are easily stressed according NMFS Bill Heard, I can see signs at the mouth of bays where the net-pen ^s are located that say, No motorized vessels allowed. I can see pens being placed in the best anchorages. We must consider the other uses for the areas. Looking at all the criteria which I won't take time to list, I can think of few areas that meet all of them.

We just had an outbreak of BKD at the Crystal Lake hatchery where the best biologists are watching the fish. There is great danger of it getting into the pen-reared stocks where people without biological training will be taking care of the fish. Recently Norway had to destroy many of their fish due to disease. This could happen here.

Where is the money going to come from to get started in pen-rearing. I've heard of figures from \$300,000-1 million. It will stretch the ADF&G budget to decide where to let lease, inspect the fish for disease, etc. I am opposed to using any state money for mariculture. As soon as a group gets a state loan, they want concessions in regulations or they won't be able to pay back their loan. I also do not want any of the 3% the fishermen are paying for aquaculture to be used for mariculture.

Marlyn George #6
Box 1031
Petersburg, AK
99835

the hatchery gets its water. They are expected out of the incubators by Feb. 15. They will not need the four raceways, which have not been completed, until June 15.

Crystal Lake hatchery will be releasing 700,000 king smolts, an all-time high, and 60,000 king fry in 1986, Billi said. Of these 400,000 will be released into Crystal Creek on which the hatchery is located, and 200,000 into Gunner Creek near-by of which 100,000 will be raised in net pens. If permits can be obtained, they plan to release 100,000 king smolts into Earl West Cove, south-east of Grangeville in the Snake Channel.

They will release 130,000 coho smolts into Crystal Creek and 1 million unfed coho fry into Irish Creek. Due to lack of space, they have put 250,000 eyed coho eggs into boxes in Crystal Creek.

In 1985, the hatchery had a record king return of 3370 and from those they took a record number of 6,275,000 eggs. They also took 110,000 eggs from kings in the Tahini and Farragut rivers, which they will raise in their isolation-incubation facilities and return to those rivers in the spring of 1986. Of the 2,100,000 eggs they took from Crystal Lake kings, they hope to have 1.5 million smolts to release in 1987. Of the remaining eggs takenⁿ in 1985, 5.3 million were transferred to ADF&G hatchery at Shattishan, 319,000 to Hedvigie in Sitka, 279,000 to ADF&G hatchery at Hidden Falls and 97,000 to Sheldon Jackson, Billi reported. Of the 3,440 cohoes that returned to the hatchery in 1985, they took 1.6 million eggs. They also took 329,000 anad eggs and 68,000 steelhead eggs.

Mr Chairman, members of the Committee, my name is David Bedford. I live in Petersburg.

I am very concerned that the potential for transmission of disease from farmed salmon to wild Alaskan stocks has not received adequate attention.

Curt Kevus in Marine Advisory Bulletin #26 World Salmon Farming: An Overview with Emphasis on Possibilities and Problems in Alaska devotes three sentences to the problem. He terms it a "calculated risk", but assures us that "new fish diseases pose little long term risk to indigenous populations. This would appear ingenuous at best when 80% of disease problems in the Norwegian fish farming industry come from the 'hitra' disease, a new disease that arose with the advent of intensive fish farming.

According to Dr. Arthur H. Whiteley, Professor of Zoology at the University of Washington, salmon pens "enrich the local environment for bacterial growth", and can foster a variety of diseases not only in penned fish, but in the water column and in sediments on the ocean floor. Infection of wild ~~stock~~ ^{fish} often occurring through the gills, requires only a few minutes of ^{proximity &} exposure. The tendency of outmigrating salmon smolts to gather around docks, floats and rafts will certainly create the opportunity. To quote Dr. Whiteley "it is the opinion of microbial ecologists that an infected fish pen would in all likelihood serve as a focus for the infection of fish in the environment and from them for the transmission of disease to their offspring."

David Bedford

Box 1211

Petersburg, AK 99833

Dr. Whiteley further points out that some bacteria associated with salmon pens cause shell disease and internal infections in King crab, Tanner crab and shrimp. Some of these bacteria are known to infect oysters and abalone as well.

Alaska produces 43% of the world's harvest of pacific salmon. We have important crab and shrimp fisheries. These resources are the basis for much of our coastal economy. The potential risk of a salmon farming industry to these resources is very real, regardless of how proponents of pen rearing may gloss it over. We can not go forward with Senate Bill 106 until guarantees are in place from both the mariculture industry and the responsible agencies of government for the continued health of our existing fisheries resources.

Some relationships between pathogenic bacteria and
salmon net pen culture
Pacific Fisheries Legislative Task Force, State Capitol, Olympia,
Feb. 7, 1987

Dr. Arthur H. Whiteley, Professor, Department of Zoology,
University of Washington

I intend in these few minutes to comment on one aspect
only of pen rearing of salmon - the relationship to pathogenic
bacteria and other agents of disease.

The growth of bacterial populations in a natural environment
is limited by the availability of nutrients. In a typical, natural
marine environment the bacterial populations are relatively
sparse. Given appropriate nutrients, either in the form of
dissolved materials or sediments, the opportunity for growth in
these populations will be much enhanced. It is generally agreed
that salmon pen culture contributes substantially to the
eutrophication of the environment of the pen - both in terms of
soluble and finely suspended material, and in terms of larger
particles that form heavy sediments on the bottom. In this
way, the pens enrich the local environment for bacterial growth.
Those bacteria already present in the water and substratum can
increase. Any brought in with the introduced fish can increase
as well. A variety of diseases can thereby be fostered by the
pens. Some of these are of bacterial origin, some are viral, and
some are due to organisms such as fish lice, parasitic worms,
etc. The enhancement of the bacteria by nutritional enrichment
works to the disadvantage of the penned fish. They are already
stressed by the conditions in which they grow. They are
therefore susceptible to bacterial invasion. Notably *Vibrio*
anguillarum and *Renibacterium salmonarum* infect the penned
fish and often kill them, and other vibrios and aeromonads are of
major importance as salmon pathogens. *Vibrio anguillarum*
produces disease in penned salmon in this State and in British
Columbia. It also is ubiquitous in Norwegian waters, and is
responsible for many of their fish farm diseases. With the
advent of intensive fish farming in Norway, a new disease, the
"hitra" disease, has appeared and now is responsible for 80% of
the disease problems in the Norwegian fish farms. Its cause is
uncertain, but vibrio species occur in connection with the disease

outbreaks (Håstein, 1986).

A significant question is whether these infections affect wild fish. Weston (1986) concludes that the evidence argues against such transmission. Others point out the difficulty of making such a determination because of the mobility of the wild fish and other complexities associated with working in a submerged, marine environment (Trust, 1986; Johnson, 1989; Staley, pers. com.). It takes only a few minutes exposure for a fish - penned or wild - to become infected. Often the route of transmission is through the gills. The infected fish often die, but if they survive, they frequently become carriers of the pathogenic organism. Both viruses and bacteria can be shed through the feces of the fish, thus spreading the focus of contamination in the natural environment. Moreover, in certain cases (*Renibacterium*) the bacteria can be passed from a female to her eggs, where it associates with the yolk, and transmits the disease to her offspring (Trust, 1986). It is too early to conclude that there is no transmission from a pen to the general environment and to the wild fish there. On the contrary, it is the opinion of microbial ecologists that an infected fish pen would in all likelihood serve as a focus for the infection of fish in the environment, and from them for the transmission of disease to their offspring (Staley, pers. com.).

In addition to pathogenic bacteria, the stressed salmon can serve as a focus for a number of serious viruses. These, too, may enter their host through the gills, and can be transmitted to other fish and to next generations (Trust, 1986). It is expected that they will be locally enhanced by the concentrations of wastes associated with fish pens (Staley, pers. com.), and this enhancement poses problems for the penned fish, and for wild fish as well. The danger that such viruses can be transmitted to wild fish is recognized by laws that prevent introduction of salmonids from the Columbia River system, which is infected by viruses, into any other river system in this State.

These pathogens and related ones that will multiply in the accumulated fish wastes, can serve as a reservoir of infection of marine invertebrate organisms as well. This, too, is a difficult field of inquiry because of the nature of the environment and the mobility of some of the organisms, and most information is derived from study of captive invertebrates. It is believed,

however, that animals living in degraded environments (which I assume would include under-pen locales) can be seriously disabled by such bacteria. Bacteria that degrade chitin, including *Vibrio*, *Beneckea* and *Pseudomonas*, cause shell disease in a host of crustacea, including spiny lobsters, tanner crabs, king crabs, various shrimp, and others of economic importance (Johnson, 1983). The species of *Vibrio* bacteria that infect crabs and shrimp include those associated with salmon pens or are present in local waters: *V. anguillarum*, *V. parahaemolyticus*, *V. alginolyticus*. (Johnson, 1983). Laboratory experience indicates that animals kept in clean sea water are difficult to infect, but those in the presence of sewage sludge developed shell disease. In addition to causing shell diseases, bacteria invade shrimp, crabs and other crustacea and cause internal infections. Again, the total relation of these infections to stress, to polluted environments, to salmon pen sewage is not resolved (Johnson, 1983), but we believe this relationship needs analysis in relation to establishing fish pens in the vicinity of shrimp and crab populations.

There is a well documented literature demonstrating that molluscan embryos and larvae - some of commercial significance - are subject to serious infection by these same species of vibrio bacteria. Abalone embryos and Pacific oyster (*Crassostrea gigas*) embryos and veliger larvae in hatcheries suffer serious mortalities from vibriosis (Sparks, 1985; Jeffries, 1984; Tubiash and Elston, 1984). It would be prudent to determine carefully the potential damage that may be caused by juxtaposing salmon pens to oyster and abalone culture facilities, and to native bivalve beds.

It would be of interest, also, to determine if vibriosis similarly affects these same kinds of molluscan larvae and embryos in the natural plankton, thereby affecting natural populations. Beyond that, it is important to know if populations of these *Vibrio* species or other pathogens, enhanced by sewage or fish pen wastes, infect other forms of invertebrate larvae or adults. I am thinking of the sponges, sea urchins, starfish and the host of other invertebrates which, though not of direct commercial value, are absolutely fundamental to the ecosystems of these water and to their productivity. Their impairment would sound the death knell for these waters.

Some of these bacteria are pathogenic to man as well. Knowledge of the genus *Vibrio* is expanding rapidly. This genus, which includes *V. cholerae*, includes species that typically live in marine locales (Kelly et al., 1982). *V. anguillarum* appears not to infect humans. However, *V. vulnificus* and *V. parahaemolyticus* do infect humans. *V. vulnificus*, a recently recognized species, is a deadly pathogen that is carried in sea water. It is readily filtered and concentrated from sea water by oysters and clams and it is easily transmitted to humans when these bivalves are eaten. The results are often fatal. Other than through ingestion, humans can contract the disease through simple contact of sea water with open wounds or mucosal tissues. It is predominately a warm water organism, which suggests that our waters may be safe from it, but virulent strains of this species have been found in Oregon associated with fish, crabs and clams and in Japan associated with eels (Tison and Kelly, 1986; Kelly and McCormick, 1981; Tison and Kelly, 1984; Blake, Weaver and Hollis, 1980). A preliminary search for this species in the San Juan Islands has not revealed it, but its presence in warmer bays there, and in the Canadian Gulf Islands, or elsewhere in the Sound cannot yet be discounted (Kelly, pers. com.). *V. parahaemolyticus* is, by contrast, commonly found around the San Juan Islands and doubtless is ubiquitous here (Kelly, pers. com.). It causes acute gastroenteritis in humans (Tison and Kelly, 1984; Blake, Weaver and Hollis 1980). This form of gastroenteritis appears to be transmitted exclusively through food, usually seafood (Blake, Weaver and Hollis, 1980). It can be a very significant infectious agent: in Japan, over a 10 year span, 24% of reported cases of food poisoning were attributed to this bacterium.

V. parahaemolyticus, thus, is present here, is a known pathogen of humans, and is transmitted through filter feeders such as clams and oysters. *V. vulnificus* is found nearby, and with further searching may be found in the Sound and Gulf. Simple contact with infected sea water will lead to serious infection. The former species, and probably the latter as well, thrives in heavy, enriched sediments such as sewage sludge. It can also be expected to grow in salmon pen sludge (Staley, pers. com.; Kelly, pers. com.).

It has been argued by associates of the salmon pen aquaculture industry that human diseases associated with these vibrios have been rarely found in the Puget Sound region, and therefore no danger is posed by them. Thus fish pen aquaculture is justified. It is good that the base line now, before salmon pens are well established, is essentially zero. The water is relatively clean, now, and the populations of these pathogens are within tolerable limits, using customary screening methods for detecting these pathogens. But a further complication is introduced by a recent paper (Grimes, et al, 1986). They find that when such pathogens as I have been discussing are introduced into marine waters, they rather quickly lose their identity as measured by conventional culture methods. They enter into dormancy, but remain viable though not culturable by traditional methods. Failure to find them using these methods could lead to overlooking a substantial, but cryptic source of serious pathogens in the environment.

The important question, then, is not whether these organisms pose a present health threat, or ecological threat. The proper question is: can these organisms, and this ecosystem, and these humans tolerate the eutrophic burden that will be imposed by a full blown fish pen industry? It is our belief that there are many too many questions that need resolution, of a public health nature, and of an ecological nature, before we proceed further.

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SB 106

TESTIMONY OF CHRISTOPHER PACE CONCERNING ~~FOR SB 106 BEFORE THE HOUSE~~
~~RESOURCES SUBCOMMITTEE, MARCH 31, 1987~~

April 24, 1987

Thank you. My name is Christopher Pace. I'm from Petersburg. I'm an aquaculture biologist, a commercial salmon fisherman, a member of the American Fisheries Society and a member of the Alaska Trollers Association. I support the concept of mariculture adopted by the 1986 Southeast Conference, and I'm considering personally investing in mariculture technology. However, I have reservations concerning the private captive rearing of salmon for profit in Alaska, and I'm opposed to the ~~Committee Substitute for SB 106~~. I'm requesting my district's legislators, Representatives Sund and Taylor and Senator Jones, to take those actions necessary to stop passage of this bill. It contains some good concepts, but overall it is a bad piece of legislation and acts as a detriment both to the creation of a viable mariculture industry and to the people and institutions of this state.

First, I'm against a law that takes control and responsibility of fishery resources away from the commissioner of fish and game. This bill places vital fisheries decision making on a par with decisions regarding licensing of the state's professional support industries, such as hairdressers, building contractors, chiropractors, and realtors. The other chapters in Title 08 reference professional qualifications, examination and competency boards, and performance bonds. None of these kind of stipulations are present in the proposed Chapter 6.

Another criticism I have is with regard to the potential issuance of hatchery permits by the commissioner of commerce and economic development. The fish and game statutes (Title 16) governing private hatchery permits stipulate that the commissioner of ADF&G "may" issue a hatchery permit, while Bill 106 implies that the commissioner of commerce "will" issue the same permit as a matter of course. I believe it is an invitation to legal chaos to allow for the issuance of a hatchery permit by either of two separate state agencies. This would occur if Bill 106 is adopted. As it is written, Bill 106 would place the burden of proof on the departments of fish and game and environmental conservation to provide to the commissioner of commerce the measures necessary to mitigate impacts caused by commercial hatcheries authorized under Title 08. This situation is reminiscent of the flawed logic that led to the space shuttle disaster, i.e., the necessity to prove that a system will not self-destruct rather than to prove that it will actually work safely.

I'm against a law that could permit the commissioner of commerce to make decisions that result in obligating the commissioner of fish and game. The result is the creation of a super agency of state government with extraordinary power over ADF&G. This sort of power should be reserved for the governor, the legislature, and the courts. Additionally, the bill does not address how the commissioners of fish and game or environmental conservation should adopt the regulations necessary to implement the proposed mariculture policy.

I'm also confused regarding the difference between an "aquisition permit" and the present fish and egg transport permits (FTP) issued by the commissioner of fish and game as per 5 AAC 41.005. Are they the same thing or will there be two alternative permit processes? I'm afraid that with two separate processes the existing pathological, genetic, and management safeguards may be lessened or neutralized. If it is necessary to have a new statute, I want to see

transport or aquisition remain under Title 16. However, I believe the existing FTF system is adequate to allow for development of algal and shellfish culture.

What clinches my opposition to Bill 106 are the proposed ammendments to Title 16 of the Alaska Statutes. It is the proposed exemption of fish farming from regulation by the Board of Fisheries, from participation in ASMI, from recognition as a commercial fisheries activity, or from regulation by the Commercial Fisheries Entry Commission, that generates the animosity from most segements of the fish production industry against the concept of mariculture. All the other participants in the Alaska seafood business have to play by the system. Bill 106 would give an unfair competitive advantage to a new mariculture industry that is supposed to be complementary to the existing industry.

Next, I'd like to question certain conclusions presented in the report titled "Aquaculture in Alaska". I believe the report understates the current level of salmon cultural technology practiced in Alaska. I would argue that Alaska already has legal salmon pen culture for coho and chinook, and you can see examples of it at Neets Bay, Hidden Falls, Medvejie Creek, Taku Harbor, and Carroll Inlet. These are FRED and PNP facilities that rear the salmon to the optimal size necessary to generate maximum social and economic benefits in relation to dollar expenditure.

I agree with the report that this program is the best investment the state has made in renewable natural resources and that it remains the first choice for future investment. However, the report seems to imply that the investment is completed and that now it is time tap the enhancement loan fund to enable development of private salmon farms. Who said the present program is done? If Alaska needs to increase chinook and coho production to avoid erosion in premium salmon markets then why not promote expansion of the FRED and PNP programs? I believe that from a social standpoint it would be the most cost-effective method to retain Alaska's market share of world salmon production and would be consistent with earlier recommendations from the Fisheries Mini Cabinet.

The report understates the impact of the regional aquaculture associations. Alaska's associations rival any of the Japanese, Norwegian, or Canadian "models of cooperation" mentioned by the House Research Agency. Much of the success of the present FRED and PNP program arises because of the comprehensive salmon production planning that resulted from the cooperation of the state, the regional associations, and the federal government. The existence of the programatic goals contained in these plans increased the probability of success of the present investments.

What disturbs me is the lack of evidence of a reciprocal publically identifiable plan or goal for a new mariculture industry, presented either in the bill or in the report. Without a publically supported plan, and quantifiable goals and objectives, an Alaskan mariculture industry will quickly resemble the uncontrolled Canadian example. Problems will arise that will be impossible to resolve.

Another conclusion in the report I question is the premise that there will be surplus chinook eggs that could be sold to salmon farmers without affecting the quota imposed on Alaska by the U.S./Canada Salmon Treaty. This is incorrect. What limits Alaska's hatchery-originated chinook production is not

egg incubation space but rather water availability and containment structures for feeding and rearing juvenile fish. The present method to bypass these constraints is to transport surplus fry to saltwater rearing pens at locations away from the hatchery central incubation facility in order to maximize production and spread the locus of terminal harvests. These fish are optimally released as either 0. or 1. check smolts and result in an addition to Alaska's chinook quota. Further, they serve to secure Alaska's access to our coastal production resources.

What happens when a FRED or PNP project cannot site a saltwater net complex because a private salmon farm also desires the same site? What happens is that existing Alaska industry loses potential market share for premium quality salmon. This is an example of the allocative issues mentioned last week by Dr. Allee.

Should these siting questions be addressed or coordinated through a comprehensive salmon production plan? I think they should. However, it would be difficult to revise or update the present salmon production plans to include recommended development zones for mariculture without a comprehensive assessment of the state's potential. The only quantification of viable culture sites is the report's statement that the potential appears to be "quite large". The case with actual salmon hatcheries has proven otherwise. The real number of viable salmon enhancement opportunities has turned out to be quite less than original estimates.

I believe it is ill advised for the state to throw the door wide open for the development of the remaining sites by private industry without knowing the potential of the resource. Further, it is ill advised to invite site development without a clear goal and a plan for utilization that provides for the greatest public benefit.

In summary, while I oppose Bill 106, I support the concept of a complementary mariculture industry. I'm in favor of funding for a mariculture resource inventory and for the resumption of funding for the regional comprehensive planning program that was halted in FY 87. Without this information, and a relevant salmon production plan, Alaska's fish production industry will actually resemble the inefficient and overcapitalized situation alluded to in the House Research Agency report.

Thank you. I've left a copy of my prepared remarks with the LIO in Petersburg and I'm available for any additional questions the committee may have.

*CHRIS did not have the
time to present this
Testimony to the Committee*

MARICULTURE
ISSUES AND PROPOSED GOALS AND GUIDELINES

PLANNING TEAM DRAFT

PRINCE WILLIAM SOUND AREA PLAN
PRINCE OF WALES ISLAND AREA PLAN

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INTRODUCTION TO MARICULTURE IN ALASKA

The headlines of the Southeastern Log on August 25, 1986 read, "Mariculture, a boom about to happen." In recent months, with the state economy on the skids and people taking a fresh look at options for finding viable and stable economic projects in the state, the subject of mariculture has been receiving increased interest. In just this year alone, DNR has issued a total of XXXXXX permits for mariculture. An additional XXXXXX applications are currently waiting to be processed. Along with the increase in the number of permits issued there also has been an increase in the number of voices that are identifying problems with mariculture. User groups, local residents, native corporations and federal agencies are identifying conflicts that have not been clearly articulated to date since up until recently mariculture received only minor interest in the state. The department does not have a clear policy or set of guidelines for dealing with mariculture.

This paper is intended to be a starting point for discussions that will result in DNR policy. The paper first outlines the department's proposed goals for mariculture. Then, issues that have been identified are presented and recommendations made. Those recommendations that are accepted will be included in the Prince William Sound and Prince of Wales Island Area Plan Agency Review drafts as area wide policies and guidelines for mariculture. The plans may also identify areas where mariculture is a designated use or a prohibited use based on its compatibility or incompatibility with other important uses of state tidelands.

Proposed Definition of Mariculture. The culture and husbandry of marine aquatic organisms, including but not limited to fish,* shellfish, mollusks, crustaceans, kelp and other algae. This does not include fish hatcheries.

*Note: At this time, rearing salmon is not legal in Alaska. Two identical bills were introduced in the legislature on February 4, 1987 (HB 108 and SB 106) that would enable finfish mariculture to be allowed through a change in regulations by the Department of Commerce and Economic Development.

Issue 1: DNR Goals

Description of the Issue

Mariculture is a new industry in Alaska and has potential to play a role in a diversified state economy. For these reasons the Department of Natural Resources supports mariculture development along with other uses of state lands.

The competition between mariculture and other uses is the subject of the rest of this paper. At this point, it is important to

establish the department's goals for mariculture. The proposed goals are as follows.

Proposed Goals for Mariculture

- GOAL #1 Economic Opportunities and Community Development.
Opportunities to increase income and diversify the state's economy through the use of state tide and submerged lands for mariculture.
- GOAL #2 Optimum Use of Areas. The optimum use of the most suitable mariculture areas.

Issue 2: Competition Between Mariculture and Other Commercial and Industrial Uses of State Tide and Submerged lands.

Description of the Issue

The best sites for mariculture facilities may often be the best sites for other uses such as mineral or timber transfer and support facilities, log storage, commercial fishing anchorages, or commercial recreation development. Although mariculture is a new industry in Alaska, experiences in British Columbia and Washington have demonstrated there can be conflicts with other uses.

Timber and Mineral Development. Besides the need for space, water quality standards for mariculture may preclude the use of favored sites for other commercial or industrial facilities. Forcing more stringent mitigation measures or alternative siting for timber or mineral transfer or tailings disposal could reduce or eliminate the economic viability of the resource extraction industry in a given area.

Conversely, mineral or timber transfer, log storage, and floating camps associated with resource development activities may limit the space available or degrade water quality for mariculture facilities, thus making mariculture development more difficult and less likely.

In Washington State mariculture sites have created navigational hazards. Log rafts towed by tugboats need ample space to navigate and may be effectively blocked by a mariculture facility.

Commercial Fishing. Mariculture sites are often located in good anchorages for protection from the weather. Though operations may initially be small (1-3 acres), mariculture sites can grow to be, or even start, quite large (over 20 acres). Use of bays as important anchorages by the fishing fleet and associated operations, such as fish buyers, could slowly be displaced as the

mariculture facility expanded. A fishing boat at anchor requires considerable room to allow for changing tides, winds and currents. Although permits retain legal public access outside of improvements, the area remaining may not be sufficient to allow for adequate anchoring in smaller coves with expanding mariculture facilities. There is also the potential for commercial setnet sites, purse seine hook-offs, and other commercial harvest areas to be blocked by mariculture facilities.

Recreation. As a result of human waste, high coliform develops in the vicinity of high recreational boat use, wharves and marinas. Commercial fishing operations (tenders, seiners, etc.) experience similar coliform counts. Washington prohibits mariculture within one-quarter mile of state parks, popular recreation areas and anchorages, and primary navigational routes. There is also the potential for toxic effects from bottom paints on boats.

Mariculture. Mariculture operations may compete with other mariculture operations for space and for food carried by the tidal currents. They may also impact each other by transmitting disease or lowering down-current water quality. Separation guidelines in British Columbia and Washington require 0.8 kilometer (proposed to be increased to 3 km) and 2 miles respectively between most operations.

Current Process for Addressing the Issues

The department has no policy to guide adjudicators when potentially conflicting uses are proposed for the same area. Some of the issues raised above are addressed under the current permit review process. The Army Corps of Engineers and the Department of Environmental Conservation do a public notice for concerns related to navigation, wetlands, and water quality. Adjacent upland owners who might be planning mineral or timber development are notified of the proposed project by DNR adjudicators.

However, the DNR permitting process does not require public notice (a lease does), so concerns of competing tideland users are not specifically sought through a public process. This can make it difficult to assess the potential conflicts between proposed mariculture facilities and other uses such as existing mariculture facilities, anchorages used by the commercial fishing fleet, or potential timber or mineral development sites.

Recommendations

There are several fundamental assumptions underlying the policies and designations proposed as the means to address the issues raised here. First, it is assumed that there are enough suitable tideland sites to avoid potential conflicts and accommodate all potentially competing uses somewhere without having to unreasonably restrict any use. Fortunately, Prince William Sound has a

long, 3,200-mile, coastline with many capable mariculture sites. There is only a small portion of that coastline where developed uses are planned that could preclude mariculture. Therefore, an appropriate method for accommodating and encouraging the mariculture industry in the Prince William Sound will be to allow mariculture in most areas and rely on siting guidelines to resolve potential conflicts.

* A second assumption is that some uses may be restricted in some areas in order to avoid conflict. The general approach is to only restrict uses where there is an absolute conflict that cannot otherwise be reasonably mitigated. Where a choice has to be made, the use with the greater public benefit and fewer options for alternative siting will be favored. The Prince of Wales Island Area Plan proposes alternative approaches to designations for mariculture while the Prince William Sound Plan will deal with the issue primarily through guidelines.

The third assumption is that, unlike some uses such as mineral and timber transfer and support facilities, it is doubtful that there will be adequate data to allow the identification and designation of many areas for mariculture.

The following guidelines are intended to help managers fairly balance potentially competing uses when they make tideland allocation decisions the plans do not have the information to make now.

For Prince of Wales Island Area Plan Guideline A below should be reviewed under the assumption that the alternative that does not prohibit mariculture in any areas is chosen.

Guidelines for competing commercial uses

- A. Mariculture and Competing Uses. Mariculture is encouraged on all state tidelands where there is not a significant competing use. The siting of mariculture facilities is discouraged on all tidelands designated for log transfer or storage, mineral transfer or access, or other commercial activities. These areas will be available for mariculture (a) if the land manager determines that it is possible to site, design, and operate the two or more uses compatibly in the area, or (b) there is no feasible and prudent alternative for mariculture while one exists for the competing use. In no case will mariculture be allowed to foreclose access to mineral, timber, or developed recreation resources unless feasible or prudent alternative access exists. In some cases it may be in the public interest to concentrate uses in one bay, (i.e. pen-reared salmon and timber transfer) rather than allowing the proliferation of uses in many bays.
- B. Separation Between Facilities. Mariculture operations will be sited to avoid the risk of disease transmission and competition for food from existing mariculture developments.

Permitted mariculturists that may be affected by a proposed operation should be notified and given an opportunity to comment. Generally, a two mile separation should exist between finfish operations. Other types of mariculture, such as shellfish may be more closely grouped together.

Issue 3. Mariculture and Upland Management.

Description of the Issue

Mariculture may affect activities on adjacent and nearby uplands. Resource extraction on the uplands, even without associated support facilities on the tidelands, may, for instance, affect water quality or reduce wind protection. Forcing mitigation on the upland manager to protect mariculture facilities could reduce or eliminate economic viability of upland resource development.

Mariculture generally requires a caretaker for feeding and security purposes. At this time, DNR permits for mariculture are generally only for the actual mariculture facilities. Caretaker facilities require a separate permit. Upland managers (primarily the USFS) are reluctant to issue permits for caretaker cabins because of the implied permanence and the potential for abandonment. Therefore, where caretaker facilities are not addressed in the tidelands permit and where decisions on the tidelands are not coordinated with the upland owner, floathouses or upland cabins are likely to be placed in trespass.

The economic viability of the mariculture operation may be in jeopardy if the upland owner does not grant the operator the right to use the uplands for needed support facilities, thus forcing the operator to develop more expensive floating facilities.

Because of access to transportation systems and commercial support services, mariculturists may find it economical to locate near communities. However, mariculture may also be incompatible with residential uses on adjacent uplands. Sewage disposal, theft, the potential for trespass, aesthetic concerns, and competition for tideland space by upland residents can make mariculture undesirable directly adjacent to residential areas.

Current Process for Addressing the Issues

Under the current DNR permit review process, the immediately adjacent upland owner is notified during the coastal consistency process. Nearby upland owners whose activities may be impacted by the stringent water quality standards of mariculture are notified only in the DEC/COE public notice. By procedure, DNR permittees in the southeast region request applicants to submit applications or identify the method of caretaking. The department does not have a policy on what to do if upland owners object to mariculture facilities.

Recommendations

Proposed guidelines for upland owner concerns

- C. Coordination with the Upland Manager. The department will try to coordinate its management of the tidelands with the needs of the upland owner. While the department can neither put a moratorium on permitting mariculture facilities adjacent to private or federal uplands nor close those areas to mariculture, it will endeavor to coordinate its tideland management with the upland needs. On the other hand, upland owners are encouraged to locate areas where mariculture (including upland facilities) should be encouraged and to communicate their conclusions to the department and to the mariculture industry.
- D. Upland Owner Objections. An application for mariculture facilities adjacent to private or federal land will be approved if the application meets the other guidelines of this plan, and either the applicant has the approval of the upland owner or the department receives no objection from the upland owner. If the upland owner does object and suggests a feasible alternative site (one that is both physically suitable, meets both the guidelines of this plan and other permit requirements, and has the approval of that upland owner), the department will uphold the upland owner's objection. If the objection is not accompanied by the suggestion of a feasible alternative site, the department will adjudicate the permit or lease application considering at least the following:
- (1) the feasibility of using site design and/or operating stipulations to minimize or eliminate the objection;
 - (2) the presence or absence of feasible alternative sites where there would be no conflict between upland management and mariculture facilities; and
 - (3) the cost to the public or the upland owner of approving the facility.
- E. Permission of Upland Owner. Permits/leases will not be granted for applications that show support facilities, including shoreties, on the adjacent uplands unless there is a demonstrable agreement between the applicant and the upland owner. The term of the lease/permit will not be longer than the term of the agreement between the applicant and the upland owner. If the applicant has not made arrangements for the use of the adjacent uplands, the application must show how all necessary housing, warehousing, processing and other associated uses will be accommodated on the tidelands.

F. Consistency with State Upland Management. Mariculture facilities adjacent to state uplands will be consistent with the upland management intent.

** See also guideline V for coordinated permitting proposal.

Issue 4: Mariculture and Public Use

Description of the Issue

Mariculture sites may effectively block or inhibit public access to important recreation and subsistence use areas. The expectation and desire for seclusion when recreating in rural Alaska is highly valued by residents and visitors. If the sense of seclusion is lost an important part of the aesthetics of many bays is lost and the recreational experience is less valuable. A mariculture facility, particularly with caretaker facilities and in a smaller cove, will essentially eliminate that sense of seclusion for recreation users other than the permit holder. The tendency will be for traditional recreational users of the cove to find other, secluded and aesthetically pleasing areas. This is a significant problem in Washington, British Columbia and California. The Washington Department of Ecology has documented the aesthetic impacts of mariculture in Puget Sound. British Columbia placed a moratorium on issuing permits partly because of aesthetic effects.

These experiences, plus some here in Alaska, demonstrate that activities affecting the natural and scenic features of an area may cause controversy. Interestingly, AS 41.21.302 specifically allows aquaculture facilities in the State Marine Park system. The Division of Parks and Outdoor Recreation interprets aquaculture in this statute to mean only facilities operated by the Department of Fish and Game.

In order to protect their investment from sewage discharge, theft, etc., mariculturists may discourage recreationists from using the area. In other states and in Canada bays have been roped off and shots fired to discourage public use of areas with mariculture facilities.

The noise and general effects of local habitation associated with mariculture will also tend to displace wildlife. Mariculture employees will increase competition for resources such as beach logs, berries, and wildlife. Facilities may also bar access to or directly impact traditional harvest areas.

Current Process for Addressing the Issue

Land Use Permits technically allow public access to all but the actual physical improvements covered under the permit. Thus, some of the problems are primarily ones of perception and enforcement and not legality. Access is addressed through the Coastal Consistency process, but public notice for area users to

comment is not included in the DNR permit review process. Besides the coastal standards, DNR only has the general policy that legal public access be maintained along state tidelands.

Recommendations

In general, mariculture facilities are compatible with dispersed recreation. However, in chapter 3 of the Prince William Sound Area Plan mariculture will be discouraged from high use areas where the amount of recreation currently exceeds or is projected to exceed the capacity of the available anchorages or campsites. In addition, mariculture -- especially the caretaker facilities -- are discouraged in Prince William Sound in areas proposed for wilderness, tourist attractions (like the Columbia Glacier), and adjacent to developed recreating facilities. In both plans access will be maintained to resources such as campsites, fishing/hunting areas, anchorages, and trails.

For Prince of Wales Island Area Plan the following guidelines should be reviewed under the assumption that the alternative which does not prohibit mariculture in any areas is chosen.

Proposed Guidelines for recreation and public use conflicts

G. Use of Anchorages and Recreation Areas. Mariculture is discouraged from designated or other important anchorages, campsites, or high use recreation areas where the land manager finds that mariculture will significantly diminish the remote, secluded nature of the anchorage or would significantly diminish its capacity. These areas are delineated in the management intent discussions or on the maps in Chapter 3 of the plans.

H. (Prince William Sound only) Developed Recreation Facilities. Mariculture is not allowed adjacent to designated recreation sites or developed recreation facilities unless the facility manager or the land manager determines that the two uses can be made compatible by design, siting, or operating guidelines.

I. Mariculture Caretaker Facilities. Floating caretaker facilities for mariculture operations are encouraged in areas where there is no significant competing use. Floating caretaker facilities for mariculture operations will not be allowed in designated recreation or personal use areas unless the regional manager determines that there is no feasible or prudent alternative. The determination will be made available for public comment.

J. Access to trails and other public access points. Mariculture will not foreclose public access to important

clamming areas, trails, public beaches or other similar public resources.

Issue 5: Mariculture Facilities in Crucial and Prime Habitat Areas

Description of the Issue

In his 1986 report entitled, "The Environmental Effects of Floating Mariculture in Puget Sound," Dr. Donald P. Weston, of the University of Washington School of Oceanography, found that few negative impacts from mariculture operations on fish and wildlife or their habitats have been substantiated. However, there is the possibility that significant habitats, such as eel grass beds, and species such as geoducks could be buried by debris and lost. Furthermore, mariculture facilities, like any other floating facility, can block fish passage if placed in the mouth of a fish stream they can compact productive substrates if allowed to ground.

Marine mammals are attracted to the concentration of delectable food contained within mariculture facilities. The presence and "trespass" of marine mammals can be a nuisance to mariculturists. Unfortunately, they not only cause the mariculturists grief but also put themselves at risk by becoming entangled in the nets and occasionally drowning. In Washington state, some mariculturists have received exclusion to the Marine Mammal Protection Act and are allowed to kill marine mammals that are a nuisance to their operation.

Petroleum spills may cause long term degradation of the habitat value of public tidelands and may impact adjacent mariculture facilities. The impacts are worse where currents and flushing are minimal.

Current Process for Addressing the Issue

Agency review of leases and permits is the process now used to identify potential conflicts between mariculture and habitat areas. DNR permits do not receive public review nor are adjacent mariculturists or some nearby upland managers asked to comment (the directly adjacent upland owner is given notice), therefore, many potential conflicts may not be identified at the time the permit decision is made. The Corps of Engineers and Department of Environmental Conservation issue public notices and copy any comments to DNR.

DEC does not regulate oil and gas storage below XXXXXX gallons, so there is no formal method of addressing this potentially significant issue. ADNR has in the past required stipulations on its land use permits that address petroleum storage below amounts covered under DEC regulations.

Recommendations

Outlined below are guidelines that will be used to help managers decide how to avoid potential conflicts between Mariculture facilities and crucial or prime habitats.

Proposed guidelines for mariculture in significant habitats

- K. (Prince of Wales only) Siting in Certain Habitats. Mariculture facilities should not be sited on or within 300 feet of extensive kelp or eelgrass beds; seaweed harvest areas; or shellfish concentration areas (as identified in the ADF&G Regional Guides or determined by ADF&G) unless the manager determines after consultation with ADF&G that there is no feasible and prudent alternative.
- L. Siting Near Anadromous Fish Streams. Mariculture facilities will not be sited within 300' of the mouth of a catalogued anadromous fish stream at Mean Lower Low Water without the approval of ADF&G.
- M. (Prince of Wales only) Siting Near Marine Mammals and Seabirds. Mariculture facilities will be at least one-half mile from marine mammal and seabird concentration areas (as identified in the ADF&G Regional Guides or determined by ADF&G).
- N. Designing to Prevent Marine Mammal Entanglement. Mariculture facilities should be designed to prevent entanglement of marine mammals.
- O. Dissolved Oxygen Depletion. Pens will not be sited where respiration and biochemical oxygen demand will significantly depress dissolved oxygen concentrations or where nutrient input attributable to net-pen culture will affect the frequency, extent, intensity or duration of phytoplankton blooms.
- P. Tri-n-butyltin. Tri-n-butyltin should not be used as an antifouling agent on nets.
- Q. Water Circulation. In order to maintain water circulation and flushing action which disperses pollutants, net-pens should occupy no more than one-third the water column depth.
- R. Storage of Petroleum Products. Petroleum products will be stored in a manner that will prevent spillage onto the tidelands or aquatic waters.
- ** See also Guideline X2 for policy on grounding at mean lower low water.

Issue 6: Floathomes and Mariculture

Description of the Issue

There is potential for coliform pollution of mariculture sites from nearby floathome waste water discharge. The waste of one person requires 8 million cubic feet of water to dilute to acceptable standards. Greywater presents related problems. These concerns are the same for floating mariculture caretaker facilities.

While few floathouses exist in Prince William Sound, there are up to 100 unauthorized floathomes on Prince of Wales Island. These may not conform to DEC wastewater standards. They occupy potential sites for mariculture development. Refer to the issue papers and proposed guidelines for floating settlement facilities under Floathomes in the Draft Plan.

Current Process for Addressing the Issue

The current permit process does not require DNR public notice for floathomes (although the COE and DEC do a joint notice) so mariculture permit holders do not get a chance to comment on proposed floathome permits. Since most floathome owners do not bother to get permits it is almost impossible to control the problem before it occurs and a complaint is filed.

Proposed guidelines for floathome conflicts

S. Highest Economic Benefits. Where there are conflicts between floathomes and other uses, the department generally will decide in favor of the applicant with the greatest economic benefit to the state. Except for areas designated for floathome settlement, competing applications between floathomes and mariculture will favor economically viable mariculture unless the regional manager determines it is in the state's interest to permit the floathome or there are more reasonable and prudent alternatives for the mariculturist. Where a floathome is already permitted at a site proposed for a mariculture facility, the regional manager will determine if there are feasible and prudent alternatives for the mariculture operation and weigh the impacts on the permitted floathome resident. Unpermitted floathomes will not be given any standing in the permit adjudication process. This guideline also applies to floating caretaker facilities for mariculture.

** See also Guideline I for policy on floating caretaker facilities.

** See also Guideline W for policy on public notice.

** See also Guidelines on Floathomes.

Issue 7: Speculation and Economic Viability

Description of the Issue

Aquaculture permits do not require proof of economic viability or intent. A non-existent or perennially non-profitable operation may continue to occupy a favorite bay to the detriment of other public benefits or uses and other mariculture operations. There is concern that permits are secured for speculation purposes, making the area unavailable to legitimate applicants. For example, only a small percentage of existing mariculture permits in Southeast actually have development on them, let alone produce seafood.

Mariculture permits may be used as a front for acquiring a private secluded residence or vacation home on public lands. A small oyster raft next to a floathouse might grease the wheels for getting the right to use a particular bay for an exclusive private residence. The mariculture permit may provide a loophole for obtaining a USFS Special Use Cabin Permit.

Current Process for Addressing the Issue

Economic viability is currently not addressed in ADNR permitting. The USFS requires an Environmental Assessment and economic prospectus in order to issue a "Special Use Permit" for commercial upland facilities, this includes support facilities or caretaker cabins for aquaculture sites. The USFS is not inclined to issue "Special Use Permits" for aquaculture support facilities until an operation is proven to be successful.

Proposed guidelines for speculation and economic viability

- T. Performance Standards. The Regional Manager will attach reasonable performance standards to the permit or lease for project development and operation. The performance standards are to ensure the permitted area is used for the approved activity, the proposal is economically viable, and the permit is not held for speculation or removal of a land base from competition. In all cases the approved development plan must be adhered to. If the performance standards are not met, the permit or lease may be cancelled.
- U. Clean-up Bonds. A clean-up bond may be required to protect existing resources for future use.

Issue 8: Permit Procedures

Description of the Issue

Agencies requiring permits related to siting of mariculture facilities include the Departments of Natural Resources, Environmental Conservation, possibly Fish and Game, and the Army Corps of Engineers. The upland land owner/manager may also require permits. Separate applications are required from each agency. The Division of Governmental Coordination coordinates review of

these permits plus makes a determination of consistency with the Alaska Coastal Management Plan. Applicants are burdened with completing redundant application information while agencies have difficulty acquiring the necessary information to make good permitting decisions.

The issues of competing uses (Issues 2, 3, 4, 5 and 6) can only be resolved in the public's best interest if all available information is used in making the decision. To ensure that all available information is applied to the permitting/leasing decision, it is proposed that a coordinated permitting/leasing process be developed so that all potentially competing interests and all affected agencies be given a chance to review, comment on and make decisions on a proposal at the same time. A coordinated process like the "Tri-agency Permit" used for mining could have the added advantage of making both the applicant's and the agencies' task simpler and more efficient, thus encouraging the development of the mariculture industry without foreclosing other valuable uses of state tide and submerged lands.

This process would have to include all of the agencies involved in reviewing and permitting mariculture activities and upland owners and be coordinated with other permitting procedures such as the ACMP consistency review process.

Proposed guidelines for mariculture permitting and leasing

- V. Coordinated Permitting. The Department of Natural Resources will support development of a coordinated permitting/leasing process with other agencies if it will meet the following objectives: 1) the process will lessen the application complexity for prospective mariculturists; 2) the process will provide for better agency decision making; and 3) each agency maintains its' own decision making authority.
- W. Public Notice for Mariculture Facilities. Public notice of a proposed permit or lease for mariculture facilities will be given under AS 38.05.945 or its equivalent. Permits will be treated as a lease for public notice purposes, including notification in a local newspaper. However, joint DNR notification with the DEC/DGC public notice is encouraged if practical. Copies of the public notice should be sent to adjacent upland land owners such as U.S. Forest Service and native corporations and other mariculturists within affected waters and communities (such as the postmaster) of 25 people or more within 6 miles of the proposed activity. If it is known, the public notice should mention that the proposed activity may impact resource development, commercial fishing, or recreation use and anchorages in the vicinity.
- X. Development Plans. A development plan will be required before a lease or permit application for mariculture facilities is approved. The preferred approach is for the application and development plan requirements to serve (at the

minimum) as the basis for DNR, ADF&G, DEC, ACMP, and upland owner review approval.

The application and development plan will require the applicant to provide the following information. The application form will give the applicant policy guidance on several issues. Any changes to the development plan after authorization is given will be submitted to the Regional Manager for a determination if project review will be reinitiated.

1. Describe the species to be raised. A permit or lease will be issued for a specified species. Raising a different species will require a new permit or lease.
2. Describe the size and type and map the location of all floating and shore-based mariculture facilities needed over the life of the project. The map should include the general location of the facility on a 1:63,360 or equivalent map. The development plan map should be of a size and scale that will readily indicate the location and size of all facilities with reasonable proportion and scale and relation to the shoreline.

Facilities such as rafts or pens should be indicated with size, location, and configuration. Fresh water sources and access to roads or markets should also be shown. The map will also indicate mean high water, mean lower low water, depths below the facilities, and water circulation patterns. Except where specifically allowed, facilities may not ground at mean lower low water. All facilities will be reviewed and authorized at one time.

Other plan guidelines and the Alaska Coastal Management Plan Standards should be used for guidance in designing an acceptable development plan.

3. Describe the size and map the location of areas to be used for temporary storage of equipment, supplies or shellfish pending paralytic shellfish poisoning test results and shipping. Because they are less biologically productive than saltmarshes and tideflats, gravel and sand beaches are generally the preferred sites for on-shore storage of shellfish while waiting for PSP test results and shipment.
4. Describe the method of anchoring floating mariculture facilities. Anchoring must be adequate to keep the facility from breaking loose and creating a hazard to other users or habitats. When siting mariculture facilities, public access will be maintained to and along public tidelands. Shoreties will not be used for anchoring mariculture facilities in significant

recreation or personal use areas or where public access or navigation would be adversely impacted unless doing so decreases the conflict between the mariculture facility and public access.

5. Describe the size and map the location of caretaker facilities. If floating or upland facilities are not shown, the method of housing persons responsible for caretaking and operating the facility must be described.
 6. Describe methods of wastewater treatment and disposal. (Only include if this is a cooperative process. DEC will want to insert standards here.)
 7. Describe methods of solid waste disposal. (Ibid)
 8. Describe the method of fuel storage.
 9. A schedule of development should be outlined for all facilities. Significant stages of development should be projected such as when the first young will be placed for growing and the first anticipated date of marketing the product.
 10. For fin fish operations producing more than 20,000 pound annually a site characterization survey should be submitted that includes: 1) a bathymetric survey of depth, range, and distribution of water and marine life (including predators); 2) a hydrographic survey of ebb and flood currents, temperatures, salinity, potential or existing sources of pollution, and level of storm protection; and 3) a diver survey of the biological resources during April to September including the level of plankton.
- Y. Coast Guard Approval. Permits or leases will not be given until the U.S. Coast Guard has certified that the proposed facility will not be a significant navigational hazard.

APPENDIX D

COMPILATION OF PROPOSED GOALS AND GUIDELINES FOR MARICULTURE

Proposed Goals for Mariculture

- GOAL #1 Economic Opportunities and Community Development. Opportunities to increase income and diversify the state's economy through the use of state tide and submerged lands for mariculture.
- GOAL #2 Optimum Use of Areas. The optimum use of the most suitable mariculture areas.

Proposed Guidelines for Mariculture

- A. Mariculture and Competing Uses. Mariculture is encouraged on all state tidelands where there is not a significant competing use. The siting of mariculture facilities is discouraged on all tidelands designated for log transfer or storage, mineral transfer or access, or other commercial activities. These areas will be available for mariculture (a) if the land manager determines that it is possible to site, design, and operate the two or more uses compatibly in the area, or (b) there is no feasible and prudent alternative for mariculture while one exists for the competing use. In no case will mariculture be allowed to foreclose access to mineral, timber, or developed recreation resources unless feasible or prudent alternative assess exists. In some cases it may be in the public interest to concentrate uses in one bay, (i.e. pen-reared salmon and timber transfer) rather than allowing the proliferation of uses in many bays.
- B. Separation Between Facilities. Mariculture operations will be sited to avoid the risk of disease transmission and competition for food from existing mariculture developments. Permitted mariculturists that may be affected by a proposed operation should be notified and given an opportunity to comment. Generally, a two mile separation should exist between finfish operations. Other types of mariculture, such as shellfish may be more closely grouped together.
- C. Coordination with the Upland Manager. The department will try to coordinate its management of the tidelands with the needs of the upland owner. While the department can neither put a moratorium on permitting mariculture facilities adjacent to private or federal uplands nor close those areas to mariculture, it will endeavor to coordinate its tideland management with the upland needs. On the other had, upland owners are encouraged to locate areas where mariculture (including upland facilities) should be encouraged and to

communicate their conclusions to the department and to the mariculture industry.

- D. Upland Owner Objections. An application for mariculture facilities adjacent to private or federal land will be approved if the application meets the other guidelines of this plan, and either the applicant has the approval of the upland owner or the department receives no objection from the upland owner. If the upland owner does object and suggests a feasible alternative site (one that is both physically suitable, meets both the guidelines of this plan and other permit requirements, and has the approval of that upland owner), the department will uphold the upland owner's objection. If the objection is not accompanied by the suggestion of a feasible alternative site, the department will adjudicate the permit or lease application considering at least the following:
- (1) the feasibility of using site design and/or operating stipulations to minimize or eliminate the objection;
 - (2) the presence or absence of feasible alternative sites where there would be no conflict between upland management and mariculture facilities; and
 - (3) the cost to the public or the upland owner of approving the facility.
- E. Permission of Upland Owner. Permits/leases will not be granted for applications that show support facilities, including shoreties, on the adjacent uplands unless there is a demonstrable agreement between the applicant and the upland owner. The term of the lease/permit will not be longer than the term of the agreement between the applicant and the upland owner. If the applicant has not made arrangements for the use of the adjacent uplands, the application must show how all necessary housing, warehousing, processing and other associated uses will be accommodated on the tidelands.
- F. Consistency with State Upland Management. Mariculture facilities adjacent to state uplands will be consistent with the upland management intent.
- G. Use of Anchorages and Recreation Areas. Mariculture is discouraged from designated or other important anchorages, campsites, or high use recreation areas where the land manager finds that mariculture will significantly diminish the remote, secluded nature of the anchorage or would significantly diminish its capacity. These areas are delineated in the management intent discussions or on the maps in Chapter 3 of the plans.

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- I. Mariculture Caretaker Facilities. Floating caretaker facilities for mariculture operations are encouraged in areas where there is no significant competing use. Floating caretaker facilities for mariculture operations will not be allowed in designated recreation or personal use areas unless the regional manager determines that there is no feasible or prudent alternative. The determination will be made available for public comment.
- J. Access to trails and other public access points. Mariculture will not foreclose public access to important clamming areas, trails, public beaches or other similar public resources.
- K. (Prince of Wales only) Siting in Certain Habitats. Mariculture facilities should not be sited on or within 300 feet of extensive kelp or eelgrass beds; seaweed harvest areas; or shellfish concentration areas (as identified in the ADF&G Regional Guides or determined by ADF&G) unless the manager determines after consultation with ADF&G that there is no feasible and prudent alternative.
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- T. Performance Standards. The Regional Manager will attach reasonable performance standards to the permit or lease for project development and operation. The performance standards are to ensure the permitted area is used for the approved activity, the proposal is economically viable, and the permit is not held for speculation or removal of a land base from competition. In all cases the approved development plan must be adhered to. If the performance standards are not met, the permit or lease may be cancelled.
- U. Clean-up Bonds. A clean-up bond may be required to protect existing resources for future use.
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adjacent upland land owners such as U.S. Forest Service and native corporations and other mariculturists within affected waters and communities (such as the postmaster) of 25 people or more within 6 miles of the proposed activity. If it is known, the public notice should mention that the proposed activity may impact resource development, commercial fishing, or recreation use and anchorages in the vicinity.

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4. Describe the method of anchoring floating mariculture facilities. Anchoring must be adequate to keep the facility from breaking loose and creating a hazard to other users or habitats. When siting mariculture facilities, public access will be maintained to and along public tidelands. Shorelines will not be used for anchoring mariculture facilities in significant recreation or personal use areas or where public access or navigation would be adversely impacted unless doing so decreases the conflict between the mariculture facility and public access.
 5. Describe the size and map the location of caretaker facilities. If floating or upland facilities are not shown, the method of housing persons responsible for caretaking and operating the facility must be described.
 6. Describe methods of wastewater treatment and disposal. (Only include if this is a cooperative process. DEC will want to insert standards here.)
 7. Describe methods of solid waste disposal. (Ibid)
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APR 21 1987

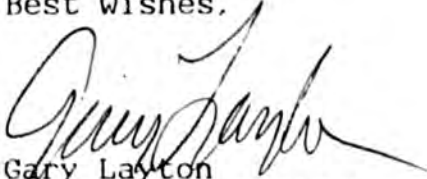
April 14, 1987

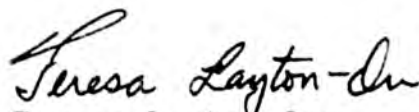
Senators Coghill; Sturgulewski; Zharoff
Pouch V
Juneau, AK 99811

Dear Senator,

This letter is to express our appreciation of your sponsorship and advocacy of SB106, the Mariculture Bill. We feel that mariculture development in Alaska is a needed and appropriate addition to the state's economy and poses no threat to established fisheries. Please feel confident that you will continue to have our support.

Best wishes.


Gary Layton
1803 Branigan Circle
Kenai, AK 99611


Teresa Layton-Orr

Tina Ortman
P.O. Box 442
Talkeetna, AK 99676
(907) 733-2565

April 15, 1987

APR 21 1987

Jack Coghill
P.O. Box V
Juneau, AK 99811

Dear Mr. Coghill,

I am writing to voice my approval of Aquaculture. It is surprising to me that anyone would oppose developing our marine resources to their fullest. It would be like having a fertile, tilled garden plot but not planting any seeds. The fishermen who are opposed to aquaculture are like "the dinosaurs picketing the emergence of mammals". Aquaculture is the future, let's get started on it now.

Thank-you for your attention.

Kind regards,

Tina Ortman

Tina Ortman

the **LODE** **STAR**

Charting the course of fisheries development today.

Alaska Fisheries

Development Foundation, Inc.

Volume V, No. 1 Winter 1986/87

News to Use

It may be Spring where you are, but here the ground is still frozen hard as a ship's plank, and so we call this the Winter issue. (In Alaska, everyone but the pussy willows knows better than to be optimistic in March.)

New executive director joins AFDF April 1

Mel Monsen, former consultant to the Bering Sea Fishermen's Association and legislative specialist on fisheries issues, was named executive director of AFDF at the board of directors meeting March 23 in Anchorage.

Monsen brings to AFDF broad experience in the natural resource industries in Alaska, and has worked with many segments of Alaska's seafood industry.

Monsen begins his duties on April 1. The AFDF board, staff and membership welcome Monsen to his post.

AFDF welcomed five new associate members this year. They are:

Fletcher Fishing, Ltd.
Bellevue, WA

Roquette Corporation
Gurnee, Ill.

Nobel Insurance, Ltd.
Dallas, Texas

Pacific Rim Fishery Projects
Danville, CA

Specialty Foods, Inc.
Richmond, CA

New surimi product contest

AFDF will sponsor a Prototype Development Contest this spring as part of our effort to diversify the market for Alaska's surimi. The foundation will invite proposals to create a prototype surimi product that is a non-analogue, non-substitute, stand-alone item that demonstrates the unique advantages of surimi.

AFDF will seek proposals from food technologists, engineers, and surimi consultants who can provide a development plan and product concept that will significantly enhance consumption of surimi-based foods beyond current market niches. To the selected applicants, AFDF will provide cooperation and limited financial assistance for product development and market evaluation.

AFDF will issue a request for proposals in April. If you are interested, please contact AFDF.

Kodiak is on top of bottomfish

By Krus Holmes

Probably several metric tons of paperwork have been generated to explore and explain fisheries development in Alaska, but no one has explained it better than Al Burch, when he told the Kodiak Daily Mirror in November, "Last year at this time I had boats looking for markets. This year the markets are crying for boats."

Al Burch is executive director of the Alaska Dragger Association, a groundfish harvesters' group whose boats suddenly are in hot demand after several years of slow going since the decline of shrimp and crab resources in the late 1970s.

Burch's statement illustrates what fisheries development really means: a lively boat harbor, a string of active shoreside plants, reliable markets for fish. Employment, commerce, jobs. The groundfish industry has come alive in Alaska, and Kodiak is the state's shining example. In a town virtually still during the winter months even two years ago, now ten processors are handling groundfish, three of them processing more than 400,000 pounds per day.

"All the plants in Kodiak were virtually idle between September and April before this year," said Chris Blackburn, director of Kodiak's Groundfish Data Bank. "In 1987, three plants will operate year-round, processing surimi September till March, and pollock fillets year-round. Next year, it's expected that all eight plants will operate year-round."

A number of factors have converged to improve the seafood scene in Kodiak:

- Cod prices vaulted 75% in one year, as high as \$3.50/lb. for fresh and \$2.50/lb. for frozen fillets FOB Boston. The Seafood Leader 1987 Buyer's Guide said higher prices were "more a function of de-

mand than a lack of production." They predicted prices would not drop below \$2/lb. in the future.

- Pollock prices stretched from \$1.45/lb. to \$1.85/lb. for shatterpack, and pollock nuggets entered the fast-food business for the first time in 1986. Pollock has become increasingly acceptable on the world market as a high-quality substitute for cod, and pollock supplies are expected to remain tight.

- Alaska Pacific Seafoods, Kodiak's only surimi plant, doubled its surimi production capacity in late 1986, signalling that shore-based surimi processing in Alaska can be an extremely profitable venture.

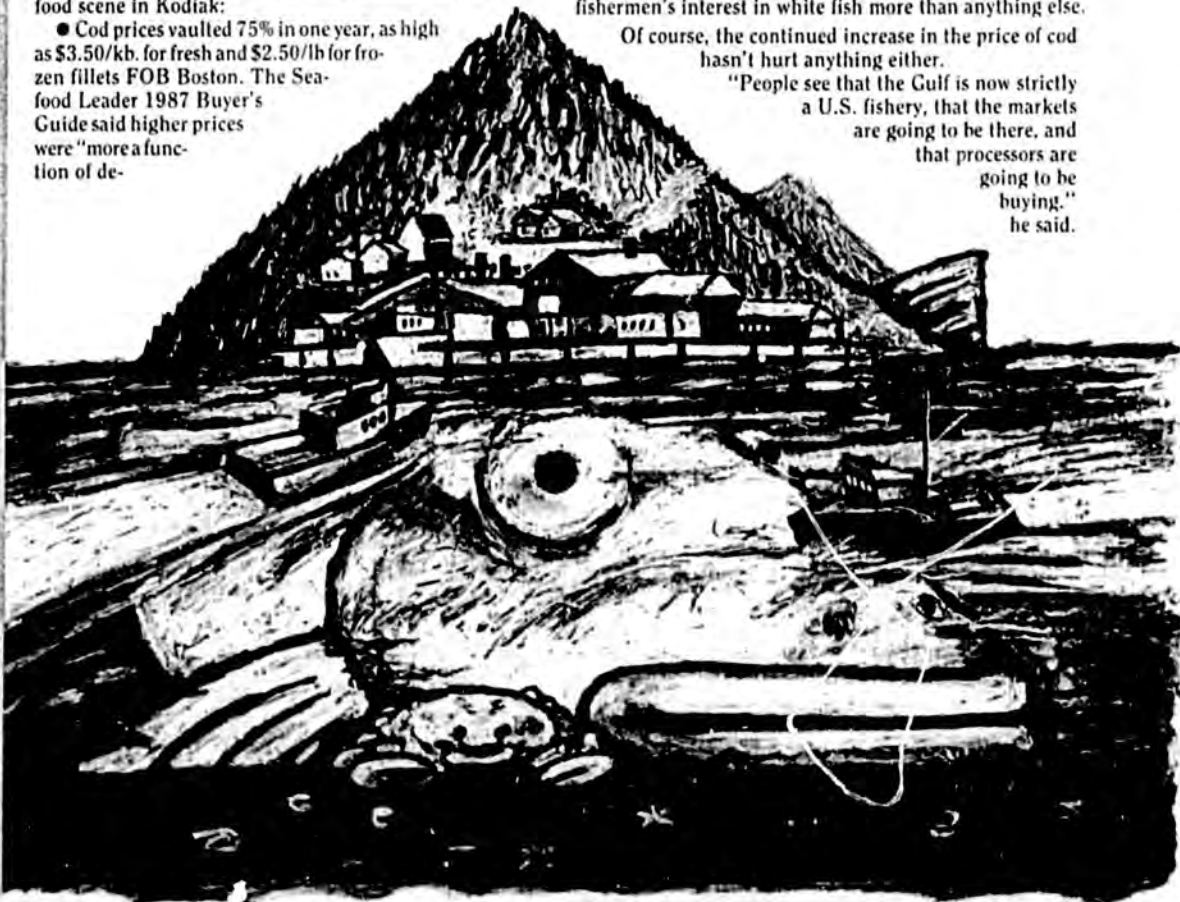
- National Marine Fisheries Service issued a report in late 1986 following a survey of Alaskan processors which predicted that Kodiak could process 45,000 metric tons of groundfish in 1987. The Kodiak Borough countered with 82,000 metric tons. Either way, it became clear by late 1986 that foreign and joint venture fishing were over in the Gulf of Alaska.

- Equally convinced was the North Pacific Fishery Management Council (NPFMC), which in December ended all foreign fishing and severely limited joint venture fishing in the Gulf of Alaska for 1987, reserving 190,000 metric tons of groundfish for domestic processing.

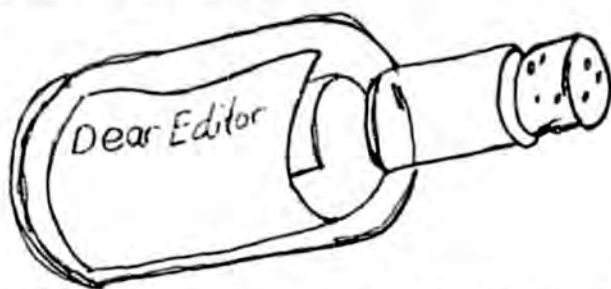
Kodiak fishermen and processors may have been lined up at the starting gate before this year's white fish season, but many say it was the NPFMC that pulled the trigger on the starting gun. Chris Bublitz of the Kodiak Marine Advisory Program said, "Their decision to reserve the Gulf for the domestic industry, I think, sparked the fishermen's interest in white fish more than anything else."

Of course, the continued increase in the price of cod hasn't hurt anything either.

"People see that the Gulf is now strictly a U.S. fishery, that the markets are going to be there, and that processors are going to be buying," he said.



LETTER TO THE EDITOR:



Dear Editor:

I was appalled to see your article entitled, "A New Twist on Surimi Testing," in which you reported that the NFI Surimi Technical Committee agreed to select torsion tests as a standard method.

As I correctly understood at the meeting, the Committee agreed to re-examine three methods, namely: punch, torsion and compression tests, for their appropriateness as a standard technique in evaluating the quality of surimi. Currently, data are being compiled to assess the performance of each method at various research laboratories. However, without having a sample preparation procedure standardized, I don't see how accurately the comparison can be made. It was a general consensus that the standardization of the testing method should be done in conjunction with the sample preparation procedure.

In searching for the most appropriate method, one must define what is the most important quality index to be

measured in evaluating surimi. The binding property of the surimi gel, specifically cohesiveness, has been used as a primary quality index. It can be measured only by breaking a gel, either twisting (torsion), bending/folding (no procedure reported for bending/folding test is done manually), compression, or punch test. The first three allow the entire sample to undergo a breaking process, while in punching only the local portion is subjected to breakage. Both torsion and bending tests would require extra care in getting a specimen of precise geometry as well as in setting and handling during testing. As for a punch test, because of its local breakage with a probe point having a 5mm-diameter head, the result may not correctly reflect the property of the whole sample body unless the sample is uniform in structure.

Breaking force and extent of deformation are used in measuring the gel cohesiveness, where stress is force/area and strain is deformation/sample

length. Strain is generally not as sensitive as stress when the gel sample is highly elastic and firm as in the case of a surimi gel according to our results as well as others from both compression and torsion tests.

Rigidity, on the other hand, is a ratio of stress to strain and remains relatively unchanged if strain changes proportionally with stress, even if substantial changes occurred in gel properties as a result of treatment. Therefore, this can be best used when comparison of surimi made from different species or different types of protein gel is made, but generally not for the quality changes due to freshness, handling, formulation, etc.

Another important factor in selecting a testing method is how sensitive, simple and reproducible the method is. Torsion test generates stress and strain; compression test yields stress, strain, non-failure stress (firmness) and expressible moisture; and punch test results in punch force and deformation (not strain). Regarding the sample preparation and testing procedure, torsion requires laborious sample preparation and an imprecise preparation will result in erroneous results.

It does not appear to be an absolute necessity for the test to generate stress and strain data unless these values have to be plugged into some type of formula to be used in evaluating the gel quality. Of more importance is whether that particular method is able to provide sensitive and discriminative results in a consistent manner.

What disappointed me and many other members of the meeting was that these facts were never made clear to the committee members. The impression the committee had was that the torsion test is the only testing method which can perform all necessary analysis, as reported in *The Lodestar*. It is a matter of principle that prior to selection of any official method, the proposed method should be opened to the scientific community for their review and careful examination until a uniform consensus is reached. Regrettably, this did not happen even after it was repeatedly suggested. Otherwise, I am sure, this whole confusion would not have occurred in the first place.

At this point in time, the choice should be left up to the individuals. In view of our relative unfamiliarity with the surimi testing methodology, we should take the necessary time to obtain sufficient information and results for each method so that a discernible decision can be made.

Chong M. Lee

Associate professor
University of Rhode Island

Editor's note: Roy Martin, head of the Surimi Technical Committee at National Fisheries Institute, said the committee is still considering the surimi testing issue. Martin preferred not to respond to Dr. Lee's letter until the committee meets again. At press time, no meeting had been scheduled, though one was expected in late April.

The editor's turn

Off the Cuff



By Kris Holmes
Lodestar Editor

About a year ago, Chris Mitchell leaned up against my door post and asked a question I've been thinking about ever since. "What's everybody going to do when this is all over?" he asked. "Surimi has been a big, fun, exciting job—and hard work, too—but what will capture our interest as much after this?"

Now AFDF is heading into a new year, and a new roster of projects, and our former director's question is still with me. Sure, there's much to do in the Alaskan seafood industry. But what will capture our creativity? What will pop our corks, the way the surimi project did?

For the foundation there are many things ahead, some of them exciting, some of them tedious, all of them equally important. But AFDF only does what industry can't. It's your creativity—the industry's—that directs us.

What's next for the industry? We think it's mariculture. AFDF is restrained by funding limitations from addressing mariculture. But the industry is restrained only by the limits of its creativity, and mariculture certainly seems to have ignited the industry's collective imagination.

Farmed salmon will comprise 14% of the Pacific salmon catch and 92% of the Atlantic salmon catch in 1990, and will dominate world trading in fresh and frozen premium products, according to Quick Frozen Foods International. One seafood processor has said mariculture is no longer promising, but is rapidly becoming a necessity.

Norway, Japan, Canada, Chile and New Zealand now lead in world production of farmed seafood. But in the Pacific, eyes are turning toward Alaska. The Alaska legislature now is considering a bill that would establish regulations for an Alaskan mariculture industry. The bill was spawned by the Alaska Mariculture Association (AMA), a newly-formed group of advocates for salmon, mussel, oyster, kelp and scallop farming, who say that Alaska's salmon industry will see fierce competition from salmon farming operations in the future, whether Alaska gets involved in mariculture or not. AMA advocates opening legal barriers to salmon farming—barriers which are not explicitly outlined but rather are implied in current Alaska Department of Fish & Game statutes. (According to an aquaculture report by the House Research Agency, the Attorney General of Alaska has stated that, since fish farming is not explicitly allowed in current statutes, "you cannot do it.") Other laws more specifically prohibit the collection of fish fry for scientific or propagative purposes. Hatchery owners are also prohibited from selling eggs or fry except to other hatcheries or to Fish & Game.

The House Research Agency report illustrated the economic benefits to producing premium farmed salmon by quoting Norway's \$180 million earnings in 1985 for 5% of the world's salmon production. By comparison, Alaska earned just more than twice that—\$370 million—for 45% of the world's salmon catch.

Curt Kerns, author of "World Sal-

mon Farming," a Marine Advisory bulletin, compared the benefits of salmon farming to poultry farming. "When reliable mass-production techniques for chickens, turkeys, and ducks were developed in the 1940s and 1950s, consumers responded by buying poultry in vast quantities," the booklet said.

Still, there is much debate over what role mariculture will play in Alaska's future. Some fear the entry of Alaskan farmed salmon onto the market would bring wild salmon prices down. John Enge of the Commercial Fishing and Agriculture Bank said that the investment capital to build an infrastructure would more than likely come from overseas. "No little fisherman is going to be able to shell out the millions of dollars it will take to build the infrastructure," he said.

Enge predicted that by the time Alaskan farmed salmon come onto the market, there will be a glut of farmed salmon anyway. "The biggest problem is that Norwegian salmon is being sold in the same markets with our wild salmon. It's even being called Alaska salmon," he said.

Still, some small fishermen are apprehensive. One seiner from Southeast Alaska said the advent of mariculture would turn small boat fishermen like him into anachronisms.

There doesn't seem to be much question that mariculture will play a powerful role in Alaska's seafood future. If Alaskans take the lead, it could become an important limb of the state's seafood economy. If not, farmed products will become formidable com-

petitors to Alaska's products on the world market.

Since we at AFDF probably won't be involved, this is our opportunity to encourage the industry to apply its pluck and passion to an idea whose time has come.

For more information:

● *Aquaculture in Alaska*, a 103-page report, House Research Agency, P.O. Box Y, Juneau, 99811.

● *World Salmon Farming: An Overview with Emphasis on Possibilities and Problems in Alaska*, by Curt Kerns, Alaska Sea Grant College Program, Univ. of Alaska, 590 University Ave., Suite 102, Fairbanks, AK 99809.

● *The Marketing Relationship Between Pacific and Pen-Reared Salmon: A Survey of U.S. Seafood Wholesalers*, by Ronald V. Rogness, and B.H. Lin, Alaska Sea Grant College Program, Univ. of Alaska, 590 University Ave., Suite 102, Fairbanks, AK 99809.

● *Mariculture in Alaska, and Straight Talk About Mariculture Development in Alaska*, Alaska Mariculture Association, Rodger Painter, executive director, P.O. Box 020704, Juneau, AK 99802. (907) 463-3600.

"For any product to be successful it has to pass the 'I'll be damned!' test. Potential buyers must say, 'Well, I'll be damned!' when they see it for the first time."

—Wilson Harrell
Inc. January 1987



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ALASKA STATE LEGISLATURE
HOUSE OF REPRESENTATIVES
RESEARCH AGENCY

MARECULTURE

Ben has

not released

This, as of
my last talk
w/ Katie
(Don't distribute)

April 13, 1987

MEMORANDUM

TO: Representative Ben Grussendorf

ATTN: Kate Tesar

FROM: Brad Pierce *BP*
Legislative Analyst

RE: Farmed Salmon Production: Impact on the Alaska Salmon Fishing Industry
Research Request 87.234

You requested this agency to provide information on several questions concerning a proposed salmon farming industry in Alaska. In consultation with your office, we have divided these questions into two discrete research topics: 1) the economic impacts of salmon farming on the existing fishing industry; and 2) options for regulating entry, the permitting process and structure of a salmon farming industry in Alaska. We anticipate further questions will arise from the current debate over aquatic farming legislation (HB 108 and SB 106) in legislative committees, which we will attempt to answer in future memorandums upon request. This is the first installment of the series.

In this memorandum, we examine available data on the economic impact of farmed salmon production on the existing Alaska salmon fishing industry. Specifically, you requested that we attempt to quantify how the market effects of increases in world farmed salmon production will affect Alaska fishermen in terms of their gross incomes and capital investments. You asked that we quantify these impacts by area and gear type. Additionally, we have posed the logical corollary to your question, i.e., what can fishermen do to mitigate these impacts. We attempt to answer this question in light of what we have learned about the successful integration of salmon farming with traditional salmon fisheries in other countries.

Much of the information contained in this memorandum is an expansion on material presented in "Aquaculture in Alaska" (House Research Agency Report 87-B, February 1987). This report should be referred to for a more complete background discussion of worldwide trends in farmed salmon production, the dynamics of premium salmon markets and their implications for Alaska.

Economic Models of Salmon Markets

In this section, we describe the difficulties of using current economic models to quantify the complex interactions of world salmon markets. We briefly discuss the factors that affect the assumptions we have used to estimate the economic impact of farmed production on traditional fisheries offered in the next section.

The state of the art in economic models purporting to simulate the interactions of worldwide salmon markets is dismal. Key measures of price/volume relationships (cross price elasticities) for various species and products as well as the relationships between market segments differ widely among models. The market effects of farmed production are particularly difficult to sort out because farmed salmon products have become a major factor in premium markets only during the past five years. This means that estimates of the market impacts of farmed salmon production have to be made from an inadequate data base. Production of farmed salmon is expected to triple, from about 44,000 metric tons (mt) in 1985 to nearly 143,000 mt in 1990.¹ Thus forecasts of price/volume relationships have to be made from volume figures that are three times higher than those in the historical data base. In statistical terms, this causes the confidence intervals around projections of the market effects of farmed salmon products to be very broad (i.e., the accuracy of such forecasts is highly questionable).

There is no doubt that the year-round availability of large volumes of high-quality fresh farmed fish has brought about a dramatic transformation in domestic premium salmon markets, but landings of wild fish in Alaska have been at or near record levels for the past seven years as well. As a whole, the U.S. seafood market is rapidly expanding and much of the growth in demand for seafood products is being met by imports. To date, the most successfully specified economic models of farmed salmon markets simply treat growth in the present period as a function of growth in the previous period.²

The growth in farmed salmon consumption in domestic markets has largely been in fresh products--mainly adult Atlantic salmon and pan-sized Pacific salmon and trout in the catering sector (hotels, restaurants and institutions), specialty fish shops, and, to a lesser extent, retail stores. Farmed salmon producers thus far have had little trouble selling all of the fresh fish they can produce to U.S. consumers at premium prices. Geographically, domestic market penetration of fresh farmed salmon has been very shallow and largely confined to the Northeast and West Coast.

¹Curt 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, p. 26.

²Patricia Lavin Riely, "An Economic Analysis Of the Market for Atlantic Salmon Aquaculture," Ph.D Dissertation, University of Rhode Island, August 1986.

Figure 1 shows the percentage of U.S. imports of Norwegian salmon for the 1981 - 1984 period by region. We do not have corresponding data for farmed Pacific salmon in domestic markets (North American farmed Pacific salmon production was less than 10 percent of the volume of Norwegian production over this period), but Figure 1 implies that there is a huge market in the heart of the U.S. that is only beginning to be penetrated.

Thus far there appears to be little competition between wild fish harvested in Alaska, which are generally marketed in frozen form (about 97 percent of the harvest of premium species in Alaska is marketed in frozen form and three percent fresh) and fresh farmed fish. However, European producers expect farmed salmon to dominate both fresh and frozen premium markets by 1990, while wild commercial landings of chinook, coho and sockeye are expected to remain fairly stagnant. 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. The key here will be lower prices. Frozen markets, particularly retail stores and family-type restaurants, are where fishermen in Alaska will experience the greatest amount of competition from farmed salmon production.

We do not know when premium salmon markets will become saturated and real price competition between wild and farmed fish will occur. To date, substitution effects (measured as cross price elasticities) are not observable in the data. We guess that competition between farmed and wild salmon will intensify in the early to mid-1990s and are using 1990 as a conservative benchmark for our analysis.

There are several efforts currently under way to model the economic impact of farmed salmon production. The Office of Commercial Fisheries Development is working on a species-specific demand model that will be of some use in this area. According to Paul Engleman, the economist in charge of this project, his model will suffer from the shortcomings described above but will allow various scenarios to be tested. Our judgment is that we are several years and several hundred thousand dollars away from a reasonably accurate economic model of salmon markets that can reliably quantify impacts of farmed salmon production. With these caveats in mind, we proceed to make some heroic assumptions and attempt to answer your question in the next section.

FIGURE 1



Percentage of U.S. Imports of Norwegian Salmon 1981 - 1984 by region:

I: Northeast	76%
II: West Coast	23%
III: Rest of Country	1%

Source: "An Economic Analysis of the Market for Atlantic Salmon Aquaculture," page 55.

The Economic Loss to Alaska Salmon Fishermen from Farmed Salmon

Robert Logan, Assistant Professor of Economics in the School of Management at the University of Alaska-Fairbanks provided this agency with some preliminary information from his study, "Salmon Farming in Alaska: Economic Feasibility and Socioeconomic Impacts" (work in progress). In this project, Dr. Logan has surveyed current econometric models of salmon markets and applied the range of demand elasticities calculated by these models to an assumed 100,000 mt increase in world farmed salmon production by 1990. An assumed 20,000 mt Alaska salmon farming industry is added incrementally to world production to gauge the impact of a salmon farming industry in Alaska relative to the impact of worldwide salmon farming.³

In both his best and worst case scenarios, Dr. Logan assumes no increase in demand for salmon through 1990, a constant wild harvest and that farmed salmon does not occupy a separate market niche from wild fish. As he puts it, "both scenarios are under the most pessimistic view one could possibly take", i.e., he is weighting his analysis to show the greatest possible economic damage to the fishing industry.⁴ Below we list the results of his worst and best case scenarios:

The Impact of World and Alaskan Salmon Farming on Revenues to the Traditional Wild Fisheries in 1990 (Thousands \$)

<u>Farmed Production Competes With</u>	<u>Elasticity</u>	<u>Impact of World Production</u>	<u>Impact of Incremental Alaska Production</u>
King, Coho, Red	-3.94	-\$36,398	-\$4,720
	-9.68	-\$14,950	-\$1,974
All Species	-3.94	-\$13,115	-\$1,671
	-9.68	-\$ 5,138	-\$ 678

The elasticities assumed above mean that for every one percent increase in production of farmed salmon, the price of wild salmon drops by 1/3.9 or .25 percent (worst case) or 1/9.7 = .1 percent (best case). The effects of increases in the demand for farmed salmon are much greater when it is assumed to compete directly with premium species than when it is assumed to

³A 20,000 mt Alaska salmon farming industry was first postulated in "Aquaculture: Opportunities and Constraints in Cultured Salmon Production", Lindgren, et al, (VBB/Sweco and Nordic Alaska, Aug. 30, 1985, page 121). The 20,000 mt figure is an arbitrary number based on a rough estimation of the potential size of the domestic fresh salmon market.

⁴Bob Logan, personal communication, April 1987.

compete with all species. In every case, the market effects of world farmed salmon production are overwhelmingly larger than the Alaska farmed salmon production increment. Virtually everyone we have contacted who is involved in studying the economic impacts of salmon farming agrees with this assessment.

Note that Dr. Logan's assumptions are heavily weighted against salmon farming. A 20,000 mt salmon farming industry in Alaska would be impossible to attain by 1990, even if enabling legislation were passed this session. In addition, domestic consumption of salmon has increased from .1 pounds per capita in 1980 to .4 pounds in 1984 and is expected to continue to increase into the future. Thus demand is actually increasing, while the scenarios have assumed it is constant.

The domestic market has been able to absorb enormous increases in farmed salmon imports (fresh salmon imports increased from 1.1 million pounds in 1982 to 13.8 million pounds in 1985) without corresponding decreases in the price of farmed or wild fish.⁵ The data suggest that we are in a young domestic market with a great deal of room for growth in sales of fresh fish before farmed salmon production begins to spill over into markets for frozen products and seriously competes with wild production. Until this occurs, prices for farmed and wild fish will continue to behave independently.

We have taken Dr. Logan's worst case (\$41 million loss) and best case (\$5.8 million loss) scenarios and applied them to the four major gear types and four major regions of Alaska's salmon fisheries. Note that the Alaska salmon farming increment assumed in this analysis accounts for about 13 percent of the total loss in revenues. We have assumed that farmed salmon would compete most directly with wild chinook and cohos in domestic markets. Further, we have spread the revenue loss to traditional fisheries by the average percentage of the total value of the combined chinook and coho catch in each region and gear type over the past five years. The other premium Alaskan species, sockeye, is primarily sold to Japan and farmed salmon imports are not likely to be much of a factor in this market.

Our area and gear type analysis of Dr. Logan's scenarios is presented in Table 1. Appendix A contains a map of Alaska's commercial fisheries regions and areas as well as a series of tables showing the commercial chinook and coho salmon catch by region and gear type for the 1981 - 1985 period we used to construct Table 1. As indicated in Table 1, we estimate that the greatest economic loss from farmed salmon production under either scenario would occur in Southeast, followed by the Central, Arctic-Yukon-Kuskokwim and Western regions of the state. By gear type, the greatest revenue loss would occur to trollers in Southeast and the least by seiners in the Central region.

⁵"An Economic Analysis of the Market for Atlantic Salmon Aquaculture," p. 45.

TABLE 1
AVERAGE DISTRIBUTION OF THE CHINOOK AND COHO CATCH AND THE IMPACT OF FARMED SALMON
ON THE ALASKA COMMERCIAL SALMON FISHING INDUSTRY BY 1990 BY REGION AND GEAR TYPE
(Volume and Value Data are in Thousands)

Gear Type	Southeastern		Central		AYK		Western		State Total	
	Pounds	Value	Pounds		Pounds	Value	Pounds	Value	Pounds	Value
1981-1985 AVERAGE GEAR TYPE										
PERCENT OF AREA TOTAL*										
Seine	15.8%	9.8%	1.1%				65.1%	64.2%	14.8%	11.0%
Drift Gillnet	10.0%	5.9%	79.1%				16.4%	17.7%	32.9%	27.8%
Set Gillnet	7.7%	4.0%	19.4%	17.7%	100.0%	100.0%	18.5%	18.1%	27.6%	22.0%
Troll	66.8%	80.3%							24.8%	39.1%
1981-1985 AVERAGE REGION										
PERCENT OF STATEWIDE TOTAL										
	37.2%	48.7%	34.1%	28.8%	15.8%	13.3%	12.9%	9.3%		
WORST CASE SCENARIO										
Economic Impact of \$41 Million Market Loss										
Seine	\$1,909		\$115		\$0		\$2,388		\$4,412	
Drift Gillnet	\$1,149		\$9,366		\$0		\$658		\$11,174	
Set Gillnet	\$779		\$2,039		\$5,320		\$673		\$8,812	
Troll	\$15,642		\$0		\$0		\$0		\$15,642	
									\$0	
REGION LOSS	\$19,480		\$11,520		\$5,320		\$3,720		\$40,040	
BEST CASE SCENARIO										
Economic Impact of \$5.8 Million Market Loss										
Seine	\$277		\$17		\$0		\$346		\$640	
Drift Gillnet	\$167		\$1,358		\$0		\$95		\$1,620	
Set Gillnet	\$113		\$296		\$771		\$98		\$1,278	
Troll	\$2,268		\$0		\$0		\$0		\$2,268	
									\$0	
REGION LOSS	\$2,825		\$1,670		\$771		\$539		\$5,806	

*Based on the 1981-85 average Chinook and Coho catch.

Note components do not add to total due to rounding.

Prepared by the House Research Agency, April 1987 (87-234; 860330-06).

Note that we have referred only to costs to the existing fishing industry above. Against the \$5.8 million - \$41 million loss in revenue to the traditional salmon fishing industry, we should measure the \$132 million in gross sales a 20,000 mt salmon farming industry is expected to produce.⁶ It is precisely those areas of the state, i.e., the Southeast and Central regions, that will experience the greatest economic loss from worldwide (and Alaska) salmon farming which stand to benefit the most from an Alaska salmon farming industry. This is because of their geography, climate, fisheries infrastructure and access to transportation links to domestic markets.

Impact on Fishermen's Capital Investments

There is very little reliable information on the financial status of individual Alaska salmon fishermen. The Commercial Fisheries Entry Commission (CFEC) conducts periodic surveys of limited entry permit holders to estimate net returns for various fisheries (a fishery is defined as a particular license for a specific gear type in a particular area). These data are used to gauge the overall economic health of the fishery. In recent years, these surveys have been targeted on fisheries that might be candidates for a buyback program as authorized in AS 16.43.290-330.

There is a great diversity among salmon fishermen of all gear types. Some rely on a single fishery as their sole source of income, while many participate in several fisheries. There are large numbers of part-time fishermen who hold down other jobs in the off-season. In some of the more remote areas of the state, the commercial salmon fisheries provide the basis for the cash economy and income to support a subsistence lifestyle. In other fisheries, participants are nonresidents. Each fishery has a different purpose, for which the surveys attempt to compensate in their net returns. Thus, while the CFEC surveys are an important source of information about individual fisheries, they cannot tell us how an individual fisherman's livelihood depends on a particular fishery.

We do not know what effect a decrease in revenue for the salmon fisheries calculated in Table 1 will have in terms of marginal fishermen being forced out of business or defaulting on State gear and/or permit loans. Table 2 lists the individual fisheries that comprise the gear type and region data presented in Table 1. We show the average earnings per permit fished for the 1977 - 1985 period and average permit price for 1986. A more complete breakdown of Alaska's salmon fisheries data is provided in Appendix B which lists: permits issued, permits fished, total gross earnings and average earnings per permit for the 1977 - 1985 period; 1986 limited entry permits issued by resident vs. nonresident and permanent or interim use status; and average permit prices for the 1978 - 1986 period.

⁶"Aquaculture: Opportunities and Constraints in Cultured Salmon Production," p. 124.

Table 2

REGION	FISHERY	AVERAGE GROSS EARNINGS PER PERMIT FISHED 1977-85	AVERAGE 1986 PERMIT PRICE
Southeast	Purse Seine	\$ 89,833	\$ 36,059
	Drift Gillnet	25,056	44,849
	Power Troll	21,722	15,383
	Hand Troll	3,022	5,297
	Yakutat Setnet	15,644	26,857
Central	PWS Purse Seine	79,622	98,841
	PWS Drift Gillnet	25,633	61,606
	PWS Setnet	10,022	59,917
	CI Purse Seine	41,667	60,000
	CI Drift Gillnet	26,167	64,962
	CI Setnet	16,022	18,191
	BB Drift Gillnet	49,500	124,605
	BB Setnet	14,711	33,054
AYK	Kuskokwim Gillnet	4,967	10,133
	Lower Yukon Gillnet	8,189	22,455
	Upper Yukon Gillnet	4,178	7,667
	Upper Yukon Fishwheel	5,244	13,500
	Kotzebue Gillnet	8,273	10,819
	Norton Sound Gillnet	4,944	10,167
Western	Kodiak Purse Seine	57,667	37,036
	Kodiak Beach Seine	15,078	20,000
	Kodiak Setnet	24,544	61,792
	Chignik Purse Seine	150,878	315,667
	P/A Purse Seine	135,533	236,250
	P/A Drift Gillnet	67,844	197,000
	P/A Setnet	37,344	56,357

Note: PWS = Prince William Sound, CI = Cook Inlet, BB = Bristol Bay,
 AYK = Arctic-Yukon-Kuskokwim, P/A = Peninsula-Aleutians.

Source: Commercial Fisheries Entry Commission.

Comparing the data presented in Table 1 with Table 2, it is clear that some of the fisheries which will be affected the most by salmon farming also have low average gross revenues (less than \$30,000). These are: Southeast trollers (hand and power); Cook Inlet and Prince William Sound drift gillnetters; Cook Inlet, Prince William Sound and Bristol Bay setnetters; and Arctic-Yukon-Kuskokwim gillnetters. It is likely that participants in these fisheries will experience even lower revenues and consequently lower permit values in the 1990s due to competition from farmed salmon in their markets.

In most salmon fisheries there is a relatively small percentage of high-liners who consistently catch a large proportion of the total volume landed. Generally there is a somewhat larger proportion of marginal fishermen who consistently have gross revenues that are lower than the average for the fishery. Permit holders in the fisheries cited above who fit into this marginal category should be concerned about the long-term viability of their fishing investment. This is particularly true for those fisheries that have a relatively high cost, (i.e., trollers and drift gillnetters).

Options for Mitigating the Impacts of Farmed Salmon

As we have shown in previous sections, there is no way that fishermen in Alaska can be protected from the economic impacts of worldwide farmed salmon production in the marketplace. Even an improbably large (20,000 mt) Alaska salmon farming industry will have a small negative effect on fishermen's gross revenues compared to worldwide farmed production. Eventually, fishermen in Alaska will have to come to terms with the reality of the marketplace in the 1990s. What then can fishermen and their elected officials in the legislature do to mitigate the impacts of farmed salmon on their markets? In this section, we offer two options for dealing with the situation--a buyback program and/or marketing farmed fish to supplement fishermen's wild catch.

For those fisheries identified in the previous section which have low average gross revenues and will be most affected by farmed salmon production, a permit buyback program may be an attractive option. Alaska Statute 16.43.010(b) allows the Commercial Fisheries Entry Commission (CFEC) to tax up to seven percent of the gross value of annual landings for each permit in a given fishery to be put in a buyback fund. This fund could then be used to buy back permits of marginal fishermen. Other participants in the fishery would benefit from decreased competition and by being able to spread their costs over larger catches, which would presumably increase their net revenues.

The CFEC staff have prepared an extensive analysis of legislative changes necessary to make the existing buyback statutes workable and have drafted legislation to implement these changes.⁷ The CFEC is not an advocacy agency however, and will only offer support to fishing groups if they formally apply to institute a buyback program in their fishery. Thus far, several fishermen's groups have expressed informal interest in a buyback program. However, no group has formally applied and no legislator has offered to sponsor a bill to clean up the statutes. It is probable that by the time participants in the fisheries cited above begin to experience the effects of price competition with farmed salmon in the 1990s in the forms of lower gross revenues and declining permit prices, they will be unwilling to subject themselves to a buyback tax.

⁷-----
Ben 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.

Another option for dealing with the market effects of farmed salmon production is for fishermen to produce farmed fish themselves and market them to supplement their wild harvest. There are several ways of accomplishing this. Individual fishermen could run family farming operations in addition to their fishing business or could enter into partnerships with other fishermen or entrepreneurs. One of the most promising ideas would be for fishermen to participate in salmon farming through their marketing cooperatives. Operations such as the Seafood Producers Cooperative in Sitka or the Copper River Fishermen's Cooperative in Cordova are excellent candidates for this type of enterprise. It is also possible for cooperatives in regions where salmon farming is impractical (e.g., AYK) to operate farms or contract with farmers in other regions such as Prince William Sound or Southeast.

We have previously documented how foreign domestic producers of farmed salmon are attempting to shorten the chain of distribution from producer to consumer by entering into direct contracts with hotels, supermarket chains, restaurants, etc., thereby absorbing the margins of middlemen.⁸ We have described how the Prince Rupert Fisherman's Cooperative has incorporated salmon farming into its long-range competitive strategy.⁹

A fishermen's cooperative with a fairly substantial pen-reared production capacity could lock in a position in growing domestic fresh fish markets by offering year-round, long-term, fixed-price contracts and selling farmed fish in the winter to supplement their members' wild fish in season. More importantly, members of the cooperative could also lock in a price for a substantial portion of their wild catch and not be subject to volatile price fluctuations during the season. This would take some of the risk out of their business decisions. Earnings from their stock in the salmon farm could be used to help make boat, permit and gear payments. On years with poor natural runs, income from the farm could offset losses in the wild fishery. This is a natural extension of the goals of Alaska's salmon enhancement programs.

If, as we have predicted, farmed salmon becomes a close substitute for wild fish in the 1990s, then all of the premium species will become increasingly interchangeable commodities in world markets. It follows then that fishermen should adopt some of the same methods that farmers have used to protect themselves from volatile swings in commodity prices. By investing in salmon farming and attempting to lock in prices and margins in fresh markets--in effect taking out futures contracts--cooperatives could offer security to their members that they could not achieve individually.

⁸"Aquaculture in Alaska," p. 64.

⁹Ibid., p. 69.

Most cooperatives pay their fishermen a nominal price for their catch and retain some of the margin they receive from sales to help with cash flow during the season. They pay their members a settlement from these retained earnings (based on the member's sales of fish to the cooperative net of operating costs) when the season is over. One method of financing a salmon farming investment that is open to cooperatives would be to use these retained earnings to invest in farming capacity (thereby improving the cooperative's long-term marketing position) instead of paying a settlement. This would be a relatively painless way for members to invest.

* * *

We have attempted to answer your questions to the best of our ability in a nontechnical manner, given the current level of understanding of the workings of salmon markets. There is a great deal of emotionalism in the debate over salmon farming in Alaska at the moment. The mechanical models we have used in this memorandum can add a measure of rationality to the debate but they cannot provide an authoritative description of the future. We caution that the impact numbers given in this analysis are meant to be illustrative and not definitive. We have had to make many simplifying assumptions (which we have identified) that do not reflect present reality. The important point, however, is how well these assumptions will fit the market reality faced by Alaska fishermen in the 1990s. We think we have come close to describing it.

We have asked CFEC staff for a series of printouts of the distribution of the value of the chinook and coho catch by permit to gauge the number of highliners and marginal fishermen in each fishery. We will send this information on to your office when we receive it. We will also send a copy of Dr. Logan's paper when it is released. Please call if you have further questions.

Attachments

APPENDIX A

MAP OF ALASKA COMMERCIAL FISHERIES REGIONS AND AREAS
ALASKA COMMERCIAL CHINOOK AND COHO SALMON CATCH
BY REGION AND GEAR TYPE 1981 - 1985



ALASKA COMMERCIAL FISHERIES REGIONS AND AREAS

REGION I: SOUTHEASTERN: Dixon Entrance to Cape Suckling

- Areas: A. Juneau & Yakutat
B. Ketchikan
C. Petersburg
D. Sitka

REGION II: CENTRAL: State Third Judicial Division Northern Boundary to Cape Suckling to Cape Douglas to Cape Menshikof to Cape Newenham

- Areas: E. Prince William Sound
H. Cook Inlet
T. Bristol Bay (salmon and herring catch; all fish and shellfish production)

REGION III: ARCTIC-YUKON-KUSKOKWIM (AYK): North of State Third Judicial Division Northern Boundary which ends at the west at Cape Newenham including Nunivak, St. Matthew, and St. Lawrence Islands

- Areas: W. Kuskokwim
X. Kotzebue
Y. Yukon
Z. Norton Sound

REGION IV: WESTERN: Cape Douglas to Unimak Pass to Cape Newenham including Kodiak and Aleutian Islands

- Areas: K. Kodiak
L. Chignik
M. Alaska Peninsula
O. Dutch Harbor
Q. Bering Sea
R. Adak & W. Aleutians
T. Bristol Bay (fish other than salmon and herring catch; and shellfish catch)

TABLE 1
ALASKA COMMERCIAL CHINOOK AND COHO SALMON CATCH BY REGION AND GEAR TYPE 1985
(Volume and Value Data are in Thousands)

Gear Type	Southeastern		Central		AYK		Western		State Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
CHINOOK										
Seine	382	\$ 667	12	\$ 4			258	\$ 310	652	\$ 981
Drift Gillnet	98	106	3,061	3,783			288	273	3,447	4,162
Set Gillnet	21	25	1,019	1,161	4,556	\$5,834	184	177	5,780	7,197
Troll	3,493	8,363							3,493	8,363
TOTAL CHINOOK	3,994	\$ 9,161	4,092	\$ 4,948	4,556	\$5,834	730	\$ 760	13,372	\$20,703
COHO										
Seine	3,276	2,458	197	86			5,124	3,966	8,597	6,510
Drift Gillnet	3,017	2,347	13,565	11,498			735	611	17,317	14,456
Set Gillnet	2,056	1,305	2,720	2,118	3,367	1,736	1,091	888	9,234	6,047
Troll	11,614	15,926							11,614	15,296
TOTAL COHO	19,963	\$21,406	16,482	\$13,702	3,367	\$1,736	6,950	\$5,465	46,762	\$42,309
TOTAL CHINOOK AND COHO	23,957	\$30,567	20,574	\$18,650	7,923	\$7,570	7,680	\$6,225	60,134	\$63,012
GEAR TYPE PERCENT OF AREA TOTAL										
Seine	15.3%	10.2%	1.0%	0.5%			70.1%	68.7%	15.4%	11.9
Drift Gillnet	13.0%	8.0%	80.8%	81.9%			13.3%	14.2%	34.5%	29.5
Set Gillnet	8.7%	4.4%	18.2%	17.6%	100.0%	100.0%	16.6%	17.1%	25.0%	21.0
Troll	63.1%	77.4%							25.1%	37.5
AREA % OF STATEWIDE TOTAL	39.8%	48.5%	34.2%	29.6%	13.2%	12.0%	12.8%	9.9%		

Note that statewide totals in these tables do not exactly correspond to ADF&G totals, due to rounding.

Source: "Alaska 1985 Catch and Production: Commercial Fisheries Statistics," Statistical Leaflet No. 38," Alaska Department of Fish and Game, Division of Commercial Fisheries, December 1986.

Prepared by the House Research Agency, April 1987 (87-234A; 860330-03).

TABLE 2
ALASKA COMMERCIAL CHINOOK AND COHO SALMON CATCH BY REGION AND GEAR TYPE 1984
(Volume and Value Data are in Thousands)

Gear Type	Southeastern		Central		AYK		Western		State Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
CHINOOK										
Seine	391	\$ 867	2	\$ 2			319	\$ 334	712	\$ 1,203
Drift Gillnet	82	87	2,965	3,510			343	359	3,390	3,956
Set Gillnet	20	21	527	553	3,790	\$4,891	165	172	4,502	5,637
Troll	3,842	10,882	1	1					3,843	10,883
TOTAL CHINOOK	4,335	\$11,857	3,495	\$ 4,066	3,790	\$4,891	827	\$ 865	12,447	\$21,679
COHO										
Seine	3,009	2,812	275	222			4,713	3,384	7,997	6,418
Drift Gillnet	1,878	1,999	10,814	9,774			1,205	866	13,897	12,639
Set Gillnet	1,827	1,502	2,683	1,865	7,451	4,608	1,145	851	13,106	8,826
Troll	9,169	14,592							9,169	14,592
TOTAL COHO	15,883	\$20,905	13,772	\$11,861	7,451	\$4,608	7,063	\$5,101	44,169	\$42,475
TOTAL CHINOOK AND COHO	20,218	\$32,762	17,267	\$15,927	11,241	\$9,499	7,890	\$5,966	56,616	\$64,154
GEAR TYPE PERCENT OF AREA TOTAL										
Seine	16.8%	11.2%	1.6%	1.4%			63.8%	62.3%	15.4%	11.9%
Drift Gillnet	9.7%	6.4%	79.8%	83.4%			19.6%	20.5%	30.5%	25.9%
Set Gillnet	9.1%	4.6%	18.6%	15.2%	100.0%	100.0%	16.6%	17.1%	31.1%	22.5%
Troll	64.4%	77.8%							23.0%	39.7%
AREA % OF STATEWIDE TOTAL	35.7%	51.1%	30.5%	24.8%	19.9%	14.8%	13.9%	9.3%		

Note that statewide totals in these tables do not exactly correspond to ADF&G totals, due to rounding.

Source: "Alaska 1984 Catch and Production: Commercial Fisheries Statistics," Statistical Leaflet No. 37,
Alaska Department of Fish and Game, Division of Commercial Fisheries, April 1986.

Prepared by the House Research Agency, April 1987 (87-234B; 860330-03).

TABLE 3
ALASKA COMMERCIAL CHINOOK AND COHO SALMON CATCH BY REGION AND GEAR TYPE 1983
(Volume and Value Data are in Thousands)

Gear Type	Southeastern		Central		AYK		Western		State Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
CHINOOK										
Seine	218	\$ 235	7	\$ 6			472	\$ 354	697	\$ 595
Drift Gillnet	45	34	5,081	4,049			423	321	5,549	4,404
Set Gillnet	16	10	1,076	919	3,724	\$3,937	231	174	5,047	5,040
Troll	4,344	8,166							4,344	8,166
TOTAL CHINOOK	4,623	\$ 8,445	6,164	\$4,974	3,724	\$3,937	1,126	\$ 849	15,637	\$18,205
COHO										
Seine	2,492	934	141	70			2,478	1,268	5,111	2,272
Drift Gillnet	1,802	950	6,111	3,413			234	126	8,147	4,489
Set Gillnet	778	454	1,719	778	1,748	695	747	330	4,992	2,257
Troll	8,537	7,137	1	4					8,538	7,141
TOTAL COHO	13,609	\$ 9,475	7,972	4,265	1,748	\$ 695	3,459	\$1,724	26,788	\$16,159
TOTAL CHINOOK AND COHO	18,232	\$17,920	14,136	\$9,239	5,472	\$4,632	4,585	\$2,573	42,425	\$34,364
GEAR TYPE PERCENT OF AREA TOTAL										
Seine	14.9%	6.5%	1.0%	8.0%			64.3%	63.0%	13.7%	8.3
Drift Gillnet	10.1%	5.5%	79.2%	80.8%			14.3%	17.4%	32.3%	25.9
Set Gillnet	4.4%	2.6%	19.8%	18.4%	100.0%	100.0%	21.3%	19.6%	23.7%	21.2
Troll	70.7%	85.4%							30.4%	44.5
AREA % OF STATEWIDE TOTAL	43.0%	52.1%	33.3%	26.9%	12.9%	13.5%	10.8%	7.5%		

Note that statewide totals in these tables do not exactly correspond to ADF&G totals, due to rounding.

Source: "Alaska 1983 Catch and Production: Commercial Fisheries Statistics," Statistical Leaflet No. 36,"
Alaska Department of Fish and Game, Division of Commercial Fisheries, December 1984.

Prepared by the House Research Agency, April 1987 (87-234C; 860330-03).

TABLE 4
ALASKA COMMERCIAL CHINOOK AND COHO SALMON CATCH BY REGION AND GEAR TYPE
(Volume and Value Data are in Thousands)

Gear Type	Southeastern		Central		AYK		Western		State Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
CHINOOK										
Seine	477	\$ 1,021	4	\$ 5			207	\$ 243	688	\$ 1,269
Drift Gillnet	139	187	5,979	7,560			394	420	6,512	8,167
Set Gillnet	27	40	992	1,240	4,341	\$4,765	259	303	5,619	6,348
Troll	4,005	11,208							4,005	11,208
TOTAL CHINOOK	4,648	\$12,456	6,975	\$ 8,805	4,341	\$4,765	860	\$ 966	16,824	\$26,992
COHO										
Seine	3,028	2,605	578	412			6,777	5,159	10,383	8,176
Drift Gillnet	1,752	1,417	12,145	9,497			1,213	895	15,110	11,809
Set Gillnet	1,388	787	3,950	2,887	5,008	2,693	1,382	904	11,728	7,271
Troll	9,145	12,723	5	4					9,150	12,727
TOTAL COHO	15,313	\$17,532	16,678	\$12,800	5,008	\$2,693	9,372	\$6,958	46,371	\$39,983
TOTAL CHINOOK AND COHO	19,961	\$29,988	23,653	\$21,605	9,349	\$7,458	10,232	\$7,924	63,195	\$66,975
GEAR TYPE PERCENT OF AREA TOTAL										
Seine	17.6%	12.1%	2.5%	1.9%			68.3%	68.2%	17.5%	14.1%
Drift Gillnet	9.5%	5.3%	76.6%	78.9%			15.7%	16.6%	34.2%	29.8%
Set Gillnet	7.1%	2.8%	20.9%	19.1%	100.0%	100.0%	16.0%	15.2%	27.4%	20.3%
Troll	65.9%	79.8%							20.8%	35.7%
AREA % OF STATEWIDE TOTAL	31.6%	44.8%	37.4%	32.3%	14.8%	11.1%	16.2%	11.8%		

Note that statewide totals in these tables do not exactly correspond to ADF&G totals, due to rounding.

Source: "Alaska 1982 Catch and Production: Commercial Fisheries Statistics," Statistical Leaflet No. 35,"
Alaska Department of Fish and Game, Division of Commercial Fisheries, July 1984.

Prepared by the House Research Agency, April 1987 (87-234D; 860330-03).

TABLE 5
ALASKA COMMERCIAL CHINOOK AND COHO SALMON CATCH BY REGION AND GEAR TYPE 1981
(Volume and Value Data are in Thousands)

Gear Type	Southeastern		Central		AYK		Western		State total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
CHINOOK										
Seine	166	\$ 326	8	\$ 11			203	\$ 278	377	\$ 615
Drift Gillnet	61	73	4,647	5,874			244	286	4,952	6,233
Set Gillnet	46	73	613	808	5,379	\$5,834	171	218	6,209	6,933
Troll	4,124	9,884							4,124	9,884
TOTAL CHINOOK	4,397	\$10,356	5,268	\$ 6,693	5,379	\$5,834	618	\$ 782	15,662	\$23,665
COHO										
Seine	1,987	1,702	53	44			2,515	1,925	4,555	3,671
Drift Gillnet	1,059	870	7,048	5,793			632	455	8,739	7,118
Set Gillnet	1,321	1,127	2,252	1,801	2,169	1,348	841	595	6,583	4,871
Troll	6,149	8,181	3	3					6,152	8,184
TOTAL COHO	10,516	\$11,880	9,356	\$ 7,641	2,169	\$1,348	3,988	\$2,975	26,029	\$23,844
TOTAL CHINOOK AND COHO	14,913	\$22,236	14,624	\$14,334	7,548	\$7,182	4,606	\$3,757	41,691	\$47,509
GEAR TYPE PERCENT OF AREA TOTAL										
Seine	14.4%	9.1%	0.4%	0.4%			59.0%	58.6%	11.8%	9.0
Drift Gillnet	7.5%	4.2%	80.0%	81.4%			19.0%	19.7%	32.8%	28.1
Set Gillnet	9.2%	5.4%	19.6%	18.2%	100.0%	100.0%	22.0%	21.6%	30.7%	24.8
Troll	68.9%	81.2%							24.6%	38.0

AREA % OF STATEWIDE TOTAL 35.8% 46.8% 35.1% 30.2% 18.1% 15.1% 11.0% 7.9%

Note that statewide totals in these tables do not exactly correspond to ADF&G totals, due to rounding.

Source: "Alaska 1981 Catch and Production: Commercial Fisheries Statistics," Statistical Leaflet No. 34,"
Alaska Department of Fish and Game, Division of Commercial Fisheries, January 1984.

Prepared by the House Research Agency, April 1987 (87-234E; 860330-03).

APPENDIX B

ALASKA SALMON FISHERIES BY GEAR TYPE 1977 - 1985
Permits Issued, Permits Fished,
Total Gross Earnings, Average Gross Earnings Per Permit,
Residency and Status of Permit Holders, and
Average Permit Prices

S01A 3/11/87

Commercial Fisheries Entry Commission

SOUTHEAST SALMON PURSE SEINE

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	420	368	\$ 52,058,700	\$ 141,500
1984	422	382	35,027,600	91,700
1983	421	337	33,294,700	98,800
1982	421	369	28,068,300	76,100
1981	418	364	36,763,100	101,000
1980	417	334	29,460,800	88,200
1979	418	319	19,636,200	61,600
1978	420	376	27,675,000	73,600
1977	414	325	24,704,300	76,000

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	180	1	181
Non-residents	229	3	232
Unpaid	7	0	7
Total	416	4	420

Average Permit Prices

1986 \$ 36,059	1983 \$ 38,531	1980 \$ 39,778
1985 \$ 37,907	1982 \$ 40,636	1979 \$ 39,917
1984 \$ 40,884	1981 \$ 40,435	1978 \$ 30,929

S03A 3/11/87

Commercial Fisheries Entry Commission

SOUTHEAST SALMON DRIFT GILLNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	485	446	\$ 16,980,300	\$ 38,100
1984	481	436	13,462,900	30,900
1983	480	431	7,588,600	17,600
1982	486	431	10,424,400	24,200
1981	487	447	9,393,100	21,000
1980	489	445	9,385,900	21,100
1979	491	447	11,355,500	25,400
1978	491	473	9,566,100	20,200
1977	474	437	11,797,400	27,000

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	327	16	343
Non-residents	139	4	143
Unpaid	2	0	0
Total	468	20	488

Average Permit Prices

1986 \$ 44,849	1983 \$ 34,653	1980 \$ 41,250
1985 \$ 36,245	1982 \$ 38,650	1979 \$ 41,763
1984 \$ 34,615	1981 \$ 43,898	1978 \$ 34,604

S15B 3/11/87

Commercial Fisheries Entry Commission

SOUTHEAST SALMON POWER TROLL

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	962	830	\$ 21,072,200	\$ 25,400
1984	963	795	22,655,800	28,500
1983	968	810	13,485,600	16,600
1982	968	809	20,348,200	25,200
1981	970	792	16,226,600	20,500
1980	974	841	13,216,800	15,700
1979	979	814	21,315,800	26,200
1978	976	816	17,478,700	21,400
1977	970	750	12,035,800	16,000

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	730	12	742
Non-residents	208	3	211
Unpaid	4	0	4
Total	942	15	957

Average Permit Prices

1986 \$ 25,383	1983 \$ 20,878	1980 \$ 33,596
1985 \$ 21,530	1982 \$ 21,630	1979 \$ 26,680
1984 \$ 19,624	1981 \$ 28,938	1978 \$ 15,457

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Commercial Fisheries Entry Commission

SOUTHEAST SALMON HAND TROLL

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	2,030	901	\$ 3,923,900	\$ 4,400
1984	2,147	856	3,925,800	4,600
1983	2,150	939	2,484,300	2,600
1982	1,905	1,066	4,064,100	3,800
1981	2,048	1,147	3,416,800	3,000
1980	2,436	1,667	3,158,500	1,900
1979	3,700	2,205	6,408,500	2,900
1978	3,922	2,622	5,659,400	2,200
1977	2,951	1,834	3,311,400	1,800

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	1,601	16	1,617
Non-residents	120	2	122
Unpaid	246	0	246
Total	1,967	18	1,985

Average Permit Prices

1986 \$ 5,297	1983 \$ 4,948
1985 \$ 5,109	1982 \$ 3,828
1984 \$ 4,732	

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Commercial Fisheries Entry Commission

YAKUTAT SALMON SETNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	164	148	\$ 2,776,800	\$ 18,800
1984	164	140	2,305,100	16,500
1983	165	145	1,200,100	8,300
1982	164	147	2,219,900	15,100
1981	167	158	2,630,000	16,600
1980	167	158	2,268,300	14,400
1979	167	155	3,020,600	19,500
1978	164	155	2,578,300	16,600
1977	159	143	2,150,000	15,000

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	142	0	142
Non-residents	21	0	21
Unpaid	1	0	1
Total	164	0	164

Average Permit Prices

1986 \$ 26,857	1983 \$ 27,250	1980 \$ 32,500
1985 \$ 25,862	1982 \$ 32,792	1979 ***
1984 \$ 23,750	1981 \$ 26,682	1978 \$ 10,480

S01E 3/11/87

Commercial Fisheries Entry Commission

PRINCE WILLIAM SOUND SALMON PURSE SEINE

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	271	264	\$ 23,034,200	\$ 87,300
1984	269	261	21,811,200	83,600
1983	270	265	12,057,800	45,500
1982	270	258	19,044,200	73,800
1981	270	268	44,925,100	167,600
1980	270	237	19,947,000	84,200
1979	268	243	26,680,400	109,800
1978	272	203	5,023,900	24,700
1977	273	232	9,303,600	40,100

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	185	8	193
Non-residents	69	1	70
Unpaid	8	0	8
Total	262	9	271

Average Permit Prices

1986 \$ 98,841	1983 \$ 143,186	1980 \$ 38,259
1985 \$ 109,625	1982 \$ 97,587	1979 \$ 33,846
1984 \$ 131,695	1981 \$ 74,250	1978 \$ 24,272

S03E 3/11/87

Commercial Fisheries Entry Commission

PRINCE WILLIAM SOUND SALMON DRIFT GILLNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	544	530	\$ 23,903,800	\$ 45,100
1984	543	522	18,056,000	34,600
1983	543	528	9,743,600	18,500
1982	543	524	22,388,600	42,700
1981	546	479	11,462,700	23,900
1980	545	393	4,818,300	12,300
1979	549	505	7,945,900	15,700
1978	544	514	8,907,600	17,300
1977	532	497	10,233,800	20,600

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	384	8	392
Non-residents	149	0	149
Unpaid	3	0	3
Total	536	8	544

Average Permit Prices

1986 \$ 61,606	1983 \$ 61,760	1980 \$ 27,810
1985 \$ 55,991	1982 \$ 46,337	1979 \$ 35,632
1984 \$ 53,544	1981 \$ 32,836	1978 \$ 27,742

S04E 3/11/87

Commercial Fisheries Entry Commission

PRINCE WILLIAM SOUND SALMON SETNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	30	20	\$ 71,400	\$ 3,600
1984	30	19	430,600	22,700
1983	30	17	150,300	8,800
1982	30	5	23,200	4,600
1981	31	3	19,000	6,300
1980	30	11	54,800	5,000
1979	30	7	88,900	12,700
1978	28	2	32,400	16,200
1977	29	14	143,700	10,300

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	26	0	26
Non-residents	1	0	1
Unpaid	3	0	3
Total	30	0	30

Average Permit Prices

1986 \$ 59,917	1983 \$ 24,167	1980 ***
1985 \$ 32,375	1982 \$ 19,400	1979 ***
1984 \$ 31,250	1981 ***	1978 ***

S01H 3/11/87

Commercial Fisheries Entry Commission

COOK INLET SALMON PURSE SEINE

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	81	50	\$ 2,276,700	\$ 45,500
1984	81	54	1,847,200	34,200
1983	83	70	1,692,500	24,200
1982	84	63	1,784,200	28,300
1981	85	82	6,882,500	83,900
1980	84	71	1,434,600	20,200
1979	84	77	5,774,100	75,000
1978	83	65	1,413,000	21,700
1977	82	61	2,563,300	42,000

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	76	1	77
Non-residents	1	0	1
Unpaid	5	0	5
Total	82	1	83

Average Permit Prices

1986	\$ 60,000	1983	\$ 90,000	1980	\$ 82,785
1985	\$ 58,375	1982	\$ 84,267	1979	***
1984	***	1981	\$ 83,714	1978	\$ 40,000

S03H 3/11/87

Commercial Fisheries Entry Commission

COOK INLET SALMON DRIFT GILLNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	591	583	\$ 18,749,400	\$ 32,200
1984	588	574	10,273,300	17,900
1983	587	579	19,539,600	33,700
1982	591	577	24,514,600	42,500
1981	598	584	10,227,400	17,500
1980	597	553	6,891,600	12,500
1979	599	590	8,927,100	15,100
1978	591	578	22,006,200	38,100
1977	575	529	13,755,200	26,000

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	396	22	418
Non-residents	162	7	169
Unpaid	1	0	0
Total	559	29	588

Average Permit Prices

1986 \$ 64,962	1983 \$ 69,919	1980 \$ 67,224
1985 \$ 62,605	1982 \$ 58,176	1979 \$ 82,636
1984 \$ 67,962	1981 \$ 67,629	1978 \$ 36,825

S04H 3/11/87

Commercial Fisheries Entry Commission

COOK INLET SALMON SETNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	745	623	\$ 16,981,600	\$ 27,300
1984	744	616	6,893,600	11,200
1983	745	625	10,120,900	16,200
1982	748	602	12,203,200	20,300
1981	747	599	8,830,500	14,700
1980	747	592	6,168,200	10,400
1979	749	609	6,187,700	10,200
1978	747	604	11,445,800	19,000
1977	733	546	8,116,600	14,900

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	663	0	663
Non-residents	75	0	75
Unpaid	5	0	5
Total	743	0	743

Average Permit Prices

1986 \$ 18,191	1983 \$ 18,340	1980 \$ 18,362
1985 \$ 16,312	1982 \$ 17,200	1979 \$ 23,412
1984 \$ 17,881	1981 \$ 15,276	1978 \$ 9,824

S01K 3/11/87

Commercial Fisheries Entry Commission

KODIAK SALMON PURSE SEINE

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	384	270	\$ 15,601,300	\$ 57,800
1984	384	296	21,173,100	71,500
1983	383	342	10,338,600	30,200
1982	386	345	13,561,500	39,300
1981	387	325	25,952,200	79,900
1980	387	369	23,068,300	62,500
1979	387	362	18,544,100	51,200
1978	389	372	26,294,400	79,700
1977	378	336	15,766,400	46,900

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	277	5	282
Non-residents	79	0	79
Unpaid	24	0	24
Total	380	5	385

Average Permit Prices

1986 \$ 37,036	1983 \$ 69,903	1980 \$ 70,960
1985 \$ 46,337	1982 \$ 75,511	1979 \$ 66,045
1984 \$ 61,265	1981 \$ 69,605	1978 \$ 47,611

S02K 3/11/87

Commercial Fisheries Entry Commission

KODIAK SALMON BEACH SEINE

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	34	21	\$ 176,500	\$ 8,400
1984	35	25	308,500	12,300
1983	35	27	159,800	5,900
1982	35	30	331,200	11,000
1981	35	30	808,400	26,900
1980	35	33	771,700	23,400
1979	34	27	567,900	21,000
1978	34	29	428,400	14,800
1977	32	24	288,400	12,000

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	26	0	26
Non-residents	3	0	3
Unpaid	5	0	5
Total	34	0	34

Average Permit Prices

1986 \$ 20,000	1983 \$ 50,000	1980 \$ 41,375
1985 \$ 23,750	1982 ***	1979 \$ 36,500
1984 ***	1981 \$ 42,429	1978 ***

S04K 3/11/87

Commercial Fisheries Entry Commission

KODIAK SALMON SETNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	188	169	\$ 4,649,600	\$ 27,500
1984	188	168	4,460,800	26,600
1983	188	174	2,903,900	16,700
1982	187	170	4,911,200	28,900
1981	187	169	5,878,700	34,800
1980	187	168	3,564,200	21,200
1979	186	164	3,831,500	23,400
1978	188	160	3,633,800	22,700
1977	186	147	2,810,100	19,100

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	148	0	148
Non-residents	39	0	39
Unpaid	0	0	0
Total	187	0	187

Average Permit Prices

1986 \$ 61,792	1983 \$ 76,525	1980 \$ 38,750
1985 \$ 56,357	1982 \$ 39,817	1979 \$ 33,667
1984 \$ 57,200	1981 \$ 41,278	1978 \$ 19,800

S01L 3/11/87

Commercial Fisheries Entry Commission

CHIGNIK SALMON PURSE SEINE

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	101	100	\$ 8,948,100	\$ 89,500
1984	100	100	18,989,200	189,900
1983	100	100	11,405,500	114,100
1982	101	101	14,867,900	147,200
1981	102	102	21,733,900	213,100
1980	101	100	7,738,000	77,400
1979	101	101	15,890,300	157,300
1978	95	93	17,538,400	188,600
1977	91	88	15,912,300	180,800

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	77	10	87
Non-residents	13	0	13
Unpaid	0	0	0
Total	90	10	100

Average Permit Prices

1986 \$ 315,667	1983 ***	1980 ***
1985 \$ 321,233	1982 ***	1979 ***
1984 \$ 322,500	1981 ***	1978 ***

S01M 3/11/87

Commercial Fisheries Entry Commission

PENINSULA/ALEUTIANS SALMON PURSE SEINE

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	127	123	\$ 17,193,200	\$ 139,800
1984	126	121	23,343,600	192,900
1983	127	119	14,225,800	119,500
1982	127	116	18,253,500	157,400
1981	127	122	21,974,000	180,100
1980	125	122	18,409,200	150,900
1979	123	117	18,704,400	159,900
1978	123	110	9,824,800	89,300
1977	113	82	2,463,400	30,000

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	100	6	106
Non-residents	19	0	19
Unpaid	0	0	0
Total	119	6	125

Average Permit Prices

1986 \$ 236,250	1983 \$ 195,000	1980 \$ 102,500
1985 ***	1982 ***	1979 \$ 66,000
1984 \$ 243,333	1981 ***	1978 \$ ***

S03M 3/11/87

Commercial Fisheries Entry Commission

PENINSULA/ALEUTIANS SALMON DRIFT GILLNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	165	157	\$ 16,335,000	\$ 104,000
1984	165	157	10,772,600	68,600
1983	166	156	12,235,700	78,400
1982	164	156	13,543,300	86,800
1981	164	152	12,983,600	85,400
1980	163	155	5,391,200	34,800
1979	161	146	13,045,200	89,400
1978	158	132	5,135,400	38,900
1977	156	111	2,700,900	24,300

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	93	5	98
Non-residents	63	3	66
Unpaid	1	0	0
Total	157	8	165

Average Permit Prices

1986 \$ 197,000	1983 \$ 157,700	1980 \$ 92,454
1985 \$ 175,176	1982 \$ 128,833	1979 \$ 60,625
1984 \$ 186,429	1981 \$ 123,500	1978 \$ 15,000

S04M 3/11/87

Commercial Fisheries Entry Commission

PENINSULA ALEUTIAN SALMON SETNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	113	102	\$ 4,754,900	\$ 46,600
1984	113	102	5,884,900	57,700
1983	114	94	3,456,600	36,800
1982	115	91	3,223,300	35,400
1981	115	87	4,966,700	57,100
1980	113	85	2,004,300	23,600
1979	113	80	3,774,100	47,200
1978	113	60	1,172,000	19,500
1977	108	56	681,900	12,200

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	89	1	90
Non-residents	19	0	19
Unpaid	5	0	5
Total	113	1	114

Average Permit Prices

1986 \$ 56,357	1983 \$ 55,420	1980 \$ 15,625
1985 \$ 50,313	1982 \$ 54,636	1979 ***
1984 \$ 50,374	1981 \$ 54,278	1978 ***

S03T 3/11/87

Commercial Fisheries Entry Commission

BRISTOL BAY SALMON DRIFT GILLNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	1,834	1,813	\$ 109,146,000	\$ 60,200
1984	1,818	1,798	92,464,500	51,400
1983	1,821	1,792	127,270,400	71,000
1982	1,824	1,791	69,074,500	38,600
1981	1,827	1,781	112,245,800	63,000
1980	1,827	1,762	72,580,000	41,200
1979	1,800	1,711	121,576,400	71,100
1978	1,777	1,569	49,058,100	31,300
1977	1,728	1,355	23,980,500	17,700

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	981	78	1,059
Non-residents	758	17	775
Unpaid	4	0	4
Total	1,743	95	1,838

Average Permit Prices

1986 \$ 124,605	1983 \$ 98,923	1980 \$ 91,925
1985 \$ 117,983	1982 \$ 95,936	1979 \$ 64,588
1984 \$ 116,905	1981 \$ 84,327	1978 \$ 21,638

S04T 3/1/87

Commercial Fisheries Entry Commission

BRISTOL BAY SALMON SETNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	959	872	\$ 12,309,700	\$ 14,100
1984	962	866	11,107,800	12,800
1983	960	865	15,140,700	17,500
1982	957	859	10,349,200	12,000
1981	956	841	20,391,600	24,200
1980	947	804	11,501,400	14,300
1979	934	768	17,351,700	22,600
1978	910	650	6,224,900	9,600
1977	840	495	2,642,600	5,300

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	706	18	724
Non-residents	219	4	223
Unpaid	15	0	15
Total	940	22	962

Average Permit Prices

1986 \$ 33,054	1983 \$ 41,246	1980 \$ 32,014
1985 \$ 35,974	1982 \$ 37,394	1979 \$ 18,184
1984 \$ 41,533	1981 \$ 26,000	1978 \$ 8,507

S04W 3/11/87

Commercial Fisheries Entry Commission

KUSKOKWIM SALMON GILLNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	834	777	\$ 3,371,000	\$ 4,300
1984	835	765	6,402,200	8,400
1983	835	757	2,481,900	3,300
1982	836	752	4,321,900	5,700
1981	827	773	3,636,800	4,700
1980	817	737	2,863,300	3,900
1979	816	745	4,357,900	5,800
1978	840	752	2,383,500	3,200
1977	836	707	3,852,900	5,400

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	818	4	822
Non-residents	2	0	2
Unpaid	9	0	9
Total	829	4	833

Average Permit Prices

1986 \$ 10,133	1983 \$ 10,222	1980 \$ 6,912
1985 \$ 10,043	1982 \$ 9,722	1979 \$ 6,420
1984 \$ 9,894	1981 \$ 8,339	1978 \$ 6,100

S04Y 3/11/87

Commercial Fisheries Entry Commission

LOWER YUKON SALMON GILLNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	708	663	\$ 6,065,500	\$ 9,100
1984	708	673	5,125,300	7,600
1983	708	655	4,835,600	7,400
1982	710	664	5,328,400	8,000
1981	711	666	8,025,100	12,000
1980	709	650	4,927,100	7,600
1979	708	659	6,421,100	9,700
1978	699	642	4,122,200	6,400
1977	700	606	3,601,100	5,900

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	691	3	694
Non-residents	7	0	7
Unpaid	5	1	6
Total	703	4	707

Average Permit Prices

1986 \$ 22,455	1983 \$ 22,630	1980 \$ 9,060
1985 \$ 22,917	1982 \$ 13,250	1979 \$ 5,834
1984 \$ 28,441	1981 \$ 9,333	1978 \$ 6,700

S04P 3/11/87

Commercial Fisheries Entry Commission

UPPER YUKON SALMON GILLNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	71	40	\$ 153,300	\$ 3,800
1984	73	39	159,200	4,100
1983	73	40	105,200	2,600
1982	76	45	180,000	4,000
1981	70	45	254,100	5,600
1980	71	49	151,100	3,100
1979	70	50	374,000	7,500
1978	71	47	190,800	4,100
1977	69	44	123,900	2,800

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	64	1	65
Non-residents	1	0	1
Unpaid	5	0	5
Total	70	1	71

Average Permit Prices

1986	\$ 7,667	1983	\$ 10,600	1980	***
1985	***	1982	\$ 8,366	1979	***
1984	***	1981	\$ 5,000	1978	***

S08P 3/11/87

Commercial Fisheries Entry Commission

UPPER YUKON SALMON FISHWHEEL

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	159	113	\$ 723,600	\$ 6,400
1984	159	96	433,900	4,500
1983	164	114	427,300	3,700
1982	166	111	721,100	6,500
1981	162	125	1,032,400	8,300
1980	163	127	782,600	6,200
1979	165	127	487,300	3,800
1978	158	137	701,700	5,100
1977	160	130	357,300	2,700

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	127	28	155
Non-residents	0	0	0
Unpaid	6	0	6
Total	133	28	161

Average Permit Prices

1986 \$ 13,500	1983 \$ 11,643	1980 \$ 9,320
1985 \$ 11,667	1982 \$ 10,500	1979 ***
1984 \$ 12,333	1981 \$ 10,893	1978 ***

S04X 3/11/87

Commercial Fisheries Entry Commission

KOTZEBUE SALMON GILLNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	221	189	\$ 2,750,300	\$ 14,600
1984	221	179	1,110,300	6,200
1983	222	187	448,800	2,400
1982	223	198	2,134,900	10,800
1981	214	187	3,439,000	18,400
1980	201	172	1,613,900	9,400
1979	204	180	1,051,100	5,800
1978	233	206	379,200	1,800
1977	235	208	1,066,900	5,100

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	208	1	209
Non-residents	3	0	0
Unpaid	8	1	9
Total	219	2	221

Average Permit Prices

1986	\$ 10,819	1983	\$ 13,083	1980	***
1985	\$ 10,475	1982	\$ 9,591	1979	\$ 5,200
1984	***	1981	\$ 7,812	1978	***

S04Z 3/11/87

Commercial Fisheries Entry Commission

NORTON SOUND SALMON GILLNET

Year	Permits Issued	Permits Fished	Total Gross Earnings	Average Gross Earnings Per Permit
1985	205	155	\$ 818,500	\$ 5,300
1984	204	141	738,100	5,200
1983	203	168	945,300	5,600
1982	203	162	1,069,000	6,600
1981	200	167	761,500	4,600
1980	201	157	572,100	3,600
1979	200	172	878,400	5,100
1978	199	175	901,900	5,200
1977	210	166	545,700	3,300

1986 Permits Issued

	Permanent	Interim-use	Total
Resident	196	2	198
Non-residents	3	0	3
Unpaid	2	0	2
Total	201	2	203

Average Permit Prices

1986 \$ 10,167	1983 \$ 11,500	1980 \$ 7,833
1985 \$ 12,167	1982 \$ 10,100	1979 \$ 6,300
1984 \$ 13,150	1981 \$ 9,450	1978 \$ 4,350

Sentinel Staff Writer

None of the dozen or so Sitkans testifying at a legislative teleconference hearing at the Centennial Building Saturday recommended inauguration of salmon farming in Southeast Alaska.

The hearing was conducted by the State Senate Subcommittee on Fisheries. Taking testimony were senators Dick Eliason, R-Sitka, Fred F. Zharoff, D-Kodiak, and Jim Duncan, D-Juneau. Listening to the testimony from Juneau via teleconference hookup were Rep. Ben Grussendorf, D-Sitka, and aides.

A number of those testifying said they believed some space could be set aside for the pen-rearing of seafood other than salmon, such as shellfish or kelp.

Sitka has one of the highest "value-rated" fishing ports in the nation, said Sitka City Administrator Rick Anderson, cautioning against legislation that could put the local fishing industry at risk. Twenty-eight percent of the community's work force relies on the fishing industry, he said.

Even though 13 other nations already are involved in the mariculture industry, Anderson said Alaska is different in that it has a healthy existing industry and wild salmon stocks to protect.

"If it ain't broke, don't fix it," he said, summing up his views on the issue in Southeast Alaska.

On March 24 the Sitka City and Borough Assembly voted 6-0 to adopt a resolution urging the state to prohibit salmon farming.

A Sitka fisherman who gave testimony, Al Brookman Sr., said:

"These bills have been introduced by a consortium of unthinking people that have no regard of the more than 20,000 voters that make their living from fishing ocean-going wild salmon stocks in the clean, pure environment in the Gulf of Alaska and adjoining waters."

"If this monstrous bill is crammed down our throats, we will retaliate in every way possible."

Brookman and others claimed that large sums of foreign capital would be involved in setting up salmon farms in Alaska, and that few Alaskans would benefit.

This Year's Decision

The bill under consideration in the Senate (106) and its counterpart in the House (108) would provide for the stocking of aquaculture projects, and require inspections and quarantines in cases of diseased stocks. Under the bill, inspection costs would be borne by the state Department of Fish and Game.

The senators admitted the bill, which was based largely on information from the Alaska Mariculture Association, had flaws, and said even its sponsors have conceded that it is unlikely the bill will become law this year.

Even so, the hearings and testimony hold significance, Zharoff said, since the international salmon farming industry has grown so dramatically in recent years, with sales measured in the hundreds of millions of dollars.

The real question for Alaskans, Zharoff said, is whether Alaska should enter or ignore the salmon mariculture field.

"The intent of this bill is to get discussion going and people thinking about it," he said. "If we do get into it, what do we need to do?"

He warned Sitkans that an attorney general's opinion issued last month said Alaska has no laws or regulations that prohibit mariculture permits for any species from being issued as long as all requirements are met.

"We can only hold up permits so

If Alaskans choose to ignore mariculture opportunities, Zharoff said, then they should figure a way to "improve (wild) stocks so that they offer a reasonable lifestyle for fishermen in the 11 1/2 months of the year when they are not fishing."

Eliason has asked state agencies not to issue any salmon pen-rearing permits.

The state agencies maintain there is no legislation enabling mariculture projects, other than oysters, to begin.

Constitutionality?

Mark Jacobs Jr., a Sitka fisherman, said mariculture is prohibited by Article VIII, Section 15, of the state constitution: "No exclusive right or special privilege of fishery shall be created or authorized in the natural waters of the state."

He also pointed out that the Grand Camp of the Alaska Native Brotherhood unanimously passed a resolution last fall opposing salmon mariculture.

He said most Alaska Natives oppose the industry, even though Sealaska Inc., the regional Native corporation for Southeast, was instrumental in starting the Alaska Mariculture Association and has had representatives urge that the state loosen regulations to allow the industry to take off in Alaska.

Zharoff reported he had a Feb. 7 letter from Sealaska stating "salmon mariculture would be beneficial to Alaska."

Eliason said he received a letter in March from Byron Mallot, president of Sealaska, stating that the corporation's position on fish farming is neutral.

Jobs

Zharoff said he, too, had concerns about whether mariculture would offer jobs to Alaskans. He pointed out many fishermen from other parts of Alaska and the U.S. come to fish in waters off his district, creating few local jobs.

The few Alaskans employed would be at the low end of the pay scale, said George Eliason, the senator's son, representing the Alaska Trollers Association.

Jacobs, speaking on that point, said, "If you try to compete with foreign imports, you will have to start robbing

Continued on Page 8

Fisherman Oppose Farming of Salmon

Fishermen . . .

Continued from Page 1
the American wage earner."

Mariculture would not be a small business, said Bill Froust, chairman of Sitka Troll PAC and a member of the board of directors of the Alaska Trollers Association.

He quoted from a mariculture journal article which claimed that by 1990 the only surviving salmon mariculture projects would be ones producing 500 tons or more, and with startup capital costs of several million dollars.

Zharoff agreed with George Eliason that only the massive operations would be economically viable, and said: "That scares me — I'm not sure we're ready for that."

He added: "I want to keep it Alaska-controlled — and the only way to do that is to provide Alaskan money, and I don't think we can do that."

Demand for Fish

Zharoff pointed out in 1985 that the United States imported \$4.5 billion more fish than it exported, and that U.S. per capita fish consumption is expected to continue to increase. Meanwhile, he said, the production level of salmon has stayed about level in recent years and is not expected to increase dramatically.

If Alaska is to satisfy the trade deficit in fish, Zharoff said, the fish will have to come from some other source.

The Pike Place Market in Seattle and Carr's, the grocery chain in Anchorage, now sell fresh salmon from Norway on a daily basis, he said.

"There are a lot of people who can't tell the difference between a fresh pen-reared salmon and a fresh Alaskan king," he said.

Sen. Eliason said the presence of pen-reared salmon on the market may be used to Alaska's advantage and he suggested a trade campaign slogan: "Buy Alaskan Salmon — The Only Wild Salmon Left in the World."

"We are not scared of the competition," said Froust, adding Japan, a major market, continues to prefer fresh Alaskan salmon over pen-reared varieties. Fishermen are concerned that pen stocks might cause disease in wild salmon.

He referred to a University of Washington report that states wild fish can contract disease just by passing by a pen of infected salmon.

He described the potential for disease to existing stocks "too dangerous" to even consider mariculture.

He said that in 1983, 29 out of 40 pens of salmon in Norway had to be destroyed after a disease swept through the stocks. About 1 percent of penned salmon escape into the wild, he said.

Shellfish

Steve Laposki of Sitka, who owns an oyster-raising business south of Petersburg, said he believed it was in the best interest of the state to further study the ramifications of salmon farming on the existing fishing industry before setting "everyone loose on this modern-day bonanza."

He said he hoped the subcommittee would consider passing separate, and less controversial, legislation on mariculture of shellfish and kelp.

The shellfish mariculture industry could be controlled by Alaskans through small businesses, suggested Ray Rollande, a fisheries instructor at Sheldon Jackson College. He said he

was neutral on the subject of finfish mariculture, but expressed concern for the economics, pointing out foreign interests might manage the Alaska tidelands in a manner not suitable to Alaskans.

The Alaska Mariculture Association has expressed desire to see a whole bill on finfish and shellfish mariculture or nothing at all, said Duncan. Rollande expressed disappointment, after noting the shellfish growers have been working for years to have some clearcut regulations established.

Obstacles

Even though Alaska's clean waters and protected bays offer much potential for mariculture, senators Eliason and Zharoff pointed out many obstacles exist, such as the limited access to private or state land. Much of the uplands of Southeast Alaska bays are federal and designated for timber harvest or wilderness.

Also, the state has only one laboratory for the testing of paralytic shellfish poisoning — in Palmer — and Southeast shellfish farmers must send samples of all their stocks to that site. Results are not returned in a timely manner, the subcommittee was told.

Ann Lowe, a member of the Sitka Coastal Zone Management Plan Advisory Committee, said the group has decided that its policy will be to not oppose mariculture ventures, but to recommend that they be given lowest priority for use of bays after subsistence, recreation, log transfer sites, floathouses, fish scows and other uses.

"We want to leave the opportunity there," she said, speaking for the committee which is in the process of reviewing the Sitka plan and holding hearings in preparation for making a final recommendation to the assembly.

The committee will also recommend that mariculture applicants submit a 10-year plan, subject to public comment, and provide annual reports, she said.

Saturday's hearing was the fifth held by the subcommittee on Senate Bill 106. Other hearings were in Dillingham, Anchorage, Kodiak and Ketchikan.



Senators Listen

The Senate Subcommittee on Fisheries was in Sitka Saturday for a public hearing on maricul-

ture. From left are Sen. Fred Zharoff (D-Kodiak), Sen. Dick Eliason (R-Sitka) and Sen. Jim Duncan (D-Juneau). (Sentinel photo)

April 4, 1987

million
My name is Rocky Stone. I am a Cordova resident. My partner, Robert Sullivan, and I have made our living in the Copper River-Prince William Sound fishery for 24 years. 85% of our income is recycled here in Alaska. Alaska harvests 130 million salmon yearly. It's fishing industry is the largest employer of persons in the state.

Those who think fish farming will be labor intensive should think twice. Norway now offers a robot feeder that can assess conditions of fish farms and administer the food, which means that one person and a computer are all that is needed most of the year.

In reports I've read, the Norwegians are faced with disease and genetic deterioration threats to their salmon. They have already invested 12 million dollars in a cryogenic gene bank and have imposed farm free zones near wild streams. A new disease, the "hitra" is responsible for 80% of salmon disease in Norway. This and market saturation are big problems for them. Findings now show that Norway's getting out of this, selling their technology to us, and we're being conned.

Now Norwegian companies, fleeing stringent guidelines of that country, are moving in with a vengeance to B.C. where no controls on farm size and ownership exist. Canada's calling for moratoriums and is worried about disease and the wiping out of her wild stock.

To quote a brief to the Gillespie Commission in B.C., "assurances of the fish farming industry are worthless. In the event of a genetic or disease catastrophe, the huge cost and lost fish production would be borne entirely by the public. It is impossible to put a dollar value on wild salmon resources, and yet this is what we risk in the absence of proper safeguards."

These same problems are going to plague us and farmers will be treating fish with hormones, antibiotics and chemicals. Already TBT, an anti-fouling agent, has been detected in penreared salmon on U.S. markets. This hardly speaks of quality and we don't need to be a part of it.

People are concerned about heart attacks and cancer. Witness the drastic decline in beef sales in the last 2 years. With some marketing expertise, we could rely on the consumer to refuse fish that's a health hazard too.

I read last week that by 1990, just 3 years from now, there will be 153,000 metric tons of farmed salmon on the market...23,000 tons in excess of the total world demand. With this in mind, we're crazy to be wasting money and time on fish farming.

With some marketing ingenuity, we can close this window of panic and open a door of opportunity. We could easily be in a position of having the only quality fish left in the world---Alaska WILD salmon.

Looking Into An Uncertain Future:

"Aquatic Farming" in Alaska

Aquatic "farming" in Alaska - the subject of debate in the state legislature this year - may not pose a threat to commercial fisheries markets, but the boom in worldwide pen-raised salmon presents a formidable long-range challenge to the fishing of wild Alaska salmon. These are the conclusions of two separate University of Alaska assessments of salmon farming.

A preliminary assessment by Dr. Robert L. Logan and John Weddleton of the University of Alaska's Economics Department in Fairbanks: "Any feasible short-run developments (in Alaska) are miniscule when compared to world salmon production. Our preliminary results suggest that any increases in the 10 to 30 thousand metric ton range can easily be absorbed by salmon markets without significant effects on market prices or on wild salmon sales," the two write. "... the same, salmon farming in Alaska will produce substantial net increases in employment and income."

The primary short-run displacement, if any, will be in fresh wild salmon market, they said. Given that this comprises only 3% of sales of Alaska Pacific salmon, "we expect minimal displacement in the short run."

However, long-term effects are more disturbing: "Farmed salmon production is rapidly expanding throughout the world, and is expected to more than double by 1990. Thus, there is no guarantee that today's prices will prevail throughout the 1990s and beyond. Indeed, preliminary results from this study indicate that if demand for salmon products does not increase between now and then, prices for salmon could fall from 4% to 13%. This would cause a displacement of marginal producers in the traditional fishery, whether Alaska pursues salmon farming or not," the two economists write.

"It would reduce the feasibility of salmon farming, especially in light of feed and labor costs in Alaska. We expect significant increases in demand over this period...but if displacement of the traditional fishery is going to occur, it does not matter whether Alaska pursues salmon farming or not. The only question is who will earn the income - Alaskans or foreigners."

Long-Range Threat

A second study of the market effects of pen-raised salmon, this one by Drs. Ronald V. Rogness and Biing-Hwan Lin of the U of A's School of Man-

agement, and released last September, predicts substantial growth in the imports and number of distributors of Atlantic pen-raised salmon. But because 97% of Alaskan salmon is marketed frozen or canned, growth in salmon farming will immediately affect only the small segment of Alaska fishermen marketing their product fresh. However, "the marketing relationship between Atlantic and Pacific salmon can change, especially when there is a glut in the supply of pen-raised Atlantic salmon."

The Norwegian Fresh Fish Marketing Association predicts their annual exports will reach 60,000 metric tons by 1990, up from 28,650 mt in 1985. At least 20,000 mt (44 million lbs.) of this will be imported into the U.S., if current ratios of Norwegian exports and U.S. fish imports continue; in addition, British Columbia salmon farmers say they will export 22 million lbs. of Atlantic and Pacific salmon to the U.S. by 1990; Chile, Scotland and New Zealand are also targeting increased exports of farm-raised fresh salmon to the U.S.

Alaska's total harvest (729 million lbs. in 1985) dwarfs these imports, but the market most immediately affected are those for troll-caught Alaskan chinook and coho, which totalled 19 million lbs. in 1985. The markets for these are mostly "white tablecloth" restaurants, into which pen-raised Atlantic salmon are now making significant inroads.

Marketing Survey

The U of A's surveys of U.S. fish distributors, however, show that farm-raised salmon have the long-range potential of being substituted for wild fresh or frozen salmon on a much wider scale. Here are some highlights:

- Of 62 distributors handling both pen-raised Atlantic and wild Pacific fresh salmon, 49 said the Atlantic variety could substitute for Pacific salmon. Analysis of questions relating to substitution indicate a consciousness of freshness in pen-raised salmon that is sometimes absent in wild salmon shipped from Alaska.

- Distributors surveyed reported they increased sales of pen-raised Atlantic salmon 14% in 1982-3, 22% in 1983-4, and 30% from 1984-5, indicating the markets for these imports are rapidly expanding.

(Cont'd Page 6)

Alaska News Summaries

AMCHITKA SUPER-RADAR BASE: The Navy is planning to base a \$92 million radar system using the "over the horizon" backscatter technology at Amchitka Island, in the Aleutians. Navy officials also plan making plans to spend \$80 million in construction for the Adak Naval Air Station.

ELMENDORF TO RECEIVE 8 COMMUNICATIONS AIRCRAFT: A recent navy decision to base 8 E-6 communications aircraft at Elmendorf Air Force Base, near Anchorage, will mean half of the Navy's 15 E-6's will be operating out of Alaska by 1990, according to Everett Pyatt, assistant secretary of the Navy. The decision will base an estimated 200 support personnel and crew members at Elmendorf.

FAIRBANKS OPTS FOR SALES TAX: The Fairbanks City Council voted 5-1 to begin a 3 percent sales tax and to leave property tax levels alone. Citizens testified on a proposal to either more than triple the property tax mill rate or to reinstate the sales tax. Fairbanks faces a \$5.2 million deficit by the end of this year if costs aren't cut or revenues raised.

ANCSA BILL SHOULD CLEAR SENATE: A bill amending several provisions of the 1971 Alaska Native Land Claims Settlement Act is headed for congressional approval, according to Alaska Senator Ted Stevens. The legislation will go to a conference committee between the House and Senate for approval, unlike last fall when the bill needed unanimous Senate consent. The proposed amendments would change the way corporations may issue stock and would modify some of the special provisions in the 1971 act. Stevens said there is roughly a three-way split among Alaskans who favor, oppose, or are undecided towards the amendments.

ALASKAN POTATO CHIP SELLS: Alaska Potato Chip, Inc. put its chips on the market recently, selling them to grocery stores in Anchorage, Wasilla and Palmer. A 10-ounce bag retails for \$2.99, about 6 cents less than other brands, says Daniel Bagley, general manager of the corporation. The potato chip factory, located in the Matanuska Valley, will soon operate 20 hours a day and employ a dozen people, according to Bagley. The company is presently importing potatoes from the Pacific Northwest but plans to test local potatoes for usage this summer. Alaskans can buy stock in the company for \$1 a share, Bagley said.

HELICOPTERS DENIED LANDING PERMITS: Helicopter companies seeking summertime landing permits to bring tourists to the Eagle River area of Chugach State Park have been denied because of strong public reaction against the idea, according to Neil Johannsen, state parks director. State park officials said they will consider pursuing bids for a more conditional concession permit.

15,000 MAY BENEFIT IF LEGISLATURE PASSES AHFC PROGRAM: A new home refinance program proposed by the Alaska Housing Finance Corp. could lower mortgage payments for up to 15,000 Alaska homeowners if approved by the state legislature. Passage would mean the AHFC could sell \$1 billion in bonds on New York and European financial markets this year. That sale would be largest run of bond sales in the agency's seven year history. Under the new AHFC refinance program, mortgage interest rates would be lowered to approximately 8.5%, about half of the 16% homeowners paid a few years ago. The proposed program would be available to people in financial difficulties, AHFC officials say. The AHFC is already looking at 2,000 foreclosures.

UNITED BANCORPORATION ALASKA REPORTS \$32.2 MILLION LOSS: The parent company of the United Bank Alaska reports losses of \$32.2 million for last year, a figure which is \$6.4 million more than losses reported previously in an unaudited statement. The increase is attributed to the bank enlarging its reserves in preparation for possible future delinquent loans.

FAIRBANKS HOLDS PROPERTY TAXES, BUDGET: The Fairbanks Borough Administration has proposed a budget that contains no mill rate increase for property taxes; funds schools at current levels and cuts about \$3.4 million from spending. The budget depends on the new 2% sales tax to raise about \$7.2 million in new revenue. The locally funded share of the borough budget will go from 58.2% to 69.6%, making up for lost state and federal funds.

DIVIDEND TO RISE AFTER FUND STOCK SALE: Profits from the February sale of about one-third of the Alaska Permanent Fund Corporation's \$1.8 billion stock portfolio are not the \$290 million board members were hoping for, but are enough to increase 1987 dividends to about \$723, according to corporation spokesman Jim Kelly. The \$221 million profits from the sale also edged the earnings reserve account above \$500 million. By the end of this fiscal year the fund is expected to earn \$1 billion.

MORE CRUISE SHIPS TO VISIT SOUTHCENTRAL ALASKA: The Anchorage Convention & Visitors Bureau expects a 30% increase of cruise ships docking this year in the southcentral cities of Whittier, Seward and Anchorage with three ships - Explorer Starship, the Sea Princess and the Royal Princess - voyaging in the area for the first time. A total of 72 visits are scheduled for the region from May through September. 15% of all visitors to Anchorage are cruise ship passengers, and the significant increase in passengers is good news for hotels and retailers.

ALASKA "FRESH FROZEN" SEAFOOD PROMOTION: Evans-Kraft advertising agency of Seattle has been promoting Alaska "fresh frozen" seafood since last year throughout the United States for the Alaska Seafood Marketing Institute. The facts that Americans are now consuming 14.6 pounds of seafood a year, up from 12.5 pounds three years ago, and that fish contain the widely publicized "omega-3" fatty acids which are believed to reduce cholesterol levels in the blood are strong points in the sales pitch. The greatest problem now encountered in the sales of Alaska frozen salmon is the competition from fresh pen-raised Norwegian salmon which is being sold throughout the United States with a particularly strong market on the east coast. Evans-Kraft marketers have the task of convincing retailers and consumers that "fresh frozen" - if frozen properly - is as good as any fresh fish.

MORE SALMON FOR BRISTOL BAY THAN FIRST FORECASTED: Alaska Dept. of Fish and Game has added 700,000 salmon to its original bleak forecast of a 43% declined Bristol Bay salmon run. Still, the harvest will only be fair at an estimated 9.3 million fish catch, but with current prices at least as strong as last year's at \$1.50 to \$1.65 per pound, the Bristol Bay fishery could top an \$86 million value. Naknek river, opened to fishing last year for the first time, may be opened even earlier this year to setnetters and driftnetters.

The Alaska Economic Report

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Fisheries:

ASMI: Domestic Success

Alaska Seafood Marketing Institute's campaign to promote sales of Alaska pollock in three Midwestern target cities scored some notable success and proved the point that frozen Alaska whitefish sales have considerable potential for expansion. ASMI did the project under a federal fisheries grant, unfortunately not continued this year.

Denver, Chicago and Minneapolis were selected as test targets because ASMI had experience and market demographics from salmon promotions in those cities. Newspaper ads and in-store promotions were used. All of Denver's supermarkets participated, as well as 72.5% of Chicago's and 97% of Minneapolis stores. ASMI knows that at least 326,455 lbs. of pollock fillets moved in those markets during the promotions, but the actual volume is far higher because distributors and food stores keep such data confidential.

One Alaska company, Arctic Alaska Seafoods, reports it sold \$1.5 million in pollock due to the promotion, and expects sales of \$2.5 million to those markets this year, a residual effect of the project.

Probably of more importance is that several major food retailers are now stocking frozen Alaska pollock year-around, which will lay the base for long-term demand growth. Also, valuable data for future marketing strategy was gained in the project. Whitefish sales can successfully be targeted to lower-income families with a stress on price and taste, for example.

ASMI Seeks USDA Money

ASMI wants a \$3.5 million loan from the United States Department of Agriculture to promote Alaska seafood overseas. After the 1982 botulism scare, Alaska has lost more than 50% of its fish market in Europe. \$2.5 million would be dedicated to the promotion of Alaska frozen salmon in France, Belgium and the United Kingdom; and \$1 million would promote Alaska herring and pollock in Japan. Reclaiming the European market won't be easy with the prevalence of Norwegian and Scottish salmon. Europeans have already grown accustomed to the light-colored Atlantic salmon and have voiced suspicion over the dark red Pacific salmon meat. The federal government should lend a sympathetic ear to ASMI's request; The Department of Commerce has recognized the U.S.' \$5 million seafood deficit and has employed marketing experts in both Belgium and Tokyo to promote U.S. seafood.

Pacific Salmon Fishing Quota

The Pacific Salmon Commission has recommended to the U.S. and Canadian governments that the 1987 fishing quotas be about the same as 1986, with the addition of hatchery kings in Alaska waters. The governments will set the actual seasons under advice of detailed recommendations of the salmon commission, which will be worked out in a meeting next June. The addition of Alaska hatchery salmon could mean up to 22,050 chinook for Alaska fishermen.

Domestic Processing Zone

On April 13, North Pacific Fisheries Management Council (NPFMC) will release a study of the proposed domestic processing priority zone around Unalaska and Dutch Harbor for public review. The proposed zone would exclude foreign processing vessels from 100 miles off the coast in an effort to increase domestic processing. Most fishermen deliver to floating foreign processors rather than make the trip back to shore. Public comment and testimony will be accepted at the next NPFMC meeting in May. NPFMC will then vote on the proposition, and pass it on to National Oceanic and Atmospheric Administration for approval. The proposal is highly favored, and in keeping with the targeted phase out of foreign vessels from U.S. waters by 1991. Many other areas will undoubtedly propose local domestic zones, if this proves successful.

More Black Cod Fishing

More fishermen than ever are fishing for black cod, because of especially strong prices. At the beginning of the season, April 7, processors were paying up to \$1.38 per pound, \$1.13 per pound more than last year's best price. The North Pacific Management Council expects the season to be shorter than last because of the increase of effort.

Aquatic Farming (Cont'd from Pg. 3)

- Twenty five distributors in the survey purchased Atlantic salmon independent of the availability of wild Pacific salmon, and 18 purchased it when Pacific salmon were out of season. Five purchased no Pacific salmon, and five for only certain markets.
- Distributors reported they liked pen-raised Atlantic salmon because of its year-around availability, freshness, consistency and more uniform size. Pacific salmon were preferred at times because of price and color, firmness and less fat.

Senator —

10-130 Million FISH

ROBIN SAMUELSON — ~~was~~ opposed

- ① CANT BEFORE THE HOUSE. NORWAY —
DEPLETED THEIR STOCK — SAME WITH JAPAN.
COMPETITION — #1 CONFLICT WITH LIVELIHOOD.
PROTECT DOMESTIC FISHERIES — EXCLUDE FROM
FISHERY — ALASKANS ONLY.
DISEASE SPREAD TO DOMESTIC STOCKS —
B.B. EXCLUDED FROM TAKING PART ~~IN~~
23% # FOR PINK. (BB)
- ② TOM TILDEN — 3 CHILDREN — INTO FISHERY
EVOLUTION IN FISHING INDUSTRY — $\frac{1}{4}$ - $\frac{1}{2}$ MILLION
START UP — BB CANNOT PARTICIPATE — RESIDENT
PARTICIPATE — STATE PROVIDE BUCKS FOR SMALL
OPERATIONS — CUTS IN INCOME TO FISHERMEN I
- ③ JOE CLARK — LIFE LONG COMMERCIAL FISHERMAN —
THREATENED — SUPPORTS WILD STOCKS — NO
POSITIVE EFFECTS IN BB. FUNDING CUTS ~~==~~
- ④ JOE MCGILL — NOT IN FAVOR — BUT GOING
TO HAPPEN — NOT A MA & PA OPERATION —
COST VERY HIGH TO RAISE — RESEARCH BEFORE
WE GET INTO IT — NEED MONEY INTO BUDGET —
- ⑤ HARVEY SAMUELSON — OPPOSE BILL BECAUSE
ALASKA HAS FOR INDIVIDUAL PROFIT — NO WAY
TO PRICE OR POLICE THE INDUSTRY — SELFISH
DEVELOPMENT AND FISHING PLANT — NEED TO
REGULATE STREAMS —
- ⑥ NORMAN STADEM — ANCHORAGE — UFA
BOARD MEMBER — OPPOSE PEN REMOVAL
SESSION — LACK INFO ON IMPACT —

NORMAN STADEN —

STUDIES NEED TO BE MADE — TOLLY
SHOULD ASKED TO COMPILE INFO —
IDENTIFY PROBLEM WITH INFO NOW
AVAILABLE — BILL TOO VAGUE — NEED
STATE CONTROL IE FISH BOARD — NEED
BUDGET PREPARED UP — COULD BE BENEFICIAL
MUST KNOW WHAT RESULTS WOULD BE



① JOHN DOYLE — UOFA — VIEWS OWN...
NEED BILL SUCH AS THIS — NEED PATH
TO FOLLOW — REGULATORY IMPEDIMENT — DAIRY
FARM ROUTINE — COMING ANYWAY — 17 IN
MAINE ~~HOW~~ HOW ABOUT ASHES CAPACITY

② NELS ANDERSON JR. WE DON'T UNDERSTAND
THE ISSUE AT THIS POINT — STATE SHOULD
EDUCATE YOUNG TO GO FORWARD WITH PLANNING —
NOT ONLY ISSUE IN BB — DECLINING REV.
CAUSE DISRUPTION IN NATIVE STOCKS —
FISHERY IMPACTS IF BILL ADOPTED — CONCERN
ON F&G BUDGET AND REINFORCEMENT —
EQUITY FOR BB IN PROGRAM ~~KIDS~~ KIDS WRESTLE
WITH THIS = PROTECT WHAT WE HAVE NOW

③ REIDAR SILBERG — BB 1962 — LAST
NATURAL STOCKS IN WORLD — DAM ILLIANA
POWER SYSTEM — 200 MILLION FOR EX-USE/
FISHERMAN —

④ MITCH KING — ASMA — COMPETITION FOR
BB — BB NOT ALL SUBM & HANDY —
10% OF GROUNDS TAKEN UP — WILD
STOCK SHOULD HAVE REMARKS — DO NOT REALLY
RECOGNIZE THE TRUE VALUE OF OUR WILD
STOCKS.

Box 668
Wrangell, Alaska 99929
April 7, 1987

Gentlemen:

The following is a copy of my testimony given at the April 2, 1987 teleconference, which I want to share with you:

My name is Volney Smith, I, my wife and family have been commercial fishing for 16 years. We are members of the Seafood Producers Cooperative in Sitka, which has 250 members. I have been on the board of directors of this co-op for 4 years, and also on the marketing and quality control committees. I am very much aware of what good quality is, and where the world markets are for fresh and frozen salmon. I have been aware of Norwegian pen raised salmon for at least 3 years. I would like to shed some light on the origin of pen raised salmon. Norway used to have a large ocean going cod fishery as well as an Atlantic salmon fishery. They have overfished the cod on the Norwegian coasts, as well as the Atlantic salmon on the high seas. This latter being done mainly by the Danish drift gill-net fisheries.

Ten years ago the fishermen of this state voted themselves a 3% enhancement tax to start state hatchery programs. To date we haven't reached the maximum amount of high quality salmon and are still in the building mode. I must compliment not only the fishermen, but the state of Alaska as they now have probably the finest and most successful hatcheries in the world. As part of the fishing community, we have been catching some of these stocks as well as our natural stocks, which are worth millions of dollars to this state. At the beginning of our hatchery program, we decided not to have private (for) profit hatcheries, but to have just the opposite so as not to compete with the commercial salmon fisheries.

After learning of what has taken place in British Columbia this past year when the Norwegian government bought their way into the pen raised salmon business with 40 million dollars, I wonder what they are offering this fine state. Believe me, after listening to the biologist who testified yesterday, the so called "blue revolution" will not be what they say it will be. Anchorage should be well aware of what can happen in an oil glutted world market and should know what will happen if and when a world salmon glut happens. Vance Lipovsky predicts 1991 will be the first crash of the industry. Then the merger phase will begin and he expects to see bargain prices on both fish and fish farms within two years. He also states "in the next 3 or 4 years, B.C. will be the largest exporters of salmon to the U.S." In the March ASMI it states that in recent years Alaska has watched as it's share of the foreign

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market in both Europe and Japan eroded under pressure from Norwegian farmed salmon. The Norwegian Ministry of Fisheries funded \$175 million dollars in 1985 to support fish farms. In 1985 Alaska salmon was America's leading fish export, valued at \$614 million. Norwegian pen raised salmon is mounting a major assault on Alaska's market share. In 1975 Norway raised 1.9 million pounds of salmon. By 1985 it reached 75 million pounds. If Alaska doesn't do something to counter the Norwegian sales efforts Norway will capture the lions share of the European market by 1990. According to the U.S. Dept. of Commerce, in 1983 the U.S. was the leading supplier of fresh salmon to Japan, selling over 1200 tons of fresh fish to that country, or 94% of its total imports. By 1985 Norway replaced the U.S. as the leading fresh fish supplier of Japan. The threat to our market is very serious. We need to mount an aggressive sales campaign this summer and fall to help stem the tide or we may find ourselves without major markets for Alaska products.

In 1985 U.F.A. stated that pen raised salmon was a rapid growing industry and that it was already having impacts on traditional markets with an even greater market penetration in the future. They requested the state of Alaska to perform a thorough study of the biological, economic, and sociological problems and potentials of pen rearing in Alaska. To date no such impartial study has been done.

The potential for disease contamination of wild stock has not been explored at all. In 1985 Norwegian fish farms were forced to destroy 2900 metric tons of farmed salmon due to contaminated stock, but since Norway doesn't have a natural viable salmon run no one knows what effects this might have had on a natural run. This is a serious concern to the commercial fishing industry as well as the sports fishery. Many proponents of pen rearing salmon are touting the industry as one which can be done by small as well as large operations. They present it as a boost to the economy of Alaska coastal villages and suggest "mom and pop" operations can be successful. In fact current evidence indicates this is far from the case. Because of the high cost of fish food, brood stock and establishment of adequate transportation facilities, in addition to the length of time it takes to produce the first saleable product it will be almost impossible to succeed much less compete with an already highly subsidized Norwegian or Canadian product.

In closing I would like to point out that by telling the fisherman he must sell his 3% hatchery fry to a pen raiser only to directly compete with his ocean caught would be a crime against all that he stands for. As for the mariculture bill before the legislature you must separate mariculture from pen raised salmon. There is possible merit in the raising of shellfish, aquatic plant life, and existing salmon programs to accent our existing communities.

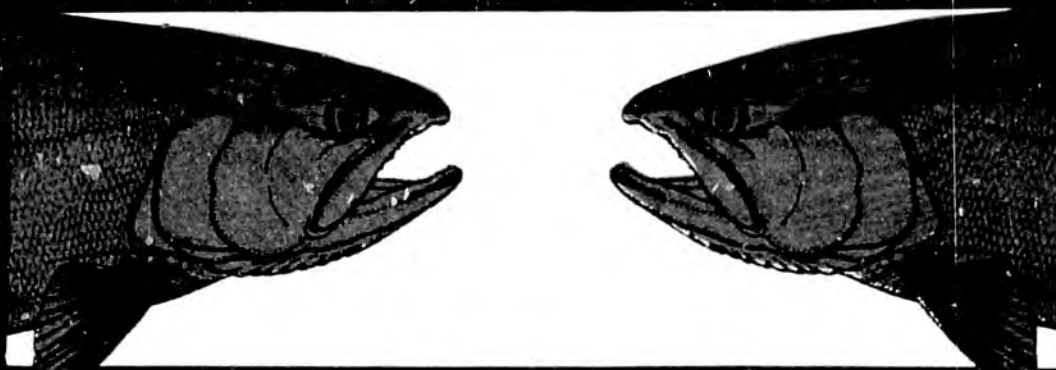
Madam chairman, members of the resource committee, and fellow listeners, this state has spent over 10 years and literally millions of dollars building, managing, and now hopefully promoting Alaska's natural wild salmon renewable resource. Nearly 45,000 people worked in last years 414 million dollar salmon harvest. As legislatures you should be looking at a possible state income tax for needed revenue. You should stand alongside of Alaska's leading employer and not allow pen raised salmon to undermine our most viable industry. At this time it would be extremely foolish for the State of Alaska to be lead blind folded down this path of pen raised salmon which is highly subsidized.

Thank you.

Sincerely,

Volney Smith

874-2497



**THE MARKETING RELATIONSHIP
BETWEEN
PACIFIC AND PEN-RAISED SALMON:
A SURVEY OF
U.S. SEAFOOD WHOLESALERS**

By Ronald V. Rogness
and
Biing-Hwan Lin

University
of
Alaska

Alaska Sea Grant
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Alaska Sea Grant College Program
590 University Ave., Suite 102
Fairbanks, AK 99709-1046

THE MARKETING RELATIONSHIP BETWEEN PACIFIC AND PEN-RAISED
SALMON: A SURVEY OF U.S. SEAFOOD WHOLESALERS

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INTRODUCTION

The Pacific salmon industry has become increasingly concerned about U.S. imports of fresh Atlantic salmon (Atlantics) from Norway: a product that has built a very strong niche in U.S. salmon markets. Industry members and policy makers are uncertain about how these imports will affect wild Pacific salmon markets.

The worldwide trend in pen-raised Atlantic salmon production is one of rapid increase. Table 1 shows the Norwegian production of Atlantics in the last five years and their projected production in 1990.

Table 1. Norwegian production of pen-raised Atlantic salmon (mt)

<u>Year</u>	<u>Production</u>
1981	8,422 ¹
1982	10,266 ¹
1983	17,016 ¹
1984	22,300 ²
1985	28,650 ²
1990 (projected)	80,000

¹ U.S. Department of Commerce, NMFS (1983)

² Michael Gordon, 1986 personal communication.

The fish are produced primarily for export, and the United States is the largest importer. Figure 1 shows imports of Norwegian pen-raised Atlantics into the U.S. from 1982 through 1985. The graph shows a substantial increase in imports for each of the last four years.¹ Note the annual upward shift during the late summer and early fall. This is when Pacific salmon reach the markets and when the potential for substitution between the pen-raised Atlantics and the Pacifics is the greatest.

Future production estimates indicate that we can expect continued increases in imports of both pen-raised Atlantic and Pacific salmon. In all, 21,742 mt of pen-raised Norwegian Atlantics were exported in 1985, 6,460 mt of which were sent to the U.S.² The Norwegian Fresh Fish Marketing Association predicts that by 1990 their total annual exports will reach 60,000 mt. If the ratio of U.S. imports to total exports remains constant, we can expect approximately 20,000 mt (44 million lbs) of pen-raised Atlantics imported into the U.S. in 1990. In addition, British Columbian salmon

¹ Norwegian Export Committee for Fresh Fish. 1982-1985. Statistikk: Markeder Eksport av Fersk Fish og Skalldyr.

² Ibid. 1985

Monthly Exports of Fresh Norwegian Pen-Raised Atlantic Salmon to the United States

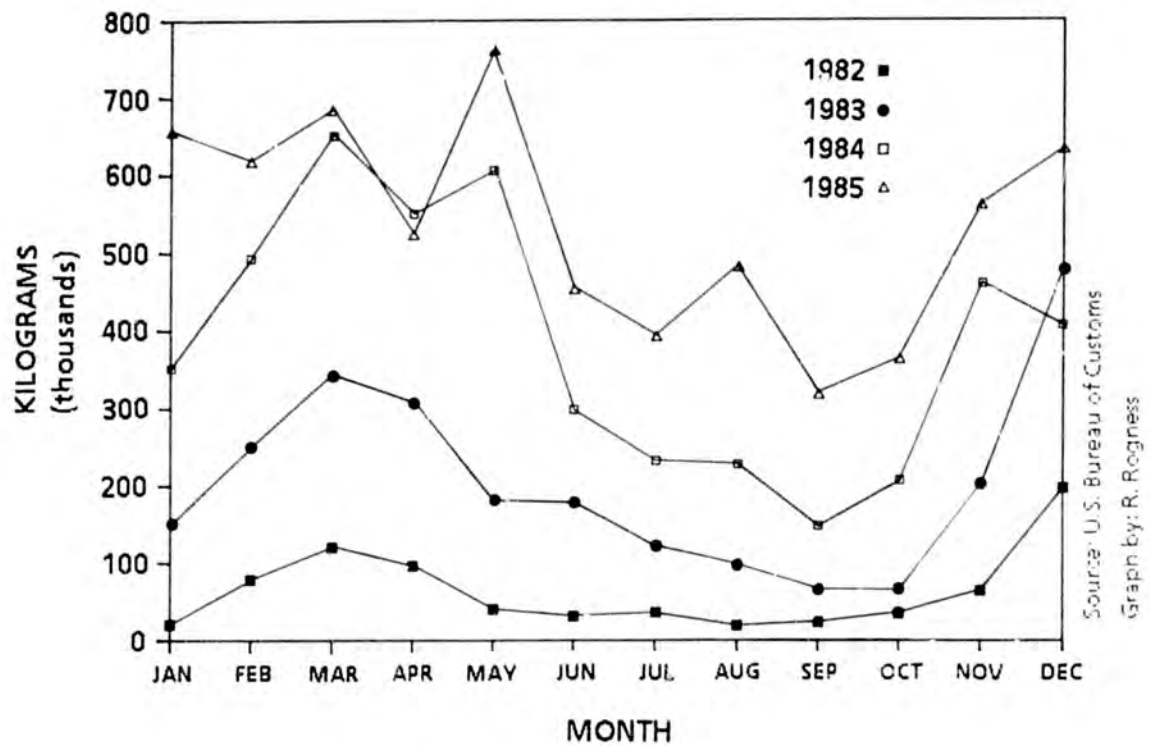


Figure 1.

farmers project they will export 22 million lbs (Atlantics and Pacifics) into the U.S. in 1990.³ Chile, Scotland and New Zealand are also anticipating major increases in their exports of pen-raised salmon to the U.S. as well. The total imports of pen-raised salmon into the U.S. will still fall substantially below the total wild Alaskan Pacific salmon harvest (729 million lbs in 1985). But these imports exceed recent Alaskan harvests of chinook and coho salmon (19 million lbs in 1985), thought to be the species most affected by increased imports of pen-raised Atlantics.⁴ These projected increases in imports highlight the importance of understanding how the fresh salmon market operates.

This report summarizes the results of a mail survey about marketing pen-raised salmon in the U.S. By conducting this survey we hoped to:

- * Obtain the seafood marketers' opinions of the substitutability between pen-raised and wild salmon in the U.S.
- * Understand the factors promoting pen-raised salmon marketing in the U.S.
- * Obtain the seafood marketers' assessments of the future marketing development of pen-raised salmon in the U.S.

This survey is part of an ongoing Alaska Sea Grant project, "Economic Impact of Farmed Salmon Upon the Alaskan Commercial Fishing Industry." In addition to this survey, an econometric analysis is being performed to estimate the cross-price elasticity between pen-raised Atlantic salmon and wild Pacific salmon, and other demand elasticities in the U.S. and European markets. Monthly data on salmon exports from the U.S., Canada and Norway from 1982 to 1985 are used in a market share approach. The econometric analysis should be completed in 1986. Because worldwide marketing of pen-raised Atlantic salmon is recent, the survey approach and the econometric study will produce complimentary results.

This survey was conducted jointly by the Alaska Sea Grant College Program and the School of Management at the University of Alaska, Fairbanks. On July 31, 1985 the Alaska Sea Grant College Program sent questionnaires to 925 seafood wholesalers and distributors listed in the Yellow Pages for Boston, New York, Chicago, Los Angeles, San Francisco and Seattle. It was impossible to determine from

³ Michael Gordon, March 3, 1986 personal communication

⁴ Alaska Department of Fish and Game. 1985. Preliminary 1985 harvest, by region, by species: 1985 ADF&G Salmon Season Summary.

Alaska Sea Grant College Program

PUBLICATION ANNOUNCEMENT

TITLE: "The Marketing Relationship Between Pacific and Pen-raised Salmon: A Survey of U.S. Seafood Wholesalers" AK-SG-86-03

AUTHOR: Ron V. Rogness and Bing-Hvan Lin

TOPIC AREA: Fisheries Resources: Economics

PAGES: 27 **FIGURES:** 1 **TABLES:** 1

PUBLISHED: September, 1986

PRICE: \$5.00 (plus 2.00 shipping per order)

ABSTRACT

The Pacific salmon industry has become increasingly concerned about U.S. imports of fresh Atlantic pen-raised salmon, a new product that has built a very strong niche in traditional U.S. salmon markets. In 1985, researchers conducted a survey of U.S. fish wholesalers to determine their attitudes on three areas: substitutability between pen-raised and wild salmon in the U.S., what factors are promoting pen-raised salmon marketing in the U.S., and their assessment of the future marketing development for pen-raised salmon in the U.S. This report contains the results of the survey returns, in which about 24 percent of those receiving surveys responded. The sample includes both firms that have sold Pacific salmon and those that have not.

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the listings whether or not the individual firm had handled pen-raised salmon, so two different questionnaires (see Appendix) were sent out to each firm. One questionnaire was for firms that handled or handle pen-raised salmon. The other was for those firms that had not ever handled pen-raised salmon.

Of the 925 firms, 127 returned their questionnaires, about 24 percent. Seven of these returned questionnaires were not used. Of those seven, five were returned blank, and two firms answered both questionnaires. Among the usable questionnaires, 63 were from firms that have handled pen-raised salmon, and 57 from firms that have not. Even though the return rate of 24 percent is less than expected, the budget did not allow for follow-up letters.

This report has two sections. In the first, survey results are reported for firms that have handled pen-raised salmon. In the second section are the results from firms that do not handle pen-raised salmon. For discussion, each question is restated (with some format modifications) first, followed by a short numerical summary of the result. Then the question is justified, followed by an interpretation of the results and how they compare with our expectations.

SECTION I

SURVEY RESULTS FROM FIRMS THAT HANDLE PEN-RAISED SALMON

QUESTION 1

1. Please designate which type(s) of pen-raised salmon your firm has distributed or currently distributes.

<u>Type</u>	<u>Responses</u>
Norwegian Atlantic	59
Pan-sized coho	30
Scottish Atlantic	20
Domestic Atlantic	13
Other Atlantic	12
New Zealand	3
Chilean	1

This question confirms the sources of supply and their relative importance in terms of the number of distributors. Norwegian Atlantics are the the major supply of pen-raised salmon, by a large margin. Fifty-nine of the 63 respondents indicated that they received at least part of their supply from Norway. The next major supplier of pen-raised salmon are the producers of pan-sized coho. These salmon are raised in the Pacific Northwest of the U.S. and in British Columbia. The other major supplier is Scotland. The Chilean product is pen-raised coho, which is notably larger than the pan-sized coho.

The results conform to expectations. Norway has been and will continue to be the world's leading producer of pen-raised salmon. In 1985, the Norwegians exported over 47 million lbs of pen-raised Atlantics with just over 14 million lbs exported to the United States. It is reasonable that the second major exporter of Atlantics is Scotland, since it was the second country to initiate commercial pen-raising. It is surprising that quite a few respondents have distributed domestically-raised Atlantic salmon. The suppliers would have to be in New England since the West Coast producers of pen-raised Atlantics had not yet marketed their fish when this survey was conducted. The large number of firms handling pan-sized cohos seems reasonable since Dom-Sea and some of the other producers around Chehalis, Washington have been marketing their product since the late 1970s.

QUESTION 2

2. Please indicate the range of values in which your firm's total sales belong.

<u>Range</u>	<u>Responses</u>
Less than \$10 million	39
Greater than \$25 million	12
\$10 million to \$25 million	11

By combining this question with others, we hoped to detect any patterns in distribution linked to the firms' sizes. The results show that the majority of firms are relatively small, with sales less than \$10 million. The remainder are evenly divided between medium-sized firms with sales between \$10 and \$25 million dollars and large firms. These size categories were taken from a survey of seafood distributors and wholesalers done by the West Coast Fisheries Development Foundation.

QUESTION 3

3. If your firm has bought and sold pan-sized coho salmon, do you consider it a legitimate substitute for fresh or frozen wild Pacific salmon?

<u>Product Type</u>	<u>Response</u>		
	<u>Yes</u>	<u>No</u>	<u>No Response</u>
Fresh	5	25	1
Frozen	2	27	

Question 3 is the first of a series of three questions pertaining to substitutability between pen-raised and wild Pacific salmon. The overwhelming majority of them do not feel that the pan-sized cohos are substitutes for either fresh or frozen wild Pacific salmon. The results are consistent with our expectation. In discussions with

industry, the majority opinion has been that pan-sized cohos fill the same market niche as do pond-raised rainbow trout. Neither of these products compete directly, it is felt, with the larger Pacific salmon. Therefore, recent or further development in raising pan-sized cohos should not have any immediate economic affect on the Pacific salmon fishing industry.

Question 4

4. If your firm has bought and sold fresh, pen-raised Atlantic salmon, do you consider it to be a legitimate substitute for fresh or frozen wild Pacific salmon?

<u>Product Types</u>	<u>Responses</u>	
	<u>Yes</u>	<u>No</u>
Fresh	49	13
Frozen	15	42

This was one of the most important questions in the survey. It was to determine if firms that have handled pen-raised Atlantic salmon think fresh pen-raised Atlantics are substitutes for wild fresh or frozen Pacific salmon. We felt that these firms might be substituting the products for one another and, if the substitution occurs at the retail level, that they would be aware of it and would adjust their product line accordingly.

The results indicate that the majority of distributors of pen-raised Atlantic salmon believe that fresh Atlantics can compete with fresh Pacific salmon. If these responses truly represent the situation, the results are significant to Alaskan salmon fishermen. Very little of the Alaskan salmon harvest is marketed fresh. The Alaska Seafood Marketing Institute roughly estimates that 3 percent of the market share is for fresh product. Outside of troll-caught chinook and coho, the only other significant quantity of salmon marketed fresh seem to be the Copper River sockeye catch. This means that 97 percent of the harvest, roughly 707 of the 792 million lbs of salmon harvested in Alaska in 1985, would be more or less unaffected by the sales of pen-raised Atlantics. However, a significant portion of troll-caught chinooks and cohos from Southeastern Alaska is frozen and marketed to white tablecloth restaurants, which are one of the primary markets for fresh pen-raised Atlantic salmon. The 15 votes for substitutability between fresh Atlantic and frozen Pacific salmon should therefore not be discounted as unimportant. Nevertheless, the results seem to suggest that some of the concern about pen-raised salmon imports shown by Alaskan commercial salmon fishermen may be somewhat unwarranted.

Question 5

5. If your firm has bought and sold frozen, pen-raised Atlantic salmon, do you consider it to be a legitimate substitute for fresh or frozen wild Pacific salmon?

<u>Product Type</u>	<u>Responses</u>	
	<u>Yes</u>	<u>No</u>
Fresh	15	24
Frozen	13	24

This question may not be as important as Question 4 since the quantity of frozen pen-raised Atlantic imports does not rival the quantity of fresh Atlantic imports. In 1985, Norway exported just over 130,000 lbs of frozen pen-raised salmon compared to the 47 million lbs of fresh Atlantics. For this reason, fewer firms answered this question although interesting results have emerged from it.

Even though the majority of the respondents felt that frozen pen-raised Atlantics do not substitute for either fresh or frozen wild Pacific salmon, these results are not as conclusive as those of Question 4. There is a possibility of market competition between frozen Atlantic and Pacific salmon implied in the results. Therefore, an increase in imports of frozen Atlantics could affect the price of Pacific salmon.

The combined results of Questions 4 and 5 seem to indicate that distributors of pen-raised Atlantic salmon are conscious of seafood freshness and are impressed with the freshness of the pen-raised Atlantics. This observation is reinforced in Question 13.

Question 6

6. What year did your firm start buying and selling fresh pen-raised Atlantic salmon?

<u>Year</u>	<u>Responses</u>
1974	1
1979	2
1980	9
1981	9
1982	19
1983	8
1984	8
1985	2

This question analyzed the pattern of growth in the number of firms handling pen-raised salmon. The results are quite interesting. One firm started handling pen-raised Atlantic salmon as early as 1974. This date seems early and may be incorrect. The next year any of the respondents started was

1979. Nine started in both 1980 and 1981. In 1982, the largest number of respondents starting selling pen-raised salmon.

After 1982, however, the number of firms starting to buy and sell pen-raised salmon began to decrease. We had anticipated a steady increase, reflecting the increase in imports. U.S. imports of Norwegian pen-raised salmon were 90,076; 335,713; 721,476; and 1,155,752 lbs for 1982, 1983, 1984 and 1985, respectively. If the responses are indicative of the industry, we would expect that those firms already handling the pen-raised product experienced substantial sales increases. This could have resulted from exclusive contracts with producers and importers, or simply from the increases in sales within the existing markets.

Question 7

7. Please estimate your annual percent change (+ for increase and - for decrease) in sales of fresh, pen-raised Atlantic salmon for the following years:

+14.3 percent change from 1982 to 1983
+22.3 percent change from 1983 to 1984
+30.3 percent change from 1984 to 1985

This question was designed to find out the growth or decline in sales of those firms that have handled pen-raised salmon. A growth in sales and an increase in the number of firms mean that the market of pen-raised Atlantics is expanding.

Results of this question confirm that on average these companies experienced substantial growth in their business involving pen-raised Atlantic salmon. The annual rate of growth increased steadily from 1982 through 1985. It was thought that firms of different sizes might have experienced different growth rates. To find out, we divided the responses using the size categories established in Question 2 (Table 2).

Table 2. Increases in sales of fresh, pen-raised Atlantic salmon for firms of various sizes¹

Period of Change	Percent Change		
	Small Firms	Medium Firms	Large Firms
1982 to 1983	11.9	12.9	23.3
1983 to 1984	20.8	21.2	26.5
1984 to 1985	33.6	26.4	23.3

¹ Small firm = less than \$10 million in annual sales
Medium firm = \$10 to \$25 million in annual sales
Large firm = more than \$25 million in annual sales

The smaller firms have grown the fastest only in the last year. Before that, the growth rates were directly related to the firm's size. We cannot determine if they have taken over a larger market share since we only know the percent increase and not the absolute amounts.

Question 8

8. Was your firm's decision to buy and sell fresh, pen-raised Atlantic salmon based on requests to distribute the product from:

<u>Requests Generated By</u>	<u>Responses</u>
Brokers or importers	26
Retailers	24
Yourselves	12
Fishermen (fish farmers)	5
Wholesalers	4
Customers	1
Resort, Country Club, Hotel	1

Question 8 was used to pinpoint who initiated the respondents' handling of pen-raised salmon. If the action was based on demand from customers, it indicates that demand for the product already existed. If the action was based on requests from producers or importers, it indicates that demand for the product was not yet formed.

The results show a fairly even split. From the supply side, 26 started handling pen-raised salmon based on suggestions from brokers or importers and five started upon suggestions from producers of pen-raised salmon. From the demand side, 26 started because of retail demand. This is the sum of the different types of customers mentioned. Also, 12 started handling the product on their own initiative and four started based on suggestions from wholesalers. The wholesalers could be either demand or supply initiated depending on the market level of the respondent.

In order to see how the market has evolved (whether it is supply or demand led), the responses to Question 6 were categorized accordingly. First, the possible responses to Question 11 were combined to make three general categories. Those that selected retailers, resorts, country clubs, hotels, and customers were combined to make the demand-initiated category. Those that selected brokers, importers or fish farmers were combined to make the supply-initiated category. The 12 who started handling pen-raised salmon on their own comprised the last category. The four respondents who started handling it because of requests from other wholesalers and retailers were left out because we could not determine whether they were supply- or demand-initiated.

Table 3. Comparison of years when companies began selling Atlantics and who requested the fish

Year	Demand initiated	Supply initiated	Self
1974	0	0	1
1979	1	1	1
1980	3	5	3
1981	3	7	2
1982	9	10	3
1983	5	5	2
1984	2	3	0
1985	2	0	0

We hypothesized that the producers, importers and brokers would need to promote a new product to the wholesalers, retailers and consumers. Once consumers were introduced to the product, then their requests would drive production and entry of new companies into the market. Although not conclusive, Table 3 shows that until 1982, more wholesalers started to handle pen-raised Atlantics because of broker and producer requests than because of consumer and retailer requests. After 1982 however, the market matured somewhat and more wholesalers entered the market because of requests from consumers and retailers.

Question 9

9. Which of the following best describes your firm's purchases of fresh, pen-raised Atlantic salmon?

<u>When Purchased</u>	<u>Responses</u>
Independent of the availability of fresh Pacific salmon	25
When fresh Pacific salmon is not available	18
In place of Pacific salmon for all markets	4
In place of Pacific salmon for the following markets:	5
Restaurants	4
Retail	4
Seafood Markets	4
Other wholesalers	4

This question attempts to verify whether the respondents actually substitute pen-raised salmon for wild Pacific salmon in any or all markets. It allows us to rank firms' degree of belief in the substitutability of these two

species of salmon, while the Question 4 solicited a firm's general opinion regarding substitutability.

Eighteen respondents purchase Atlantic salmon only when fresh Pacific salmon is not available and these firms seem to have a strong commitment to or preference for Pacific salmon. Because 49 of the 62 firms from Question 4 believe that fresh Atlantic salmon are substitutes for fresh Pacific salmon, some of these 18 firms believe that these two species are competing for consumers' dollars to some extent. These firms generally increase the availability of fresh salmon by offering fresh Atlantics when fresh Pacific salmon is not available. If this marketing practice is continued, the fresh Atlantic salmon will contribute toward consumers' demand for all fresh salmon by increasing their exposure to fresh salmon. When this is the case, pen-raised Atlantics can be regarded as a complement of Pacific wild salmon.

Twenty-five firms have purchased fresh Atlantic and Pacific salmon simultaneously, apparently in order to increase their line of products. These firms are more likely to substitute Atlantic for Pacific salmon than those in the first group, since they are willing to place the products on the market at the same time.

Five firms have substituted Atlantic salmon for Pacific salmon in certain markets. Four of them do so in their dealings with restaurants, retail seafood market and other wholesalers, respectively. These five firms, together with the next group of firms, are strong advocates of Atlantic salmon. The next group contains five respondents who have completely substituted Atlantic salmon for Pacific salmon.

In summary, 18 firms are committed to marketing Pacific salmon and 5 of them believe that the two salmon are substitutes; 25 firms not only believe in substitutability between these two salmon, but also market both salmon simultaneously; 9 firms strongly believe that Atlantic salmon are superior to Pacific salmon, at least in certain markets.

Question 10

10. Please estimate the average composition of your annual sales of fresh, pen-raised Atlantic salmon by category of retailers as a percent of the total.

<u>Market</u>	<u>Percent of Total Annual Sales¹</u>
Restaurants	42.3
Other wholesalers	28.8
Retail seafood markets	19.1
Supermarkets	5.5
Others	4.7

¹ Percentages for the "average" respondent

Here we intend to verify the contention that the restaurant trade, particularly the white tablecloth segment, is the primary market for pen-raised Atlantic salmon. As the responses show, the average respondent sells 42.3 percent of his/her Atlantic salmon product to restaurants. The average distributor sells a large percentage of the product to other wholesalers. This would indicate that some of the respondents are brokers rather than wholesalers. Thus, this percentage is high not because many firms sold both to other wholesalers and retailers, but because a few firms sold only to wholesalers. The other major type of market was retail seafood. Many of these shops specialize in fresh seafood, and thus are naturally well-suited for the fresh Atlantic product. Although supermarkets do not currently account for a large portion of the total harvest sold, they are a market with potential that we expect will be targeted for expansion soon.

Question 11

11. Please estimate the average composition of your total annual sales of fresh, pen-raised Atlantic salmon by seasonal percent of total.

<u>Season</u>	<u>Percentage of Total</u>
Winter (Dec.-Feb.)	43.7
Summer (June-Aug.)	10.1
Spring (March-May)	23.1
Fall (Sept.-Nov.)	23.0

This question is designed to determine the seasonal variation of imports into the U.S. by requesting the percentage of composition by season. The response is consistent with the general pattern of Norwegian exports to the U.S. The mean responses confirm that the largest quantities were sold in the winter. The sales of pen-raised salmon dropped sharply to about 20 percent in the spring and then bottomed out at about 9 percent in the summer, when Pacific salmon begins to reach market. In the fall, the sales of pen-raised Atlantic salmon moved back up to their spring level.

Because Norwegian salmon imports have increased substantially and will likely continue this trend, the seasonal pattern in the supply of Norwegian Atlantics may vary. If distributors sense possible consumer resistance to high price and large volume in a particular season, they may alter their distribution pattern. In any event, we do not expect a big push in the sales of Atlantics during the Pacific salmon season. Fresh Atlantic salmon commands a high price mainly because of its quality advantage when the Pacific salmon season is closed. In order to confirm this, we asked a follow-up question.

Question 12

12. Does your firm plan to increase its distribution of fresh, pen-raised Atlantic salmon?

Yes	45
No	9

If yes, does your firm plan to?

Maintain current seasonal distribution pattern?	30
Concentrate more distribution during winter and spring?	12
Concentrate more distribution during summer and fall?	3

This question solicits distributors' opinion on the market condition for pen-raised Atlantics. Because the supply of pen-raised Atlantics will be increased, distributors will make their business decision based upon the strength of demand in each season. According to the results, 45 firms are optimistic about the market for Atlantic salmon and plan to increase their distribution. Nine firms do not plan to increase their distribution of Atlantic salmon. These firms are not necessarily pessimistic about the market for Atlantic salmon, they may have other difficulties (such as capital and capacity constraints) in increasing their distribution. In short, the market for Atlantic salmon will continue to grow.

It is interesting to note the direction of growth in terms of seasonal marketing pattern. Of the 45 firms that plan to increase their future distribution, 30 plan to maintain current seasonal marketing pattern. In economic terms, these 30 firms indicate an equilibrium in marketing pattern; that is, the demand price elasticity is roughly the same across the four seasons. In this case we would expect heavier competition between Atlantic and Pacific salmon. Twelve firms plan to increase the proportion of their sales during winter and spring. These firms believe that it is not worthwhile to compete directly with fresh Pacific salmon for the consumer's dollar. Again, in economic terms, these firms believe that the demand for Atlantic salmon in the summer and fall is more price elastic than in the winter and spring. In other words, the same proportional increase in all seasons will depress price more during summer and fall than in the spring and winter.

Only three firms plan to increase the proportion of their sales during summer and fall. These firms are either greatly impressed with the marketability of Atlantic salmon or they do not perceive a direct competition between the two species.

Questions 13 and 14

13. What advantages does the fresh, pen-raised Atlantic salmon have over the fresh, wild Pacific salmon?

<u>Advantage</u>	<u>Responses</u>
Year-round availability	28
Freshness	26
Consistency	19
Size	12
Price	11
Longer shelf life	5
None	4

14. What advantages does the fresh, wild Pacific salmon have over the fresh, pen-raised Atlantic salmon?

<u>Advantage</u>	<u>Responses</u>
Price	24
Flesh characteristics (color, firmness, less fat)	19
No advantage	8
Large fish	5
Volume	2
Ease of ordering	1
Never had any fresh Pacific salmon	1

The survey concluded with these two open-ended questions regarding the relative advantages of these two species of salmon. Question 13 solicits the distributors' opinions on the advantages enjoyed by the Atlantics. The advantages most often mentioned were the year-round availability and freshness or quality. Consistency also scored highly with 19 votes. It is not apparent whether they meant consistency of product availability or consistency in quality. Twelve firms enjoyed the ability to order fish of uniform size rather than just taking what they could get. Therefore, a better grading system may improve U.S. processors' business.

As mentioned, Atlantic salmon enjoys a price premium over its Pacific counterpart. Therefore, we were surprised, and do not know how to interpret, that 11 firms indicate a price advantage for Atlantic salmon. Five respondents mentioned the longer shelf-life of Atlantics. This is due to its rapid shipment (often within 24 hours) from producers to retailers. Finally, four respondents did not recognize any superiority of the Atlantic salmon over the Pacific salmon.

Question 14 asked what advantages fresh Pacific salmon possesses over the pen-raised Atlantics. Twenty-seven firms indicate that Pacific salmon has a price advantage. Seventeen firms out of this group listed price as the only advantage. The next most-mentioned advantage was flesh characteristics, including color, firmness and lower fat

content. As U.S. consumers become more health conscious, the Pacific salmon industry may want to use this advantage in sales promotion. Eight respondents did not recognize any advantage enjoyed by the Pacific salmon. Five felt that the ability to obtain large fish (greater than 12 lbs) was an advantage of Pacific salmon. Two felt that the ability to obtain a large volume of wild Pacific salmon was an advantage. One might expect that as worldwide production of pen-raised Atlantic salmon increases, this advantage enjoyed by Pacific salmon will not be sustained.

In summary, the most important point discovered in this survey is that the majority of wholesalers and distributors who handle pen-raised salmon feel that product only competes with fresh, wild Pacifics (Question 4). This may lessen the impact of pen-raised Atlantics on Alaskan fishermen, but may affect the Pacific Northwest and British Columbian salmon fisheries that sell a higher percentage of fish in fresh markets.

It also seems that the number of firms handling pen-raised Atlantics is still increasing but the growth is slowing, with each firm increasing its purchases of Atlantics (Questions 6 and 7). These firms expect to continue increasing these quantities in the near future, but will continue to concentrate at times of the year when wild fresh Pacific salmon is not available (Question 12).

SECTION II: SURVEY RESULTS FROM FIRMS THAT DO NOT HANDLE PEN-RAISED SALMON

The second questionnaire was directed to those who do not handle pen-raised salmon. Fifty-seven firms responded to this part of the survey. Because these firms do not actually handle pen-raised salmon, many of these returned questionnaires are not as complete and thus are less informative.

Question 1

1. Does your firm distribute fresh or frozen Pacific salmon?

Yes	27
No	28
No answer	2

This question allows us to separate the respondents according to whether they have engaged in salmon marketing. By asking this question, we hope to detect any differences in answering the Question 2 by these two groups of distributors.

Question 2

2A. Has your firm considered or would it consider substituting fresh, pen-raised Atlantic salmon when both are available?

Yes	11
No	16

2B. What if fresh Pacific salmon were not available?

Yes	18
No	6

These questions are designed to find out distributors' readiness to market fresh pen-raised Atlantic salmon and their opinion regarding the substitutability of Atlantic salmon for Pacific salmon. For our purposes, these questions are meaningless for those who do not distribute Pacific salmon. Therefore, we only analyzed the results from distributors of Pacific salmon. Among those firms that distribute Pacific salmon, 11 would consider substituting Atlantic salmon for Pacific salmon when both are available, while 18 firms would do so when fresh Pacific salmon were not available. Of the same group of respondents, 16 would not substitute Atlantic salmon for Pacific salmon when both are available, while only six would not do so when fresh Pacific salmon were not available.

The results suggest that a substantial number of salmon distributors are considering marketing fresh Atlantic salmon. Therefore, we may expect a continuous growth in the number of distributors of Atlantic salmon in the near future. Since existing distributors of Atlantic salmon have experienced a growth in sales over time, we are likely to see a continuous increase in imports of pen-raised Atlantic salmon. It should be noted, however, that quite a few distributors of Pacific salmon are still committed to marketing their product. This is expected because it takes time for a new product to penetrate a well-established market.

Question 3

3A. Has your firm had requests from retailers to purchase pen-raised fresh Atlantic salmon?

Yes	5
No	42
No answer	8

3B. Has your firm had requests from brokers or importers to purchase their pen-raised fresh Atlantic salmon?

Yes	16
No	33
No answer	8

This set of questions is designed to find out whether the supply side or the demand side is more active in marketing pen-raised Atlantic salmon. Clearly, the suppliers are taking the initiative in marketing pen-raised Atlantic salmon. The results indicate that 21 firms have received and declined requests from either the demand or the supply side for marketing pen-raised salmon. From the previous question, we learn that quite a few firms are almost ready to market Atlantic salmon. Therefore, it is interesting to find out the reasons for not handling pen-raised Atlantic salmon. This is the rationale for asking the next set of questions.

Question 4

4A. If you answered "no" to both 3A and 3B, why has your firm decided not to purchase pen-raised Atlantic salmon?

<u>Reason</u>	<u>Responses</u>
Don't handle salmon	13
No demand	12
Prefer Pacific salmon	3
Handle only frozen salmon	2
Economically tied to Pacifics	2

Question 4 is an open-ended question and responses were summarized into groups. Because 42 firms have not received requests from the demand side, it is understandable that many perceive no demand for Atlantic salmon. Thirteen firms do not handle salmon and have not received requests for marketing salmon, therefore they have good reasons for not handling Atlantic salmon. Five firms either have a strong preference for or commitment to marketing Pacific salmon. Two firms handle frozen salmon only and one firm did not know much about pen-raised Atlantic salmon.

- 4B. If you answered "yes" to either 3A or 3B, why didn't your firm purchase pen-raised fresh Atlantic salmon?

<u>Reasons</u>	<u>Responses</u>
Prefer Pacific salmon	3
Price is too high	3
No request	3
Too busy	1

Of those respondents that had turned down requests to handle pen-raised Atlantic salmon, three did so because the price of Atlantic salmon is too high, and one is too busy to handle it. Three said that they did not handle Atlantic salmon due to no requests. These three respondents should not have answered this question. Because at least 16 firms have received requests for marketing Atlantic salmon and we only received seven reasonable responses, we therefore believe that information collected in this part is incomplete and less useful.

Question 5

5. Under what conditions might your firm consider distributing pen-raised Atlantic salmon?

<u>Condition</u>	<u>Responses</u>
None	8
If receive requests	7
If handle salmon	6
If do not get Pacific salmon	6
If available	3
If consistent supply available	3
If price comes down	1

Question 5 is open-ended and its results were summarized into groups. This question sought to uncover any changes in the market conditions required to induce firms to distribute pen-raised Atlantic salmon.

Eight firms indicate a strong loyalty to Pacific salmon, by stating that they would not handle salmon under any circumstances. The remainder of the firms indicate that if conditions change they would initiate the product in their line, another reason we might expect the number of firms handling pen-raised salmon to increase.

Question 6

6. Please place a check by the range of values in which your firm's total sales belong.

<u>Range</u>	<u>Responses</u>
Less than \$10 million	25
\$10 million to \$25 million	6
Greater than \$25 million	12

This question was also asked of firms that handled pen-raised salmon (Section 1). We posted this question here in order to help determine if the size of firm affects responses. Fourteen firms chose not to answer this question. Of those that did, 25 are classified as small, 12 as medium and 6 as large. Compared with the respondents in Section I, the same percentage of small firms, a higher percentage of medium firms and a lower percentage of large firms participated in this part. Given the small number of respondents, these differences may not be significant.

Although not as informative as the other survey, these results indicate that the main reasons for not distributing pen-raised Atlantics are a lack of requests and a lack of knowledge of the pen-raised product. We might expect that as the production increases and the market matures, these reasons might diminish and we can expect to see continued new entrants in the business of distributing pen-raised Atlantic salmon.

CONCLUSION

In summary, it is likely that both the number of distributors and imports of pen-raised Atlantic salmon will continue to grow in the U.S. Furthermore, a substantial number of firms do not rule out substituting fresh Atlantic salmon for fresh Pacific salmon. Because about 97 percent of the salmon catch in Alaska is marketed frozen, the continuous growth of a fresh pen-raised Atlantic salmon market in the U.S. may immediately impact only a small portion of the Alaskan salmon industry. However, the Alaskan salmon industry should pay close attention to development of the Atlantic salmon market. The marketing relationship between Atlantic and Pacific salmon can change, especially when there is a glut in the supply of pen-raised Atlantic salmon. Therefore, research in this area should continue.

This survey used an indirect method to gain an understanding of future market growth in the pen-reared salmon market. The econometric study conducted in conjunction with this project should provide direct assessment of consumer and retailer attitudes about these salmon product forms. Again, because of the economic importance of salmon resources in Alaska and the rapid developments in producing and marketing pen-raised Atlantic salmon, future economic analysis of the salmon market is warranted.

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APPENDIX

Alaska Sea Grant College Program
Survey of Seafood Wholesalers Who Do Not Distribute Pen-Raised Salmon

1. Does your firm distribute fresh or frozen Pacific salmon? ___ yes ___ no

- 2.a. Has your firm considered or would it consider substituting fresh, pen-raised Atlantic salmon for fresh Pacific salmon when both are available? ___ yes ___ no
- b. What if fresh Pacific salmon were not available? ___ yes ___ no

- 3.a. Has your firm had requests from retailers to purchase pen-raised fresh Atlantic salmon? ___ yes ___ no
- b. Has your firm had requests from brokers or importers to purchase their pen-raised fresh Atlantic salmon? ___ yes ___ no

- 4.a. If you answered "no" to both 3(a) and 3(b), why has your firm decided not to purchase pen-raised Atlantic salmon?

- b. If you answered "yes" to either 3(a) or 3(b), why didn't your firm purchase the pen-raised fresh Atlantic salmon?

5. Under what conditions might your firm consider distributing pen-raised Atlantic salmon?

6. Please place a check by the range of values in which your firm's total sales belong.
___ Less than \$10 million ___ \$10 million to \$25 million ___ Greater than \$25 million

Alaska Sea Grant College Program
Survey of Seafood Wholesalers Distributing Pen-Raised Salmon

1. Please designate which type(s) of pen-raised salmon your firm has distributed or currently distributes, by placing a check next to the appropriate type(s).
- | | | |
|---|--|---|
| ☐ Norwegian Atlantic | ☐ Scottish Atlantic | ☐ Other Atlantic |
| ☐ Domestic Atlantic | ☐ Pan-sized Coho | |
2. Please place a check by the range of values in which your firm's total sales belong.
- ☐ Less than \$10 million ☐ \$10 million to \$25 million ☐ Greater than \$25 million
3. If your firm has bought and sold pan-sized, pen-raised Coho salmon, do you consider it a legitimate substitute for fresh or frozen wild Pacific salmon?
- Fresh: ☐ yes ☐ no
Frozen: ☐ yes ☐ no
4. If your firm has bought and sold fresh, pen-raised Atlantic salmon, do you consider it to be a legitimate substitute for fresh or frozen wild Pacific salmon?
- Fresh: ☐ yes ☐ no
Frozen: ☐ yes ☐ no
5. If your firm has bought and sold frozen, pen-raised Atlantic salmon, do you consider it to be a legitimate substitute for fresh or frozen wild Pacific salmon?
- Fresh: ☐ yes ☐ no
Frozen: ☐ yes ☐ no
6. What year did your firm start buying and selling fresh, pen-raised Atlantic salmon?
- _____
7. Please estimate your annual percent change (using + for increase, - for decrease) in sales of fresh, pen-raised Atlantic salmon for the following years:
- ☐ % Change from 1982 to 1983
☐ % Change from 1983 to 1984
☐ % Change from 1984 to 1985
8. Was your firm's decision to buy and sell fresh, pen-raised Atlantic salmon based on requests to distribute the product from:
- ☐ Retailers ☐ Brokers or Importers ☐ Other (specify) _____

9. Which of the following best describes your firm's purchases of fresh, pen-raised Atlantic salmon?

☐ We purchase it only when fresh Pacific salmon is not available.
☐ Our purchases of fresh, pen-raised Atlantic salmon are independent of the availability of fresh Pacific salmon.
☐ We purchase it in place of Pacific salmon for all markets.
☐ We purchase it in place of Pacific salmon for the following markets:
☐ Restaurants ☐ Retail seafood markets ☐ Supermarkets ☐ Other wholesalers

10. Please estimate the average composition of your total annual sales of fresh, pen-raised Atlantic salmon by category of retailers as a percent of the total. The total should equal 100%; please leave categories that do not apply blank.

☐ Restaurants ☐ Other wholesalers ☐ Supermarkets
☐ Retail seafood markets ☐ Other (specify) _____

11. Please estimate the average composition of your total annual sales of fresh, pen-raised Atlantic salmon by seasonal percent of total. Total should equal 100%; please leave seasons that do not apply blank.

☐ Winter (Dec., Jan., Feb.) ☐ Summer (June, July, Aug.)
☐ Spring (March, April, May) ☐ Fall (Sept., Oct., Nov.)

- 12.a. Does your firm plan to increase its distribution of fresh, pen-raised Atlantic salmon?

☐ yes ☐ no

- b. If yes, does your firm plan to (check one):

☐ maintain current seasonal distribution patterns?
☐ concentrate more distribution in _____ and spring?
☐ concentrate more distribution in _____ and fall?

13. What advantages does the fresh, _____ salmon have over the fresh, wild salmon?

14. What advantages does the fresh, wild Pacific salmon have over the fresh, pen-raised Atlantic salmon?

Dick

Attached is a summary of the report on finfish aquaculture in British Columbia; presented by Dr. Gillespie

The information gathered for this report was collected at four public meetings within a month. Written testimony was also incorporated in the report.

MAJOR ISSUES EXPRESSED

PRO AQUATIC FARMING	CON AQUATIC FARMING	INQUIRY RECOMMENDATION
<u>Lack of clear policy on aquatic farming</u> Hindrance to the development of the industry due to the traditional working relationship with the commercial fishery.	<u>Lack of clear policy on aquatic farming</u> Government doesn't support the commercial fishery as hatchery eggs are used to support aquatic farming.	<u>Develop an aquatic farming policy</u> The policy should clarify provincial direction, agency roles, and responsibilities of both government and the private sector. <u>Establish an aquatic farming advisory council</u> The government should establish an advisory council from key agencies and interest groups. <u>Encourage private sector funding</u> Although the government supported marketing, research, egg supply, disease and diagnostic services during initial stages of development, the private sector should fund the industry. <u>Government Coordination</u> Federal, provincial, and local governments should cooperate to regulate the industry. <u>Maintain commitment to enhancement program</u> The provincial government should continue to provide Salmoid Enhancement Program (seems similar to FRED) funding. <u>Lift the current moratorium</u> Information available fails to adequately substantiate maintaining the October 31, 1986, moratorium. The moratorium should be lifted in conjunction with the initiation of the studies and policy changes recommended.
<u>Moratorium</u> Urged the moratorium be lifted immediately to avoid financial losses.	<u>Moratorium</u> Settle land claim issues, conduct environmental impact studies, and review concerns expressed prior to lifting the moratorium.	

MAJOR ISSUES EXPRESSED

PRO AQUATIC FARMING	CON AQUATIC FARMING	INQUIRY RECOMMENDATION
<u>Lack of public knowledge</u> Fish farming economic benefits and potential were generally unknown. The public is unaware of the government safeguards for the industry. <u>Native Involvement</u> Support for aquatic farming for its potential for generating direct and indirect employment for natives in the small coastal communities of B.C. <u>Pricing Farm Salmon</u> Farm salmon compete only minimally with wild salmon. The recent price lines are well within the range of normal price fluctuations. <u>Impact on Market Demand and Supply</u> The increased availability of salmon is leading to increased consumption.	<u>Lack of public knowledge</u> Many government studies regarding marketing and environment impact are not readily available to commercial fishermen. <u>Native Involvement</u> Concern about loss of native employment in the commercial fishery and concern on the environmental effects of fish farming in their traditional harvest areas were expressed by the native leaders. <u>Pricing Impact of Farm Salmon</u> Concerns were expressed that the influx of farm salmon will cause both farm and wild salmon industries to suffer drastic price declines. <u>Impact on Market Demand and Supply</u> The anticipated growth in farm salmon production will lead to market saturation. Production controls should be in place (as in Norway). Farmed salmon should be labeled as such. <u>Effect on Processing Facilities</u> If new processing plants are built to process farm salmon, it may aggravate the current over-capitalization of existing plants.	<u>Communication link should be established</u> The provincial government should encourage a formal communication link between the commercial wild fishery and the fish farming industry. <u>Native Involvement</u> The federal government should be encouraged to develop programs to assist natives to become involved in aquatic farming. Fish farming industry leaders should establish a policy to promote native participation. <u>Rely upon market forces to dictate prices</u> B.C. farm salmon should concentrate on specialty markets in the U.S.A. in which the major B.C. wild catch product does not compete. <u>Support a strategy for the integrated marketing of farm and wild salmon products</u> New markets, new ways of packaging, and new salmon products should be explored. Government should support this strategy through financial assistance, trade missions and technology transfer. <u>Promote use of existing processing plants</u> Farm operators should be encouraged to contract between existing processing companies. Government promotion should include review of regulations governing the on-farm processing of salmon, transport of live salmon to plants, and inspection/grading of processed products.

MAJOR ISSUES EXPRESSED

PRO AQUATIC FARMING	CON AQUATIC FARMING	INQUIRY RECOMMENDATIONS
<u>Impact on Employment</u> Fish farmers projected large growth in feed plants, plastics and equipment manufacturing construction.	<u>Impact on Employment</u> Currently the commercial fish industry generates many, many jobs. As salmon farming will never generate this level of employment, farming should not be permitted to put the employment health of the salmon fishery in jeopardy.	
<u>Disease Transference</u> Some studies indicate the risk of transmission of disease from farm to wild stock is minimal.	<u>Disease Transference</u> Transfer of fish diseases between farms and between farm fish and wild stock was a real concern of many. An immediate ban on egg importation was called for. Farm fish are more susceptible to disease and the diseases will be transmitted to the wild stock. <u>Genetic Alterations</u> Concerns were expressed about the possible escapement of farm stock which might interbreed with wild salmon and produce undesirable genetic alterations. <u>Predator Control</u> There is insufficient enforcement capability by fish and wildlife officials to stop fish farmers from destroying eagles, herons, seals, otters, and other animals.	<u>Disease Transference</u> To minimize transfer of diseases between fish farms, 3 kilometres should separate aquatic farms. The provincial government should end the importation of Atlantic salmon eggs.

MAJOR ISSUES EXPRESSED

PRO AQUATIC FARMING	CON AQUATIC FARMING	INQUIRY RECOMMENDATIONS
<u>Impact on Water Quality</u> It is in the farmer's own self-interest to maintain a healthy growing environment for the fish.	<u>Impact on Water Quality</u> The following examples of potential damage to water quality were cited: build up of sediments on the sea bed, increased algae growth, mortality of bottom creatures and plants, and destruction or reduced growth of nearby shellfish beds.	<u>Support research on long-term effects of salmon farming</u> Studies should be performed on the effects of fish farms on shellfish and other bottom dwellers and upon water quality.
<u>Use of Toxicants and Pharmaceuticals</u> Antibiotics may not be a problem as the substances are water soluble and quickly dilute.	<u>Use of Toxicants and Pharmaceuticals</u> Studies were cited which implicated the toxicant tributyltin (TBT) as a human health risk, through its concentration in the flesh of farm salmon and shellfish. Lack of manpower reduced the frequency of periodic checks on toxicant levels in farm fish. The use of antibiotics was expressed as a concern.	<u>Establish a mandatory environmental monitoring system</u> Monitoring of on and near-site environmental conditions should be required for a permit. The measurement should be regularly submitted for government review. Government needs to establish standards which divide acceptable conditions from unacceptable conditions.
<u>Inadequate Consultation with Interest Groups</u> Short referral period was necessary to keep processing time delays to a minimum.	<u>Inadequate Consultation with Interest Groups</u> Dissatisfaction with the application referral process was expressed - either because the time available to provide comments was too short (30 days) or because their interests were not included in the process.	<u>Increased government research, health inspection, and testing activities</u> Funding for an adequate inspection and testing program should be approved. <u>Establish standards for finfish aquaculture equipment</u> The standards should eliminate the use of toxicants which effect human health.

MAJOR ISSUES EXPRESSED

PRO AQUATIC FARMING	CON AQUATIC FARMING	INQUIRY RECOMMENDATIONS
<u>Local Government Involvement</u> Salmon farmers expressed concern that local government involvement might delay the approval process.	<u>Local Government Involvement</u> Local government agencies were concerned that they were given insufficient time in the referral process to consult with an advisory planning group or landowners adjacent to the proposed aquaculture site.	<u>Local governments should redefine local zoning bylaws</u> Approval of aquaculture locations should remain a provincial decision. However, zoning will allow local governments to ensure aquaculture operation are compatible with adjacent uses. The degree to which local government referral comments influence provincial decisions on aquaculture should be clearly identified in government policy.
<u>Length and Complexity of Approval System</u> The high number of agencies involved in the approval system was a source of frustration to many farm operators.	<u>Length and Complexity of Approval System</u> Provincial regulations and approvals are not tight enough.	<u>Continue its use of the interagency referral system</u> The referral system is important in identifying land use concerns and should be continued. The provincial government should expand its list of referral groups, increase the time available for response (to 60 days), and establish subsequent notification practices for finfish referrals.
<u>Health and Safety of Farm Workers</u> Fish farmers stated that concerns are known and the industry has been working on a set of standards.	<u>Health and Safety of Farm Workers</u> The lack of safe diving conditions and lack of safety regulations were listed as a concern.	<u>Government should adopt regulations for the occupational health and safety of farm workers</u> The regulations should include requirements for diver training and rescue, personal floatation devices, hand rail systems, emergency medical services, and proper handling of chemicals and pharmaceuticals.

MAJOR ISSUES EXPRESSED

PRO AQUATIC FARMING	CON AQUATIC FARMING	INQUIRY RECOMMENDATIONS
<u>Site Selection</u> Established farmers expressed concerns that temporary licenses were being used for financial gain through speculation and as means of tying up sites to prevent competition. <u>Control of Foreign Investment</u> Foreign money is needed to offset the reluctance of Canadian financial institutions to provide loans. <u>Loss of Anchorage and Access</u> Farm operators spoke of their concerns about boater noise, fuel slicks, and discharge of wastes.	<u>Site Selection</u> The need for coastal planning studies was stressed often by boaters, commercial fishermen, and government agencies. <u>Control of Foreign Investment</u> Individuals argued that foreign control of salmon farming was not in the best interest of B.C. because of the likelihood of export of jobs and profits. Strict controls to prevent foreign corporations from taking over B.C. farms were requested. <u>Inadequate Rental and Bonding Requirements</u> The low annual rental charged for fish farms was a concern expressed. It was felt by some that a bond should be posted to allow government to pay for site clean-up in the event of environmental problems. <u>Loss of Anchorage and Access</u> Concerns that the coastline would soon be devoid of open anchorages for emergency and recreational use was discussed.	<u>Identification study</u> The government should initiate studies that will identify sites of high value for other important coastal interest and which should be reserved from aquaculture activities. Specific siting within these remaining areas can then be determined on the basis of environmental factors. Fish farms should not be adjacent to provincial parks and recreation areas. <u>Establish minimum fish production levels</u> To determine whether land is used productively, the government should set standard levels of fish production. A new rental structure should be established as well as a bond should be required for environmental clean-up. <u>Offer safe anchorages</u> The aquaculture industry should be encouraged to institute a program to provide anchorage, access, and emergency assistance to other coastal users.

MAJOR ISSUES EXPRESSED

PRO AQUATIC FARMING	CON AQUATIC FARMING	INQUIRY RECOMMENDATIONS
<u>Upland Owner Impact</u> The farms benefit communities by adding a tax base. <u>Effects on Recreational and Tourism Industry</u> Aquaculture may increase tourisms due to the attraction of touring farms <u>Involvement of Fishermen in the Farm Industry</u> arming will allow fishermen to offset their short income earning period with fish farm equipment.	<u>Upland Owner Impact</u> Declining property values were due to the imposition of a fish farm along their view frontage. <u>Effects on Recreational and Tourism Industry</u> A concern was expressed that the proliferation of fish farms would ultimately erode the tourism industry as related to recreational boating, sports fishing, and commercial fish guiding. <u>Involvement of Fishermen in the Farm Industry</u> A large capital outlay is required to start a fish farm. This makes it very difficult to get into the fish farming business	<u>Minimum Distance</u> The distance between fish farms should be determined regarding the potential of the spread of disease and the surrounding property.

STATE OF ALASKA 1987 LEGISLATIVE SESSION

FISCAL NOTE SENATE

REQUEST:

BILL VERSION: CSSB 106(L&C) a
PUBLISH DATE: 3/19/87Revision Date: N/A
Title: Aquatic Farming: MaricultureAgency Affected: Commerce & Econ. Dev.
BRU: Economic Development AdvocatesSponsor: Rep. Ellis/Senator Zharoff
Requestor:Components: Office of Commercial
Fisheries Development

EXPENDITURES/REVENUES: (Thousands of Dollars)

OPERATING	FY 87	FY 88	FY 89	FY 90	FY 91	FY 92
PERSONAL SERVICES	15.0	5.5	6.0	6.6	7.3	8.0
TRAVEL	10.0	5.5	6.1	6.7	7.3	8.1
CONTRACTUAL						
SUPPLIES						
EQUIPMENT						
LAND & STRUCTURES						
GRANTS, CLAIMS						
MISCELLANEOUS						
TOTAL OPERATING	25.0	11.0	12.1	13.3	14.6	16.1

CAPITAL						
---------	--	--	--	--	--	--

REVENUE	5.0	10.0	15.0	20.0	25.0	30.0
---------	-----	------	------	------	------	------

FUNDING: (Thousands of Dollars)

GENERAL FUND	25.0	11.0	12.1	13.3	14.6	16.1
FEDERAL FUNDS						
OTHER						
TOTAL	25.0	11.0	12.1	13.3	14.6	16.1

POSITIONS:

FULL-TIME						
PART-TIME						
TEMPORARY						

ANALYSIS:

This program will become a priority mission of OCFD and shall be assigned to existing personnel. Initial permit requests are not expected to exceed 80% of one Development Specialist II available time. Travel is programmed for site visits as envisioned by the bill and contractual includes phone, photocopy and

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Division: Office of Commercial Fisheries DevelopmentPhone: 465-2162
Date: 2/17/87Approved by Commissioner: Anthony Smith
Agency: Department of Commerce and Economic DevelopmentDate: 2/17/87

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1987 LEGISLATIVE SESSION
FISCAL NOTE
CS SB 106 LRC

Analysis: (Continued)

other expenses related to permitting as required by the bill. FY 87 includes funding for public hearings, etc., to finalize new regulations. Program receipts have been estimated by using a fee of \$100 per annual permit; 50 new permits per year.

**AN INQUIRY
INTO FINFISH AQUACULTURE
IN BRITISH COLUMBIA**

REPORT AND RECOMMENDATIONS

Presented to the Government of British Columbia

by

David Gillespie, Chairman
B. C. Finfish Aquaculture Inquiry

December 12, 1986

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APPENDIX II PUBLIC SUBMISSIONS
APPENDIX III WRITTEN GOVERNMENT SUBMISSIONS

B.C. Finfish Aquaculture Inquiry

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LETTER OF TRANSMITTAL

December 12, 1986

Honourable Jack J. Kempf
Minister
Ministry of Forests and Lands
Legislative Buildings
Victoria, B.C.

Honourable John Savage
Minister
Ministry of Agriculture and Fisheries
Legislative Buildings
Victoria, B.C.

Dear Sir:

It is my pleasure to transmit my Report and Recommendations on Finfish Aquaculture in British Columbia, as commissioned by the Government of British Columbia on November 6, 1986.

Respectfully yours,



David W. Gillespie
Chairman

ACKNOWLEDGEMENTS

The Inquiry wishes to express its appreciation to the private citizens, interest groups, and government agencies who provided the information and support necessary to complete this report on finfish aquaculture. A special note of gratitude is due to those who responded to the challenge to prepare written submissions at short notice, and to those who made time available to attend and participate in the four public meetings held along the coast. The ability of the Inquiry to achieve its 30 day mandate is directly attributable to their efforts and is testament to the impact and interest that finfish aquaculture is generating in British Columbia.

"Commercial fisherman are, I think, by and large philosophically unprepared for this kind of a change. I am a high seas hunter".

1.0 PURPOSE AND SCOPE OF THE INQUIRY

1.1 TERMS OF REFERENCE

The Inquiry was officially established on November 6, 1986 with the appointment of David Gillespie as its chairman. The appointment was made by the Honourable Jack J. Kempf, Minister of Forests and Lands under authority of the provincial Land Act and in response to a moratorium on the issuance of finfish aquaculture tenures imposed by the Minister on October 31, 1986.

The terms of reference established by the Ministry of Forests and Lands provided for appointment of a single commissioner of inquiry, with secretarial services and support provided by the Ministry. The commissioner was to consult with appropriate government agencies and submit a report with recommendations to the Minister of Forests and Lands within 30 days of commencing the inquiry.

The report and recommendations were to be made on the following aspects of marine finfish aquaculture operations:

- (a) Impact on commercial fishery operations, markets, and localized production-related facilities.
- (b) Potential environmental impacts and effect on wild fish stocks.
- (c) Impact and involvement of local government and interest groups.
- (d) Government approval and monitoring procedures.

The terms of reference also identified specific tasks to be performed. These were to establish a process and schedule for review of concerns of key interest groups, hold meetings with interest groups in coastal communities, review background material provided by government agencies, summarize issues, and formulate recommendations to resolve these issues.

1.2 MORATORIUM ON CROWN LAND TENURES

The Inquiry was precipitated by a moratorium on the issuance of Crown land leases and licences of occupation for finfish aquaculture operations. This moratorium was imposed on October 31, 1986 for an indefinite period by the agency responsible for issuing Crown land tenures, the Ministry of Forests and Lands.

The moratorium is a result of concerns raised by the B.C. Fishery and Allied Workers Union (UFAWU). The UFAWU called for a moratorium to allow a full review of the impacts of the salmon farming industry, given the rapid increase in Crown land applications for finfish aquaculture during the past year.

The moratorium imposed by the Ministry of Forests and Lands applies to the issuance of leases and licenses of occupation for finfish aquaculture. The Ministry continues to accept applications for all tenure, including "Section 10" licences,¹ but does not adjudicate and issue leases or licences of occupation for the production of finfish until the lifting of the moratorium. Any verbal or written commitments to issue a tenure which were made prior to the moratorium may be honoured as legal contracts. Where the moratorium has severely jeopardized financial, legal, or production commitments of an applicant, the possibility exists for an exemption of the application from the moratorium by the Ministry.

From the initiation of the moratorium to December 5, 1986 the Ministry has accepted a further 31 applications for finfish aquaculture sites, 26 of which are Section 10 applications.

¹ A licence issued under Section 10 of the Land Act, which permits an applicant to enter and occupy a site to conduct research and investigative studies for up to one year. The licence is not renewable or assignable, and does not authorize fish production.

2.0 THE INFORMATION GATHERING PROCESS

2.1 METHODS OF INQUIRY

The general approach to the Inquiry was established in the terms of reference (Section 1.1). Major decisions were required, however, on what process would be used to contact and consult the greatest possible number of interest groups along the coast, as well as to collect as much background information as possible in the short time available.

The Inquiry decided the best approach to be one of conducting a series of open public meetings in strategic coastal communities where both aquaculture and the commercial fishery are in evidence. These meetings would be supplemented by meetings with all government agencies involved in finfish aquaculture and commercial fisheries. Where time and scheduling would permit, the Chairman would also be available for meetings with individual citizens and interest groups. In addition, the opportunity to send a written submission to the Inquiry would also be made available for the information gathering period, ending November 30, 1986.

2.1.1 Stage One (Nov. 12 - Nov. 20)

The first few days of the Inquiry were spent in making logistical arrangements for the public meetings, advertising, and inviting all known interest groups to make presentations. Public hearings were scheduled for Parksville on November 21 (south and central Vancouver Island), Campbell River on November 24 (north Vancouver Island), Sechelt on November 26 (south coast) and Prince Rupert on November 26, 1986 (north and central coast). A public notice, outlining the Inquiry Terms of Reference and requesting submissions, was prepared and placed in all appropriate coastal community newspapers. In addition, 32 local government agencies and 45 private interest groups and associations representing all known areas and types of concern with finfish aquaculture were contacted and invited to make presentations. Provincial and federal agencies were also contacted formally with a request to arrange meetings and prepare position statements.

Meetings were held with private interest groups at their request, and with the provincial ministries of Environment and Parks, Forests and Lands, Agriculture and Fisheries, and Municipal Affairs.

On November 17, a news release announcing the dates and locations of the public meetings was distributed to the electronic media and to all newspapers along the coast. Staff began to prepare agendas for each public meeting in response to the many interest groups who began to declare their intent to present briefs at specific locations.

2.1.2 Stage Two (Nov. 21 - Nov. 28)

The second stage of the Inquiry was devoted to the four public meetings. An "information-style" meeting structure was used, in which all verbal presentations, questions to speakers and general comments were directed to the Chairman at specific allocated times during each session. Morning, afternoon, and evening sessions were scheduled for each meeting to allow full opportunity for the public to contribute to the information base.

A preliminary schedule of speakers was posted at the beginning of each meeting. Those who decided at the meeting to make a formal submission were added to the schedule as the day progressed. When gaps appeared in the schedule, they were used by the Chairman to entertain comments and discussion from the general audience, and to call for additional submissions. When time permitted, the public was given opportunity to ask questions about a presentation immediately following its delivery. All speakers were required to identify themselves and all of the proceedings were recorded.

This meeting structure proved to be highly educational and informative for both the Inquiry and the general public. It provided the necessary control to complete each session on time and with ample public participation. Most importantly, it prevented the development of "cross-floor" adversarial relationships among interest groups, often a characteristic of less-structured public meetings.

Meetings were also held during this period with the Canadian Coast Guard and the B.C. Salmon Farmers Association.

2.1.3 Stage Three (Nov. 29 - Dec. 2)

During Stage Three of the Inquiry, final meetings were held with key government agencies. The Chairman met with the Federal Department of Fisheries and Oceans and the Provincial Ministry of Economic Development. Two short meetings were also held to receive written submissions from interest groups unable to attend the previously scheduled public meetings. Finally, the Inquiry reviewed and collated the many written briefs and letters which had been mailed to the Vancouver Office in response to the call for written submissions.

2.1.4 Stage Four (Dec. 3 - Dec. 12)

Stage Four consisted of analyzing all the information obtained during the first three stages of the Inquiry, and formulating the final report and recommendations.

2.2 THE RESPONSE

2.2.1 General Response

The general response to the call for information was overwhelming, given the short time period available for preparation and delivery. A total of 258 submissions were received in the form of letters, formal briefs, and oral presentations at the public meetings. Many of the submissions were supplemented with background material, such as newspaper clippings, thesis dissertations, scientific journal articles, environmental studies, and plans, policies and procedures of various government agencies. These submissions came from local government, provincial government, consulting companies, commercial fishermen, salmon farmers, oyster growers, seaweed farmers, aviation companies, fish processing companies, construction companies, native groups, fish

and wildlife groups, marine recreationists, tow boat operators, environmental groups, upland owners, divers, and college students. Several citizens with no specific affiliation also made presentations at the public meetings.

Attendance at the public meetings was also high given the short notice provided. A total attendance of 387 was recorded from the registration book placed at the entrance to each meeting. Attendance was greatest at Sechelt, where 146 people sat through some part or all of the sessions. Campbell River attracted 110 people, while the Parksville and Prince Rupert meetings recorded 72 and 59 participants, respectively. (See Table 1)

2.2.2 Range of Interest

An indication of the range of interests affected by finfish aquaculture is evident in a review of the affiliation of participants at the public meetings. In total 18 percent of those attending the meetings were engaged in aquaculture, 11 percent in the commercial fishery, and 5 percent in related fishing activities. Seven percent of total attendance represented local government and 6 percent native groups. Private citizens represented 34 percent of the turnout.

With respect to specific interest areas, it is worth noting that local citizens interest was highest at Sechelt (46% of attendees) and Campbell River (32% of attendees). Native peoples representation was very high in Prince Rupert (27% of audience). The Sechelt meeting contained the highest proportion of commercial fisherman compared to other meetings; while at Campbell River the aquaculture industry had its greatest representation.

2.2.3 Government Response

The local, provincial, and federal agencies contacted were quick to respond to the opportunity to provide background information. In general, local government was much more willing to present a formal

position on finfish aquaculture than were provincial and federal agencies. The latter were prepared to provide background information and staff recommendations. Overall, 29 formal position statements were received from various levels of government.

2.3 EXPECTATIONS

A wide range of issues became evident during the Inquiry. Some are beyond the terms of reference and cannot be dealt with in this report. Expectations for their resolution have no doubt been raised, and consequently they form part of the information record in the event that a supplementary evaluation of the issues is undertaken by the various agencies involved in finfish aquaculture.

One of the most important expectations raised by the Inquiry is that the final report will be used to provide better public information about finfish aquaculture and establish better communication among the participating interests. To satisfy this expectation, a comprehensive review of issues has been made an integral part of the report.

2.4 INFORMATION RECORD

The Inquiry places great importance on the need to make available to the public its record of information. This approach is necessary not only to allow more detailed assessment of issues and recommendations by government, but also to alleviate concerns expressed by some members of the public that the "real" facts about finfish aquaculture are being hidden from public view. It is also considered an important way to meet the expectations for better public information and communication as mentioned in Section 2.3. This report therefore includes, as three appendices, the transcripts of public meetings, and all written submissions.

For matters of personal confidentiality, not all position statements from provincial government agencies are included. Background material relevant to those statements is provided, however.

TABLE 1

B.C. FINFISH AQUACULTURE INQUIRY
AFFILIATION AND ATTENDANCE AT PUBLIC MEETINGS

Location Interest Meeting Affiliation	PARKSVILLE (%)	CAMPBELL RIVER (%)	SECHELT (%)	PRINCE RUPERT (%)	TOTAL (%)
Government					
° Provincial	3 (4.2)	0	0	2 (3.4)	5 (1.3)
° Local	10 (13.8)	7 (6.4)	8 (5.5)	3 (5.1)	28 (7.2)
° Federal	2 (2.8)	3 (2.7)	0	3 (5.1)	8 (2.1)
Fishing Industry					
° Wild Fishery	7 (9.7)	8 (7.3)	22 (15.1)	5 (8.5)	42 (10.8)
° Aquaculture	15 (20.8)	29 (26.4)	17 (11.6)	7 (11.9)	68 (17.6)
° Other Related	4 (5.6)	6 (5.5)	8 (5.5)	1 (1.7)	19 (4.9)
Forest Industry	1 (1.4)	1 (0.9)	1 (0.7)	0	3 (0.8)
Other Bus./Industry ¹	4 (5.6)	5 (4.5)	9 (6.2)	2 (3.4)	20 (5.2)
Environmental GPS	2 (2.8)	3 (2.7)	3 (2.1)	0	8 (2.1)
Recreation	6 (8.3)	6 (5.5)	0	0	12 (3.1)
Native Groups	1 (1.4)	5 (4.5)	1 (0.7)	16 (27.1)	23 (5.9)
Private Citizens	14 (19.4)	35 (31.8)	67 (45.9)	15 (25.4)	131 (33.9)
Press/Media	3 (4.2)	2 (1.8)	10 (6.8)	5 (8.5)	20 (5.2)
MEETING TOTAL	72	110	146	59	387

¹ Includes construction, building supply, diving, consultants etc. and unidentified companies.

NOTE: These figures represent registered attendance. Some participants did not register.

3.0 THE MAJOR ISSUES

3.1 CENTRAL ISSUES

3.1.1 Extent of Government Support and Control

The extent of support and control of finfish aquaculture by all levels of government pervaded much of the Inquiry's review of major issues. The lack of a clear, comprehensive and integrated policy on aquaculture was identified by fish farming groups as a hindrance to the development of the industry. Some industry spokesmen believe that federal agencies are reluctant supporters of aquaculture because of traditional working relationships with the commercial fishery. In contrast, many of the commercial and sport fishery groups believe that the federal agencies are becoming too supportive of finfish aquaculture, and to the detriment of the Salmonid Enhancement Program. In particular, the diversion of SEP hatchery eggs to supply the aquaculture industry is seen as a direct indication of the withdrawal of federal support for the commercial fishery.

The "gold rush" image which now pervades the finfish aquaculture industry is viewed as another issue involving government support and control. Established farm interests are generally concerned that unbridled government enthusiasm and simple rules have led to speculative activities which jeopardize their own future expansions. In addition, the large number of applications has become a detriment to the whole industry due to adverse reactions among the commercial fishing industry and other interests. The fact that many of the sites are considered unlikely to be approved for farm use is not generally understood.

Several local government agencies who have successfully attracted aquaculture into their areas now identify the need for a more cautious level of support.

The extent of government control is also of concern. Most farm industry groups have called for a reduction in controls over business management, claiming the government's involvement should be limited to

land and environmental concerns. Government agencies have pointed out that government support to date has been limited and directed towards technology transfer, minor tax exemptions, business planning assistance and a small scale loan program. Other groups have called for increasing controls on foreign investment, marketing, and environmental alteration.

3.1.2 The Moratorium

The necessity and duration of the moratorium was frequently mentioned. The majority of interest groups, including most salmon farmers, welcomed the moratorium (and the resultant Inquiry) as a means of reviewing the industry's progress and problems and re-establishing its priorities. Several local governments questioned the apparent "about-face" of the provincial government after having spent considerable effort and funds to promote the industry in their respective regions.

Salmon farmers urged the moratorium be lifted immediately upon conclusion of the Inquiry to permit resumption of business planning and to avoid financial losses. Most native groups wanted the moratorium lifted to allow their own aquaculture activities to proceed; although a minority wanted it contingent on settlement of aboriginal land claims. The U.F.A.W.U. and other commercial fishery groups supported the settlement of land claims, along with completion of environmental impact studies and a more elaborate commission of inquiry, prior to lifting of the moratorium. The Islands Trust requested the moratorium be removed on a regional basis, contingent on completion of local government zoning for aquaculture.

3.1.3 Public Knowledge

Evident in discussions on all major issues was lack of public knowledge of the aquaculture industry and of existing government policies and programs.

Several farming interests identified the main benefit of the Inquiry as providing better understanding of fish farming. The placing of a mora-

torium on tenure approvals was itself the result of a lack of information on industry impacts. One local government submission termed salmon farming a "public relations disaster". Studies that would provide many answers to the concerns raised by commercial fishermen and other groups about marketing and environmental impacts are not all in general distribution and some submissions charged government with intentionally withholding their findings. On the other hand, the finfish farm industry was concerned that its economic benefits and potential were generally unknown, citing the estimated \$150 million in annual revenue projected by 1995, and employment of nearly 3,500. The general public were unaware of existing approval procedures, the agencies involved, siting and diligent use requirements, bonding and other matters. Without such information, the image of rampant and uncontrollable development of fish farming has been easily spread.

Despite differences of opinion, every major interest group expressed a desire to cooperate and co-exist. The issue is to identify the circumstances under which these groups will be willing to do so.

3.1.4 Native Involvement

The question of native peoples involvement in aquaculture arose in discussion of all the basic issues being addressed by the Inquiry.

Most bands voiced support and enthusiasm for finfish aquaculture, and its potential for generating direct and indirect employment for their people in the small coastal communities of B.C. There is, however, a concern that native venture opportunities will be quickly lost as a result of a speculative rush of licence applications, overcapitalization, and high subsequent failure rates which will deter future financial support for native enterprise. Many bands are about to enter the industry at the encouragement of various federal reports which recognize the compatibility of fish farm operations with native skills and tradition. There is also concern about loss of native employment in the commercial fishery, and on the environmental effects of fish farming in their traditional harvest areas.

All bands derided the lack of consultation by the provincial Lands agency concerning tenure applications fronting and adjacent to Indian reserves. Those bands which have recently made applications for provincial land tenure were also concerned that the aboriginal land claims dispute would prejudice the processing and approval of their applications, as well as prejudice the outcome of their claim to such lands.

3.2 MARKETING ISSUES

3.2.1 Pricing Impact of Farm Salmon

The commercial fishing industry has expressed major concern over the impact of farm salmon on the market price of wild salmon. Several briefs provided information on recent price declines due to competition from farmed salmon produced in Norway. The UFAWU expressed the concern that there would be an eventual head-on collision between B.C. farm salmon and the wild catch, with both industries suffering through drastic price declines. In contrast, the salmon farming groups believed that B.C. farm salmon will compete only minimally with B.C. wild salmon. Recent reports and studies presented by both federal and provincial agencies were cited as evidence that the recent price declines of wild catch are well within the range of price fluctuations experienced over the past two decades. It was further pointed out that only chinook and coho salmon prices were at issue, and these account for only 15-30% of the wild fish caught by B.C. fishermen. Several participants admitted that even with year-round competition, the worst that could happen would be a natural elimination of inefficient producers in both industries and lower consumer prices, neither of which would be undesirable.

3.2.2 Impact on Market Demand and Supply

The commercial fishery groups contended that the anticipated growth in B.C. farm salmon production will lead to market saturation and called for regulations to restrict such production, either through a ban on issuing of tenures or through production controls. It was pointed out

that in Norway, the government has instituted limits on the output of individual farms. The farm industry pointed to recent studies in world market trends which suggested that the increased availability of salmon due to fish farms is actually leading to increased consumption. It was also stated that B.C. farm salmon is being targeted on U.S. specialty markets for fresh fish, and not the canned or frozen fish markets where most of the wild catch competes. B.C. farm salmon is apparently being marketed in the winter months when frozen and fresh chinook and coho is generally unavailable. B.C. farm salmon producers would be foolish, according to one industry submission, to bother trying to compete head on with the fresh wild catch market when it can pursue a separate and more lucrative, expanding market elsewhere. The real marketing battle, it was suggested, will be between the various world suppliers of farm salmon.

3.2.3 Effect on Processing Facilities

A primary concern of commercial fishing industry spokesmen was the future effect of increased salmon farm production on existing processing facilities. The UFAWU expressed concerns that new plants would be built to process farm salmon, thereby aggravating the current over-capitalization and undermining employment at existing, underutilized facilities. It demanded a freeze on the issuance of new plants. The B.C. Fisheries Council, comprised of major fish processing companies in the province, indicated that current plants have sufficient physical capacity to accommodate the potential increase in farm salmon product for at least 5 years. However, the Council reported that a trend was beginning whereby many processing companies were joint venturing with fish farms to market their product, thereby using the excess capacity of existing plants. Government sources indicated that over 50% of farm salmon had recently been contracted for processing by the major unionized companies. Some companies were offering low interest loans to fish farms as an incentive for such contracts. The Prince Rupert Fisherman's Co-op was mentioned as being particularly progressive in its outlook, as it had begun its own salmon and trout farms to supply

its plants and offered various incentives to its members to become involved in fish farming.

3.2.4 Impact on Employment

Various commercial fishing interests also raised employment as a major issue, citing the large base of full time and part time jobs generated by the B.C. salmon fishery and its high wage levels. It expressed the view that the salmon farming industry would never generate this level of employment, and consequently should not be permitted to put the employment health of the salmon fishery in jeopardy. Comments were also made about the low wages paid to salmon farm workers. The salmon farming industry submissions also identified employment as an issue. A very large growth was projected in associated feed plants, plastics and equipment manufacturing, construction and other service industries. Many submissions were received in the Sechelt area confirming extensive increases in business due to finfish aquaculture activity. Several identified the prospects for increasing fishery jobs through fishing for non-commercial or underutilized wild fish to supply new feed plants.

3.2.5 Need for Marketing Strategy and Research

Need for a comprehensive market strategy for B.C. salmon products was identified as an issue to be dealt with by several government agencies, due to the increasing erosion of the commercial fishery share of the world salmon market. Trends in the B.C. fishery towards high labour rates, and increasing protectionism in the U.S.A. and other markets were also mentioned as reasons for initiating a strategy to identify new markets, new product lines, and higher quality and appearance of product from both industries. The Salmon Farmers Association pointed out that it had already commissioned studies on marketing strategies for its products, with financial support from government. Similarly the B.C. Fisheries Council was given a large 3 year grant by government to assist member companies in their export marketing activities. The

UFAWU however, identified its marketing strategies as ensuring a reduction in B.C. farm salmon and ensuring its proper labelling because of its reported inferior quality and presence of foreign substances. Submissions pointed to the fact that B.C. was one of the few areas in the world capable of sustaining viable commercial wild fishery and farm salmon industries, and it should endeavour to market both products to provide a year round supply of fish to a wide range of consumer markets.

3.3 ENVIRONMENTAL ISSUES

3.3.1 Disease Transference

Transfer of fish diseases represented a major issue in the Inquiry. It concerned transmittal of disease between farms, and transmittal between farm fish and wild stock. The most critical issue was the importation of Atlantic salmon eggs, and with them the risk of outbreak of exotic diseases for which Pacific salmon have no natural immunity. The majority of commercial fishery, recreational sport fishery, wildlife, and environmental groups called for an immediate ban on egg importation, citing concerns of federal and provincial specialists, research studies, and reports of outbreaks introduced through similar methods in other countries. Salmon farmers currently involved with Atlantic salmon described the very elaborate egg screening, quarantine and effluent treatment conditions imposed by government as evidence of low risk. The federal and provincial agencies provided a draft agreement which proposes to end Atlantic egg importation by March of 1989, as evidence of their concerns about this disease risk. The Salmon Farmers Association indicated that it shared some of the concerns expressed about egg importation.

The other disease issue involved concerns by commercial fishery interests that farm fish are more susceptible to disease and will transmit such diseases to wild fish stock. The Salmon Farmers Association and government agencies, however provided recent studies to indicate that the risk of transmission of disease from farm to wild stock is minimal, and has never actually been reported. They argued that it was much

more likely that wild stocks would spread disease to farm stock since the farm eggs and smolts are treated and monitored for diseases while natural stock is not. An offshoot of this concern was the separation distance between farm sites, which has been set by the province as 0.8 kilometres to minimize the risk of disease transfer between farm operations. Many interest groups called for an increase in this distance, including the Salmon Farmers Association. There were also concerns raised about the disposal of dead fish and the effluent discharge from fish farms as potential sources of disease transference. Finally, the disease issue also raised concerns over the adequacy of disease diagnostic and veterinary services. Government has to date provided advice and assistance but has insufficient manpower to increase its commitment. It has been assumed the private sector would soon meet this challenge for more services. However, several briefs indicated a basic deficiency in training programs and laboratory services.

3.3.2 Genetic Alterations

The UFAWU and several other fisheries interest groups were concerned about possible escapement of farm stock. It was speculated that they might interbreed with wild salmon and produce undesirable genetic alterations affecting growth, size, quality and other factors. Also of concern was the possibility of escaped Atlantic salmon becoming established in the wild and out-competing native stock. However, government agencies pointed out that these situations were not likely to occur, and referenced the unsuccessful attempts by government during a 30 year period to deliberately establish Atlantic salmon to the B.C. coast. Salmon farmers reported that most "escapements" tend to congregate around the nets in any case, or get eaten by predators.

3.3.3 Predator Control

Control of predators was raised as an issue by a number of environmental organizations and individuals from recreational and fishery interests. The basic concern was that fish farmers were destroying river otters, eagles, herons, seals and various other wild creatures

attempting to obtain a free meal. Despite provincial regulations prohibiting the shooting or entrapment of some of these animals, there was insufficient enforcement capability by fish and wildlife officials. Many farm operators, however, spoke of different approaches they were using to discourage predators, such as false bottom nets, screens, and electric shock. A number of submissions, however, called for a review and identification of appropriate predator control methods.

3.3.4 Impact on Water Quality and Marine Environment

A large number of interest groups expressed concern about potential damage to water quality and the marine environment created by finfish aquaculture. Many cited such effects as buildup of sediments on the sea bed, increased water cloudiness, increased algae growth, mortality of bottom creatures and plants, and destruction or reduced growth of nearby shellfish beds. The sources of these pollution factors were identified as excess fish feed falling through net pens, human waste disposal from living quarters, water current reductions by net pens, and blood and offal from cleaning and preparation of fish for market. These problems were to be encountered where the chosen farm sites have poor tidal flushing, shallow depth, and relatively high nutrient and sediment loads. Several studies performed in Europe and in Puget Sound, Washington were used to reference these problems as expected outcomes of combining improper farm practices with inadequate sites. Several examples were given of locations where site approvals had been made by the provincial Lands agency despite warnings by the DFO of inadequate natural conditions. Many groups called for monitoring of sites and long term studies to properly assess impact. The Oyster Growers Association called for a wide separation between fish farms and oyster farms until more could be found out about the effects on oyster growth. The farm industry acknowledged these potential problems but emphasized that it is in the farmer's own self-interest to minimize such impacts to maintain a healthy growing environment for his fish. It similarly recognized the need for proper site selection and testing. Most farmers already provided extensive monitoring of water quality for culture conditions, while some reported being involved in

specific studies with federal agencies to gauge impact around their sites. The industry also pointed to technological solutions to these potential risks, including bottom sediment vacuums or dispersal fans, and the planting of certain seaweeds to use excess nutrients in the water. Fish farmers also submitted that aquatic life beneath their pens was actually increasing, and that oyster growth was enhanced by nutrients from fish farms. Government agencies also referenced the Puget Sound study and others to indicate that the major environmental impact appears to be on the seabed beneath the farm site and dependent on site specific characteristics. They also reported a recent study in the Sechart Inlet, which concluded that at present production levels, salmon farms have little effect on surrounding water quality.

3.3.5 Use of Toxicants and Pharmaceuticals

Major concerns were raised about the effects of toxicants, antibiotics and hormones on human health and the food chain. The UFAWU identified a number of studies implicating the toxicant tributyltin (TBT) as a human health risk, through its concentration in the flesh of farm salmon and shellfish. The Oyster Growers Association and the UFAWU called for a ban on this toxicant, used as a net pen antifoulant dip. Other submissions merely called for greater awareness of its hazards by fish farmers and the use of alternative antifoulants. Some farms indicated they had stopped using TBT antifoulant for this reason. Government agencies indicated that the main source of antifoulants is from pen construction materials, and that construction standards were being considered for net pens to eliminate use of potentially harmful substances. They also reported recent studies which suggest TBT accumulations can be effectively dealt with. Federal agencies lamented the fact that despite stringent fish inspection standards, the lack of manpower and a close testing laboratory reduced the frequency of periodic checks on toxicant levels in farm fish.

The use of antibiotics was also identified as a problem by several groups, with concerns expressed that excessive quantities were being used to combat pathogens in farm fish, and which might lead to development of antibiotic resistant bacteria that could find their way into

the food chain. Government provided comments from a major study indicating that there is little likelihood of these problems occurring since the substances are water soluble and quickly diluted. Other submissions from a professional pharmacologist indicated that antibiotics are metabolized by the fish. Work was also cited which showed a low chance that antibiotic-treated fish food would contaminate nearby shellfish.

Discussion also took place on hormones used to manipulate the sex of fish for brood stock. While several interest groups were concerned about hormonal concentrations in fish and effects on humans, the farming industry indicated that there was no scientific evidence to show any harmful effect. It was also pointed out that farm fish have fewer hormones in their system when marketed than do wild fish.

3.3.6 Health and Safety of Farm Workers

Several people identified occupational concerns related to the working environment. A professional diver provided a lengthy discussion of inadequacies of fish farms in providing safe diving conditions and dealing with diving accidents. The lack of coverage by regulations, and the lack of proper net pen diver training were also considered problems. The UFAWU pointed to a number of recent diving accidents on farms, and was concerned that the risks would increase with the growth of the industry. The major aquaculture associations indicated their concerns about such deficiencies, and stated they have been working on standards. Some companies reported having their own safety committees for employees. A submission from a major finfish company also discussed the lack of safety standards on fish farms, including guard rails, personal flotation devices, emergency medical aid, and requirements for handling of chemicals and pharmaceuticals.

3.4 AGENCY APPROVAL ISSUES

3.4.1 Proliferation and Abuse of Section 10 Licenses

The Inquiry found Section 10 licences to be very contentious. The very large number of these licences issued in the past year was of major concern to all parties involved in the Inquiry, including the established aquaculture industry. A general misunderstanding of their intent and limitations was identified by provincial agencies as a reason for their unpopularity. Some instances of abuse were also identified in which licence holders began illegal farming operations on these sites with no subsequent remedial measures taken by government. Established operators were concerned that licences were being used for financial gain through speculation, and as means of tying up sites to prevent competition. Submissions dealing with Section 10 applications either recommended a halt to their use or a means of reducing their attractiveness. Limits on the number issued to an individual, increases in their cost, and bonds were called for. Bond amounts from \$500 to \$10,000 were suggested as a means of deterring speculation.

3.4.2 Control of Foreign Investment

Foreign investment in B.C. finfish aquaculture was identified as a major concern, even though it was not actually within the Inquiry terms of reference. The commercial fishery associations argued that it is not in the best interests of B.C. to have foreign control of the salmon farming industry because of the likelihood of export of jobs and profits. They requested strict controls to prevent foreign corporations from taking over B.C. farms and related industries. They also urged government to buy out such foreign investment where it exists today. However, the aquaculture industry and certain government agencies pointed to the necessity of foreign money to offset the reluctance of Canadian financial institutions to provide loans. They argued that foreign capital and expertise is necessary to establish the industry but will soon decline in importance as companies begin obtaining funds through stock issues, and as Canadian investors gain more confidence.

It was also pointed out that most of the foreign investment is through equity financing, whereby partnerships are established with existing farm owner-operators, rather than through takeovers and creation of subsidiary companies. In the service industry, such as feed plants and equipment, Norwegians were reported to have established some subsidiary companies, but competing Canadian ventures were on the increase. One submission from fish farm interests pointed out that there were no controls on the sale of fish boats.

3.4.3 Inadequate Consultation With Interest Groups

Many concerns were expressed over consultation of interest groups in the aquaculture approval process. Many groups expressed dissatisfaction with the application referral process, either because the time available to provide comments is too short (30 days) or because their interests are not included in the process. Such groups as native bands, recreation associations and fish and wildlife clubs identified the need for prior consultation. Others stated that because of scattered membership, constitutional needs and other factors they needed more time for meaningful input. This comment was supported by several provincial and federal agencies that participated in the referral process. The aquaculture interests observed that the short referral period was necessary to keep processing time delays to a minimum. Another related concern was the ineffectiveness of the required advertising of application notices in informing the general public. Some groups argued that in many areas of application there are no effective ways to advertise, and requested that either the applicant or the government seek to inform the public by letter. Several local governments and residents suggested that prior notification and consultation by the applicant would be beneficial to him in properly designing his operations for public acceptance.

3.4.4 Local Government Involvement

The majority of local government agencies heard from were concerned over their degree of influence and role in the approval system. Agencies with heavily populated districts were concerned that they were

given insufficient time or opportunities in the referral process to consult with advisory planning groups or landowners adjacent to proposed aquaculture sites. Their stated preference was for participation, rather than information in referrals and approvals. Many did not have zoning in place to adequately regulate aquaculture operations or to address its impact on local services and adjacent zones. Salmon farmers, however, had mixed responses to this issue. Some welcomed greater local government involvement to educate the public on the benefits of their operations and gain the security of local support. Others were more cautious, pointing to the delays that would be encountered and the ability of local politicians to be influenced by local resident groups with personal rather than community interests in mind.

3.4.5 Length and Complexity of Approval System

The finfish aquaculture industry identified the approval system as a source of frustration. The high number of agencies involved in site approval, business licensing, fish production plans, hatchery effluent discharge, transfer of live fish, inspection of fish going to market, navigation permits, and other requirements was seen as a major source of frustration. Several groups identified the need to establish a "single window" agency responsible for coordinating all agency approvals, while other submissions reported that the existing framework of approvals was adequate but needed to be streamlined.

Also of concern was the fact that the federal Department of Fisheries and Oceans (DFO) requires an aquaculture licence in addition to provincial approvals, and that many of its requirements were a duplication of those obtained from provincial agencies. In contrast, many submissions, including those from organized interest groups, pointed to a lack of tight provincial regulations and approvals. Many groups were obviously unaware of existing provincial requirements, but generally cognizant of DFO siting requirements for locating salmon farms near shellfish beds, spawning streams, harbours and docks, and commercial fishing, recreational and native food fisheries. Several examples of applications approved by the provincial Lands agency in disregard for DFO guidelines were raised by various interest groups.

3.4.6 Production Plans and Diligent Use Enforcement

Salmon farmers were concerned that the existing fish farm production plans were too onerous and are responsible for major delays in the approval system (up to six months). Their association argued for its replacement by a performance contract which commits the farmer to a certain level of performance. They indicated that the current requirements for costing information, husbandry strategies and production harvesting strategies are inconsistent with the entrepreneurial spirit that government has encouraged in the industry. Several government agencies also believed its focus should return to ensuring proper site selection and management, while others thought such information necessary to monitor industry production and to ensure farm operations are properly planned. The general public interest tended to focus on "diligent", or proper site use. Several concerns were expressed that the basis of diligent use should be maintenance of site environmental quality. The infrequency of site inspection to check on diligent use was also mentioned, with a general concern that the approval agencies were too busy dealing with the backlog of plans to be able to conduct field inspections. Another concern was that existing farm operators who need to make major changes to approved production plans cannot get priority attention for these changes. As a result, they are forced to operate in contravention of the original diligent use standards of their lease.

3.4.7 Inadequate Rental and Bonding Requirements

Many comments were received from commercial fishery spokesmen and several other interest groups about low rental of Crown land. Government agencies readily admitted that the annual rental charged for finfish farms was considerably less than for other commercial or agriculture uses of public land, including shellfish operations. They recommended a review of the rental structure with the intent of increasing rental, and proposed a number of alternate methods. In addition, several groups called for establishment of bonds to allow government to pay for site clean up in the event of environmental problems or termination of a finfish operation, especially given the potential for damage

and the often remote location of sites. Several submissions suggested that a portion of rentals and bonds be allocated for research studies on finfish environmental effects.

3.5 LAND AND RESOURCE USER CONFLICT ISSUES

3.5.1 Need for Coastal Planning Studies

A consistent comment during the Inquiry was the need for coastal planning studies. This comment was made by all affected groups, including recreational boaters, commercial fishermen, and government agencies. Groups showed maps outlining their key interest areas and offered to participate in planning. Specific approaches to the way planning should be done were also suggested. Some desired planning for the entire coastline, while others preferred to work on specific priority areas. The Campbell River area was identified because of commercial fishery and recreational boating concerns, while the Islands Trust area was recommended due to settlement patterns, shellfish resources and recreational resources. Calls were also made for a more comprehensive planning approach in the Sechelt Inlet, due to potential impact on shellfish aquaculture operations as well as environmental limitations. Salmon farmers tended to focus their comments on indirect planning measures, such as site separation guidelines.

3.5.2 Loss of Anchorage and Access

The loss of anchorage was identified as a major problem. Marine towing companies, commercial net fishermen, and recreational boating groups expressed concerns that the coastline would soon be devoid of open anchorages for emergency and recreational use. Recreational boaters mentioned encountering blocked access to favourite bays and public beaches. One submission reported of fish farmers having roped off entire bays and occasionally firing warning shots to discourage access. Where boaters had chosen to anchor near fish farms, they reported encountering noise and general loss of pleasurable experience. Several

groups were concerned about the potential loss of park and recreational area shoreline to aquaculture, particularly in Desolation Sound. In contrast, farm operators spoke of their concerns about boater noise, fuel slicks, and discharge of human wastes. Several did, however, mention the positive relations they have built up with boaters by offering fish, farm tours, mooring buoys and emergency aid.

3.5.3 Upland Owner Impact

Several local residents spoke of concerns about declining property values due to the imposition of a fish farm along their view frontage. There were problems identified regarding generator noise, lights, loss of private boat moorage, water pollution, and aesthetic value deterioration where farms were adjacent to homes. Several local municipalities indicated that the farms were benefitting local residents indirectly through greater tax revenue and increased employment. Some submissions also believed that in most contentious areas of concern the landowners were seasonal residents and not appreciative of such benefits. Opinions were also shared that upland resident reaction was based primarily on fear of change. The aquaculture industry was concerned that studies done with over emphasis on adjacent residential owner concerns would drive the industry into remote and uneconomical settings, such as was the case with a recently completed guide to applicants in the Sechelt area.

3.5.4 Physical Obstructions to Fishery and Navigation

Several presentations to the inquiry expressed concerns regarding the physical impact of fish farm sites. At least 4 examples were given by commercial fishery spokesmen of licences issued in traditional gill netting and seine netting grounds. Even if these licences might not result in farms, they were worried since there could certainly be impact on net dragging operations through installation of site monitoring equipment. Such occurrences were seen as evidence of disregard by provincial agencies for the commercial fishing fleet. A related concern was the navigational obstruction of fish farms, as feared by

representatives of the tow boat industry and recreational boaters. It was pointed out by the industry that Coast Guard permits are required to ensure navigation is not impaired, and that farms are required to place caution buoys within their vicinity. Coast Guard staff stated they were sufficiently concerned about the proliferation of site applications to be now considering more detailed permitting requirements.

3.5.5 Size and Spacing of Farms

Several resident groups, environmental interests and local government agencies wanted to see controls placed on the spacing or density of fish farms along the coastline and even within bays. Their concerns involved needs for reduction in concentrations of noise, environmental pollution, and aesthetics. Proposals for distance separations of up to 8 kilometres were made. Size limits on individual farms were also suggested as important to minimize such effects, and recent size restrictions imposed by the State of Washington were given as examples. Farm operators expressed concern over these suggestions, pointing out that many companies operate several farm sites and require closeness for economical reasons. Restrictions on area occupied by a farm could, they argued, lead to excessive crowding and stressing of fish, and result in increased fish mortality. It was also mentioned as preferable for a farm to have a relatively large area for "fallow" purposes to permit pen rotation.

3.5.6 Effects on Recreational and Tourism Industry

A number of submissions identified a major concern that the proliferation of fish farms would ultimately erode the tourism industry as related to recreational boating, sports fishing and commercial fish guiding. Statistics outlining the revenue and employment of this tourism activity were presented to show its significance compared to aquaculture. It was argued that environmental deterioration, reduced visual attractiveness, and disease-related reductions in the wild salmon population would all contribute to the decline in this industry. Aquaculturists believe that recreation and tourism would actually

benefit due to the attraction of touring farms. They also stated that increased demand by their industry for boats, motors, plastics and other equipment commonly manufactured by recreational related companies would increase employment in the recreation and tourism industries.

3.5.7 Involvement of Fishermen in Farm Industry

A central issue was the opportunity for commercial fishermen and shore-workers to become involved in the aquaculture industry. Several submissions identified Norwegian government programs designed to allow fishermen to offset their short income earning period with fish farm employment. The Prince Rupert Fishermens Co-op was cited for its attempt to encourage fishermen in this fashion through loans and technical training. The greater safety and efficiency of farming rather than chasing fish was frequently mentioned as evidence of the desirability of increased farm involvement. Fishermen, however, found the concept unacceptable for philosophical reasons, stating a preference for being "high seas hunters" rather than farmers living, in their opinion, a boring and isolated existence. Some identified the low wages of farm work as a major factor, while many submissions pointed to the very large capital outlay required to start a fish farm and the difficulty of obtaining loans. The fallacy of believing that "ma and pa" operations could ever develop with the large investment now required was also mentioned, and generally confirmed by existing farm operators. In addition, the heavy commitment to fishing through investment in equipment, licences and vessels was also identified by fishermen as a major factor working against their entry into the aquaculture industry.

4.0 RECOMMENDATIONS TO GOVERNMENT

4.1 GOVERNMENT SUPPORT

- 4.1.1 The provincial government should continue its support for the finfish aquaculture industry.

British Columbia has demonstrable competitive advantages over other countries in attracting and developing a world-scale finfish aquaculture industry. It is important to the economic growth and diversification of the province that government continue its support of the industry in key stages of development. The 70 currently operating salmon farms already represent a direct capital investment of \$75 million, employ 375 people directly and annually spend an estimated \$50 million on services and supplies. Aquaculture holds the promise of expanding employment, increasing capital investment in B.C., revitalizing economically depressed communities, and strengthening the commercial fishery sector as a whole. The Province should seize this opportunity to generate additional capital, employment, and business activity along the coast.

- 4.1.2 The provincial government should develop a provincial aquaculture policy which clarifies provincial direction, agency roles, and the responsibilities of both government and the private sector for the industry.

The lack of a strong provincial statement is viewed as detrimental to orderly and efficient growth of the industry. Development of such a policy should provide better understanding between government and the industry, reduced likelihood of competition between programs of different agencies, and better coordination of government activities. It is also viewed as necessary to ensure that environmental, land use, social and economic factors are identified as critical components of growth and regulation of the industry. Inclusion of policy on these topics of concern will help alleviate public concerns over lack of controls, and lack of protection of the public resource. It would also serve to off-

set creation of the image of an uncontrolled, "gold rush" in aquaculture, which has been responsible for generating considerable misunderstanding and suspicion about provincial government objectives. This policy should be developed by the provincial lead agency and formally adopted by all pertinent ministries.

- 4.1.3 The provincial government should establish an aquaculture advisory council from key agencies and interest groups.

The Inquiry supports the recent provincial government call for an aquaculture advisory council. This group will be able to provide an industry perspective on resolution of issues, government program priorities, interagency agreements, and provincial policies. Direct involvement of the industry is considered critical for the development of finfish aquaculture, and should ease its adjustment to changes in government regulation and support as it continues to evolve. The Inquiry believes that other key resource user groups should also be members of this council. Representation by commercial fishery groups, native groups, recreational groups, and the Fisheries Council of B.C. would ensure that future industry development is in harmony with these interests.

- 4.1.4 The provincial government should continue to encourage private sector initiatives as the basis for growth and development of the finfish aquaculture industry.

The B.C. finfish aquaculture industry has to date developed with very limited direct funding. The provincial government has provided some financial assistance programs; while both federal and provincial agencies have provided support in marketing, research, egg supply, disease and diagnostic services, and other critical areas of the industry during its initial stages of development. Evidence suggests that the industry is rapidly attracting the expertise and capital to provide its own servicing needs without the necessity of long-range government involvement. Controls on foreign investment, vertical integration and other elements of a free enterprise system in this industry are inconsistent with the treatment of other industries in British Columbia.

- 4.1.5 The provincial government should proceed immediately to establish a master agreement with the federal government respecting approvals, regulation, monitoring and servicing of the finfish aquaculture industry.

Both provincial and federal agencies are involved in regulation, approvals, monitoring, marketing, and promotion of the industry. To assist in the streamlining of industry approvals, assure protection of wild fish stocks and monitor the environment, the two levels of government should coordinate their efforts. This agreement is also needed to reduce incidences of agency friction and establish clearly in the public mind specific responsibilities and jurisdictions. The Inquiry believes that such an agreement should promote the development of "subsidiary" agreements between specific agencies on particular issues, such as referrals and site monitoring. One agency in each government level should be designated the lead agency to work with others in developing the master agreement. Federal agencies should include Department of Fisheries and Oceans, Environmental Protection Service, the Coast Guard, and Indian Affairs.

- 4.1.6 The provincial government should support greater cooperation with local government in promotion, planning and approval of finfish aquaculture.

Cooperation between both levels of government is important for political, economic and social reasons. Local government is the first line of approach when local residents object to a proposed fish farming operation. Unfortunately many local governments are unable to direct the proposal to more socially-acceptable locations. In other instances, proposals are poorly advertised or referrals are made with inadequate opportunity for local citizen comment. In some locations along the coast, local governments are eager to attract this development but lack the resources and expertise. Provincial cooperation should include funding for promotion and planning of aquaculture, provision of model by-laws, and participation by provincial resource agencies in local planning. It should also include the opportunity for better consultation with local government and a commitment for greater

consideration of local government concerns in the tenure approval process.

- 4.1.7 The provincial government should affirm and maintain its commitment to the federal-provincial Salmonid Enhancement Program, Phase 2.

The Salmonid Enhancement Program is very important to the commercial and sport fishing industry as a supply of wild salmon stock. It is similarly of great importance to the salmon farming industry at this time as a source of eggs for brood stock and marketable fish. Phase 2 of the program is designed to establish additional wild stock hatcheries in B.C. Continued support of the Salmonid Enhancement Program is necessary to assure prosperity of all segments of the B.C. fishery. A statement of continued provincial support should include a commitment to provide SEP funding, provincial land for site requirements, and to procedures and policies of government agencies preventing degradation of enhancement watersheds.

- 4.1.8 The provincial government should lift the current moratorium on the adjudication of applications for finfish aquaculture sites.

The information made available to the Inquiry fails to adequately substantiate maintaining the October 31, 1986 moratorium. The Inquiry believes that the recommendations contained in this report, if implemented, will alleviate most of the problems attributed to fish farming and establish mechanisms for alleviating the others.

A larger or lengthier commission of Inquiry would certainly have generated more detailed scientific submissions and more information on market impacts and resource conflicts. It is doubtful, however, that the outcome of this report would have been substantially different. The moratorium should be lifted in conjunction with initiation of the studies and policy changes recommended in this report.

4.2 INFORMATION AND EDUCATION

- 4.2.1 The provincial government should expand its public information programs to provide a broader range of services and information access.

Public information on finfish aquaculture and its potential impacts is both limited in scope and availability. While a number of government agencies have developed brochures on specific topics, these have been directed to specific user groups and largely written in reaction to problems. These publications tend to be distributed in areas only after aquaculture concerns have surfaced and not before. It is also important for the provincial government to increase its circulation of information to a much wider segment of the population, including schools, libraries, municipal halls, and interest groups.

Public access to research reports acquired by government is also suggested. This can be done through the industry newsletter published by government and by distributing summaries of findings to the many interest groups affected by, or interested in the results of these marketing, environmental, or land use studies. The government should also seek to increase public awareness of the aquaculture resource centres that it has helped establish. Such information and education programs should be rationalized as part of a broader extension services function by the Ministry of Agriculture and Fisheries.

- 4.2.2 The provincial government should encourage a formal communication link between the commercial wild fishery and finfish aquaculture associations.

Increased awareness and understanding between commercial fishermen and salmon farmers is a desirable method of reducing friction. The results of this Inquiry will certainly increase group awareness but will be less effective in promoting understanding. The provincial government is urged to create opportunities for formal exchange of interests among these groups by involving both in future planning studies, advisory

councils, seminars, conferences, and other activities of mutual interest sponsored by government. Through such learning processes the two groups may be able to minimize philosophical differences and work to the benefit of the entire B.C. seafood industry.

4.3 NATIVE INVOLVEMENT

- 4.3.1 The provincial government should endorse federal initiatives to increase native involvement in finfish aquaculture development.

Finfish aquaculture provides a rare economic development opportunity for native bands. They are, however, disadvantaged with respect to ability to obtain the necessary venture capital, job training, farm management expertise, marketing and support services. The federal government, which has prime jurisdiction over native affairs, should be encouraged to develop programs to assist native bands in overcoming these disadvantages. The provincial government should seek ways of involving native bands in its aquaculture assistance and extension programs.

- 4.3.2 The provincial government should encourage the finfish aquaculture industry to involve native peoples in the industry.

Native communities provide several potential advantages to aquaculture developments. In remote areas they will offer a stable and readily available source of farm labour. Joint venture developments on Indian reserves may offer tax advantages as well as the potential for accessing federal funds related to manpower training and native economic development. Several farm operations have realized these advantages and are including natives in their employment plans. The Salmon Farmers Association should establish a policy to promote native interaction and utilization and encourage their participation in the industry and in its association.

- 4.3.3 Current aboriginal land claim negotiations should not influence government policies and procedures respecting issuance of finfish aquaculture tenures.

The current dispute over aboriginal land claims threatens to disrupt the opportunities of native bands to become involved in the aquaculture industry. The provincial government should ensure that aquaculture applications by native bands are dealt with using the same process and time periods that govern the review and adjudication of any other application. Tenure documents issued to native groups should also be no different in substance than those issued to other applicants. Conversely, native groups cannot expect the province to abrogate its current jurisdictional responsibilities for land tenure as a result of this Inquiry, and must be prepared to obtain legal tenure from the province in order to initiate aquaculture development. It would be irresponsible of either party to use the land claims issue to the detriment of future economic development of native communities.

- 4.3.4 The provincial government should recognize native bands as legitimate interest groups in the land referral and tenure process.

The Inquiry does not support the native group call for control on tenures within an 8 kilometre radius of Indian reserves, due to the implications for the aboriginal land claims position. Native bands nevertheless deserve equal treatment with other interest groups when applications are made in the vicinity of reserves. Referral of finfish aquaculture applications should be made to native bands when proposed sites are adjacent to, or within 3 kilometres of the boundary reserve. Referrals will be useful not only to allow an identification of potential resource conflicts, but also to allow the band to discuss with the applicant the possibilities of native involvement in the aquaculture operation.

4.4 FISH MARKETING AND PROCESSING

- 4.4.1 The provincial government should continue to rely upon market forces to dictate farm and wild salmon prices.

The Inquiry believes that the increased production of B.C. farm salmon will enhance the economic health of the total fisheries industry of the

West Coast. Government efforts to eliminate or minimize fish farm "competition" through marketing controls, production limits, or other mechanisms, would have little effect on prices of wild chinook and coho, since competition will be derived from foreign sources of farmed salmon on the world market. B.C. farm salmon products have not been demonstrated to affect wild salmon prices to date, and should be able to avoid price influences in the future by concentrating on specialty markets in the USA in which the major wild catch product does not compete.

4.4.2 The provincial government should support a strategy for the integrated marketing of B.C. farm and wild salmon products.

Improved marketing of B.C. salmon is the most desirable course of action to strengthen both finfish aquaculture and commercial fishery industries. New markets should be explored, as well as new ways of packaging and new types of salmon product. More efficient marketing and quality improvement is also required. Products should be directed to different markets at different times of the year, and distinctly identified as B.C. products. The government can support such a strategy through financial assistance, trade missions, and technology transfer. Government should also work with industry to monitor downstream market impact of this strategy on salmon prices to gauge the degree of compatibility of wild and farm products in the market place.

4.4.3 The provincial government should promote use by the aquaculture industry of existing processing plants and infrastructure developed for the wild fishery.

The Inquiry believes the current trend among existing farm operators to process their product through existing plants, and the increased joint venturing and contracting between existing processing companies and fish farms will strengthen the fishing industry in B.C. and should be encouraged. Government promotion should include review of regulations governing the on-farm processing of salmon, transport of live salmon to plants, and inspection and grading of processed products both on and off-farm.

4.5 MARINE ENVIRONMENT

- 4.5.1 The provincial government should increase its support for research and studies on the potential long-term effects of salmon farming on the marine biological and physical environment.

Studies performed to date do not confirm the fears expressed over the effects of fish farming on the marine environment. Available studies identify the major impact as alteration of the local seabed due to the build up of organic waste from fish pens. The Inquiry believes that studies should be initiated in selected areas to develop an improved information base on this subject. In particular, studies should be performed on the effects of fish farms on shellfish and other bottom dwellers, and upon water quality. These studies will prove as important to the industry in identifying potential problems as they will to the general public. Support should come through form of grants to independent research facilities and universities as well as through government staff investigations.

- 4.5.2 The provincial government should establish a mandatory environmental monitoring and data gathering system for each aquaculture site and surrounding area, the results of which should be submitted on a regular basis for review of changes in environmental quality.

Environmental monitoring represents a major deficiency in the regulation of finfish aquaculture. While most finfish aquaculture operations maintain a monitoring system, the logical focus is on-site growing conditions. Monitoring of on and near-site environmental conditions should become a standard requirement of aquaculture tenures, with the measurements to be recorded and regularly submitted for government review. The Environment ministry should establish the parameters to be measured, acceptable standards for these parameters, and methods of measurement and recording. The parameters should be those commonly used to assess changes in marine environmental conditions and also those of value for monitoring of the finfish growth environment. This data will be of value in studies of long-term environmental changes and

can also be used to determine whether or not an operation should be moved. Inherent in this requirement is the necessity for government to establish standards which divide acceptable conditions from unacceptable.

4.5.3 The provincial government should end the importation of Atlantic salmon eggs.

The continued importation of Atlantic salmon eggs extends the risk of introducing European diseases to wild stocks, with consequent impacts on the fishing industry. This risk exists despite the severe screening, quarantine and effluent treatment standards imposed by government on egg imports. A draft federal-provincial agreement confirms these rigid standards and calls for an end to egg importation in March, 1989. While supporting most of the agreement, the Inquiry believes importation should be maintained only for the time necessary for the industry to meet existing purchase commitments. Brood stock is now or will shortly be producing eggs to supply West Coast farms. Provided that small volume imports are occasionally permitted for genetic improvement, a fall-1987 closure is considered realistic. The two governments are urged to ratify their agreement with amendments as noted above. This reduction does, however, place greater importance on the need for government to maintain its commitment to supply surplus chinook and coho eggs to the aquaculture industry.

4.5.4 The provincial government should continue the use of a distance guideline to separate fish farms, and should apply this guideline to separate fish farms from shellfish aquaculture operations.

Transfer of native diseases between fish farms should continue to be minimized to reduce the potential for crop losses to aquaculturists. The Inquiry believes that the current 0.8 kilometre distance used to separate fish farms should be increased to at least 3 kilometres, and that the guideline be similarly applied to separate existing oyster farms from proposed fish farms. Any decision to reduce this distance

for a new farm should be based on specific site factors, such as flushing and depth characteristics, and not on the preference of the established operator. This recommendation does not rule out the possibility of growing salmon and oysters in the same farm operation, but serves to protect existing farms from new ones.

- 4.5.5 The provincial government should establish, in conjunction with industry, environmental practices for fish farms addressing aesthetic considerations, disposal of dead fish and human waste, predator control, and efficient feeding practices.

A variety of on-farm operating practices have the potential for damaging effects on the local marine environment and its enjoyment by other users. Although most existing farm operators are very conscious of maintaining sound environmental practices they should be documented and distributed to encourage their application on the farm and change public perceptions. It is suggested that a handbook be prepared in consultation with the industry and made available to aquaculturists and the public through government aquaculture extension services.

- 4.5.6 Government should increase its research, health inspection and testing activities with respect to the impact of toxicants, hormones and antibiotics used in finfish aquaculture on the environment and the human food chain.

As with most cultured food products, farm fish are exposed to a number of chemicals designed to manipulate growth and maintain health. The findings of several recent studies indicate no human health implications with the possible exception of the toxicant TBT, used as an anti-foulant for net pens. Investigative research and testing is required to provide more information on the type, degree and severity of risks as a basis for eliminating them. At present, stringent provincial and federal legislation is in place to govern the testing and inspection of fish products for the presence of toxic materials, hormones and antibiotics. However, evidence suggests that inspection activity is very

limited due to staff shortages. Testing is also infrequent due to the remoteness of federal testing facilities. Both of these activities should be increased.

- 4.5.7 Government and industry should support the development and operation of an aquaculture research centre as a focus for environmental studies, disease research, fish testing and diagnostic services.

The controversy over potential environmental impacts of finfish aquaculture has underlined the importance of research studies and testing. Research needs have been identified in almost every specific area of environmental concern addressed by this report. Staff and funding levels in government have not kept pace with growth of the industry. While private sector initiatives in research have been commendable, they have focused on developmental aspects of fish culture rather than environmental effects. Government should expand its responsibility for research on those aspects of fish culture affecting other marine resources and seek to provide the testing and monitoring services for public benefit as described in Recommendation 4.5.6.

- 4.5.8 Government should encourage establishment of standards for finfish aquaculture equipment to remove the potential for accumulation of toxicants in farm fish products.

The toxicant tributyltin (TBT) is a current concern at this time. Since the source of most toxicants in fish flesh is specific plastics and paint used in net pen structures, the provincial government should encourage the appropriate federal board to establish legally enforceable standards for finfish aquaculture pens and other containment devices. These standards should eliminate the use of toxicants which may affect human health through concentrations in fish and shellfish. Government should also request a full review by the federal Department of Agriculture of TBT health impacts. In the meantime, the province should discourage the use of TBT as part of its extension and information services program (see Recommendation 4.5.5).

- 4.5.9 The provincial government should undertake a review of the occupational environment of finfish aquaculture operations to ensure appropriate regulations for occupational health and safety are in place.

The Inquiry believes that attention must be focused towards impacts of finfish aquaculture on the working environment of its employees. A review of existing labour regulations applicable to finfish aquaculture is appropriate given the projected increase in farms and farm workers, and should include requirements for diver training and rescue, personal flotation devices, hand rail systems, emergency medical services, and proper handling of chemicals and pharmaceuticals.

4.6 USER CONFLICTS AND SITING

- 4.6.1 The provincial government should initiate a program of coastal resource identification studies for use in directing aquaculture applications away from major resource and user conflict areas.

The importance of multiple use of coastal waters and the diversity of resource users must be acknowledged. While the application referral process of government attempts to consider such factors it creates considerable uncertainty among competing site users about the identification and protection of their interests. Planning studies are urgently required to minimize this uncertainty. The most appropriate course of action at this time is to initiate studies that will identify sites of high value for other important coastal interests and which should be reserved from aquaculture activities. Identification of these sites will allow government to direct aquaculture proposals to areas where physical impact on other users will be lessened. Specific siting within these remaining areas can then be determined on the basis of environmental factors.

- 4.6.2 Coastal resource identification studies should be initiated immediately for the Campbell River - Johnstone Strait, Islands Trust, and Sechart Inlet areas with direct involvement of all resource user groups in those areas.

Three particular areas of the coast require priority attention for completion of coastal resource studies. These were identified on the basis of areas of conflict apparent in written and oral submissions to the Inquiry, and on the areas of high aquaculture growth projections as identified through the mapping of Section 10 licence applications. The studies for areas of lower priority can be initiated under less pressing circumstances. The quality and success of these studies will depend on the degree to which all recognized interests are involved. Government should review the information record of this Inquiry to identify interest groups in the priority study areas. They will include commercial fishery unions, tow boat operators, recreational boaters, aquaculture associations, native groups and local government. Such studies should aim for completion within a 10 week time frame, given the need to maintain confidence in the finfish aquaculture industry and the fact that many groups have already mapped their high interest areas.

4.6.3 The provincial government should discontinue issuance of aquaculture licences adjacent to provincial parks and recreation areas.

Maintenance of natural shorelines fronting provincial parks and recreation areas is considered important for aesthetics, anchorage, and a satisfactory recreational experience. The potential aquaculture sites along the coast line are sufficiently great that the provincial government should feel no obligation to authorize finfish aquaculture adjacent to park and recreation areas. While there are no finfish aquaculture operations in such areas at present, they are no doubt attractive due to absence of adjacent residents and other potential sources of conflict or competition. A statement from government on this matter will ease considerably the concerns of the public.

4.6.4 Local governments should be encouraged to develop or refine local zoning bylaws to address finfish aquaculture operations within their boundaries.

The Inquiry believes that approval of aquaculture locations should remain a provincial resource allocation decision. However, zoning is a

major tool available to local government to ensure aquaculture operations are compatible with adjacent uses. Local zoning for aquaculture is highly desirable in the more heavily populated areas of the coast, and should be encouraged through provincial technical assistance and grants. Zoning should emphasize restrictions on operating conditions, aesthetics, servicing and other items of community importance and consider the economic implications of such restrictions on the proposed fish farms.

- 4.6.5 The provincial government should utilize a minimum distance separation guideline for fish farms in populated coastal areas as a means of reducing impact on upland owners and other resource users.

In most cases fish farms are located a sufficient distance offshore to avoid impact on riparian rights of upland owners and navigational rights of boaters. However, concerns exist in some areas over visual impact and reductions in property values due to increasing concentrations of farms along the coastline. To address these concerns the Inquiry considers it appropriate to establish a distance separation between farms. To date, distance separation relates to concerns over disease transference between farms. However, the concept is also valuable for use in establishing a crude development density in selected coastal areas, in the absence of detailed site investigation or resource user information. The distance should coincide with that established for disease as in Recommendation 4.5.4.

- 4.6.6 The aquaculture industry should be encouraged to institute a program to provide anchorage, access, and emergency assistance to other coastal resource users.

Coastal resource identification studies will not entirely negate the requirements of other coastal resource users for access to previously undeveloped bays, coves and beach areas. It is in the best interests of fish farmers to offer safe anchorage, emergency medical and mechanical assistance, and other services to boaters under controlled conditions. A "friendly cove" program could be developed among the aquacul-

ture associations which provides standard identification signs and outlines basic services available from participating farms. Government could assist through navigation chart identification and through information and extension services aimed at public and commercial boaters.

4.7 REFERRALS AND ADVERTISING

- 4.7.1 The provincial government should continue its use of the interagency referral system as a primary tool for conflict resolution.

The referral system for approval of land applications is important to government as a primary planning tool to identify land use concerns of various interest groups. It is also of value in identifying site limitations and establishing special management provisions to be attached to the legal occupation of the land. The referral system should therefore continue to play an integral part in the finfish aquaculture approval process. Within areas where coastal resource identification studies are in place, it will be more appropriate to give greater weight to referral comments dealing with environmental characteristics of proposed sites and special management considerations rather than user conflicts.

- 4.7.2 The provincial government should expand its list of referral groups, increase the time available for response, and establish subsequent notification practices for finfish aquaculture referrals.

The provincial Lands agency should reduce the discretion available in selecting interest groups to participate in its referral process and establish a broader list of standard interest groups to be consulted. These should include commercial fishery groups, native bands, oyster growers, and recreational boating interests. The information record of this Inquiry should assist in identifying such groups. The time available for meaningful comment on applications should also be extended. The Inquiry believes that a sixty day referral period is necessary, given the increased involvement of groups whose comments are made difficult to assemble as a result of remote locations, commitments to

full communication, or broad membership distribution. The notification practices of government are also in need of change to ensure that the referral groups are informed of the outcome of the review process for inventory and planning purposes.

- 4.7.3 The provincial lands agency should establish an agreement with federal agencies respecting siting of tenures, information requirements, documentation of concerns, and importance given to referral comments.

The overlapping site approval requirements between the provincial and federal agencies is a source of frustration to the aquaculture industry, and deleterious to public confidence in the ability of government to provide adequate development safeguards. The Inquiry believes that the Department of Fisheries and Oceans (DFO) must be an integral part of the provincial referral system in order to assist in streamlining the approvals procedure. DFO approval of a site should be required prior to the issuance of tenure by the provincial Lands agency. An agreement will be necessary to establish this relationship and to reconcile requirements of both agencies for growing sites and hatcheries. It is also required to determine the degree of substantiation that is acceptable to the provincial government as a basis for site rejection. This agreement should be a subsidiary to any master agreement on finfish aquaculture established between the provincial and federal government as per Recommendation 4.1.5.

- 4.7.4 The provincial lands agency should review its practices involving advertising and notification for prospective finfish aquaculture operations.

The lack of adequate public notification of finfish aquaculture applications should be remedied by the Ministry of Forests and Lands. Current requirements should be reviewed to ensure that notification reaches residents adjacent to the site, especially where such residents are poorly served by the print media. Telephone, letter or other communication services may be required to offset the lack of notification. Where rezoning is required, or where no zoning is in place, an

applicant should also be required to notify local residents and local government of his intentions, as a means of activating discussion. Such notification will be of value to the applicant in site and facility planning as well as in determining the likelihood of local government cooperation.

- 4.7.5 The provincial lands agency should place greater emphasis on local government input to the finfish aquaculture referral process.

The degree to which local government referral comments influence provincial decisions on aquaculture should be clearly identified in government policy. The relevance of local government comments has generally been minimized by the lack of time available to respond to the referrals. Extension of the referral period to 60 days should assist in lending more weight by providing local government the opportunity to obtain additional information. Local governments should use the additional time to refer the applications to local advisory committees or to affected adjacent landowners for input, as a means of increasing the impact of their recommendations.

4.8 PRODUCTION PLANS AND DILIGENT USE

- 4.8.1 The provincial government should remove requirements for cost, husbandry, production and harvest strategies from its fish farm production plan.

The Inquiry believes the involvement of government in finfish aquaculture is more appropriately directed to the protection and proper management of public resources, rather than to private businesses and privately-owned fish. Removal of costing information, husbandry strategies, production and harvest strategies from existing production plans is needed to return the government focus to resource management, and to assist in streamlining the approval process. Increased government field extension services, and the need to obtain business financing should ensure that the prospective aquaculturist is cognizant of these requirements. Site characteristics, locational information, and

schedules of improvements should constitute the main elements of the plan for site management.

- 4.8.2 The provincial government should establish minimum fish production levels and environmental quality standards for use in measuring diligent use, and increase its site monitoring and inspection activities.

Standards are required to allow government to determine whether or not a finfish aquaculture operation is making appropriate use of a tenured site. A minimum production level of fish is the simplest and most appropriate measure of diligent use from a development perspective. Standards should be prepared on the basis of current knowledge of fish mortality and growth rates by species at different ages, and combined with an applicant's schedule of net pen improvements to establish annual production levels for each year of operation on a site. From a protection perspective, diligent use should be measured according to changes in site environment as measured against standards proposed as per Recommendation 4.5.2. Failure to maintain environmental standards or to achieve fish production levels should be a basis for tenure cancellation. The existing level of site inspection must also be increased to enforce diligent use.

- 4.8.3 Production plans for site and improvement locations should be expanded to include the demarcation of public use and access requirements.

The production plan approved by government becomes a legally enforceable component of the lease or licence tenure. It therefore provides an opportunity to legally incorporate desirable forms of access and assistance to other users. The site map and location of improvement submitted in a plan should be required to indicate provisions for emergency or overnight anchorage, access channels to public beach, and riparian access channels for upland owners where applicable. These requirements are appropriate to promote cooperation between private finfish aquaculture and public interests along the coastline.

- 4.8.4 The production plan process should establish a priority system to accommodate review and approval of significant plan revisions necessitated by disease outbreak, tenure assignments, and other factors influencing tenured operations.

The policy of requiring approval of alterations to existing production plans is basically sound but causes difficulty as a result of the existing backlog of production plans in the review process. Government should give priority to review of modifications required for existing farms. This practice should not be used to expedite the plans of farms which are in illegal occupation of sites, but rather to accommodate problems or requirements of existing tenured farms.

4.9 LAND TENURE

- 4.9.1 The provincial government should continue its use of Section 10 of the Land Act to authorize site investigations for finfish aquaculture.

The Section 10 licence is an appropriate form of tenure for the finfish aquaculture industry. It provides the opportunity to conduct site research and investigation without committing government to subsequent approval of a fish farm. Unfortunately its use has been largely responsible for the "gold rush" image created in the public mind and has been abused in some areas by establishment of unauthorized improvements and fish production. To offset this negative image and more accurately reflect its nature, the Section 10 should be renamed (eg. "investigative permit"). In addition, government should begin to increase its surveillance of these permits and cancel them upon discovery of abuse.

- 4.9.2 The provincial government should require a commitment bond to accompany all finfish aquaculture applications.

A commitment bond is recommended as a means of minimizing the ability of applicants to tie up potential sites for speculative or competition reducing purposes. As the name implies, this bond should establish the

commitment of an applicant to seriously pursue his aquaculture interests. The Inquiry believes that such a bond should also be used to provide a source of funding for joint government-industry research on aquaculture development and environmental effects. Consequently the bond should be levied for all types of finfish tenure applications. Government should implement a system of refunds and partial refunds for the bond, which ensures that each application generates some level of support for research on the basis of success in the approval process. With this bond system in place, it may be unnecessary for government to retain an arbitrary ceiling on the number of sites which can be applied for by one applicant.

4.9.3 The provincial government should revise its rental rates and clean-up bond requirements for finfish aquaculture tenures.

Inadequate rentals and clean-up bonds are a recognized weakness in existing government policy. The maximum rental of \$200 per year is insufficient compensation to government for private use of Crown land. The Inquiry recommends a new rental structure be established, consistent with other approaches used by the provincial government. Clean-up bonding should also be required as a condition of tenure. Government should require deposit of a bond to cover clean up expenses in the event of cancellation or abandonment of the site tenure. The bond should be accessible to provincial and federal agencies responsible for rehabilitation of such sites.

4.9.4 The provincial government should review and expand its legal tenure documents for finfish aquaculture.

This report recommends a shift in the regulation process towards provision of environmental safeguards, consideration of other user interests, and conflict avoidance. Such items should be incorporated as legally enforceable provisions of leases and licences issued for finfish aquaculture operations. They include special provisions for mandatory site monitoring and reporting, aesthetic and visual standards, and demarcation of tenure area. The identification of naviga-

tion and access channels and emergency anchorage should also be included as per Recommendation 4.8.3.

4.10 PROVINCIAL AGENCY APPROVAL SYSTEM

4.10.1 The present provincial agency approval framework should be maintained.

The Inquiry believes that the finfish aquaculture approval system should continue to evolve within the existing framework of legislative responsibilities. Establishment of a "single window" agency would, unless accompanied by a major legislative overhaul, result in one additional level of contact, further time requirements, and major staff reallocation. To be effective, the single window agency would have to be a neutral rather than an advocate agency. The consolidation of legislative requirements affecting aquaculture siting and approval (eg. an Aquaculture Act) would create anomalies and inconsistencies among remaining programs of the affected agencies. The Inquiry suggests that agencies involved in the existing process should continue to work together using operational agreements and other mechanisms to achieve their objectives. Policies and procedures should be constantly reappraised to ensure they continue to encourage orderly development of the industry and safeguard the public interest.

4.10.2 The role of the Ministry of Agriculture and Fisheries as lead provincial agency should be clarified and focussed.

The role of lead agency is presently blurred by the heavy involvement of the Ministry of Agriculture and Fisheries in production plan approvals. As such it is often perceived as a support agency for the Ministry of Forests and Lands, which is responsible for approval of land tenure. Absence of a major field extension and information services program also diminishes the public perception of Agriculture and Fisheries as the lead aquaculture agency. To clarify its role, the Ministry should reallocate its aquaculture resources to satisfy ever-increasing needs for extension services to fish farmers, information to the public, and research support to both industry and environ-

mental monitoring agencies as per recommendations in Section 4.2. In addition it should begin a central inventory service for up-to-date information on tenures, land interests, land conflicts, and coastal resource inventory data of value to future aquaculture planning and development.

4.11 REPORT IMPLEMENTATION

- 4.11.1 Due to the broad scope of the Inquiry terms of reference, the report on finfish aquaculture in B.C. should be reviewed by all provincial government ministries with responsibilities for implementation of its recommendations.
- 4.11.2 The implementation of recommendations by individual agencies should be done in a coordinated manner and over as short a time period as possible to minimize disruption to the finfish aquaculture industry and to prevent speculative activity.
- 4.11.3 Adjustments to the government approval process and the preparation of coastal resource identification studies should be performed over the same time frame.
- 4.11.4 In fairness to those tenures caught in the government moratorium, finfish site applications filed before October 31, 1986 should be allowed to proceed under existing policies and procedures. Those received after the October 31 moratorium should be subject to new policies, procedures, and resource study restrictions as they fall into place.
- 4.11.5 Given the many similarities and the efficiency of a single policy framework, the recommendations of the Inquiry on finfish aquaculture should be considered by government for their application and relevance to other forms of commercial aquaculture.

SALMON FARMING IN BRITISH COLUMBIA

Prepared by the B.C. Salmon Farmers Association

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WHAT IS THE B.C. SALMON FARMERS ASSOCIATION?

The B.C. Salmon Farmers Association was incorporated July 11, 1984 under the Societies Act of British Columbia to serve as a producers' organization dedicated to furthering the salmon farming industry and the interests of its members.

Starting with nine charter members, the Association's membership now totals 75, which represents some 95% of active salmon farmers in British Columbia. A ten member Board of Directors, representing a cross-section of members with respect to size of operation and geographic location, establishes policy. A full-time staff of six implements policy and administers the affairs of the Association.

To broaden the range of services delivered to members, the Association has recruited a Director of Communications, a Director of Research and a Director of Marketing. Comprehensive programs will be developed in each of those areas and implemented early in 1987.

The Association has initiated and now operates active programs in the following areas:

- disease screening
- egg allocation
- brood stock development
- marketing studies
- education

Disease Screening

A program to halt the vertical transmission of disease from parent salmon to offspring was initiated by the Association in 1985. Screening techniques and protocols were developed in conjunction with Malaspina College, Nanaimo, and with the staff of the Pacific Biological Research Station, Department of Fisheries and Oceans, Nanaimo. The program ensures that all diseased eggs are destroyed and only disease-free eggs are distributed to salmon farmers.

Disease screening is not utilized on eggs used in the Department of Fisheries and Oceans' Salmonid Enhancement Program (SEP), thus increasing the risk of disease being introduced into the wild salmon stock.

Program costs of \$250,000 in 1985 and \$600,000 in 1986 were paid by farmer members of the Association. In addition, salmon farmers paid for some \$100,000 worth of laboratory and other equipment required by Malaspina College to conduct the disease screening program.

In 1986, the Ministry of Agriculture and Fisheries provided \$60,000 to fund development of a comparative method analysis for disease screening. This method is expected to increase screening effectiveness at reduced cost in future years.

Egg Allocation

One of the Association's principal functions is to allocate eggs to farmer members, a role the Association accepted in 1985 at the request of the Department of Fisheries and Oceans. Up until that time, a salmon farmer ordered eggs direct from the Department. But as the number of farms increased, the Department found it increasingly difficult to satisfy demand on an equitable basis, and asked the Association to develop and administer an equitable egg allocation system.

The Association's present allocation system is based on three main principles:

1. New farms are assured enough eggs to start their own brood stock.
2. Existing farms expanding their capacity have the same egg rights as new farms, to the extent of the expansion.
3. Farms with product in the water get first right to egg quantities equivalent to those received in the past, provided that total industry needs are considered.

Historically, all eggs have been purchased from the Department of Fisheries and Oceans hatcheries. These eggs are from fish returning to Salmon Enhancement Program hatcheries and are surplus to S.E.P. management needs. Any of these returning fish not used by B.C. Salmon Farmers Association members for eggs are sold to processors; thus, any eggs not used by the industry are wasted.

As domestic brood stocks develop, reliance on S.E.P. sources will decrease over time. The point at which the industry achieves self sufficiency in egg supply will depend on its rate of growth, but the advantages of domestic versus wild stock should ensure relatively rapid development.

By the end of 1986, the Association allocated some 30 million eggs to 85 farms; in 1985, 11 million eggs were distributed to 45 farms.

Brood Stock Development

With the ultimate goal of achieving industry self sufficiency in egg supply the B.C. Salmon Farmers Association launched, in 1985, a two-year \$650,000 program to develop domestic Chinook salmon brood stock.

Participating farms contributed \$400,000 of the cost and the National Research Council \$250,000 through the Program for Industry/Laboratory Projects.

Five salmon farms are participating in the program, which produced some 6 million domestic Chinook eggs in 1986. The program will produce new technological applications that will help to improve domestic egg production in future years.

Marketing Studies

Early in 1986 the B.C. Salmon Farmers Association commissioned a \$50,000 marketing study as a first step toward developing a comprehensive marketing plan for the farmed salmon industry. Ten percent of the cost was borne by the Association with the remaining 90% funded through a joint federal-provincial agreement.

The study has three primary objectives:

1. to examine post-production industrial linkages affecting market access and penetration;
2. to detail strategies and methods in production, distribution and promotion with a view to maximizing returns to farmed salmon producers;
3. to examine Association organization and by-laws in relation to market development targets.

Quality Control and Processing

As an integral part of its marketing strategy, the Association is now developing a "superior" grade standard for farmed salmon, together with quality control and processing regulations to enable continuous monitoring of product quality.

Working in conjunction with representatives of the processing, distribution, transportation and packaging industries, and with regulatory authorities, the Association has developed detailed quality and processing guidelines.

Education

The Association has, since its inception, taken an active role in disseminating information about aquaculture to its members and to interested groups and individuals outside the salmon farming industry. In 1986, for example, the Association, utilizing scientists, expert consultants and experienced salmon farmers, conducted four two-day workshops for farmer members. These comprehensive working sessions dealt with fish nutrition, production strategies, phyto-plankton hazards, processing and quality control.

In addition, Association directors and staff spoke at some fifteen different information seminars organized by groups and individuals interested in aquaculture.

A major responsibility of the newly recruited Director of Information is to increase the Association's information/education activities in 1987 and beyond.

A "TYPICAL" SALMON FARM IN BRITISH COLUMBIA

Experience has shown that to be economically viable as a full-time aquaculture business, a salmon farmer requires the capacity to produce 50,000 fish annually.

To achieve that capacity, the farmer will require a capital investment of approximately \$1 million during the first two years of operation. No revenue from product sales will be generated until the third year of operation.

The farmer would have to place an initial order of 100,000 eggs to ensure production of 50,000 fish. He would require eight 50-foot by 50-foot net pens the first year and an additional eight pens of the same size the second year, plus another 100,000 eggs to start the second crop.

Some 8,000 square feet of surface area (approximately one-fifth of an acre) is required to accommodate the 16 pens. On-shore facilities for housing, feed and equipment storage require perhaps a half-acre of space.

From three to six on-site and management employees are required to operate the farm efficiently.

Expenditures for feed and supplies, excluding pens, salmon eggs or smolts, and on-shore facilities would average approximately \$60,000 in the first year and \$200,000 in the second year of operation.

In British Columbia today, the size of operating salmon farms ranges from some 40,000 fish produced annually to the large integrated operations that produce upwards of 1 million fish per year.

THE ECONOMIC IMPACT OF SALMON FARMING IN BRITISH COLUMBIA

The Association has not yet had an opportunity to develop detailed data on the economic and financial contribution generated by salmon farming in British Columbia. This matter will be addressed as part of the Association's expanding service capability in 1987. We have, however, canvassed industry members, financial institutions and investors and have developed order of magnitude numbers that we feel accurately describe the scope of the industry in today's economy.

The 75 farms now in operation represent a direct capital investment of some \$75 million. Upwards of 40% of that total has been provided by foreign investors, largely from Norwegian banks, where understanding of the salmon farming industry is more highly developed than among Canadian financial institutions.

Operating farms now provide direct employment for some 375 people and spend an estimated \$50 million on services and supplies annually.

Of particular note is the fact that many of the farms now established and planned are near coastal and island communities that have relied historically on one primary economic generator, such as logging, fishing, tourism, etc. The advent of aquaculture broadens the economic base and growth potential of such communities.

If the industry continues to grow at current rates salmon farming will, within two years, develop into a major component of the provincial economy and contribute positively to Canada's balance of payments through export sales.

Based on egg orders now in hand and on the number of licence applications now in process and pending, the industry will by 1988:

- have capital investment in excess of \$200 million;
- employ 2,000 people directly;
- generate some \$250 million in product export sales.

Indirect Benefits

A full economic impact model would be required to identify all of the indirect economic benefits generated by salmon farming industry activity. Some indirect benefits are already evident.

1. Every new job created by direct employment in salmon farming generates at least two additional new jobs in related service industries.
2. The growth of British Columbia's salmon farming industry is directly responsible for the emergence of a strong fish feed industry in the province: two new mills commenced manufacturing during 1986 and two major European manufacturers purchased existing suppliers and are broadening their range of product supplies.
3. Manufacturers and suppliers of nets, pens, construction materials and other related equipment and supplies report significant increases in sales.

One benefit of particular note will be the increased activity for fish processing plants when farmed salmon product moves to market in larger volume in 1987 and 1988.

Salmon farmers typically process and market their product in the period December 1 through May 31, a time when the commercial fishery is largely idle and processing plants have low or no volume.

Increasing volumes of farmed salmon will contribute strongly to higher activity levels in the processing sector.

ENVIRONMENTAL IMPACTS OF SALMON FARMING

The farming of salmon, like any other type of farming, unavoidably impacts to some degree on its immediate environment. However, if the pen sites are properly selected, and the farmer utilizes sound management and production techniques, negative environmental impacts will be minimal. This fact is not widely known in the public mind, which tends to view the concentration of fish in pens as a source of pollution and/or disease.

The primary responsibility of any farmer, whether land or water based, is to prevent and/or control so far as is possible any negative risk to his crop, and thus his livelihood, and to ensure that his activities pose minimal or no risk to the environment shared with others.

One of the principal thrusts of the B.C. Salmon Farmers Association is to increase public understanding and awareness of the real environmental facts of salmon farming.

All of the material in this Environmental Section has been developed in conjunction with members of the scientific community, who are credited for their work in each case.

Fish Disease Transference

Claims have been made that fish disease originating in salmon farm pens transfers to and infects wild salmon stock.

At the request of the Association, Dr. Stephen G. Newman, a microbiology consultant with Microtek Research and Development Limited, Sidney, B.C. examined the question of disease transference. Dr. Newman obtained his Ph.D. in Microbiology from the University of Miami, Miami, Florida; served for seven years as Director of Microbiology Research and Development for Biomed Research Laboratories in Seattle, Washington and has extensive industry experience in fish pathology, immunology, physiology and culture.

Dr. Newman has the following comments on disease transference:

"The following excerpt was taken from Aquaculture Digest, a monthly report on Fish and Shellfish Farming, December 1986 issue.

'Some concern has been expressed that the culture environment may serve as a reservoir for those diseases which are present in the environment but demonstrating no clinical symptoms in wild fish. There is a fear that the disease organisms may proliferate among the cultured fish, become more virulent and

re-infect the wild stocks. However, there is no evidence to indicate that this scenario has ever occurred. The outbreak of a disease is often associated with some form of stress. In the culture environment, fish may be stressed by overcrowding, undernourishment, poor water quality and physical damage associated with handling and confinement. Thus, while fish held in culture are likely to show more frequent appearance of disease than wild fish, disease does not appear to be transmitted to the wild populations.'

(Abstracted from a study entitled "The Environmental Effects of Floating Mariculture on Puget Sound" prepared for the Washington Department of Fisheries and the Washington Department of Ecology by the University of Washington.)

One of the conclusions reached by this study was that the capacity of a mariculture operation to serve as a disease reservoir for the infection of wild organisms has never been demonstrated and that the existence of such an effect remains largely speculative. There are a number of very good reasons why the spread of disease from cultured fish to wild fish has not been observed and why it is unlikely to occur.

Infectious disease in all animals, including fish, is a result of an interaction between the host, the organism that has the ability to produce the disease and the environment that the animal (fish) is being reared in. How these factors interplay determines the type, severity and incidence of the disease.

For disease to occur, the disease producing organism must have a susceptible host. This susceptibility is determined by many factors and can vary considerably even within a single population of fish. There must also be some means for the pathogen to be transmitted from fish to fish either through intermediate vectors (parasites), the environment, feed, etc. Finally, assuming that the host is susceptible to the disease, then the environmental conditions must be such that a disease process can occur. Each component of this interactive process must be just right for the disease process to occur.

For fish, the single most important component in disease appears to be the environment. Fish can tolerate narrow ranges of environmental fluctuations (such as temperature variations, loading densities, handling, etc.) without becoming stressed. All net pen reared fish are stressed at various times during their growth cycles.

Continual stress is a normal part of the process in some net pen operations. The presence of stress and the subsequent physiological effects on the fish are directly responsible for most of the disease that occurs in net pen operations. Unlike wild fish populations, net pen reared fish don't have the option of thinning themselves out or avoiding excessively warm water temperatures or poor water quality. Since the stresses that correlate strongly with the onset of disease in commercially reared fish don't affect wild populations, wild populations are much less susceptible to disease.

Two of the organisms that can cause a problem to aquaculturists, the etiologic agents of Bacterial Kidney Disease and Infectious Hematopoietic Necrosis, are transmitted principally from adult carriers to fry through infected eggs. Thus transmission of the diseases via these routes of infection to wild stocks is not likely. Screening programs on brood fish, as currently practiced, can significantly minimize the impact of these organisms on commercial stocks.

These disease organisms can be transmitted by other routes though these are not usually significant sources of disease. Since neither organism survives very long in the environment outside of the host, the chances of them being transmitted to wild fish that come in proximity to net pens during disease outbreaks is minimal.

It is noteworthy that these organisms are endemic in wild stocks, though at very low levels. As both of these pathogens require the fish for survival in the environment, the wild stocks are likely the source of these diseases in commercial stocks. These organisms proliferated in wild fish long before the advent of aquaculture. Since wild stocks are often the source of eggs and milt for the initiation of commercial broodstock programs, commercially reared fish (using improperly screened eggs and milt from wild stocks) will continue to have problems with these disease organisms.

Two of the other diseases that cause problems in net pen reared fish are due to bacteria that cause disease primarily in stressed animals. These organisms, responsible for vibriosis and furunculosis, may be present in the fish without ever producing disease. They are not normally found in adult wild animals. It is only when the fish are stressed that the disease process occurs. Sick fish may shed organisms into their immediate environment from lesions and infected fecal material, increasing the chances that fish in close proximity to sick fish will contact a high enough level of pathogens to produce disease.

These pathogens must be present in net pens at very high levels to initiate disease. There is usually a threshold level of micro-organisms below which disease is unlikely to occur. As one moves away from the environment of the net pen, the level of potential pathogens present decreases rapidly. In fact, it is not uncommon for disease outbreaks to occur in a single net pen and net pens that are adjacent to this net pen to have no disease outbreak. The possibility of the disease being transmitted to wild stocks in close proximity to the net pens during a disease outbreak is very small. Even if wild stocks were to encounter a sufficiently high enough level of organisms capable of producing disease in stressed commercial stocks, there are so many factors involved that affect susceptibility, including the presence of stress, that the chances of the disease occurring in the wild stocks is very small.

A final point to consider is the fact that wild fish stocks do not usually congregate around net pens. They may be in contact with waters that have net pens in them, but generally only for very short periods of time during migrations. This usually would occur only if the net pens are situated such that the fish must pass near to them to migrate to the open ocean or to return to spawn. These migrations do not occur at times of the year when environmental conditions are such that the fish in net pens are predisposed to becoming diseased.

To summarize, the transmission of disease from cultured to wild stocks in sufficient magnitude to adversely affect wild stocks is highly unlikely. The nature of the disease organisms, the role of stress in the increased susceptibility of commercial stocks to disease and the migration patterns of wild stocks all substantiate this. Furthermore, the lack of any direct evidence that disease transmission from commercial to wild stocks has ever occurred suggests that this is an issue of little or no concern when considering the potential impact of commercial aquaculture on 'natural' populations."

Stephen G. Newman, Ph.D.

Use of Pharmaceuticals in Salmon Farming

Some concern has been expressed about the environmental impacts of pharmaceutical products used in salmon farming.

Two factual statements address this concern:

1. No scientific evidence has yet been presented to indicate that pharmaceuticals used in salmon farming create risk or threat to human health, or diminish in any way the nutritional value, appearance or taste of the salmon product.
2. No scientific evidence has yet been presented to demonstrate that pharmaceuticals used in salmon farming are harmful to or pose any threat to proximate marine life or foreshore environments.

These and other environmental facts notwithstanding, the B.C. Salmon Farmers Association fully supports the principle of continuous, scientifically sound monitoring of, and action on, the environmental impacts of all ocean and foreshore based seeding, nurturing and harvesting of ocean resources.

Impact of Salmon Farming on Marine Water Quality

One of the most commonly expressed concerns about salmon farming is its potentially negative impact on water quality. Early in 1987, the Ministry of Agriculture and Fisheries released the results of a scientific study conducted in March 1986 in the Sechelt Inlet. The following abstract is reprinted from Fisheries Development Paper Number 11, by E.A. Black and B.L. Carswell.

"Considerable development of mariculture in Sechelt Inlet is projected for the next few years. Salmon farms having a total capacity of at least 4,500 tonnes have been proposed for Sechelt Inlet.

A study was conducted to determine the present level of salmon farming activity was having on water quality in the Inlet and to establish baseline levels for future water quality assessments. Samples were collected during March 1986 at salmon farm sites and compared with those taken from nearshore and mid-channel stations.

Water quality parameters measured included ammonia, nitrite and nitrate nitrogen, orthophosphate, total phosphorus, oxygen, 5 day biochemical and chemical oxygen demands, total coliforms, temperature, salinity, pH and non-filterable residue. While most parameters were comparable to historical ranges for Sechelt Inlet or the Strait of Georgia, two parameters, ammonia and total coliforms, were significantly higher at farm sites than at other sample locations.

Although salmonid excretion must contribute to the elevated ammonia levels, observations suggest that bivalve fouling may make a more significant contribution to the observed ammonia levels. The data also indicates that contaminated salmon feed may not be responsible for the elevated coliform levels near the pens. Proposed sources for the elevated coliforms

are marine birds or mammals. These findings are consistent with data available on other sites.

Water circulation patterns in Sechart Inlet are inferred from available physical and chemical oceanographic data. They indicate longer retention times of water in certain areas, particularly the southernmost portion of Sechart Inlet from Nine Mile Point to Porpoise Bay.

Available evidence thus suggests that at present production levels the existing salmon farms have little effect on surrounding water quality. The data collected may reasonably be used as a baseline for comparison for future studies."

Importation of Live Salmonids

Since 1919 the Department of Fisheries and Oceans has made several unsuccessful attempts to transplant Atlantic salmon into Pacific waters.

For the salmon farmer, Atlantic salmon may have advantages over Pacific species: there are indications that Atlantics have faster growth rates than Pacific Chinook and Coho and Atlantics are more docile and thus less subject to stress and related disease.

Atlantic salmon have been actively cultivated in Puget Sound, Washington state, for a number of years. The first successful transplantation into B.C. waters occurred in 1985 at D.F.O.'s Pacific Biological Station at Nanaimo and at one salmon farm. Three B.C. farms are now growing-out Atlantic salmon.

Concern has been expressed about possible negative environmental impacts resulting from the importation of Atlantic salmon. The Association shares some of those concerns and is monitoring closely the development and behavior of the Atlantic salmon that have been brought into Pacific waters.

The federal Department of Fisheries and Oceans has developed a set of stringent guidelines governing such importations. The guidelines will become formal policy and practice when signed by D.F.O. and by the B.C. Ministry of Environment.

It is worth noting that Atlantic salmonid imported to date have been governed by the guidelines established.

LICENCE APPLICATION PROCEDURES

The licence application process is long and cumbersome, requiring from nine to twelve months from site selection to issuance of the final permits.

A total of eight regulatory authorities from three governmental jurisdictions are involved in the process, as summarized below.

<u>Licence/Permit</u>	<u>Jurisdiction</u>
Section 10 Licence	Ministry of Agriculture & Fisheries (Prov)
Foreshore Lease or Licence of Occupation	Ministry of Forests & Lands (Prov)
Bona Fide Aquaculturist Certificate	Ministry of Agriculture & Fisheries (Prov)
Aquaculture Permit	Department of Fisheries and Oceans (Fed)
Navigation Compliance Permit	Transport Canada (Fed)
Fish Transfer Licence	Inter-Departmental Committee
Business Licence	Municipal or Regional District
Local Building, Sewage, etc. Permits	Municipal or Regional District

Applications for foreshore leases or licences of occupation are advertised to the public. Municipal or regional governments may also advertise applications for business licences, building permits, etc.

An applicant will pay some \$2,000 in licence and permit fees to the various levels of government involved.

MARKETS FOR FARMED SALMON AND WILD SALMON

Some segments of the commercial fishing industry have expressed fears that salmon farming threatens the future viability of commercial salmon fishing. The following excerpts from the independent study commissioned by B.C.S.F.A. addresses these fears.

"The traditional Pacific salmon industry has been increasingly concerned about potential competition from pen-reared salmon in British Columbia and other parts of the world. Industry members are concerned with, among other things, how imports will affect existing markets for wild Pacific salmon. A considerable body of evidence supports two important conclusions:

1. B.C. pen-reared salmon will compete only minimally with B.C. wild salmon production;

2. increasing consumption of fresh (and frozen) seafood generally means that increased consumption of farmed salmon will not be at the expense of wild-caught salmon.

The supporting evidence for these conclusions is provided in the paragraphs that follow.

Total production of salmon in British Columbia for 1984 and 1985 is shown in the following table.

Production of Wild Salmon in British Columbia
(tonnes)

	<u>1985</u>	<u>1984</u>
Chinook	5,461	6,211
Coho	8,977	10,089
Sockeye	31,561	12,877
Pink	37,701	12,059
Chum	23,541	9,003
Steelhead	<u>201</u>	<u>150</u>
Total	<u>107,561</u>	<u>50,432</u>

Source: B.C. Ministry of Environment

As the table above illustrates, the majority of production in B.C. is sockeye, pink and chum. Combined chinook and coho production was 13% in 1985 and 32% in 1984. These two species are the predominant farmed varieties.

Salmon markets can be distinguished on the basis of product form, season and, to some extent, species. There is considerable evidence that the various product forms of salmon do not compete with each other.

Canned salmon competes with other canned products like tuna. Similarly, fresh B.C. salmon competes with fresh salmon from other sources and other forms of fresh seafood. Fresh and frozen salmon do not generally compete with each other in most markets. A restaurant that cannot purchase fresh salmon will seek other forms of fresh seafood, not frozen salmon, as a substitute.

Product form is important for an understanding of salmon markets. The following table provides a breakdown of production by product form for 1984 and 1985.

Production of Salmon by Product Form in British Columbia
(round weight equivalents in tonnes)

	<u>1985</u>	<u>1984</u>
Canned*	60,344	21,168
Fresh†	3,078	2,975
Frozen†	38,312	24,824
Other Forms	<u>5,829</u>	<u>1,465</u>
Total	<u>107,563</u>	<u>50,432</u>

* Canned salmon is converted to round weights @ 70 lbs/case.

† Fresh and frozen dressed salmon is converted to round weight assuming a 90% yield.

Source: B.C. Ministry of Environment

As shown in the table above, a significant proportion of salmon is canned. Canned salmon typically utilizes lower grades of pink and sockeye salmon and sells for considerably less than fresh and frozen salmon. In contrast, the majority of chinook, coho and chum is sold in fresh or frozen form. Farmed chinook and coho compete in the fresh/frozen salmon market. The markets for fresh/frozen salmon in B.C. in 1985 are shown in the following table.

Markets for B.C. Fresh/Frozen Salmon Production in 1985
(tonnes)

	<u>Fresh</u>	<u>Frozen</u>	<u>Total</u>
<u>Domestic</u> ¹	1,180	9,191	10,371
<u>Exports</u> ²			
U.S.A.	1,675	3,530	5,205
Europe	-	14,059	14,059
Japan	-	11,365	11,365
Other	<u>223</u>	<u>167</u>	<u>390</u>
Subtotal	1,898	29,121	31,019
Total	<u>3,078</u>	<u>38,312</u>	<u>41,390</u>
	7%	93%	100%

Source: ¹ B.C. Ministry of Environment; ² Statistics Canada

The table above highlights the following factors important to an understanding of the markets for fresh and frozen salmon:

- frozen salmon comprises 93% of total fresh/frozen production, the majority of which is exported to Europe and Japan;
- fresh salmon production comprises 7% of total fresh/frozen production, the majority of which is exported to the U.S.A.

The table illustrates that fresh sales of B.C. wild salmon constitute a very small proportion of total salmon production. Moreover, there is considerable evidence that this fresh production alone is, by and large, the only portion of B.C. catch that will compete with B.C. farmed salmon.

The conclusions of a major study conducted by the University of Alaska and completed in September, 1986 reinforces this finding. The study, which included a survey of 127 wholesalers in the major salmon markets of Los Angeles, San Francisco, Seattle, Chicago, New York and Boston, was commissioned because of concern about the impacts of U.S. imports of fresh Atlantic salmon from Norway on markets for wild-caught Pacific salmon. One of the important findings of the survey was that the majority of wholesalers and distributors who handle pen-raised salmon feel their product competes only with fresh wild Pacifics.¹

Seventy-five percent of respondents contended that pen-raised salmon were not a legitimate substitute for frozen wild Pacific salmon, (i.e., did not compete with) while 80% felt that fresh wild Pacific salmon and pen-raised salmon were substitutes.

Given the fact that only 1% of Alaskan catch is marketed fresh, the authors concluded, on the basis of the survey evidence, that "some of the concern about pen-raised salmon imports shown by Alaskan commercial salmon fishermen may be somewhat unwarranted".

This viewpoint is further reinforced in a recent article contained in a leading seafood industry journal.² Based on interviews with brokers and producers, the authors concluded that competition at current price levels was minimal. It was contended that most restaurants that handled a fresh cultured product would be unlikely to offer salmon if they had to resort to frozen fish. Some industry observers quoted in the article conceded that farmed fish expanded the market "by keeping fresh salmon on consumers' minds during the off-season".

Other factors, listed as follows, lead to the same conclusion.

- fresh wild caught exports to the U.S.A. have not decreased since the introduction of farmed salmon into British Columbia (see below);
- the vast majority of British Columbia farmed salmon is and will be sold in the months when fresh wild-caught salmon is not available;

- most farmed salmon is priced above fresh and frozen wild-caught salmon, suggesting that there is minimal price competition.

Furthermore, with respect to prices, there is no indication that the introduction of farmed salmon has had an impact on prices for wild-caught salmon. Average wholesale prices for fresh and frozen chinook and coho for the period 1981-1985 are shown in the following table.

**Average Wholesale Prices
of Fresh and Frozen Chinook and Coho
1981 - 1985
(\$/kg)**

	Fresh		Frozen	
	Chinook	Coho	Chinook	Coho
1981	6.46	5.68	8.30	6.41
1982	6.92	4.78	8.33	6.17
1983	6.29	4.49	7.51	4.91
1984	8.03	6.24	9.31	7.12
1985	7.89	5.79	9.78	6.84

Source: B.C. Ministry of the Environment

The prices indicated in the table above suggest that demand for fresh and frozen wild-caught salmon remains strong. Some industry observers suggest that the introduction of farmed salmon has had a positive impact on prices for wild-caught salmon.

The vagaries of the export market, in particular exchange rates, present a much greater challenge to traditional salmon producers in B.C. than incursions in their markets by B.C. farmed salmon. Where wild B.C. Pacific salmon stands to lose a substantial market share is in the smoking markets in Europe where farmed Atlantic salmon production from Norway and Scotland has recently eroded market shares held by Canadian and American frozen Pacific salmon.

It is unlikely that B.C. farmed salmon will be exported to Europe because of the transportation disadvantages. Rather, B.C. farmed salmon sales will likely be mostly in the U.S.A.

The U.S.A., in spite of having large domestic supplies and being the dominant exporter, is also the world's largest importer of fresh salmon. A comparison of American imports of fresh and frozen wild and farmed salmon in 1981 and 1984 is shown in the following table.

U.S.A. Imports of Fresh Wild and Farmed Salmon *
(tonnes)

	Fresh		Frozen	
	1981	1984	1981	1984
Canada	591	2,522	1,946	2,542
Norway	5	3,888	8	80
U.K.	-	104	-	-
Chile	-	32	-	-
Others	2	279	44	122
Total	598	6,825	1,998	2,744

* excludes fresh fillets

Source: U.S. Department of Commerce

As indicated in the table above, both fresh and frozen imports have increased. As well, Norway has replaced Canada as the leading exporter of fresh salmon to the U.S.A. With the exception of Canada, imports were mostly farmed salmon.

So, while the size of the fresh salmon market has grown dramatically since 1981, it has not been at the expense of fresh or frozen wild-caught production from British Columbia whose exports also increased. Demand for fresh salmon has increased in the U.S.A. because: more outlets have increased availability; demand has been stimulated by greater consumer awareness; and real incomes have been rising.

Most industry observers expect American demand to continue to grow. Suppliers of pen-reared salmon from countries like Canada, Norway, Chile and New Zealand are also rising dramatically.

As a result, the real marketing battle in the future will be fought between various suppliers of farmed salmon, not between farmed and wild sources. And that international competition will exist whether or not B.C. develops a strong salmon farming industry."

FOOTNOTES

- 1 Ernald V. Rogress and Bing-Hwan Lin, The Marketing Relationship Between Pacific and Pen-Raised Salmon: A Survey of U.S. Seafood Wholesalers, University of Alaska, Alaska Sea Grant Report 86-3, September, 1986.
- 2 Richard Bard, Salmon: An Ever-Changing Supply, in Seafood Business Report, March/April, 1985.

PROVINCIAL GOVERNMENT SUPPORT OF SALMON FARMING

The Government of the Province of British Columbia has been an active and high-profile proponent of the desirability of developing a vibrant salmon farming/aquaculture industry in this province.

Creation and staffing of aquaculture administrative divisions in appropriate Ministries, supportive advertising programs and other activities all attest to the Provincial Government's positive view of and support for this industry.

Of particular note are the foreign trade missions sponsored and organized by government Ministries in each of the past three years. These missions, composed of industry and government representatives, were designed specifically to obtain first-hand information about salmon farming/aquaculture in other countries and to encourage investment in the developing industry in British Columbia.

In response to some stated concerns about the rapid development of salmon farming in B.C., the provincial government imposed in late 1986 a moratorium on the issuance of salmon farm licences and appointed Mr. David Gillespie to head a 30-day public inquiry into finfish aquaculture in the province.

The B.C. Salmon Farmers Association supported the Inquiry and prepared a major submission to Mr. Gillespie. His report and recommendations were released on December 16, 1986 and the licence moratorium was lifted three days later.

The Association supports the major recommendations of the Gillespie Report and looks forward to assisting government in implementing those recommendations and associated programs.

January 1987

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AQUACULTURE IN ALASKA

ALASKA DEPARTMENT OF
FISH AND GAME
SPECIAL REPORT NO. 1

AQUACULTURE IN ALASKA

Brad Pierce
House Research Agency
Alaska State Legislature
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INTRODUCTION

Aquaculture is a general term which is defined as the cultivation of fin-fish, shellfish and aquatic plants in fresh or saltwater. **Mariculture** refers to the cultivation of plants and animals in saltwater. This distinction is significant because the most controversial form of mariculture development in Alaska--the pen culture of salmon--is intimately connected with the state's hatchery programs and includes a freshwater component.

At the recommendation of his Fisheries Mini-Cabinet, Governor Sheffield appointed an ad hoc Mariculture Advisory Committee on July 15, 1985, consisting of individuals from fishermen organizations, fish processors, a Native corporation, governmental agencies, the universities, and individuals in the private sector interested in mariculture development. The committee was charged with formulating a workable and effective mariculture policy to guide the development of the industry in Alaska. In its policy statement to the Mini-Cabinet titled "A Philosophy for Aquaculture Development in Alaska" (January 20, 1986), the committee expanded its original charge to include culture of all aquatic plants and animals in both the fresh and saltwater environments. We concur with the conceptual scope of the Mariculture Advisory Committee, and have adopted their convention of dividing the issues in aquacultural development into the three general categories of: 1) ocean ranching salmon (i.e., hatcheries); 2) pen rearing salmon; and 3) other forms of mariculture.

There has been a great deal of public interest in aquaculture development in Alaska during the past few years and numerous articles have been published in the popular press on the potential for producing pen-reared salmon and other species such as oysters and mussels. State and federal agencies are studying the biological feasibility as well as the social and economic implications of aquaculture development. Undoubtedly the legislature will hear very competent testimony on all of the issues involved as it considers aquaculture/mariculture legislation in the upcoming session. In this report, we attempt to: 1) guide the reader through the recent research on aquaculture issues in Alaska; 2) convey an overall sense of how these issues relate to each other; and 3) assess their meaning in economic terms to State fisheries policy. It is very easy to lose sight of the ultimate goals of successful fisheries policy in the Byzantine world of Alaska fish politics. We will attempt to separate the long-term factors which affect the competitiveness of Alaska's products in world seafood markets from short-term controversy and try to give the reader a broad frame of reference to accommodate expert testimony on aquaculture issues in the upcoming legislative session.

The appendix lists some of the recent aquaculture research in Alaska from which we have drawn basic information. After reviewing the wealth of available literature and speaking with various researchers involved in

studying aquaculture development, it is clear that even though there are some biological and economic questions which cannot currently be answered with certainty, policymakers presently have an adequate information base for making rational decisions about the future of aquaculture development in the state. It is important to note that all of these research efforts are made in support of administrative and legislative leadership. With the exception of the Sealaska Corporation, none of the agencies involved in studying aquaculture has adopted an advocacy position.

Each chapter of this paper dealing with specific aquaculture issues is well documented; the reader should be able to easily locate references to specific topics. The House Research Agency has collected an extensive library on aquaculture and will respond to specific questions on topics contained in this study.

Chapter One discusses expected trends in worldwide aquaculture production and Alaska's place in it. The unique circumstances of Alaska's situation and colonial legacy of fisheries development are posited as reasons the state is not in the forefront of worldwide aquaculture development. The basic strengths of countries with model aquaculture programs are described and the possible role of State government in future development is outlined.

Chapter Two focuses on Alaska's salmon ocean-ranching program. Ocean-ranching programs in other Pacific Rim countries are described briefly and their impact on markets for Alaska's hatchery-produced salmon are discussed. Alaska's public and private hatchery programs are described in detail. State financial involvement and the benefits/costs of the hatchery programs are examined. Future trends in markets for high-volume salmon species are analyzed. State policy options aimed at maintaining fishermen's incomes are discussed and the possible relationship between Alaska's hatcheries and a salmon-farming industry are described.

Chapter Three focuses on salmon farming. The history of salmon farming and the outlook for future farmed production are described. Premium salmon markets are examined in detail. The role of tariffs and subsidies is analyzed. The structure of the salmon-farming industry in its various forms around the world is examined. The issues surrounding a salmon-farming industry in Alaska are examined in detail. The economics of salmon-farming production are analyzed and the economic impacts of salmon farming in the state are estimated in light of available information.

Chapter Four is devoted to forms of mariculture other than salmon that are underway or proposed in Alaska. Oysters, mussels, scallops and giant kelp mariculture are described. Issues of importance to entrepreneurs and options for State involvement in dealing with them are discussed.

EXECUTIVE SUMMARY

Chapter One--World Aquaculture

World commercial landings of all species of fish and shellfish have remained rather static during the past 15 years. This suggests that naturally occurring stocks are being harvested at or near their upper level of capacity. By the turn of the century, world consumption of fish and shellfish is expected to increase by 33 billion pounds per year. This provides an enormous opportunity for aquaculture development (pp. 1, 2).

The U.S. seafood market is regarded by many in the business as the largest underdeveloped market in the world. The U.S. annual per capita consumption of fish and shellfish grew 13 percent from 12.8 lbs. to 14.5 lbs. between 1980 and 1985 (549 million pound annual increase). This trend is expected to continue as consumers become more knowledgeable about the health benefits of eating seafood and increasingly sophisticated about different species and various methods of preparation (p. 3).

Many experts believe that we are in the early stages of a worldwide "blue revolution" in aquaculture similar to the "green revolution" of the 1960s and early 1970s, which transformed agriculture in developing countries. Just as the "green revolution" turned several food-importing countries from food importers into net food exporters, the "blue revolution" will have profound social and economic consequences as the protein production potential of aquaculture is realized (pp. 1, 4).

Alaska's competitive position in the "blue revolution" of aquaculture development will depend on its comparative advantages in relation to the rest of the world. **Worldwide conditions of supply and demand combined with the economics of production and distribution will ultimately determine which species and markets are feasible for aquaculture products from Alaska** (p. 3).

Alaska's physical potential for aquaculture development is quite large, though narrowly defined. The major physical advantages include enormous natural salmon runs, clean nutrient-rich waters and vast areas of suitable habitat for development. For species other than salmon, cold water temperatures limit varieties that can be cultivated economically (p. 4).

Aquaculture development in Alaska has the economic advantage of a well-developed fisheries infrastructure and access at reasonable cost to rapidly growing domestic seafood markets. The classic economic development triad of cooperation between government, the university system and private industry (which has been one of the key characteristics of successful aquaculture programs in developed countries such as Japan and Norway) already

exists in Alaska. Other sources of strength that we have observed in successful aquaculture programs around the world include the cooperative structure of producer organizations and vertical integration from production through distribution. The aquaculture industry in Alaska lags in these areas. (p. 3).

Compared to salmon, all other potential aquaculture products which could be developed in the near future (within five years) are likely to be of relatively minor economic importance. In the intermediate future (five to ten years), the farming of oysters, mussels, scallops and sea vegetables could substantially diversify the state's aquaculture industry and become important to the economies of coastal communities (p. 4).

The major economic disadvantage to aquaculture development in Alaska is generally high operating costs. While not necessarily a disadvantage, State policy is certainly a significant factor in aquaculture development. The State controls tidelands from mean high water to three miles offshore and the State and federal government control most of the coastal lands in Alaska. Thus, the terms that government agencies set for leasing aquaculture sites and the amount of red tape that operators must wade through to obtain control of the resource can be important factors in the economic viability of aquaculture ventures (p. 4).

Impediments to further aquaculture development are mainly political and legal. The traditional fishing industry is generally receptive to developments such as oyster and mussel farming but more ambivalent toward competing enterprises such as pen rearing salmon. The Sheffield administration policy generally reflected the attitude of the fishing industry and attempted to separate salmon farming from other forms of aquaculture development (p. 4).

The state's colonial history of fisheries development explains much of the political ambivalence of the Alaska fishing industry regarding pen rearing salmon as well as the xenophobic attitude towards developments in other countries (pp. 5 - 10).

Long-term economic prosperity--as expressed by employment, income and profits--in the fishing industry springs from producing as many competitively priced products as possible. To this end, the State's role in setting fisheries policy needs to be oriented toward lowering producer costs to make products from Alaska more competitive in world markets (p. 4).

Fish politics in Alaska (particularly among salmon fishermen's groups) have recently focused inward on narrow allocation issues instead of outward on

new developments in world markets. Instead of actively dominating all segments of world salmon markets, Alaska is experiencing an erosion of its market share, particularly in higher valued products (pp. 9, 10).

There are several legal bottlenecks in State statutes that must be addressed by the legislature for aquacultural diversification to proceed. The present legal situation, as interpreted by the Attorney General's Office, is an impediment to all new forms of aquaculture development. The most pressing need to further aquaculture development in Alaska is a comprehensive State policy which addresses all forms of aquaculture (p. 11).

Chapter 2--Ocean Ranching

The ocean ranching of salmon, i.e., raising smolts in hatcheries and sending them out to sea to return as adults, is and will continue to be the most important aquacultural activity in Alaska. Alaska's system of public and private hatcheries is the key to further diversification in salmon aquaculture (p. 13).

All the major salmon-producing countries in the North Pacific have salmon-ranching programs. It is likely that international disputes over rights to ocean feeding grounds and high seas salmon catches will intensify in the future as producing countries seek to maximize the economic potential of salmon-ranching investments. The market implications of these salmon-ranching programs point to a long-term increase in the world supply of low-value/high-volume species of Pacific salmon, specifically pinks and chums, which are the cheapest and easiest species to raise (pp. 13, 14).

The Hokkaido Salmon Propagation Association offers a concrete example of how the Japanese ocean-ranching system works and is a model of how fishermen's organizations can cope with decreases in government support for aquaculture. The cooperation of individuals within the group is the dominant characteristic and a source of great economic strength and adaptability in the Japanese fishermen's cooperative system. Operating costs are minimized and economic return to members of the Hokkaido cooperative is maximized through a combination of vertical integration from the hatchery through harvesting and marketing of adult fish, substantial amounts of free labor from association members, and use of the most efficient available harvesting methods (pp. 15, 16).

The Japanese have the most cost-effective salmon ocean-ranching program in the world, with benefit/cost ratios for individual chum salmon hatchery programs estimated to range between 16:1 and 33:1 (pp. 14 - 16).

All of the available information on Soviet ocean-ranching programs points to a very large-scale and long-term commitment to hatchery production, particularly of pink and chum salmon. Exports of salmon products are an important source of foreign exchange and are likely to increase in the future (pp. 16, 17).

EXECUTIVE SUMMARY

At its present funding level, the overall benefit/cost ratio for British Columbia salmon hatcheries is estimated to range between 1.31:1 and 1.67:1 (p. 19).

The cornerstone of Alaska's aquaculture industry is the state's unique system of public (FRED) and private nonprofit (PNP) hatcheries. By almost any economic measure, this is probably the best investment in renewable natural resources the State has made with its oil wealth (p. 21).

The impetus for the PNP hatchery system came from the desire of commercial fishermen to enhance the severely depressed salmon stocks of the early 1970s. The program represented an unprecedented partnership among fishermen, processors, legislators and the Governor's Office (p. 31).

The industry requirement of extended payback periods and the uncertainty of returns through the common property fishery are the primary reasons the State is involved in financing PNP hatcheries. The terms offered by the Fisheries Enhancement Revolving Loan Fund are crucial to the viability of PNP hatcheries (p. 37).

In late 1984, Governor Sheffield'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 enhancement projects. This move was prompted by processor complaints of unsold inventories of frozen and canned salmon (particularly pinks and chums) and fishermen's concerns over low ex-vessel prices following five years of near record harvests (p. 39).

It is probable that a pause in the construction of new hatchery production facilities was inevitable given the magnitude (over \$100 million) of the State's investment to date. After publication of a benefit/cost analysis of Alaska's public and private hatchery systems in 1986, the moratorium was lifted for production of species other than pinks and chums (p. 41).

The benefit/cost ratio for Alaska's hatchery system computed by the Department of Fish and Game was estimated to be 1.43:1 with a net present value of production of \$96.5 million. This ratio was based on price forecasting models for the commercial salmon catch that reflect an extraordinarily high dollar exchange rate in foreign markets and very limited data on the value of the state's sport fishery. In our judgment, this benefit/cost ratio significantly underestimates the value to the economy of the State's investment in hatchery facilities (pp. 44, 45).

The major difficulty faced by both regional and nonassociation PNP hatchery operations has been to work out a reasonable harvest management scheme with the Board of Fish and the Division of Commercial Fisheries to assure adequate cost recovery (p. 41).

EXECUTIVE SUMMARY

The Division of Commercial Fisheries is charged with managing salmon harvests to separate natural and hatchery stocks and to assure adequate escapement for natural runs. It is not charged with assuring cost recovery for hatchery operators. FRED, as the regulator of PNP hatcheries, is in somewhat of an advocacy position. Thus, a philosophical conflict often exists between the goals of the two divisions of ADF&G . 41).

The aquaculture assessment tax on the value of the commercial catch and the partial cost recovery/assessment method of financing regional association PNP hatcheries appears to be working fairly well. For nonassociation PNP hatcheries, the financial situation is more precarious. It is probable that some change in the present institutional arrangement for nonassociation hatcheries (e.g., allowing hatcheries to obtain for-profit corporate status or to pen rear salmon and/or sell eggs and smolts to salmon farms) is needed to assure their long-term viability (p. 42).

Product development is beginning to catch up with production in Alaska's low-value/high-volume salmon fisheries. The Department of Commerce and Economic Development, Office of Commercial Fisheries Development has been instrumental in facilitating the transfer of bottomfish technology to the salmon processing industry. We are on the verge of a major breakthrough in product development for pink and chum salmon. Skinless and boneless fillets and minced products will command a higher price in the marketplace and attract new consumers in the intermediate future (five to ten years), which should increase fishermen's and processors' gross incomes (pp. 45 - 47).

State policy decisions--such as the moratorium on loans for hatchery construction--have attempted to maintain fishermen's incomes and processors' profit margins by placing limits on the potential number of pink and chum salmon produced by PNP hatcheries. This indirect method of meeting policy goals is based on questionable assumptions about price/volume relationships in Alaska's salmon markets. **A more direct policy tool for raising fishermen's incomes and improving harvesting efficiency is implementing a limited entry permit buyback program.** A number of changes to State statutes concerning buyback are necessary to make a program workable. The Commercial Fisheries Entry Commission has drafted legislation that would address the legal problems in current statutes (pp. 42, 47, 48).

If a salmon-farming industry in Alaska is allowed to develop, the availability of smolts will be a critical factor in how quickly it can proceed. The most practical means of obtaining eggs and/or smolts for salmon farms would be to purchase them from FRED and PNP hatcheries. This could reduce the cost recovery problems of PNP hatcheries, increase the performance potential of the State's Enhancement Loan portfolio and help to finance expensive wild egg takes to further the genetic diversification of chinook and coho brood stocks. Existing statutes would have to be modified to allow sales of eggs or smolts to occur (pp. 49 - 51).

Chapter 3--Salmon Farming

Salmon farming, which began in Norway and has developed largely since 1970, has become a worldwide growth industry, especially during the past five years. The opening of the U.S. market through air freight and the high value of the dollar relative to European currencies were key factors which accelerated the growth of the industry (p. 53).

Farmed salmon provided slightly over six percent of the world salmon supply in 1985 and may reach 14 percent by 1990. Norway is expected to be the dominant producer of farmed Atlantic salmon, accounting for about 80 percent of total production. British Columbia is becoming the main focus of Pacific salmon farming, but Chilean, Japanese and New Zealand production are also rapidly expanding (p. 56).

By 1990, farmed production is expected to dominate world trading in both fresh and frozen premium markets. As new markets for farmed salmon are opened and lower cost producers enter the supply picture, price competition could escalate. New producers who have 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) (p. 56).

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, 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. 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 beyond the 1990s (p. 58).

On a value comparison basis, Norway earned approximately \$180 million on sales of farmed salmon in 1985 (five percent of world salmon production), while the record 1985 Alaska salmon harvest of 144.6 million fish (43 percent of world salmon production) earned \$370 million (p. 58).

Thus far, farmed salmon 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 will be to penetrate further into the mass retail segment of fresh and frozen markets and win acceptance with the great bulk of consumers (p. 58).

According to a recent survey of domestic seafood wholesalers, a majority of firms that handle pan-sized farmed cohos do not consider them to be a legitimate substitute for fresh or frozen adult wild Pacific salmon. However, fresh farmed adult Atlantic salmon are viewed as a close substitute for fresh wild Pacific salmon. The marked seasonality of imports of pen-reared Atlantics, which corresponds to the unavailability of Pacific species during winter months, is becoming less of a factor over time. Many firms now make their purchases of Atlantic salmon independent of the availability of fresh wild Pacific salmon (pp. 58, 59).

It appears that frozen farmed Atlantic salmon do not currently substitute for frozen Pacific salmon. Since about 97 percent of the harvest of premium species (coho, sockeye and chinook) in Alaska is sold frozen, this indicates that farmed Atlantic salmon compete only marginally in the same domestic markets as wild Pacific fish from Alaska. This situation is probably only temporary; the enormous increase in farmed production forecast by 1990 will inevitably drive down prices so that farmed Atlantics will compete directly with wild Pacific species in frozen markets (p. 60).

The domestic catering sector is where farmed salmon has enjoyed its greatest market penetration. The most significant marketing criteria in this market appear to be high quality, freshness, uniform sizing, consistent pricing and continuity of supply. There appears to be major room for expansion of sales of fresh and frozen farmed salmon (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 (p. 60).

The smoking market is very important for farmed salmon. By 1980, European smokers began switching from frozen wild species to farmed Atlantic salmon because they could buy fresh product as needed and avoid or minimize risky inventory decisions with associated borrowing and energy costs. Another reason was consistently higher average quality in farmed as opposed to wild fish. There appears to be a significant opportunity for farmed salmon in domestic smoker markets (pp. 61, 62).

Multiple retail outlets are buying increasing quantities of fresh farmed salmon in Europe and potentially offer a 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. The key to further growth in this market appears to be lower prices for adult farmed salmon, particularly relative to pan-sized fish (p. 62).

In general, there appears to be a geographic component to domestic product differentiation between fresh farmed Atlantic and wild Pacific species, with West Coast consumers preferring the larger size and deep red colored flesh of premium Pacific species (pp. 62, 63).

EXECUTIVE SUMMARY

Eliminating middlemen, reducing freight costs and minimizing exchange rate fluctuations are all reasons that established foreign salmon-farming companies wish to invest in the U.S. and Canada (pp. 63 - 65).

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 (p. 66).

Marine pen-rearing operations in Washington State 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"). It is most likely that the rapidly expanding salmon-farming industry in British Columbia will become the main competitor for a salmon-farming industry in Alaska (p. 67).

A kind of Klondike gold rush atmosphere pervades the wildly speculative growth of the British Columbia salmon-farming industry, with a significant portion of the investment capital coming from foreign--mainly Scandinavian--banks. A painful shakeout of independent farmers who do not have an assured source of smolts and are not tied to a marketing entity is likely to ensue in the near future (pp. 68, 69).

The Prince Rupert Fisherman's Cooperative is a model of how a group of traditional North American fishermen can successfully integrate salmon farming into their operations to take advantage of new developments in seafood markets. Members will market their farmed fish in the off season to supplement their wild fish in season. The cooperative produces smolts and fish food for its members and is experimenting with various types of shellfish for farming application. 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 (pp. 69, 70).

The carefully controlled development of the Norwegian salmon-farming industry stands in sharp contrast to the free-for-all atmosphere of British Columbia. Many of the pioneers of Norwegian salmon farming were small businessmen and fishermen on the coast. The Norwegian program has been highly successful at realizing the government's goals of providing and promoting economic development in depressed coastal economies, with a total employment effect of 4,000 jobs in the industry (p. 70, 71).

Points most frequently mentioned by industry observers as the major comparative advantages to salmon farming in Alaska are site availability, the relatively short distance to domestic markets and the lack of international boundaries to cross (p. 72).

EXECUTIVE SUMMARY

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 (p. 73).

There appears to be a consensus among proponents of aquaculture that since the development of all mariculture species except oysters is in legal limbo in Alaska, a comprehensive overhaul of the appropriate statutes is desirable. A permitting process that applies to all forms of mariculture (including multi-species operations) is also highly desirable, but policy decisions on the number, size and location of mariculture sites is critical to the further development of a reasonable permitting procedure (p. 74).

American banks and insurance companies have little or no experience with aquaculture, so at least some financing of salmon farms would likely come from foreign investment. Outside investment in aquaculture is qualitatively different from that in traditional fisheries because it creates year-round employment and promotes greater use of underutilized processing facilities (p. 76).

The Fisheries Enhancement Revolving Loan Fund will be receiving large payments from hatchery operators in the near future as many PNP hatcheries reach the end of their deferred payment schedule and begin to repay their 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 (p. 76).

The greatest danger from importing nonindigenous (i.e., Atlantic salmon smolts or eggs) species into Alaska is the possibility of also importing diseases. This has been a major problem in the Norwegian salmon-farming industry. There are several precedents for importing nonindigenous species into Alaska, but the risks must be carefully weighed against the potential benefits. The zero-age chinook technique developed by FRED could be an important development for a salmon-farming industry in Alaska (p. 78, 79).

Feed costs comprise the largest component of total operating costs in salmon farming. It is very unlikely that a farmer could profitably pen rear salmon at prevailing feed costs in Alaska. Dry pellet feed costs would probably need to drop from the present \$0.55 per pound to the \$0.30-\$0.40/lb. range for pen rearing to be profitable. The economies of scale in feed production in Alaska are not well known, but even a small farming industry could support more than one feed plant (p. 79, 80).

The economics of salmon farming in Alaska have not been studied in depth. A 20,000 metric ton salmon-farming industry in the state could realistically produce a total employment effect of about 1,920 jobs and a payroll

of \$48.8 million on gross sales of \$132 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 employment (pp. 80 - 84).

Salmon farming is a particularly appealing industry for Native regional and village corporations with large coastal landholdings. It uses the skills of local residents and brings in year-round income. At least two Indian tribes in Puget Sound are involved in salmon farming. Vertically integrated companies such as Sealaska Corporation could become the nucleus of technical, financial and marketing support to a large number of satellite farming operations (p. 84).

Given Alaska's comparative advantages as a salmon producer, ocean ranching is the State's first investment choice. Salmon farming is the next logical State investment in salmon aquaculture. Failure 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 potential jobs); and 3) a PNP hatchery system that may not be able to generate sufficient revenues (under current operating constraints) to repay its State loans and attain financial self-sufficiency (p. 85).

Alaska fishermen will face competition from farmed salmon regardless of whether or not they come from farms in Alaska. There is a limited "window of opportunity" for Alaska to enter salmon farming and gain a market share (p. 85).

Chapter 4--Other Forms of Mariculture

Species other than salmon which are presently being pursued or contemplated for mariculture development in Alaska are: oysters, mussels, scallops and giant kelp (p. 87).

Oysters only rarely spawn naturally in Alaska. Because they do not generally spawn, oysters grown in the state's waters remain fat and succulent and do not become mushy and bitter as they do in regions where spawning occurs (p. 87).

The lack of locally produced oyster larvae requires that juveniles (spat) be purchased from oyster hatcheries outside the state. 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 imported into the state (pp. 87, 88).

There are 20 permitted oyster farms in Alaska; with seven currently producing oysters for commercial sale. Oyster farmers enjoy a market situation where demand is increasing and production declining because of water quality problems experienced by producers outside Alaska (p. 88).

EXECUTIVE SUMMARY

Oyster farmers stress three things they need from the State for orderly development of their industry to proceed: 1) an oyster hatchery; 2) conveniently located paralytic shellfish poisoning (PSP) testing facilities; and 3) a loan program (pp. 88, 89).

Many of the developmental concerns of Alaska shellfish farmers focus on the present Department of Natural Resources (DNR) site permit regulations. The current site permit process was designed for the logging industry (log transfer sites) and is full of uncertainties for shellfish farmers (p. 89).

Blue mussels are indigenous species found throughout coastal Alaska. There are large and growing markets in North America and Europe for mussels. Presently there are five permitted mussel farms in Alaska, with one producing mussels in commercial quantities. Mussel farmers are currently operating under clam shovel licenses because the Division of Commercial Fisheries has made a very liberal interpretation of regulations (p. 91).

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 (p. 92).

The transportation delay for shellfish operators in Alaska to get their samples tested for PSP is a serious problem, but it is not clear that the solution is simply to build more testing labs. From the Department of Environmental Conservation's budgetary perspective, the centralized testing lab is the most cost-effective means of providing PSP testing. As the scale of farmed shellfish production increases, satellite labs (perhaps in the Homer-Kodiak area and Southeast) may become viable (pp. 93, 94).

There are currently four permitted scallop larvae collection efforts underway in the waters around Kodiak which are targeting on the weather-vane scallop. Kodiak has some of the richest scallop-growing habitat in the world. The stable price of scallops and growing domestic shellfish market makes it a very attractive species for mariculture. In recognition of these facts, the Japanese Overseas Development Foundation is cooperatively funding (along with State and local agencies) the current research efforts. The current scallop spat collection effort has been underway for less than a year and has thus far been unsuccessful (pp. 94, 95).

The herring roe-on-kelp fishery could serve as the basis for giant kelp mariculture in Alaska. A major concern in the management of the current roe-on-kelp pound fishery (where herring spawn on suspended kelp fronds contained within a net or pound) is the potential for overharvesting the kelp resource. The State of Alaska and Japan have agreed to a joint three-year study of the feasibility of giant kelp mariculture in Southeast (p. 96).

EXECUTIVE SUMMARY

The pound fishery offers an attractive alternative to the sac roe fisheries because the adult herring are not killed and a much higher valued product is produced. It appears that while kelp farmers could have a good roe-on-kelp market, the ultimate feasibility of giant kelp mariculture in Alaska will probably depend on locating an adequate roe-herring resource that is not presently being fully utilized by traditional fisheries (pp.98, 99).

CHAPTER ONE

WORLD AQUACULTURE

THE BIG PICTURE

World commercial fisheries landings (i.e., fish captured from the sea) of natural or wild stocks of all species have remained rather static at 70 to 75 million metric tons (158 billion pounds, in 1983) during the past 15 years subject to minor annual fluctuations.¹ An annual average increase in landings of only 0.3 percent is forecast through 2010 (171 billion pounds) by the National Marine Fisheries Service (NMFS).² This suggests that, despite many improvements in harvesting technology in recent years, fish are being harvested at or near their natural upper level of capacity.

By 1983, world commercial fisheries landings accounted for 87.8 percent of total world production of fish and shellfish while aquaculture accounted for the remaining 12.2 percent.³ The NMFS expects the commercial fisheries component to slip to 80.5 percent by 2000 and 75.7 percent by 2010. In contrast to the meager 0.3 percent annual increase in commercial fisheries landings, world aquaculture production is expected to increase at a 5.5 percent annual rate over the next 25 years (see Figure 1).

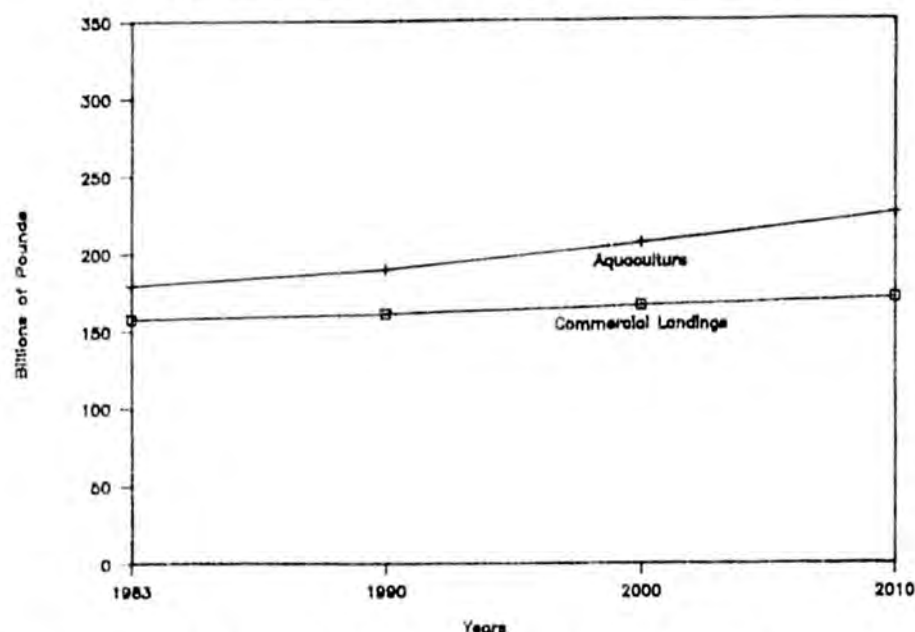
Many experts believe that we are in the early stages of a worldwide "blue revolution" in aquaculture similar to the "green revolution" of the 1960s and early 1970s, which transformed agriculture in developing countries through the use of improved seed strains, pesticides, fertilizers and modern farming techniques imported from the developed nations. Just as the "green revolution" turned food-importing countries, like India and Indonesia, from importers into net food exporters, the "blue revolution" will have profound social and economic consequences as the protein production potential of aquaculture is realized.

¹Memorandum from O.A. Mathisen, Dean, University of Alaska, Juneau, School of Fisheries and Science, to Donald O'Dowd, President, University of Alaska, regarding the Mariculture Advisory Committee, October 7, 1985.

²"The Outlook for Salmon and Shrimp Aquaculture Products in the World Markets," U.S. Department of Commerce, National Marine Fisheries Service, January 1985.

³"Future of Aquaculture: Profile of a Growth Industry," International Aquaculture Foundation, February 1985, p. 8.

FIGURE 1
World Production of Fish and Shellfish



Source: "Future of Aquaculture: Profile of a Growth Industry."

* * * *

Annual Per Capita Consumption

The current (1983) annual world per capita consumption of fish and shellfish is approximately 28.6 pounds (live weight equivalent). World population is expected to increase from 5 billion today to 6.1 billion by the year 2000.⁴ Anticipated annual world fisheries landings of 171 billion pounds by then would provide 28.5 pounds per person. However, annual world per capita consumption is growing and is expected to continue to grow to 34 pounds by the turn of the century. An additional 33 billion pounds per year will be required to meet anticipated demand, which provides an enormous opportunity for aquacultural development.⁵

⁴Statistical Abstract of the United States 1986, U.S. Department of Commerce, Bureau of the Census, December 1985, p. 838.

⁵"Future of Aquaculture: Profile of a Growth Industry," p. 8.

The U.S. seafood market is regarded by many in the business as the largest underdeveloped market in the world. Current U.S. annual per capita consumption of fish and shellfish grew 13 percent from 12.8 lbs. to 14.5 lbs. (edible meat) between 1980 and 1985 which translates into a 549 million pound annual increase.⁶ This trend is expected to continue into the future as American consumers become more knowledgeable about the health benefits of eating fish and shellfish and increasingly sophisticated about different species and various methods of preparation. One manifestation of this trend is the recent series of articles in the popular press extolling the virtues of omega-three fatty acids in seafood which have been directly linked to reductions in coronary heart disease, strokes and certain forms of cancer.⁷

Alaska's Place in the Blue Revolution

Alaska's competitive position in worldwide aquaculture development will depend on exploiting its comparative advantages in relation to the rest of the world. To this end, it is very important that we remain up to date on aquaculture development in other countries. A fundamental fact of free international trade in seafood products is the movement of capital and labor to their most productive uses. As this occurs, changes in the structure of the seafood industry are inevitable. New constituencies arise with different goals and objectives from the traditional fishing industry (i.e., a farmer's philosophical and political perspective is inherently different from a hunter's). Worldwide conditions of supply and demand combined with the economics of production and distribution will ultimately determine which species and markets are feasible for aquaculture products from Alaska.

Aquaculture development in Alaska has the economic advantage of a well-developed fisheries infrastructure and access at reasonable cost to rapidly growing domestic seafood markets. The classic economic development triad of cooperation between government, the university system and private industry (which has been one of the key characteristics of successful aquaculture programs in developed countries such as Japan and Norway) already exists in Alaska.

⁶"Fisheries of the United States 1985," U.S. Department of Commerce, National Marine Fisheries Service, Current Fishery Statistics No. 8380, April 1986, p. 79.

⁷William R. Heard and Thomas M. Kron, "Salmon Farming," Alaska Fish and Game, May-June 1986, p. 2.

Alaska's physical potential for aquaculture development is quite large, though narrowly defined. Alaska's major physical advantages are enormous natural salmon runs, clean nutrient-rich waters and vast areas of suitable habitat for development, which have heretofore been utilized with great success in the state's ocean-ranching and salmon-enhancement programs. For species other than salmon, cold water temperatures limit varieties that can be cultivated economically. Compared to salmon, all other potential aquaculture products which could be developed in the near (five-year) future are likely to be of relatively minor economic importance. In the intermediate (five to ten-year) future, the farming of oysters, mussels, scallops and sea vegetables could substantially diversify the state's aquaculture industry and become important to the economies of coastal communities.

The major economic disadvantage in Alaska is generally high operating costs. Alaska seafood products compete with close (or identical) substitutes from many other countries. Thus, we ignore developments in other countries that affect our markets at our own peril. The downside of the "green revolution" in world agriculture for farmers in developed countries has been that a diet of government subsidies led to massive overproduction, falling commodity prices and falling farm incomes. To be successful, State policies toward future aquaculture development should be oriented toward lowering producer costs to remain competitive in world markets.

While not necessarily a disadvantage, State policy is certainly a significant factor in the development of aquaculture in Alaska. Alaska is different from some of its competitors (e.g., Washington State, Norway or Japan) in that most of the potential aquaculture sites (at least the adjacent shoreline) in the state are owned by the government (State or federal) and not by private individuals and companies. The State controls tidelands from mean high water to three miles offshore. Thus, the terms that State government sets for leasing sites and the amount of red tape an operator must wade through to obtain control of the resource can be important factors in the economic viability of an aquaculture venture.

Other impediments to further aquaculture development are mainly political and legal. The state's fishing industry is generally receptive to developments such as oyster and mussel farms that do not threaten the status quo, but is more ambivalent toward competing enterprises such as the pen rearing of salmon. The Sheffield administration's policy generally reflected the attitude of the fishing industry and attempted to separate salmon farming (which it said should be studied further) from other forms of mariculture (which it flatly encouraged).

The Governor's Mariculture Advisory Committee policy statement recommended that "every effort be made to assure that the developing aquaculture industry: 1) be complementary to, and not in conflict with, the existing fishing

industry; 2) be economically viable and self-sustaining; 3) provide opportunities for family and other small-scale businesses; 4) provide an overall enhancement to the marketing image of all Alaska seafood products; and 5) give due consideration to wild stocks".⁸ These guidelines are ideals which have yet to be translated into firm development policies.

ALASKA'S UNIQUE SITUATION

In many ways, the circumstances surrounding aquaculture development in Alaska are unique. The fact that there is very little private ownership of the prime coastline for aquaculture sites (an important exception is coastline owned by Native corporations) has already been mentioned. A key prerequisite for investors in the economic development of any natural resource based industry is private ownership or long-term exclusive access to the resource (e.g., oil leases, timber sales, limited entry permits). Thus, the State and federal government are de facto partners with the aquaculture industry through their site-leasing arrangements and permit requirements.

Unlike most of the other countries that have turned to aquaculture for salmon production, Alaska's salmon stocks are not depleted. In fact, the commercial salmon harvest in Alaska has been at or near record levels for the past several years (Figure 2). Most experts agree that this is due, in order of importance, to a combination of favorable climatic conditions, improved management techniques and enhancement efforts.⁹ In 1985, Alaska produced 90 percent of U.S. commercial salmon landings and approximately 43 percent of the world salmon supply by volume (Figure 3).¹⁰

Much of the political ambivalence of the fishing industry in Alaska towards new forms of aquaculture (particularly salmon farming) and the xenophobic attitude towards developments in other countries can be explained by the states' colonial history of fisheries development.

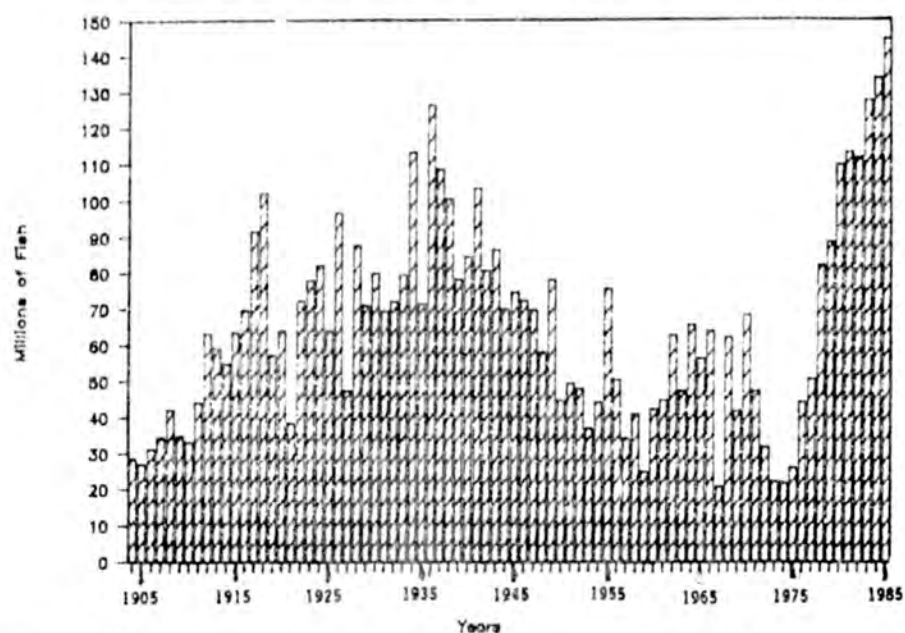
hatred or distrust of foreigners

⁸Alaska Mariculture Advisory Committee, "A Philosophy for Aquaculture Development in Alaska," Memorandum to the Governor's Fisheries Mini-Cabinet, January 20, 1986.

⁹Lynn Hutton and Brad Pierce, "North Pacific Fisheries Delphi Project Final Report," Alaska Department of Commerce and Economic Development, September 1985, p. 15.

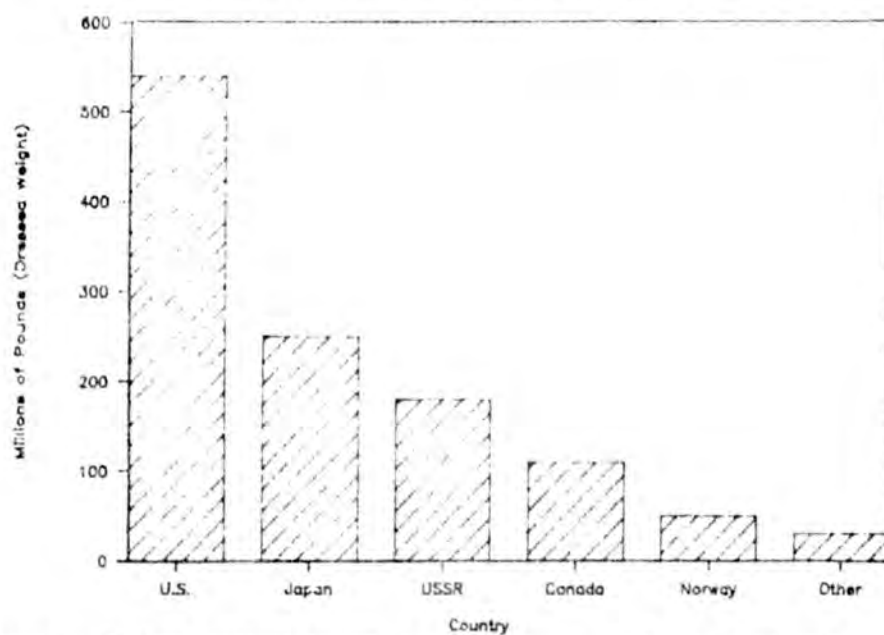
¹⁰Estimated from "Fisheries of the United States 1985" p. vii, and The University of Stirling (Scotland) Institute for Retail Studies market reports No. 2, p. 43.

FIGURE 2
Alaska Commercial Salmon Catch 1904-85



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

FIGURE 3
World Salmon Production, 1984



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

The Colonial Heritage of Alaska's Fishing Industry

Alaska suffers from a colonial heritage in its fisheries development that is very different from other states and countries that compete in the same world seafood markets. The headquarters, marketing and distribution segments of many seafood companies that operate in Alaska have traditionally been located outside of the state. Because of high costs and the remote location, seafood companies have historically invested as little as possible in Alaska, generally limiting themselves to the minimum required to extract resources in transportable form (i.e., canneries, cold storage facilities).

Foreign investors (particularly Japanese) own substantial equity and control much of the capital in the state's fishing industry.¹¹ In many cases, foreign interests have used their investment in the Alaska seafood industry merely as a means of securing an adequate source of raw product. Historically, much of the value added involved in secondary processing and producing finished consumer products has occurred in foreign marketing and distribution systems.

Like many developing nations (which the Alaska economy resembles) with colonial legacies, an attitude of resentment of residents against outside economic domination of the fishing industry persists.¹² One recent study by the Alaska Department of Labor showed that 65 percent of the 18,683 jobs and \$58.1 million in earnings in the food processing industry (which is almost entirely composed of seafood processing companies) during 1984 went to nonresidents who generally remained only for the duration of the fishing season and left to spend the bulk of their accumulated wages elsewhere.¹³

¹¹Franklin L. Orth, James R. Wilson, James A. Richardson, and Sandra M. Piddle, "Market Structure of the Alaska Seafood Processing Industry, Volume II, Finfish," University of Alaska Sea Grant Report 78-14, March 1981.

¹²George W. Rogers and Donna Mayer, "The Economic Importance of Commercial Fishing in the Southeastern Alaska Region," Institute of Social and Economic Research (ISER), University of Alaska, prepared for the National Marine Fisheries Service, February 1982, 2 Volumes.

¹³"Nonresidents Working in Alaska: A Special Study to Measure the Economic Impact of Nonresidents on Alaska's Economy During Calendar Year 1984," Department of Labor, January 17, 1986, p. 10.

In the harvesting sector of the state's salmon industry in 1984, 17,283 Alaska residents had gross earnings of \$219.1 million (\$12,700 per capita), while 5,858 nonresidents earned \$121.6 million (\$20,800 per capita).¹⁴ Slightly over 20 percent of permit holders in Alaska's limited fisheries are nonresidents.¹⁵ Thus, not only is much of the value added in the marketing and distribution sectors of the industry produced outside of the state, but also a major portion of the secondary effects of employment (i.e., processing employees and nonresident fishermen spending earnings on consumption and investment) escapes the local economy.

Alaska's Traditional Salmon-Fishing Industry

Fish politics are likely to be a major factor in future aquaculture development (particularly salmon farming) and deserve some further explanation. By its very nature, the commercial fishing industry tends to produce conservative individuals as skills are passed from generation to generation. Change tends to occur very slowly and painfully. Permit, vessel, gear and area restrictions (regulated inefficiencies) in Alaska's salmon fisheries are designed to limit harvester efficiency and maximize local employment.¹⁶ Within these constraints, fishermen tend to be fiercely independent and value their individualism highly. The commercial fishing industry has strong free market traditions but is heavily dependent on State management and financial involvement.

Historically, there has been an underlying adversarial labor versus management type of relationship between fishermen and processors, which dates back to early in the century when Seattle-based canneries held tight control over Alaska's salmon fisheries. With the implementation of limited entry in 1974, the balance of power shifted. Commercial fishermen gained exclusive harvest rights in the common property fishery and became less economically dependent on their relationship to specific processors. Fishermen's organizations also gained substantial political power. Throughout the history of Alaska's fishing industry, fishermen have tended to resist change until confronted by a biological crisis, as in the early 1970s when a series of severe winters and overharvesting by the Japanese (and other) high seas fleets devastated the state's salmon runs. Limited

¹⁴Source: Rich Focht, Commercial Fisheries Entry Commission, personal communication, August 1986.

¹⁵E. Dinneford and B. Hart, "Changes in the Distribution of Permit Ownership in Alaska's Limited Fisheries 1975-1985," Alaska Commercial Fisheries Entry Commission, CFEC Report Number 86-6, June 1986, p. vii.

¹⁶Crutchfield and Pontecorvo, The Pacific Salmon Fisheries: A Study of Irrational Conservation, Resources for the Future, Inc., 1969, p. 92.

entry and the current structure of the state's salmon hatchery system grew out of the resolution to this crisis, which involved an unprecedented cooperative agreement between fishermen, processors and State government (described in Chapter Two).

More recently, salmon fishermen's groups (which are organized by area and gear types) have tended to focus on narrow issues in the political arena. For the past several years, these groups have devoted inordinate amounts of time to internecine squabbles between gear types and with sportfishing interests over allocation decisions by the Board of Fish. Thus far, the reaction of fishermen's groups to aquaculture developments in other parts of the world, such as the rapid growth in production of pen-reared Atlantic salmon (and the possibility of salmon farming in Alaska) has been largely defensive. Fishermen do not currently perceive any personal economic incentive for themselves in salmon farming or other forms of mariculture. As one industry observer explained the attitudes of salmon fishermen toward farming, "There is a small and vocal group that have been affected in their traditional markets by salmon farming in other countries (i.e., trollers) and adamantly oppose pen rearing in Alaska. There is another segment who are interested in getting into salmon farming and are very well informed about it. The majority of salmon fishermen though are not directly affected and are probably interested in learning more about salmon farming but fairly uninformed about it."¹⁷

Processors, until very recently, have been preoccupied with financial problems caused by exchange rate fluctuations and unsold inventories of traditional salmon products. Some processors are interested in getting into salmon farming. Others see farmed fish as a competing source of supply, although several major processors in Alaska broker farmed fish from other countries. There are a number of conservatives among cannery owners and managers who feel that the economic benefits derived from Alaska's ocean ranching of salmon are vastly overrated. Some would like to scrap or scale back Alaska's hatchery programs.

Thus, the participants in Alaska's salmon-fishing industry do not speak with one voice about future aquaculture developments (particularly salmon farming). There is no biological crisis at hand, like that which precipitated limited entry, to solidify opinion. The economic impact of foreign aquaculture production on traditional markets has not affected all sectors of the industry equally. Rather, there is a more subtle erosion of Alaska's share of world salmon markets. Future aquaculture production in other countries will make global salmon markets (for both premium and low-value/high-volume species) increasingly competitive. It is ironic that, with such a huge share of the world's salmon production capacity and

¹⁷-----
Roger Painter, Alaska Mariculture Association, personal communication, November 1986.

larger runs than ever, Alaska does not actively dominate world salmon markets. Indeed, sockeye is the only salmon species where production from Alaska enjoys unchallenged dominance in world markets (and will probably continue to do so) and that is only because the state contains most of the world's prime natural habitat and other countries have so far been unable to produce significant volumes artificially due to disease problems. The fragmented structure and fractious nature of the fishing industry in the state has historically meant that fishermen and processors in Alaska are continually playing catch up with developments in other countries that affect their markets.

ROLE MODELS FOR AQUACULTURE DEVELOPMENT

In the following chapters, we attempt to take a broad view of aquaculture programs in other countries that affect markets for Alaska seafood products. We focus on the structure of extraordinarily successful aquaculture industries in Japan and Norway because they seem to be the most applicable to the situation in Alaska. After examining the industry structure in these countries, a few common sources of strength emerge. One is the close relationship between the government, private industry and the university system we have already mentioned. Other characteristics are the cooperative structure of producer organizations and vertical integration (backward and forward) of foreign seafood producers.

Typically in these model programs, there is close coordination between government, academic and private sector research efforts, with a very short distance between research and practical application. Some individuals are involved as both researchers and entrepreneurs. The opportunity for biologists and others to move easily between academia, government service and private industry appears to be very important in accelerating aquaculture development.

When the cooperative structure of producer organizations in the aquaculture industries of other countries is combined with vertical integration (from producer to distributor), it produces a self-sufficient economic entity with considerable market power. All fishermen and participants in the mariculture industry on the island of Hokkaido in Japan belong to the local cooperative. The same is true in Norway where all farmed salmon producers belong to a cooperative. The cooperative system derives its strength from the advantages of economies of scale and the incentive of individual members owning a share and having a personal economic stake in the quality and diversity of the products being produced.

In 1985, Alaska had 22 fishermen's cooperatives with an estimated 3,819 members, which is only a small fraction of the state's fishing industry.¹⁸ (Cooperatives in Alaska provide one or more of the following purposes: insurance, transportation, purchasing supplies, legislative lobbying, production, processing, marketing and/or collective bargaining.)

As we show in the following chapters, vertical integration of seafood companies is becoming increasingly important. It is likely that consolidation of the chain of distribution from producer to consumer will change the structure of many seafood companies in the future. Backward vertical integration refers to the development of the capability of a company to provide its own sources of supply (e.g. feed and smolts for salmon farms or spat for oyster farms). Forward vertical integration exists when companies acquire capability in the distribution chain of the goods they produce.¹⁹ Both of these forms of vertical integration tend to lower producer costs and increase revenues as they internalize the margins of middlemen. We give specific examples of vertically integrated cooperative associations in Japan, British Columbia and Norway in Chapters Two and Three.

The Role of State Government

The most pressing need for further aquaculture development in Alaska is to have a comprehensive State policy which addresses all forms of aquaculture. Since the State will be an active partner in future aquaculture development by virtue of its control over coastal waters, a game plan is needed to fit the different industry segments together. There are several legal bottlenecks (described in detail in the following chapters) in the State statutes that need to be dealt with by the legislature. The present legal situation, as interpreted by the Attorney General's Office, is an impediment to all new forms of aquaculture development. A nonindigenous species, Pacific oysters, is allowed to be commercially cultivated in the marine waters of Alaska, while native species such as salmon and scallops are illegal to farm for commercial sale.

In other states and countries, aquaculture is usually administered under either the category of fisheries or agriculture. Newer forms of mariculture contemplated for Alaska do not neatly fit into the existing executive branch structure. Some mariculture proponents have called for a "lead agency" to coordinate the development of State policy with other State agencies and interested parties. The Department of Commerce and Economic Development (DCED) has been suggested as an appropriate lead

¹⁸"Fisheries of the United States, 1985," p. 88.

¹⁹"Market Structure of the Alaska Seafood Processing Industry," p. 47.

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agency for policy development since it contains the Office of Commercial Fisheries Development, Alaska Seafood Marketing Institute and administers the Fisheries Enhancement Loan Program. Developing a proper organizational structure for the aquaculture industry is an area where legislative leadership would be useful.

The extent of State financial involvement in diversifying the aquaculture industry needs to be determined. Several aspiring salmon farmers would like to be able to purchase smolts and receive disease control and genetic development support from the State. Shellfish growers would like paralytic shellfish poison testing labs located within reasonable distance from their operations and in-state hatchery facilities. Many potential mariculture operators would like some form of State loan program, similar to those currently enjoyed by fishermen and private nonprofit hatchery operators.

Other mariculture proponents think that the State should simply stay out of the way of development. They claim that further diversification of aquaculture in Alaska will occur spontaneously if the legislature simply removes the legal bottlenecks mentioned above and develops an adequate permitting system. The newer forms of mariculture discussed in Chapters Three and Four of this paper are ultimately bankable enterprises and will probably attract investors without a financial commitment from the government. The character of the aquaculture industry (the mix of corporate and family-type operations) and the pace of development will, to a certain extent, be determined by the level of State financial support. We identify specific policy considerations and discuss the general propositions stated above for each form of aquaculture in the state (existing or contemplated) in the following chapters.

CHAPTER TWO

OCEAN RANCHING

The ocean ranching of salmon, i.e., the raising of juveniles in hatcheries which are released to go to sea and return as adult fish, is by far the most important aquacultural activity in Alaska. Ocean ranching augments Alaska's comparative advantage of enormous natural salmon runs and smoothes cyclical fluctuations in the supply of the resource. No other form of aquaculture in the foreseeable future will even come close to being as important to the State economy as ocean ranching. Additionally, the State's system of public and private salmon hatcheries is the key to further diversification of salmon aquaculture in Alaska.

In this chapter, we discuss the relationship between Alaska's ocean-ranching program and ocean ranching in other countries around the world. The issues surrounding salmon hatchery production in Alaska are discussed in detail and related to world markets for high-volume salmon species. The relationship between Alaska's salmon hatcheries and a possible salmon-farming industry is analyzed.

HATCHERY RELEASES IN THE NORTH PACIFIC

The major salmon producers in the North Pacific--Japan, the Soviet Union, British Columbia, and the Pacific Coast states of Washington, Oregon and Alaska--all have salmon-ranching programs. It is conceivable that, if all of these programs reach their production goals (which is unlikely given present funding levels), as many as 11 billion hatchery-produced juvenile salmon could be released into the ocean feeding grounds by the end of the century. Hatchery releases of this magnitude could bring Pacific Rim salmon production back to peak 1930s levels.²⁰ Salmon hatcheries are about eight times more efficient at converting eggs into fish than the natural environment.²¹ No one really understands the biological factors (i.e., the nature of mortality processes, interaction of natural and hatchery stocks, environmental factors, species and timing of releases) which determine the salmon-carrying capacity of North Pacific, but many experts feel that eventually some sort of political accommodation will have to be reached among the various countries involved over rights to ocean feeding grounds outside their respective 200-mile Exclusive Economic Zones (EEZ).

²⁰-----
"North Pacific Fisheries Delphi Project Final Report," p. 22.

²¹Jeffrey A. Hansen, ed., "FRED 1985 Annual Report to the Alaska State Legislature," Alaska Department of Fish and Game, FRED Report 59, January 1986.

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Some experts feel that a future treaty among North Pacific salmon producers may be necessary to establish production levels on some sort of grandfather basis, in which case, the participants out there earliest with the most releases would be the best off. Currently, the U.S., Canada and the Soviet Union are exerting considerable diplomatic and economic pressure on Japan and Taiwan to curtail their high seas salmon harvests. It is likely that these types of disputes will continue and possibly intensify in the future as each country seeks to maximize the economic potential of its salmon-ranching investment. The market implications of these programs point to a long-term increase in the world supply of the low-value/high-volume species of Pacific salmon, specifically pinks and chums, which are the cheapest species to raise.

A BRIEF OVERVIEW OF SALMON-RANCHING PROGRAMS IN OTHER STATES AND COUNTRIES

Japan

Japan is currently the world's largest single producer of hatchery-raised salmon.²² It is estimated that between 70 and 80 percent of all fry descending Japanese rivers are hatchery-raised. Although the quality of the water in Japanese rivers and streams is quite high, nearly all of the natural spawning areas have been rendered unsuitable through habitat degradation of one form or another. Poaching of fish in the rivers is also a serious problem, so most returning salmon are not allowed to spawn naturally. (Limited sportfishing for salmon is allowed only in saltwater and is not nearly the popular leisure pursuit in Japan that it is in North America.) Returning adults are collected in traps as they enter the rivers, where the eggs are taken and transported to hatcheries. Fry are then released where needed.

The 1985 Anadromous Salmon Artificial Incubation and Release Plan, published by the Japanese Fishery Agency, calls for release of 1.17 billion fry (1.04 billion chum, 114 million pinks, 13 million cherry salmon and 150 thousand sockeye), which is slightly lower (two percent) than the 1984

²²Jeff Hansen, "A Look at International Aquaculture: How Many Fish Can the Oceans Hold?" Alaska Fish Tails and Game Trails, Spring 1982, p. 36.

level of releases.²³ There is some evidence that Japan has nearly maximized its hatchery production potential.

Since the late 1960s, the Japanese high seas catch of salmon has declined from approximately 83 million fish to about 20 million, due mainly to the imposition of the U.S. 200-mile limit and other international agreements that restrict the high seas salmon harvest. During the same period, the Japanese coastal catch, consisting mainly of returning hatchery-raised adult chum salmon, increased from 12.8 percent of the total salmon catch in 1965 to 67.3 percent in 1979. Thus, the cumulative increase in hatchery production has more than offset the loss of the high seas fishery. The 1984 return of chum salmon (which is the predominant species and the only one for which we have data) to the Japanese coastal salmon fishery was 37.8 million fish.

Commercial salmon fishermen in Japan are highly organized and work very closely with prefectural governments as well as federal and municipal officials to manage the salmon harvest.²⁴ About 90 percent of the chum salmon harvest in coastal waters is taken with fish traps, though gillnets and longlines are also used. Fishermen in a given area belong to the local fishermen's cooperative and sell their catch through the cooperative. In 1983, there were 301 salmon hatcheries in Japan. Of these, 37 were operated by the national government, 15 by prefectural governments and the remainder by fishermen's cooperatives or local governments.

The Hokkaido Fishermen's Cooperative

The Hokkaido Salmon Propagation Association offers a concrete example of how the Japanese ocean-ranching system works. The association was established in 1976 in response to public concern over the level of government funding of hatchery operations (approximately \$10 million in 1983) on the island. On Hokkaido, major decisions concerning the salmon fisheries are made every five years, while adjustments concerning the opening and closing dates for the season at each of the 24 management areas (covering 790 salmon trap and gillnet permits) are made annually. Within their association, salmon fishermen work closely with hatchery staff. The fishermen bear most of the costs and contribute large amounts of free labor to adult

²³Kay Hayashi, Alaska State Office, Tokyo, Japan, Memorandum dated July 9, 1986 to Greg Baker, Department of Commerce and Economic Development, Office of Commercial Fisheries Development, containing a translation of a Fisheries News release.

²⁴Thomas M. Kron, "Japan's Salmon Culture Program and Coastal Salmon Fisheries," Alaska Department of Fish and Game, FRED Report Number 50, September 1985, p. 7.

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capture and spawning operations (e.g. weir operations and egg stripping). To help pay for operating costs, the association is allowed to sell a portion of the male fish (50 to 60 percent) at the time of capture in the river, and also the spawned-out salmon carcasses. There is a two percent tax on the fishery to cover the remainder of the association's costs.

The Hokkaido example is a model of how fishermen's organizations can cope with decreases in government support for aquaculture. Within the fishermen's association, there is a great diversity of effort. In addition to ranching chum salmon, individual operators may focus on raising and harvesting scallops, abalone, oysters and various species of seaweed or pen rearing cherry and coho salmon (coho eggs are generally purchased from Washington and Oregon).²⁵

The cooperation of individuals within the group is the dominant characteristic and a source of great economic strength and adaptability in the Japanese fishermen's cooperative system. The combination of vertical integration from the hatchery through harvesting and marketing of adult fish, substantial amounts of free labor from association members, and use of the most efficient available harvesting methods minimizes operating costs and maximizes economic return to members of the cooperative. The Japanese have the most cost-effective ocean-ranching programs in the world and the great diversity of aquaculture products they produce through their cooperative system is a model for other nations. Benefit/cost ratios for individual chum salmon hatchery programs on Hokkaido are estimated to range between 16:1 and 33:1.

Soviet Union

The Soviet Union has a natural spawning potential for Pacific salmon that is very similar to Alaska, i.e., most of their salmon-rearing and spawning habitat has not been altered or destroyed and hatchery production is designed to augment rather than replace natural production. One significant difference is the relative lack of sockeye habitat (stream systems containing lakes) in the U.S.S.R. Information on the number and species of hatchery releases is sketchy and difficult to verify, but it is estimated that one quarter of the Soviet salmon harvest (40 to 70 million fish,

²⁵ Cherry salmon are an Asian species, similar to coho, which is native to Japan and is produced (in limited quantity) entirely for the domestic Japanese market.

mainly pink salmon) comes from returning hatchery adults.^{26, 27} In 1980, the Soviets released 1.14 billion juvenile salmon from 30 hatcheries and planned to build 52 more hatcheries and release 4.97 billion fry by 2000.

Another, more recent source has quoted Soviet Fisheries Minister Vladimir Kementsev as claiming the number of Pacific salmon released in 1985 at "up to 7 billion."²⁸ (We have no independent confirmation of this figure and suspect that this claim was probably either misquoted or a gross exaggeration.) Thus, it is difficult to determine the actual magnitude of the Soviet ocean-ranching program. We do know that their most productive hatcheries are on Sakhalin Island, which they took over from the Japanese (along with 12 operating hatchery facilities) after World War II and have since rebuilt and expanded. Under a recent (1983) agreement, receipts from a tax on the Japanese high seas gillnet fishery in Soviet waters (\$17.1 million in 1983) have been used to purchase materials and hatchery technology from the Japanese. All of the available information we have gathered on the Soviet ocean-ranching programs points to a very large-scale and long-term commitment to hatchery production, particularly of pink and chum salmon. Exports of salmon products currently are an important source of foreign exchange for the Soviets and are likely to become even more important in the future.

British Columbia

The British Columbia Salmonid Enhancement Program (SEP) of the Department of Fisheries and Oceans (DFO) is the Canadian version of the public hatchery program in Alaska and uses the same diversified approach (hatcheries, spawning channels, incubation boxes and lake fertilization techniques) to produce salmon for sport and commercial fisheries. The SEP is currently in the first phase of a project whose long-term goal is to produce an additional 27 million adult fish. A summary of 1985 SEP fish production and a forecast of the future catch from SEP projects at design capacity is given on the next page.

²⁶Jeff Hansen, "A Look at International Aquaculture--How Many Fish Can the Oceans Hold?", p. 13.

²⁷Richard Bard, "Salmon, An Ever Changing Supply," Seafood Business Report, March/April 1985, p. 45.

²⁸"Russian Show Focus on Fish Breeding," Fish Farming International, Vol. 13, No. 6, p. 16.

Table 1

British Columbia Hatchery Production Statistics

Species	Summary of 1985 SEP Fish Production			Phase I Forecast
	Juveniles Released	Expected Adult Production	Expected Catch (number of fish)	Expected Catch at Design Capacity
Sockeye	253,538,358	3,584,125	1,944,317	2,644,786
Chum	164,466,012	2,298,653	1,209,414	1,337,226
Pink	6,146,989	49,918	29,940	98,241
Coho	25,406,466	1,480,479	965,767	1,581,901
Chinook	34,629,812	488,126	292,048	451,862
Steelhead	2,020,396	45,526	27,684	28,942
Cutthroat	145,447	12,685	8,497	11,745
Total	486,353,480	7,959,512	4,477,667	5,318,493

*Preliminary data as of September 1986.

Sources: Carol Cross, Assessment Biologist, SEP, "1985 SEP Fisheries Statistics" raw data.

* * * * *

In addition to supplying juvenile salmonids for sport and commercial fisheries, the SEP sold about 14 million surplus eggs (three million chinook, nine to ten million coho and 1.5 million steelhead) to private salmon farms in 1986.²⁹ Demand for 1987 is expected to be 29 million eggs (15 million coho and 14 million chinook). The Salmonid Enhancement Program will probably be able to supply only about four million chinook eggs due to treaty obligations. As we discuss in Chapter Three, the British Columbia salmon-farming industry has undergone explosive development in the past two years, which has caused a critical shortage of chinook

²⁹Under the terms of the U.S.-Canada salmon treaty concluded in 1984, harvest quotas for chinook salmon were set which were based on each country's natural and hatchery-raised production. Each country is obligated to produce at least as many hatchery-raised adult chinook as it produced before the treaty was signed. Surplus eggs, then, are defined as numbers estimated to be in excess of the amount required to meet this minimum hatchery production level. The current SEP strategy is to hold chinook egg production for hatcheries at the minimum treaty level.

and coho eggs and/or smolts. British Columbia has no privately run hatcheries (comparable to the private nonprofit system in Alaska) which produce juvenile salmon for the common property sport and commercial fisheries. Because there are currently only five or six private fish farms in the province with adult salmon and trout capable of producing eggs (which are currently being sold to salmon farmers at exorbitant prices), the SEP has been under intense pressure from salmon farmers to either sell them eggs or smolts or allow imports from other countries (including imports of Atlantic salmon).

Conflicts between commercial and sport fishermen over the common property fishery catch are similar to those that exist in Alaska. The situation is exacerbated by the fact that the SEP is almost entirely funded by appropriations from the provincial government. The only revenues which the SEP generates (aside from egg sales mentioned above) come from the sale of spawned-out carcasses and surplus jacks recovered at hatchery sites, which go into the government's general fund. The current funding level of the SEP (\$33.4 million Canadian) is about 70 to 80 percent of what is required to meet the enhancement goals (portrayed in Table 1). This incomplete level of funding has persuaded program managers to change the species composition of its enhancement efforts toward fewer pink and greater chum and sockeye releases. The British Columbia Department of Fisheries and Oceans is currently studying the possibility of imposing an assessment or user fee on the commercial salmon catch to help fund enhancement efforts. In its present form and at the current funding level, the overall benefit/cost ratio of the SEP (average for all projects) is estimated to be between 1.31 and 1.67 to 1.³⁰

Washington State

Washington State hatchery production of juvenile salmon (365 million total releases in 1985) is on the same order of magnitude as British Columbia. Due to budget reductions, however, Washington hatchery releases are expected to decline slightly into the indefinite future, which will lower the Department of Fisheries annual target level of 4.8 million pounds of adult returns. Washington State salmon hatchery releases for 1985 by species are listed below:³¹

Chinook	147,908,180
Sockeye and Steelhead	2,636,291
Coho	108,768,864
Chum	105,849,424
Pink	210,000
Total	365,372,759

³⁰Carol Cross, personal communication, August 1986.

³¹Source: Bob Foster, Fish Biologist, Washington Department of Fisheries, Salmon Culture Division, August 1986.

OCEAN RANCHING

Washington State hatcheries are funded primarily through general fund appropriations. Hatchery construction debt service is paid through fees charged for commercial salmon fishing licenses and a \$3 salmon punchcard required of sportfishermen. Salmon rehabilitation programs in the Pacific Northwest are mainly aimed at mitigating the losses of natural spawning and rearing habitat destroyed by the construction of hydroelectric dams. There are approximately 150 hatchery facilities in Washington state, of which 46 are state-operated, 50 are run by cooperative groups (including educational facilities and fishermen's cooperatives), 16 are run by Indian tribes and 9 are run directly by the federal government. Seven hatcheries on the Columbia River are federally funded but run by the state, while six others are financed and run by public utilities. The remainder are private facilities which mainly produce eggs and/or smolts for their own salmon-farming operations, or for sale to other salmon farms and/or for export. The state also sells surplus eggs to other countries (e.g. Japan, Chile, New Zealand) and other states, but only after all in-state demands have been met.

Washington State law requires salmon rehabilitation facilities to be built, regardless of cost, on hydroelectric projects. Therefore, benefit/cost ratios for individual hatcheries can vary widely from about 14:1 to less than 1:1, though the average for all facilities is estimated at 5-6:1.

Oregon

Oregon has a state and federally funded hatchery program similar to Washington's. Additionally, there are three major private ocean-ranching companies in Oregon, which collectively released approximately 13 million coho, three million chinook, two million pinks and two million chums in 1985. Releases from state, federal and private utility hatcheries over the next two years (Oregon has a biennial budget process) will total 34.7 million coho, 95.3 million chinook and 12.2 million steelhead.³² Oregon's state-run hatchery programs are funded via general appropriations, sport and commercial license fees, and poundage fees on the commercial catch. Additional hatchery facilities (federally funded) to be constructed over the next two years will increase production by five million smolt. So far, harvests by the private ocean-ranching companies (after passing through the common property commercial and sport fisheries) have been highly variable and insufficient to generate sustained profits. Thus, the future of these operations is unclear. Potentially, private ocean-ranching corporations could release another 10 to 15 million smolts annually over the next several years.

³²Source: Jerry Baur, Program Director for Propagation, Oregon Department of Fish and Wildlife, August 1986.

The Oregon Department of Fish and Wildlife will be making an effort to evaluate the hatchery contribution to the state's salmon fisheries during the next biennium and thus does not currently have benefit/cost figures for its hatchery programs.

OCEAN RANCHING IN ALASKA

The cornerstone of Alaska's aquaculture industry is the State's system of public [Fisheries Rehabilitation and Enhancement Division (FRED)] and private nonprofit (PNP) salmon hatcheries which are designed to augment the state's enormous natural runs. As enumerated in Chapter One, by almost any economic measure (i.e., employment, income, total economic activity), aquaculture is probably the best renewable resource investment the State has made with its oil wealth. Figure 4 is a map showing the location and permitted capacity of Alaska's 20 FRED and 29 PNP salmon hatcheries (a location key follows the map).³³ In 1985, 987 million eggs were taken for incubation in the State's hatcheries and 653 million juvenile salmon were released. About 17.1 million adult salmon returned to the state in 1985 from hatchery releases in previous years. Table 2 provides a breakdown of eggs taken, juveniles released and adult returns for 1985 by species and hatchery operator. The statewide commercial salmon catch in 1985 (natural production plus hatchery returns) was a record 144.6 million fish.³⁴ The goal of the State ocean-ranching program is to produce 25 million adult salmon for harvest. Considering that this goal was set in 1975 when the two previous years had seen total statewide salmon harvests below 25 million, remarkable progress has been made (Figure 2).³⁵ The phenomenal growth in production from Alaska's hatcheries is portrayed in Table 3.

Following the figure and tables, we present a brief overview of the current status of the public and private hatchery systems in Alaska.

³³Of 29 PNP hatcheries that have applied to Alaska Department of Fish and Game, FRED, for permits to operate, seventeen are operational, five are at the preliminary application stage (four inactive and one--the Virginia Lake hatchery--with review suspended), six are classified as not operational and one--the Gastineau Channel site--listed as applied.

³⁴Source: Alaska Department of Fish and Game, Computer Services Division.

³⁵"FRED 1985 Annual Report to the Alaska State Legislature," Preface.

FIGURE 4

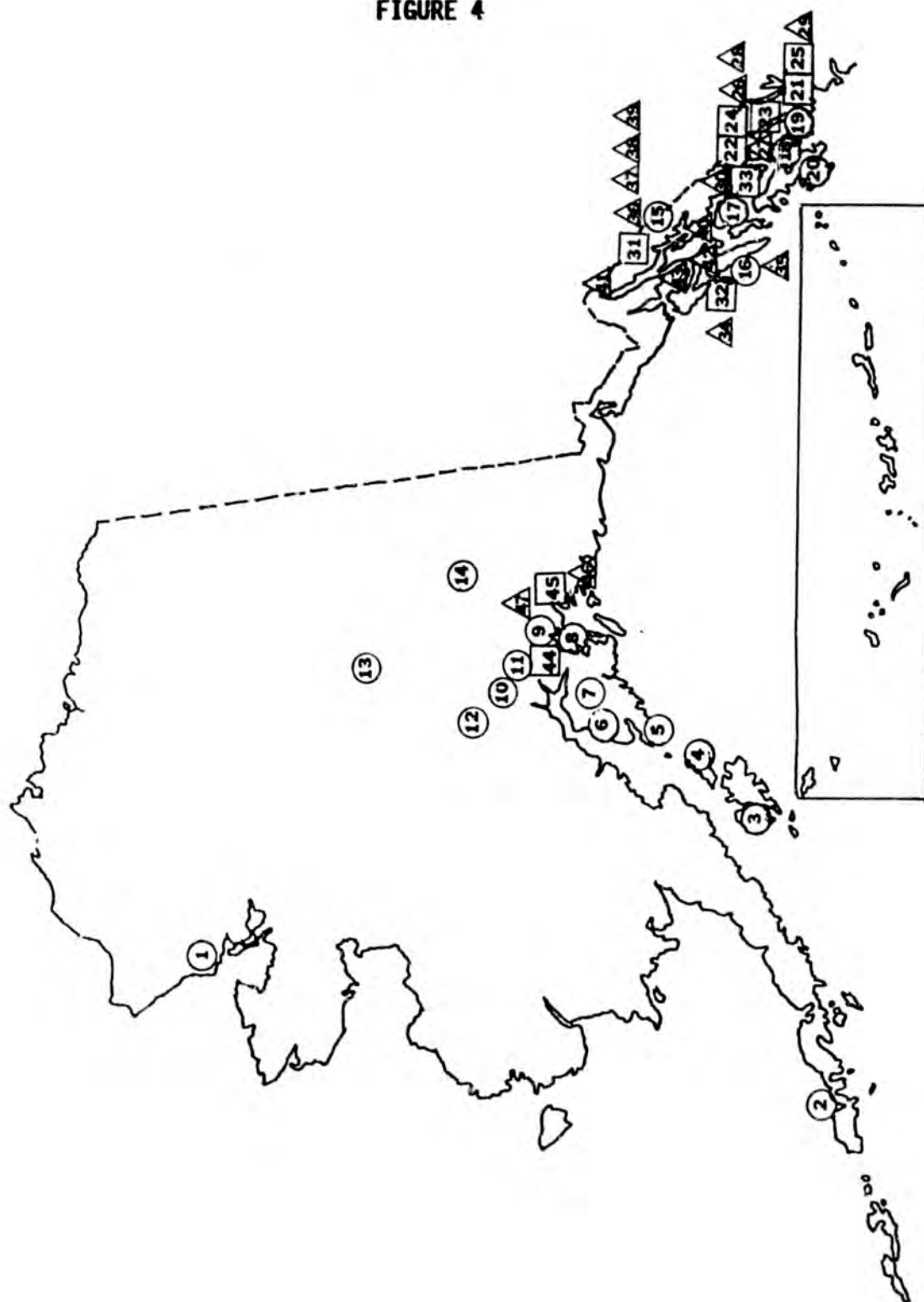


FIGURE 4 KEY
LOCATION AND DESIGN CAPACITY OF ALASKA DEPARTMENT
OF FISH & GAME, FRED, HATCHERIES

<u>Hatchery</u>	<u>Status</u>	<u>Location</u>	<u>Actual Egg Capacity (In Millions)</u>
(1) Sikusilaq	Operational	Noatak River	2.0 Chum
(2) Russell Creek	Operational	Cold Bay	5.0 Chum
(3) Karluk Lake	Operational	Kodiak Island	25.0 Sockeye
(4) Kitoi Bay	Operational	Afognak Island	100.0 Pink/Chum
(5) Tutka Bay	Operational	Homer	30.0 Pink/Chum
(6) Crooked Creek	Operational	Kasilof	20.0 Sockeye
(7) Trail Lakes	Operational	Moose Pass	30.0 Sockeye--6.0 Coho--4.0 Chinook
(8) Main Bay	Operational	Prince William Sound	125.0 Pink/Chum
(9) Cannery Creek	Operational	Prince William Sound	100.0 Pink/Chum
(10) Elmendorf	Operational	Anchorage	1.0 Coho--1.6 Chinook
(11) Fort Richardson	Operational	Anchorage	3.2 Coho--1.6 Chinook--2.7 Rainbow
(12) Big Lake	Operational	Wasilla	20.0 Sockeye--10.0 Coho
(13) Clear	Operational	Anderson	.2 Coho--.2 Chinook-- .5 Chum--1.6 Grayling/Sheefish

FIGURE 4 KEY (Continued)
 LOCATION AND DESIGN CAPACITY OF ALASKA DEPARTMENT
 OF FISH & GAME, FRED, HATCHERIES

<u>Hatchery</u>	<u>Status</u>	<u>Location</u>	<u>Actual Egg Capacity (In Millions)</u>
(14) Gulkana River	Operational	Paxson	30.0 Sockeye
(15) Snettisham	Operational	Juneau	71.5 Chum--1.5 Coho--3.5 Chinook
(16) Hidden Falls	Operational	Baranof Island	61.0 Chum--.5 Chinook
(17) Crystal Lake	Operational	Petersburg	.3 Chum--1.5 Coho--4.2 Chinook-- .1 Steelhead
(18) Deer Mountain	Operational	Ketchikan	.9 Coho/Chinook
(19) Beaver Falls	Operational	Ketchikan	3.0 Sockeye
(20) Klawock	Operational	Prince of Wales Island	30.0 Chum--1.5 Coho--3.5 Chinook

FIGURE 4 KEY (Continued)
LOCATION AND PERMITTED CAPACITY
OF PNP HATCHERIES

<u>Region/Company</u>	<u>Hatchery</u>	<u>Status</u>	<u>Location</u>	<u>Permitted Egg Capacity (In Millions)</u>
Southern Southeast Regional Aquaculture Association (SSRAA)	[21] Whitman Lake	Operational	Ketchikan	31.8 Chum-- 3.4 Coho-- 1.5 Chinook--2.5 Sockeye
	[22] Tyee Lake	Preliminary Appli- cation (Inactive)	Wrangell	40.0 Pink/Chum--4.0 Coho-- 2.0 Chinook (Requested at start up)
	[23] Neets Bay	Operational	Revill- agigedo Island	60.0 Chum--5.0 Coho-- 4.0 Chinook
	[24] Virginia Lake	Preliminary Appli- cation-Review Suspended	Wrangell	40.0 Chum--4.0 Coho-- 4.0 Sockeye (Requested at start up)
	[25] Beaver Falls	Operational	Ketchikan	.3 Sockeye
Alaskan Aquaculture, Inc.	[26] Burnett Inlet	Operational	Wrangell	10.0 Pink--20.0 Chum-- 0.25 Coho--0.75 Chinook
Meyers Chuck Aqua- culture Association	[27] Meyers Creek	Operational	Meyers Chuck	5.0 Pink--1.0 Coho--5.0 Chum
Aquaculture, Inc.	[28] Crittenden Creek	Not Operational	Wrangell	12.0 Chum--3.0 Pink
Gro-Fish, Inc.	[29] Santa Ana Creek	Not Operational	Ernest Sound	3.0 Pink--10.0 Chum

FIGURE 4 KEY (Continued)
LOCATION AND PERMITTED CAPACITY
OF PNP HATCHERIES

<u>Region/Company</u>	<u>Hatchery</u>	<u>Status</u>	<u>Location</u>	<u>Permitted Egg Capacity (In Millions)</u>
Twin Creek Salmon Ranch Inc.	[30] Twin Creek	Preliminary Application (Inactive)	Petersburg	0.5 Pink (Request at start up)
Northern Southeast Regional Aquaculture Association (NSRAA)	[31] Salmon Creek	Not Operational	Juneau	30.0 Pink/Chum--0.8 Coho
	[32] Medvejie Creek	Operational	Sitka	28.0 Chum--3.3 Coho-- 0.3 Chinook--0.1 Pink
	[33] Port Camden	Operational	Kuiu Island	10.0 Chum
Sheldon Jackson College Aquaculture Program	[34] Indian River	Operational	Sitka	16.0 Pink/Chum--0.15 Coho-- 0.3 Chinook-- 0.1 Pink
Tlingit & Haida Fisheries Development Corporation	[35] Sandy Bay	Not Operational	Baranof Island	25.0 Pink/Chum
Douglas Island Pink & Chum, Inc.	[36] Kowee Creek	Operational	Juneau	10.0 Pink/Chum
	[37] Sheep Creek	Operational	Juneau	40.0 Pink/Chum--0.5 Coho
	[38] Fish Creek	Preliminary Application (Inactive)	Juneau	60.0 Pink--10.0 Chum--trout undetermined (Requested at start up)
	[39] Gastineau Channel	Application	Juneau	100.0 Pink--111.0 Chum-- 1.0 Coho-- 0.2 Chinook
Kake Nonprofit Fisheries Corporation	[40] Gunnuk Creek	Operational	Kake	16.0 Pink/Chum

FIGURE 4 KEY (Continued)
LOCATION AND PERMITTED CAPACITY
OF PNP HATCHERIES

<u>Region/Company</u>	<u>Hatchery</u>	<u>Status</u>	<u>Location</u>	<u>Permitted Egg Capacity (In Millions)</u>
Burro Creek Farms	[41] Burro Creek	Operational	Skagway	10.0 Pink/Chum 0.015 Coho
Armstrong-Keta, Inc.	[42] Port Armstrong	Operational	Baranof Is.	16.0 Pink--4.0 Chum 0.8 Chinook
Angoon Aquaculture Association, Inc.	[43] Favorite Bay	Not Operational	Angoon	7.5 Pink--20 Chum 1.5 Coho
Prince William Sound Aquaculture Corp. (PWSAC)	[44] Port San Juan	Operational	Evans Is.	150.0 Pink--13.0 Chum
	[45] Esther Lake	Operational	Esther Is.	211.0 Pink--111.0 Chum 1.0 Chinook--1.0 Coho 31.0 Sockeye
Nerka, Inc.	[46] Perry Island	Not Operational	Prince William Sound	10.0 Pink--10.0 Chum
Valdez Fisheries Development Association	[47] Solomon Gulch	Operational	Valdez	136.0 Pink--18.0 Chum 1.0 Coho--0.05 Chinook
McClure Bay Hatchery Inc.	[48] Port Nellie Juan	Preliminary Appli- cation (inactive)	McClure Bay	30 Pink--undetermined Chum
Cook Inlet Aquaculture Association (CIAA)	[49] Eklutna Hydro Project	Operational	Matanuska Valley	20.0 Pink/Chum--1.1 Coho 0.1 Chinook

Source: Private Nonprofit Hatchery Program Status Sheet, July 1986.

Prepared by the House Research Agency, December 1986.

TABLE 2

Number of Salmonid Eggs taken in Alaska by Species & Hatchery Operators (1985)

	<u>SSRA</u>	<u>NSRRA</u>	<u>PWSAC</u>	<u>CIAA</u>	<u>NON-ASSOC</u>	<u>FRED</u>	<u>ALASKA TOTAL</u>
Pink			162,750,000	80,000	177,080,000	264,700,000	604,610,000
Chum	45,330,000	26,800,000	19,520,000	2,070,000	25,730,000	112,292,600	231,742,600
Sockeye	310,000					108,070,000	108,380,000
Coho	3,480,000	50,000		190,000	380,000	13,234,000	17,334,000
Chinook	5,840,000	290,000			50,000	11,862,000	18,042,000
Other						7,180,000	7,180,000

Releases of Juvenile Salmonids in Alaska by Species & Hatchery Operators (1985)

Pink			103,530,000	280,000	95,680,000	164,400,000	363,890,000
Chum	55,130,000	6,230,000	23,410,000		13,110,000	102,881,100	200,761,100
Sockeye						71,019,000	71,019,000
Coho	3,010,000	1,080,000		40,000	90,000	9,620,100	13,840,100
Chinook	700,000	20,000				3,220,100	3,940,100
Other						3,267,000	3,267,000

Estimated Number of Adult Salmon Returns in Alaska by Species & Hatchery Operators (1985)

Pink		60,000	5,030,600		2,314,200	7,312,900	14,717,700
Chum	435,780	45,980	31,940	2,880	8,510	863,860	1,388,950
Sockeye						765,000	765,000
Coho	143,900	20,670		610	3,250	130,960	299,390
Chinook	7,500	690				20,450	28,640

SOURCE: Compiled by Jeff Hansen, Biologist--FRED Division, Department of Fish and Game, August 1986.

TABLE 3

Alaska's Ocean Ranching Program 1976-85

FRED Hatcheries

Year	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>
Eggs Taken (millions)	55.0	70.0	95.0	88.3	169.3	225.3	287.7	401.2	441.2	517.3
Fry Released (millions)	7.0	27.0	43.0	55.0	53.2	131.6	197.4	258.7	305.3	354.3
Adult Returns (thousands)	30.0	35.0	275.0	688.0	880.0	2,003.0	1,593.0	2,279.0	3,163.7	9,093.1

PNP Hatcheries

Year	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>
Eggs Taken (millions)	16.6	37.0	37.3	54.3	125.7	223.6	234.4	261.3	372.9	470.0
Fry Released (millions)	3.7	12.4	26.8	29.1	35.6	101.6	127.0	170.4	217.7	302.3
Adult Returns (thousands)		160.1	161.0	356.5	1,506.5	2,563.9	5,340.7	4,286.0	4,764.1	8,106.5

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

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FRED Hatcheries

The Alaska Department of Fish and Game, Fisheries Rehabilitation and Enhancement Division (FRED) was established by the State Legislature in 1971 to encourage the use of hatcheries and other enhancement techniques to return the state's then depressed salmon fisheries to abundance.

FRED was charged with planning and implementing a program to ensure the perpetual and increasing production and use of the state's fishery resources. Bond issues totaling \$56.17 million were authorized by the 1976 and 1978 Legislatures (and overwhelmingly endorsed by voters) to fund the construction and operational costs of hatchery production and other enhancement developments in each region of the state.³⁶ The division currently operates 20 hatcheries which produce salmon and trout for subsistence, commercial and sport fisheries (see Table 3). An additional 23 fish passes (several maintained cooperatively with the U.S. Forest Service) provide access to spawning and rearing habitat that would otherwise be unavailable to salmon stocks. Other enhancement operations include lake fertilization, habitat improvement and fish stock introduction to provide increased freshwater survival and new salmon production opportunities.

FRED administers the Private Nonprofit (PNP) Hatchery Program and coordinates the development of regional aquaculture associations, approves annual operations management plans for all salmon hatcheries, and reviews PNP hatchery applications and the permitting process (which includes hatchery and fish transporting permits). FRED operates four biological laboratories--Fish Pathology, Genetics, Limnology, and Tag Recovery facilities--which provide information and support for FRED and PNP hatchery programs. In addition, FRED provides engineering service support to the department (including field facilities) and coordination with consultants, contractors and landowners.

The FY 87 FRED budget (Governor's revised plus all other funding sources) is \$14.7 million, down 6.4 percent from FY 86 (\$15.69 million). Of the \$56.17 million in bond issues for FRED enhancement projects cited above, \$50.3 million has been spent on hatcheries around the state, while the remainder has been used for other purposes (e.g., boats, fish passes, etc).³⁷

³⁶Jeff Hansen and Jerry Madden, "Hatcheries in Alaska," Alaska Fish and Game, May/June 1986, p. 7.

³⁷Jeff Hansen, Biologist, Alaska Department of Fish & Game, FRED, personal communication, November 1986.

Private Nonprofit Hatcheries

The Private Nonprofit (PNP) Hatchery Program was created by the legislature to provide private sector participation in rebuilding Alaska's depleted salmon fisheries. The impetus for the program came from the desire of commercial fishermen to enhance the severely depressed salmon stocks of the early 1970s. The program represented an unprecedented partnership among fishermen, processors, legislators and the Governor's Office.³⁸ The statutes for Private Nonprofit Salmon Hatcheries (AS 16.10.375-620 passed in 1974) authorized the Alaska Department of Fish and Game, FRED to issue hatchery permits to qualified PNP corporations. In 1976, the legislature authorized the formation of regional aquaculture associations. Regional associations are comprised of representatives of commercial fishermen and other user groups in the region, including sport fishermen, processors, subsistence fishermen and members of local communities.³⁹ Each regional association must have a board of directors consisting of at least one representative from each user group within the association. Currently there are seven regional aquaculture associations:

- Cook Inlet Aquaculture Association (CIAA)
- Lower Yukon/Kuskokwim Regional Aquaculture Association (LYKRAA)
- Northern Southeast Regional Aquaculture Association (NSRAA)
- Prince William Sound Aquaculture Association (PWSAC)
- Southern Southeast Regional Aquaculture Association (SSRAA)
- Imparik Regional Aquaculture Corporation (IRAC)
- Kodiak Regional Aquaculture Association (KRAA)

Regional Planning Teams

Three representatives from each regional association are appointed by their respective boards of directors to serve on a regional planning team (RPT) along with three Alaska Department of Fish and Game (ADF&G) personnel. These teams are responsible for developing regional comprehensive salmon plans for both FRED and PNP hatchery production. From FY 77 to FY 86, the legislature provided funds for planning teams via grants and contracts administered through the ADF&G commissioner's office. As of FY 87, funds for planning are no longer provided to regional associations.

³⁸Brian J. Allee, "The Private, Non-Profit Hatchery Perspective," Alaska Fish and Game, May/June 1986, p. 17.

³⁹Deborah L. Greenberg, "Alaska Fisheries Plan for Salmon," House Research Agency Memorandum 83-074, March 16, 1983.

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Phase I of each regional salmon plan includes: a regional profile; a determination of desired harvest levels (by species) user groups would like to attain at five-year increments through 2000; an assessment of the gap between existing harvest levels and desired levels; and a description of strategies or programs for achieving the stated objectives and goals. After extensive departmental review and public comment, a plan is accepted as amended by the Salmon Rehabilitation and Enhancement Coordinator in FRED and moves on to Phase II.

The Phase II process identifies a priority list of site-specific project ideas and enhancement potentials to reach the goals identified in Phase I. After the same sort of extensive review as Phase I, the Phase II plan is accepted and new proposals (e.g., a new hatchery facility, fishpass or lake fertilization project) are reviewed by the regional planning team with respect to the general goals and specific strategies identified in the planning process. Each RPT also produces an annual update of its salmon plan which includes any new enhancement opportunities identified by the private sector, ADF&G, the Forest Service, Fish and Wildlife Service or other interested parties. Currently, the Northern, Southeast, Southern Southeast and Prince William Sound Aquaculture Associations have completed Phase II plans while the Cook Inlet and Kodiak Associations are at the Phase I stage.

To date, 29 PNP hatchery permits have been received by FRED. There are presently 17 operational PNP hatcheries (eight regional association hatcheries and nine nonassociation "Mom and Pop" hatcheries). Six hatcheries are classified as not operational (of these one permit has been given up). The remaining six PNP hatcheries are somewhere in the permit process (see Figure 4 key).⁴⁰ Nonassociation operators do not have representatives on the regional planning team, and thus, no direct role (other than public comment) in setting harvest goals. Permits for nonassociation hatchery production capacity are reviewed by the RPT for consistency with planning goals.

STATE LOANS AND THE ECONOMICS OF PRIVATE NONPROFIT HATCHERY PRODUCTION

In 1976, the Fisheries Enhancement Loan Program was passed by the legislature to provide private hatchery organizations with the opportunity to acquire long-term, low-interest loans for hatchery planning, construction and operations. All private nonprofit hatchery operations (regional associations as well as nonassociation operations) are eligible for State loans. In 1982, the legislature modified the loan program to its present terms which allow a \$10 million maximum loan amount for an individual

⁴⁰"Private Non-Profit Hatchery Status Sheet," Alaska Department of Fish and Game, FRED, July 1986.

project with a payback period of up to 30 years at 9.5 percent interest. Payments on these loans can be deferred six to ten years.

The PNPs are allowed to sell surplus salmon harvested in terminal fisheries near the hatchery sites and spawned-out salmon carcasses to commercial buyers. Surplus eggs can be sold to other hatchery operators through FRED (which supervises and certifies all egg transfers). Regional associations receive revenues from assessment taxes collected on the gross sales of salmon harvested by commercial fishermen within the region (these funds are reallocated to the regional aquaculture associations via ADF&G contracts). Under the private nonprofit status, proceeds are allowed to be spent for reasonable operating costs (including debt retirement), expanding facilities, salmon rehabilitation projects, fisheries research and administrative costs of the qualified regional association for the area in which the hatchery is located.⁴¹ Table 4 lists the available information on cumulative State loans received by all PNP hatchery operations, enhancement funds (FY 77 through FY 86) received by regional associations and estimated annual fish sales for the 17 private nonprofit hatcheries in operation (through December 15, 1985). Note that several of the operations listed had more than one hatchery in operation.

⁴¹Alaska Statute, Section 16.10.450 "Sale of Salmon and Salmon Eggs by Hatchery."

TABLE 4

Cumulative State Loans (through August 7, 1986) and Enhancement Funds
Returned to Associations (through June 30, 1986) and Annual Fish Sales
for 17 Private Nonprofit (PNP) Hatcheries (through December 15, 1985)

Region/Corporation (Number of Permits)	State Loans		Cumulative Enhancement Funds	Grants* and Contracts	Estimated Revenue 1985 Sales of Fish
	Capital Construction	Operations			
<u>Southern Southeast</u>					
Southern Southeast Regional Aquaculture Assoc.--SSRAA (2)	\$ 9,093,000	\$2,848,942	\$ 5,516,643 (Note 1)	\$1,196,119	\$ 547,034
Alaska Aquaculture Foundation, Inc.-- AAFI (1)	1,053,285	1,200,275	N/A		3,369
Meyers Chuck Aqua- culture Assoc.-- MCAA (1)	10,000	0	N/A		0
<u>Northern Southeast</u>					
Northern Southeast Regional Aquaculture Assoc.--NSRAA (2)	2,714,405	1,351,573	3,647,119 (Note 1)	694,892	17,304
Armstrong-Keta, Inc.-- A-K (1)	1,152,145	875,500	N/A		15,000
Burro Creek Farms, Inc.--BCF (1)	27,500	255,875	N/A		1,745
Douglas Island Pink and Chum Corp.-- DIPC (2)	843,000	1,504,500	N/A		152,830

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
			Adult 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.

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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.

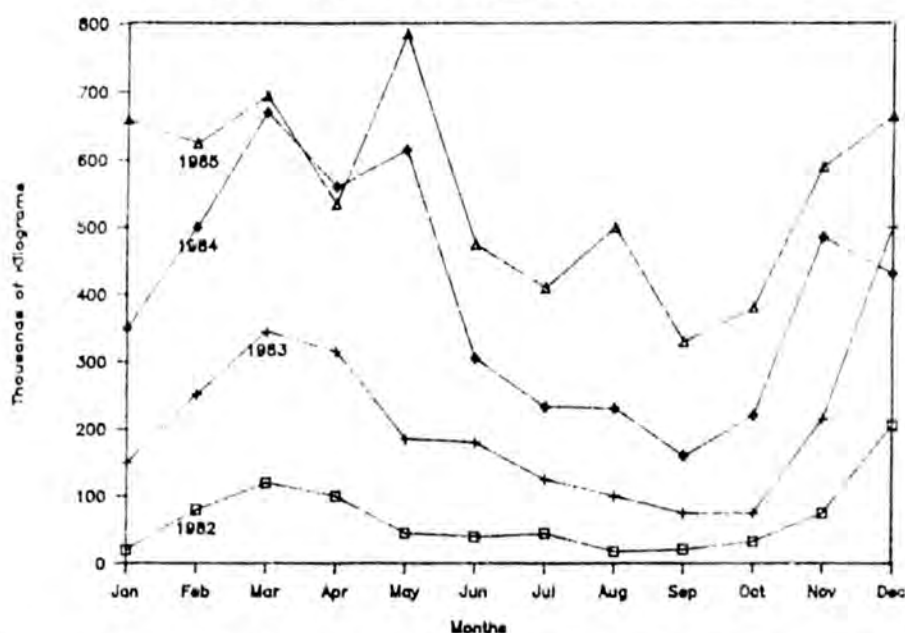
⁶⁸Computed from "Fisheries of the United States, 1985," U. S. Department of Commerce, National Marine Fisheries Service, Current Fisheries Statistics No. 8380, April 1986, p. 2.

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.

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.

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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 overheaded 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

OTHER FORMS OF MARICULTURE

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

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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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