

ALASKA LEGISLATURE SPECIAL COMMITTEE/SUBJECT FILE 8672
1903 SCOMM 75: MARICULTURE (FISH FARMING), 1987-1990

120

1 commercial finfish farming in the natural marine, estuarine, and fresh
2 water of the state and authorizing closed-system finfish aquatic farms at
3 upland locations.

4 (b) It is the policy of the state that

5 (1) scientific research projects relevant to the commercial
6 finfish farming industry be incorporated into the fishery research programs
7 of the Department of Fish and Game and the University of Alaska;

8 (2) aquatic farming of Arctic char and Dolly Varden, steelhead
9 and rainbow trout, sablefish, and sheefish, as well as Pacific salmon be
10 permitted in the state at upland locations.

11 * Sec. 2. AS 16.05.940(14) is amended to read:

12 (14) "[FISH OR] game farming" means the business of prop-
13 agating, breeding, raising, or producing [FISH OR] game in captivity
14 for the purpose of marketing the [FISH OR] game or game [THEIR] prod-
15 ucts, and "captivity" means having the [FISH OR] game under positive
16 control, as in a pen [, POND,] or an area of land [OR WATER] that is
17 completely enclosed by a generally escape-proof barrier; [IN THIS
18 PARAGRAPH, "FISH" DOES NOT INCLUDE SHELLFISH, AS DEFINED IN AS 16.40.-
19 199;]

20 * Sec. 3. AS 16.40.100(a) is amended to read:

21 (a) A person may not, without a permit from the commissioner,
22 construct or operate

23 (1) an aquatic farm; or

24 (2) a hatchery for the purpose of supplying aquatic plants,
25 finfish or shellfish to an aquatic farm.

26 * Sec. 4. AS 16.40.100(b) is repealed and reenacted to read:

27 (b) A permit issued under this section authorizes the permittee,
28 subject to the conditions of AS 03.05 and AS 16.40.100 - 16.40.199, to
29 acquire, purchase, offer to purchase, transfer, possess, sell, and

1 offer to sell stock and aquatic farm products that are used or reared
2 at the hatchery or aquatic farm.

3 * Sec. 5. AS 16.40.100(c) is amended to read:

4 (c) The commissioner may attach conditions to a permit issued
5 under this section that are necessary to protect natural fish and
6 wildlife resources, including standards for

7 (1) prevention and control of disease at a hatchery or
8 aquatic farm;

9 (2) treatment of water discharged by a hatchery or aquatic
10 farm to prevent the spread of disease and pollution of fish and wild-
11 life habitats;

12 (3) siting, design, and construction of hatchery and
13 aquatic farm facilities to ensure the structural integrity of these
14 facilities and to provide protection from floods and tides.

15 * Sec. 6. AS 16.40.100(d) is repealed and reenacted to read:

16 (d) Notwithstanding other provisions of law, the commissioner
17 may not issue a permit under this section for the farming of or hatch-
18 ery operations involving

19 (1) a subspecies, race, or variety of Pacific salmon that
20 does not occur and reproduce in the state or the water of rivers that
21 cross the border between the state and Canada;

22 (2) Atlantic salmon.

23 * Sec. 7. AS 16.40.100 is amended by adding a new subsection to read:

24 (e) The commissioner may not issue a permit under this section
25 for aquatic farming of finfish in the marine or estuarine water of the
26 state or in natural freshwater lakes or ponds. The commissioner may
27 issue a permit for aquatic farming of finfish, other than Pacific
28 salmon, in freshwater or saltwater; aquatic farming of Pacific salmon
29 may be permitted only in freshwater. Aquatic farming of finfish may

1 be permitted only at an upland location in tanks, raceways, or man-
2 made ponds approved by the commissioner.

3 * Sec. 8. AS 16.40.105 is amended to read:

4 Sec. 16.40.105. CRITERIA FOR ISSUANCE OF PERMITS. The commis-
5 sioner shall issue permits under AS 16.40.100 on the basis of the
6 following criteria:

7 (1) the physical and biological characteristics of the
8 proposed farm or hatchery location must be suitable for the farming of
9 the finfish, shellfish, or aquatic plant proposed;

10 (2) the proposed farm or hatchery may not require signifi-
11 cant alterations in traditional fisheries or other existing uses of
12 fish and wildlife resources;

13 (3) the proposed farm or hatchery may not significantly
14 affect fisheries, wildlife, or their habitats in an adverse manner;
15 and

16 (4) the proposed farm or hatchery plans and staffing plans
17 must demonstrate technical and operational feasibility.

18 * Sec. 9. AS 16.40 is amended by adding a new section to read:

19 Sec. 16.40.115. ASSISTANCE TO FINFISH AQUATIC FARMS. (a) The
20 department and the Board of Fisheries shall promote the development of
21 finfish aquatic farms by assisting finfish aquatic farms in obtaining
22 finfish brood stock from surplus production of brood stock by state
23 hatcheries and private hatcheries authorized under AS 16.10.400 or
24 from wild stocks of finfish.

25 (b) The department may obtain brood stock from a private
26 hatchery authorized under AS 16.10.400 on behalf of an aquatic farm or
27 hatchery authorized under AS 16.40.100, if the private hatchery and
28 the aquatic farm or hatchery execute an agreement that the aquatic
29 farm or hatchery will compensate the private hatchery for the value of

1 the brood stock received through the department. The acquisition of
2 brood stock on behalf of an aquatic farm or hatchery under this sub-
3 section is contingent upon no charge or fee being assessed against the
4 department by the private hatchery for obtaining brood stock on behalf
5 of the aquatic farm or hatchery.

6 * Sec. 10. AS 16.40.120(a) is amended to read:

7 (a) A person may not acquire aquatic plants, finfish, or shell-
8 fish from wild stock in the state for the purpose of supplying stock
9 to an aquatic farm or hatchery required to have a permit under AS 16.-
10 40.100 unless the person holds an acquisition permit from the commis-
11 sioner. The commissioner may not issue an acquisition permit to ac-
12 quire finfish from wild stock in the state unless

13 (1) the permit applicant has received a finfish brood
14 stock license issued under AS 16.40.125; and

15 (2) if the permit is for acquisition of Pacific salmon,

16 (A) surplus Pacific salmon brood stock is not avail-
17 able from a state hatchery or a hatchery authorized under AS 16.-
18 10.400; and

19 (B) the Board of Fisheries has allocated Pacific
20 salmon to be taken from wild stock under the permit.

21 * Sec. 11. AS 16.40.120(c) is amended to read:

22 (c) The commissioner shall specify the expiration date of an
23 acquisition permit and may attach conditions to an acquisition permit,
24 including conditions relating to the time, place, and manner of har-
25 vest. ~~Size, gear, place, time, licensing.~~ and other limitations
26 applicable to sport, commercial, or subsistence harvest of aquatic
27 plants, finfish, and shellfish do not apply to a harvest with a permit
28 issued under this section. The commissioner [OF FISH AND GAME] shall
29 issue or deny a permit, other than a permit to acquire Pacific salmon.

1 within 30 days after receiving an application.

2 * Sec. 12. AS 16.40 is amended by adding a new section to read:

3 Sec. 16.40.125. FINFISH BROOD STOCK LICENSE. (a) An aquatic
4 farm or hatchery that holds a permit issued under AS 16.40.100 to
5 engage in the propagation, farming, or cultivation of finfish may

6 (1) obtain finfish stock only from

7 (A) the department;

8 (B) another aquatic farm or hatchery; or

9 (C) a private hatchery authorized under AS 16.10.400
10 through a transaction arranged under AS 16.40.115(b); and

11 (2) possess finfish only under terms of a finfish brood
12 stock license issued by the department.

13 (b) A finfish brood stock license allows an aquatic farm or
14 hatchery to possess, propagate, farm, and cultivate finfish under the
15 following conditions:

16 (1) the licensee may farm and cultivate finfish for produc-
17 tion of aquatic farm products for food and finfish byproducts;

18 (2) the licensee may propagate finfish for production of
19 finfish stock, subject to regulations adopted by the department;

20 (3) the licensee may not sell or otherwise transfer live
21 finfish or live finfish gametes except for

22 (A) production of food and finfish byproducts; or

23 (B) farming and cultivation by another aquatic farm or
24 hatchery that holds a finfish brood stock license, provided that
25 the sale or other transfer is approved by the department;

26 (4) the licensee surrenders all rights and interests in the
27 genetic material of finfish brood stock and its succeeding generations
28 to the department;

29 (5) the licensee surrenders all rights to patent or

1 otherwise create commercial rights in genetic material of finfish
2 brood stock and its succeeding generations to the department.

3 * Sec. 13. AS 16.40.130 is amended to read:

4 Sec. 16.40.130. IMPORTATION OF AQUATIC PLANTS, FINFISH, OR
5 SHELLFISH FOR STOCK. A person may not import into the state an
6 aquatic plant, finfish, or shellfish for the purpose of supplying
7 stock to an aquatic farm or hatchery unless authorized by a regulation
8 of the Board of Fisheries.

9 * Sec. 14. AS 16.40.140(a) is amended to read:

10 (a) A private hatchery required to have a permit under AS 16.-
11 40.100 may sell or transfer stock from the hatchery only to the de-
12 partment or to an aquatic farm or other hatchery that has a permit
13 issued under AS 16.40.100, except that

14 (1) shellfish stock may also be sold or offered for sale to
15 an aquatic farm or related hatchery outside of the state;

16 (2) finfish stock may be sold or transferred only to the
17 department or to an aquatic farm or other hatchery that has a permit
18 issued under AS 16.40.100 and a license issued under AS 16.40.125.

19 * Sec. 15. AS 16.40.140 is amended by adding a new subsection to read:

20 (f) A person who holds a permit issued under AS 16.40.100 and
21 who sells a finfish aquatic farm product shall conspicuously label the
22 container in which the product is sold as containing a finfish aquatic
23 farm product. The department shall adopt regulations implementing
24 this subsection.

25 * Sec. 16. AS 16.40.160 is amended by adding a new subsection to read:

26 (b) The commissioner shall adopt regulations prohibiting the use
27 of lethal means to control vertebrate predators at hatcheries and
28 aquatic farms and establish guidelines for the use of nonlethal means
29 to control vertebrate predators at hatcheries and aquatic farms.

1 * Sec. 17. AS 16.40.170 is amended to read:

2 Sec. 16.40.170. PENALTY. Except as provided in (b) of this
3 section, a [A] person who violates a provision of AS 16.40.100 -
4 16.40.199, a regulation adopted under AS 16.40.100 - 16.40.199, or a
5 term or condition of a permit issued under AS 16.40.100 - 16.40.199,
6 is guilty of a class B misdemeanor.

7 * Sec. 18. AS 16.40.170 is amended by adding a new subsection to read:

8 (b) A person who holds a permit under AS 16.40.100 and who
9 knowingly engages in, or attempts to engage in, aquatic farming of a
10 finfish species, subspecies, race, or variety that is not authorized
11 by a permit and license issued by the commissioner under AS 16.40.-
12 100 - 16.40.199 is guilty of a class C felony.

13 * Sec. 19. AS 16.40.199(2) is amended to read:

14 (2) "aquatic farm product" means an aquatic plant, finfish,
15 or shellfish, or part of an aquatic plant, finfish, or shellfish, that
16 is propagated, farmed, or cultivated in an aquatic farm and sold or
17 offered for sale;

18 * Sec. 20. AS 16.40.199(5) is amended to read:

19 (5) "hatchery" means a facility for the artificial propa-
20 gation of stock, including rearing of juvenile aquatic plants, fin-
21 fish, or shellfish;

22 * Sec. 21. AS 16.40.199(8) is amended to read:

23 (8) "stock" means live aquatic plants, finfish, or shell-
24 fish acquired, collected, possessed, or intended for use by a hatchery
25 or aquatic farm for the purpose of further growth or propagation.

26 * Sec. 22. AS 16.40.199 is amended by adding a new paragraph to read:

27 (9) "Pacific salmon" means pink salmon, chum salmon, coho
28 salmon, sockeye salmon, or chinook salmon.

29 * Sec. 23. AS 16.40 is amended by adding a new section to read:

1 ARTICLE 3. FISH FOR EXHIBITION OR AQUARIUM PURPOSES.

2 Sec. 16.40.210. COMMERCIAL CULTURE OF FISH FOR EXHIBITION OR
3 AQUARIUM PURPOSES. (a) The department may issue a permit for the
4 possession, propagation, and sale of native or exotic fish or their
5 eggs for exhibition purposes or for stocking aquariums and private
6 ornamental ponds.

7 (b) The board may adopt regulations relating to activities
8 permitted under this section that are necessary to protect native
9 stocks of fish.

10 * Sec. 24. AS 43.75.015 is amended by adding a new subsection to read:

11 (d) Aquatic farm products produced at an aquatic farm are sub-
12 ject to the tax levied under this section.

13 * Sec. 25. This Act takes effect immediately under AS 01.10.070(c).
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29

ALASKA STATE LEGISLATURE · SENATE

SENATOR RICHARD I. ELIASON

LABOR & COMMERCE COMMITTEE, CHAIRMAN
RESOURCES COMMITTEE
RULES COMMITTEE
SPECIAL COMMITTEE ON HIGH SEAS
SALMON INTERCEPTION
SELECT COMMITTEE ON
LEGISLATIVE ETHICS



P.O. BOX 143
SITKA, ALASKA 99835

P.O. BOX V
JUNEAU, ALASKA 99811
(907) 485-4916

FAX (907) 485-4928

**** PRESS RELEASE ** FOR IMMEDIATE RELEASE ** PRESS RELEASE ****

ELIASON PROPOSES LAW TO BAN COMMERCIAL FISH FARMING

¹⁹⁹⁹
JAN. 19, 1989. Senator Dick Eliason (R-Sitka) today introduced legislation to prohibit commercial finfish farming in Alaska.

"It's clear to me that the serious risks to Alaska and our fishery resources far outweigh any potential benefits from finfish farming. We stand to lose much more than we could ever gain," Eliason explained. "In my view it would be highly irresponsible to allow it. Quite a few of my colleagues seem to agree that the time has come to make a final determination on this and get on with other issues," he said, referring to co-sponsorship of the bill by many Senate members.

Prior to introducing the legislation, Senator Eliason studied the final report of the Finfish Farming Task Force, a non-legislative group which released its final recommendations to the legislature earlier this week. One of the report's recommendations is that the legislature act to resolve the finfish farming issue, rather than extending the current moratorium.

The question of whether to allow the commercial farming of finfish has plagued the state Legislature for several years. Two consecutive moratoriums temporarily prohibiting finfish farming have been enacted, the last of which expires July 1 of this year.

#

ALASKA STATE LEGISLATURE · SENATE

SENATOR RICHARD I. ELIASON

LABOR & COMMERCE COMMITTEE, CHAIRMAN
RESOURCES COMMITTEE
RULES COMMITTEE
SPECIAL COMMITTEE ON HIGH SEAS
SALMON INTERCEPTION
SELECT COMMITTEE ON
LEGISLATIVE ETHICS



P.O. BOX 143
SITKA, ALASKA 99835

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

FAX (907) 465-4928

1/19/90

SETTLING THE FISH FARMING DEBATE:

NOW IS THE TIME TO SAY "NO"

Senator Dick Eliason

After four years of discussion on the subject of mariculture, the time has come for the Legislature to end the debate on fish farming and resolve the matter once and for all.

The grave problems associated with fish farms operating in other states and countries, the testimony of witnesses from Ketchikan to Bristol Bay expressing staunch opposition to the legalization of fish farm operations, and the findings and recommendations contained in the recently released report of the Finfish Farming Task Force have led me to introduce legislation prohibiting commercial finfish farming in Alaska.

Several years ago, when the issue of fish farming was first raised, the Legislature recognized the need to proceed slowly and withhold action until more information could be gathered. We have enacted two consecutive moratoriums on finfish farming and in 1988 called for a non-legislative task force to examine the key issues pertaining to finfish farming in Alaska and providing a well-balanced report to the legislature. The group, which completed its work this month, has done a commendable job of laying out the pertinent facts, noting several possible benefits and some serious risks, and leaves

to the legislature the disposition of the issue. One of the main conclusions in the report is that the legislature should not simply extend the current moratorium on finfish farming (expiring in July), but should instead enact a law either allowing or prohibiting finfish farming.

The legislation I introduced, Senate Bill 397, reflects the concerns addressed in the task force report. In evaluating the costs and benefits of fish farming identified in the report, it seems apparent to me that the serious risks outweigh any potential benefits. These risks include the spread of disease among wild fish by farmed fish, genetic intermingling of wild fish stocks with farmed fish unsuited to survival in the wild, degradation of water quality near finfish farms, and land use conflicts over farm siting. The report acknowledges that these potential threats to Alaska's valuable fishery resources and the environment can never be eliminated if fish farming is permitted, they can only be minimized.

Minimizing the risks would be accomplished largely through state regulation, which would necessitate a substantial expenditure of public funds. I don't believe the public would support such an expenditure when there it is unlikely that a fish farming industry can succeed here, and nobody can guarantee the absolute protection of wild fish stocks upon which commercial fishing, subsistence harvests, recreational fishing, and increasing sportfish-based tourism depend.

Although the proposed ban on finfish farming is necessitated by the legislature's responsibility to protect Alaska's natural resources, I have some additional personal concerns. The proponents of finfish farming speak of "employment" and "economic development." The truth is that fish farms employ very few people, approximately 3 people per farm. Is that worth risking harm to resources which currently support, among other things, Alaska's commercial fishing industry: our largest employer and second only to "Big Oil" in terms of its value to the state in dollars? Furthermore, I am concerned about the fact that most of the private sector investment in any finfish farming industry in Alaska will not be by Alaskans. Even if the industry were to make a profit here, much of it would leave the state.

We are fortunate to have resisted jumping into such a volatile enterprise -- lucky that during our moratoriums we have been able to learn from others' mistakes. We have seen genetics and disease problems cropping up at Norwegian fish farms, water contamination problems in Washington, and some of British Columbia's leading fish farms on the brink of bankruptcy, due in part to a glut of farmed salmon on the world market requiring many to sell below cost.

A couple of other good things emerged from the extended debate stimulated by the proposal of mariculture legislation. The question of shellfish and sea vegetable cultivation was divided from the fish farming issue during the course of legislative work on the issue. This has, in turn, given rise

to a fledgling industry to which Alaska has given both its blessing and the benefit of a comprehensive regulatory process.

Another positive aspect of the long discussion on the issue was the great degree of public participation which was achieved. Public awareness of the implications of launching a fish-farming industry in Alaska led to the expression of concern, and finally staunch opposition from the majority of Alaskans interested in the issue.

In response to all that we have learned, the responsible course of action is for the legislature to now move swiftly in adopting legislation prohibiting finfish farming and thus settling the debate once and for all.

Senate
TESTIMONY BEFORE ~~HOUSE~~ RESOURCES

BY SEN. ELIASON

(d Senate floor)

HB 432, PROHIBITING FINFISH FARMING
or SB 195
or SB 397

When the issue of finfish farming first surfaced several years ago, I knew that it would be of the utmost importance to the district I represent in the state Senate. My district includes Sitka, a major center for Alaska's seafood industry, as well as the "iceworm district" which is made up of thousands of miles of coastline and dozens of coastal communities.

From the beginning I have had a keen interest in the issue and have studied it carefully. I have visited fishfarms in both Washington and Norway, read extensively, and talked with hundreds of people on the subject.

I must admit that at first I was excited about the prospects for this new industry, and enthusiastic about investigating its potential in Alaska. But it was also clear that this was a MAJOR policy decision for this state and had to be done with great care and complete information. The more I've learned, the more I've come to realize just what a terrible mistake it

would be for us to allow a finfish farming industry to gain even a small foothold in this state.

I believe that the three years of moratorium we've had have been extremely beneficial. By not rushing into this new venture, we have had time to study it further, and to learn from the experiences in other states and nations where fish farming is underway. And what a lesson it has been!

Many of the areas that jumped on the finfish farming bandwagon are now experiencing enormous problems including bankruptcies, large numbers of fish escaping from farms, disease and genetics problems which are jeopardizing natural stocks, and very bad market conditions leading to the dumping of farmed fish on the market at a loss. Far fewer jobs have been generated than many people had been led to expect.

We can learn from all this. And while we note the problems in the industry elsewhere, there is an additional factor for us to consider here. In the other places where finfish farming has been legalized, they didn't have strong natural stocks to worry about - either they never had them or they had already destroyed them. Here in Alaska we have the healthiest natural runs of salmon and many other species of finfish in the world. The seafood payroll in Alaska in 1988 topped one billion dollars - more than the combined payrolls for the oil and gas,

tourism, mining and forest products industries. Now THAT is a lot to risk.

And it WOULD be at risk with the introduction of finfish farming in Alaska. And I do NOT mean because of any economic competition. With the enormous quantities of farmed fish already glutting world markets, Alaska's seafood already has that competition. The small amount that would be added to that by fishfarming in Alaska would not make a difference. Where the risk lies is in the potential dangers to our natural stocks upon which all of our commercial, sport and subsistence use depends.

As the Finfish Farming Task Force Report points out, the dangers involved in the development of the farming industry can, with enough regulation, funding, and enforcement, be MINIMIZED. Not eliminated, but minimized. To even minimize the risks we would need to spent large amounts of state money, time and personnel to set up tight regulation and monitoring, pathology services, enforcement personnel, and so on. And as we know all too well, there is simply no extra state money sitting around to do this with. We would end up chopping it off some other state program, probably other resource management programs, to fund the necessary state oversight.

WHY would we spend that kind of money, and/or take those kinds of risks with some of the most important resources in the

state, to try to start an industry that offers so LITTLE potential benefit to the state? I support economic diversification --- WHEN it makes sense. We should be able to see when something is better left untouched.

I believe that you will be asked by some fishfarming advocates to perhaps ban netpens for salmon, but to allow SOME fish farming --- a LITTLE fish farming, maybe upland tanks, or non-salmon species, or some other small slice of the pie.

Please don't be fooled by this approach. We know from past experience how easy it is to fall into the trap of throwing good money after bad to bail out a floundering venture. We know how easy it is to be pressured into easing restrictions, weakening our resolve, once an industry is going and is in financial trouble.

Whether we have two fish farms or 100, and whether they are saltwater net pens or upland tanks, the state must resolve the whole question of broodstock acquisition, must invest a great deal of state funding for siting, permitting, regulatory functions, enforcement, pathology services, etc.

With even one fish farm, we can never again advertise that "If it's from Alaska, it is wild natural fish." With more and more consumer awareness of the huge amounts of antibiotics and other drugs and chemicals used, and disease and pollution

problems involved in fish from fishfarms around the world, a consumer backlash at some point could make the the claim of "all natural" the best marketing edge Alaska's finfish has ever had.

Even more important to the question of allowing "a little" fish farming is the "foot in the door" argument - a little fishfarming now will certainly lead to more and more of it.

After initial involvement and expense by the state, and after allowing private businesses to invest time and money and get started, we are not likely to go back later and repeal it even if it is found to have detrimental effects. On the contrary, if the industry is allowed to start, and then runs into financial troubles (which it is clear it would from the economic crisis this industry is already experiencing worldwide) the state is most likely to add a bit more area, relax the restrictions, invest more and more money and time in trying to make the industry more "viable."

This has been exactly the case in British Columbia. There they began the industry with a tight restriction prohibiting Atlantic salmon. But once the farms were established and began to struggle, they repealed that ban to bail them out.

We spoke with people in the Washington state legislature and found that they have experienced a similar phenomenon. As soon

as their "little" industry was underway, they became a very real political force, lobbying and forming political coalitions with other special interest groups to gain passage of measures they wanted.

NO KIND of finfish farming is completely without risks to Alaska's water quality and fisheries resources. And no kind of finfish farming shows much potential of bringing economic benefit to the state. And no kind of fishfarming is worth risking its eventual expansion into the other methods and species, or more massive scale, which we know pose the greatest potential harm.

Let's not be misled into believing that allowing this industry to begin is "farsighted." Recognizing a bad deal when it comes along, and preventing our state and its resources from suffering inevitable negative impacts, - THAT is farsighted.

I hope you will read over the articles in your folders to get an idea of the experiences other states and countries have had with finfish farming - the problems with disease, chemicals, pollution, and so on.

I urge your passage of HB 432.

6

Approach fish farming with a degree of caution

By SEN. RICHARD I. ELIASON

There is a groundswell of interest in Alaska and around the world in the mariculture/aquatic farming industry, including the farming of finfish, shellfish and sea vegetables. Alaskans are actively exploring economic development possibilities, and the concept of launching a new renewable resource industry is a tantalizing one. Enthusiasm, however, needs to be tempered with prudence.

The states and foreign countries currently involved in intensive fish-farming have become involved because their natural stocks are no longer strong. However, the opposite is true in Alaska. Our wild salmon stocks yield harvests among the most abundant in the world.

Alaska now produces 43 percent of the worldwide total wild salmon, and 90 percent of all the wild salmon produced in the U.S. It's no exaggeration to assert that salmon is a mainstay of the state economy.

The actual economic impact of Alaska's salmon harvest is worth many times the harvest value. Processing alone can nearly double the value of the catch. The seafood industry, in which salmon play the leading role, provides more jobs than any other.

The state's natural fishing resources and the industry they support must be protected. Conscientious stewardship of Alaska's valuable seafood resources is of overriding importance. If Alaska proceeds with finfish farming, the



cost of this stewardship will increase significantly.

Concern has been expressed about the potentially negative effect of fish farms on water quality. Water pollution from fish feces, unconsumed feed and land-based farm operations must be carefully controlled, necessitating the careful development of siting guidelines and a process for site reviews. The appropriate regulatory agency must have funding to carry out monitoring and enforcement. A means for resolving disputes over use of coastal waters must be created: Many of the best prospective sites for finfish farming are cherished as safe harbors by fishermen and recreational boaters.

The subject of fish disease has generated heated controversy. Indigenous fish diseases are found in natural stocks, but most are self-limiting in the wild. Wild fish tend to be dispersed, and are not subject to the stress of a pen-rearing environment. The effects of large concentrations of biomass in a limited area are largely unknown. The presence of unconsumed fish feed and feces provides a nutrient-rich environment conducive to the growth of bacterial populations harmful to fish, and no matter how clean the environment of a pen, there is always the risk of disease: bacterial, viral and parasitic.

most disturbing aspect of the of fish disease is that most are easily transferable. pens are not designed to adequately safeguard against escape- of farm fish, wild fish can be attracted to the proximity of the pen by the presence of nutrients, and some diseases can even be borne in the water by currents. One can only speculate upon the impact of intensive pen-rearing of salmon on wild fish stocks. It won't necessarily be detrimental, but not enough scientific research has been conducted to prove that it won't be detrimental.

If private for-profit pen-rearing of salmon is authorized, the state will have to determine what government's regulation and support role will be. To what degree should the state regulate salmon farms to insure their stocks are healthy? Is Alaska willing to expend public funds to gear up for a large-scale application of technical disciplines including fish-disease control? Failure to do so has been a source of a number of British Columbia's problems in its trouble-plagued experience with salmon farming.

The Norwegian government subsidies have effectively reduced the price of their farmed salmon enabling that nation to become a leader in this new industry. Assistance takes the form of capital investment subsidies, capital grants, salmon shipping and transportation subsidies (including the creation of a complete road-sea-air system), and salmon product and price subsidies.

If private for-profit pen-rearing of salmon is authorized, the state will have to determine what government's regulatory and support role will be.

The government provides support in the areas of research and development, quality control, advisory services, free disease-diagnostic services and marketing assistance including international trade provision.

These forms of government support make Norway a formidable competitor and will enable that nation to outstrip the United States as a leading fish exporter by 1990. By that time, worldwide farm production of the premium species of salmon may account for half of total production of fresh and frozen salmon available on the world market. Some industry analysts predict that the supply of Atlantic salmon will overtake the demand by 1990.

Given this scenario, will Alaska fish-farmers be able to compete successfully? Just in order to gear up for the industry, the state would need to make operating budget appropriations to various agencies. How much support can the state afford to provide, or not to provide? Where will the money come from?

Will we take resources away from our existing rehabilitation and product promotion efforts which have already been cut from significant budget cuts two years? Will we really be creating new jobs or will we be giving them away from one group to another? (500 gillnetters will be laid off of business next year — possibly.)

There may indeed be unanswered questions about mariculture in Alaska, but the questions about market conditions, profitability, fish and its impact on nature and the degree to which the industry is willing to support and subsidize industry point to a cautious approach to finfish farming.

□ Sen. Richard I. Eliason is a member of the Fisheries Subcommittee of the Natural Resources Committee in the Alaska Legislature. He was one of the first Alaskans who traveled to Norway in 1978 to study Atlantic salmon farming.

Listen to concerns about fish farming's dangers

By SEN. DICK ELIASON

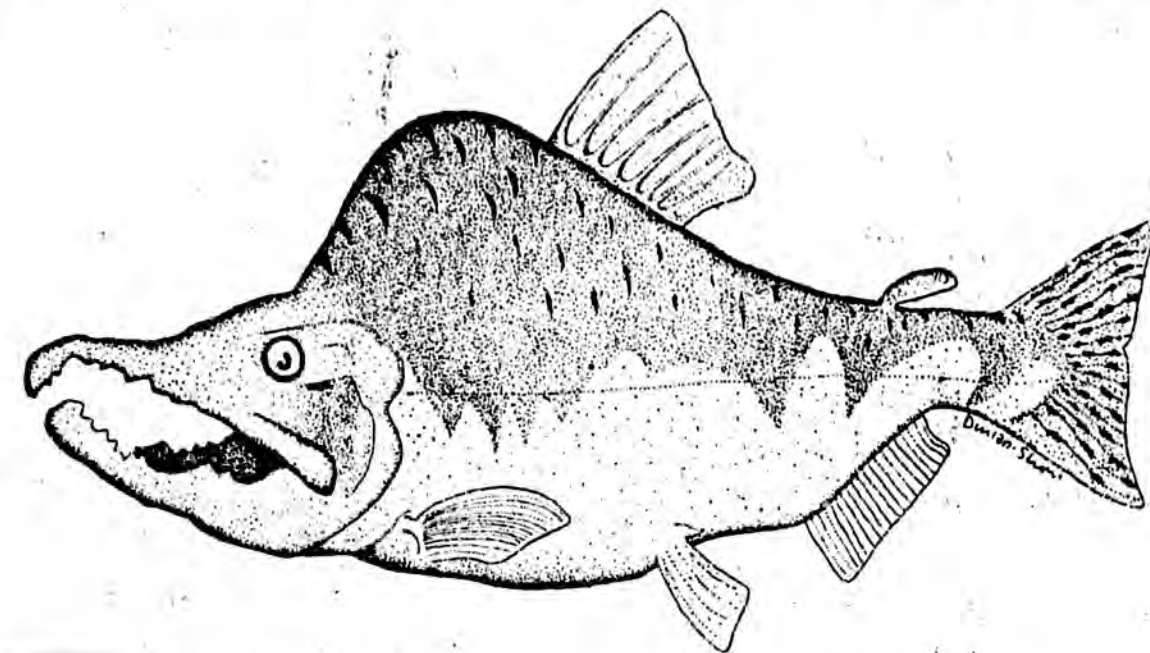
SITKA — The legislature's extension of the moratorium on finfish farming in Alaska reflects the overwhelming opposition to salmon farms expressed by residents of coastal areas.

Fishermen, environmental organizations, recreational and other user groups, as well as a great number of individual citizens accepted the legislature's invitation to speak out on the issue during an extensive series of public hearings in coastal communities throughout the state. To the question of whether Alaska should allow development of salmon farms to begin this year, the response has been a resounding "No!"

It might be easy for legislators representing Interior and Southcentral Alaska to support a swift resolution of the conflict over fish farming. Indeed, the cause has become a popular one in areas which will not bear the potential negative impact on the fishing industry occurring as a result of fish farming.

It would be most unfair to residents of coastal areas, who have expressed opposition to salmon farming, if their representatives were to blithely ignore their concerns.

Many questions remain unanswered in the areas of land use management/siting, potential negative impact on the existing fishing industry, and threats presented to healthy natural stocks by diseases prevalent on fish farms. Until these questions are resolved, divisive legislative debates over the issue can



be expected to continue.

One can learn a great deal from the experience of other countries which have been in fish farming for years. There is a great deal of information available, and much of it is conflicting information, which really facilitate the legislature in reaching a single conclusion or promptly resolving the mariculture debate.

The catastrophic effects of fish disease from farmed fish infecting dwindling natural stocks have been documented in Norway — the world's leader in salmon farming, and the

world's pioneer in growing halibut.

Our neighbor to the south, British Columbia, has shown us how likely it is that any economically feasible level of salmon farming activity would be fueled by outside investment, exclude "ma & pa" operations, create a few low-paying, menial jobs (which would never replace the value of jobs lost in the fishing industry) and generate profits which would flow directly outside.

Alaska's natural stocks are among the most abundant in the world. We offer the world a vanishing commodity — wild salmon. It is

COMPASS
POINTS OF VIEW FROM OUR COMMUNITY

well worth ensuring that our healthy stocks remain as free as possible from disease. The fishing industry is the state's leading employer.

In light of the unknown effect fish farming would have on fishing industry employment, it is worth ensuring that we retain the employment opportunities that the fishing industry and its support sectors now provide.

There has been much speculation about the expense to the state of mariculture development, particularly regulatory costs. It is worth ensuring that we adequately fund the budget for existing commercial fisheries programs, and continue to expand marketing and product quality improvement efforts.

It is only reasonable that the Alaskans who would be most affected by the state's move into salmon farming should be given the opportunity to speak out, and that their voices should be listened to. The legislature list and acted accordingly in choosing to extend the moratorium on salmon farming in Alaska.

☐ Sen. Dick Eliason represents District B in the State Senate.

Opinion

by Senator Dick Eliason

Alaska's reluctance to open the door to fish farming has disgruntled the handful of people pushing for the establishment of the industry here, but it's clear that imposing the temporary moratorium on finfish farming in Alaska's coastal waters was a step in the right direction, and permanently outlawing it is the wisest choice we can make for the future.

The salmon farming industry is in its infancy in neighboring British Columbia and Washington, and developments there relating to disease, pollution, and site location merit our attention.

Salmon farming operations must perpetually guard against disease, and the prospect of disease spreading from farmed fish to wild fish is frightening. A shock wave of alarm reverberated throughout the Northwest early this year when a fish disease known as VHS, never before seen in North America, mysteriously broke out at two salmon ranching operations in Washington.

All the diseased fish at the facilities were destroyed and buried, however unless samples taken this fall from spawning salmon reveal that the fish are free of VHS, the case is not closed. If the disease is present, the entire Soes River may have to be poisoned. The demise of a salmon-spawning river is a high price to pay, but the toll will be even greater if the disease spreads.

Two fish farming companies in B.C., including the province's second largest, were recently fined for dumping diseased fish into open ditches near the ocean. The carcasses were eaten by bears and eagles, providing a route for the disease into the food chain.

Battle in Washington

In Washington, a battle is raging between the burgeoning salmon farming industry, and a coalition of private landowners and fishermen. Landowners are worried about the negative impact of the farms on waterfront property values, as well as environmental and visual pollution. Fishermen are concerned about the threat of fish disease, damage to the marine environment attributable to massive quantities of organic wastes, use of antibiotics at fish farms, and escaped farm fish breeding with native stocks. Such issues would spark even greater controversy in Alaska due to public ownership of most proposed sites and adjacent uplands, and the multitude of natural stocks at risk.

Farmed Salmon Glut

A significant challenge facing salmon farming operations just gaining a foothold in the market is the current global glut of farmed salmon. This predicted oversupply has created intense competition in the U.S. market, causing farmed salmon to be dumped on the market at a price below cost, and in turn causing a major reduction this season in prices for fresh salmon from Alaska.

These market conditions really put the squeeze on newcomers to the salmon fishing industry, and those with high production/operating costs. If Alaska had promoted fish farming when the topic was first debated, Alaska product would have been hitting the market now, and the higher-cost Alaska operations would likely have gone under.

Global expansion of the industry, its rapid growth in Chile (which has no native salmon stocks and offers some of the lowest production costs in the world), and a supply which already outstrips demand indicate that, from an economic perspective alone, it would be a foolish gamble for Alaska to jump into the arena at this time, or at any time in the foreseeable future.

Protection

Alaska must be dedicated to protecting and developing her existing fishing industry. It is the state's leading industry based on a renewable resource, worth hundreds of millions of dollars, and has for many years provided the greatest number of non-government jobs; the health of the industry is critical for local economies large and small. We cannot afford to jeopardize this valuable industry by putting natural stocks at risk; our economy could be completely upended.

The potential of fish farming to devastate Alaska's wild fish stocks is greater than that of a major oil spill. If rivers need to be poisoned to eradicate fish disease, as they have been in Norway, if the clear waters of Alaska become polluted by fish farming operations, if our natural salmon stocks are crossbred with fish lacking characteristics for survival in the wild, we will suffer catastrophic economic consequences.

Focus on Strengths

In order to hold her own as well as possible in an international marketplace in which Atlantic salmon are gaining market share at an alarming rate, Alaska must focus on improving finfish quality, securing markets for the products which are her specialty (such as wild Pacific salmon from unpolluted waters), and to protecting our valuable fishery resources from the threat of degradation posed by fish farming.

Senator Dick Eliason represents Senate District B, stretching from Metlakatla to Yakutat. He is a member of the Senate Resources Committee, and a Chairman of the Senate Labor and Commerce Committee.

FORUM

Lawmakers should ban fish farming in Alaska

by Dick Eliason

ANCHORAGE — After four years of discussion of mariculture, the time has come for the legislature to end the debate and ban commercial finfish farming in Alaska. The current economic outlook for fish farming is bleak, and does not provide any indication for jeopardizing a natural resource base which supports subsistence, and valuable commercial fisheries. Economic development is important to the state, however, one must weigh the potential detriment of each economic development prospect against the potential bene-

fits. Unlike the other states and countries which have pursued fish farming, Alaska has a wealth of healthy natural fish stocks. These support a seafood industry worth \$1 billion in Alaska which in 1988 exceeded \$1 billion. That's more than the combined value of Alaska's other leading industries: oil and gas, tourism, mining and forest products.

A fish farm, which costs about \$1 million to start and takes two years to realize the earliest income, employs an average of three people. Financing for fish farm ventures in Alaska would likely come from investors in other states and nations, and a large share of any profits flowing out of state.

Fish farms in other states and in nearby British Columbia have been forced to sell their products at or below cost due to a glut



of farmed fish on the market, and some have faced bankruptcy. Profitability is, at best, uncertain.

The report submitted to the legislature by the (non-legislative) Finfish Farming Task Force states that the potential negative impacts of fish farming on natural stocks cannot be eliminated, a finding with which even fish farming advocates reluctantly agree.

The chief areas of concern which have emerged during the course of the fish farming debate in Alaska are those of water quality, siting, and hazards to natural stocks.

Water pollution is hard to sidestep in an operation which generates tons of oxygen-demanding waste. One typical fish farm using net-pens produces pollutants equivalent to untreated sewage from about 10,000 people, according to a Washington state report. Hormones and antibiotics given the fish are part of this waste, and their use is believed a threat to public health.

The likelihood of irreversible damage is greatest, however, in the threat to natural stocks posed by disease, accidental escape-

ment, and genetic intermingling, all of which have presented genuine problems in Norway, the world's most advanced fish farming nation.

Despite advanced technology and massive government subsidies supporting the industry, thousands of diseased fish escape from farms, threatening wild stocks.

Even when disease exists in wild fish, fish farms have indicated higher rates of infection near net pens. Renegade farm fish, even if they are free of disease, may constitute a threat by competing for space in rivers inhabited by wild fish, and inbreeding can weaken the qualities which suit a fish for life in the wild (such as the ability to migrate).

These various risks to wild stocks can be minimized, according to fish farm proponents, with proper controls, siting guidelines and adequate funding. The cost of these controls and the attendant layers of bureaucracy would be considerable, and regulations would be ineffective unless accompanied by rigorous enforcement efforts.

From Norway to British Columbia there have been documented cases of flagrant violations of regulations, including the release of diseased fish into the wild (to spare the expense of proper disposal) and the improper dumping of diseased carcasses (in one case an open trench enabled scavengers to provide a route for the disease into the food chain).

The legislature has a constitutional mandate to manage natural resources for the maximum benefit of Alaskans. To gamble with these resources at public expense simply irresponsible.

Our stewardship of Alaska's natural resources, her lands, her waters, and her fisheries, involves both development and conservation. The public interest would best served by our unfailing commitment to managing Alaska's fisheries resources according to sustained yield principles, maximizing returns through controlled harvesting and enhancement, providing incentives for shore-based processing, continuing marketing and quality assurance campaigns, and protecting the marine environment from pollution.

The moratorium on fish farming now in place will expire in July. Legislation has been introduced which would ban commercial finfish farming in Alaska.

Legislative committees are now taking public testimony on this issue. If the legislature lives up to its constitutional mandate, Alaska will refuse to flirt with the potential catastrophe which could be brought about by fish farming and will institute prohibition.

Sen. Dick Eliason represents District B in the Alaska State Legislature. He is chairman of the Senate Labor and Commerce Committee, a member of the Senate Resources Committee.

FORUM

Pen-farmed salmon industry requires more research

By SONJA CORAZZA

Alaska fishermen's concerns over genetic pollution and disease problems associated with escaped pen-farmed salmon are not unwarranted.

Thirteen to 20 percent of all farmed fish escape, as documented by Norwegian scientists and European countries, and large numbers can escape from pens.

The escapees can spawn in rivers up to a proven distance of 20 kilometers from their net pens.

As a consequence of this research, and with great concern for the genetic integrity and survival of their wild salmon stocks, Norway has just imposed a series of new regulations on their pen-

COMPASS

POINTS OF VIEW FROM OUR COMMUNITY

farmed salmon industry. No salmon farms will be located within 20 kilometers of salmon rivers, and entire fjords will be closed to farming where salmon rivers are present.

This past December in Jarvis Inlet, B.C., 300,000 pen-farmed salmon escaped in winter storms that hit Canada. Floating net pens were found for miles up and down the coast.

Norwegians have lost tons of their pen-farmed salmon to a deadly salmon disease *furunculosis*, and last summer 5,000 fish infected with

furunculosis escaped in Norway. Despite intensive efforts to capture the diseased fish, an infected fish was found in a freshwater stream.

In order to control disease in pens, Norway's use of antibiotics in pen farming has risen 170 percent in the past two years to reach a level of 48 tons, more than the use in animal husbandry and human use combined.

With the present focus on health and nutrition, how does this reliance on antibiotics fit our view of pen-farmed salmon as a healthy addition to our diets?

Norway's most severe threat to wild stocks is from the parasite *gyrodactylus salaris*, which has wiped out

30 wild salmon rivers. This parasite entered Norway via imported salmon eggs from Sweden. Importing eggs had been prohibited, but those regulations were overturned by farmers with economic concerns.

The chemical rotenone which kills the parasite destroys everything in the rivers, hence the loss of wild salmon by the tons in Norway.

In the state of Washington, which two years ago allowed the importation of Atlantic salmon for the economic benefit of their farmers, a report was released on fin fish farming and disease. It stated that the VHS disease carried by Atlantic salmon had never been

found outside of Europe and that there was little likelihood of it ever being a problem.

Now, VHS has been found and millions of their eggs and fish are being destroyed. VHS is particularly fatal for rainbow trout and steelhead.

Domesticating Pacific salmon takes three to four generations of fish and the gene pool may be reduced for docile characteristics. It is possible the migration instinct may breed out of wild salmon, and scientists are concerned interbreeding could affect the wild salmon's ability to migrate.

Ownership of the pen farming industry continues to be an issue. In Washington state a local fish farmer

is suing foreign corporations, primarily Norway, for attempting to monopolize the industry.

Who would own the in Alaska? Alaska is entirely the world leader in ocean ranching and the program is responsible for at least \$80 million in revenue and 2,300 jobs.

The Alaska State Legislature should fund the culture Task Force, a body where legitimate concerns about fin fish farming to be researched.

□ Sonja Corazza is a member of the United Fishermen of Alaska, Mariculture Committee.

Virus threatens state's salmon and steelhead hatcheries

By Jane Hadley
and George Foster
P-I Reporters

State and federal biologists have destroyed almost 4 million fish and eggs at two Washington state hatcheries because some of the fish were infected with a fatal

viral disease that has never before occurred in North America.

The hatcheries have been quarantined, but the virus may already have spread into valuable Pacific salmon and steelhead stocks, alarmed fisheries experts say. The disease has previously infected European commercial

trout operations.

"The worse-case scenario is that every hatchery would become infected," Joseph Blum, director of the Washington state Department of Fisheries, said yesterday.

"The hatchery world throughout the U.S. has been put on alert. The word is out and traveling

quickly," said David Klinger, a spokesman for the U.S. Fish and Wildlife Service's regional headquarters in Portland.

The virus, which cannot be treated and is always fatal to infected fish, poses no risk to human health, even if a contaminated fish is eaten, according to

the state fisheries department. Two hatcheries, the Makah Hatchery near Neah Bay and the Glenwood Springs Hatchery on Orcas Island, are being disinfected. No fish or eggs can enter or leave the facility, said Klinger.

Coho, chum, fall chinook, and steelhead were destroyed.

The virus first showed up in December at Glenwood Springs, a joint private-state salmon rearing operation.

A short time later the virus appeared at the U.S. Fish and Wildlife Service's Makah Hatch-

See **VIRUS**, Page A7

Virus: Threat to hatcheries

From Page 1

ery on the Olympic Peninsula. But the virus was not positively diagnosed until last week.

The disease, called viral hemorrhagic septicemia or "VHS," has previously been reported only in continental Europe, where it has caused "significant fisheries losses" at commercial trout operations, according to the fisheries department.

Blum said a little over 300 million young fish and 60 million eggs are produced annually in the state. The fish and eggs destroyed this week would amount to about 1 percent of that.

"Obviously, it's a significant number of fish," said Klinger. And the Makah hatchery fish also are considered especially valuable because the hatchery is so close to the open ocean that the fish have a very high survival rate, he said. But the possibility that the disease might spread to other hatcheries is now the main worry.

Glenn Yokoyama, manager of the University of Washington's fish hatchery on Portage Bay, said if fish and eggs were transferred into or out of the infected hatcheries after the virus discovered but before the quarantine was put into effect, it would heighten the chances the disease would spread.

Bob Byrne, a spokesman for the state Department of Wildlife, said department biologists are concerned that the virus will

"The likelihood of this virus showing up someplace else at some point is pretty high," he said.

Top fish disease experts throughout the Northwest met in Medford, Ore., this week to discuss the virus and other matters, according to the state fisheries department.

The disease causes the blood-forming tissues of the kidneys to degenerate.

The disease could have been introduced by certain fish species, or by ships or travelers carrying contaminated water.

"The possibilities are bilge water from vessels or that people who travel worldwide pick it up on their boots, or that other fish could have it," Blum said. "My understanding from our technical folks is that black sea bass are a carrier. Atlantic salmon have been known to have it."

The new disease may well fan the flames of the controversy over salmon net pens and other aquaculture operations in the state. Opponents have insisted that net pens pose the risk of introducing new fish diseases, while supporters have downplayed the risk. The favored fish at net pen operations is the Atlantic salmon.

The state has 13 net pen operations, most of which raise Atlantic salmon, and a number of new ones are proposed.

Hatcheries in this state have been plagued by a virus for many years known as IHN. Since 1982 the UW's hatchery has had to test each egg and young salmon individually for the presence of IHN.

Senator Eliason

The recent articles commenting on the success of Norway's fin fish farming industry have ignored the high price that Norway has paid in fish diseases that have ravaged their industry and destroyed thirty of their wild salmon rivers, and the very real fears their scientists have concerning genetic pollution of their wild stocks of salmon.

Norwegian salmon farmers, in the business for twenty years, find themselves continually fighting new diseases that have required the slaughter of tons of pen-farmed salmon. A group of farmers, who lost their harvest either to furunculosis (a disease that kills 60% of affected stocks) or to government control of diseased fish, is suing the Norwegian government for \$25 million dollars. Farmers themselves are demanding that 100 more fish veterinarians specializing in disease control be hired before anymore fish farm permits are issued... those in addition to 60 fish disease specialists and nearly 150 fish veterinarians already working around the country.

Norway's use of antibiotics for controlling these diseases rose over 170% last year to reach 48 tons. This is more than the amount used for animal husbandry and humans combined. With our focus on health and nutrition how does this use of such large quantities of antibiotics affect our view of pen farmed salmon? Scientists have expressed concerns of effects on the food chain and the increase of human resistance to antibiotics.

Last summer in Norway 5,000 farmed salmon infected with the deadly furunculosis escaped into their waters. Despite their best efforts to blockade and capture the sick fish, an infected fish was found in one of their rivers. "If the disease spreads to natural stock, the situation may be out of control in Norway," their scientists warned. Studies by three Norwegian fish biologists conclude that disease in farms can

lead to higher infection rates of wild stocks in the vicinity of the net pens even if the disease itself may already exist in the natural stocks.

The fish farm disease that kills wild salmon in rivers and has destroyed 30 wild salmon rivers in Norway is *Gryodactylus salaris*, a parasite that entered Norway via infected smolts from Sweden. The only way to clean up the rivers is by the use of a chemical called rotenone. Unfortunately along with killing the parasite, it also kills every other

living thing in the river, including wild salmon. A top Norwegian scientist says, "I feel we are on a sharp edge with diseases. If we have the *Gryodactylus salaris* in more rivers we may just accept our wild salmon is extinct."

It has recently been suggested that one of the reasons that Alaskans might be interested in a pilot project in salt water would be to assess the probability of fish escaping. We don't have to experiment... it is documented. At least 13% of farmed salmon escape and there are occasionally very large numbers that escape. For instance, this last December in Jarvis Inlet, B.C. an estimated 300,000 fish escaped from their pens in winter storms and residents reported many net pens floating up and down the coast. Also, in Washington State, commercial fishermen have reported substantial numbers of escaped farmed salmon in their catches. Should these escapees concern Alaskans?

Svein Mehli, head of Norway's Directorate for Nature Management, which is responsible for protection of wild salmon, appeared in Washington State on December 14 as an expert witness on fish disease and genetic pollution. He testified that up to 40% of the fish in many of their rivers is now of farmed stock origin and says they are very concerned about the genetic effects of farmed salmon on wild stocks. "We are very afraid it could affect their ability to migrate," he said. Three major fisheries institutes in Norway have reported that escaped farmed salmon do spawn in rivers. In order to combat this threat, Norway has implemented new zoning regulations this year... **no salmon farms will be located within 20 kilometers of salmon rivers, and entire fjords will be closed to farming where salmon rivers are present.**

In Alaska, using indigenous species that would take at least three generations to tame (until they had lost their basic will to survive in the wild) and the resulting genetic pollution from escaped fish could pose the same threat. Although the magnitude of that threat would be related to the population size and density in individual streams, spawning escaped salmon would still be a danger, especially in streams with small populations.

Alaskans who imagine that we could control diseases better than other countries because we have a large hatchery system and would not be forced to import eggs or smolts need to examine the situation in Washington State

areas have overturned strict fish regulations banning the importation of foreign stocks at the economic pressure of fish farmers who find that native wild stocks are slow to domesticate and growth rates are not rapid. The already domesticated Atlantic salmon is the economic savior of fish farmers. Fish biologists were mystified at the reversal of their regulations and a Canadian biologist wrote that his government was playing "Russian Roulette with our wild fish stocks." That same economic pressure forced Norway to lift their ban on importation and the result was the *Gryodactylus salaris* parasite that has caused such a tragedy in their country. Acquisition of eggs or smolts from hatcheries or river systems is also a major public policy issue for Alaskans to consider. The only experimental on-land tank farm in Alaska acquired its eggs from a northern sport fish hatchery... that may be fine as long as the public, through the Board of Fish process, has an opportunity to comment. The demand for eggs in British Columbia has created conflicts between sport and commercial fishermen and fish farmers.

In Washington, a local fish farmer is now suing in U.S. District Court alleging that foreign national interests, primarily Norwegian, have made an attempt to monopolize the commercial farming industry in his state. 80% to 95% of the fin fish farming industry in both Washington and British Columbia is owned by Norwegian Corporations. Could Alaska escape such a fate? It's doubtful.

There seems to be a plentiful supply of pen-raised salmon these days... it's starting to go into freezers in Europe as well as being sold fresh. Alaska is presently the world leader in ocean ranching. The State's hatchery programs are responsible for at least 80 million dollars in resident income and 2300 resident jobs.

Last year's mariculture legislation, which addressed shellfish and aquatic plant farming, also called for an Alaska Mariculture Task Force to study the issues relating to fin fish farming (especially, salmon pen rearing). We believe that this Task Force should be funded now to give all concerned parties and the Legislature an approved forum in which to study and assess the impacts of fin fish farming on Alaska. Alaska contains 48% of the wild salmon in the world... we should not let the winds of economic development sway our way of thinking. It is imperative that we fully understand the consequences of our actions and protect the future of our uni-

information, contact UFA's office in Juneau at 586-2820 or 1-800-478-FISH. *

Editor's Note: This article was provided by the United Fishermen of Alaska, Mariculture Committee. For more

Excerpts



UNITED FISHERMEN OF ALASKA

211 4th Street, Suite 106
Juneau, AK 99801
907-586-2820

March 17, 1988

Dear Alaskan:

UFA OPPOSES fish farms -- saltwater or freshwater, in tanks or in net pens. The following enclosures support our position.

- * A one-page briefing paper summarizing why UFA feels that large numbers of Alaskans should OPPOSE fish farms.
- * A series of annotated news articles and commentary based on several themes such as...

Genetics. We take alarm at reports of domesticated escapees from netpens mingling with the few remaining wild stocks in the Atlantic salmon spawning streams of Norway.

Disease. We further take alarm at reports of disease from farmed fish destroying salmon in Norway's streams, at reports of diseased farm salmon being released in Canadian waters, at photographs of diseased fish in garbage dumps in Canada.

Conflicts with other water and land users, the "lock up" of public bays. We don't like fish farmers firing guns to frighten off recreational boaters in B.C. We don't like net pens anchored where we fish or set crab pots.

Nutrition. Why would health-conscious fish consumers want pen-reared salmon, with lower oil content, mushy flesh, and artificial coloring?

Foreign or corporate ownership of Alaska's fish. Small farms in B.C. have gone bankrupt to be bought out by large foreign corporations, setting an unnerving example.

- * Position papers and letters that further explain the opposition of UFA and other groups to mariculture.
- * References and bibliography.

We hope you will study this report and other information on fish farming. We ask you to join us in our support of shellfish and algae aquaculture and in our opposition to fish farming.

Kate Graham
Executive Director



UNITED FISHERMEN OF ALASKA

211 4th Street, Suite 106
Juneau, AK 99801
907-586-2820

MANY OPPOSE FISH FARMING

March 15, 1988

Alaska's **COMMERCIAL FISHERMEN**, who depend upon wild salmon stocks, oppose fish farming. Alaska's wild salmon stocks have not been depleted, as they have been in Norway and Scotland, and with 43% of the world's wild salmon, we Alaskans have much to lose from **DISEASE** and **GENETIC MUTATIONS** from escaped pen-fish.

Commercial fishermen are not the only ones who fear the risks inherent in fish farming. **SPORT FISHERMEN** also fear genetic dilution of wild, fighting fish and are concerned that the parasites and diseases bred in salmon "feedlots" would spread to our wild fish.

UFA shares the concerns of Alaska's **SUBSISTENCE** users, who see our common fish resources diverted to corporate profits. Note British Columbia's precedent: foreign national corporations now own two-thirds of the fish-farms. As smaller B.C. fish-farms have been taken over by foreign corporations, ugly memories of the fish-trap era return. As further insults, **SUBSISTENCE** users will find areas around fish-farms **OFF-LIMITS** to fishing, hunting, and trapping.

UFA fears further **FISCAL** impact to state agencies that can neither meet their present responsibilities, nor take on new ones. Hatcheries are now losing state support. Several of our commercial fisheries are not even understood, much less managed.

UFA shares the concerns of **HEALTH-CONSCIOUS CONSUMERS** who prefer their Alaskan salmon without artificial coloring and antibiotics, who seek the nutritional and aesthetic advantages of wild salmon, and who would be alarmed by newspaper reports of fish-kills of pen salmon from disease, pollution, and algae blooms.

We also share the concerns of **OUTDOOR RECREATIONALISTS** and wilderness seekers. We fear that choice public lands and prime public waters will be **LOCKED UP** by net-pens, with "no trespassing" signs posted at the entrances of bays we formerly fished, kayaked, and anchored in.

UFA shares the concerns of the outdoor **TOURISM** and **GUIDING** businesses, who fear the "land-rush" of farms to remote areas will impair wilderness values essential for their success.

UFA shares the concerns of **LOGGERS** who will suffer restrictions on tow-boat traffic, log transfer facilities and rafting sites, and logging in watersheds draining into net-pen areas.

UFA shares the concerns of **ENVIRONMENTAL** groups who see

- * treasured scenic areas and wilderness anchorages spoiled;
- * seals and otters being shot for intruding upon net-pens;
- * bears and eagles being shot in upland garbage dumps;
- * more trespass cabins and conflicts with upland users;
- * no planning between federal upland managers and state agencies;
- * no long-range planning to prevent net-pen siting conflicts.

Like these environmental groups, **UFA** is uneasy with the assurances of government agencies, who say, if only given enough budget, they can handle all problems, large and small.

THE NEED TO SAFEGUARD THE GENETIC DIVERSITY OF WILD STOCKS

Genetic diversity makes wild salmon special. The legendary ability of wild salmon to return and spawn in the streams of their birth creates a genetic link bonding them to a specific ecosystem of the earth. Thus each stream cultivates its own stock of salmon. The genetic material of the salmon in that stream does not mingle with the genetic material of any other salmon. Thus, even if disease or disaster should wipe out one stream's stock, salmon in adjoining streams may not be adversely impacted.

Wild salmon's selection of specific spawning streams is akin to investors' protection of their money: wise investors put their money in many small accounts rather than in one large one. The survival of wise investors and wild salmon is based on this principle.

From this principle comes a basic policy of the State designed to safeguard these natural genetic differences: transporting salmon eggs or breeding stock from one region of Alaska to another is not allowed.

The siting criterion for fish farms also comes from this principle. Escapees from fish farms have little "homing" sense; that is, they don't know which stream to return to spawn in. Escaped salmon may stray into several areas when the urge to spawn takes over them. Therefore, fish farms should be located far away from spawning streams.

Therein lies a dilemma. How can you keep fish farms close enough to their source of eggs or broodstock to maintain the genetic character of the region, yet far enough away that escapees do not enter the stream to spawn? And exactly what are the safe maximum and minimum separation distances? As yet there are no scientifically-based answers to these critically important questions.

DO NOT CONFUSE THE GENETICS OF WILD, HATCHERY, AND PENNED FISH

- ***HATCHERY fish breeders seek to mimic wild stocks.***

They promote Type "A" aggressive fish, with hyperactive traits. They breed fish to compete and mate with wild stocks. Hatchery fish, like wild stocks, chase their prey and, in turn, escape predators. Their genes remember the strength of the chase, their muscles flex with the test of speed, their flesh tastes of the stamina of the ocean. The slow ones, the weak ones don't survive.

- ***PENNED fish breeders seek genetic traits unlike wild stocks.***

They seek tame fish, docile and of broken spirit. Penned fish swim in circles, preying upon sinking food pellets. Breeders unnaturally select genes which tolerate stresses of confinement, overcrowding, and noise. Diseased pen-reared fish survive on the crutches of vaccines, antibiotics, chemicals, and dietary additives. Their flesh feels soft and, without red dye in the food pellets, looks pasty white.

WHY FISH FARMING WORSENS DISEASE RISK

Several factors aggravate disease problems in fish farms, whether incubated in net pens or in tank farms.

• CONFINEMENT

Disease and parasites thrive where their hosts are densely packed, such as in fish farms, feedlots, and so forth. Disease organisms prefer to be safe inside their hosts rather than outside. Outside, in clean water or clean soil, it's only a matter of time before disease organisms die. Thus, disease organisms thrive in or near fish farms, where the distance between hosts is short, where the nets and structures attract slime and growth, and where the bottom is fouled with energy-sustaining filth and uneaten food.

• DIET

Dry food pellets, normal fish farm fare, do not seem to suit Pacific salmon so well as Atlantic salmon. Dry food requires rehydration after ingestion and forces the fish to process more water through its body, thus inducing more stress. Pacific salmon seem to prefer fresh or frozen feed. With either feed type, Pacific salmon will not eat well if frightened or stressed. If the feed does not contain proper nutrients, the penned salmon will not develop resistance to disease.

• LACK OF EXERCISE

The restraints of confinement limit the fitness and health of penned salmon. This not only impairs the resistance to disease but also impairs muscle tone, which accounts for the mushiness of penned salmon's flesh.

"Disease outbreaks have plagued the life of fish farmers through the years... The hitra disease of Norway is clearly the most frequent cause of loss there. It appears to be a reoccurring event. The insurance industry of Norway has posed the question of whether this disease is an insurable risk or whether the losses caused by the disease should be regarded as a normal calculable operating expense which should be excluded from the insurance industry.

"The overtones of these thoughts parallel the thoughts of underwriters about BKD [bacterial kidney disease] in British Columbia.

"The losses in Norway due to hitra disease were enormous last year. Losses due to the disease and early slaughtering could be as high as 8000 tons or \$65,000,000."

*Ian Angus, Vice-President,
Sedgwick Tomenson Inc.,
International Insurance Brokers,
of Vancouver, B.C., in a speech
before the 1987 Sitka aquaculture
conference.*

Commissioner J. Anthony Smith, Alaska Department of Commerce and Economic Development, testifying before the President's Export Council Subcommittee on Foreign Trade Practices.

"The Norwegian Government continues to provide extensive financial and non-financial supports to Norwegian salmon farming..."

"The Government assists small-scale farmers by guaranteeing loans... The guaranteed loans finance the start-up costs and initial capital investments associated with salmon farms. Loans for the erection of buildings in areas with low levels of economic development may be granted with a repayment of up to thirty years...the fund may permit exemption from installment payments and deferment of interest payments for a period up to five years...special capital grants are also available through the Norwegian Government. Grants to salmon farms in the northern-most region are available to cover up to 40 percent of capital investment costs."



"In the 1970's, the Norwegian Government subsidized the construction and planning of an extensive road-sea-air transportation system to link the coastal areas with inland salmon... The Government also forged an important partnership with the Scandinavian Airline System (SAS) to ship salmon to various world markets. The Government pays SAS a \$0.50 per kilo subsidy for all international shipments... Direct flights, not justified by passenger volume, go from Bergen to Seattle and other important U.S. markets, and space is always made available for salmon shipments."

"Price supports have also been established for the Norwegian fish farmer... If the market price falls below the minimum level, the Government will subsidize the farmer to cover his costs."



"The Ministry of Fisheries extends free disease-diagnostic services to all farmers. Due to a shortage of trained fishery pathologists, the Government has encouraged the development of university curricula to study fish health diseases. All Norwegian salmon operations also have access to a full range of advisory services on density of stocking, diets and feeding regimes, and harvesting processing and packaging."



"This magnitude of R&D financing underscores how aggressively the Norwegian salmon industry has been targeted for assistance. Indeed, in 1985, aquaculture was designated one of four top priority areas for industrially oriented research funding... Other studies have focused on population genetics, improving flesh color and body oil content...."



"These subsidies dramatically reduce the price of farmed salmon, which would otherwise be far too expensive for foreign purchasers."

"The insurance industry's attitude to aquaculture provides another clue to the inherent risk in the industry. Insurers are the most skilled risk assessors available in society and their approach in insuring aquacultural provides an excellent insight into the realities everyone involved in aquaculture must face. If they, the most skilled assessors in society, are considering getting out of aquaculture insurance, or if they are seeking to restrict the cover that they give to fish farms, then, surely, that is a warning to everyone."

Ian Angus, Vice-President, Sedgwick Tomenson Inc., International Insurance Brokers, of Vancouver, B.C., in a speech before the 1987 Sitka aquaculture conference.

"Only one careless producer selling infected fish can tarnish the image of the industry. The liability exposure can be measured and consequential effect on markets can be devastating. One need only look at the canned salmon industry as an example."

Ian Angus, Vice-President, Sedgwick Tomenson Inc., International Insurance Brokers, of Vancouver, B.C., in a speech before the 1987 Sitka aquaculture conference.

Going for Atlantics In Washington State

PUGET SOUND—Washington state salmon farmers may be on the verge of a momentous decision, a decision that may impact salmon farming in British Columbia and Alaska. Three out of the state's 11 salmon farms have decided to go with Atlantics rather than cohos.

Reports last fall suggested that if this decision is followed by the remaining farmers in the state, it could have a major impact on marketing farmed salmon. Atlantics, according to some experts, grow faster and are more disease resistant than cohos. This

means that larger Atlantics could be produced by the farmers, and subsequently sold for a higher price.

According to a report in the *Seattle Times*, coho give a return of \$.75-\$1.50 to the dollar, while Atlantics give \$3-\$4 return.

A change to Atlantics could be the start of market competition between Washington and British Columbia. B.C. farmers have focused on coho, with the government there frowning on the introduction of Atlantic salmon and possible new diseases.

B.C. Salmon Farms Continue to Increase

VICTORIA—Salmon farming in British Columbia continues to grow, say the preliminary results of a survey conducted on the province's salmon farms by the B.C. Ministry of Agriculture and Fisheries.

As reported by *Canadian Aquaculture Magazine*, the survey shows 113 operational farms as of the end of November 1987. Another 38 sites were licensed but not yet operating. This brings the total to 151.

To show how much the industry is growing, the survey compared the number of operating farms in 1987 vs. the number in 1986. The Sunshine Coast, for instance, had 45 farms by the end of 1987 compared to 34 in 1986. Campbell River/Desolation Sound

had 30 farms vs. 12 farms a year earlier. Northwest Vancouver Island had 8 farms last year compared to 3 farms the year before.

This growth in numbers has meant a corresponding growth in holding capacity, according to the *Canadian Aquaculture* report. In 1986, total holding capacity was about 3,717 tons. At the end of 1987, capacity had jumped to 16,990 tons.

These farms employ a number of people, and the B.C. government wanted to get a handle on how many. According to the survey results, 544 people are employed by B.C. fish farms. That total is broken down to 318 full-time farm employees, 137 part-time employees, and 89 office employees.

Fish farming in tanks doesn't solve the problems. While tank farming may ease some fish farming problems, it worsens others.

The table below shows, on an issue-by-issue basis, how upland tank farming will be better or worse than net pens anchored in marine waters.

PROBLEM/ISSUE	TANKS vs. NET PENS
GENETICS	
Magnitude	• fewer adult escapees
Domesticity	• tamer fish in tanks, less "wild" genes
DISEASE	
Incidence	• perhaps more, with stress in tanks
Transmittal to Wild Stock	• less probability with tanks
Diagnosis/Treatment	• easier with tanks
Sick/Dead Fish Disposal	• easier with tanks
Biocides	• used more with tanks
ENVIRONMENT	
Waste Generation	• same volume
Waste Treatment	• upland facilities required
Waste Disposal	• upland fish food/fecal site required
Site Cleanup	• more bonding needed for tanks
Hazardous Chemicals	• more controls/bonding for tanks
HABITAT	
Predation	• less seals, more bears with tanks
Attraction Nuisance	• no diversion of migrating fish
Bottom Deposits	• none in marine waters with properly operating tanks
Algae	• less fish kills with properly operating tanks
USER CONFLICTS	
Navigation	• less impact with tanks
Commercial Fishing	• less displacement with tanks
Subsistence	• less fishing impact; more hunting and trapping impacts with tanks
Logistical Traffic	• same
Intertidal	• docks needed
Upland	• more impact with tanks
Timber/Mining Conflicts	• perhaps lessened with tanks
Recreation Conflict	• less for kayakers, more for hikers
IMPACT ON AGENCIES	
Hatcheries	• same diversion of eggs/smolts from public to private hands
Permitting	• more for upland activities
Budget	• same drain upon staff, budget to issue permits, inspect sites
SOCIO-ECONOMIC	
Ownership	• higher capital/operating costs for tanks mean larger corporations
Complexity	• more training for tank operators
Risk	• more mechanical failures with tanks
Insurance	• same, not available for either
Bank Financing	• same, not available for either
Nutrition	• less consumer appeal with tank fish

The preceding pages contained opening paragraphs and highlights from various articles and technical papers. The sources for those pieces are listed below. UFA keeps files of these articles, and copies are available upon request.

GENETICS

"Renegade Norwegian farm salmon polluting wild runs." *The Fishermen's News*, January 1988

"Farmed Salmon Affects Wild Stocks." *The Latest Developments in West European and Canadian Fisheries*, National Marine Fisheries Service, June 1987

"Salmon farm owner to switch harvests." *Anchorage Daily News*, C-4, January 9, 1988

"Norwegian 'renegade salmon' are mingling with wild stocks." *Pacific Fishing*, March 1988

"Farm Salmon Stock Fears in Ireland and Norway." *Fish Farming International*, p. 32, June 1987

"Norway: Wild-salmon endangered by bred-salmon." *Fish international*, p. 31, 4/87

DISEASE

"Farm fish diseases killing the wild stocks in Norway." *The Fisherman*, January 23, 1988

"Norwegian Salmon Farms Hit By Virus." *The Latest Developments in West European and Canadian Fisheries*, National Marine Fisheries Service, August 1987

"Norwegian Farmed Salmon Disease." *The Latest Developments in West European and Canadian Fisheries*, National Marine Fisheries Service, July 1987

"Disease threatens Norway's farms." *The Fisherman*, p.18, September 18, 1987

"Atlantic salmon fish kill at Hadlock said not infectious." *The Fishermen's News*, January 1988

ENVIRONMENT

"Toxic pollutant feared cause of pen-reared salmon deaths." *The Leader* October 1987

"Salmon 'feedlots' in Northwest." *Christian Science Monitor*, June 23, 1987

"Mariculture Pollution." *Marine Pollution Bulletin*

"Pollution problems in Norwegian fish farming." Bjorn Braaten et al, Institute of Marine Research, Austevoll Marine Aquaculture Station, Storebo, Norway 1983

"You can't have it both ways." *Fish international*, p. 31, April, 1987

ENVIRONMENT, continued

"The effect of salmon farming on the benthos of a Scottish sea loch." J.R. Brown et al, *Journal of Experimental Marine Biology and Ecology*, 109: 39-51, 1987

"The environmental effects of floating mariculture in Puget Sound." D.P. Weston, University of Washington, Seattle, 1986

"The interaction between fish farming and the marine environment." R.J. Gowen et al, University of Stirling, Scottish Fish Farming Conference, February 1987

"Studies find TBT in B.C. farm fish." *The Fishermen*, May 22, 1987

"New algae bloom hits Gulf salmon farmers." *The Fisherman*, March 22, 1987

"Some relationships between pathogenic bacteria and salmon net pen culture." A.H. Whiteley, Pacific Fisheries Legislative Task Force, Olympia, Washington, Feb 7, 1987

NUTRITION

"Fatty acids controversy between farm and wild fish continues." Tim St. Clair, *The Fishermen's News*, p.1, July 1987

"Salmon trollers' gourmet market." *Christian Science Monitor* November 24, 1986

"In the Pink." *Forbes*, March 1987

"What's Up Down on the Salmon Farms." *Seafood Leader*, Winter 1987

BRITISH COLUMBIA

"All's not well down on the farm." *The Fisherman*, August 16, 1985

"Aquaculture: the Boom Out of Control." *The Fisherman*, June 23, 1986

"Fish Farm Flasco." *The Fishermen*, April 18, 1986

"Conference on aquaculture poses threat." *The Fisherman*, June 23, 1986

"Disease, egg supply limit farm growth." *The Fisherman*, April 16, 1987

"As finfish farms spread coastwise, wild stock fishermen are finding traditional fishing grounds closed." *The Fisherman*, April 16, 1987

"Nanaimo salmon farm would be illegal in Norway." *The Fisherman*, May 22, 1987

"The Norwegian Connection." *BC Business*, October 1987

"Some fish farmers predict B.C.'s salmon farmers will ultimately switch to farming Atlantic salmon." *Seafood Leader*, Spring 1987

"DFO says no restrictions on dumping diseased fish." *The Fisherman*, January 23, 1988

Salmon Farming in Alaska: Myths and Facts

Myth: Alaska's wild salmon won't be harmed by farmed salmon.

Fact: The Norwegian government has begun establishing farm-free zones near salmon streams and are establishing a gene bank: they have discovered that 10 to 57% of the fish in their streams aren't wild, but instead are escaped farmed salmon.

Myth: No one can afford to buy into commercial fishing these days. The only way to get into the salmon business is through salmon farming.

Fact: Prices in last month's Alaska Fisherman's Journal for complete fishing packages range from \$30,000 to \$500,000 depending on the fishery. Last month, Paul Fuhs (president of the Alaska Mariculture Assoc.) said establishing a salmon farm would cost from \$300,000 to \$1,000,000. A fisherman begins to make money the very first year; a farmer must wait at least two to three years.

In addition, Rodger Painter (Alaska Mariculture Association) and Judy Brady (commissioner, DNR) have recently admitted that, because of the magnitude of capital and operational costs, fish farming will not be a mom and pop operation.

Myth: Fishermen are opposing salmon farming in order to legislate their competition out of existence.

Fact: Salmon farming is being done around the world and Alaskan fishermen must contend with this competition by better quality control and more aggressive marketing. Fishermen oppose its establishment in Alaska for four primary reasons: 1) It will put common property resources into private hands; 2) it will sap State money and personnel from existing fisheries programs; 3) it will primarily benefit wealthy corporate and foreign investors; 4) it will harm Alaska's economy by harming Alaska's fisheries.

Myth: Farmed salmon won't compete for markets with wild salmon and they'll help keep the price high.

Fact: If a product is in demand, scarcity drives the price up and a large supply lowers it. When Norwegian farmers dumped their salmon on the European market early this year (before they were killed by virus), the price for Alaska's salmon in France went down 50¢ a pound. Adding farmed salmon on top of wild salmon in the market is like having a banner season when the price drops because of the quantity available. Farmed salmon now compete directly with all top quality wild salmon, and farms want to enter the frozen market too.

Myth: Salmon farms will pay their own way because they are willing to pay a tax just like fishermen.

Fact: Rodger Painter (executive director of the Alaska Mariculture Association) has said it would be unreasonable to tax salmon farmers until they'd begun to make a profit. Since it would take a farmer two to three years to make even the first sale, there will be a substantial period of time with State money going out and nothing coming in. The most logical source for this State money is current commercial fisheries programs, which are already being cut back.

Myth: The State can limit the size of farms to keep them locally owned.

Fact: Norwegians have found that small farms aren't profitable. There and in B.C. small farmers have either formed associations or been bought out by large corporations.

Myth: Salmon farmers can regulate themselves: they don't need the State telling them how to run their business.

Fact: Government has an obligation to protect the welfare of the public and the public's resources. It must, at a minimum, check the quality of a product being sold for human consumption, see that environmental standards are being maintained, and monitor use of public tidelands. If government turned its responsibilities over to salmon farmers, the high costs would be prohibitive to someone on a tight budget.

Myth: Thousands of new jobs for Alaskans will be created by salmon farms.

Fact: According to British Columbia's Ministry of Agriculture and Fisheries, the average salmon farm employs only six people. It would take 166 farms to create 1000 jobs in Alaska. In B. C. many of the most highly paid jobs have gone to Norwegians, since they are experienced in the business. The Alaska Legislature has been unsuccessful in requiring local hire. How many Alaskans will be hired?

Myth: The spin-off benefits will be a shot in the arm for local economies.

Fact: According to "B.C. Business" (Oct. 87) Norwegian investors included strings in their finance packages: they required monopolies on construction and supply purchases so operators were unable to take advantage of competitive prices and local merchants received few benefits. In addition, the Norwegians' share of the profits returned to Norway with the investors.

Myth: We'll be able to keep this an Alaskan business.

Fact: Bill Hall (Alaska Commercial Fishing and Agriculture Bank) has said neither CFAB nor any other Alaska bank is willing to loan money for salmon farms. Start up and operating costs will be financed either by foreigners or by corporations such as Weyerhaeuser, British Petroleum, Mitsubishi, Union Carbide and the Campbell Soup Company. Business owners rarely ignore their partners' needs, goals or desires.

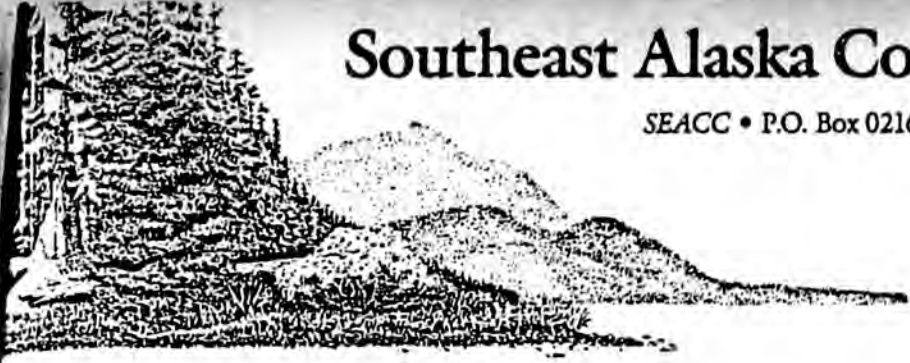
In addition, the B.C. fish farming industry is currently 65-90% Norwegian controlled. The largest fish farm in Washington has been recently purchased by Global Aqua, a Norwegian company.

Myth: Norway isn't subsidizing their salmon farms so Alaska won't have to either.

Fact: According to Commissioner Tony Smith (Dept. of Commerce and Economic Development) Norwegian fish farm subsidies include: capital grants; guaranteed loans for start up costs and capital investments; a 50¢/kilo subsidy for all international shipments; salmon egg production; research; price supports; a guaranteed minimum income and vacations for workers. They have budgeted \$14.7 million for these programs for next year. What reason is there to think Alaskan farmers won't need State financial help?

Myth: Salmon farms won't hurt the environment.

Fact: They will certainly change the environment: algaecides are used to prevent growths on the nets; fish food containing additives and massive quantities of fecal matter are deposited on the ocean floor; dead fish which have been fed antibiotics are prey for other species, thus entering the food chain.



Southeast Alaska Conservation Council

SEACC • P.O. Box 021692 • Juneau, Alaska 99802 • (907-586-6942)

MARICULTURE

The controversy surrounding mariculture continues in the '88 legislature and has prompted an influx of new bills and a revision of last year's legislation. Mariculture, the farming for profit of shellfish, finfish, and sea vegetables in marine environments, has raised many issues of concern for the commercial fishing industry, conservationists, and recreational users of Alaska's tidelands and navigable waters.

After thorough investigation and debate, the Southeast Alaska Conservation Council (SEACC) opposes finfish farming in Alaska because of its potential for serious environmental degradation of our coastlines. SEACC believes a moratorium on other forms of tideland development, including shellfish and sea vegetable farming and floating lodges, is imperative until comprehensive regional planning has been accomplished and sufficient funds are secured to effectively enforce and monitor adopted regulations and policies. Current policy promotes tideland development without taking into full account its potential for resource use conflicts and environmental impacts.

SEACC has a deep concern about the potential loss of important fishery habitat. A broad acceptance of fish farming could reduce the incentive to retain the natural habitat of wild salmon stocks and open the door for increased logging and road building in important fish habitat areas. In other countries, the fish farming industry has followed the destruction of wild stocks and their habitat. Alaska's wild runs are still strong and deserve proper protection. Another SEACC apprehension is that the historic uses of our coastal areas will be eroded as bays, inlets, and coves become sites for mariculture operations or fishing lodges.

Pending mariculture legislation must include provisions that statutorily prohibit the development of tidelands adjacent to all wilderness areas and state parks, high value fish and wildlife habitat areas, Critical Habitat Areas, popular recreation areas, important subsistence areas, bird rookeries, marine mammal haul outs, estuarine habitat for shellfish and benthic organisms, and anadromous fish streams. Legislation should also clearly outline siting criteria and provide guidelines for the planning and development processes. Development should focus on the tidelands of interested private property holders, and areas suitable for development should be nominated through the public process. The permit and leasing processes should include commitment bonds, development schedules, and restrictions on permit and lease transfers to prevent tideland speculation. Clean up bonds should be required to ensure site rehabilitation and structure removal in case of site abandonment. All proposed developments must be subjected to public review, and annual review should be mandated to ensure compliance with the laws.

necessary to make permits non-transferable or to limit permit transfer payments to the amount of investment the permit holder has made in construction of facilities. Ownership of the tidelands will remain with the state and the state agencies must have the right to review and control transfers of tideland permits. Privatization through site development will occur to some extent, but it is necessary and possible to minimize this impact. The public must be involved in scoping and siting processes and beyond to ensure public use and access is maintained and the responsible agencies actively protect these rights in developed areas.

These issues can best be addressed through comprehensive regional planning and related siting and permitting processes that include extensive public involvement. Final plan implementation should be in accordance with the public's interest.

ADDITIONAL PROBLEMS WITH FINFISH MARICULTURE

The issues already discussed are common to all types of tideland development. However, finfish mariculture presents additional problems and impacts that must be dealt with, including:

WATER QUALITY The food, wastes and chemicals involved in fishfarming are of a much greater magnitude than shellfish or sea vegetable farming. They have the potential to bury in nutrient rich wastes existing habitat for crab and other types of shellfish, thus depleting oxygen levels. These wastes also affect the benthic organisms that salmon fry feed on.

PREDATION Marine mammals and birds will be drawn to a penned food source, and the predator control employed by mariculturists is of concern to the environmental community. Violations of the Marine Mammal Protection Act and the Bald Eagle Protection Act are possible.

UPLAND EFFECTS Support facilities for fish farms are liable to be more extensive than for other types of mariculture, and therefore will have greater impact on the uplands. Also, there is a great deal of concern that with the capacity to create fish, the maintenance of wild fish habitat will have diminished support. The fish farming industry has traditionally followed the destruction of wild stocks and their habitat, but our wild runs are still strong and deserve proper protection.

Issue paper prepared by Laura Dameron 2/11/88



Alaska Environmental Lobby, Inc.

P.O. BOX 22151 JUNEAU, ALASKA 99802

907-586-2345

MARICULTURE IN THE 1988 LEGISLATURE

Due to the raging controversy surrounding mariculture in the '87 legislature and the many issues raised during the days of public testimony before the House Resources committee, Representative Johnny Ellis (D-Anch.) and Senator Dick Eliason (R-Sitka) are presently revising last year's bills to reflect public concerns. Mariculture, the farming for profit of shellfish, finfish, and sea vegetables in marine environments, is a major issue for the commercial fishing industry and recreational users of Alaska's tidelands and navigable waters.

After much consideration and debate, the Alaska Environmental Lobby has concluded that we must oppose finfish farming in Alaska because its long-term effects would be detrimental to our coastal environment. We cautiously support other forms of tideland development, including shellfish and sea vegetable farming and floating lodges, with the provision that there be a strong planning process wherein environmental concerns will be addressed.

The most important aspect of any tideland development is the siting process. Intensive public participation is a necessary component of that process which should, we feel, address the following concerns:

CONFLICTING USES Historic uses of both tidelands and adjacent uplands should be documented to avoid user conflicts. Such uses include recreation, tourism, anchorages, navigable waters, and areas of subsistence and commercial harvest. Natural estuarine habitat for shellfish must be protected, as well as uplands designated as wilderness areas or marine parks.

UPLAND EFFECTS Upland development to support mariculture facilities is a grave consequence of tideland development. The federal or state agency responsible for uplands adjacent to potential mariculture sites must be involved in siting and permitting to minimize the effects of upland support facilities accompanying tideland development. No mariculture should occur adjacent to uplands in protected status.

CUMULATIVE IMPACTS The cumulative effects of tideland development must be recognized and minimized. We see comprehensive regional planning as the best means of avoiding over-development of an area.

WATER QUALITY The flushing capacity as well as the other marine qualities of potential development sites must be considered to prevent degradation of existing water quality. Potential problems resulting from the introduction of fungicides and other chemicals into our waters will not be fully mitigated but can be minimized by proper siting.

PRIVATIZATION OF PUBLIC RESOURCES In order to avoid tideland and upland speculation, thereby creating a de facto disposal program, it will be

ALASKA CENTER FOR THE ENVIRONMENT • ALASKA CHAPTER, SIERRA CLUB • JUNEAU GROUP, SIERRA CLUB • SITKA GROUP, SIERRA CLUB
KNIK GROUP, SIERRA CLUB • DENALI GROUP, SIERRA CLUB • ANCHORAGE AUDUBON SOCIETY • ARCTIC AUDUBON SOCIETY
DENALI CITIZENS' COUNCIL • ALASKA FRIENDS OF THE EARTH • JUNEAU AUDUBON SOCIETY • KACHEMAK BAY CONSERVATION SOCIETY
KENAI PENINSULA AUDUBON SOCIETY • KODIAK AUDUBON SOCIETY • LYNN CANAL CONSERVATION • ALASKA WILDLIFE ALLIANCE
SITKA CONSERVATION SOCIETY • NORTHERN ALASKA ENVIRONMENTAL CENTER • SOUTHEAST ALASKA CONSERVATION COUNCIL

Planning and siting must address the following concerns:

CONFLICTING USES. Historic uses of both tidelands and adjacent uplands should be documented to avoid user conflicts. Such uses include recreation, tourism, anchorages, navigation, and areas of subsistence and commercial harvest.

UPLAND EFFECTS. Construction of upland support facilities is a major consequence of tideland development. The federal or state agency responsible for managing adjacent uplands must be involved in siting and permitting to minimize negative impacts.

CUMULATIVE IMPACTS. The cumulative effects of tideland development must be recognized and minimized through comprehensive regional planning.

WATER QUALITY. The flushing capacity as well as other marine qualities of potential development sites must be considered to prevent degradation of existing water quality. The food and organic wastes produced by fishfarming may bury existing habitat for crab and other types of shellfish in nutrient rich wastes, depleting oxygen levels. These wastes also affect the benthic organisms that are a food source to salmon fry. Potential problems resulting from the introduction of fungicides and other chemicals into our waters will not be fully mitigated but can be minimized by proper siting.

PREDATION. Mariculture facilities must be designed and sited to avoid attracting marine mammals and birds to a penned food source. The Marine Mammal Protection Act and the Bald Eagle Protection Act may not be sufficient to prevent unlawful predator control by mariculturists.

SEACC believes that, in the correct context, some forms of coastal development can be of value to both the State of Alaska and its citizens. However, the key to responsible decision making lies in knowing the likely results of various development scenarios. We do not feel that this has been accomplished yet.

SEACC is a grassroots conservation organization comprised of 13 member groups located in 11 communities from Yakutat to Ketchikan and represents the interests of a wide variety of people with an assortment of lifestyles. It has been their overwhelming request that SEACC work to help ensure that family well being, community stability, and quality of life do not suffer at the hands of irresponsible commercial development on state tidelands. These goals can be achieved as the public is provided the opportunity to participate in planning based on the best available information.

UFA TESTIMONY TO HOUSE RESOURCES ON HB 432 MARCH 13, 1990

Good evening, my name is Sonja Corazza. I am co-chair of United Fishermen of Alaska's mariculture committee. We support this bill prohibiting finfish farming in Alaska. Our statewide newspapers have lately run articles on the competition Alaskan salmon is getting from farmed salmon. But salmon farmers are in a competition battle with each other and small farms worldwide are losing out to large businesses. B.C. farmers had a economic shake out this fall and large processing companies ended up the winners, buying out small farmers at 20 cents to the dollar. On some farms workers had not been paid in several months and finally walked off the job leaving hungry and dead fish for the Canadian government to dispose of.

Less well known is that Norway is in the same boat. It is estimated that for every fall in price of one Norwegian crown ten small farmers go bankrupt, and Norway is trying to curb new development. Last year Norway increased their production by 80% and ended up freezing a large number of fish. Chile, a country with extremely low labor costs and warm water temperatures is so productive they fear their industry is overcapitalized. We have strong wild runs and successful enhancement programs. Wild salmon as a renewable resource remains our best hope in these days of markets flooded with farmed salmon.

Wild salmon need protection of salmon streams and certain wetlands to survive. Unfortunately, many see salmon farming as a way to avoid protection of salmon habitat. We have a letter from a logging company in S.E. which explains the steps their company took to protect salmon streams but then goes on to say that it was all needless because "Norwegians can grow fish cheaper in bathtubs." He was wrong, Alaskan fish eat free & healthy meals in the North Pacific Ocean; the costs of growing fish are astronomical. How unfortunate some people think wild salmon and the environment are expendable if domesticated fish can be pulled out of tanks. To commercial fishermen, wild fish may be our economic mainstay but they are also a natural treasure.

We are concerned about the budgetADF&G is 1.5 million dollars underbudgeted now. We have commercial fisheries pouring hundreds of millions of dollars into our State and the State has not dedicated enough money to properly assess stocks or do research. We strongly feel that any newly funded money must go into these programs. While working on shellfish mariculture regulations SE shellfish farmers told me about leases that had not been checked in three years..empty logs holding mariculture permits. DNR said they did not have the personnel or money to adequately monitor

all the sites. NO TIME, NO MONEY, NO STAFF...that is the song of the resource agencies. How can anyone ask for funds to go into new programs that are very likely to be dominated by foreign corporations, when the cornerstones of Alaska's resident fisheries are being damaged by underfunding? Finfish farming would not produce any measurable economic benefits for at least five years from its start. The salmon fleet has a capital investment of \$800 million in vessels and onboard equipment and \$900 million in permits. Alaskan residents hold nearly 80% of all salmon permits. The salmon industry pays raw fish tax, license fees, and fuel taxes. Every year salmon fishermen in this state tax themselves \$4 million a year for our Ocean Ranching programs.

Egg surplus from hatcheries is a hot topic. A Department of Fish and Game report States, "The principle reason salmon smolts would be surplus to the common property fishery is that the present ocean ranching program is operating below capacity due to funding constraints." While other countries envy us our success and are trying to improve their own programs, Alaska is neglecting her own. In the fisheries world our biologists are famous and in Alaska we're putting them out of work. This past year there was a major shortage of chum salmon eggs in Southeast. Coho in the northern region of Southeast did not fare well. If a finfish farm had been looking for eggs this last year they'd have been in trouble. No one can assume that a large number of surplus eggs is available and from ADF&G's statement we must assume they should not be any surplus eggs.

If fish farming were allowed in Alaska with a ban on imports of eggs, the pressure to legalize egg imports would not stop because Pacific salmon is not economically profitable to raise. Last spring a company in Washington State destroyed 1,000,000 chinook fry because they would have lost money raising the fish to maturity and marketing them. The company switched to Atlantic salmon. Would future legislatures resist pleas of economic hardship due to an importation ban? Washington State and B.C. did not and now there are hundreds of thousands of escaped farmed salmon in their waters.

Salmon in Alaska are a common property resource which no Alaskan should take for granted. We may squabble over fish allocations but the public as a whole has fish to argue over. Salmon farmers want private hatchery rights...private ownership of one of our most valuable resources. We strongly believe that control of Alaska's egg supply should always remain under control of the State for the good of all the people. All anadromous fish in Alaska are fully allocated between commercial, sport, subsistence and personal use fishermen. If the State of Washington had not exported salmon eggs Chile would not be their competitors in the

marketplace. Nor would Japan have a chum salmon run. Washington gave away the goose that laid the golden egg. Alaska must not make the same mistake.

There is one strong opinion coming from Dutch Harbor that fin fish farming is the best thing since king crab. Dutch Harbor relies on bottom fishing (which is dominated by factory trawlers from Seattle) and crab stocks and herring. Salmon is not a critical issue for Dutch Harbor but it is the economic lifeline for the rest of Alaska's coastal communities.

UFA thanks you for your time tonight and we urge you to pass this bill. Thank you.

Sources of my information
are:

1. "1989 May Issue of "Fish
International Magazine"
(European)

2. Alaska Seafood Industry Study

3. Bill Heard - NOAA

4. FRED Report

ng gillnetters off 1990

ira boats and purse seiners were ng, since the quota is split among us gear groups. The round-haul a fourth group, receive separate y individual boats, and in mid-, only four of the 32 boats had heir limits.

Overall roe herring season on the bay
Nov. 29, 1989, when the first gillnet
designated XII set out to harvest its

On Jan. 2, the second gillnet group known as the "odd platoon," started fishing. They worked week-on, week-off in rotation with the third, or "even platoon." The odd platoon filled its 2,300-ton quota in just 42 hours, leaving the even platoon to fish straight through the month to make its quota.

Though the even-platoon members landed 1,640 tons in a two-day stretch in mid-January, they suffered slow fishing until going over the top on Feb. 5. Roe counts averaged 14.3% for evens, 13% for odds and 11.6% for the XH boats — all up from last season. "Some fish even hit

17%," says John Greenwood of Producers Seafood in Oakland.

Ex-vessel prices were still undetermined in mid-February, though most expected them to settle in the \$1,000- to \$1,100-per-ton range for the baseline 10% roe content, with more money for higher percentages.

— Mick Kronman

April 1990 — Mick Kronman
National Fishermen
**VHS disease appears
again in Wash. hatchery**

BELLINGHAM — A deadly European fish virus surfaced again in a salmon hatchery north of Seattle operated by the Lummi Indian tribe. The outbreak of viral hemorrhagic septicemia (VHS) resulted in the destruction of 2.7 million coho salmon eggs.

The virus, which has killed up to 90% of the fish at trout farms in Europe in the past, was detected for the first time in North America at hatcheries on the Olympic Peninsula and Orcas Island in Puget Sound in

1989. Almost 4 million salmon eggs were destroyed in those cases.

Fisheries authorities had hoped the VHS was contained after the first outbreaks, and they remain puzzled as to the source and continued spread of the disease.

Though many fishermen remain skeptical, state investigators say the state's sea farm industry is an unlikely source for the VHS transmission because eggs used on the farms are sanitized and quarantined. More likely, they say, is transmission from ships passing nearby, though that, too, is a remote possibility.

The Lummi tribe says it will lead an effort to establish a research program to determine the source of the VHS in U.S. waters.

— Brad Matsen

West Coast Shake-out

Supply and demand tremors rattle B.C. growers.

by Peter Chettleburgh

THE SHAKE-OUT has begun. Sagging salmon prices, excessive debt, high interest rates and a worldwide glut of salmon have triggered a period of consolidation in the west coast salmon farming industry. On the East Coast where prices are firmer and farmers have been more conservative in their approach there is still a margin of profit, but it too is narrowing as prices continue to slide in the face of skyrocketing worldwide production (220,000 tonnes in '89).

Everyone said it would happen, but no one really wanted to believe it. On the west coast, where prices have been hovering at or below production levels for most of the summer, reality has struck home with a vengeance. The need for cash flow has caused many farmers to sell a lot of small pre-market fish for ridiculously low prices - 90¢ a pound was one figure this writer heard mentioned earlier this summer.

Since May we have heard of at least four west coast farms that have been put into receivership, another two that have been sold at fire sale prices and at least a dozen more which are in desperate need of working capital. Everyone else is holding on, praying for higher prices in the fall.

One of the big ones that went into receivership is the Fremstad Group which has four farms, a hatchery and processing plant in the vicinity of Campbell River. It's being handled by the accounting firm of Coopers

and Lybrand which was looking for a buyer as we went to press in August.

Triangel Resources near Tofino on the west coast of Vancouver Island found itself in trouble earlier this spring and was taken over by General Sea Harvest, an affiliate of the Finnish conglomerate, Cultor Ltd. (formerly Finnish Sugar Co.), the parent company of Ewos Canada. General Sea and B.C. Packers were also looking at the assets of Ross Passage Salmon Farm, another west coast operation which found itself in trouble earlier this spring.

One other company that is known to be in receivership is Seagrow Industries Inc. (400 tonne capacity) with two sites in Jervis Inlet. The receiver, Coopers and Lybrand, was still looking for a buyer as we went to press.

There were also some amalgamations before the current shake-up began. For instance, within the last year Five Fishes (Sechelt) and Nordic Ventures (Quadra Island) were purchased by B.C. Packers, the large west coast fishing company-cum-processor owned by Westons. Apparently B.C. Packers is on the lookout for other expansion prospects, but doesn't plan to walk into a situation unless all the biological criteria, etc. are just right.

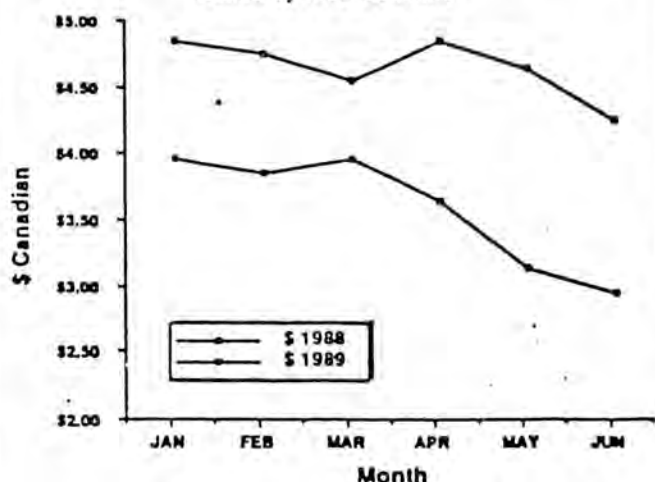
As a general comment, it can be said that the farms with some of the worst financial problems are in the Sechelt area. This is where the goldrush started in 1984

and it is the area that received a lot of the initial debt financing from Norway. Now the Norwegian financing has all but dried up and few investors are prepared to put additional

salmon farms at about \$250 million. And this does not include an additional investment of at least \$50 million in the supply and services sector (cages, feed, nets, etc.). Of this total in-

Fresh B.C. Salmon Prices 4-6 lbs.

Sales by first receivers



The graph above tells the story. The top line shows prices for B.C. farmed salmon (4-6 lbs.) during the first six months of 1988, while the lower line shows prices for the first six months of 1989. Prices are FOB Vancouver (Source BCSFA).

money into the farms because of their current debt structure. Adding to their woes are the growing conditions which many in the industry agree are not as good as those north of Campbell River or on the west coast of Vancouver Island. Indeed, some of the salmon farm sites may end up in the hands of oyster growers who are already lining up for a chance at leases that will probably turn out to be better for shellfish than salmon.

\$250 million investment

A recent estimate puts the total investment in B.C.

vestment, at least \$85 million has come in through Norwegian banks, much of which is now exposed to major losses, according to a recent report in a Norwegian newspaper.

Even for the smaller farms, those with debt in the neighbourhood of \$2-3 million, the debt servicing costs of 15-18% will skim off between \$300,000 and \$400,000 a year. That's a lot of fish, and a lot of debt relative to inventory, assets and equity, particularly in an industry that has yet to establish a solid production base.

>>>>

Problems for suppliers
Although the depressed prices are toughest on the farmers, the suppliers behind the scenes are also hit hard. Scantech Resources of Sechart folded in July after becoming one of B.C.'s major suppliers of fish farm equipment in just four years. President Clark Hamilton says that he lost everything in the failure but is still a strong believer in the future of the industry in British Columbia.

Another supplier which was hard hit was Powell River Net Loft which ceased doing any further work for the fish farming industry in June. The suppliers that are the most exposed are the companies which specialize solely in fish farming equipment and services for the B.C. market. They don't have the flexibility of companies that serve other industries or those that have national distribution.

What went wrong
It's small consolation that salmon farmers around the world are facing the same problems of overproduction and falling prices. Indeed, both the Scots and

a continued shakeout in the Norwegian smolt producing sector.
In British Columbia the problems seem even worse. Excessive debt financing, high jacking rates and high

producers who already arrived late in the world growth curve of farmed salmon production.
Glutted markets

As if this weren't enough, world markets are currently glutted with high inventories of frozen Pacifics, a legacy of an oversupply last year and ample reserves of fresh and frozen farmed Atlantics on world markets this year. Farmed Atlantics now take preference in most European and some North American markets, areas that were once dominated by wild Pacifics. Consequently, the price for both farmed and wild Pacifics has seen a dramatic fall since last December with farm gate prices for farmed chinook (6-9 lb.) dropping more than \$1.50 per pound to \$2.50 and lower for a while early this summer. (New Brunswick Atlantics (6-9 lb.) were wholesaling for about \$1.25 more per

"At the end of the day salmon farming will end up like other producing sectors with only the low-cost producers surviving."

Norwegians are taking a serious beating in Europe where production continues to grow at about 50% per year while demand is at about 25%. In Norway the Fish Farmers Sales Organization (FOS) has recommended holding the number of smolts going into the sea at about 50 million this season. This is to reduce production and maintain prices in the years ahead. One of the consequences, however, will be

mortalities from algal blooms and BKD have continued to chip away at profit margins. B.C. growers have also had to cope with a relatively new and untried culture species, chinook. It doesn't have the 20 year track record of the Atlantic species which the Norwegians and Scots have been able to use to their advantage on both the production and marketing sides. It's taken extra time and money for west coast

The Rutland Windcharger

**FURL
MATIC
FM 910**



Bourque Manufacturing Ltd.
P.O. Box 2659
Grandview Industrial Park
Saint John, New Brunswick
E2L 4Z1
Tel: (506) 633-9620
Fax: (506) 633-1617

Harbour Mast & Rigging
10222 Bowerbank Road
Sidney, British Columbia
V8L 3S6
Tel: (604) 656-4520

- For use in high-wind areas where regular supervision is not possible.
- Maintains charge in any 12 volt rechargeable battery.
- Charging begins at very low wind speeds of 4 M.P.H.
- Tailfin assembly enables unit to "furl" out of the wind when it is in excess of 40 M.P.H.



NORPLEX, INC.

NORTHWEST PLASTIC EXTRUSION
206-251-6030
FAX 206-251-8071

AQUACULTURE Netting For All Applications

The Netting Is Made From
Top Quality Materials.

- OYSTER NET
- OYSTER CULTCH BAGS
- CLAM GROW OUT BAG
- HEAVY NET; TUBE AND LAY FLAT
- MUSSEL NET
- CABLE TIES
- POLY BAGS, SHEETS AND TUBING
- OYSTER GROW OUT BAGS



manufactured by
NORPLEX, INC.
7048 South 190th - Kent, WA 98032
(206) 251-6030

pound than B.C. chinooks of the same size mid-summer, while Norwegian Atlantics were about 50¢/lb less than the New Brunswick product.).

The depressed market conditions came at a particularly awkward time for B.C. growers. The 60 or so companies that started operations within the last four years are at a stage of maximum investment, everything's out on the line, but as yet they haven't had a good chance to make any major earnings and reduce their debt. And now, with salmon prices the way they are, you can be sure that any fish under 4 pounds is being sold below the break-even point.

The worst part is that there aren't any major miracles expected in the near future. Though there should be a modest price rise when the wild-catch season ends this fall, a significant jump in farm gate

World's shrimp producers face same problems

Shrimp producers in southeast Asia are facing the same slide in prices that hit salmon farmers this year. According to a recent article in *Aquaculture Digest* (July 25, 1989) the pond-side price for giant tiger shrimp fell from \$8.50 to \$4.40 per kilo in Taiwan last spring and only recovered slightly during the summer. Taiwanese production costs are about \$5.00 per kilo.

Once again the main culprit is a hyper-active production sector trying to sell product into already-glutted markets. According to *Aquaculture Digest* the winners in the shrimp game are likely to be the low-cost producers in China and Indonesia while the losers are going to be the high-cost, intensive shrimp farmers of Taiwan, the Philippines, Thailand and the rest of the world. Commercial shrimp fishermen will also have problems remaining competitive in the years ahead, the article adds.

prices is not likely since the ever-increasing supply of farmed product from Norway, Scotland, Chile and Ireland is flooding markets in Europe and Japan, and making serious inroads into adjacent turf in the United States. It's a classic case of supply and demand

theory in action and will only be stabilized by market expansion, strong promotional efforts, more efficient production techniques and well organized selling.

Who will survive?

The farms in the best position are those with the

least debt, highest efficiency and deepest pockets, all linked to an efficient means of selling their product. The big integrated national and multinational companies are in a strong position. They can benefit from profits in several segments of the production, processing and distribution chain.

But there is also a future for independent farms if they can maintain a low cost of production. To do so they must run a lean operation, maximizing growth rates, while keeping feed wastage and equipment purchases to the minimum. They will want to have the least expenses possible and get the best prices they can for their product by pursuing niche markets.

Production costs are hard to pin down, but estimates run between \$2.50 and \$3.50 a pound farm gate depending on the site and

... Please turn to page 48

PAPER OVERLOAD?

HOW WOULD YOU RATHER FIND YOUR INFORMATION?



OR



EASY AND POWERFUL SOFTWARE

FOR AQUACULTURE PRODUCERS, SEAFOOD PROCESSORS, AND DISTRIBUTORS

ISLAND SCIENCE: experienced, international, aquaculture biologists and computer specialists with advanced cost effective software for personal computers (IBM PC and compatibles)

- Aquaculture packages include hatchery through growout.
- Seafood sales/distribution programs with full accounting.
- We design custom programs.
- Our programs SPEAK English, Spanish, and Norwegian.



ISLAND SCIENCE

P.O. Box 564 • 1650 Indian Valley Rd • Novato, CA 94948
Tel: (415) 898-1422 • Telex: 7431827 • FAX: (503) 688-0005
BBS: (415) 898-9892 • DEALER INQUIRIES INVITED

W. C. SHAKE-OUT

Continued from page 23

what costs are included. This means that in mid August, with farm gate prices hovering at about \$3.00 per pound, B.C. farmers could make a modest profit if they were operating on the lean side or could be losing up to 50¢ a pound if they were on the high side. Unfortunately, for many of them there was no choice but to sell chinook and coho that were starting to mature. A couple of farmers were seriously looking into the possibility of establishing U-catch'em pens catering to wealthy U.S. yachtsmen.

Key to success

One of the most important keys to success in the years ahead will be management. As aquaculture consultant Ted Needham pointed out in a recent issue of UK-based *Fish Farmer* magazine "... every farmer has to find out what his rearing costs really are. ... he can only do this if he works to proper budgets with monthly cash flows projected over two years and updated at least quarterly. All forecasts of fish growth should be based on what has been achieved to date

rather than on some hoped-for improvements." Needham's advice is as sound here in Canada as it is in Scotland. The margin for sloppy record keeping slipped away sometime last winter.

What is the outlook?

Is there any light at the end of the tunnel? Depends on who you talk to, but with another 50,000 tonnes projected to come onto world markets next year (275,000 tonnes total) there's not much hope that prices will again reach 1988 levels.

Who are the consumers?

Who's going to eat all this fine, fresh fish? The European market is nearing saturation and what's left will probably go to Scottish and Norwegian producers. The Japanese market is still available but it takes work to penetrate and, once again, the canny Norwegians are already in there, picking up what the Japanese can't produce for themselves (domestic farmed salmon production for Japan is estimated at about 25,000 tonnes of coho this year). The most accessible market left is our big, convenient neighbor to the south and there's still lots of opportunity there

if the Canadians will make a serious effort to go after it. Marketing and distribution are pivotal. It will take a concentrated, cooperative effort on the part of all Canadian producers of both wild and farmed fish.

At the end of the day salmon farming will end up like other producing sectors with only the truly low-cost producers surviving. They will sell their fish in a well disciplined market where demand will determine the production that is planned and financed. But at this point not even a prophet could say how long the restructuring will take and who the survivors will be. Ω

FRANK SIMON

Continued from page 42

The intense competition in the salmon business doesn't worry Simon either. "There is always room for a producer who's doing things right," he says. "We want to differentiate ourselves on the basis of quality. We believe that if we do everything right, we'll have a prominent position in the market." Ω

**IF YOU WANT IT,
WE MAKE IT!**

We're specialists ...

- Salmon and trout fish-pen nets
- Predator and dip nets
- Fish hatchery nets
- Custom-made crowding nets

and we carry a good stock of:

Knotless web, Ropes, Hardware,
Rubber wear, Buoys, Floats and Mort rings



PACIFIC NET & TWINE LTD.
3731 Moncton Street
Richmond, B.C. V7E 3A5
TEL (604) 274-7238
FAX (604) 274-2914

Factory Plant - Parksville, B.C. (604) 248-8953
Branch - Prince Rupert (604) 627-1770
Branch - Sominia (604) 973-6513

FISH FARMER'S INSURANCE

A quality alternative...



**LESLIE
& WRIGHT
& ROLFE
LIMITED**

Contact: Colin Roberts

1055 WEST GEORGIA VANCOUVER, B.C. V6E 4G2
TELEPHONE: (604) 682-4211
TELEX: 04-507556 FAX: (604) 682-3520

Complete fish farm services and area
main agents
for the RMB FISHSTOCK™
Insurance Contract at Lloyd's.



MIX AND MIS-MATCH

Genetic pollution is the most invidious consequence of the escape of farmed salmon, argues Richard Douthwaite, who fears that the mating of farmed with wild fish may eventually eliminate our native stocks

On 9 February 1988 a storm of unusual ferocity hit the west coast of Ireland and swept across the country, leaving a trail of destruction in its wake. In Clew Bay on the Atlantic coast winds were so severe that farmers went down to the beaches the next day with their tractors and collected large quantities of dead fish. It was no surprise that two salmon cages moored in the bay broke up, releasing more than 30,000 fish into the open sea.

It is not always the weather which is to blame for fish farm escapes. One moonless night a few months before the storm, two men in a rowing boat cut the nets of 12 salmon cages moored in Mulroy Bay in Donegal. Almost 10,000 fish, worth £100,000, got away and the farm recaptured less than a quarter of them. The raiders' motive was to catch the escapees in their drift nets and then sell them.

Only recently has concern been expressed about the effects that these escapees might have on wild

salmon stocks. Perhaps the matter should have been addressed earlier. The first Scottish attempts to rear salmon in cages were made in the late 1960s and it was as long ago as 1981 that Scotland's output of farmed salmon exceeded its wild catch, with Ireland reaching that position about four years later.

Today the problem is so large it cannot be ignored. Scottish farmed output is expected to be 54,000 tonnes in 1991, about fifty times the size of the wild catch, and Ireland hopes to produce 15,000 tonnes that year. There is so much salmon in cages at sea that if only two or three per cent break free in any year, they will substantially outnumber the native stock.

Escapes would not matter if the freed fish were genetically identical to those born in the rivers up which they swim. However, this is rarely the case. The salmon in each river – even sometimes in the carrier streams – are unique strains which have evolved in the ten thousand

years since the ice sheets retreated. In most cases escapees will not be of that strain. There are 400 distinct stocks of wild salmon in Scotland, according to a report produced last year by the Scottish Wildlife and Country Link. It also states that wild salmon transferred from one river to another perform less well and have harmful effects on the native stock.

Farmed fish are increasingly being bred, like pigs and cattle, for characteristics which suit life in captivity rather than in the wild. Consequently, if escapees enter a river and mate with wild fish, they will pass on genes which tend towards placid behaviour, late sexual development and more rapid growth. Cross-bred young are therefore less likely than pure-bred natives to survive in the sea and return to the river as adults.

Even if farmed fish turn up in a river but mate with each other rather than with the wild fish, the effects are still adverse. They will

Genetic pollution is not the only threat which fish farming poses to the survival of wild salmon. Disease organisms and parasites multiply rapidly in the confined conditions of a salmon cage and from there they can easily migrate to affect other fish. It is for this reason that salmon farmers become wary if another farm establishes cages within a few miles of their own, which is why whole rivers in Scotland are allocated to one firm.

Now it appears in farmed salmon an every year Pancreas disease an

after occurring first in Scotland in 1976. Seventeen of the 21 farms in Ireland now have it and output is consequently down by 25 per cent because of deaths or stunted growth.

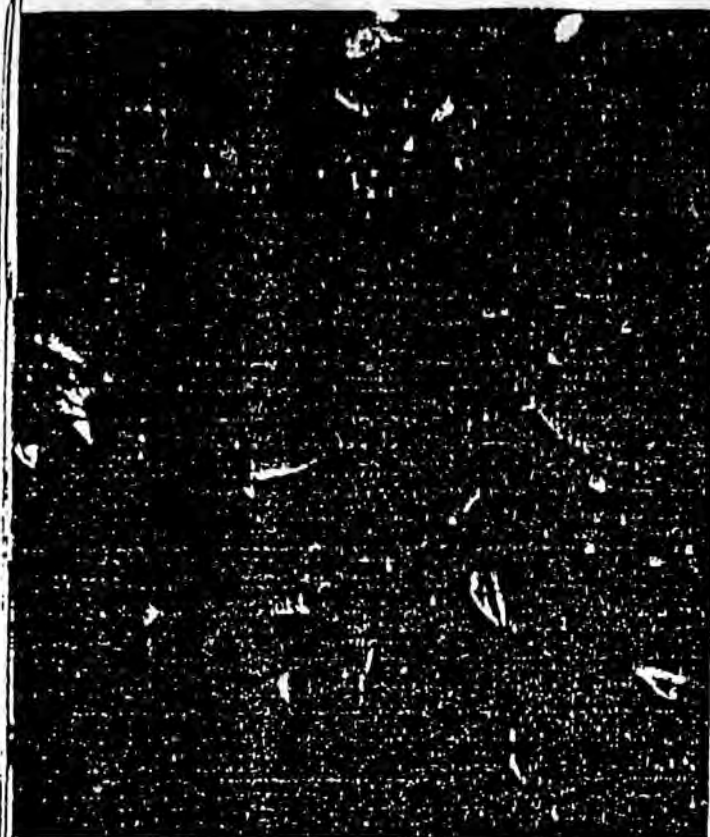
The most worrying disease appeared only last year, in Norway: Salmon Anaemia Syndrome kills 80-90 per cent of young fish. Again, its cause is completely unknown.

In spite of the threat that diseases present both to their own and to the wild stock, some fish farms are their own worst enemy. In Scotland dead diseased salmon are

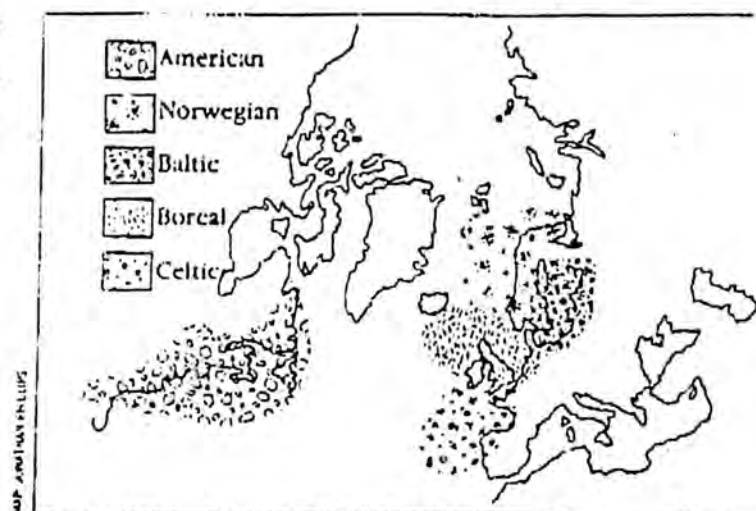
known to have been dumped at sea rather than incinerated on land, spreading pathogens far and wide. There are also two dangerous parasites. One is a tape worm which uses the edible mussel as an intermediate host, then moves on to affect wild fish. The worm weakens wild salmon, rather than killing them directly, lessening their ability to return up turbulent rivers to their spawning grounds and also making them more vulnerable to disease.

The second parasite is a flatworm, *Gyrodactylus salaris*, which has completely wiped out stocks of

wild salmon in 28 rivers in Norway. It was accidentally introduced when farmed fish were imported from infected hatcheries and put out into freshwater cages. The pest attacks parr – young salmon which have not yet developed the physical features that allow them to live in the sea. It is the most serious threat to Atlantic salmon in Norway today, says Rear Admiral D.J. Mackenzie, director of the Atlantic Salmon Trust, Pitlochry. The only cure so far is a drastic one – to poison any remaining salmon in the river and then restock with uninfected fish.



Previous page: grilse from the Spey.
 Above: fish jostle for food in the confinement of the cages. Right: distribution of the main races of Atlantic salmon



Although fishermen have known for hundreds of years that salmon stocks differ from river to river, scientists have only confirmed this belief within the last 20 years. Using a technique called electrophoresis they can analyse the proteins with which each fish is made up with great precision.

The first finding revealed by this technique was that there are five main races of Atlantic salmon, four of which share a common feeding ground off western Greenland. The Baltic salmon is the exception, feeding as an adult in the sea which gives it its name.

The second finding was that salmon vary genetically to a surprising extent from river to river, even within the same race. Dr Tom Cross, now of

University College, Cork, examined fish from the Bandon and Munster Blackwater rivers in the south of Ireland and found significant differences in their liver enzymes even though they were both of the Celtic race and the river mouths only 80 miles apart. Dr Cross repeated his tests with Boreal fish from the Moy and Carrowiskey in north-west Ireland and found the Carrowiskey fish very different again.

The differences that exist between salmon from different rivers, says Dr Cross, 'are due to the small population sizes and the fact that they have been apart for 5,000 years. How important the differences are to survival, we cannot say. I think we ought at least to keep the different races apart.'

compete with the natives for spawning areas and their young will compete for food. As a result, fewer native fry may survive to set off for the sea as smolts and consequently fewer adult natives will return after a year or more to complete the reproductive cycle. (A young salmon passes through fry, parr, smolt and grilse stages before becoming a mature adult.)

The situation is so serious that regular escapes from farms could eventually wipe out all native salmon. Research in Norway, where salmon have been farmed for much longer than in Scotland or Ireland, shows that in some rivers up to two-thirds of the fish are already of the farmed variety. 'If genetic pollution continues at its present rate, the hereditary variations of some of the river species will be halved within seven years,' says Professor Harald Skjervold whose research findings in this field all point to this alarming conclusion.

Any experienced salmon fisherman will confirm that salmon stocks vary from river to river.

'Some are early rivers where large salmon enter in the spring,' says leading salmon geneticist Professor Noel Wilkins of University College, Galway. 'Other rivers have significant runs only in late summer, when the returning fish are smaller and younger. Some rivers are noted for the fine shape of their fish, others are not.'

Andrew Young, who managed the fisheries of the Duke of Sutherland more than 130 years ago, knew why this was: 'Each river has its own peculiar race of fish,' he wrote. 'We have now shown that salmon undoubtedly return to the river where they have spawned and where they belong to the race of fish that inhabit that particular river.' Professor Wilkins agrees: 'Salmon return to their own river with amazing accuracy and mating occurs predominantly between individuals who were born in the same river system.'

It is this inbreeding which has allowed the different strains to develop. In some rivers a higher proportion of fish come back after two or more winters at sea than after one year as grilse. Thus, if all the smolt are killed by disease or pollution one year, others are left to return to the river the following year to spawn, giving a chance for numbers to recover.

Fish farmers are deliberately trying to eliminate this characteristic: what they want are fish with a low grilse rate, because it is more profitable to produce bigger fish which spend two winters in the sea than smaller fish which spend one. Norwegian salmon fit this bill and consequently their eggs have been widely used in Scottish and Irish hatcheries instead of the native strains. Farms also want their hatched fish to be ready to go to sea after one year in fresh water - it is obviously uneconomical to keep them in freshwater cages for an extra season. But again, in the wild, a stock in which some fish go to sea after one year and some after two has a better chance of surviving than one which does not.

Then there is the question of homing. Tagging experiments have shown that a higher proportion of wild fish return to their native rivers from the sea than do hatchery-bred fish released as fry into streams other than those from which their parents came. However, if any introduced fish which do return are caught and mated, their young will show a better return rate, which will

• Contrary to claims by B.C. salmon farmers that salmon egg transfers pose little threat to wild stocks, an Atlantic salmon advisory body has advised extreme caution to avoid disease and genetic problems.

Report sees genetic threat

"None of the benefits of transfer of young Atlantic salmon and salmon eggs into Canadian waters outweigh the threats to native stocks," says a top body of Canadian fisheries scientists.

Fish farmers, the B.C. government and the federal fisheries department have allowed major imports of Atlantic salmon to Pacific waters, claiming they pose a minimal threat to wild stocks. The imports are scheduled to end in 1989.

But a review of egg imports by the Canadian Atlantic Fisheries Scientific Advisory Committee in 1986 warned that "there are unpredictable genetic risks associated with transferring European salmon stocks to North America and the potential benefits to Canadian aquaculture interests may be low."

CAFSAC is a top scientific advisory group which provides background information for Canadian representatives on international bodies studying conservation of Atlantic salmon.

Its conclusions go a long way to support the call issued by the UFAWU in May demanding a halt on any movement of salmon eggs and smolts, particularly Atlantics, until protection of wild stocks can be assured.

The CAFSAC scientists concluded that most of the benefits of imports accrued to the aquaculture industry because "it could allow the industry to expand as quickly as possible (and) it could be cheaper than purchasing local seedstocks."

In the long run, they said, it would "encourage the multinational nature of the aquaculture industry by allowing surplus seedstock in one country to be moved to another country."

But the imports carry the risk of disease, they warned, pointing to the Norwegian experience with the parasite *Gyrodactylus salaris*.

"Although the Canadian Fish

Health Protection Regulations are considered among the best fish disease control mechanisms in the world," they wrote, "they are not infallible, a fact which, along with the large number of potential pathogenic organisms that are not considered under the Canadian regulations, makes the likelihood of an unwanted pathogen or strain of pathogen entering the country with fish from a certified (disease-free) source a very real possibility."

The CAFSAC report is part of a longer study by the North Atlantic Salmon Conservation Organization, a Scotland-based body supported by Atlantic salmon-producing nations.

B.C. salmon farmers have been enraged by UFAWU calls for controls to avert genetic pollution of wild stocks by farmed fish, claiming such pollution is unknown or unlikely to occur.

But NASCO warns that importation of European Atlantics to Atlantic Canada "provide risks of undesirable impacts on North American Atlantic salmon stocks."

"There are new disease or strains of diseases which may be introduced, also hybridization with North American stocks could result in loss of genetic diversity and reduced productivity."

NASCO concluded there is "an urgent need to develop new techniques to study the effects of hybridization, e.g. potential impacts of genetic impoverishment resulting from 'domesticated' or genetically engineered Atlantic salmon stocks (cultured salmon) spawning with wild stocks and hybridization of different strains of wild stock."

NASCO recommends that until definitive measures are in place to protect the genetic integrity of wild stocks, aquaculture projects should:

• use stocks originating as closely as possible to the project area,

• use sterile fish,

• establish "river preserves where no transfers or hatchery stocks is allowed in order to maintain the genetic integrity of some wild stocks; and

• manage stocks to ensure they are not reduced below a minimum size.

The Fisherman 7-15-88

UCLUELET

NEW

USED

DICKINSON STOVES
COLUMBIAN STOVES
and PARTS

ROMAN'S MARINE STOVE REBUILDS

Box 747 Shop: Basement
Ucluelet B.C. Ucluelet Lodge
V0R 3A0

Phone 726-4324 (Leave Message)

ERIK LARSEN DIESEL CO. LTD.

- ENGINE SALES & SERVICE
- FUEL INJECTION
- WELDING
- HEAVY EQUIPMENT REPAIRS

K.C. GM PARTS - CHRYSLER MARINE
CUMMINS - VOLVO PENTA
ANDERSON ROSE - FORD
CATERPILLAR AND PERKINS

1351 EBER ROAD
UCLUELET, B.C. V0R 3A0

726-7011

726-7244

Pioneer Boat &
Ship Chandlery Gear Store & More

Bonnie & Eric Box 886



James
Chevi

U

- Fuel • Filters
- Charts •

PHONE



PHONE

Competitive Price

- 3 UNLOADING WINCHES
- CUSTOM UNLOADING
- CUSTOM FREEZING

BUYERS: SALMON, HALIBUT
ABALONE, ROE H

FAX: (604) 726-4221
P.O. BOX 1089, UCL

Open 7 days per week

Government of Canada
Fisheries and Oceans

Gouvernement du Canada
Pêches et Océans

NOTICE



'TOP PRICES FOR SALMON (TROLL/NET) - GROL

- Free Ice for Regular Fishermen
- Free Mooring & Parking
- Gear Storage
- Sauna - Showers - Lau
- Boat Launch Ramp

• Price Information SSB ch. 2318

Algae, disease, low prices hammer B.C. salmon farmers

British Columbia's fish farming industry, wracked by collapsing prices, disease, algae blooms and bankruptcies, is facing a major corporate shakedown.

Despite continued assurances by industry leaders that all is well, signs of trouble include:

- ★ a rash of receiverships affecting about 12 farms and three companies;
- ★ devastating algae blooms throughout the Strait of Georgia which have wiped out some farms and crippled others;

★ industry agreement that the Sunshine Coast, the scene of a salmon farming goldrush only three years ago, may see an exodus of operations to colder, algae-free waters; and

★ continued low prices which are driving down wild salmon prices and forcing more producers to the wall.

The most visible problem has been the algae blooms, which sweep in on hot, calm days and suffocate salmon in their pens within hours. Persistent low levels of algae are believed to contribute to stress and disease.

Losses to various diseases continues to be high on many B.C. farms, according to industry publications.

According to the *Sechelt Press*, a plankton bloom during the Labor Day weekend wiped out five farms, severely damaged five others and destroyed 300 tons of salmon worth about \$2 million. The regional dump, which was to be closed to farm waste Oct. 20, was opened especially to handle the emergency.

Farms in Agamemnon Channel took the brunt of the assault, but the entire

region was affected. Local fishermen heard radio chatter from farmers seeking some place to dispose of the sudden large volumes of dead fish.

Professor Larry Albright of Simon Fraser University told a public meeting on the impact of fish farms later that month that the entire Strait of Georgia is so infested with the algae that farms will be removed from the area completely.

Meanwhile, prices continue to drop, heading below \$1 a pound according to some market reports. The break-even point is estimated to be around \$2.25 to \$2.50 a pound level.

The crunch of falling prices, provoked in part by aggressive marketing by Norwegian producers, is hitting farms hard in many areas.

Coopers and Lybrand, receiver for three firms put into receivership by secured creditors, reports continued financial problems for farms in the Campbell River area.

Eric van Soeren, receiver for North American Salmon Corp., operator of six sites around Quadra Island, and Sea

Grow, with operations at Nelson Island, said Sept. 19 that new buyers had not been found.

But both firms were thrown into receivership by Norwegian banks seeking to slow their losses on loans to B.C. producers. Now van Soeren is seeking a buyer for Atwood Bay farm near Desolation Sound and expects a busy fall with other troubled firms. He would not disclose who is buying the farm.

As a result of the chaos, the normally boosterish industry is shying away from an optimistic DFO analysis of the industry which predicts production could hit 80,000 to 100,000 metric tons by the year 2000.

Product of 50,000 tons is very realistic, the Price Waterhouse report claims. But industry spokesmen believe that disease and other problems will keep them in the low-growth range of about 20,000 tons until the turn of the century.

(Ed: The above article was reprinted with permission from *The Fisherman*, Geoff Meggs, Editor)

Fish farmer sues foreigners

A Washington state fish farmer and his corporation have sued in U.S. District Court alleging that foreign national interests have attempted to monopolize the commercial fish farming industry in his state. Lee A. Holley III of Lopez Island in northern Puget Sound alleges in his suit that foreign business interests, primarily

Norwegian, operated through American national fronts to destroy competition in the industry, remove local control and violate antitrust laws.

Holley, owner of Northern Nights Fish Farms Inc., is suing several Norwegian corporations that have either sole or partial ownership of farms in Puget Sound. Also named in the suit are state officials and other individuals who allegedly contributed to illegal activity. Holley charges that large financial contributions were made to state political campaigns by the foreign interests, which, he says, also assisted in defeating a moratorium proposed against new businesses in San Juan County, where Holley lives.

Comments from the Norwegian companies and state officials were being withheld pending litigation, according to several reached by telephone.

— Brad Matsen

The Fisherman January 25, 1989

Fish farm drug hits wild stock

Fishermen harvesting shellfish off Scotland say a chemical used by salmon farmers is killing marine life.

Scientists at Aberdeen University have linked the chemical with increasing numbers of wild salmon going blind.

The controversy has erupted over Nuvan 500, which farmers use to control pests. Its byproduct, dichlorvos, is listed by the 1987 North Sea Conference as one of 26 most dangerous chemicals in waterways.

The debate highlights the severe problems salmon farming disease treatment can pose for

the marine environment and other marine life.

According to the *London Observer*, in a report on its wire service Jan. 11, scientists at Norway's Institute of Marine Research in Bergen have found the chemical could be damaging sensitive lobster and crab larvae around the farms. Mussels and oysters also absorb the chemical.

Nuvan is strictly controlled on land, but salmon farmers have easy access because they are not subject to the same regulations.

Fishermen and environmentalists are demanding a ban on Nuvan, but farmers say they will

be decimated by sea lice if Nuvan is taken from their arsenal. They favour voluntary controls.

Nuvan is not registered for use in Canada, meaning it is unavailable. Valery Brooks, of the B.C. Salmon Farmers Association, said sea lice are not a problem in this province, but a special session on lice is scheduled for an aquaculture conference in Dartmouth next month.

Scientists there have concluded that sea lice threaten the viability of salmon farming in Atlantic waters and 90 percent of farms must use treatments to control the parasite.

Puget Sound anglers hooking Atlantic salmon

by Brad O'Connor
Times staff reporter



Steve Loop caused quite a stir in June when he showed up at Seacrest Boathouse in West Seattle with a 5½-pound Atlantic salmon he'd caught while fishing for blackmouth near the Southworth Ferry landing.

Atlantics are not supposed to be swimming around Puget Sound and it was only the second Dave Nelson, Seacrest manager, had seen in his 17

years at the boathouse.

Atlantics — 1 million or more of them — are in the Sound, but all are supposed to be confined to net pens where they are reared by private growers for markets mostly in the south, the East Coast and California.

Loops' Atlantic was an escapee.

Since June, Nelson has weighed about a dozen others, all caught on hook and line, which is remarkable. While Atlantics provide some of the world's greatest freshwater sports fishing, they rarely are caught on sports gear in salt water.

"Ponder this," said Nelson, "if we've seen a dozen here, there must be many, many more swimming around out there."

He's correct. There are more.

Will Sandoval, biologist for the Muckleshoot Tribe, said his tribal fishermen have told of netting several Atlantics during summer and fall salmon seasons.

"Some told of catching three or four a day," he said.

Three that Sandoval checked during a state and tribal test fishery for sockeye in July were approaching sexual maturity.

"What concerns me is that they may have been looking for somewhere to spawn. Even if they can't spawn successfully, there's a risk they could be carrying some exotic disease."

Decades ago, attempts were made to establish spawning runs of Atlantics in Washington and British Columbia. All failed and the belief among some fisheries scientists is that further attempts to establish Atlantic runs on the West Coast also would fail.

In fact, most fisheries managers nowadays shudder at the thought of Atlantics spawning in any West Coast stream — not only because of the risk of disease, but because of increased competition for food and space with native trout and salmon.

Reports of Atlantic catches are funneled to Lee Hoines, a Department of Fisheries biologist at Olympia. Of the 203 reported to him last year, most were caught by commercial fishermen in the Bellingham area and around the San Juans.

However, two were caught in fresh water,

on the Nooksack River and another in July in Cedar Creek, a tributary of the Nisqually.

What if they did spawn successfully?

"My assumption is that they can't. I can't say that absolutely is the case, but I hope they don't," said Tim Flint, another WDF biologist.

De Yonge was right on fish-farm perils

By Arthur H. Whiteley, John W. Brookbank and Annamaria K. Johnstone

In his article (P-I Op-Ed, March 29), State Land Commissioner Brian Boyle took severe exception to John de Yonge's March 5 Focus Section article on fish farms.

We believe that de Yonge's pithy comments were right on target.

Boyle argues against relating fish-farm pollutants to untreated human sewage. In terms of organic sludge whose combustion consumes dissolved oxygen from the water, and loading of the water with various nitrogen compounds and phosphate which act as fertilizers, the two pollutants are essentially alike.

The question of dilution of these discharges is relevant.

Metro's West Point Wastewater Treatment Plant dumps its soluble discharge into the main channel of Puget Sound at considerable depth, permitting dispersion. Fish-pen wastes are deposited on the site as feed pellets and feces, which settle as sediment and dissolved components that enter the water column. The sites are channels or embayments with restricted water flow, not rivers, with a one-way flow that flushes things away. Tides flow and ebb and currents in bays create eddies, leading to retention and accumulation of the pen wastes.

Metro sewage must undergo treatment, at substantial and justified expense to our citizens who create this waste. Discharge is monitored by a permit, mandated by federal Clean Water Act. The fish pen solid waste enters the bay raw, untreated, without disinfection — and free to the fish farmer. Washington's pens have avoided the federal discharge permits, although the Sierra Club Legal Defense Fund threatens the state with legal action if this requirement is not enforced.

real, just as it has been in Norway.

Boyle's understanding of the *Gyrodactylus salaris* issue in Norway is at variance with reports from Dag Dolmen of the Directorate for Nature Management in Trondheim. This trematode parasite has been introduced into Norway, according to Dolmen's analysis, "through stocking with salmon parr from infected hatcheries/fish farms." Johnson and Jensen report that total salmon catches in infested Norwegian rivers (1970 to 1984) dropped to 16 percent of levels in uninfested rivers. These were mostly wild fish, which have been nearly decimated by a parasite spread through "hatchery/fish farm" stockings. The smolts that are stocked in salt water fish farms are reared as fry in fresh water hatcheries.

In November, Svein Mehli, head of the division of the Directorate for Nature Management concerned with protection of wild salmon in Norway, testified for Skagit County before the State Shorelines Hearing Board. Mehli reported the escape into Norway waters of thousands of pen-reared salmon carrying furunculosis, the appearance of bacterial kidney disease in farmed stock, the presence of redmouth disease in 300 salmon pens — a disease previously unknown in Norway — and of his concern about "other diseases knocking at the door." Given these facts, we disagree with Boyle's position that "environmental arguments against fish farms are essentially specious."

Boyle objected to de Yonge's extrapolation of the targeted 100 fish pens to the sewage equivalent of Seattle's sewage outfall — as "scientifically absurd." But Boyle can find a graph on pages 133 and 134 of the draft Programmatic Environmental Impact Statement to which he referred that shows that 100 pens will load Puget Sound with biological oxygen demand (organic sludge) 150 percent higher than that of the West Point plant, and add an amount of dissolved nitrogen to the embayments equal to that from this sewage plant. We think de Yonge stated things correctly.

In Norway, which has much smaller farms than are permitted here, pens are moved every couple of years, to try to mitigate environmental problems. Moreover, they are located closer to the open water at the mouth of fjords. In some regions, alternate fjords are kept free of pens to create security zones between sites.

Atlantic salmon can become diseased in their pens and they do escape. This year commercial fishermen have recorded many Atlantics caught along with native salmon south of San Juan Island and between Bellingham and Point Roberts. Escaped Atlantics have been picked up in the Nooksack, Skagit and Nisqually rivers. These are adult fish, apparently ready to breed. We feel that there remains a possibility that they will breed, that they will become established and that they will compete on the breeding grounds with native salmonids — how successfully neither we nor Boyle knows yet. The presence of potentially diseased pen escapees among breeding natives poses a danger that in our opinions is

Boyle must be well aware of the current concern about appearance of viral hemorrhagic septicemia (VHS) in resident salmonids and doubtless has seen the U.S. Fish and Wildlife Service summary of March 3, 1989, which reports that this virus is confirmed in yearling coho and steelhead trout and fall chinook salmon fry from the Makah hatchery. We assume that he is aware of the opinion from the U. S. Fish and Wildlife Service that the logical, though not proven avenue for entry of this new disease is via Atlantic net-pen culture. If these are proved to be "specious arguments," then we can drop them.

Is it fair for "the working stiffs" on the gillnet boats, purse seiners and reef boats — white and Indian alike — to be crowded off their fishing grounds, or worse, to have their resource diminished? Should clam growers, who have husbanded their rich resource for three generations, be forced to contend with pollution from a fish pen?

In order to generate new jobs and revenue, a wiser course for our state would be to accept the mitigation measure in the draft EIS — to culture salmon in tank farms. These should be on privately owned land with effluent monitored and regulated by permit and then discharged into deep water. In this way the negative impacts of floating mariculture — navigation hazards, storm-caused breakup of pens, dissemination of disease, release of untreated wastes, difficulties with antibiotics and impairment of aesthetics — would be eliminated. Lastly land-based fin-fish culture would place the costs of this industry on those who profit from it.

■ Dr. Arthur H. Whiteley is professor emeritus of zoology at the University of Washington; Dr. John W. Brookbank is professor emeritus of microbiology and cell biology at the University of Florida; Dr. Annamaria K. Johnstone is a marine microbiologist. Soapbox columns are contributed by readers.

Donna Pliner

Additives to the Environment of Net-Pen Reared Fish
Pacific Marine Fisheries Commission 42nd Annual Meeting
Seattle, Washington, October 16-18, 1989

PHD Arthur H. Whiteley and Annamarie Johnstone

We have been asked to address our remarks to the matter of additives to the environment of net-pen reared fish. In this particular forum, we assume the emphasis should be on additives that may have an impact on humans when these fish come to market, rather than the impact on the plant and animal communities in the natural environment, though these are not wholly separable.

By its very nature, net-pen rearing of salmon requires the use of numerous chemicals, sometimes in large amounts, some used in the fresh water hatcheries to produce the fry and smolts, some used in the grow-out period in the marine pens, and others used during processing of the fish for the market. Partial lists are shown in Table 1, compiled from Austin and Austin, 1987, from a 1988 report for the Nature Conservancy Council by the University of Stirling, and from other sources.

The lists include chemicals used in salmon and in other forms of fish culture, both in this country and in foreign countries. Inasmuch as farmed fish are imported from some of these other countries, inclusion of these chemicals in the lists may be relevant to the matter of seafood surveillance in the United States marketplace.

Chemotherapeutics. The most relevant additives for present purposes are antibiotics and therapeutants used to control bacterial diseases. Because of stress, disease may cause losses of 30-40%, sometimes higher. Diseases in salmon farms include *Vibrio anguillarum* (vibriosis), *Aeromonas salmonicida* (furunculosis), *Aeromonas hydrophila* (hemorrhagic septicemia), *Yersenia ruckeri* (red mouth), *Vibrio salmonicida* (Hitra disease), *Renibacterium salmonarum* (bacterial kidney disease). To combat these diseases, medicated food containing antibiotics is supplied. In Washington, the FDA approved antibiotics and therapeutants are oxytetracycline (OTC), Romet 30 (sulfadimethoxine and orhomethoprim) and sulfamerazine. In addition, Tribissen (sulfadiazine and trimethoprim) is used in Norway and Scotland, and in British Columbia erythromycin is used to control BKD. In Japanese fish culture a wide variety of antibiotics has been used, but has recently restricted the use of chemotherapeutics in cultured fish (Aoki, 1988, pers. comm).

In the US, Norway, BC and Scotland, doses of drugs are as indicated in Table 1B. It is anecdotal, however, that additional amounts of antibiotics are used by farmers, who may mix the drugs with feed and binders. Control of use of antibiotics in Norway and Scotland is regulated by veterinarians, and this is supposed to be the case in B.C. In the British Isles it is apparently easy to find legal loopholes to permit other antibiotics and doses to be used (Austin and Austin, 1987). In Washington fish farmers are supposed to notify the Department of Fisheries if they use antibiotics, but veterinarian supervision is not required. Generally approval exists for only therapeutic use of these

drugs. Nonetheless they often are used prophylactically inasmuch as sick fish may not take the medicated food.

There appears to be no medical or public health supervision or regulation here, or in the other fish farming countries, on the use of antibiotics and chemotherapeutics other than the requirement of FDA approval of the three drugs and their dosages. There appears to be no monitoring by agencies of the use of these drugs or their persistence in marketed fish.

The amounts of drugs used are enormous. In Norway last year, 48 metric tons (105,000 lbs) of OTC alone were used - more than in animal husbandry and human health uses combined (Mehli, 1988, pers. comm. and press accounts). This figure has grown from 13,691 lbs in 1984 (Midtlying, 1985). The 1984 figure for Tribissen, nitrofurazolidon and sulfamerazine is 30,204 lbs (Midtlying, 1985). Comparable figures for British Columbia and Washington are not at hand. Assuming the dosages cited earlier for the 13 Washington pens, calculation leads to a first approximation of about one ton of OTC, a figure similar to that given by a Washington fish pen operator (Dr. A. Bill, 1989, pers. comm.).

The relevant issue here is "Do these uses affect man?" Consumers clearly would be exposed to residual antibiotics in the fish meat. Because of the potential for these residues producing a serious problem in public health, Japan has recently restricted the use of chemotherapeutics, and does not allow cultured fish to move to market if residual drugs can be detected in fish meat (Aoki, 1988, pers. comm.). The potential for adverse effects has been emphasized by Austin (1988, conference in Vancouver, B.C.; Austin and Austin, 1987). The current regulations for control of such residues are based on admittedly minimal research. The FDA requires a 21 day withdrawal period after the last medicated feeding of OTC and 42 days for Romet 30 before slaughtering for the market. In B.C. the withdrawal period is 42 days, and in Norway 61 days. Very few data exist for measurement of persistence of these drugs in fish flesh after feeding. McCracken et al (1976) measured the presence of trimethoprim in trout muscle 77 days after medication; Salte and Liestøl (1983) calculated that the withholding period for trout receiving OTC should be 100 days at winter temperatures, and for Romet 30 they recommended withdrawal periods of 60 days, above 10°C. All authors emphasize that temperature is a seriously complicating factor - residues of Romet 30 persisted for several months in fish at colder temperatures, leading Salte and Liestøl to recommend using the component drugs only in summer. Clearly these limited data do not support the FDA regulation of 21 days. New, more refined measurements of drug residues in salmon coming to market clearly are needed - a recurrent theme of the Austins. Some of these measurements are being made now at the University of British Columbia by McErlane et al. (1989), and Grondel et al. (1987) have published a pharmacokinetic analysis of OTC distribution in carp. In the absence of more detailed studies, humans ingesting farmed salmon may be receiving subtherapeutic doses of antibiotics. One would like to see regulations established for testing the product, by agencies, as it comes to market to ensure the absence of detectable residues. Methods used should be such as those approved by the National Committee for Clinical Laboratory Standards

used by the Clinical Laboratories, Laboratory Medicine, University Hospital, University of Washington.

The issue extends beyond the limits of the penned salmon. Much of the antibiotic fed escapes into the fluid environment and, notably, into the sediments that accumulate beneath the pens (Jacobsen and Berglund, 1988), where it may be exposed to native fish, shellfish, and other indigenous species, thus providing another avenue to humans who may catch and consume these forms.

The medical consequences of the mis-administration of antibiotics are numerous, and are well discussed in such modern treatises as Goodman and Gilman (1985) and Kucers and Bennett (1987). A number of them are antigenic and elicit immunological hypersensitivity responses; some have toxic effects in various tissues varying with the physiological and health state of the person; some particularly should be avoided during pregnancy; tetracyclines lead to discoloration of infants' teeth and may interfere with bone growth; some, notably the tetracyclines, may lead to the development of superinfections by resistant strains of bacteria; they may interfere with the normal immune response; and the breakdown products of antibiotics, including OTC, can be toxic particularly in individuals with compromised livers. Basically, it is poor medical practice to ingest unneeded antibiotics or deteriorating antibiotics.

Another cluster of problems associated with use and misuse of antibiotics is the generation of strains of pathogenic bacteria that have resistance to the drugs. Such strains have now appeared in essentially all fish culture communities that have been adequately tested. Mostly the resistance factors are carried on R plasmids, which also usually are found to carry resistance determinants for 1 to 8 additional antibiotics, thus showing multiple drug resistance. In high proportions, these R plasmids are transferable to other bacteria, and thus drug-resistance may be disseminated to other ecosystems. Studies at the Centers for Disease Control have shown that outbreaks of salmonellosis could be traced to drug-resistant *Salmonella* derived through the foodchain back to land farms associated with agricultural antimicrobial use (Cohen and Tauxe, 1986). It is prudent to evaluate the possibility for a similar generation of R plasmids in fish farms and their dissemination to human populations in the marketplace. When drug-sensitive populations of pathogens are replaced by drug-resistant populations, then treatment of the affected fish becomes ineffective, and, if the R plasmids are in human pathogens, treatment of patients would be adversely affected. Particularly, it is a general principle that medically important antibiotics, including oxytetracycline, the sulfas and erythromycin, should be restricted in their nonmedical uses to minimize R plasmid selection and transmission.

When antimicrobials are used in fish farms near commercial or recreational shellfish beds, there is the further potential for drug-resistant organisms to be concentrated by the shellfish, through filtration, and thus enter human populations.

Food additives. The dry pellets, fed to the penned fish in the marine environment, contain fish meal, grains, fish oils and carbohydrates, supplemented by minerals and vitamins as indicated in Table 2. While these additives have no direct human import, it is reported that planktonic blooms of

the ichthyotoxic dinoflagellate, *Gyrodinium aureolum*, were enhanced by the biotin in fish farm wastes (Turner et al., 1984). These blooms cause mortalities to cultured fish, and, unfortunately, to wild fish as well (Bellock et al., 1985).

Pigment is added to the feed to produce a colored flesh in farmed salmon, inasmuch as the color of wild salmon flesh is derived from natural food organisms. In Great Britain, the carotenoid canthaxanthin, an analog of astaxanthin common in natural food organisms, is used in the form of carophyll red. It is stated in a report from the University of Stirling that this use is banned in the US because of possible carcinogenic properties of canthaxanthin (NCC Report, 1988). To date a petition for its use has not been submitted to the FDA (FDA, Seattle Office, 1989). A petition is presently under consideration for use of astaxanthin as a colorant. A main local supplier adds canthaxanthin as a colorant. There clearly are gray areas here where research and regulation is sorely needed.

Many wild fish are rich in omega 3, polyunsaturated fatty acids. A higher ratio of omega 3/omega 6 fatty acids is believed favorable for maintaining low cholesterol levels in humans. Cultured fish and other sea foods, because of their artificial diets, may have low levels of omega 3 fatty acids, and thus unfavorable ratios of omega 3/omega 6 (Suzuki et al., 1986; Chanmugam et al., 1986). Consequently, individuals eating farmed salmon in the expectation of gaining this supplement will typically be erring, unless the farmer has specifically added it as a dietary supplement and indicated this in marketing. The dry pellets supplied locally generally do not have omega 3 acids added as a supplement (Moore-Clark Co., 1989, pers. comm.) because these are contained in the fish oils of the fish meal used.

Moist pellets, which are more commonly fed during the hatchery phases of salmon farming, are derived from fish meal that is pasteurized, combined with additives, and frozen. However, moist pellets used in some fish farms in Puget Sound contained *Salmonella* spp. (Draft PEIS, WDF, p. 116, 1989). Moist pellets used in British Columbia have been found to contain *Salmonella* (Kelly, 1988, pers. comm.; Babink, 1988, pers. comm.). In these cases it is unclear whether the pathogens had survived the pasteurization, or had appeared subsequently. These pathogens can persist for a period of time in marine waters, are harbored by fish in polluted waters, without harm to them (Buttiaux, 1963). Marine shellfish can concentrate *Salmonella* and transmit them to humans. There is, therefore, a potential for fish culture to join animal husbandry as a mode for affecting humans in the manner described by Cohen and Tauxe (1986).

Hormones. At this time, hormones are being used in B.C., experimentally and perhaps to an extent in actual culture, to control the sex, size and behavior of penned salmon, both *Oncorhynchus* spp. and *Salmo salar*. Gonadotropin, gonadotropin releasing factor and analogs, and antiestrogens have been used in adult females to modify spawning. Androgens and estrogens are used to cause feminization, and, in combination with other techniques, to produce triploid and tetraploid stocks for production of sterile salmon. A review is provided by Donaldson (1986).

In general, these treatments are used on egg-producing females or on eggs and sperm, and the likelihood of carry-over of hormones to adult, marketable fish is tiny. Anabolic steroids including methyl testosterone,

thyroid hormones, somatotropins, certain pituitary hormones can be used to accelerate growth in juveniles and the timing of smoltification (Donaldson, 1986). If these hormones, or androgens and estrogens, were used for growth acceleration or other effects on near-harvest adults, then there would be cause for concern to human consumers.

Pesticides. A remarkable list of agents are or have been used in salmon culture. Examples are: formalin, malachite green, acriflavin, Nuvan, Neguvon, Chloramine T, MS222, copper sulfate, tributyltin, diquat, in addition to the chemotherapeutics. Some are used in Scotland and Norway which apparently are not used, or not permitted, in the U.S. and B.C. Lists are incorporated into Table 1 of this presentation.

Treatment of salmon lice (*Lepeophtherius salmonis*). These copepod ectoparasites pose a severe problem for adult penned fish in Scotland and Norway. In Europe, organophosphate pesticides (Nuvan^R (dichlorvos; Scotland) and Neguvon^R (trichlorfon which forms dichlorvos; Norway) are primarily used. Fish are treated by immersion in a concentration of 1 ppm for 1 hr, as needed. In 1984 39,600 lbs of Neguvon were used in Norway (Midtlyng, 1985). They are inhibitors of acetylcholinesterase activity in the cholinergic nervous system. These agents not only kill fish lice, but other crustacea in the environment as well, including commercially important species such as crabs, lobsters and mussels (Egidius and Moster, 1987), and they cause potentially serious problems to the treated fish (Davies and McKie, 1987; NCC Report, 1988). These agents are restricted by the EPA in the U.S. (Seattle EPA Office, 1989). In Washington, the carbamate Sevin^R (carbaryl) has been suggested for use for treatment of salmon lice, and it is used in oyster culture for controlling ghost shrimp. Sevin, also, is an inhibitor of acetylcholinesterase. Sevin has recently been restricted in parts of the United States, and its discharge is regulated by an NPDES permit. BRAVO (chlorothalonil), a fungicide has been suggested for and used recently on fishpen nets, a use banned by EPA because it is a class B carcinogen (EPA, Seattle, 1989).

Disinfectants and Antifoulants. Formalin and malachite green have been used for control of ectoparasites and fungi, usually in the fresh water phases of farming. Malachite green, a potential teratogen (NCC Report, 1988), is now banned. MS-222 is used under certain conditions for anaesthesia, but with a 21-day withdrawal period for clearance from tissues. Hatchery ponds are sterilized with chlorine.

To prevent fouling of nets by growth of algae and encrusting invertebrates, fish farmers have treated nets and pen structures with the antifouling agent, tributyltin (TBT). This substance, at exceedingly low concentrations, has a variety of adverse effects on marine invertebrates and perhaps on vertebrates (Bailey, D.S., 1987). When, in 1987, farmed salmon appeared in the Seattle markets carrying substantial amounts of TBT in their flesh, the state enacted a law prohibiting this use and partially eliminating it from use on boats. A similar law exists in the national statutes, in Great Britain and other parts of Europe. Despite this ban, a Canadian Governmental memorandum on August 11, 1988, titled "Private Salmon Hatcheries and Netpen Facilities, Some Serious Concerns" indicates that 25% of BC pens are still treated with unregistered boat hull paints, sometimes including TBT, which liberate

large quantities of particulate paint into the water, sometimes onto oyster beds, thus creating potential hazards for two kinds of aquacultured products.

If antifoulant is used on nets now, usually it is copper-based. Copper and other heavy metals are highly toxic to many marine invertebrates. Standards for permissible amounts of copper in farmed fish flesh appear to be lacking.

Summary. There are a number of chemicals and additives used in net pen culture now that have the potential for adverse human impact. Often these are used at the discretion only of the user, and with little or no external monitoring. There appears to be little or no input into this regulation by public health agencies.

References cited.

- Aoki, T., 1988. Personal communication.
- Austin, B., and D.A. Austin. 1987. *Bacterial Fish Pathogens: Disease in Farmed and Wild Fish*. John Wiley & Sons, N.Y.
- Babink, T. 1988. Personal communication.
- Bailey, D.S. 1987. Toxic boat paint threatens life in coastal waters. *Env. Def. Fund Letter*, 18 (4): 7.
- Bullock, A.M., M.S. Turner, and R.J. Gowen. 1985. The toxicity of *Gyrodinium aureolum*. *Bull. Mar. Sci.*, 37(2): 763.
- Buttiaux, R. 1963. Salmonella problems in the sea. In: *Fish as Food*, 2:503-519. G. Borgstrom, ed.
- Chanmugam, P., M. Boudreau, and H.D. Hwang. 1986. Differences in the w3 fatty acid contents in pond-reared and wild fish and shellfish. *J. Food Sci.*, 51: 1556.
- Cohen, M. 1988. Personal communication.
- Cohen, M.L. and R.V. Tauxe. 1986. Drug-resistant Salmonella in the United States: an epidemiologic perspective. *Sci.*, 234: 964-969.
- Davies and McKie. 1987. Accumulation of total tin and TBT in muscle tissue of farmed Atlantic salmon. *Mar. Pollution Bull.* 18(7): 405-407.
- Donaldson, E.M. 1986. The integrated development and application of controlled reproduction techniques in Pacific salmonid aquaculture. *Fish Physiol. and Biochem.*, 2: 9-24.
- Draft Programmatic Environmental Impact Statement, Fish Culture in Floating Net Pens, WDF, Jan., 1989.
- Egidius and Moster, 1987. Effect of Neguvon and Nuvan treatment on crab (*Cancer pagurus*, *C. maenas*), lobster (*Homarus gammarus*) and blue mussel (*Mytilus edulis*). *Aquaculture*, 60: 165-168.
- Goodman and Gilman. 1985. *The Pharmacological Basis of Therapeutics*. 7th Ed. Macmillan Publ. Co., N.Y..
- Grondel, M., J.F.M. Nouris, J. de Jong, and A.R. Schutte. 1987. Pharmacokinetics and tissue distribution of oxytetracycline in carp, *Cyprinus carpio* L., following different routes of administration. *J. Fish Diseases*, 10: 153-163.
- Jacobsen, P. and L. Berglund. 1988. Persistence of oxytetracycline in sediments from fish farms. *Aquaculture*, 70: 365-370.
- Kelly, M. 1988. Personal communication.

- Kucers, A., and N.McK. Bennett. 1987. The Use of Antibiotics. 4th Ed. Lippincott Co., Phil.
- McCracken, A., S. Fidgeon, J.J.O'Brien, and D.Anderson. 1976. An investigation of antibiotic and drug residues in fish. J. appl. Bact. 40: 61-66.
- McErlane, K.M., H.M.Burt, and D.D.Kitts. 1989. Drug residue detection in finfish. Aquatech. Conference, Vancouver, B.C., (abs.)
- Mehli, S.A., 1988. Personal communication.
- Midtlyng, P. J., 1985. Bruk av medikamenter og desinfeksjonsmidler i norske fiskeoppdrettsanlegg. Vann, 3: 177-180.
- Salte, R., and K. Liestøl. 1983. Drug withdrawal from farmed fish. Depletion of oxytetracycline, sulfadiazine, and trimethoprim from muscular tissue of rainbow trout (*Salmo gairdneri*). Acta Vet. Scand., 24: 418-430.
- Suzuki, H., K. Okazaki, S. Hayakawa, S. Wada, and S.Tamura. 1986. Influence of commercial dietary fatty acids on cultured freshwater fish and comparison with those of wild fish of the same species. J. Agric. Food Chem., 34: 58.
- The reduction of the impact of fish farming on the natural marine environment. 1988. The Nature Conservancy Council Report, by The Institute of Aquaculture, University of Sterling, Edinburgh.
- Turner, M.F., A.M.Bullock, P.Tett, and R.J.Roberts. 1984. Toxicity of *Gyrodinium aureolum*: some initial findings. ICES Special Meeting on the Causes, Dynamics, and Effects of Exceptional Marine Blooms and Related Events, Copenhagen, Oct. 4-5, 1984.

Table 1
Chemicals Used in Net Pen Culture of Fish
(From Austin and Austin, 1986; The Nature Conservancy
Report, Scotland, 1988; and other sources)

Chemotherapeutics

Oxytetracycline	Streptomycin
Romet 30 ^R (sulfadimethoxine and orthomeprim)	Sulfisoxazole
Sulfamerazine	Kanamycin
Tribrissen ^R (trimethoprim	Fumequine
Erythromycin	Chloramphenicol
Penicillin G	Chloramine T
Oxolinic acid	Acriflavin
Minocycline	Acetic acid
Clindamycin	Formalin
Kitasamycin	Malachite green
Rifampicin	Iodine
Hyamine 3500	Iodophor
Copper sulfate	Benzalkonium
	Nitrofurantoin

Pesticides

Dichlorvos (Nuvan^R, an organophosphate)
Trichlorfon (Neguvon^R, an organophosphate)
Carbaryl (Sevin, a carbamate; used in oyster culture)
Diquat

Antifoulants and Disinfectants

Tributyl tin - now banned
Copper paint
Bitumen
Chlorine
Chlorothalonil

Anaesthetics

MS-222 (tricaine methane-sulfonate)
Benzocaine
Carbon dioxide

Food additives

Colorants-canthaxanthin
Minerals
Vitamins
Omega 3 fatty acids

Table 1B
Doses of Antimicrobials Commonly Used in Salmon Net-pen Culture

Antimicrobial	Dose, mg/kg of fish/day	Days of Treatment
Oxytetracycline	75	10
Romet 30	50	5
Sulfamerazine	220	14
Tribrissen	30	10
Erythromycin	10-25, or unspecified	4-21

These regimens are repeated 2 or 3 times a year

Table 2
Mineral and Vitamin Food Additives
in Salmon Pellets

(Data from Nature Conservancy Council Report 1988, and
Moore-Clark Analysis)

Minerals

- Calcium phosphate
- Magnesium sulfate
- Sodium Chloride
- Potassium chloride
- Iron sulfate
- Zinc sulfate
- Copper sulfate
- Manganese sulfate
- Cobalt sulfate
- Chromium chloride
- Ethylenediamine dihydroiodide
- Selenium

Vitamins

- Thiamine hydrochloride
- Riboflavin
- Calcium pantothenate
- Niacin
- Pyridoxine hydrochloride
- Biotin
- Folic acid
- Cyanocobalamin
- Inositol
- Ascorbic acid
- Choline chorlide
- Menadione
- alpha tocopherol acetate
- p-aminobenzoic acid
- Retinol acetate
- Vitamin A
- Vitamin B12
- Vitamn D3
- BHA-BHT, antioxidant

HOUSE BILL No. 432 (Resources)

WHAT WE KNOW

- Fishing is the second largest industry in terms of dollars, and **the largest** in terms of employment, in Alaska.
- The wild stocks of Alaska salmon are **healthy** - in numerical strength and because they are virtually disease free.

WHY IS THIS SO ?

- **Because many years ago the people of the Alaska made a commitment.** We said to the federal government and to the exploitive outside interests: "let us control our own destiny and we will be responsible stewards of our natural resources". Some could argue that we haven't always lived up to that commitment as it relates to other natural resources, but I think we've done a pretty good job with our fisheries.
- For it's part, the State of Alaska has **invested** millions and millions of dollars in capital investment for docks, harbors, grids, processing sites; not to mention the numerous loans made to capitalize the fleet. We've appropriated millions more in operating budget funds for fisheries management, enhancement, enforcement, inspection, and a variety of other programs all designed to keep this industry healthy and prosperous. As best we could, **we have honored our commitment.**
- In 1972, the people of Alaska passed a constitutional amendment which paved the way for the limited entry system. There was too much gear in the water - our stocks were endangered and the viability of the industry was in question. Limited Entry was enacted not only to protect the stocks but to allow the Alaskan fisherman to continue making a living. This was not a decision made lightly. Everyone knew that limitation meant that some would not be able to freely participate in the industry; but they made the hard choice. **The people of Alaska honored their commitment to keep the industry healthy.**
- Hand in hand with the Limited Entry program was increased attention to fisheries rehabilitation and enhancement. The State invested considerable amounts in hatcheries and other enhancement programs. The Alaskan fishermen formed aquaculture associations

and taxed themselves to help keep the enhancement effort strong. In the past several years, the responsibility of operating a number of state hatcheries has been turned over to the aquaculture associations, thereby easing the need for state funding of those hatcheries. Remember, hatchery fish come to maturity in the wild and are harvested by all user groups - sport, commercial, and subsistence. **The fishermen who tax themselves and try to keep costs down and returns strong at these hatcheries are honoring their commitment to healthy fisheries.**

- Because we all have kept the commitment we made over thirty years ago, we have a strong, healthy fishing industry, and at the pinnacle of that industry is the wild Alaska salmon; in the opinion of many, the finest seafood in the world.

NOW, IF WE KNOW THIS, WHY WOULD WE WANT TO DO ANYTHING THAT MIGHT JEOPARDIZE THE INDUSTRY WE HAVE ALL FOUGHT SO HARD TO KEEP HEALTHY?

- Some risks associated with fish farming:
 - The health of the wild stocks. I'm not going to print the laundry list of diseases to which farmed fish are susceptible because they seem to be finding previously undiscovered ones every day. Fish kept in captivity until maturity experience much more stress than do wild fish, and this heightened stress makes them susceptible to disease. If diseased fish should escape into the wild, there is a distinct possibility that the disease they carry could be transmitted to the wild stocks with which they mingle. The migration of disease through the wild stocks could be devastating.
 - The reputation for quality that Alaska salmon now possess. In order to control all these diseases, fish farmers must mix large amounts of chemicals into the food pellets given to the captive fish. There is growing concern that these chemicals could make their way into the human food chain. (See "Additives to the Environment of Net-Pen Reared Fish" by zoologist Arther H. Whiteley, included in your bill packet.) Even if these concerns are eventually dealt with through strict regulations, the perception that farmed fish are unhealthy could be detrimental to the marketing of our wild salmon. We all remember the botulism "scare" of the early 1980's and how one or two bad cans of salmon damaged the entire industry.
 - Pressure on a budget built with dwindling revenue. No one seems to know how much the State of Alaska will need to spend should we become involved with fish farming. Licensing, monitoring, enforcement, and siting concerns will all have to be addressed through the State

operating budget. (Not to mention the potential need for State loans or other "bail-out" measures that would have been looked at down the road. The economic disaster that British Columbia fish farmers recently faced gives some indication of what could be in store for us.) Given that many of our constituents, and a number of the members of this body, believe that we are presently underfunding the agencies that manage and protect our fisheries, I am not ready to gamble millions of State dollars on fish farming.

• Market control. Fish farming evolved in Norway because of that country's concern about its wild stocks of Atlantic Salmon and its fishermen. Norway then instituted its own "limited entry" system: fishermen became fish farmers and the government was able to control "supply" as the demand for fish in the European markets fluctuated. At first Norway did well, capitalizing on the sudden drop in demand for Alaska salmon following the botulism scare of the early 1980's.

Today, however, Norway is faced with a number of growing problems. The market is glutted with farmed fish and prices have dropped. Their own high government officials have now acknowledged that the spread of disease from farmed fish threatens what's left of their wild stocks with extinction. Last Spring the government of Norway was under siege to fund 100 new fish disease specialists and 150 fish veterinarians. They are now paying the price for what they allowed to happen to their own fisheries.

The light at the end of the tunnel for Norway is the exportation of fish farming technology and as much control as they can exert over the world supply and demand of salmon. We all know where the investment dollars will come from for fish farming in Alaska, and who will pay 10¢ on the dollar when the so-called "Mom & Pop" fish farms can't make it and have to sell out. Take a look at which country's corporations started taking over the British Columbia fish farms that went into receivership this past year. It is interesting to note that a fish farmer in the state of Washington has filed suit in U.S. District Court claiming that foreign national interests have attempted to monopolize the industry in his state; that Norwegian concerns operating through American "fronts" have conspired to destroy competition, remove local control, and violate antitrust laws.

• In conclusion, the Norwegian-type farmed fish may have captured a large share of the world market in the short term, but I am convinced that, in the long term, the wild fish - the quality fish - harvested by the Alaskan fisherman will be the winner. We should not risk our dwindling State dollars, and our reputation for a quality product, on a capital intensive, foreign dominated industry that has brought collapsing prices, environmental problems, and questionable genetic practices in its wake.

GENERAL CONCERNS WITH 'UPLAND' FISH FARMS:

1. Groundwater contamination.

Fish diseases are commonly transmitted through water sources. Contaminated water discharged from an upland farm could seep into the water table or surrounding streams.

2. Broodstock.

Broodstock ownership, genetic mutations and alterations of broodstock by private business could threaten common property ownership of fisheries. The source of broodstock for these farms is a major concern because it would have to come from either: (a) hatcheries within the state (which you cannot presume will have the excess eggs or smolt to sell), or (b) sources from outside the state. Importation of broodstock from outside is extremely hazardous in terms of not knowing exactly what you getting. The Finfish Farming Task Force recommended that the importation of salmon broodstock and the private ownership of broodstock be banned.

3. Water appropriation.

Upland farms will use an enormous amount of water. A 200 ton production capacity farm requires 50 cubic feet of water per second, an amount equal to the amount of water the city of Eugene, Oregon uses. The debate over House Bill 210 demonstrated the controversy which exists relative to the appropriation of water in this state.

4. State budget.

Upland farms will still need to be licensed, inspected and monitored for compliance with state laws and regulations. This will take money away from other programs the resource agencies are having a difficult time administering now. Sonja Corazza, the co-chair of the United Fishermen of Alaska's Mariculture Committee testified in House Resources that Southeast shellfish farmers told her that some lease sites had not been checked in three years. DNR didn't have the personnel or the funds to adequately monitor all the sites.

TWO EXAMPLES OF PROBLEMS WITH "UPLAND" FISH FARMS:

1. The Finfish Farming Task Force toured an upland farm in Washington State that is owned by Dan Swecker and a subsidiary of Sealaska Corporation. The farm grows pan-sized coho salmon.

The majority of the facility consists of above-ground swimming pools where the salmon are raised. The water is supplied from several wells. The farm also has a number of small, man-made ponds where the adult brood stock is kept.

Members of the task force noticed that a couple of the ponds were dry and abandoned, and asked why. The answer was that the adult fish in those ponds had passed a pathogen down into the water table and that the pathogen had then travelled back into the wells and had been introduced into the swimming pools containing the juvenile fish. This caused an unexpected, but devastating, outbreak of disease among the population.

It took them quite a while to discover the source of the infection, and the solution was to move the earthen ponds as far away as possible and drain them into an adjacent swamp.

2. The deaths of 100,000 cohos in a river in Washington State have been linked to the seepage of water discharged from a nearby landlocked fish farm, as reported in the Seattle P-I, November 1, 1989.

COMMENTS ON 3-26-90 DRAFT CS FOR SB195
PRO-FISH FARMING BILL

What the bill allows:

Marine and uplands rearing of Arctic char, Dolly Varden, steelhead, rainbow trout, sablefish, and sheefish.

Uplands rearing of Pacific Salmon in both fresh and salt water.

Concerns:

Sets up enormously time and money consuming responsibilities for the Dept. of Fish and Game. Where will the funding come from? Will we cut programs that support and manage common property fisheries which bring huge benefits and tax revenues to the people of the state in order to fund support for a few private businesses?

Directs Dept. and University to spend time and money on research for fish farming. What research will have to be stopped to do this?

Rearing of salmon and other species is allowed in "upland locations." It does not limit this to TANKS alone. Upland ponds increase the danger of groundwater contamination and less positive control of wastes, chemicals, and used water.

Allows non-salmon species to be farmed anywhere, including in marine net pens. There are environmental risks involved with that, including water contamination (ground water, streams, and ocean water) and genetic intermingling with wild stocks, siting conflicts with the many other shoreline user groups, and a host of other netpen problems that are not exclusively related to salmon.

Broodstock acquisition. Allowing fish farming and setting up mechanism to get eggs either from "surplus" hatchery eggs or from wild stocks implies a "forever" obligation on the part of the state to ensure a source of eggs for this new industry.

Who determines if eggs are surplus? Surplus to what? Do we circumvent the intended purpose of the state and PNP hatchery systems which was to produce the maximum possible number of fish for the common property resource. What if they can make more "cost recovery" money by selling eggs to farms than sticking to their original goals?

And for species not currently available in established hatcheries, will we be forced to take eggs from wild stock at the expense of sport, subsistence, and commercial fisheries,

and the health of natural runs? If there is a huge investment in the fishfarming industry, the Department and Board of Fish will be under tremendous pressure to keep the industry supplied with enough broodstock. A new, and competing "user" group will have been established for broodstock.

Will fishermen, who directly and indirectly have paid to build the hatcheries, and rebuild and conserve the natural fish stocks of this state, be forced to inadvertently fund the broodstock sources for the fish farming industry which could so easily destroy the very resources and markets upon which they depend?

Fish and Game is made responsible for standards for waste water treatment - the expertise for that sort of thing is in DEC.

Water rights, "in-stream flow" issues are not addressed. Farms will require large amounts of water. Where will their right to the water fit in with rights of municipalities, homeowners, miners, etc?

What are the penalties for violations of fishfarm regulations? Besides a fine for a violation of water discharge regs or regs regarding disposal of diseased fish, does the state have any recourse if streams and wild stocks are irreparably harmed by a fish farmer's actions?

Pathology services. Bill allows for certification of private pathology labs to service farms. It would be very expensive for state to provide all those services but is it safe to leave it to private industry? If the lab is private for-profit, and thus is working FOR the fish farmer, will they be strict in their reporting of results? Would they want to shut down their own client? How much will it cost the state to properly monitor those private labs?

The Seattle Times 2/28/89

WASHINGTON'S LARGEST NEWSPAPER ■ COPYRIGHT 1989 SEATTLE TIMES COMPANY

'An emergency disease'

Lethal virus may have infected wild salmon and trout, biologists say

by Jack Broom
Times staff reporter

A potentially lethal fish virus that prompted biologists to destroy 3.8 million fish and eggs in two Washington hatcheries last week may also have infected wild salmon and trout and could spread like a plague, experts say.

"This is classed as an emergency disease. It's not to be taken lightly," said Jerry Grover, an associate manager in the U.S. Fish and Wildlife Service's regional office in Portland.

Thousands of wild salmon, trout and other species will be gathered in the next few weeks from areas around the two hatcheries where the virus was recently detected.

Biologists fear that viral hemorrhagic septicemia (VHS), never before seen in North

STEELHEAD RUN SUFFERS

■ An early count of fish at the locks is "terrible." Northwest, B 5.

America, may have the potential to spread rapidly in Northwest hatcheries, net pens and fish populations in open waters.

"Right now there's about a 50-50 chance" that the virus has infected fish in the wild, said Ray Brunson, a fish pathologist for the Fish and Wildlife Service.

The virus, known as VHS, is not regarded as dangerous to humans, even if people eat fish that have been infected.

Biologists say VHS may be far more dangerous to steelhead, a form of trout, than to salmon, but the extent of the danger to both species is not yet known.

In Europe, where VHS has been detected previously, coho salmon have been observed to carry the virus and suffer no ill effects, said Larry Peck, head of salmon-culture operations for the state Department of Fisheries. But Peck said that is no

Please see **FISH** on A 6

Virus called 'emergency'

FISH

continued from Page 1

guarantee that Pacific salmon would survive the infection.

In recent laboratory tests on trout here, about 70 percent died after being injected with large doses of the virus.

The presence of VHS was discovered in routine tests at the state's Glenwood Springs Hatchery on Orcas Island and the federally run Makah National Fish Hatchery on the Olympic Peninsula.

Although the virus itself had not killed any fish at those facilities, all fish and eggs at both hatcheries were intentionally killed to prevent its spread. Workers killed the fish by adding chlorine to the water or by turning off the fresh-water supply, causing the fish to die from lack of oxygen.

Yesterday, workers were still killing the last of the fish and putting them into trenches to be buried.

The next step is to determine whether fish outside the hatcheries have the infection.

"We're setting up a very aggressive sampling schedule," Peck said.

He said crews will use nets, lines, traps and electric-shock devices to gather fish from streams and open water near the two hatcheries.

After the fish are caught, it will take two weeks to test them for the virus.

Peck would not speculate on the chance that the virus is now in wild fish, but he said it's possible that salmon returning from the ocean brought the virus into the two hatcheries.

No one knows how the virus got to this country, Peck said. If

anyone had a guess at this point, he said, "it would be just speculation."

Opponents of net-pen salmon raising believe, however, that the importation of Atlantic salmon eggs to the state is the most likely cause.

"It could have come over as infected Atlantic salmon eggs, and Pacific salmon could have picked it up from them. I think that's the most probable cause," said L. Joe Miller, president of the Marine Environmental Consortium.

Miller said his organization will ask at a public hearing tomorrow for a moratorium on new net-pen permits until the cause and extent of the disease are known.

It is impossible to determine how much damage the virus could do to fish populations here because so little is known about its effects, particularly on salmon.

In Europe, where the virus has been detected mainly in trout, it was responsible for killing 80 percent to 90 percent of the trout in a certain confined area, Grover said.

The ability of the disease to spread quickly among fish poses great concern to commercial operators raising salmon in net pens.

"We're cooperating with the state Department of Fisheries in its investigation," said Haavard Rabben, general manager of Global Aqua USA, which raises Atlantic salmon in floating net pens in Puget Sound.

Eggs and fry used by Global Aqua are routinely tested for many diseases and have never tested positive for VHS, Rabben said. But he said if the virus is in wild fish in Puget Sound, it could spread to his fish.

Brunson said the fish kill hurt the morale of hatchery workers. "They've invested a lot of their effort and their heart in trying to rear fish, and then we call them and tell them to kill them," he said.

The number of fish destroyed last week represented only about 1 percent of the fish raised in state, federal and tribal hatcheries in Washington state, but there is deep concern over whether the

disease will be found elsewhere.

"It was discovered in routine sampling at Glenwood Springs, and we know we've transferred fish in and out of that facility to and from other hatcheries," said Tony Floor, state fisheries spokesman.

But Peck said no eggs or fish were transferred out of the Glenwood Springs hatchery last year because egg samples from returning adult fish showed that some type of virus was present. "We knew we had some type of problem. We didn't know what it was, but we red-flagged that facility," he said.

Peck said it is too early to gauge the extent of the threat to the state's 30 major salmon hatcheries, but he said additional tests are being done at each site.

More than 327 million fish were released last year from state, tribal and cooperative hatcheries. The smaller federal fisheries program released 60 million fish last year in Washington, Oregon and Idaho.

Grover said the fish destroyed at the Makah hatchery represented "a substantial portion of our total production" in the Northwest. He said fish raised on the Olympic Peninsula are considered particularly valuable because they are close to the ocean and usually have a good survival rate when released.

CANADA'S

Don W. Collinsworth, Commissioner

Public Communications
Box 3-2000
Juneau, Alaska 99802-2000
(907) 465-4112



Alaska Department of Fish & Game

NEWS

FOR IMMEDIATE RELEASE

March 1, 1989

ALASKA CONCERNED ABOUT NEW FINFISH VIRUS

Juneau...Fishery pathologists in the Fisheries Rehabilitation, Enhancement, and Development (FRED) Division of the Alaska Department of Fish and Game (ADF&G) are very concerned about the discovery in the State of Washington of Viral Hemorrhagic Septicemia (VHS), a fish virus that has not occurred before in North America.

Recently, a VHS virus was identified in spawning coho and chinook salmon in two hatcheries in the State of Washington: the Glenwood Springs Hatchery on Orcas Island and the Makah Hatchery operated by the U.S. Fish and Wildlife Service near Neah Bay. All fish in these hatcheries were destroyed, and the facilities have been quarantined in order to prevent the spread of this virus.

VHS, first discovered in 1938 in Europe, causes disease primarily in rainbow trout in both fresh and salt water. Other fish shown to be susceptible include Atlantic salmon, brook trout, golden trout, rainbow trout-coho salmon hybrids, and goldfish. Transmission is by contact with other infected fish or contaminated waters. VHS has not been detected in North America despite extensive disease monitoring. VHS is capable of causing severe mortalities in older, larger fish, while Infectious Hematopoietic Necrosis Virus (IHNV), indigenous to wild Alaskan sockeye salmon, typically kills fry and juveniles. As with other viral diseases, there is no treatment for VHS except prevention.

Dr. Ted Meyers, Principal Pathologist for the FRED Division, has found no evidence of VHS disease in Alaskan

salmon stocks. According to Dr. Robert Burkett, Chief of Technology and Development for the FRED Division of ADF&G, Alaska maintains the best possible protection against invasion of exotic fish diseases because it prohibits the importation of any finfish into the state. "The most important thing was done ten years ago when regulations were established prohibiting import of finfish," Burkett says.

Dr. Meyers has been in contact with investigators performing the VHS identification and survey work at the Sand Point U.S. Fish and Wildlife Service Fish Pathology Laboratory in Seattle. Dr. Meyers will be travelling to the Seattle Laboratory to monitor the progress of the investigations and to determine the extent of the VHS problem in Washington and the Pacific Northwest. FRED Division pathologists will continue to monitor Alaskan salmonid stocks for IHNV using procedures that would detect other viruses as well, including VHS.

As a result of the potential risk to Alaskan stocks, the Commissioner of ADF&G, Don Collinsworth, is calling for the immediate formation of a Pacific Coastal Task Force composed of state and provincial representatives from Alaska, Washington, Oregon, Idaho, California, and British Columbia, with appropriate representatives from state, federal, tribal, and private industry, to investigate the risk of spreading VHS from infected hatcheries in Washington State and to develop effective control methods to contain this disease.

* * * * *

FISH FARMING IN ALASKA:
GAMBLING WITH RESOURCES AT PUBLIC EXPENSE

BY
SENATOR DICK ELIASON

Alaska should move now to ban commercial finfish farming in the state. Development of a fish farming industry could jeopardize our natural resources, our sport and subsistence fisheries, and our billion-dollar commercial fishing industry.

Stewardship of common property resources is one of the most challenging responsibilities with which Alaska's government is charged. Our state Constitution (Art.VIII, Sec.2) provides, "The legislature shall provide for the utilization, development, and conservation of all natural resources belonging to the State...for the maximum benefit of its people." As a member of the legislature for nineteen years I can assure you that implementing this policy so that everyone is happy is an impossible task, but it is nonetheless essential to strive for the greatest common good.

The mandate to manage natural resources for the public good is, in itself, ample reason for the legislature to ban fish farming. Even fish farm advocates agree that risks to wild stocks can be minimized but not eliminated, and that the current economic potential for fishfarming is bleak. How can we justify spending public funds to help establish an industry which could bring catastrophe to natural resources and to the state's largest private sector employer?

The small group of individuals pushing for fish farming in Alaska is quick to point out that many countries around the globe are ardently pursuing mariculture, and that Alaska should jump on the bandwagon. Does any one of these other countries boast natural fishery resources on a par with

Alaska's? On the contrary. In most cases, they've either never had significant natural stocks or their fisheries have been decimated by poor management. These countries have little to lose by experimenting with fish farming.

The development of the world's finfish farming industry has been marked by an initial period of very rapid growth, and more recently by severe economic woes including many bankruptcies and the dumping of large quantities of farmed fish on the market at a loss. Farm operations have been established long enough in many places for us to see that the industry is plagued by problems Alaska does not have now, and does not want.

Critical areas of concern include water quality, siting, and hazards to natural stocks. The degradation of water quality seems impossible for fish farms to avoid. According to a state report done in Washington, one typical fish farm using net-pens produces pollutants "equivalent to untreated sewage from approximately 10,000 persons." Pollutants are also laced with hormones and antibiotics given to the fish; these are believed to pose a serious threat to the public health by producing antibiotic-resistant bacteria in the human food chain. Over time, in a single site, tons of oxygen-demanding waste are produced. Complaints about pollution from salmon farms are cropping up in Ireland, Norway and Canada. Fish farms contributed to the pollution which likely was a key factor in the frightening killer-algae-bloom which destroyed all marine life in its path when it swept

through the North Sea in 1988. Maintaining the quality of the marine environment along our coasts is something in which most Alaskans have a stake.

The location of fish farms has sparked bitter public debate in places like Puget Sound. Even in Alaska a limited number of sites possess the features desirable for fish farms: accessibility, protection from heavy wave action, good flushing action, availability of a fresh water source, a good distance from anadromous fish streams, and so on. Many of these same attributes are desired for other uses: shellfish farms, hatcheries, recreation, boat moorage, residential development, etc. Conflict over siting is inevitable.

Perhaps the most unsettling of the potential dangers of fish farming center around the problems of fish disease, accidental escapement, and genetic intermingling.

These are serious concerns even in Norway, where mariculture is "state of the art" and fish farmers have access to extensive subsidized technical expertise. Fish escaping from pens pose a threat even if the renegade fish are free of disease. Renegade salmon may compete for space in a river inhabited by natural stocks, and inbreeding can weaken the qualities which suit a fish to life in the wild (such as the ability to migrate).

In Norway the escapement of large numbers of fish infected with a deadly disease has threatened wild stocks. Fish biologists there have concluded that disease in farms can lead to higher rates of infection in the vicinity of the net