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FOREWORD

This report on Marine Resources and Aquaculture Programs in the State of Hawaii was prepared in response to Senate Resolution No. 186, adopted during the 1978 legislative session.

The report traces the role of the ocean and the practice of aquaculture in ancient Hawaii, and the surge of interest in marine and aquaculture affairs since the publication of Hawaii and the Sea in 1969; and sets forth the present status of the marine resources and aquaculture programs in Hawaii's state government.

The report was initiated, organized, and conducted by Lloyd K. Migita of the Office of the Legislative Reference Bureau until his departure from the Bureau. In mid-1982, Ann M. Oyata of the Bureau was assigned to update and complete the report.

We wish to express our sincere appreciation and gratitude to the following individuals for providing us with personal interviews and information required in the course of this study: Dr. John Craven, Chairman of the Marine Council, University of Hawaii; Dr. Noel P. Kefford, Dean of the College of Tropical Agriculture and Human Resources, University of Hawaii; Rose T. Pfund, Acting Associate Director of the Sea Grant College Program, University of Hawaii; Kent M. Keith, Deputy Director of the Department of Planning and Economic Development; Edgar A. Hamasu, Deputy Director of the Department of Land and Natural Resources; John S. Corbin, Manager of the Aquaculture Development Program, Department of Land and Natural Resources; Henry M. Sakuda, Director of the Division of Aquatic Resources, Department of Land and Natural Resources; Paul Y. Kawamoto, Chief of the Fisheries Branch, Department of Land and Natural Resources; Eugene S. Imai, Administrative Services Officer, Department of Agriculture; Wilbert Kubota, Food and Drug Inspector, Department of Health; Harry Murakami, Chief Engineer of the Harbors Division, and Staff, Department of Transportation; Artemio Delos Reyes, Section Head of Property Management of the Harbors Division, and Staff, Department of Transportation; David E. Parsons, State Boating Manager of the Harbors Division, Department of Transportation; Dennis E. Ruthrauff, Oahu District Manager of the Harbors Division, Department of Transportation; and Clarence Okamura, Assistant Chief for Administration of the Harbors Division, Department of Transportation.

Samuel B. K. Chang
Director

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SUMMARY

This report, Marine Resources and Aquaculture Programs in the State of Hawaii, identifies and sets forth the marine and aquaculture programs of the State Departments of Agriculture; Land and Natural Resources; Planning and Economic Development; Health; Transportation; and the University of Hawaii. It touches as well upon the significance of the ocean in ancient Hawaii, and upon the early practice of aquaculture by the Hawaiians.

The report finds that substantial strides have been made in recent years by the State in defining and implementing its goals in these important areas of industry, and that no major reorganization of state programs is necessary at this time.

The report makes two recommendations to the Legislature to further the realization of the State's goals in these areas:

- (1) The statutory designation of the Department of Land and Natural Resources as the lead agency for aquaculture; and
- (2) The statutory creation of an Aquaculture Coordinating Advisory Council and an Ocean Resources Coordinating Advisory Council.

Chapter 3

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Part I. Findings

Senate Resolution No. 186 of 1978 was based upon the premise that the fragmentation of marine resources and aquaculture programs among various state departments and agencies could only lead to "a duplication of effort and possible conflicts regarding priorities, goals, and implementation."¹ The Resolution focused upon one possible solution to these concerns: the creation of a new State Department of Marine Resources and Aquaculture.

In performing this study, the Office of the Legislative Reference Bureau determined that a more useful approach would consist of first ascertaining whether the fragmentation of functions and activities in these areas constituted a problem in need of a solution.

The Bureau's findings on the issue of fragmentation are as follows.

1. Some fragmentation of programs is inevitable.

Hawaii's executive departments are grouped according to a mixture of functions and subject areas. Under this kind of organizational strategy, some fragmentation is inevitable. For example, departments organized according to broad functional responsibilities such as the Department of Planning and Economic Development, which by statute is charged with the development and promotion of industry (including fisheries development), and tourism,² will sometimes overlap the activities of other departments organized by subject area, such as the Department of Land and Natural Resources, which is charged with the management of the State's fisheries resources.³

2. Programs dealing with major natural resources tend toward diffusion.

Generally, it appears that programs dealing with major natural resources such as land or the ocean tend to be diffused to a greater extent than other subject area programs. In the case of land, a large number of state departments are involved in some aspect of land development, management, regulation, or conservation. For example, the Department of Land and Natural Resources manages conservation lands; the Department of Planning and Economic Development is involved with land use management and coastal zone management; the Department of Health administers sanitation, solid waste, and other land pollution abatement programs; the Department of Hawaiian Home Lands manages Hawaiian Homes Commission Act lands; and the Department of Land and Natural Resources and the Department of Agriculture cooperatively implement the agricultural park program.

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3. Major organizational and reorganizational efforts have taken place since the adoption of Senate Resolution No. 186-78.

- (a) Establishment of the Hawaii Fisheries Coordinating Council. The Hawaii Fisheries Coordinating Council was established by Act 282 of the 1980 legislative session,⁴ for the purpose of advising the Board of Land and Natural Resources on fisheries matters and coordinating fisheries activities among the various federal, state, and county agencies and private industry.

The Council is charged with advising the Board of Land and Natural Resources on matters relating to fisheries development including:⁵

- (1) Proposing and preparing programmatic fisheries development plans and policies;
 - (2) Coordinating all state fisheries activities as they relate to the federal and county governments, public and private organizations, and commercial enterprises;
 - (3) Coordinating state agency requests for federal grants and technical assistance;
 - (4) Promoting communication between industry and government sectors, including the consideration of problems, requirements, and available financial and technical assistance;
 - (5) Performing such services as may be required by the Governor and the Legislature; and
 - (6) Preparing and submitting an annual report to the Governor and the Legislature prior to each regular session.
- (b) Transfer of the Aquaculture Development Program to the Department of Land and Natural Resources. The Aquaculture Development Program was transferred by the Governor from the Department of Planning and Economic Development to the Department of Land and Natural Resources in January 1981 to consolidate state aquaculture activities. Administratively, the Program was placed in the Office of the Chairman of the Board of Land and Natural Resources.

This transfer was consistent with a major recommendation of the State's aquaculture development plan, Aquaculture Development for Hawaii: Assessment and Recommendations, which set forth the need for a permanent aquaculture lead agency to consolidate efforts and provide a focal point to promote and expedite the development of aquaculture production in Hawaii.⁶

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The Plan listed three important requirements to be considered in determining the most suitable lead agency for aquaculture: (1) involvement in economic development, (2) functions compatible with aquaculture and involvement with fisheries, natural resource management, and/or food production, and (3) adequate facilities and support services. The Plan found that the Department of Agriculture and the Department of Land and Natural Resources were the most logical candidates for lead agency, with no distinct advantage in selecting one department over the other.⁷

- (c) Reorganization of the Department of Land and Natural Resources' responsibilities in fisheries, wildlife, and enforcement into separate divisions. This reorganization was accommodated by Act 85 of the 1981 legislative session.⁸ Act 85 restructured Title 12 of the Hawaii Revised Statutes, Conservation and Resources, to: (1) transfer the management of terrestrial animals from the Division of Fish and Game to the Forestry Division, which was redesignated as the Division of Forestry and Wildlife, and (2) redesignate the Division of Fish and Game as the Division of Aquatic Resources.⁹

The Division of Aquatic Resources administers the State's programs in commercial fisheries and aquaculture, aquatic resources and habitat protection, and aquatic recreation. Act 85 defined "aquatic life" to mean "any type of species of mammal, fish, amphibian, reptile, mollusk, crustacean, arthropod, invertebrate, coral, or other animals that inhabit the freshwater or marine environment", including any part, product, egg, or offspring thereof; or freshwater or marine plants,¹⁰ including seeds, roots, and other parts thereof. This definition brings marine as well as aquacultural resources under the jurisdiction of the Division, in accord with the State's efforts to consolidate aquaculture activities.

- (d) Transfer of the functions of the Marine Affairs Coordinator to the Department of Planning and Economic Development. Act 302 of the 1980 legislative session transferred the Office of the Marine Affairs Coordinator to the Department of Planning and Economic Development for administrative purposes.¹¹ Act 281 of the 1982 legislative session abolished the Office and transferred all rights, powers, functions, duties, and positions of the Office of the Marine Affairs Coordinator to the Department of Planning and Economic Development.¹²

These powers and duties include the following:¹³

- (1) Develop plans, including objectives, criteria to measure accomplishments of objectives, programs through which the objectives are to be attained, and financial requirements for the total and optimum development of Hawaii's marine resources, including plans, objectives, and criteria for the expenditure of State matching funds

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for federally funded projects based on the needs and goals of the State;

- (2) Conduct systematic analysis of existing and proposed marine programs, evaluate the analysis conducted by the agencies of state government, and recommend to the Governor and the Legislature programs which represent the most effective allocation of resources for the development of the marine environment;
- (3) Assist those departments having interests in marine affairs, coordinate those activities which involve the responsibilities of multiple state agencies, and insure the timely and effective implementation of all authorized marine projects and programs;
- (4) Establish a continuing program for informing the federal government, other state governments, governments of nations with interests in the Pacific basin, private and public organizations involved in marine science and technology, and commercial enterprises of Hawaii's leadership potential as the center for marine affairs;
- (5) Coordinate the State's involvement in national and international efforts to investigate, develop, and utilize the marine resources of the Pacific basin;
- (6) Develop programs to continuously encourage private and public marine exploration and research projects which will result in the development of improved technological capabilities in Hawaii; and
- (7) Formulate specific program and project proposals to solicit increased investment by the federal government and other sources to develop Hawaii's marine resources and coordinate the preparation and submission of program and project proposals of State agencies.

The Conference Committee report attached to Act 281 stated that "Your Committee finds that if Hawaii is to capitalize on the immediate and long-term opportunities to develop and utilize marine resources, the total efforts of the State's planning, research, development, and promotion of the marine environment need to be effectively addressed."¹⁴

To implement Act 281, the Department of Planning and Economic Development has proposed establishing an Office of Ocean Resources, under the supervision of the Director of Planning and Economic Development, to bring a coordinated approach to marine activities in the State, and to ensure that Hawaii derives maximum economic and societal benefits from its surrounding marine environment.¹⁵

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The Office would assume the former functions of the Office of the Marine Affairs Coordinator transferred by Act 281.¹⁶

4. Masterplans in the areas of aquaculture and commercial fisheries have been completed and are being implemented; an ocean management plan is nearing completion.

The State's aquaculture masterplan, Aquaculture Development for Hawaii: Assessments and Recommendations, has been in the process of implementation by the Aquaculture Development Program since January 1979. A major recommendation of the State's commercial fisheries masterplan, Hawaii Fisheries Development Plan, was the legislative establishment of the Hawaii Fisheries Coordinating Council in 1980.

A draft of the State's new ocean management plan is now being circulated by the Department of Planning and Economic Development's Hawaii Coastal Zone Management Program for review to various state and federal agencies. It is intended to provide consistency in management by setting forth objectives and policies, and could also provide a forum for conflict resolution as well as for the determination of priorities relating to ocean resources. The draft resulted from ten issue papers on fisheries management, marine conservation and preservation, mariculture, ocean thermal energy conversion, coastal energy facilities, harbors development, beach erosion, near-shore recreation, ocean dumping, and manganese nodule mining.¹⁷

Part II. Conclusions

The Bureau's conclusions are as follows.

1. The creation of a new State Department of Marine Resources and Aquaculture would not necessarily remedy any problems allegedly caused by the present organizational structure of the State's marine resources and aquaculture programs. A system to coordinate existing programs would effect a less disruptive yet effective alternative.

It appears that the major problem allegedly caused by the present organization of programs is one of coordination among the state departments having marine resources and aquaculture programs. Even with a new department, constant coordination efforts would be required among the state departments to maximize the benefits of the State's marine resources and aquaculture programs.

Many of the existing marine resources and aquaculture programs are so closely tied to major functions and expertise of existing departments that to separate them and place them in a new department would create more problems of coordination than previously existed. For example, health and sanitation concerns would still have to be addressed by the Department of Health, and

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water and land development and land management issues would still need to be directed to the Department of Land and Natural Resources.

It is therefore neither necessary nor desirable to include all related programs that are diffused throughout the state government and that require policy, program, and procedural coordination, or technical assistance, into a new department of marine resources and aquaculture at this time. What is needed is a means of achieving such coordination while leaving existing programs in those locations where they can be administered most effectively.

2. The creation of a new State Department of Marine Resources and Aquaculture would be premature at this time.

The projections of the growth of the State's aquaculture industry have not been fulfilled, and the manganese nodule mining and ocean thermal energy programs are still in early stages of their development. Regarding commercial fisheries, Hawaii has historically ranked near the bottom among coastal states in terms of commercial fish landings, consequently requiring importation of most of its seafood products. Until these and other major marine industries have evolved, stabilized, and realized their full potential, the creation of a new department would be premature. This, of course, is not to dismiss the possibility that a new department may be justified at some later date.

3. Duplication and overlapping of functions and activities are not necessarily signs of waste and inefficiency; undesirable duplication and the possibility of conflicts have diminished since adoption of Senate Resolution No. 186-78.

In 1969, Martin Landau first alerted administrative scientists to the benefits of redundancy and overlapping in administrative organizations. He found that:¹⁸

At one and the same time, thus, redundancy serves many vital functions in the conduct of public administration. It provides safety factors, permits flexible responses to anomalous situations and provides a creative potential for those who are able to see it. If there is no duplication, if there is no overlap, if there is no ambiguity, an organization will neither be able to suppress error nor generate alternate routes of action. In short, it will be most unreliable and least flexible...

"Streamlining an agency," "consolidating similar functions," "eliminating duplication," and "commonality" are powerful slogans which possess an obvious appeal. But it is just possible that their achievement would deprive an agency of the properties it needs most--those which allow rules to be broken and units to operate defectively without doing critical injury to the agency as a whole. Accordingly, it would be far more constructive, even under conditions of scarcity, to lay aside easy slogans and turn attention to a principle which lessens risks without foreclosing opportunity.

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Much of the undesirable and unnecessary duplication of efforts which was the impetus for adoption of Senate Resolution No. 186-78 has been alleviated by the organizational and reorganizational changes which have taken place since 1978.

The possibility of conflicts regarding priorities, goals, and implementation has also diminished with the publication of masterplans in the areas of aquaculture and commercial fisheries, which provided overall implementation guidelines for the State's programs in these areas by providing a structure in which all program components were identified, guidelines for development were formed, required financial resources were determined, and implementation schedules were developed.

4. The establishment of coordinating advisory councils would provide mechanisms for information exchange and aid the State's efforts towards coordination of programs.

Coordinating advisory councils composed of federal, state, and county government officials and individuals in private industry knowledgeable in the fields of ocean resources and aquaculture could advise the state departments with lead agency responsibilities on all matters relating to aquaculture and ocean resources, and generally promote communication between industry and government, and among governmental agencies. In particular, private industry council members can provide direct external review of the effectiveness of the State's programs. The importance of interaction with private industry was recognized in Hawaii and the Sea--1969:¹⁹

For the State to advance boldly and wisely in the marine field, it must go outside the State Government to get advice on a regular basis from highly knowledgeable people having strong interests in a broad range of marine activities...

In the relatively short time the Task Force has existed, it has made a number of important recommendations and contributions to the State's marine effort.

Part III. Recommendations

The State has made great strides in the past four years in defining and implementing its goals in the areas of marine resources and aquaculture. The benefits of these first steps, however, can only be enhanced by further action. Therefore, the Bureau makes the following recommendations to the Legislature:

1. The Department of Land and Natural Resources should be statutorily designated as the lead agency for aquaculture.

Although the Aquaculture Development Program and the Aquatic Resources Division of the Department of Land and Natural Resources have

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been assigned the responsibilities necessary for the overall implementation and management of the State's aquaculture program, the statutory designation of the Department of Land and Natural Resources as the State's lead agency for aquaculture will clarify the Department's role as the agency with foremost responsibility for aquacultural activities.

2. An Aquaculture Coordinating Advisory Council and an Ocean Resources Coordinating Advisory Council should be established by statute.

Although informal coordinating committees in each of these areas presently exist,²⁰ statutory establishment of these two bodies will clearly set forth their powers, duties, and membership. Official establishment of the coordinating advisory councils is also important because of the number of members which should be included at a minimum, and to assure the performance of duties.

At a minimum, state departments with responsibilities in the field of aquaculture should be represented on the Aquaculture Coordinating Advisory Council, including the Department of Agriculture, the Department of Land and Natural Resources, the Department of Health, the Department of Hawaiian Home Lands, the Department of Planning and Economic Development, and the University of Hawaii; and state departments with ocean-related responsibilities should be represented on the Ocean Resources Coordinating Advisory Council, including the Department of Land and Natural Resources, Department of Planning and Economic Development, Department of Health, Department of Transportation, and the University of Hawaii.

Legislation appropriately patterned after Act 282 of the 1980 legislative session, which established the Hawaii Fisheries Coordinating Council, will additionally assure membership of the various industries and county government officials, and an annual report to the Governor and the Legislature.

Logically, the Aquaculture Coordinating Advisory Council should be administratively attached to the Department of Land and Natural Resources; and the Ocean Resources Coordinating Advisory Council to the Department of Planning and Economic Development.

Some relationships between pathogenic bacteria and
salmon net pen culture

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

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

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

outbreaks (Håstein, 1986).

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

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

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

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

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

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

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

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

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

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

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Otter Sea Farms

BLUE MUSSEL MARICULTURE

IN

KACHEMAK BAY, ALASKA

by

JAMES E. AND NANCY HEMMING

OTTER SEA FARMS

November 1984

With partial support from the Alaska Office of Commercial Fisheries
Development

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INTRODUCTION

The blue mussel (Mytilus edulis) is probably the most common shellfish on beaches from Ketchikan to Bristol Bay, Alaska. In recent years the human consumption of this species in Alaska has been relatively low, perhaps due to fear of paralytic shellfish poisoning (PSP) that results from an occasional red tide or, more likely, because people are generally unaware of the gastronomic qualities of this gourmet species.

In 1982, the Alaska Office of Commercial Fisheries Development contracted Otter Sea Farms to study the feasibility of growing blue mussels, in Halibut Cove Lagoon near Homer, Alaska with the primary objective of assessing the potential of blue mussel aquaculture as a new commercial enterprise in Alaska. This report describes the techniques that were tested for raising mussels in commercial quantities. Included is a market assessment for southcentral Alaska and an evaluation of the regulatory process and its potential influence on shellfish aquaculture in Alaska.

THE AREA

The blue mussel culture project is located in Halibut Cove Lagoon. The lagoon is situated on the south side of Kachemak Bay approximately eight miles from the Homer Spit (Figure 1). The majority of land surrounding the lagoon is in State of Alaska ownership as part of Kachemak Bay State Park. A state cabin and warehouse and a private cabin are located at the head of the lagoon. These facilities, plus the cabin and warehouse associated with Otter Sea Farms, constitute the only development in the lagoon.

The lagoon itself is essentially a fjord with high, steep, rocky sides and an incised bottom configuration. The mouth of the lagoon is shallow with tidal rapids and, at low tide, the connection with Kachemak Bay is extremely narrow, bounded on the west by a rocky hillside and on the east by extensive

Table 2: Permits for Culture and Sale of Blue Mussels in Kachemak Bay, Alaska.

<u>Authorization</u>	<u>Agency</u>
Alaska Business License	Alaska Department of Revenue
Clam Shovel Permit	Commercial Fisheries Entry Commission
Section 10 Permit	U.S. Army Corps of Engineers
Critical Habitat Permit	Alaska Department of Fish and Game
Tidelands Lease	Alaska Department of Natural Resources
Section 401 Water Quality Certification	Alaska Department of Environmental Conservation
Paralytic Shellfish Poisoning Certification	Alaska Department of Environmental Conservation
Coastal Management Consistency Determination	Office of Management and Budget
Shucker-shipper Permit	Alaska Department of Environmental Conservation

CONCLUSIONS

1. A good mussel mariculture site should include:
 - close proximity to large populations of wild mussel seed stock.
 - protection from heavy wave action.
 - no winter ice.
 - excellent water circulation.
 - nutrient and plankton-rich waters.
 - excellent water quality.
 - proximity to transportation to market.
2. The raft/sock net culture technique appears to be more promising than the long line system of mussel culture.
3. PSP levels in Halibut Cove Lagoon have remained well below the toxic threshold; however, it will be necessary to test each shipment of marketable mussels to meet ADEC requirements. PSP should not limit commercial operation.
4. Given the relatively short shelf life of live mussels, the present method of PSP testing will decrease the usable time available to buyers by 24 to 36 hours. A quick, in situ test needs to be developed.
5. Locations for blue mussel mariculture installations must be in areas where no pollutants from industrial sources (including fish processing), domestic sewage, or petroleum products exists.
6. The current regulatory framework within the state is not equipped to handle shellfish aquaculture. Changes in, or additions to, existing statutes and regulations must occur in order to protect the mussel grower and his product.

7. Profitable mussel culture requires good growing conditions, low cost labor, efficient spat collection, and mechanized harvest methods.

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EARTHWATCH

Farming the seas, says Walter Adey, could double the world's food supply

THE BLUE REVOLUTION

BY KAREN MCGLATHERY



IMAGINE THE OCEAN as a huge field where millions of square miles could be used for growing and harvesting enormous quantities of food, with no polluting effects. This vision is hardly new. When the "green revolution" failed twenty-odd years ago and we first realized the land's limited capacity for food production, people turned with hungry eyes to the open seas, covering nearly three-fourths of the earth's surface. But scientists concluded that, with the exception of relatively small coastal areas and coral reefs, the ocean is a biological desert, incapable of massive food production. And so, says Walter Adey, "In the vast and alien oceans we are still the same hunter-gatherers that we were on land ten thousand years ago."

Dr. Adey, director of the Smithsonian Institution's Marine Systems Laboratory, is the architect of an ingenious new mariculture technique that challenges the conclusions of earlier researchers and suggests that large-scale farming in the open ocean is not only feasible but cost-effective. His system is based on the extraordinarily rapid growth of coral-reef algae—tiny aquatic plants that can be used in turn to raise grazing crabs and other valuable seafood. It may well lead to a "blue revolution" in worldwide food production, particularly in the tropics. And it's all happening partly because one day two years ago, thanks to Walter Adey, Ronald Reagan had crab for lunch.

The window of Adey's Washington office looks across the Mall to the Capitol. He smiles and leans back in his chair as he tells the story of that lunch. His success in the field growing coral-reef algae on artificial substrates (platforms), he says, had prompted him to think about harvesting a primary grazer like the West Indian spider crab, a Caribbean delicacy

that is far more appealing to the local people than algae.

"I realized that this mariculture project had the potential of putting thousands of fishermen to work making ten times their present income, or more," he says. "But we needed money to get the project off the ground, and the government was an obvious source. So I talked with someone very high in the government—a person concerned with national security—and pointed out that since the Caribbean is a politically sensitive area, wouldn't it make sense to provide some economic support through this mariculture project—something that wasn't in the form of a gun? And I hit the right person. He asked me how much money I needed. I told him, 'A million bucks,' and he said, 'It's yours.'"

It wasn't quite that easy. The money had to be channeled through the Agency for International Development, a process that normally takes years. To cut the red tape, Adey and his friend had to get to the president, and they decided that the best way was through his stomach. Adey flew to St. Croix to buy some spider crab (also known as Caribbean king crab because it closely resembles its relative, the Alaskan king crab), and later that same day he marched up the White House steps, cooler in hand, and delivered three crabs to the chef, who agreed to make a last-minute change in the menu.

The next day's lunch was a success in more ways than one: three months later, Adey's money came through. He is now using the funds to establish, with the help of EARTHWATCH volunteers, a research laboratory on Grand Turk Island, which serves as a permanent base of operations for their mariculture work throughout the Caribbean.

THE IDEA of growing algae on artificial substrates in the open ocean had its beginnings back in the Marine Systems Lab at the Smithsonian's National Museum of

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Captain Adey and his lady have hopscoched throughout the Caribbean.

Natural History. There Dr. Adey has developed the world's first living coral-reef exhibit with more than three tons of coral rubble and over 300 species of plants and animals transported from the Caribbean. The 3,000-gallon system is kept alive by high-intensity lights, which simulate the tropical sun, and by an automatic wave generator.

When it is "night" on the reef, water circulates through nearby trays containing algae growing on screens, which are illuminated by lamps. These algal "scrubbers" simulate the flow of fresh ocean water over the reef at night by removing toxins and nutrients from the water. In the absence of natural grazers, the algae grows so fast that it must be harvested once a week; the screens are scraped and the algae regenerates from basal parts that remain intact. "A year after we set up the exhibit," says Adey, "I realized that an awful lot of algae was coming off these screens. I thought to myself, if we can do this in an artificial system, why can't we do it in the field?"

Under Adey's direction, crews of students

and EARTHWATCH volunteers have been working to perfect the technique of growing algae on artificial reefs—one-square-meter screens suspended in the water from rafts. The teams work from the Smithsonian's research vessel *Marsys Resolute*, under the command of Captain Walter Adey.

Coral reefs, those oases in the vast, nutrient-poor tropical seas, were thought to be richly productive only because they recycled nutrients so efficiently. By adjusting the screen type, water depth, light intensity, and harvest rate on his tropical algae farm, Adey has discovered that it is light, and not the tight recycling of nutrients, that is the limiting factor in coral-reef production. The algae's efficient capture of sunlight for photosynthesis and the continuous wave action together account for the productivity of both the natural and artificial reefs.

Natural reefs occur only in shallow waters, but all that is necessary to make Adey's mariculture process feasible in the open sea is a reflecting surface for the screens. "The real

difference between the open ocean and the shallow water," explains Adey, "is not the nutrients, as everyone would propose; it's not a difference in the currents, although everyone would argue about it. Light is the difference, because in the deep water you don't have return reflection; it's only what hits directly on the screens." Adey envisions future anchor stations in the open ocean with numerous mariculture rafts attached to them.

Adey's algal production results to date are nothing short of phenomenal. The highest production rate recorded for single-celled phytoplankton in the open ocean, even under the most favorable conditions, is .3 to .5 grams of dry weight per square meter per day. And this amount is spread so diffusely over a huge area that there is no economic means of harvesting it. That's what led biologists to conclude that the oceans held no hope for massive food production. But Adey is now regularly achieving rates of more than 20 grams of dry weight per square meter per day—the equivalent of ten times the productivity of good Midwestern farmland. And he predicts that productivity can be increased by another 30 to 40 percent with only a few inexpensive modifications of his technique.

ALGAE are the key to Walter Adey's plan to establish Caribbean king crab fisheries, but it's the crabs that interest the local inhabitants. Though it's a prized seafood throughout the area, the king crab has never been harvested on any significant scale because it lives in the coral reef's deep crevices and comes out only at night to feed. It's not economically feasible to dive for the crabs; fishermen simply capitalize on the occasional stray that shows up in their lobster pots. The crabs bring \$4 a pound at the dock.

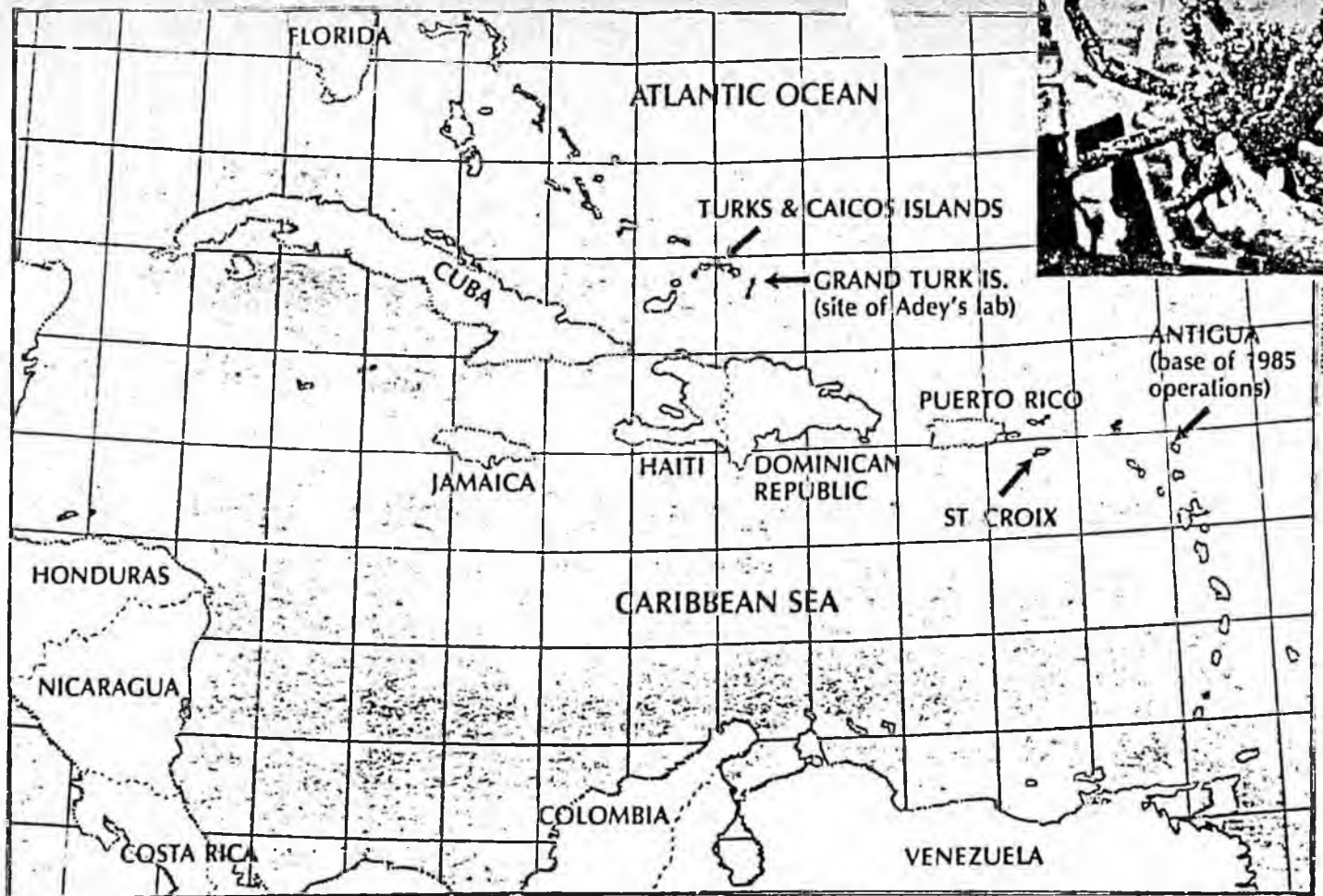
Getting the crab's end of the mariculture project started was no easy job. It took three months for Adey's dive crew to locate enough crabs to start a hatchery at the marine lab on Grand Turk. When the crabs reach adolescence they are placed on the algal screens for fattening up; it then takes about a year for them to grow to edible size. It's possible that crabs raised in this way could satisfy the demand created by the now-collapsed Alaskan king crab market, which had reached \$150 million per year, without the threat of overfishing or environmental degradation.

Support for Adey's work has come from all levels from the fishermen to the government, although in at least one case the traditional sex roles of the local culture have presented an obstacle. "It's Governor Chris Turner's personal feeling," says Adey, "that the Turks and Caicos fishermen are too macho and won't accept the process when they realize it's farming. Only women are supposed to farm, so they'll be the ones who end up doing the work—but in that culture the women won't go on the water."

Adey has agreed to try to adapt the process for use on land, and is experimenting with a series of terraced algal screens for the grazing crabs. He is not convinced, however, that the



Volunteers scrape the algae harvest off a screen that has been suspended from a floating platform made of plastic plumbing pipe, while a video cameraman records the process for a recent Smithsonian TV documentary on Adey's mariculture project.



An experienced navigator, Adey steers *Marsys Resolute* on a safe course in tricky seas.

land-based version will prove economical because of the large amounts of energy it requires.

Walter Adey is a maverick. He has succeeded in challenging assumptions that have been part of accepted biological theory for decades, and he is changing people's ideas about what drives the coral-reef ecosystem. He's been at this for years, but now people are finally

listening. "It's interesting the way modern science works," he says. "It's become more group science. In the first place, the review and publication processes are such that you're not going to have any money to work with or have your ideas published unless you get people to agree with you. When you're challenging the basics that people have accepted all their lives it's exceedingly difficult to get

Adey first tested turf algae's productivity at sea off Mayaguana. Last year's teams established a crab hatchery on Grand Turk (where Adey's laboratory is) and raised crabs at sea. This season Adey will expand crab—and possibly whelk—mariculture to Antigua.

the support you need. The result is that innovation is hard to come by. The problem of modern science is to find a way to allow innovation to get back into the research endeavor."

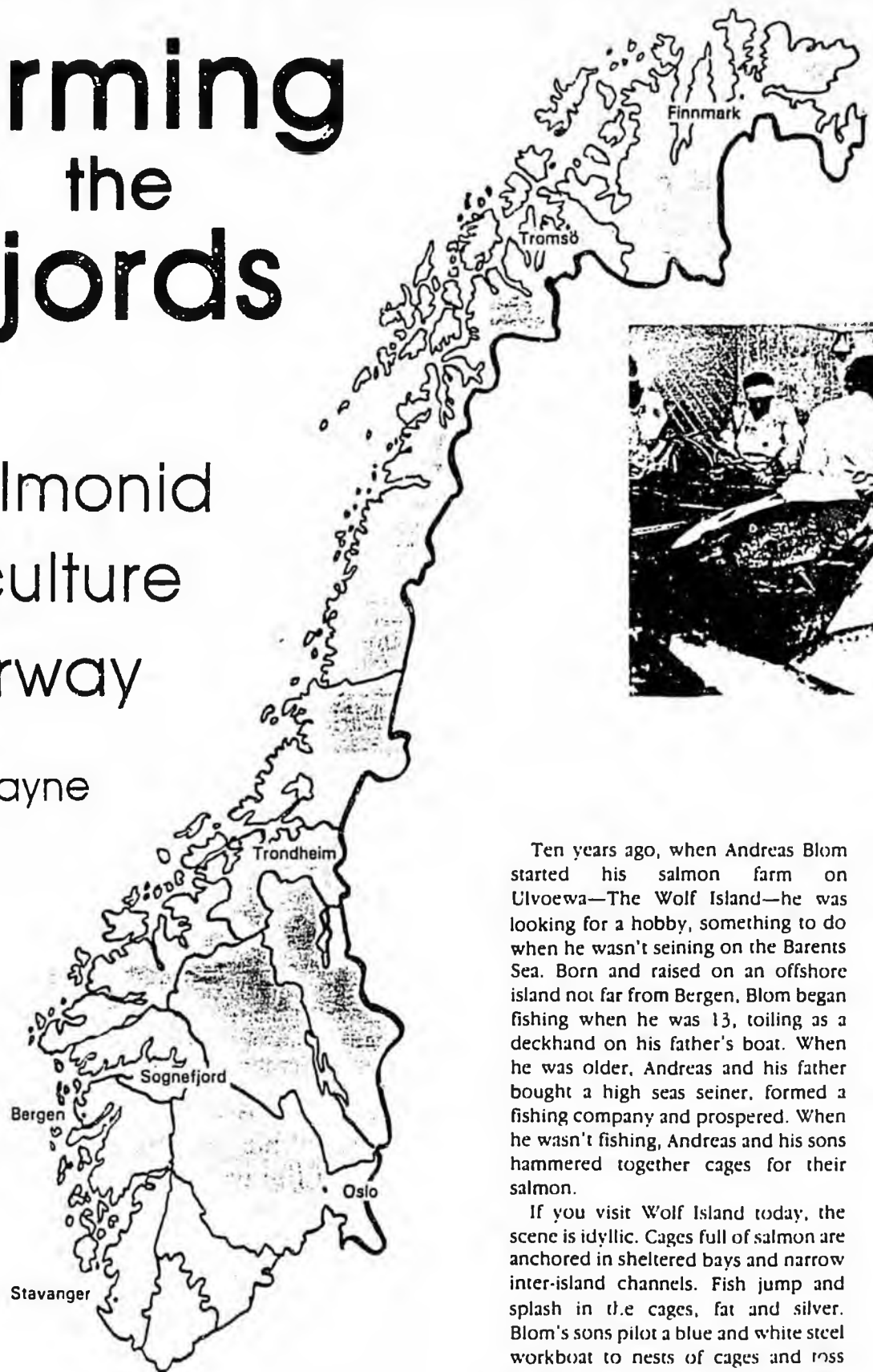
Adey plans to extend his research project throughout the Caribbean and into Central America, where several governments have expressed strong interest. His work has attracted the attention of officials in Antigua, the Dominican Republic, and Belize, among others. The Grand Turk marine lab and hatchery will also become a training center for fisheries officers and fishermen, and Peace Corps volunteers have been enlisted to help in the training program. Adey and his staff are expanding the research to include other edible organisms, including the whelk, parrotfish, and sea urchin, and there are many other possibilities.

Adey says his mariculture process is feasible anywhere in the tropics in the trade-wind belt of 5 to 30 degrees north latitude, and the same in the south—an enormous chunk of the ocean. There's even the potential to adapt the technique for temperate waters. "If we work out the bugs so that we can do it everywhere," says Adey, his eyes sparkling, "we are talking about doubling or tripling the world food supply." ⊕

Farming the Fjords

Salmonid Aquaculture in Norway

by Peter Redmayne

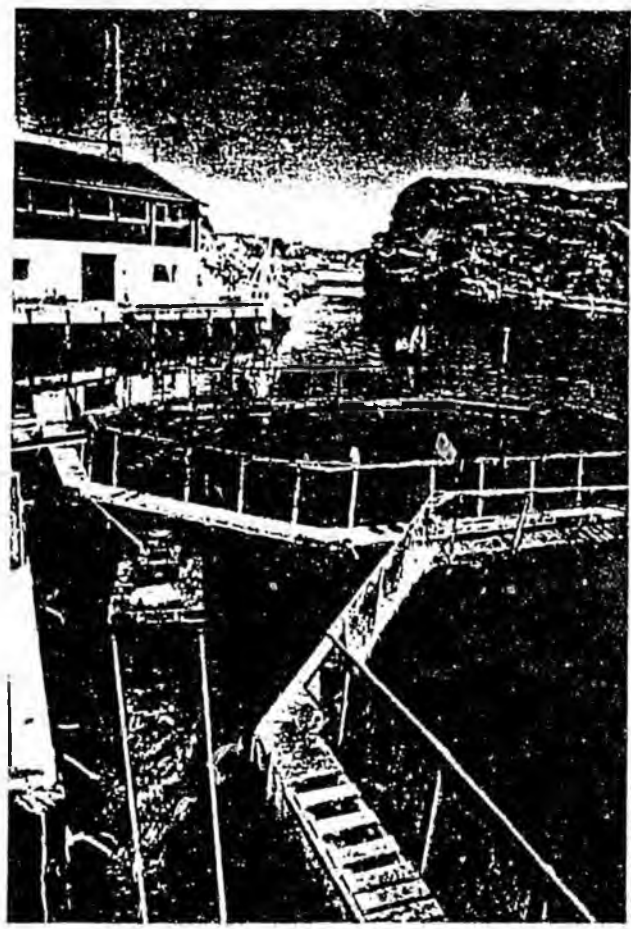


Ten years ago, when Andreas Blom started his salmon farm on Ulvoewa—The Wolf Island—he was looking for a hobby, something to do when he wasn't seining on the Barents Sea. Born and raised on an offshore island not far from Bergen, Blom began fishing when he was 13, toiling as a deckhand on his father's boat. When he was older, Andreas and his father bought a high seas seiner, formed a fishing company and prospered. When he wasn't fishing, Andreas and his sons hammered together cages for their salmon.

If you visit Wolf Island today, the scene is idyllic. Cages full of salmon are anchored in sheltered bays and narrow inter-island channels. Fish jump and splash in the cages, fat and silver. Blom's sons pilot a blue and white steel workboat to nests of cages and toss shovelfuls of ground up capelin and krill from loaded wheelbarrows into the water, boiling with frenzied feeders. When the fish are fat and the market is right, salmon are carefully removed



Bengt Wilson AS



Peter Redmayne

Boxing Tokyo-bound salmon at A/S Mowi: Disposable diapers and a Copenhagen connection (far left). Andreas Blom's Wolf Island fish farm: After seining in the Barents Sea, a vote for the domestic life. In the foreground, Swedish technology creates an artificial current to keep the cages clean (left). Frozen blocks of krill and capelin, ground up and mixed with a binder, moist diets are preferred by about half of Norway's fish farmers (below).

from the cages, anesthetized and dispatched with a quick severing of an artery behind their gills.

Salmon are dressed on spotless stainless steel in a cement processing building a hundred yards down the shoreline from Blom's home. A poster, provided by the Norwegian government, hangs on the wall detailing the do's and don't's of fish handling. With the help of his two daughters and three sons, the fish are packed on ice in styrofoam boxes and ferried to a lorry which will deliver the fish to a SAS jet at the Bergen airport. Within 24 hours, after changing planes in Copenhagen, Blom's salmon may be served at a gourmet restaurant in Tokyo, New York or Paris. Farmed Atlantic salmon from Norway is even served in Seattle, home of the Alaskan salmon industry. It's expensive fish, but customers say the quality makes it all worthwhile.

For Andreas Blom, salmon farming has turned into something more than a hobby. The Blom family have their



Bengt Wilson AS

hands full with a backyard business that grosses over half a million dollars a year.

Norwegians will tell you Blom's is a model farm, producing about 100 tons of Atlantic salmon a year. Almost 400 fish farms are scattered along Norway's long fragmented coast from Rogaland in the south, to Finnmark, north of the Arctic Circle. Norway's unique geography makes the country ideal for development of a large fish farming industry. The Gulf Stream arcs along much of the coast, warming the ocean water and keeping the countless coastal bays ice-free through the long dark winters. Offshore islands punctuate the coast, offering fish farmers protection from the winter storms marching in from the Atlantic Ocean with monotonous regularity.

Fish farming in Norway dates back to 1912, when the Norwegian government gave the go ahead to permit sea farming of rainbow trout. The industry faltered when the cages kept breaking apart and the fish escaped. Perhaps, a Norwegian newspaper suggested at the time, the fish farmers should try oysters since they would be less likely to escape from the fragile cages. The next serious attempts at farming in the ocean occurred in the late 1950s and early 1960s, again with rainbow trout. A strain bred by a University of Washington professor, Dr. Lauren Donaldson, seemed to adapt especially well and fish farming in Norway began in earnest.

While rainbows have been



Bengt Wilson AS

successfully farmed in the sea, the fish have yet to find a marketing niche outside of Norway, although many gourmets will tell you they prefer the flesh of sea farmed rainbows to farmed Atlantic salmon. The problem, says Johan Muri, Director of the Norwegian Export Committee for Fresh Fish, is the sea farmed rainbows (marketed as "salmon-trout" by the Norwegians) have been mistaken for the small (single-serving) rainbow trout which are farmed in freshwater in great quantities by such European countries as Italy, France and Denmark. Norwegian "salmon-trout" are bigger, weighing between 5-10 pounds. But size, Muri concedes, isn't the only problem the Norwegians have encountered trying to export their big rainbows.

Freshwater trout farmers on the European continent have no desire to compete with the Norwegians and they have persuaded the European Economic Community to impose a stiff tariff on Norwegian ocean trout. Finding themselves on the outside



looking in (Norway has declined to join the Common Market), Norwegian fish farmers began raising Atlantic salmon—a fish that has turned out to be considerably easier to market.

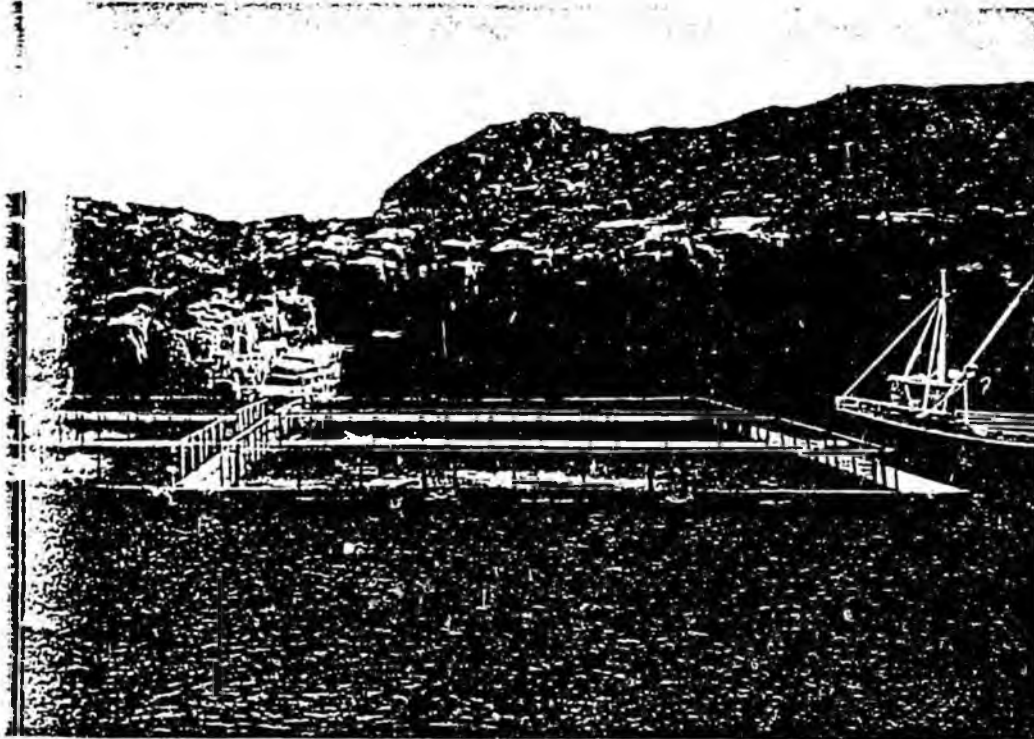
Although Atlantic salmon have only been intensively farmed for the last ten years and the technology involved in domesticating them is still in its infancy, Norway's production of farmed Atlantic salmon is impressive. In ten years, production has increased ten-fold.

By 1977, Norway's fish farmers produced more salmon than trout. And by the end of 1982, when production should reach 12,000 tons, Norway's production of farmed



Cold-smoked salmon slices on the table at a food editor's banquet in Bergen: About half of Norway's farmed salmon is sold to European smokers (far left). A/S Mowi's Veloey farm: Fences across a bay and a thousand tons of salmon a year (left). Salmon feeding time at the Blom farm: For now, shovels and a wheelbarrow . . . next, computer-operated, solar-powered mechanical feeders (below).

Peter Redmayne



Peter Redmayne

Atlantic salmon will exceed the total world catch of wild Atlantic salmon. In the next three years production is expected to triple again. Once it is convinced the markets are there, Oslo is expected to lift the lid on the number of salmon farming permits, increasing the number of fish farms by 50%.

"I am optimistic," says Thor Mowinkel, Managing Director of A/S Mowi, Norway's largest salmon farm, "and see no reason why Norway should not be able to produce and sell 100,000 tons of Atlantic salmon. The markets must be prepared for this increase and it cannot be done overnight."

So far, markets have not been a

limiting factor for the salmon farmers. They can sell every fish they grow for about twice the price of troll-caught Pacific salmon. A shortage of salmon smolts has been more of a problem than a shortage of markets.

On its way to market, most of Norway's farmed salmon passes through Bergen, a city with a long tradition of fish trading. At one time Norway's capital and now the country's second largest city, Bergen boomed after the arrival of the Hanseatic traders in the 14th century. For the next two centuries, "the city between the mountains and the sea" controlled commerce in northern Europe. Salt cod, brought down from

the north of Norway in ships rigged with one large square sail, was the foundation of Bergen's early trade. Six centuries later salt cod has been replaced by salmon from Norsk fish farms bound for the populations of the European continent.

So far, the bulk (about 85%) of Norway's farmed salmon has been bought by European smokers and gourmet restaurateurs. Until recently, observed one salmon exporter in Bergen last June, "the European market has pretty much had the Norwegians by the tail." But with production expected to triple in three years, Norwegian fish traders have been on the stump for new markets from Singapore to Seattle and have met with some success. "The Norwegians have so much production planned . . . they need the American market," the exporter said. "This year the Europeans became aware and scared by the Norwegians' ability to sell to the U.S."

Norwegians call Atlantic salmon (*Salmo salar*) "the only real salmon," as it belongs to a separate genus from the five species of Pacific salmon, *Oncorhynchus*. It was Atlantic salmon that first drew Scottish lairds across the North Sea to fish the fjords on their summer vacations. Wealthy Europeans, sailing from the continent on plush yachts followed. The steep green mountains plunging to the aqua blue sea impressed the visitors. A frequent voyager to the Sognefjord, Norway's longest fjord, Kaiser Wilhelm II was so

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Norway's Top Salmon Farm is Big Business

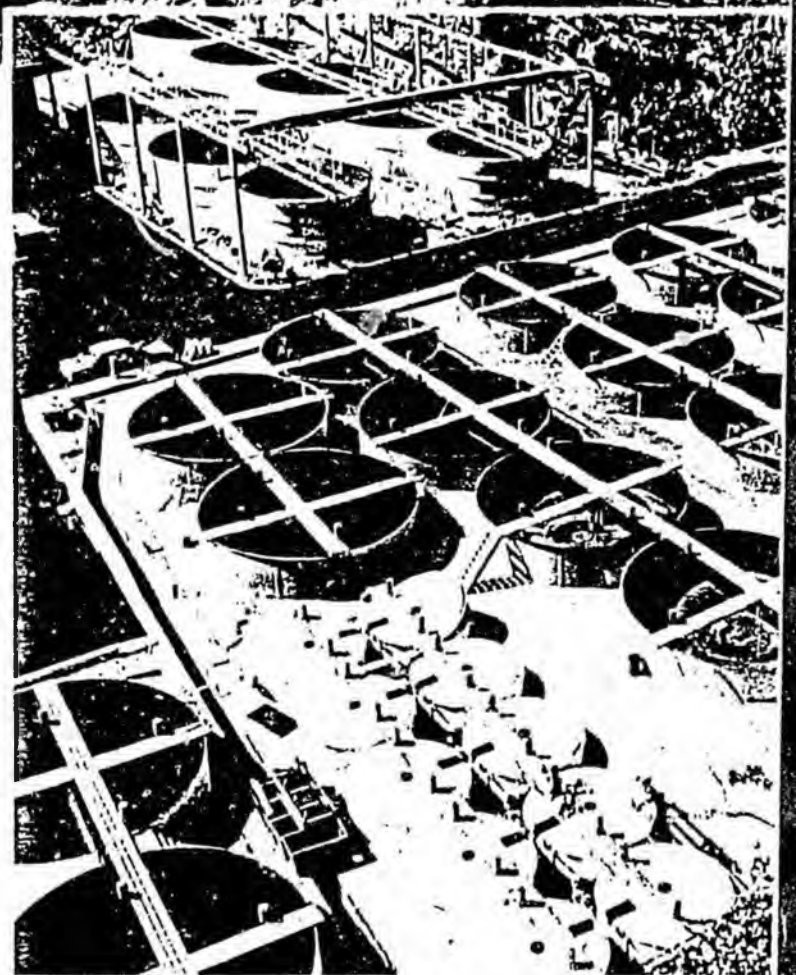
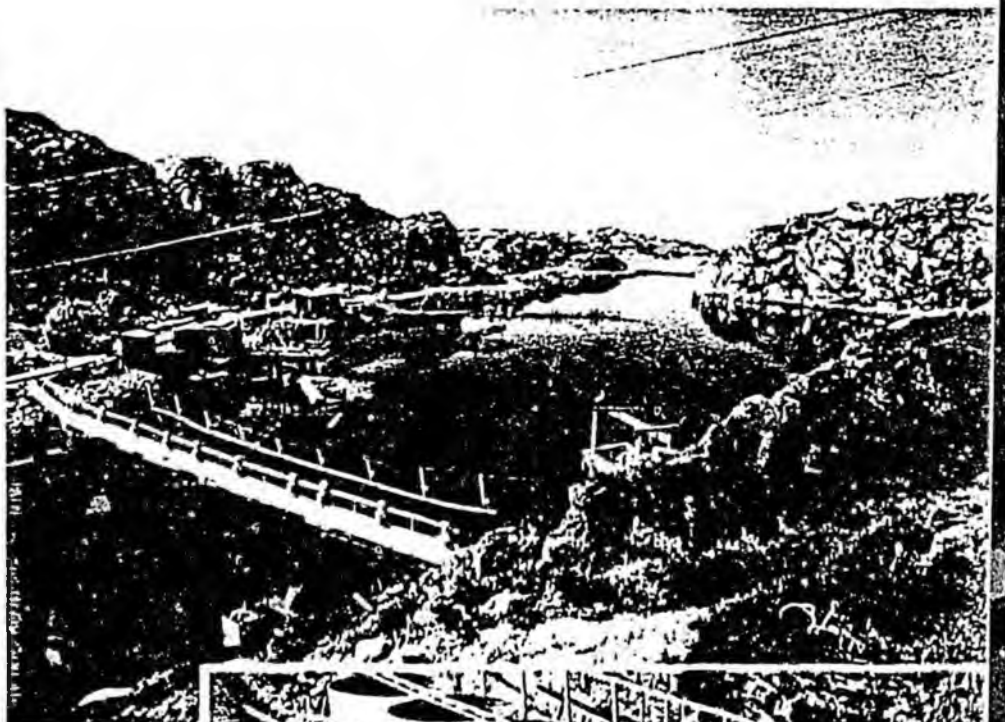
MOWI

IN 1965, WHEN HE WAS 21, Thor Mowinckel decided to become a fish farmer. Capital was available; his father had just sold the family's jam and marmalade business. So, in 1966, the young Norwegian said goodbye to Bergen and traveled to Seattle to see what the Americans had learned about raising salmonids.

Mowinckel's American mentor, Dr. Lauren Donaldson, had been breeding fish for over thirty years when the visitor from Norway showed up. The University of Washington professor of fish farming advocated the wisdom of selective breeding, a lesson Mowinckel learned well. However, Mowinckel realized there is more to fish farming than breeding. In the summer, he worked at the Waterfall Cannery, near Ketchikan, to see how Alaskan packers handle salmon.

By 1968, Mowinckel was back in Bergen—ready to pioneer an industry. From the beginning the Mowi Company went into salmon farming in a big way. The coast of Norway is accented by countless rocky offshore islets, islands and bays, offering protection to fish farmers from the storms which regularly roll in from the North Sea. (Bergen, located on Norway's west coast, receives over 200 inches of rainfall a year.) For their first farm, Mowinckel simply built concrete fences across a huge inter-island bay at Veleoy, not far from Bergen.

The aquaculture business absorbs large amounts of capital long before the first fish is sold. Like most fish farmers, Mowinckel recalls, he underestimated the need for capital. By 1969, he was looking for a partner with deep pockets. He tried a fish meal company. They weren't interested in investing in a fledgling industry that had yet to show a profit. Too risky, they said. Deep in the hole, Mowinckel considered aborting his career as a fish farmer. He



A/S Mowi's Veleoy farm: Brand name identity and a partner with deep pockets (top). The hatchery and smolt farm at Oeyerhamn: Vertical integration and reaping the rewards of selective breeding (above). Thor Mowinckel and salmon: An American education and a Norwegian commitment to aquaculture (right).

changed his mind, though, after he talked to Norsk Hydro.

Besides owning the country's extensive hydroelectric system, Norsk Hydro is a major investor in North Sea oil. "What better associate could we have found than Norsk Hydro," Mowinckel asks rhetorically, "... Norway's biggest concern?" By 1970, Mowinckel was on the road in Europe spreading the word about farmed salmon.

It wasn't an easy sale. The Europeans, it seemed, were skeptical. "They were suspicious about anything new," Mowinckel recalls, and they associated salmon farming with broiler fowl production. Almost unanimously it was expected the salmon would be a cheap, inferior product." He was told the Norwegians handled their salmon poorly—not the way their customers wanted. Buyers took him into cold storages and explained how they wanted their fish to be handled. Again, Mowinckel listened and learned his lesson well.

In 1972, Mowi got the green light from the government and fenced off another bay. Although Mowi's second farm was only about half the size of the Veloev operation, together the two farms had the potential to produce several million pounds of salmon a year. By 1975, Mowi had turned the corner and posted their first profit. In the last five years, Mowinckel says, the company has enjoyed "healthy profits."

One big reason Thor Mowinckel is a success story, says Dr. Donaldson, is because he understands the economic rewards of selective breeding and stock development. Unlike smaller farms, which buy their young salmon from smolt farms, Mowi raises their own smolts, giving the vertically-integrated company total control over its operation. Two fresh water hatcheries near Bergen incubate about 5 million eggs a year from Mowi's carefully chosen brood stock. Fish are bred for fecundity, resistance to disease and stress, and high growth rates. After taking what he needs for his own farms, Mowinckel sells the remaining smolts to other farms. He prefers selling smolts to farms that will sell the fish back to him when they are ready to be marketed. Mowinckel knows how to market as well.

While Thor Mowinckel understands the importance of selective breeding, he also understands the importance of selective marketing. Taking a cue from the marmalade business, Mowi has developed a brand name identity for their salmon. Each salmon that makes the quality grade is tagged with a green and white gill clip, bearing the Mowi name and



company logo. According to Mowinckel, the guarantee of quality is worth an extra 5 krone per kilo (about 40¢/lb.) to his customers—more than enough to cover Mowi's added cost of advertising and printing four-color brochures.

Although his farms currently account for close to 10% of the total Norwegian production of farmed salmon, Mowinckel, young, ambitious, and aggressive, wants more. He would like to market another three or four thousand tons of salmon from other farms. He would also like to farm more fish in Norway, but Oslo has different ideas.

The Norwegian government would rather see more small salmon farms than more operations on the scale of Mowi's. Salmon farming, the government feels, is an ideal occupation for commercial fishermen displaced from the North Sea. To farm more salmon, Mowi had to leave Norway.

In 1981, Mowi bought an existing salmon farm on the Irish coast—good for another three or four hundred tons of Mowi salmon a year. Mowi also joined the rush to ranch Atlantic salmon in Iceland, entering a joint venture with an Icelandic company with an operation at Lön. Iceland's ample supply of geothermal water is ideal for raising smolts which are released into the ocean to return a year or two later, fully grown. The results, so far, have been encouraging, Mowinckel reports. A 5% return, he figures, will cover his costs, while a 10% return would make for "a healthy business."

After salmon, what's next for the 38-year-old Thor Mowinckel? He's committed to a future in aquaculture, he says, and is already at work on methods of farming flatfish and eels. And, he adds, he's "fascinated by shrimp." □



Dan Wilson photos

[continued from page 33]

taken with the place he returned one summer with a full naval escort and a massive statue of Fridtjov the Bold, a legendary Norse Viking. A large crowd gathered in boats of all sizes to watch the unveiling on the last day of July. But when the shroud was dropped, the Norwegians were not impressed.

"True, it was a most generous gift," wrote historian Frithjof Saalen, "but the massive statue—more like a Wagnerian tenor than an old Norse Viking—and the Imperial bombast stuck in most Norwegian throats."

Acid rain and high seas gillnetters have taken their toll of Norway's wild Atlantic salmon runs. With numerous river systems flowing into fjords along the country's lengthy coast, Norway has historically had a large number of distinct salmon runs, a definite advantage to geneticists in their efforts to engineer a domesticated Atlantic salmon.

In the wild, Atlantic salmon spend their first three years swimming in riffles where the river's current is not too strong, but the water is well-




Peter Rodmevne

Bergen's waterfront fish market: Live cod, salmon steaks, shrimp and tourists.

oxygenated. After smoltification, the fish migrate to the open sea to feed on fat oily fish like capelin, sand eels or herring. Shrimp and squid are

consumed as well, depending on the age of the salmon. Biologists believe salmon that fatten fastest feed in the teeming waters of the Norwegian and


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Managing the Market

Odd Steinsbø spends a lot of time these days exhorting fish farmers. He wants them to harvest more salmon in the winter and spring, before the summer glut of wild salmon hits the fresh market. Left to their own devices, farmers tend to grow their fish as big as they can, harvesting them in the summer just before they start to mature. But if they continue to do that, with all the farmed salmon coming out of Norway, they'll collapse the market, Steinsbø explains.

As Managing Director of the Trondheim-based *Fiskeoppdretternes Salgslag* (Fish Farmers' Sales Association), Steinsbø is an educator helping his members to learn the rewards of playing the market. When the Norwegian Parliament passed a law in 1978 creating the FFSA, the idea was to establish control in the marketplace. Whether he wanted to or not, every fish farmer in Norway was now required to join and sell his fish through the Association.

Norwegian fish farmers can't just sell their fish to anybody. After reviewing their confidential disclosures, FFSA has approved about 60 exporters (including a dozen or so of the largest fish farms) to buy farmed fish. The exporters have their own association as well, and once a year both associations meet and set a minimum price for farmed fish.

FFSA extracts a 2.5% sales tax (1.25% from both the farmer and buyer) to pay for its overhead which includes a computerized tracking system for farmed fish and smolt raised in Norway. The Association relays the information to the farmers to keep them abreast of the latest market developments. If it looks like a glut of farmed fish may occur, the Association (through its ties with a fisherman's bank) can obtain preferential financing and is prepared to step in and buy up any surplus and freeze it. Fish farmers are paid half the money up front and the balance when the frozen fish are sold.

FFSA spends the bulk of its budget promoting farmed fish. Advertising campaigns, trips to Norway for food editors and in-flight smoked salmon sandwiches are all part of the strategy. An important part of the promotional campaign (about half the budget) is a concerted effort to get Norwegians to eat more farmed fish. If the Norwegians eat it, FFSA thinks it adds credibility to their export campaign.

When Norwegians fly on SAS, their national airline, they may see an ad in the in-flight magazine touting farmed fish. During the flight, passengers receive a snack box containing an open-faced lox sandwich. Another pitch for fish greets the

passengers as they open the snack box and see an ad on the underside of the boxtop lids. With a population of four million (the size of greater Philadelphia), it takes a much bigger market than Norway to absorb all that farmed fish.

Export trade is the lifeblood of most Norwegian business, a reality that was apparent to Terje Korsnes while growing up in a coastal fishing village. Recruited by Seamark Corporation, a Boston seafood importer, Korsnes moved to the U.S. in 1977 to develop markets for Norway's salmon farms. Korsnes took a cautious, intelligent approach. "We identified an opportunity early on and said we have to go at it in a small way . . . and try to build an identity for the product."

The identity was quality and steady supply—for a price. Test marketing started in 1978 and it soon became apparent restaurants and delicatessens were in the best position to market the high-priced farmed salmon. By 1981, Korsnes says, the U.S. market was buying 50 tons of farmed salmon a year. "It was interesting to see how immediate the repurchase was," he recalls. "People were disappointed unless they could get Norwegian salmon." Then last winter, sales really

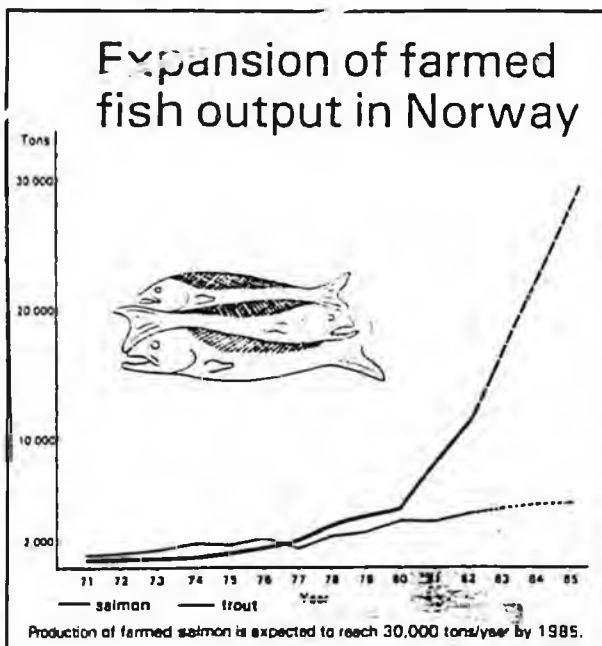
took off. In the first six months of 1982, 400 tons of Norwegian salmon were sold in the U.S. and Seamark (along with Inter-sea of New York which imports Mowi salmon) had the lion's share of the American market.

Seamark imports farmed salmon from Hallvard Lerøy A/S, a Bergen fish exporter with a long tradition of selling fresh Norwegian fish in Europe. Lerøy used to export Mowi salmon before Mowi got so big and started exporting their own. Now, with investments in several fish farms and an extensive supply network along much of the Norwegian coast, Lerøy can deliver fresh farmed salmon "practically every week of the year."

With production of farmed salmon expected to triple in three years, the question on the seafood industry's mind is: "Just what do the Norwegians plan to do with all that farmed fish?"

"It's impossible to guess what might happen," answers Terje Korsnes who predicts the U.S. market should be good for 50 tons a week most of the year and about 10 tons a week during the summer months when fresh wild salmon is available. That still leaves a lot of farmed Norwegian salmon to market.

Vacuum packed convenience items may be one answer, according to Kjell Landaas, Managing Director of Norway Foods Ltd., a consortium of Norwegian food processors. Sold in supermarkets, the frozen vacuum packs may include a sauce; however, the product is still in the developmental stage. Whatever the ultimate marketing strategy, one thing appears certain: production from the Norwegian fish farming industry will only expand as markets are developed, and the United States, a big market with a growing devotion to quality seafood, is the key. □



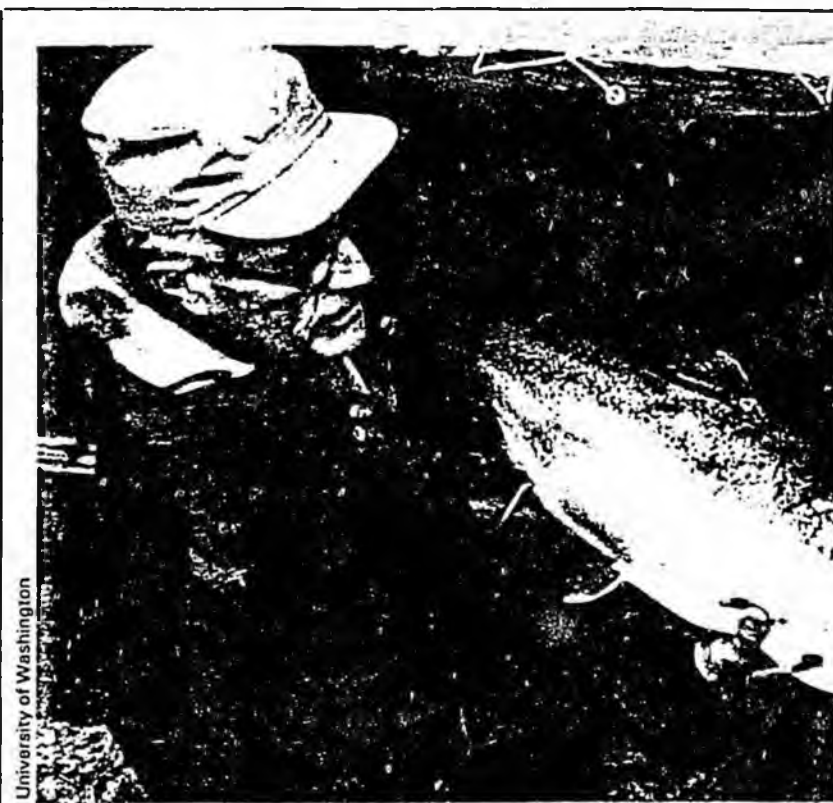
'Barent's Seas. Because the fish feed in northern waters, biologists explain, wild Atlantic salmon seem to grow faster in colder water—a characteristic that is of considerable importance to salmon farmers.

After only one year at sea, some precocious salmon mature and return in the fall. Called "grilse," they are relatively small, weighing 4-8 pounds. Most wild Atlantic salmon stay at sea

two years before returning and usually run between 9-15 pounds. A small percentage of Atlantic salmon remain at sea longer than two years, but rarely more than four. These fish occasionally exceed 30 pounds, but normally run between 18-30 pounds, although the record for a net caught Atlantic salmon exceeds 100 pounds.

Genetic studies of Atlantic salmon have shown considerable variation

between fish, depending on their river of origin. One river system, for example, may consistently have a higher percentage of fish that stay at sea for more than the normal two years. Another river system may have a high percentage of grilse. Or fish from one river may have a faster than average growth rate. This natural variation among the species gives Norwegian geneticists certain



University of Washington

Dr. Lauren Donaldson: The Grand Master of Salmonid Aquaculture

Donaldson and 'Susie'—'the most productive animal that ever lived.'

The king salmon return in the fall to a plywood fish ladder outside his Lake Union office window on Portage Bay. Although "home" is the University of Washington campus in urban Seattle and the fish must swim through a set of locks to reach fresh water, Lauren Donaldson maintains this is the most successful chinook run in the country. Fertilized eggs from the fish are air-freighted around the world, multiplying growing runs in Chile, Japan, New Zealand and the Great Lakes.

A Minnesota native, Donaldson remembers being taught that king salmon would only return to big wide streams after swimming up big wide rivers. Donaldson's kings swim in from Lake Union through a 12-inch gap in the plywood ladder. He also remembers listening to biologists explain why a sockeye run could never be established on Seattle's other urban lake, Lake Washington. Last summer, weekend anglers and Indian gillnetters caught thousands of his Cedar River reds at the south end of Lake Washington, near Boeing's 727/757 plant. The run used to be better, before environmentalists cleaned up the lake, removing some of the food for the sockeye fry. Donaldson's fish have also helped establish thriving resident freshwater pink and chinook (king) salmon runs in the Great Lakes, to the delight of local sports

fishermen. The professor credits much of his success with salmonids to not always going by the book. Salmonids, he explains, are "fantastically adaptable" fish.

Lauren Donaldson arrived at the University of Washington in 1930 with his wife and young son Jack. He had been a high school science teacher in Montana, but he wanted to be a fish farmer in Seattle. After arriving on campus to attend graduate school, he was informed that the College of Fisheries had been downgraded to the School of Fisheries. He also learned the university didn't have any of its own fish—a situation Donaldson rectified in short order. For his first experiments in selective breeding, the aspiring fish farmer selected a local species of *Salmo gairdnerii*: the ordinary rainbow trout.

The rainbows Donaldson began experimenting with normally tipped the scales at a pound and a half at age four. Females were expected to produce something less than a thousand eggs per spawning. Since 1932, Donaldson has selectively bred rainbows: females for fecundity and males for size. The rainbows were bred to have small heads and big bodies. Donaldson even bred a strain of albino rainbows.

One of his favorite rainbows was Susie—the mother of Lot 240. In 1969, three-year-old Susie spawned 23,489 eggs which were fertilized with the sperm from a pair of two-year-

advantages in their efforts to select a stock of Atlantic salmon which will thrive in captivity. It also makes Trygve Gjedrem's job more interesting.

In Norway, government research agencies make an attempt at paying their own way. It is a policy that tends to keep their research oriented to the real world. Scientists have a hard time selling their programs unless industry

perceives the research to be to their advantage. In the case of Norway's salmonid research program, there really hasn't been much of a problem. According to Trygve Gjedrem, director of the salmonid research program, the two research sites at Sunndalsøra and Averøy cover 75% of their operating costs by selling smolts to fish farmers. Genetically engineered, his smolts are in great demand,

Gjedrem says.

Genetic technology is one big reason the Norwegians have a head start in making salmonid aquaculture a profitable business. It is a science that requires considerable time. With Atlantic salmon, for example, it takes four years, or one generation, to get results from an experiment. Although Gjedrem and his colleagues have only been experimenting with Atlantic

old males, each weighing over ten pounds. Although other females broke Susie's egg record, Donaldson refers to the fish as "the most productive animal that ever lived." Within two years the total weight of the surviving offspring from Lot 240 (only 17% died) was 196,000 pounds—nearly 100 tons of fish from the eggs of one female's single spawning. Results such as these do not go unnoticed.

Not long after Boeing delivered its first 707, Donaldson started using the jet airplane to establish both himself and his salmonids around the world. In the early 1960s, he took some of his rainbows to Norway and left them with Dr. Gunnar Rowlefson, a colleague at the Bergen Aquarium. Some time later he took a call from the excited Norwegian who told Donaldson he had thrown the rainbows in salt water and "they were growing like hell." Calling the fish "salmon-trout," the Norwegians used the rainbows to develop their fish farming industry.

From the tip of the southern hemisphere to the tip of the northern hemisphere, Donaldson has helped establish thriving salmon runs. In Chile, his king eggs have helped introduce a run which grows red and fat on Antarctic krill. The Chilean chinooks are ranches and the industry has tremendous commercial potential, Donaldson believes. The professor from the University of Washington has also made good friends in Japan and Russia by lending a helping hand.

Japanese salmon ranchers release over a billion chum fry into the North Pacific every year, mostly from the northern island of Hokkaido. Using a relatively simple hatchery technology, the Japanese welcomed home over 21 million salmon last fall. According to one salmon aquaculturist familiar with the chum runs in Japan, the operations "... are extremely viable from an economic standpoint ... for every dollar they spend on growing fish, they generate \$20 in raw product back." To the north of Hokkaido, on Sakhalin Island, the Russians have even bigger plans. They want to eventually release 3 billion salmon fry (chum and pink) into the North Pacific. In both countries, the salmon are used for domestic consumption. The Japanese like the chums fresh or salted, while the Russians like to smoke their fish whole.

In Japan and Russia, many of the salmon ranches are cooperatives run by displaced commercial fishermen who find life ashore more agreeable and profitable than life on the high seas.

Lauren Donaldson takes pride in the mushrooming successes of commercial salmon farmers around the world. He should. Some of the industry's most successful commercial operations are run by his former students. At one time, Donaldson himself, along with his son Jack (now the Director of the Oregon Department of Fish and Wildlife), gave fish

farming for profit a try. The two were instrumental in forming Oregon Aqua Foods, a private salmon ranching company founded in 1971 which releases cohos and chinooks from the Oregon coast, the only Pacific coast state where private-for-profit companies are releasing salmon smolts into the ocean.

Although private and public non-profit salmon ranching is going on in the remaining Pacific Northwest states and Alaska, for-profit enterprises have been stifled by the political pressure applied by commercial fishermen and state fish politics. The fishermen think private salmon ranching is the reinvention of the fish trap, a device which effectively limited commercial fishing in the past by putting the fish directly in the hands of the processors. Biologists argue that the Pacific Ocean will hold only so much salmon, implying that private runs would compete with existing stocks for food. While the Japanese and Russians send billions of fry to forage in the Pacific, private-for-profit salmon ranching operations in the U.S. release less than a hundred million smolts a year into the same ocean.

Oregon Aqua Foods is a long way from paying its bills in spite of large infusions of capital (including a \$7 million hatchery) from the Weyerhaeuser Company which bought the struggling venture in 1975 "lock, stock and barrel." Donaldson believes that the financial picture would improve for private salmon ranchers using a mixed stock approach, if they take the time to develop a brood stock and if the fish are not all picked off by commercial salmon trollers, sports fishermen and seals. "In Iceland," Donaldson explains, where a growing number of private companies (including Weyerhaeuser) are developing Atlantic salmon ranching, "they'll hang you" if you catch a salmon in the sea.

At the age of 79, Professor emeritus Lauren Donaldson still comes to the office every day as he has for the last 52 years. These days he goes home at noon. He looks out at the raceways, full of plump young rainbows, from his ground floor window on Lake Union. His information is still much in demand. The Chinese want their own salmon program, and they want the professor of fish farming to stay for a month in September. Donaldson will give them two weeks. A Rose Bowl poster is hanging on his office wall; the former high school athletic coach explains he doesn't want to miss all those Husky games.

And the kings come back in the fall. He wants to be there "hollerin'" to make sure the future fish farmers select the best fish for breeding. His students will enter a growing industry full of opportunity. "Fish farming is just too efficient," Dr. Lauren Donaldson explains; if you have to hunt in the ocean, he adds, "you just can't compete." □

'In just one generation geneticists have obtained a 15% improvement in growth rates . . .'

salmon for ten years, the results of their work are already beginning to pay off. In just one generation, Gjedrem says, geneticists have obtained a 15% improvement in growth rates by selecting for fast growing fish. Drawing on the large gene pool, scientists are breeding for resistance to disease and stress, rapid growth rates, early smoltification, and delayed sexual maturation. Scientists can even select for fish that assimilate the natural pigment astaxanthin found in crustacea such as shrimp and krill. Some fish retain the pigment better than others giving them the deep red flesh consumers will pay extra for.

The scourge of the salmon farmer, grilse, can be selectively bred against. But better yet, they say, is a fish that

never matures: a sterile salmon. With a sterile fish, a salmon farmer would be free to market his fish at whatever age and size he deemed appropriate. To a geneticist, it's all a question of diploids and triploids—a reference to a chromosomal makeup. Normal Atlantic salmon are diploids. Triploids are relatively rare; they have a high frequency of sterility. The trick is to make diploids into triploids and there may be an answer.

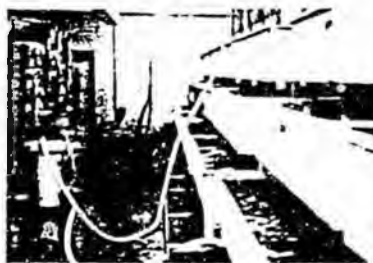
A short heat shock (about 30°C appears to do the job) to the newly fertilized egg apparently results in a significantly higher percentage of sterile or triploid fish. The heat treatment also seems to be more successful with females.

Salmon farmers will tell you their

fish tastes better. "You know, the small differences," one explains. Wild salmon are normally caught in bays and river mouths, long after their instincts have turned from food to sex. Changes in their flesh, subtle at first, have begun. Farmed salmon, on the other hand, are fed a high fat diet and colored with krill; then they are starved for several days and slaughtered. Some farmers feed their fish relatively expensive food, but they have figured how to get their money back on the other end. Explains one farmer who pays more for capelin frozen at sea by Russian trawlers because the quality is better: "... This is a very costly procedure, but we like to stick to this diet as long as we feel our customers are willing to pay a price



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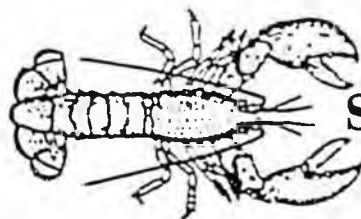
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Ask a Norwegian why the salmon farming industry is so successful and chances are he'll answer you with one word: quality. The Norwegians have developed quality control to an art form and farmed salmon is their masterpiece. Here's why.

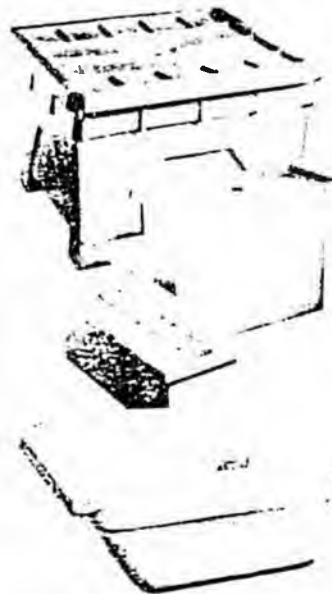
Before salmon are harvested, they are starved for at least seven days, cleansing their digestive systems. If a farmer has been using antibiotics, the treatment must be stopped at least two months before the salmon are harvested. Laboratory tests are required before each harvest, to ensure no traces of antibiotics remain.

After the salmon are carefully removed from their cages, they are placed in a water-filled box, lined with a plastic tube. Carbon dioxide (CO₂) is injected into the water, knocking the salmon out. Once knocked out, they are dispatched with a quick severing of an artery behind their gills. The salmon are then put into a tank with running water where they bleed to death. Depending on the location of the packing plant, salmon are either gutted at the farm or at the packing plant if it is nearby. The general consensus in the salmon farming community is salmon should be gutted within two hours after they are put to death and before rigor mortis sets in.

At the packing plant, salmon are laid on ice in polystyrene boxes which are commonly lined with disposable diapers to absorb ice melt, preventing flesh from lying in water where it can lose water soluble proteins. In the summer, salmon are cooled to 0°C (32°F) before they are packed on ice to prevent the ice from melting in transit. The Fish Farmers' Sales Association is attempting to standardize the type of boxes used for packing. Each box is stamped with the farm's serial number so any quality complaints can be traced to the farm of origin.

Most of Norway's farmed salmon is transported by road and ferry to reach markets in Europe within 48-72 hours from the time the fish leave the water. The rest of the salmon is moved by air freight (almost exclusively on SAS) to markets all over the world. Dubbed the "Salmon Airlines System" by people in the industry, SAS has invested considerable time and money perfecting the critical product distribution system, including designing special air freight containers to keep the product at a constant 32°F.

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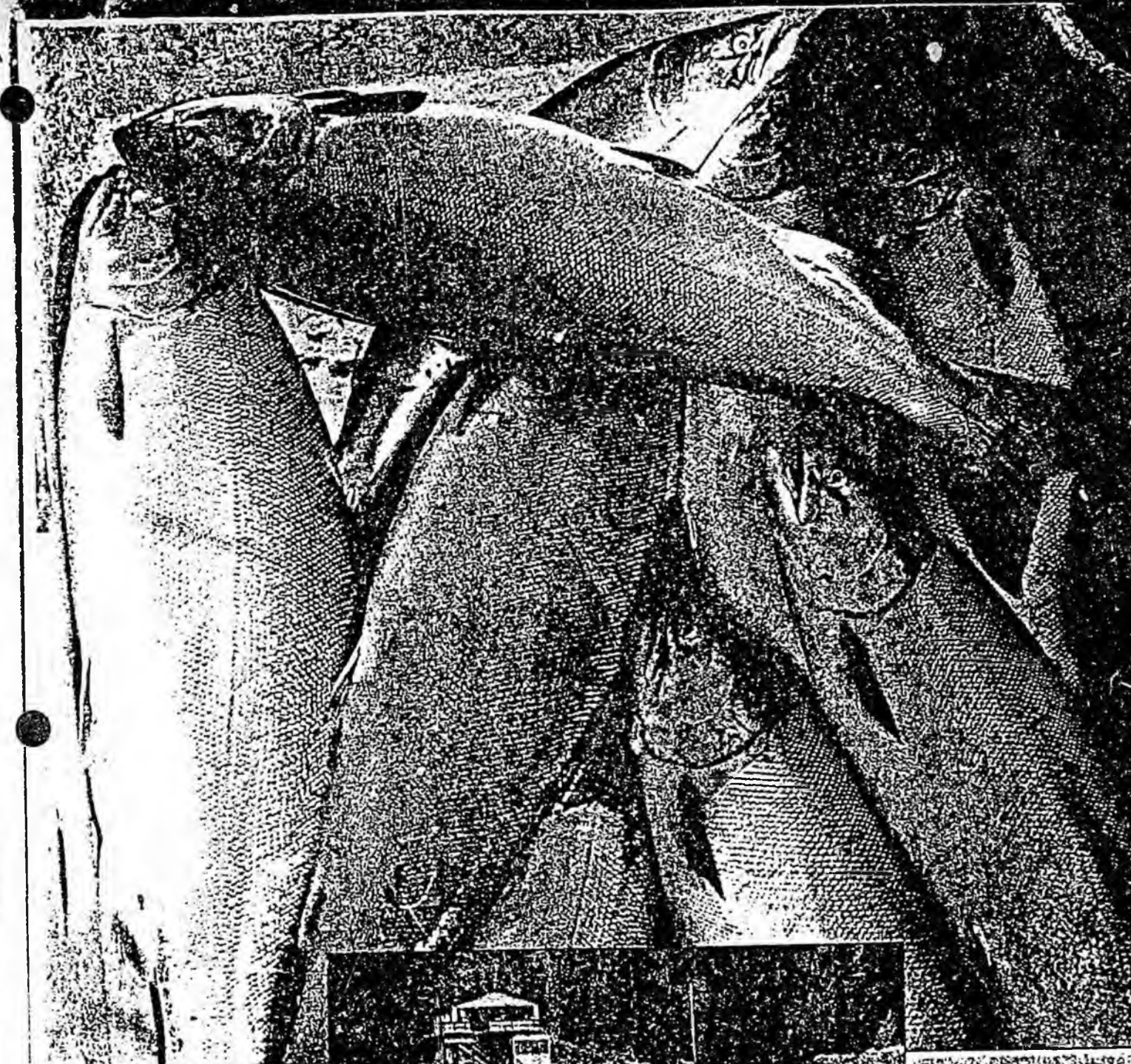


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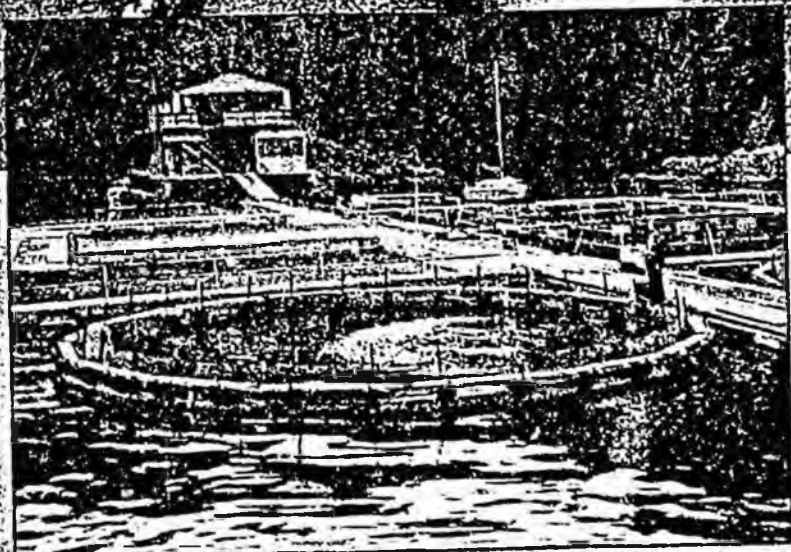
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JOHN SABELLA



RICK JAMES

The major unanswered question: Will the coho produced at farms such as this small "mom-and-pop" operation (inset) on B.C.'s Sunshine Coast hurt the market for troll-caught silvers (large photo)?

Farmed Salmon in British Columbia

Just how will salmon farming fit into the West Coast fishing industry? Right now British Columbia is grappling with that question, and finding there are no easy answers.

by Mary Murphy

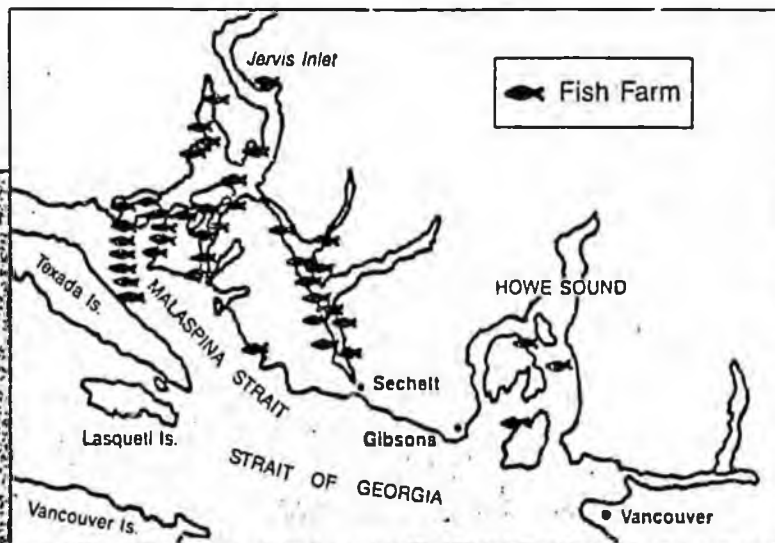
Salmon farming is beginning to have an impact in British Columbia. While output is still low, especially by European standards, the industry is growing rapidly. Is it a promising addition to a beleaguered economy, a complement to the existing salmon fishery—or a threat to its existence?

Only a dozen or so of these pen-rearing operations are harvesting fish, but about 60 more are fully licensed and at least half of these have fish in the water.

The highest concentration of salmon farms is in the "Sunshine Coast," the area just north of

Howe Sound and the city of Vancouver. There are some on Vancouver Island and a scattering near Prince Rupert, with many more expected in sheltered places in various parts of the coast. Jim Fralick, the province's aquaculture coordinator, says that 120 of these facilities could be in operation by next summer.

In 1984, British Columbia's output of farmed salmon was a little over 100 metric tons. Figures for 1985 aren't yet available, but production was expected to be larger. Output should increase considerably in a year or two as new farms begin to harvest fish. Coho and chinook are the only



The center of B.C.'s salmon farming is the "Sunshine Coast," the area just north of Howe Sound and Vancouver. There could be as many as 120 salmon farms in operation by the summer of 1986.

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Pacific species presently being farmed, though a few aquaculturists are trying to grow imported Atlantic salmon as well.

Officials in both the federal and B.C. governments believe the industry shows promise. The province has boosted aquaculture in slick television ads, maintaining it will help provide the new jobs needed so badly in British Columbia as the province's resource-based economy has struggled with double-digit unemployment rates since 1982.

Much of the technology of salmon farming was developed in Norway, where the industry has been spectacularly successful since its introduction in the early 1970s. Ironically, the Norwegians benefited a great deal from Canadian research and development, since the Canadian's Department of Fisheries and Oceans has long been a world leader in hatchery technology.

Fish farming is also well-established in Scotland and other areas of northern Europe. Japan is rapidly increasing its pen-reared production as well. Now aquaculturists in Canada, the United States, Chile and New Zealand are trying to capture part of the expanding world market for fresh fish.

There are three distinct operations involved in salmon farming. In Canada, farmers buy most of their eggs from government hatcheries. During the first phase, the eggs are hatched and the fry cultured until they reach the smolt stage.

This is followed by the "grow out" period, when the fish are raised in net pens and fed a specially manufactured diet until they reach market size. Often these two operations are performed at different sites and by different firms. Some farmers specialize in smolt production, selling their product to others who perform the grow-out functions. A few also concentrate on brood stock development. It is hoped that eventually the industry will become more or less independent of government hatchery programs.

The third phase involves processing and selling the salmon. Typically, aquaculturists slaughter, gut, pack and ship their fish very carefully and quickly, to ensure quality and fresh-

ness. Meticulous handling, year-round supply and reliability of size, taste and texture account for the product's appeal. In British Columbia as a rule, farmers market their fish independently, either to brokers or directly to restaurants and stores. Markets are mainly in the Vancouver area and the western United States.

According to Tom May, president of the Mariculture Association of B.C., aquaculturists currently receive the following prices (in U.S. dollars): \$2.08 per pound for pan-size coho, \$3.58 for 4-6-pound fish and up to \$4.30 for 6-9-pound chinook. Farmers are now aiming to bring more of the large, high-valued product to market.

A buoyant spirit characterizes many B.C. fish farmers today, a sense that—while serious challenges face them—their time has arrived.

Brad Hope, one of the industry's most successful entrepreneurs, exemplifies this. In 1984 he declined an investment offer from a large, multinational corporation. Instead, he merged his Tidal Rush Marine Farms with another local aquaculture firm, Pacific Aqua Foods, to form a vertically integrated company.

Hope watches the industry's rapid growth with bemused concern. "On the Sunshine Coast everybody is either salmon farming or their brother-in-law is going to be salmon farming."

He recognizes that the sudden influx of investors and entrepreneurs, many of them inexperienced and undercapitalized, will lead to an industry shake out as many of the newcomers fail. Aquaculture will benefit in the long run, he says. "We'll end up with more sophisticated fish farmers and more sophisticated investors," and, he says, greatly increased production to satisfy the tremendous demand he envisions.

This process will probably also lead to higher concentration levels within the industry. Now it is mostly made up of small- to medium-sized companies and investors. Some large multinationals are involved, with many more showing interest as fish farming becomes established. Norwegian investment is especially likely, as the aquaculture giants of

Scandinavia look around for new coastlines and new markets to develop. British Columbia, with its clean water and sheltered inlets, is particularly attractive.

Canadian resource and manufacturing industries are, on the whole, very dependent on outside capital. Both the federal and provincial governments are actively courting foreign investment, particularly since the Mulroney government declared Canada "open for business" last year.

This bothers Hope, a man who displays a maple leaf in his company's logo. "I find it frustrating that a big foreign company can come in and talk one hundred jobs and get more consideration [from the government] than 10 Canadian companies talking 10 jobs each."

Nevertheless, according to Hope, a technological constraint will ensure that smaller, domestically-owned businesses can thrive. "I think it's going to be very difficult for multina-

tionals to come in and completely control the industry, particularly the growing out of fish. It's so intense on net pen sites. They've found in Norway that if you get too large in any one space, you run into disease problems."

Hope is confident that aquaculture can co-exist with the commercial fishery. He foresees a cooperative marketing structure developing. During the summer fishing season when farmers get their best growth, the fresh market will use good quality commercial fish. As soon as the season is over, the market will plug into farmed fish. Under this scenario, the market for both industries will increase.

Michael Hunter, president of the B.C. Fisheries Council, an umbrella organization of fish companies, agrees that the two industries can be complementary. "Fish farming could be an adjunct to the commercial fishery. Our existing infrastructure could offer aquaculturists a cost advantage, in terms of things like cold storage and processing plants . . . Our investors would have to agree, of course." Like Hope, he sees the availability of fresh salmon in the off-season leading to a larger overall demand for fish.

Hunter maintains there will be little direct competition from European farmed salmon in Canada's export markets—even in the frozen sector, an area which would appear to be especially vulnerable. "There is a new market, finding new niches, particularly in restaurants. It's not the market that B.C. has serviced or ever plans to." He believes currency fluctuations pose a more serious marketing problem than supply increases.

In any case, demand for canned salmon will still be entirely satisfied by the traditional industry. Pen-rearing facilities could never produce this product as cheaply and efficiently as the fishery can. Nor are fish farmers presently able to grow the sockeye, pinks and chums that are canning staples.

According to Hunter, the Council expects world demand for canned fish to remain stable. In other words, the market for fresh fish will not grow at the expense of the canned sector.

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Because British Columbia's fishing industry still depends most heavily on canned products, the fish processing companies do not foresee a serious competitive threat from fish farming. Although Hunter declined comment, it seems likely that some processors will invest in aquaculture developments of their own and in this way diversify both their products and their markets.

Will the effects of this new industry be as beneficial to the commercial fishery as its promoters and even the Fisheries Council suggest? Many fishermen doubt it.

Leading the attack on fish farming are the United Fishermen and Allied Workers Union and its newspaper, *The Fisherman*. According to assistant editor Jim Sinclair, the union has called for a federal and provincial moratorium on further licensing of fish farms until five conditions are met.

First, there must be a guarantee that the industry will not be controlled by multinational corporations and banks. Second, no undue pressure must be placed on wild stocks of salmon eggs needed for spawning. Third, the Salmon Enrichment Program must be fully implemented. Fourth, aquaculture cannot be used as a trade-off for lost fish habitat. Fifth, there must be no move to privately-owned hatcheries or ocean ranching.

Since adopting this policy, the union also expressed concern about possible disease transfers from penned to wild stocks. It is particularly worried about the importation of the "exotic" Atlantic species, despite the DFO's assurance that only certified "disease-free" eggs are being used.

Aquaculture is often promoted as an industry that can provide off-season work for fishermen, as well as employment for those displaced by fleet reductions. The union, however, maintains that the employment projections made for the industry by the provincial government, among others, are greatly exaggerated.

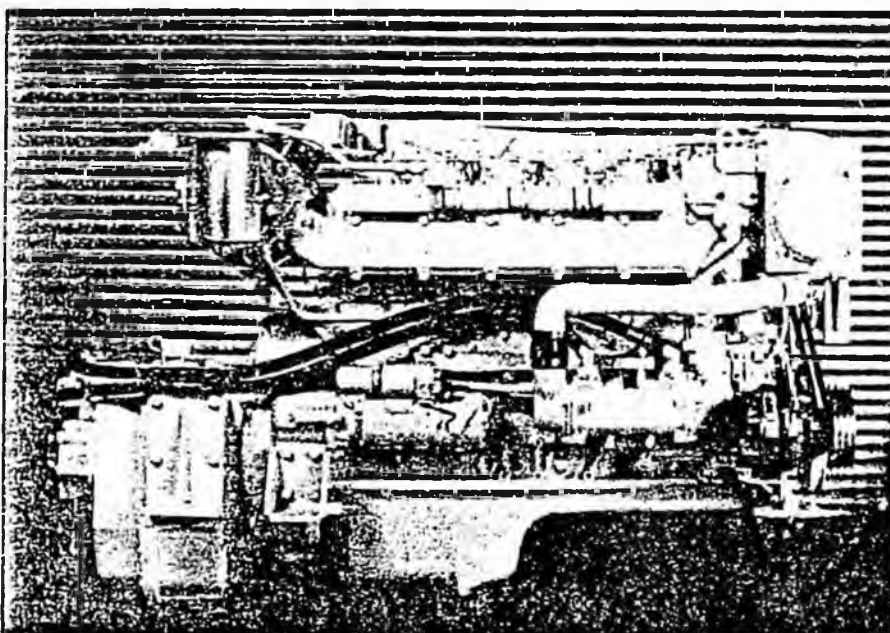
Salmon farming, in particular, is a capital-, not a labor-intensive activity. The Science Council of Canada, a government-funded think tank, has promoted the industry's development,

but predicts that only about one person-year of direct employment will be created for every 20 tons of production. Even an enthusiast like Brad Hope admits that indirect employment from feed and equipment manufacturers and suppliers, transport companies, etc. is likely to outweigh direct job creation.

The union also wonders what impact aquaculture will have on fishery markets and faults the federal government for not doing more research.

"Even the DFO admits a study should be done on the effects of farmed fish on our markets," said a recent editorial, "but the department hasn't got around to it yet."

But probably more troubling to the union and many others in the industry is the issue of "privatization." The UFAWU believes that fish farming could lead to corporate control over habitat and fish stocks, the decline—or death—of the common property-based fishery, and the genetic deter-



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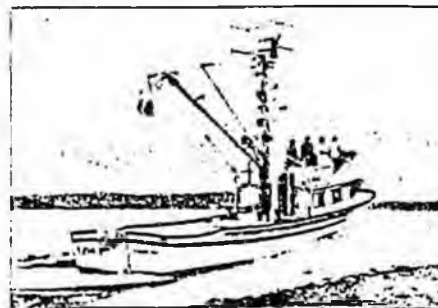
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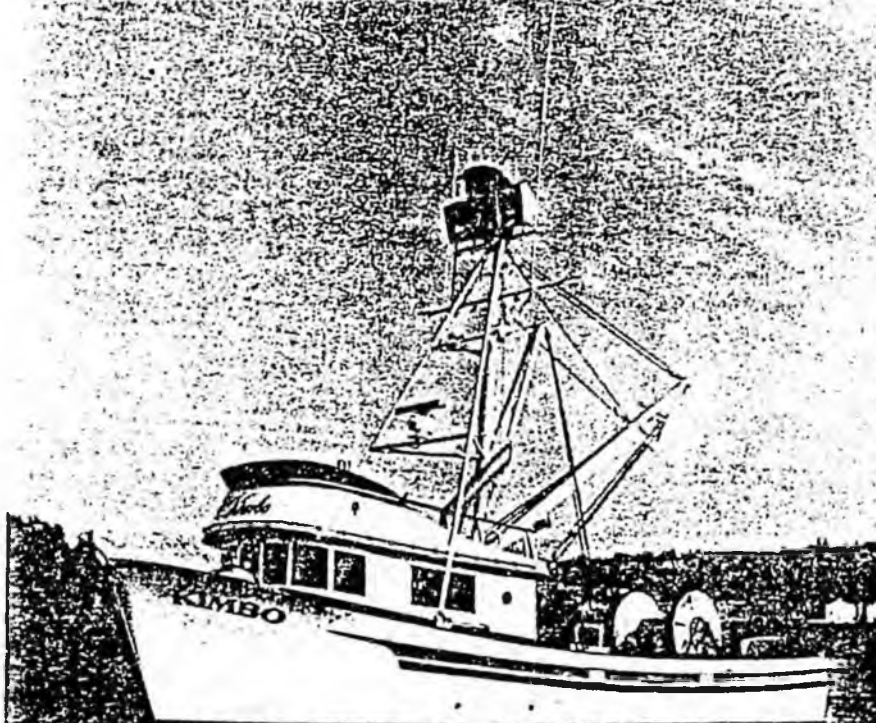
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ioration of salmon. The last item in this gloomy scenario could occur because of an increasing reliance on biologically-engineered species, whether "farmed" (raised in pens) or "ranching" (allowed to go out to sea).

The union wants more funding and effort put into protecting and improving fish habitat and less emphasis on "high tech" aquaculture projects, even those that are government-funded. It believes public control over fisheries is essential to maintain vigorous, genetically diversified wild stocks, as well as the industry which depends on them.

Sinclair dismisses the argument that private management would be more efficient than a common property arrangement. "That's saying that the public is so stupid it can't manage the resource," he says. "Show me an industry where private companies run a resource that meets the long-term needs of society."

Not everyone in British Columbia's commercial fishery is so militantly opposed to fish farming. According to Fred Penland, president of the Pacific Gillnetters Association, fishermen must learn to live with the new industry. He does not see pen-rearing operations leading inevitably to private management and ocean ranching schemes. He cautions, however, that Canada must be careful to protect its wild, public stocks, especially as the world comes to rely more and more on domesticated, inbred species. "Canada nurtures its wild stocks and must continue to do this. If we maintain genetically diversified salmon, we'll have a long-term advantage over other producers."

Penland, like people in the fishermen's union, is concerned about the effects fish farming could have on markets. He worries that a large influx of farmed fish, plus the hatchery-reared stocks that Japan, the United States, Canada, and others are putting into the ocean, could disrupt world supply patterns and help to lower prices to fishermen. This concern, however, isn't universal either.

Since trollers have the largest stake in fresh and frozen salmon markets, they are the ones likely to be first affected by supply increases of farmed

products. This doesn't worry David Elliott, executive director of the Pacific Trollers Association.

His organization has no position on the development of pen-rearing operations in the province, though it, too, is opposed to ocean ranching. Elliott says that world demand for high quality fresh and frozen salmon is so large—and growing rapidly larger—that wild salmon will continue to command high prices, despite the addition of farmed fish to the market.

Certainly the most positive response to fish farming comes from the Prince Rupert Fishermen's Co-op, a major fishermen's organization and British Columbia's second largest processor as well. The Co-op has a farm in operation in Miller Bay, near Prince Rupert, where both chinook and trout are being reared.

According to Co-op President, Paddy Greene, the facility is a pilot project "to check on the industry's viability." If it is successful, the Co-op plans to develop a chinook brood stock and establish a marketing program for off-season fresh fish.

Greene rejects the negative attitude of many B.C. fishermen toward salmon farming. "I think we're burying our head in the sand if we think it's going to go away," he says. "It's happening all around us." He believes the aquaculture industry could offer "great potential for small, coastal communities."

Nor does Greene think the industry's growth should be checked in order to protect sales for B.C. fishermen. "There's going to be a lot of farmed salmon on international markets, whether B.C. gets into it or not. . . . If done properly, aquaculture could enhance the market for fishermen."

Whether British Columbia experiences a significant disruption in its export markets due to fish farming appears to depend on the following: how much world demand for high quality fish increases; how supply expands to match (or exceed) this increase; how well the industry competes in terms of both cost and quality; and exchange fluctuations, both of the Canadian dollar and other relevant currencies.

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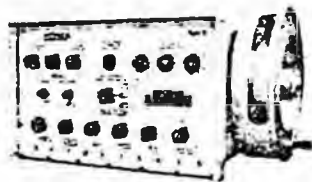
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9. Provide immediate and correct treatment in cases of disease.
10. Properly dispose of all dead fish.

able to competition from Norway. "A lot depends on where Norway sends its fish," he observes. "If it sends most of it to Europe, it may not affect our aquaculture industry too much." A strong assault by Norway on British Columbia's "natural" markets in the United States and Asia could be hard on the developing industry, however. "It looks like Norway's costs are a lot lower than their selling price," he notes, making it possible to drop prices considerably if competition required.

Mylchreest stresses that these are preliminary observations. He is working on a study on the marketing prospects for B.C. farmed salmon. Results should be out this spring or summer and will likely have implications for the commercial fishery as well.

It is apparent that development of fish farming raises important issues, both in Canada and the United States. For the first time, this industry is being established in an area—the northwest coast of North America—which already supports a viable in-shore salmon fishery, based on common property.

Will fish farming serve to stimulate overall market demand for seafood, thus benefiting the established industry? Or will the two compete for markets? Will selective breeding and technological innovation produce larger, hardier salmon? Or will domestication cause genetic deterioration and introduce disease to wild stocks? Will privately-owned aquaculture operations provide government with a convenient excuse to limit its support for fisheries protection and enhancement, with fishermen suffering directly from such a policy? Or will *both* industries—and the general public—recognize the crucial role that healthy wild stocks play in the West Coast economy and in world fish production?

These and other questions don't have clear answers yet. But, while we ask and wonder, fish farming isn't going away. Somehow it has to fit into an already complex and contentious environment, the West Coast fishing industry. 

Demand is difficult to predict, but there is some information on supply possibilities. In just fifteen years, Norway has increased its production from almost nothing to about 30,000 metric tons, more than 4 percent of total world production. The industry there expects to produce 80,000 tons by 1990. It has been estimated that Norway could be putting 200,000 tons into world markets by the year 2000. (Current world production is now about 700,000 tons.) Should these figures materialize, Norway—with virtually no wild salmon fishery at all—will become a major player among world producers.

Russell Mylchreest, an economic adviser for the DFO, warns that, in theory at least, B.C. frozen salmon producers could be hurt by this large year-round supply of farmed fish on world markets. "I don't know if demand can expand as fast as the supply appears to be going . . .," he says. "A hundred thousand metric tons coming on stream in about five years [from Norway and other producers] has to have some effect on price."

Mylchreest says that British Columbia's emerging fish farming industry will have little impact on the commercial fishery's markets, at least for some time. In fact, it could be vulner-

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FARMED FISH: Do They Really Compete?

by John van Amerongen

Competition for salmon markets is a lot like musical chairs—nobody loses as long as there are enough seats to go around. The big question come 1990 is whether there will be enough salmon markets for all the salmon produced, given the astronomical production figures currently being tossed about by salmon farmers and those who keep an eye on them.

The growth potential of the Norwegian salmon industry is now beyond debate. In 1971 Norway produced a mere 100 metric tons. By 1985 Norwegian farmers produced 34,000 mt. There's no reason to doubt they'll produce at least 80,000 mt. of Atlantics by 1990. That same year Canadian farmers are expected to market 30,000 mt. of coho and chinook. And that has wild harvesters legitimately nervous. The Canadian projection alone is 6,000 metric tons more than the total wild catch of coho and chinook salmon in Alaska in 1988.

Whether or not the frenzy of activity in B.C. will bear full fruit in 1990 is still speculation, but the potential is certainly there (see related article p. 32). And now that salmon mariculture is seeing a resurgence of activity in Washington State and proposals are making their way to the Alaska Legislature as well, analysts are focusing on a key question.

"The key question," according to Steven White, former director of Prince William Sound Aquaculture Corp., "is will they compete with or complement wild salmon?"

White addressed the question January 13 as part of the University of Washington's Fisheries Research Institute seminar series on floating marine aquaculture.

Unfortunately, White admitted from the onset, "I can't answer it." It's one of those questions, he said, that creates "a lot of heat and very little light."

"Terror," he noted, "creates a lot of heat."

The audience of fisheries students remained relatively calm as White alternately turned the heat on and off the wild salmon industry. After citing the terrifying farm production figures, White eased back a bit, noting optimistically that seafood consumption has been rising steadily.

U.S. consumers are currently eating about 15 pounds of seafood a year, White said. By 1990 we'll be consuming about 20 pounds a year per capita, and that, he said "is a great opportunity for all of us."

"If production would stay stable," he said, "we would assume higher prices for our fishermen."

But the light at the end of the tunnel faded as White reminded everyone that production was not stable, and that as European and Canadian farmed production increased, so too would their exports to the U.S. Not only will their production increase, said White, but the production of farmed catfish and shellfish will increase as well. So too, he said, will hatchery releases from state and non-profit facilities. By 1990, said White, "2.6 billion fish will be released into the wild... a 245 percent increase since 1982."

There are two ways to look at it.

White explained. "Pessimists believe competition is going to be the result... increased demand will be met by increased production and drive down the price."

The optimists, said White, believe that farmed and wild salmon will complement each other in the marketplace. "High priced and high quality imports will create a taste in consumers' mouths that will create an explosion in the market," he said, assuming the role of one whose glass was half-full instead of half-empty.

But White had a problem with the up-beat view that wild and pen-reared salmon will walk hand-in-hand to economic glory. There's "no evidence," he said; "I can't find anything concrete that makes me believe that is going to be the result."

Still, White had almost as much

difficulty finding evidence to confirm that the sky was falling. What he did find was a recent study

co-authored by Ron Rogness of the North Pacific Fishery Management Council and the School of Management at the University of Fairbanks, and Dr. Bing-Hwan Lin of the Department of Agricultural Economics at the University of Idaho. The title of the Rogness-Lin study is "The Marketing Relationship Between Pacific and Pen-Raised Salmon: A Survey of U.S. Seafood Wholesalers."

According to White, the survey was taken as preliminary research for a master's thesis on the subject in conjunction with Alaska Sea Grant. Now that the authors are busy elsewhere [away from the University of Alaska at Fairbanks], White doubts that the research will be completed. Nevertheless, the survey does reveal some interesting information.

In July of 1985, Sea Grant sent out surveys to 925 seafood wholesalers and distributors in Boston, New York, Chicago, Los Angeles, San Francisco, and Seattle. About 24 percent (127) of those surveyed responded to a series of questions dealing with their salmon purchasing decisions.

Of central concern to White were the survey questions aimed at the "substitutability" of wild and farmed salmon. If there's no substitutability, the argument goes, there's no competition.

The responses concerning pan-sized coho, the variety raised by Domsea Farms in Puget Sound, offered no particular cause for alarm among wild salmon harvesters. The "overwhelming majority" of respondents said they did not consider the small silvers a legitimate substitute for wild Pacific salmon. If anybody has to worry about pan-sized coho, it's the farmers of rainbow trout.

And if you can believe the survey, the bulk of frozen Pacific salmon appears to be on its own in the marketplace as well. Only 15 of the 57 respondents viewed fresh pen-reared Atlantics and frozen wild Pacifics as substitutes. Since only about three percent of the Alaska harvest is sold fresh, the authors concluded that "97 percent of the harvest... would be more or less unaffected by the pen-raised Atlantics."

That's good news unless you happen to be a troller. "...It should be noted," the authors caution, "that a significant portion of the troll-caught chinooks and cohos in Southeast Alaska is frozen and marketed to white tablecloth restaurants which is one of the primary markets of fresh pen-raised Atlantic salmon; the 15 (out of 57) votes for the substitutability between fresh Atlantic and frozen Pacific salmon should therefore not be discounted."

Still, the authors weren't particularly worried about the overall impact of fresh Atlantics on the domestic market for Alaska-caught fish. According to Rogness and Dr. Lin, "...the results seem to suggest that much of the concern shown by many commercial salmon fishermen in Alaska may be somewhat unwarranted."

Like it or not, the survey suggests two separate market niches for fresh farmed and frozen wild-caught Pacific salmon. In automotive terms, one is viewed as a BMW, the other is a lot like riding the bus.

The situation for fresh wild-caught fish seems to be different. The overwhelming majority of respondents (49 of 62) said that pen-raised Atlantics were a legitimate substitute for fresh wild Pacifics.

But legitimate substitutes are not always the same, as the Rogness and Dr. Lin discovered.

Two questions in the survey asked respondents to list the advantages of each variety over the other.

Asked what advantages pen-raised Atlantics had over wild Pacifics, the characteristic most often cited was availability year round (28), followed by freshness or quality (26), consistency (19), size (12), price (11), and shelf life (6).

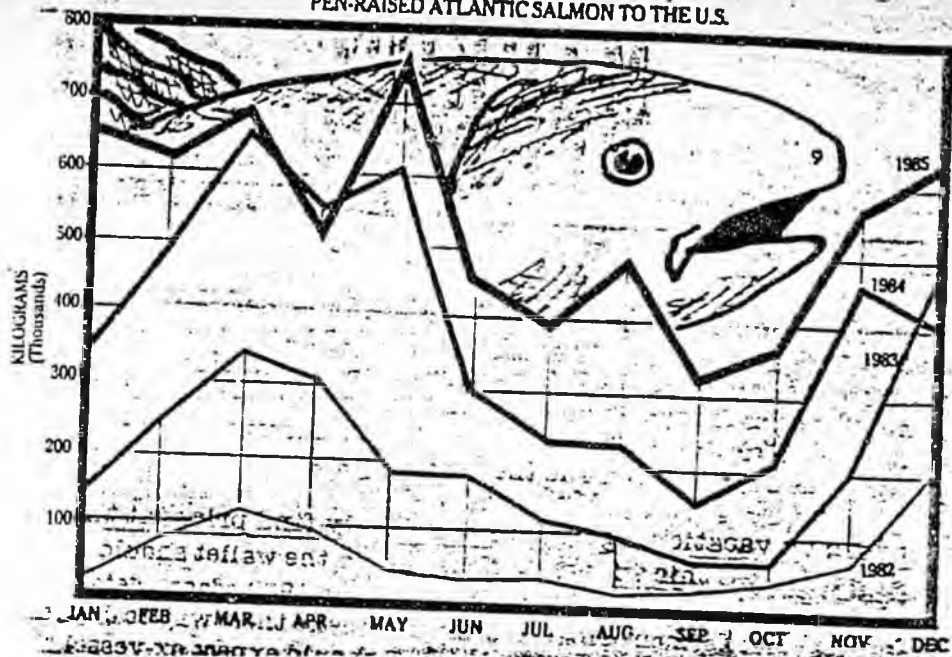
Asked what advantages wild-caught had over farmed, the most common response was price (27), followed by flesh characteristics — color, firmness, fat content (19), availability of large fish (5), volume of supply (2), and ease of ordering (1).

Price appeared to be the most motivating factor in choosing wild over farmed, while year-round availability and high quality were the best reasons to buy farmed fish, according to the survey. Four respondents could find no advantages

of pen-reared over wild, while eight could see no advantages of wild over pen-reared. In automotive terms,

MONTHLY EXPORTS OF FRESH NORWEGIAN

PEN-RAISED ATLANTIC SALMON TO THE U.S.



they are both good cars — one a BMW, the other a Ford Thunderbird. Ford has a better idea as long as the sticker price is right.

How long wild salmon can maintain a price advantage over pen-reared fish is another key question addressed by Mr. White at the FRI seminar. Trollers would understandably like to see the price of wild salmon rise, and salmon farmers aren't anxious to see the price of pen-raised fish fall. As the world supply of salmon increases, however, it's going to be more and more difficult to keep the prices apart and avoid a head to head battle in the marketplace.

Right now transportation costs and the relative inefficiency of the small farms have kept the cost of Norwegian salmon up. The falling value of the dollar in world currency markets is helping, too. When British Columbia comes on line in 1990, however, the situation could be very different. As one industry wag put it, "The Canadians have never met a market they couldn't dump."

White put it another way: "There's a great potential for oversupply." British Columbia is planning to produce a lot of product," White said, "...and there's no indication that product has any market set up for it."

This may have been music to the ears of fishermen who are looking for a gigantic shake-out to put the salmon farming industry on its gills. But White saw it differently.

"Which industry is going to survive the Crash of '89?" White asked. "If the farms crash," he said, answering his own question, "we'll go down with it."

One might think White's best advice to the fisheries students in the audience would have been to pack up their pee-chees and head it on over to the School of Dentistry. But he didn't suggest that. Perhaps all the doom and gloom was just a test to see who was really serious about a career in the salmon industry.

His conclusion offered a ray of hope, even if the light at the end of the tunnel turns out to be Madison Avenue.

The salmon industry, said White, is in a state of transition. "The biological hurdles," he said, "are pretty much over."

"The next problem," said White, "is how [the salmon] can be marketed to keep the [aquaculture] industry alive and maintain the commercial fishing industry."

To accomplish this White suggested a conciliation between wild harvesters and farm producers. "Our real target is not each other," he said, noting that salmon sales are completely eclipsed by beef and chicken. "They're the targets, not each other."

—John van Amerongen

Salmon Farming Goes Crazy in B.C.

by Clark Miller

Salmon farming in British Columbia — they're calling it a Gold Rush, an out-of-control frenzy of production that will glut the world market and plunge prices in two years. Is it really that hazardous?

Vance Lipovsky thinks so. He is director of aquaculture development for British Columbia Packers, Ltd., in Vancouver, B.C. He says production of farmed salmon in British Columbia will hit 30,000 tons by 1990 — in 1984 it was only 107 tons. Meanwhile, prices to producers will dive below \$3 a pound — right now, they're between \$3.50 and \$3.75.

Kicking off a series of lectures on aquaculture at the University of Washington's School of Fisheries last month, Lipovsky said, "It's impossible to keep up with the industry up there... and the pace will not change." In 1985, there were 45 farms. Last year, there were 108 farms. This year there are perhaps 150, with more than 500 applications pending.

"In the three or four years British Columbia will be the largest exporter of salmon to the U.S.," he predicts.

Orders for salmon cages are backed up for six months. B.C.'s 20 hatcheries are charging 65 to 79 cents each for smolts (there ten to twenty more hatcheries on line, Lipovsky says).

The provincial government slowed things down with a 30-day freeze on licenses in October, in order to ask a few questions, but basically decided there are no com-

PELLING reasons to interfere with something that is boosting the economy of a traditionally depressed area with 69,000 miles of wilderness coastline. "A month later, it was business as usual," Lipovsky said.

One question asked during the moratorium involved the impact of aquaculture on wild salmon prices. The answer in Canada was, None.

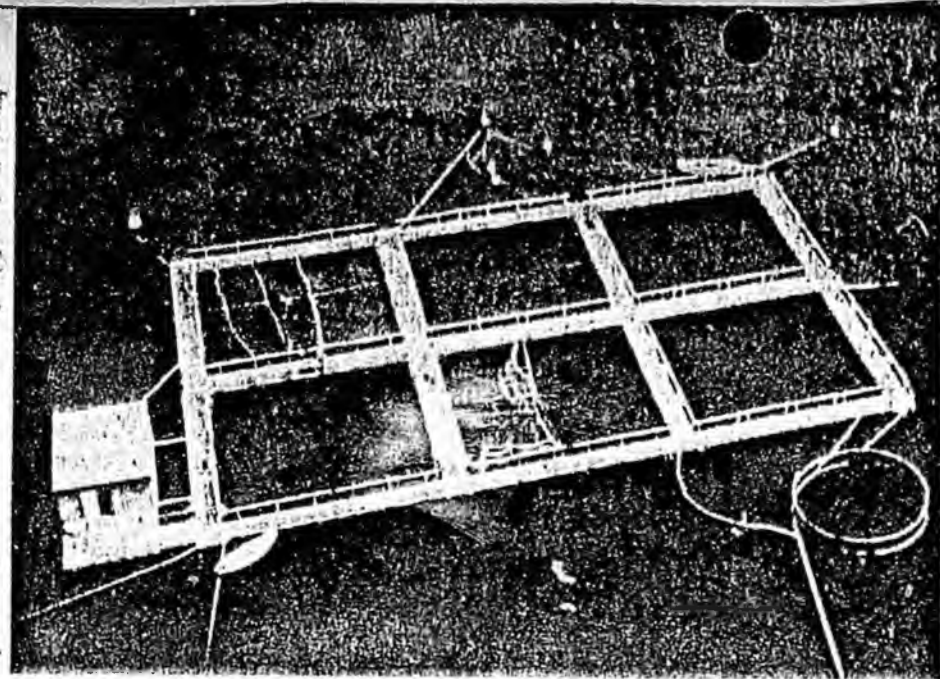
One way of measuring the growth is the number of smolts that are reared each year. In 1984, the number was 1.5 million. In 1985, it was 5 million. In 1986, it was 14 million. This year it will be 30 million. Figuring 50 percent mortality (35 percent is typical, even lower in the north), a million smolts yields about 1,000 tons of salmon. Therefore, 1990's harvest should easily reach 30,000 tons; the B.C. government predicts 40,000, with a potential value to farmers of \$352 million.

Will the market be able to absorb that amount? "Markets are the big unknown," says Lipovsky. "Only the markets will limit us."

Lipovsky thinks the future will be a mixture of successes and failures. In addition to softening prices, he's worried about the high price of feed and a predicted shortage of skilled labor. He told the mostly student audience that employment prospects in aquaculture look very good in B.C. for the next five years at least.

"1991 will be the first crash of the industry," he predicts. Then the "merger phase" will begin; Lipovsky expects to see bargains on farms in two years.

Forty percent of the investment



This photograph from a Norwegian equipment supplier shows a typical small Norwegian fish farm. B.C. farmers have no such size restrictions.

so far as Norwegian, Lipovsky speculates. Norwegian applications for sites began mounting in 1984.

Have the commercial fishermen of B.C. become involved? No, Lipovsky said, the lifestyle is too harsh (he wasn't joking — he said the stresses of living in these isolated wilderness areas is taking its toll on participants, especially women).

The B.C. government makes it easy to get into this business: \$100,000, interest-free loans; grants; no environmental impact statement required for sites. You can claim virtually any wilderness site for \$150, as long as it's a mile and a half from the nearest salmon farm (that's one of the new rules, non-retroactive; formerly, it was only a half mile). Annual rent on government land is only \$200 per acre.

This massive buildup of salmon farming includes some problems. The fish — chemically neutered coho and feminized chinook — aren't growing as fast as they should, and no one is sure why. Inventories are

mysteriously low — farmers accuse the hatcheries of shortchanging them. Much of the feed has been low in quality, but now farmers are being offered high-fat, extruded feeds (at 40 cents a pound, expected to climb to 60 cents by 1990).

Some stress-related diseases have cropped up, as well as some minor hassles with algal blooms. However, Lipovsky gave the impression that the government finds very little to worry about with aquaculture so far.

One of the paradoxes of the business, according to Lipovsky, is that farmers are mostly growing 4-6 pounders, even though the greatest market-size need is for 6-9 pounders (restaurants prefer the big fish for "steaking"). The reason — the price of feed. Physical growth is rapid and economical during the first 24 months, especially for coho; continued growth, however, cuts profits.

"Coho will be the fish of the future because of its fast growth rate," Lipovsky said. □

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UFA NOTEBOOK

'Salmon Can Wait'

Alaska Mariculture

The feverish surge of interest in salmon farming in British Columbia, which has been likened to the Klondike Gold Rush, seems to be spreading to Alaska. Identical bills have been introduced this session in both houses of the Alaska legislature which would permit pen rearing of salmon.

UFA has been interested in mariculture problems since at least 1985. At their annual meeting that year, the Board of Directors noted that pen rearing of salmon was a rapidly growing industry that was already having impact on traditional domestic and export markets for Alaska salmon, with potential for even greater market penetration in the future. (They requested the State of Alaska perform a thorough study of the biological, economic and sociological problems and potentials of salmon pen rearing in Alaska. To date no such impartial studies have been done.)

The increasing interest in beginning this industry in Alaska was discussed at some length at the

determined that there are many potential problems with pen rearing salmon which must be addressed by state government before the industry is allowed to begin.

UFA's concerns about mariculture were expressed in a resolution issued by the Board at the close of this meeting. They conclude with a request that the State of Alaska take no action on legislation and development of salmon mariculture until such time as specific issues are addressed. The issues of concern cover a wide range.

*State funds and services for DEC, DNR, and FRED division at DF&G, already cut back due to shrinking revenues, will have to be further reallocated to address salmon farming. For example, the farms must be inspected periodically by state officials for maintenance of health and resource protection standards. Many of the salmon farms will be in remote locations, increasing travel costs to the State. It will require staff time to issue and monitor permits for operation

tained. Since the industry depends on freshness of its product, transportation needs must be met: the remoteness of the farming sites will require additional transportation routes which must at least be addressed by state government, even if subsidies are not requested. Money and staff time for these activities must be taken from existing programs. As yet no realistic fiscal note has been developed to identify the cost to the state incurred by management of the proposed activities.

*Competition for market with wild salmon will increase. Troll-caught fish are already in direct competition with pen reared salmon. Optimists believe the demand for fish will continue to rise and there will be substantial markets for both farmed and wild salmon. Increasing international participation in salmon farming, however, indicates there may soon be a flood of farmed product on the market. The commer-

cial fishing industry now needs marketing efforts which the state is unable to fund. UFA foresees additional problems if forced to compete with farmed Alaska salmon. UFA, however, is not opposed to mariculture of shellfish or aquatic plants and, indeed, sees these operations as offering great potential for the state's economy.

*Water and land use of traditional fishing, hatchery, rehabilitation, and smolt rearing and release sites may be locked out as permits are granted for establishment of salmon farms. Many of the land use permits that have been granted for oyster farming (shellfish is the only form of mariculture now allowed in Alaska) are not being used, and there is concern that speculators are establishing claim to desirable sites, intending to use them when salmon farming is allowed. The State has done no planning to determine the best locations for these farms, and

Alaska Fisherman's JOURNAL, March 1987

no controls have been proposed. Alaska has thousands of miles of coastline but there could easily be conflict between homeowners and salmon farmers, as has occurred in Washington. There may also be conflicts with the tourism industry and with sport fishermen, both of which are important activities for Alaska's economy.

*The potential for disease contamination of the wild stock has not been explored at all. In 1985 Norwegian fish farms were forced to destroy 2,900 metric tons of farmed salmon due to contaminated stock, but since Norway doesn't have its own salmon runs, no one knows what the effects might have been on wild fish. This is an area of serious concern to the commercial fishing industry.

*Many proponents of pen rearing salmon are touting the industry as one which can be done by small as well as large operations. They present it as a boost to the economy of Alaska's coastal villages and suggest that "mom and pop" operations can be as successful as those of a large corporation. In fact, current

evidence indicates this is far from the case. Because of the high costs of fish food, brood stock, and establishment of adequate transportation facilities, in addition to the length of time it takes to produce the first saleable product, it will be almost impossible for any small operation to succeed. Weyerhaeuser, Sealaska and some multi-national corporations which have expressed interest in beginning the industry in Alaska may be among the few operations which can actually be viable.

A recent report by the House Research Agency of the Alaska Legislature titled "Aquaculture in Alaska" mentions these and other concerns, but does not discuss them in any detail and presents few or no solutions to these potential problems. There is a feeling around the state that salmon farming is the wave of the future: it can't be stopped so the only choice is to jump on the bandwagon. UFA disagrees with this sentiment and offers a suggestion: if Alaska must become involved in pen rearing salmon then it should take this chance to do it right the first time. We have excellent international examples of successes and problems before us and we would be wise to emulate the

good and avoid the bad. This can be accomplished only through careful study and planning.

The House Research Agency report states that there is only a narrow window of time for Alaska to join the pen reared salmon industry, after which it will not be economically feasible to begin. UFA disagrees with this position: it feels there will always be room in the marketplace for a competitive product. In the meantime it is essential that studies be done and safeguards be developed to ensure that Alaska's already healthy commercial fishing industry is protected. □



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Prospects

Of Debt and the Dollar

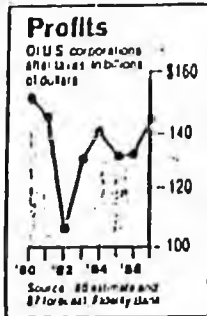
It was no accident that six of the so-called Group of Seven industrialized nations finally met last weekend to discuss the dollar, says Gert von der Linde, chief economist at Donaldson, Lufkin & Jenrette. The meeting came right on the heels of Brazil's announcement that it will suspend interest payments on its \$109 billion in international debt — a plan, says Mr. von der Linde, that has introduced a new threat to the dollar.

If American banks cannot collect on debt owed by Brazil or other South American nations, he says, foreign investors could lose confidence, withdraw their dollar deposits and sell the dollars on international markets — thus weakening the currency further.

But the G-7 meeting "prevented substantial decline in the dollar," Mr. von der Linde said. And the participants "pledge to intervene in the future if the dollar dips too low should help neutralize the Brazilian factor." "With the threat of intervention, the potential negative that Brazil represents is at least postponed, if not eliminated," he said.

Plumper Profits

One reason for the stock market's soaring rise is that investors are anticipating higher corporate profits in 1987, says Mickey D. Levy, chief economist at Fidelity Bank in Philadelphia. Mr. Levy predicts that profits this year will be 9 percent higher than in 1986.

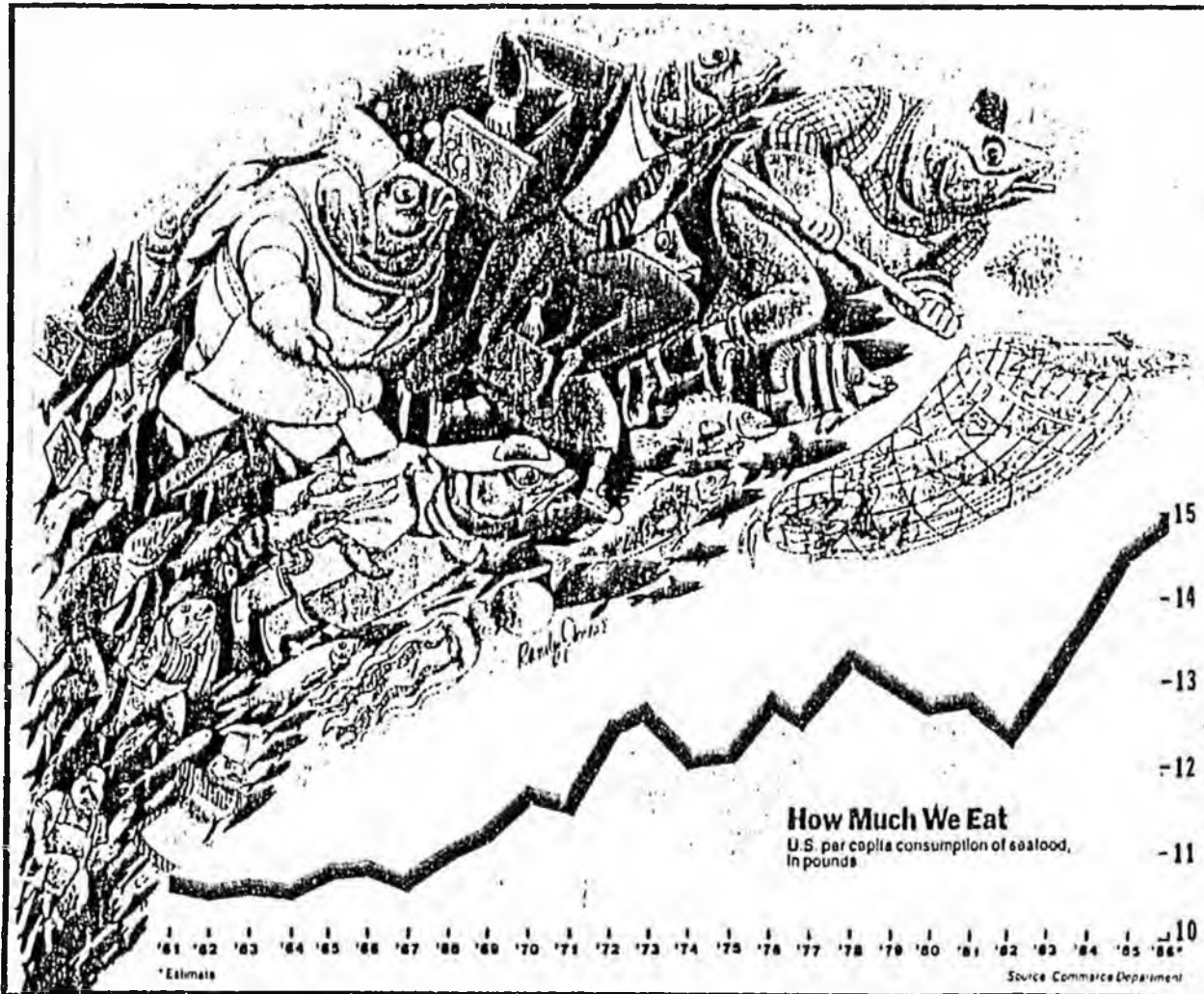


The weaker dollar is at the heart of the expected improvement, he says. The dollar's diminished value makes imports more expensive, and this, in turn, raises demand — and prices — for American-made products. Since labor costs are likely to remain relatively low —

major wage settlements are not expected until 1988 — profit margins will increase.

Where will profit gains be the greatest? Probably among companies that have been hurt by foreign competition during the strong-dollar years — chemical and pharmaceutical corporations, for instance. Such companies are poised for greater profitability, says Mr. Levy, since by now "they have trimmed their inventories, lowered their operating costs and reduced their break-even points."

Across America, the Fish Are Jumpin'



Passport Discrimination?

maybe some lobsters or some shrimp, and that would

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It's a bigger business than chicken. Even tilapia and skate wings sell.

By N. R. KLEINFELD

DURING Steve Connolly's early days in the seafood business back in the late 1940's, he was accustomed to getting the brush-off.

Working as a salesman for a Boston fish wholesaler, he would go out on his rambling pilgrimages to supermarkets and restaurants and, as he recalled, "I'd tell them I was selling fish. They'd say, 'Well,

maybe some lobster or some shrimp,' and that would be it. All the time, I'd hear, 'We don't use much fish. Now get going. The meat man just walked in.'"

Five years ago, Mr. Connolly founded his own wholesale company in Boston, called Steve Connolly Seafood. When his salesmen make their rounds, he said, the reaction is, "You're selling seafood? Sit right down. Take the best chair. I want something of everything you've got." His company sold \$8 million worth of fish its first year and \$25 million last year.

The seafood industry has changed drastically. As Americans have become bewitched by things like orange roughy, tilapia and opakapaka, the business has gone from mom-and-pop dimensions to sizable operations like Mr. Connolly's that do \$10 million to \$40 million in fish sales annually. With something like 4,000 seafood wholesalers and processors in the country, no one dominates the fish industry, though consolidation is beginning to occur.

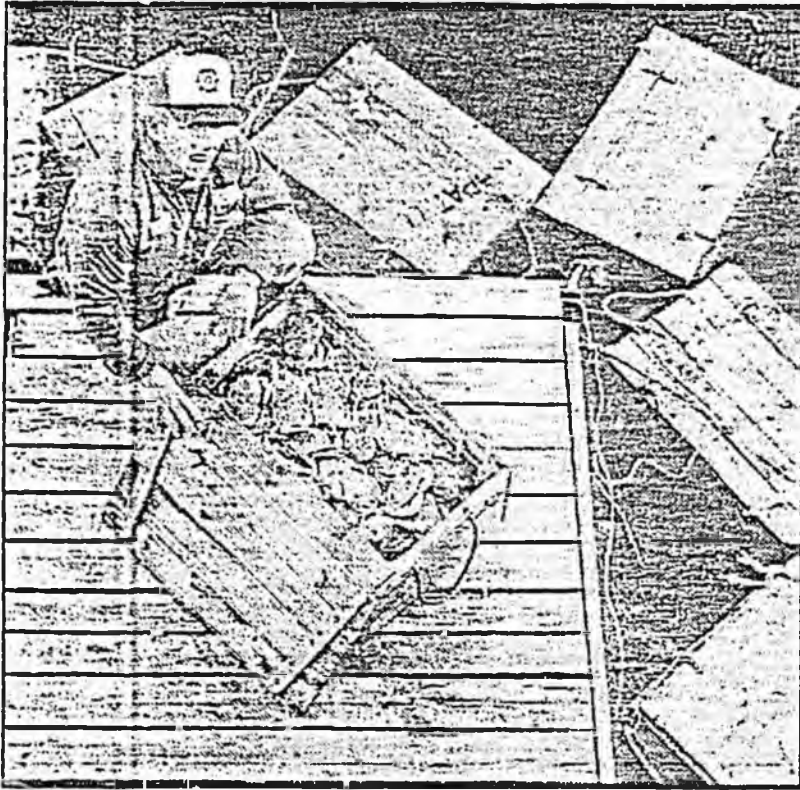
Seafood businessmen like to say that consumers have developed a penchant for just about anything that swims. To meet this demand, the 61-year-old Mr. Connolly has been fairly crafty in marketing peculiar fish products. Even he, though, is sometimes startled at what people will eat. His latest offering, for instance, is skinned skate wings (skate is a flat fish with the broad-winged body of a ray fish). It is tough to remove a skate's skin. Some people accomplish it by taking pliers and yanking it off. A few weeks ago, however, Mr. Connolly succeeded in adapting a machine normally used to skin liver to shave off skate wings.

"I think the wings are going to work well," he said. "They're cheap and so I see them having a wide appeal. Skate could really go."

Only a decade or two ago, fish had a dull image. It was something to eat grudgingly on Friday or when the budget was too strapped for a sirloin. Various fac-

Continued on Page 8

The Fish Are Jumpin' All



The New York Times/Sieve Liss

Culling live crabs at the dock for Connoily's Crabs in Gloucester (left). The crabs are shelled by machine.

Continued from Page 1

tors, however, have conspired to lift it from a food associated with penance to an everyday staple, and even a gourmet treat. Most of all, the concern for healthier diets has prompted consumers to gravitate to meat substitutes, like fish, that are low in calories and in fat. The steady spread of aquaculture, the science of raising fish on watery farms outside of oceans, has increased the seafood stock; some 12 percent of total American fish consumption now comes off farms, four times the amount in 1975. And wider use of airplanes to transport fish and better refrigeration equipment has introduced more fresh species to inland parts of the country.

These factors, says the National Marine Fisheries Service, have pushed per-capita seafood consumption up from 10.9 pounds in 1966 to 12.9 pounds in 1976 to 14.5 pounds in 1985. Expectations are that consumption may approach 30 pounds by 1990. That is still well shy of chicken, in the 59.5-pound neighborhood, and beef, at a dwindling 09.

Nobody, though, expects fish to catch poultry or meat. Not enough fish swim in the world's waters for that to happen, even though America imports more than half its seafood. And most fish do not grow quickly enough for fish farms to meet huge demand. If chicken eating goes up, farmers can toss more eggs into the incubators and within weeks chickens are plump enough for market. Fish,

however, can take two or three years to mature, at sea or on the farm.

"To increase per-capita consumption by one pound," explained Lee Weddig, the executive vice president of the National Fisheries Institute, a trade association, "you would need to catch 700 million additional pounds of fish in the water. The total amount of cod and haddock caught in New England is about 100 million pounds. So you see the problem."

Nevertheless, the taste for fish and the preoccupation with health, have elevated seafood to a roughly \$16 billion annual business — compared with \$12 billion in revenue for chicken, which is cheaper, and \$44 billion for beef — and encouraged a lot of companies to take a new look at it.

Now you can visit any burger outlet — McDonald's, Burger King, Wendy's — and find fish. There is also a growing network of fish specialty chains like Long John Silver, Sea Galle and the Red Lobster. Supermarkets, meanwhile, are opening new and sizable seafood sections. And big corporations like Ralston Purina, W.R. Grace, Campbell Soup, Weverhauser and Con Agra have gotten into fish farming. One group of companies has applied its energies to producing imitation fish products.

Demand keeps climbing even though prices of some species have reached the \$7 to \$10 a pound range. New, inexpensive varieties, however, are hitting the market, some selling for as little as \$2 a pound. Fish are not

enough that "trash fish" like monkfish that used to be dumped back are now being served in expensive restaurants and at classy dinner parties.

Kroger's feels it is as plugged-in as the wisest supermarket chains to middle American tastes. It was one of the first to discover fresh seafood — even though its 1,050 stores are largely sprinkled through the Midwest, where not a lot of fish swim.

Kroger will fly red snapper in from Taiwan, if that's the only place it can get enough. The chain even has its own fresh fish distribution warehouse, handling 72 varieties, in Greensburg, Ind.

Kroger's got into fresh seafood in 1977, and is steadily adding departments to all of its stores. It has gotten up to store No. 491. Its sales are growing by 15 percent a year, according to Bill Parker, a vice president. "It's probably the best growth category we have," he added. Fish, moreover, generally command higher markups than meat and poultry, Mr. Parker said. And the supermarkets realize that there is an enormous opportunity to be mined, since fish have predominantly been a restaurant product. According to surveys, two-thirds of the seafood sold is consumed at restaurants, though fish people believe the pendulum is starting to swing toward home preparation.

Grand Union took enough care with its new seafood departments that it hired Milton Glaser, a well-known

Alaska

Mariculture Association

Testimony to House Resources Committee Regarding CSHB 108
Rodger Painter, Executive Director

Since the issue of just who is interested in mariculture has been raised, I thought it might be appropriate to start off by telling you who I represent because the members of my organization are very interested in sea farming. Nearly all members are residents, and most are individuals, although nine Native corporations, two municipalities, one fishermen's group and a handful of Alaska businesses also have joined. The biggest single component of our individual members ~~are~~ commercial fishermen.

AMA's board of directors is composed of a city mayor, a vice-mayor who is managing a scallop farming project, vice-president of a native corporation, an oyster farmer and a legislative aide who fishes during the summer.

The common bond is that we believe that mariculture represents one of the state's best economic opportunities. This opportunity could mean literally thousands of year-round jobs in rural communities, tens of millions of dollars in outside investment capital, significant new sources of local and state revenues, and an economic boost to our sagging state economy from the private sector.

AMA believes mariculture development could help stimulate Alaska's economy, and it won't be at the expense of the fishing industry or other Alaskans. In fact, the seafood industry would be a primary beneficiary of mariculture in Alaska by fuller utilization of our processing plants, demand for fish feed, improved air freight services, and new off-season opportunities.

The year-round supply of seafood generated by sea farmers also could help protect Alaska's dwindling share of world seafood markets. Many of our processors already purchase foreign farmed salmon, scallops, shrimp and other cultured products to satisfy the needs of their customers. And, consumer demand for fresh seafood is continuing to increase at phenomenal rates, so imports of foreign products also will continue to climb.

Since the committee has been inundated with statistics, I have prepared a number of handouts for you to review at your leisure. I'll keep my testimony limited to issues raised during committee debate and some proposed solutions.

The question has been raised whether Alaska has a limited window of opportunity to enter sea farming. The answer in our opinion is no, but the longer we wait to get involved in opportunities like salmon farming the more difficult it will be to succeed. This is particularly true for smaller-scale investors.

Concern has been voiced about the potential for a glut on world salmon markets foreclosing Alaska's opportunity. While there certainly is a lot of farmed salmon headed toward the marketplace, consumer demand also is rising dramatically. Remember, U.S. seafood consumption grew by 21.5 percent or 609 million pounds in only four years.

We believe there is tremendous potential for growth of salmon markets in the United States. American per capita consumption of salmon climbed from .1 to .4 pounds between 1980 and 1984. This represents a very small percentage of the total seafood market, and can be improved through vigorous marketing, continuity of supply and product diversity. We believe there can be a very successful marriage between wild and farmed Alaska salmon to penetrate untapped Midwest and Southwest markets.

When looking at the market for farmed salmon, it also may be useful to examine the experiences of other fish farming industries. Market analysts projected demand for farmed catfish at about 20,000 metric tons or 44 million pounds a year when the industry was initially started. Catfish production now stands at 200,000 metric tons or 440 million pounds. Similarly, market experts originally predicted a 20,000 metric tons a year demand for Norwegian farmed salmon. This year's Norwegian salmon farming production should double that amount.

The marketplace is volatile and each investor will have to weigh the risks. Our experiments with the Alaska Renewable Resources Corporation taught us that government should not attempt to make those kinds of decisions for the marketplace.

There's been a lot of discussion about how Alaska should not duplicate the disasters of the Canadians and the need for orderly development. We must learn from B.C.'s good decisions as well as its mistakes. The Gillespie Report's primary recommendation was that the government continue to support salmon farming because the 70 existing farms already employ 375 people directly and spend \$50 million annually on services and supplies. The farms represent a total capital investment of \$75 million in areas with traditionally depressed economies.

We agree that the industry should develop in an orderly fashion, and we endorse the policy goals adopted by Governor Cowper as a sound approach.

We must caution that if you support development of an industry with maximum opportunity for small growers, you must keep this objective clearly in mind while rewriting House Bill 108. The more difficult you make the regulatory process, the more difficult it will be for small farmers to become involved.

An important issue raised during committee discussion has been use of the state's tidelands and public waters. Can mariculture occur in a manner that doesn't displace existing beneficial uses of these waters? We are convinced they can. The state should require that mariculture permits be found compatible with existing uses and the public be given adequate notification of proposed mariculture permits.

We also believe sea farming is no different than any other new use of public lands and waters. While we're not asking for preferential use of the tidelands, we don't want to be treated differently than other tidelands users.

We support the following changes to House Bill 108:

1. Tightening of the definition of who's allowed to hold a tidelands permit for mariculture. The present language allowing companies licensed to do business in the state does not adequately restrict permits to Alaskans.
2. Development of a mariculture tax designed to ensure Alaska gets a fair return on use of common property resources such as tidelands and public waters. Tax proceeds should be shared with local governments.
3. Tidelands management language ensuring protection of existing uses of public waters and adequate notification of the public.
4. Revision of the aquatic farm stock acquisition process to allow the commissioner of fish and game to protect existing uses of fishery resources. The Board of Fisheries should make decisions on stock acquisition permits that might affect allocations.
5. Restrictions on the size of salmon farms and number of permits held by individuals or companies to ensure that control of the industry is not concentrated in too few hands. This must be done in a careful manner to avoid strangling an industry before it gets a chance to start.

We also urge the committee to consider directing state agencies to adopt as interim standards siting criteria for salmon farms developed by the State of Washington. These criteria provide strong protection of the environment and wild stocks.

Important to keep in mind as the committee is deciding how to deal with CS HB 108 is the attorney general's opinion saying mariculture including salmon farming is legal. The decision is yours on how this fledgling industry should take shape and be regulated. No action will result in a gray legal situation inviting the courts to decide those issues without adequate guidelines to protect the public interest.

Alaska

Mariculture

Association

Mariculture Development and Alaska Processors

Alaska has some of the world's largest seafood processing capacities, but most of these plants remain idle or under-utilized for much of the year. Mariculture offers the opportunity to utilize these plants on a year-round basis, lowering overhead costs, providing more stable work forces and allowing Alaska companies to be more competitive in markets seeking continual supplies of fresh seafood.

Cultivation of shellfish--oysters, mussels, scallops--offer the opportunity for Alaska processors to diversify product lines, while salmon farming can provide a flow of fresh product during the off-season for commercial fishing. The year-round nature of mariculture also will help improve transportation services and lower the cost of moving product to the marketplace.

Mariculture also will provide a good market for fish food made from the waste generated at processing plants.

The complementary nature of mariculture to commercial seafood production is apparent in British Columbia where processors report an increasing flow of farmed salmon into existing processing facilities. A recent report prepared for the B.C. government said the B.C. Fisheries Council which represent major fish processors in the province "reported that a trend was beginning whereby many processing companies were joint venturing with fish farms to market their product, thereby using the excess capacity of existing plants. Government sources indicated that over 50 percent of farm salmon had recently been contracted for processing by the major unionized companies."

A recent article in the magazine Canadian Aquaculture points to a growing interest among processors in fish farming. "I think salmon farming could be the biggest thing in the seafood industry," said Harry Guenther of J.S. McMillan Fisheries. Guenther said the company plans to develop hatcheries to supply salmon farms, pick up grown fish from the farm sites, and provide processing and marketing services.

"Right now we all have underutilized production capacity," Guenther said. "Fish farming means these assets can be operated 12 months a year."

(over)

B.C. Packers, the largest processor in the province, also is processing and marketing farmed salmon. Explains company officer Vance Lipovsky: "B.C. Packers is in the business of selling fish. It's not important whether it comes off a boat or from a farm as long as it's of high quality."

Another example of the compatibility of fish farming and seafood processing comes from the east coast of Canada where Connors Brothers Limited has expanded into salmon farming. "We've taken an idle fish plant and turned it into a hatchery and feed plant," said a Connor Brothers spokesman. "Aquaculture allows us to keep employees we might otherwise have to lay off and provides additional employment opportunities as well."

The Prince Rupert Fishermen's Cooperative, B.C.'s second largest processing company, provides a clear example of the opportunities for both processors and fishermen. The House Research Agency reports that groups of six to eight fishermen are forming partnerships with local entrepreneurs to finance and operate salmon farms. Cooperative members have 10-20 farms under development. The coop operates hatcheries and a feed mill to service farms of members and to sell surplus production to others. The cooperative processes and markets the wild and farmed production of its members. These fishermen also are experimenting with oyster and mussel farming.

In explaining his support for mariculture development, one Southeast Alaska processor recently told the Alaska Mariculture Association that he wants to operate his plant, retain his local work force and supply customers seeking fresh fish on a year-round basis. Despite his efforts to buy all the troll salmon available during the winter fishery, he was able to purchase only 500 pounds of product the previous week. Naturally, the workers were sent home, the plant sat idle and the customers bought fish elsewhere.

Alaska Mariculture Association

Alaska Mariculture and Seafood Markets

Development of mariculture in Alaska could strengthen the competitiveness of Alaska seafood in the world marketplace. By broadening the diversity of products and providing year-round supplies of premium quality seafood, sea farming will help Alaska take better advantage of the growing appetites of consumers for fish and shellfish.

Seafood consumption in the U.S. grew by 609 million pounds or 21.5 percent during the past four years for which statistics are available (1982-85), but nearly all of that growth came from increased imports of foreign products. In fact, imports of foreign fish and shellfish increased by 14 percent in 1985 alone. The U.S. fisheries trade deficit amounted to a staggering \$5.6 billion that year.

The growing consumer demand for seafood in the U.S. and throughout the world is being filled by aquatic farm products. Global aquaculture production in 1983 was 22 billion pounds and accounted for about 12.2 percent of the total world supply of edible fish and shellfish. Experts say aquatic farming production will reach 48 billion pounds by 2000.

At the same time, commercial fishing production in the U.S. is declining slowly and world fisheries landings have stabilized. World aquaculture production is expected to grow by 5.5 percent annually over the next 25 years, while fisheries landings are anticipated to increase by .5 percent annually.

Development of oyster, mussel and scallop farms would bolster Alaska's ability to offer a variety of high quality fresh seafood, while salmon farming could allow seafood distributors to offer year-round supplies of fresh Alaska salmon. A long-term strategy of supplementing commercial fisheries landings with supplies of cultured seafood is Alaska's best hope of remaining a major force in world markets.

Another important market consideration for Alaska in mariculture development is the potential impact of farmed salmon production in the state upon commercial fishermen. A close look at the discrete markets for Alaska's diverse salmon industry reveals that farmed salmon competes with a very small segment of our wild salmon production.

(more)

Farmed salmon sales in the United States are directed at buyers willing to pay a premium for year-round supplies of high quality fresh seafood. Canned salmon and lower-value fresh and frozen products (pinks and chums) do not compete with farmed salmon. The deep red flesh and stronger flavor of sockeye salmon provides a secure market niche for Alaska's most valuable salmon species.

The premium quality U.S. markets being penetrated by foreign farmed salmon are important to only a small portion of Alaska's salmon production. Alaska's troll salmon production which supplies the bulk of premium quality salmon marketed in the "white tablecloth" restaurant trade accounted for less than 4 percent of the total value of Alaska's 1985 salmon production.

While farmed salmon has had a dramatic impact on European markets for Alaska's premium quality chinook and coho catches, the effect in the United States is very unclear. A 1986 survey of U.S. seafood buyers by the Marine Advisory Program showed that distributors and brokers, by a three-to-one margin, do not regard farmed salmon as a substitute for frozen Pacific salmon. This is significant since the Alaska Seafood Marketing Institute estimates that only three percent of Alaska's salmon production is sold on fresh markets.

Also important to keep in mind is that demand in the U.S. for seafood is rising so rapidly the market appears to be prepared to handle tremendous new volumes of product. And, foreign production of farmed salmon will be streaming into the U.S. from the 13 other countries now involved in salmon farming, regardless of what happens in Alaska.

A Scottish marketing research report said farmed salmon provided slightly more than six percent of the world salmon supply in 1985 and is expected to increase its total world market share to about 14 percent by 1990. The Alaska House Research Agency in a 1987 report to the legislature said, "By 1990, total farmed (salmon) production is expected to dominate world trading in both fresh and frozen premium products."

The additional amount of farmed salmon an Alaska industry is likely to produce will have an insignificant influence on any market competition between world supplies of pen-reared salmon and Alaska's wild catch. If the premium quality markets for Alaska's commercial fishing salmon production is to be affected, then these impacts will occur whether or not Alaskans are involved.

The House Research report on salmon farming summed up the situation like this: "...the question of whether or not pen rearing of salmon should be allowed in Alaska misses the crux of the issue. Rather, the basic question is whether or not Alaska will use its comparative advantages as a producer of farmed salmon to compete in growing domestic markets."

Alaska

Mariculture Association

STRAIGHT TALK ABOUT MARICULTURE DEVELOPMENT IN ALASKA

- Q. I've been hearing a lot about mariculture development in Alaska. What is it all about anyway?
- A. Mariculture--or sea farming--is a rapidly growing industry throughout the world that produces food, pharmaceutical and industrial products. Interest in Alaska focuses on the cultivation of high value fresh products to supply growing premium quality seafood markets. The productive, unpolluted waters of Alaska's many sheltered bays and fjords are considered some of the best mariculture sites in the United States. These sea-farming operations offer tremendous opportunities in coastal Alaska to develop year-round jobs. This is particularly important in rural communities where there are few other realistic, stable sources of new local employment. Literally thousands of non-petroleum dependent jobs could be created.
- Q. What kind of jobs and how many will be created? Are we talking about another industry that will employ many non-residents and provide few local benefits?
- A. One of the most attractive features of mariculture is that it will offer year-round jobs which are likely to be filled with local residents. Many mariculture operations, particularly shellfish culturing, are ideally suited for family enterprises. Finfish farming is more likely to involve a range of businesses from family operations to medium sized farms employing up to ten people. These businesses also will create new opportunities for local processing plants, light industrial manufacturing of equipment such as nets and pens, and new markets for fish and fish wastes to be used in production of fish food. The increased exports of fresh seafood products also could help lower transportation costs for all Alaskans. The number of new jobs that could be achieved under development of the full potential of sea farming in Alaska is difficult to estimate. A 1987 study for the legislature projected "a total employment effect of about 1,920 jobs and a payroll of \$48.8 million" for salmon farming alone. This would provide more resident jobs than the present Alaska logging industry and nearly double the resident payroll.

Q. Isn't mariculture something new and untested?

A. Fish farming probably originated in China about 600 B.C. and oyster culturing thrived in ancient Rome and Gaul. Recent advances have led to an aquaculture explosion around the world. The federal government estimated the 1983 world production of aquaculture seafood at about 22 billion pounds; this is expected to increase to 48 billion pounds by the turn of the century. Commercial fishing landings are expected to remain relatively stable during the same period. This production from aquatic farms will become increasingly important to keep pace with projections for increased consumption of seafood.

Q. How do we know it will work in Alaska?

A. Alaska already has nearly a dozen sea farms producing oysters, one producing mussel farm, and a recently concluded agreement between the State of Alaska and Japan calls for the development of seven scallop sites on Kodiak Island to test the feasibility of scallop farming in Alaska. The agreement also covers a feasibility study of giant kelp (Macrocystis) farming in Sitka. Experiments conducted in Southeast by the state and federal governments have proven the feasibility of pen-rearing king salmon to marketable size in a competitive period of time.

Q. I'm concerned about salmon farming. Can you tell me more about it?

A. There currently are about 15 countries currently producing pen-reared salmon. Worldwide production of farmed salmon increased from 27 million pounds in 1981 to 97 million pounds in 1985. This is expected to grow to 314 million pounds by 1990. These dramatic increases are reacting to a strong and growing demand in the marketplace for fresh, high quality seafood. Seafood consumption is growing rapidly throughout the world, and no where faster than in the U.S. Americans ate 609 million more pounds of fish in shellfish in 1985 than they did in 1982 which represents a 21.5 percent growth in only four years. Since domestic commercial fishing production declined over the same period nearly all of the increased sales were enjoyed by foreign producers. In fact, America's seafood trade deficit increased by 14 percent in 1985 alone to climb to a staggering \$5.6 billion.

Q. Even though the market is growing, the increases in farmed salmon production sound like they might hurt our salmon fishermen.

Sales of farmed salmon in the U.S. are directed at markets for premium quality fresh seafood; the Alaska Seafood Marketing Institute estimates that only three percent of Alaska's salmon catch is sold on fresh markets. A 1986 survey of major U.S. seafood distributors conducted by the Alaska Sea Grant Program and the University of Alaska reveals that few buyers consider

farmed salmon to be a legitimate substitute for frozen wild salmon. Markets for Alaska's great volume of lower value salmon species (pinks and chums) and virtually all canned production clearly are unaffected by the high value farmed salmon. Likewise, existing markets for frozen sockeye salmon appear to be unthreatened. The only area of market impact on Alaska fishermen from farmed salmon is the "white tablecloth" restaurant trade which is primarily filled by troll salmon. Trollers accounted for about four percent of the value of the 1985 salmon catch. The relatively minor impact of farmed salmon on prices for wild salmon is underscored by recent figures from the Alaska Department of Fish and Game. The 1986 Alaska salmon catch of 123.5 million fish was worth \$385 million to fishermen or \$15 million more than value of the previous year's harvest of 144.6 million salmon.

- Q. This information appears to suggest that farmed salmon is having little impact on markets for wild salmon, and there is a growing demand for premium quality salmon. How can we take advantage of this opportunity?
- A. To take full advantage of the growing markets for premium salmon Alaska should move forward on two fronts. First, we need to more aggressively promote our premium quality salmon products, both fresh and frozen. A pilot project for a Premium Quality Seal Program was tested in 1986 by the Alaska Seafood Marketing Institute and Department of Environmental Conservation using frozen troll-caught salmon. If successful, this project could forge the way for the needed promotional effort. Secondly, Alaska should move forward with the pen-rearing of salmon so we don't miss out on this important opportunity for growth. Millions of dollars have been pumped into the Norwegian economy from 740 salmon farms and 250 hatcheries. This fact has not gone unnoticed by Alaska's neighbors--British Columbia and Washington State--who are aggressively promoting salmon farming. The market opportunities will be filled by others if Alaska fails to act.
- Q. Have salmon fishermen in other countries become involved in salmon farming?
- A. Yes. More than half (55 percent) of the applicants for Norwegian salmon farming permits between 1973 and 1978 came from a fishing background. The Prince Rupert Fishermen's Cooperative in British Columbia provides an excellent example of how fishermen can take advantage of fishing and farming. Groups of six to eight fishermen are forming partnerships with local entrepreneurs to finance and operate salmon farms. Cooperative members have 10-20 farms under development. The Prince Rupert Cooperative operates hatcheries and a feed mill to service farms of members and to sell surplus production to others. The cooperative processes and markets the wild and farmed production of its members. These fishermen also are experimenting with oyster and mussel farming.

- Q. How about impacts on our wild stocks? Won't exotic diseases be introduced, and what about the potential for sea-farmed fish and shellfish to escape and intermingle with wild stocks?
- A. The State of Alaska already has recognized the need to ensure that cultured fish and shellfish do not pose a health risk to wild stocks. The state has implemented the most stringent cultured fish health standards in the nation. These regulations apply to the existing private nonprofit salmon ocean ranching program and to mariculture operations. The impressive track record of Alaska's ocean ranching program demonstrates that salmon, other finfish and shellfish can be cultivated in public waters without risk to wild stocks. These proven regulations are a model for health management systems at mariculture facilities. Mariculturists are very concerned and careful about the prevention of disease because it is critical to the profitability of sea farms that production losses be very minimal. State government will play major regulatory and extension agent roles in ensuring that mariculture operators have adequate health management systems to maintain the health of the cultured species while protecting wild stocks. A 1986 study by the University of Washington concluded that disease from farmed fish "does not appear to be transmitted to the wild population." The study went on to say, "The potential consequences of the interbreeding of escaped and wild organisms, if any at all, are unclear. However, for salmonids at least, the potential magnitude of the problem would seem minimal" when compared to the impacts of present ocean ranching programs.
- Q. Mariculture operations obviously require continual sources of brood stock. Where will it come from? Will it impact existing fisheries and enhancement programs?
- A. Sea farms will require dependable sources of disease-free brood stock. During initial development of a salmon farming industry, brood stock will be acquired through purchases of surplus eggs from private or public hatcheries. This can be replaced by private hatcheries developed by salmon farmers. Some shellfish farms--mussels and scallops--will require the collection of brood stock from wild sources. Brood stock taken from these common property sources--hatcheries or gathering from the wild--will occur only if a surplus exists.
- Q. I'm concerned about pollution. Will sea farms create accumulations of waste that will pollute our waters?
- A. Clean water is a primary concern of mariculture operators as most cultured species are very susceptible to pollution. One of the reasons Alaska is so attractive as a mariculture center is its clean and pure waters. A recently completed study by the University of Washington of salmon farms and shellfish operations in Puget Sound said there appears to be little risk of adverse environmental impacts from mariculture. Only farms located in

areas of very poor circulation pose any danger of accumulations of organic rich debris threatening sea life.

Q. If mariculture is such a natural for Alaska and could be so beneficial why are there so few sea farms?

A. Alaska has lagged behind other areas primarily because of the strength of its natural fisheries resources; mariculture development has been pioneered in countries where the natural stocks have been depleted. The strong market demand for cultured seafood has sparked considerable interest in Alaska in recent years. Individuals and companies interested in mariculture in Alaska have encountered the normal problems facing the development of any new industry. In this case, those problems have been exacerbated by the lack of a state policy on mariculture development and the resulting void in direction to regulatory agencies. The many Alaskans interested in mariculture have found that permitting processes presently exist only for oyster farming.

Q. Does this mean Alaska needs to develop a new layer of regulations and bureaucracy to deal with mariculture?

A. No. Existing permitting processes can easily be adapted for mariculture licensing, and the industry will require little in the way of new government services. Mariculture supporters are primarily interested in getting the state to provide a regulatory climate conducive to development of stable, profitable businesses.

Q. Who will be able to participate in mariculture anyway?

A. Mariculture is open to everyone. No limited entry system or other artificial legal barriers have been erected. As mentioned earlier, there is great opportunity for many small-scale businesses, many of which will primarily require sweat equity investments.

Q. You've convinced me. How do I find out more about mariculture and get involved in this wonderful opportunity?

A. The Alaska Mariculture Association has been formed to advocate policies leading to the development of a stable, year-round mariculture industry, and to assist businesses develop into profitable operations. The AMA will provide members with information pertaining to the permitting and regulatory system, markets, sources of investment capital, quality assurance practices, research, suppliers and other issues of concern. Memberships start at only \$25 per year.

Alaska

Mariculture

Association

Costs of Entering Salmon Farming vs. Fishing

One of the issues raised during discussions of mariculture development is the high cost of entering salmon farming. The Alaska Mariculture Association (AMA) believes the costs of establishing a salmon farm are comparable to many fishing operations in Alaska.

An economic feasibility study of salmon farming prepared for an Alaska corporation estimated the initial capital and operating costs of establishing a small (110,000 pounds annual production) at \$243,000. The study estimated the initial cost of a larger farm (440,000) at \$896,000.

According to the fisheries consulting firm of Garner and Williams, following are typical initial costs of entering the Bristol Bay salmon fishery, including the purchase of a new vessel and permit.

Estimated Costs of Entering the Bristol Bay Drift Salmon Fishery

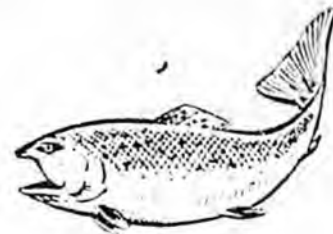
Vessel, electronics, gear	\$120,000-200,000
Permit	130,000
Insurance (4% of vessel cost)	4,800-8,000
Groceries	2,000
Fuel	2,000
Transportation/miscellaneous	5,000
TOTAL	<u>\$263,800-347,000</u>

The cost of entering the Bristol Bay salmon fishery should be considered a mid-range fishing investment. The following examples of capital costs taken from the classified ads show a wider range on entry costs. The vessel costs are for used boats.

Vessel/Gear/Permit Costs for Some Alaska Fisheries

Power troller (44' wooden) with permit	\$87,000
Prince William Sound gillnet (28') w/permit	110,000
Cook Inlet salmon seine (36' fiberglass) w/permit	157,500
Steel seine vessel w/SE salmon permit	289,500
w/SE salmon & herring permits	589,500
w/False Pass salmon permit	500,000
AK Peninsula drift/longline (46') w/salmon permit	550,000
66' steel crabber/longliner w/refrigeration	350,000
53' steel seiner/crabber	400,000
103' steel joint venture dragger	1,950,000

MTC
Meyers Trading Co.
Fish Buying • General Store



Meyers Chuck, Alaska 99903

March 7, 1987

Representative Adelheid Herrmann
Alaska State Legislature
Pouch V (MS 3100)
Juneau, Alaska

Dear Representative Herrmann:

I am requesting your support of HB 108 because strong legislative leadership is needed if Alaskans are to participate in the "Blue Revolution" (see House Research Agency Report 37-8: Aquaculture in Alaska).

Aquaculture offers remote coastal communities like Meyers Chuck an opportunity to diversify their economies, which are based generally on fishing and logging. For example, during the past ten years, the volume and value of salmon harvested at Meyers Chuck decreased by nearly 50 percent as a result of market conditions and changes in harvest regulations. Because of the depressed lumber market local residents have been unable to enter this industry and have had to move from the community or seek financial assistance from the state in order to remain.

Aquaculture can ameliorate the effect that the volatile fishing and logging industries have on local economies by providing off-season employment for fishermen and loggers as well as year round employment. As stated in the aforementioned report, employment in aquaculture if it is allowed to develop in Alaska may exceed that provided by the logging industry.

Many of your constituents are involved in the salmon industry and are concerned about the effect of salmon farming on their traditional markets. Rightly, they should be concerned, because regardless of what the legislature decides pursuant to aquaculture, the industry is and will continue to compete with high quality pen reared fish from Europe, South America, New Zealand and parts of the Pacific Rim. I am concerned that by concentrating their efforts on resisting development of an Alaska based salmon farming industry, they are hiding from the need to improve the quality and marketing of wild caught salmon (which is needed if the industry is to maintain its market share).

Thank you for your consideration.

Sincerely

A handwritten signature in dark ink, appearing to read "R. Meyer". The signature is fluid and cursive, written over the typed name below it.

Robert M. Meyer



Resource Development Council

for Alaska, Inc.

807 "G" Street, Suite 200, Anchorage, Alaska 99501-3440
Box 100516, Anchorage, Alaska 99510-0516 - 907/276-9700

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EX-OFFICIO MEMBERS
Senator Ted Stevens
Senator Frank Murkowski
Congressman Don Young

March 2, 1987

The Alaska Legislature
Juneau, AK 99811

re: Mariculture legislation

Dear Alaska Legislator:

The Resource Development Council supports HB 108 and SB 106 as a means of diversifying the seafood industry and creating resident employment through mariculture development. It is important that we have legislation in place which addresses all types of mariculture projects.

Existing law bans many forms of aquatic farming in Alaska. We must legalize all shellfish, sea vegetable and finfish operations if we are to take advantage of the market opportunities that mariculture presents.

Mariculture products compete in markets completely separate from commercially caught and processed seafood products. By penetrating these new markets and introducing consumers to new, high-quality Alaska seafood products, all Alaska seafoods will benefit from a more positive image.

Mariculture operations require full-time, year-round labor forces. Not all regions of the state will be suitable for mariculture, but where it is feasible, it can provide a much-needed expansion and stabilization of local employment. For some communities where traditional fisheries are declining and little or no opportunities exist in other industries, mariculture may be the brightest spot on the horizon.

HB 108 and SB 106 provide a framework within which all areas of mariculture can be developed with concern for the environment and existing fishery activities. The Resource Development Council supports passage of these bills to help diversify and stabilize Alaska's economy.

Sincerely,

RESOURCE DEVELOPMENT COUNCIL
for Alaska, Inc.

Paula Easley
Paula P. Easley
Executive Director

MAR 25 1987

Adelheid Herrmann, Representative
Alaska State Legislature
P.O. Box V (MS 3100)
Juneau, Alaska
99801

February 23, 1987

Dear Representative Herrmann:

As a partner in a private, non-profit salmon hatchery and "hopeful-to-be" participant in a mariculture operation, I have a personal interest in HB-108. As a professional economist in Alaska since 1971 and a resident since 1963 I am convinced that your support of mariculture in Alaska is in the public interest.

Many people who have an interest in mariculture do not expect state loans, gifts or other forms of "help". What we do expect and hope for is a simple approach that will remove the bureaucratic pitfalls and redundant state "processes" that required over four years of persistence and dedication to obtain just the permits for one of the private non-profit hatcheries.

What we ask for is a cleared path that we can walk on in pursuit of our entrepreneurial interests. I cannot afford another four or five years of expense, labor and opportunity cost.

It is predictable, I suppose, but disturbing that the regional aquaculture associations have solicited proposals from lobbyists to mount a campaign designed to prevent passage of legislation that will allow for private mariculture operations.

Your expertise and leadership will prove invaluable in allowing the mariculture industry in Alaska to prosper and grow. Alaska is a small part of the international fishery economy, but the potential exists to become very significant. If you will assist by making sure that we are allowed to pursue our goals the potential may be realized.

I will look forward to your response and contribution to enabling legislation.

Respectfully,

Michael A. Bryan
1435 J ST.
Anchorage, Alaska
99501

March 3, 1987

The Honorable Adelneid Herrman
HOUSE OF REPRESENTATIVES
P. O. Box V
Juneau, Alaska 99811

Dear Representative Herrman:

I am 23 years old. I was born and raised in Alaska. I have commercial fished for the past 6 years, as a deckhand in both the Bristol Bay and Cook Inlet salmon fisheries, and I have longlined for halibut. I am writing to voice my support of House Bill 108, the mariculture bill. As a young Alaskan, I seek employment in a field that will provide me with security and a sense of permanence. More specifically, I have reached the point where I wish to obtain my own commercial fishing operation, yet, prohibitively high start-up costs prevent me from doing so.

The limited entry system has created an economic barrier that prevents many Alaskans like me from participating in the salmon fishing industry in an owner/operator capacity. It requires anywhere from \$100,000 to \$500,000 to break into today's salmon fishery at a successful level. Over half of this start-up cost derives from the exorbitant value placed on limited entry permits.

Traditionally, Alaskan fishermen have been a symbol of independence. In the past, they have prided themselves on being their own bosses, on making a living from Alaska's waters. Recently, however, the economic barriers erected by limited entry have created an exclusive fishery that excludes many Alaskans, both white and native, from participating in a traditional livelihood. Young, aspiring commercial fishermen have been denied access to a natural resource that is the common property of all Alaskans. Currently, over 20% of all limited entry salmon permits are held by non-residents. Additionally, most fish processing plants are owned and operated by Seattle-based firms. Obviously, with such a high percentage of nonresident fishermen and processors, much of the revenue generated by Alaska's salmon fishing industry leaves the State. Alaska's commercial salmon fishery no longer offers

The Honorable Adelheid Herrman
March 3, 1987
Page 2

an alluring sense of independence. Since going limited entry, the salmon industry has transformed into an economically exclusive enterprise. For me, and many like me, the commercial salmon fishery is a closed door.

A second problem which plagues Alaska's salmon fisheries is a short, but intense fishing season during which huge volumes of salmon must be harvested and processed in a matter of weeks. High volumes of fish result in a poor quality product. The fish are thrown about, are walked upon, and in some instances, remain aboard tenders for as long as 48 hours without being processed or refrigerated. Despite precautionary measures taken in transporting and processing the product, salmon are severely bruised by seine nets and gill nets before they are even removed from the water. Because of poor quality, 97% of Alaska's salmon are sold on the frozen and canned market.

A mere 3% of Alaska's salmon are sold on the fresh market. Alaska's fresh salmon production is caught by a handful of Southeast troll fishermen whose low volume fishery enables them to maintain a high standard of quality. As a result, they are rewarded with a sale price that is as much as four times the price of salmon destined for the canned market.

Fish farms will produce a similar, premium product and will cater to this same fresh market. Only fish farms will be able to supply fresh fish on a year-round basis. Southeast troll fishermen contend that fish farming in Alaska will undermine their markets. Such is not the case. Southeast troll fishing cannot possibly meet the rapidly growing demand for fresh salmon. Presently, demand is so great, yet U.S. production is so low, that the United States must import the majority of its fresh salmon from salmon farms in Norway. Secondly, the southeast troll fishermen will not be displaced by Alaskan fish farmers. Instead, foreign suppliers will be forced out of U.S. markets as Alaskan fish farms begin to fill the demands of a fresh market.

Fish farming is an industry that is taking root throughout the world. Norway and Japan, world leaders in fish farming, already have developed worldwide markets for

The Honorable Adelheid Herrman
March 3, 1987
Page 3

pen-reared salmon. France, New Zealand, Great Britain, Chile, and Canada are rapidly following suit. Although many commercial salmon fishermen sincerely believe that salmon farming in Alaska will destroy their livelihood, this is not the case. Japan, for one, has shown the opposite to be true. In Japan, fish farmers and commercial fishermen coexist successfully. And, closer to home, Washington state has demonstrated similar cooperation between farmers and fishermen. Besides, if commercial fishermen's concerns over competition from Alaskan fish farms were truly warranted, then should they not be equally concerned about competition from foreign fish farms? The fact is, the rest of the world will develop mariculture industries regardless of what Alaska decides to do. Fulfilling this country's fresh market through pen-reared domestic salmon rather than through pen-reared foreign salmon will ultimately secure this country's salmon markets for Alaska's commercial fishermen and fish farmers alike.

Finally, fish farming can bolster Alaska's depressed economy. It can provide new opportunity for stranded commercial fishermen like me. More importantly, a mariculture industry can directly employ thousands of Alaskans on a year-round basis, and can indirectly employ thousands more in the fields of engineering, construction, transportation and marketing.

Governor Cowper, in his State of the State address, stressed the need for Alaska to break away from its dependence on oil. He emphasized the need to diversify Alaska's economy to ensure fiscal strength in the future. The mariculture industry provides one such opportunity to diversify. Alaska, with its clean waters and limitless coastline, is ideally suited to support a multimillion dollar mariculture industry. The time to act is now. As policymakers and fellow Alaskans, I urge you to support House Bill 108. Mariculture in Alaska can pick up where oil left off by providing high quality, fresh seafood products that can be marketed worldwide and throughout the year. Together, Alaska's fish farmers and commercial fishermen can develop international markets that will propel them to the forefront of world salmon production and will give new

The Honorable Adelheid Herrman
March 3, 1987
Page 4

dimension to Alaska's proud title of "the salmon capital of
the world."

Sincerely,

Thomas C. Pease

Waterfour Industries Ltd.
P.R. 1 Site 6 Comp. 4
Denman Island, B.C. V0R 1T0

MAR 25 1987

March 26, 1987

The Honorable Adelheid Herrmann, Cochair,
House Resource Committee

Attention: Deborah.

Madam Chairman and House Resource Committee members:

Due to the particular topics scheduled on March 24th much of the results of my experiences in salmon farming went unsaid. I would like to make the following statements in hopes of assisting Alaska to begin developing of what many of us believe to be one of the best economic opportunities Alaska has -- aquaculture. The following opinions are that of the General Manager of a salmon farming venture that is in the process of developing 10 sites with annual sales of US\$25 million within five years, relative to some B.C. ventures, not a particularly aggressive plan.

1. Salmon industry evolution. Salmon farming has become an important part of world salmon marketing. It will not cease to exist. If Alaska chooses not to become part of it, other nations will applaud. Along with their salmon farmers, other countries processing plant workers will work year around, as will their dragners, net, feed and equipment makers, marketers and many others.

2. Farm size: Aquaculture is a very competitive economic endeavor, Alaska has to come from way behind over a dozen other nations in technical, financial and in infrastructure matters. Aquaculture cannot be expected to have much of a chance if made to bear, however well intended, legislated inefficiencies -- such as farm size restrictions. (Two sizes appear to be the most viable -- small, perhaps family based, operated by someone who already lives on or near a site, who combines with other small farmers in purchasing and sales, and larger, corporate based clusters of five-ten farms. Big corporations have not, thus far, done well in aquaculture.)

The result of making the same mistake Norway has made in limiting the volume of net pens allowed is too high of fish density. The result of that is increased costs due to disease resulting from stress, increased point source organic loads, and overall much greater financial risk.

3. Markets: What harm that has been done to Alaskan salmon fishers, for the near term has already been done. (Norway alone produces more farmed Atlantic salmon than the total U.S. catch of coho and chinook combined, all states, all gear types.) In regards to salmon farming, what Alaska does or does not do will not matter for many years in international farmed salmon markets. If no discernible difference exists, and if a net increase in jobs are to be realized, then we should have it. Additionally a consistent supply of fish, commercially harvested in the summer and commercially farmed in winter will result in year around jobs -- the best way to "Alaskanize" the fishing industry that I know of.

Page 2

4. Supply of domesticated smolts. Each small farm will need about 10,000 smolts, large farms, 100,000-plus. It is suggested that strong urging be given to ADF&G-FRED Division to at least supply eggs, and that provisions for converting local PNP corporations to private-profit hatcheries (with loan payback as a condition) be provided for. (The IRS status of PNP hatchery corporations must be carefully considered.)

It is also suggested that domesticated broodstock be prudently allowed into Alaska, in small numbers, for a restricted period of time while we are testing and selecting local stocks. Without fish stocks long held in captivity, Alaska will have a difficult time catching up. (See the latest Canadian regulations for a guideline -- enclosed.)

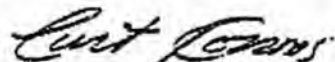
5. Ongoing research and development/training. No new species of aquatic organism has recently been brought into cultivation without extensive R&D efforts. The model that appears to work best is typically university-based, with a state providing the facility and the researchers finding the actual research project funds. Combined with community college efforts, workers can also be trained at the facility.

6. Unnecessary/duplicated controls. There already exists a plethora of studies in which no major problems have been found -- at least none that compare with the question "What is the effect of commercial or intensive recreational fishing?". Many agencies already have a myriad of laws and regulations, just ask someone who has been through the maze already. Pollution (salmon are a pristine water organism so that problem is self-correcting), shipping lanes and safe harbors, traditional fishing grounds and other land use conflicts and a number of other potential problem areas already have a number of concerned agencies. As you know all too well, these times of decreasing budgets. Imposing additional demands upon state agencies, when existing statutes and regulations already protect the public interest due to vague concerns, serves no one.

7. Financing. Salmon farming is capital intensive due to the two-three year period at start-up with no revenues. To start even a small farm can easily require \$50,000 or more. A moderate-sized farm can require \$2 million. Banks do not readily loan monies for new ventures in start-up industries. The only source of financing that I know of from financial institutions comes from countries already well established in salmon farming. (The best source is Norway.)

You do not have an easy task ahead of you, but Alaskans need the work.

Thank you for your time,



Curt Kerns, General Manager

Federal-Provincial Policy for the Importation of Live Salmonids into British Columbia

In recognition of the commercial and recreational value of wild and cultured native salmonid stocks in British Columbia and the Yukon Territory, it is essential to protect their genetic integrity and freedom from exotic diseases.

Therefore, no importations of fish belonging to the family Salmonidae will be authorized by Federal or Provincial fisheries management agencies which are not in compliance with this policy, effective on date of signing.

General:

1. Approved importation of live salmonids must comply with the Canadian Fish Health Protection Regulations (CFHPR).
2. Only surface-disinfected, fertilized eggs will be imported. No live fish or unfertilized eggs or milt will be allowed.
3. Only Atlantic salmon (Salmo galar) and ~~non-anadromous rainbow trout (Salmo gairdneri)~~ will be considered for importation.
4. Importation of rainbow trout will be considered only from brood stock that was hatched and reared in Canada and continental U.S.A.

Atlantic Salmon:

5. As of April 1, 1987, egg imports will be limited to 100,000 eggs/year/licence and allowed only from brood stock that has been held at the source facility (hatchery and sea pen), separate from other stocks, for one full generation. This means that consideration could be given to F₂ Atlantic salmon from Canada and the U.S.
6. No direct importation of Atlantic salmon eggs will be permitted from continental Europe, from the southern hemisphere, or from countries in which viral hemorrhagic septicemia (VHS) is known or suspected to occur. Importation will be considered only from sites that (i) a Canadian Local Fish Health Officer has approved after a site inspection; (ii) can demonstrate a thorough record of disease history to the satisfaction of a Canadian Local Fish Health Officer; (iii) can document and demonstrate disease-free water supply system; and (iv) can document and demonstrate the capability of the physical plant to isolate stocks and prevent disease transfer between stocks.

- 2 -

7. Importation of Atlantic salmon eggs will be for the purpose of developing aquaculture brood stocks in British Columbia. Importers must propose a number or percent of fish to be held to maturity for reproduction and collection of sex products and demonstrate progress and intent to establish brood stocks.
8. Consideration for import will be given particularly to stocks that are demonstrably adapted for commercial aquaculture pen rearing, assuming that all other conditions are met.
9. After March 31, 1989, no further shipments of Atlantic salmon will be permitted.
10. All Atlantic salmon must be held under strict quarantine (as outlined below).

All Live Salmonids:

11. Notwithstanding sections 2,3,5,6 and 8, exceptions may be permitted for limited numbers of eggs or small volumes of milt for such activities as research or brood stock development and improvement when work is to be conducted under strict supervision of government fisheries agencies. Approval for exceptions must be obtained from the Director General, Pacific Region, Department of Fisheries and Oceans and the Director, Fisheries Branch, British Columbia Ministry of Environment and Parks.

Atlantic Salmon Quarantine Conditions:

12. Prior to the arrival of any eggs, a quarantine facility must be inspected and approved by designated government personnel according to the following conditions as judged by the designated Fish Health Officer. The quarantine facility must:
 - a) be an adequately enclosed area, physically separated from any other hatchery operation;
 - b) have restricted access;
 - c) have approved facilities for disinfection of effluent.
13. All eggs and resultant fish must be held in quarantine for a minimum of 12 months after arrival.
14. All stocks in the initial year and thereafter all stock kept for brood stock must be inspected and sampled according to the CFHPR Manual of Compliance. Fish must be sampled 3 times in their quarantine year and once just after transfer to salt water. Brood stock must be sampled at maturity.
15. Diseased stocks:
 - a) shall be destroyed if VHS, IPN, or whirling disease is detected, and
 - b) may be ordered destroyed or treated if any disease listed in Schedule II of the CFHPR is detected.
 Also, detection of any other disease designated by Federal and Provincial fisheries management agencies may lead to the same requirement for stock destruction or to further quarantine of the stock.

...3

16. Failure to comply with importation or quarantine conditions will result in suspension of the Commercial Fish Farm Licence of the facility.

Marine Rearing of Atlantic Salmon:

17. All movements of Atlantic salmon from hatchery to salt water will be by Federal-Provincial Transplant Committee approval only.

The precautions taken in 1 to 17 above are designed to minimize the risk of introducing exotic fish diseases and to maximize the chances for detection of any exotic fish diseases that may be carried by introduced stock.

Procedures:

18. All requests for permission to import live salmonids are to be addressed to the Canada-British Columbia Transplant Committee, c/o Local Fish Health Officer, Pacific Biological Station, Hammond Bay Road, Nanaimo, British Columbia, V9R 5K6.

19. In recognition of the importance of managing fish disease upon the orderly development of aquaculture in British Columbia, and recognizing the lead role of the Ministry of Agriculture and Fisheries in aquaculture; the Department of Fisheries and Oceans and the Ministry of Environment and Parks will confer with the Ministry of Agriculture and Fisheries:

- a) prior to any decision being made by the parties regarding item 11 requests;
- b) prior to any amendments to the policy under item 20;
- c) at least semi-annually regarding the nature and status of requests to the Canada-British Columbia Transplant Committee to import live salmonids to British Columbia.

Amendment:

20. This policy may be amended by mutual consent of the signatories.

APPROVED:

Peter Mayboom, Deputy Minister
Department of Fisheries & Oceans

B. E. Marr, Deputy Minister
B.C. Ministry of Environment and Parks

Date

Date

November 17, 1986

APR 02 1987

VILLAGE PARTICIPATION CONFERENCE RESOLUTION # 87 - 4

ENTITLED: IN SUPPORT OF SENATE BILL 106.

WHEREAS, mariculture presents important economic opportunities to many rural communities; and

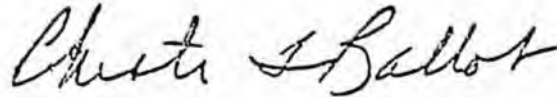
WHEREAS, rural communities need to become more self sufficient; and

WHEREAS, this method of economic development suits many rural communities.

Now, therefore, be it

RESOLVED: that the 1987 Village Participation Conference hereby supports pending legislation regarding mariculture (Senate Bill 106).

ADOPTED this 27th day of February, 1987 at the Village Participation Conference in Juneau, Alaska.



Chester Ballot, Chairperson
1987 Village Participation Conference

CORRECTION

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APR 02 1987

VILLAGE PARTICIPATION CONFERENCE RESOLUTION # 87 - 4

ENTITLED: IN SUPPORT OF SENATE BILL 106.

WHEREAS, mariculture presents important economic opportunities to many rural communities; and

WHEREAS, rural communities need to become more self sufficient; and

WHEREAS, this method of economic development suits many rural communities.

Now, therefore, be it

RESOLVED: that the 1987 Village Participation Conference hereby supports pending legislation regarding mariculture (Senate Bill 106).

ADOPTED this 27th day of February, 1987 at the Village Participation Conference in Juneau, Alaska.

Chester S. Ballot

Chester Ballot, Chairperson
1987 Village Participation Conference

APR 02 1987

Teletype Cover Sheet

To: JPH/LIO

Phone

From: Donn-Valdez LIO

Phone 835-2011

Instructions: For- Rep. Herrmann H. Resources

Number of pages: 1 (Not counting this Cover Sheet)

Re: HB 108: Mariculture

My name is Paul Mc Collum. I've been raising salmon at State, Federal and private hatcheries in Alaska for 13 years.

The opposition to HB 108 seems to fall into (4) categories:

1. Competition
2. Effective Control of proposed industrial development
3. Environmental Impact
4. Feasibility

The feasibility of a private business is in my view the burden of the business community and not the government. Any mariculture project involving net pen rearing will require a lot of vested capital and most people are not going to proceed on these projects without a pretty fair indication that they have a reasonable chance of making a profit.

Environmental impacts of these projects in my opinion would be insignificant when compared to most industries that Alaska bends over backwards trying to develop. This issue should be dealt with through policy and not legislation. Disease issues could be dealt with as specified in HB108 through the ADF&G FRED division pathology which already is in a position to handle this.

Effective control of this industry's development is a very important issue. I feel that this bill provided enough control for the initial process and that, if passed, would allow for follow-up policy to be put in place, which is critical to avoid foreign or outside control of this industry.

Competition is, in my mind, the only real issue here that has enough merit to question this bill's ability to pass. I think that pen rearing in Alaska will be more difficult than a lot of people believe. It is also possible that due to our temperature and climate many facilities would be better off producing pan-sized fish, which seems to be more effective, and has no wild market counterpart.

I think this is a serious issue. But, if this bill passes, it would be appropriate to have a meeting between ADF&G, AK Mariculture Assn., regional associations, and ASMI to sit down and fine tune policies and marketing strategies to hopefully allow for a peaceful coexistence between these important industries.

We're talking about a viable business here, and it's farming pure and simple. I don't think Alaska has the legal grounds nor the justifications to pass up this opportunity. The rest of the world will continue to crank out more and more of these fish regardless of the success or failure of this bill. Whatever competition there is will be there anyway. I support passage of this bill.

Paul McCollum
Box 1878
Valdez, AK 99686

TELECOPY COVER SHEET

KETCHIKAN LIO (225-9675)

TO: REP. HERMANN/Hansen PHONE 465 ~~225~~ 4942

FROM: MIKE JUDSON PHONE 225-2532

INSTRUCTIONS: Please deliver

RECEIVED: DATE 4-6-87 TIME 10:00am

SENT: DATE 4-6-87 TIME 10:02am

DISPOSAL OF ORIGINAL: THROW AWAY X HOLD FOR PICK UP _____

NUMBER OF PAGES: 4 (NOT COUNTING COVER SHEET)

SENT BY: LIO/KETCHIKAN (JMS)