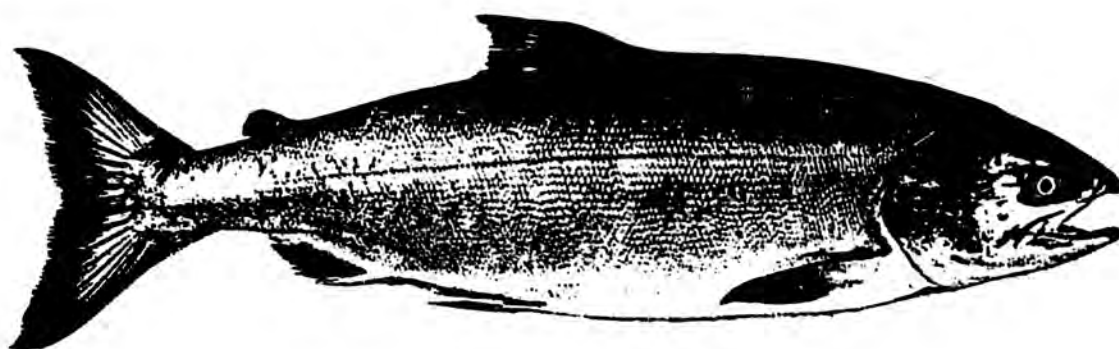


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**LEGISLATIVE REVIEW
OF THE
ALASKA SALMON
ENHANCEMENT PROGRAM**



**Alaska State Senate
Special Committee on
Domestic & International Commercial Fisheries**

FINAL REPORT

DECEMBER 1992

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**LEGISLATIVE REVIEW
OF THE ALASKA
SALMON ENHANCEMENT PROGRAM**

**FINAL REPORT
DECEMBER 1992**

Alaska State Senate
Special Committee on
Domestic and International Commercial Fisheries

Senator Dick Eliason, Chairman

Members: Senator Sam Cotten
Senator Lyman Hoffman
Senator Fred Zharoff
Senator Lloyd Jones
Senator Robin Taylor

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Alaska State Legislature

SENATE

Official Business

P.O. Box V
State Capitol
Juneau, Alaska 99811

December 1992

The Senate Special Committee on Domestic and International Commercial Fisheries has been conducting a review of the Alaska salmon enhancement program since May of 1991. The work of this particular committee concludes with the publication of both this final report and an additional chapter in draft form which contains an economic analysis of the enhancement program. It is the Committee's hope that these two reports will be used during the next few years as "working documents," providing a focus as the Legislature and all those interested in Alaska's fisheries enhancement efforts work together to make sound policy decisions regarding this important state program.

A number of people and agencies have worked hard on this review project. The Committee would especially like to thank legislative staff members Molly McCammon, Mary McDowell, Ginny Fay, Jo-Eve Benedict and Doug Rickey, the Alaska Department of Fish and Game, the Commercial Fisheries Entry Commission, the Legislative Research Agency, and the faculty members of the University of Alaska who have contributed to the project.

Many individuals and organizations from throughout the state have also put considerable amounts of time, thought and effort into following the progress of this review, testifying before the Committee, submitting written comments, and providing information for use in the economic analysis. I want to thank everyone for your willingness to be involved and work constructively towards the goal of improving the state's enhancement program.

A handwritten signature in dark ink, appearing to read "Dick Eliason", is positioned above the printed name.

Senator Dick Eliason, Chairman

Senate Special Committee on
Domestic and International
Commercial Fisheries

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LEGISLATIVE REVIEW OF ALASKA'S SALMON ENHANCEMENT PROGRAM

**FINAL REPORT
December 1992**

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CHAPTER I. INTRODUCTION

In May 1991, the Alaska Senate's Special Committee on Domestic and International Commercial Fisheries initiated a review of fisheries enhancement in Alaska. While the Committee recognized the success of the salmon enhancement program, its statutes, regulations, and role in Alaska's fisheries had not been thoroughly reviewed since the program's inception nearly 20 years ago.

During the last 20 years, Alaska's Salmon Enhancement Program and fishing industry have undergone enormous changes. New variables are influencing Alaska's fisheries which had not been anticipated when the enhancement laws were enacted: the implementation of limited entry, the advent of fish farming, oil spills, a worldwide glut of salmon markets, the rising and crashing of various fish and shellfish stocks, enactment of the federal Endangered Species Act, impacts of trawling and highseas driftnets, annual state revenues that grew dramatically for some years and are now declining, and the possibility of enhancement and pen-rearing of fish and shellfish species not thought to be feasible in the past.

The Committee did not initiate its review of the enhancement program with any preconceived notion of conclusions, recommendations, or actions. Rather, it began with the recognition of the Legislature's responsibility to review the history and evolution of the program and establish future policy direction. *The goal was to assemble and analyze information about the program and the global context in which it operates. The review was to serve as the first step in ensuring that current and future enhancement efforts will be economically and biologically sound, while fulfilling the goals for which the program was established.*

Legislative staff members were assigned to conduct most of the research, with the assistance of the Legislative Research Agency and private contractors. Staff were directed to compile a report listing possible options for consideration, rather than specific recommendations, after each chapter. The aim was to create a "working document" which would provide policy-makers with information and a full range of approaches to consider. The University of Alaska, Fairbanks was placed under contract to provide an economic benefit-cost analysis.

In February 1992 the Committee released the draft of its report entitled, "Legislative Review of the Alaska Salmon Enhancement Program." Copies of the draft report and its executive summary were distributed statewide. Since the University's economic study was just getting underway at that time, the economics chapter included only an outline of the economic research to be conducted.

On February 24, 1992, the Committee held a statewide teleconference to hear public comment on the draft report. The hearing was well attended and resulted in several hours of testimony and discussion. Many individuals and groups also submitted written comments to the Committee. *Most public comments spoke to agreement or disagreement with the options presented. A few also suggested minor changes or corrections in the report content.* The public comments have been made available to the Legislature, and are included in the appendices to the final report, which are available from the legislative library in Juneau.

The issue raised most frequently in public comments was the status of wild fish stocks and enhanced stocks, especially in the context of fisheries

management and allocation. That very issue, raised by the Alaska Board of Fisheries, was one of the primary reasons that the Committee undertook the review of the enhancement program. There appeared to be near-unanimous consent among fishermen, hatchery operators, fisheries managers, members of the general public, and legislators that a successful enhancement program necessitates that the sustained yield of Alaska's wild stocks be specified, in law, as the highest management priority.

After considering public comment, the Committee decided to take immediate action on a "wild-stock priority" bill. Senate Bill 457, sponsored by the Committee, passed the Legislature in May 1992 and became the first legislative action to result from this review of the enhancement program. (A copy of SB 457 is included in Chapter V of the final report.)

The University of Alaska's work on the economic studies took more time than originally anticipated. The benefit-cost analysis was not completed until the end of December. Because the Committee is a temporary, special committee established only for the duration of the 17th Legislature, it was not possible for the Committee to hold public hearings on the economic portion of the review project. *Since the economics chapter has not yet undergone scientific peer review or the same public review that the rest of the chapters have received, the Committee decided to publish it separately in "draft" and make it available to the public at the same time as this final report containing the remaining chapters.*

This final report is largely the same as the draft report that was distributed in February 1992. Minor revisions have been made to update information and to incorporate several suggestions made in public comments.

Both the final report and the draft chapter on economics are being submitted to the incoming 18th Alaska Legislature. A letter accompanying the two documents requests that public hearings be held on the draft chapter, that consideration be given to the information and suggested options in the full report, and that legislative committees carry on with the work begun in this review.

CHAPTER II. HISTORY AND DEVELOPMENT OF SALMON ENHANCEMENT IN ALASKA

See the attached memorandum from Linda J. Snow of the Legislative Research Agency, regarding "Legislative History of Alaska's Fish Hatchery Program."

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Alaska State Legislature

Legislative Research Agency



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July 31, 1991

MEMORANDUM

TO: Senator Richard I. Eliason, Chairman
Senate Special Committee on International and Domestic Fisheries

FROM: Linda J. Snow *L. Snow*
Legislative Analyst

RE: Legislative History of Alaska's Fish Hatchery Program
Research Request 91.296

You asked us to review the legislative history of Alaska's salmon hatchery program and to assess legislative intent regarding several current program issues. This memorandum has two sections. The first reviews the development of the hatchery program. The second addresses 12 specific questions about probable legislative intent.

Few relevant legislative records exist from the early 1970s, the formative years of Alaska's hatchery program.¹ We examined the few committee files and hearings records, as well as other available documents. Also, we interviewed several key players in the development of the hatchery program, including former Representative Terry Gardiner; former Senators Bob Palmer, Chancy Croft, Clem Tillion and Kay Poland; Bob Roys, former director of the Fisheries Rehabilitation, Enhancement and Development (FRED) Division within the Alaska Department of Fish and Game (ADF&G); Dr. Mike Kaill, former private nonprofit coordinator for the FRED Division; and Dr. William J. McNeil, a former biologist with the U.S. National Marine Fisheries Service (NMFS).

Attachment A presents a list of all legislation introduced in the Alaska Legislature concerning Alaska's hatchery program from 1959 to 1990.

¹Alaska's salmon hatchery program involves salmon ranching, where salmon eggs are hatched, reared to a juvenile stage, and released into the natural waters of the state. Salmon farming involves hatcheries also, but Alaska does not allow salmon farming in the state. Therefore, in this report, all reference to Alaska's hatchery program refers to salmon ranching, not salmon farming.

DEVELOPMENT OF ALASKA'S HATCHERY PROGRAM

The development of Alaska's hatchery program was an evolutionary process. Prior to statehood, several attempts at hatchery production of salmon were undertaken by the federal government and by private industry. These attempts proved largely unsuccessful, as hatchery technology was crude and undeveloped. In the late 1960s, Alaska was faced with the crisis of a severely depleted commercial salmon fishery, which wrought economic hardships for fishermen, fish processors, and others who depended indirectly on the fishing industry. The state legislature took the lead in revitalizing Alaska's commercial salmon fishery. The development of Alaska's salmon hatchery program was a crucial component in that revitalization. Generally speaking, this development had three phases. Initially, the legislature established state-owned and state-operated hatcheries and research programs. Then the emphasis shifted to encouraging the private sector to participate in hatchery development and operation. As the nonprofit hatcheries grew in number and scale of operation, the legislature turned its attention to the problems of economic viability and improved methods of hatchery funding.

A recurrent controversy underlies the development of Alaska's hatchery program. Although during initial development of the program in the early 1970s it was unknown if salmon hatcheries would be successful in Alaska, many people--including fishermen's groups and processors--believed that because the fishery was already depressed, there was nothing to lose by a failed attempt to propagate fish by means of hatcheries. The legislature seemed enthusiastic about the program, apparently more so than professional fishery biologists, who perhaps feared the unknown biological and management problems associated with pell mell development of hatcheries. Such questions as genetic intermingling, disease, and habitat competition were raised, and the legislature understood that the venture was not without biological risks. However, the depression of the fishery was an immediate and pressing economic problem. The legislature decided to proceed, but with an eye toward protecting the wild stocks. It was hoped that potential problems could be solved or at least mitigated by reasonable precautions, such as regional management plans and careful siting of hatchery facilities to segregate hatchery and wild stocks.

Hatchery Development Before Statehood

By the late 1800s commercial salmon fishing was a major industry in Alaska. The fishing industry was not regulated, and it became evident that the huge catches were beginning to deplete the salmon runs. There was concern about sustaining the resource, and fish hatcheries were viewed as a possible solution. The first salmon hatchery in Alaska was built by several fish processors at Karluk Lagoon on Kodiak Island in 1891. Technology was new and expertise lacking, and consequently this and other early private hatcheries proved largely unsuccessful. In 1900, federal regulations were adopted that required fish processors to build hatcheries capable of releasing four times as many fish as the company processed in a year. The regulations were not enforced. In 1905, the U.S. Bureau of Fisheries built the first government

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hatchery in Alaska. Beginning in 1906, the bureau instituted a federal tax credit for fish processors with hatcheries in order to encourage this type of enhancement.

Despite the operation of private and government hatcheries, depletion of the salmon runs continued. In 1915, the U.S. Bureau of Fisheries office in Alaska made an unsuccessful attempt to have Congress buy out all private hatcheries in Alaska. Franklin Roosevelt closed all government hatcheries in 1932 after the Commissioner of the Bureau of Fisheries declared that they had been a "complete waste of public funds." Only one private hatchery remained in operation, and it closed in 1936. Between 1932 and 1951, the U.S. Bureau of Fisheries approached the problem of depleted salmon runs by imposing regulations on fishermen in order to decrease the commercial catch, not by encouraging artificial propagation of salmon. During this time a few experimental hatcheries were started. The federal government built an experimental hatchery at Little Port Walter on Baranof Island in 1939, which stressed research on salmon biology, rather than fish production.

A territorial department of fisheries was established in 1949. Policy makers again looked to artificial propagation as a tool to sustain the fishery. The availability of king and coho salmon for sport fishing was increased by lake stocking and transplanting. Salmon enhancement research continued at the Little Port Walter facility. In 1952, the Deer Mountain hatchery near Ketchikan was built, and in 1953, the Kitoi research station on Kodiak Island became operational. When Alaska achieved statehood in 1959, the U.S. National Marine Fisheries Service was developing a fish culture research lab at Auke Bay near Juneau.

State-Operated Hatchery Program

Salmon runs in Alaska had been declining rapidly since 1936, and were in a state of depression during the 1960s and 1970s. The 30-year consecutive high average annual commercial harvest (1945 to 1975) was 83,300,000 fish, compared to an average annual harvest of 45,108,000 fish between 1960 and 1975, and an average annual harvest of 23,111,000 fish between 1973 and 1975. This dramatic drop in commercial salmon harvest prompted state action. Although the state Department of Fish and Game had been involved on a small scale with enhancement of the sport fishery, and with research and experimental hatchery production of salmon for the commercial fishery, the legislature sought to consolidate and expand the programs despite possible risks to Alaska's natural salmon runs.

By 1968, public concern about the depressed fishery was high, and the progress of hatchery programs in other states and countries was being watched with interest. A general obligation bond authorization for \$3,000,000 to build state hatcheries was passed by the legislature, and overwhelmingly approved by the general public that year.

In 1969, Alaska received \$900,000,000 from the sale of oil and gas leases on the North Slope. The legislature realized the potential of the future income

from oil production. It decided to channel some of the public income from nonrenewable resources (oil and gas) into development of renewable resources to provide a long-term source of employment and economic activity. The salmon resource was an obvious candidate for this long-term investment.

The basic idea behind the state hatchery program was to supplement the existing wild salmon stocks in the state with hatchery fish which would be available for harvest by commercial, sport and subsistence fishermen. Past fish runs indicated that the carrying capacity of the Alaska coastal salmon habitat was at least 150 million salmon. As there were only about 30 million fish in Alaska waters in the early 1970s, the legislature looked to a goal of producing 100 million salmon for a healthy fishery. Although some interest groups suggested depleting the wild stocks and replacing them with hatchery fish, the legislature preferred to protect the wild stocks to preserve the resource base. In the early days of the hatchery program, technology was unproven in Alaska and no one really knew for sure whether the experiment would work. Thus, the legislature did not want to expose the wild stocks to undue risk.

In 1970, HB 777 and HB 778 were introduced that would create and fund a long-range fisheries research and enhancement program within the Department of Fish and Game. Research functions existed within the department, but these bills sought to consolidate and expand the functions into a long-range program. These bills died in the House Resources Committee, but resurfaced later in the session as HB 828 and HB 829. The purpose of the program was to "...use funds realized by the state from nonrenewable resources to advance the orderly and long-range development of the state's fisheries, a renewable resource." There was controversy over the form of the program--should a long-term working fund be established, or should the program be evaluated and funded yearly? While the program enjoyed strong legislative support, the Alaska Department of Fish and Game (ADF&G) opposed it because some of its biologists felt that large-scale hatchery development should await scientific evidence that hatchery and wild salmon could safely coexist in the offshore and nearshore environments. House Bills 828 and 829 did not pass out of the Senate Resources Committee.

On May 28, 1971, SSSB 107 was signed into law (AS 16.05.092), creating a Division of Fisheries Rehabilitation, Enhancement and Development within the Department of Fish and Game. The division had four main responsibilities: 1) develop and maintain a state plan for long-range fishery rehabilitation, enhancement and development; 2) encourage private investment in the development and use of Alaska's fishery resources; 3) insure the perpetuation of Alaska's food resources; and 4) make an annual report to the legislature. No long-term funding mechanism was established by this legislation.

The poor fishing season in Bristol Bay in 1968 reinforced the legislature's interest in means to increase economic returns to Alaska's commercial fishermen. One such proposal was limiting entry of new fishermen so that the level of capitalization could be stabilized. Eventually, an amendment to Article VIII, Section 15 of the Alaska Constitution was approved by public vote in 1972. Section 15 originally stated "No exclusive right or special privilege of fishery shall be created or authorized in the natural waters of the State."

The amendment added "This section does not restrict the power of the State to limit entry into any fishery for purposes of resource conservation, to prevent economic distress among fishermen and those dependent upon them for a livelihood and to promote the efficient development of aquaculture." In 1973, legislation implemented limited entry in the commercial salmon fishery with the long-term goal of increasing economic returns to commercial fishermen.

In 1973 and 1974, the United Fisherman's Association (UFA) was formed, organizing commercial fishermen at the state level for the first time. Fishermen's groups such as UFA were a driving force behind Alaska's salmon hatchery programs.

Movement Toward Private Nonprofit Hatcheries

With the limited entry program in place, legislators felt more confident about expanding the hatchery program because the economic benefits of a rehabilitated fishery resource would not be dissipated among an ever-increasing number of fishermen. At this time, legislators were coming to the view that the private sector would be more efficient than the government in the operation of hatcheries. Also, nongovernmental hatcheries had much to recommend them from the perspective of public finance issues: the operation of private hatcheries could be funded from the harvest of returning fish and from tax assessments on the fishermen who had access to the hatchery production, thus shifting the cost of the facilities from the shoulders of the general public to the people who derived benefits directly from them. Thus, the next stage of the hatchery program was one of encouraging fisheries organizations to build and operate private nonprofit hatchery facilities.

By 1974, the FRED Division had several stream enhancement and stocking programs underway, as well as hatchery incubation and salt water rearing tests in several locations around the state. Several new hatcheries were in the planning stages at this time. A 1974 bond issue was authorized putting most of \$10,500,000 into capital improvements for state hatchery facilities. The concept of authorizing private nonprofit (PNP) corporation hatcheries took the form of law also in 1974 and was developed and refined over the next several years (AS 16.10.375 - 470). The legislature estimated it would take \$400 million to build up the entire fishery resource to a healthy level. It envisioned \$200 million for state hatcheries coming from state funds, with the additional \$200 million for private nonprofit hatcheries coming from other sources (fisheries groups, private foundations, and possibly federal grants). For the most part, there was great enthusiasm about the prospect of PNP hatcheries from fishermen's groups, education centers, Native corporations, and the legislature itself.

In these early years, little was known about the life cycle of wild salmon or the interaction between wild and hatchery fish. Concerns about adverse biological consequences from this interaction were expressed often by state and federal fishery management agencies. However, the legislature was preoccupied with the economic depression of the fishing industry. While biological

concerns were known to framers of hatchery legislation, such matters seemed overly speculative and hypothetical in the face of cries for relief from coastal communities. The sense of urgency felt by legislators, and their frustration with what they seemed to perceive as hand-wringing and foot-dragging by the department biologists, is expressed well in a 1975 letter from Representative Oral Freeman to Governor Jay Hammond (Attachment B). Representative Freeman bemoans the caution and reluctance of the biologists, who were worried about such things as the "unfavorable changes in the genetic composition of some wild salmon...stocks." To this, Representative Freeman remarked: "Governor, I'm sure that proper 'genetics' of salmon are important. However, I'll wager that if our fishermen have to make a choice between salmon with the wrong 'genetics' or no salmon at all they'll not worry that much about the salmon's parents or where he came from."

The biologists' preference for rehabilitating wild stocks over the propagation of hatchery stocks was also alluded to during the Aquaculture Policy Study Group meetings in late 1978 and 1979. It was suggested by Chairman Gardiner that the both state and federal fishery management agencies approached the problem of fisheries development from the point of view of the "resource," while the legislature approached it from the point of view of the "people" (excerpt of the minutes in Attachment C).

In 1976, Alaska legislation was passed creating regional aquaculture associations responsible for the regional planning and coordination of salmon enhancement activities. The legislation provides:

"Sec. 16.10.380. REGIONAL ASSOCIATIONS. (a) The commission shall assist in and encourage the formation of regional associations for the purpose of enhancing salmon production. A regional association is qualified if the commissioner determines that

(1) it is comprised of associations representative of commercial fishermen in the region;

(2) it includes representatives of other user groups interested in fisheries within the region who wish to belong; and

(3) it possesses a board of directors which includes no less than one representative of each user group that belongs to the association.

(b) In this section "user group" includes, but is not limited to, sport fishermen, processors, commercial fishermen, subsistence fishermen, and representatives of local communities."

The legislature felt that comprehensive planning on the regional level, primarily careful hatchery site selection, would help mitigate potential

problems such as intermingling hatchery and wild stocks. Also in 1976, another bond issue was authorized and publicly approved, making most of \$29,205,000 available for capital improvements to state hatchery facilities.

Economic and Funding Issues

As the PNP hatchery program developed and hatchery technology progressed, it became evident that the costs of developing viable salmon hatcheries were far greater than initial expectations. Legislative focus fell on the economic viability of the program and on expanded methods of funding PNP hatchery development. New methods of financing construction and operation of PNP hatcheries were sought.

In 1974, AS 16.10.450 was amended to read that proceeds from the sale of salmon or eggs by a PNP hatchery could be applied to debt retirement as well as operating costs. Prior to 1974 there was no state funding available for PNP hatcheries. Funds became available through the Renewable Resources Development Fund established in that year. Additional state loans for construction of private nonprofit hatcheries became available when a 1975 bill was passed expanding the commercial fisheries loan program to include hatcheries. The following year, a separate fisheries enhancement loan program was established.

The 1976 legislation which created the Fisheries Enhancement Loan Program also gave authority to regional aquaculture associations to assess a fisheries enhancement tax of between two and three percent on the sale of salmon in established areas. Although Alaska has no private, for-profit hatcheries, private, nonprofit corporations independent of regional aquaculture associations have developed hatcheries in cooperation with regional salmon enhancement plans. These independent PNP hatcheries, sometimes called "mom and pop" hatcheries by ADF&G, are funded in the same manner as regional association hatcheries except that they have no authority to assess a regional salmon enhancement tax.

In 1977, legislators grappled further with the problem of financing private, nonprofit hatcheries. Building a hatchery requires a substantial capital outlay. It may take six to ten years (depending on the salmon species propagated) before a hatchery might expect viable fish returns which can be sold to cover operating costs and debt service. The initial loan program required the operators to provide 25 percent of the capital cost of the hatchery before loan approval. Although the law allowed qualified regional associations to assess a tax of up to three percent on the sale of salmon in their area, this assessment could not cover both the 25 percent of capital costs required to obtain a state loan and the operating costs of the hatchery.

The 1977 legislation (HB 264, §§ 2 - 19 Ch 154 SLA 1977) created a Fisheries Enhancement Revolving Loan Fund within the Department of Commerce and Economic Development. The conditions for obtaining loans were relaxed, requiring only "sufficient financial resources to insure the establishment of an equity

position in the project equal to ten percent of the loan within six years or less." House Bill 264 also gave regional associations the power to form regional salmon enhancement authorities, but this section was repealed in 1988. This bill also established property tax exemption status for the authorities on land used for salmon enhancement and made state matching grants for organization and planning (50/50) available to qualified regional associations.

Another general obligation bond authorization was approved in 1978. This issue was for \$26,965,000 for capital improvements to state hatchery facilities. The Commercial Fisheries and Agriculture Bank was also created in 1978. Although this institution did not directly benefit hatchery programs in the state, it did provide sources of credit for development of Alaska's fisheries businesses.

Also in 1978, HB 638 was introduced by Representative Haugen which would have added a new section to AS 16.10 which stated: "Sec. 16.10.480. TERMINATION DATE FOR APPLICATIONS FOR PERMITS. No application for a [private nonprofit hatchery] permit under secs. 400 - 470 of this chapter may be received by the department [of Fish and Game] after the effective date of this Act." The bill was later withdrawn by the sponsor. This bill would have stopped the development of the PNP hatchery program and indicates that not everyone in the legislature supported the program.

In 1979, after much legislative debate, a law was passed which allowed the granting of special harvest area entry permits to PNP hatchery operators. Chapter 64, SLA 1979 added a new section to AS 16.43 which reads "Special Harvest Area Entry Permits. (a) In addition to entry permits, interim-use permits, and educational permits, the [limited entry] commission may issue special harvest area entry permits to holders of private, nonprofit hatchery permits issued by the Department of Fish and Game under AS 16.10.400 - 16.10.475." The legislation also established that the permits are good for one year, renewable and nontransferable. Prior to enactment of this legislation, PNP hatchery operators were not allowed to harvest their own brood stock or cost recovery fish; they had to hire permitted fishermen to harvest these fish.

A general obligation bond issue of \$7,718,800 for state hatchery facility improvements was authorized in 1980. Also during that legislative session, the structure for imposing mandatory salmon enhancement taxes on the fishermen of specific regions was refined, prompted by a lawsuit challenging the constitutionality of the system established by SB 689 in 1976 (it represented an illegal delegation of the state's taxing authority). The new legislation required approval of the tax by a majority of the members of the qualified regional association which is to be taxed, and it involved payment of the tax to the state, which reimbursed the collections to the regional association.

In 1981, the Alaska Seafood Marketing Institute was established to spearhead Alaska's seafood promotion and marketing efforts. Also during that session, a House Concurrent Resolution (HCR 16) died in the Senate Resources Committee

without a hearing. This resolution states "BE IT RESOLVED that the Alaska State Legislature respectfully requests the governor, through the Department of Fish and Game, and the Board of Fisheries to provide for broodstock for fisheries rehabilitation and enhancement projects from already depressed fish stocks." It suggested that the priority for management of the fishery be shifted from wild stocks to hatchery stocks in the event of a depressed fishery.

In 1983, SB 156 passed the legislature allowing the lease, sale or grant of state hatchery facilities to qualified PNP hatchery permit holders. The bill reflected concern about the cost to the general fund of state-operated hatcheries, as well as the pervasive feeling that private nonprofit management was more efficient. It was vetoed by Governor Sheffield because he felt the question needed further analysis. Also, Governor Sheffield stated in his veto letter that the Attorney General felt there were possible constitutional problems with "granting" or other transfer of public property for other than public purposes. In 1988, SB 140 (Ch 14 SLA 1988) passed which allowed the state to contract the operation of state hatcheries to a nonprofit corporation, with preference given to qualified regional aquaculture associations located in the region where the hatchery is located. With this legislation, the state retains ownership of the hatcheries and passes the operation onto nonprofit corporations, thus avoiding the possible constitutional problems apparent in SB 156.

House Bill 38, sponsored by Representative Taylor in 1987, would have established limits on the dollar amount of state loans outstanding to regional aquaculture associations and independent private, nonprofit hatchery operators. The bill was later withdrawn by the sponsor. Senate Bill 410 (Ch 152 SLA 1988) passed in 1988, which exempted all broodstock and cost recovery fish from salmon enhancement taxes, and SB 62 (Ch 33 SLA 1989) which passed in 1989, allowed an additional one percent salmon enhancement tax to be levied under certain circumstances.

CURRENT HATCHERY PROGRAM

Currently, the FRED Division operates 16 hatcheries throughout the state and private, nonprofit corporations operate 21 hatcheries (including regional associations and independent corporations). Ownership and management of these facilities are changing as budget cuts have prompted the state to give control of some of their hatcheries to PNP corporations (through sales, leases and management contracts). FRED Division facilities saw returns of 6.3 million hatchery-reared fish in 1990, while PNP facilities saw returns of 42.3 million. Hatchery fish represented about 24 percent of Alaska's commercial salmon harvest in 1990. The FRED Division also maintains two pathology labs, one genetics lab, one limnology lab, and a coded-wire tag processing lab. The FRED Division also provides technical and management assistance to PNP hatcheries. FRED Division hatcheries tend to emphasize research while PNP facilities are more narrowly focused on production for the commercial fishery. The FRED Division is also concerned with the production of sport fish species

and with the experimental farming of oysters, mussels, scallops, abalone, clams and aquatic plants.

The attached table (Attachment D) presents fiscal year capital and operating appropriations as well as bond authorizations for state-operated hatcheries and administration of the FRED division from FY 68 through FY 92.² To date, a total of approximately \$208 million has been appropriated for operating expenses of the state hatchery program. Cumulative capital appropriations during the same time period have reached a total of \$41,334,600. Also, \$77,388,800 in bond authorizations have been approved, most for hatchery construction and improvement.

Attachment E presents a table of cumulative PNP hatchery funding from the 1990 FRED annual report to the legislature. Through December 31, 1990, private, nonprofit corporations have borrowed \$51,310,503 in state funds for capital construction, and \$19,762,723 in state funds for hatchery operations. They have also received \$42,219,711 from salmon enhancement tax assessments and \$13,644,040 from the sale of cost recovery fish during the same time period. At least \$30,509,323 of state funds has gone to PNP hatcheries in the form of grants and contracts between 1974 and 1990.³

LEGISLATIVE INTENT

This section addresses 12 questions about the legislative history of the hatchery program. The sketchy and incomplete documentation of the legislative history makes the answers to some of these questions elusive and ambiguous. However, a general response to each question is provided.

Did the legislature foresee management conflicts (in mixed stock fisheries or between gear groups) over the requirement of hatcheries to capture a sufficient number of returning salmon for broodstock and, in the case of PNPs, cost recovery?

Early in the development of the hatchery program there is no indication the legislature foresaw conflicts developing among user groups (gear groups), nor did we find evidence of anticipated conflicts over excessive escapement requirements for cost recovery. Perceived conflicts had mainly to do with competition and interaction between natural and hatchery-produced salmon.

²This table does not include supplemental appropriations or reappropriations, nor special appropriations for special projects (e.g., additional money to complete construction of the Snettisham hatchery) or appropriations to agencies other than the FRED Division.

³This information was obtained from the FRED division and the Governor's Office of Management and Budget grants tracking system.

Senator Eliason
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However, later in the development of the program, potential *management* problems may have been foreseen. House Concurrent Resolution 8, which became Legislative Resolve 71, SLA 1977 (Attachment F) states: "BE IT RESOLVED by the Alaska State Legislature that the State of Alaska is committed to a fisheries management policy that encourages and promotes the coexistence of healthy hatchery and wild stocks of salmon, and to implement this policy the Department of Fish and Game, through regional planning teams, shall initiate planning to meet the potential conflicts which may arise from the harvest of hatchery and wild salmon stocks so that the wild stocks are adequately protected;" This passage seems to indicate that by 1977 management conflicts were foreseen and that the legislature expected ADF&G to handle them in favor of the wild stocks.

During a 1979 House Resource Committee hearing on HB 48, Bob Roys, director of the FRED Division from 1971 to 1982, stated that the division didn't anticipate PNP hatcheries operators becoming powerful enough to influence fish and game management policy in favor of their broodstock and cost recovery needs over the escapement needs of the wild stocks. He felt there were adequate safeguards in the program to prevent this kind of pressure on management from PNP hatchery operators.

Did the legislature discuss how or why wild stocks were to have priority over hatchery stocks?

According to Terry Gardiner, wild stocks had priority over hatchery stocks for genetic reasons. Wild stocks were genetically superior and contained a diverse gene pool which was needed to sustain the species. In the early years of the program, the legislature was not sure that the hatchery program would work, so there was concern about the risk of losing the wild stocks and their gene pools on a failed experiment. The legislature saw hatcheries as a tool to supplement the wild stocks, not replace them.

Bob Roys recalls that a statutory preference for wild stocks was urged by Rick Lauber, a lobbyist for several fish processing organizations. The processors felt that if fish and game management protected the wild stocks, then it didn't matter if the hatcheries worked or not.

Both Terry Gardiner and Bob Roys felt that the protection of wild stocks would be brought about through management via regional planning teams and through careful placement of hatcheries to minimize interference with wild salmon runs. In a mixed stock fishery, the harvest would allow for appropriate escapement of wild stock, without regard for escapement requirements of hatchery stock. Legislative Resolve 71, SLA 1977 (Attachment F) also speaks to the priority in managing for the wild stocks in a mixed stock fishery.

Did the legislature foresee competition between wild and hatchery stocks for ocean graze, stream bed nesting areas, or other habitat?

Whereas the issue of ocean graze is mentioned in the record, there is no evidence that the possibility of overgrazing was considered a serious issue. For example, Phil Daniels of the United Fishermen of Alaska mentioned the subject of grazing in testimony at a House Resources Committee hearing on HB 264 on March 7, 1977. He stated that Japan, Washington, Canada, Russia and Korea were all far ahead of Alaska in hatchery production. Whereas Alaska released six million smolts in 1976, Japan released one billion. At a 1976 conference in Japan which he attended, limits on available graze in the North Pacific ocean was discussed. Mr. Daniels felt that Alaska was in a bad position to negotiate for graze rights because we lagged far behind the rest of the pacific rim in hatchery production. Thus, the competition the legislature may have foreseen for ocean graze was between our fish and fish from other countries, not between hatchery and wild stocks.

According to Terry Gardiner, legislators assumed there was plenty of room in the North Pacific Ocean to graze all of Alaska's hatchery fish. The environment had at one time supported 150 million salmon from Alaska. At the time these programs were being instituted, there were about 30 million fish coming from Alaska's streams and rivers, so there was room for at least 100 million more.

The legislature intended the hatchery program to utilize barren and unproductive streams, thereby minimizing competition for habitat with wild stocks on the spawning grounds.

Did the legislature foresee possible intermingling and/or genetic deterioration of wild stocks from hatchery stock influence?

Everyone acknowledged the possibility of adverse genetic impact. However, legislators were willing to take risks posed by the theoretical possibility of genetic degeneration of wild stocks.⁴ According to former Senator Bob Palmer, genetic intermingling was a concern of the opposition to the hatchery program, not a concern of the legislature. According to former Senator Clem Tillion, the legislature expressed concern about genetics early in the program, but the people who wanted to mass produce salmon politically outweighed the people who wanted to be extra cautious about the intermingling of salmon stocks. The

⁴According to Dr. William McNeil, biologist with the National Marine Fisheries Service in the 1970s, genetics was just beginning to become an issue as Alaska's hatchery program got underway. Dr. McNeil also chaired the Alaska Fisheries Council for many years. This council was established through the Governor's Office and dealt with many issues involving the evolving hatchery program. Several members of the legislature sat on this council, and it appears to have been a legislative forum for many of these issues.

legislature later funded a fish pathology and genetics laboratory for the FRED Division.

The legislature was aware that Alaska wild stocks of salmon stray from stream to stream, but were willing to risk the consequences in order to restore the strength of the salmon resource. To avoid genetic intermingling, hatchery operators tried to place hatcheries where there were no natural runs of salmon. Any eggs incubated at a stream site came from the local brood stock, or from a stock in the local area.

An unidentified legislator at a 1974 Senate Resources hearing of HB 830, the bill which established private nonprofit hatcheries, said he had lunched with 15 federal fisheries biologists who expressed concerns about the intermingling of wild and hatchery stocks (genetic problems). The biologists felt the problems would be small if only barren streams were used for hatchery facilities. The hearing participant also stated that federal and state biologists couldn't seem to agree among themselves about how serious genetic intermingling could be.⁵ By then, the state had already placed some hatcheries on producing streams. Bob Roys, director of the FRED Division testified at the same hearing that there would be no problem with intermingling if barren streams are used. They currently had wild stocks from different streams intermingling together and it was not a major concern.⁶ He said he'd "rather have the problem of too many fish than not enough." The ADF&G controls where eggs are sold and transferred to avoid the intermingling of stocks.

Did the legislature consider limiting hatchery production because of: 1) adverse impacts on wild stocks; or 2) adverse impacts on salmon market prices?

We found no discussion in the legislative record that hatchery production should be restrained to a predetermined level, for either biological or economic reasons. While the legislature was presumably prepared to take whatever corrective measures were necessary in the face of persuasive evidence that the hatchery program was causing serious biological problems, there appears to have been no discussion of establishing a ceiling on the production of fish from hatcheries.

⁵Fish which survive well in a hatchery environment have different characteristics from fish which survive well in the wild. Hatchery fish need to adapt well to the stress of being raised in crowded incubators and rearing pens, and they must adapt to eating manmade food for the first stages of their life. These characteristics are not necessary, nor desirable in wild stock.

⁶In a recent interview, Bob Roys stated that genetic intermingling was mentioned in legislative hearings, however, no one had adequately defined wild and hatchery stocks. When 80 percent of the gene pool is harvested, the species is altered. Thus our wild stocks are altered by man and may not be considered wild.

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There also appears to have been no contemplation of imposing a ceiling on the production of hatchery fish to support market prices. According to Terry Gardiner, salmon stocks were so depressed in the 1970s that there was no thought given to the possibility of oversupply.

Jack Milnes from the Southern Southeast Regional Aquaculture Association presented a possible scenario for enhancing the salmon runs in Southeast Alaska at a 1977 House Resources Committee hearing for HB 264. He discussed returning salmon to the previous level of 38,000,000 from the current 8,000,000. He goes on to say "At current prices of \$6.00 per adult chum salmon, the increased value for the 30,000,000 adults would be \$180,000,000. Everybody hopes the price will hold or inflate in time." Bob Palmer stated that the legislature knew the price of salmon would come down because of foreign production, so they felt inspired to produce even more fish to make up for the lower price. Clem Tillion told us that the legislature did not anticipate dependence on hatchery salmon by Alaska's commercial fishermen, and if adverse impacts on salmon market price were suspected by any legislators, it was not a widespread feeling, for they did not take steps to be able to limit production if that occurred.

Did the legislature consider the question of property rights to ocean-ranched salmon?

Consensus is that the legislature had always intended that the fish from PNP hatcheries belong to the common property fishery until such time as they return to the hatchery, and then they belong to the hatchery for broodstock and cost recovery. Testimony by Senator Dick Eliason at a 1975 Senate Resources Committee hearing on SB 180 indicates that the initial concept of a private hatchery system considered profit-making corporate ownership. However, a profit-making corporation might advance a claim to exclusive ownership of everything it produced. Thus, it was felt that private, nonprofit ownership of hatcheries would be more consistent with the concept of publicly owned hatchery fish. This opinion is echoed by former Representative Terry Gardiner.

At a March 7, 1977 House Resources Committee hearing, Jack Milnes, executive director of Southern Southeast Regional Aquaculture Association testified; "I wish to recognize the fact that these are common property fish, that they belong to the state of Alaska and to the people of Alaska and therefore they should be protected by the representatives of the people of the state of Alaska." At a 1979 Senate Resources Committee hearing on HB 48, Don Clockson, an attorney with Alaska Legal Services discussed the question of ownership of hatchery fish. In his testimony, he asked "When are fish no longer common property fish?" He felt that constitutionally, they were considered to be common property at all times. Consequently, it appears there was never any question that hatchery fish were common property of the people of the state while in Alaska waters, and they may or may not be the property of the PNP hatchery operator at the hatchery, but that he is allowed to harvest a sufficient number for broodstock and cost recovery.

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Did the legislature consider what "substantial public benefits" (contribution to the public fishery) hatcheries were supposed to make (percentages)?

We found no record of a discussion or definition of the actual contribution to the public fishery expected from PNP hatcheries. Presumably there was an expectation that cost recovery and broodstock requirements would not divert a significant number of fish from the open access harvest.

During a 1974 Senate Resources Committee hearing on HB 830, an unidentified hearing participant stated that it was assumed 50 to 70 percent of PNP hatchery fish would be available for harvest by commercial, sport and subsistence fishermen, and that 50 to 30 percent would go to the hatchery operator for brood stock and cost recovery. In a recent interview, Terry Gardiner recalled that the legislature was content to allow the contribution to the common property fishery to be determined on regional and fishery basis by ADF&G commercial fisheries management.⁷

Did the legislature consider a conflict of interest by the state when managing for cost recovery to hatcheries with state loans?

No such possibility was contemplated by the legislature in the early days of the program. As stated by Phil Daniels in a 1974 Senate Resources Committee hearing on HB 830, fishermen were initially asking the state for permission to put their own money into building up the resource. The initial concept was that PNP hatcheries would not require state funds, but would be built and operated with money from the fishermen, with additional funds from private foundations, and possibly federal grant monies. As the program evolved, state funds were used. In a recent interview, Dr. Bill McNeil stated that as he recalled, the legislature had lots of oil money to spend in the early days of the hatchery program, and it was not concerned about payback. The legislature was attempting to establish a resource base which would help sustain the state in the future.

However, as the state increased its financial stake in the PNP hatcheries, concern about the repayment of loans also increased. For example, SB 830 (Ch 111 SLA 1974) authorized the sale of salmon and salmon eggs by hatcheries for debt retirement. During a March 7, 1977 House Resources Committee hearing on HB 264, Committee Chairman Terry Gardiner suggested that the legislature eliminate voluntary enhancement tax assessments on fishermen and require

⁷According to Herman Savikko, ADF&G commercial fisheries division, escapement to the hatchery, and therefore, contribution to the common property fishery, is determined on an individual hatchery basis. Fishery biologists who manage regional commercial fisheries do so with information from hatchery operators about how much escapement of hatchery stock is needed, just as they know how much escapement is needed for wild stocks from different streams and watersheds.

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mandatory assessments because it would give the state more security about receiving loan payments.

In a recent interview, Clem Tillion stated that the state avoided the conflict of interest by separating management and loan functions. Fishery management was undertaken by the Department of Fish and Game, and the loans were managed by the Department of Commerce and Economic Development. The ADF&G did not want control of the loan program. According to Bob Roys, many times the management of the fishery went in the reverse direction, and resulted in PNP hatcheries not receiving enough fish for cost recovery purposes.

In 1981, the House Resources Committee presented HCR 16. This resolution (Attachment G) requested that the governor, the Board of Fisheries and ADF&G manage the fishery such that hatcheries would receive their broodstock even if the fishery were depressed. The resolution discusses, and falls just short of asking for, management for cost recovery. The resolution died without a hearing in the Senate Resources Committee.

Did the legislature consider under what conditions a PNP hatchery permit might be revoked?

We could find no evidence of any legislative discussion on the revocation of PNP permits. The consensus of our interviewees is also that there was no legislative discussion of the subject. Former Representative Terry Gardiner recently stated that ADF&G was not in favor of PNP hatcheries, and that the legislature was very careful of their wording when requiring that PNP permits be issued for fear that ADF&G would sabotage the intent. However, nothing specific was mentioned about the conditions under which a PNP permit might be withdrawn. It was an administrative matter. According to Bob Roys, the legislature left the matter of withdrawing PNP permits up to the commissioner of the Department of Fish and Game. Conditions of a permit were set by regulation, and no real ADF&G policy evolved. Very few PNP permits have been revoked to date.

Did the legislature consider PNP hatcheries would have to borrow state funds to pay operating costs?

At the outset of the PNP hatchery program, the legislature did not contemplate the use of state funds. The original idea was for PNPs to be built and operated with money from fishermen's associations and grants from private foundations and the federal government. However, as the program evolved, it became evident that the development and operation of hatcheries was more expensive than initially thought. The need for state funds, first for construction, and then later for hatchery operations, was answered with state loan programs developed for those purposes.

In a recent interview, Terry Gardiner stated that the funding situation evolved over time. The first bill was one page and stated that PNP hatcheries

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were legal. As time passed, the scale of the program changed. PNP hatcheries had no collateral to borrow from banks, and the enhancement tax assessments were not enough to cover the escalating capital and operating costs. During a March 7, 1977, House Resources Committee hearing on HB 264, Terry Gardiner presented an amendment to the bill which would change AS 16.10.510 (1) (under "Powers and duties of the commissioner") acknowledging the need for PNP hatcheries to borrow funds for operation from the Fisheries Enhancement Revolving Loan Fund. The new language stated "(1) make loans to permit holders under sections 400 - 470 of this chapter, including those holders issued permits before the effective date of this Act for the planning, construction and operation of hatchery facilities;"

Did the legislature consider direct employment in hatcheries as a goal of PNP hatchery development?

The primary goal of the PNP hatchery program was to produce fish for the commercial, sport and subsistence fisheries and create jobs in those industries. Economic development through direct employment in hatcheries may have been a secondary goal, especially in independent "mom and pop" operations. In a recent interview, Terry Gardiner stated that the answer to this question depended on who you were. This was not a goal if you were a fisherman. Some legislators may have considered direct hatchery employment as a goal, but it was not a primary goal. During a Senate Resources Committee hearing in 1974, the question was asked what will PNP operators get out of the program that will make them want to open a hatchery? The answer was "...jobs."

In Chapter 59 SLA 1979, "An Act Relating to Salmon Enhancement," under Section 1. Findings and purpose, subsection (9)(b) states "It is the purpose of AS 16.10.375 - 16.10.620 to provide for continuing efficient aquaculture development in the coastal and interior regions of the state and in a manner which equally affects and benefits all persons similarly situated and to encourage development of small, private, nonprofit hatcheries that may provide important benefits to the state through increased employment, educational training, and research opportunities."

Did the legislature indicate that one goal of hatchery development was to even out yearly catches of salmon?

The objective of Alaska's salmon hatchery program was to increase the total number of harvestable fish, not to produce fish in any kind of cyclical pattern that sought a consistent level of fish from year to year.

I hope this information is helpful to you. If you have further questions, feel free to contact this office.

Attachments

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ATTACHMENT A

ALASKA LEGISLATION DEALING WITH FISHERIES ENHANCEMENT
(Legislation which became law is in italics)

- 1959 - *Ch 94 SLA 1959 (HB 201): Required the building of hatcheries or fishways as mitigation for damage to streams.*
- 1968 - *Ch 227 SLA 1968 (HB 357): Authorized the state to issue \$3,000,000 in general obligation bonds for construction of hatchery facilities (after approval through popular election).*
- 1970 - HB 778 (HB 777 - appropriation bill to fund HB 778): Established a long-range fisheries research, rehabilitation and development program. Died in House Resources.
 - HB 828 (HB 829 - appropriation bill to fund HB 828): Reworked HB 778 and 777. Controversy developed over whether to create a long-term fund to fund the program, or whether to have it justified each year for legislative appropriation. Died in Senate Resources.
- 1971 - *Ch 113 SLA 1971 (SB 107): Established the Division of Fisheries Rehabilitation, Enhancement and Development in the Department of Fish and Game. Approved no long-term funding mechanism.*
- 1972 - SB 16: Established a Fisheries Rehabilitation, Enhancement and Development Investment Fund/Working Fund (\$100,000,000). Died in Senate Resources.
- 1973 - *Ch 79 SLA 1973 (HB 126): Established the regulation of entry into Alaska's commercial fisheries.*
- 1974 - *Ch 111 SLA 1974 (HB 830): Established the private nonprofit hatchery program and the corresponding permitting system.*
 - *Ch 130 SLA 1974 (HB 673): Established a Renewable Resources Permanent Fund and Development Fund for capital and operating expenditures for the rehabilitation, enhancement and development of renewable resource programs. (Repealed in 1984.)*
 - *Ch 133 SLA 1974 (HB 475): Authorized the state to issue \$10,500,000 in general obligation bonds, mostly for capital improvements to state hatchery facilities (after approval through popular election).*
- 1975 - *Ch 128 SLA 1975 (SB 181): Related to loans for the construction of hatchery facilities. (Forerunner to the fisheries enhancement loan program).*
 - *Ch 97 SLA 1975 (SB 180): Established that the Department of Fish and Game will provide technical and advisory assistance to private nonprofit hatchery permit holders and applicants.*

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- 1976 - *Ch 161 SLA 1976 (SB 688): Established Regional Associations and required a regional salmon enhancement plan.*
- *Ch 190 SLA 1976 (SB 689): Established the Fisheries Enhancement Loan Program. Also authorized regional aquaculture associations to assess fishery enhancement taxes on the sale of salmon in established areas.*
- *Ch 214 SLA 1976 (HB 615): Authorized the state to issue \$29,205,000 in general obligation bonds for capital improvements to state hatchery facilities (after approval through popular election).*
- 1977 - *Ch 154 SLA 1977 (HB 264): Related to fisheries enhancement loans, regional salmon plans, fisheries enhancement revolving loan fund, and creating Regional Salmon Enhancement Authorities.*
- *Legislative Resolve 71 (HCR 8): Stated Department of Fish and Game's policies for managing hatchery and wild salmon stocks.*
- *HB 252: Established a Fisheries Enhancement Revolving Loan Fund. Died in House Finance.*
- *SB 39: Companion bill to HB 264, which became Ch 154. Died in Senate Finance.*
- *SJR 49: Expressed support for the "National Aquaculture Organic Act of 1978."*
- 1978 - *Ch 140 SLA 1978 (SB 618): Authorized the state to issue \$26,965,000 in general obligation bonds for capital improvements to state hatchery facilities (after approval through popular election).*
- *Ch 159 SLA 1978 (HB 763): Established the Commercial Fishing and Agriculture Bank to provide sources of credit for development of Alaska agriculture and fishing businesses.*
- *HB 638: Established a termination date for receipt of application for private nonprofit hatchery permits. (Would have effectively stopped any future PNP hatcheries.) Died in House Resources.*
- *HB 669: Established hatcheries in the Anchorage area. Died in House Resources.*
- *HB 710: Related to the issue of general obligation bonds. Companion bill to SB 618 which became Ch 140. Died in House Finance.*

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- HB 808: Related to the certification of independent fishery biologists to inspect Alaska hatcheries. Died in House Resources.
- HB 821: Special appropriation for a chum hatchery near Kotzebue Sound. Died in House Finance.
- 1979 - *Ch 59 SLA 1979 (HB 359): Better defined royalty assessments and the powers of the Board of Fisheries relating to PNP permits. Establishes Regional Associations as service areas.*
- *Ch 64 SLA 1979 (HB 290): Established special harvest area entry permits.*
- HB 48: Established special harvest area entry permits. Died in House Resources. Re-emerged as HB 290 in rules and became Ch 64.
- 1980 - *Ch 14 SLA 1980 (HB 948): Special appropriation of \$900,000 for the Department of Transportation and Public Facilities to complete construction of Snettisham hatchery.*
- *Ch 91 SLA 1980 (HB 691): Authorized the state to issue \$7,718,800 in general obligation bonds for capital improvements to state hatchery facilities (after approval through popular election).*
- *Ch 154 SLA 1980 (HB 969): Refined and defined salmon enhancement taxes. (Inspired by a lawsuit against mandatory assessments of salmon enhancement taxes.)*
- SB 344: Related to the issuance of general obligation bonds for hatchery improvements. Companion bill to HB 691, which became Ch 91.
- HB 777: Expanded fisheries enhancement loans to include lake fertilization and habitat improvement. Died in House Finance.
- HB 924: Supplemental appropriation of \$30,000 to operate the division of Fisheries Rehabilitation, Enhancement and Development. Died in House Finance.
- HB 971: Extended repayment time (from 25 to 30 years) and length of time to establish ten percent equity position (from six to ten years) for fisheries enhancement loans. Died in House Finance.
- 1981 - *Ch 106 SLA 1981 (HB 198): Established the Alaska Seafood Marketing Institute for the promotion and marketing of Alaska seafood.*
- HCR 16: Requested the Department of Fish and Game to manage for hatchery broodstock recovery. Died in Senate Resources.

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- SB 268: Special appropriation of \$115,000 for a hatchery near Bethel. Died in Senate Resources.
- SB 269: Special appropriation of \$50,600 for a hatchery in the Yukon Kuskokwim area. Died in Senate Resources.
- HB 389: Companion bill to SB 269. Died in House Finance.
- HB 390: Companion bill to SB 268. Died in House Finance.
- HB 471: Special appropriation of \$25,000,000 to the Fisheries Enhancement Revolving Loan Fund. Died in House Finance.
- HB 479: Redefined the jurisdiction of regional salmon enhancement plans. Died in House Resources.
- HB 480: Forbid hatcheries without state permits and profit-making hatcheries. Died in House Resources.
- 1982 - *Ch 32 SLA 1982 (HB 472): Increased the maximum amount for a private nonprofit hatchery loan from \$6,000,000 to \$10,000,000.*
- HB 664: Allowed the conversion of hatchery construction loan to long-term loan and other changes. Died in House Resources.
- 1983 - SB 156: Allowed sale, lease or grant of state hatcheries to regional associations or other approved hatchery operators. Vetoed by the governor.
- HB 393: Allowed qualified private, nonprofit hatchery permit holders to operate (lease) state hatcheries. Companion bill to SB 156. Died in House Resources.
- 1984 - Nothing introduced.
- 1985 - *Legislative Resolve 22 (HJR 38): Requested continued fishery enhancement activities in the Kenai National Wildlife Refuge.*
- *Ch 79 SLA 1985 (SB 78): Made changes to the fisheries enhancement revolving loan fund and established a special account to fund foreclosure expenditures.*
- 1986 - Nothing introduced.
- 1987 - HB 38: Established limits on the dollar amount of state loans outstanding to private nonprofit hatchery owners and regional associations. Withdrawn by the sponsor.

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- 1988 - *Ch 14 SLA 1988 (SB 410): Allowed the operation of state hatcheries by contract.*
- *Ch 152 SLA 1988 (SB 494): Exempted broodstock and cost recovery fish from salmon enhancement tax. Also repealed AS 16.10.600 - 620 on Salmon Enhancement Authorities.*
- 1989 - *Ch 33 SLA 1989 (SB 62): Allowed the levy of an additional one percent salmon enhancement tax under certain circumstances.*
- *House Resolve 7 (HR 11): Encouraged Exxon to fund salmon enhancement to mitigate the Exxon Valdez oil spill.*
- *Senate Resolve 11 (SR 16): Companion resolve to House Resolve 7.*
- *SB 84: Clarified language in Ch 152 SLA 1988 regarding salmon enhancement tax exemption. Died in House Resources.*
- *SB 290: Gave salmon hatcheries the first priority to receive water released by state-owned hydroelectric projects. Died in Senate Rules.*
- *HB 291: Companion bill to SB 290. Died in House Resources.*
- 1990 - *Ch 36 SLA 90 (HB 85): Established changes in accounting procedures for the fisheries enhancement revolving loan fund.*

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ATTACHMENT B

December 1, 1975

Honorable Jay Hammond
Governor of Alaska
Juneau, Alaska

This letter is prompted by recent News reports of your having appointed a "Fisheries Task Force" to study ways of reviving our depressed Fishing industry. Since I may, or may not, have an opportunity for input into that committee and my belief that the makeup of the committee precludes recommendation of one action I consider necessary for a start toward resolution of our Fisheries problems, I'd like to make the following comments to you directly.

First, I'd like to assure you that I lay no claim to any expertise on fishing or fisheries problems. I've been an Alaskan resident for the past thirty years. The first five years of my residency I was a commercial fisherman. The main thing I learned during that five years was how little I knew about fishing.

I was an early and ardent supporter of Statehood for Alaska. One reason was because of my conviction that Alaskans could do a better job of controlling and managing our fisheries than was being done by the U.S. Fish and Wildlife Service.

During the first years following Statehood I made excuses for the management policies of the Alaska Dept. of Fish and Game because, I reasoned, the things they should be doing cost money and the new State didn't have that much money. With the advent of the nine hundred million dollar lease sale in the north I hoped the Dept. would come to life and start making progress with the problem of our declining salmon fishery.

Nothing happened.

Again I made the excuse that it takes a little time to get going in a new direction.

Although I had begun to harbor some serious doubts, my real disillusionment finally came about in the 1973 session of the legislature.

At that time I was a member of the House Finance Committee. The late Representative Hillstrand was at that time Chairman of House Finance.

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Mr. Hillstrand, recognizing the need for some kind of constructive action, appointed a special sub-committee from members of the Finance Committee, charged with concerning themselves with the problems of Fisheries Rehabilitation, Enhancement and Development. In other words the so-called F.R.E.D. programs.

I was a member of that sub-committee.

Being members of the Finance Committee, obviously our greatest contribution would be in proposing funds for worthwhile projects within the F.R.E.D. Division.

As you well know, membership on the Finance Committee requires long hours of work. The sub-committee did its regular work during the day then came back at night, many nights, and met with the Commissioner of Fish and Game and ten or fifteen members of his staff.

All of this effort was non-productive. We were unable to help. Unable to help for the simple reason that as far as the top management of the Dept. of Fish and Game was concerned--they simply do not believe in Fisheries Rehabilitation, Enhancement, and Development.

I know this may sound a bit harsh, and I want to point out this is my personal opinion. But, a majority of my colleagues on the committee came to the same conclusion.

I'll never forget one particular phrase used by the Commissioner of Fish and Game during the meetings, and that was "the most economical way to produce fish is to properly manage the wild stock".

No one in his right mind would argue with that. The point is that we were not there to discuss the value of proper management. We were there to try to assist with the F.R.E.D. program. As far as I can remember, we received no hints, no clues of any kind, how we, as members of the Finance Committee, could help or assist them with the F.R.E.D. programs.

It would seem to me that sixteen years of following a strict "Management" philosophy in our Fisheries has proved a dismal failure.

I'll admit there are other contributing factors, some of them beyond the State's control. One of course is that the Federal Government has allowed foreign fleets to lay off our shores and harvest Alaska's fish. American foreign policy, which quite often seems to me to be more "foreign" than "American" has and still is using our Fisheries as a pawn in the diplomatic game with little or no regard for Alaskan interest. I

think it is reasonable to assume that sometime in the near future we will have a two hundred mile limit, and possibly other improvements. But even with this, simple "management of the wild stock" will not be enough. If we are to rehabilitate our fisheries we are going to have to give mother nature a hand. We are going to need a change in philosophy and direction. We must get out of the old "management only" groove. We must have more than just "grudging" support for innovative approaches. It is my honest opinion that this will never come about with the prevailing philosophy of the present management of the Department.

Please believe me when I say that I have no "ulterior" motive, no desire to question the honesty, integrity, or devotion to duty of the Commissioner of Fish and Game. I simply believe that the direction and philosophy to which the management is so dedicated is wrong. Further, I don't believe it is going to change.

Fisheries Rehabilitation, Enhancement, and Development programs are working in other states, in Canada, and in Japan. They'll work for Alaska if given a fair chance. I don't believe they're getting that chance.

I may be unfair, but, it seems to me the top people in Fish and Game never miss an opportunity to downplay or belittle F.R.E.D. programs or proposals. Let me quote some excerpts from a recent article: "In its attempt to rejuvenate its failing salmon runs, Alaska is plunging headlong into a hatchery program that is causing concern to Fisheries Scientists". Or take this one from the same article: "...the committee warned that lack of genetic planning in the artificial propagation program could result in unfavorable changes in the genetic composition of some wild salmon and trout stocks. Haphazard attempts to enhance salmon stocks by transplanting eggs, juveniles or adults from one area to another should be avoided until critical evaluations are made".

These quotes are from an article in "Alaska's Seas and Coasts", published last April, but, to me, the strange thing is that I heard the Commissioner of Fish and Game make the same argument three years ago when we tried to talk about F.R.E.D. programs.

Governor, I'm sure the proper "genetics" of salmon are important. However, I'll wager that if our fishermen have to make a choice between salmon with the wrong "genetics" or no salmon at all they'll not worry that much about the salmon's parents or where he came from.

If you'll check the record I'll predict that you'll find that nearly every rehabilitation project now in existence was pushed and promoted, not by the top management of the Dept. of Fish and Game but by some individual legislator. I'm saying that almost without exception, every rehabilitation program outside the laboratory had to be forcibly pushed down the throat of the Department's top men.

It is my belief that there is no problem facing the State of Alaska that commands more interest and sympathy from the State Legislature than that of Fisheries. The Legislators want to do something to solve the problem. The trouble is that they don't know what to do. Obviously the responsibility for planning, guidance, and direction, as well as suggestions, should come from the "experts" in the Dept. of Fish and Game. This is not being done. Wanting to do what needs to be done and being unable to get any help from the people whose responsibility it is to furnish that "expertise" is terribly frustrating. I'm well aware that this situation in our Fisheries is something you inherited from the former Governor, likewise he from the former Governor, etc., etc. For the last sixteen years nothing has changed, the same approach, the same disastrous results, a steady decline in our fishing industry. Something has to be done and you, and only you, have the power to remove or replace a person in such a policy-making position. As you well know this last fishing season was a disaster in the District I represent. A lot of good people who depend on our fisheries for a livelihood, people who are not only my constituents but my good friends, are going to become economic "basketcases" if the people who bear the ultimate responsibility don't get off their backsides and make an all out effort to turn this situation around. I sincerely believe that you, as the state's Chief Executive, are in a position to get us started in the right direction.

I submit that the prevailing philosophy is not going to change as long as he is in control, that if we continue to concentrate on "management" and "management" only, soon there will be nothing left to "MANAGE".

I'm suggesting that the present Commissioner of Fish and Game be thanked for his years of devoted duty and removed from a policy-making position--that he be replaced with some qualified person with a new and different approach. I'm suggesting that such a replacement be hired solely on qualifications without regard as to what part of the world he, or she, might come from. Governor, it is my honest opinion that until this is done all the "Task Forces" you could possibly appoint will bring about no improvements in our Fisheries.

Respectfully,

Representative Oral Freeman
Election District 1
Ketchikan, Alaska

(Retyped copy of Rep. Freeman's letter, by permission)

ACE 5437493



STATE OF ALASKA
OFFICE OF THE GOVERNOR
JUNEAU

December 8, 1975

The Honorable Oral Freeman
Alaska State House of
Representatives
2743 3rd Avenue
Ketchikan, Alaska 99901

Dear Representative Freeman:

Thank you for your letter of December 1, expressing your concerns over the present state of our salmon resources and your recommendation that the present Commissioner of the Department of Fish and Game be replaced. Be assured that I am familiar with the issues you raise and share your concerns for the future of our fishery resources.

Because of my belief in the potentials offered by an aggressive fisheries rehabilitation and enhancement effort, I have assigned the review and coordination of such a program to my Chief of Staff, Mr. Bob Palmer. As you know, Mr. Palmer was in large measure responsible for initiating such a program during his tenure in the State Senate. It is my understanding that some significant changes in this program have taken place as a result. Rather than detail these changes, I suggest that you meet with Mr. Palmer after your arrival in Juneau for the legislative session. I am sure you will be pleased with the progress we have made.

As you know, all commissioners serve at the pleasure of the Governor. However, the legislation splitting the Board of Fish and Game into separate boards, which was passed by the Legislature last session, also speaks to the removal of the commissioner. It provides a mechanism by which either board can send a resolution to the Governor requesting the removal of the commissioner. Such a mechanism certainly meshes with my philosophy that the management of our fish and game resources should be removed at least a half step from the political arena. In addition, this mechanism implies a degree of legislative intent in this regard. Consequently, I would be most reluctant to replace the commissioner without a resolution from either board.

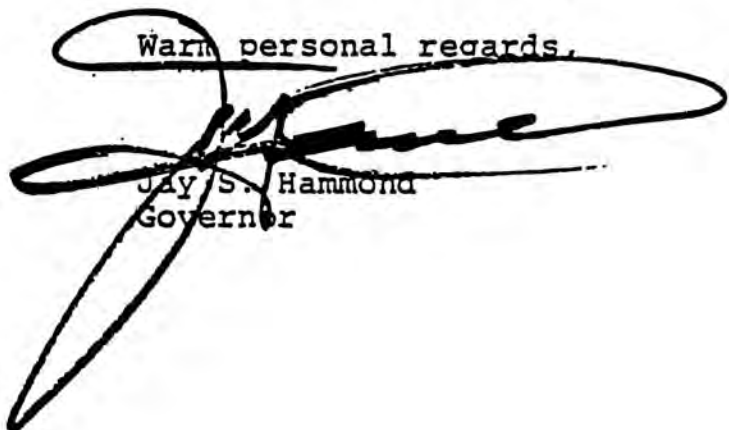
ACE 5437494

December 8, 1975

In closing, I would like to clarify any misunderstanding about the charges given to the Fisheries Economic Impact Task Force which I recently appointed. Basically, their charges deal with the economic stress placed on our fishermen as a result of poor seasons, rather than to "revive our depressed fishing industry". Certainly, these two issues are closely related and both are being actively worked on by members of this Administration.

Oral, I greatly appreciate your apprising me of your concerns, and I am hopeful that we will have the opportunity to discuss them in greater detail while you are in Juneau for the legislative session.

Warm personal regards,



Jay S. Hammond
Governor

ACE 5437495

ATTACHMENT C

Excerpt from Oct. 4, 1978 Meeting of the
Aquaculture Policy Study Group Minutes

RECONVENE 11:30 a.m.

Upon reconvening, John Sund proposed the following goal statement for the study group:

A healthy salmon industry, paying its own way,
providing employment, return on investment,
and pleasure in recreation (sport fishing),
by the year 2000.

PROPOSED
GOAL
STATEMENT

Referring to "paying its own way," Mr Sund advised that prior to 1968, the salmon industry was the greatest state revenue producer. Since that time, the greatest revenue has come from the oil industry. He further advised that the Group should discuss whether "paying its own way" should include regulation of the industry.

Concerning "providing employment," Mr. Sund advised that such employment involves one of the functions of government which is to provide that which people do not provide for themselves.

Mr. Sund stated that he hoped that by analyzing aquaculture, the group could come up with reasons why and how it could function concerning what should be done for the future, including statutory changes if necessary, creation of new entities, and/or destruction of outdated entities.

Dr. Burkette advised that he believed the group should approach aquaculture problems from the direction of a resource industry and couch its goal statement in those terms. Chairman Gardiner then asked group members if they wished to view the salmon industry from a resource or a people oriented outlook, adding that he tends to look from a people point of view while the Department takes the resource viewpoint. Dr. Burkett stated that the Department views aquaculture from the philosophy of a healthy resource; nothing else is involved. Armin Koernig advised that in the early days of Alaska, no attention was paid to the resource itself but rather to the economic income of the industry. He felt the committee should attempt to effect a well balanced resource that is a social/economic industry as well. Bob Simpson advised that National Marine Fisheries prefers to see salmon runs enhanced rather than enhancing the industry.

IS AQUA-
CULTURE
RESOURCE
OR PEOPLE
ORIENTED

BOTH
RESOURCE
AND SOCIAL
ECONOMIC
INDUSTRY

Jack Milnes read Article VIII of the Alaska State Constitution, concerning natural resource policy, advising that the Constitution makes clear that use of the resource be directed toward the people.

CONSTITUTION
ON RESOURCE

Suggestion was made by Barbara Sorensen that language be included within the goal statement to cover processing within the industry, advising that processing has not heretofore been addressed by state policy.

SHOULD
PROCESSING
BE INCLUDED
IN GOAL
STATEMENT

Further suggestion was made that provision for subsistence fishing be included within the statement, and Mr. Sund advised he had no objection to the inclusion of subsistence. He further stated that he believed the group needed a statement set within a time frame in order to produce a definite goal against which the group can measure accomplishments.

GOAL STATE-
MENT TO
INCLUDE
SUBSISTENCE

Dr. Burkett objected to the proposed statement asking when it was decided the group should have such a statement, what the advantages to having one are, and who decided to effect such a statement. Chairman Gardiner advised that the decision had been made at the previous meeting of the group when Dr. Burkett and Mr. Sund were directed to come up with a goal statement. Mr. Sund formulated the wording and put it before the group. Dr. Burkett advised that he assumed the goal statement was going to be tabled as a possible area of pursuit. Dr. Kaill advised that he thought the purpose of the group was statutory clarification, and Armin Koernig attested to the need for a goal statement from which the group could work forward.

OBJECTION
TO GOAL
STATEMENT

A brief discussion followed concerning whether or not there was need for a goal statement, after which the committee recessed for lunch.

LUNCH RECESS 12:05 p.m.

RECONVENE 1:40 p.m.

Discussion resumed concerning the need for a group goal statement, and Dr. Kaill proposed language providing for "optimum yield for the state salmon fisheries," advising that such a goal doesn't really mean anything until the group gets down to its real objectives.

KAILL,
GOAL
LANGUAGE

Sandy Somerville advised that he believed a goal statement to be useful to the extent it would acknowledge that there is both a social and economic system at work here as well as a biological function. It would acknowledge conflicting economic, social, and biological needs, although the resources and needs would vary from region to region. Value judgments would be made by each region to determine how it will proceed in developing its resource, remembering that these economic, social, and biological needs are at odds, and each region must determine what is most important and what comes first. The group must design a process for reconciling competing goals.

SOMERVILLE,
SOCIAL,
ECONOMIC
BIOLOGICAL
CONFLICT

GROUP MUST
ESTABLISH
PROCESS FOR
RECONCILING
COMPETING
GOALS

Mr. Sund read a section from the letter of intent formulating the study group, advising that the directive covers a lot of ground. He further stated that he believed the group could very easily agree on a goal, but he would prefer to have goal areas broken down and measurable against time.

Mr. Somerville suggested that assignments be made for developing goals in economic, social, and biological areas, advising that he felt the Alaska Department of Fish and Game would be in conflict with some of the guidelines the group might establish, adding that the group would have to get a consensus in each separate area. Mr. Sund advised that he would try to include all these areas in his statement citing as an example of Department action the Bristol Bay closure; a biological decision made without regard to economic or social results. He added that he did believe it necessary to set some statement down on paper in order to determine a realistic method for attaining the goal. Mr. Somerville stated that the question would remain as to where the checks rest, who makes the decision to intervene in action taken in the industry, who invests authority to integrate regional plans and reconcile competing interests.

Chairman Gardiner attested to the problem of different types of fishermen fishing the same area within differing time frames, advising that the Department has no method for evaluating its decisions. There should be some guidelines such as those governing Canadian and American catches.

PROBLEM
DIFFERENT
GEAR
FISHING
SAME
AREA

Mr. Somerville advised that regional plans should make very clear statements of goals in a region where economic, social, and biological needs conflict. They would also define management goals, and goals for economic sharing of the income. The group must acknowledge that it understands the competition between these needs. Chairman Gardiner advised that he felt favorably toward Mr. Somerville's suggestion.

Jack Milnes advised that the goal statement is already in the Constitution of the State, stating that what the group must do is determine how to interpret the Constitution, adding that he was not addressing aquaculture but salmon restoration. Legislature has already been used in this area but it has not sufficiently defined functions. The group needs to start with some specific interpretations of what it is going to do.

Dr. Burkett raised a question concerning the area encompassed by the group, advising that some of the previously discussed problem areas are the responsibility of the Regional Planning Teams. He further advised that in the course of operation, goals can change and flexibility is needed, adding that concerning the people and many areas involved, he believed goal determination should be set at the regional level.

SHOULD
GOALS
BE SET BY
REG. PLANNING
TEAMS

Mr. Sund spoke to problems with Regional Planning Teams arising from the fact that they are composed of half volunteer participants (fishermen, etc.) and half paid participants (employees of the Alaska Department of Fish and Game), advising that he didn't believe the power to function could be given these people without funding. Apparently funding is provided through Fish and Game which poses a problem in that getting funding out of Fish and Game has proven to be a "disaster." He advised that if the state is going to push responsibility on the Regional Teams, it is going to cost approximately \$100,000 to \$200,000 per year, per region (approximately \$1,000,000 statewide).

FUNDING FOR
REG. PLANNING
TEAMS

Chairman Gardiner advised that Regional Planning Teams would be discussed at a later time and directed group attention back to the pending agenda.

Dr. Kaill furnished group members his Overview of Policy and Procedures Manual (copy attached to these minutes), advising that such policies have tried to deal with genetic problems of natural versus hatchery salmon.

POLICY &
PROCEDURES
MANUAL
OVERVIEW

Legislative Appropriations and Bond Authorizations for Alaska's Hatchery Program, FY 68 - FY 92

Fiscal Year	Operating Appropriations	Capital Appropriations	Bond Authorizations
1968			3,000,000
1969			
1970			
1971			
1972	1,023,400		
1973	1,130,300	50,000	
1974	1,418,200	1,698,400	
1975	2,089,300	1,633,800	10,500,000
1976	3,188,800	387,600	
1977	4,368,500	1,691,500	29,205,000
1978	4,695,000	1,089,300	
1979	9,063,900	1,315,500	26,965,000
1980	8,094,200	178,000	
1981	9,611,200	7,298,000	7,718,800
1982	10,378,400	5,928,000	
1983	12,286,900	845,000	
1984	12,932,000	1,138,600	
1985	14,808,800	5,871,400	
1986	15,619,300	2,714,000	
1987	15,225,800	1,377,800	
1988	14,557,700	386,000	
1989	15,330,900	335,000	
1990	15,600,600	1,211,700	
1991	17,487,900	1,185,000	
1992	18,925,400	5,000,000	
TOTAL	\$207,836,500	\$41,334,600	\$77,388,800

Note: This table does not include supplemental appropriations, reappropriations, special appropriations for special projects, or appropriations to agencies other than the Division of Fisheries Rehabilitation, Enhancement and Development in the Department of Fish and Game.

Source: Session Laws of Alaska, 1967 - 1991.

Prepared by the Legislative Research Agency, July 1991 (91.296A).

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ATTACHMENT E
FRED 1990 Annual Report

Table 12.1. Cumulative state loans and enhancement funds returned to associations (through December 31, 1990), and annual fish sales for 20 private nonprofit (PNP) hatcheries (through Dec. 31, 1990).

Region/Corporation (number of permits)	State	Loans	Cumulative Enhancement Funds Generated through Assessments, Returned to Associations via Contract	Estimated Revenue From 1990 Sales of Fish Returning to Special Harvest Areas
	For Capital Construction	For Operations		
SOUTHERN SOUTHEAST				
Southern Southeast Regional Aquaculture Association-SSRAA (3)	\$9,093,000.00	\$2,848,942.00	\$13,820,467.21 (note 1)	\$1,180,692.00
Alaska Aquaculture, Inc.-AAI (1)	\$1,091,985.00	\$2,303,208.00	N/A	\$21,499.30
Meyers Chuck Aquaculture Association-MCAA (1)	\$10,000.00	\$0.00	N/A	N/A
NORTHERN SOUTHEAST				
Northern Southeast Regional Aquaculture Association-NSRAA (3)	\$2,724,265.00	\$1,638,496.00	\$7,895,083.89 (note 1)	\$1,253,052.38
Armstrong-Keta, Inc.- AKI (1)	\$1,733,645.00	\$2,015,500.00	N/A	\$350,934.30
Burro Creek Farms, Inc.-BCF (1)	\$51,500.00	\$332,875.00	N/A	\$606.00
Douglas Island Pink and Chum Inc.-DIPAC (3)	\$9,171,000.00	\$3,821,000.00	N/A	\$68,366.00
Kake Nonprofit Fisheries Corp.-KNFC (1)	\$1,500,724.00	\$1,632,060.00	N/A	\$101,328.93
Sheldon Jackson College-SJC (1)	\$362,254.00	\$61,370.00	N/A	\$0.00
Tlingit and Haida Fisheries Development Corp.-THFDC (0)	\$1,464,000.00	\$89,860.00	N/A	N/A
PRINCE WILLIAM SOUND				
Prince William Sound Aquaculture Corp.-PWSAC (3)	\$19,475,419.00	\$1,085,500.00	\$8,019,732.53 (note 2)	\$8,005,445.08
Valdez Fisheries Development Assoc.-VFDA (1)	\$3,193,830.00	\$3,250,543.00	N/A	\$2,614,413.59
COOK INLET				
Cook Inlet Regional Aquaculture Assoc.-CIAA (2)	\$1,438,881.00	\$683,369.00	\$9,301,544.64 (note 2)	\$47,703.19
KODIAK				
Kodiak Regional Aquaculture Assoc.-KRAA (1)	\$0.00	\$0.00	\$3,182,883.56 (note 2)	\$0.00
STATEWIDE TOTALS	\$51,310,503.00	\$19,762,723.00	\$42,219,711.83	\$13,644,040.77

note 1: 3% mandatory assessment tax collected from commercial fishermen.

note 2: 2% mandatory assessment tax collected from commercial fishermen.

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ATTACHMENT F
Legislative Resolve 71 SLA 1977
Re: Protection of Wild Stocks

Original sponsor: Haugen

Offered: 4/7/77
For Today's Calendar

1 IN THE HOUSE

BY THE RULES COMMITTEE

2 CS FOR HOUSE CONCURRENT RESOLUTION NO. 8 am

3 IN THE LEGISLATURE OF THE STATE OF ALASKA

4 TENTH LEGISLATURE - FIRST SESSION

5 Relating to the study of hatchery and wild
6 salmon stock harvest and the comparative
7 economics of salmon hatchery construction
8 and operation.

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

10 WHEREAS the nonprofit salmon hatchery program was established by the
11 Legislature in 1974; and

12 WHEREAS the express legislative intent was to ". . . authorize the pri-
13 vate ownership of salmon hatcheries by qualified nonprofit corporations for
14 the purpose of contributing, by artificial means, to the rehabilitation of
15 the state's depleted and depressed salmon fishery. . ."; and

16 WHEREAS the program is to be administered in a manner ". . . without
17 adversely affecting natural stocks of fish in the state. . ." and in a manner
18 ". . . which allows reasonable segregation of returning hatchery-reared salmon
19 from naturally occurring stocks"; and

20 WHEREAS the nonprofit salmon hatchery program was subsequently amended
21 in 1976 to allow for the creation of regional associations for the purpose of
22 salmon fishery enhancement and gives qualified associations preference to
23 hatchery permits from the Department of Fish and Game; and

24 WHEREAS the state can make loans to regional hatchery associations in
25 the amount of \$3,000,000 maximum per loan to regional associations and
26 \$300,000 maximum per loan to other hatchery permit holders; and

27 WHEREAS the voters of Alaska approved the construction of state-owned
28 hatchery and rearing facilities in the amount of \$24,565,000 in the 1976
29 general election; and

1 WHEREAS there has not been a comprehensive analysis of the relative cost
2 to the state of the state-owned hatcheries and the private nonprofit hatch-
3 eries; and

4 WHEREAS these state-owned facilities will be located in Southeastern
5 Alaska, Bristol Bay, Cook Inlet, Kodiak, Prince William Sound, and the Alaska
6 Interior; and

7 WHEREAS the locations of these state-owned hatchery facilities are in
8 the general proximity of present and potential future private nonprofit
9 salmon hatchery facilities; and

10 WHEREAS both the state and private hatchery facilities will release
11 salmon into the common property fishery; and

12 WHEREAS private hatchery fish will be subject to the common property
13 fishery along with the naturally occurring salmon runs in Alaska; and

14 WHEREAS it is the stated policy of the Alaska Department of Fish and
15 Game that "if complexities arise in managing mixed stocks, including both
16 hatchery fish and wild fish, it will be state policy to manage the collective
17 resource in a manner that favors protection of the wild stocks."; and

18 WHEREAS the proper management of this multi-stock fishery is of vital
19 importance to the people of Alaska in light of the importance of the salmon
20 fishery to the economic welfare of a significant portion of the state's
21 population.

22 BE IT RESOLVED by the Alaska State Legislature that the State of Alaska
23 is committed to a fisheries management policy that encourages and promotes
24 the coexistence of healthy hatchery and wild stocks of salmon, and to imple-
25 ment this policy the Department of Fish and Game, through the regional
26 planning teams, shall initiate planning to meet the potential conflicts which
27 may arise from the harvest of hatchery and wild salmon stocks so that the
28 wild stocks are adequately protected; and be it

29 FURTHER RESOLVED that the Alaska Fisheries Council study the comparable
CSHCR 8 am

1 salmon hatchery cost to the state for both capital and operational costs for
2 state-owned hatcheries and private nonprofit hatcheries; and be it

3 FURTHER RESOLVED that the Department of Fish and Game and the Alaska
4 Fisheries Council report their findings and recommendations to the Second
5 session, Tenth Legislature.

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ATTACHMENT G

Introduced: 4/3/81
Referred: Resources

1 IN THE HOUSE

BY THE RESOURCES COMMITTEE

2 HOUSE CONCURRENT RESOLUTION NO. 16

3 IN THE LEGISLATURE OF THE STATE OF ALASKA

4 TWELFTH LEGISLATURE - FIRST SESSION

5 Relating to broodstocks for fisher-
6 ies rehabilitation and enhancement.

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

8 WHEREAS the people of the state have approved \$78,000,000 in bond
9 issues for the construction of hatcheries in the state; and

10 WHEREAS the Department of Fish and Game, division of fisheries rehabili-
11 tation, enhancement and development, with an annual budget of \$10,000,000,
12 has been established for the sole purpose of fishery rehabilitation enhance-
13 ment, and development; and

14 WHEREAS the fisheries enhancement loan program has been established to
15 support an active, private, nonprofit hatchery program; and

16 WHEREAS private associations have expended thousands of volunteer hours
17 and have invested millions of dollars of state loans in hatchery programs;
18 and

19 WHEREAS the loan money must be paid back to the state through revenues
20 derived from the capture and sale of returning fish; and

21 WHEREAS hatchery programs and the rehabilitation and enhancement of
22 state fisheries require adequate supplies of broodstock eggs; and

23 WHEREAS fisheries management agencies, specifically the division of
24 commercial fish and the Board of Fisheries, have not been given clear direc-
25 tion regarding the allocation of fishery stocks to provide the necessary
26 broodstock eggs for the hatchery programs and for rehabilitation, enhance-
27 ment, and development of the fisheries; and

28 WHEREAS many of the fish stocks are in a depressed condition and have
29 been depressed for some time; and

1 WHEREAS a fishery rehabilitation and enhancement program cannot be
2 effective unless, in many cases, the initial broodstock eggs are taken from
3 an already depressed fish stock; and

4 WHEREAS, due to the difficulty in obtaining adequate broodstock eggs,
5 many state and private facilities, worth millions of dollars are empty; and

6 WHEREAS fisheries enhancement loan repayments are dependent on the
7 capture and sale of returning fish and the lack of broodstock eggs to in-
8 crease the number of returning fish will cause loans to be in default;

9 BE IT RESOLVED that the Alaska State Legislature respectfully requests
10 the governor, through the Department of Fish and Game, and the Board of
11 Fisheries to provide for broodstock for fisheries rehabilitation and enhance-
12 ment projects from already depressed fish stocks.

ATTACHMENT H

REFERENCES

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CHAPTER III. PRODUCTION POLICIES AND TRENDS IN ALASKA AND WORLDWIDE

See the attached memoranda regarding "Overview of World Commercial Salmon Production" by Linda J. Snow and Maria Gladziszewski of Legislative Research Agency.

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Alaska State Legislature

Legislative Research Agency



130 Seward Street, Suite 218
Juneau, Alaska 99801-2196

Phone: (907) 465-3991
Fax: (907) 463-3351

February 7, 1992

MEMORANDUM

TO: Senator Richard Eliason, Chairman
Senate Special Committee on International and Domestic Fisheries

FROM: Linda J. Snow *L. Snow*
Legislative Analyst

RE: Overview of World Commercial Salmon Production
Research Request 92.058 [REVISED]

You asked for information about world commercial salmon production (harvest). In particular, you asked for an overview of world production of farmed salmon, wild salmon and ranched salmon, and information about trends and policies of the major salmon-producing countries.

SUMMARY

World salmon production over the last decade has been characterized by a decline in wild salmon stocks and an increase in hatchery-bred (ranched) and farmed salmon production.¹ Farmed salmon production nearly doubled between 1988 and 1990, increasing from about 310 million pounds to over 600 million pounds. Commercial salmon catch increased only slightly during that time. In 1990, farmed salmon made up about 27 percent of world salmon production. The increased supply of salmon on the world market lowered the price of the fish. Lower salmon prices and rising operating costs have brought economic hardship to salmon-farming operations worldwide, although many farms remain competitive. Recent trends indicate a slight reduction of farmed salmon production. Lower prices have also adversely impacted commercial salmon-fishing operations worldwide.

¹In this memorandum, the term "ranched" salmon refers to salmon which are hatched in a hatchery facility and released into the ocean, regardless of whether they are harvested by the common property fishery or harvested as private property.

OVERVIEW OF WORLD COMMERCIAL SALMON PRODUCTION

This section begins with an assessment of the sources of data available about worldwide commercial salmon production. It is followed by a brief statistical overview of wild, ranched and farmed salmon production worldwide.

Data Sources

Commercial salmon production reporting takes place in many countries around the world. However, there is no uniformity in the recordkeeping and statistical reporting among the various countries. Some countries report live weight of fish, while others report cleaned weight. Some estimate production by sampling commercial landings, while others compile comprehensive catch statistics from all vessels. Different units of measure may be used in reporting (i.e., numbers of fish, pounds of fish, metric tons of fish), and rounding errors may occur in converting from one unit of measure to another. Reports are prepared for different time periods (i.e., calendar year vs. fiscal year). Some sources report preliminary estimates which may or may not be revised. Sometimes statistics gathered within the same agency are not consistent because reporting requirements and techniques have changed from year to year. Thus, we have not only found it difficult to obtain comparable international data, we have also found inconsistent data reported by different government entities for the same national salmon production.

To make the best use of available worldwide salmon production data, we used two criteria in our selection of data for this report. First, we obtained data from the primary source, or as close to the primary source as possible. Second, we used the same source for the data when possible to be consistent. We obtained the data in Table A from the Department of Fish and Game, Division of Fisheries Rehabilitation, Enhancement and Development (FRED) and Division of Commercial Fisheries, the primary source. We obtained the data in Table B from the *Bill Atkinson's News Report*, a respected industry news letter which discusses developments in world fish markets. Table B is a compilation of data from the United Nations Food and Agricultural Organization (FAO), and from *Salmon 2000*, produced by the Alaska Seafood Marketing Institute. Tables 1 and 2 (attached) were taken from *Salmon 2000*, produced by the Alaska Seafood Marketing Institute. Tables 1 and 2 are composites of several tables in that document. Inconsistencies may be visible between the tables used in this report; however, the basic trends in salmon production are apparent from the data.

Statistical Overview

Salmon production includes the harvest of wild and hatchery-bred (ranched) fish and the harvest of farmed fish. All species of Atlantic and Pacific salmon are ranched, and Atlantic salmon and the coho and chinook varieties of Pacific

salmon are farmed. Many countries which ranch salmon do not distinguish between ranched and wild fish in their statistics of commercial harvests.

Alaska's government hatchery salmon program tags a large percentage of hatchery-bred fish before their release into the ocean. Thus, when recovering tags from commercially caught salmon, a reasonably accurate estimate of the number of hatchery-bred fish caught in the commercial fishery can be made.

Table A gives number of pounds of commercial salmon harvested in Alaska by species and by hatchery and wild fish, from 1980 through 1990. The hatchery contribution to the commercial harvest has become increasingly important, amounting to nearly 23 percent of the commercial catch in 1990. Although the contribution of hatchery harvest for each species has grown, the contribution of hatchery-bred pink salmon is the most significant at over 45 percent of the 1990 commercial pink salmon harvest.

Table B presents the world commercial salmon harvest for the years 1985 through 1990. The table lists commercial salmon catch by species for United States, Canada and Japan, as well as worldwide farmed production. United States statistics include the Alaska harvest. The farmed salmon category includes production from all countries which farm salmon. The "other" category includes salmon commercially caught by countries not listed separately, such as Korea, U.S.S.R., and Poland. Although commercial salmon catch fluctuated between 1985 and 1990, it appears that the increase in worldwide salmon production during that time is due to an increase in farmed salmon production. According to this data source, farmed salmon harvest increased from about 159 million pounds in 1985 to over 600 million pounds in 1990.

Tables 1 and 2 (attached) present some detailed country information for commercial salmon production. This information was taken from *Salmon 2000*, by the Alaska Seafood Marketing Institute. Table 1 presents worldwide harvest of wild and ranched salmon for 1980 through 1990. Note that only three years worth of Soviet commercial salmon catch are reported.

Table 2 presents worldwide farmed salmon production for 1980 through 1990. According to the source, farmed salmon production has increased dramatically from 15.7 million pounds in 1980 to 621.0 million pounds in 1990. Norway is the world's largest farmed salmon producer, harvesting 330.0 million pounds in 1990, over half the worldwide production.

TABLE A
Hatchery and Wild Salmon Commercial Harvest in Alaska, 1980 - 1990
(In thousands of pounds)

	Chinook	Sockeye	Coho	Pink	Chum	Total
1980 Commercial Harvest						
Wild Fish	11,478.3	186,842.7	21,845.2	209,492.9	70,852.2	500,511.3
Hatchery Fish	521.7	157.3	154.8	7,507.1	147.8	8,488.7
Total Harvest	12,000.0	187,000.0	22,000.0	217,000.0	71,000.0	509,000.0
Hatchery Contribution	4.35%	0.08%	0.70%	3.46%	0.21%	1.67%
1981 Commercial Harvest						
Wild Fish	14,963.2	224,678.0	25,630.8	228,186.8	98,850.9	592,309.8
Hatchery Fish	36.8	322.0	369.2	15,813.2	149.1	16,690.2
Total Harvest	15,000.0	225,000.0	26,000.0	244,000.0	99,000.0	609,000.0
Hatchery Contribution	0.25%	0.14%	1.42%	6.48%	0.15%	2.74%
1982 Commercial Harvest						
Wild Fish	15,981.1	188,822.9	45,345.0	198,509.5	89,179.8	537,838.3
Hatchery Fish	18.9	177.1	655.0	20,490.5	820.2	22,161.7
Total Harvest	16,000.0	189,000.0	46,000.0	219,000.0	90,000.0	560,000.0
Hatchery Contribution	0.12%	0.09%	1.42%	9.36%	0.91%	3.96%
1983 Commercial Harvest						
Wild Fish	14,962.7	304,080.1	25,423.0	176,128.7	77,351.9	597,946.5
Hatchery Fish	37.3	919.9	577.0	16,871.3	1,648.1	20,053.5
Total Harvest	15,000.0	305,000.0	26,000.0	193,000.0	79,000.0	618,000.0
Hatchery Contribution	0.25%	0.30%	2.22%	8.74%	2.09%	3.24%
1984 Commercial Harvest						
Wild Fish	11,852.1	220,523.7	42,846.7	260,732.8	92,040.0	627,995.2
Hatchery Fish	147.9	1,476.3	1,153.3	15,267.2	11,960.0	30,004.8
Total Harvest	12,000.0	222,000.0	44,000.0	276,000.0	104,000.0	658,000.0
Hatchery Contribution	1.23%	0.67%	2.62%	5.53%	11.50%	4.56%
1985 Commercial Harvest						
Wild Fish	12,646.6	218,305.3	45,033.4	260,585.5	74,452.1	611,022.9
Hatchery Fish	353.4	2,694.7	1,966.6	43,414.5	8,547.9	56,977.1
Total Harvest	13,000.0	221,000.0	47,000.0	304,000.0	83,000.0	668,000.0
Hatchery Contribution	2.72%	1.22%	4.18%	14.28%	10.30%	8.53%
1986 Commercial Harvest						
Wild Fish	10,637.6	191,159.2	42,973.1	231,847.2	86,419.8	563,036.9
Hatchery Fish	362.4	4,840.8	3,026.9	27,152.8	11,580.2	46,963.1
Total Harvest	11,000.0	196,000.0	46,000.0	259,000.0	98,000.0	610,000.0
Hatchery Contribution	3.29%	2.47%	6.58%	10.48%	11.82%	7.70%
1987 Commercial Harvest						
Wild Fish	11,434.7	209,697.0	21,462.3	89,918.2	66,559.3	399,071.4
Hatchery Fish	565.3	5,303.0	1,537.7	69,081.8	11,440.7	87,928.6
Total Harvest	12,000.0	215,000.0	23,000.0	159,000.0	78,000.0	487,000.0
Hatchery Contribution	4.71%	2.47%	6.69%	43.45%	14.67%	18.06%
1988 Commercial Harvest						
Wild Fish	9,276.3	177,420.0	31,737.1	131,921.2	103,906.5	454,261.0
Hatchery Fish	723.7	7,580.0	1,262.9	44,078.8	17,093.5	70,739.0
Total Harvest	10,000.0	185,000.0	33,000.0	176,000.0	121,000.0	525,000.0
Hatchery Contribution	7.24%	4.10%	3.83%	25.04%	14.13%	13.47%
1989 Commercial Harvest						
Wild Fish	9,296.7	253,818.3	27,840.0	246,819.3	50,790.5	588,564.9
Hatchery Fish	703.3	8,181.7	2,160.0	104,180.7	7,209.5	122,435.1
Total Harvest	10,000.0	262,000.0	30,000.0	351,000.0	58,000.0	711,000.0
Hatchery Contribution	7.03%	3.12%	7.20%	29.68%	12.43%	17.22%
1990 Commercial Harvest						
Wild Fish	9,041.7	291,493.6	28,537.8	145,284.9	46,855.9	521,214.0
Hatchery Fish	958.3	17,526.4	4,462.2	119,715.1	11,144.1	153,786.0
Total Harvest	10,000.0	309,000.0	33,000.0	265,000.0	58,000.0	675,000.0
Hatchery Contribution	9.58%	5.67%	13.52%	45.18%	19.21%	22.78%

Note: Data includes "cost recovery" harvest, but does not include "broodstock" harvest.

Sources: Alaska Department of Fish and Game, Division of Fisheries Rehabilitation, Enhancement and Development, and Division of Commercial Fisheries.

Prepared by the Legislative Research Agency, February 1992 (92.058A).

TABLE B
World Salmon Commercial Harvest, 1985 – 1990
(in millions of pounds)

Species	1985	1986	1987	1988	1989	1990
United States						
Sockeye	235.9	211.6	227.1	189.6	271.2	321.9
Pink	319.7	269.0	169.8	167.5	363.8	264.6
Chum	92.6	86.0	86.0	134.5	63.9	70.5
Coho	52.9	59.5	39.7	46.3	41.9	44.1
Chinook	26.5	30.9	39.7	46.3	37.5	22.0
Total United States	727.5	657.0	562.2	584.2	780.4	723.1
Canada						
Sockeye	70.5	66.1	33.1	26.5	75.0	81.6
Pink	83.8	63.9	59.5	70.5	68.3	57.3
Chum	52.9	55.1	22.0	66.1	19.8	37.5
Coho	19.8	26.5	17.6	15.4	19.8	24.3
Chinook	13.2	8.8	11.0	13.2	11.0	11.0
Total Canada	240.3	220.5	143.3	191.8	194.0	211.6
Japan						
Fall Chum	330.7	310.4	282.7	308.2	350.3	363.8
High Seas Fishery	224.9	164.5	124.7	85.7	114.5	78.9
Total Japan	555.6	474.9	407.4	393.9	464.8	442.7
Farmed						
Atlantic	133.4	147.5	248.0	358.0	464.1	474.0
Pacific (Coho & Chinook)	25.6	39.0	62.2	89.9	104.7	127.9
Total Farmed	159.0	186.5	310.2	448.0	568.8	601.9
Other	265.3	0.0	0.0	110.0	80.5	76.3
TOTAL	1,947.6	1,538.9	1,423.1	1,727.9	2,088.6	2,055.6

Sources: Taken from Bill Atkinson's News Report. Original sources listed as United Nations Food and Agricultural Organization (U.S., Canada and farmed data) and Alaska Seafood Marketing Institute, Salmon 2000 (world totals).

Note: The original table was in metric tons.

Prepared by the Legislative Research Agency, February 1992 (92.058B).

POLICIES AND TRENDS OF MAJOR SALMON PRODUCING COUNTRIES AND REGIONS

The countries and regions which commercially harvest the largest quantities of wild and hatchery-bred ranched salmon are the United States (Oregon, Washington and Alaska), Canada (British Columbia), Japan and the U.S.S.R. Other areas have experimented with salmon ranching, but as yet produce few fish. Major salmon-farming industries are located in Norway, Scotland, Chile, U.S. and Japan. Iceland, the Faroe Islands, Ireland, Australia, New Zealand and France also farm salmon but are not considered major producers. The following overview presents a brief description of current trends in salmon production in the major producing countries and regions.

United States

Alaska's commercial salmon catch accounts for about 90 percent of U.S. commercial salmon harvest. Washington, Oregon and California have commercial chinook and coho fisheries, and Washington and Oregon state governments engage in salmon ranching. Private companies farm salmon commercially in Washington, Maine, Oregon, Minnesota and Idaho. Most U.S.-produced farmed salmon comes from farms in Washington and Maine. Experimental salmon farms are operating in Hawaii and California, but no substantial commercial harvest of the salmon has yet occurred.

In 1990, the Alaska commercial catch of salmon was 675 million pounds. Of that catch, about 23 percent was hatchery-bred salmon. Hatchery pink salmon made up over 45 percent of Alaska's commercial pink catch in 1990, while hatchery sockeye salmon made up only slightly over 5 percent of Alaska's commercial catch. Alaska has no salmon-farming operations.

Commercial salmon catch in Washington has dropped from 68.6 million pounds in 1985 to 36.1 million pounds in 1990. The Washington state government operates about 50 salmon hatcheries, which produce nearly 60 percent of the state's commercial salmon catch (about 21.7 million pounds in 1990). The hatcheries produce mostly chinook and coho salmon, but some chum, pinks and sockeye are hatchery-bred as well. Although the program is expanding slightly, very few new hatchery facilities are being developed. The Washington state government attempts to manage its fisheries to protect the wild stocks, and the hatcheries are meant to enhance and not replace the natural runs. Washington has some profitable private salmon farms, but several had financial trouble last year when algae blooms killed many fish.

Oregon's commercial salmon catch fell dramatically in 1990. The five-year average commercial salmon harvest (1986 - 1990) was 11.9 million pounds. The 1990 harvest was only 5.2 million pounds. Oregon produces 69 percent of its commercial coho catch in 34 state-owned hatcheries and one privately owned hatchery. Ranched fish make up about 25 percent of the coastal chinook commercial catch, and 85 percent of the Columbia River kings caught commercially are from hatcheries. Oregon also hatches and releases some chum

and pink salmon. The state hatchery program has undergone slight expansion recently, funded by federal money. The Oregon Department of Fish and Wildlife attempts to manage the state fishery to minimize negative impact on wild stocks, and hatchery fish supplement the natural runs.

Canada

British Columbia (B.C.) is the only Canadian province with a substantial commercial salmon fishery. The 1990 catch of 191.4 million pounds was slightly higher than the five-year average (1986 - 1990) catch of 187.7 pounds. In recent years, B.C. hatcheries have produced about 12 to 16 percent of the salmon commercially caught off Canada's west coast (between 25 and 34 million pounds in 1990). No new government hatcheries have been built in the past five years. The Canadian government spends about \$40 million (Canadian dollars) per year for B.C. hatchery operation. British Columbia hatcheries concentrate on chinook and coho salmon; they produce very few pink salmon. Between 20 and 30 percent of the chinook and coho catch is hatchery-bred, and 12 to 16 percent of the sockeye and chum catch is from hatcheries. The government management policy favors wild stocks, and hatcheries are for enhancement, not replacement, of the natural runs.

All Canadian salmon farms are privately owned and operated. Canadian farms produced 51 million pounds of salmon in 1990, nearly one-quarter the amount of commercially caught Canadian salmon on the market. New Brunswick, Newfoundland, Nova Scotia and Quebec all engage in Atlantic salmon farming. There are about 89 farms, most of which are located in New Brunswick. In Canada's Atlantic region, expansion has slowed because the government has limited the number of licenses for farms. British Columbia began farming in 1972, and in 1984, private Norwegian companies began investing in Canadian farms. Norwegian investment now amounts to about one-third the value of all B.C. salmon farms. Recent financial trouble due to lower prices for farmed salmon and increased operations costs has contributed to several bankruptcies of farms in B.C. However, Canadian farmed salmon is increasingly filling the U.S. market niche vacated by Norwegian farmed salmon, which is high priced due to the recent implementation of U.S. import duties. Thus, the economic future of Canadian farmed salmon looks good. British Columbia farms produce mostly chinook and Atlantic salmon, but production of farmed coho is developing. The B.C. government began to take a hand in the regulation of farms and research and development of farming technology in 1989 to help foster rapid development. Canadian farms anticipate production of 145 million pounds by the year 2000.

Japan

Commercial catch of salmon by Japanese fishermen has historically come from two fisheries, the high seas drift net fishery, and the coastal set net fishery. Japan has worked to be self-sufficient in supplying its country's demand for salmon. As the high seas fishery became increasingly unprofitable due to

political and environmental pressures, the Japanese government decided to supplement the coastal fishery with hatchery production. The coastal set net fishery now supplies about half the Japanese salmon demand.

Japan has a very ambitious and successful hatchery program. The national government operates its own hatcheries, and subsidizes private ones. In 1980, 58 percent of the commercial fall chum catch off the coast of Japan was hatchery-bred fish. Today, about 85 percent of the coastal catch (about 309 million pounds in 1990) is bred in hatcheries. Japanese hatcheries produce chum, pink, cherry and sockeye salmon. The number of salmon hatcheries in Japan is still increasing. In the Hokkaido area, only about 1 percent of the salmon is wild; the rest are hatchery chums. In the Honshu area, about 80 percent of the chum catch is hatchery reared. There are no longer any native chinook or sockeye salmon in Japanese waters, and few native pink and cherry salmon.

As the high seas catch declines, salmon imports have risen to meet Japanese demand for salmon. The Japanese are experimenting with fish farming to further supply their markets and decrease national reliance on imports. Private firms are developing floating coho farms and experimenting with chinook and Atlantic salmon farms. Farmed salmon production in Japan has increased to 57.2 million pounds in 1990. Farmed coho that cannot be sold fresh are salted rather than frozen.

U.S.S.R.

Information about historic commercial salmon catch by the U.S.S.R. is difficult to obtain. The first Soviet hatcheries were built on Sakhalin Island, with one or two on the Amur River. The Japanese developed hatcheries on the southern part of Sakhalin Island while they occupied that area in the early 1900s. The Soviets inherited those hatcheries when Japan ceded south Sakhalin to the U.S.S.R. after World War II. The Soviets are currently expanding hatchery operations to the Kamchatka Peninsula. They intend to increase hatchery production to bring commercial catch from about 375 million pounds to 661 million pounds. Soviet fishery policy does not mandate protection of wild salmon stocks. Movement of stocks and the possibility of genetic intermingling does not seem to concern the Soviet government.

Soviets are experimenting with salmon farms, although little production has resulted. Perestroika has caused some reorganization of the Soviet fishing industry, and Soviet companies have entered into international joint ventures which will allow them access to new salmon fishing areas in the north Pacific. Recent political developments in the Soviet Union may slow advancements in the fish propagation field in that country in the immediate future.

Norway

Norway's historic wild run of Atlantic salmon has been severely depleted from over fishing. The country began farming Atlantic salmon in the 1960s, and production has increased rapidly since then. In 1990 there were approximately 790 privately owned farms in Norway, providing half the world supply of farmed salmon, and 14 percent of the world supply of salmon. Norway exports about 85 percent of its farmed salmon. The Norwegian government has supported the salmon farming industry through loans, research and technical assistance and regulation. Government policy has limited the size of private farms, and the number of farms a company may operate, and thus has encouraged exportation of salmon-farming technology.

The phenomenal growth of farmed salmon production in Norway and other countries has altered the economics of the world salmon market. As the supply of fresh salmon on the world market increased, the price fell, and some farms became unable to meet their production costs. The Norwegian government is now encouraging a slowdown in farmed salmon production and has placed a cap of approximately 286 million pounds for 1991, down from 330 million pounds in 1990. In recent years, Norwegian firms have been accused of flooding the market with farmed salmon. A quasi-governmental industry organization has begun buying excess production and freezing it for future sales (about 88 million pounds in 1990). Private Norwegian farming companies are now investing heavily in salmon farms in Scotland, Canada, the U.S. and Chile. The U.S. has recently imposed an import tariff (anti-dumping and countervailing duties) on Norwegian farmed salmon, which ranges from about 15 percent to 32 percent, depending on the exporting company. The duty has decreased U.S. imports of Norwegian farmed salmon to about ten percent of U.S. fresh Atlantic salmon imports, compared to 61 percent of U.S. imports in 1989. Canadian and Chilean farmed salmon imports to the U.S. now supply the markets lost to Norwegian fish.

Scotland

Scottish production of farmed Atlantic salmon has been steadily increasing since the early 1980s. Scotland has about 290 farms in sheltered areas along the coast which produced 77.0 million pounds in 1990, second only to the production of Norwegian farms. Half the production is exported. Currently, Scottish farms are experiencing financial difficulties as costs are up and salmon prices have fallen. Seven farming companies in Scotland went bankrupt last year. This year there is a decrease in smolt production. Farms have also seen increasing losses from disease recently. Only two of three fish are surviving until harvest, a 10 percent decline in survival from recent years. The British government has been supportive with financing and is currently helping with a re-evaluation of the market for Scottish farmed salmon.

Chile

Chile began salmon farming on a small scale in the 1970s. There was a slow expansion of farming until 1988, when production took a large jump. Approximately 320 private Chilean farms produced 41.8 million pounds of salmon in 1990. Fish farming is Chile's fastest growing economic activity. First coho were farmed; now Atlantic salmon, chinook salmon and salmon trout are being farmed. Chileans are currently developing sockeye and cherry salmon farms. Chile has no native salmon, but the habitat is similar to that of the Norwegian coast and is perfect for their propagation. Chilean firms are experimenting with ocean ranching of salmon, which so far has not proven successful.

Chilean farms produce high quality salmon. Because Chile is a major world fish meal producer, feed costs are low, allowing farmers to lower stock densities in pens, resulting in healthier fish. The major drawback to Chilean farmed salmon success is the distance to major markets. Transportation costs increase the retail price of Chilean fish by as much as \$.75 per pound. However, through superior quality, Chile has obtained strong markets and can compete even in the face of declining prices. Chilean salmon producers have gained markets in the U.S. because of import duties on Norwegian farmed salmon. About 97 percent of Chilean farmed salmon is frozen for market. The Japanese are investing heavily in Chilean salmon farms. Chilean farms are privately owned and they operate with little government regulation or economic intervention. The farmers work together to set prices and quality restrictions.

Other Salmon-Producing Regions

Other regions which artificially propagate salmon are Korea, Iceland, the Faroe Islands, Ireland, Australia, New Zealand, France, Sweden, Finland, Spain and Italy. Korea does some salmon ranching, as does Iceland and New Zealand. The Faroe Islands, Ireland, Iceland, Australia and New Zealand have small and successful salmon-farming operations. The other regions are in the process of developing salmon-farming technology.

I hope this information is helpful to you. If you need further assistance, please don't hesitate to call this agency.

Attachments

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**World Wild and Ranched Salmon Harvest
from Major Fishing Countries and World
Farmed Salmon Productions**

TABLE 1
World Wild and Ranched Salmon Harvest
From Major Fishing Countries
(millions of pounds)

Year	Canada	Japan	U.S.S.R	Alaska	Other U.S.A.	Total*
1980	118.0	284.0		512.0	48.0	962.0
1981	173.0	344.0		611.0	61.0	1,189.0
1982	144.0	314.0		562.0	67.0	1,087.0
1983	164.0	367.0		621.0	31.0	1,183.0
1984	110.0	359.0		660.0	34.0	1,163.0
1985	236.0	460.0		669.0	78.0	1,443.0
1986	228.0	389.0	176.0	606.0	72.0	1,471.0
1987	143.0	397.0		490.0	73.0	1,103.0
1988	191.0	373.0		527.0	80.0	1,171.0
1989	185.0	478.0	173.8	714.0	73.0	1,623.8
1990	191.4	484.0	286.0	678.7	44.4	1,684.5

*Totals may not be accurate due to missing years of U.S.S.R. catch data.

Note: The numbers may not always appear exactly as in the source document.
These differences are due to rounding and discrepancies between
original sources.

Sources: Salmon 2000, Alaska Seafood Marketing Institute, March 1991, unless
otherwise indicated. Canadian data from page 37, Japanese data from
page 38, U.S.S.R. data from page 17, Alaska and Other U.S.A. data
from page 35, 1990 Canadian and Japanese data from page 17. 1990
Alaska and Other U.S.A. data from Bill Atkinson's New Report.

Prepared by the Legislative Research Agency, February 1992 (92.058C).

TABLE 2
World Farmed Salmon Production
(millions of pounds)

Year	Norway	Scotland	Chile	Canada	U.S.	Japan	Other	Total
1980	9.1	1.3	0.0	0.4	0.9	4.0	0.0	15.7
1981	18.5	2.9	0.0	0.5	1.9	2.5	0.0	26.3
1982	22.6	4.7	0.4	0.9	1.5	4.7	0.0	34.8
1983	37.4	5.6	0.2	0.7	0.8	3.9	0.0	48.6
1984	49.0	8.6	0.2	0.7	2.7	11.0	1.8	74.0
1985	63.0	15.0	1.1	0.9	4.0	14.1	3.9	102.0
1986	100.5	22.7	2.5	2.2	3.0	17.6	7.5	156.0
1987	123.6	27.9	2.6	6.0	5.5	26.8	17.6	210.0
1988	184.0	39.5	6.8	20.0	8.1	36.0	24.6	319.0
1989	252.7	68.2	18.0	38.8	12.3	40.9	48.1	479.0
1990	330.0	77.0	41.8	51.2	16.9	57.2	46.9	621.0

Note: The numbers may not always appear exactly as in the source document. These differences are due to rounding and discrepancies between original sources.

Source: Salmon 2000, Alaska Seafood Marketing Institute, March 1991. Body of the table is the bottom table on page 14, and the totals are from the top table on page 14 with some adjustments to avoid having negative numbers in the Other column.

Prepared by the Legislative Research Agency, February 1992 (92.058D).

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Alaska State Legislature

Legislative Research Agency



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December 30, 1992

MEMORANDUM

TO: Senator Dick Eliason

FROM: Maria Gladziszewski *MG*
Legislative Analyst

RE: **Update on World Salmon Production**
Research Request 93.057

You asked us to update Legislative Research Agency Memorandum 92.058 on world salmon production.

Information included and trends cited in that memorandum are, for the most part, still correct. Worldwide and Alaska production continues to increase, while salmon farming continues to increase at a rate more rapid than other contributors to production. Norway, responsible for more than half of all farmed salmon production in 1990, has continued to produce more salmon despite internal agreements to decrease production. The freezing of Norwegian salmon for future sales, conducted by a quasi-governmental organization, was mentioned in Legislative Research Agency Memorandum 92.058. The Norwegian Fish Farmers Sales Organization (FOS), the largest salmon financing and sales cartel in the world, went bankrupt in November 1991, with 66 million pounds of salmon in the freezers. According to the Alaska Seafood Marketing Institute, as a result of this bankruptcy as well as a continued desire to boost prices, Norwegian production will probably be curbed by nearly 80 million pounds in 1992 (from 342 to 260 million pounds).¹

Included in this memorandum are updates of Table One (world salmon harvest) and Table Two (farmed salmon production). The only significant changes in the tables are the addition of 1991 data and data formerly unavailable about Russian production. As noted in the original 1992 memorandum, data in these tables may not be considered as entirely reliable because of the difficulty in obtaining worldwide production figures.

¹Alaska Seafood Marketing Institute, *Salmon 2000 Yearbook 1992*, April 1992.

Senator Eliason
December 30, 1992
Page 2

Also, data from Table One are presented in two graphs to illustrate worldwide salmon production trends between 1980 and 1991. Figure One illustrates total world salmon production, Alaska catch and worldwide farmed salmon in billions of pounds. Figure Two illustrates the percent of worldwide production contributed by the Alaska catch and by worldwide salmon farming.

Figure One shows that while worldwide salmon production has increased from 1,242 million pounds in 1980 to 2,563 million pounds in 1991, and Alaska production has also increased from 510 million pounds to 726 million pounds, the contribution of salmon farming has increased even more dramatically from 15 million pounds in 1980 to 673 million pounds in 1991. Whereas worldwide salmon production has doubled and Alaska production has increased approximately 1.5 times in the past 11 years, salmon farming has increased nearly 45 times over the same period. Figure Two illustrates that Alaska's contribution to worldwide salmon production has decreased from 41 percent in 1980 to 28 percent in 1991 while the contribution of salmon farming to worldwide production has increased from one percent in 1980 to 26 percent in 1991.

I hope this information is useful for your purposes. Please do not hesitate to call this agency if you have additional questions.

Attachments

**TABLE ONE:
WORLD SALMON HARVEST
FROM MAJOR FISHING COUNTRIES
(millions of pounds)***

Year	Alaska	Other U.S.		Canada		Japan		Russia	Norway	Scotland	Chile	Percent	Percent	Sum	WORLD
	Total	Wild	Farmed	Wild	Farmed	Wild	Farmed	Total	Farmed	Farmed	Farmed	Farmed**	Alaska**	Total**	TOTAL**
1980	510	50	1	na	0	na	4	na	9	1	0	1%	41%	576	1,242
1981	612	60	2	na	1	na	3	na	19	3	0	2%	44%	698	1,379
1982	562	67	2	na	1	na	5	na	23	5	0	3%	43%	664	1,307
1983	561	78	1	na	1	na	4	na	37	6	0	3%	35%	688	1,595
1984	660	31	3	110	1	378	11	na	49	9	0	5%	44%	1,252	1,512
1985	669	58	4	240	1	488	14	271	63	15	1	5%	34%	1,825	1,948
1986	590	69	3	220	2	409	18	179	101	23	3	10%	40%	1,615	1,458
1987	493	69	6	143	6	374	27	308	124	28	3	14%	35%	1,579	1,390
1988	526	80	8	189	20	374	36	109	184	40	7	17%	30%	1,573	1,726
1989	713	66	12	176	39	440	41	402	253	68	18	21%	34%	2,228	2,089
1990	689	44	17	191	51	484	57	267	330	77	42	29%	33%	2,249	2,106
1991	726	54	14	187	62	370	49	554	342	76	54	26%	28%	2,488	2,563

NOTES:

* Data for U.S. and Alaska were listed on several tables in the source document. For virtually every year, data did not match across tables. Data for this table are best-guess approximations from all sources and are rounded to the nearest one million pounds. Given the discrepancies for Alaska, the reader is cautioned that other country data are also suspect.

** The sum total and percents are the arithmetic calculations using data from all countries listed. World totals and individual country data were not taken from the same table. World totals should exceed the sum totals in all cases but, for unexplained reasons, they do not in 1986, 1987, 1989 and 1990.

na = not available

SOURCE:

Salmon 2000 Yearbook 1992, Alaska Seafood Marketing Institute, April 1992 (pages 3, 5 and 8).
Data on wild salmon harvest from page 5, farmed salmon harvest from page 3, world totals from page 3, some U.S. data from page 8.

Prepared by the Legislative Research Agency, December 1992 (93.057A).

TABLE TWO:
WORLD FARMED SALMON PRODUCTION
(millions of pounds)

YEAR	NORWAY	SCOTLAND	CHILE	CANADA	U.S.	JAPAN	OTHER	TOTAL
1980	9.1	1.3	0.0	0.4	0.9	4.0	0.0	15.0
1981	18.5	2.9	0.0	0.5	1.9	2.5	0.0	26.0
1982	22.6	4.7	0.4	0.9	1.5	4.7	0.0	33.0
1983	37.4	5.6	0.2	0.7	0.8	3.9	0.0	48.0
1984	49.0	8.6	0.2	0.7	2.7	11.0	1.8	74.0
1985	63.0	15.0	1.1	0.9	4.0	14.1	3.9	102.0
1986	100.5	22.7	2.5	2.2	3.0	17.6	7.5	156.0
1987	123.6	27.9	2.6	6.0	5.5	26.8	17.6	210.0
1988	184.0	39.5	6.8	20.0	8.1	36.0	24.6	319.0
1989	252.7	68.2	18.0	38.8	12.3	40.9	48.1	479.0
1990	330.0	77.0	41.8	51.2	16.9	57.2	46.9	621.0
1991	341.7	76.0	54.0	61.9	14.3	49.2	75.9	673.0

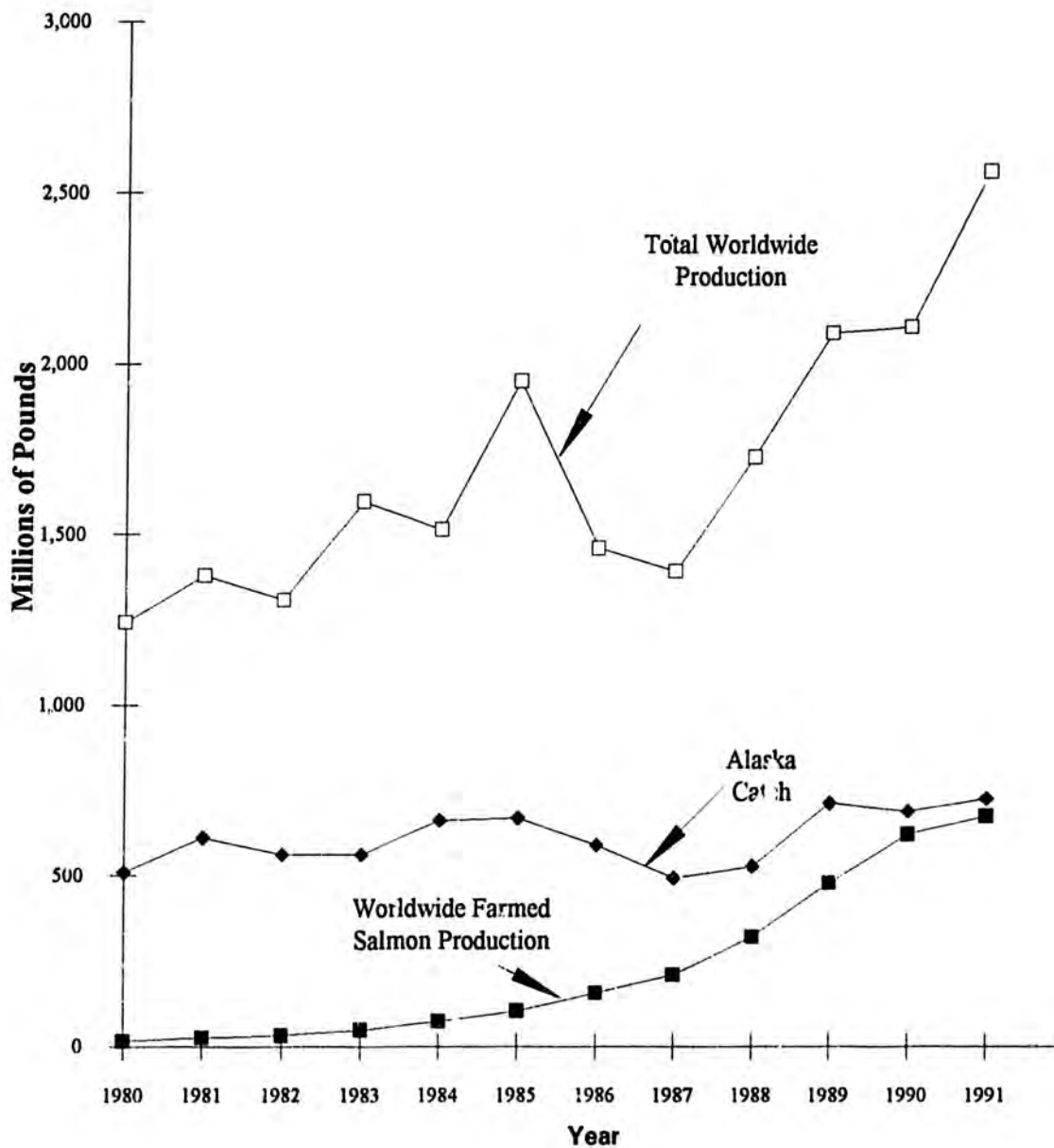
SOURCE:

Salmon 2000 Yearbook 1992, Alaska Seafood Marketing Institute, April 1992.

Body of the table is the bottom table on page 3 and the totals are from the top table on page 3.

Prepared by the Legislative Research Agency, December 1992 (93.057B).

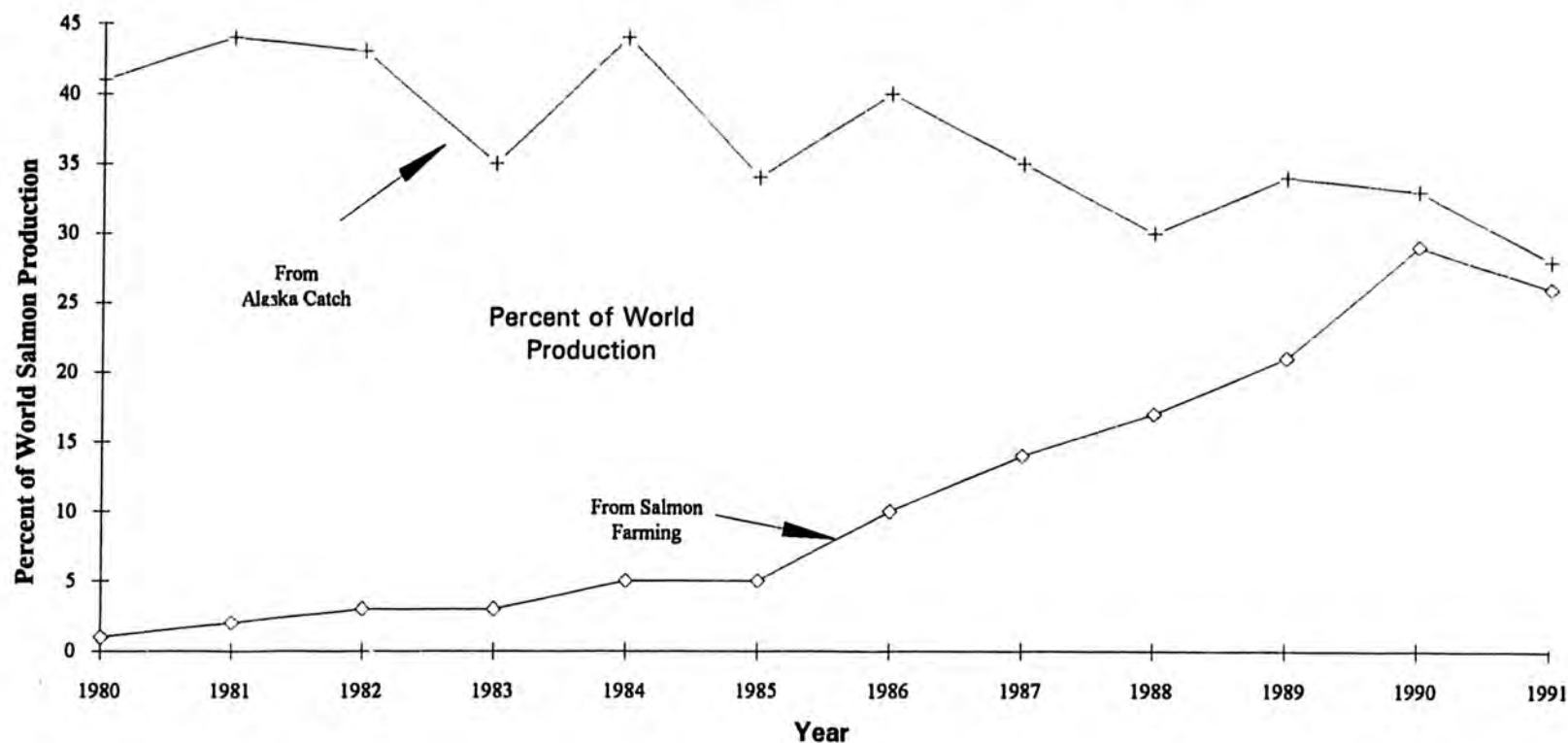
**Figure One:
Worldwide Salmon Production
(1980 - 1991)**



Source: Alaska Seafood Marketing Institute, "Salmon 2000 1992 Yearbook" April 1992.

Prepared by the Alaska Legislative Research Agency, December 1992, (93.057F1).

Figure Two:
PERCENT OF WORLD SALMON PRODUCTION
Alaska Catch & Worldwide Farmed, 1980-1991



Source: Alaska Seafood Marketing Institute, "Salmon 2000 1992 Yearbook" April 1992.

Prepared by the Alaska Legislative Research Agency, December 1992, (93.057F2).

CHAPTER IV. FISHERIES MANAGEMENT ISSUES

The success of the state's enhancement program has made managing Alaska's salmon fisheries more complicated. Much of this research project was initiated by a request from the Board of Fisheries to provide clearer legal and policy direction on the issues of

- managing fisheries for a wild stock priority;
- providing sufficient hatchery returns for broodstock; and
- providing cost recovery fisheries for hatchery operators.

These three issues encompass a number of legal questions and are addressed in Chapter V, Legal Issues. In this chapter a variety of other management issues are discussed.

MIXED-STOCK FISHERIES

A fundamental issue facing fisheries managers is how to control fishing effort in mixed-stock fisheries composed of several stocks. The predominant management concern is that the weakest stocks will be overfished. This is a major issue throughout the state even where no hatchery fish are present. However, in cases in which hatchery productivity is significantly greater than natural stock productivity, wild stocks face the risk of being depleted. In cases where hatchery stocks are smaller, these stocks run the risk of being lost among the wild stocks. Smaller stocks are more likely to be in danger of depletion in mixed-stock fisheries because there is a tendency to optimally harvest the larger stocks before quality declines in terminal fisheries.

The Alaska Department of Fish and Game (ADF&G) has the constitutional responsibility to conserve and manage wild stocks of salmon for sustained yield. In a wild stock fishery, the conservation responsibility entails maintaining minimum spawning escapement levels for wild stocks. However, when hatcheries are established in wild stock salmon producing areas, the department has additional conservation responsibilities:

- maintaining the genetic diversity of wild stocks as stated in the ADF&G genetic policy;
- maintaining fish health and prohibiting the spread of fish disease; and
- providing sufficient returns of fish to the hatchery to provide for broodstock and cost recovery.

Strict regulations govern the selection of broodstock and the transporting and remote release of hatchery produced fry and smolt, requiring a comprehensive genetic monitoring and permitting process (see Biological Issues chapter).

Because salmon runs occur in a short period of time, field managers rely on early test fisheries or initial fishery performance as the indicators of run strength. When runs of hatchery or wild stocks are weak, commercial fishing effort must be reduced or re-directed. *The ability to determine the strength of various stocks requires some capability to distinguish wild fish from hatchery fish, which increases management costs.*

With large scale hatchery enhancement, ADF&G's Division of Commercial Fisheries is concerned that the additional costs of managing mixed stock commercial fisheries composed of wild and hatchery stocks are not always accounted for in the planning and operation of hatchery facilities, and fisheries managers are often not given adequate funds to properly manage what can become a very complicated fishery.

It should be noted that the problems posed by mixed-stock fisheries are not new. Almost all Alaska salmon fisheries, composed entirely of wild stocks, had some degree of mixed stocks prior to the development of hatcheries. Prince William Sound, however, is the focus of the Division of Commercial Fisheries' current concern, largely because of the scale of the hatchery operations in the Sound, with hatchery stocks now responsible for over 80 percent of the total pink salmon production.

Managing the fisheries in Prince William Sound has also been made significantly more difficult as a result of the 1989 *Exxon Valdez* oil spill. Certain pink salmon stocks were greatly impacted by the oil spill and require intensive stock-specific management measures in order to protect and rebuild these populations. Additionally, most of the information gathered as a result of the recent influx of oil spill damage assessment funds has been confidential, and is only now being made available to the general public.

QUALITY

State law requires that fish returning to hatcheries and sold for public consumption be of comparable quality to fish harvested by commercial fishermen in the area. Prince William Sound is the major focal point for the issue of managing hatchery and wild stocks to optimize quality and marketability.

During the planning process for the Prince William Sound hatcheries, the Basic Management Plans that addressed the harvest of hatchery fish were developed cooperatively by the department and hatchery operators. ***Returning adults were to be primarily harvested in terminal areas, thereby minimizing harvest conflicts with wild stocks.*** Additional harvest management costs were not considered under this strategy. Initially, fish quality was not an issue as terminally caught fish were of high quality. However, as the program grew, processing capacities became fully utilized, sometimes forcing delays in harvesting terminal fish. Such delays resulted in poorer quality fish, and thus, the demand to harvest fish farther away from terminal areas. The 1989 oil spill also contributed to the concern over quality. The spill delayed harvest of the large 1989 pink salmon run, which resulted in an extremely poor quality pack and a public perception of oil contamination of the fish harvested.

Early in 1991, the Prince William Sound Aquaculture Corporation (PWSAC) expressed concern about the processing capacity in the Sound given the large forecasted pink return. PWSAC officials began exploring the possibility of bringing foreign processors into the Sound, but their request was denied when state officials and domestic processors insisted that existing processing capacity would be sufficient. A delay in the return of the majority of the run in 1991, large pink salmon runs statewide and overall low prices created a major problem for fishermen, hatchery operators, and fishery managers. To maximize the quality of the harvest, processors and fishermen asked to harvest returning adult pink salmon at the entrance areas to Prince William Sound. Fishery managers were reluctant to do so since at these locations, the wild stocks damaged by the *Exxon Valdez* spill are mixed with non-

impacted wild stocks as well as the large returns of hatchery fish. ADF&G feared that harvesting in mixed-stock areas, while maximizing quality, would also jeopardize wild stocks through the risk of being overharvested. As a result, fishing was delayed, and when it was finally opened, the season turned into a disaster with insufficient processing capacity and large quantities of salmon either being destroyed, or processed and given away.

During discussions in 1991 of Governor Hickel's Salmon Strategy Task Force (see Marketing chapter), it became apparent that there is no definitive information on how close to their spawning areas salmon can be harvested without sacrificing quality. Some people believe that the concern for quality of terminal-area salmon is created by processors as part of a price-setting strategy. ADF&G has suggested a research project be funded to analyze salmon quality at various distances from their spawning areas in an effort to determine how best to manage fishing effort to produce a top-quality and marketable product.

TAGGING NEEDS

Since hatchery-produced fish often complicate fisheries management, a way to simplify management is to determine the mix of hatchery and wild stocks in a mixed-stock fishery. For most mixed-stock fisheries composed of hatchery fish, an adequate program of tagging, recovery and analysis is required.

The tagging method most commonly used now is the coded-wire tag (CWT). The CWT is typically a 1.0 mm long by 0.25 mm diameter stainless steel wire which has been etched with notches that represent a code of information. The CWT can be injected into the nasal cartilage in salmon smolts. Tags from returning fish are recovered by fishermen and field biologists and sent to a lab in Juneau for analysis. The Juneau lab has extremely poor working conditions, and ADF&G for years has attempted to improve lab conditions and expand its capabilities. In spite of these conditions however, the lab produces quality data.

Scale analysis is another technique that has been used for years to reliably identify the country of origin for salmon in the north Pacific. However, the use of scale analysis has so far not been able to provide the detailed level of information necessary for management of specific fisheries.

Otolith marking is seen as the most viable mass marking technique on the horizon. Otolith bone development provides a daily record of the internal and external forces affecting fish growth beginning at the eyed-egg stage. This growth occurs in rings somewhat similar to the circuli of a fish scale or the rings of a tree. Growth of the otolith is in alternating rings of high and low concentrations of protein calcium carbonate. The optical density of these rings is easily manipulated to make an obvious visible change in structure. One way to do this is by thermal marking - causing a rapid drop or elevation in water temperature. The benefit of otolith marking is that virtually *all* hatchery fish can be marked at the same time.

ADF&G is seeking funds in its FY 94 capital budget for \$1.1 million to build a new tag lab. ADF&G is also actively pursuing genetic stock identification (GSI) research and applications using both protein electrophoresis and deoxyribonucleic acid (DNA) analysis. This approach can be used for a variety of purposes, including measuring the contributions of unmarked but genetically identifiable hatchery fish to commercial fisheries. Biologists are already doing

extensive work using this technique on salmon from the Yukon River. A new GSI lab is being built with the \$500,000 in funds appropriated by the Legislature in FY 93.

Although otolith marking and GSI hold promise for the future, coded-wire tags will probably always have a place in the state's marking program. The CWT Lab currently supplies information for hatchery and natural stock evaluation, as well as for evaluation of U.S./Canada salmon interceptions. The CWT Lab is a vital link in the in-season management of fisheries in Southeast and Prince William Sound. Using coded-wire tag data, fishery managers are able to take in-season advantage of the hatchery add-on clause of the U.S./Canada Pacific Salmon Treaty. In 1991 the CWT tag lab processed over 76,000 heads, using a large number of seasonal staff because of the short salmon season and the need for in-season hatchery contribution estimates.

The extent of any particular tagging program is determined by funding. The general assumption is that the people who tag the fish pay for the tagging. In the case of hatchery operators, that usually means the state or the PNP operator. However, ***the greater expense lies with the recovery and analysis of tags by the state, and the issue of who pays for that portion has never been resolved.*** Commercial fisheries managers would like to see more tagging to enable increased management precision. The Board of Fisheries would like to see additional tagging in order to provide information for allocation disputes. Hatchery operators have been reluctant to pay for the recovery and analysis program. This issue has been debated for the past decade and is still unresolved.

At the time of the *Exxon Valdez* oil spill, the hatchery/wild stock assessment program in Prince William Sound was not fully developed nor was the funding for such a program in the Commercial Fisheries Division's base budget. As a result, the program was unable to assess the oil spill damage or provide the stock-specific information needed to protect and restore damaged pink salmon stocks. Fortunately, Natural Resource Damage Assessment funds provided ADF&G with sufficient resources to assess the population level response of Prince William Sound pink salmon to the oil spill. However, once oil spill funds expire, additional state money will be needed if a stock-specific harvest management program is to be implemented and maintained.

FRED Division is informing hatchery operators that new increments of hatchery production will be permitted with a requirement that the operator pay for tagging and analysis. Whether or not to require that of existing production is being debated. Some people, including some members of the Board of Fisheries, advocate for a requirement that all hatchery production be categorically tagged and analyzed. However, existing operations have permits that do not require tagging. These operations were planned, permitted and funded without accounting for tagging their costs. It is likely that imposing a tagging requirement on permitted facilities would be subject to legal challenge.

Another issue, however, is whether an all encompassing tagging requirement is necessary. In some cases, a multi-year tagging study to show migration patterns and run timing would be sufficient. In other cases, where tagging is intended for in-season management, a large tagging program would need to be maintained. Not all hatchery production results in complicated, mixed-stock fisheries that would necessitate extensive tagging, and would even be used. Although CWT data has been supplied to Prince William Sound fisheries managers on a daily and weekly basis for the past two years, it has yet to be used for in-season management.

OPTIONS FOR POSSIBLE CONSIDERATION:

- Development of a state policy on managing mixed-stock fisheries composed of hatchery and wild stocks.
- Requiring hatchery production to have tagging, recovery and analysis programs. This could range from a blanket requirement for all production to site-specific requirements.
- Development of a policy regarding funding for tagging, recovery, processing and analysis.
- Funding a study to analyze salmon quality at various distances from terminal streams to determine the effect of fishery management effort on product quality and marketability.
- Direction to the Board of Fisheries on how to factor managing for quality into fisheries management plans.
- Funding research and development of new tagging and marking techniques suitable for mass marking.
- Clarifying the roles and uses of tagging--for biological information, allocation, or management purposes.
- Expanding tagging and stock identification studies of wild fish stocks for the purpose of comparing wild and hatchery stocks.

UPDATE: *In May 1992, the Alaska Legislature passed legislation (HB 541 - Attachment A) requiring the Board of Fisheries to develop a mixed stock fisheries policy. Development of such a policy is currently underway.*

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CHAPTER V. LEGAL ISSUES RAISED BY BOARD OF FISHERIES

In a May 6, 1991 letter to Senate President Richard Eliason, Fisheries Board Chairman Michael R. Martin stated the following:

In managing fisheries that involve hatchery raised salmon, the Board of Fisheries has encountered problems due to ambiguities in the current Alaska statutes. These problems commonly arise when the management of hatchery stocks conflicts with either the health of wild stocks or with the opportunity of fishermen to harvest wild stocks. Essentially, the statutes are not clear on the status of wild stock management.

State statutes are also not clear about the state's duty to provide fish for hatchery broodstock and cost recovery, and about hatcheries' obligations to contribute to the common property fisheries. We perceive that the development of state policy toward hatcheries may create a conflict of interest. On the one hand, the state manages fisheries as a common property resource for the benefit of all user groups. On the other hand, the state loans money to hatcheries with the expectation that the hatcheries will receive enough fish to be able to repay these loans.

While Chairman Martin went on to note other concerns,¹ *an overriding problem for the board appeared to be the perceived statutory ambiguities which lead to difficulty in resolving conflict between wild stock protection and broodstock/cost recovery.*

ALASKA STATUTES AND ADF&G REGULATIONS

The board was created "for purposes of the conservation and development of the fishery resources of the state . . ." (AS 16.05.221 (a)). In order to carry out that charge, the board may "adopt regulations it considers advisable in accordance with the Administrative Procedures Act (AS 44.62)." (AS 16.05.251(a)).²

¹/These included potential changes to the statutes relating to regional salmon plans (AS 16.10.375), regional associations (AS 16.10.380), and definition of various words and phrases used in Title 16. See attached letter.

²/AS 16.05.251 (b) lists the purposes for which the board may exercise this power, including

- . . . (2) establishing open and closed seasons and areas for the taking of fish;
- (3) setting quotas, bag limits, harvest levels, and sex and size limitations on the taking of fish;
- (4) establishing the means and methods employed in the pursuit, capture and transport of fish; . . .
- (6) classifying as commercial fish, sport fish, personal use fish, subsistence fish, or predators or other categories essential for regulatory purposes;

The board has adopted a number of regulations relating to private nonprofit hatcheries. Codified at 05 AAC 40.005 - 05 AAC 40.900, they include: delegating to the commissioner the authority to specify gear type and fishing periods for hatchery cost recovery; requiring hatchery permit holders who harvest salmon to comply with fish purchaser reporting requirements; allowing hatchery permit holders who harvest salmon for broodstock exemptions from the salmon "waste" statute and the regulations concerning "closed waters" and vessel area registration; designating special harvest areas; procedures for permit application, application review, public hearings, review and determination, and reconsideration; establishing regional comprehensive planning teams and procedures to be followed by them; prohibiting permit transfers; requiring hatchery management plans, inspections, and performance reviews; establishing criteria for the sale of surplus salmon eggs.

A number of these regulations contain references to wild stock protection.³ However, any regulation may be successfully challenged in court if it falls outside the statutory authority granted to the state agency that adopted it,⁴ or if it conflicts with other statutes,⁵ or the constitution.

The statutes governing the private nonprofit hatchery system are AS 16.10.375 - AS 16.10.470. They provide for: regional salmon plans; regional associations; criteria for the issuance of hatchery permits; public hearings prior to permit issuance; permit conditions; criteria for permit alteration, suspension or revocation; board regulation authority; department assistance and cooperation for permit applicants and holders; salmon egg sources; salmon egg sales; hatchery inspection; and an annual report to the department by permittees.

There are only two direct references in statute to the protection of wild stocks from harm due to hatchery operations. The first, AS 16.10.400(g) ("Permits for salmon hatcheries"), provides:

During the development of a comprehensive plan for a region, no permit may be issued for a hatchery unless the commissioner determines that such an action would

(7) watershed and habitat improvement, and management, conservation, protection, use, disposal, propagation and stocking of fish;

(8) investigating and determine the extent and effect of disease, predation, and competition among fish in the state, exercising control measures considered necessary to the resources of the state;

(9) prohibiting and regulating live capture, possession, transport, or release of native or exotic fish or their eggs; . . .

(12) regulating commercial, sport, subsistence, and personal use fishing as needed for the conservation, development, and utilization of fisheries...

AS 16.05.251(b).

³/See e.g., 5 AAC 40.005 (c) (segregation of hatchery fish from natural runs), 5 AAC 40.170 (2) (regional planning team review of hatchery permit application to determine extent of wild stock protection),

⁴/See, Beran v. State, 705 P.2d 1280 (Alaska App. 1985)

⁵/Id.

result in substantial public benefits and would not jeopardize natural stocks. (emphasis added)

The second AS 16.10.420(10) ("Conditions of a permit"), states:

The department shall require, in a permit issued to hatchery operator, that . . . a hatchery be located in an area where a reasonable segregation from natural stocks occurs, but, when feasible, in an area where returning hatchery fish will pass through traditional salmon fisheries.

The board is concerned that these statutes require the department to make a judgment concerning the potential harm to wild stocks only prior to the issuance of a hatchery permit; the inference being that once a judgment is made and a hatchery permit is issued, there is no statutory "protection" for wild stocks that are jeopardized by hatchery-related dangers arising after a permit is issued.⁶ This raises the possibility that a management regime which protects wild stocks to the detriment of hatchery operations would conflict with existing statutes that indicate the state should manage hatchery fish for broodstock and cost recovery.

An additional concern, not raised in Chairman Martin's letter, is whether the state constitution requires that hatchery fish be managed for broodstock and cost recovery.

RECENT LEGAL OPINIONS

Hatchery Fish and "Sustained Yield"

Article VIII, section 4, of the Alaska Constitution states:

Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield principle, subject to preferences among beneficial users.

The Alaska Supreme Court has stated that wild salmon, while they are in the natural waters of the State, "belong" to the State. Metlakatla Indian Community, Annette Island Reserve v. Egan, 362 P.2d 901, 914-915 (Alaska 1961). Because wild salmon belonged to the State while in our waters, they are subject to Article VIII, Section 4, of the Constitution, and thus must be managed on the sustained yield principle. Whether hatchery-reared salmon share the same status is less clear, and has been the subject of disagreement among attorneys who have recently written on that issue. The issue is important in the context of Chairman Martin's concerns because if hatchery fish must be managed on the sustained yield principle, that implies the Board of Fish *must* manage fisheries to provide hatcheries with broodstock, and possibly cost-recovery fish, even if the board does not believe that to be in state's best interest.

In an August 1990 letter to Alaska Department of Fish & Game Commissioner Don Collinsworth, Assistant Attorney General Steve White concluded that the Department of Fish & Game and the Board of Fish had the legal authority, and were in fact directed by law, to manage fisheries so that salmon hatcheries receive broodstock and cost recovery fish for their operations. He based these conclusions in part on the assumption that the

⁶/See Martin letter, p. 2.

above quoted section of the Alaska Constitution mandates that hatchery fish be managed in the same manner as wild stocks. Two other attorneys, George Utermohle of the Legislative Affairs Agency's Legal Services Division, and Juneau attorney Michael Stanley, later called that assumption into question. Sometime after that, Anchorage attorney A. William Saupe analyzed the three prior opinions and concluded that Mr. White's initial assumption was correct.⁷ What follows is a summary, extracted from the four opinions, of the arguments on both sides of the question of whether sustained yield management requirement of art. VIII, sec. 4 of the Alaska Constitution applies to hatchery-raised fish.

First is the issue of "ownership." On its face, sec. 4 of art. VIII applies only to resources "belonging" to the state. Are hatchery-raised fish in that category? Stanley and Utermohle argue that they may not be.

Stanley points out that the framers of the Alaska Constitution did make distinctions between resources "occurring in their natural state" and those that are "subject to intensive culture," at least for the purpose of exempting the latter from the requirements of art. VIII, sec. 3 (the "common use clause").⁸ Because humans play a substantial role in the growth and development of hatchery fish, Stanley reasons that they may not be the "natural resources" the drafters of article VIII had in mind.

George Utermohle points to the fact that the legislature, when it created the private nonprofit hatchery system, used the following language (AS 16.10.440(a)) to provide for the common use of hatchery fish:

Fish released into the natural waters of the state by a hatchery operated under AS 16.10.400 - 16.10.470 are available to the people for common use and are subject to regulation under applicable law in the same way as fish occurring in their natural state until they return to the specific location designated by the department for harvest by the hatchery operator.

Utermohle finds the above language significant in a number of respects: first, while the statute provides for the common use of hatchery fish, it is silent as to state ownership and makes no mention of sustained yield; second, the fact that hatchery fish are to be treated "in the same way" as fish occurring in their natural state "until they return to the specific location. . ." suggests that the legislature did not consider them a common property resource belonging to state, but merely felt they should be treated as if they were until they returned to the hatchery for harvest; finally, Utermohle suggests that the provision for harvest by the hatchery operator indicates "some lingering private property interest in the hatchery fish by the hatchery," another indicator that these fish may not "belong" to the state for purposes of the sustained yield section of art. VIII.

In his lengthy memorandum to PWSAC President John McMullen, attorney A. William Saupe disagreed with the arguments made by Stanley and Utermohle that the sustained yield clause may not apply to hatchery fish.

⁷/Copies of the four legal opinions are included in the appendices to the final report which are available through the Legislative Library.

⁸/Art. VIII, sec. 3 provides: "Common Use. Wherever occurring in their natural state, fish, wildlife, and waters are reserved to the people for their common use."

Initially, Saupe relies on legislative history to refute the "ownership" argument. He quotes this passage from a Legislative Research Agency memorandum by Linda J. Snow (July 31, 1991) to Senator Eliason:

Consensus is that the legislature had always intended that the fish from PNP hatcheries belong to the common property fishery until such time as they return to the hatchery, and then they belong to the hatchery for broodstock and cost recovery. Testimony by Senator Dick Eliason at a 1975 Senate Resources Committee hearing on SB 180 indicates that the initial concept of a private hatchery system considered profit-making corporate ownership. However, a profit-making corporation might advance a claim to exclusive ownership of everything it produced. Thus, it was felt that private, nonprofit ownership of hatcheries would be more consistent with the concept of publicly-owned hatchery fish. This opinion is echoed by former Representative Terry Gardiner.

At a March 7, 1977 House Resources Committee hearing, Jack Milnes, Executive Director of Southern Southeast Regional Aquaculture Association testified: "I wish to recognize the fact that these are common property fish, that they belong to the state of Alaska and to the people of Alaska and therefore they should be protected by the representatives of the people of the state of Alaska." At a 1979 Senate Resources Committee hearing on HB 48, Don Clocksin, attorney with Alaska Legal Services, discussed the question of ownership of hatchery fish. In his testimony, he asked "When are fish no longer common property fish?" He felt that constitutionally, they were to be considered common property fish at all times. Consequently, it appears there was never any question that hatchery fish were common property of the people of the state while in Alaska waters, and they may or may not be the property of the PNP hatchery operator at the hatchery, but that they be allowed to harvest a sufficient number for broodstock and cost recovery.

(Emphasis his).

Saupe also relies on certain portions of the commentary of the Committee on Resources of the Alaska Constitutional Convention. The first concerns the common use clause:

Game fish, wildlife, fisheries, and water are recognized as belonging to the state so long as in a natural state. These resources are subject to a private right only when they have been acquired or utilized as provided by law. (emphasis his).

Saupe asserts that this passage indicates the framers' belief that fish reserved for common use "belonged" to the state. Because hatchery fish are reserved for common use by AS 16.10.440 (a), Saupe reasons that they must be owned by the state and be subject to the sustained yield principle.

The second commentary is the sustained yield clause itself:

Sustained yield is recognized as a principle applicable to the administration of plant and animal life subject to the immediate authority of the state. (emphasis his).

Because hatchery fish are subject to the authority of the state by AS 16.10.440(a), Saupe reasons, they are subject to the sustained yield clause.

This conclusion, he asserts, "also comports with common sense" because

[i]f they did not belong to the State, it could not reserve hatchery fish for use by others without paying for them. Moreover, if the mere expectation that a hatchery will later be allowed to harvest some unidentified fraction of the returning fish constitutes an ownership interest in all of its fish, then every other limited entry permit holder could be said to have the same "lingering property interest," leading to the false conclusion that none of the fish in Alaska's waters ever belong to the State or are subject to the sustained yield principle of management.

A more reasonable interpretation of these related statutory and constitutional provisions is that, once released, hatchery fish become like wild stocks in every legal respect. They belong to the state, are reserved to the people for common use and must be managed for sustained yield. . .

Saupe, pp. 10-11.

However, even if the state "owns" the hatchery fish, it does not automatically follow that the state must manage those fish on a sustained yield basis. As George Utermohle notes, the drafters of our constitution chose to make sustained yield requirement subject to "beneficial uses". The commentary on Article VIII, Natural Resources, at page 98, states:

This principle [sustained yield] is qualified in terms of "the highest beneficial public use" in recognition of its not being in the public interest to preserve certain parasitic or predatory organisms destructive of more beneficial plant and animal life.

And, during the debate on the sustained yield clause, Delegate Riley explained:

. . . we have in mind no narrow definition of "sustained yield," as is used for example, in forestry, but the broad premise that insofar as possible a principle of sustained yield shall be used with respect to administration of those resources which are susceptible of sustained yield, and where it is desirable. For example, predators would not be maintained on a sustained yield basis. (Alaska Constitutional Convention Proceedings, p. 2451.)

Utermohle argues that:

The delegates understood that the concept of preferences among beneficial uses would allow the state to make reasoned decisions to prefer certain renewable resources over other renewable resources to achieve a more beneficial public purpose. The authority to establish preference among beneficial uses may permit the state to harvest hatchery fish without providing for a sustained yield from the hatchery, provided that those who have vested rights in hatchery fish are compensated for those rights that are taken by the state.

The ability of the state to establish preferences among beneficial users is reflected in AS 16.10.430(b) which allows the commissioner of Fish and Game to terminate the operation of a hatchery in the best interests of the public, if the adverse effects of the operation of the hatchery are irreversible and cannot be mitigated. (Utermohle memo, pp. 3-4.)

Saupe, on the other hand, argues that AS 16.10.430(b) is not merely a reflection of the state's ability to establish preferences among beneficial uses but is in fact the only basis upon which a hatchery permit may be terminated. He also argues that the contribution made by PWSAC to the growth of the commercial fishing industry in Alaska demonstrates its beneficial use to the state, and that "short of the extreme situation envisioned by AS

14.10.430(b) it is hard to conceive how denial of a reasonable hatchery harvest in favor of other beneficial uses could achieve a greater public purpose." Saupe memo, p. 14.

It is unfortunate that our supreme court has never defined "sustained yield," much less taken up the question whether hatchery raised fish must be managed on that principle. Suffice to say that knowledgeable people disagree on this issue and it would probably take a constitutional amendment to guarantee an unassailable legal conclusion one way or the other.

No one would seriously argue that the preservation of wild stocks is not a "beneficial use" of the fishery resource, and there apparently is a concern that managing hatchery fish for broodstock and cost recovery may, in some instances, be harmful to that beneficial use. The difficulty with such a conclusion is that it probably raises more questions than it answers. How significant must the harm be? Can it be clearly substantiated? Is not the continued health and development of hatchery raised fish also a "beneficial use" of the resource?

As the above arguments, conclusions and questions demonstrate, there is no clear answer to the question whether there is a constitutional mandate that hatchery fish be managed on a sustained yield basis. That is not to say, however, that the legislature should not exercise its constitutional law making authority in this area. As Chairman Martin's letter makes clear, the Board of Fisheries is struggling with statutory ambiguities, and the board is obviously looking for legislative action.

Allocating for Broodstock and Cost Recovery

As noted earlier, assistant attorney general Steve White concluded that the board and the department are authorized and directed by law to allocate fishery resources for broodstock. He also concluded that the board has the authority, but is not required, to manage for cost recovery. White memo., p. 7. Going a step further, Mr. Saupe reached the conclusion that the board and the department must manage for both broodstock and cost recovery. Saupe memo., p. 16. In reaching their conclusions, White and Saupe both rely on the notion that hatchery fish must be managed on the principle of sustained yield, discussed above, and on the a number of statutes and court decisions which point to legislative approval for such activity.

As noted above, the board is to provide for "the conservation and development of of the fishery resources of the state." AS 16.05.221(a). The Alaska Supreme Court, in Kenai Peninsula Fishermens Coop Ass'n v. State, 628 P. 2d 897, 903 (Alaska 1981), defined "conservation" as "controlled utilization of a resource to prevent its exploitation, destruction or neglect." Steven White argues that, since managing for broodstock helps to perpetuate the fishery resource (i.e., prevents its "exploitation, destruction or neglect"), managing for broodstock is analogous to managing for escapement of wild fish. Therefore, the board has the power to adopt regulations that will provide for hatchery broodstock. White memo., p. 2.

Saupe argues that, in addition to the constitutional mandates, managing for broodstock is required by AS 16.10.443, which states:

Department assistance and cooperation. (a) Before and after permit issuance under AS 16.10.440 - 16.10.470, the department shall make every effort, within the limits of time and resources, to advise and assist applicants or permit holders, as appropriate, in the planning, construction, or operation of salmon hatcheries.

Saupe concludes that, because broodstock recovery is essential to hatchery operations, and the department is required to assist in hatchery operations, any regulation or action of the department that denies broodstock recovery would be invalid as inconsistent with the above-quoted statute. Saupe memo., p. 15.

Whether the board has the authority to manage for cost recovery is less clear than it is for broodstock. The board does have the authority to allocate fish to various user groups.⁹ However, private nonprofit hatcheries are not specifically designated in law as a user group. Nevertheless, Steve White has concluded that private nonprofit hatcheries could be considered a "subgroup" of commercial users. Because the Alaska Supreme Court has upheld the board's power to allocate among subgroups (e.g., drift gillnetters and set gillnetters),¹⁰ White concludes that the board could make a valid allocation to hatchery operators as a "subgroup."¹¹

Michael Stanley on the other hand, argues that the statutory definition of "commercial fishing" leads to a different conclusion. AS 16.05.940(5) states:

the taking, fishing for, or possession of fish, shellfish, or other fishery resources with the intent of disposing of them for profit, or by sale, barter, trade, or in commercial channels . . .

Stanley asserts that hatchery operators do not sell cost recovery fish "for profit." He does acknowledge that cost recovery sales may be "in commercial channels," but argues that a reading of that phrase broad enough to include hatchery operators would also have to include other users, such as salmon derby operators. The inference he makes is that the legislature did not intend hatchery operators to be included in either definition, and therefore hatchery operators cannot be allocated to as a subgroup. Stanley also points to the statutory definition of "commercial fisherman, AS 16.10.940 (5), which states that they are "individuals," meaning natural persons and not corporations.

Saupe, on the other hand, argues that cost recovery is essential to sustain hatchery yields and to promote aquaculture, two requirements of the state constitution.¹² He also points to a number of statutes which he believes evince a legislative mandate for cost recovery. Principal among these is AS 16.10.450 (a), which provides:

⁹/See AS 16.05.251(e).

¹⁰/Meyer v. State, 739 P.2d 172, 174 (Alaska 1987)

¹¹/White op., p. 3.

¹²/Along with the sustained yield requirement already discussed, Saupe relies on art. VIII, sec. 15, which states:

No Exclusive Right of Fishery. No exclusive right or special privilege of fishery shall be created or authorized in the natural waters of the State. This section does not restrict the power of the state to limit entry into any fishery for the purposes of resource conservation, to prevent economic distress among fishermen and those dependent upon them for a livelihood and to promote the efficient development of aquaculture in the State. (emphasis added).

Sale of salmon and salmon eggs by hatchery. (a) Except as otherwise provided in a contract for the operation of a hatchery under AS 16.10.480, a hatchery operator who sells salmon returning from the natural waters of the state, or sells salmon eggs to another hatchery operating under AS 16.10.400 - 16.10.470, after utilizing the funds for reasonable operating costs, including debt retirement, expanding its facilities, salmon rehabilitation projects, fisheries research, or costs of operating the qualified regional association for the area in which the hatchery is located, shall expend the remaining funds on other fisheries activities of the qualified regional association.

Also cited by Saupe as evidence of the legislature's mandate for cost recovery: AS 16.43.420 (Limited Entry Act provision allowing sale of fish caught under special harvest area entry permit); AS 16.10.430 (b) (allowing a holder of a terminated hatchery permit to harvest salmon during the termination period); AS 16.05.020 (requiring the commissioner of Fish & Game to "improve and extend" the fish resources of the state in the interest of the state's economy and general well-being).

Restricting Hatchery Output

The Saupe memorandum also discusses the authority of the board to restrict individual hatchery output. Based in part on Linda Snow's legislative history memorandum, and in part on a review of the board's authorizing statute, Saupe concluded that there is "little or no basis for regulation of hatchery output by the board." Saupe memo., p. 28. He asserts that AS 16.10.440 (b), which allows the board to amend the terms of a hatchery permit,¹³ speaks only to regulation of harvest, not production. Saupe memo., p. 30.

As to whether the board can set regional production limits, such as by capping the hatchery sockeye output in Prince William Sound to maintain historical levels relative to Bristol Bay sockeye production, Saupe is not as sure. However, he does suggest that the board's authority to regulate propagation and stocking¹⁴ is a "very slender thread from which to hang an unprecedented, statewide regulatory program of production allocations." He also asserts that serious practical and policy problems would arise when the board attempts to allocate between regions of the state.¹⁵

¹³/AS 16.10.440(b) allows the board to amend "the terms of the permit relating to the source and number of salmon eggs, the harvest of fish by hatchery operators, and the specific locations designated by the department for harvest."

¹⁴/AS 16.05.251(7)

¹⁵/Saupe memo., p. 31-32.

CONCLUSIONS

This chapter illustrates some of the ambiguities in Alaska law relating to the authority of the Board of Fisheries to manage hatchery fish and leads to several conclusions:

1. There is no specific statutory mandate directing the board to give wild stocks preferential management treatment relative to hatchery raised fish.
2. The Alaska Constitution may require that hatchery fish be managed to allow for broodstock and cost recovery by the hatcheries, but that requirement may be invalidated by a determination that the sustained yield of hatchery fish is not as "beneficial" a "use" of the fishery resource as that of protecting the health of the wild stocks.
3. Existing statutes appear to allow the board to allocate to hatcheries fish for broodstock, but are less clear as to the authority for cost recovery.
4. Existing statutes are not clear on the board's authority to restrict hatchery production on a local or regional basis.

OPTIONS FOR POSSIBLE CONSIDERATION

- Placing a wild stock priority into state statutes; or alternatively, making the status of wild and hatchery stocks of equal priority, or leaving the statutes ambiguous.
- Clarifying in state statutes whether or not the Board of Fisheries is required to provide for hatchery broodstock or for cost-recovery fisheries.
- Clarifying the Board of Fisheries' authority to restrict hatchery production.

UPDATE: *In May 1992 the Alaska Legislature responded to the concerns described in this chapter by passing SB 457, establishing a wild fish stock priority. See attached.*

pink

ATTACHMENT

May 6, 1991

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

Dear President Eliason:

This letter is in response to a request by the Senate Resources Committee and the Special Senate Fisheries Committee when Board of Fisheries members appeared before the committee in March. We appreciated the opportunity to sit down with the committee and discuss items which will improve the board's ability to serve the people of Alaska.

In managing fisheries that involve hatchery raised salmon, the Board of Fisheries has encountered problems due to ambiguities in the current Alaska statutes. These problems commonly arise when the management of hatchery stocks conflicts with either the health of wild stocks or with the opportunity of fishermen to harvest wild stocks. Essentially, the statutes are not clear on the status of wild stock management.

State statutes also are not clear about the state's duty to provide fish for hatchery broodstock and cost recovery, and about the hatcheries' obligations to contribute to the common property fisheries. We perceive that the development of state policy toward hatcheries may have created a conflict of interest. On one hand, the state manages fisheries as a common property resource for the benefit of all user groups. On the other hand, the state loans money to hatcheries with the expectation that the hatcheries will receive enough fish to be able to repay these loans.

The board has the following comments on the existing statutes:

1. AS 16.10.375 Regional Salmon Plan. Should new language require a review or synthesis of the regional plans to give a statewide perspective on hatchery production?

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2. AS 16.10.380 Regional Associations. One of the great strengths of the regional associations is the representation of all user groups on their boards of director. However, the PNP's have no such requirement. Should all hatcheries and enhancement activities in a region be under the control of the regional associations?

Should state laws apply to all hatcheries and enhancement activities in Alaska and not just private non-profit hatcheries? Other activities that might be covered include state-owned hatcheries, regional hatcheries, and the U.S. Fish and Wildlife Service, the U.S. Forest Service, and the National Marine Fisheries Service. Should all these activities be included in the Regional Comprehensive Plan?

Should the role of the regional associations be to coordinate region wide production and allocation subject to biological review by the Regional Planning Team and allocative review by the Board of Fisheries?

Given an expanded role for the regional associations, should their means and levels of funding be re-examined by the legislature?

3. AS 16.10.400 Permits for Salmon Hatcheries. The legislature should re-examine (g) of this section: "During the development of a comprehensive plan for a region no permit may be issued for a hatchery unless the commissioner determines that such an action would result in substantial public benefits and would not jeopardize natural stocks."

The first ten words of this section, "During. . . region . . .", suggest that once the plan is completed, the prohibited actions could be allowed. Perhaps this wording should be deleted. Also, we believe that there should be more specific grounds and procedures for terminating hatchery permits after they have been issued.

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Legislators should note that 5 AAC 40.860 provides generic standards for performance review of hatchery success in producing smolt from broodstock. There are no statutory standards, however, for performance review of hatchery contribution to common property fisheries. If a hatchery cannot demonstrate that it is providing "substantial public benefit", is the state required to continue to provide for returns to the hatchery for broodstock or cost recovery purposes?

In this subsection, "substantial public benefit" is not clearly defined. The board recommends that the legislature consider linking the number of eggs taken as broodstock or the number of smolt released by a hatchery to that hatchery's required contribution to the common property fisheries.

The board may contribute to clarifying "substantial public benefit" by requiring the marking of hatchery fish. While we believe that the board has the authority to require this, it would be helpful to have this authority specifically provided by statute. Should the cost of implementing a marking program be borne by the producers of hatchery fish or by the state?

The last five words of this subsection, ". . . would not jeopardize natural stocks", is one of only two places (the other is AS 16.10.420(10)) which declares that it is the legislature's intent that the conduct of the entire state hatchery system is conditional on the protection of natural stocks. Perhaps because our hatcheries have flourished over time, and given some of the intense debate occurring in Oregon, Washington and Canada on how hatchery stocks have impacted natural systems, it is especially timely for the legislature to review the treatment natural stocks receive.

4. The necessity of protecting Alaska's vigorous natural stock populations is recognized by Department of Fish and Game regulations and policies. The regulations are in 5 AAC 40. For example, some of the strongest language exists in 5 AAC 40.220(b)(1), "the proposed hatchery returns may not unreasonably or adversely affect management of natural stocks. . ." Additional language exists in 5 AAC 40.005(a), (c), and (e), 5 AAC 40.007(b), 5 AAC 40.170 (2), 5 AAC 40.220 (b)(1), (3) and (7), and 5 AAC 40.860 (b)(2) and (4). As this issue of natural stock protection is examined by the legislature, the board recommends that the legislature seek input from the Commissioner of the Department of Fish and Game.

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5. The legislature may wish to further clarify their intent in additional and more concise definitions of terms used in Title 16. For example, the following terms should be clarified: "escapement", "brood stock", "cost recovery", "substantial public benefit", and "private non-profit."

Should escapement apply strictly to natural stocks returning to natural systems?

Should broodstock be defined as the number of eggs authorized by permit to meet the production levels of the hatchery and to contribute to the common property fisheries? Some wording to this effect would be valuable in light of AS 16.10.420 and AS 16.10.450 which allow for the sale of salmon and salmon eggs for cost recovery. Fish which return to the hatchery for broodstock should be differentiated from fish which return and may be taken for cost recovery.

Does the legislature wish to rank or prioritize escapement to natural systems compared to return of broodstock to hatcheries?

"Cost recovery" is another term which warrants some further clarification. However, a clear definition of broodstock, coupled with a definition of substantial public benefits in terms of what is contributed to common property fisheries from broodstock, would provide a de facto identification of fish available for cost recovery as long as identification of hatchery stocks can be achieved.

These concerns of the Board of Fisheries are presented for your consideration. Your interest, and past support, in these resource issues has been greatly appreciated.

Should you have further questions, please feel free to call me.

Sincerely,

Michael R. Martin
Chair
Alaska Board of Fisheries

cc: Board of Fisheries members
Carl Rosier, Commissioner, ADF&G



LAWS OF ALASKA

1992

Source
CSSB 457(RES)

Chapter No.
49

AN ACT

Relating to management of wild and enhanced stocks of fish; and amending the definition of "fishery."

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

THE ACT FOLLOWS ON PAGE 1

Approved by the Governor: June 10, 1992
Actual Effective Date: September 8, 1992

AN ACT

1 Relating to management of wild and enhanced stocks of fish; and amending the definition of "fishery."

2

3

4 * Section 1. AS 16.05 is amended by adding a new section to read:

5 ARTICLE 5. MANAGEMENT OF FISH AND FISHERIES.

6 Sec. 16.05.730. MANAGEMENT OF WILD AND ENHANCED STOCKS OF FISH.

7 (a) Fish stocks in the state shall be managed consistent with sustained yield of wild fish stocks
8 and may be managed consistent with sustained yield of enhanced fish stocks.

9 (b) In allocating enhanced fish stocks, the board shall consider the need of fish
10 enhancement projects to obtain brood stock. The board may direct the department to manage
11 fisheries in the state to achieve an adequate return of fish from enhanced stocks to enhancement
12 projects for brood stock; however, management to achieve an adequate return of fish to
13 enhancement projects for brood stock shall be consistent with sustained yield of wild fish stocks.

14 (c) The board may consider the need of enhancement projects authorized under

Chapter 49

1 AS 16.10.400 and contractors who operate state-owned enhancement projects under AS 16.10.480
2 to harvest and sell fish produced by the enhancement project that are not needed for brood stock
3 to obtain funds for the purposes allowed under AS 16.10.450 or 16.10.480(d). The board may
4 exercise its authority under this title as it considers necessary to direct the department to provide
5 a reasonable harvest of fish, in addition to the fish needed for brood stock, to an enhancement
6 project to obtain funds for the enhancement project if the harvest is consistent with sustained
7 yield of wild fish stocks. The board may adopt a fishery management plan to provide fish to an
8 enhancement project to obtain funds for the purposes allowed under AS 16.10.450 or
9 16.10.480(d).

10 (d) In this section, "enhancement project" means a project, facility, or hatchery for the
11 enhancement of fishery resources of the state for which the department has issued a permit.

12 * Sec. 2. AS 16.05.940(12) is repealed and reenacted to read:

13 (12) "fishery" means a specific administrative area in which a specific fishery
14 resource is taken with a specific type of gear; however, the Board of Fisheries may designate a
15 fishery to include more than one specific administrative area, type of gear, or fishery resource;
16 in this paragraph,

17 (A) "gear" means the specific apparatus used in the harvest of a fishery
18 resource; and

19 (B) "type of gear" means an identifiable classification of gear and may
20 include

21 (i) classifications for which separate regulations are adopted by the
22 Board of Fisheries or for which separate gear licenses were required by former
23 AS 16.05.550 - 16.05.630; and

24 (ii) distinct subclassifications of gear such as "power" troll gear
25 and "hand" troll gear;

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Chapter VI. PLANNING AND PERMITTING

A major element of the statewide salmon enhancement program is the planning and permitting process.

CURRENT PLANNING AND PERMITTING PROCESS

Legislation in 1976 authorized the commissioner of the Alaska Department of Fish and Game (ADF&G) to designate regions of the state for the purpose of enhancing salmon production. This statutory responsibility is implemented through Regional Planning Teams (RPTs), composed of department personnel from the fisheries divisions and representatives from the regional aquaculture associations. The RPTs also have ex-officio members from other agencies (e.g. U.S. Forest Service, U.S. Fish & Wildlife Service). See attached charts for an illustration of the planning and permitting process.

In regions where no regional aquaculture association has been formed, planning core groups representing ADF&G fisheries divisions, fishermen and other agencies and interest groups are established for the purpose of developing comprehensive salmon plans.

The mission of the RPTs is to plan for the long-term utilization of the salmon resource using an orderly process that examines the full potential of the region's salmon production capacity. Regional comprehensive salmon planning progresses in stages. Phase I sets the goals, objectives and strategies for the region by developing a 20 year, long-range plan. Phase II identifies potential projects and establishes criteria for evaluating the enhancement and rehabilitation potential of the salmon resource in that region through the development of 5-year action plans. Upon completion of these phases, the RPT annually reviews the status of the program and prepares updates to the Phase II plans. In Prince William Sound, the RPT has initiated development of a Phase III plan that incorporates Board of Fisheries-approved allocation and fisheries management plans with hatchery production plans. All plans are reviewed and approved by the ADF&G commissioner.

The RPTs not only develop the comprehensive salmon plans, but also review and comment to the ADF&G on:

- private nonprofit (PNP) hatchery permit applications;
- proposed alterations to PNP hatchery permits;
- PNP and ADF&G annual hatchery management plans; and
- annual reports by PNP hatchery operators.

Each hatchery enhancement project is reviewed, based on some relatively consistent criteria:

- Will the hatchery make a significant contribution to the common property fishery?
- Does the proposed project allow for continued protection of natural stocks?
- Is the proposed project compatible with the comprehensive plan?
- Does the proposed project make the most appropriate use of the site's potential?

Comprehensive salmon plans have been developed and approved for northern Southeast Alaska, southern Southeast Alaska, Yakutat, Prince William Sound/Copper River, Cook Inlet, Kodiak, and Bristol Bay. The comprehensive salmon planning process has recently

been initiated for the Alaska Peninsula/Aleutian Island/Area M region, the Chignik region, and for the Kotzebue Sound area in relation to the Sikusilaq Springs Hatchery.

Regional Aquaculture Associations

In addition to regional planning, ADF&G was also directed to assist and encourage the formation of qualified regional associations for the purpose of planning and implementing fisheries enhancement and rehabilitation projects. An association must be representative of commercial fishermen and other user groups in the region. Once formed, an association typically receives a planning and organizational grant from the Department of Commerce and Economic Development.

Private Nonprofit Permit Application Process

The commissioner of ADF&G may issue a nontransferable permit to a nonprofit corporation for the construction and operation of a salmon hatchery after the permit application has been reviewed by the regional planning team.

The permit application process is rigorous and includes: 1) pre-application assistance from ADF&G, 2) a management feasibility analysis, 3) the permit application and fees, 4) determination of acceptance by the department for formal review, 5) regional planning team review, 6) a provision for requesting additional information, 7) completeness determination by the department, 8) the public hearing process, 9) review and determination by the commissioner (this includes six major criteria), and 10) a provision for reconsideration. The departmental review of all PNP hatchery permit applications includes review and comment by all fisheries divisions, the Habitat Division, the principal geneticist, and the principal pathologist. A public hearing and full review by state and federal agencies through the coastal zone review process is also required.

Conditions may be placed on a PNP permit, including a provision that donor stock eggs must be from the department or a source approved by the department. Other permit conditions include restrictions on placement of salmon eggs or resulting fry into the waters of the state; restrictions on the sale of eggs or resulting fry; the timing and conditions of releasing salmon; destruction of diseased salmon; departmental control over where salmon are harvested by hatchery operators; and siting requirements so that reasonable segregation from natural stocks occurs while still allowing, to the extent feasible, returning hatchery fish to pass through traditional salmon fisheries.

The commissioner may alter, suspend, or revoke a PNP permit if the operator fails to comply with the terms and conditions of the permit within a reasonable period after notification of noncompliance. The commissioner may also alter the permit or terminate the operation, if it is found that the hatchery is not in the best interest of the public.

Fish released by hatchery operators are available for common use as natural stocks, until they return to the location established by the department for hatchery harvest. The Board of Fisheries may, after a permit has been issued, amend by regulation the terms of the permit relating to the source and number of eggs, the harvest by hatchery operators, and the locations of hatchery special harvest areas [AS 16.10.440(b)]. This is the basis for the Board-regulated Fish Transport Permit process (see Biological Issues chapter), establishment of hatchery special harvest areas, and board-

approved terminal harvest area plans. *The statutes also appear to give the Board the authority to limit or control production at individual hatcheries based on egg-take for broodstock.* This authority has never been used, and there is a strong difference in opinion as to whether or not the Legislature actually intended the Board of Fisheries to regulate hatchery production, or instead, to regulate the take of eggs from wild stocks for hatchery production.

A hatchery operator must file an annual report with ADF&G by December 15 of each year. The report contains information on hatchery returns, numbers of eggs taken, and numbers of fry or smolt released.

A *Basic Management Plan* (BMP) is developed as part of the actual permit. The BMP includes a complete description of the facility and special harvest area, broodstock development schedules, and descriptions of broodstock and hatchery stock management. Marking programs for hatchery-produced fish can be required in the hatchery permit and BMP. Tagging is usually considered optional, unless during the permit or permit alteration process, fisheries managers specify the need for special in-season management capability.

When a permit is approved and operational, an *Annual Management Plan* (AMP) is developed for each year of operation. Specific plans for egg-takes, cost-recovery harvest, fry and smolt releases, and marking and recovery are included. AMPs are developed by the department in conjunction with the operator and are reviewed by all the fisheries divisions and the RPT before being approved by the commissioner.

Alaska Statutes 16.10.400-16.10.475 address this process, as well as regulations in 5 AAC 40.100-40.990.

Fish Transport Permits

The possession, transportation or release of live fish and their reproductive products (eggs) into the waters of the state requires a *Fish Transport Permit* (FTP) from ADF&G. The FTP permit application covers only one specific operation and is quite detailed, including:

- effective period,
- transport dates,
- maximum number of fish or eggs to be taken,
- incubation and rearing location,
- release location,
- purpose and benefits,
- evaluation methods,
- native stocks present,
- history of known transport of this stock,
- disease history,
- description of proposed egg-take methods,
- planned disease control measures, and
- water source for rearing and effluent discharge location.

The FTP application is intensively reviewed by the regional supervisors of the FRED, Commercial Fish and Sport Fish Divisions, the FRED pathologist and principal geneticist, as well as the FRED chief of technology and development and the FRED director. A signature page is attached to the actual permit which includes recommendations and comments. The permit is then approved or disapproved by the commissioner of ADF&G.

The potential for disease and genetic impacts are the primary considerations in the FTP review process.

Fish Resource Permits

ADF&G is currently developing a policy on ***Fish Resource Permits*** (FRP). The FRP was previously called a scientific/educational (sci/ed) permit. This policy is being developed as a result of a previous lack of standards for the scientific and educational projects. Alaska statutes have only brief references to these activities, but it is clear that the Legislature intended them to be allowed.

Under the proposed policy, Fish Resource Permits will be issued with the stipulations of no commercial activities, no human consumption, and no sale of the species. These permits are classified into collecting permits for scientific or educational purposes, holding permits for either exhibition or scientific research, and limited propagation permits for various scientific or educational purposes, including mariculture site suitability.

ADF&G's proposed policy clearly indicates what reviews and permits are required for each kind of project and should alleviate the prior problems caused by a lack of such standards.

PROBLEMS AND ISSUES

1. Lack of statewide goals and objectives for enhancement program.

The 1974 authorizing legislation provides the legislature's intent that private nonprofit corporations (PNPs) contribute to the rehabilitation of the state's depleted and depressed salmon fisheries. Except for some specific regions of the state and gear groups in those regions, this goal has been met. The numbers of Alaska's wild and hatchery fish are at an all time high. Other than the problems of marketing and price, most of the state's salmon fisheries are no longer depressed. Few people dreamed the state's enhancement program would be so successful in terms of quantity of fish. Large enhanced production, in combination with improved management of wild runs and favorable environmental conditions, have resulted in Alaska once again producing record amounts of salmon.

The state does not have a clearly defined policy for future management and development goals for hatcheries and other enhancement efforts that goes beyond increased production. It has been proved it is possible to grow large numbers of fish. Where should we go from here? For example, should our goal be to cap salmon production at a certain level, or cap production of specific species at a set level? Should the focus be on enhancement efforts in other areas of the state that have very small or depressed fisheries with a goal of economic development? Should the focus be shifted to other species such as crab enhancement or sheefish or arctic char? These are the kinds of policies and goals that are yet to be made on a statewide basis.

ADF&G's FRED Division is currently developing a strategic plan for the next decade. Although this effort has been delayed during reorganization of the department, this plan needs to be developed in conjunction with a statewide planning effort so that FRED's goals and objectives are coordinated with the other elements of the state's enhancement program, including the PNPs. Additionally, adequate financial support is essential to meeting those goals and objectives.

2. Regional or Statewide Planning.

State law directs salmon production planning to be done on a regional basis. Although the commissioner of ADF&G has overall authority for both PNP and department enhancement efforts, little comprehensive statewide planning is done, with only minimal interaction between regions of the state. Most planning focuses on *production* in a region and not whether the production is *desirable* relative to other regions. Additionally, within each region, state hatcheries have varying interaction with the private enhancement efforts.

Today, however, hatchery produced fish comprise a growing proportion of the statewide harvest. There are concerns that Alaska's production-oriented enhancement program may result in one region's program affecting markets, prices and management in other regions. This subject is covered more fully in Chapter IX, Economics, published separately as a draft document.

Fisheries managers argue that the state needs a statewide planning policy that will take into account the potential impacts of one region on another, as well as closely scrutinizing potential management problems and marketing feasibility.

Others agree with the idea in principle, but maintain that such an effort is impossible in a state where competing interests would find it difficult to agree on a system that diminishes local control over hatchery development and production goals. Shifting to a statewide review could create enormous tensions between the user groups of different regions. During the public comment period on the draft report, most regional hatchery operators opposed the idea of statewide planning.

The Board of Directors of the United Fishermen of Alaska (UFA) in January 1992, requested the FRED Division to involve all RPTs in a statewide review process of hatchery production. The request was based on the premise that "[s]ince hatchery production is now at a level that the impacts are no longer confined to one region, UFA believes that such a review is warranted now more than ever." No action has been taken on that request.

3. Funding and support for planning.

Fishermen, hatchery operators, and state fisheries managers agree that the RPT planning process provides an important forum for discussing and resolving difficult issues on an ongoing basis.

However, *state support for planning has declined since the early 1980s* when FRED had a budget of over \$500,000 for grants to aquaculture associations. Grants were gradually reduced and eliminated in 1987. Meanwhile, the number of regions requiring plans increased from six in 1987, to ten by the end of 1991. Initial, one-time-only planning grants of up to \$100,000 are still available for regional aquaculture associations from the Department of Commerce and Economic Development.

Despite the need for more rigorous planning because of increased enhanced production, FRED planning staff has declined from two to one and a half positions. These positions coordinate all enhancement efforts statewide, including state facilities, provide technical assistance to the PNPs, and plan new ventures.

Budget reductions have forced state planners to shift priorities from plan development and implementation to plan maintenance. As a result of decreased state support, Prince William Sound and Cook Inlet Aquaculture Associations have hired full time planners. Although hired by the regional associations, these planners consider themselves staff to the local RPT. However, they are also involved in internal corporate planning, and arguably, this could be considered a conflict.

As a result of budget cuts, new planning efforts are minimal. New ventures are at a distinct disadvantage when compared to those started ten years ago. In the past, there was money for new hatchery projects, either through state general bond initiatives, grants or loans. More recently however, new hatchery initiatives have received little financial support.

FRED managers, gear group representatives and several aquaculture association managers strongly believe that present funding levels for planning are inadequate for FRED to properly oversee the functions of the 37 hatcheries in operation in Alaska. As a result, they believe that many more conflicts and issues will develop that should have been resolved early in the process. Perhaps just as importantly, FRED managers indicate that they are unable to consider the "big picture" issues such as long-term analyses and guidance for future developments.

RPT members also complain that the cutback in funds for planning has limited their contribution to a cursory discussion and approval of permit changes. If a hatchery requests a change in permit, they often have to wait six months or longer to be considered because funds are not available for some RPTs to meet more than twice a year.

4. Composition of Regional Planning Teams

Although many people believe the regional planning team (RPT) process is a good one if adequately staffed and funded, there are others who believe that the entire structure of the RPT should be changed. A frequent complaint is that the composition of the RPT is heavily weighted towards the commercial sector of the fishing industry, without sufficient representation of subsistence and sport fishing users, community and regional governments, environmentalists, and the general public. These critics argue that in order to have a truly *balanced* decision, all the varied interests of the region need to be adequately represented. Some RPTs have tried to address this complaint by broadening the composition of the team to include all interested groups.

Another, more fundamental concern is that ADF&G managers are usually out-numbered on the RPTs. As a result, the group can pressure department managers into approving projects that should probably be denied. Department personnel who raise future management concerns are under considerable pressure to be a *positive* presence in the RPT process, which in some cases, translates into withdrawing or modifying their objections without these concerns being adequately addressed. On the other hand, concern has also been expressed that department managers sometimes have a strong, anti-hatchery bias that can influence their management recommendations.

There is also the concern that the non-Fish and Game members of the RPT may not be sufficiently capable of evaluating and making decisions on issues that are increasingly technical in nature.

5. Allocation issues.

While issues such as location, harvest timing and cost recovery projections are scrutinized, the question of allocation is not considered by any of the parties involved with the FPT review process; AS 16.05.251 delegates that responsibility to the Board of Fisheries.

Without the ability to consider allocation issues as part of the permit review process, ADF&G may approve a hatchery permit that could create future allocation problems. By the time the Board of Fisheries begins to consider allocation problems resulting from hatchery production, millions of dollars may have been invested through state loans. The state may well feel a financial obligation to ensure the success of the facility.

In addition, allocation conflicts over hatchery-produced fish may eventually require tagging programs as part of their resolution. The question of tagging -- and who should pay for it -- is one that is more easily addressed early in the planning and permitting process.

Recent developments seem to indicate a change for the future. *In 1988, the Board of Fisheries charged the Prince William Sound Aquaculture Corporation (PWSAC) with development of an allocation plan for enhanced stocks in Prince William Sound.* After an intense planning effort and several drafts, PWSAC was able to come up with an allocation scheme that all user groups and the department could support. The allocation plan was approved by the Board of Fisheries in 1991 and was in effect this past fishing season. The regional planning team incorporated the allocation plan with its production and management plans into a comprehensive Phase III maintenance plan.

Using the success of PWSAC as a model, the Board of Fisheries has also directed the two Southeast regional aquaculture associations (NSRAA and SSRAA) to develop an allocation plan for hatchery stocks by March 1993. There is considerable debate among participants and observers as to whether this can be done. Unlike the Prince William Sound plan which deals primarily with one species and a single user group, Southeast must deal with deep-seated conflicts between two aquaculture associations, three commercial and several species of salmon, as well as factoring in the complexities of the salmon treaty.

6. Management issues.

Another complaint is that regional comprehensive salmon plans often focus exclusively on production goals for a hatchery, but provide little specific information on fishery management. Statements such as "management agencies and fishermen should work together to find the best solutions currently available to reverse declines" are common.

Initially, hatchery permitting was a two-stage process. The preliminary application included identification of such things as site, species, and run-timing. It contained little detail, and was given a relatively cursory review by ADF&G to notify the permittee if there were any significant potential problems before the applicant went to the expense of a full permit application. In 1985, however, hatchery permits were placed under the Coastal Zone Management process. As part of permit reform, FRED planners were told that only a single application could be required.

To replace the preliminary application, FRED now requires an initial ***Management Feasibility Analysis*** (MFA) be completed before a final application is submitted. The MFA covers the basics of siting, species, timing, and magnitude of production, and is developed by the Commercial Fisheries and Sport Fisheries Divisions to avoid potential management problems. Quite often, if red flags are raised during this review process, the original proposal ends up being modified.

Additionally, once an application is deemed acceptable by the department, the department's divisions are again given further opportunity to comment.

FRED planners believe that they have never permitted a hatchery or enhancement project that fisheries managers did not initially approve.

7. Uniform review.

State hatcheries and projects are not subject to the same permitting requirements as PNPs. Some fishermen believe that state projects cause the most allocation, management, and potential biological problems because of the lack of this additional layer of scrutiny. They would like to see permits required for state hatcheries and projects, as well as for PNP projects.

FRED Division believes adding this requirement is unnecessary. Although PNP-type permits are not required, state projects are reviewed through the Coastal Zone Management review process. In addition, the annual management plans for state facilities are submitted to the Regional Planning Teams for review. Some people believe these projects often receive more critical review than the PNP projects. Both state and PNP operations also require Fish Transport Permits (FTP's).

8. Criteria to show public benefit.

Four criteria must be considered by the RPT to determine if a permit application is in compliance with the regional comprehensive salmon plan:

- the contribution the proposed hatchery would make to the common property fishery;
- the provisions for protecting wild stocks from any adverse effects which may originate from the proposed hatchery;
- the compatibility of the proposed hatchery with the goals and objectives of the comprehensive salmon plan for the region; and
- whether the proposed hatchery would make the best use of the site's potential to benefit the common property fishery.

Critics say these criteria should be expanded to consider other public benefits and costs. Possible additions include marketability, a detailed cost-benefit analysis, and ongoing genetic and biological monitoring.

9. Operation performance reviews and permit revocation.

State managers and RPT gear group representatives are also concerned about ADF&G's authority over hatcheries that are out of compliance with state laws, regulations, and permit requirements.

Present regulations allow RPTs, at the direction of the ADF&G commissioner, to review a hatchery's compliance with statutes and regulations, and to recommend the suspension, alteration or revocation of a permit if certain performance standards are not met such as survival rates and contribution to the common property fishery. However, a recent attorney general's opinion required that one hatchery facing revocation of a permit must be given a hearing before an administrative officer under the Administrative Procedures Act. This can be a relatively lengthy process.

With the potential risk of impacts on the state's common property fisheries, managers and some RPT members believe a mechanism to allow for the timely revocation of a permit is necessary. They advocate for a change in the statute to allow the ADF&G commissioner to revoke, suspend or alter a permit for any violation of Title 16 without going through APA requirements.

10. Hatchery Siting Privileges

If a region has an organized aquaculture association, that association, under state statutes, has the preference rights to all potential hatchery sites in that region. Non-association PNPs (Mom and Pops) have expressed concern that giving priority use of potential sites to an association is not good public policy. The Mom and Pop operations believe that any unused hatchery sites should be available to both associations and non-association PNPs.

11. Canadian evaluation model.

The Canadian government is considered to have a model evaluation program of its national salmon enhancement program. Under the auspices of the Internal Audit and Program Evaluation Branch of the Department of Fisheries and Oceans, this program is intended to provide a thorough and comprehensive review of the program, by facility.

The first evaluation project began in 1985 and concluded that there was not enough production and biological data available to carry out a proper program evaluation. The program audit branch then designed the optimum evaluation framework and determined what kind of data would be needed. These data included biological and production information, as well as an analysis of economic costs and benefits. With that data in hand, program auditors are now preparing to spend a year reviewing the entire program, with a final report due in March 1993. Federal funds are being used for this project, although university staff and consulting firms are conducting the actual evaluation.

OPTIONS FOR POSSIBLE CONSIDERATION:

- Working with the public and user groups to develop statewide goals and objectives for the state's entire fisheries enhancement program.

- Directing FRED Division to develop a program to implement these goals and objectives.
- Declaring a moratorium on further hatchery development or increased production until the Legislature's economic cost-benefit studies are complete and a full assessment of the state's program can be made.
- Development of a statewide planning process.
- Development of a statewide production plan.
- Requiring FRED to develop a comprehensive annual report that not only compiles production figures from state and PNP facilities, projects, and current management regimes, but also includes future production and management plans.
- Evaluation of the composition and procedures of the RPT to determine if changes in the RPT structure are necessary.
- Expansion of state statutes to require all hatcheries, including state facilities, to comply with a single planning and permitting process, with the same requirements for monitoring and review.
- Widening the scope of RPT review, including recommendations for allocation of enhancement production.
- Providing adequate funding for planning.
- Reviewing the required Management Feasibility Analysis to determine if it needs to be a more comprehensive review.
- As part of permit review and solicitation of state loans, consideration of adding new criteria to show public benefit, including marketability, a detailed cost/benefit analysis instead of a financial feasibility analysis, a more specific indication of the "significant contribution" to be made to the common property fishery, and some kind of environmental assessment.
- Providing concrete direction for the timely performance review of PNP hatcheries and a more workable mechanism for closing or converting hatcheries not making a "significant" contribution to the common property fishery.
- Exempting the alteration, suspension or revocation of an enhancement permit for violation; from the Administrative Procedures Act.
- Instituting a regular review process similar to the Canadian model.
- Clarifying Board of Fisheries authority to regulate hatchery production levels.
- Re-evaluation of the policy of giving regional aquaculture associations the preference rights to develop future hatchery sites in the region.

Planning Process

Regional Planning Team



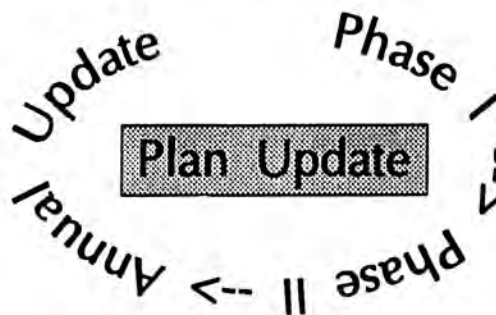
Historic harvests,
production/harvest
goals by area, species



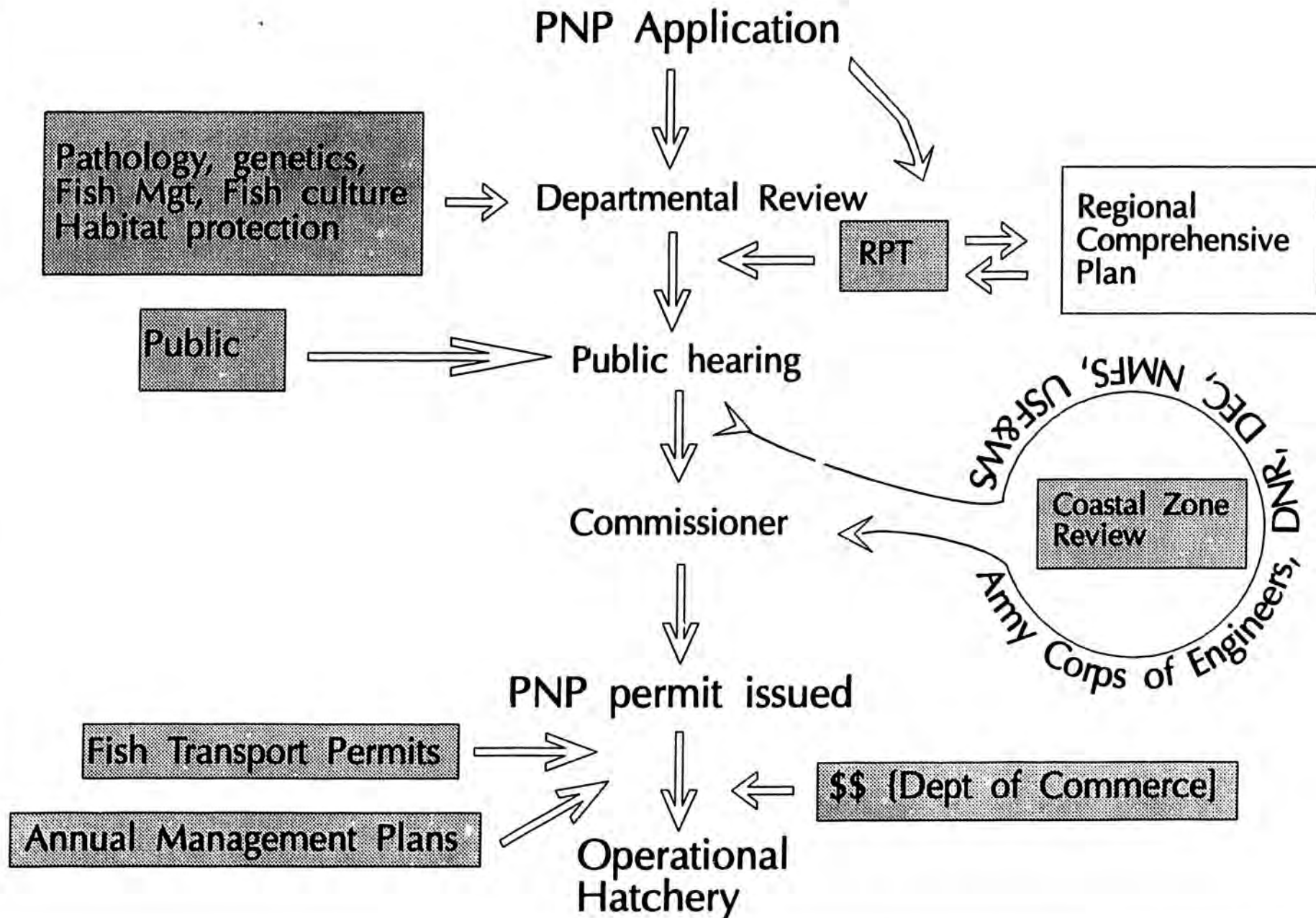
Regional Comprehensive Plans



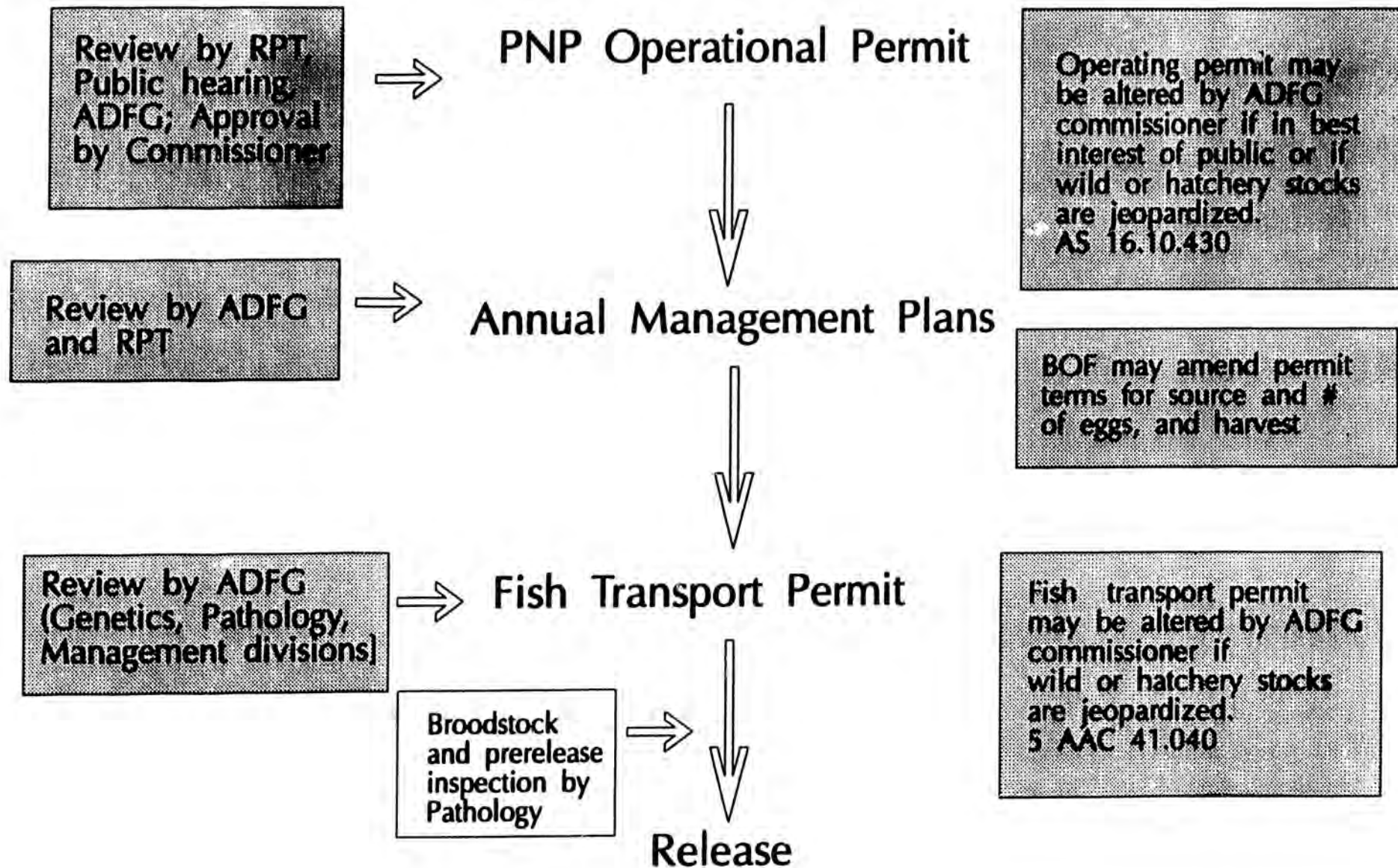
Project
opportunities
to fill gaps



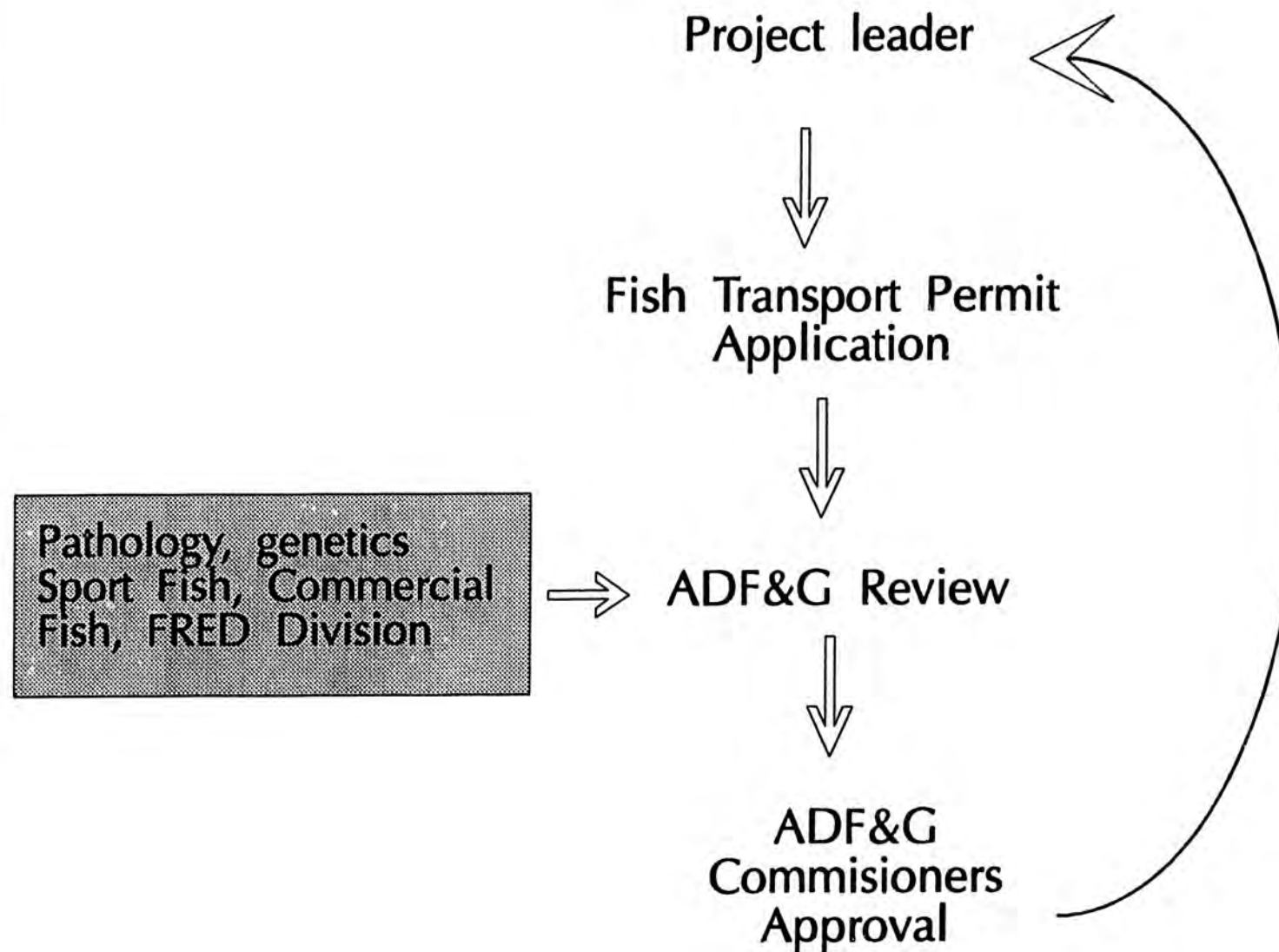
PNP Application Process



Regulation of PNP Hatcheries



Fish Transport Permit Process



CHAPTER VII. BIOLOGICAL/GENETIC ISSUES

In November 1991, in Cordova, Alaska, the Prince William Sound Science Center (PWSSC) and the School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, convened a group of world-renowned experts to examine "The Biological Basis for Maintaining Strong Co-existing Stocks of Natural and Enhanced Salmon Populations in Alaska." This workshop followed a series of international symposiums on this topic during the past two years. Top fisheries biologists, ecologists and geneticists from the United States, Norway, Sweden, the Soviet Union and Japan were present at the Cordova workshop. As a follow-up to the workshop, the group produced an interim report and list of recommended policies and procedures to be considered by the state of Alaska in managing its wild and enhanced salmon stocks. Attachment A.

The cumulative effect of hydroelectric dams, habitat destruction, overfishing, and large-scale hatcheries has led to the decimation of many wild salmon stocks in Pacific Northwest states. Biologists in states with a long history of hatchery programs are generally less enthusiastic about these programs than biologists in areas such as Alaska and British Columbia with comparatively recent programs. *Although poor hatchery practices can clearly endanger wild salmon populations, scientists do not agree on the extent to which hatcheries with sound practices can co-exist with sustained healthy runs of wild salmon.*

The lack of consensus among scientists largely results from insufficient data and research, and at times, professional bias. Even where information exists, however, it is often subject to conflicting interpretations. To complicate matters, results of specific studies may not be transferable to other areas or salmon species, and year-to-year environmental changes may affect the results of these studies.

THE GENETIC EFFECTS OF HATCHERIES

Most scientists agree that it is essential to have healthy wild stocks to maintain the health and genetic diversity of both wild and hatchery stocks; genetic diversity must be preserved. Scientific knowledge about the genetic impact on wild stocks of hatchery fish, however, is still incomplete. Reduction in the fitness of salmon stocks, to the extent it has been documented, may involve numerous factors. Most scientists agree that hatcheries can complicate mixed-stock fisheries and affect the genetic composition of wild fish stocks. Scientists do not agree on the extent to which genetic changes affect the short- or long-run fitness of wild stocks.

Straying and intermingling of stocks is a major concern to scientists. The extent of straying, the variables involved in imprinting, and the effects of interbreeding are largely unknown. Large-scale ocean ranching appears to set the stage for straying of wild stocks in the harvest areas of enhanced stocks and also for hatchery fish to stray into the natural streams. What impact this has on the genetic diversity of salmon stocks in a given region is a question that remains to be answered. However, the concern is that intermingling may reduce the fitness of the locally adapted populations.

It is known that the greater the distance between the donor stream or hatchery and the release site, the greater the amount of straying. Many scientists are concerned about the extensive releases at remote sites practiced by many hatchery operations today, with many more planned for the future. They fear that such

straying could potentially, in time, destroy genetic diversity -- resulting in a permanent, irreversible loss. Some scientists believe remote releases should be banned altogether. Others believe they should be permitted with stringent controls and careful monitoring.

OCEAN CARRYING CAPACITY

Some scientists suspect that the carrying capacity of nearshore marine waters and the high seas for salmon may be exceeded by large-scale releases of hatchery salmon. A reduction in the average size of salmon was reported throughout the Pacific region in 1991, but various factors may be responsible. Since 95 percent of the growth of salmon occurs at sea, some researchers believe ocean conditions affect the size of salmon more than competition. Much evidence, however, supports the theory of density-dependent growth for some salmon species, although there is considerable debate regarding its occurrence. More information is needed on the effects of predation and competitors.

DISEASE

Few studies document the transmittal of diseases between hatchery and wild salmon, and there is no documentation of such transmittal in Alaska. Where transmittal of a disease by hatchery salmon has been documented, it occurred after fish were transplanted long distances. Hatchery fish appear to be more vulnerable to disease than wild fish because of the stress of hatchery conditions and large concentrations of eggs and fry. Norway has had considerable problems with disease transmitted by farmed salmon that have escaped and mixed with wild stocks.

Active fish pathology laboratories are maintained by the FRED Division in both Juneau and Anchorage. Their basic function is to implement policies and procedures that guard against the spread of fish and shellfish diseases in Alaska. Reviewing fish transport permits in order to reduce the occurrence of disease is a major task of the labs, as is examining each broodstock for disease prior to its use in a hatchery.

STATE GENETICS PROGRAM AND POLICY

The state genetics program is intended to implement policies and procedures that protect and maintain the genetic uniqueness of Alaska's wild salmon stocks in the face of North America's largest salmon enhancement program. The state's fish genetics policy, considered to be one of the most stringent in the world, was last revised in 1985, and is currently being reexamined and updated.

Alaska's genetic policy contains guidelines and restrictions intended to protect the genetic integrity of wild stocks. The *goal* is to maintain adequate genetic variability, ensuring that the enhanced stock will be able to adapt to changing environmental conditions.

Geneticists have two primary concerns in protecting wild stocks and implementing a successful enhancement program. The first is possible genetic impacts due to gene flow between wild or enhanced stocks; the primary concern being, of course, for wild stocks. The second concern is the loss of genetic variation within or among stocks. Both impacts can potentially cause the reduction of total fitness in wild stocks and hatchery broodstocks.

These problems are addressed in the policy's three main topic areas: stock transport, protection of wild stocks, and the maintenance of genetic variation.

Since specific knowledge of salmon population genetics and the genetic impacts of salmon enhancement on wild stocks was limited, the 1985 genetic policy was based primarily on information from agricultural genetics and research on other species. As a result, the policy contains guidelines that are rather flexible. The policy suggests that because scientific knowledge is limited, fish transport should be evaluated conservatively. For example, if genetic similarity decreases with distance, arbitrary limits must be set on the distance a stock can be transported. For that reason, the Fish Transport Permit process is the prime regulatory tool in the genetic policy. *ADF&G is attempting to clarify some of the flexible guidelines in the revised policy by incorporating knowledge gained from recent studies of the population genetics of salmonids.*

The genetic policy also acknowledges that all salmon runs are not of equal importance. The effect of a salmon enhancement project depends to some degree on the relative value of the stock that might be impacted. However, the policy says that the concept of "significant stock" only relates to the size of a fish population in the context of local importance and use. A population that would be considered insignificant in size in one region, may be of vital importance in another region.

OPTIONS FOR POSSIBLE CONSIDERATION:

Although a report of recommended management actions resulting from the Cordova workshop is expected in late February, some preliminary options for consideration include:

- Evaluation of how well the current hatchery program protects wild salmon from possible negative effects of hatchery salmon. Such a review would help policy makers determine the risk of various alternatives for the future of Alaska's hatchery program.
- Increasing the amount of genetic monitoring required of hatchery operators, and directing ADF&G to continuously review and analyze resulting data statewide.
- Considering creation of genetic sanctuaries that are "enhancement free".
- Obtaining consensus about research priorities concerning the interaction of hatchery and wild fish in Alaska, coordinating future studies, and deciding how and when to apply the results of those studies to current management practices.
- Conducting research to define the minimum conditions for imprinting for remote release programs.
- Review of current and future programs for their compliance with the state genetics policy.
- Placing greater emphasis on management concerns in the permitting process in order to protect wild stocks.
- Re-examination of escapement goals in order to maximize wild productivity.

- Increased use of marking and tagging programs to monitor interactions between hatchery and wild populations.
- Policy development to minimize inbreeding and straying, including an evaluation of remote releases.
- Treating a remote release site as a de facto hatchery site in terms of broodstock and hatchery site guidelines, even if all fish are expected to be harvested.
- Identification of genetic population structures to determine what populations are genetically distinct.
- Survey of populations prior to any enhancement activity to provide a baseline for subsequent genetic monitoring. Evaluation of genetic consequences of hatchery production on adjacent populations during phased-in expansion, with production increases halted if adverse impacts are noted.
- Monitoring wild and hatchery stocks to determine extent of straying and intermingling.
- Continuing to build on cooperative UAF, ADF&G and hatchery studies of environmental factors affecting regional-level production of salmon in southeast, southcentral and western Alaska.
- Funding a joint state and federal workshop on salmon ecology in Prince William Sound, using recently released oil spill research.
- Conducting research to determine impact of salmon harvest on other species such as crab, sea lions, sea birds, etc., which may compete for same food sources.



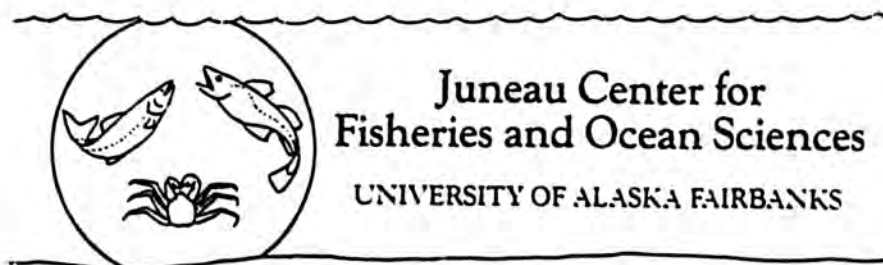
Biological Interactions of Natural and Enhanced Stocks of Salmon in Alaska

Interim Report from the Cordova Workshop, November 10-15, 1991

Editors

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I.
EXECUTIVE SUMMARY
O. A. Mathisen and G. L. Thomas

Genetic Considerations

It was agreed at the workshop that wild stocks in Alaska contain the genetic resources necessary for continued production of salmon under shifting environmental conditions. The Genetic Policy of Alaska¹ acknowledges that genetic diversity buffers biological systems against disaster, either natural or human-induced. There was almost universal agreement that maintaining genetic diversity both within and between local populations is essential for the long-term sustained production of Alaskan salmon.

A distinction must be made between preservation and conservation. In the strict sense preservation implies leaving everything untouched, which excludes enhancement activities, while conservation denotes enhancement, which is in conformity with the inherent characters of the stocks being enhanced.

The same basic principle of the importance of genetic variability (both within and between stocks) applies equally well to the management of hatchery brood stocks. Loss of genetic variability can be brought about by inbreeding and selection; the rate of loss can, however, be reduced using a large number of spawners and approximately a 50:50 sex ratio. To minimize impacts of hatchery fish on native stocks, phenotypic variation in brood stocks should reflect the variation observed in wild populations. However, this should not preclude that there may be opportunities to use genetic differences to avoid interaction between hatchery and wild stocks.

Homing and Straying

The homing ability of anadromous species leads to reproductive isolation of the various populations in their distinct environmental setting, which results in genetic adaptations to the local environment. Some hatchery fish with specific but different genetic characteristics will stray into wild populations. If they successfully interbreed with wild fish, the fitness of locally adapted populations may decrease.

Although the imprinting process is an important factor in homing, our knowledge about the imprinting process is still very limited. Additional studies are especially critical for species involved in remote releases.

Improperly imprinted fish tend to home less accurately. Introduced populations and salmon whose rearing history involves displacement or changes in water source often stray more than members of native stock and those released on-site.

The genetic impact of strays on local gene pools depends not only on the prevalence of straying and the mating success of the strays, but also on the differential survival of the populations. Because remote released fish may have a high straying rate, continuation of

¹Alaska Department of Fish and Game Genetic Policy. 1985. R. Davis, ed. Special Report of the Division of Rehabilitation, Enhancement, and Development. 25 p. (Appended to the Legislative Review of the Alaska Salmon Enhancement Program by the Senate Special Committee on Domestic and International Commercial Fisheries, Feb. 19, 1992.)

remote site releases without knowledge of the underlying biological processes may lead to loss of the original genetic diversity through undesirable gene flow from hatchery populations to wild populations.

Because of the potentially negative consequences, a funding base should be established so that appropriate research of these problems can commence without delay. At the same time, remote site releases should be limited until their effects on the adjacent wild stocks are understood and can be considered.

Ocean Carrying Capacity

Density dependent growth in the ocean or nearshore marine environment has been documented more exactly in recent years, especially for Bristol Bay sockeye salmon and Japanese chum salmon. In Japan the size of chums has been decreasing, and the average ages of the returning chums have increased in recent years.

For Alaskan pink salmon there is strong evidence that survival and final length or weight are largely determined by the growth conditions when the pink larvae reach the estuaries and while they continue to feed in inlets and nearshore waters. For sockeye salmon, it appears that final size is largely determined during the last months of ocean residence. The average length or weight of pink salmon decreased sharply in 1991, for both North American and Asian stocks. This coincided with record catches in the Far East, 216,248 metric tons or about 216 million fish, as well as large catches in Alaska, about 128 million fish. In an even year like 1992 the Far East catches will be down, and reduced catches are also expected in North America. The length or weight to be observed in 1992 should, therefore, contribute greatly to our understanding of the carrying capacity of the North Pacific Ocean for salmon.

Management of Mixed-Stock Fisheries

Pink salmon.—For pink salmon (*Oncorhynchus gorbuscha*) the most successful hatcheries are found in Prince William Sound, where returns range from 30 to 40 million fish. However, data presented at the workshop pointed out the need for larger escapements of the wild stocks in the region before these runs would reach their maximum productivity. In order to increase escapements, mixed stock fisheries must be reduced and enhanced stocks harvested closer to the hatchery. Such a management scheme could reduce the quality of the fish and the value of hatchery production.

If enhancement activities are conducted over broad areas, the risk of losing genetic diversity is increased. It might be suggested that new hatcheries be confined to restricted areas, at least until our knowledge of straying and the importance of genetic structures and variates has been expanded vastly.

Chum salmon.—Some chum salmon (*O. keta*) hatcheries have been very productive. Harvest of mixed stock fisheries at a high rate of exploitation, however, can result in an excessive harvest rate on the less productive stocks. Tagging or marking of enhanced and wild fish stocks or both chums and pinks followed by in-season test fishing can be used to design a harvest strategy to maximize harvest of enhanced stocks in mixed wild and enhanced areas while meeting escapement goals for wild stocks. Because chum salmon operations are smaller in scale than for pink salmon, interaction problems are not as visible. Chums deteriorate

rapidly in terminal areas, which makes large-scale chum enhancement projects difficult for optimizing effects.

Coho salmon.—For coho salmon (*O. kisutch*), as for all other species of Pacific salmon, the statutes and regulations are to manage for the natural stocks with enhancement as a supplemental tool. Most of the production of coho in southeast Alaska is from natural stocks; the average harvest of enhanced coho from 1986 through 1990 was 8.1% of the total harvest. Even though enhanced cohos represent a small percentage of the total production, similar concerns exist regarding straying and inbreeding, especially with projected future increases in the enhancement program. Other concerns, such as predation by coho salmon on pink salmon larvae and juveniles, are surfacing, although no conclusive research has been conducted to date. Coho smolts today are commonly released after the pink salmon larvae have left the estuaries, but the pink fry or juveniles may not leave the inshore area before July, which leaves ample time for predation to become a reality.

Since most coho smolts are tagged with coded wire, there are means available to study the changes brought about by expanded enhancement programs.

At the present time, the coho enhancement program appears to be meeting the original legislative intent of supplementing the harvest of coho salmon while not negatively impacting wild stocks.

Chinook salmon.—The chinook salmon (*O. tshawytscha*) is the least abundant but the most prized salmon species. Fifteen enhancement programs operate at the present time in southeast Alaska, but none were built on extant wild chinook streams. Four primary hatchery stocks, derived from regional wild stocks, are used. Movements of eggs between hatcheries are carefully regulated based on stock, disease history, and location of hatchery.

The small numbers involved—average harvest since 1985 has been only 19,590 chinooks or 10.2% of total production—seemingly have had no adverse effect. If numbers of enhanced chinook should increase, some interaction problems may arise, especially due to straying. It is noteworthy that although the production of wild chinook salmon in southeast Alaska is small, it is increasing.

Sockeye salmon.—Sockeye salmon (*O. nerka*) stocks are less enhanced than other species at the present time. There are several attempts to accelerate the smolting process for early releases to sea after 3 months or so in freshwater. Many large streams have populations of sockeye which migrate to sea after 3 months' rearing in the rivers or estuaries, but these races are not always used in sockeye enhancement projects.

In view of the anatomical and physiological changes taking place at time of smoltification, the early releases carry with them the possibility of improper imprinting and subsequent straying at time of return unless natural zero age sockeye are used for brood stocks (Ebbesson, abstract).

Atlantic Salmon

The Atlantic salmon (*Salmo salar*) has been under enhancement for 40 to 50 years in Norway and Sweden under two different regimes and with different results.

Large-scale enhancement of the Atlantic salmon commenced in Sweden in the late forties when most of the major streams were developed for hydroelectric power, thus eliminating most of the natural habitats. In order to compensate for this loss, one hatchery

was built for each stream and smolts were released only in the stream of their origin. This program proved so successful that the Swedish salmon stocks were not only maintained, but increased. In later years, an intensified high seas fishery has increased the total fishing mortality. The enhanced stocks have been able to tolerate it, but this rate of exploitation has placed an undue strain on the small remaining natural stocks of salmon, which are in decline. In spite of the success of their hatcheries, the Swedes are managing their salmon fisheries with primary focus and priority on natural populations, by attempting to bring the harvest back to the estuaries and eliminating the mixed stock fisheries. According to the Swedes, management without a primary focus and priority on natural populations is a serious mistake.

In order to satisfy the demand of its rapidly expanding pen farming of the Atlantic salmon, Norway allowed free import of smolts from a number of European countries and from any stream in Norway with a smolt surplus. What was not anticipated was the large number of salmon escaping from the farm pens, with the result that some rivers contain spawning stocks made up of 80% or more of cultured fish. Attempts are under way to create sperm banks in order to save what may be left of the original gene pool, if any.

Conclusions

As our knowledge of salmon increases, there is emerging a picture of an organism closely tuned to its environment as an integral component in a complex environmental system. Synchrony between stock characteristics and the environment requires working with the native gene pool and avoiding contamination from other sources. Early enhancement projects in Alaska did not pay enough attention to the origin of the brood stocks in order to get started, and a number of sources were used and eggs have been shifted around, especially for chinook and coho. So far there is little evidence of harmful effects, probably because of the low level of enhancements as well as our inability to measure the effect.

The contrast between what has happened in Sweden and in Norway contains some important guidelines for good and less desirable enhancement practices. It points out the need in new enhancement projects to work in conformity with the life history strategies of the enhanced stocks of salmon and not consider the most convenient procedures from a construction or operational standpoint.

II. INTRODUCTION

The Problem

Hatchery operations of salmon and trout have been in progress for more than a century in Europe, North America, and Asia. For a long time little effect was apparent on the natural stocks because the operations were small or were generally unsuccessful due to a lack of understanding of the reproductive process and survival mechanisms in salmonid species. In later years new knowledge and better techniques brought about major changes in salmonid enhancement programs throughout the world, especially in Alaska.

Non-profit hatchery operations and ocean ranching were legalized by the Alaska State Legislature in 1974. This occurred when natural production of salmonids was at low levels, which also coincided with cool ocean temperatures. The objective of the hatchery and ocean ranching programs was to supplement the production of natural fish during years of low abundance. In the beginning, enhancement was on a limited scale and not a problem, but in recent years with favorable survival conditions both natural and enhanced stocks have reached unprecedented levels of abundance. Further complicating matters has been a dramatic increase in the world supply of salmon. During the last few years the cumulative production of salmon has created such an oversupply that markets have been saturated and prices for some species have collapsed, profoundly affecting fishing, processing, and marketing of Pacific salmon.

The growth and success of the hatchery and ocean ranching programs has also created concern about the potential effects of enhanced fish on natural stocks of Alaskan salmon. Conflicts have arisen between the non-profit enhancement organizations and the State's regulatory agencies, who manage by protecting the escapement of natural stocks. The Alaska Legislature established this agency policy in order to protect wild stocks of Pacific salmon from potentially irreversible changes. Despite the magnitude of the enhancement programs and Alaska's mandate to protect wild salmon stocks, no environmental impact statement has been required for developing the enhancement programs.

In 1991 the Prince William Sound Science Center and the University of Alaska Fairbanks began planning a workshop on the biological interactions of natural and enhanced fish stocks in Alaska. The workshop followed four international symposia on hatchery and wild salmon interactions: (1) in 1990 at the Institute of Nature Conservation, Norway; (2) in 1991 at the Department of Fisheries and Oceans, Nanaimo, British Columbia, Canada; (3) in 1991 at the University of Idaho, Moscow, Idaho, and at Washington State University, Pullman, Washington, which was sponsored by NATO; and (4) in 1991 at the University of Hokkaido, in Hokkaido, Japan.

In the 1991 Alaska State Legislature, four study groups prepared background material on wild and hatchery interaction issues for a legislative examination and debate. The present workshop was independent of these legislative study groups, but complementary because of its focus on the *biological* questions related to salmon enhancement. For practical purposes in the workshop, salmon enhancement is used synonymously with ocean ranching, and pen farming, lake fertilization, or other indirect measures, such as habitat manipulation, were not addressed.

Goals and Objectives

In recent international scientific meetings the enhancement of salmon production has been challenged for its potentially detrimental biological impacts. Since Prince William Sound and southeast Alaska have significant salmon enhancement programs, it was thought appropriate to bring together a group of scientists and public to examine the biological basis for maintaining strong coexisting stocks of natural and enhanced salmon stocks in Alaska. This issue has raised specific concerns that are related to the effects of enhancement on the genetic composition, behavior, survival, and fitness of natural stocks, and the carrying capacity of the marine ecosystem. The goal of this workshop was to define the scientific basis for demonstrating a biological impact of enhanced salmon on natural stocks, the nature and magnitude of the impact, and identifying available and missing information. With this goal in mind this workshop examined (1) evidence, or lack of, that enhanced stocks are affecting the genetic composition and behavioral characteristics of natural stocks of salmon in Alaska, and (2) the potential for a limited ocean carrying capacity for rearing salmon.

III. THE PROCESS

The workshop was convened in Cordova, Alaska, from November 11 to 15, 1991, and was hosted by the Prince William Sound Science Center. The participants represented three categories: international experts, national experts outside Alaska, and experts from inside Alaska. The participants were asked to prepare abstracts, submit papers for publication, and bring information related to the workshop's goal and objectives. The public was invited to attend and participated in all phases of the process.

The workshop was organized into four primary sessions:

- 1) Genetic and behavioral characteristics of natural and enhanced stocks.
- 2) Ocean carrying capacity limitations on salmon rearing.
- 3) Mixed-stock management problems.
- 4) Case histories of natural and enhanced stocks.

A report was prepared for each section where the participants mainly relied upon their own knowledge and experience supplemented by the background papers presented at the beginning of the workshop. Time did not permit extensive analysis of individual salmon fisheries in Alaska. The conclusions reached and recommendations made should therefore be considered as the best advice this group could make at this time by pooling their combined experiences and wisdom accumulated over many years. In many cases it was impossible to make definite statements because of lack of knowledge and research. The only prudent course of action is a conservative approach to avoid making irreversible decisions in management of the state's renewable resources, which are the inheritance of all people of Alaska and not a few selected groups.

Following the workshop the conveners, Dr. Mathisen and Dr. Thomas, served as editors in assembling this report of the workshop and publishing individual papers in a peer-reviewed journal. As conveners we sought consensus, but in recognition of the complexity of this issue and the limited amount of information available for evaluating issues, where differences could not be resolved by the present level of understanding, we attempted to document the disagreement and suggest future avenues of research to resolve the disputes.

IV. RESULTS

A.

BIOLOGICAL INTERACTIONS OF WILD AND ENHANCED STOCKS OF SALMON IN ALASKA: GENETIC CONSIDERATIONS

*F. W. Allendorf, R. J. Everett, A. J. Gharrett, M. K. Glubokovsky, W. Jones,
T. P. Quinn, J. E. Seeb, W. Smoker, and F. M. Utter*

SALMON MANAGERS ARE STEWARDS OF A PUBLIC RESOURCE. They are obliged to conserve the genetic diversity of wild salmon stocks. This diversity is the insurance for the future productivity of the resource; this diversity is essential to the continuing survival of the resource. Managers are obliged to hold paramount the genetic diversity of wild stocks in any calculation of costs and benefits of salmon enhancement. Carrying out this obligation is difficult because despite convincing evidence for the genetic basis of stock diversity, science has inadequate knowledge of this diversity. In many cases there is convincing evidence of genetic structure which includes genetic differences among populations of salmon as well as differences within populations that relate to productivity. However, in many other instances knowledge is limited. In the absence of specific information, managers must assume that spawning populations are genetically distinct and that even within populations there are important genetically based differences.

Our recommendations for managing wild and enhanced stocks of salmon in Alaska to conserve genetic diversity reflect the collected knowledge of participants in the workshop.

Recommendation 1.—Follow the Alaska Department of Fish and Game Genetics Policy in all enhancement programs. Understanding of the conservation biology and genetics of salmon is advancing rapidly; therefore, it is important that the policy be reviewed by the scientific community frequently.

Recommendation 2.—Develop and use effective methodology to monitor the genetic makeup (genotype and phenotype) of natural salmon stocks and to measure the extent of introgression by straying fish. Monitoring should be continuous and a prerequisite of all enhancement projects and should focus on the parent stream used for broodstock and the most vulnerable neighboring streams.

Recommendation 3.—Develop and use the best available mark or tag technology (e.g., coded wire, otolith, genetic) to determine the extent of straying by hatchery and wild stocks.

Recommendation 4.—Treat all remote release sites as *de facto* hatchery operations. Increased straying is likely from releases at a distance from hatcheries and such releases should be evaluated accordingly. Monitor remote releases for straying and introgression into wild stocks and change practices or terminate the releases if introgression is observed.

Introduction

The central goal of salmon management, as trustee of the resource, is to conserve and stabilize productivity of fishery resources and increase them where possible. In this workshop Allendorf and Washington each presented historical examples that rapid expansion of

hatchery production coupled with increased exploitation rates usually results in the eventual collapse of the wild stock (option A, Fig. 1). In contrast, a more measured rate of increase can be sustained and, thus, is preferred in the long term (option B, Fig. 1). Option B shows the result of increasing production while also protecting the genetic integrity of wild stocks. It is difficult to resist the opportunity to maximize production in the immediate future. Nevertheless, history demonstrates that this is an unwise choice for a variety of reasons.

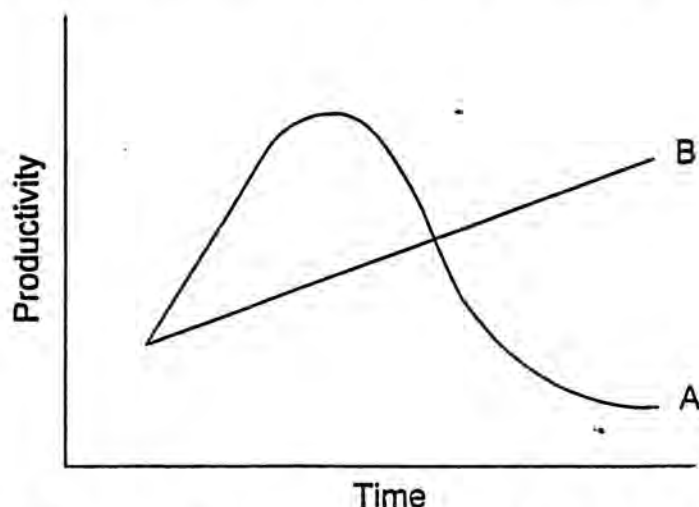


FIGURE 1.—Effects of maximizing immediate increase in productivity without regard to sustainability of the resource. Option A shows likely effect of the single objective of maximizing productivity. Option B shows likely effect of acting to increase productivity while safeguarding genetic resources.

For example, the abundance of coho salmon in the lower Columbia River, having been reduced by a period of severe overfishing below the hydroelectric dams, was greatly increased by the production of very few hatchery stocks. Enhancement was accompanied by greatly increased fishing pressure that, in combination with straying from hatchery stocks, has resulted in the extinction of wild stocks of coho salmon in the lower Columbia River. Washington (this workshop) added that the total catch of coho in the U.S. Pacific Northwest has decreased to less than 1 million fish since 1988 from an average of more than 2 million in the 1970s; this has been accompanied by a reduction of nearly 50% in the number of eggs per female since around 1970 in some hatcheries.

The Columbia River situation with coho and other salmon has been incorrectly labeled as "meat vs. museums." That is, we can either use the salmon as a resource or lock them up to preserve their genetic diversity. This characterization is untrue and dangerous; if we don't protect genetic diversity there won't be any resource to use in the future. A group of biologists at a recent workshop concluded that "sustainable increases in salmon and steelhead productivity in the Columbia River Basin can only be achieved if the genetic resources required for all forms of production, present and future, are maintained in perpetuity."

The genetic diversity of our natural stocks of salmon is the only insurance to protect fisheries resources in the future. In recognition of that fact, the Alaska Department of Fish

and Game (ADFG) developed its Genetics Policy in 1985. The policy is based upon the principle that the long-term productivity of Alaska's fisheries resources depends on the genetic resources necessary for continued production in an uncertain future. The team of scientists and resource managers, representing both the private and public sectors, wrote, "Certainly in Alaska, where wild stocks are the mainstay of the commercial fishery economy, it is necessary to protect these stocks through careful consideration of the impacts of enhancement activities." The authors recognized that in Alaska, hatchery production is meant to stabilize or augment wild stock production, not to replace it. The precedence of wild stock diversity must continue as the first principle in salmon enhancement in Alaska.

The ADFG Genetics Policy is based on the principle that diversity buffers biological systems against disaster, either natural or human-induced. In this report we discuss the biological basis for maintaining genetic diversity within and among local populations of salmon in Alaska. We discuss possible interactions between wild and enhanced populations and the importance of maintaining their genetic diversity, and make a series of recommendations to protect these important resources.

Interactions of Enhanced and Wild Populations

Hatchery supplementation of natural production of salmonids, which has been practiced for well over 100 years, has increased the harvest of salmonid fisheries in some instances. However, problems involving long-term survival and loss of diversity of wild stocks have arisen as a direct result of these practices. The conflicts are both genetic and nongenetic.

The genetic concerns are derived from the large number of distinct local populations that have arisen from the strong homing instincts of anadromous salmonids and the differential patterns of natural selection among rivers. Examples were presented by Allendorf, Everett, L. Seeb, J. Seeb, and Utter at the workshop. Reproductive isolation of these populations in their distinct environmental settings has resulted in genetic adaptations to the local environment. Examples were described by Brannon, Smoker, and Gharrett. As a result of both inadvertent and intentional unnatural selective pressures in the hatchery environment and bottlenecks, hatchery stocks often diverge genetically from their wild counterparts.

Inevitably, some hatchery fish will stray into wild populations (Quinn, this workshop). The genetic outcome of such straying is unpredictable. Hatchery fish that successfully produce progeny when they interbreed with wild fish (introgress into the wild population), may reduce fitness of the local populations. Reduced fitness may result from the displacement of locally adapted genes or the disruption of coadapted gene complexes (described by Gharrett at this workshop). Introgression can only be detected through genetic monitoring. Hatchery fish that do not successfully produce progeny when they interbreed with wild fish directly reduce the productivity of that wild population, and may—in the extreme—lead to its extirpation.

Hatchery practices may erode the homing precision of the enhanced populations, resulting in an increased tendency to stray into wild populations (as described by Quinn). It is important to emphasize that even a small straying rate from a large hatchery may produce a large number of strays in comparison to local wild stocks. If the number of strays is large enough, it will almost certainly overwhelm the native fish, regardless of any survival differential favoring the wild stock.

The return of large numbers of enhanced fish also can make conservation of wild populations difficult. In the absence of programs that monitor interactions of enhanced and wild fish, large numbers of hatchery strays can mask the decline of wild fish. Consequently, the estimates of escapement and returns-per-spawner made by fisheries managers may be inaccurate. Furthermore, behavioral interactions with hatchery fish may affect the migratory behavior of wild fish; a disproportionate abundance of hatchery fish may increase the likelihood of interception of wild fish near the hatchery.

The objective of Alaska hatchery management is primarily to stabilize and secondarily to increase the harvest. The difficulty is that hatchery stocks tolerate much higher exploitation rates than wild stocks. As a result, wild stocks mingling with hatchery fish during harvest may be exploited at intolerably high rates, significantly threatening genetic diversity. Such management conflicts should be addressed prior to development of a production facility.

There are a number of additional biological concerns related to hatchery and wild stock interactions. These include increased potential for disease transmission from hatchery to wild stocks, potential of competition for food resources which may be limiting particularly for young fish, and the attraction of more predators than normal.

Importance of Genetic Diversity Among and Within Stocks

The productivity (fitness) of a regional system of salmon stocks depends on variation among populations. It is likely, for instance, that different stocks may feed in different parts of the marine environment or may use an area at different times, as suggested by Brannon and Washington. A system that relies on a variety of stocks is more likely to take advantage of localized areas of abundant food and to avoid density-dependent effects of overpopulating such localized areas.

Similarly, Smoker and Gharrett pointed out that an important component of the productivity of a stock is the phenotypic variability for numerous traits such as size, age, migration and spawning times, or emergence times. Most such phenotypic traits have a significant genetic component. For a stock which faces unpredictable environments from generation to generation, genotypic and phenotypic variation in a population increases the likelihood that its members will distribute to different places and times where opportunities for food, growth, and survival may present themselves. Maintenance of genetic variation within a population is analogous to "bet hedging."

Geneticists are able to obtain biochemical genetic information with which populations can be characterized and often differentiated. However, these are very simple characters that usually have little effect on the productivity of a population. More critical to the production of a population are the much more complex life history traits. We are just learning which of these characteristics have important genetic components and how to identify and monitor those traits. With currently employed biochemical genetic techniques, science can document introgression of individuals and genes from one salmon population to another; however, we are not yet able to measure the effects of this introgression on population productivity.

Hatchery Broodstock Management

It is inevitable that enhanced fish will stray into wild stocks. Wild stocks close to the source of the enhanced fish will probably receive relatively more strays. Because it is not yet possible to project the effects of the interactions between enhanced and wild fish, proper hatchery broodstock management has a critical role in conservation of the genetic diversity of wild stocks. At the same time it has an important positive relationship to the hatchery stock.

The importance of genetic variability, both within stocks and between stocks, has implications both for donor stock selection and for the actual management of broodstocks. Donor stocks must be chosen judiciously to optimize their hatchery performance and minimize their effects on local wild stocks. Broodstock management practices in hatcheries can alter the genetic composition of a hatchery stock. The primary causes are inbreeding and selection, whether inadvertent or directed. Inbreeding which results from using too few parents can rapidly reduce genetic variability. Domestication selection, an unavoidable consequence of hatchery production or inadvertent selection of broodstock (e.g. for size or timing,) usually results in some loss of variability. Loss of genetic variability from inbreeding can be reduced by using a large number of spawners and approximately equal numbers of males and females.

Phenotypic variation in broodstocks should reflect variation observed in wild populations in order to reduce the effect of inadvertent selection. The broodstock should include an array of individuals that represent the extent of variation normally observed in a population, especially with respect to timing (migration, spawning, smolting, emergence), and size (and correlated traits such as fecundity, egg size, age). Even if the practice is inconvenient, hatchery broodstock managers should use spawners from the entire stock. Failure to do so is likely to cause the loss of the stock's valuable variety of traits. Particular practices that perhaps should be avoided are inadvertent selection for run timing (for example, using the earliest returns to ensure adequate egg numbers) and selection against jacks.

It is important that broodstock managers monitor the performance of the broodstock over the generations. Without a recorded history, changes will not be apparent. If changes are not apparent and understood, broodstock management practices cannot adapt to changes. At the least, the broodstock manager of a hatchery stock should monitor such fitness-related traits as timing of migration and maturation, size and age of spawners, and egg size and egg number in spawners.

Recommendations

Therefore, we recommend the following policies and activities.

Policies

1. *Abide by established genetic policy.*

The Alaska Department of Fish and Game, with public input, has developed a genetic policy. The policy was written to protect Alaska's valuable salmon resource. Wild stocks are the mainstay of the Alaska fishery economy; hatchery enhancement is meant to supplement but not to replace them. Hatchery programs must be carefully designed to

protect wild stocks, and all aquaculture programs, present and future, should be reviewed for compliance with the ADFG Genetic Policy.

2. *Assume that all local populations are genetically distinct.*

Unless otherwise indicated, spatially or temporally distinct spawning aggregations should be presumed to be reproductively isolated populations.

3. *Use best possible marking or tagging strategies to monitor interactions between hatchery and wild populations and the genetic "health" of wild and enhanced populations.*

Marking techniques might include coded-wire tags, otolith marking, genetic marking or other methods appropriate to the species and logistical constraints of the facility. Genetic marking would be especially valuable for monitoring introgression of hatchery stocks with natural populations. Genetic stock identification or other appropriate techniques should be used to facilitate in-season management of mixed-stock harvests.

4. *Remote releases of hatchery fish should be conducted in a manner that minimizes potential gene flow to wild populations.*

Remote releases have been identified as a source of heightened gene flow from hatchery populations to wild populations. The use of remote releases should be approached conservatively. Best available practices should be used to insure maximum imprinting. Juveniles for remote releases should be held for an appropriate amount of time for imprinting at a release site possessing a freshwater source devoid of conspecifics. A remote release site, even if designed for complete mop-up fisheries, should be considered to be a *de facto* hatchery site (see Genetic Policy for broodstock/hatchery site guidelines).

Activities

1. *Keep genetic policy current and pertinent to Alaska's resources and industry.*

2. *Describe genetic population structure to identify genetically distinct populations and to describe genetically distinct components within populations that may contribute to long-term stability.*

Traits examined should include life history, production, and molecular genetics. Populations should be surveyed prior to any aquacultural activity to provide a baseline for subsequent genetic monitoring. The genetic consequences of hatchery production on adjacent populations should be evaluated during phased-in expansion, and production increases should be halted at the first indication of adverse effect.

Local populations may consist of temporally or spatially distinct components that contribute to the productivity and long-term survival of these populations. This substructure should be identified and considered when making management decisions.

3. *Monitor wild and hatchery stocks for extent of straying and introgression.*

Long-term monitoring of genetic traits of adjacent wild populations should accompany any aquaculture program. Again, production strategies should be adjusted to eliminate any observed straying or introgression.

4. *Evaluate the homing of remote-released fish to make the practice as safe as possible.*

Evidence is accumulating that the remote release of salmon away from natal hatcheries can increase straying. Such remote releases are often advocated as production or management tools despite this increased risk. All remote releases should be treated in the same manner as releases from hatcheries and should be evaluated accordingly. They should be monitored for straying, and where straying is observed, for introgression into wild stocks. Remote releases should be planned conservatively and should be modified or terminated if introgression is observed.

B.
OCEAN CARRYING CAPACITY
R. T. Cooney

THEORETICALLY, POPULATIONS OF CONSUMERS IN MARINE ECOSYSTEMS exist in dynamic equilibrium with naturally occurring levels of food. It is generally believed that when environmental factors favor greater-than-average survival in a population, the biomass per individual will be reduced if forage populations limit growth. This density-dependent "effect" has been observed in historic salmon population data. For pink salmon particularly, but including the other species as well, the largest returns are generally composed of smaller fish, whereas the smaller runs are usually characterized by larger individuals (see workshop abstracts by Rogers, Eggers, Ida, and Percy). These size trends occur in both wild and enhanced salmon populations, but there are exceptions (Olsen, workshop abstract).

As enhanced stocks grow in response to improved culturing techniques and release strategies that favor greater survival, there will eventually be an upper limit to the ability of coastal, shelf, and oceanic ecosystems to support these stocks. In the past, nature has conspired to produce periods of greater or lesser wild salmon abundance in the Gulf of Alaska. These natural trends are now being augmented by ocean-ranched salmon in increasing numbers. In view of the success of ocean ranching in Alaska and elsewhere, it is not unreasonable to formally begin investigating what is presently understood about the carrying capacity of the ocean, and recommend actions that will improve this understanding before limitations on ocean growth are exceeded. Unusually small adult sizes of some species of salmon this past year (see abstracts by Olsen and Rogers) are indicators to some that the problem of sufficient ocean forage is more immediate than generally acknowledged. However, without information about the other factors that influence growth (temperature fields and migratory feeding patterns), alternative explanations cannot be ruled out.

Carrying Capacity Concerns

Production-related density-dependent growth leading to smaller-than-average sizes of maturing individuals is a concern for several reasons. Japanese ocean-ranched chum salmon have been declining in size and increasing in age at maturity over the past decade in concert with increasing hatchery production (Ida, workshop abstract):

	1975	1980	1985	1990
Adult age, yr	3.30	3.90	4.47	4.20
Mean weight, kg	2.42	3.39	3.54	3.12

These fish exhibit reduced condition factors and lower fecundity with smaller size, a distinct biological impairment. Pushed to the limit, unregulated hatchery production could theoretically produce very small fish with greatly reduced reproductive and market potential. Of perhaps greater concern is the effect that international ocean ranching practices may have on all salmon stocks (wild and hatchery) that use the northern Pacific Ocean as a feeding ground. Because there is competition for food and overlapping ocean distributions, greatly increased production by one or two countries could conceivably affect the growth conditions

for all stocks using the region. Moreover, it is not known what effect the increase in salmon production could have on the overall structure and function of coastal, shelf, and oceanic ecosystems. Salmon share forage resources with other consumers (fishes, marine mammals, and seabirds), some of which may be seriously disadvantaged by increased salmon abundance.

It is not known exactly how adult size is influenced by growth during each of the major life-history stanzas (early marine, oceanic or adult migration). Some contend that both size and abundance are determined by events occurring during the first 2-4 months of early ocean residence, perhaps due to competition occurring in large schools of juveniles. Other observations indicate that growth during the later stages of the oceanic migration (prior to spawning) most influences adult size. Rogers (workshop abstract) observes that for Bristol Bay red salmon, growth constraints are associated with the last year at sea, presumably resulting from dense schooling during the spawning migration. Clearly, understanding which variables influence adult size is fundamental to any long-term evaluation of salmon management and enhancement.

Workshop Recommendations

(1) In order to understand where growth reduction may be occurring, studies documenting the growth histories of individuals using scales, coded-wire tags and otolith structure are needed. The technologies for these studies are available and should be applied in long-term investigations of salmon and their feeding environments. Parallel but interacting studies are recommended, such as: (a) growth studies of juveniles and returning adults (in the escapement and/or commercial catch) to elucidate interannual and seasonal patterns of growth relative to the numbers of wild and hatchery salmon released and surviving to adulthood; and (b) studies of the growth environment of the fish to include nearshore distributions of wild and hatchery fry, temperature and salinity conditions, current patterns, and the kinds and abundances of forage stocks present.

When possible, mass marking techniques (thermal and other) should be used to identify ocean-ranched juveniles released from hatcheries. The ability to separate wild and hatchery fish will establish a powerful tool for comparing growth and survival during all phases of their life histories.

(2) Direct estimates of losses to predators have not been possible in most cases. Observations at some hatcheries suggest that large fish (cod, pollock, and other) and birds (terns, gulls) occasionally concentrate around net pens to feed on fry escaping or being released. However, beyond published accounts of salmon preying on other salmon (cohos on pinks and chums), very little information is available in the literature about the direct effects of other fish and bird predators. Furthermore, little is known about which other fish share food resources with juvenile and adult salmon. The problem of carrying capacity will eventually have to be addressed in terms of how matter and energy are distributed in food webs supporting the salmon. These food webs do not ignore other consumers in the system.

We recommend that all hatcheries keep records of the obvious occurrence of fish and bird predators each year. Casual observation suggests that predation pressure varies from year to year, and perhaps location to location. In addition, emerging technology in quantitative acoustics provides a highly efficient means to "survey" stocks of predators within

geographic regions. Information on the biomass and relative size of "targets" could be used to begin assessing variability in other fish populations.

We also recommend that field studies of juvenile and adult salmon feeding dependencies also collect food information on incidentally captured species to further our understanding of which other consumers share or compete for specific forage stocks.

Observations of recent marine mammal declines in the North Pacific (sea lions, fur seals) suggest, among other factors, that some major change in forage stocks is probably occurring. While the nature of these changes is not fully understood, any ocean-wide shift in forage abundance must be viewed as potentially interactive with the salmon portion of the ecosystem. We recommend that this broader phenomenon be followed closely for correlation with salmon production and adult size changes.

(3) It is generally believed that overall levels of salmon survival are set early in the life history of each species. This means the "critical period" occurs in the freshwater or nearshore coastal environments. We recommend that ongoing investigations, like Cooperative Fisheries and Oceanographic Studies (CFOS), designed to characterize the growth environment for juvenile pink and chum salmon each year in Prince William Sound, be continued and when possible, extended to other regions of Alaska. CFOS includes research contributions from the Alaska Department of Fish and Game and the non-profit hatcheries in the region and oceanographic observations and experimental studies from the University of Alaska (temperatures, current fields, meteorology, food field composition and energetics). An expansion of this study to other regions of the state as an Alaska Ocean Watch program would provide critical and now missing insight about salmon production responses to growth conditions experienced by juveniles each year.

CFOS is using satellite and RF-linked oceanographic buoys and satellite-sensed thermal and optical information of the northern Gulf of Alaska to characterize the coastal and shelf growth environment for salmon each year. These technologies are available and should also be applied to other regions of the state.

(4) An immense state- and federally-funded research program on salmon is now in its concluding phase in Prince William Sound as part of the damage assessment following the grounding of the Exxon Valdez in March, 1989. To date, only a tiny fraction of that information has entered the public domain. Because much of the research focused on the freshwater and early marine stanzas of resident salmon, that database is potentially of great value relative to questions about the carrying capacity of the region. The workshop recommends a speedy release of all data (salmon and other) so that the results of these studies can be examined from the perspective of wild and hatchery salmon growth and feeding dependencies on the region.

(5) The international scope of carrying capacity issues requires that questions concerning production limitation in the open North Pacific Ocean be pursued through multinational cooperative management and research programs. Open-ocean studies of salmon growth and ecology and the oceanic environment may need to be renewed if density-dependent growth and mortality is demonstrated from the oceanic (different from the near-shore coastal) phase of salmon life history. Jointly sponsored U.S., Canadian, Japanese and

Soviet investigations could address the broader question of oceanic food limitation on salmon growth in those parts of the North Pacific that serve as the major feeding regimes.

(6) Several large federally funded and mandated studies of the atmosphere and ocean, responding to questions about global change, have components in the North Pacific. These programs (like the World Ocean Circulation Experiment [WOCE], and the Coastal Ecology Program) will provide data that should contribute to a better understanding of nearshore ocean processes in relationship to the larger oceanic environment. The workshop recommends that, whenever possible, advantage be taken of these large-scale oceanographic and meteorological studies to build databases relevant to the issue of carrying capacity and wild and hatchery stock interactions in Alaska and elsewhere.

Summary

Workshop participants evaluated several examples where the time-series of the size of both wild and hatchery salmon in the Gulf of Alaska suggested that food-limited density-dependent modification of adult size is occurring. Although a theoretical evaluation of the effects of present levels of fry feeding (wild and hatchery) on forage stocks in Prince William Sound demonstrated only minor apparent effects (Cooney, abstract in this report), this assessment was based on several untested assumptions.

Workshop participants agreed that salmon production in the North Pacific at some as-yet-to-be-determined level will be limited by food stocks in coastal, shelf, and oceanic environments. The level at which this will occur cannot be predicted from present information. However, Japanese chum salmon appear to be approaching a size limitation that is seriously impairing their reproductive potential, condition factor, and market value. This has not been observed for wild or hatchery salmon in Alaska, although record or near-record returns of pink salmon to most regions of Alaska last year were characterized by unusually small individuals. Much smaller than average red salmon have been observed recently in Bristol Bay.

This workshop recommends several courses of action to establish a framework for monitoring the growth environment and sizes of Pacific salmon. These efforts will track the carrying capacity issue and provide information to the management and enhancement sectors for mitigative purposes should that become necessary in the future.

C. MANAGEMENT

Management of Mixed Stock Fisheries

O. A. Mathisen

THE BASIC PHILOSOPHY GOVERNING SALMON MANAGEMENT in Alaska is to separate the harvest by individual stocks. In practice this is difficult to achieve and there are all degrees of mixed fisheries. Until recently the high seas salmon fisheries intercepted large numbers of all species and stocks of North American and Asian origin. The next level of mixed fishery is harvest along the migratory path of adult salmon. A classical example is the False Pass fishery in western Alaska. There are many "cape" or outside fisheries both in southeast Alaska and Prince William Sound and elsewhere which operate on mixed stocks. Even in the estuaries of many large rivers fishing is on the mixed stocks belonging to that river or watershed or adjacent ones.

Mixed fisheries may not be detrimental as long as the different stocks have approximately the same survival rates. Otherwise the weaker races will decline with time. This is especially true in fisheries where enhanced stocks represent a strong and dominant component. If enhancement is successful the survival of the progeny to the larval or smolt stage is usually several percent higher than for the progeny from natural stocks, as demonstrated for pink salmon in Prince William Sound (Cooney abstract). Consequently, the fishing mortality which can be imposed on enhanced stocks for full utilization in a mixed fishery is higher than the natural stocks can sustain and they decline in numbers. This has happened in Sweden and Norway with the Atlantic salmon (Heggberget and Eriksson abstract), in the Columbia River and other Washington and Oregon coastal rivers for chinook and coho salmon (Washington abstract), and it may happen in Robertson Creek chinook hatchery in British Columbia if production there is expanded beyond its current level.

Larger escapements seem to be warranted for the natural runs of pink salmon in Prince William Sound according to the presented data (Eggers abstract), which implies that the present harvest rate on mixed stocks will have to be reduced to protect the weaker stocks of wild pink salmon.

Mixed stock harvest conflicts could have been avoided to a large extent if the planning process of enhancement installations had considered the distinctive biological requirements of the salmon populations being enhanced, and especially the timing of the returning adults. If enhanced stocks and natural runs overlap in space and time, mixed fisheries must be limited to an exploitation rate which the weakest of the natural stocks can tolerate while delaying the harvest of enhanced stocks until they reach the terminal areas. This of course is undesirable for pinks and chums whose truncated maturation process reduces their quality in the terminal areas. Thus, without sufficient biological criteria on the interaction of wild and hatchery fish, the management philosophy of "weakest run" provides at least a conservative if not the "best" criteria for predicting the limit for enhancement programs.

In other Alaskan fisheries, the chinook and coho fisheries of southeast Alaska, the harvest of mixed stocks is common rather than the exception. The absence of adverse effects is attributed to the relatively minor contribution of enhanced stock to the average harvest of

these two species, 10.2% and 8.1%, respectively, since 1985 (Amend, this workshop). Were these percentages to increase, the situation might change drastically.

There is no reason not to believe that the two factors, survival rate and abundance relative to the natural stocks, will operate differently for any species of salmon. Management of enhanced stocks therefore reverts back to setting a rate of exploitation in mixed fisheries compatible with what the natural runs can tolerate and harvesting the excess enhancement production in the terminal areas. Because of the deterioration of the quality of the fish during the maturation process in pinks and chums, the exploitation rate on the weakest natural runs in the mixed fishery will ultimately determine the limits of the production of enhanced stocks, if wild stocks are to survive and preserve their genetic integrity.

Another alternative is to manage for enhanced stocks. One might successfully argue for this in light of our success in domestication and hybridization of terrestrial animals. However, this involves the risk of losing the production of enhanced stocks, if a calamity like diseases should decimate them one year. It might be difficult to rebuild such stocks unless there are sufficient wild stocks left to restore production. Whether Alaska is ready to embark on such a management strategy requires a very careful and cautious analysis.

For the enhancement installations already in operation an acceptable management strategy is to monitor the harvest in mixed fisheries and determine the contributions from enhanced and wild stocks and regulate the exploitation rate so that the desired escapement of wild fish can be secured. But this is a costly process involving extensive tagging or marking experiments combined with thorough recovery programs. Unfortunately, no explicit funding exists in the state's management budget or in the operational budgets of the hatcheries for such undertakings.

In future enhancement projects some of the problems discussed above can to a large degree be avoided by judiciously selecting sites and broodstocks which are in conformity with the life history strategies of the stocks of fish being enhanced.

Harvest Management of Mixed Stocks of Enhanced and Wild Pink and Chum salmon

D. D. Bailey

AMPLE EVIDENCE EXISTS IN PACIFIC SALMON HARVEST MANAGEMENT that harvesting has occurred above their sustainable capacity. Hatchery production in many cases has been a response to low production caused in part by environmental factors aggravated by over-harvesting. Evidence also exists that wild stocks can be harvested beyond their sustainable capacity when mixed with the more abundant and more productive enhanced stocks.

Depending on their productivity, wild pink and chum stocks may be able to sustain harvest rates of 50-70% while enhanced stocks should be able to sustain harvest rates of 85-95%. In British Columbia where enhanced and wild stocks coexist, exploitation level is based on the lower wild stock productivity and often on the weakest stock. Additional harvest of enhanced stocks is then carried out in terminal harvest areas. This is the procedure used to manage the south coast of British Columbia chum stocks passing through Johnstone Strait.

Data on the productivity of wild stocks is important both annually and during the fishing season in order to adjust harvest to meet fixed escapement goals. In the above example pre-season estimates via test fisheries and catch sampling for marked enhanced stocks are critical for management to fixed escapement goals. Careful management is especially critical when productivity is low. Pink salmon productivity has been related to Gulf of Alaska air temperature (Tom Royer, pers. commun.), which would indicate that pink salmon production may be lower in the future. Changes in stream flows from logging on the watershed are also known to seriously reduce the freshwater productivity of wild pink and chum stocks. Harvesting the forests in Prince William Sound and lower marine survivals for all regions in Alaska have the potential to result in wide variability in wild pink and chum productivity.

In order to maintain or increase wild pink and chum populations while maintaining or increasing enhanced production and maximizing its harvest the following recommendations should be considered.

(1) Marking of enhanced and wild pink and chum salmon stocks, both juvenile and adult, could and should be used to design a harvest strategy to maximize harvest of enhanced stocks in mixed wild and enhanced areas while meeting escapement goals for wild stocks. Use this data during and after fishing season to estimate wild and enhanced components of the catch. Research into mass marking of juvenile salmonids should be funded.

(2) Institute test fisheries in various locations (catch to be used to pay for charter) throughout the fishing areas to evaluate their use in wild escapement management. Sample catches for marks. These charters could also be used for adult tagging for timing and migration studies.

(3) Study the freshwater productivity of wild stocks by estimating egg deposition and fry output in index streams. This is especially important if escapement goals are increased to determine if increased escapement results in higher fry output. This should also be carried out in streams before and after logging.

(4) Evaluate the effect of logging on egg-to-fry survival and spawning habitat capacity.

(5) Consider increasing the escapement goal to maximize wild productivity.

(6) Evaluate the timing and migration of wild stocks and use stocks which will minimize wild and enhanced mixed fishery interception.

(7) Evaluate future enhancement for site location and stocks selected to minimize wild stock interception. Manageability should be a major criterion in the permission process.

(8) Hold a small workshop of pink and chum management biologists from Alaska, British Columbia, and Washington to make recommendations for the management of enhanced and wild pink and chum stocks in Prince William Sound and southeast Alaska.

Can Wild and Enhanced Coho Stocks Coexist in Southeast Alaska?

D. Amend

THE ALASKA LEGISLATIVE MANDATE DURING THE DEVELOPMENT OF STATUTES and regulations for the Alaska enhancement program was to manage for the natural stocks while enhancing salmon to supplement natural production. The enhancement of coho salmon in southeast

Alaska started in the mid-1970s by the FRED division and the private non-profit operations started in the early 1980s. These programs have now matured and production has stabilized.

The average annual harvest of coho salmon from 1980 through 1988 was 1.71 million. The average harvest of enhanced coho from 1986 through 1990 was 8.1% of the total harvest, but the average in the future, based on current production, is expected to average about 16%.

Coho in southeast Alaska are harvested primarily by trollers but significant harvest occurs by the drift gillnet and seine fleets as a by-catch during the conduct of traditional fisheries. Although some coho are harvested from Canadian systems, most are produced from southeast Alaska systems. Because most of the coho harvested in southeast Alaska are from natural production, it is important to maintain the wild coho stocks.

Enhancement Strategy

The enhancement strategy in southeast Alaska follows three basic courses: (1) release from freshwater raceways as smolts into adjacent rivers, (2) release from marine net pens as smolts at remote locations following an imprinting period, and (3) release of fed fry into non-anadromous lake systems and the fish emigrate after rearing and smolting in the lake. Typically, broodstock were secured from local wild stocks and the fry reared in hatcheries located on non-anadromous systems which are not near natural producing stocks. Fish released as smolts are typically reared about 18 months in a hatchery, and the fish return after about 18 months at sea. Fish released as fed fry are reared to about a 1 gram size in the hatchery, but they complete the remainder of their life cycle similar to wild coho.

Threats and Concerns

There are both intraspecies and interspecies concerns. The intraspecies concerns include wild stock interactions due to straying or competition and management implications. Interspecies concerns primarily involve predation.

There have been no documented negative impacts of enhanced coho on wild coho in Alaska. Hatcheries in southeast Alaska are located on non-anadromous systems; therefore, the smolts do not compete with wild stocks in the freshwater phase after being released. Coho salmon imprint well to the site where they are released and there have been no documented straying problems. Consequently, there have been no documented genetic problems. Potential exists for future problems if hatchery stocks become inbred and significant straying occurs. Continued monitoring is required. In addition, research should better define minimum conditions for imprinting for remote release programs. Enhancement practices should continue to follow policies that would minimize inbreeding or increased straying.

The recent past average of 8% enhanced coho salmon in the harvest has not been a management problem. Even with production capacity at a maximum, the forecast is to average 16% of the harvest. All coho releases include a coded wire tagging program. This allows managers to account for the hatchery contribution to the harvest. Due to the low percentage of enhanced coho in the total harvest, there should be no future management concern. However, the coded wire or marking programs should continue to avoid potential problems of local abundance near hatchery sites.

The interspecies concerns are primarily coho smolts preying on pink fry and to a lesser extent on chum fry. The scientific literature well documents that coho smolts will eat pink fry and in preference to chum fry. In areas where there is a high abundance of coho smolts, the potential exists for the coho to have a significant impact on pink salmon populations. Whether coho are a limiting factor overall to pink salmon abundance is a much broader question which can only be answered by resolving the overall predator-prey relationship among all predators. The coincidence of coho and pink abundance cycles appears to argue against coho limiting pink abundance. However, this does not resolve the concern of high coho abundance near hatcheries where wild pink fry are migrating.

Several studies have been conducted in southeast Alaska to answer concerns about coho preying on pink salmon fry. The results were inconclusive. Pink fry were occasionally found in the stomachs of coho fry, but the problem could not be fully resolved. Early life histories of pink salmon fry showed that they typically spend a short time in the inter-estuaries and 90% of them migrate offshore by late May. In order to minimize the impact period, hatchery releases of coho smolts have been delayed to after June 1. Although this is not considered to be the optimum release time for coho (mid-May would be better), satisfactory survival rates for coho have occurred. This appears to be a satisfactory compromise in order to reduce the concerns of high abundance of hatchery coho negatively impacting pink populations.

Conclusions and Recommendations

Enhanced coho stocks can coexist with wild coho stocks as long as current policies and practices are maintained. Coho hatcheries should not be located on anadromous systems or near major coho producing systems. Hatchery practices should be followed to minimize inbreeding and practices which would increase straying should be avoided. The current level of production should not be a management concern but tagging programs should be maintained to resolve concerns of local abundance. Research is needed to better define the conditions for optimum imprinting and the predator-prey relationship between coho smolts and pink fry should be better defined. The coho enhancement program in southeast Alaska appears to be meeting the original legislative intent of supplementing the harvest of coho salmon while not negatively impacting wild stocks.

Can Abundant Wild and Enhanced Stocks of Chinook Salmon Coexist in Southeast Alaska?

W. R. Heard

CHINOOK ARE THE LEAST ABUNDANT SALMON IN ALASKA but are among the most highly prized and are often at the center of controversial fishery issues. Coastwise declines in the wild chinook stocks, especially in Washington, Oregon, and British Columbia, along with mixed stock ocean-troll fisheries in both countries, were among the major factors leading to the Pacific Salmon Treaty between Canada and the United States.

One reason for the focus on chinook in the treaty was oceanic migration patterns of many stocks that migrate in a northwesterly direction along the U.S. and British Columbia

coastlines. Many stocks of chinook become vulnerable to distant area fisheries. The troll fishery in southeast Alaska was especially important because it caught large numbers of non-Alaska chinook originating from southerly stocks. Among other things, the treaty called for limiting such interceptions of chinook between countries and states and for initiating a coordinated rebuilding program of depressed stocks along the coast. Other treaty provisions include a limited quota on numbers of chinook that could be caught in certain fisheries and an option for developing new stocks or groups of enhanced fish that could be harvested by the country or state of origin in addition to fish counted under the quota.

Chinook salmon hatcheries and significant related enhancement programs in southeast Alaska increased from two in 1976 to fifteen in 1990. New hatchery add-on provisions of the treaty were a major incentive for much of this development and the basic goal of this effort was to provide more chinook of local origin for southeast Alaska fisheries. The primary targeted user groups for chinook salmon in this region are the commercial troll and marine recreational troll fisheries.

Most hatcheries in the region were developed with principles to have minimal impacts of hatchery fish on endemic wild stocks of chinook. Alaska Fish Genetic and Pathology Policy statements were important guidelines for selecting chinook hatchery sites, brood stocks, and enhancement practices. Unlike chinook hatcheries in many other regions, none were built on extant wild chinook streams. Most are located on islands 50 km to 200 km distant from wild stocks that are, with one exception, on the mainland. Four primary hatchery stocks, derived from regional wild stocks, are in use in different parts of southeast Alaska. Three other stocks have been involved in supplemental enhancement of their depressed natal runs. Chinook brood stock selection for use in hatcheries and other enhancement efforts in this region is important because of differences in ocean migration patterns that result in different fishery contribution potentials for target fisheries. Upriver stocks from larger transboundary rivers (Taku, Stikine, Alsek) tend to have longer, more distant ocean migrations than stocks from shorter coastal streams. Movement of eggs between hatcheries is carefully regulated based on stock, disease history and location of hatchery.

A formal interagency chinook plan for the region, with an annual annex update, provides oversight guidance on hatchery and other chinook enhancement activity within the region. The Chinook Plan Team and Plan Annex also serves as an annual monitor of individual hatchery broods relative to stock performance, fishery contributions, and marine survival. Production from both hatchery and wild stocks of chinook salmon in southeast Alaska has steadily increased in recent years. Regional hatchery contributions to southeast Alaska fisheries have grown from an average annual catch of about 5000 fish (1980-85) to an actual estimated catch of 79,546 fish in 1991. After pre-treaty hatchery fish and risk factor adjustments are made, the hatchery add-on allowance for 1991 becomes 65,546 fish. One long-term goal of enhancement in southeast Alaska is to provide 100,000 add-on chinook to the commercial troll fishery. Total estimated escapements of wild chinook stocks in the region have doubled from an average of 43% of target goal (1975-80) to 84% (1986-90). Target escapement goals for several wild chinook stocks within the region are increasing as better knowledge of spawner distributions within river systems becomes available.

In view of the general increases in both hatchery and wild chinook production in southeast Alaska and taking into account the conservative approaches used in development of the chinook enhancement program, there do not appear to be major problem areas of adverse hatchery stock-wild stock interactions in this region. The only known possible exception involves small numbers of adult hatchery chinook recovered in non-natal areas. The majority of these known chinook strays have been recovered from areas without natural chinook runs, although a few hatchery fish have been found in some wild chinook streams. There is some concern for the specific stock presently used for hatchery and enhancement activity in the greater Juneau area because of the proximity of the Taku River and possibility of hatchery strays into that system. Steps are in progress to use a more suitable hatchery stock in this area. In other regions of Alaska where there are chinook hatchery and enhancement activities, including Cook Inlet, there also are no known major adverse enhanced stock-wild stock interactions.

Management of Mixed Enhanced and Wild Salmonids in British Columbia

D. D. Bailey

MIXED SPECIES AND STOCKS IN BRITISH COLUMBIA salmon management have been a problem since the Department of Fisheries first began to actively manage the fisheries. Overfishing, habitat destruction from forestry, industrial, and urban expansion, and poor marine survival all combined to seriously depress stocks in the 1960s and early 1970s.

The Salmonid Enhancement Program (SEP) was designed to double salmon catches in two phases starting in 1977 over a span of about 15 years. Fishery management plans were also devised to rehabilitate depressed stocks through conservation and enhancement. This paper will address enhanced and wild fishery management for chum salmon throughout British Columbia and for coho salmon in Georgia Strait.

SEP projects were planned to minimize species and stock management problems by selecting sites where terminal harvests were possible and where all stocks and more than one species were usually enhanced. Because of the high value of chum salmon roe in the late 1970s this species was the most enhanced in the early phases of SEP. Chinook were also enhanced because of the severely depressed state of many of the stocks. Species such as sockeye and pink salmon were enhanced at a lower rate particularly in the North and Fraser until international management treaties were negotiated.

SEP is still a bit player in enhancement with only 10% of the 1985 to 1989 mean catch of enhanced origin (Table 1). Except for chum at 33%, the catch of enhanced salmon for all other species is less than 15% of the total catch.

SEP has 11 major chum salmon facilities producing 90 million fed fry and 100 million unfed fry annually. Fed fry are produced from Japanese style hatcheries and unfed fry from spawning channels. An additional 5 million fed fry and 25 million unfed fry are produced from small facilities, mostly improved side channels.

TABLE 1.—SEP production, 1985–89 average.

Species	Total Catch (millions)	SEP Catch (millions)	% SEP	Technology
Sockeye	9.3	1.1	12	Lake fert./channel
Chinook	0.9	0.1	11	Hatchery
Coho	4.2	0.6	14	Hatchery
Pink	18.4	0.4	2	Hatchery/channel
Chum	4.3	1.4	33	Hatchery/channel
Total	37.1	3.6	10	

SEP chum enhancement maintains the genetic integrity of each stream and only releases fry into the stream of origin unless the stream is barren or has reached a very low level. It also attempts to utilize all portions of the run, although there is a tendency to enhance the early to middle portion of the run because of the tendency to ensure the project reaches its egg target. Because a hatchery works with a number of stocks, broodstock collection is a mix of enhanced fish and naturally spawning stocks.

Fishery Management of Enhanced Stocks

Pre-season estimates of returns for enhanced stocks are supplied by SEP to management biologists based on past survival of the enhanced stock and average age composition of return. Because of the high variability of survival and age of return, pre-season estimates are of limited reliability. In-season management through test fisheries and biological sampling are critical for management of enhanced and natural stocks.

At Pallant and Kitimat, where enhanced chum presently make up less than 20% of the total catch in the major fishing area (Table 2), total abundance of all stocks drives the fishing plan. Snootli chum were originally enhanced to buffer the high harvest rate on chum during the harvest of Area 8 pinks. Snootli hatchery has been so successful that its stocks make up only about 8% of the Area 8 chum escapement yet have risen to comprise 40% of the Area 8 chum catch. Harvesting of these enhanced stocks has increased harvest rates from the pre-enhanced average of about 8% to 76% between 1985 and 1989.

"Harvesting this very productive enhanced stock in the mixed stock traditional fishing areas at a high harvest-rate suitable for the enhanced stocks results in an excessive harvest rate on the less productive natural stocks. . . . The significant benefits of enhancement can be realized without serious loss of enhancement only if excess production is assessed through scientific index fisheries and harvested terminally to protect natural chum stocks." (Central Coast SSMP Report, DFO Internal Report 1991)

At Conuma and Nitinat, virtually all the chum stocks have been enhanced and the fishery is managed to achieve escapement goals for the mixed enhanced and wild stocks returning to the native streams. At both sites the fishery is conducted terminally with minimal interception of passing stocks.

Clockwork Strategy

In the Johnstone Strait Fraser River Study Area (i.e., all streams on the east coast of Vancouver Island and on the adjacent mainland plus the Fraser River) a plan was initiated in 1983 to try to rebuild the depressed chum stocks to historic levels in 12 to 15 years by limiting fishing to a predetermined harvest rate schedule. Wild escapement levels would be raised from the previous 10-year average of 1.2 million to 1.8 million in the 1983 to 1986 period and then in stages every four years to 2.5 million in 1995. For 1987 to 1990 the total stock would have to be greater than 3.0 million (i.e. 2.0 million wild escapement goal and 0.9 million enhanced production plus 0.1 million U.S. production) before fishing would take place. Depending on stock size, harvest rate could increase to a maximum of 40% when stock size was over 5.2 million (Table 2).

TABLE 2.—Clockwork harvest rate schedule for Johnstone Strait, 1987–90.

Wild Stock (millions)	Total Stock (millions)	Harvest Rate (%)
0–2.0	0–3.0	10
2.0–2.7	3.0–3.7	20
2.7–4.2	3.7–5.2	30
over 4.2	over 5.2	40

Early season (third week of September) commercial fisheries and all-season test fisheries in Johnstone Strait are used to estimate total run size. Analysis of mark returns from in-season sampling of chum catches is used to estimate enhanced production.

As a result of this strategy, harvest rates of East Coast of Vancouver Island chum (Puntledge, Big Qualicum and Little Qualicum) and Fraser chum (Inch, Chehalis, and Chilliwack) in Johnstone Strait totaled only 21% and 29%, respectively, from 1984 to 1989 (Table 3).

An additional terminal harvest for East Coast Vancouver Island stocks has raised harvest rates to 64% for these stocks. A minor terminal harvest in the Fraser River increased the total Fraser harvest rate to 35%. The late timing Fraser enhanced stocks have had a lower harvest rate because of a late timing component which misses being harvested. In 1985, a new strategy was put in place to select eggs from those portions of the escapement of the component stocks which migrate in the middle portion of the Fraser timing. Weather problems and market quality make late Fraser fisheries undesirable. Harvest of early timing Fraser chums conflicts with the valuable migration of North Thompson steelhead. We are just starting to evaluate the success of this strategy of selecting the mid timing.

As a result of these low harvest rates on Fraser enhanced chum excess escapements have occurred chiefly to Chehalis Hatchery. In 1989 Chehalis had a surplus of 27,000 chums. Because of the depressed nature of many of the stocks, these surpluses have increased the natural spawning escapement.

TABLE 3.—Production of enhanced chum salmon, 1984–89 total.

Hatchery	Catch Area	Enhanced Catch	Exploitation Rate (%)	% of Catch Enhanced
Pallant	Area 2E	273,656	54	20
Kitimat	Area 6	42,620	29	9
Snootli	Area 8	990,569	89	40
Conuma	Area 25	218,858	46	55
Nitinat	Area 21	3,099,608	74	72
ECVI	Johnstone Strait	627,539	21	18
	Area 14	1,341,795	44	70
	Total	1,969,334	64	
Fraser	Johnstone Strait	372,507	29	10
	Area 14	15,896	1	2
	Fraser	70,473	5	37
	Total	458,876	35	
ECVI + Fraser	Johnstone Strait	1,000,046	23	28
	Area 14			72
	Fraser			37
Total		7,053,521	65	

Georgia Strait Coho Problem

Declining coho stocks in the Strait of Georgia are believed to have been caused by overfishing and habitat loss. Currently, about 40% of the Georgia Strait troll and sport catch is made up of Canadian enhanced salmon. Exploitation rates have averaged 80% (1985 to 1988) compared to the 65–70% considered acceptable for wild coho stocks.

Management of the Georgia Strait coho stocks is complicated by the fact that they are harvested in troll, net, and sport fisheries, both inside and outside Georgia Strait. A consultation process has been occurring through which options for rebuilding can be developed and evaluated with all interested parties. These include habitat protection and restoration, enhancement, and harvest restrictions.

One of the most interesting proposals is for all hatchery fish to be marked and sport regulations would set a higher bag limit for marked than for unmarked fish. Wild fish would be conserved, while hatchery benefits would increase. Fewer enhanced coho would return to the hatcheries where their market value is low. The catch of enhanced Georgia Strait coho averaged 578,000 for the 1985 to 1989 period. Hatchery coho surpluses average approximately 100,000 for the same period. Commercial harvest limitation is complicated by the fact that many Georgia Strait coho are caught incidental to large sockeye, pink, and chum fisheries. Whatever options are chosen, the decision will not be an easy one.

D.

INTERACTIONS BETWEEN WILD AND CULTURED SALMON IN NORWAY AND SWEDEN

T. G. Heggberget and T. Eriksson

ATLANTIC SALMON SMOLTIFY AND LEAVE FRESHWATER at sizes between 12 and 17 cm. The smolt ages vary between 1 and 6 years, depending on growth conditions during the presmolt freshwater period. The salmon return to freshwater to spawn after 1–4 years, at sizes from 1 to 25 kg.

Some significant life history variations between stocks exist. Examples of variations between stocks are: timing of spawning, timing of emergence of fry, timing of smolt migration, timing of return migration, and age and size at maturity. Atlantic salmon in Norway are genetically distinct from the Baltic salmon.

Norway

In Norway there are three main sources of cultured fish (1) presmolt salmon released for general enhancement of stocks, (2) smolts released to compensate negative effects due to hydropower development and ocean ranching along the coast, and (3) escapees from pen farms along the coast.

There are about 500 streams with natural stocks of salmon in Norway. The production of farmed salmon in Norway was about 150,000 tonnes in 1991, while the natural production was about 2000 tonnes.

A number of problems have occurred. Due to pen farming activities a great number of farmed salmon have escaped and are now mixing with the wild stocks. Proportions of cultured fish in spawning populations have increased during the last decade, and now exceed 80% of the total number of spawners in some streams. Parasites and diseases introduced with import of smolts from other countries have been transferred to wild stocks with some dramatic effects; high mortality of wild salmon has occurred both due to the parasitic monogenean *Gyrodactylus* and due to furunculosis. Ecological interactions—for instance, competition during spawning and presmolt stages—between wild and cultured fish have been observed. Interbreeding may result in erosion of local adaptations in wild stocks of Atlantic salmon in Norwegian streams. As well, ocean ranching increases fishing pressure on wild stocks.

Several attempts to minimize the negative effects of interactions between cultured and wild fish have been or are being tried: conversion from pen farming to land-based salmon farming; minimizing numbers of strayers from ocean ranching to wild stocks; releasing in connection to rivers, not directly in the sea; harvesting ocean-ranched fish apart from wild stocks; releasing away from important salmon streams; emphasizing locally and regionally based salmonid aquaculture and not transporting live fish material between regions; and practicing effective and intensive health control of release material.

Sweden

The Baltic stocks of Atlantic salmon have been exploited by humans for many centuries. At the end of the 19th century salmon spawned in 60–70 rivers in the Baltic. From 1940

onwards many of the large salmon rivers were dammed and destroyed as spawning habitats. To compensate for the losses hatcheries were established at the rivers used for hydroelectric power production.

Several problems persist. Most of the natural populations have disappeared due to human activities in the rivers. Today between 80 and 90% of the catches in the fishery have a hatchery origin. The catches are dominated (80-90%) of offshore catches on mixed stocks and represent a high exploitation rate on wild stocks. Wild stocks are unable to cope with the present exploitation rate while the reared stocks can, due to high egg-to-smolt survival in the hatcheries. Thus only about 20-25% of the production potential in the natural rivers is actually met today. Management plans are proposed, including a reduction of the offshore fishery.

V. ABSTRACTS

A. GENETIC CONSIDERATIONS

Conservation of Salmonid Fishes: Why, What, and How

F. W. Allendorf

Three questions must be addressed before we can develop objectives and methods for conserving salmonid fishes: (1) Why should we preserve salmonid fishes? (2) What should we attempt to preserve? and (3) How should we conserve salmonid fishes? It is important to address the issue of why we want to conserve salmonids in order to unify our efforts and to obtain the resources that are necessary to do it. The question of what we should be preserving is an important and perhaps surprisingly difficult one. Loss of local salmonid populations is occurring throughout the world. We cannot halt this ongoing process; that is, we cannot conserve all local salmonid populations. Therefore, choices and compromises must be made. How do we best use our limited resources to conserve genetic diversity in salmonid fishes? Our first priority should be to protect extant wild populations and their habitat. The loss of genetic diversity is usually irreversible. Therefore, our primary efforts should be to prevent such losses.

Do Culture Conditions of Hatchery-Reared Salmon Affect Return and Straying of Adults?

S. O. E. Ebbesson

Available data indicate that caution should be exercised in rearing certain species of salmon under accelerated growth regimes; additional research is needed to determine if such regimens result in straying. We know from our experience in Alaska with accelerated rearing programs for chinook salmon, for example, that the result is significantly lower returns of adults and returns characterized by a high percentage of jacks. The reasons for this are unknown, but a better understanding of factors affecting smolt transformation and development in general are likely to lead to augmentation of current rearing strategies which will result in better developed smolts. Recent studies have revealed the importance of thyroid hormones on olfactory imprinting and development in general.

Studies comparing saltwater survival of yearling and zero-age coho salmon have showed differential rates of survival related to the timing of release into salt water and to the timing and extent of the plasma thyroid hormone surge. In a 1982 study by Dickhoff and others, about 5 times as many yearling smolts survived as compared to zero-age smolts. Those data, taken together with the information that the thyroid hormone surge (T_4) during smolt transformation in the zero-age fish was half the amplitude of the yearlings', indicate that in addition to poor survival as postsmolts, some zero-age fish may not imprint properly on the stream where they are released. The reason for that is that thyroid hormones play an

essential role in olfactory imprinting. Our studies on brain chemistry and brain circuitry changes during smolt transformation revealed sequential surges of select neurotransmitters before, during, and after the plasma T₄ surge. Irregularities in any of these surges may result in inadequate imprinting or lead to inadequate brain development, which in turn could affect subsequent behavior and survival.

There is to my knowledge no direct evidence for straying of zero-age fish, but research in this area should, in my view, be carried out before accelerated rearing programs are implemented.

Adaptive Importance of Genetic Infrastructure in Salmon Populations

A. J. Gharrett and W. W. Smoker

Genetic differences among populations of Pacific salmon are well known, both for neutral biochemical traits and to a lesser extent for quantitative, ecologically adaptive traits. This knowledge is the basis for present day genetic policy which seeks to conserve the genetic variation which underlies that variability. There is increasing evidence of adaptively important genetic variability within populations; that is, genetic infrastructure. In Auke Creek pink salmon, for instance, there is genetically based variability of timing of anadromous migration that is important to the survival of offspring. The adaptability and productivity of commercially important populations are dependent on that infrastructure and rational resource management should seek to conserve it.

Homing, Straying, and the Interaction Between Wild and Hatchery-Produced Salmon

T. P. Quinn

This paper reviews studies on the patterns of straying of adult salmonids from their river or hatchery of origin, with an emphasis on Pacific salmon. The prevalence of straying varies greatly among populations. In general, introduced populations and salmon whose rearing history involves displacement or changes in water source may stray more than native stock and those reared and released on-site. Normal hatchery practices do not necessarily increase the tendency of salmon to stray, although evidence indicates that this may occur. While a generalized estimate of the proportion of salmon that stray would be useful, none seems appropriate because rivers and hatcheries vary so greatly in their tendency to produce and attract strays. There is evidence that the offspring of hatchery-produced salmon may be less viable than those from local wild fish, hence straying between hatcheries and spawning grounds is cause for concern. Whether or not strays actually affect local gene pools depends not only on the prevalence of straying but on the degree of assortative mating and differential survival between populations. At present, fundamental gaps in our understanding of the genetic and environmental factors influencing straying hinder accurate prediction of the levels and consequences of straying.

Complementary Uses of Ecological and Biochemical Genetic Data in Identifying and Conserving Salmon Populations

F. M. Utter, J. E. Seeb, and L. W. Seeb

This paper addresses the need to define distinct population segments within species of salmonid fishes. The focus is on identifying the smallest detectable population with unique sets of characters (i.e., a "species" under the phylogenetic species concept); such units require identification prior to any subsequent groupings under which individual populations may ultimately be managed. The inability of stream distances between populations to identify ancestral discontinuities excludes such measurements as a basis for estimating relationships. The requirement for genetic information in distinguishing populations has been met through characters reflecting ancestral lineages (including adequate biochemical genetic surveys and some meristic information), and those reflecting local adaptations (such as timing of migration and spawning, and distinct temperature tolerances). These different types of genetic information comprise complementary data sets for distinguishing populations because they reflect different evolutionary processes and time scales. Within distinct ancestral groupings defined by biochemical genetic data (supplemented with some meristic information) may exist adaptively distinct populations that cannot be distinguished in the absence of life history and ecological information. Examples are summarized in which a logical process has been applied for distinguishing populations including an initial survey focusing on identifying ancestral groupings followed by a systematic search for adaptive distinctions within these groupings.

Genetic Stock Identification Study of Yukon River Chum and Chinook Salmon

R. L. Wilmot, W. J. Spearman, R. Everett, and R. Baccus

The United States and Canada opened negotiations in 1985 concerning the allocation of Yukon River chum and chinook salmon. Approximately 90% of the in-river harvest is by U.S. fishermen. An unknown proportion of this catch would have returned to the Canadian portion of the Yukon Drainage. In order to negotiate an equitable treaty between the two countries, it is necessary to determine what proportion of the U.S. harvest is of Canadian origin. In 1987, the U.S. Fish and Wildlife Service began a genetic stock identification (GSI) study in the Yukon River to address this problem.

Tissue samples were taken from 34 chum salmon populations and 30 chinook salmon populations and genetically characterized using enzyme electrophoresis. Nineteen variable characters were used to analyze the population structure of Yukon River chum salmon, and 22 variable characters in chinook salmon. Genetic separation between the summer run and fall run of chum salmon was very good as determined using simulations of stock mixtures of given contributions of each stock. Separation between U.S. fall run stocks and Canadian fall run stocks was also good. Estimates down to the stock level are not reliable for management purposes at this time. Resolution of an additional known 14 variable characters, and the use of mtDNA variation, may allow reliable estimates to the stock level. Genetic separation between U.S. and Canadian chinook stocks was very high as determined by simulations.

Separation was also very good for subgroups within both the U.S. and Canadian groups. Accuracy down to the stock level is substantially better for chinook salmon than for chum salmon, but is still not reliable for management purposes. Resolution of an additional 13 variable characters, and use of mtDNA variation, may allow discrimination to the stock level.

Samples have been taken from the mixed-stock fishery at the mouth of the Yukon River and estimates of stock contribution were calculated for the years 1987-90. Due to legal problems concerning management of the Yukon River fishery, these results will not be released until a thorough peer review of the data.

B.

OCEAN CARRYING CAPACITY

A Theoretical Evaluation of the Carrying Capacity of Prince William Sound, Alaska, for Juvenile Pacific Salmon

R. T. Cooney

Present levels of feeding on zooplankton resources by wild and ocean-ranched juvenile Pacific salmon in Prince William Sound are estimated to be between 1% and 4% of the annual macrozooplankton production in the region. When annual fry losses to early ocean mortality are taken into account, the feeding demand associated with growth rates averaging 3-4% of the body weight per day fall to 0.4-1.6% of the total herbivore production and 1.5-5.0% of the macrozooplankton production. Uncertainties associated with the numerous assumptions used in this analysis are discussed in relation to what is understood about the biology and ecology of salmon in Prince William Sound and elsewhere.

Density Dependent Changes in Chum Salmon, *Oncorhynchus keta*, Returning to Iwate Prefecture, Japan

H. Ida

In the last two decades in Iwate prefecture, Japan, hatchery operations were prolonged in order to overcome several problems: (1) to reduce natural mortality in early life stages, (2) to supply food for increased numbers of fry from hatcheries, and (3) to adjust the time of release from the hatchery, where fry hatch much earlier than in the natural beds because of higher temperature of incubating water in the hatchery.

Release after feeding of chum fry started in the early 1970s in Iwate, and the method prevailed throughout the prefecture in the later seventies. In addition to this feeding in freshwater, feeding of fry in cages set close to shore started in the early eighties. The rate of return of adults to Iwate for brood year 1970 was 0.82%; for 1975 it was 1.52%; and for 1985, 3.50%. Thus, the rate of return increased serially. In the earlier stages of this change, feeding or prolonged hatchery operations seemed to accelerate maturation, especially in males; the number of precocious 2-year-old males ("jacks") reached 25-30% in some rivers. There was a tendency toward decreased mean age and mean size, but this lasted only a few years.

Size of fry at the time of release was increased from about 1 gram in the 1970s to several grams in the early 1980s. Mean age and weight of adults returned were as follows.

	1975	1980	1985	1990
Mean age	3.3	3.90	4.47	4.27
Mean weight (kg)	3.42	3.39	3.54	3.12

On the whole, the effort of raising chum fry up to a certain size seemed to increase the survival rate of their early life history stages in coastal areas. At the same time, the number of fry released from Iwate prefecture increased from 30 million in 1970 to 400 million in 1990. Both of these efforts accelerated the biomass of chum salmon originating from Iwate, and as a result growth was stunted and the mean age at maturity was increased.

Factors Affecting Marine Growth of Bristol Bay Sockeye Salmon

D. E. Rogers and G. T. Ruggerone

Growth of Bristol Bay sockeye salmon in freshwater and in the last few months at sea, had been shown to be dependent on their density (higher density, poorer growth) and temperature (colder temperature, poorer growth). In both 1990 and 1991, the sockeye salmon returning to Bristol Bay was unusually small; i.e., for a given age and sex the fish were smaller than expected from the number of fish in the run and the prevailing spring temperatures. The pronounced increase in North Pacific salmon catches in recent years combined with the small size of sockeye in Bristol Bay prompted a reexamination of the factors influencing marine growth. We estimated the annual runs of sockeye and chum salmon in the North Pacific (central and western Alaska plus Asia) and compiled air and water temperature statistics for southwestern Alaska from 1952 to 1991. We estimated the annual mean lengths and weights of adult sockeye in Bristol Bay runs during 1959-91 and marine growth was estimated from scale measurements on samples from Nushagak sockeye catches during 1959-89. We used data plots, linear correlation, and step-wise multiple correlation analyses to relate the various measures of abundance (Bristol Bay, western Alaska, Asia, sockeye and chum) and measures of temperature (air and water for various monthly combinations).

The inclusion of numbers of sockeye and chum salmon from other areas did not improve on the inverse correlation between numbers of Bristol Bay sockeye and the mean lengths in the run. The inclusion of sea surface temperatures during late winter improved the multiple correlation (only April-May had been used before); however, the overall correlation with Bristol Bay lengths was poorer with the addition of the 1990 and 1991 observations. Scale radii measurements of Nushagak sockeye during each year at sea (1956-88) indicated that growth was positively related to temperature during the first (ages 1.2 and 1.3) and second (age 1.3 only) years at sea. Growth during the last year at sea of age 1.2 and 1.3 sockeye was not correlated with sea surface temperature nor salmon run size. Scale growth during the first and second years at sea was not correlated with adult length; however, growth during the third year (age 1.3) was positively correlated with adult length. These data indicate that abundance of Bristol Bay sockeye most affects their growth in the final months before their return, which is a time when they are probably most concentrated.

Table: PWSAC Adult Pink Salmon Weight Relative to PWS Return

J. Olsen

PWS PINK RETURN	YEAR	AFK		WNH		CCH	
		LB.S	KG	LB.S	KG	LB.S	KG
15,723,637	1980	3.30	1.50			?	?
22,085,837	1981	3.50	1.59			?	?
23,051,963	1982	3.20	1.45			?	?
16,696,998	1983	3.00	1.36			?	?
26,476,567	1984	3.40	1.55			?	?
28,254,589	1985	3.30	1.50			?	?
12,771,529	1986	3.40	1.55			?	?
31,544,027	1987	3.60	1.64	3.65	1.66	?	?
13,126,476	1988	3.10	1.41	3.48	1.58	?	?
24,157,149	1989	3.30	1.50	3.45	1.57	3.65	1.66
43,831,188	1990	3.00	1.36	2.99	1.36	2.97	1.35
38,354,826	1991	2.40	1.09	2.33	1.06	2.43	1.10
	1992						
	1993						
	1994						
	1995						
	1996						
	1997						
	1998						
	1999						
	2000						
	AVG						
24,672,899	1980-91	3.21	1.46	3.18	1.45	3.02	1.37
	1980-90	3.28	1.49	3.39	1.54	3.31	1.51
	MIN	2.40	1.09	2.33	1.06	2.43	1.10
	MAX	3.60	1.64	3.65	1.66	3.65	1.66

Regression Output:

Constant	3.51
Std Err of Y Est	0.31
R Squared	0.14
No. of Observations	12.00
Degrees of Freedom	10.00
X Coefficient(s)	-0.00001
Std Err of Coef.	0.00001

Interactions and Environmental Carrying Capacity Limitations of Natural and Artificial Stocks of Salmonids

P. M. Washington

Artificial propagation of salmonids has been practiced for more than a century. In theory, this practice allows the production of almost unlimited amounts of fish. The practice was developed and used to mitigate losses of smolts formerly produced in natural habitats, and evolved to reduce the high mortality during the early freshwater life of anadromous salmonids. Stocks used in hatcheries were homogenized to produce more easily handled fish. Short pulsed hatchery runs currently provide the basis for many coastal net fisheries.

Artificial facility releases can produce yields of salmonids up to ocean carrying capacity. Oceanic salmonid yield potential is limited by both density-dependent and -independent factors. Monoculture has produced localized density limiting production, but actual production limitation may not be approached until the use of all niches and niche subsets approaches maximum.

Fisheries precluding individual stock management should be terminated before extinctions of wild stocks result. Harvest policies can no longer be to the detriment of wild stocks. Artificial propagation based policy has reduced genetic diversity, manipulated adult size and age downward, and had profoundly negative impacts upon wild stocks.

C.

MANAGEMENT

Overview of Salmon Enhancement Programs in Southeast Alaska

D. F. Amend

All five of the Pacific salmon species are being enhanced by hatcheries in southeast Alaska. Non-hatchery enhancement is not included in this report. Hatcheries are operated by the FRED Division of the Alaska Department of Fish and Game, the Northern and Southern Southeast Regional Aquaculture Associations, and private non-profit corporation. Hatcheries played a minor role in the commercial harvest prior to 1985. Since 1985, the average annual harvest of enhanced chum salmon has been 695,700 (31.2%), chinook 19,590 (10.2%), coho 195,650 (8.1%), sockeye 58,480 (2.4%), and pink 475,000 (2.1%). At full production the percentage of enhanced salmon in the commercial harvest is expected to be about 66.4% chum, 32.5% chinook, 18.2% sockeye, 16.2% coho, and 5.8% pinks. The annual value to the commercial fleet has averaged \$8.4 million annually and at full production is expected to average \$36.8 million annually. The annual 3% enhancement tax paid by fishermen has averaged \$2.39 million. Cost recovery is conducted only by the two regional aquaculture associations and the private non-profit corporations. The annual revenue generated from cost recovery is estimated to be about \$2 million.

The Perpetual Oversight of Hatchery Programs

E. L. Brannon

A major concern of fisheries biologists and managers has been the perception that hatchery fish are inferior to wild fish, and the belief that hatchery fish tend to degrade natural populations. These perceptions are not without foundation, but the problems are the fault of how we have managed hatcheries, and not with either concept or the potential which hatcheries can offer. The perpetual oversight that we have demonstrated consistently throughout our history of fisheries management has been to ignore the fact that fish populations are an integral component in a complex environmental system. If we neglect the requirements that populations have, and hence the traits they possess to synchronize their life history with specific environmental constraints, failure is guaranteed. Although appropriate technology is the key in producing healthy fish, the absolute critical component for success of the hatchery concept is the seed stock used for propagation. Synchrony between stock characteristics and the environment cannot be sacrificed, which means that every possible effort must be extended on working with the native gene pool and avoiding contamination from other brood sources. Adherence must be given to the stock concept in the use and management of hatcheries.

Trends in Abundance of Hatchery and Wild Stocks of Pink Salmon in Cook Inlet, Prince William Sound, and Kodiak, Alaska

D. M. Eggers, L. R. Peltz, B. G. Bue, and T. M. Willette

Trends in pink salmon (*Oncorhynchus gorbuscha*) abundance, production, and average weight of hatchery and wild stock catches, were examined for the years 1960 through 1990 for the lower Cook Inlet, Prince William Sound, and Kodiak Island areas. The abundance of wild pink salmon was the sum of wild stock catches and escapement, which were aerial survey index counts expanded by estimates of stream life. Abundance of hatchery stock was the sum of the estimated contribution of hatchery stocks to catches and the returns to the hatchery. Production estimates were based on hatchery stock returns from fry released at the hatchery and wild stock returns from parent escapement. Hatchery runs have increased greatly since the late 1970s and currently exceed wild stock runs. The total central Gulf of Alaska runs of pink salmon have increased and average weights have decreased since the early 1970s. Since the construction of hatcheries, wild pink salmon runs in Kodiak and Cook Inlet have not declined; however, in Prince William Sound a marked decrease in wild stock runs has coincided with the increase in hatchery runs. Return per spawner for wild stocks and survival of releases for hatchery stocks were similarly affected by ocean temperatures. The recent decline in Prince William Sound wild pink salmon runs is believed to be the result of lower wild stock escapement levels due to the heavy exploitation of weak to moderate wild stock runs.

Gene Frequencies, Risk Assessment, and the Management of Hatchery Production of Pacific Salmon

J. E. Seeb

The legislative mandate of the Alaska Department of Fish and Game (ADFG) is the "enhancement and development of all aspects of the state's fisheries for the perpetual use, benefit and enjoyment of all citizens" (Alaska Statutes Title 16). The legislature accompanied this mandate with the requirement that enhancement of crucial native stocks should only be undertaken if careful consideration indicated that they can be conserved in the presence of hatchery management (Title 16; ADFG Genetics Policy).

Native stocks of salmon are important because they not only are the mainstay of the Alaska fisheries economy, but they also represent thousands of years of adaptive evolution. Reproductive isolation, through homing, leads to between-population genetic differences. This component of genetic variation is responsible for adaptive fitness to diverse environments, a factor which permits different stocks of salmonids to thrive under different environmental regimes; and it is the factor that provides for optimal sustained production of wild stocks given the vagaries of environmental variation.

Hatchery production of enhanced fish can relax many of the pressures of selection on a population. While such a stock may thrive in a hatchery and produce fish for harvest, after several generations it may lose some of the genetic traits that made it optimally fit for response to the natural environment. Thus it is important that hatchery fish only be used to truly enhance harvests, and they must be kept from replacing the important wild stocks from which they were derived.

Of paramount concern (this symposium) is the loss of genetic integrity of the isolated salmon populations that can result if hatchery practices lead to increased straying of hatchery fish (and their interbreeding with the native populations). As a part of its effort to protect wild stocks, ADFG is conducting (and proposing) genetic research such as: (1) genetic stock identification (GSI)—genetic screening to determine stock boundaries, provide GSI data to identify hatchery and wild stocks in mixed stock fisheries, genetic marking to monitor straying of hatchery fish; (2) risk assessment and genetic monitoring—evaluation of the genetic consequences of new or increased hatchery production during phased-in expansion, monitoring of changes in fitness and possible effects on wild stocks, conducting long-term monitoring of hatchery and wild stock genetic diversity, modifying hatchery strategies if called for; and (3) use of best possible breeding practices to maintain fitness and genetic variability.

The ADFG believes that this recommendation of a conservative hatchery management strategy incorporating genetic monitoring will facilitate responsible development of the fishery resource. Strict adherence to this strategy will help ensure that hatchery enhancement does not cause any genetic alteration resulting in the loss of these important wild stocks.

Population Genetic Structure of Chum Salmon: Identification of Wild and Hatchery Fish in Mixed Fisheries

L. W. Seeb

The control and management of mixed-stock harvest of chum salmon is one of the most difficult problems facing salmon managers today. Interception of chum salmon exacerbates allocation issues and may contribute to conservation problems in certain areas. Genetic stock identification (GSI) is the primary tool which is being implemented to address these mixed-stock interception issues. Through GSI analyses, scientists can identify the origin and amounts of the different stocks harvested in mixed-stock areas. These values can be used both in-season and post-season to insure conformance to international treaties, to allocate future harvests by nation and user group, or to separate hatchery from wild stocks. They can also be used to adjust harvest areas or times to protect important depleted stocks, the extinction of which would represent an irreversible loss of distinct population segments of the species.

Genetic data from chum salmon have been collected for over a decade by many state, federal, and provincial agencies along the Pacific Rim. These data show that chum salmon subdivide genetically not only into large regional groups, but also one a finer scale into local genetic races. Federal and state agencies have invested considerable resources in the collection of data from stocks originating from Washington, southeast Alaska, Russia, and Japan; the Canadians have likewise gathered extensive data from British Columbia populations. Yet, with the exception of stocks inhabiting the Yukon River and Bristol Bay, no database currently exists for the remaining Alaskan stocks which comprise approximately 40% of the chum salmon production of North America. Many of these stocks have not been sampled because they inhabit remote areas difficult to access. The Alaska Department of Fish and Game has placed a high priority on obtaining genetic data from these stocks.

Further development of the Prince William Sound chum salmon genetic database would allow for identification of wild stocks adjacent to hatchery installations. The current chum salmon broodstock in Prince William Sound is a heterogenous group originating from multiple sources and timings. The effect of hatchery stocks on the wild stocks within Prince William Sound could be monitored through GSI techniques to insure the continued health of these important wild stocks.

D.

ATLANTIC SALMON

Status of Wild and Hatchery-Propagated Swedish Salmon Stocks After 40 Years of Hatchery Releases in the Baltic

T. Eriksson and L-O. Eriksson

The Baltic stocks of Atlantic salmon have been exploited by humans for many centuries. Especially during the last century, salmon populations have been subjected to dramatic changes in spawning stream access, fishing patterns, and fishing pressure.

At the end of the 19th century salmon spawned in 60-70 rivers in the Baltic proper. From 1940 onward, many of the large salmon rivers were dammed, most of them below the lowest spawning rapids for salmon. Methods for rearing salmon up to the smolt stage were developed and the first smolt releases were around 1950. The number of smolts released in Swedish rivers gradually increased to between 2 and 2.5 million by the middle of the 1980s. During the last 10 years other countries have started salmon release programs, resulting in an annual release of about 3 million smolts. The smolt releases have been successful, showing high survival rates of stocked fish. Today, only about 20 rivers, most of them in Sweden, are attainable for natural spawning runs. The runs are very weak.

Before the second world war the Baltic salmon fishery mainly consisted of coastal and river catches of spawning migrators ascending the rivers. After the war an offshore drift gillnet fishery developed, nowadays making up the major part of the total catch. As a consequence, the spawning runs of wild salmon have decreased dramatically. One hundred years ago the natural production of salmon smolts from the Baltic salmon rivers was around 7-8 million smolts annually. In the early 1970s the wild smolt run to the Baltic was about 2 million. At present, only about 0.5 million wild smolts are produced to the whole Baltic proper, which is only about 20% of still remaining smolt production capacity of the rivers.

The offshore fishery on mixed populations in the central areas of the Baltic proper leads to an extremely high fishing pressure on the Baltic salmon stocks. Wild stocks are unable to cope with the present exploitation rate. As a result, the number of wild spawners in natural streams gradually diminishes. In the absence of a compensatory program, a reduction in stock size of the magnitude shown by wild salmon in the Baltic would decrease catch per unit effort to such a degree that a salmon fishery would be meaningless. At present, however, about 90% of the salmon smolts leaving Baltic rivers are of hatchery origin. Depending on extremely high egg-to-smolt survival rates the reared stocks can withstand this high exploitation. It is concluded that the success of hatchery enhancement programs in combination with the lack of effective regulations allowing a high catch per unit effort in the offshore fishery, explains a major part of the sad fate of the remaining wild salmon stocks in the Baltic.

A biologically sound management program for the Baltic salmon is bound to include a stop (or strict regulation) of the offshore fishery on mixed stocks. Salmon stocks should be exploited in relation to the carrying capacity of individual populations, by a more terminal fishery at the coast, or in rivers.

However, an established offshore fishery in the main Baltic, including (at least) seven nations, has so far made any kind of regulations difficult. A recent and, hopefully, more accessible management program is a compromise, suggesting a ban on salmon fishing outside 24 nautical miles from the coast. The fishery closer to the coast will be supported by net-pen delayed releases of salmon at selected areas along the coast of the Baltic main basin. The proposed offshore fishery regulation would increase escapement considerably, while total catch (in tons) would remain unchanged. If the proposal is accepted, we estimate that most wild salmon stocks would have a possibility to recover within 3-4 generations. If not, we believe that the fate of all the wild salmon stocks in the Baltic is extinction within a few additional salmon generations.

**Interactions Between Wild and Cultured Atlantic Salmon:
A Review of the Experience in Norway**

T. Heggberget

About 500 streams in Norway support Atlantic salmon. Most of the Norwegian salmon populations are characterized by small numbers of fish. Physical conditions, for instance water flow and temperature regimes, vary significantly along the Norwegian coast. Analyses of age and size at maturity, timing of spawning, and timing of smolt migrations clearly support the hypothesis of ecological adaptation to different physical environments. The differences in life history patterns are results of different selection pressures on salmon under varying physical conditions.

Proportions of cultured salmon have increased together with the rapid growth of the Norwegian salmon farming industry, and a maximum of 80% cultured fish in spawning populations have been observed. The sources of cultured salmon in Norwegian streams are fish released for general enhancements of stocks, ocean ranching, and escapees from the fish farming industry. Escapees from closed pen operations are the main source of cultured fish in nature.

The most striking effect of the increasing numbers of cultured fish so far has been the introduction of parasites and diseases. In recent years more than 30 populations of salmon have been completely wiped out by the monogenean *Gyrodactylus*, and high mortality of adult salmon due to furunculosis has been observed in some streams. The long-term effects of genetic interbreeding might result in extra mortality of wild fish due to erosion of local adaptations.

VI. ACKNOWLEDGMENTS

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**VII.
AGENDA**

**Workshop on the Biological Interactions of Natural and Enhanced
Stocks of Salmon in Alaska**

Saturday, November 9

Participants arrive during the day.

Sunday, November 10 *Open to the public*
First Morning Session - 8:30-10:00 a.m.

Opening remarks:

1. Gary L. Thomas, Director Prince William Sound Science Center
2. Goals of the Conference - Ole A. Mathisen, Univ. of Alaska-Juneau
3. Prince William Sound Aquaculture Corporation - John McMullen, President
4. State Genetic Policy - James E. Seeb, Alaska Dept. of Fish & Game

Session 1 -- Ocean carrying capacity
10:30-12:00

1. *A theoretical evaluation of the carrying capacity of Prince William Sound, Alaska for juvenile Pacific salmon.* R. Ted Cooney, School of Fisheries and Ocean Sciences, University of Alaska, Fairbanks
2. *Density dependent changes in chum salmon, *Oncorhynchus keta*, returning to Iwate Prefecture, Japan.* Hitoshi Ida, Kitasato University School of Fisheries Sciences, Sanriku-cho, Kesen-gun, Japan
3. *Factors affecting marine growth of Bristol Bay sockeye salmon.* Donald E. Rogers, Fisheries Research Institute, University of Washington, Seattle, Washington
4. *Interactions in natural carrying capacity limitations for natural and enhanced stocks of salmon.* Percy M. Washington, GAIA NW, Inc., Seattle, Washington
5. *The carrying capacity of the North Pacific Ocean.* William G. Pearcy, Oregon State University, Corvallis (Summary)

Session 2 -- Management of mixed stocks
1:30-3:00 p.m.

1. *Trends in abundance of hatchery and wild stocks of pink salmon in Cook Inlet, Prince William Sound and Kodiak, Alaska.* Doug M. Eggers, Chief Fisheries Scientist, Alaska Department of Fish & Game, Juneau, Alaska
2. *Management of mixed enhanced and wild salmonids in British Columbia.* Don D. Bailey, Salmon Enhancement Division, Department of Fisheries and Ocean, Vancouver, Canada

3. *Gene frequencies, risk assessment and the management of hatchery production of Pacific Salmon.* James E. Seeb, Alaska Department of Fish & Game, Anchorage, Alaska

Session 3 -- Summary and general discussion

3:30-4:30 p.m.

Monday, November 11 Open to the public

Session 4 -- Basic Genetic Structure

8:30-10 am Session Chair: James E. Seeb

1. *Conservation of genetic diversity in salmonid fishes: why, what and how.* Fred W. Allendorf, Division of Biological Sciences, Missoula, Montana
2. *The predictive value of stream distances for estimating genetic relationship in salmonid species.* Fred M. Utter, National Oceanic and Atmospheric Administration (NOAA), Seattle, Washington
3. *Population genetic structure of chum salmon: identification of wild and hatchery fish in mixed fisheries.* Lisa W. Seeb, Alaska Department of Fish & Game, Anchorage, Alaska
4. *The importance of fine genetic structures in natural populations.* Anthony Gharrett, School of Fisheries and Ocean Science, University of Alaska, Juneau, Alaska

Session 4 continued

10:30-12:00

5. *Quantitative genetic variation of life history traits in pink salmon.* William Smoker, School of Fisheries and Ocean Science, University of Alaska, Juneau, Alaska
6. *Genetic stock identification of Yukon River chum and chinook salmon.* Richard L. Wilmot, U.S. Fish & Wildlife Service, Anchorage, Alaska
7. *Genetic relationships among Pacific salmon of the Bristol Bay area of Alaska.* Rebecca J. Everett, U.S. Fish & Wildlife Service, Anchorage, Alaska

Session 5 -- Straying

1:30 - 2:00 pm

1. *Homing, straying and the interaction between wild and enhanced stocks of salmon.* Thomas P. Quinn, Fisheries Research Institute, University of Washington, Seattle, Washington
2. *Do culture conditions of hatchery reared salmon affect return and straying of adults?* Sven Ebbesson (abstract only)

Session 6 -- Long Term Case Histories

2:00-3:00 pm

1. *Interactions between wild and cultured Atlantic salmon -- A review of the experience in Norway.* Tor G. Heggberget, NINA, Norsk Institutt for Naturforskning, Trondheim, Norway
2. *The status of wild and hatchery propagated Swedish salmon stocks after 40 years of hatchery releases in the Baltic rivers.* Torieif Eriksson, Swedish University of Agricultural Sciences, Department of Aquaculture, Umea, Sweden

Session 6 continued

3:30-5 pm

3. *The perpetual oversight of hatchery programs.* Ernest Brannon, University of Idaho, Moscow, Idaho
4. *The Soviet experience in the field of salmon interactions.* Mikhail Glubokovsky, Institute of Marine Biology, Far East Branch, Vladivostok, USSR
5. General discussion

Tuesday, November 12

Field trip to Wally Norenberg Hatchery at Esther Island (western Prince William Sound) --

Wednesday, November 13

Session 7 -- Interactions in Prince William Sound

8:30-10 am

1. *Overview of Ocean Ranching in Prince William Sound,* Jeff Olsen, Operations Manager, Prince William Sound Aquaculture Corporation, Cordova, Alaska

Session 7 continued

10:30-12 noon -- *Interactions in Prince William Sound*

Session 8 -- Interactions in Southeast Alaska

1:30-3 pm Session Chair: Ole Mathisen

1. *Southeast Alaska Chinook; Fisheries, management, enhancement, wild stocks and treaties.* William R. Heard, National Marine Fisheries Service, Auke Bay Laboratory, Auke Bay, Alaska
2. *An Overview of the Pink, Chum and Coho Enhancement programs in Southeast Alaska.* Donald F. Amend, Southern Southeast Aquaculture Association, Ketchikan, Alaska

Session 8 continued

3:30-5 pm -- ***Interactions - General discussion***

Thursday, November 14

Session 9 -- Interactions regarding other species, especially sockeye

8:30-10 am

Session 9 continued

10:30-12 Noon

Session 10 -- The Working Party: Writing sessions divided into sub-groups

1:30-5:00 pm Session Chairs in charge of each group

Friday, November 15 *Open to the public*

Session 11 Concluding Session

Session Chair: Gary Thomas

8:30-10 am Session leaders will present a short discussion of the findings of their working group followed by an open discussion session and approval of reports and documents.

10:30-noon Open discussion session continues.

Afternoon

Departures

VIII.
LIST OF MANUSCRIPTS SUBMITTED

E.L. Brannon

The Perpetual Oversight of Hatchery Programs

R.T. Cooney

A Theoretical Evaluation of the Carrying Capacity of Prince William Sound, Alaska, for Juvenile Pacific Salmon

T. Eriksson and L.O. Eriksson

Status of Wild and Hatchery-Propagated Swedish Salmon Stocks after 40 Years of Hatchery Releases in Baltic Rivers

A.J. Gharrett and W.W. Smoker

Adaptive Importance of Genetic Infrastructure in Salmon Populations

T.G. Heggberget

Interactions Between Wild and Cultured Atlantic Salmon: A Review of the Experience in Norway

T.P. Quinn

Homing and Straying of Wild and Hatchery-Produced Pacific Salmon

D.E. Rogers and G.T. Ruggerone

Factors Affecting marine Growth of Bristol Bay Sockeye Salmon

F.M. Utter, J.E. Seeb, and L.W. Seeb

The Predictive Value of Stream Distance for Estimating Genetic Relationship in Salmonid Species

P.M. Washington

The Interactions and Environmental Carrying Capacity Limitations of Natural and Artificial Stocks of Salmonids

IX.
LIST OF PARTICIPANTS

Workshop on the Biological Interactions of Natural and Enhanced
Stocks of Salmon in Alaska
November 9 - 15, 1991 - Cordova, Alaska

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CHAPTER VIII. FUNDING OF THE ALASKA SALMON ENHANCEMENT PROGRAM

INTRODUCTION

Sources of funds for the Alaska salmon enhancement program and projects include bond issuances, state general fund appropriations, salmon enhancement tax assessments paid by fishermen, state enhancement loans, and cost recovery sales of fish. This chapter provides information on funding of Alaska salmon enhancement program.

STATE HATCHERIES AND ENHANCEMENT PROJECTS

The Alaska Department of Fish and Game, Fisheries Rehabilitation and Enhancement Division (FRED) was established by the State Legislature in 1971 to encourage the use of hatcheries and other enhancement techniques to return the state's then depressed salmon fisheries to abundance.

At its peak, the division operated 20 hatcheries. Currently, the FRED Division operates 12 (though 16 are owned by the State) hatcheries to produce salmonid fishes for commercial, sport, and subsistence fisheries. As a result of declining state revenues, state policy shifted regarding the construction and operation of state hatcheries. In general, the state will only continue to operate salmon hatcheries that primarily benefit sport and subsistence fisheries and/or are primarily research facilities. In keeping with this policy, four permits have been issued to regional aquaculture associations for the operation of state-owned hatcheries at Trail Lakes, Cannery Creek, Kitoi Bay, and Hidden Falls. Additional permits will be issued to regional aquaculture associations for operation of the Main Bay, Tutka, and Beaver Falls hatcheries in 1992. Many of the state hatcheries were constructed for research purposes and not with cost recovery and loan repayment in mind. Therefore, in order to transfer these facilities to PNPs, the state has invested funds to make the hatcheries cost effective. While these transfers may be cost effective from an amortized capital and annual operating cost analysis, questions have been raised regarding the resulting fisheries management problems. Information on state hatcheries is provided in Table 1.

In addition to hatcheries, FRED has constructed numerous fish passes (several maintained cooperatively with the U.S. Forest Service) which provide access to spawning and rearing habitat that would otherwise be unavailable to salmon stocks. Other enhancement operations include lake fertilization, habitat improvement, and fish stock introduction to provide increased freshwater survival and new salmon production opportunities.

FRED also administers the PNP Hatchery Program and coordinates the development of regional aquaculture associations, approves annual operations management plans for all salmon hatcheries, and reviews PNP hatchery applications and the permitting process (which includes hatchery and fish and egg transporting permits). FRED operates five biological laboratories--Fish Pathology, Genetics, Limnology, and Tag Recovery facilities--which provide information and support for FRED and PNP hatchery programs. FRED

also provides engineering service support to the department (including field facilities) and coordination with consultants, contractors, and landowners.¹

STATE ENHANCEMENT PROJECT FUNDING

Funding for the operation of the state salmon enhancement program and state project construction, operation, and maintenance has been primarily through state bonds and general fund appropriations to ADF&G, FRED Division. From FY 72 - 92 operating budget, funding for the FRED Division totalled approximately \$210.3 million, the majority of which was for salmon enhancement. Bond issues totalling \$56.17 million were authorized by the 1976 and 1978 Legislatures, and overwhelmingly endorsed by voters, to fund the construction and operation of hatchery production and other enhancement projects in each region of the state. Of the \$56.17 million in bond issues for FRED enhancement projects, \$10.3 million was spent on the construction of hatcheries, while the remainder was used for other enhancement projects. In addition to bond issues, the capital appropriations for FRED division construction of state facilities totaled approximately \$24.8 million through FY 92.

As part of the Pacific Salmon Treaty, the federal government agreed to provide \$20 million in mitigation monies to produce new salmon through enhancement as a means to mitigate losses to Alaska fishermen resulting from treaty catch quotas. These funds have all been transferred to the State, although not all have been spent.

PRIVATE NONPROFIT HATCHERIES

The PNP Hatchery Program was created by the legislature to provide private sector participation in rebuilding Alaska's depleted salmon fisheries. The impetus for the program came from the desire of commercial fishermen to enhance the severely depressed salmon stocks of the early 1970s. The program represented an unprecedented partnership among fishermen, processors, legislators, and the Governor's Office.² The statutes for PNP salmon hatcheries (AS 16.10.375-620 passed in 1974) authorized the ADF&G, FRED to issue hatchery permits to qualified PNP corporations. The intent of the program was to allow private ownership of salmon hatcheries that would contribute to the state's salmon fisheries. Costs of constructing and operating these hatcheries was to be derived from the sale of a portion of the returning fish. Comprehensive salmon planning is part of the PNP program and is implemented through the regional planning teams in conjunction with the regional aquaculture associations.

Since the inception of the PNP program, 32 salmon-hatchery permits have been issued, three given up and one revoked. Thirty-nine applications have either been denied or withdrawn from the permitting process. Twenty-four of the permitted PNP hatcheries are in operation. Currently, there are two applications for PNP hatchery permits under consideration.

¹Brad Pierce, Aquaculture in Alaska, House Research Agency Report 87-B, February 1987, p.30.

²Brian J. Allee, "The Private, Non-Profit Hatchery Perspective", Alaska Fish and Game, May/June 1986, p.17 and Brad Pierce, op.

Regional Aquaculture Associations

In 1976, the legislature authorized the formation of regional aquaculture associations. Regional associations are comprised of representatives of commercial, sport, and subsistence fishermen; processors; local communities members; and other user groups in the region. Each regional association must have a board of directors consisting of at least one representative from each user group within the association. Currently, there are eight regional aquaculture associations:

Northern Southeast Regional Aquaculture Association (NSRAA)
Southern Southeast Regional Aquaculture Association (SSRAA)
Prince William Sound Aquaculture Association (PWSAC)
Cook Inlet Aquaculture Association (CIAA)
Lower Yukon/Kuskokwim Regional Aquaculture Association (LYKRAA)
Bristol Bay Regional Aquaculture Association (BBRAA)
Kodiak Regional Aquaculture Association (KRAA)
Chignik Regional Aquaculture Association (CRAA)

Regional Planning Teams

Three representatives from each regional aquaculture association are appointed by their respective boards of directors to serve on a regional planning team (RPT) along with three ADF&G representatives--two from FRED and one from the Division of Commercial Fisheries. These teams are responsible for developing regional comprehensive salmon plans for both FRED and PNP hatchery production. From FY 77 to FY 86, the legislature provided funds for planning teams via grants and contracts administered through the ADF&G commissioner's office. With the exception of an initial start-up planning grant available to all regional aquaculture associations from DCED, no funds for planning have been provided to regional associations since FY 86.

Private Non-Profit Hatchery Funding

Funding for PNP hatcheries is primarily through state loans, the salmon enhancement tax, and cost recovery sales of fish. To a lesser extent, the state has provided grants to some facilities and fishing organizations; these have totalled approximately \$12.3 million.

Since 1977, a significant portion of the funding necessary for the implementation of salmon rehabilitation and enhancement activities by PNP corporations has been provided through the *Fisheries Enhancement Revolving Loan Fund* administered by the Alaska Department of Commerce and Economic Development (DCED), Division of Investments (AS 16.10.500-620). The loan program has gone through several modifications by the legislature, the most recent occurring in 1987. The maximum loan amount available for an individual project is \$10 million at approximately 9.5 percent interest, with a payback period of up to 30 years.

According to state statute (AS 16.10.525), payments and accrual of interest on these loans *must* be deferred for 6 to 10 years. Loans for non-regional aquaculture association projects have these same terms with the exception that the loan maximum is limited to \$1 million. Loans are available for the purpose of planning, construction, and operation of salmon rehabilitation and enhancement projects, primarily salmon hatcheries. These loans are secured through collateral that may include returning hatchery fish and enhancement

assessment of commercial fishermen. State regulations to implement these statutes have been revised, but many hatchery operators still feel they are not flexible enough. This topic is being addressed by a legislative audit team.

State law allows limited entry permit holders within a region where there is a qualified regional aquaculture association to establish a *Salmon Enhancement Tax* (AS 43.76.010-.015). The permit holders may establish enhancement tax rates ranging from one to three percent of the ex-vessel value of the salmon catch within the region. The Cook Inlet and Northern and Southern Southeast Regional Association assessment rates (2, 3, and 3 percent, respectively) have been in place since 1981. The Prince William Sound assessment (2 percent) began in 1985 and the Kodiak assessment became effective in 1988. Buyers of salmon are required to collect the tax and remit the revenue to the Alaska Department of Revenue. This is a pass-through program, since the legislature appropriates Salmon Enhancement Tax revenues to the regional associations from whose members the tax was collected.

Through November, 1991, \$71.0 million has been borrowed by PNP corporations. Approximately \$67.7 million (95 percent) of the \$71.0 million principal balance is currently outstanding. Including state appropriations (\$12.3 million), approximately \$83.3 million has been provided in state loans and grants to PNPs. Another \$46.2 million has been generated through enhancement tax assessments. To date, PNP operators have sold approximately \$70.9 million worth of cost recovery fish to help pay for hatchery operations. The amount and percentage of funding by category is shown below.

\$71.0 million	35 percent	State Loans
\$12.3 million	7 percent	General Fund Grants
\$46.2 million	23 percent	Enhancement Tax Assessments
\$70.9 million	35 percent	Cost Recovery Sales of Fish
\$200.4 million		Total

As can be seen, the private sector has provided over 58 percent of the direct funding for PNP operation and construction through self-imposed taxes and cost recovery sales of fish.

OPTIONS FOR POSSIBLE CONSIDERATION:

- Requiring a more extensive public benefit-cost analysis before providing enhancement loans. This means that a project or facility expansion would not only have to be financially feasible--capable of paying back loans--but also provide net benefits to the public.
- Eliminating the statutory loan repayment deferment requirement on operating loans.
- Development of a mechanism for placing moratoriums on state enhancement loans for increased fish production. Consideration of a moratorium on loans until results of the Legislative Enhancement Program Review economic studies are complete.
- Implementing a requirement for more complete analysis of transfers of the operation of state hatchery facilities that includes factors such as fisheries management, increased need for cost recovery, and the impact on traditional common property fisheries.
- Analysis of the enhancement tax program to determine 1) whether costs are distributed in proportion to benefits, and 2) the impact of a mechanism to allow

specific gear groups to opt out of the program or pay in proportion to the enhancement benefits they receive.

- Analysis of increasing the salmon enhancement tax so fishermen who benefit from the program will pay for more of the costs.
- In light of declining state revenues and lower fish prices, development of an auditing mechanism to ensure that annual PNP operating costs, paid by loans, enhancement tax receipts and cost recovery, are "reasonable."
- Development of a requirement that funds provided in treaty agreements for enhancement be used for fish production to the maximum extent possible. In addition, a requirement for a comprehensive feasibility analysis of using enhancement as part of treaty agreements could be considered.
- Analysis of use of enhancement loan funds for operating funds versus capital investment.

UPDATE: In June 1992, Senator Dick Eliason requested through the Legislative Budget and Audit Committee an audit of funding issues related to fisheries enhancement programs in order to respond to concerns raised during the review process. A final audit is expected in February 1993. Attachment A is the preliminary information generated by the audit team.

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Alaska Department of Fish and Game-FRED Division
Public Hatchery Strategic Plan

Hatchery	Location	Species	FY92			Operating Costs	Funding Source	Operational FY	Plan Agency	Comments
			Percent Commercial	Percent Sport	Percent Subsistence **					
1 Beaver Falls	Ketchikan	Sockeye	100%	0%	***			92	SSRAA	
2 Big Lake	Big Lake	Sockeye Coho	85% 30%	0% 65%	15% 5%	\$50.0 \$344.3	Unfunded GF	92	FRED	Sockeye unfunded Interim funding or contract required
3 Cannery Creek	Whittier	Pink	100%					89	PWSAC	
4 Clear	Clear	Arctic char Arctic grayling Lake trout		100% 100% 100%		\$22.4 \$308.5 \$90.8	GF DJ/WB F&G	92	FRED	Major sport fish production facility Vital to US/Can chum and chinook programs
5 Crooked Creek	Soldotna	Sockeye Coho Steelhead	95%	0% 95% 100%	5% 5%	\$46.0 \$346.2 \$12.0	CIAA GF PgR	92	FRED CIAA	Sockeye contracted to CIAA Contributes substantially to chinook sport fish program through eggtakes for other facilities
6 Crystal Lake	Petersbur	Chinook CL re Chinook remot Coho Steelhead	56% 99% 83%	44% 1% 17% 100%	***	\$618.7	GF	92	FRED	Large US/Can capital investment US/Can involvement including Harding River, Deep Cove, and Farragut River Provides 5-7 million chinook eggs in addition to its own needs, primary stream rehab work from unique isolation modules.
7 Deer Mountain	Ketchikan	Chinook Coho Steelhead	60% 83%	40% 17% 100%	*** ***	\$144.2 \$144.2	GF ANAD	92	FRED	Fisheries technology development results supplied to other state and private programs. Prime tourist facility, over 200,000 visitors annually. Major role in public education.
8 Elmendorf	Anchorage	Chinook Coho	9% 10%	90% 87%	1% 3%	\$112.6 \$375.2 \$67.9	F&G DJ/WB GF	92	FRED	Major sport fish production facility High visibility tourist attraction
9 Ft Richardson	Anchorage	Chinook Coho Rainbow	13% 10%	88% 90% 100%		\$144.2 \$583.5 \$181.6	GF DJ/WB F&G	92	FRED	Major sport fish production facility

Hatchery	Location	Species	FY92			Operating Costs	Funding Source	Operational FY	Plan Agency	Comments
			Percent Commercial	Percent Sport	Percent Subsistence					
10	Gulkana	Glennalle Sockeye Chinook	90% 50%	2% 30%	8% 20%			92	FRED/PWSAC	The most cost effective sockeye facility in the world 35 million sockeye salmon egg take annually
11	Hidden Falls	Sitka Pink Chum	100% 100%					89	NSRAA	
12	Kitoi Bay	Kodiak Pink Chum Coho Sockeye	100% 100% 50% 100%	50%				92	FRED/KRAA	
13	Klawock	Klawock Sockeye Coho Steelhead Chum	93% 50%	7% 100%	100% *** 50%	\$446.9 \$18.0 \$100.0	GF WB BIA (request)	92	FRED	BIA funds to address local projects, chum and sockeye. GF used in projects to rehabilitate POW in post-logging years.
14	Main Bay	Whittier Sockeye	99%	1%				92	PWSAC	
15	Pillar Creek	Kodiak Sockeye	100%		***	\$200.1 38.6	PgR GF	92	FRED/KRAA	Unfunded Interim funding or contract required
16	Russell Creek	Cold Bay Chum Pink Coho	100% 99% 50%	1% 50%		\$420.1 \$53.0	GF PgR	99	Reg. Assoc.	FY92 PgR from Aleutian's East Borough Fisheries developmental facility to be contracted in FY98
17	Sikusuilag	Kotzebue Chum	80%		20%	\$391.4	GF	99	Reg. Assoc.	Developmental facility, fisheries technology development Great potential for subsistence harvest. To be contracted in FY98
18	Snettisham	Juneau Sockeye CIF Sockeye (smol Chinook (Deep Chinook (juve	100% 100% 94% 66%	6% 34%	*** ***	\$775.8 \$167.6 \$108.0 \$190.0	GF US/Can Deep Cove US/CAN W/B	92	FRED	Tremendous involvement in US/Can projects, \$1.35 million plus 5 years operational funding in Deep Cove. Applied technology development for sockeye smolt. Major sport fish production in Juneau recreation project.
19	Trail Lakes	Moose Pas Coho Sockeye	100%	100%	***			89	CIAA	
20	Tutka	Homer Pink Chum Sockeye	98% 100% 100%	2%	*** ***	\$429.3	CIP	96	CIAA/ LCI Seiner	Unfunded Interim funding or contract required.

** - Includes personal use

*** - Thought to contribute to subsistence but as yet unquantified



LAWS OF ALASKA

1992

Source
CSHB 541(RES)

Chapter No.
93

AN ACT

Relating to the management of mixed stock fisheries by the Board of Fisheries.

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

THE ACT FOLLOWS ON PAGE 1

Approved by the Governor: June 18, 1992
Actual Effective Date: September 16, 1992

AN ACT

1 Relating to the management of mixed stock fisheries by the Board of Fisheries.

2

3 * Section 1. AS 16.05.251 is amended by adding a new subsection to read:

4 (h) The Board of Fisheries shall adopt by regulation a policy for the management of
5 mixed stock fisheries. The policy shall provide for the management of mixed stock fisheries in
6 a manner that is consistent with sustained yield of wild fish stocks.

ALASKA STATE LEGISLATURE

LEGISLATIVE BUDGET AND AUDIT COMMITTEE

Division of Legislative Audit



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Juneau, AK 99811-3300
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MEMORANDUM

TO: Members of Legislative Budget
and Audit Committee

FROM: Randy S. Welker *Randy*
Legislative Auditor

DATE: November 12, 1992

RE: Excerpted Information Related to Private Non-Profit Hatchery
Financing and Operations

In June 1992 the committee approved an audit request from Senator Eliason relating to various issues involving the financing and operations of private non-profit hatcheries. In the approved request Senator Eliason noted that *"the information derived from this audit will be used as part of the on-going Legislative Hatchery Review Project."*

We are in the process of completing audit fieldwork. We plan on presenting a preliminary report to the committee in January 1993, which most likely will not result in a final public report being available until February. This prospective timeline does not fit in with the completion schedule of the review project. Accordingly, we have contacted the lead legislative staff responsible for the review project regarding various audit information they may be interested in using. Based on this contact, we identified four major areas of information that we could develop and make available to them, with the committee's approval. This information, primarily compiled in tabular form includes the following:

1. Economic benefits compared to tax contributions - Attachment 1 consists of five tables comparing the estimated economic value of hatchery-generated fish summarized by fishing gear group, with the amount of salmon enhancement taxes (SET) paid by each gear group. This information is presented for the five major regional

aquaculture associations.¹ The table provides information that addresses the issue of equity that is often raised by certain gear groups. That is, in various regions of the state, certain gear groups complain that although they are assessed SET, they receive minimal, if any, economic benefit from the fish produced by the regional association.

2. Contribution to the common property fishery - Attachment 2 is a table which summarizes the contribution to the common property fishery made by various hatcheries. The table compares the contribution made by hatcheries and other enhancement projects operated or administered by regional aquaculture associations to those of non-regional independent operators. This table provides information related to the concerns that many fishers have about the benefits of independent hatcheries. Fishers are concerned that independent hatchery operators, who do not benefit from SET revenues, require a large number of their returning fish in order to generate operating revenues. In this context, fishers are concerned that independent hatchery operators become competitors for selling fish rather than benefactors.
3. Estimating SET revenues generated by independent operators - Independent, non-association hatchery operators often point out that they are indirectly subsidizing regional association operations. The fish they produced that are caught in the common property fishery generate SET revenues for the regional associations. They however, do not benefit from these revenues and accordingly may have to rely on a larger share of their production, which they have to take out of the common property fishery (see previous discussion in number 2. above). The table on Attachment 3 estimates the SET generated from the fish believed to have been produced by the non-association independent operators over the last four years.
4. Detailed schedule of recipients of Fisheries Enhancement revolving loans - Also included in the information to be provided to the legislative review project is a listing of organizations which have borrowed funds through the Fisheries Enhancement Revolving Loan fund program. The information provided on Attachment 4 includes the amounts of the original loans for each borrower organization, the current loan balance, and the number of loans that have been "restructured" due to delays in repayment. The schedule also summarizes loan activity between regional associations and non-regional operators.

¹As of the date of this memorandum six regional aquaculture associations receive SET distributions from the state. The five major associations are Southern Southeast Aquaculture Association, Northern Southeast Aquaculture Association, Cook Inlet Aquaculture Association, Prince William Sound Aquaculture Corporation, and Kodiak Regional Aquaculture Association. A sixth association, the Chignik Regional Aquaculture Association, was eligible to receive SET for the first time in 1991, and actually received its first payment in the State's FY 92 budget.

We request that the committee review the tables and notes that accompany this memorandum and authorize release to the Legislative Hatchery Review Project team. Our discussions and observations regarding the information presented follows.

Attachment 1, Tables 1 through 5 - These comparisons of SET paid by gear group to the value of hatchery fish harvested were developed from annual operating reports submitted by the various organizations. These reports are submitted to the Division of Fisheries Rehabilitation, Enhancement and Development (FRED). Weight and value of fish were determined from information maintained by the Commercial Fisheries Entry Commission. The information in the tables related to value of hatchery fish is necessarily developed from estimates and data generated by various fish tagging programs that the organizations have in place.

As reflected in Table 2, the entire production of the Kodiak Regional Aquaculture Association (KRAA) has been harvested by the region's seine fleet. The gill net fleet does not benefit from the hatchery production, however it does receive benefits from other enhancement projects administered by KRAA, which are not reflected in the table. Further the lack of any hatchery harvest in 1989 and 1990 is due to the Exxon Valdez oil spill. No commercial fishing was permitted by the Division of Commercial Fisheries on hatchery stocks. Rather, the 1989 return was harvested and used entirely for cost recovery for KRAA.

In Prince William Sound, as shown in Table 3, both the seine and gill net fleet receive more benefits than SET paid to support the regional association. In contrast, that is not consistently the case in Southeast Alaska. As shown on Table 4, gillnetters have paid more than \$ 1 million in SET since 1988 while harvesting less than \$50,000 in fish generated by the Northern Southeast Regional Aquaculture Association (NSRAA).

For the Southern Southeast Aquaculture Association (SSRAA) the situation is somewhat the opposite. As shown on Table 5, gillnetters have received from SSRAA produced fish on average more than three times the amount of SET they have paid. The seine fleet by comparison have paid more in SET than they received in three of the last four years. The troll fleet in southern southeast also receive a disproportionate share of the hatchery produced fish when compared to the SET paid by the fleet. It is interesting to note that when NSRAA and SSRAA are considered together, the benefits received by all gear groups are fairly consistent with the amount of SET each fleet has paid over the last four years.

Attachment 2, Table 6 - The information on this table reflects the contribution that has been made to the common property fisheries by both regional and non-regional independent organizations. The statutes which established the Fisheries Enhancement Revolving Loan Fund (FERLF) required that hatchery projects make a "significant" contribution to the common property fishery. The Department of Commerce and Economic Development, Division of Investments has proposed regulations to further define "significant" contribution as being at least 50%. That is, a hatchery organization would have to contribute at least 50%

of its returning fish to the common property fishery in order to remain eligible for FERLF loans.

As shown by Table 6, non-regional associations have generally contributed less to the common property fishery than regional aquaculture associations. For two of the past four years the total contribution rate for all non-regionals has fallen below 50%. It should be noted that for 1989, the contribution of the regionals was only 39.6%. This is due to the Exxon Valdez oil spill. As mentioned in previous discussions, due to the oil spill commercial fishing of returning KRAA stocks was prohibited. Rather, the entire return was harvested and used for cost recovery for KRAA. As a result, there was no common property contribution by KRAA for these stocks in 1989. If KRAA totals are excluded, the contribution rate for all associations increases to over 55%.

Attachment 3, Tables 7 through 10 - Included in Attachment 3 are four schedules estimating the amount of SET generated by independent non-profit hatchery operators. As mentioned previously, independent operators point out that while they do not benefit from SET, their common property returning fish generate SET revenues for the regional associations.

When compared with total SET revenues for the five regional associations presented in Tables 1 through 5, these SET revenues represent much less than 10% of regional association revenues. However, it should be noted that these revenues are based on estimated returns. Most non-regional operators specialize in raising and releasing pink and chum salmon. Tagging of pink and chum salmon is for the most part impractical. The absence of widespread tagging generally yield more conservative, perhaps less reliable, projections.

Attachment 4, Table 11 - This schedule lists various information for borrowers of the FERLF program. As can be seen on the table, most borrowers have multiple loans with the program. The number of loans that have been restructured reflects, in part, operational difficulties which have prevented borrowers from making repayments as required under the original terms of their loan. It should be emphasized that under the program's statutes the Division of Investments (DOI) has a great deal of discretion in setting repayment periods, interest rates, and other terms. Typically DOI has been conservative when setting loan terms. Accordingly, although many loans have necessarily been restructured, few if any, have been restructured beyond the discretionary limits provided for in statute.

The schedule is further summarized between regional aquaculture associations and non-regional independent operators. This summary addresses concerns of associations that the available loan funds have been inordinately granted to independents. As shown, historically the available funding has been divided fairly equally through the end of FY 92. Two borrowers, a independent operator and a regional association account for more than half of the fund's outstanding loan balance at June 30, 1992. Douglas Island Pink and Chum, an independent operator, accounts for over 20% of the more than \$73 million in outstanding loans while the Prince William Sound Aquaculture Corporation has more than 30% of the fund's balance.

ATTACHMENT 1

COOK INLET AQUACULTURE ASSOCIATION <i>Schedule of Estimated SET Paid and Estimated Value of Hatchery Fish Harvested By Gear Group 1988 - 1991</i>					
GEAR GROUP		1988	1989	1990	1991
SEINE	SET Paid	\$ 155,500	\$ 52,400	\$ 30,500	\$ 33,400
	Value of Hatchery Fish Harvested	\$ -0-	\$ -0-	\$ -0-	\$ 31,800
GILL NET	SET Paid	\$ 2,361,300	\$ 1,236,900	\$ 940,600	\$ 328,000
	Value of Hatchery Fish Harvested	\$ 54,100	\$ 2,200	\$ 179,100	\$ 636,200
TROLL	SET Paid	\$ -0-	\$ -0-	\$ -0-	\$ -0-
	Value of Hatchery Fish Harvested	\$ -0-	\$ -0-	\$ -0-	\$ -0-

Table 1

KODIAK REGIONAL AQUACULTURE ASSOCIATION <i>Schedule of Estimated SET Paid and Estimated Value of Hatchery Fish Harvested By Gear Group 1988 - 1991</i>					
GEAR GROUP		1988	1989	1990	1991
SEINE	SET Paid	\$1,428,600	\$ 1,500	\$ 823,000	\$ 522,800
	Value of Hatchery Fish Harvested	\$ 945,200	\$ -0-	\$ -0-	\$ 543,800
GILL NET	SET Paid	\$ 368,800	\$ 521,100	\$ 250,600	\$ 197,500
	Value of Hatchery Fish Harvested	\$ -0-	\$ -0-	\$ -0-	\$ -0-
TROLL	SET Paid	\$ -0-	\$ -0-	\$ -0-	\$ -0-
	Value of Hatchery Fish Harvested	\$ -0-	\$ -0-	\$ -0-	\$ -0-

Table 2

ATTACHMENT 1

PRINCE WILLIAM SOUND AQUACULTURE ASSOCIATION <i>Schedule of Estimated SET Paid and Estimated Value of Hatchery Fish Harvested By Gear Group 1988 - 1991</i>					
GEAR GROUP		1988	1989	1990	1991
SEINE	SET Paid	\$ 694,100	\$ 490,800	\$ 749,500	\$ 210,700
	Value of Hatchery Fish Harvested	\$20,682,900	\$ 13,429,400	\$ 17,868,800	\$ 6,328,200
GILL NET	SET Paid	\$ 763,600	\$ 528,500	\$ 526,400	\$ 388,700
	Value of Hatchery Fish Harvested	\$ 8,052,600	\$ 1,715,300	\$ 4,222,600	\$ 3,521,800
TROLL	SET Paid	\$ -0-	\$ -0-	\$ -0-	\$ -0-
	Value of Hatchery Fish Harvested	\$ -0-	\$ -0-	\$ -0-	\$ -0-

Table 3

NORTHERN SOUTHEAST REGIONAL AQUACULTURE ASSOCIATION <i>Schedule of Estimated SET Paid and Estimated Value of Hatchery Fish Harvested By Gear Group 1988 - 1991</i>					
GEAR GROUP		1988	1989	1990	1991
SEINE	SET Paid	\$ 296,500	\$ 530,900	\$ 266,300	\$ 301,100
	Value of Hatchery Fish Harvested	\$ 1,757,600	\$ 188,800	\$ 1,179,500	\$ 1,434,900
GILL NET	SET Paid	\$ 571,000	\$ 231,200	\$ 313,700	\$ 183,200
	Value of Hatchery Fish Harvested	\$ 43,900	\$ 100	\$ 1,600	\$ 2,000
TROLL	SET Paid	\$ 553,600	\$ 387,200	\$ 662,300	\$ 470,300
	Value of Hatchery Fish Harvested	\$ 155,600	\$ 228,200	\$ 499,000	\$ 576,200

Table 4

ATTACHMENT 1

SOUTHERN SOUTHEAST REGIONAL AQUACULTURE ASSOCIATION <i>Schedule of Estimated SET Paid and Estimated Value of Hatchery Fish Harvested By Gear Group 1988 - 1991</i>					
GEAR GROUP		1988	1989	1990	1991
SEINE	SET Paid	\$ 1,173,200	\$ 1,952,800	\$ 1,307,000	\$ 805,500
	Value of Hatchery Fish Harvested	\$ 2,536,900	\$ 1,010,600	\$ 303,200	\$ 297,500
GILL NET	SET Paid	\$ 436,500	\$ 386,100	\$ 329,300	\$ 218,100
	Value of Hatchery Fish Harvested	\$ 2,872,900	\$ 961,100	\$ 684,300	\$ 1,047,800
TROLL	SET Paid	\$ 193,600	\$ 141,300	\$ 276,500	\$ 203,100
	Value of Hatchery Fish Harvested	\$ 713,200	\$ 473,300	\$ 2,040,900	\$ 1,392,400

Table 5

ATTACHMENT 2

STATE OF ALASKA <i>Schedule of Hatchery Contribution to the Common Property Fishery By Regional and Non-Regional Organizations 1988-1991</i>								
Organization	<u>1988</u>		<u>1989</u>		<u>1990</u>		<u>1991</u>	
	Hatchery Return %	Common Property Fishery %	Hatchery Return %	Common Property Fishery %	Hatchery Return %	Common Property Fishery %	Hatchery Return %	Common Property Fishery %
Regional	23.1%	76.9%	60.4%	39.6%	28.9%	71.1%	32.9%	67.1%
Non-Regional	68.3%	31.7%	31.7%	68.3%	30.2%	69.8%	62.3%	37.7%

Table 6

ATTACHMENT 3

STATE OF ALASKA <i>Contribution to Salmon Enhancement Taxes For the Five Largest Independent Non-Profit Organizations</i> 1991					
Organization	Common Property Value		Regional SET Rate		Estimated SET Contribution
AAI	\$181,200	x	3%	=	\$5,400
AKI	199,800	x	3%	=	6,000
DIPAC	905,900	x	3%	=	27,200
KAKE	24,300	x	3%	=	700
VALDEZ	965,100	x	2%	=	19,300
					<u>\$58,600</u>

Table 7

STATE OF ALASKA <i>Contribution to Salmon Enhancement Taxes For the Five Largest Independent Non-Profit Organizations</i> 1990					
Organization	Common Property Value		Regional SET Rate		Estimated SET Contribution
AAI	\$189,900	x	3%	=	\$5,700
AKI	233,000	x	3%	=	7,000
DIPAC	43,000	x	3%	=	1,300
KAKE	55,400	x	3%	=	1,700
VALDEZ	9,282,600	x	2%	=	185,700
					<u>\$201,400</u>

Table 8

ATTACHMENT 3

STATE OF ALASKA <i>Contribution to Salmon Enhancement Taxes For the Five Largest Independent Non-Profit Organizations</i> 1989					
Organization	Common Property Value		Regional SET Rate		Estimated SET Contribution
AAI	\$840,400	x	3%	=	\$25,200
AKI	78,600	x	3%	=	2,400
DIPAC	129,200	x	3%	=	3,900
KAKE	2,500	x	3%	=	100
VALDEZ	3,825,800	x	2%	=	76,500
					<u>\$108,100</u>

Table 9

STATE OF ALASKA <i>Contribution to Salmon Enhancement Taxes For the Five Largest Independent Non-Profit Organizations</i> 1988					
Organization	Common Property Value		Regional SET Rate		Estimated SET Contribution
AAI	\$67,700	x	3%	=	\$2,000
AKI	12,600	x	3%	=	400
DIPAC	315,200	x	3%	=	9,500
KAKE	4,800	x	3%	=	100
VALDEZ	1,320,700	x	2%	=	26,400
					<u>\$38,400</u>

Table 10

ATTACHMENT 4

STATE OF ALASKA Fisheries Enhancement Revolving Loan Fund Schedule of Borrowers, Loans, Current Balances, and Status June 30, 1992					
Organization	Original Loan Amount	# of Loans Outstanding at 6/30/92	# of Loans Restructured as of 6/30/92	Current Loan Balance at 6/30/92	% of Total Loan Receivable Balance
Regional					
PWSAC	\$24,560,900	21	3	\$23,149,800	31.4
SSRAA	11,941,900	13	13	12,201,000	16.6
NSRAA	2,840,700	7	0	2,557,000	3.5
CIAA	328,600	2	0	328,600	.4
Total Regional Organizations	\$39,672,100	43	16	\$38,236,400	51.9
Non-Regional					
DIPAC	\$15,579,500	41	0	\$15,289,100	20.7
VFDA	6,444,400	17	12	6,491,500	8.8
AKI	4,845,100	20	2	4,702,400	6.4
AAI	4,571,800	30	14	4,705,900	6.4
KNPFC	3,534,600	17	6	3,713,100	5.0
SJ	362,300	2	1	346,700	.5
BCF	275,000	4	2	244,600	.3
Total Non-Regional Organizations	\$35,612,700	131	37	\$35,493,300	48.1
Total	\$75,284,800	174	53	\$73,729,700	100.0

Table 11

ATTACHMENT 5

STATE OF ALASKA

**Fisheries Enhancement Revolving Loan Fund
Schedule of Borrowers, Loans, Operating, and Capital**

June 30, 1992

<i>Organization</i>	<i># of Loans Outstanding at 6/30/92</i>	<i>Current Loan Balance at 6/30/92</i>	<i># of Operating Loans at 6/30/92</i>	<i>Operating Loan Balance at 6/30/92</i>	<i># of Capital Loans at 6/30/92</i>	<i>Capital Loan Balance at 6/30/92</i>
Regional						
PWSAC	21	\$23,149,800	2	\$ 981,900	19	\$22,167,900
SSRAA	13	12,201,000	7	2,778,700	6	9,422,300
NSRAA	7	2,557,000	4	926,100	3	1,630,900
CIAA	2	328,600	1	238,600	1	90,000
Total Regional Organizations	43	\$38,236,400	14	\$4,925,300	29	\$33,311,100
Non-Regional						
DIPAC	41	\$15,289,100	26	\$7,126,900	15	\$ 8,162,200
VFDA	17	6,491,500	9	3,294,000	8	3,197,500
AKI	20	4,702,400	11	2,173,800	9	2,528,600
AAI	30	4,705,900	18	3,300,400	12	1,405,500
KNIPFC	17	3,713,100	11	2,132,500	6	1,580,600
SJ	2	346,700	0	0	2	346,700
BCF	4	244,600	2	123,700	2	120,900
Total Non-Regional Organizations	131	\$35,493,300	77	\$18,151,300	54	\$17,342,000
Total	174	\$73,729,700	91	\$23,076,600	83	\$50,653,100

CHAPTER IX. ECONOMICS

The Legislative review of the salmon enhancement program included a benefit-cost analysis of the program. This analysis was completed under contract to the University of Alaska, Fairbanks. *Given recent low Alaska salmon prices and relatively dismal international salmon markets, the economic analysis was conducted to address questions such as whether Alaska enhanced salmon stocks are over-produced given current international salmon markets, the impact on Alaska regional salmon prices of additional enhanced production, the optimal species production mix, and the appropriate level of continued state fiscal support.*

The study consisted of four parts. First, a biological model (Collie, 1992) was used to estimate the returns of adult fish available for harvest under a variety of scenarios. Second, given the return of fish, an international demand model was estimated to predict the prices fishermen would receive at the ex-vessel level (Herrmann and Greenberg, 1992). Third, a fishing cost model was estimated to predict the producer's surplus in each fishery given the ex-vessel prices and returns of fish from the biological model (Boyce, 1992). Fourth, a survey of the hatcheries provided the costs of producing various levels of hatchery fish. The combined results of these four studies comprise the benefit-cost analysis of the salmon enhancement program. (Boyce, Herrmann, Bischak and Greenberg, 1992)

While the contractors have completed their work on the research, the public has not had the opportunity to review and comment on the results of the study. Therefore, the draft economics chapter, with options for possible consideration, and the final benefit-cost report have been printed separately. That document, entitled "Legislative Review of the Alaska Salmon Enhancement Program, Draft Chapter IX, Economics", is available in the Legislative Library in Juneau.

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CHAPTER X.

MARKETING

Following the precipitous decline in Alaska salmon prices in 1991, Governor Hickel formed a Salmon Strategy Task Force. The purpose of the group was to identify the problems facing Alaska's salmon fishing industry and recommend state actions to address these problems. A primary focus of the task force was salmon marketing. The task force recently finalized its recommendations. To avoid duplication with the task force's efforts, it was decided that the Legislative review of the Alaska salmon enhancement program would analyze the economic costs and benefits of the enhancement program and review past state salmon marketing efforts. In addition, as part of the legislative review, the Salmon Strategy Task Force's final recommendations are summarized (a copy of the Task Force's report is included in the Appendices).

INTRODUCTION

The Alaska Seafood Marketing Institute (ASMI) was established in 1981 as a quasi-state corporation in the Alaska Department of Commerce and Economic Development (DCED). The institute's statutory responsibilities include:

- To conduct educational, research, advertising, and sales promotional programs to increase awareness of all species of seafood and their by-products that are harvested in Alaska.
- To develop quality specifications to enhance the high quality image of Alaska seafood worldwide, and to adopt recommendations for the handling of seafood from the moment it is caught until it is shipped to the marketplace.
- To prepare market research and product development plans for all species of seafood and their by-products harvested in Alaska.

State statutes prohibit ASMI from favoring any region, product, or processor. For that reason, ASMI uses "generic" marketing campaigns aimed at enhancing the sales of particular "species" of fish or broad product categories (such as canned or frozen) rather than specific products. Also, because it is likely to favor individual processors, ASMI does not promote new products.

ORGANIZATION

Board of Directors

To accomplish its statutory mission, the ASMI organization consists of a board of directors, numerous committees, and a relatively small number of staff. Policy and program direction is set by the 18-member board of directors. The board membership consists of 12 fish processors, 5 commercial fishermen, and 1 public citizen. Of the 12 processors, 8 are to be appointed from "large processors" (annual Alaska payroll of \$1 million or more) and 4 are to be appointed from "small processors" (annual Alaska payroll between \$50,000 and \$1 million). Although not required by statute, the board has three non-voting ex-officio members: the DCED commissioner, and a legislator appointed from each chamber.

Committees

The ASMI committee system is extensive, with the largest portion being a system of marketing committees. The primary marketing committee plans the generic Alaska seafood marketing program for the domestic market. Committee members include the chairs from the five individual species committees (halibut, shellfish, canned seafood, whitefish, and salmon), plus the chairs of the export and quality committees, and two board members. The philosophy of the primary marketing committee is to promote Alaska seafood through the development of long-term marketing goals and strategies.

Under the marketing committee are the five individual species committees. These committees generically address marketing concerns related to their particular species group. The philosophy of the individual marketing committees is to promote the species with short-term marketing goals and strategies that are consistent with the long-term goals and strategies of the marketing committee.

The quality and export committees develop industry guidelines for the care and handling of seafood and oversee the federal Market Promotions Program (MPP) program, respectively. The MPP program was developed to increase U.S. exports.

Most of the members of the marketing committees are marketing specialists employed by the fish processors represented on the ASMI board. Other committee members are representatives from fishery organizations that are knowledgeable about the fishing industry.

Staff

The ASMI executive director is selected by the board of directors and permitted to hire additional staff upon approval of the board. The central staff members include: comptroller, quality manager, special projects coordinator, and office manager. In the past year, ASMI was authorized to hire four additional marketing specialists who had previously worked with ASMI as contractors.

ASMI FUNDING SOURCES

A portion of ASMI's funding is derived from a self-imposed seafood marketing assessment. All fish processors who purchase annually \$50,000 or more (ex-vessel value) of seafood pay an assessment of 0.03 percent of their total purchases. These assessments are collected in the state's general fund and are appropriated annually to ASMI. The balance of ASMI's funding is derived from state general fund and federal appropriations. Table 1 shows funding sources and levels since FY 82.

According to an ASMI briefing paper, ASMI has spent nearly \$35 million in the domestic market since 1981 in their "generic" seafood marketing program. Since FY 88, an additional \$24 million was spent in foreign markets, using federal funds and small state general fund matching appropriations. *Federal funding, which has increased as a result of the MPP program, is restricted to international marketing efforts.* In contrast, state general fund appropriations have declined in recent years. Given the outlook for Alaska salmon prices, industry contributions can be expected to remain below historic levels. *State general fund appropriations and industry contributions are used primarily to fund domestic marketing efforts. As a result, ASMI will have fewer resources for domestic marketing at a time when the domestic market has been identified by analysts as having the greatest potential for increasing sales of Alaska salmon.*

EFFECTIVENESS OF ASMI'S MARKETING PROGRAM

When ASMI was established, the Alaska salmon industry provided most of the U.S. production and about half of the world production from wild and ocean-ranched salmon stocks. As a major supplier, the generic marketing of Alaska salmon was relatively effective. A recent Legislative Audit report evaluated whether there has been an increase in awareness of Alaska seafood since ASMI's inception. The audit report analyzed ASMI effectiveness based on the following criteria:

- *Perception that Alaska is the best region for seafood.
- *Awareness of Alaska as a seafood-producing region.
- *Positive beliefs/attitudes toward Alaska seafood.
- *Awareness of Alaska seafood advertising.
- *Association of seafood species with Alaska.
- *Awareness of seafood species.

The Legislative Audit review of market research provided by ASMI concluded that increases had occurred in consumers' perception of Alaska seafood. In addition, consumers are more aware of Alaska as a seafood-producing region.

Despite these overall improvements in consumer perceptions and increased consumption of seafood, Alaska has lost a significant share of both the domestic and international salmon markets as a result of the tremendous growth in world farmed-salmon production. The dramatic rise in production and growing acceptance of farmed salmon as a source of fresh salmon represents the single greatest threat to the Alaska salmon market. The consistent year-round availability and quality of fresh, farmed salmon has made wild (and ocean ranched) Alaska salmon, with its short fresh season and quality and supply inconsistencies, a secondary choice for a large number of buyers. United States and foreign markets generally prefer fresh over frozen salmon.

According to ASMI board chair, Bob Waldrop, the large farmed-salmon producer nation of Norway spends about five cents per pound marketing salmon, while only one cent per pound is spent marketing Alaska salmon. *The new producers of salmon are out-competing Alaska producers in product preference, quality, availability, and marketing.*

Another problem is the fact that canned salmon production represents 59 percent of all retail salmon volume. U.S. per capita consumption of canned salmon declined 60 percent from 1980 to 1989, at the same time that harvests of pink salmon--the majority of which is canned--increased approximately 50 percent. Canned salmon suffers from an "old-fashioned" image with most younger consumers. The bones and skin also result in the perception that it is inconvenient and unappealing. In foreign markets, canned salmon markets fluctuate around pricing and supply conditions.

Analysts who are critical of ASMI's marketing programs maintain that the "generic" approach promotes all salmon, regardless of origin, because Alaska products are not clearly identified in the market. They argue that without brand identification and a quality assurance program to assure that Alaska salmon is superior, generic marketing may actually be helping Alaska's competitors.

LABELING OF ALASKA SALMON

A 1992 *Consumer Reports* article attacking the wholesomeness and safety of seafood sold in the United States has caused considerable concern within the Alaska fishing industry. The industry already faces difficult marketing challenges in a changing competitive environment. Despite its flawed methodology and lack of specificity, the report's long-term potential impact on Alaska must be taken seriously.

The Consumer Reports article also illustrates the problem of insufficient labeling of seafood products when sold in retail markets. The salmon samples tested in the report could not be identified by species, origin, or whether it was wild or pen reared. The Alaska Seafood Marketing Institute has recently developed a new U.S. promotion of Alaska salmon in order to meet increasing market challenges. This promotion is to emphasize the freshness and purity of Alaska's wild salmon. However, without specific labeling of salmon products as to species, state of origin, and identification as to whether wild or pen reared, the effectiveness of such marketing will be reduced.

To address the labeling problem, the Alaska State Legislature sent a letter to the Alaska Congressional delegation requesting that they introduce federal legislation requiring the labeling of seafood products as to their source and type, and whether the product is wild or farmed. Proper labeling will ensure that consumers can identify and select Alaska salmon, and provide better information and clearer choices in the market place. It would also reward those states that maintain strict quality control programs, such as Alaska, and ensure that the benefits of promotional efforts accrue to Alaska.

It should be noted that Alaska does have a statute that requires that any farmed salmon sold in the state must be labeled that it is farmed and is from outside Alaska.

THE SALMON STRATEGY TASK FORCE RECOMMENDATIONS

The Salmon Strategy Task Force finalized its recommendations on January 24, 1992. The Task Force provided immediate, mid-range, and long-range recommendations which are summarized below.

Recommendations for Immediate Action. (1) ASMI should develop a budget and strategy for selling the existing inventory surplus of Alaska salmon; (2) processors and fishermen should initiate price negotiations early; (3) The University of Alaska, DCED, and ADF&G should provide the best possible information to fishermen regarding world salmon markets; (4) DCED should review Prince William Sound processing capacity; (5) DCED and the Alaska Commercial Fishing and Agriculture Bank (CFAB) should provide loan extensions as needed.

Mid-Range Recommendations. The mid-range recommendations included actions for product and market development, salmon quality, and marketing and a review of ASMI's role.

Long-Term Recommendations. The long-term recommendations included the development of a strategic plan to help strengthen the fishing industry and its support sector. This included an integrated marketing and production strategy, a review of loan and limited entry permit policies, a review of ASMI, a review of fish tax policy, and the reduction of regulatory burdens to lower costs. ASMI's Salmon Recovery proposal was included in the Task Force's long-range recommendations as well as its recommendations for immediate action. This proposal, which did not receive support from the Hickel Administration, is discussed in the following section.

The ASMI Salmon Recovery Proposal

One of the recommendations of the Salmon Strategy Task Force was ASMI's Salmon Recovery Proposal. According to an ASMI briefing paper, the *goal* of the Salmon Recovery Proposal was to increase annual per capita U.S. salmon consumption from 1 to 1.5 pounds. This increase would absorb an additional 119 million pounds of salmon each year or about 15 percent of Alaska's annual production. Of the expansion, 60 percent would be frozen and 40 percent would be canned salmon.

The *strategy* of the program would be a combination of consumer and trade education and advertising, direct trade contacts, and other promotional methods used by ASMI over the last decade. Instead of patchwork, crisis-response marketing, this would be an integrative approach tying all marketing elements together. The basis for the marketing effort comes from a number of core issues identified by ASMI. These include:

- *trade and consumer preference for fresh salmon,
- *decreased consumer consumption of canned salmon,
- *low consumer knowledge and awareness of Alaska salmon products,
- *negative consumer perception of quality of frozen and canned salmon,
- *limited regional and seasonal purchases of Alaska salmon,
- *limited food-service use of Alaska salmon, especially canned,
- *fluctuating supply and prices of Alaska salmon, and
- *increased competition.

It is unclear from ASMI's information how consumer and trade preference for fresh over frozen and canned salmon was expected to be changed. It appears that efforts would be made to increase overall salmon consumption while convincing purchasers that Alaska frozen and canned salmon are also high quality products. To avoid merely expanding the farmed-salmon market, central to ASMI's recovery program is an Alaska salmon product identification promotion using a logo or seal of origin. This is similar to the "Alaska Made" program.

ASMI does have a record of success. As a result of direct marketing, Alaska canned salmon exports to the United Kingdom increased from 370,000 cases to 946,500 cases between 1989 and 1991.

The *cost* of the proposal was estimated at \$10 million annually for five years, totalling \$50 million. A lower annual amount would be needed after the first five years to sustain the marketing effort. ASMI has identified some potential sources of funds as follows:

- 1) state general fund appropriations,
- 2) a raw fish tax credit,
- 3) an endowment from the *Exxon Valdez* settlement as part of the restoration agreement,

4) a redirection of salmon enhancement taxes paid by fishermen to regional aquaculture associations, and

5) a combination of the above sources.

In reality, a raw fish tax credit amounts to an indirect state appropriation because a small amount (0.03 percent) of the foregone general fund fish tax revenues would then be paid in the form of industry processor contributions. Unless the legislature deems that a well specified and directed raw fish tax credit is desirable public policy in and of itself, a direct state general fund appropriation to ASMI is a superior method for funding the proposal.

Regarding a redirection of the enhancement tax, ASMI states that Alaska does not have a salmon production problem but a salmon marketing problem. While this may be true, the pass-through salmon enhancement taxes pay for the operation and/or repayment of state loans for salmon enhancement projects. As a result, this funding source is also an indirect state appropriation---the funding the aquaculture associations would forego would reduce payments on state loans and/or require additional operating loans. In general, if the legislature supports the salmon recovery proposal, a direct appropriation would be the best fiscal approach for funding the program.

ALTERNATIVE PROPOSALS TO INCREASE MARKETING EFFORTS

Proposed Changes to Alaska Statutes:

A number of pieces of legislation have been introduced recently to address the salmon marketing problem. The general intent of the proposals is to provide funding for the immediate increased promotion of Alaska salmon and to increase the voice of fishermen in those marketing efforts either through changes to ASMI or creation of a new salmon marketing association. No action was taken on any of these proposals in 1992.

- Creation of six regional salmon marketing committees and the Alaska State Salmon Marketing Association. Two fishermen from each committee would sit on the association. Funding for marketing efforts would be provided through a 1 percent marketing tax on value of salmon landed.
- Expansion of ASMI's statutes to allow for targeted development of Alaska salmon markets and product development.
- Imposition of a temporary one percent (1%) marketing tax on the value of salmon landed and increasing the ASMI Board of Directors by two positions that must be filled by commercial fishermen.
- Establishment of a temporary one percent (1%) salmon marketing tax and a committee within ASMI to provide fishermen with control over how the funds would be expended.
- Endowing the Alaska Fisheries Development Foundation to fund fisheries development research projects.

Development of a Salmon Marketing Council

Under the federal Seafood Promotion Act of 1986, after rigorous fisherman and processor review and approval, a salmon marketing council could be developed to increase the U.S. marketing

efforts of salmon. If properly organized and chartered, a "National Salmon Council" would have the power to assess industry participants for funds to be used for salmon promotion and marketing, product research, and consumer education. The council would also be able to develop and offer salmon quality standards for U.S. Department of Commerce approval.

OPTIONS FOR POSSIBLE CONSIDERATION:

- Review of the state's role in the marketing of Alaska seafood, and salmon in particular, including a review of the ASMI program.
- Given that ASMI's generic approach to marketing was statutorily established prior to the significant increase in world farmed-salmon production, expansion of ASMI's statutes to reflect changes in world salmon markets. In particular, ASMI's marketing efforts could be expanded to include new product and market development, including targeting and distribution of salmon products at the wholesale and retail levels.
- Providing funding for ASMI's Salmon Recovery Proposal.
- Supporting the Salmon Strategy Task Force's recommendation that ADF&G review the impact of fisheries management practices on fish quality, especially related to the quality of cost-recovery fish harvested in terminal areas.
- Conducting a comprehensive analysis of ASMI privatization including whether 1) privatization would provide greater flexibility and possibly more effective marketing and 2) privatization would result in the loss of control over marketing activities to the detriment of Alaska and Alaska fishermen.
- Encouragement of the development of a national salmon marketing council.

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CHAPTER XI. OTHER ISSUES

A. USE OF ENHANCEMENT AS ENVIRONMENTAL MITIGATION

Hatcheries are sometimes built with the goal of mitigating environmental damage caused by such things as construction of dams and other projects, and water pollution. The goal of environmental mitigation has been a driving force in salmon hatchery development in the Pacific Northwest, particularly in association with dams on the Columbia River.

In contrast, Alaska's hatchery system has been developed for fisheries enhancement, mitigation of the effects of over-fishing, and the offsetting of reductions in fishing quotas for Alaskan fishermen negotiated as part of the U.S./Canada Salmon Treaty. However, Alaska law does contain several provisions regarding use of fisheries enhancement projects as a means of mitigating environmental damage. The primary one is the "Fishways Act."

Alaska Statutes 16.05.840 through 860, referred to as the "*Fishways Act*," gives the Commissioner of Fish and Game the authority to require the builder of a dam or other obstruction across a stream containing fish to provide and maintain a fishway or other device for fish passage. Where a fishway is not practical because of cost, the builder of the obstruction can choose among several other mitigation options with the approval of the commissioner. The options include:

1. Paying a lump sum to the state Fish and Game Fund;
2. Conveying land and funding the building, maintenance and operation of a fish hatchery, rearing ponds, buildings and other facilities; or
3. Agreeing to provide money (both initially and in annual payments) to expand, maintain, and operate additional facilities at existing hatcheries within a reasonable distance of the dam or obstruction.

The Fishways Act was passed in 1959. Since that time, other environmental protection laws and regulations have been enacted setting water quality standards and regulating the types, locations, designs, and allowability of development projects. The *Anadromous Fish Act* (AS 16.05.870) is especially important as it spells out requirements for pre-approval of any projects which could potentially impact fish or fish habitat. This Act and other environmental protection requirements work in conjunction with the mitigation requirements in the Fishways Act.

According to the Department of Fish and Game, the requirement to provide a fishway, either as a permanent structure or as a temporary one during construction, logging, or other work, is used frequently. The State often requires construction of spawning channels in streams that are being disturbed by such things as highway projects. *Although the other provisions of the Fishways Act which require construction of hatcheries or monetary compensation are rarely imposed, state officials believe their existence in statute encourages modifications in project plans that will avoid the actual stream obstruction and serious risk to fish that would activate these very expensive mitigation measures.*

Obviously, preventing damage to fish and fish habitat in the first place is the simplest and most practical means of ensuring the health and ongoing availability of fish. State and

Federal officials are charged with making every effort to ensure that the siting, planning and construction of any development project is done in a way that avoids or minimizes potential damage. *Realistically, however, development will occur which will damage fish and fish habitat. In those cases where environmental protection methods, even fishways, cannot prevent that damage, mitigation of some sort is usually required by law.* In other states and countries, hatchery production has indeed provided enough fish to keep some commercial and sport fisheries alive, at least for a time, that would otherwise have been curtailed due to a lack of fish. This is particularly true in areas where major dam projects or pollution have completely changed or destroyed salmon habitat and spawning patterns. To fishermen in an affected area, hatcheries seem better, at least initially, than no mitigation at all.

While salmon and steelhead hatcheries do produce fish to offset declines in natural runs, there is increasing concern among some scientists in the Pacific Northwest that under some circumstances hatcheries may actually cause the further depletion of already suffering natural stocks, even to the point of extinction. These concerns are further addressed in Chapter VII of this report, regarding biological and genetic issues.

It is important to note how the federal Endangered Species Act (ESA) relates to the matter of using hatcheries as a means of mitigating environmental damage. In the state of Washington, where hatcheries have been used extensively with mitigation as a goal, scientists and fishermen are concerned that regardless of how productive hatcheries might be, they cannot prevent the federal government from invoking the provisions of the ESA if particular stocks are declared endangered. Indeed, the National Marine Fisheries Service (NMFS), which has jurisdiction over endangered species, proposed in 1991 that one stock of Snake River sockeye be listed as endangered under the ESA, and that two stocks of Snake River chinooks be listed as threatened. Decisions on two more salmon stocks (in the Snake and Columbia Rivers) are expected soon.

The Washington Legislature is considering legislation to address issues which have arisen from the application of the ESA to Washington's salmon. These issues include salmon habitat, wild stock protection, tagging of hatchery stocks, and how to define "species" or "stocks" of fish.

Declaration of a salmon stock as "endangered" can have enormous impacts on fisheries and local and state economies. Since salmon are migratory, any restrictions placed on fisheries to protect a particular stock could affect fishing hundreds or even thousands of miles from the spawning area of that stock.

The Endangered Species Act in effect sets the parameters within which hatcheries can be used to mitigate environmental damage. The Act does not recognize the creation of strong runs of one stock of salmon, through hatcheries or other enhancement efforts, as adequate compensation for the destruction of another stock. If a natural stock is at risk of becoming "endangered," the ESA will not allow for hatcheries to serve as a substitute for damaged habitat. The end result is that efforts to mitigate damage through hatcheries can backfire, closing down fisheries rather than enhancing them, if the hatcheries contribute to the further depletion of a stock. *Thus, to avoid the impacts of the strict protective measures which can be imposed under the ESA, primary concern must be focused on preservation of wild stocks.*

It should be noted however, that in some instances, such as where dams have irreparably destroyed the ancestral habitat of a particular salmon stock, a carefully designed hatchery or other enhancement project may represent the only hope for survival of that stock. For the purposes of ESA, federal law defines "conservation" as including "propagation" if it is necessary to help an endangered or threatened species recover. *Thus, while the ESA serves as a warning against hatchery development that could deplete natural stocks, it also recognizes the potential usefulness of hatcheries in the ultimate survival of an endangered stock.*

Judgement about how effective hatcheries can be for "mitigating environmental damage" must be made on a case by case basis and with a recognition that mitigation is just that, a means of minimizing or offsetting some of the change or damage. Hatcheries can produce new harvestable salmon, but they do not generally repair or duplicate a damaged resource. Hatchery production of fish is an expensive ongoing commitment. *The use of hatcheries to mitigate damage must be employed with the understanding that salmon which have been provided "free" and perpetually by nature, are being replaced by salmon that will initially and continuously cost money to produce.* This cost, along with the possibility that hatcheries may harm remaining natural stocks, must be realistically considered and weighed in each case, against what is to be gained through the project that will cause the damage and set the mitigation effort into motion.

OPTIONS FOR POSSIBLE CONSIDERATION:

- Re-evaluation of the state Fishways Act and Anadromous Fish Act in light of the provisions of the federal Endangered Species Act.
- Evaluation of whether specific consideration of potential consequences of the ESA should be required before the commissioner can pre-approve a project (under the Anadromous Fish Act) or approve of mitigation measures (under the Fishways Act).
- Tracking the current and upcoming debate and actions occurring in other areas, particularly the state of Washington, regarding environmental mitigation of damage to fish habitat. Determine the relevance of findings to Alaska.

B. ROLE OF ENHANCEMENT IN INTERNATIONAL TREATIES

U.S./Canada Pacific Salmon Treaty

After many years of negotiation, the United States and Canada signed a treaty in 1985 regarding the interception of Pacific Salmon. *The primary goals of the treaty were to protect and rebuild depleted salmon stocks, assure the long-term viability of salmon stocks within the jurisdiction of the treaty, and bring equity by providing that each country receive benefits from the fisheries which are roughly commensurate with their respective production of salmon in the treaty area.* Fisheries management guidelines for the region covered by the treaty (Oregon, Idaho, Washington, Southeast Alaska and British Columbia, Canada) are provided in a series of annexes to the treaty which are renegotiated on a regular basis. The annexes establish baseline-harvest numbers for many areas but the authority over allocation

of fish between user groups within specific areas is maintained by the respective states, provinces, and tribes.

In 1983, a tentative treaty agreement was reached, but Alaska fishing groups found the provisions to be unacceptable and the treaty was not signed. Concerns centered on the concessions to be made by Alaska in the treaty. The reduction in the level of chinook salmon that Alaska trollers would be allowed to harvest was especially controversial. Key to the eventual acceptance of the treaty by Alaska was an offer by the U. S. federal government to give Alaska approximately \$20 million for salmon enhancement to help offset impacts of the treaty. *This mitigation money was not part of the negotiated multi-party treaty. It was a separate agreement between Alaska and the U.S. federal government, offered fundamentally as an incentive to Alaska to agree to the treaty.*

Under the terms of the treaty, Alaska hatchery fish caught after 1985 were not to be counted as part of the negotiated quota of allowable catch, and could be taken in addition to that quota. *While everyone involved seemed to understand that the federal mitigation money was intended to replace what the Southeast Alaska fisheries groups had lost in the treaty settlement, the specific purpose of the money was not clearly spelled out at the time of the agreement. This lack of clarity and documentation has caused considerable confusion and controversy over the years.* Initially many fishermen and the Alaska Department of Fish and Game believed that the money was to go towards an annual production goal of 100,000 chinook for the trollers, 1,000,000 chum for the seiners, and 20,000 to 40,000 sockeye for the gillnetters. Although the state appears to have honored the general purpose of salmon enhancement with the mitigation funds, it has not spent the funds in accordance with the most widely-held understanding of the intent for those funds.

The governments of Washington and Oregon have not allocated any funds specifically for enhancement projects related to this treaty. British Columbia instigated a treaty-related enhancement project on the Fraser River, but has since run out of funds to continue it.

A computer model was developed to calculate the allowable catch of each of the parties to the treaty, and to update that quota annually. Information about hatchery-bred fish indicates the health and numbers of the natural stocks for the computer model.

Alaska fishermen agreed to the Pacific Salmon Treaty, despite the sacrifices it required in their allowable catch levels, because of guarantees that increased hatchery efforts and production would result in increases in these allowable catches. For reasons which may have included misunderstandings of original intentions, a lack of clear binding language in the treaty, or ineffectual negotiating at annual sessions to update agreements and re-negotiate treaty annexes, many fishermen are dissatisfied with what the treaty has accomplished. Hatchery efforts funded with mitigation funds have indeed produced salmon, but fishermen, particularly trollers, do not believe they have received the benefits they were promised from that production.

While fishermen may not have seen the specific benefits they had hoped for in the form of increased allowable catches, the state hatchery program has received more funding than it would have had without mitigation funds, and the Alaska Department of Fish and Game has been able to use mitigation money to supplement their budget for projects and personnel which are related directly or indirectly to the goals of the treaty.

Yukon River Treaty

Salmon restoration and enhancement have been discussed as part of the United States/Canada Yukon River salmon negotiations since 1985. The goal of the United States in these talks has been to ensure the long-term health of salmon stocks and assure consistency in harvest for both countries of the Yukon River system.

The U.S. proposal, agreed to by the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the Yukon River Drainage Fisheries Association, includes:

- Restoration projects to increase production of transboundary stocks that do not respond to harvest management.
- Fisheries enhancement projects where appropriate, consistent with state genetics and disease policies.
- Planning strategies to allocate and manage restored stocks before the program starts.
- Operational plans for enhancement projects, with protection of wild stock genetic diversity as the paramount concern.

The FRED Division has developed a Yukon Fisheries Enhancement Initiative with its key components being overall design and planning work, expansion of the Clear Hatchery near Nenana, Alaska, and rehabilitation of natural salmon production. The cost of this initiative is estimated to be more than \$13 million.

Fishermen along the Yukon are primarily interested in bringing natural stocks back to historic levels. Rehabilitation projects and protection of wild stocks are their top priorities.

Some biologists believe that supplemental hatchery production on the Yukon River will only further complicate mixed stock fisheries management, and risk the reduction or elimination of small wild stocks. They are also concerned about the risks of genetic dilution of natural stocks, reduced stock fitness, and disease.

OPTIONS FOR POSSIBLE CONSIDERATION:

- Evaluation of the effectiveness of enhancement as an international treaty component.
- Requirement of a comprehensive feasibility and benefit-cost analysis of enhancement in treaty proposals prior to treaty agreements. Because state agency budgets tend to "benefit" from enhancement agreements, consider contracting these reviews to disinterested third parties.
- Development of an auditing mechanism to determine if enhancement benefits are realized by fishermen impacted by treaty agreements.

C. ENVIRONMENTAL REGULATIONS RELATED TO ENHANCEMENT

There are a number of environmental considerations involved in the siting, construction, and operation of hatcheries. In addition to the biological and genetics matters associated with the fish and eggs themselves, other environmental protection issues include the siting of hatcheries, their water usage requirements, the effluent they produce, and the disposal of fish carcasses (of broodstock or fish which are excess or diseased).

While Alaska law does not contain many environmental statutes and regulations which are specific to hatcheries, it does have a number of general provisions regarding protection of the environment which come into play during the planning, development, and operation of hatcheries. These include the Anadromous Fish Act which controls and requires approval for any construction projects or other action which might affect "rivers, lakes or streams or parts of them that are important for the spawning, rearing or migration of anadromous fish"; the Fishways Act which requires the construction of a fishway or hatchery construction if a dam or other obstruction will impact the passage of fish (see section on environmental mitigation); plus many laws and regulations about water quality and pollution, protection of genetic purity of fish stocks (see chapter on biology and genetics), fish health inspections (AS 16.05.868), and siting of hatcheries.

A significant environmental protection issue associated with hatcheries is the discharge of waste into public waters. The procedures and permits required of hatchery operators in this regard have been confusing and in a state of flux for several years, but now seem to be headed for some resolution and streamlining. Part of the confusion stems from the fact that both the Federal Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation (DEC) have some jurisdiction in this matter.

It appears that both EPA and DEC have been fairly lenient about requiring the various waste disposal permits that have technically been required. Even so, there have been very few complaints or problems regarding hatchery impacts on water. Hatcheries do discharge effluent which may contain organic fish waste, as well as some disinfectants or other chemicals used to prevent or control disease, but generally they discharge only very small amounts of pollutants. *However, recent developments necessitating the disposal of large numbers of fish carcasses have raised the subject of waste disposal monitoring.* These developments include 1) a joint decision by the Federal Food and Drug Administration and the Alaska DEC in 1990 that the carcasses of hatchery broodstock (mature fish used for the taking of eggs and milt) should no longer be sold for canning for human consumption, and 2) the recent huge returns of fish, particularly in Prince William Sound, which have resulted in the inability of hatcheries to sell large numbers of their "cost-recovery fish." Both of these developments demonstrated the need to establish procedures for hatcheries to dispose of large numbers of fish carcasses.

The federal Clean Water Act prohibits the point source discharge of pollutants by any person into the waters of the United States, except in compliance with the terms and conditions of a National Pollutant Discharge Elimination System (NPDES) permit issued by EPA. *Under federal regulations, discharges of concentrated aquatic animal production facilities require NPDES permits.* The regulations identify the annual level of production and feeding of a facility to require an NPDES permit, but also leaves to the EPA the discretion to require the permit of any facility it deems to be a significant contributor of pollutants.

In a January 1991 letter to all hatchery operators in Alaska, the EPA explained these requirements and noted that even if the regular operations of a hatchery did not fall under the NPDES permit guidelines, a permit would be required if the operator planned to dispose of fish carcasses in the water. It further explained that fish processors who dispose of greater than 1000 pounds of waste per day may be covered by the "Authorization to Discharge Under the National Pollutant Discharge Elimination System for Alaska Seafood Processors" general permit (the GP), and that for the purposes of carcass disposal, the EPA was willing to cover hatcheries under the same GP. The letter explained that this "greatly simplifies the administrative process and reduces the time frame in which a NPDES permit is obtained." The letter ended by asking that hatchery operators notify the EPA of their plans for fish waste disposal prior to the 1991 season.

In April 1991, the Anchorage EPA office sent another letter to all hatchery operators stating that many of the responses they had received to the January letter had raised a number of issues to be considered. Since resolving these issues is likely to take some time, the EPA established an interim policy to allow the hatcheries to operate and to provide for environmental protection in the interim period. The letter goes on to lay out three conditions under which the disposal of whole fish carcasses would be permissible. The criteria include 1) the depth of water where discharge may occur, 2) a requirement of pre-approval of the discharge site by EPA, and 3) a requirement that the skipper of the discharge vessel maintain records of each discharge occurrence, its location, and the date.

Alaska is currently operating under the interim criteria spelled out in the EPA's April 1991 letter. Many hatcheries, particularly state-run hatcheries, have submitted their applications for the NPDES permits to EPA. However, the EPA considers these state hatcheries to be minor dischargers and has agreed to turn over to the state the authority for permitting and monitoring of their waste discharge. EPA has forwarded copies to DEC of all the NPDES permit applications they have received from hatchery operators, and has asked that the state implement a hatchery waste permitting process.

Under current state law, hatchery effluent is covered under the DEC waste disposal permit statute (AS 46.03.100). DEC reports that few hatcheries apply for this permit but DEC has been comfortable with the situation, and has made permitting hatcheries a low priority, since hatcheries generally handle effluent in a manner that maintains acceptable water quality standards.

DEC has drafted a "General Waste Disposal Permit for Fish Hatchery Discharges," to be issued to hatcheries to fulfill the state waste permit requirement. Once the state has officially adopted this permit, hatchery operators will obtain waste permits only from DEC under the operating agreement between DEC and EPA. This state permit would in effect fulfill both state and federal waste permit requirements. This centralization and consolidation should simplify the permitting and reporting processes for hatchery operators, ensure more compliance, and improve uniformity in the monitoring and information available.

The state's draft permit contains a provision stating that the permit is effective until a specified date, "unless superseded before that time by a state certified EPA permit." This statement is included in order to provide for any potential situation in which EPA might require an NPDES permit, which would then supersede the state permit. The draft permit contains specific language regarding discharges, carcass disposal, drugs, chemicals and medications, operational, monitoring and reporting requirements, and so on. It lacks specific language to address disposal of diseased fish or eggs but other general provisions

in the permit, or language in the hatchery operational permits from ADF&G may sufficiently provide for that circumstance.

Despite the lack of clear regulations and enforcement, and the confusion over federal and state requirements, there have been very few problems reported regarding such things as hatchery waste disposal in Alaska. Even during the situation in Prince William Sound during the 1991 season when processors would not buy many of the hatchery fish that later had to be dumped, both DEC and EPA report that their agencies worked very closely with the hatcheries to devise and carry out plans for large-scale carcass disposals, and things went quite smoothly. The Alaska Departments of Fish and Game and Environmental Conservation, and the federal Environmental Protection Agency, generally believe that for this aspect of environmental protection, current laws are adequate.

Other environmental issues related to hatcheries are covered in this report in the chapters on Biology and Genetics, Planning and Permitting, and Environmental Mitigation. The topics covered in those chapters appear to raise more serious and complex environmental concerns and questions, and need more extensive review, than the more direct environmental protection regulations discussed here.

OPTIONS FOR POSSIBLE CONSIDERATION:

- Encouraging DEC and EPA to coordinate waste disposal permitting requirements to the extent possible.
- Ensuring that adequate direction is provided in regulation regarding the disposal of any diseased hatchery fish.

D. USE OF ENHANCEMENT AS TOOL FOR ECONOMIC DEVELOPMENT

The state's financial support of hatchery production and other enhancement efforts has focussed primarily on Southeast Alaska, Prince William Sound, Cook Inlet, and Kodiak. However, fisheries enhancement is increasingly being viewed in other rural areas of the state as a tool for local economic development. Potential benefits from enhancement activities include the increased number of jobs, the potential for attracting processors or other value-added businesses to the region, as well as increased harvest for fishermen.

In some cases, the regions interested in enhancement for economic development have small, localized commercial fisheries based on local stocks of fish which in many cases are depleted, and which local residents would like to see replenished. In other areas of the state, residents are interested in the potential of creating entirely new fisheries. For many rural areas of the state, fisheries development represents the most viable - and in many cases, perhaps the only - opportunity for economic development.

Some of the projects being discussed and planned include:

- Sikusuilag Springs Hatchery.* Residents of Kotzebue Sound are meeting with a planning core group that includes ADF&G, the National Park Service, and the Northwest Arctic Borough to develop increased production proposals as part of a basic management plan for this small state hatchery located on the Noatak River.

A regional aquaculture association will probably be established in 1992, and a comprehensive salmon plan for the region should be completed in 1993.

- Yukon Enhancement Initiative.** Residents of the Yukon River area are organizing an aquaculture association and seeking legislative funding so that regional enhancement planning can be reactivated and expanded. A draft comprehensive salmon plan could be completed by early 1994. Enhancement efforts are also being considered as part of the U.S./Canada Yukon River treaty negotiations.

- Western Alaska.** Feasibility studies are underway for potential fisheries enhancement projects in the Nelson Island/Chevak area. Local villages and the Bering Sea Fishermen's Association are contributing to the effort, with additional funding requested from the Bureau of Indian Affairs and the National Coastal Resources Research and Development Institute. Although there are no natural runs currently, fishermen in this region are interested in developing salmon returns in streams that are ice-free year round.

- Norton Sound Economic Development Initiative.** Under this proposal, developed in February 1991, FRED Division is providing technical support in developing a fisheries enhancement program at Elim, including stream rehabilitation and a possible hatchery.

- Port Graham Salmon Development Project.** The goal of this pink salmon development project is to create a local village economy based on high quality value-added salmon products. The goal of the hatchery is to produce fish for the processing plant.

- Kake Nonprofit Fisheries Corporation.** This southeast Alaska community proposes to expand its Gunnuk Creek Hatchery with the express goal of contributing to the economic development of the village. Kake has historically been a fishing village, but in recent years saw logging replace fishing as the major form of employment in the community. Logging is now on the decline, and the village wishes to expand its fishing industry.

It should be noted that these enhancement proposals are subject to the same concerns and conflicts generated by enhancement projects elsewhere in the state. The continued interest in enhancement and in hatcheries however, should be a prime reason for addressing the issues highlighted in other chapters.

OPTIONS FOR POSSIBLE CONSIDERATION:

- Evaluation of how much weight to give the need for local economic development when considering a new hatchery permit application.

E. IMPORTANCE OF ENHANCEMENT TO SPORT FISHERIES

While the Senate Special Committee on Domestic and International Commercial Fisheries initiated the Legislative Review of Alaska's Fisheries Enhancement Program to evaluate the contribution of the program to commercial salmon fisheries, the role of the program in

sport fisheries warrants attention. This section summarizes information provided by a FRED Division report attached to this chapter.

Many projects in the statewide enhancement program produce fish, primarily chinook, coho, pink, sockeye, and chum salmon, steelhead, rainbow trout, grayling, and Arctic char, that are highly valued by sports fishermen. Fish targeted for sport fisheries are released in over 350 locations around the state. Many of the projects operated by the FRED Division are entirely dedicated to improving recreational fishing opportunities.

Sport fishing has been growing in Alaska as evidenced by the increase in the number of licensed anglers from 1977 (200,000 total license sales) to 1990 (425,000 total license sales). This dramatic increase in sport fishing participation can be attributed to many factors, including changes in population, real per capita income of residents and non-resident visitors, and the opportunities for quality sport fishing experiences. A major component of a high quality fishing experience, especially for resident anglers, is the probability of catching a fish during the fishing experience (called the harvest per angler day). According to ADF&G, the economic value of fishing experiences are directly related to higher harvests per angler day. The statewide enhancement program has been a key factor in maintaining and augmenting these harvests despite increasing fishing effort.

The statewide salmon enhancement program has grown to the point of supporting a significant portion of total sport and commercial fishing harvests. For example, total 1990 recreational harvests of salmon, trout, grayling, Arctic char, and steelhead was approximately 1.3 million fish. The enhancement program is estimated to have contributed 28 percent of the harvest. State facilities provided 73 percent of the enhancement harvest while PNPs provided 27 percent.

According to recent studies completed by the ADF&G, sport fishing provides significant economic benefits in Alaska. A draft study prepared by ADF&G is attached.

OPTIONS FOR POSSIBLE CONSIDERATION:

- If the Legislature initiates an on-going enhancement program review similar to Canada's, include sport as well as commercial fishing aspects of the program in order to achieve a more comprehensive performance report.
- Increasing the sport fish license fees or changing priorities of sport fish funds to pay for a larger portion of the enhancement projects that benefit recreational fisheries.
- Encouraging Congress to increase Dingle-Johnson funds provided to Alaska to support increasing sport fishery enhancement and rehabilitation efforts.

F. CONTRIBUTION TO SUBSISTENCE FISHERIES

In addition to commercial and sport fisheries, there is increasing demand for the state's enhancement program to provide fish for subsistence and personal use fisheries.

Sikusilaq Hatchery on the Noatak River provides a substantial number of chum salmon for subsistence gillnets in Kotzebue Sound and on the Noatak. Subsistence users in southern Southeast harvested 5,000 sockeye salmon produced from the McDonald Lake

fertilization project. Production from the Klawock Hatchery, located on Prince of Wales Island, is extensively used by subsistence fishermen.

OPTIONS FOR POSSIBLE CONSIDERATION:

- If the Legislature initiates an on-going enhancement program review similar to Canada's, include subsistence and personal use as well as commercial and sport fishing aspects of the program in order to achieve a more comprehensive performance report.

G. ENHANCEMENT OF OTHER SPECIES

In addition to its work on such sport fish species as grayling, rainbow trout, and arctic char, FRED Division is also exploring king crab rehabilitation in a cooperative effort with Kodiak fishermen and the Kodiak Island Borough. Additional funding is being requested from the Alaska Science and Technology Foundation in order to examine shellfish rehabilitation projects in other countries and states.

Currently, research and production of non-salmon species is done almost entirely by the FRED Division. If private entities became interested in taking on such efforts, statutory changes would be required since the entire PNP program is based on salmon production.

OPTIONS FOR POSSIBLE CONSIDERATION:

- Amending statutes to allow the private sector to enhance non-salmon species.
- Taking action to encourage the production of non-salmon species.

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**The Scope, Importance and Economic Value of the Fishery
Enhancement Program to the Recreational Fishery in
Alaska**

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The Scope, Importance and Economic Value of the Fishery Enhancement Program to the Recreational Fishery in Alaska

Introduction.

The importance of enhancement program to the recreational fishery.

Many projects in the statewide enhancement program produce fish that are highly valued by sports fishermen, primarily chinook, coho, pink, sockeye, and chum salmon, steelhead, rainbow trout, grayling, and arctic char. Fish targeted for sport fisheries are released in over 350 locations around the state. Many of the projects in the state operated portion of the program (FRED Division) are entirely dedicated to improving recreational fishing opportunities.

This chapter summarizes the size and distribution of enhanced harvests, type of economic effects that result from the harvests, other non-market values associated with tourism, and to the extent possible, magnitude of these effects on Alaska's economy. Additionally, a discussion of some of the issues and conflicts relevant to the enhancement of recreational fisheries are presented.

Sport fishing has been growing in Alaska since Statehood. This is evidenced by the increase in the growth in the number of licensed anglers fishing in Alaska from 1977 (200,000 total license sales) to 1990 (425,000 total license sales) (Mills 1991).

The explosive growth in sport fishing participation in Alaska can be attributed to many factors, including changes in Alaskan population, real per capita income of resident and non-resident visitors, and the opportunity to have a good quality fishing experience. A major component of a high quality fishing experience, particularly for resident anglers is the probability of catching a fish during an angling experience (called the harvest per angler day) (Jones and Stokes 1991). The economic value of fishing experiences are directly related to higher harvests per angler day. The statewide enhancement program has been a key factor in maintaining and augmenting these catches in the presence of increasing fishing effort.

Magnitude of recreational fishing from the Enhancement Program.

The statewide salmon enhancement program has grown in recent years to the point of supporting a significant portion of the total Alaska fin fish harvest. Total finfish harvests in 1990 in the Alaska Recreational fishery were 1,995,360 (Mills 1991)¹. Total finfish harvest of trout, salmon, grayling, and arctic char and steelhead was 1,341,741. The enhancement program contributed over 28 percent of the harvest of salmon, trout, grayling, arctic char, and steelhead (Table 1.)(Fig. 1)(McKean 1991 and Mills 1991).

The state operated enhancement program produced 270,983 salmon, trout, grayling, char and steelhead in 1990, while PNP operators contributed 98,910 salmon to the recreational harvests for a Total of 369,893 fish (Table 1) (Fig. 2). The total recreational harvest from enhancement in 1991 is estimated to be 357,370 (Holland and McKean 1992).

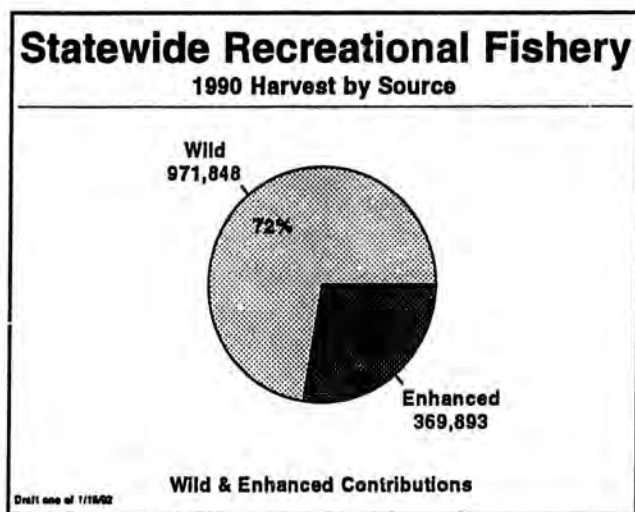


Figure 1

Table 1. Number and Percent of Enhanced Salmon, Trout, and other enhanced species harvested in 1990 in comparison with total harvest in the recreational fishery.

Species	king	searun coho	sockeye	pink	chum	landlocked coho/chin	rainbow	other	total
FRED harvest	16,100	33,447	3,550	3,900	0	37,831	170,283	5,872	270,983
PNP harvest	1,517	34,754	0	54,867	7,772	0	0	0	98,910
Enhance total	17,617	68,201	3,550	58,767	7,772	37,831	170,283	5,872	369,893
Wild totals	106,291	257,735	235,568	146,835	6,753	0	21,526	197,140	971,848
Grand Total	123,908	325,936	239,118	205,602	14,525	37,831	191,809	203,012	1,341,741
% harvest enhanc	14.22%	20.92%	1.48%	28.58%	53.51%	100.00%	88.78%	2.89%	27.57%

¹ Over 1 million razor clams were also harvested in 1990 in non-finish fisheries.

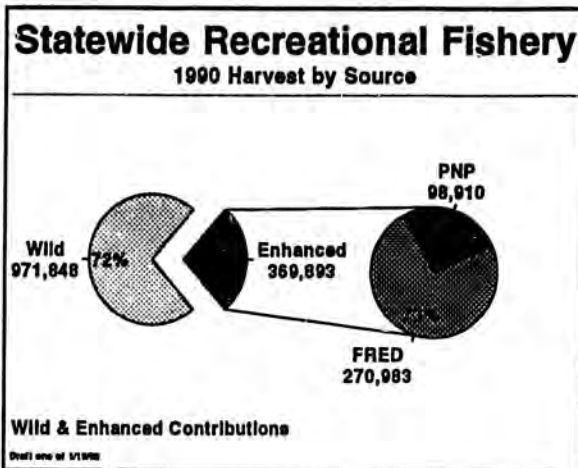


Figure 2

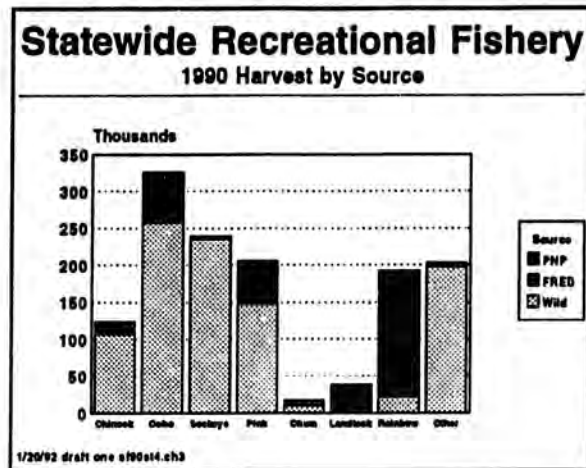


Figure 3

List of selected enhancement projects that have dramatically increased recreational catches.

- o Eighty nine percent of the 192,000 rainbow trout harvested by sport fishermen in Alaska in 1990 originated from state operated hatcheries (Fig. 3)(McKean 1991, and Mills 1991)².
- o Of 37,831 coho and chinook landlocked sport harvests, 100% were produced by state hatcheries in 1990 (McKean 1991, and Mills 1991).
- o Between 1987 and 1990, 47% of the coho salmon harvested in the popular Resurrection Bay sport fishery originated from enhancement projects at Elmendorf Hatchery, Trail Lakes Hatchery, and Bear Lake rearing Facility. The average sport harvest of enhanced fish was 9,910 (McKean 1991).
- o Harvests of coho salmon from enhancement projects in the Juneau area increased by 21 fold (2,166%) between 1990 and 1991 from 1,174 to 21,664 fish (McKean 1991). Most of the increased harvests in 1991 were estimated to originate from Gastineau Hatchery operated by Douglas Island Pink and Chum (Holland and McKean 1992).
- o In 1991 the Homer Spit recreational fishery produced 10,000 coho salmon, 3,500 chinook salmon, and 500 pink salmon entirely from enhancement releases from Crooked Creek Hatchery.

² While enhanced harvest statistics are available for recreational fisheries in 1991, statewide harvest statistics for wild and enhanced fish are produced on a one year lag, so 1990 is the most recent year that total and enhanced harvests may be contrasted.

- o Southeast chinook salmon production in 1991 totaled almost 38 thousand adult fish returning with another 5 thousand pan-sized fish harvested in stocked lake fisheries. Over six thousand adults and 5 thousand sub-adults were harvested in marine and freshwater sport fisheries.
- o The Elmendorf and Crooked Creek Hatchery increased the harvests of king salmon by 4,800 and coho salmon by 1,655 in the 1990 Kasilof River Recreational Fishery.

Contribution of enhancement program to community fishing derbies.

Dozens of fishing derbies are conducted each year in Alaska. Fishing interest groups and vendors, and municipalities are the major organizers of these events. Approximately one dozen of these derbies produce large harvests of fish into the recreational fishery (Table 2). The major reason that communities hold derbies is to increase the amount of economic activity in an area or to collect revenue for charity.

Retail businesses in some communities depend upon the angler related spending that occurs during a derby to sustain a large portion of their annual gross receipts. The ability of a derby to attract the angling public depends largely on the ability of the fishery to supply a good fishing experience with acceptable catch levels.³ The enhancement program augments catch opportunities and in some cases is the primary source of fish harvested during the derby. In Alaska some derbies would not be able to exist without fishery enhancement (i.e. Valdez coho derby pers. comm. Paul McCollum) others would not attract nearly as many participants without the acceptable catch rates offered by fishery enhancement. Approximately 82% of the salmon harvested in Alaska's major fishing derbies have originated from the statewide enhancement program (Fig. 4).

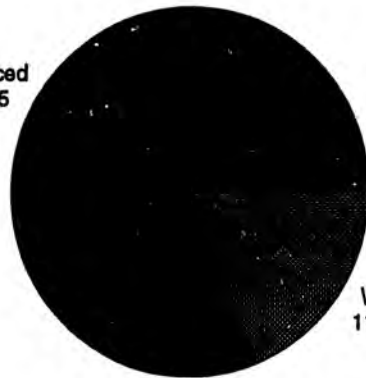
List of major fishing derbies in Alaska, augmented by enhancement

1. Juneau sport fish Derby
2. Ketchikan sport fish Derby
3. Wrangell/Petersburg
4. Sitka Derby
5. Seward Coho derby.
6. Valdez Derby
7. Big Lake Derby
8. Seldovia
9. Community of Houston
10. Assorted Kodiak derbies

³ Weather conditions, income, and substitute recreational activities, and the opportunity to compete for prizes, are also known to affect participation in fishing derbies.

Statewide Recreational Fishery Fishing Derby Harvest

Enhanced
50135



Wild
11655

Wild & Enhanced Contributions

Figure 4

Table 2. Fishing Derby Harvests, including numbers of enhanced fish by species, percent of enhanced fish by species for 1991 and other selected years.

Derby Name	Species	Location	Enhanced Harvest	Wild Harvest	% Enhanced
Golden North(1991) ^a	Chinook	Juneau	136	522	26.0%
	Coho	Juneau	173	2,567	15.8%
Petersburg(1991) ^a	Chinook	Petersburg	228	422	35.1%
Wrangell(1991) ^a	Chinook	Wrangell	48	173	21.7%
Sitka(1991) ^a	Chinook	Sitka	270	980	21.6%
Seward(1989) ^c	Coho	Seward	9,280	5,581	62.4%
Valdez(1991) ^d	Coho	Valdez	10,000	500	95.2%
Valdez(1991) ^d	Pink	Valdez	30,000	500	98.4%
Total			50,135	11,655	81.7%

^a Memo from Paul Suchanek to Fred Gaffney 12/05/91

^b Karen Crandall, Pers Comm. 1-15-91

^c Doug Vincent-Lang Sport Fish Division Anchorage, pers comm. 1-91

^d Paul McCollum, Valdez Fisheries Development Corporation, pers comm 1-91

Valuation and economic impacts of the recreational fishing that result from the statewide enhancement.

How are recreational benefits measured, and how does it differ from an expenditure and an economic impact?

The salmon, steelhead, trout, grayling, and Dolly Varden resource in Alaska provides at least two distinct forms of recreation. It provides an extensive saltwater and freshwater sport fishery, as well as non-consumptive recreation such as watching a run of salmon migrate and spawn. The same basic economic principles apply to determining the value of both forms of recreation in terms of how benefits are generated. However, the data bases differ for each kind of recreation and the methodologies developed for the sport fish evaluations will not be suitable for evaluating the non-consumptive forms of recreation.

Consumptive values from harvests and catches of fish could be likened to property values, in that they vary from location to location. Also, they vary in quality, just as a piece of property with a beautiful view or superior amenities may have a higher market value than an equal sized piece of property with a view of a city dump, and poor amenities.

In the context of a salmon or trout fishery, enhancement changes these consumptive values by increasing the abundance of fish available to anglers. This results in a larger catch which increases the harvest expectations of both current and prospective anglers. This will either cause a greater number of fishermen to go fishing, the current number of fishermen to spend more time fishing, or cause fishermen to receive a higher valued experience for the current amount of fishing effort. Since these angler decisions can occur simultaneously, economic models that estimate the value of these experiences may be quite complex. This chapter includes a short discussion of the methods used for valuing sport fishing benefits from enhancement projects and some analytical results of economic studies on enhancement.

When anglers expend more effort catching fish from an enhancement project they may spend a greater portion of their income in harvesting. For policy makers and fishing interest groups, expenditure data reported by anglers is frequently mistaken for the "value" of recreational fishing. The net economic value of a recreational fishing experience is what fisher's are willing to pay over and above their costs. These expenditures, however, are a "cost" to the consumer and must be subtracted from the total consumer surplus. While these expenditures are an unambiguous cost, they do produce economic activity in communities. This economic activity is referred to as "indirect effects" ⁴ in economics, and is further discussed in the impact section of this chapter.

Consumptive Values and economists use of the term "value".

Given the virtual free and open access to fisheries that are augmented by enhanced fish, the largest part of the incremental recreational benefits generated by FRED Division and the PNP program will accrue directly to recreationists in the form of consumer surplus. **Consumer surplus is a measure of the satisfaction people enjoy from their consumption of a commodity.** It is defined by what they would be willing to pay for it.

If charges could be levied for the rights to harvest enhanced fish, each individual would be willing to pay some maximum fee for the opportunity to participate in any particular type of fishing or other recreational opportunity. Further, the angler would choose to buy a certain number of units of that recreation at each unit price below that maximum. Of course recreationists do not buy angler days or days of salmon viewing as they do other commodities. None-the-less, this price quantity relationship does exist for each individual and forms his or her demand curve for fishing, viewing etc. The sum of all the individual demand curves forms the aggregate demand curve over all those willing to pay to participate in the recreation (Fig. 5).

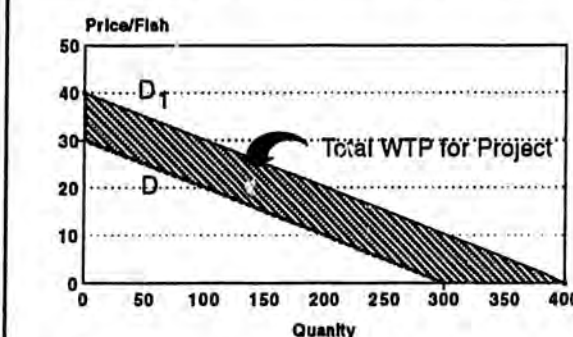
⁴ Also, they are referred to as secondary effects, secondary impacts, and regional economic impacts.

In Fig. 5, the line D represents the aggregate demand curve for some particular recreational activity associated with the salmon, trout or other resource. The area under the curve is the total willingness to pay of all recreationists. It is a measure of the total satisfaction gained from consumption of the recreation if it is offered at no charge. This demand curve is influenced by many factors such as the price of complementary goods, by incomes and by the expectations and perceptions of those who participate. The availability of more fish as a result of the enhancement program causes the quality of the product to change, thus, shifting the demand for salmon and steelhead recreation from D to D1. The expectations of fishermen are raised over the prospect of improved catch success and this, in turn, improves what they are willing to pay for the experience. This increase in willingness to pay results in the consumption of more fish at each price. The shaded area between D and D1 is the increase in consumer surplus that results from an enhancement project.

The total willingness to pay differs from the net willingness to pay in that net WTP considers the additional cost of catching fish. In (Fig. 6), the net willingness to pay for a recreational experience is demonstrated by the difference between the total willingness to pay and the cost of fishing at a given price per fish. The consumer surplus is the shaded area above the price line and below the demand curve. This graph represents the net willingness to pay for a project that creates a new fishery, and does not represent an increment in catch for an existing fishery.

In addition to generating consumer surplus by increasing the abundance of fish in existing fisheries, the statewide enhancement program can generate consumer surplus by opening new sport fisheries. Enhancement projects which rehabilitate a diminished stock have been credited with re-opening sport fishing areas, and with expanding bag limits in a recreational fishery. The reopening of a sport

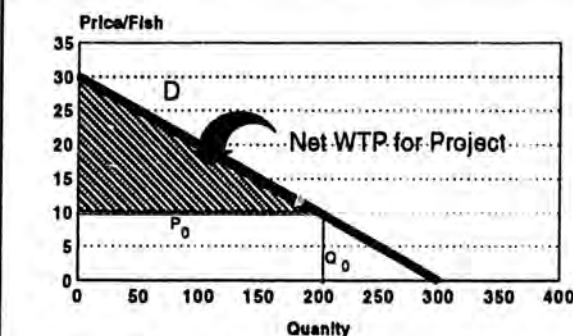
Total Willingness To Pay (WTP) For An Enhancement Project



Draft of 1/22/92 SF90ln1.ch3

Figure 5

Net Willingness To Pay (WTP) For An Enhancement Project



Draft of 1/22/92 SF90ln2.ch3

Figure 6

fishing statistical area, or relaxing of bag limits will often produce greater consumer surplus values than simply increasing catch rates during an existing opening.

Finally, there may be non-consumptive and nonuse values associated with the fishery. These values include existence, option or bequest values. People may gain satisfaction from the fishery not because they make use of it, but for other reasons. Viewing and education associated with fishery enhancement projects motivate tens of thousands of visits to state and PNP facilities each year. A discussion of some of the tourist visitation statistics are included in this chapter. Persons who never fish may still place a value on the continued existence of the fishery. Fishery rehabilitation projects have been applied to several streams with salmon populations that would be otherwise too small to sustain themselves in the future. Although nonuse values associated with fisheries in Alaska may be significant, they are not treated here.

Valuation Statistics on Enhancement of Recreational Fisheries

The State of Alaska is fortunate to have some of the finest economic models in the North America for valuation of recreational fishing. Three studies by the consulting firm of Jones and Stokes, have been carried out since 1986 (Jones and Stokes 1987, 1989, and 1991). The work, which clearly represent the state of the art in recreational demand modeling cover the regions of South Central Alaska, Juneau, and Southeast Alaska. Areas not covered by the analysis include the Arctic, Yukon, Kuskokwim regions, Alaska Peninsula, Kodiak, and Bristol Bay. The State of Alaska has expended over \$600,000 in the development of the current models. The two valuation techniques applied in these studies are (1) a modified travel cost model approach and (2) contingent valuation procedures. While the methods for these two techniques cannot be described in detail here, some of the major findings of the studies, as well as difficulties with the models are summarized.

While enough cannot be said about the analytical quality of the three Jones and Stokes studies, several obstacles exist in actually applying some of the models to policy questions related to the Statewide fishery Enhancement Program.

1. The report for the South Central studies, and Juneau area studies do not include an analysis of current enhancement projects. Some net willingness to pay values are cited in the reports that are unfortunately, not relevant to evaluation of enhancement projects. The economic models created for the studies must actually be operated on a computer program to precisely estimate sport fishing values for policy analysis (unless a relevant policy analysis simulation was carried out under the contract). In fact, the estimates of average value for a day of fishing effort will be overestimates of the marginal value of an enhanced fish by a few percent to more than an order of magnitude. This is demonstrated in the Southeast economic study where average angler willingness to pay per king salmon harvested of \$616 was nearly three times the marginal angler willingness to pay

per fish of \$210 from a king salmon enhancement project (Jones and Stokes 1991). Thus, use of the average willingness to pay figures from the reports, could produce grossly distorted and spurious results when applied to policy questions requiring marginal or incremental values.

2. The South Central Economic Study (Jones and Stokes 1987) is extremely complex, and the models created in this study required initial calibration on a Cray super computer, during their formulation. The cost of carrying out simulations on the mainframe computer is prohibitive for day to day policy analysis. Furthermore, only the staff at Jones and Stokes and a few other economists in the U.S. are capable of operating the South Central Region discrete choice models.

3. Even if the computer simulation models were operated in their current state, many of the site/species statistical areas, that are sampled in the studies are not the sites in which enhanced fish are produced. Enhanced sites must be matched with similar site/species combinations in the surveys to approximate the value of a project. This would require some ADF&G Sport Fish Division staff time to carry out the site/species matches.

4. Applied cost benefit analysis with the Jones and Stokes models require the projection of some fairly detailed catch and effort information from the Department of Fish and Game. The logit Travel Cost models and Contingent Valuation models require detailed information on probable harvests and fishing effort (angler days) for each proposed project. This information must be projected by specific statistical area and by week of harvest.

5. The Jones and Stokes models produce valuation estimates for years between 1986 and 1988. To run simulations on present day policy questions requires some updating of the models. These updates would require some ADF&G staff time and some contractual resources for economic analysis.

For the proceeding reasons (1-5), a comprehensive study of the net benefits of the statewide fishery enhancement program to the recreational fishery has not been carried out. Such a study would be of critical importance for investment and allocation purposes and would complement the economic modeling that the Legislature is now undertaking on the value of enhancement to the commercial fishery. The costs of creating the necessary software to evaluate all projects in South Central region, would require approximately \$20,000. Additional running of simulations would require approximately 1 full year of work in a cooperative effort with FRED Division and the Division of Sport Fish. The simulation of the net benefits for projects in Southeast Alaska could be undertaken with fewer resources, since the computer software was produced as part of the contract. Both the South Central and Southeast Region fishery enhancement could be evaluated with an additional \$30,000 in contractual services, and with the better part of

a year of staff time from the FRED Division economist and 1/3 year of staff time from the Biometrics section of the Division of Sport Fish.

Selected statistics for the enhancement produced Southeast Alaska king salmon fishery.

The Southeast Alaska Sport Fishing Economic Study (Jones and Stokes, 1991) does produce some analytical results that are applicable to estimating the value of proposed king salmon enhancement actions.

- They are:
- (1) An estimate of the net willingness to pay estimates for a proposed increase in hatchery operations for king salmon enhancement of 20%, and
 - (2) A policy analysis question involving the estimation of an increasing in the opening for the Juneau Statistical Area for Chinook salmon fishing.

In brief, the first analysis applies direct survey questions about what amount anglers would be willing to pay for a fishing stamp to charge for improved chinook salmon fishing from the hatcheries in Southeast Alaska. The survey relates these proposed access fees to a 20 increase in production costs from the enhancement facilities. This in turn, was estimated to yield approximately a 30% increase in the average sport harvest of Chinook salmon in Southeast Alaska. While the production costs are not exact estimates, a special simulation of the models revealed that the increase of 8,900 harvests would result in an annual net willingness to pay of approximately 1.9 million dollars annually (1988 dollars) (Table 3). The average value for a chinook salmon in this scenario is approximately \$210 per harvested adult.

Table (3) Total Annual Willingness to Pay of Resident Angler Households in Southeast Alaska for a 20% increase in the King Salmon Harvest from Hatcheries

Harvest Area	Hatchery Operations
Ketchikan	\$380,688
Prince of Wales	340,958
Kake/Petersburg/Wrangell/Stikine	352,287
Sitka	362,983
Juneau-Haines/Skagway	<u>439,104</u>
Total	\$1,876,020

The second economic statistic results from a proposed opening of the Juneau statistical area for King salmon fishing during the months of April, May, and June. This policy question focuses on a recent decision to open a portion of the Juneau Statistical area to early season king salmon fishing (from April 24 to June 18). During a previous opening of this statistical area over 1,130 king salmon were harvested, and a large increase in the number of days of effort were recorded. Angler net willingness to pay for this alteration was estimated using the travel cost, and contingent valuation methodologies. The change in the willingness to pay for the increased catch for this management action was between \$303,500 (from the results of the logit model) and \$398,000 (from results of the CV model) annually and from \$268 to \$352 per harvested fish respectively.

This simulation is similar to the approach that would be applied to computing the value of a Chinook enhancement project that increased the abundance of fish sufficiently to extend the length of the opening in a prime fishing area. For several reasons, the net willingness to pay for an identical increment in chinook harvests from a typical enhanced chinook fishery may be less than the WTP amounts cited in this example⁵, but they are probably within a similar magnitude.

While these valuation results must be offered with a note of caution, they probably provide an upper bracket for the marginal value of a Chinook salmon, produced by enhancement, and caught by recreational fishers in Southeast Alaska. The lack of updated computer software, designed to apply the Jones and Stokes models, is the major restraint to a comprehensive economic assessment of recreational net benefits for the statewide enhancement program.

Visitation Statistics for Hatcheries.

In aggregate, State and PNP hatcheries generate **nearly one half million visitor days from resident and non residents per year**. Visitation statistics have been compiled for the following hatcheries.

Table (4) Public and PNP facilities with visitor facilities and visitation records.

	Visits
Deer Mountain	150,000
Elmendorf	65,000
Ft. Richardson	1,200

⁵a. Most enhancement projects increase the catch per unit of effort in an established fishery opening, but do not result in outright extensions of area/time openings.

b. Harvests in this example consist of both enhanced and non-enhanced salmon. The Jones and Stokes models have demonstrated a small WTP premium for wild fish in the Southeast marine chinook salmon fishery.

Gastineau Hatchery (DIPAC)	100,000
Trail Lakes Hatchery (CIAA)	25,000 (20,000 to 30,000)
Bear Lake Rearing Facility (CIAA)	12,500 (10,000 to 15,000)
Crooked Creek Hatchery	80,000
Valdez Hatchery (VFDA)	8,541
Total	442,241

The tourism generated by hatchery visitation is one example of a non-consumptive value that is created by the statewide enhancement program. Non-consumptive recreational benefits generated by the enhancement program are in many ways more difficult to estimate than the benefits of sport fishing itself. Baseline information on the demand for such forms of recreation is scarce, but visitation itself is an indicator that people derive consumer surplus from these experiences. The value of a visit to a salmon enhancement facility can be compared with the value of visits to attractions such as Aquaria or a private zoo. The willingness to pay for entrance to the facility is a proxy for the minimum consumer surplus derived.

The visits vary in quality and time from facility to facility. Some facilities have extensive visitor amenities and visitation may consist of an hour or more in length. Other facilities have minimal visitor amenities and visitation may consist of a few minutes of viewing of migrating and rearing of salmon. The states largest and most extensive hatchery visitor center is at Gastineau Hatchery, in Juneau. In 1991 the facility charged \$2.25/visit (walk in fee) and recorded nearly 100,000 visits.

While a total value cannot be computed from the existing visitor information available from these facilities, total visitation suggests that benefits to Alaska are on the order of hundreds of thousands of dollars annually.

Indirect economic effects of the statewide enhancement program (employment and income effects from tourism and resident expenditures)

As previously explained, an enhancement project that increases non-market benefits of a fishery will often compel anglers to spend additional fishing effort and make additional expenditures to compete for improved fishing. Thus, fishery enhancement can compel anglers to pay more for boats, moorage, lodging, transportation, food and beverages, guiding, and other fishing related items. It is these out of pocket expenditures that lead to "economic impacts" and result in increased employment and income in the Alaska economy. Businesses that provide goods and services to anglers hire and pay employees and buy inventory from other businesses, which in turn hire and pay employees and buy from still other businesses. Multiplier effects turn these expenditures into gross business revenues in Alaska. The magnitude of these revenues can be projected with economic impact models.

Two economic impact models exist in Alaska that are suitable for computing changes in changes in expenditures and employment resulting from fishery enhancement of recreation. One is an input-output model developed for Jones and Stokes 1987, 1989, and 1991). The second is a model called SALMOD, developed by the Institute of Social and Economic Research. In the Jones and Stokes, I-O models angling expenditures are computed for anticipated change in fishing effort (angler days), and in turn, the direct, indirect, and induced economic impact for a fishery may be estimated. A major advantage of this model is that short run expenditures for a given project are empirically estimated in the behavioral models. Thus, the expenditure estimates conform more closely to the amount of additional spending resulting from a management, or enhancement action. Many impact models must use average expenditure data which can produce greatly overstated estimates of marginal expenditures.

As in the case of the Jones and Stokes non-market models, economic impacts for the statewide enhancement program could not be estimated without the creation of practical computer software, and additional fishery effort projections for enhanced sites (for South Central Alaska). Impact assessments would be possible for enhancement projects in Southeast Alaska with the soon to be completed computer software, and with additional ADF&G staff projections on fishing effort estimates for all enhancement projects. An example of an employment and personal income estimate is provided in Jones and Stokes (1991) for an expansion of recreational fishing opportunities for chinook salmon fishing in the Juneau area. An additional catch of 1,130 harvested adults is estimated to produce approximately \$13,000 in personal income and less than 1 full time job (Jones and Stokes 1991).

Results of Economic impact Assessment of Statewide Enhancement program with ISER Model.

Estimates of employment in the Alaska economy can also be made with SALMOD, an economic impact model created by the Institute of Social and Economic Research (ISER). This model was created specifically for the evaluation of the state wide enhancement program. Several revisions of the economic base model have been completed between 1986 and 1990. The model produces estimates of the expenditures of recreational fishing created by the enhancement program. Employment is expressed in full and part time jobs. The documentation for this model is in progress through a contract with Scott Goldsmith of ISER (pers comm Jeff Hartman FRED Division 1991).

The preliminary results of the FRED recreational impacts, from SALMOD, project personal income to Alaska residents of \$2.0 million to \$7.0 million annually, with a point estimate of \$4.3 million⁶. The full time employment that would result from this

⁶ Income and employment impacts vary greatly depending on what assumptions are used in this model for the expenditures that would occur in the absence of the recreational fishing

increased personal income is approximately 150 jobs. The PNP hatchery personal income impacts from recreational fishing are estimated to be approximately \$400,000. These impacts result from the eggs taken in broodyear 1988, that were projected to return between the years 1990 and 1997 (Hartman, 1988) Memo of July, 20, 1988, to Distribution. These employment and income impacts occur primarily in the Cook Inlet region, Southeast, and Kodiak regions (Table 5) (Fig. 7).

Table 5 Personal Income and Employment Impacts from 1988 simulation of SALMOD impact model for FRED Division enhancement projects by region of impact.

	Total Statewide Impacts	South east	Prince Willia Sound	Cook Inlet Mat/Su	Kodiak AK.	Pen. Interior
Personal Income (\$ 1,000'S)	\$4,309	\$731	\$59	\$2,786	\$37	\$696
Employment	148	25	2	96	1	24

Issues and Conflicts relating to Enhancement of Salmon, Trout, and other species.

1. Allocation between competing users.

Intense competition between users exists for most of the salmon fishery in Alaska as is the case in most of the salmon fisheries in North America. This competition is observed by the Alaska Board of Fisheries, and ADF&G fisheries managers who are under constant pressure to deliver more fish to each of the various interest groups in the state. Within the commercial fishery, sport fishery, personal use and subsistence fisheries of Alaska, there are a multitude of insistent claims to enhanced fish, all asserting equal validity but in total, exceeding the available supply.

Statewide Recreational Fishery

Full Time Jobs From Enhanced Sport Fish

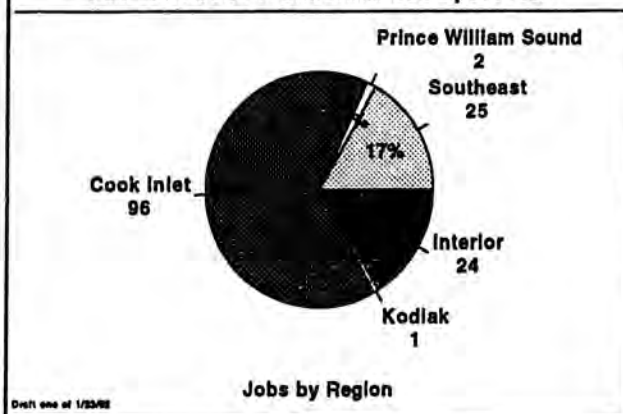


Figure 7

opportunity. Net expenditures in this simulation are equal to 1/2 of the average expenditures for an angler day, as approximated from Jones and Stokes (1987) and Mike Mills pers comm 1988.

The source of the conflict and divisiveness over allocation of enhanced fish is often misunderstood. The primary reason for the competition for these resources lies in the large economic value of the salmon resource that has been created in Alaska. If the resource created by enhancement were of little economic value, fishers would not spend so much of their time trying to seek out larger shares of the available harvest.

Since enhanced fish are often harvested along with wild stocks, allocation conflicts involving recreational fish are complex and intertwined. In Southeast Alaska, the allocation conflicts are additionally complicated by U.S./Canada treaty constraints. This treaty sets strict limits on harvests of non-enhanced chinook salmon in the region. Reduced quota's for chinook salmon, along with increased harvests in the recreational fishery, have generated a recent Board of Fish decision to hold special hearings that consider a range of restraints on the sport harvest of chinook salmon.

Examples of the types of fishing restraints that managers have applied in recreational fisheries include, bag limits, reduced area/time closures, gear restraints, increased user fees, and limited access for charter fishing operations. Most of these techniques reduce fishing effort, and may also reduce the quality of a recreational fishing experience, which in turn can actually decrease the economic value of fishing. The economic costs of some types of restraints to the recreational fishery can be greater than the economic costs of producing additional chinook salmon to targeted commercial or recreational fisheries through enhancement. While there is no substitute for careful management of salmon stocks, the fishery enhancement program may be a tool to help reduce conflict in these types of allocation disputes.

2. Funding of enhancement for recreational fisheries.

While anglers in Alaska have clearly become dependent on the statewide fishery enhancement program for sustaining a valuable fishing experience, the prognosis for sustained financing of fishery enhancement in the state is much less certain.

The existing funding for statewide fishery enhancement program is highly dependent on the continuation of Federal funding through an excise tax and distribution program called Wallop-Breaux. This amendment in the federal Register, represents somewhat of a windfall for Alaska. Alaska fisher's contribute a trivial amount the tax receipts to the total fund in comparison with other states. The current funding formula provides an amount to the State of Alaska which is not commensurate with population or the number of licensed fishermen in Alaska. Should the funding formula for distributing tax receipts to Alaska change, most of the states enhancement production would be affected.

Additionally, in the FY 93 Governor's Budget, two state owned hatcheries that produce important recreational fisheries, are not funded. They are Deer Mountain Hatchery in Ketchikan, and Big Lake Hatchery in Wasilla. Deer Mountain Hatchery produces several hundred chinook salmon harvests in the recreational fishery, and over 1,000 chinook harvests annually in the commercial fishery. It also produces a significant harvest of coho salmon in the recreational fishery. Big

Lake Hatchery plants coho salmon into lakes and streams in the Sustina drainage that are harvested in the sport fishery. While the economic value of the permanent loss of the production from these hatcheries has not been computed, it would be possible to produce an estimate by creating a simulation from the newly completed Southeast Economic Study.

3. Management Implications and Issues related to Enhancement of Recreational Fisheries

It is a statutory obligation of ADF&G to manage fisheries populations in order to maintain a "sustained yield" in the common property fisheries.⁷ Other references to wild stock protection and maintenance of healthy wild stocks are also important parts of the title 16 statutes. There is, however, no specific formula in the statutes for determining the exact population size for a stock of wild fish that is "sustainable". Fisheries managers determine escapement goals for stocks and populations of fish and corresponding catch levels that can be sustained, with a variety of techniques. These sustainable catch levels may vary from year to year based on the expectation of run strength prior to and during the fishing season. Often, there is a great deal of uncertainty over the escapement level that must be maintained to sustain a healthy population of salmon.

What a sustainable wild stock is, and what population size it corresponds to, is of importance for the State and PNP enhancement program. Enhancement projects targeted to commercial, recreational, or subsistence fisheries may increase or decrease populations of wild fish.

In so called "mixed stock" fisheries, an enhancement project may increase the probability of harvesting wild stocks. The probability of wild stock interception increases where information on the temporal and spacial mixing of the enhanced and wild population of salmonids is poor. This potential is generally thought to be of greater concern in commercial salmon fisheries where a great deal of intense fishing power may occur during an opening. Most recreational fisheries, in Alaska represent a small portion of the total salmon harvest, and as such do not contribute as acutely to unwanted interceptions. Possible exceptions to this general rule in anadromous fisheries include (1) Kenai River chinook salmon, where a conservative approach to enhancement has been applied, and (2) Southeast region recreational chinook fisheries where the resident and charter fishing fleet is catching an increasing portion of the allowable chinook harvest. There is no empirical evidence that larger catches of enhanced fish in the recreational fisheries would reduce escapements of wild stocks even in these fisheries.

Enhancement projects may also decrease the probability of over-harvesting wild stocks by drawing fishing pressure to an opening which is composed entirely of enhanced fish. Some evidence exists that demonstrates the ability of an enhancement project to reduce pressure on wild stocks in fresh and salt water fisheries.

⁷ Maintenance of a sustained yield for fish and wildlife resources also has a basis in the Alaska Constitution.

An example of this approach has occurred on the Kenai River, where fishery managers have occasionally restrained sport fisheries in an effort to control excess fishing pressure on chinook salmon. These actions have been taken to reduce the probability of over-harvesting a unique stock of large chinook salmon, that are highly valued by anglers (Jones and Stokes 1987). This stock of salmon, however, is also subjected to fishing pressure in commercial fisheries, which incidentally harvest the large fish while seeking sockeye salmon in Cook Inlet. In 1991, an adjacent chinook salmon enhancement project, in the Kasilof River provided an alternative fishing opportunity that removed fishing pressure from the Kenai (Harrington, 1991, Homer News, July 25, 1991, "Enhancement is favored way to protect sport fisheries"). Catches of enhanced chinook salmon from this project have dramatically increased in recent years (Holland and McKean 1992).

A second example of stock protection through enhancement exists in the urban rainbow trout fishery that is maintained by FRED Division in the Anchorage and Matnauska and Susitna areas. In 1990 89% of the rainbow trout harvests resulted from enhancement projects in road access fisheries. Many of these projects, which produce high catches per angler day, occur in close proximity to wild populations of trout, which are not able to sustain heavy fishing pressure. The opportunity for a higher catch per angler day of effort, undoubtedly draws fishing pressure away from alternative wild fish stocks.

LIST OF APPENDICES

Chapter V. Legal Issues Raised by Board of Fisheries

1. August 1, 1990 memorandum from Alaska Assistant Attorney General Stephen White to Alaska Department of Fish and Game Commissioner Don Collinsworth regarding "ADF&G Authority to Manage Fisheries for Hatchery Broodstock and Cost Recovery".
2. February 28, 1991 memorandum from Attorney Michael A. D. Stanley to Kate Troll, Executive Director of Southeast Alaska Seiners, regarding "Department of Law Opinion, Re: Management of Fisheries for Hatchery Broodstock and Cost Recovery".
3. April 8, 1991 memorandum from George Utermohle, Legislative Counsel, to Senator Dick Eliason regarding "Sustained Yield Management of Salmon Produced by Private Nonprofit Hatcheries".
4. October 17, 1991 memorandum from Attorney A. William Saupe to John McMullen, President of Prince William Sound Aquaculture Corporation, regarding "Proposed Hatchery Regulations".

Chapter VII. Biological/Genetic Issues

1. September 11, 1991 report with attachments by Glen Gray, Legislative Research Agency, "Effect of Hatchery Salmon on Wild Salmon".

Chapter X. Marketing

1. January 24, 1992 report by the Alaska Department of Commerce and Economic Development, "Salmon Strategy Task Force Recommendations".

Chapter XI. Other Issues

1. Background paper prepared by Office of Program Research, Washington State House of Representatives, "Declining Salmonids in Washington".

Record of Public Comment

1. February 24, 1992 Committee Minutes of the Teleconferenced Hearing for Public Comment.
2. Written Public Testimony Submitted.

(Appendices may be obtained from the Legislative Library, State Capitol, Juneau, AK 99801-1182, Phone (907) 465-3808.)

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