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CHAPTER XI. OTHER ISSUES

A. USE OF HATCHERIES 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. (See Attached information).

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 HATCHERIES 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. The Alaska Chapter of the American Fisheries Society is currently considering a resolution to support setting aside the Yukon River drainage as a Wild Stock Management Zone (hatchery-free).

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 HATCHERIES

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:

- Sikusuilaq 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 the fall of 1992. 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 HATCHERIES TO SPORT FISH

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 enhanced harvest while PNPs provided 27 percent.

According to recent studies completed by the ADF&G, sport fishing provides significant economic benefits in Alaska.

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 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 FISH

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.

BACKGROUND: DECLINING SALMONIDS IN WASHINGTON

Columbia River Salmon and the Endangered Species Act (ESA)

In April and June of 1990 petitions were filed by the Shoshone-Bannock tribe in Idaho, Oregon Trout and five other organizations, under the federal Endangered Species Act (ESA) to list five wild stocks of Columbia River salmon as threatened or endangered. These stocks were: Snake River sockeye, Snake River spring, summer, and fall chinook, and lower Columbia River coho. The National Marine Fisheries Service (NMFS) is the federal agency with jurisdiction over endangered fish species. In April and June of 1991, NMFS proposed that three of the five stocks of salmon be listed under the Endangered Species Act. These stocks are the Snake River sockeye salmon (proposed as endangered), the Snake River fall chinook (proposed as threatened) and the Snake River spring/summer chinook (proposed as threatened). On November 14, 1991, NMFS officially listed the Snake River sockeye as endangered. Decisions on the other two stocks are expected shortly.

Wild Stocks Under the Endangered Species Act

An important part of the NMFS decision was their determination of what the definition of stock would be that would constitute a "species" for purposes of the ESA. The agency determined that an "ecologically significant unit", or ESU, would constitute a species for the purposes of the ESA. Another key point in application of the ESA to fish is that the wild stocks were recognized and being genetically and biologically important and merit protection, or stocks that have not been intermixed with hatchery stocks and that still spawn naturally, are considered.

Salmon in the Columbia River System and Reasons for Decline

Approximately one-third of the Columbia River drainage that historically supported salmon populations is not currently accessible to these fish because of dam construction without fish passage facilities. Alterations in river flow and velocity, adjacent habitat changes, irrigation diversions, commercial and recreational harvest, and hatchery practices have resulted in fewer "returns" of spawning adults from the ocean than historically. In the mid-19th century, anadromous fish runs in the Columbia River basin numbered up to 16 million adult fish. Anadromous fish include salmon, steelhead, and sea-run cutthroat trout. Juveniles migrate from freshwater to the ocean, where they take between one and five years to mature. They return as adults to their streams of origin to spawn. Salmon and steelhead numbers on the Columbia have been reduced to about 15 percent of historic run sizes.

Dams: The U.S. Army Corps of Engineers, the U.S. Bureau of Reclamation, and the state's public utility districts operate water projects in the Columbia and the lower Snake Rivers. The Bonneville Power Administration, part of the U.S. Department of Energy, markets the power generated by these hydroelectric facilities. There are hindrances to both upstream and downstream fish migration that can occur because of dams. The impoundments that are associated with dams alter natural water flow, sometimes preventing downstream migration of juvenile fish. Power turbines without adequate screening can cause fish mortality when fish do attempt to migrate downstream. Five of eight Army Corps of Engineers projects have juvenile fish bypass systems. Facilities at the Lower Monumental, Ice Harbor, and the Dalles dams are not yet in place. For successful upriver migration of adult salmon, dams are equipped with fish

ladders. There are no ladders at the Chief Joseph or Grand Coulee Dams, blocking upstream spawning in the Columbia River at Bridgeport.

Habitat Alteration Out of River: Activities such as timber harvest, mining, agricultural drainage, livestock grazing and point source pollution can alter fish habitat conditions. Increased sediment, increased water temperatures, loss of riparian (adjacent to the watercourse) habitat, and reduced oxygen can negatively affect fish.

Harvest: Both recreational and commercial salmon fishing occur on the Columbia River. Salmon fishing in Washington and Oregon state waters is regulated by the Washington Department of Fisheries and by the Oregon Department of Fish and Wildlife, respectively. The two states coordinate their commercial fishing regulation development through the Columbia River Compact. Recreational fishing is regulated by the Washington Department of Wildlife (steelhead trout and resident game fish), Washington Department of Fisheries (salmon and marine fish), and the Oregon Department of Fish and Wildlife (all species of fish).

Fish Production: 80-90% of salmon returning to the Columbia River from the ocean are produced in hatcheries. There is an ongoing debate over the role of hatchery practices in preservation of wild stocks of fish. Deterioration of wild stocks of salmon and steelhead can occur through poor hatchery management practices. Hatchery practices have begun to explore the use of wild stock in breeding programs, to avoid deterioration of hatchery stocks.

Water Use: There are several large users of water in Washington, including municipal, industrial, irrigation, hydroelectric generation, and instream. Municipal water use includes water supplied by public water systems for domestic, commercial, and fire protection. Industrial use includes process and cooling water. Irrigation accounts for the majority of water use in Washington. Water is diverted from water sources. Diversions must be screened to prevent fish from entering the irrigation system, unless the area of the diversion is under the management authority of the Department of Wildlife and the diversion existed prior to 1947. Water storage for irrigation, power production or flood control affects timing of peak flows that under natural conditions coincide with juvenile anadromous fish migration downstream.

The American Fisheries Society Endangered Species Committee Report

According to a report by the Endangered Species Committee of the American Fisheries Society, entitled Pacific Salmon at the Crossroads, 214 stocks of wild salmon, steelhead, and cutthroat trout are in decline in the Pacific Northwest. 52 of these are in the Columbia River basin. In the coastal and Puget Sound areas of Washington, outside of the Columbia River basin, 41 stocks are in jeopardy. There are currently no mandated recovery efforts for these stocks, other than for the Snake River sockeye salmon.

Other Efforts to Recover the Columbia River Salmon

Columbia River Salmon Flow Measures

The Army Corps of Engineers, Bureau of Reclamation, and the Bonneville Power Administration are conducting an Environmental Impact Statement (EIS) to examine water management actions to help both juvenile and adult salmon. These actions will be taken in 1992, for a one year period, on an experimental basis. The alternatives include various combinations of reservoir drawdown and flow augmentation to assist juvenile salmon migration.

The final EIS is expected to be released in March of 1992.

The Salmon Summit

The Salmon Summit was convened at the urging of Senator Mark Hatfield by agencies and organizations in the Pacific Northwest to develop a management and recovery program for the Columbia and Snake River salmon. This effort concluded in March 1991 and the participants failed to reach a consensus on major recovery methods. However, the task of continuing these efforts was subsequently undertaken by the Northwest Power Planning Council (NWPPC).

The Northwest Power Planning Council Amendments

In 1980, Congress passed the Northwest Power Act. The Act created the NWPPC and directed it to determine how much energy the region would require over the next twenty years and to develop an electric power plan to meet those needs; and to develop a program to protect, mitigate, and enhance fish and wildlife and related habitat in the Columbia River basin. The NWPPC develop a Fish and Wildlife Program (FWP) to accomplish this. In response to the declining salmon on the Columbia and Snake Rivers, the NWPPC is amending its FWP. The amendments are in four phases. Phase I identified immediate measures to assist in salmon recovery. Phase II, completed on December 12, 1991, recommends the following actions, as well as many others not listed below:

- mainstem passage improvements on the Snake and Columbia by increasing flows for juvenile salmon migrating downstream and by improving screens so that juveniles don't experience as much mortality in dam turbines;
- reductions in commercial harvest;
- implementation of a temporary commercial salmon license leaseback program;
- adoption of water conservation measures including the placement of instantaneous flow meters on all diversions from anadromous fish streams tributary to the Snake and Columbia;
- improvement of hatchery management practices;
- development of habitat management standards for salmon protection.

NMFS will use this Phase II Amendment as the basis for their recovery plan for the endangered sockeye salmon. Phase III and IV are watershed level planning, and resident fish and wildlife protection, respectively. The NWPPC has just begun to develop these phases.

HOUSE BILL ANALYSIS

HB 2626

AN ACT RELATING TO WILD STOCKS OF SALMONIDS

Brief Description: Conserving and enhancing wild stocks of salmonids.

Committee: Fisheries & Wildlife

Sponsor(s): Representatives R. King, May, Orr, Rust, Belcher, Fraser, Hochstatter, Horn, Morris, R. Meyers, Basich, Jones, Sheldon, Leonard, Franklin, Zellinsky, Valle, Pruitt, O'Brien, Nelson, Bowman, Brough, Jacobsen, Haugen, Rasmussen and J. Kohl

Background:

Recovery Planning

The Northwest Power Planning Council, in their Phase II Amendment process, developed a management plan for salmon on the Columbia and Snake Rivers, which will be used by the National Marine Fisheries Service as a basis for their recovery plan for sockeye salmon. The Snake River sockeye salmon was listed as endangered under the Endangered Species Act in November of 1991.

There is currently no mandatory or ongoing recovery effort for wild stocks of salmon, steelhead and cutthroat trout that have not been petitioned for listing under the Endangered Species Act. There are many other wild salmon, steelhead, and sea-run cutthroat trout stocks that have been identified as declining by the American Fisheries Society. Forty-one of these are in Washington, outside of the Columbia River Basin.

Management Techniques for Increasing Wild Fish Runs

The Department of Wildlife regulates the recreational harvest of resident fish including steelhead trout and sea-run cutthroat trout. The Department of Fisheries regulates the harvest of the commercial and recreational salmon fisheries for non-treaty fishers. Both agencies coordinate with the tribes in developing commercial harvest regulations. Regulations are designed to provide harvest opportunities and sustain fish runs.

The Northwest Power Planning Council, in their Phase II Amendment, proposed a reduction in harvest of fall chinook in the Columbia river. Part of the mechanism for accomplishing this will be by providing for a commercial license leaseback program. The federal government will assist in paying to temporarily lease back commercial fishing licenses. Current Washington law requires that a commercial fisher, in order to renew a salmon license, catch one fish. The director of the Department of Fisheries has the authority to waive this requirement if the fisher has not had the opportunity to catch fish, such as would occur if a fisher participated in the leaseback program.

Marking and Catch and Release

Where a distinction between wild and hatchery stocks needs to be made for the purpose of allowing wild fish, if caught, to be released, the hatchery fish may be marked by clipping the adipose fin, using a coded wire tag, or using a newer ocular marking technique. The Department of Wildlife has marked most of its hatchery raised steelhead and sea-run cutthroat trout and is therefore able to implement catch and release regulations for recreational fishers. For almost all of the steelhead and sea-run cutthroat stocks identified by the American Fisheries Society as stocks of concern, these regulations are already in place. The Department of Fisheries has not marked all hatchery fish. Even if all were marked, the utility in returning wild fish caught commercially with current techniques is low, since these fish, caught in nets are usually dead shortly after the nets are hauled in. The recreational fishery could be managed for catch and release if all hatchery raised salmon were marked.

Hatcheries

The Department of Fisheries operates 39 major hatcheries and 19 satellite facilities. The Department of Wildlife operates 32 hatcheries. The tribes and the U.S. Fish and Wildlife Services also operate hatcheries, and there are hundreds of cooperative production facilities operated by volunteers and coordinated by the state Departments of Fisheries and Wildlife.

Captive Broodstock and Wild Stock Supplementation:

Wild salmonids spawn in river gravel. Their progeny reside in freshwater until ready to go to the ocean, where they mature. As adults, they return to their natal streams to spawn. Fish produced in hatcheries are artificially spawned by removing eggs from the female and raising the young fish and releasing them to travel downstream as smolts. New technologies are being developed to use artificial production means to supplement wild populations of salmonids with fish that are genetically of the same wild stock. One technique, called captive broodstock rearing, raises the fish from egg to mature adult, rearing in saltwater if necessary by using saltwater net pens. That adult is spawned artificially. Wild stock supplementation is the process of using eggs from the wild stock that one wants to supplement, by taking the fish out of the wild, rearing the progeny, and releasing the progeny back into the natal stream from which the parents originated. The Department of Wildlife has sea-run cutthroat captive broodstock programs in Shelton and Aberdeen, which have been implemented in the last five years. Many stocks of sea-run cutthroat on coastal streams have been identified by the American Fisheries Society as being stocks of concern.

Summary of Bill:

The Departments of Fisheries and Wildlife are directed to establish a review and recovery team to recommend recovery methods for salmonid stocks outside of the Columbia River Basin. The review and recovery team is to develop a definition of the term "stock", determine the status of all wild salmonid stocks in Washington, set escapement objectives for these wild stocks, and where escapement objectives are not currently being met, develop a recovery plan for each subbasin containing the wild stock. Priorities for recovery are to be, in descending order, natural production, supplementation using hatcheries, and captive broodstock technology. The team shall evaluate the role of existing hatcheries in recovery, and shall evaluate methods of

harvest that have less impacts on wild stocks. The recovery plan shall be submitted to the appropriate legislative committees by June 30, 1993.

By January 1, 1993, the Department of Wildlife is directed to implement an experimental captive broodstock program on a coastal river to be selected by the Department for wild sea-run cutthroat trout.

The Department of Fisheries, by December 31, 1992, is to determine the cost of marking all hatchery fish at all Department operated hatchery facilities.

The director of the Department of Fisheries is directed to use authority granted under existing law to waive requirements for commercial fishing license renewal, in order to accomplish the goals of the license leaseback program of the Northwest Power Planning Council, described in the Council's Phase II Amendment.

*Prepared by Keithyn Watson, Research Analyst (786-7310)
House Fisheries and Wildlife Committee
Office of Program Research
January 23, 1992*

SECTION BY SECTION SUMMARY: H-2626
Conserving and enhancing wild stocks of salmonids

Section 1. Legislative findings.

Section 2. The Departments of Fisheries and Wildlife are directed to establish a review and recovery team to recommend recovery methods for salmonid stocks outside of the Columbia River Basin. The review and recovery team is to develop a definition of the term "stock", determine the status of all wild salmonid stocks in Washington, set escapement objectives for these wild stocks, and where escapement objectives are not currently being met, develop a recovery plan for each subbasin containing the wild stock. Priorities for recovery are to be, in descending order, natural production, supplementation using hatcheries, and captive broodstock technology. The team shall evaluate the role of existing hatcheries in recovery, and shall evaluate methods of harvest that have less impacts on wild stocks. The recovery plan shall be submitted to the appropriate legislative committees by June 30, 1993.

Section 3. By January 1, 1993, the Department of Wildlife is directed to implement an experimental captive broodstock program on a coastal river to be selected by the Department for wild sea-run cutthroat trout, using existing facilities where possible.

Section 4. The Department of Fisheries, by December 31, 1992, is to determine the cost of marking all hatchery fish at all Department operated hatchery facilities.

Section 5. Amends existing law to require the director of the Department of Fisheries to use authority granted under existing law to waive requirements for commercial fishing license renewal, in order to accomplish the goals of the license leaseback program of the Northwest Power Planning Council, described in the Council's Phase II Amendment.

HOUSE BILL 2626

State of Washington 52nd Legislature 1992 Regular Session

By Representatives R. King, May, Orr, Rust, Belcher, Fraser, Hochstatter, Horn, Morris, R. Meyers, Basich, Jones, Sheldon, Leonard, Franklin, Zellinsky, Valle, Pruitt, O'Brien, Nelson, Bowman, Brough, Jacobsen, Haugen, Rasmussen and J. Kohl

Read first time 01/22/92. Referred to Committee on Fisheries & Wildlife.

1 AN ACT Relating to wild stocks of salmonids; amending RCW
2 75.30.120; and creating new sections.

3 BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF WASHINGTON:

4 NEW SECTION. Sec. 1. The legislature finds that wild stocks
5 of salmonids in the state of Washington are in a state of decline.
6 Stocks of salmon on the Columbia river are proposed for listing as
7 threatened and endangered, the Snake river sockeye has been officially
8 listed as endangered, and the American fisheries society has indicated
9 that there are two hundred fourteen other stocks of salmonids in the
10 Pacific Northwest that are in decline or possibly extinct. Many of
11 these are within Puget Sound or the coast, and therefore are not within
12 the jurisdiction of the Northwest power planning council. The
13 legislature recognizes that to lose these wild stocks would be
14 detrimental to the genetic integrity of the fisheries resource and the

1 economy, and will represent the loss of a vital component of
2 Washington's aquatic ecosystems. The legislature further finds that
3 to postpone the recovery of stocks that are on the decline but that are
4 not yet listed as threatened or endangered is short-sighted, and that
5 it will be less costly to act now to save this important resource.

6 NEW SECTION. Sec. 2. (1) The departments of fisheries and
7 wildlife shall establish a wild salmonid review and recovery team
8 consisting of fisheries biologists and geneticists. The purpose of the
9 team shall be to review and recommend recovery methods for salmonid
10 stocks outside of the Columbia river basin. The departments shall
11 invite representatives of the Northwest Indian fisheries commission and
12 the national marine fisheries service to participate on the team.

13 (2) By June 30, 1993, the review and recovery team shall:

14 (a) Develop a meaningful definition of stock. The definition shall
15 be formulated to allow preservation of genetic integrity of the wild
16 fish resource and to avoid future federal listings under the endangered
17 species act. The team shall consider the national marine fisheries
18 service's species definition as well as the American fisheries society
19 definition of stock;

20 (b) Determine the status of all wild salmonid stocks in Washington;

21 (c) Set escapement objectives for all wild salmonid stocks in
22 Washington; and

23 (d) Where escapement objectives are not currently being met,
24 develop a recovery plan for each subbasin containing the wild stock,
25 attempting to achieve escapement objectives within two generations.
26 The recovery plan shall identify baseline conditions as well as
27 recommend actions. Priorities for recovery shall be, in descending
28 order, natural production, supplementation using hatcheries, and
29 captive broodstock technology. The recovery plan shall include an

1 evaluation of the role of existing hatcheries in wild salmonid
2 recovery, as well as of methods of harvest that have less impact on
3 wild stocks.

4 (3) By June 30, 1993, the review and recovery team shall provide
5 a recovery plan to the appropriate legislative committees. The plan
6 shall include:

7 (a) A definition of stock;

8 (b) A state-wide list of wild stocks, with status of and escapement
9 objectives for each;

10 (c) A summary of data management needs; and

11 (d) A range of recovery alternatives for wild stocks outside of the
12 Columbia river basin, with accompanying time frames for implementation,
13 time frames for expected recovery, costs, and risk assessments.
14 Alternatives shall consider actions in the areas of water quality and
15 quantity, flow management, hatchery management, captive broodstock
16 programs, harvest, and land management. Costs shall be developed in
17 consultation with an advisory committee of appropriate membership to
18 be appointed by the departments.

19 (4) This section shall expire January 1, 1994.

20 NEW SECTION. Sec. 3. By January 1, 1993, the department of
21 wildlife shall implement experimental captive broodstock programs on
22 a coastal river to be selected by the department, for wild sea-run
23 cutthroat trout. Existing facilities shall be used where possible.

24 NEW SECTION. Sec. 4. By December 31, 1992, the department of
25 fisheries shall determine the cost of marking all hatchery fish at all
26 department of fisheries operated hatchery facilities.

1 Sec. 5. RCW 75.30.120 and 1983 1st ex.s. c 46 s 146 are each
2 amended to read as follows:

3 (1) A commercial salmon fishing license issued under RCW 75.28.110
4 or salmon delivery permit issued under RCW 75.28.113 may be issued only
5 to a vessel:

6 (a) Which held a state commercial salmon fishing license or salmon
7 delivery permit during the previous year or had transferred to the
8 vessel such a license, and has not subsequently transferred the license
9 or permit to another vessel; and

10 (b) From which food fish were caught and landed in this state or
11 in another state during the previous year as documented by a valid fish
12 receiving document.

13 Where the failure to obtain the license or permit during the
14 previous year was the result of a license or permit suspension, the
15 vessel may qualify for a license or permit by establishing that the
16 vessel held such a license or permit during the last year in which the
17 license or permit was not suspended.

18 (2) The director may waive the landing requirement of subsection
19 (1)(b) of this section if:

20 (a) The vessel to which an otherwise valid license is transferred
21 has not had the opportunity to have caught and landed salmon; and

22 (b) The intent of the commercial salmon vessel limitation program
23 established under this section is not violated.

24 (3) The director shall exercise his or her authority under
25 subsection (2) of this section to accomplish the goals of the Northwest
26 power planning council's phase two amendment to its fish and wildlife
27 program, dated December 11, 1991, concerning a temporary commercial
28 salmon fishing license leasing program. The director may adopt rules
29 to accomplish the goals of the leasing program.

- 1 (4) Commercial salmon fishing licenses and salmon delivery permits
- 2 are transferable.

Draft

**The Scope, Importance and Economic Value of the Fishery
Enhancement Program to the Recreational Fishery in
Alaska**

Edited by
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February, 1992

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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).

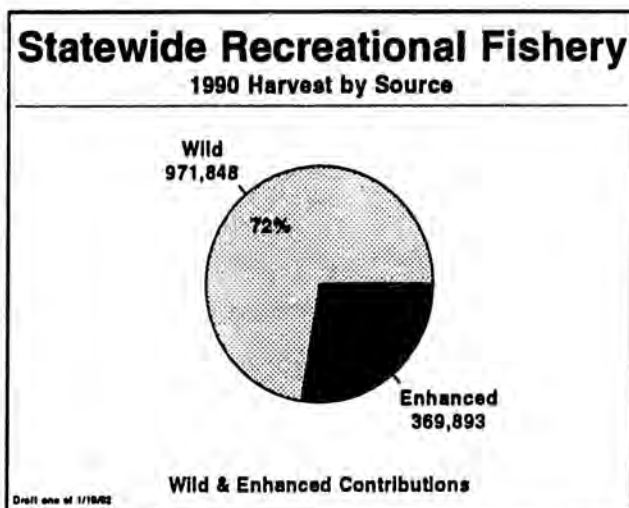


Figure 1

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-fisheries.

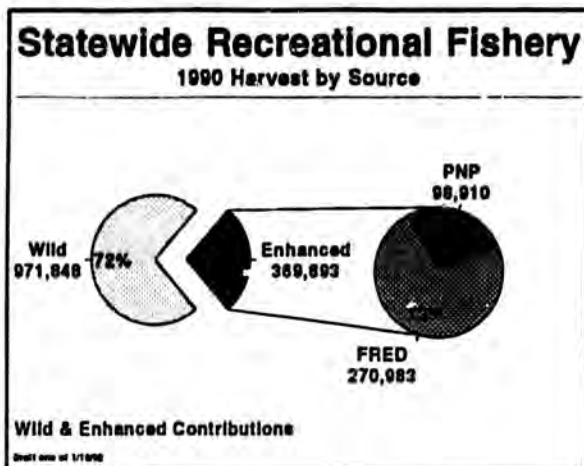


Figure 2

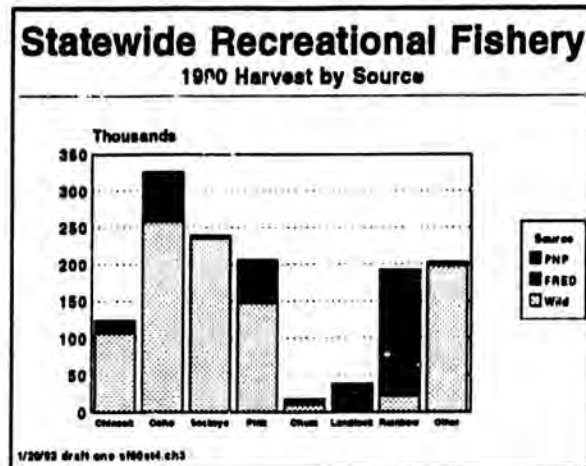


Figure 3

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.

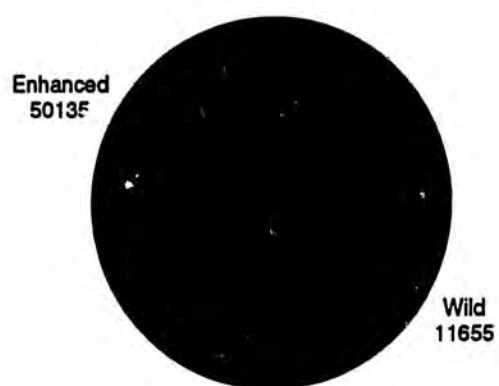
Retail businesses in some communities depend upon the angler related spending that occurs during a derby to sustain a large portion of their annual gross receipts. The ability of a derby to attract the angling public depends largely on the ability of the fishery to supply a good fishing experience with 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



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

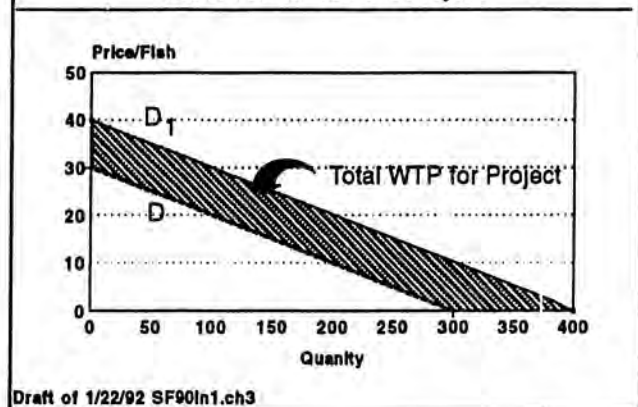


Figure 5

Net Willingness To Pay (WTP) For An Enhancement Project

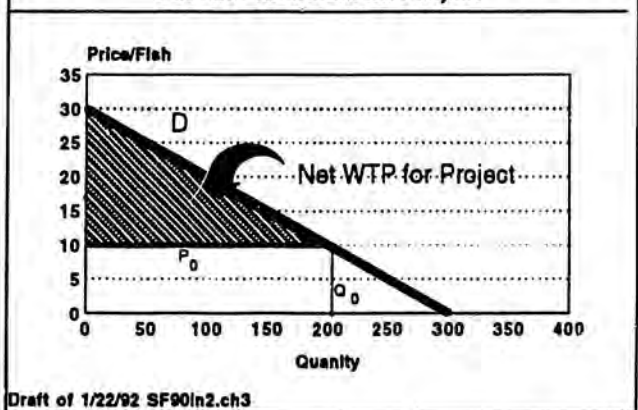


Figure 6

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 conditions requires some updating of the models. These updates would require ADF&G staff time and some contractual resources for economic analysis.

For the proceeding reasons (1-5), a comprehensive study to estimate 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

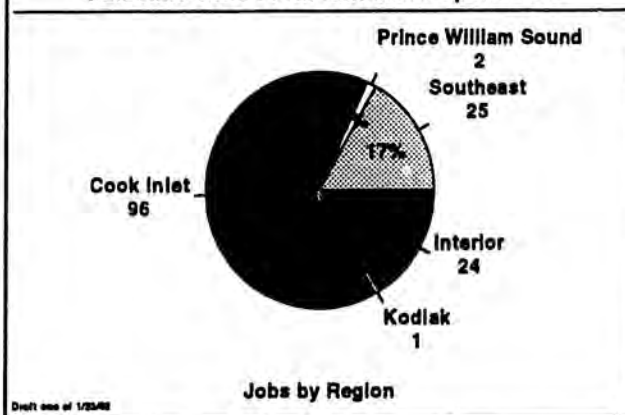


Figure 7

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 fishers 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 anadromos 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 Kaslof 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.