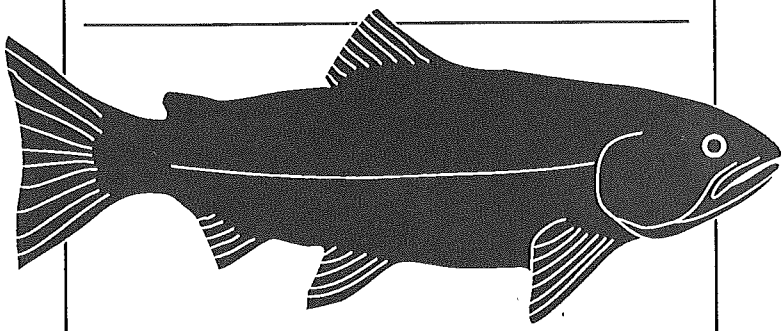
# SALMON AND THE COLUMBIA RIVER SYSTEM



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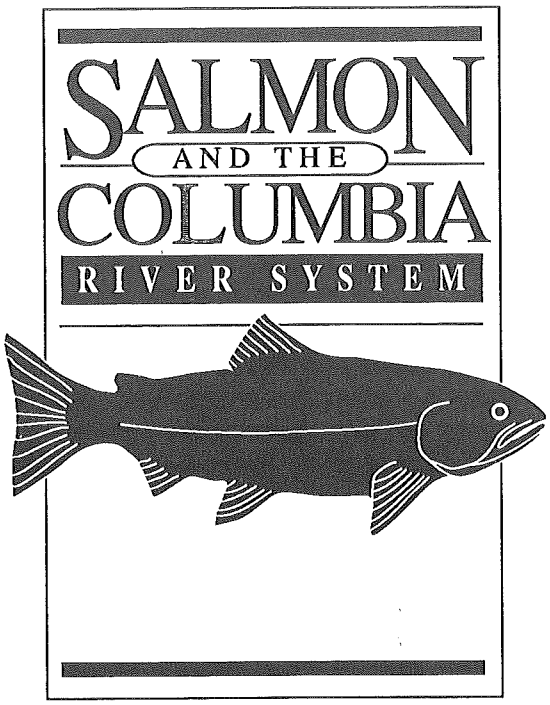


James C. Barron
Extension economist
and
Gary Thorgaard
professor of genetics/zoology
Washington State University

## Task Force Members

Ludwig M. Eisgruber, Coordinator
Oregon State University

James E. Lannan, Deputy Coordinator
Oregon State University

James C. Barron, Campus Contact
Washington State University

Robert C. Francis, Campus Contact
University of Washington

Joel Hamilton, Campus Contact
University of Idaho

Mike Martin, Campus Contact
Oregon State University

Richard M. Adams
Oregon State University

Earnest Brannon
University of Idaho

Jay O'Laughlin
University of Idaho

Carl B. Schreck
Oregon State University

Gary H. Thorgaard
Washington State University

Norman K. Whittlesey
Washington State University

## What is the University Task Force on Salmon and the Columbia River System?

The Task Force is a group of faculty from the University of Idaho, Oregon State University, Washington State University, and the University of Washington with interest and expertise relating to the Columbia River system. They were appointed by the Agricultural Experiment Station and Extension Service directors of Idaho, Oregon, and Washington and given the following charges:

- Identify research and educational issues that the universities can address within the framework of their missions, capabilities, and resource bases;
- Identify resources and create working networks in each state to address identified issues relating to the Columbia River system salmon and steelhead runs;
- Develop a working plan to organize research and public education programs:

  Document the current knowledge base;
  Prepare educational materials;
  Plan and conduct workshops with interested agencies, organizations, and interest groups, and
  Conduct research and education programs.

The Land Grant and Sea Grant universities of Idaho, Oregon, and Washington are repositories for a substantial amount of information relating to the resources of the Columbia River system. They also are home for many highly trained scientists with relevant expertise. These scientists and the knowledge available to them could have considerable bearing on improving solutions to the problems arising from reduced populations of native salmon. Although the issues will, in the end, be decided by the public through a variety of political processes, the quality of public decisions will depend to a substantial degree on the quality of information on which the decisions are based.

# Salmon and the Columbia River System

The Columbia River system with its Oregon, Washington, and Idaho tributaries still provides major habitat for production of wild salmon and steelhead. All anadromous salmonids spawn in freshwater. Juveniles emerge from their incubation gravels and stay in freshwater as little as a few hours to as much as 3 years before they migrate to sea. Marine residence also varies by species, and can last from 1 to 5 years before they make the return as adults to their birthplace to spawn and die. All salmon die after spawning, and thus complete the life cycle, but steelhead may live to return once or twice again before death. Although, salmon and steelhead enter the Columbia River nearly 12 months of the year, each population of fish is temporally and site specific, with spawning times repetitive within days, year after year. Such behavior is genetically coded in response to the environmental factors associated with their "home stream," and hence the concern that these unique "stocks" of fish be preserved.

Salmon have been an important food source for indigenous people for centuries and remain an important part of the cultural heritage of Native Americans. For more than 100 years Columbia River salmon have been harvested commercially and sold throughout the nation and world. Salmon have also provided a highly prized sport fishery for anglers in the ocean and fresh water river system.

As economic development of the Pacific Northwest occurred in this century many other uses of the water in the Columbia River system have been developed. Beginning with the completion of Bonneville Dam in 1937, the river system has been transformed by dams for electric power generation, flood control, transportation, and irrigation. The lower river dams have fish ladders to allow returning adults to pass upstream, but salmon cannot get over Chief Joseph Dam in north central Washington, Hells Canyon Dam on the Oregon–Idaho border, or Dworshak Dam on the North Fork of the Clearwater River in Idaho. This has cut off thousands of miles of upstream habitat for salmon.

Salmon runs have declined in the past century as a consequence of a variety of factors including reduced spawning habitat, mortality of young fish at the dams, commercial and sport harvest, disease, predation, and the rigors of adult upstream migration. These factors have reduced the salmon runs to varying degrees, with dams having the largest effect in recent history. A variety of actions have been taken at dams to screen downstream migrating juvenile fish away from the turbines. Some young fish are collected and transported around the dams by barge and truck to below Bonneville. Fish

hatcheries have been built to propagate fish to offset declines in wild stocks. Despite these efforts, some specific wild or natural stocks of salmon have gone extinct and others have reached extremely low levels.

In April and June 1990, respectively, several interested groups petitioned the National Marine Fisheries Service (NMFS) to list the Snake River sockeye salmon; the spring, summer, and fall runs of Snake River chinook salmon; and the lower Columbia River coho salmon under the Endangered Species Act (ESA) as either threatened or endangered. This set in motion an extensive process with potentially very significant consequences for the Pacific Northwest.

## Endangered Species Act (ESA) Process

NMFS has 1 year from the filing of the ESA petition to study the status of the petitioned species and make a decision on whether to list them as threatened or endangered. In April 1991 the first decision will be required under the ESA. That will be a decision to intend to list (or not to list) for the first petition with others to be determined by June 1991. Following a decision, up to a year may be taken for hearings and collection of information. By April 1992 there will be a final decision by the Secretary of the Commerce on whether to make the listing.

The decision as to whether or not to list a species as threatened or endangered is made strictly on biological information. Economics can (but does not have to) enter the ESA process through an infrequently invoked set of procedures whereby economics can be considered on balance with biological needs.

If listing occurs then NMFS will develop and implement a recovery plan. Depending on the components of such a plan there could be major changes in existing uses of the water in the Columbia River system. The Secretary of Commerce would have the power to overrule or set aside certain water uses in an attempt to assure survival of the salmon. The possible changes in power production, transportation, streamside zone management, grazing, irrigation, sport and commercial salmon harvest, and the Native American fisheries could be far reaching and have significant economic effects.

At the end of those procedures a presidentially appointed committee (often unofficially referred to as the "God squad") can determine if saving a species carries too high a price tag.

## Major Planning Activities

While they are not a part of the listing process per se, several related activities have occurred. At the urging of Senator Mark Hatfield of Oregon a group of interested agencies and organizations in the Pacific Northwest conducted a series of meetings that concluded in March 1991 to seek some solutions. The aim of this process was to bring together the affected interest groups for the purpose of developing a management and recovery program based on the region's interest rather than having a solution imposed by the federal government. This group, known informally as the "Salmon Summit," was comprised of about 30 people representing Native Americans; federal agencies such as the Corps of Engineers, Bonneville Power Administration, and Bureau of Reclamation; conservation and fishing interest groups; power producers; transportation; irrigation; and representatives of the governors of Oregon, Washington, Idaho, and Montana. The group was unable to reach agreement on a comprehensive plan, but established communication linkages and suggested a variety of action strategies for future consideration.

Another activity is the development of the Columbia River Basin Plan under the auspices of the Northwest Power Planning Council. Among other things it gives attention to salmon and the factors important to their continued survival.

Given this background, the following sections offer a brief look at some of the key issues involved. The purpose is not to provide definitive answers but to describe and explain what is at stake and the questions that need to be addressed.

## Why Save the Salmon?

There are two quite different issues with respect to salmon in the Columbia River system. The first is the protection and enhancement of naturally reproducing indigenous (wild or native) stocks. This is what the petitions and the ESA listing process are all about. The second is production of "fish for harvest." The latter issue can most likely be solved, at least up to Bonneville Dam, by hatchery production. The enhancement of the native stocks is a far more difficult issue to resolve.

Those who want to preserve the diversity of salmon stocks make the following arguments. Salmon are an important part of the region's natural heritage. Genetic diversity is clearly one major element and it is critical to maintain a wide range of genetic stock of salmon. Hatchery stocks of fish are susceptible to domestication that can reduce viability of salmon over the long run by disease, predation, and other factors. The inbreeding in hatcheries might also lead to reduced viability. In hatcheries there is always risk of a catastrophic event such as disease. The wild stocks of salmon have evolved over thousands of years and have adapted to the environment of the river ecosystem. These native salmon stocks show specific adaptations in traits such as disease resistance and migration behavior to their individual

environments. These cannot easily be replaced. It is argued that genetic diversity may be highly desirable for stock preservation and future enhancement programs.

The major issue in salmon conservation is the maintenance of natural or wild stocks. In the long run, say over several hundred years, genetic diversity may be important for all existing salmon runs. Survival of the species could be at stake somewhere in the future and once lost it cannot be regained. What is the economic, social, and cultural value of species conservation both now and in the future? Accurate economic evaluation cannot be made over such long time horizons and the debate is complicated by different interest groups ascribing widely varying social and cultural values to salmon conservation. Some argue that the value is near zero while others say it is infinite.

A major argument for conservation of native stocks is made by and on behalf of the Native American tribes in the region. They have relied historically on salmon for food, income, and as part of cultural practices that date back hundreds of years. The tribes have treaty rights to land and water that supersede other vested rights and interests in the resources of the area. As part of the cultural heritage of the tribes, and the rest of the population, it is argued that it is essential that the salmon resource be conserved for the future.

Some people question the need to save all races of wild salmon in the Columbia River system. They argue that the overall ocean salmon population might not be seriously depleted if some runs of Columbia or Snake River salmon are lost. Fish hatcheries can produce large numbers of salmon to maintain the overall population of salmon in the river. They raise the question of how much it is worth to preserve a viable gene pool of each race. Possible large costs of foregone power production or other uses of the water would cause some economic damage to the region, imposing costs that may exceed the benefits of the fish.

Other people take a somewhat different approach. The conservation (or destruction) of endangered species symbolically expresses an ethical position taken by society. People care deeply about the ethical or moral positions that a society, through its policies, either supports or rejects even if there are no material consequences of the policies. In this view, salmon should be saved simply because a society that would save salmon is the kind of society (and ethical system) that is desirable.

Another consideration is the effect that loss of the salmon could have on ecosystems (the web of interrelated organisms) in the Northwest. Some ecosystems would not be the same without salmon. For example, salmon have historically returned nutrients to headwater streams in the form of carcasses of dead adults.

Finally, the Endangered Species Act is a policy statement of the U.S. Congress that says if salmon (or any other species) are endangered a recovery plan shall be established. The preservation of species is an overriding public policy. Quite simply, it is a stringent and uncompromising law which must be followed.



**Habitat and production**

Salmon need gravel beds that are not silted in for their redds (nests with eggs). Riparian uses such as forest harvest, grazing, and roads can result in runoff that adversely affects spawning areas. Water quality is critical to fish production. Contamination from chemical discharges or runoff along with sedimentation can damage or destroy eggs or young fish. Much of the river environment has been permanently altered or lost as spawning or rearing habitat as a result of dam construction. There is fairly general agreement, however, that other constraints on salmon (such as survival of downstream migrants) are presently more limiting than the availability of adequate spawning area.

To some extent, decreased natural spawning can be compensated for with increased production in fish hatcheries. However, the crucial question is: What balance should there be between production of wild and hatchery salmon stocks? The petitions for ESA listing were triggered by declines in wild fish numbers.

The role of hatcheries is double-edged. They can produce large numbers of fish, and can serve as a reservoir of genetic variability, but they can also cause problems for wild fish. This can happen in several ways. One is that disease control is important in hatcheries, but if a disease breaks out it will spread rapidly. Such disease problems can also be transmitted to adjacent wild stocks under some circumstances. A second factor is interbreeding between hatchery and wild fish. Some hatchery stocks have been altered through intentional or inadvertent artificial selection that reduces their ability to successfully survive and reproduce in the wild. When hatchery fish with reduced viability interbreed with wild fish the genetic integrity of the wild stock can be threatened.

## Migration and survival

Getting the young fish down the river to the ocean and back again to spawn as adults presents tremendous difficulties even in free flowing streams. From the Snake and Salmon river drainages, downstream migrants must traverse four dams on the Snake River and four more on the Columbia. At each dam there is a high mortality rate from the turbines, predators, disorientation, or nitrogen supersaturation downstream. Some, but not all, of the dams are equipped with fish screens to keep the fish away from the generator turbines, but they are not completely effective in their operations. Approximately 15 percent of downstream migrants are lost at each dam. Stress from dam passage may make the young fish more susceptible to disease and predators or disrupt their instincts to continue to migrate to the sea. The fish have a built in biological clock which allows them a limited time to complete the trip to salt water or they will be unable to adapt to it. In a free flowing river the current hastens their movement, but in slack water reservoirs the fish are delayed in the timing of their migration.

Physically transporting fish around the dams is one approach that has been in use for over 10 years. Some fish are collected by screens at Lower Granite, Little Goose, and McNary dams and moved by barge or tank truck below Bonneville where they are released. While this has worked fairly well for steelhead, it has been much less successful for salmon. Salmon are very prone to stress when handled in the collection process and being crowded together in the transport system. Consequently they are more likely to suffer from disease, disorientation, and predation.

Through the planning process of the Pacific Northwest Power Planning Council a "water budget" has been identified to facilitate the downstream migration of fish. Idaho is the source of water for this purpose. The water budget allows an increased amount of water to be released in the important spring period when juvenile fish need more water flow to move through the river. Debate continues over the amount of water required for water budget. Biologists and river management agencies have not agreed on what can be achieved or what the benefits to fish will be.

Returning adult salmon face the task of climbing over eight dams to reach spawning grounds in the Snake and Salmon rivers. Fish ladders are in place at all those dams, but the number of adult fish getting through continues to decline. Summer water temperatures in the Columbia and Snake rivers are high enough to raise the risk of disease and mortality among returning adults.

## Harvest

Those fish that survive the trip to the ocean and do not get consumed by predators then have to run the gauntlet of humans interested in harvesting them. Starting in the late 1860's, and continuing to the present, Columbia

River salmon runs have been heavily exploited by a number of different fisheries. It is certain that some of the salmon populations in the Columbia River basin have been overharvested. In the ocean there are both commercial and sport fisheries. The sport fishing takes place within 10 to 15 miles of shore, but some commercial fishing boats go many miles off shore. The ocean migration patterns typically take Columbia River fish north and west toward the Aleutian Islands and the mid-Pacific where commercial boats from Japan, Korea, and other nations fish. As the fish near the Columbia River, they are harvested by commercial trollers and sport fishers in large numbers. When salmon return to the river for spawning they are awaited by large numbers of sport fishers and commercial harvest by gill nets as Native Americans harvest salmon for sale, food, and ritual purposes.

The decision-making process which allocates fish for harvest among the various groups is a complex one that involves international agreements, treaty rights, and decisions of how many fish are needed to maintain the run. Precise control of harvest is difficult and not all groups are satisfied with the harvest allocated to them. An additional concern is that many fisheries harvest hatchery and wild stocks at the same time and wild stocks are often over-harvested in this situation.

**Legal complexities**

There are various ways to alter current practices and water uses for the benefit of salmon runs, but there are many legal and institutional constraints that inhibit some actions for restoring declining salmon stocks. For any kind of major facility construction, such as dams for more storage or changing operation of existing facilities, the National Environmental Policy Act (NEPA) lays out detailed requirements for an environmental impact statement and review process before any action can take place. For some alternatives that process could take years.

There are other treaties and contracts that affect salmon. An international treaty with Canada on the Columbia River has been in place for over 30 years and sets forth certain requirements for flows and river operation on both nations. The Bonneville Power Administration has contracts with direct service industries, power companies, municipal utilities, and other regions to provide electric power. The Bureau of Reclamation has contracts to deliver irrigation water. Industries rely on barge transport of commodities and supplies to and from Portland and other downriver ports.

It is not easy to say how these and other legal complexities involving the use of the Columbia River will influence or be influenced by plans to enhance salmon stocks.

## Alternatives for Consideration

What are the prospects for successful resolution of the issues under discussion? A number of alternatives to enhance salmon stocks are under consideration. However, at this writing it is not clear which of these will eventually receive support for implementation. A major difficulty is the lack of knowledge regarding the possible biological, economic, and other consequences of the proposed alternatives. The problems are complex and have been over 50 years in the making. To this point they have defied solution. On the other hand, the interest groups involved have some incentive to reach agreement in order to avoid measures with more significant impacts that might be promulgated by the NMFS in a recovery plan of their own making.

The problems involved in the salmon issue go far beyond biological factors. The biology of migration and survival is extremely important and reasonably well understood, although more data are needed. Political and economic forces concerning current uses of all resources in the Columbia basin are also very strong. Water use for power production, irrigation, and transportation involve vast economic interests that extend well beyond the region. Flood control is one of the determining factors in the operation of the river system and it is not always consistent with salmon production. There are, of course, strong incentives for various groups to protect their potentially conflicting interests listed above.

A wide variety of programs, strategies, or actions are under consideration to improve existing salmon runs. There is not agreement, however, on what has worked, what should be continued, what should be expanded, and what should be discontinued. Getting the juvenile salmon downstream to the ocean successfully is probably the most immediate issue and there are numerous suggestions for improvement. The current management regime for water volume and flow velocity in the river system is the subject of much discussion. If sufficient volumes of water can be made available for juvenile salmon passage in the April to June period, the downstream survival rate could be increased. Another alternative is to significantly lower the river level at certain key periods to increase the velocity of flow. Either of these alternatives would mean reduced electric power generation. In addition, lowering pool levels would disrupt barge transportation. Installing additional fish screens has strong support. Transportation of juvenile fish from Lower Granite and Little Goose to below Bonneville is controversial, but is likely to continue until a more effective alternative can be agreed upon. Other alternatives such as bypass channels for downstream migrants are also under consideration.

Controlling salmon harvest in both the ocean and river could increase adult returns. One suggested action is to fin clip all hatchery-produced fish and then require harvest methods that assure that fish are caught live so wild fish could be returned to the stream to continue their migration. This would require major changes in how fish are harvested.

Watershed management that considers the relationships between uplands, riparian zones, and aquatic systems could enhance the prospects for successful spawning and rearing of salmon. This approach would involve improving water quality through the reduction of stream sedimentation by assuring that best forest management practices are applied during timber harvesting and that grazing is restricted near spawning and rearing areas.

## Possible Consequences

If a recovery plan for salmon can successfully increase wild stocks of salmon in the Columbia River system there could be major benefits to the region. These include enhanced sport and commercial fishing along with the maintenance of genetic diversity. While some of these benefits can be measured economically, much of the effect cannot be so quantified. Rather, the payoff is in cultural, aesthetic, and biological values.

It is obvious that some of the possible action plans would have large economic costs. The major and most obvious one is electrical energy production. Water that does not pass through the turbines cannot generate electricity. Regional electric consumers would ultimately bear those costs.

Proposals to get more water running downriver to carry fish with it could mean less water available upstream in Idaho for irrigated agriculture. Among various proposals is one that farmers sell or lease some of their water rights so that it remains in the river. Acquisition of such water will entail costs. Proposals to lower the levels of reservoirs would make better use of the limited water budget, but would interfere with transportation and power production. There is also some uncertainty whether power facilities would work at low pool levels and how fish ladders could be modified to allow adult salmon to move upstream under these conditions.

Harvest limitations would affect both commercial and sport fishing interests, including the economic vitality of some coastal towns.

In summary, there are no easy, quick, or cheap solutions to the problem of conserving the wild salmon in the Columbia River system. The Endangered Species Act of 1973 forces us as a nation to deliberate and redress past decisions and actions that have caused declines in wild salmon stocks. The ESA does not mandate that the river systems and salmon be brought back to the way they used to be. It does, however, argue that efforts be made to ensure the viability of the salmon. The current debate is about whether wild salmon can maintain themselves in the Columbia River system under the current circumstances. If not, what efforts should be considered for action?

While solutions are not always obvious, what is obvious is that issues relating to maintenance of a viable salmon population in the river will continue to receive important consideration in the years to come.

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