Columbia Basin System Planning

SALMON and STEELHEAD PRODUCTION PLAN

WHITE SALMON RIVER SUBBASIN

September 1, 1990

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Columbia Basin System Planning

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Last, but not least, the System Planning Group recognizes the members of the System Planning Oversight Committee and the Columbia Basin Fish and Wildlife Authority's Liaison Group for their guidance and assistance over the past several months.

INTRODUCTION

The Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program calls for long-term planning for salmon and steelhead production. In 1987, the council directed the region's fish and wildlife agencies, and Indian tribes to develop a systemwide plan consisting of 31 integrated subbasin plans for major river drainages in the Columbia Basin. The main goal of this planning process was to develop options or strategies for doubling salmon and steelhead production in the Columbia River. The strategies in the subbasin plans were to follow seven policies listed in the council's Columbia River Basin Fish and Wildlife Program (Appendix A), as well as several guidelines or policies developed by the basin's fisheries agencies and tribes.

This plan is one of the 31 subbasin plans that comprise the system planning effort. All 31 subbasin plans have been developed under the auspices of the Columbia Basin Fish and Wildlife Authority, with formal public input, and involvement from technical groups representative of the various management entities in each subbasin. The basin's agencies and tribes have used these subbasin plans to develop the Integrated System Plan, submitted to the Power Planning Council in late 1990. The system plan will guide the adoption of future salmon and steelhead enhancement projects under the Northwest Power Planning Council's Columbia Basin Fish and Wildlife Program.

In addition to providing the basis for salmon and steelhead production strategies in the system plan, the subbasin plans attempt to document current and potential production. The plans also summarize the agencies' and tribes' management goals and objectives; document current management efforts; identify problems and opportunities associated with increasing salmon and steelhead numbers; and present preferred and alternative management strategies.

The subbasin plans are dynamic plans. The agencies and tribes have designed the management strategies to produce information that will allow managers to adapt strategies in the future, ensuring that basic resource and management objectives are best addressed. Furthermore, the Northwest Power Planning Council has called for a long-term monitoring and evaluation program to ensure projects or strategies implemented through the system planning process are methodically reviewed and updated.

It is important to note that nothing in this plan shall be construed as altering, limiting, or affecting the jurisdiction, authority, rights or responsibilities of the United States, individual states, or Indian tribes with respect to fish, wildlife, land and water management.

PART I. DESCRIPTION OF SUBBASIN

Location and General Environment

The White Salmon is located in south central Washington in Klickitat and Skamania counties. The river begins on the southwest slope of Mount Adams and flows south about 45 miles into Bonneville Pool on the Columbia River (RM 168.3). Drainage area is approximately 386 square miles.

Subbasin elevation ranges from 72 feet to 12,300 feet and topography varies from rugged mountains to rolling hills to river valleys. Consolidated sediments are overlain with basaltic lava flows; subsequent erosion, mud flows, and glaciation have resulted in precipitous cliffs, deeply incised canyons, and relatively flat valley floors. Several peaks and buttes reach elevations above 4,000 feet, but most prominent is 12,307-foot Mount Adams. Trout Lake Valley is the major subbasin valley and is bordered by hills to the west and rolling plateaus to the east.

The subbasin is located in the climatic transition zone on the eastern edge of the Cascade Mountain range. The climate has wet winters and relatively dry summers. Average annual precipitation is 49.4 inches of which 85 percent occurs in October through March. Above 7,000 feet, most precipitation is snow. Temperatures vary considerably because of the large range in elevation, but are tempered by prevailing westerly winds. Typically, temperatures range from 29 degrees Fahrenheit in January to 65 F in July.

Soils in the valleys are deep and coarse with moderate fertility. In hilly areas, soils are deep and well-drained, being derived from weathered volcanic ash and lava underlined with olivine basalt. At the lower end of the basin, soils are generally shallow and less porous.

The climate is conducive to both wet western and eastern Cascade dry forests. The subbasin contains a mix of Douglas fir, western hemlock and western red cedar, typical of the western Cascades, and ponderosa pine and Oregon white oak, typical of the eastern Cascades. Major understory vegetation includes Oregon grape, dogwood, vine maple, willow, blackberry, elderberry, huckleberry, mock orange, wild cherry, soapbrush, and manzanita. Much of the river valley has been converted to crops and fruit orchards. In addition to the common vegetation, Sukdorf's desert parsley and blue-eyed grass are also found; both are federal register candidates for threatened or endangered species. The majority of riparian vegetation is Oregon white oak, alder and conifers.

Fisheries Resources

The White Salmon Subbasin presently contains summer and winter steelhead, spring and fall chinook, and coho. Spring chinook were relatively recently reintroduced and were not thought to be present after Condit Dam was completed. Sea-run cutthroat were probably present prior to Bonneville and Condit dams, but presently the run is thought to be minimal. In addition, the subbasin contains an active and popular trophy resident trout fishery above Condit.

Affidavits from local residents state that chinook were seen at Husum Falls (RM 7.6) and steelhead were observed upstream as far as Trout Lake. Most current reports agree that Husum Falls may have impeded salmon, but the falls at RM 16.3 were the upper limit to both salmon and steelhead migrations although steelhead may have been able to negotiate these falls under ideal conditions. Fall chinook, coho, and steelhead presently use the area below Condit Dam (RM 0 to RM 3.3) for spawning and rearing.

Condit Dam was built in 1913 at RM 3.3 and blocked upstream migration of anadromous fish. Two attempts were made to ladder the dam, but failed. In 1919, the project owners (then Northwestern Electric Company) signed an agreement with the state fish commissioner "forever" releasing them from the responsibility of maintaining a fishway at Condit Dam for $5,000. Federal and tribal interests were not parties to the settlement.

The magnitude of anadromous runs prior to construction of Condit Dam is unknown. Chapman (1981) estimated 5,489 coho, 625 chinook, and 763 steelhead adults would be found in the White Salmon River under pristine conditions.

Public access to the White Salmon River is limited in some reaches. Private ownership of shorelines could conflict with a large bank fishery.

In 1968, the Federal Energy Regulator Commission (FERC) granted Pacific Power and Light Company a second license with a requirement that the company "consult and cooperate with local, state, and federal recreation and environmental agencies" (Article 30). No explicit mitigation requirements were established in this license. In 1980, the FERC ordered Pacific Power and Light to study the feasibility of constructing fish passage facilities at Condit. The 1982 study concluded that passage is technically feasible. However, Pacific Power and Light questioned the anadromous fish production potential above Condit, the impact of anadromous fish on the resident fisheries, and the cost-effectiveness of anadromous fish restoration. In response to these questions, state, federal, and tribal agencies initiated several studies and reports (Ceballos 1985, Crawford and Chilcote 1985, Young and Rybak 1986).

The Columbia River Basin Fish and Wildlife Program, adopted by the Northwest Power Planning Council in 1982 and amended in 1984 and 1987, contains measures to protect, mitigate, and enhance fish and wildlife resources affected by the development, operation, and management of hydroelectric facilities on the Columbia River and its tributaries. Program Measure 703(c)(2) directs the Federal Energy Regulatory Commission to consider requiring Pacific Power and Light to design and construct fish passage facilities at Condit Dam. Concerned agencies (Washington departments of Wildlife and Fisheries, U.S. Fish and Wildlife Service, Yakima Indian Nation, and National Marine Fisheries Service) have met with Pacific Power and Light to discuss implementation of Program Measure 703(c)(2) and river management options.

In United States vs. Oregon, a need was identified for the release of 1.45 million hatchery spring chinook smolts into the White Salmon River. Neither implementation level planning or funding was attached to this proposal.

Water Resources

Streamflows in the subbasin originate from rain, snow and glacial-melt, and groundwater. Flows vary from 644 cubic feet per second (cfs) in fall to 1,538 cfs in spring (Table 1). During low flow, the major water sources are Trout Lake Creek and Cascade Creek; the latter is fueled by glacial-melt. Many tributaries have intermittent flows during summer while irrigation diversions further reduce tributary habitat during low flow periods.

River temperatures are generally 52 F or lower due to its glacial source (Table 2). Low flows in some tributaries are usually accompanied by high water temperatures; temperatures above 65 F have been recorded at Rattlesnake Creek. Seasonal variations in water temperature and river flow could affect juvenile salmonid survival.

Table 1. Mean monthly discharge (cfs) for the White Salmon River at Underwood, 1913-1979 (USGS # 14123500, RM 1.9).

Month	Discharge (cfs)	Month	Discharge (cfs)
January	1342	July	912
February	1478	August	714
March	1465	September	644
April	1495	October	649
May	1538	November	814
June	1300	December	1172

Table 2. Physical characteristics of the White Salmon River at Underwood, RM 1.9, 1975-1980 (USGS # 14123500). All quantities are median values.

Characteristic	Fall	Winter	Spring	Summer
pH	7.6	7.4	7.3	7.5
Temperature (F)	46.1	41.1	46.3	50.9
Dissolved Oxygen (mg/l)	11.6	12.3	11.5	10.7
Conductivity (micromho)	65.3	59.2	57.5	59.4
Turbidity (JTU)	4.0	6.1	2.8	2.0

Althauser (1982) determined the average river width to be 10 to 20 yards, excluding Northwestern Lake, having an average depth of 3 feet, and a pool-riffle-rapid ratio of approximately 10-50-40. Bottom composition averaged a boulder-rubble-gravel-sand ratio of 25-50-15-10 for RM 0 to RM 12, and 30-30-20-10 for RM 12 to RM 35; the latter section had 10 percent bedrock. Gravel quantity below Condit Dam is poor and may limit downstream spawning habitat.

Water quality in the subbasin is good. However, high nutrient concentrations probably cause extensive seasonal aquatic plant growth in Northwestern Lake. The river suffers from a yearly high sediment discharge due to glacial-melt in the headwaters. Cascade Creek enters the river at RM 36.9 and is heavily laden with glacial flour. Substantial quantities of sediment are delivered downstream, which can reduce the quality of spawning gravel.

Subbasin stream gradients are fairly steep. From the headwaters to Trout Lake, the river loses over 5,000 feet in elevation, and from Trout Lake to the Columbia River, the river loses another 1,800 feet. Between RM 35 and RM 30 elevation changes at a rate of 200 feet per mile (4 percent) and from RM 17 to RM 12 the gradient drop averages 100 feet per mile (2 percent). At RM 7.6 there is a 6-foot to 12-foot high falls (Husum Falls), a partial barrier to anadromous salmonids (Table 3). From RM 12 to RM 16.3, the river travels through a steep gorge that contains several falls. At RM 12.4 there is a 15-foot high fall and at RM 16.3 there are series of falls, the largest being 21 feet high. This probably represented the upstream limit of salmonid migration prior to Condit Dam. All tributaries between RM 7.5 and 21.4 are inaccessible to fish due to high falls at their mouths.

Table 3. Areas of complete or partial blockage to upstream migrations on the White Salmon River.

River Mile	Description
7.6	Husum Fall, 6-12 feet high
12.4	15-foot high fall
16.3	Series of four falls, 6,8,12,21 feet high
20.5-21.5	Falls and cascades, 3-8 foot drops
30.0-35.0	Steep gradient, 200 foot drop/mile

Pacific Power and Light presently owns and operates Condit Dam hydroelectric project. The dam is 125 feet high and forms the 97-acre Northwestern Lake with storage capacity of 1,080 acre-feet. In addition to hydropower, Northwestern Lake is also used for recreation and supports a popular rainbow trout fishery.

Pacific Power and Light holds a claim to vested water rights of 1,200 cfs for power generation. A wood-stove pipe 13.5 feet in diameter carries water from Condit Dam to the power plant at RM 2. Under the current license, Pacific Power and Light is required to provide a minimum flow of 15 cfs below the dam. However, leakage from the pipe and dam normally keeps this flow at 30 cfs or more.

There is also a seven kilowatt water power project under construction on Spring Creek (FERC No. 7214).

Major tributaries to the White Salmon River include Big Buck Creek (RM 5), Rattlesnake Creek (RM 7.5), and Trout Lake Creek (RM 26). Marsh and wetland habitat exists at Trout Lake, a shallow, weed-covered lake. Trout Lake Creek provides the sediment and nutrient influx needed to sustain this habitat.

Caufield (1984) listed 16 unscreened water diversions in the subbasin. On the mainstem, diversions that might impact fish are located at RM 23.1, RM 25.1, RM 26.9, RM 17, RM 27.8, and RM 29.3. Most diversions are small (2 to 15 cfs), but two are 30 cfs to 50 cfs. Maximum water rights for domestic use is 12 cfs.

Big Buck Creek has two water diversions, each with a recommended design for 4 cfs. The city of White Salmon's water supply is at RM 3.9, 50 feet above an impassable falls. Young and Rybak (1986) reported that the lower irrigation diversion removed up to 75 percent of the water from Buck Creek. Young (1985) found this creek to be particularly productive for coho. Trout Lake Creek has three unscreened diversions near the town of Trout Lake that result in substantial withdrawals.

Portions of the river (RM 5 to RM 13) have been designated as a national "scenic river" under the Wild and Scenic Rivers Act. The U.S. Forest Service is currently developing a management plan for this section of river. Plans are also under way to study RM 13 to RM 26 to determine suitability for possible federal designation or other options for river protection.

Land Use

The principal uses of land are timber production, forest range, and agriculture. The area is rural with unincorporated towns and scattered residences along the river. Highway 141 generally parallels the river and provides primary access.

Approximately 47 percent of the subbasin is in the Gifford Pinchot National Forest. The National Forest maintains a multiple use policy, principally timber production, livestock grazing, and recreation. Timber productivity in the subbasin is classified above average and forest range is used for grazing cattle, horses, and sheep. Recreation includes hiking, fishing, berry picking, horseback riding, hunting, white water rafting, snowmobiling, and cross country skiing. The remaining land is either state land managed by the Department of Natural Resources or privately owned.

Agricultural areas are concentrated in Trout Lake Valley and along the river valley between BZ Corner and White Salmon. Approximately 4,500 acres in the subbasin are cultivated, and over 70 percent is in Trout Lake Valley. At RM 28, the river flows into Trout Lake Valley and much of the flow is diverted for crops, dairy and beef farms. Major crops include alfalfa, grain sorghum, corn, potatoes, and fruit orchards. Maximum water rights for irrigation from the river are 59 cfs. The Washington Department of Ecology maintains an inventory of active surface and groundwater rights for the subbasin. Many tributaries in the Trout Lake Valley area lose water due to irrigation diversions and underground percolation. However, from the lower valley to Husum, springs replenish the river's main channel.

Grazing occurs along riparian zones in the subbasin and accounts for habitat degradation through bank erosion and loss of streambank cover. Plans are under way to improve habitat in the Rattlesnake Creek area by constructing fences to stabilize the creek channel and reseeding the banks (P. Giles, Soil Conservation Service, pers. commun.).

The subbasin population is rural and most residents are scattered along the river in the unincorporated towns of Trout Lake, BZ Corner, and Husum. Windsurfing has increased tourism in Klickitat and Skamania counties dramatically and future growth in these rural areas is expected. The community of White Salmon (population 1,900) located to the east of the White Salmon River has rights to 4 cfs on Buck Creek for its municipal water supply. The U.S. Fish and Wildlife Service has the rights to 30 cfs from the White Salmon River for the Spring Creek National Fish Hatchery off-station rearing facility (RM 1.5).

The U.S. Army Corps of Engineers has established an "in-lieu" site for tribal fishing access at the mouth of the river. The site has been set aside in compensation for tribal fishing grounds inundated by the Bonneville Dam reservoir.

PART II. HABITAT PROTECTION NEEDS

History and Status of Habitat

Prior to active state and federal regulation of forest practices, fishery habitat was damaged. Indiscriminate logging around and through streams, use of splash dams to transport logs, and poor road construction with associated siltation reduced or eliminated anadromous fish from many streams. Other problems include destruction of riparian vegetation, land reclamation and non-point source pollution from agricultural development. Urbanization, port development, and flood control efforts further impacted stream habitat. Presently, numerous laws limit impacts but the cumulative loss of habitat continues.

Fishery managers can influence fish habitat through management of the water and management of the physical habitat including the riparian edge. Physical modification of aquatic habitat is controlled by state and federal statutes. Regulations overlap and are designed to limit impacts to public stream and shoreline resources. Laws addressing developments that could degrade stream and shoreline resources follow.

Federal

1. Clean Water Act, Section 404 and 10, U. S. Army Corps of Engineers, with State of Washington, Department of Ecology certification.

2. National Environmental Policy Act (NEPA), Federal Agency taking action.

State (Washington)

1. State Water Quality Laws RCW 90.48, Department of Ecology.

2. State Surface Water Codes RCW 90.03, Department of Ecology.

3. State Groundwater Codes RCW 90.44, Department of Ecology.

4. Shoreline Management Act, local government with state oversight by Department of Ecology.

5. Hydraulics Code RCW 75.20.100 and 103, Washington Department of Fisheries or Wildlife.

6. Minimum Flow Program, Department of Ecology.

7. State Environmental Policy Act (SEPA), local government or Department of Ecology.

8. Flood Control Statutes, local government.

9. Forest Practices Act, Department of Natural Resources.

Constraints and Opportunities for Protection

Fish production in the subbasin competes with timber, irrigation, and grazing uses. Fishery agencies usually work with resource agencies to identify and reduce practices that impact fish habitat. Although fishery habitat laws and agreements are well intentioned, the inherent topography, geology, soils, and climate, and such would preclude most subbasin resource utilization without some habitat degradation.

In some cases, important factors affecting the quantity and quality of stream habitat are outside the direct regulatory authority of the fisheries management agencies. Interagency cooperation is important to address this difficult management situation. Good interagency communication of goals and objectives within watersheds and cooperative administration and enforcement could improve habitat protection.

Resource managers are currently cooperating to protect riparian habitat through a Timber/Fish/Wildlife Agreement. Harvest plans are reviewed by an interdisciplinary team and decisions are based on cooperative research, monitoring, and evaluation. The goal is to provide protection for wildlife, fish and water quality while allowing forest management activities to occur at reduced levels and under controlled operating conditions. Methods, among others, are to maintain adequate stream shading, leave trees that will later contribute large woody debris to streams, and to create silt traps to reduce silt entry into streams.

Several agencies share the responsibility of managing the White Salmon River Subbasin's resources. While each agency has its own policy and management objectives, no one agency has sole authority over the subbasin. All of the following agencies work cooperatively to protect and enhance the natural resources of the area.

Federal

- Federal Energy Regulatory Commission (FERC)
- U.S. Army Corp of Engineers (COE)
- U.S. Forest Service (USFS)
- U.S. Geological Survey (USGS)
- Soil Conservation Service (SCS)
- U.S. Fish and Wildlife Service (USFWS)
- National Marine Fisheries Service (NMFS)
- Bureau of Indian Affairs (BIA)

State

- Department of Ecology (DOE)
- Department of Natural Resources (DNR)
- Washington Department of Fisheries (WDF)
- Washington Department of Wildlife (WDW)
- Washington Department of Transportation (WDT)
- Columbia Gorge Commission (CGC)

Tribes

- Yakima Indian Nation

Local

- Underwood Conservation District
- Klickitat PUD
- Klickitat/Skamania Counties

Private

- Pacific Power and Light (PP&L)
- Longview Fibre
- Champion International Lumber
- SDS Lumber Co.

Habitat Protection Objectives and Strategies

In general, all fisheries management agencies subscribe to the concept of "no net loss" of existing habitat as a management goal. Even though this is difficult to attain, it is prudent policy and should be supported within the subbasin planning process for long-term production protection.

Guidelines for habitat protection include:

1) No net loss of existing habitat.

2) No degradation of water quality.

3) No decrease of surface water quantity.

4) Increased security for existing habitat.

5) Increased salmonid use of underutilized habitat.

Strategies to protect habitat are not always easily implemented and as a result, the habitat portion of the subbasin process may not receive the attention it deserves. Prevention of cumulative loss of habitat is ultimately one of public policy.

Methods for implementing the guidelines mentioned are generally outside the normal activities of the Northwest Power Planning Council and the typical approach is through regulatory programs. However, this results in habitat protection being defensive whereby some habitat loss frequently occurs.

The combination of an effective public education program, an aggressive regulatory program with stiff penalties, tax incentives for riparian landowners, and demonstrated resource benefits to local residents is likely the only way to preserve and realize the production potential of the region's stream habitat resources. Within these broad categories, there is opportunity for the Power Planning Council to take a leadership and coordinating role. However, the daily business of protecting small habitat units will continue to be an agency burden. Effectiveness of these programs will depend on agency staffing levels of field management and enforcement personnel, public and political acceptance of program goals, local judicial support and, importantly, the level of environmental awareness practiced by individual landowners.

The area of cumulative habitat loss is one that the Northwest Power Planning Council must be involved in for sake of the investments made in the Columbia River Basin Fish and Wildlife Program to date. The council could support the agencies' regulatory habitat protection work and become more involved by:

1) Continuing to broaden the public education and information program it already supports.

2) Purchasing riparian property adjacent to critical habitat.

3) Purchasing water rights if they can revert to instream uses.

4) Publishing additional inventories of important habitat for specific stocks.

5) Working with state and federal government for the development and passage of improved habitat protective legislation.

PART III. CONSTRAINTS AND OPPORTUNITIES FOR ESTABLISHING PRODUCTION OBJECTIVES

Systemwide Considerations

In terms of identifying objectives, general consideration should focus on the United States vs. Oregon document and the need to use this planning process as a means to fulfill the implementation of that decision. At the core of this agreement is the objective to rebuild weak runs at full productivity and to achieve fair sharing of the available harvest between Indian and non-Indian fisheries. A secondary objective is to rebuild upriver spring and summer chinook runs that would restore fisheries within 15 years. Harvests would be managed so that natural steelhead and other salmon runs also continue to rebuild. The rebuilding is to be accomplished through a systematic harvest management approach as well as implementation of appropriate production measures.

Consistent with United States vs. Oregon is the need to maintain flexible and dynamic plans, which can be evaluated at defined intervals and modified whenever conditions change or new information becomes available. Long-term plans should also work to avoid disputes among the parties and attempt to resolve disagreements over fishing regulations and the collection and interpretation of management data.

As an extension of these objectives, subbasin plans should:

1) Achieve a balance with the stock of any given type (such as spring and fall chinook).

2) Work toward harvest stability within subbasins.

3) Provide equitable opportunity to each user group.

4) Maintain habitat and improve where possible.

5) Manage for the consistent escapement of escapement allowances.

6) Optimize production and maximize long-term net benefits.

7) Use indigenous stocks where feasible and maintain stock diversity of all species to ensure perpetual existence and ability to adapt to change.

In fulfilling their obligations, the parties will cooperate in management research and enhancement. In addition, the parties will take into account the following items.

1) The desirability, in most cases, of reducing interceptions.

2) The desirability, in most cases, of avoiding undue disruption of existing fisheries.

3) Annual variation in abundance of the stocks.

Local Considerations

A considerable amount of logging has taken place in the watershed, which has contributed to streambank instability and sedimentation, reduced riparian vegetation, and increased road surfaces (sedimentation source and culverts). Current forest practices are seeking to minimize these impacts and rectify problems created during operations.

The Gifford Pinchot National Forest, Washington Department of Fisheries, and Washington Department of Wildlife have signed a memorandum of understanding to work cooperatively to promote the successful management of fishery and wildlife resources, and habitat in national forest lands. Opportunities exist for these agencies to work together to increase the fisheries resources by minimizing proposed activities that would impact fish habitat and implementing habitat rehabilitation and enhancement projects.

A federal court case involving treaty fishing rights on the mainstem Columbia River also has implications for the management of tributary fish resources. The Columbia River Fish Management Plan includes specific instructions for hatchery production of spring chinook in the White Salmon River Subbasin. Consequently, subbasin production plans must be compatible with the production goals set forth in the Columbia River Fish Management Plan.

The water rights of the Yakima Indian Nation for beneficial uses including its fisheries are based on the Treaty of June 9, 1855 (12 Stat. 951). These rights are based on the aboriginal rights of the Confederated Tribes and Bands of the Yakima Indian Nation, and secure the right of taking fish at all usual and accustomed places in addition to the exclusive right of taking fish in all streams, whether running through or bordering reservations. Neither the White Salmon River or its tributaries run through or border any reservations. Tribes that are party to the treaty retain authority over activities that affect hunting and fishing, and participate equally in the fishery management decisions affecting the Columbia River and its tributaries.

In 1968, the federal Wild and Scenic Rivers Act was passed. The main objective of the act is to preserve and maintain the free-flowing characteristics of certain rivers possessing outstanding qualities (scenic, cultural, fish and wildlife) for the benefit and enjoyment of present and future generations. The act classifies rivers as either wild, scenic, or recreational, and provides protection from future development and pollution, which may harm the rivers aesthetic and environmental quality.

The White Salmon River from RM 5 to RM 13 has been designated "scenic," which means the area is generally primitive and shorelines are undeveloped. Under U.S. Forest Service general guidelines, a scenic river classification protects the river view and does not allow large clearcuts adjacent to the river, though selective logging could continue. The U.S. Forest Service is developing a management plan for this section of the river, due October 1990. Also due at this time is the recommendation of RM 13 to RM 26 for federal designation or other river management options.

The White Salmon River and one of its tributaries, Trout Lake Creek, have stands of mature timber that have been designated "spotted owl habitat areas". Approximately 2,400 acres comprise a habitat area and no timber harvest is allowed. Currently, there are six spotted owl habitat areas in the subbasin.

The portion of the White Salmon River in Klickitat County is classified as a "shoreline of statewide significance" under the County Shorelines Master Plan. This gives special recognition to the river as a resource not only to the county, but to the entire state. Proposed uses of the shoreline are reviewed in terms of their benefit to the public.

The operating license for Condit Dam will expire December 31, 1993 and Pacific Power and Light is seeking to relicense the project. Statutory procedures for consultation during relicensing are outlined in the Federal Power Act as amended by the Electric Consumers Protection Act, and FERC rules and regulations. The Federal Energy Regulatory Commission treats relicensing as substantially equivalent to issuing an original license. The relicensing procedure allows discussion to be opened for input concerning the public needs and desires concerning the use of the river. When the FERC issues a license, articles are incorporated into the license specifying conditions under which the licensee may operate in a river that is under public ownership. Typically, these articles specify safety standards and mitigation for losses from the presence of the dam. These losses may be commercial, fish, wildlife, and/or recreational values. Section 10(j) of the Federal Power Act states that to adequately and equitably protect, mitigate damages to, and enhance fish and wildlife (including related spawning grounds and habitat) affected by the development and operation of a project, each license shall include conditions for protection, mitigation, and enhancement. The current license has no article requiring mitigation for lost production, but does require Pacific Power and Light to cooperate with the fisheries resource agencies (U.S. Fish and Wildlife Service, Washington Department of Wildlife, Washington Department of Fisheries, National Marine Fisheries Service, and Yakima Indian Nation) to study options on the mitigation issue. The primary mitigation issue for evaluation during relicensing at Condit Dam is loss of anadromous fish above the dam.

PART IV. ANADROMOUS FISH PRODUCTION PLANS

SUMMER STEELHEAD

Fisheries Resource

Natural Production

History and Status

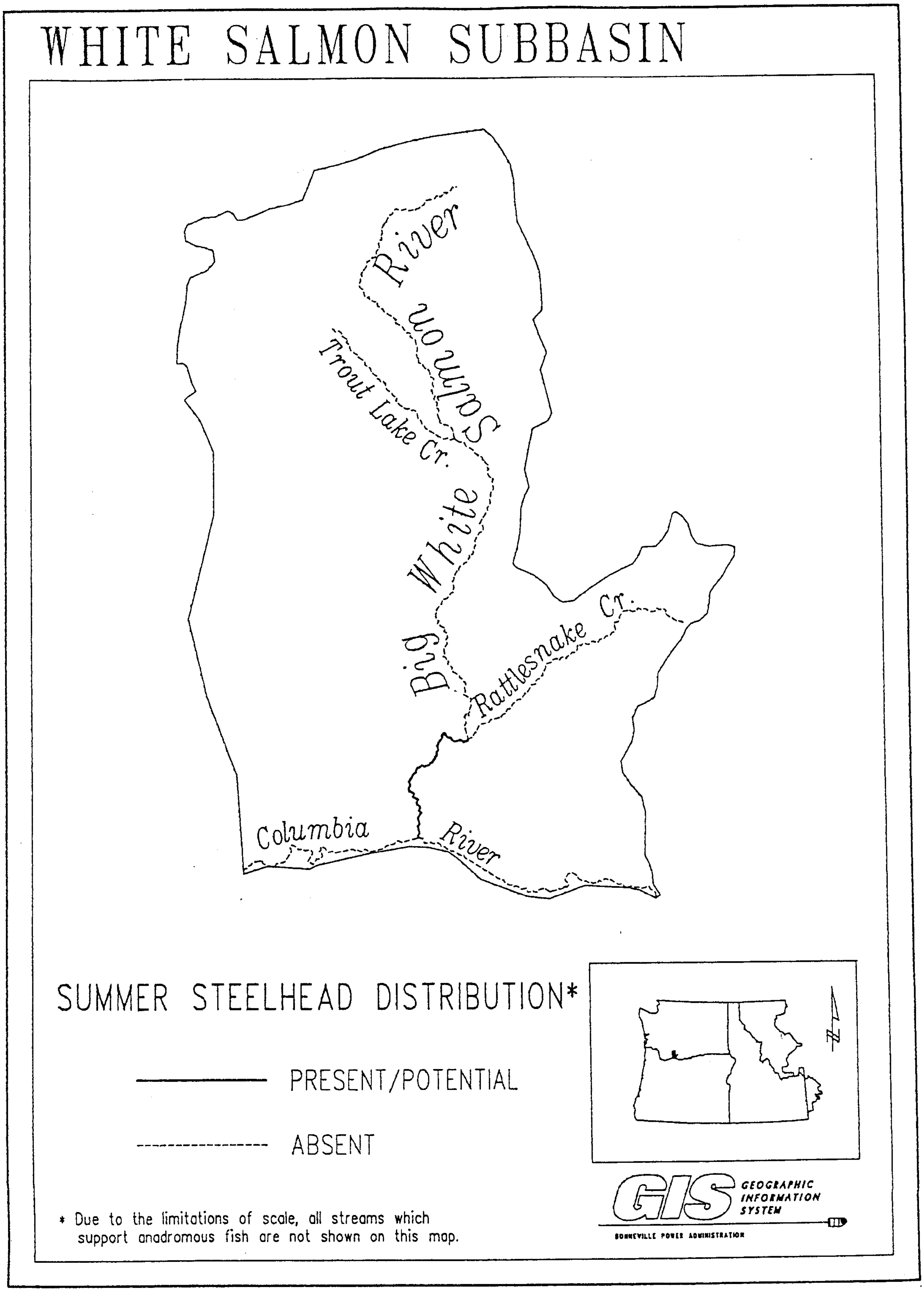
Affidavits from local residents state that steelhead were observed upstream as far as Trout Lake. Most current reports agree that Husum Falls could have been an impedance at low flows to salmon, but the falls at RM 16.3 were the upper limit to both salmon and steelhead (although steelhead may have been able to negotiate these falls under ideal conditions). Chapman (1981) estimated 763 steelhead adults would be found in the White Salmon River under pristine conditions. Currently, steelhead are limited to the lower 3.3 miles of river due to Condit Dam.

Run size of natural steelhead is unknown since spawning surveys or harvest data are not available. However, based on the smolt capacity and 3 percent smolt-to-adult return rate, run size of natural fish was estimated to be 50 fish. The White Salmon has "wild release" regulations so natural fish are not harvested. There is a popular fishery at the mouth of the river, but most fish are "dip-ins" or strays from other subbasins. The wild release regulations primarily protect natural fish from these other subbasins. The existence of genetically independent natural summer steelhead in the White Salmon is questionable.

The Northwest Power Planning Council's smolt carrying capacity model for below Condit Dam was 3,541 smolts, which was divided in half to account for the sympatric population of winter steelhead amounting to 1,771 smolts. Seiler and Neuhauser (1985) estimated natural production of steelhead smolts in a 1.6-mile reach below the dam to be 5,116 smolts. Above Condit Dam, Young and Rybak (1987) estimated 10,471 smolts could be produced between Condit Dam and RM 16.3 and 22,916 smolts between RM 16.3 and the headwaters.

Life History and Population Characteristics

Summer steelhead enter the subbasin in April through December, peaking in July through September. Spawning extends from January through April, peaking in February and March (Howell et al. 1984). Emergence occurs in spring and early summer. Smolts rear two to three years before emigrating in April and May.


WHITE SALMON SUBBASIN
Big White Salmon River
Trout Lake Cr.
Rattlesnake Cr.
Columbia River
SUMMER STEELHEAD DISTRIBUTION*
PRESENT/POTENTIAL
ABSENT
* Due to the limitations of scale, all streams which support anadromous fish are not shown on this map.
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There is no specific sex ratio or fecundity data for White Salmon River natural steelhead. Data from Kalama River summer steelhead are thought to be similar and are substituted herein. Juvenile freshwater age structure of Kalama steelhead smolts (winter and summer combined) was 6.1 percent, 80.6 percent, and 13.3 percent for age I, II, and III, respectively (Loch et al. 1985). Mean fork length of smolts was 14.2 cm, 16.1 cm, and 17.2 cm for age I, II, and III, respectively.

For adults, excluding repeat spawners, ocean age structure was dominated by 78.9 percent 2-salts followed by 14.5 percent 1-salts and 6.6 percent 3-salts (Table 4) (Leider et al. 1986). Females made up 51.9 percent of initial spawners. Mean length of all initial spawners combined was 70.6 cm -- 70.3 cm for males and 70.8 cm for females. Repeat spawners comprised 6 percent of the total, were 55.8 percent females, and averaged 78.2 cm (n=170). Mean length of all fish combined was 71 cm.

No fecundity information was found for natural summer steelhead in the subbasin. Fecundity of Skamania Hatchery fish was 4,170 eggs per female (Randolph 1987).

Table 4. Ocean age structure, length and sex of Kalama Subbasin natural summer steelhead (Leider et al. 1986).

	Ocean Age		
	1	2	3
Age Composition	14.5 %	78.9 %	6.6 %
Percent Females	31.8 %	59.2 %	8.9 %
Mean Length (cm) Male	57.4	72.7	79.0
Mean Length (cm) Female	60.6	71.7	78.7
Number of Fish	368	2,004	168

Supplementation History

Since 1982, an average of 13,044 smolts of Skamania stock have been planted in the subbasin (Table 5). Recent plants have fluctuated due to budget and disease problems at Skamania Hatchery. Sport catch, escapement, and total return data from these plants are lacking. Smolt-to-adult return rate was thought to be similar to the Wind River where it averaged 3 percent. Although harvest information is available, it is unrepresentative of fish planted in the subbasin. As mentioned earlier, most fish caught in the subbasin are "dip-ins." In addition, there is no spawning survey data to estimate escapement.

In 1984, the Washington Wildlife Department released steelhead smolts above Condit Dam. Seiler and Neuhauser (1985) estimated steelhead survival past Condit Dam at 74 percent. They also found that natural steelhead smolts below the dam had a mean fork length of 193 mm.

Table 5. Releases of subbasin hatchery summer steelhead smolts below Condit Dam.

Release Year	Hatchery and Stock	Smolts	Fingerlings
1982	Skamania	20,144	
1983	Skamania	21,001	
1984 1/	Skamania	14,252	
1985	Skamania	10,006	
1986	Skamania	19,836	
1987	Vancouver	10,000	20,619
1988		0	
1989	Skamania	9,115	
	AVE	13,044	

1/ An experimental plant of 285,400 fry and 10,141 smolts were made above Condit Dam.

Hatchery Production

Currently, a net pen operation exists in Northwestern Lake behind Condit Dam, a cooperative project of Pacific Power and Light, Washington Department of Wildlife, and the White Salmon Steelheaders. Pacific Power and Light has furnished the net pen, Washington Department of Wildlife provides the fish and feed, and the White Salmon Steelheaders operate and maintain the pens. One net pen was used to raise 7,200 fish from March to the end of April 1988. Fish were released below the dam at RM 1.5. The program raised approximately 20,000 fish in 1989. There is considerable room for facility expansion.

Life history of White Salmon hatchery summer steelhead is generally lacking, but thought to be similar to Skamania stock fish returning to the Kalama River. Hatchery smolts emigrate after about 14 months, about one year sooner than natural fish. Saltwater age composition of initial migrant adults was 4.5 percent, 85.7 percent, 9.8 percent for age I, II, III, respectively (Table 6) (Leider et al. 1986). Females comprised 17.5 percent, 54 percent, and 32.9 percent of each age class, respectively, and 50.3 percent of the total. Repeat spawners comprised 2.8 percent of hatchery adult runs, had a mean length of 78.2 cm and were comprised of 50.7 percent females. Mean length of all hatchery adults combined was 72.7 cm. Fecundity of Skamania Hatchery fish was 4,170 eggs per female (Randolph 1987). Based on the assumed 3 percent smolt-to-adult return rate, run size of hatchery fish was estimated to be 391 fish for 1977 through 1989.

Table 6. Ocean age, sex, and length of initial migrant Kalama River hatchery summer steelhead (Leider et al. 1986).

	Ocean Age		
	1	2	3
Age Composition	4.5%	85.7%	9.8%
Percent Females	17.5%	54.0%	32.9%
Mean Length (cm) Male	57.9	72.8	85.2
Mean Length (cm) Female	60.8	71.2	79.7
Total number of fish	228	4,378	501

Harvest

Subbasin sport harvest is limited to hatchery steelhead and natural fish must be released. Fishermen are allowed to fish from the mouth to within 400 feet of Condit Dam; natural steelhead must be released from May 16 to October 31. The daily catch limit is two fish.

An average of 1,841 steelhead were caught in the subbasin between May and October in 1977 through 1989 (Table 7). An average of 91 fish were caught between November through April for the same years. As mentioned earlier, most fish caught are believed to be "dip-ins." Creel surveys in August 1988 estimated fishermen took a total of 8,793 trips to catch 3,506 steelhead; 1,169 fish were harvested and 1,837 were released (C. Morrill, WDW, pers. commun.). Harvest rate is unknown, but is assumed to be 70 percent on subbasin hatchery fish due to intense angler effort.

Table 7. Harvest of White Salmon steelhead, 1977-1989.

Year	May-October	November-April
1977-78	1,564	0
1978-79	624	12
1979-80	738	9
1980-81	713	13
1981-82	1,311	7
1982-83	1,188	3
1983-84	1,173	133
1984-85	1,855	336
1985-86	3,456	81
1986-87	2,934	173
1987-88	3,762	195
1988-89	2,773	146
AVE	1,841	91

Specific Considerations

Production constraints for natural fish include lack of habitat caused by Condit Dam. However, due to the desire to protect the resident trout fishery from intraspecific competition, planners are not proposing reestablishing steelhead above Condit Dam. Smolt and adult mortality associated with Bonneville Pool and Dam has further constrained subbasin production.

Opportunities to increase production are associated with hatchery fish and Northwestern Lake. This body of water offers a large potential rearing area via net pens.

Critical Data Gaps

Population size and composition is needed along with life history characteristics such as age, lengths, sex ratios and fecundities.

Objectives

Utilization Objective

Provide 2,400 fish for insubbasin sport harvest and 2,400 tribal harvest out of basin. The utilization component has priority within the subbasin for this stock.

Biological Objective

Maintain the biological characteristics of the existing population.

This goal represents an increase in subbasin harvest of 559 fish.

Alternative Strategies

Strategies for summer steelhead in this report have specific themes. Means to obtain the objectives are first attempted using natural methods followed by less natural techniques and finally, hatchery production. Actions identified under each strategy are closely related to the theme. Strategy 1 has a natural production theme seeking to improve the productivity of the existing natural stock. Strategy 2 is a "benign" supplementation strategy, emphasizing actions to develop a single supplemented run with yet higher productivity. Strategy 3 relies on a traditional hatchery program to meet objectives. Only those actions necessary for the success of a hatchery program would be included in Strategy 3.

Modeling results for each strategy are presented in Table 8 as fish produced at "maximum sustainable yield" (MSY). The sustainable yield of a fish population refers to that portion of the population that exceeds the number of fish required to spawn and maintain the population over time. Sustainable yield can be "maximized," termed MSY, for each stock at a specific harvest level. The MSY is estimated using a formula (Beverton-Holt function) that analyzes a broad range of harvest rates. Subbasin planners have used MSY as a tool to standardize results so that decision makers can compare stocks and strategies.

In MSY management, managers set a spawning escapement level and the remaining fish (yield) could theoretically be harvested. In practice, a portion of the yield may be reserved as a buffer or to aid rebuilding. Thus, managers may raise the escapement level to meet a biological objective at the expense of a higher utilization objective.

The amount of buffer appropriate for each stock is a management question not addressed in the subbasin plans. For this reason, the utilization objective, which usually refers to harvest, may not be directly comparable to the MSY shown in Table 8. At a minimum, a strategy should produce an estimated MSY equal to or greater than the utilization objective. A MSY substantially larger than the subbasin utilization objective may be needed to meet subbasin biological objectives.

Estimated costs of the alternative strategies below are summarized in Table 9.

STRATEGY 1: Natural Production, Level 1. This strategy seeks to achieve the objectives by eliminating sources of direct mortality to natural fish, answering management questions and reducing risks of genetic modification of natural stocks.

This strategy provides for prudent stewardship of existing habitat and water quality in the current distribution range through various existing laws and agreements. Streams in the subbasin need to be inventoried for summer temperature profiles; those exceeding temperature sensitivity criteria should be classified as such through the Department of Natural Resources so future impacts will be minimized. Water withdrawals should be reduced as possible. Riparian zones should be managed to provide a continuous recruitment of large organic debris (LOD) into the subbasin system.

Stream typing should be reviewed and streams should be upgraded as needed. Fishways should be maintained.

Hypothesis: Existing habitat, if managed properly, should provide near capacity numbers of natural smolts if adequately seeded.

Assumptions: Action 1 assumes egg-to-smolt survival will be increased by a relative 10 percent.

Numeric Fish Increases: The System Planning Model indicated an additional two fish will return to the subbasin with this strategy under current conditions. MSY would increase by six fish after mainstem program implementation.

ACTIONS: 1

1. Maintain at least current level of stream habitat quality and quantity. Seek improved water quality via reduction of sedimentation and temperatures. Seek legislation to eliminate additional or replacement water withdrawals in summer. Inventory and map habitat.

STRATEGY 2: Supplementation. This strategy seeks to achieve the objectives by supplementing natural production with an appropriate existing hatchery stock or natural stock. Any actions identified in Strategy 1 necessary for the success of the supplementation program are also required.

Hypothesis: By using natural stock for hatchery releases, the relative fitness should be improved and chances of genetic degradation will be decreased. Also, the relative fitness of progeny should be increased.

Assumptions: Action 2 assumes relative smolt survival will increase from 0.67 to 0.71 and viability of naturally spawning hatchery-hatchery and hatchery-natural crosses will increase by a relative 10 percent. Action 3 increases hatchery releases to 40,000 fish.

Numeric Fish Increases: The System Planning Model indicated an additional 896 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 742 fish after mainstem program implementation.

ACTIONS: 1-3

1. -

2. Use captured natural brood stock for hatchery supplementation in existing programs.

3. Expand the net pen program to rear 40,000 smolts using natural brood stock.

STRATEGY 3: Hatchery Production. This strategy seeks to achieve the objectives solely through traditional hatchery production. Only those actions necessary for maintenance of the hatchery program are included.

Hypothesis: Increasing hatchery plants will increase adult returns.

Assumptions: Action 4 assumes increased smolt production will result in commensurate adult returns.

Numeric Fish Increases: The System Planning Model indicated an additional 827 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 697 fish after mainstem program implementation.

ACTIONS: 4

4. Expand the net pen program to 40,000 smolts.

Recommended Strategy

The recommended strategy is Strategy 3, hatchery production. Presently, there are few natural fish and little natural production potential due to Condit Dam. Reestablishment above Condit is not sought and therefore, hatchery production is the only potential for expanded production. This strategy was also supported by the SMART analysis (Appendix B).

Table 8. System Planning Model results for summer steelhead (A's) in the White Salmon Subbasin. Baseline value is for pre-mainstem implementation, all other values are post-implementation.

Utilization Objective:
4,800 fish for sport and tribal harvest.

Biological Objective:
Maintain biological characteristics of existing stock.

Strategy[1]	Maximum[2] Sustainable Yield (MSY)	Total[3] Spawning Return	Total[4] Return to Subbasin	Out of[5] Subbasin Harvest	Contribution[6] To Council's Goal (Index)
Baseline	303 -N	122	439	46	0(1.00)
All Nat	309 -N	119	442	47	4(1.01)
1	309 -N	119	442	47	4(1.01)
2	1,045 -N	265	1,340	143	1,106(3.06)
3*	1,000 -N	239	1,266	135	1,015(2.89)

*Recommended strategy.

[1]Strategy descriptions:

For comparison, an "all natural" strategy was modeled. It represents only the natural production (non-hatchery) components of the proposed strategies plus current management (which may include hatchery production). The all natural strategy may be equivalent to one of the alternative strategies below.

1. Restore natural production of this stock above Condit Dam. Post Mainstem Implementation.
2. Construct hatchery facilities below Condit Dam capable of producing 40,000 smolts. Post Mainstem Implementation.
3. Outplant 40,000 smolts (from baseline situation). Post Mainstem Implementation.

[2]MSY is the number of fish in excess to those required to spawn and maintain the population size (see text). These yields should equal or exceed the utilization objective. C = the model projections where the sustainable yield is maximized for the natural and hatchery components combined and the natural spawning component exceeds 500 fish. N = the model projection where sustainable yield is maximized for the naturally spawning component and is shown when the combined MSY rate results in a natural spawning escapement of less than 500 fish.

[3]Total return to subbasin minus MSY minus pre-spawning mortality equals total spawning return.

[4]Total return to the mouth of the subbasin.

[5]Includes ocean, estuary, and mainstem Columbia harvest.

[6]The increase in the total return to the mouth of the Columbia plus prior ocean harvest (as defined by the Northwest Power Council's Fish and Wildlife Program), from the baseline scenario. The index () is the strategy's total production divided by the baseline's total production.

Table 9. Estimated costs of alternative strategies for White Salmon summer steelhead. Cost estimates represent new or additional costs to the 1987 Columbia River Basin Fish and Wildlife Program; they do not represent projects funded under other programs, such as the Lower Snake River Compensation Plan or a public utility district settlement agreement. (For itemized costs, see Appendix C.)

	Proposed Strategies		
	1	2	3*
Hatchery Costs			
Capital[1]	0	124,200	124,200
O&M/yr[2]	0	13,500	13,500
Other Costs			
Capital[3]	0	200,000	0
O&M/yr[4]	30,000	50,000	0
Total Costs			
Capital	0	324,200	124,200
O&M/yr	30,000	63,500	13,500

* Recommended strategy.

[1] Estimated capital costs of constructing a new, modern fish hatchery. In some subbasins, costs may be reduced by expanding existing facilities. For consistency, estimate is based on $23/pound of fish produced. Note that actual costs can vary greatly, especially depending on whether surface or well water is used and, if the latter, the number and depth of the wells.

[2] Estimated operation and maintenance costs per year directly associated with new hatchery production. Estimates are based on $2.50/pound of fish produced. For consistency, O&M costs are based on 50 years.

[3] Capital costs of projects (other than direct hatchery costs) proposed under a particular strategy, such as enhancing habitat, screening diversions, removing passage barriers, and installing net pens (see text for specific actions).

[4] Estimated operation and maintenance costs per year of projects other than those directly associated with new hatchery production. For consistency, O&M costs are based on 50 years.

WINTER STEELHEAD

Fisheries Resource

Natural Production

History and Status

Little is known about subbasin natural winter steelhead; it is unclear if a run existed historically. Subsequent hatchery introductions have been successful. Based on the natural production potential and 3 percent smolt-to-adult return rate, the estimated run size of natural winter steelhead is 50 fish. Chapman (1981) estimated 763 steelhead adults (including summer steelhead) would be found in the White Salmon River under pristine conditions. The existence of genetically independent natural winter steelhead in the White Salmon is questionable.

The Northwest Power Planning Council's smolt carrying capacity estimate for below Condit Dam was 3,541 smolts, which was divided in half to account for the sympatric population of summer steelhead amounting to 1,771 smolts. Seiler and Neuhauser (1985) estimated natural production of steelhead smolts in a 1.6-mile reach below the dam to be 5,116 smolts. Above Condit Dam, Young and Rybak (1987) estimated that 10,471 smolts could be produced between Condit Dam and RM 16.3, and 22,916 smolts between RM 16.3 and the headwaters.

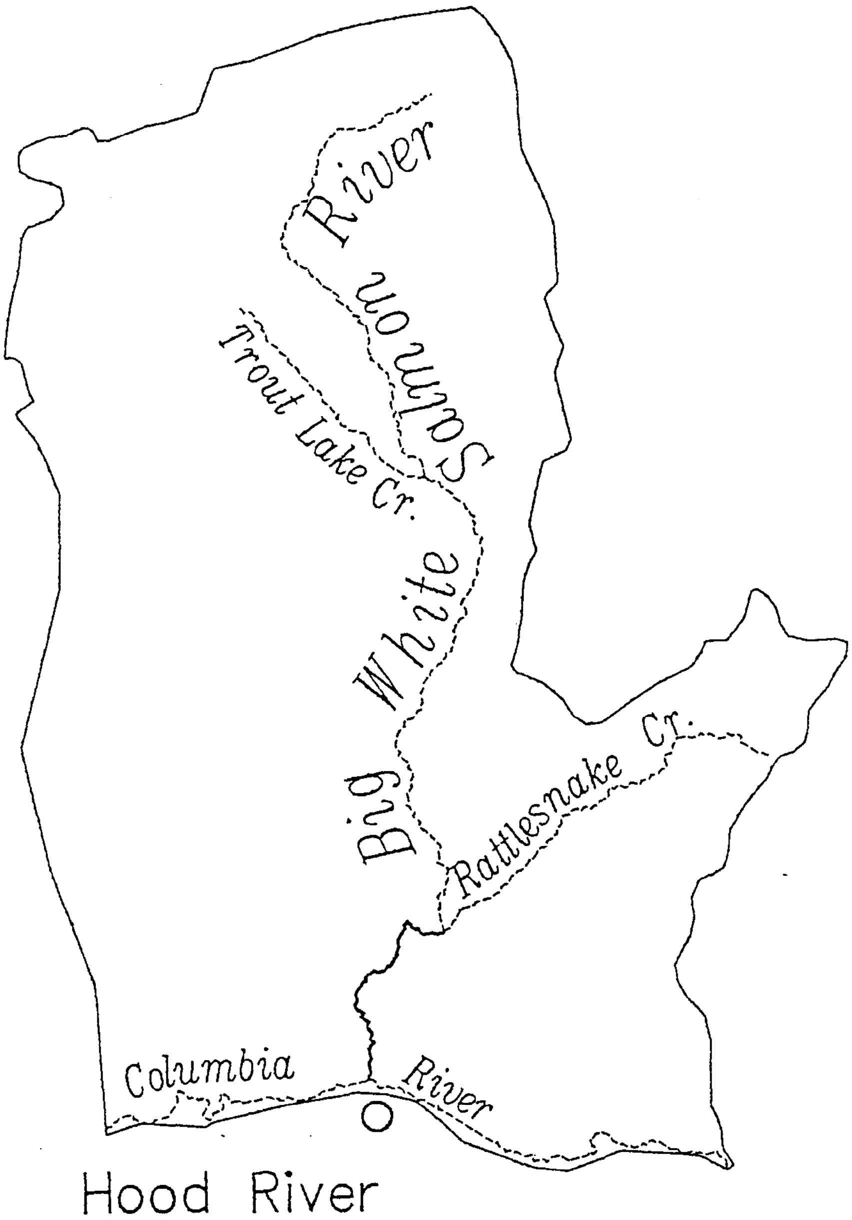
Life History and Population Characteristics

Biological data for White Salmon winter steelhead is lacking, but is thought to be similar to Kalama winter steelhead, which is presented herein. Most fish return to the river in January through May with a peak in March. Spawning occurs in March through June.

Juvenile freshwater age structure of Kalama River steelhead smolts (winter and summer combined) was 6.1 percent, 80.6 percent, and 13.3 percent for age I, II, and III, respectively (Loch et al. 1985). Mean fork length of smolts was 14.2 cm, 16.1 cm, and 17.2 cm for age I, II, and III, respectively.

For adults, excluding repeat spawners, ocean age structure was dominated by 71.1 percent 2-year ocean fish (2-salts) followed by 25.7 percent 3-year ocean fish (Table 10) (Leider et al. 1986). Females made up 51.6 percent of initial spawners. Mean length of all initial spawners combined was 72.6 cm. Repeat spawners comprised 11.3 percent of the total, were 71.4 percent females, and averaged 77.4 cm (n=298). Mean length of all fish combined was 73.1 cm.

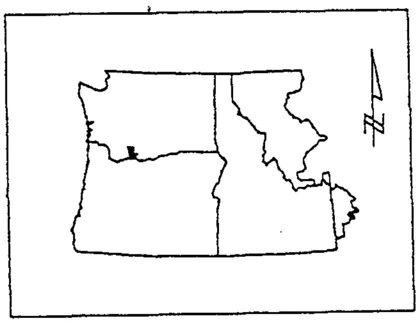
WHITE SALMON SUBBASIN



WINTER STEELHEAD DISTRIBUTION*

———————— PRESENT/POTENTIAL

---------------- ABSENT



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* Due to the limitations of scale, all streams which support anadromous fish are not shown on this map.

Table 10. Ocean age, sex, and length of Kalama natural steelhead (Leider et al. 1986).

	Ocean Age 1	Ocean Age 2	Ocean Age 3
Age Composition	3.2%	71.1%	25.7%
Percent Females	7.6%	47.5%	68.8%
Mean Length (cm) Male	52.0	70.8	85.8
Mean Length (cm) Female	59.0	69.2	80.5
Total number of fish	92	1,989	718

Fecundity of Cowlitz Hatchery kill-spawned steelhead, with lengths similar to Kalama fish, averaged 5,257 eggs per female. Beaver Creek Hatchery fish of 68.5 cm had a fecundity of 4,060 eggs per female (Randolph 1987). Based on the above, fecundity of White Salmon steelhead is assumed to be 4,500 eggs per female.

Hatchery Production

The previously mentioned (under summer steelhead) net pen operation exists in Northwestern Lake. Although there is considerable room for additional net pens, no plans for expansion currently exist. No additional production facilities are planned in the White Salmon Subbasin.

For 1982 through 1989, an average of 14,023 smolts were planted using Beaver Creek and Skamania stocks (Table 11). Smolts-planted-to-adults-harvested in the White Salmon averaged about 1.3 percent. With a 50 percent harvest rate, smolt-to-adult return has averaged 2.6 percent.

Biological data on hatchery winter fish in the White Salmon is lacking, but is thought to be similar to Kalama hatchery fish and is profiled herein. Smolts emigrate after about 14 months, about one year sooner than natural fish. Saltwater age composition of adults was 2 percent, 86.8 percent, 11.3 percent for age I, II, III, respectively (Table 12) (Leider et al. 1986). Females comprised 31.7 percent, 48.2 percent, and 73.4 percent of each age class, respectively, and 50.7 percent of the total. Repeat spawners comprised 5.8 percent of hatchery adult runs of which 71.6 percent were females. Mean length of all hatchery adults combined was 69.4 cm.

Length and fecundity of Elochoman Hatchery steelhead, which are probably representative of hatchery returns to the Kalama, were 67.4 cm - 3,910 eggs in 1983; 64.1 cm - 3,459 eggs in 1984; and 68.5 cm - 4,060 eggs in 1985 (Randolph 1986 and 1987). Mean of the three years was 3,810 eggs per female.

Table 11. Plants of winter steelhead in the White Salmon River.

Year	Smolts	Fingerlings
1982	32,901	
1983	0	
1984	10,141	
1985	10,008	78,400
1986	35,433	78,400
1987	0	
1988	7,200	
1989	16,500	
AVE	14,023	

Table 12. Ocean age, sex, and length of initial migrant Kalama River hatchery steelhead (Leider et al. 1986).

	Ocean Age		
	1	2	3
Age Composition	2.0%	86.8%	11.3%
Percent females	31.7%	48.2%	73.4%
Mean Length (cm) Male	56.4	68.9	81.2
Mean Length (cm) Female	63.6	66.8	79.2
Total number of fish	41	1,821	237

Harvest

Sport catch of winter steelhead averaged 18 fish prior to return of the 1982 hatchery plants. Harvest after the winter of 1982-83 averaged 177 fish (Table 13). Harvest rate is unknown, but is assumed to be about 50 percent for natural and hatchery fish. Based on the 50 percent harvest rate, return of hatchery fish was estimated to be 344 fish.

Table 13. Harvest of White Salmon steelhead, 1977-1989.

Year	May-October	November-April
1977-78	1,564	0
1978-79	624	12
1979-80	738	9
1980-81	713	13
1981-82	1,311	7
1982-83	1,188	3
1983-84	1,173	133
1984-85	1,855	336
1985-86	3,456	81
1986-87	2,934	173
1987-88	3,762	195
1988-89	2,773	146
AVE	1,841	91

Specific Considerations

Production constraints for natural fish include lack of habitat caused by Condit Dam. However, due to the desire to protect the resident trout fishery from intraspecific competition, planners are not proposing reestablishing steelhead above Condit Dam. Smolt and adult mortality associated with Bonneville Pool and Dam has further constrained subbasin production.

Opportunities to increase production are associated with hatchery fish and Northwestern Lake. This body of water offers a large potential rearing area via net pens.

Critical Data Gaps

Population size and composition is needed along with life history characteristics such as age, lengths, sex ratios and fecundities.

Objectives

Utilization Objective

Provide 400 fish for insubbasin sport harvest and 400 tribal harvest out of subbasin. The utilization component has priority within the subbasin for this stock.

Biological Objective

Maintain the biological characteristics of the existing population.

This goal would represent an increase in subbasin harvest of 225 fish.

Alternative Strategies

Strategies for winter steelhead in this report have specific themes. Means to obtain the objectives are first attempted using natural methods followed by less natural techniques and finally, hatchery production. Actions identified under each strategy are closely related to the theme. Strategy 1 has a natural production theme seeking to improve the productivity of the existing natural stock. Strategy 2 is a "benign" supplementation strategy, emphasizing actions to develop a single supplemented run with yet higher productivity. Strategy 3 relies on a traditional hatchery program to meet objectives. Only those actions necessary for the success of a hatchery program would be included in Strategy 3.

Modeling results for each strategy are presented in Table 14 as fish produced at "maximum sustainable yield" (MSY). The sustainable yield of a fish population refers to that portion of the population that exceeds the number of fish required to spawn and maintain the population over time. Sustainable yield can be "maximized," termed MSY, for each stock at a specific harvest level. The MSY is estimated using a formula (Beverton-Holt function) that analyzes a broad range of harvest rates. Subbasin planners have used MSY as a tool to standardize results so that decision makers can compare stocks and strategies.

In MSY management, managers set a spawning escapement level and the remaining fish (yield) could theoretically be harvested. In practice, a portion of the yield may be reserved as a buffer or to aid rebuilding. Thus, managers may raise the escapement level to meet a biological objective at the expense of a higher utilization objective.

The amount of buffer appropriate for each stock is a management question not addressed in the subbasin plans. For this reason, the utilization objective, which usually refers to harvest, may not be directly comparable to the MSY shown in Table 14. At a minimum, a strategy should produce an estimated MSY equal to or greater than the utilization objective. A MSY substantially larger than the subbasin utilization objective may be needed to meet subbasin biological objectives.

Estimated costs of the alternative strategies below are summarized in Table 15.

STRATEGY 1: Natural Production, Level 1. This strategy seeks to achieve the objectives by eliminating sources of direct mortality to natural fish, answering management questions and reducing risks of genetic modification of natural stocks.

This strategy provides for prudent stewardship of existing habitat and water quality in the current distribution range through various existing laws and agreements. Streams in the subbasin need to be inventoried for summer temperature profiles; those exceeding temperature sensitivity criteria should be classified as such through the Department of Natural Resources so future impacts will be minimized. Water withdrawals should be reduced as possible. Riparian zones should be managed to provide a continuous recruitment of large organic debris (LOD) into the subbasin system. Stream typing should be reviewed and streams should be upgraded as needed. Fishways should be maintained.

Hypothesis: Existing habitat, if managed properly, should provide near capacity numbers of natural smolts if adequately seeded.

Assumptions: Action 1 assumes egg-to-smolt survival will be increased by a relative 10 percent.

Numeric Fish Increases: The System Planning Model indicated an additional two fish will return to the subbasin with this strategy under current conditions. MSY would increase by five fish after mainstem program implementation.

ACTIONS: 1

1. Maintain at least current level of stream habitat quality and quantity. Seek improved water quality via reduction of sedimentation and temperatures. Seek legislation to eliminate additional or replacement water withdrawals in summer. Inventory and map habitat.

STRATEGY 2: Supplementation. This strategy seeks to achieve the objectives by supplementing natural production with an appropriate existing hatchery stock or natural stock. Any actions identified in Strategy 1 necessary for the success of the supplementation program are also required.

Hypothesis: By using natural stock for hatchery releases, the relative fitness should be improved and chances of genetic degradation will be decreased. Also, the relative fitness of progeny should be increased.

Assumptions: Action 2 assumes relative smolt survival will increase from 0.67 to 0.71 and viability of naturally spawning hatchery-hatchery and hatchery-natural crosses will increase by a relative 10 percent. Action 3 increases hatchery releases to 40,000 fish. This strategy assumes enough natural fish could be captured for brood stock.

Numeric Fish Increases: The System Planning Model indicated an additional 706 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 576 fish after mainstem program implementation.

ACTIONS: 1-3

1. -

2. Use captured natural brood stock for hatchery supplementation in existing programs.

3. Expand the net pen program to rear 40,000 smolts using natural brood stock.

STRATEGY 3: Hatchery Production. This strategy seeks to achieve the objectives solely through traditional hatchery production. Only those actions necessary for maintenance of the hatchery program are included.

Hypothesis: Increasing hatchery plants will increase adult returns.

Assumptions: Action 4 assumes increased smolt production will result in commensurate adult returns.

Numeric Fish Increases: The System Planning Model indicated an additional 646 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 520 fish after mainstem program implementation.

ACTIONS: 4

4. Expand the net pen program to 40,000 smolts.

Recommended Strategy

The recommended strategy is Strategy 3, hatchery production. Presently, there are few natural fish and little natural production potential due to Condit Dam. Reestablishment above Condit is not sought and, therefore, hatchery production is the only potential for expanded production that remains. This strategy was also supported by the SMART analysis (Appendix B).

Table 14. System Planning Model results for winter steelhead in the White Salmon Subbasin. Baseline value is for pre-mainstem implementation, all other values are post-implementation.

Utilization Objective:
800 fish for sport and tribal harvest.

Biological Objective:
Maintain the biological characteristics of existing stock.

Strategy[1]	Maximum[2] Sustainable Yield (MSY)	Total[3] Spawning Return	Total[4] Return to Subbasin	Out of[5] Subbasin Harvest	Contribution[6] To Council's Goal (Index)
Baseline	254 -N	124	384	41	0(1.00)
All Nat	259 -N	121	387	42	3(1.01)
1	259 -N	121	387	42	3(1.01)
2	830 -N	249	1,092	117	869(2.84)
3*	774 -N	245	1,032	111	796(2.69)

*Recommended strategy.

[1] Strategy descriptions:

For comparison, an "all natural" strategy was modeled. It represents only the natural production (non-hatchery) components of the proposed strategies plus current management (which may include hatchery production). The all natural strategy may be equivalent to one of the alternative strategies below.

1. Natural habitat enhancement. Post Mainstem Implementation.
2. Strategy 1 plus 40,000 hatchery smolts. Post Mainstem Implementation.
3. Baseline 1 plus 40,000 hatchery smolts. Post Mainstem Implementation.

[2] MSY is the number of fish in excess to those required to spawn and maintain the population size (see text). These yields should equal or exceed the utilization objective. C = the model projections where the sustainable yield is maximized for the natural and hatchery components combined and the natural spawning component exceeds 500 fish. N = the model projection where sustainable yield is maximized for the naturally spawning component and is shown when the combined MSY rate results in a natural spawning escapement of less than 500 fish.

[3] Total return to subbasin minus MSY minus pre-spawning mortality equals total spawning return.

[4] Total return to the mouth of the subbasin.

[5] Includes ocean, estuary, and mainstem Columbia harvest.

[6] The increase in the total return to the mouth of the Columbia plus prior ocean harvest (as defined by the Northwest Power Council's Fish and Wildlife Program), from the baseline scenario. The index () is the strategy's total production divided by the baseline's total production.

Table 15. Estimated costs of alternative strategies for White Salmon winter steelhead. Cost estimates represent new or additional costs to the 1987 Columbia River Basin Fish and Wildlife Program; they do not represent projects funded under other programs, such as the Lower Snake River Compensation Plan or a public utility district settlement agreement. (For itemized costs, see Appendix C.)

	Proposed Strategies		
	1	2	3*
Hatchery Costs			
Capital[1]	0	119,600	119,600
O&M/yr[2]	0	13,000	13,000
Other Costs			
Capital[3]	0	200,000	0
O&M/yr[4]	30,000	50,000	0
Total Costs			
Capital	0	319,600	119,600
O&M/yr	30,000	63,000	13,000

* Recommended strategy.

[1] Estimated capital costs of constructing a new, modern fish hatchery. In some subbasins, costs may be reduced by expanding existing facilities. For consistency, estimate is based on $23/pound of fish produced. Note that actual costs can vary greatly, especially depending on whether surface or well water is used and, if the latter, the number and depth of the wells.

[2] Estimated operation and maintenance costs per year directly associated with new hatchery production. Estimates are based on $2.50/pound of fish produced. For consistency, O&M costs are based on 50 years.

[3] Capital costs of projects (other than direct hatchery costs) proposed under a particular strategy, such as enhancing habitat, screening diversions, removing passage barriers, and installing net pens (see text for specific actions).

[4] Estimated operation and maintenance costs per year of projects other than those directly associated with new hatchery production. For consistency, O&M costs are based on 50 years.

SPRING CHINOOK SALMON

Fisheries Resource

Natural Production

Spring chinook were formerly present in the subbasin and Indians fished for salmon (probably spring chinook) at the falls near Husum (Fulton 1968). The falls at RM 16.3 is considered by most to be a barrier to salmon. Condit Dam has blocked all migration past RM 3.3 since 1917. Chapman (1981) estimated the White Salmon could produce 625 chinook (springs and falls) under pristine conditions. Chapman (1981) and Young and Rybak (1987), noted the subbasin has cool summer water temperatures and deep canyon pools, conducive to spring chinook. However, with exception of returns from recent hatchery fingerling plants above Condit, spring chinook are not present in the subbasin.

The Northwest Power Planning Council's habitat capacity model indicated 297,437 smolts could be produced above Condit Dam -- 113,685 between Condit Dam and the falls at RM 16.3. Young and Rybak (1987) estimated 35,000 smolts could be produced above Condit.

Hatchery Production

Since 1982, hatchery spring chinook have been periodically released into the upper mainstem and Trout Lake Creek above RM 16.3 (Table 16). In 1988 and 1989, the Washington Department of Fisheries recorded a peak count of 73 and 40 adult fish, respectively, below Condit Dam.

The White Salmon rearing ponds, located at RM 1.5 were originally constructed as an adult brood stock facility. The two ponds are each 10'x 300'x 3.5' and use up to 30 cfs (combined) gravity-fed river water. The ponds were used for fall chinook until 1984. In 1988, 335,662 spring chinook smolts were released from the ponds; fingerlings were previously transferred from Spring Creek Hatchery. The ponds are susceptible to flooding and in January 1990 about 1 million fry were released early due to high water. Disposition of the ponds for rearing is presently uncertain. Rearing capacity of the facility could be expanded to accommodate 1,450,000 smolts, which recognized as a long-term program need in United States vs. Oregon. The U.S. Fish and Wildlife Service owns 40 acres of land at the site, however funds are not presently available for hatchery expansion.

Table 16. Subbasin releases of hatchery spring chinook.

Year Planted	Numbers Released	Type of Release	Hatchery Stock	Location of Release
1982	300,000	Fall Release	Cowlitz	USFWS ponds
1984	145,700	Fingerling	Carson	Trout Lake Cr.
	284,500	Fingerling	Carson	upper White Salmon
1985	500,000	Fingerling	Carson	upper White Salmon
1986	125,000	Fingerling	Carson	Trout Lake Cr.
	135,000	Fingerling	Carson	upper White Salmon
1988	335,662	Smolt	Spring Ck	RM 1.5
1990	1,053,000	Fry	Spring Ck	RM 1.5

Harvest

Harvest of spring chinook from the White Salmon has been near zero from 1977 through 1986. In 1987, 51 adults were caught. Out-of-subbasin harvest on Bonneville Pool stocks, which includes ocean and Columbia River harvest, has averaged about 15 percent.

Specific Considerations

The United States vs. Oregon Fish Management Plan stipulates that non-treaty fisheries on runs between 112 percent and 125 percent of the interim management goal at Bonneville Dam (115,000 fish) shall occur in the tributaries. Treaty fisheries on runs of this same magnitude may occur either in the tributaries or the mainstem. Harvest on runs less than 112 percent of the interim management goal will occur incidentally in ocean and lower river fisheries for the non-treaty share and will occur as mainstem ceremonial and subsistence fisheries for the treaty share. The U.S. Army Corps of Engineers established an "in-lieu" site for tribal fishing access at the mouth of the river. The site has been set aside in compensation for tribal fishing grounds inundated by the Bonneville Dam reservoir.

Treaty and non-treaty harvests within Washington tributaries are managed on a regional basis to achieve appropriate harvest sharing. The United States vs. Oregon agreement recognized the desirability of flexibility in balancing harvest within regions, consistent with the unique objectives and nature of the fisheries. United States vs. Oregon identified an opportunity to provide for intensive harvest in the White Salmon by establishing an annual release of 1,450,000 smolts below Condit Dam. Returns from this production would increase fisheries management flexibility in the region.

The close proximity of the Wind, Little White Salmon, White Salmon and Klickitat rivers, and the diversity of production opportunities among them, provides a unique opportunity to develop a regional management approach that best meets the needs of treaty and non-treaty fishermen. All enter the Columbia River within a 26-mile reach.

Establishing passage at Condit Dam would provide a unique opportunity to reestablish natural spring chinook in the subbasin. Smolt capacity was estimated at 297,437 fish with the Northwest Power Planning Council's model and 35,000 fish by Young and Rybak (1987).

Large hatchery returns below Condit Dam as proposed in United States vs. Oregon would impact natural spring chinook production above Condit Dam. If both options were pursued, it would be necessary to limit harvest impacts to sustain natural fish while hatchery fish would likely be overescaped. These factors could be addressed through developing timing or spatial differences in natural and hatchery runs.

White Salmon spring chinook suffer mortality hazards associated with Bonneville Dam, which impacts survival of emigrating smolts and returning adults. Adult fish are subjected to Columbia River sport and commercial fisheries. Fingerling releases into the watershed have returned few adults.

Objectives

Utilization Objective

Provide 500 fish for sport and tribal harvest to be shared according to the United States vs. Oregon agreement. The utilization component has priority for this stock within the subbasin.

Biological Objective

Maintain the biological characteristics of an above Bonneville stock.

Alternative Strategies

Strategies for spring chinook in this report have specific themes. Means to obtain the objectives are first attempted using natural methods followed by less natural techniques and finally, hatchery production. Actions identified under each strategy are closely related to the theme. Strategies 1 and 2 have natural production themes seeking to improve the productivity of the existing natural stock. Strategy 3 is a "benign" supplementation strategy, emphasizing actions to develop a single supplemented run with yet higher productivity. Strategy 4 relies on a traditional hatchery program to meet objectives. Only those actions necessary for the success of a hatchery program would be included in Strategy 4.

Modeling results for each strategy are presented in Table 17 as fish produced at "maximum sustainable yield" (MSY). The sustainable yield of a fish population refers to that portion of the population that exceeds the number of fish required to spawn and maintain the population over time. Sustainable yield can be "maximized," termed MSY, for each stock at a specific harvest level. The MSY is estimated using a formula (Beverton-Holt function) that analyzes a broad range of harvest rates. Subbasin planners have used MSY as a tool to standardize results so that decision makers can compare stocks and strategies.

In MSY management, managers set a spawning escapement level and the remaining fish (yield) could theoretically be harvested. In practice, a portion of the yield may be reserved as a buffer or to aid rebuilding. Thus, managers may raise the escapement level to meet a biological objective at the expense of a higher utilization objective.

The amount of buffer appropriate for each stock is a management question not addressed in the subbasin plans. For this reason, the utilization objective, which usually refers to harvest, may not be directly comparable to the MSY shown in Table 17. At a minimum, a strategy should produce an estimated MSY equal to or greater than the utilization objective. A MSY substantially larger than the subbasin utilization objective may be needed to meet subbasin biological objectives.

Estimated costs of the alternative strategies below are summarized in Table 18.

STRATEGY 1: Natural Production, Level 1. This strategy seeks to achieve the objectives by allowing passage over Condit Dam and using the natural production potential.

Hypothesis: Existing habitat, if managed properly, should provide near capacity numbers of natural smolts if adequately seeded. Smolt capacity from Condit up to the falls at RM 16.3 was 113,685 fish.

Assumptions: Action 1 assumes facilities can be built to allow passage above the Dam. Action 2 assumes all the unscreened diversions between Condit and RM 16.3 will be screened and is assumed to increase the egg-to-smolt survival from 15.8 percent to 20 percent. Action 3 assumes downstream passage improvements at Condit could be made so only 10 percent of smolts are lost.

Numeric Fish Increases: The System Planning Model indicated an additional 136 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 75 fish after mainstem program implementation.

ACTIONS: 1-3

1. Allow passage of adults above Condit Dam.

2. Screen the water diversions between Condit Dam and RM 16.3.

3. Modify Condit Dam so 90 percent of downstream migrant smolts survive.

STRATEGY 2: Natural Production, Level 2. This strategy seeks to achieve the objectives by the same means as Strategy 1, but also includes providing passage over the falls at RM 16.3.

Hypothesis: Increasing available habitat will increase smolt capacity.

Assumptions: Action 4 assumes the falls at RM 16.3 can be laddered and smolt capacity will be increased to 297,437 fish. Action 5 assumes all the above Condit diversions will be screened and egg-to-smolt survival will increase from 16.7 percent to 20 percent. Action 3 assumes downstream passage improvements at Condit could be made so only 10 percent of smolts are lost.

Numeric Fish Increases: The System Planning Model indicated an additional 316 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 170 fish after mainstem program implementation.

ACTIONS: 4, 5

4. Provide passage over the falls at RM 16.3. This could be accomplished either through laddering the falls or transporting fish above the falls in the case of a trap and haul operation at Condit Dam.

5. Screen the diversions between RM 16.3 and the headwaters.

STRATEGY 3: Supplementation. This strategy seeks to achieve the objectives by utilizing the natural habitat with fingerling plants.

Hypothesis: By seeding existing habitat with a suitable stock of fingerlings, smolt capacity will be realized.

Assumptions: Action 6 assumes fingerling plants will fully utilize natural habitat. Fingerling plants to date have produced few adult returns. This strategy also assumes interspecific competition will not impact the resident trout population. Action 3 assumes downstream passage improvements at Condit could be made so only 10 percent of smolts are lost.

Numeric Fish Increases: The System Planning Model indicated an additional 316 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 170 fish after mainstem program implementation.

ACTIONS: 2-6

2. -
3. -
4. -
5. -

6. Fingerling plant the watershed to utilize natural habitat to produce smolts.

STRATEGY 4: Hatchery Production. This strategy seeks to achieve the objectives solely through traditional hatchery production. Only those actions necessary for maintenance of the hatchery program are included.

Hypothesis: Increasing hatchery plants will increase adult returns.

Assumptions: This strategy assumes increased hatchery production will result in commensurate adult returns.

Numeric Fish Increases: The System Planning Model indicated an additional 433 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 377 fish after mainstem program implementation.

ACTION: 7

7. Rear 200,000 smolts in net pens in Northwestern Lake.

Recommended Strategy

The recommended strategy for White Salmon spring chinook is to provide passage above Condit Dam and RM 16.3, Strategy 2. This strategy seeks to utilize the natural spawning and rearing habitat on the Big White Salmon and establish a natural spring chinook population above Condit Dam throughout the entire range of the watershed. This includes utilization of the habitat above RM 16.3 as well as below RM 16.3, where a natural barrier occurs. Brood stock for the program would come from outside the watershed, preferably from an aggregate of regional spring chinook stocks to maximize genetic diversity, with a recommendation that the brood stock be derived from Carson and Little White Salmon hatcheries.

As part of the program to establish a natural run of spring chinook, there is a need to develop harvest management strategies that will support the use of the natural habitat and establish balanced harvest opportunities on a regional basis.

Though the SMART analysis (Appendix B) and the System Planning Group modeling results do not rate this strategy as the highest, in terms of numeric ranking, Strategy 2 does open up one of the few significant natural spawning and rearing area within the Columbia Basin.

Table 17. System Planning Model results for spring chinook in the White Salmon Subbasin. Baseline value is for pre-mainstem implementation, all other values are post-implementation.

Utilization Objective:
500 fish to be shared between sport and tribal harvest as per United States vs. Oregon.

Biological Objective:
Maintain the biological characteristics of an above Bonneville stock.

Strategy[1]	Maximum[2] Sustainable Yield (MSY)	Total[3] Spawning Return	Total[4] Return to Subbasin	Out of[5] Subbasin Harvest	Contribution[6] To Council's Goal (Index)
Baseline	28 -N	16	46	7	0(1.00)
All Nat	198 -N	96	305	48	330(6.69)
1	103 -N	50	158	25	144(3.48)
2*	NM				
3	198 -N	96	305	48	330(6.69)
4	405 -N	69	482	76	557(10.59)

*Recommended strategy.
NM - not modeled.

[1]Strategy descriptions:

For comparison, an "all natural" strategy was modeled. It represents only the natural production (non-hatchery) components of the proposed strategies plus current management (which may include hatchery production). The all natural strategy may be equivalent to one of the alternative strategies below.

1. Natural habitat enhancement. Add 113,685 smolts to natural smolt capacity. Post Mainstem Implementation.
2. Natural habitat enhancement. Add 267,6935 smolts to natural smolt capacity (from baseline). Post Mainstem Implementation.
3. Strategy 2 plus 500,000 hatchery fingerlings. Post Mainstem Implementation.
4. Supplementation, from baseline, add 200,000 smolts. Post Mainstem Implementation.

[2]MSY is the number of fish in excess to those required to spawn and maintain the population size (see text). These yields should equal or exceed the utilization objective. C = the model projections where the sustainable yield is maximized for the natural and hatchery components combined and the natural spawning component exceeds 500 fish. N = the model projection where sustainable yield is maximized for the naturally spawning component and is shown when the combined MSY rate results in a natural spawning escapement of less than 500 fish.

[3]Total return to subbasin minus MSY minus pre-spawning mortality equals total spawning return.

[4]Total return to the mouth of the subbasin.

[5]Includes ocean, estuary, and mainstem Columbia harvest.

[6]The increase in the total return to the mouth of the Columbia plus prior ocean harvest (as defined by the Northwest Power Council's Fish and Wildlife Program), from the baseline scenario. The index () is the strategy's total production divided by the baseline's total production.

Table 18. Estimated costs of alternative strategies for White Salmon spring chinook. Cost estimates represent new or additional costs to the 1987 Columbia River Basin Fish and Wildlife Program; they do not represent projects funded under other programs, such as the Lower Snake River Compensation Plan or a public utility district settlement agreement. (For itemized costs, see Appendix C.)

	Proposed Strategies			
	1	2*	3	4
Hatchery Costs				
Capital[1]	0	0	115,000	460,000
O&M/yr[2]	0	0	12,500	50,000
Other Costs				
Capital[3]	7,250,000	1,250,000	8,500,000	0
O&M/yr[4]	75,000	45,000	120,000	0
Total Costs				
Capital	7,250,000	1,250,000	8,615,000	460,000
O&M/yr	75,000	45,000	132,500	50,000

* Recommended strategy.

[1] Estimated capital costs of constructing a new, modern fish hatchery. In some subbasins, costs may be reduced by expanding existing facilities. For consistency, estimate is based on $23/pound of fish produced. Note that actual costs can vary greatly, especially depending on whether surface or well water is used and, if the latter, the number and depth of the wells.

[2] Estimated operation and maintenance costs per year directly associated with new hatchery production. Estimates are based on $2.50/pound of fish produced. For consistency, O&M costs are based on 50 years.

[3] Capital costs of projects (other than direct hatchery costs) proposed under a particular strategy, such as enhancing habitat, screening diversions, removing passage barriers, and installing net pens (see text for specific actions).

[4] Estimated operation and maintenance costs per year of projects other than those directly associated with new hatchery production. For consistency, O&M costs are based on 50 years.

FALL CHINOOK SALMON

Fisheries Resource

Natural Production

Fall chinook are native to the White Salmon River and some natural production presently occurs below Condit Dam. Historical distribution was probably confined below the falls at RM 16.3. Bonneville Pool Hatchery "tule" brood stock was originally taken from the White Salmon River and other nearby rivers. Chapman (1981) estimated the White Salmon could produce 625 natural chinook (springs and falls) under pristine conditions. Presently, an average of 705 fish return to the subbasin, but most are thought to be of hatchery origin. An estimated 10 percent or 71 fish are assumed to be of natural origin. Because of the dominance of hatchery fish in the subbasin, life history is presented under the hatchery fish section.

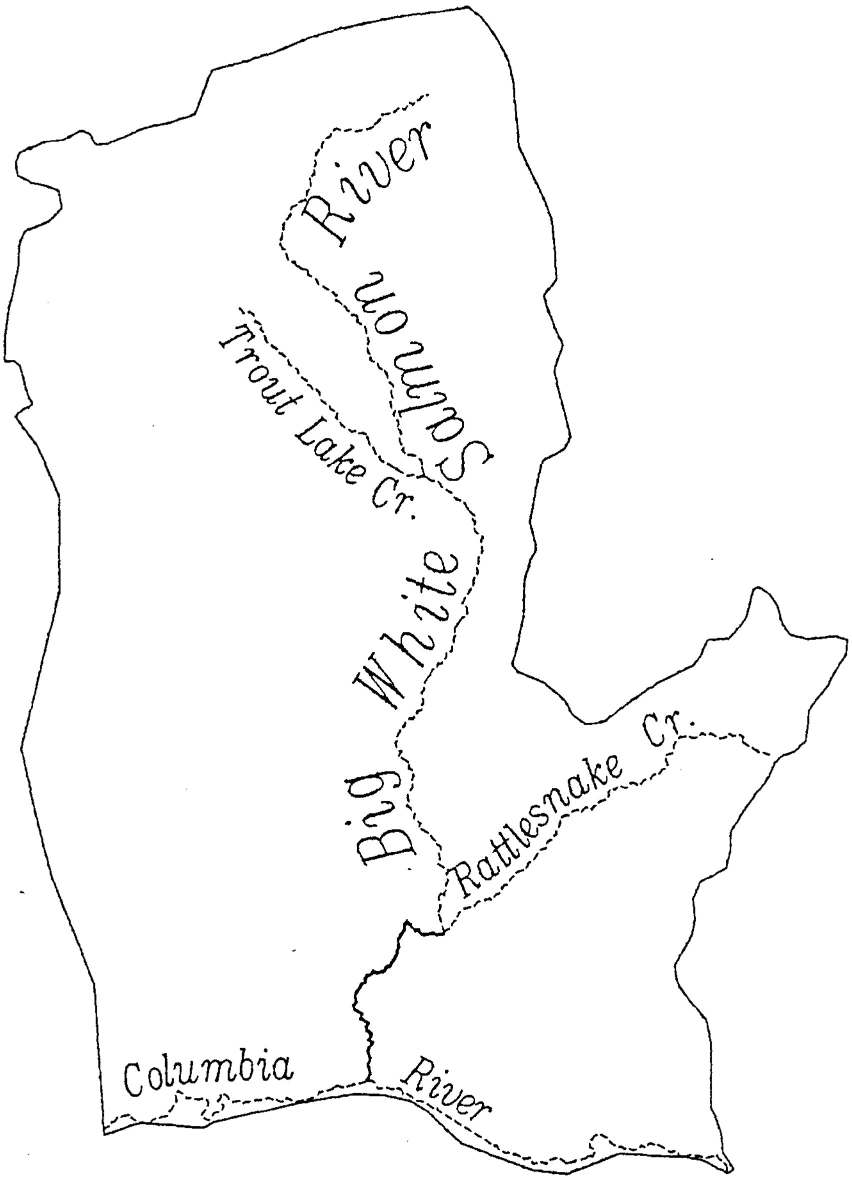
The Northwest Power Planning Council's smolt capacity model estimated 127,426 fall chinook fingerlings could be produced below Condit Dam. Production may be limited by gravel quantity. Potential production between Condit Dam and RM 16.3 was estimated to be 32,000 smolts by Young and Rybak (1987).

Hatchery Production

The previously described White Salmon rearing ponds at RM 1.5 were used to rear fall chinook fingerlings through 1984 (Table 19). Fish were reared from early March until a May release. However, poor adult returns resulted in discontinuation of the program.

Upstream migration occurs in early August and September, and spawning peaks in late September to early October. Emergence probably occurs in February and fish rear for a few months prior to spring or early summer ocean migration. Sex, age and fecundity data is not available for White Salmon fall chinook. However, Spring Creek Hatchery fall chinook are probably similar. Bonneville Pool Hatchery fall chinook typically mature at an earlier age than other Columbia River fall chinook, with the majority after two ocean years (Table 20). Fecundity averaged 4,700 eggs per female (Howell et al. 1984).

WHITE SALMON SUBBASIN



FALL CHINOOK DISTRIBUTION*

——————— PRESENT/POTENTIAL

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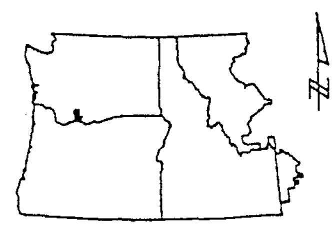


GIS GEOGRAPHIC INFORMATION SYSTEM

BONNEVILLE POWER ADMINISTRATION

* Due to the limitations of scale, all streams which support anadromous fish are not shown on this map.

Table 19. Plants of fall chinook in the White Salmon River.

Year	Fingerlings	Year	Fingerlings
1977	2,899,442	1984	2,869,174
1978	3,138,958	1985	0
1979	3,128,678	1986	0
1980	2,199,090	1987	0
1981	1,084,839	1988	0
1982	0	1989	0
1983	1,202,881	1990	0

Table 20. Spring Creek Hatchery ocean and sex ratios, 1977-1986.

	Ocean Age			
	1	2	3	4
Age Composition	8.0	61.2	30.4	0.4
Percent Females	1.8	54.5	72.4	61.9

Harvest

From 1977 through 1987, an average of 48 fish were sport caught in the subbasin, a harvest rate of 8.5 percent (Table 21). Out-of-basin harvest may approach 80 percent on Bonneville Pool Hatchery stocks with fish contributing to ocean and mainstem Columbia River fisheries. There is a limited tribal fishery for subsistence use.

In 1988 and 1989, substantial numbers of upriver bright fall chinook returned to the White Salmon River. Most of these strays were from the Little White Salmon Hatchery.

Table 21. Subbasin fall chinook escapement and sport harvest, 1977-1989 (WDF records).

Year	Spawning Escapement		Sport Catch		Total	
	Jacks	Adults	Jacks	Adults	Jacks	Adults
1977	15	216	1	19	16	235
1978	267	796	10	30	277	826
1979	26	636	1	23	27	659
1980	59	1,539	1	39	60	1,578
1981	46	293	4	62	50	355
1982	17	1,562	0	3	17	1,565
1983	30	250	5	41	35	291
1984	24	369	0	7	24	376
1985	1	152	0	51	1	203
1986	94	250*	19	97	113	347
1987	0	161	15	105	15	266
1988	16	366**	N\A		N\A	
1989	38	205**	N\A		N\A	
AVE	49	522	5	43	54	565

* Escapement from a USFWS rack across the lower river.

** An additional 2,997 and 1,182 upriver brights escaped in 1988 and 1989, respectively.

Specific Considerations

Many of the considerations for spring chinook also apply to fall chinook. Fall chinook are distributed in the lower reaches of a watershed whereas spring chinook penetrate far upstream.

Objectives

Utilization Objective

Provide 100 fish for sport and tribal harvest to be shared as per United States vs. Oregon and support out-of-subbasin harvest. The utilization component has priority for this stock.

Biological Objective

Maintain the biological characteristics of a Bonneville Pool Hatchery stock.

Alternative Strategies

Because objectives for White Salmon fall chinook are currently being met, no alternative strategies for enhancement are offered.

COHO SALMON

Fisheries Resource

Natural Production

History and Status

Information on current and historic natural coho above and below Condit Dam is unavailable. Current coho distribution is confined below Condit Dam. Current subbasin returns of natural fish are estimated to be about 10 percent of the total, which was estimated to be about 350 fish in 1977 through 1982, resulting in 35 natural fish. Chapman (1981) calculated the number of coho adults in the White Salmon River under pristine conditions to be approximately 5,489 fish.

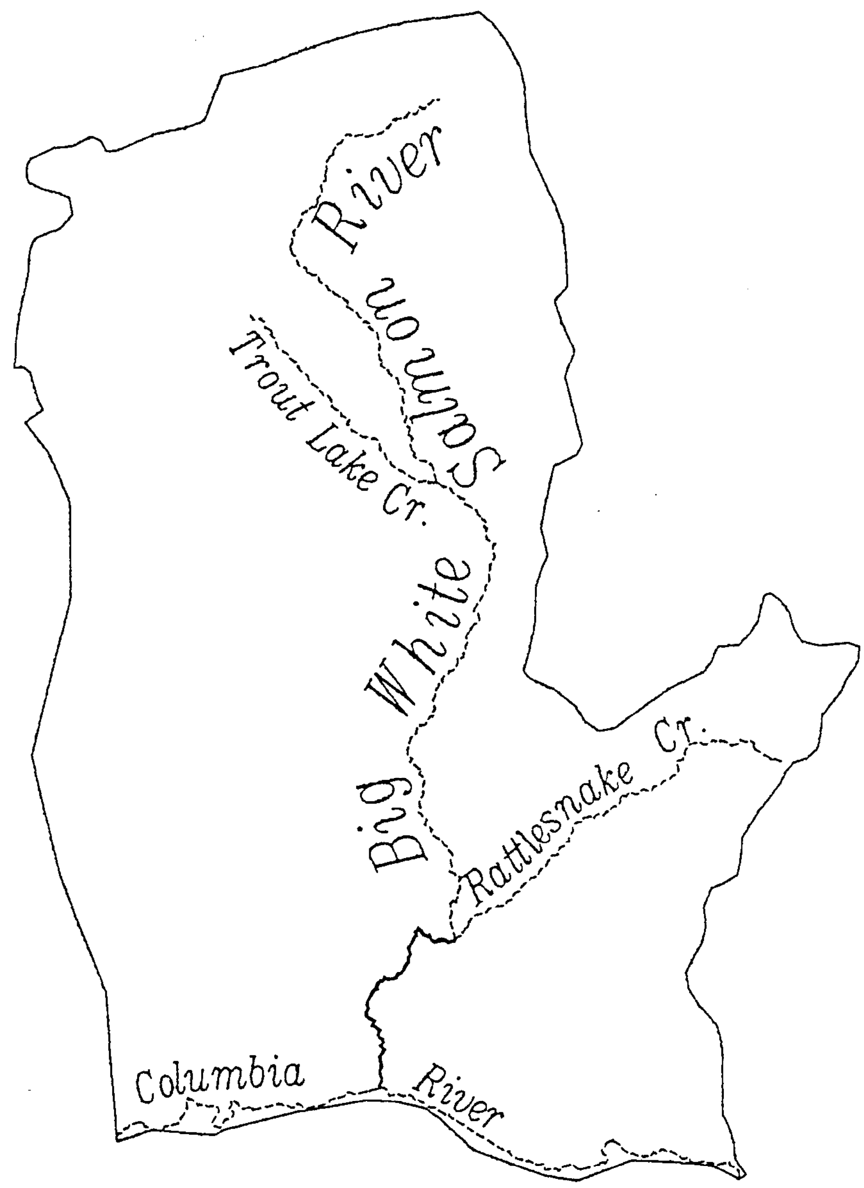
The Northwest Power Planning Council's habitat model estimated that 5,309 coho smolts could be produced below Condit Dam. Potential production above Condit Dam was estimated to be 45,000 smolts by Young and Rybak (1987).

Supplementation History

In 1981 to 1987, the Washington Department of Fisheries planted coho juveniles above Condit Dam to determine rearing potential and passage survival at Condit Dam (R. Gerke, WDF, pers. commun.). Coho were planted in the mainstem White Salmon River from RM 5 to RM 42, and in Mill, Big Buck, Spring, Rattlesnake, and Trout Lake creeks. Seiler and Neuhauser (1985) estimated dam mortality was 60 percent; turbines accounted for most mortality. Coho smolt production above Condit Dam in 1983 and 1984 was estimated at 31,583 and 43,541 smolts, respectively, representing a fingerling-to-smolt survival of 6.3 and 8.6 percent, respectively. These smolt production estimates did not represent full watershed seeding. Smolts produced were of good quality (Seiler and Neuhauser 1985). The density of coho and rainbow trout sampled in Big Buck Creek in 1985 indicated the watershed has good production potential (Young 1985). Coho densities averaged 1.27 fish per square meter with a 40 percent survival from July to October.

Both early- and late-returning coho have been planted in the subbasin (Table 22). Early coho were planted in the late 1960s and in 1971, but late coho were subsequently planted. Early coho enter the Columbia River in mid-August; stock composition shifts to late coho in late September and October. Late coho have a more northerly ocean migration pattern than early coho and contribute more to Washington fishermen (Howell et al. 1984).

WHITE SALMON SUBBASIN



COHO DISTRIBUTION*

——————— PRESENT/POTENTIAL

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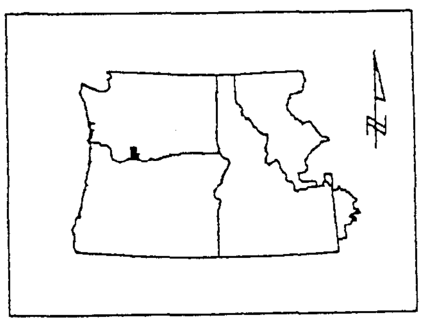

GIS GEOGRAPHIC INFORMATION SYSTEM
BONNEVILLE POWER ADMINISTRATION

* Due to the limitations of scale, all streams which support anadromous fish are not shown on this map.

Table 22. Coho planted in the White Salmon, 1967-1989.

Year	Number of Fingerlings	Race	Location
1967	250,128 1/	Early	Trout Lake Creek
1968	249,480 1/	Early	Trout Lake Creek
1971	167,564	Early	Northwestern Lake
	183,300 1/	Early	White Salmon River
1980	251,466 1/	Early	Spring Creek
1981	209,500	Late	Spring Creek
1982	378,918	Late	White Salmon River
	119,140	Late	Tributaries
1983	452,900	Late	White Salmon River
	9,757 2/	Late	White Salmon River
	52,100	Late	Tributaries
1984	315,000	Late	White Salmon River
	184,900	Late	Tributaries
1985	356,000	Late	White Salmon River
	145,100	Late	Tributaries
1986	72,500	Late	White Salmon River
	318,000	Late	Tributaries
1987	298,700	Late	White Salmon River
	229,120	Late	Tributaries
1988	0		
1989	0		

1/ Unfed fry
2/ Yearlings from Klickitat Hatchery

Data on sex and age profiles of White Salmon coho are absent, but are thought to be similar to Little White Salmon Hatchery coho. An average of 10.8 percent and 89.2 percent of Little White Salmon National Fish Hatchery coho return after one and two years in the ocean, respectively (King 1987). All 1-year ocean fish were males; 62 percent of 2-year ocean fish were males. Mean length was 62 cm for males and 64 cm for females. Fecundity averaged 2,100 eggs per female.

Hatchery Production

There is currently no hatchery production of coho in the subbasin and none is anticipated. Hatchery strays from Willard Hatchery on the Little White Salmon River probably account for most of the hatchery returns.

Harvest

Coho sport harvest in the White Salmon River averaged 63 fish for 1977 through 1987 (Table 23). Insubbasin sport harvest rate is typically 10 percent to 15 percent for coho; 12.5 percent is assumed for the White Salmon. Based on that harvest rate, run size is estimated to be 504 fish. Out-of-subbasin harvest includes ocean and Columbia River catch and sometimes exceeds 80 percent.

Subbasin sport harvest for 1977 through 1982, years when adults from fingerling plants were not expected, averaged 44 fish compared to 86 fish for 1983 through 1987. At a 12.5 percent harvest rate, this would amount to a subbasin return of 352 fish compared to 690 fish, a difference of 338 fish. Subbasin returns from the 1983 and 1984 fingerling plants plus the baseline averaged 512 fish compared to 352 fish, a difference of 160 fish. This represents a smolt-to-adult return of 0.4 percent.

Many of the coho in the White Salmon are thought to be strays from the Little White Salmon Hatchery.

Table 23. Coho sport harvest in the White Salmon, 1977-1987.

Year	Adults	Jacks	Total
1977	19	59	78
1978	3	14	17
1979	20	11	31
1980	44	24	68
1981	22	29	51
1982	12	9	21
1983	6	22	28
1984	15	12	27
1985	89	95	184
1986	99	61	160
1987	26	6	32
AVE	32	31	63

Specific Considerations

Coho in the Columbia River are managed as a large aggregate hatchery stock. Exploitation rates sometimes exceed 80 percent in the combined ocean and Columbia River mainstem fisheries. It is doubtful with these fishing mortalities, natural production could sustain itself. Subbasin adult returns from the 1983 and 1984 fingerling plants above Condit Dam averaged 0.4 percent. The introduction of coho above Condit Dam may reduce resident trout production by 10 to 25 percent (Young and Rybak 1987).

Objectives

Utilization Objective

Provide 100 fish for sport and tribal harvest to be shared as per United States vs. Oregon and support out-of-subbasin harvest. The utilization component has priority for this stock.

Biological Objective

Maintain the biological characteristics of existing stock.

Alternative Strategies

Because objectives for White Salmon coho are currently being met, no alternative strategy for enhancement is offered.

PART V. SUMMARY AND IMPLEMENTATION

Objectives and Recommended Strategies

Summer Steelhead

The objective is to provide a subbasin sport and tribal harvest of 2,400 fish each. The recommended strategy is Strategy 3, increase the net pen program in Northwestern Lake by 27,000 smolts.

Winter Steelhead

The objective is to provide a subbasin sport and tribal harvest of 400 fish each. The recommended strategy is 3, increase the net pen program in Northwestern Lake by 26,000 smolts.

Spring Chinook

The objective is to provide a sport and tribal harvest of 500 fish. The recommended strategy for White Salmon spring chinook is Strategy 2, providing passage above Condit Dam and RM 16.3. This strategy seeks to utilize the natural spawning and rearing habitat on the Big White Salmon and establish a natural spring chinook population above Condit Dam throughout the entire range of the watershed.

Fall Chinook

The objective for fall chinook is to provide a sport and tribal harvest of 100 fish. This objective is currently being met and, consequently, no alternative strategies are offered.

Coho

The objective for coho is to provide a subbasin sport and tribal harvest of 100 fish. This objective is currently being met and, consequently, no alternative strategies are offered.

Implementation

In the summer of 1990, the Columbia Basin Fish and Wildlife Authority submitted to the Northwest Power Planning Council the Integrated System Plan for salmon and steelhead in the Columbia Basin, which includes all 31 subbasin plans. The system plan attempts to integrate this subbasin plan with the 30 others in the Columbia River Basin, prioritizing fish enhancement projects and critical uncertainties that need to be addressed.

From here, the Northwest Power Planning Council will begin its own public review process, which will eventually lead to amending its Columbia River Basin Fish and Wildlife Program. The actual implementation schedule of specific projects or measures proposed in the system plan will materialize as the council's adoption process unfolds.

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APPENDIX A
NORTHWEST POWER PLANNING COUNCIL
SYSTEM POLICIES

In Section 204 of the 1987 Columbia River Basin Fish and Wildlife Program, the Northwest Power Planning Council describes seven policies to guide the systemwide effort in doubling the salmon and steelhead runs. Pursuant to the council's plan, the basin's fisheries agencies and Indian tribes have used these policies, and others of their own, to guide the system planning process. The seven policies are paraphrased below.

1) The area above Bonneville Dam is accorded priority.

Efforts to increase salmon and steelhead runs above Bonneville Dam will take precedence over those in subbasins below Bonneville Dam. In the past, most of the mitigation for fish losses has taken the form of hatcheries in the lower Columbia Basin. According to the council's fish and wildlife program, however, the vast majority of salmon and steelhead losses have occurred in the upper Columbia and Snake river areas. System planners turned their attention first to the 22 major subbasins above Bonneville Dam, and then to the nine below.

2) Genetic risks must be assessed.

Because of the importance of maintaining genetic diversity among the various salmon and steelhead populations in the Columbia River Basin, each project or strategy designed to increase fish numbers must be evaluated for its risks to genetic diversity. Over millions of years, each fish run has evolved a set of characteristics that makes it the best suited run for that particular stream, the key to surviving and reproducing year after year. System planners were to exercise caution in their selection of production strategies so that the genetic integrity of existing fish populations is not jeopardized.

3) Mainstem survival must be improved expeditiously.

Ensuring safe passage through the reservoirs and past the dams on the Columbia and Snake River mainstems is crucial to the success of many efforts that will increase fish numbers, particularly the upriver runs. Juvenile fish mortality in the reservoirs and at the dams is a major cause of salmon and steelhead losses. According to estimates, an average of 15 percent to 30 percent of downstream migrants perish at each dam, while 5 percent to 10 percent of the adult fish traveling upstream perish. Projects to rebuild runs in the tributaries have and will represent major expenditures by the region's ratepayers -- expenditures and long-term projects that should be protected in the mainstem.

4) Increased production will result from a mix of methods.

To rebuild the basin's salmon and steelhead runs, fisheries managers are to use a mixture of wild, natural and hatchery production. Because many questions still exist as to whether wild and natural stocks can coexist with significant numbers of hatchery fish, no one method of production will be solely responsible for increasing fish numbers. System planners were to take extra precaution when considering outplanting hatchery fish into natural areas that still produce wild fish. The council is relying on the fish and wildlife agencies and tribes to balance artificial production with wild and natural production.

5) Harvest management must support rebuilding.

Like improved mainstem passage, effective harvest management is critical to the success of rebuilding efforts. A variety of fisheries management entities from Alaska to California manage harvest of the Columbia Basin's salmon and steelhead runs. The council is calling on those entities to regulate harvest, especially in mixed-stock fisheries, in ways that support the basin's efforts to double its runs.

6) System integration will be necessary to assure consistency.

The Northwest Power Planning Council intends to evaluate efforts to protect and rebuild Columbia River Basin salmon and steelhead from a systemwide perspective. Doubling the runs will require improvements in mainstem passage, fish production and harvest management -- three extremely interdependent components. System planners from all parts of the basin are to coordinate their efforts so, for example, activities in the lower Columbia are consistent with and complement the activities 800 miles upstream in Idaho's Salmon River. The fisheries management organizations and their plans vary from subbasin to subbasin, but the council is calling upon the agencies and tribes to help resolve conflicts that arise.

7) Adaptive management should guide action and improve knowledge.

System planners were to design projects so that information can be collected to improve future management decisions. By designing projects that test quantitative hypotheses and lend themselves to monitoring and evaluation, managers can learn from their efforts. This learning by doing is called "adaptive management." Using such an approach, managers can move ahead with plans to rebuild the Columbia Basin's salmon and steelhead runs, despite many unanswered questions about how best to accomplish their goal. With time, the useful information revealed by these "experiments" can guide future projects.

APPENDIX B
SMART ANALYSIS

To help select the preferred strategies for each subbasin, planners used a decision-making tool known as Simple Multi-Attribute Rating Technique (SMART). SMART examined each proposed strategy according to the following five criteria. In all cases, SMART assumed that all of the Columbia River mainstem passage improvements would be implemented on schedule.

1) Extent the subbasin objectives were met

2) Change in maximum sustainable yield

3) Impact on genetics

4) Technological and biological feasibility

5) Public support

Once SMART assigned a rating for each criteria, it multiplied each rating by a specific weight applied to each criteria to get the "utility" value (see following tables). Because the criteria were given equal weights, utility values were proportional to ratings. The confidence in assigning the ratings was taken into consideration by adjusting the weighted values, (multiplying the utility value by the confidence level) to get the "discount utility." SMART then totaled the utility values and discount utility values for all five criteria, obtaining a "total value" and a "discount value" for each strategy.

System planners used these utility and discount values to determine which strategy for a particular fish stock rated highest across all five criteria. If more than one of the proposed strategies shared the same or similar discount value, system planners considered other factors, such as cost, in the selection process. Some special cases arose where the planners' preferred strategy did not correspond with the SMART results. In those cases, the planners provide the rationale for their selection.

Subbasin: White Salmon Stock: Summer steelhead Strategy: 1

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	3	0.6	20	60	36
2 CHG MSY	3	0.6	20	60	36
3 GEN IMP	6	0.6	20	120	72
4 TECH FEAS	6	0.6	20	120	72
5 PUB SUPT	4	0.6	20	80	48
TOTAL VALUE				440	
DISCOUNT VALUE					264
CONFIDENCE VALUE					0.60

Subbasin: White Salmon Stock: Summer steelhead Strategy: 2

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	5	0.6	20	100	60
2 CHG MSY	3	0.6	20	60	36
3 GEN IMP	7	0.6	20	140	84
4 TECH FEAS	4	0.6	20	80	48
5 PUB SUPT	7	0.6	20	140	84
TOTAL VALUE				520	
DISCOUNT VALUE					312
CONFIDENCE VALUE					0.60

Subbasin: White Salmon Stock: Summer steelhead Strategy: 3

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	5	0.9	20	100	90
2 CHG MSY	4	0.6	20	80	48
3 GEN IMP	6	0.6	20	120	72
4 TECH FEAS	9	0.9	20	180	162
5 PUB SUPT	8	0.6	20	160	96
TOTAL VALUE				740	
DISCOUNT VALUE					468
CONFIDENCE VALUE					0.72

Subbasin: White Salmon Stock: Winter steelhead Strategy: 1

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	3	0.6	20	60	36
2 CHG MSY	3	0.6	20	60	36
3 GEN IMP	6	0.6	20	120	72
4 TECH FEAS	6	0.6	20	120	72
5 PUB SUPT	4	0.6	20	80	48
TOTAL VALUE				440	
DISCOUNT VALUE					264
CONFIDENCE VALUE					0.60

Subbasin: White Salmon Stock: Winter steelhead Strategy: 2

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	5	0.6	20	100	60
2 CHG MSY	3	0.6	20	60	36
3 GEN IMP	7	0.6	20	140	84
4 TECH FEAS	4	0.6	20	80	48
5 PUB SUPT	7	0.6	20	140	84
TOTAL VALUE				520	
DISCOUNT VALUE					312
CONFIDENCE VALUE					0.60

Subbasin: White Salmon Stock: Winter steelhead Strategy: 3

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	5	0.9	20	100	90
2 CHG MSY	4	0.6	20	80	48
3 GEN IMP	6	0.6	20	120	72
4 TECH FEAS	9	0.9	20	180	162
5 PUB SUPT	8	0.6	20	160	96
TOTAL VALUE				740	
DISCOUNT VALUE					468
CONFIDENCE VALUE					0.72

Subbasin: White Salmon Stock: Spring Chinook Strategy: 1

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	3	0.6	20	60	36
2 CHG MSY	3	0.6	20	60	36
3 GEN IMP	4	0.9	20	80	72
4 TECH FEAS	3	0.6	20	60	36
5 PUB SUPT	2	0.9	20	40	36
TOTAL VALUE				300	
DISCOUNT VALUE					216
CONFIDENCE VALUE					0.72

Subbasin: White Salmon Stock: Spring chinook Strategy: 2

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	3	0.6	20	60	36
2 CHG MSY	4	0.6	20	80	48
3 GEN IMP	4	0.9	20	80	72
4 TECH FEAS	2	0.6	20	40	24
5 PUB SUPT	2	0.9	20	40	36
TOTAL VALUE				300	
DISCOUNT VALUE					216
CONFIDENCE VALUE					0.72

Subbasin: White Salmon Stock: Spring Chinook Strategy: 3

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	3	0.6	20	60	36
2 CHG MSY	4	0.6	20	80	48
3 GEN IMP	3	0.9	20	60	54
4 TECH FEAS	4	0.9	20	80	72
5 PUB SUPT	4	0.6	20	80	48
TOTAL VALUE				360	
DISCOUNT VALUE					258
CONFIDENCE VALUE					0.72

Subbasin: White Salmon Stock: Spring Chinook Strategy: 4

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	5	0.9	20	100	90
2 CHG MSY	5	0.6	20	100	60
3 GEN IMP	2	0.9	20	40	36
4 TECH FEAS	8	0.6	20	160	96
5 PUB SUPT	7	0.9	20	140	126
TOTAL VALUE				540	
DISCOUNT VALUE					408
CONFIDENCE VALUE					0.78

APPENDIX C
SUMMARY OF COST ESTIMATES

The cost estimates provided in the following summary tables represent new or additional costs necessary to implement the alternative strategies. Although many strategies involve projects already planned or being implemented under the Columbia River Basin Fish and Wildlife Program or other programs, such as the Lower Snake River Compensation Plan, the associated costs and hatchery production do not appear in the following tables.

In many cases, the following costs are no more than approximations based on familiarity with general costs of similar projects constructed elsewhere. Although the costs are very general, they can be used to evaluate relative, rather than absolute, costs of alternative strategies within a subbasin.

Particular actions are frequently included in strategies for more than one species or race of anadromous fish. In these cases, the same costs appear in several tables, but would only be incurred once, to the benefit of some, if not all, of the species and races of salmon and steelhead in the subbasin.

Subbasin planners used standardized costs for actions "universal" to the Columbia River system, such as costs for installing instream structures, improving riparian areas, and screening water diversions (see the Preliminary System Analysis Report, March 1989). For other actions, including the removal of instream barriers, subbasin planners developed their own cost estimates in consultation with resident experts.

Planners also standardized costs for all new hatchery production basinwide. To account for the variability in fish stocking sizes, estimates were based upon the cost per pound of fish produced. For consistency, estimated capital costs of constructing a new, modern fish hatchery were based on $23 per pound of fish produced. Estimated operation and maintenance costs per year were based on $2.50 per pound of fish produced.

All actions have a life expectancy, a period of time in which benefits are realized. Because of the variation in life expectancy among actions, total costs were standardized to a 50-year period. Some actions had life expectancies of 50 years or greater and thus costs were added as shown. Other actions (such as instream habitat enhancements) are expected to be long term, but may only have life expectancies of 25 years. Thus the action would have to be repeated (and its cost doubled) to meet the 50-year standard. Still other actions (such as a study or a short-term supplementation program) may have life expectancies of 10 years after which no further action would be taken. In this case, operation and maintenance costs were amortized over 50 years to develop the total O&M per year estimate. Capital costs, being up-front, one-time expenditures, were added directly.

Subbasin planners have estimated all direct costs of alternative strategies except for the purchase of water rights. No cost estimates have been or will be made for actions that involve purchasing water. Indirect costs, such as changes in water flows or changes in hydroelectric system operations, are not addressed.

ESTIMATED COSTS FOR ALTERNATIVE STRATEGIES

Subbasin: White Salmon River
Stock: Summer Steelhead

Action	Cost Categories*	Proposed Strategies 1	2	3**
Habitat Enhancement	Capital:	0	0	
	O&M/yr:	30,000	30,000	
	Life:	50	50	
Screening	Capital:			
	O&M/yr:			
	Life:			
Barrier Removal	Capital:			
	O&M/yr:			
	Life:			
Misc. Projects	Capital:		200,000	
	O&M/yr:		20,000	
	Life:		50	
Hatchery Production	Capital:		124,200	124,200
	O&M/yr:		13,500	13,500
	Life:		50	50
TOTAL COSTS	Capital:	0	324,200	124,200
	O&M/yr:	30,000	63,500	13,500
	Years:	50	50	50
Water Acquisition		N	N	N
Fish to Stock	Number/yr:		27,000	27,000
	Size:		S, 5/lb.	S, 5/lb.
	Years:		50	50

* Life expectancy of the project is defined in years. Water acquisition is defined as either Y = yes, the strategy includes water acquisition; N = no, water acquisition is not part of the strategy. The size of fish to stock is defined as E = eggs; F = fry; J = juvenile, fingerling, parr, subsmolt; S = smolt; A = adult.

** Recommended strategy.

ESTIMATED COSTS FOR ALTERNATIVE STRATEGIES

Subbasin: White Salmon River
Stock: Winter Steelhead

Action	Cost Categories*	Proposed Strategies 1	2	3**
Habitat Enhancement	Capital:	0	0	
	O&M/yr:	30,000	30,000	
	Life:	50	50	
Screening	Capital:			
	O&M/yr:			
	Life:			
Barrier Removal	Capital:			
	O&M/yr:			
	Life:			
Misc. Projects	Capital:		200,000	
	O&M/yr:		20,000	
	Life:		50	
Hatchery Production	Capital:		119,600	119,600
	O&M/yr:		13,000	13,000
	Life:		50	50
TOTAL COSTS	Capital:	0	319,600	119,600
	O&M/yr:	30,000	63,000	13,000
	Years:	50	50	50
Water Acquisition		N	N	N
Fish to Stock	Number/yr:		26,000	26,000
	Size:		S, 5/lb.	S, 5/lb.
	Years:		50	50

* Life expectancy of the project is defined in years. Water acquisition is defined as either Y = yes, the strategy includes water acquisition; N = no, water acquisition is not part of the strategy. The size of fish to stock is defined as E = eggs; F = fry; J = juvenile, fingerling, parr, subsmolt; S = smolt; A = adult.

** Recommended strategy.

ESTIMATED COSTS FOR ALTERNATIVE STRATEGIES

Subbasin: White Salmon River
Stock: Spring Chinook

Action	Cost Categories*	Proposed Strategies 1	2**	3	4
Habitat Enhancement	Capital:				
	O&M/yr:				
	Life:				
Screening	Capital:	250,000	250,000	500,000	
	O&M/yr:	25,000	25,000	50,000	
	Life:	50	50	50	
Barrier Removal	Capital:	7,000,000	1,000,000	8,000,000	
	O&M/yr:	50,000	20,000	70,000	
	Life:	50	50	50	
Misc. Projects	Capital:				
	O&M/yr:				
	Life:				
Hatchery Production	Capital:			115,000	460,000
	O&M/yr:			12,500	50,000
	Life:			50	50
TOTAL COSTS	Capital:	7,250,000	1,250,000	8,615,000	460,000
	O&M/yr:	75,000	45,000	132,500	50,000
	Years:	50	50	50	50
Water Acquisition		N	N	N	N
Fish to Stock	Number/yr:			500,000	200,000
	Size:			J, 100/lb.	S, 10/lb.
	Years:			50	50

* Life expectancy of the project is defined in years. Water acquisition is defined as either Y = yes, the strategy includes water acquisition; N = no, water acquisition is not part of the strategy. The size of fish to stock is defined as E = eggs; F = fry; J = juvenile, fingerling, parr, subsmolt; S = smolt; A = adult.

** Recommended strategy.