Columbia Basin System Planning

SALMON and STEELHEAD PRODUCTION PLAN

MID-COLUMBIA RIVER SUBBASIN
(Bonneville Dam to Priest Rapids Dam)

September 1, 1990

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Columbia Basin System Planning

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Table of Contents

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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.

This particular document contains information pertaining to the mainstem Columbia extending from Bonneville Dam to Priest Rapids Dam. Most of the stock-specific information obtained for this report came from the Preliminary Information Report (July 8, 1988) process, so reference to specific papers and documents will not be mentioned here. There were, however, several works that were particularly helpful and are frequently referred to throughout this draft.

PART I. DESCRIPTION OF SUBBASIN

Location and General Environment

This subbasin includes 251 miles of the mainstem Columbia River from Bonneville Dam (RM 146.1) to Priest Rapids Dam (RM 397.1). Also included in the subbasin are minor tributaries to this reach of the Columbia River not described in individual subbasin plans. On the Oregon side, these streams are:

Eagle Creek (RM 146.3)
Herman Creek (RM 150.7)
Lindsey Creek (RM 158.8)
Viento Creek (RM 161.0)
Mosier Creek (RM 174.9)
Chenoweth Creek (RM 187.3)
Mill Creek (RM 189.2)
Threemile Creek (RM 190.8)
Fulton Canyon Creek (RM 206.0)
Spanish Hollow Creek (RM 208.0)
Willow Creek (RM 252.5).

Washington tributaries in this category include:

Rock Creek (RM 150.0)
Collins Creek (RM 157.9)
Dog Creek (RM 160.8)
Jewett Creek (RM 170.6)
Catherine Creek (RM 177.4)
Major Creek (RM 177.7)
Rock Creek (RM 228.5)
Alder Creek (RM 257.7).

This reach of the Columbia also has major tributaries that are described in individual subbasin plans. In Oregon, these include Hood River, Fifteenmile Creek, Deschutes, John Day and Umatilla rivers; in Washington, the Wind, Little White Salmon, White Salmon, Klickitat, Walla Walla, Snake, and Yakima rivers are described in individual plans.

The Columbia River flows to the east from Priest Rapids Dam turning south in the vicinity of the White Bluffs in the Hanford Reach, flowing south easterly from Richland, Washington, past its confluence with the Snake River at RM 313.5, and turning to the west near the Oregon and Washington border. From this point, the river flows westerly to Bonneville Dam, forming the boundary between Oregon and Washington.

Bonneville, The Dalles, John Day and McNary dams separate the mainstem portion of the subbasin into four impoundments. From the head of Lake Wallula above McNary Dam, the river flows unimpeded at its historical profile through what is commonly referred to as the "Hanford Reach," the only free-flowing portion of the Columbia River above Bonneville Dam in the United States. Each impoundment is distinct in size and character (Table 1).

Bonneville Dam is 40 miles east of Portland. Construction of Bonneville Lock and Dam was authorized in 1933, and the first power house went into operation in 1938. A second power house was completed in 1981, which doubled the generating capacity.

The Dalles Dam is located at the head of Lake Bonneville, 90 miles east of Portland and three miles east of The Dalles, Oregon. The Flood Control Act of 1950 authorized its construction. Construction began in 1952 and completed in 1960. Lake Celilo is flanked by rugged basalt ledges and steep slopes. Much of the shoreline on both sides of the river is bordered by highways and railroads. The little arable land beside the river is developed for agriculture. Terrain in this area is generally devoid of tree cover; the primary vegetation consisting of grasses and shrubs typical of semiarid eastern Washington and Oregon. Small stands of cottonwood, willow and locust occur locally along the shoreline. Lake Celilo is nearly 24 miles long with a shoreline length of about 55 miles, a pool surface area of 9,400 acres, and a volume of 332,500 acre feet. The Dalles Dam inundated Celilo Falls, perhaps the most productive inland aboriginal fishing site in North America (Hewes 1947).

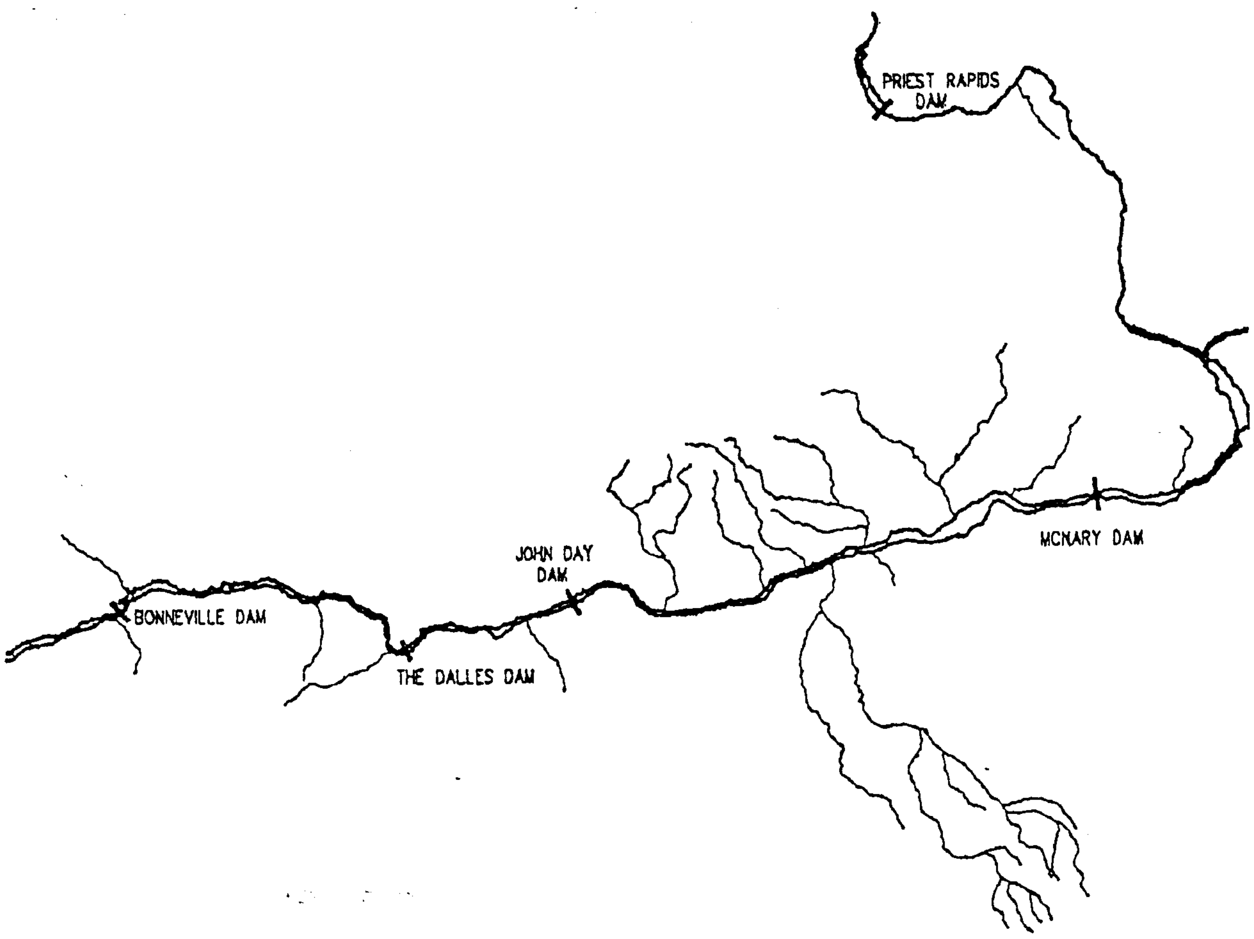
John Day Lock and Dam stretches across the Columbia River 24 river miles upstream from The Dalles (RM 215.6). The Flood Control Act of 1950 also authorized construction, but the project was not fully operational until 1968. Lake Umatilla is located in the semiarid Columbia Plateau east of the Cascade Mountains. Extensive flatlands below normal pool elevation form shallow wetlands and embayments. The river is paralleled by the railroads, highways and basalt cliffs. Lake Umatilla is over 76 miles long with a pool surface area of 49,300 acres. Along with Lake Roosevelt behind Grand Coulee Dam, Lake Umatilla is the Columbia River reservoir in the United States that has a storage capacity useful for flood control. Having little storage capacity, the other dams and reservoirs are referred to as "run of the river."

McNary Dam impounds the Columbia River at RM 292. Tailwaters of Lake Wallula flood the lowermost portions of the Walla Walla, Snake and Yakima rivers, extending upstream to its head at approximately RM 345. In the area immediately downstream from the Snake River confluence, Lake Wallula is characterized by extensive shallow and shoal water habitat and connected wetland embayments.

Table 1. Morphometric characteristics of subbasin reservoirs.
(Source: Mid-Columbia River Projects Master Plan for Resource Use.
U.S. Army Corps of Engineers, Portland District, September 1988.)

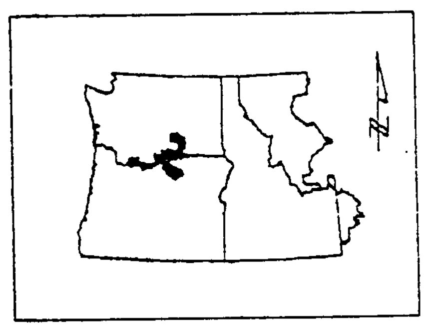
DAM	AREA (Acres)	AVERAGE DEPTH (feet)	MILES OF SHORELINE	VOLUME (acre feet)	MEAN WIDTH (miles)	LENGTH (miles)
Bonneville	20,600	22.0	130	537,000	0.85	45.4
The Dalles	9,400	24.6	55	333,000	0.88	24.1
John Day	49,300	46.3	240	2,500,000	1.11	76.4
McNary	38,100	35.4	--	1,350,000	0.98	53.0

COLUMBIA RIVER



BONNEVILLE DAM TO

PRIEST RAPIDS DAM



GIS GEOGRAPHIC INFORMATION SYSTEM

BONNEVILLE POWER ADMINISTRATION

The Hanford Reach, as mentioned earlier, is the only free-flowing section of the Columbia River above Bonneville Dam in the United States. It runs approximately 50 miles from the head of Lake Wallula upstream to Priest Rapids Dam. In the Hanford Reach, the river maintains its historical profile and riverine character, although flows are locally modified at Priest Rapids Dam for optimum power generation and fish benefits. Regulation of flows has resulted in significantly different annual and diurnal shoreline shifts that affect the river's pre-development character.

Topography in the region is diverse, ranging from the rolling landscapes of the Columbia Basin to the Columbia River Gorge. The entire subbasin area is underlain by basalt up to 5,000 feet thick, with sedimentary deposits and recent alluvium occurring locally. Elevations range from 70 feet at minimum pool elevation at Bonneville Dam to over 2,000 feet on higher ridges bordering the river.

From The Dalles, the river flows through the relatively open terrain of the Columbia Plateau into the steep walled and forested confines of the gorge. The subbasin joins distinctly different climactic regions from the rainy, forested environment in the west to the interior desert in the east (U.S. Army Corps of Engineers 1988). The transition is abrupt, occurring mostly in the area between Bonneville Dam and The Dalles Dam where the Columbia River cuts through the Cascade Mountain Range.

The climate is variable, ranging from foggy and rainy west of the Cascades to a semidesert environment starting at The Dalles. Both maritime and continental air masses effect the area with moist air penetrating up the gorge to near Dallesport. Precipitation at Bonneville averages over 12 inches in December, to a low of 0.8 inches in July. At The Dalles, December rainfall averages less than 3 inches to a low of 0.08 inches in July. Temperatures are moderate at Bonneville, averaging 40 degrees Fahrenheit in December and 67 F in July. At The Dalles, averages are 38 F in December with summer daytime temperatures frequently reaching 100 F. The prevailing wind direction is up the river from the west. Wind velocities of 30 miles per hour may persist for entire days in the gorge, giving rise to an important economic force in the area -- wind surfing.

The region contains several vegetation zones -- Western Hemlock, Grand fir and Douglas fir, Ponderosa pine, and Shrub and Shrub-Steppe zones.

Water Resources

Minor tributaries to this subbasin where production or the potential exists for anadromous fish were previously listed. These smaller streams represent an aquatic production base whose contributions are dwarfed by the large aggregate stocks managed for today on the Columbia River. These small watersheds historically contained relatively small runs of salmon and steelhead, but in their aggregate, were important components of Columbia River production. Cultural development has substantially reduced their ability to produce, and harvest rates in the fisheries geared to hatchery productivity have further impaired the status of these runs. In the face of current harvest rates for some stocks, such as coho, it is doubtful that any, but the most productive could be returned to self-sustaining status. Although adequate habitat exists to support salmonids, many subbasin tributaries have relatively short anadromous reaches due to their precipitous decline into the gorge.

The construction of dams in the United States and Canada upstream from this subbasin on both the Columbia and Snake has altered the natural streamflow regime in the Columbia. In general, the effect has been that peak flood events have dampened, annual spring freshets have decreased in amplitude and duration, and as a result of optimum power generation, a pattern of local diurnal flow fluctuations established. These flow modifications, along with the expanded cross-sectional areas of the impoundments and the consumptive use of stored water, have altered the basic riverine character of the Columbia River. Flows during the critical spring smolt migration are frequently 50 percent of flows prior to hydro development in the river.

After reaching its maximum depth in about mid-April, mountain snowpack melts with warming spring and summer weather. Runoff swells the discharge of the Columbia River to its normal annual peak usually in the first half of June. River flow recedes and reaches its normal base low flow in the fall.

Management of flow in the Columbia is complex, involving a variety of Canadian and United States interests. Competing uses of the water, such as power generation and spill flows for fish have frequently created management difficulties. Recognizing the critical nature of high flows in sustaining downstream migration of juvenile salmonids, the Northwest Power Planning Council incorporated Section 300, the "water budget," into its Columbia River Basin Fish and Wildlife Program. Funded through this amendment, water managers at the Fish Passage Center work to "shape" the flow of the Columbia River by recommending flow increases during the spring migration, April 15 to June 15. The flow increases must come from the water budget, a 3.45-million and 0.45-million-acre-foot volume of water from the Columbia and Snake rivers, respectively. Although this water has no physical location or storage designation, it has been scheduled for release for the benefit of fish passage annually.

The goal of the water budget is to protect the middle 80 percent of the spring smolt migration by maintaining minimum recommended flows for 30 of the 60 days between April 15 and June 15. Minimum recommended flows are 85 kcfs (85,000 cubic feet per second) for the Snake River at Lower Granite Dam, and 140 kcfs in the mid-Columbia at Priest Rapids Dam. Although water releases have frequently met the recommended flows for the mid-Columbia, releases in the Snake River have not. As a result, flows have been less than optimum over much of the migration period in the lower Columbia at John Day Dam. Summer migrants, such as subyearling chinook, do not benefit from the water budget. In fact, flow conditions for them may be worse under water budget implementation as a result of power marketing strategies that reduce summer flows.

Flow data for minor tributaries of the subbasin is generally not available and has not been compiled in this report. Some tributaries such as Rock Creek (RM 228.5) and Willow Creek (RM 252.5) have low flows in critical reaches due to consumptive agricultural uses and destruction of riparian habitat. Others, such as the Bonneville Pool tributaries, are little depleted by diversion and maintain adequate flows for fish production.

Land Use

A description of land ownership and land use may be helpful for subbasin planning purposes by providing a guide to where habitat values might most easily be preserved, or where they may be most in jeopardy. Such a description may also provide an understanding of upland practices that affect instream habitat quality.

Land ownership and use within minor tributary watersheds is consistent with those in other areas of similar climate and land based values. In the drier portions of the subbasin, principal impacts are associated with water diversions for irrigation and grazing. In the moister clime of downstream areas, principal impacts are from urbanization and forestry. Roads, railroads, and bridges have impacted streams in both regions.

Shoreline ownership and use is of particular interest since the riparian zone has a direct influence on productivity of adjacent aquatic habitat. Much of the shoreline along the Columbia River is privately owned, as is the majority of the land the minor tributaries traverse. Extensive reaches of shoreline along the Columbia River reservoirs have been dedicated to roads and railroads and rip rap revetments to protect them. Between The Dalles and Bonneville dams, the climate changes rapidly and upland areas along the river and on top of the overlooking bluffs steadily assume an agricultural setting to the east.

The Hanford Nuclear Reservation is a significant federal holding extending along the Columbia River from North Richland to several miles downstream from Priest Rapids Dam along the southwest shoreline. Except for intake and discharge structures for the Hanford Reservation nuclear reactors, this reach of the Columbia remains undeveloped. Across the river, private lands have been developed for various irrigated crops, but the shoreline fringe remains generally undeveloped except for an occasional pump station. The U.S. Fish and Wildlife Service and Washington Department of Wildlife own extensive land holdings opposite the Hanford Reservation, which remain in a natural state.

Eight ports are located within the subbasin, and navigation is a significant use of the river. Associated port development alters the local landscape to industrial settings, Boise Cascade's Wallula Mill and Kennewick waste treatment facilities being significant among them.

Urbanized uses of the shorelines for commercial and dwelling purposes other than industrial, constitute a significant use, especially in the Bonneville Pool. The population centers of Stevenson, Hood River, Bingen, Lyle, The Dalles, Pasco, Kennewick and Richland all have made permanent alterations to natural shorelines. Remote and dryer shorelines of Lake Umatilla and Lake Wallula are generally devoid of human habitation.

Numerous federal, state and local parks constitute another significant public use of subbasin shorelines. Less obvious, are the "in lieu" fishing sites owned by treaty Indian tribes. Until federal legislation (Review of Tribal Constitutions and Bylaws HR 2677) was signed into law in November 1988, five sites had been provided to the tribes in compensation for traditional fishing sites destroyed when Bonneville Pool filled. HR 2677 directs the U.S. Army Corps of Engineers to administer another 23 sites along Bonneville Pool, Lake Celilo and Lake Umatilla for "access to usual and accustomed fishing areas and ancillary fishing facilities" for treaty tribes. The act also directs the secretary of the Army to acquire six additional sites adjacent to Bonneville Pool for access to usual and accustomed fishing areas.

PART II. HABITAT PROTECTION NEEDS

History and Status of Habitat

Limited descriptive data is available for the minor tributaries of this subbasin. Salmon production is generally limited by natural barriers and steep gradients in the small streams as they fall into the Columbia River Gorge. Steelhead use extends farther, but in some cases, such as Mosier Creek, all upstream migration is blocked by falls up to 60 feet high. Irreconcilable allocation of water to agricultural purposes in Willow Creek presents a significant challenge to reestablishment of anadromous fish production. No water diversions exist on Fulton Canyon, Spanish Hollow, Threemile and Mosier creeks and relatively intact habitat exists in the lower reaches of these streams.

Production in Viento Creek may be limited by poor adult passage conditions in a long, cement box culvert under Interstate 84. Rock Creek, tributary to Lake Umatilla, is impacted by low summer flows and livestock grazing.

Mainstem Columbia River habitat, by virtue of the dams, has been transformed from a free-flowing, unregulated river to a series of impoundments. The Hanford Reach remains as a vestige of the historical Columbia. However, reservoir operation upstream has altered the flow regime even here. The heterogenous pool-riffle sequence of alternately slow and fast water areas that form the basic production units of stream environments were permanently altered to relatively homogeneous, slow-moving impoundments. The cross sectional changes and profile modifications have altered pre-development biological communities and trophic structure.

The inundation of spawning habitat by the reservoirs limited mainstem production immediately after completion of the dams. In this subbasin, the lack of mainstem spawning habitat, with the exception of the Hanford Reach, remains a major limiting factor for fall chinook, and to a lesser degree, for summer steelhead. Other species of salmon were not affected as greatly, since spawning occurred in the tributaries. All species have been severely affected by juvenile mortality at the dams, and delay and loss of adults.

Columbia and Snake River impoundments have also dramatically altered the rearing environment and migratory conditions in the mainstem Columbia River. Projects located within the subbasin have had large effects on the rearing environment because they changed the river's cross-sectional area and profile. Major storage reservoirs on the Columbia and Snake rivers have had a greater effect on the flow regime, which directly changed spring and early summer migratory conditions.

Increased travel time has been an extremely detrimental consequence of hydro development on the Columbia. Post-development migration rates for yearling chinook are approximately three times that of those observed in the free-flowing river prior to impoundment (Raymond 1968). It has been estimated that in the low water year of 1977 only about 10 percent of the smolts originating upstream from Bonneville Dam successfully migrated out of the river. A trip that formerly could be made in two to seven days, now may take up to a month. Delayed travel time exposes juvenile salmonids to higher water temperatures, longer periods of predation, and upsets estuary arrival timing.

The water budget, although a good measure, has not been able to provide optimum passage conditions for spring migrants during dry years. In 1986 and 1987, flows at John Day Dam were seldom above levels needed to move smolts expeditiously through the river. As a consequence of the way power managers exchange power to offset losses incurred as the water budget is implemented, summer flows are reduced, impairing downstream migration conditions for summer migrants.

Sims (in press) found no correlation between subyearling chinook travel time in John Day Pool and river flow. However, the range of flows examined was relatively narrow and the subject needs further investigation.

In spite of migratory delays, juvenile salmonids appear to exploit the prey base and use impoundment rearing habitat. Juvenile chinook use low velocity shoreline habitat in the Hanford Reach, residing in backwater slough areas (Zimmerman and Rasmussen 1981). Impoundments of the subbasin, notably Lakes Wallula and Umatilla, have areas of extensive slough and shallow shoreline habitat (Columbia River Backwater Study: Phase One, USFWS 1980). Although subyearling chinook are the principal salmonid using backwater areas, yearling smolt-sized fish of several species have been captured there.

Diet studies in various areas of this subbasin suggest juvenile salmonids are opportunistic feeders. In the riverine conditions of the Hanford Reach, various midge life stages available in the water column, comprise the bulk of subyearling chinook diet (Becker 1973, Dauble et al. 1980). Further downstream in the impoundments, much of the diet of migrating salmonids appears to be gammarid amphipods (Muir and Emmett 1984).

Temperatures, especially in shoreline backwaters, reach levels detrimental to salmonid production in the late summer.

During May through June, temperatures are in the range preferred by salmonids. Locally, temperatures in mainstem areas can approach upper thermal tolerances for salmonids during the summer, but for the most part, juveniles have either migrated from the river or are migrating in main current areas where temperatures are tolerable. In recent years, serious losses of subyearling chinook at McNary Dam have been attributed to thermal stress in July and August.

The robust condition of naturally produced subyearling chinook passing McNary Dam seems to indicate no density dependent growth suppression of juveniles at escapement levels as high as 70,000 fish. Even though some areas such as Vernita Bar are mass spawned by the adults, researchers have not collected data suggesting adult numbers have exceeded spawning habitat capacity.

Constraints and Opportunities for Protection

Institutional Considerations

Listed below are the federal, state, and local agencies and Indian tribes that have statutory or proprietary interests and mandates over the physical and biological resources affecting salmon and steelhead production in this subbasin.

Federal
- U.S. Army Corps of Engineers
- U.S. Fish and Wildlife Service
- National Marine Fisheries Service
- U.S. Coast Guard
- U.S. Forest Service
- U.S. Soil Conservation Service (SCS)
- Bureau of Land Management (BLM)
- U.S. Department of Energy (Hanford Reservation)
- Federal Energy Regulatory Commission (FERC)
- Bonneville Power Administration (BPA)
- U.S. National Park Service

Tribes
- Confederated Tribes of the Warm Springs Indian Reservation
- Confederated Tribes of the Umatilla Indian Reservation
- Yakima Indian Nation
- Nez Perce Tribe

State
- Washington
  - Washington Department of Fisheries
  - Washington Department of Wildlife
  - Washington Department of Natural Resources
  - Washington Department of Ecology

Oregon
- Oregon Department of Fish and Wildlife
- Oregon Department of Natural Resources
- Oregon Department of Ecology

County

Washington
- Skamania County
- Klickitat County
- Benton County
- Grant County
- Yakima County
- Franklin County
- Walla Walla County

Oregon
- Morrow County
- Umatilla County
- Gilliam County
- Wasco County
- Multnomah County
- Clackamas County

Interagency
- Columbia River Gorge Commission

Port Districts
- Port of Hood River
- Port of The Dalles
- Port of Umatilla
- Port of Benton
- Port of Kennewick
- Port of Klickitat
- Port of Skamania
- Port of Pasco

Specific authority or interest of these entities varies widely. This list demonstrates the great and complex demands on the Columbia's resources. The multiple uses of the river and its resources have often pitted user groups and agencies against each other. Resolution of these problems has led to the establishment of numerous interagency technical and policy committees.

Habitat management for fish production embraces two elements that fish managers have varying degrees of control over -- management of the water and management of the physical habitat structure including the riparian edge. The U.S. Army Corps of Engineers controls flows in the Columbia during the spring flood and summer "refill" periods. During the fall and winter, when the principal emphasis in the river is on power generation, the Bonneville Power Administration has primary control of flow in the river. Internationally, flow management is coordinated by a treaty with Canada. The water budget, a 3.45-million and 0.45-million-acre-foot volume of water from the Columbia and Snake rivers, respectively, is used annually to speed downstream migrants on their way to the ocean. Water managers at the Fish Passage Center use this water to "shape" flows between April 15 and June 15. Their recommendations are based on an extensive network of smolt monitoring, hatchery releases and study results identifying levels of flow needed to minimize smolt travel time. Unfortunately, experience indicates that water budget volumes will not be consistently available, especially in the Snake River.

Legal Considerations

Federal and state statutes control the physical modification of the aquatic habitat. This overlapping patchwork of regulation is designed to limit impacts to public streams and shorelines. Rules governing development are generally poorly understood by the public. Laws that set standards for, regulate, or otherwise disclose for public and agency comment, development that could degrade stream and shoreline resources are listed below.

Federal

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

2) National Environmental Policy Act (NEPA), federal agency taking action

3) PL 100-605 (Hanford Reach only)

4) PL 99-663 (Columbia River Gorge only)

Washington State

1) State Water Quality Laws RCW 90.48, Dept. of Ecology, Washington

2) State Surface Water Codes RCW 90.03, Dept. of Ecology

3) State Groundwater Codes RCW 90.44, Dept. of Ecology

4) Shorelines Management Act, local government with state oversight by Dept. of Ecology

5) Hydraulics code RCW 75.20.100 and 103, Washington Dept. of Fisheries or Dept. of Wildlife

6) Minimum Flow Program, Dept. of Ecology

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

8) Flood Control Statutes, local government

9) Forest Practices Act, Dept. of Natural Resources.

In many 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 one important way this difficult management situation can be counteracted. Better interagency communication of goals and objectives within watersheds, and then, cooperative administration and enforcement of rules could improve habitat protection.

A good example from Washington of how interagency cooperation strengthens a regulatory program is the procedure the Department of Natural Resources uses to review forest practice applications. These new rules and agreements, implemented through the interagency framework commonly referred to as the Timber/ Fish/Wildlife (TFW) agreement, encourage interdisciplinary review of individual forest practice applications. Another example is the attempt to coordinate permits for streambank stabilization through the memorandum of understanding signed by the Washington departments of Fisheries, Wildlife and Ecology, the conservation districts and the U.S. Soil Conservation Service.

The primary role of the Oregon Department of Fish and Wildlife in habitat protection is to review activities of land managers and recommend practices to minimize negative impacts on fish habitat. The Oregon Department of Fish and Wildlife has several policies that involve protection of fish habitat. The habitat conservation division of the Oregon Department of Fish and Wildlife has a policy entitled the Fish and Wildlife Habitat Protection Policy, which states in part "...the Department will cooperate fully with other agencies to implement laws and to develop coordinated resource management programs which protect fish and wildlife habitat. The Department will also work with private organizations and individuals to achieve, where possible, mutually satisfactory solutions to conflicts between the objectives of other parties and the Department's habitat protection policy." Paragraph 6 of the Fish Management Policy (OAR 635-07-515) states, "Available aquatic and riparian habitat shall be protected and enhanced to optimize fish production of desired species."

In general, all the fisheries management agencies subscribe to some management goal of "no net loss" of existing habitat. Even though this goal is difficult to attain, it is an appropriate policy, one that subbasin planning should support and the only one that will protect the long-term production potential of entire river systems.

In spite of the best efforts of numerous state and federal agencies, and regulatory programs some people deem onerous and excessive, there is a gradual loss of stream habitat. This cumulative loss is occasioned by the routine development of natural resources and dedication of shoreline and water resources to other uses. These incremental losses have, and will, continue to result in reduced anadromous fish production in the Columbia Basin. Subbasin planning needs to address the problem of cumulative habitat loss if the goals of the Northwest Power Planning Act are to be achieved.

Since the adoption of the 1917 Water Code, the state of Washington has allocated water based on the Prior Appropriations Doctrine. In many cases, the amount of water allocated has resulted in many overappropriations and the reduction in corresponding anadromous fish runs. Instream flow protection started with Chapter 75.20 RCW (1949), with Department of Fisheries and Department of Wildlife recommendations for low flow conditions and stream closures to further appropriations of water. Since 1969, beginning with passage of the Minimum Water Flows and Levels Law (RCW 90.22), the state law has acknowledged a greater need to protect instream flows for fisheries and other instream values through developing basinwide flow protection programs. In addition, the 1917 Water Code provided that water permits would not be granted that could prove "detrimental to the public welfare" (RCW 90.03.290).

Both the Minimum Water Flows and Levels Law and the Water Resources Act of 1971 (RCW 90.54) direct the Department of Ecology to set minimum or base flows that protect and preserve fish and other instream resources. Because minimum or base flow regulations do not affect existing water rights, reductions in anadromous fish runs in overappropriated streams will continue to be a problem. The Water Resources Act specifically lists fish and wildlife maintenance and enhancement as a beneficial use. It further directs the Department of Ecology (DOE) to enhance the quality of the natural environment where possible.

The state statutes, however, do not define the extent of instream resource protection, leaving to the DOE the task of determining adequate protection levels for instream flows. This has caused increasing controversy in recent years and resulted in an attempt by the DOE to define the level of flow that was to be provided for fish in the state's streams. The Department of Ecology's 1987 effort to set a standard of "optimum" flows for fish was challenged by out-of-stream water users via the Washington Legislature in 1988. The 1988 Legislature put a moratorium (which has now been lifted) on the Ecology Department's recommended standard and established a Joint Legislative Committee on Water Resources Policy to address Washington's water future. To date, the committee has yet to define the level of protection that will be afforded fish resources.

Lacking any legislative direction on instream flow protection levels, water continues to be allocated from state streams under past practices. All water right applications are reviewed by the Department of Fisheries (WDF) and the Department of Wildlife (WDW) under RCW 75.20, prior to issuance by the Department of Ecology. The DOE considers Washington Wildlife and Fisheries comments before making a decision regarding the issuance of a permit for withdrawal. Washington Wildlife and Fisheries comments are recommendations only, and can be accepted or ignored by the Ecology Department. Current DOE practice is to issue water permits if water, above that recommended to be retained instream, is available for allocation. Virtually all domestic use requests are approved as are many non-domestic requests. The impacts of specific withdrawals on fish resources is often unclear, however, the cumulative impact of the new withdrawals is less instream water and negative impacts on fish populations.

The majority of Washington's streams do not have minimum flows established. Yet the Department of Ecology continues to issue permits for diversion and water withdrawal. It is unlikely that the current system will change until the Joint Legislative Committee on Water Resources Policy defines state policy in this area. The committee's decision could have a major impact on the future of the state's fisheries resources.

The fisheries agencies have requested that for most streams, instream flows be protected at levels that would maintain <u>existing</u> fish production, including the full range of variations that occurs naturally due to environmental conditions. For some streams, like the Yakima River, the fisheries agencies request flows to levels that would achieve <u>potential</u> production. This potential production would be determined by analyzing what could reasonably and practically be expected to return to the stream in the future.

In those streams that have already been overappropriated, establishment of instream flows may limit losses of fish resources to that which has already occurred. In many of these streams, restoration of instream flows is requisite for increasing or reestablishing fish runs.

In support of the continuing investments by the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program, the following recommendations are made relative to instream flows and fisheries resources:

1) No new out-of-stream appropriations of any kind should be issued unless appropriate instream flow levels are established for the stream to be impacted either through comment on the water right application or through the adoption of an instream flow regulation.

2) There should not be any exceptions to the minimum flow levels, including domestic use.

3) Minimum flows should be impacted only if concurrence is obtained from the state and federal fish resource agencies and tribes and adequate mitigation is provided.

4) Minimum instream flow levels should be adequate to protect existing and potential (where appropriate) fish production.

5) State law should be changed so that saved, purchased or donated water can be dedicated to instream flows.

Habitat Protection Objectives and Strategies

Objectives

1. No net loss of existing habitat.
2. No degradation of water quality.
3. No decrease of surface water quantity.
4. Increase of security for existing habitat.
5. Increase of salmonid use of underutilized habitat.

Strategies

Habitat protection is an area that does not lend itself to easily implemented strategies. As a result, a danger exists that this portion of subbasin planning may be given less attention than it should receive. The struggle to prevent cumulative loss of habitat is ultimately one of public policy.

Existing methods for securing these kinds of objectives generally are outside the normal activities of the Northwest Power Planning Council. The existing typical approach to securing these objectives is through regulatory programs. However, this defensive approach to habitat protection has not resulted in the desired level of protection. "Stewardship of the public resources requires more than a defensive philosophy..." (Restoring the Balance, 1988 Annual Report of the California Advisory Committee on Salmon and Steelhead Trout). Being based on prescriptive ordinance, existing habitat protection programs by definition deploy defensive measures.

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

The area of cumulative habitat loss is one that the Northwest Power Planning Council must be involved in for the sake of the investments made in the Columbia River Basin Fish and Wildlife Program to date. Unless the cumulative loss of habitat can be halted, today's losses will become tomorrow's "debt to the past" and the "investment in the future" will have been ill spent.

An excellent example of getting out in front of habitat problems before they happen is the "protected areas" program accomplished under the auspices of the Northwest Power Planning Council. Inventory of indispensable habitat and recommendation packages such as this, developed in the full light of public participation, stand as strong statements of intent to protect habitat.

The Northwest Power Planning Council could support the regulatory habitat protection work of the agencies and tribes and become more involved by:

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

2) Funding additional habitat management positions within the agencies and tribes.

3) Hosting a habitat protection symposium entitled, "Are the Investments Being Protected?"

4) Purchasing riparian property adjacent to critical habitat.

5) Testifying at state legislative hearings when habitat protection laws are threatened, as has been the case in Washington for the past four years.

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

7) Publishing additional inventories of "key" habitat for specific stocks that must receive <u>absolute</u> protection if the goals of the Northwest Power Act are to be realized.

8) 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

The statutory, economic or mandated need to preserve the Columbia's diverse and irreplaceable resources has resulted in a highly institutionalized management environment. Nowhere is this more evident than in the arena of fisheries management. So that all interests are represented and agreements fulfilled, coordinated management has become the mode of operation. Practically, this has required fisheries managers to work with each other to develop management data bases and assess stock status. Commercial fishing seasons on the Columbia today are set by Columbia River Compact members (Oregon and Washington) in consultation with the state of Idaho and treaty Indian tribes. Individual state agencies adopt recreational seasons. When the Columbia River is the common boundary, regulations are set to be compatible or identical.

Numerous interagency technical and policy committees exist to develop consistent recommendations for fish and water managers in the Columbia Basin. Of particular importance in this subbasin are five legal or statutory constraints: 1) the Treaty of 1855, 2) United States vs. Oregon, 3) the Pacific Salmon Treaty, 4) Columbia River Gorge Legislation, and 5) Vernita Bar Settlement Agreement.

The 1855 Indian treaties stand as key legal considerations in this subbasin. The Yakima Treaty of 1855; the Treaty of June 9, 1885 Stat. 945 among the Walla, Cayuse and Umatilla tribes; and the Treaty of June 25, 1855 12 Stat. 963 with the Tribes of Middle Oregon all reserve "the exclusive right of taking fish in the streams running through and bordering said reservation...and at all other usual and accustomed stations, in common with citizens of the United States."

Subsequent judicial interpretation of the 1855 treaties defined treaty language to mean tribal fishermen were entitled to 50 percent of the harvestable fish and that, as a result of the treaty right to fish, the tribes retained substantial governmental authority over the activities that affect fishing. Thus, treaty tribes have a right to co-manage and to participate equally in fishery management decisions affecting the Columbia River, including its tributaries.

The recently executed United States vs. Oregon agreement, which settled a long standing suit the United States and the Indian tribes brought against Oregon challenging state management of the Columbia River fisheries, describes pieces of a management plan to increase fish runs and allocate harvest among various fisheries. The agreement is consistent with judicial interpretation of the 1855 treaties and must be carefully considered in any plan to rebuild anadromous fish runs in the Columbia Basin. Although the sharing principles established under the agreement are inviolate, specific plans to enhance fisheries are subject to review and development within the Northwest Power Planning Council's subbasin planning initiative.

The Pacific Salmon Treaty between Canada and the United States validates the basic principle that each nation should benefit from its own fisheries investments and production. Upriver bright fall chinook, produced in the Hanford Reach of this subbasin, are an indicator stock by which the success of the treaty, in part, will be judged.

The Columbia River Gorge National Scenic Area Act (PL 99-663) establishes the boundaries of the Columbia River Gorge National Scenic Area and administrative guidelines. The dual purpose of the act is to "1) protect and provide for the enhancement of the scenic, cultural, recreational, and national resources of the Columbia River Gorge, and 2) protect and support the economy of the Columbia River Gorge area by encouraging growth to occur in existing urban areas and by allowing future economic development in a manner consistent with the first purpose." Future cultural development in the gorge, which in this subbasin encompasses both sides of the river from Bonneville Dam upstream to near Biggs Junction on Lake Umatilla, will be consistent with purposes of the act. Administration of the legislation should be helpful in preserving natural shoreline features and aquatic resources in this subbasin.

The Vernita Bar Settlement Agreement of June 16, 1988, among the fisheries agencies, Indian tribes, Bonneville Power Administration and mid-Columbia public utility districts, provides guidelines for flows in the Hanford Reach to protect fall chinook at several life stages. The guidelines of the agreement affect flow from mid-October until fry emergence the following year (usually sometime in mid-April), which can vary depending on wintertime conditions.

During the spawning period, the agreement requires control of maximum flows during daylight hours to minimize spawning on Vernita Bar above the 70 kcfs flow elevation. After spawning is complete, managers conduct surveys to determine the vertical distribution of redds on Vernita Bar. Based on those surveys and agreement guidelines, managers determine the critical elevation that encompasses the vast majority of redds. The minimum flow required to cover this critical elevation is referred to as "protection level flow," the maximum being set at 70 kcfs. The agreement neither precludes or requires protection of redds above the 70 kcfs flow elevation.

In 1988, managers found 51 redds on Vernita Bar above the 70 kcfs elevation, which were probably lost. This is the worst problem seen in the past several years. Since tailwater effects of Priest Rapids Dam diminish rapidly downstream, agreement guidelines are thought to provide 100 percent protection for fall chinook spawning in all years in other areas of the Hanford Reach.

During incubation and prior to hatching, deviation from protection level flows is permitted within specified volume and time guidelines. Deviations are designed to permit temporary dewatering of the redds without desiccation and loss during the egg stage. To ensure protection of pre-emergent fry, no deviation from protection level flows is permitted after hatching.

Passage of Public Law 100-605 in October 1988 authorized and directed the Secretary of the Interior to conduct a comprehensive River Conservation Study of the Hanford Reach. The purpose of the study is to investigate options for protecting the outstanding resources of the area, including fisheries. Passage of this law was in response to a proposal by the U.S. Army Corps of Engineers and Port of Wenatchee to develop a navigation channel for barge transportation through the Hanford Reach. The proposal galvanized widespread public and agency opposition to development of the reach.

Following is a list intended to clearly display the principal constraints, limitations and bounds to fish production and utilization in the subbasin. These considerations have guided development of objectives and strategies.

- Mainstem areas of this subbasin were important aboriginal fishing areas and continue to be the main Indian treaty fishing areas (Zone 6) in the Columbia Basin. Due to their cultural origins and traditional nature, these fisheries are difficult to direct to specific harvest opportunities requiring adjustments in fishing pattern or gear type.

- This subbasin is the transportation corridor for upriver runs and, as such, its fisheries are on mixed stocks. Many of the upriver runs are only maintaining and cannot sustain extensive harvest. Fisheries in this subbasin are constrained by conservation needs of weak stocks (wild B-run summer steelhead, upriver spring and summer chinook).

- The dominant habitat consideration is the presence of four mainstem dams that reduce survival of juvenile and adult fish. Depending on location in the subbasin, fish must pass up to four mainstem dams. Stocks originating upstream from this subbasin must pass additional dams.

- High water temperature occasionally impedes movement of adult fish and influences their vulnerability to various fisheries in the subbasin and in the lower ends of major tributaries.

- Reservoir rearing habitat is different from normal riverine conditions, providing unknown potentials and limitations for juvenile salmonid production.

- Impoundment habitat provides suitable conditions for short-term pen rearing of salmonids.

- Significant populations of predatory fishes have established within reservoirs of this subbasin.

PART IV. ANADROMOUS FISH PRODUCTION PLANS

This subbasin plan describes fisheries resources originating in the Columbia River mainstem (primarily the Hanford Reach), minor tributaries to the Columbia River not described in individual subbasin plans, and three hatcheries that release directly to the Columbia River (Spring Creek National Fish Hatchery, Ringold Rearing Ponds and Priest Rapids Salmon Hatchery).

SPRING CHINOOK SALMON

Fisheries Resource

Natural Production

Historical spring chinook production from areas described in this subbasin plan was probably quite limited. Today, production does not exist, and the potential for establishing natural production does not exist. Substantial spring chinook production originates in major tributaries to this subbasin and is described in other subbasin plans.

Hatchery Production

The Ringold Rearing Ponds are the only source of hatchery spring chinook in this subbasin not already described in other subbasin plans. The Ringold facility has been in operation since 1962 and is located on the east bank of the Columbia River in the Hanford Reach at RM 353. The National Marine Fisheries Service, through the Columbia River Fisheries Development Program (Mitchell Act), funds the facility. Fourteen raceways and a 9-acre pond are available for a release capacity of 1 million juveniles. The water source is from the Ringold Springs and is free from infectious hematopoietic necrosis (IHN). Incubation and early rearing must be done at other facilities.

The Ringold facility has reared spring chinook of various origins, including Carson, Cowlitz and Klickitat, during its 25-year history. Managers release spring chinook on station, usually as yearlings. Since 1976, releases have averaged about 545,000 fish during years of active spring chinook production (Table 2). A funding hiatus due to the loss of federal monies suspended spring chinook production at Ringold with the 1982 brood, released in 1984. Availability of surplus Columbia River spring chinook free of IHN virus could occasionally limit production.

Table 2. Spring chinook releases from Ringold Rearing Ponds (1976-1986).

RELEASE YEAR	BROOD YEAR	NUMBER RELEASED	SIZE AT RELEASE FISH PER POUND	STOCK
1976	1974	520,000	3.3	Klickitat
1977	1975	124,000	3.5	Cowlitz
1978	1976	153,538	10.0	Cowlitz
1979	1977	610,000	7.0	Cowlitz
1980	1978	350,000	7.0	Cowlitz
1981	1979	750,000	10.0	Cowlitz
1982 1/	1981	900,000	25.0	Cowlitz
1983		0	--	
1984	1982	950,000	7.0	Klickitat
1985	1983	0	--	
1986	1984	0	--	

1/ Fall release on September 20, 1982

Run size and escapement data are difficult to reconstruct for Ringold releases. Based on data compiled for this report, subbasin returns have averaged about 880 adults from 1977 through 1986. Detailed biological data is not available for spring chinook returning to Ringold Rearing Ponds. Default values that may approximate those for Ringold returns are presented for the Cowlitz stock, which was used in six of the last eight releases (Table 3).

Harvest

Spring chinook returns to the Ringold Ponds are a minor part of the upriver aggregate run that passes Bonneville Dam primarily in April and May. Since 1974, with the exception of one year, managers have curtailed target commercial fisheries in the lower Columbia River (below Bonneville Dam) and between Bonneville and McNary dams (Zone 6) to protect the upriver spring chinook runs. An incidental catch of upriver spring chinook occurs in both the lower Columbia River and Zone 6 commercial fisheries. However, the February and March winter seasons terminate before any meaningful numbers of spring chinook are counted at Bonneville Dam. In 1986 for example, only about 1,200 and 1,300 upriver fish were taken incidentally in the commercial (non-treaty and treaty combined) and recreational fisheries, respectively. In addition, 7,060 upriver spring chinook were taken in ceremonial and subsistence treaty fisheries. Ringold fish probably represented a very minor component of all these catches.

A terminal recreational fishery for returns to the Ringold Ponds has been a popular local fishery. The fishery was cancelled prior to the 1987 season because returns were not expected after cessation of production with the 1982 brood. Although the fishery occurs in a mixed-stock area, managers believe the localized nature of the fishery (restricted to a short reach of shoreline only) and behavior of the fish limit impacts to other upriver stocks.

Specific Considerations

- No habitat is available for natural production of spring chinook. Habitat in minor tributaries that historically may have supported small runs is seriously depleted.

- Funding for the Ringold Rearing Ponds has not been sufficient to operate the facility in recent years.

Table 3. Age structure, sex ratios and fecundity for Cowlitz spring chinook. Data may approximate values for adults returning to Ringold Rearing Ponds.

TOTAL AGE	PERCENT OF RUN	SEX RATIO MALE:FEMALE	FECUNDITY 1/
2	8.0	NA	
3	18.0	1:0	3852-4270
4	56.0	1:0	
5	17.0	0.67:1	
6	1.0	NA	

1/ 1978-82 average has ranged between these values, all ages combined.

Data sources:
Age data: WDF unpublished.
Sex ratio: Howell et al 1985.
Fecundity: Howell et al 1985.

Objectives

Biological Objective

Develop a fishery that does not impact rebuilding of other upriver runs of spring chinook.

Utilization Objective

Reestablish a limited shore-based recreational fishery in the vicinity of the Ringold Rearing Ponds.

Opportunities for spring chinook recreational fisheries in this subbasin are limited. The Ringold fishery has been popular locally for many years and has widespread public support. Production at Ringold must also take into account continued availability for use by the Wanapum and Yakima Indians for subsistence purposes.

The fishery exists in a mixed-stock area and, in the past, ran from April 1 to July 31, the entire period of upriver spring chinook migration. Since this strategy is strictly of recreational benefit and does nothing to rebuild depleted natural stocks or develop an appropriate brood stock for supplementation programs, it should be monitored to be sure it does not have an undue impact on the rebuilding of upriver natural runs.

Alternative Strategies

Strategies for all species in this report have specific themes. Actions identified under each strategy are closely related to the theme. Strategies 1 and 2 have natural production themes; Strategy 3 is a "benign" supplementation strategy, emphasizing actions to develop a single supplemented run. Strategy 4 relies on meeting objectives solely through a traditional hatchery program. Only those actions necessary for the success of a hatchery program would be included in Strategy 4. Species-specific considerations may preclude the development of any one of these four strategies for individual species. Planners did not model the following strategies, nor did they estimate costs.

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

NO ACTIONS IDENTIFIED

STRATEGY 2: Natural production, Level 2. This strategy seeks to achieve the objectives by the same means as Strategy 1, but goes an additional step by enhancing habitat.

NO ACTIONS IDENTIFIED

STRATEGY 3: 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 Strategies 1 and 2 necessary for the success of the supplementation program are also included.

ACTIONS: 3

3. Expand facilities at Ringold Hatchery. There are two spring water sources (55 cfs) for which the Washington departments of Fisheries and Wildlife hold applications, but have not been developed for fish rearing purposes. Development and delivery of this water into the hatchery and existing ponds is needed along with expansion of raceways and incubation facilities:

   A) Placement of an intake, pump and appropriate plumbing to hatchery.

   B) Construction of an additional 55 rearing raceways.

   C) Modification of an existing 9-acre pond to handle the additional flows.

   D) Construction of 11 starting raceways and incubation facilities (this would occur at another site, such as Klickitat Hatchery).

   Implementing this action would accommodate an additional 5 million spring chinook at 10 fish per pound.

STRATEGY 4: Hatchery production. This strategy seeks to reestablish spring chinook production at Ringold Rearing Ponds to restore a limited shore-based recreational fishery and satisfy treaty subsistence fishery needs.

ACTIONS: 1, 2

1. Secure adequate and permanent funding for the Ringold Rearing Ponds. Program is only for yearling releases of spring chinook, with eggs imported annually from available upriver sources.

2. Structure area and timing of fishery to maximize harvest of Ringold spring chinook. Fin clip all Ringold releases and permit retention only of marked fish.

Recommended Strategy

Planners recommend Strategy 4, reestablishing spring chinook production at Ringold Rearing Ponds.

FALL CHINOOK SALMON

Fisheries Resource

Fall chinook once migrated as far as the San Poil, Spokane, Pend Oreille, and Kootenay rivers in the Columbia and ascended the Snake River to the base of Shoshone Falls (Fulton 1968). Two general types of fall chinook, informally referred to as "tules" and "brights," existed historically and persist today. Tules are sexually mature upon entry to the Columbia River, migrate quickly to their natal stream, and spawn soon thereafter. Brights, on the other hand, enter the river over a broader time span than the tules, exhibit a bright silver coloration, spawn as much as two months later, and exhibit secondary sexual characteristics only after extended freshwater residence. Brights were generally distributed in the mid and upriver mainstem areas more than 200 miles from the river mouth, while tules inhabited the lower river tributaries. Some brights also occurred in the lower river tributaries. The range of fall chinook within the Columbia Basin has been limited by Chief Joseph and Hells Canyon dams. Spawning and rearing habitat has been further reduced by inundation from other mainstem dams.

Today, for management accounting purposes, fisheries managers classify fall chinook into four major stocks -- upriver bright (URB), Bonneville Pool Hatchery (BPH), lower river wild (LRW), and lower river hatchery (LRH) fish. The URB and LRW are bright types; the BPH and LRH are tule types. Although general biological characteristics are shared by individuals within each stock, the classification is not based on predetermined genetic similarities.

Lower river wild and lower river hatchery fall chinook are produced exclusively from tributary streams and hatcheries downstream from Bonneville Dam. These stocks will be described in other subbasin plans. Upriver bright and Bonneville Pool Hatchery fall chinook are produced primarily from natural production areas and hatcheries upstream from Bonneville Dam and will be dealt with in this subbasin plan.

Most upriver brights are produced as natural fish in the Hanford Reach of the Columbia River. Other subbasins, such as the Snake and Deschutes rivers produce lesser numbers of natural upriver brights. URBs are also produced at the Little White Salmon National Fish Hatchery, Priest Rapids, Klickitat, and Lyons Ferry Salmon hatcheries and Ringold Rearing Ponds. Additional minor upriver bright fall chinook production occurs upstream from this subbasin at the Rocky Reach Salmon Hatchery. Spawning fall chinook have been observed in the mainstem Columbia River locally in Wanapum Pool, in the tailwater of Wells Dam, and in lower ends of Sand Hollow Creek, the Wenatchee, Entiat, Chelan, Methow and Okanogan rivers. Managers do not know what production is generated by these spawning concentrations. Downstream from this subbasin, a hatchery program has developed at the Bonneville Hatchery. This subbasin plan will deal with upriver bright production from the Hanford Reach, the Priest Rapids Salmon Hatchery and the Ringold Rearing Ponds.

Bonneville Pool Hatchery fall chinook are produced primarily at Spring Creek National Fish Hatchery. The Klickitat Salmon Hatchery and the Little White Salmon National Fish Hatchery have reared BPHs, but since the weak hatchery escapements of the BPH stock in 1985 and redirection of stock production prescribed by United States vs. Oregon, managers have concentrated Bonneville Pool Hatchery production at Spring Creek. The Little White Salmon and Klickitat hatcheries last produced BPH fall chinook with the 1984 and 1985 brood years, respectively. Additional minor amounts of naturally produced BPHs occur in the Wind, Hood, White Salmon and Klickitat rivers and minor tributaries to Bonneville Pool. This subbasin plan deals with production from the Spring Creek National Fish Hatchery and minor tributaries to the subbasin.

Each of the four major stocks of fall chinook are composites of smaller production units. Precise estimates for the individual units within upriver bright and Bonneville Pool Hatchery stocks are not available. However, for purposes of this report, planners attempted to isolate the amounts of upriver bright and BPH production originating from this subbasin. This data was generally derived by applying escapement area ratios and coded-wire tag data to the fall chinook management data base and will be referred to in later sections (WDF, unpubl. data, 1988). The most difficult problem in this exercise was apportioning the harvest in the mainstem Columbia among small production units. This is where the greatest potential for error exists.

Natural Production

Upriver Brights

Natural production of upriver bright chinook occurs in the Hanford Reach, one of the most important natural production areas for all chinook in the entire Columbia Basin. Some spawning has been observed in Rock Creek (RM 228.5), but in general, little spawning occurs in the tributaries. Researchers have documented spawning in water up to 30 feet deep in the Hanford Reach (Chapman et al. 1983, Swan et al. 1986), and it is possible that deep areas in other reaches of the Columbia in this subbasin, where suitable substrate and velocities exist, may be providing local spawning habitat for upriver bright fall chinook.

Natural adult spawning escapement into the Hanford Reach from 1977 through 1986 has ranged from a low of 15,300 fish to a high of 72,500 fish (Table 4). Estimates of escapement are based on McNary, Ice Harbor, and Priest Rapids Dam count differences, minus Ringold and Priest Rapids Hatchery volunteer returns and the Hanford Reach catch. Estimates also include a relatively small number of fish returning to the Yakima River. Estimates for the Yakima River from 1977 through 1987 range from no redds to 134 redds, but because of poor visibility, these estimates are considered conservative (Battelle Pacific Northwest Laboratories, unpubl. data). The last few years have shown the highest escapements in the Hanford Reach.

Since 1979, biologists have sampled age structure of the spawning population in the Hanford Reach (WDF, unpubl. data). Age determination was based on the analysis of scales collected from dead fish that researchers systematically sampled on the spawning grounds. The component of the population comprised of 2-year-old precocious males (jacks) is based on numbers determined by dam counts. Results indicate nearly half the spawning population is jacks (Table 5a). The data reflect considerable size selectivity of downstream commercial gill net fisheries. Return year age structure is further skewed by the 1985 and 1986 years, which were large jack years. A more representative age structure prior to mainstem fisheries was construction for the run to the mouth of the river (Table 5b).

Except for 3-year-old fish, males of the same age are larger than females (Table 5a). Of the 4-, 5-, and 6-year-old fish, females predominate 2-to-1 (Table 6). Planners used the length fecundity relationship derived by Allen and Meekin (1973) to calculate age specific fecundities for Hanford Reach natural upriver brights (Table 6).

Spawning extends from late October, peaking in mid to late November and tapering off into December (Table 7). Biologists observe concentrations of spawners on Vernita Bar and in the White Bluffs area, although spawning occurs throughout the free flowing section. Fry are observed along the shoreline from late March through July, with peak numbers occurring in April and May. Generally, fry reside inshore, moving into deep waters as they increase in size before emigrating. By August, shoreline areas are generally absent of juvenile chinook. Downstream migration studies with juveniles from the Priest Rapids spawning channel showed that fingerlings released in May and June arrived at McNary Dam (105 miles downstream) in late July and early August (Allen and Meekin 1973). Estuary arrival occurs about a month later (Howell et al. 1985).

Table 4. Columbia River and subbasin run size and escapement of upriver bright fall chinook, 1977-1986 (in thousands).

Year	Run to River		Subbasin Run to River[2]				Subbasin Escapement[3]			
			Natural		Hatchery		Natural		Hatchery	
	Adults[1]	Total[2]	Adults	Total	Adults	Total	Adults	Total	Adults	Total
1977	95.1	173.2	67.2	128.9	3.4	8.5	31.6	74.8	1.6	5.2
1978	85.3	135.7	54.4	83.4	5.5	11.6	20.6	33.4	2.1	4.8
1979	89.2	136.0	58.6	85.8	6.2	11.3	23.6	39.2	2.5	5.4
1980	76.8	101.1	50.0	61.7	5.0	8.7	21.9	28.3	2.3	4.3
1981	66.6	109.3	38.0	61.2	6.0	9.5	15.3	25.1	2.5	4.0
1982	79.0	140.6	42.4	83.0	7.5	15.3	20.4	42.1	3.8	8.0
1983	86.1	136.0	59.4	100.4	7.9	10.2	37.0	58.6	5.2	6.4
1984	131.4	229.2	91.5	166.3	15.4	26.2	45.3	84.2	8.1	13.7
1985	195.6	351.5	132.1	240.0	27.9	55.1	60.6	128.2	13.4	30.5
1986	281.5	471.4	182.1	324.7	39.3	55.6	72.5	162.5	16.2	26.5
Average	118.7	198.4	77.6	133.5	12.4	21.2	34.9	67.6	5.8	10.9

[1] From review of the 1987 ocean salmon fisheries, Pacific Fisheries Management Council, February 1988.

[2] From WDF unpublished data, 1988. Provisional data base subject to review and modification.

[3] From WDF, unpublished data.

Table 5a. Age structure and individual size of Hanford Reach upriver bright fall chinook spawning population, 1983-1986 (WDF, unpublished data).

Total Age	Percent of Population	Size (fork length in cm)			
		Male		Female	
		Mean	Range	Mean	Range
2	47.8	4	30-62	--	--
3	13.2	66	41-103	72	54-98
4	28.3	91	54-115	87	59-106
5	10.2	106	82-120	96	77-114
6	0.5	110	105-116	95	87-104

Table 5b. Brood year age composition of upriver bright fall chinook at mouth of Columbia River, all production units included, 1974-1982 (WDF, fall chinook management data base, progress report 89-18, July 1989).

Total Age	Percent of Population
2	34.8
3	14.2
4	34.5
5	15.8
6	0.6

Table 6. Age composition, sex ratio and age (size) specific fecundity for Hanford Reach natural upriver bright spawning population, return years 1983-1986 (WDF, unpublished data; memos Roler et al.).

Total Age	Percent of Population	M:F Sex Ratio	Average size Fork Length (cm)	Female Fecundity[1]
2	47.8	1:0	--	--
3	13.2	9.32:1	72	3,691
4	28.3	0.53:1	87	4,959
5	10.2	0.45:1	96	5,720
6	0.5	0.50:1	95	5,635

Table 7. Freshwater life history of Hanford Reach URB fall chinook.

	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY
ADULT IMMIGRATION	----	----										
ADULT HOLDING		----	----									
SPAWNING			----	----	----							
EGG/ALEVIN INCUBATION			----	----	----	----	----	----	----			
EMERGENCE								----	----	----		
REARING	---								----	----	----	----
JUVENILE EMIGRATION	----	----									----	----

Estimating carrying capacity for fall chinook in this subbasin is difficult due to a lack of understanding on how large riverine systems and impounded areas are used by juveniles. Data from other systems and methodologies derived for similar problems on smaller streams are not applicable. Planners tried four methods and evaluated the results by comparing the adult production expected from the smolt estimate, with the observed returns in the 1977 through 1986 period.

Methods tried included 1) application of different default rearing densities to estimates of usable habitat, 2) application of a smolts per kilometer standard for rivers greater than 100 meters wide, 3) applications of the egg-to-smolt survival rates used in United States vs. Oregon, and 4) application of Lewis River data (WDF, unpubl. data). All methods except the third, the United States vs. Oregon standards, resulted in estimates that planners considered too low. The range of values determined by this third method was 13 million to 57 million fall chinook smolts.

Smolt-to-adult survival for natural upriver brights is not available. Coded-wire tag data for Priest Rapids Hatchery fish indicates an average of 0.8 percent for three groups (Howell et al. 1985). Managers began tagging natural fish in the Hanford Reach in 1987.

The upriver bright run from the Hanford Reach has been characterized electrophoretically and is genetically distinct from four other major runs of upriver bright fall chinook in the Columbia and Snake rivers (J. Shaklee, WDF, pers. commun.). The run that returns voluntarily to the Priest Rapids Salmon Hatchery and the Hanford natural fish are genetically the most similar, but are still statistically different. This data suggests that managers must be careful when selecting and maintaining brood stock for the various URB hatchery programs in existence and consider carefully the cultural practices influencing homing behavior of adults.

Carcass surveys in the Hanford Reach have recovered tagged fish from several hatcheries, primarily Priest Rapids, that have spawned with the natural population. Maintenance of genetic integrity of individual upriver bright production units is not only of great biological importance, but may be important for fishery management purposes as genetic stock identification procedures are refined and developed.

Managers do not know what limits natural production of Hanford upriver brights. Spawning ground surveys indicate some areas are very densely spawned, but do not indicate that capacity of the spawning habitat has been exceeded. It will be important to evaluate production from the higher escapements of 1985 through 1987, but managers must also consider other factors such as river flows during downstream passage and ocean conditions. Other critical data gaps include ocean survival, habitat utilization patterns and predator-prey interactions.

Bonneville Pool Hatchery Stock

Today the Bonneville Pool Hatchery stock of fall chinook is produced almost entirely in hatcheries. Some natural production of the tule stock occurs in the Klickitat, Wind, White Salmon, and Hood rivers, along with some minor tributaries. Of the tributaries that flow into Bonneville Pool, tule fall chinook were native to the Wind, Little White Salmon, White Salmon, Klickitat, and Hood rivers (Fulton 1968). Bonneville Dam, completed in 1938, inundated spawning areas in the Little White Salmon River. Condit Dam blocked the White Salmon run of fall chinook in 1912. Historically, fall chinook migrated as far as Castile Falls in the Klickitat River (Fulton 1968).

Estimates of fall chinook production originating in minor tributaries is limited. Natural spawning occurs in late September and early October, about two to four weeks later than spawning at Spring Creek National Fish Hatchery. The tributaries where some natural production occurs in this subbasin are:

Bonneville Pool
- Rock Creek, Washington
- Collins Creek, Washington
- Eagle Creek, Oregon
- Herman Creek, Oregon
- Lindsey Creek, Oregon

John Day Pool
- Rock Creek, Washington

For size, sex ratio and fecundity, the most closely related stock is the Bonneville Pool Hatchery stock cultured at Spring Creek National Fish Hatchery (Table 8). Specific available information on tributary production is as follows.

Collins Creek: Some intermittent field observations estimated annual escapements of about 50 fish. Based on this estimate, along with age composition, sex ratio and fecundity information for the Spring Creek stock, annual production may be roughly 122,000 eggs. Information on survival is not available. No directed harvest exists on Collins Creek fish.

Table 8. Age structure, sex ratios and fecundity for BPH stock fall chinook.

TOTAL AGE	PERCENT OF RUN	SEX RATIO MALE:FEMALE	FECUNDITY 1/
2	9.0	32.8:1	
3	61.0	0.81:1	4707
4	30.0	0.58:1	
5	<.0	0.54:1	
6	0.0	--	

1/ Average value for all ages

Data sources:
Age and sex ratio: Spring Ck NFH sampling, WDF unpub. data.
Fecundity: T. Roth, USFWS, pers. comm. 1987.

Eagle Creek: No escapement or survival information is available. Sport harvest from 1977 to 1984 has averaged about 57 adults annually. In 1980, managers released 9,560 hatchery fish into Eagle Creek.

Herman Creek: No escapement or survival information is available. Sport harvest from 1977 through 1984 has averaged about 48 fish annually.

Lindsey Creek: Average escapement has been estimated at 10 fish annually (J. Newton, ODFW, pers. commun.). During 1983, managers released 425,292 fingerlings in Lindsey Creek. No information is available on survival rates or harvest numbers.

Rock Creek (WA, Bonneville Pool): Managers estimate average escapement at 200 fish annually. No directed terminal harvest occurs on this run. Some releases of upriver bright fingerlings have been made into Rock Creek (1984: 183,408 fish, 1985: 392,672 fish, 1986: 603,879 fish).

Hatchery Production

Upriver Brights

Columbia River upriver bright fall chinook are raised at a number of hatcheries including Rocky Reach (near Wenatchee), Priest Rapids Salmon Hatchery (in the Hanford Reach), Klickitat Salmon Hatchery (Klickitat River), Little White Salmon National Fish Hatchery (Little White Salmon River), Bonneville Fish Hatchery (Columbia River, just downstream from Bonneville Dam) and Lyons Ferry Salmon Hatchery (Snake River). Upriver brights were intermittently produced at Ringold Rearing Ponds prior to 1987. The Priest Rapids Salmon Hatchery remains the focus of Columbia River upriver bright hatchery production and is the only hatchery described in this subbasin plan that raises upriver brights.

Priest Rapids Hatchery is located just downstream from Priest Rapids Dam and has released fall chinook annually since 1971. Prior to 1971, the facility operated as a spawning channel. Until about 1981, releases from Priest Rapids Hatchery ranged between 1 million to 3 million fingerlings. As water sources, hatchery facilities, and production programming developed, releases stabilized near the 6-million-fish mark (Table 9). The last upriver bright release from Ringold Rearing Ponds was the 1985 brood as yearlings in 1987 (Table 10).

Table 9. Release of URB fall chinook from Priest Rapids Salmon Hatchery (1977-1986).

RELEASE YEAR	BROOD YEAR	NUMBER RELEASED (MILLIONS)	SIZE AT RELEASE (fish per pound)	STOCK
1977	1976	1.467	98.9	Priest Rapids
1978	1977	1.460	78.6	Priest Rapids
1979	1978	1.200	74.9	Priest Rapids
1980	1979	2.383	75.4	Columbia River
1981	1980	0.946	69.2	Columbia River
1981	1980	2.238	89.0	Priest Rapids
1981	1980	1.635	89.1	Bonneville
1982	1981	3.822	81.3	Priest Rapids
1982	1981	1.687	90.0	Bonneville
1983	1982	4.245	84.0	Priest Rapids
1983	1982	5.190	84.4	Bonneville
1984	1983	0.245	84.0	Priest Rapids
1984	1983	3.800	79.5	Bonneville
1985	1984	6.989	61.9	Priest Rapids
1986	1984	0.196	8.0	Priest Rapids
1986	1985	6.363	61.2	Priest Rapids

Table 10. Release of URB fall chinook from Ringold Rearing Ponds (1977-1986).

RELEASE YEAR	BROOD YEAR	NUMBER RELEASED (MILLIONS)	SIZE AT RELEASE (fish per pound)	STOCK
1976	1975	0.987	53.8	Priest Rapids
1977	1976	0	--	--
1978	1977	0.497	35.0	Priest Rapids
1979	1978	0	--	--
1980	1978	0.275	10.0	Priest Rapids
1980	1979	0.669	88.0	Priest Rapids
1981	1980	0	--	
1982	1980	0.788	7.5	Bonneville
1983	1982	0	--	--
1984	1983	2.100	55.0	Bonneville
1985	1983	1.200	7.0	Bonneville
1986	1984	1.300	6.0	Priest Rapids

To ensure meeting egg-take requirements and to increase the likelihood of mixing natural fish into the hatchery population, managers have collected some brood stock at a trap located in the left bank fishway at Priest Rapids Dam. Since tag codes recovered in this group of fish indicate many are bound for Rocky Reach or Wells hatcheries, managers are phasing out this practice. The number of adult spawners recorded in hatchery records are usually voluntary hatchery returns and Priest Rapids Dam fishway captures. Other measures to attract adults into the hatchery, such as adding olfactory cues to the hatchery effluent, show promise of eliminating shortfalls in adult returns.

Adult run timing through the Columbia River fisheries and into the subbasin is similar to that of Hanford Reach natural fish. Hatchery adult run size to the river (Priest Rapids and Ringold Rearing Ponds combined) has ranged from about 3,000 fish to 39,000 fish from 1977 through 1986 (Table 4). Hatchery run size has followed the same increasing trends since 1983 as the Hanford Reach natural run. This suggests that the two runs may be benefitting from the same inriver and ocean environmental conditions and harvest modifications that have led to the overall stock improvement since record low returns in 1981.

The age structure of the population that returns to the Priest Rapids Hatchery is skewed by the selectivity of downstream net fisheries toward 2- and 3-year-old fish that are predominantly male. Four-year-old fish comprise about 26 percent of the population. In this age group and older, females substantially outnumber males (Table 11). Average fecundity of hatchery fish has been estimated at 4,513 eggs per female for all ages (M. Dell, Grant County PUD, pers. commun.). Size at release varies, but recently has been between 53 fish and 62 fish per pound (Table 9). Normal release time is in mid-June.

Bonneville Pool Hatchery Stock

The BPH stock was brought into hatchery production with the first egg-take in 1896. Egg-take facilities were established on the Wind and White Salmon rivers within a few years. In 1901, managers used White Salmon River fall chinook eggs to establish the Spring Creek Hatchery program. Little egg importation has occurred in the Spring Creek BPH program over the years. Managers have transferred surplus Spring Creek eggs to numerous other hatcheries. With the elimination of Bonneville Pool Hatchery production at the Klickitat and Little White Salmon hatcheries, BPH production is now focused at Spring Creek.

Table 11. Age structure, individual size, sex ratios and fecundity for voluntary URB returns to Priest Rapids Salmon Hatchery.

TOTAL AGE	PERCENT OF RUN	FORK LENGTH (in cm)	SEX RATIO MALE:FEMALE	FECUNDITY 1/
2	39.6	29-66	1:0	
3	30.0	46-100	7.62:1	
4	26.1	65-111	0.68:1	4513
5	4.2	76-119	0.59:1	
6	0.1	106-113	0.59:1	

1/ Total egg take divided by the number of females spawned, 1977-1986, all ages.

Data sources:
Age, fork-length and sex ratio: (WDF, unpublished data).
Fecundity: (Mike Dell, Grant Co. PUD, pers. comm.)

Historically, a portion of Spring Creek fish were transferred downstream to the Bonneville Hatchery. With poor returns of this stock in 1986, and to guarantee an adequate egg-take, managers collected tule chinook in the fishway at Bonneville Dam. Hatchery release data is provided in Table 12 for the Spring Creek Hatchery.

Age determinations from scales collected from Spring Creek Hatchery between 1977 and 1986 show that about 9 percent of the fish return as 2-year-olds, 61 percent as 3-year-olds, 30 percent as 4-year-olds, and just a few at 5 years of age (WDF, unpubl. data) (Table 8). Two-year-old fish are males averaging about 59 centimeters (cm) in fork length, considerably larger than upriver bright jacks. Three-year-old males averaged almost 83 cm, while 3-year-old females averaged 82 cm long. Four-year-old returns were largely females with the males averaging 93.8 cm and the females 90.2 cm. The few 5-year-olds averaged 99.2 cm for males and 93.3 cm for females. Fecundity averaged about 4,700 eggs per female over the same time period (Table 8) .

Peak spawning at Spring Creek National Fish Hatchery occurs in mid-September. Fertilization to eyed-eggs takes about four weeks; eyed-eggs hatch after 2.5 weeks. Fish are released into raceways about six weeks later. Managers have released juvenile fish primarily as fingerlings (Table 13).

Harvest

The aggregate upriver fall chinook run is composed of two large stocks, the upriver bright and Bonneville Pool Hatchery stocks. Both stocks pass through the lower Columbia River and over Bonneville Dam in peak numbers in early September. Freshwater migration of Bonneville Pool Hatchery occurs over a short time span beginning in mid-August and is 75 percent complete by mid-September. Upriver bright migration extends broadly from early August to mid-November. Over the last 10 years, stock abundance patterns have reversed, with the upriver brights now dominant.

Harvest seasons in the Columbia River are set by the Columbia River Compact in consultation with the Columbia River Treaty tribes. In 1986, fall season agreements included 1) a guarantee of at least 30 days fishing for treaty fishermen from August through October, 2) the reduction or elimination of most time and area restrictions on treaty fishermen related to obtaining hatchery escapement in the Bonneville Pool, 3) the delay of lower river commercial seasons until September 12, unless mutually changed by all parties; and 4) regulation of Buoy 10 sport fishing to a quota of 10,000 chinook and 67,000 coho (Columbia River Fish Runs and Fisheries, 1960-1987, October 1988).

Table 12. Releases of BPH fall chinook from Spring Creek National Fish Hatchery (1973-1986).

RELEASE YEAR	BROOD YEAR	NUMBER RELEASED (MILLIONS)	STOCK
1973	1972	20.236	BPH
1974	1973	16.777	BPH
1975	1974	19.978	BPH
1975	1973	0.975	BPH
1976	1975	18.592	BPH
1976	1974	0.920	BPH
1977	1976	21.251	BPH
1978	1977	21.405	BPH
1978	1976	1.241	BPH
1979	1978	22.546	BPH
1979	1977	1.203	BPH
1980	1979	16.902	BPH
1980	1978	1.112	BPH
1981	1980	16.399	BPH
1981	1979	0.291	BPH
1982	1981	13.677	BPH
1983	1982	15.797	BPH
1983	1982	1.732	URB 1/
1984	1983	13.924	BPH
1984	1983	4.090	URB 1/
1985	1984	13.905	BPH
1985	1984	2.123	URB 1/
1986	1985	10.595	BPH
1986	1985	3.200	URB 1/

1/ URB + Bonneville egg-bank bright mix

Table 13. Freshwater life history of BPH fall chinook

	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY
ADULT IMMIGRATION	---	---										
ADULT HOLDING		--										
SPAWNING		---	---									
EGG/ALEVIN INCUBATION		---	---	---	-							
EMERGENCE					---							
REARING					-	---	---	---	---	---		
JUVENILE EMIGRATION	---	-								---	---	---

Managers do not know precisely the contribution of subbasin upriver brights to the total Columbia River return, but based on a provisional data base prepared for this report and referred to earlier, its contribution has ranged from 65 percent to 84 percent between 1977 and 1986 (Table 14). These are estimates only, but may be useful in comparing the relative importance of Hanford Reach natural upriver brights to other production units and the entire river return. Prior to 1986, subbasin Bonneville Pool Hatchery production had never fallen below 22 percent of the entire Columbia River return.

Catch data for upriver brights and Bonneville Pool Hatchery fish is not broken out by individual production units (Hanford natural upriver brights, Spring Creek Hatchery BPH) in the fall chinook management data base. However, data compiled for this report indicate that in 1986, commercial fisheries in the lower river (Zones 1-5) harvested a total of 49,900 fall chinook originating from this subbasin, 45,800 (92 percent) of which were upriver brights. Zone 6 treaty fisheries caught an estimated 72,000 fall chinook originating from this subbasin, of which 71,300 (93 percent) were upriver brights. Prior to 1983, overall stock contributions were reversed with the Bonneville Pool Hatchery fish constituting the bulk of commercial catches. Columbia River recreational fisheries took another 22,300 (adults and jacks combined) subbasin chinook, all but 600 of which were upriver brights. Recreational fisheries, despite substantial effort, have not been very successful in harvesting upriver brights between Bonneville and McNary dams, except at the mouths of cooler tributaries such as the Deschutes and White Salmon rivers. The bulk of the recreational harvest occurs in the Hanford Reach and in the lower Columbia River downstream from the Megler-Astoria bridge.

Specific Considerations

- The current management goal calls for an escapement of 40,000 adults past McNary Dam. At recent run sizes, this goal is achieved by default (management for weaker stocks precludes harvesting down to the 40,000 fish goal). The latest spawner recruit analysis, conducted in 1980, does not reflect the current natural and hatchery production mix.

- The Vernita Bar Settlement Agreement dictates the level of fall chinook redd protection in the Hanford Reach, and to a lesser degree, the spawning capacity of the area through established flow regimes.

Table 14. Columbia River and subbasin adult run size and escapement of Bonneville Pool Hatchery (BPH) fall chinook 1977-1986 (in thousands).

YEAR	RUN TO RIVER 1/	SUBBASIN RUN TO RIVER 2/		SUBBASIN ESCAPEMENT 2/	
		NATURAL 3/	HATCHERY 4/	NATURAL 3/	HATCHERY 4/
1977	107.7	N/A	77.9	Minimal	13.6
1978	99.7	N/A	67.0	Minimal	11.3
1979	95.2	N/A	75.6	Minimal	15.8
1980	97.8	N/A	79.5	Minimal	23.8
1981	86.3	N/A	73.8	Minimal	23.8
1982	120.7	N/A	99.7	Minimal	27.0
1983	28.9	N/A	22.6	Minimal	9.1
1984	47.5	N/A	40.3	Minimal	8.9
1985	33.0	N/A	28.2	Minimal	7.2
1986	16.6	N/A	4.6	Minimal	1.7

1/ Source: Review of the 1987 Ocean Salmon Fisheries, Pacific Fisheries Management Council, February 1988.

2/ Source: WDF unpublished data, 1988. Provisional data base subject to review and modification.

3/ Source: Data unavailable but estimates prepared for this report suggest minor tributary production in the aggregate averages less than 1,000 adults annually.

4/ Spring Creek National Fish Hatchery only.

- Weak stocks of summer steelhead constrain harvest of surplus adult fish in net fisheries.

- United States vs. Oregon specifies catch allocation, fishing areas and fishing patterns.

- Except in the Hanford Reach and at the mouths of some tributaries, such as the Deschutes, the behavior of fall chinook does not lend itself to a recreational fishery.

- Juveniles are stranded by flow fluctuations from Priest Rapids Dam in the Hanford Reach and by barge wakes on shoal areas in other reservoirs. The scope of the loss for the entire subbasin is unknown.

- When conditions of low flow and high temperature combine at McNary Dam, severe mortality occurs on upriver bright juveniles.

- Genetic differences exist between different substocks of upriver bright fall chinook.

Objectives

Upriver bright and Bonneville Pool Hatchery fall chinook production and stock characteristics are so different that separate objectives must be developed. Production of each stock is affected by different constraints and opportunities.

Upriver Bright Biological Objective

Maintain genetic integrity of Columbia River upriver bright fall chinook stocks. Review and adjust the escapement goal based on the existing fall chinook data base including those years of particularly high escapements in the Hanford Reach.

Upriver Bright Utilization Objective

Harvest all the surplus fish returning to the Columbia River in excess of the existing escapement goal. In the past five years, the escapement goal of 40,000 adults over McNary Dam has been exceeded. Harvest of the surplus has been constrained by incidental catch of weak stocks of steelhead, usually B run summers.

Bonneville Pool Hatchery Biological Objective

Restore productivity of the stock and ensure its viability in the hatchery environment.

Bonneville Pool Hatchery Utilization Objective

Harvest all the fish surplus to the hatchery escapement goal.

Subbasin production accounted for anywhere between 35 percent and 75 percent of the upriver bright river return in 1977 through 1986. Maintenance and protection of this production should be accorded highest priority.

As long as the upriver bright natural production component is performing well, and harvests are constrained by weaker stocks in mixed-stock fisheries, primary emphasis should be on protecting naturally produced fish and improving existing cultural practices. Therefore no major changes are contemplated, but numerous actions could improve the production environment for this stock.

In 1986, the Bonneville Pool Hatchery stock suffered a precipitous decline, ending a decade-long dominance of chinook production in the Columbia River. It is not clear what all the factors were in the decline of the stock, but in part it appears to have been attributable to cultural practices related to high rearing densities. This stock needs to be returned to its former productivity to support the fisheries that had developed around it.

Alternative Strategies

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

ACTIONS: 1-6

1. Reduce mortality at mainstem dams for juveniles by improvement and installation of screening or guidance devices.

2. Determine the relationship between river flow and transportation time for subyearling chinook and take appropriate action to secure flows that minimize their travel time out of the river.

3. Eliminate loss of juvenile salmonids in water diversions (municipal, industrial and agricultural). The National Marine Fisheries Service, U.S. Army Corps of Engineers and the Washington Department of Fisheries have done partial inventories of diversion points and their screening status. Existing information needs to be compiled to fully evaluate the potential of this action.

4. Determine the scope of subyearling chinook stranding in the Hanford Reach due to flow fluctuations from Priest Rapids Dam. The extent of the loss is not known, but anecdotal observations indicate it is substantial. Additional evaluation work will be required to assess the potential of this action to increase production.

5. Review the escapement goal for fall chinook over McNary Dam in light of the continued production increases from higher escapements in the Hanford Reach since 1985 and the current production mix of hatchery and natural fish. Unlike many of the individual smaller runs of salmon and steelhead returning to the Columbia River, whose biological escapement needs cannot be adequately met by existing aggregate stock management practices, the Hanford upriver brights contribute a large enough portion of the catch to justify regulating fisheries around their management needs.

6. Initiate a pilot predator-control program consistent with results of studies completed or proposed under Section 400 of the Columbia River Basin Fish and Wildlife Program. Significant and ongoing evaluation will be required to determine the effectiveness of this action. In particular, researchers should determine the response of predator populations to direct removal of older year classes, and the potential of habitat manipulation in reducing predator populations.

STRATEGY 2: Natural production, Level 2. This strategy seeks to achieve the objectives by the same means as Strategy 1, but goes an additional step by enhancing habitat.

NO ADDITIONAL ACTIONS IDENTIFIED

STRATEGY 3: 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 Strategies 1 and 2 necessary for the success of the supplementation program are also included.

ACTIONS: 1-7

1. -
2. -
3. -
4. -
5. -
6. -

7. Initiate a pilot program of net pen rearing in all four reservoirs with egg collection at Priest Rapids. Pen rearing appears to be an ideal cultural technique for short-term rearing of fall chinook (Novotny et al., in press). Evaluate homing behavior of returning net pen reared adults. If homing behavior can be controlled, net pen culture may offer a way to selectively harvest hatchery fish or increase escapements to specific tributary drainages.

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.

ACTIONS: 8

8. Expand facilities at Ringold Hatchery. There are two spring water sources (55 cfs) for which the Washington departments of Fisheries and Wildlife hold applications but have not been developed for fish rearing purposes. Development and delivery of this water into the hatchery and existing ponds is needed along with expansion of raceways and incubation facilities:

   A) Placement of an intake, pump and appropriate plumbing to hatchery.

   B) Construction of an additional 55 rearing raceways.

   C) Modification of an existing 9-acre pond to handle the additional flows.

D) Construction of 11 starting raceways and incubation facilities (this would occur at another site, such as Klickitat Hatchery).

Implementing this action would accommodate an additional 6 million upriver brights at 50 fish per pound. Planners estimate the cost of this expansion to be approximately $2.7 million.

Recommended Strategy

Planners recommend Strategy 1 for upriver bright fall chinook. Existing harvest constraints imposed by winter steelhead stocks and continued good production of this stock from the present natural and hatchery mix indicate that maintaining current production plans is the best choice at this time. This strategy addresses mortality factors and management questions that should lead to sustainable and measurable improvement in stock performance. Changing patterns of ocean survival may make it difficult to evaluate specific freshwater production improvements unless care is taken to coded-wire tag appropriate production units.

COHO SALMON

Fisheries Resource

Natural Production

Based on information from 1973 to 1984, at least 75 percent of the coho migrating past Bonneville Dam can be accounted for in Zone 6 (Bonneville Dam to McNary Dam) catches and at hatchery facilities. The remaining escapement of approximately 11,000 adults may be assumed to distribute into tributaries to this subbasin with a minor number migrating past Ice Harbor Dam on the Snake River and past Priest Rapids on the Columbia River. On the Washington side, these tributaries include the Wind, Little White Salmon, White Salmon, Klickitat, and Yakima rivers. On the Oregon side, they include the Hood and Deschutes rivers.

The precise amount of natural coho production originating in this subbasin, or tributaries to this subbasin that are not covered by other subbasin plans, is unknown. The escapement, however, may be in the range of 1,000 fish. This figure is an approximation based on intermittent field observations in the following streams. It is clear that current natural production is relatively minor and in some cases may be supported primarily by hatchery strays.

Oregon
- Eagle Creek (RM 146.3)
- Herman Creek (RM 150.7)
- Lindsey Creek (RM 158.8)
- Viento Creek (RM 161.0)
- Mosier Creek (RM 174.9
- Chenoweth Creek (RM 187.3)
- Mill Creek (RM 189.2)
- Threemile Creek (RM 190.8)

Washington
- Rock Creek (RM 150.0)
- Collins Creek (RM 157.9)
- Dog Creek (RM 160.8)
- Jewett Creek (RM 170.6)
- Catherine Creek (RM 177.4)
- Major Creek (RM 177.7)

The coho run passing Bonneville Dam is composed of early-returning and late-returning stocks. The early-run fish, sometimes referred to as the south turning or S-type fish because they contribute well to the more southern ocean fisheries, are generally recognized as Toutle River origin hatchery fish. The late-run fish, sometimes referred to as north turning or N-type because they contribute more heavily to the northerly ocean fisheries, are generally recognized as Cowlitz origin hatchery fish. Coho migrate past Bonneville Dam between July and November with a peak in September (Table 15). The early and late run segments are arbitrarily separated on September 30 in the count at Bonneville Dam, although substantial overlap occurs.

Biological data for subbasin natural coho is assumed to be similar to data for coho returning to the Little White Salmon National Fish Hatchery (Table 16). They return from the ocean after one to two years, usually at an age of 3 years. Average size is 62 cm for males and 64 cm for females. Fecundity is about 2,500 eggs per female.

Hatchery Production

None of the hatcheries in this subbasin (Priest Rapids Salmon Hatchery, Ringold Rearing Ponds and Spring Creek National Fish Hatchery) are currently raising coho.

Harvest

The 10-year average count of coho at Bonneville Dam from 1978 through 1987 is 48,432 fish. Eighty-six percent of these coho are bound for Bonneville Pool destinations. Most of the remaining fish are destined for tributaries or hatchery facilities in this subbasin. Coho timing and distribution make them vulnerable only to the lowermost portion of Zone 6 treaty fisheries, which are further constrained by regulations designed to protect summer steelhead. The 10-year average (1977-1986) subbasin catch (Zone 6) is 3,880 fish.

Agency management policy for Columbia River coho in the past dictated that production be confined primarily to areas below Bonneville Dam. Allocation guidelines have been addressed in the United States vs. Oregon case. This agreement specifically excludes Columbia River coho from allocation requirements while seeking to provide treaty coho fisheries by creating adult returns to Zone 6. It does so through smolt releases into the Yakima and Umatilla rivers and expansion of late coho production at the Klickitat Salmon Hatchery by transferring production from the Washougal Salmon Hatchery.

Even though United States vs. Oregon may have eliminated allocation concerns about increased coho production from this subbasin, conservation needs of B-run wild summer steelhead constrain additional harvest opportunity in Zone 6. Harvest agreements allow only limited numbers of summer steelhead to be harvested,

Table 15. Freshwater life history of Columbia River coho.

	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY
ADULT MIGRATION	----	----	----									
ADULT HOLDING		----	----									
SPAWNING			----	----	----							
EGG/ALEVIN INCUBATION			----	----	----	----	----	----				
EMERGENCE								----	----			
REARING								----	----	----	----	----
	----	----	----	----	----	----	----	----	----	----	----	
JUVENILE EMIGRATION									----	----		

Table 16. Age structure, sex ratios and fecundity of Little White Salmon National Fish Hatchery coho.

TOTAL AGE	PERCENT OF RUN	SEX RAT M:F	FECUNDITY 1/
2	11.0	1:0	
3	89.0	0.95:1	2514

1/ Average value

Data sources:
Age and fork length: USFWS, unpub. 1988.
sex ratio and fecundity: Howell et al 1985.

and since fall chinook provide a more lucrative fall fishery, treaty fishermen have targeted fall chinook rather than late coho, opting to harvest their share of summer steelhead in pursuit of fall chinook. Until the summer steelhead conservation issue is resolved, there seems little point in augmenting coho production in this subbasin beyond stipulations contained in the United States vs. Oregon agreement. However, coho production within this subbasin would contribute to ocean and lower Columbia River fisheries.

Specific Considerations

- Treaty fishermen are not inclined to harvest surplus in the mainstem because of conflicts with summer steelhead. The fishermen prefer to reach summer steelhead catch limits in the pursuit of fall chinook.
- Most of the minor tributaries in the subbasin have relatively limited reaches of good coho habitat.
- The United States vs. Oregon agreement seeks to provide treaty fishing opportunity for coho by shifting lower river (below Bonneville Dam) coho hatchery production into some of the larger subbasin tributaries.
- It may not be possible to maintain self sustaining natural stocks of late coho due to lower river harvest management that is geared to hatchery stock productivity.
- Utilization of coho production from this subbasin would occur mostly in lower Columbia River fisheries or ocean areas.

Objectives

Biological Objective

Use existing natural habitat for coho production.

Utilization Objective

Produce adult coho for the ocean and lower Columbia River fisheries and as incidental harvest opportunity during fall chinook management.

Management for large aggregate hatchery coho stocks in the ocean and lower Columbia River fisheries preclude establishment of naturally sustaining runs to the minor tributaries of this subbasin. However, fry supplementation of these streams could produce high quality natural smolts at little expense. Adults resulting from such a program would be a bonus to the fisheries.

Alternative Strategies

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

Planners have not identified specific mortality causes, but are proposing an inventory to identify them and answer management questions. No genetic risks are expected because past and existing coho management in the Columbia River has eliminated much of the historical genetic diversity in coho stocks.

ACTIONS: 1, 2

1. Inventory minor tributaries for habitat problems that reduce coho production of either natural or supplemented stocks. Also, inventory for production potential to determine necessary supplementation levels.

2. Correct deficiencies as noted through Action 1.

STRATEGY 2. Natural Production, Level 2. This strategy seeks to achieve the objectives by the same means as Strategy 1, but goes an additional step by enhancing habitat.

NO ADDITIONAL ACTIONS IDENTIFIED

STRATEGY 3. 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 Strategies 1 and 2 necessary for the success of the supplementation program are also included.

ACTIONS: 1-4

1. -
2. -

3. Supplement production with release of appropriate numbers of coho fry.

4. Evaluate the success of the supplementation program with coded-wire tagged fry.

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.

NO ACTIONS IDENTIFIED

Recommended Strategy

Planners recommend Strategy 3, supplementation. This strategy can be implemented in a phased approach. Its potential to contribute to increased fish production should be evaluated at each step. The strategy can be aborted at any phase based on the evaluation.

WINTER STEELHEAD

Fisheries Resource

Natural Production

Winter steelhead enter the Columbia River from November through April. Most are destined for tributaries downstream of Bonneville Dam. No counts are made at Bonneville Dam from December 1 through February 28, although local fishery managers feel they would be helpful in defining the magnitude of the winter run above Bonneville. The 10-year average of steelhead migrating past Bonneville Dam in March and April from 1978 through 1987 is 4,112 fish. A large proportion of these fish may be winter steelhead. Some Bonneville Pool tributaries, such as the Wind, White Salmon and Hood rivers, support small runs of winter steelhead and are described in individual subbasin plans. Other minor tributaries to this subbasin that support winter steelhead and are not covered by other subbasin plans include:

Washington
- Rock Creek (RM 150)
- Collins Creek (RM 157.9)
- Catherine Creek (RM 177.4)
- Major Creek (RM 177.7)

Oregon
- Eagle Creek (RM 146.3)
- Herman Creek (RM 150.7)
- Rock Creek (RM 174.7)
- Mosier Creek (RM 174.9)
- Chenoweth Creek (RM 187.3)
- Mill Creek (RM 189.2)
- Three Mile Creek (RM 190.8)

Managers consider Fifteenmile Creek, at RM 191, to be the upstream limit of distribution of winter steelhead in the Columbia River Basin. Conservative estimates of subbasin run size for winter steelhead are listed in Table 17.

Winter steelhead ascend tributary streams from late fall through spring as mature fish. Spawning extends through spring and is usually complete by mid-June. Emergence from the gravel is complete by midsummer and most juveniles begin their seaward migration in the spring of their second year (Table 18). Run size, age structure of the run, and other biological parameters for wild winter steelhead in this subbasin are lacking, but may be similar to the Kalama River stock.

Table 17. Run size, harvest, and escapement of subbasin winter steelhead stocks.

ADULT HARVEST AND SPAWNING ESCAPEMENT										
SPAWNING ESCAPEMENT	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
HATCHERY	0	0	0	0	0	0	0	0	0	0
SUBTOTAL	0	0	0	0	0	0	0	0	0	0
WILD										
ROCK CK	4	3	20	3	0	9	3	17	2	11
COLL,CATH,MAJ CKS	25	25	25	25	25	25	25	25	25	25
OR TRIBS BONN POOL	170	170	170	170	170	170	170	170	170	170
SUBTOTAL	199	198	215	198	195	204	198	212	197	206
TOTAL SPAWNING ESCAPEMENT	199	198	215	198	195	204	198	212	197	206
ADULT HARVEST										
RECREATIONAL HARVEST										
ROCK CK	4	3	20	3	0	9	3	17	2	11
COLL,CATH,MAJ CKS	25	25	25	25	25	25	25	25	25	25
MOSIER	23	3	33	19	0	0	0	0	0	0
HERMAN CREEK	14	0	6	41	18	10	3	3	NA	NA
EAGLE CREEK	52	105	134	137	88	122	44	17	NA	NA
SUBTOTAL	118	136	218	225	131	166	75	62	27	36
TRIBAL HARVEST ZONE 6										
SUBTOTAL	0	0	0	0	0	0	0	0	0	0
COMMERCIAL										
SUBTOTAL	0	0	0	0	0	0	0	0	0	0
TOTAL SUBBASIN HARVEST	118	136	218	225	131	166	75	62	27	36
TOTAL RUNSIZE	317	334	433	423	326	370	273	274	224	242