Columbia Basin System Planning

SALMON and STEELHEAD PRODUCTION PLAN

WIND RIVER SUBBASIN

September 1, 1990

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INTRODUCTION

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

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

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

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

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

PART I. DESCRIPTION OF SUBBASIN

Location and General Environment

The Wind River is located in southwestern Washington and enters the Columbia River above Bonneville Dam at River Mile (RM) 154.5. The Wind is about 30.5 miles long, drains about 225 square miles and lies within Skamania County. Much of the subbasin is within the Gifford Pinchot National Forest.

The subbasin is within the Cascade Mountains uplift and is characterized by deeply dissected mountains typical of recent vulcanism. Elevation changes from 3,200 feet at the river's source to 72 feet at the mouth. The river's headwaters are in a steep, narrow canyon with high gradient. At Paradise Creek (RM 25.1), the gradient decreases and a wider floodplain develops until Stabler (RM 11.5), where the river plunges into a steep canyon chute. The lower 10 miles rapidly descend through a steep basalt gorge with difficult access. Because of steep terrain, urban development in Skamania County is limited to about 1 percent of the available land.

Annual rainfall is about 70 inches and coastal mountains shield the subbasin from severe westerly winter storms. The Cascade Mountains also protect the area from the high summer and low winter temperatures of eastern Washington. Average ambient temperature is 66 degrees Fahrenheit in summer and 40 F in winter.

Most subbasin soils originated from weathered bedrock. Alluvial soil is found along the river and some soils north of Paradise Creek were buried under a thin layer of ash and pumice from Mount St. Helens. Major woodland soils are deep and well drained, but become shallow as elevation increases. Soils above 4,000 feet elevation are subject to cold temperatures, while soils along the Columbia River are subject to strong winds. Landslide topography exists and potential for soil erosion is high. Logging operations and road construction can result in erosion and sedimentation problems.

Subbasin vegetation is mostly conifer trees -- Douglas fir, western hemlock, and grand fir. Understory vegetation includes Oregon grape, salal, huckleberries, and bear grass. Riparian vegetation is a mixture of conifers and hardwoods including Douglas fir, western hemlock, western red cedar, bigleaf maple, vine maple, Oregon ash, black cottonwood, red alder, willow, and devil's club. Clearcuts have removed riparian vegetation along many tributaries and may affect fish production. Insufficient streamside vegetation can increase water temperatures, decrease input of large woody debris, and lead to bank instability.

Fisheries Resources

The Wind River is renowned for summer steelhead, but also has spring chinook and lesser numbers of winter steelhead, fall chinook, sea-run cutthroat, and coho salmon. In addition, a resident trout fishery exists and resident trout populations may expand when anadromous stocks are depressed. Crawford (1985) felt the Wind River was fully seeded, as measured by densities of steelhead and rainbow juveniles.

Carson National Fish Hatchery, constructed in 1938, is the only rearing facility within the subbasin and is located at Tyee Springs (RM 18). The hatchery is located on about 10 acres and facilities consist of two earthen ponds, two concrete adult holding ponds, 46 raceways, 24 starting tanks, and 21 trough-type incubators. Current production is about 1.8 million spring chinook smolts.

The Washington Department of Fisheries (WDF), Washington Department of Wildlife (WDW), and the Yakima Indian Nation co-manage the subbasin salmon and steelhead. An Indian "in-lieu" fishing site has been set aside at the Wind River mouth in compensation for tribal fishing grounds inundated by Bonneville Dam. Responsibility for salmon is handled by the Washington Department of Fisheries and Yakima Indian Nation; management of resident and anadromous trout is handled by the Wildlife Department and Yakima Indian Nation. Each management entity is responsible for its own fishery regulations, enhancement activities, and licensing. However, the entities generally plan these activities in a cooperative manner.

Water Resources

Monthly flows range from 235 cubic feet per second (cfs) in September to 2,138 cfs in January -- a high flow-low flow ratio of 9-to-1, reflecting mediocre summer water yield. Snowmelt fuels the river from February to June; flow drops during summer. In October, rains recharge the river and peak flows occur in December and January (Table 1).

Water quality is considered good although winter flows are turbid due to erosion and logging activities (Table 2). Some small tributaries are intermittent and others have high water temperatures during summer, but most habitat is good for anadromous fish. The Gifford Pinchot National Forest has surveyed most streams, but data has not been summarized.

Table 1. Mean monthly discharge (cfs) of the Wind River for years 1935-1977, USGS No. 14128500 (USGS).

Month	Discharge	Month	Discharge
Jan	2,138	Jul	372
Feb	1,969	Aug	242
Mar	1,751	Sep	235
Apr	1,702	Oct	475
May	1,299	Nov	1,388
Jun	741	Dec	2,118

Table 2. Physical characteristics of the Wind River at Carson gauging station, USGS No. 14128500, for years 1975-1980. All quantities are median values (USGS).

	Fall	Winter	Spring	Summer
pH	7.5	7.4	7.3	7.6
Temperature (F)	50.3	40.3	46.3	58.7
Dissolved Oxygen (mg/l)	11.7	13.4	12.3	10.7
Conductivity (micromho)	57.4	49.5	43.5	56.9
Turbidity (JTU)	3.8	10.7	4.8	2.3

Major subbasin tributaries include the Little Wind River (RM 1.1), Panther Creek (RM 4.3), Bear Creek (RM 4.3), Trout Creek (RM 10.8), Trapper Creek (RM 18.9), Dry Creek (RM 19.1), and Paradise Creek (RM 25.1). Waterfalls are common in the drainage, occurring in the mainstem Wind, the Little Wind, Bear Creek, Panther Creek, and Fall Creek. Some falls have been modified to permit passage while others remain impassable or present difficulty. Historically, Shipherd Falls on the mainstem permitted passage only to steelhead.

In 1935 the Civilian Conservation Corps completed Trout Creek Dam, located on Trout Creek, to provide electricity for the camp, Wind River Nursery, and the Wind River Ranger Station. The concrete arch dam is 26 feet high and 183 feet wide and has wooden flash boards to adjust water levels (Seeholtz 1986). There is a clean-out opening at the base of the dam used to expel sediment, but has not been used since 1977 because of concern for downstream fisheries. Although the dam was laddered, there are problems with the size of pools between ladder steps, attraction water, entrance location and amount of flow.

Hemlock Lake is a 16-acre impoundment formed by Trout Creek Dam and has a storage capacity of 120 acre-feet. The Wind River Nursery draws irrigation water from the lake to irrigate approximately 125 acres for frost protection, germination, heat control, maintenance, and ground moisture. The nursery has water rights for 10.3 cfs and has applied for an additional 4.5 cfs.

Runoff from the Wind River Nursery may be a chemical barrier to fish migration in Martha Creek, a small tributary to Trout Creek with intermittent summer flows. However, spawning and successful incubation of steelhead eggs occurs.

Shipherd Falls, a series of falls approximately 40 feet high, is located at RM 2.1. Summer steelhead were able to negotiate this stair-step barrier under favorable conditions. In 1956, the falls were laddered permitting salmon access to the upper basin.

Land Use

Most land in Skamania County is used for timber production and harvest. Steep terrain has limited agriculture while urban development is restricted to floodplains. The upper 19 miles of the river runs through the Gifford Pinchot National Forest, which includes six miles of private land within the national forest boundary. The Wind River Experimental Forest is located in the subbasin and consists of the 6,500-acre Trout Creek Division on the west side of the Wind River, and the 3,500-acre Panther Creek Division on the east side. The U.S. Forest Service manages both the Gifford Pinchot National Forest and the Wind River Experimental Forest.

The Wind River Highway parallels the river for most of its length. There are several county bridges and national forest roads in the basin. The Forest Service maintains several campgrounds along the river. Private residences are scattered along the river with concentrations in Stabler and Carson.

The Wind Subbasin is part of the Yakima Indian Nation lands ceded to the United States in the Treaty of June 9, 1855. Within this area, the tribe reserved the right to hunt and fish at all usual and accustomed places in common with citizens of the territory. Legal challenges to the treaty have affirmed the tribe's right to take no more than 50 percent of the harvestable fish resources and the right to participate in resource management decisions.

PART II. HABITAT PROTECTION NEEDS

History and Status of Habitat

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

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

Federal

1. Clean Water Act, Section 404 and 10, U.S. Army Corps of Engineers, with State of Washington, Department of Ecology certification.
2. National Environmental Policy Act (NEPA), Federal Agency taking action.

State (Washington)

1. State Water Quality Laws RCW 90.48, Department of Ecology.
2. State Surface Water Codes RCW 90.03, Department of Ecology.
3. State Groundwater Codes RCW 90.44, Department of Ecology.
4. Shoreline Management Act, local government with state oversight by Department of Ecology.
5. Hydraulics Code RCW 75.20.100 and 103, Washington Department of Fisheries or Wildlife.
6. Minimum Flow Program, Department of Ecology.

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

8. Flood Control Statutes, local government.

9. Forest Practices Act, Department of Natural Resources.

In response to needs and corrections of degraded areas, the U.S. Forest Service has implemented various habitat improvement activities throughout the Wind River Subbasin.

Constraints and Opportunities for Protection

Fish production in the Wind River Subbasin competes primarily with timber interests. Fishery agencies work with other agencies and landowners through various federal, state, and local laws and agreements to identify and reduce practices impacting fish habitat. Although fishery habitat laws and agreements are well intentioned, the inherent topography, geology, soils, and climate would preclude most subbasin resource use without some habitat degradation.

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

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

The Gifford Pinchot National Forest is charged with managing fish habitat in the Wind River Subbasin while the state agencies act in an advisory role. The Gifford Pinchot National Forest, Washington Department of Wildlife, and Washington Department of Fisheries have signed a memorandum of understanding to work cooperatively to promote successful management of fish and wildlife resources and habitat on national forest lands. Opportunities exist for these agencies to work together to potentially increase the fishery resource by 1) minimizing proposed activities impacting fish habitat, and 2) implementing habitat rehabilitation and enhancement projects.

The Gifford Pinchot National Forest surveyed the Wind River in 1980 to evaluate spawning areas for adults and juvenile rearing habitat for anadromous fish. In 1981, the national forest, Washington departments of Wildlife and Fisheries, and the U.S. Fish and Wildlife Service developed a salmon and steelhead habitat improvement plan for the subbasin with the objective to improve fish habitat and apply fisheries management techniques to increase native runs of anadromous fish. The Gifford Pinchot National Forest is currently nearing completion of a new land and resource management plan that will guide the management of the national forest lands for the next 10 years.

The following agencies have statutory or proprietary interests to salmon and steelhead production within the subbasin.

Federal
- U.S. Forest Service (USFS)
- U.S. Geological Survey (USGS)
- U.S. Soil Conservation Service (USSCS)
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Army Corps of Engineers (COE)
- National Marine Fisheries Service (NMFS)

State
- Washington Department of Ecology (DOE)
- Washington Department of Fisheries (WDF)
- Washington Department of Wildlife (WDW)
- Washington Department of Natural Resources (DNR)
- Washington Department of Agriculture

Tribes
- Yakima Indian Nation (YIN)

Local
- Skamania PUD
- Skamania County

Habitat Protection Objectives and Strategies

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

Guidelines for habitat protection include:

1) No net loss of existing habitat.

2) No degradation of water quality.

3) No decrease of surface water quantity.

4) Increased security for existing habitat.

5) Increased salmonid use of underutilized habitat.

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

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

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

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

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

2) Purchasing riparian property adjacent to critical habitat.

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

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

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

PART III. CONSTRAINTS AND OPPORTUNITIES FOR ESTABLISHING PRODUCTION OBJECTIVES

Systemwide Considerations

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

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

As an extension of these objectives, subbasin plans should:

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

2) Work toward harvest stability within subbasins.

3) Provide equitable opportunity to each user group.

4) Maintain habitat and improve where possible.

5) Manage for the consistent escapement of escapement allowances.

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

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

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

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

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

3) Annual variation in abundance of the stocks.

Local Considerations

A major problem for subbasin fish is the difficulty associated with juvenile and adult passage around Bonneville Dam. Losses accrue from bypass, turbines, reservoir mortality, and predator accumulations, which did not occur historically.

Also, a considerable amount of logging has taken place in the watershed. Past logging operations devastated fish populations by scouring the stream and by eliminating access to portions of the drainage. Logging activity has contributed to excessive debris and log jams in some areas, streambank instability and sedimentation, reduced riparian vegetation, and increased road surfaces (sedimentation source and culverts) throughout the basin. Current forest practices are seeking to minimize these impacts and rectify problems created during operations. A 1980 habitat assessment suggested that 94 percent of needed improvements were the result of logging activity.

Trout Creek Dam impedes or prevents passage of adult fish. Major problems with the ladder include insufficient size of jumping pools, poor flow, and poor attraction, differential passage structures, debris accumulation, and flashboard management practices (Orsborn et al. 1987). Smolt mortality through the existing Trout Creek facility is probably greater than 15 percent; adult mortality is probably greater than 5 percent.

The Wind River Nursery may present problems due to chemical runoff into Martha Creek, which provides habitat only for spawning and incubation during normal water years.

PART IV. ANADROMOUS FISH PRODUCTION PLANS

SUMMER STEELHEAD

Fisheries Resource

Natural Production

History and Status

Before Shipherd Falls was laddered in 1956, Wind River summer and winter steelhead were the only anadromous fish to pass the falls. Wind River summer steelhead were known for their large size and great leaping ability. However, the present population is about 370 fish, well below historic levels of 2,500 fish (Howell et al. 1984). In the early 1900s, the Carson Lumber Company operated a mill dam at about RM 14 that effectively blocked steelhead migration until 1947 when the dam was removed (Bryant 1949). Splash dams impeded passage, while flushing and scouring from log drives had disastrous effects on spawning and rearing habitat. After construction of Bonneville Dam in the 1930s, about one mile of spawning habitat was inundated and the dam delayed adult upstream migration and destroyed migrant smolts.

Subbasin steelhead smolt capacity was estimated to be 66,037 fish using the Northwest Power Planning Council's model for winter and summer steelhead combined. Summer steelhead smolt capacity was estimated to be 62,273 fish based on 94.3 percent of habitat being used by summer steelhead. The Washington Department of Wildlife developed a methodology for estimating steelhead potential parr production based on stream gradient and known densities of parr in Washington streams. Lucas and Nawa (1986) calculated that 58,744 parr could be produced, which at 40 percent parr-to-smolt survival would be 23,498 smolts, equal to 1,557 adults at 6.6 percent survival.

Life History and Population Characteristics

Adult steelhead enter the river from March through December with a peak between July and October. Historically, entry peaked in spring. Spawning usually occurs from February to May with peaks in March and April. Emergence occurs from May through June. Because life history information on this stock is limited to 19 adult fish and Wind River fish are thought to be similar to Kalama River summer steelhead, the extensive Kalama data base was used. Juvenile rearing is thought to last for two years prior to spring ocean migration, although some juveniles probably emigrate after one or three years (Loch et al. 1985).

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

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

Table 3. Ocean age structure, length and sex of Kalama Subbasin natural summer steelhead (Leider et al. 1986).

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

No fecundity information was found for natural summer steelhead in the subbasin. Fecundity of Skamania stock steelhead, after several generations of adaptation to the Cowlitz Hatchery, was 4,617 eggs per female (n=698) with a mean length of 72.2 cm. Randolph (1986) determined that fecundity of Skamania Hatchery summer steelhead was 4,170 eggs per female. For the Wind River, fecundity is assumed to be 4,500 eggs per female for 2-year and 3-year ocean fish and 2,000 eggs for 1-year ocean fish.

Subbasin spawning surveys for 1985 through 1988 estimated that an average of 564 fish escaped to spawn (Table 4). However, some were hatchery fish and others were winter steelhead. Lucas and Nawa (1986) felt the upper basin was underescaped.

Table 4. Subbasin steelhead spawning escapement, 1985-1988.

Section	1985[1]	1986[2]	1987[3]	1988[4]	1989[4]
Wind River					
Mainstem	208	190	206	376	
Tribs.	30	26	44	88	
Trout Cr.					
Mainstem	48	88	96	92	
Tribs.	114	98	234	156	
Panther Cr.					
Mainstem	18	22	6	68	
Tribs.	16	4	22	46	
Totals	434	428	608	826	525

1/ Lucas and Nawa 1986.
2/ Unpublished WDW report written by Mark Chilcote and Tim Willson.
3/ Lucas and Pointer 1987.
4/ Unpublished WDW data provided by John Weinheimer.

On August 27, 1988, the Washington Department of Wildlife and volunteers conducted a snorkel survey from Carson National Fish Hatchery to Shipherd Falls (about 20.5 miles). Snorklers recorded 209 natural, 194 hatchery (adipose-fin clipped) and 122 "unclassified" steelhead (WDW, unpubl. data).

Hatchery fish spawn in the river, but their contribution to natural production is unknown. Chilcote et al. (1986), through electrophoretic examination of juveniles for a specific genetic marker, found the success of hatchery fish in producing smolt offspring was 28 percent of wild fish on the Kalama River. Milner et al. (1980) did an electrophoretic profile of Wind summer steelhead along with other Columbia River stocks to examine the feasibility of using biochemical genetic variation for estimating composition of mixed-stock fisheries. They concluded sufficient genetic differentiation existed to do so. Shreck et al. (1986) looked at stock identification of various Columbia River steelhead, including Wind River, using cluster analysis of meristic and electrophoretic features and concluded geographical proximal stocks tend to be like each other.

Supplementation History

In 1957, the Washington Department of Wildlife introduced Skamania Hatchery steelhead to supplement harvest of natural fish. In 1980 the Wind River was designated a "wild steelhead" river and hatchery plants were stopped. Hatchery supplementation was reinstated in 1984 due to inadequate harvest opportunity. For 1984 through 1989, plants averaged 29,829 smolts (Table 5). Eyed eggs, fry and fingerlings were planted around the time of the "wild steelhead" program, but have been subsequently discontinued. Smolt-to-adult returns to the subbasin for the 1984 through 1986 releases averaged 3 percent.

Hatchery production of steelhead does not occur within the subbasin and none is anticipated. Hatchery fish for the Wind River are Skamania stock fish transferred as smolts from Skamania or Vancouver hatcheries.

Table 5. Summer steelhead plants in the Wind River 1977-1989.

Year	Smolts	Fry of fingerlings	Eyed eggs
1977	76,833		
1978	82,947		
1979	98,706		
1980	75,103		48,574
1981	63,583		261,812
1982	0	119,000 fry	
1983	0	6,000 fry	4,988
1984	40,141		
1985	30,195		
1986	27,950	16,008 fingerlings	
1987	20,000		
1988	20,276		
1989	40,412		

Fish Production Constraints

Fish production constraints within the subbasin are primarily associated with logging practices, which have decreased habitat diversity and riparian vegetation. As a result, increased sediment load, water temperature, and seasonal high and low flows have deteriorated fish habitat. Most constraints, however, are thought to occur out of the basin. Smolts and adults must survive Bonneville Dam. Adults must also survive a mainstem Columbia River sport fishery plus a treaty commercial and subsistence fishery before entering the Wind River.

Hatchery Production

Life history profiles for Wind River hatchery steelhead are generally lacking. Cho (1982) sampled 170 fish, which had a mean length of 76.3 cm and weight of 3.7 kilograms. Skamania stock fish returning to the Kalama River are assumed similar to Wind hatchery fish and are profiled herein.

Although beginning and ending times are similar, time of spawning and incubation is about one month sooner for Kalama hatchery fish than Kalama natural steelhead. Hatchery smolts emigrate after about 14 months, about one year sooner than natural fish. Saltwater age composition of initial migrant adults was 4.5 percent, 85.7 percent, 9.8 percent for age I, II, III, respectively (Table 6) (Leider et al. 1986). Females comprised 17.5 percent, 54 percent, and 32.9 percent of each age class, respectively, and 50.3 percent of the total. Repeat spawners comprised 2.8 percent of hatchery adult runs, had a mean length of 78.2 cm, and were comprised of 50.7 percent females. Mean length of all hatchery adults combined was 72.7 cm. Fecundity of Skamania Hatchery fish was 4,170 eggs per female for 2-ocean and 3-ocean fish (Randolph 1987) while 1-salt are assumed to have fecundity of 2,000 eggs. Run size of hatchery fish averaged 978 steelhead for 1986 through 1988.

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

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

Harvest

In recent years, the Wind River had "wild" fish release regulations between June 1 and November 30 whereby all natural fish (no clipped fins) had to be released. For 1990, the Wind River has "wild" fish release regulations year-round. Catch limit is two fish. To protect juveniles, a 12-inch minimum size and two-fish bag limit for trout is also imposed. No fishing is allowed 400 feet below to 100 feet above Shipherd Falls fish ladder; Tyee Springs is closed to fishing.

Harvest of subbasin steelhead averaged 1,373 fish from 1977 to 1982, but declined to an average of 418 fish from 1983 to 1988 after "wild" fish release regulations were imposed (Table 7). Harvest increased to an average of 696 fish after returns of 1984 hatchery plants (1986-1988). Harvest rate of hatchery and natural fish was estimated at 70 percent and 1.3 percent, respectively, for 1986 to 1988. Washington Department of Wildlife punch-card data indicated 39 percent of December to May harvest were unmarked fish in 1988, indicating natural summer or winter fish. For the December to May harvest, 75 percent were assumed to be winter steelhead.

Few steelhead are harvested in the ocean although the ocean drift net fishery may have intercepted some in recent years. Columbia River harvest of Wind subbasin summer steelhead above and below Bonneville dam was estimated by the System Planning Model to be 7.7 percent and 2.4 percent, respectively.

Table 7. Subbasin sport catch, 1977-1988.

Year	Sport Catch June-Nov	Sport Catch Dec-May	Sport Catch Total
1977	1,728	196	1,924
1978	1,300	171	1,471
1979	959	95	1,054
1980	974	64	1,038
1981	1,315	156	1,471
1982	1,217	60	1,277
1983	177	36	213
1984	77	17	94
1985	95	9	104
1986	678	36	714
1987	539	131	670
1988	672	41	713

Subbasin returns for 1986 through 1988 were estimated to average 960 hatchery and 332 natural fish prior to adding in a 10 percent pre-spawning mortality, which increases subbasin returns to 1,067 hatchery and 369 natural fish (Table 8). Spawning escapement was estimated to be 325 natural and 288 hatchery fish.

Table 8. Estimated run size of Wind Subbasin steelhead, 1986-1988.

	Brood Year		
	1987	1988	1989
Sport harvest			
Hatchery	700	619	697
Natural	4	13	4
Winter SH	10	38	12
Subtotal	714	670	713
Escapement			
Hatchery	300	265	299
Natural	288	485	202
Winter SH	20	76	24
Subtotal	608	826	525
Total run size			
Hatchery SSH	1,000	884	996
Natural SSH	292	498	206
Winter SH	30	114	36
TOTAL	1,322	1,496	1,238

Specific Considerations

The goal of steelhead management in the subbasin is to rebuild the natural run to meet spawning escapement goals. To protect the genetic integrity of natural fish, harvest is targeted on hatchery fish. Natural steelhead are managed for a maximum sustained population; escapement at that level is the minimum acceptable escapement. Minimum spawning escapement requirements have been set with the best available information and is presently 1,557 adults.

The largest natural fish production limitation has been inadequate escapement reaching the subbasin as a result of smolt and adult mortalities at Bonneville Dam and adult overharvest downstream of the subbasin. Natural fish destined for the Wind River are subjected to non-selective mixed-stock fisheries in the Columbia River. Because large hatchery programs are present, which need relatively little escapement, non-selective harvest can overharvest smaller natural populations that need a relatively large amount of escapement. As hatchery programs in other basins expand, the jeopardy of overharvest by non-selective fisheries in the Columbia increases. Returns of natural fish are estimated to be about 370 fish; unless out-of-basin harvest rates or techniques are altered, this run will be terminated. Selective harvest of hatchery fish at Bonneville Dam would allow natural fish to escape.

Within the basin, habitat has been impacted by logging and construction of a dam. Harvest rates within the basin appear to be high (70 percent) on the hatchery stock and only about 1.3 percent on the natural stock. Recently, returns of natural fish have averaged only about 370 fish compared to over 2,500 fish historically, while total returns are about 1,400 fish. Opportunities exist to correct some habitat degradation and improve survival such as at the Trout Creek Dam. In addition, natural fish have been protected through "wild" fish release regulations until the population grows large enough to support a consumptive fishery.

Critical Data Gaps

Origin of naturally spawning fish is needed to better determine run sizes of hatchery and wild fish. Life history characteristics such as age, lengths, sex ratios and fecundities are needed.

Objectives

Stock: Wind River Hatchery Summer Steelhead

Utilization Objective: 1,000 fish for insubbasin sport harvest and 1,000 fish for tribal harvest out-of-basin. The utilization objective has priority within the subbasin for this stock.

Biological Objective: Maintain the biological characteristics of the hatchery stock or natural fish.

Stock: Wind River Natural Summer Steelhead

Utilization Objective: Zero; catch and release only. The utilization component is secondary to the biological objective.

Biological Objective: Maintain the biological characteristics of the natural fish. The biological objective has priority within the subbasin for this stock and requires a minimum of 1,557 adult spawning escapement.

Alternative Strategies

Strategies for summer steelhead in this report have specific themes. Means to obtain the objectives are first attempted using natural methods followed by less natural techniques and finally, hatchery production. Actions identified under each strategy are closely related to the theme. Strategies 1 and 2 have natural production themes seeking to improve the productivity of the existing natural stock. Strategy 3 is a "benign" supplementation strategy, emphasizing actions to develop a single supplemented run with yet higher productivity. Strategy 4 relies on a traditional hatchery program to meet objectives. Only those actions necessary for the success of a hatchery program would be included in Strategy 4. Strategy 5 is a combination of actions.

Modeling results for each strategy are presented in Table 9 as fish produced at "maximum sustainable yield" (MSY). The sustainable yield of a fish population refers to that portion of the population that exceeds the number of fish required to spawn and maintain the population over time. Sustainable yield can be "maximized," termed MSY, for each stock at a specific harvest level. The MSY is estimated using a formula (Beverton-Holt function) that analyzes a broad range of harvest rates. Subbasin planners have used MSY as a tool to standardize results so that decision makers can compare stocks and strategies.

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

The amount of buffer appropriate for each stock is a management question not addressed in the subbasin plans. For this reason, the utilization objective, which usually refers to harvest, may not be directly comparable to the MSY shown in Table 9. At a minimum, a strategy should produce an estimated MSY equal to or greater than the utilization objective. A MSY substantially larger than the subbasin utilization objective may be needed to meet subbasin biological objectives.

Estimated costs of the alternative strategies below are summarized in Table 10.

STRATEGY 1: Natural Production, Level 1. This strategy seeks to achieve the objectives by eliminating sources of direct mortality to natural fish, answering management questions, and reducing risks of genetic modification of natural stocks. However, this strategy is inadequate for steelhead management in the subbasin because of increased need for hatchery fish.

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

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

Assumptions: Action 1 assumes egg-to-smolt survival will be increased by a relative 10 percent. Action 2 assumes smolt-to-smolt survival will be increased by 15 percent while pre-spawning mortality of adults will be reduced 5 percent above the Trout Creek Dam.

Numeric Fish Increases: The System Planning Model indicated an additional 25 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 31 fish after mainstem program implementation.

ACTIONS: 1, 2

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

2. Redesign and reconstruct the fish ladder at Trout Creek Dam. This includes a slotted wasting weir with screening and auxiliary flow, a rock berm to provide a calmer entrance pool and distinctive attraction flow, and an adult trap so biological data can be obtained.

STRATEGY 2: Natural Production, Level 2. This strategy seeks to achieve the objectives by the same means as Strategy 1, but also includes actions to enhance productivity of habitat already available to the stock in question.

Hypothesis: Increasing streamflows will increase habitat and therefore smolt capacity.

Assumptions: Action 3 assumes smolt capacity will be increased by 10 percent on the mainstem Wind River. Action 4 assumes smolt capacity will be increased by 4 percent below Trout Creek. Action 5 assumes egg-to-smolt survival will be increased a relative 10 percent in Trout Creek.

Numeric Fish Increases: The System Planning Model indicated an additional 63 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 48 fish after mainstem program implementation.

ACTIONS: 1-5

1. -
2. -

3. Construct an upper basin augmentation facility to ease summer low flows and suppress high winter flows.

4. Construct a well to replace surface water withdrawals at the Wind River nursery.

5. Reestablish riparian corridors in degraded areas via closing roads and vegetating riparian areas. About 10 acres of woody vegetation is needed.

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 required.

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

Assumptions: Action 6 assumes relative smolt survival will increase from 0.67 to 0.71 and viability of naturally spawning hatchery-hatchery and hatchery-natural crosses will increase by a relative 10 percent. Action 7 increases hatchery releases to 40,000 fish. Action 8 assumes relative smolt survival increases from 0.71 to 0.75.

Numeric Fish Increases: The System Planning Model indicated an additional 1,841 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 1,495 fish after mainstem program implementation.

ACTIONS: 1-8

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

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

7. Increase hatchery plants to 40,000 fish using natural brood stock.

8. Construct a conditioning pond to rear 40,000 smolts using natural brood stock.

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

Hypothesis: Increasing hatchery plants will increase adult returns. Construction of a conditioning pond will provide an improved quality hatchery smolt.

Assumptions: Action 10 will increase relative smolt survival from 0.67 to 0.71.

Numeric Fish Increases: The System Planning Model indicated an additional 2,968 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 2,472 fish after mainstem program implementation.

ACTIONS: 9, 10

9. Increase Skamania stock hatchery plants to 75,000 fish.

10. Construct a conditioning pond to rear 75,000 smolts using Skamania brood stock.

STRATEGY 5: Combination of Actions. This strategy seeks to achieve the objectives using a combination of the above actions deemed to have important population benefits.

Hypothesis: Existing habitat, if managed properly, should provide near capacity numbers of natural smolts if adequately seeded. By using natural stock for hatchery releases, the relative fitness should be improved and chances of genetic degradation will be decreased. Also, the relative fitness of progeny should be increased. Increasing hatchery plants should increase adult returns. Construction of a conditioning pond will provide an improved quality hatchery smolt.

Assumptions: See assumptions in previous strategies.

Numeric Fish Increases: The System Planning Model indicated an additional 1,799 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 1,471 fish after mainstem program implementation.

ACTIONS: 1, 2, 6-8 (see above)

Recommended Strategy

The recommended strategy is Strategy 5. This strategy consists of actions having substantial benefit to adult returns. Habitat needs aggressive protection to compensate for smolts losses at Bonneville Dam while Trout Creek Dam has been identified as an important within basin source of smolt and adult losses. Use of natural brood stock for hatchery supplementation should reduce genetic impacts on natural fish while use of a rearing pond will further improve smolt quality and return rates. This strategy was also supported by the SMART analysis (Appendix B).

Table 9. System Planning Model results for summer steelhead (A's) in the Wind Subbasin. Baseline value is for pre-mainstem implementation. All other values are post-implementation.

Utilization Objective:
Zero natural and 1,000 hatchery fish for within subbasin recreation harvest and 1,000 hatchery fish tribal harvest out of subbasin.

Biological Objective:
Maintain the biological characteristics of the natural stock. Minimum spawning escapement is 1,557 natural fish.

Strategy[1]	Maximum[2] Sustainable Yield (MSY)	Total[3] Spawning Return	Total[4] Return to Subbasin	Out of[5] Subbasin Harvest	Contribution[6] To Council's Goal (Index)
Baseline	903 -N	438	1,389	148	0(1.00)
All Nat	951 -N	443	1,441	154	63(1.04)
1	934 -N	436	1,415	151	32(1.02)
2	951 -N	443	1,441	154	63(1.04)
3	2,398 -N	761	3,240	346	2,272(2.33)
4	3,375 -N	907	4,383	468	3,673(3.15)
5*	2,374 -N	753	3,209	343	2,233(2.31)

*Recommended strategy.

[1]Strategy descriptions:

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

1. Aggressive habitat protection. Post Mainstem Implementation.
2. Strategy 1 plus flow augmentation reservoir. Post Mainstem Implementation.
3. Strategy 2 plus use natural brood stock for hatchery, increase hatchery plants. Post Mainstem Implementation.
4. Baseline plus 75,000 hatchery smolts. Post Mainstem Implementation.
5. Strategy 1 plus 3 - Strategy 2. Post Mainstem Implementation.

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

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

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

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

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

Table 10. Estimated costs of alternative strategies for Wind River summer steelhead. Cost estimates represent new or additional costs to the 1987 Columbia River Basin Fish and Wildlife Program; they do not represent projects funded under other programs, such as the Lower Snake River Compensation Plan or a public utility district settlement agreement. (For itemized costs, see Appendix C.)

	Proposed Strategies				
	1	2	3	4	5*
Hatchery Costs					
Capital[1]	0	0	46,000	207,000	46,000
O&M/yr[2]	0	0	5,000	22,500	5,000
Other Costs					
Capital[3]	350,000	10,660,000	11,110,000	0	800,000
O&M/yr[4]	35,000	157,000	182,000	0	60,000
Total Costs					
Capital	350,000	10,660,000	11,156,000	207,000	846,000
O&M/yr	35,000	157,000	187,000	22,500	65,000

* Recommended strategy.

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

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

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

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

WINTER STEELHEAD

Fisheries Resource

Natural Production

History and Status

Presently, there is a small subbasin return of natural winter steelhead estimated at 60 fish. Historical run size was also thought to be small. Fish were probably distributed above Shipherd Falls; recent distribution has been documented up to Trout Creek (Howell et al. 1984).

Subbasin steelhead smolt capacity was estimated to be 66,037 fish using the Northwest Power Planning Council's model, for winter and summer steelhead combined. Winter steelhead smolt capacity was estimated to be 3,764 fish based on 5.7 percent of habitat being used by winter steelhead. The Washington Department of Wildlife developed a methodology for estimating steelhead potential parr production based on stream gradient and known densities of parr in Washington streams. Lucas and Nawa (1986) calculated potential parr production to be 58,744 fish, which at 40 percent parr-to-smolt survival would be 23,498 smolts, equal to 1,557 adults at 6.6 percent survival.

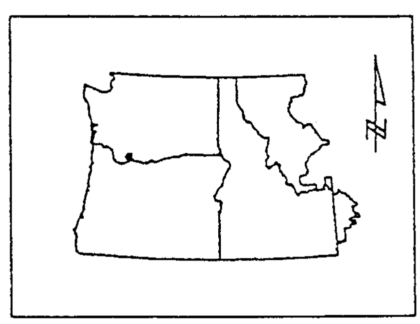
Life History and Population Characteristics

Because life history information is absent for Wind River winter steelhead, Kalama River data is presented, which is thought to be similar to Wind fish. Winter steelhead probably enter the Wind Basin in January through May with a peak in March. In the Kalama River, four-year average mean time of spawning in Gobar Creek, a Kalama River tributary, was April 14, with most spawning occurring from March through May (Leider et al. 1984). Emergence occurs from April through early July. Juvenile rearing generally lasts for two years prior to spring ocean emigration, although some juveniles emigrate after one or three years (Loch et al. 1985).

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

WIND SUBBASIN

WINTER STEELHEAD DISTRIBUTION*



———————— PRESENT/POTENTIAL

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

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

GIS GEOGRAPHIC INFORMATION SYSTEM

BONNEVILLE POWER ADMINISTRATION

For adults, excluding repeat spawners, ocean age structure was dominated by 71.1 percent 2-year ocean fish (2-salts) followed by 25.7 percent 3-year ocean fish (Table 11) (Leider et al. 1986). Females made up 51.6 percent of initial spawners. Mean length of all initial spawners combined was 72.6 cm. Repeat spawners comprised 11.3 percent of the total, were 71.4 percent females, and averaged 77.4 cm (n=298). Mean length of all fish combined was 73.1 cm.

Table 11. Ocean age, sex, and length of Kalama natural steelhead (Leider et al. 1986).

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

Fecundity of Wind River winter steelhead is unknown. Fecundity of Cowlitz Hatchery winter steelhead averaged 5,257 eggs per female. Beaver Creek Hatchery fish of 68.5 cm had a fecundity of 4,060 eggs per female (Randolph 1987). Based on the above, fecundity of Wind steelhead is assumed to be 4,500 eggs per female for 2-salt and 3-salt fish, and 2,000 eggs per female for 1-salt fish.

Hatchery Production

Adult returns from hatchery fish stocked in the 1950s and early 1960s were poor and, consequently, have not been planted for years. However, it is thought by using a locally adapted natural brood stock, hatchery returns will succeed.

Harvest

The Wind River has "wild" fish release regulations between June 1 and November 30 whereby all natural fish (no clipped fins) have to be released. The sport season closes on March 31. For 1990, wild fish release regulations are imposed year-round. Catch limit is two fish. To protect juvenile steelhead, a 12-inch minimum size and two-fish bag limit for trout is also imposed. No fishing is allowed 400 feet below to 100 feet above Shipherd Falls fish ladder and Tyee Springs is closed to fishing.

Washington Department of Wildlife punch-card data indicated 39 percent of December to May harvest was unmarked fish in 1988, indicating natural summer or winter fish (Table 12). For the December to May harvest, 75 percent of the unmarked fish were assumed to be winter steelhead (J. Weinheimer, WDW, pers. commun.). Therefore an average of 39 winter steelhead were harvested between 1982 and 1988 with a harvest rate of 33 percent (Table 13).

Few steelhead are harvested in the ocean although the ocean drift net fishery may have intercepted some in recent years. Columbia River harvest of Wind River Subbasin winter steelhead above and below Bonneville dam was estimated by the System Planning Model to be 7.7 percent and 6.2 percent, respectively.

Table 12. Subbasin sport catch, 1977-1988.

Year	Sport Catch June-Nov	Sport Catch Dec-May*	Sport Catch Total
1977	1,728	196	1,924
1978	1,300	171	1,471
1979	959	95	1,054
1980	974	64	1,038
1981	1,315	156	1,471
1982[a]	1,217	60	1,277
1983	177	36	213
1984	77	17	94
1985	95	9	104
1986	678	36	714
1987	539	131	670
1988	672	41	713

* Sport season closes on March 31.

Table 13. Estimated run size of Wind River steelhead, 1986-1988.

	Brood Year		
	1987	1988	1989
Sport harvest			
Hatchery	700	619	697
Natural	4	13	4
Winter SH	10	38	12
Subtotal	714	670	713
Escapement			
Hatchery	300	265	299
Natural	288	485	202
Winter SH	20	76	24
Subtotal	608	826	525
Total run size			
Hatchery SSH	1,000	884	996
Natural SSH	292	498	206
Winter SH	30	114	36
TOTAL	1,322	1,496	1,238

Specific Considerations

Winter steelhead comprise a small part of the steelhead return to the Wind River and are second to summer steelhead in priority in steelhead management. Smolt capacity was estimated to be about 3,300 fish. The largest natural fish production limitation has been inadequate escapement reaching the subbasin as a result of smolt and adult mortalities at Bonneville Dam and adult overharvest downstream of the subbasin. Natural fish destined for the Wind are subjected to non-selective mixed-stock fisheries in the Columbia River. Returns of natural fish are estimated to be about 60 fish; unless out-of-basin harvest rates or techniques are altered, this run will be terminated. Selective harvest of hatchery fish at Bonneville Dam would allow natural fish to escape.

Critical Data Gaps

Life history and population dynamics such as run size, age, lengths, sex ratios and fecundities are needed.

Objectives

Stock: Wind River Natural Winter Steelhead

Utilization Objective: Zero; catch and release only. The utilization objective is secondary to the biological objective for this stock.

Biological Objective: Maintain the biological characteristics of the natural fish. The biological objective has priority within the subbasin and requires a spawning escapement of 300 fish.

Stock: Wind River Hatchery Winter Steelhead

Utilization Objective: 100 fish for within subbasin sport harvest and 100 fish for tribal harvest out of basin.

Biological Objective: Maintain the biological characteristics of the natural fish as possible.

Alternative Strategies

Strategies for winter steelhead in this report have specific themes. Means to obtain the objectives are first attempted using natural methods followed by less natural techniques and finally, hatchery production. Actions identified under each strategy are closely related to the theme. Strategies 1 and 2 have natural production themes seeking to improve the productivity of the existing natural stock. Strategy 3 is a "benign" supplementation strategy, emphasizing actions to develop a single supplemented run with yet higher productivity. Strategy 4 relies on a traditional hatchery program to meet objectives. Only those actions necessary for the success of a hatchery program would be included in Strategy 4. Strategy 5 is a combination of actions.

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

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

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

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

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

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

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

Assumptions: Action 1 assumes egg-to-smolt survival will be increased by a relative 10 percent. Action 2 assumes smolt-to-smolt survival will be increased by 15 percent while pre-spawning mortality of adults will be reduced 5 percent above the Trout Creek Dam.

Numeric Fish Increases: The System Planning Model indicated an additional 20 fish will return to the subbasin with this strategy under current conditions. MSY would increase by eight fish after mainstem program implementation.

ACTIONS: 1, 2

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

2. Redesign and reconstruct the fish ladder at Trout Creek Dam. This includes a slotted wasting weir with screening and auxiliary flow, a rock berm to provide a calmer entrance pool and distinctive attraction flow, and an adult trap so biological data can be obtained.

STRATEGY 2: Natural Production, Level 2. This strategy seeks to achieve the objectives by the same means as Strategy 1, but also includes actions to enhance productivity of habitat already available to the stock in question.

Hypothesis: Increasing streamflows will increase habitat and therefore smolt capacity.

Assumptions: Action 3 assumes smolt capacity will be increased by 10 percent on the mainstem Wind River. Action 4 assumes smolt capacity will be increased by 4 percent below Trout Creek. Action 5 assumes egg-to-smolt survival will be increased a relative 10 percent in the mainstem Trout Creek.

Numeric Fish Increases: The System Planning Model indicated an additional 30 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 11 fish after mainstem program implementation.

ACTIONS: 1-5

1. -
2. -

3. Construct an upper basin augmentation facility to increase summer low flows and suppress high winter flows.

4. Construct a well to replace surface water withdrawals at the Wind River nursery.

5. Reestablish riparian corridors in degraded areas via closing roads and vegetating riparian areas. About 10 acres of woody vegetation is needed.

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 required.

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

Assumptions: Actions 6 establishes a hatchery smolt production of 10,000 fish and assumes relative smolt survival will increase from 0.67 to 0.71 and viability of naturally spawning hatchery-hatchery and hatchery-natural crosses will increase by a relative 10 percent. Action 7 assumes relative smolt survival increases from 0.71 to 0.75.

Numeric Fish Increases: The System Planning Model indicated an additional 482 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 293 fish after mainstem program implementation.

ACTIONS: 1-7

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

6. Use captured natural brood stock for hatchery supplementation of 10,000 smolts.

7. Construct a conditioning pond to rear 10,000 smolts using natural brood stock.

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

Hypothesis: Increasing hatchery plants will increase adult returns. Construction of a conditioning pond will provide an improved quality hatchery smolt.

Assumptions: Action 9 will increase relative smolt survival from 0.67 to 0.71.

Numeric Fish Increases: The System Planning Model indicated an additional 621 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 399 fish after mainstem program implementation.

ACTIONS: 8, 9

8. Plant 15,000 Skamania winter steelhead smolts.

9. Construct a conditioning pond to rear 15,000 smolts using Skamania winter steelhead.

STRATEGY 5: Combination of Actions. This strategy seeks to achieve the objectives using a combination of the above actions deemed to have important population benefits.

Hypothesis: Existing habitat, if managed properly, should provide near capacity numbers of natural smolts if adequately seeded. By using natural stock for hatchery releases, the relative fitness should be improved and chances of genetic degradation will be decreased. Also, the relative fitness of progeny should be increased. Increasing hatchery plants should increase adult returns. Construction of a conditioning pond will provide an improved quality hatchery smolt.

Assumptions: See assumptions in previous strategies.

Numeric Fish Increases: The System Planning Model indicated an additional 468 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 294 fish after mainstem program implementation.

ACTIONS: 1, 2, 6, 7 (see above)

Recommended Strategy

The recommended strategy is Strategy 5. This strategy consists of actions having substantial benefit to adult returns and includes introduction of hatchery fish with natural brood stock. Habitat needs aggressive protection while Trout Creek Dam has been identified as an important inbasin source of smolt and adult losses. The Wind River is managed primarily for summer steelhead. Introductions of hatchery winter steelhead has repeatedly failed. This strategy was also supported by the SMART analysis (Appendix B).

Table 14. System Planning Model results for winter steelhead in the Wind River Subbasin. Baseline value is for pre-mainstem implementation. All other values are post-implementation.

Utilization Objective:
Zero natural and 200 hatchery fish for sport and tribal harvest.

Biological Objective:
Maintain the biological characteristics of the natural fish. Minimum spawning escapement needed is 300 natural fish.

Strategy[1]	Maximum[2] Sustainable Yield (MSY)	Total[3] Spawning Return	Total[4] Return to Subbasin	Out of[5] Subbasin Harvest	Contribution[6] To Council's Goal (Index)
Baseline	22 -N	45	72	8	0(1.00)
All Nat	33 -N	59	97	11	31(1.35)
1	30 -N	53	87	9	19(1.21)
2	33 -N	59	97	11	31(1.35)
3	315 -N	182	516	55	545(7.16)
4	421 -N	213	658	70	719(9.13)
5*	316 -N	168	502	54	528(6.97)

*Recommended strategy.

[1]Strategy descriptions:

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

1. Aggressive habitat protection. Post Mainstem Implementation.
2. Strategy 1 plus flow augmentation reservoir. Post Mainstem Implementation.
3. Strategy 2 plus use natural brood stock for hatchery, increase hatchery plants. Post Mainstem Implementation.
4. Baseline plus 75,000 hatchery smolts. Post Mainstem Implementation.
5. Strategy 1 plus 3 - Strategy 2. Post Mainstem Implementation.

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

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

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

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

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

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

	Proposed Strategies				
	1	2	3	4	5*
Hatchery Costs					
Capital[1]	0	0	46,000	207,000	46,000
O&M/yr[2]	0	0	5,000	22,500	5,000
Other Costs					
Capital[3]	350,000	10,660,000	11,110,000	0	800,000
O&M/yr[4]	35,000	157,000	182,000	0	60,000
Total Costs					
Capital	350,000	10,660,000	11,156,000	207,000	846,000
O&M/yr	35,000	157,000	187,000	22,500	65,000

* Recommended strategy.

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

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

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

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

SPRING CHINOOK SALMON

Fisheries Resource

Natural Production

Historically, Shipherd Falls at RM 2.1 blocked spring chinook migration. Fulton (1968) indicated spring chinook spawning habitat was absent below the falls and a native run did not exist. The Washington Department of Fisheries currently manages Wind River spring chinook as a hatchery stock; natural spawners (hatchery and natural origin) averaged 156 fish for 1977 through 1986.

Carrying capacity was estimated at 157,533 smolts with the Northwest Power Planning Council's model. Spring chinook production may be limited by steep gradients and low summer flows.

Hatchery Production

In 1955, agencies of the Columbia River Fishery Development Program began a program to introduce spring chinook to the Wind River. The program consisted of 1) construction of a ladder at Shipherd Falls, 2) transfer of adult spring chinook from the Columbia River to Carson National Fish Hatchery and 3) rearing and releasing juvenile spring chinook into the Columbia River. As a result, approximately 66,000 adult spring chinook returned to Carson Hatchery between 1959 and 1979, and additional adults spawned in the river (Wahle and Chaney 1981). Carson Hatchery rears spring chinook only and is funded through Mitchell Act monies. Spring chinook production began in 1958 and adults were trapped at Bonneville Dam for brood stock. In the 1960s and thereafter, eggs were taken from returning Wind River adults.

Carson Hatchery is located on about 10 acres within the Gifford Pinchot National Forest at the confluence of Tyee Creek and the Wind River. Facilities consist of two earthen rearing ponds, two concrete adult holding ponds, 46 raceways, 24 starting tanks, and 21 trough-type incubators. The primary water source is 44-degree, spring-fed Tyee Creek; the hatchery has water rights to 53 cfs from the creek. The Wind River is used to warm and supplement Tyee Creek as needed. The hatchery has two water permits for up to 42 cfs from the Wind River. The hatchery minimizes use of the Wind River because temperatures are often too high and increase susceptibility of fish to diseases. The station development plan calls for construction of a new water intake to reduce disease jeopardy. Resident rainbow trout and steelhead with bacterial kidney disease (BKD) are found in the

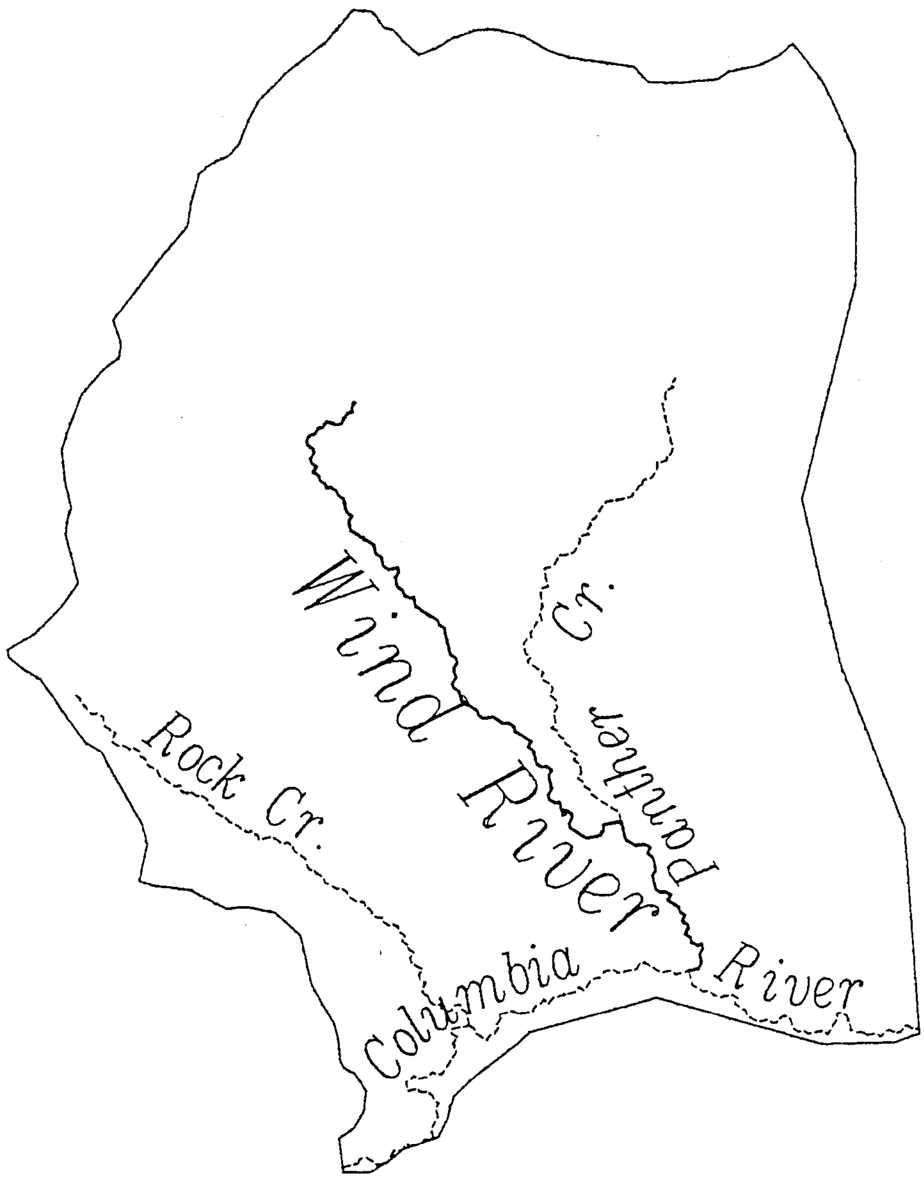
Wind River above the hatchery intake (J. Davis, USFWS, Carson Hatchery, pers. commun.).

Production at Carson Hatchery averaged 2,260,627 smolts for 1977 through 1989 (Table 16). Hatchery escapement goal is 3,000 fish while 1977 through 1989 returns averaged 3,029 adults and 40 jacks (Table 17). Fingerling releases have apparently failed to increase naturally spawning adults and have been discontinued.

Table 16. Spring chinook plants in the Wind River.

Year	Smolts	Fingerlings
1977	2,812,853	
1978	2,856,148	
1979	1,791,815	460,000
1980	2,585,611	
1981	2,598,912	
1982	2,578,650	
1983	1,722,080	
1984	2,886,560	80,046
1985	2,390,971	
1986	2,166,978	485,000
1987	2,439,000	680,000
1988	1,956,200	617,800
1989	2,215,000	
AVE	2,260,627	

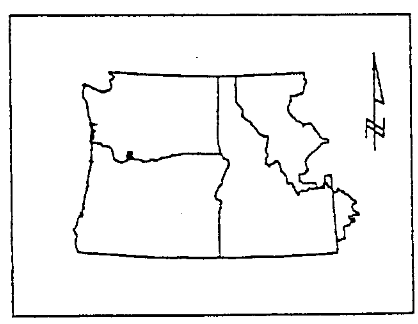
WIND SUBBASIN



SPRING CHINOOK DISTRIBUTION*

——————— PRESENT/POTENTIAL

- - - - - - - - ABSENT



GIS GEOGRAPHIC INFORMATION SYSTEM

BONNEVILLE POWER ADMINISTRATION

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

Table 17. Return of Wind River spring chinook, 1977-1987.

Year	Hatchery 1/ Escapement		Natural 2/ Escapement		Sport Catch		Total Return	
	Jacks	Adults	Jacks	Adults	Jacks	Adults	Jacks	Adults
1977	22	2,953	0	126	5	1,579	27	4,658
1978	14	2,964	0	243	7	1,627	21	4,834
1979	4	2,537	0	154	1	776	5	3,467
1980	33	3,336	0	91	0	0	33	3,427
1981	3	2,545	0	155	0	0	3	2,700
1982	22	1,635	0	79	0	0	22	1,714
1983	9	2,485	0	266	0	0	9	2,751
1984	86	2,074	0	213	0	0	86	2,287
1985	53	4,681	0	192	0	0	53	4,873
1986	48	5,608	0	111	6	1,797	54	7,516
1987	4	4,374	0	87	2	779	6	5,240
1988	56	2,054	0	164	N\A		N\A	
1989	162	2,134	0	148	N\A		N\A	
AVE	40	3,029	0	156	2	596	29	3,951

1/ Counts at Carson Hatchery.
2/ Estimated from WDF spawning surveys.

Adults return to the subbasin from mid-May to mid-August and are held until the first week in September. Fish are spawned from August to mid-September. Eggs are incubated from August to the end of December and emerge in January. Juveniles are reared in raceways for approximately 15 months (January to April) and released in late April.

Age profiles of adults indicate 0.9 percent, 57.4 percent, 41.5 percent, and 0.2 percent returned at ocean age I, II, III, and IV. Females comprised 0 percent, 67.8 percent, 39.6 percent, and 0 percent, respectively (Howell et al. 1984). Mean length of ocean-age III and IV fish was 75 cm and 92 cm, respectively. Mean fecundity is 4,300 eggs per female (Howell et al. 1984).

Hatchery egg-to-smolt survival is now about 90 percent. Previous problems with BKD reduced fry-to-smolt survival to 65 percent. In recent years, returning adults have been injected with erythromycin and the disease appears to be under control. Smolt-to-adult survival for Carson Hatchery spring chinook has averaged 0.3 percent. Based on tag recoveries and genetic stock identification studies, most Carson spring chinook harvest occurs in fresh water.

In 1987, infectious hematopoietic necrosis (IHN) was detected in 70 percent of returning adults; managers used only eggs from non-infected adults. A sample of adults tested positive for IHN in 1988, but eggs were disinfected with iodophor and retained. The hatchery has subsequently not reported any unusual losses.

The Carson Hatchery has capacity to produce 2.4 million smolts. This capacity is recognized as a long-term program need in the Columbia River Fish Management Plan and increased production will probably be released on station. Funds, however, are not currently allocated for hatchery expansion.

Harvest

Wind River spring chinook are managed for hatchery escapement. When the hatchery is expected to achieve its escapement goal, the Washington Department of Fisheries and Yakima Indian Nation develop a harvest plan for sharing the harvestable surplus between the recreational fishery and Yakima tribal members. The recreational fishery occurs downstream of Shipherd Falls while tribal harvest occurs in the Columbia River. In some years, only certain days of the week were open to sport fishing and harvest was negligible (Table 17). In years of a sport fishery, harvest averaged 1,316 fish. The subbasin harvest rate was 25.8 percent and 18.6 percent on adults and jacks, respectively, and 25.7 percent overall. Out-of-subbasin harvest, which includes ocean and Columbia River harvest, has averaged about 15 percent.

Specific Considerations

The United States vs. Oregon management plan stipulates that non-treaty fisheries on runs between 112 percent and 125 percent of the interim management goal at Bonneville Dam (115,000 fish), shall occur in the tributaries. Treaty fisheries on runs of this same magnitude may occur either in the tributaries or the mainstem. Harvest on runs less than 112 percent of the interim management goal will occur incidentally in ocean and lower river fisheries for the non-treaty share and will occur as mainstem ceremonial and subsistence fisheries for the treaty share. A tribal "in-lieu" fishing site, set aside in compensation for tribal fishing grounds inundated by the Bonneville Dam reservoir, occupies land on the west bank at the mouth of the Wind River.

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

Wind River spring chinook suffer mortality hazards associated with Bonneville Dam, which impacts survival of emigrating smolts and returning adults. Adult fish are subjected to Columbia River sport and commercial fisheries and within the basin, habitat has been impacted by logging and construction of a dam. Despite some releases of fry into the watershed, few spring chinook spawn naturally.

Objectives

Utilization Objective

5,000 fish for subbasin sport and tribal harvest to be shared as per the United States vs. Oregon agreement. The utilization objective has priority for this stock.

Biological Objective

Maintain the biological characteristics of the Carson Hatchery stock. At existing harvest rates, this will require a subbasin return of 9,700 fish.

Alternative Strategies

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

Modeling results for each strategy are presented in Table 18 as fish produced at "maximum sustainable yield" (MSY). The sustainable yield of a fish population refers to that portion of the population that exceeds the number of fish required to spawn and maintain the population over time. Sustainable yield can be "maximized," termed MSY, for each stock at a specific harvest level. The MSY is estimated using a formula (Beverton-Holt function) that analyzes a broad range of harvest rates. Subbasin planners have used MSY as a tool to standardize results so that decision makers can compare stocks and strategies.

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

The amount of buffer appropriate for each stock is a management question not addressed in the subbasin plans. For this reason, the utilization objective, which usually refers to harvest, may not be directly comparable to the MSY shown in Table 18. At a minimum, a strategy should produce an estimated MSY equal to or greater than the utilization objective. A MSY substantially larger than the subbasin utilization objective may be needed to meet subbasin biological objectives.

Estimated costs of the alternative strategies below are summarized in Table 19.

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

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

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

Assumptions: Action 1 assumes egg-to-smolt survival will be increased by a relative 10 percent. Action 2 assumes smolt-to-smolt survival will be increased by 15 percent while pre-spawning mortality of adults will be reduced 5 percent above the Trout Creek Dam.

Numeric Fish Increases: The System Planning Model indicated an additional five fish will return to the subbasin with this strategy under current conditions. MSY would increase by 74 fish after mainstem program implementation.

ACTIONS: 1, 2

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

2. Redesign and reconstruct the fish ladder at Trout Creek Dam. This includes a slotted wasting weir with screening and auxiliary flow, a rock berm to provide a calmer entrance pool and distinctive attraction flow, and an adult trap so biological data can be obtained.

STRATEGY 2: Natural Production, Level 2. This strategy seeks to achieve the objectives by the same means as Strategy 1, but also includes actions to enhance productivity of habitat already available to the stock in question.

Hypothesis: Increasing streamflows will increase habitat and therefore smolt capacity.

Assumptions: Action 3 assumes smolt capacity will be increased by 10 percent on the mainstem Wind River. Action 4 assumes smolt capacity will be increased by 4 percent below Trout Creek. Action 5 assumes egg-to-smolt survival will be increased a relative 10 percent in the mainstem Trout Creek.

Numeric Fish Increases: The System Planning Model indicated an additional 27 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 89 fish after mainstem program implementation.

ACTIONS: 1-5

1. -
2. -

3. Construct an upper basin augmentation facility to increase summer low flows and suppress high winter flows.

4. Construct a well to replace surface water withdrawals at the Wind River nursery.

5. Reestablish riparian corridors in degraded areas via closing roads and vegetating riparian areas. About 10 acres of woody vegetation is needed.

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 required.

Hypothesis: By seeding existing habitat with a suitable stock of fingerlings, smolt capacity will be realized. Increasing hatchery smolt production should increase adult returns.

Assumptions: Actions 6 assumes fingerling plants will use natural habitat. Fingerling plants to date have failed to increase natural spawners possibly indicating the smolt capacity model results were too high or habitat may be seeded with existing natural spawners. An adaptive approach should be used to guide the supplementation program and no irreversible decisions or facilities development (such as acclimation ponds) would be made prior to a full testing and evaluation. A detailed evaluation plan would be prepared prior to releases and would include assessment of impacts on resident trout and steelhead as well as monitoring the production from the releases at various points. Actions 7 and 8 assume relative smolt survival will increase from 0.5 to 0.75.

Numeric Fish Increases: The System Planning Model indicated an additional 3,028 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 2,816 fish after mainstem program implementation.

ACTIONS: 1-8

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

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

7. Construct an acclimation pond for 500,000 smolts near Paradise Creek.

8. Construct an acclimation pond for 500,000 smolts on Trout Creek near Layout Creek.

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

Hypothesis: Increasing hatchery plants will increase adult returns.

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

Numeric Fish Increases: The System Planning Model indicated an additional 3,612 fish will return to the subbasin with this strategy under current conditions. MSY would increase by 3,328 fish after mainstem program implementation.

ACTIONS: 9

9. Increase hatchery production by 1.8 million smolts.

Recommended Strategy

The recommended strategy for Wind spring chinook is Strategy 4, hatchery expansion by 1.8 million smolts. Spring chinook in the subbasin were not present historically and are presently managed as a hatchery stock. Fingerling plants to use natural habitat apparently failed to increase naturally spawning fish. This strategy also reduces possible interspecific competition with steelhead which was identified as a concern by the public. The SMART analysis also supports Strategy 4 (Appendix B).

Table 18. System Planning Model results for spring chinook in the Wind River Subbasin. Baseline value is for pre-mainstem implementation. All other values are post-implementation.

Utilization Objective:
5,000 for subbasin sport and tribal harvest to be shared as per United States vs. Oregon.

Biological Objective:
Maintain the biological characteristics of the Carson Hatchery stock.

Strategy[1]	Maximum[2] Sustainable Yield (MSY)	Total[3] Spawning Return	Total[4] Return to Subbasin	Out of[5] Subbasin Harvest	Contribution[6] To Council's Goal (Index)
Baseline	3,987 -N	683	4,746	750	0(1.00)
All Nat	4,076 -N	648	4,795	758	63(1.01)
1	4,061 -N	646	4,777	754	39(1.01)
2	4,076 -N	648	4,795	758	63(1.01)
3	6,803 -N	916	7,819	1,235	3,917(1.65)
4*	7,315 -N	984	8,407	1,328	4,666(1.77)

*Recommended strategy.

[1]Strategy descriptions:

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

1. Aggressive habitat protection. Post Mainstem Implementation.
2. Strategy 1 plus flow augmentation reservoir. Post Mainstem Implementation.
3. Strategy 2 plus fry plants, increased hatchery plants. Post Mainstem Implementation.
4. Baseline plus 1,800,000 hatchery smolts. Post Mainstem Implementation.

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

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

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

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

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

Table 19. Estimated costs of alternative strategies for Wind River spring chinook. Cost estimates represent new or additional costs to the 1987 Columbia River Basin Fish and Wildlife Program; they do not represent projects funded under other programs, such as the Lower Snake River Compensation Plan or a public utility district settlement agreement. (For itemized costs, see Appendix C.)

	Proposed Strategies			
	1	2	3	4*
Hatchery Costs				
Capital[1]	0	0	2,300,000	4,140,000
O&M/yr[2]	0	0	250,000	450,000
Other Costs				
Capital[3]	350,000	10,660,000	12,660,000	0
O&M/yr[4]	35,000	157,000	167,000	0
Total Costs				
Capital	350,000	10,660,000	14,960,000	4,140,000
O&M/yr	35,000	157,000	417,000	450,000

* Recommended strategy.

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

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

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

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

FALL CHINOOK SALMON

Fisheries Resource

Natural Production

History and Status

Bryant (1949) noted a small run of fall chinook to the Wind River below Shipherd Falls. Much of this area was inundated with the filling of Bonneville Pool. The 1956 laddering of Shipherd Falls provided access into the upper watershed and fish have been observed up to Carson Hatchery. However, most spawning occurs in the lower river and an average of 569 fish spawned naturally in 1977 through 1986, although many could be strays from Spring Creek Hatchery. Migration of fall chinook in the subbasin corresponds with low flows, which may be a limiting factor.

Fall chinook in the Columbia are managed on large aggregate stocks and the Wind River stock is part of the Bonneville Pool Hatchery "tule" stock. Principal production units mask the contribution of small units like the Wind River; management attention to small natural production units is minimal.

Life History and Population Characteristics

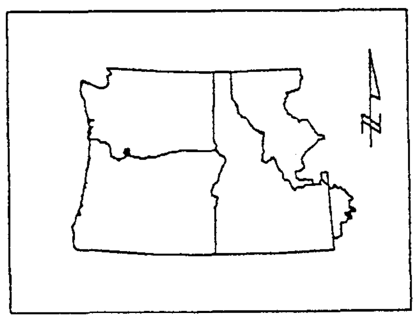
Life history data is not available for Wind River fall chinook, but is assumed similar to Spring Creek Hatchery fish. Most adults return after three years in the ocean and females dominate the larger age groups (Table 20). Adults enter the subbasin from August to October and spawn in September and October. Fry emerge in January through March and emigrate from the subbasin as fingerlings in spring and early summer. Fecundity was estimated at 4,700 eggs per female (Howell et al. 1984). The Northwest Power Planning Council's carrying capacity model estimated that 206,608 fingerling smolts could be produced within the subbasin.

WIND SUBBASIN

FALL CHINOOK DISTRIBUTION*

PRESENT/POTENTIAL

ABSENT



GIS GEOGRAPHIC INFORMATION SYSTEM

BONNEVILLE POWER ADMINISTRATION

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

Table 20. Age and sex of Spring Creek fall chinook (from Howell et al. 1984)

	Ocean Age			
	1	2	3	4
Age Composition	11.9%	71.4%	16.7%	0.2
Females	1.5%	57.9%	67.7%	66.5%
Number of fish: 1,361 in 1981; 848 in 1982.				

Hatchery Production

No hatchery production of fall chinook occurs in the Wind River and none is anticipated.

Harvest

Harvest of fall chinook primarily occurs in the mainstem of the Columbia River although an average of one jack and eight adults are sport caught annually in the subbasin. Subbasin harvest rate averaged 1.9 percent on jacks, 1.5 percent on adults and 1.6 percent overall (Table 21).

Table 21. Fall chinook returns to the Wind River, 1977-1986.

Year	Sport Catch 1/		Escapement 2/		Total Return	
	Jacks	Adults	Jacks	Adults	Jacks	Adults
1977	1	16	49	922	50	938
1978	0	3	205	1,322	205	1,325
1979	11	47	62	884	65	926
1980	4	11	46	355	47	366
1981	0	0	59	197	59	197
1982	0	0	4	361	4	361
1983	3	0	53	442	56	442
1984	0	0	8	126	8	126
1985	0	0	2	168	2	168
1986	6	10	19	403	19	413
AVE	1	8	51	518	52	526

1/ Sport catch from WDF punch cards.
2/ Escapement from WDF spawning surveys.

Specific Considerations

Migration and spawning of Wind River fall chinook occurs in September, which is the lowest flow period and limits production opportunities. Increases of fall chinook from the Wind River would not contribute substantially toward the doubling goal when viewed in context of large aggregate stock management.

The United States vs. Oregon fish management plan stipulates that the interim spawning escapement goal for Bonneville Pool fall chinook is to return enough brood stock necessary to meet hatchery production requirements; the majority of harvest opportunity shall go to the non-Indian fisheries. In addition, the United States vs. Oregon plan states treaty Indian and non-Indian fisheries in Columbia River tributaries, other than the mainstem Columbia River between McNary and Priest Rapids dams, shall be governed by the subbasin plan.

Objectives

Utilization Objective

Support out-of-basin harvest. The utilization component has priority for this stock.

Biological Objective

Maintain fall chinook population characteristics of the Bonneville Pool "tule" stock.

Alternative Strategies

Because objectives for this stock are currently being met and a population increase is not desired, no alternative strategies are offered. However, monitoring the annual spawning population is recommended.

COHO SALMON

Fisheries Resource

Natural Production

For 1973 through 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 probably entered tributaries between Bonneville and McNary dams, with a minor number migrating past Ice Harbor Dam on the Snake River and Priest Rapids Dam on the Columbia River. On the Washington side, these rivers include the Wind, Little White Salmon, White Salmon, Klickitat, and Yakima rivers. No records are available for natural spawning coho in the Wind River. However, potential was identified for early- and late-returning coho in surveys for the Columbia River Fisheries Development Program (unpublished manuscripts).

Surveys and electroshocking sampling (WDF) indicate coho are seldom found above Shipherd Falls. Most fish are thought to be strays. Total spawning escapement is estimated to be about 50 fish.

Biological data for subbasin coho is assumed to be similar to coho returning to the Little White Salmon National Fish Hatchery. An average of 10.8 percent and 89.2 percent of these hatchery coho return after one and two years in the ocean, respectively (King 1987). All 1-year ocean fish were males and 62 percent of 2-year ocean fish were males. Mean length was 62 cm for males and 64 cm for females. Fecundity averaged 2,100 eggs per female.

The Northwest Power Planning Council's carrying capacity model estimated that 146,380 smolts could be produced.

Hatchery Production

No hatchery production currently exists in the Wind River and none is anticipated.

Harvest

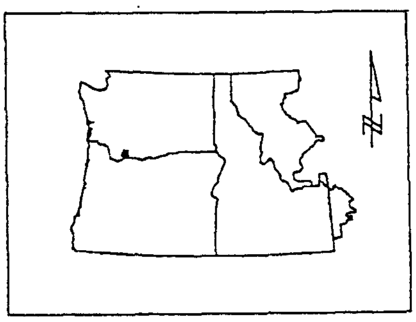
Records indicate a variable coho catch ranging from zero to 103 fish and averaging three jacks and 18 adults (Table 22). Out-of-basin exploitation rates run as high as 85 percent in the combined ocean and Columbia River mainstem fisheries.

WIND SUBBASIN

COHO DISTRIBUTION*

——————— PRESENT/POTENTIAL

- - - - - - - - ABSENT



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

GIS GEOGRAPHIC INFORMATION SYSTEM

BONNEVILLE POWER ADMINISTRATION

Table 22. Sport harvest of coho in the Wind River.

Year	Jacks	Adults	Year	Jacks	Adults
1977	10	19	1983	0	0
1978	7	40	1984	2	0
1979	1	12	1985	0	0
1980	4	14	1986	6	103
1981	0	4	1987	0	3
1982	0	0	AVE	3	18

Specific Considerations

Coho are managed as a large aggregate hatchery stock in the Columbia River. Exploitation rates are high in ocean and Columbia River mainstem fisheries and it is doubtful natural production could meet spawning escapement needs; supplementation would be required to support natural production.

The United States vs. Oregon agreement seeks to expand harvest opportunities for treaty Indian fishing for early coho within tributary areas and within the mainstem area for late coho. Some lower river (below Bonneville Dam) coho hatchery production has been shifted into larger tributaries above Bonneville.

Objectives

Utilization Objective

Support out-of-basin harvest. The utilization component has priority for this stock.

Biological Objective

Maintain biological characteristics of coho found in the Bonneville Pool.

Alternative Strategies

Because objectives for this stock are currently being met and a population increase is not desired, no alternative strategies are offered.

PART V. SUMMARY AND IMPLEMENTATION

Objectives and Recommended Strategies

Summer Steelhead

The objective is to provide a subbasin sport harvest and a tribal out-of-subbasin harvest of zero natural and 1,000 hatchery fish each while protecting the genetic integrity of the natural stock. The recommended strategy is Strategy 5; provide aggressive habitat protection, reconstruct the Trout Creek Dam fish ladder, and supplement with 40,000 smolts from natural brood stock with smolts reared in a rearing pond.

Winter Steelhead

The objective is to provide a subbasin sport harvest and a tribal out-of-subbasin harvest of zero natural and 100 hatchery fish each while protecting the genetic integrity of the natural stock. The recommended strategy is 5; provide aggressive habitat protection, reconstruct the Trout Creek Dam fish ladder, and supplement with 10,000 smolts from natural brood stock with smolts reared in a rearing pond.

Spring Chinook

The objective is to provide a subbasin sport and tribal harvest of 5,000 fish. The recommended strategy is 4; increase hatchery production by 1.8 million smolts.

Fall Chinook

The objective is to provide out-of-subbasin harvest. Because enhancement is not sought for this stock, no strategy is recommended.

Coho

The objective is to provide out-of-subbasin harvest. Because enhancement is not sought for this stock, no strategy is recommended.

Implementation

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

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

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APPENDIX A
NORTHWEST POWER PLANNING COUNCIL
SYSTEM POLICIES

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

1) The area above Bonneville Dam is accorded priority.

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

2) Genetic risks must be assessed.

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

3) Mainstem survival must be improved expeditiously.

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

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

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

5) Harvest management must support rebuilding.

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

6) System integration will be necessary to assure consistency.

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

7) Adaptive management should guide action and improve knowledge.

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

APPENDIX B
SMART ANALYSIS

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

1) Extent the subbasin objectives were met

2) Change in maximum sustainable yield

3) Impact on genetics

4) Technological and biological feasibility

5) Public support

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

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

Subbasin: Wind Stock: Summer steelhead Strategy: 1

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	8	0.6	20	160	96
2 CHG MSY	5	0.6	20	100	60
3 GEN IMP	7	0.6	20	140	84
4 TECH FEAS	8	0.6	20	160	96
5 PUB SUPT	7	0.6	20	140	84
TOTAL VALUE				700	
DISCOUNT VALUE					420
CONFIDENCE VALUE					0.60

Subbasin: Wind Stock: Summer steelhead Strategy: 2

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	4	0.6	20	80	48
2 CHG MSY	3	0.6	20	60	36
3 GEN IMP	7	0.6	20	140	84
4 TECH FEAS	7	0.6	20	140	84
5 PUB SUPT	7	0.6	20	140	84
TOTAL VALUE				560	
DISCOUNT VALUE					336
CONFIDENCE VALUE					0.60

Subbasin: Wind Stock: Summer steelhead Strategy: 3

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	8	0.9	20	160	144
2 CHG MSY	6	0.6	20	120	72
3 GEN IMP	7	0.9	20	140	126
4 TECH FEAS	8	0.9	20	160	144
5 PUB SUPT	8	0.6	20	160	96
TOTAL VALUE				740	
DISCOUNT VALUE					582
CONFIDENCE VALUE					0.79

Subbasin: Wind Stock: Summer steelhead Strategy: 4

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	8	0.6	20	160	96
2 CHG MSY	5	0.6	20	100	60
3 GEN IMP	7	0.6	20	140	84
4 TECH FEAS	8	0.6	20	160	96
5 PUB SUPT	7	0.6	20	140	84
TOTAL VALUE				700	
DISCOUNT VALUE					420
CONFIDENCE VALUE					0.60

Subbasin: Wind Stock: Summer steelhead Strategy: 5

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	4	0.6	20	80	48
2 CHG MSY	3	0.6	20	60	36
3 GEN IMP	7	0.6	20	140	84
4 TECH FEAS	7	0.6	20	140	84
5 PUB SUPT	7	0.6	20	140	84
TOTAL VALUE				560	
DISCOUNT VALUE					336
CONFIDENCE VALUE					0.60

Subbasin: Wind Stock: Winter Steelhead Strategy: 1

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	3	0.6	20	60	36
2 CHG MSY	3	0.6	20	60	36
3 GEN IMP	2	0.9	20	40	36
4 TECH FEAS	5	0.6	20	100	60
5 PUB SUPT	6	0.6	20	120	72
TOTAL VALUE				380	
DISCOUNT VALUE					240
CONFIDENCE VALUE					0.63

Subbasin: Wind Stock: Winter steelhead Strategy: 2

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	6	0.6	20	120	72
2 CHG MSY	6	0.6	20	120	72
3 GEN IMP	3	0.9	20	60	54
4 TECH FEAS	8	0.6	20	160	96
5 PUB SUPT	7	0.6	20	140	84
TOTAL VALUE				600	
DISCOUNT VALUE					378
CONFIDENCE VALUE					0.63

Subbasin: Wind Stock: Winter steelhead Strategy: 3

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	5	0.6	20	100	60
2 CHG MSY	6	0.6	20	120	72
3 GEN IMP	3	0.9	20	60	54
4 TECH FEAS	8	0.6	20	160	96
5 PUB SUPT	6	0.6	20	120	72
TOTAL VALUE				420	
DISCOUNT VALUE					258
CONFIDENCE VALUE					0.61

Subbasin: Wind　　Stock: Winter steelhead　　Strategy: 4

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	5	0.6	20	100	60
2 CHG MSY	6	0.6	20	120	72
3 GEN IMP	3	0.9	20	60	54
4 TECH FEAS	9	0.9	20	180	162
5 PUB SUPT	6	0.9	20	120	108
TOTAL VALUE				580	
DISCOUNT VALUE					456
CONFIDENCE VALUE					0.79

Subbasin: Wind　　Stock: Winter steelhead　　Strategy: 5

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	5	0.6	20	100	60
2 CHG MSY	6	0.6	20	120	72
3 GEN IMP	3	0.9	20	60	54
4 TECH FEAS	8	0.6	20	160	96
5 PUB SUPT	6	0.6	20	120	72
TOTAL VALUE				420	
DISCOUNT VALUE					258
CONFIDENCE VALUE					0.61

Subbasin: Wind Stock: Spring Chinook Strategy: 1

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	3	0.6	20	60	36
2 CHG MSY	3	0.6	20	60	36
3 GEN IMP	2	0.9	20	40	36
4 TECH FEAS	5	0.6	20	100	60
5 PUB SUPT	6	0.6	20	120	72
TOTAL VALUE				380	
DISCOUNT VALUE					240
CONFIDENCE VALUE					0.63

Subbasin: Wind Stock: Spring chinook Strategy: 2

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	5	0.9	20	100	90
2 CHG MSY	5	0.6	20	100	60
3 GEN IMP	2	0.9	20	40	36
4 TECH FEAS	6	0.6	20	120	72
5 PUB SUPT	6	0.6	20	120	72
TOTAL VALUE				480	
DISCOUNT VALUE					330
CONFIDENCE VALUE					0.69

Subbasin: Wind Stock: Spring Chinook Strategy: 3

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	5	0.9	20	100	90
2 CHG MSY	6	0.9	20	120	108
3 GEN IMP	2	0.9	20	40	36
4 TECH FEAS	6	0.9	20	120	108
5 PUB SUPT	6	0.6	20	120	72
TOTAL VALUE				500	
DISCOUNT VALUE					414
CONFIDENCE VALUE					0.83

Subbasin: Wind   Stock: Spring Chinook   Strategy: 4

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	5	0.9	20	100	90
2 CHG MSY	5	0.6	20	100	60
3 GEN IMP	2	0.9	20	40	36
4 TECH FEAS	7	0.6	20	140	84
5 PUB SUPT	5	0.9	20	100	90
TOTAL VALUE				480	
DISCOUNT VALUE					360
CONFIDENCE VALUE					0.75

Subbasin: Wind   Stock: Spring Chinook   Strategy: 5

Criteria	Rating	Confidence	Weight	Utility	Discount Utility
1 EXT OBJ	5	0.9	20	100	90
2 CHG MSY	5	0.6	20	100	60
3 GEN IMP	2	0.9	20	40	36
4 TECH FEAS	7	0.6	20	140	84
5 PUB SUPT	7	0.9	20	140	126
TOTAL VALUE				520	
DISCOUNT VALUE					396
CONFIDENCE VALUE					0.76

APPENDIX C
SUMMARY OF COST ESTIMATES

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

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

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

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

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

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

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

ESTIMATED COSTS FOR ALTERNATIVE STRATEGIES

Subbasin: Wind River
Stock: Summer Steelhead

Action	Cost Categories*	Proposed Strategies 1	2	3	4	5**
Habitat Enhancement	Capital:	0	10,000	10,000		0
	O&M/yr:	30,000	32,000	32,000		30,000
	Life:	50	50	50		50
Redesigning of Trout Creek Dam	Capital:	350,000	350,000	350,000		350,000
	O&M/yr:	5,000	5,000	5,000		5,000
	Life:	50	50	50		50
Augmentation Facility & WRN Well	Capital:		10,300,000	10,300,000		
	O&M/yr:		120,000	120,000		
	Life:		50	50		
Nat. Prod. & Acclimation Pond	Capital:			450,000		450,000
	O&M/yr:			25,000		25,000
	Life:			50		50
Hatchery Production	Capital:			46,000	207,000	46,000
	O&M/yr:			5,000	22,500	5,000
	Life:			50	50	50
TOTAL COSTS	Capital:	350,000	10,660,000	11,156,000	207,000	846,000
	O&M/yr:	35,000	157,000	187,000	22,500	65,000
	Years:	50	50	50	50	50
Water Acquisition		N	N	N	N	N
Fish to Stock	Number/yr:			10,000	45,000	10,000
	Size:			S, 5/lb.	S, 5/lb.	S, 5/lb.
	Years:			50	50	50

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

** Recommended strategy.

ESTIMATED COSTS FOR ALTERNATIVE STRATEGIES

Subbasin: Wind River
Stock: Winter Steelhead

Action	Cost Categories*	Proposed Strategies 1	2	3	4	5**
Habitat Enhancement	Capital:	0	10,000	10,000		0
	O&M/yr:	30,000	32,000	32,000		30,000
	Life:	50	50	50		50
Redesigning of Trout Creek Dam	Capital:	350,000	350,000	350,000		350,000
	O&M/yr:	5,000	5,000	5,000		5,000
	Life:	50	50	50		50
Augmentation Facility & WRN Well	Capital:		10,300,000	10,300,000		
	O&M/yr:		120,000	120,000		
	Life:		50	50		
Nat. Prod. & Acclimation Pond	Capital:			450,000		450,000
	O&M/yr:			25,000		25,000
	Life:			50		50
Hatchery Production	Capital:			46,000	207,000	46,000
	O&M/yr:			5,000	22,500	5,000
	Life:			50	50	50
TOTAL COSTS	Capital:	350,000	10,660,000	11,156,000	207,000	846,000
	O&M/yr:	35,000	157,000	187,000	22,500	65,000
	Years:	50	50	50	50	50
Water Acquisition		N	N	N	N	N
Fish to Stock	Number/yr:			10,000	45,000	10,000
	Size:			S, 5/lb.	S, 5/lb.	S, 5/lb.
	Years:			50	50	50

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

** Recommended strategy.

ESTIMATED COSTS FOR ALTERNATIVE STRATEGIES

Subbasin: Wind River
Stock: Spring Chinook

Action	Cost Categories*	Proposed Strategies 1	2	3	4**
Habitat Enhancement	Capital:	0	10,000	10,000	
	O&M/yr:	30,000	32,000	32,000	
	Life:	50	50	50	
Redesigning of Trout Creek Dam	Capital:	350,000	350,000	350,000	
	O&M/yr:	5,000	5,000	5,000	
	Life:	50	50	50	
Augmentation Facility & WRN Well	Capital:		10,300,000	10,300,000	
	O&M/yr:		120,000	120,000	
	Life:		50	50	
Rearing Ponds	Capital:			2,000,000	
	O&M/yr:			10,000	
	Life:			50	
Hatchery Production	Capital:			2,300,000	4,140,000
	O&M/yr:			250,000	450,000
	Life:			50	50
TOTAL COSTS	Capital:	350,000	10,660,000	14,960,000	4,140,000
	O&M/yr:	35,000	157,000	417,000	450,000
	Years:	50	50	50	50
Water Acquisition		N	N	N	N
Fish to Stock	Number/yr:			1,000,000	1,800,000
	Size:			S, 10/lb.	S, 10/lb.
	Years:			50	50

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

** Recommended strategy.