Columbia Basin System Planning

SALMON and STEELHEAD PRODUCTION PLAN

IMNAHA RIVER SUBBASIN

September 1, 1990

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Columbia Basin System Planning

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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.

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PART I. DESCRIPTION OF SUBBASIN

Location and General Environment

The Imnaha River Subbasin is located in the extreme northeast corner of Oregon and drains an area of 980 square miles (Fig. 1). The mainstem is formed by the juncture of the North and South forks at an elevation of 5,300 feet and flows in a northerly direction for approximately 63.5 miles to its confluence with the Snake River at River Mile (RM) 191.7. The entire drainage is contained in EPA Reach 17060102.

Most of this section which pertains to geology, topography, soils, climate, and vegetation is taken from U.S. Forest Service (1981) and Johnson et al. (1987). A knowledge of the geology, geomorphology, climate, and plant ecology of the subbasin is necessary if fisheries managers are to be involved in land management issues such as logging, road building, and mining that potentially could affect fish.

The Imnaha River Subbasin lies entirely within the Wallowa-Snake physiographic province and is characterized by majestic peaks, high tablelands, and deeply incised valleys. Elevations range from nearly 10,000 feet in the Wallowa Mountains to 975 feet at the river's mouth, while the plateaus, such as Lord Flat Plateau, rise to nearly 7,000 feet. Plant associations and climate vary with the topography and geology of the region.

The exposed geologic record begins in the late Paleozoic Era (250 million years ago) with the Clover Creek Formation greenstones, which are visible in the Wallowa Mountains. The Mesozoic Era (225 million to 65 million years ago) was a period of active volcanism during which the Wallowa Mountains were uplifted. The Snake River granites (exposed near the Imnaha River's mouth) were formed in the Triassic Period (220 million years ago). The Wallowa batholith (which created the Wallowa Mountains) formed during the Cretaceous Period (approximately 100 million years ago). During the same period, limestones, slates, shales, and sandstones were formed, all of which are visible in the Eagle Cap Wilderness.

The Cenozoic Era (70 million years ago to the present) produced the dominant rock type found in the subbasin. During the Miocene Period (15 million years ago), fluid basalt flowed across the landscape, covering previous geologic formations and lapping up the sides of the Wallowa Mountains. These flows erupted simultaneously from fissures scattered across the landscape and during successive flows, pooled to depths of 2,600 feet to 4,100 feet. Individual flows ranged in thickness from 50 feet to 200 feet.

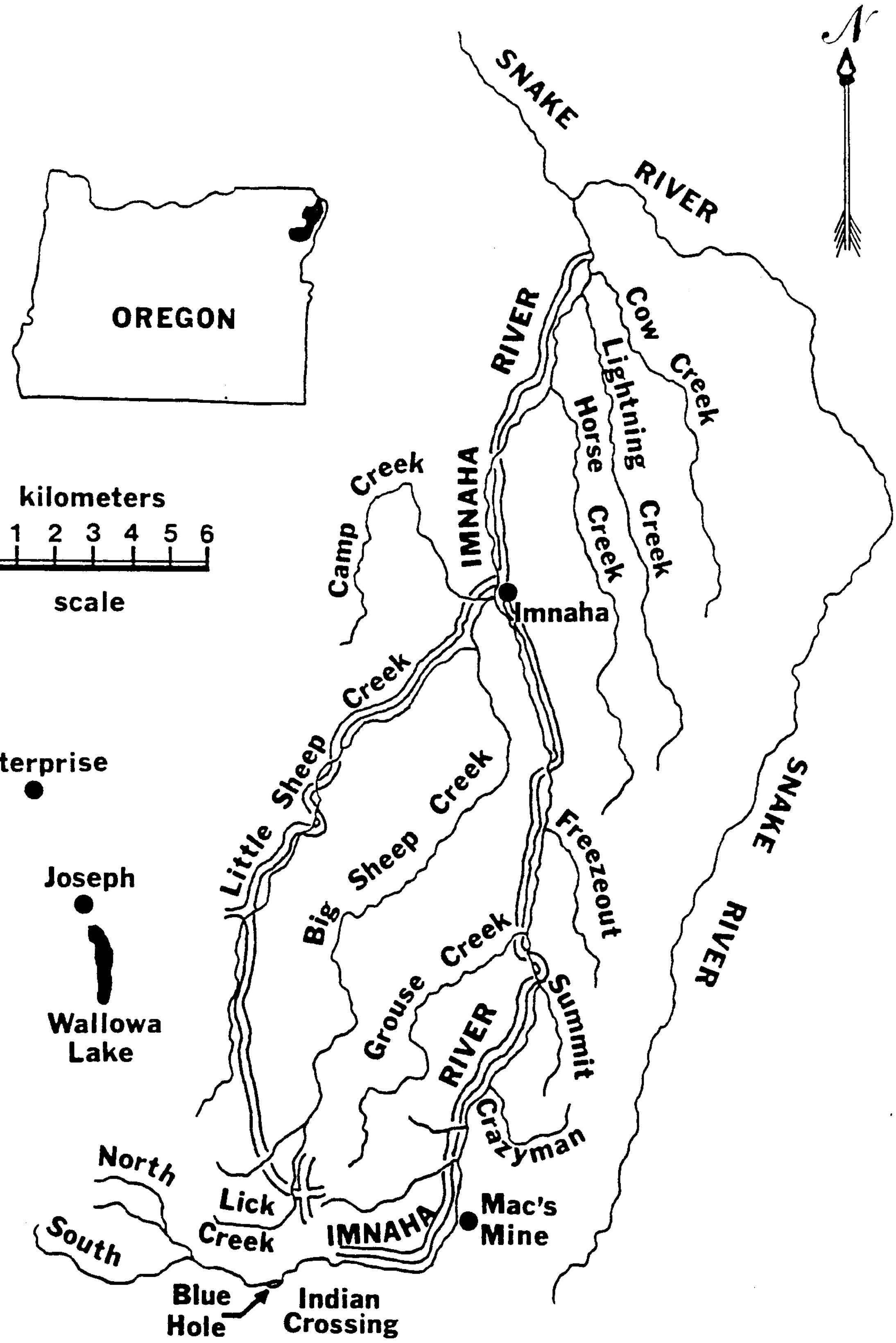


Figure 1. Map of Imnaha River Subbasin.

Three to seven glacial periods during the Pleistocene Epoch (500,000 to 11,000 years ago) carved the upper U-shaped valleys and provided the increased runoff that cut through the basalt, forming the deeply incised lower valleys. Mass wasting processes, such as rock falls, debris flows, and mass slumping, continue to widen the valleys. Sediment loading in the streams is frequently the result of these processes.

Soils are generally derived from the weathering of local bedrock or colluvial rock materials (these are called residual soils). Thus, granitic soils predominate above Indian Crossing (from weathering of the Wallowa batholith) while basaltic soils predominate below Indian Crossing. Residual soils tend to be deeper on north and east facing slopes (capable of supporting conifer stands) and more shallow on south and west facing slopes (capable of supporting mainly grasslands). Forces other than weathering of bedrock, however, have also been active in the subbasin. Wind derived soils (loess) and ash deposits from the eruptions of Glacier Peak (12,000 years ago) and Mount Mazama (6,600 years ago) have added greatly to the productivity of the local soils. Ash deposits are very productive with low compactibility and high permeability and water holding capacity but, because of their low density, are easily erodible. They are generally found on the plateaus where the densest conifer stands are located.

The climate is essentially temperate continental and dry, with the Cascade Mountains acting as a barrier to the coastal marine influence. Temperature and precipitation are greatly influenced by elevation. Mean summer temperatures below 3,000 feet are 80 degrees to 90 degrees Fahrenheit and mean winter temperatures are 30 F. Between 3,000 feet and 6,000 feet, the mean summer temperature is 61 F and the mean winter temperature is 20 F. Above 6,000 feet the average temperature in July is 54 F and in January is 14 F. Precipitation below 2,000 feet there is substantial loess influence. Bluebunch wheatgrass and Idaho fescue communities occur on soils between the two extremes. Cheatgrass is a common invader of overgrazed slopes. Occasional Douglas fir stands are also found in sheltered, north slope areas.

Midslope areas (3,000 feet to 5,000 feet) have Douglas fir, often in association with ninebark, growing on the north aspect slopes. Grassland meadows are found in scattered locations on the north slopes while they predominate on the drier south slopes.

Areas above 5,000 feet are more heavily forested, primarily with grand fir associations. The soil characteristics again help to determine which tree species grow best. Soils with ash present support stable grand fir or subalpine fir communities. Douglas fir and ponderosa pine communities are found in areas with little or no ash. Douglas fir needs a high loess content in the soil, however, and is at a competitive disadvantage to ponderosa pine on residual soils. Subalpine fir and whitebark pine associations dominate the highest elevations until they finally give way to true alpine plant associations in the Eagle Cap Wilderness Area's highest reaches.

In the low elevation areas, white alder, box elder, cottonwood, and water birch are common where surface water is available. Douglas hackberry and occasional ponderosa pine are found in the drier areas. Choke cherry and bitter cherry are common components of the understory. Black locust, an introduced species, is increasing its range. The midelevations are dominated by Douglas fir and ponderosa pine stands, providing good shading for the streams. Engelmann spruce is located throughout the moister forested reaches.

The North Fork Imnaha River and the South Fork were considered to be inaccessible to anadromous fish due to a series of cataracts and torrential flows (Table 1) in the upper five miles of the mainstem above the Blue Hole (RM 58.6) (Thompson and Haas 1960). Twenty-two chinook redds, however, were counted above this section in 1988. This is the first documented evidence of spawning in this area (K. Witty, ODFW, pers. commun.) Barriers to fish migration in the other tributaries are steep gradients except in Big Sheep and Little Sheep creeks where low flows caused by irrigation withdrawals can be a problem.

Table 1. Major habitat constraints in the Imnaha River Subbasin.

Location Other	Anadromous Fish Present	Sedimentation	Low Flows	Water Quality	Migration Barriers
Imnaha River	spring chinook summer steelhead				numerous cataracts and falls in upper five miles before the forks
Horse Creek (RM 12)	summer steelhead				
Lightning Creek (RM6)	summer steelhead				
Big Sheep Creek	spring chinook summer steelhead		Area below Wallowa Valley Improvement canal diversion dam		diversion dams, steep gradients in upper reach.
Lick Creek	spring chinook summer steelhead				steep gradients in upper reaches
Little Sheep Creek	summer steelhead		area below Wallowa Valley Improvement canal diversion dam		Wallowa Valley Improvement canal diversion dam
Camp Creek	summer steelhead				steep gradients in upper reaches

(See presence/absence file for a more complete list.)

Water Resources

Water resources are generally sufficient to sustain anadromous fish (Smith 1975). A water gage at the town of Imnaha, Oregon has been monitored continuously by the U.S. Geological Survey since 1928. The average river flow through water year 1985 was 522 cubic feet per second (cfs). The maximum discharge of 10,100 cfs occurred on January 17, 1974 while the minimum discharge of 16 cfs occurred on November 22, 1931 (Alexander et al. 1985). The mean monthly discharge is shown in Table 2.

Table 2. Mean monthly discharge for the Imnaha River Subbasin at Imnaha, Oregon, USGS Gage 13292000, 1928-1982 (Friday and Miller 1984).

Month	Discharge (cfs)
January	193
February	236
March	377
April	942
May	1,603
June	136
July	567
August	193
September	143
October	159
November	187
December	219

The only major irrigation withdrawal occurs in the Big Sheep Creek drainage. The Wallowa Valley Improvement Canal withdraws water from Big Sheep Creek just below the forks. This water is transported to Little Sheep Creek via a canal, picking up several small tributaries on the way. A diversion dam then shunts this water into another canal that connects with the Wallowa Valley. Water sufficient to irrigate 6,502 acres (162.6 cfs) is removed from the system May through September. The first water right for this system was filed in 1905 on Little Sheep Creek. In 1919 Big Sheep Creek was added to the system with the stipulation that any springs and tributaries along the canal could be included. The affected creeks include Big Sheep, Little Sheep, Salt, Cabin, Redmont, Canal, and Ferguson. Their screened diversions occur in high gradient reaches near the respective headwaters.

Domestic wells supply water to the majority of private residences while the town of Imnaha acquires its water from springs located on an adjacent farm. Livestock watering is another small consumptive use.

Three small hydroelectric projects, Upper Little Sheep Creek, Canal Creek, and Ferguson Ridge, are operated by Joseph Hydro Associates. These projects use water flowing through the Wallowa Valley Improvement District's canal system to produce power. They are "run-of-river" projects and are not, in themselves, water consumptive in nature. Water from the canal system is diverted through penstocks and then returned directly back to the canal system. During the irrigation period no additional waters are diverted in excess of the irrigation district's water rights. The situation changes, however, during the non-irrigating period. The projects are capable of handling 120 cfs to produce power and the owners have applied for an equivalent water right. As the irrigation district is no longer diverting water, the hydro projects now become "consumptive" water users because they are diverting water through the canals that would have normally been left in the Big Sheep Creek system. A minimum of 3 cfs must be left in Big Sheep Creek during the non-irrigating period, according to the Federal Energy Regulatory Commission (FERC) license. Only the Ferguson Ridge powerhouse is allowed to operate all year. The other two powerhouses are not allowed to operate from December through March. The reason for this prohibition is that 100 percent of Big Sheep Creek's flow is needed during the winter months to minimize ice buildup and to provide adequate rearing habitat for juvenile fish.

Fifty-nine water rights on the Imnaha River mainstem total 37.33 cfs. Out of this total, the Lower Snake River Compensation Plan (LSRCP) chinook hatchery facility will use 15 cfs in a non-consumptive manner. There are an additional 69 water rights on tributaries (excluding the Big Sheep system) for a total of 24.98 cfs. Eighteen water rights on Big Sheep Creek total 6.36 cfs; five additional water rights on tributaries (excluding Little Sheep Creek) total 1.65 cfs (this does not include the Wallowa Valley withdrawals). Four additional water rights are filed on springs for 0.29 cfs. In Little Sheep Creek, 13 claims total 22.47 cfs, 19.6 cfs of which will be used by the Lower Snake River Compensation Plan steelhead facility in a non-consumptive manner. There are an additional 11 claims on tributaries for 26.55 cfs and eight claims on springs for 0.41 cfs. This equals a combined water right of 279.61 cfs (including the Wallowa Valley diversions), 34.6 of which is non-consumptive. An additional 36 recent filings have not yet been approved (R.

DeBow, water master, Enterprise, pers. commun.). The present minimum flow required by the Oregon Department of Water Resources is 85 cfs at the Imnaha gage. Minimum flows have also been established for Big Sheep and Little Sheep creeks (Table 3), but they are ungaged. All minimum flows were converted to instream water rights on February 1, 1989.

Table 3. Instream water rights (in cfs), measured at the mouth, for Big Sheep and Little Sheep creeks, located in the Imnaha River drainage (K. Witty, ODFW, pers. commun).

	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Big Sheep	25	25	30	45	45	37	55	55	55	37	37	25
Little Sheep	10	10	13	20	20	13	13	10	10	10	10	10

Water temperatures at Imnaha are generally not a constraint to fish production. Average water temperatures range from 35.4 F in the winter to 61 F in the summer. Fall water temperatures average 43.4 F and spring temperatures average 47 F (Thompson and Haas 1960). Water quality is good to excellent with the major potential problems being in the areas around feedlots located in the lower valley, roads, and logging.

Water quality monitoring has not been conducted in any systematic fashion. The U.S. Geological Survey sampled water quality at the Imnaha gage in July and October 1971. The October water analysis included heavy metal concentrations. Mercury was the only constituent of the October sample that exceeded current water quality standards (1 milligram per liter versus 0.012 mg per liter). The source of the mercury is unknown (USGS personnel, pers. commun.). New samples should be analyzed to compare present conditions with past conditions and also with the current water quality standards. The water samples should be taken at the Imnaha gage.

Land Use

The Imnaha River Subbasin is split in ownership between the Wallowa-Whitman National Forest (71 percent), private individuals (28.5 percent) and the Bureau of Land Management (0.5 percent) (Fig. 2). The Wallowa-Whitman National Forest is further divided into separate management units -- Wallowa Valley Ranger District (20.6 percent), Eagle Cap Wilderness Area (9.1 percent) and Hells Canyon National Recreational Area (41.3 percent) (Wallowa-Whitman National Forest personnel, pers. commun.).

The headwaters of the Imnaha River above RM 70 are located in the Eagle Cap Wilderness Area and drain the eastern portion of the Wallowa Mountains. All major tributaries are located in either the Eagle Cap Wilderness Area or the Hells Canyon National Recreational Area except for the Big Sheep Creek drainage and Camp Creek.

The Wallowa-Whitman National Forest administers both the Eagle Cap Wilderness Area and the Hells Canyon National Recreational Area. Private ownership extends up the river from its mouth to RM 51 and includes most of Little Sheep Creek. The only municipality in the subbasin is the town of Imnaha (population 25). Grazing is the major activity on private land with some fields planted in hay.

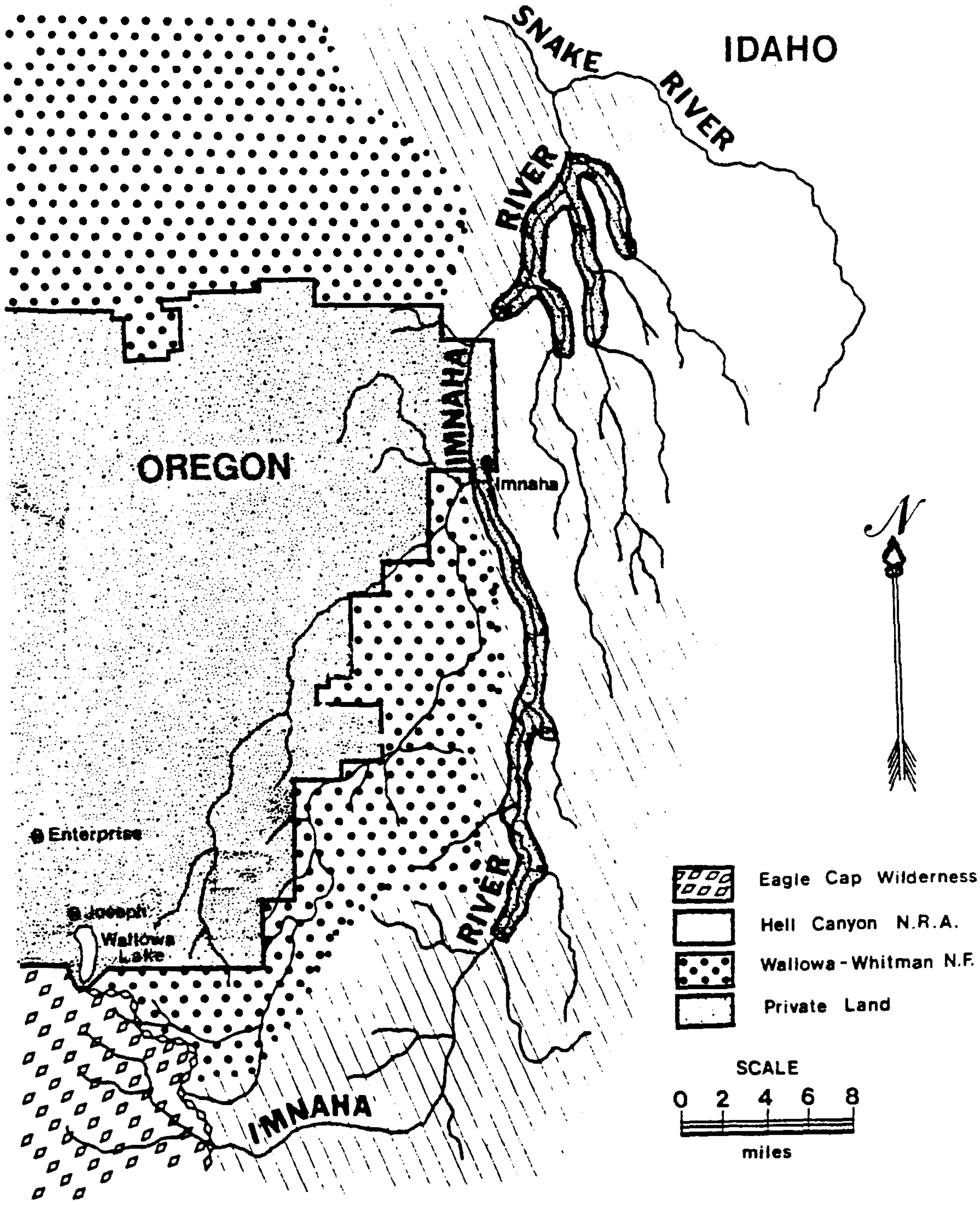


Figure 2. Imnaha Basin land ownership.

PART II. HABITAT PROTECTION NEEDS

History and Status of Habitat

The Imnaha River Subbasin is characterized by high mountains and deeply incised valleys. Elevations range from 945 feet at the mouth to nearly 10,000 feet in the headwaters. The riparian zone is generally narrow because of the steep terrain. The condition of the riparian zone is generally good.

The runoff cycle consists of maximum flows in April, May and June and minimum flows from August through January (Table 2). Precipitation varies from 10 inches in the valley bottoms to over 50 inches at the higher elevations (Johnson and Simon 1987).

Habitat degradation is generally the result when humans enter the scene with their industry, agriculture, mining, logging, and road construction. The isolation and ruggedness of the Imnaha River Subbasin has worked to prevent many of these depredations. Mining prospects are predominantly low-grade copper deposits of limited size and this, coupled with poor accessibility of the area in the 1800s, limited mining activity and its consequent habitat destruction. There are no industrial pollutants as there is no industry.

Past and present land and water uses have had and are having an unknown impact on water quantity and quality, although neither is thought to be a major factor limiting fish production (Smith 1975). Flows are generally adequate during the adult salmonid migrations and smolt outmigrations. Flows would be double their current value in August and September at the Imnaha gage if 162.6 cfs were not being diverted to the Wallowa Valley (Table 2). This extra volume of water would be useful to help reduce ambient summer water temperatures in the river, potentially increasing rearing habitat. Temperature profiles for the Big Sheep drainage have never been determined. Water rights claims for the subbasin total 279.61 cfs, 34.6 cfs of which are used in a non-consumptive manner by the Lower Snake River Compensation Plan chinook and steelhead facilities.

Roads and road construction are known to be major contributors to sediment loading in streams. Side casting of the overburden during road construction has been a common practice. In the Imnaha system, with its steep side slopes, this usually meant that the side cast material found its way into the streams. The U.S. Forest Service now endhauls this material to designated dump sites. Road construction along the Imnaha River during the winter of 1952 and 1953 (Road 3955) resulted in a rock slide approximately 15 miles above the town of Imnaha that posed a serious barrier to fish migration. The slide material was subsequently removed. U.S. Forest Service Road 39, where it enters the Gumboot Creek drainage, is constructed either on steep side slopes or in the Gumboot Creek riparian zone. This road is a potential source of sedimentation in the system and has channelized the creek.

Agricultural spraying is minimal. The major agricultural impact to fish runs is from feedlots located along Little Sheep Creek, Camp Creek, and the lower mainstem, and some seasonal irrigation problems. Riparian degradation, streambank stability problems, and manure derived sediments are usually the result when feedlots are located on streams. The actual degree to which the Imnaha River system is being impacted is unknown. The use of fertilizers could be having some affect on water quality. Overgrazing has been a major problem in the past and continues to be a major problem at the feedlots. Overgrazing and stream channelization have created some bank instability problems in Little Sheep, Big Sheep, and Camp creeks, and some portions of the mainstem (U.S. Forest Service 1981).

Chinook habitat is considered to be excellent with respect to pool-riffle ratios, spawning gravel abundance and distribution. Steelhead habitat, although not ideal, is considered to be good. Much of the riparian vegetation has been modified over time and shade is limited, except in the upper reaches. The steep canyon walls provide the majority of shade in the lower reaches.

Constraints and Opportunities for Protection

Institutional Considerations

Private individuals own 28.5 percent of the subbasin. The Wallowa-Whitman National Forest is split into three distinct management units, each with its own unique purpose and consequent management guidelines. Changing land ownership in the private sector and changing economics in the cattle and timber industries dictate continually changing land-use practices. Land use management agencies have, however, developed guidelines and regulations in an attempt to minimize these fluctuations. The only area that remains relatively static in management goals and strategies is the Eagle Cap Wilderness Area.

The Soil Conservation Service has formulated "best management practices" (BMPs) to protect agricultural lands from unnecessary erosion. There is, however, no enforcement capability inherent in the BMPs. Their usage is on a voluntary basis. Money is available from the Soil Conservation Service to help offset costs in the implementation of these practices, but it is up to the individual landowner to maintain and utilize them. Some of the best management practices applicable to the subbasin are contour plowing, exclusion fencing (designed to keep cattle out of the streams), development of off-river water troughs, and moving feedlots away from the streams (SCS personnel, pers. commun.).

The U.S. Forest Service and the Oregon Department of Forestry have both developed "forest management practices," which lay out general and specific management requirements for logging on federal and private lands, respectively. An environmental impact statement and comprehensive management plan was developed for the Hells Canyon National Recreational Area and was published in final form in 1981. The U.S. Forest Service wrote the plan with input from the public and industry. The plan delineates how the Hells Canyon National Recreational Area will be managed. The Wallowa-Whitman Forest plan is still in the draft stage. When complete, this plan will lay the foundation for management goals and strategies on national forest lands outside of the Hells Canyon National Recreational Area and the Eagle Cap Wilderness Area. The above plans and practices must in themselves conform to various state and federal laws and regulations discussed in Part III of this plan. The Eagle Cap Wilderness Area is managed according to the guidelines written into the Wilderness Act under which it was created.

The Lord Flat-Somers Point Wilderness Study Area (U.S. Forest Service 1981) is in the Imnaha drainage and includes portions of Horse, Lightning, and Cow creeks and their tributaries. This area was removed from consideration as wilderness in 1984 and was designated as a "roadless" area. The "wild and scenic" designation for the entire Imnaha River mainstem and South Fork, enacted in 1988, will help determine the future management parameters for a large portion of the subbasin.

The Hells Canyon National Recreational Area is contained within five counties, Wallowa and Baker counties in Oregon and Nez Perce, Idaho, and Adams counties in Idaho. These counties, in cooperation with the U.S. Forest Service, developed a model ordinance for managing the use and development of private lands within the Hells Canyon National Recreational Area. Under the ordinance, primary responsibility for zoning and enforcement falls on the five counties. The majority of private land in the Hells Canyon National Recreational Area is located in Wallowa County (U.S. Forest Service 1981).

Critical Data Gaps

Critical information needs are developing in regard to the Engelmann Spruce salvage sales. Spruce tends to grow in moist locations, frequently representing a substantial proportion of the riparian shading. Decisions on logging in the riparian zone are pending. The mainstem is presently poor in large woody matter, partly due to the U.S. Forest Service removing windthrows during salvage operations. Water temperatures and sedimentation rates will probably increase as a result of these salvage operations. The U.S. Forest Service uses computer models to determine logging effects on these two parameters. Monitoring to gather baseline data is identified as a recommended action (see habitat protection actions) and should continue during logging operations to verify accuracy of the U.S. Forest Service's models.

Sedimentation has not been a severe problem in the subbasin. The granitic soils tend to be more erodible than the basaltic soils, however, and Wallowa District personnel have assumed that most of the sedimentation observed in the drainage is coming from the Eagle Cap Wilderness Area during major storm events (U.S. Forest Service, Wallowa District, pers. commun., 1988). Domestic sheep grazing in the Eagle Cap Wilderness Area may be exacerbating the problem (K. Witty, ODFW, pers. commun.). These suppositions should be checked.

Habitat Protection Objectives and Strategies

Objective

Strive for no net loss (actual net gain where practical) in habitat quality and quantity.

To accomplish this end, certain information needs to be gathered and certain strategies need to be formulated. As in all aspects of water and land management, cooperation among various entities is essential to the realization of the objective because no one entity controls the entire subbasin.

Strategies

The Imnaha Subbasin is in a relatively pristine condition. Sedimentation is potentially the most serious problem. Logging, road building, feedlots, and farming all have the potential of being sediment producers and thereby adversely affecting fish production.

Species-specific effects have not been documented and may not yet have occurred from habitat degradation. The following actions are designed to determine the present state of the habitat, prevent further degradation, and to reverse present adverse trends.

1) Water quality has not been evaluated at the Imnaha gage since 1971. A new study should be initiated to determine current conditions and to compare these conditions with present standards.

2) Irrigation diversions are not monitored. All diversions should be monitored to ensure they are within established water rights.

3) Minimum streamflows have been established for Big Sheep and Little Sheep creeks. Stream gages should be installed at the mouths of these creeks to monitor whether these minimum lows are being met.

4) Unscreened irrigation diversions kill fingerlings and smolts. By 1988, most of the diversions in the subbasin will have been screened. Oregon Department of Fish and Wildlife personnel have been screening these diversions for the last few years with money provided by the National Marine Fisheries Service under the Mitchell Act. The last diversions, in Lightning and Horse creeks, will be screened in 1989 (ODFW personnel, pers. commun.).

5) The U.S. and Oregon "forest practices" acts delineate various logging practices based on soil type, slope, aspect, and tree species. The guidelines are designed to minimize erosion and maximize stand recovery and should be followed. Logging should be excluded from the riparian zone on Class I and II streams. "Leave strips" along Class III streams should be 75 feet, and along Class IV streams and wet areas 50 feet or sufficient in all cases to prevent sedimentation and temperature increases.

6) The U.S. Forest Service bases its estimates of habitat degradation due to timber sales on various models. The veracity of these models in relation to the Imnaha Subbasin needs to be checked.

7) The mainstem Imnaha is poor in large woody debris. This deficit could be reduced by either allowing dead trees to naturally fall in the river or by creating artificial windthrows.

8) Road construction and corresponding sediment production should be limited by minimizing the number of roads constructed. The roads that are constructed should be well engineered, constructed by qualified personnel and located outside of the riparian zone.

9) Cattle feedlots have increased in recent years. Problems associated with the feedlots include riparian zone degradation, bank stability, and water pollution. Feedlots should be moved away from streams and constructed to prevent the manure-derived sediment from reaching the water.

10) Cattle grazing is a problem in some areas. Riparian vegetation has been impacted and bank stability problems have developed. Exclusion fencing along streams where cattle grazing has created bank erosion and riparian degradation would prevent future problems in these areas. The areas that would benefit from fencing are Big Sheep Creek (7 miles), Little Sheep Creek (12 miles), Camp Creek (4 miles), and the Imnaha River mainstem (10 miles). Since both sides would need to be fenced, the above mileages would need to be doubled. Fencing costs are estimated to be $3,710 per mile for 3-strand wire fences. Construction of these fences will not produce identifiable increases in production capacity, but they will help to prevent future identifiable decreases in production capacity that will result if unrestricted grazing is allowed to continue. Most of the areas are where feedlots have been constructed directly adjacent to the streams.

11) Monitoring for the purpose of collecting baseline fisheries production information should commence in areas proposed for U.S. Forest Service logging activities. This information is essential to evaluating future fisheries impacts of proposed timber sales.

PART III. CONSTRAINTS AND OPPORTUNITIES FOR ESTABLISHING PRODUCTION OBJECTIVES

Institutional Considerations

Various federal, state, tribal, and local governmental agencies are involved in managing the resources of the subbasin:

Federal
- Forest Service
- Bureau of Land Management
- Fish and Wildlife Service
- Soil Conservation Service
- Geological Service
- Army Corps of Engineers
- Federal Energy Regulatory Commission
- Bonneville Power Administration
- Northwest Power Planning Council
- Bureau of Reclamation
- Bureau of Indian Affairs

State
- Oregon Department of Fish and Wildlife
- Department of Environmental Quality
- Division of State Lands
- Land Conservation and Development Commission
- Department of Forestry
- Water Resources Department/Commission

Tribal
- Nez Perce Tribe
- Confederated Tribes of the Umatilla Indian Reservation

Local
- Wallowa County Road Department
- Wallowa County Planning Commission
- Wallowa County Court

Cooperation between fish and wildlife interests and water and land management entities has been limited. The permit process for stream alterations and small hydro projects has provided access for outside interests to get involved in management decisions relating to the environment and, incidentally, fisheries. Forest plans have provided an additional opportunity for the various entities, through a comment and appeal process, to have an effect on land and aquatic management decisions involving the Wallowa-Whitman National Forest. Fisheries management decisions have been primarily the domain of the Oregon Department of Fish and Wildlife and the Nez Perce Tribe through United States vs. Oregon. Cooperative fisheries management between the tribe and Oregon Department of Fish and Wildlife has been increasing in recent years.

Federal

The U.S. Forest Service (USFS) is responsible for managing the Wallowa-Whitman National Forest. The Bureau of Land Management (BLM) manages a small amount of acreage for grazing. The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) are resource-protection agencies. The U.S. Soil Conservation Service (SCS) and the U.S. Geological Survey deal with soil, hydrology, and geomorphology. The Federal Energy Regulatory Commission (FERC) is responsible for the licensing and regulation of non-federal hydropower projects. The Bonneville Power Administration (BPA) owns the federal power dams and markets power through the federal power grid. BPA provides money for mitigation of fisheries resource damage in the Imnaha River caused by the four lower Snake River dams under the Lower Snake River Compensation Plan (LSRCP). The U.S. Army Corps of Engineers (COE) operates the federal dams and maintains an interest in all waters of the United States. Stream alterations must be approved by the Corps through a permit process. The Columbia Basin Fish and Wildlife Authority (CBFWA) is made up of Columbia Basin fisheries agencies and tribes and is a coordination body of those entities.

State

Oregon state agencies active in the subbasin are involved in the day to day management of the resources and environmental quality. The Oregon Department of Environmental Quality (DEQ) monitors water and air quality. The Oregon Department of Fish and Wildlife (ODFW) develops management plans for fish and wildlife, administers the plans, and operates state hatcheries. The Oregon Department of Water Resources (ODWR) allocates water rights and oversees their use. The Oregon Division of State Lands (DSL) issues stream alteration permits. The Department of Forestry (DOF) developed the state Forest Practices Act. Two Wallowa County agencies are active in the subbasin. Wallowa County Road Department maintains all non-Forest Service roads and the Wallowa County Zoning Commission sets zoning codes and issues building permits.

Tribal

The Nez Perce Tribe ceded vast areas of the Snake River Basin, including lands of the Imnaha Subbasin, to the U.S. government in 1863, but maintained fishing rights reserved by treaty with the U.S. government (see Nez Perce Tribe Treaty of 1855). The treaty, among other things, reserved Nez Perce tribal rights to fish at all usual and accustomed fishing sites within the Imnaha Subbasin. The tribe is actively involved with the

Oregon Department of Fish and Wildlife in the co-management of natural resources within the Imnaha. Also by treaty, the Confederated Tribes of the Umatilla Indian Reservation have reserved usual and accustomed fishing sites located within the Imnaha Subbasin.

Local

The County Road Department constructs and maintains county roads in the subbasin. The County Planning Commission sets zoning ordinances and issues building permits. The County Court mediates legal differences and enforces laws through the sheriff's department.

Private

Two private organizations are located in the subbasin. The Wallowa Valley Improvement District maintains and operates a series of canals that divert water from the Big Sheep Creek drainage into the Wallowa Valley. Joseph Hydro Associates operates three small hydro projects in the canal system.

Legal Considerations

Several federal laws and acts relating to fish, water and land management are applicable to the subbasin. The Hells Canyon National Recreation Area was established by PL 94-199 in 1975 while the Eagle Cap Wilderness Area was established in 1940. The U.S. Forest Service operates under several acts that mandate protection and enhancement of fisheries resources (The Organic Administration Act of 1897, Multiple Use-Sustained Yield Act of 1960, and the National Forest Management Act of 1974). The National Environmental Policy Act (NEPA) of 1969 requires that environmental impact statements be developed for all major land and stream alteration projects.

The Fish and Wildlife Coordination Act of 1958 (PL 88-624) provided the means for mitigating the impacts of federal dams on fish and wildlife. The Water Resources Development Act of 1976 authorized the development of the Lower Snake River Compensation Plan to mitigate for damages to fish and wildlife directly attributable to the four lower Snake River dams. The United States-Canada Pacific Salmon Treaty of 1985 provides a framework for protection and enhancement of Columbia River stocks coastwide. Senate Bill 2148, the Omnibus Oregon Wild and Scenic Rivers Act of 1988, protects 68 miles of the mainstem Imnaha River and nine miles of the South Fork Imnaha. Various management units are included on the mainstem. The 6-mile segment from the confluence of the forks to Indian Crossing is "wild." The 58-mile segment from Indian Crossing to Cow Creek is "recreational." The last four miles from Cow Creek to the mouth is "scenic." All of the South Fork is classified as wild.

The United States vs. Washington and United States vs. Oregon case laws provide legal guidelines for joint state and tribal management of fisheries in the Imnaha Subbasin. The treaty between the Nez Perce Tribe and the U.S. government reserved to the tribe rights to hunt and fish within the subbasin and elsewhere. The Nez Perce Tribe ceded large areas of its reservation to the U.S. government in 1863, establishing the boundaries of the present reservation. Included in these ceded lands was the Imnaha River Subbasin. The rights in the 1855 Treaty, reaffirmed in the 1863 Treaty, reserved to the tribe "...the right of taking fish in all usual and accustomed places in common with citizens of the territory..."

Tribal laws applicable to the subbasin are found in the Nez Perce Tribe Fish and Game Code. Harvest seasons are recommended by the Fish and Wildlife Subcommittee (with input from the tribal fisheries department) and passed by resolution during the Nez Perce Tribal Executive Council. This tribal government entity is the legal successor in interest to the Treaty of 1855.

State agencies active in the subbasin operate under various state laws and regulations. Laws regulating air and water quality are enforced by the Department of Environmental Quality. The Oregon Department of Water Resources operates under a mandate to establish minimum flows to protect fish. The Oregon Department of Fish and Wildlife protects and enhances the fishery resources through the development of statewide management plans that, although not specific to a particular subbasin, offer guidelines for management decisions.

Two actions affect management of the Imnaha River, itself. Water rights in the Imnaha River drainage were adjudicated in 1920. The Northwest Power Planning Council has recommended that all streams with anadromous and significant resident populations of fish be withdrawn from further hydroelectric development.

There are unresolved considerations. The Wallowa-Whitman Forest plan has not been published in a final form. With over 60 percent of the subbasin potentially loggable, the potential impacts to anadromous fish are considerable.

A major consideration for the Imnaha Subbasin is the currently anticipated level of mitigation under the Lower Snake River Compensation Plan. Mitigation goals for chinook in the Imnaha Subbasin have not been met under that program, nor will they be met with the current low (0.1 percent) smolt-to-adult survivals. The hatcheries were designed in anticipation of a smolt-to-adult survival rate of 0.66 percent.

PART IV. ANADROMOUS FISH PRODUCTION PLANS

SPRING CHINOOK SALMON

Fisheries Resources

Natural Production

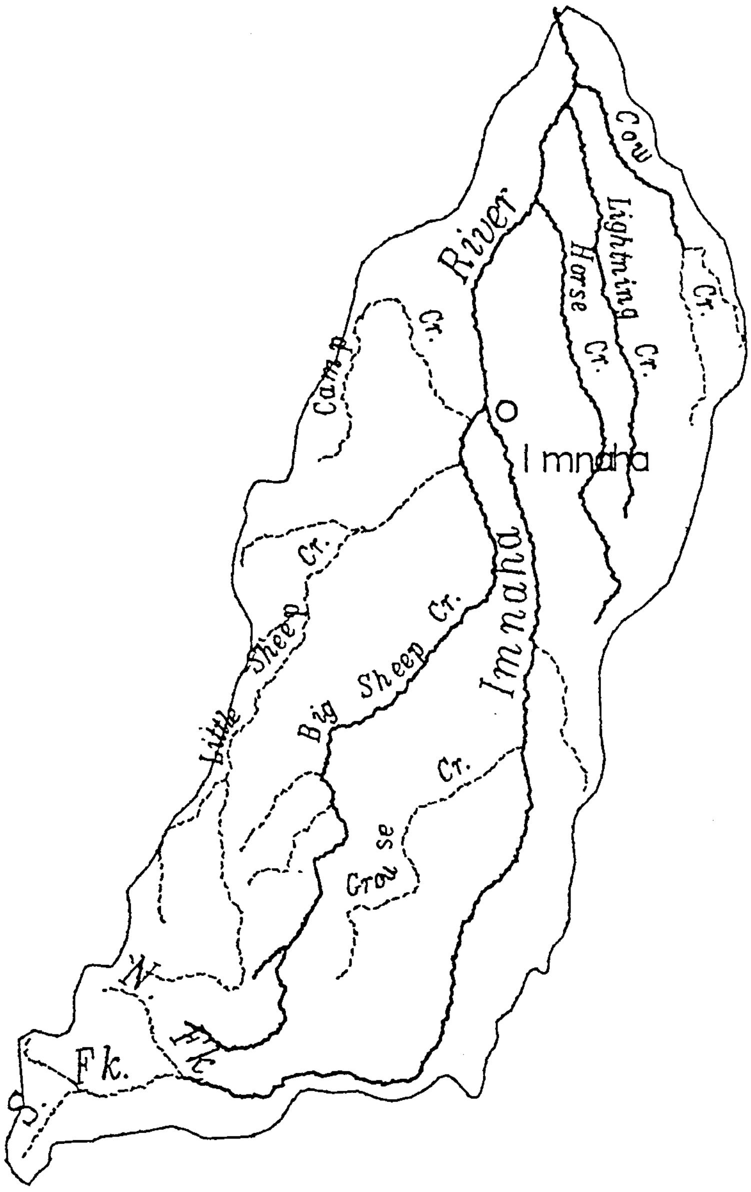
History and Status

The Imnaha River Subbasin was historically an important producer of spring chinook. Escapement to the river prior to the settlement of the area by non-Indians is unknown, but today's runs are probably a small fraction of the prehistoric runs. Overfishing in the lower Columbia River in the late 1800s and early 1900s, and the construction of power dams on the mainstem Columbia and Snake Rivers, beginning in the 1930s and ending in the mid-1970s, were the major causes of the decreased runs.

Fisheries managers have estimated that, prior to construction of the four lower Snake River dams, 6,700 spring chinook escaped to the subbasin annually (COE 1975). This estimate was based on estimating the proportion of Snake River chinook that were of Imnaha River origin and was used to determine Lower Snake River Compensation Plan mitigation goals. Smith (1975) listed an early 1970s spawning escapement of 4,392 spring chinook and 2,192 summer chinook. His numbers, however, are larger than the largest escapement estimate made by the Oregon Department of Fish and Wildlife -- 3,821 fish -- which was based on spring chinook redds counted in 1957. This number is used in United States vs. Oregon as the 100 percent seeding level for adults in the subbasin (Carmichael and Boyce 1986) and has been incorporated into subbasin planning. Using either of the above estimates, present escapement levels are substantially lower. The escapement between 1977 and 1987 is estimated to range from 132 adults to 1,428 adults, averaging 555 adults. The 1987 estimate was 480 fish (Kucera 1989).

Spring chinook spawn in the mainstem (a 30-mile section from Freezeout Creek to the Blue Hole), Big Sheep Creek (an 11.5-mile section from Coyote Creek to 0.25 miles above Lick Creek) and Lick Creek (a 2.8-mile section from the confluence to the crossing of Forest Service Road 39) (Thompson and Haas 1960, Carmichael and Boyce 1986). Spawning historically occurred in Little Sheep Creek (Thompson and Haas 1960) and was documented for the first time in the South Fork Imnaha River in 1988.

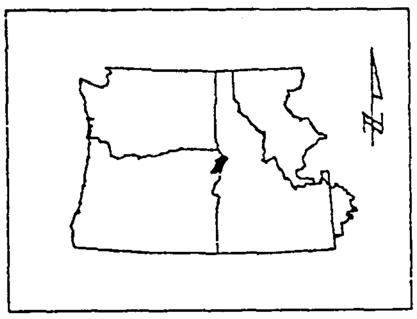
IMNAHA SUBBASIN



SPRING CHINOOK 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

Spawning surveys have been conducted annually on the Imnaha River since 1949 (Table 4) and on Lick Creek and Big Sheep Creek since 1964 (Table 5). Redd counts and their associated population estimates have been at record low levels since 1979, following the poor outmigration in the 1977 low flow year (Table 6). The run appears to be rebuilding from 1981 through 1987, although the high points are still generally below the 1977 low point (Fig. 3). Hatchery brood stock removal since 1982 is partly responsible for the reduced redd counts from 1982 to 1987.

The riverine habitat today is considered to be relatively pristine. Sedimentation rates have increased somewhat due to logging, road building, and farming and ranching practices, but that is not the major factor limiting production (Carmichael and Boyce 1986). The fact that the runs are not rebuilding (in-subbasin harvest rates are considered to be negligible) implies that out-of-subbasin smolt-to-adult survivals are still the major problem. For fish not being transported, there is a 73 percent cumulative loss of downstream migrants (smolts) in subbasins located above eight dams (15 percent per dam), although this loss is expected to decrease somewhat with installation of smolt bypass systems.

Steep gradients in the headwater reaches of the mainstem above the Blue Hole and in the tributaries form the only serious blockages to the passage of anadromous fish. A rock slide in the winter of 1952 and 1953 resulting from road construction along the Imnaha River posed a serious barrier, but was subsequently removed (Thompson and Haas 1960). During most summers, low flows and warm water temperatures prevail in the lower reaches of Big Sheep Creek. These conditions are due primarily to the diversion of Big Sheep Creek water into the Wallowa Valley Improvement Canal; with other factors being additional irrigation withdrawals, stream channelization, and riparian habitat degradation.

Life History and Population Characteristics

Fisheries managers are using only native Imnaha stocks for the hatchery supplementation program, with a continuing reliance on wild and natural fish. Natural fish are hatchery-derived fish that are spawning in the natural environment. This stock is unique in northeastern Oregon, with its run timing, age composition, and size at age more closely emulating Snake River summer chinook. An elongated anal fin and parr marks similar to a coho are also found occasionally (Carmichael and Boyce 1986).

Table 4. Annual spring chinook redd counts in the Imnaha River index area (Mac's Mine to the Blue Hole) from 1949-1987 (Carmichael and Boyce 1987, unpubl. data).

Year	Miles Surveyed	Redds	Redds/Mile
1949	9.7	256	17.0
1950	9.7	122	8.1
1951	--	--	--
1952	9.7	426	32.5
1953	9.7	348	26.6
1954	9.7	364	26.2
1955	9.7	698	69.1
1956	5.8[a]	206	35.5
1957	9.7	747	74.0
1958	9.7	129	13.2
1959	9.7	115	11.9
1960	9.7	323	33.0
1961	9.7	221	22.6
1962	9.7	248	25.3
1963	9.7	133	13.6
1964	9.7	250	25.5
1965	9.7	189	19.3
1966	9.7	223	22.8
1967	9.7	215	21.9
1968	9.7	302	24.6
1969	9.7	176	30.8
1970	9.7	176	18.0
1971	9.7	366	37.3
1972	9.7	336	34.3
1973	9.7	520	53.1
1974	9.7	277	28.3
1975	9.7	149	15.2
1976	9.7	127	13.0
1977	9.7	143	14.6
1978	9.7	415	42.3

(continued)

[a] From 1.3 miles above Coverdale to the Blue Hole.

Table 4 continued.

Year	Miles Surveyed	Redds	Redds/Mile
1979	9.7	52	5.3
1980	9.7	40	4.1
1981	9.7	99	10.1
1982	9.7	129	13.2
1983	9.7	95	9.7
1984	9.7	121	12.3
1985	9.7	145	14.8
1986	9.7	127	13.1
1987	9.7	112	11.4

Table 5. Annual spring chinook redd counts within the four mile index survey areas on Big Sheep and Lick creeks.

Year	Big Sheep Creek Redds	Big Sheep Creek Redds/Mile	Lick Creek Redds	Lick Creek Redds/Mile
1964	40	10.0	14	3.5
1965	26	6.5	25	6.3
1966	61	15.3	47	11.8
1967	30	7.5	30	7.5
1968	36	9.0	34	8.5
1969	30	7.5	4	1.0
1970	55	13.8	50	12.5
1971	57	14.3	13	3.3
1972	28	7.0	27	6.8
1973	31	7.8	16	4.0
1974	8	2.0	12	3.0
1975	14	3.5	11	2.8
1976	24	6.0	17	4.3
1977	5	1.3	5	1.3
1978	14	3.5	32	8.0
1979	0	0.0	4	1.0
1980	0	0.0	4	1.0
1981	2	0.5	2	0.5
1982	9	2.3	0	0.0
1983	11	2.8	0	0.0
1984	7	1.8	2	0.5
1985	6	1.5	3	0.8
1986	15	3.8	2	0.5
1987	3	0.8	0	0.0

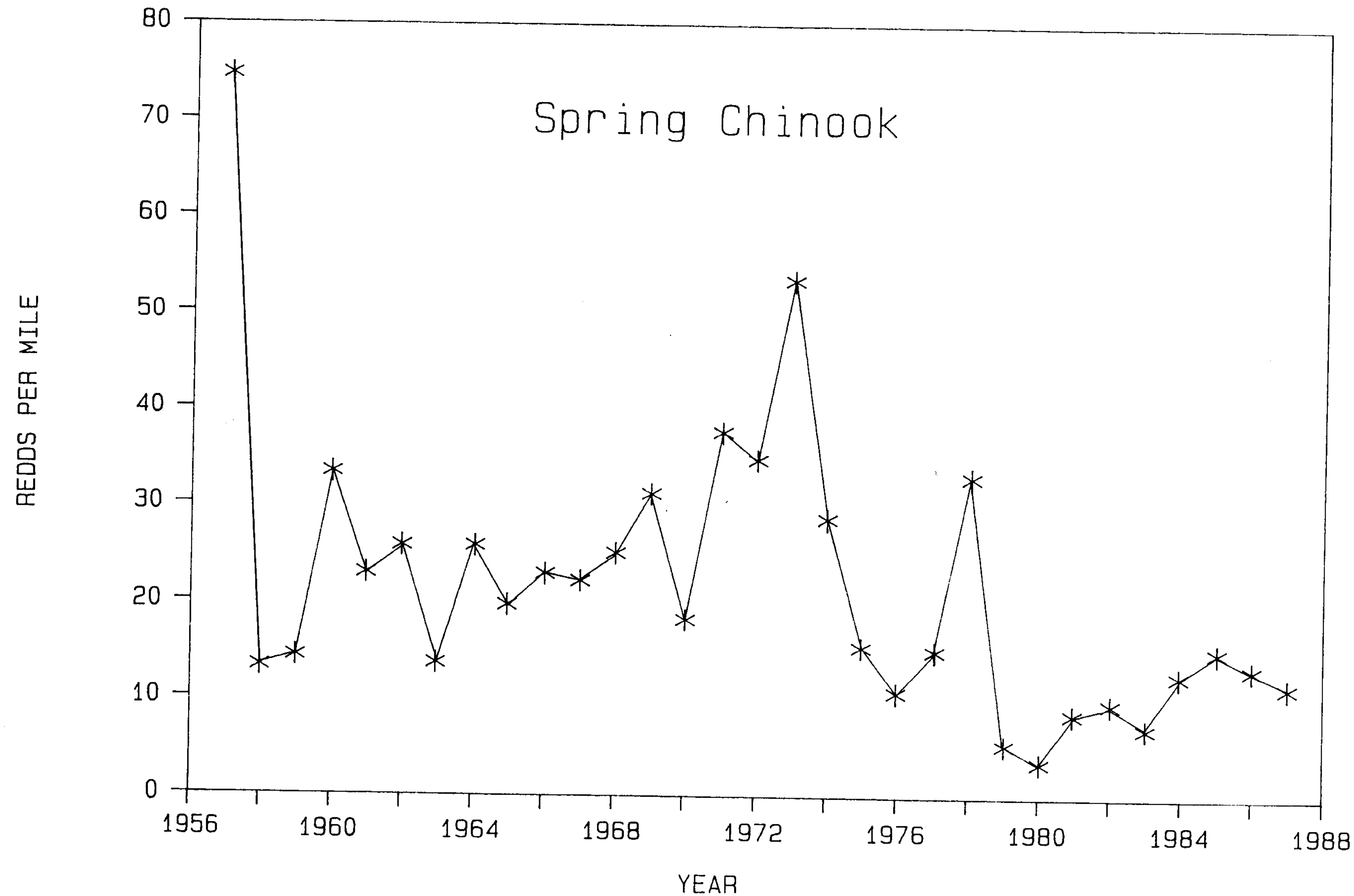


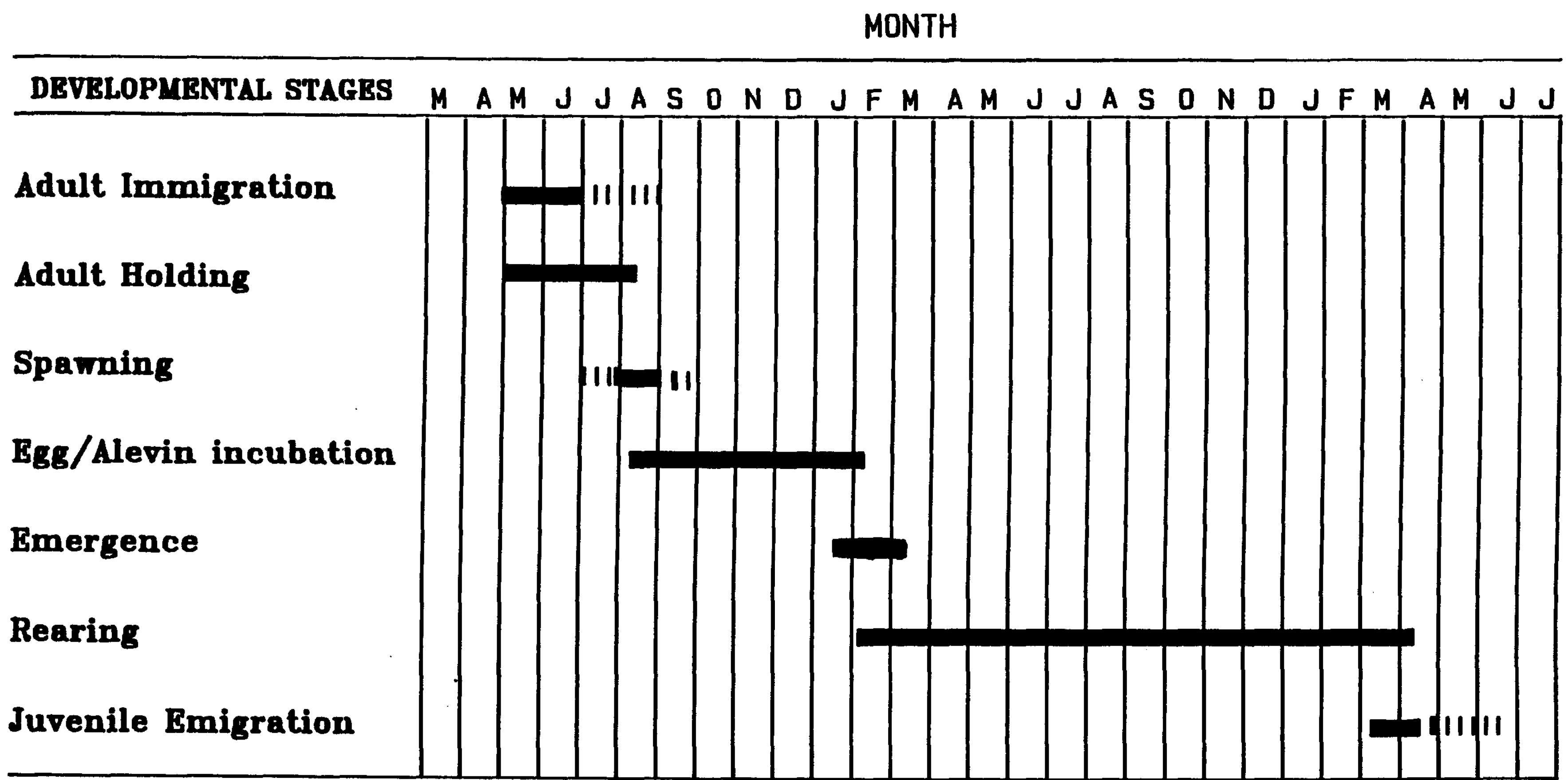
Figure 3 . Redds per mile in the index area (Blue Hole to Mac's Mine), by year, in the Imnaha River (1957-1987) .

Adults begin entering the Imnaha River in May. Spawning generally commences in July and peaks in late August to early September (Table 6). Zero-age fish begin appearing in February (Gaumer 1968). Fingerling movement in the river is related to age. Gaumer (1968) stated that 0-age fish migrated through the upper Imnaha in May, but not the lower river. Extensive migration of age-0+ chinook occurred throughout the upper river from July through September, but not the lower river. Most movement occurred in Big Sheep Creek in November and in the lower river in October and November. Juveniles produced in the Imnaha moved past Ice Harbor and McNary dams in April and May. Most were yearlings with some 2-year-olds evident. Some fish may rear for one year in the Snake River before smolting (Gaumer 1968). Fingerlings appeared in every stream sampled by Gaumer except Little Sheep Creek.

The Imnaha temporary trap facility, located at RM 49, was generally not installed until mid to late June each year, thereby missing the early part of the run. The best information available for chinook physiological parameters, however, comes from fish collected at the trap and from spawning ground surveys. Age structures vary from year to year. From 1961 through 1974, age-5 fish comprised 49 percent of the total run (Carmichael and Boyce 1986). However, only 37.1 percent of the 367 fish trapped in 1984 were age-5 fish (Carmichael and Messmer 1985). The average age structure from 1961 through 1974 was 5 percent age-3, 44 percent age-4, and 49 percent age-5 fish. Escapement in 1987 was estimated to be 480 fish and has ranged from 132 fish in 1980 to 1,428 fish in 1978 (Table 4). The average length for 1983 through 1986 was 31.3 inches (from data gathered at the Imnaha weir and carcass surveys). No attempt has been made to develop length and weight tables. Sex ratios derived from the same data were 41.4 percent females and 58.6 percent males. The average fecundity from 1984 through 1987 was 4,805 eggs per female (Carmichael et al. 1985, 1986 and unpubl. data).

PIT (passive integrated transponder) tagging studies initiated in 1988 will help to determine survival rates for wild and natural stocks. Egg-to-smolt survival has been estimated to be 3 percent at full seeding (Carmichael and Boyce 1986). Smolt production potential for the subbasin using the System Planning Model is 1,098,376 smolts, whereas for <u>United States vs. Oregon</u> (Carmichael and Boyce 1986), smolt capacity was estimated to be 245,260 smolts.

Table 6. Freshwater life history for wild and natural spring/summer chinook, Imnaha River subbasin.



Notes:
1. The developmental stage timing represents basin-wide averages, local conditions may cause some variability.
2. Solid bars indicate periods of heaviest adult immigration, spawning and juvenile emigration.

Supplementation History

Table 7 shows all known releases of hatchery fish in the system. An attempt to rebuild the runs occurred in 1966 when 119 adults were trapped at Hells Canyon Dam and released into the Imnaha River and Lick Creek. Lower Snake River Compensation Plan supplementation activity started in 1982 when 28 adults were trapped near the mouth of Gumboot Creek. Ten females were spawned and the eggs were transported to Lookingglass Hatchery located in the Grande Ronde River Subbasin (see COE 1979, Design Memorandum No. 5 for description of the facility). In 1984, managers released 29,178 smolts from that first spawning at the trap site. Since 1982, managers have spawned 182 females (1982 through 1987) and released 378,549 smolts (1984 through 1988). No smolts were released into the Imnaha River in 1987 when they became infected with erythrocytic inclusion body syndrome (EIBS). Oregon regulations prohibit the introduction of diseased fish into a system that has not previously been known to harbor the particular disease. All of the smolts were released into Lookingglass Creek.

Fish Production Constraints

Imnaha River chinook runs have decreased dramatically since the mid-1970s, even though the habitat has remained relatively stable and inbasin harvest rates have been near zero. This implies that the major problems relating to fish production are out of the subbasin. Significant improvement in mainstem passage survival rates, and/or actions to increase overall production to compensate for those passage losses (such as supplementation with hatchery reared stocks), will be necessary if runs in the subbasin are to be rebuilt to levels supporting sustained production and harvest.

Table 1 lists the major environmental constraints to production in the subbasin. Sixteen active unscreened diversions were identified by the Oregon Department of Fish and Wildlife in 1983 (CTUIR 1984). All of these diversions will have been screened by the end of 1989 under the Northwest Screening Program with funding provided by the National Marine Fisheries Service under the Mitchell Act.

Table 7. Summary of release data for spring chinook in the Imnaha River Subbasin, 1966-1988.

Brood Year	Hatchery/Stock	Release Year	Release Date	Number Released 1/	Release Site	Adult Brood Collection Site	Remarks
2/	/Snake River	1966		101(A)	Imnaha River	Hells Canyon Dam	
2/	/Snake River	1966		18(A)	Lick Creek	Hells Canyon Dam	
1982 2/	Lookingglass/Imnaha	1984	3/22/84	24,920(S)	Imnaha River	Imnaha River	
1982 2/	Lookingglass/Lookingglass	1984	3/22/84	4,258(S)	Imnaha River	Lookingglass Creek	Accidental mixing of stocks
1983 2/	Lookingglass/Imnaha	1984	9/14/84	56,235(S)	Imnaha River	Imnaha River	
1983 3/	Lookingglass/Imnaha	1985	3/25/85	59,595(S)	Imnaha River	Imnaha River	
1984 4/	Lookingglass/Imnaha	1986	3/28/86	35,035(S)	Imnaha River	Imnaha River	
1985 5/	Lookingglass/Imnaha	1987	4/20/87	123,000(S)	Lookingglass	Imnaha River	Disease forced Creek total release into Lookingglass Creek
1986 6/	Lookingglass/Imnaha	1988	3/21-22/88	102,164(S)	Imnaha River	Imnaha River	
1986 6/	Lookingglass/Imnaha	1988	4/20-21/88	97,342(S)	Imnaha River	Imnaha River	Held for EIBS treatment

1/ (A) adults
(S) smolts

2/ Carmichael and Boyce, 1986.

3/ Carmichael and Messmer, 1985.
4/ Carmichael et al., 1986.

5/ Carmichael et al., 1987

6/ Personal communication, Don Faulhaber, Lookingglass Hatchery, 1988.

At present, increasing smolt-to-adult survival levels, rebuilding of the run, and attainment of subbasin harvest and production objectives are not possible without additional assistance from hatchery production. Managers estimate that a 15 percent loss of smolts occurs at each dam (70 percent to 75 percent cumulative) although this loss is expected to decrease somewhat when all of the dams are equipped with smolt bypass facilities. Ocean and lower river mixed-stock fisheries impacts are unknown and undocumented. All combined losses equate to an estimated smolt-to-adult survival of 0.4 percent for natural fish. The survival for smolts from subbasins located above no dams is estimated to be 5.3 percent (Carmichael and Boyce 1986).

Hatchery Production

Description of Hatcheries

No hatcheries are located in the subbasin. A Lower Snake Compensation Plan satellite facility located on the Imnaha River at RM 49 serves as a collection point for chinook brood stock and as a release site for chinook smolts. The Imnaha River satellite facility is located approximately 29.5 miles south of Imnaha, Oregon at an elevation of 2,760 feet. Access is provided by Forest Service Road 3955. The facilities were completed in 1988 and consist of a fish ladder, weir type fish trap (mechanical and electrical), adult holding pond (21' X 100' X 6.5') that doubles as a smolt acclimation pond (20,000-pound capacity) and a spawning shelter. Temporary structures were in use from 1982 until completion of the permanent facilities.

Mitigation goals under the Lower Snake River Compensation Plan involve trapping 400 adults, which will provide 614,400 eggs from 128 females. The underlying assumptions are that the pre-spawning mortality will equal 20 percent, the average fecundity is 4,800 eggs per female, and that females equal 40 percent of the population. Out of the 490,000 smolts expected, 250,000 smolts will be outplanted at the satellite facility, 140,000 smolts will be outplanted in the upper Imnaha (between Freezeout Creek and Indian Crossing), and 100,000 smolts will be outplanted in Big Sheep and Lick creeks. Returns to the subbasin are expected to be 3,216 adults from these outplantings (0.66 percent smolt-to-adult survival). The 1988 spawning season used an alternate day trapping strategy for collecting brood stock where all fish trapped one day were used for production and those trapped the next day were bypassed to spawn naturally. A male-female ratio of 1-to-1 was used during spawning.

The electric weir mentioned above will allow trapping the early part of the run, which was missed with the late yearly installation of the temporary trap. This will allow for estimates of the hatchery run size to be developed with tagging studies. Even then it will be difficult to develop an estimate because of the low numbers of chinook that enter Big Sheep Creek or spawn below the trap. Hatchery returns are shown in Table 8. The first hatchery-produced fish arrived back at the trap in 1985 as jacks (14 fish). Twenty-one hatchery returns were trapped in 1986 and 22 fish in 1987.

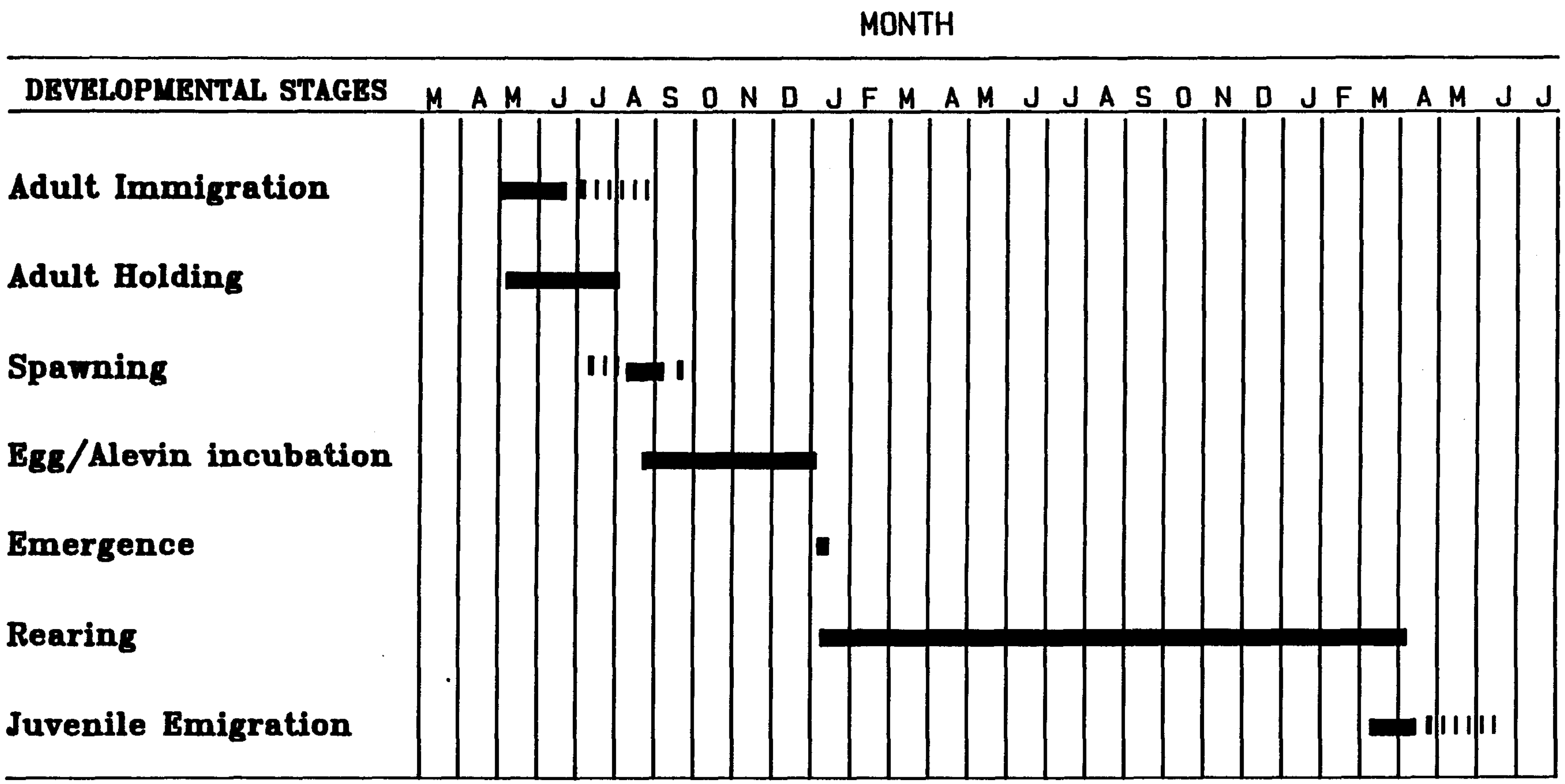
The hatchery system in the Imnaha River is of such a recent origin that a distinct "hatchery" stock has not developed and, with the continued use of non-hatchery brood stock, may be avoided. Returns to date have not been large enough to accurately develop any life history statistics. Although differences in age structure have been observed, the intent is that adult run timing, age structure, sex ratios, weight and length relationships, time of spawning and average fecundity would remain the same as for wild stocks.

Adults are trapped from June 15 to September 15 and spawning occurs from mid-July to September 15. The eggs are transported to Lookingglass Hatchery for hatching and rearing. Eggs are generally incubated until December (Table 9). "Swim-up" fish (emergence) are usually ponded around January 1. By manipulating temperatures, eggs taken throughout the spawning period can be brought to swim-up at the same time. The fry are generally ponded outdoors in April where they are raised to about 12.5 fish to 20 fish to the pound. At that time they are transferred to the acclimation pond on the Imnaha River in March or April, for release in late April. The total process usually takes about 20 months. Egg-to-smolt survival has been averaging about 70.7 percent (Evaluation Reports; Carmichael et al. 1985, 1986, and 1987). Smolt-to-adult survivals are presently estimated to be less than 0.1 percent, but are expected to improve to the 0.2 percent survivals found in the Grande Ronde spring chinook hatchery program with the completion of the permanent facilities.

Table 8. Adult spring chinook which returned to the Imnaha River weir from 1985-1987. (Carmichael et al. 1986 and in press.)

Date	Origin	Total Number	Jacks	Males	Females	Females Spawned	% Prespawning Mortality		
							J	M	F
1985	Wild	151	32	78	41	32			
1985	Hatchery	14	14	0	0	0			
1986	Wild	319	22	173	124	53	13.6	31.8	56.5
1986	Hatchery	21	7	7	7	6	0.0	0.0	14.3
1987	Wild	165	4	96	65	38	0.0	12.5	9.3
1987	Hatchery	22	16	4	2	1	0.0	75.0	50.0

Table 9. Freshwater life history for hatchery spring/summer chinook, Imnaha River subbasin.



Notes:

1. The developmental stage timing represents basin-wide averages, local conditions may cause some variability.
2. Solid bars indicate periods of heaviest adult immigration, spawning and juvenile emigration.

Constraints to Hatchery Production

Many factors will continue to constrain production of hatchery produced smolts. The continuing usage of Imnaha stocks for supplementation will necessarily mean a slow rebuilding process. Late trap installation and high pre-spawning moralities have made it difficult to meet egg-take goals. The Lower Snake River Compensation goal of 490,000 smolts has not yet been met. The largest release was 199,300 smolts in 1988. Disease has not been a major problem except in 1987 when erythrocytic inclusion body syndrome (EIBS) caused the entire smolt output to be released in Lookingglass Creek. The presence of infectious hematopoietic necrosis (IHN) virus in the parents was cited as the reason for destroying eggs in 1985 and 1986 (Carmichael et al. 1986, 1987). Whirling disease has also been reported present in the subbasin (Kucera 1989). Completion of the permanent facilities should help to reduce handling stress and subsequent pre-spawning mortalities. The weir can also be installed earlier, allowing for more of the run to be trapped.

Harvest

Sport fishing has long been a popular pastime on the Imnaha River, but diminished returns have limited the opportunities. Non-Indian sport harvest of chinook was closed in 1974 to conserve the stocks and remains closed. From 1959 through 1973, the sport catch averaged 101 fish per year. The highest catches occurred in 1959 and 1960 at 315 fish and 387 fish, respectively. The lowest catch was 19 fish in 1964 (Table 10). Carmichael and Boyce (1986) do not state what the effort was for the various years. Harvest regulations are set yearly by the Oregon Department of Fish and Wildlife with input from the district biologists.

The Imnaha River Subbasin lies within the Nez Perce Tribe's ceded area. The only data available for tribal chinook harvest is from 1973 when 39 Indians harvested 54 chinook in four days. The Nez Perce Tribe closed their subsistence fishing for chinook in 1984 and had a partial closure in 1985. The fishery has been open during all other years, however, tribal harvest is considered to be insignificant (Carmichael and Boyce 1986). Harvest regulations are set annually by the Nez Perce Tribe Executive Committee with advice from the Fish and Wildlife Subcommittee and input from tribal biologists.

Table 10. Estimated sport harvest of spring chinook salmon in the Imnaha River Subbasin, 1959-1973. (Carmichael and Boyce, 1986.)

Year		Catch
1959		315
1960		387
1961		125
1962		54
1963		45
1964		19
1965		46
1966		60
1967		45
1968		162
1969		46
1970		48
1971		26
1972		45
1973		96
	Average 1959-1973	101

Reopening of the spring chinook sport fishery and increased opportunities for tribal harvest are goals with a common solution and provide an opportunity for cooperation between the Nez Perce Tribe and Oregon Department of Fish and Wildlife. Annual production meetings are held in late winter to establish hatchery operation procedures and outplanting goals. Personnel from the Department of Fish and Wildlife and the tribe represent the fish management entities in the subbasin at these meetings.

Specific Considerations

The Imnaha River historically produced spring chinook. Prehistoric and early historic run sizes are unknown, but it was estimated that 6,700 fish were entering the river prior to construction of the four lower Snake River dams. The run size in 1987 was estimated to be 480 fish.

The Lower Snake River Compensation Plan's hatchery system is presently supplementing production in the subbasin. Under this program, 490,000 smolts will be released each year when full production is reached. The United States vs. Oregon estimate for smolt-to-adult survival above eight dams is 0.4 percent for natural production and 0.2 percent for hatchery production. This would be considered a pre-implementation estimate. The System Planning Model uses a 9 percent increase in survivals for post-implementation. This would equal 0.44 percent and 0.22 percent, respectively. Even survivals of 0.44 percent, however, are not sufficient to maintain high natural spawning population levels without supplementation. Expected Lower Snake Compensation Plan mitigation goals will not be met with survivals of 0.22 percent. Implementation refers to expected mainstem passage improvements.

Critical Data Gaps

The major data gaps are associated with survival characteristics. Egg-to-fry, fry-to-smolt, and smolt-to-adult survivals are unknown. The percent of Imnaha fish captured in the lower Columbia ocean sport and commercial fisheries is unknown. The extent of pre-spawning mortalities is unknown. PIT tagging studies initiated in 1988 along with previous coded-wire tag studies will help to answer some of these questions.

Certain natural history information is also needed. The proportion of females and fecundity for each age group is lacking. Adult and smolt capacities based upon habitat have not been determined.

A critical uncertainty is the ability of the present hatchery system to meet the Lower Snake River Compensation Plan mitigation goal. Smolt-to-adult survivals have been averaging less then 0.1 percent, but are expected to increase to 0.2 percent with the completion of the permanent facilities. Even if this survival is increased to the post-implementation survival of 0.22 percent, however, 1,461,818 smolts would be needed to produce the mitigation goal of 3,216 adults, leaving a present shortfall of 971,818 smolts. The present hatchery capacity of 490,000 smolts will only return 1,078 adults, leaving an adult shortfall of 2,138 fish.

Personnel from the Oregon Department of Fish and Wildlife field office at LaGrande expect improvements in hatchery procedures and mainstem passage to eventually increase smolt-to-adult survival to 0.4 percent (R. Carmichael, Oregon Department of Fish and Wildlife, pers. commun.). Even with this expected increase, however, 804,000 smolts would still be needed to meet the mitigation goal, leaving a shortfall of 314,000 smolts. The present hatchery smolt capacity will only produce 1,960 adults, leaving a shortfall of 1,256 fish. The Oregon Department of Fish and Wildlife is evaluating the Lower Snake River Compensation Plan's hatchery system to determine what hatchery techniques will give the greatest survivals. If an upward trend in survivals cannot be shown in three hatchery generations, and mitigation goals cannot be met in four hatchery generations, then the Lower Snake River Compensation Plan should be required to provide additional funding for a new hatchery sized to meet the shortfall.

Another critical uncertainty is whether population dynamics and genetics will change with such a large influx of hatchery fish.

<u>Objectives</u>

Management Guidelines

1. Native stock will be used for the present and planned future hatchery supplementation programs. A natural component will continue to be a part of the hatchery brood stock program.

2. Yearly production coordination meetings will continue to be held during the late winter for the purpose of developing fish release programs.

Biological Objectives

1. Obtain an escapement to the mouth of the river of 5,740 adults (natural spawners, hatchery brood stock, and harvest).

2. Return 3,800 natural spawners to the spawning grounds (1957 level) and return 1,240 adults for hatchery program brood stock (0.22 percent smolt-to-adult survival).

3. Achieve a reasonable distribution of spawners throughout the available spawning areas.

Utilization Objectives

1. Establish tribal and sport harvest opportunity in the subbasin.

2. Provide opportunity for an annual non-selective tribal harvest of 350 fish.

3. Provide opportunity for an annual non-selective sport harvest of 350 fish.

Assumptions and Rationale: The utilization objectives are based on full realization of the production goals. Obviously, many years will pass prior to fulfillment of these goals. At some point, harvest can be reopened on a reduced scale.

The estimated potential for natural spawners is 3,821 adults (Carmichael and Boyce 1986).

In-subbasin habitat has not changed appreciably since the late 1950s and may actually have improved in recent years due to a reduction in sheep grazing.

The following profile is based on post-implementation smolt-to-adult survivals. These survival rates are carried through the following strategies unless otherwise stated.

Natural Production:	
natural escapement	1033
hatchery supplementation	2797
Brood Stock Needs:	
present LSRCP	282
additional LSRCP needs	560
additional needs	398
Harvest	<u>700</u>
Total	5770

Assumptions:

adult returns from natural spawners 1003

2.4 fish per redd

4800 eggs per female

3.0 % egg-to-smolt survival (<u>United States vs. Oregon</u>)

0.44 % smolt-to-adult survival (post implementation)

3,800 - 1,003 = 2,797 (shortfall from natural spawners which must be made up yearly by hatchery supplementation)

2,797 + 700 (total harvest) = 3,497 (total returning adults needed from yearly hatchery supplementation, excluding brood stock)

<u>Alternative Strategies</u>

The exclusion fencing action mentioned in the habitat protection objectives and strategies section is preventive in nature and could not, therefore, be modeled for increased production potential. For this reason, it has not been included in the following actions, which are designed to increase production potential. This does not mean, however, that the fencing action can be ignored. Unrestricted cattle use in the riparian zone, especially in feedlots, will eventually result in a net loss of productive capacity for salmonids.

Modeling results for each strategy are presented in Table 11 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 11. 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 11a.

STRATEGY 1: Use present Lower Snake River Compensation Plan smolt production facilities to increase run size.

This strategy, by itself, will not meet the described objectives even if smolt-to-adult survivals were increased to 0.4 percent (a rate that Oregon Department of Fish and Wildlife feels is possible) The 490,000 smolt release under the Lower Snake River Compensation Plan would only return 1,960 adults to the subbasin at the 0.4 percent survival rate. This is not sufficient to meet Lower Snake Compensation mitigation requirements or harvest and natural spawning goals.

ACTIONS: 1

1. Continue using current LSRCP facilities.

STRATEGY 2: Use present Lower Snake River Compensation Plan production and provide access to additional suitable spawning areas.

ACTIONS: 1, 3

1. -

3. Provide access to additional spawning areas. The steep section above the Blue Hole should be modified so that favorable chinook passage conditions can be made permanent. The first documented spawning in this area occurred in 1988. Approximately 20 redds were counted from the top of the steep section to about 1.5 miles up the South Fork. The hypothesis is that a freshet in 1986 flushed material into the steep section which changed the hydraulics and facilitated passage (K. Witty, Oregon Department of Fish and Wildlife, pers. commun.). Planners did not estimate costs for this action.

STRATEGY 3: Develop new hatchery production capacity by increasing production from the Lower Snake River Compensation Plan hatchery or by constructing additional facilities to meet identified mitigation objectives under Lower Snake River Compensation Plan, plus state and tribal fishery objectives.

ACTIONS: 1, 2

1. -

2. Expand production at the existing LSRCP hatchery or construct a new hatchery facility, preferably in the subbasin. The facility should be capable of producing approximately 1.66 million smolts (0.22 percent smolt-to-adult survival) of which 972,000 should be provided by the Lower Snake River Compensation Plan (the present shortfall needed to meet mitigation goals). Preferred hatchery brood stock is native Imnaha chinook.

STRATEGY 4: Increase run size by developing new hatchery production capacity in conjunction with opening new spawning areas.

ACTIONS: 1-3 (see above)

Recommended Strategy

The recommended strategy for Imnaha spring chinook is Strategy 3 (existing Lower Snake River Compensation Plan plus new hatchery capability). The rationale for this recommendation is that presently authorized Lower Snake River Compensation Plan production will not meet either LSRCP anticipated adult returns or presently identified inbasin fisheries and escapement objectives. Current analysis indicates that Strategy 3 will produce the minimum required 5,740 adults to meet objectives. The identified additional smolt need is approximately 1.66 million.

Strategy 1 produces approximately 1,578 adults (present natural run of 500 plus 1,078 from Lower Snake River Compensation Plan) to the subbasin under present low smolt-to-adult survival rates (using post-implementation survivals), while Strategy 2 (access to new spawning areas) increases production by less than 50 adults, using the System Planning Model methodology. Neither meet subbasin objectives.

Table 11. System Planning Model results for spring chinook in the Imnaha Subbasin. Baseline value is for pre-mainstem implementation, all other values are post-implementation.

Utilization Objective:
1. Establish tribal and sport harvest opportunity in the subbasin. 2. Provide opportunity for a non-selective tribal annual harvest of 350 fish. 3. Provide opportunity for a non-selective sport annual harvest of 350 fish.

Biological Objective:
1. Return 3800 natural spawners to the spawning grounds (1957 level), and 1379 for hatchery program brood stock. 2. Achieve a reasonable distribution of spawners throughout the available spawning areas.

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	347 -N	410	806	226	0(1.00)
All Nat	409 -N	446	909	255	224(1.13)
1	408 -N	445	907	255	220(1.13)
2	409 -N	446	909	255	224(1.13)
3*	1,908 -N	1,245	3,347	940	5,519(4.15)
4	1,909 -N	1,246	3,349	941	5,523(4.16)

*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. Utilize present LSRCP smolt production facilities to increase run size. No change. Post Mainstem Implementation.
2. Strategy 1 plus provide access to additional suitable spawning areas. Post Mainstem Implementation.
3. Strategy 1 plus develop new hatchery capacity. Post Mainstem Implementation.
4. Strategy 2 and 3. 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 11a. Estimated costs of alternative strategies for Imnaha 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	3,680,000	3,680,000
O&M/yr[2]	0	0	400,000	400,000
Other Costs				
Capital[3]	0	0	0	0
O&M/yr[4]	0	0	0	0
Total Costs				
Capital	0	0	3,680,000	3,680,000
O&M/yr	0	0	400,000	400,000

* 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

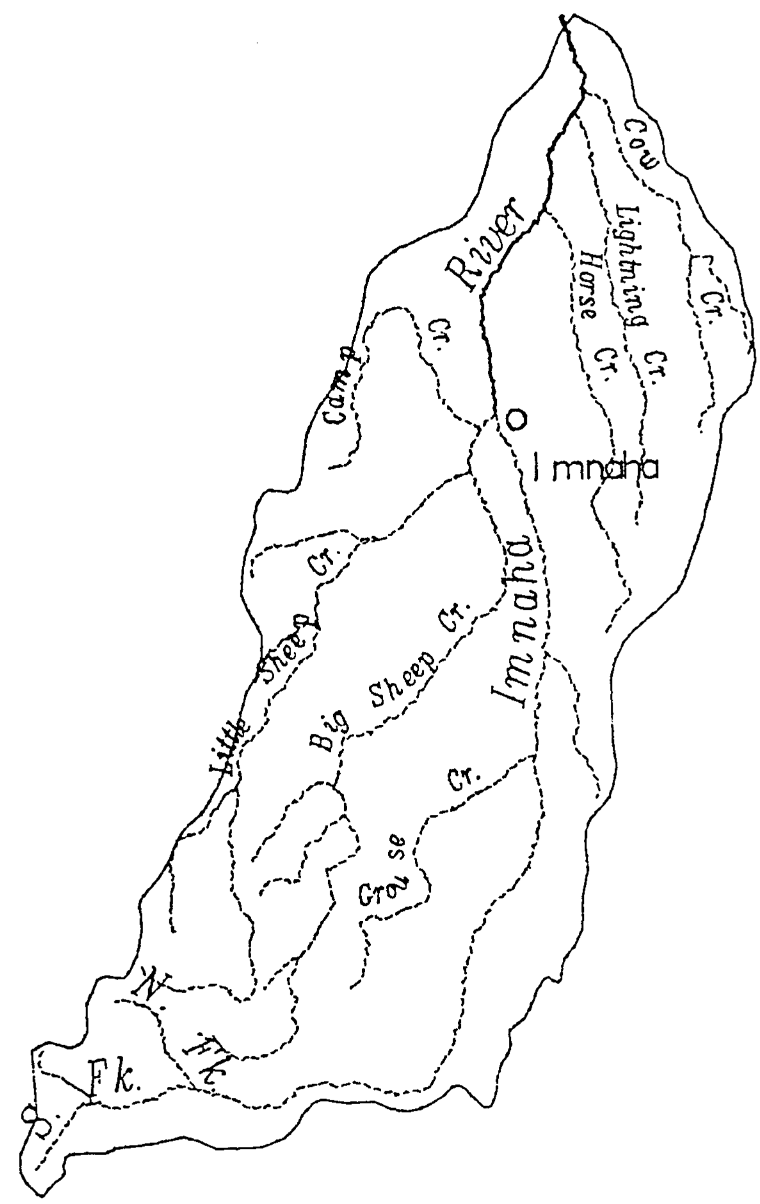
The Imnaha River fall chinook run is extinct. The historic distribution of fall chinook in the subbasin is not known, but probably extended upstream as far as the town of Imnaha, Oregon. Historic run sizes are also unknown. Three hundred fish were estimated to enter the river prior to construction of the four lower Snake River dams. This estimate was the basis for determining the Lower Snake River Compensation Plan mitigation goal of 100 adults (COE 1975) and was based on an estimate of the potential number of spawners that would fully seed the observed available habitat from the mouth to the town of Imnaha (J. Haas, ODFW, retired, pers. commun.). Smith (1975) estimated that 100 fish entered the river in the early 1970s. This estimate was based on the number of fall chinook that local district ODFW biologists felt would fully seed the available habitat in the first four miles of the river (A. Smith, Oregon Department of Fish and Wildlife, pers. commun.). Spawning surveys conducted by the Oregon Department of Fish and Wildlife between 1964 and 1968 located only zero (1968) to nine (1964) redds in the lower two to four miles of the mainstem (Table 12). A flyby while tracking radio tagged steelhead in 1987 failed to show any spawning activity, but an aerial fall chinook survey in 1988 may have documented two redds. No on-the-ground verification was made.

No studies were ever conducted to determine life histories or habitat requirements, but they were probably similar to the Snake River stock (Table 13). Although the Lower Snake River Compensation Plan initially designated a mitigation goal for fall chinook in the Imnaha River, the mitigation production was deferred to Lyons Ferry Hatchery for outplanting in the Snake River. No supplementation has occurred, nor is any presently planned.

Specific Considerations

The Imnaha River historically produced fall chinook although prehistoric and early historic run sizes are unknown. The first spawning surveys occurred in 1964 and documented the decline to extinction. The last observed spawning occurred in 1967. Spawning and rearing capacities need to be determined by experimental studies. When completed, management goals can be developed for hatchery needs and potential sport and tribal harvest.

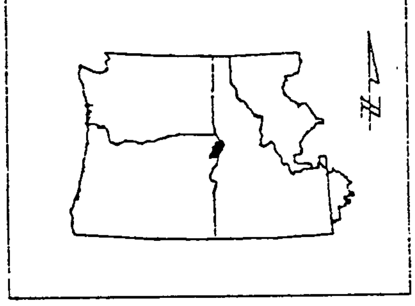
IMNAHA SUBBASIN



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 12. Fall chinook redd counts in the lower four miles of the Imnaha River.

Year	Live Fish	Redds	Location
1964	12	9	lower two miles
1965	10	3	lower two miles
1966	3	8	lower four miles
1967	1	2	lower four miles
1968	0	0	lower four miles
1969-1972			no surveys
1973	0	0	lower four miles
1974-1986			no surveys
1987 1/	0	0	flyby looking for tagged steelhead
1988 a/	3	2	lower ten miles

a/ aerial survey for fall chinook with three fish thought to be fall chinook and two possible redds with no on ground verification (NPT personnel made the observations).

1/ personal communication, Mark Schuck, WDW, Dayton, WA. 1988

Table 13. Freshwater life history for fall chinook, Imnaha River subbasin.

DEVELOPMENTAL STAGES	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Adult Immigration									■																				
Adult Holding																													
Spawning									■																				
Egg/Alevin incubation																													
Emergence																													
Rearing																													
Juvenile Emigration																													

Notes: 1. The developmental stage timing represents basin-wide averages, local conditions may cause some variability.

2. Solid bars indicate periods of heaviest adult immigration, spawning and juvenile emigration.

A critical uncertainty is the capacity for fall chinook spawning and rearing in the Imnaha River. Winter water temperatures are low and may not provide sufficient temperature units for hatching. It is possible that successful spawners were those that spawned in gravels with spring water upwelling.

The major data gaps are associated with survival characteristics. Egg-to-fry, fry-to-smolt, and smolt-to-adult survivals for the Imnaha River are unknown. These survivals need to be estimated if sufficient smolts are to be outplanted to fully seed the habitat.

Objectives

Management Guidelines

1. Snake River stock is preferred for supplementation.

2. Lyons Ferry Hatchery is the preferred source for smolts.

Biological Objective

An in-subbasin run size objective of 300 fish is identified for purposes of discussion. No utilization objective has been established.

Assumptions: In-subbasin habitat has not changed appreciably since documented spawning occurred. Straying and therefore colonization from the Snake River (Lyon's Ferry program) can be expected to occur as populations increase. This situation may have occurred in 1988 when two redds were observed.

Alternative Strategies

Modeling results are not available; Imnaha fall chinook strategies were not modeled.

STRATEGY 1: Reintroduce stock using the existing Snake River's Lower Snake River Compensation Plan fall chinook program.

ACTIONS: 1

1. Acquire smolts from Lyons Ferry Hatchery sufficient to produce returning adults to meet objectives (not modeled).

STRATEGY 2: Develop new artificial production capability by constructing a fall chinook facility. Use smolts to promote natural spawning within existing areas of the subbasin.

ACTIONS: 2, 3

2. Explore feasibility of a new artificial production facility (in-subbasin or out-of-subbasin) for the purpose of rearing smolts to meet objectives (not modeled).

3. Determine quantity and quality of spawning and rearing habitat for natural production.

Recommended Strategy

Planners have not identified a preferred strategy for fall chinook. Costs associated with additional fall chinook production have not been estimated.

SUMMER STEELHEAD

Fisheries Resource

Natural Production

History and Status

The Imnaha River was historically an important producer of summer steelhead, however, no data exists for estimating the actual run size. It was estimated that 4,000 adults escaped to the subbasin in the late 1960s, prior to construction of the four lower Snake River dams (COE 1975). This estimate was based on an estimate of the Imnaha's contribution to the Snake River run and was used to determine Lower Snake River Compensation Plan (Lower Snake River Compensation Plan) mitigation goals. Smith (1975) estimated that 3,030 adults entered the system in the early 1970s. The 1986 run size was estimated to be 1,000 adults (Carmichael and Boyce 1987). Overfishing in the late 1800s and early 1900s, and the construction of power dams on the mainstem Columbia and Snake rivers, beginning in the 1930s and ending in the 1970s, were the major causes of the decreased runs.

The historical distribution of summer steelhead in the subbasin is not known, but was probably comparable to the present. Steelhead are found in all available habitat. Steep gradients in the headwaters form the only serious blockage to anadromous fish. A rock slide in the winter of 1952 and 1953 resulting from road construction along the Imnaha River posed a serious barrier, but was subsequently removed (Thompson and Haas 1960). Low flows could be a problem in upper Big and Little Sheep creeks due primarily to irrigation withdrawals for the Wallowa Valley Improvement Canal, with other problems being additional irrigation withdrawals, stream channelization, and riparian habitat degradation.

Spawning surveys have been conducted annually on Camp Creek (a tributary to Big Sheep Creek) since 1967 (Table 14). The peak count occurred in 1967 when 18 redds per mile were observed. The average count from 1967 through 1971 was 8.4 redds per mile. In 1972 the count dropped to 1.7 redds per mile and reached a low point in 1975 and 1976 of 0.7 redds and 0.6 redds per mile, respectively. From 1977 through 1984, the counts averaged 1.9 redds per mile. The counts in 1985, 1986, and 1987 were 6.5 redds, 7.2 redds and 10.7 redds per mile, respectively. This may indicate rebuilding due in part to the supplementation efforts on Little Sheep Creek and subsequent straying, as well as improvements in mainstem Columbia River passage and harvest restrictions. Figure 4 illustrates the population rebound that has occurred since 1977.

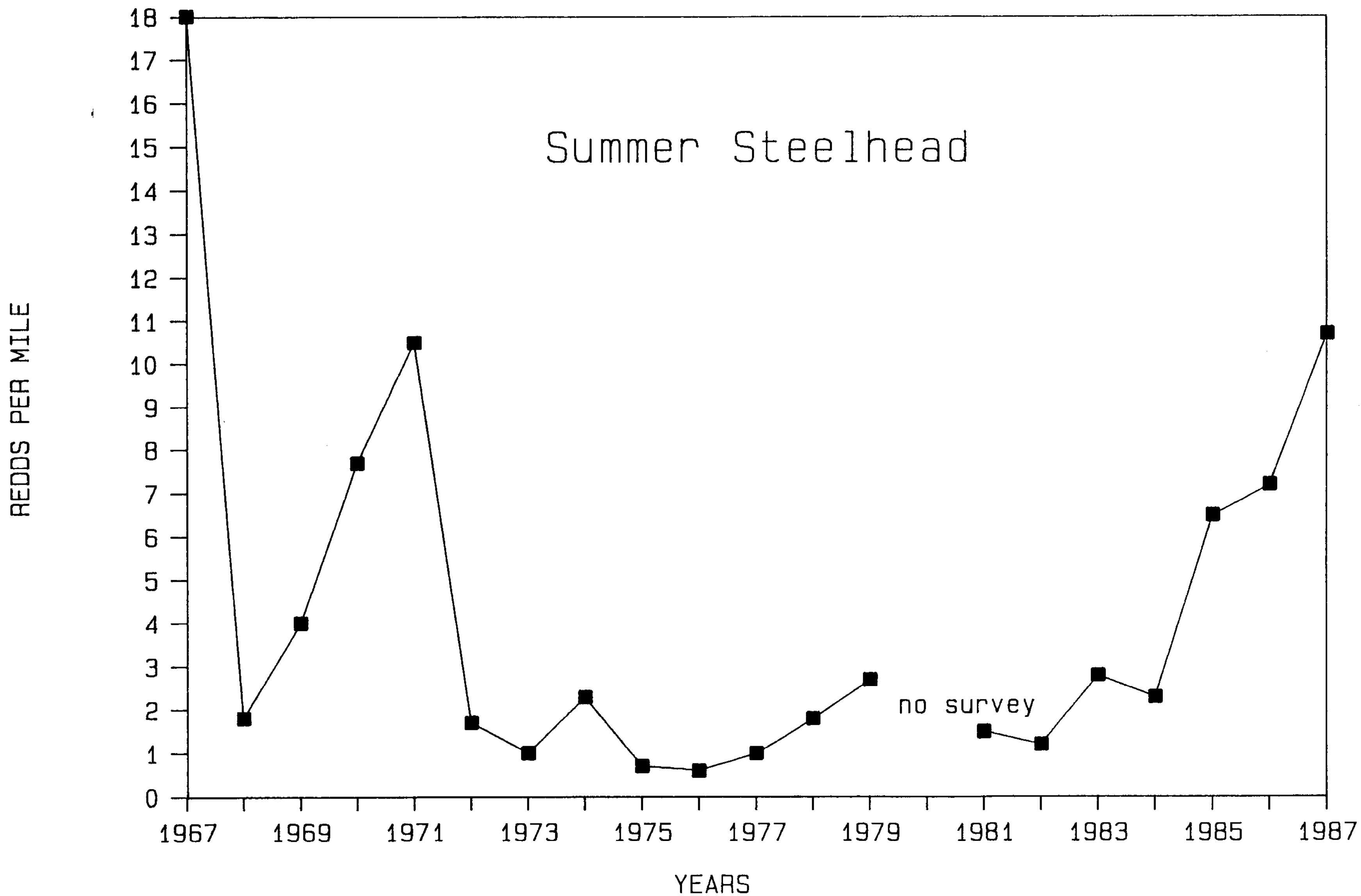
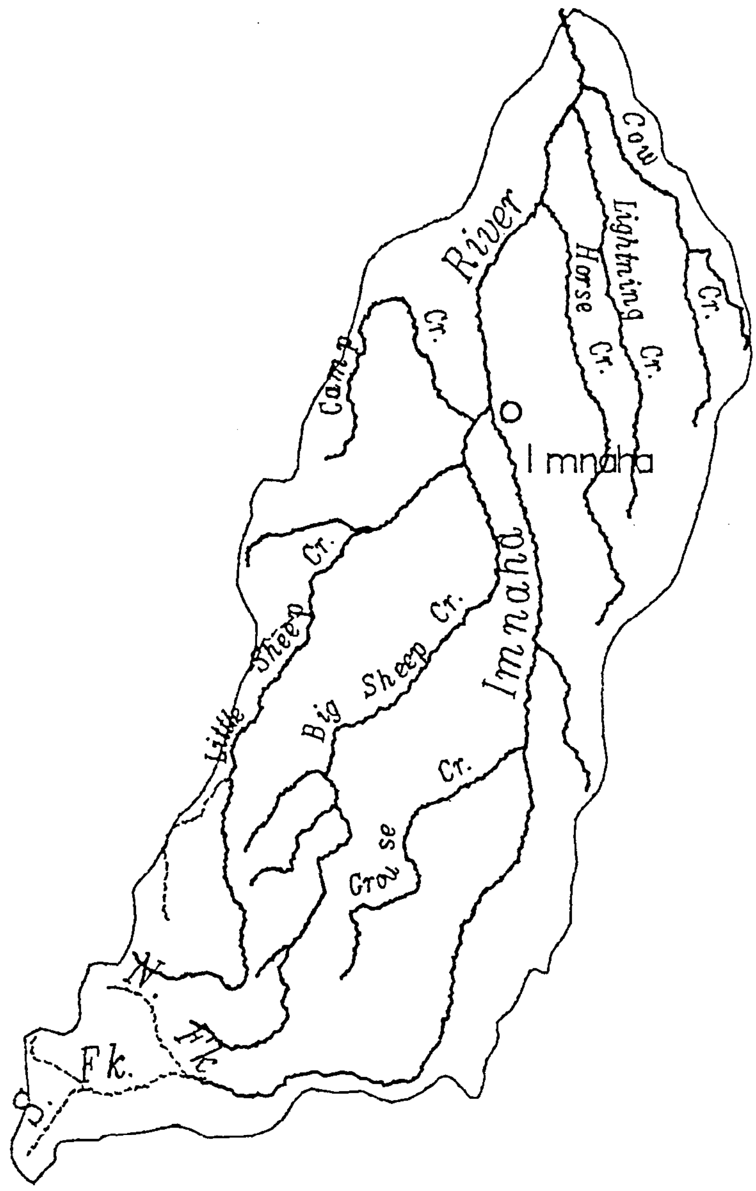


Figure 4. Redds per mile in the index area on Camp Creek, by year, in the Imnaha River Subbain (1967-1987).

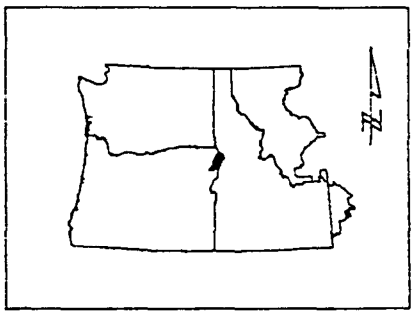
IMNAHA SUBBASIN



SUMMER STEELHEAD 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 14. Summer steelhead redd counts in the lower six miles of Camp Creek (tributary to Big Sheep Creek) from 1967-1987. (Carmichael and Boyce 1987 and in press.)

Year	Redds	Redds/Mile
1967	108	18.0
1968	11	1.8
1969	24	4.0
1970	46	7.7
1971	63	10.5
1972	10	1.7
1973	6	1.0
1974	14	2.3
1975	4	0.7
1976	1	0.6
1977	6	1.0
1978	11	1.8
1979	16	2.7
1980	a/	--
1981	9	1.5
1982	7	1.2
1983	17	2.8
1984	14	2.3
1985	39	6.5
1986	43	7.2
1987	64	10.7

a/ no survey

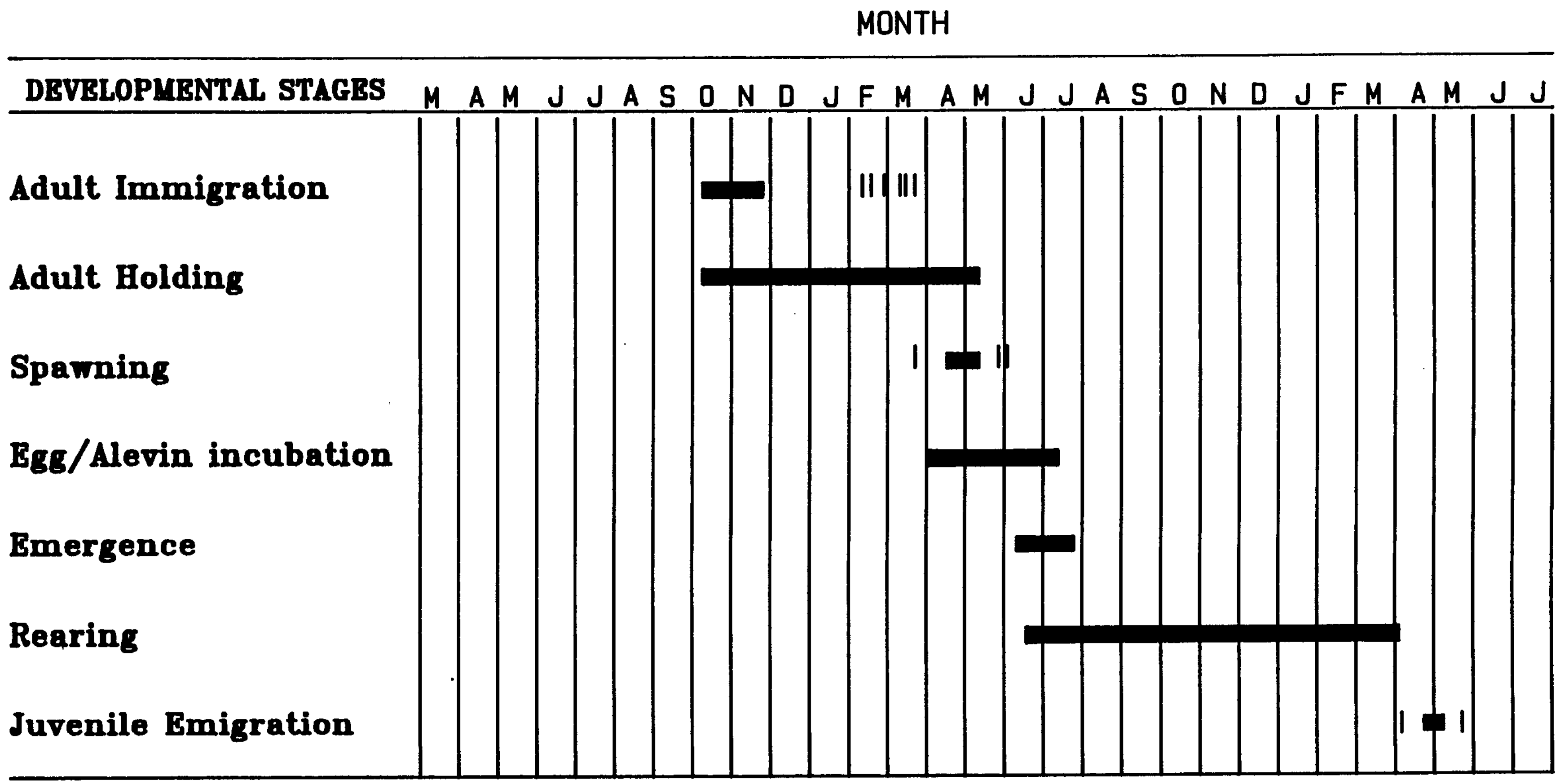
Life History and Population Characteristics

Only the native Imnaha stock is being used for the hatchery supplementation program and wild and natural fish are still being added to the hatchery brood stock. Natural fish are hatchery derived fish that spawn in the natural environment.

Adults begin entering the river as early as August with the majority entering in September and October (Table 15) (Carmichael and Boyce 1987). Fry emerge from the gravels from June to early July (Gaumer 1968). Rearing and emigration patterns vary for different streams. Gaumer (1968) reported that steelhead 1- to 3-years-old were found in most tributaries sampled, but migrated out of the smaller ones by June. Zero-age fish appeared in the upper Imnaha River and Big Sheep Creek traps in June and July and moved through the lower river in the fall. Age-1 and age-2 fish moved mostly in August and September in the upper Imnaha whereas most movement occurred in November in Big Sheep Creek. Most movement in the lower Imnaha occurred in September, October and November. Steelhead appear to move throughout the subbasin in the spring. The outmigration to the ocean generally occurs in April and May.

The best information available for steelhead population characteristics comes from the Lower Snake River Compensation Plan satellite facility on Little Sheep Creek. Freshwater rearing can take one to three years and, consequently, adult ages vary considerably. Steelhead are also potentially repeat spawners, but the survival through eight Columbia and Snake River dams for repeat spawners is probably insignificant and few would be expected in the Imnaha River. The majority of wild fish trapped at the Little Sheep Creek facility from 1983 through 1986 had reared for two years in fresh water (Carmichael and Boyce 1987). Age-4 adults comprised 62.5 percent of the total while age-5 fish were 36.7 percent and age-6 fish were 0.8 percent. There were no age-3 fish. Females equaled 88.7 percent of the total wild populations

Table 15. Freshwater life history for wild/natural summer steelhead, Imnaha River subbasin.



Notes:

1. The developmental stage timing represents basin-wide averages, local conditions may cause some variability.
2. Solid bars indicate periods of heaviest adult immigration, spawning and juvenile emigration.

The average fecundity from 1984 through 1987 was 4,495 eggs per female (hatchery and wild). No length and weight relationships have been developed. More years of data will be necessary to determine whether a separate hatchery stock is developing. However, with the continued reliance on wild and natural fish for the hatchery egg-take, such a development may be prevented. An egg-to-smolt survival rate of 0.75 percent (100 percent seeding level) and smolt-to-adult survival of 1.5 percent for natural production (Carmichael and Boyce 1987) was submitted to the System Planning Group for the Preliminary Information Report. Habitat carrying capacity for smolts, using the standard method developed for Subbasin Planning, is 188,885 smolts, whereas for United States vs. Oregon, the smolt capacity was estimated to be 156,200 fish. The adult 100 percent seeding level in United States vs. Oregon was estimated to be 7,729 fish. The United States vs. Oregon estimates were developed by considering habitat potential.

Supplementation History

No supplementation occurred prior to the Lower Snake River Compensation Plan. The only supplementation activity at present is the Lower Snake River Compensation Plan facility at Little Sheep Creek (described below). Lower Snake Compensation mitigation goals for the subbasin call for production of 330,000 smolts, with 250,000 smolts to be released at the Little Sheep Creek facility, 40,000 smolts at Horse Creek, and 40,000 smolts in the upper Imnaha River. Summer steelhead were first trapped in 1982 at the Little Sheep Creek weir and the smolts, through 1987, were all returned to the facility for release. Table 16 summarizes the releases.

Fish Production Constraints

Imnaha River steelhead runs decreased dramatically in the early 1970s, even though in-subbasin habitat remained relatively stable and the harvest rates have been zero or near zero since 1974. The major problems relating to fish production are out of the subbasin, principally the construction of lower Snake River dams throughout the 1960s and mid-1970s. Significant improvements in downstream passage survival rates have been accomplished in recent years through the barging and trucking of smolts collected at Lower Granite and Little Goose dams on the Snake River and McNary Dam on the Columbia River and their subsequent release below Bonneville Dam. Hatchery supplementation, however, will still be necessary if runs in the subbasin are to be rebuilt to levels supporting sustained natural production and harvest.

Table 16. Summary of release information for summer steelhead in the Imnaha River Subbasin, 1982-1987.

Brood Year	Hatchery/Stock	Release Year	Release Date	Number Released 1/	Release Site	Adult Brood Collection Site	Remarks
1982 2/	Irrigon/Imnaha	1983	5/2-5/83	46,803(s)	Little Sheep Creek	Little Sheep Creek	
1982 2/	Wallowa/Imnaha	1983	5/5/83	16,428(s)	Little Sheep Creek	Little Sheep Creek	
1983 2/	Irrigon/Imnaha	1984	4/23/84	22,819(s)	Little Sheep Creek	Little Sheep Creek	
1983 2/	Irrigon/Imnaha	1984	4/30-5/2/84	35,786(s)	Little Sheep Creek	Little Sheep Creek	
1984 2/	Irrigon/Imnaha	1985	4/10-5/1/85	79,225(s)	Little Sheep Creek	Little Sheep Creek	
1985 2/	Irrigon/Imnaha	1986	4/25-30/86	115,396(s)	Little Sheep Creek	Little Sheep Creek	
1986 3/	Irrigon/Imnaha	1987	5/01-05/87	93,716(s)	Little Sheep Creek	Little Sheep Creek	
1987 4/	Irrigon/Imnaha	1988		248,114(s)	Little Sheep Creek	Little Sheep Creek	
1987 4/	Irrigon/Imnaha	1988		84,519(s)	Imnaha River	Little Sheep Creek	

1/ (a) adults
(s) smolts

2/ Carmichael and Boyce, 1985.

3/ Carmichael et al., 1987.

4/ Irrigon Hatchery personnel, pers. commun.

Hatchery Production

Description of Hatcheries

No hatcheries are located in the subbasin, although a Lower Snake River Compensation Plan satellite facility is located on Little Sheep Creek, a tributary to Big Sheep Creek, approximately eight miles from Imnaha, Oregon. Access is provided by State Route 350. The facilities consist of an adult trap, concrete adult holding pond (20' X 40' X 9' with water depth at 5'), concrete smolt acclimation pond (50' X 196' X 7' with water depth at 3' to 4'), two fish ladders, water intake and spawning facilities. The adult holding pond is designed to hold 400 adults and the acclimation pond is designed to hold 250,000 smolts at five fish per pound (COE 1985). The facility became fully operational in 1987.

The preferred stock for hatchery use is Imnaha River stock and no outside introductions are planned. Several years of evaluation will be required to determine smolt-to-adult survivals. Returns have been increasing, with 52 fish returning in 1985, 23 fish in 1986, and 620 fish in 1987 (Table 17). Survivals may be approaching one percent. The actual hatchery return to the subbasin will be difficult to determine due to possible straying into other tributaries. Previously low egg-to-smolt survivals (49.1 percent in 1985) have been improving and are now 60.2 percent (Carmichael et al. 1987).

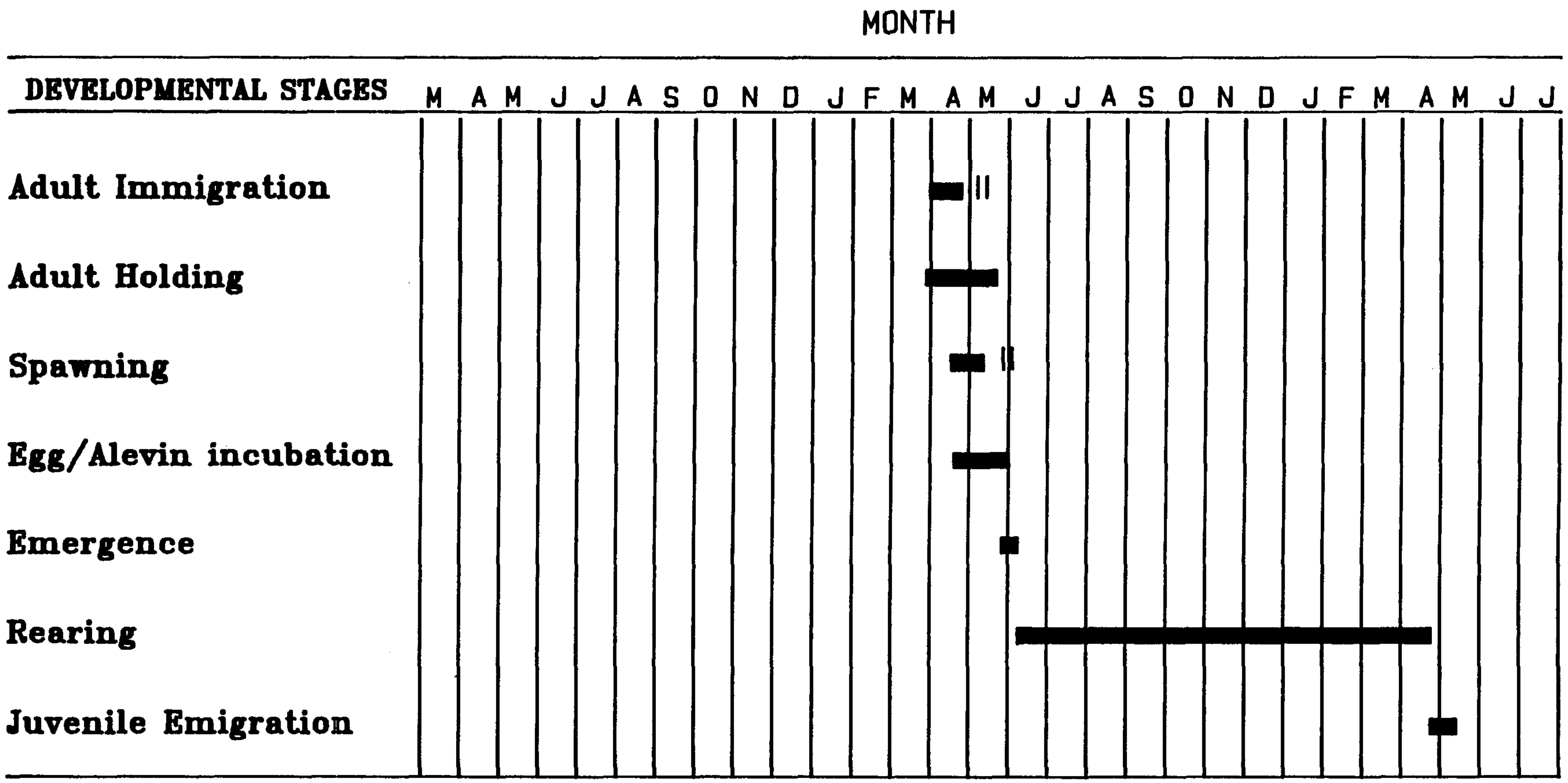
Summer steelhead adults are trapped from March to May and the fish are spawned during April and May (three males to two females) (Table 18). The eggs are then transferred to Wallowa Hatchery, located in the Grande Ronde River Subbasin, and reared to the eyed stage. Eyed eggs are then transported to Irrigon Hatchery in May and June for hatching and rearing. Descriptions of the out-of-subbasin facilities can be found in U.S. Army Corps of Engineers 1983, Design Memoranda 11 and 12. Eggs generally begin hatching in late May. By controlling the temperature, most of the eggs hatch at approximately the same time and are ponded in late June. The fish are transported back to the acclimation pond on Little Sheep Creek the following March as smolts at five fish per pound and generally outmigrate in late April and May.

Hatchery fish first returned to the weir in 1985. Age-3 fish comprised 97.3 percent of the total (as compared to 0 percent for the wild fish trapped from 1983 through 1986) while age-4 fish were 2.7 percent (1985 through 1986) as compared to 66.5 percent for wild fish. Females comprised 72.7 percent of the total hatchery population. Egg-to-smolt survival is 60.2 percent and smolt-to-adult survival is 1 percent for hatchery production.

Table 17. Adult steelhead which returned to the Little Sheep Creek Weir, 1985-1987. (Carmichael, et al. 1986 and in press.)

Date	Stock	Total Number	Males	Females	Number of Females	% Prespawning Mortality Males	% Prespawning Mortality Females
1985	wild	163	40	123	75	60.8	24.5
	hatchery	52	26	26	19	80.8	26.9
1986	wild	49	14	35	32	35.7	5.7
	hatchery	23	7	16	10	57.1	37.5
1987	wild	110	60	50	11	12.5	4.8
	hatchery	620	255	365	151	10.7	5.8

Table 18. Freshwater life history for hatchery summer steelhead, Imnaha River subbasin.



Notes:
1. The developmental stage timing represents basin-wide averages, local conditions may cause some variability.
2. Solid bars indicate periods of heaviest adult immigration, spawning and juvenile emigration.

Table 19. Estimated sport harvest of summer steelhead in the Imnaha River Subbasin, 1959-1987. (Carmichael and Boyce 1987, Carmichael et al., in press.)

Year	Harvest	Year	Harvest
1959	1,334	1968	1,282
1960	1,018	1969	667
1961	995	1970	473
1962	928	1971	638
1963	704	1972	609
1964	354	1973	280
1965	937	1977	48
1966	784	1986	18
1967	1,066	1987	0

Only the Lower Snake River Compensation Plan's hatchery system is presently supplementing natural production in the subbasin. Under this program, 330,000 smolts are scheduled to be released each year with a projected return of 1,920 adults (0.58 percent smolt-to-adult survival). Actual smolt-to-adult survivals are running higher than expected and returns will probably exceed 3,600 adults.

The United States vs. Oregon estimate for smolt-to-adult survival above eight dams is 1.5 percent for natural production and 1 percent for hatchery production. These would be considered pre-implementation estimates. The System Planning Model uses a 6 percent increase in survivals for post-implementation. This would equal 1.6 percent and 1.1 percent, respectively. Survivals in the Imnaha are expected to be sufficient to provide for natural production, harvest, and increased runs without additional supplementation. Implementation refers to the mainstem passage improvements.

Critical Data Gaps

The major data gaps are associated with survival characteristics. Egg-to-fry, fry-to-smolt, and smolt-to-adult survivals for wild and natural fish are unknown. Some of this can be accomplished with tagging studies using PIT tags or coded-wire tags. Out-of-subbasin harvest rates on Imnaha hatchery fish and pre-spawning mortalities caused by dams and fishing techniques are also unknown.

Certain natural history information is also needed. The proportion of females as well as fecundity for each age group has not been determined, and the total in-subbasin run size is not well documented.

As for critical uncertainties, spawning surveys are only conducted on Camp Creek. This creek is the only north/south oriented stream in the subbasin, however, and is probably not a good representative stream. Water temperatures are probably warmer and the stream has been more heavily impacted by man's activities than other streams in the subbasin (K. Witty, Oregon Department of Fish and Wildlife, pers. commun.). The stream is also more susceptible to straying from the Little Sheep Creek facility. For these reasons, the current escapement estimate of 1,000 fish is very rough. While acknowledging the difficulty of access to many of the steelhead streams and the length of the spawning period, expanded surveys should be made into additional streams to gain a better estimate of the actual escapement to the subbasin.

Water quality at the Wallowa facility continues to pose a problem in rearing eggs to the eyed stage before transfer to Irrigon Hatchery.

Objectives

Management Guidelines

1. Native stock will be used for the present and planned future hatchery supplementation programs.

2. A wild and natural component will continue to make up a portion of the hatchery program.

3. Yearly production coordination meetings will continue to be held during the late winter for the purpose of developing fish release programs.

Biological Objectives

1. Obtain an escapement to the mouth of the river of 4,315 adults (natural spawners, hatchery brood stock, and harvest).

2. Return 2,100 natural spawners to the spawning grounds and return 215 adults for hatchery brood stock.

3. Achieve a reasonable distribution of spawners throughout the available spawning areas.

Utilization Objectives

1. Provide a non-selective tribal harvest of 1,000 fish annually.

2. Provide a non-selective sport harvest of 1,000 fish annually.

3. These objectives are based on full realization of the production goals. Obviously, many years will pass before these goals are met. It can be expected that the present selective sport harvest will continue and that overall increases in harvest will coincide with increases in production.

Assumptions and Rationale: The estimated potential for natural spawners is 7,700 adults (Carmichael and Boyce 1987).

The habitat is in good to excellent conditions and no habitat improvements are expected to significantly increase production.

The following profile is based on post-implementation smolt-to-adult survivals and these survival rates are carried through the following strategies unless otherwise stated.

Natural Production:	
natural returns	1,260
hatchery supplementation	840
Brood Stock Needs:	
Lower Snake River Compensation Plan 215	
Harvest	2,000
Total	4,315

Assumptions:

adult returns from natural spawners = 1,260

2.4 fish per redd

4,500 eggs per female

2.0% egg-to-smolt survival : 25% seeding level, United States vs. Oregon (Carmichael and Boyce 1986)

1.6% smolt-to-adult survival (post implementation)

2,100 - 1,260 = 840 (shortfall from natural spawners which must be made up yearly by hatchery supplementation)

840 + 2,000 (total harvest) = 2,840 (total returning adults needed from yearly hatchery supplementation, excluding brood stock)

Lower Snake River Compensation Plan should return 3,630 adults to the mouth of the river: 3,630 - 215 (brood stock) = 3,415 surplus

Alternative Strategies

The exclusion fencing action mentioned in the habitat protection objectives and strategies section is preventive in nature and could not, therefore, be modeled for increased production potential. For this reason, it has not been included in the following actions, which are designed to increase production potential. This does not mean, however, that the fencing action can be ignored. Unrestricted cattle use in the riparian zone, especially in feedlots, will eventually result in a net loss of productive capacity for salmonids.

Modeling results for each strategy are presented in Table 20 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 20. 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.

Strategy 1 presents no new or additional costs to the Columbia River Basin Fish and Wildlife Program. Planners did not estimate costs for Strategy 2.

STRATEGY 1: Continue present Lower Snake River Compensation Plan production plans.

The present hatchery system will return approximately 3,630 adults to the subbasin with releases of 330,000 smolts and a smolt-to-adult survival of 1.1 percent (post-implementation). Present returns show this to be an achievable rate. The hatchery surplus of 3,415 adults [3,630 - 215 (brood stock)] exceeds the subbasin goal by 575 fish. If this "surplus" does actually occur in the future, its distribution will be decided jointly by the Nez Perce Tribe and Oregon Department of Fish and Wildlife.

ACTIONS: 1

1. Continue current program.

STRATEGY 2: Develop new hatchery production capacity by increasing production from the Lower Snake River Compensation Plan hatchery or by constructing additional facilities. Planners did not estimate costs for this strategy.

ACTIONS: 2

2. Construct a new facility or increase production at an existing Lower Snake River Compensation Plan hatchery.

Recommended Strategy

Based upon expectations that the present Lower Snake River Compensation Plan program can meet in-subbasin objectives under current survival rates, Strategy 1 is recommended. Under this strategy, approximately 4,315 adults will return to the subbasin. A precaution regarding survival rates is appropriate; it is not clear whether currently observed hatchery smolt-to-adult survival rates will be maintained or estimated post-implementation rates will be achieved. Good mainstem survival and overall survival have been observed in recent years. If this level cannot be sustained, additional production capability will be warranted.

Table 20. System Planning Model results for summer steelhead (A's) in the Imnaha Subbasin. Baseline value is for pre-mainstem implementation, all other values are post-implementation.

Utilization Objective:
1. Provide a non-selective tribal harvest of 1000 fish annually. 2. Provide a selective sport harvest (hatchery fish only) of 1000 fish annually.

Biological Objective:
Return 2100 natural spawners to the spawning grounds.

Strategy1	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	431 -N	693	1,196	406	0(1.00)
All Nat	569 -N	769	1,421	483	506(1.19)
1*	496 -N	734	1,305	444	246(1.09)
2	569 -N	769	1,421	483	506(1.19)

*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. No action. Continue present LSRCP production plans. Post Mainstem Implementation.
2. Develop new artificial production capacity by increasing production from the LSRCP hatchery or by construction of additional facilities. 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.

PART V. SUMMARY AND IMPLEMENTATION

Objectives and Strategies

Spring Chinook

The objectives for spring chinook salmon are to return 3,800 natural spawners to spawning grounds, and 1,240 fish for hatchery program brood stock. Managers are also seeking to achieve a reasonable distribution of spawners throughout the available spawning areas. As for utilization objectives, managers are seeking to establish tribal and sport harvest opportunities in the subbasin by providing an annual, non-selective harvest of 350 fish for tribal fishers, and the same for sport fishermen.

Planners recommend Strategy 3, which calls for developing new hatchery production capacity, either by increasing production from the Lower Snake River Compensation Plan hatchery or by constructing additional facilities.

Fall Chinook

Managers have not clearly identified objectives for fall chinook salmon. For discussion, planners identified an in-subbasin run size objective of 300 fish. Planners have proposed alternative strategies, but are not recommending a particular strategy at this time.

Summer Steelhead

The objectives for summer steelhead are to return 2,100 natural spawners to spawning grounds, and 215 fish for hatchery program brood stock. Utilization objectives are to establish equal tribal and sport harvest opportunities. Planners identified a non-selective tribal harvest of 1,000 fish annually, and a non-selective sport harvest of 1,000 fish annually.

Planners recommend Strategy 1, which consists of no new action, but continuing the present Lower Snake River Compensation Plan production.

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: IMNAHA

STOCK: SPRING/SUMMER CHINOOK

STRATEGY: 1

CRITERIA	RATING	CONFIDENCE	WEIGHT	UTILITY	DISCOUNT UT
1	8	0.9	22	176	158.4
2	7	0.9	18	126	113.4
3	3	0.9	28	84	75.6
4	7	0.6	20	140	84
5	8	0.9	12	96	86.4

TOTAL VALUE 622

DISCOUNT VALUE 517.8

CONFIDENCE VALUE 0.83247588

SUBBASIN: IMNAHA

STOCK: SPRING/SUMMER CHINOOK

STRATEGY: 2

CRITERIA	RATING	CONFIDENCE	WEIGHT	UTILITY	DISCOUNT UT
1	2	0.6	22	44	26.4
2	3	0.9	18	54	48.6
3	9	0.9	28	252	226.8
4	1	0.9	20	20	18
5	5	0.9	12	60	54

TOTAL VALUE 430

DISCOUNT VALUE 373.8

CONFIDENCE VALUE 0.86930232

SUBBASIN: IMNAHA

STOCK: SPRING/SUMMER CHINOOK

STRATEGY: 1

CRITERIA	RATING	CONFIDENCE	WEIGHT	UTILITY	DISCOUNT UT
1	8	0.9	20	160	144
2	7	0.9	20	140	126
3	3	0.9	20	60	54
4	7	0.6	20	140	84
5	8	0.9	20	160	144

TOTAL VALUE 660

DISCOUNT VALUE 552

CONFIDENCE VALUE 0.83636363

SUBBASIN: IMNAHA

STOCK: SPRING/SUMMER CHINOOK

STRATEGY: 2

CRITERIA	RATING	CONFIDENCE	WEIGHT	UTILITY	DISCOUNT UT
1	2	0.6	20	40	24
2	3	0.9	20	60	54
3	9	0.9	20	180	162
4	1	0.9	20	20	18
5	5	0.9	20	100	90

TOTAL VALUE 400

DISCOUNT VALUE 348

CONFIDENCE VALUE 0.87

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: Imnaha River
Stock: Spring Chinook

Action	Cost Categories*	Proposed Strategies 1	2	3**	4
Habitat Enhancement	Capital:				
	O&M/yr:				
	Life:				
Screening	Capital:				
	O&M/yr:				
	Life:				
Barrier Removal	Capital:		a		a
	O&M/yr:				
	Life:				
Misc. Projects	Capital:				
	O&M/yr:				
	Life:				
Hatchery Production	Capital:			3,680,000	3,680,000
	O&M/yr:			400,000	400,000
	Life:			50	50
TOTAL COSTS	Capital:	0	0	3,680,000	3,680,000
	O&M/yr:			400,000	400,000
	Years:			50	50
Water Acquisition		N	N	N	N
Fish to Stock	Number/yr:			1,600,000	1,600,000
	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.

[a] Cost for the single passage-improvement action is not available.