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STOCK SUMMARY REPORTS for COLUMBIA RIVER COLUMBIA RIVER ANADROMOUS SALMONIDS

Volume IV Washington Subbasins above McNary Dam for the coordinated information sytem

Annual Report 1992

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STOCK SUMMARY REPORTS
for
COLUMBIA RIVER ANADROMOUS SALMONIDS

Volume IV: Washington Subbasins above McNary Dam

for
THE COORDINATED INFORMATION SYSTEM

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Project No. 88-108
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VOLUME IV

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PREF'ACE

An essential component of the effort to rebuild the Columbia Basin's anadromous fish resources is that available information and experience be organized and **shared** among numerous organizations and individuals. Past experience and knowledge must form the basis for actions into the future. Much of this knowledge exists only in unpublished form in agency and individual **files.** Even that information which is published in the form of technical and contract reports receives only limited distribution and is often out of print and unavailable after a few years. Only a small fraction of the basin's collective knowledge is captured in permanent and readily available databases (such as the Northwest Environmental Database) or in recognized journals.

State, tribal, and federal fishery managers have recognized these information management problems and have committed to a program, the Coordinated Information System Project, to capture and share more easily the core data and other information upon which management decisions are based. That project has completed scoping and identification of key information needs and development of a project plan. Work performed under the CIS project **will** be coordinated with and extend information contained in the Northwest Enviromnental Database. Construction of prototype systems will begin in Phase **3.**

This report is one in a series of seven describing the results of the Coordinated Information System scoping and needs identification phase. A brief description of each of these reports follows.

CIS **Phase II** Products

Phase II Summary Report

This report (Roger 1992) summarizes and integrates the results of the next five reports and relates them to deliverables identified in the Phase II cooperative agreement. Broader issues of organization and operation which are not appropriate for the more focused reports are also discussed. This report should be viewed as an executive summary for the CIS project to date. If one wants a quick overview of the CIS project, this report and the project plan will provide that perspective.

Report on Information **Needs**

This report **(Weber** et al. 1992) identifies the core information needed to plan, implement, monitor, and evaluate projects to manage and restore anadromous **fish.** This information has been organized into various categories and missing items are identified. Prototype testing in Phase 3 will focus on this core information.

Data Catalog Report

This report (O'Connor et al. 1992) might be thought of as a "yellow pages" directory describing relevant numeric data available throughout the basin. An easily searched electronic version will be developed during prototype development and the catalog will be maintained and expanded.

Technical and Administrative Options Report

This report (Allen et al. 1992) describes a process for implementing the CIS and feasible hardware, software, and operational options. Recommendations are made for the prototype and implementation phases of the project.

Library Resource Options Report

This report (Roseberry 1992) describes options for the size and operational features for the non-numeric portion of the CIS. Recommendations are made for the prototype and implementation phases.

Stock Summary Reports

These reports (Olsen et al. 1992; Hymer et al. 1992; Kiefer et al. 1992) are available in five separate volumes for Oregon (2), Washington (2), and Idaho (1). The reports contain basic biologic information on anadromous fish populations in the Columbia Basin. This information will be incorporated into computerized data bases during prototyping and implementation and will be updated annually.

Project Plan

The Project Plan (Roger et al. 1992) is derived directly from recommendations from the above reports. It describes anticipated activities, staff needs, and cost of the project for the testing and implementation phases.

ACKNOWLEDGEMENTS

Many thanks are due to the numerous people who contributed to the preparation of the information contained in this report. Those from the Washington Department of Fisheries included Lisa Harlan, Bob Woodard, Steve Campbell, Bill Kinney, Ken Keller, Wolf Dammers, and Dick O'Connor. Those from the Washington Department of Wildlife included Brodie Cox and Dan Fender. Helen Morrison and Ann Roseberry of the Columbia River Inter-Tribal Fish Commission worked on the draft and final documents, and Phil Roger, CIS project leader, saw it through to completion.

INTRODUCTION

Purpose of the Report.

These volumes update the Stock Assessment Report (SAR) published in 1985 (Howell et al.). They have been enlarged partially in response to Northwest Power Planning Council comments concermng the 1985 report. The volumes are new in their format and an annual updating and refining of their information is anticipated. The volumes include both genetic information such as electrophoretic profiles, and non-genetic information. Non-genetic items include the abundance of populations, number of smolts released or outmigrating, and number of adults caught in the subbasin, etc.

The reports are divided into subbasin chapters composed of sections reporting the species of salmon and steelhead present, and their production type (natural and/or hatchery). Within each subbasin, the species are listed in the following order, if present:

spring chinook
summer chinook
fall chinook
coho
chum
sockeye
summer steelhead
winter steelhead

Within each species, naturally produced fish are listed before hatchery produced fish and early run types before late run types.

It should not be presumed that the geographical scale of these units is of biological significance. The subbasins used were the same as those units defined in the Columbia Basin Subbasin Planning Process. Some agencies chose to summarize data in finer geographic subdivisions. The use of the word “stock” in the title “Stock Summary Report” refers to these geographic subbasin units, and does not presuppose any evolutionary significance. As in the 1985 SAR, the information varies from specific conclusions based on substantial data, to general statements which have not been verified. The standards established and agreed upon by the contributors may have not yet been met in all categories by the authors.

Desired Qualities in Stock Assessment Data.

These data should be used with caution if used to compare subbasin populations. A description of how the data was collected and summarized follows in the methods section, and the reader is urged to contact the primary authors for further clarification.

The methods of comparing stock data may vary, but there are certain qualities such data should have. A calibration of the effects the environment has on the traits described would also give analyses more meaning. For example, the environmental influences of temperature, size and timing of release or outmigration, and harvest may all influence the observed age composition of a brood.

Life history differences between stocks should not be artifacts of year-to-year variations in abundance. This is one reason information was reported in the brood year format. Multiple year class data were reported so the magnitude of a trait’s temporal variation might be assessed.

Brood Year Format

The brood year format was used in the majority of the standard tables as a way of tracking the progeny of a season's spawners (a cohort). For instance, 1987 brood coho salmon came from adults that spawned in the fall of 1987. As juveniles, these coho might not have migrated until the spring of 1989. The 1987 brood jacks (two year olds) returned and were accounted for in the fall of 1989. The remaining adults returned and were accounted for in 1990. Thus, a 1987 brood year entry in a coho table is in fact current through 1990 returns. Similarly, a complete accounting of a chinook salmon brood may take six years. In such a case, the 1984 brood would be the latest brood fully reportable with 1990 return year data (reporting up to the 1990 run year was mimimum goal for these reports).

Authorship

Information contained in this volume represents the work of several agencies. The Washington Department of Wildlife (WDW) compiled the steelhead reports. The Washington Department of Fisheries (WDF) compiled the chinook, coho, sockeye, and chum salmon reports for all subbasins except the Yakima, which was compiled by Columbia River Inter-Tribal Fish Commission (CRITFC) staff. The views represented in this volume are those of the agencies compiling the information, and do not necessarily represent the views of other CIS participants. Portions of the information in this report are reported in standard formats developed by the CIS participants. CRITFC provided coordinating services to provide consistency among the five Stock Summary Report volumes. This report includes all data received from the agencies by September 30, 1992.

METHODS

Following Howell et al.'s methodology (1985), published and unpublished anadromous fish data derived from both a literature review and contacts with biologists and hatchery personnel were summarized by subbasin. This report includes all of that information which could be located and fit into a set of standardized tables. The agencies were free to introduce these tables in the order they found appropriate to the following major text headings:

Geographic Location
    (A brief description of the subbasin)
Origin
    (Source of broodstock or eggs for hatchery stocks, history of hatchery stock introductions)
Distribution
    (The distribution of the species in the subbasin)
Production
Adult Life History
Juvenile Life History
Biochemical-Genetic Characteristics
Diseases
References

Ten categories of information based on the Northwest Power Planning Council comments on the 1985 SAR were addressed. A list of the standard tables developed to address these categories, and a key to the two letter codes used to identify them throughout the document, follows at the end of this section.

1. Species and Strain

Maps were used to depict spawning, rearing, and hatchery locations for at least one anadromous species per subbasin. A complete set of these maps may be found in the 1990 Subbasin Production Plans.

2. Timing of Runs

Charts also developed for the 1990 Subbasin Production Plans were used to depict the freshwater life history of the salmon and steelhead. Peak dates were added when available. Available information that related to adult migration timing (such as jaw tags, radio telemetry, pit tags, freeze brands) was summarized. These timing charts also addressed incubation, rearing, and emergence times.

3. Disease Status and Tolerance

Diseases with management importance, as defined by the Model Comprehensive Fish Health Protection Program for the Pacific Northwest (Wold et al. 1987), were listed in the standard table coded "TD". These diseases are generally those that restrict stock transfers. In some cases agencies reported more comprehensive lists. Any known subbasin specific information on resistance or treatment response was cited in the text.

4. Stock Size, Stock Recruitment

Accounting for the number of recruits per spawner first requires an estimate of the total number of spawners. Age-specific return data for a series of years is then needed to track the recruits. Standard age composition table code "RN" reports a breakdown of spawner escapement by total age. Age specific estimates of sport catch (code RS), hatchery rack (code RH), and subbasin totals (code RB), were also generated when possible.

In the special case of summer steelhead, the total age assigned may have been the eventual total age of the fish at maturity in the spring. Steelhead needing such a projected total age might include steelhead non-lethally sampled in August at a weir or ladder during the first calendar year of their two year run span. These fish would not be spawning until the following spring. Such data was only reported if it was considered an adequate sample for describing the age composition of the run at maturity.

Estimates of the total number of smolts were included in standard table (code JM) that reports outmigration totals by season and brood year.

5. Freshwater and Ocean Migration Characteristics

Residualism was described in tables of age composition (code AC) that included freshwater age. Anything known about non-anadromous populations existing in sympatry with anadromous forms was discussed in the text.

Ocean and river distribution data are, with few exceptions, only available from coded wire tags recovered during fisheries not designed to scientifically sample distribution. This report focused on providing a subbasin specific guide to the available coded wire tag groups, including their number and size at release (table code TR). Numerous reports available from the Pacific States Marine Fisheries Commission and the Pacific Salmon Commission detail aspects of time and place of recovery for any coded wire tag code of interest.

6. Survival and Fecundity

Actual measurements of survival by life stage are extremely rare and most subbasin specific data are described in a text format.

Fecundity data are also rare, and infrequently measured even in hatcheries. When such data was available, it was reported in standard table "AF." Fecundity data are usually a measure of total egg take divided by the number of females spawned. Sometimes the total egg take figure itself is based on old fecundity estimates multiplied by the number of females.

The proportion of females in a brood's various age classes are reported in a table coded "AS". The "Total % Female" value in this table is based on the age composition of a brood, weighted by the "% Female" in each age class (unless otherwise stated). For example, if 10% of a coho brood returned at two years of age, the rest as three year olds, all of the jacks were male, and fifty percent of the adults were female, then:

$$(.10 \times .00) + (.90 \times .50) = .45$$

Forty-five percent of the accounted for brood was female.

The "N" reported in this table is the sum of the fish belonging to the brood that were actually aged and sexed.

7. Age and Size Composition, Life Stage Timing

The timing of early life stages was reported in charts developed for the Subbasin Production Plans. These charts (coded TT) depict the freshwater life history of the salmon and steelhead.

Length was the most universally measured parameter of smolt size. Mean length, range, and sample size basis were displayed for outmigrating smolts (table code SL). Such data may reflect rearing conditions or the timing of outmigration sampling, therefore a reference was included directly in these tables.

The life history trait of freshwater/ocean age combinations was displayed in standard table "AC". In this and other tables, the number of years of freshwater residence is denoted by the number displayed before a decimal point. The balance of the total age in years (usually equivalent to the number of years of saltwater residence) follows the decimal point. Thus a coho jack salmon would be described as a "2.0", a three year adult a "2.1 ".

The "N" column in the table reports the sum of fish belonging to a brood that were aged. This was a crude measure of confidence, because each of the run years summed could have had a different sampling rate. Note the size of entire brood was reported elsewhere.

Adult length data was displayed utilizing the above freshwater-ocean age specific format. Methods, sample size and standard deviations are also included in standard table code "AL". Because the availability of weight data is rare, no standard tables were developed to report this data.

8. Current Rearing and Release Methods (Hatcheries)

Standard table code "TR", based on a Washington Department of Fisheries format reports most of the information concerning hatchery releases. The use of a uniform set of definitions for the 'Life Stage' at release column proved impossible, both between, and within some states. The states therefore defined the terms they used for this table.

Outplanting was described in the hatchery release table. The reporting of all hatchery releases in the Columbia Basin in a common format, on 8.5 x 11 inch paper led to less detail than is available in the assorted source databases. Further CIS development will likely allow additional detail for this table. For instance in the 'Release Site' field, where presently only the common name of the creek or river of release is listed.

9. Anatomical and Biochemical Traits

A collection of electrophoretic tables from major published works in the Columbia Basin were collected and appear as appendices. These tables were reproduced verbatim, and reflect the nomenclature used by researchers to report allele frequencies at their time of publishing. Efforts have subsequently been made by the American Fisheries Society to standardize the reporting of this type of information. The availability of meristic data was noted for the applicable subbasins.

10. Genetic Variability, Straying

Emigration and immigration were described in a standard table format proposed by Idaho (standard table codes AE and AI). These tables report the number of carcasses examined for coded wire tags at hatcheries and during spawning ground surveys, the number of tags recovered, and an expanded "total number estimated" based on the numbers reported by PSMFC. Approximately 4,600 individual coded wire tag codes have been released to date in the Columbia River Basin, the bulk of these into Washington and Oregon waters. Harvest recoveries were not listed in the standard form of the these tables.

Standard, and Non-standard Table Codes.

A collection of standardized tables conveyed the above information. An upper case, two letter code identifies the category of these tables. The standard table codes are as follows:

(HB) NPPC habitat quality
(RN) Returns back as Natural spawners.
(RH) Returns back to a Hatchery. 99% of the time these are rack returns, but a few places with 100% marking have made splits between marked and unmarked fish.
(RT) Tribal catch in the **subbasin**
(RS) Sport catch in the subbasin.
(RB) **Subbasin** grand total, (subbasin catches, natural and hatchery escapement).
(JM) Number of juvenile migrants
(SL) Length of smolts
(AC) Age composition **(freshwater.ocean)**
(AS) Percent females by brood year and age class
(AL) Mean fork length by brood year and age class
(AF) Mean fecundity by brood year and age class
(TR) Hatchery releases by brood year
(AE) Emigration of tagged fish
(AI) Immigration of tagged fish
(TD) Parasites and diseases
(AD) Distribution, present/potential and absence figure
(TT) **Subbasin** plan bar chart of life stage timing

Deviations from the standard formats, (i.e. run years instead of brood years), are identified with a third lowercase letter such as: RS-a or RS-b.

Tables for categories of information without standardized formats also have a third lowercase letter, and were coded as follows:

TS-a, etc.	Survival tables, any life stage
ST-a, etc.	Non-standard Smolt Timing information
AT-a, etc.	Non-standard Adult Timing information
AH-a, etc.	Adult Harvest information, i.e. Ocean or **mainstem**
ET-a, etc.	Egg Take data
AW-a, etc.	Mean weight by brood year and age class
JC-a, etc.	Juvenile age Composition

REFERENCES

Howell, P. J., K. Jones, D. Scarnecchia, L. LaVoy, W. Kendra, and D. Ortmann. 1985. Stock assessment of Columbia River anadromous salmonids, volumes I & II. Final report of Oregon Department of Fish and Wildlife, Washington Department of Fisheries, Washington Department of Game, and Idaho Department of Fish and Game (Project 83-335, Contract DE-AI79-84BP12737) to Bonneville Power Administration, Portland, Oregon.

Wold, E., J. Gearheard, and J. Warren. Model Comprehensive Fish Health Protection Program, Part I. Pacific Northwest Fish Health Protection Committee. January 1, 1987.

RESULTS

The results of this project are contained in five volumes.

Volume I includes the following Oregon subbasins below Bonneville Dam:

Lower Columbia
Mid-Willamette
clackamas
Molalla
Tualatin
Coast Range
Santiam
Mckenzie
Coast Fork
Long Tom
Middle Fork
Sandy
Hood River

Volume II includes the following Oregon subbasins above Bonneville Dam:

15 Mile
Deschutes
John Day
Umatilla
Grande Ronde (including data for Washington)
Imnaha

Volume III includes the following Washington subbasins below McNary Dam:

Lower Columbia
Grays
Elochoman
cowlitz
Kalama
Lewis
Washogal
Wind
White Salmon
Klickitat

Volume IV includes the following Washington subbasins above McNary Dam:

Walla Walla (including data for Oregon)
Snake
Tucannon
Yakima
Upper Columbia
Wenatchee
Entiat
Wells
Methow
Okanoagan

Volume V includes the following Idaho subbasins:

Clearwater
- **Mainstem**
- South Fork
- Mid Fork
- **Locksa**
- Selway

Salmon River
- Lower **Mainstem**
- Little Salmon
- Mid-Mainstem
- Upper **Mainstem**
- **Lemhi**
- Headwaters
- South Fork
- Pahsimeroi

The following Tables 1 through 6 summarize, by species, the presence or absence of the **standardized** (and some non-standardized) tabular data for the Washington subbasins below McNary **Dam.** Tables 7 through 12 cover the region above McNary Dam.

Table 1. Summary of tabular information on spring chinook salmon in ten Washington subbasins.

	Lower Columbia	Grays	Elochoman	Cowlitz	Kalama	Lewis	Washougal	Wind	White Salmon	Klickitat
HABITAT				✓	✓			✓		✓
SUBBASIN DISTRIBUTION								✓		✓
PRODUCTION										
HATCHERY RELEASES					✓	✓		✓	✓	✓
HATCHERY RETURNS				✓	✓	✓		✓		✓
SUBBASIN HARVEST										
SPORT				✓	✓	✓		✓		✓
TRIBAL										✓
ADULT LIFE HISTORY										
# SPAWNERS				✓	✓	✓				✓
TOTAL SUBBASIN RETURNS				✓	✓	✓		✓		✓
LENGTH					✓	✓		✓		
AGE COMP.				✓	✓	✓		✓		
SEX RATIO				✓	✓	✓		✓		
FECUNDITY										
IMMIGRATION				✓	✓	✓		✓		
EMIGRATION				✓				✓	✓	
JUVENILE LIFE HISTORY										
TIMING				✓						
SMOLT LENGTH										
# SMOLTS										
BIOCHEMICAL				✓	✓					
DISEASE				✓	✓	✓		✓		✓

Table 2. Summary of tabular information on fall chinook salmon in ten Washington subbasins.

	Lower Columbia	Grays	Elochoman	Cowlitz	Kalama	Lewis	Washougal	Wind	White Salmon	Klickitat
HABITAT		✓	✓	✓	✓		✓	✓	✓	✓
SUBBASB'J DISTRIBUTION										
PRODUCTION										
HATCHERY RELEASES		✓	✓	✓	✓	✓	✓		✓	✓
HATCHERY RETURNS		✓	✓	✓	✓	✓	✓	✓	✓	✓
SUBBASIN HARVEST										
SPORT										
TRIBAL										
ADULT LIFE HISTORY										
# SPAWNERS		✓	✓	✓	✓	✓	✓	✓	✓	✓
TOTAL SUBBASIN RETURNS										
LENGTH		✓	✓	✓	✓	✓	✓	✓	✓	
AGE COMP.		✓	✓	✓	✓	✓	✓	✓	✓	
SEX RATIO		✓	✓	✓	✓	✓	✓	✓	✓	
FECUNDITY										
IMMIGRATION		✓	✓	✓	✓	✓	✓	✓	✓	
EMIGRATION		✓	✓	✓	✓	✓	✓			✓
JUVENILE LIFE HISTORY										
TIMING				✓			✓			
SMOLT LENGTH		✓			✓	✓	✓			
# SMOLTS					✓	✓	✓			
BIOCHEMICAL						✓				
DISEASE		✓	✓	✓	✓		✓		✓	✓

Table 3. Summary of tabular information on coho salmon in ten Washington subbasins.

	Lower Columbia	Gnyr	Blochoman	Cowlitz	Kalama	Lewis	Washougal	Wind	White Salmon	Klickitat
HABITAT		✓	✓	✓		✓	✓	✓		✓
SUBBASIN DISTRIBUTION										
PRODUCI-ION										
HATCHERY RELEASES		✓	✓	✓	✓	✓	✓	✓	✓	✓
HATCHERY RETURNS		✓	✓	✓	✓	✓	✓	✓		
SUBBASIN HARVEST										
SPORT	✓		✓							
TRIBAL										
ADULT LIFE HISTORY										
# SPAWNERS					✓					
TGTAL SUBBASIN RETURNS										
LENGTH									✓	
AGE COMP.		✓		✓	✓	✓			✓	
SEX RATIO		✓	✓						✓	
FECUNDITY		✓	✓							
IMMIGRATION		✓		✓	✓	✓	✓		✓	
EMIGRATION		✓		✓	✓	✓	✓		✓	
JUVENILE LIFE HISTORY										
TIMING										
SMOLT LENGTH										
# SMOLTS										
BIOCHEMICAL										
DISEASE		✓	✓	✓	✓	✓	✓			✓

Table 4. Summary of tabular information on chum salmon in ten Washington subbasins.

	Lower Columbii	Grays	Elochoman	Cowlitz	Kalama	Lewis	Washougal	Wind	White salmon	Klickitat
HABITAT										
SUBBASIN DISTRIBUTION										
PRODUCTION										
HATCHERY RELEASES	✓	✓								
HATCHERY RETURNS										
SUBBASIN HARVEST										
SPORT	✓									
TRIBAL										
ADULT LIFE HISTORY										
# SPAWNERS	✓									
TOTAL SUBBASIN RETURNS										
LENGTH	✓	✓								
AGE COMP.	✓	✓								
SEX RATIO	✓	✓								
FECUNDITY										
IMMIGRATION										
EMIGRATION										
JUVENILE LIFE HISTORY										
TIMING										
SMOLT LENGTH	✓	✓								
# SMOLTS										
BIOCHEMICAL										
DISEASE										

Table 5. Summary of tabular information on summer steelhead in ten Washington subbasins.

	Lower Colum- bii	Grays	Elocho- man	Cowlitz	Kalama	Lewis	Washou- gal	Wind	white Salmon	Klick- itat
HABITAT				✓	✓	✓	✓	✓	✓	✓
SUBBASIN DISTRIBUTION										
PRODUCTION										
HATCHERY RELEASES			✓	✓	✓	✓	✓	✓	✓	✓
HATCHERY **RETURNS**				✓	✓		✓			
SUBBASIN HARVEST										
SPORT	✓		✓	✓		✓			✓	
TRIBAL										
ADULT LIFE **HISTORY**										
# SPAWNERS					✓			✓	✓	
TOTAL SUBBASIN RETURNS				✓	✓		✓	✓		✓
LENGTH				✓	✓		✓	✓	✓	✓
AGE COMP.				✓	✓		✓	✓	✓	✓
SEX RATIO				✓	✓		✓	✓	✓	✓
FECUNDITY				✓			✓			
IMMIGRATION				✓						
EMIGRATION										
JUVENILELIFE HISTORY										
TIMING				✓	✓	✓	✓			
SMOLT LENGTH					✓					✓
# SMOLTS					✓					
BIOCHEMICAL					✓					
DISEASE			✓	✓	✓	✓	✓	✓		✓

Table 6. Summary of tabular information on winter steelhead in ten Washington subbasins.

	Lower Columbia	Grays	Elochoman	Cowlitz	Kalama	Lewis	Washougal	Wind	White Salmon	Klickitat
HABITAT	f	f	f	f	f	f	f		f	
SUBBASIN DISTRIBUTION		f	f		f	f				
PRODUCTION										
HATCHERY RELEASES	f	f	f	f	f	f	f		f	
HATCHERY REIVRNS			f	f	f					
SUBBASIN HARVEST		f								
SPORT	f	f	f	f		f	f			
TRIBAL										
ADULT LIFB HISTORY										
# SPAWNERS				f	f					
TOTAL SUBBASIN *REIVRNS*				f	f				*f*	
LENGTH				*f*	*f*	*f*				
AGE COMP.				f	*f*	✓				
SEX RATIO			*f*	*f*	*f*					
FECUNDITY			*f*	*f*			*f*			
IMMIGRATION				*f*						
EMIGRATION				*f*						
JUVENILE LIFE HISTORY										
TIMING	f			f	f	*f*	✓			
SMOLT *LENGTH*				*f*	*f*					
# SMOLTS				f	*f*					
BIOCHEMICAL										
DISEASE	✓	f	✓	✓	✓	✓	✓		✓	

Table 7. Summary of tabular information on spring chinook salmon in ten Washington subbasins.

	Walla Walla	Snake	Tucannon	Yakima	Upper Columbia	Wenatchee	Entiat	Wells	Methow	Okanogan
HABITAT				f		f	f		f	
SUBBASIN DISTRIBUTION				f						
PRODUCTION										
HATCHERY *RELEASES*				f		f	f		f	
HATCHERY RETURNS						f	f		f	
SUBBASIN HARVEST										
SPORT						f				
TRIBAL				f		f				
ADULT LIFE HISTORY										
# SPAWNERS				f		f	f		f	
TOTAL SUBBASIN RETURNS				f		f				
LENGTH				f						
AGE COMP.				f						
SEX RATIO				f						
FECUNDITY				f						
IMMIGRATION			f			f				
EMIGRATION										
JUVENILE LIFE HISTORY										
TIMING										
SMOLT LENGTH										
# SMOLTS				f						
BIOCHEMICAL										
DISEASE										

Table **8.** Summary of tabular information on summer chinook in ten Washington subbasins.

	Walla Walla	Snake	**Tucannon**	**Yakima**	**Upper Columbia**	**Wenatchee**	**Entiat**	**Wells**	**Methow**	**Okanogan**
HABITAT						*f*			*f*	*f*
SUBBASIN DISTRIBUTION										
PRODUCTION										
HATCHERY RELEASES									f	
HATCHERY RETURNS										
SUBBASIN HARVEST										
SPORT										
TRIBAL										
ADULT LIFE **HISTORY**										
# SPAWNERS						✓			✓	✓
TOTAL SUBBASIN RETURNS										
LENGTH										
AGE COMP.										
SEX RATIO										
FECUNDITY										
IMMIGRATION										
EMIGRATION										
JUVENILE LIFE HISTORY										
TIMING										
SMOLT LENGTH										
# SMOLTS										
BIOCHEMICAL										
DISEASE										

Table 9. Summary of tabular information on fall chinook salmon in ten Washington subbasins.

	Walla Walla	Snake	Tucannon	Yakima	Upper Columbia	Wenatchee	Entiat	Wells	Methow	Okanogan
HABITAT				*f*						
SUBBASIN DISTRIBUTION										
PRODUCTION				*f*						
HATCHERY *RELEASES*		*f*		*f*	*f*					
HATCHERY RETURNS					*f*					
SUBBASIN HARVEST										
SPORT					f					
TRIBAL										
ADULT LIFE HISTORY										
# SPAWNBRS					✓					
TOTAL SUBBASIN RETURNS				*f*						
LENGTH				✓	✓					
AGE COMP.		✓			✓					
SEX RATIO		✓			✓					
FECUNDITY										
IMMIGRATION		*f*		✓	*f*					
BMIGRATION					*f*					
JUVBNILB LIFE HISTORY										
TIMING										
SMOLT LENGTH										
# SMOLTS				*f*						
BIOCHEMICAL										
DISEASE		*f*			*f*					

Table 10. Summary of tabular information on coho salmon in ten Washington subbasins.

	Walla Walla	Snake	Tucannon	Yakima	Upper Columbia	Wenatchee	Entiat	Wells	Methow	Okanogan
HABITAT				✓						
SUBBASIN DISTRIBUTION										
PRODUCTION										
HATCHERY *RELEASES*				✓						
HATCHERY RETURNS										
SUBBASIN HARVBST										
SPORT										
TRIBAL										
ADULT LIFE HISTORY										
# SPAWNERS										
TOTAL SUBBASIN RETURNS										
LENGTH										
AGE COMP.										
SEX RATIO										
FECUNDITY										
IMMIGRATION										
EMIGRATION										
JUVENILE LIFE HISTORY										
TIMING										
SMOLT LENGTH										
# SMOLTS										
BIOCHEMICAL										
DISEASE										

Table 11. Summary of tabular information on sockeye salmon in ten Washington subbasins (the Okanogan **subbasin** still to be completed).

	Walla Walla	Snake	Tucannon	Yakima	Upper Columbia	Wenatchee	Entiat	Wells	Methow	Okanogan
HABITAT										
SUBBASIN DISTRIBUTION										
PRODUCTION										
HATCHERY RELEASES										
HATCHERY **RETURNS**										
SUBBASIN HARVEST										
SPORT										
TRIBAL										
ADULT LIFE HISTORY										
# SPAWNERS						✓				✓
TOTAL SUBBASIN RETURNS										
LENGTH										
AGE COMP.										
SEX RATIO										
FECUNDITY										
IMMIGRATION										
EMIGRATION										
JUVENILE LIFE HISTORY										
TIMING										
SMOLT LENGTH										
# SMOLTS										
BIOCHEMICAL										
DISEASE										

Table 12. Summary of tabular information on summer steelhead in ten Washington subbasins.

	Walla Walla	Snake	Tucan-mm	Yakima	Upper Colum-bii	Wenat-chee	Entiat	Wells	Methow	Okano-gan
HABITAT	f	f	f	f		f	✓		f	f
SUBBASIN DISTRIBUTION	f		f			f				
PRODUCI'ION										
HATCHERY *RELEASES*	f	f	f	f		f	f	f	f	f
HATCHERY RETURNS								f		
SUBBASIN HARVEST										
SPORT	f						f			
TRIBAL										
ADULT **LIFE** HISTORY										
# **SPAWNERS**										
TOTAL SUBBASJN **RETURNS**		f	f	f		f			f	f
LENGTH	f	f	f	f			f	f	f	✓
AGE COMP.	f	f	f	f		f	✓	f	f	f
SEX RATIO	f	f		f			f		f	✓
FECUNDITY	f	f	f	f					f	
IMMIGRATION	✓		✓							
EMIGRATION	✓	✓	✓							
JUVENILE LIFE HISTORY										
TIMING	✓		✓							
SMOLT **LENGTH**		f	f	f					✓	✓
# SMOLTS			f	f					✓	
BIOCHEMICAL										
DISEASE	f	f	f	f		f	f	f		f

WALLA WALLA SUBBASIN

Naturally Produced Summer Steelhead

GEOGRAPHIC LOCATION

The Walla Walla River originates in northeastern Oregon. Starting from its source high in the Blue Mountains the river heads west and north entering Washington and joining the Columbia River at river mile (RM) 314.6. The terrain surrounding the middle and lower sections of the river is extensively and intensively dry farmed with much of the land sparsely or without vegetative cover. River valley's are dominated by highly irrigated agricultural areas. The Walla Walla River drains a 1,758 square mile watershed encompassing northeast Oregon and southeast Washington with approximately 73 percent of the basin within Washington. The Touchet River, a major tributary, enters the Walla Walla River in the lower section within Washington and accounts for approximately 750 square miles of drainage.

ORIGIN

The wild summer steelhead stock in the Walla Walla River is native, although within Washington's section of the basin interbreeding with introduced Skamania, Wells and Dworshak hatchery stocks may have occurred.

DISTRIBUTION

Table 1 lists rearing and spawning habitat, by quality, for Walla Walla River steelhead based on estimates from the Northwest Power Planning Council. Figure 1 illustrates the distibution of summer steelhead in the Walla Walla River subbasin.

Historical distribution of summer steelhead spread throughout the middle and upper reaches of the Walla Walla River, Touchet River and their tributaries. Habitat degradation is widespread in this subbasin. Factors including, 1) low stream flows from intensive irrigation, 2) livestock grazing, 3) logging, and 4) farming have all reduced the usable spawning habitat by approximately 50 percent.

PRODUCTION

Production Facilities

No hatchery operates on the Walla Walla River. In Washington, Dayton Pond is located on the Touchet River at the City of Dayton. Dayton Pond is a conditioning pond used to acclimate summer steelhead smolts prior to release into the Touchet River. Dayton Pond is capable of holding 150,000 steelhead smolts which usually are released March through April. The conditioning pond consists of earthen rock walls with an asphalt bottom and was constructed as a short term rearing station to improve survival and homing of hatchery steelhead.

Production Summary

No data are available on natural smolt production. Natural production continues in both the mainstem Walla Walla and throughout most tributaries. Smolt production in the upper portion of the river is reduced from habitat related problems. Low streamflow heads the list of major constraints limiting steelhead production in this subbasin. Streamflows which are normally low during the summer are severely compounded by extensive irrigation withdrawals. Water diversions in Oregon, at times, reduce the Walla Walla River to a dry streambed at the Washington/Oregon border. Diversions in Washington create similar conditions on the lower Touchet River during periods of low flows. Many of the numerous tributaries also have diversions which deplete streamflows and reduce valuable water needed for fish rearing. The cumulative effect of the widespread water withdrawals from this river system has decreased rearing habitat and increased juvenile mortalities at diversion screens.

ADULT LIFE HISTORY

Run Size and Escapement

No estimates of wild run size or escapement exists. Native steelhead returning to the Walla Walla River from 1977 through 1987 were estimated at 1,090 to 1,817 summer steelhead annually, which is a reduction from estimates in the mid-1960's of steelhead runs from 4,000 to 5,000 wild fish (Eldred 1964; Strickland 1968).

Harvest

No estimate for ocean harvest of Walla Walla steelhead.

Harvest of Walla Walla steelhead in the Columbia is unknown although the Columbia River supports a tribal and sport fishery which harvest a large number of steelhead with some Walla Walla fish being part of the harvest.

Treaty Indian rights allow harvest of Walla Walla River steelhead although actual tribal harvest is negligible.

Sport harvest occurs throughout the mainstem Walla Walla River and its tributaries both in Washington and Oregon. Sport catch from Washington waters averaged 1,152 fish (hatchery and wild) annually from 1980 through 1990 based on permit-card harvest estimates (Table 2). Washington Department of Wildlife has established fishing regulations for that portion of the river which flows within Washington State. Oregon Department of Fish and Wildlife regulates fishing in the Oregon portion. In 1983, Washington restricted fishing by reducing a year around fishing season to a fishing season of September 1 through April 15. In addition, in 1986 anglers were legally allowed to keep only fin-clipped hatchery fish, releasing all wild fish. Both measures were initiated to protect and increase escapement of the native fish.

Time of Migration

Wild summer steelhead bound for the Walla Walla River enter the Columbia River June through September. These fish migrate up the Columbia entering the Walla Walla between December and March, peaking in February through March. Figure 2 depicts the freshwater life history of summer steelhead in the Walla Walla River.

Snawnine period

Peak spawning for wild steelhead occurs from April through May (Hunter and Cropp 1975).

Spawning area

Wild steelhead spawn in the middle and upper reaches of the mainstem Walla Walla River, Touchet River and several of the tributaries. Spawning areas have diminished by up to 50 percent due to habitat problems listed earlier (Howell et al. 1985).

Fecundity

Nine wild steelhead spawned from the upper Walla Walla River in 1987 produced an average of 3,975 eggs per female (Table 6).

Aee Composition

Data are limited on steelhead age. A sample of 13 wild steelhead collected from run years 1985-1986 and 1986-1987 resulted in all fish being either l-ocean or 2-ocean fish (Table 3).

Size

No data on individual lengths. Biologists collected 20 wild steelhead from run years 1984 through 1987, average length from the total group was 67.3 cm (Table 5).

Sex ratio

Twenty wild steelhead collected from run years 1984 through 1987 produced sixteen females and four males. Fourteen wild fish sampled in 1986 were 78.5 percent female (Table 4).

Survival Rate

No data are available on smolt to adult survival.

JUVENILE LIFE HISTORY

Emergence

Emergence occurs from May through July.

Egg

No data on egg production or egg to smolt survival.

Juvenile rearing

Juvenile rearing for the majority of wild smolts lasts approximately two years prior to ocean emigration, however, substantial numbers of one year old juveniles emigrate from the headwaters of Oregon. Wild steelhead smolts emigrate in late April and May, at an average size of 170 mm.

Hatchet-v releases

Wells Hatchery steelhead are the predominate stock used for supplemental releases into the Walla Walla River. Lyons Ferry Hatchery and Dayton Pond were responsible for the majority of incubation and rearing of hatchery steelhead. Table 7 outlines rearing locations, steelhead stocksand hatchery releases from 1981 through 1990. All hatchery steelhead released into the subbasin were yearlings. Egg to smolt survival from 1985 through 1988 ranged from 90.5 percent to 85.0 percent.

Straying

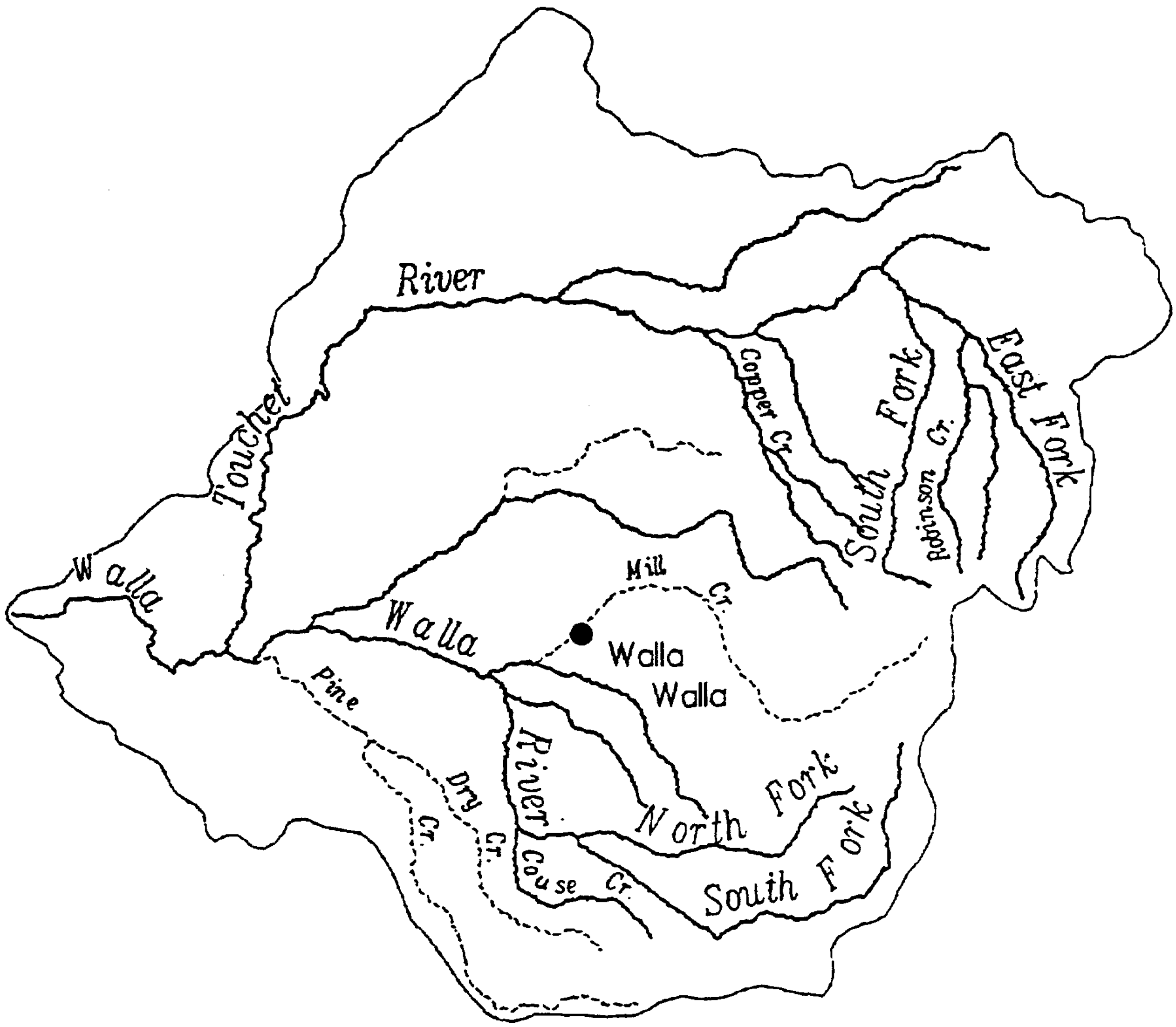
Walla Walla coded wire tagged hatchery steelhead have been recovered in neighboring streams. Table 8 lists recovery of Walla Walla River steelhead.

BIOCHEMICAL-GENETIC CHARACTERISTICS

No data available on Walla Walla steelhead.

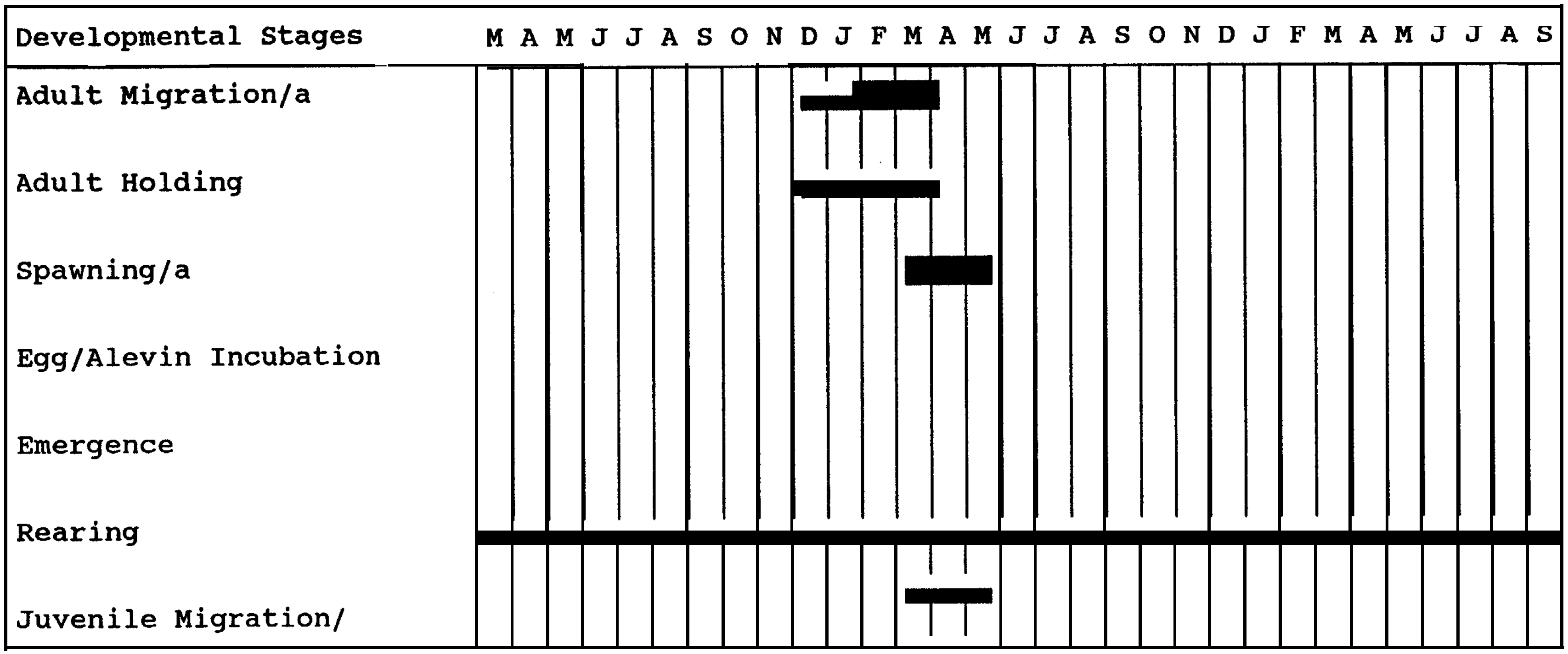
DISEASES

Disease history for hatchery smolts planted in the Walla Walla River is presented in Table 10.



'igure 1 (AD). Summer steelhead distribution in the Walla Walla River subbasin based on the NPPC presence\absence database (solid and dashed lines respectively) and the BPA Geographic Information System.

Figure 2 (TT). Freshwater life history of summer steelhead in the Walla Walla River Subbasin.



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

/a U.S. vs Oregon Production Report

Table 1 (HB-1). Estimated* amount of rearing and spawning habitat, by quality, of Walla Walla River subbasin summer steelhead.

Area	Excellent	Good	Fair=	Poor[B]	Unknown	Total	Confidence
Miles	1.1%	43.2%	35.3%	20.4%		207.9	Fair
Acres	0.4%	42.2%	33.6%	23.7%		452.2	Fair

*Northwest Power Planning Council estimates based on limited observations.
[B]Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by man.

Source: Presence/Absence Database, NPPC, 199 1.

Table 2 (RS-a). Returns (sport catch and escapement) of summer steelhead to the Walla Walla River subbasin.

Return Year	Escapement	Sport Catch[A]	Adult Total
1980		411	Unknown
1981		455	Unknown
1982		274	Unknown
1983		463	Unknown
1984		844	Unknown
1985		2,445	Unknown
1986		1,915	Unknown
1987		1,058	Unknown
1988		1,402	Unknown
1989		2,256	Unknown

[A]Sport catch within subbasin only, includes Touchet River.

Source: Sport catch based on WDW permit-card harvest estimates.

Table 3 (AC-a). Age composition percentage (freshwaterocean) by return year for adult wild summer steelhead originating in the Walla Walla River subbasin.

Age Composition (%)[A]

Return Year	N[B]	X.1	X.2	X.3	
1983	7	85.7	14.3		
1984	4	50.0	50.0		
1985	3	66.6		33.3	
1986	13	30.7	61.5	7.6	

[A]Age determined by scale analysis.
[B]Samples obtained from Oregon sport fishery.
x.1 = l-ocean fish
x.2 = 2-ocean fish
x.3 = 3-ocean fish.

Source: Walla Walla River Subbasin Plan, Confederated Tribes of the Umatilla Indian Reservation, 1987..

Table 4 (AS-a). Percent females by return year and age class[A] for adult wild summer steelhead originating in the Walla Walla River subbasin.

% Females

Return Year	N[B]	2.1	2.2	2.3	Total % Female
1986	14	21.4	50.0	7.1	78.5

[A]Age based on scale analysis.
[B]Based on fish sampled from Oregon Sport fishery.

Source: Walla Walla Subbasin Plan, Confederated Tribes of the Umatilla Indian Reservation, 1987.

Table 5 (AL-a). Mean fork length by return year and age class for adult wild summer steelhead originating in the Walla Walla River subbasin.

Mean Fork Length (cm)

Return Year	x.1	x.2	x.3	Age Unknown
1987				67.3 cm[A]

*Lengths based on average length of a 20 wild fish sample collected in 1987.

Source: Walla Walla Subbasin Production Plan, 1990.

Table 6 (AF-a). Mean fecundity by brood year and age class for wild summer steelhead originating in the Walla Walla River subbasin.

Mean Fecundity

Brood Year	1.1	1.2	1.3	No age information
1986				3,975 [A B]

'Fecundity from nine wild fish captured in the upper Walla Walla River,
[B]Fecundity determined by dividing total number of eggs by total females spawned.

Source: Columbia Basin Production Plan, Walla Walla River, 1990.

Table 7 **(TR).** Hatchery releases of summer steelhead into the **Walla Walla** River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT code/ Fin Clip
1981	Columbia, Wells	Lyons Ferry	Smolt	05/11/83	6.3	12,600	Mill Cr	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/11/83	7.8	15,600	Mill Cr	
1981	Columbia, Wells	Lyons Ferry	Smolt	04/28/83	6.1	46,596	Touchet R (+North Fk)	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/06/83	5.9	9,735	Touchet R (+North Fk)	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/09/83	6.4	6,560	Touchet R (+North Fk)	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/09/83	6.6	19,635	Touchet R (+North Fk)	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/12/83	7.8	14,820	Touchet R (+North Fk)	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/12/83	7.5	13,125	Touchet R (+North Fk)	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/12/83	7.5	12,375	Touchet R (+North Fk)	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/05/83	6.0	9,900	Walla Walla R	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/10/83	6.8	27.200	Walla Walla R	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/10/83	6.8	11,220	Walla Walla R	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/10/83	7.6	30,400	Walla Walla R	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/10/83	7.6	12,540	Walla Walla R	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/18/84	5.4	8,910	Mill Cr	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/18/84	5.4	21,600	Mill Cr	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/10/84	4.8	7,920	Touchet R (+North Fk)	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/11/84	4.8	13,440	Touchet R (+North Fk)	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/11/84	4.7	7,050	Touchet R (+North Fk)	
1983	Columbia, Wells	Lyons Ferry,	Smolt	04/11/84	4.7	18,800	Touchet R (+North Fk)	

Table 7 (cont.). Hatchery releases of summer steelhead into the **Walla Walla** River by brood year and, if marked, the coded wire tag codes.

Brood **Year**	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	**CWT** code/ Fin Clip
1983	Columbia, Wells	Lyons Ferry	Smolt	04/11/84	4.7	7,050	Touchet R (+North Fk)	
1983	Columbia. Wells	Lyons Ferry	Smolt	04/16/84	4.9	8,085	Touchet R (+North Fk)	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/16/84	4.9	19,600	Touchet R (+North Fk)	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/16/84	5.7	9,690	Touchet R (+North Fk)	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/16/84	5.7	23,085	Touchet R (+North Fk)	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/18/84	5.3	8,745	Touchet R (+North Fk)	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/18/84	5.3	21,200	Touchet R (+North Fk)	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/12/84	4.6	18,400	Walla Walla R	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/12/84	4.5	7,425	Walla Walla R	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/12/84	4.8	7,920	Walla Walla R	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/12/84	4.8	19,200	Walla Walla R	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/17/84	4.9	19,600	Walla Walla R	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/17/84	4.9	8,085	Walla Walla R	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/17/84	4.9	19,600	Walla Walla R	
1983	Columbia, Wells	Lyons Ferry	Smolt	04/17/84	4.9	8,085	Walla Walla R	
1983	Columbia, Wells	Lyons Ferry	Smolt	04120184	5.6	24,920	Walla Walla R	
1984	Columbia, Wells	Lyons Ferry	Smolt	04119185	6.2	24,800	Mill Cr	AD
1984	Columbia, Wells	Lyons Ferry	Smolt	04/15/85	5.2	23,400	Touchet R (+North Fk)	AD
1984	Columbia, Wells	Lyons Ferry	Smolt	04/16/85	5.2	17,680	Touchet R (+North Fk)	AD
1984	Columbia, Wells	Lyons Ferry	Smolt	04/16/85	6.3	28,350	Touchet R (+North Fk)	AD

Table 7 (cont.). Hatchery releases of summer steelhead into the Walla Walla River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1984	Columbia, Wells	Lyons Ferry	Smolt	04/19/85	6.2	31,000	Touchet R (+North Fk)	AD
1984	Columbia, Wells	Lyons Ferry	Smolt	04/19/85	6.5	9,119	Touchet R (+North Fk)	AD
1984	Columbia, Wells	Lyons Ferry	Smolt	04/17/85	5.7	22,800	Walla Walla R	AD
1984	Columbia, Wells	Lyons Ferry	Smolt	04/17/85	5.7	22,800	Walla Walla R	AD
1984	Columbia, Wells	Lyons Ferry	Smolt	04/17/85	5.5	22,000	Walla Walla R	AD
1984	Columbia, Wells	Lyons Ferry	Smolt	04/18/85	5.7	22,800	Walla Walla R	AD
1984	Wallowa	Lyons Ferry	Smolt	05/08/85	8.4	16,716	Touchet R (+North Fk)	AD
1985	Columbia, Wells	Lyons Ferry	Smolt	04/30/86	6.3	25,830	Mill Cr	AD
1985	Columbia, Wells	Lyons Ferry	Smolt	04/22/86	5.3	16,800	Touchet R (+North Fk)	AD
1985	Columbia, Wells	Lyons Ferry	Smolt	04/23/86	5.5	21,800	Touchet R (+North Fk)	AD
1985	Columbia, Wells	Lyons Ferry	Smolt	04124186	5.4	21,400	Touchet R (+North Fk)	AD
1985	Columbia, Wells	Lyons Ferry	Smolt	04/24/86	5.6	22,120	Touchet R (+North Fk)	AD
1985	Columbia, Wells	Lyons Ferry	Smolt	04/29/86	6.5	27,300	Touchet R (+North Fk)	AD
1985	Columbia, Wells	Lyons Ferry	Smolt	04/29/86	5.9	18,585	Touchet R (+North Fk)	AD
1985	Columbia, Wells	Lyons Ferry	Smolt	04/29/86	6.9	27,600	Touchet R (+North Fk)	AD
1985	Columbia, Wells	Lyons Ferry	Smolt	04/22/86	5.4	18,900	Walla Walla R	AD
1985	Columbia, Wells	Lyons Ferry	Smolt	04/23/86	5.6	22,200	Walla Walla R	AD
1985	Columbia, Wells	Lyons Ferry	Smolt	04/23/86	5.6	22,200	Walla Walla R	AD
1985	Columbia, Wells	Lyons Ferry	Smolt	04/24/86	5.4	21,600	Walla Walla R	AD
1985	Columbia, Wells	Lyons Ferry	Smolt	04/30/86	6.5	26,000	Walla Walla R	AD

Table 7 (cont.). Hatchery releases of summer steelhead into the Walla Walla River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1985	Columbia, Wells	Lyons Ferrv	Smolt	04/30/86	6.9	27,945	Walla Walla R	AD
1986	Columbia, Wells	Lyons Ferry	Smolt	04/20/87	5.2	102,050	Touchet R (+North Fk)	AD
1986	Columbia, Wells	Lyons Ferry	Smolt	04/20/87	5.2	34,677	Touchet R (+North Fk)	AD
1986	Columbia, Wells	Lyons Ferry	Smolt	04/14/87	5.8	26,100	Mill Cr	AD
1986	Columbia, Wells	Lyons Ferry	Smolt	04/21/87	6.0	24,000	Walla Walla R	AD
1986	Columbia, Wells	Lyons Ferry	Smolt	04/21/87	5.9	26,527	Walla Walla R	AD
1986	Columbia, Wells	Lyons Ferry	Smolt	04/22/87	5.9	18,880	Walla Walla R	AD
1986	Columbia, Wells	Lyons Ferry	Smolt	04/22/87	5.5	7,150	Walla Walla R	AD
1986	Columbia, Wells	Lyons Ferry	Smolt	04/24/87	5.2	23,400	Walla Walla R	AD
1986	Columbia, Wells	Lyons Ferry	Smolt	04/30/87	5.1	25,016	Walla Walla R	AD
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/15/88	4.7	18,871	Touchet R (+North Fk)	63503 1 AD LV
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/15/88	4.7	19,992	Touchet R (+North Fk)	635028 AD LV
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/30/88	4.8	19,681	Touchet R (+North Fk)	634949 AD LV
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/30/88	4.7	20,001	Touchet R (+North Fk)	734947 AD LV
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/30/88	4.8	92,179	Touchet R (+North Fk)	AD
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/21/88	5.7	25,650	Mill Cr	AD

Table 7 (cont.). Hatchery releases of summer steelhead into the Walla Walla River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/26/88	5.8	26,100	Mill Cr	AD
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/21/88	5.6	25,200	Walla Walla R	AD
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/21/88	5.7	25,650	Walla Walla R	AD
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/22/88	5.3	19,080	Walla Walla R	AD
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/22/88	5.6	5,040	Walla Walla R	AD
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/22/88	5.6	25,200	Walla Walla R	AD
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/22/88	5.4	30,596	Walla Walla R	AD
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/25/88	5.6	25,200	Walla Walla R	AD
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/26/88	5.6	25,200	Walla Walla R	AD
1988	Snake R Lower Monumental	Lyons Ferry	Smolt	04/15/89	4.8	20,467	Touchet R (+North Fk)	630250 AD LV
1988	Snake R Lower Monumental	Lyons Ferry	Smolt	04/15/89	4.8	20,224	Touchet R (+North Fk)	630249 AD LV
1988	Snake R Lower Monumental	Lyons Ferry	Smolt	04/15/89	4.8	20,443	Touchet R (+North Fk)	630247 AD LV

Table 7 (cont.). Hatchery releases of summer steelhead into the Walla Walla River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1988	Snake R Lower Monumental	Lyons Ferry	Smolt	04/15/89	4.8	20,563	Touchet R (+North Fk)	635052 AD LV
1988	Snake R Lower Monumental	Lyons Ferry	Smolt	04/15/89	4.8	76,771	Touchet R (+North Fk)	AD
1988	Snake R Lower Monumental	Lyons Ferry	Smolt	04/19/89	4.8	21,600	Mill Cr	AD
1988	Snake R Lower Monumental	Lyons Ferry	Smolt	04/19/89	4.8	21,600	Walla Walla R	AD
1988	Snake R Lower Monumental	Lyons Ferry	Smolt	04/20/89	4.8	2 1,600	Walla Walla R	AD
1988	Snake R Lower Monumental	Lyons Ferry	Smolt	04/20/89	4.8	21,600	Walla Walla R	AD
1988	Snake R Lower Monumental	Lyons Ferry	Smolt	04/20/89	4.8	21,360	Walla Walla R	AD
1988	Snake R Lower Monumental	Lyons Ferry	Smolt	04/21/89	4.8	1,680	Walla Walla R	AD
1988	Wallowa R	Lyons Ferry	Smolt	04/21/89	6.0	18,300	Walla Walla R	AD
1989	Columbia, Wells	Lyons Ferry	Smolt	04/15/90	3.5	20,190	Touchet R (+North Fk)	633908 AD LV
1989	Columbia, Wells	Loyns Ferry	Smolt	04/15/90	3.5	19,780	Touchet R (+North Fk)	633907 AD LV
1989	Columbia, Wells	Lyons Ferry	Smolt	04/15/90	3.5	69,775	Touchet R (+North Fk)	AD
1989	Columbia, Wells	Lyons Ferry	Smolt	04/18/90	3.8	15,200	Mill Cr	AD
1989	Columbia, Wells	Lyons Ferry	Smolt	04/20/90	3.4	17,000	Mill Cr	AD

Table 7 (cont.). Hatchery releases of summer steelhead into the Walla Walla River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT code/ Fin Clip
1989	Columbia, Wells	Lyons Ferry	Smolt	04/23/90	3.3	6,600	Touchet R (+North Fk)	AD
1989	Columbia, Wells	Lyons Ferry	Smolt	04/17/90	3.9	15,600	Walla Walla R	AD
1989	Columbia, Wells	Lyons Ferry	Smolt	04/18/90	4.6	18,400	Walla Walla R	AD
1989	Columbia, Wells	Lyons Ferry	Smolt	04/18/90	3.6	14,400	Walla Walla R	AD
1989	Columbia, Wells	Lyons Ferry	Smolt	04/19/90	3.3	13,200	Walla Walla R	AD
1989	Columbia, Wells	Lyons Ferry	Smolt	04/19/90	3.7	14,800	Walla Walla R	AD
1989	Columbia, Wells	Lyons Ferry	Smolt	04/20/90	3.5	14.000	Walla Walla R	AD
1989	Columbia, Wells	Lyons Ferry	Smolt	04/24/90	3.7	19,802	Walla Walla R	633910 AD LV
1989	Columbia, Wells	Lyons Ferry	Smolt	04/25/90	3.8	20,015	Walla Walla R	633909 AD LV
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/15/91	4.0	20,044	Touchet R (+North Fk)	63406 1 AD LV
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/16/91	4.0	20,108	Touchet R (+North Fk)	634060 AD LV
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/17/91	4.0	20,128	Touchet R (+North Fk)	634062 AD LV
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/18/91	4.0	20,044	Touchet R (+North Fk)	634059 AD LV
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/19/91	4.0	20,132	Touchet R (+North Fk)	634058 AD LV
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/22/91	4.0	20,104	Touchet R (+North Fk)	63 1456 AD LV

Table 7 (cont.). Hatchery releases of summer steelhead into the Walla Walla River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/30/91	4.0	27,960	Touchet R (+North Fk)	AD
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/17/91	3.4	17,000	Mill Cr	AD
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/23/91	3.7	12,950	Mill Cr	AD
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/16/91	3.4	17,000	Walla Walla R	AD
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/16/91	3.4	17,000	Walla Walla R	AD
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/17/91	3.3	16,500	Walla Walla R	AD
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/18/91	3.3	16,500	Walla Walla R	AD
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/18/91	3.3	16,500	Walla Walla R	AD
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/22/91	3.7	18,500	Walla Walla R	AD
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/23/91	3.7	18,500	Walla Walla R	AD
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/25/91	3.7	18,500	Walla Walla R	AD
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/25/91	3.7	18,500	Walla Walla R	AD

Table 7 (cont.). Hatchery releases of summer steelhead into the Walla Walla River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/26/91	3.5	17,500	Walla Walla R	AD
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/29/91	3.3	16,269	Walla Walla R	
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/30/91	3.4	7,480	Walla Walla R	AD

Source: Terry Lovgren, WDW Hatchery Stocking Database, 1991.

Table 8 (AE-a). Coded wire tagged adult steelhead from the Walla Walla subbasin recovered in other subbasins.[A]

Hatchery/Release Site	Recovery Year	Recovery Site	Recovery Method	Number Recovered	Total Number Estimated	CWT Codes
Touchet River	1989	Dworshak NFH	Hatchery Rack		3	63-49-47, 63-49-49 63-50-28, 63-50-3 1
Touchet River	1989	Snake River	Sport Catch		107	63-50-28, 63-50-3 1 63-49-47, 63-49-49
Touchet River	1989	Idaho Snake	Sport Catch		16	63-50-28, 63-50-3 1 63-49-47, 63-49-49
Touchet River	1989	Tucannon	Sport Catch		9	63-49-47, 63-49-49 63-50-28, 63-50-3 1

Hatchery/Release Site	Recovery Year	Recovery Site	Recovery Method	Number Recovered	Total Number Estimated
No Data					

Table 10 **(TD).** Parasites and diseases isolated at stations which reared **Walla Walla** River steelhead smolts.

Disease Type	Hatchery	Specific Pathogen
Bacterial	Lyons **Ferry**[A]	***Flavobacterium*** *sp.*
Bacterial	Lyons Ferry	*Flexibacter cytophaga* (Coldwater)
Bacterial	Lyons Ferry	***Renibacterium salmonarium*** **(BKD)**
Viral	Lyons Ferry	*Infectious Hematopoietic Necrosis* (IHN)
Viral	Lyons Ferry	***EIBS***
Viral	Dayton **Pond**[B]	*EZBS*

*Lyons Ferry Hatchery is located on the lower Snake river.

[B]**Dayton** Pond is a short term rearing station used to acclimate **steelhead** smolts and is located on the **Touchet** River, a tributary of the **Walla Walla** River.

Disease history represents only pathogens isolated at these rearing stations and not necessarily a disease outbreak.

Source: Steve Roberts, Washington Department of Wildlife, 1991.

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SNAKE RIVER SUBBASIN

Lyons Ferry Hatchery Fall Chinook

GEOGRAPHIC LOCATION

The Snake River in Washington state begins at River Mile (RM) 177.1 at the Washington Oregon border and flows northwesterly along the border of Washington and Idaho to RM 139.1. At this point the Snake River is completely within Washington state. It flows southwesterly to its confluence with the Columbia River at RM 324.2 The Lyons Ferry Hatchery is located at the confluence of the Palouse River with the lower Snake River at RM 56.2.

ORIGIN

The Lyons Ferry fish hatchery has been developing its brood stock since the facility was completed in 1984. Snake River fall chinook, upriver bright (URB), brood stock are currently obtained from two sources, 1) returns to Lyons Ferry ladder and 2) adults trapped at Ice Harbor Dam for transport to Lyons Ferry. A third source, transport of eyed eggs from Kalama Falls Fish Hatchery, was done as part of the Snake River Egg Bank Program, and was completed in 1986.

DISTRIBUTION

Lyons Ferry Hatchery.

PRODUCTION

The Lyons Ferry facility has a single pass well water system through the incubators, two adult holding ponds, and 28 raceways. Fall chinook salmon are hatched and reared at the Lyons Ferry facility and either released on station or barged downstream and released. Adult fall chinook salmon return to the fish ladder at the Lyons Ferry facility for brood stocks; 1987 was the first year of adult (four-year-old and older) returns to the hatchery. Design capacity is 101,800 pounds of fall chinook. Numbers of fall chinook salmon returning to the Lyons Ferry Fish Hatchery ladder are increasing. On-station releases since 1985 are returning as adults. As of 1987, voluntary returns to the hatchery have been the primary source of brood stock.

Prior to completion of the Lyons Ferry Fish Hatchery, a portion of the Snake River stock fall chinook salmon adults were collected and reared at the Kalama Falls Fish Hatchery on the lower Columbia River as part of the Snake River Fall Chinook Egg Bank Program. When the Lyons Ferry facility was completed, eyed eggs were transported from the Kalama Falls Fish Hatchery to Lyons Ferry for rearing and subsequent release. Hatchery staff transported 219,800 1984 brood eggs, 1,182,000 1985 brood eggs, and 749,355 1986 brood eggs from Kalama Falls Fish Hatchery.

The objectives of the Lyons Ferry Fish Hatchery under the Lower Snake River Compensation Plan are to compensate for the losses of 18,300 fall chinook, Snake River stock.

ADULT LIFE HISTORY

<u>Run size. catch and escapement</u>

Ocean commercial and recreational fisheries from Alaska to Washington, in addition to Columbia River treaty, non-treaty and sport fisheries all harvest a portion of the Snake River fall chinook.

A total of 1,654 adults and 543 jacks (fish under 61 cm fork length) returned to Lyons Ferry Hatchery in 1987. From aerial spawning ground counts of Hells Canyon, two adults were counted in 1974, 11 adults in 1975, and six adults in 1976. In 1987, 13 were observed (WDF 1990).

Strays from other hatcheries do occur. The analysis of coded wire tags recovered at Lyons Ferry Hatchery using standard expansion techniques has shown a steady increase in the percentage of strays. Umatilla River fall chinook, which are URB's from Bonneville Hatchery and therefore very heavy to the Priest Rapids genotype, comprise the largest segment of the strays (Roler, Memo. 1990). Data for these strays is unavailable. Strays of fall chinook that originated outside of the Lyons Ferry Hatchery are presented in Table 5.

Time of Migration

Snake River fall chinook enter the Columbia River in August, September and early October (Bjorn 1960). The peak movement of the run over Ice Harbor Dam (lower Snake River) is in September.

Spawning Period

The duration of fall chinook salmon spawning is from mid-October to mid-December with peak spawning occurring in mid-November.

Spawning Areas

Lyons Ferry Fish Hatchery.

Aee Composition

Ages range from two-year-old jacks to six-year-old adults. Age composition percentage (freshwater-ocean) by brood year for fall chinook returning to the Lyons Ferry Hatchery is presented in Table 1.

Sex Ratio

Female fall chinook comprised 34.33 percent of the fall chinook returning to the Lyons Ferry Hatchery for the 1985 brood year. The percent females by brood year and freshwaterocean rearing ages for the Lyons Ferry fall chinook hatchery are presented in Table 8.

The mean fork length by brood year and age class (freshwaterocean) for female and male fall chinook returning to the Lyons Ferry Hatchery are presented in Tables 3 and 4, respectively.

Fecundity

Average fecundity of Snake River stock fall chinook salmon since inception of the egg bank program in 1977 is 4,297 eggs per female. Lyons Ferry hatchery fecundity by age and brood year are unavailable.

JUVENILE LIFE HISTORY

Time of Emergence

Time of emergence for the Lyons Ferry Hatchery is unavailable.

Time. age and size at migration

Migration of fall chinook begin in March, peaks in mid-April and is completed by the end of June (WDF, 1990). The average size for age-0 downstream migrants of the Snake River was 42 mm, with a range of 30 mm to 55 mm (Mains and Smith 1955). Specific length data for smolts released from the Lyons Ferry Hatchery is unavailable.

Hatchery release information for the Lyons Ferry by brood year is presented in Table 6.

Survival Rate

Of the 1983 brood released, 1.21 percent returned to Lyons Ferry as two, three, and four-year-olds. The 1984 brood subyearling on-station releases have experienced and overall survival rate of 0.22 percent. The overall survival rate (fishery contribution and returns to the Lower Snake River Compensation Plan project area) is 5.23 percent (WDF 1990).

DISEASE

Some of the pathogens isolated at the Lyons Ferry Hatchery include bacterial gill disease, bacterial kidney disease, and enteric redmouth disease. A list of the parasites and diseases of fall chinook at the Lyons Ferry Hatchery is presented in Table 7.

BIOCHEMICAL-GENETIC CHARACTERISTICS

Genetic electrophoretic test (Seidel et al. 1988) were conducted on Snake River fall chinook and concluded; no evidence of genetic difference between fish returning to the Snake River and Lyons Ferry Hatchery and those derived from the Snake River/Lyons Ferry egg-band program at Kalama Falls Hatchery.It also showed clear evidence of significant genetic differences between the Priest Rapids Hatchery Stock (mainstem Columbia River Hanford Reach) and the Snake River/Lyons Ferry Hatchery stock.

Table 1 (AC). Age composition percentage **(freshwater.ocean)** by brood year for fall chinook returning to the Lyons Ferry Hatchery.

		Age Composition **(%)**								
Brood **Year**	N	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4
1982										
1983										
1984										
1985	533	26.09	6.19	22.33	2.25		12.95	27.20	2.99	
1986										
1987										
1988										

Age based on scale reading analysis.

Table 2 (AS-l). Percent females by brood year and age class (freshwater.ocean) for fall chinook returning to the Lyons Ferry Hatchery.

Females (%)

Brood year	N	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	Total % Females
1980											
1981											
1982					75.00				66.67		
1983				67.14	75.00			71.41	75.53	75.00	
1984			26.79	63.54	69.44		4.44	66.13	80.85		
1985	183	0	27.27	68.07	50.00		1.45	53.10	56.25		34.33
1986		0	25.77	70.27			0.97	70.83			
1987		2.86	26.32				0				
1988		0									
1989											
1990											

Age based on scale reading analysis.
Does not include 1.0 and 2.0 mini-jacks.

Table 3 (AL-a). Mean fork length by brood year and age class **(freshwater.ocean)** for male fall chinook returning to the Lyons Ferry Hatchery.

Mean Fork Length (cm)

Brood Year	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4
1982				106				103	
N				2				1	
St. Dev.				12.02				---	
1983			89	103			77	96	94
N			23	5			191	23	1
St. Dev.			15.32	7.56			11.48	9.26	---
1984		61	94	100		54	74	92	
N		82	35	11		43	21	9	
St. Dev.		8.74	10.03	6.50		5.21	9.23	11.50	
1985	38	68	83	96		53	74	82	
N	139	24	38	6		68	68	7	
St. Dev.	4.81	3.83	10.85	8.99		4.6	8.14	7.83	
1986	43	69	91			54	73		
N	90	121	11			99	14		
St. Dev.	5.52	5.21	8.48			4.19	9.12		
1987	46	63				54			
N	34	14				35			
St. Dev.	6.38	4.66				3.91			
1988	43								
N	21								
St. Dev.	9.11								

Age based on scaled reading analysis.

Table 4 (AL-b). Mean fork length by brood year and age class (freshwater.ocean) for female fall chinook returning to the Lyons Ferry Hatchery.

Mean Fork Length (cm)

Brood Year	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4
1982				94				98	
N				6				2	
St. Dev.				6.77				3.54	
1983			86	92			77	87	
N			47	15			477	71	
St. Dev.			6.57	12.73			6.06	7.09	
1984		71	85	92		72	75	83	
N		30	61	25		2	41	38	
St. Dev.		4.79	7.34	7.42		4.95	4.82	7.88	
1985	0	73	82	84		67	75	84	
N		9	81	6		1	77	9	
St. Dev.		4.53	6.55	6.71		---	5.93	7.62	
1986	0	73	84			64	75		
N		42	26			4	34		
St. Dev.		3.88	8.72			4.79	4.94		
1987	43	68							
N	1	5							
St. Dev.	- -	4.64							
1988	0								
N									
St. Dev.									

Age based on scale reading analysis.

Table 5 (AI). Immigration of coded wire tagged fall chinook into the Lyons Ferry subbasin.

Hatchery/Release Site	Recovery site, Run **Year(s)**	Recovery Method	Number Sampled	Number Recovered	Total Number Estimated, (PSMFC)
Priest Rapids	Lyons Ferry, 1988	Hatchery	1413	1	1
Priest Rapids	Lyons Ferry, 1989	Hatchery	1880	1	1
Priest Rapids	Lyons Ferry, 1989	Hatchery	1880	1	1

*Based on the following tag codes: 63-23-30, and 63-41-28.

Table 6 (TR). Hatchery releases of fall chinook salmon from the Lyons Ferry Hatchery, sorted by brood year, hatchery and life stage.

Brood Year	stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /lb.	Number Released	Release Site	CUT Code
1983	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/17/85	04/17/85	10	250831	SNAKE RIVER (LOWER)	632152
1983	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/17/85	04/17/85	10	236894	SNAKE RIVER (LOWER)	UNTAGGED
1983	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/17/85	04/17/85	10	83611	SNAKE RIVER (LOWER)	633218
1983	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/17/85	04/17/85	10	78964	SNAKE RIVER (LOWER)	UNTAGGED
1984	SNAKE RIVER (LOUER)	LYONS FERRY HATCHERY	Fingr	06/06/85	06/06/85	67	78417	SNAKE RIVER (LOWER)	633226
1984	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/06/85	06/06/85	67	101636	SNAKE RIVER (LOWER)	UNTAGGED
1984	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/06/85	06/06/85	67	78064	SNAKE RIVER (LOWER)	633227
1984	SNAKE RIVER (LOUER)	LYONS FERRY HATCHERY	Fingr	06/06/85	06/06/85	67	101135	SNAKE RIVER (LOWER)	UNTAGGED
1984	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/06/85	06/06/85	67	78504	SNAKE RIVER (LOWER)	633228
1984	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/06/85	06/06/85	67	101636	SNAKE RIVER (LOWER)	UNTAGGED
1984	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/03/86	04/03/86	8	258355	SNAKE RIVER (LOWER)	632841
1984	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/03/86	04/03/86	8	183321	SNAKE RIVER (LOWER)	UNTAGGED
1984	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/04/86	04/04/86	8	39974	SNAKE RIVER (LOWER)	UNTAGGED
1984	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/08/86	04/08/86	8	300	SNAKE RIVER (LOWER)	UNTAGGED
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/10/86	06/10/86	58	98650	SNAKE RIVER (LOWER)	633638
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/10/86	06/10/86	58	468	SNAKE RIVER (LOWER)	UNTAGGED
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/10/86	06/10/86	58	49325	SNAKE RIVER (LOWER)	633639
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/10/86	06/10/86	58	468	SNAKE RIVER (LOWER)	UNTAGGED
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/10/86	06/10/86	58	49325	SNAKE RIVER (LOWER)	633640
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/10/86	06/10/86	58	468	SNAKE RIVER (LOWER)	UNTAGGED
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/10/86	06/10/86	58	49325	SNAKE RIVER (LOWER)	633641
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/10/86	06/10/86	58	468	SNAKE RIVER (LOWER)	UNTAGGED
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/10/86	06/10/86	58	49325	SNAKE RIVER (LOWER)	633642
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/10/86	06/10/86	58	468	SNAKE RIVER (LOWER)	UNTAGGED
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/10/86	06/10/86	87	1212200	SNAKE RIVER (LOWER)	UNTAGGED
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/10/86	06/10/86	70	81003	SNAKE RIVER (LOWER)	UNTAGGED
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/13/86	06/13/86	55	49112	SNAKE RIVER (LOWER)	633633
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/13/86	06/13/86	55	366	SNAKE RIVER (LOWER)	UNTAGGED
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/13/86	06/13/86	55	49112	SNAKE RIVER (LOWER)	633634
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/13/86	06/13/86	55	366	SNAKE RIVER (LOWER)	UNTAGGED
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/13/86	06/13/86	55	49112	SNAKE RIVER (LOWER)	633635
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/13/86	06/13/86	55	366	SNAKE RIVER (LOUER)	UNTAGGED
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/13/86	06/13/86	55	49113	SNAKE RIVER (LOWER)	633636
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/13/86	06/13/86	55	367	SNAKE RIVER (LOWER)	UNTAGGED
1985	SNAKE RIVER (LOUER)	LYONS FERRY HATCHERY	Fingr	06/13/86	06/13/86	55	49112	SNAKE RIVER (LOWER)	633637
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/13/86	06/13/86	55	366	SNAKE RIVER (LOWER)	UNTAGGED
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/14/87	04/14/87	6	152479	SNAKE RIVER (LOWER)	634156
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/14/87	04/14/87		1075	SNAKE RIVER (LOWER)	UNTAGGED
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/14/87	04/14/87	8	653	SNAKE RIVER (LOWER)	UNTAGGED
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/14/87	04/14/87	9	39906	SNAKE RIVER (LOWER)	UNTAGGED
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/16/87	04/16/87	7	156036	SNAKE RIVER (LOWER)	634159
1985	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/16/87	04/16/87	7	470	SNAKE RIVER (LOWER)	UNTAGGED
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/01/87	06/01/87	48	126076	SNAKE RIVER (LOWER)	634259
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/01/87	06/01/87	48	2836	SNAKE RIVER (LOWER)	UNTAGGED
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/01/87	06/01/87	48	125570	SNAKE RIVER (LOWER)	634261
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/01/87	06/01/87	48	2824	SNAKE RIVER (LOWER)	UNTAGGED
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/01/87	06/01/87	76	80484	SNAKE RIVER (LOWER)	UNTAGGED
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/02/87	06/02/87	71	127715	SNAKE RIVER (LOWER)	634262
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/02/87	06/02/87	71	1030	SNAKE RIVER (LOWER)	UNTAGGED
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/02/87	06/02/87	71	128283	SNAKE RIVER (LOWER)	634401
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/02/87	06/02/87	71	1034	SNAKE RIVER (LOWER)	UNTAGGED
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/02/87	06/02/87	105	78200	SNAKE RIVER (LOWER)	UNTAGGED
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/14/88	04/14/88	8	58735	SNAKE RIVER (LOWER)	634411
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/14/88	04/14/88	8	64348	SNAKE RIVER (LOWER)	UNTAGGED
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/14/88	04/14/88	8	58970	SNAKE RIVER (LOWER)	634413

Table 6 (cont.). Hatchery releases of fall chinook salmon from the Lyons Ferry Hatchery, sorted by brood year, hatchery and life stage.

Brood Year	Stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /lb.	Nunber Released	Release Site	CUT Code
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	smott	04/14/88	04/14/88	8	64606	SNAKE RIVER (LOWER)	UNTAGGED
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/14/88	04/14/88	8	39952	SNAKE RIVER (LOWER)	UNTAGGED
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/19/88	04/19/88	8	60523	SNAKE RIVER (LOWER)	634407
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/19/88	04/19/88	8	213	SNAKE RIVER (LOWER)	UNTAGGED
1986	SNAKE RIVER (LOUER)	LYONS FERRY HATCHERY	Smolt	04/19/88	04/19/88	8	60281	SNAKE RIVER (LOWER)	634408
1986	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/19/88	04/19/88	8	212	SNAKE RIVER (LOWER)	UNTAGGED
1987	SNAKE RIVER (LOUER)	LYONS FERRY HATCHERY	Fingr	06/01/88	06/01/88	53	124345	SNAKE RIVER (LOWER)	635214
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/01/88	06/01/88	53	840056	SNAKE RIVER (LOWER)	UNTAGGED
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/01/88	06/01/88	53	124394	SNAKE RIVER (LOWER)	635216
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/01/88	06/01/88	53	840392	SNAKE RIVER (LOWER)	UNTAGGED
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/01/88	06/01/88	53	79961	SNAKE RIVER (LOWER)	UNTAGGED
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/88	06/08/88	53	122850	SNAKE RIVER (LOWER)	635211
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/88	06/08/88	53	23371	SNAKE RIVER (LOWER)	UNTAGGED
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/88	06/08/88	53	122899	SNAKE RIVER (LOWER)	635213
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/88	06/08/88	53	23379	SNAKE RIVER (LOWER)	UNTAGGED
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/88	06/08/88	124	1114000	SNAKE RIVER (LOWER)	UNTAGGED
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/88	06/08/88	w	886300	SNAKE RIVER (LOWER)	UNTAGGED
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/88	06/08/88	70	271500	SNAKE RIVER (LOWER)	UNTAGGED
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/14/89	04/14/89	10	57756	SNAKE RIVER (LOWER)	634752
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/14/89	04/14/89	10	69501	SNAKE RIVER (LOWER)	UNTAGGED
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/14/89	04/14/89	10	57594	SNAKE RIVER (LOWER)	634756
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/14/89	04/14/89	10	69307	SNAKE RIVER (LOWER)	UNTAGGED
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/14/89	04/14/89	10	12994	SNAKE RJVER (LOWER)	UNTAGGED
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/14/89	04/14/89	10	13033	SNAKE RIVER (LOWER)	UNTAGGED
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/14/89	04/14/89	10	13017	SNAKE RIVER (LOWER)	UNTAGGED
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/20/89	04/20/89	10	59608	SNAKE RIVER (LOWER)	634750
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/20/89	04/20/89	10	299	SNAKE RIVER (LOWER)	UNTAGGED
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/20/89	04/20/89	10	59609	SNAKE RIVER (LOWER)	634755
1987	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Smolt	04/20/89	04/20/89	10	299	SNAKE RIVER (LOWER)	UNTAGGED
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/89	06/08/89	90	113193	SNAKE RIVER (LOWER)	630226
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/89	06/08/89	90	20319	SNAKE RIVER (LOWER)	UNTAGGED
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/89	06/08/89	90	113285	SNAKE RIVER (LOWER)	630228
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/89	06/08/89	90	20320	SNAKE RIVER (LOWER)	UNTAGGED
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/89	06/08/89	122	118119	SNAKE RIVER (LOWER)	UNTAGGED
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/89	06/08/89	115	134467	SNAKE RIVER (LOWER)	UNTAGGED
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/89	06/08/89	113	116961	SNAKE RIVER (LOWER)	UNTAGGED
1988	SNAKE RIVER (LOUER)	LYONS FERRY HATCHERY	Fingr	06/08/89	06/08/89	102	131545	SNAKE RIVER (LOUER)	UNTAGGED
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/89	06/08/89	98	117022	SNAKE RIVER (LOWER)	UNTAGGED
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/89	06/08/89	72	105787	SNAKE RIVER (LOWER)	UNTAGGED
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/89	06/08/89	69	40025	SNAKE RIVER (LOWER)	UNTAGGED
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/08/89	06/08/89	69	39991	SNAKE RIVER (LOWER)	UNTAGGED
1988	SNAKE RIVER (LOUER)	LYONS FERRY HATCHERY	Fingr	06/08/89	06/08/89	68	104584	SNAKE RIVER (LOWER)	UNTAGGED
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/14/89	06/14/89	75	116935	SNAKE RIVER (LOWER)	635204
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/14/89	06/14/89	75	24329	SNAKE RIVER (LOWER)	UNTAGGED
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/14/89	06/14/89	75	117168	SNAKE RIVER (LOWER)	635207
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/14/89	06/14/89	75	24335	SNAKE RIVER (LOWER)	UNTAGGED
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/14/89	06/14/89	118	125091	SNAKE RIVER (LOWER)	UNTAGGED
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/14/89	06/14/89	90	88378	SNAKE RIVER (LOWER)	UNTAGGED
1988	SNAKE RIVER (LOWER)	LYONS FERRY HATCHERY	Fingr	06/14/89	06/14/89	63	173595	SNAKE RIVER (LOWER)	UNTAGGED
1988	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Smolt	04/16/90	04/16/90	9	55922	SNAKE RIVER (LOWER)	630235
1988	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Smolt	04/16/90	04/16/90	9	83760	SNAKE RIVER (LOWER)	UNTAGGED
1988	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Smolt	04/16/90	04/16/90	9	56597	SNAKE RIVER (LOWER)	630237
1988	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Smolt	04/16/90	04/16/90	9	83766	SNAKE RIVER (LOWER)	UNTAGGED
1988	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Smolt	04/17/90	04/17/90	11	58988	SNAKE RIVER (LOWER)	630231
1988	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Smolt	04/17/90	04/17/90	11	19166	SNAKE RIVER (LOWER)	UNTAGGED

Table 6 (cont.). Hatchery releases of fall chinook salmon into the LYONS FERRY subbasin sorted by brood year, hatchery and life stage.

Brood Year	stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /lb.	Number Released	Release Site	CUT Code
1988	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Smolt	04/17/90	04/17/90	11	58989	SNAKE RIVER (LOWER)	630232
1988	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Smolt	04/17/90	04/17/90	11	19166	SNAKE RIVER (LOWER)	UNTAGGED
1989	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Fingr	06/06/90	06/06/90	55	123640	SNAKE RIVER (LOWER)	635544
1989	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Fingr	06/06/90	06/06/90	55	3662	SNAKE RIVER (LOWER)	UNTAGGED
1989	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Fingr	06/06/90	06/06/90	55	123233	SNAKE RIVER (LOWER)	635547
1989	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Fingr	06/06/90	06/06/90	55	3601	SNAKE RIVER (LOWER)	UNTAGGED
1989	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Fingr	06/06/90	06/06/90	77	39813	SNAKE RIVER (LOWER)	UNTAGGED
1989	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Fingr	06/06/90	06/06/90	77	39863	SNAKE RIVER (LOWER)	UNTAGGED
1989	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Fingr	06/06/90	06/06/90	70	303255	SNAKE RIVER (LOWER)	UNTAGGED
1989	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Fingr	06/08/90	06/08/90	62	118104	SNAKE RIVER (LOWER)	635549
1989	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Fingr	06/08/90	06/08/90	62	4716	SNAKE RIVER (LOWER)	UNTAGGED
1989	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Fingr	06/08/90	06/08/90	62		SNAKE RIVER (LOWER)	635550
1989	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Fingr	06/08/90	06/08/90	62	119941 4787	SNAKE RIVER (LOWER)	UNTAGGED
1989	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Fingr	06/18/90	06/18/90	73	793349	SNAKE RIVER (LOWER)	UNTAGGED
1989	LYDNS FERRY HATCHERY	LYONS FERRY HATCHERY	Fingr	06/25/90	06/25/90	69	604205	SNAKE RIVER (LOWER)	UNTAGGED
1989	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Fingr	07/02/90	07/02/90	71		SNAKE RIVER (LOWER)	UNTAGGED
1989	LYONS FERRY HATCHERY	LYONS FERRY HATCHERY	Fingr	07/12/90	07/12/90	84	534174 227413	SNAKE RIVER (LOWER)	UNTAGGED

Table 7 **(TD-1).** Parasites and diseases of fall chinook at the Lyons Ferry Hatchery.

Disease type	Hatchery	Specific Pathogen .
Bacteria	Lyons Ferry	Bacterial Gill Disease
Bacteria	Lyons Ferry	Renibacterium salmoninarium (Bacterial Kidney Disease)
Bacteria	Lyons Ferry	Yersinia ruckeri (Enteric Redmouth Disease)
Virus	Lyons Ferry	EIBS - Erythrocytic Inclusion Body Syndrome
	Lyons Ferry	Chills

Disease history only represents pathogens isolated at the hatchery and not necessarily a disease outbreak.

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SNAKE RIVER SUBBASIN

Naturally Produced Summer Steelhead

GEOGRAPHIC LOCATION

The Snake River originates deep in the state of Idaho with the upper portion of the river forming the state line between Idaho and Oregon and Washington. Entering Washington State at river mile (RM) 177.1 the Snake River flows northwesterly along the Oregon\Washington\Idaho borders and flows entirely into Washington State at RM 139.1. Major tributaries within Washington include the Grande Ronde, and Tucannon rivers and Asotin Creek. The Washington portion of the Snake River subbasin encompasses approximately 4,351 square miles. The drainage includes parts of Asotin, Garfield, Columbia, Walla Walla, Franklin and Whitman counties. Much of the basin within Washington State is in the canyons and forested hills of the Blue Mountains. The Snake enters the Columbia River at RM 324.2.

ORIGIN

The wild summer steelhead stock in the Snake River is native, although interbreeding has probably occurred with stocks from tributaries of the mainstem Snake River.

DISTRIBUTION

Table 1 lists rearing and spawning habitat, by quality, for Snake River steelhead based on estimates from the Northwest Power Planning Council.

Historically, distribution of summer steelhead spread throughout the entire Snake River subbasin. Presently, the upper limit for all anadromous fish is at Hell's Canyon Dam, located in Idaho, which blocks access to the upper reaches of the Snake River. Within Washington State, steelhead are found throughout the mainstem river and in many of the lower reaches of tributaries including: Asotin, Deadman, Meadow, Penawawa, Almota, Alkali Flat Creek, Tenmile, Couse creeks and Steptoe Canyon.

PRODUCTION

Production Facilities

Steelhead production occurs at Lyons Ferry Hatchery which is located on the Snake River below the confluence of the Palouse River. The hatchery was completed in 1982 under the Lower Snake River Compensation Plan and was intended to compensate or replace the natural production of salmon, steelhead and resident fish which were lost due to hydroekctric projects built on the lower Snake River.

Production Summarv

No data is available on natural smolt production. Natural production continues in both the mainstem Snake River and throughout most tributaries although seriously reduced from the number of steelhead the river once produced. Factors affecting steelhead survival start with the eight hydroelectric dams steelhead smolts encounter before reaching the ocean with each dam adding to the mortality of migrating smolts. In addition, construction of four dams on the Snake River inundated a large portion of spawning and rearing habitat (see below). Irrigation, unscreened diversions, logging, mining, farming and range-land grazing have all combined to reduce and degrade the habitat within the subbasin.

Habitat loss due to construction of Snake River Dams:

Dam	Location	Inundated River Miles
Ice Harbor	Snake River (RM 9.7)	35.0
Lower Monumental	Snake River (RM 41.6)	29.0
Little Goose	Snake River (RM 70.3)	37.2
Lower Granite	Snake River (RM 107.5)	39.0

ADULT LIFE HISTORY

Run Size and Escapement

The Snake River once supported large numbers of steelhead. As many as 4,600 wild Snake River steelhead were estimated to return to the lower river annually (1960) and although the present run sire is unknown it is believed to be less than the steelhead runs of the past. Large numbers of steelhead, primarily hatchery fish, still travel through the lower Snake on their return journey further upstream. Some of the steelhead entering the Snake River remain in the lower river, mostly hatchery fish, with returns of wild steelhead to the lower river considered small. Snake River steelhead returns (hatchery and wild), as measured by fish counted crossing Lower Granite Dam, from 1980 through 1990 ranged from 38,352 in 1980 to 141,957 in 1990 (Table 2).

Based on a creel survey of 81 steelhead caught in the sport catch during 1983-84, wild steelhead comprised 28.4 percent of the lower Snake River catch. Another creel survey of 129 sport caught steelhead in 1985-86 at four separate locations showed wild fish comprised 17 to 19 percent of the total catch.

Harvest

Ocean harvest of Snake River steelhead is unknown.

There is no estimate for the number of Snake River steelhead harvested in the Columbia River, although sport and treaty Indian fisheries harvest large numbers of steelhead which would include some Snake River fish.

The Snake River once provided the largest summer steelhead fishery in Washington. Based on U.S. Army Corps of Engineers (1975) calculations, 63.1 percent of the steelhead in the Columbia River entered the Snake River from 1962 through 1974. Sport harvest occurs throughout the mainstem Snake River and many of the tributaries within Washington. Sport catch from Washington waters averaged 4,277 fish annually from 1980 through 1990 based on permit-card harvest estimates. Yearly sport catch from 1980 through 1990 is presented in Table 2. Exact number of wild fish harvested is unknown although sport harvest is composed mainly of hatchery fish. Washington Department of Wildlife has established fishing regulations for that portion of the river which flows within Washington State. To protect and increase escapement of wild steelhead current fishing regulations include: wild steelhead release, and certain portions of the river closed to fishing or restricted to the use of single barbless hooks.

The tribal fishery on the Columbia River intercepts summer steelhead bound for the Snake River.

No estimate exists for the impact of this fishery. Several Indian tribes in Idaho have traditionally fished within the subbasin.

Time of Migration

Past data from the 1950's identified two peak migration periods when steelhead entered the Snake River, a late summer/fall period of movement in the river starting in late September and a spring period of movement starting in early April to mid-May.

Spawning period

Eldred (1961) indicated steelhead migrating towards Asotin Creek travel up the Columbia River July through September with these fish moving up the Snake River and finally entering Asotin Creek in mid-February, peaking in March and April. Spawning was believed to occur April through May.

Spawning area

Construction of the lower Snake River dams eliminated approximately 80 percent of the mainstem spawning and rearing habitat (Howell et al. 1985). Presently, spawning is limited on the mainstem river to above RM 145 and the lower portions of the following Snake River tributaries: Asotin, Alpowa, Alkali Flat Creek, Deadman, Meadow, Penawawa, Almota, Tenmile, Couse creeks and Steptoe Canyon (Howell et al. 1985).

Fecundity

No data are available for wild steelhead on the mainstem Snake River. Eighteen wild steelhead spawned from Asotin Creek in 1954 averaged 3,615 eggs (Kray 1959). Fecundity of hatchery steelhead spawned at Lyons Ferry Hatchery for from 1987 through 1990 averaged 4,611 for l-ocean fish and 6,059 for 2-ocean fish (Table 7).

Age Composition

Limited data are available on age structure. Age data on 354 fish caught in the upper Snake River and 157 fish caught in the lower river from run years 1985-1986 is presented in Table 4.

Size

Data on wild steelhead size are lacking. Length for individuals age classes from steelhead run years 1985-86 is presented in Table 7. Length data for age classes for steelhead returning to Lyons Ferry Hatchery 1982 through 1990 consistently ranged from 58 to 61 cm for 1.1 age class and 69 to 75 cm for 1.2 age class. Length data on hatchery steelhead returns is also presented in Table 6.

Sex ratio

Sex ratio data for steelhead in this subbasin are limited. Wild summer steelhead sampled from sport catches above Lower Granite Dam in 1985-86 showed 58.1 percent of the 55 fish sampled were females. Sex ratio for hatchery steelhead collected at Lyons Ferry Hatchery averaged 55.6% female for l-ocean fish and 44.0% female for 2-ocean fish (Table 5).

Survival Rate

No data are available on Snake River steelhead.

JUVENILE LIFE HISTORY

Emergence

Emergence occurs from May through July.

Egg

No data are available on egg production or egg to smolt survival.

Juvenile rearing

Juvenile rearing for the majority of wild smolts lasts approximately two years prior to ocean emigration. Most smolts outmigrate in April and May at the size of 170 to 200 mm (Table 3).

Hatchery releases

Lyons Ferry Hatchery, which is located on the lower Snake River, annually releases large numbers of steelhead into the Snake River. Several stocks of steelhead have been reared and released into the river including: Wells, Skamania, Wallowa, and Lyons Ferry. Data on returning adults to Lyons Ferry Hatchery showed the following:

1985-86, 524 captured returning fish, 76.0 percent female, 24.0 percent male,
1987-88, 1,081 captured returning fish, 56.7 percent female, 43.2 Percent male,
1988-89, 1,127 captured returning fish, 52.0 percent female, 47.9 percent male,
1989-90, 2,458 captured returning fish, 61.4 percent female, 38.6 percent male.

Hatchery releases into lower Snake River basin is outlined in Tables 8 and 9.

Straying

Snake River coded wire tagged hatchery steelhead have been recovered in neighboring streams. Table 10 lists recovery of Snake River steelhead.

BIOCHEMICAL-GENETIC CHARACTERISTICS

No data is available for Snake River steelhead.

DISEASES

Disease history for hatchery smolts planted in the Snake River is presented in Table 11.

Table 1 **(HB-1).** Estimated* amount of rearing and spawning habitat, by quality, of Snake River **subbasin** summer steelhead.

Area[B]	Excellent	Good	**Fair**[C]	**Poor**[C]	Unknown	Total	Confidence
Miles	39.7%	31.4%	17.6%	11.3%		115.0	Unknown
Acres							

*Northwest Power Planning Council estimates based on limited observations.

[B]**80%** of mainstream spawning and rearing habitat eliminated by construction of dams.

[C]**Ratings** of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by man

Source: Presence/absence database, NPPC 1991.

Table 2 (RR-a). Returns (escapement and sport catch) of summer steelhead to the Snake River subbasin.

Return **Year**	**Escapement**[A] Wild/Natural Fish	Escapement! Hatchery Fish	Sport **Catch**[B]	Adult Total
1980	19,700	18,300	352	38,352
1981	23,300	19,100	490	42,890
1982	25,100	47,300	860	73,260
1983	24,500	64,300	1,548	90,348
1984	24,500	79,900	7,395	111,795
1985	26,700	89,600	4,973	121,273
1986	26,500	103,500	7,232	137,232
1987	26,400	44,900	3,598	74,898
1988	18,500	61,400	6,523	86,423
1989	21,500	109,800	10,657	141,957

*Escapement estimated by number of steelhead counted crossing Lower Granite Dam.

[B]**Sport** catch permit-card harvest estimates.
Catch within **subbasin** only, includes Asotin Creek.

Sources: Schuck M., WDW 1985-86 Annual Report, # 87-3
Schuck M., WDW 1986-87 Annual Report, # 89-l 1.
1991 All Species Review, Columbia River Fish Management Plan.

Table 3 (SL). Lengths of wild/natural summer steelhead smolts from Snake River subbasin.

Location and Year	Number Fish	Length ave. (mm)	Length range (mm)	Reference
Cottonwood Creek1986-87	306	163. lmm	123-245mm	Schuck, 1986-87 annual report. # 89- 11.
Cottonwood Creek1987-88	340	163.9mm	125-245mm	Schuck, 1987-88 annual report. # 89-l 1

Table 4 (AC). Age composition percentage (freshwater.ocean) by brood year for adult summer steelhead originating in the Snake River subbasin.

Age composition (%)

Brood Year	N	1.1	1.2	1.3	2.1	2.2	2.3	Repeat Spawners
1985-86 Upper Snake[A]	157[C]	58.2	24.9	1.4	7.3	7.1	1.1	0.3
1985-86 Lower Snake[B]	354[C]	52.2	34.4	3.2	6.4	3.8		

[A]Upper Snake refers to that section of the river above Lower Granite Dam.
[B]Lower Snake refers to that section of the river below Lower Granite Dam.
[C]Fish collected from sport catch.
Age determined by scale analysis.

Sources: Snake River Production Plan, 1990.
Schuck M., WDW 1985-86 Annual Report, # 87-3.
Schuck M., WDW 1987-88 Annual Report, # 89-l 1.

Table 5 (AS-a). Percent female by age class for adult hatchery summer steelhead originating in the Snake River.

% Females

Return Year	1.1	1.2	Total Number Females*
1985	54.0	46.0	359
1986	55.9	44.1	
1987	56.7	43.2	267
1988	61.0	39.0	243
1989	50.7	47.6	437

[A]Based on fish collected at Lyons Ferry Hatchery.

Source: Snake River Subbasin Production Plan, 1990.
WDW, 1985-86 Lyons Ferry Hatchery Evaluation, Report # 87-3.
WDW, 1987-88 Lyons Ferry Hatchery Evaluation, Report # 89-11.
WDW, 1988-89 Lyons Ferry Hatchery Evaluation, Report # 90-11.

Table 6 (AL-a). Mean fork length and age class for adult summer steelhead originating in the Snake River subbasin.

Mean Fork Length (cm)

Return Year[A]	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3
1982	58.6	72.0							
1983	59.0	75.0							
1984	59.2	71.2							
1985	61.1	72.9	81.3	63.4	80.5	97.7	67.3	82.4	86.0
1986	57.8	71.6							
1987	59.5	69.6							
1988	58.2	71.4							
1989	59.5	71.5							

[A]Age data for 1985 based on 54 wild steelhead collected from Snake River sport catch. Other years based on hatchery steelhead returning to Lyons Ferry Hatchery. Age determined by scale analysis.

Sources: Snake River Subbasin Production Plan, 1990.
WDW, 1985-86 Snake River Steelhead Creel Survey, # 87-3.
WDW, 1987-88 Annual Report, # 89-11.
WDW, 1989-90 Lyons Ferry Evaluation Study, # 90-11.

Table 7 (AF-a). Mean fecundity by return year and age class for hatchery steelhead originating in the Snake River subbasin.

Mean **Fecundity**[A]

Return Year	1.1	1.2	1.3	Number **Females**[B]
1980				No Data
1987	4,572	5,596		267
1988	4,365	6,021		243
1989	4,898	6,561	8,797	437
1990	4,966			261

*Fecundity determined by dividing total eggs by total females spawned.
[B]**Based** on fish captured at Lyons Ferry Hatchery.

Source: WDW, 1987-88 Evaluation of Lyons Ferry Hatchery, # 89-l 1.
WDW, 88-89 Evaluation of Lyons Ferry Hatchery, # 90-l 1.
Mark **Schuck,** unpublished WDW data.

Table 8 (TR-1). Hatchery releases of summer steelhead into the Snake River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Codes/ Fin Clip
1981	Skamania	Tucannon	Smolt	05-06-82	8.0	8,400	Snake R Lyons Ferry	621650 AD
1981	Skamania	Tucannon	Smolt	05-07-82	8.0	4,240	Snake R Lyons Ferry	621650 AD
1981	Skamania	Tucannon	Smolt	05-10-82	8.0	4,320	Snake R Lyons Ferry	621650 AD
1981	Skamania	Tucannon	Smolt	05-11-82	8.0	12,320	Snake R Lyons Ferry	621650 AD
1982	Lyons Ferry	Lyons Ferry	Non-Smolt	01-31-83	52.5	69,422	Snake R Lyons Ferry	
1982	Wallowa	Lyons Ferry	Smolt	05-02-83	4.3	6,020	Snake R Lyons Ferry	AD
1982	Wells	Lyons Ferry	Smolt	05-20-83	4.3	50,253	Snake R Lyons Ferry	
1982	Wells	Lyons Ferry	Smolt	05-20-83	7.0	35,680	Snake R Lyons Ferry	AD
1982	Wallowa	Lyons Ferry	Smolt	05-20-83	4.3	50,619	Snake R Lyons Ferry	AD
1982	Unknown	Lyons Ferry	Non-Smolt	10-05-83	119.5	2,975	Unknown	
1982	Unknown	Lyons Ferry	Non-Smolt	10-31-83	25.0	71,205	Unknown	
1983	Unknown	Lyons Ferry	Non-Smolt	01-05-84	51.0	18,360	Unknown	
1983	Wells	Lyons Ferry	Smolt	04-21-84	5.6	24,920	Snake R Lyons Ferry	
1983	Wallowa	Lyons Ferry	Smolt	04-30-84	3.3	50,450	Snake R Lyons Ferry	

Table 8 (cont.). Hatchery releases of summer steelhead into the Snake River by brood year and, if marked, the coded wire tag codes.

Brood **Year**	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Coded Fin Clip
1983	Wells	Lyons Ferry	Smolt	04-30-84	3.3	5,193	Snake R Lyons Ferry	
1983	Wells	Lyons Ferry	Smolt	04-30-84	3.3	30,400	Snake R Lyons Ferry	
1983	Wells	Lyons Ferry	Smolt	04-30-84	5.3	20,605	Snake R Lyons Ferry	
1983	Wells	Lyons Ferry	Smolt	04-30-84	9.4	6,810	Snake R Lyons Ferry	
1984	Wells	Lyons Ferry	Smolt	05-06-85	5.8	21,035	Snake R Little Goose	AD
1984	Wells	Lyons Ferry	Smolt	05-06-85	2.6	22,394	Snake R Lyons Ferry	
1984	**Wallowa**	Lyons Ferry	Smolt	05-06-85	5.5	25,540	Snake R Lyons Ferry	
1984	Wells	Lyons Ferry	Smolt	05-08-85	5.1	4,159	Snake R	AD
1984	Wells	Lyons Ferry	Smolt	05-09-85	5.2	4,038	Snake R	AD
1984	Wells	Lyons Ferry	Smolt	05-10-85	5.6	20,309	Snake R Little Goose	AD
1984	Wells	Lyons Ferry	Smolt	05-10-85	5.1	4,378	Snake R	AD
1984	Wells	Lyons Ferry	Smolt	05-13-85	5.0	4,050	Snake R	AD
1984	Wells	Lyons Ferry	Smolt	05-13-85	5.0	4,020	Snake R	AD
1984	**Wallowa**	Lyons Ferry	Smolt	05-13-85	2.6	28,191	Snake R Lyons Ferry	621644 **LV**

Table 8 (cont.). Hatchery releases of summer steelhead into the Snake River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Coded Fin Clip
1984	Wallowa	Lyons Ferry	Smolt	05-13-85	5.5	28,373	Snake R Lyons Ferry	621645 LV
1984	Wells	Lyons Ferry	Smolt	05-14-85	5.3	4,219	Snake R	AD
1985	Wells	Lyons Ferry	Smolt	04-21-86	5.8	19,604	Snake R Little Goose	AD
1985	Wells	Lyons Ferry	Smolt	04-21-86	5.8	12,006	Snake R	AD
1985	Wells	Lyons Ferry	Smolt	04-25-86	5.8	19,865	Snake R Little Goose	AD
1985	Wells	Lyons Ferry	Smolt	04-25-86	5.5	20,135	Snake R Lyons Ferry	633836 LV AD
1985	Wells	Lyons Ferry	Smolt	04-25-86	5.4	20,639	Snake R Lyons Ferry	633837 LV AD
1985	Wells	Lyons Ferry	Smolt	04-25-86	5.3	20,506	Snake R Lyons Ferry	633838 LV AD
1985	Wells	Lyons Ferry	Smolt	04-25-86	5.8	20,246	Snake R Lyons Ferry	633303 LV AD
1985	Wallowa	Lyons Ferry	Smolt	04-25-86	5.9	20,234	Snake R Lyons Ferry	633305 LV AD
1985	Wallowa	Lyons Ferry	Smolt	04-25-86	6.1	11,999	Snake R	AD
1985	Wells	Lyons Ferry	Smolt	04-29-86	5.6	20,087	Snake R Little Goose	AD
1985	Wells	Lyons Ferry	Smolt	04-29-86	5.2	12.028	Snake R	AD
1985	Unknown	Lyons Ferry	Non-Smolt	06-09-86	1143	149,162	Unknown	
1985	Unknown	Lyons Ferry	Non-Smolt	06-16-86	567.0	55.566	Unknown	

Table 8 (cont.). Hatchery releases of summer steelhead into the Snake River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Codes/ Fin Clip
1985	Unknown	Lyons Ferry	Non-Smolt	07-10-86	270.0	10,800	Unknown	
1985	Unknown	Lyons Ferry	Non-Smolt	07- 15-86	139.0	88,665	Unknown	
1985	Unknown	Lyons Ferry	Non-Smolt	07-23-86	423.0	47,799	Unknown	
1985	Unknown	Lyons Ferry	Non-Smolt	07-30-86	132.0	75,900	Unknown	
1985	Unknown	Lyons Ferry	Non-Smolt	09-30-86	55.3	25,801	Unknown	
1986	Wells	Lyons Ferry	Smolt	04-23-87	5.5	11,314	Snake R	AD
1986	Wells	Lyons Ferry	Smolt	04-23-87	5.9	19,972	Snake R Lyons Ferry	AD
1986	Wells	Lyons Ferry	Smolt	04-23-87	5.5	649	Snake R Lyons Ferry	AD
1986	Lyons Ferry	Lyons Ferry	Smolt	04-24-87	4.8	25,384	Snake R Lyons Ferry	633915 AD LV
1986	Lyons Ferry	Lyons Ferry	Smolt	04-24-87	4.8	25,459	Snake R Lyons Ferry	633914 AD LV
1986	Wallowa	Lyons Ferry	Smolt	04-24-87	5.7	25,43 1	Snake R Lyons Ferry	633903 AD LV
1986	Wallowa	Lyons Ferry	Smolt	04-24-87	5.7	25,586	Snake R Lyons Ferry	633913 AD LV
1986	Wells	Lyons Ferry	Smolt	04-27-87	5.5	11,468	Snake R	AD
1986	Wells	Lyons Ferry	Smolt	04-27-87	5.6	18,676	Snake R Lyons Ferry	AD
1986	Wells	Lyons Ferry	Smolt	04-27-87	5.6	650	Snake R Lyons Ferry	AD

Table 8 (cont.). Hatchery releases of summer steelhead into the Snake River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Codes/ Fin Clip
1986	Wells	Lyons Ferry	Smolt	04-30-87	5.7	11,406	Snake R Lyons Ferry	AD
1986	Wells	Lyons Ferry	Smolt	04-30-87	5.7	19,716	Snake R Lyons Ferry	AD
1986	Wells	Lyons Ferry	Smolt	04-30-87	5.7	650	Snake R Lyons Ferry	AD
1986	Unknown	Lyons Ferry	Non-Smolt	07-16-87	120.0	18,720	Unknown	
1986	Unknown	Lyons Ferry	Non-Smolt	07-21-87	434.0	94,178	Unknown	
1986	Unknown	Lyons Ferry	Non-Smolt	07-30-87	120.0	45,420	Unknown	
1986	Unknown	Lyons Ferry	Non-Smolt	07-31-87	118.0	38,704	Unknown	
1987	Lyons Ferry	Lyons Ferry	Smolt	04-28-88	4.7	25,025	Snake R Lyons Ferry	635019 AD LV
1987	Lyons Ferry	Lyons Ferry	Smolt	04-28-88	4.7	25,317	Snake R Lyons Ferry	635016 AD LV
1987	Wallowa	Lyons Ferry	Smolt	04-29-88	4.8	4,392	Snake R Lyons Ferry	AD
1987	Lyons Ferry	Lyons Ferry	Smolt	04-30-88	4.7	25,260	Snake R Lyons Ferry	635014 AD LV
1987	Lyons Ferry	Lyons Ferry	Smolt	04-30-88	4.7	25,123	Snake R Lyons Ferry	635013 AD LV
1987	Lyons Ferry	Lyons Ferry	Non-Smolt	09-14-88	68.9	22,116	Snake R Lyons Ferry	
1988	Lyons Ferry	Lyons Ferry	Smolt	04-30-89	4.9	25,5 14	Snake R Lyons Ferry	635508 AD LV

Table 8 (cont.). Hatchery releases of summer steelhead into the Snake River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Codes/ Fin Clip
1988	Lyons Ferry	Lyons Ferry	Smolt	04-30-89	5.1	25,638	Snake R Lyons Ferry	635508 AD LV
1988	Lyons Ferry	Lyons Ferry	Smolt	04-30-89	4.5	25,380	Snake R Lyons Ferry	630132 AD LV
1988	Lyons Ferry	Lyons Ferry	Smolt	04-30-89	4.7	21,972	Snake R Lyons Ferry	630132 AD LV
1989	Pahsimeroi	Lyons Ferry	Smolt	04-27-90	5.7	20,805	Snake R Lyons Ferry	630842 AD LV
1989	Pahsimeroi	Lyons Ferry	Smolt	04-30-90	5.8	4,524	Snake R Lyons Ferry	AD
1989	Pahsimeroi	Lyons Ferry	Smolt	04-30-90	5.5	18,150	Snake R Lyons Ferry	631421 AD LV
1990	Pahsimeroi	Lyons Ferry	Smolt	04-18-91	3.4	19,550	Snake R Lyons Ferry	AD
1990	Pahsimeroi	Lyons Ferry	Smolt	04-18-91	3.3	16,830	Unknown	AD
1990	Pahsimeroi	Lyons Ferry	Smolt	04-18-91	3.7	21,275	Unknown	AD

Table 9 (TR-2). Hatchery releases of summer steelhead into Asotin Creek by brood year and, if marked, the coded wire tag codes.

Brood **Year**	Stock	Hatchery	Life Stage	Release Date	Fish - lb.	Number Released	Release Site	**CWT** Coded Fin Clips
1981	Columbia, Wells	Lyons Ferry	Smolt	5-03-83	6.4	23,904	Asotin Cr	
1981	Columbia, Wells	Lyons Ferry	Smolt	5-11-83	7.8	12,870	Asotin Cr	
1983	**Wallowa** R	Lyons Ferry	Smolt	5-07-84	8.2	33,005	Asotin Cr	
1984	**Wallowa** R	Lyons Ferry	Smolt	4-24-85	8.4	31,500	Asotin Cr	
1985	Columbia, Wells	Lyons Ferry	Smolt	4-30-86	6.4	14,080	Asotin Cr	
1985	Wailowa R	Lyons Ferry	Smolt	4-28-86	5.8	23,200	Asotin Cr	
1985	**Wallowa** R	Lyons Ferry	Smolt	4-30-86	6.7	7,370	Asotin Cr	
1986	Snake R L. Monumental	Lyons Ferry	Smolt	4-22-87	5.1	22,950	Asotin Cr	
1987	**Wallowa** R	Lyons Ferry	Smolt	4-20-88	6.1	28,975	Asotin Cr	
1988	**Wallowa** R	Lyons Ferry	Smolt	4-27-89	5.5	29,975	Asotin Cr	
1989	Pahsimeroi R	Lyons Ferry	Smolt	4-17-90	5.4	20,142	Asotin Cr	630725 AD
1989	Pahsimeroi R	Lyons Ferry	Smolt	4-18-90	5.7	19,950	Asotin Cr	631422 AD
1989	Pahsimeroi R	Lyons Ferry	Smolt	4-24-90	4.6	23,000	Asotin Cr	
1989	Pahsimeroi R	Lyons Ferry	Smolt	4-24-90	4.9	23,275	Asotin Cr	
1989	Pahsimeroi R	Lyons Ferry	Smolt	4-26-90	5.2	28,600	Asotin Cr	
1989	Pahsimeroi R	Lyons Ferry	Smolt	4-30-90	5.2	22,880	Asotin Cr	

Source: Terry Lovgren, WDW Hatchery Stocking Database, 1991.

Table 10 (AE). Emigration of coded wire tagged adult steelhead from the Snake River Subbasin.

Hatchery/Release Site	Recovery **Year**	Recovery Site	Recovery Method	CWT Codes	Number Recovered	Total Number Estimated
Snake River Lyons Ferry Hatchery	1987	Idaho Snake River	Sport Catch	63-16-44, 63-16-45 63-38-36, 63-38-37 63-38-38		75
Snake River Lyons Ferry Hatchery	1987	Tucannon River	Sport Catch	63-38-36, 63-38-37 63-38-38		2
Snake River Lyons Ferry Hatchery	1987	Deschutes River	Sport Catch	63-38-36, 63-38-37 63-38-38		5
Snake River Lyons Ferry Hatchery	1987	Snake River Tributaries	Sport Catch	63-16-44, 63-16-45 63-38-36, 63-38-37 63-38-38		12
Snake River Lyons Ferry Hatchery	1988	Dworshak Hatchery	Hatchery Return	63-38-36, 63-38-37 63-38-38, 63-33-03 63-33-04		2
Snake River Lyons Ferry Hatchery	1988	Idaho Snake River	Sport Catch	63-38-36, 63-38-37 63-38-38, 63-33-03 63-33-04, 63-39-14 63-39-15, 63-39-13 63-37-03		41
Snake River Lyons Ferry Hatchery	1988	Priest Rapids Dam		**63-38-36,** 63-38-37 **63-38-38,**		3
Snake River Lyons Ferry Hatchery	1988	Deschu tes River	Sport Catch	63-39-14, 63-39-15, **63-39-** 13, 63-37-03		

Table 10 (cont.). Emigration of coded wire tagged adult steelhead from the Snake River Subbasin.

Hatchery/Release Site	Recovery Year	Recovery Site	Recovery Method	CWT Codes	Number Recovered	Total Number Estimated
Snake River	1989	Dworshak Hatchery	Hatchery Returns	63-50-13, 63-50-14, 63-37-03 63-50-16. 63-50-19. 63-39-13 63-39-14; 63-39-15'		7
Snake River	1989	Idaho Snake	sport Catch	63-50-13, 63-50-14, 63-37-03 63-50-16, 63-50-19, 63-39-13 63-39-14, 63-39-15		166

Sources: WDW, 1984-85 Lyons Ferry Evaluation report # 87-3.
WDW, 1987-88 Lyons Ferry Evaluation report # 89-l 1.
WDW, 1988-89 Lyons Ferry Evaluation report # 90-l 1.
WDW, 1989-90 Lyons Ferry Evaluation report # 91-11.
Charles Morrill, Columbia River Tag Recovery, 1980-81.

Table 11 **(TD).** Parasites and diseases isolated at stations which reared Snake River steelhead smolts.

Disease Type	Hatchery	Specific Pathogen
Bacterial	Lyons **Ferry**[A]	*Flavobacterium sp.*
Bacterial	Lyons Ferry	***Flexibacter*** *cytophaga* (Coldwater)
Bacterial	Lyons Ferry	*Renibacterium* ***salmonarium*** **(BKD)**
Viral	Lyons Ferry	Infectious Hematopoietic Necrosis (IHN)
Viral	Lyons Ferry	***ElBS***

*Lyons Ferry Hatchery is located on the lower Snake River.

Disease history represents only pathogens isolated at these rearing stations and not necessarily a disease outbreak.

Source: Steve Roberts, Washington Department of Wildlife, 1991.

REFERENCES

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TUCANNON RIVER SUBBASIN

Spring Chinook Salmon

GEOGRAPHIC LOCATION

The Snake River in Washington state begins at River Mile (RM) 177.1 at the Washington-Oregon border and flows northwesterly along the border of Washington and Idaho to RM 139.1. At this point the Snake River is completely within Washington state. The Tucannon River enters Lake Herbert G. West created by Lower Monumental Dam on the Snake River at RM 63 near the town of Powers, Washington. The Tucannon River originates at Oregon Butte of the Blue Mountains in the Umatilla National Forest in southeastern Washington. The Tucannon River drains approximately 500 square miles and in about 50 miles long. Tributaries to the Tucannon include Pataha Creek RM 10, Marengo Creek RM 24, Tumalum Creek RM 33, and the Little Tucannon River RM 44.

An adult trap and satellite facility exist on the Tucannon at RM 38.

ORIGIN

The Tucannon River spring chinook run is currently maintained from natural production of the indigenous stock. The Washington Department of Fisheries planted spring chinook from the Klickitat stock in 1962 and Willamette stock in 1964. The program ended when the holding ponds at Russell Spring were destroyed in a major flood.

DISTRIBUTION

Adequate habitat exists from approximately RM 32 to the headwaters at RM 69. The upper 10 miles does not get seeded due to high gradient (WDF 1990).

PRODUCTION

The Tucannon River historically contained a large run of spring chinook salmon. Estimated chinook runs averaged 2,400 fish annually and exceeded 5,000 fish as recently an 1953 (WDF 1990). The Tucannon River run of spring chinook is maintained entirely from natural production of the indigenous stock. Since 1986, Washington Department of Fisheries has trapped adults on the Tucannon River to supplement and rebuild the spring chinook run.

A satellite facility is now maintained on the Tucannon River, RM 38, for collection of spring chinook adults and release of yearlings. It has an adult collection trap and one holding pond. Returning adult spring chinook are trapped and spawned at the Tucannon satellite facility. Progeny are incubated and reared to parr size at the Lyons Ferry facility, then trucked back to the Tucannon satellite for acclimation to river water and release. The first spring chinook salmon smolt released from the Tucannon facility occurred in 1987.

In 1986 the carrying capacity was estimated to be 180,000 smolts. The Washington Department of Fisheries is currently involved in an extensive study through the Lower Snake River Compensation Plan to examine the smolt carrying capacity.

The amount of spawning and rearing habitat by quality, available in the Tucannon River is unavailable.

The Tucannon River spring chinook natural spawn escapement at the adult trap for 1987 was 209 fish of which 101 were collected for brood stock (WDF 1990). Tucannon natural spawn age by brood year and age class (freshwaterocean) is unavailable.

ADULT LIFE HISTORY

Run size, catch and escapement

Ocean commercial and recreational fisheries from Alaska to Washington, in addition to Columbia River treaty, non-treaty and sport fisheries all harvest a portion of the Snake River fall chinook.

In recent years Columbia River sport and commercial fisheries have been curtailed by Snake River spring chinook escapement goals.

The harvest of spring chinook in the Tucannon has been minimal. The final recreation season occurred in 1973 when 149 were caught (Howell et al. 1985).

Strays from the Lyons Ferry Hatchery do occur. Strays of spring chinook that originated outside of the Tucannon subbasin are presented in Table 1.

Time of Migration

Adults begin to arrive by late April until late June. Peak runs are usually around mid-May.

Spawning Period

Spawning begins in late August and concludes by the end of September. Peak spawning usually occurs the first or second week in September (WDF 1990).

Snawnine Areas

Spawning occurs in the 20 mile reach of the Tucannon River between Cummins Creek Bridge (RM 34.7) upstream to Bear Creek. The principle spawning area is between Camp Wooten (RM 42.4) and the 2.4-mile distance between Camp Wooten upstream to Cow Camp Bridge. Beginning in 1980, the index area was expanded to include the river from Cow Camp Bridge to Panjab Creek Bridge. In 1984 a complete river survey was performed and index area redds comprised 50.5 percent of the total observed (Howell et al. 1985).

Age Comnosition

Tucannon River spring chinook generally return as three to five-year-old adults. Four-year-old adults are the dominant age class (WDF 1990). However, age composition by age, brood year, and freshwaterocean rearing is unavailable.

The mean fork length of spring chinook salmon spawned at the Tucannon Hatchery for 1985 through 1987 return years was 72.6 cm for four-year-olds and 86.7 for five-year-olds (WDF 1990). The mean fork length by brood year and age class (freshwater.ocean) for female and male spring chinook returning to the Tucannon River are unavailable.

Sex Ratio

The female-male ratio for wild adults trapped for hatchery brood stock in 1986 were one-to-one and in 1987 were 1.2-to-1 (WDF 1990). The percent females by brood year and freshwater.ocean rearing ages for the Tucannon River spring chinook naturally spawning are unavailable.

Fecundity

Average fecundity of for the Tucannon River spring chinook salmon was 4,095 eggs per female in 1987, compared to 3,916 eggs per female in 1986 (WDF 1990)

JUVENILE LIFE HISTORY

Time of Emergence

Tucannon River spring chinook fry usually emerge in February.

Time, age and size at migration

In the mid 1950's, downstream migrants were trapped with two Fyke nets at RM 14 and the mouth of the Tucannon River. Peak out migration occurred in November, April, and May with the majority of the smolts were caught in April and May. The Washington Department of Fisheries evaluation program began trapping in November 1986 with a downstream migrant trap on the Tucannon River at RM 13. From December 1, 1986 to June 30, 1987, 6,239 wild spring chinook smolts were caught. Average trap efficiency was 21.6 percent. Peak out migration was from April 26 to May 10. Tucannon spring chinook migrate as yearlings. Mean length was 89 mm (WDF 1990).

Hatchery release information for the Tucannon facility by brood year is unavailable.

Survival Rate

Smolt-to-adult survival rate for the 1985 brood year of spring chinook was about 0.38 percent. Fry-to-adult survival for the 1986 brood year was about 0.12 percent (WDF 1990).

DISEASE

Information on bacteria and parasitic diseases found at the Tucannon facility and in naturally spawning Tucannon River spring chinook is unavailable.

BIOCHEMICAL-GENETIC CHARACTERISTICS

Isozyme gene frequencies of 16 enzyme systems for Tucannon River spring chinook were identified in 1985. At that time they were not compared to other stocks of spring chinook (Howell et al. 1985). Since then, extensive baseline development for Tucannon spring chinook has occurred. Significant genetic variability has been observed. One of the primary uses of the data base will be to observe any potential long-term genotypic changes in a wild chinook salmon receiving hatchery enhancement. Tucannon spring chinook may also be readily identifiable in downstream mixed-stock fisheries.

Table 1 (AI). Immigration of coded wire tagged spring chinook into the Tucannon subbasin.

Hatchery/Release Site	Recovery site, Run **Year(s)**	Recovery Method	Number Sampled	Number Recovered	Total Number Estimated, (PSMFC)
Lyons Ferry	Tucannon, 1988	Hatchery	11	10	15

*Based on the following tag code: 63-34-42

Beginning with the 1978 brood.

REFERENCES

Howell, P. J., K. Jones, D. Scarnecchia, L. LaVoy, W. Kendra, and D. Ortmann. 1985. Stock assessment of Columbia River anadromous salmonids, volumes I & II. Final report of Oregon Department of Fish and Wildlife, Washington Department of Fisheries, Washington Department of Game, and Idaho Department of Fish and Game (Project 83-335, Contract DE-AI79-84BP 12737) to Bonneville Power Administration, Portland, Oregon.

Washington Department of Fisheries. 1990. Tucannon River Subbasin, Salmon and Steelhead Production Plan.

TUCANNON RIVER SUBBASIN

Naturally Produced Summer Steelhead

GEOGRAPHIC LOCATION

The Tucannon River originates in the Blue Mountains of the Umatilla National Forest in southwestern Washington. Starting at an elevation of 6,387 feet the Tucannon River drops through forested hills, rangeland and agricultural land before entering the Snake River at river mile (RM) 63. The river drains a watershed of 504 square miles.

ORIGIN

The wild summer steelhead stock in the Tucannon River is native, although interbreeding may have occurred with introduced steelhead stocks of Skamania, Wells and Dworshak hatcheries.

DISTRIBUTION

Table 1 presents rearing and spawning habitat, by quality, for Tucannon summer steelhead based on estimates from the Northwest Power Planning Council. Based on the Northwest Power Planning Council's smolt capacity model, a total of 49,100 smolts could be produced in the subbasin. Kelly et al. (1982) estimated that under current conditions, the Tucannon River would be capable of producing approximately 111,000 smolts. In addition, Kelly et al. (1982) estimated under improved conditions the Tucannon River from Sheep Creek to its mouth would be capable of producing 280,000 smolts.

Steelhead distribution occurs throughout the Tucannon River and in several of its tributaries including; Panjab Creek, Cummings Creek and Pataha Creek (Figure 1). Habitat degradation has reduced the distribution and production of steelhead within the Tucannon River. The major habitat constraints are 1) large areas of sedimentation deposits which infiltrate and destroy spawning gravel, 2) areas stripped of riparian vegetation, 3) summer river water temperatures which increase above the lethal limit for salmonids, 4) highly unstable streambanks, 5) flash flooding, 6) irrigation diversion, 7) and damage by livestock grazing. Habitat degradation, although evident throughout the subbasin has caused the greatest damage in the lower section of the river, especially below Pataha Creek.

Action has been taken to reduce the streambank erosion and sedimentation problems. Through the combined efforts of state agencies, conservation groups and individual landowners, two projects were carried out to reduce sedimentation problems: 1) catch basins were constructed to collect eroding soils, 2) streambanks were fortified through the installation of rip-rap to shore up streambanks and planting of trees and shrubs to stabilize streambanks.

PRODUCTION

Production Facilities

The Tucannon Hatchery, operated by Washington Department of Wildlife, primarily produces rainbow trout and chinook salmon. In previous years the hatchery raised and released steelhead into the Tucannon River but discontinued steelhead rearing after the completion of Lyons Ferry Hatchery. Curl Lake, a satellite facility to the Tucannon Hatchery is located five miles upstream from the Hatchery, serves as a conditioning/rearing pond receiving pre-smolts from Lyons Ferry Hatchery which are reared to smolts and released into the Tucannon River.

Production Summary

No data is available on native summer steelhead smolt production. Table 4 presents smolt migration data for native summer steelhead from 1986 through 1989. Natural production continues in the Tucannon River and its tributaries although production is severely depressed compared to historic levels. Smolt production in the lower Tucannon River has been reduced by habitat degradation. The upper Tucannon River has fewer habitat problems, but provides few of the deep pools necessary for juvenile rearing.

Major constraints to summer steelhead production in the Tucannon subbasin are summarized below.

Location	Sedimentation Problems	Low Flows	Water Temperatures
Tucannon River below Pataha Creek	Yes	Yes	High Summer Temperatures
Pataha Creek	Yes	Yes	High Summer Temperatures
Tucannon River Pataha to Marengo	Yes	Yes	High Summer Temperatures
Tucannon River Marengo to Hatchery	Yes*	Yes*	Moderate Summer Temperatures
Tucannon River Hatchery to Headwaters		Yes[A]	

*Action has been taken which has reduced the impact at these locations.

ADULT LIFE HISTORY

Run Size/ Escapement

No data is available on run size. Limited data on steelhead escapement for 1986 through 1989 is presented in Tables 2 and 3. Estimates of the wild run size from the early 1900's were reported to be as high as 5,000 to 6,000 fish, compared to the 1975 U.S. Corps of Engineers estimates of 3,400 fish. Currently, only 600 native steelhead are thought to return to the subbasin.

Time of migration

Wild adult summer steelhead begin entering the Columbia River May through September and migrate upstream through the Columbia River and into the Snake River before reaching the Tucannon River in October through March. Figure 2 illustrates the freshwater life history of summer steelhead in the Tucannon River.

Lyons Ferry Hatchery intercepts fish throughout the Snake River basin including the Tucannon River. During 1985 and 1986, 524 steelhead were captured in the trap at Lyons Ferry. From this group personnel spawned 359 females of which 65.6 percent were hatchery origin and 34.4 percent were natural origin. In addition, a second group of steelhead sorted included 17.2 percent natural fish. Determination of hatchery versus wild fish was made by hatchery personnel based on condition of dorsal fin.

Harvest

No estimate on the ocean harvest of Tucannon steelhead is available.

Columbia River harvest is thought to take a substantial portion of the Tucannon steelhead return. Schuck and Mendel (1987) reported that fish harvested outside of the Tucannon subbasin accounted for 0.21 percent of fish released. Two fishery groups were responsible for the harvest of Tucannon steelhead in the Columbia River. The sport fishery accounts for approximately 35 percent of the catch and a treaty Indian gill-net fishery that harvests as much as 65 percent of the catch.

Sport harvest within the Tucannon subbasin has averaged less than 300 fish annually. The river was closed to fishing from 1975 to 1985 in an attempt to increase escapement of native fish. When the river reopened for fishing in 1986, harvest was restricted to only to hatchery fish. Along with wild fish release regulations, all tributaries were closed to sport angling on the mainstem Tucannon upstream of the Little Tucannon River. Yearly sport catch results are presented in Table 2.

Treaty Indian fishing rights permit harvest of Tucannon River fish by the Umatilla and Nez Perce tribes. However, both tribes apparently have no records to indicate any treaty harvest of steelhead within the subbasin.

Spawning period

Wild summer steelhead spawning occurs from March through May.

Spawning area

Summer steelhead spawn in the middle and upper portions of the Tucannon River and in Cummings and Panjab Creeks.

Fecundity

No data are available on wild steelhead fecundity. Mean fecundity for summer steelhead captured at Lyons Ferry Hatchery is presented in Table 8.

Age composition

No data is available on Tucannon steelhead.

Size

Limited data on wild steelhead. Table 7 outlines eight return years of length data, primarily for returning hatchery fish. For the return year of 1985-86 lengths are listed on several age classes of wild fish.

Sex ratio

No data on wild fish, data on hatchery fish is presented in Table 6.

Survival rate

No data is available on Tucannon steelhead.

JUVENILE LIFE HISTORY

Egg

Egg to smolt and smolt to adult survival are unknown.

Emergence

Fry emerge from April through early July.

Juvenile rearing

Juvenile rearing for the majority of wild smolts lasts approximately two years prior to ocean emigration. However wide variances to ocean migration have been observed in summer smolts. Groups of smolts have been observed migrating out as yearling parr with peak emigration occurring in January.

Outmigration usually occurs from April through June with smolts averaging 170-200 mm in length. Trapping data on native Tucannon smolts is presented in Table 5.

Hatchery releases

Steelhead fry were released as early as 1936 but only since the late 1970's have steelhead annually been released into the Tucannon River. The Tucannon Hatchery originally supplied smolts for release into the Tucannon River although production was shifted to Lyons Ferry Hatchery in the 1980's. The Tucannon subbasin has received Priest Rapids, Wells, Skamania, Wallowa, Dworshak and Lyons Ferry hatchery steelhead stocks. The hatchery brood stock is collected at Lyons Ferry Hatchery where eggs are incubated, hatched and reared until presmolts, at which time the fish are transferred to Curl Lake conditioning pond for short term rearing and acclimation prior to release into the Tucannon River. Table 9 outlines smolt releases into the Tucannon River from 1981 through 1990.

Straying

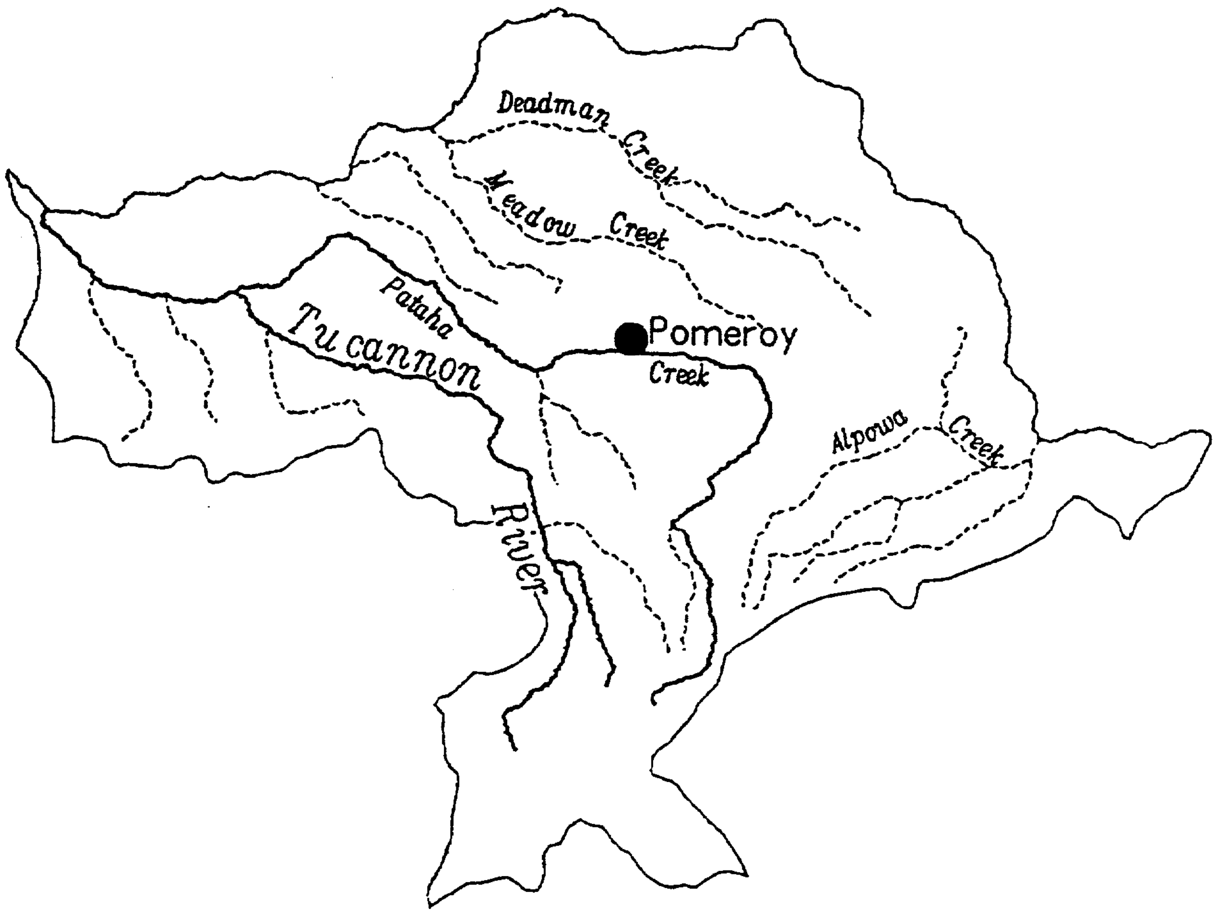
A small number of coded wire tagged steelhead released in the Tucannon River were recovered in neighboring streams. Table 10 lists recoveries of Tucannon steelhead outside of the subbasin.

BIOCHEMICAL-GENETIC CHARACTERISTICS

No data is available for Tucannon steelhead.

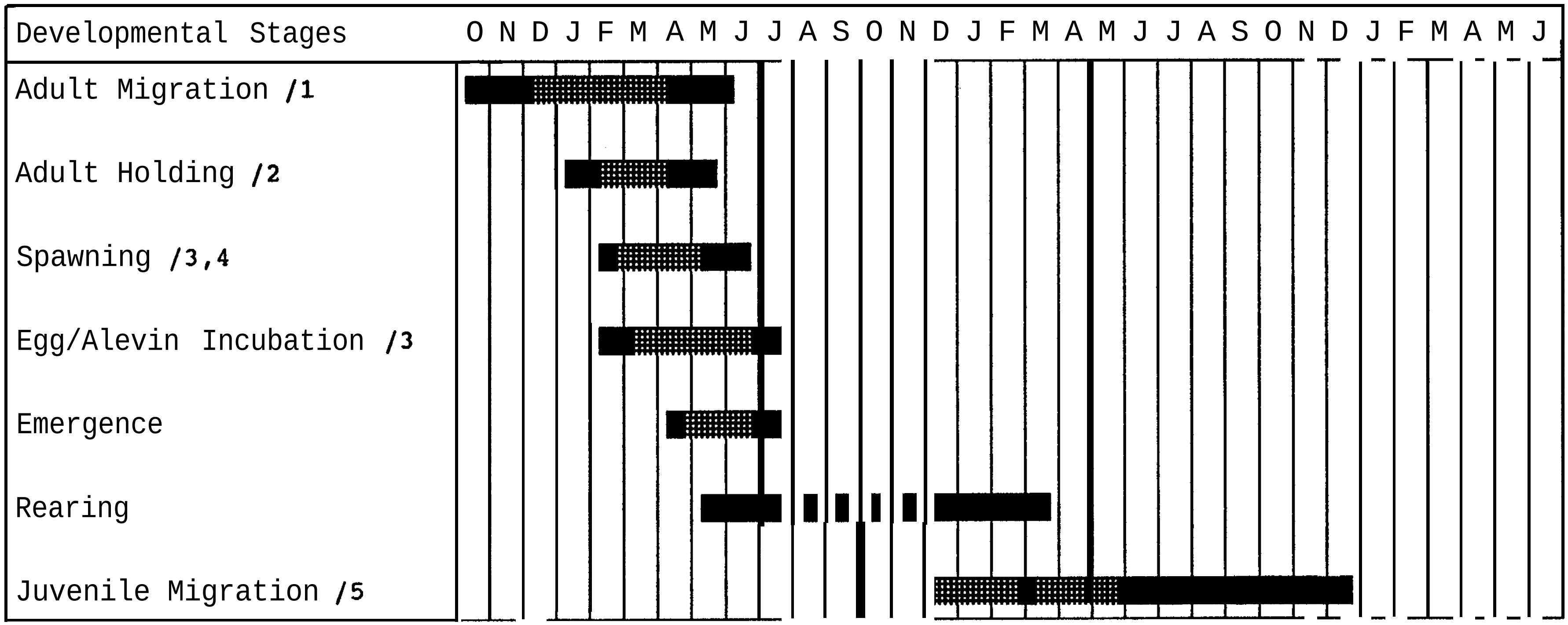
DISEASES

Disease history for summer steelhead released into the Tucannon River is presented in Table 12.



'igure 1 (TD). Summer steelhead distribution in the Tucannon River subbasin based on the NPPC presence\absence database (solid and dashed lines respectively) and the BPA Geographic Information System.

Figure 2 (TT). Life history profiles for summer steelhead developmental stages of the Tucannon River.



Notes : ▓▓ = Periods of heaviest activity.

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

/1 Kelley et al., 1982
/2 M. Schuck, WDW, person. commun. Traditional adult holding does not seem to occur in the Tucannon River. Adults appear to hold in the Snake River and enter the Tucannon strictly for spawning.
/3 Miller, 1985
/4 Schuck, 1985
/5 Based on WDF smolt trap data, November 1986-June 1987 (unpubl.)

Table 1 (HB-1). Estimated* amount of rearing and spawning habitat, by quality, of Tucannon River subbasin summer steelhead.

Area	Excellent	Good	Fair[B]	Poor[B]	Unknown	Total	Confidence
Miles	11.7%	31.2%	13.0%	44.2%		67.7	Good
Acres	11.5%	29.1%	7.3%	52.5%		225.7	Good

*Northwest Power Planning Council estimates based on limited observations.
[B]Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused cause by humans.

Source: Presence/absence database, NPPC, 1991.

Table 2 (SR). Redd survey for the Tucannon River 1988-1989.

River Section	Section Length (miles) A	Section Length (miles) B	Total Redds A	Total Redds B	Total Adults A	Total Adults B	Redds per mile (cumulative)
Upper Tucannon	6.2	7.8	49	9	11	1	10.1
Panjab Creek	2.3	2.3	13	5	4	0	7.8
Panjab Cr. to weir	10.9		159		7		14.6
Main Tucannon	11.3	22.4	197	45	9	3	18.5
Cummings Creek	6.5	6.5	132	28	33	2	24.6

Source: WDW, 1987-88 Lyons Ferry Evaluation Study, report # 89-l 1.
A = Redd survey conducted from April 19 through May 19, 1988.
B = Redd survey conducted from May 16 through May 31, 1989.

Table 3 (RR-a). Returns (sport catch and escapement) of summer steelhead to the Tucannon River subbasin.

Return Year	Escapement[A]	Sport Catch[B]	Adult Total
1980		closed	Unknown
1981		closed	Unknown
1982		closed	Unknown
1983		closed	Unknown
1984		closed	Unknown
1985		87	Unknown
1986	731	206	937
1987	1,025	189	1214
1988	270[C]	255	Unknown
1989		310	Unknown

*Escapement based on redd counts from the Tucannon River.

[B]Sport catch within subbasin only.

[C]Incomplete counts, actual number probably higher.

Sources: Tucannon Subbasin Production Plan, 1990.
WDW, 1988-89 Lyons Ferry Evaluation Study, Report # 90-11.
Sport catch from Washington Department of Wildlife punchcards.

Table 4 (JM-a). Number of natural summer steelhead smolts that migrated from the Tucannon River subbasin.

Brood Year	Number	Time of migration	Peak Migration
1986	4,172[A]		
1987	668[B]	Oct. ‘87 - June ‘88	
1988	95[C]	Oct. ‘87 - June ‘88	
1989	No Data		

[A]An additional 13,225 parr & transitional steelhead were estimated to have also emigrated.

[B]An additional 3,083 parr & transitional steelhead were estimated to have also emigrated.

‘Actual trapping number, using 1987-88 expansion yields 765 smolts plus 2,053 parr & transitional steelhead would be estimated to have also emigrated.

Sources: WDW, 1985-86 Lyons Ferry Evaluation, Report # 87-3.
WDW, 1988-89 Lyons Ferry Evaluation, Report # 90-11.
WDW unpublished data.

Table 5 (SL). Lengths of wild/natural summer steelhead smolts from the Tucannon River subbasin.

Location and Year	Number Fish	Length ave. (mm)	Length range (mm)	Reference
1980-86	No Data			
1987 Nov.	1	137.0		Lyons Ferry Evaluation, 1987-88, report # 89-11.
1988 Jan.	1	103.0		
Feb.	3	112.0		
Mar.	13	168.6		
Apr.	162	156.8		
May		185.5		
Jun.	15	187.7		
1988-89	95	168.4	not reported	Lyons Ferry Evaluation, 1988-89, report # 90-11.
1989-90	No Data			

Table 6 (AC-a). Age composition percentage (freshwaterocean) by return year, for adult hatchery female summer steelhead returning to Lyons Ferry Hatchery.

Age Composition females (%)[A]

Return Year	N[B]	1.1	1.2	1.3	
1980-85					No Data
1985	876	54.0	46.0		
1986	385	55.9	44.1		
1987	1,201	56.7	43.2		
1988	1,236	61.0	39.0		
1989	2,296	50.7	47.6		

[A]Age determined by scale analysis of subsample of collected fish.
[B]Based on fish collected at Lyons Ferry Hatchery.

Sources: WDW, 1985-86 Lyons Ferry Evaluation Study, # 87-3.
WDW, 1987-88 Lyons Ferry Evaluation Study, # 89-11.

Table 7 (AL-a). Mean fork length and age class for adult summer steelhead originating in the Tucannon River subbasin.

Mean Fork Length (cm)

Return Year	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3
1982	58.6	72.0							
1983	59.0	75.0							
1984	59.2	71.2							
1985	61.1	72.9	81.3	63.4	80.5	97.7	67.3	82.4	86.0
1986	57.8	71.6							
1987	61.1	72.9							
1988	58.2	71.4							
1989	59.5	71.5							

Age determined by scale analysis from subsample of fish captured at Lyons Ferry Hatchery.

Sources: WDW, 1985-86 Lyons Ferry Evaluation Study, Report # 87-3.
WDW, 1987-88 Lyons Ferry Evaluation Study, Report # 89-11.
WDW, 1989-90 Lyons Ferry Evaluation Study, Report # 90-11.
Mark Schuck, personnel correspondence, 199 1.

Table 8 (AF-a). Mean fecundity* by return year and age class for Tucannon River summer steelhead.

Return Year	N[B]	x.1	x.2	x.3
1980-86				
1988	37	5,152	5,575	
1989	243	4,365	6,021	
1990	437	4,898	6,561	8,797

*Fecundity determined by total eggs divided by total females spawned.
[B]Based on fish spawned at Lyons Ferry Hatchery.
x.1 = l-ocean fish.
X.2 = 2-ocean fish.
x.3 = 3-ocean fish.

Sources: WDW, 1987-88 Lyons Ferry Evaluation Study, Report # 89-l 1.
WDW, 1988-89 Lyons Ferry Evaluation Study, Report # 90-l 1.

Table 9 (TR). Hatchery releases of summer steelhead into the Tucannon River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish /lb.	Number Released	Release Site	CWT Code/ Fin Clip
1981	Columbia, Wells	Lyons Ferry	Smolt	04/25/83	6.5	65,925	Tucannon R	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/04/83	6.7	25,125	Tucannon R	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/05/83	6.6	6,270	Tucannon R	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/05/83	5.9	17,995	Tucannon R	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/05/83	6.0	24,000	Tucannon R	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/11/83	6.5	10,705	Tucannon R	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/11/83	6.5	26,000	Tucannon R	
1981	Columbia, Wells	Lyons Ferry	Smolt	05/12/83	9.1	38,180	Tucannon R	
1983	Snake R Lower Granite	Tucannon	Smolt	05/10/84	8.3	39,000	Tucannon R	AD
1983	Wallowa R	Lyons Ferry	Smolt	04/26/84	4.9	30,930	Tucannon R	633215 LV
1983	Wallowa R	Lyons Ferry	Smolt	04/26/84	5.2	31,790	Tucannon R	633214 LV
1983	Wallowa R	Lyons Ferry	Smolt	04/26/84	5.5	15,680	Tucannon R	633213 LV
1983	Wallowa R	Lyons Ferry	Smolt	05/08/84	9.0	36,000	Tucannon R	
1983	Wallowa R	Lyons Ferry	Smolt	05/08/84	5.3	11,442	Tucannon R	633213 LV
1983	Wallowa R	Lyons Ferry	Smolt	05/09/84	4.9	30,473	TucannonR	633212 LV
1984	Wallowa R	Lyons Ferry	Smolt	05/17/85	5.7	39,094	Tucannon R	621629 LV AD
1984	Wallowa R	Lyons Ferry	Smolt	05/17/85	5.7	39,094	Tucannon R	621630 LV AD
1984	Wallowa R	Lyons Ferry	Smolt	05/17/85	5.7	73,421	Tucannon R	AD
1985	Columbia, Wells	Lyons Ferry	Smolt	05/01/86	5.5	60,225	Tucannon R	AD

Table 9 (cont.). Hatchery releases of summer steelhead into the Tucannon River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish /lb.	Number Released	Release Site	CWT code/ Fin Clip
1986	Columbia, Wells	Lyons Ferry	Smolt	05/00/86	5.5	20,172	Tucannon R	633202 LV AD
1986	Columbia, Wells	Lyons Ferry	Smolt	05/13/86	5.5	20,177	Tucannon R	633302 LV AD
1986	Snake R Lower Monumental	Lyons Ferry	Smolt	04/21/87	5.7	101,408	Tucannon R	AD
1986	Snake R Lower Monumental	Lyons Ferry	Sniolt	04/22/87	5.7	20,272	Tucannon R	633845 AD LV
1986	Snake R Lower Monumental	Lyons Ferry	Smolt	04/22/87	5.7	20,357	Tucannon R	633903 AD LV
1986	Snake R Lower Monumental	Lyons Ferry	Smolt	04/22/87	5.7	20,194	Tucannon R	633838 AD LV
1986	Unknown	Lyons Ferry	Smolt	05/01/86	5.5	20,244	Tucannon R	633350 AD LV
1986	Unknown	Lyons Ferry	Smolt	05/13/86	5.5	20,250	Tucannon R	63335 1 AD LV
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/25/88	5.7	20,121	Tucannon R	634944 AD LV
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/25/88	5.7	20,110	Tucannon R	634944 AD LV
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/30/88	5.7	20,115	Tucannon R	634944 AD LV
1987	Snake R Lower Monumental	Lyons Ferry	Smolt	04/30/88	5.7	100,947	Tucannon R	AD
1988	Snake R Lower Monumental	Lyons Ferry	Smolt	05/15/89	4.4	20,261	Tucannon R	635035 AD LV

Table 9 (cont.). Hatchery releases of summer steelhead into the Tucannon River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish /lb.	Number Released	Release Site	CWT Code/ Fin Clip
1988	Snake R Lower Monumental	Lyons Ferry	Smolt	05/15/89	4.4	20,502	Tucannon R	635049 AD LV
1988	Snake R Lower Monumental	Lyons Ferry	Smolt	05/15/89	4.4	20,178	Tucannon R	635050 AD LV
1988	Snake R Lower Monumental	Lyons Ferry	Smolt	05/15/89	4.4	99,190	Tucannon R	AD
1989	Pahsimeroi R	Lyons Ferry	Smolt	04/15/90	5.0	20,012	Tucannon R	633912 AD LV
1989	Pahsimeroi R	Lyons Ferry	Smolt	04/15/90	5.0	20,065	Tucannon R	6339 11 AD LV
1989	Pahsimeroi R	Lyons Ferry	Smolt	04/15/90	5.0	39,175	Tucannon R	AD
1989	Pahsimeroi R	Lyons Ferry	Smolt	04/15/90	5.5	20,020	Tucannon R	63084 1 AD LV
1989	Pahsimeroi R	Lyons Ferry	Smolt	04/25/90	5.6	19,992	Tucannon R	630838 AD LV
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/23/9 1	3.6	19,987	Tucannon R	63 1444 AD LV
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/24/9 1	3.6	19,998	Tucannon R	63 1447 AD LV
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/24/9 1	3.7	20,032	Tucannon R	631449 AD LV
1990	Snake R Lower Monumental	Lyons Ferry	Smolt	04/24/9 1	3.7	20,184	Tucannon R	63 1450 AD LV

Source: Terry Lovgren, Washington Department of Wildlife, Hatchery Stocking Database, 1991.

Table 10 (AE). Emigration of coded wire tagged adult steelhead from the Tucannon Subbasin.

Hatchery/Release Site	Recovery Year	Recovery Site	Recovery Method	**CWT Codes**	**Number Recovered**	Total Number Estimated
Tucannon River	1987	Idaho Snake	Sport Catch	**63-33-02, 63-32-02**		22
Tucannon River	1988	Dworshak NFH	Hatchery Return	63-38-44, 63-38-45 63-39-03, 63-32-02 63-33-02		4
Tucannon River	1988	Idaho Snake	Sport Catch	63-38-44, 63-38-45, 63-39-03		28
Tucannon River	1988	Deschutes River	Sport Catch	63-33-02, 63-32-02		2
Tucannon River	1989	Dworshak NFH	Return	63-49-4 1, 63-49-42 63-49-44, 63-38-44 63-38-45, 63-39-03		8
Tucannon River	1989	Grande Ronde	Sport Catch	63-38-44, 63-38-45, 63-39-03		3
Tucannon River	1989	Idaho Snake	Sport Catch	63-49-4 1, 63-49-42 63-49-44.		10

Sources: WDW, 1987-88 Lyons Ferry Evaluation Study, Report # 89-l 1.
WDW, 1988-89 Lyons Ferry Evaluation Study, Report # 90-l 1.
WDW, 1989-90 Lyons Ferry Evaluation Study, Report # 91-l 1.

Table 11 (AI). Immigration of coded wire tagged adult steelhead into the Tucannon Subbasin.

Hatchery/Release Site	Recovery Year	Recovery Site	Recovery Method	CWT Codes	Number Recovered	Total Number Estimated
Snake River Lyons Ferry	1987	Tucannon River	Sport Catch	63-38-38		2

Source: WDW, 1987-88 Lyons Ferry Evaluation Study, Report # 89-l 1.

Table 12 **(TD).** Parasites and diseases isolated at the hatcheries which reared Tucannon River steelhead smolts.

Disease **Type**	**Hatchery**	Specific Pathogen
Bacterial	Lyons **Ferry**[A]	*Flavobacterium sp.*
Bacterial	Lyons Ferry	***Flexibacter*** *cytophaga* (Coldwater)
Bacterial	Lyons Ferry	***Renibacterium salmonarium*** **(BKD)**
Viral	Lyons **Ferry**	Infectious Hematopoietic Necrosis **(IHN)**
Viral	Lyons **Ferry**	*EZBS*
Bacterial	**Tucannon**[B]	*Flavobacterium sp.*
Viral	Tucannon	Infectious Hematopoietic Necrosis **(IHN)**
Parasite	Tucannon	***Ichthyophthirius multiflis*** **(Ich)**

*Lyons Ferry Hatchery is the primary rearing station for hatchery smolts and is located on the lower Snake River.

[B]**Tucannon** Hatchery is located on the Tucannon River.

Disease history represents only pathogens isolated at these rearing stations and not necessarily a disease outbreak.

Source: WDW pathologist Steve Roberts, 1991.

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YAKIMA RIVER SUBBASIN

Spring Chinook Salmon

GEOGRAPHIC LOCATION

The Yakima Subbasin is located in south-central Washington and includes most of Yakima and Kittitas counties as well as small portions of Benton and Klickitat counties. The Yakima River originates in the Cascade Mountains above Keechelus Lake at an elevation of 6,900 feet and flows southeasterly for 214 miles, joining the Columbia River at river mile (RM) 335. Major tributaries include the Kachess, Cle Elum and Teanaway rivers in the northern section of the subbasin, and the Naches River in the West. The Yakima River subbasin drams a watershed of approximately 6,155 square miles and the Naches River drams an additional 1,106 square miles.

ORIGIN

Spring chinook are indigenous to the Yakima River (Fulton 1968) and have numbered as high as 12-15,000 since the 1950's (Howell et al. 1985). Roughly 90% of the subbasins fishery was lost in the period between 1850 and 1900 (Yakima Subbasin Production Plan, 1990).

DISTRIBUTION

Tables 1 and 2 list rearing and spawning habitat, by quality, for Yakima River spring chinook based on the Northwest Power Planning Council presence/absence data base.

Dams on many tributaries and the upper Yakima create unpassable barriers to spawning adults. Large, unscreened diversions also effectively prevent or impede spring chinook passage. Known Barriers or diversions include, but are not hmited to the following locations: Manastash Creek, Taneum Creek, Cowiche Creek, Ahtanum Creek, Simcoe Creek, the North Fork Simcoe Creek, the Wilson/Naneum drainage, Swauk Creek and Reecer Creek (Yakima Subbasin Production Plan, 1990).

With few exceptions, tributary juveniles are found within a mile of the Yakima mainstem. In the winter juveniles tend to move into the lower river.

PRODUCTION

Production Facilities

No salmon production facilities presently operate in the subbasin, although design research for the Yakima/Klickitat Fisheries Project (YKFP) is in process. Numerous acclimation facilities exist, including Nile Springs pond and the Naches River. Supplemental releases have occurred regularly since the mid-19703 (from Leavenworth, Klickitat, Carson and Entiat hatcheries).

Production Summarv

A five year average return of spring chinook to the Yakima was reported as 5,647 in the Yakima/Klickitat Production Project Preliminary Design Report (YIN et al. 1990). In 1984, approximately 20 percent of the returns were considered to be of hatchery origin (Howell et al. 1985).

ADULT LIFE HISTORY

Run Size and Escapement

Between 1980 and 1990 estimates of run size ranged from 1118 fish in 1981 and 1982, to 8,687 fish in 1986 (Tables 3-6). These estimates are based on redd count expansions; fish counts at Prosser Dam; and estimates of tribal catch. Adults have been counted at Prosser dam since 1982.

Time of Migration

Daily counts at Prosser Dam (April-August) in 1989 showed that 50% of the run had arrived May 15th for adults, and May 24th for jacks (Fast et al. 1989). At Roza Dam (counted May-September), 50% of the adult run had arrived by June lst, for jacks this date was July 13th.

Harvest

The ocean catch profile of spring chinook from the Yakima subbasin should begin to become clear as more coded wire tagging studies are completed. If this distribution mirrors recoveries from other upper Columbia marking studies, than the ocean harvest is likely minor (Howell et al. 1985). Tribal catch in the 1950's was as high as 7,900 in 1957 (the escapement for this year was 4,752. There has been intensive YIN monitoring of the in-river dipnet fishery since 1981, and these data are summarized in Table 7. Harvest between 1987 and 1990 averaged 600 fish per year.

Spawning period

The population in the American river spawns in mid-August. In the Yakima river above the Naches confluence (Upper Yakima), spawning takes place in mid-September. "Length frequency histograms developed from Prosser indicate that 5-year-olds return earlier than 3- or 4-year-olds." (Fast et al. 1991). The earlier spawning time of the American and Naches populations may be related to their older age class structure.

Spawning area

"About 65 percent of the spawning occurs in the upper Yakima between Ellensburg and Easton (Mongillo and Falconer 1980)." " Between 1970 and 1984, index area redd counts in the upper Yakima River averaged 91 annually or 66 percent of the total index redd counts for the Yakima Basin" (Howell et al. 1985).

Complete spawning surveys have been conducted since at least 1981 by cooperative efforts between the YIN, WDF, and the USFWS. Expanded YIN/WDF index area redd counts for the years prior to 1981 are available.

Fecundity

Data on spring chinook fecundity is limited. In 1984 at Roza dam, the fecundity of 23 spring chinook was determined by weighing 4 lots of 100 eggs from each fish, and weighing the total egg mass (Fast et al. 1986). The age of these fish was determined using mid-eye hypural length (fish 48.7 cm to 75.1 cm were assumed to be three years old). The mean fecundities for these samples of four and five year olds were 4,257 and 7,787 respectively (Table 8). A correlation coefficient of .94 was found for the following regression:

Fecundity= 195.248 (MEHP Length)- 7736.78

Based on this work, the egg complement of average three, four and five year old females was estimated to be 1,367, 4,005, and 6,670 respectively. (Yakima Basin Preliminary Information Report, undated).

"Major and Mighell(l969) reported a fecundity of 5,245 eggs per female for Naches spring chinook and 3,523 eggs per female in the upper Yakima for the 1957-1961 brood years." (Howell et al. 1985).

Age Composition

The age composition data cited prior to 1988 was derived from a collection of 613 scales collected since 1980 (Yakima Basin Preliminary Information Report, undated). Results indicate the population in the American River tends to mature at an older age than chinook from the rest of the basin. The population from the "Upper Yakima" above the Naches River tends to mature at a younger ages. In the Naches system exclusive of the American river, the frequency of younger maturing fish tends be between the American and Upper Yakima frequencies. Table 9 summarizes the available brood year data for these geographic units.

Size

Naches system spring chinook averaged 79.8 cm in fork length during **1980-1983.** In this same period the upper Yakima fish averaged 68.2 cm in fork length (Howell et al. 1985). Table 10 summarizes the available length data for three age classes (total age of these samples was based on fork lengths).

Sex ratio

The available sex ratio data from the 1980 brood on is summarized in Table 11. In general most three-year-old fish are males, and females comprise most of the four and five-year-old spring chinook (Howell et al. 1985).

Survival Rate

Table 12 summarizes Egg-to-smolt and smolt-to-adult survival rate estimates for 1981-1987 broods (Fast et al. 1991). Two sets of estimates are given, one with, and one without the high mortality that occurs to smolts as they migrate to **Prosser** Dam.

Egg-to-fry survival was investigated in 1985 and 1986 by capping 14 redds in the upper Yakima with fine-meshed nests equipped with live-boxes. The lengths of the females making these redds was used in the length-fecundity relationship to estimate total egg deposition. Emergent fry were counted daily from early March through June. The mean egg-to-fry survival was estimated at 62.5% in 1985, and 56.7% in 1986. (Fast et al. 1989)

Smolt-to-adult survival rates for the 1981-1985 brood years were estimated at **4.4%,5.3%,4.9%,** 2.496, and 1.7% respectively (Fast et al. 1989)

JUVENILE LIFE HISTORY

Emergence

"In 1983, Wasserman and Hubble (1984) trapped emerging fry at a site on the American River at

Hells Crossing Campground and at another site on the Yakima River near Ellensburg. Fry were collected on the first day of trap operation on March 28th, suggesting that emergence occurs prior to this date. All fry had barely absorbed their yolk sacs. Peak fry capture date was May 5, 1983 on the American River. On the Yakima River, peak capture occurred on April 6, 1983, shortly before the trap became inoperable on April 20th." (Howell et al. 1985).

Juvenile rearing

All Yakima Basin spring chinook smolts are "I+", that is they have one freshwater annulus. No "II+" or older scales have were observed in the more than 5000 smolt scales observed between 1983 and 1988. (Yakima Basin Preliminary Information Report, 1988)

In addition to the juvenile migration data summarized in Table 13, March-November outmigration data since 1985 are available for Wapatox Diversion Canal Trap on the Naches River. The Wapatox trap average about 10 percent of the total smolt migration as measured at Prosser. These data show the major outmigration usually occurring in April, with significant winter migrations also occurring. It is felt the winter migration is a redistribution of fish into more favorable winter rearing habitat (B. Watson, personal communication).

Hatchery Releases

Releases of spring chinook into the Yakima for the 1974-1987 brood years are summarized in Table 14.

Straying.

Data unavailable at this time.

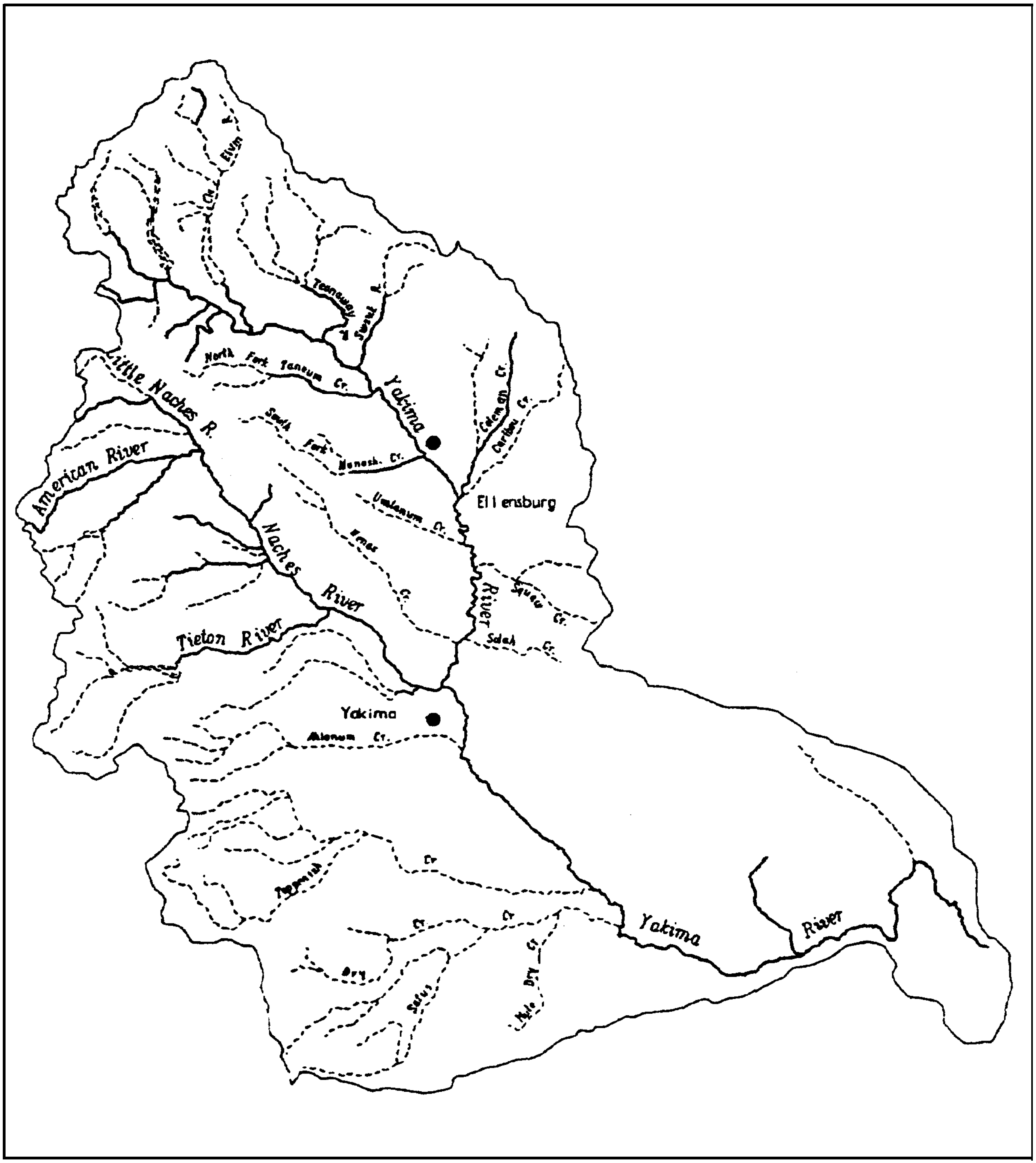
BIOCHEMICAL-GENETIC CHARACTERISTICS

Appendix 3 list electrophoretic data collected by Schreck et al 1986.
Appendix 5 lists chinook data collected by Fast et al. 1991.

DISEASES

Data unavailable at this time.

Figure 1 (AD). Spring chinook distribution in the Yakima River subbasin, based on the NPPC presence/absence database (solid and dashed lines respectively) and the BPA Geographic Information System.



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

Table 1 **(HB-1).** Estimated* amount of rearing and spawning habitat, by quality, of Yakima River **subbasin** spring chinook.

Area	Excellent	Good	**Fair**[B]	**Poor**[B]	Unknown	Total	Confidence
Miles	29%	23%	17%	31%		217.2	Unknown
Acres	32%	24%	17%	27%		1364.2	Unknown

*Northwest Power Planning Council estimates based on limited observations

[B]**Ratings** of fair and poor may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/absence database, NPPC 1991.

Table 2 **(HB-2).** Estimated* amount of rearing habitat, by quality, of Yakima River **subbasin** spring chinook.

Area	Excellent	Good	**Fair**[B]	**Poor**[B]	Unknown	Total	Confidence
Miles	00%	35%	02%	64%		59.5	Unknown
Acres	00%	54%	00%	45%		276.3	Unknown

*Northwest Power Planning Council estimates based on limited observations

[B]**Ratings** of fair and poor may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/absence database, NPPC 1991.

Table 3 **(RB-a).** Total run size (harvest and escapement) of spring chinook returning to the Yakima River subbasin, by run year.

Total Age

Run Year	2	3	4	5	6	Total	Adult Total
1957						12,665	
1958						6,357	
1959						4,810	
1960						4,412	
1961						5,862	
1962						4,735	
1963							
1964						3,555	
1965						2,106	
1966						5,105	
1967						3,583	
1968						2,636	
1969						1,480	
1970						1,682	
1971							
1972						854	
1973						3,387	
1974						1,916	
1975						-	
1976						-	
1977						-	
1978						-	
1979						-	
1980						1,224	
1981						1,334	
1982						1,686	

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Table 3 (cont.) **Total** run size (harvest and escapement) of spring chinook returning to the Yakima River subbasin, by run year.

Run Year	2	3	4	5	6	Total	Adult Total
1983						1,324	
1984						2,677[a]	
1985						4,527[a]	
1986						8,687[a]	
1987						4,390[a]	
1988						4,247[a]	
1989						4,919[a]	
1990						3,698[a]	

Note: 1957-1975 harvests estimated by WDF. 1980-1987 harvest estimates by the YIN.
Ages determined from length frequencies.
Escapements 1958-1981 estimated by redd counts x 2.4.
Escapements 1982-1987 estunated by redd counts x **actual** fish per redd.

[a] Total run size from 1984 are the sum of Prosser Dam counts and the estimated harvests below Prosser Dam.

Source: Fast et al. 1991

Table 4 (RN-l). Total escapement of spring chinook originating in three areas of the Yakima River, by brood year.

Total Age

Area\ Brood Year	2	3	4	5	6	Total	Adult Total
American 1980		7	93	146		246	239
American 1981		1	219	762		982	981
American 1982		1	258	193		452	451
American 1983		1	210			211	
American 1984		7				7	
Naches 1980		1	262	201		464	463
Naches 1981		16	531	950		1497	1,481
Naches 1982		12	908	417		1337	1,325
Naches 1983		11	413			424	
Naches 1984		12				12	
U.Yakima 1980		34	1,316	215		1,565	1,531
U.Yakima 1981		164	2,169	59		2,392	2,228
U.Yakima 1982		120	3,678	262		4,060	3,940
U.Yakima 1983		192	1,659			1,851	
U.Yakima 1984		47				47	

Note: Ages determined from length frequencies.

Source: Derived from the Yakima/Klickitat Production Facility Appendix (undated).

Table 5 (RN-a). Total escapement of spring chinook originating in three areas of the Yakima River, **by run year, 1980-1987.**

Total Age

Area\ Run Year	2	3	4	5	6	Total	Adult Total
American 1980							91
American 1981							173
American 1982							20
American 1983							101
American 1984						261	
American 1985		26				350	324
American 1986		8				1,456	1,448
American 1987		85				545	460
Naches 1980							180
Naches 1981							240
Naches 1982							86
Naches 1983							132
Naches 1984						536	
Naches 1985		52				711	659
Naches 1986		16				2,669	2,653
Naches 1987		174				1,116	942
U.Yakima 1980							847
U.Yakima 1981							705
U.Yakima 1982							1,057
U.Yakima 1983		147				1,007	860
U.Yakima 1984		248				1,507	1,259
U.Yakima 1985		263				2,504	2,241
U.Yakima 1986		283				3,928	3,645
U.Yakima 1987		76				1,968	1,892

Note: Ages determined from length frequencies.

Source: Yakima Basin Preliminary Information Report, undated.

Table 6 (RN-b). Total escapement of spring chinook originating in the Yakima River, by run year.

Total Age

Run Year	2	3	4	5	6	Total	Adult Total
1957						4,752	
1958						1,956	
1959						1,346	
1960						744	
1961						818	
1962						550	
1963						-	
1964						314	
1965						343	
1966						305	
1967						388	
1968						206	
1969						862	
1970						170	
1971						-	
1972						374	
1973						166	
1974						168	
1975						-	
1976						343	
1977						314	
1978						967	
1979						574	
1980						1,118	
1981						1,118	
1982						1,252	

Table 6 (cont.) Total escapement of spring chinook originating in the Yakima River, by run year.

Run Year	2	3	4	5	6	Total	Adult Total
1983						1,240	
1984						2,050	
1985						3,582	
1986						7,387	
1987						3,294	
1988						3,242	
1989						4,172	
1990						3,035	

Note: Ages determined from length frequencies.
Escapements 1957-1981 estimated by redd counts x 2.4 (the 1982-1986 Upper Yakima mean.)
Escapements 1982-1987 estimated by redd counts x actual fish per redd.

Source: Fast et al. 1991

Table 7 (RT-a). Total tribal harvest of spring chinook originating in the Yakima River, by run year.

Total Age

Run Year	2	3	4	5	6	Total	Adult Total
1957						7,913	
1958						4,401	
1959						3,464	
1960						3,668	
1961						5,044	
1962						4,185	
1963						2,992	
1964						3,241	
1965						1,763	
1966						4,800	
1967						3,195	
1968						2,430	
1969						618	
1970						1,512	
1971						1,232	
1972						480	
1973						3,221	
1974						1,748	
1975						600	
1976						-	
1977						-	
1978						-	
1979						-	
1980						106	
1981						216	
1982						434	

Table 7 (cont.) Total tribal harvest of spring chinook originating in the Yakima River, by run year.

Run Year	2	3	4	5	6	Total	Adult Total
1983						84	
1984						289	
1985						865	
1986						1,300	
1987						546	
1988						444	
1989						747	
1990						663	

Note: 1957-1975 estimates by WDF. 1980-1990 estimates by the YIN.
Ages determined from length frequencies.

Source: Fast et al. 1991.

Table 8 (AF). Mean fecundity by brood year and age class (freshwaterocean) for spring chinook originating in the Yakima River subbasin.

Mean Fecundity

Brood Year	1.1	1.2	1:3	2.1	2.2	2.3	3.1	3.2	3.3
1981				4,257	7,787				
N				21	2				
st. dev.									

Table 9 (AC). Age composition percentage (freshwaterocean) by brood year for Spring Chinook originating in three areas of the Yakima River.

Age Composition (%)

Area\ Brood Year	N	1.1	1.2	1.3	2.1	2.2	2.3
American 1980					03	38	59
American 1981					00	22	78
American 1982					00	57	43
Naches 1980					00	56	43
Naches 1981					01	35	63
Naches 1982					01	68	31
U.Yakima1980					02	84	14
U.Yakima1981					07	91	02
U.Yakima1982					03	91	06

Note: Age determined by length.

Source: Derived from Table 7 of the Yakima/Klickitat Production Facility Appendix (undated).

Table 10 (AL-a). Mean fork length by run year, sex and age class (freshwater.ocean) for spring chinook originating in the Yakima River subbasin.

Mean Fork Length (cm)

Brood Year	Male 2.1	Female 2.1	Male 2.2	Female 2.2	Male 2.3	Female 2.3
1975					78.3	75.2
1976			57.3	57.4	74.3	69.9
1977	44.6	48.0	58.7	60.5	77.3	75.3
1978	38.6	49.3	58.2	59.7	80.3	73.7
1979	44.1	46.5	60.1	59.7	78.8	74.3
1979 American					78.7	76.1
1979 Naches					76.8	73.8
1979 U. Yakima					79.3	---
1980	44.6	47.4	58.2	57.1	79.7	73.2
1980 American			59.4	68.7	80.7	75.5
1980 Naches			58.2	58.8	79.3	73.6
1980 U. Yakima			57.9	56.0	---	72.9
1981 American	53.9	---	64.0	64.2	81.8	77.6
1981 Naches	53.2	---	62.1	64.7	80.5	76.6
1981 U. Yakima	40.8	44.3	61.5	60.5	---	72.9
1982 American	51.8	---	63.1	70.9	81.6	78.4
1982 Naches	---	46.8	63.4	66.6	79.9	76.5
1982 U. Yakima	41.6	---	60.1	59.0	76.8	72.5
1983 American	53.6	---	59.4	62.8		
1983 Naches	45.0	---	60.7	66.9		
1983 U. Yakima	44.6	44.3	59.0	60.8		
1984 American	40.1	---				
1984 Naches	43.4	---				
1984 U. Yakima	45.3	---				

Note: Scales were not readable, freshwater age assumed to be 2, and total age based on Hanford Reach age-length relationships. Lengths are mid-eye to hypural plate.
Source: Yakima Basin Preliminary Information Report, undated.

Table 11 (AS). Percent females by brood year and age class (freshwater.ocean) for spring chinook in three areas of the Yakima River subbasin.

% Females

Area\ Brood Year	N	2.1	2.2	2.3	Total % Female
American 1981		0.0	43.7	50.1	48.69
Naches 1981		0.0	42.3	53.9	48.76
U. Yakima 1981		23.2	68.6	100.0	66.05
American 1982		0.0	69.7	59.9	65.49
Naches 1982		100.0	67.1	74.9	69.85
U. Yakima 1982		0.0	75.0	59.6	71.83
American 1983		0.0	45.0		
Naches 1983		0.0	71.8		
U. Yakima 1983		25.5	68.6		
American 1984		0.0			
Naches 1984		0.0			
U. Yakima 1984		0.0			

Note: Total ages based on lengths, freshwater age assumed to two years.
Sources: Yakima Basin Preliminary Information Report undated, Yakima Subbasin Production Plan 1990.

Table 12 **(TS-a).** Estimated egg-to-smolt and smolt-to-adult survival rates for Yakima spring chinook 1981 through 1987 brood years (Fast et al. 1991).

Brood Year	Egg to Smolt Surv.[1] (%)	Smolt to Adult Surv.[2] (%)	Early Rearing Flows[3] (cfs)	Rearing Flows[4] (cfs)	Over Winter Flows' (cfs)	smolt flows[6] (cfs)
1981	18.1 (8.7)	2.1 (3.0)	EN=876 0 days<90 cfs 0 days < 76 cfs	CE=2836 EB=3220 YC=3611	YC= 1468 TH=2863	PK=4778
1982	13.2 (6.4)	2.1 (4.2)	EN=414 0 days<90 cfs 0 days < 76 cfs	CE=2594 EB=2814 YC=3264	YC=1742 TH=3834	PK=2560
1983	12.0 (5.8)	1.8 (3.6)	EN=800 0 days<90 cfs 0 days < 76 cfs	CE=3303 EB=3435 YC=3333	YC=892 TH=1577	PK=2023
1984	12.4 (6.0)	N.D.	EN=383 0 days<90 cfs 0 days<76 cfs	CE=3058 EB=2884 YC -3608	YC=924 TH=2035	PK=1291
1985	8.6 (4.1)	N.D.	EN=255 0 days<90 cfs 0 days < 76 cfs	CE=2808 EB-2832 YC=3225	YC=687 TH=1443	PK= 1756
1986	3.9 (1.9)	N.D.	EN=246 14 days<90 cfs 7 days<76 cfs	CE=2527 EB=2005 YC=2812	YC=586 TH=897	PK= 1423
1987	2.2 (1.1)	N.D.	EN=203 38 days<90 cfs 20 days < 76 cfs	CE=2575 EB=N.D. YC=2782	YC=1037 TH= 1800	PK=3267

[1] Upper figure for egg-to-smolt survival expressed in terms of smolts before losses in transit ("headwater smolts"). Lower figure in terms of smolts counted past Prosser.

[2] Upper figure for smolt-to-adult survival in terms of headwater smolts, lower figure in terms of smolts counted past Prosser.
Continued.

[3] Early resting flows are measured in the Easton reach (EN), the reach of the Yakims from Easton Dam to the Cle Elum confluence. This is the most important spawning and early rearing reach in the system. The first figure represents mean flow in the period April 1 through July 7, when reservoirs usually begin irrigation releases. Note that IFIM data indicates side channels are dry when total Bow through the reach is 76 cfs or less. Flows in side channels are critically low (-2 cfs) when total flow is 90 cfs. Accordiily, the second and third figures represent the number of days flows were less than 90 or 76 cfs, respectively, from April through July.

[4] Rearing flows are mean flows June through September.

[5] Overwinter flows are mean flows October through February. Flows were monitored at **Easton** (EN),- Cle Elum (CE), **Ellensburg (EB),** the Yakima Canyon at Umptanum **(YC),** and the Yakima River immediately below the **Naches** confluence at Terrace Heights **(TH).**

[6] Smolt flows are April through May mean flows at Parker **(PK),** just below Sunnyside Dam.

Mean discharges at critical places and times from the Yakima **Subbasin** Production Plan, 1990.

Table 13 **(JM).** Number of juvenile spring chinook that migrated from the Yakima River.

Time of Migration

Run Year	Winter	Spring	Total
1959			593,030
1960			320,745
1961			271,643
1962			127,706
1963			334,844
1983			199,594
1984			175,517
1985			117,272
1986			219,246
1987			345,208
1988			282,514[a]
1989	20,669	88,996	
1990			

Sources: Through 1987, this data was derived from the Yakima Basin Preliminary Information Report, undated.

‘1988 total value is from Fast et al. 1991.

1989 migration: winter counts from 11-23-88 to 3-31-89.

spring migration from 4-l-89 to 7-13-89 (Fast et al. 1989).

Table 14 (TR). Hatchery releases of spring chinook salmon into the Yakima River subbasin, sorted by brood year, hatchery and life stage.

Brood Year	stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /Lb.	Number Released	Release Site	CUT Code
1972	KLICKITAT RIVER	KLICKITAT HATCHERY	Fingr	06/26/73	06/26/73	58	162400	AMERICAN R (38.1000)	UNTAGGED
1972	KLICKITAT RIVER	KLICKITAT HATCHERY	Fingr	06/27/73	06/27/73	58	162400	NACHES R (38.0003)	UNTAGGED
1974	KLICKITAT RIVER	KLICKITAT HATCHERY	Smolt	04/07/76	04/07/76	10	20613	MARION RIVER	UNTAGGED
1974	RINGDLD HATCHERY	LTL WHITE SALMON NFH	Smolt	04/01/76	04/01/76	3	7230	NILE SPRINGS (38)	UNTAGGED
1974	KLICKITAT RIVER	NILE SPRINGS PONDS	Smolt	03/21/76	03/21/76	3	8580	NILE SPRINGS (38)	UNTAGGED
1975	UNKNOWN STOCK	NILE SPRINGS PONDS	smott	03/26/77	03/26/77	19	13300	LOWER YAKIMA RIVER	UNTAGGED
1976	COWLITZ RIVER	NILE SPRINGS PONDS	smott	04/20/78	04/20/78		886	NILE SPRINGS (38)	UNTAGGED
1977	ABERNATHY CREEK	CARSON NF HATCHERY	Smolt	04/12/79	04/12/79	28	8740	LOWER YAKIMA RIVER	UNTAGGED
1977	UNKNOWN STOCK	CARSON NF HATCHERY	Smolt	04/12/79	04/12/79	20	50000	UPPER YAKINA RIVER	UNTAGGED
1977	ABERNATHY CREEK	LTL WHITE SALMON NFH	Smolt	04/11/79	04/11/79	22	150000	LOWER YAKIMA RIVER	UNTAGGED
1977	UNKNOWN STOCK	NILE SPRINGS PONDS	Smolt	04/24/79	04/24/79	10	25000	NACHES R (38.0003)	UNTAGGED
1978	UIND R (CARSON NFH)	LEAVENUDRTH HATCHERY	Smolt	04/15/80	04/15/80	19	30000	UPPER YAKIHA RIVER	UNTAGGED
1978	KLICKITAT RIVER	NILE SPRINGS PONDS	Smolt	04/25/80	04/25/80	10	23900	NILE SPRINGS (38)	UNTAGGED
1979	LEAVENUDRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/01/81	04/01/81	24	400221	LOWER YAKIMA RIVER	UNTAGGED
1979	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/01/81	04/01/81	20	400221	UPPER YAKIMA RIVER	UNTAGGED
1979	KLICKITAT RIVER	NILE SPRINGS PONDS	Smolt	03/15/81	03/15/81	19	39919	NILE SPRINGS (38)	UNTAGGED
1980	LEAVENUDRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/21/82	04/21/82	14	21814	NILE SPRINGS PONDS	051041
1980	LEAVENUGRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/21/82	04/21/82	14	78236	NILE SPRINGS PONDS	UNTAGGED
1980	LEAVENWORTH HATCHERY	NILE SPRINGS PONDS	Smolt	04/20/82	04/20/82	19	43523	LOWER YAKIMA RIVER	051061
1980	LEAVENWORTH HATCHERY	NILE SPRINGS PONDS	Smolt	04/20/82	04/20/82	19	358191	LOWER YAKIMA RIVER	UNTAGGED
1981	LEAVENWORTH HATCHERY	LEAVENWRTH HATCHERY	Smolt	04/22/83	05/15/83	19	94199	LDUER YAKIMA RIVER	051339
1981	LEAVENUGRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/22/83	05/15/83	19	2813	LOWER YAKINA RIVER	UNTAGGED
1981	LEAVENUGRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/25/83	05/31/83	18	94539	NACHES R (38.0003)	051338
1981	LEAVENUDRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/25/83	05/31/83	18	5186	NACHES R (38.0003)	UNTAGGED
1981	LEAVENUDRTH HATCHERY	LEAVENWORTH HATCHERY	smott	04/25/83	04/25/83	18	94539	NILE SPRINGS (38)	UNTAGGED
1981	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/22/83	04/22/83	20	97012	UPPER YAKIMA RIVER	UNTAGGED
1982	WIND R (CARSDN NFH)	ENTIAT NF HATCHERY	Smolt	04/01/84	04/01/84	24	41573	LOWER YAKIMA RIVER	051148
1982	WIND R (CARSON NFH)	ENTIAT NF HATCHERY	Smolt	04/01/84	04/01/84	24	979	LOVER YAKIMA RIVER	UNTAGGED
1982	WIND R (CARSON NFH)	ENTIAT NF HATCHERY	Smolt	04/01/84	04/01/84	19	28450	NACHES R (38.0003)	051147
1982	WIND R (CARSON NFH)	ENTIAT NF HATCHERY	smott	04/01/84	04/01/84	19	1186	NACHES R (38.0003)	UNTAGGED
1983	LEAVENUDRTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	06/01/84	06/01/84	70	93582	LOWER YAKINA RIVER	051528
1983	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	06/01/84	06/01/84	70	9255	LOWER YAKIMA RIVER	UNTAGGED
1983	LEAVENUDRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	09/30/84	09/30/84	25	93064	LDUER YAKIMA RIVER	051529
1983	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	09/30/84	09/30/84	25	9769	LOWER YAKIMA RIVER	UNTAGGED
1983	LEAVENWORTH HATCHERY	LEAVENUGRTH HATCHERY	Smolt	11/01/84	11/01/84	21	101008	LOWER YAKIMA RIVER	051530
1983	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	11/01/84	11/01/84	21	7253	LOWER YAKIMA RIVER	UNTAGGED
1983	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/09/85	04/09/85	18	24917	LOWER YAKIMA RIVER	051223
1983	LEAVENUDRTH HATCHERY	LEAVENUGRTH HATCHERY	Smolt	04/09/85	04/09/85	18	a??	LOWER YAKIMA RIVER	UNTAGGED
1983	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/12/85	04/12/85	20	40437	LOWER YAKIMA RIVER	051532
1983	LEAVENUDRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/12/85	04/12/85	20	1773	LOWER YAKIMA RIVER	UNTAGGED
1983	LEAVENUDRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/12/85	04/12/85	20	43297	LOWER YAKIHA RIVER	051533
1983	LEAVENWORTH HATCHERY	LEAVENWRTH HATCHERY	Smolt	04/12/85	04/12/85	20	1898	LOWER YAKIMA RIVER	UNTAGGED
1983	WIND R (CARSON NFH)	LEAVENUDRTH HATCHERY	Smolt	04/30/85	04/30/85	16	7800	UPPER YAKIMA RIVER	UNTAGGED
1983	WIND R (CARSON NFH)	LEAVENWORTH HATCHERY	Smolt	04/30/85	04/30/85	16	7800	UPPER YAKIHA RIVER	UNTAGGED
1984	WIND R (CARSON NFH)	LEAVENUDRTH HATCHERY	Fingr	06/04/85	06/04/85	62	96216	LDUER YAKIMA RIVER	051545
1984	WIND R (CARSON NFH)	LEAVENUDRTH HATCHERY	Fingr	06/04/85	06/04/85	62	4534	LOWER YAKIRA RIVER	UNTAGGED
1984	WIND R (CARSON NFH)	LEAVENWORTH HATCHERY	PreSm	09/19/85	09/19/85	23	95621	LOWER YAKIMA RIVER	051546
1984	UIND R (CARSON NFH)	LEAVENWORTH HATCHERY	PreSm	09/19/85	09/19/85	23	6103	LOWER YAKIMA RIVER	UNTAGGED
1984	UIND R (CARSON NFH)	LEAVENWORTH HATCHERY	PreSm	11/20/85	11/20/85	21	95431	LOVER YAKIMA RIVER	051547
1984	WIND R (CARSON NFH)	LEAVENWORTH HATCHERY	PreSm	11/20/85	11/20/85	21	6091	LOWER YAKIMA RIVER	UNTAGGED
1984	LEAVENUDRTH HATCHERY	LEAVENUDRTH HATCHERY	Smolt	03/26/86	03/26/86	18	46017	LDUER YAKIMA RIVER	051549
1984	LEAVENUDRTH HATCHERY	LEAVENUDRTH HATCHERY	smott	03/26/86	03/26/86	18	4663	LDUER YAKIMA RIVER	UNTAGGED
1984	LEAVENUGRTH HATCHERY	LEAVENUDRTH HATCHERY	Smolt	03/28/86	03/28/86	18	35715	LOWER YAKIMA RIVER	051550
1984	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	03/28/86	03/28/86	18	5337	LDUER YAKIMA RIVER	UNTAGGED
1984	LEAVENUDRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	03/28/86	03/28/86	17	29092	LOWER YAKIMA RIVER	051551

Table 14 (cont.). Hatchery releases of spring chinook salmon into the Yakims River subbasin sorted by brood year, hatchery and life stage - CONTINUED.

Brood Year	Stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /lb.	Number Released	Release Site	CUT Code
1984	LEAVENWRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	03/28/86	03128186	17	3559	LOWER YAKIMA RIVER	UNTAGGED
1984	LEAVENUDRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04128186	04128186	18	46607	LOWER YAKIMA RIVER	051548
1984	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/28/86	04/28/86	18	3725	LOWER YAKIMA RIVER	UNTAGGED
1985	LEAVENUDRTH HATCHERY	BUREAU OF RECL YA	Smolt	03/19/87	03/19/87	17	2698	LOWER YAKINA RIVER	UNTAGGED
1985	LEAVENUDRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	03/04/87	03/04/87	769	10000	LOWER YAKIMA RIVER	UNTAGGED
1985	LEAVENUDRTH HATCHERY	LEAVENWRTH HATCHERY	Smolt	03/04/87	03/04/87	17	4700	LOWER YAKIMA RIVER	UNTAGGED
1985	LEAVENWRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	03/04/87	03/14/87	17	8348	LOWER YAKIMA RIVER	UNTAGGED
1985	LEAVENWRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	03/06/87	03/06/87	17	2000	LOWER YAKIMA RIVER	UNTAGGED
1985	LEAVENUDRTH HATCHERY	LEAVENUDRTH HATCHERY	Smolt	03/14/87	03/14/87	17	1352	LDUER YAKIMA RIVER	634158
1985	LEAVENWRTH HATCHERY	LEAVENUDRTH HATCHERY	Smolt	03/14/87	03/14/87	I?	3000	LOWER YAKIUA RIVER	UNTAGGED
1985	LEAVENUDRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/14/87	04/14/87	27	19668	UPPER YAKIMA RIVER	051446
1985	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/14/87	04/14/87	27	3969	UPPER YAKIMA RIVER	UNTAGGED
1985	LEAVENUDRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/14/87	04/14/87	27	20197	UPPER YAKIMA RIVER	051447
1985	LEAVENWRTH HATCHERY	LEAVENUDRTH HATCHERY	Smolt	04/14/87	04/14/87	27	3779	UPPER YAKIUA RIVER	UNTAGGED
1985	LEAVENUDRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/14/87	04/14/87	27	3445	UPPER YAKINA RIVER	051448
1985	LEAVENWRTH HATCHERY	LEAVENWRTH HATCHERY	Smolt	04/14/87	04/14/87	27	669	UPPER YAKINA RIVER	UNTAGGED
1985	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/14/87	04114187	26	41248	UPPER YAKIMA RIVER	051755
1985	LEAVENUDRTH HATCHERY	LEAVENUDRTH HATCHERY	Smolt	04/14/87	04/14/87	26	6500	UPPER YAKIMA RIVER	UNTAGGED
1985	LEAVENWRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/22/87	04/22/87	24	47628	UPPER YAKINA RIVER	051738
1985	LEAVENWRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/22/87	04/22/87	24	9408	UPPER YAKINA RIVER	UNTAGGED
1985	LEAVENWORTH HATCHERY	LEAVENWRTH HATCHERY	Smolt	04/22/87	04/22/87	24	50615	UPPER YAKIMA RIVER	051756
1985	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/22/87	04/22/87	24	8000	UPPER YAKIMA RIVER	UNTAGGED
1986	LEAVENWRTH HATCHERY	LEAVENWRTH HATCHERY	Fingr	03/04/87	03/04/87	769	10000	LDUER YAKIMA RIVER	UNTAGGED
1987	YAKINA RIVER	GDHR (WILDSTOCK- N	PreSm	11/23/88	03/31/89		12592	LOWER YAKIMA RIVER	211818
1987	YAKIMA RIVER	GDNR (WILDSTOCK- N	PreSm	11/23/88	03/31/89		663	LOWER YAKIMA RIVER	UNTAGGED

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YAKIMA RIVER SUBBASIN

Fall Chinook Salmon

GEOGRAPHIC LOCATION

The Yakima Subbasin is located in south-central Washington and includes most of Yakima and Kittitas counties as well as small portions of Benton and Klickitat counties. The Yakima River originates in the Cascade Mountains above Keechelus Lake at an elevation of 6,900 feet and flows southeasterly for 214 miles, joining the Columbia River at river mile (RM) 335.2. Major tributaries include the Kachess, Cle Elum and Teanaway rivers in the northern section of the subbasin, and the Naches River in the West. The Yakima River subbasin drains a watershed of approximately 6,155 square miles and the Naches River drains an additional 1,106 square miles.

ORIGIN

The fall chinook in the Yakima river are considered upriver brights. "There is reason to believe the fall chinook population above Prosser Dam is still primarily of natural origin" (YKFP Science Committee, pre-draft) .

DISTRIBUTION

Table 1 lists rearing and spawning habitat, by quality, for Yakima River fall chinook based on estimates from the Northwest Power Planning Council. One segment of the Yakima fall chinook population spawns in the lower 32 miles of the mainstem, the other utilizes the 17-mile long Marion Drain (Howell et al. 1985).

PRODUCTION

Production Facilities

There are no fall chinook hatcheries in the subbasin. Releases in the subbasin have come from a number of sources, including the Klickitat Hatchery, Spring Creek National Fish Hatchery, Priest Rapids, and Little White Salmon National Fish Hatchery. Net pens have also been used in the basin. Between 1984 and 1988, over 100,000 fall chinook smolts were released above Prosser Dam. In this same time period, releases below Prosser ranged from 323,000 to 1,763,000.

Production Summary

A five year average return of fall chinook to the Yakima was reported as 1,959 in the Yakima/Klickitat production project preliminary design report (1990). Of the 419 redds counted in a 1987 aerial survey, 157 of them were above Prosser Dam (Yakima Basin Preliminary Information Report, 1988). Since 1987 releases have generally come from the Little White Salmon National Fish Hatchery, and been planted in the lower Yakima.

ADULT LIFE HISTORY

Run Size and Escapement

Table 2 summarizes the Prosser Dam fall chinook counts, which began in 1983. The majority of fall chinook spawning occurs below Prosser Dam. These counts range form 1,332 in 1984, to 283 in 1985.

Time of Migration

The main portion of the upriver bright fall chinook run begins entering the Columbia River about the third week of August. Passage over Bonneville Dam generally reaches a peak between September 4 and September 10 (Howell et al. 1985). "The above-Prosser run begins around the second week in September, peaks the third or fourth week of October, and is complete by the third week of November." The migration of spawners into Marion Drain appears to be related to irrigation operations. (YKFP Science Committee, pre-draft).

Harvest

Table 3 summarizes the history of John Day Mitigation fall chinook releases, 1984-1991, and includes some Columbia and all fisheries catch estimates.

Spawning period

In 1983 Marion Drain redd deposition occurred in two peaks, on in the second week of October, and one in the second week of Novermber (YKFP Science Committee, pre-draft).

Spawning area

One segment of the Yakima fall chinook population spawns in the lower 32 miles of the mainstem, the other utilizes the 17-mile long Marion Drain (Howell, et al. 1985).

Fecundity

No data are available.

Age Corn-position

There is virtually no information on the age composition of fall chinook in the Yakima subbasin. It is known that between 1983 and 1987, jacks averaged 43 percent of the run (Yakima Basin Preliminary Information Report, undated.)

Size

As of the publishing of the Yakima Basin Preliminary Information Report, six adult lengths were available from a 1987 spawner survey. None of these scales could be aged, but the fish were presumed to be four years old. The date is summarized in Table 4. Rough visual estimates however report that fal chinook at the Prosser Trap frequently exceed three feet in length.

Sex ratio

There is virtually no information available on the sex ratio of fall chinook in the Yakima subbasin. (Yakima Basin Preliminary Information Report, undated.) Of six sexed fish in an on the ground 1987 spawner survey, half were female.

Survival Rate

Egg-to-smolt survival has never been estimated for fall chinook, and is undoubtedly lower than the 59.6% attributed to spring chinook, as the substrate in the lower river is heavily impacted by sediment (Yakima Basin Preliminary Information Report, undated). Coded wire tag releases have shown high mortality between Sunnyside and Prosser dam (Tables 3 and 8). Table 3 contrasts the smolt-to-adult survivals of Sunnyside Dam and Prosser Dam releases. Estimates of losses to the journey between these two dams range from 54 to 98 percent.

JUVENILE LIFE HISTORY

Egg

No information available at this time.

Emergence

"Newly-emergent chinook fry have occasionally been observed at the Chandler (Prosser) smolt trap as early as late January. Observations of chinook fry (fork length 35 mm to 40 mm) become frequent at Prosser by mid-February, and fry continue to be observed through the first few weeks of March." (YKFP Science Committee, pre-draft)

Juvenile rearing

Scale analysis of fall chinook collected at Prosser Trap indicates these fish migrate as young-of-the-year (Yakima Basin Preliminary Information Report, undated).

Hatchery Releases

Table 6 summarizes the annual total outplantings of fall chinook above and below Prosser Dam. It also includes estimates of natural natural smolt production. An average of 475,000 fall chinook have been planted above Prosser Dam each year since 1984 (YKFP Science Committee, pre-draft). Table 9 describes individual releases of fall chinook into the lower Yakima.

Straying

Table 7 describes the immigration and recovery of coded wire tagged fall chinook into the Yakima subbasin. Most of these fish origated in the Umatilla River.

BIOCHEMICAL-GENETIC CHARACTERISTICS

Appendix three list electrophoretic data collected by Schreck et al. 1986.

DISEASES

No information available at this time.

Table 1 **(HB-1). Estimated**[A] amount of rearing and spawning habitat, by quality, of Yakima River **subbasin** fall chinook.

Area	Excellent	Good	**Fair**[B]	**Poor**[B]	Unknown	Total	Confidence
Miles	87%	13%	00%	00%		98.5	Unknown
Acres	85%	15%	00%	00%		629.9	Unknown

[A]**Northwest** Power Planning Council estimates based on limited observations

[B]**Ratings** of fair and poor may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/absence database, NPPC 1991.

Table 2 **(RB-a).** Total returns of fall chinook salmon to the Yakima River subbasin, as counted at Prosser Dam.

	Total Age						
Return **Year**	2	3	4	5	6	Total	Adult Total
1983		116	-	-		380	264
1984		637	-	-		1332	695
1985		95	-	-		283	188
1986		722	-	-		1214	492
1987		74	-	-		541	467
1988							
1989							

Note: Fall chinook were first counted at Prosser Dam in 1983. The majority of fall chinook spawning occurs below Prosser Dam.

Table 3 (TR-a). Summary of John Day Mitigation hatchery fall chinook released in the Yakima River, 1984 through 1991 (YKFP Science Committee, pre-draft).

RELEASE YEAR	RELEASE POINT	RELEASE DATE	TAG NUMBER	NUMBER OF TAGGED FISH RELEASED	SIZE AT RELEASE (#/lb)	SURVIVAL TO PROSSER (%)	CATCHES IN COL. RIVER FISHERIES	CATCHES IN ALL FISHERIES	SMOLT TO HARVESTED ADULT SURVIVAL (%)	"N", the TOTAL NUMBER OF SMOLTS (TAGGED & UNTAGGED) RELEASED	ESTIMATED TOTAL CATCH (av. rate X N)
1984	Horn	6/12/84	051531	99,522	123	N/A	136	259	0.26	479,536[a]	1,247
1984	Horn	6/13/84	051526	103,822	113	N/A	101	227	0.22	105,097	231
1985	Prosser	6/12/85	051242	25,819	85	N/A	57	81	0.31	1,763,500[b]	5,379
1985	Prosser	6/12/85	051243	25,997	85	N/A	61	107	0.41		
1985	Prosser	6/12/85	051244	26,112	85	N/A	54	65	0.25		
1985	Prosser	6/12/85	051245	30,078	86	N/A	31	76	0.25		
1985	Sunnyside	6/13/85	051249	25,103	86	15.7	0	0	0	100,655	0
1985	Sunnyside	6/13/85	051246	25,290	86		0	0	0		
1985	Sunnyside	6/13/85	051247	25,648	86		0	0	0		
1985	Sunnyside	6/13/85	051248	24,614	86		0	0	0		
1986	Prosser	5/19/86	051805	48,207	104	N/A	13	31	.064	1,547,700[a]	750
1986	Prosser	5/19/86	051806	48,536	104	N/A	4	16	.033		
1986	Sunnyside	5/20/86	051762	47,443	127	32.2	5	5	.010	97,460	5
1986	Sunnyside	5/20/86	051763	46,271	127		0	0	0		
1987	Prosser	5/5/87	051917	49,331	116	N/A	62	101	.20	872,609	1,941
1987	Prosser	5/5/87	051918	48,796	116	N/A	68	162	.33		
1987	Prosser	5/5/87	051916	49,769	116	N/A	74	132	.26		
1987	Prosser	5/27/87	051922	48,995	65	N/A	20	43	.088		

Table 3 (cont.). Summary of John Day Mitigation hatchery fall chinook released in the Yakima River, 1984 through 1991.

RELEASE YEAR	RELEASE POINT	RELEASE DATE	TAG NUMBER	NUMBER OF TAGGED FISH RELEASED	SIZE AT RELEASE (#/lb)	SURVIVAL TO PROSSER (%)	CATCHES IN COL. RIVER FISHERIES	CATCHES IN ALL FISHERIES	SMOLT TO HARVESTED ADULT SURVIVAL (%)	"N", the TOTAL NUMBER OF SMOLTS (TAGGED & UNTAGGED) RELEASED	ESTIMATED TOTAL CATCH (av. rate X N)
1987	Sunnyside	5/4/87	051921	49,511	106	45.6	23	54	.11	196,980	286
1987	Sunnyside	5/4/87	051920	48,943	106		25	56	.11		
1987	Sunnyside	5/4/87	051919	49,551	106		20	43	.09		
1987	Sunnyside	5/5/87	051915	48,975	106		80	133	.27		
1988	Prosser	5/17/88	850615	59,339	316	N/A	0	1		1,375,888	
1988	Prosser	5/17/88	850715	35,224	316	N/A	0	0			
1988	Prosser	5/17/88	850708	29,993	316	N/A	0	0			
1988	Prosser	5/17/88	850107	66,195	316	N/A	0	7			
1988	Wapato High density net pen	5/18/88	0501010 101	114,678	122	17.3	0	0		246,012	
1988	Wapato Med. density net pen	5/18/88	0501010 102	73,619	95	21.9	0	0			
1988	Wapato Low density net pen	5/18/88	0501010 103	48,172	101	18.7	2	2			
1988	Sunnyside	5/17-18/88	850709	66,390	186-316	15.3	3	3		198,783	
1988	Sunnyside	5/17-18/88	850710	29,523	186-316	6.2	0	0			
1988	Sunnyside	5/17-18/88	850711	60,211	186-316	4.3	0	0			
1988	Sunnyside	5/17-18/88	850712	36,980	186-316	1.8	3	3			

Table 3 (cont.). Summary of John Day Mitigation hatchery fall chinook released in the Yakima River, 1984 through 1991.

RELEASE YEAR	RELEASE POINT	RELEASE DATE	TAG NUMBER	NUMBER OF TAGGED FISH RELEASED	SIZE AT RELEASE (#/lb)	SURVIVAL TO PROSSER (%)	CATCHES IN COL. RIVER FISHERIES	CATCHES IN ALL FISHERIES	SMOLT TO HARVESTED ADULT SURVIVAL (%)	"N", the TOTAL NUMBER OF SMOLTS (TAGGED & UNTAGGED) RELEASED	ESTIMATED TOTAL CATCH (av. rate X N)
1989	Wapato net pen #1	5/30/89	0501010 204	120,174 (85% CWT)	72	18.5	0	0		340,121	
1989	Wapato net pen #2	5/30/89	0501010 203	100,153 (85% CWT)	66		0	0			
1989	Wapato net pen #3	5/30/89	0501010 202	119,794 (85% CWT)	75		0	0			
1989	Prosser	5/31/89	0501010 205	200,204	157	N/A	0	0		1,430,316[4]	
1989	Sunnyside	5/31/89	0501010 206	100,038	154	8.7	0	0		200,077	
1989	Sunnyside	6/1/89	0501010 206	100,039	154		0	0			
1990	Prosser	5/14/90	0501010 207	38,113	206	N/A	0	0		880,344	
1990	Prosser	5/14/90	052120	42,546	206	N/A	0	0			
1990	Sunnyside	5/15/90	0501010 211	79,413	180	33.9	0	0		199,980	
1990	Wapato net pen #1	5/18/90	0501010 210	72,271	105	41.3	0	0		159,690	
1990	Wapato net pen #2	5/18/90	0501010 209	79,141	102	33.7	0	0		160,003	
1990	Wapato net pen #3	5/18/90	0501010 208	79,173	102	39.0	0	0		160,041	

Table 3 (cont.). Summary of John Day Mitigation hatchery fall chinook released in the Yakima River, 1984 through 1991.

RELEASE YEAR	RELEASE POINT	RELEASE DATE	TAG NUMBER	NUMBER OF TAGGED FISH RELEASED	SIZE AT RELEASE (#/lb)	SURVIVAL TO PROSSER (%)	CATCHES IN COL. RIVER FISHERIES	CATCHES IN ALL FISHERIES	SMOLT TO HARVESTED ADULT SURVIVAL (%)	"N", the TOTAL NUMBER OF SMOLTS (TAGGED & UNTAGGED) RELEASED	ESTIMATED TOTAL CATCH (av. rate X N)
1991	Data not yet complied.										

Table 4 (AL). Mean fork length by brood year and age class (freshwaterocean) for fall chinook originating in the Yakima River.

Mean fork length (cm)

Brood Year	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3
1983					**male:72.0** **female:74.4**				
N					male: 3 female: 3				
st. dev.									

Note: Scales were not readable, freshwater age assumed to be 2, and total age based on Hanford Reach age-length relationships.

Table **5 (JM).** Number of fall chinook that migrated from the Yakima River, as counted at Prosser Dam, 1982-1987 brood years.

Time of Migration

Brood Year	Fall	**Spring**	Total
1982			114,264
1983			44,852
1984			73,956
1985			37,868
1986			179,645
1987			**ND**
1988			
1989			

Note: Juveniles enumerated by expansion of raw catch by spring chinook in-canal survival and capture efficiency.

Source: Yakima Basin Preliminary Information Report, 1988.

Table 6 (JM-a). Smolt production and adult returns to the Yakima River, 1983 through 1991 (YKFP Science Committee, pre-draft).

Year	Hatchery Outplants **(upper no. above Prosser lower no.** below) Prosser)	Natural Smolt Production (above Prosser)	Passage of adult and jack fall chinook above Prosser Dam				Estimated Total Return to **Subbasin**[b]
			Natural	Hatchery	Total	Marion Drain”	
1983	**0** **323,796**	99,752	380	0	380	232	1,267
1984	105,097 479,556	39,140	1,332	0	1,332	186	4,440
1985	100,655 **1,763,500**	64,628	283	0	283	177	943
1986	97,460 **1,547,700**	33,038	1,212	2	1,214	269	4,047
1987	196,980 872,609	157,581	511	25	536	172	1,787
1988	444,795 **1,375,888**	101,624	215	6	221	28	737
1989	540,198 **1,430,316**	47,598	505	47	552	262	1,840
1990	679,714 880,344	123,619	1,333	172	1,505	No Data	5,017
1991	**1,63** 1,745 0	87,111	861	73	934	165	3,113
Mean	421,849 963,745	83,788	737	36	773	186	2,577

a. Marion Drain escapement is included in the wild count at Prosser, and was estimated by multiplying redd counts by 2.4 **spawners/redd** (spring chinook average).

b. Estimated by dividing **total** Prosser count by 0.3, the assumed proportion of **subbasin** escapement spawning above Prosser Dam.

Table 7 (AI-2). Immigration of coded wire tagged fall chinook into the Yakima subbasin.

Hatchery/Release Site	Recovery site, Run Year(s)	Recovery Method	Number Sampled	Number Recovered	Total Number Estimated, (PSMFC)
Umatilla	Benton City, 1991	GSI	1		
Umatilla	Zillah/Granger, 199 1	GSI	1		
Klickitat	Marion Drain, 1990	GSI	1		
Umatilla	Benton City, 1990	GSI	1		
Umatilla	Benton City, 1990	GSI	1		
Umatilla	Prosser Dam, 1990	Weir	1		
Umatilla	Marion Drain, 1989	GSI	1		
Meacham Cr. Umatilla	Chandler Canal, 1988	?	1		
Umatilla	Chandler Canal, 1987	?	1		

Table 8. Summary statistics for wild and hatchery production of fall chinook in the Yalcima Subbasin, 1983-1991 (YKFP Science Committee, pre-draft).

YEAR	NAT. SMOLT COUNT AT PROSSER	NAT. RETURN AT PROSSER (Adults plus jacks)	EST'D TOTAL NAT. RETURN TO YAKIMA (Pros/.3)	HAT. PLANTS ABOVE PROSSER		HAT. PLANTS BELOW PROSSER		HAT. SMOLT SURVIVAL TO PROSSER, PEN-REARED FISH ONLY (%)	HAT. SMOLT SURVIVAL TO PROSSER, DIRECT RELEASES ONLY (%)	CLIPPED HATCHERY ADULT RETURNS TO PROSSER	ESTIMATED HATCHERY RETURNS TO YAKIMA (PROS/.3)	MARION DRAIN REDD COUNTS
				NO.	% CLIPPED	NO.	% CLIPPED					
1983	99752	380	1267	0	N. A.	323,796	0	N. A.	N. A.	0	0	101
1984	39140	1332	4440	105,097 (Sunnyside Dam)	100 (98.8% tagged)	479,556 (84.6% Horn, 15.4% Prosser)	21.5 (all Horn; 99,522 tagged)	N. A.	27.1	0	0	81
1985	64628	283	943	100,655 (Sunnyside Dam)	100 (100% tagged)	1,763,500 (52.4% Horn, 47.6% Prosser)	6.1 (all Prosser, all tagged)	N. A.	15.7	0	0	77
1986	33038	1212	4040	97,460 (Sunnyside Dam)	100 (96.1% tagged)	1,547,700 (53.2% Horn, 46.8% Prosser)	6.5 (all Prosser, all tagged)	N. A.	32.2	2	7	117
1987	157581	511	1703	196,980 (Sunnyside Dam)	100 (100% tagged)	872,609 (all Prosser)	22.6 (all Prosser, all tagged)	N. A.	44.4	25	83	75

Table 8 (cont.). Summary statistics for wild and hatchery production of fall chinook in the Yakima Subbasin, 1983-1991 (YKFP Science Committee, pre-draft).

YEAR	NAT. SMOLT COUNT AT PROSSER	NAT. RETURN AT PROSSER (Adults plus jacks)	EST'D TOTAL NAT. RETURN TO YAKIMA (Pros/.3)	HAT. PLANTS ABOVE PROSSER		HAT. PLANTS BELOW PROSSER		HAT. SMOLT SURVIVAL TO PROSSER, PEN-REARED FISH ONLY (%)	HAT. SMOLT SURVIVAL TO PROSSER, DIRECT RELEASES ONLY (%)	CLIPPED HATCHERY ADULT RETURNS TO PROSSER	ESTIMATED HATCHERY RETURNS TO YAKIMA (PROS/.3)	MARION DRAIN REDD COUNTS
				NO.	% CLIPPED	NO.	% CLIPPED					
1988	101624	215	717	444,795 (55.3% Wapato net pens, 44.7% Sunnyside Dam)	100 (100% tagged)	1,375,888 (all Prosser)	14.5 (all Prosser, 95.6% tagged)	22.6	6.7	6	20	12
1989	47598	505	1683	540,198 (63% Wapato net pens, 37% Sunnyside Dam)	90.6 (85% Wapato ffish clipped and tagged; 100% Sunnyside fish clipped and tagged)	1,430,316 (24% Horn, 76% Prosser)	14.0 (18.4% Prosser fish clipped and tagged; 0% Horn fish clipped and tagged)	18.5	8.7	47	157	114
1990	123619	1333	4443	679,714 (70.6% Wapato net pens, 29.4% Sunnyside Dam)	45.6 (39.9% Sunnyside fish clipped and tagged; 50% Wapato fish clipped, 48% Wapato fish clipped and tagged)	880,344 (all Prosser)	9.2 (9.2% Prosser fish clipped and tagged)	38.0	33.9	172	573	~130

Table 8 (cont.). Summary statistics for wild and hatchery production of fall chinook in the Yakima Subbasin, 1983-1991 (YKFP Science Committee, pre-draft).

YEAR	NAT. SMOLT COUNT AT PROSSER	NAT. RETURN AT PROSSER (Adults plus jacks)	EST'D TOTAL NAT. RETURN TO YAKIMA (Pros/.3)	HAT. PLANTS ABOVE PROSSER		HAT. PLANTS BELOW PROSSER		HAT. SMOLT SURVIVAL TO PROSSER, PEN-REARED FISH ONLY (%)	HAT. SMOLT SURVIVAL TO PROSSER, DIRECT RELEASES ONLY (%)	CLIPPED HATCHERY ADULT RETURNS TO PROSSER	ESTIMATED HATCHERY RETURNS TO YAKIMA (PROS/.3)	MARION DRAIN REDD COUNTS
				NO.	% CLIPPED	NO.	% CLIPPED					
1991	87111	>748	>2493	478,916 (Wapato net pens); 1,152,829 (Roza WW #3)	100% Wapato fish clipped and tagged; all of the Roza WW#3 fish were *ventral* clipped, but none were tagged.	0	N/A	35.0	31.4	>66	>220	****

Table 9 (TR). Hatchery releases of fall chinook salmon into the Yakima River subbasin, sorted by brood year, hatchery and life stage.

Brood Year	stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /lb.	Number Released	Release Site	CUT Code
1975	LOWER KALAMA(FALLERT	KLICKITAT HATCHERY	Fingr	05/12/76	05/12/76	86	138360	MARION RIVER	UNTAGGED
1982	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/21/83	06/22/83	148	323794	LOWER YAKIMA RIVER	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/12/84	06/12/84	123	99522	LOWER YAKIMA RIVER	051531
1983	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/12/84	06/12/84	123	105116	LOWER YAKIMA RIVER	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/12/84	06/12/84	96	201077	LOWER YAKIHA RIVER	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/12/84	06/12/84	96	201077	LDUER YAKIMA RIVER	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	fingr	06/13/84	06/13/84	113	103822	LOWER YAKIMA RIVER	051526
1983	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/13/84	06/13/84	113	1102	LOWER YAKIMA RIVER	UNTAGGED
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/10/85	06/17/85	90	792721	LOWER YAKIMA RIVER	UNTAGGED
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/12/85	06/12/85	85	25819	LOWER YAKIMA RIVER	051242
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/12/85	06/12/85	85	261	LOWER YAKIMA RIVER	UNTAGGED
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/12/85	06/12/85	85	25997	LOWER YAKIMA RIVER	051243
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/12/85	06/12/85	85	263	LOWER YAKIMA RIVER	UNTAGGED
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/12/85	06/12/85	85	26112	LOWER YAKIHA RIVER	051244
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/12/85	06/12/85	85	264	LOWER YAKIMA RIVER	UNTAGGED
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/12/85	06/12/85	86	30078	LOWER YAKIMA RIVER	051245
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/12/85	06/12/85	86	304	LOWER YAKIMA RIVER	UNTAGGED
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/13/85	06/13/85	86	25290	LOWER YAKIMA RIVER	051246
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/13/85	06/13/85	86	676	LDUER YAKIMA RIVER	UNTAGGED
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/13/85	06/13/85	86	24648	LOWER YAKIMA RIVER	051247
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/13/85	06/13/85	86	659	LOWER YAKIMA RIVER	UNTAGGED
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/13/85	06/13/85	86	24614	LDUER YAKIMA RIVER	051248
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/13/85	06/13/85	86	658	LOWER YAKIMA RIVER	UNTAGGED
1984	COLLJMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/13/85	06/13/85	86	25103	LOWER YAKIMA RIVER	051249
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/13/85	06/13/85	86	670	LOWER YAKIMA RIVER	UNTAGGED
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/17/85	06/17/85	86	788966	LOWER YAKIMA RIVER	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/19/86	05/19/86	111	48207	LOWER YAKIMA RIVER	051805
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/19/86	05/19/86	111	1697	LOWER YAKIMA RIVER	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/19/86	05/19/86	111	48536	LOWER YAKIMA RIVER	051806
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/19/86	05/19/86	111	1708	LOWER YAKIMA RIVER	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/19/86	05/19/86	105	208182	LDUER YAKIMA RIVER	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/19/86	05/19/86	105	250444	LOWER YAKIMA RIVER	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/19/86	05/22/86	113	1492552	LOWER YAKIMA RIVER	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/20/86	05/20/86	111	47443	LOWER YAKIMA RIVER	051762
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/20/86	05/20/86	111	1977	LOWER YAKIHA RIVER	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/20/86	05/20/86	111	46271	LOWER YAKIMA RIVER	051763
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/20/86	05/20/86	111	1928	LDUER YAKIMA RIVER	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/20/86	05/20/86	107	163656	LDUER YAKIMA RIVER	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/20/86	05/20/86	105	227570	LOWER YAKIMA RIVER	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/21/86	05/21/86	131	255047	LDUER YAKIMA RIVER	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/21/86	05/21/86	123	129442	LDUER YAKIHA RIVER	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/21/86	05/21/86	106	125716	LOWER YAKIMA RIVER	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/22/86	05/22/86	121	132495	LOWER YAKIMA RIVER	UNTAGGED
1986	PRIEST RAPIDS	BUREAU OF RECL YA	Fingr	03/20/87	03/20/87	287	9746	LDUER YAKIMA RIVER	UNTAGGED
1986	PRIEST RAPIDS	BUREAU OF RECL YA	Fingr	04/05/87	04/05/87	200	7200	LDUER YAKIMA RIVER	UNTAGGED
1986	PRIEST RAPIDS	BUREAU OF RECL YA	Fingr	04/26/87	04/26/87	120	840	LDUER YAKIMA RIVER	UNTAGGED
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/04/87	05/04/87	106	49551	LOWER YAKIMA RIVER	051919
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/04/87	05/04/87	106	501	LOWER YAKIMA RIVER	UNTAGGED
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/04/87	05/04/87	106	48943	LOWER YAKIMA RIVER	051920
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/04/87	05/04/87	106	494	LOWER YAKIMA RIVER	UNTAGGED
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/04/87	05/04/87	106	49511	LOWER YAKIMA RIVER	051921
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/04/87	05/04/87	106	627	LOWER YAKIMA RIVER	UNTAGGED
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/05/87	05/05/87	116	48975	LDUER YAKIMA RIVER	051915
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/05/87	05/05/87	116	150280	LOWER YAKIMA RIVER	UNTAGGED
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/05/87	05/05/87	116	49769	YAKIMA @ PROSSER DAM	051916

Table 9 (cont.). Hatchery releases of fall chinook salmon into the Yakima River subbasin, sorted by brood year, hatchery and life stage.

Brood Year	stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /lb.	Number Released	Release Site	CUT Code
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/05/87	05/05/87	116	152719	YAKIMA @ PROSSER DAM	UNTAGGED
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/05/87	05/05/87	II6	49331	YAKIMA a PROSSER DAM	051917
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/05/87	05/05/87	116	151315	YAKIMA @ PROSSER DAM	UNTAGGED
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/05/87	05/05/87	116	48796	YAKIHA a PROSSER DAM	051918
I986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/05/87	05/05/87	116	149673	YAKIMA a PROSSER DAM	UNTAGGED
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/27/87	05/27/87	65	48995	YAKIMA a PROSSER DAM	051922
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/27/87	05/27/87	65	579	YAKIMA a PROSSER DAM	UNTAGGED
1987	LYDNS FERRY HATCHERY	HARRY SENN	Fingr	04/05/88	04/05/88	189	9825	LOWER YAKIMA RIVER	UNTAGGED
1987	COLUMBIA RIV BRIGHTS	LTL WHITE SALMON NFH	Fingr	05/17/88	05/17/88	289	66195	LOWER YAKIHA RIVER	850107
1987	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	Fingr	05/17/88	05/17/88	289	I52777	LOWER YAKIHA RIVER	UNTAGGED
1987	COLUMBIA RIV BRIGHTS	LTL WHITE SALMON NFH	fingr	05/17/88	05/17/88	289	59339	LOWER YAKIMA RIVER	850615
1987	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	fingr	05/17/88	05/17/88	289	131868	LOWER YAKIMA RIVER	UNTAGGED
1987	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	Fingr	05/17/88	05/17/88	289	29993	LOWER YAKIHA RIVER	850708
1987	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	Fingr	05/17/88	05/17/88	289	69225	LOWER YAKIMA RIVER	UNTAGGED
1987	COLUMBIA RIV BRIGHTS	LTL WHITE SALMON NFH	fingr	05/17/88	05/17/88	289	35224	LOWER YAKIMA RIVER	850715
1987	COLUMBIA RIV BRIGHTS	LTL WHITE SALMON NFN	fingr	05/17/88	05/17/88	289	91725	LOUER YAKIHA RIVER	UNTAGGED
1987	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	fingr	05/18/88	05/18/88	226	66390	LOWER YAKIHA RIVER	850709
1987	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	fingr	05/18/88	05/18/88	226	2362	LOWER YAKIMA RIVER	UNTAGGED
1987	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	Fingr	05/18/88	05/18/88	222	29523	LOWER YAKIHA RIVER	850710
I987	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	Fingr	05/18/88	05/18/88	222	1050	LOWER YAKIMA RIVER	UNTAGGED
1987	COLUMBIA RIV BRIGHTS	LTL WHITE SALMON NFH	Fingr	05/18/88	05/18/88	222	60211	LDUER YAKIMA RIVER	850711
1987	COLUMBIA RIV BRIGHTS	LTL WHITE SALMON NFH	Fingr	05/18/88	05/18/88	222	1966	LOWER YAKIMA RIVER	UNTAGGED
1987	COLWBIA RIV BRIGHTS	LTL WHITE SALMON NFH	Fingr	05/18/88	05/18/88	222	36980	LOWER YAKIMA RIVER	850712
1987	COLWBIA RIV BRIGHTS	LTL WHITE SALMON NFH	Fingr	05/18/88	05/18/88	222	301	LOWER YAKIMA RIVER	UNTAGGED
1987	COLWBIA RIV BRIGHTS	LTL WHITE SALMDN NFH	Fingr	05/19/88	05/19/88	344	739542	LOWER YAKIMA RIVER	UNTAGGED
1987	COLUMBIA (N BONNEVL)	LTL WHITE SALMON NFH	Fingr	05/19/88	05/19/88	344	739542	LOWER YAKIMA RIVER	UNTAGGED
1987	COLUMBIA RIV BRIGHTS	YAKIMA NET PENS @DAM	Fingr	05/18/88	05/18/88	120	II4678	UPPER YAKIMA RIVER	0501010101
1987	COLUMBIA RIV BRIGHTS	YAKIHA NET PENS @DAM	fingr	05/18/88	05/18/88	120	6461	UPPER YAKIHA RIVER	UNTAGGED
1987	COLUMBIA RIV BRIGHTS	YAKIMA NET PENS @DAM	Fingr	05/18/88	05/18/88	95	73619	UPPER YAKIMA RIVER	0501010102
1987	COLUMBIA RIV BRIGHTS	YAKIMA NET PENS @DAM	Fingr	05/18/88	05/18/88	95	1248	UPPER YAKIMA RIVER	UNTAGGED
1987	COLUMBIA RIV BRIGHTS	YAKIMA NET PENS @DAM	Fingr	05/18/88	05/18/88	102	48172	UPPER YAKIMA RIVER	0501010103
1987	COLUMBIA RIV BRIGHTS	YAKIMA NET PENS @DAM	Fingr	05/18/88	05/18/88	102	1834	UPPER YAKIMA RIVER	UNTAGGED
1988	COLUMBIA RIV BRIGHTS	LTL WHITE SALMON NFH	Fingr	06/07/89	06/07/89	128	342606	AHTANUM CR (37.1382)	UNTAGGED
1988	COLWBIA RIV BRIGHTS	LTL WHITE SALMON NFH	Fingr	05/02/89	05/02/89	149	356020	LOWER YAKIMA RIVER	UNTAGGED
1988	COLUMBIA RIV BRIGHTS	LTL WHITE SALMDN NFH	Fingr	05/31/89	05/31/89	149	185996	LOWER YAKIMA RIVER	0501010205
1988	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	Fingr	05/31/89	05/31/89	149	190661	LOWER YAKIHA RIVER	UNTAGGED
1988	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	Fingr	05/31/89	06/01/89	153	194075	LOWER YAKIMA RIVER	0501010206
1988	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	Fingr	05/31/89	06/01/89	153	6002	LOWER YAKIMA RIVER	UNTAGGED
1988	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	Fingr	05/31/89	05/31/89	154	100038	LOWER YAKIMA RIVER	UNTAGGED
1988	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	Fingr	06/02/89	06/08/89	133	1060059	LOWER YAKIHA RIVER	UNTAGGED
1988	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	Fingr	06/05/89	06/05/89	133	355033	LOWER YAKIHA RIVER	UNTAGGED
1988	COLUMBIA RIV BRIGHTS	LTL WHITE SALMON NFH	Fingr	06/08/89	06/08/89	128	6400	LOWER YAKIMA RIVER	UNTAGGED
1988	COLUMBIA RIV BRIGHTS	YAKIHA NET PENS @DAM	Fingr	05/30/89	05/30/89	75	96556	YAKIMA NET PENS @DAM	0501010202
1988	COLUMBIA RIV BRIGHTS	YAKIHA NET PENS @DAM	Fingr	05/30/89	05/30/89	75	23238	YAKIMA NET PENS @DAM	UNTAGGED
1988	COLUMBIA RIV BRIGHTS	YAKIHA NET PENS @DAM	Fingr	05/30/89	05/30/89	66	88828	YAKIMA NET PENS @DAM	0501010203
1988	COLUMBIA RIV BRIGHTS	YAKIMA NET PENS @DAM	Fingr	05/30/89	05/30/89	66	11325	YAKIMA NET PENS @DAM	UNTAGGED
1988	COLUMBIA RIV BRIGHTS	YAKIMA NET PENS @DAM	Fingr	05/30/89	05/30/89	72	96918	YAKIMA NET PENS @DAM	0501010204
I988	COLUMBIA RIV BRIGHTS	YAKIMA NET PENS @DAM	Fingr	05/30/89	05/30/89	72	23256	YAKIMA NET PENS @DAM	UNTAGGED
1989	COLUMBIA RIV BRIGHTS	LTL WHITE SALMON NFH	Fingr	05/14/90	05/14/90	184	37159	LOWER YAKIMA RIVER	0501010207
1989	COLUMBIA RIV BRIGHTS	LTL WHITE SALMON NFH	Fingr	05/14/90	05/14/90	184	180794	LOWER YAKIMA RIVER	UNTAGGED
1989	COLUMBIA RIV BRIGHTS	LTL UHITE SALMDN NFH	Fingr	05/14/90	05/14/90	184	41481	LOWER YAKIMA RIVER	052120
1989	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	Fingr	05/14/90	05/14/90	184	180910	LDUER YAKIMA RIVER	UNTAGGED
1989	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	Fingr	05/15/90	05/15/90	185	78325	LOWER YAKIMA RIVER	0501010211
1989	COLUMBIA RIV BRIGHTS	LTL UHITE SALMON NFH	Fingr	05/15/90	05/15/90	185	21675	LDUER YAKIMA RIVER	UNTAGGED
1989	COLUMBIA RIV BRIGHTS	LTL WHITE SALMON NFH	Fingr	05/16/90	05/16/90	215	980055	LOUER YAKIMA RIVER	UNTAGGED

Table 9 (cont.). Hatchery releases of fall chinook salmon into the Yakims River subbasin, sorted by brood year, hatchery and life stage.

Brood Year	Stock	Hatchery	Life Stage	Release Date I	Release Date 2	Fish /lb.	Number Released	Release Site	CUT Code
1989	COLUMBIA RIV BRIGHTS	LTL WHITE SALMON NFH	Fingr	05/16/90	06/05/90	215	980055	LOWER YAKIHA RIVER	UNTAGGED
I989	COLUMBIA RIV BRIGHTS	YAKIMA NET PEWS aDAM	Fingr	05/18/90	05/18/90	102	78432	YAKIHA WET PENS aDAM	0501010208
1989	COLUMBIA RIV BRIGHTS	YAKIHA NET PENS aDAM	Fingr	05/18/90	05/18/90	102	81609	YAKIMA NET PENS aDAM	UNTAGGED
1989	COLUNBIA RIV BRIGHTS	YAKIMA NET PENS PAM	Fingr	05/18/90	05/18/90	102	79202	YAKIMA NET PENS BDAM	0501010209
1989	COLUMBIA RIV BRIGHTS	YAKIMA NET PENS aDAM	Fingr	05/18/90	05/18/90	102	80801	YAKIMA NET PENS PAM	UNTAGGED
1989	COLUMBIA RIV BRIGHTS	YAKIMA NET PENS BDAM	Fingr	05/18/90	05/18/90	105	79431	YAKIMA NET PENS aDAM	0501010210
1989	COLUMBIA RIV BRIGHTS	YAKIHA NET PENS PAM	Fingr	05/18/90	05/18/90	I05	80259	YAKIHA NET PENS aDAM	UNTAGGED

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YAKIMA RIVER SUBBASIN

Coho Salmon

GEOGRAPHIC LOCATION

The Yakima Subbasin is located in south-central Washington and includes most of Yakima and Kittitas counties as well as small portions of Benton and Klickitat counties. The Yakima River originates in the Cascade Mountains above Keechelus Lake at an elevation of 6,900 feet and flows southeasterly for 214 miles joining the Columbia River at river mile (RM) 335.2. Major tributaries include the Kachess, Cle Elum and Teanaway rivers in the northern section of the subbasin, and the Naches River in the West. The Yakima River subbasin drains a watershed of approximately 6,155 square miles and the Naches River drains an additional 1,106 square miles.

ORIGIN

Coho salmon were endemic to the Yakima, and were once on the the Yakima's largest salmon runs. "The wild coho populations which once existed within the Yakima River have been extirpated and any adult returns are considered to be of hatchery origin (Cascade Hatchery stock)." (YKFP Science Committee, pre-draft).

DISTRIBUTION

Table 1 lists rearing and spawning habitat, by quality, for Yakima River coho based on estimates from the Northwest Power Planning Council. "The only natural production now occurring is thought to be the result of hatchery fish outplantings in the subbasin. In 1986, spawning coho salmon believed to be the result of 1985 outplantings were observed in Ahtanum and Snipes creeks. In 1989, spawning was observed in Wide Hollow and Cowiche Creeks and the lower Naches River." (YKFP Science Committee, pre-draft).

"Little is known of the historic distribution of Yakima Subbasin coho salmon although managers believe the production areas in the Yakima mainstem were mainly restricted to the reaches above the mouth of the Teanaway River, and that virtually all major upper Yakima tributaries (the Teanaway River and Taneum, Manastash, Swauk, Big and Umtanum creeks) supported coho salmon. The Naches River and tributaries above the Tieton are also considered to have produced substantial numbers of coho salmon. A smaller amount of production also occurred in the upper Tieton (above Rimrock), the upper Cle Elum and its tributaries (above Cle Elum Dam), and Ahtanum and Logy creeks" (YKFP Science Committee, pre-draft).

PRODUCTION

Production Summary

The goal of the Yakima/Klickitat Production Project is produce about 40,000 harvestable adults. Of the coho observed at the Prosser smolt trap between 1983 and 1988, all but an extremely small percentage were believed to be of hatchery origin. Coho fry were observed twice in five years of beach seining and electroshocking (Yakima Basin Preliminary Information Report, undated). Once in the Upper Yakima near Easton, and once in the Naches near Upper Nile Bridge.

Coho releases for the years 1982-1988 totaled respectively: 53,820, 19,424, 0, 260,690, 84,879, 440,309, and 200,000.

ADULT LIFE HISTORY

Run Size and Escapement

"Mullan (1983) estimated that coho salmon comprised 19% of the runs over Roza Dam from 1949 through 1967. With a historic run size for all salmon and steelhead estimated to be 600,000 to that area, the run of coho salmon above Roza may have numbered as many as 114,000 fish." (YKFP Science Committee, pre-draft).

From a 1985 release of 260,690 smolts, 229 returns were counted (Yakima Basin Preliminary Information Report, undated). A 1986 release of 84,879 smolts yielded 94 returns.

Time of Migration

No information is available.

Harvest

"No terminal sport or tribal coho fishery now exists, nor has there been a fishery targeting coho for over 30 years." (Yakima Subbasin Production Plan).

Spawning period

No information is available.

Spawning area

The spawning areas of the historical coho population was probably similar to the areas described above under the distribution heading.

Fecundity

No information is available.

Age Composition

No information is available.

Size

No information is available.

Sex ratio

No information is available.

Survival Rate

Of the early run coho releases accounted for in the Yakima Basin Preliminary Information Report, smolt to returning adult survival was 0.07 and 0.11 percent for the 1985 and 1986 release years.

Smolt survival to Prosser dam is thought quite low (43 to 56 percent) for the 1985-1987 migration years.

JUVENILE LIFE HISTORY

Egg, Emergence, Juvenile rearing, Straying

No information is available.

Hatchery releases

Table 2 describe coho releases into the Yakima subbasin.

BIOCHEMICAL-GENETIC CHARACTERISTICS

No information is available on coho from the Yakima subbasin.

DISEASES

Disease information for the hatchery sources of coho released in the Yakima may be found in other subbasin sections.

Table 1 **(HB-1).** Estimated* amount of rearing and spawning habitat, by quality, of Yakima River **subbasin coho** salmon.

Area	Excellent	Good	**Fair**[B]	**Poor**[B]	Unknown	Total	Confidence
Miles	36%	64%	00%	00%		77	Unknown
Acres	35%	65%	00%	00%		721.4	Unknown

*Northwest Power Planning Council estimates based on limited observations

[B]**Ratings** of fair and poor may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/absence database, NPPC 1991.

Table 2 (TR). Hatchery releases of coho salmon into the Yakima River subbasin, sorted by brood year, hatchery and life stage.

Brood Year	stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /lb.	Number Released	Release Site	CUT Code
1976	UNKNOWN STOCK	NILE SPRINGS PONDS	Smolt	04/20/78	04/20/78	6	17540	NILE SPRINGS (38)	UNTAGGED
1976	COWLITZ TYPE-N STOCK	RINGOLD HATCHERY	Fingr	10/07/77	10/07/ 77	31	179800	AMERICAN R (38.1000)	UNTAGGED
1976	COWLITZ TYPE-N STOCK	RINGOLD HATCHERY	Fingr	10/10/77	10/10/77	31	173600	LITTLE NACHES R (38)	UNTAGGED
1976	COWLITZ TYPE-N STOCK	RINGOLD HATCHERY	Fingr	10/05/77	10/05/77	31	502200	LOWER YAKIMA RIVER	UNTAGGED
1976	COWLITZ TYPE-N STOCK	RINGOLD HATCHERY	Fingr	I 0/06/77	1 0/06/77	31	173600	NACHES R (38.0003)	UNTAGGED
1978	ABERNATHY CREEK	CARSON NF HATCHERY	Fingr	10/30/79	10/30/79	37	78400	LOWER YAKIMA RIVER	UNTAGGED
1978	UNKNOWN STOCK	CARSDN NF HATCHERY	Fingr	10/30/79	10/30/79	37	78400	UPPER YAKIHA RIVER	UNTAGGED
1978	ABERNATHY CREEK	LTL UHITE SALMON NFH	Fingr	10/31/79	10/31/79	47	390626	LOWER YAKIHA RIVER	UNTAGGED
1978	ABERNATHY CREEK	LTL WHITE SALMON NFH	Fingr	1 1/01/79	1 1/06/79	42	384595	LDUER YAKIHA RIVER	UNTAGGED
1978	LTL UHITE SALMON-NFH	UILLARD NF HATCHERY	Fingr	10/31/79	10/31/79	36	76635	LOWER YAKIMA RIVER	050638
1978	LTL UHITE SALMON-NFH	WILLARD NF HATCHERY	Fingr	10/31/79	10/31/79	36	776986	LOWER YAKIMA RIVER	UNTAGGED
1979	COLUMBIA R - TYPE-S	CARSON NF HATCHERY	Smolt	03/25/81	03/25/81	20	405736	LOWER YAKIMA RIVER	UNTAGGED
1979	ABERNATHY CREEK	CARSDN NF HATCHERY	Smolt	03/16/81	03/25/81	20	405736	UPPER YAKIMA RIVER	UNTAGGED
1979	COWLITZ TYPE-N STOCK	NILE SPRINGS PONDS	Smolt	03/25/81	03/25/81	17	683975	LOWER YAKIMA RIVER	UNTAGGED
1980	LOUER KALAMA(FALLERT	NILE SPRINGS PONDS	Smolt	05/12/82	05/12/82	22	53820	LOWER YAKIMA RIVER	UNTAGGED
1981	UASHUJGAL RIVER	NILE SPRINGS PONDS	Smolt	05/05/83	05/05/83	II	19424	UPPER YAKIHA RIVER	UNTAGGED
1983	UASHUJGAL RIVER	NILE SPRINGS PONDS	Smolt	05/25/85	05/25/85	I0	84000	NACHES R (38.0003)	UNTAGGED
1983	COLUMBIA R - TYPE-S	TURTLE ROCK POND	Smolt	05/31/85	05/31/85	13	260690	UPPER YAKIMA RIVER	UNTAGGED
1985	ABERNATHY CREEK	LTL UHITE SALMON NFH	Fingr	07/03/86	07/03/86	63	101300	LOWER YAKIMA RIVER	UNTAGGED
1985	COLUMBIA R - TYPE-S	NILE SPRINGS PONDS	Smolt	05/15/87	05/15/87	11	52107	NACHES R (38.0003)	UNTAGGED
1985	TOUTLE (GREEN RIVER)	UILLARD NF HATCHERY	Smolt	04/29/87	04/29/87	15	14800	AHTANUM CR (37.1382)	UNTAGGED
1985	TOUTLE (GREEN RIVER)	WILLARD NF HATCHERY	Smolt	05/06/87	05/06/87	15	45423	AHTANUM CR (37.1382)	UNTAGGED
1985	TDUTLE (GREEN RIVER)	WILLARD NF HATCHERY	Smolt	05/06/87	05/07/87	15	96138	AHTANUM CR (37.1382)	UNTAGGED
1985	TOUTLE (GREEN RIVER)	UILLARD NF HATCHERY	Smolt	05/07/87	05/07/87	15	50715	AHTANUM CR (37.1382)	UNTAGGED
1985	TDUTLE (GREEN RIVER)	UILLARD NF HATCHERY	Smolt	04/29/87	04/29/87	15	14800	LOWER YAKIMA RIVER	UNTAGGED
1985	TOUTLE (GREEN RIVER)	UILLARD NF HATCHERY	Smolt	05/05/87	05/05/87	15	69678	LOWER YAKIMA RIVER	UNTAGGED
1985	TWTLE (GREEN RIVER)	UILLARD NF HATCHERY	Smolt	05/06/87	05/06/87	15	28739	LOWER YAKIMA RIVER	UNTAGGED
1985	TOUTLE (GREEN RIVER)	UILLARD NF HATCHERY	Smolt	05/06/87	05/06/87	15	30503	LDUER YAKIMA RIVER	UNTAGGED
1985	TOUTLE (GREEN RIVER)	UILLARD NF HATCHERY	Smolt	05/06/87	05/06/87	I5	64680	LOWER YAKIHA RIVER	UNTAGGED
1985	TWTLE (GREEN RIVER)	WILLARD NF HATCHERY	Smolt	05/07/87	05/07/87	15	38955	LOWER YAKIMA RIVER	UNTAGGED
1985	TOUTLE (GREEN RIVER)	UILLARD NF HATCHERY	Smolt	05/07/87	05/07/87	15	66150	LOWER YAKIMA RIVER	UNTAGGED
1985	TWTLE (GREEN RIVER)	UILLARD NF HATCHERY	Smolt	05/01/87	05/01/87	15	28665	TOPPENISH CR 37.1178	UNTAGGED
1985	TWTLE (GREEN RIVER)	UILLARD NF HATCHERY	Smolt	05/01/87	05/01/87	15	28665	TOPPENISH CR 37.1178	UNTAGGED
1985	TWTLE (GREEN RIVER)	WILLARD NF HATCHERY	Smolt	05/05/87	05/07/87	I5	298705	UPPER YAKIMA RIVER	UNTAGGED
1986	COLUMBIA R - TYPE-S	GRAYS R HATCHERY -WF	Smolt	04/15/88	04/15/88	16	125000	LOVER YAKIMA RIVER	UNTAGGED
1986	COLUMBIA R - TYPE-S	LDUER KALAMA HATCHRY	Smolt	04/15/88	04/15/88	17	75000	LOWER YAKIMA RIVER	UNTAGGED
1989	COLUMBIA R - TYPE-S	WIDE HOLLOW CR COOP	EmFry	11/28/89	11/28/89	1745	30000	LOWER YAKIMA RIVER	UNTAGGED

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YAKIMA RIVER SUBBASIN

Naturally Produced Summer Steelhead

GEOGRAPHIC LOCATION

The Yakima Subbasin is located in south-central Washington and includes most of Yakima and Kittitas counties as well as small portions of Benton and Klickitat counties. The Yakima River originates in the Cascade Mountains above Keechelus Lake at an elevation of 6,900 feet and flows southeasterly for 214 miles joining the Columbia River at river mile (RM) 335.2. Major tributaries include the Kachess, Cle Elum and Teanaway rivers in the northern section of the subbasin, and the Naches River in the West. The Yakima River subbasin drains a watershed of approximately 6,155 square miles and the Naches River drains an additional 1,106 square miles.

ORIGIN

The wild summer steelhead stock in the Yakima River is native, although interbreeding with introduced Skamania and Wells hatchery-stocks has likely occurred.

DISTRIBUTION

Table 1 lists rearing and spawning habitat, by quality, for Yakima River steelhead based on estimates from the Northwest Power Planning Council.

Historically, steelhead were found throughout all reaches of the mainstem Yakima River and in many of its tributaries. Present distribution is concentrated below the confluence of the Naches and Yakima rivers. Steelhead distribution is impeded by Roza Dam (RM 127.9). Although the dam contains a fish-ladder, which has not always operated properly, fish counts since 1983 show fewer than 80 steelhead spawners (and usually fewer than 20) crossing over Roza Dam (Subbasin Plan 1990).

Limiting steelhead distribution are dams on the upper Yakima and many tributaries which create unpassable barriers to spawning adults and/or have large, unscreened diversions which effectively prevents or impedes steelhead passage. Known barriers or diversions exist on Manastash Creek, Taneum Creek, Cowiche Creek, Ahtanum Creek, Simcoe Creek, the North Fork Simcoe Creek, the Wilson/Naneum drainage, Swauk Creek and Reecer Creek and there are undoubtedly others (Subbasin Plan 1990).

PRODUCTION

Production Facilities

Three fish rearing facilities operate in the subbasin with all three producing some steelhead. Two of the facilities, Yakima Trout Hatchery and Naches Hatchery are operated by the Washington Department of Wildlife. The third rearing facility, Nelson Springs raceway, is operated by a Yakima steelheader's sport fishing club. The Yakima Hatchery is located on the Yakima River just west of the Town of Yakima. The Naches Hatchery is located near the Naches River approximately five miles from Yakima, and the Nelson Springs raceway is located on Buckskin Creek, a tributary 3.3 miles up the Naches.

Production Summary

Smolt capacity, as determined by Northwest Power Planning Council's smolt production model, was estimated at 508,861 smolts. This estimate does not reflect areas in the subbasin -(Little Naches, upper Toppenish, and the Yakima above Roza dam) which have recently been made accessible to steelhead and may result in increased smolt production. A highly preliminary estimate of steelhead production is that 50 percent occurs in the Satus Creek drainage, 10 percent in the Naches River drainage, 20 percent in the Yakima River drainage between Roza and Wapato dams, and 20 percent in the Yakima drainage below Wapato Dam (Subbasin Plan 1990)[A]. Smolt production, as measured by outmigrating smolts counted at Prosser Dam, for the period of 1983 through 1991 ranged from a low of 38,333 smolts in 1991 to a high of 112,180 smolts in 1986 (Tables 3, 4 and 5). Recent smolt counts have declined by over 50 percent from levels recorded in the mid-1980's. The exact reason for the decline is not known although possible conditions which could impact production include the drought in recent years which has reduced instream water flows, irrigation diversions which are poorly or totally unscreened, suboptimal flows reducing rearing habitat and impeding fish passage, degraded riparian and instream habitat from urbanization and livestock grazing, and excessive water temperatures.

ADULT LIFE HISTORY

Run Size and Escapement

Historically, an estimate of the steelhead run numbered approximately 100,000 fish (Smoker 1957). Current estimates of run size, based on the combined fish counts at Prosser Dam and sport catch estimates, from 1980 through 1990 ranged from 255 fish in 1980 to 2,693 fish in 1987 (Table 2). Steelhead returns where predominately wild fish with estimates from 1980 through 1990 showing hatchery fish ranging from 0% to 14.7 % of a years return.

Time of Migration

Adult time of entry for steelhead into the Yakima River generally begins in September with migration slowing or stopping during December and January and resuming in February through June. The run has two peaks, one in late October and one in February or March. Estimates from Prosser Dam show the majority of hatchery steelhead return before January.

Harvest

Ocean harvest of Yakima Subbasin steelhead is unknown.

Harvest of returning adult summer steelhead within the Columbia River by treaty and sport fisheries was estimated at about 15 percent for unclipped wild fish and 20 percent for adipose-clipped hatchery fish (Subbasin Plan 1990).

[A]This distribution is based on smolt counts made at Wapatox and Roza dams, from redd counts (and inferred escapement) in the Status Creek drainage in 1988, and also on estimated smolt capacity in the Yakima drainage between Wapatox and Roza dams and below Wapota Dam. Sport harvest of steelhead within the Yakima subbasin during the mid-1960's averaged an annually catch of over 2,000 fish. Sport harvest, based on permit-card harvest estimates, from 1980 through 1990 ranged from 119 fish in 1989-1990 to 1,506 fish in 1984-1985 with an average catch of 560 fish annually (Table 2). Sport harvest of steelhead has declined to less than 200 fish harvested each year for the past two seasons (1988 through 1990). The reduction is a result of regulations imposed in 1986 which require release of all wild steelhead, reduced the catch limit to one fish and a shortened fishing season. These regulation changes were implemented to increase escapements and production within the Yakima Subbasin.

A tribal subsistence dip net fishery exist for chinook and coho salmon and although steelhead are not targeted some incidental catch of steelhead may occur.

Spawning period

Spawning is believed to take place in April and May.

Spawning area

Spawning occurs in the mainstem Yakima River and throughout many tributaries. Spawning area has been reduced considerably over the past century as hydropower and irrigation development has reduced steelhead spawning habitat.

Fecundity

Limited data on wild steelhead fecundity. In 1986-1987, 22 wild females where captured for brood stock collection on which both age and fecundity were determined. The mean fecundity for l-ocean steelhead was 4,858 eggs per female, while 2-ocean steelhead averaged 7,119 eggs per female (Table 10).

Age Composition

Data on age structure from 123 wild females taken as broodstock in 1985-1986 and 1986-1987 showed a fairly even split between l-ocean fish and 2-ocean fish with age composition of l-ocean, 2-ocean and 3-ocean fish at 52.0 percent, 47.3 percent and 0.7 percent, respectively (Subbasin Plan 1990). This age structure corresponded to a small sample of wild steelhead aged in 1983 which showed an even 50/50 split between 2.1 age and 2.2 age fish. Age composition for several return years of wild steelhead is presented in Tables 6 and 7.

Size

Mean fork lengths from wild summer steelhead captured in 1985-1986 and 1986-1987 were 60.5 cm for l-ocean fish and 71.5 cm for 2-ocean fish (Table 9).

Sex ratio

Sex ratio observed in three years of broodstock collection were very similar; 65 percent of the fish collected in 1985 were females, 63 percent were females in the 19861987 collection, and 73 percent were females in the 1987-1988 collection. Based on these findings sex ratio averages 67 percent.

Percent females by individual age class is presented in Table 8.

Survival Rate

No data on egg-to-smelt and smolt-to-adult survival.

JUVENILE LIFE HISTORY

Egg

No data are available on Yakima steelhead.

Emergence

No data are available on Yakima steelhead.

Juvenile rearing

Age composition of Yakima Subbasin steelhead smolts, as determined by length frequencies at Prosser Dam from 1983 through 1990, showed age composition of age I+, age II+, and age III+ smolts at 45.7 percent, 48.6 percent and 5.7 percent, respectively. A second sample of smolt age composition, as determined from Satus Creek smolts in 1981, conformed rather closely to the Yakima River smolt ages with age composition of age I+, age II+, and age III+ smolts at 43 percent, 54.3 percent and 1.7 percent, respectively. Finally, 181 scales sampled from Naches River steelhead smolts in 1988 showed 17 percent were age I+, 83 percent were age II+ fish and none were age III+ fish. Juvenile outmigration generally occurs from April through June with peak migration in early May.

Hatchery Releases

Steelhead releases have occurred in the Yakima Subbasin since 1961. Table 11 outlines smolt releases from 1980 through 1990. Stocks released included Priest Rapids, Klickitat, and Skamania hatchery-stocks, but since 1987 smolts released have been exclusively hatchery-reared natural Yakima steelhead. The use of natural Yakima stock begins when wild adults are captured in the Yakima River and transferred to Yakima Trout Hatchery for maturation and spawning. Eggs are divided into two lots of approximately equal number. Lot 1 is transferred to Naches Hatchery as eyed-eggs in late March to early May where they are incubated and reared until late October when they are transferred as presmolts to Nelson Springs raceway for final rearing and release. Eggs from lot 2 remain at the Yakima Trout Hatchery where they are incubated and reared until smolts at which time they are released (from 1986 through 1989) into the Naches River System. Future planning to determine the need and use of hatchery production and corresponding smolt releases is under study by the Experimental Design Work Group of the Yakima/Klickitat Production Project.

Straying

No data are available on Yakima River steelhead.

BIOCHEMICAL-GENETIC CHARACTERISTICS

No data are available on Yakima River steelhead.

DISEASES

Disease history for smolts planted in the Yakima River is presented in Table 12.

Table 1 (HB-1). Estimated* amount of rearing and spawning habitat, by quality, of Yakima River subbasin summer steelhead.

Area	Excellent	Good	Fair[B]	Poor[B]	Unknown	Total	Confidence
Miles	16.2%	31.7%	26.4%	25.7%		668.2	Unknown
Acres	9.8%	41.1%	28.9%	20.2%		4802.3	Unknown

[A]Northwest Power Planning Council estimates based on limited observations

[B]Ratings of fair and poor may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/absence database, NPPC 1991.

Table 2 (RB-a). Returns (sport catch and escapement) of steelhead to the Yakima River subbasin.

Return Year	Escapement[A] Hatchery	Wild	Sport Catch[B]	Adult Total
1980-81	16	64	175	255
1981-82	53	210	603	866
1982-83	58	230	630	918
1983-84	72	286	782	1140
1984-85	138	550	1506	2194
1985-86	276	1104	728	2227
1986-87	368	1472	520	2491
1987-88	0	2198	395	2693
1988-89	0	856	142	1166
1989-90	90	755	119	964

[A]Escapement estimates from 1985 through 1990 based on adults counted at Prosser Dam. Escapements prior to 1985 based on total catch/exploitation rate.

[B]Catch within subbasin only, includes Naches River.

Source: Columbia Basin System Planning, Yakima Subbasin Production Plan, 1990. Bruce Watson, Yakima Indian Nation, Results of Fish Sampling, Yakima River, 1991.

Table 3 (SM-a). Number of summer steelhead smolts that migrated from the Yakima River subbasin.

Outmigration Year	Number[A B]	Peak Migration	% Smolts Migrating April	May
1983	67,854	April-May	41.2	56.4
1984	75,106	April-May	34.7	56.6
1985	62,223	April-May	42.2	51.6
1986	112,180	April-May	38.4	32.3
1987	100,043	April-May	44.0	35.0
1988	89,360	April-May	28.6	68.4
1989	42,062	April-May	43.8	49.7
1990	51,496	April-May	53.2	21.8
1991	38,333	April-May	45.8	41.9

[A]Estimate based on total number of smolts counted at Prosser Dam.
[B]Estimate for outmigration period only, March through June.

Source: Stock Assessment of Columbia River Anadromous Salmonids Vol. II, 1985. Bruce Watson, Yakima Indian Nation, Yakima River Downstream Smolt Migration, 1991.

Table 4 (SL-a). Lengths of wild summer steelhead smolts from the Yakima River subbasin.

Mean Fork Length (mm)

Year[A]	March	April	May	June
1983		193	182	197
1984	190	192	188	202
1985	202	193	182	206
1986	189	187	184	198

[A]Steelhead smolts captured in fish trap at Prosser Dam.

Source: Bruce Watson, Yakima Indian Nation, personal correspondence, 1991.

Table 5 (SL-b). Length frequency of wild steelhead trapped at Prosser Dam in 1983.

Length (mm)	Frequency	Percent
80-120	27	2.8
120-160	167	17.1
160-200	424	43.5
200-240	306	31.4
240-280	38	3.9
280-330	12	1.2

source: Stock Assessment of Columbia River Anadromous Salmonids Vol. II, 1985.

Table 6 (AC-a). Age composition percentage **(freshwater.ocean)** by return year, for adult summer steelhead originating in the Yakima River subbasin.

Age composition **(%)**

Return Year	N[B]	1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	4.1
1983	12	0	0	50.0	50.0	0	0	0	0	0
1985-86[A]	69	13.0	2.9	55.1	23.2	1.4	4.3	0	0	0
1986-87[A]	38	5.3	18.4	23.7	44.7	0	2.6	5.3	0	0
1989-90	52	2.0	6.0	44.0	33.0	4.0	4.0	4.0	0	2.0

[A]Age data for these years obtained only from female steelhead.

[B]Fish collected at Prosser Dam. Age determined by scale analysis.

Source: Columbia Basin System Planning, Yakima Subbasin Production Plan, 1990. Yakima Hatchery Experimental Design Annual Report, 1990. BPA Project # 89-082.

Table 7 (SL-b). Age composition percentage (freshwaterocean) for steelhead captured in Satus Creek.

Age Composition **(%)**

Return Year	N	x.1	x.2
1979-80	5	100	
1980-81	28	94.3	5.7
1981-82	25	65.0	35.0

x.1 = l-ocean fish.
x.2 = 2-ocean fish.

Source: Bruce Watson, Yalcima Indian Nation, personal correspondence, 1991.

Table 8 (AS-a). Percent females for adult wild summer steelhead originating in the Yakima River subbasin.

% Females

Return Year	Number Collected[A]	Total % Female
1985-86	119	65
1986-87	131	63
1987-88	100	73

[A]Number collected represents total number of broodstock collected at Prosser Dam.

Source: Yakima Subbasin Production Plan 1990.

Table 9 (AL-a). Mean fork length by age class for adult summer steelhead originating in the Yakima River subbasin.

Mean Fork Length (cm)

Return Year[A]	N	X.1	X.2	X.3	
1979-80	5	60.8			
1980-81	28	59.2	66.7		
1981-82	25	59.8	70.1		
1982-83	12	58.7	71.5		
1985-86[B]	69	60.8	71.8	86.4[C]	
1986-87[B]	38	159.0	171.0		

[A]Years 1979-80, 1980-81 and 1981-82 captured in Satus Creek. All other years collected at Prosser Dam on the Yakima River.

[B]Lengths from female steelhead only.

[C]Only one fish sampled in this age class.

x.1 = 1 ocean fish
x.2 = 2 ocean fish
x.3 = 3 ocean fish

Source: Yakima Subbasin Production Plan, 1990. Bruce Watson, Yakima Indian Nation, personal correspondence, 199 1.

Table 10 (AF-a). Mean fecundity by age class for wild steelhead originating in the Yakima River subbasin.

Return Year	N[A]	x.1	x.2	x.3
1986-87	22	4,932	7,119	

[A]Fish collected as broodstock at Prosser Dam.

x.1 = l-ocean fish.
X.2 = 2-ocean fish.

Source: Yakima Subbasin Production Plan, 1990.

Table 11 (TR). Hatchery releases of summer steelhead into the Yakima subbasin by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1981	Columbia McNary-Upper	Naches	Smolt	04/08/83	6.0	64,810	Naches R	
1981	Washougal R	Naches	Smolt	04/14/82	6.0	51,486	Naches R	
1981	Washougal R	Naches	Smolt	05/04/82	7.0	728	Naches R	AD
1983	Columbia McNary-Upper	Nelson Springs (Yakima)	Smolt	04/16/84	8.0	24,654	Naches R	AD
1983	Columbia McNary-Upper	Nelson Springs (Yakima)	Smolt	04/16/84	8.0	24,635	Naches R	AD
1983	Columbia, Wells	Naches	Non-smolt	11/19/84	54.0	8,316	Naches R	AD
1984	Columbia, Wells	Naches	Smolt	04/08/85	6.0	6,060	Naches R	AD
1984	Columbia, Wells	Naches	Smolt	04/08/85	6.0	6,230	Naches R	AD
1984	Columbia, Wells	Naches	Smolt	04/09/85	6.0	6,160	Naches R	AD
1984	Columbia, Wells	Naches	Smolt	04/09/85	6.0	6,060	Naches R	AD
1984	Columbia, Wells	Naches	Smolt	04/09/85	6.0	6,720	Naches R	AD
1984	Columbia, Wells	Naches	Smolt	04/09/85	6.0	58,740	Naches R	AD
1985	Columbia McNary-Upper	Battelle Research Lab	Smolt	06/02/86	8.0	620	Yakima	AD
1985	Columbia McNary-Upper	Battelle Research Lab	Smolt	06/02/86	8.0	620	Yakima	AD
1985	Columbia McNary-Upper	Battelle Research Lab	Smolt	06/02/86	8.0	620	Yakima	AD

Table 11 (cont.). Hatchery releases of summer steelhead into the Yakima subbasin by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1985	Columbia McNary-Upper	Battelle Research Lab	Smolt	05/13/86	8.0	300	YakimaR	AD
1985	Columbia McNary-Upper	Battelle Research Lab	Smolt	05/13/86	8.0	300	YakimaR	AD
1985	Columbia McNary-Upper	Battelle Research Lab	Smolt	05/13/86	8.0	300	YakimaR	AD
1985	Columbia McNary-Upper	Battelle Research Lab	Smolt	05/23/86	8.0	620	Yakima R	AD
1985	Columbia McNary-Upper	Battelle Research Lab	Smolt	05/23/86	8.0	325	Yakima R	AD
1985	Columbia McNary-Upper	Battelle Research Lab	Smolt	05/23/86	8.0	325	Yakima R	AD
1985	Columbia McNary-Upper	Battelle Research Lab	Smolt	05/23/86	8.0	325	Yakima R	AD
1985	Columbia McNary-Upper	Battelle Research Lab	Smolt	06/12/86	8.0	620	Yakima R	AD
1985	Columbia McNary-Upper	Nelson Springs (Yakima)	Smolt	04/01/86	5.8	33,050	Naches R	AD
1985	Columbia McNary-Upper	Nelson Springs (Yakima)	Smolt	04/13/86	5.8	33,050	Naches R	AD
1985	Washougal R - WF/NF	Nelson Springs (Yakima)	Smolt	04/01/86	5.8	42,530	Naches R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03/13/87	8.9	223	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03/13/87	9.0	224	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03/13/87	9.0	225	Yakima R	AD

Table 11 (cont.). Hatchery releases of summer steelhead into the Yakima subbasin by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1986	Columbia, Wells	Chelan PUD	Smolt	03/13/87	9.0	225	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03/13/87	9.0	225	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03/13/87	9.0	225	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03113187	9.0	225	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03/13/87	9.0	225	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03/17/87	9.0	198	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03/17/87	9.0	199	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03/17/87	9.0	199	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03117187	9.0	199	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03117187	9.1	200	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03/17/87	9.1	200	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03/17/87	9.1	200	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03/17/87	9.1	200	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03/17/87	9.1	201	Yakima R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	03/17/87	9.0	225	Yakima R	AD
1986	Unknown	Yakima	Non-smolt	12/04/86	58.6	4,512	American R	AD
1986	Unknown	Yakima	Non-smolt	12/04/86	58.6	7,207	Bumping Cr	AD
1986	Unknown	Yakima	Non-smolt	12/04/86	58.6	29,651	Naches R	AD
1986	Unknown	Yakima	Non-smelt	12/04/86	58.6	586	Swamp Cr	AD
1986	Unknown	Yakima	Non-smolt	12/14/86	58.6	3.750	Nile Cr	AD

Table 11 (cont.). Hatchery releases of summer steelhead into the Yakima subbasin by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/06/87	8.1	27,540	Naches R	623716 AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/06/87	8.1	27,605	Naches R	623719 AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/11/87	8.1	13,770	Naches R	623716 AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/11/87	8.1	13,802	Naches R	623719 AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/06/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/06/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/06/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/06/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/06/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/06/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/06/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/06/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/07/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Sprinps (Yakima)	Smolt	04/07/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/07/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/07/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/07/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Sprines (Yakima)	Smolt	04/07/87	8.8	150	Yakima R	AD LV

Table 11 (cont.). Hatchery releases of summer steelhead into the Yakima subbasin by brood year and, if marked, the coded wire tag codes.

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1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/07/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/07/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/07/87	8.8	150	Yakima R	AD LV
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/07/87	8.8	100	Yakima R	
1986	Yakima R	Nelson Springs (Yakima)	Smolt	04/13/87	8.8	100	YakimaR	
1986	Yakima R	Yakima	Smolt	04/14/87	7.3	5,475	Naches R	AD
1986	Yakima R	Yakima	Smolt	04/14/87	6.1	8,125	Naches R	AD
1986	Yakima R	Yakima	Smolt	04/14/87	7.9	8,690	Naches R	AD
1986	Yakima R	Yakima	Smolt	04/14/87	7.9	10,033	Naches R	AD
1986	Yakima R	Yakima	Smolt	04/15/87	6.2	4,960	Naches R	AD
1986	Yakima R	Yakima	Smolt	04/15/87	6.2	5,394	Naches R	AD
1986	Yakima R	Yakima	Smolt	04/15/87	6.2	2,697	Naches R	AD
1986	Yakima R	Yakima	Smolt	04/14/87	6.1	5,400	Wildcat Cr	AD
1986	Yakima R	Yakima	Smolt	04/15/87	6.2	5,611	Nile Cr	AD
1987	Yakima R	Nelson Springs (Yakima)	Smolt	04/12/88	7.3	6,570	American R	621912 RV AD
1987	Yakima R	Nelson Springs (Yakima)	Smolt	04/12/88	7.3	4,964	American R	621912 RV AD
1987	Yakima R	Nelson Springs (Yakima)	Smolt	04/13/88	7.3	6,716	American R	621912 RV AD
1987	Yakima R	Nelson Springs (Yakima)	Smolt	04/14/88	7.3	3,927	American R	621912 RV AD

Table 11 (cont.). Hatchery releases of summer steelhead into the Yakima subbasin by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT code/ Fin Clip
1987	Yakima R	Nelson Springs (Yakima)	Smolt	04/14/88	7.3	8,176	Bumping R	621912 RV AD
1987	Yakima R	Nelson Springs (Yakima)	Smolt	04/14/88	7.3	6,862	Naches R	621912 RV AD
1987	Yakima R	Nelson Springs (Yakima)	Smolt	04/15/88	7.3	5,840	Bumping R	621912 RV AD
1987	Yakima R	Nelson Springs (Yakima)	Smolt	04/15/88	7.3	6,643	Naches R	621912 RV AD
1987	Yakima R	Nelson Springs (Yakima)	Smolt	04/16/88	7.3	5,256	Naches R	621912 RV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	53.7	7,950	American R	621907 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	53.7	4,669	American R	621910 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	53.8	9,946	Bumping Cr	621907 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	53.6	5,842	Bumping Cr	621910 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	53.7	6,766	Crow Cr	621907 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	53.7	3,974	Crow Cr	621910 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	53.8	2,368	Naches R	62 1907 LV AD

Table 11 (cont.). Hatchery releases of summer steelhead into the Yakima subbasin by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT code/ Fin Clip
1987	Yakima R	Yakima	Non-smolt	10/27/87	53.5	1,391	Naches R	621910 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	53.7	5,692	Naches R	621907 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	53.7	3,383	Naches R	621910 LV AD
1987	Yakima R	Yakima	Non-smol t	10/27/87	53.7	3,329	Naches R	621907 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	53.7	1,933	Naches R	621910 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	53.5	642	Pile Up Cr	621907 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	54.0	378	Pile Up Cr	621910 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	53.7	322	Quartz Cr	62 1907 LV AD
1987	Yakima R	Yakima	Non-smelt	10/27/87	53.7	161	Quartz Cr	621910 LV AD
1987	Yalcima R	Yakima	Non-smolt	10/27/87	30.0	8,010	Rattlesnake Cr	621910 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	30.0	5,010	Little Rattlesnake Cr	621910 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	30.0	7,980	Tieton R	621910 LV AD

Table 11 (cont.). Hatchery releases of summer steelhead into the Yakima subbasin by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1987	Yakima R	Yakima	Non-smolt	03/09/88	25.0	12,200	Naches R	621911 LV AD
1987	Yakima R	Yakima	Smolt	04/11/88	9.4	8,319	Tieton R	621911 AD
1987	Yakima R	Yakima	Smolt	04/12/88	10.0	5,500	Crow Cr	621911 AD
1987	Yakima R	Yakima	Smolt	04/12/88	10.0	500	Pile Up Cr	621911 AD
1987	Yakima R	Yakima	Smolt	04/12/88	10.0	500	Quartz Cr	621911 AD
1987	Yakima R	Yakima	Smolt	04/12/88	8.4	7,980	Rattlesnake Cr	621911 AD
1987	Yakima R	Yakima	Smolt	04/12/88	10.0	6,000	Little Rattlesnake Cr	621911 AD
1987	Yakima R	Yakima	Smolt	04/13/88	8.4	7,770	Bumping R	621911 AD
1987	Yakima R	Yakima	Smolt	04/14/88	10.0	6.400	American R	621911 AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	53.7	642	Fawn Cr	621907 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	53.7	378	Fawn Cr	621910 LV AD
1987	Yakima R	Yakima	Non-smolt	10/27/87	30.0	5,010	Nile Cr	621910 LV AD
1988	Yakima R	Naches	Smolt	03/28/89	8.3	23,123	Naches R	621607 RV AD
1988	Yakima R	Naches	Smolt	03/28/89	9.2	9,936	Toppenish Cr	621607 RV AD

Table 11 (cont.). Hatchery releases of summer steelhead into the Yakima subbasin by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT code/ Fin Clip
1988	Yakima R	Naches	Smolt	03/29/89	9.2	22,944	Toppenish Cr	621607 RV AD
1988	Yakima R	Yakima	Non-smolt	04/13/89	10.6	1,000	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/13/89	10.6	1,000	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/13/89	10.6	1,000	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/13/89	10.6	1,000	Unknown	621606
1988	Yakima R	Yakima	Non-smelt	04/13/89	10.6	100	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/13/89	10.6	180	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/13/89	10.6	1,000	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/13/89	10.6	1,000	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/13/89	10.6	1,000	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/13/89	10.6	11,759	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/14/89	11.3	1,000	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/14/89	11.3	1,000	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/14/89	11.3	1,000	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/14/89	11.3	1,000	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/14/89	11.3	1,000	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/14/89	11.3	1,000	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/14/89	11.3	1,000	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/14/89	11.3	1,000	Unknown	621606
1988	Yakima R	Yakima	Non-smolt	04/ 14189	11.3	12,058	Unknown	621606

Table 1 1 (cont.). Hatchery releases of summer steelhead into the Yakima subbasin by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1989	Yakima R	Nelson Springs (Yakima)	Smolt	04/07/90	4.5	32,301	Naches R	AD
1989	Yakima R	Nelson Springs (Yakima)	Smolt	04/21/90	9.0	24,147	Naches R	AD
1989	Yakima R	Yakima	Non-smolt	05/09/90	12.0	12,480	Naches R	AD
1989	Yakima R	Yakima	Smolt	04/30/90	9.0	6,600	Naches R	AD
1989	Yakima R	Yakima	Smolt	05/30/90	9.0	3,829	Naches R	AD
1989	Yakima R	Yakima	Smolt	06/30/90	6.8	74,830	Naches R	AD
1989	Yakima R	Yakima	Non-smolt	1 1/30/89	248.0	1,984	Wide Hollow Cr	AD
1989	Yakima R	Yakima	Non-smolt	05/10/90	11.2	18,032	Wide Hollow Cr	AD
1989	Yakima R	Yakima	Non-smolt	04/25/90	12.0	2,712	Yakima R	AD
1989	Yakima R	Yakima	Non-smolt	05/02/90	12.0	2,004	YakimaR	AD
1989	Yakima R	Yakima	Non-smolt	05/09/90	12.0	2,004	YakimaR	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	04/22/9 1	5.8	260	Teanaway R NF	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	04/22/91	5.8	260	Teanaway RNF	AD LV
1990	Yakima R	Nelson Springs (Yakima)	Smolt	04/24/9 1	5.8	254	Teanaway RNF	AD RV
1990	Yakima R	Nelson Springs (Yakima)	Smolt	04/24/91	5.8	250	Teanaway RNF	AD LV
1990	Yakima R	Nelson Springs (Yakima)	Smolt	04/29/91	5.8	250	Teanaway RNF	AD AN

Table 11 (cont.). Hatchery releases of summer steelhead into the Yakima subbasin by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT code/ Fin Clip
1990	Yakima R	Nelson Springs (Yakima)	Smolt	04/29/91	5.8	250	Teanaway RNF	AD RV
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/01/91	5.8	250	Teanaway RNF	AD RV
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/01/91	5.8	250	Teanaway RNF	AD LV
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/06/91	5.8	4,901	Jungle Cr	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/06/91	5.8	6,757	Jungle Cr	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/06/91	5.8	3,364	Jungle Cr	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/08/91	5.8	6,380	Jungle Cr	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/08/91	5.8	4,640	Jungle Cr	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/15/91	10.0	5,500	Jungle Cr	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/20/91	5.8	250	Teanaway R NF	AD RV
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/20/91	5.8	250	Teanaway R NF	AD LV
1990	Yakima R	Nelson Springs (Yakima)	Smolt	04/10/91	5.8	496	Yakima R	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	04/16/91	5.8	496	Yakima R	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	04/18/91	5.8	496	Yakima R	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	04/22/91	5.8	496	Yakima R	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	04/24/91	5.8	4,611	Yakima R	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	04/24/91	5.8	496	Yakima R	AD

Table 11 (cont.). Hatchery releases of summer steelhead into the Yakima subbasin by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT code/ Fin Clip
1990	Yakima R	Nelson Springs (Yakima)	Smolt	04/30/91	5.8	496	Yakima R	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/01/91	5.8	4,640	Yakima R	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/02/91	5.5	496	Yakima R	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/04/91	5.5	496	Yakima R	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/10/91	5.5	496	Yakima R	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/15/91	5.5	430	Yakima R	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/22/91	6.0	5,220	Yakima R	AD
1990	Yakima R	Nelson Springs (Yakima)	Smolt	05/24/91	5.5	496	Yakima R	AD
1990	Yakima R	Yakima	Non-smolt	02/07/91	117.0	7,020	Athanum Cr	AD
1990	Yakima R	Yakima	Non-smolt	02/07/91	42.0	3,990	Athanum Cr	AD
1990	Yakima R	Yakima	Non-smolt	02/07/91	28.0	15,820	Athanum Cr	AD
1990	Yakima R	Yakima	Non-smolt	02/07/91	117.0	7,020	Wide Hollow Cr	AD
1990	Yakima R	Yakima	Non-smolt	02/07/91	42.0	3,150	Wide Hollow Cr	AD
1990	Yakima R	Yakima	Non-smolt	02/07/91	28.0	14,448	Wide Hollow Cr	AD
1990	Yakima R	Yakima	Non-smolt	06/06/91	12.4	11,160	Wide Hollow Cr	AD
1990	Yakima R	Yakima	Smolt	05/10/91	9.4	9,400	Yakima R	AD

Table 11 (cont.). Hatchery releases of summer steelhead into the Yakima subbasin by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1990	Yakima R	Yakima	Smolt	05/13/91	9.4	11,045	Yakima R	AD
1990	Yakima R	Yakima	Smolt	05/21/91	9.0	8,415	Yakima R	AD

Source: Terry Lovgren, WDW, Hatchery Stocking Database, 1991.

Table 12 (TD). Parasites and diseases isolated at hatcheries which reared Yakima River Steelhead smolts[A].

Disease Type	Hatchery	Specific Pathogen
Bacterial	Naches[B]	*Flavobacterium sp.*
Bacterial	Naches	*Flexibacter columnaris* (Columnaris)
Bacterial	Naches	*Flexibacter cytophaga* (Coldwater)
Bacterial	Naches	*Aeromonas salmonicida* (Furunculosis)
Parasite	Naches	*Hexamita sp.*
Bacterial	Yakima	*Flavobacterium sp.*
Bacterial	Yakima	*Renibacterium salmonarium* (BKD)
Bacterial	Yakima	*Flexibacter columnaris* (Columnaris)
Parasite	Yakima	*Gyrodactylus sp.*
Parasite	Yakima	*Ichthyoboda sp.* (Costia)
Parasite	Yakima	*Ichthyophthirius multiflis* (Ich)
Parasite	Yakima	*Hexamita sp.*
Viral	Yakima	Infectious Pancreatic Necrosis(IPN)
Viral	Yakima	EIBS

‘Summer steelhead smolts released into the Yakima River were also reared at the Chelan hatchery located on the Columbia River.
[B]Naches Hatchery is located on the Naches River, a tributary of the Yakima River.

Disease history represents pathogens isolated at these hatcheries and not necessarily a disease outbreak.

Source: WDW pathologist, Steve Roberts, 1991.

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WENATCHEE SUBBASIN

Spring Chinook

GEOGRAPHIC LOCATION

The Wenatchee watershed drains a portion of the east Cascade Mountains in north central Washington within Chelan County. The mainstem flows generally in a southeasterly direction, emptying into the Columbia River at river mile (RM) 468.4. The watershed encompasses approximately 1,327 square miles, with 230 miles of major streams and rivers. The watershed originates in high mountainous regions of the Cascade crest, with numerous tributaries draining subalpine regions within the Alpine Lakes and Glaciers Peak Wilderness areas. The Little Wenatchee and White rivers flow into Lake Wenatchee, the source of the Wenatchee River. From the lake outlet (RM 54.2) the river descends rapidly through Tumwater Canyon, dropping into a lower gradient section in the region of Leavenworth, where Icicle Creek joins the mainstem (RM 25.6). Other major tributaries include Mission, Peshastin, Chumstick and Chiwaukum Creeks, Chiwawa River and Nason Creek (Hydrology Subcommittee, 1964). Leavenworth National Fish Hatchery is located on Icicle River at river mile 2.8.

ORIGIN

Hydroelectric and diversion dam construction reduced the abundant populations of native spring chinook in the upper Columbia tributaries (Fulton, 1968). Spring chinook stocking history for the federal hatcheries is divided into two periods. Beginning in the 1940's, spring chinook broodstock were intercepted at Rock Island Dam or occasionally obtained from lower Columbia hatcheries (J. Mullan, USFWS, personal communication). Commencing in 1969, Carson stock spring chinook were reared at Leavenworth Hatchery, although Cowlitz stock spring chinook were released in 1976 and 1978.

DISTRIBUTION

Spring chinook production of wild fish occurs in four tributaries; the Chiwawa River, Nason Creek, White River, and the Little Wenatchee River. Currently, there is no distinguishing differences in the runs to each tributary other than spatial separation. These populations are probably not impacted by hatchery production at Leavenworth National Fish Hatchery on Icicle River. However, populations may have common ancestry from the Rock Island Dam spring chinook relocation program which began in 193941. Indigenous spring chinook stocks were decimated by mill dams and irrigation diversions by the early 1900's. Additionally, some natural spring chinook spawning occurs in the Icicle River. These fish are likely of Leavenworth Hatchery origin.

PRODUCTION

Wild production occurs in four tributaries of the Wenatchee River. Escapement into the Chiwawa River has ranged from 400-4,000 spring chinook. Escapement into Nason Creek has ranged from 300-3,000 spring chinook. Escapement into the White River has ranged from 100-700 spring chinook. Escapement into the Little Wenatchee River has ranged from 100-700 spring chinook. All four of these natural runs are depressed and have experienced a sharp decline since 1989.

The number of naturally spawning spring chinook in the Icicle River from 1979-1990 return years averaged 281 with a low return of 58 for the 1989 return year and a peak of 800 for the 1986 and 1987 return years. Icicle River spring chinook natural spawn escapement by total age and return year is presented in Table 4.

Habitat carrying capacity for wild spring chinook in the Wenatchee River Basin is estimated to be 1.2 million smolts using the approach detailed in the Data Standardization Report. The estimate arrived at using this method may be unreliable due to the inability to effectively quantify and qualify the habitats and the relationships of organisms within these microhabitats.

Tables 1 and 2 describe the amount of spawning and rearing habitat, by quality, available in the Wenatchee subbasin. This data was derived from the Presence/Absence database of the Northwest Power Planning Council, 1991.

Leavenworth National Salmon Hatchery spring chinook returns from 1979-1990 return years averaged 2,720 with a low return of 1,822 for the 1979 return and a peak of 3,565 for the 1986 return year. Leavenworth National Fish Hatchery spring chinook returns by total age and return year are presented in Table 5.

Icicle River tributary spring chinook sport catch estimates between 1980-1990 return years ranged from a low of 100 for the 1982 return and a high of 1,454 for the 1987 return. Icicle River tributary spring chinook sport catch by total age and return year is presented in Table 6.

Icicle River spring chinook tribal harvest from return years 1987-1990 averaged 1,302 with a low catch of 888 for the 1990 return and a peak of 1,770 for the 1988 return. Icicle River tribal harvest by return year and total age is available in Table 7.

ADULT LIFE HISTORY

Run size, catch and escapement

Ocean commercial and recreational fisheries from Alaska to Washington, in addition to Columbia River treaty, non-treaty and sport fisheries all harvest a portion of the Wenatchee River spring chinook.

Strays from other hatcheries are not unusual. Table 8 lists Leavenworth NFH origin spring chinook stray coded wire tag recoveries beginning with the 1978 brood, through to the 1988 brood, and Table 9 lists the coded wire tags recovered within the Wenatchee subbasin which originated outside the Wenatchee subbasin.

Time of Migration

Spring chinook upriver migration timing of wild and hatchery fish is generally the same. Spring chinook peak at Bonneville Dam mid to late April; About 50 percent of the mid-Columbia River run passes Priest Rapids Dam by late May. Returns of the Leavenworth stock to Icicle River peak late May to early June. Arrival time is earlier in low flow years and later in high flow years.

Spawning Period

Spawning usually commences about the second week of August and into the first week of September. Different annual temperature regimes will vary the time of spawning. According to Mullan (1987), threshold temperatures for egg deposition and normal development are between 42.5 F to 57.5 F. This applies primarily up to the time eggs eye, which is about the first 20 days. Normal hatching patterns and success decreases acutely above and below the temperature range

(Mullan 1987).

Spawning Areas

Rearing habitat within the headwaters are sometimes limiting due to low productivity and low water temperatures.

Age Composition

Information pertaining to age composition, size, sex ratios, and eggs per females of wild spawning spring chinook is derived from Leavenworth returns. Because of scale erosion, age is based on length-frequency calculations.

Age for Icicle River spring chinook ranges from three-year-old jacks to six-year-old adults with four-year-olds and five-year-olds usually the dominant age classes. Icicle River spring chinook age composition data is summarized in Table 3. Table 5 lists the age composition percentages by return year and total age for spring chinook returning to Leavenworth Hatchery.

Sex Ratio

Information is limited to hatchery escapements. Jacks are entirely males. Four-year-old adults are predominately females and age-5 adults mostly males.

Fecundity

Fecundity ranged from 4,200-4,600 eggs per female at Leavenworth Hatchery during 1978-1981 (Mullan 1982).

JUVENILE LIFE HISTORY

Time of Emergence

No information is available on the naturally produced population. Artificial emergence (absorbed yolk-sac) at the hatcheries occurs in late November.

Time. aee and size at migration

Hatchery release information for the Wenatchee subbasin by brood year is presented in Table 10. Hatchery reared juveniles are customarily released as yearlings in April and May at 10-18 fish/pound and 120-150 mm in length. Median recapture data in the Columbia estuary for two coded wire tagged releases (1978 and 1979 brood) occurred about one month after release.

Survival Rate

No specific data is available for egg-to-fry or fry-to-smolt survival for wild spawners. Some estimates have been made, however, for egg-to-smolt survival. Based on a regression equation from the Data Standardization Report, egg-to-smolt survival ranges from 4.88 percent to 7.94 percent. Actual survival rates quite possibly are higher than this. Other estimates give a 10 percent to 20 percent range. It is thought that naturally produced fish survive at a greater rate than hatchery fish. A standard value of 26 percent was used for the modeling analysis.

DISEASE

Bacteria and parasitic diseases found in the Leavenworth Hatchery are listed in Table 11.

BIOCHEMICAL-GENETIC CHARACTERISTICS

Schreck et al. (1984) determined a statistically significant difference existed for one enzyme system in the returns to Leavenworth between their samples and the historical profile from Milner et al. (1983).

Table 1 (HB-1). Estimated amount of rearing and spawning habitat, by quality, of the Wenatchee River spring chinook production area.

Distance/Area	Excellent	Good	Fair[a]	Poor[a]	Unknown	Total	Confidence
Miles (%)		33	52	16		105.8	
Acres (%)		30	60	9		598.2	

[a] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/Absence database, NPPC, 1991.

Table 2 (HB-2). Estimated amount of rearing habitat, by quality, of the Wenatchee River spring chinook production area.

Distance/Area	Excellent	Good	Fair[a]	Poor[a]	Unknown	Total	Confidence
Miles (%)			100			38.7	
Acres (%)			100			281.2	

[a] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/Absence database, NPPC, 1991.

Table 3 **(RB-a).** Total escapement of spring chinook to the Icicle River by return year. 1/

	Total Age					
Return Year	3	4	5	6	Total	Adult Total
1979	65	704	1,408	0	2,177	2,112
1980	103	893	2,205	0	3,201	3,098
1981	37	1,101	1,496	0	2,634	2,597
1982	87	870	2,041	0	2,998	2,911
1983	36	2,388	988	0	3,412	3,376
1984	252	2,986	957	0	4,195	3,943
1985	249	5,668	2,121	0	8,038	7,789
1986	241	6,523	2,425	0	9,189	8,948
1987	171	3,130	4,490	0	7,791	7,620
1988	31	2,584	3,650	0	6,265	6,234
1989	87	3,802	1,233	14	5,136	5,049
1990	70	2,345	2,058	0	4,473	4,403

1/ Excludes wild spring chinook caught in the mainstem Wenatchee

Table 4 (RN-a). Total natural spawner escapement of spring chinook to the Icicle River by return year. 1/

Return Year	Total Age 3	4	5	6	Total	Adult Total
1979	11	115	229	*	355	344
1980	12	101	250	*	363	351
1981	1	30	41	*	72	71
1982	3	24	57	*	84	81
1983	0	43	17	*	60	60
1984	8	123	41	*	172	164
1985	11	127	117	*	255	244
1986	8	488	304	*	800	792
1987	6	305	489	*	800	794
1988	0	50	77	*	127	127
1989	0	41	17	0	58	58
1990	2	52	66	0	120	118

1/ Estimated as the larger of redds multiplied by 2.4 or adults from Leavenworth NFH released into mainstem Icicle River.

Leavenworth NFH age composition was used.

* All 6's included in the 5's column.

Table 5 (RH-a). Total hatchery returns of spring chinook to the Wenatchee subbasin by return year 1/.

Return Year	Total Age 3	4	5	6	Total	Adult Total
1979	54	589	1,179	*	1,822	1,768
1980	79	684	1,689	*	2,452	2,373
1981	26	1,015	1,379	*	2,420	2,394
1982	81	817	1,916	*	2,814	2,733
1983	18	1,994	826	*	2,838	2,820
1984	159	2,299	786	*	3,244	3,085
1985	99	2,142	1,054	*	3,295	3,196
1986	36	2,174	1,354	*	3,564	3,528
1987	26	1,196	1,920	*	3,142	3,116
1988	3	843	1,375	*	2,221	2,218
1989	3	1,652	657	12	2,324	2,321
1990	52	1,082	1,375	0	2,509	2,457

1/ Does not include tribal donations.

* All 6's included in the 5's column.

Table 6 (RS-a). Icicle River spring chinook sport catch by return year. 1/

	Total Age					
Return Year	3	4	5	6	Total	Adult Total
1980	7	59	147	*	213	206
1981	10	56	76	*	142	132
1982	3	29	68	*	100	97
1983	18	173	71	*	262	244
1984	80	260	89	*	429	349
1985	62	757	219	*	1,038	976
1986	64	1,057	122	*	1,243	1,179
1987	12	554	888	*	1,454	1,442
1988	7	497	442	*	946	939
1989	36	573	126	0	735	699
1990	10	347	99	0	456	446

1/ Harvest estimate in recent year from census; previous years from catch record cards.

* All 6's included in the 5's column.

Table 7 (RT-a). Icicle River spring chinook tribal harvest by return year.

Return Year	Total Age 3	4	5	6	Total	Adult Total
1987	66	375	603	*	1,044	978
1988	16	646	1,108	*	1,770	1,754
1989	38	1,162	304	0	1,504	1,466
1990	0	524	364	0	888	888

Table 8 (AE). Emigration of coded wire tagged spring chinook from the Wenatchee subbasin.

Hatchery/Release Site	Recovery site, Run **Year(s)**	Recovery Method	Number Sampled	Number Recovered	Total Number Estimated, (PSMFC)
Leavenworth	Carson, 1983	Hatchery	2494	1	1

Table 9 (AI). Immigration of coded wire tagged fall chinook into the Wenatchee subbasin.

Hatchery/Release Site	Recovery site, Run Year(s)	Recovery Method	Number Sampled	Number Recovered	Total Number Estimated, (PSMFC)
Dworshak	Leavenworth, 1989	Hatchery	2141	1	1
Priest Rapids	Leavenworth, 1989	Hatchery	2141	1	1
Priest Rapids	Leavenworth, 1989	Hatchery	2141	2	2
Priest Rapids	Leavenworth, 1989	Hatchery	2141	1	1
Wanapum	Leavenworth, 1989	Hatchery	2141	1	1
Wanapum	Leavenworth, 1989	Hatchery	2141	1	1
Wanapum	Leavenworth, 1989	Hatchery	2141	1	1
McNary	Leavenworth, 1989	Hatchery	2141	1	1
McNary	Leavenworth, 1989	Hatchery	2141		
McNary	Leavenworth, 1989	Hatchery	2141	1	1
McNary	Leavenworth, 1989	Hatchery	2141	1	1
McNary	Leavenworth, 1989	Hatchery	2141	1	1
McNary	Leavenworth, 1989	Hatchery	2141	1	1

Table 10 (TR). Hatchery releases of spring chinook salmon into the Wenatchee River subbasin sorted by brood year, hatchery and Life stage.

Brood Year	Stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /lb.	Number Released	Release Site	CWT Code
1982	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/23/84	04/23/84	15	2316500	ICICLE CR (45.0474)	UNTAGGED
1983	LEAVENWORTH HATCHERY	LEAVENUORTH HATCHERY	Fingr	01/30/84	01/30/84	639	368880	ICICLE CR (45.0474)	UNTAGGED
1983	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	01/30/84	01/30/84	639	368880	ICICLE CR (45.0474)	UNTAGGED
1983	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	04/06/84	04/06/84	436	626400	ICICLE CR (45.0474)	UNTAGGED
1983	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	07/09/84	07/09/84	43	203553	ICICLE CR (45.0474)	UNTAGGED
1983	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	07/09/84	07/09/84	43	203553	ICICLE CR (45.0474)	UNTAGGED
1983	LEAVENWORTH HATCHERY	LEAVENUORTH HATCHERY	Fingr	07/09/84	07/10/84	43	203553	ICICLE CR (45.0474)	UNTAGGED
1983	LEAVENUORTH HATCHERY	LEAVENUORTH HATCHERY	Fingr	01/12/84	01/12/84	709	310000	PESHASTIN CR 45.0232	UNTAGGED
1983	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	01/12/84	01/12/84	709	310000	PESHASTIN CR 45.0232	UNTAGGED
1983	LEAVENWORTH HATCHERY	LEAVENUORTH HATCHERY	Fingr	01/26/84	01/26/84	639	90320	PESHASTIN CR 45.0232	UNTAGGED
1983	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	01/26/84	01/26/84	639	90320	PESHASTIN CR 45.0232	UNTAGGED
1983	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/21/85	04/21/85	17	2200000	ICICLE CR (45.0474)	UNTAGGED
1983	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/21/85	05/15/85	17	2200000	ICICLE CR (45.0474)	UNTAGGED
1984	UIND R (CARSON NFH)	LEAVENUORTH HATCHERY	PreSm	10/29/85	10/29/85	22	24727	ICICLE CR (45.0474)	051258
1984	WIND R (CARSON NFH)	LEAVENWORTH HATCHERY	PreSm	10/29/85	10/29/85	22	1165	ICICLE CR (45.0474)	UNTAGGED
1984	WIND R (CARSON NFH)	LEAVENUORTH HATCHERY	PreSm	10/29/85	10/29/85	22	25695	ICICLE CR (45.0474)	051259
1984	WIND R (CARSON NFH)	LEAVENWORTH HATCHERY	PreSm	10/29/85	10/29/85	22	1211	ICICLE CR (45.0474)	UNTAGGED
1984	LEAVENUORTH HATCHERY	LEAVENUORTH HATCHERY	smott	04/23/86	04/23/86	17	1969668	ICICLE CR (45.0474)	UNTAGGED
1984	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/23/86	04/23/86	17	1969668	ICICLE CR (45.0474)	UNTAGGED
1985	UIND R (CARSON NFH)	LEAVENWORTH HATCHERY	Fingr	03/20/86	03/20/86	295	200100	ICICLE CR (45.0474)	UNTAGGED
1985	WIND R (CARSON NFH)	LEAVENWORTH HATCHERY	Fingr	03/20/86	03/20/86	295	200100	ICICLE CR (45.0474)	UNTAGGED
1985	WIND R (CARSON NFH)	LEAVENWORTH HATCHERY	Fingr	06/20/86	06/20/86	66	128964	ICICLE CR (45.0474)	UNTAGGED
1985	WIND R (CARSON NFH)	LEAVENWORTH HATCHERY	Fingr	06/20/86	06/20/86	66	128964	ICICLE CR (45.0474)	UNTAGGED
1985	WIND R (CARSON NFH)	LEAVENWORTH HATCHERY	Fingr	07/20/86	07/26/86	32	44800	ICICLE CR (45.0474)	UNTAGGED
1985	UIND R (CARSON NFH)	LEAVENWORTH HATCHERY	Fingr	07/26/86	07/26/86	32	44800	ICICLE CR (45.0474)	UNTAGGED
1985	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	07/26/86	07/26/86	29	104110	ICICLE CR (45.0474)	UNTAGGED
1985	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	07/26/86	07/26/86	29	104110	ICICLE CR (45.0474)	UNTAGGED
1985	LEAVENWORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	04/22/87	04/22/87	17	1527578	ICICLE CR (45.0474)	UNTAGGED
1985	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/22/87	04/22/87	17	1527578	ICICLE CR (45.0474)	UNTAGGED
1985	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/22/87	04/22/87	15	809290	ICICLE CR (45.0474)	UNTAGGED
1985	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/22/87	04/22/87	15	809290	ICICLE CR (45.0474)	UNTAGGED
1986	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	01/15/87	01/15/87	926	842000	ICICLE CR (45.0474)	UNTAGGED
1986	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	01/15/87	01/15/87	926	842000	ICICLE CR (45.0474)	UNTAGGED
1986	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	07/28/87	07/28/87	30	80900	ICICLE CR (45.0474)	UNTAGGED
1986	LEAVENUORTH RATCHERY	LEAVENWORTH HATCHERY	Fingr	07/28/87	07/28/87	30	80900	ICICLE CR (45.0474)	UNTAGGED
1986	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/20/88	04/20/88	16	46458	ICICLE CR (45.0474)	051706
1986	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/20/88	04/20/88	16	236950	ICICLE CR (45.0474)	UNTAGGED
1986	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/20/88	04/20/88	16	46719	ICICLE CR (45.0474)	051707
1986	LEAVENWORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	04/20/88	04/20/88	16	236772	ICICLE CR (45.0474)	UNTAGGED
1986	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/20/88	04/20/ 88	16	44688	ICICLE CR (45.0474)	051708
1986	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/20/88	04/20/88	16	239016	ICICLE CR (45.0474)	UNTAGGED
1986	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/20/88	04/20/88	16	48630	ICICLE CR (45.0474)	051709
1986	LEAVENUORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	04/20/88	04/20/88	16	235037	ICICLE CR (45.0474)	UNTAGGED
1986	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/20/88	04/20/88	16	33919	ICICLE CR (45.0474)	232318
1986	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	smott	04/20/88	04/20/88	16	34462	ICICLE CR (45.0474)	232319
1986	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/20/88	04/20/88	16	348	ICICLE CR (45.0474)	UNTAGGED
1986	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/20/88	04/20/88	16	34652	ICICLE CR (45.0474)	232320
1986	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/20/88	04/20/88	16	350	ICICLE CR i45.0474)	UNTAGGED
1986	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	smott	04/20/88	04/20/88	16	34212	ICICLE CR (45.0474)	232321
1986	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/20/88	04/20/88	16	698	ICICLE CR (45.0474)	UNTAGGED
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/22/88	04/22/88	53	32478	ICICLE CR (45.0474)	232322
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/22/88	04/22/88	53	799	ICICLE CR (45.0474)	UNTAGGED
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/22/88	04/22/88	53	32695	ICICLE CR (45.0474)	232323
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	smott	04/22/88	04/22/88	53	804	ICICLE CR (45.0474)	UNTAGGED
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/22/88	04/22/88	53	32822	ICICLE CR (45.0474)	232324

Table 10 (cont.). Hatchery releases of spring chinook salmon into the Wenatchee River subbasin sorted by brood year, hatchery and life stage.

Brood Year	Stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /lb	Number Released	Release Site		CWT Code
1987	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/22/88	04/22/88	53	24344 670	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENUORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	04/22/88	04/22/88	53		ICICLE CR	(45.0474)	232325
1987	LEAVENUGRTH HATCHERY	LEAVENWORTH HATCHERY	smott	04/22/88	04/22/88	45	28353 497	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENWGRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/16/88	05/16/88			ICICLE CR	(45.0474)	232326
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/16/88	05/16/88	45	757	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENWORTH HATCHERY	LEAVENUORTH HATCHERY	smott	05/16/88	05/16/88	45	27671	ICICLE CR	(45.0474)	232327
1987	LEAVENWRTH HATCHERY	LEAVENWGRTH HATCHERY	Smolt	05/16/88	05/16/88		739	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENWORTH HATCHERY	LEAVENUGRTH HATCHERY	Smolt	05/16/88	05/16/88	45	28632	ICICLE CR	(45.0474)	232328
1987	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	smott	05/16/88	05/16/88	45	825	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENUGRTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	05/16/88	05/16/88	45	29203	ICICLE CR	(45.0474)	232329
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/16/88	05/16/88		841	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	smott	04/19/89	04/19/89	21	47364	ICICLE CR	(45.0474)	051951
1987	LEAVENWORTH HATCHERY	LEAVENUORTH HATCHERY	smott	04/19/89	04/19/89	21	479803	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENWGRTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	04/19/89	04/19/89	21	47437	ICICLE CR	(45.0474)	051953
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/19/89	04/19/89	21	479451	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENWORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	04/19/89	04/19/89	21	48854	ICICLE CR	(45.0474)	051954
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/19/89	04/19/89	21	479898	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENUORTH HATCHERY	LEAVENUGRTH HATCHERY	smott	04/19/89	04/19/89	21	46646	ICICLE CR	(45.0474)	051957
1987	LEAVENWORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	04/19/89	04/19/89	21	480470	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	smott	04/19/89	04/19/89	8	95182	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89	19	32313	ICICLE CR	(45.0474)	232362
1987	LEAVENWORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	05/03/89	05/03/89	19	293	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENWORTH HATCHERY	LEAVENWRTH HATCHERY	smott	05/03/89	05/03/89	19	31960	ICICLE CR	(45.0474)	232363
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89	19	290	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89	19	31407	ICICLE CR	(45.0474)	232401
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89	19	285	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89	19	32784	ICICLE CR	(45.0474)	232402
1987	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89	19	298	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENVORTH HATCHERY	WELLS DAM SP CHANNEL	Smolt	04/22/88	04/22/88	44	27264	ICICLE CR	(45.0474)	232314
1987	LEAVENWORTH HATCHERY	WELLS DAM SP CHANNEL	Smolt	04/22/88	04/22/88	44	1195	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENWORTH HATCHERY	WELLS DAM SP CHANNEL	smott	04/22/88	04/22/88	44	28203	ICICLE CR	(45.0474)	232315
1987	LEAVENWORTH HATCHERY	WELLS DAM SP CHANNEL	smott	04/22/88	04/22/88	44	694	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENUORTH HATCHERY	WELLS DAM SP CHANNEL	Smolt	04/22/88	04/22/88	44	27840	ICICLE CR	(45.0474)	232316
1987	LEAVENWORTH HATCHERY	WELLS DAM SP CHANNEL	Smolt	04/22/88	04/22/88	44	950	ICICLE CR	(45.0474)	UNTAGGED
1987	LEAVENWORTH HATCHERY	WELLS DAM SP CHANNEL	Smolt	04/22/88	04/22/88	44	23000	ICICLE CR	(45.0474)	232317
1987	LEAVENWRTH HATCHERY	WELLS DAM SP CHANNEL	smott	04/22/88	04/22/88	44	398	ICICLE CR	(45.0474)	UNTAGGED
1988	LEAVENWORTH HATCHERY	LEAVENWURTH HATCHERY	Fingr	03/03/89	03/03/89	267	143000	ICICLE CR	(45.0474)	UNTAGGED
1988	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	03/03/89	03/03/89	267	143000	ICICLE CR	(45.0474)	UNTAGGED
1988	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	03/21/89	03/21/89	252	76000	ICICLE CR	(45.0474)	UNTAGGED
1988	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	03/21/89	03/21/89	252	76000	ICICLE CR	(45.0474)	UNTAGGED
1988	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	04/03/89	04/03/89	97	9120	ICICLE CR	(45.0474)	UNTAGGED
1988	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	04/03/89	04/03/89	97	9120	ICICLE CR	(45.0474)	UNTAGGED
1988	LEAVENWORTH HATCHERY	LEAVENWGRTH HATCHERY	Smolt	05/03/89	05/03/89	31	28227	ICICLE CR	(45.0474)	232358
1988	LEAVENWORTH HATCHERY	LEAVENWURTH HATCHERY	Smolt	05/03/89	05/03/89	31	754	ICICLE CR	(45.0474)	UNTAGGED
1988	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89	31	29522	ICICLE CR	(45.0474)	232359
1988	LEAVENWORTH HATCHERY	LEAVENWCRTH HATCHERY	Smolt	05/03/89	05/03/89	31	788	ICICLE CR	(45.0474)	UNTAGGED
1988	LEAVENWGRTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89	31	28193	ICICLE CR	(45.0474)	232360
1988	LEAVENWGRTH HATCHERY	LEAVENWURTH HATCHERY	Smolt	05/03/89	05/03/89	31	753	ICICLE CR	(45.0474)	UNTAGGED
1988	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89	31	28908	ICICLE CR	(45.0474)	232361
1988	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89	31	772	ICICLE CR	(45.0474)	UNTAGGED
1988	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89	57	31809	ICICLE CR	(45.0474)	232403
1988	LEAVENWGRTH HATCHERY	LEAVENMRTH HATCHERY	smott	05/03/89	05/03/89	57	649	ICICLE CR	(45.0474)	UNTAGGED
1988	LEAVENWORTH HATCHERY	LEAVENWGRTH HATCHERY	Smolt	05/03/89	05/03/89	57	30510	ICICLE CR	(45.0474)	232404
1988	LEAVENWORTH HATCHERY	LEAVENWGRTH HATCHERY	Smolt	05/03/89	05/03/89	57	623	ICICLE CR	(45.0474)	UNTAGGED
1988	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89	57	31331	ICICLE CR	(45.0474)	232405

Table 10 (cont.). Hatchery releases of spring chinook salmon into the Wenatchee River subbasin sorted by brood year, hatchery and life stage.

Brood Year	stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /lb	Number Released	Release Site	CWT Code
1988	LEAVENWORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	05/03/89	05/03/89	57	30782 639	ICICLE CR (45.0474)	UNTAGGED
1988	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89			ICICLE CR (45.0474)	232406
1988	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89	57	628	ICICLE CR (45.0474)	UNTAGGED
1988	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89	40	14731	ICICLE CR (45.0474)	232407
1988	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	05/03/89	05/03/89	40	14815 316	ICICLE CR (45.0474)	UNTAGGED
1988	LEAVENUORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	05/03/89	05/03/89			ICICLE CR (45.0474)	232408
1988	LEAVENUORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	05/03/89	05/03/89	40	318	ICICLE CR (45.0474)	UNTAGGED
1988	LEAVENUORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	05/03/89	05/03/89	40	14695	ICICLE CR (45.0474)	232409
1988	LEAVENWORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	05/03/89	05/03/89	40	315	ICICLE CR (45.0474)	UNTAGGED
1988	LEAVENUORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	05/03/89	05/03/89	40	14939	ICICLE CR (45.0474)	232410
1988	LEAVENWORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	05/03/89	05/03/89		320	ICICLE CR (45.0474)	UNTAGGED
1988	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/18/90	04/18/90	18	44207	ICICLE CR (45.0474)	052136
1988	LEAVENUORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	04/18/90	04/18/90	18	44599	ICICLE CR (45.0474)	UNTAGGED
1988	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/18/90	04/18/90	18	527072	ICICLE CR (45.0474)	052137
1988	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/18/90	04/18/90			ICICLE CR (45.0474)	UNTAGGED
1988	LEAVENWORTH HATCHERY	LEAVENUORTH HATCHERY	Smolt	04/18/90	04/18/90	18	47644	ICICLE CR (45.0474)	052138
1988	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/18/90	04/18/90	18	524771	ICICLE CR (45.0474)	UNTAGGED
1988	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/18/90	04/18/90	18	47539	ICICLE CR (45.0474)	052139
1988	LEAVENUORTH HATCHERY	LEAVENWORTH HATCHERY	Smolt	04/18/90	04/18/90	18	524687	ICICLE CR (45.0474)	UNTAGGED
1989	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	EmFry	12/19/89	12/19/89	2268	128520	ICICLE CR (45.0474)	UNTAGGED
1989	LEAVENWORTH HATCHERY	LEAVENUORTH HATCHERY	EmFry	12/21/89	12/21/89	2268	275400	ICICLE CR (45.0474)	UNTAGGED
1989	LEAVENWRTH HATCHERY	LEAVENWRTH HATCHERY	EmFry	12/21/89	12/21/89	2268	359280	ICICLE CR (45.04741	UNTAGGED
1989	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	EmFry	12/22/89	12/22/89	2268	442620	ICICLE CR (45.0474)	UNTAGGED
1989	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	EmFry	12/26/89	12/26/89	2268	588036	ICICLE CR (45.0474)	UNTAGGED
1989	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	05/04/90	05/04/90	46	121038	ICICLE CR (45.0474)	635919
1989	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	Fingr	05/04/90	05/04/90	46	12962	ICICLE CR (45.0474)	UNTAGGED
1989	LEAVENUORTH HATCHERY	LEAVENWRTH HATCHERY	PreSm	12/19/89	12/19/89	2268	128520	ICICLE CR (45.0474)	UNTAGGED
1989	LEAVENWRTH HATCHERY	LEAVENWRTH HATCHERY	PreSm	12/21/89	12/21/89	2268	275400	ICICLE CR (45.04744)	UNTAGGED
1989	LEAVENWRTH HATCHERY	LEAVENUORTH HATCHERY	PreSm	12/21/89	12/21/89	2268	359280	ICICLE CR (45.0474)	UNTAGGED
1989	LEAVENWRTH HATCHERY	LEAVENWORTH HATCHERY	PreSm	12/22/89	12/22/89	2268	442620	ICICLE CR (45.0474)	UNTAGGED
1989	LEAVENWORTH HATCHERY	LEAVENWORTH HATCHERY	PreSm	12/26/89	12/26/89	2268	588036	ICICLE CR (45.0474)	UNTAGGED

Table 11 (TD-1). Parasites and diseases of spring chinook at the Leavenworth hatchery.

Disease type	Hatchery	Specific Pathogen
Bacteria	Leavenworth	*Renibacterium salmoninarum* (Bacterial Kidney Disease)
Parasite	Leavenworth	*Ichthyophthirius multifilis* (Ichthyopthirius)

Disease history only represents pathogens isolated at the hatchery and not necessarily a disease outbreak.

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WENATCHEE SUBBASIN

Summer Chinook

GEOGRAPHIC LOCATION

The Wenatchee watershed drains a portion of the east Cascade Mountains in north central Washington within Chelan County. The mainstem flows generally in a southeasterly direction, emptying into the Columbia River at river mile (RM) 468.4. The watershed encompasses approximately 1,327 square miles, with 230 miles of major streams and rivers. The watershed originates in high mountainous regions of the Cascade crest, with numerous tributaries draining subalpine regions within the Alpine Lakes and Glaciers Peak Wilderness areas. The Little Wenatchee and White rivers flow into Lake Wenatchee, the source of the Wenatchee River. From the lake outlet (RM 54.2) the river descends rapidly through Tumwater Canyon, dropping into a lower gradient section in the region of Leavenworth, where Icicle Creek joins the mainstem (RM 25.6). Other major tributaries include Mission, Peshastin, Chumstick and Chiwaukum Creeks, Chiwawa River and Nason Creek (Hydrology Subcommittee 1964). Leavenworth National Fish Hatchery is located on Icicle River at river mile 2.8.

ORIGIN

Prior to hydroelectric dam development, summer chinook migrated as far as Windermere Lake in British Columbia (Fulton 1968). Immediately prior to the completion of Grand Coulee Dam in 1941, the summer chinook runs destined for the upper most reaches of the Columbia River were intercepted at Rock Island Dam (1939-1941) with some being transplanted into the Wenatchee subbasin. Native summer chinook runs were virtually eliminated by the time of the relocation program. Historical affidavits and other records indicate a negligible native run returned to the Wenatchee system (J. Mullan, USFWS, personal communication).

DISTRIBUTION

Spawning of summer chinook occurs from river mile 3.5 to river mile 46.2.

PRODUCTION

Initial artificial propagation of summer chinook in the Wenatchee subbasin began in 1941 at Leavenworth Hatchery on the Icicle River. Nearly all releases were fry and varied in number from 1,200 in 1956 to a peak release of 2,854,000 in 1965 (Mullan 1987).

Summer chinook carrying capacity for the Wenatchee River Basin is estimated to be 2,960,504 smolts. The above estimate was derived from methodology described in the Northwest Power Planning Council's Data Standardization Report. The estimate may not be reliable due to the inability to effectively quantify and qualify the habitats and the relationships of organisms within these microhabitats.

The maximum number of adult summer chinook spawning naturally in the Wenatchee River from 1979-1990 return years averaged 8,678, with the low return estimated to have been 3,937 for the 1983 return year, and a peak of 12,764 for the 1989 return year. The maximum escapement estimates are derived by subtracting Rock Island Dam counts from Rocky Reach Dam counts. Wenatchee River summer chinook natural spawn escapement is available in Table 2.

Table 1 describes the amount of spawning and rearing habitat, by quality, available in the Wenatchee subbasin. This data was derived from the Presence/Absence database of the Northwest Power Planning Council, 1991.

ADULT LIFE HISTORY

Run size. catch and escapement

Ocean commercial and recreational fisheries from Alaska to Washington all harvest a portion of the Wenatchee River summer chinook. No directed fisheries on Wenatchec summer chinook have occurred in the Columbia River system since the mid-1970's.

Time of Migration

Summer chinook migration begins in late May or early June with peak counts at Bonneville Dam during early July. Approximately 50 percent if the upper Columbia run has migrated past Priest Rapids Dam in mid-July.

Spawning Period

Spawning occurs during late September through early November.

Spawning Areas

Spawning occurs in the middle and upper reaches of the Wenatchee River.

Age Composition

Age structure of summer chinook in the Wenatchee River Basin is predominately four-year-old and five-year-old fish.

Sex Ratio

The sex ratio is unknown, but may resemble that of Wells Dam Hatchery summer chinook stock.

Fecundity

No information is available on the naturally produced population. Based on Wells Dam Hatchery spawning reports, average fecundity was 4,935 eggs per female during 1978-1982.

JUVENILE LIFE HISTORY

Time of Emergence

Juveniles emerge from mid-February through mid-April and rear in the Wenatchee River, (and most likely the Columbia River too) as they migrate as young of the year. Emigration and rearing may occur at the same time, however, the greatest emigration occurs June through July.

Time. age and size at migration

Juvenile summer chinook in the Wenatchee system generally migrate downstream during June through October of their first year (J. Easterbrooks, WDF, personal communication), although about half of the returning adults appear to have migrated as yearlings, based on scale analysis (J. Fryer, personal communication.

Survival Rate

Egg-to-smolt survival rates are not fully known at this time, however, a 30 percent survival rate was cited in the Rock Island Settlement Agreement. It is believed that egg-to-smolt survival rates are density dependent (Data Standards Report), therefore an accurate estimate of seeding rate would allow a determination of survival rates for varying escapement years. Presently the seeding rate of summer chinook is unknown for the Wenatchee River Basin. Smolt-to-adult survival rate is expected to be greater than the hatchery production rate of 0.3 percent to 0.6 percent (Stock Assessment Report).

DISEASE

No data available.

BIOCHEMICAL-GENETIC CHARACTERISTICS

Schreck et al. (1984) compared isozyme gene frequencies of seven enzyme systems from Wells Hatchery production samples to natural production samples collected in the Wenatchee, Methow, and Okanogan systems. In paired statistical comparisons, gene frequency profiles were similar for all seven enzyme systems between Wells Hatchery production and the natural production in the Wenatchee and Methow rivers.

Table 1 **(HB-1).** Estimated amount of rearing and spawning habitat, by quality, of the Wenatchee River summer chinook production area.

Distance/Area	Excellent	Good	Fair[a]	Poor[a]	Unknown	-Total	Confidence
Miles (%)		87	13			41.5	
Acres (%)		86	14			302.0	

[a] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/Absence database, NPPC , 199 1.

Table 2 (RN-a). Total natural spawner escapement of summer chinook to the Wenatchee River subbasin by return year. 1/

Return Year	Total
1979	12,623
1980	8,995
1981	4,515
1982	4,113
1983	3,937
1984	8,420
1985	9,185
1986	10,021
1987	9,831
1988	10,389
1989	12,764
1990	9,343

1/ Rock Island Dam and Rocky Reach Dam count difference.

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WENATCHEE SUBBASIN

Sockeye

GEOGRAPHIC LOCATION

The Wenatchee watershed drains a portion of the east Cascade Mountains in north central Washington within Chelan County. The mainstem flows generally in a southeasterly direction, emptying into the Columbia River at river mile (RM) 468.4. The watershed encompasses approximately 1,327 square miles, with 230 miles of major streams and rivers. The watershed originates in high mountainous regions of the Cascade crest, with numerous tributaries draining subalpine regions within the Alpine Lakes and Glaciers Peak Wilderness areas. The Little Wenatchee and White rivers flow into Lake Wenatchee, the source of the Wenatchee River. From the lake outlet (RM 54.2) the river descends rapidly through Tumwater Canyon, dropping into a lower gradient section in the region of Leavenworth, where Icicle Creek joins the mainstem (RM 25.6). Other major tributaries include Mission, Peshastin, Chumstick and Chiwaukum Creeks, Chiwawa River and Nason Creek (Hydrology Subcommittee 1964). Leavenworth National Fish Hatchery is located on Icicle River at river mile 2.8.

ORIGIN

With the construction of the Grand Coulee Dam in 1939, access to 1,140 miles of the upper Columbia River by anadromous salmonids was lost, and upper Columbia sockeye production was almost completely limited to the Okanogan and Wenatchee systems. Beginning in 1939, sockeye were collected at Rock Island Dam and either transferred to Lake Wenatchee and Lake Osoyoos for natural propagation, or to three recently constructed hatcheries on the Wenatchee, Entiat and Methow rivers. Sockeye production at the Leavenworth NFH occurred from 1941 to 1969.

DISTRIBUTION

Wenatchee River natural production of sockeye occurs in the lower reach of the Little Wenatchee, the lower reach of the White River, and the Napeequa River, (a tributary to the White River). In the 1960's production was also reported in Nason Creek (Mullan, 1984).

PRODUCTION

Beginning in 1939, and continuing until 1943, sockeye were trapped at Rock Island Dam for relocation to three national fish hatcheries (Leavenworth, Entiat, and Winthrop). Releases of sockeye smolts occurred from 1941 through 1969, with all three Grand Coulee Fish Maintenance Project hatcheries contributing to the Wenatchee River Basin. The Leavenworth facility continued to rear sockeye up until 1969 when it was decided to abandon sockeye propagation due to a number of factors including losses from IHN. Mullan (1986) contends that the effects of artificial propagation of sockeye salmon in the Columbia River were not inconsequential, indicating that hatchery production composed as much as 98 percent of the return in some years. Wenatchee sockeye are presently managed on a natural stock basis.

The Wenatchee River sockeye natural spawn escapement from 1977-1990 return years averaged 29,917 with a low return of 6,500 for the 1978 return and a peak of 64,700 for the 1977 return. Natural spawn escapements by return year are presented in Table 1.

Since 1970, recreational harvests on sockeye occurred only in 1984, 1985, 1987, and 1990-1992 in

Lake Wenatchee. Beginning in 1986 permanent sport sockeye fishery regulations were adopted for Lake Wenatchee. The run is tracked closely in-season to determine if regulation modifications should occur.

ADULT LIFE HISTORY

Run size, catch and escapement

Sockeye are not harvested in significant numbers in ocean fisheries. Limited non-treaty and treaty commercial gillnet fisheries as well as subsistence net fisheries and the Lake Wenatchee sport fishery all harvest a portion of the Lake Wenatchee origin sockeye. No commercial season has occurred since 1988.

Time of Migration

Upstream migration commences in late May and early June with counts at Bonneville Dam increasing sharply in late June. Approximately 50 percent of the run has migrated past Bonneville Dam by early July and past Priest Rapids Dam about ten days later. Sockeye reach Lake Wenatchee in July and August (Mullan 1984). In 1991, sockeye initially passed Tumwater Dam on the Wenatchee River on July 22 and reached a peak count on August 1 (Hatch et al. 1992).

Spawning Period

Spawning activity peaks in the Wenatchee River about the third week of September (H. Fiscus, WDF, personal communication).

Spawning Areas

Principal spawning areas for Wenatchee River sockeye is in the lower 3.5 mile reach of the Little Wenatchee River and in the lower 5 miles of the White River at the upper end of Lake Wenatchee (river mile 58.6). Some incidental spawning occurs in Napeequa River (White River tributary).

Age Composition

Wenatchee River sockeye are primarily four-year-olds in most years, but in some years five year old fish predominate. (Fryer et al. 1992).

Sex Ratio

Information is very limited. The sex ratio of carcasses is highly variable and dependent on the proximity to suitable riffles and, consequently, representative samples are difficult to obtain (Fiscus 1984). Wenatchee sockeye sampled in 1972 were almost exclusively four-year-old and five-year-old fish and predominately females (70 percent) (Allen and Meekin 1973).

Fecundity

Based on Leavenworth, Entiat, and Winthrop hatchery records between 1944 and 1964, fecundity averaged about 2,600 eggs per female (Mullan 1984).

JUVENILE LIFE HISTORY

Time of Emergence

Emergent fry were collected from the Little Wenatchee and White rivers in April (Allen and Meekin 1973).

Time. age and size at migration

After rearing in the nursery lake for about a year, sockeye yearlings begin a rapid migration to the ocean. A small number of sockeye may remain in the nursery lake for an extra year. Between 1949-1953, yearlings comprised 93 percent of the smolts sampled at Bonneville Dam (Anas and Gauley 1956; as reported in Mullan 1984). From Leavenworth Hatchery reports, smolt migration past Tumwater Dam (river mile 32) on the Wenatchee River commenced in mid-April and continued for about a month (Mullan 1984). Based on mark recoveries of branded sockeye smolts, arrival in the Columbia estuary occurs about 2 weeks after passing McNary Dam (Dawley et al. 1982).

Survival Rate

Egg-to-smolt survival from information collected from 1970 through 1976 indicated a range of 1.7 percent to 12.3 percent, with an average of 5.5 percent. Smolt-to-adult survival for 1973, 1974, and 1975 were 1.7 percent, 2.0 percent, and 0.7 percent, respectively.

DISEASE

Hatchery production was discontinued partly because of the catastrophic losses from infectious hematopoietic necrosis (Mullan 1984). Sockeye are common carriers of this virus.

BIOCHEMICAL-GENETIC CHARACTERISTICS

Information on Wenatchee and Okanogan sockeye is negligible. May and Utter (1974), as reported in Mullan (1984), found different variants of allelic frequencies for two enzyme between some individual Wenatchee and Okanogan samples, indicating possible genetic differentiation.

Table 1 (RN-a). Total natural spawner escapement of sockeye to the Wenatchee River subbasin by return year.1/

Return Year	Total
1977	64,700
1978	6,500
1979	21,700
1980	22,800
1981	16,500
1982	23,700
1983	60,300
1984	35,800
1985	49,100
1986	16,900
1987	29,636
1988	15,100
1989	21,200
1990	34,900

1/ Rock Island Dam and Rocky Reach Dam count difference.

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WENATCHEE RISER SUBBASIN

Naturally Produced Summer Steelhead

GEOGRAPHIC LOCATION

The Wenatchee River subbasin is located in north central Washington within Chelan county. The Wenatchee subbasin originates high in the Cascade mountains where numerous streams and creeks drain the upper subbasin into Lake Wenatchee, the source for the Wenatchee River. Once the Wenatchee River leaves Lake Wenatchee it descends rapidly through Tumwater Canyon, leaving the canyon and heading in a southeasterly direction, the Wenatchee River flows through the town of Leavenworth before joining the Columbia River at river mile (RM) 468.4. Major tributaries include Little Wenatchee, Chiwawa and White Rivers, plus Icicle, Mission, Peshastin, Chumstick, Chiwaukum and Nason creeks. The Wenatchee Subbasin drains a watershed of approximately 1,327 square miles.

ORIGIN

The wild summer steelhead in the Wenatchee River is native, although interbreeding has likely occurred with Wells hatchery-stock. From 1939 through 1943 all adult steelhead bound for the upper Columbia were trapped at Rock Island Dam and distributed into the Methow, Entiat and Wenatchee rivers. Thus, Wenatchee River steelhead were mixed with other steelhead stocks of the upper Columbia River.

DISTRIBUTION

Table 1 lists rearing and spawning habitat, by quality, for Wenatchee River steelhead based on estimates from the Northwest Power Planning Council.

Table 2 lists estimated amount of rearing/spawning hatitat and potential smolt production for the Wenatchee River based on Washington Department of Wildlife gradient, area and flow methodology.

Distribution of summer steelhead is spread throughout the entire Wenatchee River subbasin (Figure 1). However, numerous irrigation diversions on tributaries below Leavenworth may restrict steelhead distribution. Much of the subbasin above the town of Leavenworth lies within the Wenatchee National Forest and is generally free from obstacles restricting steelhead distribution.

PRODUCTION

<u>Production Facilities</u>

Leavenworth National Fish Hatchery is located on Icicle Creek, a tributary of the Wenatchee River just outside the town of Leavenworth. Althought primarily a chinook salmon hatchery, Washington Department of Wildlife provides Leavenworth Hatchery with 150,000 steelhead eggs annually for incubation and rearing. The goal is to release 100,000 smolts annually into Icicle Creek.

<u>Production Summary</u>

No data are available on wild smolt production. Natural production continues in both the mainstem Wenatchee River and throughout many tributaries including: Mission, Peshastion, Icicle, Chiwaukum and Nason creeks and in the Little Wenatchee, White and Chiwawa rivers. Although exact numbers on smolt production are unknown, fish production has declined from past levels.

Production constraints would include the seven Columbia River dams which steelhead encounter during their migration to and from the ocean.

ADULT LIFE HISTORY

Run Size and Escapement

The Wenatchec River is considered a major producer of steelhead in the mid-Columbia. In the early 1960s as many as 3,000 wild steelhead were estimated to return to the Wenatchee River annually (Brown 1985). Annual counts of steelhead at Rock Island Dam averaged 2,780 fish for the 1930s, 2,605 fish for the 1940s and 3,722 fish for the 1950s with these numbers representing the combined return of all steelhead to all upper Columbia subbasins (Methow, Okanogan, Wenatchee, Entait and upper-Columbia rivers). Presently, estimates of wild steelhead escapement is based on the difference between Rock Island and Rocky Reach dam counts. Escapement was estimated at 374 wild fish annually within the subbasin from 1977 through 1987. Wild steelhead escapement has increased in recent years with escapement estimates of 820 steelhead and 1,041 steelhead for return years 1986 and 1987, respectively (sport fishing regulations were changed in 1986 requiring release of wild steelhead, allowing legal harvest of only hatchery steelhead).

Table 3 presents steelhead escapement and sport catch for wild steelhead from 1977 through 1990. Table 4 outlines hatchery steelhead escapement and sport catch from 1977 through 1990.

Harvest

No estimate for the ocean harvest of Wenatchee steelhead is available.

No estimate is available for Wenatchee River steelhead harvested in the Columbia River, although the Columbia River fishery harvests a large number of steelhead including some Wenatchee River fish.

An average of 871 hatchery steelhead were harvested in the Wenatchee subbasin sport catch for 1977 through 1987 based on permit-card harvest estimates (Table 2). Sport catch of wild steelhead averaged 57 fish annually from 1977 through 1985 with zero catch starting in 1986 due to "wild" fish release regulations. Regulations designed to protect and increase escapement of wild steelhead were implemented in 1986. Included in the current regulations, only hatchery steelhead can be legally retained, certain areas of the subbasin are either closed to steelhead fishing or fishing with bait is prohibited.

Time of migration

Based on observations of Wahle and French (1959) wild fish bound for the Wenatchee River enter the Columbia River between June and August. Steelhead begin entering the Wenatchee River in mid August, peaking in late September to early October and ending in November.

Spawning period

Spawning begins in March, peaking in May and ending in June.

Spawning area

Wild steelhead spawn throughout the subbasin including the mainstem Wenatchee, Little Wenatchee, White and Chiwawa rivers plus Mission, Peshastin, Icicle, Chiwaukum and Nason creeks.

Fecundity

No data for wild steelhead.

Aee Composition

Limited data on age structure. Age data from steelhead crossing Rock Island Dam showed 9.3 percent wild fish for 1986, 25.9 percent wild fish for 1987, 20.2 percent wild fish for 1988 and 24.8 percent wild fish for 1989, 18.0 percent wild fish for 1990, and 17.0 percent wild fish for 1991 (Brown 1992).
Individual age classes for hatchery and wild steelhead from 1979 and 1980 return years is presented in Table 5.

Size

No data are available on wild steelhead size.

Sex ratio

No data on sex ratio of wild steelhead.

Survival Rate

No data on wild steelhead smolt to adult survival.

JUVENILE LIFE HISTORY

Emergence

No data are available on wild steelhead.

Egg

No data on egg production although estimate of 1.7 percent for egg to smolt survival (Wenatchee Subbain Plan 1990).

Juvenile rearing

Juvenile rearing for wild smolts last between two and seven years with a mean age of 2.63 (Pevan 1990) based on smolt sampling from 1988 through 1990. Most smolts outmigrate in April through mid-June, peaking in early May. Estimates on smolt size range from 170 to 200 mm.

Hatchery releases

Steelhead releases into the Wenatchee subbasin occurred as early as 1933 and consisted of small fry. In 1963, the Washington Department of Wildlife and Chelan County Public Utility District #1 entered into a 50 year legal agreement to mitigate fish losses incurred from the installation of Rocky Reach Dam. The agreement required Chelan County PUD to fund construction and operation of a hatchery with a production of 195,000 steelhead smolts annually. The hatchery production results in approximately 155,000 smolts released annually into the Wenatchee Subbasin (Table 6) while the remaining 40,000 smolts are released into the Entiat River. In addition, Washington Department of Wildlife has provided up to 150,000 eyed-eggs to Leavenworth Hatchery for hatching and grow out. Unfortunately, low water temperatures at Leavenworth Hatchery has resulted in poor survival of these fish. Eastbank Hatchery, as a result of the Rock Island Dam settlement, also rears up to 180,000 steelhead smolts for release into the Wenatchee Subbasin.

Straying

No data are available on Wenatchee steelhead.

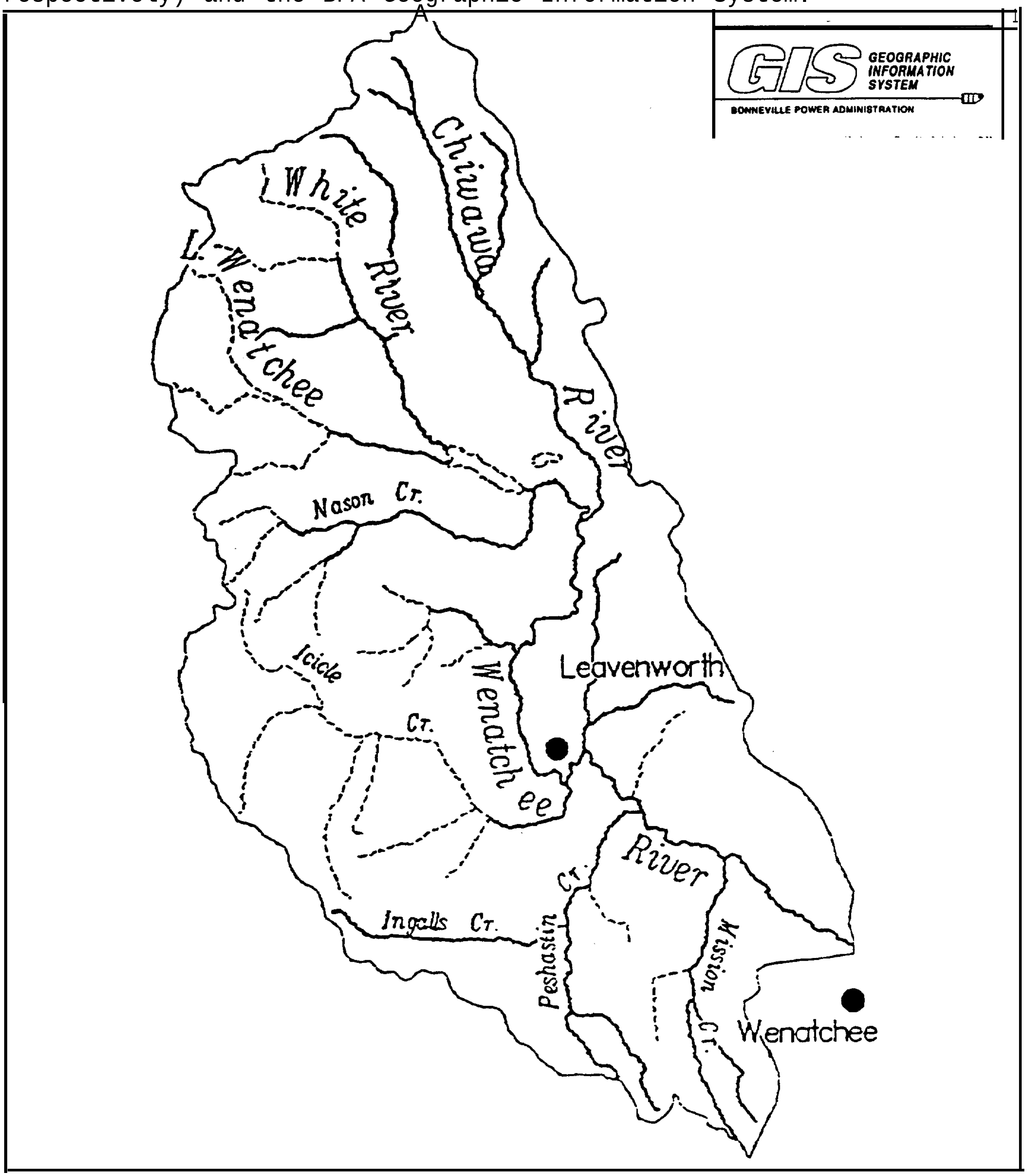
BIOCHEMICAL-GEN-ETIC CHARACTERISTICS

No data are available on Wenatchee steelhead.

DISEASES

Disease history for hatchery smolts planted in the Wenatchee River is presented in Table 7.

Figure 1. Summer steelhead distribution in the Wenatchee River subbasin based on the NPPC presence\absence data base (solid and dashed line respectively) and the BPA Geographic Information System.



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

Table 1 (HB-1). Estimated* amount of rearing and spawning habitat, by quality, of Wenatchee River **subbasin** summer steelhead.

Area	Excellent	Good	**Fair**[B]	**Poor**[B]	Unknown	Total	Confidence
Miles	0.0%	24.3%	65.5%	10.2%		202.5	Unknown
Acres	0.0%	18.7%	78.4%	2.9%		1967.0	Unknown

*Northwest Power Planning Council estimates based on limited observations.
[B]**Ratings** of fair and poor habitat quality may reflect natural physical features such as waterfall barriers as well as degradation caused by man.

Source: Presence/absence database, NPPC , 199 1.

Table 2 (HB-2). Estimated amount of spawning/rearing habitat and potential steelhead production for the Wenatchee River. Based on the gradient, area and flow methodology (GAFM).

Water Name	From	To	Length miles	Width feet	Gradient	Area (ha)	Parr Potential
Wenatchee R	mouth	Mission Cr	10.6	197	0.36	102.3	16,263
Mission Cr	mouth	Sand Cr	6.9	13	2.47	4.3	13,079
Sand Cr	mouth	headwaters	6.0	6	2.47	0.9	3,977
Mission Cr	Sand Cr	East Fork	2.5	13	2.47	1.5	5,150
EF Mission	mouth	headwaters	8.8	6	2.47	1.3	5,079
Mission Cr	East Fork	headwaters	9.7	13	2.47	2.4	6,786
Wenatchee R	Mission Cr	Peshastin Cr	7.4	197	0.36	71.4	12,363
Peshastin Cr	mouth	Diversion	3.1	36	1.84	5.5	8,130
Peshastin Cr	Diversion	Ingalls Cr	5.9	36	1.84	10.5	15,274
Ingalls Cr	mouth	headwaters	16.1	37	4.02	8.5	19,805
Peshastin cr	Ingalls Cr	Tronsen Cr	4.7	18	2.9	4.1	15,120
Tronsen Cr	mouth	headwaters	9.4	6	2.65	0.3	1,134
Peshastin Cr	Tronsen Cr	headwaters	5.7	18	1.9	2.1	4,318
Wenatchee R	Peshastin cr	Derby Canyon	1.1	197	0.36	10.6	1,745
Derby Canyon	mouth	headwaters	6.6	0	0	0	0
Wenatchee R	Derby Canyon	Chumstick Cr	4.5	197	0.36	43.4	7,518
Chumstick Cr	mouth	Eagle Cr	1.9	8	1.3	0.7	1,611
Eagle Cr	mouth	headwaters	10.3	4	1.3	0.2	588
Chumstick Cr	Eagle Cr	headwaters	11.5	6	1.3	1.4	3,310
Wenatchee R	Chumstick	Icicle Cr	2.1	197	0.36	20.3	3,172
Icicle Cr	mouth	FWS Dam	2.8	62	0.18	8.5	1,014
Wenatchee R	Icicle Cr	Tumwater	1.3	197	0.36	20.3	2,172
Wenatchee R	Tumwater	Chiwaukum Cr	9.0	155	1.09	68.3	35,711
Chiwaukum Cr	mouth	headwaters	10.2	42	3.51	7.1	16,283

Table 2 (cont.) Estimated amount of spawning/rearing habitat and potential steelhead production. for the Wenatchee River. Based on the gradient, area and flow methodology (GAFM).

Water Name	From	To	Length miles	Width feet	Gradient	Area (ha)	Parr Potential
Wenatchee R	Chiwaukum Cr	Chiwawa R	12.5	157	0.21	96	9,954
Chiwawa R	mouth	Alder Cr	6.9	105	0.73	35.5	16,982
Alder Cr	mouth	headwaters	5.9	8	5.3	0.4	1,944
Chiwawa R	Alder Cr	Chikamin Cr	6.9	105	0.73	35.5	15,482
Chikamin Cr	mouth	headwaters	7.4	28	2.23	4.8	9,017
Chiwawa R	Chikamin Cr	Rock Cr	7.5	85	0.39	31.2	8,368
Rock Cr	mouth	headwaters	11.7	24	2.57	2.9	6,404
Chiwawa R	Rock Cr	Phelps Cr	8.9	55	0.39	24.2	7,788
Phelps Cr	mouth	headwaters	8	30	8.87	0.9	3,268
Chiwawa R	Phelps Cr	Buck Cr	2.8	55	0.39	7.6	2,450
Buck Cr	mouth	headwaters	3.3	15	7.57	0.4	1,245
Chiwawa R	Buck cr	headwaters	3.3	85	11.47	1.4	2,179
Wenatchee R	Chiwawa R	Nason cr	5.2	157	0.21	39.9	4,545
Nason Cr	mouth	Roaring Cr	9.3	71	0.44	32.2	10,469
Roaring Cr	mouth	headwaters	5.2	15	4.5	0.6	1,818
Nason Cr	Roaring Cr	Whitepine Cr	6.1	64	0.98	19.1	13,341
Whitepine Cr	mouth	headwaters	9.4	30	5.55	4.8	12,314
Nason Cr	Whitepine Cr	headwaters	9.8	95	2.52	10.9	13,248
Wenatchee R	Nason Cr	Lake Wenatchee	0.6	157	0.21	4.6	555
Wenatchee R	Lake Wenatchee	Lake Interior	4.4	0	0	0	0
White R	Lake Wen	Napeequa R	11.0	87	0.11	47.1	3,181
Napeequa R	mouth	headwaters	16.4	34	2.81	5.5	11,082
White R	Napeequa R	Panther Cr	2.1	74	0.72	7.6	3,814
Panther Cr	mouth	headwaters	6.8	20	6	0.9	3,182
White Cr	Panther Cr	Falls	1.2	113	0.72	6.6	2,772
Little Wenatchee R	Lake Wenatchee	Rainy Cr	7.9	78	0.34	27.6	6,731

Total Potential Parr = 372,073.
Total Potential Smolts = 62,167.

Based on a 5 % smolt to adult survival 62,167 smolts = a potential 3,108 adults.

Source: Larry Brown, Washington Department of Wildlife, Wenatchee River Survey, 1991.

Table 3 **(RB-a).** Returns (sport catch and escapement) of wild summer steelhead to the Wenatchee River subbasin.

Return Year	Escapement[A]	Sport Catch[B]	Adult Total
1977	36	67	103
1978	104	19	123
1979	58	52	108
1980	47	93	140
1981	30	46	76
1982	125	46	71
1983	651	157	808
1984	533	75	608
1985	671	68	739
1986	820	0	820
1987	1,041	0	1,041

*Escapement estimates based on differential of number of wild fish counted between Rock Island and Rocky Reach dams.

[B]Sport catch within subbasin only.

Source: Larry Brown, Washington Department of Wildlife, Estimates of Run Sizes, Oct. 1991. Sport catch based on permit-card harvest estimates.

Table 4 **(RB-b).** Returns (sport catch and escapement) of hatchery steelhead to the Wenatchee Subbasin.

Return Year	Escapement[A]	Sport Catch[B]	Adult Total
1977	612	1,123	1,735
1978	152	281	433
1979	1,129	1,026	2,155
1980	713	1,408	2,121
1981	505	780	1,285
1982	2,113	784	2,897
1983	6,746	1,625	8,371
1984	5,523	777	6,300
1985	6,953	710	7,663
1986	5,152	863	6,015
1987	3,955	207	4,162

*Escapement estimates based on differential of number of hatchery fish counted between Rock Island and Rocky Reach dams.
[B]Sport catch within subbasin only.

Source: Wenatchee Subbain Production Plan, 1990. Sport catch based on permit-card harvest estimates.

Table 5 (AC-a). Age composition percentage **(freshwater.ocean)** by return year, for adult summer steelhead originating in the Wenatchee River subbasin.

Age composition (%)

Return **Year**	**N[A B]**	11 .	1.2	1.3	2.1	2.2	2.3	3.1	3.2
1979	17				64.7	5.9	5.9	11.8	11.8
1980	13				53.8	46.2			

*Data collected from wild steelhead harvested in sport catch.
[B]**Age** determined by scale analysis.

Source: Stock Assessment of Columbia River Anadromous Salmonids Vol II., 1985.

Table 6 (TR). Hatchery releases of summer steelhead into the Wenatchee River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT code/ Fin Clip
1981	Columbia, McNary-Upper	Chelan PUD	Smolt	05/10/83	7.0	17,780	Icicle R	
1981	Columbia, McNary-Upper	Chelan PUD	Smolt	04/07/83	9.2	14,986	Unknown	
1981	Columbia, McNary-Upper	Chelan PUD	Smolt	04/08/83	9.2	14,986	Unknown	
1981	Columbia, McNary-Upper	Chelan PUD	Smolt	04/08/83	9.2	14,904	Unknown	
1981	Columbia, McNary-Upper	Chelan PUD	Smolt	05/09/83	7.0	15,890	Wenatchee R	
1981	Columbia, McNary-Upper	Chelan PUD	Smolt	05/09/83	7.0	17,710	Wenatchee R	
1981	Columbia, McNary-Upper	Chelan PUD	Smolt	05/10/83	7.0	18,550	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/15/82	5.5	6,875	Icicle R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/15/83	6.2	6,448	Icicle R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/16/82	5.3	6,943	Icicle R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/19/82	5.8	7,279	Icicle R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/19/83	5.0	5,125	Icicle R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/19/83	5.0	5,225	Icicle R	
1981	Columbia Priest Rapids	Chelan PUD	Smolt	04/20/82	6.5	8,190	Icicle R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/20/83	5.0	5,050	Icicle R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/20/83	5.0	7,725	Icicle R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/21/82	6.5	3,672	Icicle R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/21/82	6.0	4,260	Icicle R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/22/82	6.0	7,530	Icicle R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/04/83	5.0	5,150	Unknown	

Table 6 (cont.). Hatchery releases of summer steelhead into the Wenatchee River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/04/83	5.0	5,000	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/05/83	5.2	5,200	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/05/83	5.2	5,252	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/12/82	4.6	5,014	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/12/82	4.6	5,359	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/13/82	4.6	1,633	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/13/82	5.6	3,192	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/14/82	5.6	5,768	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/11/83	5.5	7,177	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/11/83	5.5	5,472	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/11/83	5.5	7,205	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/11/83	5.5	5,582	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/12/83	5.5	7,012	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/12/83	5.5	5,610	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/12/83	5.5	2,942	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/12/83	7.5	3,637	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/12/83	7.5	9,488	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/13/83	7.5	9,375	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/14/82	5.6	6,860	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/14/82	5.8	7,076	Wenatchee R	

Table 6 (cont.). Hatchery releases of summer steelhead into the Wenatchee River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT code/ Fin Clip
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/15/82	5.8	3,045	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/15/82	5.5	6,600	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/15/82	5 . 5	6,627	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/15/82	5.5	2,310	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/15/82	5.3	1,563	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/16/82	5.8	7,482	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/19/82	5.8	2,842	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/19/82	6.5	5,102	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/20/82	6.5	8,255	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/20/83	5.0	7,525	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/20/83	5.0	5,225	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/21/82	6.0	7,590	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/21/83	5.0	5,050	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/21/83	5.0	5,175	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/22/82	6.0	6,540	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/22/82	5.5	880	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/22/83	5.0	5,375	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/22/83	5.0	5,150	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/27/83	4.6	7,130	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/27/83	4.6	4,738	Wenatchee R	

Table 6 (cont.). Hatchery releases of summer steelhead into the Wenatchee River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/27/83	4.6	6,969	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/27/83	4.6	644	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/27/83	9.6	8,400	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04127183	9.6	9,024	Wenatchee R	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/29/82	5.7	4,588	Wenatchee R	
1981	Washougal R - WF/NF	Turtle Rock Pond	Smolt	04/19/82	6.5	16,250	Icicle R	
1981	Washougal R - WF/NF	Turtle Rock Pond	Smolt	04/13/82	6.5	8,775	Unknown	
1981	Washougal R - WF/NF	Turtle Rock Pond	Smolt	04/13/82	6.5	7,800	Unknown	
1981	Washougal R - WF/NF	Turtle Rock Pond	Smolt	04/13/82	6.5	7,800	Unknown	
1981	Washougal R - WF/NF	Turtle Rock Pond	Smolt	04/19/82	6.5	15,600	Wenatchee R	
1981	Washougal R - WF/NF	Turtle Rock Pond	Smolt	04/20/82	6.5	8,450	Wenatchee R	
1981	Washougal R - WF/NF	Turtle Rock Pond	Smolt	04/20/82	6.5	15,600	Wenatchee R	
1981	Washougal R - WF/NF	Turtle Rock Pond	Smolt	04/21/82	6.5	14,300	Wenatchee R	
1981	Washougal R - WF/NF	Turtle Rock Pond	Smolt	04/21/82	6.5	12,350	Wenatchec R	
1981	Washougal R - WF/NF	Turtle Rock Pond	Smolt	04/21/82	6.5	14,300	Wenatchee R	
1982	Icicle R	Leavenworth NFH	Smolt	05/18/83	9.9	106,890	Icicle R	
1983	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/26/84	6.2	2,027	Icicle R	621635 AD
1983	Columbia McNary-Upper	Turtle Rock Pond	Smolt	04/26/84	6.2	14,093	Icicle R	
1983	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/04/84	8.0	2,464	Napeequa Cr	621635 AD
1983	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/04/84	8.0	17.136	Unknown	

Table 6 (cont.). Hatchery releases of summer steelhead into the Wenatchee River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1983	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/04/84	8.0	2,464	Nason Cr	621635 AD
1983	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/04/84	8.0	17,136	Unknown	
1983	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/05/84	8.0	2,464	Chiwawa Cr	621635 AD
1983	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/05/84	8.0	17,136	Unknown	
1983	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/25/84	6.2	2,027	Wenatchee R	621635 AD
1983	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/25/84	6.2	2,027	Wenatchee R	621635 AD
1983	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/25/84	6.2	2,027	Wenatchee R	621635 AD
1983	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/25/84	6.2	14,093	Wenatchee R	
1983	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/25/84	6.2	14,093	Wenatchee R	
1983	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/25/84	6.2	14,093	Wenatchee R	
1983	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/26/84	6.2	2,065	Wenatchee R	621635 AD
1983	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/26/84	6.2	14,365	Wenatchee R	
1983	Columbia, Wells	Chelan PUD	Smolt	04/19/84	5.5	12,870	Icicle R	
1983	Columbia, Wells	Chelan PUD	Smolt	04/20/84	7.5	8,775	Icicle R	
1983	Columbia, Wells	Chelan PUD	Smolt	04/20/84	6.0	7,920	Icicle R	
1983	Columbia, Wells	Chelan PUD	Smolt	04/23/84	5.5	4,455	Icicle R	
1983	Columbia, Wells	Chelan PUD	Smolt	04/02/84	4.4	10,120	Unknown	
1983	Columbia, Wells	Chelan PUD	Smolt	04/02/84	4.4	10,296	Unknown	
1983	Columbia, Wells	Chelan PUD	Smolt	04/03/84	4.0	5,100	Unknown	
1983	Columbia, Wells	Chelan PUD	Smolt	04/16/84	4.5	12,353	Wenatchee R	

Table 6 (cont.). Hatchery releases of summer steelhead into the Wenatchee River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1983	Columbia, Wells	Chelan PUD	Smolt	04/16/84	4.5	11,385	Wenatchee R	
1983	Columbia, Wells	Chelan PUD	Smolt	04/17/84	4.5	4,410	Wenatchee R	
1983	Columbia, Wells	Chelan PUD	Smolt	04/17/84	5.0	7,200	Wenatchee R	
1983	Columbia, Wells	Chelan PUD	Smolt	04/17/84	5.0	12,000	Wenatchee R	
1983	Columbia, Wells	Chelan PUD	Smolt	04/18/84	6.0	15,150	Wenatchee R	
1983	Columbia, Wells	Chelan PUD	Smolt	04/18/84	6.0	14,640	Wenatchee R	
1983	Columbia, Wells	Chelan PUD	Smolt	04/19/84	6.5	8,060	Wenatchee R	
1983	Columbia, Wells	Chelan PUD	Smolt	04/19/84	5.5	6,820	Wenatchee R	
1983	Columbia, Wells	Chelan PUD	Smolt	04/20/84	5.5	13,640	Wenatchee R	
1984	Columbia, Wells	Chelan PUD	Smolt	04/15/85	4.5	5,445	Icicle R	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/19/85	5.8	8,120	Icicle R	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/23/85	5.2	14,040	Icicle R	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/24/85	4.9	7,350	Icicle R	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/09/85	4.5	11,250	Nason Cr	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/09/85	4.5	9,900	Peshastin Cr	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/10/85	4.5	11,250	Nason Cr	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/10/85	4.5	5,850	Peshastin Cr	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/16/85	4.7	11,280	Wenatchee R	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/16/85	4.7	7,050	Wenatchee R	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/17/85	4.9	13,230	Wenatchee R	AD

Table 6 (cont.). Hatchery releases of summer steelhead into the Wenatchee River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1984	Columbia, Wells	Chelan PUD	Smolt	04/17/85	4.9	2,940	Wenatchee R	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/17/85	5.8	12,760	Wenatchee R	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/24/85	4.6	12,420	Wenatchee R	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/25/85	7.8	9,360	Wenatchee R	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04125185	7.8	11,700	Wenatchee R	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/26/85	7.8	11,700	Wenatchee R	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/51/85	4.6	6,900	Wenatchee R	AD
1984	Icicle R	Leavenworth NFH	Non-Smolt	04/16/85	10.3	111,600	Icicle R	
1984	Icicle R	Leavenworth NFH	Smolt	04/28/86	6.7	35,198	Icicle R	
1984	Washougal R	Turtle Rock Pond	Smolt	04/12/85	6.9	9,660	Icicle R	AD
1984	Washougal R	Turtle Rock Pond	Smolt	0411 1/85	6.9	9,315	Chiwawa Cr	AD
1984	Washougal R	Turtle Rock Pond	Smolt	0411 1/85	6.9	10,350	White Cr	AD
1984	Washougal R	Turtle Rock Pond	Smolt	04/12/85	6.9	9,600	Nason Cr	AD
1984	Washougal R	Turtle Rock Pond	Smolt	0411 1/85	6.9	17,940	Wenatchee R	AD
1984	Washougal R	Turtle Rock Pond	Smolt	04/12/85	6.9	9,660	Wenatchee R	AD
1984	Washougal R	Turtle Rock Pond	Smolt	04/12/85	6.9	10,350	Wenatchee R	AD
1985	Columbia, Wells	Chelan PUD	Smolt	04/01/86	5.5	6,600	Peshastin Cr	AD
1985	Columbia, Wells	Chelan PUD	Smolt	04/09/86	5.1	13,750	Nason Cr	AD
1985	Columbia, Wells	Chelan PUD	Smolt	04/10/86	6.5	7,800	Nason Cr	AD
1985	Columbia, Wells	Chelan PUD	Smolt	04/10/86	6.5	9,750	Peshastin Cr	AD

Table 6 (cont.). Hatchery releases of summer steelhead into the Wenatchee River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1985	Columbia, Wells	Chelan PUD	Smolt	04/08/86	4.9	13,230	Wenatchee R	AD
1985	Columbia, Wells	Chelan PUD	Smolt	04/08/86	4.9	12,250	Wenatchee R	AD
1985	Columbia, Wells	Chelan PUD	Smolt	04/09/86	5.0	12,500	Wenatchee R	AD
1985	Columbia, Wells	Chelan PUD	Smolt	04/10/86	6.5	9,750	Wenatchee R	AD
1985	Columbia, Wells	Chelan PUD	Smolt	04/11/86	5.5	14,850	Wenatchee R	AD
1985	Columbia, Wells	Chelan PUD	Smolt	0411 1/86	5.5	14,300	Wenatchee R	AD
1985	Columbia, Wells	Chelan PUD	Smolt	04/14/86	5.5	8,250	Wenatchee R	AD
1985	Columbia, Wells	Chelan PUD	Smolt	04/14/86	5.5	21,450	Wenatchee R	AD
1985	Columbia, Wells	Chelan PUD	Smolt	04/16/86	5.8	10,440	Wenatchee R	AD
1986	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/24/87	6.2	36,250	Icicle R	AD
1986	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/22/87	6.2	19,840	Nason Cr	AD
1986	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/23/87	6.2	19,200	Nason Cr	AD
1986	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/27/87	6.2	19,200	White Cr	AD
1986	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/22/87	6.2	39,350	Wenatchee R	AD
1986	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/23/87	6.2	39,040	Wenatchee R	AD
1986	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04124187	6.2	19,200	Wenatchee R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	04/16/87	7.3	10,950	Icicle R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	04/16/87	5.0	14,750	Icicle R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	04/13/87	4.7	13,630	Peshastin Cr	AD
1986	Columbia, Wells	Chelan PUD	Smolt	04/15/87	4.8	19,200	Nason Cr	AD

Table 6 (cont.). Hatchery releases of summer steelhead into the Wenatchee River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1986	Columbia, Wells	Chelan PUD	Smolt	04/13/87	4.7	5,640	Wenatchee R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	04/13/87	4.9	20,090	Wenatchee R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	04/15/87	4.8	20,160	Wenatchee R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	04/16/87	7.3	5,475	Wenatchee R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	04/16/87	5.5	18,975	Wenatchee R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	04/17/87	5.0	14,000	Wenatchee R	AD
1986	Columbia, Wells	Chelan PUD	Smolt	04/20/87	5.0	19,000	Wenatchee R	AD
1986	Iclcle R	Leavenworth NFH	Smolt	04/22/87	6.3	104,400	Icicle R	AD
1987	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/25/88	6.0	14,400	Wenatchee R	AD
1987	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/25/88	6.0	27,600	Wenatchee R	AD
1987	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/26/88	6.0	13,800	Wenatchee R	AD
1987	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/26/88	6.0	28,200	Wenatchee R	AD
1987	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/27/88	6.0	27,600	Wenatchee R	AD
1987	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/27/88	6.0	13,800	Wenatchee R	AD
1987	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/28/88	6.0	19,800	Wenatchee R	AD
1987	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/28/88	6.0	13,800	Wenatchee R	AD
1987	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/29/88	6.0	13,800	Wenatchee R	AD
1987	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/29/88	6.0	13,800	Wenatchee R	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/11/88	4.8	10,080	Peshastin Cr	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/11/88	5.0	9,500	White Cr	AD

Table 6 (cont.). Hatchery releases of summer steelhead into the Wenatchee River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Staee	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1987	Columbia, Wells	Chelan PUD	Smolt	04/12/88	5.2	13,000	Peshastin Cr	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/12/88	3.6	7,920	White Cr	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/13/88	7.0	16,000	Chiwawa Cr	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/18/88	4.0	8,000	Nason Cr	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/19/88	5.0	12,200	Nason Cr	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/21/88	5.0	6,500	Chiwawa Cr	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/21/88	4.8	4,800	Nason Cr	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/21/88	5.0	5,000	Peshastin Cr	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/13/88	5.0	11,500	Wenatchee R	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/14/88	5.0	11,500	Wenatchee R	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/15/88	4.0	18,400	Wenatchee R	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/18/88	3.8	10,200	Wenatchee R	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/19/88	6.0	12,000	Wenatchee R	AD
1988	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/25/89	7.9	15,800	Wenatchee R	AD
1988	Columbia McNary-Upper	Turtle Rock Pond	Smolt	04/26/89	7.9	43,845	Wenatchee R	AD
1988	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/26/ 89	7.9	10,270	Wenatchee R	AD
1988	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/26/89	7.9	11,850	Wenatchee R	AD
1988	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/27/89	7.9	10,270	Wenatchee R	AD
1988	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/27/89	7.9	10,270	Wenatchee R	AD
1988	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/27/89	7.9	10,270	Wenatchee R	AD

Table 6 (cont.). Hatchery releases of summer steelhead into the Wenatchee River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1988	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/28/89	7.9	10,270	Wenatchee R	AD
1988	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/28/89	7.9	10,270	Wenatchee R	AD
1988	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	04/28/89	7.9	10,270	Wenatchee R	AD
1988	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	05/01/89	7.9	31,600	Wenatchee R	AD
1988	Columbia, McNary-Upper	Turtle Rock Pond	Smolt	05/01/89	7.9	12,640	Wenatchee R	AD
1988	Columbia, Wells	Chelan PUD	Smolt	04/10/89	6.5	7,800	Chiwawa Cr	AD
1988	Columbia, Wells	Chelan PUD	Smolt	04/10/89	6.6	17,160	Peshastin Cr	AD
1988	Columbia, Wells	Chelan PUD	Smolt	04/10/89	6.5	9,750	White Cr	AD
1988	Columbia, Wells	Chelan PUD	Smolt	04/12/89	6.3	9,450	Chiwawa Cr	AD
1988	Columbia, Wells	Chelan PUD	Smolt	04/12/89	6.6	16,830	Peshastin Cr	AD
1988	Columbia, Wells	Chelan PUD	Smolt	04/12/89	5.8	6,670	White Cr	AD
1988	Columbia, Wells	Chelan PUD	Smolt	04/14/89	6.6	17,490	Nason Cr	AD
1988	Columbia, Wells	Chelan PUD	Smolt	04/11/89	5.8	15,080	Wenatchee R	AD
1988	Columbia, Wells	Chelan PUD	Smolt	04/13/89	6.3	34,020	Wenatchee R	AD
1988	Columbia, Wells	Chelan PUD	Smolt	04/14/89	6.2	16,740	Wenatchee R	AD
1989	Columbia, Wells	Chelan PUD	Smolt	04/10/90	7.0	8,400	Peshastin Cr	AD
1989	Columbia, Wells	Chelan PUD	Smolt	04/11/90	7.0	7,700	Peshastin Cr	AD
1989	Columbia, Wells	Chelan PUD	Smolt	04/03/90	7.0	16,800	Wenatchee R	AD
1989	Columbia, Wells	Chelan PUD	Smolt	04/04/90	7.0	23,100	Wenatchee R	AD
1989	Columbia, Wells	Chelan PUD	Smolt	04/10/90	7.0	8,400	Wenatchee R	AD

Table 6 (cont.). Hatchery releases of summer steelhead into the Wenatchee River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1989	Columbia, Wells	Chelan PUD	Smolt	04/11/90	7.0	41,300	Wenatchee R	AD
1989	Columbia, Wells	Chelan PUD	Smolt	04/12/90	7.0	30,800	Wenatchee R	AD
1989	Columbia, Wells	Chelan PUD	Smolt	04/12/90	7.0	12,600	Wenatchee R	AD
1989	Columbia, Wells	Chelan PUD	Smolt	04/13/90	7.0	17,500	Wenatchee R	AD
1989	Columbia, Wells	Eastbank	Smolt	04/16/90	6.9	25,530	Wenatchee R	AD
1989	Columbia, Wells	Eastbank	Smolt	04/17/90	6.9	13,110	Wenatchee R	AD
1989	Columbia, Wells	Eastbank	Smolt	04/18/90	6.9	15,180	Wenatchee R	AD
1989	Columbia, Wells	Eastbank	Smolt	04/18/90	6.6	7,920	Wenatchee R	AD
1989	Columbia, Wells	Eastbank	Smolt	04/18/90	6.6	6,600	Wenatchee R	AD
1989	Columbia, Wells	Eastbank	Smolt	04/23/90	6.3	9,450	Wenatchee R	AD
1989	Columbia, Wells	Eastbank	Smolt	04/23/90	6.3	34,650	Wenatchee R	AD
1989	Columbia, Wells	Eastbank	Smolt	04/24/90	6.3	18,270	Wenatchee R	AD
1990	Columbia, Wells	Chelan PUD	Smolt	05/06/91	7.6	50,160	Wenatchee R	AD
1990	Columbia, Wells	Chelan PUD	Smolt	05/06/91	7.6	38,000	Wenatchee R	AD
1990	Columbia, Wells	Chelan PUD	Smolt	05/06/91	7.6	8,360	Wenatchee R	AD
1990	Columbia, Wells	Chelan PUD	Smolt	05/07/91	7.4	22,200	Wenatchee R	
1990	Columbia, Wells	Chelan PUD	Smolt	05/07/91	7.4	41,440	Wenatchee R	AD
1990	Columbia, Wells	Chelan PUD	Smolt	05/07/91	7.4	39,220	Wenatchee R	
1990	Columbia, Wells	Chelan PUD	Smolt	05/08/91	7.4	11,100	Wenatchee R	AD
1990	Columbia, Wells	Eastbank	Smolt	04/16/91	5.1	66,300	Wenatchee R	AD

Table 6 (cont.). Hatchery releases of summer steelhead into the Wenatchee River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1990	Columbia, Wells	Eastbank	Smolt	04/16/91	5.3	20,140	Wenatchee R	AD
1990	Columbia, Wells	Eastbank	Smolt	04/17/91	4.9	42,630	Wenatchee R	AD
1990	Columbia, Wells	Eastbank	Smolt	04/17/91	4.9	23,520	Wenatchee R	AD

Source: Terry Lovgren, WDW Hatchery Stocking Database, 1991.

AD = Adipose Clip.

Table 7 (TD-1). Parasites and diseases isolated at hatcheries which reared Wenatchee River steelhead smolts[A].

Disease Type	Hatchery	Specific Pathogen
Bacterial	Chelan[B]	*Aeromonas salmonicida* (Furunculosis)
Bacterial	Chelan	*Flavobacterium sp.*
Bacterial	Chelan	*Flexibacter columnaris* (Columnaris)
Bacterial	Chelan	*Flexibacter cytophaga* (Coldwater)
Parasite	Chelan	*Gyrodactylus sp.*
Parasite	Chelan	*Hexamita sp.*
Parasite	Chelan	*Ichthyoboda sp.* (Costia)
Parasite	Chelan	*Ichthyophthirius multiflis* (Ich)
Parasite	Chelan	*Trichodina sD.*
Viral	Chelan	EZBS
Viral	Chelan	Infectious Hematopoietic Necrosis (IHN)
Bacterial	Turtle Rock[B]	*Aeromonas salmonicida* (Furunculosis)
Bacterial	Turtle Rock	*Flexibacter columnaris* (Columnaris)
Parasite	Turtle Rock	*Ichthyophthirius multiflis* (Ich)
Viral	Turtle Rock	Infectious Hematopoietic Necrosis (IHN)
Viral	Eastbank[B]	*EIBS*
Viral	Eastbank	Infectious Hematonoietic Necrosis (IHN)

[A]Smolts were also reared at Wells Hatchery located at Wells Dam on the Columbia River.

[B]Chelan and Eastbank hatcheries, plus Turtle Rock Rearing Ponds are all located on the Columbia River.

Disease history only represents pathogens isolated at these rearing locations and not necessarily a disease outbreak.

Source: Steve Roberts, Washington Department Of Wildlife, 1991.

Table 8 (I'D-2). Disease history for summer steelhead reared at Leavenworth Hatchery and released into the Wenatchee River subbasin.

Disease Type	Hatchery	Snecific Pathogen
Bacterial	Leavenworth*	*Aeromonas salmonicida* (Furunculosis)
Bacterial	Leavenworth	*Yersinia ruckeri* (Redmouth)
Bacterial	Leavenworth	*Cytophaga psychrophila*
Bacterial	Leavenworth	*Renibacterium salmonarium* (BKD)
Parasite	Leavenworth	*Ichthyoboda sp.* (Costia)
Parasite	Leavenworth	*Zchthyophthirius multiflis* (Ich)
Parasite	Leavenworth	*Hexamita sp.*
Parasite	Leavenworth	*Trichodina sp.*
Parasite	Leavenworth	*Gyrodactylus sp.*
Parasite	Leavenworth	*Epistylis sp.*
Parasite	Leavenworth	*Ceratomyxa shasta*
Viral	Leavenworth	*EZBS*
Viral	Leavenworth	Infectious Pancreatic Necrosis (IPN)
Viral	Leavenworth	Infectious Hematouoietic Necrosis (IHN)

^Leavenworth Hatchery is located on the Wenatchee River near the city of Leavenworth.

Disease pathogens listed above were only isolated at this rearing location and are included in disease history even if the pathogen has never caused a disease outbreak.

Source: Ray Brunson, Pathologist USFW, for Leavenworth Hatchery.

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ENTIAT SUBBASIN

Spring Chinook

GEOGRAPHIC LOCATION

The Entiat River Basin is located in north central Washington, within Chelan County. Originating in a glaciated basin near the crest of the Cascade Mountains, the Entiat River flows southeasterly, joining the Columbia River at River Mile (RM) 483.7 near the town of Entiat, approximately 20 miles upstream of Wenatchee. The drainage covers approximately 419 square miles and ranges in elevation from over 9,000 feet in the Entiat River headwaters to about 700 feet at the confluence with the Columbia River. The drainage is bounded on the northeast by the Entiat Mountains (Hydrology Subcommittee, 1964). Two major tributaries drain into the Entiat River, the North Fork Entiat, which joins the Entiat River at RM 33, and the Mad River, which flows into the Entiat at RM 10.5. Entiat National Fish Hatchery is located at RM 6.3 on the mainstem Entiat.

ORIGIN

Hydroelectric and diversion dam construction reduced the abundant populations of native spring chinook in the upper Columbia tributaries (Fulton 1968). The Entiat National Fish Hatchery was completed in 1942 as mitigation for salmon losses caused by the construction of Grand Coulee Dam (Mullan 1982). Spring chinook stocking history for the federal hatcheries is divided into two periods. Beginning in the 1940's, spring chinook broodstock were intercepted at Rock Island Dam or occasionally obtained from lower Columbia hatcheries (J. Mullan, USFWS, personal communication). Entiat Hatchery released Klickitat stock spring chinook in 1975 and Cowlitz stock in 1976. The current spring chinook releases are considered to be a derivative of Carson stock. The natural spawning populations in the Entiat River may be genetically linked to the adjacent hatchery production.

DISTRIBUTION

Spawning primarily takes place from RM 20.0 to RM 29.0.

PRODUCTION

Entiat spring chinook are managed on a natural stock basis. Tables 1 and 2 describe the amount of spawning and rearing habitat, by quality, available in the Entiat subbasin. This data was derived from the Presence/Absence database of the Northwest Power Planning Council, 1991.

The estimated maximums of Entiat River spring chinook natural spawn escapement for the 1980 through 1990 return years averaged 680 with a low return of 8 for the 1984 return and a peak of 2,549 for the 1985 return. These maximum potential natural spawning escapement estimates are based on the Rocky Reach Dam count minus the Wells Dam count minus the sport catch and hatchery escapenent to the Entiat NFH. Natural spawn maximum escapement estimates by return year are presented in Table 3.

The Entiat Hatchery spring chinook escapement returns from 1982-1990 return years averaged 706 with a low return of 247 for the 1982 return and a peak of 969 for the 1986 return. Hatchery returns by return year and total age are presented in Table 4.

Some fair spawning and rearing habitat occurs sporadically up the Entiat from Mud Creek to Potato

Creek; from Stormy Creek to Tommy Creek; and from Lake Creek to the North Fork of the Entiat River. Fair rearing habitat occurs from the mouth of the Entiat up through these spawning and rearing areas. Smolt carrying capacity is estimated at 176,000 smolts, based in the Smolt Density Model.

ADULT LIFE HISTORY

Run size, catch and escapement

Ocean commercial and recreational fisheries from Alaska to Washington, in addition to Columbia River treaty, non-treaty, commercial and subsistence fisheries, and sport fisheries all harvest a portion of the Wenatchee River spring chinook.

Strays from other lower river hatcheries are not unusual. Table 5 lists the coded wire tags recovered within the Entiat subbasin which originated outside the Entiat subbasin.

Time of Migration

Spring chinook upriver migration timing of wild and hatchery fish is generally the same. Spring chinook peak at Bonneville Dam mid to late April; About 50 percent of the mid-Columbia River run passes Priest Rapids Dam by late May.

Spawning Period

Spawning commences in mid-August and continues into September. Different annual temperature regimes will vary the time of spawning. According to Mullan (1987), threshold temperatures for egg deposition and normal development are between 42.5 F to 57.5 F. This applies primarily up to the time eggs eye, which is about the first 20 days. Normal hatching patterns are altered and survival decreases acutely above and below this temperature range (Mullan 1987).

Spawning Areas

See distribution.

Age Composition

Age information is not available for the natural spawning population. Age structure is based on length-frequency information from 1984 and 1985 samples. In both years, 76 percent of the adults returned as ocean age-2 fish, 24 percent as ocean age-3 fish.

Sex Ratio

Information is limited to hatchery escapements. Jacks are entirely males. Four-year-old adults are predominately females and age-5 adults mostly males.

Fecundity

A standard value of 4,400 eggs per female is assumed.

JUVENILE LIFE HISTORY

Time of Emergence

No information is available on the naturally produced population. Artificial emergence (absorbed yolk-sac) at the hatcheries occurs in late November.

Time, age and size at migration

Hatchery release information for the Entiat subbasin by brood year is presented in Table 6. Hatchery reared juveniles are customarily released as yearlings in April and May at 10-18 fish/pound and 120-150 mm in length. Median recapture data in the Columbia estuary for two coded wire tagged releases (1978 and 1979 brood) occurred about one month after release.

Survival Rate

No specific data is available for egg-to-fry or fry-to-smolt survival for wild spawners. Using the Data Standardization Report's egg-to-smolt survival rate regression, the average for 1977 through 1985 was 7.37 percent. The survival rate ranged from 11.91 percent for peak years like 1978, to 3 percent in poor years like 1982. The record year of 1978, according to this method, would have produced 297,341 smolts (1.7 times the estimated carrying capacity). It is therefore likely that the egg-to-smolt survival or fecundity estimates are high.

DISEASE

For hatchery reared juveniles, bacterial kidney disease can be a major problem. Furunculosis and redmouth disease are occasionally present. Infectious hematopoietic necrosis (IHN) has been detected in smolts released from Entiat Hatchery but has not been a source of significant loss. IHN was diagnosed in a small number of adults in 1982 and 1983 (G. Taylor, USFWS, personal communication).

BIOCHEMICAL-GENETIC CHARACTERISTICS

No data available.

Table 1 **(HB-1).** Estimated amount of rearing and spawning habitat, by quality, of the Entiat River spring chinook production area.

Distance/Area	Excellent	Good	**Fair**[a]	**Poor**[a]	Unknown	Total	Confidence
Miles **(%)**	0	0	82	18		11.3	
Acres **(%)**	0	0	86	14		74.5	

[a] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/Absence database, NPPC, 1991.

Table 2 **(HB-2).** Estimated amount of rearing habitat, by quality, of the Entiat River spring chinook production area.

Distance/Area	Excellent	Good	**Fair**[a]	**Poor**[a]	unknown	Total	Confidence
Miles **(%)**	0	0	100	0		17.2	
Acres **(%)**	0	0	100	0		125.1	

[a] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/Absence database, NPPC, 1991.

Table 3 (RN-a). Entiat River spring chinook maximim potiential natural spawning escapement by return year. 1/

Return Year	Jacks	Adults	Total
1980	*	586	586
1981	38	1,477	1,515
1982	*	223	223
1983	*	13	13
1984	*	8	8
1985	66	2,483	2,549
1986	10	143	153
1987	10	283	293
1988	44	964	1,008
1989	*	797	797
1990	19	320	339

1/ The Maximum potential natural spawning escapement is the Rocky Reach Dam count minus the Wells Dam count minus the sport catch and hatchery escapenent to the Entiat NFH.

* The maximum potential formula yielded negative numbers for the jacks for these years.

Table 4 **(RH-a).** Entiat Hatchery spring chinook escapement by return year and total age.

	Age					
Return Year	3	4	5	6	Total	Adult Total
1982	4	171	72	*	247	243
1983	0	251	409	*	660	660
1984	55	572	181	*	808	753
1985	0	738	174	*	912	912
1986	14	588	367	*	969	955
1987	0	593	220	*	813	813
1988	27	179	483	*	689	662
1989	17	612	40	0	669	652
1990	0	306	277	0	583	583

* All 6's included in the 5's column.

Table 5 (AI). Immigration of coded wire tagged spring chinook into the Entiat subbasin.

Hatchery/Release Site	Recovery site, Run **Year(s)**	Recovery Method	Number Sampled	Number Recovered	Total Number Estimated, **(PSMFC)**
McNary	Entiat, 1989	Hatchery	669	1	1
McNarv	Entiat. 1989	**Hatcherv**	669	1	1

Based on the following tag codes: **23-** 19-53, and 23-20-12.

Beginning with the 1978 brood.

Table 6 (TR). Hatchery releases of spring chinook salmon into the Entiat River subbesin sorted by brood year, hatchery and life stage.

Brood Year	Stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /Lb.	Number Released	Release Site	CUT Code
1972	KLICKITAT RIVER	KLICKITAT HATCHERY	Fingr	06/28/73	06/28/73	58	139200	ENTIAT R (46.0002)	UNTAGGED
1974	KLICKITAT RIVER	KLICKITAT HATCHERY	Fingr	06/19/75	06/19/75	50	50000	ENTIAT R (46.0002)	UNTAGGED
1975	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/15/77	04/15/77	14	99132	ENTIAT R (46.0002)	131204
1975	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/ 15/77	04/15/77	14	532282	ENTIAT R (46.0002)	UNTAGGED
1975	UNKNQUN STOCK	ENTIAT NF HATCHERY	Smolt	04/15/77	04/15/77	15	631205	ENTIAT R (46.0002)	UNTAGGED
1976	LEAVENWORTH HATCHERY	ENTIAT NF HATCHERY	Fingr	07/15/77	07/15/77	70	400000	ENTIAT R (46.0002)	UNTAGGED
1976	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/14/78	04/25/78	10	87849	ENTIAT R (46.0002)	631725
1976	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/14/78	04/25/78	10	169186	ENTIAT R (46.0002)	UNTAGGED
1976	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/ 14/78	04/14/78	16	39237	ENTIAT R (46.0002)	UNTAGGED
1976	LEAVENWORTH HATCHERY	ENTIAT NF HATCHERY	smott	04/25/78	04/25/78	27	165710	ENTIAT R (46.0002)	UNTAGGED
1976	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/25/78	04/25/78	27	165710	ENTIAT R (46.0002)	UNTAGGED
1976	ENTIAT RIVER	ENTIAT NF HATCHERY	smott	04/25/78	04/25/78	17	217789	ENTIAT R (46.0002)	UNTAGGED
1977	ABERNATHY CREEK	ENTIAT NF HATCHERY	smott	04/23/79	04/23/79	16	448238	ENTIAT R (46.0002)	UNTAGGED
1977	UNKNQUN STOCK	ENTIAT NF HATCHERY	smott	04/23/79	04/23/79	16	448238	ENTIAT R (46.0002)	UNTAGGED
1977	UIND R (CARSON NFH)	LEAVENUDRTH HATCHERY	Fingr	05/09/78	05/09/78	15	IQ1161	ENTIAT R (46.0002)	UNTAGGED
1977	UIND R (CARSON NFH)	LEAVENWORTH HATCHERY	Fingr	05/1 1/78	05/1 1/78	14	94416	ENTIAT R (46.0002)	UNTAGGED
1977	UIND R (CARSON NFH)	LEAVENWORTH HATCHERY	Fingr	05/25/78	05/25/78	23	115902	ENTIAT R (46.0002)	UNTAGGED
1978	LTL UHITE SALMON-NFH	ENTIAT NF HATCHERY	smott	04/16/80	04/16/80	28	61936	ENTIAT R (46.0002)	UNTAGGED
1978	LTL UNITE SALMON-NFH	ENTIAT NF HATCHERY	Smolt	04/16/80	04/16/80	17	596162	ENTIAT R (46.0002)	UNTAGGED
1978	LTL UHITE SALMON-NFH	ENTIAT NF HATCHERY	smott	04/16/80	04/16/80	28	61936	ENTIAT R (46.0002)	UNTAGGED
1978	LTL UHITE SALMON-NFH	ENTIAT NF HATCHERY	Smolt	04/16/80	04/16/80	17	596162	ENTIAT R (46.0002)	UNTAGGED
1979	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/13/81	04/13/81	16	623373	ENTIAT R (46.0002)	UNTAGGED
1979	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/13/81	04/13/81	17	326844	ENTIAT R (46.0002)	UNTAGGED
1979	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/13/81	04/13/81	16	48566	ENTIAT R (46.0002)	UNTAGGED
1979	ENTIAT RIVER	ENTIAT NF HATCHERY	smott	04/13/81	04/13/81	16	247963	ENTIAT R (46.0002)	UNTAGGED
1980	LEAVENWORTH HATCHERY	ENTIAT NF HATCHERY	Smolt	04/15/82	04/15/82	20	135962	ENTIAT R (46.0002)	UNTAGGED
1980	UIND R (CARSON NFH)	ENTIAT NF HATCHERY	Smolt	04/15/82	04/15/82	20	380577	ENTIAT R (46.0002)	UNTAGGED
1980	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/15/82	04/15/82	19	481302	ENTIAT R (46.0002)	UNTAGGED
1980	LEAVENUDRTH HATCHERY	ENTIAT NF HATCHERY	Smolt	04/15/82	04/15/82	20	135962	ENTIAT R (46.0002)	UNTAGGED
1980	UIND R (CARSON NFH)	ENTIAT NF HATCHERY	smott	04/15/82	04/15/82	20	380577	ENTIAT R (46.0002)	UNTAGGED
1980	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/15/82	04/15/82	19	481302	ENTIAT R (46.0002)	UNTAGGED
1981	UIND R (CARSON NFH)	ENTIAT NF HATCHERY	Smolt	04/18/83	04/18/83	20	136191	ENTIAT R (46.0002)	UNTAGGED
1981	LTL WHITE SALMON-NFH	ENTIAT NF HATCHERY	smott	04/18/83	04/18/83	18	621844	ENTIAT R (46.0002)	UNTAGGED
1981	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/18/83	04/18/83	15	197935	ENTIAT R (46.0002)	UNTAGGED
1981	UIND R (CARSON NFH)	ENTIAT NF HATCHERY	smott	04/18/83	04/18/83	20	136191	MAD RIVER (46.0125)	UNTAGGED
1981	LTL UHITE SALMON-NFH	ENTIAT NF HATCHERY	Smolt	04/18/83	04/18/83	17	621844	MAD RIVER (46.0125)	UNTAGGED
1981	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/18/83	04/18/83	15	197935	MAD RIVER (46.0125)	UNTAGGED
1982	ABERNATHY CREEK	ENTIAT NF HATCHERY	Smolt	04/15/84	04/15/84		645458	ENTIAT R (46.0002)	UNTAGGED
1982	UIND R (CARSON NFH)	ENTIAT NF HATCHERY	Smolt	04/23/84	04/23/84	21	259022	ENTIAT R (46.0002)	UNTAGGED
1982	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/23/84	04/23/84	17	386436	ENTIAT R (46.0002)	UNTAGGED
1983	ENTIAT RIVER	ENTIAT NF HATCHERY	Fingr	02/28/84	02/28/84	756	150000	ENTIAT R (46.0002)	UNTAGGED
1983	ENTIAT RIVER	ENTIAT NF HATCHERY	smott	04/21/85	04/21/85	19	894600	ENTIAT R (46.0002)	UNTAGGED
1983	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/21/85	04/21/85	19	894600	ENTIAT R (46.0002)	UNTAGGED
1984	ENTIAT RIVER	ENTIAT NF HATCHERY	smott	04/22/86	04/22/86	19	835090	ENTIAT R (46.0002)	UNTAGGED
1984	ENTIAT RIVER	ENTIAT NF HATCHERY	smott	04/22/86	04/22/86	20	835090	ENTIAT R (46.0002)	UNTAGGED
1985	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/21/87	04/21/87	17	925000	ENTIAT R (46.0002)	UNTAGGED
1985	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/21/87	04/21/87	17	925000	ENTIAT R (46.0002)	UNTAGGED
1986	ENTIAT RIVER	ENTIAT NF HATCHERY	smott	04/21/88	04/21/88	21	838940	ENTIAT R (46.0002)	UNTAGGED
1986	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/21/88	04/21/88	21	838940	MAD RIVER (46.0125)	UNTAGGED
1987	ENTIAT RIVER	ENTIAT NF HATCHERY	FeFry	02/02/88	02/02/88	540	263018	ENTIAT R (46.0002)	UNTAGGED
1987	ENTIAT RIVER	ENTIAT NF HATCHERY	Fingr	02/08/88	02/08/88	319	24942	ENTIAT R (46.0002)	UNTAGGED
1987	ENTIAT RIVER	ENTIAT NF HATCHERY	Fingr	05/12/88	05/12/88	101	10800	ENTIAT R (46.0002)	UNTAGGED
1987	ENTIAT RIVER	ENTIAT NF HATCHERY	Fingr	02/02/88	02/02/88	540	263018	HAD RIVER (46.0125)	UNTAGGED
1987	ENTIAT RIVER	ENTIAT NF HATCHERY	Fingr	02/08/88	02/08/88	319	24942	MAD RIVER (46.0125)	UNTAGGED
1987	ENTIAT RIVER	ENTIAT NF HATCHERY	Fingr	05/12/88	05/12/88	101	10800	MAD RIVER (46.0125)	UNTAGGED

Table 6 (cont.). Hatchery releases of spring chinook salmon into the Entiat River subbasin sorted by brood year, hatchery and life stage.

Brood Year	Stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /lb.	Number Released	Release Site		CUT Code
1987	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/20/89	04/20/89	21	791263	ENTIAT R	(46.0002)	UNTAGGED
1987	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/20/89	04/20/89	21	791263	ENTIAT R	(46.0002)	UNTAGGED
1988	METHOW RIVER	ENTIAT NF HATCHERY	EmFry	01/04/89	01/04/89	567	49605	ENTIAT R	(46.0002)	UNTAGGED
1988	ENTIAT RIVER	ENTIAT NF HATCHERY	Fingr	01/04/89	01/04/89	567	49605	ENTIAT R	(46.0002)	UNTAGGED
1988	METHOW RIVER	ENTIAT NF HATCHERY	Fingr	02/04/89	02/04/89	283	66540	ENTIAT R	(46.0002)	UNTAGGED
1988	ENTIAT RIVER	ENTIAT NF HATCHERY	Fingr	02/04/89	02/04/89	283	66540	ENTIAT R	(46.0002)	UNTAGGED
1988	UPPER COLUMBIA RIVER	ENTIAT NF HATCHERY	Smolt	04/18/90	04/18/90	19	8268	ENTIAT R	(46.0002)	052144
1988	UPPER COLUMBIA RIVER	ENTIAT NF HATCHERY	Smolt	04/18/90	04/18/90	19	45038	ENTIAT R	(46.0002)	UNTAGGED
1988	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/19/90	04/19/90	19	39600	ENTIAT R	(46.0002)	051960
1988	ENTIAT RIVER	ENTIAT NF HATCHERY	Smolt	04/19/90	04/19/90	19	222863	ENTIAT R	(46.0002)	UNTAGGED
1988	METHOW RIVER	ENTIAT NF HATCHERY	Smolt	04/19/90	04/19/90	19	43954	ENTIAT R	(46.0002)	051963
1988	METHOW RIVER	ENTIAT NF HATCHERY	Smolt	04/19/90	04/19/90	19	226077	ENTIAT R	(46.0002)	UNTAGGED

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ENTIAT RIVER SUBBASIN

Naturally Produced Summer Steelhead

GEOGRAPHIC LOCATION

The Entiat River Basin is located in north central Washington, within Chelan County. The Entiat River originates at an elevation of over 9,000 feet in the Cascade Mountains. From its headwaters, the Entiat River flows southeasterly for approximately 42 miles before entering the Columbia River at river mile (RM) 483.7. Two major tributaries drain into the Entiat River, the North Fork Entiat, which joins the mainstem Entiat at RM 33 and the Mad River, which enters into the Entiat at RM 10.5. Total drainage area of the subbasin is 419 square miles. Approximately 84 percent of the Entiat subbasin is contained within the Wenatchee National Forest. Ninety percent of the Mad River watershed and the entire North Fork watershed lie within the Wenatchee National Forest. In addition, approximately 14,000 acres or five percent of the Entiat watershed has been designated as federal wilderness areas.

Portions of the Entiat subbasin are being considered for inclusion into the National Wild and Scenic Rivers System, a classification designed to protect the undeveloped and natural habitat of a river system.

ORIGIN

The wild summer steelhead in the Entiat River are native, although interbreeding with introduced Wells hatchery-stock may have occurred. In addition, between 1939 and 1943 all returning upper Columbia River steelhead (Methow, Okanogan, Wenatchee, Entiat and Upper Columbia) were trapped at Rock Island Dam and released into the Methow, Entiat and Wenatchee rivers and may have mixed with other upper Columbia River stocks.

DISTRIBUTION

Entiat River steelhead are distributed throughout the mainstem Entiat River. Fish passage becomes difficult at about RM 27 where the stream gradient on the Entiat steepens. In addition, a partial barrier to fish migration is located at Box Canyon Cascades, RM 29.1, and a complete barrier (a falls) located at RM 33.8 which prevents fish passage into both the upper Entiat and the North Fork Entiat.

PRODUCTION

Production Facilities

One hatchery (Entiat National Fish Hatchery) operates in subbasin under the direction of the U.S. Fish and Wildlife Service. Entiat Hatchery rears and releases spring chinook. No steelhead production presently occurs within the subbasin.

Production Summary

No data are available on smolt production. The Northwest Power Planning Council's habitat model indicated 51,037 smolts could be produced within the subbasin (Table 1). The Washington Department of Wildlife gradient area flow model produced a smolt capacity estimate of 12,739 (refined Smolt Model estimate, Brown 1992; Table 2).

Production constraints would include; eight Columbia River dams which migrating smolts and adults encounter, subbasin diversions, low flows, improper screening and poor system productivity all have a negative impact on steelhead production and juvenile survival.

ADULT LIFE HISTORY

Run Size and Escapement

No data arc available on run size and escapement. Steelhead counts made at Rock Island Dam, which represents steelhead from five subbasins the Methow, Wenatchee, Entiat, Okanogan, and upper Columbia rivers, averaged 2,780 fish for the 1930's, 2605 fish for the 1940's, and 3,722 fish for the 1950's. Presently, about 140 natural steelhead are thought to return to the subbasin (Subbasin Plan 1990).

Time of migration

Freshwater migration generally begins when Entiat steelhead enter the Columbia River between May and September. Fish migrate upstream arriving at Wells pool in early July. Steelhead begin entering the Entiat in mid-July and peak between mid-September and October.

Harvest

Ocean catches of Entiat River steelhead are unknown.

Harvest of returning Entiat River steelhead within the Columbia River is unknown. However, some Entiat River steelhead probably are part of the Columbia River harvest.

Sport catch accounted for an average annual catch of 98 steelhead between 1980 and 1990 (Table 3). Wild fish release regulations for the subbasin were implemented in 1986. Sport harvest, after wild release regulations were imposed in 1986, averaged 74 fish.

The Confederated Tribes and Bands of the Yakima Indian Nation and its members have treaty rights to fish and participate in fishery management decisions affecting the Entiat Subbasin.

Spawning period

Spawning is primarily from March through June, peaking in early May.

Spawning area

Steelhead spawning occurs on the mainstem Entiat upstream approximately 30 miles.
Steelhead spawning has been documented in the Mad River but no major runs have been noted to return in recent years.

Fecundity

No data are available for wild steelhead.

Age Comoosition

Very limited data are available on Entiat steelhead. From eight wild steelhead adults sampled in

1979 and 1980, 87.5 percent were 2.1 age class and 12.5 percent were 2.2 age class (Table 4).

Size

From adults sampled in 1979 and 1980, 2.1 age steelhead averaged 62.4 cm, while the single 2.2 age fish was 72.4 cm (Table 6).

Sex ratio

From 73 wild steelhead sampled at Wells Dam, females comprised 72.4 percent of the sample (Table 5).

Survival Rate

No data are available on Entiat River Steelhead.

JUVENILE LIFE HISTORY

Egg

No data are available on egg production or egg to smolt survival.

Emergence

No data are available on Entiat steelhead.

Juvenile rearinp

Juvenile rearing lasts approximately two to seven years prior to ocean emigration. Mean smolt age is considered to be 2.65 years (Pevan, 1990). Juvenile migration generally occurs from April through May with peak migration in early May.

Hatcherv Releases

Chelan Hatchery, which was constructed to mitigate fish losses incurred from the installation of Rocky Reach Dam, rears and releases approximately 195,000 steelhead smolts per year of which about 40,000 are allocated to the Entiat River. Releases of hatchery steelhead smolts into the Entiat River from 1980 through 1990 are presented in Table 7.

Straying

No data are available on Entiat River steelhead.

BIOCHEMICAL-GENETIC CHARACTERISTICS

No data are available on Entiat River steelhead.

DISEASES

Disease history for smolts released into the Entiat River is presented in Table 8.

Table 1 **(HB-1).** Estimated" amount of spawning and rearing habitat, by quality, of Entiat River **subbasin** summer steelhead.

Area	Excellent	Good	**Fair**[b]	**Poor**[b]	Unknown	Total	Confidence
Miles	0.0%	2.1%	92.7%	9.2%		751.7	Unknown
Acres	0.0%	0.3%	95.2%	4.4%		234.2	Unknown

'Northwest Power Planning Council estimates based on limited observations.

[b]**Ratings** of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/absence database, NPPC 199 1.

Table 2 **(HB-a).** Estimated amount of spawning/rearing habitat and potential smolt production for the **Entiat** River. Based on Gradient, **Are**ı and-Flow Methodology **(GAFM).**

Water Name	From	To	Length miles	Width feet	Gradient	Area (ha)	Parr Potential
Entiat R	mouth	Roaring Cr	6.1	59	1.01	17.6	11,609
Roaring Cr	mouth	headwaters	7.8	8	1.5	0.3	0
Entiat R	Roaring Cr	Mad R	4.5	59	1.01	13.0	9,656
Mad R	mouth	Tillicum Cr	2.0	28	2.93	2.7	6,127
Tillicum Cr	mouth	Indian Cr	1.9	13	5.18	1.2	4,191
Indian Cr	mouth	headwaters	5.3	3	7.0	0	0
Tillicum Cr	Indian Cr	headwaters	3.5	8	5.18	0.4	0
Mad R	Tillicum Cr	Young Cr	9.2	28	2.93	12.5	7,046
Young Cr	mouth	headwaters	4.0	0	0	0	0
Mad R	Young Cr	Cougar Cr	2.7	43	0	0	0
Cougar Cr	mouth	headwaters	5.5	0	0	0	0
Mad R	Cougar Cr	headwaters	12.1	43	0	0	0
Entiat R	Mad R	Mud Cr	1.1	59	1.01	3.2	2,194
Mud Cr	mouth	headwaters	10.6	0	0	0	0
Entiat R	Mud Cr	Potato Cr	3.5	59	1.01	10.1	7,509
Potato Cr	mouth	headwaters	7.1	0	0	0	0
Entiat R	Potato Cr	Stormy Cr	3.2	86	.38	13.5	3,503
Stormy Cr	mouth	headwaters	5.2	0	0	0	0
Entiat R	Stormy Cr	Preston Cr	4.7	86	.38	19.8	5,144
Preston Cr	mouth	headwaters	5.0	0	0	0	0
Entiat R	Preston Cr	Burns Cr	2.3	60	.68	6.8	3,501
Burns Cr	mouth	headwaters	5.0	0	0	0	0
Entiat R	Burns	Tommy Cr	3.2	51	1.59	7.9	9.106
Tommy Cr	mouth	headwaters	5.6	0	0	0	0
Entiat R	Tommy Cr	Lake Cr	0.3	51	1.59	0.7	854
Lake Cr	mouth	headwaters	8.0	0	0	0	0
Entiat R	Lake Cr	NF Entiat	5.1	51	1.59	10.1	5,805
NF Entiat	mouth	headwaters		0	0	0	0
Entiat R	NF Entiat	headwaters		0	0	0	0

Total Parr Potential = 76,242
Total Smolt Potential = 12,739
Based on a 5% smolt to adult survival 12,739 smolts could produce 637 adults.
Source: Larry Brown, Washington Dept. of Wildlife, 1992

Table 3 (RS-a). Returns (sport catch/escapement) of summer steelhead to the Entiat River subbasin.

Return Year	Escapement	Sport Catch[a]	Adult Total
1981		43	Unknown
1982		88	Unknown
1983		69	Unknown
1984		174	Unknown
1985		120	Unknown
1986		183	Unknown
1987		118	Unknown
1988		44	Unknown
1989		114	Unknown
1990		24	Unknown

"Catch within subbasin only.

Source: Catch based on permit-card harvest estimates.

Table 4 (AC-a). Age composition percentage (freshwater-ocean) by return year, for wild adult summer steelhead originating in the Entiat River subbasin.

Age composition (%)

Return Year	N^	2.1	2.2	
1979	4	75.0	25.0	
1980	4		100	

*Based on wild steelhead sampled from creel census.

Source: Stock Assessment of Columbia River Anadromous Salmonids, 1985.

Table 5 (AS-a). Percent females by return year and age class for wild adult summer steelhead originating in the Entiat River subbasin.

% Females

Return Year	N^A	2.1	2.2	Total % Female
1980-81	73	60.2	81.9	72.4

*Fish collected at Wells Dam represents fish from several upper Columbia River subbasins.

Source: Enitat River Subbasin Production Plan, 1990.

Table 6 (AL-a). Mean fork length by return year and age class for wild adult summer steelhead originating in the Entiat subbasin.

Mean Fork Length (cm)

Return Year	N^A	2.1	2.2	1.3	
1980-81	8	62.4	72.4		

*Based on wild fish sampled from creel census.

Source: Stock Assessment of Columbia River Anadromous Salmonids, 1985.

Table 7 **(TR).** Hatchery releases of summer **steelhead** into the Entiat River by brood year and, if marked, the coded wire tag codes.

Brood **Year**	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Codes/ Fin Clip
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/13/83	5.6	5,740	Entiat	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/13/83	5.6	7,095	Entiat	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/13/83	7.5	7,538	Entiat	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/14/83	5.6	5,516	Entiat	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/14/83	5.6	3,808	Entiat	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/14/83	6.2	3,813	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/14/83	6.2	6,448	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/14/83	6.2	8,370	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/27/82	5.4	6,966	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/27/82	5.4	7,290	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/27/82	5.4	6,912	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/28/82	5.4	2,160	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/28/82	5.7	5,158	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/28/82	5.7	7,125	Unknown	
1981	Columbia, Priest Rapids	Chelan PUD	Smolt	04/29/82	5.7	5,643	Unknown	
1983	Columbia, Wells	Chelan PUD	Smolt	04/18/84	6.5	15,925	Unknown	
1983	Columbia, Wells	Chelan PUD	Smolt	04/19/84	6.0	14,490	Unknown	
1983	Columbia, Wells	Chelan PUD	Smolt	04/20/84	7.5	10,088	Unknown	
1983	Columbia, Wells	Chelan PUD	Smolt	04/20/84	5.5	6,518	Unknown	

Table 7 (cont.). Hatchery releases of summer steelhead into the Entiat River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Codes/ Fin Clip
1984	Columbia, Wells	Chelan PUD	Smolt	04/22/85	6.4	24,320	Entiat	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/23/85	5.2	6,240	Entiat	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/23/85	4.9	7,840	Entiat	AD
1984	Columbia, Wells	Chelan PUD	Smolt	04/24/85	4.9	5,880	Entiat	AD
1985	Columbia, Wells	Chelan PUD	Smolt	04/15/86	5.5	30,525	Entiat	AD
1985	Columbia, Wells	Chelan PUD	Smolt	04/15/86	5.8	15,660	Entiat	AD
1986	Columbia, Wells	Chelan PUD	Smolt	04/20/87	7.0	9,520	Entiat	AD
1986	Columbia, Wells	Chelan PUD	Smolt	04/20/87	5.0	37,000	Entiat	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/20/88	5.5	32,260	Entiat R	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/21/88	5.0	6,500	Entiat R	AD
1987	Columbia, Wells	Chelan PUD	Smolt	04/22/88	4.0	5,200	Entiat R	AD
1988	Columbia, Wells	Chelan PUD	Smolt	04/17/89	6.5	38,350	Entiat R	AD
1989	Columbia, Wells	Eastbank	Smolt	04/17/90	6.9	21,735	Entiat R	AD
1989	Columbia, Wells	Eastbank	Smolt	04/18/90	6.9	15,180	Entiat R	AD
1990	Columbia, Wells	Eastbank	Smolt	04/15/91	6.4	47,360	Entiat R	AD

Source: Lovgren, T., WDW Hatchery Stocking Database 1991.

Table 8 (TD). Parasites and diseases isolated at hatcheries which reared Entiat River steelhead smolts.

Disease Type	Hatchery	Specific Pathogen
Bacterial	Chelan[a]	*Aeromonas salmonicida* (Furunculosis)
Bacterial	Chelan	*Flavobacterium sp.*
Bacterial	Chelan	*Flexibacter columnaris* (Columnaris)
Bacterial	Chelan	*Flexibacter cytophaga* (Coldwater)
Parasite	Chelan	*Gyrodactylus sp.*
Parasite	Chelan	*Hexamita sp.*
Parasite	Chelan	*Ichthyoboda sp.* (Costia)
Parasite	Chelan	*Ichthyophthirius multiflis* (Ich)
Parasite	Chelan	*Trichodina sp.*
Viral	Chelan	EIBS
Viral	Chelan	Infectious Hematopoietic Necrosis (IHN)
Viral	Eastbank[a]	EIBS
Viral	Eastbank	Infectious Hematopoietic Necrosis (IHN)

[a]Chelan and Eastbank hatcheries are located on the Columbia River.

Disease history only represents pathogens isolated at these rearing locations and not necessarily a disease outbreak.

Source: Steve Roberts, Washington Dept. of Wildlife, 1991

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UPPER COLUMBIA SUBBSIN

Hanford Reach Fall Chinook

GEOGRAPHIC LOCATION

Hanford Reach is located between McNary Dam (RM 292) and Priest Rapids Dam (RM 397.1). The Hanford Reach is approximately 50 miles in length from the head of Lake Wallula upstream to Priest Rapids Dam. Located between McNary and Priest Rapids Dams are two hatcheries, Priest Rapids Hatchery which is located at RM 397 and Ringold Hatchery which is located at RM 353.

The Columbia River flows to the east from Priest Rapids Dam turning south in the vicinity of the White Bluffs in the Hanford Reach. It then flows south easterly from Richland, Washington, past its confluence with the Snake River at RM 313.5, and turning to the West near the Oregon and Washington border. The Hanford Reach is the only free flowing section of the Columbia River above Bonneville Dam in the United States. In the Hanford Reach, the river maintains its historical profile and riverine character, although flows are locally modified at Priest Rapids Dam for optimum power generation and fish benefits. Regulation of flows has resulted in significantly different annual and diurnal shoreline shifts which have affected the rivers pre-development character.

ORIGIN

Natural production of native upriver bright fall chinook occurs in the Hanford Reach, one of the most important natural production areas for chinook in the entire Columbia basin. Researchers have documented spawning in water up to 30 feet deep in the Hanford Reach (Chapman et al. 1983, Swan et al. 1986), and it is possible that deep areas in other reaches of the Columbia in this subbasin, where suitable substrate and velocities exist, may be providing local spawning habitat for upriver bright fall chinook.

DISTRIBUTION

Fall chinook once migrated as far as the San Poil, Spokane, Pend Oreille, and Kootenay rivers in the Columbia and ascended the Snake River to the base of Shoshone Falls (Fulton 1968). Most upriver brights (URB's) are now produced as natural fish in the Hanford Reach of the Columbia River.

PRODUCTION

Natural adult spawning escapement into the Hanford Reach from 1981 through 1984 brood has ranged from a low return of 71,874 for the 1981 brood to a peak of 195,885 for the 1984 brood. Hanford Reach natural spawn returns by age and brood year are presented in Table 1.

Estimates of escapement are based on McNary, Ice Harbor, and Priest Rapids Dam count differences, minus Ringold and Priest Rapids Hatchery volunteer returns and Hanford Reach sport catch. Estimates also include a relatively small number of fish returning to the Yakima River. Estimates for the Yakima River from 1977 through 1987 range from no redds to 134 redds, but because of poor visibility, these estimates are considered conservative (Battelle Pacific Northwest Laboratories unpublished data).

Since 1979, biologists have sampled age structure of the spawning population in the Hanford Reach

(WDF, unpublished data). Age determination was based on the analysis of scales collected from carcasses that researchers systematically sampled on the spawning grounds. The component of the population comprised of 2-year-old precocious males (jacks) is based on numbers determined by dam counts. Results indicate nearly half the spawning population is jacks. The data suggests considerable size selectivity of downstream commercial gill net fisheries.

ADULT LIFE HISTORY

Run size, catch and escapement

Ocean commercial and recreational fisheries from Alaska to Washington, in addition to Columbia River gill net and sport fisheries, all harvest a portion of the Hanford Reach origin fall chinook. Columbia River sport and commercial fisheries are managed to ensure attainment of natural spawn escapement.

Strays from other hatcheries are not unusual. Table 3 lists the coded wire tags recovered within the Hanford Reach which originated outside the Hanford Reach. Priest Rapids Hatchery CWT's were the predominant tags recovered.

Time of Migration

The main portion of the run begins entering the Columbia River about the third week of August. Passage over Bonneville Dam generally reaches a peak between September 4 and September 10. Without extensive downstream fisheries, the maximum count at McNary Dam would probably occur about a week later than the peak count at Bonneville Dam. A critical in-river harvest management period occurs from about September 1 through September 14 when most of the run migrates past Bonneville Dam.

Spawning Period

Spawning extends from late October, peaking in mid to late November and tapering off into December.

Spawning Areas

The primary natural spawning area is in the mainstem Columbia from Priest Rapids Dam (RM 397.1) downstream about 45 miles to the upper end of McNary Pool.

Age Comuosition

Age ranges from two-year-old jacks to six-year-old adults with two-year-old jacks the dominant return overall and four-year-olds usually the dominant age class for the adults. Age composition is summarized in Tables 1 and 2. Table 4 lists the age composition percentages by brood year and freshwaterocean rearing for fall chinook returning to the Hanford Reach.

Sex Ratio

Female fall chinook comprised 32-47 percent of the natural spawners returning to the Hanford Reach between 1981-1984 brood years. The percent females by brood year and freshwaterocean rearing ages for Hanford Reach fall chinook returns are presented in Table 5.

The mean fork length by brood year, sex, and freshwater.ocean rearing ages for Hanford Reach from 1987-1984 brood years are presented in Tables 6 and 7.

Fecundity

No data available.

JUVENILE LIFE HISTORY

Time of Emergence

For the 1963-1967 brood years at the Priest Rapids Hatchery spawning channel, eyed-egg stage was most prevalent during late December to early January.

Time. aee and size at migration

Biologists observe concentrations of spawners on Vemita Bar and in the White Bluffs area, although spawning occurs throughout the free flowing section. Fry are observed along the shoreline from late March through July, with peak numbers occurring in April and May. Generally, fry reside inshore, moving into deep waters as they increase in size before emigrating. By August, shoreline areas are generally absent of juvenile chinook. Downstream migration studies with juveniles from the Priest Rapids spawning channel showed that fingerlings released in May and June arrived at McNary Dam (105 miles downstream) in late July and early August (Allen and Meekin 1973). The five year median (1984-1988) for sub-yearling chinook passing through McNary Dam has generally occurred on July 9 with 90% of the sub-yearlings passing through McNary Dam by July 24. Estuary arrival occurs about a month later (Howell et al. 1985).

Survival Rate

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

DISEASE

No data available.

BIOCHEMICAL-GENETIC CHARACTERISTICS

The upriver bright run from the Hanford Reach has been characterized electrophoretically and is genetically distinct from four other major runs of upriver bright fall chinook in the Columbia and Snake rivers (J. Shaklee, WDF, pers. commun.). The run that returns voluntarily to the Priest Rapids Salmon Hatchery and the Hanford natural fish are genetically the most similar.

Table 1 (RN). Total age of natural spawner escapement of bright fall chinook returning to Hanford Reach of the Columbia River, by brood year.

Total Age

Brood Year	2	3	4	5	6	Total	Adult Total
1974							
1975							
1976							
1977							
1978				5,252	1,363		
1979			21,745	8,768	0		
1980		9,985	26,396	17,383	621		54,385
1981	21,612	8,905	26,926	12,777	1,654	71,874	50,262
1982	38,945	16,472	40,202	24,244	1,971	121,834	82,889
1983	67,803	20,300	35,014	27,247	538	150,902	83,099
1984	90,354	25,243	35,454	44,266	568	195,885	105,531
1985	36,680	9,129	13,637	21,032		80,478	
1986	42,368	5,904	15,976				
1987	15,019	1,594					
1988	17,034						

Does not include spring/summer chinook counted as falls. In general, the number of Hanford Reach natural spawners is calculated by subtracting the Priest Rapids Dam count, the voluntary return to Priest Rapids and Ringold Hatchery, the Hanford Reach sport catches, and the Ice Harbor Dam counts from the McNary Dam counts. In addition 1989-90 Yakima River escapement was subtracted from the McNary Dam counts.

Age composition based on scale reading analysis.

Table 2 **(RS).** Total age of bright fall chinook sport harvested in the Hanford Reach of the Columbia River, by brood year.

Total Age

Brood Year	2	3	4	5	6	Total	Adult Total
1974							
1975							
1976							
1977							
1978					0		
1979				160	0		
1980			934	1,526	0		
1981		595	1,641	512	43		2,791
1982	4,711	3,430	1,104	1,534	0	10,779	6,068
1983	14,103	1,856	1,663	956	92	18,670	4,567
1984	12,528	2,160	3,549	3,238	115	21,590	9,062
1985	1,800	728	1,222	1,458			
1986	3,803	397	1,725				
1987	397	267					
1988	1,035						

The sport harvest was estimated by comparing CPUE to previous years' CPUE and punchcard estimated catches. Age composition based on scale reading analysis.

Table 3 (AI). Immigration of coded wire tagged fall chinook into the Hanford Reach subbasin.

Hatchery/Release Site	Recovery site, Run Year(s)	Recovery Method	Number Sampled	Number Recovered	Total Number Estimated, (PSMFC)
Hagerman Hatchery, released below Bonneville	Hanford Reach, 1981	Spawning Ground	---	1	18
Hagerman Hatchery, released below Bonneville	Hanford Reach, 1982	Spawning Ground	2,439	1	10
Hagerman Hatchery	Hanford Reach, 1982	Spawning Ground	2,439	1	9
Hagerman Hatchery	Hanford Reach, 1982	Spawning Ground	2,439	1	64
Bonneville Hatchery	Hanford Reach, 1982	Spawning Ground	2,439	1	64
Priest Rapids Hatchery	Hanford Reach, 1981	Spawning Ground	---	2	36
Priest Rapids Hatchery	Hanford Reach, 1982	Spawning Ground	2,439	8	77
Priest Rapids Hatchery	Hanford Reach, 1982	Spawning Ground	2,439	1	10
Priest Rapids Hatchery	Hanford Reach, 1982	Spawning Ground	2,439	4	38
Priest Rapids Hatchery	Hanford Reach, 1982	Spawning Ground	2,439	2	129
Kalama Falls Hatchery	Hanford Reach, 1982	Spawning Ground	2,439	1	10
Lyons Ferry Hatchery	Hanford Reach, 1987	Spawning Ground	6,102	1	21
Lyons Ferry Hatchery	Hanford Reach, 1988	Spawning Ground	5,519	1	21
Lyons Ferry Hatchery	Hanford Reach, 1989	Spawning Ground	4,813	3	52
Priest Rapids Hatchery	Hanford Reach, 1984	Spawning Ground	---	3	34
Priest Rapids Hatchery	Hanford Reach, 1985	Spawning Ground	4,145	1	22
Priest Rapids Hatchery	Hanford Reach, 1985	Spawning Ground	4,145	1	22

Table 3 (cont.) Immigration of coded wire tagged fall chinook into the Hanford Reach subbasin.

Hatchery/Release Site	Recovery site, Run **Year(s)**	Recovery Method	Number Sampled	Number Recovered	Total Number Estimated, (PSMFC)
Priest Rapids Hatchery	Hanford Reach. 1986	Spawning Ground	5,877	2	57
Priest Rapids Hatchery	Hanford Reach, 1989	Spawning Ground	4,813	1	17
Priest Rapids Hatchery	Hanford Reach. 1986	Spawning Ground	5,877	4	114
Priest Rapids Hatchery	Hanford Reach, 1987	Spawning Ground	6,102	2	42
Priest Rapids Hatcherv	Hanford Reach, 1986	Spawning Ground	5,877	21	599
Priest Rapids Hatchery	Hanford Reach, 1987	Spawning Ground	6,102	6	125
Priest Rapids Hatchery	Hanford Reach, 1986	Spawning Ground	5,877	1	29
Priest Rapids Hatchery	Hanford Reach. 1987	Spawning Ground	6,102	5	104
Priest Rapids Hatchery	Hanford Reach, 1988	Spawning Ground	5,519	4	85
Priest Rapids Hatcherv	Hanford Reach, 1986	Spawning Ground	5,877	2	57
Priest Rapids Hatchery	Hanford Reach, 1987	Spawning Ground	6,102	3	62
Priest Rapids Hatchery	Hanford Reach, 1988	Spawning Ground	5,519	4	85
Priest Rapids Hatchery	Hanford Reach. 1987	Spawning Ground	6,102	3	62
Priest Rapids Hatchery	Hanford Reach, 1988	Spawning Ground	5,519	1	21
Priest **Rapids** Hatcherv	Hanford Reach. 1983	Spawning Ground	---	2	30
Priest Rapids Hatchery	Hanford Reach, 1983	Spawning Ground	---	6	89
Priest **Rapids** Hatcherv	Hanford Reach. 1986	Spawning Ground	5,877	1	29
Priest Rapids Hatchery	Hanford Reach, 1988	Spawning Ground	5,519	1	21

Table 3 (cont.) Immigration of coded wire tagged fall chinook into the Hanford Reach subbasin.

Hatchery/Release Site	Recovery site, Run Year(s)	Recovery Method	Number Sampled	Number Recovered	Total Number Estimated, (PSMFC)
Priest Rapids Hatchery	Hanford Reach, 1989	Spawning Ground	4,813	1	17
Priest Rapids Hatchery	Hanford Reach, 1988	Spawning Ground	5,519	1	21
Priest Rapids Hatchery	Hanford Reach, 1989	Spawning Ground	4,813	1	17
Priest Rapids Hatchery	Hanford Reach, 1988	Spawning Ground	5,519	1	21
Turtle Rock Pond (Rocky Reach)	Hanford Reach, 1986	Spawning Ground	5,877	79	89
Turtle Rock Pond (Rocky Reach)	Hanford Reach, 1987	Spawning Ground	6,102	5	5
Turtle Rock Pond (Rocky Reach)	Hanford Reach, 1987	Spawning Ground	6,102	7	8
Turtle Rock Pond (Rocky Reach)	Hanford Reach, 1988	Spawning Ground	5,519	19	20
Turtle Rock Pond (Rocky Reach)	Hanford Reach, 1989	Spawning Ground	4,813	8	8

Based on the following tag codes: 05-04-20, 05-05-27, 10-22- 11, 07-25-07, 63- 18-21, 63-18-57, 63-19-48, 63-22-61, 63-19-57, 63-21-52, 63-41-59, 63-19-48, 63-21-55, 63-22-52, 63-23-30, 63-26-11, 63-26-12, 63-28-48, 63-28-59, 63-28-60, 63-18-21, 63-19-48, 63-32-22, 63-41-02, 63-41-28, 63-28-44, 63-28-57, and 63-31-12.

Beginning with the 1978 brood.

Table 4 (AC). Age composition percentage (freshwater.ocean) by brood year for fall chinook spawning naturally in Hanford Reach.

Age Composition (%)

Brood Year	N	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4
1978										
1979										
1980										
1981	1,154	13.86	47.05	23.92	15.08		0.09			
1982	1,486	35.00	11.51	36.20	16.62	0.13		0.27	0.27	
1983	1,267	11.76	19.81	38.91	24.63	0.55	1.34	1.10	1.82	0.08
1984	1,694	12.93	19.07	29.69	35.83	0.30	0.12	0.89	1.17	
1985										
1986										
1987										
1988										

Table 5 (AS). Percent females by brood year and age class (freshwater.ocean) for fall chinook spawning naturally in Hanford Reach.

Females (%)

Brood Year	N	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	Total % Female
1976											
1977											
1978					62.07	0					
1979				65.04	69.46						
1980			11.65	59.87	64.16	62.50					
1981	375	0	9.02	68.84	78.16		0				32.50
1982	548	0	9.94	66.73	66.80	100.00		25.00	100.00		36.87
1983	581	0	8.37	63.49	69.55	85.71	0	50.00	69.56	100.00	45.86
1984	800	0	9.91	67.59	66.56	80.00	0	46.67	65.00		47.22
1985											
1986											
1987											
1988											

Table 6 (AL-a). Mean fork length by brood year and age class (freshwater.ocean) for male fall chinook spawning naturally in' Hanford Reach.

Mean Fork Length (cm)

Brood Year	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4
1978				106	110			101	
N				66	1			5	
St. Dev.				7.51	---			6.87	
1979			92	106					
N			596	135					
St. Dev.			10.17	5.47					
1980		66	91	107	110		85		
N		584	630	62	3		1		
St. Dev.		7.21	8.86	6.95	5.69		---		
1981	43	65	90	105		55			
N	160	494	86	38		1			
St. Dev.	4.33	7.67	10.27	7.94		---			
1982	42	67	92				67		
N	520	154	179				3		
St. Dev.	4.14	7.41	9.27				3.00		
1983	46	66				58			
N	149	230				17			
St. Dev.	5.76	6.59				3.94			
1984	42								
N	219								
St. Dev.	4.81								

Table 7 (AL-b). Mean fork length by brood year and age class (freshwater.ocean) for female fall chinook spawning naturally in Hanford Reach.

Mean Fork Length (cm)

Brood Year	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4
1978				94				90	
N				108				8	
St. Dev.				5.19				5.89	
1979			87	96					
N			1,109	307					
St. Dev.			5.59	4.96					
1980		72	87	97	95			91	
N		77	940	111	5			1	
St. Dev.		6.48	5.69	4.9	8.35			---	
1981		70	88	96					
N		49	190	136					
St. Dev.		6.86	6.26	5.26					
1982		75	87				88		
N		17	359				1		
St. Dev.		5.22	5.84				---		
1983		70							
N		21							
St. Dev.		6.31							
1984									
N									
St. Dev.									

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Priest Rapids Hatchery Fall Chinook

GEOGRAPHIC LOCATION

Priest Rapids Hatchery is located just downstream from Priest Rapids Dam (RM 397).

ORIGIN

Priest Rapids Hatchery has released fall chinook annually since 1971. Prior to 1971, the facility operated as a spawning channel. Fall chinook spawning stock for the Priest Rapids channel were primarily obtained by trapping in the left bank fish ladder at Priest Rapids Dam and voluntary returns.

DISTRIBUTION

Fall chinook once migrated as far as the San Poil, Spokane, Pend Oreille, and Kootenay rivers in the Columbia and ascended the Snake River to the base of Shoshone Falls (Fulton 1968). Most hatchery upriver brights (URB's) are now produced at Priest Rapids Hatchery.

PRODUCTION

Priest Rapids spawning channel was constructed as a mitigative facility for fall chinook salmon spawning habitat inundated by Priest Rapids and Wanapum reservoirs on the Columbia River. The channel is located on the cast bank of the river immediately below Priest Rapids Dam. Operation of the channel commenced in September 1963.

Priest Rapids Hatchery is located just downstream from Priest Rapids Dam and has released fall chinook annually since 197 1. Until about 1981, releases from Priest Rapids Hatchery ranged from 1 million to 3 million fingerlings. As water sources, hatchery facilities, and production programming developed, releases stabilized near the six million fish mark. Hatchery releases are available in Table 4.

To ensure meeting egg-take requirements and to increase the likelihood of mixing natural fish into the hatchery population, managers have collected some brood stock at a trap located in the left bank fishway at Priest Rapids Dam. Since tag codes recovered in this group of fish indicate many are bound for Rocky Reach or Wells hatcheries, managers are phasing out this practice. The number of adult spawners recorded in hatchery records are usually voluntary hatchery returns and Priest Rapids Dam fishway captures. Other measures to attract adults into the hatchery, such as adding olfactory cues to the hatchery effluent, show promise of eliminating shortfalls in adult returns. Priest Rapids Hatchery fall chinook returns from 1979-1984 brood year averaged 18,154 with a low return of 6,487 for the 1979 brood year and a peak of 33,280 for the 1983 brood year. Total age of fall chinook returning to the Priest Rapids Hatchery, by brood year is available in Table 1.

ADULT LIFE HISTORY

Run size, catch and escapement

Ocean commercial and recreational fisheries from Alaska to Washington, in addition to Columbia River gill net and sport fisheries all harvest a portion of the Hanford Reach origin fall chinook. Columbia River sport and commercial fisheries are managed to ensure attainment of natural spawn escapement.

Strays from other hatcheries are not unusual. Tables 2 and 3 list the coded wire tags recovered within the Priest Rapids Hatchery which originated outside of Priest Rapids Hatchery. Hanford Reach **CWT's** were the predominant tags recovered.

Time of Migration

The main portion of the run begins entering the Columbia River about the third week of August. Passage over Bonneville Dam generally reaches a peak between September 4 and September 10. Without extensive downstream fisheries, the maximum count at McNary Dam would probably occur about a week later than the peak count at Bonneville Dam. A critical in-river harvest management period occurs from about September 1 through September 14 when most of the run migrates past Bonneville Dam.

Spawning Period

Spawning extends from late October, peaking in mid to late November and tapering off into December.

Spawning Areas

See Distribution.

Age Comoosition

Age ranges from two-year-old jacks to six-year-old adults with two-year-old jacks the dominant return overall and four-year-olds usually the dominant age class for the adults. Age composition is summarized in Table 1.

Sex Ratio

No data available.

Fecundity

No data available.

JUVENILE LIFE HISTORY

Time of Emergence

For the 1963-1967 brood years at the Priest Rapids Hatchery spawning channel, eyed-egg stage was most prevalent during late December to early January.

Time, age and size at migration

Downstream migration studies with juveniles from the Priest Rapids spawning channel showed that fingerlings released in May and June arrived at McNary Dam (105 miles downstream) in late July and early August (Allen and Meekin 1973). The five year median (1984-1988) for sub-yearling chinook passing through McNary Dam has generally occurred on July 9 with 90% of the sub-yearlings passing through McNary Dam by July 24. Estuary arrival occurs about a month later (Howell et al. 1985).

Survival Rate

Coded-wire tag recoveries for Priest Rapids Hatchery fish indicated an average of 0.8 percent survival for three release groups (Howell et al. 1985).

DISEASE

Bacteria and parasitic diseases found in the Priest Rapids Hatchery are listed in Table 5 (WDF Salmon Culture, Olympia).

BIOCHEMICAL-GENETIC CHARACTERISTICS

The upriver bright run from the Hanford Reach has been characterized electrophoretically and is genetically distinct from four other major runs of upriver bright fall chinook in the Columbia and Snake rivers (J. Shaklee, WDF, pers. commun.). The run that returns voluntarily to the Priest Rapids Salmon Hatchery and the Hanford natural fish are genetically the most similar.

Table 1 **(RH).** Total age of fall chinook returning to the Priest Rapids Hatchery, by brood year.

Total Age

Brood Year	2	3	4	5	6	7	Total	Adult Total
1974								
1975					0			
1976				246	0			
1977			1,355	314	6			
1978		779	633	268	4			1,684
1979	1,523	2,584	1,868	474	38		6,487	4,964
1980	4,201	2,668	4,197	1,604	31		12,701	8,500
1981	1,214	2,978	4,264	711	0		9,167	7,953
1982	5,581	7,585	7,292	2,121	60	1	22,640	17,059
1983	17,266	5,374	8,543	2,038	59		33,280	16,014
1984	7,637	8,112	6,160	2,610	129		24,648	17,011
1985	1,334	1,862	2,298	1,206				
1986	1,531	1,707	1,954					
1987	202	306						
1988	335							

1990 return year includes 106 chinook trapped at Priest Rapids Dam left ladder.
1988 return year includes 709 fall chinook trapped at Priest Rapids Dam left ladder.
1987 return year includes 855 fall chinook trapped at Priest Rapids left ladder.
1986 return year includes 2,119 fall chinook trapped at Priest Rapids Dam left ladder. Does not include 3,825 jacks and 1,583 adult male fall chinook that were passed upstream from Priest Rapids Dam during trapping.
1985 return year includes 6,165 fall chinook trapped at Priest Rapids Dam left ladder.
1984 return year includes 7,311 fall chinook trapped at Priest Rapids Dam left ladder.
1983 return year includes 1,788 adult and 2,371 jack fall chinook trapped at Priest Rapids Dam left ladder.
1982 return year includes 2,513 adults and 4,858 jack fall chinook trapped at Priest Rapids Dam left ladder.
1981 return year includes 1,224 adult and 1,272 jack fall chinook trapped at Priest Rapids Dam left ladder.

Table 2 (AE). Emigration of coded wire tagged fall chinook from the Priest Rapids Hatchery.

Hatchery/Release Site	Recovery site, Run Year(s)	Recovery Method	Number Sampled	Number Recovered	Total Number Estimated, (PSMFC)
Priest Rapids Hatchery	Wells Hatchery, 1980	Hatchery	---	1	1
Priest Rapids Hatchery	Hanford Reach, 1981	Spawning Ground	---	2	36
Priest Rapids Hatchery	Hanford Reach, 1982	Spawning Ground	2,439	8	77
Priest Rapids Hatchery	Hanford Reach, 1982	Spawning Ground	2,439	1	10
Priest Rapids Hatchery	Ringold, 1982	Hatchery	191	1	1
Priest Rapids Hatchery	Lewis, 1982	Spawning Ground	2,939	1	3
Priest Rapids Hatchery	Hanford Reach, 1982	Spawning Ground	2,439	4	38
Priest Rapids Hatchery	Hanford Reach, 1982	Spawning Ground	2,439	2	129
Priest Rapids Channel	Ringold Hatchery, 1983	Hatchery	1,138	1	1
Priest Rapids Channel	Hanford Reach, 1983	Spawning Ground	2,787	2	30
Priest Rapids Channel	Hanford Reach, 1983	Spawning Ground	---	6	89
Priest Rapids Channel	Wells Dam Sp. Channel, 1983	Hatchery	837	1	1
Priest Rapids Channel	Wells Dam Sp. Channel, 1983	Hatchery	837	2	2
Priest Rapids Channel	Lyons Ferry, 1988	Hatchery	1,413	1	1
Priest Rapids Channel	Lyons Ferry, 1989	Hatchery	1,880	1	1
Priest Rapids Channel	Lyons Ferry, 1989	Hatchery	1,880	1	1
Priest Rapids Channel	Hanford Reach, 1984	Spawning Ground	---	3	34
Priest Rapids Channel	Hanford Reach, 1985	Spawning Ground	4,145	1	22
Priest Rapids Channel	Hanford Reach, 1985	Spawning Ground	4,145	1	22

Table 2 (cont). Emigration on coded wire tagged fall chinook from the Priest Rapids Hatchery.

Hatchery/Release Site	Recovery site, Run Year(s)	Recovery Method	Number Sampled	Number Recovered	Total Number Estimated, (PSMFC)
Priest Rapids Channel	Hanford Reach, 1986	Spawning Ground	5,877	2	57
Priest Rapids Channel	Hanford Reach, 1989	Spawning Ground	4,813	1	17
Priest Rapids Channel	Hanford Reach. 1986	Spawning Ground	5,877	4	114
Priest Rapids Channel	Hanford Reach, 1987	Spawning Ground	6,102	2	42
Priest Rapids Channel	Hanford Reach, 1986	Spawning Ground	5,877	21	599
Priest Rapids Channel	Hanford Reach, 1987	Spawning Ground	6,102	6	125
Priest Rapids Channel	Hanford Reach, 1986	Spawning Ground	5,877	1	29
Priest Rapids Channel	Hanford Reach, 1987	Spawning Ground	6,102	5	104
Priest Rapids Channel	Hanford Reach, 1988	Spawning Ground	5,519	4	85
Priest Rapids Channel	Hanford Reach, 1986	Spawning Ground	5,877	2	57
Priest Rapids Channel	Hanford Reach, 1987	Spawning Ground	6,102	3	62
Priest Rapids Channel	Hanford Reach, 1988	Spawning Ground	5,519	4	85
Priest Rapids Channel	Hanford Reach, 1987	Spawning Ground	6,102	3	62
Priest Rapids Channel	Hanford Reach, 1988	Spawning Ground	5,519	1	21
Priest Rapids Channel	Hanford Reach, 1986	Spawning Ground	5,877	1	29
Priest Rapids Channel	Hanford Reach, 1988	Spawning Ground	5,519	1	21
Priest Rapids Channel	Hanford Reach, 1989	Spawning Ground	4,813	1	17
Priest Rapids Channel	Hanford Reach, 1988	Spawning Ground	5,519	1	21
Priest Rapids Channel	Hanford Reach, 1989	Spawning Ground	4,813	1	17

Table 2 **(cont).** Emigration on coded wire tagged fall chinook from the Priest Rapids Hatchery.

Hatchery/Release Site	Recovery site, Run Year(s)	Recovery Method	Number Sampled	Number Recovered	Total Number Estimated, (PSMFC)
Priest Rapids Channel	Hanford Reach, 1988	Spawning Ground	5,519	1	21
Priest Rapids Channel	Sand Hollow Creek, 1989	Spawning Ground	81	1	---
Priest Rapids Channel	Sand Hollow Creek, 1988	Spawning Ground	260	1	---
Priest Rapids Channel	Sand Hollow Creek, 1988	Spawning Ground	260	3	---
Priest Rapids Channel	Sand Hollow Creek, 1988	Spawning Ground	260	2	---
Priest Rapids Channel	Sand Hollow Creek, 1989	Spawning Ground	81	1	---
Priest Rapids Channel	Rocky Reach, 1986	Hatchery	257	1	1
Priest Rapids Channel	Rocky Reach, 1986	Hatchery	257	1	1
Priest Rapids Channel	Rocky Reach, 1986	Hatchery	257	1	1
Priest Rapids Channel	Rocky Reach, 1986	Hatchery	142	1	1
Priest Rapids Channel	Wells Dam Sp Channel, 1985	Hatchery	1,397	1	1
Priest Rapids Channel	Wells Dam Sp Channel, 1985	Hatchery	1,397	4	5
Priest Rapids Channel	Wells Dam Sp Channel, 1986	Hatchery	1,901	2	2
Priest Rapids Channel	Wells Dam Sp Channel, 1986	Hatchery	1,901	1	1
Priest Rapids Channel	Wells Dam Sp Channel, 1987	Hatchery	997	1	1
Priest Rapids Channel	Wells Dam Sp Channel, 1989	Hatchery	1,642	4	4
Priest Rapids Channel	Wells Dam Sp Channel, 1986	Hatchery	1,901	3	3
Priest Rapids Channel	Wells Dam Sp Channel, 1986	Hatchery	1,901	13	13
Priest Rapids Channel	Wells Dam Sp Channel, 1986	Hatchery	1,901	6	6

Table 2 **(cont).** Emigration on coded wire tagged fall chinook from the Priest Rapids Hatchery.

Hatchery/Release Site	Recovery site, Run Year(s)	Recovery Method	Number Sampled	Number Recovered	Total Number Estimated, (PSMFC)
Priest Rapids Channel	Wells Dam Sp Channel, 1986	Hatchery	1,901	8	8
Priest Rapids Channel	Wells Dam Sp Channel, 1987	Hatchery	997	2	2
Priest Rapids Channel	Wells Dam Sp Channel, 1988	Hatchery	1,174	1	1
Priest Rapids Channel	Wells Dam Sp Channel, 1986	Hatchery	318	5	5
Priest Rapids Channel	Wells Dam Sp Channel, 1987	Hatchery	997	1	1
Priest Rapids Channel	Wells Dam Sp Channel, 1988	Hatchery	1,174	1	1
Priest Rapids Channel	Wells Dam Sp Channel, 1986	Hatchery	1,901	2	2
Priest Rapids Channel	Wells Dam Sp Channel, 1987	Hatchery	997	3	3
Priest Rapids Channel	Wells Dam Sp Channel, 1988	Hatchery	1,174	1	1
Priest Rapids Channel	Wells Dam Sp Channel, 1986	Hatchery	318	2	2
Priest Rapids Channel	Wells Dam Sp Channel, 1988	Hatchery	1,174	6	6
Priest Rapids Channel	Wells Dam Sp Channel, 1989	Hatchery	1,642	7	7
Priest Rapids Channel	Wells Dam Sp Channel, 1986	Hatchery	318	1	1
Priest Rapids Channel	Wells Dam Sp Channel, 1988	Hatchery	1,174	3	3
Priest Rapids Channel	Wells Dam Sp Channel, 1989	Hatchery	1,642	3	3
Priest Rapids Channel	Wells Dam Sp Channel, 1988	Hatchery	1,174	1	1
Priest Rapids Channel	Wells Dam Sp Channel, 1989	Hatchery	1,642	5	5

Based on the following tag codes: 63-18-21, 63-18-57, 63-19-48, 63-22-61, 63-23-30, 63-41-28, 63-21-55, 63-22-52, 63-26-l 1, 63-26-12, 63-28-48, 63-28-59, 63-28-60, 63-32-22, 63-41-02, 63-32-21, and 63-24-56.
Beginning with the 1978 brood.

Table 3 (AI). Immigration of coded wire tagged fall chinook to the Priest Rapids Hatchery rack.

Hatchery/Release Site	Recovery site, Run Year(s)	Recovery Method	Number Sampled	Number Recovered	Total Number Estimated, (PSMFC)
Trinity River	Priest Rapids, 1982	Hatchery	5,732	1	1
Hagerman	Priest Rapids, 1981	Hatchery	---	1	2
Turtle Rock	Priest Rapids, 1986	Hatchery	13,374	79	89
Turtle Rock	Priest Rapids, 1987	Hatchery	18,085	5	5
Turtle Rock	Priest Rapids, 1986	Hatchery	13,374	7	8
Turtle Rock	Priest Rapids, 1987	Hatchery	18,085	19	20
Turtle Rock	Priest Rapids, 1988	Hatchery	9,928	8	8
Turtle Rock	Priest Rapids, 1988	Hatchery	9,928	3	3
Turtle Rock	Priest Rapids, 1988	Hatchery	9,928	7	7
Turtle Rock	Priest Rapids, 1989	Hatchery	6,496	5	5
Turtle Rock	Priest Rapids, 1989	Hatchery	381	1	1
Hanford/Wild	Priest Rapids, 1988	Hatchery	1,391	3	3
Hanford/Wild	Priest Rapids, 1989	Hatchery	6,496	3	3

Based on the following tag codes: 06-61-09, 05 05-27, 63-28-44, 63-28-57, 63-28-58, 63-31-12, 63-49-52, and 63-41-52.

Beginning with the 1978 brood.

Table 4 (TR). Hatchery releases of fall chinook salmon into the Upper Columbia mainstem sorted by brood year, hatchery and life stage.

Brood Year	Stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /Lb.	Nunber Released	Release Site	CUT Code
1971	UNDETERMINED MIXED	R INGOLD HATCHERY	Fingr	06/29/72	06/29/72	19	46127	COLUMBIA RIVER - GEN	150508
1971	UNDETERMINED MIXED	RINGOLD HATCHERY	Fingr	06/29/72	06/29/72	19	941	COLUMBIA RIVER - GEN	UNTAGGED
1971	UNDETERMINED MIXED	RINGOLD HATCHERY	Fingr	05/20/72	05/20/72	36	976876	HANFORD REACH	UNTAGGED
1971	UNDETERMINED MIXED	RINGOLD HATCHERY	Fingr	06/30/72	06/30/72	19	152950	HANFORD REACH	UNTAGGED
1971	UNDETERMINED MIXED	RINGOLD HATCHERY	Fingr	07/06/72	07/06/72	17	18700	HANFORD REACH	UNTAGGED
1971	UNDETERMINED MIXED	RINGOLD HATCHERY	Fingr	07/11/72	07/11/72	32	121984	HANFORD REACH	UNTAGGED
1971	OREGON - BIG CREEK	WELLS DAM SP CHANNEL	Fingr	01/07/72	01/07/72	547	1747200	LAKE ROOSEVELT (53)	UNTAGGED
1973	LOWER COLUMB I A	PRIEST RAPIDS CHANNL	Fingr	06/23/74	06/23/74	130	94306	COLUMBIA RIVER	UNTAGGED
1973	LOWER COLUMBIA	PRIEST RAPIDS CHANNL	Fingr	06/23/74	06/23/74	105	2274726	COLUMBIA RIVER	UNTAGGED
1973	LOWER COLUMBIA	PRIEST RAPIDS CHANNL	F ingr	07/18/74	07/18/74	a7	540913	COLUMBIA RIVER	UNTAGGED
1973	SPRING CREEK	RINGOLD HATCHERY	Fingr	05/06/74	05/06/74	17	a92500	COLUMBIA RIVER	UNTAGGED
1973	SPRING CREEK	RINGOLD HATCHERY	Fingr	05/27/74	05/27/74	12	855000	COLUMBIA RIVER	UNTAGGED
1973	GREEN R +SKAGIT RIVS	SKAGIT HATCH.(CLARK)	Fingr	07/10/74	07/10/74	127	28327	MEDICAL LAKE (56)	UNTAGGED
1973	SPRING CREEK	WELLS DAM SP CHANNEL	PreSm	09/09/74	09/09/74	3		BANKS LAKE (42.0097)	UNTAGGED
1974	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/24/75	06/24/75	38	37715 66914	COLUMBIA RIVER	UNTAGGED
1974	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/24/75	06/24/75	38	503086	COLUMBIA RIVER	UNTAGGED
1974	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	07/15/75	07/15/75	40	714855	COLUMBIA RIVER	UNTAGGED
1974	SATSOP SPRINGS	TURTLE ROCK POND	PreSm	10/01/75	10/01/75	la	41639	COLUMBIA RIVER	UNTAGGED
1974	SATSOP SPRINGS	TURTLE ROCK POND	PreSm	09/30/75	09/30/75	25	62500	SAN POIL RIVER (52)	UNTAGGED
1974	SATSOP SPRINGS	TURTLE ROCK POND	PreSm	10/01/75	10/01/75	la	31891	SAN POIL RIVER (52)	UNTAGGED
1974	DESCHUTES RIVER	WELLS DAM SP CHANNEL	PreSm	10/28/75	10/28/75	20	35510	BANKS LAKE (42.0097)	UNTAGGED
1975	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	07/01/76	07/01/76	95	759480	COLUMBIA RIVER	UNTAGGED
1975	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	07/01/76	07/01/76	37	296839	COLUMBIA RIVER	UNTAGGED
1975	LOWER COLUMBIA	PRIEST RAPIDS CHANNL	Fingr	07/10/76	07/10/76	40	547439	COLUMBIA RIVER	UNTAGGED
1975	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	07/01/76	07/01/76	95	132004	COLUMBIA RIVER - GEN	131101
1975	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	07/01/76	07/01/76	95	759480	COLUMBIA RIVER - GEN	UNTAGGED
1975	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	07/01/76	07/01/76	37	152412	COLUMBIA RIVER - GEN	131202
1975	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	07/01/76	07/01/76	37	296839	COLUMBIA RIVER - GEN	UNTAGGED
1975	PRIEST RAPIDS	RINGOLD HATCHERY	Fingr	06/17/76	06/17/76	46	102710	COLUMBIA RIVER - GEN	130713
1975	PRIEST RAPIDS	RINGOLD HATCHERY	Fingr	06/17/76	06/17/76	46	794778	COLUMBIA RIVER - GEN	UNTAGGED
1975	PRIEST RAPIDS	RINGOLD HATCHERY	Fingr	06/17/76	06/17/76	55	794778	HANFORD REACH	UNTAGGED
1975	SKYKOMISH -MAY CREEK	TURTLE ROCK POND	PreSm	09/24/76	09/24/76	24	45840	BANKS LAKE (42.0097)	UNTAGGED
1975	SKYKOMISH -MAY CREEK	TURTLE ROCK POND	PreSm	09/27/76	09/27/76	22	26400	BANKS LAKE (42.0097)	UNTAGGED
1976	SPRING CREEK	KLICKITAT HATCHERY	PreSm	10/13/77	10/13/77		74889	SAN POIL RIVER (52)	UNTAGGED
1976	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/01/77	06/01/77	22:	241000	COLUMBIA RIVER	UNTAGGED
1976	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/24/77	06/24/77	150	57000	COLUMBIA RIVER	UNTAGGED
1976	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/24/77	06/24/77	80	314640	COLUMBIA RIVER	UNTAGGED
1976	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/24/77	06/24/77	58	91988	COLUMBIA RIVER	UNTAGGED
1976	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/28/77	06/28/77	9 6	611808	COLUMBIA RIVER	UNTAGGED
1976	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/27/77	06/27/77	96	147338	COLUMBIA RIVER - GEN	631662
1976	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/27/77	06/27/77	96	615095	COLUMBIA RIVER - GEN	UNTAGGED
1976	SPRING CREEK	WELLS DAM SP CHANNEL	Fingr	07/25/77	07/25/77	26	56337	LAKE ROOSEVELT (53)	UNTAGGED
1977	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/27/78	06/27/78	90	385560	COLUMBIA RIVER	UNTAGGED
1977	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/27/78	06/27/78	42	218400	COLUMBIA RIVER	UNTAGGED
1977	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/28/78	06/28/78	98	450600	COLUMBIA RIVER	UNTAGGED
1977	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	07/06/78	07/06/78	101	210686	COLUMBIA RIVER	UNTAGGED
1977	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	07/06/78	07/06/78	60	41520	COLUMBIA RIVER	UNTAGGED
1977	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/27/78	06/27/78	90	152532	COLUMBIA RIVER - GEN	631741
1977	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/27/78	06/27/78	90	386791	COLUMBIA RIVER - GEN	UNTAGGED
1977	PRIEST RAPIDS	RINGOLD HATCHERY	Fingr	06/23/78	06/23/78	35	146296	COLUMBIA RIVER - GEN	631745
1977	PRIEST RAPIDS	RINGOLD HATCHERY	Fingr	06/23/78	06/23/78	35	351110	COLUMBIA RIVER - GEN	UNTAGGED
1977	PRIEST RAPIDS	RINGOLD HATCHERY	Fingr	06/23/78	06/23/78	35	346674	HANFORD REACH	UNTAGGED
1977	COLUMBIA (N BONNEVL)	WELLS DAM SP CHANNEL	PreSm	08/11/78	08/11/78	50	90000	LAKE ROOSEVELT (53)	UNTAGGED
1978	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/23/79	05/23/79	74	776403	COLUMBIA RIVER	UNTAGGED
1978	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/28/79	06/28/79	77	267738	COLUMBIA RIVER	UNTAGGED

Table 4 (cont.). Hatchery releases of fall chinook salmon into the Upper Columbia mainstem sorted by brood year, hatchery and life stage.

Brood Year	Stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /lb.	Number Released	Release Site	CWT Code
1978	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/23/79	05/23/79	74	48130	COLUMBIA RIVER - GEN	631821
1978	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/23/79	05/23/79	74	778408	COLUMBIA RIVER - GEN	UNTAGGED
1978	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/28/79	06/28/79	77	17467	COLUMBIA RIVER - GEN	631857
1978	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/28/79	06/28/79	77	267852	COLUMBIA RIVER - GEN	UNTAGGED
1978	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/28/79	06/28/79	77	5316	COLUMBIA RIVER - GEN	631958
1978	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/28/79	06/28/79	77	16367	COLUMBIA RIVER - GEN	UNTAGGED
1978	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/28/79	06/28/79	77	a2243	COLUMBIA RIVER - GEN	632017
1978	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/28/79	06/28/79	77	251944	COLUMBIA RIVER - GEN	UNTAGGED
1978	PRIEST RAPIDS	RINGOLD HATCHERY	Smolt	03/26/80	03/26/80	10	275000	HANFORD REACH	UNTAGGED
1979	LOWER COLUMBIA	PRIEST RAPIDS CHANNL	Fingr	05/20/80	05/20/80	69	791920	COLUMBIA RIVER	UNTAGGED
1979	LOWER COLUMBIA	PRIEST RAPIDS CHANNL	Fingr	06/24/80	06/24/80	78	1434137	COLUMBIA RIVER	UNTAGGED
1979	LOWER COLUMBIA	PRIEST RAPIDS CHANNL	Fingr	06/26/80	06/26/80	200	46836	COLUMBIA RIVER	UNTAGGED
1979	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/20/80	06/26/80	69	147145	COLUMBIA RIVER - GEN	631948
1979	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/20/80	06/26/80	69	2858509	COLUMBIA RIVER - GEN	UNTAGGED
1979	PRIEST RAPIDS	RINGOLD HATCHERY	Fingr	06/26/80	06/26/80	88	631732	COLUMBIA RIVER	UNTAGGED
1979	ELOCHOMAN RIVER	TURTLE ROCK POND	Smolt	05/06/81	05/06/81	12	296127	COLUMBIA RIVER	UNTAGGED
1980	LOWER COLUMBIA	PRIEST RAPIDS CHANNL	Fingr	05/18/81	05/18/81	67	787884	COLUMBIA RIVER	UNTAGGED
1980	COLUMBIA (N BONNEVL)	PRIEST RAPIDS CHANNL	Fingr	06/24/81	06/24/81	a9	1555200	COLUMBIA RIVER	UNTAGGED
1980	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/24/81	06/24/81	89	2237970	COLUMBIA RIVER	UNTAGGED
1980	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/18/81	05/18/81	67	42089	COLUMBIA RIVER - GEN	632261
1980	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/18/81	05/18/81	67	787969	COLUMBIA RIVER - GEN	UNTAGGED
1980	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/24/81	06/24/81	91	194649	COLUMBIA RIVER - GEN	632155
1980	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/24/81	06/24/81	91	3794635	COLUMBIA RIVER - GEN	UNTAGGED
1980	COLUMBIA RIV BRIGHTS	RINGOLD HATCHERY	Smolt	03/18/82	03/18/82	7	788000	HANFORD REACH	UNTAGGED
1981	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/18/82	05/18/82	67	48700	COLUMBIA RIVER - GEN	632456
1981	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/18/82	05/18/82	67	a37300	COLUMBIA RIVER - GEN	UNTAGGED
1981	MID COLUMBIA RIVER	PRIEST RAPIDS CHANNL	Fingr	05/24/82	06/16/82	90	262176	COLUMBIA RIVER - GEN	632252
1981	MID COLUMBIA RIVER	PRIEST RAPIDS CHANNL	Fingr	05/24/82	06/16/82	90	4361065	COLUMBIA RIVER - GEN	UNTAGGED
1982	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/03/83	06/03/83	87	2001600	COLUMBIA RIVER	UNTAGGED
1982	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/08/83	06/08/83	88	1a30500	COLUMBIA RIVER	UNTAGGED
1982	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/21/83	06/21/83	90	1517800	COLUMBIA RIVER	UNTAGGED
1982	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/21/83	06/21/83	88	1972400	COLUMBIA RIVER	UNTAGGED
1982	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/22/83	06/22/83	63	731000	COLUMBIA RIVER	UNTAGGED
1982	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/24/83	05/24/83	84	204141	COLUMBIA RIVER - GEN	632611
1982	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	05/24/83	05/24/83	a4	1836159	COLUMBIA RIVER - GEN	UNTAGGED
1982	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/22/83	06/22/83	63	202388	COLUMBIA RIVER - GEN	632612
1982	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/22/83	06/22/83	63	712	COLUMBIA RIVER - GEN	UNTAGGED
1982	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/23/83	06/24/83	144	317061	HANFORD REACH	UNTAGGED
1982	COLUMBIA RIV BRIGHTS	TURTLE ROCK POND	Smolt	05/10/84	05/10/84	14	196208	COLUMBIA RIVER - GEN	632844
1982	COLUMBIA RIV BRIGHTS	TURTLE ROCK POND	Smolt	05/10/84	05/10/84	14	30068	COLUMBIA RIVER - GEN	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/11/84	06/11/84	93	653	COLUMBIA RIVER	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/11/84	06/11/84	84	a0947	COLUMBIA RIVER	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/11/84	06/11/84	84	176147	COLUMBIA RIVER	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/11/84	06/11/84	a4	1883453	COLUMBIA RIVER	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/13/84	06/13/84	76	1724963	COLUMBIA RIVER	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/19/84	06/19/84	74	151200	COLUMBIA RIVER	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/19/84	06/19/84	74	499100	COLUMBIA RIVER	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/19/84	06/19/84	74	1206800	COLUMBIA RIVER	UNTAGGED
1983	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	07/03/84	07/03/84	84	245000	COLUMBIA RIVER	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	07/03/84	07/03/84	a4	1862000	COLUMBIA RIVER	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	07/10/84	07/10/84	80	1687000	COLUMBIA RIVER	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/13/84	06/13/84	76	74170	COLUMBIA RIVER - GEN	632848
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/13/84	06/13/84	76	575313	COLUMBIA RIVER - GEN	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/13/84	06/13/84	76	74392	COLUMBIA RIVER - GEN	632859
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/13/84	06/13/84	76	577036	COLUMBIA RIVER - GEN	UNTAGGED

Table 4 (cont.). Hatchery releases of fall chinook salmon into the Upper Columbia mainstem sorted by brood year, hatchery and life stage.

Brood Year	Stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /Lb.	Number Released	Release Site	CUT Code
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/13/84	06/13/84	76	74170	COLUMBIA RIVER - GEN	632860
1983	COLUMBIA RIV BRIGHTS	PRIEST RAPIDS CHANNL	Fingr	06/13/84	06/13/84	76	575313	COLUMBIA RIVER - GEN	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	RINGOLD HATCHERY	Fingr	05/22/84	05/22/84	55	21D0000	HANFORD REACH	UNTAGGED
1983	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/25/84	06/25/84	130	199121	HANFORD REACH	051525
1983	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/25/84	06/25/84	130	1669845	HANFORD REACH	UNTAGGED
1983	SNAKE X PRIEST RAPID	TURTLE ROCK POND	Fingr	07/10/84	07/10/84	117	533800	COLUMBIA RIVER	UNTAGGED
1983	SNAKE X PRIEST RAPID	TURTLE ROCK POND	Smolt	05/01/85	05/01/85	10	197528	COLUMBIA RIVER - GEN	632857
1983	SNAKE X PRIEST RAPID	TURTLE ROCK POND	Smolt	05/01/85	05/01/85	10	56272	COLUMBIA RIVER - GEN	UNTAGGED
1984	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/05/85	06/05/85	65	1625000	COLUMBIA RIVER	UNTAGGED
1984	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/11/85	06/11/85	68	1284500	COLUMBIA RIVER	UNTAGGED
1984	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/15/85	06/15/85	60	1469100	COLUMBIA RIVER	UNTAGGED
1984	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/18/85	06/18/85	65	78312	COLUMBIA RIVER	UNTAGGED
1984	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/18/85	06/18/85	65	1109688	COLUMBIA RIVER	UNTAGGED
1984	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/11/85	06/11/85	54	103665	COLUMBIA RIVER - GEN	633221
1984	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/11/85	06/11/85	54	606652	COLUMBIA RIVER - GEN	UNTAGGED
1984	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/11/85	06/11/85	54	105224	COLUMBIA RIVER - GEN	633222
1984	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/11/85	06/11/85	54	606659	COLUMBIA RIVER - GEN	UNTAGGED
1984	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Smolt	04/01/86	04/01/86	8	107461	COLUMBIA RIVER - GEN	632330
1984	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Smolt	04/01/86	04/01/86	8	88539	COLUMBIA RIVER - GEN	UNTAGGED
1984	PRIEST RAPIDS	RINGOLD HATCHERY	Smolt	04/01/86	04/01/86	6	50000	HANFORD REACH	UNTAGGED
1984	PRIEST RAPIDS	RINGOLD HATCHERY	Smolt	04/01/86	04/01/86	6	1250000	HANFORD REACH	UNTAGGED
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/18/85	06/19/85	82	185399	HANFORD REACH	UNTAGGED
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/19/85	06/19/85	87	194965	HANFORD REACH	051524
1984	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	06/19/85	06/19/85	87	4999	HANFORD REACH	UNTAGGED
1984	SNAKE X PRIEST RAPID	TURTLE ROCK POND	PreSm	08/07/85	08/07/85	143	95500	COLUMBIA RIVER	UNTAGGED
1984	SNAKE X PRIEST RAPID	TURTLE ROCK POND	Smol t	05/05/86	05/05/86	11	202861	COLUMBIA RIVER - GEN	632858
1984	SNAKE X PRIEST RAPID	TURTLE ROCK POND	Smolt	05/05/86	05/05/86	11	49407	COLUMBIA RIVER - GEN	UNTAGGED
1985	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/10/86	06/10/86	60	1199849	COLUMBIA RIVER	UNTAGGED
1985	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/10/86	06/10/86	58	100151	COLUMBIA RIVER	UNTAGGED
1985	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/19/86	06/19/86	61	1187000	COLUMBIA RIVER	UNTAGGED
1985	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/24/86	06/24/86	64	922000	COLUMBIA RIVER	UNTAGGED
1985	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/05/86	06/12/86	58	203534	COLUMBIA RIVER - GEN	634102
1985	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/05/86	06/12/86	58	2750466	COLUMBIA RIVER - GEN	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/22/86	05/22/86	101	45919	HANFORD REACH	051758
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/22/86	05/22/86	101	49857	HANFORD REACH	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/22/86	05/22/86	101	44658	HANFORD REACH	051759
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/22/86	05/22/86	101	51118	HANFORD REACH	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/22/86	05/22/86	101	45106	HANFORD REACH	05 1760
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/22/86	05/22/86	101	50671	HANFORD REACH	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/22/86	05/22/86	101	45364	HANFORD REACH	051761
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/22/86	05/22/86	101	50412	HANFORD REACH	UNTAGGED
1985	COLUMBIA RIV BRIGHTS	SPRING CR NF HATCHRY	Fingr	05/22/86	05/23/86	105	383106	HANFORD REACH	UNTAGGED
1985	PRIEST RAPIDS	TURTLE ROCK POND	Smolt	05/05/87	05/05/87	9	208492	COLUMBIA RIVER - GEN	633112
1985	PRIEST RAPIDS	TURTLE ROCK POND	Smolt	05/05/87	05/05/87	9	28975	COLUMBIA RIVER - GEN	UNTAGGED
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/15/87	06/15/87	51	200645	COLUMBIA RIVER	UNTAGGED
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/15/87	06/15/87	51	901355	COLUMBIA RIVER	UNTAGGED
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/08/87	06/25/87	55	201779	COLUMBIA RIVER - GEN	634128
1986	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/08/87	06/25/87	55	4744221	COLUMBIA RIVER - GEN	UNTAGGED
1986	WELLS DAM	TURTLE ROCK POND	Fingr	05/20/87	05/20/87	140	247500	COLUMBIA RIVER	UNTAGGED
1986	UELLS DAM	TURTLE ROCK POND	Smolt	04/28/88	04/28/88	9	227964	COLUMBIA RIVER - GEN	632843
1986	WELLS DAM	TURTLE ROCK POND	Smolt	04/28/88	04/28/88	9	1838	COLUMBIA RIVER - GEN	UNTAGGED
1986	UELLS DAM	UELLS DAM SP CHANNEL	Fingr	03/25/87	03/25/87	264	100000	BUFFALO LAKE (53)	UNTAGGED
1986	UELLS DAM	WELLS DAM SP CHANNEL	Fingr	03/24/87	03/24/87	264	198372	TWIN LAKES	UNTAGGED
1987	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/06/88	06/06/88	69	40887	COLUMBIA RIVER	UNTAGGED
1987	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/09/88	06/09/88	61	38045	COLUMBIA RIVER	UNTAGGED

Table 4 (cont.). Hatchery releases of fall chinook salmon into the Upper Columbia mainstem sorted by brood year, hatchery and life stage.

Brood Year	stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /Lb.	Number Released	Release Site	CUT Code
1987	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/12/88	06/12/88	74	43486	COLUMBIA RIVER	UNTAGGED
1987	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/15/88	06/15/88	60	36356	COLUMBIA RIVER	UNTAGGED
1987	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/18/88	06/18/88	77	45230	COLUMBIA RIVER	UNTAGGED
1987	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/06/88	06/18/88	69	196221	COLUMBIA RIVER - GEN	635226
1987	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/06/88	06/18/88	69	7308775	COLUMBIA RIVER - GEN	UNTAGGED
1987	MID COLUMBIA RIVER	QDNR (WILDSTOCK- N	EmFry	05/23/88	06/06/88	285	205103	HANFORD REACH	635232
1987	MID COLUMBIA RIVER	QDNR (WI LDSTOCK- N	EmFry	05/23/88	06/06/88	285	1446	HANFORD REACH	UNTAGGED
1987	PRIEST RAPIDS	TURTLE ROCK POND	Smolt	04/27/89	04/27/89	9	175069	COLUMBIA RIVER - GEN	634952
1987	PRIEST RAPIDS	TURTLE ROCK POND	Smolt	04/27/89	04/27/89	9	14931	COLUMBIA RIVER - GEN	UNTAGGED
1988	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/12/89	06/12/89	56	40600	COLUMBIA RIVER	UNTAGGED
1988	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/18/89	06/18/89	49	40320	COLUMBIA RIVER	UNTAGGED
1988	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/25/89	06/25/89	47	40620	COLUMBIA RIVER	UNTAGGED
1988	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/27/89	06/27/89	47	40450	COLUMBIA RIVER	UNTAGGED
1988	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/29/89	06/29/89	44	40553	COLUMBIA RIVER	UNTAGGED
1988	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/12/89	06/29/89	56	201608	COLUMBIA RIVER - GEN	635249
1988	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/12/89	06/29/89	56	5000399	COLUMBIA RIVER - GEN	UNTAGGED
1988	HANFORD REACH	QDNR (UILDSTOCK- N	FeFry	06/10/89	06/10/89		200630	HANFORD REACH	635252
1988	HANFORD REACH	QDNR (WILDSTOCK- N	FeFry	06/10/89	06/10/89		5144	HANFORD REACH	UNTAGGED
1988	PRIEST RAPIDS	TURTLE ROCK POND	Smolt	04/27/90	04/27/90	8	230000	COLUMBIA RIVER	UNTAGGED
1989	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/07/90	06/07/90	57	39360	COLUMBIA RIVER	UNTAGGED
1989	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/10/90	06/10/90	59	40170	COLUMBIA RIVER	UNTAGGED
1989	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/13/90	06/13/90	61	40150	COLUMBIA RIVER	UNTAGGED
1989	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/16/90	06/16/90	63	40450	COLUMBIA RIVER	UNTAGGED
1989	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/19/90	06/19/90	59	40380	COLUMBIA RIVER	UNTAGGED
1989	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/07/90	06/19/90	57	194530	COLUMBIA RIVER - GEN	630732
1989	PRIEST RAPIDS	PRIEST RAPIDS CHANNL	Fingr	06/07/90	06/19/90	57	6036060	COLUMBIA RIVER - GEN	UNTAGGED
1989	HANFORD REACH	PDNR (UILDSTOCK- N	Fingr	05/30/90	06/05/90		144164	HANFORD REACH	630755
1989	HANFORD REACH	QDNR (UILDSTOCK- N	Fingr	05/30/90	06/05/90		4234	HANFORD REACH	UNTAGGED
1989	UELLS DAM	TURTLE ROCK POND	Fingr	03/21/90	03/21/90	420	438300	COLUMBIA RIVER	UNTAGGED
1989	WELLS DAM	TURTLE ROCK POND	Fingr	03/21/90	03/21/90	311	241500	COLUMBIA RIVER	UNTAGGED

Table 5 (TD). Parasites and diseases of fall chinook at the Priest Rapids Hatchery.

Disease type	Hatchery	Specific Pathogen
Bacteria	Priest Rapids	*Yersinia ruckeri* (Enteric Redmouth Disease)
Parasite	Priest Rapids	*Ichthyopthirius multifilis* (Ichthyopthirius)
	Priest Rapids	Coagulated Yolk

Disease history only represents pathogens isolated at the hatchery and not necessarily a disease outbreak.

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UPPER COLUMBIA RIVER

Wells Hatchery Summer Steelhead

GEOGRAPHIC LOCATION

The Wells Salmon and Steelhead Hatchery is located on the upper-Columbia River immediately downstream of Wells Dam at river mile (RM) 516.

ORIGIN

The Wells summer steelhead broodstock was developed in the early 1960's at the Wells Hatchery. Wells broodstock were originally developed from wild summer steelhead stocks captured from above Priest Rapids Dam.

PRODUCTION

Production Facilities

The hatchery was constructed by Wells County Public Utility District in 1967. The County PUD maintains the facility while the departments of Wildlife and Fisheries manage fish rearing operations. Rearing areas consist of 40 15 ft x 1 ft troughs, 10 10 ft x 100 ft raceways and four 1.5 acre rearing ponds. Incubation is by vertical stacks and hatchery troughs. Hatchery water is supplied from wells and the Columbia River.

Production Summary

Wells Hatchery annually produces approximately 500,000 to 750,000 summer steelhead smolts. Wells Hatchery released approximately 740,000 steelhead smolts between June 1989 and July 1990. Progeny of fish spawned at Wells Hatchery are also reared at Chelan and Leavenworth hatcheries.

ADULT LIFE HISTORY

Run Size and Escapement

Hatchery returns from 1977 through 1986 averaged 8,164 steelhead although runs increased substantially after 1983 (Table 1).

Time of migration

Wells steelhead migrate over Bonneville Dam from May through September, cross over Priest Rapids Dam from early June through mid-October, and first arrive at Wells Hatchery in mid-July with peak returns in September and October (Table 2).

Harvest

The ocean catch of Wells Hatchery steelhead is unknown.

Columbia River sport harvest consists of mixed stocks, and although the exact number of Wells hatchery steelhead caught is not known, some Wells hatchery fish are likely part of the Columbia

River harvest.

Sport catch of Wells hatchery-stock steelhead within the **Methow** Basin, Okanogan Basin and Wells Pool on the Columbia River averaged 7,289 fish for the period 1981 through 1986.

A tribal fishery exists at the base of Chief Joseph Dam which harvested an annual average of 258 steelhead for the period of 1980 through 1986.

Snawnine **period**

Spawning begins in early January, peaks in early February and is completed by early March.

Snawnine area

Spawning occurs at the Wells Hatchery.

Fecundity

Fecundity of Wells steelhead for return year 1983 through 1987 averaged 5,082 eggs per female for l-ocean fish and 6,368 eggs per female for **2-ocean** fish (Subbasin Plan 1990).

Age Composition

Age structure for Wells steelhead are predominantly l-ocean and **2-ocean** fish (Table 3). Age data collected from four of five age studies conducted from 1982 through 1987 showed only two age classes 1.1 and 1.2. In the **fifth** study, Williams (1984) determined that approximately 14.5 percent of returning hatchery adults had **residualized** in freshwater for at least one year following their release, thus classifying steelhead with freshwater ages of 2 or more years as wild-origin steelhead can be incorrect. No repeat spawners were observed in any of the age studies.

Size

Mean fork lengths for Wells stock summer steelhead sampled in 1978 through 1982 averaged 61.9 and 72.9 for l-ocean and **2-ocean** fish, respectively (Table 4).

Sex ratio

Sex ratio (male-to-female) for Wells steelhead returning in 1983 was 0.91 for l-ocean fish (n = 885) and 1.90 for **2-ocean** fish (n = 194).

Survival Rate

Smolt to adult returns for Wells summer stock steelhead averaged 1.45 percent for smolts released above Wells Dam between 1972 and 198 1 (Table 5).

JUVENILE LIFE HISTORY

Egg

Egg production (total hatchery egg take) for the 1990 return year was approximately **1,693,000** eggs. Egg to smolt survival rates for Wells steelhead spawned at Wells Hatchery average approximately 85-90 percent although survival is highly variable.

Juvenile rearing

Wells steelhead smolts are typically reared to l-year old fish at which time they are released at a size of 4-7 fish per pound (65-114 grams each). Wells smolts are generally released in April and May. Peak movement of smolts over Priest Rapids Dam occurs in mid-May with Wells hatchery steelhead smolts generally arriving at the Columbia River estuary by the end of May (Howell et al. 1985).

Hatcherv Releases

Wells hatchery smolts are currently released into the Methow River, Okanogan River, Similkameen River, Wenatchee (Icicle River) and Entiat rivers. In addition, Wells stock steelhead have, in the past, been released in many rivers including the Walla Walla, Snake, Tucannon, Grande Ronde, Big White Salmon, and Yakima plus the smaller waters of Asotin and Crab creeks.

Straying

No data are available on Wells steelhead.

BIOCHEMICAL-GENETIC CHARACTERISTICS

Thorgaard (1977) reported that Wells hatchery steelhead sampled at Wells Dam resulted in 87.5% with 58 chromosomes, 6.2% with 59 chromosomes and 6.2% with 60 chromosomes.

DISEASES

The major disease afflicting Wells hatchery-stock steelhead has been infectious hematopoietic necrosis (IHN). Disease history, outlining all pathogens detected at Wells Hatchery is presented in Table 6.

Table 1 @H-a). Returns of Wells stock summer steelhead to Wells Dam.

Return Year	Wells Return*
1977	4,960
1978	1,306
1979	3,336
1980	2,802
1981	3,756
1982	5,419
1983	19,372
1984	14,703
1985	15,587
1986	10,398

*Based on fish counts at Wells Dam.

Source: Methow Subbasin Plan 1990.

Table 2 (RH-b). Counts of adult steelhead arriving at Wells Dam.[A]

Return Year	May	June	July	Aug	Sept	Oct	Nov	Total
1978	177	32	12	399	432	528		1,580
1979	72	2	22	1,212	938	1,040	355	3,641
1980	202	24	15	382	1,032	1,358	413	3,426
1981	139	23	107	212	1,702	1,401	513	4,097
1982	149	7	67	814	2,428	3,733	730	7,928
1983	26	2	145	1,891	11,074	5,294	1,327	19,759

*Returns to Wells Dam for these years is approximately 95% hatchery fish.

Source: Stock Assessment of Columbia River Anadromous Salmonids, Vol. II., 1985.

Table 3 (AC-a). Age composition percentage (freshwaterocean) by return year for adult Wells steelhead sampled at Wells Dam.

Age Composition (%)

Return Year	N[A]	1.1	1.2
1978	68	26.5	73.5
1979	111	92.8	7.2
1980	341	75.1	24.9
1982	282	28.7	71.3

*Fish collected at Wells Dam.
Age determined from scale analysis, or length frequency.

Source: Stock assessment of Columbia River Anadromous Salmonids Vol II., 1985.

Table 4 (AL-a). Fork lengths by return year and age class (freshwaterocean) for Wells stock summer steelhead sampled at Wells Dam.

Fork Lengths (cm)

Return Year	N	1.1	1.2
1978	68	61.9	76.4
1979	111	64.3	75.1
1980	341	61.4	74.5
1982	282	60.6	71.3

Source: Stock Assessment of Columbia River Anadromous Salmonids Vol II., 1985.

Table 5 (TS-a). Smolt to adult returns for Wells stock steelhead released above Wells Dam.

Year Planted	Smolts Planted[A]	Adult Returns[B]	Percent Return[C]
1972	327,902	1,919	0.6
1973	146,880	288	0.2
1974	182,111	1,573	0.9
1975	249,279	5,032	2.0
1976	238,405	5,571	2.3
1977	172,978	596	0.3
1978	164,259	4,482	2.7
1979	268,252	6,900	2.6
1980	471,420	6,628	1.4
1981	358,234	5,214	1.5

[A]Smolts reared at Wells Hatchery and released into the Methow and Okanogan Subbasins.
[B]Hatchery return includes steelhead harvested in Methow and Okanogan sport catch.
[C]Percent return does not include fish which may be harvested in the Columbia River treaty and sport fisheries.

Source: Stock Assessment of Columbia River Anadromous Salmonids Vol II., 1985

Table 6 (TD). Parasites and diseases isolated at Wells Hatchery located on the Washougal River.

Disease Type	Hatchery	Specific Pathogen
Bacterial	Wells	*Renibacterium salmonarium* (BKD)
Bacterial	Wells	*Flexibacter cytophaga* (Coldwater)
Bacterial	Wells	*Flavobacter sp.*
Parasite	Wells	*Hexamita sp.*
Viral	Wells	Infectious Pancreatic Necrosis (IPN)
Viral	Wells	EIBS
Viral	Wells	Infectious hematopoietic necrosis (IHN)

Disease history represents pathogens isolated at these hatcheries and not necessarily a disease outbreak.
Source: WDW pathologist, Steve Roberts, 1991.

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METHOW SUBBASIN

Spring Chinook

GEOGRAPHIC LOCATION

The Methow River is located in north central Washington with its source on the eastern slopes of the Cascade Mountains, and flows southeasterly to enter the Columbia River at River Mile (RM) 524 near the town of Pateros. The Methow subbasin encompasses about 1,800 square miles. The Methow and Okanogan subbasins represent the upper limit of anadromous salmonid distribution in the Columbia River Basin. The Methow River enters the Columbia between Wells and Chief Joseph dams. At present the Winthrop National Fish Hatchery (opened in 1942) is the only hatchery in the subbasin.

ORIGIN

Spring chinook were once abundant in the upper Columbia River (Mullan 1987). However, overfishing and habitat alterations depleted spring chinook numbers in the early 1900's. Flood control dikes, roads, logging, housing developments, and irrigated agriculture have caused cumulative losses of habitat. A hydro-irrigation dam constructed in 1912 across the Methow at Pateros (Mullan 1983) harmed salmon runs. The extent of depletion of Methow fish is difficult to ascertain due to the lack of historical data. Columbia River dams with associated smolt and adult mortalities are thought to be current limiting factors. Prior to completion of Grand Coulee Dam, spring chinook destined for the upper Columbia were intercepted at Rock Island Dam (1939-1941) and released into the Wenatchee, Entiat and Methow Rivers.

DISTRIBUTION

Spring chinook production of wild fish occurs in the mainstem Methow and three tributaries; the Twisp River (RM 40.2), Chewuck River (RM 50.1), and the Lost River (RM 73.0). There are no known distinguishing differences between the runs to various tributaries other than spatial separation. These populations may be influenced to a small degree by hatchery production at Winthrop National Fish Hatchery on the Methow River at RM 50.4.

PRODUCTION

Based on 30 years of redd counts, production is declining gradually and all production is chronically depressed. Tables 1 and 2 describe the amount of spawning and rearing habitat, by quality, available in the Methow subbasin. This data was derived from the Presence/Absence database of the Northwest Power Planning Council, 1991.

Based on the Northwest Power Planning Council's habitat carrying capacity model, spring chinook production potential for the Methow is estimated at 826,359 smolts. The greatest limitation of subbasin spring chinook production is loss of smolts and adults at nine Columbia River dams and impoundments. Within the subbasin, dewatering impacts production in some reaches and low flows resulting from irrigation diversions reduce rearing habitat. Juvenile losses occur at substandard irrigation diversions. Loss of juveniles may also occur from winter icing conditions. Habitat losses from riparian developments have also reduced production potential, although unquantified.

The maximum potential for naturally spawning spring chinook in the Methow River for the 1980-1990 return years (based on the Wells Dam count) averaged 1,970, with a low return of 860 in the

1990 return year and a peak of 4,038 in the 1985 return year. Methow River spring chinook natural spawn escapement by return year is presented in Table 3.

Winthrop National Fish Hatchery spring chinook returns during the 1982-1990 return years averaged 683 fish, with a low return of 121 in the 1990 return and a peak of 1,327 in the 1988 return year. Winthrop National Fish Hatchery spring chinook returns by total age and return year are presented in Table 4.

ADULT LIFE HISTORY

Run size, catch and escapement

Ocean commercial and recreational fisheries from Alaska to Washington, in addition to Columbia River non-treaty commercial, treaty subsistence, and sport fisheries all harvest a portion of the Methow River spring chinook.

Time of Migration

Spring chinook upriver migration timing of wild and hatchery fish is generally the same. Spring chinook peak at Bonneville Dam mid to late April; About 50 percent of the mid-Columbia River run passes Priest Rapids Dam by late May. Returns of spring chinook to the Methow River peak early May to late June.

Spawning Period

Spawning usually commences about the second week of August and continues into the first week of September. Different annual temperature regimes will vary the time of spawning. According to Mullan (1987), threshold temperatures for egg deposition and normal development are between 42.5 F to 57.5 F. This applies primarily up to the time eggs eye, which is about the first 20 days. Normal hatching patterns and success decreases acutely above and below the temperature range (Mullan 1987).

Spawning Areas

Primary spawning of spring chinook in the mainstem Methow River occurs from RM 59.7 to RM 65.4. Primary spawning of spring chinook in the Twisp River occurs from RM 12.7 to RM 20.4. Primary spawning of spring chinook in the Chewuch River occurs from RM 13.6 to RM 20.4. Primary spawning of spring chinook in the Lost River occurs from RM 0.0 to RM 3.9.

Age Composition

Age information is not available for the natural spawning population. Age for Methow River spring chinook ranges from three-year-old jacks to six-year-old adults with four-year-olds and five-year-olds usually the dominant age classes. Table 4 lists the age composition percentages by return year and total age for spring chinook returning to Winthrop Hatchery.

Sex Ratio

Information is limited to hatchery escapements. Jacks are entirely males. Four-year-old adults are predominately females and age-5 adults mostly males.

Fecundity

Fecundity at Winthrop National Fish Hatchery averages 4,400 eggs per female (Howell et al. 1984).

JUVENILE LIFE HISTORY

Time of Emergence

No information is available on the naturally produced population. Artificial emergence (absorbed yolk-sac) at the hatcheries occurs in late November.

Time. aee and size at migration

Hatchery release information for the Methow subbasin by brood year is presented in Table 5. Hatchery reared juveniles are customarily released as yearlings in April and May at 10-18 fish/pound and 120-150 mm in length. Median recapture data in the Columbia estuary for two coded wire tagged releases (1978 and 1979 brood) occurred about one month after release.

Survival Rate

Egg-to-smolt or smolt-to-adult survival data was not available for natural spring chinook in the subbasin. Hatchery egg-to-smolt survival is 94 percent (B. Wallien, USFWS, pers. comm.). Smolts are released in spring as yearlings. Smolt-to-adult survival ranged between 0.33 percent and 0.38 percent (Howell et al. 1984).

DISEASE

Bacterial kidney disease has been a major problem at the hatchery and furunculosis and redmouth have also caused losses occasionally. Infectious hematopoietic necrosis (IHN) was detected in the 1988 brood stock. Performance of the Winthrop National Fish Hatchery stock needs to be improved as it has consistently exhibited poor returns.

BIOCHEMICAL-GENETIC CHARACTERISTICS

No data available.

Table 1 (HB-1). Estimated amount of rearing and spawning habitat, by quality, of the Methow River spring chinook production area.

Distance/Area	Excellent	Good	Fair”	Poor”	Unknown	Total	Confidence
Miles (%)	0	9	81	10		68.8	
Acres (%)	0	13	80	7		360.3	

[a] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/Absence database, NPPC, 1991.

Table 2 (HB-2). Estimated amount of rearing habitat, by quality, of the Methow River spring chinook production area.

Distance/Area	Excellent	Good	Fair”	Poor”	Unknown	Total	Confidence
Miles (%)	0	32	68	0		52	
Acres (%)	0	36	64	0		338.6	

[a] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/Absence database. NPPC, 1991

Table 3 (RN-a). Methow River spring chinook maximum potential natural spawning escapement by return year. 1/

	Maximum Potential		
Return Year	Adults	Jacks	Total
1980	799	223	1,022
1981	1,734	97	1,831
1982	1,710	82	1,792
1983	1,951	119	2,070
1984	2,562	205	2,767
1985	3,942	96	4,038
1986	2,162	54	2,216
1987	1,709	43	1,752
1988	1,710	89	1,799
1989	1,443	82	1,525
1990	846	14	860

1/ The maximum potential natural spawning escapement is the Wells Dam count minus the hatchery escapement to Winthrop NFH.

Table 4 **(RH).** Total returns of spring chinook to the Winthrop Hatchery by return year.

	Total Age					
Return Year	3	4	5	6	Total	Adult Total
1982	49	318	234	*	601	552
1983	24	233	498	*	755	731
1984	8	442	69	*	519	511
1985	20	796	385	*	1,201	1,181
1986	9	609	218	*	836	827
1987	31	315	248	*	594	563
1988	13	611	703	*	1,327	1,314
1989	5	98	92	0	195	190
1990	0	64	57	0	121	121

* All 6's included in the 5's column.

Table 5 (TR). Hatchery releases of spring chinook salmon into the Methow River subbasin sorted by brood year, hatchery and Life stage.

Brood Year	stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /lb.	Number Released	Release Site	CUT Code
1975	UNKNOWN STOCK	WINTHROP NF HATCHERY	Smolt	04/11/77	04/11/77	14	412000	METHOW R (48.0002)	UNTAGGED
1975	UELLS DAM	WINTHROP NF HATCHERY	Smolt	04/11/77	04/13/77	13	219275	METHOW R (48.0002)	UNTAGGED
1975	UELLS DAM	UINTHROP NF HATCHERY	Smolt	04/12/77	04/12/77	12	99185	METHOW R (48.0002)	130701
1975	UELLS DAM	WINTHROP NF HATCHERY	Smol t	04/12/77	04/12/77	12	211740	METHOW R (48.0002)	UNTAGGED
1975	UNKNOWN STOCK	WINTHROP NF HATCHERY	Smolt	04/12/77	04/12/77	12	118200	METHOW R (48.0002)	UNTAGGED
1975	UNKNOWN STOCK	UINTHROP NF HATCHERY	Smolt	04/13/77	04/13/77	11	95155	METHOW R (48.0002)	UNTAGGED
1976	UNKNOWN STOCK	UINTHROP NF HATCHERY	EmFry	01/03/77	01/03/77	1194	700000	METHOW R (48.0002)	UNTAGGED
1976	UNKNOWN STOCK	WINTHROP NF HATCHERY	FeFry	01/03/77	01/03/77	1226	700000	METHOW R (48.0002)	UNTAGGED
1976	UNKNOWN STOCK	WINTHROP NF HATCHERY	Fingr	06/16/77	06/16/77	94	201600	METHOW R (48.0002)	UNTAGGED
1976	WELLS DAM	WINTHROP NF HATCHERY	Smolt	04/24/78	04/24/78	15	365785	METHOW R (48.0002)	UNTAGGED
1976	UELLS DAM	UINTHROP NF HATCHERY	Smolt	04/24/78	04/26/78	15	597107	METHOW R (48.0002)	UNTAGGED
1976	WELLS DAM	WINTHROP NF HATCHERY	Smolt	04/25/78	04/25/78	15	326100	METHOW R (48.0002)	UNTAGGED
1976	WELLS DAM	WINTHROP NF HATCHERY	Smolt	04/25/78	04/25/78	13	85964	METHOW R (48.0002)	UNTAGGED
1976	WELLS DAM	UINTHROP NF HATCHERY	Smolt	04/26/78	04/26/78	14	89600	METHOW R (48.0002)	UNTAGGED
1977	UIND R (CARSON NFH)	WINTHROP NF HATCHERY	Smolt	04/20/79	04/20/79	15	427240	METHOW R (48.0002)	UNTAGGED
1977	UNKNOWN -STOCK	UINTHROP NF HATCHERY	Smolt	04/20/79	04/20/79	15	427240	METHOW R (48.0002)	UNTAGGED
1978	LTL WHITE SALMON-NFH	UINTHROP NF HATCHERY	Smolt	04/17/80	04/17/80	14	60000	METHOW R (48.0002)	UNTAGGED
1978	LTL WHITE SALMON-NFH	UINTHROP NF HATCHERY	Smolt	04/17/80	04/18/80	17	1207000	METHOW R (48.0002)	UNTAGGED
1978	LTL UHITE SALMON-NFH	WINTHROP NF HATCHERY	Smolt	04/18/80	04/18/80	17	1147000	METHOW R (48.0002)	UNTAGGED
1979	METHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/13/81	04/13/81	18	966300	METHOW R (48.0002)	UNTAGGED
1979	METHOW RIVER	UINTHROP NF HATCHERY	Smolt	04/13/81	04/13/81	18	966300	METHOW R (48.0002)	UNTAGGED
1980	METHOW RIVER	WINTHROP NF HATCHERY	Smolt	03/16/82	03/16/82	20	268100	METHOW R (48.0002)	UNTAGGED
1980	LEAVENWORTH HATCHERY	UINTHROP NF HATCHERY	Smolt	04/15/82	04/15/82	16	612500	METHOW R (48.0002)	UNTAGGED
1980	METHOW RIVER	UINTHROP NF HATCHERY	Smolt	04/15/82	04/15/82	15	100200	METHOW R (48.0002)	UNTAGGED
1980	LEAVENWORTH HATCHERY	WINTHROP NF HATCHERY	Smolt	04/15/82	04/15/82	16	612500	METHOW R (48.0002)	UNTAGGED
1980	METHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/15/82	04/15/82	15	100200	METHOW R (48.0002)	UNTAGGED
1981	UNKNOWN STOCK	UINTHROP NF HATCHERY	Smolt	04/18/83	04/18/83		953508	METHOW R (48.0002)	UNTAGGED
1981	UIND R (CARSON NFH)	WINTHROP NF HATCHERY	Smolt	04/18/83	04/18/83	18	782988	METHOW R (48.0002)	UNTAGGED
1981	METHOW RIVER	UINTHROP NF HATCHERY	Smolt	04/18/83	04/18/83	13	170520	METHOW R (48.0002)	UNTAGGED
1982	METHOW RIVER	UINTHROP NF HATCHERY	PreSm	12/25/83	12/25/83	19	363200	METHOW R (48.0002)	UNTAGGED
1982	UNKNOWN STOCK	WINTHROP NF HATCHERY	Smol t	04/15/84	04/15/84		903181	METHOW R (48.0002)	UNTAGGED
1982	METHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/23/84	04/23/84	16	20381	METHOW R (48.0002)	UNTAGGED
1982	METHDW RIVER	WINTHROP NF HATCHERY	Smolt	04/23/84	04/23/84	16	601500	METHOW R (48.0002)	UNTAGGED
1983	METHOW RIVER	WINTHROP NF HATCHERY	Fingr	04/20/84	04/20/84	197	281300	METHOW R (48.0002)	UNTAGGED
1983	METHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/21/85	04/21/85	17	1167600	METHOW R (48.0002)	UNTAGGED
1983	METHOW RIVER	UINTHROP NF HATCHERY	Smolt	04/21/85	04/21/85	17	1167600	METHOW R (48.0002)	UNTAGGED
1984	LEAVENWORTH HATCHERY	WINTHROP NF HATCHERY	Smolt	04/21/86	04/21/86	18	528502	METHOW R (48.0002)	UNTAGGED
1984	LEAVENWORTH HATCHERY	WINTHROP NF HATCHERY	Smolt	04/21/86	04/21/86	18	528502	METHOW R (48.0002)	UNTAGGED
1984	METHOW RIVER	UINTHROP NF HATCHERY	Smolt	04/21/86	04/21/86	16	34466	METHOW R (48.0002)	UNTAGGED
1984	METHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/21/86	04/21/86	16	401501	METHOW R (48.0002)	UNTAGGED
1984	METHOW RIVER	UINTHROP NF HATCHERY	Smolt	04/21/86	04/29/86	IS	534292	METHOW R (48.0002)	UNTAGGED
1984	METHOW RIVER	UINTHROP NF HATCHERY	Smolt	04/25/86	04/25/86	IS	49334	METHOW R (48.0002)	UNTAGGED
1984	HETHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/29/86	04/29/86	15	48991	METHOW R (48.0002)	UNTAGGED
1985	METHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/20/87	04/20/87	14	1069293	METHOW R (48.0002)	UNTAGGED
1985	METHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/20/87	04/20/87	15	145693	METHOW R (48.0002)	UNTAGGED
1985	METHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/20/87	04/20/87	14	923600	METHOW R (48.0002)	UNTAGGED
1986	WIND R .(CARSON NFH)	WINTHROP NF HATCHERY	Smolt	04/19/88	04/19/88	17	85236	METHOW R (48.0002)	UNTAGGED
1986	WIND R (CARSON NFH)	WINTHROP NF HATCHERY	Smolt	04/19/88	04/19/88	17	85236	METHOW R (48.0002)	UNTAGGED
1986	HETHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/19/88	04/19/88	15	1004964	METHOW R (48.0002)	UNTAGGED
1986	METHOW RIVER	UINTHROP NF HATCHERY	Smolt	04/19/88	04/19/88	15	1004964	METHOW R (48.0002)	UNTAGGED
1987	METHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/18/89	04/18/89	15	49469	METHOW R (48.0002)	UNTAGGED
1987	METHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/18/89	04/18/89	15	816265	METHOW R (48.0002)	UNTAGGED
1987	METHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/18/89	04/18/89	15	49469	METHOW R (48.0002)	UNTAGGED
1987	METHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/18/89	04/18/89	15	816265	METHOW R (48.0002)	UNTAGGED
1988	METHOW RIVER	WINTHROP NF HATCHERY	EmFry	01/11/89	01/11/89	907	250000	METHDW R (48.0002)	UNTAGGED

Table 5 (cont). Hatchery releases of Spring Chinook salmon into the Methow River subbasin sorted by brood year, hatchery and life stage.

Brood Year	Stock	Hatchery	Life Stage	Release Date 1	Release Date 2	Fish /lb.	Number Released	Release Site	CUT Code
1988	METHOW RIVER	WINTHROP NF HATCHERY	Fingr	01/11/89	01/11/89	907	250000	METHOW R (48.0002)	UNTAGGED
1988	METHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/17/90	04/17/90	21	1121395	METHOW R (48.0002)	UNTAGGED
1988	METHOW RIVER	WINTHROP NF HATCHERY	Smolt	04/17/90	04/17/90	21	1121395	METHOW R (48.0002)	UNTAGGED

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METHOW SUBBASIN

Summer Chinook

GEOGRAPHIC LOCATION

The Methow River is located in north central Washington with its source on the eastern slopes of the Cascade Mountains, and flows southeasterly to enter the Columbia River at River Mile (RM) 524 near the town of Pateros. The Methow subbasin encompasses about 1,800 square miles. The Methow and Okanogan subbasins represent the upper limit of anadromous salmonids in the Columbia River Basin and enter the Columbia between Wells and Chief Joseph dams.

ORIGIN

Historically, summer chinook were abundant in the middle to upper Columbia River and may have been the most plentiful of the chinook races. Prior to hydroelectric dam development, summer chinook migrated as far as Windermere Lake in British Columbia (Fulton 1968). Before completion of Grand Coulee Dam, summer chinook destined for the upper Columbia were intercepted at Rock Island Dam (1939-1941) and transplanted into the Wenatchee, Entiat, Methow and Okanogan rivers.

Tributary developments contributed to the decline of these fish. Such developments include: 1) obstructions to upstream migrants (such as the 1912 through 1930 hydro-irrigation dam at Pateros, and irrigation dams that impede access to spawning and rearing areas); 2) diversion structures in which fingerlings and smolts become entrapped; 3) streamside and riparian developments that impact rearing and spawning habitat; and 4) poor instream flows resulting from agricultural diversions.

DISTRIBUTION

Methow summer chinook use the lower mainstem reaches of the Methow River and are managed for natural production.

PRODUCTION

Methow River summer chinook wild stock is considered chronically depressed and has been gradually declining for the past 25 years, based on redd counts. Some of the spawning population may be from production at Wells Dam Salmon Hatchery on the mainstem Columbia River. Tables 1 and 2 describe the amount of spawning and rearing habitat, by quality, available in the Methow subbasin. This data was derived from the Presence/Absence database of the Northwest Power Planning Council, 199 1.

Based on the Northwest Power Planning Council's habitat carrying capacity model, potential summer chinook production is estimated at 1,470,822 smolts. This estimate may be misleading as summer chinook depend on downstream rearing habitat, which is provided by Columbia River reservoirs. It is not known whether production is limited in the earlier stages of tributary residence.

The minimum escapement for naturally spawning summer chinook in the Methow River for the 1977-1990 return years averaged 1,092 fish, with a low return of 440 in the 1988 return year and a peak of 2,775 in the 1979 return year. Methow River summer chinook natural spawn escapement by return year is presented in Table 3. The minimum escapement is determined by redd counts within river miles 27.2 through 73 .0, multiplied by 3.1 fish/redd.

Initial propagation of summer chinook began in the early 1940's at Leavenworth, Entiat and Winthrop hatcheries (Howell et al. 1984). The earliest releases in the Methow was from Winthrop Hatchery, which has intermittently planted summer chinook. Brood stock for Wmthrop Hatchery after 1946 originated from fish collected at Wells Dam or from rack returns to Wells Hatchery. Winthrop Hatchery only rears summer chinook when surplus eggs are available or when sprmg chinook egg sources are insufficient.

In 1967, an artificial propagation facility began at the Wells spawning channel. Brood stock originated from rack returns and trapped adults. Conventional hatchery rearing began in 1978; the spawning channel was discontinued. Most fish produced at the previously described Wells Hatchery were planted in the Columbia river, an average of 319,011 yearlings and 1,565,838 fingerlings in recent years. Under the current mitigation program, Wells Hatchery rears 4,444 pounds of summer chinook at 90 fish per pound, which are released into the Methow River in May and June. However, this happened only in 1987 when 212,732 fingerlings were planted at 45 per pound. Brood stock is collected at Wells Dam fishway.

As part of the Rock Island Dam Settlement Agreement (Chelan County PUD), additional hatchery production of summer chinook is planned for the Methow Basin using acclimation ponds. Additional production of summer chinook may result as part of the Wells Dam Settlement Agreement (Douglas County PUD), depending on the success of an experimental net pen rearing project with sockeye. Brood stock will likely be collected at Wells Dam. Smolt releases will be acclimated and imprinted before outmigration. Acclimation ponds will be constructed between Carlton and Winthrop. The objective of this increased production is to offset dam mortality with augmented natural production.

ADULT LIFE HISTORY

Run size. catch and escapement

Ocean commercial and recreational fisheries from Alaska to Washington all harvest a portion of the Methow River spring chinook.

Time of Migration

Summer chinook migration begins in late May or early June with peak counts at Bonneville Dam during early July. Approximately 50 percent of the upper Columbia run has migrated past Priest Rapids Dam in mid-July and past Wells Dam in late July. Entry into the Methow occurs in late August.

Spawning Period

Spawning occurs during late September through early November. At Wells Dam Hatchery spawning commences in late September with a peak in late October or early November.

Spawning Areas

Primary spawning of summer chinook in the mainstem Methow River occurs from RM 2.0 to RM 50.4.

Aee Composition

Age information is not available for the natural spawning population. Age composition data for Wells Dam summer chinook are limited to the returns of coded-wire tagged fish from the 1974 through 1977 broods (tag codes 13-05-11, 13-09-10, 63-16-42, and 63-17-62 respectively). An average of 4 percent of these broods returned at two-year-olds, 16 percent three-year-olds, 48 percent four-year-olds, 30 percent five-year-olds, and 2 percent six-year-olds.

Sex Ratio

Data unavailable.

Fecundity

Age-specific mean fecundity data is unavailable for **Methow** summer chinook. Mathews and **Meekin** (1971) determined a length-fecundity relationship for summer chinook where eggs = 214 x (fork length in inches) **-** 2,234. The corresponding fecundities are 2,284 for four-year-olds, 4,306 for five-year-olds, and 4,980 for six-year-olds.

JUVENILE LIFE HISTORY

Time of Emergence

No information is available on the naturally produced population. At the Wells spawning channel, fry emergence occurred from January through April during 1968-1971 (Allen et al. 1968, 1969, 1971; and Allen 1970).

Time. aee and size at migration

Hatchery release information for the **Methow subbasin** by brood year is presented in Table 4.

Survival Rate

Egg-to-smolt or smolt-to-adult survival data was not available for natural summer chinook in the subbasin. Survival rate to al fisheries and escapement averaged 0.3 percent for 10 coded wire tagged sub-yearlings released from Wells Dam Hatchery **(WDF** 1984a).

DISEASE

No data available.

BIOCHEMICAL-GENETIC CHARACTERISTICS

Schreck et al. (1984) compared isozyme gene frequencies of seven enzyme systems from Wells Hatchery production samples to natural production samples collected in the Wenatchee, **Methow,** and Okanogan systems. In paired statistical comparisons, gene frequency profiles were similar for all seven enzyme systems between Wells Hatchery production and the natural production in the Wenatchee and **Methow** rivers.

Table 1 (HB-1). Estimated amount of rearing and spawning habitat, by quality, of the Methow River summer chinook production area.

Distance/Area	Excellent	Good	Fair”	Poor[a]	Unknown	Total	Confidence
Miles (%)	0	35	65	0		42.2	
Acres (%)	0	35	65	0		306.9	

• Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/Absence database, NPPC, 1991.

Table 2 (HB-2). Estimated amount of rearing habitat, by quality, of the Methow River summer chinook production area.

Distance/Area	Excellent	Good	Fair[a]	Poor[a]	Unknown	Total	Confidence
Miles (%)	0	0	100	0		6.1	
Acres (%)	0	0	100	0		58.9	

[a] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/Absence database, NPPC, 199 1.

Table 3 (RN-a). Minimum natural spawner escapement of summer chinook to the Methow River subbasin by return year. 1/

Minimum Potential

Return Year	Minimum Escapement
1977	1628
1978	2310
1979	2775
1980	1538
1981	868
1982	632
1983	288
1984	722
1985	732
1986	753
1987	778
1988	440
1989	561
1990	1268

1/ Redd count withins river miles 2.0 through 50.4, multipled by 3.1 fish/mile.

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METHOW RIVER SUBBASIN

Naturally Produced Summer Steelhead

GEOGRAPHIC LOCATION

The Methow River is located in north central Washington with its source on the eastern slopes of the Cascade Mountains. From its headwaters the Methow River flow southeasterly passing near the town of Pateros where it enters the Columbia River at river mile (RM) 524. The Methow subbasin drains a watershed of approximately 1,800 square miles.

The Methow River and its major tributary, the Chewack River, are included in the "nationwide inventory of wild and scenic rivers" (USDI 1982). In addition, the Methow River and its tributaries of the Chewack and Twisp rivers are being studied for inclusion in the Washington Scenic River System.

ORIGIN

The wild summer steelhead stock in the Methow River is native, although interbreeding has likely occurred with introduced Wells hatchery-stock. From 1939 through 1943 all adult steelhead bound for the upper Columbia were trapped at Rock Island Dam and distributed into the Methow, Entiat and Wenatchee rivers. Thus, Methow River steelhead were mixed with other steelhead stocks of the upper Columbia River.

DISTRIBUTION

Table 1 lists rearing and spawning habitat, by quality, for Methow River steelhead based on estimates from the Northwest Power Planning Council (NPPC). In addition, the NPPC habitat carrying capacity model estimates that 169,610 smolts could be produced in the subbasin (see production for WDW estimate).

Distribution of summer steelhead is spread throughout the entire Methow River subbasin although steelhead are found primarily within the mainstem Methow, Twisp, and Chewack rivers plus the lower section of Gold Creek. Steelhead distribution is limited within many of the small tributaries which have steep gradients which impede or prevent fish access.

PRODUCTION

Production Facilities

No steelhead rearing facility operates in the Methow Subbasin although the Wells Salmon and Steelhead Hatchery, which is located immediately downstream of Wells Dam, is located 8.5 miles downstream from the confluence of the Methow and Columbia Rivers. The Wells Hatchery is the source for steelhead smolts planted in the Methow River.

Production Summary

No historical data on smolt production. An estimate of smolt production based on Washington Department of Wildlife gradient, area and flow methodology (GAFM) in 1985 was 58,552 (Williams 1985). Based on counts at Wells Dam, smolt outmigrations for the years 1988, 1989 and 1990 were 35,097, 36,448 and 53,910 respectively (Table 3). The greatest impact on natural production has been inadequate escapement reaching the subbasin as a result of smolt and adult mortalities at each dam (steelhead migrating from and returning to the Methow Subbasin encounter nine hydroelectric dams between the Methow River and the Pacific Ocean).

ADULT LIFE HISTORY

Run Size and Escapement

Historical counts of steelhead at Rock Island Dam averaged 2,780 fish for the 1930's, 2,605 fish for the 1940's and 3,722 fish for the 1950's, these numbers represent the combined return of steelhead to all upper Columbia subbasins (Methow, Okanogan, Wenatchee, Entiat and upper-Columbia rivers). Escapement of wild steelhead based on counts at Wells Dam from 1980 through 1990 ranged from 108 steelhead in 1983-1984 to 627 fish in 1987-1988 (Table 2). From 1981 through 1990 wild steelhead contributed an average of 7.0 percent of the annual return of Methow River steelhead although the wild portion of the Methow steelhead run has increased in the past three years to an average annual rate of 20.0 percent (sport fishing regulations were changed in 1986 requiring release of wild steelhead).

Harvest

No estimate for ocean harvest of Methow steelhead.

No estimate for Methow River steelhead harvested in the lower Columbia River, although this section of the Columbia River supports a sport fishery which harvests large numbers of steelhead which likely include some Methow River fish. Another popular sport fishery exists on the upper Columbia River, primarily at Wells Pool, where for the five year period of 1982 through 1986 an annual average of 3,641 steelhead (hatchery and wild) were harvested with the catch representing fish from the Methow, Okanogan and upper Columbia rivers.

Sport harvest within the Methow Subbasin showed an annual harvest of hatchery steelhead for the period 1982 through 1990 averaged 4,744 fish (Table 2). Additionally, the annual average harvest of wild steelhead for the period of 1982 through 1986 was 240 fish (Table 2). Wild release regulations were implemented in 1986 restricting legal harvest to hatchery fish only. In addition, new regulations designed to protect juveniles and natural adults include 1) use of bait prohibited, 2) 12 inch minimum size limit, and 3) delay in the opening of stream fishing season.

Treaty fishing for the eight year period 1982 through 1990 yielded an annual average of 242 hatchery steelhead and 15 wild steelhead (Table 2).

Time of migration

Wild steelhead destined for the Methow River likely migrate through the Columbia River between June and September, and arrive at the Methow River from mid-August through early November. A substantial number of steelhead do not migrate up into the Methow River until spring, but instead overwinter in Wells Pool near the mouth of the Methow River (Howell et al. 1985).

Spawning period

Spawning occurs primarily in April and May.

Spawning area

Wild steelhead spawn throughout the subbasin including the mainstem Methow River upstream to the town of Winthrop, lower Gold Creek and portions of the Twisp and Chewack-rivers.

Fecundity

Limited data for wild steelhead. Steelhead spawned back in 1937 showed fecundity of 4,713 eggs per female for l-ocean and 6,996 eggs per female for 2-ocean fish. Similar fecundities were recorded in 1985 when l-ocean wild steelhead averaged 4,960 eggs per female and 2-ocean fish averaged 6,505 eggs per female (Mullan et al. 1992)

Age Composition

Age structure for wild steelhead returns showed some years being dominated by l-ocean fish such as 1979 and 1980 with l-ocean fish at 94.0 percent and 87.5 percent respectively, of fish sampled, while in other years steelhead returns were predominately 2-ocean fish as in the case of 1982 and 1989 with 100 percent and 73 percent of the fish sampled being 2-ocean fish (Table 5).

Size

From wild adults sampled in 1978 and 1982, l-ocean fish averaged 63.3 cm and 2-ocean fish averaged 72.6 cm. From steelhead captured at Wells Dam in 1989, wild male steelhead average 59.4 cm for l-ocean fish and 68.2 cm for 2-ocean fish while females averaged 61.5 cm for l-ocean fish and 67.2 cm for 2-ocean fish (Table 7).

Sex ratio

Wild steelhead collected in 1988, 1989 and 1990 averaged 54.3 percent females for l-ocean fish and 77.0 percent females for ‘L-ocean fish (Table 6).

Survival Rate

No data on wild steelhead smolt to adult survival.

JUVENILE LIFE HISTORY

Emergence

No data are available on Methow steelhead.

Egg

No data on egg production or egg to smolt survival.

Juvenile rearing

Juvenile rearing for wild smolts last between two and four years although smolts within the subbasin have been sampled up to age seven. The older age smolts are generally present in the upper reaches of the subbasin where cold and unproductive waters necessitate an additional 1 to 3 years of freshwater residence in order for juveniles to achieve smolt size.

Wild steelhead smolts outmigrate in April and May. Strickland (1967) reported that wild smolts emigrate pass Priest Rapids Dam in peak abundance between mid-May and early June.

Hatchery releases

For the past thirteen years (1980 through 1992) steelhead releases into the Methow subbasin were from Wells hatchery-stock. Prior to this steelhead broodstock were collected primarily at Priest Rapids Dam. Since the early 1980's the Methow Subbasin has typically received annual releases of from 300,000 to 400,000 smolts (Table 9).

Straying

No data are available on Methow steelhead.

BIOCHEMICAL-GENETIC CHARACTERISTICS

Wild steelhead and hatchery-stock Wells steelhead were investigated by Loeppke et al. (1983) who studied eight enzyme systems and tentatively concluded that wild and hatchery stocks were indistinguishable electrophoretically. This conclusion seems possible since some wild fish are used as broodstock for Wells hatchery-stock and that wild-hatchery fish interbreeding likely occurs in the natural environment. However, their sampling of tissues for electrophoresis was biased toward the early portion of the run which is generally composed of a high number of hatchery fish, with some fish identified as wild stock may have been residual hatchery fish that spent at least two years in freshwater prior to smolting. Together with the observation that wild broodstock at Wells Hatchery are brighter and later maturing than hatchery fish indicates that the findings of Loeppke et al. may not be correct and indeed the wild Methow steelhead are genetically distinct from the Wells hatchery-stock.

DISEASES

No data are available on Methow steelhead.

Table 1 (HB-1). Estimated* amount of rearing and spawning habitat, by quality, of Methow River subbasin summer steelhead.

Area	Excellent	Good	Fair[B]	Poor[B]	Unknown	Total	Confidence
Miles	0.0%	0.0%	41.6%	58.4%		134.1	Unknown
Acres	0.0%	0.0%	61.8%	38.2%		988.3	Unknown

*Northwest Power Planning Council estimates based on limited observations.
[B]Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers as well as degradation caused by man.

Source: Presence/absence database, NPPC , 199 1.

Table 2 (RB-a). Returns (sport catch and escapement) of wild and hatchery summer steelhead to the Methow River subbasin.

Return Year	Escapement		Sport Catch[A]		Tribal Catch		Adult Total[B]
	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild	
1980	1,330		1,996		21		3,346
1981	2,032		1,939		130		4,101
1982	2,389	213	2,167	226	72	8	7,782
1983	8,664	108	10,332	130	188	3	19,428
1984	6,831	182	7,839	210	136	4	15,118
1985	6,822	328	8,070	448	542	30	16,240
1986	4,831	169	5,091	186	652	23	10,952
1987	2,437	627	1,653	0	182	29	4,928
1988	1,471	428	1,545	0	130	18	3,592
1989	1,702	563	1,254	0	34	7	3,560

[A]Sport catch includes subbasin catch and percentage of mixed stock catch above Wells Dam.
[B]Adult total (run size) equals the steelhead count over Wells Dam.

Source: Williams, J. WDW unpublished data, 1992.

Table 3 (SM-a). Number of natural summer steelhead smolts that migrate from the **Methow** subbasin.

Outmigration Year	Peak Migration*	Number
1987	April 1 - June 15	35,097
1988	April 1 - June 15	36,448
1989	April 1 - June 15	53,910

*Migration based on a five year average.

Source: **Methow** River **Subbasin** Production Plan 1990. **Mullan** et al. 1992. Currently being published. Peven, C. 1991. The Downstream Migration of Sockeye Salmon and Steelhead Trout Past Rock Island Dam, 1991 Chelan PUD.

Table 4 **(SL).** Lengths of wild/natural summer steelhead **smolts** from the **Methow** River subbasin.

Location and Year	Number **Fish^**	Length ave. (mm)	Length range (mm)	Reference
1988	746	163	70-280	Peven, C. 1988
1989	583	179	loo-280	Peven, C. 1989
1990	2,686	179	135-280	Peven, C. 1990

*Fish sampled at Rock Island dam and represent mixed upper Columbia River stocks.

Table 5 (AC-a). Age composition percentage (freshwater.ocean) by return year, for adult summer steelhead originating in the Methow River subbasin.

Age composition (%)

Return Year[A B]	N	2.1	2.2	3.1	3.2	4.2
1978	20	35.0	40.0	10.0	15.0	
1979	15	60.0	6.6	33.4		
1980	8	62.5	25.0	12.5		
1982	60		71.6		21.6	6.7
1983		31	69			
1988		41	59			
1989		27	73			
1990		36	64			

*Data collected from wild steelhead sampled at Wells Dam, samples represent mixed stocks.

[B]Age determined by scale analysis.

Sources: Stock Assessment of Columbia River Anadromous Salmonids Vol II., 1985.
Williams, J. 1992. unpublished WDW data.

Table 6 (AS-a). Percent females by brood year and age class for adult summer steelhead originating in the **Methow** River subbasin.

% Females

Return Year	x.1	x.2	x.3	
1983	63	72		
1988	63	82		
1989	50	76		
1990	50	73		

x.1 = l-ocean fish
x.2 = **2-ocean** fish
Based on steelhead sampled at Wells Dam, steelhead represent mixed stocks.

Source: Williams, J. 1992. Unpublished WDW data.

Table 7 (AL-a). Mean fork length and age class for adult summer steelhead originating in the **Methow** River subbasin.

Mean Fork Length (cm)

Return Year	N	2.1	2.2	2.3	3.1	3.2
1978	20	59.3	75.8		63.0	67.7
1979	15	67.3	74.0		63.8	
1980	8	61.8			62.0	67.0
1982	34		72.4			72.4
1985		61.2	73.9			
1988	male female	61.2 58.6	68.8 71.3	 68.0		
1989	male female	59.4 61.5	68.2 67.2			
1990	male female	60.8 61.0	72.2 72.8			

Fish sampled at Wells Dam, steelhead sampled represent mixed stocks.
Age determined by scale or otolith analysis.

Sources: **Methow Subbasin** Production Plan 1990.
Howell et al. 1985. Stock Assessment of Columbia River Anadromous Salmonids Vol II.
Williams, J. 1992. Unpublished WDW data.

Table 8 **(AF-a).** Mean fecundity by return year and age class for summer steelhead originating in the **Methow** River subbasin.

Return Year	X.1	x.2	x.3	
1	4,716 9	6,996	3	7
1985	4,960	6,505		

x.1 = l-ocean fish
x.2 = **2-ocean** fish
1985 Fecundity based on wild steelhead spawned at Wells Hatchery.

Sources: **Methow Subbasin** Production Plan 1990.
Mullan et al. 1991.

Table 9 **(TR).** Hatchery releases of summer steelhead into the **Methow** River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish /lb.	Number Released	Release Site	CWT Code/ Fin Clip
1981	Columbia, Wells	Wells	Smolt	04/11/83	5.0	4,350	Methow R	
1981	Columbia	Wells	Smolt	04/13/83	5.0	14,450	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/14/83	5.0	14,775	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/14/83	5.0	5,000	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/16/83	4.5	6,975	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/17/82	5.1	6,885	Methow R	AD
1981	Columbia, Wells	Wells	Smolt	04/17/83	4.5	7,200	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/18/82	5.0	7,500	Methow R	AD
1981	Columbia, Wells	Wells	Smolt	04/18/83	5.3	28,838	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/18/83	4.5	7,155	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/18/83	4.5	6,750	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/19/82	5.0	7,500	Methow R	AD
1981	Columbia, Wells	Wells	Smolt	04/19/82	5.0	7,500	Methow R	AD
1981	Columbia, Wells	Wells	Smolt	04/19/82	5.5	5,005	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/19/83	5.5	26,510	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/19/83	4.5	7,200	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/20/82	5.0	7,500	Methow R	AD
1981	Columbia, Wells	Wells	Smolt	04/20/82	5.1	4,208	Methow R	AD
1981	Columbia, Wells	Wells	Smolt	04/20/82	5.5	9,543	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/20/82	5.5	4,455	Methow R	

Table 9 (cont.). Hatchery releases of summer steelhead into the **Methow** River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish /lb.	Number Released	Release Site	CWT Code/ Fin Clip
1981	Columbia, Wells	Wells	Smolt	04/20/82	5.5	4,565	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/20/83	5.5	25,080	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/20/83	4.7	4,606	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/20/83	4.7	24,675	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/21/82	5.2	7,722	Methow R	AD
1981	Columbia, Wells	Wells	Smolt	04/21/82	5.4	4,266	Methow R	AD
1981	Columbia, Wells	Wells	Smolt	04/21/82	5.4	4,482	Methow R	AD
1981	Columbia, Wells	Wells	Smolt	04/21/82	5.4	14,796	Methow R	
1981	Columbia. Wells	Wells	Smolt	04/22/82	5.6	9,800	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/22/82	5.5	9,735	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/22/82	5.5	3,355	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/22/82	5.2	11,960	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/22/83	4.7	20,610	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/22/83	5.5	5,060	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/23/82	5.3	8,030	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/23/82	5.3	5,565	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/23/82	5.2	5,330	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/26/82	5.2	27,066	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/27/82	5.2	48,905	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/27/82	5.2	9,776	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/27/83	6.2	11,387	Methow R	

Table 9 (cont.). Hatchery releases of summer steelhead into the Methow River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish /lb.	Number Released	Release Site	CWT Code/ Fin Clip
1981	Columbia, Wells	Wells	Smolt	04/27/83	4.7	8,766	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/28/82	5.2	5,408	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/28/83	6.2	16,182	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/28/83	4.7	13,465	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/30/82	5.2	9,360	Methow R	
1981	Columbia, Wells	Wells	Smolt	05/02/83	6.2	23,529	Methow R	
1981	Columbia, Wells	Wells	Smolt	05/02/83	4.7	4,630.	Methow R	
1981	Columbia, Wells	Wells	Smolt	05/03/82	5.5	19,690	Methow R	
1981	Columbia, Wells	Wells	Smolt	05/03/83	6.2	48,236	Methow R	
1981	Columbia, Wells	Wells	Smolt	05/04/82	5.5	4,510	Methow R	
1981	Columbia, Wells	Wells	Smolt	05/04/83	6.2	24,986	Methow R	
1981	Columbia, Wells	Wells	Smolt	05/04/83	6.2	27,993	Methow R	
1981	Columbia, Wells	Wells	Smolt	05/05/82	5.5	11,275	Methow R	
1981	Columbia, Wells	Wells	Smolt	05/06/82	5.5	22,385	Methow R	
1981	Columbia, Wells	Wells	Smolt	05/07/82	5.8	12,325	Methow R	
1981	Columbia, Wells	Wells	Smolt	05/07/82	5.8	12,673	Methow R	
1981	Columbia, Wells	Wells	Smolt	05/07/82	5.8	12,818	Methow R	
1981	Columbia, Wells	Wells	Smolt	05/07/82	5.8	5,858	Methow R	
1981	Columbia, Wells	Wells	Smolt	04/24/83	6.2	16,988	Twisp R	
1981	Columbia, Wells	Wells	Smolt	04/27/82	5.2	9,282	Twisp R	
1981	Columbia, Wells	Wells	Smolt	04/28/82	5.2	5,720	Twisp R	

Table 9 (cont.). Hatchery releases of summer steelhead into the Methow River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish /lb.	Number Released	Release Site	CWT code/ Fin Clip
1981	Columbia, Wells	Wells	Smolt	04/27/83	6.2	11,129	Unknown	
1981	Columbia, Wells	Wells	Smolt	04/29/82	5.2	5,226	Unknown	
1981	Columbia, Wells	Wells	Smolt	04/29/83	6.2	5,239	Unknown	
1981	Columbia, Wells	Wells	Smolt	05/04/82	5.5	9,790	Unknown	
1982	Columbia, Wells	Wells	Non-smolt	07/15/82	126.0	63,000	Methow R	
1982	Columbia, Wells	Wells	Non-smolt	07/16/82	126.0	25,200	Methow R	
1982	Columbia, Wells	Wells	Non-smolt	07/19/82	126.0	34,650	Twisp R	
1982	Columbia, Wells	Wells	Non-smolt	07/16/82	126.0	42,210	Unknown	
1983	Columbia, Wells	Wells	Smolt	05/01/84	6.7	5,829	Methow R	
1983	Columbia, Wells	Wells	Smolt	05/02/84	7.0	12,040	Methow R	
1983	Columbia, Wells	Wells	Smolt	05/02/84	7.3	12,775	Methow R	
1983	Columbia, Wells	Wells	Smolt	05/02/84	6.9	12,316	Methow R	
1983	Columbia, Wells	Wells	Smolt	05/03/84	6.7	17,688	Methow R	
1983	Columbia, Wells	Wells	Smolt	05/04/84	6.7	12,194	Methow R	
1983	Columbia, Wells	Wells	Smolt	05/07/84	6.7	47,403	Methow R	
1983	Columbia, Wells	Wells	Smolt	05/08/84	6.7	13,467	Methow R	
1983	Unknown	Wells	Smolt	04/20/84	5.0	11,424	Methow R	
1983	Unknown	Wells	Smolt	04/23/84	5.5	32,193	Methow R	
1983	Unknown	Wells	Smolt	04/24/84	6.4	15,072	Methow R	
1983	Unknown	Wells	Smolt	04/25/84	6.4	42,272	Methow R	
1983	Unknown	Wells	Smolt	04/26/84	7.3	16,717	Methow R	

Table 9 (cont.). Hatchery releases of summer steelhead into the Methow River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish /lb.	Number Released	Release Site	CWT Code/ Fin Clip
1983	Unknown	Wells	Smolt	04/26/84	6.0	5,100	Methow R	
1983	Unknown	Wells	Smolt	04/27/84	5.4	31,335	Methow R	
1983	Unknown	Wells	Smolt	04/27/84	7.3	6,169	Methow R	
1983	Unknown	Wells	Smolt	04/27/84	6.0	14,430	Methow R	
1983	Unknown	Wells	Smolt	04/30/84	6.7	27,470	Methow R	
1983	Unknown	Wells	Smolt	04/30/84	6.0	20,940	Methow R	
1983	Unknown	Wells	Smolt	04/17/84	6.4	14,336	Twisp R	
1983	Unknown	Wells	Smolt	04/17/84	6.8	5,655	Unknown	
1983	Unknown	Wells	Smolt	04/18/84	6.0	14,340	Unknown	
1984	Columbia, Wells	Wells	Smolt	05/01/85	7.3	17,374	Methow R	AD
1984	Columbia, Wells	Wells	Smolt	05/06/85	6.1	30,005	Methow R	AD
1984	Columbia, Wells	Wells	Smolt	05/07/85	6.2	32,126	Methow R	AD
1984	Columbia, Wells	Wells	Smolt	05/08/85	6.5	70,819	Methow R	AD
1984	Columbia, Wells	Wells	Smolt	05/10/85	6.3	30,000	Methow R	AD
1984	Columbia, Wells	Wells	Smolt	05/13/85	6.5	19,565	Methow R	AD
1984	Columbia, Wells	Wells	Smolt	05/14/85	6.5	30,000	Methow R	AD
1984	Columbia, Wells	Wells	Smolt	05/14/85	7.3	24,747	Methow R	AD
1984	Columbia, Wells	Wells	Smolt	05/16/85	7.3	54,276	Methow R	AD
1984	Columbia, Wells	Wells	Smolt	05/17/85	7.0	17,780	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	04/28/86	6.8	19,108	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	04/28/86	6.8	9,316	Methow R	AD

Table 9 (cont.). Hatchery releases of summer steelhead into the Methow River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish /lb.	Number Released	Release Site	CWT Code/ Fin Clip
1985	Columbia, Wells	Wells	Smolt	04/29/86	6.8	28,866	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	04/30/86	6.8	9,962	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	04/30/86	6.2	7.440	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	05/01/86	6.2	30,054	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	05/01/86	7.5	20,175	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	05/05/86	7.4	30,259	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	05/05/86	7.6	19.722	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	05/07/86	7.5	8,963	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	05/09/86	7.5	30,186	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	05/12/86	7.5	28,238	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	05/13/86	8.1	20,979	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	05/14/86	8.1	20,614	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	05/15/86	8.1	54,027	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	05/16/86	8.1	9,680	Methow R	AD
1985	Columbia, Wells	Wells	Smolt	05107186	7.5	10,500	Twisp R	AD
1985	Columbia, Wells	Wells	Smolt	05/12/86	7.5	10,800	Twisp R	AD
1985	Columbia, Wells	Wells	Smolt	05/00/86	7.5	19,912	Chewuch	AD
1986	Columbia, Wells	Wells	Smolt	05/01/87	5.9	30,345	Methow R	AD
1986	Columbia, Wells	Wells	Smolt	05/01/87	6.4	42,880	Methow R	AD
1986	Columbia, Wells	Wells	Smolt	05/05/87	6.4	43,200	Methow R	AD
1986	Columbia, Wells	Wells	Smolt	05/07/87	6.2	18,600	Methow R	AD

Table 9 (cont.). Hatchery releases of summer steelhead into the **Methow** River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish /lb.	Number Released	Release Site	CWT Code/ Fin Clip
1986	Columbia, Wells	Wells	Smolt	05/1 1/87	6.2	18,600	Methow R	AD
1986	Columbia, Wells	Wells	Smolt	05/12/87	6.3	37,800	Methow R	AD
1986	Columbia, Wells	Wells	Smolt	05/13/87	6.4	19,200	Methow R	AD
1986	Columbia, Wells	Wells	Smolt	05/14/87	6.4	19,200	Methow R	AD
1986	Columbia, Wells	Wells	Smolt	04/23/87	6.1	18,910	Twisp R	AD
1986	Columbia, Wells	Wells	Smolt	05/11/87	6.2	9,300	Twisp R	AD
1986	Columbia, Wells	Wells	Smolt	04/22/87	6.1	12,810	Chewuch	AD
1986	Columbia, Wells	Wells	Smolt	04/23/87	6.1	31,330	Methow R	AD
1986	Columbia, Wells	Wells	Smolt	04/27/87	6.4	13,440	Chewuch	AD
1986	Columbia, Wells	Wells	Smolt	04/27/87	6.1	31,354	Methow R	AD
1986	Columbia, Wells	Wells	Smolt	04/30/87	6.2	45,880	Methow R	AD
1987	Columbia, Wells	Wells	Smolt	04/20/88	6.4	19,200	Methow R	621707 AD LV
1987	Columbia, Wells	Wells	Smolt	04/21/88	6.3	11,000	Methow R	621707 AD LV
1987	Columbia,, Wells	Wells	Smolt	04/23/88	6.4	19,200	Methow R	AD
1987	Columbia, Wells	Wells	Smolt	04/26/88	7.0	17,500	Methow R	AD
1987	Columbia, Wells	Wells	Smolt	04/27/88	7.1	85,910	Methow R	AD
1987	Columbia, Wells	Wells	Smolt	04/29/88	7.2	21,600	Methow R	AD
1987	Columbia, Wells	Wells	Smolt	05/02/88	7.3	54,750	Methow R	AD
1987	Columbia, Wells	Wells	Smolt	05/02/88	8.0	24,000	Methow R	AD

Table 9 (cont.). Hatchery releases of summer steelhead into the Methow River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish /lb.	Number Released	Release Site	CWT Code/ Fin Clip
1987	Columbia, Wells	Wells	Smolt	05/04/88	7.2	21,600	Methow R	AD
1987	Columbia, Wells	Wells	Smolt	05/04/88	8.0	12,000	Methow R	AD
1987	Columbia, Wells	Wells	Smolt	05/05/88	7.2	21,600	Methow R	AD
1987	Columbia, Wells	Wells	Smolt	05/05/88	7.2	32,400	Methow R	AD
1987	Columbia, Wells	Wells	Smolt	05/05/88	6.7	10,050	Methow R	AD
1987	Columbia, Wells	Wells	Smolt	05/06/88	6.7	70,350	Methow R	AD
1987	Columbia, Wells	Wells	Smolt	05/07/88	7.2	64,800	Methow R	AD
1987	Columbia, Wells	Wells	Smolt	05/09/88	6.9	41,400	Methow R	AD
1987	Columbia, Wells	Wells	Smolt	05/10/88	7.3	65,700	Methow R	AD
1987	Columbia, Wells	Wells	Smolt	04/26/88	6.4	19.200	Twisp R	AD
1987	Columbia, Wells	Wells	Smolt	04/29/88	7.2	10,800	Twisp R	AD
1987	Columbia, Wells	Wells	Smolt	04/25/88	6.4	19,200	Chewack R	AD
1987	Columbia, Wells	Wells	Smolt	04129188	7.2	10,800	Chewack R	AD
1988	Columbia, Wells	Wells	Smolt	04/24/89	5.2	15,600	Methow R	AD
1988	Columbia, Wells	Wells	Smolt	04/24/89	6.0	18,000	Methow R	AD
1988	Columbia, Wells	Wells	Smolt	04/26/89	6.1	18,300	Methow R	AD
1988	Columbia, Wells	Wells	Smolt	04/27/89	6.1	18,300	Methow R	AD
1988	Columbia, Wells	Wells	Smolt	04/28/89	6.5	19,500	Methow R	AD
1988	Columbia, Wells	Wells	Smolt	04/28/89	5.3	15,238	Methow R	621716 AD LV

Table 9 (cont.). Hatchery releases of summer steelhead into the Methow River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish /lb.	Number Released	Release Site	CWT Code/ Fin Clip
1988	Columbia, Wells	Wells	Smolt	04128189	5.3	15,191	Methow R	621716 AD LV
1988	Columbia, Wells	Wells	Smolt	05/01/89	6.8	20,400	Methow R	AD
1988	Columbia, Wells	Wells	Smolt	05/06/89	6.2	18,600	Methow R	AD
1988	Columbia, Wells	Wells	Smolt	05/09/89	6.2	46,500	Methow R	AD
1988	Columbia, Wells	Wells	Smolt	05/10/89	6.2	37,200	Methow R	AD
1988	Columbia, Wells	Wells	Smolt	05/11/89	6.5	19,500	Methow R	AD
1988	Columbia, Wells	Wells	Smolt	05/1 1/89	6.5	39,000	Methow R	AD
1988	Columbia, Wells	Wells	Smolt	05/1 1/89	6.5	19,500	Methow R	AD
1988	Columbia, Wells	Wells	Smolt	05/12/89	6.5	68,250	Methow R	AD
1988	Columbia, Wells	Wells	Smolt	05/01/89	6.8	20,400	Twisp R	AD
1988	Columbia, Wells	Wells	Smolt	05/08/89	7.2	10,800	Twisp R	AD
1988	Columbia, Wells	Wells	Smolt	04/27/89	6.1	18,300	Chewack R	AD
1988	Columbia, Wells	Wells	Smolt	05/08/89	7.2	10,800	Chewack R	AD
1989	Columbia, Wells	Wells	Smolt	04/23/90	6.4	28,800	Chewack R	AD
1989	Columbia, Wells	Wells	Smolt	04/24/90	6.4	19,840	Methow R	AD
1989	Columbia, Wells	Wells	Smolt	04/25/90	6.4	19,200	Methow R	AD
1989	Columbia, Wells	Wells	Smolt	04/26/90	6.1	15,129	Methow R	623115 AD LV
1989	Columbia, Wells	Wells	Smolt	04/26/90	6.1	15,130	Methow R	623115 AD LV
1989	Columbia, Wells	Wells	Smolt	04/27/90	6.3	17,100	Methow R	AD

Table 9 (cont.). Hatchery releases of summer steelhead into the **Methow** River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish /lb.	Number Released	Release Site	CWT Code/ Fin Clip
1989	Columbia, Wells	Wells	Smolt	04/30/90	6.1	18,300	Methow R	AD
1989	Columbia, Wells	Wells	Smolt	04/30/90	6.4	29,440	Methow R	AD
1989	Columbia, Wells	Wells	Smolt	05/01/90	6.3	28,350	Methow R	AD
1989	Columbia, Wells	Wells	Smolt	05/02/90	6.3	18,900	Methow R	AD
1989	Columbia, Wells	Wells	Smolt	05102190	6.3	37,800	Methow R	AD
1989	Columbia, Wells	Wells	Smolt	05/03/90	6.5	29,250	Methow R	AD
1989	Columbia, Wells	Wells	Smolt	05/03/90	6.5	19,500	Methow R	AD
1989	Columbia, Wells	Wells	Smolt	05/04/90	7.0	42,000	Methow R	AD
1989	Columbia, Wells	Wells	Smolt	05/04/90	7.0	10,500	Methow R	AD
1989	Columbia, Wells	Wells	Smolt	05/07/90	6.5	39,000	Methow R	AD
1989	Columbia, Wells	Wells	Smolt	05/08/90	6.0	90,000	Methow R	AD
1989	Columbia, Wells	Wells	Smolt	05/09/90	6.3	37,800	Methow R	AD
1989	Columbia, Wells	Wells	Smolt	04/30/90	6.3	18,900	Twisp R	AD
1989	Columbia, Wells	Wells	Smolt	05/01/90	6.4	9,600	Twisp R	AD
1990	Columbia, Wells	Wells	Smolt	04/22/91	6.1	18,300	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	04/23/91	7.0	21,000	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	04/23/91	7.0	10,500	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	04/25/91	7.2	43,200	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	04/25/91	7.3	18,980	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	04/26/91	7.4	20,720	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	04/29/91	7.3	6,205	Methow R	AD

Table 9 (cont.). Hatchery releases of summer steelhead into the Methow River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish /lb.	Number Released	Release Site	CWT Code/ Fin Clip
1990	Columbia, Wells	Wells	Smolt	04/29/91	7.3	43,800	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	04/30/91	7.2	21,600	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	05/01/91	7.4	21,460	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	05/02/91	5.7	15,463	Methow R	625061 AD LV
1990	Columbia, Wells	Wells	Smolt	05/03/91	5.7	14,529	Methow R	625061 AD LV
1990	Columbia, Wells	Wells	Smolt	05/03/91	5.7	25,650	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	05/03/91	7.3	10,950	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	05/03/91	7.3	8,760	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	05/06/91	7.3	43,800	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	05/06/91	5.7	34,200	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	05/07/91	7.4	33,300	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	05/07/91	5.7	8,550	Methow R	AD
1990	Columbia, Wells	Wells	Smolt	05/08/91	7.4	66,600	Methow R	AD

Source: Terry Lovgren, WDW Hatchery Stocking Database, 1991.

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OKANOGAN SUBBASIN

Summer Chinook

GEOGRAPHIC LOCATION

The Methow and Okanogan subbasins represent the upper limit of anadromous salmonids in the Columbia River Basin and enter the Columbia between Wells and Chief Joseph dams. The Okanogan Subbasin straddles British Columbia and Washington, begins near Armstrong, British Columbia, and flows south through a chain of lakes. The first and largest of these is Lake Okanogan, followed by Lakes Skaha, Vaseaux and Osoyoos. The US-Canadian border divides Lake Osoyoos into two, nearly equal parts. From Lake Osoyoos, the Okanogan River flows about 80 miles south where it enters the Columbia River near Brewster at RM 533.

The Similkameen River enters the Okanogan River from the northwest approximately 75 miles above the mouth, approximately two miles below Lake Osoyoos near Oroville. It is the main tributary to the Okanogan and is primarily in Canada. At the confluence, the Similkameen has about four times greater volume than the Okanogan. Collectively, the Okanogan-Sirnilkameen subbasin encompasses approximately 8,200 square miles with 2,500 square miles in the United States.

ORIGIN

Historically, summer chinook were abundant in the middle to upper Columbia River and were endemic in the Okanogan and Similkameen rivers. Prior to Hydroelectric dam development, summer chinook migrated as far as Windermere Lake in British Columbia (Fulton 1968). Before completion of Grand Coulee Dam, summer chinook destined for the upper Columbia were intercepted at Rock Island Dam (1939-1941) and released into the Wenatchee, Entiat, Methow and Okanogan rivers. Along with mainstem darns, tributary developments have contributed to the depletion of these fish.

DISTRIBUTION

Spawning in the mainstem Okanogan occurs from Lake Osoyoos (river mile 77) downstream to the town of Okanogan (river mile 26). Summer chinook in the Similkameen River spawn in the two mile area downstream of Enloe Dam.

PRODUCTION

Summer chinook in the subbasin are managed for natural production and exploit the middle to upper reaches of the mainstem Okanogan and the area below Enloe Dam in the Similkameen. Stock characteristics of Okanogan Subbasin summer chinook have not been documented, but are thought to be similar to Wells Dam Hatchery fish. The greatest limitation regarding summer chinook production in the Okanogan Subbasin is the smolt and adult mortalities encountered at Columbia River dams and impoundments. Summer chinook juvenile outmigration occurs from late spring through mid-fall with the greatest number moving through the system in July and August when Columbia outmigrant passage flows are not present. Smolt mortalities are suspected to be severe from turbine mortality, predation and loss of physiological readiness to adapt to the marine environment as a result of migration delays.

Summer chinook production in the subbasin is further limited by extensive riparian and instream habitat degradation and warm water temperatures. Accelerated erosion and resulting sedimentation have substantially reduced quality of spawning and rearing habitat. Juvenile and smolt losses at substandard diversions (pump intake screens) may be significant. Tables 1 and 2 describe the amount of spawning and rearing habitat, by quality, available in the Okanogan/Similkameen subbasin. This data was derived from the Presence/Absence database of the Northwest Power Planning Council, 199 1.

The Northwest Power Planning Council's habitat carrying capacity model estimated potential summer chinook smolt production in the subbasin at 1,435,704 smolts. However, this estimate could be misleading as so little is known about factors limiting production of summer chinook.

The Okanogan River chinook natural spawn escapement during the 1977-1990 return years ranged from a low of 363 fish in 1982 to a high of 2,300 fish in 1984, and averaged 1,346. Natural spawn escapements by return year are presented in Table 3.

The Okanogan Subbasin has not been directly supplemented with hatchery fish. However, some adults from releases at Wells Dam may have strayed to the subbasin. As part of the Rock Island Dam Settlement Agreement (Chelan County PUD), 57,600 pounds (at 10 fish/pound) of smolts are planned for the subbasin. Adults will be collected at Wells or Rock Island Dam and reared at the Chelan PUD Eastbank Hatchery until placed in the Similkameen Rearing Station on the Similkameen River. Additional production of summer chinook may result from the Wells Dam Settlement Agreement (Douglas County PUD) depending on the success of an experimental sockeye net pen project.

Historically, a tribal fishery existed in the Okanogan Basin where fish were captured with primitive weirs (Ray 1972). Currently there is no tribal fishery on the Okanogan. A Colville tribal fishery exists at the base of Chief Joseph Dam. It is unknown if Okanogan subbasin fish are harvested. There is no formal fisheries agreement between the Colville Confederated Tribes and the State of Washington, but it may become necessary to develop one.

ADULT LIFE HISTORY

Run size. catch and escapement

Ocean commercial and recreational fisheries from Alaska to Washington all harvest a portion of the Okanogan River summer chinook. At this time, a summer chinook recreational fishery is not authorized within the mid to upper Columbia River or any regional tributaries. Such a fishery would be inconsistent with the Columbia River Fish Management Plan.

Time of Migration

Summer chinook migration begins in late May or early June with peak counts at Bonneville Dam during early July. Approximately 50 percent of the Upper Columbia run has migrated past Priest Rapids Dam in mid-July and past Wells Dam in late July. Frequently, summer chinook do not enter the Okanogan River until September (J. Easterbrooks, WDF, pers. comm.).

Spawning Period

Spawning occurs during late September through early November. At Wells Dam Hatchery spawning commences in late September with a peak in late October or early November.

Spawning Areas

See distribution.

Age Composition

No information is available on the naturally produced population.

Sex Ratio

No information.

Fecundity

No information is available on the naturally produced population. Based on Wells Dam Hatchery spawning reports, average fecundity was 4,935 eggs per female during 1978-1982.

JUVENILE LIFE HISTORY

Time of Emergence

No information is available on the naturally produced population. At the Wells spawning channel, fry emergence occurred from January through April during 1968-1971 (Allen et al. 1968, 1969, 1971; and Allen 1970).

Time, age and size at migration

Summer chinook juvenile outmigration occurs from late spring through mid-fall with the greatest number moving through the system in July and August when Columbia outmigrantion passage flows are not present.

Survival Rate

No information is available on the naturally produced population. Survival rate to all fisheries and escapement averaged 0.3 percent for 10 groups of coded wire tagged sub-yearlings released from Wells Dam Hatchery (WDF 1984a).

DISEASE

No data available.

BIOCHEMICAL-GENETIC CHARACTERISTICS

Schreck et al. (1984) compared isozyme gene frequencies of seven enzyme systems from Wells Hatchery production samples to natural production samples collected in the Wenatchee, Methow, and Okanogan systems. In paired statistical comparisons, gene frequency profiles were similar for all seven enzyme systems between Wells Hatchery production and the natural production in the Wenatchee and Methow rivers. For the Wells - Okanogan comparison, a statistically significant difference in isozyme gene frequencies was determined for two enzyme systems, indicating genetically distinct populations.

Table 1 (HB-1). Estimated amount of rearing and spawning habitat, by quality, of the Okanogan River summer chinook production area.

Distance/Area	Excellent	Good	Fair”	Poor”	Unknown	Total	Confidence
Miles (%)	0	9	31	60		50.8	
Acres (%)	0	9	31	60		369.4	

[a] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/Absence database, NPPC , 199 1.

Table 2 (HB-2). Estimated amount of rearing habitat, by quality, of the Methow River spring chinook production area.

Distance/Area	Excellent	Good	Fair”	Poor”	Unknown	Total	Confidence
Miles (%)	0	0	0	1.00		15.1	
Acres (%)	0	0	0	1.00		109.8	

[a] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.

Source: Presence/Absence database, NPPC, 199 1.

Table 3 (RN-a). Minimum natural spawner escapement of summer chinook to the Okanogan River subbasin by return year. 1/

Return Year	Minimum Potential Escapement
1977	1,680
1978	1,996
1979	1,293
1980	1,252
1981	778
1982	363
1983	400
1984	2,300
1985	1,941
1986	2,158
1987	1,246
1988	989
1989	1,717
1990	729

1/ Redd counts from 69.5 miles of spawning reach and 3.1 fish/redd.

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OKANOGAN SUBBASIN

Sockeye

GEOGRAPHIC LOCATION

The Methow and Okanogan subbasins represent the upper limit of anadromous salmonids in the Columbia River Basin and enter the Columbia between Wells and Chief Joseph dams. The Okanogan Subbasin straddles British Columbia and Washington, begins near Armstrong, British Columbia, and flows south through a chain of lakes. The first and largest of these is Lake Okanogan, followed by Lakes Skaha, Vaseaux and Osoyoos. The US-Canadian border divides Lake Osoyoos into two nearly equal parts. From Lake Osoyoos, the Okanogan River flows about 80 miles south where it enters the Columbia River near Brewster at RM 533.

The Similkameen River enters the Okanogan River from the northwest approximately 75 miles above the mouth, approximately two miles below Lake Osoyoos near Oroville. It is the main tributary to the Okanogan and is primarily in Canada. At the confluence, the Similkameen has about four times greater volume than the Okanogan. Collectively, the Okanogan-Similkameen subbasin encompasses approximately 8,200 square miles with 2,500 square miles in the United States.

ORIGIN

With the construction of the Grand Coulee Dam in 1939, 1,140 miles of the upper Columbia River were barred to anadromous salmonids. Sockeye production was almost completely limited to the Okanogan and Wenatchee systems. Beginning in 1939, sockeye were collected at Rock Island Dam and either transferred to Lake Wenatchee and Lake Osoyoos for natural propagation, or to three recently constructed hatcheries on the Wenatchee, Entiat and Methow rivers.

DISTRIBUTION

Sockeye spawn in the mainstem Okanogan from the head of Lake Osoyoos (river mile 90.0) upstream to the outlet of Vaseaux Lake (river mile 106.0).

PRODUCTION

Sockeye originally inhabited as many as eight upper Columbia River lakes, but now only Lakes Osoyoos and Wenatchee remain (Mullan 1984). Sockeye were once present above Lake Osoyoos (C. Bull, Ministry of Environment, B.C., pers. comm.). Presently, upstream passage is prevented above Lake Vaseaux by an impassable irrigation diversion. Beginning in 1939, sockeye were collected at Rock Island Dam as part of the Grand Coulee fish Maintenance Project and transported to Lake Osoyoos, Lake Wenatchee, or to one of three hatcheries on the Wenatchee, Entiat and Methow rivers. Eggs and brood stock for the Methow and Okanogan subbasins were collected at Rock Island Dam, Carson Hatchery, Leavenworth Hatchery, Lake Wenatchee and Lake Whatcom (kokanee adults). The Methow and Okanogan subbasins were planted with sockeye from the Winthrop and/or Leavenworth Hatcheries between 1942 and 1958. Performance of past hatchery programs is discussed by Mullan (1986).

Estimates of sockeye smolt production from the Okanogan Basin are not included in the Northwest Power Planning Council's carrying capacity model, however, estimates of potential production range from 0.5 million to 2.1 million smolts (Meekin and Allen 1980). The greatest limitation regarding sockeye production in the Okanogan Basin is the smolt and adult mortalities encountered at each of nine Columbia River Dams.

The Okanogan River sockeye natural spawn escapement for the 1977-1990 return -years averaged 30,636 fish, with a low return of 7,957 in the 1990 return and a peak of 73,300 in the 1984 return. Natural spawn escapements by return year are presented in Table 1.

Historically a tribal fishery existed historically in the Okanogan Basin where fish were captured by weirs and spearing (Ray 1972). Currently there is a limited tribal fishery on the Okanogan. A Colville Tribal fishery exists at the base of Chief Joseph Dam where harvest averaged 110 fish per year for 1980 through 1987. There is no formal agreement between the Colville Confederated Tribes and the State of Washington regarding this fishery. Canadian natives fish for sockeye above Lake Osoyoos.

ADULT LIFE HISTORY

Run size. catch and escapement

Sockeye are not harvested in significant numbers in ocean fisheries. Limited non-treaty commercial gillnet fisheries as well as limited treaty commercial and subsistence net fisheries all harvest a portion of the Okanogan origin sockeye. No commercial season has occurred since 1988. The mainstem Columbia River sport fishery harvests minor numbers of Okanogan sockeye.

Time of Migration

Upstream migration commences in late May and early June with counts at Bonneville Dam increasing sharply in late June. Approximately 50 percent of the run has migrated past Bonneville dam by early July and past Priest Rapids Dam about ten days later. Sockeye entering the Okanogan River can be delayed when water temperatures exceed 70 degrees Fahrenheit (Allen and Meekin 1973) and the fish may mill below Chief Joseph Dam (Fiscus 1984).

Spawning Period

Spawning activity peaks in the Okanogan River about the third week of October (H. Fiscus, Washington Department of fisheries, personal communication).

Spawning Areas

Okanogan sockeye spawn in the upper Okanogan mainstem above Lake Osoyoos, although some lake spawning occurs. The primary spawning area is the approximately nine mile reach between the town of Oliver and the Vaseux Lake outlet (Allen and Meekin 1973). Spawning in Lake Osoyoos occurs in some years (Allen and Meekin 1973).

Age Composition

Little is known of Okanogan sockeye biological characteristics. Data for 1955 through 1974 indicates 60 percent of the population is three-year-old fish, although it has varied from 6.8 percent to 94.4 percent (Mullan 1986). Four-year-old fish comprised 28 percent of the run sampled at Wells Dam in 1990 (Fryer and Schwartzberg 1991) and 81 percent of the run sampled in 1991 (Fryer et al. 1992).

Sex Ratio

In 1972, males comprised 72 percent of the population less than 18 inches in length and were assumed to be three-year-old fish (Allen and Meekin 1973). Four-year-old sockeye were 47 percent males.

Fecunditv

Based on Leavenworth, Entiat, and Winthrop hatchery records between 1944 and 1964, fecundity averaged about 2,600 eggs per female (Mullan 1984).

JUVENILE LIFE HISTORY

Time of Emergence

Fry emerge on late March through early April.

Time. age and size at migration

After rearing in the nursery lake for about a year, sockeye yearlings begin a rapid migration to the ocean. A small number of sockeye may remain in the nursery lake for an extra year. Between 1949-1953, yearlings comprised 93 percent of the mixed stock sockeye smolts sampled at Bonneville Dam (Anas and Gauley 1956; as reported in Mullan 1984).

Survival Rate

Smolt-to-adult survival rates are unknown. Egg-to-smolt survival is probably about 3 percent on average escapements (Mullan 1987).

DISEASE

No data available.

BIOCHEMICAL-GENETIC CHARACTERISTICS

Information on Wenatchee and Okanogan sockeye is negligible. May and Utter (1974), as reported in Mullan (1984), found different variants of allelic frequencies for two enzyme between some individual Wenatchee and Okanogan samples, indicating possible genetic differentiation.

Table 1 (RN-a). Maximum natural spawner escapement of sockeye to the Okanogan River subbasin by return year. 1/

Return Year	Maximum Potential Escapement
1977	26,600
1978	8,700
1979	28,700
1980	29,900
1981	30,600
1982	17,400
1983	26,000
1984	73,300
1985	54,100
1986	32,900
1987	41,100
1988	34,100
1989	16,200
1990	9,300

1/ Wells Dam counts.

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OKANOGAN RIVER SUBBASIN

Naturally Produced Summer Steelhead

GEOGRAPHIC LOCATION

The Okanogan River originates in British Columbia and flows south through a series of Canadian lakes entering north-central Washington at Lake Osoyoos. The International Boundary between British Columbia and Washington is located at the middle of Lake Osoyoos and divides the lake into two nearly equal parts. From Lake Osoyoos, the Okanogan River flows south for approximately 80 miles where it enters the Columbia River at river mile (RM) 533.

The Similkameen River is a major tributary to the Okanogan River with its drainage primarily in Canada. The Similkameen River enters the Okanogan River approximately seven miles south of the Canadian border and two miles south of Lake Osoyoos. At the confluence with the Okanogan River, the Similkameen has about four times greater volume than the Okanogan. The entire Okanogan-Similkameen subbasin encompasses approximately 8,200 square mile with 2,500 square miles in the State of Washington.

ORIGIN

The wild summer steelhead stock in the Okanogan River is native, although interbreeding has probably occurred with introduced Wells hatchery-stock. From 1939 through 1943 all adult steelhead bound for the upper Columbia were trapped at Rock Island Dam and distnbuted into the Okanogan, Methow, Entiat and Wenatchee rivers. Thus, Okanogan River steelhead were mixed with other steelhead stocks of the upper Columbia River.

DISTRIBUTION

Tables 1 and 2 lists rearing and spawning habitat, by quality, for Okanogan River steelhead based on estimates from the Northwest Power Planning Council and Mullan (1992). In addition, the NPPC habitat carrying capacity model estimates that 58,104 smolts could be produced in the subbasin.

Currently, steelhead distribution is limited to the mainstem Okanogan River and to the lower reaches of the Similkameen River and Inkaneep and Vaseux creeks. Former distribution of steelhead was throughout the mainstem Okanogan and Similkameen rivers. Within the Okanogan River the historical range of steelhead is unknown, but construction of dams on Okanogan and Vaseux lakes (in Canada) reduced steelhead distribution by preventing anadromous migration into the upper basin. In addition, irrigation and agricultural development along the mainstem Okanogan have reduced valuable spawning and rearing habitat. Steelhead distribution within the Similkameen basin was affected by the construction of Enloe Dam on the lower Similkameen River. The dam which was constructed in 1918 and blocks steelhead access to most of the Similkameen Subbasin, restricting steelhead distribution to only a small portion of the lower river.

PRODUCTION

Production Facilities

No steelbead rearing occurs within this subbasin.

Production Summary

No historical data are available on smolt production although both the Okanogan and Simimlkameen basins were significantly productive steelhead streams (Okanogan Subbasin Plan 1990). Current production is considered extremely low although it is difficult to assess the exact reason for the decline. Factors limiting natural production include the inaccessiblity of tributaries (where most production formerly occurred), extensive loss of riparian and instream habitat, warm water temperatures, imgation, and Enloe Dam which blocks most of the Similkameen River. In addition, mainstem Columbia River Dams and commercial fishing have also taken a toll on Okanogan-Similkameen basin steelbead.

ADULT LIFE HISTORY

Run Size and Escapement

Historical counts of steelhead at Rock Island Dam averaged 2,780 fish for the 1930's, 2,605 fish for the 1940's and 3,722 fish for the 1950's. These numbers represent the combined return of steelhead to all upper Columbia subbasins (Okanogan, Methow, Wenatchee, Entiat and upper-Columbia rivers). Escapement of wild Okanogan steelhead, based on counts at Wells Dam, averaged 15 fish annually between 1982 and 1989 (Table 3). The wild Okanogan steelhead run has increased in the past three years (1987 through 1989) to an average annual return of 29 fish (sport fishing regulations were changed in 1986 requiring release of wild steelhead).

Harvest

No estimates are available for ocean harvest of Okanogan steelhead.

No estimates are available for Okanogan River steelhead harvested in the lower Columbia River. This section of the Columbia River supports a sport fishery which harvests large numbers of steelhead, some of which are probably Okanogan River fish. Another popular sport fishery exists on the upper Columbia River, primarily at Wells Pool. From 1982 through 1986 an annual average of 3,641 steelhead (hatchery and wild) were harvested, with the catch representing fish from the Okanogan, Methow and upper Columbia rivers.

Sport harvest within the Okanogan Subbasin showed an annual harvest of hatchery steelhead from 1982 through 1989 averaged 999 fish (Table 3). Additionally, the annual average harvest of wild steelhead from 1983 through 1986 was 18 fish (Table 3). Wild release regulations were implemented in 1986 restricting legal harvest to hatchery fish only. In addition, new regulations designed to protect juveniles in the Similkameen basin include 1) use of bait prohibited, 2) 12 inch minimum size limit, and 3) delay in the opening of stream fishing season.

Treaty fishing for the period 1984 through 1990 yielded an annual average of 57 hatchery steelhead and 1 wild steelhead (Table 3).

Time of migration

Exact times are unknown, but probably June through October.

Spawning period

Spawning occurs primarily in April and May.

Spawning area

Presently, spawning occurs in the mainstem Okanogan River upstream to Vaseux Lake, the lower reaches of the Similkameen River and Inkaneep and Vaseux creeks.

Fecundity

No data is available on Okanogan steelhead.

Age Composition

Due to lack of data on Okanogan wild steelhead age structure, the data presented here are from mixed stock steelhead sampled at Wells Dam, i.e. steelhead from the Methow, Okanogan and upper-Columbia basins. Wild steelhead sampled at Wells Dams showed some years such as 1979 and 1980 being dominated by l-ocean fish (94.0 and 87.5 percent respectively). In other years such as in 1982 and 1989, steelhead returns were predominately 2-ocean fish, (100 and 73 percent respectively, Table 5).

Size

From wild adults (mixed stocks) sampled at Wells Dam in 1978 and 1982, l-ocean fish averaged 63.3 cm and 2-ocean fish averaged 72.6 cm. From steelhead captured at Wells Dam in 1989, wild male steelhead averaged 59.4 cm for l-ocean fish and 68.2 cm for 2-ocean fish while females averaged 61.5 cm for l-ocean fish and 67.2 cm for 2-ocean fish (Table 7).

Sex ratio

Wild steelhead (mixed stocks) collected in 1988, 1989 and 1990 averaged 54.3 percent females for l-ocean fish and 77.0 percent females for 2-ocean fish (Table 6).

Survival Rate

No data on Okanogan steelhead smolt to adult survival.

JUVENILE LIFE HISTORY

Emergence

No data is available on Okanogan steelhead.

Egg

No data on egg production or egg to smolt survival.

Juvenile rearing

Juvenile rearing for wild smolts last approximately two years prior to spring emigration.

Wild steelhead smolts outmigrate in April and May. Strickland (1967) reported that wild smolts emigrate pass Priest Rapids Dam (Columbia River RM 397.1) in peak abundance between mid-May and early June.

Hatchery releases

Since 1983 steelhead releases into the Okanogan subbasin were from Wells hatchery-stock and averaged 118,684 smolts planted annually (Table 8). Prior to this, 1974 through 1982 no releases of steelhead occurred in the subbasin.

Straying

No data is available on Okanogan steelhead.

BIOCHEMICAL-GENETIC CHARACTERISTICS

No data is available on Okanogan steelhead.

DISEASES

Disease history for hatchery smolts planted in the Okanogan Subbasin is presented in Table 9.

Table 1 (HB-1). Estimated[A] amount of rearing and spawning habitat, by quality, of Okanogan River subbasin summer steelhead.

Area	Excellent	Good	Fair[B]	Poor[B]	Unknown	Total	Confidence
Miles	0.0%	0.0%	55.7%	44.3%		134.1	low
Acres	0.0%	0.0%	96.0%	4.0%		988.3	low

*Northwest Power Planning Council estimates based on limited observations.

[B]Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers as well as degradation caused by man.

Source: Presence/absence database, NPPC, 1991.

Table 2 (HB-2). Estimated amount of spawning and rearing habitat by quality of Okanogan River subbasin steelhead.

Area	Excellent	Good	Fair	Poor	Confidence
Spawning	0.0%	0.0%	5.0%	95.0%	High
Rearing	0.0%	0.0%	5.0%	95.0%	High

Source: Mullan et al. 1992. In Press.

Table 3 (RR-a). Returns (sport catch and escapement) of wild and hatchery summer steelhead to the Okanogan River subbasin.

Return Year	Escapement		Sport Catch		Tribal Catch		Adult Total[B]
	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild	
1980	6	7[C]	10				
1981	2	3[C]	3				
1982	0	3	12				25
1983	45	6	44	7			102
1984	398	6	1,029	15	13	0	1,461
1985	528	7	2,781	34	121	1	3,472
1986	255	3	1,881	16	142	1	2,298
1987	312	33	265	0	2 6	1	637
1988	334	23	378	0	31	1	767
1989	367	30	612	0	11	0	1,020

[A]Sport catch includes subbasin catch and percentage of mixed stock catch above Wells Dam, includes Similkameen River.

[B]Adult total (run size) equals the steelhead count over Wells Dam.

‘Origin unknown.

Source: Williams, K. WDW unpublished data, 1992.

Table 4 (SL). Lengths of wild/natural summer steelhead smolts from the Okanogan River subbasin.

Location and Year	Number Fish*	Length ave. (mm)	Length range (mm)	Reference
1988	746	163	70-280	Peven, C. 1988
1989	583	179	100-280	Peven. C. 1989
1990	2.686	179	135-280	Peven, C. 1990

*Fish sampled at Rock Island Dam and represent mixed stocks (steelhead from the Methow, Okanogan and upper-Columbia basins).

Table 5 (AC-a). Age composition percentage (freshwater-ocean) by return year, for adult wild summer sampled at Wells Dam.

Age composition (%)

Return Year[A B]	N	2.1	2.2	3.1	3.2	4.2
1978	20	35.0	40.0	10.0	15.0	
1979	15	60.0	6.6	33.4		
1980	8	62.5	25.0	12.5		
1982	60		71.6		21.6	6.7
1983		31	69			
1988		41	59			
1989		27	73			
1990		36	64			

*Data collected from wild steelhead sampled at Wells Dam, samples represent mixed stocks.
[B]Age determined by scale analysis.

Source: Stock Assessment of Columbia River Anadromous Salmonids Vol II., 1985.
Williams, K, 1992. unpublished WDW data.

Table 6 (AS-a). Percent females by brood year and age class for adult wild summer steelhead sampled at Wells Dam.

% Females

Return Year	x.1	x.2	x.3	
1983	63	72		
1988	63	82		
1989	50	76		
1990	50	73		

x.1 = l-ocean fish
x.2 = 2-ocean fish
Based on steelhead sampled at Wells Dam, steelhead represent mixed stocks.

Source: Williams, K. 1992. Unpublished WDW data.

Table 7 (AL-a). Mean fork length and age class for adult wild summer steelhead sampled at Wells Dam.

Mean Fork Length (cm)

Return Year	N	2.1	2.2	2.3	3.1	3.2
1978	20	59.3	75.8		63.0	67.7
1979	15	67.3	74.0		63.8	
1980	8	61.8			62.0	67.0
1982	34		72.4			72.4
1985		61.2	73.9			
1988	male female	61.2 58.6	68.8 71.3	 68.0		
1989	male female	59.4 61.5	68.2 67.2			
1990	male female	60.8 61.0	72.2 72.8			

Fish sampled at Wells Dam, steelhead sampled represent mixed stocks.
Age determined by scale or otolith analysis.

Source: Okanogan Subbasin Production Plan 1990.
Howell et al. 1985. Stock Assessment of Columbia River Anadromous Salmonids Vol II.
Williams, K. 1992. Unpublished WDW data.

Table 8 **(TR).** Hatchery releases of summer steelhead into the Okanogan River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish/lb	Number Released	Release Site	CWT Code/ Fin Clip
1981	Columbia, Wells	Wells	Smolt	04/15/83	5.0	22,325	Similkameen R	
1981	Columbia, Wells	Wells	Smolt	04/21/83	5.5	30,855	Similkameen R	
1981	Columbia, Wells	Wells	Smolt	04/2 1/83	4.7	7,168	Similkameen R	
1981	Columbia, Wells	Wells	Smolt	04/22/83	5.5	13,200	Similkameen R	
1981	Columbia, Wells	Wells	Smolt	04/25/83	5.4	12,825	Similkameen R	
1981	Columbia, Wells	Wells	Smolt	04/26/83	5.5	8,250	Similkameen R	
1981	Columbia, Wells	Wells	Smolt	04/26/83	5.7	5.016	Similkameen R	
1983	Unknown	Wells	Smolt	04/16/84	6.4	5,216	Similkameen R	
1983	Unknown	Wells	Smolt	04/17/84	6.4	5,344	Similkameen R	
1983	Unknown	Wells	Smolt	04/17/84	4.8	10,848	Similkameen R	
1983	Unknown	Wells	Smolt	04/18/84	6.4	5,408	Similkameen R	
1983	Unknown	Wells	Smolt	04/18/84	4.8	11,448	Similkameen R	
1983	Unknown	Wells	Smolt	04/19/84	6.4	5,312	Similkameen R	
1983	Unknown	Wells	Smolt	04/19/84	4.8	11,160	Similkameen R	
1983	Unknown	Wells	Smolt	04/20/84	6.4	14,912	Similkameen R	
1983	Unknown	Wells	Smolt	04/24/84	6.4	6,432	Similkameen R	
1984	Columbia, Wells	Wells	Smolt	05/13/85	6.8	10,438	Similkameen R	AD
1984	Columbia, Wells	Wells	Smolt	05/14/85	7.3	10,804	Similkameen R	AD
1984	Columbia, Wells	Wells	Smolt	05/15/85	7.3	17,702	Similkameen R	AD
1984	Columbia, Wells	Wells	Smolt	05/17/85	7.0	16,590	Similkameen R	AD

Table 8 (cont.). Hatchery releases of summer steelhead into the Okanogan River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish I lb.	Number Released	Release Site	CWT Code/ Fin Clip
1985	Columbia, Wells	Wells	Smolt	04/30/86	6.2	6,820	Similkameen R	AD
1985	Columbia, Wells	Wells	Smolt	04/30/86	6.8	14,212	Similkameen R	AD
1985	Columbia, Wells	Wells	Smolt	05/06/86	7.6	10,602	Similkameen R	AD
1985	Columbia, Wells	Wells	Smolt	05/08/86	7.5	19,350	Similkameen R	AD
1986	Columbia, Wells	Wells	Smolt	05/06/87	6.4	48,000	Okanogan R	AD
1986	Columbia, Wells	Wells	Smolt	05/07/87	6.4	19,200	Okanogan R	AD
1986	Columbia, Wells	Wells	Smolt	05/08/87	6.3	28,350	Okanomn R	AD
1986	Columbia, Wells	Wells	Smolt	04/21/87	6.1	8,540	Similkameen R	AD
1986	Columbia, Wells	Wells	Smolt	04/28/87	6.4	19,840	Similkameen R	AD
1986	Columbia, Wells	Wells	Smolt	04/29/87	6.4	19,840	Similkameen R	AD
1986	Columbia, Wells	Wells	Smolt	05/04/87	6.4	13,440	Similkameen R	AD
1986	Columbia, Wells	Wells	Smolt	05/05/87	6.4	14,720	Similkameen R	AD
1986	Columbia, Wells	Wells	Smolt	05/11/87	6.1	14,030	Similkameen R	AD
1987	Columbia, Wells	Wells	Smolt	04/28/88	7.2	43,200	Okanomn R	AD
1987	Columbia, Wells	Wells	Smolt	05/02/88	7.2	21,600	Okanomn R	AD
1987	Columbia, Wells	Wells	Smolt	05/03/88	7.3	10,950	Okanogan R	AD
1987	Columbia, Wells	Wells	Smolt	05/09/88	6.9	15,870	Okanogan R	AD
1987	Columbia, Wells	Wells	Smolt	04/18/88	7.0	9,800	Similkameen R	621706 AD LV
1987	Columbia, Wells	Wells	Smolt	04/19/88	6.3	30,478	Similkameen R	621706 AD LV
1987	Columbia, Wells	Wells	Smolt	04/22/88	6.4	9,600	Similkameen R	AD

Table 8 (cont.). Hatchery releases of summer steelhead into the Okanogan River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish / lb.	Number Released	Release Site	CWT Code/ Fin Clip
1987	Columbia, Wells	Wells	Smolt	04/23/88	6.9	20,700	Similkameen R	AD
1987	Columbia, Wells	Wells	Smolt	05/03/88	7.3	10,950	Similkameen R	AD
1988	Columbia, Wells	Wells	Smolt	05/04/89	7.2	21,600	Okanogan R	AD
1988	Columbia, Wells	Wells	Smolt	05/05/89	7.2	43,200	Okanogan R	AD
1988	Columbia, Wells	Wells	Smolt	05/05/89	5.8	17,400	Okanogan R	AD
1988	Columbia, Wells	Wells	Smolt	05/08/89	6.7	20,100	Okanogan R	AD
1988	Columbia, Wells	Wells	Smolt	04/25/89	5.2	15,600	Similkameen R	AD
1988	Columbia, Wells	Wells	Smolt	04/26/89	5.2	7,800	Similkameen R	AD
1988	Columbia, Wells	Wells	Smolt	04/26/89	6.1	9,150	Similkameen R	AD
1988	Columbia, Wells	Wells	Smolt	05/02/89	5.3	20,416	Similkameen R	621715 AD LV
1988	Columbia, Wells	Wells	Smolt	05/03/89	5.3	20,388	Similkameen R	621715 AD LV
1988	Columbia, Wells	Wells	Smolt	05/04/89	6.8	16,320	Similkameen R	AD
1988	Columbia, Wells	Wells	Smolt	05/09/89	7.0	10,500	Unknown	AD
1989	Columbia, Wells	Wells	Smolt	05/01/90	6.5	19,500	Okanogan R	AD
1989	Columbia, Wells	Wells	Smolt	05/02/90	6.3	18,900	Okanogan R	AD
1989	Columbia, Wells	Wells	Smolt	05/03/90	6.5	19,500	Okanogan R	AD
1989	Columbia, Wells	Wells	Smolt	05/04/90	6.5	19,500	Okanogan R	AD
1989	Columbia, Wells	Wells	Smolt	05/07/90	7.0	21,000	Okanogan R	AD
1989	Columbia, Wells	Wells	Smolt	04/18/90	6.2	18,600	Similkameen R	AD
1989	Columbia, Wells	Wells	Smolt	04/19/90	6.4	19,200	Similkameen R	AD

Table 8 (cont.). Hatchery releases of summer steelhead into the Okanogan River by brood year and, if marked, the coded wire tag codes.

Brood Year	Stock	Hatchery	Life Stage	Release Date	Fish I lb.	Number Released	Release Site	CWT codel Fin Clip
1989	Columbia, Wells	Wells	Smolt	04/20/90	6.4	19,200	Similkameen R	AD
1989	Columbia, Wells	Wells	Smolt	04/24/90	6.2	20,240	Similkameen R	623 114 LV AD
1989	Columbia, Wells	Wells	Smolt	04/25/90	6.2	20,254	Similkameen R	623 114 LV AD
1990	Columbia, Wells	Wells	Smolt	04/24/9 1	7.0	21,000	Okanogan R	AD
1990	Columbia, Wells	Wells	Smolt	04/25/9 1	7.3	20,440	Okanogan R	AD
1990	Columbia, Wells	Wells	Smolt	04/29/9 1	7.3	9,490	Okanogan R	AD
1990	Columbia, Wells	Wells	Smolt	04/30/9 1	7.4	11,100	Okanogan R	AD
1990	Columbia, Wells	Wells	Smolt	04/30/9 1	7.2	10,800	Okanogan R	AD
1990	Columbia, Wells	Wells	Smolt	04/22/9 1	6.1	15,860	Similkameen R	AD
1990	Columbia, Wells	Wells	Smolt	04/23/9 1	6.1	15,860	Similkameen R	AD
1990	Columbia, Wells	Wells	Smolt	04/24/9 1	7.0	18,200	Similkameen R	AD
1990	Columbia, Wells	Wells	Smolt	05/01/91	5.7	20,040	Similkameen R	625060 LV AD
1990	Columbia, Wells	Wells	Smolt	05/02/9 1	5.7	20,360	Similkameen R	625060 LV AD
1990	Columbia, Wells	Wells	Smolt	05/07/9 1	7.4	6,290	Omak Cr	AD

Source: Terry Lovgren, WDW Hatchery Stocking Database, 1991.

Table 9 (TD). Disease history for the hatchery which reared smolts released into the Okanogan River subbasin.

Disease Type	Hatchery	Specific Pathogen
Bacterial	Wells[A]	*Renibacterium salmonarium* (BKD)
Bacterial	Wells	*Flavobacter sp.*
Bacterial	Wells	*Flexibacter cytophaga* (Coldwater)
Parasite	Wells	*Hexamita sp.*
. Viral	Wells	Infectious Hematopoietic Necrosis (IHN)
Viral	Wells	Infectious Pancreatic Necrosis (IPN)
Viral	Wells	EIBS

[A]Wells Hatchery is located on the Columbia River approximately 18 miles downstream from the confluence of Okanogan and Columbia rivers.

Disease history only represents pathogens isolated at these rearing locations and not necessarily a disease outbreak.

Source: Steve Roberts, Pathologist, WDW 1991.

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Appendix Table 1. Snake River chinook electrophoretic data from Waples et al. (1991).

Allele frequency data for 1988 brood-year samples of juvenile Snake River chinook salmon. Locus abbreviations are explained in Table 1. N is the number of fish scored for each locus. Allele mobility designations are explained in text. Alleles screened but not found in any samples are shown in parentheses after locus names.

Locus/ Allele	Marsh Creek	Johnson Creek	Upper Salmon River	Valley Creek	Secesh River	Lostine River	Imnaha River	McCall Hatchery	Sawtooth Hatchery	Looking. Hatchery	Imnaha Hatchery
*sAAT-1,2** (105)											
(N)	100	96	99	97	91	100	99	100	99	100	100
100	1.000	0.956	0.977	0.992	0.995	1.000	1.000	0.998	0.975	1.000	1.000
86	0.000	0.044	0.023	0.008	0.005	0.000	0.000	0.003	0.025	0.000	0.000
*sAAT-3** (90)											
(N)	100	97	99	99	92	99	100	loo	89	99	98
100	1.000	1.000	0.965	0.990	1.000	1.000	0.995	1.000	1.000	0.980	1.000
113	0.000	0.000	0.036	0.010	0.000	0.000	0.005	0.000	0.000	0.020	0.000
*sAAT-4** (130)											
(N)	98	86	89	97	76	95	98	68		92	95
loo	0.965	0.919	1.000	1.000	0.967	0.716	0.959	0.919	0.9%	0.978	0.974
63	0.015	0.061	0.000	0.000	0.033	0.264	0.041	0.061	0.034	0.022	0.026
*mAAT-1** (-77)											
(N)	100	96	99	98	90	96	100	96	loo	94	100
-100	1.000	0.890	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.995
-104	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005
*ADA-1**											
(N)	100	97		99	92	100	100	100	100	100	100
100	0.910	0.985	0.9%	0.894	0.842	0.970	0.995	0.940	0.936	1.000	1.000
83	0.090	0.015	0.061	0.106	0.158	0.030	0.006	0.060	0.065	0.000	0.000
*ADH** (-170)											
(N)	99	97	99	99	92	100	100	100	loo	100	100
-100	1.000	1.000	1.000	1.000	1.000	0.985	0.995	1.000	1.000	1.000	1.000
-62	0.000	0.000	0.000	0.000	0.000	0.016	0.005	0.000	0.000	0.000	0.000
*sAH** (69, 108, 116)											
(N)	100	97	99	99	92	100	100	100	100	100	100
loo	1.000	1.000	1.000	1.000	1.000	0.995	1.000	0.990	0.996	1.000	0.986
86	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.010	0.005	0.000	0.016
*mAH-2**											
(N)	99	60	98	96	84	100	98	89	98	100	100
100	0.884	0.883	0.918	0.807	0.958	0.900	0.929	0.933	0.918	0.885	0.915
88	0.116	0.117	0.082	0.193	0.042	0.100	0.071	0.067	0.082	0.115	0.085
*mAH-4** (100)											
(N)	1.000	94	99	99	91	100	100	100	100	100	100
loo		1.000	1.000	1.000	1.000	0.990	0.990	0.985	1.000	1.000	0.990
119	0.000	0.000	0.000	0.000	0.000	0.010	0.010	0.015	0.000	0.000	0.010
*GAPDH-2**											
(N)	100	96	99	98	85	loo	100	100	100	100	loo
100	1.000	1.000	1.000	1.000	1.000	0.995	1.000	1.000	1.000	1.000	1.000
22	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000

Appendix Table 1. Cont.

Locus/ Allele	Marsh Creek	Johnson Creek	Upper Salmon River	Valley Creek	Secesh River	Lostine River	Imnaha River	McCall Hatchery	Sawtooth Hatchery	Looking. Hatchery	Imnaha Hatchery
*sMDH-B1,2** (83)											
(N)	100	97	9 9	99	92	100	100	100	100	100	100
100	0.990	0.979	0.985	0.944	0.997	0.988	0.985	0.993	0.980	0.993	0.943
121	0.010	0.015	0.013	0.056	0.003	0.013	0.015	0.008	0,020	0.008	0.057
70	0.000	0.005	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
mMDH-1 *											
(N)	92	49	99	99	13	95	100	92	100	100	100
-100	1.000	1.000	1.000	1.000	1.000	1.000	0.996	1.000	1.000	1.000	1.000
-900	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	o.ooo	0.000	0.000
*mMDH-2**											
(N)	99	9 7	97	97	91	100	98	100	97	100	99
100	0.646	0.598	0.485	0.557	0.753	0.735	0.658	0.736	0.526	0.800	0.697
200	0.354	0.402	0.615	0.443	0.247	0.265	0.342	0.265	0.474	0.200	0.303
*sMEP-1** (105)											
(N)	95	97	99	97	89	96	98	99	99	100	9 3
100	0.079	0.077	0.030	0.031	0.017	0.052	0.061	0.035	0.010	0.070	0.043
92	0.921	0.923	0.970	0.969	0.963	0.948	0.939	0.966	0.990	0.930	0.957
*sMEP-2**											
(N)	100	97	99	99	91	100	99	100	100	100	95
100	0.900	0.898	1.000	1.000	0.790	1.000	1.000	1.000	1.000	1.000	1.000
78	0.100	0.102	0.000	0.000	0.210	0.000	0.000	0.000	0.000	0.000	0.000
*MPI** (113)											
(N)	100	95	99	99		100	100	100	99	100	100
100	0.880	0.989	0.939	0.889	0.95	0.770	0.885	0.920	0.884	0.935	0.780
109	0.120	0.011	0.061	0.111	0.033	0.226	0.115	0.080	0.116	0.066	0.220
95	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000
*PEPA** (86)											
(N)	loo	97	99	99	92	100	100	100	loo	100	100
loo	0.995	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.995	1.000	1.000
90	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000
*PEPB-1**											
(N)	100	94	99	9 9		100	100	100	100	100	99
loo	0.945	0.856	0.879	0.904	0.9%	0.960	0.918	0.935	0.870	0.805	0.909
130	0.050	0.027	0.091	0.096	0.065	0.015	0.050	0.015	0.090	0.095	0.030
-350	0.006	0.117	0.030	0.000	0.033	0.025	0.035	0.050	0.040	0.100	0.061
*PEPD-2**											
(N)	100	97	99	99	92	100	100	100	100	100	
100	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.995	1.000	1.000	1.6008
107	0.000	0.000	0.0043	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000
*PEP-LT**											
(N)	100	97	99	99	92	100	100	100	100	100	loo
100	0.870	0.948	0.985	0.919	0.870	0.925	0.965	0.920	0.885	0.945	0.955
110	0.130	0.052	0.015	0.081	0.130	0.075	0.035	0.080	0.115	0.055	0.045
*PGK-2**											
(N)	100	97	99	9 9	92	100	100	100	95	100	100
100	0.065	0.067	a.101	0.187	0.152	0.085	0.100	0.110	0.142	0.085	0.120
90	0.935	a.933	0.899	0.813	0.848	0.915	0.!?00	0.890	0.858	0.915	0.880

Appendix Table 2, Additional Snake River chinook electrophoretic data cited by Waples et. al. (1991) Temporal comparisons of allele frequency in Snake River chinook salmon populations for which old data are available (Milner et al. 1983; Milner et al. 1986). Brood years for samples are indicated below population names; other details are as in Appendix Table 1.

Locus/ allele	McCall Hatchery 1981	McCall Hatchery 1988	Johnson Creek 1981	Johnson Creek 1988	Valley Creek 1982	Valley Creek 1988	Looking. Hatchery 1988	Rapid River H. 1981+84	Upper Salmon River 1981	Upper Salmon River 1988	Sawtooth Hatchery 1988
*sAAT-1,2**											
(N)	50	100		98	22	97	100	150	50	100	99
100	1.000	0.998	0.9:	0.957	0.977	0.992	1.000	1.000	1.000	0.978	0.975
85	0.000	0.003	0.036	0.043	0.023	0.008	0.000	0.000	0.000	0.023	0.025
*sAAT-3**											
(N)	50	100	56	100	22	99	99	150	50	100	89
100	1.000	1.000	1.000	1.000	1.000	0.990	0.980	0.990	1.000	0.965	1.000
113	0.000	0.000	0.000	0.000	0.000	0.010	0.020	0.010	0.000	0.035	0.000
*ADA-1**											
(N)	50	100	56	100	22	99	100	150	48	99	100
100	0.900	0.940	1.000	0.986	0.932	0.894	1.000	0.990	0.969	0.949	0.935
83	0.100	0.060	0.000	0.016	0.068	0.106	0.000	0.010	0.031	0.051	0.065
*sAH**											
(N)	50	100	53	99	22	99	100	148	50	100	100
100	1.000	0.990	1.000	1.000	1.000	1.000	1.000	0.993	1.000	1.000	0.995
86	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.005
*GR**											
(N)	50	100	56	100	22	99	100	150	50	100	100
100	1.000	0.985	1.000	0.995	1.000	1.000	1.000	0.997	1.000	1.000	1.000
85	0.000	0.015	0.000	0.005	0.000	0.000	0.000	0.003	0.000	0.000	0.000
*HAGH**											
(N)	50	100	56	68		99	99	144	48	100	99
100	0.970	0.960	0.991	1.000	0.9%	0.949	0.944	0.913	0.917	0.970	0.939
143	0.030	0.040	0.009	0.000	0.045	0.051	0.056	0.087	0.083	0.030	0.061

Appendix Table 2. Continued

LOWS/ allele	McCall Hatchery 1981	McCall Hatchery 1988	Johnson Creek 1981	Johnson Creek 1988	Valley Creek 1982	Valley Creek 1988	Looking. Hatchery 1988	Rapid River H. 1981+84	Upper Salmon River 1981	Upper Salmon River 1988	Sawtooth Hatchery 1988
*PEPB-1**											
(N)	50	100	56	94	22	99	100	148	50	100	100
100	0.930	0.985	0.991	0.973	0.818	0.904	0.906	0.892	0.860	0.910	0.910
130	0.070	0.015	0,009	0.027	0.182	0.096	0.095	0.108	0.140	0.090	0.090
*PEP-LT**											
(N)	50	100	56	100	22		100	150	50	100	100
100	0.890	0.920	0.929	0.950	0.841	0.9%	0.946	0.963	0.970	0.985	0.885
110	0.110	0.080	0.071	0.050	0.169	0.081	0.055	0.037	0.030	0.015	0.115
*PGK-2**											
(N)	50	100	56	100	22	99	100	150	50	99	95
100	0.080	0.110	0.046	0.065	0.205	0.187	0.086	0.103	0.090	0.101	0.142
90	0.920	0.890	0.955	0.936	0.796	0.813	0.915	0.897	0.910	0.899	0.858
*sSOD-1**											
(N)		100	56	97	22	99	100	150	48	98	100
-100	0.95800	0.980	0.973	0.974	0.886	0.939	0.970	0.913	0.948	0.964	0.965
-260	0,020	0.020	0.027	0,026	0.114	0.061	0.030	0.087	0.052	0.036	0.035

‘Includes “94” allele
[b]Includes "90" allele
‘Includes "-350" allele

Appendix Table 3. Columbia River chinook electrophoretic data from Schreck et al. (1956).

Isooyme gene frequencies and sample sizes (N) as determined by electrophoresis for chinook salmon stocks in Oregon, Washington and Idaho. Numbers at the top of each column are the relative mobilities for each allele present in the enzyme system. Minus signs indicate cathodal migration. An asterisk indicates that an allele was present at a frequency of less than .005. "Form" is the time of freshwater entry (S for spring, F for fall and SUM for summer). A pound sign (#) indicates that data for that stock was obtained from the Genetic Stock Identification Study (Milner et al. 1983).

Chinook salmon gene frequency data (continued).

CHINOOK STOCK	FORM	ACONITATE [redacted]E N	100	86	116	69	ADENOSINE DEAMINASE N	100	83	ALCOHOL DEHYDROGENASE N	-100	-52
WALLOWA-LOSTINE RIVER	S	47	1.00				47	1.00		47	1.00	
WALLOWA-LOSTINE RIVER 84	[illegible]	[illegible]	[illegible]	.01						40	.98	.03
KOOSKIA HATCHERY STOCK	[illegible]	[illegible]	[illegible]							90	.99	.01
RED R. SF CLEARWATER #	[illegible]	40	1.00				40	.98	.03	40	1.00	
IMNAHA RIVER	S	87	.99	.01			87	1.00		87	.99	.01
IMNAHA RIVER 84	S	108	.99	.01						108	1.00	
RAPID RIVER HATCHERY #	s	50	.98	.02			50	.98	.02	50	1.00	
JOHNSON CREEK #	SUM	53	1.00				56	1.00		56	1.00	
McCALL HATCHERY #	SUM	50	1.00				50	.90	.10	50	1.00	
MIDDLE FORK SALMON	s	50	.98	.02						86	1.00	
EAST FK. SALMON R. STOCK	S	50	1.00				50	.98	.02	50	1.00	
VALLEY CREEK	SUM	20	1.00							50	1.00	
VALLEY CREEK #	S	22	1.00				22	.93	.07	22	1.00	
SAWTOOTH STOCK #	S	50	1.00				48	.97	.03	50	1.00	
YAKIMA RIVER	F	36	.97	.03			36	.97	.03	36	.99	.01
YAKIMA RIVER	s	50	.98	.02			42	.96	.04	50	1.00	
NACHES RIVER	S	37	1.00				50	1.00		50	.98	.02
HANFORD REACH	F	53	.89	.11						loo	1.00	
HANFORD REACH 85	F	loo	.81	.18	.01		100	1.00		100	.97	.04
PRIEST RAPIDS HATCHERY	F	100	.84	.16			50	1.00		100	.99	.01
WENATCHEE RIVER	S	194	.99	.01			50	.95	.05	199	1.00	
WENATCHEE RIVER	SUM	40	.81	.19						50	1.00	
WENATCHEE RIVER 85	SUM	49	.83	.17			50	.99	.01	50	1.00	
LEAVENWORTH HATCHERY	s	89	.99	.01						loo	1.00	
LEAVENWORTH HATCHERY 85	S	100	1.00				100	.97	.04	100	1.00	
ENTIAT RIVER	s	128	.98	.02			50	.97	.03	133	1.00	
WELLS DAM HATCHERY	SUM	98	.88	.12			98	1.00		100	1.00	
METHOW RIVER 83	S	53	.97	.03								
METHOW RIVER 84	[illegible]	[illegible]	[illegible]	.01			50	.96	.04	50	1.00	
METHOW RIVER	SUM	85	.82	.18								
WINTHROP HATCHERY #	s	50	.92	.07	.01		129	.97	.03	129	.98	.02
OKANAGAN RIVER	SUM	100	.78	.22						90	.97	.03
OKANAGAN RIVER 85	SUM	50	.75	.24	.01		50	1.00		49	.99	.01

Chinook salmon gene frequency data (continued).

CHINOOK STOCK	FORM	GLUCOSE PHOSPHATE ISOMERASE-2			GLUCOSE PHOSPHATE ISOMERASE 1-3H			GLUCOSE PHOSPHATE ISOMERASE-3		
		N	100	60	N	STANDARD	VARIANT	N	100	90
WALLOWA-LOSTINE RIVER	S	47	.90	.10	47	1.00		47	1.00	
WALLOWA-LOSTINE RIVER 84	S	40	1.00		40	1.00		40	1.00	
KOOSKIA HATCHERY STOCK	S	78	1.00		78	1.00		78	1.00	
RED R. SF CLEARWATER #	S	40	1.00					40	1.00	
IMNAHA RIVER	S	87	1.00		87	1.00		87	1.00	
IMNAHA RIVER 84	S	108	1.00		100	1.00		100	1.00	
RAPID RIVER HATCHERY #	S	50	1.00					50	1.00	
JOHNSON CREEK #	SUM	56	1.00					56	1.00	
McCALL HATCHERY #	SUM	50	1.00					50	1.00	
MIDDLE FORK SALMON	S	50	1.00		50	1.00		50	1.00	
EAST FK. SALMON R. STOCK	S	50	1.00		50	1.00		50	1.00	
VALLEY CREEK	SUM	48	1.00		48	1.00		48	1.00	
VALLEY CREEK #	S	22	1.00					22	1.00	
SAWTOOTH STOCK #	S	50	1.00					50	1.00	
YAKIMA RIVER	F	36	1.00		36	1.00		36	1.00	
YAKIMA RIVER	S	42	1.00		30	1.00		48	1.00	
NACHES RIVER	S	50	.94	.06	50	1.00		50	1.00	
HANFORD REACH	F	96	1.00		96	.80	.20	96	1.00	
HANFORD REACH 85	F	100	1.00		100	.90	.10	100	1.00	
PRIEST RAPIDS HATCHERY	F	91	1.00		91	.90	.10	91	1.00	
WENATCHEE RIVER	S	194	1.00		194	1.00		194	1.00	
WENATCHEE RIVER	SUM	50	1.00		50	1.00		50	1.00	
WENATCHEE RIVER 85	SUM	50	1.00		50	.96	.04	50	1.00	
LEAVENWORTH HATCHERY	S	95	1.00		95	1.00		95	1.00	
LEAVENWORTH HATCHERY 85	S	93	1.00		93	1.00		93	1.00	
ENTIAT RIVER	S	133	1.00		133	1.00		133	1.00	
WELLS DAM HATCHERY	SUM	97	1.00		97	.83	.17	97	1.00	
METHOW RIVER 83	S	53	1.00		53	1.00		53	1.00	
METHOW RIVER 84	S	50	1.00		40	1.00		50	1.00	
METHOW RIVER	SUM	88	1.00		88	.89	.11	88	1.00	
WINTHROP HATCHERY #	S	129	1.00					129	.98	.02
OKANAGAN RIVER	SUM	100	.90	.10	100	.83	.17	100	1.00	
OKANAGAN RIVER 85	SUM	50	1.00		50	1.00		50	1.00	

Chinook salmon gene frequency data (continued).

CHINOOK STOCK	FORM	ASPARTATE AMINOTRANSFERASE			ISOCITRATE DEHYDROGENASE				L-LACTATE DEHYDROGENASE-4		
		N	100	90	N	100	74	127	N	100	120
WALLOWA-LOSTINE RIVER	S	25	1.00		46	.86	.11	.03	47	1.00	
WALLOWA-LOSTINE RIVER 84	S	34	1.00		35	.84	.15	.01	40	1.00	
KOOSKIA HATCHERY STOCK	S	80	1.00		73	.92	.08		100	.99	.01
RED R. SF CLEARWATER #	S	40	1.00		80	.94	.06		40	.95	.05
IMNAHA RIVER	S	87	1.00		a4	.91	.09		87	1.00	
IMNAHA RIVER 84	S	100	1.00		89	.87	.13		108	1.00	
RAPID RIVER HATCHERY #	S	50	1.00		50	.97	.04		50	.98	.02
JOHNSON CREEK #	SUM	56	1.00		56	.95	.05		56	1.00	
McCALL HATCHERY #	SUM	50	1.00		50	.87	.13		50	1.00	
MIDDLE FORK SALMON	S	40	1.00		14	.89	.11		50	.96	.04
EAST FK. SALMON R. STOCK	S	37	1.00		50	.97	.03		50	.99	.01
VALLEY CREEK	SUM	45	1.00		40	.98	.02		48	.98	.02
VALLEY CREEK #	S	22	1.00		22	.91	.05	.05	22	.98	.02
SAWTOOTH STOCK #	S	50	1.00		50	.92	.08		50	.98	.02
YAKIMA RIVER	F	36	1.00		30	.91	.03	.06	36	.97	.03
YAKIMA RIVER	S	44	1.00		44	.86	.14		50	1.00	
NACHES RIVER	S	50	1.00		50	.95	.04	.01	50	1.00	
HANFORD REACH	F	100	1.00		60	.92	.01	.07	100	1.00	
HANFORD REACH 85	F	100	1.00		91	.93	.06	.01	100	1.00	
PRIEST RAPIDS HATCHERY	F	-			65	.98	.02		92	1.00	
WENATCHEE RIVER	S	180	1.00		160	.86	.14		199	.99	.01
WENATCHEE RIVER	SUM	-			44	.98	.01	.01	50	1.00	
WENATCHEE RIVER 85	SUM	50	1.00		50	.89	.01	.10	50	1.00	
LEAVENWORTH HATCHERY	S	-			96	.90	•	.10	100	.97	.03
LEAVENWORTH HATCHERY 85	S	75	1.00		94	.93	.07		100	1.00	
ENTIAT RIVER	S	323	1.00		105	.81	.19		132	.98	.02
WELLS DAM HATCHERY	SUM	-							98	1.00	
METHOW RIVER 83	S	50	1.00		39	.89	.02	.09	43	1.00	
METHOW RIVER 84	S	43	1.00		37	.81	.19		50	.99	.01
METHOW RIVER	SUM	20	1.00		71	.95	.04	*	-		
WINTHROP HATCHERY #	S	50	1.00		129	.97	.03	.01	129	1.00	
OKANAGAN RIVER	SUM	-			84	.93	.06	.01	%	1.00	
OKANAGAN RIVER 85	SUM	50	1.00		50	.92		.08	50	1.00	

Chinook salmon gene frequency data (continued).

CHINOOK STOCK	FORM	L-LACTATE DEHYDROGENASE-5			MALATE DEHYDROGENASE-1&2					MALATE DEHYDROGENASE-3&4			
		N	100	90	N	100	140	27	140	N	100	121	70
WALLOWA-LOSTINE RIVER	S	47	1.00		47	1.00				45	.95	.05	
WALLOWA-LOSTINE RIVER 84	S	40	1.00		40	1.00				40	1.00		
KOOSKIA HATCHERY STOCK	S	100	1.00		90	1.00				100	.98	[illegible]	
RED R. SF CLEARWATER #	S	40	1.00		80	1.00				78	.99	.01	
IMNAHA RIVER	S	87	1.00		87	1.00				87	.99	.01	
IMNAHA RIVER 84	S	107	1.00		108	1.00				108	.98	.02	
RAPID RIVER HATCHERY #	S	50	1.00		50	1.00				49	1.00		
JOHNSON CREEK #	SUM	56	.98	.02	56	1.00				56	1.00		
McCALL HATCHERY #	SUM	50	.97	.03	50	1.00				50	.99	.01	
MIDDLE FORK SALMON	S	50	1.00							50	.98	.02	
EAST FK. SALMON R. STOCK	S	37	1.00		50	1.00				50	.98	.02	
VALLEY CREEK	SUM	48	1.00		45	1.00				48	.97	.03	
VALLEY CREEK #	8	22	1.00		22	1.00				22	.99	.01	
SAWTOOTH STOCK #	S	48	1.00		50	1.00				49	1.00		
YAKIMA RIVER	F	36	1.00		36	1.00				36	1.00		
YAKIMA RIVER	S	50	1.00		50	1.00				50	1.00		
NACHES RIVER	S	50	1.00		50	1.00				50	.98	.01	.01
HANFORD REACH	F	100	.97	.03	100	1.00				98	.97	.01	.01
HANFORD REACH 85	F	100	.99	.01	100	1.00				100	.96	.03	.01
PRIEST RAPIDS HATCHERY	F	100	.98	.02	100	1.00				100	.98	.01	.02
WENATCHEE RIVER	S	181	1.00		195	1.00	*			95	.97	.03	
WENATCHEE RIVER	SUM	45	.99	.01	50	1.00				48	.97	.01	.02
WENATCHEE RIVER 85	SUM	50	.96	.04	50	1.00				50	.95	.01	.04
LEAVENWORTH HATCHERY	S	100	1.00		100	1.00				100	.99	.01	
LEAVENWORTH HATCHERY 85	S	97	1.00		95	1.00				99	.97	.03	
ENTIAT RIVER	S	121	1.00		132	1.00	*			31	.99	.01	
WELLS DAM HATCHERY	SUM	90	.99	.01	98	1.00				98	.98	.01	.01
METHOW RIVER 83	S	50	.99	.01	43	1.00				45	.97	.03	
METHOW RIVER 84	S	49	1.00		50	.99	*		*	50	.97	.03	
METHOW RIVER	SUM	80	.99	.01	88	1.00				87	.97	.02	.01
WINTHROP HATCHERY #	S	129	1.00		129	1.00				129	.99	.01	
OKANAGAN RIVER	SUM	100	.93	.07	loo	1.00				95	.97	.02	.01
OKANAGAN RIVER 85	SUM	50		.05	50	1.00				50	.96	.02	.02

Chinook salmon gene frequency data (continued).

CHINOOK STOCK	FORM	MANNOSE PHOSPHATE ISOMERASE N	100	109	95	113	DIPEPTIDASE N	100	90	TRIPEPTIDE AMINOPEPTIDASE N	100	130	45
WALLOWA-LOSTINE RIVER	S	45	.76	.24			47	1.00		43	.96	.04	
WALLOWA-LOSTINE RIVER 84	S	39	.74	.26			35	1.00		40	.99	.01	
KOOSKIA HATCHERY STOCK	s	74	.95	.05			91	.98	.02	71	.99	.01	
RED R. SF CLEARWATER #	S	40	.95	.05			40	1.00		36	.94	.06	
IMNAHA RIVER	S	86	.80	.20			87	.99	.01	87	.99	.01	.01
IMNAHA RIVER 84	S	99	.82	.18			108	1.00		108	1.00		
RAPID RIVER HATCHERY #	S	50	.95	.05			50	1.00		50	.90	.10	
JOHNSON CREEK #	SUM	56	.95	.05			56	1.00		56	.99	.01	
McCALL HATCHERY #	SUM	50	.96	.04			50	1.00		50	.93	.07	
MIDDLE FORK SALMON	s	50	.96	.04			50	1.00		37	.97	.03	
EAST FK. SALMON R. STOCK	S	50	1.00				50	1.00		50	1.00		
VALLEY CREEK	SUM	35	.87	.13			45	1.00		32	1.00		
VALLEY CREEK #	s	22	.80	.21			22	.98	.02	22	.82	.18	
SAWTOOTH STOCK #	s	50	.89	.11			50	.99	.01	50	.86	.14	
YAKIMA RIVER	F	36	.92	.08			36	1.00		35	.84	.16	
YAKIMA RIVER	s	50	.86	.14			50	.98	.02	47	.95	.05	
NACHES RIVER	S	46	.77	.23			50	1.00		49	.98	.02	
HANFORD REACH	F	99	.72	.27	.01		100	1.00		100	.77	.23	
HANFORD REACH 85	F	99	.54	.46			100	.99	.01	99	.82	.18	
PRIEST RAPIDS HATCHERY	F	88	.74	.26			100	1.00		94	.68	.32	
WENATCHEE RIVER	S	165	.90	.10			191	.99	.01	181	.91	.09	
WENATCHEE RIVER	SUM	34	.66	.34			50	1.00					
WENATCHEE RIVER 85	SUM	50	.63	.37			50	.94	.06	50	.74	.26	
LEAVENWORTH HATCHERY	s	100	.90	.10			100	.99	.01	100	.87	.13	
LEAVENWORTH HATCHERY 85	S	93	.83	.17			100	.99	.01	90	1.00		
ENTIAT RIVER	S	132	.90	.10			132	.99	.01	118	.94	.06	
WELLS DAM HATCHERY	SUM	76	.71	.29			98	1.00		98	.66	.34	
METHOW RIVER 83	S	36	.85	.15			53	1.00		53	.90	.10	
METHOW RIVER 84	S	50	.97	.03			50	1.00		50	.97	.03	
METHOW RIVER	SUM	-					88	1.00		86	.73	.27	
WINTHROP HATCHERY #	S	22	.70	.30			22	1.00		22	.99	.01	
OKANAGAN RIVER	SUM	92	.74	.26			100	1.00		96	.68	.32	
OKANAGAN RIVER 85	SUM	50	.63	.37			50	.99		48	.69	.31	

Chinook salmon gene frequency data (continued).

CHINOOK STOCK	FORM	PHOSPHO-GLUCOMUTASE N	-100	-60	PHOSPHOGLYCERATE KINASE-2 N	100	90	64	SUPEROXIDE DISMUTASE N	-100	-260	1250
WALLOWA-LOSTINE RIVER	S	47	1-W		45	.07	.92	.01	47	.79	.21	
WALLOWA-LOSTINE RIVER 84	S	40	1.00		90		1.00		40	.86	.14	
KOOSKIA HATCHERY STOCK	S	100	1.00		46	.04	.96		99	.84	.16	
RED R. SF CLEARWATER #	S	40	1.00		40	.15	.85		40	.95	.05	
IMNAHA RIVER	S	87	1.00		78	.15	.85		87	.89	.11	
IMNAHA RIVER 84	S	108	1.00		90		1.00		87	.87	.13	
RAPID RIVER HATCHERY #	S	50	1.00		50	.15	.85		50	.96	.04	
JOHNSON CREEK #	SUM	56	1.00		56	.05	.96		56	.97	.03	
MCCALL HATCHERY #	SUM	50	1.00		50	.08	.92		50	.98	.02	
MIDDLE FORK SALMON	S	50	1.00		50	.05	.95		35	.80	.20	
EAST FK. SALMON R. STOCK	S	50	1.00						50	.98	.02	
VALLEY CREEK	SUM	48	1.00		43	.20	.80		48	.94	.06	
VALLEY CREEK #	S	22	1.00		22	.21	.80		22	.89	.11	
SAWTOOTH STOCK #	S	50	1.00		50	.09	.91		48	.95	.05	
YAKIMA RIVER	F	36	1.00		36	.38	.62		36	.85	.15	
YAKIMA RIVER	S	50	1.00		30	.17	.83		50	.76	.24	
NACHES RIVER	S	49	1.00		SO	.38	.62		49	.70	.30	
HANFORD REACH	F	100	1.00		39	.74	.26					
HANFORD REACH 85	F	100	1.00		100	.65	.36		100	.53	.47	
PRIEST RAPIDS HATCHERY	F	100	1.00						92	S O	.50	
WENATCHEE RIVER	S	184	1.00		76	.09	.91		170	.82	.18	•
WENATCHEE RIVER	SUM	50	1.00									
WENATCHEE RIVER 85	SUM	50	1.00		50	.58	.42		50	.46	.53	.01
LEAVENWORTH HATCHERY	S	100	1.00		76	.03	.97		100	.84	.16	
LEAVENWORTH HATCHERY 85	S	100	1.00		79	.12	.88		94	.71	.29	
ENTIAT RIVER	S	128	1.00		35	.03	.97		130	.76	.24	
WELLS DAM HATCHERY	SUM	98	1.00		74	.64	.36		97	.58	.42	
METHOW RIVER 83	S	53	1.00						36	.67	.33	
METHOW RIVER 84	S	50	1.00		35	.03	.97		50	.77	.23	
METHOW RIVER	SUM	88	.99	.01					76	.49	.51	
WINTHROP HATCHERY #	S	123	1.00		98	.50	.50		129	.74	.26	
OKANAGAN RIVER	SUM	100	1.00		49	.70	.30					
OKANAGAN RIVER 85	SUM	50	1.00		50	.68	.32		50	.52	.48	

Appendix Table 4. Columbia River steelhead electrophoretic data from Schreck et al. (1986).

Isozyme gene frequencies and sample sizes (N) as determined by electrophoresis for steelhead trout stocks in Oregon, Washington and Idaho. Numbers at the top of each column are the relative mobilities for each allele present in the enzyme system. Minus signs indicate cathodal migration. An asterisk indicates that an allele was present at a frequency of less than .005. "Form" is the time of freshwater entry (S for summer and W for winter). A pound sign (#) indicates that data for that stock was obtained from the Genetic Analysis of Columbia River Steelhead Trout (Wishard and Seeb 1983) prepared for the Idaho Department of Fish and Game.

Steelhead trout gene frequency data (continued).

STEELHEAD STOCK	FORM	CREATINE KINASE			GLUCOSE PHOSPHATE ISOMERASE-1				GLUCOSE PHOSPHATE ISOMERASE-2		
		N	100	70	N	100	130.	25	N	100	120
UMATILLA RIVER	S	loo	1.00		100	1.00			loo	1.00	
UMATILLA HATCHERY	S	loo	1.00		100	1.00			100	1.00	
WALLA WALLA RIVER	s	40	1.00		40	1.00			40	1.00	
TOUCHET RIVER	s	50	1.00		50	1.00			so	1.00	
TUCANNON RIVER	s	113	.99	.01	113	1.00			113	1.00	
TUCANNON RIVER 85	s	50	.99	.01	50	1.00			50	1.00	
GRANDE RONDE RIVER	s	50	1.00		50	1.00			50	1.00	
GRANDE RONDE RIVER 84	s	110	1.00		110	1.00			110	1.00	
WALLOWA-LOSTINE	S	73	1.00		73	1.00			73	1.00	
WALLOWA-LOSTINE 84	S	62	1.00		62	1.00			62	1.00	
WALLOWA HATCHERY	s	loo	.99	.01	loo	1.00			100	1.00	
MISSION CREEK	s	30	1.00		30	1.00			30	1.00	
BIG CANYON/COTTONWOOD CRKS.	s	88	1.00		88	1.00			88	1.00	
DWORSHAK HATCHERY	S	73	1.00		73	1.00			73	1.00	
SELWAY RIVER	s	98	1.00		97	1.00			98	1.00	
LOCHSA RIVER	s	50	1.00		47	1.00			so	1.00	
IMNAHA RIVER	s	81	1.00		96	1.00			96	1.00	
IMNAHA RIVER 84	s	58	1.00		58	1.00			S8	1.00	
IMNAHA HATCHERY	s	100	1.00		100	.90	.10		100	1.00	
SHEEP & BARGAMIN CRKS.	s	120	1.00		120	1.00			120	1.00	
S.F.SALMON (SECESH RIVER)	S	61	1.00		61	1.00			61	1.00	
S.F.SALMON (JOHNSON CREEK)	S	50	.99	.01	50	1.00			so	1.00	
CHAMBERLAIN CREEK	s	-			97	.99	.01				
HORSE CREEK	S	51	1.00		50	1.00			51	1.00	
MIDDLE FORK SALMON RIVER #	s	-			158	.97	.03		158	1.00	
PAHSIMEROI 'B' STOCK	s	50	1.00		50	1.00			so	1.00	
SAWTOOTH 'A' STOCK	s	50	1.00		50	1.00			50	1.00	
HELLS CANYON STOCK	s	loo	1.00		100	1.00			100	1.00	
YAKIMA RIVER	s	48	.99	.01	48	1.00			48	1.00	
YAKIMA RIVER 84	S	49	.99	.01	49	1.00			49	1.00	
WENATCHEE RIVER	s	96	1.00		96	1.00			96	1.00	
ENTIAT RIVER	S	50	1.00		50	1.00			50	1.00	
WELLS HATCHERY	S	81	1.00		81	1.00			81	1.00	
METHOW RIVER	S	55	1.00		58	1.00			58	1.00	

Steelhead trout gene frequency data (continued).

STEELHEAD STOCK	FORM	GLUCOSE PHOSPHATE ISOMERASE-3 N	100	120	92	ASPARTATE AMINO-TRANSFERASE-1,2 N	100	112	ASPARTATE AMINO-TRANSFERASE-3 N	loo	77
UMATILLA RIVER	S	100	1.00			100	1.00				
UMATILLA HATCHERY	s	100	1.00						loo	.98	.02
WALLA WALLA RIVER	s	do	1.00			3d	1.00		30	1.00	
TOUCHET RIVER	s	50	1.00			44	1.00		so	1.00	
TUCANNON RIVER	S	113	1.00			103	1.00		103	1.00	
TUCANNON RIVER 85	s	50	1.00			so	1.00		50	1.00	
GRANDE RONDE RIVER	s	50	1.00			50	1.00		50	1.00	
GRANDE RONDE RIVER 84	s	110	.99	.01		110	1.00		60	1.00	
WALLOWA-LOSTINE	s	73	1.00			36	1.00				
WALLOWA-LOSTINE 84	S	62	1.00						62	1.00	
WALLOWA HATCHERY	S	100	1.00			loo	1.00		100	1.00	
MISSION CREEK	s	30	1.00						30	1.00	
BIG CANYON/COTTONWOOD CRKS.	s	88	1.00						88	·1.00	
DWORSHAK HATCHERY	s	73	1.00						72	.91	.09
SELWAY RIVER	s	97	.99		.ol	-			97	1.00	
LOCHSA RIVER	s	50	1.00						50	.99	.01
IMNAHA RIVER	s	96	1.00			86	1.00		96	1.00	
IMNAHA RIVER 84	s	58	1.00			58	1.00		58	1.00	
IMNAHA HATCHERY	S	100	1.00			100	1.00		83	1.00	
SHEEP & BARGAMIN CRKS.	S	120	.99		.01	-			116	1.00	
S.F.SALMON (SECESH RIVER)	S	61	.99	.01							
S.F.SALMON (JOHNSON CREEK)	s	50	1.00			so	1.00		so	.99	.01
CHAMBERLAIN CREEK	s	97	.99	[illegible]							
HORSE CREEK	s	50	1.00						so	1.00	
MIDDLE FORK SALMON RIVER #	s	277	.99	.01							
PAHSIMEROI 'B' STOCK	s	50	1.00			50	1.00		47	1.00	
SAWTOOTH 'A' STOCK	s	50	1.00			so	.99	.01	so	1.00	
HELLS CANYON STOCK	s	95	.97	.03		75	.99	.01	94	1.00	
YAKIMA RIVER	s	48	1.00			48	1.00		48	1.00	
YAKIMA RIVER 84	s	49	1.00			49	1.00		49	.98	.02
WENATCHEE RIVER	S	96	.97	.03		96	1.00		96	1.00	
ENTIAT RIVER	s	50	1.00			50	1.00				
WELLS HATCHERY	s	81	.98	.01	.01	50	1.00		100	.99	.01
METHOW RIVER	s	58	.96	.04					58	1.00	

Steelhead trout gene frequency data (continued).

STEELHEAD STOCK	FORM	ISOCITRATE DEHYDROGENASE-3,4 N	100	40	120	71	LACTATE DEHYDROGENASE-4 N	100	76	111	MALATE DEHYDROGENASE-1,2 N	100	140	70	40
UMATILLA RIVER	S	98	.66	.19		.15	99	.42	.58		100	.99	.01		
UMATILLA HATCHERY	s	90	.66	.12		.22	100	.57	.43		100	1.00			
WALLA WALLA RIVER	S	40	.62	.16		.23	40	.36	.64		40	.99			.01
TOUCHET RIVER	S	49	.61	.17		.21	SO	.45	.55		50	.99	.01		
TUCANNON RIVER	S	106	.64	.17		.19	112	.33	.67		113	1.00			
TUCANNON RIVER 85	S	49	.62	.19		.19	50	.29	.70	.01	50	.99	.02		
GRANDE RONDE RIVER	s	50	.70	.15		.14	49	.25	.75		50	.98	.02		
GRANDE RONDE RIVER 84	s	74	.72	.12		.17	109	.39	.61		110	1.00			
WALLOWA-LOSTINE	S	72	.75	.14		.12	73	.34	.66		73	.99		.01	
WALLOWA-LOSTINE 84	s	57	.n	.12	*	.17	62	.36	.64						
WALLOWA HATCHERY	S	92	.67	.16		.17	100	.24	.77		100	1.00			
MISSION CREEK +	s	30	.64	.13		.23	30	.42	.58		30	.99	.01		
BIG CANYON/COTTONWOOD CRKS.+	S	86	.58	.15		.28	88	.16	.84		88	.99	.01		
DWORSHAK HATCHERY +	S	71	.65	.22		.13	73	.23	.77		73	.99	.01		
SELWAY RIVER +	S	96	.62	.15		.24	98	.34	.66		98	1.00			
LOCHSA RIVER +	s	43	.68	.12		.20	50	.27	.73		50	.99	.01		
IMNAHA RIVER	S	96	.70	.14		.16	96	.29	.71		96	1.00			
IMNAHA RIVER 84	s	57	.72	.13		.15	58	.28	.72		58	1.00			
IMNAHA HATCHERY	S	87	.74	.08	*	.18	99	.39	.61		50	1.00			
SHEEP & BARGAMIN CRKS. +	S	94	.57	.18		.25	120	.29	.70	.02	120	1.00			
S.F.SALMON (SECESH RIVER)	S	56	.64	.24		.12	61	.25	.75		61	1.00	•		
S.F.SALMON (JOHNSON CREEK)	s	47	.57	.33	.01	.10	50	.28	.72		[illegible]	1.00			
CHAMBERLAIN CREEK +	s	97	.67	.15	.01	.18	97	.24	.73	.03	[illegible]	1.00			
HORSE CREEK +	s	40	.68	.07	.01	.24	SO	.28	.72		50	1.00			
MIDDLE FORK SALMON RIVER #	S	158	.67	.15		.18	277	.33	.66	.01	277	1.00			
PAHSIMEROI 'B' STOCK	S	38	.68	.09	.01	.22	50	.29	.71		50	.99	.01		
SAWTOOTH 'A' STOCK	S	28	.73	.08	.02	.17	50	.43	.56	.01	50	1.00			
HELLS CANYON STOCK	S	67	.63	.19		.18	100	.21	.74	.06	100	1.00			
YAKIMA RIVER	S	46	.65	.15	.02	.18	48	.68	.32		48	1.00			
YAKIMA RIVER 84	S	46	.62	.16		.22	49	.61	.39		49	.99	.02		
WENATCHEE RIVER	S	73	.62	.21	.01	.17	95	.38	.61	.01	96	1.00			
ENTIAT RIVER	s	50	.60	.19	*	.21	SO	.29	.69	.02	50	.99	.01		
WELLS HATCHERY	S	81	.66	.18		.16	81	.26	.74		81	.98	.02		
METHOW RIVER	s	53	.66	.14		.20	58	.29	. n		58	.99	.01		

Steelhead trout gene frequency data (continued).

STEELHEAD STOCK	FORM	MALATE DEHYDROGENASE-3,4					NADP+ MALATE DEHYDROGENASE			MANNOSE PHOSPHATE ISOMERASE			
		N	100	83	110	90	N	100	85	N	100	94	110
UMATILLA RIVER	S	100	.98	*	.02		100	1.00		100	1.00		
UMATILLA HATCHERY	S	100	.98	.01	.01		100	1.00		50	1.00		
WALLA WALLA RIVER	s	40	.98	.02			do	1.00		30	.99	.01	
TOUCHET RIVER	s	so	.97	.01	.01	.02	50	1.00		50	.99	.01	
TUCANNON RIVER	s	112	.98	.01	.01		l131.w			-			
TUCANNON RIVER 85	s	50	.99	.01			50	1.00		50	.96	.03	.01
GRANDE RONDE RIVER	s	50	.99	.01			50	1.00		-			
GRANDE RONDE RIVER 84	s	110	.99	•		.01	llol.w			50	1.00		
WALLOWA-LOSTINE	s	73	.95	.01	.04		73	1.00		73	.99	.01	
WALLOWA-LOSTINE 84	S	62	.95	.01	.04	.01	62	1.00		62	1.00		
WALLOWA HATCHERY	S	100	.96	.01	.03		100	1.00		100	1.00		
MISSION CREEK	s	30	1.00							30	.95	.05	
BIG CANYON/COTTONWOOD CRKS.	s	88	1.00							88	.90	.10	
DWORSHAK HATCHERY	s	73	.99		.01					73	1.00		
SELWAY RIVER	s	981.00			*					98	.95	.04	.01
LOCHSA RIVER	S	50	.99		.01					40	1.00		
IMNAHA RIVER	8	96	1.00				94	1.00		96	.98	.01	.01
IMNAHA RIVER 84	S	58	1.00				58	1.00		58	1.00		
IMNAHA HATCHERY	S	100	1.00				100	1.00		100	1.00		
SHEEP & BARGAMIN CRKS.	S	120	.99		.02					120	.99	.02	
S.F.SALMON (SECESH RIVER)	S	61	.98		.02		61	1.00		61	1.00		
S.F.SALMON (JOHNSON CREEK)	s	50	.99	.01			50	1.00		50	.99	.01	
CHAMBERLAIN CREEK	s	97	.98		.01	.01				97	.98	.02	
HORSE CREEK	s	50	.99		.01	.01				so	1.00		
MIDDLE FORK SALMON RIVER #	S	277	.98	.02						277	1.00		
PAHSIMEROI 'B' STOCK	s	50	1.00				50	1.00		50	1.00		
SAWTOOTH 'A' STOCK	s	50	.99	.01			50	1.00		50	.95	.05	
HELLS CANYON STOCK	S	100	.98	.02			96	1.00		loo	.99	.01	
YAKIMA RIVER	s	48	.98	.02	.01		48	l.w		48	1.00		
YAKIMA RIVER 84	S	49	1.00				49	1.00		49	1.00		
WENATCHEE RIVER	s	96	.94	.02		.04	96	1.00		96	.99	.01	
ENTIAT RIVER	s	50	.99	*	*		40	1.00		50	1.00		
WELLS HATCHERY	S	76	.99		.01		76	1.00		81	1.00		
METHOW RIVER	S	58	.98	.01	.01		58	1.00		58	.99	.01	

Steelhead trout gene frequency data (continued).

STEELHEAD STOCK	FORM	DIPEPTIDASE N	100	110	85	95	TRIPEPTIDE AMINOPEPTIDASE N	100	129	74	50	PHOSPHO-GLUCOMUTASE-1 N	-100	-115	-85
UMATILLA RIVER	s	98	.90	.10			100	1.00				100	1.00		
UMATILLA HATCHERY	S	100	.95	.05			100	.99	.01			100	1.00		
WALLA WALLA RIVER	S	40	.83	.18			40	.90	.04		.06	40	1.00		
TOUCHET RIVER	s	47	.93	.07			48	.98	.02			50	.97	.03	
TUCANNON RIVER	s	112	.88	.11	*		112	1.00	*			loo	.99	.01	
TUCANNON RIVER 85	s	50	.90	.10			50	.99	.01			50	1.00		
GRANDE RONDE RIVER	s	50	.93	.04	.03		50	1.00				50	.99		.01
GRANDE RONDE RIVER 84	s	110	.90	.09	.01		llo	.99		.01		110	1.00		
WALLOWA-LOSTINE	s	73	1.00				73	1.00				73	1.00		
WALLOWA-LOSTINE 84	S	62	[illegible]	.07			52	1.00				62	1.00		
WALLOWA HATCHERY	S	100	.93	.06	.01		100	1.00				loo	1.00		
MISSION CREEK	s	30	.80	.20			30	1.00				30	.98		.02
BIG CANYON/COTTONWOOD CRKS.	S	88	.89	.09	.02		88	1.00				88	.99		.01
DWORSHAK HATCHERY	s	73	.54	.45			73	1.00				73	1.00		
SELWAY RIVER	S	98	.82	.18			98	1.00				95	1.00		
LOCHSA RIVER	S	46	[illegible]	.29			50	1.00				49	1.00		
IMNAHA RIVER	s	loo	.97	.03			100	1.00				96	1.00		
IMNAHA RIVER 84	s	58	.94	.06			58	1.00				58	1.00		
IMNAHA HATCHERY	S	100	.99	.01			100	1.00				100	1.00		
SHEEP & BARGAMIN CRKS.	S	120	.97	.04			120	1.00				120	1.00		
S.F.SALMON (SECESH RIVER)	S	61	.98	.02			57	1.00				61	1.00		
S.F.SALMON (JOHNSON CREEK)	s	50	.83	.16		.01	50	1.00				50	1.00		
CHAMBERLAIN CREEK	S	92	.95	.04		.01	97	1.00							
HORSE CREEK	S	50	.96	.04			51	1.00				50	1.00		
MIDDLE FORK SALMON RIVER #	s	277	.96	.04			277	.99	.01			277	1.00		
PAHSIMEROI 'B' STOCK	S	50	.54	.46			50	1.00				50	1.00		
SAWTOOTH 'A' STOCK	S	50	.95	.05			50	1.00				50	1.00		
HELLS CANYON STOCK	S	96	.96	.04	.01		100	.99	.01			100	1.00		
YAKIMA RIVER	S	48	.91	.09			48	1.00				48	1.00		
YAKIMA RIVER 84	S	49	.82	.18			49	1.00				49	1.00		
WENATCHEE RIVER	S	96	.94	.06			96	1.00				96	1.00		
ENTIAT RIVER	s	49	.96	.04			do	1.00				50	1.00		
WELLS HATCHERY	S	81	.91	.09			81	1.00				61	1.00		
METHOW RIVER	S	58	.95	.05			58	1.00				58	1.00		

Steelhead trout gene frequency data (continued).

STEELHEAD STOCK	FORM	PHOSPHO-GLUCOMUTASE-2 N	-100	-140	L-IDITOL DEHYDROGENASE N	100	195	SUPEROXIDE DISMUTASE N	100	152	48
UMATILLA RIVER	S	100	1.00		100	1.00		96	[illegible]		.05
UMATILLA HATCHERY	S	100	1.00		100	1.00		100	.98	.02	
WALLA WALLA RIVER	S	40	1.00		40	1.00		40	.86	.01	.13
TOUCHET RIVER	S	50	1.00		50	1.00		50	.99		.01
TUCANNON RIVER	S	113	.99	.01	113	1.00		113	.93	.06	.02
TUCANNON RIVER 85	S	50	1.00		50	1.00		50	.94		.06
GRANDE RONDE RIVER	S	50	1.00		50	.93	.07	50	.90	.10	
GRANDE RONDE RIVER 84	S	110	1.00		110	1.00		110	.93	.01	.06
WALLOWA-LOSTINE	S	73	1.00		73	1.00		73	.95	.03	.02
WALLOWA-LOSTINE 84	S	62	.99	.01	62	1.00		62	.90	.03	.07
WALLOWA HATCHERY	S	100	1.00		100	1.00		100	.99		.01
MISSION CREEK	S	30	1.00					30	.92	.07	.02
BIG CANYON/COTTONWOOD CRKS.	S	88	.98	.02				88	.93	.01	.06
DWORSHAK HATCHERY	S	73	1.00					73	1.00		
SELWAY RIVER	S	98	.97	.03				98	.91	.04	.05
LOCHSA RIVER	S	50	1.00					50	.90		.10
IMNAHA RIVER	S	87	1.00		96	1.00		86	.95	.04	.01
IMNAHA RIVER 84	S	58	1.00		58	1.00		58	.90	.02	.09
IMNAHA HATCHERY	S	100	1.00		100	1.00		89	.91	.03	.06
SHEEP & BARGAMIN CRKS.	S	120	.99	.01				120	.87	.01	.13
S.F.SALMON (SECESH RIVER)	S	61	1.00		61	.99	.01	61	.89		.11
S.F.SALMON (JOHNSON CREEK)	S	50	1.00					49	.89	.04	.07
CHAMBERLAIN CREEK	S	97	1.00					97	.96	.01	.03
HORSE CREEK	S	50	1.00					50	1.00		
MIDDLE FORK SALMON RIVER #	S	277	1.00					277	.91	.01	.08
PAHSIMEROI 'B' STOCK	S	50	.99	.01				50	1.00		
SAWTOOTH 'A' STOCK	S	50	1.00					50	.91	.01	.08
HELLS CANYON STOCK	S	100	.99	.01				100	.95	.01	.04
YAKIMA RIVER	S	48	.98	.02	48	1.00		47	.92	.04	.04
YAKIMA RIVER 84	S	49	1.00		49	1.00		49	.86		.14
WENATCHEE RIVER	S	96	1.00					96	.91	.03	.06
ENTIAT RIVER	S	50	1.00		50	1.00		49	.96		.04
WELLS HATCHERY	S	61	1.00					81	.90	.01	.09
METHOW RIVER	S	58	1.00		58	1.00		58	.97	.01	.02