Hood River and Pelton Ladder Monitoring and Evaluation Project and Hood River Fish Habitat Project

Annual Report
1999 - 2000

DOE/BP-00005645-1

February 2001

This Document should be cited as follows:

Lambert, Michael, Joseph McCanna, Mick Jennings, "Hood River and Pelton Ladder Monitoring and Evaluation Project and Hood River Fish Habitat Project", Project No. 1998-02100, 200 electronic pages, (BPA Report DOE/BP-00005645-1)

Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the author's and do not necessarily represent the views of BPA.

HOOD RIVER AND PELTON LADDER MONITORING AND EVALUATION PROJECT AND HOOD RIVER FISH HABITAT PROJECT

ANNUAL PROGRESS REPORT 1999-2000

Prepared by:

Michael B. Lambert
Joseph P. McCanna
Mick Jennings

The Confederated Tribes of the Warm Springs Reservation of Oregon
P.O. Box C
Warm Springs, OR 97761

Prepared for:

U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621, Portland, OR 97208-3621

Project Numbers
1988-053-03
1998-021-00

Contract Numbers
DE-BI79-89BP00631
1998BI-08334

FEBRUARY 2001

TABLE OF CONTENTS

Page

INTRODUCTION..... 1

HOOD RIVER MONITORING AND EVALUATION..... 3
- Acclimation..... 3
  - Introduction..... 3
    - History Of Hatchery Releases For The HRPP..... 4
  - Methods..... 5
    - Winter Steelhead..... 5
    - Summer Steelhead..... 9
    - Spring Chinook Salmon..... 12
  - Results and Discussion..... 15
    - Winter Steelhead..... 15
    - Summer Steelhead..... 23
    - Spring Chinook Salmon..... 29
  - Recommendations..... 33

- Spring Chinook Salmon Spawning Ground Surveys..... 34
  - Introduction..... 34
  - Methods..... 35
  - Results and Discussion..... 38
  - Recommendations..... 45

- Hood River Water Temperature Study..... 46
  - Introduction..... 46
  - Methods..... 46
  - Results and Discussion..... 47

- Oak Springs Hatchery Steelhead Marking Evaluation..... 66
  - Introduction..... 66
  - Methods..... 66
  - Results and Discussion..... 66
  - Recommendations..... 67

- Genetics..... 69

Page

HABITAT..... 70
Introduction..... 70
Project Work In Fiscal Years 1999 and 2000..... 70
Hood River Watershed Assessment..... 70
Hood River Fish Habitat Protection, Restoration, and Monitoring Plan.... 70
Tony Creek Dee Mill Diversion Adult Fish Passage Project..... 71
Evans Creek Fish Passage Project (Higgins Pond - Rm 2.5)..... 75
Neal Creek Riparian Fence Exclosure and Bank Stabilization (Meyers Property - Rm 2.0)..... 75
Lenz Creek Riparian Fence Exclosure (VanKoten Property - Rm 0.1)..... 77
Baldwin Creek Riparian Fence Exclosure (Schneider Property - Rm 0.6-1.2)..... 81
West Fork Of Neal Creek Fluvial Investigation And Recommendations For Enhancement And Restoration Feasibility Study..... 81
Ongoing Project Work..... 83
Neal Creek Invert Siphon And Piping Project..... 83
Farmers Canal Horizontal Flat Plate Fish Screen And Bypass Project - Mainstem Hood River Rm 11.5..... 86
Stream Habitat Surveys..... 89
East Fork Hood River Canal Fish Salvage..... 89

PELTON LADDER MONITORING AND EVALUATION..... 92

Introduction..... 92
Methods..... 95
Study Design..... 95
Rearing Procedures..... 95
Results and Discussion..... 99
Comparisons of Pre-Modification vs Post-Modification Adult Production..... 99
Measured Smolt Mortality at Pelton Ladder and Round Butte Hatchery..... 99
Recommendations..... 100

ACKNOWLEDGMENTS..... 106

REFERENCES..... 107

Page

APPENDIX A. Acclimation Supportive Data..... 113

APPENDIX B. Spring Chinook Salmon Spawning Ground Survey Supportive Data..... 133

APPENDIX C. Hood River Water Temperature Supportive Data..... 137

APPENDIX D. Oak Springs Hatchery Evaluation Supportive Data..... 146

APPENDIX E. Genetic Analysis of Rainbow and Cutthroat Trout from the Lower Columbia River..... 152

APPENDIX F. Genetic Analysis of Steelhead Trout (Oncorhynchus Mykiss) in the Hood and Bull Run River Drainages..... 169

APPENDIX G. Hood River Fish Habitat Past Project Accomplishments..... 178

APPENDIX H. Pelton Ladder Supportive Data..... 182

INTRODUCTION

The Hood River subbasin is home to four species of anadromous salmonids: chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), steelhead (*Oncorhynchus mykiss*), and sea run cutthroat trout (*Salmo clarki*). Indigenous spring chinook salmon were extirpated during the late 1960's. The naturally spawning spring chinook salmon currently present in the subbasin are progeny of Deschutes stock. Historically, the Hood River subbasin hatchery steelhead program utilized out-of-basin stocks for many years. Indigenous stocks of summer and winter steelhead were listed in March 1998 by National Marine Fisheries Service (NMFS) under the Endangered Species Act (ESA) as a "Threatened" Species along with similar genetically similar steelhead in the Lower Columbia Basin.

Measure 703(f)(5) of the Northwest Power Planning Council's (NPPC) 1987 Fish and Wildlife Program recommended Bonneville Power Administration (BPA) investigate the feasibility of developing artificial production facilities for chinook salmon and steelhead in the Hood, Umatilla, Walla Walla, Grande Ronde, and Imnaha rivers (Northeast Oregon Hatchery Project). The Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO) and the Oregon Department of Fish and Wildlife (ODFW) began the Hood River Production Master Plan process in 1988 under the planning umbrella of the Northeast Oregon Hatchery Project (NEOH). However, in 1991 the NPPC separated out and linked the Hood River portion of the NEOH to the Pelton Ladder Project on the Deschutes River. The Pelton Ladder Project converted an unused section of the fish ladder into a rearing facility for spring chinook salmon destined for the Hood.

In 1992, the NPPC approved the Hood River and Pelton Ladder Master Plans (O'Toole P. and ODFW 1991a and 1991b, and Smith and the Confederated Tribes of the Warm Springs Reservation of Oregon 1991) within the framework of the Columbia River Basin Fish and Wildlife Program and recommended adoption of a phased approach (e.g., evaluation studies, project implementation, and follow-up monitoring and evaluation studies). A comprehensive monitoring and evaluation (M&E) program was implemented in the Hood River subbasin in late 1991, including information on the life history and production of stocks of anadromous salmonids returning to the Hood River subbasin (Olsen et al. 1994). Information collected for the Hood River Production Program (HRPP) w1as used to prepare an environmental impact statement evaluating the HRPP's impact on the human environment (DOE and BPA 1996a and b).

The HRPP is jointly implemented by the CTWSRO and the ODFW. The primary goals of the HRPP are to (1) re-establish naturally sustaining spring chinook salmon using Deschutes River

stock in the Hood River subbasin, (2) rebuild naturally sustaining runs of summer and winter steelhead in the Hood River subbasin, (3) maintain the genetic characteristics of the populations, (4) protect high quality habitat and restore degraded fish habitat, and (5) contribute to tribal and non-tribal fisheries, ocean fisheries, and the NPPC's interim goal of doubling salmon runs. Data collected by the HRPP has been summarized annually in the following progress reports: Olsen et al., 1994; Olsen et al., 1995; CTWSRO and ODFW 1996; CTWSRO and ODFW January 1998; Olsen et al., December 1998; Olsen et al., September 2000; Lambert et al., December 1998; Lambert et al., December 1999; and this report.

This annual report summarizes work for two consecutive contract periods: the fiscal year (FY) 1999 contract period was 1 October, 1998 through 30 September, 1999 and 1 October, 1999 through 30 September, 2000 for FY 2000. Work implemented during FY 1999 and FY 2000 included (1) acclimation of hatchery spring chinook salmon and hatchery summer and winter steelhead smolts, (2) spring chinook salmon spawning ground surveys on the West Fork Hood River (3) genetic analysis of steelhead and cutthroat [contractual service with the ODFW], (4) Hood River water temperature studies, (5) Oak Springs Hatchery (OSH) and Round Butte Hatchery (RBH) coded-wire tagging and clipping evaluation, (6) preparation of the Hood River Watershed Assessment (Coccoli et al., December 1999) and the Fish Habitat Protection, Restoration, and Monitoring Plan (Coccoli et al., February 2000), (7) project implementation of early action habitat protection and restoration projects, (8) Pelton Ladder evaluation studies, (9) management oversight and guidance to BPA and ODFW engineering on HRPP facilities, and (10) preparation of an annual report summarizing project objectives for FY 1999 and FY 2000.

HOOD RIVER MONITORING AND EVALUATION

Acclimation

Introduction

The Hood River Production Master Plan (1991) originally called for acclimating half of the hatchery spring chinook salmon (*Oncorhynchus tshawytscha*) and summer steelhead (*Oncorhynchus mykiss*) smolts and none of the winter steelhead smolts prior to release into the Hood River subbasin. The remaining smolts were to be directly released into the subbasin. This approach was designed to evaluate the benefits associated with acclimation prior to implementing full acclimation for all species (Department of Natural Resources (CTWSRO) 1993). When the NPPC accepted the Hood River Production Master Plan in 1992, they strongly encouraged development of "facilities to acclimate all smolts to be released into the Hood River subbasin where it is feasible to provide such facilities" (NPPC 1992). Furthermore, the NPPC encouraged fishery managers to "use temporary and/or portable facilities wherever possible to reduce costs and facilitate their removal if monitoring and evaluation show them not to be needed". Therefore, all hatchery produced spring chinook salmon and winter steelhead smolts have been acclimated and volitionally released since 1996 (Lambert et al., January 1998). Beginning in 1999 all hatchery summer steelhead smolts were acclimated and volitionally released into the Hood River subbasin. Two concrete raceways were used for hatchery winter steelhead acclimation. One raceway was on the East Fork Hood River (20.5 river miles [Rm] from the Columbia River) and the other was on the Middle Fork Hood River (18 Rm from the Columbia River). Two portable acclimation raceways on the West Fork Hood River (21 Rm and 26.5 Rm from the Columbia River) and one concrete raceway on the Middle Fork Hood River (18 Rm from the Columbia River) were used for acclimating hatchery spring chinook salmon within the Hood River subbasin. One portable acclimation raceway was used for acclimating hatchery summer steelhead on the West Fork Hood River (21 Rm from the Columbia River).

Prior to spring chinook salmon juveniles being transported to the Hood River for acclimation, they were reared for about six months at Pelton Ladder. Pelton Ladder is located in the Deschutes River subbasin, at Rm 100 (**See Pelton Ladder Section, Figures 41 & 42**). Spring chinook salmon juveniles, for release into the Hood River, have been finish reared at Pelton Ladder since 1995-96 (Lambert et al. December 1999).

HRPP tribal staff have four key objectives for the acclimation project on the Hood River (Department of Natural Resources (CTWSRO) 1993):

1. Determine if acclimation significantly influences homing of spring chinook salmon and summer and winter steelhead.

2. Determine if smolt outmigration is significantly higher for acclimated smolts than directly released smolts.
3. Determine if acclimated smolts result in a higher smolt to adult survival rate than directly released smolts.
4. Determine if outmigration timing is similar between hatchery acclimated smolts and naturally produced smolts.

Therefore, winter and summer steelhead and spring chinook salmon were acclimated near primary spawning habitat with the intent that they would imprint and home back to their primary spawning areas. In addition, smolts were acclimated a minimum of four days prior to release from the acclimation ponds to reduce stress and improve survival (Schreck et al. 1989; Whitesel et al. 1994). Finally, hatchery winter steelhead and spring chinook salmon smolts were allowed to emigrate volitionally when physiologically and morphologically ready.

History Of Hatchery Releases For The HRPP

Prior to the acclimated release of hatchery winter steelhead and spring chinook salmon smolts in 1996 and hatchery summer steelhead in 1999, all smolts were directly released into the Hood River subbasin. The target hatchery production goal for the HRPP, during phase one of the project, is 125,000 spring chinook salmon smolts. Beginning with the 1991 brood, the HRPP stopped using Carson stock and began using Deschutes stock. Juvenile hatchery spring chinook salmon have been reared at Round Butte Hatchery (RBH) since the 1993 brood. Prior to the 1993 brood, spring chinook salmon juveniles were reared at Bonneville Hatchery, except for a small number that was reared at RBH for the 1991 brood. The numbers of hatchery spring chinook salmon (Deschutes River broodstock) smolts released into the West Fork Hood River were 75,205 (1991 brood year) and 170,004 (1993 brood year). No spring chinook smolts were released into the Hood River subbasin from the 1992 brood (Olsen et al., September 2000).

The target hatchery production goal for the HRPP, during phase one of the project, is 50,000 winter steelhead and 40,000 summer steelhead smolts. The numbers of hatchery winter steelhead (Hood River broodstock) smolts released into the East Fork Hood River ranged from 38,034 to 48,985 smolts for the 1992-1994 broods (Olsen et al., September 2000). Juvenile hatchery winter steelhead (Hood River broodstock) are reared at Oak Springs Hatchery. The Hood River wild summer steelhead brood collection began during the 1997-98 run. Numbers of Foster (Skamania) stock summer steelhead smolts released into the Hood River subbasin above Powerdale Dam (Rm 4.5) ranged from 60,993 to 99,973 from the 1987-1997 broods. Beginning with the 1998 brood all Foster stock hatchery summer steelhead smolts were released below Powerdale Dam (Olsen et al., September 2000).

Methods

Winter Steelhead

Hatchery winter steelhead smolts have been acclimated and volitionally released on the East Fork Hood River since 1996. In 1996, smolts were acclimated in a portable acclimation pond at Toll Bridge County Park (Lambert et al., January 1998). In 1997 and 1998 the East Fork Irrigation District's (EFID) sand trap (Rm 6.0) was used for acclimation (Figure 1). Permission was granted by the EFID to use the concrete raceway at no cost to this project. The CTWSRO modified the sand trap raceway for acclimation by inserting catwalks, channel irons and I-beams for screens and stop logs, and a baffle to disperse intake water (Figure 2). In the fall of 1998, the Parkdale Fish Facility was completed near Rm 4.0 on the Middle Fork Hood River. The facility includes two concrete acclimation ponds with dimensions of 80 ft x 8 ft x 4 ft (Lambert et al., December 1998). In 1999 and 2000 a portion (about 47%) of the hatchery winter steelhead production was moved from the EFID sand trap and acclimated and volitionally released at the Parkdale Fish Facility on the Middle Fork Hood River (Rm 4.0).

Winter steelhead smolts were volitionally released from the concrete raceways using a stop log system at both the EFID sand trap and the Parkdale Fish Facility. About 23,002 smolts at 5.7 fish/lb and 29,546 smolts at 7.6 fish/lb in 1999 and 2000 were volitionally released into the East Fork Hood River. In the Middle Fork Hood River, about 19,673 smolts at 5.7 fish/lb were volitionally released in 1999 and in 2000 about 30,857 smolts at 7.5 fish/lb. Hatchery winter steelhead smolts are acclimated in two groups at both the EFID sand trap and the Parkdale Fish Facility.

Prior to acclimation, hatchery winter steelhead at Oak Springs Hatchery were graded into two size groups, large (group one) and medium (group two). The two groups were reared in separate raceways at Oak Springs Hatchery. This allowed hatchery personnel to modify their feeding schedule and accelerate the growth of smaller juveniles so that the entire production group is more uniformly sized upon transfer to the Hood River subbasin. To keep the poundage at acceptable levels in the acclimation raceways, winter steelhead smolts were acclimated in two groups. The larger fish (group one) were acclimated first, followed by the smaller fish (group two). Group two remained at Oak Springs Hatchery on the modified feeding schedule for an additional three weeks. Group two was larger at size of release than group one in 1996, which differentiated from other release years (Table 1). Normally, the first group is transported from OSH around the first week of April, acclimated a minimum of five days, then volitionally released. Group one non-migrants are left to acclimate and volitionally release with the second group. Group two is transported around the end of April, acclimated a minimum of five days, then volitionally released.

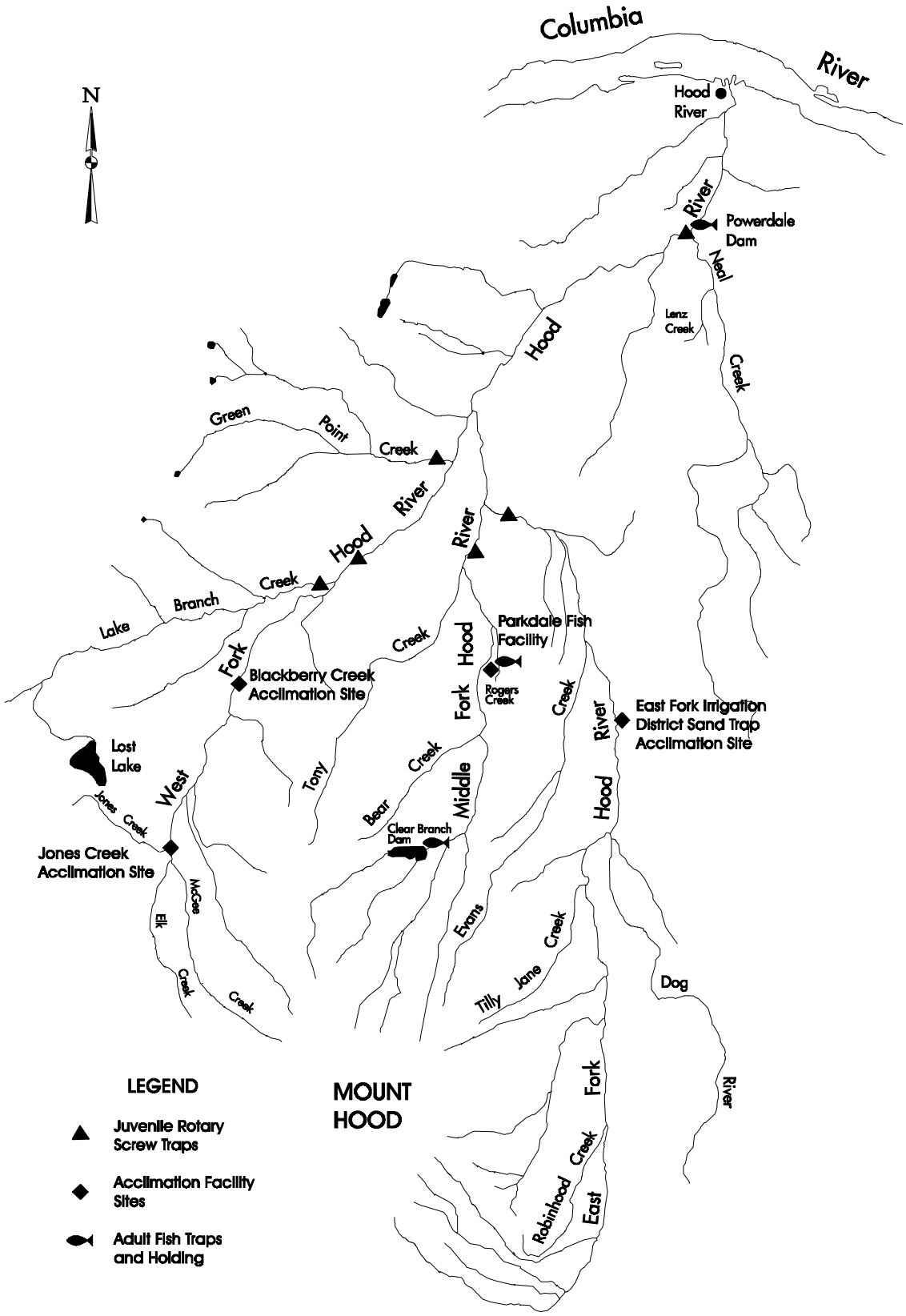


Figure 1. Project sites in the Hood River subbasin.

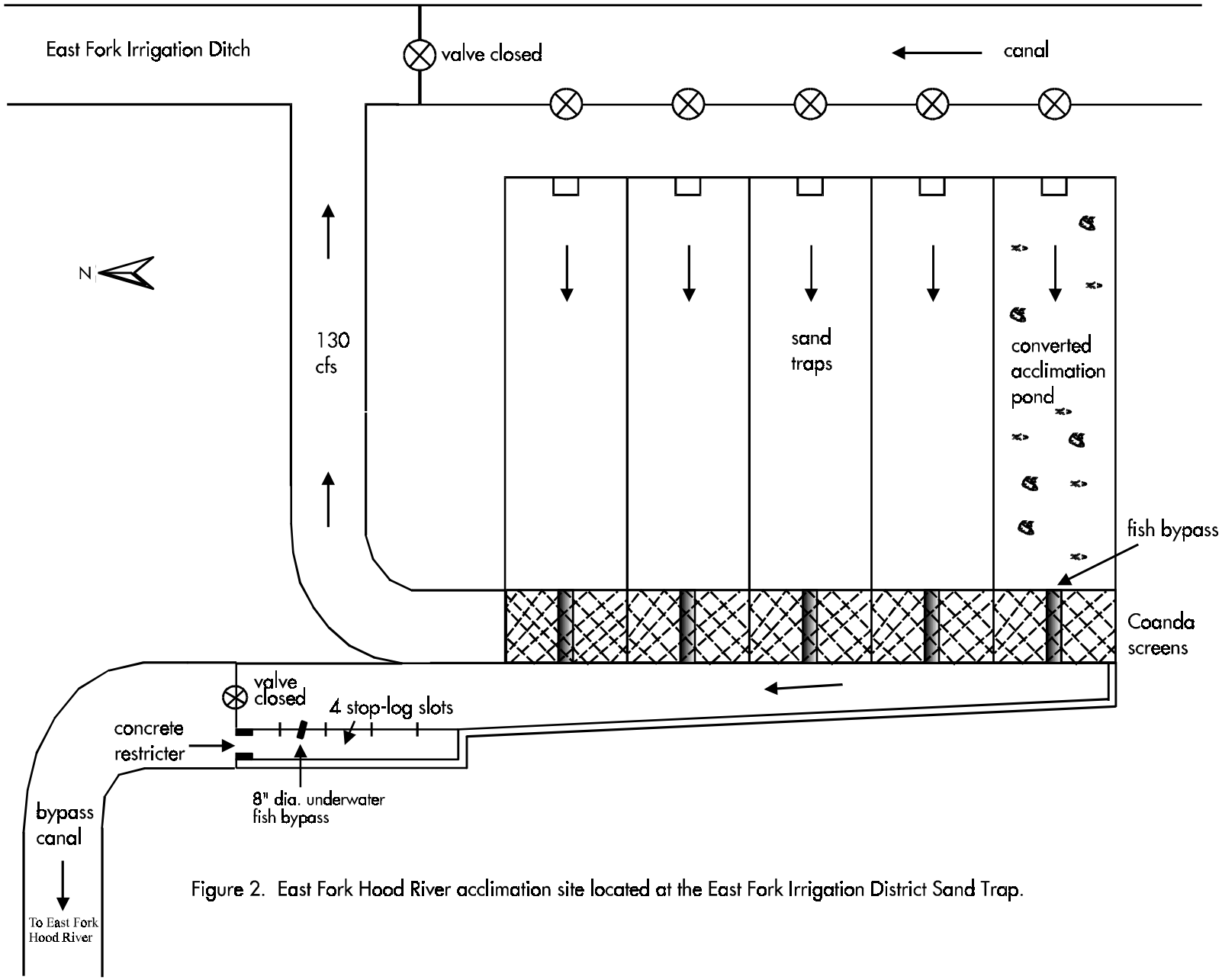


Figure 2. East Fork Hood River acclimation site located at the East Fork Irrigation District Sand Trap.

An acclimation caretaker was on site 24 hr/d at the EFID sand trap and the Parkdale Fish Facility. Dissolved oxygen, water temperature, and fish mortalities were recorded periodically during 1996-2000 acclimation (**Appendix Table A-1**). Winter steelhead smolts were fed minimally during the 1996 acclimation and taken off at least three days prior to release. Hatchery winter steelhead were not fed during acclimation from 1997 to 2000.

Winter steelhead smolts were weighed (g) and measured (mm) and condition factors calculated (weight [g] x 100/length^3 [mm]) prior to and after acclimation release. Smolts which remained in the acclimation raceway were enumerated by weighing total fish and figuring fish/lb, then hauled by truck in a portable liberation tank in May and released near the mouth of the Hood River.

Post-acclimated smolts were sampled at a rotary screw trap by ODFW at Rm 4.5 on the mainstem Hood River (Figure 1). Outmigration timing was monitored and smolt survival estimated. Comparisons were made between acclimated hatchery smolts and wild steelhead smolt migrants. ODFW project staff cannot differentiate between wild summer and winter steelhead smolts and resident rainbow. All trapped fish were anesthetized, sorted by species, examined for fin marks, and counted. ODFW used mark and recapture methods to estimate the abundance of wild, natural, and hatchery produced anadromous salmonid smolts that migrated from the Hood River subbasin. A pooled Peterson estimate with Chapman's modification was used to estimate numbers of downstream migrants by species (Olsen et al., September 2000; Methods).

Outmigration timing was based on daily numbers at the migrant trap which were extrapolated using biweekly wild trapping efficiency numbers (**Appendix Tables A-6 through A-10**). In addition, smolt outmigration survival from the acclimated smolts were compared to non-acclimated smolts from previous yearly releases.

A radio telemetry study was conducted by the ODFW in spring of 1999 to track spawning distribution of adult hatchery winter steelhead in the Hood River subbasin (unpublished data from Fish Research, ODFW, Mid-Columbia District, The Dalles, Oregon). An Advanced Telemetry Systems (ATS) radio transmitter was orally inserted into the fishes gut cavity. The transmitters operated between 40 and 41 MHZ frequencies and each transmitter had an unique frequency so individual fish could be tracked. A total of 17 hatchery winter steelhead were radio-tagged. A base station was setup in the East Fork Hood River (Rm 0.8) to record tagged fish as they passed by. During most of the sampling period fish movement within the system was monitored every 2-3 days using a mobile receiver and antenna carried on foot.

Summer Steelhead

Hatchery summer steelhead smolts have been acclimated and volitionally released on the West Fork Hood River (Rm 9.0) since 1999 at the Blackberry Creek acclimation site (Figure 1). Unlike the East Fork, water quality and quantity in Blackberry Creek, tributary to the West Fork Hood River, is considerably better because it is not influenced by glacial runoff or irrigation withdrawal. However the Blackberry Creek acclimation site is in a remote canyon with no electricity, making acclimation set-up more difficult. Land ownership includes both a private landowner (Longview Fibre) and the U.S. Forest Service (USFS) and required special use permits from both groups. A permit was also required from Hood River County.

The Blackberry Creek location is an old rock quarry site near Dry Run Bridge and is within preferred spawning and rearing habitat for summer steelhead. In 1999 and 2000, smolts were acclimated in a portable acclimation raceway, with dimensions of 11'9" x 60'7" x 4'9" and a capacity of holding 23,987 gallons of water. The portable raceway was purchased from ModuTank, Inc. in New York and is constructed of four foot galvanized steel panels bolted together, “L” braces and stainless steel cables for support, a 36 mil reinforced polypropylene liner and a six inch PVC bulkhead for draining the raceway (Figure 3). ODFW had also used this type of portable raceway successfully on the Siuslaw River (Lindsay et al., 1991-1994).

Assembly of the two ModuTank portable raceways (one spring chinook salmon raceway) and piping begins each year in mid March and lasts 1-2 weeks to complete; ranging from 400-700 hrs of labor. Water for the raceways was diverted from Blackberry Creek through a screened intake box and a 930 ft gravity flow pipeline of 8" pipe (Figure 4). The intake box dimensions were 2'6" x 2'5" x 1'9". There was about 38 ft of head differential between the intake box and the raceways. This provided approximately 348-378 gal/min of water into the east raceway (raceway one) and 374-390 gal/min into the west raceway (raceway two-spring chinook salmon).

In addition, about 360 ft of 8" pipe was used for the return flow back to the West Fork Hood River. Control valves regulated water at the intake box, the junction of the two raceways, and at each raceway outlet. An elaborate bracing and support system for the pipeline took much of the assembly time. The base for the ponds required considerable filling with gravel and sand leveling and compacting. Once the raceways were erected, a four ft high, six inch diameter PVC standpipe was connected to the outlet bulkhead of each raceway to control the water level. The standpipes were also used to release fish and to drain the raceways when needed. The raceways were covered with a fine mesh net to prevent fish from jumping out and to protect them from predators.

Figure 3. Portable raceways used for acclimating and volitionally releasing hatchery summer steelhead and spring chinook salmon smolts on the West Fork Hood River.

A battery operated flotation alarm system was attached to each raceway during acclimation. The alarm system sounded when the water level increased (i.e., plugged screen from fish mortalities or debris) or decreased (i.e., decrease in water supply). The contact points of the alarm could be adjusted to trigger at various water depths. The float consisted of a 4'6" dowel with a Styrofoam float attached to the bottom. A rain gutter pipe drain encompassed the float, protecting it from waves in the raceway created by wind.

Hatchery summer steelhead smolts are acclimated in two groups at the Blackberry Creek acclimation site. The first group is transported from OSH around the first week of April, acclimated a minimum of four days, then volitionally released. Group one non-migrants are left to acclimate and volitionally release with the second group. Group two is transported around the end of April, acclimated a minimum of four days, then volitionally released. Smolts were volitionally released from the portable raceway utilizing an aluminum hopper (or funnel). The hopper was constructed with a rectangular “V” shaped bottom, three vertical sides, one open side and the “V” bottom connected to a six inch diameter pipe. A V-shaped bottom allowed at least three inches of water to flow into the standpipe. The hopper dimensions were approximately two

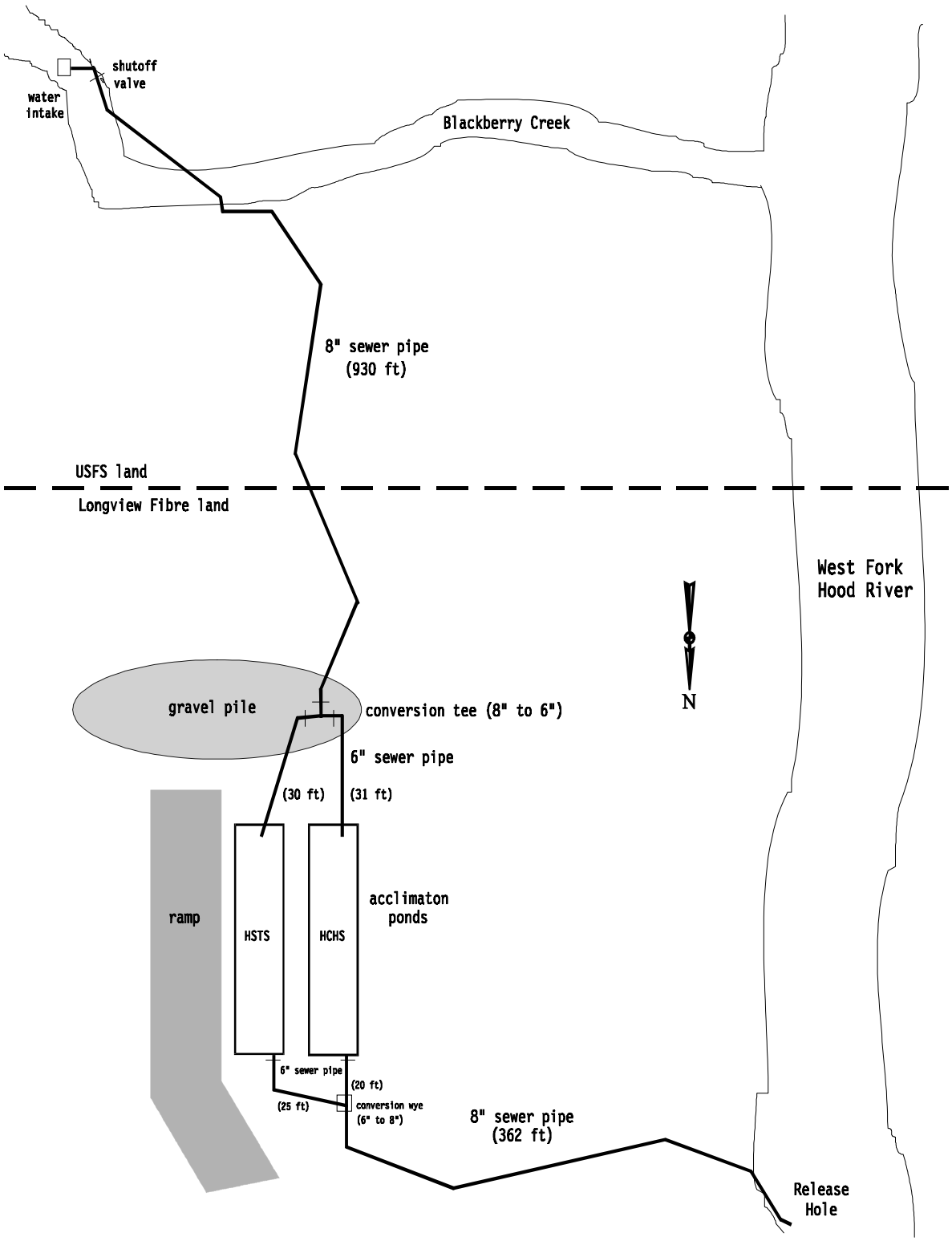


Figure 4. Schematic of the Blackberry Creek acclimation site (Rm 9.0) located near Dry Run Bridge.

ft square by one ft high. During the volitional release, individual sections of the standpipe were removed gradually to lower the water level and encourage outmigration. The hopper was placed on top of the remaining standpipe providing directional water flow and easier fish emigration.

An acclimation caretaker was on site 24 hr/d at the Blackberry Creek acclimation site. Dissolved oxygen, water temperature, and fish mortalities were recorded periodically during 1999 and 2000 acclimation (**Appendix Tables A-2 and A-3**). Hatchery summer steelhead were not fed during acclimation. Hatchery summer steelhead smolts were weighed (g) and measured (mm) and condition factors calculated (weight [g] x 100/length^3 [mm]) prior to and after acclimation release. Smolts which remained in the acclimation raceway were enumerated by weighing total fish and figuring fish/lb, then hauled by truck in a portable liberation tank in May and released near the mouth of the Hood River.

Post-acclimated smolts were sampled at a rotary screw trap by ODFW at Rm 4.5 on the mainstem Hood River (Figure 1). Outmigration timing was monitored and smolt survival estimated. Comparisons were made between acclimated hatchery smolts and wild steelhead smolt migrants. Project staff cannot differentiate between wild summer and winter steelhead smolts and resident rainbow. All trapped fish were anesthetized, sorted by species, examined for fin marks, and counted. ODFW used mark and recapture methods to estimate the abundance of wild, natural, and hatchery produced anadromous salmonid smolts that migrated from the Hood River subbasin. A pooled Peterson estimate with Chapman's modification was used to estimate numbers of downstream migrants by species (Olsen et al., September 2000; Methods).

Outmigration timing was based on daily numbers at the migrant trap which were extrapolated using biweekly wild trapping efficiency numbers (**Appendix Tables A-9 and A-10**). In addition, smolt outmigration survival from the acclimated smolts were compared to non-acclimated smolts from previous yearly releases.

Spring Chinook Salmon

Hatchery spring chinook salmon smolts have been acclimated and volitionally released into the West Fork Hood River since 1996. From 1996 to 2000, smolts have been released at the Blackberry Creek acclimation site (Rm 9.0) [Figure 1]. As described above for summer steelhead, the water quality and quantity in the West Fork is considerably better than the East Fork Hood River and acclimation sites are within preferred spawning and rearing habitat. In 1998, the Jones Creek acclimation site was established on the West Fork Hood River (Rm 14.0) [Figure 1]. This site is located at the upper end (elevation 2300 ft) of the West Fork Hood River where Jones Creek flows into a moderate terrace/hillslope confinement habitat type with a low

stream gradient; and ideal spring chinook salmon habitat in the Hood River subbasin (**See Spring Chinook Salmon Spawning Ground Surveys**). Currently, about 31% of the total production (target 125,000) is acclimated and volitionally released at the Jones Creek acclimation site.

Portable raceways were used to acclimate and volitionally release hatchery spring chinook salmon smolts at the Blackberry Creek and Jones Creek sites. With a reduction in the number of smolts released at the Blackberry Creek acclimation site, in 1999 and 2000 one portable raceway was used at the Blackberry Creek site with a dimension of 11'9" x 60'7" x 4'9" and a capacity of holding 23,987 gallons of water (Figure 4). Prior to 1999, spring chinook salmon smolts were acclimated in two portable raceways at the Blackberry Creek site with each having a dimension of 11'9" x 49'3" x 4'9" with a capacity of holding 19,500 gallons of water. At the Jones Creek site, a portable raceway was used in 1999 and 2000 with a dimension of 11'9" x 49'3" x 4'9". This was an upgrade from using a circular pond in 1998 (Lambert et. al., December 1999). Raceways were constructed of four foot galvanized steel panels bolted together, “L” braces and stainless steel cables for support, a 36 mil reinforced polypropylene liner and a six inch PVC bulkhead for draining the raceway. Assembly of the portable acclimation raceways and gravity fed pipe system was described above (**See Acclimation Methods - Summer Steelhead**). Figure 5 shows a schematic of the Jones Creek acclimation project site.

Smolts were volitionally released from the portable raceway utilizing an aluminum hopper (or funnel). The hopper was constructed with a rectangular “V” shaped bottom, three vertical sides, one open side and the “V” bottom connected to a six inch diameter pipe. A V-shaped bottom allowed at least three inches of water to flow into the standpipe. The hopper dimensions were approximately two ft square by one ft high. During the volitional release, individual sections of the standpipe were removed gradually to lower the water level and encourage outmigration. The hopper was placed on top of the remaining standpipe providing directional water flow and easier fish emigration.

In the fall of 1998, the Parkdale Fish Facility was completed near Rm 4.0 on the Middle Fork Hood River. The facility includes two concrete acclimation ponds with dimensions of 80 ft x 8 ft x 4 ft (Lambert et. al., December 1998). In 1999 and 2000 a portion of the hatchery spring chinook salmon production (about 24% of the total production) was moved from the Blackberry Creek acclimation site to the Parkdale Fish Facility for acclimation and release into the Middle Fork Hood River (Rm 4.0) [Figure 1].

A caretaker was on-site 24 hr/d. Dissolved oxygen, water temperatures, and fish mortalities were recorded periodically during 1999-2000 acclimation (**Appendix Tables A-2 through A-5**). Mean fork length (mm) and weight (g) were measured and condition factors calculated (weight

[g] x 100/length^3 [mm]) for non-migrant spring chinook salmon smolts. Non-migrant smolts were forced out of the acclimation raceways and circular tank into the West Fork Hood River at the Jones Creek site on 27 April and 7 May at the Blackberry Creek site. Once hatchery spring chinook salmon smolts left the acclimation raceways, their temporal distribution was graphed and compared to smolts produced in the wild. Downstream migrant anadromous salmonids were trapped by ODFW using a rotary screw trap located on the mainstem Hood River [Rm 4.5] (Figure 1). Outmigration timing was based on daily counts at the migrant trap and not adjusted for trapping efficiency. Low numbers of naturally produced spring chinook salmon smolts and poor survival of hatchery smolts from handling, resulted in no trapping efficiency for spring chinook salmon smolts.

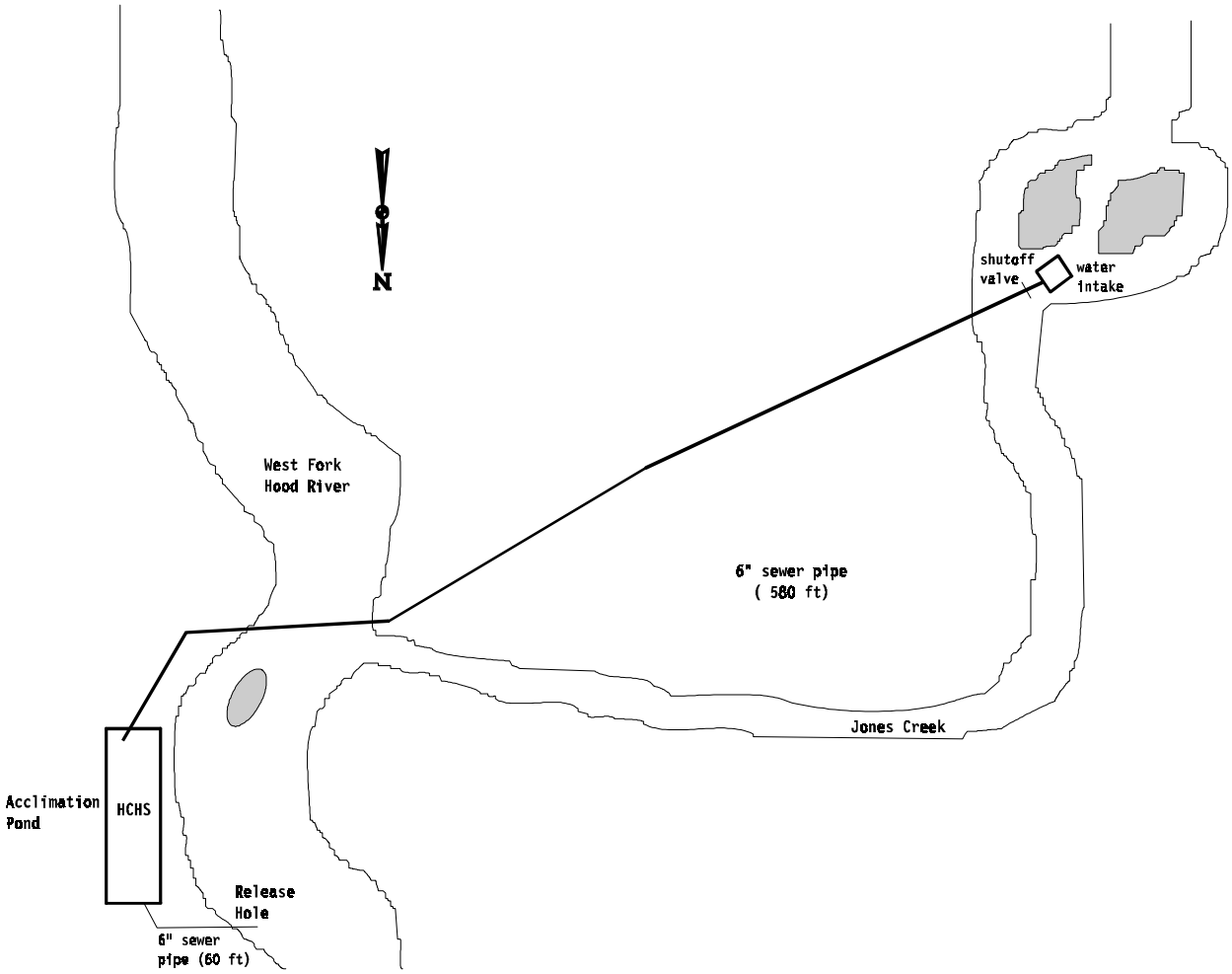


Figure 5. Schematic of the Jones Creek acclimation site, West Fork Hood River (Rm 14.0).

Results and Discussion

Winter Steelhead

In 1999 and 2000, 27,069 and 31,157 Hood River stock hatchery winter steelhead smolts were acclimated and released from early April to mid June in the East Fork Hood River. In the Middle Fork Hood River, 19,987 and 32,147 smolts were acclimated and released from the Parkdale Fish Facility (Table 1). Of the total 47,056 smolts released into the East and Middle forks in 1999, an estimated 42,675 emigrated volitionally and 2,316 non-migrants remained in the raceway and were hauled by truck and released into the mainstem Hood River. In 2000, a total of 63,304 smolts were released, an estimated 60,403 emigrated volitionally and 2,852 non-migrants remained in the raceway and were hauled by truck and released into the mainstem Hood River. One-hundred non-migrant smolts died during truck transport. Hatchery winter steelhead smolts were acclimated prior to release a minimum of 5 days, ranging from 5-9 days (Table 1).

The mainstem Hood River rotary screw trap was operational by the 10th of April in 1999 and 5th of April in 2000. Temporal distribution of hatchery winter steelhead and wild rainbow/steelhead smolts to the mainstem Hood River rotary screw trap (Rm 4.5) have remained similar since acclimation began in 1996 (Figures 6 and 7; **Appendix Figures A-1, A-2, and A-3**). In 1999, the median date of arrival of hatchery smolts was 14 May compared to 20 May for wild rainbow/steelhead. In 2000, wild rainbow/steelhead median migration on 9 May was about two weeks earlier than median migration of hatchery smolts on 20 May. The median migration dates since 1996 for hatchery and wild smolts have ranged from 9 May-20 May and 2 May-20 May respectively. The mainstem rotary screw trap for 1999 was not operated on 18- and 25 May and 15-16 April and 13-14 June of 2000 because of high numbers of hatchery steelhead and spring chinook salmon releases and trap malfunctions.

ODFW estimated in 1996, 1997, 1998 1999, and 2000 that 32,235 (71.8%), 48,337 (80.8%), 50,666 (81,5%), 38,394 (90 %), and 50,153 (83%) acclimated and volitionally released smolts migrated passed the mainstem juvenile trap (Rm 4.5), respectively. Estimates of 1994 and 1995 trap catches of unacclimated smolts were 26.6% and 37.6% (Figure 8). Based on seven years of data, acclimated and volitionally released smolts continue to migrate out of the subbasin at a greater percentage, ranging from 34.2 to 63.4 percent higher than those which were directly released by hatchery truck (Figure 8). The same trend has been true for the hatchery summer steelhead releases (Figure 12). With acclimation and a volitional release, fewer fish remain within the Hood River subbasin limiting interspecies competition between hatchery smolts and wild and naturally produced juvenile salmonids.

Table 1. Hood River stock hatchery winter steelhead acclimated in the East Fork and Middle Fork Hood River drainage, 1996-2000 releases.[a]

Drainage, Location, Release year, Release group	Date transferred to raceway	Number transferred to raceway	Fish/lb at transfer	Number of days acclimated	Mortalities in[b] acclimation raceway	Number[c] volitionally released	Number[d] trucked	Total[e] released
East Fork,								
Toll Bridge Park,								
1996,								
Group 1	Apr 1-4	24,057	5.7	9-12	26	24,031		24,031
Group 2	Apr 22-24	26,965	5.0	8-10	92	20,885	5,988	26,873
EFID Sand Trap,								
1997,								
Group 1	Apr 11-15	27,740	5.7	6-10	29	27,711		27,711
Group 2	Apr 29	32,578	8.3	6	452	32,126		32,126
1998,								
Group 1	Apr 7	29,510	5.2	7	0	29,510		29,510
Group 2	Apr 21	32,626	7.5	7	0	31,707	919(1)	32,625
1999,								
Group 1	Apr 6	13,439	5.6	9	4	12,430	1005(1)	13,434
Group 2	Apr 29	13,630	5.8	6	2,052	10,572	1006(1)	11,577
2000,								
Group 1	Apr 12	14,599	7.3	5	1	13,852	746	14,598
Group 2	Apr 25-26	16,558	7.8	5-6	20	15,694	844	16,538
Middle Fork,								
Parkdale Fish Facility,								
1999,								
Group 1	Apr 6-7	10,012	5.5	8-9	2	9,857	153	10,010
Group 2	Apr 28	9,975	6.0	7	7	9,816	152	9,968
2000,								
Group 1	Apr 11	15,912	7.3	6	8	15,279	625(50)	15,854
Group 2	Apr 25	16,235	7.7	6	20	15,578	637(50)	16,165

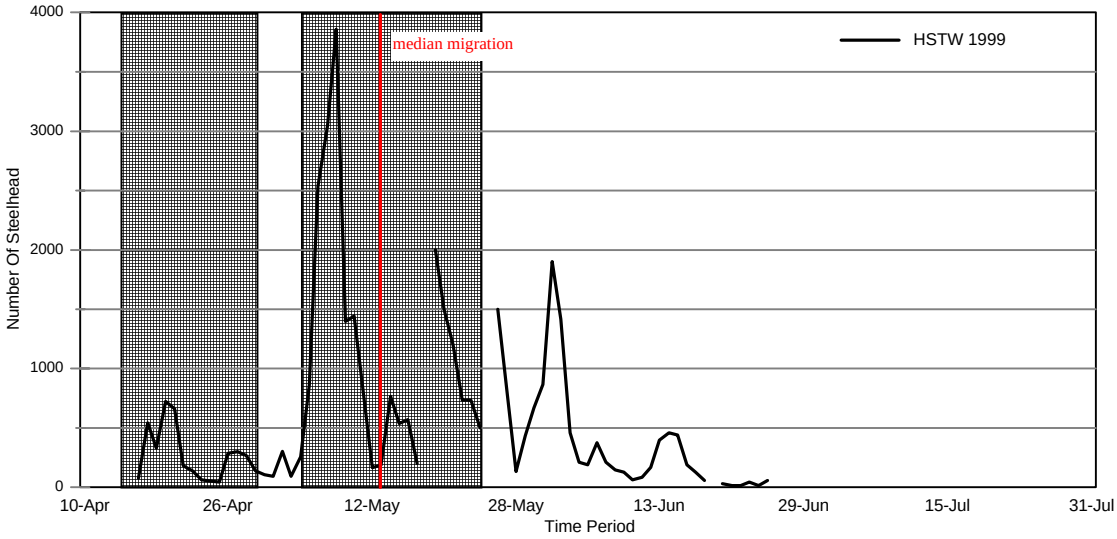
[a] In the release year 1999, 1,792 smolts were direct released by truck from Oak Spring Hatchery personnel (ODFW) into the mainstem Hood River below Powerdale Dam.

[b] Of the total 481 mortalities in 1997, 442 were the result of sampling smolts which did not emigrate volitionally from the acclimation raceway. Of the total 2,056 mortalities recorded in 1999 at the EFID Sand Trap, 1,933 fish were the result of hauling fish to the acclimation site and 123 were from seining and holding fish for the Coanda screen testing.

[c] Of the total 59,837 released in 1997, 2,545 did not emigrate volitionally of which 2,103 were forced out into the East Fork Hood River.

[d] Number trucked indicates hatchery winter steelhead which did not emigrate volitionally from the acclimation raceways and were hauled and released near the mouth of the Hood River. In parentheses are mortalities from fish truck liberations.

[e] Mortality from the number trucked was subtracted from the total released.



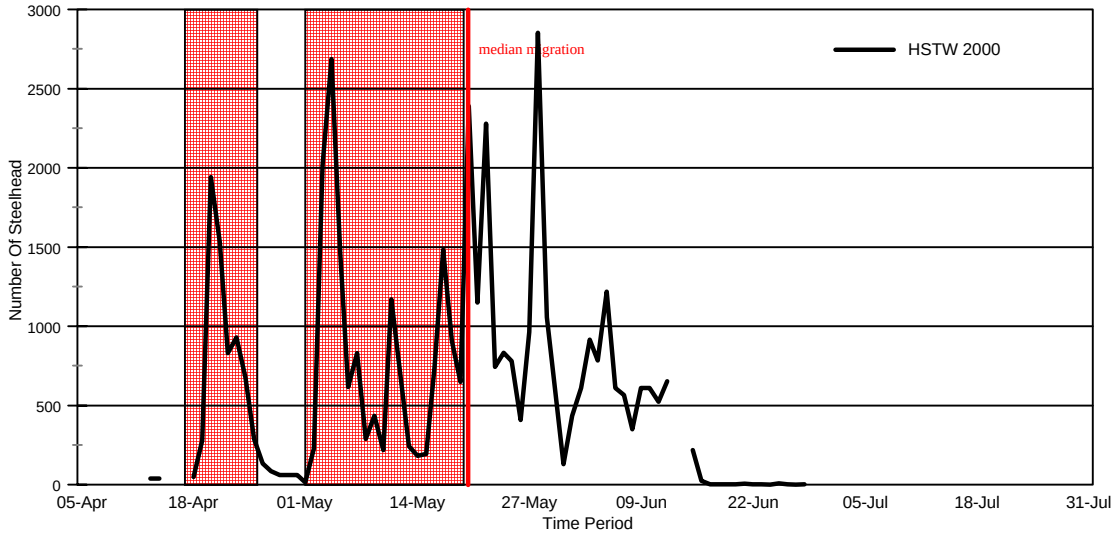
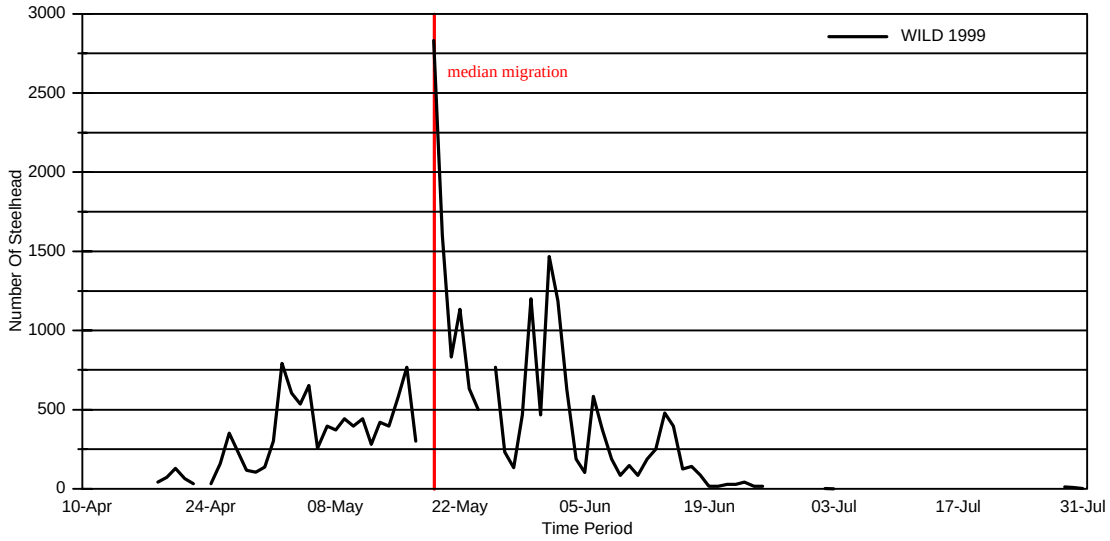


Figure 6. Migration timing of hatchery winter steelhead at the mainstem Hood River rotary screw trap, 1999 and 2000 migration year. The trap was not operational on the 18 and 25 May in 1999 or the 15-16 April and 13-14 June of 2000. Numbers were adjusted for trapping efficiency. The shaded portion represents the volitional period of release from the East Fork Hood River acclimation raceways.



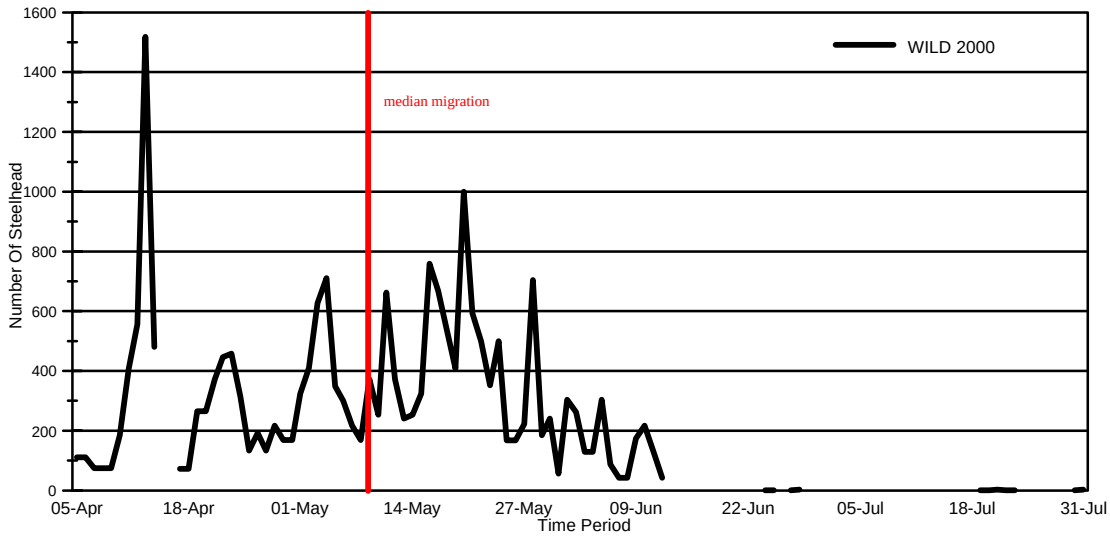


Figure 7. Migration timing of wild rainbow/steelhead at the mainstem Hood River rotary screw trap, 1999 and 2000 migration year. The trap was not operational on the 18- and 25 May in 1999 or the 15-16 April and 13-14 June of 2000. Numbers were adjusted for trapping efficiency.

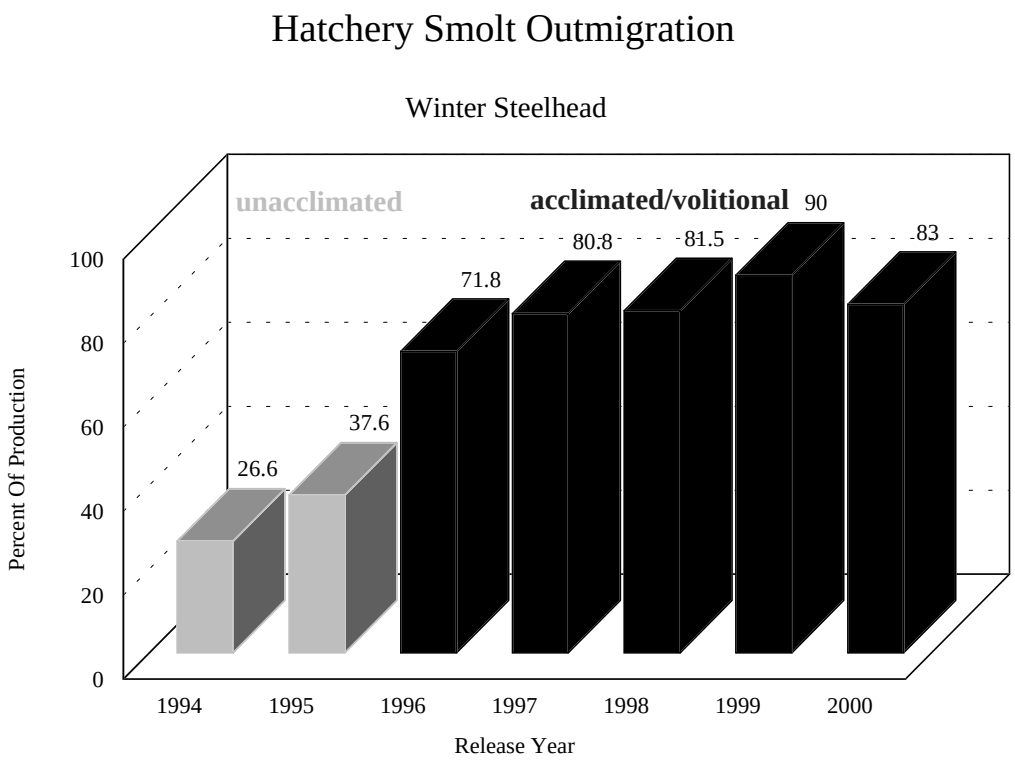


Figure 8. Percentage of the production released of hatchery winter steelhead smolts migrating past the mainstem Hood River juvenile migrant trap (Rm 4.5), 1994-2000 releases.

Increased smolt outmigration of acclimated and volitional releases may be the result of fish having time to recover from stress after they were hauled in liberation trucks. Studies have shown with coho salmon (*O. kisutch*) (Schreck et al. 1989) and steelhead (*O. mykiss*) (Whitesel et al. 1994) that stress from transportation via hatchery truck can cause a marked physiological stress response. Schreck (1989) also found "fish not given adequate time to recover from the transport stress were less capable than unstressed fish of surviving in the wild".

Although considerably more acclimated and volitionally released hatchery winter steelhead smolts are emigrating from the Hood River subbasin, there has been no noticeable difference in smolt to adult survival to the mouth of the Hood River (Table 2). When comparing acclimated and volitionally released Hood River stock hatchery winter steelhead and direct released Foster stock hatchery summer steelhead by year of migration in 1996 and 1997, the 1996 acclimated and volitionally released hatchery winter steelhead had a higher smolt to adult survival than the direct released hatchery summer steelhead; 1.145% compared to 0.978%. Whereas, in 1997 the direct released hatchery summer steelhead had a higher smolt to adult survival; 0.98% compared to 0.643% (Table 2).

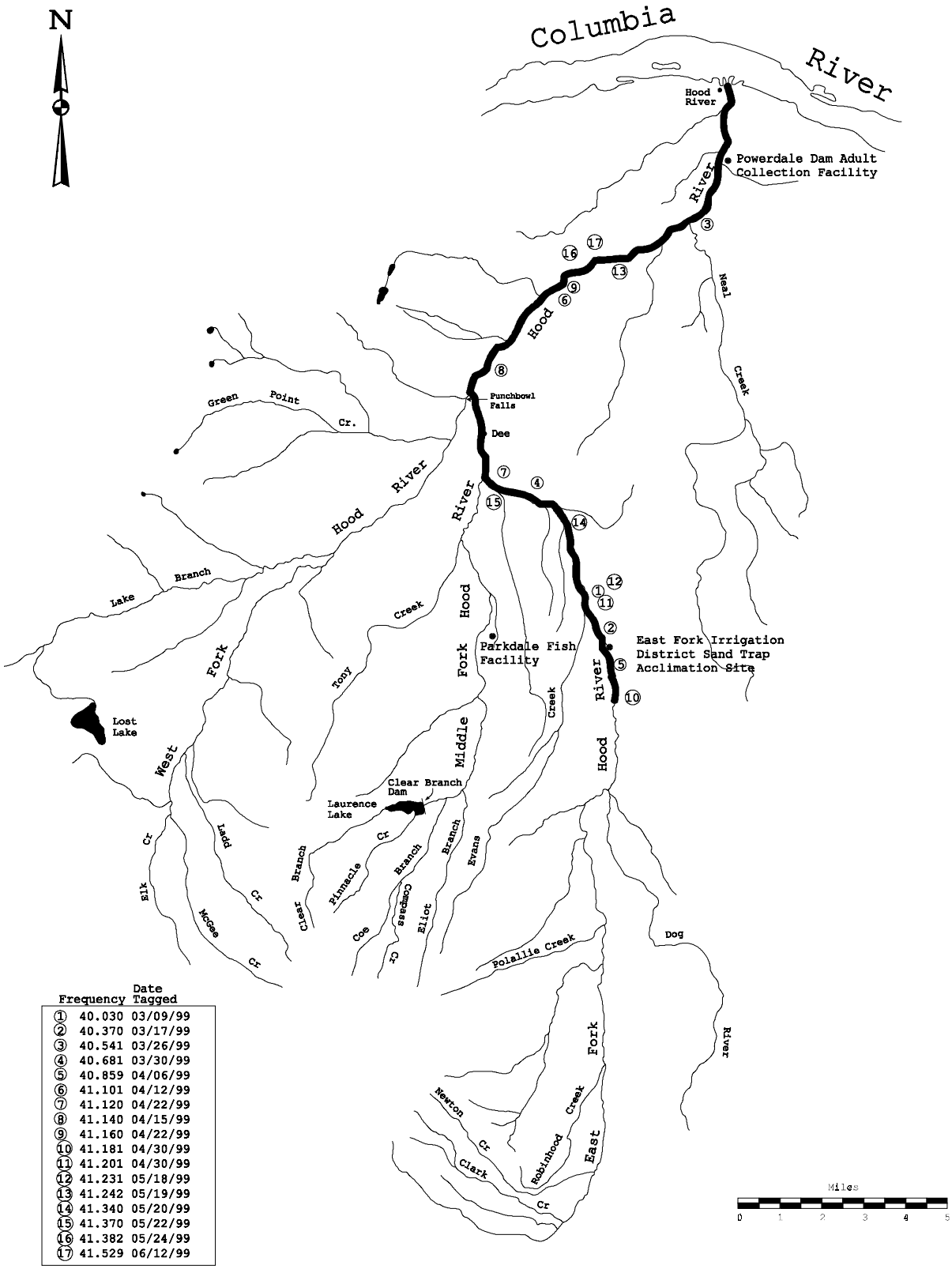
Table 2. Smolt to adult survival rates for wild rb-st (W-ST), Hood River stock hatchery winter steelhead (HSTW), and Foster stock hatchery summer steelhead (HSTS) by year of migration, 1994-1997. Unpublished data provided by the ODFW Research office in The Dalles, Oregon. (INC = Incomplete information on survival).

	Percent survival		**Difference in survival (%)**	**Percent survival**	**Difference in survival (%)**
Year of migration	W-ST	HSTW	HSTW	HSTS	HSTS (Foster)
1994	7.31	1.86	-75.54	2.30	-68.47
1995	7.37	2.39	-67.58	1.32	-82.05
1996[a]	6.30	1.15	-81.82	0.98	-84.47
1997[a]	4.13	0.64	-83.07	0.98 (INC)	-74.20 (INC)

[a] Winter steelhead were acclimated prior to release into the West Fork Hood River.

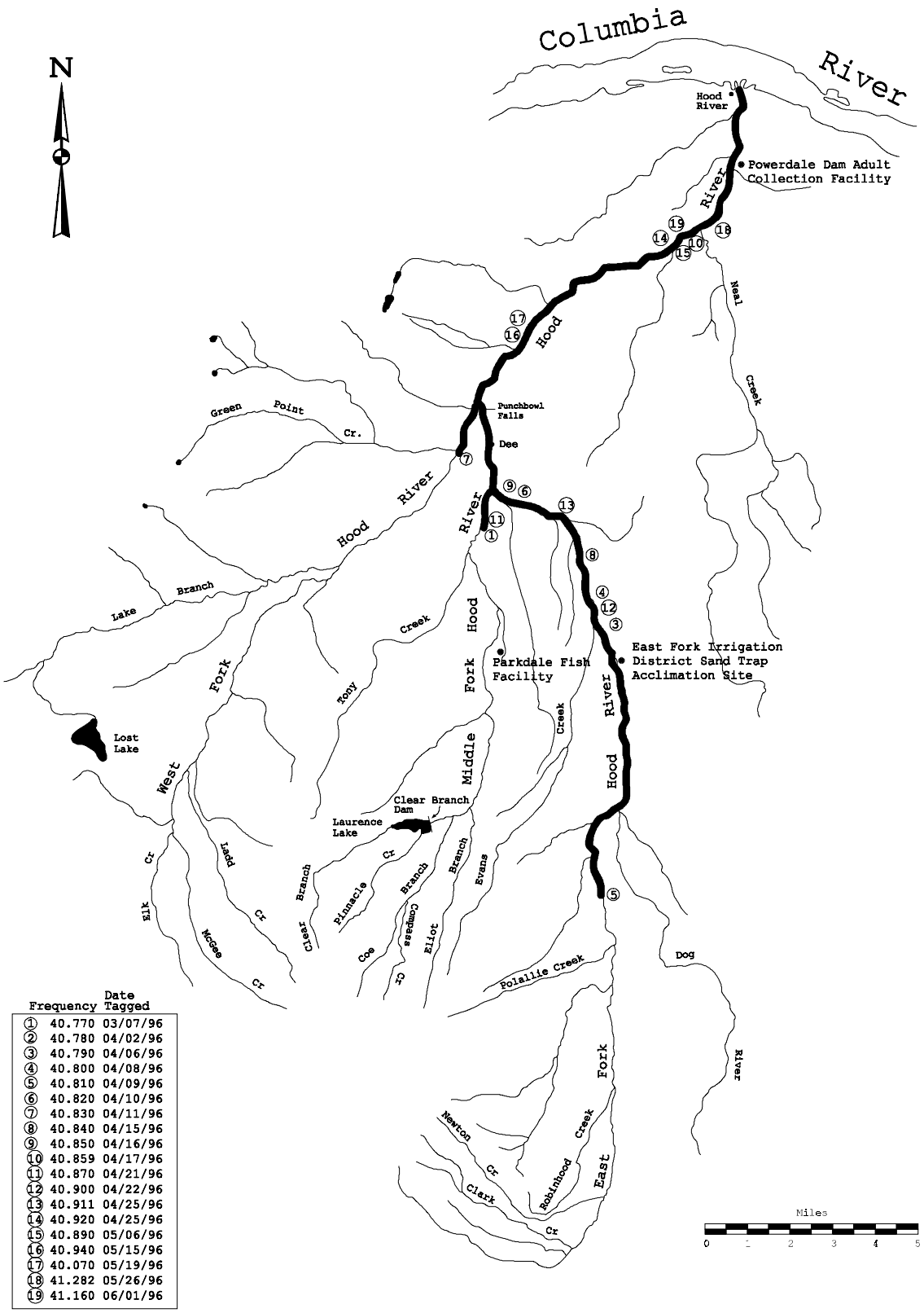
Seventeen fin clipped hatchery winter steelhead were tagged with radio transmitters in the spring of 1999 to document maximum spatial distribution. Radio-tagged hatchery winter steelhead primarily used the mainstem Hood River from the Powerdale Dam Adult Trapping Facility (Rm 4.5) to Rm 7.0 on the East Fork Hood River near Yellowjacket Creek, a distance of approximately seventeen miles (Figure 9). About 59 percent of the radio-tagged fish were found in the lower seven miles of the East Fork. No fish were detected in the West Fork, Middle Fork, or Neal Creek (Figure 9). A similar study on wild winter steelhead in 1996 found steelhead utilized the mainstem Hood River, East Fork up to Rm 12.5, and the lower Middle Fork and West Fork Hood River (Figure 10). Hatchery winter steelhead are homing back to where they were acclimated and volitionally released from the East Fork Irrigation District Sand Trap acclimation site (Figure 10). Maximum spatial distribution of hatchery winter steelhead should increase to include the Middle Fork Hood River as adults begin to return from Parkdale Fish Facility releases (Figure 9).

Hatchery winter steelhead smolt size at release has varied since the 1994 releases; ranging from 5.3 fish/lb to 7.5 fish/lb (Table 3). In 1999 and 2000, smolt releases were similar within a given year between groups one and two (Table 1). Although in other years, such as 1997 and 1998, acclimated smolts varied between release groups. In 1997, group one averaged 5.7 fish/lb and group two was 8.3 fish/lb, whereas in 1998, group one averaged 5.2 fish/lb and group two was 7.5 fish/lb (Table 1). There is no correlation between size at release (Table 3) and percentage of smolts emigrating from the Hood River subbasin (Figure 8) for hatchery winter steelhead. Hatchery winter steelhead volitional migrants, each year on average, have had a lower condition factor than non-migrants leftover in the acclimation raceways; except in release year



Frequency		Date Tagged
①	40.030	03/09/99
②	40.370	03/17/99
③	40.541	03/26/99
④	40.681	03/30/99
⑤	40.859	04/06/99
⑥	41.101	04/12/99
⑦	41.120	04/22/99
⑧	41.140	04/15/99
⑨	41.160	04/22/99
⑩	41.181	04/30/99
⑪	41.201	04/30/99
⑫	41.231	05/18/99
⑬	41.242	05/19/99
⑭	41.340	05/20/99
⑮	41.370	05/22/99
⑯	41.382	05/24/99
⑰	41.529	06/12/99

Figure 9. Maximum spatial distribution of radio tagged adult hatchery winter steelhead during 1999.



Frequency	Date Tagged
① 40.770	03/07/96
② 40.780	04/02/96
③ 40.790	04/06/96
④ 40.800	04/08/96
⑤ 40.810	04/09/96
⑥ 40.820	04/10/96
⑦ 40.830	04/11/96
⑧ 40.840	04/15/96
⑨ 40.850	04/16/96
⑩ 40.859	04/17/96
⑪ 40.870	04/21/96
⑫ 40.900	04/22/96
⑬ 40.911	04/25/96
⑭ 40.920	04/25/96
⑮ 40.890	05/06/96
⑯ 40.940	05/15/96
⑰ 40.070	05/19/96
⑱ 41.282	05/26/96
⑲ 41.160	06/01/96

Figure 10. Maximum spatial distribution of radio tagged adult wild winter steelhead during 1996.

Table 3. Average size of release by year for hatchery winter steelhead smolt releases into the Hood River subbasin, 1994-2000.

Release Year	Size (Fish/lb)
1994	5.9
1995	5.4
1996	5.3
1997	6.9
1998	6.9
1999	5.7
2000	7.5

1997 where they were the same at 0.99 (Table 4). The condition factor for volitional migrants in 1999 and 2000 averaged 1.00 and 0.95 compared to 1.03 and 0.98 for smolts which did not volitionally migrate and remained in the acclimation raceway (Table 4).

Summer Steelhead

Hood River stock hatchery summer steelhead smolts were released for the first time in 1999. In 1999 and 2000, 19,532 and 33,940 smolts were acclimated and volitionally released into the West Fork Hood River (Table 5). Of the 19,532 smolts released in 1999, an estimated 15,616 emigrated volitionally and 3,897 non-migrants remained (20%) in the raceway and were hauled by truck and released into the mainstem Hood River. In 2000, a total of 33,940 smolts were released, including an estimated 29,152 volitional migrants and 4,738 non-migrants (14%) the that were trucked to the lower mainstem Hood River (Table 5). In both years, non-migrant hatchery summer steelhead (20% in 1999 and 14% in 2000) were surpassed non-migrant hatchery winter steelhead (5% for both years) (Table 1). This may be caused by a difference in release techniques. Hatchery winter steelhead are released from concrete diversions with a stop-log system, whereas the hatchery summer steelhead are released from the portable acclimation ponds with a hopper system.

Raceway loading was low for hatchery summer steelhead smolts in the Blackberry Creek acclimation raceway in 1999 and 2000 (Table 6). In 1999, only one group was acclimated for volitional release and the loading in the east raceway at time of transfer was 10.2 lbs/gpm (1.2 lbs/cu ft). In 2000 hatchery summer steelhead smolts were acclimated in two separate groups and loading ranged from 7.7 lbs/gpm (0.9 lbs/cu ft) and 8.1 lbs/gpm (1.0 lbs/cu ft). Group two loading calculations did not include non-migrants from group one.

Table 4. Mean condition factors for hatchery winter steelhead volitional migrants collected in the mainstem Hood River juvenile rotary screw trap (Rm 4.5) and non-migrants which remained in the acclimation raceways at both the East Fork and Middle Fork facilities, 1996-2000.[a]

Race/species, release year, migrant group	N	Mean	Range	95% C.I.
Winter steelhead,				
1996,				
Volitional migrants	274	0.96	0.80 - 1.28	± 0.01
Trucked non-migrants	207	1.00	0.84 - 1.15	± 0.01
1997,				
Volitional migrants	647	0.99	0.57 - 1.30	± 0.01
Forced non-migrants	212	0.99	0.65 - 1.33	± 0.06
1998,				
Volitional migrants	1537	0.96	0.65 - 1.47	± 0.01
Trucked non-migrants	200	1.03	0.79 - 1.45	± 0.06
1999,				
Volitional migrants	730	1.00	0.76 - 1.41	± 0.01
Trucked non-migrants	622	1.03	0.76 - 1.35	± 0.04
2000,				
Volitional migrants	688	0.95	0.76 - 1.26	± 0.01
Trucked non-migrants	454	0.98	0.79 - 1.14	± 0.04

[a] Condition factor was estimated as (weight [g] * 100/length^3 [mm].

Table 5. Hood River stock hatchery summer steelhead acclimated in the West Fork Hood River drainage, 1999-2000.

Drainage, Release Location, Release year, Release group,	Date transferred to raceways	Number transferred to raceways	Fish/lb at transfer	Number of days acclimated	Mortalities in acclimation raceway	Number[a] volitionally released	Number[b] trucked	Total released
West Fork,								
Blackberry Creek,								
1999,								
Group 1	Apr 2	19,532	5.5	13	19	15,616	3,897	19,513
2000,								
Group 1A	Apr 6	18,165	6.2	7	19	15,611	2,535	18,146
Group 1B	Apr 21-24	15,775	5.2	3-6	31	13,541	2,203	15,744

[a] Hatchery summer steelhead that were volitionally released from the acclimation raceways.
[b] Number trucked indicates hatchery summer steelhead which did not emigrate volitionally from the acclimation raceways and were hauled and released near the mouth of the Hood River.

Table 6. Raceway loading and water intake in the portable raceway at Blackberry Creek, West Fork Hood River, during hatchery summer steelhead smolt acclimation, 1999-2000.

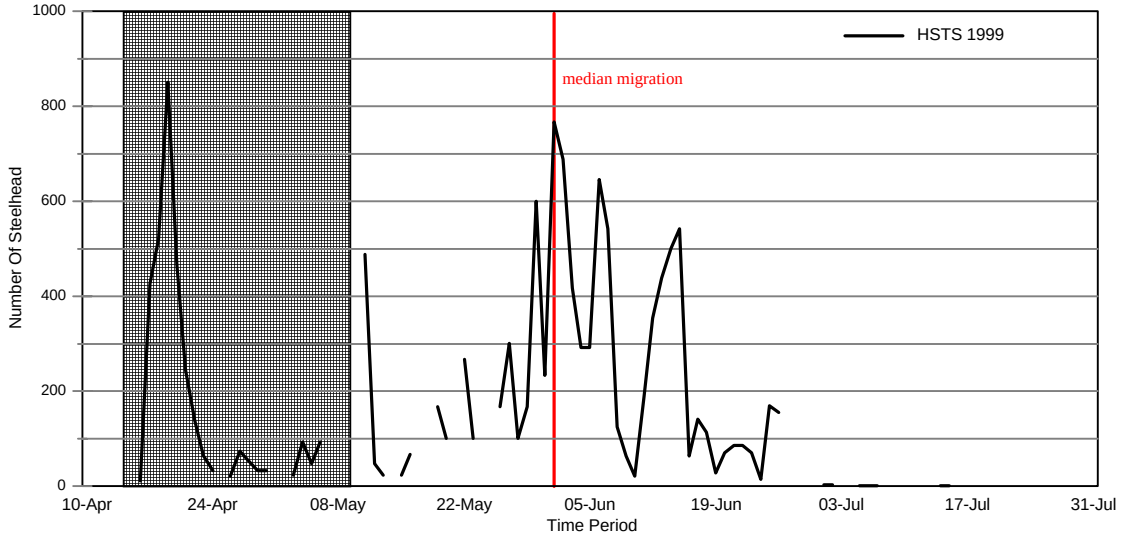
Location, Pond type, Release year, Release group[a]	Raceway loading	Raceway water intake (gpm)
Blackberry Creek,		
East raceway,		
1999,		
Group 1	10.2 lbs/gpm (1.2 lbs/cu ft)	346
2000,		
Group 1	7.7 lbs/gpm (0.9 lbs/cu ft)	377
Group 2	8.1 lbs/gpm (1.0 lbs/cu ft)	377

[a] Group 2 raceway loading does not include non-migrants from group one, only trucked smolts.

Hatchery summer steelhead were volitionally released from the Blackberry Creek acclimation site, West Fork Hood River, from 15 April through 10 May in 1999 and 13-21 April and 27 April - 9 May in 2000 (Figure 11). Unlike hatchery winter steelhead and wild rainbow/steelhead migration in 1999, hatchery summer steelhead median migration was much later on 1 June compared to 14 May for hatchery winter steelhead and 20 May for wild (Figures 6, 7, and 11). A majority of hatchery summer steelhead held within either the West Fork or mainstem Hood River after leaving the acclimation raceway. There was a large initial peak in outmigration between 17-21 April, with a more gradual outmigration from 11 May to 26 June (Figure 11). Temporal distribution in 2000 for hatchery summer steelhead smolts was similar to both hatchery winter steelhead and wild rainbow/steelhead (Figure 6, 7, and 11), with a more gradual outmigration from time of release on 13 April until mid June (Figure 11). The mainstem Hood River rotary screw trap was operational by the 10th of April in 1999 and 5th of April in 2000 and was not operational during outmigration on 18- and 25 May in 1999 and 15-16 April and 13-14 June of 2000.

Similar to the hatchery winter steelhead smolt outmigration (Figure 8), acclimated and volitionally released hatchery summer steelhead smolts out-migrated at a higher percentage than did comparable years of direct releases by truck (Figure 12). ODFW estimated in 1999 and 2000 that 12,474 (79.9%) and 24,131 (82.8%) Hood River stock hatchery summer steelhead acclimated and volitionally released smolts migrated passed the mainstem juvenile trap (Rm 4.5), respectively (unpublished data from Fish Research, ODFW, Mid-Columbia District, The Dalles, Oregon). Estimates of hatchery summer steelhead (Foster stock) smolts directly released by truck from 1994 to 1997, ranged from 34.5 to 60.6 percent (Figure 12). As described in the winter steelhead results and discussion, similar benefits exist in acclimating and volitionally releasing hatchery summer steelhead smolts in that fewer residualize within the Hood River subbasin, limiting interspecies competition between hatchery smolts and wild and naturally produced juvenile salmonids.

Hood River stock hatchery summer steelhead smolt size at release was 5.5 fish/lb in 1999 and ranged between 5.2 fish/lb and 6.2 fish/lb for two groups in 2000 (Table 5). Size of release in 1999 and 2000 was smaller than the ODFW target goal size of 5.0 fish/lb. The condition factor for hatchery summer steelhead volitional migrants averaged 0.99 for 1999 and 0.94 for 2000 compared to 1.04 in 1999 and 0.96 in 2000 for smolts which did not volitionally migrate and remained in the acclimation raceway (Table 7).



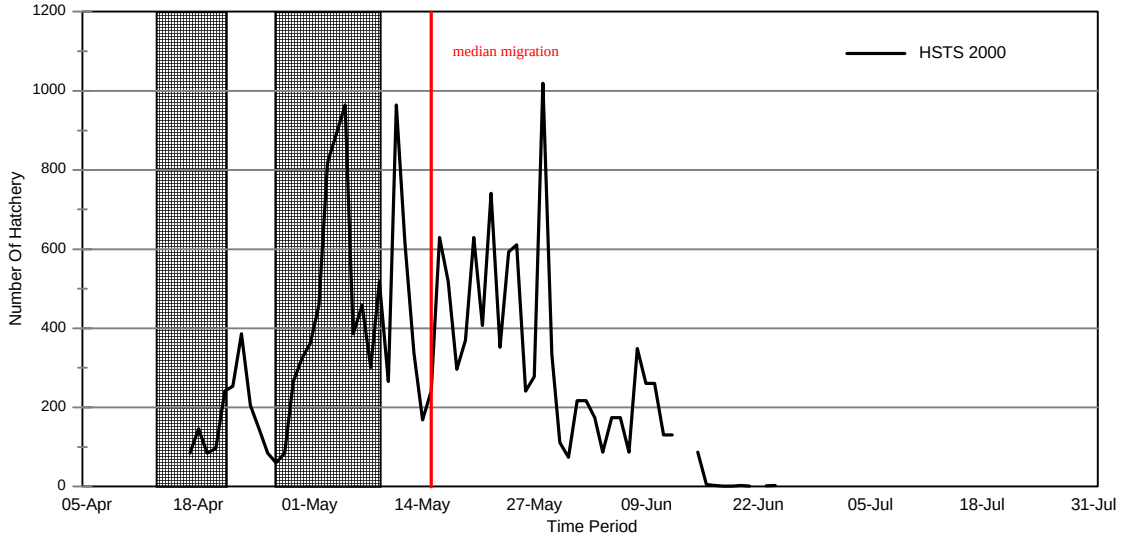
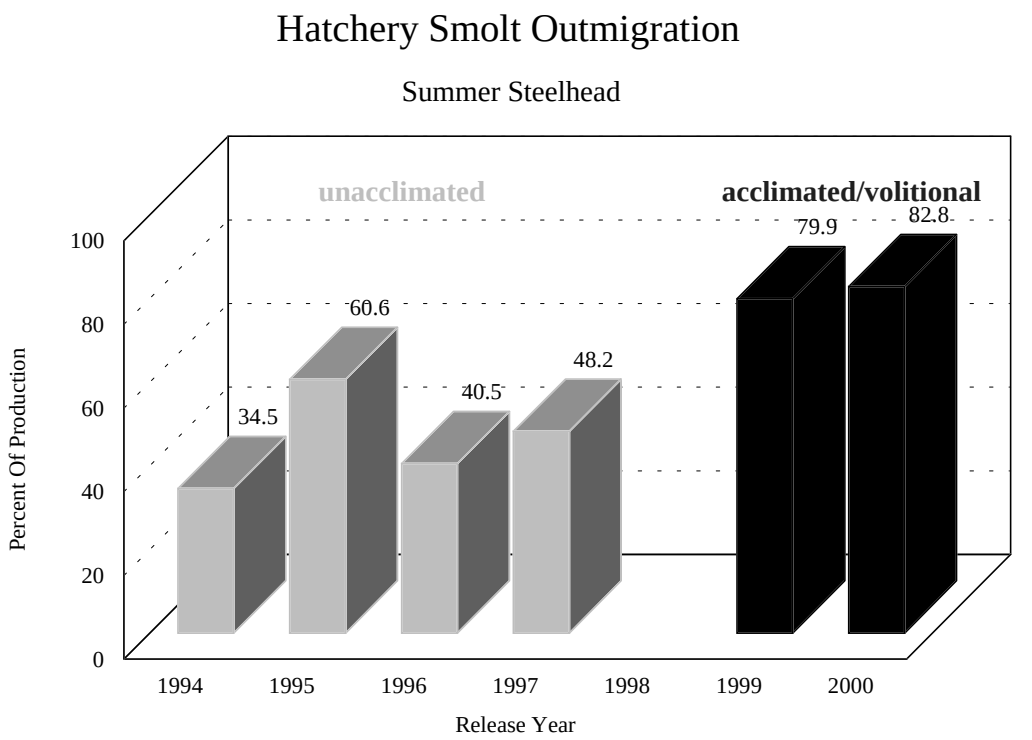


Figure 11. Migration timing of hatchery summer steelhead at the mainstem Hood River rotary screw trap, 1999 and 2000 migration year. The trap was not operational on the 18- and 25 May in 1999 or the 15-16 April and 13-14 June of 2000. Numbers were adjusted for trapping efficiency. The shaded portion represents the volitional period of release from the West Fork Hood River acclimation raceways.



Unacclimated hatchery summer steelhead from release years 1994-1997 were Foster (Skamania) stock. The releases in 1998 were below Powerdale Dam (mainstem Hood River - Rm 4.5), no outmigration estimate was possible. The 1999 and 2000 hatchery summer steelhead releases were Hood River stock.

Figure 12. Percentage of the production released of hatchery summer steelhead smolts migrating past the mainstem Hood River juvenile migrant trap (Rm 4.5), 1994-2000 releases.

Table 7. Mean condition factors for hatchery summer steelhead volitional migrants collected in the mainstem Hood River juvenile rotary screw trap (Rm 4.5) and non-migrants which remained in the Blackberry Creek acclimation raceway on the West Fork Hood River, 1999-2000.[a]

Race/species, release year, migrant group	N	Mean	Range	95% C.I.
Summer steelhead,				
1999,				
Volitional migrants	415	0.99	0.83 - 1.26	± 0.01
Trucked non-migrants	192	1.04	0.87 - 1.31	± 0.07
2000,				
Volitional migrants	573	0.94	0.61 - 1.23	± 0.004
Trucked non-migrants	185	0.96	0.78 - 1.12	± 0.06

[a] Condition factor was estimated as (weight [g] * 100/length^3 [mm]).

Spring Chinook Salmon

A total of 122,884 and 139,047 Deschutes River stock hatchery spring chinook salmon smolts were transferred by truck to the Middle Fork and West Fork Hood River in 1999 and 2000, respectively (Table 8). Of the 122,884 smolts in 1999, 92,284 were acclimated and volitionally released at the Blackberry Creek and Jones Creek acclimation sites in the West Fork Hood River; whereas, 30,600 smolts were released in the Middle Fork Hood River at the Parkdale Fish Facility (Table 8 & Figure 1). A total of 101,883 (82,9%) emigrated volitionally and 19,550 (15.9%) non-migrants, primarily from the West Fork, remained in the raceways and were hauled by truck and released into the mainstem Hood River. In 2000, 104,367 smolts were released in the West Fork and 34,680 were released in the Middle Fork, of which 4,170 smolts were an experimental release group of hatchery spring chinook salmon incubated, hatched, and reared at the Parkdale Fish Facility. Of the 139,047 smolts released in 2000, 126,663 (91.1%) emigrated volitionally and 10,756 (7.7%), of which only 99.2% were West Fork, remained in the raceways and were hauled by truck and released into the mainstem Hood River. An estimated 1,451 and 1,628 smolts died in the raceways in 1999 and 2000. Most fish showed outward signs of disease and descaling most likely from loading at Pelton Ladder and transport. Hatchery spring chinook salmon smolts have been acclimated a minimum of four days, ranging from 5-14 days in 1999 and 2000 (Table 8).

Raceway loading densities for the Blackberry Creek acclimation site for 1999 and 2000 was 10.2 lbs/gpm (1.1 lbs/cu ft) and 11.6 lbs/gpm (1.4 lbs/cu ft) for group one of each year (Table 9). In 1999 and 2000, the loading densities for the Jones Creek and Parkdale Fish Facility Rogers Creek acclimation sites for early groups was low at 5.3 lbs/gpm (1.1 lbs/cu ft) and 7.4 lbs/gpm (1.0 lbs/cu ft) for Jones Creek and 6.8 lbs/gpm (1.9 lbs/cu ft) and 3.3 lbs/gpm (0.9 lbs/cu ft) for the Rogers Creek site. Considering the lack of information on non-migrants for group one, it was impossible to accurately calculate loading in the raceways for group two at either acclimation location. Ample water supply was available for all acclimation sites (Table 9).

Hatchery spring chinook salmon smolts were released into the West Fork and Middle Fork Hood River in 1999 and 2000 (Table 8). In 1999, hatchery spring chinook salmon smolts were volitionally released from 8-13 April and 20 April-11 May on the West Fork Hood River and 12 April-5 May on the Middle Fork Hood River. A volitional release was occurring either on the Middle Fork or West Fork throughout the acclimation time period (Figure 13). The volitional release period in 2000 was 10-18 April and 24 April-9 May on the West Fork and 20 March-3 April, 10-20 April, and 25 April-15 May on the Middle Fork. The early release group from 20 March to 3 April on the Middle Fork was a test group from the Parkdale Fish Facility and was released prior to the rotary screw trap being in operation on the mainstem Hood River.

Table 8. Deschutes River stock spring chinook salmon acclimated in the Middle Fork and West Fork Hood River drainage, 1996-2000. (RA = reared and acclimated at the release location).

Drainage, Release Location, Release year, Release group[a],	Date transferred to raceways	Number transferred to raceways	Fish/lb at transfer	Number of days acclimated	Mortalities in acclimation raceway	Number[b] volitionally released	Number[c] trucked	Total[d] released
West Fork,								
Blackberry Creek,								
1996,								
Group 1	Apr 8-10	85,080	10.1	6-8	180	84,900		84,900
Group 2	Apr 22-23	44,838	9.5	7-8	527	44,311		44,311
1997,								
Group 1	Apr 7-8	46,446	8.0	6-7	679	45,767		45,767
Group 2	Apr 16-17	56,380	8.4	4-5	1054	55,326		55,326
1998,								
Group 1	Apr 1-2	63,130	9.8	8-9	1073	62,057		62,057
Group 2	Apr 15-16	55,485	9.7	7-8	944	54,541		54,541
1999,								
Group 1	Mar 30-Apr 1	25,474	7.5	7-9	155	22,232	3,087	25,319
Group 2	Apr 13	26,837	6.7	7	334	23,415	3,088	26,503
2000,								
Group 1	Apr 4-5	33,343	7.6	5-6	61	30,277	3,005	33,282
Group 2	Apr 18-19	31,410	6.4	5-6	358	28,222	2,830	31,052
Jones Creek,								
1998,								
Group 2	Apr 16	8,245	9.7	6	60	8,185		8,185
1999,								
Group 1	Mar 30-Apr 1	19,982	7.6	7-9	462	12,937	6,583(7)	19,513
Group 2	Apr 13	19,991	6.7	7	309	13,104	6,578(7)	19,675
2000,								
Group 1	Apr 4-5	20,085	8.3	5-6	216	17,420	2,449(4)	19,865
Group 2	Apr 18-19	19,529	6.3	5-6	959	16,189	2,381(4)	18,566
Middle Fork,								
Parkdale Fish Facility,								
1999,								
Group 3	Mar 29	30,600	6.4	14	191	30,195	214	30,409
2000,								
Group 3A	Apr 3	15,334	6.7	7	12	15,293	29	15,322
Group 3B	Apr 20	15,176	5.7	5	12	15,136	28	15,164
Group 4	Mar 20	4,170	14.9	RA	10	4,126	34	4,160

[a] Groups 1-3 were finish reared at Pelton Ladder and Round Butte Hatchery in the Deschutes River subbasin and group four was finish reared at the Parkdale Fish Facility in the Hood River subbasin. Group one was transferred from Pelton Ladder cell# 4, group two was transferred

from Pelton Ladder cell# 5, and group three was transferred from a pond at RBH. The group 4 pilot study fish from Parkdale Fish Facility were Hood River stock 50.

[b] Hatchery spring chinook salmon that were volitionally released from the acclimation raceways.

[c] Number trucked indicates hatchery spring chinook salmon which did not emigrate volitionally from the acclimation raceways and were hauled and released near the mouth of the Hood River. In parentheses are mortalities from fish truck liberations.

[d] Mortality from the number trucked was subtracted from the total released.

Table 9. Raceway loading and water intake in the portable raceways and circular pond during hatchery spring chinook salmon smolt acclimation, West Fork Hood River tributaries, 1996-2000. (WFK = West Fork Hood River, MFK = Middle Fork Hood River, and gpm = gallons per minute).

Location, Pond type, Release year, Release group[a]	Raceway loading	Raceway water intake (gpm)
Blackberry Creek - WFK,		
East raceway,		
1996,		
Group 1	10.6 lbs/gpm (1.6 lbs/cu ft)	351
Group 2	10.6 lbs/gpm (1.6 lbs/cu ft)	351
1997,		
Group 1	8.3 lbs/gpm (1.2 lbs/cu ft)	348
1998,		
Group 1	8.5 lbs/gpm (1.4 lbs/cu ft)	371
West raceway,		
1996,		
Group 1	11.9 lbs/gpm (2.1 lbs/cu ft)	401
Group 2	2.1 lbs/gpm (0.6 lbs/cu ft)	401
1997,		
Group 1	7.8 lbs/gpm (1.3 lbs/cu ft)	374
1998,		
Group 1	8.5 lbs/gpm (1.4 lbs/cu ft)	390
1999,		
Group 1	10.2 lbs/gpm (1.1 lbs/cu ft)	333
2000,		
Group 1	11.6 lbs/gpm (1.4 lbs/cu ft)	377
Jones Creek - WFK,		
Circular pond,		
1998,		
Group 2	6.5 lbs/gpm (2.7 lbs/cu ft)	130
Raceway		
1999,		
Group 1	5.3 lbs/gpm (1.1 lbs/cu ft)	496
2000,		
Group 1	7.4 lbs/gpm (1.0 lbs/cu ft)	325

[a] Group one was transferred from Pelton Ladder cell #4 and group two was transferred from Pelton Ladder cell #5.

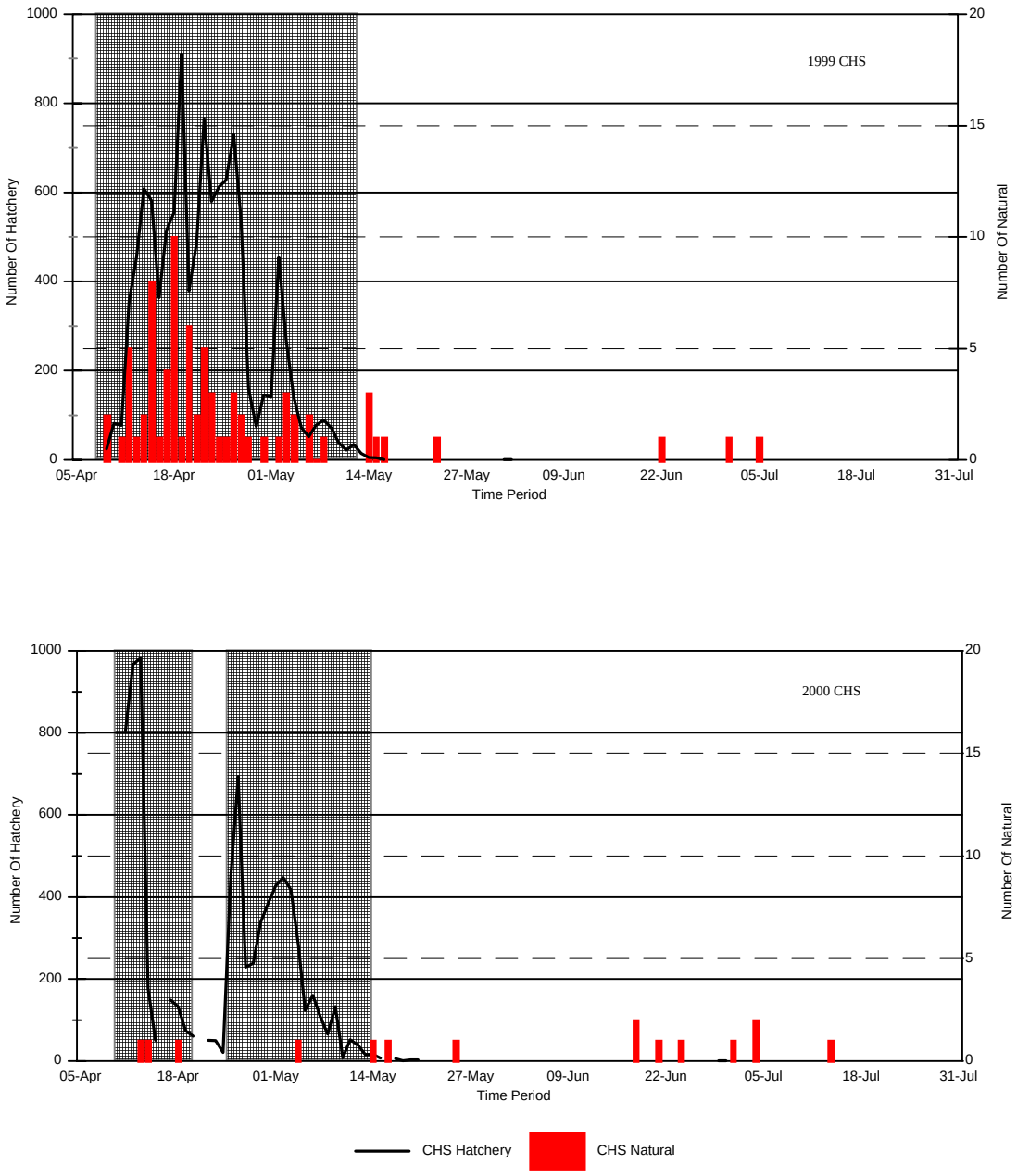


Figure 13. Migration timing of hatchery and naturally produced spring chinook salmon smolts at the mainstem Hood River rotary screw trap (Rm 4.5), 1999 and 2000 migration year. The trap was not operational on the 18- and 25 May in 1999 or the 15-16 April and 13-14 June of 2000. Numbers were not adjusted for trapping efficiency. The shaded portion represents the volitional period of release from the West Fork and Middle Fork Hood River acclimation raceways.

The 1999 and 2000 outmigration timing for hatchery spring chinook salmon smolts was similar to past years (**Appendix Figures A-4, A-5, & A-6**; Figure 13). Typically, when hatchery spring chinook salmon smolts have been released into the Hood River, they have moved out of the system very quickly. This trend held true in both the 1999 and 2000 outmigration period, although the 1999 figure shows a more gradual emigration of smolts. The gradual movement was the result of a continuous volitional release occurring at one of three acclimation facilities throughout the migration time period (Figure 13). In 2000, three noticeable spikes follow each volitional release from acclimation facilities in the Hood River. No estimate was collected by ODFW for the number of spring chinook salmon smolts leaving the subbasin. A total of 78 wild smolts were captured in the mainstem Hood River rotary screw trap in 1999 and dropped to 15 captured in 2000. From 1996 to 1998, naturally produced smolts captured in the mainstem rotary screw trap (Rm 4.5) have ranged from 22 to 66.

Recommendations

Hatchery steelhead and spring chinook salmon smolts which do not volitionally migrate should be transported and released below Powerdale Dam (Rm 4.5). Releasing non-volitional migrants below Powerdale Dam will eliminate potential competition with wild and naturally produced juveniles and resident trout in the Hood River subbasin.

The efficiency of the hopper system in allowing volitional migrants to leave the portable acclimation raceways on the West Fork Hood River should be carefully evaluated in the next acclimation season. A high number of both hatchery spring chinook salmon and summer steelhead smolts did not leave the portable raceways in 1999 and 2000 (Tables 5 and 8); whereas, at both the East Fork and Middle Fork acclimation facilities most smolts moved out of the concrete raceways which had stop-log systems (Table 1 and 8). Although, caution should be taken in blaming the hopper system. Several factors may have caused the higher number of non-migrants. Hatchery spring chinook salmon were considerably larger in size than the target of 8 fish/lb, hatchery summer steelhead were smaller than the desired size of 5 fish/lb, and inclemental weather conditions may have also played a role. One change has already been made for the next acclimation system. The standpipe that holds the hopper has been sectioned into four one-foot pieces, allowing staff to lower the ponds gradually throughout the acclimation time period.

Spring Chinook Salmon Spawning Ground Surveys

Introduction

The West Fork Hood River extends approximately twenty miles from the base of Mt. Hood to the mainstem Hood River. The Middle Fork Hood River extends approximately six miles from Clear Branch Dam at Laurance Lake to its confluence with the East Fork Hood River. The native run of spring chinook salmon which historically utilized the West and Middle forks has been extinct since the mid-1960's (O'Toole and ODFW 1991). In an effort to reestablish spring chinook salmon into the Hood River subbasin, the Oregon Department of Fish and Wildlife (ODFW) began direct releases of Carson stock spring chinook salmon into the West Fork in 1986 and later switched to Deschutes stock in 1991 (Olsen et al. 1995).

In 1996, as part of the Hood River Production Program (HRPP), the Confederated Tribes of Warm Springs (CTWS) began acclimating and volitionally releasing Deschutes stock spring chinook salmon into the West Fork Hood River (CTWS and ODFW, December 1998)[Figure 1]. Beginning in 1999, Deschutes stock spring chinook salmon have been released from the Parkdale Fish Facility into the Middle Fork Hood River. The Parkdale Fish Facility releases the hatchery spring chinook salmon into Rogers Creek which extends approximately one mile from Rogers Spring to the Middle Fork Hood River at Rm 4.0 (Figure 1).

The HRPP began extensive spring chinook salmon spawning surveys in the West Fork in 1997 and in Rogers Creek in 2000. The objective of these surveys is to develop baseline information for:

1. spawning distribution and abundance
2. spawn timing
3. prespawning mortality and fish health
4. spawner origins and sex ratios

Data gathered from these surveys, combined with upper West Fork spawning data gathered by the U.S. Forest Service (USFS) from 1992-95 (**Appendix Table B-1**) and telemetry data gathered by ODFW in 1994 and 1995 (Olsen et al. 1995; ODFW and CTWS 1996), will be used to evaluate supplementation and the effects of acclimating and volitionally releasing Deschutes stock spring chinook salmon into the Hood River subbasin. Also, this information will help determine how the West Fork and Middle Fork can best be utilized for natural production of spring chinook salmon.

Methods

Since 1997, the geographic distribution, timing, and magnitude of natural spawning has been documented for the West Fork Hood River. Survey index areas and timing of surveys were developed based on prior spring chinook spawning surveys (USFS, unpublished data 1992-1995); ODFW radio telemetry distribution surveys (Olsen et al. 1995; ODFW and CTWS 1996); run timing and abundance data collected by ODFW at the Powerdale Dam fish trap (ODFW and CTWS 1998); and stream reconnaissance. As a result of this information, the West Fork Hood River was divided into nine index areas (Figure 14).

#1 - Punchbowl Falls (Rm 0.0-Rm 0.25)(0.25 miles). From the confluence of the West Fork and the mainstem Hood River to Punchbowl Falls.
#2 - Moving Falls (Rm 0.25-Rm 2.5)(2.25 miles). From immediately above Punchbowl Falls to immediately below the fish ladder at Moving Falls.
#3 - Moving Falls/Dee Diversion (Rm 2.5-Rm 6.1)(3.6 miles). From immediately below the fish ladder at Moving Falls to the Dee Irrigation diversion head works.
#4 - Lake Branch (Rm 0.0-Rm 0.8)(0.8 miles). From the confluence of Lake Branch Creek and the West Fork to Rm 0.8 of Lake Branch Creek.
#5 - Dee diversion/Dry Run (Rm 6.1-Rm 8.2)(2.1 miles). From the rapids directly above the Dee Irrigation diversion headworks to Dry Run Bridge.
#6 - Dry Run/Red Hill (Rm 8.2-Rm 11.3)(3.1 miles). From Dry Run Bridge to .2 miles below Red Hill Creek.
#7 - Red Hill/Ladd (Rm 11.3-Rm 13.1)(1.8 miles). From .2 miles below Red Hill Creek to Ladd Creek.
#8 - Ladd (Rm 13.1-14.0)(0.9 miles). From Ladd Creek to the confluence of Elk and McGee Creeks.
#9 - McGee (Rm 0.0-Rm .75)(0.75 miles). From the mouth of McGee Creek to Rm .75 of McGee Creek.

From 1997 to 1999, all index areas were surveyed (except index area seven) every two weeks from the beginning of August to the end of October. In 2000, all index areas were surveyed during the weeks of 5-12 September and 23-31 October. Index area seven was excluded from regular surveys due to high turbidity and was surveyed one time each year in late October when turbidity loads caused by glacial waters decreased from Ladd Creek. Surveys generally required a crew of two and were conducted downstream by foot. Narrow canyon walls provided poor access in indexes two through six and required dry suits for swimming portions of these areas. The 1997-1999 surveys began prior to any evident spawning activity and continued until no spawning activity was apparent. It was determined that the low number of adult spring chinook salmon returns for 2000 did not warrant full-scale spawning surveys for this year. As a result,

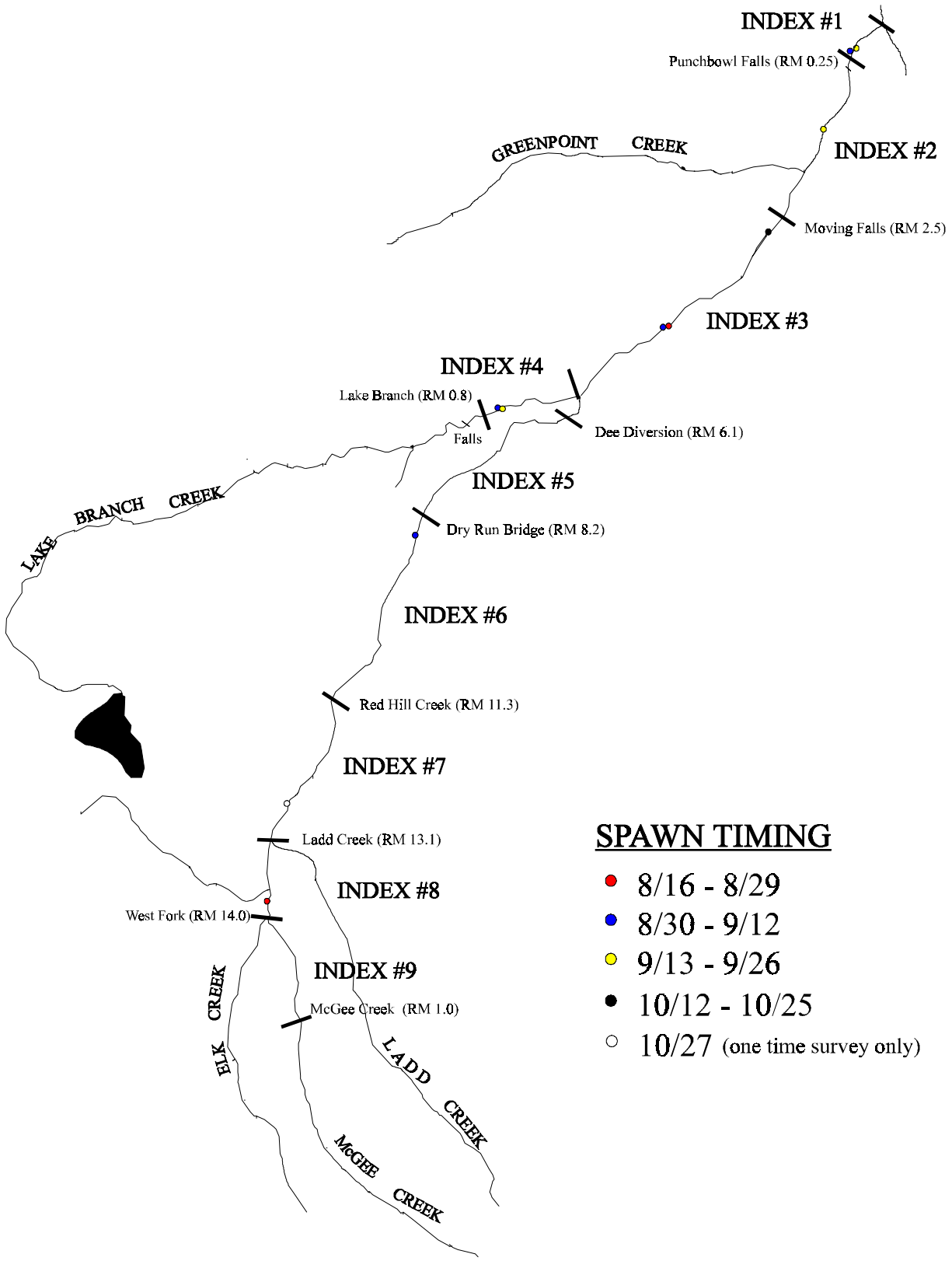


Figure 14. West Fork survey index areas and redd locations by date, 1999.

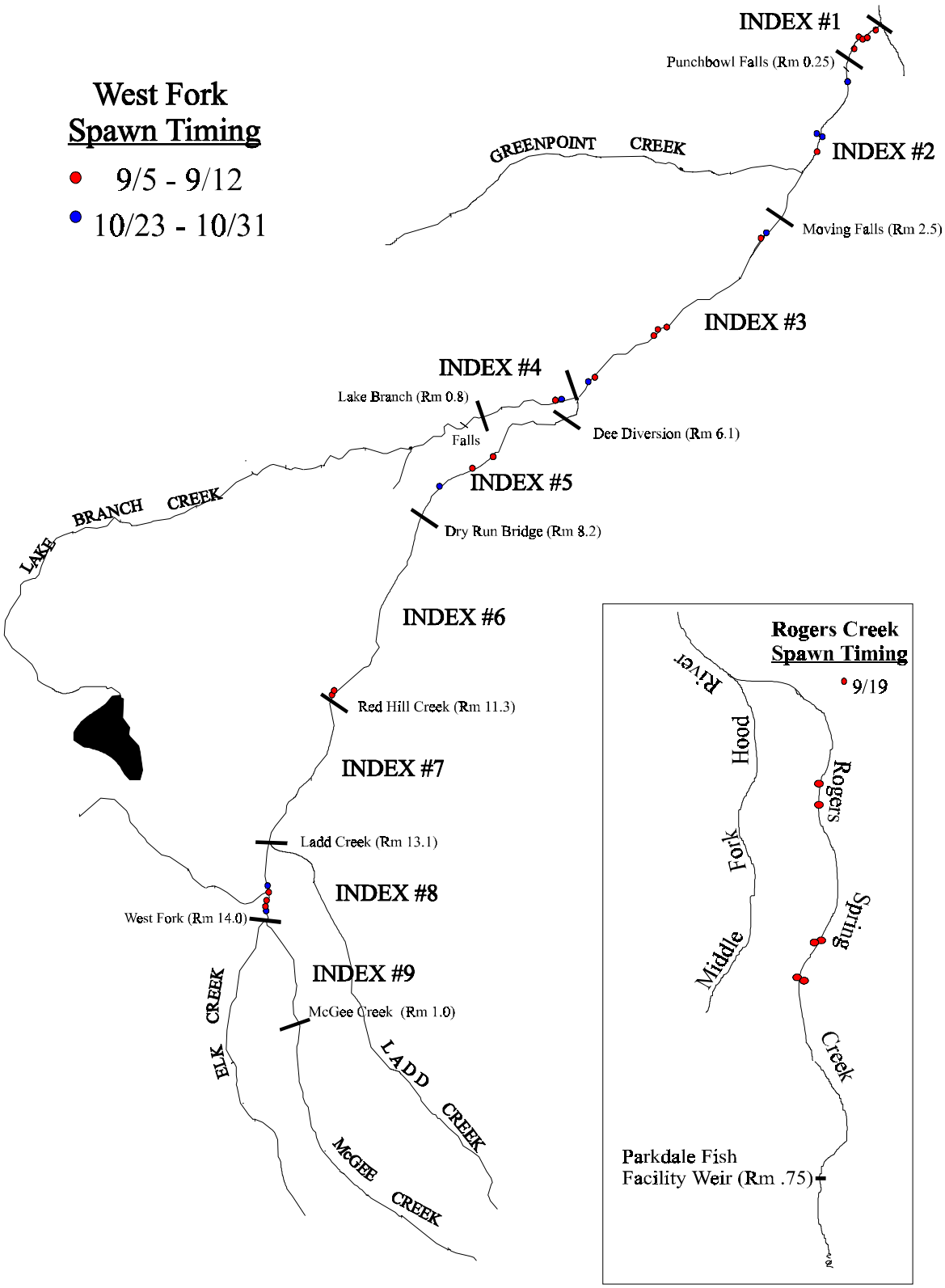


Figure 15. West Fork and Rogers Creek survey index areas and redd locations by date, 2000.

only two weeks of surveys were conducted in 2000 reflecting the peak and final spawning time periods.

Spring chinook spawning ground surveys were conducted on Rogers Creek from the confluence of Rogers Creek and the Middle Fork Hood River to a weir preventing adult passage beyond the Parkdale Fish Facility at rivermile 0.75 (Figure 15). These surveys occurred on 16 September, 2000 and 4 November, 2000.

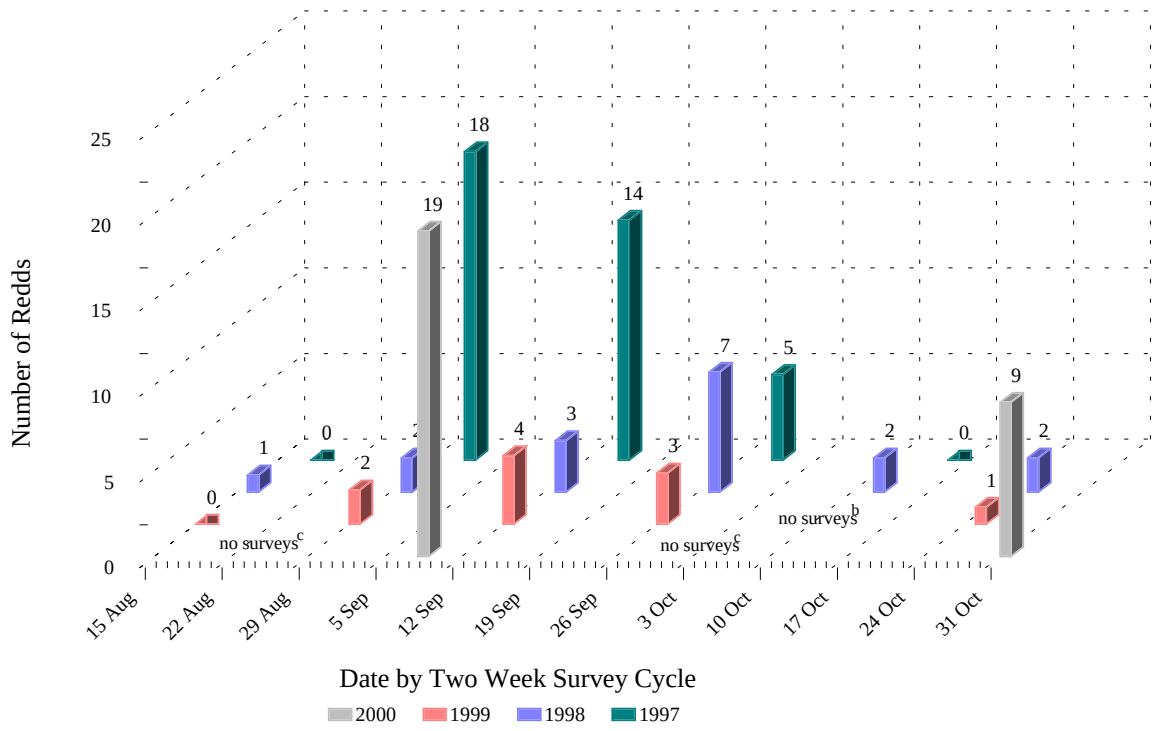
General daily field notes included date, survey crew initials, start/end time of survey, water temperature (°C), and visibility into water (high>6', 3'>mod<6', low<3'). Redds, carcasses, and live fish were counted and recorded along with the accompanying rivermile. Rivermiles were initially mapped manually then later derived by map wheel using USGS and Water Resources maps. Redds were flagged on the adjacent streambank with the date and surveyors initials which allowed the identification of old and new redds. Carcasses were examined for fin marks, sexed, measured to the nearest fork and MEPS (middle eye-posterior scale) length, and checked for Bacterial Kidney Disease and spawning success. Snouts were removed from carcasses with missing fins for the purposes of coded wire tag recovery. Scales were collected from non-Floy-tagged carcasses and were archived for later use. Finally, the caudal peduncle was severed from carcasses to indicate which fish had been sampled.

Results and Discussion

Spring chinook salmon spawning occurred throughout the West Fork Hood River from 18 August, 1999 to 14 October, 1999. Peak spawning occurred in 1999 between 30 August and 12 September, compared to 14 September through 27 September in 1998, and 19 August through 15 September in 1997 (Figure 16). Peak spawning determinations were not attempted for 2000. Eleven spring chinook salmon redds were documented in the surveyed index areas for 1999, down from 17 in1998. Twenty-eight redds were observed in 2000 (Figure 17). Spring chinook salmon redds per mile for the entire West Fork has averaged from a low of 0.7 in 1999 to a high of 3.0 in 1997 (Table 10). The greatest spawning activity for 1999 occured in index area one (8 redds/mile) and index area four (2.5 redds/mile). In 2000, the greatest spawning activity occurred in index areas one (20 redds/mile), eight (15.5 redds/mile), and three (1.9 redds/ mile)[Table 10].

The 1999 adult and jack spring chinook salmon count at Powerdale Dam was 118 fish. Two adult mortalities were recorded, one adult was recycled to the mouth of Hood River, and the remaining 115 fish were passed above the dam (Table 11). Broodstock collection at Powerdale Dam was initiated on 16 May, 1999 and was abandoned after 1 June, 1999 when it was determined that the total escapement of spring chinook salmon to the Hood River would not

Figure 16. Spring chinook salmon redd counts on the West Fork Hood River by two week survey cycle, 1997-2000.[a]

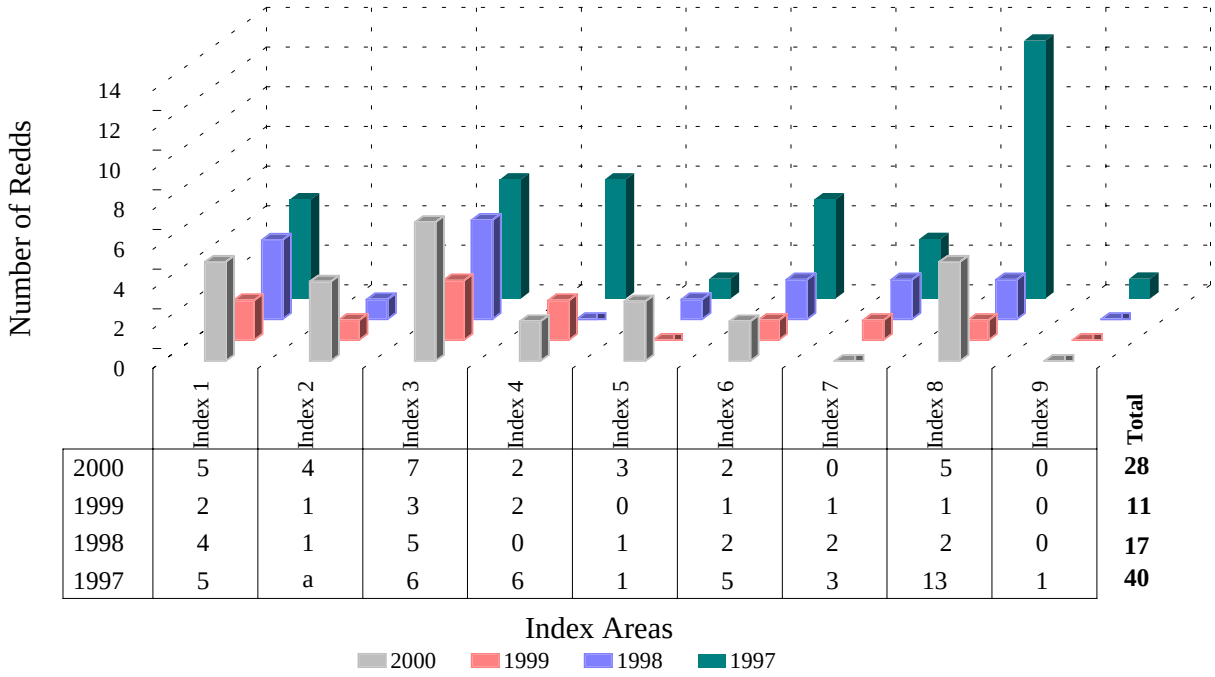


[a] Index area seven was surveyed only once at the end of the regular survey cycles and redd counts from this area have been excluded.
[b] No surveys were conducted between 25 September and 12 October due to lack of manpower.
[c] Surveys were conducted during the weeks of 5 September and 23 October.

support the numbers needed for broodstock and a naturally reproducing run. As a result, the fourteen spring chinook salmon taken for broodstock were released into the West Fork Hood River (Rm 14.0) on 8 June, 1999 before spawning had occurred. The 1999 counts at Powerdale included 66 females and 52 males for a female to male ratio of 1.3/1. Of these fish, 24 were naturally reproduced and 94 were of hatchery origin (Table 11).

The 2000 adult spring chinook salmon count at Powerdale Dam was 217 fish. No brood stock were collected for this year. The first recorded spring chinook salmon was passed at Powerdale Dam on 30 April, 2000 and the last was passed on 28 September, 2000. The 2000 counts at Powerdale included 66 (19 jacks) females and 151 (110 jacks) males for a female to male ratio of 1/2.3. Of these fish, 66 were naturally reproduced and 151 were of hatchery origin. Five adult mortalities were recorded and the remaining 212 fish were passed above the dam (Table 11).

Figure 17. Spring chinook salmon redd counts by index area in the West Fork Hood River, 1997-2000.



	Index 1	Index 2	Index 3	Index 4	Index 5	Index 6	Index 7	Index 8	Index 9	**Total**
2000	5	4	7	2	3	2	0	5	0	**28**
1999	2	1	3	2	0	1	1	1	0	**11**
1998	4	1	5	0	1	2	2	2	0	**17**
1997	5	a	6	6	1	5	3	13	1	**40**

a Index area two was not included in surveys in 1997.

Of the five flow tags retrieved from carcasses during the 1999 surveys, three were from prespawning mortalities and were excluded from run distribution and run timing analysis. Any relationship between run-timing at Powerdale Dam and spawner distribution on the West Fork has yet to be determined due to small sample size (Figure 18). Floy-tag information for 1999 showed a median of 96 days from passage at Powerdale Dam to spawning, ranging from 83 and 109 days (Figure 19). No Floy-tags were retrieved in 2000.

Eleven adult spring chinook carcasses were recovered throughout the West Fork Hood River and its tributaries during the 1999 surveys. The carcasses included five fin marked females, one unmarked female, one unmarked male, and four were unknown for a female to male ratio of 6:1 (Table 12). Index area three showed the greatest activity with three carcasses (Figure 20). Snouts from these carcasses yielded eight coded wire tags which identified them as 1995 brood year and of Round Butte Hatchery origin. Three coded wire tags were from fish reared in Pelton Ladder cell 4 (code 091747); five were from fish reared in cell 5 (code 091806); and all were released into the West Fork Hood River in 1997 (**Appendix Table B-2**). Three recovered female carcasses were prespawning mortalities.

Table 10. Spring chinook salmon redds per mile and percentage of total redds by index area in the West Fork Hood River, 1997-2000.

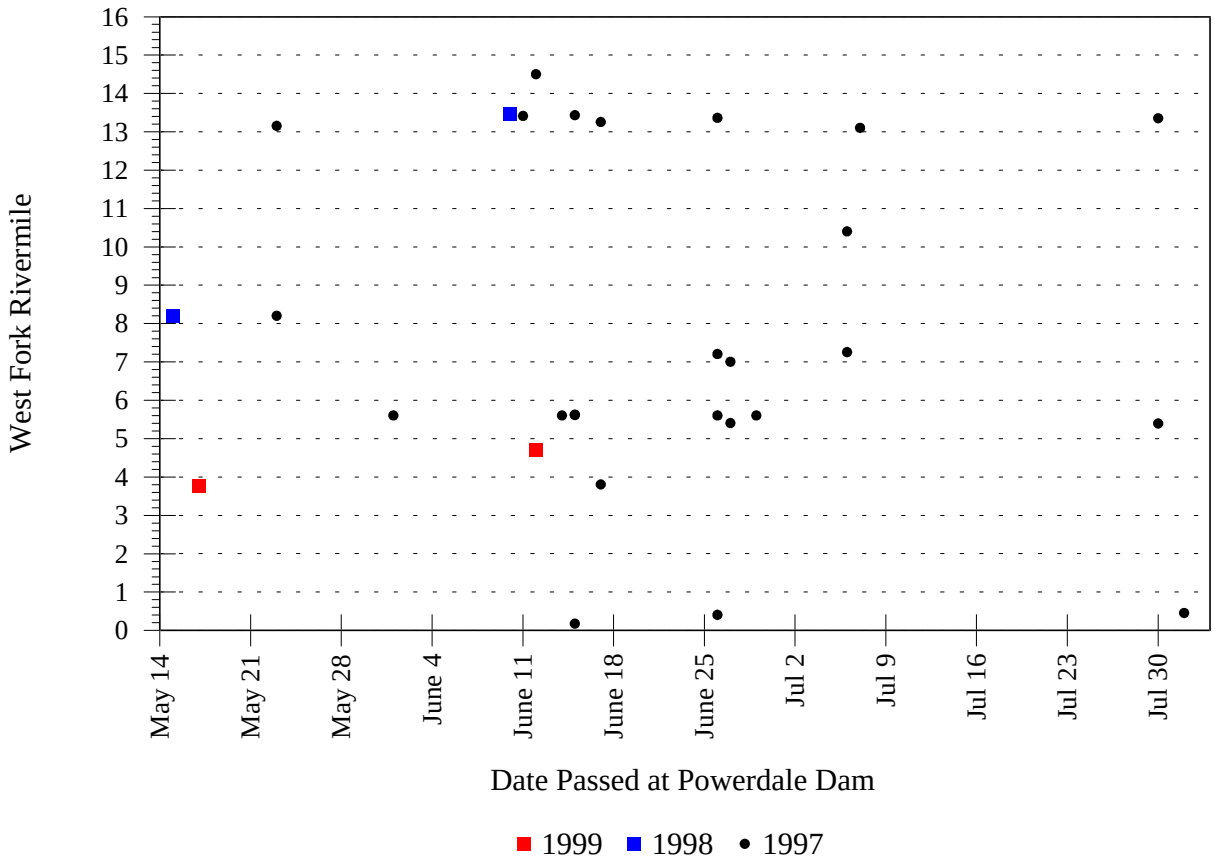
Run year, Statistic	Index 1	Index 2	Index 3	Index 4	Index 5	Index 6	Index 7	Index 8	Index 9	**Average**
1997[a],										
redds/mile	20	-	1.9	7.5	0.5	1.6	0.6	14.4	0.5	**3**
% of redds	12.5	-	15	15	2.5	12.5	7.5	32.5	2.5	
1998,										
redds/mile	16	4	1.4	0	0.5	0.6	1.1	2.2	0	**1.1**
% of redds	23.5	5.8	29.4	0	5.8	11.7	11.7	11.7	0	
1999,										
redds/mile	8	0.4	0.8	2.5	0	0.3	0.5	1.1	0	**0.7**
% of redds	18.2	9.1	27.3	18.2	0	9.1	9.1	9.1	0	
2000,										
redds/mile	20	1.8	1.9	2.5	1.4	.6	0	15.5	0	**1.8**
% of redds	17.8	14.2	25.0	7.1	10.7	7.1	0	17.8	0	

[a] Index area two was not included in surveys in 1997.

Table 11. Disposition, sex, and origin of adult and jack spring chinook salmon escapement to the Powerdale dam trap, 1998-2000.

Run year, Sex	Passed above Powerdale Dam		Broodstock		Mortalities		Recycled Hatchery	**Total**
	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery		
1997,								
Female	28	137	15	54	0	0	0	234
Male	21	64	10	31	0	0	0	126
Total	49	201	25	85	0	0	0	**360**
1998,								
Female	18	7	19	5	0	0	1	49
Male	29	3	15	3	0	1	0	50
Total	47	10	34	8	0	1	1	**101**
1999,								
Female	12	52	0	0	0	1	1	66
Male	12	39	0	0	0	1	0	52
Total	24	91	0	0	0	2	1	**118**
2000,								
Female	31	34	0	0	0	1	0	66
Male	33	114	0	0	2	2	0	151
Total	64	148	0	0	2	3	0	**217**

Figure 18. Correlation between spring chinook salmon arrival at Powerdale Dam and recovery location by rivermile in the West Fork Hood River, 1997-2000.[a]



[a] Lake Branch fish recoveries were all designated as West Fork Hood River (Rm 5.5) and the West Fork was extended beyond Rm 14 to include McGee Creek.

During the 2000 surveys three adult spring chinook salmon carcasses were recovered throughout the West Fork Hood River and its tributaries and one was recovered in Rogers Creek. One West Fork carcass was identified as an adipose and right ventral marked female and the Rogers Creek carcass was identified as an unmarked male (Table 13). The remaining two West Fork carcasses were incomplete and could not be identified (Table 12). The West Fork carcasses were collected in index areas one, five, and six (Figure 20). One snout collected from a West Fork carcass yielded a coded wire tag identifying it as a Pelton Ladder cell 5 (code 092227) fish released into the West Fork Hood River in 1998 (**Appendix Table B-2**). All carcasses appeared free of disease.

Figure 19. Number of days between spring chinook salmon arrival at Powerdale Dam and carcass recoveries, 1997-2000.

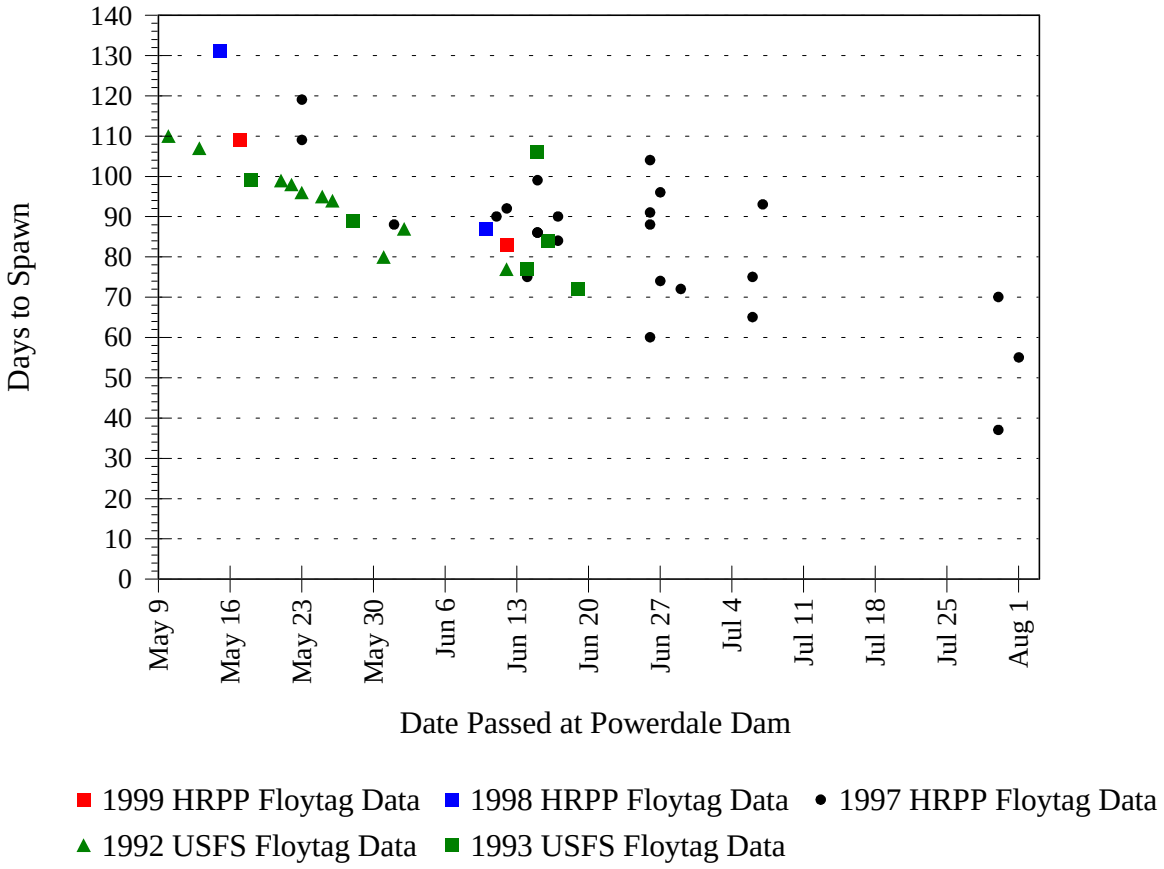


Table 12. Number of spring chinook carcasses collected during spawning ground surveys in the West Fork Hood River by sex and origin, 1997-2000.[a]

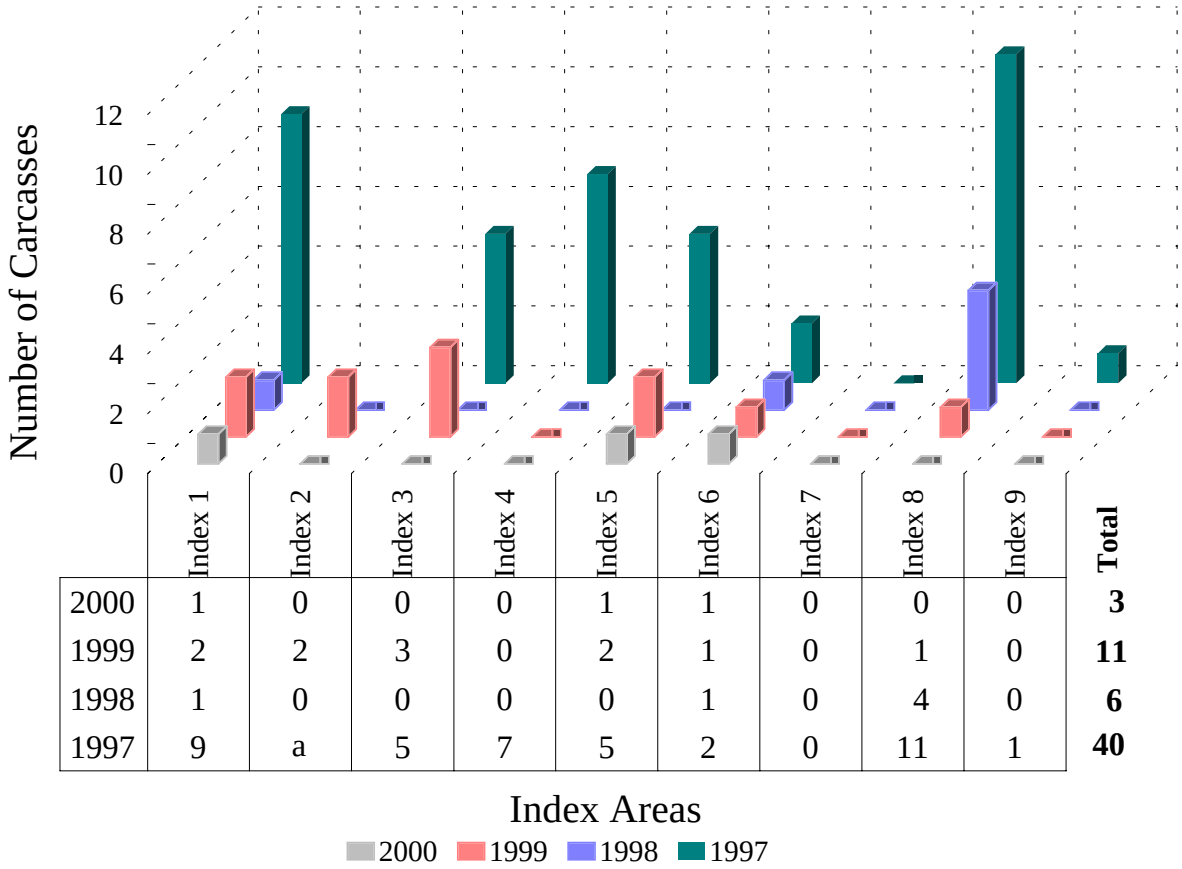
Run year, Sex	Origin			
	Natural	Hatchery[b]	Unknown	Total
1997,				
Female	19	6	0	25
Male	7	2	1	10
Unknown	0	0	5	5
1998,				
Female	1	0	1	2
Male	1	0	0	1
Unknown	0	0	3	3
1999,				
Female	0	5	0	5
Male	0	0	1	1
Unknown	0	1	4	5
2000,				
Female	0	1	0	1
Male	1	0	0	1
Unknown	0	0	2	2

[a] Only 30% of the 1993 brood year was marked.
[b] Of the hatchery marked salmon in 1997; six were adipose clipped; one was left ventral clipped; and one had a radio tag (CH 22, Code 83) and was adipose, left ventral, and right ventral. Of the marked salmon in 1999, three were adipose clipped, and three were adipose and left ventral clipped.

Table 13. Number of spring chinook carcasses collected during spawning ground surveys in Rogers Creek by sex and origin, 2000.

Run year, Sex	Origin			
	Natural	Hatchery	Unknown	Total
2000,	0	0	0	0
Female	0	0	0	0
Male	1	0	0	1
Unknown	0	0	0	0

Figure 20. Spring chinook salmon carcass counts by index area on the West Fork Hood River, 1997-2000.



	Index 1	Index 2	Index 3	Index 4	Index 5	Index 6	Index 7	Index 8	Index 9	**Total**
2000	1	0	0	0	1	1	0	0	0	**3**
1999	2	2	3	0	2	1	0	1	0	**11**
1998	1	0	0	0	0	1	0	4	0	**6**
1997	9	a	5	7	5	2	0	11	1	**40**

[a] Index area two was not included in surveys in 1997.

Recommendations

Two possible passage problem areas on the West Fork should continue to be monitored. Punchbowl Falls fish ladder (Rm 0.25) should be cleaned of sand and gravel each spring prior to the arrival of spring chinook salmon, and subsequently inspected throughout the summer. The Dee Irrigation District diversion should be monitored as a potential barrier to spring chinook salmon, especially during low water years.

Adult spring chinook salmon from the 1999 release at the Parkdale Fish Facility are expected to be returning to the Middle Fork Hood River in 2001. In preparation for this return, CTWSRO divided the Middle Fork into five reaches extending from Laurance Lake Dam (Rm 10.8) to the confluence of the Middle Fork and the East Fork Hood River. Each reach was surveyed once in the fall of 2000. Due to high turbidity from glacial silt, it is recommended that each reach should be surveyed once during the late fall after turbidity has dropped. Also, radio telemetry should be used to track the distribution of returning adults that have been acclimated and volitionally released from the Parkdale Fish Facility.

Hood River Water Temperature Study

Introduction

Water temperatures have been collected in the Hood River subbasin during the past ten years to develop a baseline data base for the Hood River Production Program (HRPP). Baseline data has been collected in the mainstem (Rm 3.9), West Fork (Rm 16), and East Fork (Rm 15) since 1990 and the Middle Fork (Rm 19) since 1994 (Figure 21). Two more sites were added in 1998 as part of the Oregon Department of Environmental Quality (ODEQ) Total Maximum Daily Load (TMDL) plan to meet Clean Water Act requirements. These sites were located at the mouth of Neal Creek and Lake Branch Creek (Figure 21). An additional site was added in 2000 at the mouth of Baldwin Creek. Furthermore, water temperatures have been collected since May, 1995 from Rogers Creek, tributary to the Middle Fork, and a zone of Middle Fork mixed waters associated with the Middle Fork Irrigation District powerhouse at Rogers Creek. This data was used to monitor and evaluate the use of these water sources for holding broodstock and for acclimation at the Parkdale Fish Facility. Site descriptions and years of monitoring are included in Table 14.

Methods

Ryan Tempmentor thermographs were used to collect baseline water temperature data through July of 1998, at which time these units were replaced with Onset Hobo Stowaways. Water temperature data was recorded in Celsius at one hour intervals. All thermographs have been calibrated in accordance with the "Stream Temperature Protocol" developed for the Oregon Coastal Salmon Restoration Initiative (ODEQ, Draft Revised Version, May 1997) since May, 1998. Water temperatures were also manually recorded with a National Institute of Standards and Technology certified thermometer at the time of thermograph deployment and retrieval.

Temperature data was downloaded into a computer every few months and reviewed for anomalies. Extreme high and low temperature anomalies, presumably caused by dewatering or freezing, were excluded. A computer program (ERVB 97.8) was used to summarize the data into daily maximum, minimum, and average temperatures and to identify the number of days in which water temperatures exceeded maximum daily and ODEQ maximum 7-day moving average water temperature standards (Figures 22-30). The ODEQ Maximum 7-day Moving Average Water Temperature Standards are; 17.9 °C for salmonids; 12.8 °C for salmonid spawning and egg incubation; and 10.0 °C for bull trout spawning, rearing, or resident bull trout (Tables 15-24). Temperature data for years prior to 1996 can be found in **Appendix Tables C-1 through C-6**.

Results and Discussion

The 1999 and 2000 temperature data (Tables 16-24) appears consistent with past years data (**Appendix C**). Daily average, maximum, and minimum water temperatures for 1999-2000 are graphically displayed in Figures 22-30. The December 2000 data was not available at the time of printing and additional data gaps due to natural events or human interference are noted in Table 15.

The ODEQ water temperature standards will be applied to the appropriate geographic area and time period as determined by the Hood River TMDL Technical Advisory Committee and the ODEQ. For the purposes of this report all standards are applied to the entire year. In 1999 and 2000 violations of the ODEQ water temperature standard for salmonids (17.9 °C) occurred in the East Fork, Neal Creek, and Baldwin Creek (Table 15). Violations of the salmonid spawning and egg incubation standard (12.8 °C) occurred in all streams monitored other than Lake Branch Creek and the bulltrout standard (10.0 °C) was surpassed in all streams. Note that the bull trout standard is applied to the Middle Fork only. It has been determined that all other study sites do not support bulltrout populations or are used solely as migratory routes for adult bull trout. Furthermore, the Rogers Creek and the Middle Fork mixed water temperature data was collected with the sole purpose of monitoring and evaluating these water sources for use at the Parkdale Fish Facility and was not included within the ODEQ water temperature standards analysis.

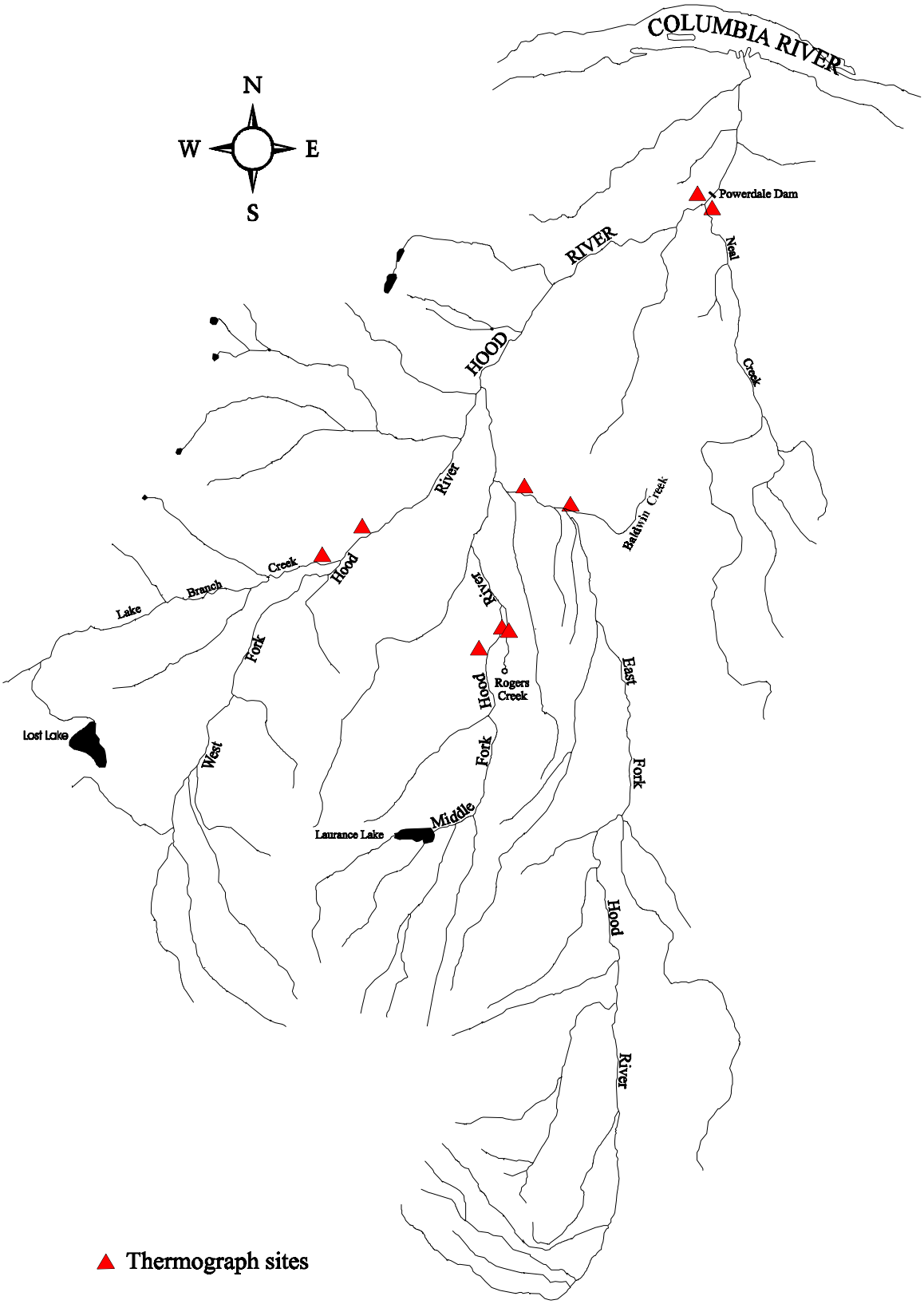


Figure 21. Water temperature sampling locations within the Hood River subbasin.

Table 14. Hood River subbasin water temperature monitoring site locations and years of data gathered.

Stream	Longitude	Latitude	Altitude	Years of Data
Mainstem Hood River (Rm 3.9)	W121º 31.464	N45º 39.931	300'	1990-2000
West Fork Hood River (Rm 16)	W121º 41.233	N45º 33.447	1180'	1990-2000
Middle Fork Hood River (Rm19)	W121º 37.557	N45º 31.410	1640'	1994-2000
East Fork Hood River (Rm 15)	W121º 37.049	N45º 34.350	1030'	1990-2000
Neal Creek (Rm 0.1) tributary to the Hood River @ Rm 4.2	W121º 31.576	N45º 39.796	310'	1998-2000
Lake Branch Creek (Rm 0.1) tributary to the West Fork Hood River @ Rm 17	W121º 41.904	N45º 32.647	1260'	1998-2000
Baldwin Creek (Rm 0.1) tributary to the East Fork Hood River @ Rm 17	W121º 35.553	N45º 33.893	1400'	2000
Rogers Spring Creek (Rm 0.8) tributary to the Middle Fork Hood River @ Rm 18	W121º 37.275	N45º 31.445	1600'	1995-2000
Mixed Middle Fork water at Rogers Spring Creek (Rm 0.8)	W121º 37.250	N45º 31.445	1600'	1995-2000

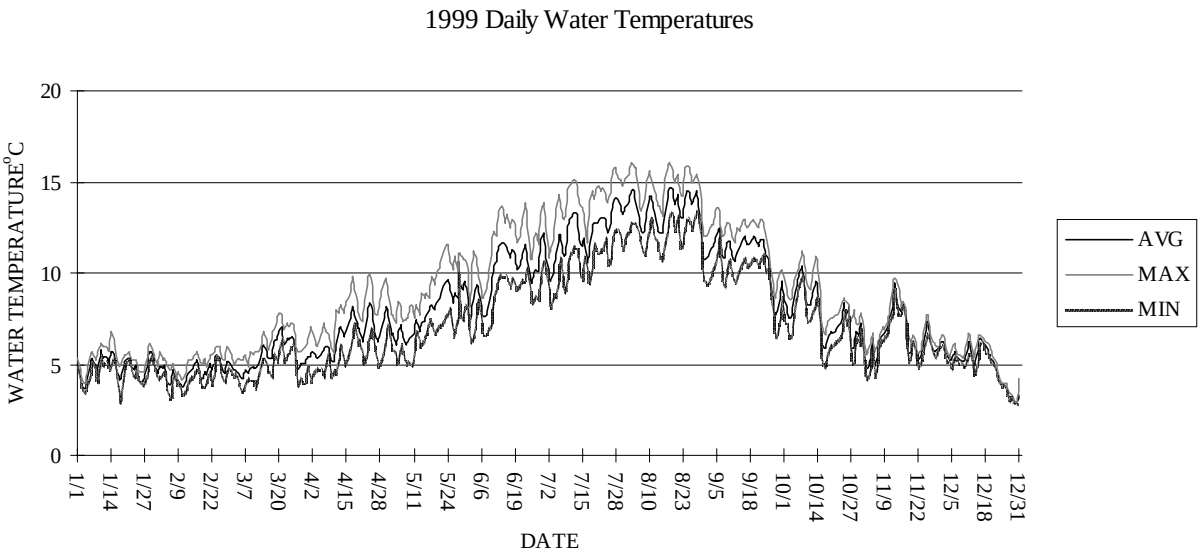
.

Table 15. Number of days that DEQ water temperature standards have been exceeded and maximum 7-day moving average by year and location, 1999-2000.

Standard, Year	Mainstem[a]	West Fork	Middle Fork[b]	East Fork[c]	Neal Creek[d]	Lake Branch Creek[e]	Baldwin Creek[f]
17.9 ºC,							
1999	0	0	0	0	13	0	-
2000	0	0	0	1	21	0	8
12.8 ºC,							
1999	61	14	5	5	116	0	-
2000	94	21	22	47	136	0	122
10.0 ºC,[g]							
1999	130	95	112	38	179	60	-
2000	137	92	119	73	202	82	145
Maximum							
1999	15.5 ºC	13.5 ºC	12.9 ºC	13.4 ºC	18.8 ºC	12.5 ºC	
2000	17.1 ºC	13.7 ºC	13.5 ºC	17.9 ºC	19.1 ºC	12.7 ºC	18.0 ºC

[a] Mainstem data from 10/2/00-11/29/00 not available.
[b] Middle Fork data from 11/29/00-5/23/00 not available.
[c] East Fork data from 6/22/99-1/21/00 and 7/22/00-11/29/00 not available.
[d] Neal Creek data from 11/3/99-1/28/00 not available.
[e] Lake Branch data from 1/1/99-6/1/99 not available.
[f] Baldwin Creek temperature data gathering began in 2000.
[g] The bull trout standard will be applied to the Middle Fork only.

Figure 22. Mainstem Hood River daily average, maximum, and minimum water temperatures, 1999-2000.



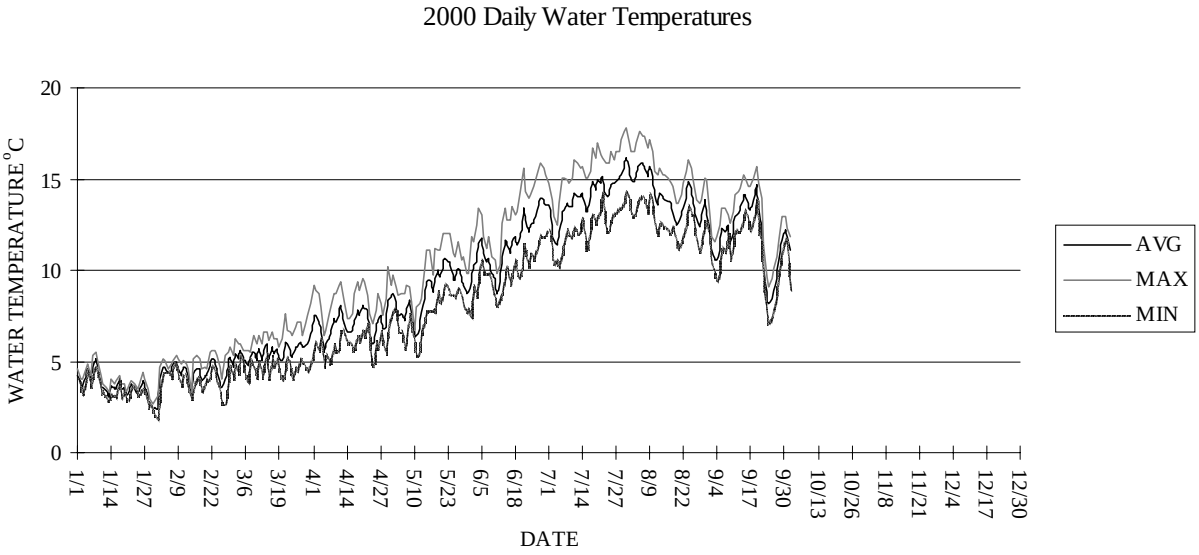
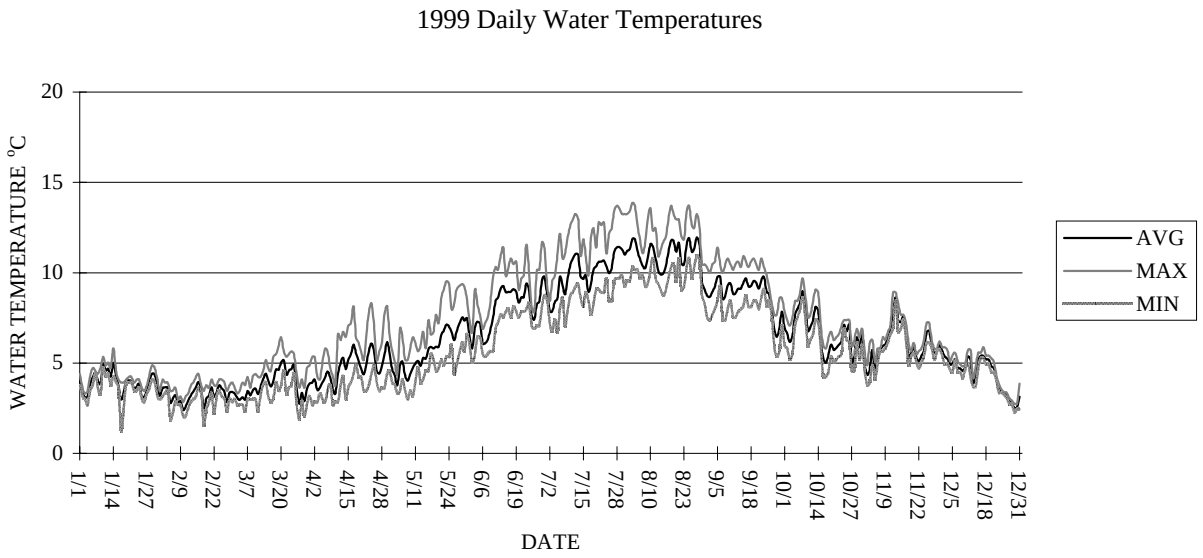


Table 16. Mainstem Hood River monthly and 7-day moving average water temperatures, and number of days above Daily and 7-Day Moving Average Water Temperature Standards, 1996-2000.

	1996	**1997**	**1998**	**1999**	**2000**
START DATE	1/1/96	1/1/97	1/1/98	1/1/99	1/1/00
END DATE	12/31/96	12/31/97	12/31/98	12/31/99	10/2/00
DATA DAYS	362	365	362	366	276
7 Day Avg Max > 10 ^{o}C	159	147	139	130	137
7 Day Avg Max > 12.8 ^{o}C	106	78	103	61	94
7 Day Avg Max > 17.9 ^{o}C	0	0	0	0	0
Daily Maximum > 10 ^{o}C	157	144	151	132	136
Daily Maximum > 12.8 ^{o}C	99	72	102	70	96
Daily Maximum > 17.9 ^{o}C	2	0	7	0	0
MONTHLY MAX TEMPERATURES					
January	7.0	5.7	5.9	6.8	5.5
February	8.9	6.0	6.0	6.0	5.8
March	9.2	7.8	7.9	7.8	8.1
April	11.4	8.8	11.1	10.0	10.1
May	12.9	11.1	12.0	11.6	12.0
June	15.3	14.0	16.7	13.9	15.9
July	18.0	15.5	18.6	15.8	17.8
August	17.3	16.4	18.3	16.1	17.6
September	14.7	14.9	16.7	13.6	15.7
October	12.0	11.8	12.2	11.2	
November	8.2	8.9	8.5	9.7	
December	5.6	6.0	6.1	6.7	
MAXIMUM 7-DAY AVG MAX	17.6	15.6	17.9	15.5	17.1

Figure 23. West Fork Hood River daily average, maximum, and minimum water temperatures, 1999-2000.



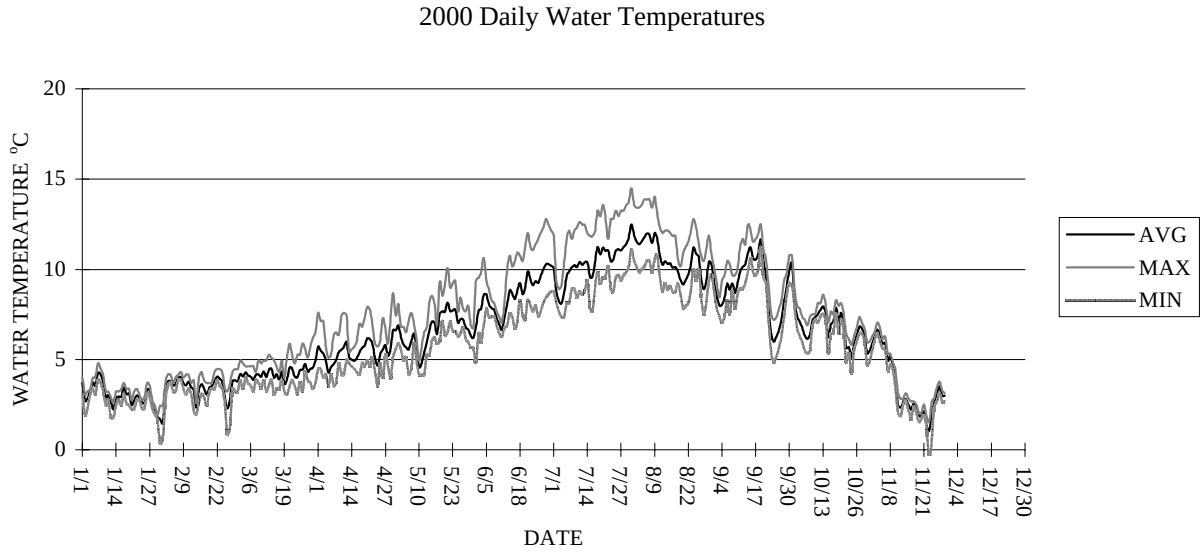
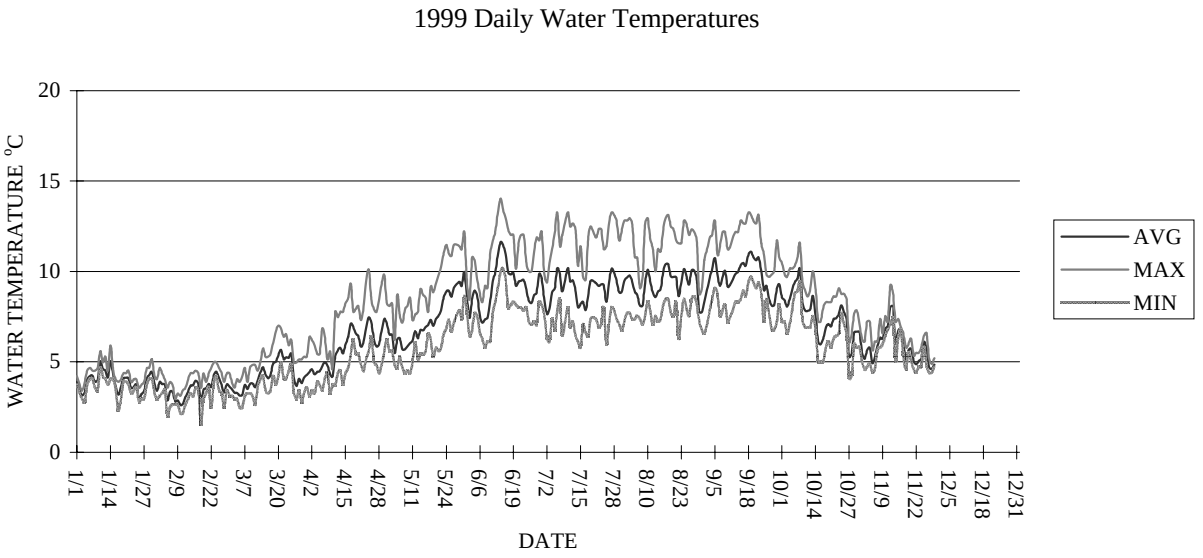


Table 17. West Fork Hood River monthly and 7-day moving average water temperatures, and number of days above Daily and 7-Day Moving Average Water Temperature Standards, 1996-2000.

	1996	**1997**	**1998**	**1999**	**2000**
START DATE	1/1/96	1/1/97	5/7/98	1/1/99	1/1/00
END DATE	12/31/96	12/31/97	12/31/98	12/31/99	11/29/00
DATA DAYS	366	365	332	364	334
7 Day Avg Max > 10 ^{o}C	109	115	102	95	92
7 Day Avg Max > 12.8 ^{o}C	30	22	8	14	21
7 Day Avg Max > 17.9 ^{o}C	0	0	0	0	0
Daily Maximum > 10 ^{o}C	106	104	104	91	93
Daily Maximum > 12.8 ^{o}C	34	16	17	22	21
Daily Maximum > 17.9 ^{o}C	0	0	0	0	0
MONTHLY MAX TEMPERATURES					
January	5.8	4.9		5.8	4.8
February	5.1	5.2		4.4	4.5
March	6.1	6.5		6.4	6.5
April	8.5	7.1		8.3	8.7
May	10.0	9.8	12.3	9.5	10.0
June	12.8	12.5	13.7	11.7	12.8
July	15.0	13.4	13.7	13.7	14.5
August	14.3	14.0	13.2	13.9	14.0
September	12.2	12.6	12.0	11.4	12.5
October	10.5	10.2	9.4	9.7	10.8
November	7.3		7.4	8.9	7.0
December	5.1		5.2	5.9	
MAXIMUM 7-DAY AVG MAX	14.2	13.5	13.3	13.5	13.7

Figure 24. Middle Fork Hood River daily average, maximum, and minimum water temperatures, 1999-2000.



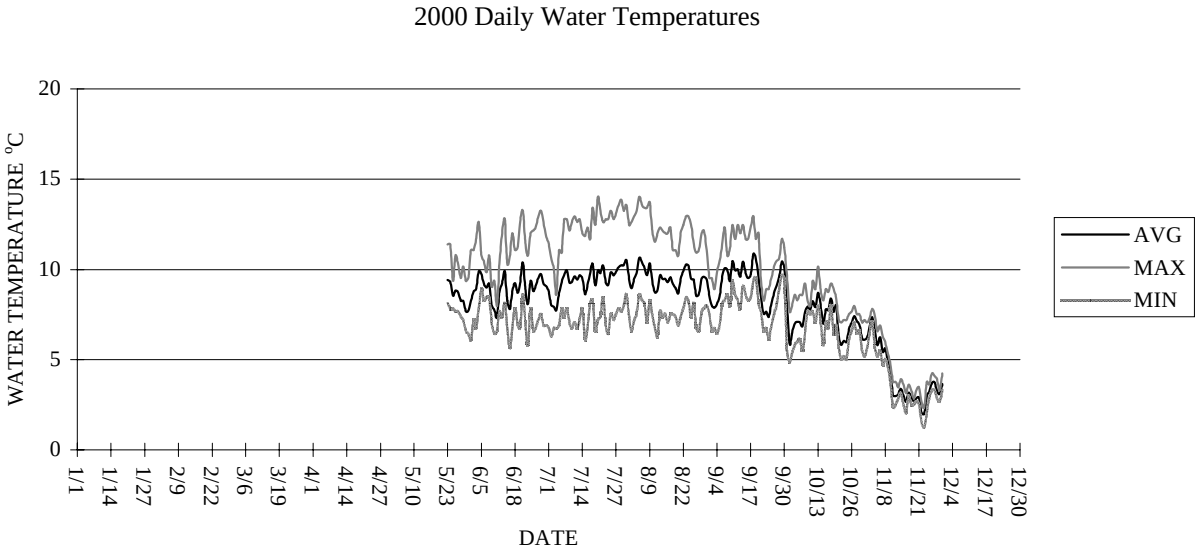
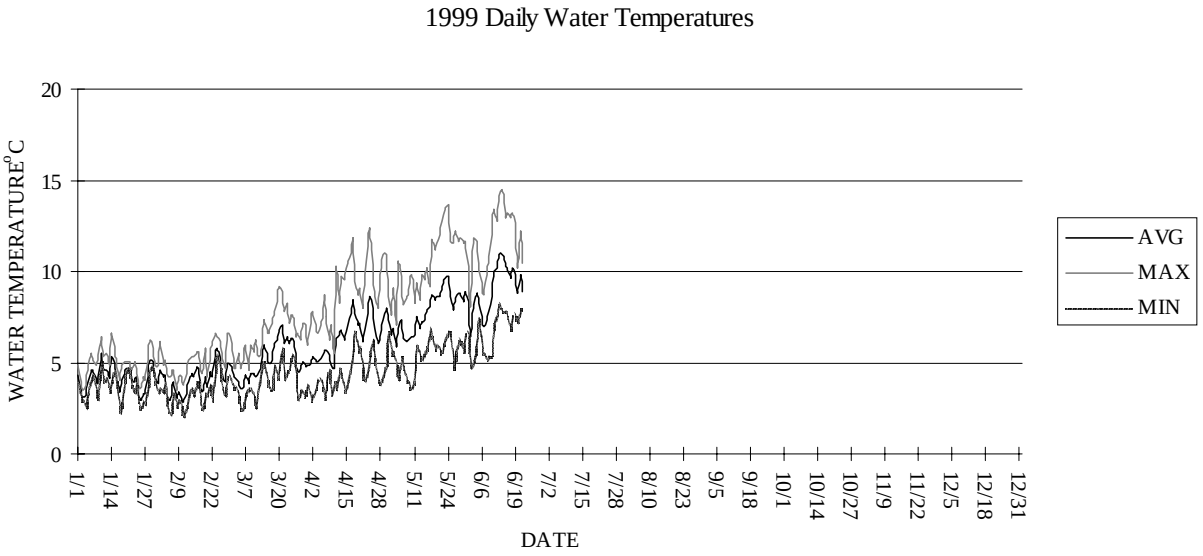


Table 18. Middle Fork Hood River monthly and 7-day moving average water temperatures, and number of days above Daily and 7-Day Moving Average Water Temperature Standards, 1996-2000.

	1996	**1997**	**1998**	**1999**	**2000**
START DATE	1/1/96	1/1/97	1/1/98	1/1/99	5/23/00
END DATE	12/31/96	12/31/97	12/31/98	11/29/99	11/30/00
DATA DAYS	364	365	361	330	192
7 Day Avg Max > 10 ^{o}C	135	124	134	112	119
7 Day Avg Max > 12.8 ^{o}C	2	0	23	5	22
7 Day Avg Max > 17.9 ^{o}C	0	0	0	0	0
Daily Maximum > 10 ^{o}C	120	118	142	119	113
Daily Maximum > 12.8 ^{o}C	11	10	40	22	23
Daily Maximum > 17.9 ^{o}C	0	0	0	0	0
MONTHLY MAX TEMPERATURES					
January	5.0	4.6	5.1	5.9	
February	5.6	5.3	5.2	5.0	
March	6.4	6.3	7.1	7.0	
April	9.0	8.1	11.1	10.1	
May	11.2	11.0	12.3	12.2	11.4
June	12.7	12.7	13.6	14.0	13.2
July	13.4	13.7	14.0	13.3	14.0
August	13.3	13.5	13.7	13.1	14.0
September	12.8	12.3	13.7	13.3	12.9
October	11.3	10.0	11.9	11.6	10.1
November	7.1	8.1	8.0	9.2	7.8
December	4.6	4.8	4.8		
MAXIMUM 7-DAY AVG MAX	13.0	12.8	13.5	12.9	13.5

Figure 25. East Fork Hood River daily average, maximum, and minimum water temperatures. 1999-2000.



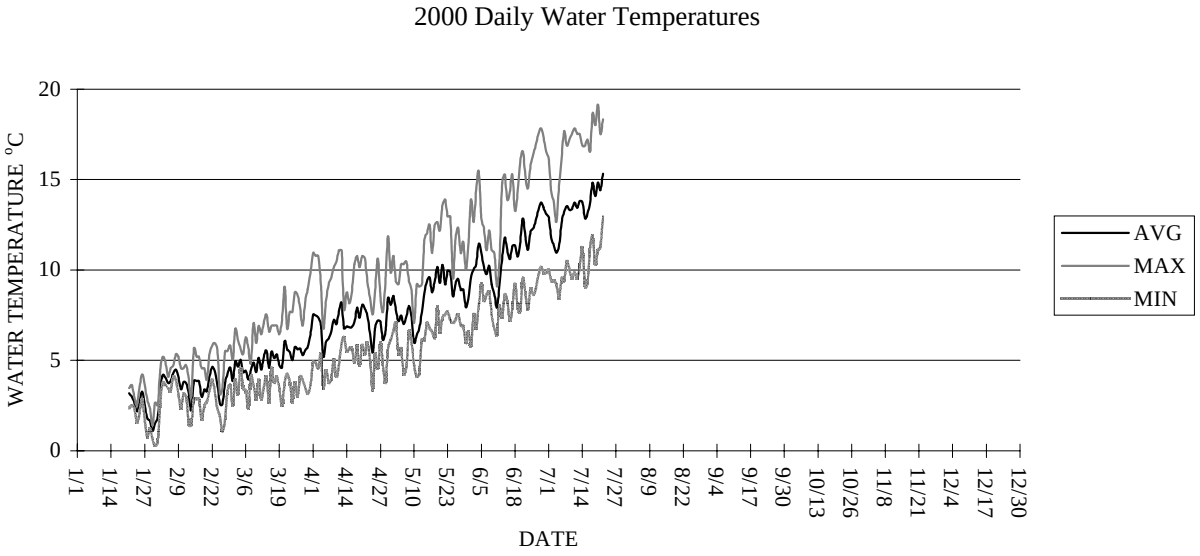
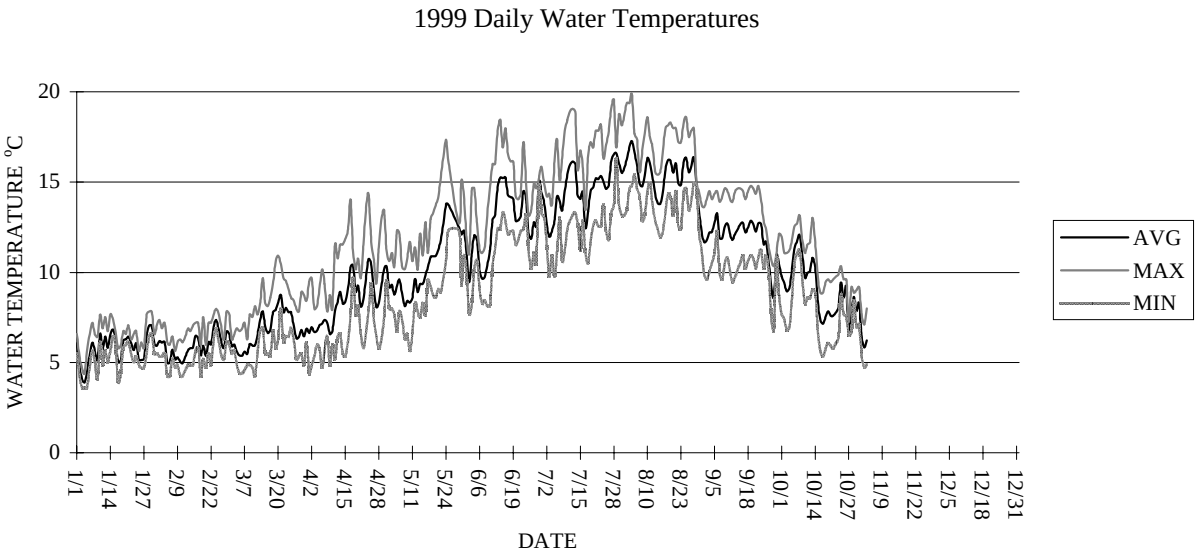


Table 19. East Fork Hood River monthly and 7-day moving average water temperatures, and number of days above Daily and 7-Day Moving Average Water Temperature Standards, 1996-2000.

	1996	**1997**	**1998**	**1999**	**2000**
START DATE	1/1/96	1/1/97	1/1/98	1/1/99	1/21/00
END DATE	12/31/96	12/31/97	12/31/98	6/21/99	7/22/00
DATA DAYS	366	365	362	172	184
7 Day Avg Max > 10 ^{o}C	149	153	148	38	73
7 Day Avg Max > 12.8 ^{o}C	96	85	104	5	41
7 Day Avg Max > 17.9 ^{o}C	1	0	31	0	1
Daily Maximum > 10 ^{o}C	146	147	153	41	86
Daily Maximum > 12.8 ^{o}C	95	85	109	9	47
Daily Maximum > 17.9 ^{o}C	13	1	32	0	4
MONTHLY MAX TEMPERATURES					
January	6.0	5.7	6.0	6.6	4.2
February	6.2	6.2	6.4	6.6	6.0
March	8.1	9.0	9.3	9.2	9.8
April	11.6	10.0	12.9	12.3	11.9
May	12.8	12.0	13.6	13.7	13.9
June	15.4	14.6	18.0	14.5	17.9
July	19.0	17.2	19.9		17.9
August	18.4	18.0	20.2		
September	15.6	16.2	18.3		
October	12.6	11.1	11.7		
November	7.5	8.9	8.7		
December	5.0	5.0	6.1		
MAXIMUM 7-DAY AVG MAX	18.1	17.0	19.2	13.4	17.9

Figure 26. Neal Creek daily average, maximum, and minimum water temperatures, 1999-2000.



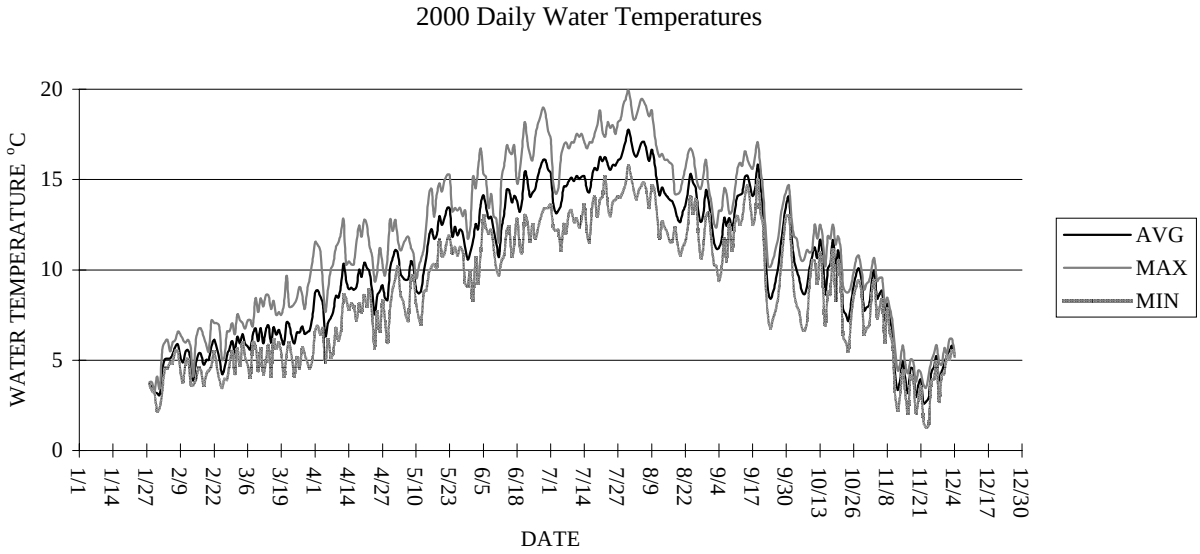
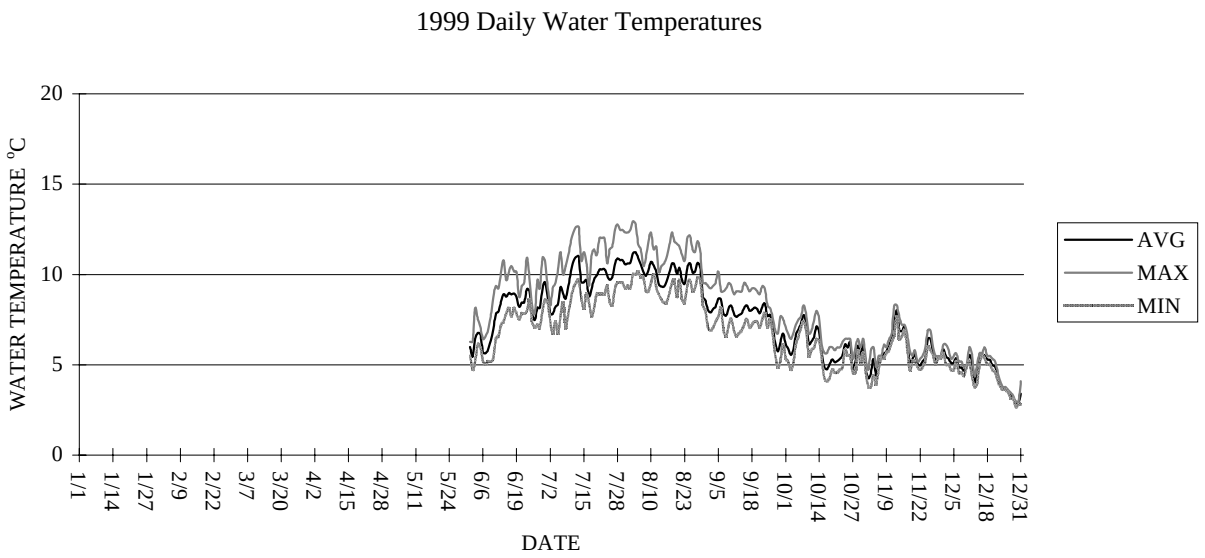


Table 20. Neal Creek monthly and 7-day moving average water temperatures, and number of days above Daily and 7-Day Moving Average Water Temperature Standards, 1998-1999.

	1998	**1999**[a]	**2000**
START DATE	5/7/98	1/1/99	1/28/00
END DATE	12/31/98	11/3/99	12/4/00
DATA DAYS	238	304	312
7 Day Avg Max > 10 ^{o}C	158	179	202
7 Day Avg Max > 12.8 ^{o}C	128	116	136
7 Day Avg Max > 17.9 ^{o}C	46	13	21
Daily Maximum > 10 ^{o}C	167	187	202
Daily Maximum > 12.8 ^{o}C	132	127	130
Daily Maximum > 17.9 ^{o}C	51	24	23
MONTHLY MAX TEMPERATURES			
January		7.8	4.1
February		8.0	7.2
March		10.9	10.5
April		14.3	12.8
May	15.4	17.3	15.3
June	19.3	18.5	19.0
July	21.1	19.5	20.0
August	20.9	19.9	19.5
September	18.1	14.8	17.1
October	13.5	13.2	14.7
November	10.8		10.6
December	8.1		
MAXIMUM 7-DAY AVG MAX	20.7	18.8	19.1

[a] Data for July through October obtained from the Hood River Watershed Group.

Figure 27. Lake Branch Creek daily average, maximum, and minimum water temperatures, 1999-2000.



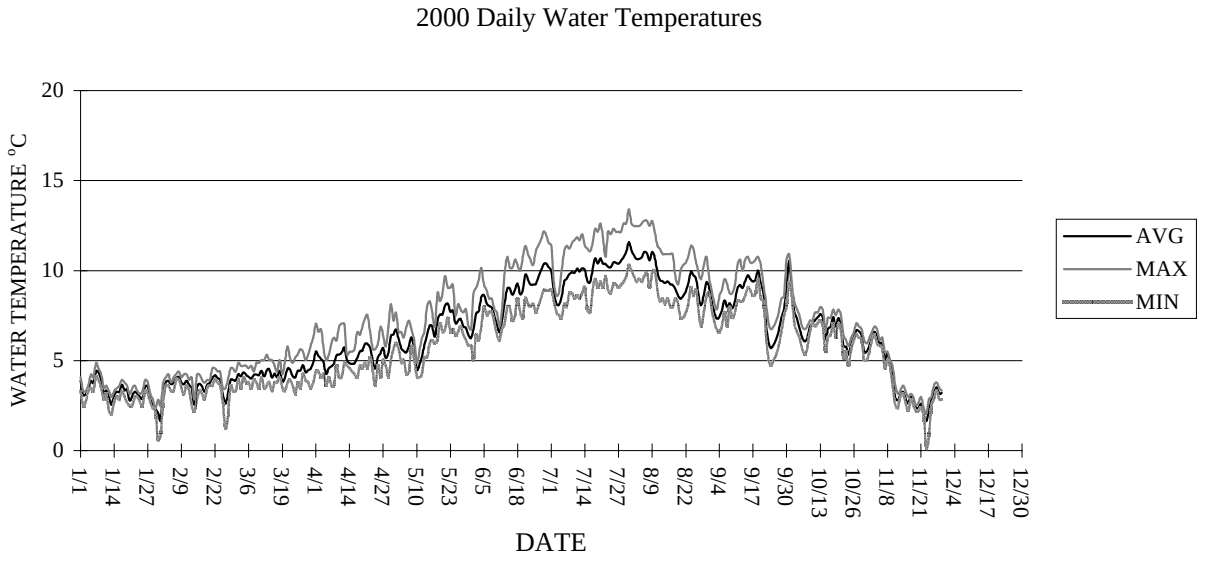


Table 21. Lake Branch Creek monthly and 7-day moving average water temperatures, and number of days above Daily and 7-Day Moving Average Water Temperature Standards, 1999-2000.

	1999	**2000**
START DATE	6/1/99	1/1/00
END DATE	12/31/99	11/29/00
DATA DAYS	214	334
7 Day Avg Max > 10 ^{o}C	60	82
7 Day Avg Max > 12.8 ^{o}C	0	0
7 Day Avg Max > 17.9 ^{o}C	0	0
Daily Maximum > 10 ^{o}C	64	80
Daily Maximum > 12.8 ^{o}C	1	1
Daily Maximum > 17.9 ^{o}C	0	0
MONTHLY MAX TEMPERATURES		
January		4.9
February		4.6
March		6.3
April		8.1
May		9.7
June	10.9	12.2
July	12.8	13.4
August	12.9	12.8
September	10.1	10.8
October	8.3	10.9
November	8.3	6.9
December	6.1	
MAXIMUM 7-DAY AVG MAX	12.5	12.7

Figure 28. Baldwin Creek daily average, maximum, and minimum water temperatures, 2000.

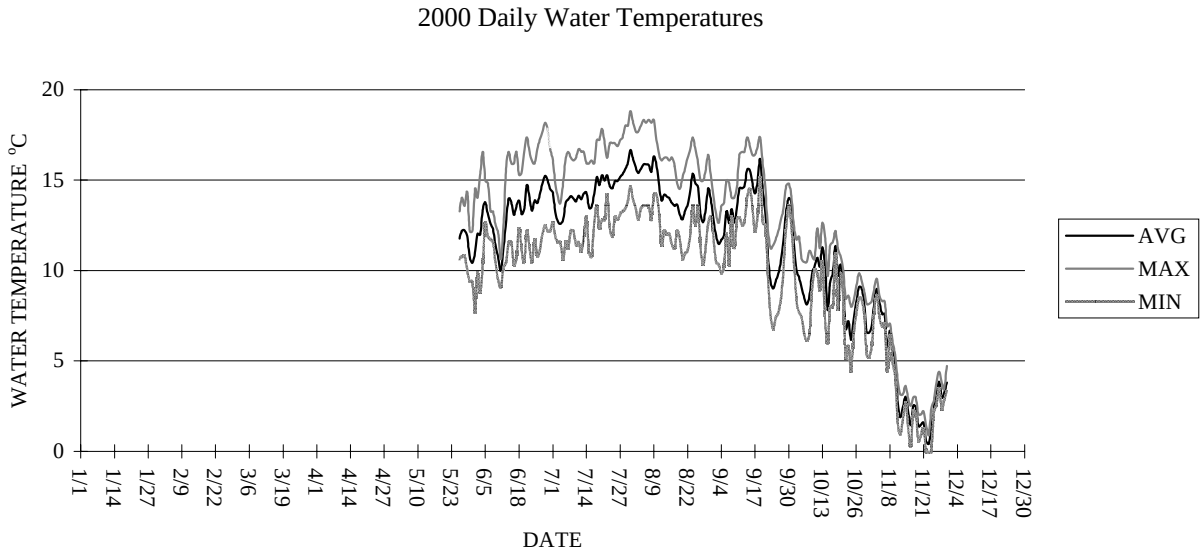


Table 22. Baldwin Creek monthly and 7-day moving average water temperatures, and number of days above Daily and 7-Day Moving Average Water Temperature Standards, 2000.

	2000
START DATE	5/26/99
END DATE	11/30/99
DATA DAYS	189
7 Day Avg Max > 10 °C	145
7 Day Avg Max > 12.8 °C	122
7 Day Avg Max > 17.9 °C	8
Daily Maximum > 10 °C	148
Daily Maximum > 12.8 °C	116
Daily Maximum > 17.9 °C	11
MONTHLY MAX TEMPERATURES	
May	14.3
June	18.2
July	18.8
August	18.3
September	17.4
October	14.2
November	9.5
December	
MAXIMUM 7-DAY AVG MAX	18.1

Figure 29. Mixed Middle Fork Hood River daily average, maximum, and minimum water temperatures, 1995-2000.

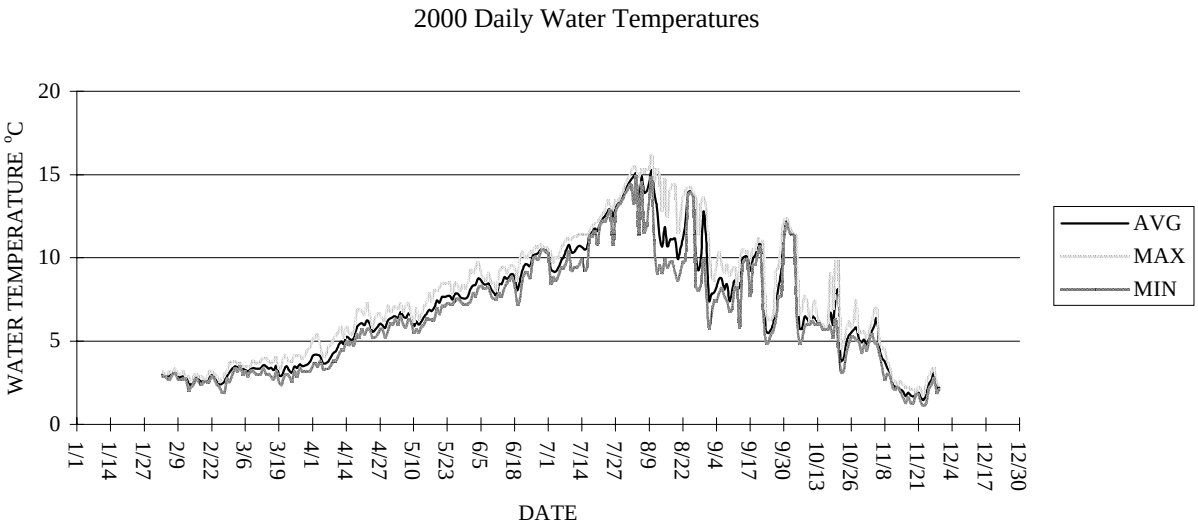


Table 23. Mixed Middle Fork Hood River monthly maximum water temperatures, 1995-2000. No water temperature data was collected for 1999.

	1996	**1997**	**1998**	**2000**
START DATE	1/1/96	1/6/97	1/1/98	1/1/00
END DATE	12/30/95	12/31/97	12/31/98	11/29/00
DATA DAYS	339	358	277	301
MONTHLY MAX TEMPERATURES				
January	3.8	3.3	3.3	
February	3.6	3.5	3.6	3.7
March	5.0	4.6	5.5	5.7
April	6.4	6.4	8.6	7.2
May	7.8	8.1	8.6	8.5
June	10.9	9.4	11.4	10.8
July	16.9	10.5	12.3	14.5
August	14.5	12.6		16.1
September	11.5	12.8	9.8	12.2
October	10.1	14.6	9.4	12.3
November	5.3	7.0	6.3	6.9
December	3.5	3.6	3.3	
MAXIMUM 7-DAY AVG MAX	14.5	12.6	11.7	15.3

Figure 30. Rogers Spring Creek daily average, maximum, and minimum water temperatures, 2000.

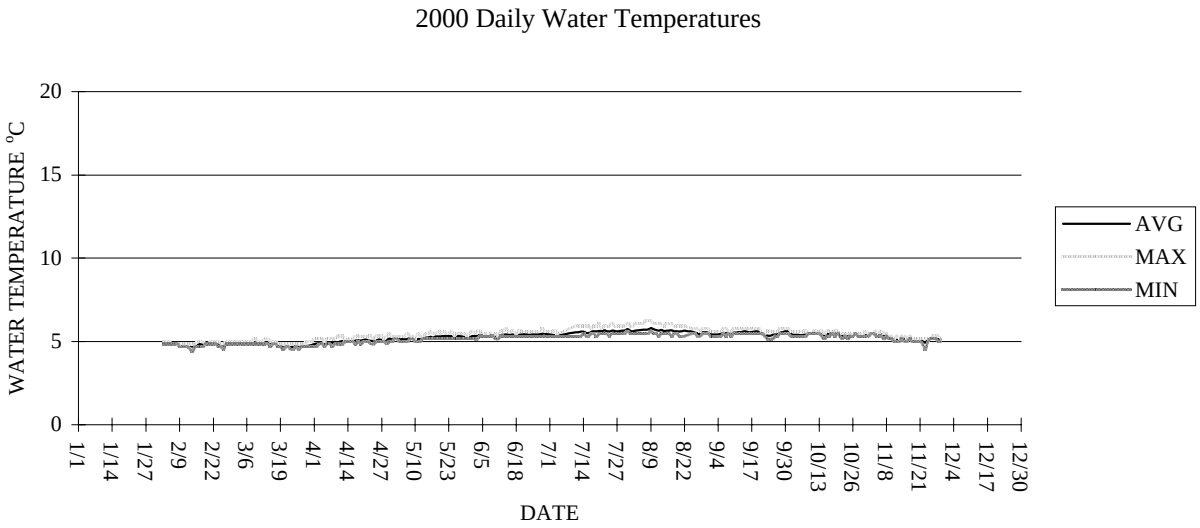


Table 24. Rogers Spring Creek monthly maximum water temperatures, 1995-2000. No water temperature data was collected for 1999.

	1996	**1997**	**1998**	**2000**
START DATE	1/1/96	1/16/97	1/1/98	2/3/00
END DATE	9/20/96	12/31/97	9/11/98	11/29/00
DATA DAYS	262	329	138	293
MONTHLY MAX TEMPERATURES				
January	4.7	4.4	4.7	
February	4.2	4.6	4.6	5.0
March	4.7	4.6		5.2
April	5.0	4.9	5.3	5.5
May	5.0	5.0	5.2	5.6
June	5.5	5.2		5.8
July	5.3	5.3		6.0
August	5.3	5.5	5.5	6.2
September	5.3	5.5	5.5	5.8
October		7.4		5.8
November		6.6		5.6
December		4.7		
MAXIMUM 7-DAY AVG MAX	5.3	6.2	5.4	6.2

Oak Springs Hatchery Steelhead Marking Evaluation

Introduction

The percent coded-wire tag retention and clipping results on Hood River stock hatchery winter steelhead have been evaluated by HRPP personnel since the 1993 brood year. Monitoring of clips for Hood River stock hatchery summer steelhead began in 1999 (1998 brood). Steelhead are reared at Oak Springs Hatchery (OSH) where they are coded-wire tagged and differentially fin clipped. All tagging is contracted through the ODFW tagging and clipping program. See **Appendix Table D-1** for past and future fin marking and coded-wire tagging of hatchery winter and summer steelhead and spring chinook salmon releases into the Hood River subbasin. Hatchery winter steelhead production at OSH was graded into two size groups (small and large) prior to tagging in late October. In alternate years when hatchery winter steelhead are clipped with an adipose-left ventral clip and coded-wire tagged, each group has a separate coded-wire tag number. Each size group was reared in a separate raceway at OSH. The hatchery summer steelhead are reared in one raceway.

Methods

Coded-wire tag retention is evaluated using a coded-wire tag detector. A subsample of fish were taken to determine presence or absence of a tag. For clipping evaluations, a random collection of marked fish were sampled from each pond to evaluate the quality of mark combinations used on hatchery winter and summer steelhead. Hatchery juveniles were examined and classified as 1) not clipped (>75% remains), 2) poor clips (25-75%), 3) clipped (less than 25% remains) or 4) fin-clipped incorrectly based on a subjective evaluation of each mark group present in the ponds.

Results and Discussion

Coded-wire tag retention and clipping results for winter steelhead (brood years 1993-1997) are summarized in **Appendix Tables D-2, D-3, and D-4**. Discussion of these results can be found in Lambert et al., January 1998; December 1998; and December 1999. The 1998 brood hatchery winter steelhead were not coded-wire tagged and were clipped with an adipose and right ventral fin clip (Table 25 and 26). All of the 1999 brood hatchery winter steelhead were coded-wire tagged and were fin-clipped with an adipose-left ventral mark (Table 25 and 26). The evaluation of the 1998 brood hatchery winter steelhead showed a high percentage of no- and poor- right ventral clips, but a low percentage of no- and poor- adipose clips (Table 25). The results were similar for the 1999 brood. About one percent were mis-marked with an incorrect ventral mark (Table 25). The coded-wire tag retention was consistent for each group of hatchery

winter steelhead (1999 brood) at 93.3 and 93.9 percent.

The hatchery summer steelhead program began using wild brood from the Hood River subbasin in 1998. Juvenile from the 1998 brood hatchery summer steelhead were fin marked with a left maxillary clip and the 1999 brood were fin marked with a right maxillary clip. About 30 percent of the 1999 brood were incorrectly marked with a left maxillary clip. Except for the mis-mark of the 1999 brood, the quality of fin marks has been consistently good (Table 27).

Continued monitoring of tag retention and clipping at OSH is necessary. Poor tag retention and clipping results for the hatchery winter and summer steelhead has resulted in more careful surveillance of tagging and clipping procedures at OSH. Poor quality fin clipping continues to be a problem with ventral clips on the hatchery winter steelhead (Table 25). Studies have shown that ventral fins regenerate on steelhead juveniles (Christine Mallette, ODFW Portland Office, *personal communication*), but improvement is needed at OSH. Hatchery summer steelhead maxillary clips were good, except for the 30 percent that were mis-marked (Table 27). Mis-marking was caused by human error and should be eliminated by better communication prior to marking. HRPP personnel will continue to work with OSH to improve fin mark quality.

Recommendations

In order to improve fin marking and coded-wire tagging of hatchery winter and summer steelhead, it is recommended that the OSH manager contact HRPP staff to verify appropriate fin-mark and coded-wire tag prior to the crews beginning their marking operations. It would also be beneficial to have someone overseeing the marking crews who could instruct them on the appropriate marks and marking techniques immediately prior to starting this job. Close monitoring of the marks throughout the fin-clipping process, should help reduce the error.

Table 25. Fin clip results for Hood River stock hatchery winter steelhead at Oak Springs Hatchery, 1998-1999 broods. (Percent of total number sampled is in parentheses. Ad = adipose, RV = right ventral, LV = left ventral)

Broodstock, hatchery, brood year	Pond	Fin clip	Date sampled	Number sampled	No Ad	Poor Ad	No RV	Poor RV	No LV	Poor LV	Fin-clipped incorrectly
Hood River, Oak Springs,											
1998	L-3	Ad-RV	5-Apr-99	200	2 (1.0)	2 (1.0)	26 (13.0)	23 (11.5)			0 (0.0)
1998	L-4	Ad-RV	26-Apr-99	195	1 (0.5)	0 (0.0)	38 (19.5)	0 (0.0)			2 (1.0)
1999	L-1	Ad-LV	10-Apr-00	208	0 (0.0)	0 (0.0)			54 (26.0)	66 (31.7)	2 (1.0)
1999	L-2	Ad-LV	24-Apr-00	196	2 (1.0)	0 (0.0)			70 (35.7)	71 (36.2)	0 (0.0)

Table 26. Percent coded-wire tag retention, tag code, and clipping information for Hood River stock hatchery winter steelhead, 1999 brood. (adipose = Ad, left ventral = LV)

Broodstock, hatchery, brood year	**Pond**	**Tag code**	**Fin clip**	**Date sampled**	**Percent tag retention**
Hood River, Oak Springs,					
1999	L-1	09-29-23	Ad-LV	10-Apr-00	93.3
1999	L-2	09-29-24	Ad-LV	24-Apr-00	93.9

Table 27. Fin clip results for Hood River stock hatchery summer steelhead at Oak Springs Hatchery, 1998-1999 broods. (Percent of total number sampled is in parentheses. Ad = adipose, RM = right maxillary, LM = left maxillary.)

Broodstock, hatchery, brood year	Pond	Fin clip	Date sampled	Number sampled	No LM	Poor LM	No RM	Poor RM	Fin-clipped incorrectly
Hood River, Oak Springs,									
1998	M-11	LM	31-Mar-99	246	1 (0.4)	2 (0.8)			
1999	L-3	RM, LM	5-Apr-00	201			5 (2.5)	1 (0.5)	57 (28.4)

Genetics

Resident and anadromous salmonids were sampled at selected sites in the Hood River and surrounding subbasins; and from hatchery fish from 1994 through 1996 (Lambert et al. December 1999). Other miscellaneous samples as needed have been collected since 1997. Samples were collected to characterize and identify populations of rainbow-steelhead and cutthroat trout by allozyme electrophoresis and morphology to determine 1) the natural biodiversity of the Hood River Basin, including the subspecies present, the population and metapopulation structure, and the presence of any exceptionally unique populations; 2) if and where hybridization was occurring; and 3) the impacts of historic hatchery programs on the biodiversity of the subbasin, including contributions to hybrid zones. Funding for the survey and analysis is provided by ODFW, USFS, and BPA. The analysis is contracted to staff at the University of Montana through the genetics program at ODFW, who are coordinating the effort.

Two progress reports have been completed by the Wild Trout and Salmon Genetics Laboratory staff at the University of Montana in the fiscal year 1999 and 2000 to ODFW, outlining genetic analysis methods and some early results (**Appendixes E and F**). In Spruell et al. December 1998 (**Appendix E**), preliminary results are presented for 17 of 21 *Oncorhynchus mykiss* and *Oncorhynchus clarki* samples originally collected from the Hood River subbasin and identified. Populations of rainbow trout and cutthroat trout have been analyzed and found to be unaffected by hybridization. Although, results have shown where these species co-occur there is hybridization (**See Appendix Table E-1 and Figure E-1**). Interestingly, *O. mykiss* has only been found in the West Fork Hood River and *O. clarki* is predominantly in the Middle Fork and East Fork Hood River (**See Appendix Table E-1 and Figure E-1**).

Neraas et al. October 2000 (**Appendix F**) presents preliminary results of genetic variation of Hood River steelhead populations. The purpose of the study is to determine if hatchery released Skamania (Stock 24) steelhead and rainbow trout have introgressed with the native summer and winter run populations. The microsatellite data suggests little difference between the wild summer steelhead samples and the hatchery stock #24. This similarity may be a result of introgression between hatchery stock #24 and wild summer steelhead, however, the answer will become clearer as additional samples are analyzed.

HABITAT

Introduction

The CTWSRO staff were involved in implementing early action habitat projects, fish salvage operations, writing the Hood River Fish Habitat Protection, Restoration, and Monitoring Plan, and assisting in completion of the Hood River Watershed Assessment. Project staff also spent time completing physical stream and riparian surveys on several anadromous fish streams, evaluating habitat opportunities, and monitoring and evaluating chosen projects. Details of individual projects and tasks for FY 1999 and 2000 are described below. Past accomplishments can be found in **Appendix Table G-1**.

Project Work In Fiscal Years 1999 and 2000

Hood River Watershed Assessment

The Hood River Watershed Assessment was completed in 1999 by the Hood River Watershed Group (Hood River Watershed Group, 1999). The Hood River Watershed Group is a forum of state, tribal and federal agencies, irrigation districts, Hood River growers, other stakeholders, and citizens. Cost-share assistance ($20,000) was provided by BPA in FY 1998 through the CTWSRO for Holly Coccoli (Hood River Watershed Group Coordinator) to complete the Watershed Assessment. The Hood River Watershed Assessment follows the Oregon Watershed Assessment Manual prepared for the Governors Watershed Enhancement Board (GWEB)[Watershed Professionals Network, 1999], which emphasizes geomorphic structure of a stream as the basis for determining habitat potential and evaluation of land use practices and natural processes.

Hood River Fish Habitat Protection, Restoration, and Monitoring Plan

Several drafts of the Hood River Fish Habitat Protection, Restoration, and Monitoring Plan (Plan) for the HRPP were completed by CTWSRO in 1999. The final copy of the Plan was completed in 2000 (Coccoli et al., 2000). The Plan uses the U.S. Forest Service analyses of the West Fork Hood River (USFS, 1996a) and East and Middle Fork Hood River (USFS, 1996b), and the Hood River Watershed Assessment (Hood River Watershed Group, 1999) to identify the historic and current status of riparian, instream and upland habitat; natural watershed processes; anadromous and resident fish status; and identifies known limiting factors, and subbasin areas in need of protection or which will likely respond to restoration. The Plan identifies projects and strategies needed to protect existing high quality habitat, correct known fish survival problems,

and improve habitat carrying capacity for natural production to meet HRPP goals. The Plan will be used as a working document that can be updated year-to-year as projects are identified and prioritized by the CTWSRO, HRWG, and ODFW.

A Watershed/Habitat Coordinator position was sub-contracted in FY 99 by CTWSRO ($10,000) to assist in writing the Plan. This position was cost-shared with Hood River Soil and Water Conservation District (HRSWCD).

Tony Creek Dee Mill Diversion Adult Fish Passage Project

The Dee Mill Diversion is located on Tony Creek (Rm 0.9), tributary to the Middle Fork Hood River (Figure 31). The diversion had not been used in several years, and as a short term solution the CTWSRO in October 1998 removed a portion of the Tony Creek diversions concrete apron (15 ft wide by 10 ft long) using a hydraulic sledge hammer (Figure 32). The project took several days to complete with three staff members. Upon removal of the existing stop-logs, Tony Creek during spring run-off did not scour a jump pool as staff had anticipated, making it necessary to create a jump pool. The ODFW assisted CTWSRO by placing 20 cubic yards of boulders with a 2800 Excavator (32,000 lbs) in June of 2000 (Figure 33).

Green Hill Lumber Company (former Dee Forest Products) had owned the water diversion on Tony Creek. When in operation, the five foot high concrete diversion, with stop-logs in place, removes up to 2.5 cfs of water; primarily for protection in case of a fire. The Tony Creek diversion has never been screened and minimal upstream fish passage existed for spring chinook salmon, coho salmon, and ESA listed winter steelhead and bulltrout.

Winter steelhead spawning ground surveys were completed in June of 1997 and 1999-2000 and showed winter steelhead spawning in Tony Creek downstream of the diversion and no spawning occurring above the diversion (Table 28). In addition, the USFS in 1999, radio-tagged several adult bull trout to track spawning distribution within the Hood River subbasin. One bull trout was tracked into Tony Creek on 2 July, held several days directly below of the diversion, then left Tony Creek (Chuti Fiedler, USFS, *personal communication*). On the same weekend a spring chinook salmon was observed in the same area (Chuti Fiedler, USFS, *personal communication*).

New ownership of the Tony Creek water diversion occurred in 2001. If the new owner decides to use the water right, a NMFS approved screen will need to be designed and installed. If the existing water right on Tony Creek is abandoned or if the company decides to use an alternative water right on the mainstem Hood River by pumping, the diversion on Tony Creek should be removed. CTWSRO will continue to monitor for success of fish passage of winter

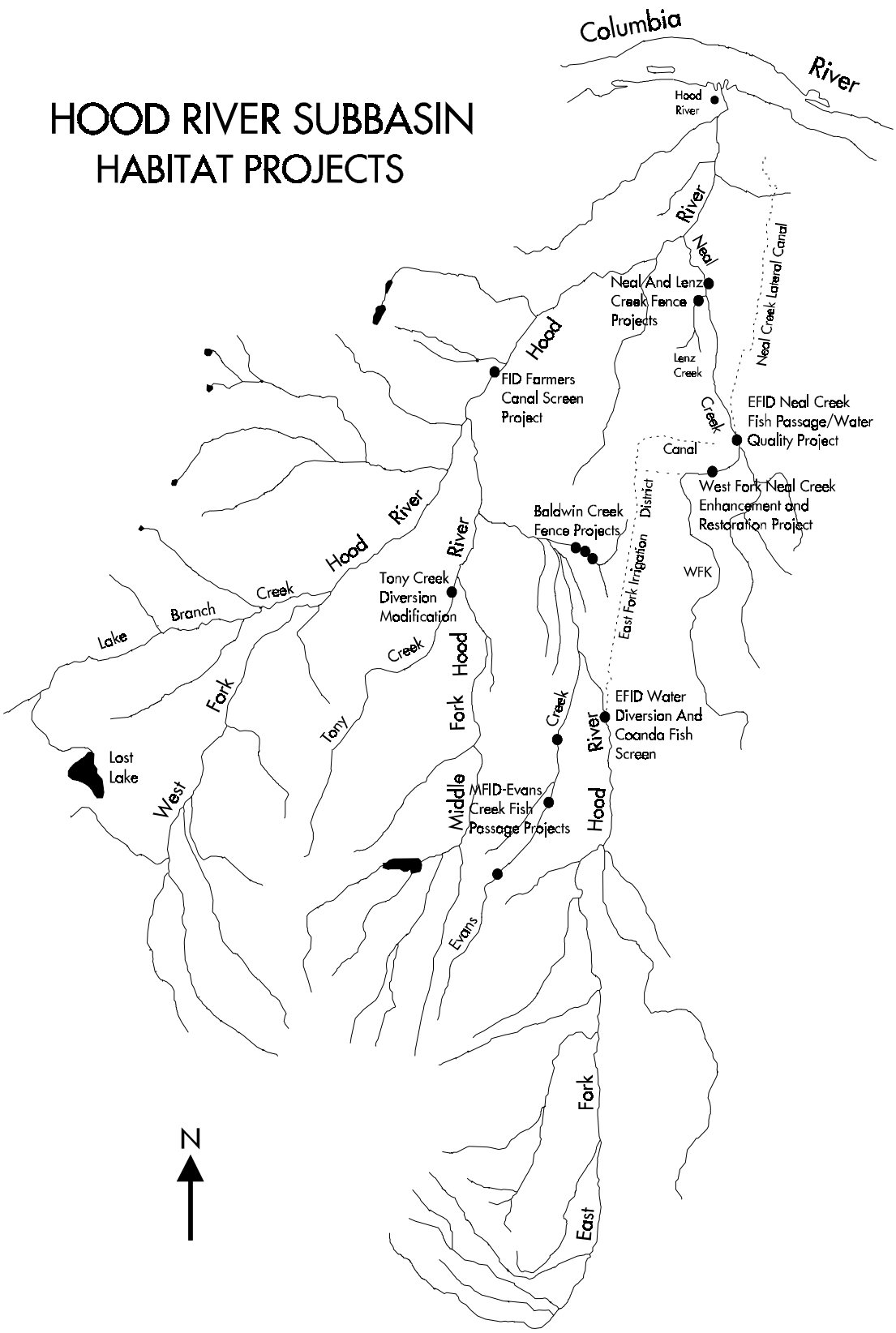


Figure 31. The location of fish habitat projects throughout the Hood River subbasin.

Table 28. Number of winter steelhead redds counted during spawning ground surveys in Tony Creek, 1997-2000.

Date	Location From	Location To	STW Redds
6-02-1997	Mouth of Tony Creek	Diversion Dam	5
6-11-1997	Diversion Dam	Powerline Crossing	0
1998	No Surveys		
6-22-1999	Mouth of Tony Creek	Diversion Dam	3
6-22-1999	Diversion Dam	Upstream ½ mile	0
6-19-2000	Mouth of Tony Creek	Diversion Dam	2
6-19-2000	Diversion Dam	Upstream ½ mile	0

Figure 32. CTWSRO staff removing a portion of the Tony Creek diversion concrete apron with a hydraulic sledge hammer in October 1998.

Figure 33. The Tony Creek diversion (Rm 0.9) before (above) and after (below) project implementation.

steelhead, spring chinook and coho salmon, and bull trout above the diversion dam.

Evans Creek Fish Passage Project (Higgins Pond - Rm 2.5)

The Middle Fork Irrigation District (MFID) has operated an irrigation diversion on Evans Creek (RM 2.5), tributary to the East Fork Hood River. As part of their long-range operational plan (10-year), the MFID proposed an alternative approach to using the Evans Creek (Higgins Pond - Rm 2.5) diversion for irrigation water (Figure 31). In August and September of 1999, MFID constructed about 4300 ft of 24 inch irrigation pipe along the shoulder of Culbertson and Clear Creek roads, between the pump house and Evans Creek, to connect to an existing pressure pipeline system. A pressure reducer station was built at the junction of the irrigation lines. Connecting to an existing pressure pipeline eliminated the needed use of the diversion dam and allowed MFID to restore fish passage to 1.5 miles of upstream habitat for listed winter steelhead, coho salmon, and resident trout (Figure 34). The total cost to the MFID was $150,000, of which BPA through CTWSRO contributed $30,000. The project was complete in November, 1999.

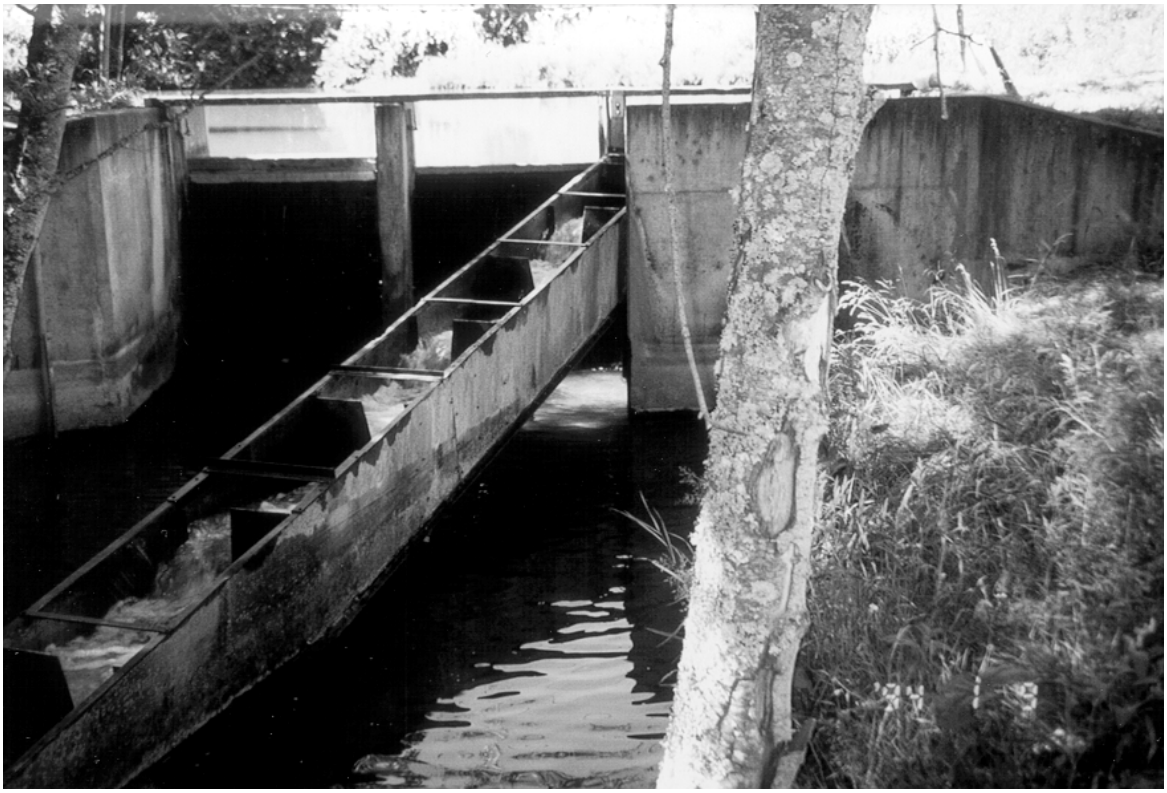
Prior to completion of the project, the eight foot high concrete diversion, with dam boards in place, removed 9.5 cfs of water and fed local orchards with a gravity pressure system. Directly upstream of the diversion was a small settling pond used to remove glacial silt from irrigation water. Adult fish passage was provided with an Alaska steep pass fish ladder, but had proven inadequate. Furthermore, the diversion was screened with stationary flat window screens and failed to meet NMFS or ODFW standards.

With completion of the project, the MFID removed the dam boards at the diversion and capped the intake pipe. Although the MFID has no plans to use the diversion, the MFID will keep the diversion structure in place to protect their water right priority date. If the State Water Resource Department determines that MFID will not lose their water right priority date by moving the point of diversion, the structure could permanently be removed.

Neal Creek Riparian Fence Exclosure and Bank Stabilization (Meyers Property - Rm 2.0)

About one-quarter mile of riparian area of Neal Creek, tributary to the mainstem Hood River, and a small portion of Meyers Creek was fenced in November, 1998 with a four strand barbed-wire fence to exclude livestock (Lambert et al. December 1999). The fence was setback 10-15 feet from the creek. A single stream crossing was provided to allow livestock access to an additional pasture and barn area on the North side of the property.

The short-term effects of a riparian fence exclosure are to remove sources of erosion and reduce disturbance levels within the riparian corridor. The long-term effect is to restore a portion



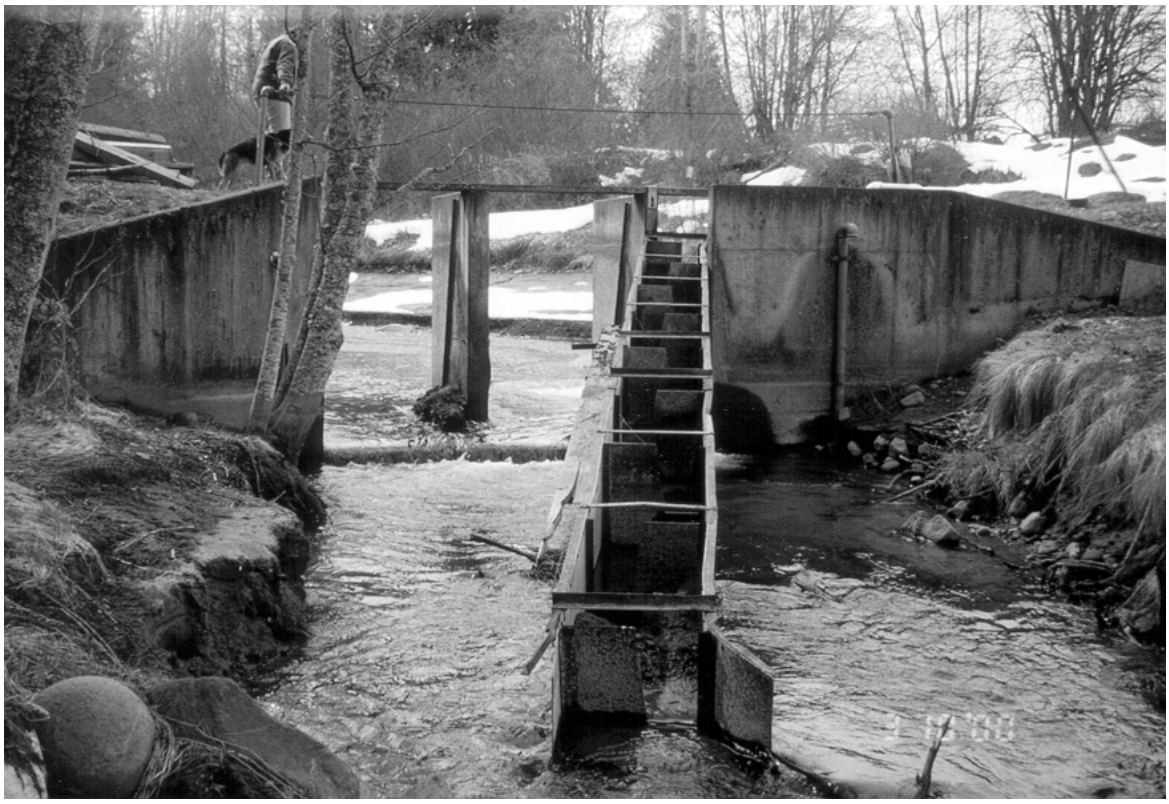


Figure 34. The Evans Creek diversion project (Higgins Pond-Rm 2.5) before (above) and after (below) project implementation.

of the riparian corridor to a more natural and higher functioning state. The ultimate goal is to increase salmonid habitat and increase egg and juvenile survival.

The property owner agreed to allow the fencing in exchange for having a portion of the streambank stabilized with bioengineered rip-rap. The flood of 1996, completely changed the location of the channel on the southern end of the property and because the property line in the deed is based on stream location, the landowner lost about an acre of land. A high flow event in 1997 continued to erode the streambank further. Prior to the project, the landowner had protected the property with old refrigerators filled with rock and placed on the bank to prevent further erosion. CTWSRO, in July 1999, hired Hanel Construction to place approximately 260 cubic yards of bioengineered rip-rap along the eroded area and filled behind with river rock and dirt (Figure 35). The approximate dimensions of the berm are: 150 feet long, by 4 feet wide, and 6 feet deep (256 cubic yards). The bottom of the berm was keyed into the bed of the stream and the vertical bank was taken back to a 1.5/1 slope prior to rock placement (Figure 36). Angular rock from an upland source was used for the bioengineered rip-rap with a minimum piece size of 18 inches. The berm also contained bundles of willow at or near the toe of the rip-rap blanket and live-staked hardwoods planted or sprigged randomly throughout the rip-rap to provide vegetation and increase berm stability (Figure 36). All disturbed areas were seeded with an appropriate upland grass seed mix.

The bioengineered rip-rap will reduce the dynamic nature of Neal Creek by protecting the bank and fencing project. Willow staking of the armored area and planting hardwoods randomly throughout the rip-rap will provide for some vegetation cover along the bank and assist in stabilizing of the bank.

Lenz Creek Riparian Fence Exclosure (VanKoten Property - Rm 0.1)

About 1/4 mile of riparian area of Lenz Creek, tributary to Neal Creek, and 1/8 mile of Neal Creek, tributary to the mainstem Hood River (Figure 31) was fenced in October 1999 with a four strand hi-tensile wire fence to specifically exclude horses (Figure 37). The fence was setback 10-15 feet from the creek. The property was divided into multiple pastures, including several stream crossings, to provide opportunity for good pasture management. Upon completion of the fence project, the HRWG with volunteers, planted 18 Douglas fir and 79 cedar conifer seedlings to hasten riparian recovery. All conifer seedlings were donated by local nurseries and summer watering and weeding provided by volunteers. The fence will decrease the level of disturbance by livestock; allowing vegetation growth, reducing erosion and sedimentation impacts, and stabilizing channels and banks. The landowner agreed to provide all maintenance over the life of the fence.

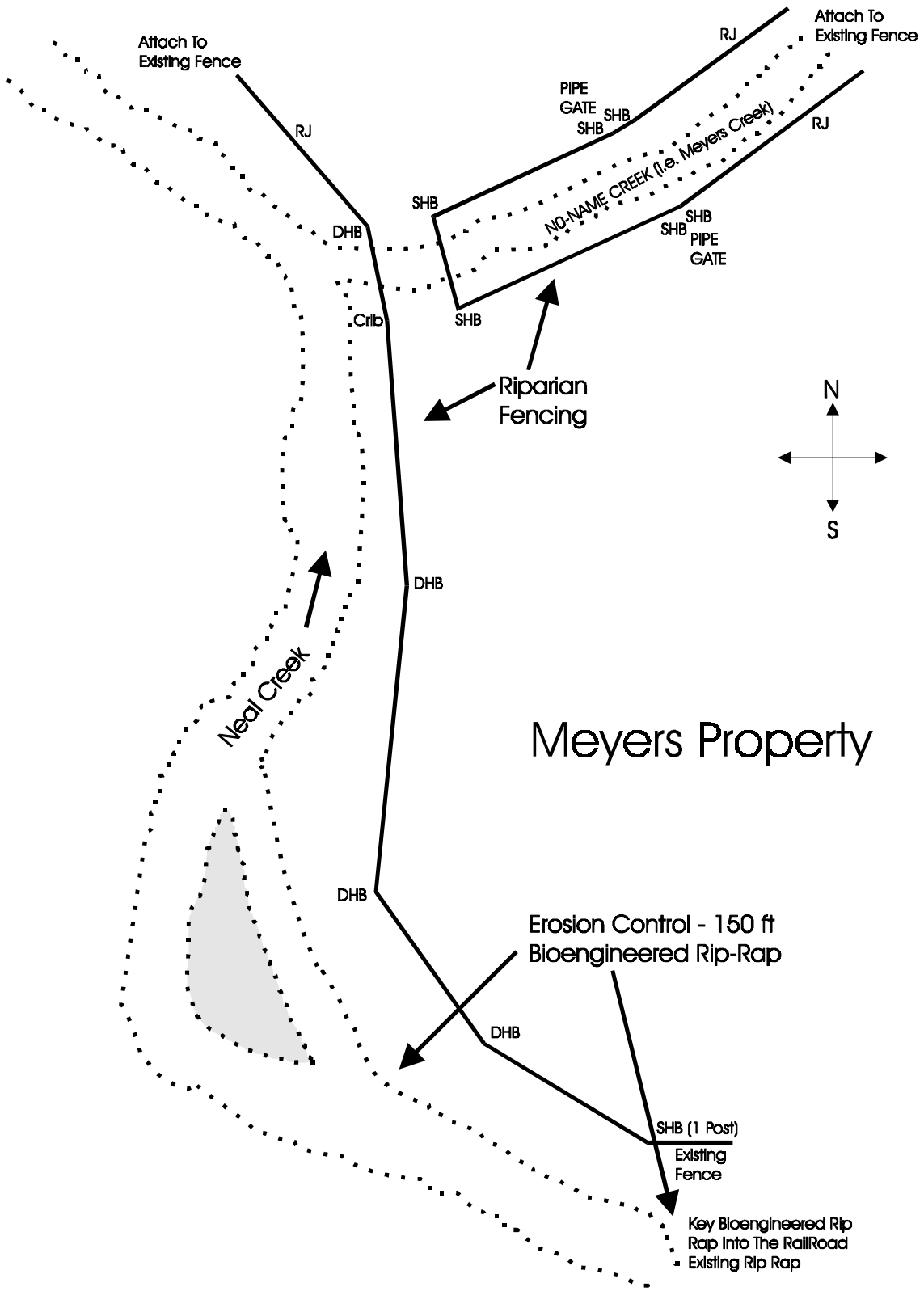


Figure 35. Diagram of the Meyers property riparian fence exclosure and bank stabilization project on Neal Creek, Rm 2.0.

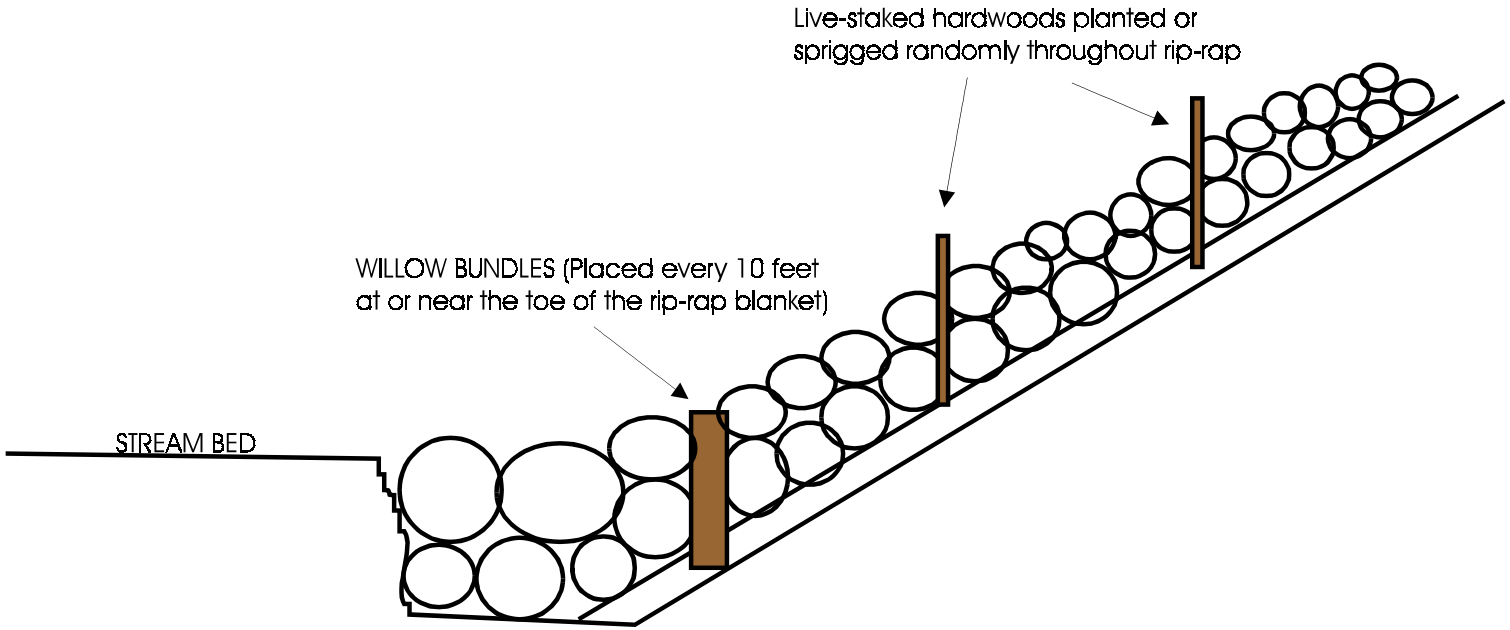


Figure 36. Cross section of the bioengineered rip-rap used on Neal Creek (Rm 2.0), 1999.

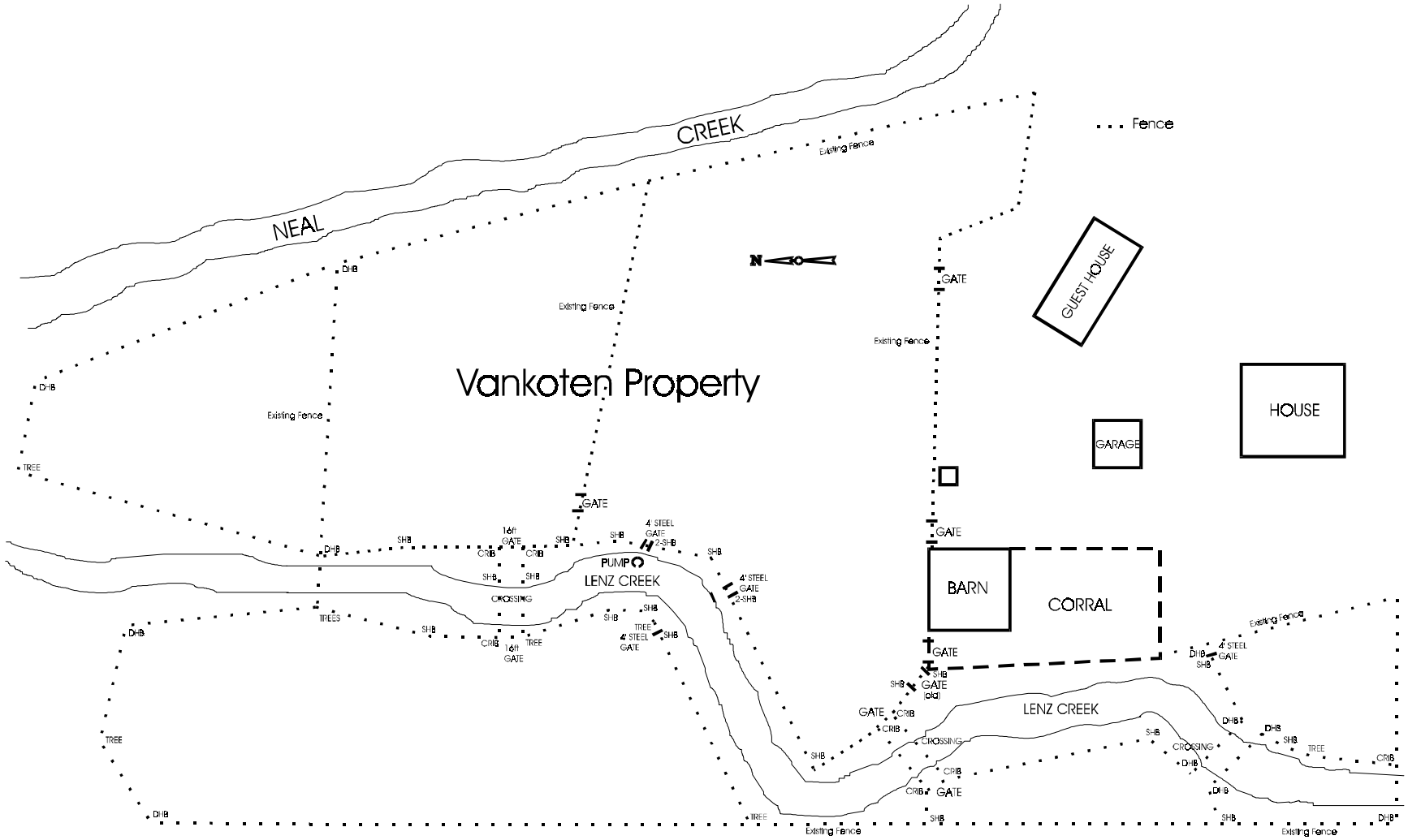


Figure 37. Diagram of the VanKoten property riparian fence exclosure project on Lenz and Neal Creek, 1999.

Baldwin Creek Riparian Fence Exclosure (Schneider Property - Rm 0.6-1.2)

In May and June, 2000 three riparian fence exclosures and modifications to a feed pen were completed on Baldwin Creek (Rm 1.0-1.6), tributary to the East Fork Hood River (Figure 31). This project had assistance from the ODFW, Natural Resource Conservation Service, Soil and Water Conservation District, and the Hood River Watershed Group. Baldwin Creek supports rainbow and cutthroat trout and coho salmon and it is designated as Essential Habitat for steelhead trout listed as a Threatened Species under the Endangered Species Act. The stream has several habitat problems including high summer temperatures, elevated nutrients, bacterial contamination, low dissolved oxygen, sedimentation, and streambank erosion. Also, non-point pollution sources include livestock access to streams, feed pens adjacent to streams, wetland drainage, failing onsite sewage treatment, riparian vegetation removal, highway maintenance activities, and road runoff.

The fences were constructed four ft high with field fencing and two strands of barbed-wire at the top to prevent livestock access to Baldwin Creek. Upon completion, the HRWG and volunteers from Mount Hood Meadows, planted 18 Douglas fir and 79 cedar conifer seedlings throughout the fence projects. All conifer seedlings were donated by local nurseries and summer watering and weeding provided by volunteers. These projects will remove sources of chronic erosion and disturbances within the riparian corridor, eventually restoring a portion of the riparian corridor to a more natural and higher functioning state. The projects were located on the Schneider property and he has agreed to maintain the fence at no cost to BPA.

The majority of the feed pen was fenced to keep cattle out of the stream and help to limit cattle waste in the creek (Figure 38). A small area was provided for winter watering. Schneider and a cattle lessee have been operating a livestock feed pen within the riparian zone of Baldwin Creek. They have agreed to let CTWSRO temporarily modify the feed pen until offsite watering could be developed through NRCS and HRSWCD. The HRSWCD is continuing to work with Schneider to develop a farm plan, including opportunities for off-channel watering, which would eliminate the feed pen completely from the creek.

West Fork Of Neal Creek Fluvial Investigation And Recommendations For Enhancement And Restoration - Feasibility Study

The February, 1996 flood washed away large portions of the West Fork Neal Creek county road, therefore, it was decided by Hood River County not to replace the high maintenance section of road. In September, 2000, Inter-Fluve, Inc. was contracted by CTWSRO to identify and assess potential improvements from near Hanel Mill downstream to the vicinity of the EFID East Lateral diversion dam, directly along the same portion of the abandoned road next to the

Figure 38. Feed pen on the Schneider property on Baldwin Creek (Rm 1.4), tributary to the East Fork Hood River, before and after completion of the fence project in 2000.

West Fork of Neal Creek (Figure 31). The feasibility study evaluated the cost-benefit ratio of removing the remaining portions of the road fill and looked at providing pool structures and/or woody debris into the channel (Interfluve, Inc., 2000). The report recognized removal of the road as a benefit and recommended some instream work by reach throughout the West Fork Neal Creek. The project would benefit listed winter steelhead, fall chinook salmon, and resident trout at an estimated cost of about $65,000. Hood River County, USFS, HRWG, and ODFW have agreed to assist with the project upon implementation.

Ongoing Project Work

Neal Creek Invert Siphon And Piping Project

A preliminary feasibility evaluation was completed in FY 98 by SJO Engineering (contracted by EFID), to look at three options to improve the EFID Neal Creek diversion: 1) construct a direct pipeline to convey the Neal Creek diversion flow of 42 cfs to the current diversion point out of Neal Creek. This pipe line would bypass Neal Creek's natural drainage channel entirely and would be routed along the existing old road bed on the west side of the stream. There would be several stream crossings involved to reach the current diversion site; 2) upgrade the existing Central Lateral Canal along the east side of the valley to increase the capacity to handle the additional Neal Creek flow of 42 cfs. This would involve approximately three miles of canal upgrades as well as 1,000 ft of piping at the end of the canal to directly convey the flow down the slope and across the stream with an invert siphon to the current diversion site; and 3) continue to divert irrigation water into Neal Creek and operate the diversion in its current configuration. This option would include a new fish screen at the current diversion site and would satisfy ODFW and NMFS criteria.

All agencies involved (EFID, CTWSRO, ODFW, HRWG, and ODEQ) have agreed that upgrading the existing Central Lateral Canal and completing an invert siphon (option 2 above) would have a greater environmental and operational benefit, but with a significantly higher cost ($8-$10 million dollars) and will need to be completed with a phased-in approach. The benefits of this alternative include improved Neal Creek water quality, elimination of a permanent irrigation structure that has impacted fish migration, and will save approximately 5 to 10 cfs of water from canal leakage to be restored as instream flow into the East Fork Hood River. In addition, no fish screen would be necessary on the Neal Creek canal once the pipe system is upgraded and operational. SJO Consulting engineers will complete preliminary engineering in FY 2001 and final engineering in FY 2002.

The East Fork Irrigation District (EFID) has used Neal Creek, tributary to the mainstem Hood River, to convey East Fork Hood River irrigation water to the Neal Creek Eastside Lateral Canal

for approximately 100 years. The East Fork Hood River originates from glaciers on Mt. Hood and as a result water transferred from the East Fork Hood River to the Eastside Lateral Canal via the Neal Creek channel frequently carries glacial flour and silt and negatively impacts Neal Creek, a non-glacial stream. Up to 42 cfs of water is diverted from Neal Creek (RM 5.0) into Neal Creek Eastside Lateral Canal to serve orchardists in the lower valley (Figure 31). The low head diversion dam (Figure 39) is a partial barrier to adults and the 32 inch diameter by 100 inch long rotary fish screen located in the ditch 1/4 mile downstream is inadequate to handle the volume of water in the ditch (Figure 40). At full operation, irrigation water tops the screen allowing fish access into the irrigation canal system. Past fish salvage operations have found steelhead/rainbow trout and cutthroat trout throughout the Neal Creek ditch and lateral canals (Table 29). Approach velocities were estimated at two ft/s, approximately five times the National Marine Fisheries Service (NMFS) standard (0.4 ft/s) and mesh size of the rotary screen (1/8 inch) does not meet NMFS criteria of 3/32 inch.

Figure 39. The Neal Creek Eastside Lateral Canal low head diversion dam operated by the EFID on Neal Creek (Rm 5.0).

Figure 40. The Neal Creek Eastside Lateral Canal rotary fish screen operated by the EFID.

Table 29. Fish salvage of the Neal Creek Eastside Lateral canal operated by the East Fork Irrigation District, 1999-2000.

	Location		Wild	
Date	**From**	**To**	**RB/STD**	**Cutthroat**
10-06-2000	Rotary screen	Swyers Drive	546	107
10-10-2000	Swyers Drive	Whiskey Creek	57	26
11-02-1999	Rotary screen	Swyers Drive	506	259

Farmers Canal Horizontal Flat Plate Fish Screen And Bypass Project - Mainstem Hood River Rm 11.5

Farmers Irrigation District (FID) plans to install a new screen in their 80-cfs diversion on the mainstem Hood River (Figure 31). Ongoing biological and hydraulic testing and engineering design has pushed the project along to the point of agencies approval should allow construction in the fall of 2001. The existing diversion has two rotary drum screens that has, over the years, been ineffective in protecting juvenile salmonids and also fails to meet federal and state screening standards. Efforts to improve the screen have helped, however, the screens do not adequately protect fish due to excessive approach velocities and periodic problems with gaps in and around the screens. Annual fish rescues in the Farmers Canal demonstrate that high numbers of anadromous fish get past the screens and are entrained in the canal (Table 30).

The new screen will consist of a horizontal plane, wedge-wire screen, which will cover an area of about 50 feet long in the canal. Irrigation water will passively infiltrate a stilling basin at extremely low velocities (over five times slower than NMFS velocity standards). Fish return water will flow in a laminar manner to the river from the distal end of the screen facility. A large-diameter pipe, connected to the stilling basin below the plane of the screen, will convey diverted water on down Farmers Canal. The pipe will serve as an outlet control reservoir facility, maintaining a constant minimum depth of one foot of water over the screen plane. The pipe will also replace a dilapidated flume system. The screen design and function will meet, and in most cases exceed, NMFS standards and ODEQ standards. The screen system passively manages debris, sediment, and fish without depending upon moving parts. FID has agreed to install a water burst cleaning system for debris maintenance on the screen.

Water that does not pass through the screen (up to 15 cfs) will be conserved for fish bypass water, which will flow through the outlet transition throat to the Joe's Creek headwater pool. This bypass water will flow across the screen with an initial sweeping velocity of about 6 fps at the screen entrance. The sweeping velocity will gradually slow to about 5 fps and then smoothly accelerate to a final exit velocity of about 9 fps through the outlet transition throat and into the Joe's Creek headwater pool.

Joe's Creek is approximately 900 feet long from its origin to its confluence with the mainstem Hood River. It has a narrow channel from 1 to 5 feet wide and is intermittent except where small seeps and impoundments form forested wetlands within and adjacent to the channel. The bypass flow for the new screen will be 10 to 15 cfs. The bypass flow will be directed to a new channel that flows into Joe's Creek and then to the Hood River. In order to utilize Joe's Creek as a fish bypass, 120 ft of new channel will be cut into the current grade from the new screen outlet to the intermittent channel. The new channel will have a slope less than one percent, bottom width

varying between 16 and 20 ft wide and top width of approximately 30 ft. Large wood material will be salvaged from the pipeline clearing and utilized to create habitat and form stream banks.

CTWSRO fish staff assisted FID and Dr. Jim Buell (FID fish screen consultant) in evaluating the biological performance of the prototype fish screen in the spring of 2000 as requested by the NMFS, USFWS, and the ODFW (Figure 41). The study evaluated the biological consequences of exposure of both fry and smolt life stages of steelhead and the fry life stage of chinook salmon. Screen tests completed showed no adverse affects of exposure (Buell, 2000). CTWSRO project staff continue to work with BPA on NEPA requirements and the completion of the biological assessments for project consultation with NMFS and USFWS.

The project cost with allowances for general testing, fish mortality studies, advanced engineering, wedge-wire screen material, telemetric supervisory control, data acquisition, and piping is estimated to be $2,300,000. BPA is providing cost-share funding of $600,000 (26%).

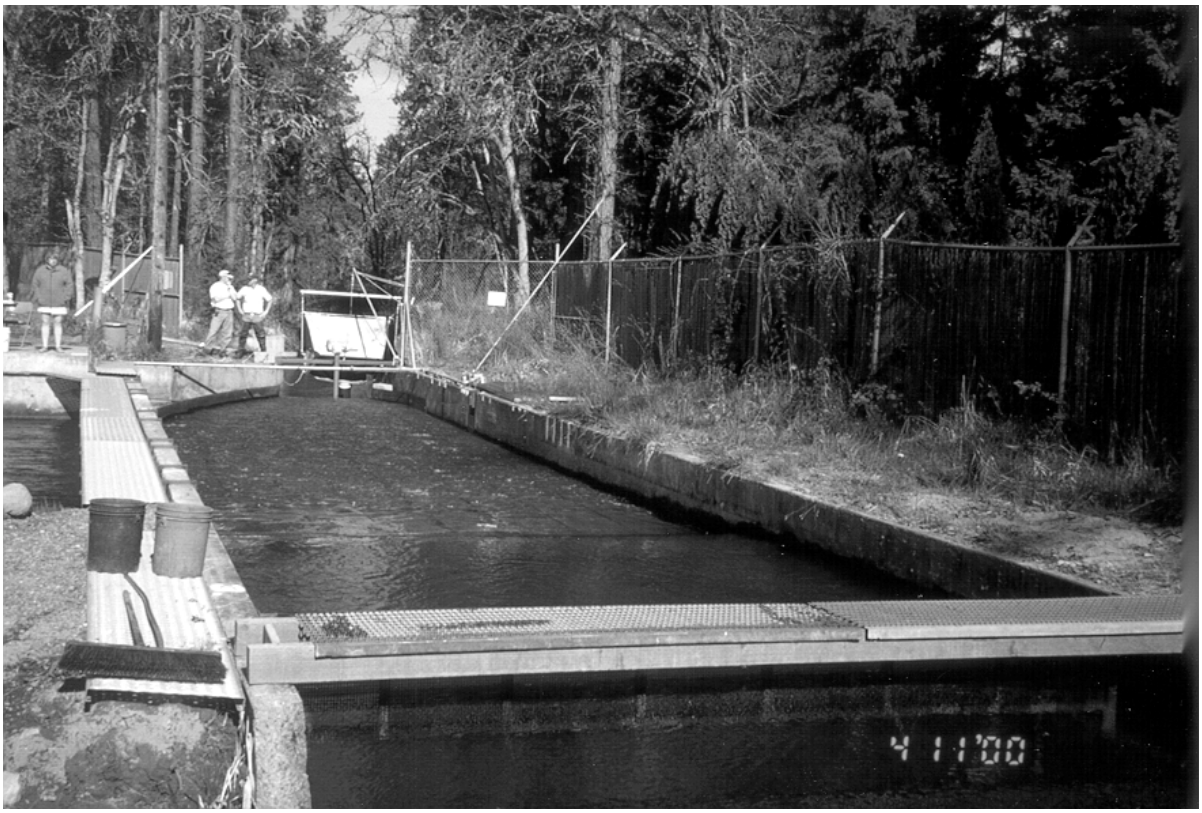


Figure 41. Photo of the FID horizontal plane, wedge-wire prototype screen during fish test activities, Spring 2000.

Table 30. Number of fish salvaged from the Farmers Irrigation District Farmers Canal by species and year.[a] (RB/STD is the abbreviation for rainbow/steelhead)

	Location		Wild	Finmarked	Resident				
Date	**From**	**To**	**RB/STD**	**RB/STD**	**Rainbow**	**Cutthroat**	**Whitefish**	**Chinook**	**Coho**
10-12-2000	Flume Crossing	Ditch Creek	841	9	13	198	58	3	1
10-12-1999	Flume Crossing	Ditch Creek	530	0	67	22	42	131	0
10-05-1998	Flume Crossing	Ditch Creek	315	0	NA	15	22	62	0
10-14-1997	Flume Crossing	Ditch Creek	206	0	NA	NA	5	6	0

[a] In 1997 and 1998 resident rainbow was not separated out from RB/STD and in 1997 cutthroat trout was not identified by species separate from RB/STD.

Stream Habitat Surveys

The Hood River Fish Habitat Protection, Restoration, and Monitoring Plan lists 17 anadromous streams that have not been surveyed within the Hood River subbasin (Table 32). Other streams have been added to Table 32, that were not identified in the Hood River Fish Habitat Protection, Restoration, and Monitoring Plan. CTWSRO surveyed Baldwin Creek, Graham Creek, and Tieman Creek in 2000 and will continue to survey additional streams in 2001.

The ODFW completed stream habitat surveys in 1993 and 1994 on 63 miles of potential anadromous salmonid (Table 31) bearing streams located primarily on private land, with selected reaches of stream located in the Mount Hood National Forest (Olsen et al., 1995). Surveys were completed using the Aquatic Inventory Project: Methods for Stream Habitat Surveys prepared by the ODFW (2000). CTWSRO used these survey summaries to describe instream and riparian conditions within the Hood River subbasin in the Hood River Watershed Assessment (HRWG 1999) and Fish Habitat Protection, Restoration, and Monitoring Plan (Coccoli et al., 2000). Stream habitat surveys are designed to provide quantitative information on habitat conditions for streams. Surveys provide managers with a basic understanding of each stream and assist field biologists in developing objectives and recommendations for protecting existing habitat and for developing and implementing habitat improvement projects. Information will also be used to determine potential limiting factors and carrying capacity.

Habitat survey data has been collected by the USFS on a number of streams on National Forest lands using a federal protocol. Although methodology used and the characteristics described for the stream surveys are compatible, the USFS has not entered the survey data into data bases for converting into ODFW methodology format. Most USFS stream surveys are available in written hard copies with provided raw data.

East Fork Hood River Canal Fish Salvage

Fish salvage in the East Fork Irrigation District (EFID) canal continues to be a tool to monitor the success of the Coanda screen project. The EFID diversion on the East Fork Hood River (Rm 6.0) was screened in FY 97 and FY 98 with a Coanda fish screen (Lambert et al., December 1999) [Figure 31]. The Coanda screen is a stationary wedge-wire screen and is considered experimental technology by the NMFS. The diversion, which had been unscreened for nearly 25 years prior to the Coanda screen installation, diverts a significant portion (130 cfs) of the East Fork Hood River from 1 March to 1 November. The CTWSRO, ODFW, USFS, and community volunteers have completed fish salvage in the EFID canal each year since 1986 to recover baseline information on fish losses behind the unscreened diversion (Table 33). Many species of

Table 31. Stream habitat surveys completed within the Hood River subbasin using ODFW methodology, 1992-2000.

Stream Name	Year	Beginning	End
West Fork Hood River	1992, 1994	Confluence of mainstem Hood River	Confluence of Elk and McGee creeks
Neal Creek	1993	Confluence of mainstem Hood River	Confluence of West Fork Neal Creek
East Fork Neal Creek	1993	Confluence of Neal Creek	Extends 3,132 meters above Beaver Creek
West Fork Neal Creek	1993	Confluence of Neal Creek	Extends 3,211 meters
Mainstem Hood River	1994	Confluence of Columbia River	Confluence of East and West Fork Hood River
East Fork Hood River	1994	Confluence of East Fork Hood River	USFS boundary, extends 1,934 meters above Dog River
Dog River	1994	Confluence of East Fork Hood River	USFS boundary, extends 1,340 meters above the mouth
Evans Creek	1994	Confluence of East Fork Hood River	Extends 514 meters above Griswell Creek
Green Point Creek	1994	Confluence of West Fork Hood River	Confluence of Lone Branch Creek
Lake Branch Creek	1994	Confluence of West Fork Hood River	Lost Lake
Middle Fork Hood River	1994	Confluence of East Fork Hood River	USFS boundary, Baseline Road
Baldwin Creek	2000	Confluence of East Fork Hood River	End of creek
Graham Creek	2000	Confluence of Baldwin Creek	End of creek
Tieman Creek	2000	Confluence of East Fork Hood River	EFID canal

Table 32. Stream habitat surveys needing completion within the Hood River subbasin.

Stream Name	Beginning	End
Lenz Creek	Confluence of Neal Creek	Entire creek
Shelly Creek	Confluence of Neal Creek	Entire creek
Middle Fork Hood River	USFS boundary, Baseline Road	Confluence of Clear Branch and Coe Branch creeks
Tony Creek	Confluence of Middle Fork Hood River	USFS boundary
Rogers Creek	Confluence of Middle Fork Hood River	Baseline Road
Bear Creek	Confluence of Middle Fork Hood River	Upstream anadromous barrier
Eliot Branch	Confluence of Middle Fork Hood River	Upstream anadromous barrier
Coe Branch	Confluence of Middle Fork Hood River	USFS Mount Hood Wilderness boundary
Clear Branch	Confluence of Middle Fork Hood River	Clear Branch Dam
East Fork Hood River	USFS boundary	Highway 35, below confluence of Mitchell Creek
Wishart Creek	Confluence of East Fork Hood River	Entire Creek
Emil Creek	Confluence of East Fork Hood River	Entire Creek
Evans Creek	Confluence of Griswell Creek	MFID Glacier ditch
Dog River	Confluence of East Fork Hood River	Dog River waterfall anadromous barrier
Crystal Spring Creek	Confluence of East Fork Hood River	Highway 35
Robinhood Creek	Confluence of East Fork Hood River	Upstream anadromous barrier
Jones Creek	Confluence of West Fork Hood River	Upstream anadromous barrier
McGee Creek	Confluence of West Fork Hood River	USFS Mount Hood Wilderness boundary
Elk Creek	Confluence of West Fork Hood River	Upstream anadromous barrier

Table 33. Number of fish salvaged from the EFID East Fork Hood River Canal by species and year.[a]

Date	Location From	Location To	Wild RB/STD	Finmarked RB/STD	Resident Rainbow	Cutthroat	Chinook	Coho
2000	No fish salvage							
11-23-1999	Miller Road Vicinity	Pine Mont Drive	156	0	b/	16	0	0
11-03-1999	Headgate	Sandtrap	1165	13	83	10	0	0
11-03-1999	Sandtrap	South end of Hess Road	391	2	b/	1	0	0
11-10-1998	Headgate	Sandtrap	592	2	0	0	0	0
11-02-1998	Sandtrap	South end of Hess Road	405	0	7	0	0	0
11-04-1997	Sandtrap	South end of Hess Road	655	17	b/	1	0	0
11-01-1996	Headgate	Sandtrap	71	0	b/	1	0	0
11-01-1996	Sandtrap	Hanel Mill/Elk Horn	164	0	b/	1	0	0
11-06-1995	Sandtrap	South end of Hess Road	397	0	b/	0	0	0
11-06-1995	Miller Road	Pine Mont Drive	128	0	b/	0	0	0
11-06-1995		Hanel Mill/Elk Horn	32	0	b/	0	0	0
11-05-1994	Sandtrap	Hanel Mill	925	0	15	2	2	2
11-04-1993		Sandtrap Vicinity	625	1	27	3	0	0
11-01-1992	Sandtrap	Hanel Mill	1191	0	83	6	0	14
11-02-1991	Sandtrap	Miller Road Vicinity	1657	0	0	6	7	34
11-03-1990	Sandtrap	Hanel Mill	739	0	0	0	36	156
11-18-1989	Sandtrap	Hanel Mill	637	0	0	14	0	68
11-19-1988	Pine Mont Drive	Hanel Mill	426	0	2	14	3	273
11-13-1988	Sandtrap	Pine Mont Drive	1719	0	2	17	12	302
11-01-1987	Sandtrap	Hanel Mill	1628	0	b/	4	19	215
11-14-1986	Miller Road	Hanel Mill	165	0	b/	3	0	0
11-05-1986	Old Screen	Highway 35	666	0	1	0	0	0

[a] No fish salvage was completed in 2000. A glacial mud flow event from Newton Creek shut down the EFID canal.

[b] Resident rainbow counted with wild rainbow/steelhead (RB/STD).

fish have been recovered in the canal including chinook and coho salmon, listed steelhead, resident rainbow and cutthroat trout, and fin-marked hatchery steelhead and trout (Table 33).

PELTON LADDER MONITORING AND EVALUATION

Introduction

The NPPC's Columbia River Basin Fish and Wildlife Program set a goal to double the runs of Columbia River salmon and steelhead. This increase is designed to offset losses resulting from the development and operation of the Columbia River hydropower system.

In its amended (1987) Fish and Wildlife Program, the NPPC included a goal to increase fish production at Pelton Ladder as a low-capital means of contributing to additional adult returns in the Columbia Basin and Deschutes River subbasin. The NPPC further specified that the ODFW and CTWS prepare a Master Plan prior to any design and construction. The Master Plan was completed in July, 1991 (Smith, M. 1991). Additional background information on the Deschutes River subbasin can be found in Lindsay et al., 1987 and 1989.

Pelton Ladder is an adult fishway extending from below Pelton Regulating Dam to the Pelton Dam (Rm 100), which impounds Lake Simtustus (Figure 41). The ladder is 10 feet wide, 6 feet deep, and 2.8 miles long. It was originally designed and constructed to allow passage of adult spring chinook salmon and summer steelhead around the re-regulating dam to Lake Simtustus. However, the ladder was abandoned for adult passage after the facilities at Round Butte Dam (located above Pelton Dam) failed to effectively pass juvenile salmonids downstream.

In the early 1980's, Pelton Ladder was modified and used as a rearing site for some of the juvenile spring chinook salmon produced at RBH. RBH, funded by Portland General Electric (PGE), was developed to mitigate for losses of spring chinook salmon and summer steelhead caused by the Pelton-Round Butte hydroelectric projects. The aim of the program is to achieve the mitigation level of 1,200 adults returning to Pelton trap each year. Prior to the 1994 brood year, RBH produced 270,000 spring chinook smolts as part of this mitigation effort.

In 1995, as part of the HRPP, the ladder was modified to create three new cells for rearing Deschutes stock hatchery spring chinook salmon (Figure 42). The three new cells were modified to replicate the existing rearing strategy in each section. These modifications allow the capability to rear 187,000 additional spring chinook salmon smolts. Fish reared in the new cells, L-4 and L-5, have been released into the Hood River since 1996. New cell L-6 (uppermost cell),

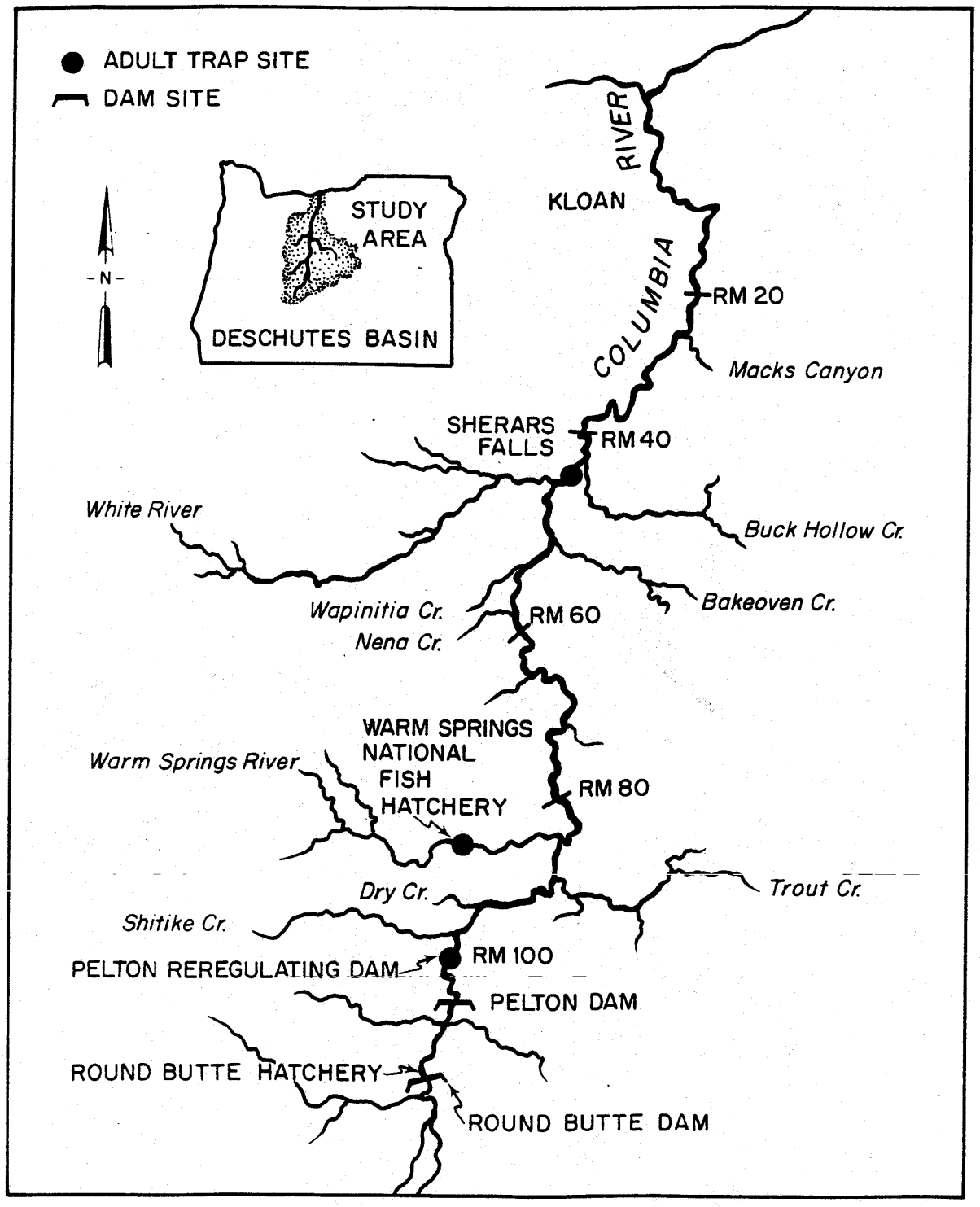


Figure 41. Lower 100 miles of the Deschutes River.

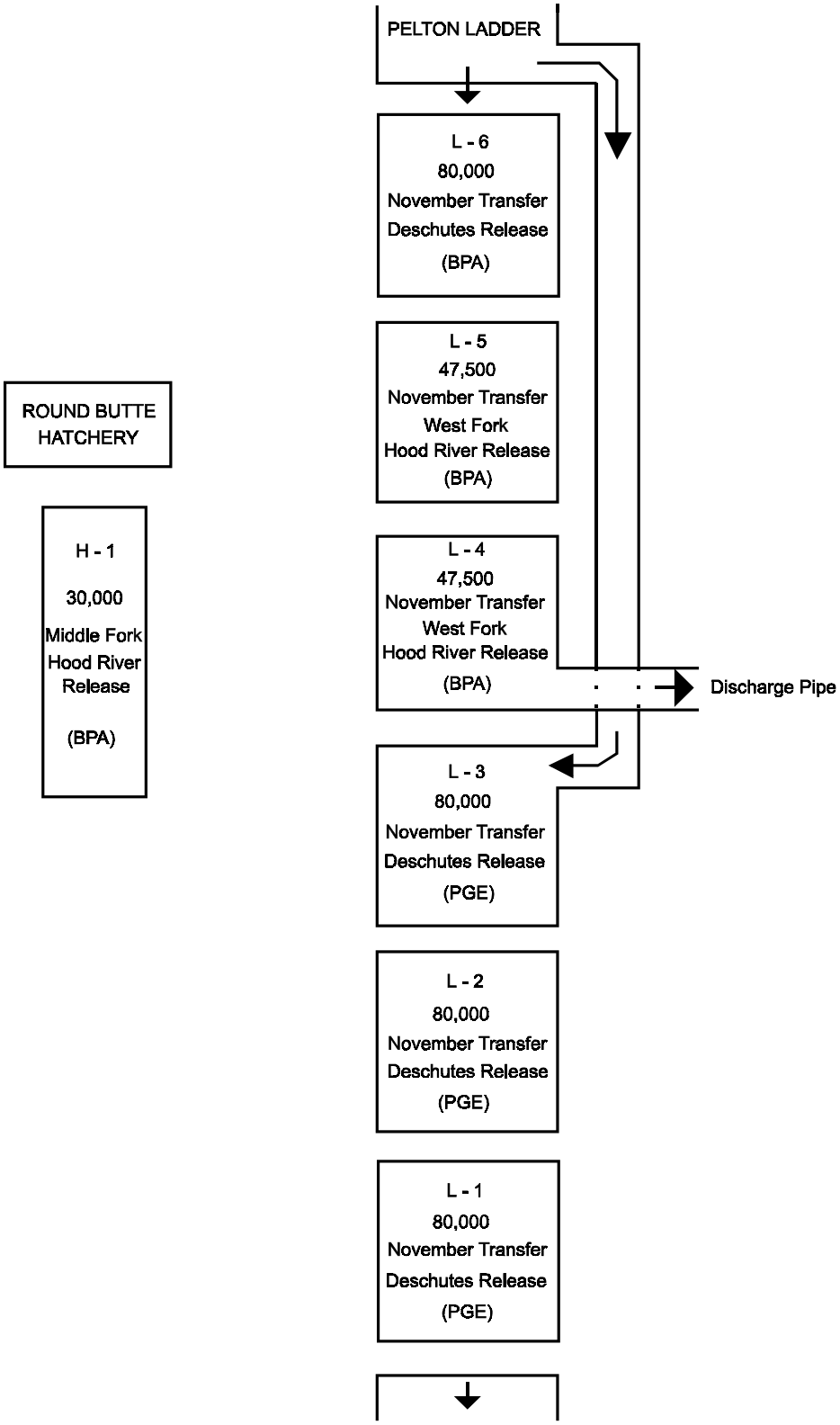


Figure 42. Rearing strategy for Round Butte Hatchery and Pelton Ladder to accommodate production of spring chinook salmon study fish, release years 1999 and 2000.

is used as an experimental study group for release into the Deschutes River. Upon completion of the Pelton Ladder studies, juvenile spring chinook salmon reared in the new cell (L-6) will be used for increasing production in the Hood River.

Methods

Study Design

The objective of experimental releases of spring chinook salmon from Pelton Ladder and RBH is to determine if modifying Pelton Ladder to rear more fish will reduce effectiveness of the existing production program. Furthermore, the study will evaluate how size at time of release effects post-release survival and provide basic information about rearing conditions in the ladder. Comparisons of the modified Pelton Ladder cells will be made against post-release survival rates of fish reared in the lower three cells of Pelton Ladder and hatchery ponds at RBH. Releases at RBH and Pelton Ladder were of two targeted size groups in release years 1996-1998: mediums (8 fish/lb) and smalls (12 fish/lb) [Figures 43 and 44].

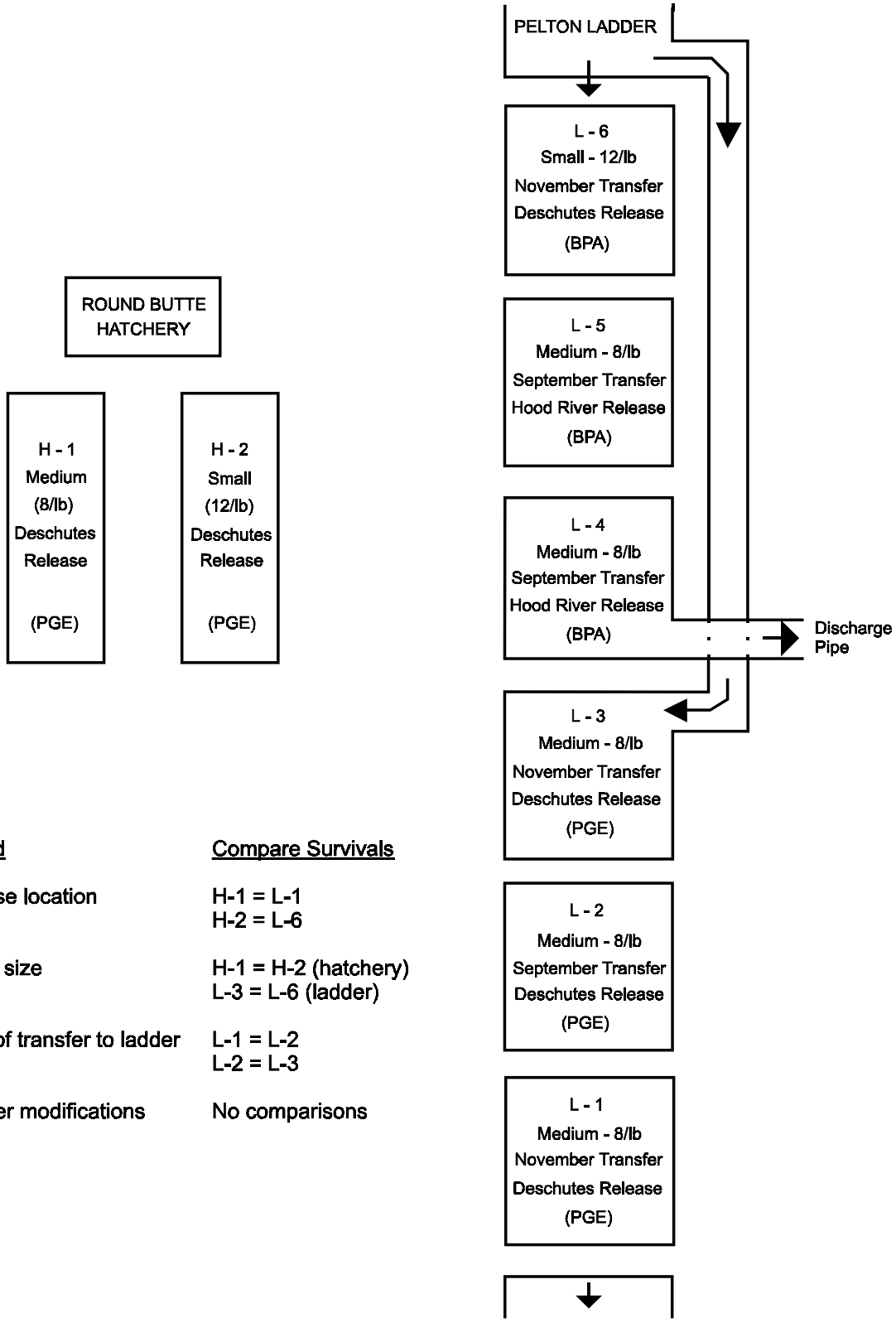
A Hobo temperature logger was used to collect water temperatures for Pelton Ladder throughout the rearing of spring chinook salmon smolts. Temperature data was recorded every hour and was downloaded at the end of rearing. Downloaded data for each site was reviewed for anomalies and was summarized into daily mean temperatures.

Rearing Procedures

Spring chinook salmon broodstock was collected randomly at Pelton Trap throughout the run between early May and mid June. Prior to the 1997 run year, 500 adults were collected and held at the hatchery. From the run year 1998 to 2000, 800 were collected for broodstock. Spring chinook salmon adults not needed for broodstock were given to the CTWSRO after snouts were removed from coded-wire tagged fish.

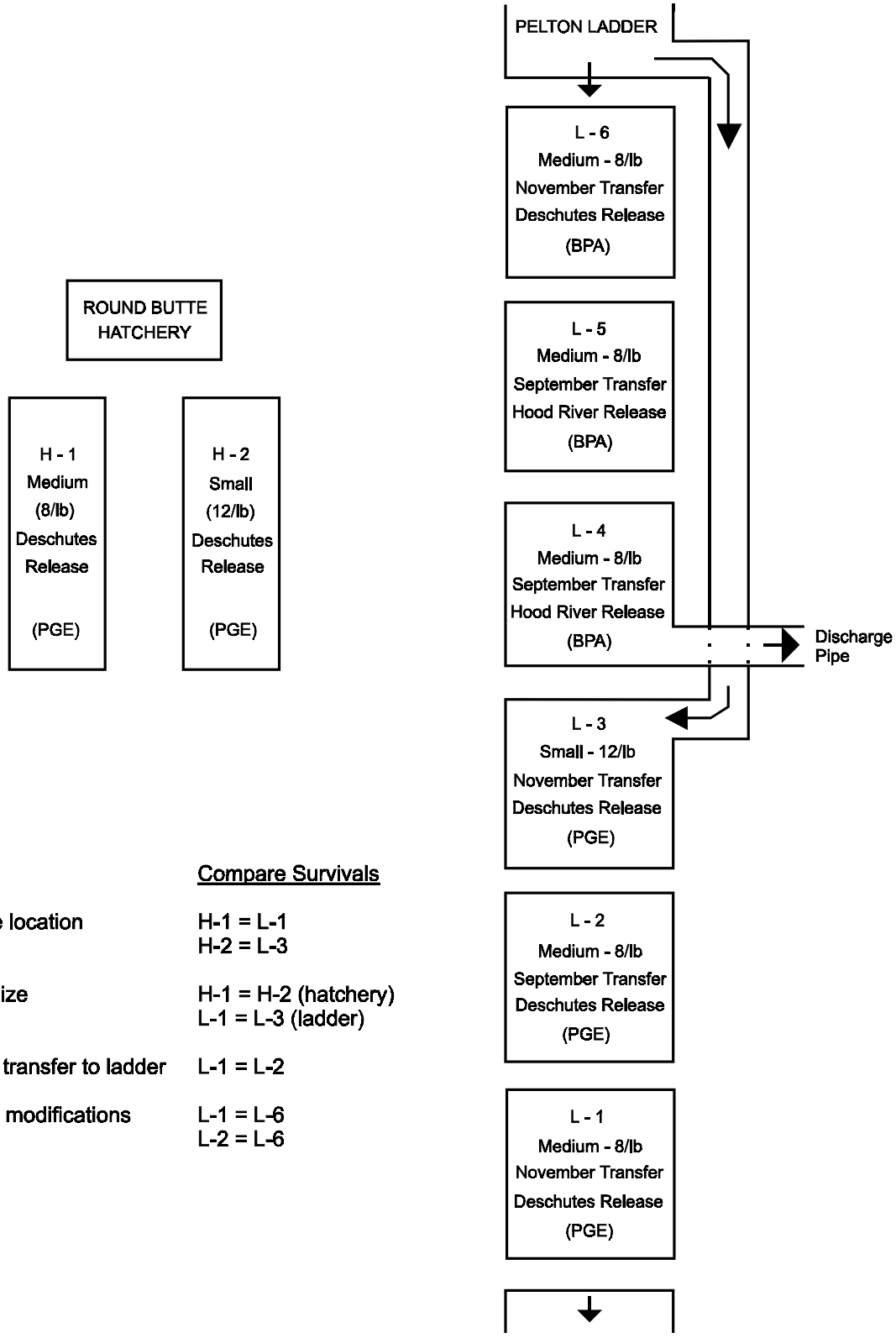
During the 1995-96 and 1996-97 finish rearing at Pelton Ladder, an extremely high level of hatchery spring chinook salmon smolt loss occurred as a result of Bacterial Kidney Disease (BKD). The parents of these smolts were highly infected with the disease and were most likely the cause of the fish loss. In 1997, following the fish loss event, a decision was made to cull eggs from adult females that carry high levels of BKD. Reducing the vertical transmission from parent to offspring is believed to be the most effective means of controlling the disease in fish hatcheries (Nyara, memo, 1997).

During the 1997 spring chinook salmon run year, 39% of the fish captured at Pelton Trap



Variable Tested	Compare Survivals
Effective release location	H-1 = L-1 H-2 = L-6
Effective smolt size	H-1 = H-2 (hatchery) L-3 = L-6 (ladder)
Effective time of transfer to ladder	L-1 = L-2 L-2 = L-3
Effects of ladder modifications	No comparisons

Figure 43. Ponding plan for RBH/Pelton Ladder to accommodate production of the 1994 brood spring chinook salmon study fish, release year 1996.



Variable Tested	Compare Survivals
Effective release location	H-1 = L-1 H-2 = L-3
Effective smolt size	H-1 = H-2 (hatchery) L-1 = L-3 (ladder)
Effective time of transfer to ladder	L-1 = L-2
Effects of ladder modifications	L-1 = L-6 L-2 = L-6

Figure 44. Ponding plan for RBH/Pelton Ladder to accommodate production of the 1995-96 brood spring chinook salmon study fish, release years 1997-1998.

were strays. Prior to the 1997 run year, approximately 2% was normal (Bill Nyara, personal communication June 25, 1998). The need to exclude eggs and milt from stray spring chinook salmon and to cull eggs from adult females with BKD after spawning has required RBH to hold 400 females and 400 males when available. If stray rates return to a more manageable level (approximately 2% or less), only 300 females and 300 males are necessary.

Spawning of spring chinook salmon at RBH occurred in late August and in early September. One male was used to fertilize the eggs of one female. Approximately 750,000 eggs were taken to produce 454,000 smolts needed for release. The eggs were moved to Heath incubators and placed on chilled water (5.5°C). Chilled water slowed the incubation period down and allowed smolts to be released as spring yearlings (fish reared from egg-take until spring of the second year). In the incubator eggs were water hardened for one hour and disinfected in a 10 ppm iodopher solution for 10 minutes.

After the eggs had eyed, they were shocked and sorted to remove dead and blank eggs. The chiller was turned off in late December. Fry were reared in ambient 10.5°C water in 6 ft diameter circular tanks until they reached a size of at least 300 fish/lb. Fry targeted as mediums (8 fish/lb) were then transferred in March to a single Burrows pond. Fry targeted as smalls (12 fish/lb) were transferred in April. Larges were split again in early May from one to two ponds. All ponds of spring chinook fingerlings were split again in July and August after being marked. Fish reared in Pelton Ladder were transferred there either in September, October, or November (**Appendix Table H-1**) and allowed to migrate volitionally the following April. **Appendix Table H-2** shows spring chinook salmon juvenile releases from RBH into the Deschutes River (1978-1999 broods).

In 1996, a high shortage occurred between what went in Pelton Ladder cells four and five from RBH (**Appendix Table H-2**) and disposition to the Hood River acclimation site (**See Acclimation, Table 8**). This was the first year an inventory was completed on fish coming out of the Pelton Ladder cells and raised concerns about the actual numbers released over the years from Pelton Ladder. Many ideas were shared to explain count inaccuracy by program staff, but most agreed mortality from BKD was likely the main factor. From 1997-2000 ODFW, PGE, and CTWSRO have evaluated spring chinook salmon smolt mortality in Pelton Ladder and RBH during the finish rearing period. RBH (ODFW) staff picked morts daily off fish screens and PGE and CTWSRO staff snorkeled every two to three weeks to account for mortality in the cells themselves. RBH staff collected non-migrant mortalities from Pelton Ladder in early May after shutdown of Pelton Ladder.

All spring chinook salmon targeted for release into the Deschutes River were marked with an adipose fin clip, while those smolts destined to the Hood River were marked with an adipose and

left or right ventral, or left or right maxillary clip combination. All Deschutes and Hood River subbasin releases were differentially marked with a coded-wire tag (**See Appendix Table H-1**). Tag retention was determined just before release by crowding the fish in a pond or raceway and evaluating a random sample of fish. The presence of a coded-wire tag was assessed with a field detector. Each fish in the sample was examined for a fin clip. Spring chinook salmon juveniles were weighed (g) and measured (mm) and condition factors (weight [g] * 100/length^3 [mm]) were calculated prior to release in the spring.

Coded-wire tags from returning adults were recovered from snouts of fish collected at the Pelton Trap, Warm Springs National Fish Hatchery, and tribal and non-tribal fisheries at Sherars Falls. Return rate was calculated as the percentage of juveniles released with coded-wire tags that returned as adults.

Results And Discussion

Comparisons Of Pre-Modification vs Post-Modification Adult Production

Release of spring chinook salmon smolts for this study were in 1996 (1994 brood). Study results, based on post-release survival rate, between the newly modified and old cells of Pelton Ladder and ponds at RBH will be analyzed in FY 2001 and 2002 upon completion of several brood years (Table 34). The first complete brood year (1994) for Pelton Ladder studies was 1999.

Mean length, weight, and condition factors were estimated for Deschutes spring chinook salmon smolts reared at RBH and Pelton Ladder prior to release (Table 35). Mean condition factors for brood years 1994-1997 ranged from 1.05 to 1.28.

Measured Smolt Mortality At Pelton Ladder And Round Butte Hatchery

Total smolt mortalities during the rearing period at Pelton Ladder more than doubled from 15,235 in 1998 to 31,994 in 1999 and then dropped to a total of 6,685 in 2000 (Table 36). Mortalities ranged from 371-10,463 morts per cell during the rearing period 1 November, 1998 to 10 May, 1999 and 26-1,282 morts per cell from 1 November, 1999 to 10 May, 2000. **Appendix Tables H-3,H-4,** and **H-5** display the monthly mortality rates, RBH pond origins, and dates of transfer to Pelton Ladder for each cell. The main cause of the Pelton Ladder smolt mortalities continues to be Bacterial Kidney Disease, however an outbreak of fungus contributed to the mortality in 1998-99.

RECOMMENDATIONS

The purchase and installation of emergency pumps at Pelton Ladder need to be considered in future budgets. Emergency pumps would be necessary if there was a loss of water supply to the fish rearing cells. Loss of water could result in fish mortality or an early release of spring chinook salmon fingerlings. An early release could result in an indirect mortality. When considering emergency pumps, project staff should consider needs for future additional cells.

Continue to evaluate hatchery spring chinook salmon smolt mortality loss at Pelton Ladder and RBH during Pelton Ladder and RBH finish rearing. Accounting for mortality in the ladder provides a more accurate count of smolts released into the Deschutes River subbasin as part of the Pelton Ladder study provides RBH staff knowledge of potential outbreaks of disease in Pelton Ladder and allows morts to be collected and sent to ODFW Pathology for determination of cause.

Table 34. Return by age of Pelton Ladder and Round Butte Hatchery (RBH) reared spring chinook salmon back to the Deschutes River subbasin, 1994-98 broods. Returns include tribal and sport harvest, and Pelton Trap. Harvest data expanded. Coded-wire tag data not expanded for no snout/no tag/lost tag. (Percent return is in parentheses).

Brood year, location reared, pond or cell	Release date	Number released	Size (fish/lb)	Total age			
				Age 3	Age 4	Age 5	Total
1994,							
RBH,							
H-1	04-25-96	19239	8.0	1(0.01)	5(0.03)	0(0.00)	6(0.03)
H-2	04-25-96	25654	10.7	1(0.01)	8(0.03)	0(0.00)	9(0.04)
Pelton Ladder,							
L-1	04-22-96	65625	7.3	8(0.01)	61(0.09)	0(0.00)	69(0.11)
L-2	04-23-96	63445	7.8	10(0.02)	49(0.08)	0(0.00)	59(0.09)
L-3	04-24-96	63551	8.3	8(0.01)	72(0.12)	1(0.01)	81(0.13)
L-4,5	04-25-96	7282	9.9	0(0.00)	3(0.04)	0(0.00)	3(0.04)
L-6	04-25-96	85151	10.9	5(0.01)	42(0.05)	0(0.00)	47(0.06)
1995,							
RBH,							
H-1	04-15-97	14910	6.5	2(0.01)	68(0.46)	0(0.00)	70(0.47)
H-2	04-15-97	25938	11.0	17(0.07)	103(0.40)	1(0.01)	121(0.47)
Pelton Ladder,							
L-1	04-16-97	61102	7.3	5(0.01)	111(0.18)	0(0.00)	116(0.19)
L-2	04-17-97	61232	7.3	8(0.01)	202(0.33)	2(0.01)	212(0.35)
L-3	04-18-97	90474	11.0	13(0.01)	335(0.37)	1(0.01)	349(0.39)
L-6	04-21-97	62530	8.0	3(0.01)	61(0.10)	2(0.01)	66(0.11)
1996,							
RBH,							
H-1	04-13-98	16397	8.6	9(0.05)	76(0.46)		85(0.52)
H-2	04-13-98	31699	12.0	26(0.08)	141(0.44)		167(0.53)
Pelton Ladder,							
L-1	04-13-98	60145	9.0	18(0.03)	104(0.17)		122(0.20)
L-2	04-14-98	63213	8.1	6(0.01)	58(0.09)		64(0.10)
L-3	04-15-98	96633	11.0	3(0.01)	24(0.02)		27(0.03)
L-6	04-16-98	64149	10.0	8(0.01)	33(0.05)		41(0.06)
1997,							
Pelton Ladder,							
L-1	04-12-99	71395	7.8	73(0.10)			73(0.10)
L-2	04-13-99	72375	7.52	54(0.07)			54(0.07)
L-3	04-14-99	79611	7.74	76(0.10)			76(0.10)
L-6	04-15-99	80940	7.12	62(0.08)			62(0.08)
1998,							
Pelton Ladder,							
L-1	04-17-00	82,130	8.1				
L-2	04-18-00	81,900	8.46				
L-3	04-19-00	82,938	7.22				
L-4	04-20-00	51,142	7.44				

Table 35. Estimates of mean fork length (FL; mm), weight (g), and condition factor (CF) for Deschutes stock hatchery spring chinook salmon smolts sampled at Pelton Ladder (C = cell) and Round Butte Hatchery (H = pond) prior to release into the Deschutes and Hood River subbasins[a], 1994-1998 broods.

Statistic, pond or cell, brood year	N	Mean	Range	95% C.I.
FL (mm),[b]				
H-1,				
1994	152	178.1	135 - 260	± 10.6
1995	177	175.7	145 - 240	± 9.9
1996	201	158.6	126 - 283	± 8.6
H-2,				
1994	209	158.9	135 - 195	± 9.4
1995	157	158.0	125 - 190	± 10.6
1996	203	153.6	130 - 236	± 8.9
H-10,				
1997	275	172.8	133 - 250	± 7.9
C-1,				
1994	226	174.7	120 - 245	± 8.2
1995	197	175.0	136 - 229	± 9.3
1996	198	155.3	118 - 230	± 9.1
1997	265	170.0	127 - 245	± 7.4
C-2,				
1994	210	170.3	130 - 260	± 8.7
1995	199	176.1	137 - 224	± 9.6
1996	200	162.1	130 - 263	± 9.0
1997	207	168.9	130 - 238	± 8.4
C-3,				
1994	204	165.1	130 - 245	± 8.7
1995	195	153.6	125 - 213	± 9.0
1996	199	152.5	129 - 239	± 9.1
1997	207	168.7	130 - 235	± 8.8
C-4,				
1994	226	158.6	125 - 265	± 8.4
1995	208	167.5	115 - 250	± 8.4
1996	203	146.3	103 - 208	± 8.3
1997	530	168.4	106 - 233	± 5.6
C-5,				
1994	229	160.9	125 - 240	± 8.8
1995	213	174.0	109 - 235	± 8.8
1996	199	156.2	103 - 216	± 9.1
1997	297	173.6	91 - 236	± 7.8

Table 35. Continued.

Statistic, pond or cell, brood year	N	Mean	Range	95% C.I.
FL (mm),[b]				
C-6,				
1994	200	148.9	125 - 210	± 8.8
1995	212	166.0	130 - 250	± 8.1
1996	202	152.9	122 - 222	± 8.6
1997	208	170.8	135 - 239	± 8.8
Weight (g),[c]				
H-1,				
1994	152	69.5	26.2 - 188.1	± 0.9
1995	177	69.6		
1996	200	49.8	22.6 - 300.0	± 0.29
H-2,				
1994	209	46.4	25.8 - 97.0	± 1.5
1995	157	44.4		
1996	203	42.4	23.0 - 152.0	± 1.02
H-10,				
1997	275	67.7	28.5 - 197.6	± 0.43
C-1,				
1994	226	66.0	22.6 - 178.1	± 0.1
1995	197	60.8	24.3 - 124.3	± 0.8
1996	198	46.3	19.3 - 177.2	± 0.77
1997	265	62.8	22.2 - 179.9	± 0.05
C-2,				
1994	210	59.8	23.4 - 199.4	± 0.08
1995	198	65.3	28.9 - 134.1	± 1.19
1996	200	53.8	24.8 - 300.0	± 0.20
1997	207	61.4	26.6 - 162.3	± 0.30
C-3,				
1994	204	54.5	24.6 - 164.1	± 0.3
1995	195	41.7	19.8 - 106.5	± 1.04
1996	199	40.5	23.4 - 153.6	± 1.1
1997	207	59.4	23.6 - 149.7	± 0.76
C-4,				
1994				
1995	208	58.4	18.6 - 174.1	± 0.3
1996	203	38.9	11.9 - 119.9	± 0.75
1997	530	61.6	15.2 - 171.8	± 0.59

Table 35. Continued.

Statistic, pond or cell, brood year	N	Mean	Range	95% C.I.
C-5,				
1994				
1995	213	63.7	10.0 - 159.8	± 0.51
1996	199	46.1	9.3 - 124.5	± 1.15
1997	297	66.8	6.7 - 175.8	± 0.80
C-6,				
1994	200	39.8	22.8 - 117.8	± 1.3
1995	212	55.3	23.7 - 167.6	± 0.08
1996	202	41.7	20.6 - 137.6	± 0.5
1997	208	62.8	26.2 - 161.4	± 0.54
CF,[d]				
H-1,				
1994	152	1.17	0.90 - 1.63	± 0.08
1995	177	1.28		
1996	200	1.17	0.90 - 1.44	± 0.07
H-2,				
1994	209	1.13	0.85 - 1.60	± 0.06
1995	157	1.05		
1996	203	1.14	0.96 - 1.70	± 0.07
H-10,				
1997	275	1.24	0.96 - 1.53	± 0.06
C-1,				
1994	226	1.15	0.78 - 1.53	± 0.07
1995	197	1.07	0.80 - 1.26	± 0.07
1996	198	1.19	1.04 - 1.49	± 0.07
1997	265	1.18	0.68 - 1.49	± 0.06
C-2,				
1994	210	1.13	0.84 - 1.40	± 0.07
1995	198	1.15	0.94 - 1.32	± 0.07
1996	200	1.19	1.06 - 1.65	± 0.07
1997	207	1.19	1.02 - 1.40	± 0.07
C-3,				
1994	204	1.15	0.90 - 1.42	± 0.07
1995	195	1.11	0.94 - 1.28	± 0.07
1996	199	1.12	0.91 - 1.38	± 0.07
1997	207	1.17	1.01 - 1.35	± 0.07
C-4,				
1994				
1995	208	1.17	1.03 - 1.42	± 0.07
1996	203	1.20	0.87 - 1.57	± 0.07

Table 35. Continued.

Statistic, pond or cell, brood year	N	Mean	Range	95% C.I.
CF,[d]				
C-5,				
1994				
1995	213	1.13	0.77 - 1.72	± 0.06
1996	199	1.17	0.85 - 1.39	± 0.07
1997	297	1.22	0.89 - 1.63	± 0.06
C-6,				
1994	200	1.19	0.95 - 1.51	± 0.07
1995	212	1.12	0.75 - 1.40	± 0.07
1996	202	1.12	0.93 - 1.39	± 0.07
1997	208	1.19	0.91 - 1.56	± 0.07

[a] Juveniles were sampled within one week of release.
[b] Lengths were rounded to the nearest 5 mm for the 1994 brood year and hatchery ponds one and two for the 1995 brood year.
[c] Fish scale maximum weight is 300 g.
[d] Condition factor was calculated as (weight [g] * 100/length^3 [mm]).

Table 36. Annual mortality at Pelton Ladder cells (L) and Round Butte Hatchery ponds (RBH) for spring chinook salmon juveniles from time of transfer to Pelton ladder to time of release from Pelton Ladder (November-May). 1997-2000.

Cell, year	L 1	L 2	L 3	L 4	L 5	L 6	RBH	Total
1997-98	6328	2419	1025	1485	2100	1743	135	15235
1998-99	11063	10067	2789	4104	2084	1516	371	31994
1999-2000	1636	1989	702	1190	785	357	26	6685

ACKNOWLEDGMENTS

The authors greatly appreciated the efforts of Lillian Dick for her assistance in conducting the field work and summarizing and tabulating the data included in report A and B. Special thanks to hatchery managers Bill Nyara (RBH) and Randy Robart (OSH) and staff for their assistance in data collection and guidance in hatchery operations.

The CTWSRO would like to acknowledge the following individuals, associations, corporations, and agencies for their cooperation and help in acclimating hatchery winter steelhead and spring chinook salmon smolts in the Hood River subbasin. Special thanks to the Hood River Ranger District of the Mount Hood National Forest, USDA Forest Service, Steve Hanson (Longview Fibre), and John Buckley (East Fork Irrigation District manager) for their support in allowing acclimation to take place on their managed lands. Additionally, we would like to thank CTWSRO Warm Springs fisheries staff; Holly Coccoli, Chuck Gehling and volunteers (Hood River Watershed Group); and Americorps, Tony DePinto, and Carrie Nelson for their help in site preparation, acclimation setup, and acclimation takedown. We also thank Carolyn Brunoe, Monica Burke, Ervin Kishwalk, Donnetta Squiemphen, and Eugene Stahi for their long hours of watching over the acclimation facilities and caring for the fish. Additionally, special thanks to Capt. John B. Johnson, Lt. Jerry Ekker (Columbia River Inter-tribal Fisheries Enforcement) and Ken Galloway (Hood River County Forestry) for providing radio communication equipment and service during acclimation.

REFERENCES

Buell and Associates, Inc. October 1996. Biological performance evaluation of an overflow weir profile bar fish screen for East Fork Irrigation District. Unpublished report. Portland, Oregon.

Blodgett J. Yakima Indian Nation, Fisheries Resource Management Program. 1994. K-Basin Fall Chinook Acclimation Report. Unpublished report. Toppenish, Washington.

Bottom, D.L., Howell, P.J., Rodgers, J.D., ODFW. 1985. The effects of stream alterations on salmon and trout habitat in Oregon. Portland, Oregon.

Buell, J.W., Ph.D. 2000. Fish screen performance tests - progress report to FID, Hood River, Oregon.

Department of Natural Resources, Confederated Tribes of the Warm Springs Reservation of Oregon. October 1993. Hood River/Pelton ladder master agreement. Bonneville Power Administration, Portland, Oregon.

DOE and BPA (U.S. Department of Energy and Bonneville Power Administration). March 1996. Hood River fisheries project. Draft Environmental Impact Statement (DOE/EIS-0241). Bonneville Power Administration, Portland, Oregon.

DOE and BPA (U.S. Department of Energy and Bonneville Power Administration). July 1996. Hood River fisheries project. Final Environmental Impact Statement (DOE/EIS-0241). Bonneville Power Administration, Portland, Oregon.

Interfluve, Inc., 2000. West Fork of Neal Creek investigation and recommendations for enhancement and restoration to CTWSRO, The Dalles, Oregon.

Keefe, M., Carmichael, R.W., Focher, S.M., Groberg, W.J., Hayes, M.C., ODFW. 1994. Umatilla Hatchery monitoring and evaluation (Project 90-005; Contract DE-BI79-91BP23720) to Bonneville Power Administration, Portland, Oregon.

Lambert M.B., M. Jennings, and P. O'Toole, Confederated Tribes of the Warm Springs Reservation of Oregon. 1996. Annual progress report 1995. In: ODFW and CTWS, cooperators. Hood River and Pelton Ladder evaluation studies. Annual Progress Report of the Confederated Tribes of the Warm Springs Reservation and Oregon Department of Fish and Wildlife (Projects 89-29, 89-29-01, 89-053-03, 89-053-04, and 93-019;

Contracts DE-BI7989BP00631, DE-BI17989BP00632, DE-BI17993BP81756, DE-BI17993BP81758, DE-BI17993BP99921) to Bonneville Power Administration, Portland, Oregon.

Lambert M.B., J. McCanna, and M. Jennings, Confederated Tribes of the Warm Springs Reservation of Oregon. January 1998. Annual progress report 1996. In: ODFW and CTWSRO, Hood River Production Program monitoring and evaluation. Annual Progress Report of the Confederated Tribes of the Warm Springs Reservation of Oregon and Oregon Department of Fish and Wildlife (Projects 89-053-03 and 89-053-04); Contracts DE-BI7989BP00631, DE-BI17989BP00632) to Bonneville Power Administration, Portland, Oregon.

Lambert M.B., J. McCanna, and M. Jennings, Confederated Tribes of the Warm Springs Reservation of Oregon. December 1998. Annual progress report 1997 of the Confederated Tribes of the Warm Springs Reservation of Oregon (Project 89-053-03; Contract DE-BI79-89BP00631) to Bonneville Power Administration, Portland, Oregon.

Lindsay, R.B. and B.C. Jonasson. 1987. An evaluation of spring chinook salmon rearing program at Round Butte Hatchery. Oregon Department of Fish and Wildlife, Fish Research Project F-88-R, Interim Report, Portland, Oregon.

Lindsay R.B., B.C. Jonasson, R.K. Schroeder, and B.C. Cates. 1989. Spring chinook salmon in the Deschutes River, Oregon. Oregon Department of Fish and Wildlife, Information Report, Portland.

Lindsay R.B., K.R. Kenaston, and R.K. Schroeder. 1991. Steelhead production factors. Oregon Department of Fish and Wildlife, Fish Research Project F-120-R, Annual Progress Report, Portland, Oregon.

Lindsay R.B., R.K. Schroeder, and K.R. Kenaston. 1992. Steelhead production factors. Oregon Department of Fish and Wildlife, Fish Research Project F-120-R, Annual Progress Report, Portland, Oregon.

Lindsay R.B., K.R. Kenaston, and R.K. Schroeder. 1993. Steelhead production factors. Oregon Department of Fish and Wildlife, Fish Research Project F-120-R, Annual Progress Report, Portland, Oregon.

Lindsay R.B., R.K. Schroeder, and K.R. Kenaston. 1994. Steelhead production factors. Oregon Department of Fish and Wildlife, Fish Research Project F-120-R, Annual Progress Report, Portland, Oregon.

Meehan, William R. (Editor). 1991. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19, Bethesda, MD.

Nelson, L.D., ODFW. 1996. A brief history of Powerdale Dam fish ladder and adult trap. Unpublished report. The Dalles, Oregon.

Northwest Power Planning Council. 1987. Columbia River basin fish and wildlife program. Portland, Oregon.

Northwest Power Planning Council. 1992. NPPC approval letter for the Hood River Master Plan to Zane Jackson, Chairman, CTWS. April 16, 1992.

Nyara, B. 1997. Memorandum to the Oregon Department of Fish and Wildlife and Confederated Tribes of the Warm Springs Reservation of Oregon staff. May 2, 1997. Oregon Department of Fish and Wildlife, Madras, Oregon.

ODFW and CTWSRO (Oregon Department of Fish and Wildlife and Confederated Tribes of the Warm Springs Reservation of Oregon). September, 1990. Hood River Subbasin Salmon and Steelhead Production Plan.

Olsen, E., P. Pierce, M. McLean, and K. Hatch. 1992. Stock summary reports for Columbia River anadromous salmonids, volume II: Oregon. Final Report of Oregon Department of Fish and Wildlife (Project Number 88-108, Contract Number DE-FC79-89BP94402) to Bonneville Power Administration, Portland, Oregon.

Olsen, Erik A., R.A. French, J.A. Newton. Hood River and Pelton Ladder Evaluation Studies, Annual Report, to Bonneville Power Administration, Portland, OR, Contract 89-BI-00631, BI-00632, 93-BI-81756, 93-BI-81758, 93-BI-99921, Project 89-29, 89-053-03, 89-053-04, 93-019, 47 electronic pages (BPA Report DOE/BP-00631-3)

Olsen, E.A., R.A. French, and A.D. Ritchey. 1995. Hood River and pelton ladder evaluation studies. Annual Progress Report 1994 of Confederated Tribes of the Warm Springs Reservation and Oregon Department of Fish and Wildlife (Projects 88-29, 89-29-01, 89-053-03, 89-053-04, 93-019; Contracts DE-BI7989BP00631, DE-BI17989BP00632,

DE-BI17993BP81756, DE-BI17993BP81758, DE-BI17993BP99921) to Bonneville Power Administration, Portland, Oregon.

Olsen, E.A., R.A. French, and A.D. Ritchey, Oregon Department of Fish and Wildlife. 1996. Annual progress report 1995. In: ODFW and CTWS, cooperators. Hood River and Pelton Ladder evaluation studies. Annual Progress Report of the Oregon Department of Fish and Wildlife (Projects 89-29, 89-29-01, 89-053-03, 89-053-04, and 93-019; Contracts DE-BI7989BP00631, DE-BI17993BP81756, DE-BI17993BP81758, DE-BI17993BP99921) to Bonneville Power Administration, Portland, Oregon.

Olsen, Erik A., R.A. French, Lambert, Micheal B., M. Jennings, J.P. McCanna, Hood River Production Program Monitoring and Evaluation; Report A: Hood River and Pelton Ladder Evaluation Studies, Report B: Hood River and Pelton Ladder, Annual Report to Bonneville Power Administration, Portland, OR, Contract 89-BI-00631, 89-BI-00632, Project 88-053-03, 88-053-04, 248 electronic pages (BPA Report DOE/BP-00631-5)

Olsen, E.A. and R.A. French, Oregon Department of Fish and Wildlife. December 1998. Annual progress report 1997 of the Oregon Department of Fish and Wildlife (Project 89-053-04; Contract DE-BI79-89BP00632) to Bonneville Power Administration, Portland, Oregon.

Olsen, Erik A. - Oregon Department of Fish and Wildlife, Hood River And Pelton Ladder Evaluation Studies, Annual Report 1998-1999, Report to Bonneville Power Administration, Contract No. 00000151, Project No. 198805304, 212 electronic pages (BPA Report DOE/BP-00000151-1)

O'Toole, P., Oregon Department of Fish and Wildlife. Hood River Production Master Plan, to Bonneville Power Administration, Portland, OR, Contract 89-BI-00631, Project 88-053, 100 electronic pages (BPA Report DOE/BP-00631-1)

O'Toole, P., Oregon Dept. of Fish and Wildlife, Hood River Production Master Plan, Appendices 1991, to Bonneville Power Administration, Portland, OR, Contract 89-BI-00631, Project 88-053, 196 electronic pages (BPA Report DOE/BP-00631-2)

PacifiCorp. 1995. Powerdale Hydroelectric Project. First stage consultation document (Ferc Project No.2659). Portland, Oregon.

Schreck, C.B., M.F. Solazzi, S.L. Johnson, and T.E. Nickelson. 1989. Transportation stress affects performance of coho salmon, *Oncorhynchus Kisutch.* Aquaculture 82:15-20.

Smith, M. ODFW and CTWS. Pelton Ladder Master Plan. 1991. Master plan prepared for the Northwest Power Planning Council by the Confederated Tribes of the Warm Springs Reservation and the Oregon Department of Fish and Wildlife. Warm Springs and Portland, Oregon.

Viola, A.E., M.L. Schuck. 1995. A method to reduce the abundance of residual hatchery steelhead in rivers. North American Journal of Fisheries Management 15:488-493.

Volkman, J., Confederated Tribes of the Umatilla Reservation of Oregon. 1994. Evaluation of adult passage facilities at water diversions in the Umatilla River. In: S.M. Knapp, ed. Evaluation of juvenile fish bypass and adult fish passage facilities at water diversions in the Umatilla River (Project 89-024-01; Contract DE-BI79-89BP01385) to Bonneville Power Administration, Portland, Oregon.

Watershed Professionals Network. 1999. Oregon Watershed Assessment Manual. June 1999. Prepared for the Governor's Watershed Enhancement Board, Salem, Oregon.

Whitesel, T.A., P.T. Lofy, R.W. Carmichael, R.T. Messmer, M.W. Flesher, D.W. Rondorf. 1994. A comparison of the performance of acclimated and direct stream released, hatchery reared steelhead smolts in Northeast Oregon. High Performance Fish Proceedings of International Fish Physiology Symposium, pp.87-93.

APPENDIX A

Acclimation Supportive Data

Appendix Table A-1. Temperature, dissolved oxygen, and mortality in the concrete acclimation raceway for hatchery winter steelhead at the East Fork Irrigation District Sand Trap, East Fork Hood River, 1999 and 2000.[a]

Date	Time	Temperature °C	Dissolved oxygen (ppm)	Mortalities [b]
15-Apr-1999				4 (4)
28-Apr-1999				1624 (1624)
29-Apr-1999				261 (261)
30-Apr-1999				40 (40)
01-May-1999				4 (4)
25-May-1999				123
12-Apr-2000	1030	6.0	11.4	
	1430	8.8	10.9	
	1830	9.2	10.8	
13-Apr-2000	0700	5.5	11.8	
	1300	5.9	11.2	
	1700	5.9	11.3	
14-Apr-2000	0800	4.9	11.5	
	1300	6.7	11.2	
	1700	7.5	10.7	
15-Apr-2000	0900	5.1	11.3	1
	1300	6.5	10.8	
	1730	7.2	10.7	
16-Apr-2000	0900	5.2	11.2	
	1230	5.9	10.8	
	1800	7.6	10.6	
17-Apr-2000	0800	4.4	11.3	
18-Apr-2000	0800	5.2	11.8	
25-Apr-2000	1030	5.2	10.7	
26-Apr-2000	0945	5.2	13.8	
27-Apr-2000	1130	7.4	9.8	
	1400	7.5	9.9	
	1730	7.4	9.8	
28-Apr-2000	0900	4.7	10.4	2
	1300	5.5	10.6	
	1700	6.1	10.5	
29-Apr-2000	0900	3.6	11.0	
	1400	7.7	9.7	
	1730	8.7	9.5	
30-Apr-2000	0930	5.7	10.2	1
	1400	7.4	9.8	
	1900	8.9	9.1	
16-May-2000	1100			17

[a] DO meter was inoperable in 1999. Temperature, dissolved oxygen, and mortality during acclimation for the East Fork Hood River facilities prior to 1999 can be found in Lambert et al., December 1999.

[b] In parentheses is mortalities at the acclimation facility as a result of fish truck liberations; these mortalities were not reported on the liberation slip from the ODFW. The 123 mortalities recorded on 25 May, 1999 were from seining and holding fish for the Coanda fish screen test at the EFID Sand Trap Facility.

Appendix Table A-2. Temperature, dissolved oxygen, and mortality in the portable acclimation ponds for hatchery summer steelhead (pond 1) and spring chinook salmon (pond 2) at the Blackberry Creek acclimation site, West Fork Hood River, 1999.

Date	Time		Temperature °C		Dissolved oxygen (ppm)		Mortalities[b]	
	Pond 1	Pond 2	Pond 1	Pond 2	Pond 1	Pond 2	Pond 1	Pond 2
30-Mar-1999		1600						18
31-Mar-1999	1600	1600	4.3	4.8	7.5	7.2		3
1-Apr-1999		1145		3.6		9.6		40
2-Apr-1999	1100	1100	3.2	3.2	10.4	9.8	0	35
	1800	1800	4.1	4.1	9.8	9.6		
	2000	2000	3.9	3.9	9.2	9.5		
3-Apr-1999							0	7
4-Apr-1999							0	7
5-Apr-1999			3.6	3.5	10.2	10.0	0	8
	1215	1215	3.4	3.4	10.6	10.4		
	1700	1700	4.3	4.0	10.4	10.4		
6-Apr-1999	0715	0715	2.4	2.6	10.7	10.5	0	13
	1700	1700	4.8	4.6	10.3	10.2		
7-Apr-1999	1100	1100	4.6	4.4	10.3	10.2	0	7
	1400	1400	4.8	5.0	10.1	10.2		
	1900	1900	5.2	5.1	10.3	10.3		
9-Apr-1999							0	3
11-Apr-1999							0	2
12-Apr-1999	1530	1530	5.9	5.6	9.1	9.5	0	12
	2015	2015	5.2	5.3	10.6	10.7		
13-Apr-1999	0730	0730	4.6	4.5	10.7	10.8	8	17
	2030	2030	4.5	4.7	10.6	9.8		
14-Apr-1999	0830	0830	4.7	4.8	9.5	9.2	4	143
	1530	1530	5.3	5.1	9.5	9.2		
15-Apr-1999	0900	0900	4.4	4.4	9.6	9.8	0	11
16-Apr-1999	0826	0832	4.9	4.8	11.1	11.4	0	9
17-Apr-1999	0800	0800		5.4	10.2	9.8	2	20
	1200	1200	6.6	6.6	10.9	10.5		
	1800	1800	7.6	7.7	10.4	9.3		
18-Apr-1999	0800	0800	5.7	5.7	10.7	10.1	0	8
	1200	1200	6.1	6.2	10.2	10.4		
	1800	1800	6.8	6.9	12.1	12.1		
19-Apr-1999	0800	0800			11.4	11.0	0	9
	1800	1800	5.8	5.9	10.8	10.0		
20-Apr-1999	0730	0730	4.7	4.7	10.9	10.4	2	35
	1700	1700	6.2	6.1	10.0	10.1		
21-Apr-1999	0900	0900	4.6	4.5	11.0	10.9	3	68
	1300	1300	4.9	4.8	11.6	10.7		
	1830	1830	5.0	5.0	11.7	10.6		
22-Apr-1999	0800	0800	3.9	3.9	12.3	11.1	0	0
24-Apr-1999							0	1
25-Apr-1999							0	8
26-Apr-1999							0	1

Appendix Table A-2. Continued.

Date	Time		Temperature °C		Dissolved oxygen (ppm)		Mortalities[b]	
	Pond 1	Pond 2	Pond 1	Pond 2	Pond 1	Pond 2	Pond 1	Pond 2
27-Apr-1999	0900	0900	4.9	5.0	11.0	11.1	0	0
	1200	1200	5.5	5.2	11.2	11.1		
	1800	1800	4.8	4.8	11.2	11.6		
28-Apr-1999	0800	0800	5.1	5.2	11.5	11.2	0	0
	1800	1800	5.4	5.8	11.0	10.8		
29-Apr-1999	0900	0900	4.5	4.2	11.6	12.0	0	1
30-Apr-1999							0	1
1-May-1999							0	1
5-May-1999	0900	0900	4.4	4.3	12.0	12.1	0	1
	1200	1200	4.7	4.8	12.6	12.2		
	1830	1830	5.7	5.7	12.2	11.9		
6-May-1999	0830	0830	4.6	4.7	12.4	12.0		

[a] Temperature, dissolved oxygen, and mortality during acclimation for the West Fork Hood River facilities prior to 1999 can be found in Lambert et al., December 1999.

[b] Of the 489 hatchery spring chinook salmon mortalities in pond two, 319 were a result of trucking the smolts to the acclimation site and 153 were a direct result of disease (fungus, bloated stomachs, and deformities). The disease outbreak may have contributed to the trucking mortality.

Appendix Table A-3. Temperature, dissolved oxygen, and mortality in the portable acclimation ponds for hatchery summer steelhead (pond 1) and spring chinook salmon (pond 2) at the Blackberry Creek acclimation site, West Fork Hood River, 2000.[a]

Date	Time		Temperature °C		Dissolved oxygen (ppm)		Mortalities[b]	
	Pond 1	Pond 2	Pond 1	Pond 2	Pond 1	Pond 2	Pond 1	Pond 2
4-Apr-2000								7
5-Apr-2000								16
6-Apr-2000							6	20
7-Apr-2000	0800	0800	4.7	5.1	11.4	11.1	2	8
	1200	1200	4.9	5.0	10.8	10.8		
	1700	1700	5.4	5.3	10.7	10.3		
8-Apr-2000	0800	0800	3.9	3.8	10.5	10.8	0	1
	1200	1200	5.2	5.0	11.2	10.3		
	1700	1700	5.6	5.6	10.1	10.0		
9-Apr-2000	0800	0800	5.0	5.0	10.5	10.5	5	0
	1200	1200	5.7	5.5	10.8	10.0		
	1700	1700	5.7	5.7	10.8	10.0		
10-Apr-2000	0800	0800	4.4	4.5	11.4	10.6	2	2
	1400	1400	5.6	5.9	10.6	11.3		
	1700	1700	6.1	6.1	11.3	10.8		
11-Apr-2000	0800	0800	5.7	5.8	10.9	11.1	2	1
	1300	1300	6.1	5.8	10.7	11.0		
	1800	1800	6.1	5.8	10.5	11.3		
12-Apr-2000	0800	0800	5.4	5.0	10.6	11.0	2	2
	1700	1700	7.1	6.5	10.1	10.3		
13-Apr-2000	0800	0800	6.0	6.3	10.7	11.0	0	0
	1600	1600	6.0	6.3	10.5	11.3		
14-Apr-2000	0830	0830	5.5	5.6	10.9	11.4	0	0
	1200	1200	5.8	5.8	11.0	11.3		
	1700	1700	6.2	6.3	10.7	11.1		
15-Apr-2000	0830	0830	5.2	5.5	11.0	11.3	0	0
	1200	1200	5.6	5.8	11.0	11.4		
	1700	1700	6.0	6.2	10.7	11.2		
16-Apr-2000	0800	0800	5.4	5.5	11.0	11.1	0	2
	1200	1200	5.5	5.5	10.8	11.3		
	1700	1700	6.2	6.4	10.8	11.3		
17-Apr-2000	0730	0730	3.9	4.1	11.0	10.9	0	2
	1200	1200	5.1	5.0	11.3	10.6		
	1700	1700	5.3	5.4	10.7	10.6		
18-Apr-2000	0900	0900	4.1	3.9	10.9	10.8	0	135
	1330	1330	5.9	6.3	10.4	10.7		
	1700	1700	6.0	5.6	11.3	10.0		
19-Apr-2000	0730	0730	3.6	3.9	11.3	11.1	0	71
	1300	1300	6.5	6.2	10.6	10.7		
	1500	1500	6.0		10.1	8.0		
	2100	2100				8.4		
20-Apr-2000	0730	0730			10.8	9.0	0	43
21-Apr-2000	1200	1200			9.4	10.1	0	50
22-Apr-2000	0900	0900			9.4	9.7	0	0
	1700	1700			9.2	9.0		

Appendix Table A-3. Continued.

Date	Time		Temperature °C		Dissolved oxygen (ppm)		Mortalities[b]	
	Pond 1	Pond 2	Pond 1	Pond 2	Pond 1	Pond 2	Pond 1	Pond 2
23-Apr-2000	0900	0900			9.9	10.1	0	6
	1700	1700			10.5	10.0		
24-Apr-2000	0800	0800			11.1	12.0	6	25
	1200	1200	3.6	3.6	11.0	10.5		
	1800	1800	5.5	5.6	10.5	11.1		
25-Apr-2000	0800	0800	4.9	5.1	11.0	10.6	5	2
	1300	1300	5.0	4.9	10.5	10.9		
	1800	1800	4.4	5.1	10.1	11.1		
26-Apr-2000	0800	0800	4.0	4.1	10.8	11.3	6	4
	1400	1400	5.4	5.5	10.5	11.0		
	1830	1830	6.1	6.1	9.6	10.1		
27-Apr-2000	0900	0900	6.0	5.7	10.1	10.8	4	2
	1700	1700	6.3	6.2	9.1	10.3		
28-Apr-2000	0800	0800	4.6	4.6	12.6	12.7	4	0
	1700	1700	4.6	4.2	12.6	12.0		
29-Apr-2000	0800	0800	4.0	4.0	12.7	12.5	0	0
	1700	1700	5.9	5.9	13.7	13.9		
30-Apr-2000	0800	0800	5.1	5.2	13.0	14.0	0	1
	1700	1700	4.9	4.9	12.7	13.2		
1-May-2000	0800	0800	5.9	5.8	11.3	11.1	1	3
	1300	1300	6.0	5.9	10.9	11.3		
	1900	1900	5.9	5.7	11.5	11.9		
2-May-2000	0800	0800	4.8	4.5	11.1	11.3	2	2
	1210	1210	5.9	6.0	11.0	11.4		
	1830	1830	6.9	6.9	11.3	11.8		
3-May-2000	0900	0900	6.7	6.8	11.3	10.8	0	3
	1300	1300	6.8	6.7	11.4	11.2		
	1830	1830	6.9	7.0	11.4	11.0		
4-May-2000	0900	0900	5.2	5.1	11.2	11.4	0	0
	1700	1700	6.3	6.5	11.2	11.0		
5-May-2000	1200	1200	5.6	5.8	11.9	11.8	0	0
	1700	1700	6.1	6.0	11.2	11.2		
6-May-2000	0800	0800	4.4	4.4	12.6	12.7	0	0
	1700	1700	5.9	6.0	11.7	11.4		
7-May-2000	0800	0800	4.4	4.6	12.0	12.0	0	3
	1700	1700	6.5	6.5	10.7	10.6		
8-May-2000	0800	0800	6.3	6.1	11.8	11.8	0	1
	1400	1400	6.5	6.5	11.7	11.6		
	2000	2000	6.6	6.6	11.8	11.6		
9-May-2000							0	0
10-May-2000							3	7

[a] Temperature, dissolved oxygen, and mortality during acclimation for the West Fork Hood River facilities prior to 1999 can be found in Lambert et al., December 1999.

[b] Of the total hatchery spring chinook salmon mortalities (419) in pond two, 363 were a result of trucking the smolts to the acclimation site. Trucking mortalities were the result of descaling from loading.

Appendix Table A-4. Temperature, dissolved oxygen, and mortality in the portable acclimation pond for hatchery spring chinook salmon at the Jones Creek acclimation site, West Fork Hood River, 1999.[a]

Date	Time	Temperature °C	Dissolved oxygen (ppm)	Mortalities[b]
30-May-1999	1400	5.0		16
31-May-1999				8
1-Apr-1999				126
2-Apr-1999				70
3-Apr-1999				129
4-Apr-1999				31
5-Apr-1999				41
6-Apr-1999				25
7-Apr-1999				10
8-Apr-1999				4
9-Apr-1999				2
13-Apr-1999				30
14-Apr-1999				62
15-Apr-1999				32
16-Apr-1999				27
17-Apr-1999				16
18-Apr-1999				31
19-Apr-1999				33
20-Apr-1999				15
21-Apr-1999				22
22-Apr-1999				11
23-Apr-1999				6
24-Apr-1999				2
27-Apr-1999				1
28-Apr-1999				13
2-May-1999				1
6-May-1999				2
9-May-1999				5

[a] DO meter was unavailable in 1999. Temperature, dissolved oxygen, and mortality during acclimation for the Jones Creek acclimation site prior to 1999 can be found in Lambert et al., December 1999.

[b] Of the total hatchery spring chinook salmon mortalities (771), 598 were a result of trucking the smolts to the acclimation site and 172 were a direct result of disease (fungus, bloated stomachs, and deformities). The disease outbreak may have contributed to the trucking mortality.

Appendix Table A-5. Temperature, dissolved oxygen, and mortality in the portable acclimation pond for hatchery spring chinook salmon at the Jones Creek acclimation site, West Fork Hood River, 2000.[a]

Date	Time	Temperature °C	Dissolved oxygen (ppm)	Mortalities[b]
4-Apr-2000	1320	3.2	12.3	55
	1630	3.3	11.9	
5-Apr-2000	0800	2.3	12.1	67
	1230	3.6	11.8	
	1300	3.7	11.1	
	1630	3.5	11.6	
6-Apr-2000	0800	2.5	11.4	15
7-Apr-2000	0850	4.5	11.5	18
	1445	6.8	10.4	
	1852	6.2	10.4	
8-Apr-2000	0858	3.2	10.8	32
	1218	4.5	10.8	
	1912	4.6	10.7	
9-Apr-2000	0845	5.1	10.6	13
	1326	5.1	10.7	
	1721	3.8	10.7	
10-Apr-2000	0850	3.9	11.0	14
	1309	4.8	11.4	
	1830	4.3	12.6	
11-Apr-2000	0827	3.4	12.1	1
	1230	4.2	11.6	
	1900	3.6	11.4	
12-Apr-2000	0830	2.9	11.5	0
	1330	4.4	11.2	
	1830	3.6	11.4	
13-Apr-2000	0830	2.8	11.4	0
	1400	4.9	11.6	
	1915	5.9	11.1	
14-Apr-2000	0900	3.7	11.1	0
	1330	4.2	11.1	
	1823	4.4	11.0	
15-Apr-2000	0816	3.1	11.5	0
	1344	3.5	11.6	
	1722	4.4	11.1	
16-Apr-2000	0900	3.9	11.2	0
	1200	4.4	11.4	
	2000	3.9	11.5	
17-Apr-2000	0800	3.1	11.5	1
	1347	4.1	11.2	
	1805	4.3	11.5	
18-Apr-2000	0800	3.7	11.5	102
	1210	3.7	12.1	
	1330	4.1	11.2	
	1800	3.6	11.2	

Appendix Table A-5. Continued.

Date	Time	Temperature °C	Dissolved oxygen (ppm)	Mortalities[b]
19-Apr-2000	0750	2.7	11.6	501
	1130	4.1	11.2	
	1230	3.1	10.6	
	1900	4.4	11.0	
20-Apr-2000	0830	3.0	11.3	140
	1500	4.5	10.6	
	1930	3.8	10.7	
21-Apr-2000	0800	3.0	11.5	38
	1530	4.5	11.1	
	2017	5.3	10.8	
22-Apr-2000	0800	3.8	11.3	95
	1330	3.9	11.2	
	1945	3.0	11.6	
23-Apr-2000	0800	2.8	11.5	30
	1400	4.5	11.1	
	2003	3.5	11.1	
24-Apr-2000	0900	2.7	11.6	32
	1315	3.8	11.9	
	1800	3.9	11.5	
25-Apr-2000	0800	2.9	11.9	6
	1300	3.9	12.1	
	1930	4.0	12.5	
26-Apr-2000	0830	2.6	12.8	3
	1200	3.5	12.9	
	1700	4.5	11.7	
27-Apr-2000	0830	3.5	11.9	0
	1600	5.9	11.6	
	2015	4.9	12.5	
28-Apr-2000	1000	2.3	13.9	0
	1330	3.0	12.8	
	1800	2.9	13.0	
29-Apr-2000	0900	2.8	13.9	0
	1230	3.9	13.3	
	1825	4.5	12.9	
30-Apr-2000	0900	3.9	12.6	0
	1316	5.2	12.4	
	1921	5.1	13.5	
1-May-2000	0900	3.8	14.0	0
	1200	4.5	13.8	
	1900	4.9	14.1	
2-May-2000	0900	3.5	14.5	4
	1200	4.8	12.2	
	1845	4.8	12.8	
3-May-2000	0730	4.1	12.7	0
	1200	4.7	12.2	
	1815	4.7	13.1	

Appendix Table A-5. Continued.

Date	Time	Temperature °C	Dissolved oxygen (ppm)	Mortalities[b]
4-May-2000	0830	4.2	13.6	0
	1330	4.9	12.0	
	1800	4.0	12.5	
5-May-2000	0830	2.9	14.2	0
	1300	3.8	13.5	
	1800	4.0	13.9	
6-May-2000	1000	4.6	12.4	0
	1330	4.8	12.6	
	1900	4.8	12.9	
7-May-2000	0900	3.6	13.0	0
	1130	4.2	12.9	
	1810	4.9	12.3	
8-May-2000				8

[a] Temperature, dissolved oxygen, and mortality during acclimation for the Jones Creek acclimation site prior to 1999 can be found in Lambert et al., December 1999.

[b] Of the 1,175 hatchery spring chinook salmon mortalities, 1,140 were a result of trucking the smolts to the acclimation site. Trucking mortalities were the result of descaling from loading.

Appendix Table A-6. Biweekly counts of migrant wild rb-st (ST-W) and hatchery winter steelhead (HSTW) marked (M) and recaptured (R) at the mainstem migrant trap, 1996. (percent recapture = %).

Location,	April 1-15			April 16-30			May 1-15			May 16-31			June 1-15			June 16-30			July 1-15		
Species	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**
Mainstem,																					
ST-W	14	1	7.1	5	3	60[a]	178	12	6.7	296	20	6.8	76	5	6.6	1	1	100	2	0	0
HSTW	50	3	6.0	95	8	8.4	409	19	4.6	343	19	5.5	246	3	1.2	10	0	0	2	0	0

[a] The formula for calculating ST-W trapping efficiency for 16-30 April was using a ratio comparison of hatchery and wild trapping efficiency numbers between 1-15 April and 1-15 May and comparing them to the time period 16-30 April. The formula was

$$\frac{13.8}{10.6} = \frac{X}{8.4}$$

$$X = 10.9$$

Appendix Table A-7. Biweekly counts of migrant wild rb-st (ST-W) and hatchery winter steelhead (HSTW) marked (M) and recaptured (R) at the mainstem migrant trap, 1997. (percent recapture = %).

Location,	April 1-15			April 16-30			May 1-15			May 16-31			June 1-15			June 16-30			July 1-15		
Species	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**
Mainstem,																					
ST-W	8	0	0	64	4	6.3	364	20	5.5	207	9	4.3	75	6	8.0	9	0	0	0	0	0
HSTW	0	0	0	306	3	1.0	202	3	1.5	340	13	3.8	276	10	3.6	29	0	0	1	0	0

Appendix Table A-8. Biweekly counts of migrant wild rb-st (ST-W) and hatchery winter steelhead (HSTW) marked (M) and recaptured (R) at the mainstem migrant trap, 1998. (percent recapture = %).

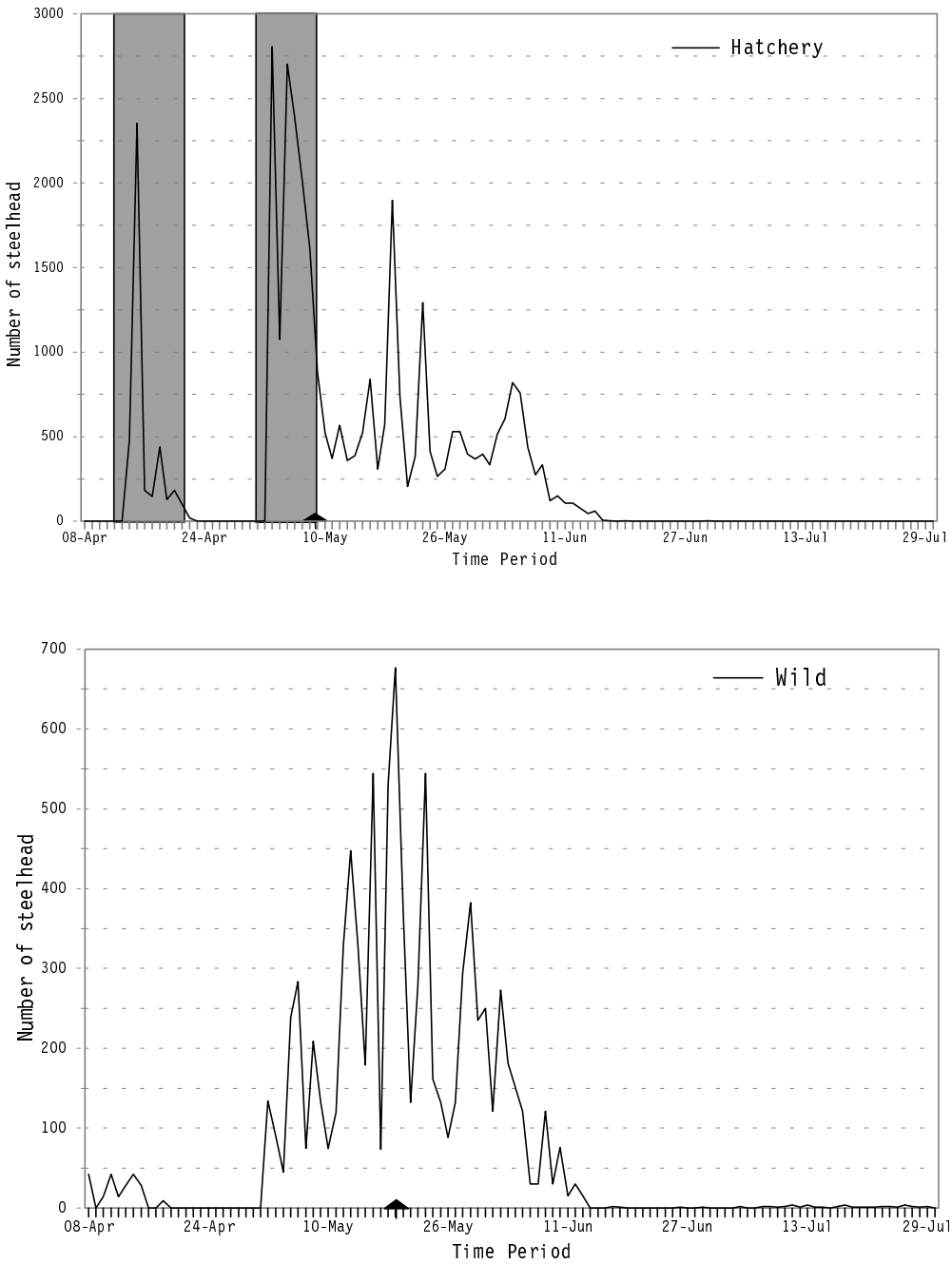
Location,	April 1-15			April 16-30			May 1-15			May 16-31			June 1-15			June 16-30			July 1-15		
Species	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**
Mainstem,																					
ST-W	12	1	8.3	358	10	2.8	458	18	3.9	345	22	6.4	49	3	6.1	4	0	0	5	0	0
HSTW	14	0	0	156	10	6.4	324	11	3.4	751	31	4.1	472	18	3.8	52	1	1.9	0	0	0

Appendix Table A-9. Biweekly counts of migrant wild rb-st (ST-W), hatchery winter steelhead (HSTW), and hatchery summer steelhead (HSTS) marked (M) and recaptured (R) at the mainstem migrant trap, 1999. (percent recapture = %).

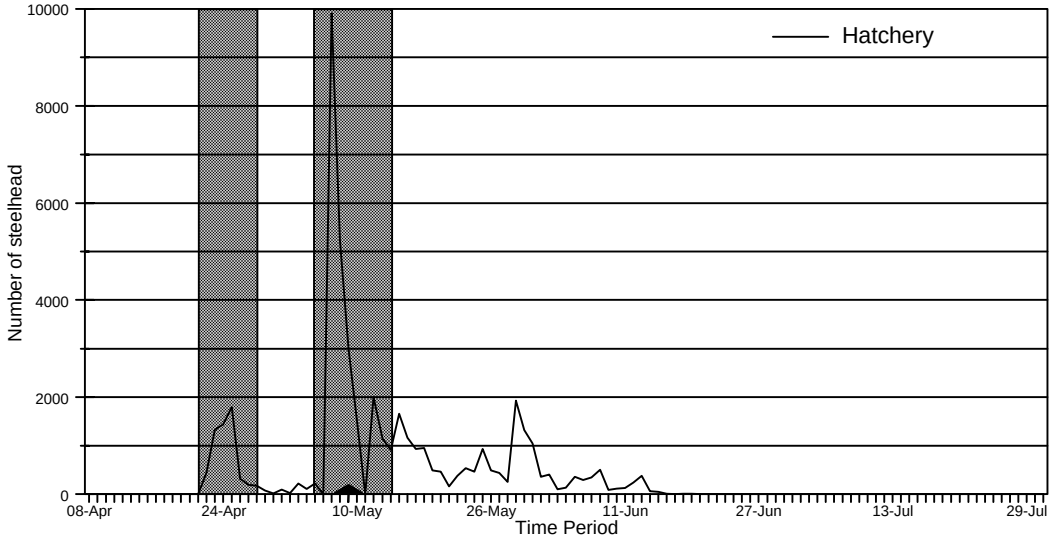
Location,	April 1-15			April 16-30			May 1-15			May 16-June 1			June 2-16			June 17-30			July 1-15			July 16-31		
Species	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**
Mainstem,																								
ST-W	0	0	0	139	13	9.4	257	11	4.3	371	11	3.0	229	11	4.8	28	2	7.1	5	0	0	0	0	0
HSTW	0	1	0	316	27	8.5	405	16	4.0	389	7	1.8	235	11	4.7	25	0	0	1	0	0	0	0	0
HSTS	0	0	0	222	20	9.0	21	2	9.5	91	1	1.1	246	11	4.5	65	4	6.2	12	0	0	3	0	0

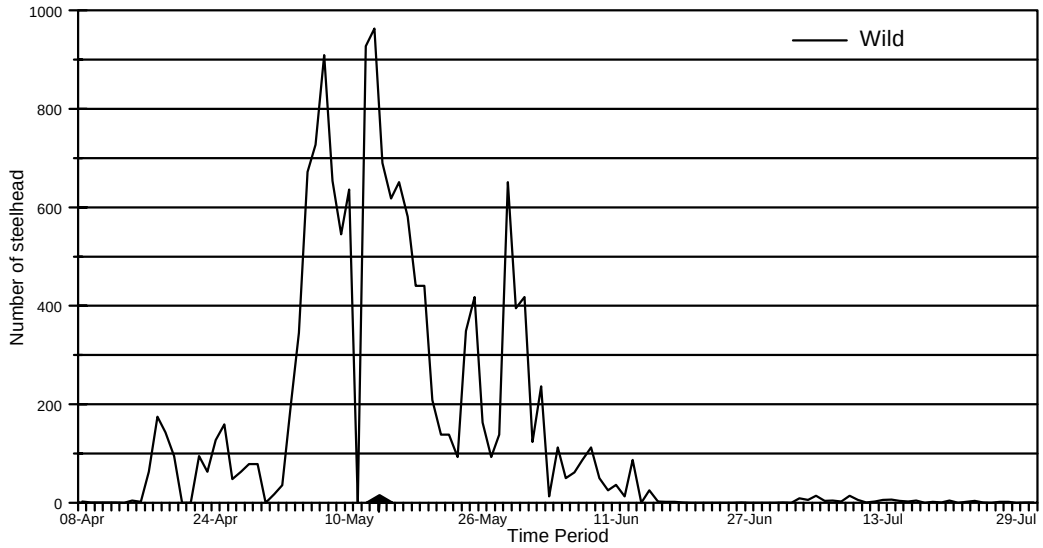
Appendix Table A-10. Biweekly counts of migrant wild rb-st (ST-W), hatchery winter steelhead (HSTW), and hatchery summer steelhead (HSTS) marked (M) and recaptured (R) at the mainstem migrant trap, 2000. (percent recapture = %).

Location,	April 1-15			April 16-30			May 1-15			May 16-31			June 1-15			June 16-30			July 1-15			July 16-31		
Species	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**	**M**	**R**	**%**
Mainstem,																								
ST-W	74	2	2.7	254	21	8.3	444	37	8.3	354	19	5.4	44	1	2.3	3	0	0	1	0	0	9	0	0
HSTW	1	0	0	257	12	4.7	375	22	5.9	500	30	6.0	166	6	3.6	57	2	3.5	2	0	0	0	0	0
HSTS	0	0	0	171	10	5.8	462	29	6.3	303	15	5.0	54	1	1.9	21	0	0	1	0	0	0	0	0

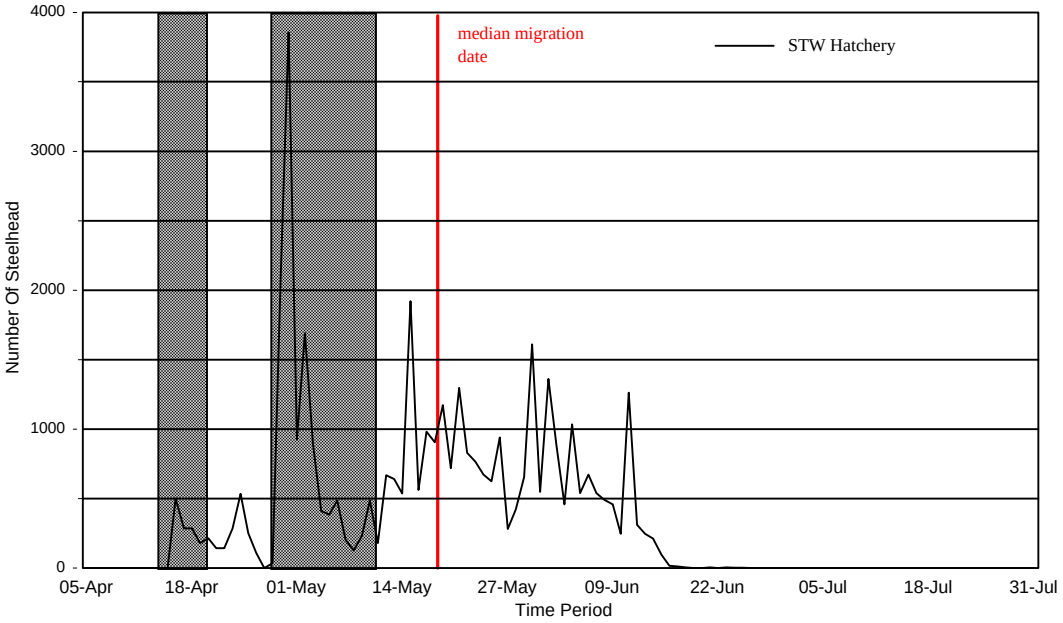


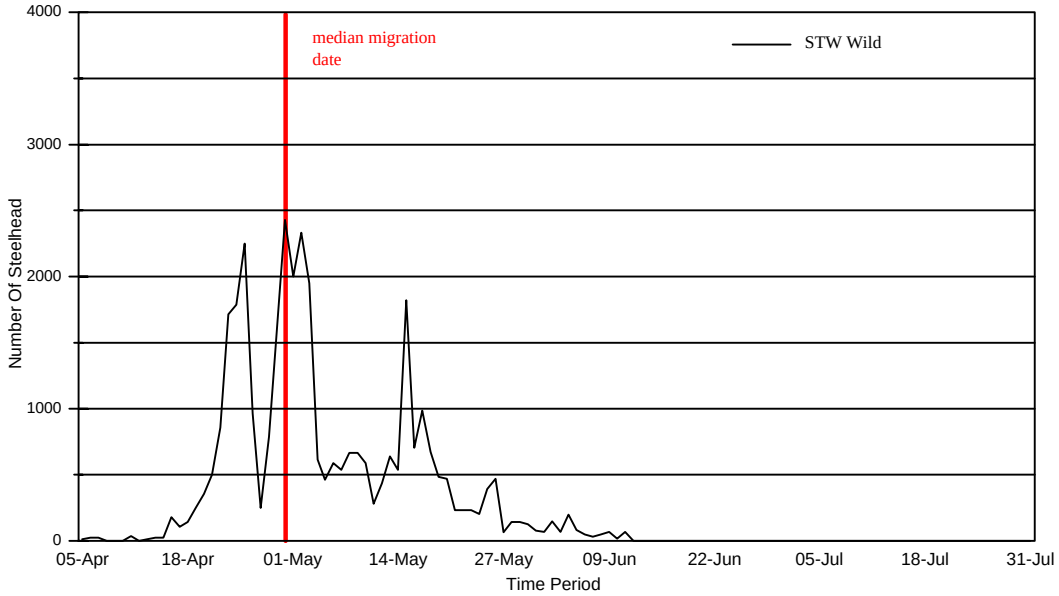
Appendix Figure A-1. Migration timing of hatchery winter steelhead and wild rainbow/steelhead at the mainstem Hood River rotary screw trap, 1996 migration year. The trap was not operational between 23 April-1 May. Numbers were adjusted for trapping efficiency.
▲ = median migration date. The shaded portion represents timing of volitional releases from the East Fork Hood River acclimation raceways.





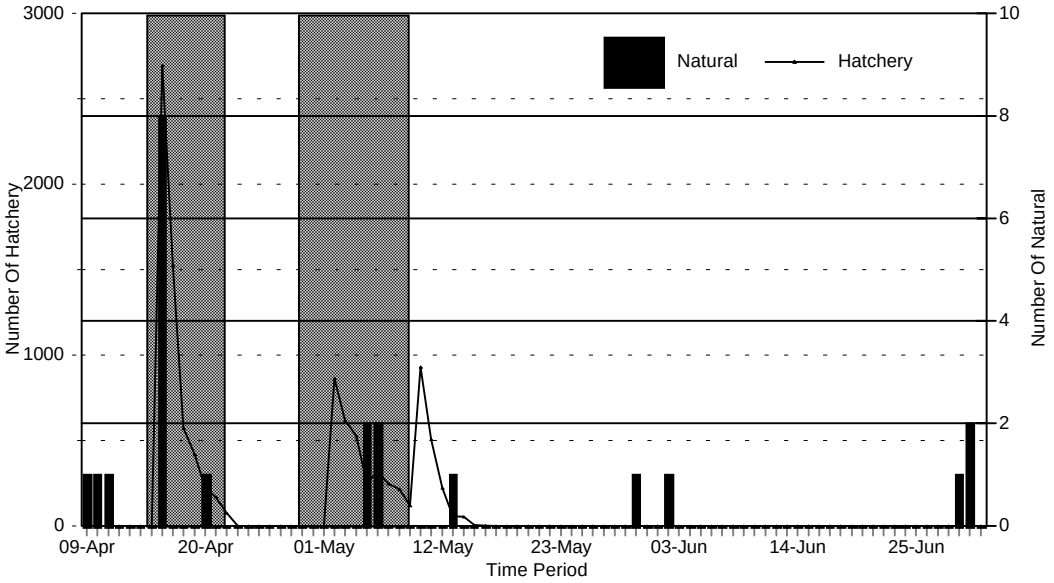
Appendix Figure A-2. Migration timing of hatchery winter steelhead and wild rainbow/steelhead at the mainstem Hood River rotary screw trap, 1997 migration year. The trap was not operational on 20-21 April and 11 May. Numbers were adjusted for trapping efficiency.
▲ = median migration date. The shaded portion represents timing of volitional releases from the East Fork Hood River acclimation raceways.



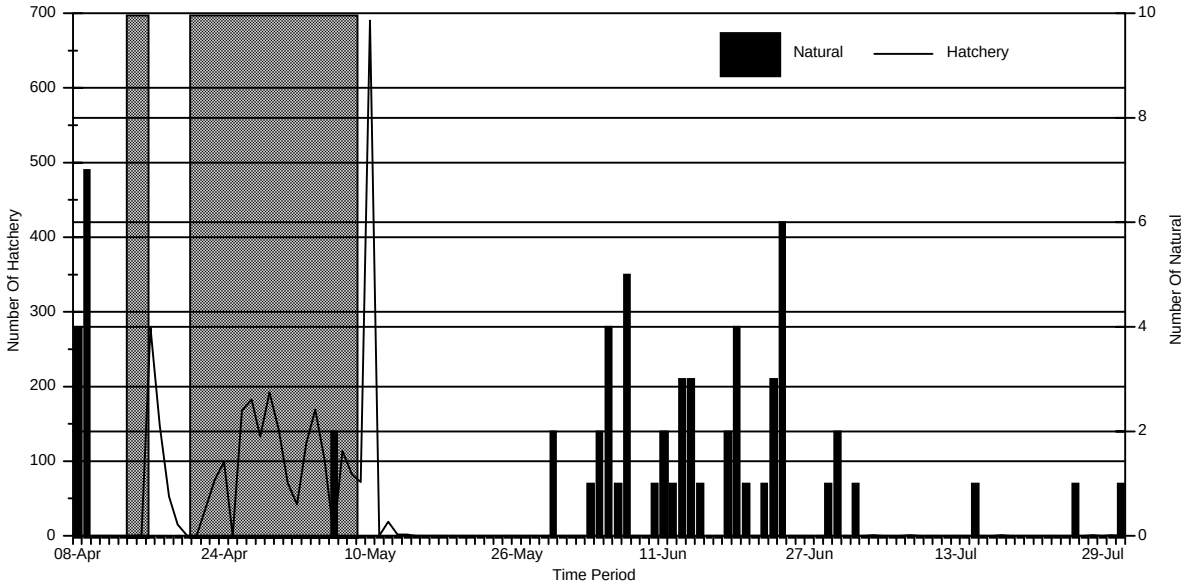


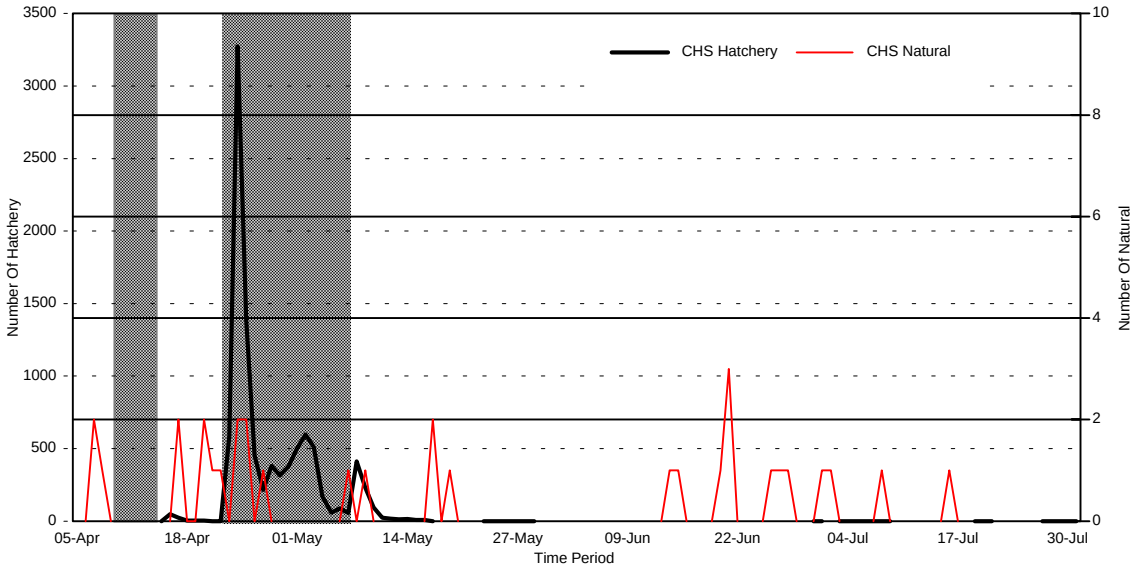
Appendix Figure A-3. Migration timing of hatchery winter steelhead and wild rainbow/steelhead at the mainstem Hood River rotary screw trap, 1998 migration year. The trap was not operational on 9-10 April and 12 April. Numbers were adjusted for trapping efficiency. The shaded portion represents timing of volitional releases from the East Fork Hood River acclimation raceways.

Appendix Figure A-4. Migration timing of hatchery and naturally produced spring chinook salmon smolts at the mainstem Hood River rotary screw trap, 1996 migration year. Trap was not operational between 23 April-1 May. Numbers were not adjusted for trapping efficiency. The shaded portion represents the timing of the volitional release from the West Fork Hood River acclimation raceways.



Appendix Figure A-5. Migration timing of hatchery and naturally produced spring chinook salmon smolts at the mainstem Hood River rotary screw trap, 1997 migration year. Trap was not operational on 20-21 April and 11 May. Numbers were not adjusted for trapping efficiency. The shaded portion represents the timing of the volitional release from the West Fork Hood River acclimation raceways.





Appendix Figure A-6. Migration timing of hatchery and naturally produced spring chinook salmon smolts at the mainstem Hood River rotary screw trap, 1998 migration year. The trap was not operational on 9-10 April and 12 April. Numbers were not adjusted for trapping efficiency. The shaded portion represents the timing of the volitional release from the West Fork Hood River acclimation raceways.

APPENDIX B

Spring Chinook Salmon Spawning Ground Survey Supportive Data

Appendix Table B-1. Summary of the USFS (Hood River Ranger District) unpublished data of the upper West Fork Hood River and McGee Creek spring chinook salmon spawning ground surveys. 1992-1995.

Year, Date	Location	Redds	Carcasses female	Carcasses male	Floytag Numbers
1992, 8/19	Ladd to lower 100' of McGee.	0	1	1	5682
	McGee (100'-500' upstream from confluence with W.F. Hood River.	9	0	0	
8/27	West Fork only.	0	5	2	5460
8/28	West Fork road access to the confluence of McGee.	11	11	5	5247, 5920, 5412, 5744, 5500, 5406, 5192, 5555
	Ladd to road access.	16	2	1	
	McGee (300 yds upstream from the confluence with the West Fork.	2	0	0	
8/31	West Fork just above Ladd Creek.	0	2	0	
1993[a], 8/25	Below Ladd only (Rm 13.0).	N/A	2	1	2232, 2465 2685, 2694, 2771
8/30	Below Ladd to the confluence of the West Fork (Rm 13 - 14).	N/A	2	1	
9/08	West Fork (Rm 13 - 13.8).	N/A	1	0	2742
1994, 8/24	Ladd to the top of the ‘93 project (Rm 13.1 - 13.7).	0	0	1	
9/17	Ladd to McGee (Rm 13.1 - 14.0)	4	2	1	4669
	McGee up 1/4 mile.	0	0	0	
1995, 9/11	West Fork (Rm 13).	0	0	0	
9/22	Ladd to McGee (Rm 13.1 - 14.0).	0	0	0	
	100' upstream from the mouth of Elk and 0.5 miles up McGee.	0	0	0	

[a] Formal redd counts were not conducted in 1993.

APPENDIX C

Hood River Water Temperature Study Supportive Data

Appendix Table C-1. Mainstem Hood River monthly and 7-day moving average water temperatures, and number of days above Daily and 7-Day Moving Average Water Temperature Standards, 1990-1995.

	1990	**1991**	**1992**	**1993**	**1994**	**1995**
START DATE	7/5/90	1/1/91	1/1/92	1/1/93	1/1/94	1/1/95
END DATE	12/31/90	12/31/91	12/31/93	12/31/93	12/31/94	12/31/95
DATA DAYS	180	365	199	365	365	365
7 Day Avg Max > 10 ^{o}C	69	173	45	163	179	172
7 Day Avg Max > 12.8 ^{o}C	57	113	23	94	133	110
7 Day Avg Max > 17.9 ^{o}C	0	3	0	0	28	0
Daily Maximum > 10 ^{o}C	72	172	49	163	175	167
Daily Maximum > 12.8 ^{o}C	60	111	23	96	127	115
Daily Maximum > 17.9 ^{o}C	3	3	0	1	25	1
MONTHLY MAX TEMPERATURES						
January		5.9	7.1	5.1	6.4	6.8
February		8.1	8.5	6.1	6.4	8.1
March		10.0	11.3	8.1	10.0	9.2
April		11.8	13.1	9.8	12.3	11.3
May		13.4	17.1	13.4	15.9	15.4
June		16.0	16.8	16.3	17.3	16.7
July	18.2	17.6		16.3	19.6	17.9
August	17.9	18.8		18.0	19.0	18.3
September	13.2	15.9		16.1	15.9	16.4
October	13.2	13.4		13.0	13.6	11.8
November	9.6	9.4	7.4	8.6	8.0	9.4
December	6.4	7.5	5.1	6.0	6.4	8.5
MAXIMUM 7-DAY AVG MAX	17.6	18.0	15.9	17.4	18.7	17.4

Appendix Table C-2. West Fork Hood River monthly and 7-day moving average water temperatures, and number of days above Daily and 7-Day Moving Average Water Temperature Standards, 1990-1995.

	1990	**1991**	**1992**	**1993**	**1994**	**1995**
START DATE	7/5/90	1/1/91	1/1/92	1/1/93	1/1/94	1/1/95
END DATE	12/31/90	12/31/91	12/30/93	12/31/93	12/31/94	12/31/95
DATA DAYS	180	365	365	334	365	365
7 Day Avg Max > 10 ^{o}C	87	120	156	91	146	129
7 Day Avg Max > 12.8 ^{o}C	44	50	87	4	57	35
7 Day Avg Max > 17.9 ^{o}C	0	0	0	0	0	0
Daily Maximum > 10 ^{o}C	91	115	149	88	135	126
Daily Maximum > 12.8 ^{o}C	42	52	83	14	64	42
Daily Maximum > 17.9 ^{o}C	0	0	0	0	0	0
MONTHLY MAX TEMPERATURES						
January		5.3	6.0	4.2	5.6	4.7
February		6.4	6.7	5.1	5.0	6.5
March		8.0	9.7	7.4	7.6	7.4
April		9.8	10.7	7.7	10.0	9.5
May		11.1	14.3	11.6	13.4	13.1
June		13.6	17.1	13.4	14.1	13.9
July	15.4	15.0	16.8	13.4	16.7	15.3
August	15.6	15.5	16.6		15.6	15.2
September	13.6	13.1	13.6	13.2	13.3	13.3
October	11.5	11.3	11.3	11.0	11.6	10.3
November	8.6	8.5	8.9	7.6	6.7	8.5
December	5.7	6.6	4.8	5.3	5.3	7.5
MAXIMUM 7-DAY AVG MAX	15.1	14.8	16.2	13.0	15.8	14.6

Appendix Table C-3. Middle Fork Hood River monthly and 7-day moving average water temperatures, and number of days above Daily and 7-Day Moving Average Water Temperature Standards, 1994-1995.

	1994	**1995**
START DATE	1/27/94	1/1/95
END DATE	12/31/94	12/31/95
DATA DAYS	339	223
7 Day Avg Max > 10 ^{o}C	165	41
7 Day Avg Max > 12.8 ^{o}C	62	5
7 Day Avg Max > 17.9 ^{o}C	0	0
Daily Maximum > 10 ^{o}C	157	45
Daily Maximum > 12.8 ^{o}C	62	11
Daily Maximum > 17.9 ^{o}C	0	0
MONTHLY MAX TEMPERATURES		
January	4.3	4.6
February	5.7	6.1
March	8.9	7.8
April	11.3	
May	13.8	
June	14.7	
July	14.6	
August	14.1	12.9
September	14.0	13.8
October	12.3	12.0
November	5.7	7.6
December	5.2	6.4
MAXIMUM 7-DAY AVG MAX	13.7	13.2

Appendix Table C-4. East Fork Hood River monthly and 7-day moving average water temperatures, and number of days above Daily and 7-Day Moving Average Water Temperature Standards, 1990 and 1992-1995.

	1990	**1992**	**1993**	**1994**	**1995**
START DATE	7/5/90	3/26/92	1/1/93	1/1/94	1/1/95
END DATE	9/28/90	12/31/928	12/31/93	12/31/94	12/31/95
DATA DAYS	86	281	343	365	223
7 Day Avg Max > 10 ^{o}C	80	185	132	169	39
7 Day Avg Max > 12.8 ^{o}C	80	139	66	120	24
7 Day Avg Max > 17.9 ^{o}C	30	65	0	43	0
Daily Maximum > 10 ^{o}C	86	185	136	171	44
Daily Maximum > 12.8 ^{o}C	86	132	67	124	26
Daily Maximum > 17.9 ^{o}C	34	63	0	46	0
MONTHLY MAX TEMPERATURES					
January			4.6	6.1	6.2
February			6.0	5.9	7.7
March		11.8	8.3	10.3	9.0
April		13.4	10.7	12.8	10.3
May		18.7	13.4	15.3	
June		22.0	17.1	18.3	
July		22.8	17.3	21.6	
August	20.4	22.8	17.7	20.6	15.6
September	21.1	18.7	17.4	17.1	16.7
October	18.0	12.4	12.7	14.3	11.5
November		8.4	8.3	6.4	8.5
December		4.8	5.6	5.9	6.8
MAXIMUM 7-DAY AVG MAX	20.5	21.8	17.1	20.7	15.8

Appendix Table C-5. Mixed Middle Fork Hood River monthly and 7-day moving average water temperatures, and number of days above Daily and 7-Day Moving Average Water Temperature Standards, 1995.

	1995
START DATE	6/5/95
END DATE	12/31/95
DATA DAYS	255
MONTHLY MAX TEMPERATURES	
January	
February	
March	
April	
May	
June	10.6
July	10.6
August	12.0
September	12.3
October	13.7
November	6.1
December	5.6
MAXIMUM 7-DAY AVG MAX	11.5

Appendix Table C-6. Rogers Spring Creek monthly and 7-day moving average water temperatures, and number of days above Daily and 7-Day Moving Average Water Temperature Standards, 1995.

	1995
START DATE	5/2/95
END DATE	12/31/95
DATA DAYS	240
MONTHLY MAX TEMPERATURES	
January	
February	
March	
April	
May	5.3
June	5.5
July	6.1
August	5.5
September	5.5
October	5.3
November	5.5
December	4.6
MAXIMUM 7-DAY AVG MAX	5.5

APPENDIX D

Oak Springs Hatchery Evaluation Supportive Data

Appendix Table D-1. Past and future fin and coded-wire tag marks for Hood River and Skamania stock hatchery summer steelhead, Hood River stock winter steelhead, and Deschutes and Hood River stock hatchery spring chinook salmon releases into the Hood River subbasin, 1992-2005 broods. All hatchery spring chinook salmon are coded-wire tagged (CWT). (Ad = adipose, LM = left maxillary, RM = right maxillary, LV = left ventral, RV = right ventral, MFK = Middle Fork Hood River, and WFK = West Fork Hood River)

Brood	Release[a]	Hood River stock		Skamania stock	Deschutes and Hood River stock spring chinook salmon	
year	year	Summer steelhead	Winter steelhead	Summer steelhead	MFK[b]	WFK
1992	1993 (1994)	—	Ad-LP	Ad	No releases	
1993	1994 (1995)	—	Ad-LV-CWT, Ad-LM, Ad-LP	Ad	Ad (31%), No mark (69%)	
1994	1995 (1996)	—	Ad-LV-CWT	Ad	—	Ad-RV, Ad
1995	1996 (1997)	—	Ad-LV-RM-CWT, Ad-RM	Ad	—	Ad-LV
1996	1997 (1998)	—	Ad-LM	Ad	—	Ad-RV
1997	1998 (1999)	—	Ad-RM	Ad	Ad-RM	Ad-LV
1998	1999 (2000)	LM	Ad-RV	Ad	Ad-RV, Ad-LV	Ad-LM
1999	2000 (2001)	RM, LM (30%)	Ad-LV-CWT	Ad	Ad-RM, Ad-RV	Ad-LV
2000	2001 (2002)	LM, Ad-LM (19.6%)	Ad-RV	Ad	Ad-RV	Ad-LM
2001	2002 (2003)	RM	Ad-LV-CWT	Ad	Ad-LV	Ad-RM
2002	2003 (2004)	LM	Ad-RV	Ad	Ad-RV	Ad-LM
2003	2004 (2005)	RM	Ad-LV-CWT	Ad	Ad-LV	Ad-RM
2004	2005 (2006)	LM	Ad-RV	Ad	Ad-RV	Ad-LM
2005	2006 (2007)	RM	Ad-LV-CWT	Ad	Ad-LV	Ad-RM

[a] Spring chinook salmon release year in parenthesis.

[b] Experimental hatchery spring chinook salmon releases in release years 2000 (4,170 smolts) and 2001 (7,000 smolts) from the Parkdale Fish Facility into the Middle Fork Hood had marks of Ad-LV and Ad-RV.

Appendix Table D-2. Percent tag retention and clipping results for the hatchery winter steelhead, 1993 brood. (Ad = adipose, LV = left ventral)

Broodstock, hatchery, brood year,	**Tag code**	**Fin clip**	**Date**	**Percent tag retention**	**Percent fin clip**
Hood River,					
Oak Springs,					
1993	07-05-36	Ad-LV	14-Oct-93	99.7	99.4
1993	07-05-37	Ad-LV	14-Oct-93	100.0	99.7
1993	07-05-38	Ad-LV	19-Oct-93	89.2	99.7
1993	07-05-39	Ad-LV	19-Oct-93	99.4	99.2

Appendix Table D-3. Percent coded-wire tag retention, tag code, and clipping information for hatchery winter steelhead, 1994-1995 broods. (adipose = Ad, left ventral = LV, right maxillary = RM)

Broodstock, hatchery, brood year	**Pond**	**Tag code**	**Fin clip**	**Date sampled**	**Percent tag retention**
Hood River,					
Oak Springs,					
1994	L-3	07-08-63	Ad-LV	28-Nov-94	95.8
		07-09-16			
1994	L-4	07-09-17	Ad-LV	28-Nov-94	88.9
		07-09-18			
1994	L-4	07-09-17	Ad-LV	05-Apr-95	86.6
		07-19-18			
1995	L-3	07-11-31	Ad-LV-RM	12-Jan-96	100.0
1995	L-4	07-11-32	Ad-LV-RM	12-Jan-96	97.1

Appendix Table D-4. Fin clip results for hatchery winter steelhead at Oak Springs Hatchery, 1994-1997 broods. (Percent of total number sampled is in parentheses. Ad = adipose, LV = left ventral, RM = right maxillary, LM = left maxillary.)

Broodstock, hatchery, brood year	**Pond**	**Fin clip**	**Date sampled**	**Number sampled**	**No Ad**	**Poor Ad**	**No LV**	**Poor LV**	**No RM**	**Poor RM**	**No LM**	**Poor LM**
Hood River,												
Oak Springs,												
1994	L-3	Ad-LV	28-Nov-94	378	7(2)	38(10)	0(0)	10(3)				
1994	L-4	Ad-LV	28-Nov-94	350	4(1)	15(4)	0(0)	6(2)				
1994	L-4	Ad-LV	05-Apr-95	322	3(1)	28(9)	0(0)	8(2)				
1995	L-3	Ad-LV-RM	12-Jan-96	104	0(0)	0(0)	2(2)	26(25)	0(0)	0(0)		
1995	L-4	Ad-LV-RM	12-Jan-96	102	0(0)	0(0)	0(0)	19(19)	0(0)	0(0)		
1996	M-2	Ad-LM	10-Apr-97	128	0(0)	3(2)					1(1)	2(2)
1996	M-1	Ad-LM	28-Apr-97	216	3(1)	7(3)					2(1)	0(0)
1997	M-1	Ad-RM	6-Apr-98	210	1(1)	23(11)			1(1)	1(1)		
1997	M-2	Ad-RM	20-Apr-98	205	10(5)	19(9)			7(3)	4(2)		

APPENDIX E

Genetic Analysis of Rainbow and Cutthroat Trout from the Lower Columbia River

PROGRESS REPORT WTSGL98
TO
Oregon Department of Fish and Wildlife
December 14, 1998

Paul Spruell✤
J. W. Pearce Smithwick
Kathy L. Knudsen
Fred W. Allendorf

Wild Trout and Salmon Genetics Laboratory
Division of Biological Sciences
University of Montana
Missoula, MT 59812

✤Author to whom correspondence should be addressed

phone (460) 243-6749
fax (406) 243-4184
email spruell@selway.umt.edu

SUMMARY

We developed a polymerase chain reaction-based technique to detect hybridization between cutthroat trout (*Oncorhynchus clarki*) and rainbow trout (*Oncorhynchus mykiss*). This technique uses primers complementary to interspersed nuclear elements to amplify anonymous DNA fragments. Some of these fragments are found only in rainbow trout, and others are diagnostic for each cutthroat trout subspecies. We used these markers to identify these species and their hybrids.

Hybridization was wide-spread in tributaries to the Lower Columbia River. At least one hybrid individual was identified in 24 of 39 populations surveyed. In no case did coastal cutthroat and rainbow trout co-exist without evidence of hybridization. We also did not detect any first generation (F_1) hybrids between coastal cutthroat trout and rainbow trout in this region. This pattern indicates historic rather than recent hybridization in these populations.

We found westslope cutthroat trout (*O. clarki lewisi*) in three tributaries to the John Day River. All populations had evidence of hybridization with rainbow trout. One F_1 hybrid was detected in Roberts Creek and many individuals contained a high proportion of markers from each species. Thus, it appears that hybridization in these populations is recent and ongoing.

We have selected several populations on the basis of the PINE results that will be analyzed using microsatellite loci. Microsatellite data will allow us to describe the genetic population structure of these populations and help determine if hatchery reared fish are influencing the location or frequency of hybridization.

INTRODUCTION

Many tributaries in the Lower Columbia River contain either rainbow/steelhead trout (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarki*), or both species. Many of these streams contain natural geological barriers that may prevent gene flow between populations. In addition, several of the drainages are quite remote and have not been influenced by hatchery programs. Therefore, the fish fauna inhabiting those streams may make a substantial contribution to the biodiversity of these two species. In other cases, hatchery programs may have altered the genetic variability found in this area. An accurate description of the genetic characteristics of the rainbow and cutthroat trout in the area around Mt. Hood would provide data necessary to properly protect and manage these populations.

Rainbow trout and cutthroat trout are closely related species and readily hybridize (Leary et al 1995). The issue of hybridization must be addressed in areas that contain both *O. mykiss* and *O. clarki*. Low level hybridization may have occurred historically in areas in which the two species are sympatric. However, higher levels of hybridization may be associated with environmental perturbations or the introduction of one species into areas from which they were previously excluded. Visual identification of *O. mykiss*, *O. clarki* and their resulting hybrids is extremely difficult, making a genetic technique to identify these fish necessary.

This project was initiated to study the biodiversity of rainbow/steelhead trout and cutthroat trout in the area surrounding Mt. Hood, Oregon. We initially identified three primary questions of interest; 1) What is the relationship among populations above and below barriers to fish movement? 2) Where is the transition between the coastal and inland (redband) form of *O. mykiss*? And 3) Is there evidence of hybridization between the species, and if so can we delineate those hybrid zones?

Questions one and two are impossible to address without first determining which species is present in each drainage and identifying hybrid populations. This project was initiated using protein electrophoresis. Those results indicated that hybridization did occur in this area (Gregg and Allendorf 1995). Subsequent work by the National Marine Fisheries Service suggested that hybridization might be more widespread than previously believed (Grant 1998). This view was also supported by our initial attempts to assess genetic relationships using microsatellites. Individuals within some populations often contained alleles well outside of the size range of the majority of individuals. Although not proof of hybridization, this observation is consistent with a hybridized populations.

To insure accurate interpretation of resulting microsatellite data, we developed a non-lethal technique to differentiate rainbow and cutthroat trout. To accomplish this task, we took advantage of the presence of repetitive elements (primarily SINEs, short interspersed nuclear elements) in the salmonid genome. These elements have characteristics that make them particularly promising for hybrid detection. SINEs are randomly inserted into the genome during episodic bouts of amplification (Deininger 1989). During these amplification events multiple copies of the element are thought to be generated and inserted at random into the genome. The result is a suite of short DNA elements of the same sequence inserted throughout the genome. Excluding these periodic events, SINEs are thought to be stable once integrated into the genome and once inserted, recombination is the only proposed mechanism to cause their removal.

Five SINEs have been described in salmonids. Kido et al. (1991) described three salmonid-specific SINEs; *Hpa* I found in all members of the family Salmonidae, *Sma* I specific to pink salmon (*O. gorbuscha*) and chum salmon (*O. keta*), and *Fok* I, specific to the genus *Salvelinus*. Spruell and Thorgaard (1996) subsequently reported that at least a portion of the 5' end of *Fok* I was found in all salmonids they examined. Kido et al. (1994) characterized a fourth SINE, the *Hpa* I-like *Ava* III element which is found to be extensively distributed throughout the family Salmonidae. A pink salmon-specific SINE, *Pvu* II has also been described (Ginatulin 1996). These five elements constitute tens of thousands of short DNA sequences distributed throughout the genomes of salmonids.

Based on the work of others (Nelson et al. 1989, Peek et al. *in press*, Greene and Seeb 1998, Spruell et al. *in prep*) and the theoretical attributes of SINEs, we hypothesized that PCR using primers homologous to the ends of these elements might produce species-specific DNA fragments in cutthroat and rainbow trout. The theoretical basis for this technique is similar to the use of human *Alu* I sequence to identify human chromosomes in somatic cell hybrid lines (Nelson et al. 1989). Primers are constructed that are homologous to the end of a SINE and are oriented such that they initiate DNA synthesis at that end of the element, progressing away from the SINE. Theoretically, primers may be used individually, in which case two of the same SINEs must be inserted within the

genome in opposite orientation within a size range amplifiable by PCR. Additional fragments could also be amplified by combining primers homologous to different SINEs. For example, primers homologous to the 5' ends of the salmonid *Hpa* I and *Fok* I elements may be combined. Using this combination, bands representing fragments flanked on one side by *Hpa* I and on the other by *Fok* I, if properly oriented, will also be amplified. Spruell et al. (in prep) have suggested the acronym PINEs (Paired Interspersed Nuclear Elements) for this technique. We will use that nomenclature throughout this report.

In this report we describe the distribution of rainbow/steelhead trout, cutthroat trout and their bydrids in the Hood River Basin and surrounding streams. Collection of these data is the first step necessary to assess the genetic effects of hatchery programs in the basin and describe the pattern of genetic variation within the two species. We are currently collecting allele frequency data at microsatellite loci that will allow us to address these issues in greater detail.

MATERIALS AND METHODS

Samples

Samples were collected from tributaries in the lower Columbia River Gorge and from selected locations within the Clackamas, Sandy, Hood/Mill, Deschutes (Table 1), and John Day basins (Table 2). All samples were collected under the supervision of Oregon Department of Fish and Wildlife (ODFW) personnel and shipped to the Wild Trout and Salmon Genetics Lab at the University of Montana. Samples consisted of either whole fish shipped on dry ice or caudal fin clips, approximately $1cm^2$, shipped in a 95% ethanol. Whole fish were stored at -40 degrees Celsius until sampled. Fin clips were stored at room temperature in 95% ethanol until DNA extraction was completed. DNA was extracted from sampled tissues using the Pure Gene kit (Gentra) following the manufacturer's instructions. The concentration of all DNA samples was estimated through visualization on agarose gels stained with ethidium bromide.

PINEs

Species identification and detection of hybridization was performed utilizing Paired Interspersed Nuclear Element-PCR or PINE-PCR. This technique uses fluorescently labeled primers that are complementary to the ends of various interspersed nuclear elements, to amplify anonymous DNA fragments flanked by two elements. A subset of the resulting of the resulting DNA fragments are found only in certain subspecies of *Oncorhynchus*. Fragment diagnostic for each subspecies were identified by analyzing individuals from throughout the range of each species.

Diagnostic fragments of DNA from the various samples in this study were amplified for analysis through PINE-PCR using the following reaction mix and protocol. Reactions were performed in total volumes of 10 1, consisting of approximately 25 ng of genomic DNA, 1 1 of 10X Perkin-Elmer STOFFEL buffer, 4.5 mM $MgCl_2$, 0.2 mM of each dNTP, 2.5 pmoles of each primer, and 0.1 U STOFFEL fragment. PCR reactions were performed in MJ Research PTC-100 thermal cyclers using the following profile: 3 min. at 95 degrees Celcius, followed by 30 cycles of 91 degrees Celcius for 1 min., 60 degrees Celcius for 1 min., then 72 degrees Celcius for an additional 2.5 min.

Products were stored at 4 degrees Celcius until electrophoretic analysis was completed.

The resulting fragments were size fractionated on 4.5% polyacrlymide gels under the following electrophoretic conditions: 2200 Volts, 65 Watts, 50 Amps for 65 to 100 minutes depending upon the primers used in the reaction. The fragments were visualized using a Hitachi FMBIO-100 fluorescent imager. Fragments were sized and scored using the MapMarker LOW size standard (Bio Ventures, Inc.) And FMBIO gel analysis software (version 6.0, Hitachi).

Microsatellites

Four microsatellite loci were amplified in an MJ Research PTC-100 thermocycler using the profiles and conditions of the individuals initially describing each locus (Table 1). Amplified products were size fractionated on 7% denaturing polyacrylamide gels and visualized using a Hitachi FMBIO-100 fluorescent imager. Product sizes were determined using MapMarkerLOW size standards (Bio Ventures Inc.) And Hitachi FMBIO software (version 6.0). Each gel also included previously amplified individuals to ensure consistent scoring across all gels.

RESULTS

Detection of Hybrids

We determined the species composition of populations by comparing the DNA fragments amplified in each individual to previously identified diagnostic loci. For example, an F_1 hybrid should have all diagnostic loci from both of the parental species. Alternatively, backcross individuals (F_1 X pure) should have all the diagnostic markers of the pure parental species and approximately half of those from the other since fifty percent of alleles from each species are lost during meiosis in the F_1. After identification of each individual, data from each population was examined to identify any aberrant results that might lead to incorrect conclusions. These determinations are presented in Tables 1 and 2 and Figures 1 and 2.

Within the Clackamas Drainage (Table 1 Figure 1), pure rainbow trout are found within Nohorn Creek, the winter steelhead sample above the North Fork Dam, and the East Fork of Collowash Creek. Considering the location of this creek, this is most probably a population of steelhead. Further genetic analysis will validate this postulation. The samples from the Upper South Fork of the Clackamas are predominantly rainbow trout but two of 30 individuals show evidence of hybridization with cutthroat. The sample from the upper reaches of the Oak Grove Fork contain many hybrid fish and is probably a hybrid swarm. Of the 30 fish in the sample, nine appeared to be rainbow trout, 13 appeared to be cutthroat trout, and eight were hybrids between the two. Samples from Cub Creek, Boyer Creek, Cripple Creek, and Dinger Creek appear to be coastal cutthroat trout and show no evidence of hybridization.

We have analyzed seven samples from the Sandy River basin (Table 1, Figure 1). Samples from both the Little Sandy River and Lady Creek were previously analyzed with protein electrophoresis and served as references for determining diagnostic fragments of DNA. The Little Sandy River contains pure rainbow trout and Lady Creek

contains pure cutthroat trout. The upper reaches of the Bull Run River contain cutthroat trout with no evidence of hybridization. The 26 samples from Marmot Dam were rainbow trout and showed no evidence of hybridization. Two samples containing hybrid fish have been found within the Sandy drainage. The first of these is in Bull Run Lake where 26 of 27 fish sampled were identified as cutthroat trout but the remaining fish possessed evidence of hybridization with rainbow trout. Three fish out of 21 from the Still Creek smolt trap were identified as hybrids while the remaining 18 were identified as pure rainbow trout.

Within the Columbia River Gorge, four samples have been analyzed (Table 1, Figure 1). At Bridal Veil Creek, the sample taken from above the falls consisted of cutthroat trout. Further up the Columbia Gorge, the samples taken from below the falls on Multnomah Creek appears to be a hybrid swarm 18 of 30 individuals contained markers diagnostic for each species. All 29 fish sampled above the falls were cutthroat trout. All fish from the sample site at Oneonta Creek were identified as pure rainbow trout. Considering the location, these are most probably steelhead, though further genetic analysis is needed to confirm their status.

Within the Hood drainage 17 of the 21 samples originally identified have been analyzed (Table 1, Figure 1). Starting at the mouth of the Hood River, the 29 fish sampled in the summer were all rainbow trout. The 11 fish comprising the winter sample from the same site showed 10 rainbow trout and 1 fish that was a hybrid between a rainbow trout and a cutthroat trout. In the West Fork of the Hood River, the samples from the North Fork of Greenpoint Creek were predominantly rainbow trout. Only 1 of 30 showed evidence of hybridization with cutthroat trout. The samples from the lower section of the main West Fork were pure rainbow trout as were the samples from the end of the West Fork at Elk and McGee Creeks. We were unable to determine which of the samples were from each creek as they were all shipped in the same bag. Nonetheless, they were all identified as pure rainbow trout. The same problem was encountered for samples from Tony and Bear Creeks, those samples were also placed into a single bag. Of the 11 fish that we received, 4 were hybrid individuals while the remaining 7 were pure cutthroat trout. Further upstream, all samples from Pinnacle Creek were identified as cutthroat trout. Samples from Emil Creek, in the east fork of the Hood River, had previously been identified through protein electrophoresis as pure coastal cutthroat trout. This population was also utilized as a reference population when the diagnostic fragments were determined. The 20 samples from Rimrock Creek were also identified as pure cutthroat trout. In the Dog River, the sample from the lower section was found to contain both pure rainbow and cutthroat trout as well as hybrid fish. Of the 18 fish in the sample, 8 were pure rainbow trout, 6 were pure cutthroat trout, and the remaining 4 were hybrids. The sample from the upper reaches of the Dog River contained 24 fish, 3 of which were hybrids, while the rest were pure cutthroat trout. Three of the 49 fish in the sample from Robinhood Creek were hybrid individuals. The remaining 46 were identified as pure cutthroat trout. One of the 46 samples from Pocket Creek was identified as a hybrid individual, while the remaining 45 samples were found to be pure cutthroat trout. The 30 samples from Bucket/Clark Creek were identified as pure cutthroat trout as well. The cutthroat trout within the Hood drainage appear to be coastal forms, analysis of additional loci will confirm this.

The 30 fish taken in the summer from the Mill drainage and labeled as “steelhead” are all rainbow trout. Below the falls on Mill Creek, of the 30 fish sampled 11 were found to be hybrids. In the North Fork of Five Mile Creek,

25 of 30 fish were found to be cutthroat trout, while the remaining 5 were hybrid individuals.

Two of three populations from the Deschutes/White drainage have been analyzed (Table 1, Figure 1). The 30 fish from Tygh Creek were found to be pure rainbow trout. One of the 30 fish from Boulder Creek possessed evidence of hybridization with cutthroat trout, while the remaining 29 fish were pure rainbow trout.

The John Day drainage is important for it is thought to contain westslope cutthroat trout. Three samples were obtained from this drainage, one from lower Dixie Creek, one from upper Dixie Creek, and one from Roberts Creek (Table 2, Figure 2). Individuals with only westslope trout markers were found in all three samples, though hybrid fish were also present in the samples (Table 2, Figure 2). In lower Dixie Creek, 29 of 35 fish were rainbow trout, 4 were westslope cutthroat trout, and the remaining 2 were hybrid fish. Further up in the upper reaches of Dixie Creek, 7 of 29 fish were rainbow trout, 17 were westslope cutthroat trout, and 5 were identified as hybrid fish. In Roberts Creek, 26 of 31 were identified as westslope cutthroat trout, while the remaining 5 fish were hybrids, including one individual that appeared to be an F_1 hybrid.

Genetic Relationships Among Populations

To assess the relationships among various populations and estimate the impact hatchery operations may be having in the Hood River, we have began collection of microsatellite data. This work is in progress and several additional loci must be run before the results can be analyzed. A list of populations analyzed and loci used thus far is given in Table 3.

DISCUSSION

We have identified both rainbow trout and cutthroat populations in the Mt. Hood area that do not appear to be effected by hybridization. However, in no instance did we find the species to co-occur and not hybridize. There are some patterns to the distribution of the species. For example, we have found only *O. mykiss* in the West Fork of the Hood River and predominantly *O. clarki* in the Middle and East Forks. However, there are also areas in which the species distribution is curious. The upper Clackamas for instance has populations of both rainbow and cutthroat. Subsequent work describing the relationships of these populations may help explain such assemblages.

All genetic techniques used to identify taxa rely on a baseline data set that is representative of all contributing populations. We have attempted to collect this baseline but two factors may confound the interpretation of our data. First, we must consider the possibility of sampling an individual that represents a lineage that was not included in our reference samples. Other taxa should also possess unique diagnostic fragments and should therefore be identified as “unknown” rather than being inappropriately assigned to another taxa. This phenomenon has not been observed in the Mt. Hood area, thus, our samples probably represent either *O. mykiss*, *O. clarki* or hybrid individuals.

It is also impossible to eliminate the possibility that some of the fragments we score are naturally polymorphic.

This is a particular concern in species such as rainbow and cutthroat trout that are evolutionarily closely related. This phenomenon has been observed in protein electrophoresis and is indicative of the biological complexity inherent to these species rather than a limitation of PCR-based methodologies.

Most of the populations in the lower Columbia basin that we have identified as containing hybrids included several individuals that contain multiple fragments indicative of hybridization. In four cases, a single individual was identified as being a hybrid. The individual from the North Fork of Greenpoint Creek lacks one of five rainbow trout diagnostic markers and has four of the 12 markers diagnostic for cutthroat trout. It is therefore very unlikely that this individual is not a hybrid. Two sample sites, Pocket Creek and Boulder Creek each contain a single individual that contains a single marker indicating hybridization. These individuals may simply be polymorphic at those loci and in the absence of other data, these populations should be considered pure. The gels for the final population, Bull Run Lake, were of sub-optimal quality and should be repeated prior to a final interpretation. Further analysis of these populations using microsatellite loci may also provide some insight on their status.

We have not observed an F_1 hybrid individuals in the Mt. Hood area. Hybridization appears to occur in many populations and in some populations most individuals are probably hybrids yet no F_1's have been identified. This observation has also been made in a more wide scale study of coastal cutthroat trout using allozymes (Grant 1998). This pattern of hybridization may indicate that hybridization has historically occurred more frequently in these populations or, more likely, that hybridization events occur episodically.

It is important to recognize that failure to detect fragments specific to other species does not equate to genetic purity. In several populations the majority of individuals contain markers indicative of hybridization. Although there are also individuals in those populations that do not have any markers diagnostic for the other species. It is most likely that all individuals in those populations are hybridized at some low level. We examine a very small subset of the genome of these species. In populations such as these in which hybridization is chronic and low level, it is likely that we fail to detect markers indicative of hybrids in some individuals.

We have used PINEs to complete the initial identification of pure and hybridized populations in the Mt. Hood vicinity. During the next phase of this project we will collect data from multiple microsatellite loci from most of these same sample locations. These markers are unlikely to be completely diagnostic, however, violations of expected Hardy-Weinberg proportions and significant levels of gametic disequilibrium may support our interpretation of the PINE data. If cases arise in which the microsatellite data appear to conflict with our conclusions based on PINEs, additional PINE loci can be run to refine our understanding of those populations.

The microsatellite loci may also allow us to identify the source of O. mykiss most often involved in hybridization with native cutthroat in the Hood River drainage. These data will assist managers determine the effects that stocking of hatchery-reared rainbow trout may have on the native fish fauna of the lower Columbia Basin and will provide insight into the most appropriate actions to preserve this valuable resource.

ACKNOWLEDGMENTS

We thank Kerry Topel for her assistance in collecting these data and we thank Kathryn Kostow for her patience.

REFERENCES

Allendorf, F. W. and R. F. Leary. 1988. Conservation and distribution of genetic variation in a polytypic species, the cutthroat trout. Conservation Biology 2:170-184.

Deininger, P. L. 1989. SINEs: short interspersed repeated DNA elements in higher eukaryotes. Pages 619-636 in D. E. Berg and M. M. Howes editors. Mobile DNA. American Society of Microbiology, Washington, D. C.

Ginatulin, A. A., and L. K. Ginatulina. 1996. Distribution of cloned Pvu-II repeated DNA sequences of pink salmon in Salmonid genomes. Russian Journal of Genetics. 32(5):597-602. Translated from Genetika 32(3):685-690.

Grant, S. 1998. The review of the status of coastal cutthroat trout (*Oncorhynchus clarki clarki*) from Washington, Oregon and California. National Marine Fisheries Service, Seattle, WA.

Green B. A., and J. E. Seeb. 1997. SINE and transposon sequences can be used to generate high-resolution DNA fingerprints, “SINE-prints”, which exhibit faithful Mendelian inheritance in pink salmon (*Oncorhynchus gorbuscha*). Molecular Marine Biology and Biotechnology. 4:331-341.

Gregg, R. and F. W. Allendorf. 1995. Systematics of Oncorhynchus species in the vicinity of Mt. Hood: Preliminary Report to Oregon Department of Fish and Wildlife.

Kido, Y., M. Aono, T. Yamaki, K. Matsumoto, S. Murata, M. Saneyoshi, and N. Okada. 1991. Shaping and reshaping of salmonid genomes by amplification of tRNA-derived retroposons during evolution. Proceedings of National Academy of Science USA 88:2326-2330.

Kido, Y., M. Himberg, N. Takasaki, and N. Okada. 1994. Amplifications of distinct subfamilies of short interspersed elements during evolution of the Salmonidae. Journal of Molecular Biology 241:633-644.

Leary, R. F., F. W. Allendorf, and G. K. Sage. 1995. Hybridization and Introgression between introduced and native fish. American Fisheries Society Symposium 15:91-101.

Nelson D. L., S. A. Ledbetter, L. Corbo, M. F. Victoria, R. Ramirez-Solis, T. D. Webster, Ledbetter DH, and Caskey CT, 1989. Alu polymerase chain reaction: A method for rapid isolation of human-specific sequences from complex DNA sources. Proc Natl Acad Sci USA 86:6686-6690.

Spruell P., and G. H. Thorgaard, 1996. SINE sequences detect DNA fingerprints in salmonid fishes. Heredity 76:317-324.

Spruell, P., K. L. Pilgrim, B. A. Greene, C. Habicht, K. L. Knudsen, K. R. Lindner, J. B. Olsen, G. K. Sage, J. E. Seeb, and F. W. Allendorf (in press) Inheritance of nuclear DNA markers in gynogenetic haploid pink salmon. Journal of Heredity.

Spruell, P., M. L. Bartron, N. Kanda, and F. W. Allendorf (in prep.) Use of PINE-PCR (Paired Interspersed nuclear element-PCR) to detect hybrids between bull trout (*Salvelinus confluentus*) and brook trout (*S. fontinalis*).

Appendix Table E-1. Sample location and species composition of Oncorhynchus mykiss, O. c clarki, and their hybrids in the lower Columbia Basin. Field ID is the species thought to predominate in a sample site based on the appearance of the individuals at the time of collection, RBT = rainbow trout, SST = summer steelhead, WST = winter steelhead, CCT = coastal cutthroat.

				Number		
Drainage	**Number**	**Sample Location**	**ID**	***O. mykiss***	***O. clarki***	**Hybrids**
Clackamas River	CR01	N. F. Dam	WST	15	--	--
	CR02	Boyer Cr.	RBT	--	30	--
	CR03	upper S. F. Clackamas	CCT	28	--	2
	CR04	Cripple Cr.	CCT	--	28	--
	CR05	Dinger Cr.	CCT	--	30	--
	CR06	upper Oak Grove Fork	CCT	9	13	8
	CR07	Cub Cr.	CCT	--	33	--
	CR08	Nohorn Creek	RBT	19	--	--
	CR09	E. F. Callowash Cr.	RBT	18	--	--
Sandy River	SR01	Marmot Dam	RBT	26	--	--
	SR02	Little Sandy R.	RBT	30	--	--
	SR03	Bull Run Lake	CCT	--	26	1
	SR04	upper Bull Run R.	CCT	--	24	--
	SR05	Still Cr. smolt trap	CCT	18	--	3
	SR06	Lady Cr.	CCT	--	20	5
	SR07	Linney Cr.	CCT	--	30	--
Columbia Gorge	CG01	Bridal Veil Falls	CCT	--	15	--
	CG02	Oneota Cr.	RBT	24	--	--
	CG03	lower Multnomah Cr.	RBT	8	4	18
	CG04	upper Multnomah Cr.	CCT	--	29	--
Hood River	HR01	mainstem	SST	29	--	--
	HR02	mainstem	WST	11	--	--
	HR03	N. F. Greenpoint Cr.	RBT	29	--	1
	HR04	West Fork	RBT	9	--	--
	HR05	Elk/McGee Crs.	RBT	8	--	--
	HR06	Tony/Bear Crs.	CCT	--	--	4

Appendix Table E-1. Continued.

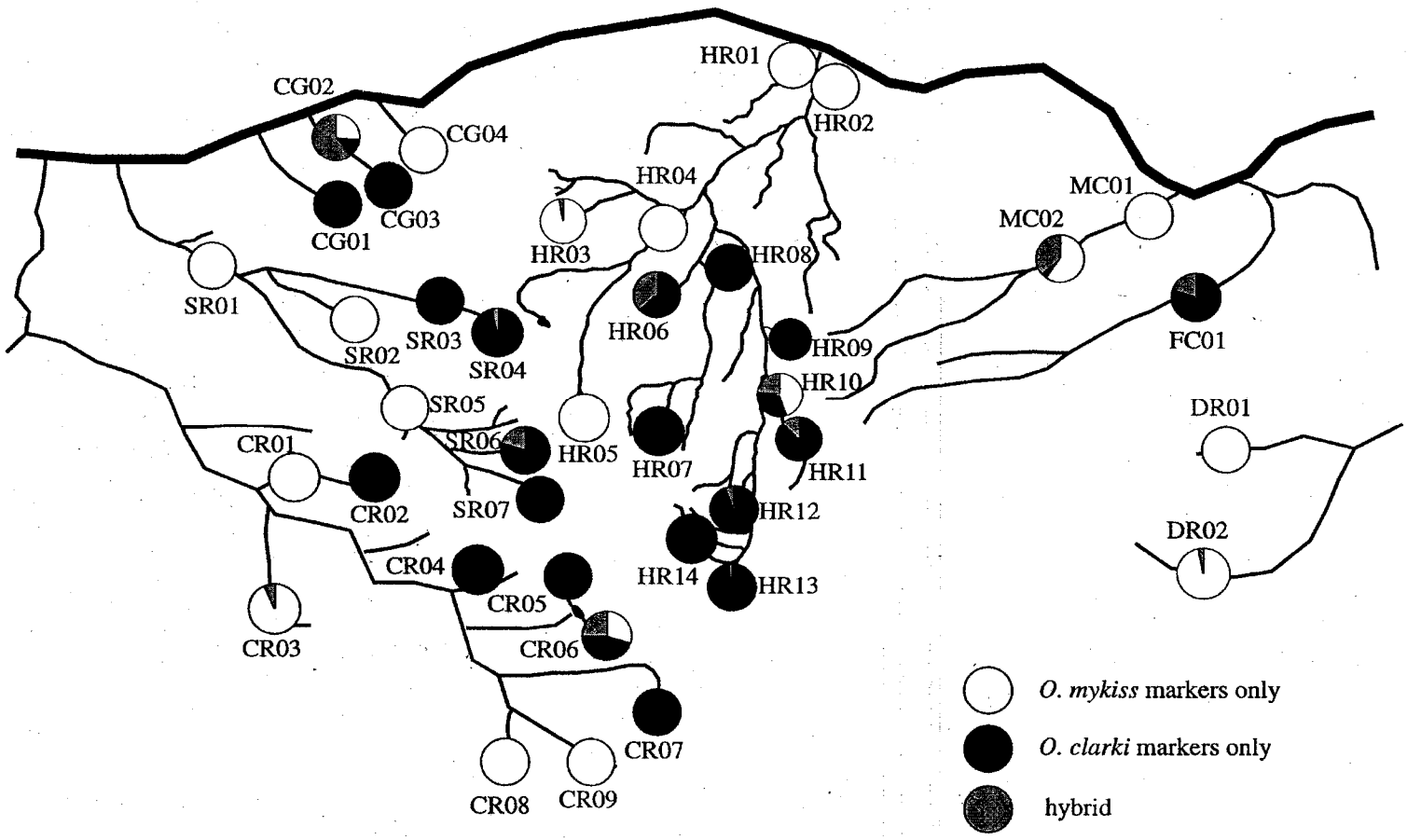
				Number		
Drainage	**Number**	**Sample Location**	**ID**	***O. mykiss***	***O. clarki***	**Hybrids**
Hood River	HR07	Pinnacle Cr.	CCT	--	30	--
	HR08	Emil Cr.	CCT	--	5	--
	HR09	Rimrock Cr.	CCT	--	20	--
	HR10	lower Dog Cr.	CCT	8	6	4
	HR11	upper Dog Cr.	CCT	--	21	3
	HR12	Robinhood Cr.	CCT	--	46	3
	HR13	Pocket Cr.	CCT	--	45	1
	HR14	Bucket Cr.	CCT	--	30	--
Mill Creek	MC01	mainstem	SST	30	--	--
	MC02	Mill Cr. (below falls)	RBT	18	1	11
Fivemile Creek	FC01	N.F. Fivemile Cr.	RBT	--	25	5
Deschutes River	DRT01	Tygh	RBT	30	--	--
	DR02	Boulder Cr.	RBT	29	--	1

Appendix Table E-2. Sample location and species composition of Oncorhynchus mykiss, O. clarki lewisi and their hybrids in the John Day Basin, Oregon. WCT = westslope cutthroat trout.

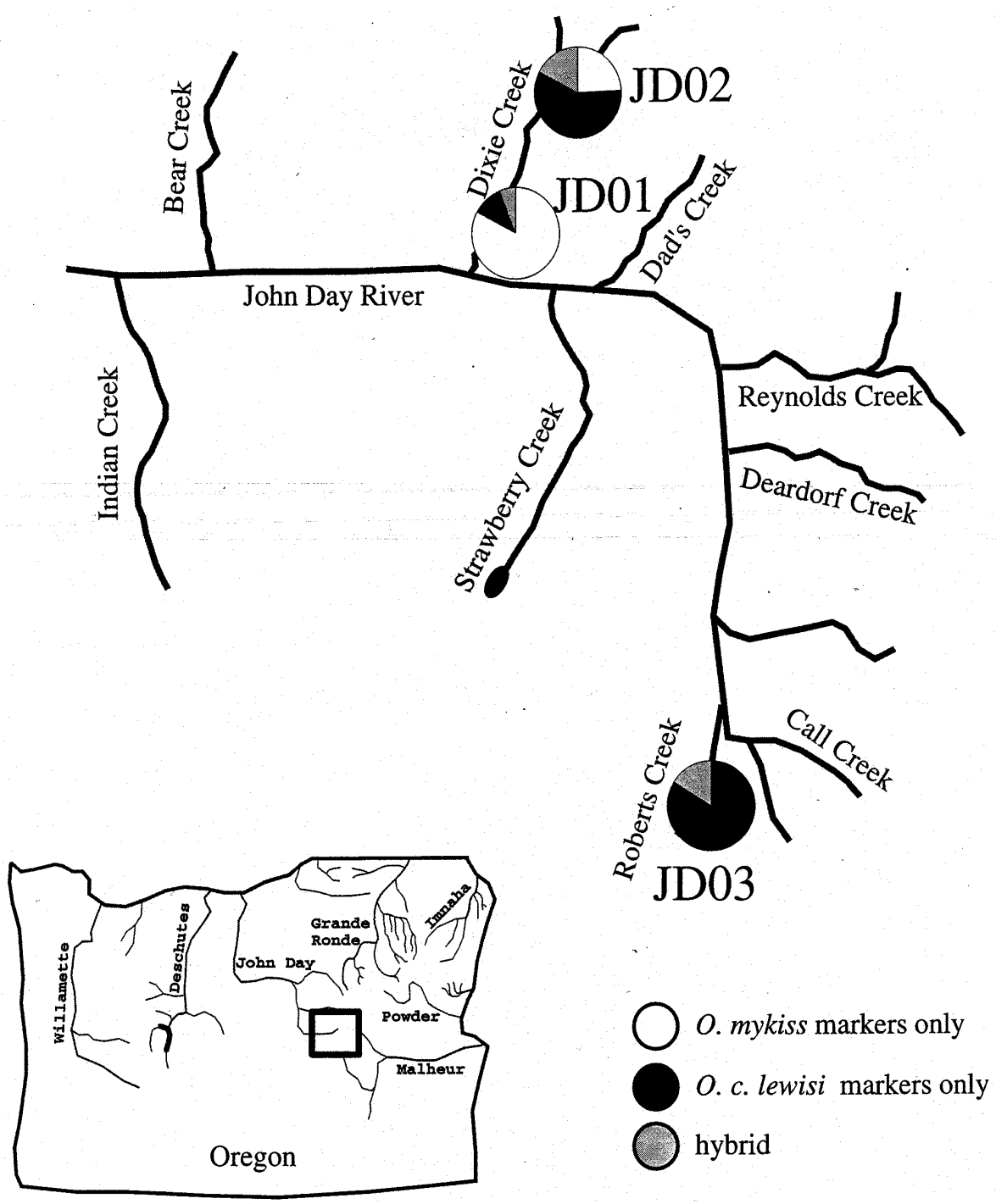
				Number		
Drainage	**Sample Number**	**Sample Location**	**Field ID**	***O. mykiss***	***O. clarki lewisi***	**Hybrids**
John Day River	JD01	lower Dixie Cr.	WCT	29	4	2
	JD02	upper Dixie Cr.	WCT	7	17	5
	JD03	Roberts Cr.	WCT	--	26	5

Appendix Table E-3. Populations that have been analyzed using microsatellite loci and loci that have been scored in those populations. "XX" indicates populations that have been analyzed at indicated locus, "--" indicates loci that have not been run in each population.

			Loci			
Species	**Sample Location**	**Number**	***OMY77***	***ONEμ11***	***ONEμ3***	***SSA197***
O. mykiss	Lower Multnomah Cr.	30	XX	XX	XX	XX
	Oneonta Cr.	24	XX	XX	XX	XX
	Marmot Dam	33	XX	XX	XX	XX
	Still Cr. smolt trap	21	XX	XX	XX	--
	Hood River, summer	29	XX	XX	XX	--
	Hood River, winter	11	XX	--	--	--
O. clarki	Upper Multnomah Cr.	29	XX	XX	XX	--
	Bridal Veil Cr.	30	XX	XX	XX	--
	Lady Cr.	25	XX	XX	XX	--
	Tony/Bear Cr.	16	XX	--	--	--



Appendix Figure E-1. Approximate sample locations and species composition of samples from the Mt. Hood vicinity.



Appendix Figure E-2. Approximate sample locations and species composition of samples from the John Day River.

APPENDIX F

Genetic Analysis of Steelhead Trout (*Oncorhynchus Mykiss*) in the Hood and Bull Run River Drainages

PROGRESS REPORT WTSGL00-02
TO
Oregon Department of Fish and Wildlife
October 10, 2000

Luke Nerass
and
Paul Spruell✤

Wild Trout and Salmon Genetics Laboratory
Division of Biological Sciences
University of Montana
Missoula, MT 59812

✤Author to whom correspondence should be addressed

phone (460) 243-6749
fax (460) 243-4184
email spruell@selway.umt.edu

INTRODUCTION

This is an annual progress report to the Oregon Department of Fish and Game describing the results of a preliminary genetic investigation of steelhead and rainbow trout (*Oncorhynchus mykiss*) in the state. The objective of this study is to investigate the genetic population structure of *Oncorhynchus mykiss* throughout the state of Oregon. One of our initial objectives is to examine the genetic variation of steelhead in the Hood River basin to determine if hatchery released steelhead trout have introgressed with the native summer and winter run populations. We are also analyzing the populations sampled from the Bull Run and Sandy River systems to describe population structure, hybridization and possible hatchery introgression.

The Hood River basin has been stocked with hatchery raised steelhead trout for at least 42 years. The brood stock was composed of individuals from mixed origins up until the late 1990's when managers started using "wild" steelhead from the Hood River as the parents for the system's broodstock. The amount of interbreeding between hatchery and native steelhead is unknown.

To date we have screened 24 microsatellite loci to identify informative markers, and have finished the analysis of five loci on nine groups of samples. Four of these samples are wild winter and summer run steelhead collected in 1993 and 1994. While these fish were collected as either summer and winter run, their actual population of origin within the basin is unknown.

Currently, we only have one hatchery stock of summer steelhead included in this analysis, summer stock #24 (HR24). It is our goal to complete the analysis of winter stocks #13 and #50 plus summer stock #50 as soon as we receive samples of these fish. Our preliminary investigation suggests that some straying could have occurred between summer hatchery stock #24 and wild summer steelhead (**Appendix Figure F-1**).

We have begun to look at hybridization between coastal cutthroat trout (*Oncorhynchus clarki clarki*) and steelhead trout in the Bull Run basin. We have finished hybrid identification of four samples in the Bull Run basin. In this report we analyzed two Bull Run samples. One sample was collected at gaging station #18 and the other was collected from the lower four miles of the stream below Bull Run Dam. The other two samples are from Bull Run Lake and the upper Bull Run River, the analysis of these samples was reported in our previous report WTSGL99-103 (**Appendix E**). Our goal is to include the Bull Run samples we have identified as steelhead and incorporate them into our hatchery / wild introgression study.

METHODS

Microsatellite Amplification and Analysis

We amplified 24 microsatellite loci in an MJ Research PTC-100 thermocycler. The amplified alleles were seperated on a 7% denaturing polyacrylamide gel and visualized using a Hitachi FMBIO-100 fluorescent imager. Allele sizes were determined relative to a standard base pair size ladder (MapMarkerLow, Bioventures). Previously amplified products were included on each gel to ensure consistent scoring of individuals across all gels (Spruell et al. 1999).

Hybrid I.D.

We used fluorescently labeled PINE-PCR primers (Spruell in press) to identify the genetic makeup of individuals collected in the Bull Run Rive basin. PCR products were size fractionated in a 4.5 % denaturing polyacrylamide gel, and visualized using a Hitachi FMBIO100 fluorescent imager (Version 6.1, Hitachi Software). Gels were visually inspected for species-specific fragments present in the sampled individuals. The size of each of these fragments was determined relative to a standard base pair size ladder (MapMarkerLow, Bioventures).

Data Analysis

We used GENEPOP to calculate heterozygosity values, allele frequencies, F_{st}, and deviations from Hardy-Weinberg expectations (Raymond & Rousset 1995). We used a Cavalli-Sforza and Edwards chord distance (CSE) to estimate the genetic similarity among samples (Cavalli-Sforza et al. 1967). A UPGMA dendrogram was generated using PHYLIP (Felsenstein 1992). This dendrogram allowed us to visualize the genetic similarity among samples within the system. We also used a Principle Component Analysis (PCA) as an alternative means to display the genetic relationship among samples (Minitab version 11).

RESULTS

Hood River Steelhead

We screened 24 microsatellite loci for use in this study. Eleven of the loci were unusable for this study due to duplication or non-amplification. Five of the Loci (SSA311; OGO8; OGO4; OMY0004; and SSA197) were used for analysis in this report. Eight more loci are promising for future use in this study. (**Appendix Table F-1**).

All five loci used were polymorphic in at least one sample. After correcting for multiple tests (Rice 1989) we found one deviation in Hardy-Weinburg proportions. Hatchery Stock #53 (HR53) did not conform to Hardy-Weinburg expectations at the SSA311 locus due to a single homozygote with a rare allele (151). A deviation from Hardy-Weinburg proportions in a hatchery stock is not unexpected because they violate the assumptions of the theory. Expected heterozygosity averaged 0.628 and ranged from 0.495 to 0.720 (**Appendix Table F-2**). The observed heterozygosity averaged 0.633 and ranged from 0.526 to 0.703 (**Appendix Table F-2**). The number of private alleles found in any sample ranged from zero to two. There is substantial differentiation among samples (Fst) decreases to 0.039. Finally, differences among the wild summer steelhead samples (HS93 and HS94) and

summer hatchery stock #24 (HR24) are only responsible for 18% of the total differentiation seen in the data set.

The UPGMA dendrogram suggests that hatchery stock # 24 (HR24) and wild summer run fish from 1993 (HS93) and 1994 (HS94) are genetically similar to one another (**Appendix Figure F-1**). The dendrogram also suggests that the wild winter run samples from 1993 (HS93) and 1994 (HR94) are closely related to each other (Appendix Figure E-1). The samples from the mainstem of the Hood (MSHD), Elk/McGee (ELKM), and the West Fork of the Hood (WFHD) do not seem to cluster with any other sample on the dendrogram (**Appendix Figure F-1**). This result is tentative due to low sample sizes. Hatchery Stock #53 is the most distant sample of the tree, suggesting that it either has not introgressed with any steelhead in the basin, or is a hatchery stock from an unrelated strain (**Appendix Figure F-1**). A Principle Component Analysis (PCA) further supports the similarities shown by the UPGMA dendrogram (**Appendix Figure F-1**).

Bull Run Hybrid Identification

We analyzed a total of seventy-five fish from two different sampling locations in the Bull River system for species identification. The sample taken from below gaging station eighteen contained seven rainbow trout, eleven coastal cutthroat trout, and one rainbow/cutthroat trout hybrid. The sample taken from the lower four miles of the Bull Run River below Bull Run Dam contained 56 rainbow trout, one coastal cutthroat trout, and zero hybrids. The individuals identified as pure *Oncorhynchus mykiss* will be included in future microsatellite analysis.

DISCUSSION

Hood River Steelhead

The microsatellite data suggests that there is relatively little differentiation between any of the wild steelhead samples and hatchery stock #24. One interpretation of the data is that there has been introgression between summer stock #24 and wild stocks. However, due to an incomplete data set, we have limited power to differentiate between recent introgression and pre-existing genetic similarities between populations in the Hood River and the basins from which donor stock originated. This hatchery/wild introgression question will become more clear as additional samples are analyzed during the subsequent years of this study.

To adequately address the hatchery/wild introgression question it is necessary that we get samples from the original populations where the brood stocks were derived. It is also important to obtain samples from independent spawning sites within the Hood River drainage. This would aid in pinpointing areas where putative hatchery introgression may be more frequent. For example, the small sample sizes from Elk/McGee creeks (ELKM), the West Fork Hood River (WFHD), and the Mainstem Hood River (MSHD) provide little confidence in the true genetic relationship these samples may have with others in the data set. We anticipate obtaining and analyzing more individual samples from the Hood River basin during the next year of this project.

Future Scope of Work

This project is scheduled to continue through the year 2004. During this time we will continue analyzing

Oncorhynchus species throughout the state of Oregon.

LITERATURE CITED

Cavalli-Sforza LL, Edwards AWF (1967) Phylogenetic analysis: models and estimation procedures. Evolution 21, 550-570.

Felsenstein J (1993) PHYLIP (Phylogeny Inference Package) version 3.5c. Distributed by the author. Department of Genetics, University of Washington, Seattle.

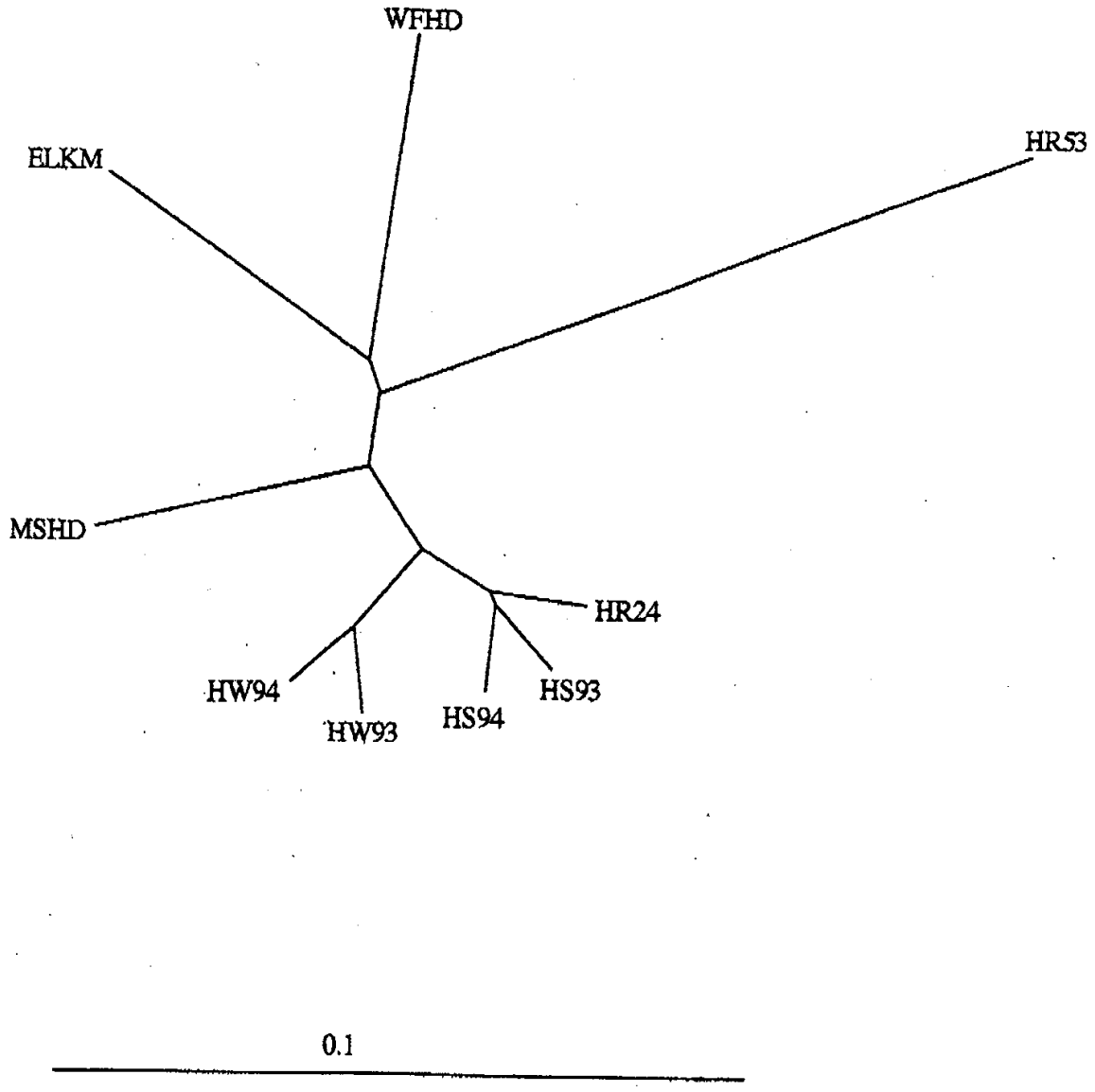
Raymond M, Rousset F (1995) GENEPOP (version 1.2): Population genetics software for exact tests and ecumenicism. Journal of Heredity, 83, 248-249.

Rice WR (1989) Analyzing tables of statistical tests. Evolution, 43, 223-225.

Spruell P, Rieman BE, Knudsen KL, Utter FM, Allendorf FW (1999) Genetic population structure within streams: microsatellite analysis of bull trout populations. Ecology of Freshwater Fish, 8, 114-121.

Spruell P, Bartron ML, Kanda N, Allendorf FW (in press) Identification of bull trout (*Salvelinus confluentus*) X brook trout (*S. fontinalis*) hybrids using nuclear DNA markers. Copeia.

Appendix Figure F-1. A Cavali-Sforza and Edwards UPGMA dendrogram showing the genetic relationship among steelhead samples in the Hood River basin. Sample abbreviations correspond with Appendix Table F-2.



Appendix Table F-1. A list of loci that were screened for the project. (A minus (-) indicates that a locus was unusable; an "X" indicates that a locus has been used in this report; and a plus (+) indicates a promising locus that will be pursued in future work).

Locus name	Status
SCO19	-
SSA20.19	-
OTS3	-
OGO1c	-
OGO3	-
SSA85	-
RGT6	-
ONEu3	-
ONEu8	-
SSA456	-
OGO1c	X
SSA311	X
OGO8	X
OGO4	X
OMYOOO4	X
SSA197	X
ONEu11	+
OC1 12	+
SFO8	+
OMY77	+
ONEu14	+
OTS1	+
OMY325	+
ONEu2	+

Appendix Table F-2. Sample site, sample size, number of alleles observed at 5 loci, number of private alleles detected, and heterozygosity values for steelhead samples collected from the Hood River basin of Oregon.

Sample Sites	Abbrev.	Sample Size	# Of Alleles	# Of Private Alleles	Heterozygosity	
Wild Hood Summer 1993	HS93	30	36	1	Ho	0.660
					He	0.592
Wild Hood Summer 1994	HS94	30	40	1	Ho	0.610
					He	0.688
Wild Hood Winter 1993	WH93	30	44	2	Ho	0.700
					He	0.720
Wild Hood Winter 1994	WH94	30	37	1	Ho	0.703
					He	0.700
Hatchery Stock #24	HS24	30	32	0	Ho	0.556
					He	0.652
Hatchery Stock #53	HS53	30	18	0	Ho	0.526
					He	0.495
Main Stem Hood River	MSHD	10	28	1	Ho	0.543
					He	0.706
Elk & McGee Creeks	ELKM	4	15	1	Ho	0.602
					He	0.516
West Fork Hood River	WFHD	3	12	0	Ho	0.634
					He	0.590

APPENDIX G

Hood River Fish Habitat Past Project Accomplishments

Appendix Table G-1. Hood River fish habitat past project accomplishments by year, as part of the Hood River Production Program. Report reference for each project is provided.

Year	Accomplishment	Biological Objective	Report Reference
1996	CTWSRO constructed 0.5 miles of riparian livestock exclosure barbed-wire fencing on Neal Creek - Rm 3.0 (Kirby property).	Exclude livestock for riparian recovery and stream bank stabilization.	Lambert et al., January 1998
1996	CTWSRO placed 75 ft (100 cubic yards) of bioengineered rip rap, which included hardwood plantings on Neal Creek - Rm 3.0 (Kirby property).	Stream bank stabilization and property protection.	Lambert et al., January 1998
1997	EFID installed Coanda screens on the East Fork Hood River Canal as part of the Sand Trap - Rm 6.0.	Eliminate fish entrainment in the irrigation canal.	Lambert et al., December 1999
1997	CTWSRO constructed 0.25 miles of riparian livestock exclosure barbed-wire fencing on Neal Creek - Rm 2.0 (Meyers property).	Exclude livestock for riparian recovery and stream bank stabilization.	Lambert et al., December 1999
1997	CTWSRO constructed 0.95 miles of riparian livestock exclosure barbed-wire fencing on Neal Creek (Rm 2.5) and small tributary Lambert Creek (Guisto property).	Exclude livestock for riparian recovery and stream bank stabilization.	Lambert et al., December 1999
1998	CTWSRO hired SJO Engineering who completed a preliminary feasibility evaluation on the Neal Creek canal diversion and screen.	Provided project options in developing a NMFS approved diversion and screen or pipe bypass system on Neal Creek.	Lambert et al, December 1999
1998	CTWSRO placed 125 ft (120 cubic yards) of bioengineered rip rap, which included various types of native hardwood plantings on Neal Creek - Rm 2.5 (Guisto property)	Streambank stabilization and property protection.	Lambert et al., December 1999
1998	HRWG volunteers and CTWSRO planted 125 ponderosa pine seedlings donated by Lava Nursery within the livestock exclosure on Neal Creek - Rm 3.0 (Kirby property).	Hasten riparian overstory recovery.	Lambert et al., December 1999
1999	HRWG volunteers planted 12 Douglas fir seedlings within the livestock exclosure on Neal Creek - Rm 3.0 (Kirby property).	Hasten riparian overstory recovery.	
1999	HRWG volunteers, Northwest Service Academy/AmeriCorp, NRCS, and the Hood River High School Lacrosse team planted 150 native willows and 63 Douglas fir seedlings on Neal Creek - Rm 2.0 (Meyers property).	Hasten riparian recovery.	Lambert et al., December 1999
1999	HRWG along with volunteers from the Northwest Service Academy/AmeriCorp, Interfluve Inc., and the Gorge Paddlers Club planted 200 red osier dogwood, 40 Douglas fir seedlings, and 40 ponderosa pine (3-yr old trees) transplanted from Kirby property on Neal Creek - Rm 2.5 (Guisto property).	Hasten riparian recovery and stabilize bioengineered rip rap.	

APPENDIX H

Pelton Ladder Supportive Data

Appendix Table H-1. Pond and cell location of hatchery spring chinook salmon juveniles during rearing at Pelton Ladder and Round Butte Hatchery, 1994-1999 broods. (Ad = adipose, RV = right ventral, LV = left ventral, RM = right maxillary, LM = left maxillary, L = ladder, H = hatchery.)

Brood year	Pond	Date transferred	Pond or cell number	Size (fish/lb)	Number	Tag code-clip
1994	H-1A	Oct.1	H-1	18.1	22,100	07-09-37-Ad
	H-1B	Oct.1	H-2	34.5	33,118	07-09-36-Ad
	H-7	Nov.13	L-1	13.6	66,181	07-09-35-Ad
	H-2	Sept.25	L-2	21.4	63,916	07-09-33-Ad
	H-3	11-15-95	L-3	14.2	63,782	07-09-34-Ad
	H-10	09-28-95	L-4	29.7	63,784	07-11-30-AdRV
	H-8	09-27-95	L-5	29.4	63,885	07-11-30-AdRV
	H-4	11-14-95	L-6	24.3	95,885	07-09-38-Ad
1995	H-1A	10-17-96	H-1	16.4	21,016	09-17-44-Ad
	H-1B	10-17-96	H-2	26.0	31,552	09-17-45-Ad
	H-5	11-13-96	L-1	14.3	64,848	09-17-42-Ad
	H-6	10-15-96	L-2	14.1	64,809	09-17-41-Ad
	H-8	11-13-96	L-3	22.0	96,643	09-17-46-Ad
	H-2	10-15-96	L-4	14.6	64,752	09-17-47-AdLV
	H-7	10-15-96	L-5	14.1	64,794	09-18-06-AdLV
	H-10	11-13-96	L-6	11.9	64,750	09-17-43-Ad
1996	H-1A	09-30-97	H-1	20.4	21,693	09-22-23-Ad
	H-1B	09-30-97	H-2	18.9	32,123	09-22-24-Ad
	H-8	11-04,05-97	L-1	13.1	66,206	09-22-20-Ad
	H-10	09-30-97	L-2	12.9	65,421	09-22-21-Ad
	H-6	11-04,05-97	L-3	19.6	97,944	09-22-25-Ad
	H-2	09-30-97	L-4	12.3	64,436	09-22-26-AdRV
	H-5	09-30-97	L-5	11.7	65,631	09-22-27-AdRV
	H-9	11-04,05-97	L-6	15.8	65,654	09-22-22-Ad
1997	H-10	11-16-98	H-10	13.4	30,487	09-25-57-AdRM
	H-1	11-20-98	L-1	14.7	82,248	09-25-51-Ad
	H-2	11-20-98	L-2	15.5	82,286	09-25-52-Ad
	H-3	11-19-98	L-3	14.5	82,282	09-25-53-Ad
	H-4	11-18-98	L-4	13.7	48,669	09-25-56-AdLV
	H-9	11-17-98	L-5	14.8	48,761	09-25-55-AdLV
	H-8	11-18-98	L-6	15.9	82,336	09-25-54-Ad
1998	H-5	No transfer	H-5	13.9	30,945	09-28-57-AdRV
	H-6	11-17-99	L-1	13.1	83,767	09-28-51-Ad
	H-8	11-18-99	L-2	13.5	83,889	09-28-52-Ad
	H-10	11-19-99	L-3	12.8	83,641	09-28-53-Ad
	H-1	11-15-99	L-4	12.9	49,925	09-28-55-AdLM
	H-2	11-16-99	L-5	13.1	49,911	09-28-56-AdLM
	H-9	11-19-99	L-6	12.9	51,498	09-28-54-Ad

Appendix Table H-1. Continued.

Brood year	Pond	Date transferred	Pond or cell number	Size (fish/lb)	Number	Tag code-clip
1999	H-6	11-01-00	H-6		31,470	09-31-22-AdRM
	H-1	11-03-00	L-1		82,340	09-31-19-Ad
	H-5	10-31-00	L-2		59,578	09-31-18-Ad
	H-2	11-2,3-00	L-3		82,272	09-31-17-Ad
	H-9	10-30-00	L-4		48,958	09-31-21-AdLV
	H-8	10-30-00	L-5		48,945	09-31-20-AdLV
	H-3	11-02-00	L-6		78,109	09-31-16-Ad

Appendix Table H-2. Releases of juvenile spring chinook salmon from Round Butte Hatchery into the Deschutes River, 1978-1999 broods. LP = left pectoral; RP = right pectoral; LM = left maxillary; RM = right maxillary. [a]

Brood year, release date	Release site	Number released	Size at release (fish/lb)	Fin clip or coded-wire tag code
1978,				
05/10/79	Pelton Ladder [b]	14579	19.7	07-18-24
05/30/79	Pelton Reregulating Dam	54300	22.0	07-18-25
04/14/80	Pelton Reregulating Dam	32865	8.0	07-19-49
04/14/80	Pelton Reregulating Dam	30758	8.8	07-19-50
04/14/80	Pelton Ladder [b]	29993	8.0	07-19-51
1979,				
05/12/80	Pelton Ladder [b]	22280	20.0	07-21-53
10/06/80	Pelton Reregulating Dam	29264	5.9	07-21-54
03/10/81	Pelton Reregulating Dam	30450	7.3	07-23-10
04/24/81	Pelton Reregulating Dam	29200	4.9	07-23-09
03/02/81	Pelton Ladder [c]	25446	8.8	07-23-11
1980,				
10/05/81	Pelton Reregulating Dam	46578	5.7	07-23-47
10/05/81	Pelton Reregulating Dam	29430	11.4	07-23-49
03/02/82	Pelton Ladder [c]	28656	5.9	07-23-48
03/23/82	Pelton Reregulating Dam	25010	4.8	07-23-50
1981,				
10/11/82	Pelton Reregulating Dam	28538	6.4	07-25-20
10/11/82	Pelton Reregulating Dam	59118	23.6	07-27-15
03/21/83	Pelton Reregulating Dam	57340	9.3	07-27-14
03/02/83	Pelton Ladder (Upper) [c]	48495	12.2	07-27-16
03/21/83	Pelton Ladder (Lower) [c]	28847	12.2	07-27-17

[a] Production releases prior to the 1978 brood are in Lindsay et al. (1987). Experimental releases totaling 70,013 were made into Pelton Ladder from 1975 to 1979 (1974-77 broods) to determine migration timing but were not included in this table.

Appendix Table H-2. Continued.

Brood year, release date	Release site	Number released	Size at release (fish/lb)	Fin clip or coded-wire tag code
1982,				
05/24/83	Pelton Reregulating Dam	28920	19.2	07-28-36
10/05/83	Pelton Reregulating Dam	53550	16.3	07-28-43
10/06/83	Pelton Reregulating Dam	28200	5.6	07-28-37
04/16/84	Pelton Reregulating Dam	28790	5.2	07-28-39
04/16/84	Pelton Reregulating Dam	28991	5.2	07-28-40
03/05/84	Pelton Ladder (Lower) [c]	53941	9.5	07-28-42
04/15/84	Pelton Ladder (Upper) [c]	50946	8.4	07-28-41
1983,				
10/08/84	Pelton Reregulating Dam	60797	12.4	07-31-31
10/09/84	Pelton Reregulating Dam	30394	6.5	07-31-32
04/02/85	Pelton Reregulating Dam	57748	5.8	07-31-28
03/09/85	Pelton Ladder (Lower) [c]	60712	7.6	07-31-29
04/01/85	Pelton Ladder (Upper) [c]	60759	7.6	07-31-30
1984,				
03/12/86	Pelton Reregulating Dam	32000	5.7	07-33-20
03/13/86	Pelton Reregulating Dam	30952	5.7	07-33-20
06/03/86	Pelton Ladder (Mix) [c]	62994	7.7	07-33-21
06/05/86	Pelton Ladder (Mix) [c]	74744	7.7	LV LM
06/05/86	Pelton Ladder (Mix) [c]	75160	7.7	LP
1985,				
04/13/87	Pelton Reregulating Dam	54863	5.5	07-39-28
05/27/87	Pelton Ladder (Mix) [c]	62000	7.5	07-39-29
05/27/87	Pelton Ladder (Mix) [c]	74000	7.5	RV RM
05/27/87	Pelton Ladder (Mix) [c]	75000	7.5	RP

Appendix Table H-2. Continued.

Brood year, release date	Release site	Number released	Size at release (fish/lb)	Fin clip or coded-wire tag code
1986,				
04/11/88	Pelton Reregulating Dam	54221	6.9	07-44-61
04/11/88	Pelton Ladder (Mix) [c]	55147	8.5	07-44-62
04/22/88	Pelton Ladder (Mix) [c]	66593	8.5	LV LM
04/22/88	Pelton Ladder (Mix) [c]	66594	8.5	LP
05/25/88	Pelton Ladder (Mix) [c]	6123	8.2	07-44-62
05/25/88	Pelton Ladder (Mix) [c]	7771	8.5	LV LM
05/25/88	Pelton Ladder (Mix) [c]	7770	8.5	LP
1987,				
04/17/89	Pelton Reregulating Dam	28186	7.3	07-46-22
04/17/89	Pelton Reregulating Dam	29528	6.4	07-46-23
04/18/89	Pelton Ladder (Cell 1) [c]	20473	9.5	07-46-24
04/18/89	Pelton Ladder (Cell 2) [c]	20408	9.3	07-46-25
04/18/89	Pelton Ladder (Cell 3) [c]	20458	10.6	07-46-26
04/18/89	Pelton Ladder (Mix) [c]	153865	9.8	RM
1988,				
04/20/90	Pelton Reregulating Dam	29590	6.5	07-50-61
04/19/90	Pelton Reregulating Dam	28608	6.0	07-50-62
05/17/90	Pelton Ladder (Cell 3) [c]	24107	10.7	07-50-58
05/17/90	Pelton Ladder (Cell 2) [c]	20967	9.7	07-50-59
05/17/90	Pelton Ladder (Cell 1) [c]	21328	8.8	07-50-60
05/17/90	Pelton Ladder (Mix) [c]	134847	9.7	LM
1989,				
04/22/91	Pelton Reregulating Dam	29959	6.1	07-53-61
04/23/91	Pelton Reregulating Dam	29959	6.1	07-53-62
05/14/91	Pelton Ladder (Cell 1) [c]	21236	9.5	07-53-63
05/14/91	Pelton Ladder (Cell 2) [c]	21232	9.5	07-54-01
05/14/91	Pelton Ladder (Cell 3) [c]	21521	10.5	07-54-02
05/14/91	Pelton Ladder (Mix) [c]	146895	9.8	RM

Appendix Table H-2. Continued.

Brood year, release date	Release site	Number released	Size at release (fish/lb)	Fin clip or coded-wire tag code
1990,				
04/28/92	Pelton Reregulating Dam	28575	6.5	07-56-48
04/28/92	Pelton Reregulating Dam	28575	6.5	07-56-49
05/21/92	Pelton Ladder (Cell 1) [c]	21148	9.8	07-56-45
05/20/92	Pelton Ladder (Cell 2) [c]	21540	9.8	07-56-46
05/21/92	Pelton Ladder (Cell 3) [c]	21393	9.8	07-56-47
05/21/92	Pelton Ladder (Mix) [c]	149548	9.8	LM
1991,				
04/07/93	Pelton Reregulating Dam	24735	6.1	07-50-08
04/05/93	Pelton Ladder (Cell 1) [c]	21122	8.7	07-59-40
04/05/93	Pelton Ladder (Cell 1) [c]	47713	8.7	07-59-49
04/06/93	Pelton Ladder (Cell 2) [c]	22020	10.0	07-59-39
04/06/93	Pelton Ladder (Cell 2) [c]	49600	10.0	07-59-48
04/07/93	Pelton Ladder (Cell 3) [c]	49127	9.8	07-59-47
04/07/93	Pelton Ladder (Cell 3) [c]	21589	9.8	07-59-38
1992,				
04/18/94	Pelton Reregulating Dam	26580	6.0	07-02-30
05/06/94	Pelton Ladder (Cell 3) [c]	70995	8.6	07-02-27
05/06/94	Pelton Ladder (Cell 2) [c]	70996	9.3	07-02-28
05/06/94	Pelton Ladder (Cell 1) [c]	68998	8.9	07-02-29
1993,				
04/17/95	Pelton Reregulating Dam	29318	5.8	08-05-29
04/17/95	Pelton Ladder (Cell 3) [c]	69446	8.7	07-05-26
04/19/95	Pelton Ladder (Cell 2) [c]	70042	8.7	07-05-27
04/18/95	Pelton Ladder (Cell 1) [c]	70413	8.1	07-05-28

Appendix Table H-2. Continued.

Brood year, release date	Release site	Number released	Size at release (fish/lb)	Fin clip or coded-wire tag code
1994,				
04/23/96	Pelton Ladder (Cell 2) [d]	63445	7.8	07-09-33
04/24/96	Pelton Ladder (Cell 3) [e]	63551	8.3	07-09-34
04/22/96	Pelton Ladder (Cell 1) [e]	65625	7.3	07-09-35
04/25/96	Pelton Reregulating Dam	25654	10.7	07-09-36
04/25/96	Pelton Reregulating Dam	19239	8.0	07-09-37
04/25/96	Pelton Ladder (Cell 6) [e]	85151	10.9	07-09-38
04/25/96	Pelton Ladder (Cell 4,5) [f]	7282	9.9	07-11-30
1995,				
04/17/97	Pelton Ladder (Cell 2) [g]	61232	7.3	09-17-41
04/16/97	Pelton Ladder (Cell 1) [e]	61102	7.3	09-17-42
04/21/97	Pelton Ladder (Cell 6) [e]	62530	8.0	09-17-43
04/15/97	Pelton Reregulating Dam	14910	6.5	09-17-44
04/15/97	Pelton Reregulating Dam	25938	11.0	09-17-45
04/18/97	Pelton Ladder (Cell 3) [e]	90474	11.0	09-17-46
1996,				
04/13/98	Pelton Reregulating Dam	16397	8.6	09-22-23
04/14/98	Pelton Reregulating Dam	31699	12.0	09-22-24
04/20/98	Pelton Ladder (Cell 1) [e]	60145	9.0	09-22-20
04/21/98	Pelton Ladder (Cell 2) [d]	63213	8.1	09-22-21
04/22/98	Pelton Ladder (Cell 3) [e]	96633	11.0	09-22-25
04/23/98	Pelton Ladder (Cell 6) [e]	64149	10.0	09-22-22
1997,				
04/12/99	Pelton Ladder (Cell 1) [e]	71395	7.8	09-25-51
04/13/99	Pelton Ladder (Cell 2) [e]	72375	7.5	09-25-52
04/14/99	Pelton Ladder (Cell 3) [e]	79611	7.7	09-25-53
04/15/99	Pelton Ladder (Cell 6) [e]	80940	7.1	09-25-54
1998,				
04/17/00	Pelton Ladder (Cell 1) [e]	82130	8.1	09-28-51
04/18/00	Pelton Ladder (Cell 2) [e]	81900	8.5	09-28-52
04/19/00	Pelton Ladder (Cell 3) [e]	82938	7.2	09-28-53
04/20/00	Pelton Ladder (Cell 6) [e]	51142	7.4	09-28-54

Appendix Table H-2. Continued.

Brood year, release date	Release site	Number released	Size at release (fish/lb)	Fin clip or coded-wire tag code
1999,				
04/16/01	Pelton Ladder (Cell 1) [e]	82139	8.4	09-31-19
04/17/01	Pelton Ladder (Cell 2) [e]	59406	8.1	09-31-18
04/18/01	Pelton Ladder (Cell 3) [e]	82072	7.8	09-31-17
04/19/01	Pelton Ladder (Cell 6) [e]	77600	8.7	09-31-16

[b] Fish were transported from the hatchery to Pelton Ladder in March and allowed to migrate on their own volition beginning on the release date.

[c] Fish were transferred from the hatchery to Pelton Ladder in late October or early November and allowed to migrate on their own volition beginning on the release date.

[d] Fish were transferred from the hatchery to Pelton Ladder in September and allowed to migrate on their own volition beginning on the release date.

[e] Fish were transferred from the hatchery to Pelton Ladder in November and allowed to migrate on their own volition beginning on the release date.

[f] Hood River destined spring chinook salmon smolts leaked through the rotary screen seals from Pelton Ladder cells four and five into the Deschutes River release cells. Fish were transferred from the hatchery to Pelton Ladder in September and allowed to migrate on their own volition beginning on the release date.

[g] Fish were transferred from the hatchery to Pelton Ladder in October and allowed to migrate on their own volition beginning on the release date.

Appendix Table H-3. Monthly mortality at Pelton Ladder cells (L) and Round Butte Hatchery ponds (P) for spring chinook salmon juveniles from October 1, 1997, through May 12, 1998. In parentheses is the number of mortalities recovered on the drum screen of each Pelton Ladder cell.

Pond or cell location	**P 8 - L 1**	**P 10 - L 2**	**P 6 - L 3**	**P 2 - L 4**	**P 5 - L 5**	**P 9 - L 6**	**P 1a - P 1**	**P 1b - P 2**	**TOTAL**
Date transferred	4,5-Nov-97	30-Sept-97	04-Nov-97	30-Sept-97	29-Sept-97	05-Nov-97	30-Sept-97	30-Sept-97	
October[a]	53	54	11	90 (2)	57 (4)	54	6	26	351 (6)
November[b]	76	20	53	106	63	48	13	16	395 (--)
December	33 (1)	33 (5)	21 (1)	47 (8)	79 (5)	34 (6)	21	6	274 (26)
January	110 (4)	212 (5)	8 (2)	146 (28)	318 (25)	70 (10)	9	6	879 (74)
February	169 (25)	507 (62)	4 (3)	332 (34)	639 (76)	87 (27)	4	5	1747 (227)
March	2369 (981)	535 (235)	28 (9)	514 (140)	656 (138)	361 (64)	9	6	4478 (1567)
April[c]	2651 (1340)	191 (96)	31 (3)	250	288 (38)	222 (60)	--	8	3641 (1537)
May[d]	867	867	869	--	--	867	--	--	3470 (--)
Total	**6328 (2351)**	**2419 (403)**	**1025 (18)**	**1485 (212)**	**2100 (286)**	**1743 (167)**	**62**	**73**	**15235 (3437)**

[a] Mortalities includes those collected at RBH. The following list is mortalities collected for each RBH pond in October:

P8-L1 - 53
P6-L3 - 11
P9-L6 - 54

[b] Mortalities includes those collected at RBH. The following list is mortalities collected for each RBH pond in November:

P8-L1 - 19
P6-L3 - 2
P9-L6 - 8

[c] All Pelton Ladder cell four mortalities and 118 of cell five mortalities in April were from loading the fish truck for transport to the Hood River.

[d] Non-migrant smolts recovered in Pelton Ladder on 12 May, 1998 by RBH staff.

Appendix Table H-4. Monthly mortality at Pelton Ladder cells (L) and Round Butte Hatchery (RBH) ponds (P) for spring chinook salmon juveniles from November 1, 1998, through May 10, 1999. In parentheses is the number of mortalities recovered on the drum screen of each Pelton Ladder cell.

Pond or cell location	**P 1 - L 1**	**P 2 - L 2**	**P 3 - L 3**	**P 4 - L 4**	**P 9 - L 5**	**P 8 - L 6**	**P 10 - P 10**	**TOTAL**
Date transferred	20-Nov-98	20-Nov-98	19-Nov-98	18-Nov-98	17-Nov-98	18-Nov-98		
November	30 (7)	104 (28)	68 (37)	174 (43)	121 (0)	68 (25)	230	795 (140)
December	1137 (240)	346 (123)	23 (0)	157 (46)	71 (27)	29 (22)	72	1835 (458)
January	4446 (433)	3881 (585)	277 (17)	2421 (145)	1282 (107)	326 (19)	37	12670 (1306)
February	648 (81)	521 (64)	81 (7)	300 (28)	189 (17)	86 (6)	18	1843 (203)
March	2589 (332)	1877 (419)	532 (143)	802 (33)	395 (18)	328 (8)	14	6537 (953)
April[b]	1613 (356)	2738 (681)	1208 (392)	250	26 (4)	81 (12)	--	5916 (1445)
May[c]	600	600	600	--	--	598	--	2398
Total	**11063 (1449)**	**10067 (1900)**	**2789 (596)**	**4104 (295)**	**2084 (173)**	**1516 (92)**	**371**	**31994 (4505)**

[a] Mortalities includes those collected at RBH. The following list is mortalities collected for each RBH pond in November:

P1-L1 - 10
P2-L2 - 61
P3-L3 - 19
P4-L4 - 99
P9-L5 - 93
P8-L6 - 20

[b] Pelton Ladder cell four mortalities in April were from the impingement on the screen during truck loading.

[c] Non-migrant smolts recovered in Pelton Ladder on 10 May, 1999 by RBH staff.

Appendix Table H-5. Monthly mortality at Pelton Ladder cells (L) and Round Butte Hatchery (RBH) ponds (P) for spring chinook salmon juveniles from November 1, 1999, through May 10, 2000.

Pond or cell location	**P 6 - L 1**	**P 8 - L 2**	**P 10 - L 3**	**P 1 - L 4**	**P 2 - L 5**	**P 9 - L 6**	**P 5 - P 5**	**TOTAL**
Date transferred	17-Nov-99	18-Nov-99	19-Nov-99	15-Nov-99	16-Nov-99	19-Nov-99		
November[a]	13	12	38	11	20	11	4	109
December	418	405	156	700	542	43	2	2266
January	467	757	64	274	135	50	3	1750
February	318	355	24	145	66	9	3	930
March	19	55	7	51	11	1	6	150
April	47	51	59	9	11	15	8	200
May	354	354	354	0	0	218	0	1280
Total	**1636**	**1989**	**702**	**1190**	**785**	**357**	**26**	**6685**

[a] Mortalities collected in November were from RBH ponds prior to transport to Pelton Ladder.
[b] Non-migrant smolts recovered in Pelton Ladder on 10 May, 2000 by RBH staff.