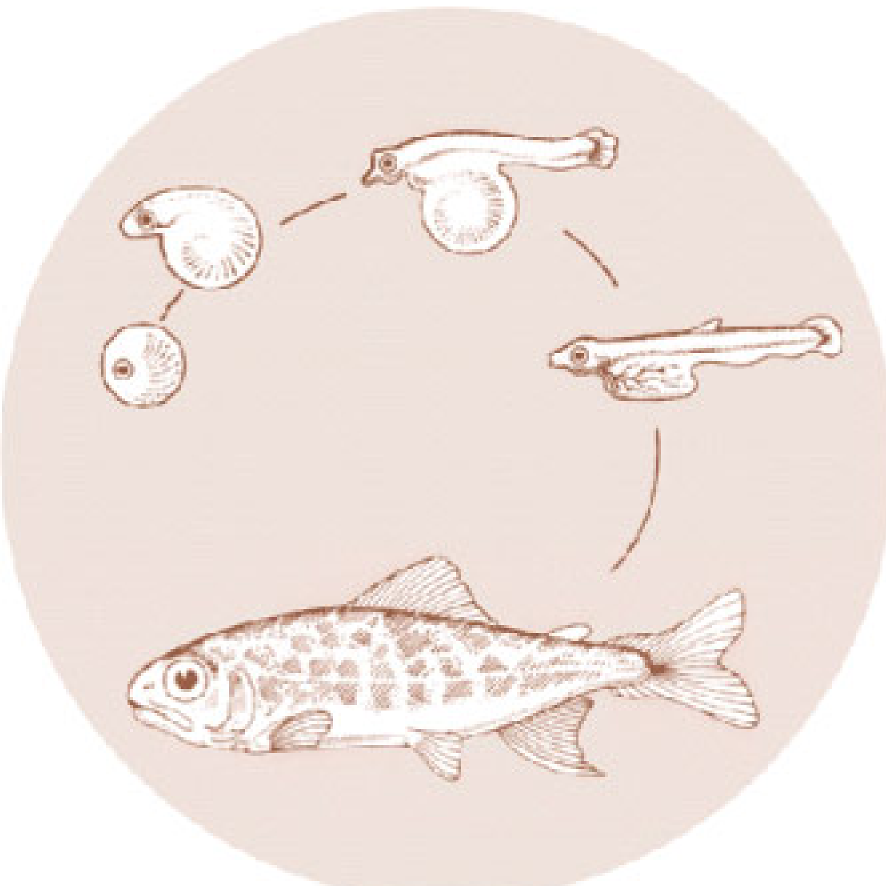
Grande Ronde Endemic Spring Chinook Salmon Supplementation Program

Facility Operations and Maintenance and Monitoring and Evaluation

Annual Report
2000



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

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Grande Ronde Endemic Spring Chinook Salmon Supplementation Program:

Facility Operations and Maintenance and Monitoring and Evaluation

Annual Report
1 January 2000 through 31 December 2000

Stephen J. Boe
Peter T. Lofy

Confederated Tribes of the Umatilla Indian Reservation
Department of Natural Resources, Fisheries Program
P. O. Box 638,
Pendleton, Oregon 97801
(541)962-3043

Prepared for:

Ken Kirkman, Project Manager

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

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EXECUTIVE SUMMARY

This is the third annual report of a multi-year project to operate adult collection and juvenile acclimation facilities on Catherine Creek and the upper Grande Ronde River for Snake River spring chinook salmon. These two streams have historically supported populations that provided significant tribal and non-tribal fisheries. Supplementation using conventional and captive broodstock techniques is being used to restore fisheries in these streams.

Statement of Work Objectives for 2000:

1. Participate in implementation of the comprehensive multiyear operations plan for the Grande Ronde Endemic Spring Chinook Supplementation Program (GRESCP).

2. Plan for recovery of endemic summer steelhead populations in Catherine Creek and the upper Grande Ronde River.

3. Ensure proper construction and trial operation of semi-permanent adult and juvenile facilities for use in 2000.

4. Collect summer steelhead.

5. Collect adult endemic spring chinook salmon broodstock.

6. Acclimate juvenile spring chinook salmon prior to release into the upper Grande Ronde River and Catherine Creek.

7. Document accomplishments and needs to permitters, comanagers, and funding agency.

8. Communicate project results to the scientific community.

9. Plan detailed GRESCP Monitoring and Evaluation for future years.

10. Monitor adult population abundance and characteristics of Grande Ronde River spring chinook salmon populations and incidentally-caught summer steelhead and bull trout.

11. Monitor condition, movement, and mortality of spring chinook salmon acclimated at remote facilities.

12. Monitor water quality at facilities.

13. Participate in Monitoring & Evaluation of the captive brood component of the Program to document contribution to the Program.

Accomplishments and Findings for 2000

The Confederated Tribes of the Umatilla Indian Reservation operated acclimation facilities for spring chinook juveniles (*Oncorhynchus tshawytscha*) (captive broodstock progeny) on Catherine Creek and the upper Grande Ronde River near La Grande, Oregon during February-April, 2000. Totals of 38,009 (729 kg) and 1,540 (36 kg) fish were delivered to the Catherine Creek and upper Grande Ronde River facilities, respectively. Catherine Creek fish were acclimated from February 28-April 18 (forceout). Catherine Creek fish were allowed to leave volitionally beginning on April 4. Fish at the upper Grande Ronde River facility were acclimated from February 28-March 14 (forceout). Mortalities during acclimation totaled 29 at the Catherine Creek facility, and 4 at the upper Grande Ronde River facility. Mean fork lengths at tagging (October 1999) of PIT-tagged fish were 111.2 mm (n=3,979) for Catherine Creek fish and 118.8 mm (n=985) for upper Grande Ronde River fish. Median arrival date of 931 PIT-tagged hatchery fish to Lower Granite Dam from Catherine Creek was May 16. Median arrival date of 241 PIT-tagged hatchery fish to Lower Granite Dam from the upper Grande Ronde River was May 6. Minimum cumulative detection rates of PIT-tagged fish were 31.3% for Catherine Creek (n=1,246 of 3,980 originally delivered) and 30.5% for upper Grande Ronde River fish (n=300 of 985 originally delivered).

The total estimated number of hatchery fish leaving the Catherine Creek facility volitionally was 18% of the estimated number delivered. Mean fork length at tagging of volitionally-released fish from Catherine Creek was 3 mm higher than forceout fish. Median arrival date to Lower Granite Dam was May 13 for volitionally-released fish (n=204), compared to May 17 for forceout fish (n=664). Minimum cumulative detection rates were 33.0% for volitionally-released fish (n=236 of 715 detected leaving volitionally) and 32.1% for forceout fish (871 of 2,713 fish detected at forceout). The detection rate of PIT-tagged fish leaving the Catherine Creek facility (volitional release and forceout) was approximately 86% (3,428 of 3,980 delivered).

Mean fork length at PIT-tagging was 28-38 mm greater for hatchery fish than wild fish. Median arrival dates to Lower Granite Dam were similar for hatchery and wild fish from both streams, but frequency distributions were different. Minimum cumulative detection rates were higher for acclimated fish than wild fish, and probably influenced by the larger size at PIT-tagging.

Volitionally-released fish from Catherine Creek were slightly larger at PIT-tagging than forceout fish, and had a slightly earlier median arrival date to Lower Granite Dam. Minimal cumulative detection rates through the migration corridor were similar for volitionally-released and forceout fish.

The Confederated Tribes of the Umatilla Indian Reservation also operated picket-style weirs on Catherine Creek (March 30-July 31) and the upper Grande

Ronde River (March 24-July 31) near La Grande, Oregon in 2000. The weir on Catherine Creek was washed out by high flows and debris on April 5 and rebuilt on May 4.

Twenty-five summer steelhead were collected from at the upper Grande Ronde River weir from April 4-June 21, including 4 adipose-clipped. Mean FL of 20 summer steelhead was 628.9 mm. Six kelts were also collected at the upper Grande Ronde River weir. Seventeen spring chinook salmon were collected at the upper Grande Ronde River weir from June 10-July 23, 2000 (mean FL = 717.5 mm). Six were transported to Lookingglass Hatchery and held for broodstock use.

Nineteen (including 8 adipose-clipped) summer steelhead were collected at the Catherine Creek weir from April 1-May 12, 2000. Mean FL of 10 unmarked summer steelhead was 687.7 mm. Twenty-four chinook salmon (mean FL = 719.6 mm) were collected from Catherine Creek during the period May 22-July 21, 2000 (mean FL = 719.6 mm). Two jacks (age 3) were collected at the Catherine Creek weir. Seven fish from Catherine Creek were transported to Lookingglass Hatchery for use as broodstock.

Five pre-spawn mortalities (3 males, two females) occurred; two at the Catherine Creek weir, two at the upper Grande River weir, and one at Lookingglass Hatchery. Less than ten broodstock for each stream were being held as broodstock on July 31, so, in accordance with provisions of the ESA permit, all fish held were returned to the streams of capture and allowed to spawn naturally.

A single bull trout (mortality) was observed at Catherine Creek. Suckers (*Catostomus* sp.) were also observed at both trapping sites.

Maximum water temperatures of 27.0^{o} C were observed during July and August at the Catherine Creek weir and 24.1^{o} C at the upper Grande Ronde River weir during the same months. Lowest temperatures during each day were observed usually at 8 AM, and highest temperatures at 5 PM. Gauge readings at the fish ladder below the Catherine Creek weir ranged from 1.1-1.2 m or greater during the spring freshets.

A total of 32 surveys of one mile sections immediately below the weirs were conducted in 2000. These resulted in observations of 12 live chinook salmon in Catherine Creek and 42 in the upper Grande Ronde River. Fourteen of the 42 fish observed during the upper Grande Ronde River surveys were observed on the last survey date (August 24). Below weir survey data were inconclusive regarding any weir effects on fish migration or behavior.

The weirs trapped 74 and 55%, respectively, of the 2000 estimated spawners migrating above the upper Grande Ronde and Catherine Creek weirs. The low numbers of fish collected resulted from low numbers of spawners, more spawning below the weirs than normal, later spawning, and poor functioning of the weirs.

Construction at the Catherine Creek adult collection facility progressed with completion of the concrete work, installation of the Denil fishway, electrical and telephone connections, and crane. Weir plans were revised to include a hydraulically-operated system. Weir plans for the upper Grande Ronde River adult facility were also undergoing revisions.

Additional investigative work carried out under this contract in 2000 involved analysis of near-infrared spectroscopy data to differentiate maturity and sex of Deschutes River rainbow trout (*Oncorhynchus mykiss*), Wallowa stock summer steelhead (*Oncorhynchus mykiss*), and Dungeness River (Washington) spring chinook captive broodstock.

Contracted activities with comanagers in 2000 included collection of captive broodstock parr from Catherine Creek and the upper Grande Ronde River, spawning ground surveys in the Grande Ronde Basin, and maturity sorts and spawning activities at Manchester Marine Laboratory and Bonneville Hatchery.

Management Implications and Recommendations

1. Weirs should be designed to be installed and fully functional in mid-April or sooner in order to sample summer steelhead and collect spring chinook salmon broodstock from across the run.

2. Weirs should have higher pickets to prevent fish from leaping over the barriers and some type of top covering to prevent fish from becoming wedged between the pickets.

3. Below-weir surveys should be continued and better methodologies developed to determine if weirs are causing aggregation of fish below the weirs.

4. Continue consultations with contractors to ensure that functional and effective weirs are installed on both Catherine Creek and the upper Grande Ronde River for use in the spring of 2001.

5. Use still photographs and videography to document condition and behavior of fish that are collected at weirs in order to conduct trapping, transportation and holding operations efficiently and with minimal danger to fish.

PART I: OPERATION OF REMOTE ADULT SPRING CHINOOK SALMON BROODSTOCK COLLECTION FACILITIES ON CATHERINE CREEK AND THE UPPER GRANDE RONDE RIVER, OREGON

Introduction

Large populations of endemic fall and spring chinook salmon (*Oncorhynchus tshawytscha)*, sockeye (*O. nerka*), and coho (*O. kisutch*) salmon and steelhead salmon formerly existed in the Grande Ronde River basin (Nehlsen et al. 1991). Escapements of spring chinook salmon in excess of 10,000 occurred as recently as the late 1950's (USACOE 1975). Commercial and sport fisheries existed and fishing for salmon was a significant cultural component for indigenous peoples in the basin.

Severe declines in natural escapement of spring chinook salmon in the Grande Ronde basin have occurred in recent years, paralleling those of other stocks in the Snake River basin (Nehlsen et al. 1991). Grande Ronde River spring chinook salmon are considered part of the Snake River Spring and Summer Run evolutionarily significant unit (ESU) located in the Blue Mountains ecoregion (Myers et al. 1998). Estimated escapements for the Grande Ronde River basin during 1979-1984 ranged from 474-1,080 (Howell et al. 1985). Estimated escapement of adult spring chinook salmon in the Grande Ronde Basin in 1995 was only 261 (Parker et al. 1995). The decline in spring chinook salmon abundance resulted from several factors, including overexploitation, habitat destruction resulting from land use practices, construction and operation of hydroelectric facilities, and large-scale environmental changes. Snake River Basin spring/summer chinook salmon were listed as threatened in 1993 under the Endangered Species Act (58 Federal Register 49880, September 23, 1993). Continuing poor escapement levels and declining population trends indicated that Grande Ronde River spring chinook salmon were in imminent danger of extinction. Managers are presently in an emergency situation where dramatic and unprecedented efforts are needed to prevent extinction and preserve options for use of endemic fish stocks in future artificial propagation programs.

Estimates of escapement from spawning ground surveys for 1979-1984 showed Catherine Creek and the Lostine and upper Grande Ronde Rivers were three of the most productive populations in the Grande Ronde Basin (Howell et al. 1985). Declines in the numbers of spawning fish led to closures of sport fishing in 1974 and commercial fishing in 1977 (Howell et al. 1985). The initial management plan for these three tributaries under the Lower Snake River Compensation Plan (LSRCP) emphasized mitigation and implemented hatchery supplementation from Lookingglass Hatchery with nonendemic stocks (Rapid River and Carson). Smolts or presmolts stocked into Catherine Creek totaled 584,000 during 1982-1984, and 503,000 into the upper Grande Ronde River during the same period (Howell et al. 1985). The emphasis of the chinook salmon program in the Grande Ronde River basin has shifted to conservation with the short-term goal to prevent extinction and allow for the possibility of recovery of endemic stocks. Ultimately, further recovery of these populations is heavily dependent on improved juvenile and adult survival through mainstem dams and reservoirs.

The Grande Ronde Spring Chinook Salmon Program (Program) was developed with two components to supplement populations: captive and conventional broodstock. The Oregon Department of Fish and Wildlife, U. S. Fish and Wildlife Service, and Nez Perce Tribe in 1995 began development of captive broodstocks to reduce the demographic risk of extinction through genetic conservation and natural production enhancement. After initiation of the captive brood component, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) joined comanagers to begin the second component (conventional broodstock development) of the Program. The conventional component was designed to increase adult returns with less genetic risk than the captive brood component by collecting a portion of the unmarked, naturally-produced adults across the run from each stream and using standard culture procedures. Because adults are removed from natural production, the demographic costs of the conventional component are higher. Success is therefore more dependent upon improved juvenile and adult survival through mainstem reservoirs and dams than captive brood. Adult collection weirs on Catherine Creek and the upper Grande Ronde River enable collection of broodstock and monitoring of returning adults to assess the effectiveness of both components of the supplementation program. The acclimation facilities are operated to maximize survival and return of captive and conventional broodstock progeny.

The use of captive brood is designed to reduce the probability of extinction, but at greater genetic risk than conventional supplementation. Parr collected for rearing to maturity may be progeny of a few adults and represent less genetic diversity than the conventional broodstock. Plans are for hatchery production from captive broodstock to decrease and conventional production increase as the number of adults returning increases and the demographic risk of extinction becomes smaller.

Adult Collection and Juvenile Acclimation Areas

The Grande Ronde River originates in the Blue Mountains of northeastern Oregon and flows for 341 kilometers (km) to join the Snake River near Lewiston, Idaho. Gradient is moderately steep in the upper reaches, becoming more gradual from La Grande, Oregon, to the mouth. The Grande Ronde River drains a sparsely populated watershed of approximately 13,727 km^2 dominated by agriculture, logging and outdoor recreation (Oregon DEQ 1995). The largest towns are La Grande (population 12,000), Union (population 1,880) and Elgin (population 1,600). Land ownership in the watershed is 53% private, 46% U. S. Forest Service, and less than 1% each by the Bureau of Land Management, and state and tribal agencies (Oregon DEQ 1995).

Adult collection weirs for the conventional supplementation component of the Program are located in the upper reaches of the Grande Ronde River and Catherine Creek (Figure 1). The Catherine Creek weir is located near the lower boundary of spring chinook spawning; about 95% of redds have historically been upstream of this location. The upper Grande Ronde River weir is also located near the lower end of the spring chinook spawning area; about 10% of redds have historically been observed below the weir site. These two tributaries, together with the Lostine River and Lookingglass Creek, have historically provided the highest numbers of spawning spring chinook salmon in the basin (Howell et al. 1985). Bull trout and summer steelhead are also present and spawn in these areas. The upper Grande Ronde River is considered to be the reach from the headwaters to the confluence with the Wallowa River, a distance of about 153 km. Watershed area for the upper Grande Ronde River is approximately 4,274 km^2. The upper Grande Ronde begins at an elevation of about 2,134 m and drops over 1,439 m over a distance of 158 km (average gradient of 9.1 m/km)to the confluence with the Wallowa River (Thompson and Haas 1960). Catherine Creek originates in the Wallowa Mountains, at an elevation similar to the upper Grande Ronde River, and drains a watershed of approximately 2,590 km^2. Average gradient over the 64 km stream length is 32.8 m. Catherine Creek is the major tributary of the upper Grande Ronde River and flows for about 48 km before joining the upper Grande Ronde 29 km below La Grande (Thompson and Haas 1960). The North and South Forks of Catherine Creek extend for about 16 km each.

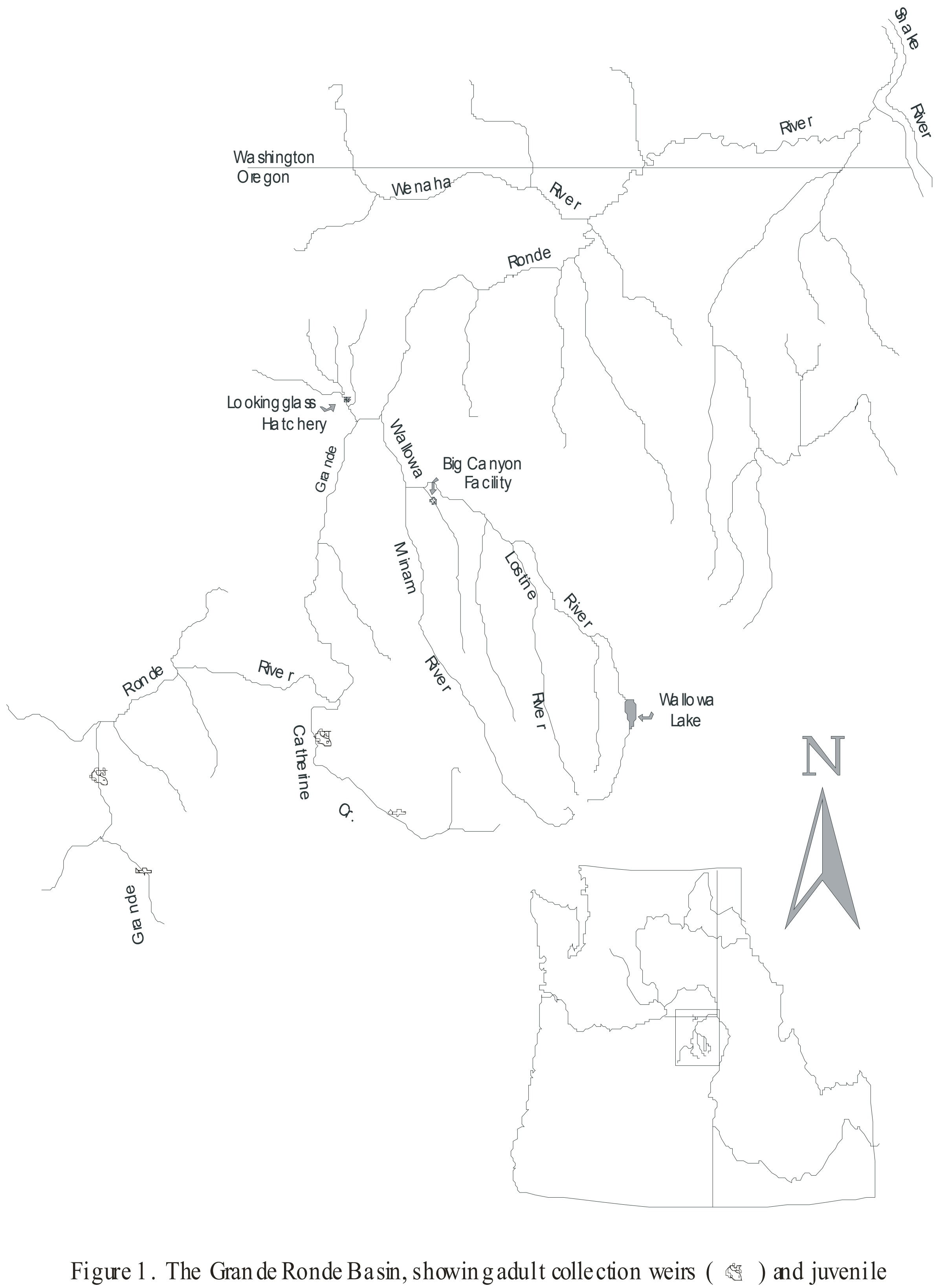

Figure 1. The Grande Ronde Basin, showing adult collection weirs ( ) and juvenile acclimation sites ( ).

Peak flow (about 300 cfs) for Catherine Creek usually occurs in May. Peak flow for the upper Grande Ronde River (about 1200 cfs) usually occurs in April or May. Flows for both streams diminish throughout the summer, reaching lows of 50-75 cfs during September-October (http://waterdata.usgs.gov/nwis-w/ORG/). Streamflows in the Grande Ronde Basin are dependent upon snowmelt at higher elevations. Typically, the Catherine Creek watershed receives more snow the upper Grande Ronde. Large amounts of snow at high elevations combined with periods of air temperatures above 32^{o}C in the spring can cause water to rise rapidly and result in downstream transport of large amounts of sediment and debris. The Catherine Creek watershed is more prone to high flows and transport of large debris than the upper Grande Ronde. Rainfall events can produce similar results, and in combination with warm weather and snowmelt in the spring, can cause severe flooding in the watershed. Flows in both streams decrease as the snow depth diminishes during June, July, and August.

Headwater areas of both Catherine Creek and the upper Grande Ronde River are in the Wallowa-Whitman National Forest. Logging, livestock grazing and various forms of outdoor recreation are significant human activities in the region. These activities in the watershed have diminished degraded habitat quality for salmonids by increasing water temperatures and sedimentation and reducing the amount of large woody debris and deep pools and off-channel rearing areas (U.S. Forest Service et al. 1992; Mobrand and Lestelle 1997). Riparian areas consist of forested canyons, dominated by conifers in the upper Grande Ronde and upper reaches of Catherine Creek, and deciduous trees in the lower reaches of Catherine Creek. Substrates are primarily gravel, cobble and boulder and the gradient is moderately steep. Spring chinook spawning and rearing habitat in the upper Grande Ronde River watershed was severely degraded after the Tanner Creek fire and subsequent flood in August of 1989. Large amounts of fine sediment were washed into the stream following the loss of vegetative cover, and still persist.

Stream temperatures in some reaches of Catherine Creek and the upper Grande Ronde may reach levels that salmonids will actively avoid during summer months and are most likely result from changes in riparian cover (Oregon DEQ 2000). Since 1990, at least four different agencies have accumulated 261 stream temperature data sets from at least 130 sites in the basin (Oregon DEQ 1998). Models are being developed to ascertain what kinds of actions will bring about lower stream temperatures and improve salmonid habitat. An attempt is also being made to identify all the organizations monitoring water quality in the basin, standardize methods, share data and avoid duplication of effort.

The adult collection site for the upper Grande Ronde River is located at the River Campground, at river km 318 in the Wallowa-Whitman National Forest, approximately 39 km above La Grande and about 24 km below the headwaters. The adult collection site for Catherine Creek is about 3 km upstream of Union on land owned by the City of Union. Both adult collection sites are below areas where most spawning activity historically occurred.

The juvenile acclimation facility for the upper Grande Ronde River is about 26 km upstream of Starkey on Forest Service property just above Vey Meadows. Considerable spawning activity has occurred in some years within the Vey Meadows reach, but access on this private land to conduct spawning ground surveys has been denied since 1996. The Catherine Creek acclimation facility is about 5 km above Catherine Creek State Park, on land owned by Oregon State University and a private lumber company. Both juvenile acclimation facilities are located in areas where the best spawning and rearing habitats are believed to exist.

Methods

Acclimation

Juvenile spring chinook were acclimated in rectangular ponds with a supporting framework of galvanized steel, neoprene liners, stoplogs, screens and screened standpipes. Each raceway also had an additional outlet pipe with a knife gate control. Fish at both facilities were fed were fed maintenance rations of Moore-Clark "Clarks Fry" 2.0 mm feed[1] once a day, with the amount depending on the total weight of fish present and water temperature (0.2% at 2^{o} C up to 2.1% at 12^{o} C). Discarded Christmas trees were placed in each of the raceways to provide cover. The Catherine Creek ponds were initially covered with netting to discourage avian predaors. Netting was removed after about 2 weeks, since no avian predators were observed and the netting made feeding, mortality recoveries, and other activities more difficult. Ponds were checked regularly for mortalities. Data recorded from mortalities included fork length to the nearest mm, and PIT tag code, if present. Dissolved oxygen levels and water temperatures with an electronic meter were taken in each raceway 2-4 times a day (0800, 1300, 1500, 1800), at depth of about 0.3 m at the downstream end of each raceway. On April 3, 2000, a sample of fish was dipnetted from each raceway, measured, weighed and scanned for PIT tags. Screens were removed and fish at Catherine Creek were allowed to leave the ponds volitionally over the top of the stoplogs beginning 2 weeks before the end of the acclimation period. Two PIT tag readers were placed around each outflow pipe to monitor fish leaving. The PIT tag readers remained operational during the forceout period.

PIT tag detection data from the PTAGIS database (http://www.ptagis.org) were obtained and used to describe migration timing and minimum survival rates for acclimated and wild fish. Migration timing was described using and date of detection at Lower Granite Dam. Detections for each date at Lower Granite were expanded by the amount of spill, since fish going over the dam in spill would not be detected. Differences in the distributions of arrival at Lower Granite Dam by week of the year were tested using the two-sample Kolmogorov-Smirnov test (Sokal and Rolhf 1995). Cumulative unique detections at all PIT tag observation sites along the Snake River-Columbia River migration corridor were used to estimate minimum survival to Lower Granite Dam. Detections to calculate minimum survival to Lower Granite Dam were not expanded. Wild spring chinook juveniles in both Catherine Creek and the upper Grande Ronde River were collected using screw traps or seining and PIT-tagged by the Oregon Department of Fish and Wildlife using screw traps (Jonasson et al. 2000). Differences in fork length between groups were evaluated using t-tests (Sokal and Rolhf 1995). A significance level of 0.05 was used for all statistical tests.

Adult collection

Temporary picket weirs, similar to those described by Schroeder (1996) and comprised of aluminum and iron frameworks with galvanized iron pickets were used to block off the study streams and collect adult spring chinook salmon returning to spawn in 2000. Pickets were 2.54-cm diameter and spaced 2.54 cm apart. After flows decreased in July, plastic sheeting and plywood were used to divert as much water as possible through the trap. A resistance board weir was also used for part of the trapping season about 30 m above the picket weir on Catherine Creek.

Traps were checked at least once daily. In the morning, usually before 0900 h, fish were individually anesthetized using MS-222 and fork length was measured to the nearest mm. Later in the season, as water temperatures rose, these fish were processed during the early morning when temperatures were lower, in order to reduce stress. A paper punch was used to mark fish and collect tissues for genetics samples. A single punch on the right opercle plate was used to mark fish for Catherine Creek and two punches were used for the upper Grande Ronde. The numbers of marked fish recovered on the spawning grounds during August and September were used to estimate the adult spawning population. Tissues from opercle punches and three additional caudal punches were collected for genetics evaluation. Tissue samples were preserved in labeled vials with 95% ethanol. Each fish was examined externally for marks, injuries or other physical conditions, and a preliminary determination of sex was made. Every third jacks male and female from each stream was transported by ODFW (Oregon Department of Fish and Wildlife) to Lookingglass Hatchery, operated by ODFW, for use as broodstock in the conventional program. Fish collected and transported before August 7, 1998, received prophylactic injections of oxytetracycline (intraperitoneal) and erythromycin (dorsal sinus) prior to transfer. Dosage (10 mg/kg of body weight) of each antibiotic was based on estimated body weight from length-weight data. Fish were individually marked using numbered jaw tags with a different color and number sequence for each stream. Transported fish were held in PVC spawning tubes (1 m x 0.25 m diameter) prior to loading, and transferred from the stream to the transport truck in black rubber sleeves with water. Fish not transported to Lookingglass Hatchery were passed upstream after recovering from recovering from the anesthetic.

The possible effects of weirs on fish behavior were evaluated by walking approximately one-mile segments of the streams immediately downstream of the weirs several times a week. Live fish, carcasses, and evidence of spawning activities (redds, test digs) were recorded. ODFW staff directed standard spawning ground surveys (Parker et al. 1995) on segments upstream and downstream of weirs on both streams in August and September and the same information was collected. Water temperatures were taken with a pocket thermometer at approximately 0600-0700 h, 1200 h, and 1700-1800 h each day. Onset®[1] temperature loggers were also used at several sites to record hourly water temperatures during the season. Gauge readings at the Catherine Creek weir were taken to index stream flows.

Bull trout in the Columbia River Basin were listed as threatened under the Endangered Species Act on June 10, 1998 (63 Federal Register 111). Bull trout are found in both the upper Grande Ronde River and Catherine Creek (Buchanan et al. 1997). Data (estimated FL, any marks or tags) on incidentally caught bull trout was collected and mortalities frozen for later analysis. Data on incidentally caught steelhead were also obtained (FL, sex, genetics samples).

Results

Acclimation

Acclimation facilities were setup and operating to receive fish on February 28, 2000. One pump at the Catherine Creek facility were initially setup too close to the stream, and a small amount of diesel fuel was spilled into the water. The spill was cleaned up and the pump was re-sited further away from the stream on the gravel pad inside the fenced area. Frazil ice clogged the water intake at the upper Grande Ronde River facility on several occasions during the acclimation period, lasting 2-3 hours each time but causing no mortalities or evident stress on fish.

Juvenile spring chinook were delivered to facilities on February 28, 2000. A total of 38,009 fish weighing approximately 729 kg was delivered to the Catherine Creek acclimation facility, and 1,540 fish weighing approximately 36 kg to the upper Grande Ronde River facility. Catherine Creek fish were split into four ponds; fish with moderate-high titer bacterial kidney disease (BKD) were kept in one pond. All upper Grande Ronde River fish were placed in one pond. All fish were captive brood progeny (F_1) and were marked with coded wire tags and adipose fin clips at Lookingglass Hatchery in the fall of 1999 and about 11% also were PIT-tagged. Volitional release began on Catherine Creek on April 4. All remaining fish were forced out of the ponds into Catherine Creek on April 18. Upper Grande Ronde River fish were forced out the evening of March 14; no volitional release occurred.

[1] Mention of this commercial product does not constitute endorsement.

Mortalities (resulting from transportation and acclimation) were 29 (0.0008 of the total delivered) from the Catherine Creek facility and 4 (0.003) of the total delivered) for the upper Grande Ronde River facility. Water temperatures at the upper Grande Ronde River facility ranged from –0.5 to 2.7 ^{o}C. Minimum, mean, and maximum water temperatures at four Catherine Creek ponds ranged from 0.2-0.3, 4.4, 8.0-9.3^{o}C, respectively. Minimum, mean, and maximum dissolved oxygen readings ranged from 8.2-8.8, 10.9-11.3, 14.1-14.4 ppm, respectively, in the four Catherine Creek ponds. Fish at the upper Grande Ronde River facility were fed about 0.3 kg of feed due to the low water temperatures and number of fish. Fish at the Catherine Creek facility received approximately 215 kg of feed.

Mean fork lengths at tagging of acclimated fish were 28-38 mm greater for hatchery fish than wild fish (Table 1). Minimum and maximum values for hatchery fish were also greater than for wild fish. Samples of 40-141 fish from each raceway at the Catherine Creek acclimation facility were collected on April 4 (including fish with and without PIT-tags). Mean FL was 130.0 mm for 297 fish.

The median arrival date for wild fish from the upper Grande Ronde River was about six days later than for hatchery fish (Table 2). The latest arriving wild fish was about 60 days after the latest hatchery fish. The median arrival date for hatchery fish from Catherine Creek was about ten days later than for wild fish. There were significant differences in the distributions of arrival timing between hatchery and wild fish for both Catherine Creek (two-tailed Kolmogorov-Smirnov statistic = 0.41, $p<0.0001$) and the upper Grande Ronde River (two-tailed Kolmogorov-Smirnov statistic = 0.33, $p<0.0001$). The minimum detection rate through the hydropower system was about 6% higher for hatchery fish than wild fish from the upper Grande Ronde River (Table 3). For Catherine Creek, detections of hatchery fish were almost double those of wild fish. The minimum detection rate for migration year 2000 wild fish tagged and released during calendar year 2000 in the upper Grande Ronde River was about 9% higher than for hatchery fish. For Catherine Creek, the minimum detection rate was 10% lower for wild fish than for hatchery fish.

The highest numbers of volitional releases from Catherine Creek occurred on two days (Figure 2). PIT-tagged fish detected leaving the ponds volitionally totaled 715 or 18% of the PIT-tagged fish initially present in the Catherine Creek ponds. The estimated number of fish (with and without PIT-tags) leaving volitionally was 6,836. Mean fork length at tagging of volitionally-released fish was significantly different (two-tailed t-test, unequal variances, $t = -6.52$, $p <0.0001$) than for forceout fish (Table 4). The median arrival date at Lower Granite Dam was four days earlier for volitionally-released fish than forceout fish (Table 5), and there was a significant difference in distributions of arrival dates (two-tailed Kolmogorov-Smirnov statistic = 0.19, $p<0.0001$). The minimal detection rate for volitionally-released fish was slightly higher than forceouts (Table 6). The PIT tag detection system at the Catherine Creek acclimation facility was about 86% efficient (3,428 tags detected out of 3,980 initially stocked).

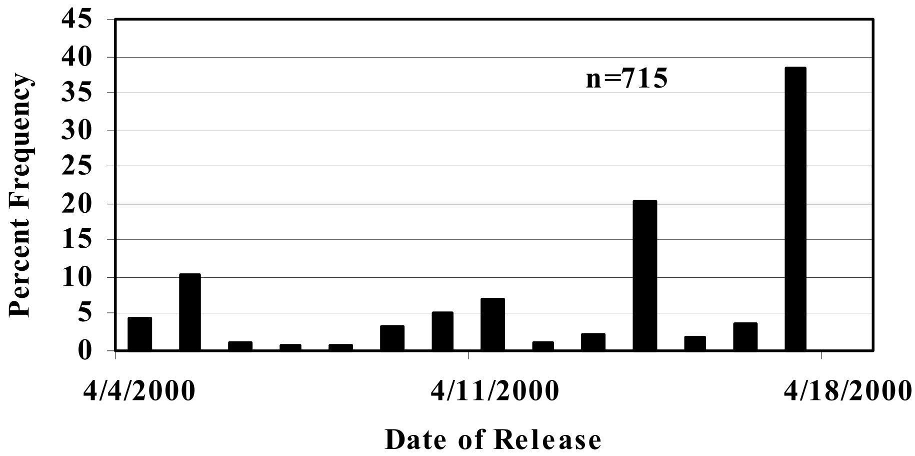

Figure 2. Frequency distribution by date of volitionally-released spring chinook salmon acclimated at Catherine Creek facility, 2000.

Table 1. Mean fork length at PIT-tagging of migration year 2000 wild and hatchery juvenile spring chinook salmon from Catherine Creek and the upper Grande Ronde River, 2000.

Stream	Group	n	Mean	SD	Range
Catherine Creek	Hatchery	3,979	111.2	10.5	68-164
	Wild	2,106	83.7	10.1	51-126
upper Grande	Hatchery	985	118.8	10.8	69-167
Ronde River	Wild	1,485	80.9	11.0	57-111

Table 2. Arrival dates at Lower Granite Dam of migration year 2000 wild and hatchery juvenile spring chinook salmon from Catherine Creek and the upper Grande Ronde River, 2000.

Stream	Group	n*	Median	Earliest	Latest
Catherine Creek	Hatchery	931	5/16/2000	4/19/2000	6/29/2000
	Wild	227	5/6/2000	4/12/2000	7/02/2000
upper Grande	Hatchery	241	5/6/2000	4/11/2000	5/25/2000
Ronde River	Wild	219	5/12/2000	4/12/2000	7/20/2000

* expanded for spill

Table 3. Minimum cumulative unique detections of migration year 2000 PIT-tagged juvenile spring chinook salmon from Catherine Creek and the upper Grande Ronde River by detection site, 2000.

	Catherine Creek				upper Grande Ronde River			
Detection Site	**H**	**%**	**Wild**	**%**	**H**	**%**	**Wild**	**%**
Lower Granite	724	18.2	160	7.6	177	18.0	158	10.6
Little Goose	238	6.0	100	4.7	61	6.2	104	7.0
Lower Monumental	119	3.0	38	1.8	26	2.6	44	3.0
McNary	92	2.3	35	1.7	14	1.4	32	2.2
John Day	17	0.4	6	0.3	6	0.6	0	0.0
Bonneville	34	0.9	9	0.4	9	0.9	16	1.1
Columbia R. Islands[1]	22	0.6	6	0.3	7	0.7	7	0.5
Columbia R. Estuary	0	0.0	0	0.0	0	0	0	0.0
All Sites	1,246	31.3	354	16.8	300	30.5	361	24.3
Number released	3,980		2,108		985		1,488	

H = hatchery
% = percent of total releases for each group
[1] Tags recovered from fish eaten by avian predators (Collis et al. 2001).

Table 4. Mean fork length at PIT-tagging of migration year 2000 hatchery juvenile spring chinook salmon from Catherine Creek by release type, 2000.

Group	n	Mean	SD	Range
Volitional	715	113.7	11.2	73-163
Forceout	2,712	110.7	10.2	68-164

Table 5. Arrival dates at Lower Granite Dam of PIT-tagged migration year 2000 hatchery juvenile spring chinook salmon from Catherine Creek by release type, 2000.

Group	n	Median	Earliest	Latest
Volitional	204	5/13/2000	4/19/2000	6/24/2000
Forceout	664	5/17/2000	5/1/2000	6/29/2000

Adult Collection

Trapping began at the upper Grande Ronde weir on March 24. The first upstream-migrating steelhead was collected on April 4 and the last on May 26. The majority of 25 steelhead were captured between April 4 and May 4 and both ad-clipped (hatchery) and wild fish were caught (Table 7). Fork length of one unmarked fish not measured was 50 cm. The mean length of hatchery fish was slightly greater than for wild fish. About 75% of the total were 1-ocean fish and the remainder 2-ocean (Figure 3). Six kelts were collected from May 28-June 21 (four females, 2 males).

Table 6. Minimum cumulative unique detections of migration year 2000 PIT-tagged juvenile spring chinook salmon from Catherine Creek by detection sites and release type, 2000.

	Catherine Creek			
Detection Site	**V**	**%***	**FO**	**%***
Lower Granite	150	21.0	506	18.7
Little Goose	38	5.3	168	6.2
Lower Monumental	23	3.2	77	2.8
McNary	18	2.5	64	2.4
John Day	2	0.3	14	0.5
Bonneville	5	0.7	26	1.0
Columbia R. Islands[1]	0	0.0	16	0.6
Columbia R. Estuary[2]	0	0.0	0	0.0
All Sites	236	33.0	871	32.1
Number released	715		2,713	

* % of total number released for each group
[1] Tags recovered from fish eaten by avian predators (Collis et al. 2001).

Seventeen spring chinook salmon (all unmarked) were collected at the upper Grande Ronde River weir (Table 8). The first was collected on June 10 and the last on July 27 (Figure 4). All were probably age 4 (Figure 5), based on length-at-age data from other streams (ODFW, unpublished data) and no jacks were collected. Seven were transported to Lookingglass Hatchery for use as broodstock. Two spring chinook trapped on June 28 were weir mortalities; both were mature males and negative for bacteria in the kidney, viruses, and *Ceratomyxa shasta* in the gut. ELISA values were 0.117 and 0.120 for these fish.

Trapping began at the Catherine Creek weir on March 30. The Catherine Creek weir was washed out by high flows and debris on April 5 and fish could pass until the weir was rebuilt on May 4.

The first upstream-migrating summer steelhead was caught by the Catherine Creek weir on April 1 and the last on May 4. Eight of 18 fish were hatchery origin (Table 9). Approximately half of the catch was 1-salt, the remainder 2-salt (Figure 6). One ad-clipped kelt was collected on May 10, 2000. Run timing data for Catherine Creek was of limited value because many steelhead likely migrated during the period when the weir was washed out.

The first spring chinook was captured at the Catherine Creek weir on May 22 (Figure 7). The last was taken on July 21. Fifteen of the 24 (60%) spring chinook were caught between June 2 and June 8. Most were males (Table 10). Two jacks were collected (< 600 mm FL) on June 26 and June 30, 2000. Three were probably age 5 (>800 mm FL) and the remainder age 4 (Figure 8).

Table 7. Summary statistics for summer steelhead collected at the upper Grande Ronde River weir, 2000.

Mark	Sex	Migration Type	Mean FL (mm)	SD	Range	n
Ad clip	Male	Upstream	613.3	18.1	597-638	4
	Total	Upstream	613.3	18.1	597-638	4
Unmarked	Male	Both*	613.8	53.9	568-715	6
	Female	Both*	635.4	50.7	579-763	14
	Total	Both*	628.9	51.2	568-763	20

* Upstream and fallback

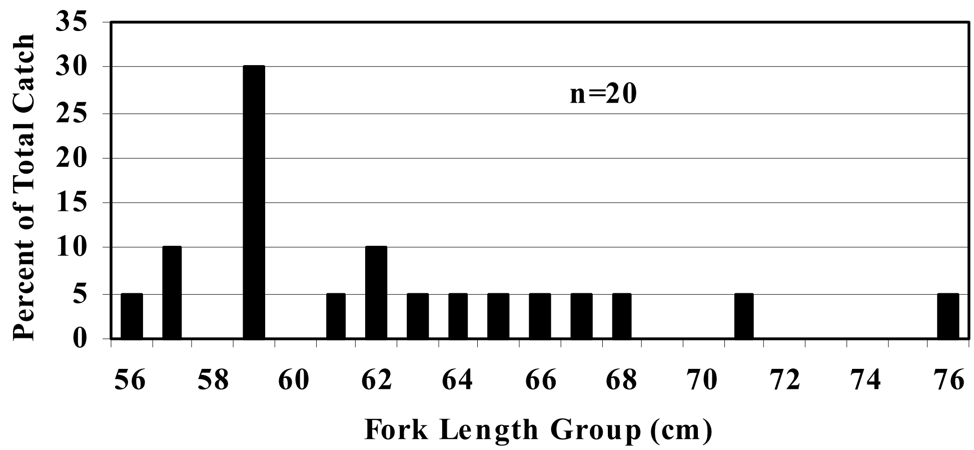

Figure 3. Length frequency of unmarked summer steelhead caught at upper Grande Ronde River weir, 2000.

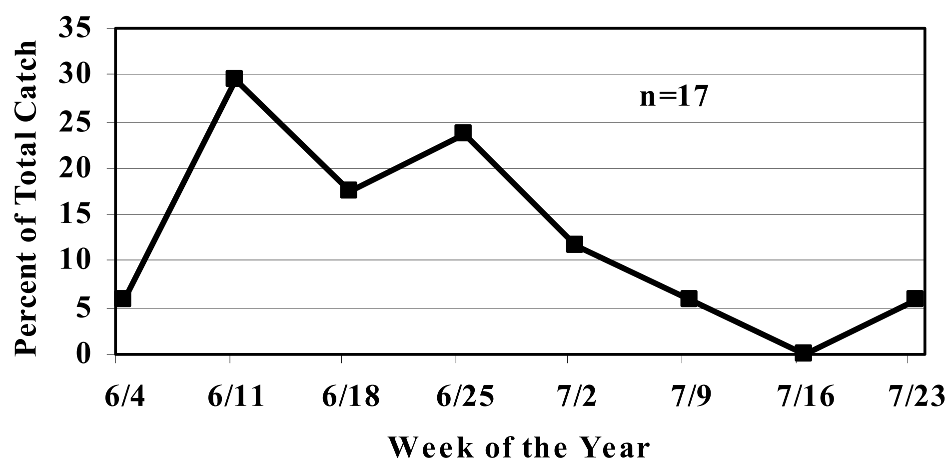

Figure 4. Percentages of spring chinook salmon caught by week of the year at the upper Grande Ronde River weir, 2000.

Table 8. Summary statistics for spring chinook salmon collected at the upper Grande Ronde River weir, 2000.

Sex*	Mean FL (mm)	SD	Range	N
Male	743.9	40.6	660-785	7
Female	701.1	32.9	658-775	9
Unknown	680.0	-	-	1
All	717.5	41.3	658-785	17

* Sex determinations were tentative.

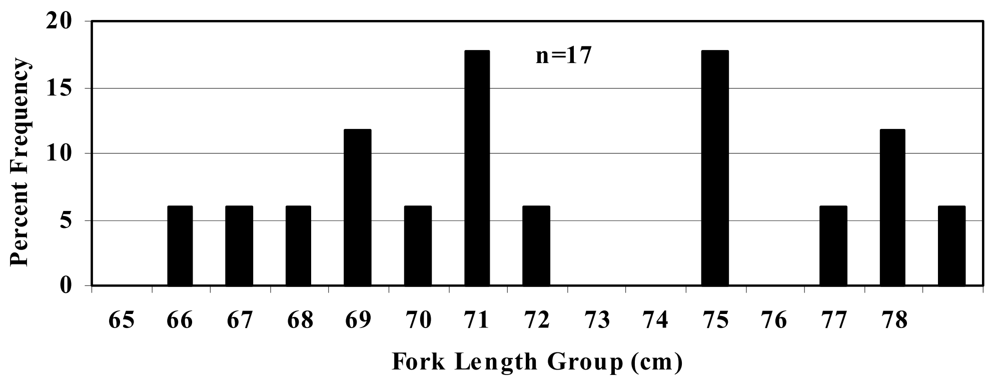

Figure 5. Length frequency of spring chinook salmon caught at upper Grande Ronde River weir, 2000.

Table 9. Summary statistics for summer steelhead collected at the Catherine Creek weir, 2000.

Mark	Sex	Mean FL (mm)	SD	Range	N
Ad clip	Male	610.7	13.6	595-619	3
	Female	623.6	46.4	570-680	5
	Total	618.8	36.5	570-680	8
Unmarked	Male	689.5	81.5	605-776	4
	Female	686.5	53.8	600-745	6
	Total	687.7	61.8	600-776	10

* One fish found decomposed on May 12, 2000; no data taken.

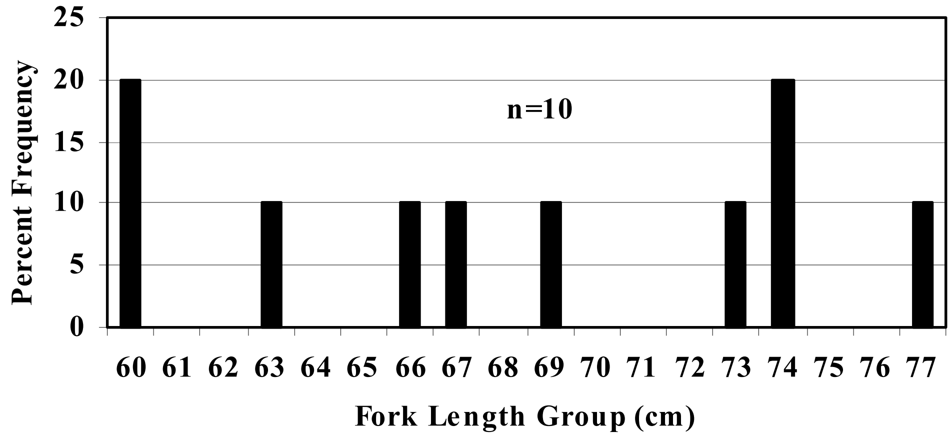

Figure 6. Length frequency of unmarked summer steelhead caught at the Catherine Creek weir, 2000.

Table 10. Summary statistics for spring chinook salmon collected at the Catherine Creek weir, 2000.

Sex*	Mean FL (mm)	SD	Range	N
Male	694.3	116.5	485-840	9
Female	741.4	37.0	705-800	5
Unknown	731.5	37.9	665-790	10
All	719.6	77.0	485-840	24

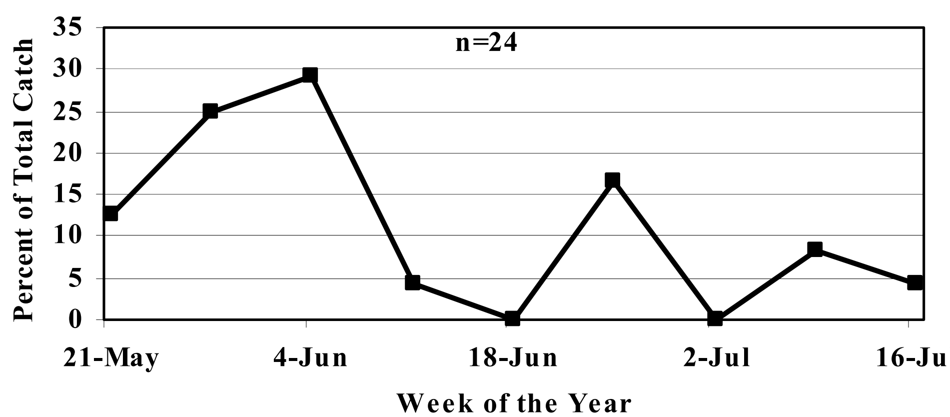

Figure 7. Percentages of spring chinook salmon caught by week of the year at the Catherine Creek weir, 2000.

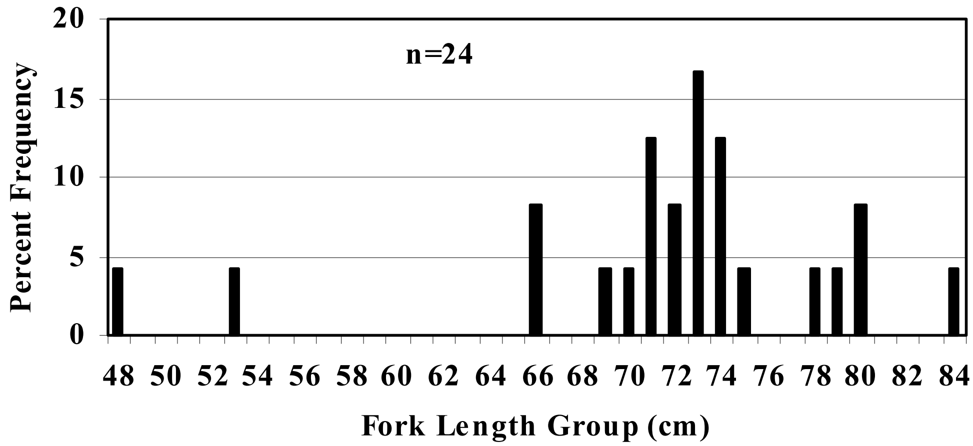

Figure 8. Length frequency of spring chinook salmon caught at the Catherine Creek weir, 2000.

Three prespawn mortalities were collected at Catherine Creek. One mortality resulted from becoming wedged between the pickets. One fish was injured after being passed through a diversion culvert. This fish was kept for several days in the trap to see if it would recover, but developed a fungus infection. It was then transported to Lookingglass Hatchery and treated with formalin, but later died. A third spring chinook with a fungal infection was passed upstream but later drifted downstream and died.

All fish transported to Lookingglass Hatchery and kept for broodstock were transported back to streams of capture and released on July 31.

Ten below-weir surveys during June-August yielded observations of 12 live spring chinook at Catherine Creek and 42 at the upper Grande Ronde River (Table 12). More chinook were observed later in the season on the upper Grander Ronde River; 14 live fish were observed on the last below weir survey on August 24. Suckers (*Catostomus* sp.) and *O. mykiss* were other species observed on upper Grande Ronde River surveys. No other species were identified on the surveys on Catherine Creek.

Table 11. Summary of below-weir surveys conducted on Catherine Creek and the upper Grande Ronde River, 2000.

Stream	Below Weir Surveys	Dates	Total Live Chinook Salmon Observed
Catherine Creek	10	June 29-Aug 22	12
upper Grande Ronde River	22	June 1-Aug 24	42

The potential spawning area in Vey Meadows was observed by helicopter on September 18. Standard spawning ground surveys were conducted on August 29, September 6, and September 12 on Catherine Creek, and August 28, September 5, September 11, September 19,and September 21 on the upper Grande Ronde River (ODFW, unpublished data). These surveys resulted in observations of 21 live spring chinook on each stream.

Spawning ground surveys were also conducted for summer steelhead in Catherine Creek, the upper Grande Ronde River, and tributaries. Twenty-five surveys of 0.5-3 hrs duration yielded 13 redds, but no live fish or carcasses.

Water temperatures observed at the adult trap sites on Catherine Creek and the upper Grande Ronde River followed a similar pattern during the period May-November. The maximum temperatures at each site were observed during mid-July through August. The highest temperature observed at the upper Grande Ronde River adult site was 27.0^{o}C and at Catherine Creek was 24.1^{o}C. Temperatures of 20^{o}C or greater were observed on a regular basis at the upper Grande Ronde River adult site during late June to late August, and during mid-July to late August on Catherine Creek. On a daily basis at both adult sites, the highest temperatures were usually observed near 5 PM and the lowest at about 0700-0800. A thermometer placed near the upper Grande Ronde River acclimation site recorded highest temperatures of 18.2-18.8^{o}C on August 9-11 and August 24 .

Catherine Creek daily stream gauge readings were not taken during the period the trap was not operational (Figure 9). Measurements during those periods were estimated at 0.9-1.2 m, as the water levels exceeded the top of the gauge.

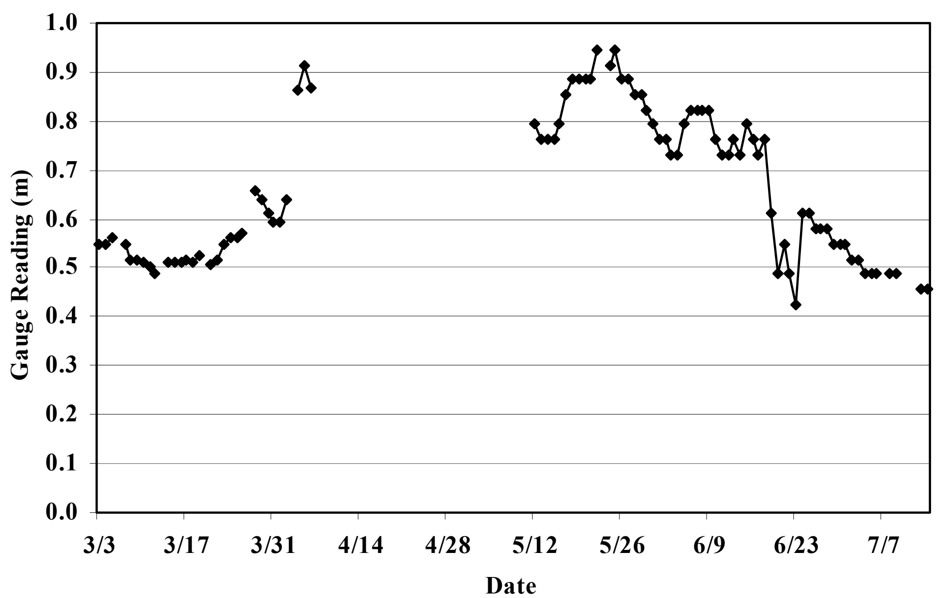

Figure 9. Daily staff gauge readings at the Catherine Creek weir, 2000.

One dead bull trout (about 35 cm FL) was collected live in the Catherine Creek trap in early June. This fish appeared to be blind in one eye, but otherwise healthy. Several days later, however, it was found dead near the weir. No other bull trout were captured or observed at either trap for the remainder of the season.

Suckers (*Catostomus* sp.) Other species collected at the weirs during 2000 included suckers (*Catostomus* sp.). Suckers were usually observed during a spawning migration. Sometimes suckers died from being wedged between the pickets.

Discussion

Mortalities during the acclimation period were minimal. This was probably due to the low numbers of fish acclimated, good water quality and quantity, and isolation of the high titer BKD fish. Frazil ice problems restricting flow were of short duration at the upper Grande Ronde River facility. During years with more fish being acclimated, colder than normal temperatures and low snowfall upstream of the acclimation facilities, frazil ice may become a problem of more consequence.

The mean lengths (at PIT-tagging and from prerelease sampling) of migration year 2000 hatchery juveniles released from the acclimation facilities were considerably larger than for wild fish. This likely resulted in the higher detection rates observed through the migration corridor. The larger size of released fish may affect the number of precocious males that contribute to the spawning population (Busack et al. 1997). Stream water temperatures were warmer for the Catherine Creek facility than the upper Grande Ronde River, and fish appeared to grow about 0.8 cm during the acclimation period. Migration timing of acclimated fish from the upper Grande Ronde River facility was slightly longer than for Catherine Creek fish, and may have been due to the earlier force-out date.

Differences in the distribution of arrival date to Lower Granite Dam were evident for hatchery and wild fish from both streams. The biological significance of these differences is unknown, but may become apparent as more data are collected.

Volitional release is a recommended tactic for hatchery salmonids (Flagg and Nash 1999). The Catherine Creek volitionally-released fish were slightly larger than forceout fish, and median date of arrival to Lower Granite Dam was closer to that of wild fish. Cumulative minimal detection rates varied little between the two release methods.

Too few adult spring chinook were collected from either Catherine Creek or the upper Grande Ronde River in 2000 to meet the minimum ESA permit requirements of 10 fish per stream on-hand by August 1 for a conventional broodstock program. Trapping through July 31 did allow valuable life history data to be collected.

The low numbers of adult chinook salmon collected from both Catherine Creek and the upper Grande Ronde during 2000 were due to low escapement, more spawning below the weirs than normal, and poor functioning of the weirs. Population estimates of spawners above the weirs were 23 for the upper Grande Ronde River and 44 for Catherine Creek (ODFW, unpublished data). About 74% percent and 55%, respectively, of the spring chinook spawning above the weirs were captured at the upper Grande Ronde River and Catherine Creek weirs (ODFW, unpublished data). Substantial numbers of fish, based on observations from below-weir and spawning ground surveys appeared to be late-migrating and spawning. Approximately 24% of the redds observed for Catherine Creek in 2000 were below the weir, and 55% for the upper Grande Ronde River (ODFW, unpublished data). Typically about 10% of the redds in the upper Grande Ronde River usually occur below the weir location, and less than 10% in Catherine Creek.

Picket-style weirs function well in low flow situations, but not during spring freshets. As flows increase, the framework twists slightly, preventing pickets from being pushed to the bottom. High flows and high debris loads eventually overwhelm the ability of the facility operators to remove it and keep water flowing through. Severe scouring underneath pickets or complete washing out of the weir then results. The limited use of the resistance-board weir on Catherine Creek did not appear to improve trapping efficiency.

In addition to the high flow and debris problems, videography at the Catherine Creek weir showed spring chinook easily jumping over the 2.3 m long pickets used. These were immediately replaced with 3.3 m pickets and tarps attached near the base of the supporting tripods to discourage fish from jumping. However, these actions may have been too late to affect efficiency much in 2000.

Most spring chinook collected in 2000 were age 4, based on length at age data from other streams (ODFW, unpublished data). Three age 5 fish were collected from Catherine Creek. Most spawning Grande Ronde River spring chinook salmon during 1966-1976 were age 4, using carcass recoveries during spawning ground surveys (Howell et al. 1985).

Lower Granite Dam passage data showed the first adult spring chinook salmon was collected on April 5, 2000 (Figure 10). By June 1, 2000, about 50% of the total run of spring chinook salmon (non-jack) passing Lower Granite Dam had been observed. During the peak migration period, 3-6% of the total season catch was passing over Lower Granite Dam. The reliability of dam passage counts has been questioned but escapement estimates for spring chinook salmon are considered fairly accurate (Dauble and Mueller 2000). Catch data from Lower Granite Dam show that run timing varies from year to year, probably due to factors such as flow and temperature. Early trap installation and operation (by April 20) and a more effective weir design are required to consistently catch a high percentage of the run.

Water temperatures observed during June-August 2000 frequently exceeded 20^{o} C, the water temperature standard established for the Grande Ronde Basin (Oregon Department of Environmental Quality 1995). On a few occasions, lethal temperatures were reached in the upper Grande Ronde River near the weir. Few fish were collected during the periods when temperatures were high. High water temperatures may present a thermal barrier to chinook salmon migration during midsummer, resulting in behavioral changes, or if temperatures become extreme, mortalities. Fish may move into a cooler tributary (e.g. Minam River) and wait to return to the Grande Ronde River until water temperatures drop in September. Migrating fish may also locate seeps of cooler water and remain there until water temperatures in the migration corridor decrease. Environmental conditions in the Grande Ronde River may also be selecting for adult chinook salmon tolerant of higher water temperatures.

Trapping equipment or procedures resulted in the deaths of two summer steelhead and three spring chinook in 2000. The two summer steelhead and one spring chinook died after becoming wedged between pickets in the weir. Measures were taken to correct these deficiencies. Two spring chinook died after jumping into an empty anesthetic tank that had been left in the trap. Such equipment is no longer left inside the traps, and closer attention is paid to any situation that might be a threat to the health of fish. Additional changes or modifications will be made as needed to reduce the possibility of injuries to fish resulting from trapping.

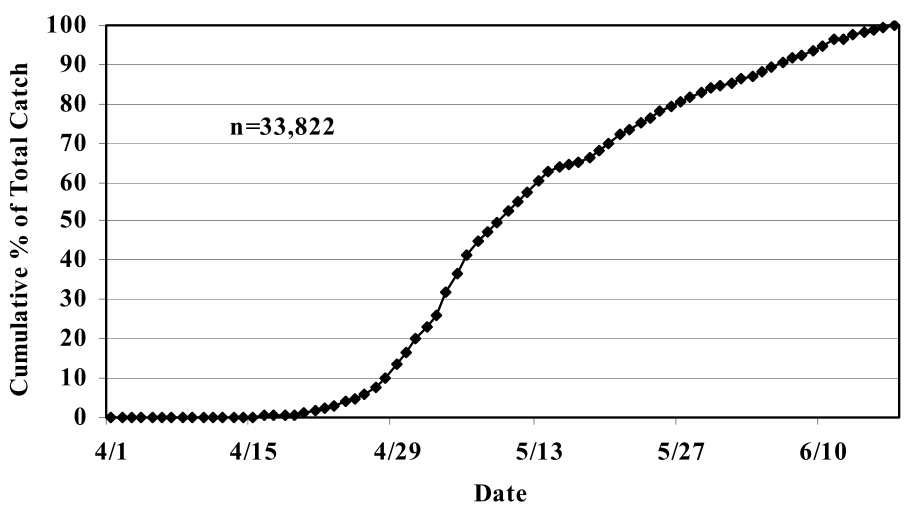

Figure 10. Cumulative percent catch of Snake River spring chinook salmon by date at Lower Granite Dam, 2000. (catches through June 17, jacks excluded)

Below weir survey data on both streams is inconclusive regarding aggregating of fish below the weirs. The small number of years sampled, changes in year to year use of spawning areas below the weirs, and the inability to observce behavior of individual fish all make interpretation of these data difficult. Movement of fish seen below the weirs upstream after weir removal may provide some evidence of weirs causing blockage. A shift in the number of redds occurring below the weirs may also suggest a weir effect on migration behavior.

Few data are available, but suggest that steelhead migrate upstream past the weir location in Catherine Creek beginning in March, and the upper Grande Ronde River weir in April. There appears to be only a small amount of steelhead spawning habitat below the Catherine Creek weir, so early operation of an effective weir should capture most of the spawning run. Steelhead in the upper Grande Ronde River appear to divert to other streams (e.g. Meadow Creek, Five Points Creek); few fish migrate upstream as far as the River Campground. Steelhead spawning ground surveys are difficult because of the high stream flows and low visibility in many Grande Ronde basin streams during spawning. Capture of most of the steelhead spawning migration in the upper Grande Ronde River may require additional trapping sites lower in the watershed. The numbers of adipose-clipped (Wallowa Hatchery stock) will decrease as harvest augmentation with non-endemic fish is phased out.

It is uncommon to observe more than one or two bull trout each season at the Catherine Creek and upper Grande Ronde River weirs.

PART II. CONSTRUCTION OF REMOTE, SEMI-PERMANENT ADULT COLLECTION AND JUVENILE ACCLIMATION FACILITIES ON CATHERINE CREEK AND THE UPPER GRANDE RONDE RIVER, OREGON

Permits were completed for construction of the Catherine Creek adult collection facility in 2000. Concrete was poured for the trap area and a trash screen, bypass pipe, stoplog slots, Denil fishway, crane, phone line and electrical service were installed. The weir was redesigned to incorporate hydraulically-operated weir panels. No field construction activity occurred at the upper Grande Ronde River site during 2000. The upper Grande Ronde River weir is also being redesigned to provide a more effective facility.

Construction at both acclimation sites was completed in 2000 and acclimation occurred at both facilities in 2000. Some minor modifications may yet be needed at both acclimation sites, particularly regarding compliance with OSHA regulations.

PART III. EXPERIMENTS TO AID IN CULTURE OF SPRING CHINOOK SALMON CAPTIVE BROODSTOCK

Use of near-infrared spectroscopy to separate maturing from non-maturing rainbow trout

Cooperators - Anna Cavinato, Melissa Wenz, (Eastern Oregon State University), Peter Lofy, Stephen Boe, and Parker Ogburn (Confederated Tribes of the Umatilla Indian Reservation), Greg Davis (Oregon Department of Fish and Wildlife).

Analysis of data collected in 1998-2000 resulted in a publication (Wenz et al. 2000) and professional presentation (Wenz et al. 2000). The technique holds promise but additional sampling is necessary before a model can be developed and tested.

PART IV. ASSISTANCE PROVIDED TO PROGRAM COOPERATORS

Program staff spent 15 person-days assisting ODFW in conducting spawning ground surveys on Catherine Creek, the upper Grande Ronde River, and other tributaries of the Grande Ronde River during 2000. Project staff also spent 2 person-days assisting in spawning ground surveys of the John Day River.

Program staff spent 14 person-days assisting ODFW in collecting captive brood parr from project streams and spawning of captive broodstock chinook salmon at Bonneville Fish Hatchery.

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Appendix Table 1. Data for spring chinook salmon collected at weirs on Catherine Creek (CC) and the upper Grande Ronde River (GR), 2000. (all fish collected were unmarked)

Stream	Date	Sex	FL (mm)	Disposition
UGR	6/10	F	658	PU
UGR	6/14	F	687	T
UGR	6/14	F	672	PU
UGR	6/16	M	773	T
UGR	6/16	F	705	T
UGR	6/16	M	785	PU
UGR	6/18	F	695	PU
UGR	6/19	F	700	T
UGR	6/19	M	749	PU
UGR	6/28	F	775	T
UGR	6/28	M	760	WM
UGR	6/28	M	740	WM
UGR	6/29	F	717	PU
UGR	7/2	F	701	PU
UGR	7/3	M	740	PU
UGR	7/13	M	660	T
UGR	7/23	U	680	PU
CC	5/22	U	715	PU
CC	5/26	U	735	PU
CC	5/26	U	737	PU
CC	5/28	U	665	T
CC	5/30	U	690	T
CC	6/2	U	723	PU
CC	6/3	M	724	PU
CC	6/3	U	740	T
CC	6/3	M	750	PU
CC	6/5	M	800	T
CC	6/6	M	735	PU
CC	6/7	F	740	T
CC	6/7	F	705	PU
CC	6/8	U	790	T
CC	6/8	U	735	WM
CC	6/10	F	715	T
CC	6/15	F	800	PU
CC	6/26	M	840	PU
CC	6/26	F	747	PU
CC	6/26	M	535	PU
CC	6/30	M	485	PU
CC	7/14	M	665	PU
CC	7/15	U	785	PU
CC	7/21	M	715	PU

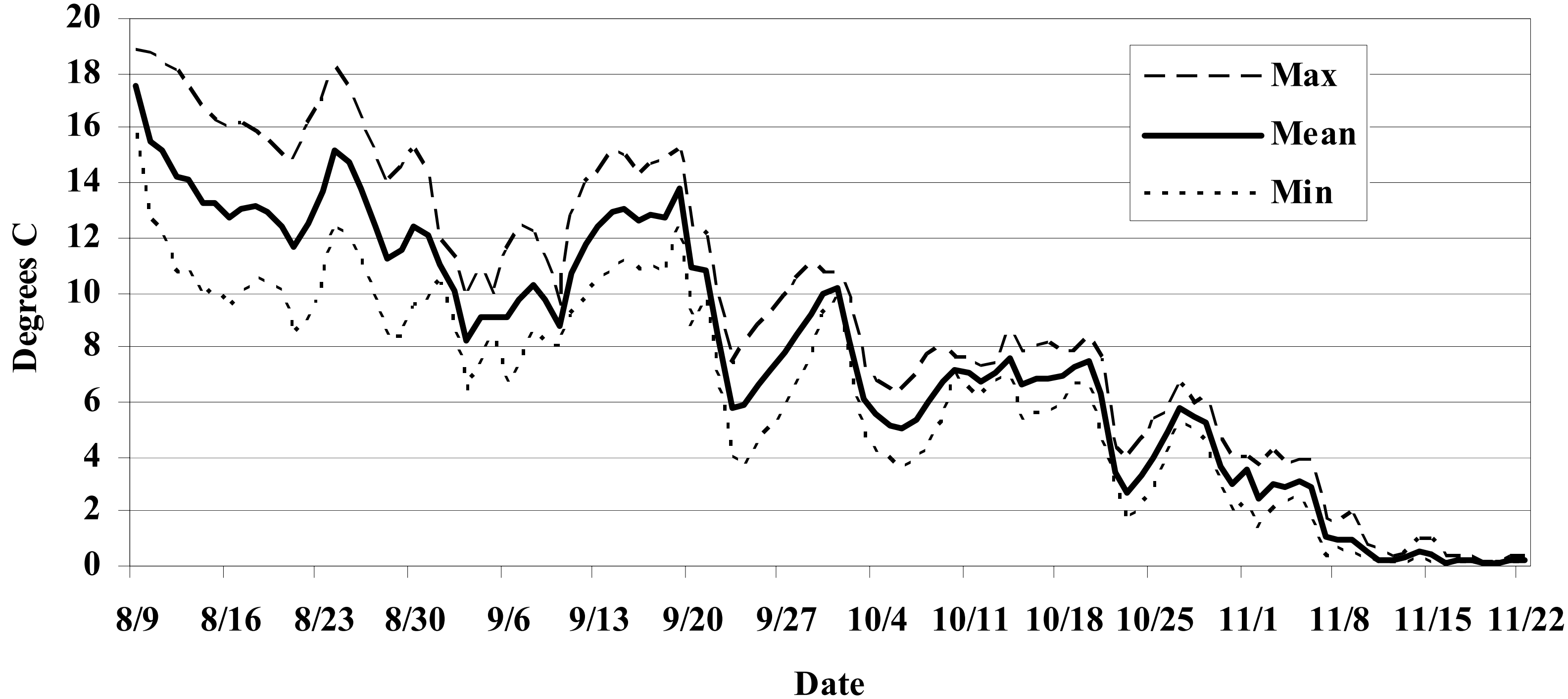
M = male, F = female, U = unknown; PU = passed upstream,
T = transport to Lookingglass Hatchery for broodstock,
WM = weir mortality

Appendix Table 2. Data for summer steelhead collected at weirs on Catherine Creek (CC) and the upper Grande Ronde River (GR), 2000.

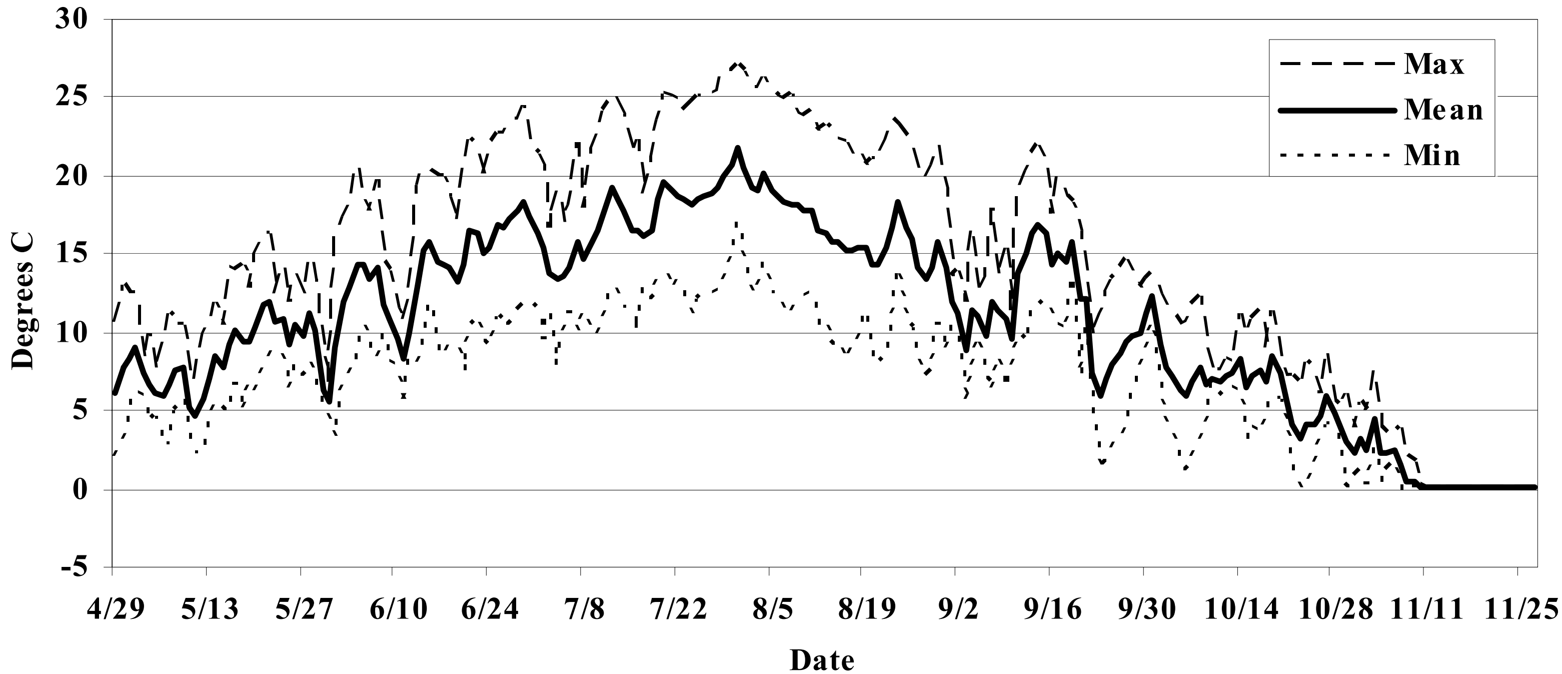
Weir	Date	Marks	Sex	FL (mm)	Disposition
UGR	4/4	None	M	625	PU
UGR	4/5	None	F	763	PU
UGR	4/8	Ad	M	603	PU
UGR	4/9	None	F	660	PU
UGR	4/19	None	F	655	PU
UGR	4/19	U	U	U	PU
UGR	4/25	None	F	595	PU
UGR	4/25	Ad	M	597	E
UGR	4/26	None	F	579	PU
UGR	4/27	None	F	597	PU
UGR	4/27	None	M	610	PU
UGR	4/28	None	F	575	PU
UGR	5/3	Ad	M	615	E
UGR	5/4	None	F	594	PU
UGR	5/4	Ad	M	638	E
UGR	5/4	None	F	679	PU
UGR	5/4	None	M	568	PU
UGR	5/16	None	F	591	PU
UGR	5/16	None	M	590	PU
UGR	5/26	None	F	625*	PU
UGR	5/28	None	F	685*	M-PS
UGR	6/4	None	M	515*	M-PS
UGR	6/4	None	M	575*	PD
UGR	6/8	None	F	640*	M-PS
UGR	6/21	None	F	637*	M-PS
CC	4/1	None	M	740	PU
CC	4/1	None	M	637	PU
CC	4/1	None	F	745	PU
CC	4/2	None	M	605	PU
CC	4/2	Ad	F	617	PU
CC	4/2	None	F	738	PU
CC	4/2	Ad	M	619	PU
CC	4/2	None	F	660	PU
CC	4/3	Ad	M	618	PU
CC	4/3	Ad	F	680	PU
CC	4/3	None	F	600	PU
CC	4/4	Ad	F	661	PU
CC	4/4	Ad	F	590	PU
CC	4/4	None	F	698	PU
CC	4/4	None	F	678	PU
CC	4/4	None	M	776	WM
CC	4/4	Ad	F	570	WM
CC	5/10	Ad	M	595*	M
CC	5/12	U	U	U	M

* = completed spawning (fallback), U = unknown, F = female
M = male, Ad = Wallowa hatchery origin, PS = postspawn
PD = passed downstream, M = mortality, E = euthanized, WM = weir mortality

Appendix Figure 1. Daily water temperature graph for the Catherine Creek acclimation site, 2000.



Appendix Figure 2. Daily water temperature graph for the upper Grande Ronde adult collection site, 2000.



Appendix Figure 3. Daily water temperature graph for the Catherine Creek adult collection site, 2000.