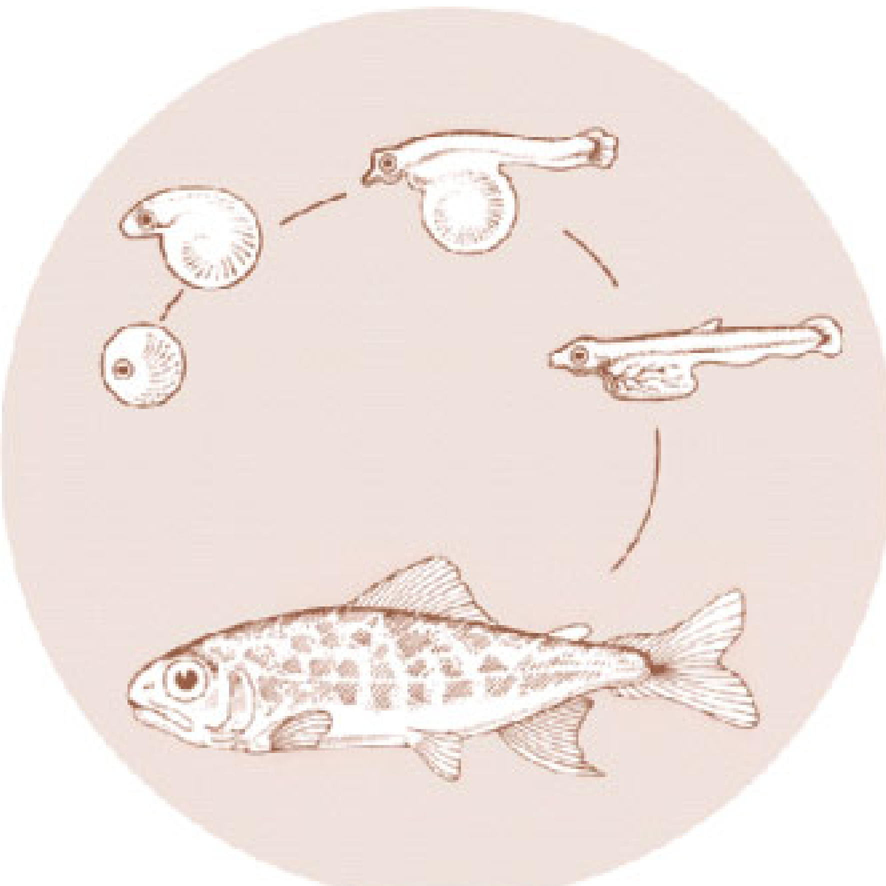
Grande Ronde Endemic Spring Chinook Salmon Supplementation Program

Facility Operations and Maintenance and Monitoring and Evaluation

Annual Report
2001



DOE/BP-00006509-3

March 2003

This Document should be cited as follows:

Boe, Stephen, Parker Ogburn, "Grande Ronde Endemic Spring Chinook Salmon Supplementation Program; Facility Operations and Maintenance and Monitoring and Evaluation", 2001 Annual Report, Project No. 199800703, 54 electronic pages, (BPA Report DOE/BP-00006509-3)

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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.

Grande Ronde Endemic Spring Chinook Salmon Supplementation Program:

Facility Operations and Maintenance and Monitoring and Evaluation

Annual Report
1 January 2001 through 31 December 2001

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Project 1998-007-03
BPA Contract No. 00006509

March 2003

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EXECUTIVE SUMMARY

This is the second 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 2001:

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

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

3. Ensure proper construction and trial operation of semi-permanent adult and juvenile facilities for use in 2001.

4. Plan for data collection needs for bull trout.

5. Ensure proper construction and trial operation of semi-permanent adult and juvenile facilities for use in 2001.

6. Collect summer steelhead.

7. Monitor adult endemic spring chinook salmon populations and collect broodstock.

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

9. Monitor adult population abundance and characteristics of Grande Ronde River spring chinook salmon populations.

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

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

12. Monitor water quality at facilities.

13. Document accomplishments and needs to permitters, comanagers, and funding agencies.
14. Communicate Project results to the scientific community.

Accomplishments and Findings for 2001

We operated acclimation facilities for spring chinook salmon (*Oncorhynchus tshawytscha*) juveniles (captive broodstock progeny) on Catherine Creek and the upper Grande Ronde River near La Grande, Oregon, during February-April, 2001. Totals of 137,588 (3,172.4 kg) and 2,570 (83.9 kg) fish were delivered to the Catherine Creek and upper Grande Ronde River facilities, respectively. Catherine Creek fish were acclimated from March 8-April 16 (forceout); fish were released volitionally beginning April 2. Fish at the upper Grande Ronde River facility were acclimated from February 27-March 27 (forceout) without any volitional release. Mortalities during acclimation were 914 (0.7%) at the Catherine Creek facility and 26 (1.0%) at the upper Grande Ronde River facility. Water temperatures ranged from -0.7-3.8 ^{o}C at the upper Grande Ronde River site and 1.6-6.7 ^{o}C at the Catherine Creek site. Daily minimum dissolved oxygen levels ranged from 8.9-11.8 ppm at the Catherine Creek site.

Volitionally-released fish totaled 1.4% of the estimated number delivered to the Catherine Creek facility. Mean FL length at PIT-tagging of force-out fish was 1.9 mm greater than for volitionally-released fish. Median arrival date to Lower Granite Dam was May 6 for volitionally-released fish (n=62), compared to May 14 for force-out fish from Catherine Creek (n=2,668). Frequency distributions of arrival dates differed significantly by release method. Minimum cumulative detection rates were 33.4% for volitionally-released fish (97 of 290 detected leaving volitionally) and 52.1% for force-out fish (3,572 of 6,862 detected) for Catherine Creek. The overall detection rate for PIT-tagged fish (volitional release and force-out combined) from Catherine Creek was 34.2% (7,152 of 20,915 fish originally delivered).

Mean fork lengths (FL) at tagging in October 2000 of PIT-tagged hatchery origin fish were 117.7 mm (n=20,889) for Catherine Creek and 131.2 mm (n=493) for the upper Grande Ronde River. Median arrival date of 7,710 PIT-tagged hatchery fish to Lower Granite Dam from Catherine Creek was May 15. Median arrival date of 197 PIT-tagged hatchery fish to Lower Granite Dam from the upper Grande Ronde River was May 4. Minimum cumulative detection rates (number of unique PIT tag detections from Lower Granite Dam downstream in 2001) of PIT-tagged fish were 49.9% for Catherine Creek (n=10,428 of 20,915 originally delivered) and 49.7% for upper Grande Ronde River fish (n=246 of 495 originally delivered).

Median date of arrival at Lower Granite Dam differed by only four days between hatchery and wild migration year 2001 spring chinook from Catherine Creek. However, frequency distributions were significantly different between the two rearing types. Mean fork length at PIT-tagging was about 36 mm greater for hatchery compared to wild fish from Catherine Creek. Minimum cumulative detection rates were higher for hatchery fish than wild fish from Catherine Creek, and probably influenced by the larger size at PIT-tagging. Two few wild fish were marked and released (6) to afford any meaningful comparisons with hatchery fish for the upper Grande Ronde River.

A total of 76,941 spring chinook captive brood progeny (brood year 2000) weighing 1,454.05 kg (49.8 fish/kg) were liberated into the upper Grande Ronde River between the acclimation and adult collection sites on October 2, 2001.

We also operated picket-style and resistance board weirs on Catherine Creek and the upper Grande Ronde River near La Grande, Oregon, during March-July, 2001. The upper Grande Ronde River weir was operated from March 31-July 13, 2001, and the Catherine Creek weir from March 20-September 4, 2001. Life history data were collected from summer steelhead (*Oncorhynchus mykiss*) and spring chinook salmon adults. A portion of the spring chinook salmon trapped from each stream were kept for broodstock, transported to Lookingglass Hatchery, held in ponds, and spawned in August and September.

Seventeen unmarked (wild) summer steelhead (first time captures) were collected at the upper Grande Ronde River weir from April 27 to June 16, 2001. Mean FL for ten males and seven females were 674.0 and 602.7 mm, respectively. Two ad-clipped (hatchery origin) summer steelhead were collected.

Thirty-eight adult spring chinook salmon were collected at the upper Grande Ronde River weir from May 23 to July 5, 2001. Nine were transported to Lookingglass Hatchery for use as broodstock. An additional 12 fish were seined from areas about 0.3 km below the weir on July 13 (n=6) and July 30 (n=6) and transported to Lookingglass Hatchery for use as broodstock. All spring chinook salmon adults were unmarked age 4/5 fish (mean FL=734.6 mm). Mean lengths and weights of males spawned were 754.8 mm (n=8) and 4.26 kg (n=7), respectively. Mean lengths and weights of females spawned were 735.6 mm (n=8) and 4.24 kg (n=8), respectively. Mean egg yield per female was 4,422.

One hundred and fifty-one unmarked (wild) summer steelhead (first time captures) were collected at the Catherine Creek weir from April 1 to May 19, 2001. Mean FL for males was 628.8 mm (n=85) and for females was 639.8 mm (n=63). Fifty ad-clipped summer steelhead (hatchery) ranging from 642-777 mm were either released downstream or in local ponds for anglers, or euthanized.

One-hundred nineteen adult spring chinook salmon were collected at the Catherine Creek weir from May 21 to September 4, 2001. Twenty-nine were ad-clipped age 3 males (brood year 1998 captive broodstock progeny) with a mean fork length of 474.1 mm. Nine were unmarked (wild) age 3 males (mean FL 511.7 mm). Mean length of the 81 remaining adults was 719.6 mm. Two mortalities occurred at the weir.

Twenty-five unmarked spring chinook salmon from Catherine Creek were transported to Lookingglass Hatchery for broodstock and 20 were spawned (13 age 4/5 females, 5 age 4/5 males and 2 age 3 males). Mean length of age 4/5 males spawned was 711.6 mm (n=7) and mean weight was 3.6 kg (n=3). Mean lengths and weights of age 3 males spawned were 565.0 mm (n=2) and 2.0 kg (n=2), respectively. Mean lengths and weights of females spawned were 714.6 mm (n=15) and 4.0 kg (n=12), respectively.

Mean egg yield per female was 3,978. One female was spawned but yielded no viable eggs.

Fifteen prespawn spring chinook carcasses were recovered within 3 km upstream or downstream of the upper Grande Ronde River weir from July 4-18, and 4 within 8 km upstream or downstream of the Catherine Creek weir from July 24-August 4. Temperature-related stress was probably the cause of most prespawn mortalities. Most carcasses recovered from the upper Grande Ronde River were badly decomposed.

A single bull trout (*Salvelinus confluentus*) (mortality) was observed at Catherine Creek. Suckers (*Catostomus* sp.) and mountain whitefish (*Prosopium williamsoni*) were also collected at both trapping sites.

Sustained periods with weekly average water temperatures over 21^{o} C occurred from June-September at the Catherine Creek weir. Weekly mean water temperatures over 25^{o} C occurred during the weeks of July 2, August 6, and August 13 at the Catherine Creek weir. Sustained periods with weekly mean water temperatures over 21^{o} C occurred from June-September also at the upper Grande Ronde River weir. Weekly average water temperatures over 25^{o} C occurred during the weeks of July 2, July 9, August 6, and August 13 at the upper Grande Ronde River weir. Water temperatures at the upper Grande River acclimation site were usually 5^{o} C cooler than temperatures at the upper Grande Ronde River adult collection site from April-early July. Lowest temperatures each day for both streams were observed at about 0800 and highest at about 1700.

Thirty-three surveys of about 1.6 km length were conducted downstream of both weirs in 2001 (Catherine Creek, n=14 and upper Grande Ronde River, n=19). Twenty-one Catherine Creek and two hundred sixty-nine upper Grande Ronde River live chinook salmon adults were observed. On the last four upper Grande Ronde River surveys, July 18-August 6), an average of nearly 30 spring chinook salmon were observed. Presence of the upper Grande Ronde River weir may have affected spring chinook salmon migration, but below weir survey data were inconclusive regarding weir effects on Catherine Creek spring chinook migration or behavior.

In addition to the regular spawning ground surveys conducted with comanagers, four spawning ground surveys were conducted on selected reaches of Catherine Creek from September 17-26 and yielded an additional 15 spring chinook carcasses. One additional spawning ground survey of approximately 1.6 km below the upper Grande Ronde River weir location yielded one additional spring chinook carcass.

The weirs trapped 85% and 16 % respectively of the 2001 estimated spawners migrating above the upper Grande Ronde and Catherine Creek weirs. The low percentage of fish collected from Catherine Creek probably resulted from ineffective weir functioning. The upper Grande Ronde River weir collected a larger proportion of the run but may have delayed migration of some spring chinook.

Construction at the Catherine Creek and upper Grande Ronde River acclimation facilities is essentially complete. Remaining work includes installation of safety railings and walkways and delivery of as-built plans. The anchor rail for the resistance board weir was installed in July 2001, with the weir panels and trap needing to be fabricated and installed. The upper Grande Ronde River weir is expected to be operational for trapping summer steelhead in April 2002. Installation of the hydraulically-operated weir and trap on Catherine Creek progressed and was completed during 2001. This facility will be operational in March 2002.

Contracted activities with comanagers in 2001 included collection of captive broodstock parr from Catherine Creek and the upper Grande Ronde River, maturity sorts and spawning activities at Manchester Marine Laboratory and Bonneville Hatchery, spawning ground surveys in the Grande Ronde, Imnaha, Wenaha, and John Day basins, and spawning of Imnaha River spring chinook salmon.

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 from across the run.

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

3. 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 2002.

4. 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.

5. To adequately evaluate volitional release, at least some groups of fish transported from Lookingglass Hatchery should not be split for when delivering to ponds, so that the initial number of PIT-tagged fish in each pond is known.

6. Consult with comanagers to determine the need for evaluating how many hatchery juvenile males that are released into Catherine Creek and the upper Grande Ronde River remain and become sexually mature without going to the ocean.

PART I: OPERATION OF REMOTE ADULT SPRING CHINOOK SALMON BROODSTOCK COLLECTION AND JUVENILE ACCLIMATION 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 (*O. mykiss*) 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 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. In 1995 the Oregon Department of Fish and Wildlife, U. S. Fish and Wildlife Service, and Nez Perce Tribe 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 (populations) are La Grande (12,000), Enterprise (1,905), Union (1,880), Elgin (1,600), and Joseph (1,054). 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 (*Salvelinus confluentus*) 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 204 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 1,433 m over a distance of 204 km (average gradient of 7.0 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/km. 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.

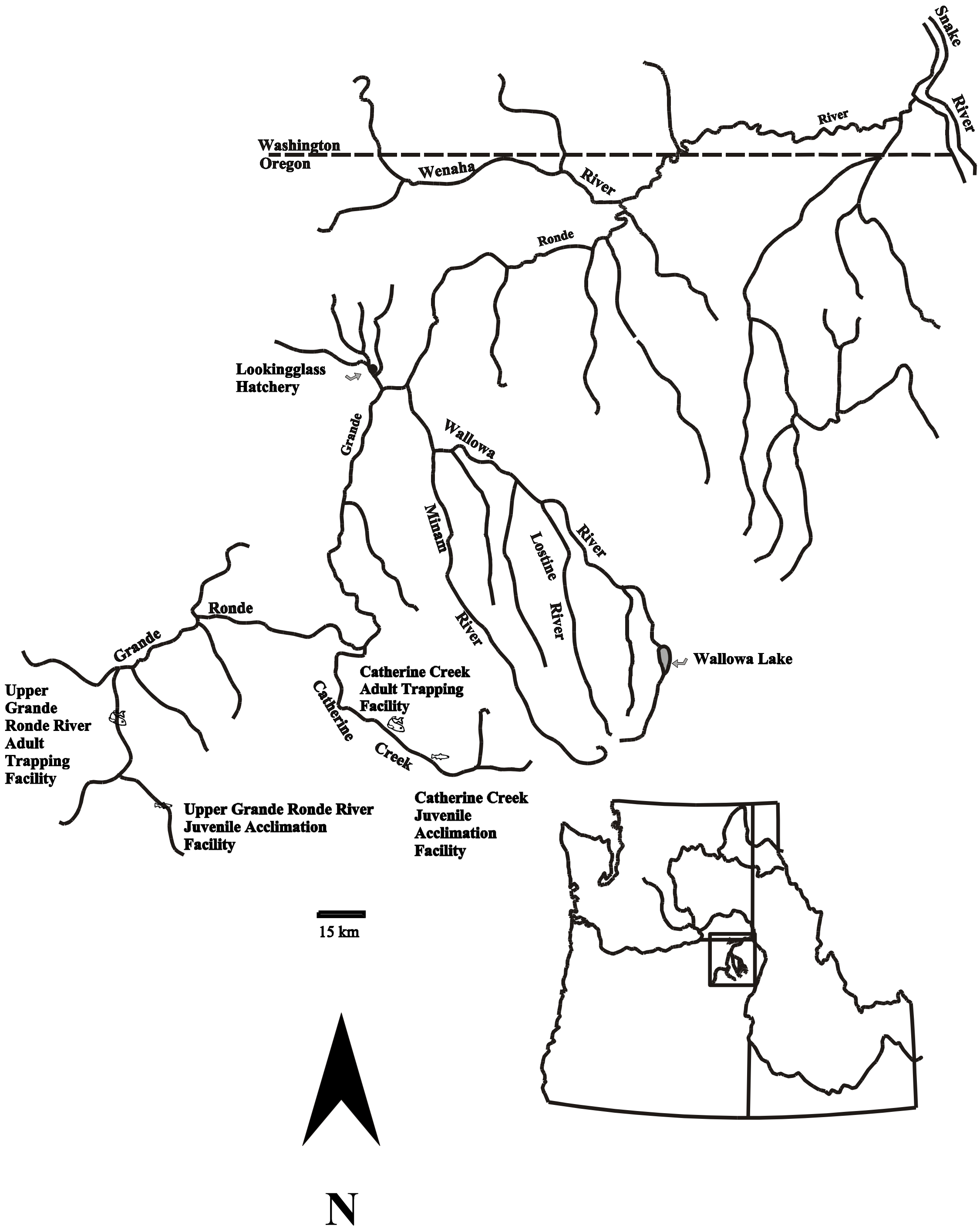

Figure 1. The Grande Ronde Basin, showing adult collection weirs ( ) and juvenile acclimation ( ) sites.

Peak flow (about 8.5 m^3/s) for Catherine Creek usually occurs in May. Peak flow for the upper Grande Ronde River (about 34.0 m^3/s) usually occurs in April or May. Flows for both streams diminish throughout the summer, reaching lows of 1.4-2.1 m^3/s 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 than the upper Grande Ronde. Large amounts of snow at high elevations combined with periods of air temperatures above 32°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 combined with warm weather and snowmelt in the spring, can cause severe flooding in the watershed. Flows in both streams diminish during June through September.

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 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 (Boehne and Gill 1990). Large amounts of fine sediment were washed into the stream following the loss of vegetative cover and persist in upstream areas used by summer steelhead and spring chinook salmon for spawning and rearing.

Stream temperatures in some reaches of Catherine Creek and the upper Grande Ronde may reach levels detrimental to salmonids for extensive periods during the summer months. These water temperatures probably result from the loss of or changes in riparian cover (Oregon DEQ). During the past decade, numerous public agencies have collected and summarized water temperature data from the Grande Ronde basin (Ballard 2002, Oregon DEQ 2000). Models are being developed to ascertain what kinds of actions will bring about lower stream temperatures and improve salmonid habitat. Efforts are underway to standardize methods, share data, and avoid duplication of effort for all organizations monitoring water quality in the basin.

The adult collection site for the upper Grande Ronde River is located at the River Campground (elevation 1,201 m above MSL), at river km 307 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 river km 33, 3 km upstream of Union on land owned by the City of Union (elevation 884 m). 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 28 km upstream of Starkey at river km 319 on Forest Service property just above Vey Meadows at an elevation of 1,317 m. 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 6 km above Catherine Creek State Park, on land owned by Oregon State University and a private lumber company. Both juvenile acclimation facilities are located within areas where the best spawning and rearing habitats are believed to exist.

METHODS

Spring Chinook Acclimation and Juvenile Life History Comparisons

Juvenile spring chinook salmon acclimated at Catherine Creek and the upper Grande Ronde River in 2001 were all captive brood progeny (F_1) and were marked with coded wire tags and adipose fin clips at Lookingglass Hatchery in the fall of 2000. Approximately 21,000 Catherine Creek fish and 500 upper Grande Ronde River fish also received PIT tags. Fish at the Catherine Creek facility were acclimated in four 26.2 m x 2.4 m rectangular ponds with a supporting framework of galvanized steel, neoprene liners, stop logs, screens, and screened standpipes. Each raceway also had an additional outlet pipe with a knife gate control. A 5.5 m diameter circular pond was also used at Catherine Creek (center drain, 1.2 m deep). Water depth was approximately 1 m (volume in each pond was approximately 63 m^3. Water was supplied by a gravity feed pipe at the upper Grande Ronde River and by a diesel pump at the Catherine Creek facility. Fish at both facilities 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. 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 and water temperature were recorded using OxyGuard Handy Beta[2] meters in each raceway 4-6 times a day from 0800-1800 at a water depth of about 0.3 m at the downstream end of each raceway 2 m from the outlet standpipe. Screens were removed and fish at Catherine Creek were allowed to leave the ponds volitionally over the top of the stop logs beginning about 2 weeks before the end of the acclimation period.

Most fish with moderate/clinical levels of BKD were not PIT-tagged and were acclimated in the circular pond and two nearest rectangular ponds. Only 469 PIT-tagged fish were in these ponds. Efforts were made to avoid introducing water from the moderate/clinical BKD ponds into the others. The great majority of the PIT- tagged fish were acclimated in two rectangular ponds. PIT-tagged fish that exited the ponds and entered Catherine Creek either volitionally or by force-out were monitored with two readers on each discharge pipe. Below-grade pits were dug for each of the four discharge

[1,2] Mention of this commercial product does not constitute endorsement.

pipes and braced with wooden studs and plywood. Each pit was covered with a hinged, lockable door made of plywood. A length of PVC pipe (approximately 1.3 m) was spliced into each discharge pipe with rubber sleeves and hose clamps. A PIT tag antenna was slid over each end of the PVC section, then the rubber sleeves were reattached and the splice made watertight. Data from each reader was downloaded periodically to a laptop computer.

Data from the PTAGIS database (http://www.ptagis.org) were obtained and used to describe fork length at tagging, migration timing and minimum survival rates for PIT-tagged fish. Differences were evaluated between wild and hatchery-origin (acclimated) fish and for hatchery-origin fish by release type (volitional or forceout). Wild spring chinook juveniles in both Catherine Creek and the upper Grande Ronde River were collected by the Oregon Department of Fish and Wildlife using rotary screw traps (Jonasson et al. 2001). Migration timing was described using 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. The expansion factor was calculated as the sum of powerhouse and spillway flows divided by the powerhouse flow. Differences in the distributions of arrival dates at Lower Granite Dam by week of the year were tested using the two-sample Kolmogorov-Smirnov test (Sokal and Rolhf 1995). Minimum survival was estimated using cumulative unique detections at all PIT tag observation sites along the Snake River-Columbia River migration corridor. Differences in fork length between groups were evaluated with t-tests (Sokal and Rohlf 1995).

Adult Summer Steelhead Trapping and Spring Chinook Salmon Trapping and Spawning

Iron panels with pickets were laid across the bottom step of the Catherine Creek fish ladder to direct fish into the newly constructed fish trap in 2001. Panels were about 0.9 m wide by 2.4 m long. Pickets were 25 mm wide and spaced 25 mm on center. Pickets were 1.5 m long and extended about 1.3 m away from the concrete to prevent fish from jumping over.

A resistance board weir (Toobin III 1994) was used to trap migrating adult summer steelhead and spring chinook salmon on the upper Grande Ronde River. Panels were 0.9 m wide by 3.7 m long and made of black HDPE. Slats in each panel were rectangular and 1.27 cm by 5.08 cm and 3.7 m long. Gap between slats was 2.54 cm. A section of railroad rail was placed perpendicular in the stream and the lip of each panel placed on the upstream side of the rail to serve as the anchor for the panels.

Traps were checked at least once daily. In the morning, usually before 0900, fish were individually anesthetized using MS-222 and fork length was measured to the nearest mm. Later in the season, as water temperatures rose, fish were processed during early morning when temperatures were lower in order to reduce stress. A paper punch was used to mark fish and obtain tissues for genetics samples. A single punch on the right opercle plate was used to mark Catherine Creek fish and two punches for upper Grande

Ronde River fish. Recaptures of marked fish recovered on the spawning grounds during August and September were used to estimate the adult spawning population (Parker et al. 1995). 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 for some. Fish < 600 mm FL were considered age 3, and 600 mm and greater, age 4/5 (age 4 or age 5). Every third fish from each stream from each of the two age groups (age 3, age 4/5) 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 July 15, 2001, received prophylactic injections of oxytetracycline (intraperitoneal) and erythromycin (dorsal sinus) prior to transport. 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 or opercle tags with a different color and number sequence for each stream, or PIT tags. 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 the anesthetic.

Broodstock from Catherine Creek and the upper Grande Ronde River were held in separate circular ponds enclosed in a building at Lookingglass Hatchery. Fish were checked for maturity weekly beginning August 1, 2001 and received prophylactic injections of erythromycin and oxytetracycline on August 7, 2001. Fork length (nearest mm) and weight (nearest 100g) were recorded from fish spawned. For each female spawned, a subsample of 20 eggs was individually weighed to the nearest 0.1 g, and the remaining eggs bulk weighed to the nearest 0.1g. Fecundity was estimated as (eggs bulk weighed/mean weight of 20 eggs) plus the weight of the 20 egg subsample). Two by two matrices were used when possible. Fish were anesthetized and rinsed with fresh water and gametes were taken, placed in labeled plastic bags and put in coolers with ice. Gametes were transported to Irrigon Hatchery where fertilization, incubation, hatching and early rearing occurred.

Between group differences in fork length or fecundity for spring chinook salmon were evaluated using two-sample t-tests (Sokal and Rohlf 1995). Statistix 7 (Analytical Software 2000) was used for all statistical tests. Differences were considered significant if $P<0.05$. In describing migration timing, week of the year were designated by the first day of each (e.g., Jan 1 for Jan 1-7, Jan 8 for Jan 8-14, Jan 15 for Jan 15-21).

The possible effect of weirs on fish behavior was evaluated by walking approximately 1.6 km 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 spawning ground surveys (Parker et al. 1995) on standardized segments upstream and downstream of weirs on both streams in August and September and the same information was collected. We conducted additional spawning ground surveys in September on selected reaches of Catherine Creek and the upper Grande Ronde River to collect additional carcasses for improving precision of population estimates and to obtain more life history information on spawners. Water temperature was recorded with a pocket thermometer at approximately 0600-0700, 1200, and 1700-1800 each day. Onset®[3] temperature loggers were also used at all four acclimation and adult collection sites to record water temperature hourly during a 24-hour period. Data from stream flow gauging stations located upstream of both acclimation facilities provided indices of stream flows in the vicinity of the weirs.

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 were recorded and mortalities frozen for later analysis. Data (FL, sex, migration status, marks), scales, and genetics tissues for summer steelhead were also collected. Steelhead < 640 mm FL were considered 1-salt and 640 mm FL or greater 2-salt.

RESULTS

Spring Chinook Acclimation

We attempted to set up the Catherine Creek acclimation facility to receive fish on February 27, 2001. Frazil ice clogging the water intake made this impossible and fish were not delivered until March 8-9, 2001. After fish were delivered, recurring frazil ice problems required frequent effort to keep water flowing into the ponds. The upper Grande Ronde River acclimation facility was ready to receive fish on February 27, 2001, and fish were delivered on that date. Frazil ice clogged the water intake at the upper Grande Ronde River facility on several occasions for brief periods, but was not a significant problem.

A total of 2,570 juvenile spring chinook weighing 83.9 kg were delivered to the upper Grande Ronde River acclimation facility on February 27, 2001, and 137,588 weighing 3,172.4 kg to the Catherine Creek acclimation facility on March 8-9, 2001. Catherine Creek fish were split into five ponds; fish from females with moderate-high titer bacterial kidney disease (BKD) were kept in the circular pond and the nearest rectangular pond. All upper Grande Ronde River fish were placed in one pond. Volitional release began at Catherine Creek on April 2 and remaining fish were forced out on the evening of April 16. All upper Grande Ronde River fish were forced out the evening of March 27 without any volitional release.

Mortalities (resulting from transportation and acclimation) were 914 (0.7% of the total delivered) from the Catherine Creek facility and 26 (1.0% of the total delivered) for the upper Grande Ronde River facility. Water temperature at the upper Grande Ronde River facility ranged from –0.7 to 3.8 ^{o}C from February 28-March 27. Dissolved oxygen (DO) ranged from 10.6-12.1 ppm. At the Catherine Creek facility, daily mean (pooled across all sampling times and ponds) water temperature ranged from 1.6-6.7 ^{o}C (Figure 2). Daily minimum DO ranged from 8.9-11.8 ppm. Fish at the upper Grande Ronde

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

River facility were fed about 3.6 kg of feed due to the low water temperatures and number of fish. Fish at the Catherine Creek facility received approximately 587.8 kg of feed.

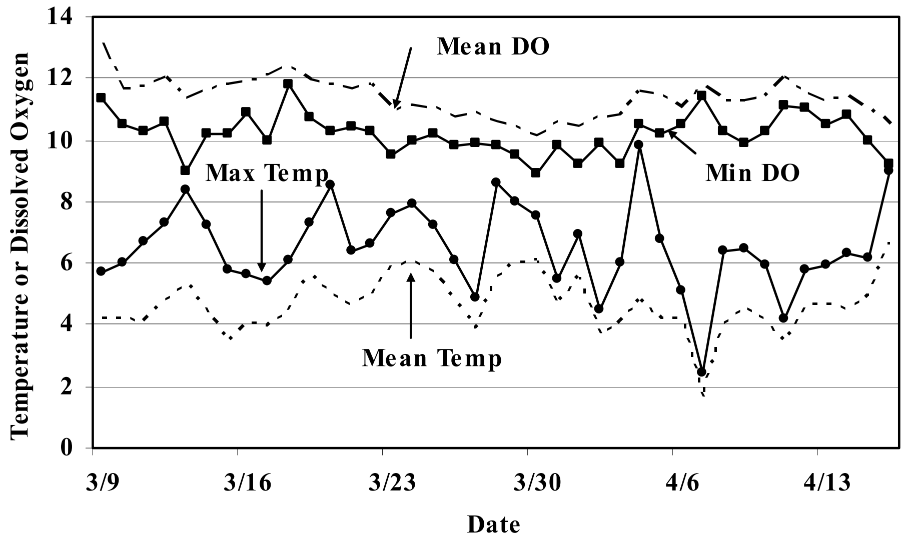

Figure 2. Daily water temperature (^oC) and dissolved oxygen levels (ppm) at the Catherine Creek acclimation facility, March 9-April 16, 2001.

Comparison of Release Type from Acclimation Facility

Volitional releases from the Catherine Creek acclimation facility were spread out roughly equally each day from April 2-April 14 (Figure 3). The total number of PIT-tagged fish detected leaving the ponds volitionally was 290 or 1.4% of the total of PIT-tagged fish initially present in the Catherine Creek ponds. The estimated number of fish (with and without PIT-tags) leaving volitionally was 1,926. Mean fork length at PIT-tagging of forceout fish was greater than for volitionally-released fish ($t=2.64$, unequal variances, $P=0.0087$) (Table 1). Median arrival date at Lower Granite Dam was earlier for volitionally-released fish (Table 2) and arrival distributions were different between the release types (two-tailed Kolmogorov-Smirnov statistic=0.33, $P<0.00001$). Minimal cumulative unique detection rate of volitionally-released fish was lower than forceouts (Table 3). The detection system at the Catherine Creek acclimation facility was about 34.2% efficient (7,152 PIT tags detected out of 20,915 initially stocked).

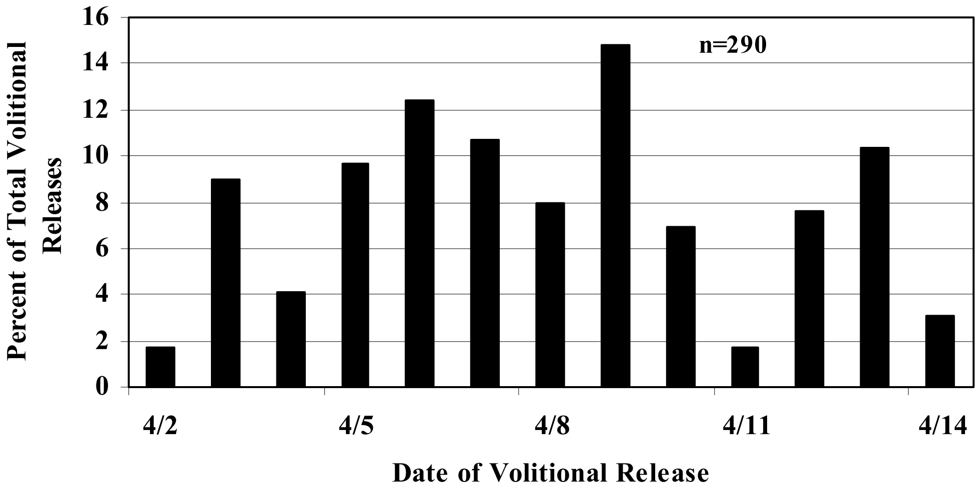

Figure 3. Frequency distribution by date of volitionally-released spring chinook salmon acclimated at Catherine Creek facility, 2001.

Table 1. Mean fork length (mm) at PIT-tagging of migration year 2001 hatchery spring chinook salmon acclimated at Catherine Creek facility by release type, 2001.

Group	n	Mean	SD	Range
Volitional	290	116.6	12.4	79-164
Forceout	6,853	118.5	10.6	77-177

Table 2. Arrival dates at Lower Granite Dam of PIT-tagged migration year 2001 hatchery spring chinook salmon acclimated at Catherine Creek facility by release type, 2001.

Group	n	Median	Earliest	Latest
Volitional	62	5/6/2001	4/16/2001	5/26/2001
Forceout	2,668	5/14/2001	4/25/2001	6/18/2001

Table 3. Minimum cumulative unique PIT-tag detections of migration year 2001 spring chinook salmon acclimated at Catherine Creek facility by detection sites and release type, 2001.

Detection Site	V	%*	FO	%*
Lower Granite	62	63.9	2,668	74.7
Little Goose	32	33.0	720	20.2
Lower Monumental	3	3.1	125	3.5
McNary			43	1.2
John Day			3	0.008
Bonneville			3	0.008
Columbia R. Islands[1]			10	0.3

Columbia R. Estuary				
All Sites	97	33.4	3,572	52.1
Number released	290		6,862	

V volitionally-released from acclimation facility
FO forced out from acclimation facility
* % of total number released for each group
[1] Tags recovered from fish eaten by avian predators (Collis et al. 2001).

Spring Chinook Juvenile Life History Comparisons

Mean fork lengths at PIT-tagging (October 2000) of hatchery fish were 23-36 mm greater than for wild fish from both Catherine Creek and the upper Grande Ronde River (Table 4). Prerelease sampling conducted on February 9-13, 2001, at Lookingglass Hatchery showed mean fork lengths of 122.7 mm (n=2,333) for Catherine Creek fish and 135.8 mm (n=300) for upper Grande Ronde River fish to be transported to acclimation facilities(ODFW, unpublished data).

Migration timing was later for wild fish from Catherine Creek than hatchery fish (Table 5). Wild fish arrived at Lower Granite roughly equally distributed (by week) from the week of April 23 to the week of June 11. Hatchery fish had a clear peak in arrival timing the week of May 14, with most fish arriving the weeks of April 30-May 21. There was a significant difference in the arrival distributions between wild and hatchery fish from Catherine Creek (two-tailed Kolmogorov-Smirnov statistic=0.37, $P<0.00001$). Wild fish from the upper Grande Ronde River also arrived earlier than hatchery fish, but only four wild fish were detected at Lower Granite Dam.

The minimum detection rate through the hydropower system was up to 3.5 times higher for hatchery fish than wild fish from Catherine Creek (Table 6). The minimum detection rate for migration year 2001 wild fish tagged and released during 2001 in the upper Grande Ronde River was about 17% higher than for hatchery fish, but, again, only four wild fish were detected at Lower Granite Dam.

Table 4. Mean fork length (mm) at PIT-tagging of migration year 2001 wild and hatchery spring chinook salmon from Catherine Creek and the upper Grande Ronde River, 2001.

Stream	Group	n	Mean	SD	Range
Catherine Creek	Hatchery	20,889	117.7	10.5	72-177
	Hatchery *	377	130.9	11.3	96-198
	Wild	1,854	81.5	8.9	52-140
upper Grande Ronde River	Hatchery	493	131.2	12.8	87-174
	Wild	6	108.7	5.8	100-115

* Fish without PIT tags that were caught and PIT-tagged at the ODFW screw trap after release from the acclimation facility.

Table 5. Arrival dates at Lower Granite Dam of PIT-tagged migration year 2001 wild and hatchery spring chinook salmon from Catherine Creek and the upper Grande Ronde River, 2001.

Stream	Group	n	Median	Earliest	Latest
Catherine Creek	Hatchery	7,710	5/15/2001	4/10/2001	7/10/2001
	Hatchery *	111	5/16/2001	4/23/2001	6/23/2001
	Wild	217	5/19/2001	4/27/2001	7/13/2001
upper Grande	Hatchery	197	5/4/2001	4/10/2001	5/25/2001
Ronde River	Wild	4	5/16/2001	5/4/2001	5/20/2001

* Fish without PIT tags that were caught and PIT-tagged at the ODFW screw trap after release from the acclimation facility.

In addition to the brood year 1999 fish released from the upper Grande Ronde River acclimation facility in 2001, 76,941 brood year 2000 spring chinook captive brood progeny weighing 1,454.05 kg (49.8 fish/kg) were liberated into the upper Grande Ronde River between the acclimation and adult collection sites on October 2, 2001.

Table 6. Minimum cumulative unique PIT-tag detections of migration year 2001 wild and hatchery spring chinook salmon from Catherine Creek and the upper Grande Ronde River by detection site, 2001.

	Catherine Ck						upper Grande Ronde		
Detection Site	**Ha**	**%**	**H***	**%**	**Wild**	**%**	**H**	**%**	**Wild**
Lower Granite	7,710	73.9	111	74.0	217	83.1	197	80.1	4
Little Goose	2,157	20.7	33	22.0	40	15.3	42	17.1	1
Lower Monumental	386	3.7	6	4.0	2	0.8	4	1.6	
McNary	130	1.2			1	0.4	1	0.4	
John Day	11	0.1					2	0.8	
Bonneville	6	0.1							
Columbia R. Islands[1]	28	0.3			1	0.4			
Columbia R. Estuary									
Recovered from All Sites[2]	10,428	49.9	150	37.0	261	14.0	246	49.7	5
Number released	20,915		405		1,862		495		6

Ha = acclimated hatchery fish tagged at Lookingglass Hatchery
H* = acclimated hatchery fish caught and tagged at Catherine Creek screw trap operated by ODFW after release from acclimation facility
% = percent of total releases for each group
[1] Tags recovered from fish eaten by avian predators (Collis et al. 2001).
[2] Not adjusted for mortalities of PIT-tagged fish (1 from UGR, 48 from CC).

Adult Summer Steelhead Trapping – upper Grande Ronde River

Trapping began at the upper Grande Ronde weir on March 31. The first upstream-migrating steelhead was sampled on April 27 and the last on May 23. Around March 20-26, stream flow increased and water became murky due to rainfall. A second period of high stream flow with accompanying turbidity occurred from about May 10-20. During high flow periods, locating and netting fish in the trap was difficult. Keeping all pickets down and completely blocking all openings except the trap entrance was also difficult, despite frequent checks. It is likely that some summer steelhead made it past the weir without being sampled.

Most of the 19 summer steelhead (first time captures) were collected during May and June. The first upstream-migrating summer steelhead was collected on April 27 and the last on May 23. Eight kelts were collected from May 31-June 16. Two fish were ad-clipped (hatchery origin); the rest had no visible marks. Ten unmarked males (mean FL=674.0 mm, SD=86.0, rang =554-823 mm) and seven unmarked females were collected (mean FL=602.7 mm, SD=50.9, range=553-707 mm). Sixty-five % of the total were 1-ocean fish and the remainder 2-ocean (Figure 4). Only one fish was recaptured after being marked and passed upstream. A badly decomposed carcass was recovered near the weir on June 7.

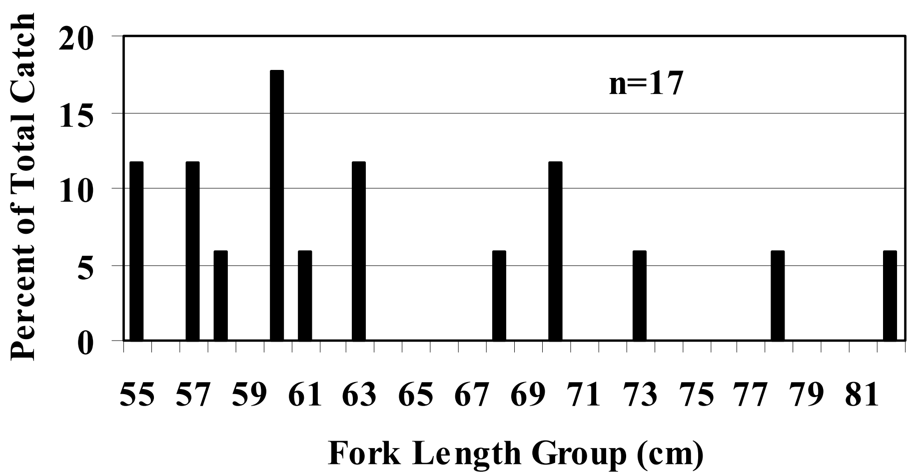

Figure 4. Length frequency of unmarked summer steelhead caught at upper Grande Ronde River weir, 2001.

Adult Spring Chinook Trapping – upper Grande Ronde River

Thirty-eight spring chinook salmon (all unmarked) were collected at the upper Grande Ronde River weir. The first was collected on May 23 and the last on July 5 (Figure 5). Nine were transported to Lookingglass Hatchery for use as broodstock. One fish marked and released on May 31 moved back downstream and was found dead on the upstream side of the weir on June 21 (excluded from Figure 5).

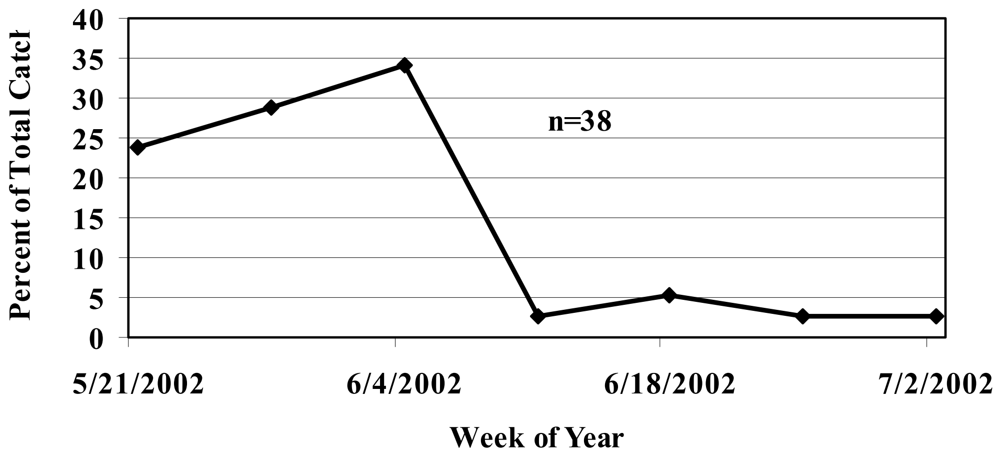

Figure 5. Percentages of spring chinook salmon caught by week of the year at the upper Grande Ronde River weir, 2001.

Spring chinook salmon stopped moving past the upper Grande Ronde River weir when high water temperatures (> 25°C) and low water levels occurred in early July. Comanagers decided to seine up to 12 fish holding in pools below the weir and transport them to Lookingglass Hatchery for broodstock. Six fish were seined on July 13 and six more on July 30. The trap was removed on July 13 to allow passage for remaining fish. Mean FL of all spring chinook first-time captures collected at the weir or by seining was 734.6 mm (SD=38.8, range=652-850). All were age 4/5 (Figure 6), based on length-at-age data from other streams (ODFW, unpublished data); no age 3 fish were collected.

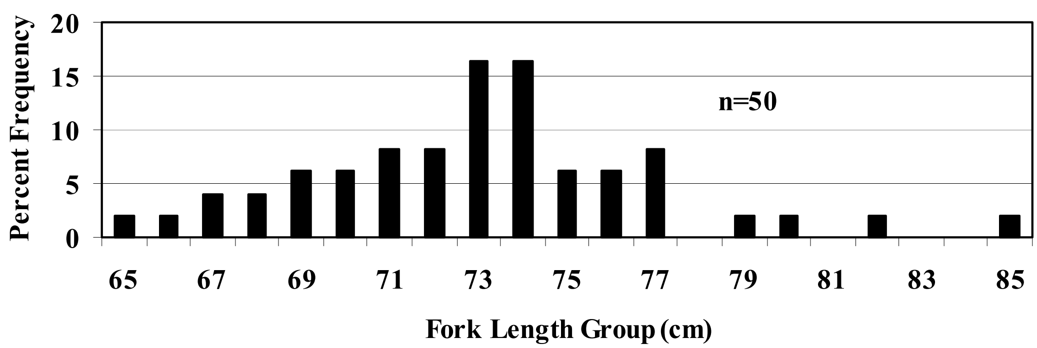

Figure 6. Length frequency of spring chinook salmon caught at or near the upper Grande Ronde River weir, 2001.

Nineteen below-weir surveys from May 31-August 15 yielded observations of 269 live spring chinook at the upper Grande Ronde River. The last four surveys on the upper Grande Ronde River occurred after the trap was removed and free passage was available to the fish (July 18-August 15). The mean number of live spring chinook observed on these dates was 29.8. Most of these fish were observed in two pool areas within 1 km of the trap site.

One dead (prespawn) spring chinook was observed below the upper Grande Ronde River weir on July 4 and another on July 5.   An additional 13 prespawn mortalities were observed in areas below the weir and upstream to the boundary of Vey Meadows from July 6-18. An additional spring chinook mortality (approximately 5 kg) was observed by an angler approximately 6 km upstream of Hilgard State Park (39 km below the weir). Some of the carcasses were badly decomposed. All four carcasses recovered above the weir had been handled and marked at the weir.

An additional spawning ground survey below the upper Grande Ronde River weir on September 19 yielded one carcass (700 mm male) without an opercle punch. The potential spawning area in Vey Meadows was viewed by helicopter once in September but no redds or fish were observed. None of the spring chinook trapped, seined, or recovered as prespawning mortalities, or spawning ground had confirmed adipose clips.

Water temperatures observed at the upper Grande Ronde River adult trap site followed a similar daily pattern during the June-September period. Lowest temperatures were usually observed around 0800 and highest around 1500. Maximum weekly temperatures > 23 °C were observed during the weeks of June 18-August 27. Average weekly temperatures ranged from 15.4-20.3 °C during the same period. The highest temperature observed at the upper Grande Ronde River adult site was 28.1°C at about 1700 on July 4. Water temperatures at the upper Grande Ronde River adult site were consistently 5 °C higher than the acclimation site (Figure 7).

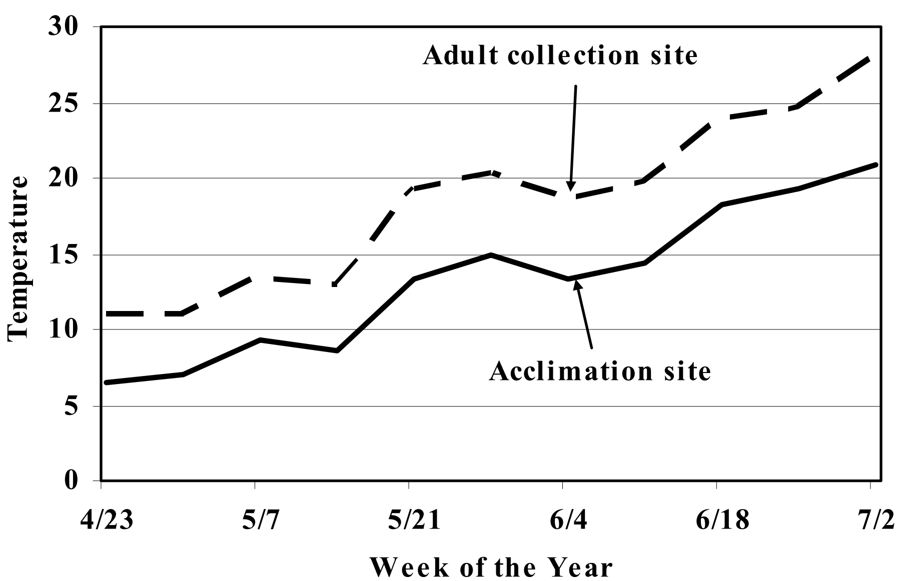

Figure 7. Comparison of maximum weekly water temperatures (° C) at the upper Grande Ronde River acclimation and adult collection sites, 2001.

Spring Chinook Spawning – upper Grande Ronde River stock

The first upper Grande Ronde River female was spawned at Lookingglass Hatchery on August 30 (Table 7). Additional spawning occurred on September 5 (3 females) and September 11 (4 females). Approximately 47,736 eggs were taken. Gametes were collected, placed in coolers and shipped to Irrigon Hatchery, where fertilization and early rearing took place. Five prespawn mortalities occurred at the hatchery, including three age 4/5 males and two age 4/5 females. A male and female found dead on August 25 were spawned but no fertilized eggs resulted.

Table 7. Summary of spawning data for upper Grande Ronde River spring chinook salmon, 2001.

Sex	Mean FL (mm)	Range	n	Mean wgt (kg)	Range	Ave. Egg Yield	n
M	754.8	703-815	8	4.26	3.07-5.09		7
F	735.6	665-785	8	4.24	2.96-5.37	4,422	8

Adult Summer Steelhead Trapping – Catherine Creek

Trapping began at the Catherine Creek weir on March 30. High flows created poor conditions for trapping during the last week of April. Several fish (probably summer steelhead) were observed passing over the downstream weir during that period. Ad-clipped summer steelhead were returned downstream for angling opportunities or after the angling season was closed, removed from the stream.

The first upstream migrating summer steelhead was caught by the Catherine Creek weir on March 23 and the last on May 19. Migration timing of ad-clipped and unmarked summer steelhead was similar. There was a small peak the week of March 26 and a larger one the week of April 16 (Figure 8). Two unmarked fish previously caught and given opercle punches fell back after spawning and were recovered dead on the weir. Two other unmarked, prespawn fish fell back over the weir and were caught in the trap a second time.

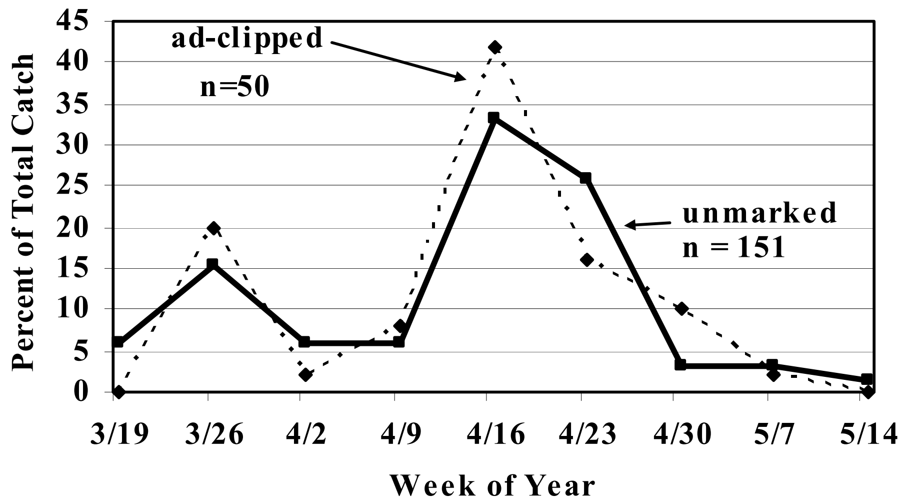

Figure 8. Percentages of summer steelhead caught by week of the year at the Catherine Creek weir, 2001.

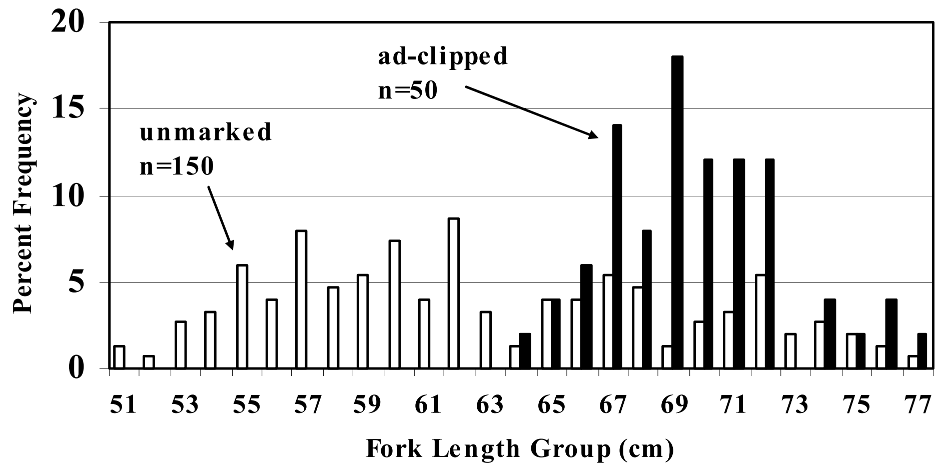

Figure 9. Length frequency of summer steelhead caught at the Catherine Creek weir, 2001.

Ad-clipped summer steelhead were larger than unmarked (Figure 9). Mean FL of unmarked female summer steelhead was 11 mm greater than for males (Table 8). Mean FL of ad-clipped males was greater than for females (Table 9).

Table 8. Summary statistics for unmarked summer steelhead collected at the Catherine Creek weir, 2001.

Sex	Mean FL (mm)	SD	Range	n
Male	628.8	64.7	519-779	85
Female	639.8	62.6	536-766	63
Unknown	519.5	7.8	514-525	2

Combined	632.0	64.7	514-779	150*

* one fish not measured

Table 9. Summary statistics for ad-clipped summer steelhead collected at the Catherine Creek weir, 2001.

Sex	Mean FL (mm)	SD	Range	n
Male	708.7	32.7	669-777	15
Female	699.0	29.0	642-760	35
Combined	701.9	30.1	642-777	50

Adult Spring Chinook Trapping – Catherine Creek

The first spring chinook was captured at the Catherine Creek weir on May 21 and the last on September 4 (Figure 10). Nearly all fish were caught by the second week of July. Eighty-one were ages 4/5 (mean FL=719.6 mm, SD=61.3, range=603-930 mm) (Figure 11). One age 4/5 fish that was collected and marked moved downstream over the weir, then upstream into the trap and was recaptured. Thirty-eight age 3 males were collected (mean FL=483.0 mm, SD=48.0, range = 370-595 mm). Twenty-nine ad-clipped (hatchery origin) age 3 fish were collected and 9 unmarked (wild). Run timing appeared to be similar for ad-clipped and unmarked age 3 fish. Unmarked age 3 fish were 10% of the total (all ages) of unmarked fish. Mean FL of the ad-clipped age 3 males was 474.1 mm compared to 511.7 for unmarked fish; this difference was not significant (P=0.1439, t-test, unequal variances). Three age 3 males had been PIT-tagged in the fall of 1999 and acclimated and released in April 2000 for a return rate of 3/3,980 or 0.075%.

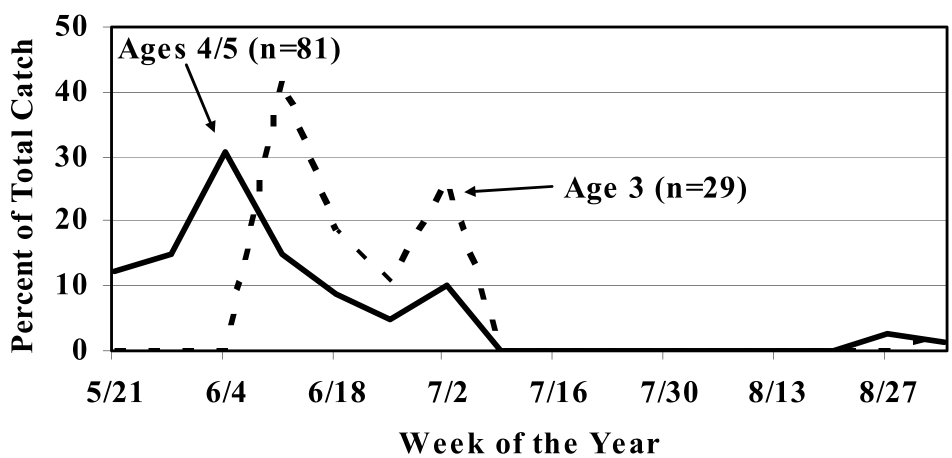

Figure 10. Percentages of spring chinook salmon caught by week of the year at the Catherine Creek weir, 2001.

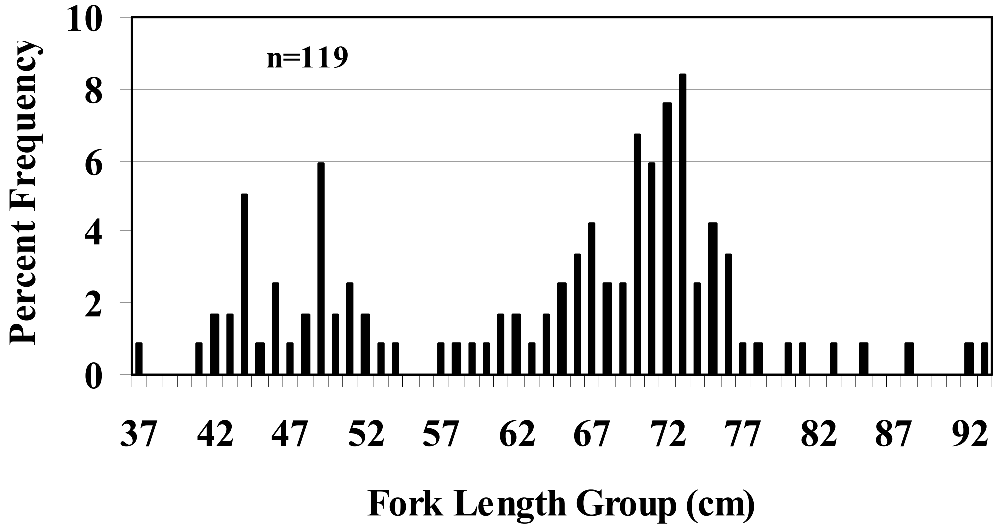

Figure 11. Length frequency of spring chinook salmon caught at the Catherine Creek weir, 2001.

Four prespawn spring chinook salmon mortalities were collected at Catherine Creek from July 24-August 1. Three were wild females, ranging from 680-900 mm FL. One of these had been sampled at the weir. One age 3 male had been sampled at the weir and had been marked. A 900 mm female was recovered just below an irrigation dam, approximately 0.3 km below the Catherine Creek weir. The three others were recovered about 8 km upstream of the Catherine Creek weir during field work by the ODFW Early Life History project staff. Necropsy of one Catherine Creek fish showed a severe infection with bacterial kidney disease.

Fourteen below-weir surveys, May 31-August 17, yielded observations of 21 live spring chinook at Catherine Creek. Additional spawning ground surveys conducted above the Catherine Creek weir on September 17-18 and 26 yielded 15 more carcasses, of which five had confirmed opercle punches. One additional survey below the Catherine Creek weir on September yielded one more carcass without an opercle punch. None of the carcasses recovered on these additional surveys had adipose fin clips. Mean FL of 6 males was 725.2 mm (SD=116.4, range 620-931 mm) and mean FL of 9 females was 718.0 mm (SD=66.1, range= 620-845 mm).

Water temperatures observed at the Catherine Creek adult site followed a similar daily pattern during June-September, with lowest temperatures around 0800 and highest around 1500. Highest daily average temperatures at each site were observed during mid-July through August. Maximum weekly temperatures were > 21^{o}C during the weeks of June 18-September 10 and mean weekly temperatures ranged from 14.7-20.2 ^{o}C during the same period. The highest temperature observed was 25.5^{o}C at 1700 on July 4. Water temperatures at the Catherine Creek adult collection site were consistently lower than at the upper Grande Ronde River site until late July (Figure 12).

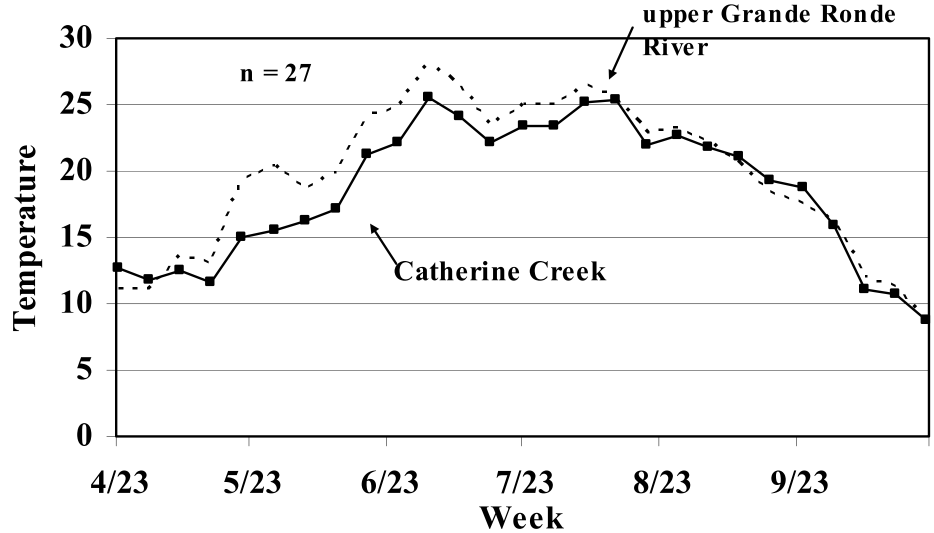

Figure 12. Weekly maximum water temperatures (°C) at the upper Grande Ronde River and Catherine Creek adult collection sites, 2001.

A single live bull trout estimated at 500 mm FL was collected at the Catherine Creek weir on May 14. Other species collected at the weirs during 2001 included suckers (*Catostomus* sp.) and mountain whitefish (*Prosopium williamsonii*). Suckers were usually observed during what appeared to be a spawning migration. Occasionally suckers died from being wedged between the bars of the resistance boards or pickets.

Spring Chinook Spawning – Catherine Creek stock

The first Catherine Creek female was spawned at Lookingglass Hatchery on August 16. Additional spawning occurred on August 23 (3 females), August 30 (6 females), and September 5 (3 females). A total of approximately 47,736 eggs were taken (Table 9). Gametes were taken, placed in coolers and shipped to Irrigon Hatchery, where fertilization and early rearing took place. Five prespawn mortalities occurred at the hatchery, including 2 age 4/5 males, 2 age 4/5 females, and 1 age 3 male.

Table 10. Summary of spawning data for Catherine Creek spring chinook salmon, 2001.

Sex	Mean FL* (mm)	Range	n	Mean wgt (kg)	Range	Ave. Egg Yield	n
M[#]	711.6	102.7	7	3.6	2.9-4.2		3
M[&]	565.0	32.8	3	2.0	1.8-2.2		2
F	714.6	617-805	15	4.0	2.67-4.66	3978.0	12

* Includes prespawn mortalities at Lookingglass Hatchery.
[#] Age 3 (jacks) only.
[&] Ages 4/5 only.

Fecundity (eggs/female) of Catherine Creek females spawned at Lookingglass Hatchery was lower than for upper Grande Ronde River females (3,978 vs. 4,422). The difference in fecundity (eggs/female) between Catherine Creek and upper Grande Ronde River fish was not significant (P=0.1317, t-test, equal variances).

DISCUSSION

Mortalities at the acclimation facilities in 2001 were again minimal but slightly higher than in 2000 (0.7% in 2001 at Catherine Creek, compared to 0.076% in 2000; 1.0% in 2001 at the upper Grande Ronde River, compared to 0.26% in 2000). The increase at Catherine Creek was most likely due to the higher numbers of moderate/clinical BKD fish. In 2000, the number of moderate/high/clinical fish (progeny with maternal parents having these levels of BKD) acclimated was about 5% of the total. In 2001, this increased to about 27%. Losses at two ponds at Lookingglass Hatchery in January 2001, prior to transfer to Catherine Creek acclimation ponds were experiencing losses of 0.08% and 0.02% daily. The two acclimation ponds that received these fish continued to experience higher rates of mortality than the other ponds during the acclimation period. The good water quality, isolation of the BKD fish, good sanitation practices probably kept losses to a minimum. Frazil ice problems are likely to be recurring problems in winters with little snowfall upstream of the acclimation facility. This will require changes in intake design, starting acclimation later, or additional effort to manually keep the water intakes open.

Volitional release is a recommended practice for hatchery salmonids (Flagg and Nash 1999). The Catherine Creek volitionally-released fish were slightly larger but arrival timing to Lower Granite Dam and cumulative minimal detection rates were similar to forceout fish. The low number of fish leaving volitionally limited the utility of these data.

The low percentage of fish detected leaving from the Catherine Creek facility may have resulted from several factors. There were some problems experienced with the power supply to the readers initially and an unknown, but probably small, number of fish leaving volitionally were not detected. The lower water temperatures observed in 2001 compared to 2000 may also have reduced departures. The efficiency of the PIT tag readers is thought to be very high, perhaps near 90%, for volitionally released fish, since few are likely to leave at any given time. Having several PIT-tagged fish move through the reader too close together may cause interference and result in no tags being read.

Similar to 2000, the mean lengths (at PIT-tagging and from prerelease sampling) of migration year 2001 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 for hatchery fish.

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. Migration timing of acclimated fish compared to wild fish (fall-released, spring-released, or combined) did not show any pattern. The minimum detection rates for acclimated fish from both streams were slightly lower than for spring-released wild fish.

The larger size of hatchery-reared fish probably has limited short-term effect on wild conspecifics, since they rapidly leave headwaters areas and enter the Snake and Columbia rivers and then the ocean. Over the longer term, the larger size of hatchery fish may affect the number of precocious males that contribute to the spawning population (Busack et al. 1997). At present, there is no effort to evaluate the numbers or rearing history (hatchery, wild) of precocious males in the populations of either stream.

Life histories of hatchery fish (juveniles) were different than wild fish in 2001. Mean lengths at PIT-tagging of hatchery fish were greater than for wild fish and survival to Lower Granite Dam was greater for hatchery fish. Migration timing differed in 2001 for at least one stock. More years of data for both juveniles and adult returns and including genetics analyses of returning adults are needed for any meaningful comparisons.

The numbers of adult spring chinook captured at both weirs was higher in 2001 than previous years. Enough fish were captured from both streams in 2001 to spawn conventional broodstock at Lookingglass Hatchery and have the first egg production. Fecundity of spring chinook salmon spawned from both streams in 2001 was similar to previous values reported for the Grande Ronde River and Snake River populations (Myers et al. 1998). Prespawn mortalities while fish were in holding tanks reduced potential egg production.

Poor functioning of the Catherine Creek weir prevented us from trapping more fish and collecting more broodstock. The population estimate of spawners above the Catherine Creek weir was 397 (ODFW, unpublished data). Trapping efficiency [Total catch at weir/population estimate above the weir x 100] was 16%.
Fish likely were able to swim or jump over the horizontal pickets during high water. Fish also may have passed through the V-notch in the concrete fish ladder.

Trapping efficiency (85% of estimated spawners above the weir were handled at the weir) indicated the upper Grande Ronde River weir functioned effectively. The improved trapping efficiency was probably due to the short spring freshet period and relatively low flows throughout the season. Mean monthly flows for the Grande Ronde River at the confluence with the Wenaha River near Troy, Oregon ranged from 29-70% of the long-term (1945-2001) means during the months of January-September 2001 (Herrett et al. 2001).

After water temperatures reached levels near the upper Grande Ronde River weir in early July, approximately 30 live fish were observed on below-weir surveys. Fish appeared to concentrate in a few pools and holding areas below the weir and not move upstream. The concentration of fish in a few pools visible from the road created potential for poaching but this was not confirmed. There appeared to be little movement of fish holding below the weir even after the weir was removed.

There was little spawning below the weir in Catherine Creek, based on spawning ground surveys conducted in late August and early September (ODFW, unpublished data). Of 133 total redds in the sections surveyed, only 2 were observed below the weir. Spawning activity above and below the weir in the upper Grande Ronde River was almost equal. There were 8 redds observed above the weir in the upper Grande Ronde River and 7 below the weir. Typically about 10% of redds in the upper Grande Ronde River occur below the weir location and less than 10% in Catherine Creek.

All but one spring chinook from the upper Grande Ronde River in 2001 and two-thirds of Catherine Creek spring chinook were age 4/5, based on length at age data from other streams (ODFW, unpublished data). Age 3 males made up almost one-third of the total catch of spring chinook at the Catherine Creek weir, higher than previous years. Ineffective weir functioning at high flows may skew the apparent number of age 3 males in the population. Typically, age 3 males migrate later in the season and this corresponds to the period after the spring freshet when weirs are functioning better. Seventy-six percent of the age 3 males collected at Catherine Creek were ad-clipped captive brood progeny released from the Catherine Creek acclimation facility in April 2000.

Lower Granite Dam passage data showed the first adult spring chinook salmon was collected on April 2, 2001. This was approximately 7 weeks before the first spring chinook was collected at both the Catherine Creek and upper Grande Ronde River traps. Catches at Lower Granite Dam increased rapidly the week of April 16 (Figure 12). About 50% of the total run of spring chinook salmon (> age 3) passing Lower Granite Dam had been observed by April 26.

The percentage of age 3 fish collected at the Catherine Creek trap in 2001 (age 3 fish/total chinook*100) was higher than the percentage of age 3 fish passing Lower Granite Dam in 2001 (1.8%), but similar to the average percentage of age 3 fish passing above Lower Granite Dam for the 1991-2001 period (11.1%).

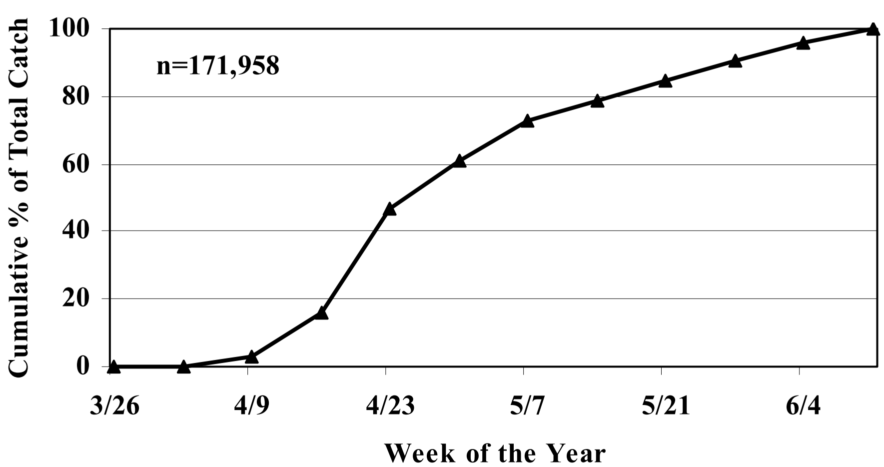

Figure 13. Cumulative percent catch of Snake River spring chinook salmon by week of the year at Lower Granite Dam, 2001 (catches through June 17, age 3 excluded).

Water temperatures observed during June-August 2001 at the upper Grande Ronde River and Catherine Creek adult collection sites frequently exceeded 17.8^{o} C, the water temperature standard for general salmon and trout use established by the Oregon Department of Environmental Quality. Water temperatures exceeded 25^{o} C in both streams, but for extended periods during the period of spring chinook migration and spawning in the upper Grande Ronde River. 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 (McCoullough 1999). Brett (1952) reported an incipient lethal water temperature limit of 25^{o}C for chinook salmon. McCullough (1999) reviewed existing data and indicated an incipient lethal temperature for migrating adult Columbia River chinook stocks of 21^{o}C. Fish that are downstream when water temperatures become excessive may move into a cooler tributary (e.g., Minam River) and wait to return to the Grande Ronde River until temperatures drop in September. Migrating fish may also locate seeps of cooler water and remain there until water temperatures in the migration corridor decrease. It is possible that fish holding below the upper Grande Ronde River weir were able to locate cool water seeps. Environmental conditions in the Grande Ronde River may also be selecting for adult chinook salmon tolerant of higher water temperatures.

Based on the number of known prespawn mortalities, the loss of natural production from the upper Grande Ronde River in 2001 may have been substantial, perhaps on the order of 20-25%. For Catherine Creek, the percentage was probably much lower. Unusually high numbers of prespawn mortalities were also observed on the Imnaha River in 2001 (Pat Keniry, personal communication). There appears to be little information in the published literature regarding prespawning mortality rates of wild spring chinook salmon in the stream environment. Carcasses decomposed rapidly in the higher temperatures and scavengers also made recoveries unlikely for many fish. Our efforts to locate prespawn mortalities were haphazard; we made no systematic effort to estimate prespawn mortalities on either stream.

Trapping equipment or procedures resulted in the deaths of two summer steelhead and three spring chinook in 2001. One age 3 ad-clipped spring chinook died at the Catherine Creek trap on June 18 after being wedged between pickets. Pickets were modified to prevent any further occurrence. One age 4 spring chinook died on September 4 after attempting to jump the weir above the fish ladder and becoming stranded on the rocks. Trapping ended that day and the weir was removed. Evaluation of equipment and procedures to minimize mortalities or injuries to fish is an ongoing process.

Below weir survey data on Catherine Creek remain inconclusive regarding aggregation of fish below the weir. The small number of years sampled, changes in run timing and year to year use of spawning areas below the weirs, and the inability to observe behavior of individual fish all make interpretation of these data difficult. The number of shaded areas below the weir in Catherine Creek makes observations more difficult than in the upper Grande Ronde River. 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.

The presence of the weir on the upper Grande Ronde River may have affected spring chinook migration, based on the number of fish observed holding below the weir. However, immediately after trap/weir removal, observations did not indicate that there was any significant movement upstream. It could have been that the warm water temperatures existing below Vey Meadows presented a thermal barrier to migration.

From limited data, including angler reports, it appears 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 and this appeared to be the case in 2001. Some steelhead in the upper Grande Ronde River may to divert to other streams (e.g., Meadow Creek, Five Points Creek) before reaching the weir. Since over three weeks passed between the start of trapping on the upper Grande Ronde River and the first capture of summer steelhead, it is unlikely any substantial number were missed. Steelhead spawning ground surveys are difficult because of high stream flows and low visibility in many Grande Ronde basin streams during spawning. The numbers of ad-clipped steelhead (Wallowa Hatchery stock) will decrease as release of non-endemic fish is phased out (NMFS 1999).

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

Ironwood Specialties Inc.[4] began constructing a resistance board weir for the upper Grande Ronde River site in July 2001. Completion was expected in time to begin trapping for summer steelhead in April 2002. Installation of the hydraulically-operated weir on Catherine Creek began in July 2001. Most installation activities were completed by the end of 2001 and the weir was expected to be in operation in time to trap summer steelhead in 2002.

Construction at both acclimation sites was completed in 2001 and acclimation occurred at both facilities in 2000-2001. 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 assess sex and maturity of salmonids

[4] Mention of this company does not imply commercial endorsement.

Cooperators - Anna Cavinato and Melissa Wenz, (Eastern Oregon State University), Stephen Boe and Parker Ogburn (Confederated Tribes of the Umatilla Indian Reservation), Tim Hoffnagle , Willie Noll, Marla Chaney, and Greg Davis (Oregon Department of Fish and Wildlife).

Work on this project by CTUIR consisted of consultation and proposal review in 2001.

PART IV. ASSISTANCE TO PROGRAM COOPERATORS

Program staff assisted ODFW in conducting spawning ground surveys on Catherine Creek, the upper Grande Ronde River, tributaries of the Grande Ronde River, the Imnaha River, Wenaha River, and John Day River during 2001. Project staff also assisted ODFW in spawning of Imnaha River spring chinook salmon, collecting captive brood parr from project streams and spawning of captive broodstock chinook salmon at Bonneville Fish Hatchery.

ACKNOWLEDGEMENTS

Patricia Chorazy, Bob Kausler, Jud Savage, Terry Speelman, Laurie Hewitt, Albert Miller, Stewart Kirby, Nick Allamand, and Terijo Arianna-Lovasz served as facility operators or technicians in 2001. Mike McLean and Ryan Seeger assisted in setting up weirs, trailers and other equipment. Bill Ricker, Vern Spencer, Dave Ricker, the City of Union, and the U. S. Forest Service – La Grande Ranger District have allowed access and use of their property and facilities to carry out program activities. Pat Keniry (ODFW) provided unpublished spawning ground survey data. Sam Onjukka (ODFW) performed necropsy data for spring chinook. Gary James, Michelle Thompson, and Julie Burke (CTUIR) provided program administrative assistance. Craig Contor (CTUIR) and Tim Hoffnagle (ODFW) reviewed and provided comments on a draft of this report.

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Appendix Table 1. Data for summer steelhead collected at the upper Grande Ronde River weir, 2001.

Date Collected	FL (mm)	Sex	Marks	Spawning status	Disposition
4/27	680	M	None	PreS	PU
4/27	570	F	None	PreS	PU
4/30	762	M	Ad	PreS	Mort
5/8	600	M	None	PreS	PU
5/8	553	F	None	PreS	PU
5/10	707	F	None	PreS	PU
5/17	823	M	None	PreS	PU
5/19	578	F	None	PreS	PU
5/19	618	F	None	PreS	PU
5/19	586	F	None	PreS	Mort
5/20	731	M	None	PreS	PU
5/23	630	M	None	PreS	PU
5/31	679	M	Ad	PostS	PD
5/31	631	M	None	PostS	Mort
6/1	603	M	None	PostS	Mort
6/1	607	F	None	PostS	PD
6/1	708	M	None	PostS	Mort
6/4	780	M	None	PostS	PD
6/16	554	M	None	PostS	Mort

M = male, F = female, Ad = adipose clip, PreS = prespawn, PostS = postspawn, PD = passed downstream, PU = passed upstream, Mort = either recovered dead on the weir or mortality caused by weir

Appendix Table 2. Data for spring chinook salmon collected at the upper Grande Ronde River weir and by seining, 2001.

Date	FL	Sex	Disp
5/23	708	M	PU
5/23	688	M	PU
5/23	722	M	PU
5/24	731	M	PU
5/25	739	M	T
5/25	715	F	PU
5/25	731	M	PU
5/25	733	F	PU
5/26	678	U	PU
5/30	720	U	T
5/30	850	U	PU
5/30	670	U	PU
5/30	695	U	PU
5/31	738	U	PU
5/31	793	U	T
5/31	652	U	PU*
5/31	740	U	PU
5/31	691	U	PU
6/2	685	M	PU
6/2	704	U	T
6/6	765	M	PU
6/7	712	U	PU
6/7	748	F	PU
6/9	775	F	PU
6/9	775	F	T
6/9	757	F	PU
6/9	749	F	PU
6/9	708	F	PU
6/9	715	M	PU
6/9	757	M	T
6/9	721	M	PU
6/10	771	M	PU
6/10	719	U	PU
6/16	744	M	T

Date	FL	Sex	Disp
6/22	726	F	T
6/23	757	F	PU
6/27	740	M	PU
7/5	762	M	T
7/13	770	M	T
7/13	740	F	T
7/13	732	M	T
7/13	763	M	T
7/13	665	F	T
7/13	809	M	T
7/30	735	M	T
7/30	735	F	T
7/30	820	M	T
7/30	740	M	T
7/30	745	F	T
7/30	690	F	T

* This fish was trapped, data recorded, and released on 5/31/2001. It was found dead on upstream side of the weir on 6/21/01.

Note: We ceased operation of the weir on July 13, 2001. Fish were collected by seining holding areas below the weir on July 13 and July 30 and transported to Lookingglass Hatchery for use as broodstock. In order to minimize handling stress, no lengths were taken in the field. Lengths and sex were taken at the maturity sort at Lookingglass Hatchery on August 1, 2001 and at spawning.

F = female, M = male, U = unknown
Disp = disposition, T = transport to Lookingglass Hatchery for broodstock
PU = passed upstream

Appendix Table 3. Data for spring chinook salmon carcasses collected during prespawn and additional spawning ground surveys on the upper Grande Ronde River, 2001.

Date	FL (mm)	Sex	Spawn status	Marks	Location
7/4	770	M	Unknown	None	Below weir
7/5	760	M	Unknown	None	Below weir
7/6	710	F	Prespawn	2 ROP	Above weir
7/6	695	F	Prespawn	2 ROP	Above weir
7/7	686	F	Prespawn	2 ROP	Above weir
7/7	805	M	Unknown	None	Below weir
7/10**	NR	F	Prespawn	None	Below weir
7/10**	NR	F	Prespawn	None	Below weir
7/11**	650	F	Prespawn	None	Below weir
7/11**	650	U	Prespawn	None	Below weir
7/11**	710	F	Prespawn	None	Below weir
7/13	762	F	Prespawn	None	Below weir
7/16	705	F	Prespawn	2 ROP	Above weir
7/18**	NR	U	Prespawn	None	Below weir
7/18**	NR	U	Prespawn	None	Below weir
9/19	700	M	Postspawn	None	Below weir

* ROP = right opercle punch
** These fish were badly decomposed and it was difficult to get an accurate fork length or determine sex, spawning status, or marks. It is unlikely any of these fish had spawned.
NR = not recorded

Appendix Table 4. Data for summer steelhead collected at the Catherine Creek weir, 2001.

Date	FL	Sex	Marks	Disp
3/23	748	M	None	PU
3/25	779	M	None	PU
3/25	694	M	None	PU
3/25	705	M	None	PU
3/25	715	M	None	PU
3/25	685	M	None	PU
3/25	621	M	None	PU
3/25	555	M	None	PU
3/25	622	M	None	PU
3/26	642	F	Ad	K
3/26	730	F	Ad	K
3/26	715	M	Ad	K
3/26	703	F	Ad	K
3/26	625	F	None	PU
3/26	670	M	None	PU
3/26	754	M	None	PU
3/26	654	F	None	PU
3/26	683	M	None	PU
3/27	695	F	Ad	K
3/29	679	M	Ad	O
3/29	669	F	Ad	K
3/29	570	F	None	PU
3/29	754	M	None	PU
3/29	636	M	None	PU
3/29	765	M	None	PU
3/29	672	M	None	PU
3/29	582	M	None	PU
3/29	738	M	None	PU
3/29	653	M	None	PU
3/29	NR	F	None	PU
3/29	623	F	None	M
3/30	700	M	Ad	K
3/30	677	F	None	PU
3/30	598	M	None	PU
3/30	620	M	None	PU
3/31	710	F	Ad	O
3/31	559	M	None	PU
3/31	740	F	None	PU
3/31	722	F	None	PU
4/1	678	F	Ad	O
4/1	618	M	None	PU
4/1	615	M	None	PU

Date	FL	Sex	Marks	Disp
4/2	655	F	None	PU
4/2	519	M	None	PU
4/2	539	M	None	PU
4/2	599	F	None	PU
4/3	620	M	None	PU
4/6	650	F	Ad	O**
4/6	570	M	None	PU
4/6	650	F	None	PU
4/6	590	M	None	PU
4/8	578	F	None	PU
4/9	667	F	None	PU
4/10	579	M	None	PU
4/10	558	M	None	PU
4/11	577	M	None	PU
4/11	777	M	Ad	K
4/11	695	M	Ad	PD
4/12	766	F	None	PU
4/14	615	M	None	PU
4/14	695	F	Ad	PD
4/14	675	F	Ad	PD
4/15	677	F	None	PU
4/15	554	M	None	PU
4/15	544	M	None	PU
4/16	744	F	Ad	O
4/16	669	M	Ad	O
4/16	704	F	Ad	O
4/16	660	M	None	PU
4/16	624	M	None	PU
4/16	758	F	None	PU
4/16	600	M	None	PU
4/16	572	M	None	PU
4/16	712	F	None	PU
4/16	713	M	None	PU
4/16	607	M	None	PU
4/16	556	M	None	PU
4/17	702	F	None	PU
4/17	699	M	Ad	K
4/17	730	F	Ad	K
4/17	695	F	Ad	K
4/17	735	M	Ad	K
4/17	690	F	Ad	K
4/17	692	F	Ad	K

Appendix Table 4 continued

Date	FL	Sex	Marks	Disp
4/17	671	F	Ad	K
4/17	695	F	Ad	K
4/17	573	M	None	PU
4/17	680	F	Ad	K
4/17	625	M	None	PU
4/17	660	F	None	PU
4/17	622	F	None	PU
4/17	585	F	None	PU
4/17	680	F	None	PU
4/17	634	M	None	PU
4/17	707	F	None	PU
4/17	720	F	None	PU
4/17	582	M	None	PU
4/17	629	M	None	PU
4/17	569	M	None	PU
4/17	697	F	Ad	K
4/18	670	M	Ad	K
4/18	760	F	Ad	K
4/18	730	F	Ad	K
4/18	704	F	Ad	K
4/18	690	F	None	PU
4/18	710	F	None	PU
4/18	684	M	None	PU
4/18	733	M	None	PU
4/18	723	M	None	PU
4/18	657	F	None	PU
4/18	575	F	None	PU
4/18	678	F	None	PU
4/18	741	F	None	PU
4/18	610	F	None	PU
4/18	673	F	None	PU
4/18	685	M	None	PU
4/18	657	F	None	PU
4/18	557	M	None	PU
4/18	578	F	None	PU
4/18	674	M	None	PU
4/18	724	M	None	PU
4/19	716	M	Ad	K
4/19	609	M	None	PU
4/19	559	M	None	PU
4/19	537	F	None	PU
4/21	751	F	Ad	K

Date	FL	Sex	Marks	Disp
4/21	731	F	Ad	K
4/21	595	F	None	PU
4/21	553	M	None	PU
4/21	590	F	None	PU
4/21	724	M	None	PU
4/21	607	F	None	PU
4/21	630	M	None	PU
4/21	564	M	None	PU
4/21	605	M	None	PU
4/23	670	F	Ad	K
4/23	762	M	Ad	K
4/23	585	M	None	PU
4/23	740	M	None	PU
4/23	600	F	None	PU
4/24	729	F	None	PU
4/24	600	M	None	PU
4/24	649	F	None	PU
4/24	599	M	None	PU
4/24	622	M	None	PU
4/24	680	F	None	PU
4/24	610	M	None	PU
4/24	721	F	None	PU
4/24	548	M	None	PU
4/24	681	F	None	PU
4/24	580	F	None	PU
4/24	611	F	None	PU
4/24	593	F	None	PU
4/25	719	F	Ad	K
4/25	685	M	Ad	K
4/25	745	F	Ad	K
4/25	662	F	Ad	K
4/25	683	F	Ad	K
4/25	608	F	None	PU
4/25	630	F	None	PU
4/25	570	F	None	PU
4/25	550	F	None	PU
4/25	539	F	None	PU
4/25	600	M	None	PU
4/25	563	M	None	PU
4/25	561	F	None	PU
4/25	723	F	None	PU
4/25	536	F	None	PU

Appendix Table 4 continued

Date	FL	Sex	Marks	Disp
4/25	576	M	None	PU
4/25	710	M	None	PU
4/25	669	F	None	PU
4/25	560	F	None	PU
4/25	621	M	None	PU
4/26	584	M	None	PU
4/26	649	F	None	PU
4/26	671	M	None	PU
4/26	620	M	None	PU
4/27	660	F	None	PU
4/27	568	F	None	PU
4/28	665	M	None	PU
4/28	605	F	None	PU
4/29	705	F	Ad	K
4/30	738	M	Ad	K
4/30	685	F	Ad	K
4/30	700	F	Ad	K
4/30	590	M	None	PU
4/30	715	F	Ad	PD
5/4	514	U	None	PU
5/4	525	U	None	PU
5/5	700	F	None	PU
5/5	548	M	None	PU
5/5	659	F	Ad	K
5/8	545	F	None	PU
5/9	572	M	None	PU
5/10	605	M	None	PU
5/10	737	M	None	PU
5/10	712	M	Ad	K
5/12	580	M	None	PU
5/18	543	F	None	PU
5/19	630	M	None	PU

F = female, M = male, U = unknown
PU = passed upstream
PD = passed downstream
K = killed
O = outplant to Ladd Pond
NR = not recorded

Appendix Table 5. Data for spring chinook salmon (ages 4/5) collected at the Catherine Creek weir, 2001.

Date	FL	Sex	Disp
5/21	682	U	PU
5/21	882	U	PU
5/23	706	M	PU
5/23	717	M	PU
5/23	838	F	PU
5/23	655	M	T
5/24	660	F	PU
5/25	704	M	PU
5/26	647	F	PU
5/27	739	F	T
5/28	750	M	PU
5/31	686	F	PU
5/31	723	M	PU
6/1	743	F	PU
6/2	621	M	PU
6/2	703	F	PU
6/2	724	F	PU
6/2	732	F	PU
6/2	754	M	PU
6/2	689	F	T
6/2	738	M	T
6/3	762	M	PU
6/5	645	M	PU
6/5	610	M	T
6/7	730	M	PU
6/7	734	F	PU
6/7	735	M	PU
6/7	782	M	PU
6/8	635	F	PU
6/8	675	F	PU
6/8	678	F	PU
6/8	710	F	PU
6/8	668	M	T
6/9	603	M	PU
6/10	657	F	PU
6/10	666	F	PU
6/10	703	F	PU
6/10	725	M	PU
6/10	745	F	PU
6/10	765	M	PU
6/10	765	M	PU
6/10	720	F	T
6/10	728	F	T
6/10	705	F	T
6/14	660	M	PU
6/14	805	F	T
6/14	695	F	PU
6/14	702	M	PU
6/14	709	M	PU
6/14	738	M	PU
6/14	760	F	PU
6/15	720	F	T
6/17	691	M	PU
6/17	709	F	PU
6/17	732	M	PU
6/17	753	M	PU
6/17	617	F	T
6/17	732	F	T
6/17	675	F	T
6/19	672	M	T
6/21	695	F	PU
6/22	722	M	PU
6/22	716	F	T
6/23	728	F	PU
6/23	775	M	PU
6/23	925	M	T
6/29	718	F	T
6/29	713	M	T
6/30	756	M	PU
6/30	856	F	PU
7/3	659	F	PU
7/5	673	M	PU
7/5	743	F	PU
7/5	715	F	T
7/5	722	F	T
7/7	621	F	PU
7/7	751	F	PU
7/7	930	M	PU
9/1	718	F	T
9/2	732	F	PU
9/4	810	M	WM

M = male, F = female, U = unknown, Disp = disposition, PU = passed upstream, T = transport, WM = weir mortality

Appendix Table 6. Data for spring chinook salmon (age 3) collected at the Catherine Creek weir, 2001.

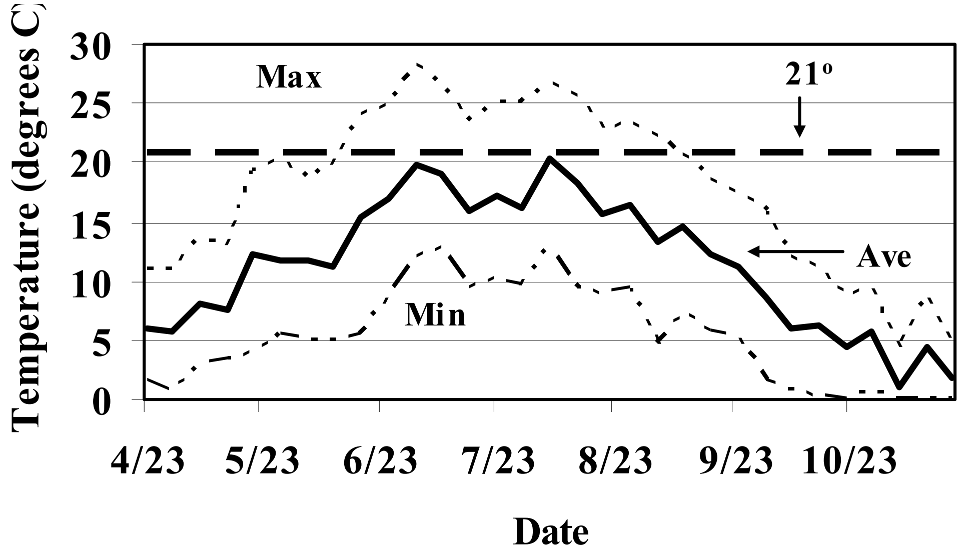
Date	FL	Marks	Sex*	Disposition
6/10	370	Ad	M	KNS
6/10	490	Ad	M	KNS
6/10	589	None	M	PU
6/14	440	Ad	M	KNS
6/14	444	Ad	M	KNS
6/14	465	Ad	M	KNS
6/14	495	Ad	M	KNS
6/14	505	Ad	M	KNS
6/14	520	Ad	M	KNS
6/14	428	None	M	PU
6/15	431	Ad	M	KNS
6/15	461	Ad	M	KNS
6/15	495	Ad	M	KNS
6/15	515	Ad	M	KNS
6/17	449	Ad	M	KNS
6/17	448	None	M	PU
6/18	432	Ad	M	WM
6/19	508	Ad	M	KNS
6/21	419	None	M	PU
6/21	499	None	M	PU
6/22	480	Ad	M	KNS
6/22	510	Ad	M	KNS
6/22	530	None	M	T
6/29	441	Ad	M	KNS
6/29	447	Ad	M	KNS
6/29	450	Ad	M	KNS
6/29	497	Ad	M	KNS
7/2	478	Ad	M	KNS
7/2	487	Ad	M	KNS
7/2	517	Ad	M	KNS
7/2	527	None	M	PU
7/2	570	None	M	T
7/3	491	Ad	M	KNS
7/3	595	None	M	T
7/4	495	Ad	M	KNS
7/5	427	Ad	M	KNS
7/5	462	Ad	M	KNS
9/4	546	Ad	M	KNS

Ad = adipose clip, M = males, KNS = killed and not spawned, T = transport to Lookingglass Hatchery for use as broodstock, PU = passed upstream, WM = weir mortality

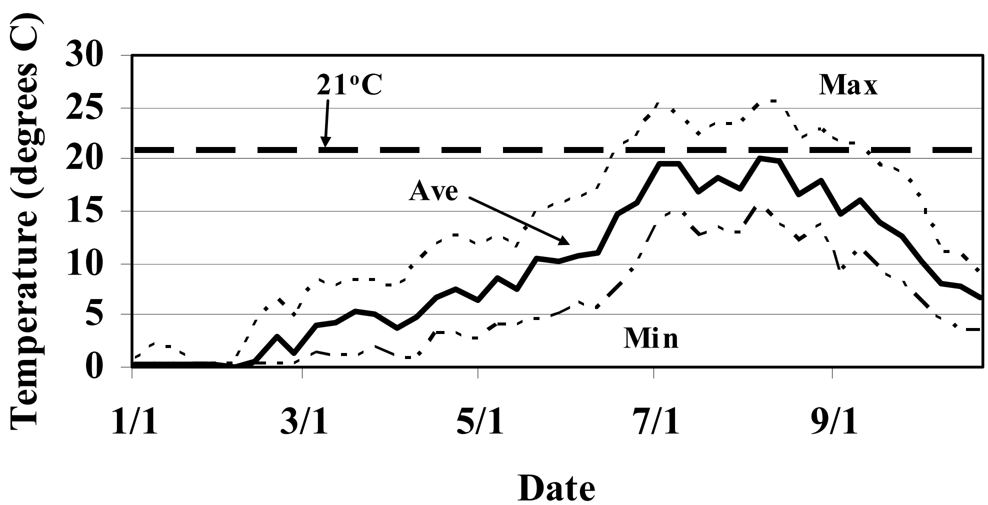
Appendix Table 7. Data for spring chinook salmon carcasses collected during prespawn and additional spawning ground surveys on Catherine Creek, 2001.

Date	FL (mm)	Sex	Spawn status	Marks	Location
7/24	695	F	Prespawn	None	Hall Ranch
7/27	900	F	Prespawn	None	Below Ricker's dam
8/1	421	F	Prespawn	1 ROP	Below CC State Park
8/1	680	M	Unknown	1 ROP	Below CC State Park
9/17	695	F	Postspawn	None	Accl site to weir
9/17	745	F	Postspawn	None	Accl site to weir
9/17	735	F	Postspawn	None	Accl site to weir
9/18	660	M	Postspawn	None	Accl site to weir
9/18	790	M	Postspawn	Unk	Accl site to weir
9/18	620	M	Postspawn	Unk	Accl site to weir
9/18	695	M	Postspawn	1 ROP	Accl site to weir
9/18	655	M	Postspawn	1 ROP	Accl site to weir
9/18	645	F	Postspawn	1 ROP	Accl site to weir
9/18	732	F	Postspawn	1 ROP	Accl site to weir
9/18	690	F	Postspawn	None	Accl site to weir
9/18	620	F	Postspawn	None	Accl site to weir
9/18	755	F	Postspawn	None	Accl site to weir
9/26	845	F	Postspawn	None	Accl site to weir
9/26	931	M	Postspawn	None	Accl site to weir

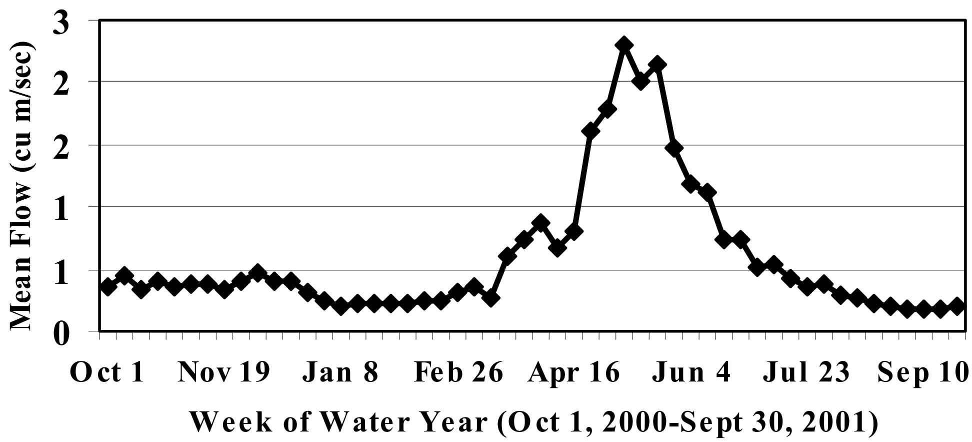
ROP = right opercle punch
PU = passed upstream
Unk = unknown
M = male
F = female



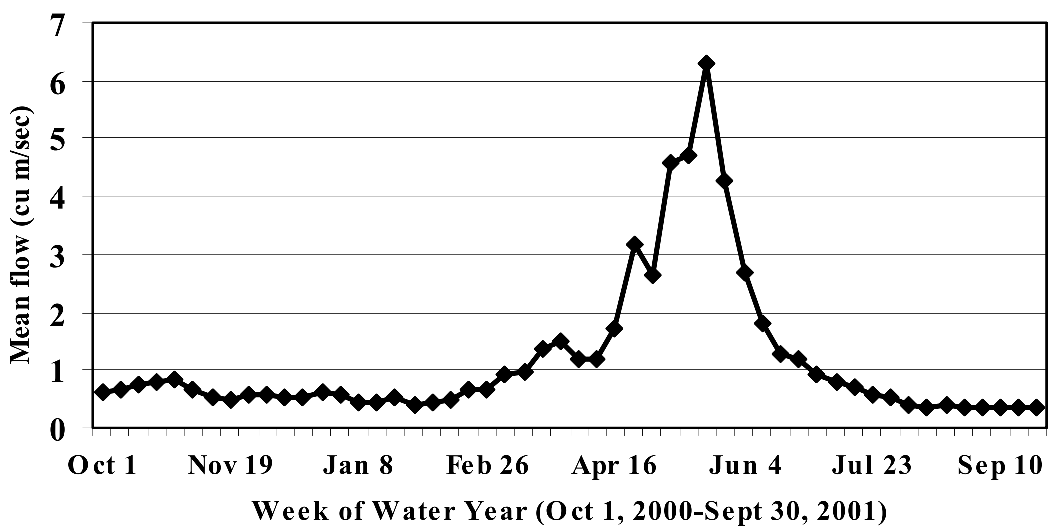
Appendix Figure 1. Weekly maximum, mean, and minimum water temperatures (°C) at the upper Grande Ronde River adult collection site, 2001.



Appendix Figure 2. Weekly maximum, mean, and minimum water temperatures (°C) at the Catherine Creek adult collection site, 2001.



Appendix Figure 3. Weekly mean flows (cu m/sec) at gauging station in the upper Grande Ronde River just below mouth of Clear Creek, water year 2001. (Gauge #13317850 operated by U. S. Forest Service and located about 1.6 km upstream of acclimation facility).



Appendix Figure 4. Weekly mean flows (cu m/sec) at gauging station in North Fork Catherine Creek, water year 2001. (Gauge #13319900 operated by U. S. Forest Service and located about 4.8 km upstream of acclimation facility).