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Monitoring and Evaluation of Supplemented Spring Chinook Salmon and Life Histories of Wild Summer Steelhead in the Grande Ronde Basin

Annual Report

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1 SECTION I. MONITORING AND EVALUATION OF ENDEMIC SPRING CHINOOK SALMON SUPPLEMENTATION IN CATHERINE CREEK AND THE UPPER GRANDE RONDE RIVER, OREGON

1.1 EXECUTIVE SUMMARY

This is the seventh annual report for a multi-year project designed to monitor and evaluate supplementation of endemic spring Chinook salmon in Catherine Creek and the upper Grande Ronde River. These two streams have historically supported anadromous fish populations that provided significant tribal and non-tribal fisheries. Conventional and captive broodstock supplementation methods are being used to restore these spring Chinook salmon populations.

Statement of Work Objectives for 2006 included:

1. Participate in management forums and develop management, monitoring and evaluation strategies and master plans in cooperation with co-managers for the restoration of salmon, steelhead and bull trout and their habitats within the Grande Ronde River Basin.

2. Evaluate and contrast performance of supplemented endemic juvenile spring Chinook salmon of conventional and captive broodstock hatchery origin acclimated and released at facilities on Catherine Creek and the upper Grande Ronde River and naturally-produced juveniles.

3. Evaluate life history differences between natural and supplemented (hatchery-origin F_1) adult spring Chinook salmon from Catherine Creek and the upper Grande Ronde River.

4. Describe life history characteristics and genetic stock structure of adult summer steelhead from Catherine Creek and the upper Grande Ronde River.

5. Assist comanagers with program activities.

This project included operations and maintenance (O&M) and monitoring and evaluation (M&E) components prior to 2002. Beginning in 2002, project O&M responsibilities were removed and placed in a separate project (Bonneville Power Administration (BPA) Project 9800703, BPA Contract No. 0006509, CTUIR Project 410), with a separate budget and reporting requirements. We report here the spring Chinook salmon monitoring and evaluation and summer steelhead life history components (BPA Project 9800703, BPA Contract No. 00012785, CTUIR Project 413).

A total of 68,820 Catherine Creek spring Chinook salmon juveniles were acclimated and released from 27 March 2006-12 April 2006 (forceout), and 18,977 upper Grande Ronde River juveniles from 27 March-12 April 2006 (forceout). All juveniles were marked with coded-wire tags (CWT), adipose fin clips, and PIT tags, in some combination. About 1%

of the upper Grande Ronde River and 13% of the Catherine Creek juveniles were PIT-tagged. Conventional broodstock progeny received visual implant elastomer (VIE) tags in the fatty tissue posterior to the eye. Volitional release at each site began on 1 April 2006.

Mean FL (mm) for various sample or release groups of Catherine Creek hatchery-origin fish ranged from 94.1-119.5 (overall mean 102.2), compared to 88.6 for natural-origin. Median arrival dates at Lower Granite Dam for various groups of hatchery-origin fish from ranged from 3 May-16 May 2006 (overall median 7 May 2006), compared to 2 June 2006 for natural-origin fish. Harmonic mean travel times ranged from 37.860-43.784 d (overall mean 41.706) for hatchery-origin fish compared to 40.807 d for natural-origin fish. Survival rates for hatchery-origin fish ranged from 0.2972-0.3488 (overall 0.3108), compared to 0.3373 for natural-origin fish.

Mean FL at PIT-tagging for hatchery-origin upper Grande Ronde River fish ranged from 98.4-116.0 mm (overall mean 101.6), compared to 79.2 mm for natural-origin fish. Median arrival date at Lower Granite Dam for hatchery-origin upper Grande Ronde River fish ranged from 9 May-16 May 2006 (overall median 14 May 2006), compared to 20 May 2006 for natural-origin. Harmonic mean travel times ranged from 43.059-47.994 d (overall mean 45.223 d for hatchery-origin and 44.927 d for natural-origin fish. Survival rates ranged from 0.5044-0.6527 (overall 0.5448) for hatchery-origin and 0.4082 for natural-origin fish.

Adult spring Chinook salmon collected from 29 May-25 July 2006 at the Catherine Creek trap totaled 112 natural-origin (28 females, 32 males) and 190 hatchery-origin (67 females, 99 males). Based on scales and an age-length key, age composition of natural-origin fish was 6.7% age 3, 78.3% age 4, and 15.0 % age 5. Mean FL at age were 427.0 mm (age 3), 688.6 mm (age 4) and 830.4 (age 5). Age composition of hatchery fish was 18.1% age 3, 67.2% age 4, and 14.8% age 5. Mean FL at age were 478.1 mm (age 3), 718.0 mm (age 4) and 844.7 (age 5). Ten natural-origin and twenty-four hatchery-origin (conventional broodstock progeny) spring Chinook salmon were transported to Lookingglass Hatchery for use as conventional broodstock.

Adult spring Chinook salmon collected from 31 May-3 August 2006 at the upper Grande Ronde River trap totaled 14 natural-origin (8 females, 6 males) and 263 hatchery-origin (138 females, 125 males). Age composition of natural-origin fish was 53.5% age 4 and 46.4% age 5. Mean FL of natural-origin fish was at age were 722.0 mm (age 4) and 822.3 mm (age 5). Age composition of hatchery fish was 2.3% age 3, 96.3% age 4, and 1.5% age 5. Mean FL at age were 509.5 mm (age 3), 739.7 mm (age 4) and 856.7 (age 5). Seven natural-origin and sixty-four hatchery-origin (conventional broodstock progeny) spring Chinook salmon were transported to Lookingglass Hatchery for use as conventional broodstock.

Estimated total returns (ages 4 and 5 only) from the 2001 brood year release of Catherine Creek hatchery-origin spring Chinook salmon were 163 and in-river spawners were 179. Smolt-to-adult ratios for 3 coded wire tag groups ranged from 0.0001-0.001. Estimated

total returns of brood year 2001 fish acclimated and released from the upper Grande Ronde facility were 492 and in-river spawners were 405. Smolt-to-adult ratios for 8 coded wire tag groups ranged from 0.0004-0.016.

Differences in spring Chinook salmon life history were observed in both juvenile and adult stages and both streams. The significance of the differences is hard to assess because of the limited amount of years of data and frequently low sample sizes for natural-origin fish used in comparisons.

Program assistance provided to comanagers in 2006 included collection of captive broodstock parr from Catherine Creek and the upper Grande Ronde River, maturity sorts and spawning activities at Bonneville Hatchery and Lookingglass Hatchery and spawning ground surveys in the Grande Ronde, Imnaha, and Wenaha basins.

1.2 INTRODUCTION

Spring Chinook salmon populations in Catherine Creek and the upper Grande Ronde River, and other streams in the Snake River Basin have experienced severe declines in abundance over the past two decades (Nehlsen et al. 1991). A supplementation program was initiated in Catherine Creek and the upper Grande Ronde River, incorporating the use of both captive and conventional broodstock methods, inn order to prevent extinction in the short term and rebuild populations over the long term. The captive broodstock component of the program (BPA Project 199801001) uses natural parr collected by seining that are reared to maturity at facilities near Seattle, Washington (Manchester Marine Laboratory) and Hood River, Oregon (Bonneville Hatchery). These fish are spawned, their progeny reared in hatcheries, then acclimated and released into the streams of parental origin. The conventional broodstock component uses returning adults collected at traps near the spawning areas, transported to Lookingglass Hatchery near Elgin, Oregon, and held until ripe. These fish are spawned, and their progeny are also reared in a hatchery environment, acclimated, and released into streams of parental origin. All progeny released receive one or more marks including a fin (adipose) clip, coded-wire tag, PIT tag, or visual implant elastomer tag. The numbers of adults used for conventional broodstock are determined by an agreement among comanagers (Zimmerman and Patterson 2002). Activities for this project focus on two life stages of spring Chinook salmon: juveniles during the migration from freshwater to the ocean and adults during prespawning migration through the end of spawning. Life history, production, and genetics are monitored and used to evaluate program effectiveness.

1.3 STUDY AREA

The Grande Ronde River originates in the Blue Mountains of northeastern Oregon and flows for 341 km to join the Snake River near Lewiston, Idaho (Figure 1). 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. The largest cities are La Grande (population 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 U. S.Bureau of Land Management, and state and tribal agencies. More detailed information about the upper Grande Ronde River basin is contained in the Grande Ronde Subbasin Plan, available at http://www.nwcouncil.org/fw/subbasinplanninng/granderonde/plan/.

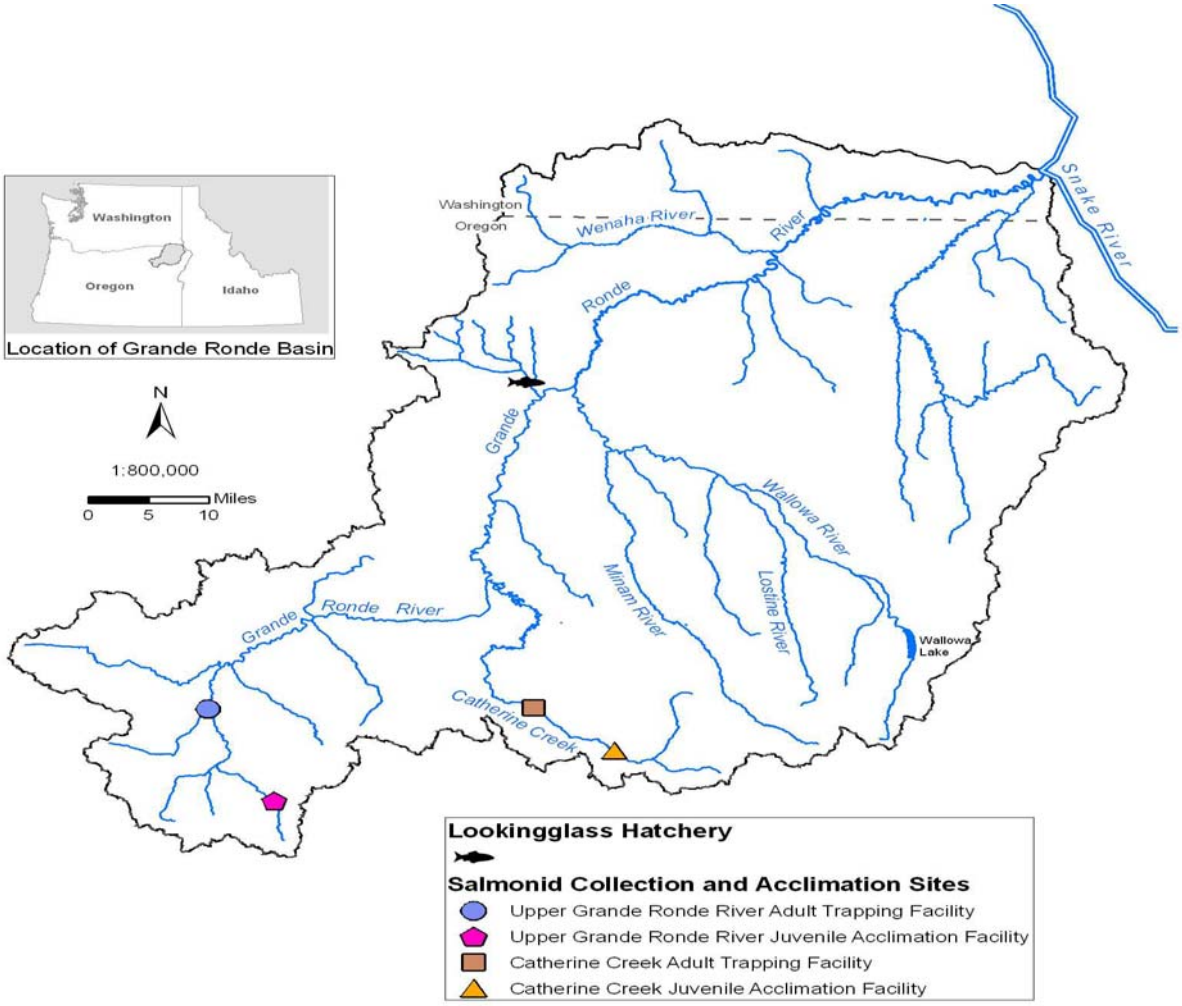

Figure 1. The Grande Ronde Basin, showing adult collection traps and juvenile acclimation sites.

1.4 METHODS

1.4.1 Juvenile Spring Chinook Salmon

ODFW staff marked (adipose clip) and tagged (coded wire) or visual implant elastomer) juvenile spring Chinook salmon at Lookingglass Hatchery in the summer of 2005. All Catherine Creek captive broodstock progeny received AD clips and coded wire tags (codes 93427 and 94215). All Catherine Creek conventional broodstock progeny received coded wire tags (code 94218) and VIE tags. Upper Grande Ronde River conventional broodstock progeny received coded wire tags (code 94213) but were not AD-clipped. Upper Grande Ronde River conventional broodstock progeny (only 76 were acclimated and released) received AD clips but no other tags.

Some juveniles were also PIT-tagged by ODFW staff assisted by CTUIR and Nez Perce Tribe staff at Lookingglass Hatchery in October 2005. Totals PIT-tagged for Catherine Creek and the upper Grande Ronde River were 20,963 and 498, respectively. The higher number of fish PIT-tagged for Catherine Creek is for the Comparative Survival Study (Bouwes et al. 2002).

FL (mm) and weight (0.1 g) data from of a portion of the fish were collected at the time of PIT-tagging. ODFW and comanagers completed length, weight, and mark retention sampling at Lookingglass Hatchery prior to transfer to the acclimation facilities on 7 February 2006 (ODFW, unpublished data). Juveniles were also sampled at the Catherine Creek acclimation facility (50 fish per raceway) on 23 March (before volitional release of early group), 25 March 2006 (before forceout of early group), and 12 April 2006 (before volitional release of late group).

Performance metrics monitored for hatchery spring Chinook salmon juveniles acclimated and released from both facilities included migration timing (median arrival timing to Lower Granite Dam), mean travel time, mean FL, mean weight, mean K factor ($K=W/FL^3*10^5$, where W=weight in grams and FL=fork length in mm), survival to Lower Granite Dam, and smolt-to-adult ratio (SAR).

Acclimation procedures were described in McLean et al. (2006). Juveniles were acclimated in two groups (early and late) at the Catherine Creek facility due to space constraints (Table 1).

Table 1. Acclimation summary for juvenile spring Chinook salmon from Catherine Creek (CC) and the upper Grande Ronde River (UGR), 2006 (McLean et al. 2006).

Stream	Broodstock Method	Volitional Release	Forceout	Number Released
CC	Captive	3/27/2006	4/12/2006	45,604
	Conventional	3/27/2006	4/12/2006	23,216
UGR	Conventional	3/27/2006	4/12/2006	18,977*

** includes 76 captive brood progeny*

Date and time-stamped detections of PIT-tagged juveniles leaving each acclimation facility were recorded with PIT tag readers (Digital Angel Model FS2001[1]) placed on outlet pipes at each facility. Placement of the PIT tag readers at the Catherine Creek facility potentially allowed for detection of all juveniles leaving the facility. Readers probably detected a high percentage (assumed to be over 90%) of the volitionally released juveniles. The large number of PIT-tagged fish leaving this facility in a short period of time at force-out meant that a significant number of tags were not detected due to tag interference (multiple tags passing through the field at essentially the same time). We assumed that PIT-tagged upper Grande Ronde River fish detected at release were representative of the particular group of PIT-tagged fish for the metrics used.

PIT tag data from the web-based PTAGIS database (Bauman et al. 1998) were used to describe migration timing and survival to Lower Granite Dam. To describe arrival timing at Lower Granite Dam, daily PIT tag detections were expanded for spill using flow data from the U. S. Army Corps of Engineers, Portland District website at http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=id:LWG, and calculating a daily expansion factor [(Powerhouse Outflow+ Spill) /Powerhouse Outflow]. Median arrival timing at Lower Granite Dam for each group was the date by which 50% of the expanded detections had occurred. Survival, capture probabilities, and travel time to Lower Granite Dam were calculated using PitPro software (Westhagen and Skalski 2006). We used the standard configuration, and excluded the *.rcp file. Observation sites used, in downstream order, were Lower Granite Dam, Little Goose Dam, Lower Monumental Dam, McNary Dam, John Day Dam, Bonneville Dam, and the Estuary Towed Array (Juvenile). Lower Granite Dam was used as the last recapture site. Natural-origin spring Chinook juveniles from both Catherine Creek and the upper Grande Ronde River used for performance comparisons with hatchery-origin fish were collected and PIT-tagged by the Oregon Department of Fish and Wildlife using rotary screw traps (Jonasson et al. 2002).

1.4.2 Adult Spring Chinook Salmon

Adult spring Chinook salmon life history attributes described for Catherine Creek and upper Grande Ronde River stocks included migration timing (arrival at traps), smolt-to-adult ratios (SAR), abundance, age, length and sex frequencies, hatchery/natural ratios, occurrence of strays, spawn timing, redd distribution, prespawning mortality, and egg size..

Much of the information for this project was collected at adult collection weirs and during spawning ground surveys. ODFW, assisted by comanagers, coordinates and conducts spawning ground surveys of known spawning areas of Catherine Creek and the upper Grande Ronde River during 3 consecutive weeks in late August and early September (Parker et al. 1995). Data are also collected during additional pre- and post-spawn surveys and spawning of conventional broodstock at Lookingglass Hatchery. McLean et al. (2006) described weir operations and methods used to collect data for spring Chinook salmon captured at the upper Grand Ronde River and Catherine Creek adult traps. Rarely, fish that had been previously sampled fell back over the weir, swam

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

upstream and were trapped again; these fish were omitted from the data summaries. Some fish from each stream were removed to maintain appropriate hatchery/natural ratios and some were taken to Lookingglass Hatchery for use as broodstock. Only unmarked spring Chinook or conventional broodstock progeny are currently used for conventional broodstock. Scales were used to age natural-origin (unmarked) spring Chinook salmon (Mosher 1969) and coded wire tags for hatchery—origin fish. Coded wire tag data were obtained from the database maintained by the Pacific States Marine Fisheries Commission at http://www.rmpc.org. Code recovery site and tag status definitions were obtained from the CWT Data File Definition, Specification, and Validation Version 4.0 available at the same website.

SAR estimates for various coded wire tag groups of brood year 2003 hatchery-origin releases were obtained from http://www.cbr.washington.edu/cwtSAR/, a website maintained by the Columbia Basin Research unit of the University of Washington. School of Aquatic and Fishery Sciences. Skalski and Townsend (2006) describe methods for calculation of SAR.

Returns to the stream for age 3 fish by mark (ad, unclipped) were estimated by numbers of age 3 fish caught at the weir and the ratio of age 3 fish to ages 4/5 fish in the weir catch to the numbers of ages 4/5 fish below the weir. Returns to the stream for ages 4/5 fish (ad, unclipped) were made using the population estimates of ages 4/5 above the weir, fish per redd from above the weir, redds below the weir, fractions of ad-clipped and unmarked fish in the weir catch, and known dispositions of fish.

Ages 4/5 in-river spawners (ad-clipped, unmarked) were estimated from the population estimate above the weir, fish per redd, and redds below the weir. Age 3 in-river spawners (ad-clipped, unmarked) were estimated from the ratio of age 3 to ages 4/5 fish in the weir catch and the population estimate above the weir, fish per redd, and redds below the weir.

Genetics tissues were collected from all fish collected at the weirs and any unclipped carcasses observed on spawning ground surveys. Samples were preserved in labeled vials with about 2 ml of 95% ethanol and later sent to the NOAA-Fisheries genetics laboratory as part of BPA Project 198909600. A second set of samples was sent to the Columbia River Iinter-Tribal Fish Commission (CRITFC) genetics laboratory for archiving.

1.4.3 Environmental Data

CTUIR cost-shares to operate flow and temperature recorders located on the North Fork of Catherine Creek about 4.4 rkm above the acclimation site and on the upper Grande Ronde River below the mouth of Clear Creek at the old Woodley Campground, about 3.2 rkm above the upper Grande Ronde River acclimation site. Methods used for calculations of instantaneous flows and summary statistics are available at the Oregon Water Resources website (http://www.wrd.state.or.us/surface_water/data.shtml). Water temperature data were also recorded hourly at the Catherine Creek acclimation and

Catherine Creek and upper Grande Ronde River adult trap sites using Onset[2] programmable data loggers (McLean et al. 2006). Flow data for the Grande Ronde River near Troy, OR were obtained from the U. S. Geological Service website (http://waterdata.usgs.gov/or/nwis/dv/?site_no=13333000&referred_module=sw),

1.4.4 Data Analysis

Graphs and descriptive statistics in tables were used to summarize data for different life stages and groups of spring Chinook salmon. Least squares regression using $\log_{10}$ transformed data was used to describe length-weight relationships for female conventional broodstock spawned at Lookingglass Hatchery. JMP 6 (SAS Institute, Inc. 2006) and Microsoft Office 2003 were used to conduct summarize data and prepare the report.

1.5 RESULTS

1.5.1 Juvenile Spring Chinook Salmon

1.5.1.1 Catherine Creek

The Catherine Creek acclimation facility is in the middle of the primary spawning are for spring Chinook salmon. Mean daily water temperatures in 2006 fluctuated around 5°C from late March until the end of May, and then rapidly increased reaching a maximum of 18.3 °C on 24 July (Figure 2).

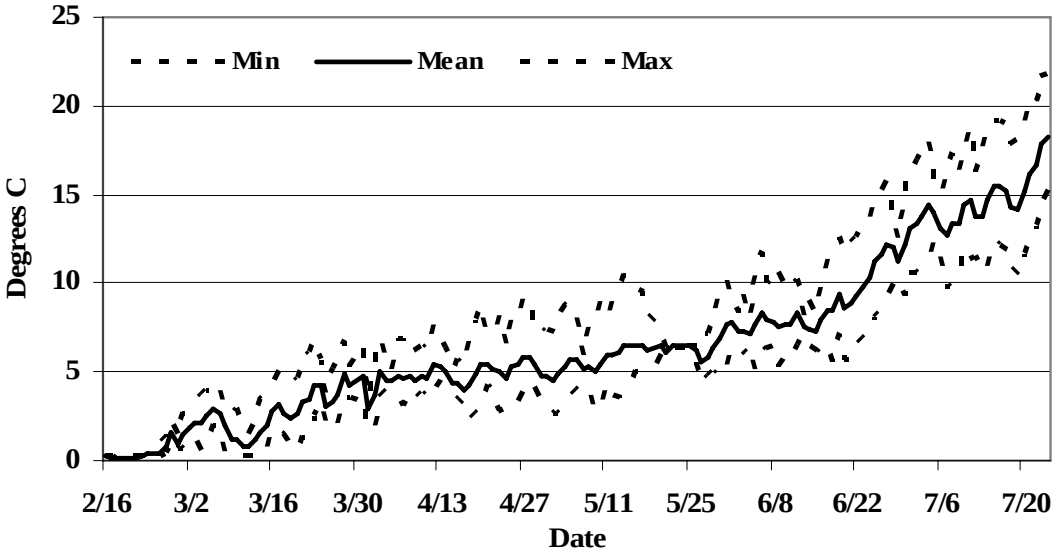

Figure 2. Daily minimum, mean, and maximum water temperatures at the Catherine Creek acclimation site, 2006.

[2] Mention of this commercial product does not imply endorsement.

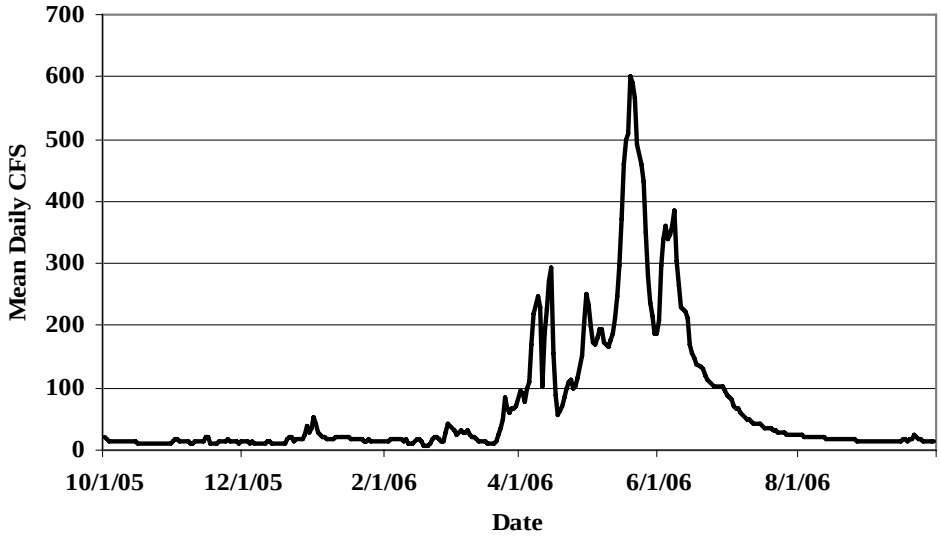

Figure 3. Mean daily stream flows at the North Fork Catherine Creek site, water year 2006 (preliminary data courtesy Steve Linnmeyer, Oregon Water Resrources Department).

Stream flows at the North Fork Catherine Creek site remained near base levels from October 2005 through the end of March 2006 (Figure 3). Rapidly increasing flows began about 1 April 2006 and remained high until August 2006, when beas flows resumed. Volitional release of Catherine Creek juveniles began just prior to the spring freshet and forceout occurred when flows were approximately 200 CFS.

Mean FL at PIT-tagging (October 2005) for various groups of hatchery-origin spring Chinook salmon juveniles from Catherine Creek were considerably greater than for natural-origin-fish (Table 2). Mean FL at PIT-tagging of captive broodstock progeny was 7.1 mm greater than conventional. The differences between mean lengths of fish at PIT-tagging in October of 2005 and prevolitional release sampling in March 2006 showed increases of 3.1-8.0 mm for captive and convention al progeny. The increase between October 2005 and pretransfer sampling in February 2006 for the entire group of hatchery fish was 5.8 mm. Mean FL at PIT-tagging of fish detected leaving volitionally were 3.4-4.9 mm greater than those detected at force-out.

Table 2. FL summary for migration year (MY) 2006 spring Chinook salmon by rearing method[a] and sample/release type[b] from Catherine Creek (CTUIR data and ODFW, unpublished data).

Rearing Method	Sample/Release Type	FL (mm)			
		Mean	SE	Range	n
H	CaPT	110.8	0.4	69-178	696
H	CaPV	113.9	1.0	81-139	100
H	CaV	106.6	0.5	72-163	515
H	CaPFO	119.5	0.8	105-136	100
H	CaFO	103.2	0.3	78-141	855
H	Ca	104.6	0.2	72-163	2,105
H	CoPT	102.0	0.5	76-122	330
H	CoPV	110.0	1.0	86-123	50
H	CoV	99.0	0.3	74-124	733
H	CoPFO	112.7	1.0	90-125	50
H	CoFO	94.1	0.7	75-114	147
H	Co	97.5	0.3	74-124	1,052
H	PT (all)	108.0	0.3	69-178	1,026
H	All	102.2	0.2	72-163	3,157
N	All	88.6	0.4	67-127	360

[a] *H=hatchery, N=natural-origin tagged/released 2/27/06-5/15/06,* [b]*Ca=captive broodstock progeny, Co=conventional broodstock progeny, PT=pretransfer sampling at Lookingglass Hatchery, 2/7/06, PV=prevolitional sampling at acclimation facility (3/23/2006), V=volitional release detection, PFO=preforceout sampling (4/12/2006) at acclimation facility, FO=forceout detections*

Mean weight for hatchery-origin fish was much higher than for natural-origin fish (Table 3). Comparisons of various release groups of hatchery-origin fish also showed patterns similar to those of mean FL.

Table 3. Weight summary for MY 2006 spring Chinook salmon by rearing method and release type from Catherine Creek (ODFW, unpublished data).

Rearing Method	Sample/Release Type	Weight (g)			
		Mean	SE	Range	n
H	CaPT	17.5	0.5	3.3-35.5	100
H	CaPV	18.1	0.5	5-31.4	100
H	CaV	13.6	0.9	4.7-24.2	28
H	CaPFO	21.1	0.5	13.9-32.1	100
H	CaFO	15.2	0.7	7.3-24.6	42
H	Ca	14.4	0.4	4.7-24.6	108
H	CoPT	13.5	0.5	5.6-19.7	50
H	CoPV	16.3	0.5	7.2-23.8	50
H	CoV	10.7	0.4	5.1-17.2	43
H	CoPFO	18.0	0.5	9.7-27.3	50
H	CoFO	9.7	0.9	7.6-11.7	4
H	Co	10.3	0.4	5.1-17.2	53
H	PT (all)	16.1	0.4	3.3-35.5	150
H	All	13.1	0.3	4.7-24.6	161
N	All	7.5	0.1	2.6-21.4	339

Mean K at PIT-tagging for hatchery-origin fish was greater than for natural-origin fish (Table 4). K decreased slightly between October 2005 PIT-tagging and pretransfer sampling in February 2006.

Table 4. K factor at PIT-tagging summary for MY 2006 spring Chinook salmon by rearing method and sample/release type from Catherine Creek.

Rearing Method	Sample/Release Type	K factor			
		Mean	SE	Range	n
H	CaPT	1.17	0.01	0.81-1.60	100
H	CaPV	1.19	0.01	0.83-1.45	100
H	CaV	1.26	0.03	0.99-1.49	28
H	CaPFO	1.22	0.01	1.01-1.64	100
H	CaFO	1.29	0.02	1.08-1.66	42
H	Ca	1.27	0.01	0.97-1.85	108
H	CoPT	1.17	0.01	1.05-1.34	50
H	CoPV	1.21	0.01	0.91-1.39	50
H	CoV	1.15	0.02	0.91-1.65	41
H	CoPFO	1.25	0.01	0.91-1.40	50
H	CoFO	1.12	0.05	1.01-1.21	4
H	Co	1.14	0.02	0.91-1.65	51
H	PT (all)	1.17	0.01	0.81-1.60	150
H	All	1.23	0.01	0.91-1.85	159
N	All	1.05	0.01	0.59-2.15	339

Median arrival date at Lower Granite Dam for Catherine Creek hatchery-origin juveniles was almost a month earlier than for natural-origin fish (Table 5). The earliest detection of a hatchery-origin fish was also almost a month earlier than the first detection of a natural origin fish, but the latest detections from both groups differed by only 4 d. Median arrival dates for all the subgroups of hatchery-origin fish varied from 3-16 May 2006.

Table 5. Arrival dates at Lower Granite Dam of PIT-tagged MY 2006 spring Chinook salmon by rearing method and release type from Catherine Creek.

Rearing Method	Release Type	n^r	n^e	Median	Earliest	Latest
H	CaV	345	561	5/3/2006	4/8/2006	6/18/2006
H	CaFO	519	820	5/8/2006	4/27/2006	6/18/2006
H	Ca	1,284	2,007	5/7/2006	4/8/2006	6/18/2006
H	CoV	421	680	5/6/2006	4/17/2006	5/19/2006
H	CoFO	73	132	5/16/2006	4/28/2006	6/7/2006
H	Co	617	998	5/7/2006	4/17/2006	6/17/2006
H	All	1,902	2,989	5/7/2006	4/8/2006	6/18/2006
N	All	34	67	6/2/2006	5/3/2006	6/22/20006

n^r =*raw detections,* n^e =*detections expanded for spill*

Travel times to Lower Granite Dam differed by less than a day between hatchery- and natural-origin fish (Table 6). Travel times for the captive and conventional groups were almost identical. Travel times for volitional release groups were about 6-7 d less than for forceout fish.

Table 6. Harmonic mean travel time (d) to Lower Granite Dam of PIT-tagged MY 2006 spring Chinook salmon by rearing method and release type from Catherine Creek.

Rearing Method	Release Type	Travel Time (d)	SE	n
H	CaV	37.860	0.471	617
H	CaF	43.784	0.344	286
H	Ca	41.707	0.240	1,298
H	CoV	39.624	0.337	176
H	CoF	47.118	0.970	282
H	Co	41.676	0.321	604
H	All	41.706	0.193	1,902
N	All	40.807	4.413	34

Frequency distributions of detections at Lower Granite Dam showed that hatchery-origin arrivals occurred for a similar length of time as for natural-origin fish, about 5-6 weeks (Figures 3, 4).

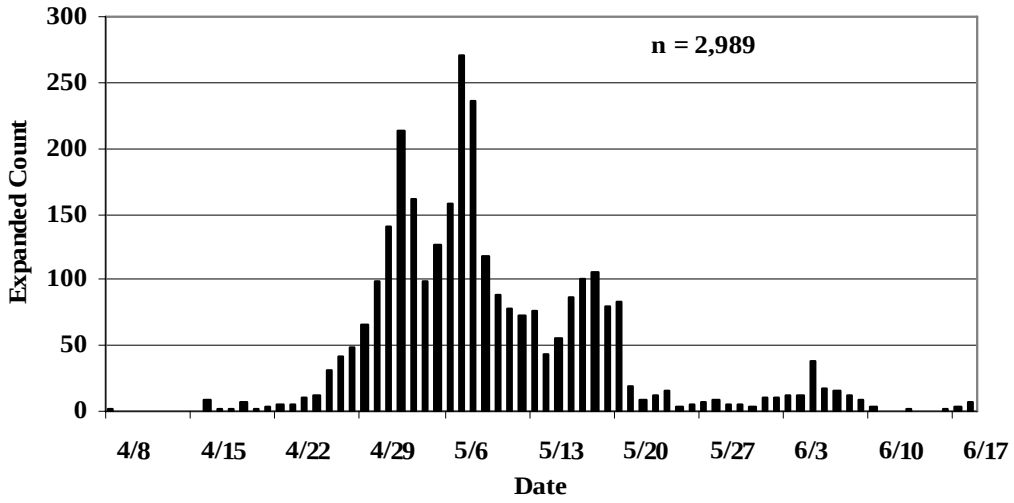

Figure 4. Frequency distribution of arrival dates (expanded for spill) at Lower Granite Dam for Catherine Creek hatchery-origin spring Chinook salmon, MY 2006.

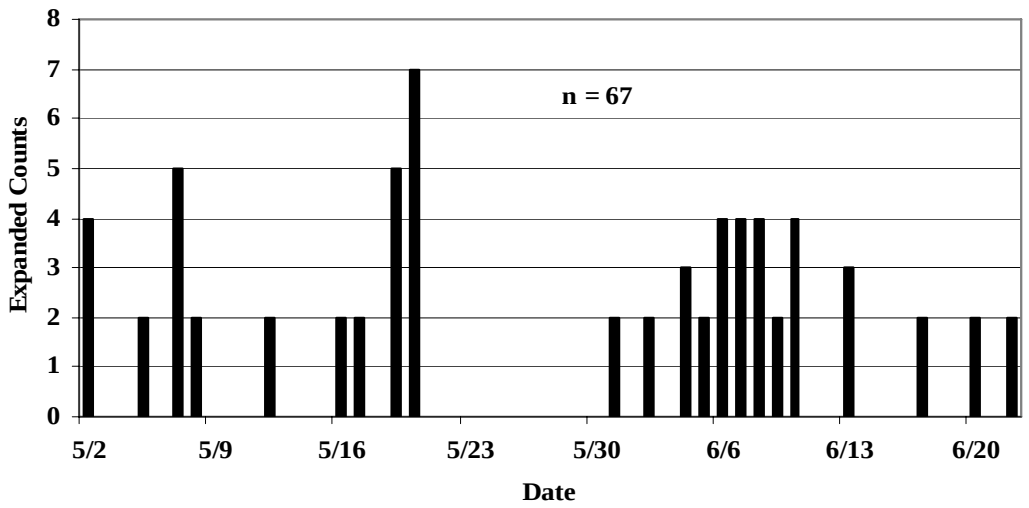

Figure 5. Frequency distribution of arrival dates (expanded for spill) at Lower Granite Dam for Catherine Creek natural-origin spring Chinook salmon (spring release group), MY 2006.

The peak detection date (expanded for spill) at Lower Granite Dam for hatchery-origin fish was slightly less than 2 weeks earlier than for natural-origin fish (Figure 5). The peak detection date for natural-origin fish was just before the date of peak flow.

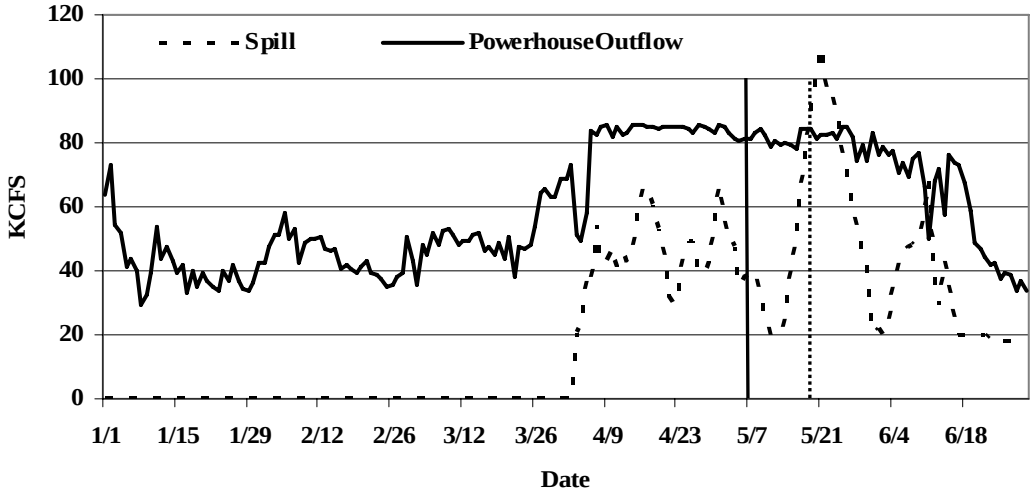

Figure 6. Streamflows at Lower Granite Dam with dates of peak MY 2006 PIT-tag detections for Catherine Creek stock spring Chinook salmon smolts (solid vertical line – hatchery; dotted vertical line - natural).

Survival to Lower Granite Dam of hatchery-origin fish was 0.0665 less than for natural-origin fish (Table 7). Survival of conventional broodstock progeny was about 0.04 higher than captive. Survival of captive forceout fish was about 0,02 greater than volitional released fish and conventional forceout fish was about 0.01 lower than conventional volitional released fish.

Table 7. Survival to and capture probabilities at Lower Granite Dam for MY 2006 spring Chinook salmon by rearing method and release type from Catherine Creek.

Rearing Method	Release Type	n	Survival	SE	Capture Probability	SE
H	CaV	3,715	0.2972	0.0154	0.3117	0.0198
H	CaFO	5,537	0.3187	0.0142	0.2942	0.0160
H	Ca	13,965	0.2974	0.0079	0.3092	0.0101
H	CoV	4,892	0.3488	0.0178	0.2463	0.0156
H	CoFO	826	0.3302	0.0286	0.2679	0.0327
H	Co	6,996	0.3371	0.0127	0.2612	0.0127
H	All	20,963	0.3108	0.0067	0.2918	0.0079
N	All	360	0.3773	0.0492	0.2503	0.0465

1.5.1.2 upper Grande Ronde River

Flows in the upper Grande Ronde River above the acclimation facilityhad several mid-winter spikes, then entered a stable period near base flow when juvenile release began (Figure 7). By the time forceout occurred, increasing flows of the spring freshet were occurring.

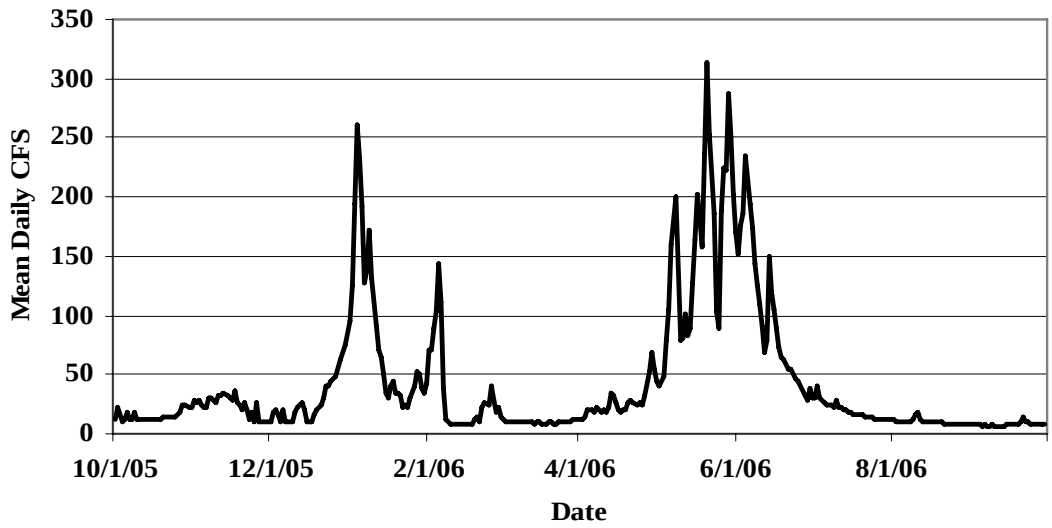

Figure 7. Mean daily stream flows at the upper Grande Ronde River below Clear Creek site for water year 2006 (preliminary data courtesy Steve Linnmeyer, Oregon Water Resources Department).

Mean FL at PIT-tagging of hatchery-origin upper Grande Ronde River fish was about 20 mm greater than for natural-origin (Table 8). Hatchery fish grew on average about 8 mm from October 2005 PIT-tagging until pretransfer sampling in February 2006. Mean FL of volitionally-released fish was about 5 mm greater than forceout fish. Fish sampled just before the start of both volitional release and forceout were substantially larger (12.4-15.9 mm) than fish sampled the day before (volitional release) or the same day (forceout).

Table 8. FL summary for MY 2006 spring Chinook salmon by rearing method[a] and sample/release type[b] from the upper Grande Ronde River (CTUIR data and ODFW, unpublished data).

Rearing Method	Sample/Release Type	FL (mm)			
		Mean	SE	Range	n
H	PT	108.0	0.5	80-130	311
H	PV	116.0	0.9	89-134	100
H	V	103.6	0.7	81-120	110
H	PFO	114.3	0.9	89-133	103
H	FO	98.4	1.1	79-120	78
H	All	101.6	0.6	79-120	207
N	All	79.2	0.4	59-110	500

[a] *H=hatchery, N=natural-origin, tagged/released 3/706-4/24/06,* [b]*PT=at Lookingglass Hatchery prior to transfer to acclimation sites (2/7/ 2006), PV=prevolitional release at acclimation facility (3/22/2006), V=volitional release detections, PFO=preforceout sampling at acclimation facility (4/12/2006), FO=forceout detections*

Patterns of mean weight for hatchery- and natural-origin fish were similar to those seen for mean FL (Table 9).

Table 9. Weight summary for MY 2006 spring Chinook salmon by rearing method and sample/release type from the upper Grande Ronde River (ODFW, unpublished data).

Rearing Method	Sample/Release Type	Weight (g)			
		Mean	SE	Range	n
H	PT	15.5	0.5	7.7-26.6	50
H	PV	17.6	0.4	6.6-29.2	100
H	V	12.6	0.5	6.9-18.6	37
H	PFO	16.1	0.4	6.7-25.4	103
H	FO	11.7	0.9	6.5-22	22
H	All	12.6	0.4	6.5-22	65
N	All	4.8	0.1	2-10.1	379

Mean K at PIT-tagging for hatchery-origin fish was 0.14 higher than for natural-origin fish (Table 10). Mean K for fish detected as volitional releases was identical to forceout fish. Mean K for fish at pretransfer in February 2006 was slightly higher than at PIT-tagging in October 2005.

Table 10. K factor summary for MY 2006 spring Chinook salmon by rearing method and sample/release type from the upper Grande Ronde River.

Rearing Method	Sample/Release Type	K factor			
		Mean	SE	Range	n
H	PT	1.14	0.02	0.96-1.75	50
H	PV	1.10	0.01	0.85-1.25	100
H	V	1.06	0.02	0.78-1.22	37
H	PFO	1.06	0.01	0.78-1.22	102
H	FO	1.06	0.03	0.74-1.27	22
H	All	1.07	0.01	0.74-1.27	65
N	All	0.93	0.003	0.68-1.28	379

Median arrival date at Lower Granite Dam of hatchery-origin fish was bout a week earlier than for natural-origin fish (Table 11). A similar time span separated the different release groups of hatchery fish. The earliest detected natural-origin fish arrived about a month before the first hatchery fish, and the latest detected natural-origin fish also about a month later than the last hatchery fish.

Table 11. Arrival dates at Lower Granite Dam of PIT-tagged MY 2006 spring Chinook salmon by rearing method and release type from the upper Grande Ronde River.

Rearing Method	Release Type	n^r	n^e	Median	Earliest	Latest
H	V	25	45	5/9/2006	4/27/2006	5/18/2006
H	FO	19	39	5/16/2006	5/4/2006	5/20/2006
H	All	52	92	5/14/2006	4/27/2006	5/19/2006
N	All	47	98	5/20/2006	3/30/2006	6/20/2006

n^r = *raw detections*, n^e = *detections expanded for spill*

Mean travel time to Lower Granite Dam for hatchery-origin fish differed by only 0.4 d from natural-origin fish (Table 12). For forceout fish, mean travel time was almost 5 d more than for volitionally-released fish.

Table 12. Harmonic mean (d) of travel time to Lower Granite Dam of PIT-tagged MY 2006 spring Chinook salmon by rearing method and release type from the upper Grande Ronde River.

Rearing Method	Release Type	Harmonic Mean	SE	n
H	V	43.059	1.299	25
H	FO	47.994	1.137	19
H	All	45.223	0.888	52
N	All	44.927	2.147	49

The arrival period for hatchery- and natural-origin fish was about 3 weeks, compared to about two months for natural-origin fish (Figures 8, 9). Arrival dates were more equitably distributed for hatchery-origin fish.

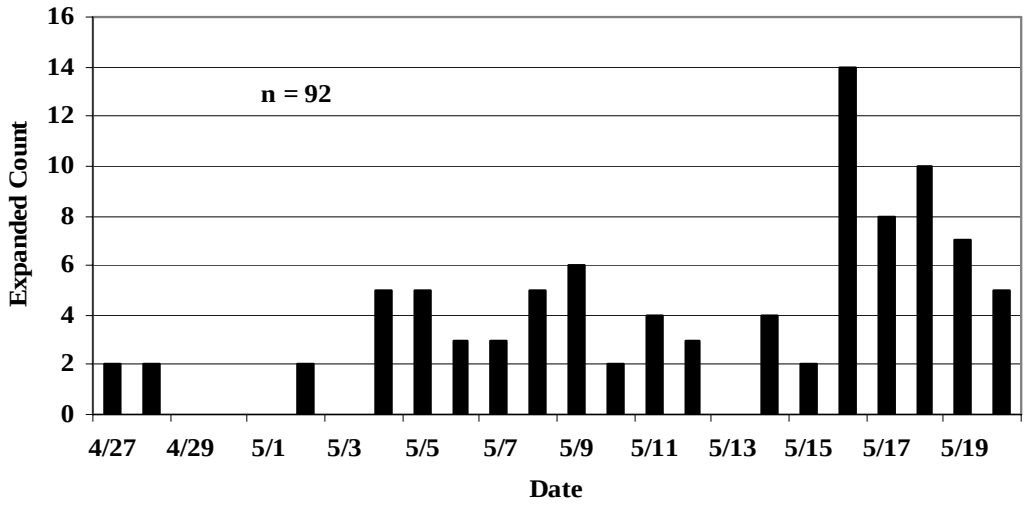

Figure 8. Frequency distribution of arrival dates (expanded for spill) at Lower Granite Dam for upper Grande Ronde River hatchery-origin spring Chinook salmon, MY 2006.

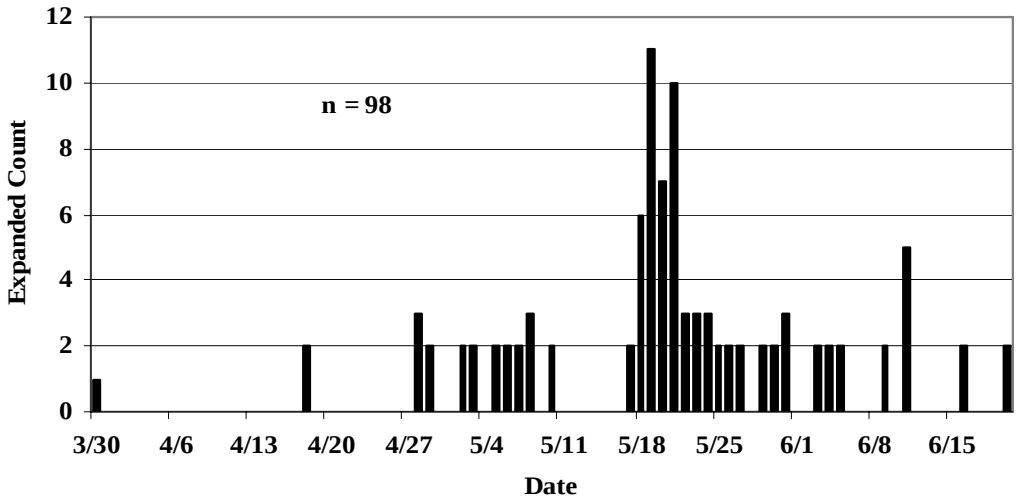

Figure 9. Frequency distribution of arrival dates (expanded for spill) at Lower Granite Dam for upper Grande Ronde River natural-origin spring Chinook salmon (spring release group), MY 2006.

The peak detection dates at Lower Granite Dam for hatchery- and natural-origin fish differed only slightly and occurred just prior to the date of peak flow (Figure 10).

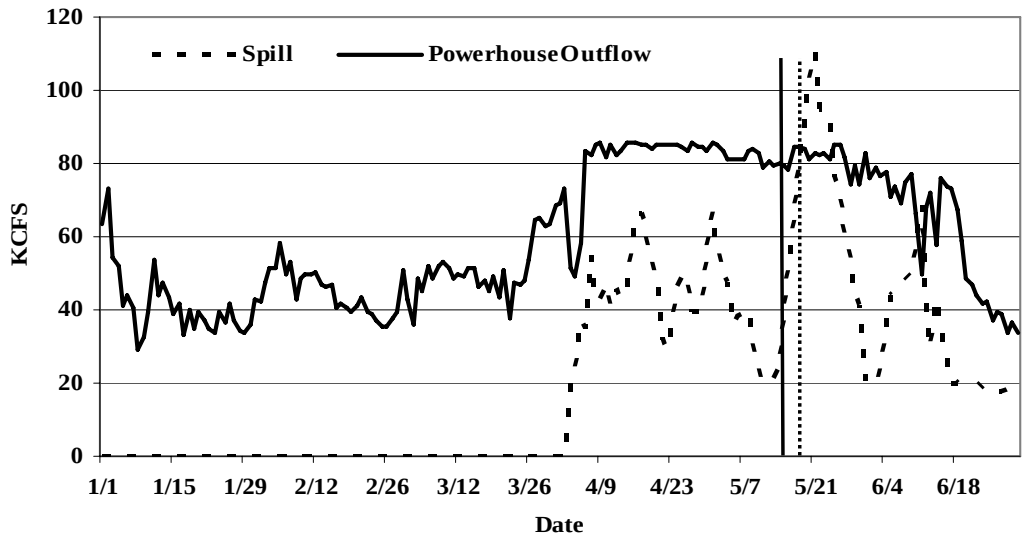

Figure 10. Streamflows at Lower Granite Dam during the juvenile outmigrating period with dates of peak MY 2006 upper Grande Ronde River stock spring Chinook salmon smolt detections (solid vertical line – hatchery-origin; dotted vertical line – natural-origin).

Survival for hatchery-origin fish was about 0.15 higher than natural-origin fish (Table 13). Survival for forceout fish was about 0.15 higher than for volitionally-released fish. Capture probabilities were similar for the various groups of hatchery-origin fish but about 0.04-0.06 lower than for natural-origin fish.

Table 13. Survival to and capture probabilities of MY 2006 spring Chinook salmon at Lower Granite Dam by rearing method and release type from the upper Grande Ronde River.

Rearing Method	Release Type	n	Survival	SE	Capture Probability	SE
H	V	272	0.5044	0.1096	0.1822	0.0503
H	FO	167	0.6527	0.1298	0.1743	0.0492
H	All	498	0.5448	0.0728	0.1916	0.0341
N	All	500	0.4082	0.0598	0.2303	0.0430

1.5.2 Adult Spring Chinook Salmon

1.5.2.1 Catherine Creek

1.5.2.1.1 Trapping

The Catherine Creek trap was operated from 1 March-25 July 2006. Natural-origin fish collected were passed above the trap to spawn, trap mortalities, or transported to

Lookingglass Hatchery to be held for use as conventional broodstock. Disposition of the catch of hatchery-origin fish from Catherine Creek included trap mortalities, removal (euthanizing) of jacks to maintain desired hatchery:natural ratios, and passing above the trap to spawn. Only conventional broodstock progeny were used for spawning at Lookingglass Hatchery.

Natural-origin fish were collected from 6 June-17 July 2006 and hatchery-origin fish from 29 May-25 July 2006. No fish had radio tags or could be confirmed as strays by visual marks. Total catches of natural- and hatchery-origin fish were 112 and 189, respectively. Putative sex ratios of natural- and hatchery-origin fish were 0.96 F:M and 1.28 F:M, respectively. Cumulative frequency distributions for arrival timing at the Catherine Creek trap for hatchery- and natural-origin fish varied slightly (Figure 10).

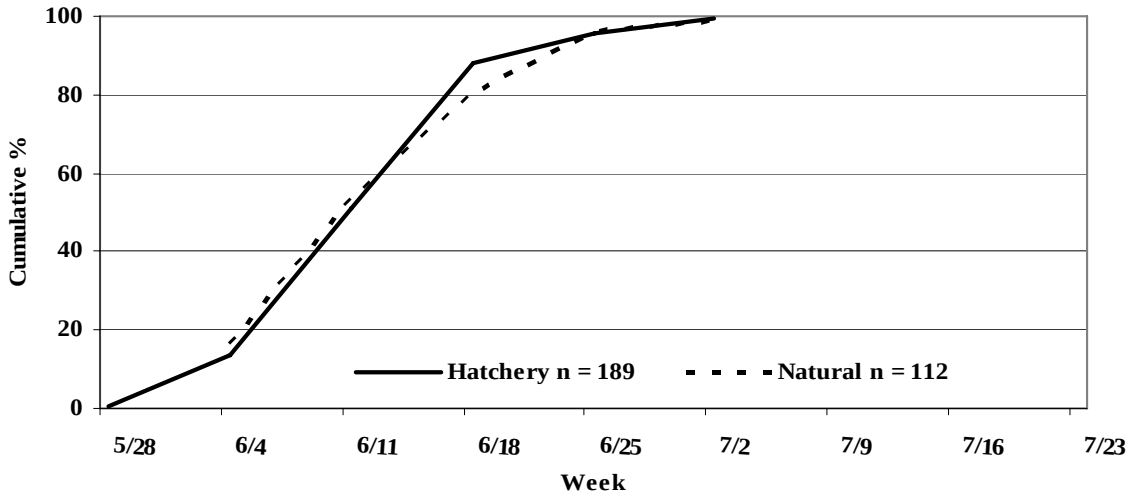

Figure 10. Cumulative percentages of natural- and hatchery-origin spring Chinook salmon caught by week of the year and age group at the Catherine Creek trap, 2006.

Conventional broodstock progeny were collected at the weir from 7 June-7 July 2006. Total catch was 69 and the sex ratio was 1.03 F:M. Captive broodstock progeny were collected at the weir from 29 May-25 July 2006. Total catch was 120 and the sex ratio was 1.45 F:M.

Peak catches of hatchery- and natural-origin fish occurred at or slightly after a rapid rise in water temperature began (Figure 11). Water temperatures were recorded from 16 February-24 July 2006. The peak temperature recorded was 25.7^{o}C on 23 July 2006 and the highest daily mean of 21.8^{o}C on 24 July 2006.

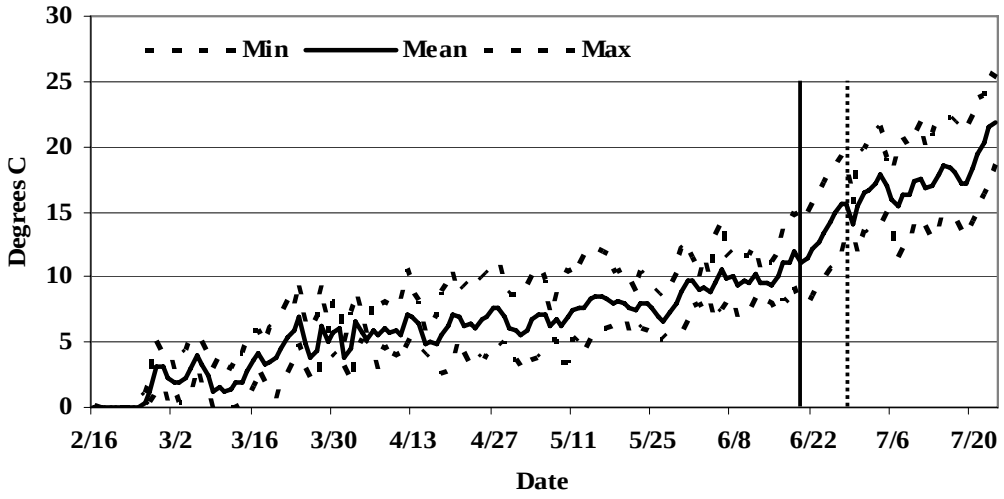

Figure 11. Daily minimum, mean, and maximum water temperatures at the Catherine Creek adult site, with peak catches of hatchery- (solid vertical line) and natural-origin (dashed vertical line) spring Chinook salmon, 2006.

Water temperatures at the North Fork Catherine Creek site peaked at 15.3^{o}C on 21 August 2006 (Figure 12). The highest mean daily temperature was 13.2^{o}C on 22 August 2006. Temperatures began a rapid increase in late June and rapidly decreased I early September. Mechanical problems prevented obtaining data for 5-27 February and 6 July-7 August 2006.

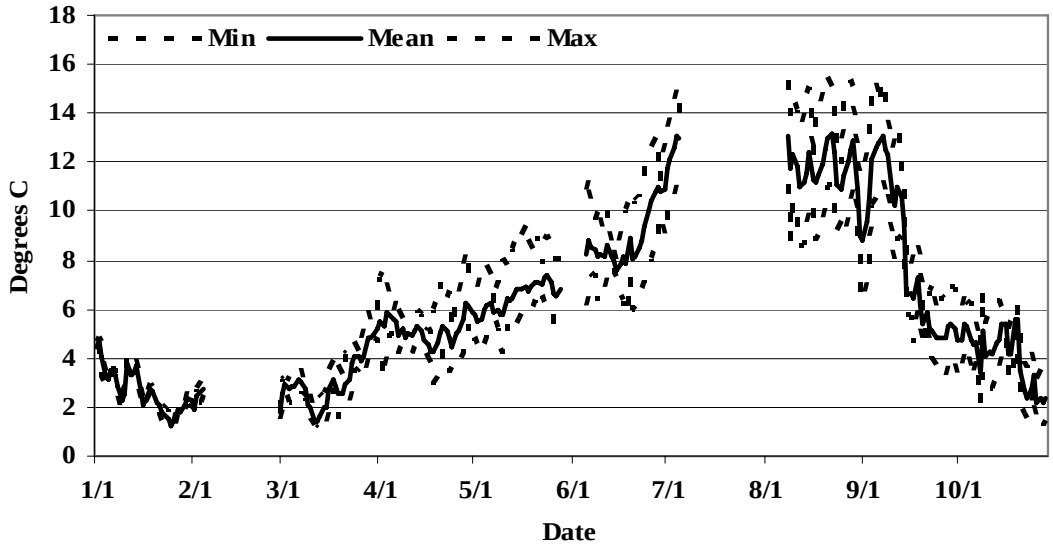

Figure 12. Daily minimum, mean, and maximum water temperatures at the Wallowa-Whitman National Forest North Fork Catherine Creek site, 2006 (preliminary data courtesy Jennifer Wiseman, Wallowa-Whitman National Forest)..

Peak catches of fish at the Catherine Creek adult trap occurred three to four weeks after the peak flow was observed at the gauging station at Troy, OR (Figure 13).

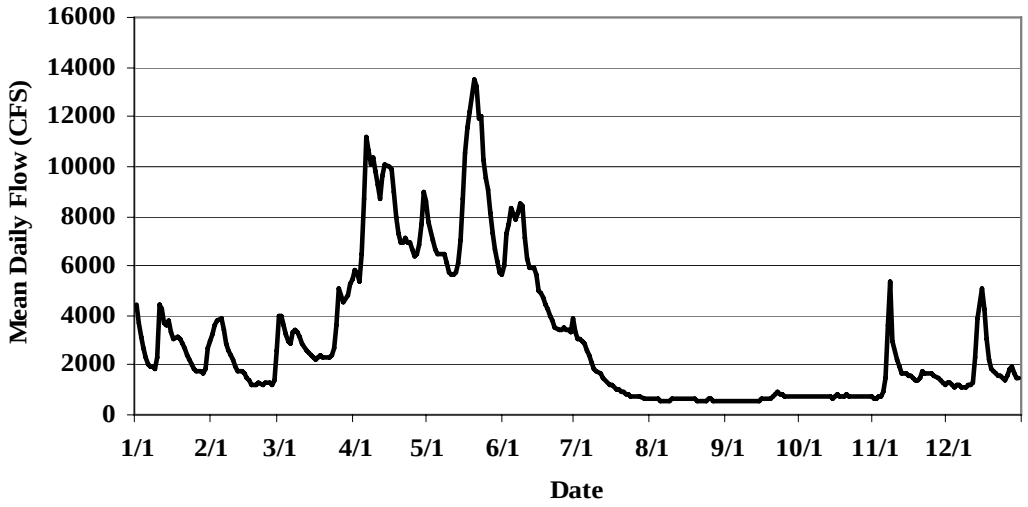

Figure 13. Mean daily flows (CFS) recorded at the USGS gauging station on the Grande Ronde River near Troy, OR, 2006.

Length frequencies for hatchery- and natural-origin fish were similar, suggesting the presence of 3 age groups (Figures 14, 15). The length frequency distributions for hatchery-conventional and captive progeny suggested most fish were probably 4 year olds (Figures 16, 17).

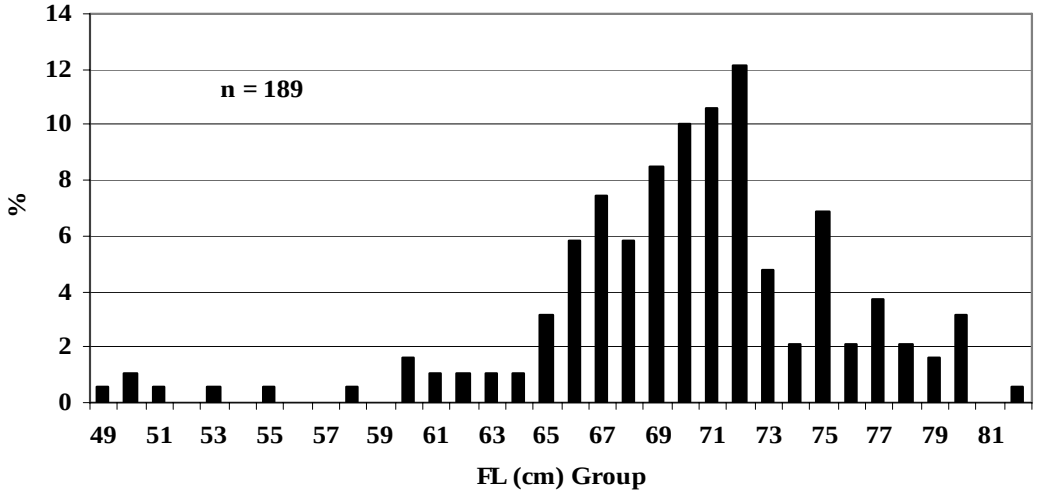

Figure 14. FL distribution of hatchery-origin spring Chinook salmon caught at the Catherine Creek trap, 2006 (first time captures).

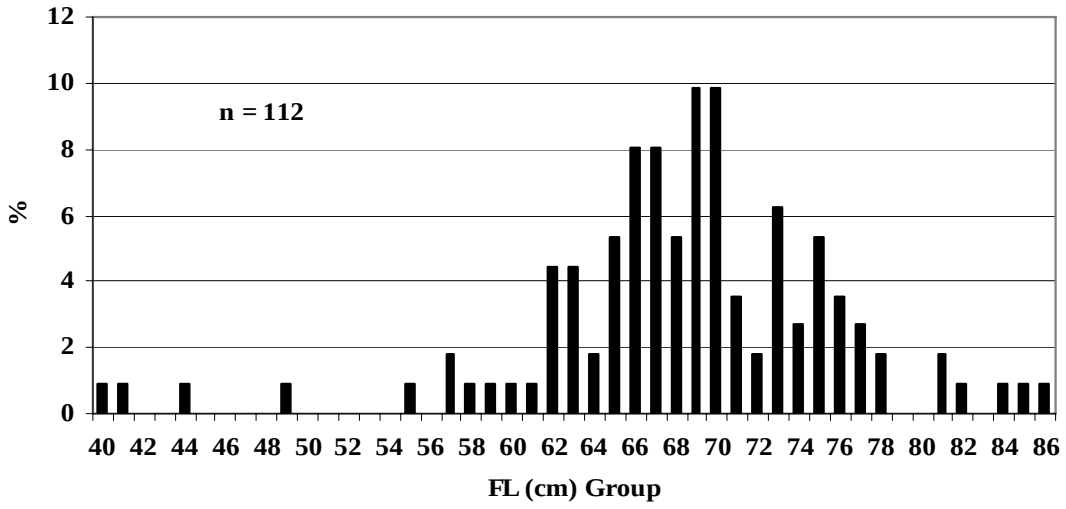

Figure 15. FL distribution of natural-origin spring Chinook salmon caught at the Catherine Creek trap, 2006 (first time captures).

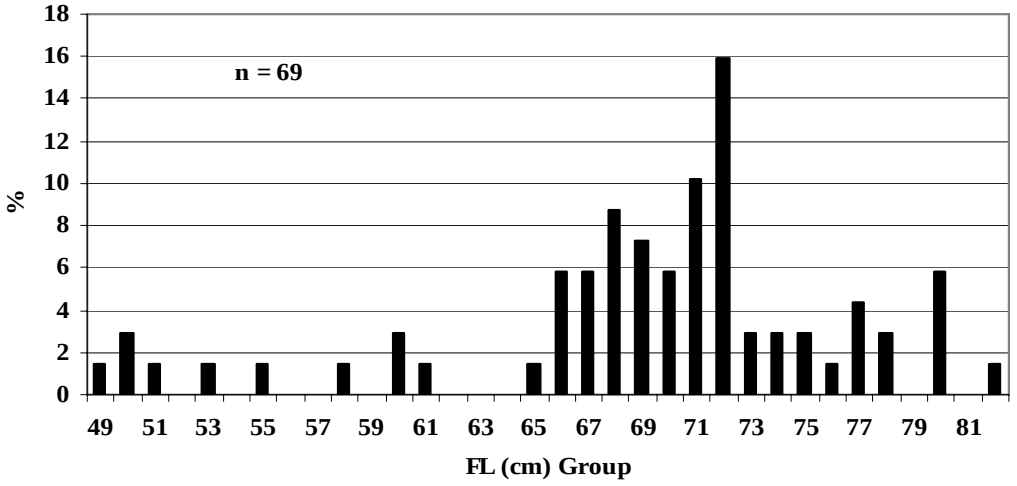

Figure 16. FL distribution of hatchery-origin (conventional broodstock progeny) spring Chinook salmon caught at the Catherine Creek trap, 2006 (first time captures).

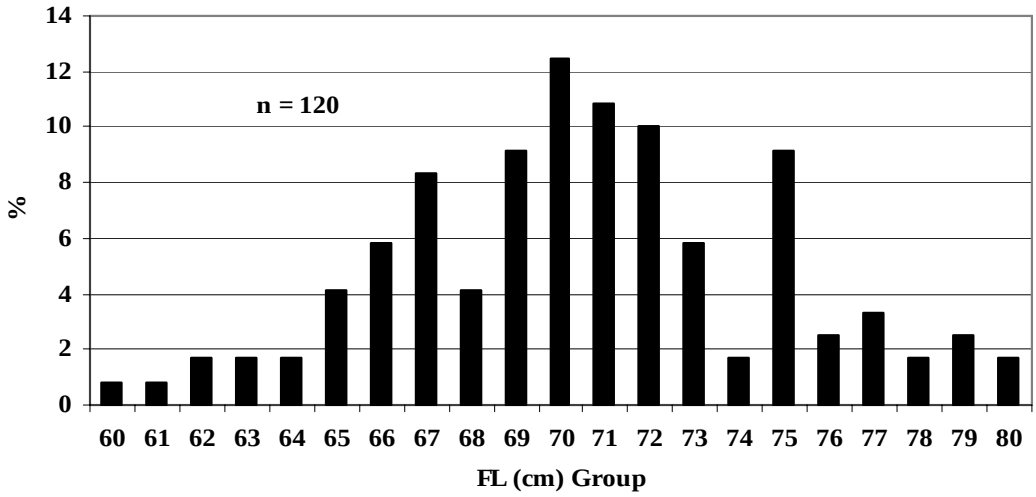

Figure 17. FL distribution of hatchery-origin (captive broodstock progeny) spring Chinook salmon caught at the Catherine Creek trap, 2006 (first time captures).

CWT recovered from fish collected at the Catherine Creek trap were from 2 tag groups, both Catherine Creek stock (Table 14). All but two recoveries were 4 year old fish.

Table 14. Run year 2006 CWT recovery data for fish from the Catherine Creek trap (euthanized or taken for conventional broodstock).

Tag status	Tag code	Brood Year	Stock	n	%
1	70754	2003	Cath Creek	2	3.85
	93840	2002	Cath Creek	48	92.31
2*				2	3.85
				52	

* *no CWT recovered*

1.5.2.1.2 Conventional spawning

Totals used for conventional broodstock in 2006 included 12 natural-origin males, and 8 females, and 16 hatchery-origin males and 29 females. One hatchery-origin female and one hatchery-origin male died while being held at the hatchery. One natural-origin male and one hatchery-origin male were killed and not spawned. Natural-origin females were spawned on 31 August (3) and 7 September (5). Hatchery-origin females were also spawned on 31 August (17) and 7 September (12). Length frequencies of hatchery- and natural-origin males were similar (Figures 18, 19). A higher percentage of large females (> 80 cm) were spawned from the natural-origin group (Figures 20, 21).

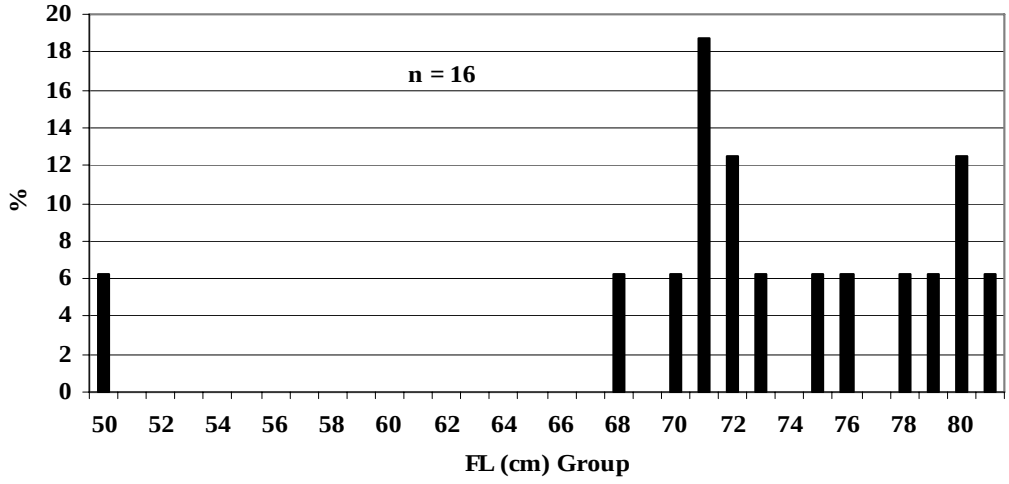

Figure 18. FL distribution for male Catherine Creek conventional broodstock, 2006 (AD-clip).

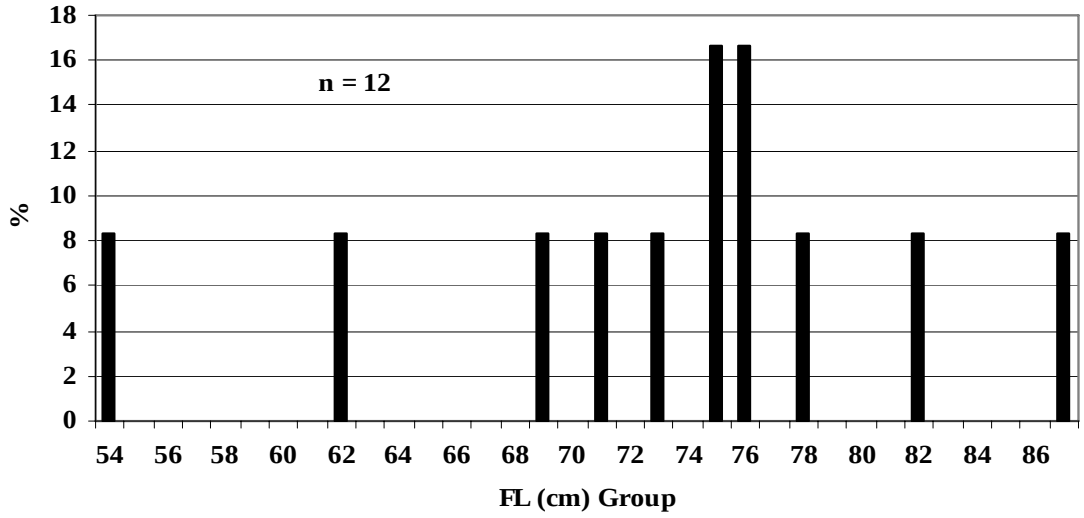

Figure 19. FL distribution for male Catherine Creek conventional broodstock, 2006 (natural).

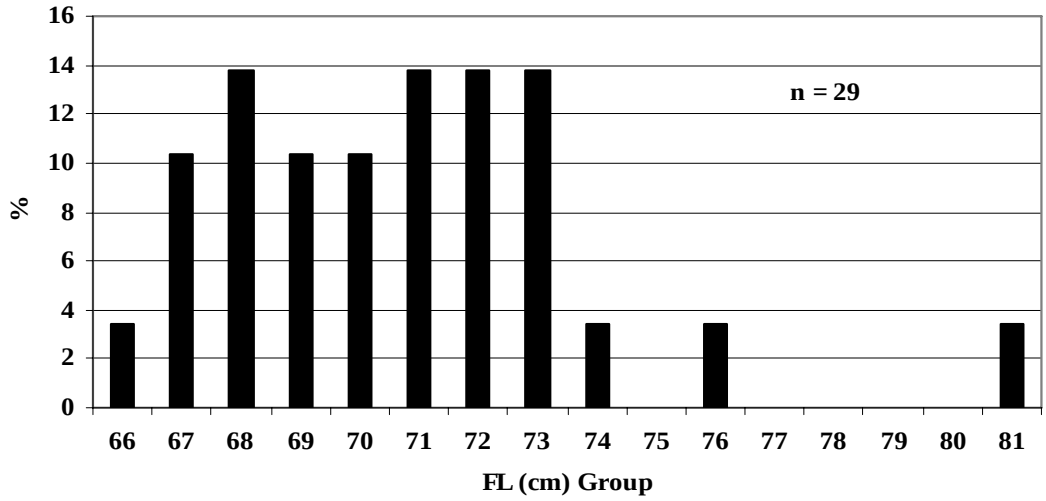

Figure 20. FL distribution for female Catherine Creek conventional broodstock (AD clip), 2006.

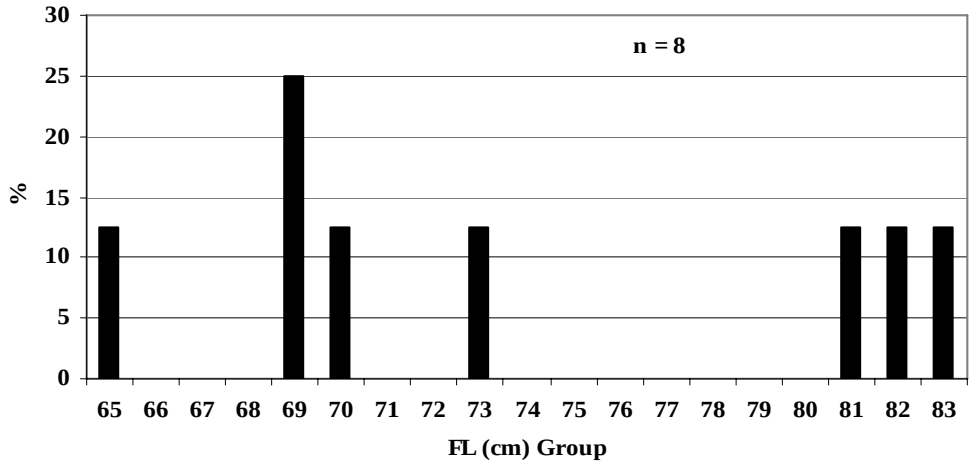

Figure 21. FL distribution for female Catherine Creek conventional broodstock (natural), 2006.

Mean FL (mm) of hatchery-origin males spawned was slightly less than for natural-origin males (Table 15). Mean FL of hatchery-origin females spawned was about 33 mm less than for natural-origin females. Mean weight (kg) of hatchery-origin males spawned was slightly greater than for natural-origin males (Table 16). Mean weight hatchery-origin females spawned was almost 0.6 kg less than for natural-origin females.

Table 15. FL (mm) summary for Catherine Creek conventional broodstock spawned in 2006.

Origin	Sex	Mean FL	SE	Range	n
Hatchery	M	733.5	18.7	500-810	16
Natural	M	752.2	19.6	625-872	11
Hatchery	F	710.0	5.8	665-810	29
Natural	F	743.3	24.3	657-833	8

Table 16. Weight (kg) summary for Catherine Creek conventional broodstock spawned in 2006.

Origin	Sex	Mean FL	SE	Range	n
Hatchery	M	3.8	0.3	1.1-5.4	13
Natural	M	4.0	0.3	2.3-5.8	11
Hatchery	F	3.7	0.1	2.9-5.3	29
Natural	F	4.2	0.4	2.8-5.6	8

Adjusted R^2 values were higher for females than for males (Table 17). Mean fecundity was slightly higher for natural-origin than hatchery-origin fish, probably due to the larger mean size for natural-origin fish (Table 18).

Table 17. Length-weight (log) regression summary for Catherine Creek conventional broodstock spawned in 2006.

Origin	Sex	Slope	Intercept	Adj. R^2	n
Hatchery	M	-5.45666	3.146557	0.986287	12
Natural	M	-5.036140	2.998060	0.976578	11
Hatchery	F	-5.02946	3.012226	0.828669	29
Natural	F	-3.50805	2.481514	0.847398	8

Table 18. Fecundity (eggs/female) summary for Catherine Creek conventional broodstock spawned in 2006.

Origin	Mean	SE	Range	n
Hatchery	3,534	90	2,501-4,411	29
Natural	3,751	417	1,362-5,321	8

Mean egg weights for 36 Catherine Creek conventional broodstock ranged from 0.15-0.28 g with a median of 0.28 g (Figure 22). Mean egg weights for 7 natural-origin females ranged from 0.20-0.26 g with a median of 0.24 g. Mean egg weights for 29 hatchery-conventional broodstock progeny females ranged from 0.15-0.28 g with a median of 0.22 g.

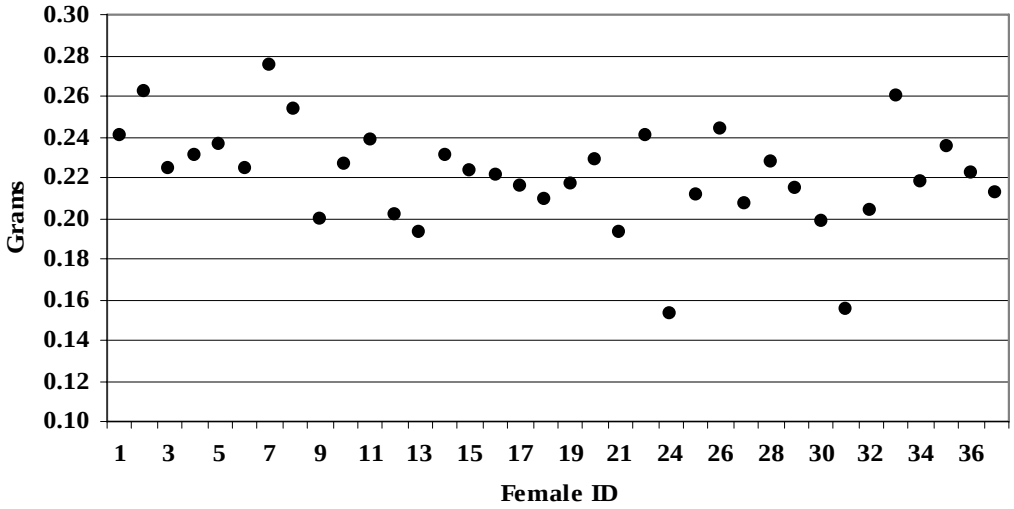

Figure 22. Mean weights for groups of 20 eggs each from 36 Catherine Creek conventional broodstock females spawned in 2006 (ODFW, unpublished data).

1.5.2.1.3 Spawning ground surveys

Catherine Creek spawning ground surveys during August-September 2006 yielded 86 carcass recoveries (Table 19). Two carcasses were recovered below the weir 1 hatchery-origin female, 1 natural-origin male). Origin, sex, or FL could not be determined for six fish. Total carcass recoveries above the trap were 37% of the number released. Recovery percentages were 22% for hatchery-origin and 43% for natural-origin fish. Natural-origin males and females released above the weir were roughly equal, but females dominated the recoveries. Females dominated the hatchery-origin fish released above the trap and carcass recoveries.

Table 19. Natural- and hatchery-origin spring Chinook salmon released above the Catherine Creek weir and carcass recoveries above the weir in 2006 by FL group, sex, and origin.

Passed					Recovered*			
Natural		Hatchery		FL (cm) Group	Natural		Hatchery	
M	F	M	F		M	F	M	F
3				40-44				
1		1		45-49			3	1
				50-54				
4		2		55-59				
6	6	9	2	60-64		2	1	
17	21	14	30	65-69		8	2	19
10	10	16	37	70-74	2	6	4	19
6	6	15	12	75-79		2	3	3
	1	2	1	80-84			3	2
				85-89				
47	44	59	82	Totals	2	18	16	44`

** Sex, origin, FL known; some carcasses were deteriorated so that these could not be determined.*

Forty-two hatchery-origin females were examined for percent spawned; thirty-eight were 100% spawned out, one was a prespawn mortality (0%) and 3 were 25-75% spawned out. Eighteen natural-origin females were examined for percent spawned; sixteen were 100% spawned out, and two were prespawn mortalities (0%).

Hatchery-origin female recoveries occurred on 29 August (6), 6 September (29), and 12 September (7). Nineteen natural-origin females were recovered on 29 August (8), 6 September (9), and 12 September (2). Natural-origin female carcasses appeared to be slightly more dispersed than those of hatchery-origin (Figure 21). The highest numbers of both hatchery- and natural-origin female carcasses were found in section 4, just below the acclimation facility. .

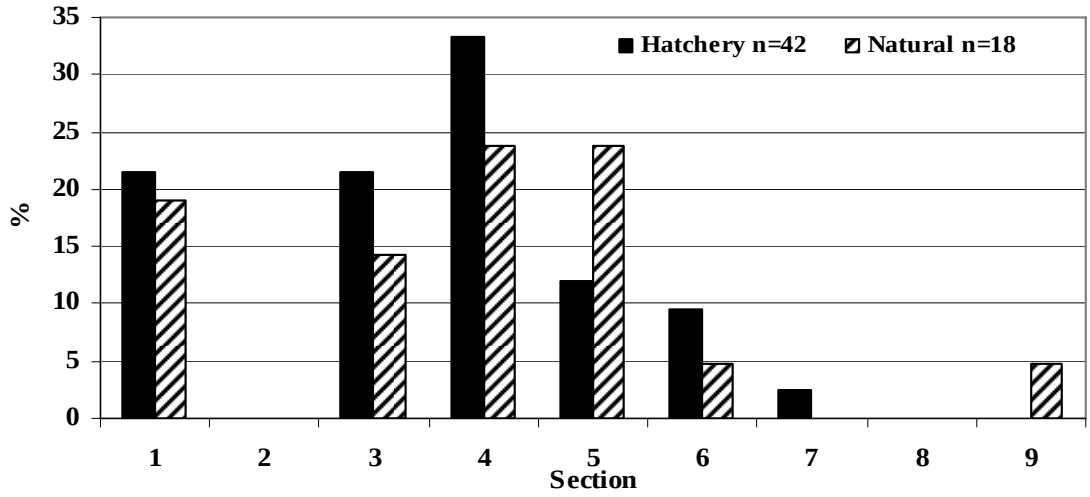

Figure 23. Female spring Chinook salmon carcass recoveries from Catherine Creek by section and origin, 2006.

Hatchery-origin carcasses on spawning ground surveys totaled 62. All tag status 1 carcass recoveries were from Catherine Creek stock tag groups released in Catherine Creek (Table 16). The largest numbers of fish were from brood year 2002 and over half were tag code 93840. Three of the tag status 2 recoveries (no CWT detected) were from fish with adipose clips; the fourth was from a fish of unknown clip status.

Table 20 Run year 2006 carcass recovery data for Catherine Creek.

Tag status	Tag code	BY	Stock	n	%
1	70753	2003	Cath Creek	1	1.61
	94040	2003	Cath Creek	1	1.61
	93835	2002	Cath Creek	8	12.90
	93836	2002	Cath Creek	8	12.90
	93840	2002	Cath Creek	32	51.61
2				9	14.52
7				3	4.84
				62	

1.5.2.1.4 Run reconstruction

All but 3 of the natural-origin fish collected at the Catherine Creek trap were aged using scales, and the estimated age composition of the total catch was 6.7% age 3, 78.3% age 4, and 15.0% age 5 (Table 17).

Table 21. Age-length key for unmarked spring Chinook salmon collected at the Catherine Creek trap, 2006.

	Scales Read				Expanded Total			
FL (cm)	Age 3	Age 4	Age 5	Totals	Age 3	Age 4	Age 5	Totals
40-59	6	2		8	7	2		9
60-79		94	2	96		94.8	2.2	97
≥80		1	5	6		0.3	5.7	6
Totals	6	97	7	110	7	97.1	7.9	112

Age composition of hatchery-origin fish was 4% age 3 and 96% age 4 (Table 18).

Table 22. Age-length table for hatchery-origin spring Chinook salmon collected at the Catherine Creek trap and on spawning ground surveys, 2006.

FL (cm)	Age 3	Age 4	Age 5	Totals
47	1			1
48	1			1
50	1			1
51	1			1
65		4		4
66		3		3
67		6		6
68		11		11
69		7		7
70		8		8
71		11		11
72		12		12
73		11		11
74		4		4
75		2		2
76		2		2
77		1		1
78		3		3
79		2		2
80		4		4
81		3		3
83		2		2
Totals	4	96	0	100

About 117 age 4/5 hatchery-origin BY 2001 fish returned to the stream during ryn years 2004-2005-2006, but only 79 contributed as in-river spawners (Table 23). Most of the remaining hatchery-origin fish were outplanted to Lookingglass Creek or used as conventional broodstock. Hatchery-origin BY 2001 age 4/5 returns to the stream were 0.000902 (117/129,705) of the total released, and age 4/5 in-river spawners were

0.000586. About 53 age 4/5 natural-origin BY 2001 fish returned to the stream and 40 contributed as in-river spawners. Most of the remainder were used as conventional broodstock.

Table 23. Summary of adult spring Chinook salmon returns to Catherine Creek and in-river spawners for brood year 2001, by return year and mark.

			Estimated	
Return Year	Age	Mark	Returns to River	In-river spawners
2004	3	Ad clip	46	3
2005	4	Ad clip	117	76
2006	5	Ad clip	0	0
BY 2001 Totals			163	79
BY 2001 Totals (excluding age 3)			117	76
2004	3	Unclipped	5	5
2005	4	Unclipped	48	39
2006	5	Unclipped	5	1
BY 2001 Totals			58	45
BY 2001 Totals (excluding age 3)			53	40

All recoveries but one (Imnaha River) of BY 2001 CWT-fish (expanded) from smolts released in Catherine Creek in 2002 were from two general areas: mainstem Columbia R./Snake R., and the Grande Ronde Basin (including Catherine Creek) (Table 24). The largest number was recovered at the Catherine Creek trap or on Catherine Creek spawning ground surveys. All but 2.28 of the Columbia River recoveries were from AD-selective sport fisheries. Some of the Lookingglass Creek recoveries were fish that were caught at the Catherine Creek weir in 2004 and outplanted to Lookingglass Creek for harvest or to spawn naturally. Tag code 93541 accounted for 54.62% of the recoveries, tag code 93543 for 41.31% and tag code 93542 for 4.07%.

Table 24. Brood year 2001 coded wire tag code recoveries* by location during 2004-2006 for juvenile spring Chinook salmon released in Catherine Creek.

Recovery Location	Totals	%
Columbia River[1]	31.34	25.2
Imnaha River Trap	1	0.8
Lookingglass Creek[2]	20.2	16.3
upper Grande Ronde River[3]	17.17	13.8
Catherine Creek Trap	31.24	25.2
Catherine Creek Spawning Ground Surveys	23.23	18.7
	124.18	

[1] *includes commercial, sport, tribal fisheries, Cowlitz Salmon Hatchery*
[2,,3] *includes trap, spawning ground surveys, and hatchery*

SAR for three tag groups ranged from 0.0001-0.002 (Figure 24). Sample sizes ranged from 24,242-52348, after correcting for tag loss.

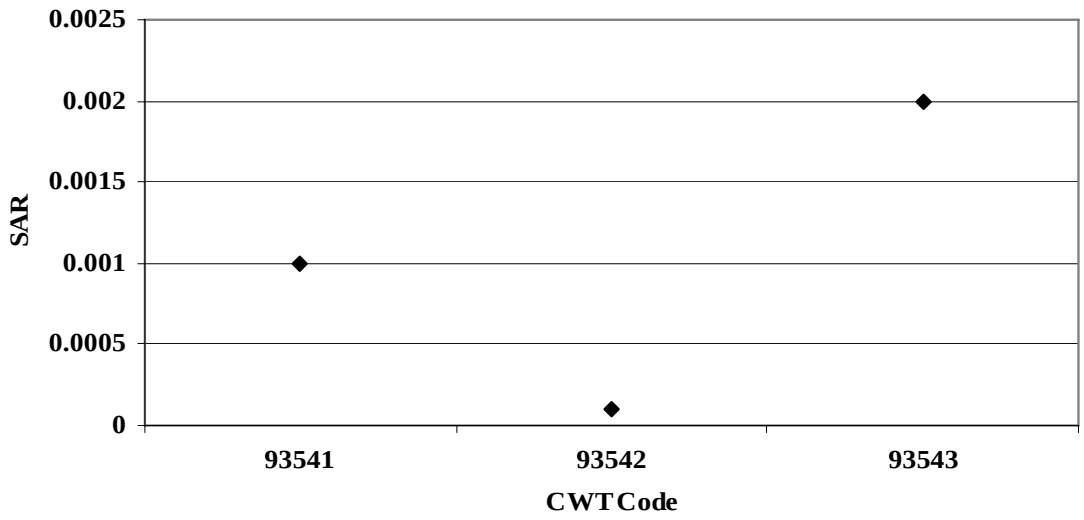

Figure 24. SAR for BY 2001 spring Chinook salmon released into Catherine Creek.

1.5.2.1.5 Mean FL at age

Hatchery-origin fish were larger than natural-origin fish at ages 3 and age 4 (Table 25). This difference was slightly less than 10 mm for age 3 males, but 43 mm for age 4 males and 20.7 mm for age 4 females.

Table 25. FL at age summary for Catherine Creek spring Chinook salmon by age, sex, and origin for fish collected at the trap or on spawning ground surveys, 2006.

Age	Sex	Origin	Mean FL (mm)	SE	Range	n
3	M	Hatchery	498.0	9.9	480-514	3
3	M	Natural	488.7	32.4	404-590	6
3	F	Hatchery	470			1
3	F	Natural				0
4	M	Hatchery	748.3	9.5	650-830	27
4	M	Natural	705.3	7.1	575-823	61
4	F	Hatchery	710.0	4.4	650-810	69
4	F	Natural	689.3	5.2	610-774	51
5	M	Hatchery				0
5	M	Natural	872	0		2
5	F	Hatchery				0
5	F	Natural	814.1	6.7	778-833	9

Mean FL at age 3 ranged from 481.0-495.9 for two tag code groups (Figure 25). Sample sizes were 15 (code 93541) and 17 (code 93543).

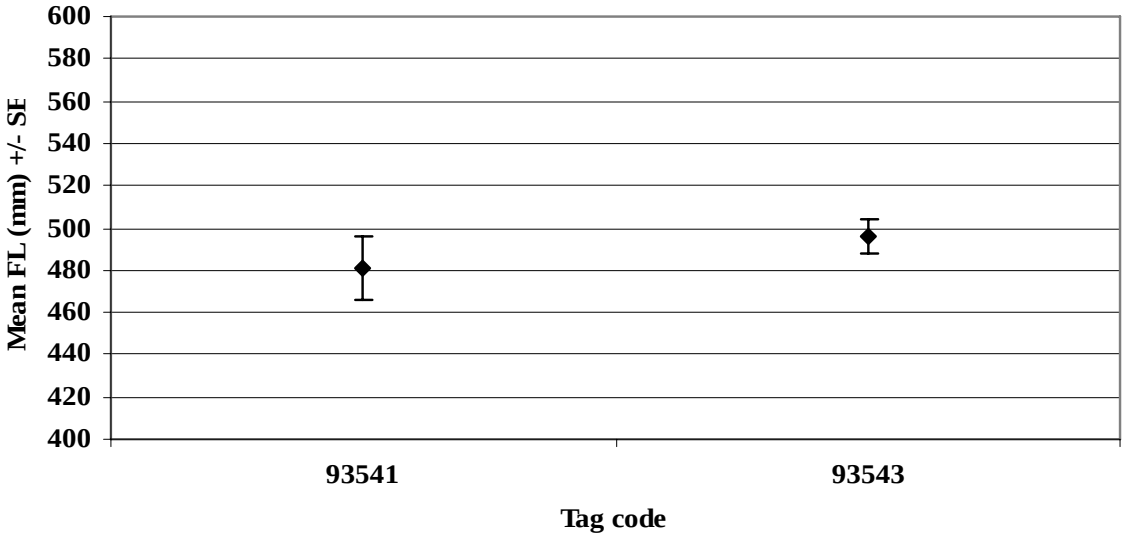

Figure 25. Mean FL (mm, +/- SE) for brood year 2001 hatchery-origin spring Chinook released into Catherine Creek and recovered during 2004 as age 3 fish.

Mean FL at age 4 for 3 tag codes ranged from 694.6-732.9 mm (Figure 26). Sample sizes were 33 (tag code 93541), 5 (tag code 93542), and 29 (tag code 93543).

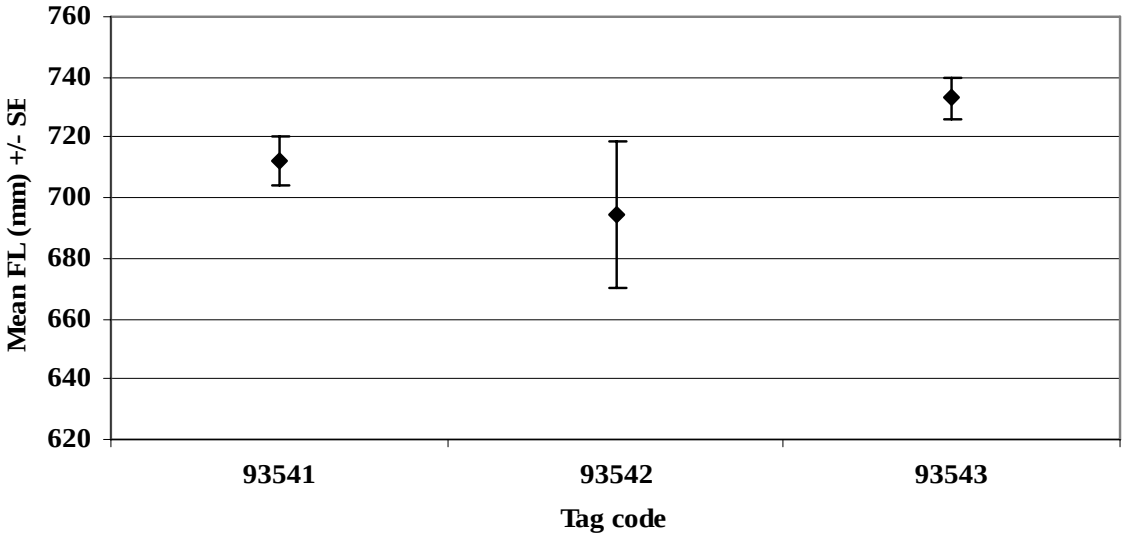

Figure 26. Mean FL (mm, +/- SE) for brood year 2001 hatchery-origin spring Chinook released into Catherine Creek and recovered during 2005 as age 4 fish.

1.5.2.2 upper Grande Ronde River

1.5.2.2.1 Trapping

The upper Grande Ronde River trap was operated from 3 March-25 July 2006. Natural-origin fish from the upper Grande Ronde River were passed above the trap to spawn, weir mortalities, or transported to Lookingglass Hatchery to be held for use as conventional broodstock. Disposition of hatchery-origin fish included trap mortalities, removal (euthanizing) of jacks to maintain desired hatchery:natural ratios, and passing above the trap to spawn. Only conventional broodstock progeny were used for spawning at Lookingglass Hatchery.

The first natural- and hatchery-origin fish were collected on 12 June 2006. The last natural-origin fish was collected on 30 June 2006 and the last hatchery-origin on 12 July 2006. No fish had radio tags or could be confirmed as strays by visual marks. Total catches of natural- and hatchery-origin fish were 56 and 151, respectively. Putative sex ratios of natural- and hatchery-origin fish were 1.07 F:M and 1.46 F:M, respectively. Peak catch of hatchery-origin fish occurred on 13 June 2006 and peak catches of natural-origin fish occurred on 16 June and 23 June 2006. Differences in the cumulative frequency distributions for arrival timing at the upper Grande Ronde River trap between hatchery- and natural-origin fish differed only slightly (Figure 27).

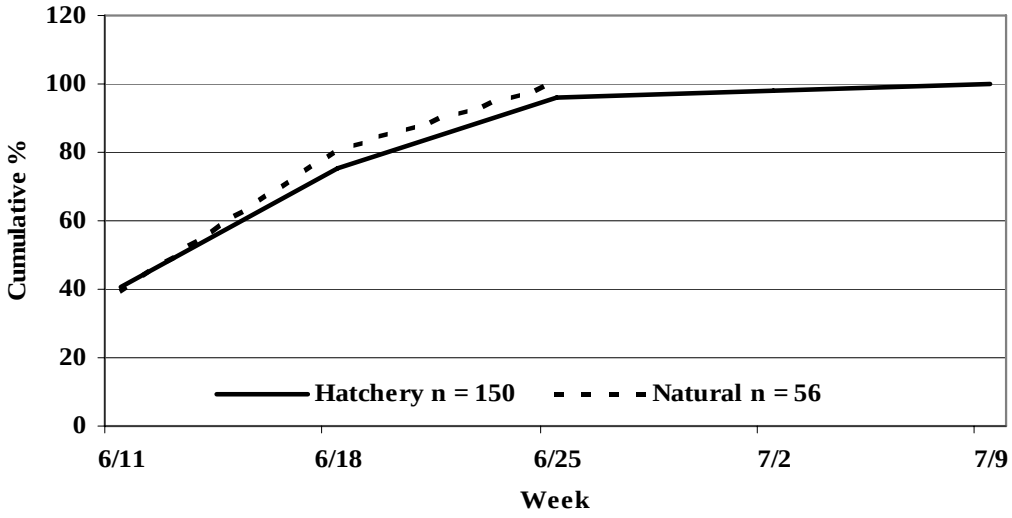

Figure 27. Cumulative percentages of natural- and hatchery-origin spring Chinook salmon caught by week of the year and age group at the upper Grande Ronde River weir, 2006.

Conventional broodstock progeny collected in the trap from 12 June-12 July 2006 totaled 142 and the sex ratio was 1.41 F:M. Eight captive broodstock progeny (6 F, 2 M) were collected from 13 June-26 June 2006.

Peak catches occurred about the time a rapid increase in water temperatures began (Figure 28). Water temperatures were recorded from 18 March-30 June 2006. The

highest water temperature recorded was 23.5°C on 25 June and the highest daily mean temperature of 18.6°C occurred on 28 June.

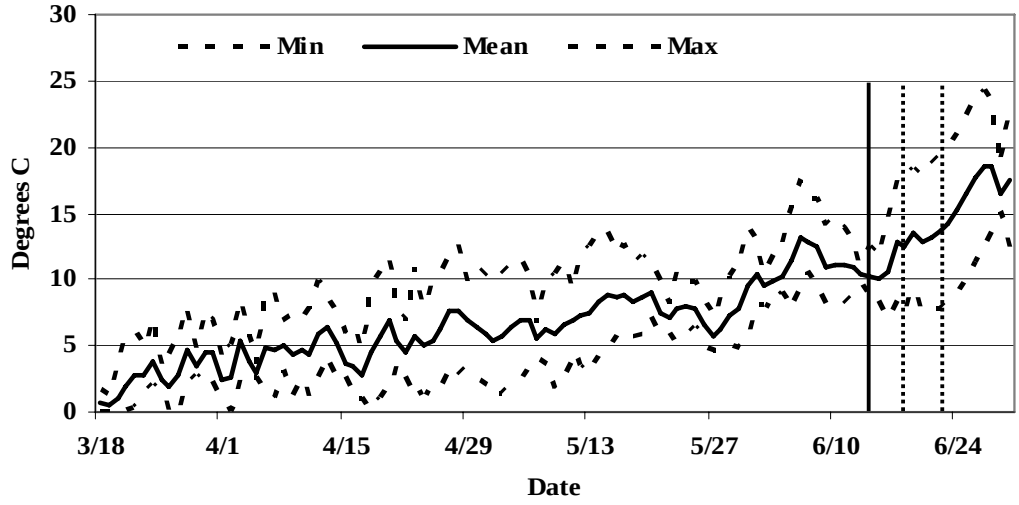

Figure 28. Daily minimum, mean, and maximum water temperatures at the upper Grande Ronde adult site, with peak catches of hatchery- (solid vertical line) and natural-origin (dashed vertical line) spring Chinook salmon, 2006.

The highest water temperatures recorded at the upper Grande Ronde River site below Clear Creek were 23.5°C on 24-25 and 28 July 2006 (Figure 29). The highest daily temperature was 17.4°C on 24 July 2006.

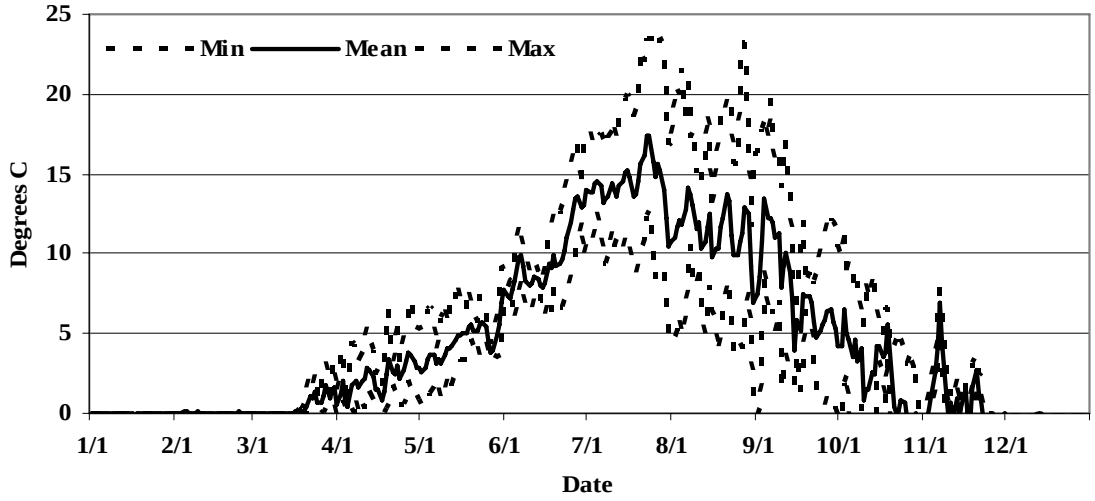

Figure 29. Daily minimum, mean, and maximum water temperatures at the upper Grande Ronde River (below Clear Creek) site, 2006 (preliminary data provided courtesy Jennifer Wiseman, Wallowa-Whitman National Forest).

Peak catches at the upper Grande Ronde River trap occurred about three weeks after the peak flow was observed at the USGS gauging station near Troy, OR (Figure 30).

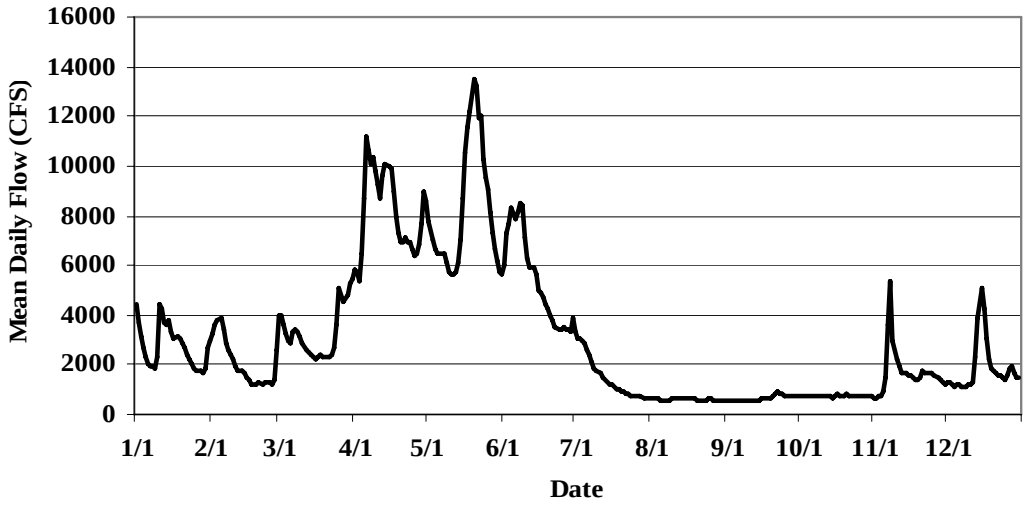

Figure 30. Mean daily flows (CFS) recorded at the USGS gauging station on the Grande Ronde River near Troy, OR, 2006.

A large number of hatchery-origin fish were in the 67-80 cm FL groups (Figure 31), suggesting a large number of 4 year olds, with few 3 or 5 year olds. FL frequency distributions for both conventional (Figure 32) and captive broodstock progeny (Figure 33) showed a similar pattern. A low number natural-origin fish was collected and most were 60-80 cm FL (Figure 34).

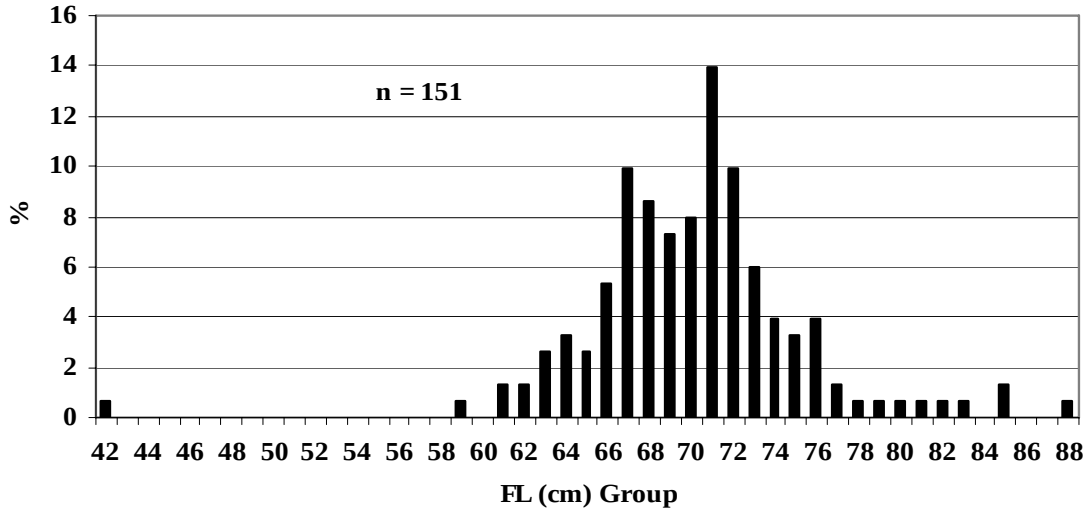

Figure 31. FL distribution of hatchery-origin spring Chinook salmon caught at the upper Grande Ronde River trap, 2006 (first time captures).

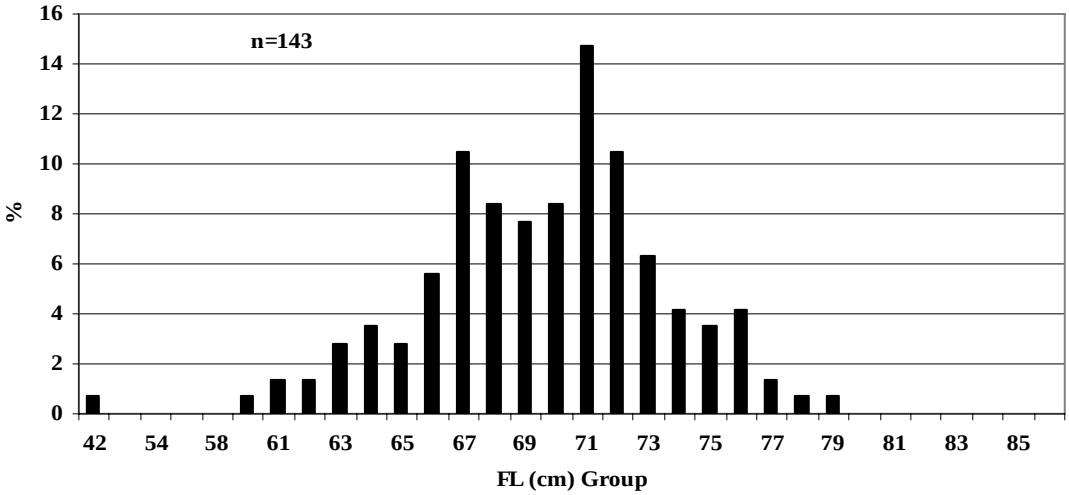

Figure 32. FL distribution of hatchery-origin (conventional broodstock progeny) spring Chinook salmon caught at the upper Grande Ronde River trap, 2006 (first time captures).

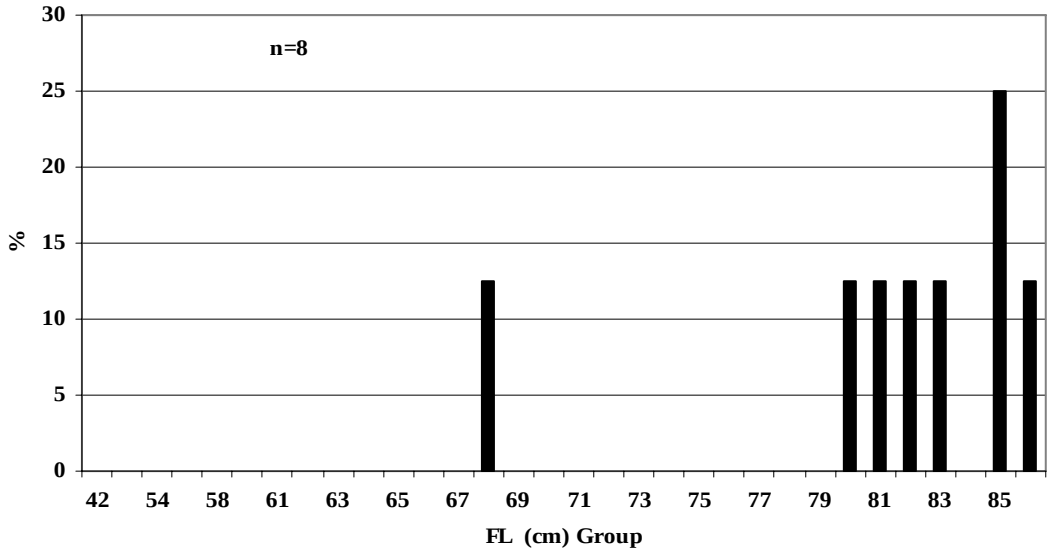

Figure 33. FL distribution of hatchery-origin (captive broodstock progeny) spring Chinook salmon caught at the upper Grande Ronde River trap, 2006 (first time captures).

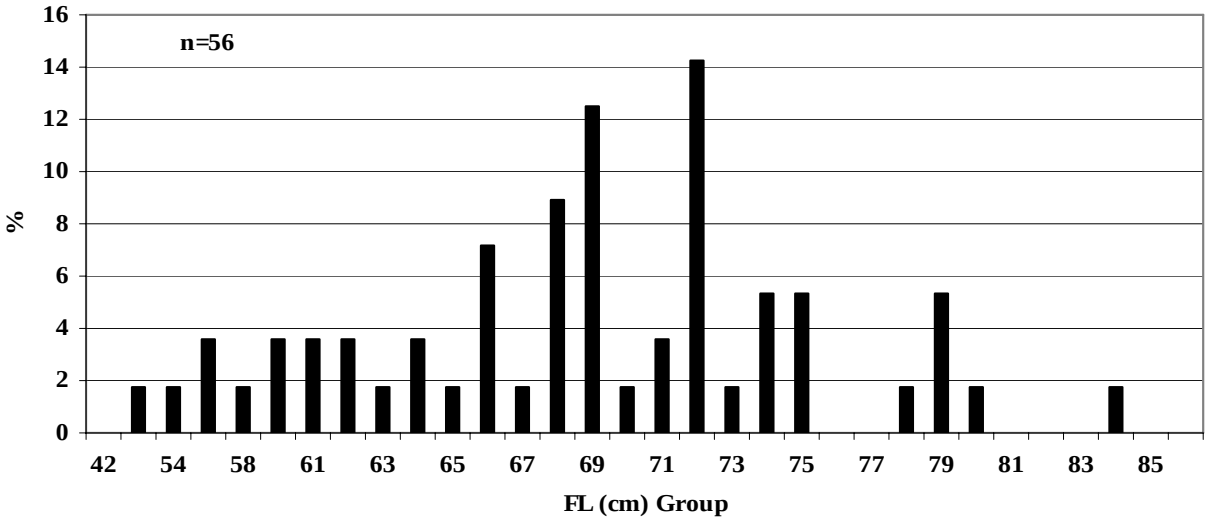

Figure 34. FL distribution of natural-origin spring Chinook salmon caught at the upper Grande Ronde River trap, 2006 (first time captures).

Only one CWT group was represented in fish killed at the trap or used for conventional broodstock (Table 26).

Table 26. Run year 2006 CWT recovery data for fish from the upper Grande Ronde River trap (euthanized or taken for conventional broodstock).

Tag status	Tag code	Brood Year	Stock	n	%
1	93833	2002	UGR	120	93.02
2				2	1.55
3				1	0.78
7				6	4.65

1.5.2.2.2 Conventional spawning

Conventional broodstock included 12 natural-origin males and 13 females, and 45 hatchery-origin males and 71 females. Three natural-origin and one hatchery-origin males were killed without being spawned. Fifteen hatchery-origin males and two natural-origin females died while being held at Lookingglass Hatchery. Natural-origin females were spawned on 24 August (2), 7 September (3), 14 September (7), and 19 September (1). Hatchery-origin females were spawned on 17 August (4), 24 August (10), 31 August (14), 7 September (24), 14 September (18), and 19 September (1). Length frequencies of hatchery- and natural-origin fish were similar for males and females (Figures 35-38).

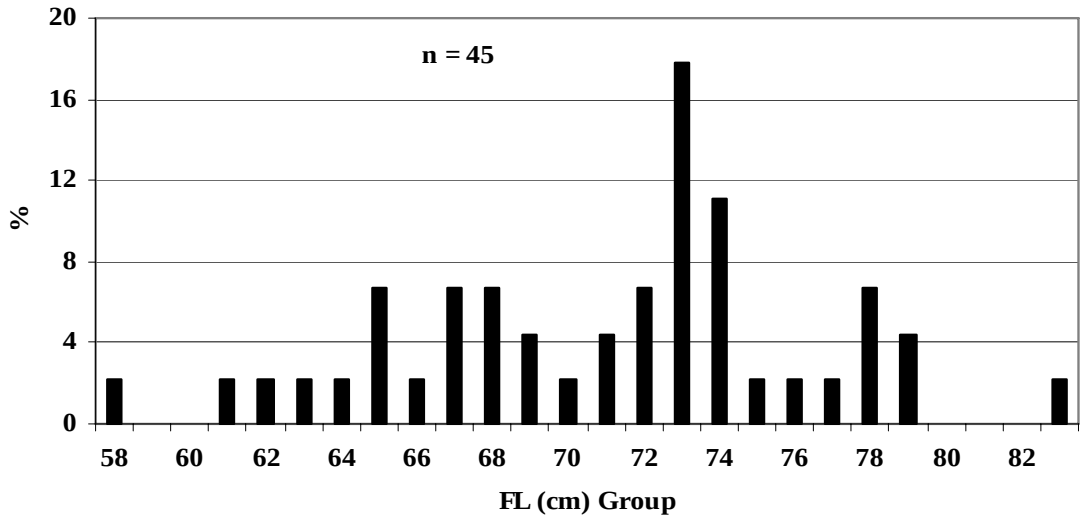

Figure 35. FL distribution for male upper Grande Ronde River conventional broodstock (CWT, no AD clip), 2006.

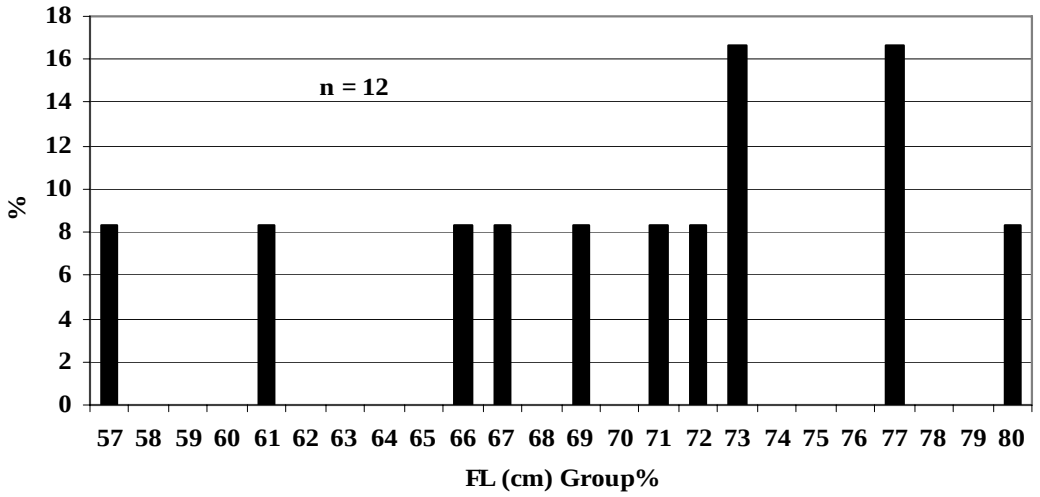

Figure 36. FL distribution for male upper Grande Ronde River conventional broodstock (natural), 2006.

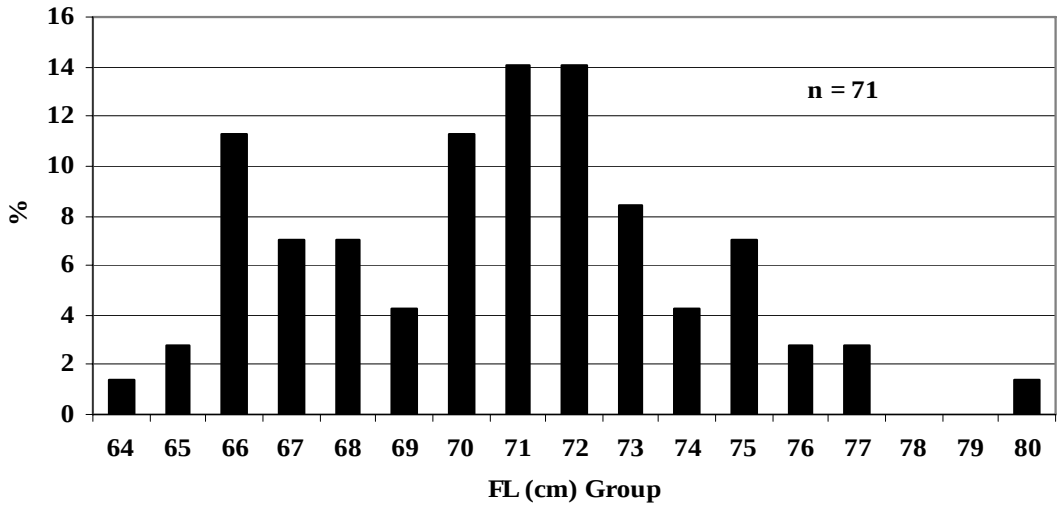

Figure 37. FL distribution for female upper Grande Ronde River conventional broodstock (CWT, no AD clip), 2006.

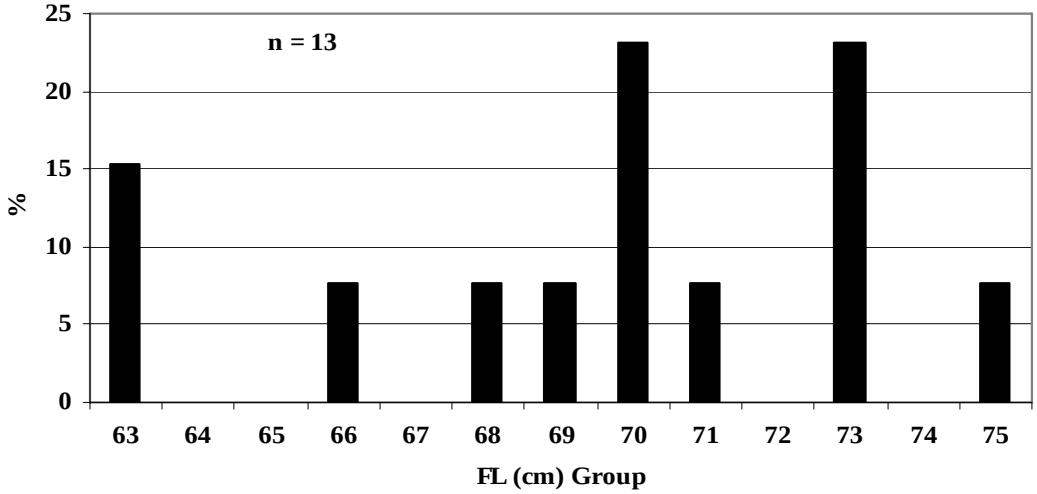

Figure 38. FL distribution for female upper Grande Ronde River conventional broodstock (natural), 2006.

Mean FL of hatchery-origin males and females spawned were both slightly larger than for natural-origin (Table 27). Mean weights of hatchery- and natural origin males spawned differed by 0.1 kg (Table 28). Because of the small number of fish weighed, the length-weight regression for natural-origin males was not calculated (Table 29). Mean fecundities of hatchery- and natural origin fish varied by only 25 eggs/fish (Table 30). .

Table 27. FL (mm) summary for upper Grande Ronde River conventional broodstock spawned in 2006.

Origin	Sex	Mean FL	SE	Range	n
Hatchery	M	714.2	8.0	589-836	45
Natural	M	707.0	19.5	578-808	12
Hatchery	F	710.7	4.0	645-800	71
Natural	F	696.4	9.4	630-753	13

Table 28. Weight (kg) summary for upper Grande Ronde River conventional broodstock spawned in 2006.

Origin	Sex	Mean Wgt	SE	Range	n
Hatchery	M	3.1	0.1	1.7-4.4	29
Natural	M	3.2	0.6	1.8-4.5	4
Hatchery	F	3.5	0.1	2.3-4.7	71
Natural	F	3.5	0.2	2.6-4.2	13

Table 29. Length-weight (log) regression summary for upper Grande Ronde River conventional broodstock spawned in 2006.

Origin	Sex	Slope	Intercept	Adj. R^2	n
Hatchery	M	-3.539718	2.458879	0.834009	29
Hatchery	F	-4.408393	2.787290	0.748337	71
Natural	F	-4.743910	2.910096	0.898075	13

Table 30. Fecundity (eggs/female) summary for upper Grande Ronde River conventional broodstock spawned in 2006.

Origin	Mean	SE	Range	n
Hatchery	3,521	66	2,376-4,579	70
Natural	3,546	164	2,366-4,489	13

Mean egg weights for 84 females ranged from 0.12-0.27 g with a median of 0.21 g (Figure 39). Mean egg weights for 13 natural-origin females ranged from 0.18-0.26 g with a median of 0.21 g. Mean egg weights for 71 hatchery-conventional broodstock progeny females ranged from 0.12-0.27 g with a median of 0.21 g.

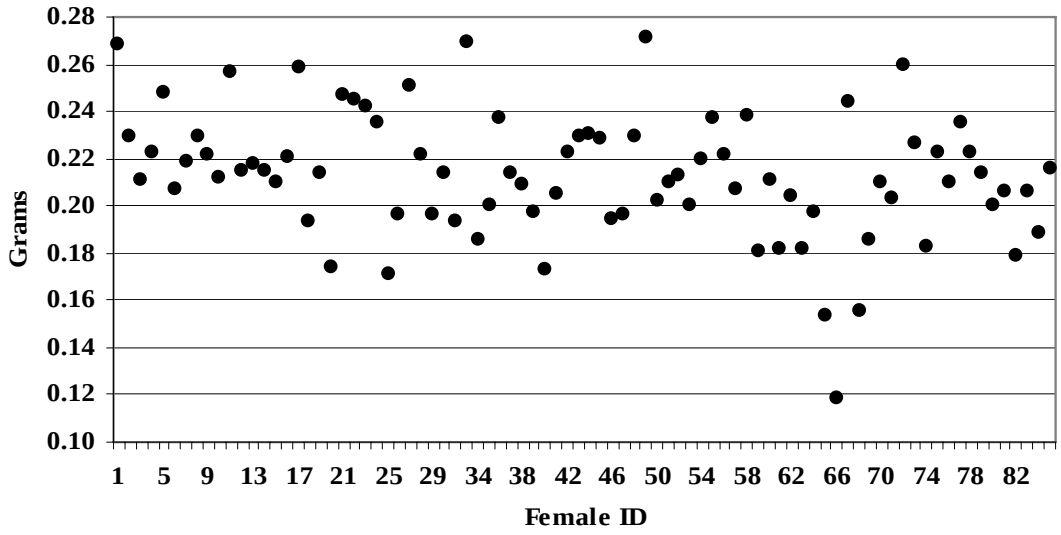

Figure 39. Mean weights for 20 eggs each from 84 upper Grande Ronde River conventional broodstock females spawned in 2006 (ODFW, unpublished data).

1.5.2.2.3 Spawning ground surveys

Only 55 fish were released above the weir to spawn naturally in 2006 (Table 31). Imilar numbers of hatchery- and natural-origin fish were passed, but few hatchery-origin males were passed. Hatchery-origin fish included 19 marked with coded wire only (conventional broodstock progeny) and 8 with coded wire and adipose clips (captive broodstock progeny). Ten conventional broodstock progeny initially transported to Lookingglass Hatchery and held were released at the acclimation facility on 17 August 2006.

Table 31. Natural- and hatchery-origin spring Chinook salmon released above the upper Grande Ronde River trap in 2006 by FL group, sex, and origin.

Hatchery			Natural	
M	F	FL (cm) Group	M	F
1		40-44		
		45-49	1	
		50-54	1	
		55-59	3	
	2	60-64	1	2
	10	65-69	2	6
1	6	70-74	3	3
		75-79	2	2
1	3	80-84	1	1
1	2	85-89		
4	23	Totals	14	14

Seven carcasses were recovered during spawning ground surveys in August and September 2006; five above the trap and two below. Four of the five carcasses above the trap were spawned out females, and one was male. FL were 675-710 mm for the females and 725 for the male. The two carcasses recovered below the weir had apparently been poached and few data could be obtained.

Snouts were taken from five fish recovered on spawning ground surveys. Four were tag code 93833 (BY 2002), and three that were measured ranged from 675-710 mm. One was tag code 93834 (BY 2002) and was 685 mm FL.

1.5.2.2.4 Run reconstruction

All natural-origin fish collected in the trap aged using scales were age 4 and ranged from 578-808 mm FL. All hatchery-origin fish were also age 4 (Table 32).

Table 32. Age-length table for hatchery-origin spring Chinook salmon collected at the upper Grande Ronde River trap or on spawning ground surveys, 2006.

FL (cm)	Age 3	Age 4	Age 5	Totals
58		1		1
.				
62		1		1
63		2		2
64		2		2
65		6		6
66		8		8
67		10		10
68		11		11
69		7		7
70		8		8
71		13		13
72		11		11
73		15		15
74		7		7
75		8		8
76		3		3
77		3		3
78		3		3
79		3		3
80		1		1
.				
83		1		1
.				
99		1		1
Totals	0	125	0	125

A total of 237,560 ad-clipped BY 2001 spring Chinook salmon smolts were released from the upper Grande Ronde River acclimation facility in 2003. About 390 age 4/5 hatchery-origin BY 2001 fish returned to the stream and 345 contributed as in-river spawners (Table 33). Most of the remaining hatchery-origin fish were used as conventional broodstock. Hatchery-origin BY 2001 age 4/5 returns to the stream were 0.0016416 (390/237,560) of the total released, and age 4/5 in-river spawners were 0.0014522. About 16 age 4/5 natural-origin BY 2001 fish returned to the stream and 11 contributed as in-river spawners. Most of the remainder were used as conventional broodstock.

Table 33. Summary of adult spring Chinook salmon returns to the upper Grande Ronde River and in-river spawners for brood year 2001, by return year and mark.

			Estimated	
Return Year	Age	Mark	Returns to River	In-river spawners
2004	3	Ad clip	77	49
2005	4	Ad clip	406	347
2006	5	Ad clip	9	9
BY 2001 Totals			492	405
BY 2001 Totals (excluding age 3)			415	356
2004	3	Unclipped	7	5
2005	4	Unclipped	13	9
2006	5	Unclipped	6	6
BY 2001 Totals			26	20
BY 2001 Totals (excluding age 3)			19	15

Most (expanded) recoveries of CWT-fish from BY 2001 smolts released in the upper Grande Ronde River during 2004-20062003 were from the upper Grande Ronde River trap and spawning ground surveys (Table 34). Columbia River recoveries were primarily in AD-selective sport fisheries (68.13) or gillnet fisheries (18.4). Tag codes 93549, 93544, and 93545 each comprised from 17.8-35.1% of the totals in Table 34. The remaining 5 tag codes (92607, 93546, 93547, 93548, and 93649) comprised 1.2-7.7%.

Table 34. Brood year 2001 coded wire tag code recoveries* by location during 2004-2006 for juvenile spring Chinook salmon released in the upper Grande Ronde River.

Recovery Location	Totals	%
Columbia River[1]	91.98	37.7
Lookingglass Creek[2]	13.14	5.4
Catherine Creek[3]	2.01	0.8
upper Grande Ronde River trap	84.33	34.6
upper Grande Ronde River spawning ground surveys	52.58	21.5
	244.04	

[1] *includes commercial, sport, tribal fisheries, high seas, Cowlitz Salmon Hatchery*
[2,3,] *includes traps and spawning ground surveys*

SAR values for most BY 2001 tag groups were less than 0.005 (Figure 40). Sample sizes for the 8 tag groups ranged from 479-57,684, after correcting for tag loss.

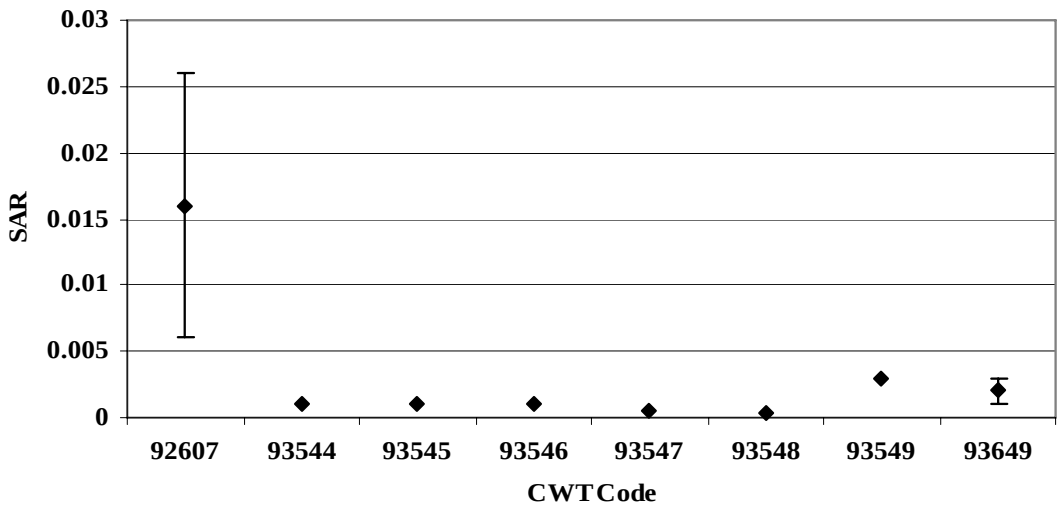

Figure 40. SAR for BY 2001 spring Chinook salmon released into the upper Grande Ronde River.

1.5.2.2.5 Mean FL at age

Mean FL for males was greater than for females, and was also greater for hatchery-origin fish than natural (Table 35).

Table 35. FL summary by sex and origin for age 4 upper Grande Ronde River spring Chinook salmon caught at the trap or on spawning ground surveys in 2006.

Sex	Origin	Mean FL (mm)	SE	Range	n
M	Hatchery	716.3	7.0	589-836	53
M	Natural	711.8	12.8	578-808	26
F	Hatchery	712.4	5.6	645-999	72
F	Natural	703.4	6.4	630-753	26

Mean FL at return for age 3 fish ranged from 503.6-534.3 (sample sizes 5-9), for age 4 ranged from 690.3-788.3 (sample sizes 3-73) and age 5, 807.5-902 (sample sizes 1-2) (Figures 41-43).

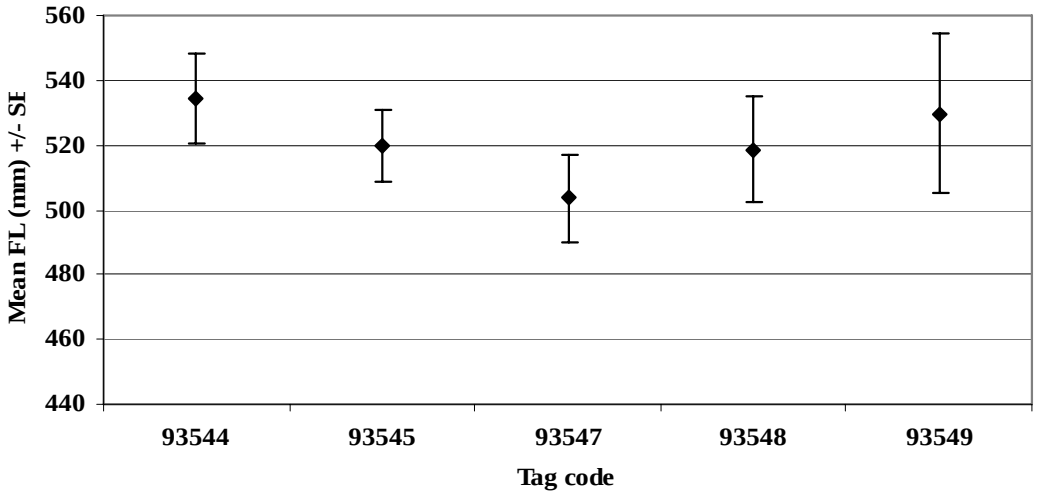

Figure 41. Mean FL (mm, +/- SE) for brood year 2001 hatchery-origin spring Chinook released into the upper Grande Ronde River and recovered during 2004 as age 3 fish.

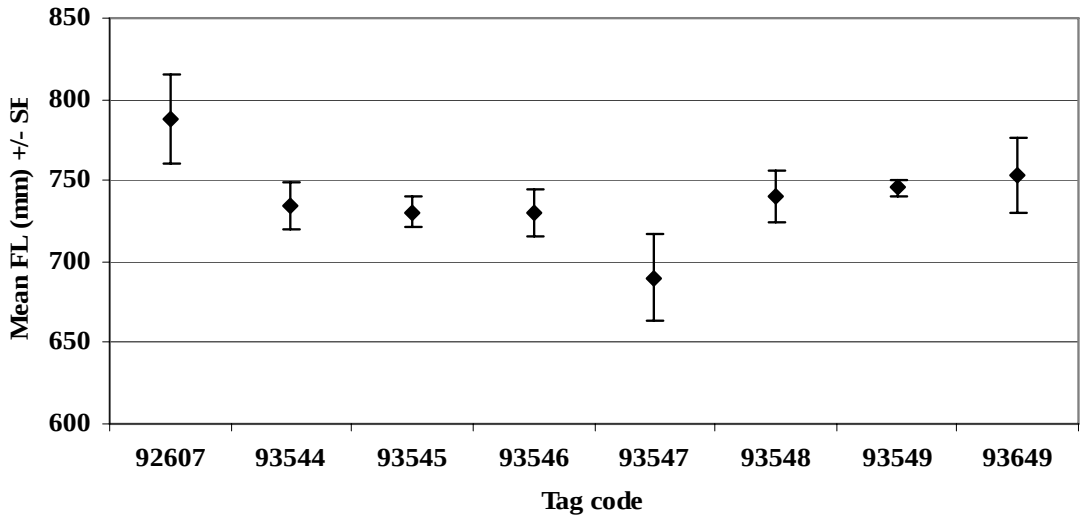

Figure 42. Mean FL (mm, +/- SE) for brood year 2001 hatchery-origin spring Chinook released into the upper Grande Ronde River and recovered during 2005 as age 4 fish.

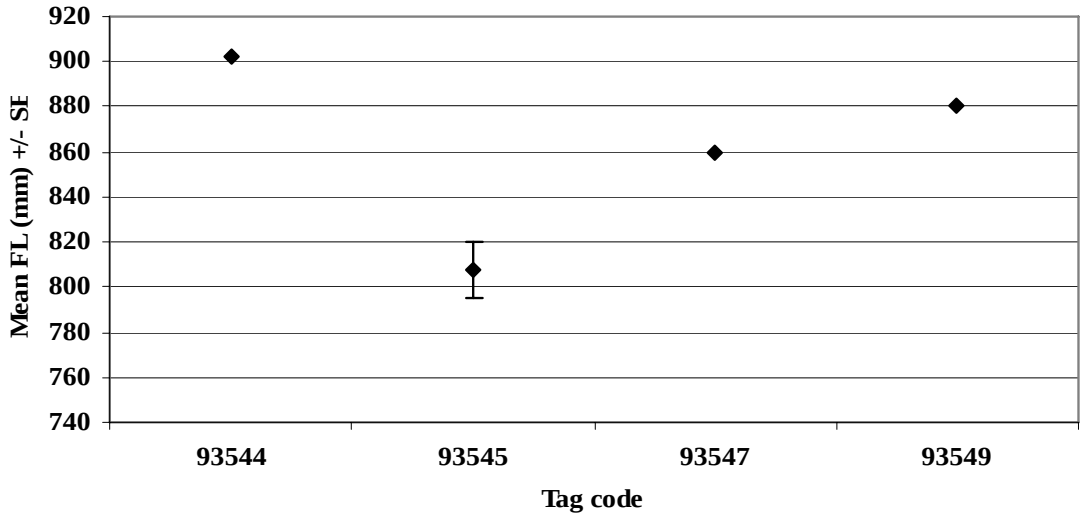

Figure 43. Mean FL (mm, +/- SE) for brood year 2001 hatchery-origin spring Chinook released into the upper Grande Ronde River and recovered during 2006 as age 5 fish.

1.6 DISCUSSION

Differences were evident between hatchery- and natural origin outmigrants in 2006 as in past years and included fork length, weight, K factor, migration timing, travel time, and survival. Rearing and release practices used for spring Chinook salmon juveniles from deviate from some of the recommendations by Flagg et al. (2000). Comanagers rear

hatchery juveniles to a larger size at release and release high numbers to compensate for expected poor smolt-to-adult survival.

Some past SAR values of hatchery-origin fish for both Catherine Creek and the upper Grande Ronde River were below the LSRCP/NEOH goal of 0.65% (Hesse et al. 2006). SAR values for various tag codes of BY 2001 fish were not available from the Columbia Basin Research website, so an overall value was estimated for hatchery returns. The estimated BY 2001 SAR for both Catherine Creek and the upper Grande Ronde River hatchery releases were also well below the goal. The numbers of returning adults has responded positively, with most being hatchery-origin. The first year of progeny-per-parent data for Catherine Creek will be available in 2007, to evaluate the productivity of returning hatchery-origin fish that spawned naturally.

Estimating the total returns and the number of spawners in each stream was difficult. In the upper Grande Ronde River, considerable spawning takes place below the weir. The age and mark composition of these fish has to be assumed, either from the group of fish passed or the total catch at the weir. These two groups are probably not the same, since broodstock are taken from each. Carcass recoveries for both streams are biased, with jacks rarely recovered in most years. Developing a consistent method for estimating returns to the stream that can be compared between years for the same stream is important.

Migration timing was similar between hatchery- and natural-origin adults for both streams. Sizes at return of hatchery fish were greater for all three age groups of Catherine Creek fish. Obtaining scale samples from natural-origin fish at the weirs and developing a method to accurately sex fish at the weirs would be helpful, in light of the small number of natural-origin fish returning, the even smaller number of natural-origin carcasses recovered during spawning ground surveys, and the biases toward females and larger fish evident in carcass recoveries.

No surveys prior to those regularly scheduled occurred in 2006, and only a few prespawn mortalities were observed during the regular surveys. However, poor water quality (excessive water temperatures just prior to and during spawning) has been problem in some years, particularly in the upper Grande Ronde River.

Differences in several aspects have been observed between hatchery- and natural origin fish. Firm conclusions are not possible due to the small samples sizes often available for natural fish, and the relatively small series of years available. Nonetheless, the cumulative effects of all factors may be substantial, may not be strictly additive, and may be both direct and indirect.

In future reports, graphs or tables summarizing various performance measures should be constructed, comparing hatchery- and natural-origin fish for each stream side-by-side. These performance measures should include mean FL, weight, and K factor at release, median arrival timing at and survival to Lower Granite Dam, for juveniles. Smolt-to-adult ratio should also be summarized for hatchery-origin fish. For adults, performance

measures should include arrival timing at the weirs, mean FL by age, age composition, fecundity, egg size, spawn timing, total returns and total in-river spawners.

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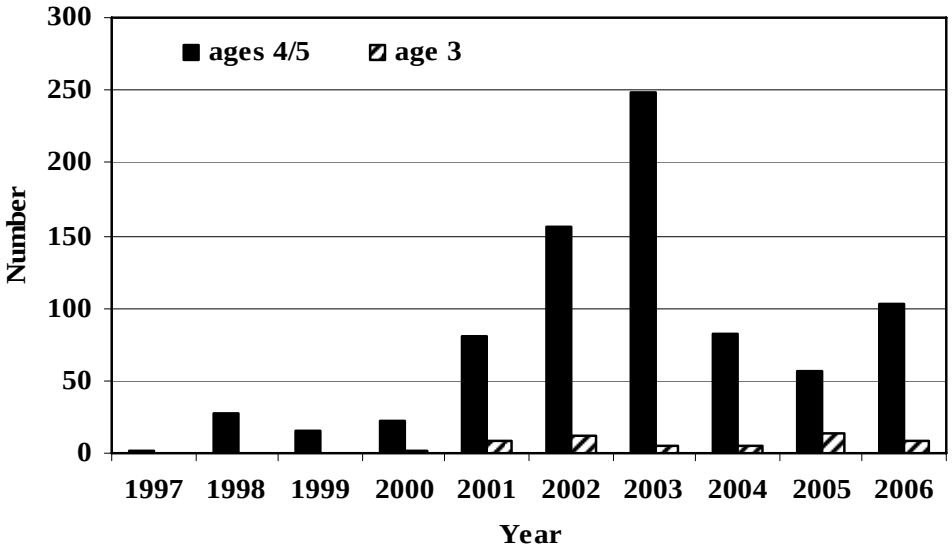
1.8 APPENDIX A

Appendix Table A1. Section locations for Catherine Creek spawning ground surveys.

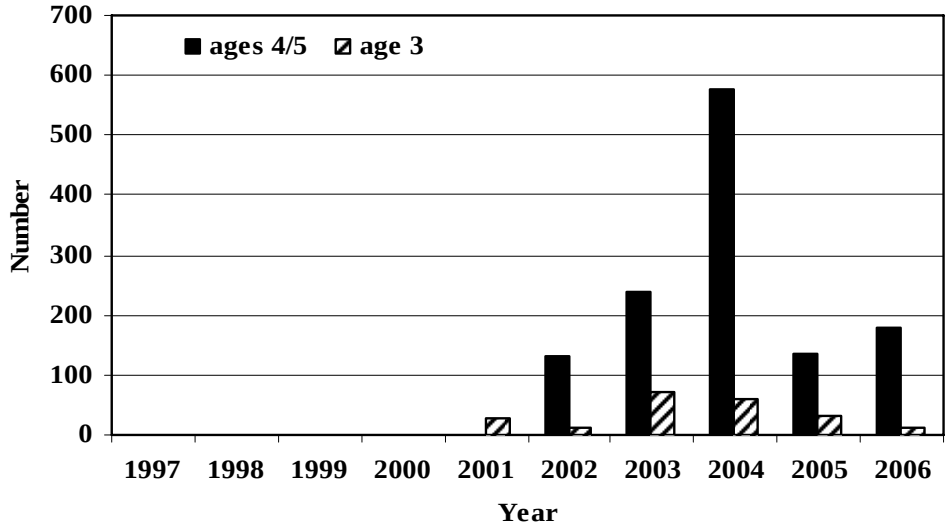
Section	Number
North Fork Campground to Forks	1
South Fork	2
Forks to 7735 Bridge	3
7735 Bridge to 203 Bridge	4
203 Bridge to Badger Flat Road	5
Badger Flat Road to Culvert (MP 5)	6
Culvert to top of Southern Cross	7
Bottom of Southern Cross to Weir	8
Weir to Second Bridge in Union	9

Appendix Table A2. Section locations for upper Grande Ronde River spawning ground surveys.

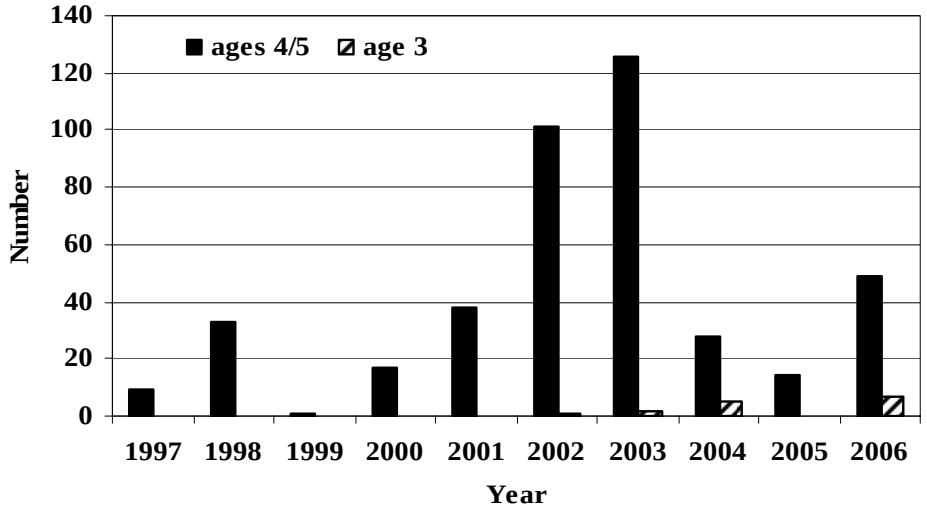
Section	Number
Three Penny to Carson Claim Bridge	1
Carson Claim Bridge to WWNF Boundary	2
Vey Meadow-WWNF Boundary to Cooper's Bridge	3
Vey Meadow-Cooper's Bridge to WWNF Boundary	4
WWNF Boundary below Vey Meadow to Weir	5
Weir to Time-and-a-Half Campground	6
Time-and-a-Half Campground to Spoolcart Campground	7
Spoolcart Campground to Starkey Store	8



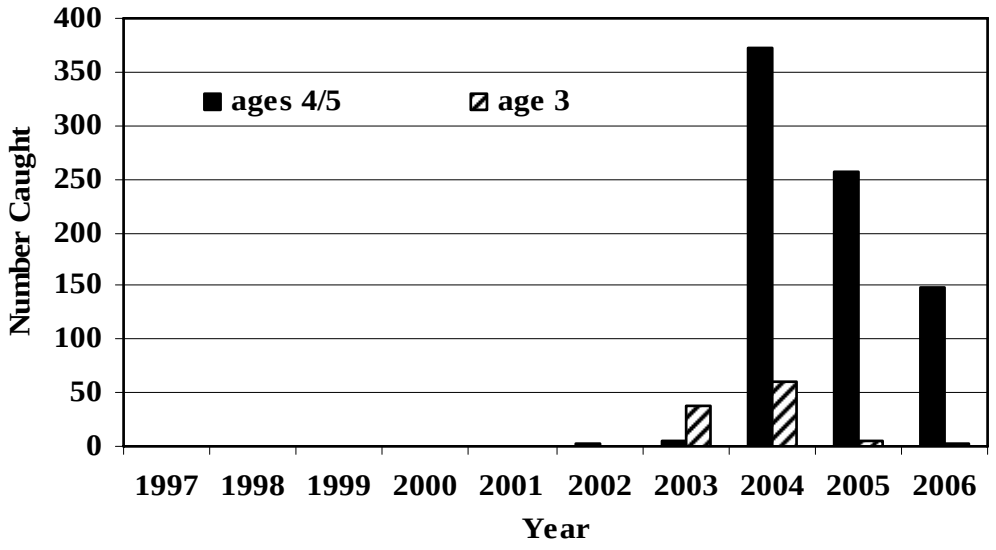
Appendix Figure A1. Natural-origin spring Chinook salmon collected at the Catherine Creek trap, 1997-2006.



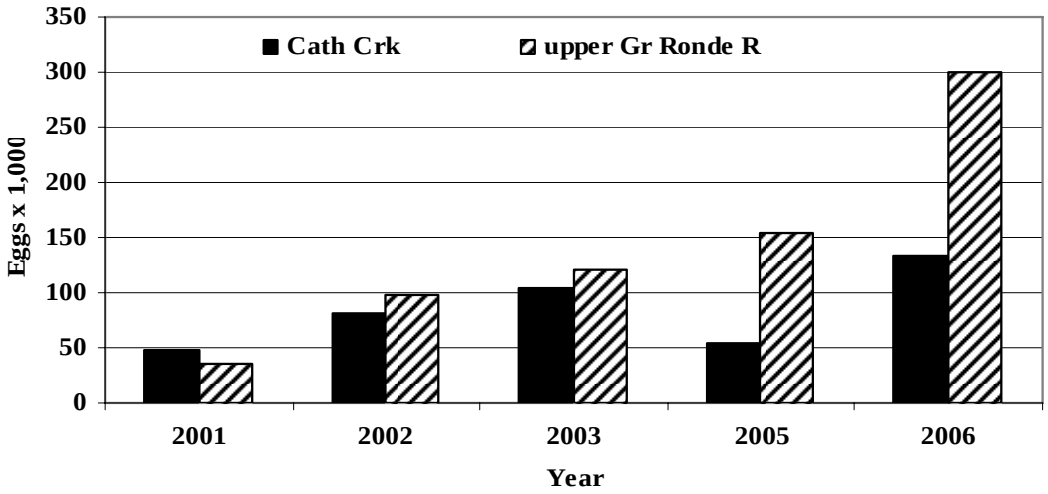
Appendix Figure A2. Hatchery-origin spring Chinook salmon collected at the Catherine Creek trap, 1997-2006.



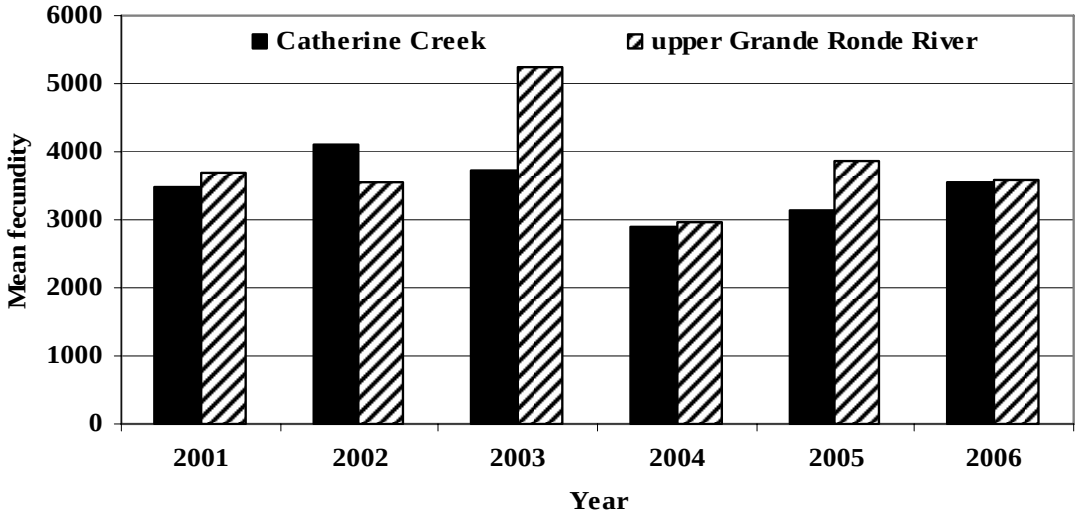
Appendix Figure A3. Natural-origin spring Chinook salmon collected at the upper Grande Ronde River trap, 1997-2006.



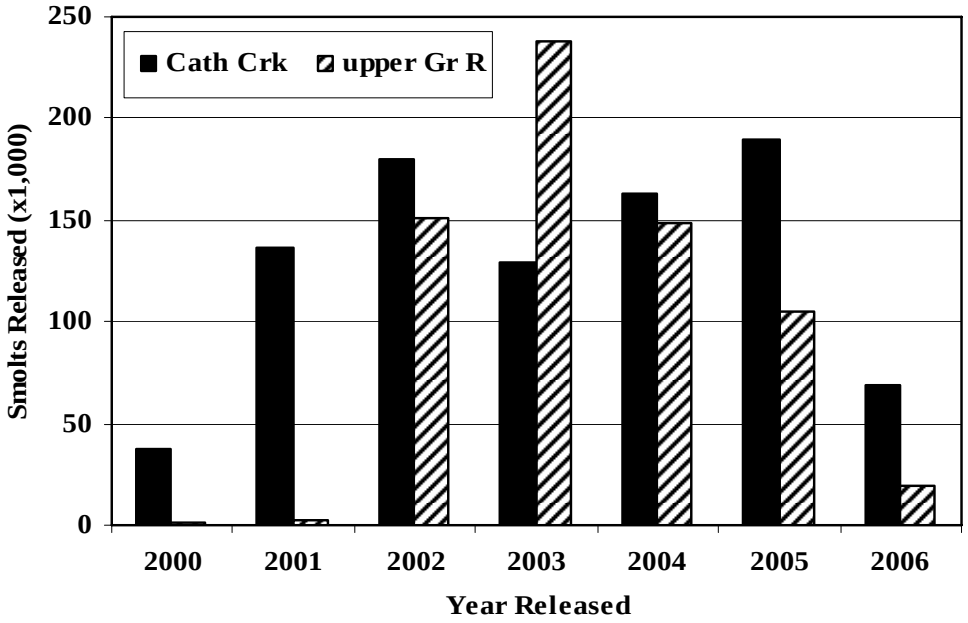
Appendix Figure A4. Hatchery-origin spring Chinook salmon collected at the upper Grande Ronde River trap, 1997-2006.



Appendix Figure A5. Egg production from conventional broodstock spring Chinook salmon collected from the Catherine Creek and upper Grande Ronde River traps, 2001-2006.



Appendix Figure A6. Mean fecundity (eggs/female) for conventional broodstock spring Chinook salmon collected from the Catherine Creek and upper Grande Ronde River traps, 2001-2006.



Appendix Figure A7. Hatchery-origin spring Chinook salmon smolt releases from Catherine Creek and upper Grande Ronde River acclimation facilities (captive and conventional broodstocks), 2000-2006.

2 SECTION II. SUMMER STEELHEAD IN CATHERINE CREEK AND THE UPPER GRANDE RONDE RIVER, OREGON

2.1 EXECUTIVE SUMMARY

This is the seventh annual report for a multi-year project designed to monitor and evaluate supplementation of endemic spring Chinook salmon in Catherine Creek and the upper Grande Ronde River. These two streams have historically supported anadromous fish populations that provided significant tribal and non-tribal fisheries. Conventional and captive broodstock supplementation methods are being used to restore these spring Chinook salmon populations. The presence of effective adult salmonid collection facilities allows for collecting basic life history data for adult summer steelhead and providing managers the background needed for decision-making. The 2006 Statement of Work included describing life history characteristics of adult summer steelhead from Catherine Creek and the upper Grande Ronde River.

This project included operations and maintenance (O&M) and monitoring and evaluation (M&E) components prior to 2002. Beginning in 2002, project O&M responsibilities were removed and placed in a separate project (Bonneville Power Administration (BPA) Project 199800703, BPA Contract No. 0006509, CTUIR Project 410), with a separate budget and reporting requirements. The two sections of this annual report include spring Chinook salmon monitoring and evaluation and summer steelhead life history (BPA Project 199800703, BPA Contract No. 00012785, CTUIR Project 413).

One hundred seventy-one, upstream-migrating wild summer steelhead were captured format the Catherine Creek trap during 8 March-17 May 2006. FL ranged from 396-837 mm. Twenty-four fallbacks were collected; all had been previously collected at the weir and marked with opercle punches. The estimated population of summer steelhead spawning above the trap was 172. No upstream-migrants were caught at the upper Grande Ronde River weir in 2006; two fallbacks were collected (one male, one female).

Life history characteristics of summer steelhead collected from Catherine Creek and the upper Grande Ronde River in 2006 were similar to those observed in previous years for these streams, and also similar to the limited data available for summer steelhead in the Snake River Basin.

2.2 INTRODUCTION

Wild steelhead populations in the Snake River basin have declined along with other anadromous species. Sport fisheries in the Grande Ronde and Imnaha Rivers were closed in 1974 (Flesher et al. 2000). Managers have used harvest augmentation of summer steelhead since 1978 to restore sport fisheries in Catherine Creek, the upper Grande Ronde River, and other streams in the Grande Ronde Basin (Carmichael et al. 1990). Creel surveys since 1985 show this program has been very successful (Flesher et al. 2000). However, the hatchery stock used (Wallowa), for reasons poorly understood, has a high rate of straying into the Deschutes River. The National Marine Fisheries Service

directed use of Wallowa stock be phased out by 2008 (NMFS 1999). The lack of basic life history data for Grande Ronde Basin summer steelhead and has limited the development of management alternatives. The existence of adult collection weirs on Catherine Creek, the upper Grande Ronde River, and other streams in the basin provide opportunities to collect valuable adult life history information during the spawning migration that occurs during February-July.

2.3 STUDY AREA

The study area is the same as described in Section I of this report.

2.4 METHODS

Adult summer steelhead life history metrics included migration timing (arrival at traps), age, abundance, migration status (upstream or fallbacks (kelts)), length and sex frequencies, occurrence of strays and hatchery/wild ratios. Population estimates were made for spawners above the trap by marking all fish collected with an opercle punch before passing upstream and observing fallbacks on the weir as recaptures. The Chapman modification of the Petersen method of population estimation was used (Ricker 1975). Confidence limits (95%) were made using Appendix II of Ricker (1975). Tissues (from opercle punches) were collected and preserved in vials with 95% ethanol. Descriptive statistics in tabular and graphical form were used to summarize data.

2.5 RESULTS

2.5.1 Catherine Creek

The first wild, upstream-migrating (prespawn) female summer steelhead was collected at the Catherine Creek trap on 8 March and the first male on 24 March 2006. The last female was collected on 17 May and the last male on 17 May 2006. The largest numbers of upstream-migrants from Catherine Creek were collected the weeks of 26 March-9 April, with 76.0% caught during those three weeks (Table 1). Female to male ratio was 1.25:1. There were 24 fallbacks (kelts) captured. Females were caught from 9 April-15 May and males from 28 April-16 June. Most kelts were recovered during the weeks of 9 April-7 May and females outnumbered males by 2:1.

Table 1. Wild summer steelhead captured at the Catherine Creek trap by week, migration status, and sex, 2006.

	Upstream-migrating			Fallbacks		
Week	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
3/5		1	1			
3/12						
3/19	1	1	2			
3/26	28	23	51			
4/2	17	32	49			
4/9	10	20	30		2	2
4/16	4	2	6		2	2
4/23	10	9	19	1	7	8
4/30	2	4	6			
5/7	3	2	5	5	3	8
5/14	1	1	2	1	2	3
5/21						
5/28						
6/4						
6/11				1		1
Totals	76	95	171	8	16	24

The FL frequency distribution showed most in the 55-77 cm groups with a peak at 70 cm but no distinct modes (Figure 1). Females were usually 54-71 cm (Figure 2). The FL frequency distribution for males was more irregular, and suggested two or possibly three age groups present (Figure 3).

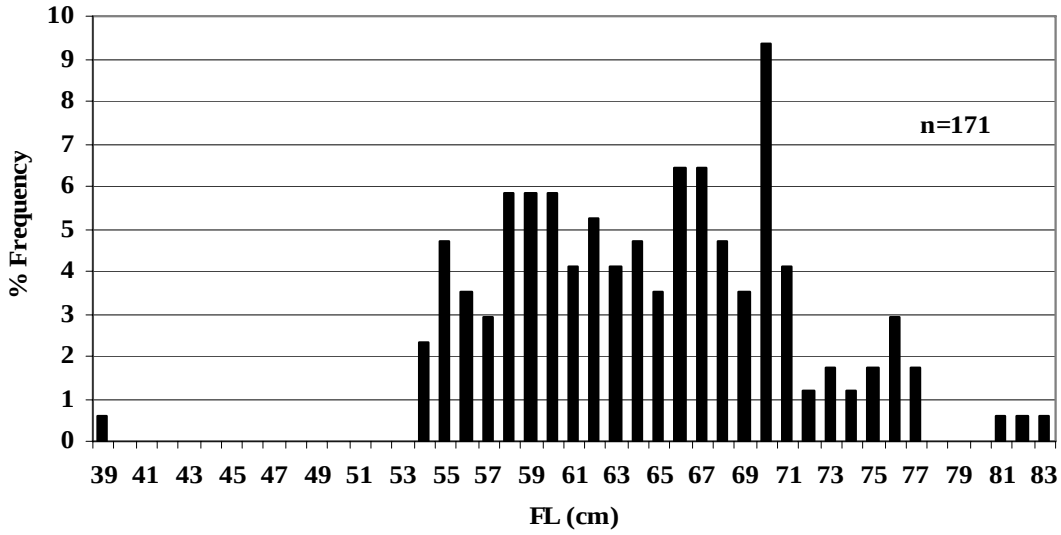


Figure 1. FL distribution of all wild summer steelhead caught at the Catherine Creek trap, 2006 (first time captures).

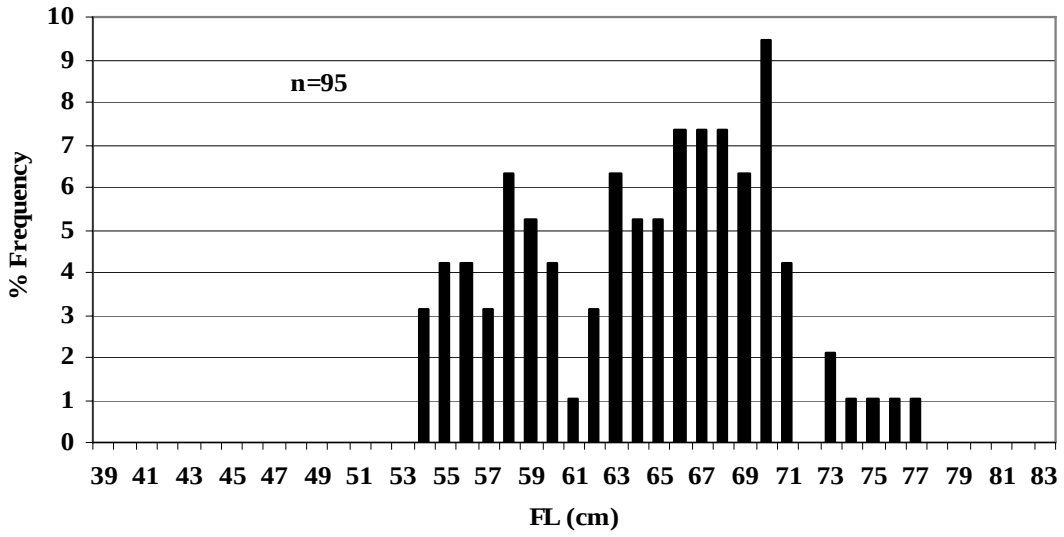


Figure 2. FL distribution of female wild summer steelhead caught at the Catherine Creek trap, 2006 (first time captures).

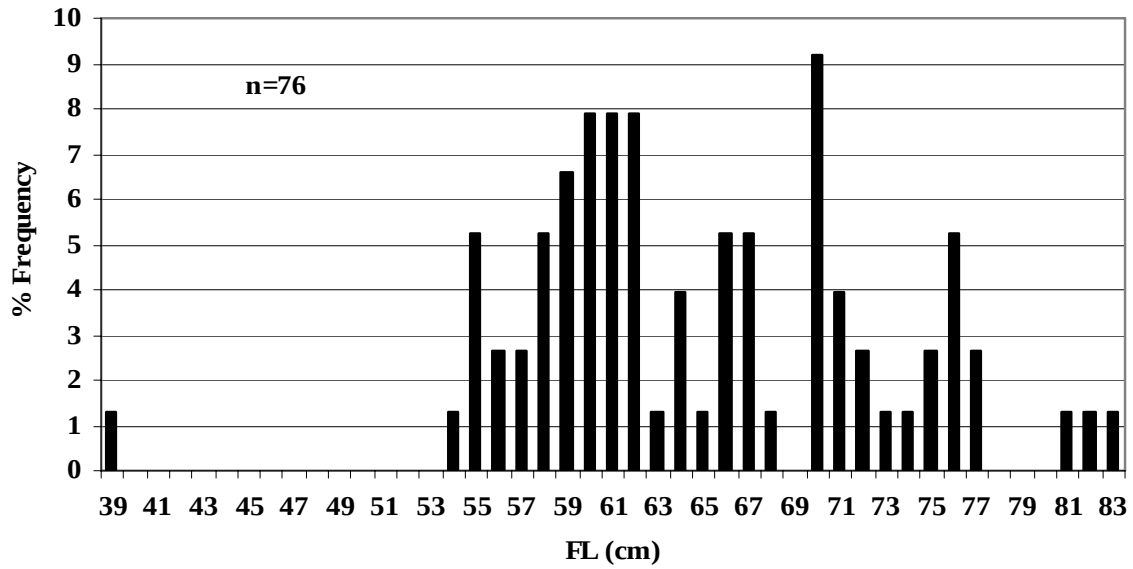


Figure 3. FL distribution of male wild summer steelhead caught at the Catherine Creek trap, 2006 (first time captures).

The size range of males was greater than for females and mean length was also greater for males (Table 2). The size range of fallback males was greater than for females but mean FL was greater for females, in contrast to upstream-migratng fish (Table 3).

Table 2. FL summary by sex for wild upstream-migrating summer steelhead collected at the Catherine Creek trap, 2006 (first-time captures only).

Sex	Mean FL (mm)	SE	Range	n
Male	653.2	9.0	396-837	76
Female	647.7	5.8	544-770	95
Total	650.1	5.1	396-837	171

Table 3. FL summary by sex for wild fallback summer steelhead collected at the Catherine Creek trap, 2006.

Sex	Mean FL (mm)	SE	Range	n
Male	652.0	34.2	545-835	8
Female	667.2	11.9	598-770	16
Total	662.1	13.5	545-835	24

Three fish with PIT tags were collected at the Catherine Creek trap. One was PIT-tagged as an outmigrant at Lower Granite Dam on 31 May 2002 at a FL of 166 mm. One was collected in Catherine Creek with a seine and PIT-tagged on 14 July 2003 at a FL of 155 mm. The third was collected in the Catherine Creek screw trap and PIT tagged on 24 April 2002 at a FL of 88 mm.

All fallbacks were recovered dead on the weir and had opercle punches. The population estimate of summer steelhead passed above the weir was 172 (95% confidence interval 171-251). The actual number of fish caught at the weir was substituted for the lower bound.

2.5.2 upper Grande Ronde River

The adult trap on the upper Grande Ronde River began operation on 15 March 2006. Only two summer steelhead were captured. A 610 mm FL spawned out female was recovered dead on the weir on 19 June 2006. A fallback live male was passed downstream on 15 June 2006 but no length data was collected.

2.6 DISCUSSION

The numbers of wild summer steelhead collected at the Catherine Creek trap have remained fairly stable over the last 5 years. Trapping conditions have usually been excellent and most of the run each year has been collected. Catches at the upper Grande Ronde River trap have been more sporadic. There did not appear to be any problems with the weir in 2006 (Ryan Seeger, personal communication), yet only two fallbacks occurred. The upper Grande Ronde River trap will be moved prior to the 2007 trapping season to a location near Starkey, about 11 mi downstream. Relocation of the upper Grande Ronde River trap should allow collection of a greater number of fish.

Adult life histories for summer steelhead from Catherine Creek and the upper Grande Ronde River are consistent with the general characteristics described for the species by numerous authors (Burgner et al. 1992, Meehan and Bjornn 1991, Busby et al. 1996, and Quinn 2006). Data from fish collected at the weirs are also consistent with the limited published data available for populations in the Grande Ronde River basin. Olsen et al. (1992) reported escapement to the larger tributaries in early fall, and smaller tributaries in the spring. Peak migration into Lookingglass Creek occurred in May, with spawning occurring from March through early June, with fry emergence in July and August. Annual estimates of age composition for unmarked fish collected at the Big Canyon trap ranged from 47-69% 1-salt and 31-53% 2-salt. Sex ratios (% females) also for unmarked fish collected at the Big Canyon trap, ranged from 18-63% for 1-salt and 2-salt fish.

A journal article was published in 2006 describing genetic variation in the Grande Ronde River, including Catherine Creek and the upper Grande Ronde River (Narum et. al. 2006). Periodic collections of genetics tissues will continue. The journal article recommended in the 2005 report should also include how adult summer steelhead trap counts relate to index redd counts in the basin as well as counts of adults passing Lower Granite Dam.

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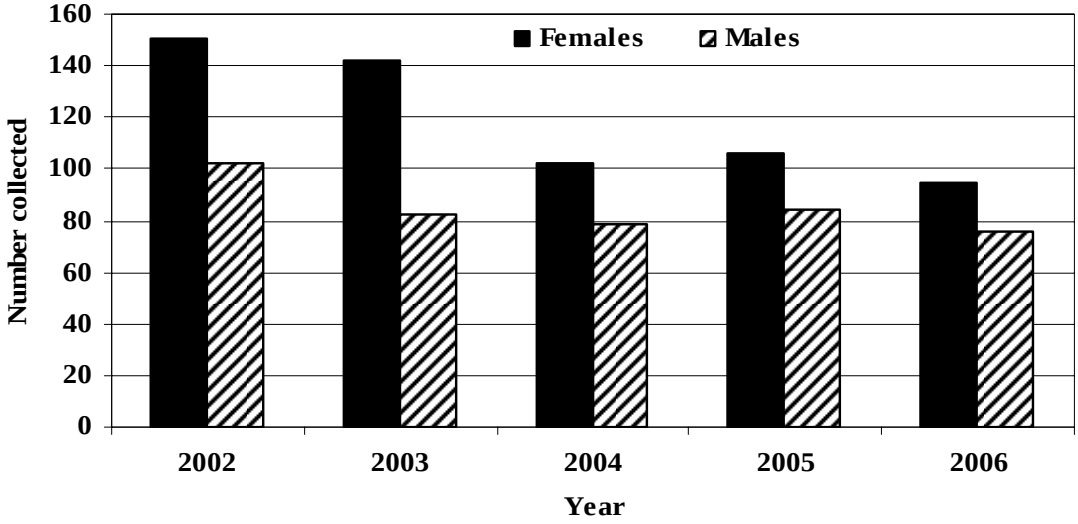
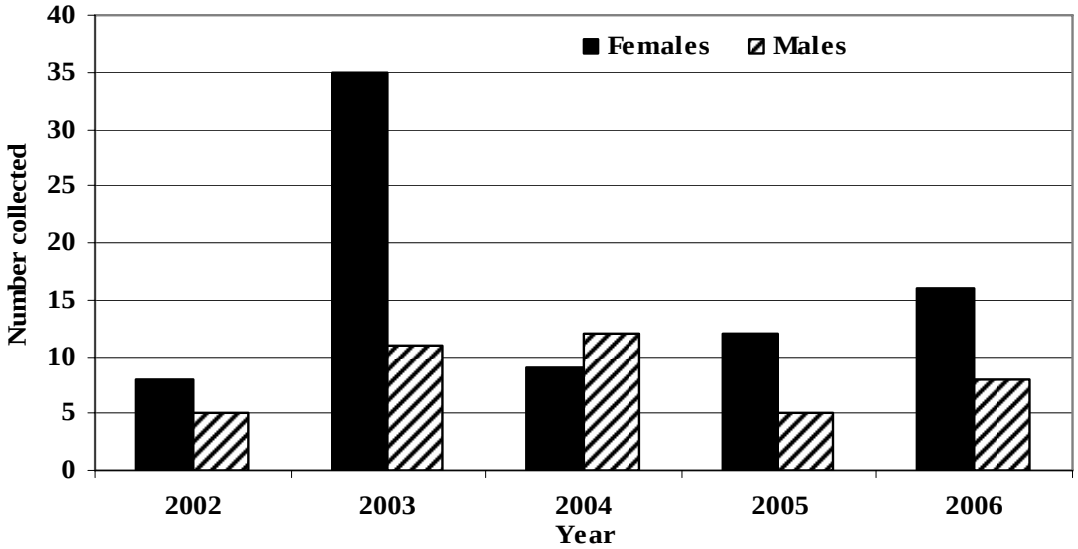
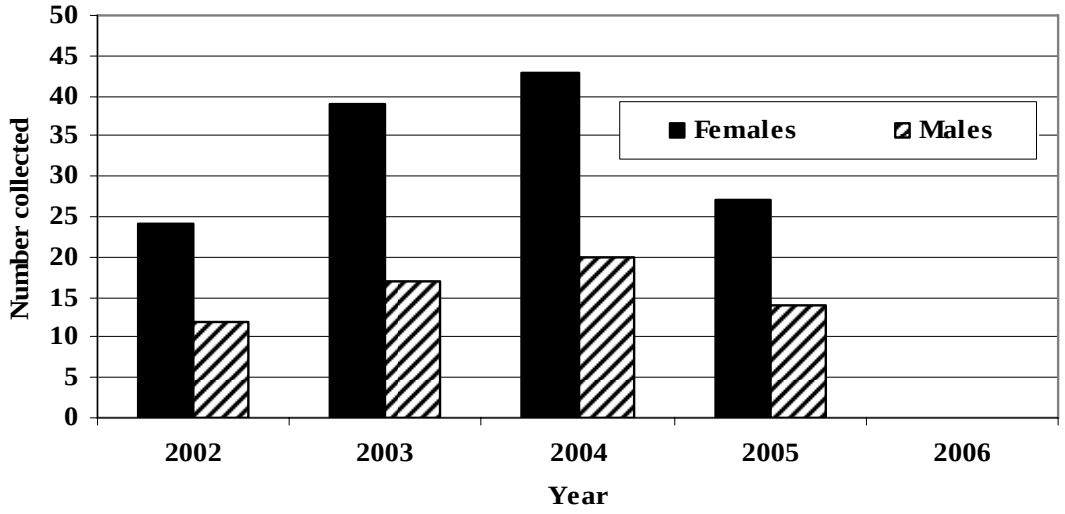
2.8 APPENDIX



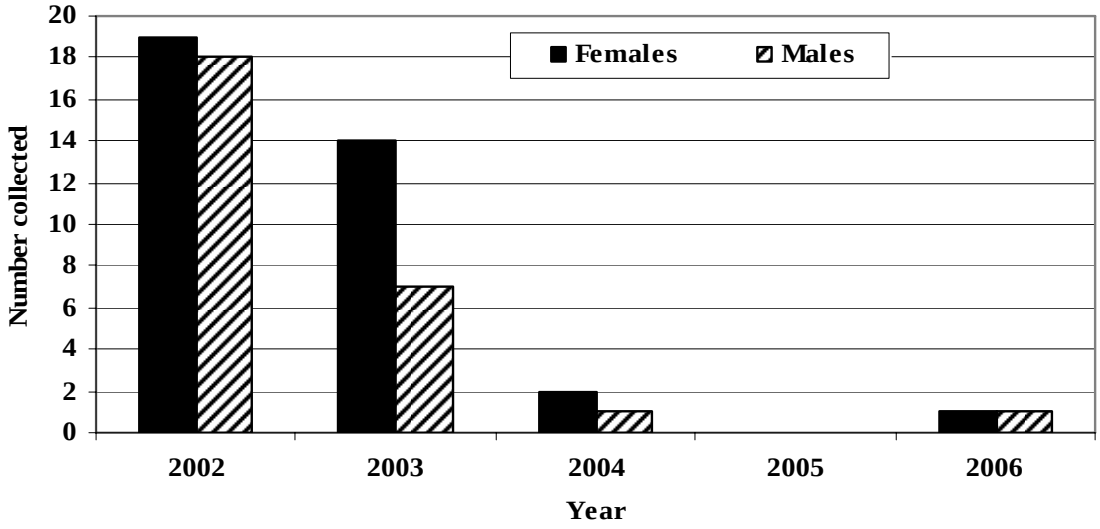
Appendix Figure 1. Upstream-migrating wild summer steelhead collected by sex at the Catherine Creek trap, 2002-2006.



Appendix Figure 2. Fallback wild summer steelhead collected by sex at the Catherine Creek trap, 2002-2006.



Appendix Figure 3. Upstream-migrating wild summer steelhead collected by sex at the upper Grande Ronde River trap, 2002-2006.



Appendix Figure 4. Fallback wild summer steelhead collected by sex at the upper Grande Ronde River trap, 2002-2006.

3 SECTION III. ASSISTANCE TO PROGRAM COOPERATORS

Program staff assisted in conducting spawning ground surveys in the Grande Ronde River basin, the Imnaha River, Wenaha River and John Day River. Staff also assisted in spawning of Imnaha River spring Chinook salmon, collecting captive brood parr from Catherine Creek and the upper Grande Ronde River and spawning of captive broodstock Chinook salmon at Bonneville Fish Hatchery.

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