

LOWER SNAKE RIVER COMPENSATION PLAN:
Oregon Spring Chinook Salmon Evaluation Studies
1999 Annual Progress Report

Oregon Department of Fish and Wildlife
Fish Research and Development, NE Region



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Preface

This progress report provides summary information for spring Chinook salmon Lower Snake River Compensation Plan (LSRCP) programs operated by Oregon Department of Fish and Wildlife (ODFW) in the Grande Ronde and Imnaha river basins during 1999. These ongoing monitoring and evaluation programs provide technical, logistical and biological information to managers charged with maintaining viable Chinook salmon populations and associated fisheries in northeast Oregon.

The data in this report serve as the basis for assessing the success of meeting management objectives and were derived from hatchery inventories and standard databases (e.g., PSMFC, coded-wire tag) or through standard measuring techniques. As such, specific protocols are usually not described. In cases where expansions of data or unique methodologies were used, protocols are described in more detail. Additional descriptions of protocols can be found in the 1999 work statement (Carmichael et al. 1999b). Coded-wire tag (CWT) data collected from 1999 adult returns were used to evaluate smolt-to-adult survival rates in production and experimental rearing and release groups. In 1999, experimental treatments from which salmon returned included size at release, presmolt exercise, and rearing density. In 1999, experimental treatments for which salmon were released included size at release, and rearing density treatments. Analysis of data for specific survival studies will be completed once all cohorts have returned and CWT data are complete for a given experiment. In addition, much of the data that we discuss in this report will be used in separate and specific evaluations of ongoing supplementation programs for Chinook salmon in the Grande Ronde and Imnaha river basins. We began fish culture evaluations in 1983 and have dramatically improved many practices. Progress for work completed in previous years is presented in annual progress reports (Carmichael and Wagner 1983; Carmichael and Messmer 1985; Carmichael et al. 1986a 1987, 1988, 1999a and 2004; Hoffnagle et al. 2005; Messmer et al. 1989, 1990, 1991, 1992 and 1993) and United States v. Oregon production report (Carmichael et al. 1986b).

Within each section of this report, data are organized into salmon culture monitoring for juveniles, adults, CWT recoveries, compensation goals and estimates for total escapement. During the period covered in this report, Chinook salmon from the 1997 cohort were released as smolts, Chinook salmon from the 1994-1996 cohorts returned to spawn, and adult Chinook salmon that returned to spawn were used to create the 1999 cohort.

Acknowledgments

We would like to thank Tim Whitesel for overseeing the collection of the data presented in this report as well as coordinating many of the experiments. Mike Gribble, Bob Lund and many other hatchery personnel exhibited great dedication and provided essential assistance. Numerous personnel from the U.S. Fish and Wildlife Service, U.S. Forest Service, the Nez Perce Tribe and the Confederated Tribes of the Umatilla Indian Reservation were enthusiastically supportive during spawning ground surveys and spawning at Lookingglass Fish Hatchery. This project was funded by the U.S. Fish and Wildlife Service under the Lower Snake River Compensation Plan, contract numbers 14-48-0001-95560 and 96540, a cooperative agreement with the Oregon Department of Fish and Wildlife.

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EXECUTIVE SUMMARY

In 1999, we released 194,893 smolts from the 1997 cohort into the Imnaha River including groups for evaluation of rearing density and size-at-release. We estimated 92.1% of the released smolts were recognizably marked with ad clips. In the Grande Ronde Basin we released 312,143 Rapid River stock smolts into Lookingglass Creek, 95.7% of which were recognizably marked with ad clips. In addition, 57,290 ad-clipped Rapid River Chinook salmon were released as parr (1998 cohort) into Lookingglass Creek. Also in the Grande Ronde Basin, we released 11,871 Lostine River stock smolts into the Lostine River, 94.5% of which were recognizably marked with ad clips.

In 1999, we trapped 315 hatchery- and 75 naturally-produced Chinook salmon at the Imnaha River weir. In 1995, we began trapping Rapid River stock adults destined for Lookingglass Fish Hatchery at Lower Granite Dam in order to reduce the number of these hatchery salmon straying on the spawning grounds in the Grande Ronde Basin. In 1999, we trapped 555 Rapid River stock Chinook salmon at Lower Granite Dam and 47 at Lookingglass Fish Hatchery.

We estimated 1,282 Imnaha River and 604 Rapid River stock hatchery Chinook salmon returned to the LSRCP compensation area in 1999 as a result of hatchery releases in the Imnaha and Grande Ronde basins. These returns achieved only 39.9% and 10.4% of the adult compensation goals in the Imnaha and Grande Ronde basins, respectively. In 1999, we recovered 181 carcasses and found 190 redds during spawning ground surveys in the Imnaha River Basin. In the Grande Ronde Basin, we recovered 100 carcasses and found 180 redds. There were four strays recovered in 1999. In both the Minam and Wenaha rivers, one Rapid River Chinook salmon from Lookingglass Fish Hatchery was recovered. Two more hatchery strays were recovered in the Lostine River but origin was not determined.

INTRODUCTION

This report summarizes spring Chinook salmon monitoring data for the Lower Snake River Compensation Plan (LSRCP) facilities in 1999. The main objective of this report is to document and evaluate salmon culture performance for spring Chinook salmon hatchery programs and achievement of management objectives in the Grande Ronde and Imnaha river basins. These data are used to design culture practices to optimize egg-to-smolt survival rate, smolt quality and smolt-to-adult survival rate. This report provides information on rearing and release operations for the 1997 and 1998 cohorts of juvenile Chinook salmon, the collection, spawning and adult characteristics for the 1999 return of adult Chinook salmon, and the collection of eggs for the 1999 cohort.

Program Objectives

1. Document spring Chinook salmon rearing and release activities at all LSRCP facilities.
2. Determine optimum rearing and release strategies that will produce maximum survival to adulthood for hatchery-produced spring Chinook salmon smolts.
3. Document Chinook salmon adult returns by stock to each LSRCP broodstock collection facility.
4. Determine if the total production of spring Chinook salmon adults meet mitigation goals and index annual smolt survival and adult returns to Lower Granite Dam for production groups.
5. Coordinate spring Chinook salmon broodstock marking programs for Lookingglass Fish Hatchery.
6. Participate in planning activities associated with anadromous salmon production and management in the Grande Ronde and Imnaha river basins and participate in ESA permitting, consultation and rearing activities.
7. Conduct index, extensive and supplemental spring Chinook salmon spawning ground surveys in selected streams in northeast Oregon.
8. Identify hatchery and wild origin for carcasses collected on spawning ground surveys in the Grande Ronde Basin.

RESULTS AND DISCUSSION

During 1999, Chinook salmon from the 1997 cohort were released as smolts into the Imnaha River, Lookingglass Creek (Rapid River stock), and the Lostine River. Adult Chinook salmon from the 1994-1996 cohorts returned to spawn and were used to create the 1999 cohort to be reared at Lookingglass Fish Hatchery (LFH). Experimental treatments from which adult salmon returned included size-at-release and rearing density for Imnaha River stock and pre-smolt exercise for Rapid River stock. In addition, returns from the 1996 cohort of Rapid River stock included size of release treatments of progeny from natural parents and comparisons of progeny of natural and hatchery parents. Experimental treatments for which salmon smolts were released included size at release and rearing density treatments for Imnaha River stock. Analysis of data for specific survival studies will be completed once all cohorts have returned and coded-wire tag (CWT) data are complete for a given experiment and will be presented in separate and

specific ODFW Information Reports for these experiments. In addition, much of the data discussed in this report will be used in separate and specific evaluations of ongoing supplementation programs for Chinook salmon in the Imnaha and Grande Ronde river basins.

Juveniles

Eyed egg-to-smolt survival rate for the 1997 cohort was 68.9% for Imnaha stock, 67.7% for Lostine stock, and 75.7% for Rapid River stock Chinook salmon (Table 1). The release of 194,893 smolts from the 1997 Imnaha River cohort was far below the mitigation goal of 490,000. This was the result of a poor 1997 return, as well as broodstock collection strategies that placed a large proportion of trapped hatchery and natural salmon above the weir to spawn naturally. The smolt production goal for the 1997 cohort Rapid River Chinook salmon was also set at 490,000. The release of 312,143 smolts from the 1997 cohort into Lookingglass Creek was below this modified production goal and was a result of poor returns of Rapid River stock adults in 1997. We also released 57,290 parr from the 1998 cohort Rapid River stock into Lookingglass Creek in 1999. We released 11,871 Lostine River smolts in 1999 from a goal of 150,000. This was the first year of conventional hatchery program releases in the Lostine River and the first release of endemic Chinook salmon into the Grande Ronde Basin.

We attempted to mark 100% of the 1997 cohort Imnaha and River Rapid River stock smolts with Ad+CWT. Rapid River stock were also marked with an RV clip. We had a poor mark rate with the AD+CWT clip for the Imnaha, Lostine, and Rapid River stocks, as we achieved AD+CWT rates of only 90.7, 94.2, and 94.7%, respectively (Table 2). The RV clip rate was also poor for Rapid River stock, achieving only 74.2% identifiable clips.

The 1997 cohort of Imnaha River Chinook salmon was reared in ten raceways at Lookingglass Fish Hatchery at two different densities, one-half (~40,000/raceway) and one-quarter (~20,000/raceway), and at two different growth rates, resulting in different sizes at release of 18g and 30g. To evaluate the influences of rearing density and size at release on smolt-to-adult survival, we marked all ten raceways with unique CWT codes. All Imnaha River Chinook salmon smolts were acclimated at the Imnaha Acclimation Facility and released on 16 March 1999 (Table 3). Rapid River Chinook salmon from the 1997 cohort were reared in five raceways at rearing densities of about 75% (~60,000) of normal past practices. All Rapid River stock smolts were released from Lookingglass Fish Hatchery on 1 April 1999. In addition, parr from the Rapid River 1998 cohort were released from Lookingglass Fish Hatchery on 24 June 1999. Lostine River smolts were reared in one raceway at Lookingglass Fish Hatchery and acclimated at the Lostine River acclimation facility before release on 1 April 1999. Smolt migration success was monitored based on PIT-tag observations at mainstem dams. Mean first-time detection rates were 54.3% for Imnaha River smolts, 42.4% for Rapid River smolts, and 52.8% for Lostine River smolts (Table 3).

Adults

The Imnaha River weir was installed on 21 July 1999, well after the target date of 15 June, and operated until 14 September (Table 4). We trapped 315 hatchery- and 75 naturally-produced salmon and retained 69% for broodstock: 247 hatchery and 24 natural (Table 5). The remaining 119 adults were released above the weir to spawn naturally. Age structure was determined from CWT age, scale age and length-at-age relationships (Figure 1). Age 3 males

comprised 54.9% of hatchery- and 29.3% of naturally-produced returns to the weir. Age 4 adults comprised 44.8% of hatchery- and 53.4% of naturally-produced returns to the weir. Age 5 adults comprised 0.3% of hatchery- and 16.03% of naturally-produced returns to the weir. Pre-spawn mortality of combined hatchery and natural Imnaha River Chinook salmon held at LFH was 7%. We spawned 31 hatchery and 6 natural females with 200 hatchery and 15 natural males (Table 5). We collected 168,930 eggs, well below our goal of 576,500 green eggs, and incubated them at Lookingglass Fish Hatchery (Table 6). Mortality to shocking was moderately high (23.9%), compared to previous years.

In 1999, we trapped Rapid River stock Chinook salmon at Lower Granite Dam and at Lookingglass Fish Hatchery. A total of 587 Ad-RV+CWT marked Chinook salmon were collected at Lower Granite Dam and transported to Lyons Ferry Fish Hatchery, Washington (Table 4). Of these, an estimated 555 were Rapid River stock released into Lookingglass Creek. An additional 64 Chinook salmon were trapped at Lookingglass Fish Hatchery. Of these, 17 Rapid River Chinook salmon were transported to Lyons Ferry Fish Hatchery and 30 Rapid River and 17 natural salmon were transported to South Fork Walla Walla Fish Hatchery, Washington (Tables 4 and 5). A total of 27,542 eggs from hatchery x natural crosses were collected at South Fork Walla Walla Fish Hatchery and transported to Irrigon Fish Hatchery for incubation and early rearing. These eggs comprised the 1999 cohort for release as parr into Lookingglass Creek in 2000.

The Lostine River weir captured 12 natural adult Chinook salmon, 7 females and 5 males (Table 5). In addition, one hatchery adult was trapped. Two natural origin adults were originally kept for broodstock but were later returned to the river because of insufficient numbers. At the Catherine Creek weir, we captured 16 natural Chinook salmon and all were released above the weir to spawn naturally. At the Grande Ronde River weir, only one adult Chinook salmon was collected and it was released above the weir. No stray hatchery Chinook salmon were captured at any weir.

Coded-Wire Tag Recoveries

Coded-wire tag recoveries from adult returns, strays, and fisheries collections from experimental groups of each Chinook salmon stock were used to evaluate hatchery treatments and assess the success in achieving mitigation goals and management objectives. We mark all experimental and most production groups with coded-wire tags to provide basic information on survival, harvest, escapement and straying and specific information on experimental results. We summarized the number of recoveries of each CWT code from the Regional Mark Information system (RMIS) CWT recovery database maintained by the Pacific States Marine Fisheries Commission.

To account for the total number of coded-wire tagged hatchery adults returning to the Imnaha River, we develop expansion factors for CWT recoveries based on estimated escapement and average tag retention for each hatchery cohort. Estimated total hatchery escapement was the sum of the estimated number of hatchery adults above the weir, the estimated number below the weir, and the total retained at the weir listed in Table 5.

We marked every adult captured and passed above the weir with an opercle punch and examined carcasses for marks during spawning ground surveys. We estimated total adults above the weir as the sum of the known number captured and passed above the weir and an estimated number of untrapped adults above the weir, based on a mark-recapture population estimate. An

estimate for untrapped jacks was calculated separately from age 4 and 5 adults because they are released in small numbers and they are not recovered at the same rate as older males or females. The estimated number of untrapped age 4 and 5 adults was the difference between the mark-recapture population estimate and the known number marked. Weir efficiency was determined by dividing the number marked by the estimated total number of age 4 and 5 adults above the weir. We applied the weir efficiency estimate to the known number of jacks trapped to estimate the number of untrapped jacks above the weir. Total adults above the weir was the sum of the estimated numbers of untrapped jacks and age 4 and 5 adults above the weir and the known numbers passed above the weir. The number that comprised each cohort was determined by multiplying the total estimate by the percent age composition found in Table 5.

The estimated total number of hatchery adults below the weir was determined by first calculating a fish per redd estimate above the weir based on the total estimated number of adults above the weir (described above) divided by the total number of redds observed above the weir. This ratio was applied to the number of redds observed below the weir to estimate total adults below the weir. The total number of each hatchery cohort below the weir was calculated by multiplying the total estimate by the percent age composition found in Table 5. The estimated total escapement of hatchery adults from each cohort was the sum of the estimate above the weir, the estimate below the weir, and the number collected at the weir that were retained and transported to the hatchery or outplanted into other streams in the basin.

We estimated the number of coded-wire tagged hatchery adults returning to the Imnaha River for each cohort as the escapement estimate multiplied by average tag retention for that cohort weighted by the number of smolts released in each CWT group. We expanded CWT recoveries for each CWT group within a cohort by multiplying the estimated number of CWT adults by the relative proportion of CWT recoveries.

We recovered 300 hatchery-reared Imnaha River Chinook salmon with CWTs from the 1994-1996 cohorts in 1999 (Table 7). These recoveries were expanded to an estimated 1,249 CWT returns to the Imnaha River, four from the 1994 cohort (size at release evaluations), 577 from the 1995 cohort (size at release and rearing density) and 668 from the 1996 cohort (size at release and rearing density). We captured three marked Imnaha River salmon in the Snake River (two from 1995 cohort; one from 1996 cohort, all captured at Lower Granite Dam tailrace). In addition, one Imnaha River salmon strayed within the Snake River Basin (1996 cohort collected at Lookingglass Fish Hatchery) and three strayed outside the Snake River Basin (two 1995 cohort caught in Lewis River, Washington, and one 1996 cohort caught in the Deschutes River, Oregon).

In 1999, we recovered 581 CWT marked Rapid River Chinook salmon from the 1994-1996 cohorts released from Lookingglass Fish Hatchery (Table 8). A total of 527 CWT marked Rapid River Chinook salmon were captured at Lower Granite Dam, 29 at the LFH weir, and eight in the Columbia River (Bonneville Pool). Two CWT marked fish were captured as strays in the Snake River Basin (Wenaha River, 1995 cohort; Minam River, 1996 cohort) and 15 were captured as strays outside of the Snake River Basin (Willamette, Deschutes, and Klickitat rivers, and Ringold Springs Hatchery, WA).

Compensation Goals

Nearly all CWT recoveries for hatchery Chinook salmon that were released in the Grande Ronde and Imnaha basins occurred in the Snake River basin (Tables 7 and 8). The total number of hatchery-produced salmon for each stock that are recovered in fisheries, escape to the stream

of release, or stray within or outside the Snake River basin can be estimated based on CWT recoveries, weir counts, redd counts, and mark-recapture estimates during spawning ground surveys. To calculate the return to the LSRCP Compensation Area, defined as the Snake River basin above Ice Harbor Dam, we summed all estimated escapement for the 1999 return year that occurred above Ice Harbor Dam.

We did not reach the compensation goal in 1999 for either the Imnaha or Grande Ronde river basins (Table 9). We estimated 1,282 Imnaha River adults returned to the compensation area, 39.9% of the 3,210 adult goal for the Imnaha Basin. We estimated 604 Rapid River adults returned to the compensation area, 10.4% of the 5,820 adult goal for the Grande Ronde Basin (Table 9). Similar to 1998, the two primary factors causing low returns were poor smolt-to-adult survival and smolt releases that were below the goal.

The progeny-to-parent ratio for natural and hatchery origin Imnaha River salmon that spawned naturally in 1994 was 0.61, slightly higher than the mean value since 1982, but well below replacement (Figure 2). This represented the eleventh year in a row that productivity has been well below replacement. The progeny-to-parent ratio for the hatchery component was 0.82, better than naturally spawning salmon but also below replacement. The number of natural salmon that returned to the basin (291) was similar to the 1998 return of 249 adults. The 1999 return was also similar to the mean return since 1990 but well below the mean of the late 1980s (Figure 3).

Natural Escapement Monitoring

Spring Chinook salmon spawning ground surveys were conducted from late August to mid September. Specific stream index surveys were originally scheduled to take place following peak spawning. Extensive area surveys cover nearly all possible spring Chinook salmon spawning areas and were conducted the day of the index survey. Supplemental surveys were in the index and extensive areas and were conducted twice, at approximately one week intervals following the index survey. Surveys were conducted on foot in a downstream direction with one or more surveyors. Surveyors recorded the number of redds observed (occupied and unoccupied), the number of live adults and jacks observed (on and off redds), and the number of carcasses encountered in each survey section. Each redd was numbered and marked with colored flagging. Data obtained from each carcass encountered included: sex, length, fin marks, degree of spawning (females only), and presence of opercle marks, indicating a fish that was captured and released at a weir. In addition, a sample of 10 scales was removed from each carcass. To determine age composition and age-length relationships, scales were mounted on gummed cards and acetate impressions were made using a heat press. Fish age was determined by counting the winter annuli and adding one. Snouts were removed from all adipose fin marked carcasses and recovery and decoding of coded wire tags was conducted by the ODFW CWT Laboratory. The caudal peduncle of every carcass was severed after sampling to avoid repeat sampling on subsequent surveys. Flagging was removed on the last supplemental survey. We surveyed three streams in the Imnaha River Basin and nine in the Grande Ronde Basin (Table 11).

In 1999, we counted a total of 190 redds and recovered 181 carcasses in the Imnaha Basin (Table 11). All marked hatchery salmon recovered in the Imnaha River were Imnaha stock, thus no out-of-basin strays were observed (Table 10). Marked salmon comprised 37.4% of the recovered carcasses. In the Grande Ronde Basin in 1999, we observed a total of 180 redds

and recovered 100 carcasses on the spawning grounds. We recovered two marked hatchery strays in the Grande Ronde Basin that came from Lookingglass Fish Hatchery: one stray recovered in the Wenaha River and one in the Minam River. Two additional marked hatchery strays were recovered in the Lostine River but CWT information was not available to determine origin. Hatchery strays comprised 4% of the total carcasses recovered. Age composition of the carcass recoveries differed between basins (Table 12). The majority of the recovered carcasses (89.7% in the Grande Ronde Basin and 65.2% in the Imnaha Basin) were age 4. The majority of the age 4 adults in the Grande Ronde Basin (67.8%) and the Imnaha Basin (62.9%) were female. Age 3 salmon comprised 2.1% of the carcasses recovered in the Grande Ronde Basin and 11.8% of those in the Imnaha River Basin. Age 5 adults comprised 8.2% of the carcasses in the Grande Ronde Basin and 22.4% in the Imnaha River Basin.

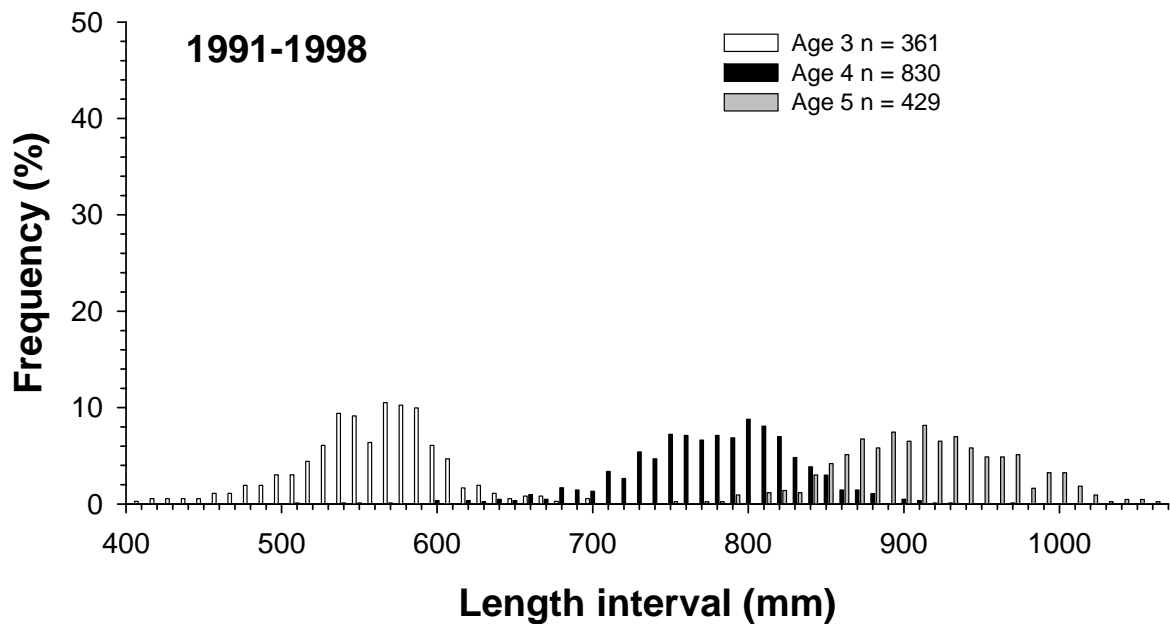
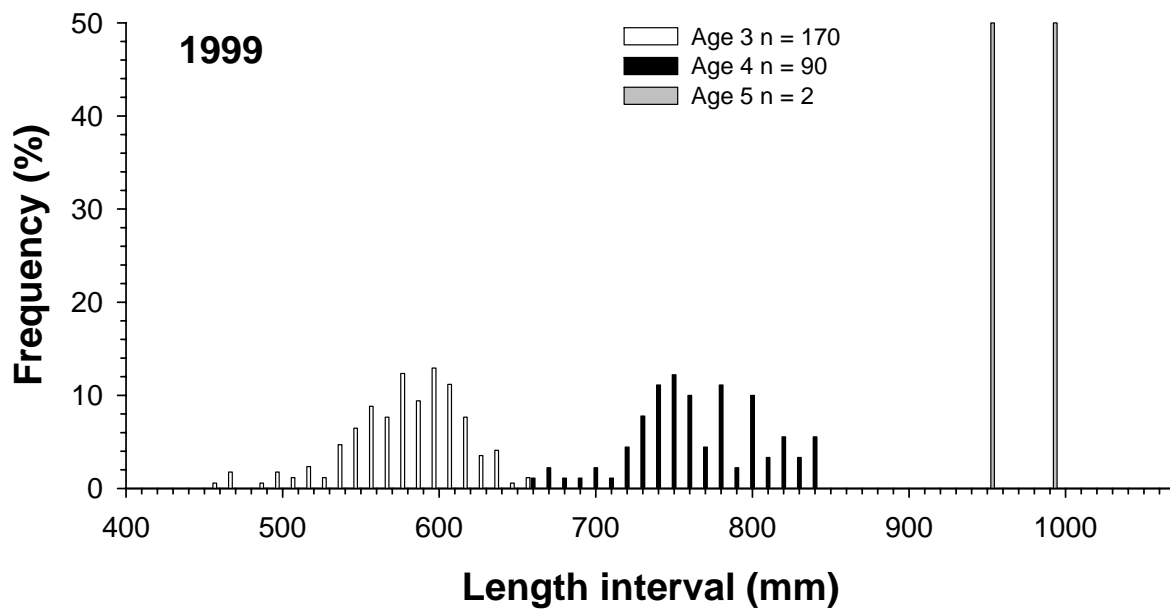


Figure 1. Length frequency-at-age relationship for Imnaha River Chinook salmon adults used as hatchery broodstock in 1999 (top) and from 1991-1998 (bottom).

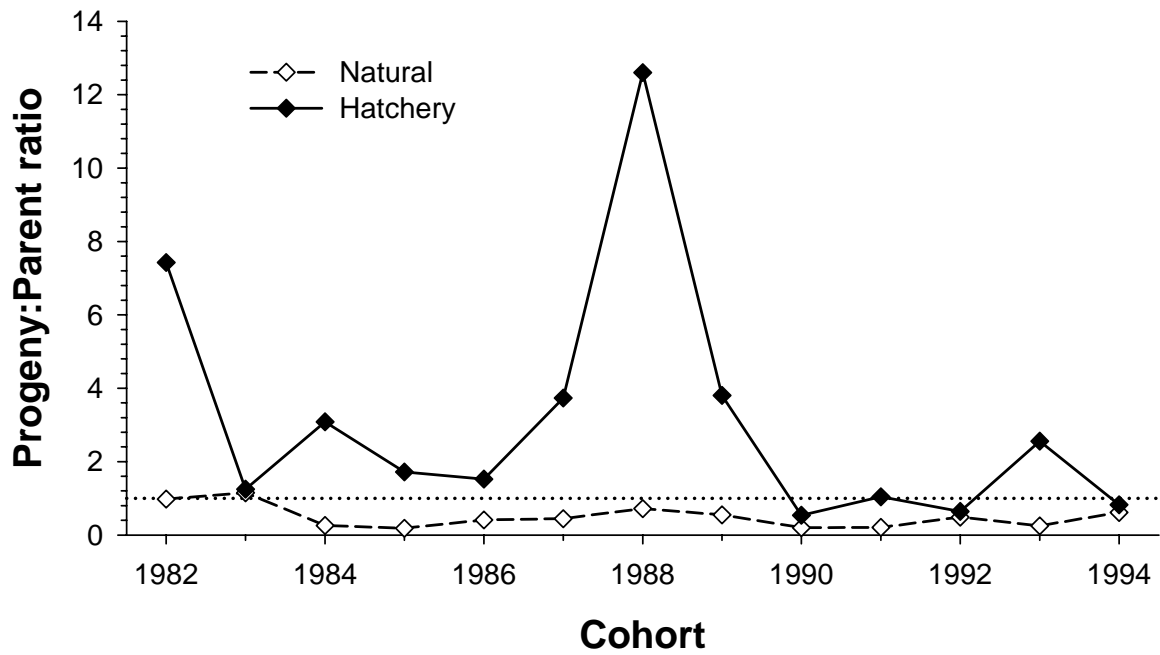


Figure 2. Progeny-to-parent ratios for completed cohorts (1982-94) of Imnaha River Chinook salmon. Note: dotted line indicates P:P ratio = 1.

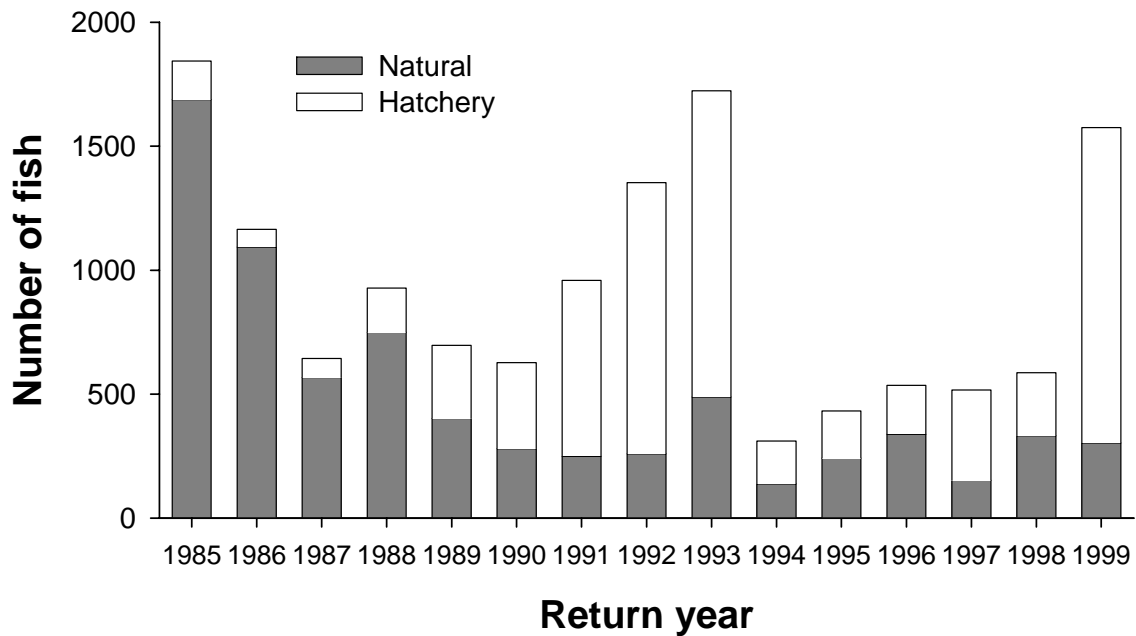


Figure 3. Estimated number of natural- and hatchery-origin spring Chinook salmon that spawned naturally in the Imnaha River, 1985-1999.

Table 1. Rearing summaries for 1997 and 1998 cohorts of juvenile spring Chinook salmon released into the Grande Ronde and Imnaha river basins in 1999.

Cohort, stock	Number of eggs taken	Eyed embryos	Percent Survival		Total smolts released
			Egg to embryo	Embryo to smolt/parr	
<u>1997 cohort</u>					
Imnaha River	282,823	208,215	73.6	93.6	194,893
Lostine River	17,541	12,054	68.7	98.5	11,871
Rapid River	412,355	333,064	80.9	93.7	312,143
<u>1998 cohort</u>					
Rapid River	74,740	63,483	84.9	90.2	57,290

Table 2. Estimates of percent of fin clip (Ad) and coded-wire tag application success for 1997 cohort spring Chinook salmon reared at Lookingglass Fish Hatchery and released in 1999. Imnaha River and Lostine River stock targets were 100% Ad with CWT and Rapid River stock target was 100% AdRV with CWT. The 1998 cohort Rapid River stock was ad-clipped but no information is available on application success.

Stock, raceway	Number checked	Ad clip, with CWT	Ad clip, no CWT	No Ad clip, with CWT	No Ad clip, no CWT	RV Clip	No RV Clip
<u>Imnaha River</u>							
7	447	89.0	2.5	8.1	0.4	-	-
8	332	94.9	1.5	3.3	0.3	-	-
9	332	92.8	1.8	5.4	0.0	-	-
10	341	89.1	0.3	10.3	0.3	-	-
11	311	87.8	1.0	10.9	0.3	-	-
12	325	91.7	1.5	6.8	0.0	-	-
13	330	93.7	1.2	4.8	0.3	-	-
14	307	90.6	0.3	9.1	0.0	-	-
15	269	87.4	0.7	11.9	0.0	-	-
17	<u>303</u>	<u>90.1</u>	<u>3.6</u>	<u>6.3</u>	<u>0.0</u>	-	-
Total / mean	3,297	90.7	1.4	7.7	0.2		
<u>Lostine River</u>							
6	326	94.2	0.3	5.2	0.3	-	-
<u>Rapid River</u>							
1	326	96.0	2.5	1.2	0.3	69.3	30.7
2	369	96.2	0.8	2.7	0.3	66.9	33.1
3	343	95.6	1.2	3.2	0.0	74.9	25.1
4	416	88.2	0.0	11.8	0.0	77.4	22.6
5	<u>357</u>	<u>96.9</u>	<u>0.3</u>	<u>2.5</u>	<u>0.3</u>	<u>82.6</u>	<u>17.4</u>
Total / mean	1,811	94.7	1.0	4.3	0.2	74.2	25.8

Table 3. Size of 1997 cohort Imnaha River, Lostine River and Rapid River spring Chinook salmon smolts, total number released into Imnaha and Grande Ronde river basins, number PIT-tagged and percent detected at Snake and Columbia river dams in 1999.

Stock, raceway	Release date (1999)	Cohort	Life stage at release	CWT code	Fork length (mm)		Weight (g)		Condition factor (K)		Total released ^a	Number PIT- tagged	Percent PIT tags detected
					Mean	SD	Mean	SD	Mean	SD			
<u>Imnaha River – released at Imnaha Acclimation Site</u>													
7	16 MAR	1997	Smolt	91720	113	6.2	16.7	3.2	1.2	0.06	44,712	9,903	54.9
8	16 MAR	1997	Smolt	92615	115	6.4	18.6	2.9	1.2	0.07	22,385	4,988	56.3
9	16 MAR	1997	Smolt	92616	116	7.6	18.8	2.8	1.2	0.07	21,787	4,988	55.2
10	16 MAR	1997	Smolt	92612	127	10.4	21.8	1.2	1.2	0.10	13,395	496	53.4
11	16 MAR	1997	Smolt	92614	124	13.6	24.3	6.1	1.2	0.11	13,997	499	54.7
12	16 MAR	1997	Smolt	71248	124	9.1	22.2	5.6	1.2	0.07	26,796	498	52.8
13	16 MAR	1997	Smolt	92613	126	10.2	23.8	6.5	1.2	0.09	13,363	499	58.9
14	16 MAR	1997	Smolt	92558	126	9.7	25.3	5.9	1.2	0.09	13,308	497	56.5
15	16 MAR	1997	Smolt	92559	130	8.0	26.9	5.8	1.2	0.09	14,872	501	53.5
17	16 MAR	1997	Smolt	92609	129	7.0	26.5	3.8	1.2	0.07	<u>10,278</u>	<u>498</u>	<u>47.2</u>
Total / Mean											194,893	23,367	54.3
<u>Rapid River- released at Lookingglass Hatchery</u>													
1	1 APR	1997	Smolt	92622	115	5.8	18.2	2.8	1.1	0.06	66,142	0	
2	1 APR	1997	Smolt	92620	120	9.1	21.1	6.2	1.1	0.09	66,301	0	
3	1 APR	1997	Smolt	92621	120	7.5	20.1	3.2	1.2	0.09	58,896	0	
4	1 APR	1997	Smolt	70148	123	11.8	21.9	6.7	1.2	0.08	56,638	34,592	55.7
5	1 APR	1997	Smolt	70749	121	13.9	20.8	6.5	1.1	0.07	64,166	9,962	29.0
16	24 JUN	1998	Parr	92819	69.3	4.1	3.8	0.8	1.1	0.10	<u>57,290</u>	<u>0</u>	
Total / Mean											369,433	44,554	42.4
<u>Lostine Stock- released at Lostine Acclimation Site</u>													
6	1 APR	1997	Smolt	92610	122	6.7	20.4	3.8	1.1	0.07	<u>11,871</u>	<u>4,958</u>	<u>52.8</u>
Total / Mean											11,871	4,958	52.8

^a Equals total number released in Table 1 by stock. Total released includes all fish with adipose clip and CWT (target 100%).

Table 4. Recoveries of adult spring Chinook salmon at northeast Oregon LSRCP facilities and Lower Granite Dam in 1999. No fish were captured in any trap after 9 September.

Period	Week of year	Imnaha River		Grand Ronde River		Lostine River		Catherine Creek		Lookingglass Creek ^a		Lower Granite Dam ^b
		Marked	Un-marked	Marked	Un-marked	Marked	Un-marked	Marked	Un-marked	Marked	Un-marked	Marked
Trap operation dates		21 JUL – 14 SEP		5 MAY- 17 SEP		5 MAY – 10 OCT		7 MAY – 30 SEP		16 JUN –20 SEP		
23-29 APR	17	-	-	-	-	-	-	-	-	0	0	5
30 APR - 6 MAY	18	-	-	0	0	0	0	-	-	0	0	28
7-13 MAY	19	-	-	0	0	0	0	0	0	0	0	64
14-20 MAY	20	-	-	0	0	0	0	0	0	0	0	166
21-27 MAY	21	-	-	0	0	0	0	0	0	0	0	146
28 MAY - 3 JUN	22	-	-	0	0	0	0	0	0	0	0	74
4-10 JUN	23	-	-	0	0	0	0	0	0	0	0	33
11-17 JUN	24	-	-	0	0	0	0	0	0	8	3	27
18-24 JUN	25	-	-	0	0	0	0	0	2	11	3	23
25 JUN - 1 JUL	26	-	-	0	0	0	0	0	2	11	2	9
2-8 JUL	27	-	-	0	0	0	0	0	0	11	2	5
9-15 JUL	28	-	-	0	0	0	0	0	2	1	1	4
16-22 JUL	29	-	-	0	1	0	1	0	4	0	0	3
23-29 JUL	30	35	6	0	0	1	7	0	3	2	1	0
30 JUL - 5 AUG	31	77	17	0	0	0	0	0	1	0	0	0
6-12 AUG	32	31	4	0	0	0	2	0	1	1	0	0
13-19 AUG	33	14	8	0	0	0	1	0	0	0	1	0
20-26 AUG	34	106	25	0	0	0	0	0	0	0	1	0
27 AUG - 2 SEP	35	48	13	0	0	0	1	0	1	1	0	0
3-9 SEP	36	<u>4</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>3</u>	<u>0</u>
Total		315	75	0	1	1	12	0	16	47	17	587

^a All fish were trucked to and spawned at South Fork Walla Walla Fish Hatchery, Washington.

^b All fish were trucked to Lyons Ferry Fish Hatchery. A total of 555 were Rapid River stock released into Lookingglass Creek.

Table 5. Number and disposition of adult spring Chinook salmon that returned to northeast Oregon LSRCP facilities in 1999 by origin, age, and sex.

Stock, disposition	Hatchery							Natural							Grand total
	3		4		5		Total	3		4		5		Total	
	F	M	F	M	F	M		F	M	F	M	F	M		
<u>Imnaha River</u>															
Trapped	0	173	52	89	0	1	315	1	22	17	23	3	9	75	390
Passed ^a	0	7	20	41	0	0	68	0	13	12	15	3	8	51	119
Outplanted	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kept	0	166	32	48	0	1	247	1	9	5	8	0	1	24	271
Actual spawned ^b	0	154	31	45	0	1	231	1	7	5	7	0	1	21	252
Killed, not spawned	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre-spawn mortality	0	12	1	3	0	0	16	0	2	0	1	0	0	3	19
Mean fork length (mm) ^c	-	578	770	750	-	990	-	-	589	811	758	899	941	-	-
Standard deviation (mm)	-	38.0	32.4	40.3	-	-	-	-	35.2	30.1	57.0	26	-	-	-
Age composition (%)	0	54.9	16.5	28.3	0	0.3	100	1.3	29.3	22.7	30.7	4.0	12.0	100	
<u>Lostine River</u>															
Trapped	0	1 ^d	0	0	0	0	1	0	1	7	2	0	2	12	13
Passed	0	0	0	0	0	0	0	0	1	6	2	0	1	10	11
Kept ^e	0	0	0	0	0	0	0	0	0	1	0	0	1	2	2
Mean fork length (mm) ^c	-	525	-	-	-	-	-	-	580	751	758	-	885		
Standard deviation (mm)	-	NA	-	-	-	-	-	-	NA	53	18	-	64		
Age composition (%)	0	100	0	0	0	0	100	0	8.3	58.3	16.7	0	16.7	100	
<u>Lookingglass Creek</u>															
Trapped	0	49	315	228	2	8	602	0	5	4	4	0	4	17	651
Trapped at LG Dam ^f	0	29	296	221	2	7	555	0	0	0	0	0	0	0	587
Trapped at LFH	0	20	19	7	0	1	47	0	5	4	4	0	4	17	64
Mean fork length (mm) ^c	0	477	699	761	0	945	-	0	473	721	692	0	901		
Standard deviation (mm)	0	37.5	42.9	16.8	0	-	-	0	71.9	51.9	40.5	0	74.3		

Table 5 continued.

Stock, disposition	Hatchery							Natural							Grand total
	3		4		5		Total	3		4		5		Total	
	F	M	F	M	F	M		F	M	F	M	F	M		
Age composition (%)	0	8.1	52.3	37.9	0.3	1.3	100	0	29.4	23.5	23.5	0	23.5	100	
<u>Catherine Creek</u>															
Trapped	0	0	0	0	0	0	0	0	0	1	0	0	0	1	16 ^g
Passed	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
Mean fork length (mm) ^c											768				
<u>Grande Ronde River</u>															
Trapped	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1 ^h

^a An additional 15 fish were recaptures and passed (6 males on 23 AUG, 6 males and 1 jack on 30 AUG, and 2 males on 7 SEP)

^b Includes 18 hatchery and 2 natural age 3 males that had semen cryopreserved.

^c Mean length per age class determined from known age fish based on either CWT or scale data.

^d One age 3 male (525 mm) escaped from the trap

^e The two fish kept were returned to the river

^f Trapped one more female of unknown age not included in trapped numbers. Also includes 14 recycled males.

^g 15 unclipped fish were trapped, all age 4 of unknown sex

^h One unmarked fish was trapped and passed of unknown age or sex

Table 6. Timing of spawning and spawning summaries for Imnaha River spring Chinook salmon at Lookingglass Fish Hatchery in 1999. Rapid River stock were spawned at South Fork Walla Walla Fish Hatchery.

Stock, spawn date	Origin of parents	Number of parents		Number of eggs collected	Shock loss	Number of eyed eggs	Mortality through shocking (%)
		F	M ^a				
<u>Imnaha River</u>							
6 AUG	Hatchery	1	1	3,541	2,969	572	83.8
12 AUG	Mixed	1	4	3,976	427	3,549	10.7
19 AUG	Mixed	2	18	10,421	2,851	7,570	27.4
25 AUG	Mixed	14	55	67,973	20,271	47,702	29.8
27 AUG	Mixed	4	28	22,535	3,110	19,425	13.8
1 SEP	Mixed	8	50	34,477	9,447	25,030	27.4
1 SEP	Hatchery	2	2	8,392	705	7,687	8.4
9 SEP	Mixed	<u>4</u>	<u>42</u>	<u>17,615</u>	<u>652</u>	<u>16,963</u>	<u>3.7</u>
Total		36	200	168,930	40,432	128,498	23.9
<u>Rapid River</u>							
24 AUG	Mixed	1	1	3,185	n/a	n/a	n/a
31 AUG	Mixed	4	6	14,080	n/a	n/a	n/a
7 SEP	Mixed	<u>3</u>	<u>7</u>	<u>10,277</u>	<u>n/a</u>	<u>n/a</u>	<u>n/a</u>
Total ^b		8	14	27,542	2,506	25,036	9.1 ^c

^a The number of males in table are greater than the number kept because 17 males were recycled.

^b Eggs from separate spawn dates were pooled before shocking.

^c Only total percent mortality due to shocking at South Fork Walla Walla hatchery.

Table 7. Expanded recoveries of coded-wire tagged Imnaha River spring Chinook salmon for the 1999 return year. Mainstem recoveries were collected in Columbia/Snake rivers en route to the Imnaha River (includes ocean recoveries). In-basin strays were recovered in other streams within the Snake River basin. Out-of-basin strays were recovered from streams outside the Snake River basin (not in the migration route) or in the upper Columbia River. Numbers in parentheses are unexpanded recoveries.

Cohort	Experimental group (target size at release and rearing density)	CWT code	Recovery location				Total
			Imnaha River ^a	Mainstem rivers	In-basin strays	Out-of- basin strays	
1994	30 g, 1/4 Density	071225	2 (2)	0	0	0	2
	30 g, 1/4 Density	071226	1 (1)	0	0	0	1
	18 g, 1/4 Density	071228	0 (0)	0	0	0	0
	18 g, 1/4 Density	071229	0 (0)	0	0	0	0
	18 g, 1/4 Density	071230	<u>1 (1)</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
	Total		4 (4)	0	0	0	4
1995	18 g, 1/4 Density	091719	5 (1)	1	0	0	6
	30 g, 1/8 Density	091720	104 (22)	0	0	0	104
	30 g, 1/4 Density	091721	118 (25)	0	0	0	118
	18 g, 1/8 Density	091722	189 (40)	0	0	2	191
	18 g, 1/4 Density	091723	<u>161 (34)</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>162</u>
	Total		577 (122)	2	0	2	581
1996	30 g, 1/4 Density	092124	16 (4)	0	0	0	16
	30 g, 1/8 Density	092163	32 (8)	1	0	0	33
		092201	32 (8)	0	0	0	32
	18 g, 1/8 Density	092202	124 (31)	0	0	0	124
	30 g, 1/4 Density	092203	68 (17)	0	0	0	68
	30 g, 1/4 Density	092204	100 (25)	0	0	0	100
	18 g, 1/8 Density	092205	140 (35)	0	0	0	140
	30 g, 1/4 Density	092206	<u>156 (39)</u>	<u>0</u>	<u>1</u>	<u>1</u>	<u>158</u>
	Total		668 (167)	1	1	1	671
Grand Total			1,249 (293)	3	1	3	1,256

^a Expansion factor for CWT recoveries are based on estimated total return of hatchery cohort to the Imnaha River and estimated tag retention rates. Total return based on weir counts and spawning ground surveys.

Table 8. Expanded adult recoveries for the 1999 return year of coded-wire tagged Rapid River spring Chinook salmon, released as smolts from Lookingglass Fish Hatchery. Mainstem river recoveries were collected in Columbia/Snake/Grand Ronde rivers (other than Lower Granite Dam) en route to Lookingglass Creek (includes ocean recoveries). In basin strays were fish collected in streams within the Snake River basin other than Lookingglass Creek. Out of basin strays were collected in streams outside the Snake River basin not in the migration route.

Cohort	Experimental group ^a	CWT code	Recovery location					Total
			LFH weir ^b	Lower Granite Dam	Mainstem rivers	In basin strays	Out of basin strays	
1994	Exercise	071231	0	0	0	0	0	0
	Control	071232	0	1	0	0	4	5
	Exercise	071233	0	0	0	0	0	0
	Control	071234	<u>0</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>2</u>
	Total		0	2	1	0	4	7
1995	Control	091724	0	124	2	0	2	130
	Control	091725	0	131	2	1	3	140
	Exercise	091726	1	140	2	0	2	148
	Exercise	091727	0	104	1	0	4	111
	Unmarked	091728	<u>12</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>12</u>
	Total		13	499	7	1	11	531
1996	Production	075309	0	5	0	0	0	5
	Production	075310	0	3	0	0	0	3
	Production	075311	0	2	0	0	0	2
	Production	075850	0	4	0	0	0	4
	Unmarked ^c	092207	6	0	0	0	0	6
	Unmarked ^c	092208	10	0	0	1	0	11
	Production	092209	0	2	0	0	0	2
	Production	092210	0	3	0	0	0	3
	Production	092211	0	5	0	0	0	5
	Production	092212	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>
	Total		16	26	0	1	0	43
Grand Total			29	527	8	2	15	581

^a All groups reared at target size at release of 22.8g except 092207 (10.8g)

^b Salmon from production and exercise/control groups were used as broodstock at South Fork Walla Walla and Lyons Ferry hatcheries. No CWT data were collected from these fish so weir recoveries not expanded by CWT group.

^c Progeny were from unmarked parents.

Table 9. Catch and escapement distribution of hatchery adult spring Chinook salmon by recovery location in 1999. Data summarized through April 2005 from the PSMFC and ODFW CWT recovery databases. Recruitment to Imnaha River expanded number based on escapement estimate. Lower Granite Dam expanded number includes actual CWT recoveries and fish collected with no CWT but AdRV mark and assumed to be Rapid River stock. Recruitment to Lookingglass Creek (Rapid River stock) expansion based on weir count.

Location, recovery type	Imnaha River stock			Rapid River stock		
	Actual recoveries	Expanded adults	Percent of total	Actual recoveries	Expanded adults	Percent of total
Ocean catch	0	0	0	0	0	0
Columbia River						
Treaty net	0	0	0	8	8	1.4
Non-treaty net	0	0	0	0	0	0
Sport	0	0	0	0	0	0
Deschutes River						
Trap	1	1	0.08	9	9	1.6
Sport	0	0	0	0	0	0
Ceremonial and subsistence	0	0	0	0	0	0
Strays						
Outside Snake River Basin	1	2	0.16	3	6	1.0
Within Snake River Basin ^a	1	1	0.08	2	2	0.3
Lower Granite Dam ^a	3	3	0.2	527	555	92.8
Recruitment to river ^a	293	1,279	99.5	29	47	2.9
Total estimated return		1,286			627	
Return to compensation area ^a		1,282			604	
Percent of compensation goal ^b		39.9			10.4	

^a Indicates areas defining the compensation area.

^b The compensation goal for Imnaha River stock is 3,210 adults and the goal for Rapid River stock is 5,820 adults.

Table 10. Summary of adipose-clipped Chinook salmon carcasses recovered during spawning ground surveys in 1999.

Recovery location ^a	CWT code	Number recovered	Release site and cohort
Imnaha River	71225	2	Imnaha River, 1994 cohort
Imnaha River	71230	1	Imnaha River, 1995 cohort
Imnaha River	91720	8	Imnaha River, 1995 cohort
Imnaha River	91721	4	Imnaha River, 1995 cohort
Imnaha River	91722	14	Imnaha River, 1995 cohort
Imnaha River	91723	14	Imnaha River, 1995 cohort
Imnaha River	92163	1	Imnaha River, 1996 cohort
Imnaha River	92202	2	Imnaha River, 1996 cohort
Imnaha River	92203	1	Imnaha River, 1996 cohort
Imnaha River	92204	1	Imnaha River, 1996 cohort
Imnaha River	92205	1	Imnaha River, 1996 cohort
Imnaha River	92206	3	Imnaha River, 1996 cohort
Imnaha River	Snout lost	6	Unknown
Imnaha River	Tag lost	2	Unknown
Wenaha River	91725	1	Lookingglass Creek, 1995 cohort
Minam River	92208	1	Lookingglass Creek, 1996 cohort

^a Two additional adipose-clipped Chinook salmon were collected in the Lostine River but CWT information was not recovered.

Table 11. Summary of hatchery- and naturally-produced spring Chinook salmon carcass recoveries and number of redds discovered in each stream during spawning ground surveys in 1999. Hatchery salmon were determined by the presence of a coded-wire tag.

Basin, stream	Hatchery	Natural	Unknown mark	Percent marked	Number of redds
<u>Grande Ronde River Basin</u>					
Bear Creek	0	0	0	0	0
Hurricane Creek	0	2	0	0	6
Lostine River	2	45	1	4.3	57
Wallowa River	0	0	0	0	3
Grande Ronde River	0	0	0	0	0
Catherine Creek	0	17	0	0	40
Lookingglass Creek	0	0	0	0	3
Minam River	1	20	0	4.8	46
Wenaha River	1	9	3	10.0	25
<u>Imnaha River Basin</u>					
Big Sheep Creek	0	0	0	0	1
Imnaha River	65	109	7	37.4	189
Lick Creek	0	0	0	0	0

Table 12. Age composition of spring Chinook salmon carcasses recovered in 1999 during spawning ground surveys in the Imnaha and Grande Ronde river basins.

Basin, parameter	Age 2		Age 3		Age 4		Age 5	
	M	F	M	F	M	F	M	
<u>Grande Ronde River Basin</u>								
Number ^a	0	0	2	59	28	4	4	
Percent of total	0	0	2.1	60.8	28.9	4.1	4.1	
Mean fork length (mm)			510	734	778	860	976	
Standard deviation			14.1	46.9	63.1	37.2	37.7	
<u>Imnaha River Basin</u>								
Number ^b	1	2	19	73	43	15	25	
Percent of total	0.6	1.1	10.7	41.0	24.2	8.4	14.0	
Mean fork length (mm)	120	686	571	782	768	938	924	
Standard deviation		90.5	42.7	31.8	70	34.4	109.3	

^a One unknown sex of age 4, one male and one female of unknown age not included.

^b One unknown sex of age 3 and two males of unknown age.

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