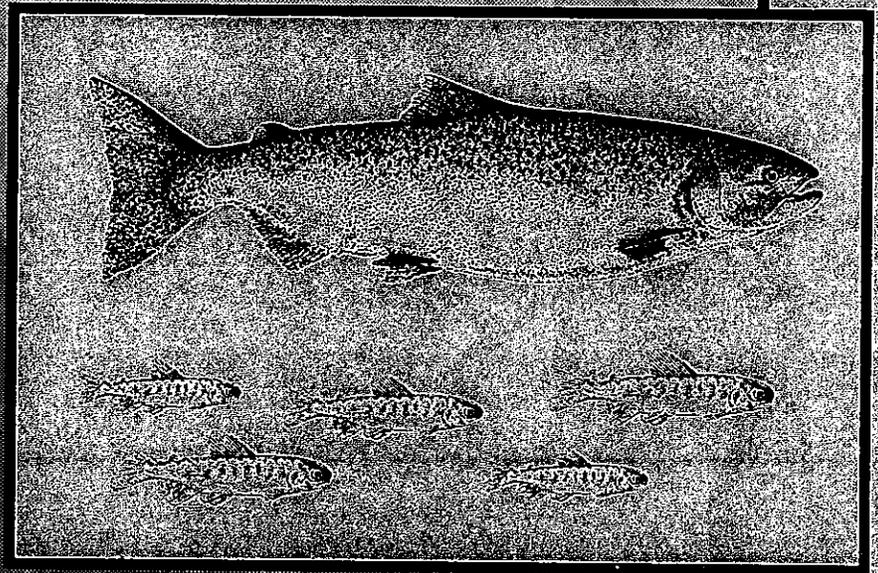


# Lyons Ferry Hatchery Evaluation Fall Chinook Salmon Report: 1996 and 1997



by Lorna Wargo, Deborah Milks  
and Glen Mendel



Washington Department of  
**FISH AND WILDLIFE**  
Fish Program

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# Lyons Ferry Hatchery Evaluation

## Fall Chinook Salmon Annual Report: 1996 and 1997

by

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Cooperative Agreement  
14-48-0001-96539  
and  
14-48-14110-97-J038

Fish Program Report Number FPA 99-06

**September 1999**

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## Acknowledgments

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The Lyons Ferry Fall Chinook Salmon Hatchery Evaluation Program is the result of work by many individuals within the Washington Department of Fish and Wildlife (WDFW) Hatcheries Program. We want to thank all those who contributed to this program.

We would like to thank the Snake River Lab staff: Joe Bumgarner, Jerry Dedloff, Lance Ross, Mark Schuck, Michelle Varney and Art Viola. Our tasks would have been much more difficult without their help.

We thank Rob Allan, Pat Phillips, Larry Barger, Ted Parks, and other personnel at Lyons Ferry Hatchery for their cooperation with sampling and providing information regarding hatchery operations. A special thanks to Butch Harty and Bruce Walters for their assistance with summarizing hatchery data for this report. We appreciate the assistance of Lynn Anderson and her crew at the WDFW Tag Recovery Lab. John Sneva (WDFW) processed scale samples for us.

We appreciate the efforts of Jerry Harmon (National Marine Fisheries Service) and his crew at Lower Granite Dam for trapping, tagging and documenting fall chinook salmon for transport to Lyons Ferry Hatchery.

We thank Mark Schuck, Joe Bumgarner, and Daniel Herrig for reviewing a draft of this report and providing valuable comments.

Finally, we thank Ed Crateau and Dan Herrig, U.S. Fish and Wildlife Service, Lower Snake River Compensation Plan Office for providing funding, and encouragement for this program.

# Abstract

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This report summarizes activities by the Washington Department of Fish and Wildlife's Lower Snake River Hatchery Evaluation Program from April 1, 1996 to May 1, 1998. However, data from March 1996 and July 1998 are included to fully encompass the life stages of each brood year addressed. This work was completed with Fiscal Year 1996 and 1997 funds provided by the U.S. Fish and Wildlife Service (USFWS) under the Lower Snake River Compensation Plan (LSRCP). We describe the fall chinook salmon program at Lyons Ferry Fish Hatchery (LFH), and some related natural production in tributaries of the Snake River. We have also incorporated information about salmon trapping at Lower Granite (LGR) Dam.

Fall chinook salmon broodstock were obtained from two sources: voluntary returns to the LFH ladder; and fish trapped and transported to LFH from LGR Dam. Only coded-wire tagged (CWT), blank-wire tagged (BWT), and ventral fin clipped salmon were collected at LGR Dam and transported to the hatchery. During collection, the number of adults and jacks available for broodstock at Lyons Ferry was estimated to be 1,750 in 1996 and 1,877 in 1997. However, in 1996 the total number processed at spawning was 1,807, including 1,431 fall chinook adults and jacks that had voluntarily returned to the hatchery, and 376 salmon transported from trapping operations at LGR Dam. In 1997, the total number processed at spawning was 1,840, including 1,194 adult and jack chinook and one coho that had voluntarily returned to the hatchery, and 645 salmon transported from trapping operations at LGR Dam.

Fall chinook were spawned at LFH from October 22 to December 3, 1996, and October 21 to December 2, 1997. Peak of spawning was November 5 in 1996 and November 4 in 1997. Coded-wire tags from all marked hatchery fish were read before mating fish. Matings consisted of single female/single male lots (with a backup male). Only salmon verified to be of LFH origin were used for broodstock. All Lyons Ferry origin salmon from the 1989 brood, marked (CWT) hatchery strays, and unmarked fish were spawned together as "strays" or mixed origin.

Total egg take from all fish was 1,698,309 in 1996 and 1,451,823 in 1997. The 1996 egg take from Lyons Ferry origin salmon was 1,433,862 with 1,377,202 of these eggs surviving until "eye up." The 1997 egg take from Lyons Ferry origin salmon was 1,184,141 with 1,134,641 surviving until "eye up". Progeny from stray and unmarked salmon were transferred to Klickitat Fish Hatchery (243,677 "eyed" eggs in 1996 and 196,400 in 1997) for subsequent release there. An additional 13,168 eyed eggs were shipped to Little White Salmon in 1997.

LFH released 404,270 yearling (1994 brood) fall chinook salmon directly from the hatchery April 9-15, 1996. In 1997, LFH volitionally released 456,776 yearling (1995 brood) fall chinook salmon from the hatchery April 4-26. The Nez Perce Tribe (NPT) released a total of 346,715 fall chinook yearlings (95 brood) in April 1997 from acclimation facilities upstream of LGR Dam. In 1998, LFH volitionally released 418,992 yearling (96 brood) fall chinook April 3-16. The

NPT released 252,705 subyearling (96 brood) fall chinook in 1997 from the Big Canyon acclimation facility. A total of 336,191 yearling (96 brood) fall chinook salmon were released in 1998 by the NPT from acclimation sites above LGR Dam. All fall chinook salmon released from Lyons Ferry were adipose clipped (marked), coded-wire tagged and tagged with a red elastomer tag in the clear tissue behind the left eye. Snake River Lab (SRL) staff participated in planning, coordination, and monitoring of fall chinook releases from the NPT's acclimation sites:

Sex, age, and mean length information was compiled for Lyons Ferry origin fall chinook salmon. Males have been more abundant in the younger age classes of returning fall chinook salmon most years. Few females return prior to age four. Subyearling releases return larger adult fish at age than yearling releases, but substantially fewer fish.

Surveys were conducted to enumerate fall chinook spawning in the Tucannon River. In 1996, we observed 43 redds (2.9 redds/km below Rk 9.6) and 22 carcasses, including three that originated from Umatilla Hatchery and one that originated from Klickitat Hatchery. All other carcasses were unmarked. In 1997, we observed 27 redds (3.3 redds/km below Rk 9.6) and 19 carcasses, which included seven that originated from LFH, one from the Umatilla Hatchery and one that was a fully spawned female coho of natural origin. The origin of one hatchery fish was not determined. The remaining 10 were unmarked.

We are unable to account for approximately 29 percent (1,370 salmon) and 30 percent (1,389 salmon) of fall chinook escapement past Ice Harbor Dam (IHR) in 1996 and 1997, respectively. These estimates are calculated as the difference between the number of fish crossing IHR Dam and the numbers of fish entering LFH, spawning in the Tucannon River, or crossing LGR Dam.

In 1996 and 1997, as in previous years, CWTS recovered from fall chinook salmon showed that many had strayed into the Snake River. Unlike previous years, however, more stray salmon originated from Klickitat Hatchery than Umatilla Hatchery. In 1996, Klickitat Hatchery adults represented 25.7 percent of the hatchery fall chinook that escaped to LGR Dam; fall chinook from Umatilla accounted for 7.5 percent. In 1997, hatchery strays from Klickitat constituted 27.8 percent of the adult hatchery fall chinook that escaped to LGR Dam; adult strays from Umatilla accounted for 14.1 percent.

# Introduction

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## Program Objectives

Congress authorized the Lower Snake River Fish and Wildlife Compensation Plan (LSRCP) in 1976. As a result of that plan, LFH was constructed and has been in operation since 1984. One objective of the hatchery was to compensate for the loss of 18,300 adult, Snake River stock, fall chinook salmon (U.S. Army Corps of Engineers 1975). An evaluation program was initiated in 1984 to monitor the success of LFH in meeting the LSRCP compensation goals and to identify any production adjustments required to accomplish those goals.

The Washington Department of Fish and Wildlife (WDFW)<sup>1</sup> has two general goals in its evaluation program: 1) monitor hatchery practices at LFH to ensure quality smolt releases, high downstream migrant survival, and sufficient contribution to fisheries with escapement to meet the LSRCP compensation goals; and 2) gather genetic information to help maintain the integrity of Snake River Basin fall chinook salmon stocks (WDF 1994). Specific program objectives were outlined previously (Mendel et al. 1995).

This report summarizes the results and activities performed by the WDFW's LSRCP Fall Chinook Salmon Evaluation Program from April 1, 1996, through juvenile release in April 1998. Additional summarization and analyses of these data may be reported in subsequent reports.

## Description of Facilities

LFH is located at the confluence of the Palouse and Snake Rivers at river kilometer (Rk) 90 (Lower Monumental Pool, Figure 1). Design capacity for the fall chinook salmon program was 101,800 pounds (9,162,000 subyearling smolts at 90 fish per pound). Salmon<sup>2</sup> are hatched and reared at LFH and have been released as yearlings and subyearlings. Release locations have included the hatchery (on-station), downstream of IHR Dam (barged), or upstream of LGR Dam (direct and acclimated releases). Broodstock are obtained from various sources (Broodstock Collection and Management).

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<sup>1</sup> All references to either the Washington Departments of Fisheries, or Wildlife are listed here as WDFW; the agencies merged in March 1994.

<sup>2</sup> The term salmon in this report refers to fall chinook salmon.

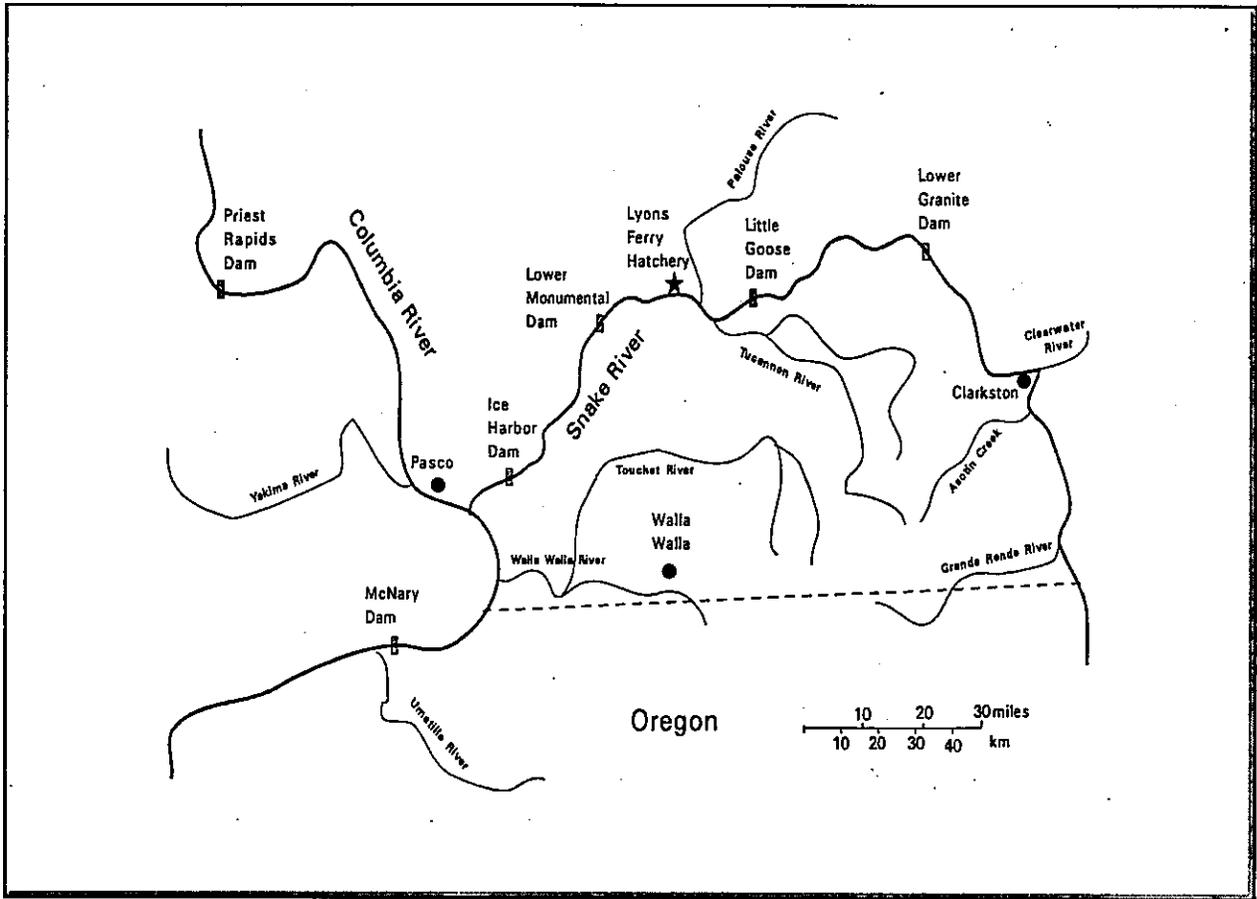


Figure 1. Lower Snake River Basin, showing the location of Lyons Ferry Fish Hatchery and major tributaries in the area.

## Broodstock Collection And Management

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LFH has been developing its broodstock since the facility began operating in 1984. Broodstock collection, from 1984-1990, and during the egg bank program (1977-1984) has been summarized previously (Bugert and Hopley 1989, Bugert et al. 1991, Bugert et al. 1995). Until 1990, salmon were obtained from two primary sources: 1) returns to the LFH ladder; and 2) adults trapped at IHR Dam (Bugert and Hopley 1991). LFH broodstock collection from these two sources averaged 37 percent of total escapement to the project area above IHR Dam (Bugert et al. 1991). Beginning in 1990, salmon were collected at Lower Granite Dam (LGR), providing a third source for broodstock. Collection of salmon from IHR Dam ceased in 1994 because of the high incidence of stray salmon, concerns about salmon passage delay caused by trapping, and personnel safety issues. The first year of adult ( $\geq 3$  years old) returns from LFH production was 1986.

National Marine Fisheries Service (NMFS) and WDFW personnel have cooperatively trapped and transported adult salmon since 1990, and jack salmon<sup>3</sup> (or killed hatchery jacks and mini jacks) since 1992 at LGR Dam for the following reasons: 1) to obtain information about run composition and stray hatchery salmon; 2) to reduce the number of stray hatchery salmon spawning naturally upstream of LGR Dam; and 3) to collect broodstock for LFH.

The number of fish counted at LFH at the time of collection is considered a preliminary estimate of return (Table 1). The final estimate of total return to LFH is determined using the number of fish actually processed. Despite continual efforts to improve accounting procedures, discrepancies occur between the number of salmon estimated at collection and the number actually processed. This is due, in part, to misidentification of chinook, steelhead, and coho while sorting using the partially automated sorting system at LFH. Also, small jacks can pass through the crowders and escape.

Discrepancies also occur between the number of salmon trapped at LGR and the number actually processed at LFH. At LGR, jaw tags were placed on trapped fish bound for LFH. This enabled us to distinguish them at processing from voluntary returns and also identify their date of collection. Occasionally, jaw tags fell off or were missed during processing. The result was that some fish originally trapped at LGR might have been documented at processing as volunteers to LFH.

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<sup>3</sup> Throughout this report, jacks were distinguished only by size at the time of collection. The length criterion for jacks collected at the dams was  $\leq 56$  cm total length, whereas the criterion at LFH was  $< 49$  cm fork length. Mini-jacks were  $\leq 30$  cm fork length.

**Table 1.** Fall chinook returns estimated at collection from Ice Harbor Dam, Lyons Ferry Hatchery (LFH) ladder, and Lower Granite Dam.

Year	Collection location <sup>a</sup>	Number collected		Dam counts <sup>c</sup>			
		adults	jacks <sup>b</sup>	(through October)		(November)	
				adults	jacks	adults	jacks
1990	LFH	521	602				
	Ice Harbor Dam	1,092	0	3,470	1,847	-	-
	Lower Granite Dam	49	0	385	190	-	-
1991	LFH	863	675				
	Ice Harbor Dam	361	71	4,500	1,526	-	-
	Lower Granite Dam	37	0	630	397	-	-
1992	LFH	898	176				
	Ice Harbor Dam	256	71	4,636	894	-	-
	Lower Granite Dam	178	26	855	102	-	-
1993	LFH	714	157				
	Ice Harbor Dam	127 <sup>b</sup>	-	2,805	332	-	-
	Lower Granite Dam	218	4	1,170	39	-	-
1994	LFH	656	-				
	Ice Harbor Dam	-	-	2,069	1,033	-	-
	Lower Granite Dam	328	-	791	255	-	-
1995	LFH	2,231	-				
	Ice Harbor Dam	-	-	2,750	2,452	-	-
	Lower Granite Dam	693	-	1,067	308	-	-
1996	LFH	1,359	-				
	Ice Harbor Dam	-	-	3,810	808	41	3
	Lower Granite Dam	396	-	1,308	424		
1997	LFH	1,224 <sup>d</sup>	-				
	Ice Harbor Dam	-	-	2,752	1,726	15	128
	Lower Granite Dam	653	-	1,451	504		

<sup>a</sup> Salmon have not been trapped at IHR since 1994.

<sup>b</sup> Salmon were not classified by size at time of collection from 1994-1997.

<sup>c</sup> Classification of adults and jacks is based upon size at the counting window at each dam.

<sup>d</sup> Includes three coho.

## LGR Dam Trapping Operations

Salmon with CWT, BWT, or other metal objects activated the door to the trap in the south shore fish ladder at LGR Dam. Also, fin clipped (right or left ventral; RV or LV) salmon without wire were captured and retained during periods when the trap door was kept open to scale sample a portion of the steelhead passing the dam.

Stray salmon were collected at the trap for transport to LFH<sup>4</sup>. Lyons Ferry origin fish were also collected to supplement broodstock at LFH. Some small fish (jacks and mini jacks) not needed as broodstock were killed and frozen for CWT recovery, and to prevent their upstream passage. Prior to transport, NMFS staff anesthetized the stray and LFH salmon, gathered length and sex data, and tagged them with numbered metal jaw tags. The fish were hauled to the hatchery by WDFW personnel in a 1,200 L aerated, unrefrigerated tank truck, with water from LFH or the adult trap at LGR Dam.

## 1996

The number of fall chinook counted at the LGR Dam adult trap was 396 (Table 1). Five mini jacks were killed at LGR Dam to recover CWTS. The remaining salmon were transported to LFH for spawning. The number of salmon processed was 376, leaving 13 fish unaccounted for (Table 2a). At least 39 of the fish processed originated from Umatilla Hatchery .

**Table 2a.** Summary of salmon collected and processed in 1996.

Number of fish	Comments
396	Total salmon collected at LGR Dam
- 5	Sacrificed jacks for CWT recovery (minijacks)
- 2	Fish collected for transport but later found dead under grating at LGR
<u>-13</u>	Jaw tagged fish unaccounted for at LFH
376	Salmon transported to Lyons Ferry
326	With readable CWTS or VIs (293 from Lyons Ferry)
10	No tags (2) or lost tags (8)
34	BWTs from Umatilla Hatchery
5	RV or LV fin clips from Umatilla Hatchery
<u>1</u>	CWT from a fish that was not adipose clipped
376	Salmon processed at Lyons Ferry

## 1997

The number of fall chinook counted at the LGR Dam adult trap was 653 (Table 1). Eight mini jacks were killed prior to transport to recover CWTS. The remaining 645 salmon were transported to LFH for spawning (Table 2b). At least 69 of the fish processed were of Umatilla origin.

<sup>4</sup> NMFS requires that stray salmon trapped at LGR be removed from the Snake River system. These fish are taken to LFH for spawning. Progeny of these strays are reared and released at Klickitat Hatchery.

**Table 2b.** Summary of salmon collected and processed in 1997.

Number of fish	Comments
653	Total salmon collected
- 8	Sacrificed jacks for CWT recovery (minijacks)
645	Salmon transported to LFH
560	With readable CWTS or VIs (509 from Lyons Ferry)
5	No tags (2) or lost tags (3)
69	BWTs from Umatilla Hatchery
10	No wire or marks, collected in error
1	Not jaw tagged at LGR, could not be tracked at LFH
645	Salmon processed at LFH

## LFH Trapping Operations

The trap was opened in September to permit salmon to voluntarily enter the hatchery. Several times a week, salmon that had entered the trap were directed into a holding pond.

### 1996

The final count (and the number processed) of adults and jacks that voluntarily returned to LFH was 1,431 fish. The number of voluntary returns initially estimated at collection was 1,354 fish. Duration of trapping was 92 days (Table 3). Entry peaked on October 11 when 109 adults entered the hatchery.

### 1997

The final count (and the number processed) of adults and jacks that voluntarily returned to LFH was 1,194 fish. Voluntary returns were initially estimated at 1,224 fish. Duration of trapping was 100 days (Table 3). Entry peaked on October 31 when 77 adults entered the hatchery.

**Table 3. Voluntary returns of fall chinook to Lyons Ferry Hatchery estimated at collection.**

Year	Number of return		Trapping dates	Peak return day	
	adults	jacks <sup>a</sup>		date	adults
1986	245	1,125	Sep 5 - Nov 15	Sep 18	24
1987	1,654	543	Sep 13 - Dec 12	Sep 26	202
1988	327	1,053	Sep 9 - Dec 5	Sep 16	95
1989	704	670	Sep 6 - Dec 4	Oct 1	56
1990	521	602	Sep 5 - Nov 14	Nov 7	57
1991	863	675	Sep 13 - Dec 4	Oct 1	54
1992	898	176	Sep 14 - Dec 7	Oct 19	181
1993	714	157	Sep 8 - Dec 7	Nov 11	42
1994	1,310	-	Sep 11 - Nov 29	Nov 13	80
1995	2,231	-	Sep 8 - Dec 3	Oct 17	42
1996 <sup>b</sup>	1,354	-	Sep 1 - Dec 1	Oct 11	109
1997 <sup>c</sup>	1,224	-	Aug 18 - Nov 25	Oct 31	77

<sup>a</sup> Jacks were classified by size ( $\leq 61$  cm fork length) at the time of collection prior to 1994. After 1994, adults and jacks were not classified at time of collection.

<sup>b</sup> Actual number of fish accounted for in 1996 that volunteered into Lyons Ferry was 1,431 adults and jacks.

<sup>c</sup> Actual number of fish accounted for in 1997 that volunteered into Lyons Ferry was 1,194 adults and jacks.

# Hatchery Operations

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## Spawning Operations

### Spawning and Egg Take

Fall chinook collected at LGR Dam were held separately from those that voluntarily entered the hatchery<sup>5</sup>. At spawning, ripe fish were killed and their gametes collected and set aside unmixed. CWTS were removed from marked fish and read to determine the fish's origin prior to fertilization of the eggs. Fish were spawned in two groups: 1) Lyons Ferry origin fish, identified through examination of CWTS or the presence of elastomer tags; and 2) all others. This latter category included all unmarked fish, strays identified by CWT, and all 1989 brood (BWT and CWT) salmon from LFH. Lyons Ferry origin fish were mated together (excluding the 1989 brood) and retained for subsequent Snake River releases. All fish were mated as single male/single female pairs (with a back up male 15-30 seconds later). Fertilized eggs from Lyons Ferry fish were incubated separately from those eggs known to be from stray or unmarked fish.

In 1996, chilled water was used for eggs from the first two egg takes of Lyons Ferry origin fish so that some of the egg takes would hatch on approximately the same date. Eggs from later egg takes could not be chilled because of limited chiller capacity. Chilled water was not used in 1997.

### 1996

Fish were spawned from October 22 through December 3, 1996 (Table 4a). The peak of spawning was November 5, when approximately 520,380 eggs were taken. The total egg take at LFH was 1,698,309<sup>6</sup>; initial mortality was 4.56 percent (Table 5). Lyons Ferry origin salmon produced 1,433,862 total eggs ("green" or unfertilized eggs), while the total from stray fish was 264,447 eggs.

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<sup>5</sup> Broodstock were collected and spawned in 1996 and 1997 according to the 1992 Broodstock Collection and Spawning Protocol (Mendel et al. 1995) with slight modifications (Appendix A).

<sup>6</sup> This is the number of eggs counted after picking. A preliminary estimate of eggtake using 3,100 eggs per female is used at the hatchery before picking.

**Table 4a.** Weekly spawning summary for fall chinook broodstock processed at Lyons Ferry Hatchery, 1996. Volunteer and transported fish are included. Jacks are included with males.

Week Ending	Mortality <sup>a</sup>		Spawned		Surplused Males	Eggtake
	M	F	M <sup>b</sup>	F <sup>c</sup>		
Sep 7						
Sep 14	1					
Sep 21		1				
Sep 28	1					
Oct 5	1	1				
Oct 12	1					
Oct 19	1	1				
Oct 26	12	7	22	21	194	52,734
Nov 2	24	3	76	70	116	234,809
Nov 9	43	3	172	155	21	520,380
Nov 16	40	1	155	146	10	435,103
Nov 23	61	1	119	111	17	325,200
Nov 30	31	3	55	36	27	102,076
Dec 7	<u>8</u>	<u>-</u>	<u>26</u>	<u>11</u>	<u>2</u>	<u>28,007</u>
Totals <sup>d</sup>	224	21	625	550	387	1,698,309

<sup>a</sup> Accounts for mortalities occurring to fish transported or volunteering to Lyons Ferry.

<sup>b</sup> Many males were live spawned early in the season but not documented as spawned until they were killed at a later date.

<sup>c</sup> Includes eleven females that had bad eggs, were not ripe when killed, had spawned in pond, or were crushed during sorting: six fish on October 22, two on October 29, one on November 5, five on November 12, five on November 19, and one on November 26.

<sup>d</sup> The number of salmon broodstock accounted for during processing at LFH was 1,807 adults and jacks.

## 1997

Fish were spawned from October 21 through December 2, 1997 (Table 4b). The peak of spawning was November 4, when approximately 461,932 eggs were taken. The total egg take at LFH was 1,451,823; initial mortality was 5.22 percent (Table 5). Lyons Ferry origin salmon produced 1,184,141 total eggs ("green" or unfertilized eggs), while the total from stray fish was 267,682 eggs.

**Table 4b.** Weekly spawning summary for fall chinook broodstock processed at Lyons Ferry Hatchery, 1997. Volunteer and transported fish are included. Jacks are included with males.

Week Ending	Mortality <sup>a</sup>		Spawned		Surplused Males	Eggtake
	M	F	M <sup>b</sup>	F <sup>c</sup>		
Aug 23						
Aug 30						
Sep 6	6					
Sep 13	1	1				
Sep 20	3	2				
Sep 27	1	6				
Oct 4	4	16				
Oct 11	7	14				
Oct 18	7	24				
Oct 25	19	15	42	24	19	89,487
Nov 1	51	16	92	63	156	230,374
Nov 8	72	18	152	133	155	461,932
Nov 15	61	12	115	104	44	318,259
Nov 22	45	5	88	81	40	238,963
Nov 29	21	2	36	33	1	98,573
Dec 6	9	1	10	6	8	14,235
Totals <sup>d</sup>	307	131	535	444	423	1,451,823

<sup>a</sup> Only accounts for mortalities occurring to fish transported or volunteering to Lyons Ferry.

<sup>b</sup> Many males were live spawned early in the season and listed as spawned when they were killed.

<sup>c</sup> Includes eight females that had bad eggs, were not ripe when killed, had spawned in pond, or were crushed during sorting: one fish on October 21, one on October 28, one on November 4, two on November 10, two on November 18, and one on December 2.

<sup>d</sup> The number of salmon broodstock accounted for during processing at LFH was 1,840 adults and jacks, which includes one coho spawned on November 4 as a fall chinook.

**Table 5.** Duration and peak of spawning, egg take, and percent egg mortality at Lyons Ferry Hatchery (LFH).

Year	Spawning duration	Peak of spawning	Total Egg take	Total	Initial egg loss (%)	
					Known LFH	Other/Stray
1984	Nov 8 - Dec 5	Nov 21	1,567,823	21.58		
1985	Nov 2 - Dec 14	Nov 7	1,414,342	3.99		
1986	Oct 22 - Dec 17	Nov 19	592,061	3.98		
1987	Oct 20 - Dec 14	Nov 17	5,957,976	3.82		
1988	Oct 18 - Dec 6	Nov 12	2,926,748	3.41		
1989	Oct 21 - Dec 16	Nov 11	3,518,107	5.75		
1990	Oct 20 - Dec 8	Nov 6	3,512,571	8.28		
1991	Oct 15 - Dec 10	Nov 12	2,994,676 <sup>a</sup>	8.30		
1992	Oct 20 - Dec 8	Nov 21	2,265,557 <sup>a</sup>	5.96	5.06	9.29
1993	Oct 19 - Dec 7	Nov 2	2,181,879	6.69	9.60	6.10
1994	Oct 18 - Dec 6	Nov 8	1,532,404	5.09	5.40	4.90
1995	Oct 25 - Dec 5	Nov 14	1,461,500	5.64 <sup>b</sup>	3.22	12.13
1996	Oct 22 - Dec 3	Nov 5	1,698,309	4.56	3.95	7.85
1997 <sup>c</sup>	Oct 21 - Dec 2	Nov 4	1,451,823	5.22	4.18	9.80

<sup>a</sup> Plus 9,000 eggs from stray females given to Washington State University.

<sup>b</sup> Doesn't include loss from 10,000 stray eggs given to University of Idaho. The egg loss from strays was 8.63 percent excluding eggs used in fertilization experiments.

<sup>c</sup> Total eggtake includes eggs from one coho female crossed with a fall chinook.

## **Cryopreservation**

Semen from eight and ten males of Lyons Ferry origin were archived in 1996 and 1997, respectively. Data and results from experiments conducted in 1996 will be presented in a separate report. No experiments were conducted in 1997.

## **Incubation, Rearing, Marking and Transfer**

### **1995 Brood Year**

Progeny of 1995 Lyons Ferry origin broodstock numbered 959,773 fish at ponding. Yearlings were marked in September and October of 1996 with adipose fin clips, CWTS, and VI tags. Depending on the eventual release site, red, blue or green VIs were placed in the clear tissue behind the eye (Appendix B).

A red VI was placed behind the left eye of fish that were to be released on-station at LFH. The 1995 brood fish were reared in raceways until marking in September and October 1996. As the fish were marked they were placed into Lake 2, a large earthen pond previously used for rearing steelhead. This was the second year fall chinook were reared in Lake 2 at LFH.

Green VIs were placed behind the right eye of fish for acclimation and release at Pittsburg Landing in the Hells Canyon portion of the Snake River. WDFW transferred 148,054 yearlings (11.6 fish per pound [fpp]) on March 6, 1997. These fish were reared in raceways at LFH and held in 20 foot diameter fiberglass ponds at Pittsburg Landing until release.

Two groups of fish scheduled for release at the Big Canyon acclimation facility on the Clearwater River, Idaho, were marked behind the left eye. Green VI tags were used for the first group of 148,022 yearlings (11.7 fpp) transferred on March 28, 1997. Blue VI tags were used for the second group of 51,180 yearlings (11.8 fpp) transferred on April 23-24, 1997. These fish were reared in raceways at LFH and acclimated in 20 foot diameter fiberglass ponds at Big Canyon.

### **1996 Brood Year**

The final estimate of the 1996 egg take was 1,433,862 eggs from Lyons Ferry origin broodstock. Loss to the eyed stage was 4.0 percent, leaving 1,377,202 eyed eggs of Lyons Ferry origin for hatchery production. "Eye up" to ponding loss was estimated to be 1.1 percent. Total number of fry ponded was 1,361,577 .

Stray or unmarked fall chinook from the 1996 brood produced 264,447 unfertilized eggs. Loss to the eyed stage was 5.0 percent, and an additional 2.9 percent (7,721 eggs) died in cryogenic

fertilization experiments. Klickitat Hatchery was shipped the balance (243,677) of eyed eggs (which included 10,087 eyed eggs from cryogenics and fertilization experiments).

Salmon to be released by the NPT at Big Canyon as subyearlings were adipose clipped, and coded- or blank-wire tagged (left cheek) in April 1997. In May, 272,631 subyearlings (161 fpp) were transported to Big Canyon.

Yearling salmon for on- and off-station release were marked with clipped adipose fins, CWTS (multiple codes per release site), and VI tags in September and October 1997 (Appendix B). A red VI was placed behind the left eye of fish that were to be released on-station at LFH. The fish were reared in raceways until marking in September and October 1997. As the fish were marked, they were placed into Lake 2.

Green VIs were placed behind the right eye of 147,585 yearlings (12.3 fpp) transferred on March 3-4, 1998 to Pittsburg Landing. Green VIs were placed behind the left eye of 49,259 yearlings (10.3 fpp) transferred to Big Canyon on March 3-4, 1998. Big Canyon also received a group of 19,456 small fish (30.4 fpp) on March 3, 1998. Blue VIs were placed behind the left eye of 135,549 fish transferred on March 5 and 9-11, 1998, to Captain John, a new acclimation facility on the Snake River. These fish were reared in raceways at LFH until transfer. At Pittsburg Landing and Big Canyon the fish were held in 20 foot diameter round fiberglass ponds until release. At Captain John, the fish were held in an earthen pond.

### **1997 Brood Year**

The final estimate of the 1997 egg take was 1,184,141 eggs from Lyons Ferry origin broodstock. Loss to the eyed stage was 4.2 percent, leaving 1,134,641 eyed eggs of Lyons Ferry origin for hatchery production. Eye-up to ponding loss was estimated at approximately 3.0 percent. Total number of fry ponded was 1,101,070.

Stray or unmarked fall chinook from the 1997 brood produced 267,682 unfertilized eggs. Included in this total are eggs resulting from a coho-chinook mating. At spawning a small (54 cm) female coho was misidentified as chinook and mated with a stray male chinook. The number of coho eggs involved is likely low given the small size of the female. Stray egg loss to the eyed stage was 9.8 percent. Klickitat FH was shipped 196,400 eyed eggs; Little White Salmon was shipped 13,168 eyed eggs.

Also included in the unfertilized egg total are eggs which were initially identified as LFH origin but were subsequently determined to be of stray origin. Unfortunately, this error was not discovered until after the fish had been ponded with known LFH fish. The number of green

eggs, estimated at 35,332, was arrived at by back calculating from the number of fry ponded (32,853)<sup>7</sup>.

## **Disease Incidence and Prophylaxis**

### **Broodstock**

The 1996 and 1997 broodstocks were given flow through treatments of formalin (1:7000; 143 mg/L) as prophylaxis for *Saprolegnia sp.* (Fungus). Salmon were injected at capture with Erythromycin 200 (20 mg/kg of fish), and again every 30 days, to reduce infection levels of *Renibacterium salmonarum* (causative agent of Bacterial Kidney Disease, BKD).

Females were examined for the incidence of BKD (using enzyme linked immuno-sorption assay [ELISA] techniques), but only three females had high ELISA values (>0.45 optical density, OD) and four had moderate ELISA values (0.2 - 0.45 OD) in 1996. In 1997, seven females had high and eleven females had moderate ELISA values. Results from most females were low (0.11 - 0.199 OD) or below low levels (< 0.11 OD) for both brood years.

### **Eggs**

Eggs were initially disinfected and water hardened for one hour in iodophor (1:100; 100 ppm) and formalin (1:600; 1,667 ppm) was added every other day for 15 minutes to control fungus on the incubating eggs.

### **Juveniles**

#### **1995**

The 1995 brood showed signs of drop out syndrome caused by a feed type and size change. No prophylactic treatments were administered throughout the rearing cycle.

#### **1996**

The 1996 brood showed signs of Cold Water Disease in March 1997. May 13, the fish were examined and Cold Water Disease confirmed. All fish were fed Oxytetracycline (2%) at the rate of 2 percent body weight per day for ten days. Only one regimen was needed to eliminate the disease.

In June 1997, BKD was diagnosed. Fish documented as having BKD were treated with Aquamycin 100 (4.5%) once a day, fed at a rate of 1 percent body weight per day, for 28 days

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<sup>7</sup> WDFW hatchery records include the 35,332 stray eggs with Lyons Ferry origin green egg total.

beginning in June. BKD broke out at different times so treatments were staggered depending upon start date of the disease. The first treatment cycle ended in August. Fish were examined September 4, and BKD was confirmed again. The second cycle of Aquamycin 100 treatment occurred from September through November. Prior to marking, a portion of the brood exhibited BKD, but after marking, all fish broke with BKD. A third cycle of Aquamycin 100 treatments began December 1997 and ended January 6, 1998. Fish were diagnosed with BKD again after the completion of the third treatment cycle in January. A fourth regimen was planned, however, the medicated feed was not available until mid-February. A decision was made not to treat these fish again because the entire regimen could not be completed prior to the transfer of fish off-station. Fish were still exhibiting signs of BKD at release.

## **1997**

The 1997 brood had no fish health problems during the report period and no prophylactic treatments were administered.

## **Juvenile Releases and Migration**

The current fall chinook production goal for LFH, beginning with the 1995 brood, is 900,000 fish for release as yearlings. Half of the yearlings are to be released on-station; the other half are to be released from acclimation sites upstream of LGR Dam. If the number of eggs available is insufficient to meet the goal, the first priority is to produce 450,000 yearlings for release at the hatchery.

Any production beyond the full yearling program, is to be reared for release as subyearlings. Subyearlings may be released either above LGR Dam, or at LFH. WDFW continues, however, to emphasize yearling releases as a means to increase the number of adult salmon returning to the Snake River as quickly as possible. Nonetheless, we wish to evaluate subyearling releases (size and time of release experiments) and also compare them with yearling releases in an attempt to improve subyearling survival and maintain natural age and sex composition of adult returns.

## **1994 Brood Year Migration**

The 1994 brood yearlings (404,270 fish; 10.7 fpp) were volitionally released April 9 through 15, 1996, into the Snake River from Lake 2 at LFH. Mean length at release was 160.4 mm. These fish were marked with a red VI tag behind the left eye. In addition, three groups totaling 2,997 fish were tagged with PIT tags: the first group of fish was tagged in Fall 1995 prior to being moved to Lake 2; the second and third groups were tagged on April 9 and 12, 1996, respectively. PIT tag retention was estimated at 100 percent at time of release.

Sampling of Lyons Ferry fall chinook yearlings (left red VI) at juvenile bypass collection facilities at Lower Monumental and McNary Dams, and PIT tag interrogation units at downstream Snake and Columbia River Dams provided passage data for both tag types (Table 6). The estimated number (based on sample rate) of left red VI tagged fish collected at Lower Monumental was 91,327, which represented 22.6 percent of the fish released from LFH. By comparison, 785 unique PIT tags were detected at Lower Monumental, which represented 26.2 percent of the 2,997 tagged fish released from LFH. PIT tag interrogation units, at all dams combined, detected 1,135 (37.8%) different PIT tagged fish of the 2,997 tags released from Lyons Ferry<sup>8</sup>.

The passage data derived from sampling VI tagged fish at Lower Monumental and McNary were similar to PIT tag passage data at those dams<sup>9</sup>. Results from PIT tag data showed that travel time (mean days) decreased for Group 3 salmon which were released three days later than Group 2 salmon. Group 1 salmon were volitionally released from Lake 2 precluding a comparison with Groups 2 and 3.

**Table 6.** Passage data for Lyons Ferry Hatchery fall chinook at Snake and Columbia River dams, 1996.

Tag type - group no.	No. Sampled / Detected	Mean Travel Days	Release Date	Peak Passage Date	Passage Date Range 1996	Passage Dates	
						10%	90%
<b>Lower Monumental Dam</b>							
Left Red VI tag	2,488	-	April 9-15	April 16	April 4 - May 14	April 14	April 27
PIT - 1	269	na <sup>a</sup>	April 9-15	April 14	April 11 - May 17	April 11	May 17
PIT - 2	246	5	April 12	April 14	April 13 - May 16	April 13	April 25
PIT - 3	270	5	April 15	April 18	April 16 - May 13	April 16	April 26
<b>McNary Dam</b>							
Left Red VI tag	689	-	April 9-15	April 26	April 19 - June 30	April 21	May 4
PIT - 1	127	na	April 9-15	April 25	April 7 - May 21	April 20	May 1
PIT - 2	152	13	April 12	April 25	April 18 - May 14	April 19	April 29
PIT - 3	134	12	April 15	April 25	April 20 - May 21	April 22	May 4
<b>John Day Dam</b>							
PIT - 1	5	19	April 9-15	May 7	April 20 - May 14	-	-
PIT - 2	13	23	April 12	May 2	April 23 - May 16	-	-
PIT - 3	9	17	April 15	-	April 23 - May 10	-	-
<b>Bonneville Dam</b>							
PIT - 1	6	22	April 9-15	-	April 28 - May 12	-	-
PIT - 2	6	28	April 12	-	April 27 - May 19	-	-
PIT - 3	6	19	April 15	May 2	April 27 - May 18	-	-

<sup>a</sup> A specific release date could not be determined. These fish were PIT tagged prior to transfer into Lake 2 and, therefore, were part of the volitionally released production group released April 9-15, 1996.

<sup>8</sup> Numbers of detections presented in Table 6 include multiple detections of the same tag as a fish migrates downstream.

<sup>9</sup> Peak passage dates for VI tagged salmon were based on passage indices for each dam. A passage index is calculated by assuming a 100 percent collection efficiency at the turbine intake diversion screens, and by adjusting based on the proportion of river flow that is spilled at a dam.

## 1995 Brood year release and migration

In March of 1996, LFH personnel estimated that 83,183 fry (brood year 1995) accidentally escaped because of an improperly placed screen in the raceway. The fry were unmarked and their size was estimated at 500 fpp. This release was documented as an unintentional fry plant to the Snake River. The 1995 brood yearlings were released from LFH and at two NPT acclimation facilities above LGR Dam: Big Canyon and Pittsburg Landing. Prior to release, the yearlings were sampled to collect size and condition data as well as to evaluate tag loss.

At LFH, 456,776 yearlings were volitionally released April 4-26, 1997, from Lake 2. Mean fork length was 167.2 mm (SD 15.9) and mean weight was 48.9 gm (SD 13.9) or 9.3 fpp. The coefficient of variation for length was 9.5 percent. Condition factor (K) was 1.04. These fish were marked with a red VI tag behind the left eye; tag (VI) loss was estimated at 12.8 percent. In addition, 3,009 fish were PIT tagged on April 7, 21, and 24. PIT tag retention was estimated at 100 percent at time of release on April 10, 21, and 26. Samples were also collected for smoltification index (organosomatic index and ATPase levels) and cortisol levels (stress index); data and analyses will be included in a subsequent report.

The NPT released 147,316 yearling fall chinook from Pittsburg Landing April 14-17, 1997. Two groups were released at Big Canyon: the first group of 148,628 yearlings, was released April 14-17; the second group of 50,771, was released May 14-15. Prior to release, NPT and WDFW personnel PIT tagged fish at each facility. Samples were also collected by NPT and USFWS for smoltification index (organosomatic index and ATPase levels) and cortisol levels (stress index). Complete sampling information and data analyses are included in NPT monitoring and evaluation reports (Steve Rocklage, personal communication).

Based on the sampling rate of left red VI tagged fish at juvenile bypass collection facilities, the estimated number of Lyons Ferry chinook collected at Lower Monumental Dam was 112,824 or 24.7 percent of the fish released from LFH. By comparison, 820 unique or 27.3 percent of the PIT tagged fish released from LFH were detected at Lower Monumental. PIT tag interrogation units, at all dams combined, detected 1,190 (39.6%) different PIT tagged fish of the 3,009 tags released from Lyons Ferry<sup>10</sup>.

PIT and VI tag data from Lower Monumental and McNary Dams were similar for the peak passage, and the 10 percent and 90 percent passage, dates (Table 7). VI tag data captured a broader passage date range than did PIT tag data which was likely due to the small number of

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<sup>10</sup> Numbers of detections presented in Table 7 include multiple detections of the same tag as a fish migrates downstream.

PIT tagged fish. Among the groups of PIT tagged fish, the data showed that travel time (mean-days) decreased for fish released on later dates. The addition of more detectors at Bonneville Dam resulted in a more detections compared to previous years and relative to John Day Dam.

**Table 7.** Passage data for Lyons Ferry Hatchery fall chinook at Snake and Columbia River dams, 1997.

Tag type/group	No. Sampled/ Detected	Mean Travel Days	Release Date	Peak Passage Date	Passage Date Range 1997	Passage Dates	
						10%	90%
<b>Lower Monumental Dam</b>							
Left Red VI tag	2,284	-	April 4-26	April 23	April 10 - June 22	April 22	May 8
PIT - 1	283	10	April 10	April 21	April 4 - May 5	April 12	April 30
PIT - 2	238	9	April 21	April 23	April 22 - May 28	April 22	May 9
PIT - 3	299	6	April 26	April 28	April 27 - May 19	April 27	May 9
<b>McNary Dam</b>							
Left Red VI tag	1,827	-	April 4-26	May 1	April 15 - June 10	April 27	May 13
PIT - 1	184	16	April 10	April 25	April 15 - June 5	April 18	May 5
PIT - 2	117	14	April 21	May 4	April 24 - May 19	April 26	May 13
PIT - 3	128	11	April 26	May 2	April 29 - May 21	April 27	May 15
<b>John Day Dam</b>							
PIT - 1	2	14	April 10	-	April 23 & 25	-	-
PIT - 2	0	-	-	-	-	-	-
PIT - 3	1	13	April 26	-	May 9	-	-
<b>Bonneville Dam</b>							
PIT - 1	20	26	April 10	May 4-10	April 21 - May 21	April 27	May 20
PIT - 2	27	20	April 21	May 10	April 30 - May 22	May 2	May 21
PIT - 3	31	15	April 26	May 10	May 4 - May 26	May 6	May 18

### 1996 Brood Year Release and Migration

In 1997, the NPT released 252,705 subyearling fall chinook from Big Canyon on June 10-13. Another 83,777 subyearlings were transferred to NPT, NMFS and USFWS for various research projects. These fish were released May-July 1997 into the Snake and Clearwater River drainages. Yearling fall chinook (brood year 96) were also released from LFH and at three NPT acclimation facilities above LGR Dam: Big Canyon, Pittsburgh Landing, and Captain John in 1998. Before release, yearlings were sampled to determine size and condition as well as to evaluate tag loss.

A volitional release of 418,992 yearlings occurred April 3-16, 1998, from Lake 2 at LFH. Mean fork length was 159 mm (SD 15.2) and the coefficient of variation (CV) for length was 9.6

percent. Mean weight was 44.8 gm (SD=12.1); or 10.1 fpp. Condition factor (K) was 1.1. These fish were marked with a red VI tag behind the left eye; VI loss was estimated at 15.7 percent. In addition, 2,240 fish were PIT tagged and released on April 6 (Group 1) and 14 (Group 2), 1998. PIT tag retention was estimated at 100 percent at time of release. Samples were also collected for smoltification index (organosomatic index and ATPase levels) and cortisol levels (stress index); data and analyses will be included in a subsequent report.

The NPT released 141,814 and 61,172 yearling fall chinook from Pittsburg Landing and Big Canyon, respectively, April 13-16, 1998. Another 133,205 yearlings were released from Captain John on April 15, 1998. Prior to release NPT and WDFW personnel PIT tagged fish at each facility. Samples were collected by NPT and USFWS for smoltification index (organosomatic index and ATPase levels) and cortisol levels (stress index). Complete sampling information and data analyses are included in NPT monitoring and evaluation reports (Steve Rocklage, personal communication).

Sampling Lyons Ferry fall chinook yearlings (left red VI) facilities, and PIT tag interrogation units at downstream Snake and Columbia River dams provided passage data for both tag types in 1998 (Table 8). At Lower Monumental Dam about 16.7 percent of the VI tagged fish released from LFH were collected at the juvenile bypass collection facility. In contrast, PIT tag units detected 540 or 22.3 percent of the PIT tagged fish released from LFH. PIT tag interrogation units, at all dams combined, detected 1,147 (47.4%) different PIT tagged fish of the 2,420 tags released from LFH<sup>11</sup>.

At both Lower Monumental and McNary Dams, PIT and VI tag data were similar for the peak passage and the 10 percent and 90 percent passage dates. VI tag data captured a broader passage date range than did PIT tag data which was probably due to the small number of PIT tagged fish. As in previous years, PIT tagged fish released at a later date (Group 2) traveled faster than those from the earlier release group (Group 1).

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<sup>11</sup> Numbers of detections presented in Table 8 include multiple detections of the same tag as a fish migrates downstream.

**Table 8.** Passage data for Lyons Ferry Hatchery PIT tagged fall chinook at Snake and Columbia River dams, 1998.

Tag type/group	No. Sampled/ Detected	Mean Travel Days	Release Date	Peak Passage Date	Passage Date Range 1998	Passage Dates	
						10%	90%
<b>Lower Monumental Dam</b>							
Left Red VI tag	3,063	-	April 3-16	April 23	April 4 - Aug 10	April 18	May 12
PIT Group 1	276	20	April 6	April 23	April 11 - May 27	April 17	May 11
PIT Group 2	264	17	April 14	April 27	April 18 - May 26	April 22	May 15
<b>McNary Dam</b>							
Left Red VI tag	3,250	-	April 3-16	April 29	April 12 - June 5	April 24	May 11
PIT - 1	301	24	April 6	April 27	April 16 - May 29	April 23	May 14
PIT - 2	256	21	April 14	May 1	April 23 - May 30	April 26	May 20
<b>John Day Dam</b>							
PIT - 1	99	33	April 6	May 2-5	April 23 - May 31	April 28	May 27
PIT - 2	105	28	April 14	May 9 & 18	April 27 - June 3	May 1	May 28
<b>Bonneville Dam</b>							
PIT - 1	57	33	April 6	May 7	April 27 - June 13	May 1	May 21
PIT - 2	58	28	April 14	May 7	April 30 - June 2	May 3	May 24

## Survival Rates

We used the estimated number of eggs and fish present at life stages in the hatchery for 1990-1997 broods (Table 9) to estimate survival rates within the hatchery environment (Table 10). Mean egg-to-release survival rates are 84.8 percent (SD=6.3) for yearlings and 87.8 percent (SD=3.2) for subyearlings. Smolt-to-adult survivals for recent broods are generally incomplete at this time. However, we have documented that fall chinook smolt-to-adult survival rates from LFH are several times higher for yearling releases than for subyearling releases (Bugert et al. 1997).

**Table 9.** Estimated salmon progeny from known Lyons Ferry origin adults, 1990-1997 brood years.

Brood Year	Total green eggs	Eyed eggs	Fry ponded	Subyearlings released	Yearlings	
					marked <sup>a</sup>	released
1990	1,103,745 <sup>b</sup>	1,011,998 <sup>c</sup>	958,241 <sup>d</sup>	224,439 <sup>e</sup>	694,388 <sup>f</sup>	689,601
1991	906,411 <sup>b</sup>	828,514	807,685	-0-	765,207	760,018
1992	901,232	855,577	835,171	206,775 <sup>g</sup>	611,107	603,050
1993 <sup>h</sup>	400,490	363,129	352,574	-0-	349,805	349,024
1994 <sup>i</sup>	583,871	553,189	542,461	25,858 <sup>j</sup>	536,867	521,822 <sup>k</sup>
1995 <sup>l</sup>	1,056,700	1,022,700	959,773	28,855 <sup>m</sup>	817,290	803,491 <sup>n</sup>
1996	1,433,862	1,377,202	1,361,577 <sup>o</sup>	336,482 <sup>p</sup>	904,332	755,183 <sup>q</sup>
1997 <sup>r</sup>	1,184,141	1,134,641	1,101,070	--	--	--

- <sup>a</sup> Marking (CWT and adipose clip) occurs in late August through early October.
- <sup>b</sup> Number of known Lyons Ferry origin eggs estimated by back calculating from the combined survival to eyed egg stage, and combined survival from eyed egg to fry (ponding).
- <sup>c</sup> Total eyed eggs = 3,210,779, but only 1,171,058 were retained for rearing.
- <sup>d</sup> Total fry ponded = 1,108,853, but 149,096 fry were shipped to Klickitat shortly after ponding (loss after ponding for this group was 1,516).
- <sup>e</sup> Total group of subyearlings was 228,930 at ponding (loss was 4,491).
- <sup>f</sup> Total number tagged with an elastomer or BWT, marking was completed earlier.
- <sup>g</sup> Loss for subyearlings was 3,435; 210,210 fish ponded were later released as subyearlings (from 226,837 green eggs: estimated by using the overall survival for all eggs to ponding).
- <sup>h</sup> Hatchery records show 389,179 green eggs taken and 351,818 eyed eggs. However, 11,311 fish too many (overage) were identified during counting as 349,805 fish were marked. Mortality was 2,769 fish before tagging in October, and 10,555 fry died prior to ponding.
- <sup>i</sup> During marking, 16,767 more fish were counted than expected, this amount was added to each of the population estimates at earlier life stages.
- <sup>j</sup> Progeny of 1989 brood Lyons Ferry fish shipped to Klickitat FH and marked as strays. In May, 30,300 fish were shipped back to Lyons Ferry to be released by NMFS/USFWS for the subyearling survival study.
- <sup>k</sup> Includes the 3,233 yearling fall chinook released by NMFS to test juvenile facilities at Ice Harbor Dam and 114,299 released by the Nez Perce Tribe at Pittsburg Landing.
- <sup>l</sup> An overage of 58,500 fish was found during marking. This number was added (unexpanded) to total green and eyed eggs and fry ponded. Also includes 83,183 fry up to ponding that were accidentally released as strays. Back calculated to estimate 32,088 eggs for subyearlings and 91,808 eggs for escaped fry (resulting in 847,241 ponded for yearling release). The numbers reported for 1995 in this report reflect corrections made since the previous report.
- <sup>m</sup> Progeny of known Lyons Ferry origin broodstock, released by NMFS for subyearling survival study.
- <sup>n</sup> Includes 199,399 yearling fall chinook released at Big Canyon and 147,316 released at Pittsburg Landing.
- <sup>o</sup> Takes into account hand picked loss prior to ponding of 15,625 eggs and fry.
- <sup>p</sup> Progeny of known Lyons Ferry origin broodstock: 252,705 released at Big Canyon for subyearling survival study; and an additional 83,777 subyearlings were transferred to NPT, NMFS, and USFWS for research on the Snake and Clearwater Rivers.
- <sup>q</sup> Includes 61,172 yearling fall chinook released at Big Canyon, 141,814 released at Pittsburg Landing, and 133,205 released at Captain John.
- <sup>r</sup> Included are eggs from a coho female mated to a known LF chinook male. Does not include stray eggs accidentally mixed with known LF origin fish at ponding. Hatchery records include the stray green eggs which produced 32,853 fry at ponding in LF origin eggtake and ponding numbers.

**Table 10.** Estimated survivals (%) between various life stages at Lyons Ferry Hatchery for fall chinook of Lyons Ferry origin.

Brood year	Release Stage	Green egg-to-Ponded fry	Ponded fry-to-release	Green egg-to-release
1990	yearling	86.8 <sup>a</sup>	94.5	82.1
	subyearling	86.8 <sup>a</sup>	98.0	85.1
1991	yearling	89.1 <sup>a</sup>	94.1	83.8
1992	yearling	92.7	96.5	89.5
	subyearling	92.7	98.4	91.2
1993	yearling	88.0 <sup>a</sup>	99.0	87.1
1994	yearling	92.7	99.3	92.1
1995 <sup>b</sup>	yearling	90.8	94.8	86.1
	subyearling	90.8	99.0	89.9
1996	yearling	95.0	76.6	72.8
	subyearling	95.0	89.5	85.0
yearling mean %		90.7	93.5	84.8
SD		2.9	7.8	6.3
subyearling mean %		91.3	96.2	87.8
SD		3.5	4.5	3.2

<sup>a</sup> Based on back calculation to estimate green eggs taken.

<sup>b</sup> Estimated after partitioning loss in that raceway for subyearlings (33,459 eggs), yearlings, and escaped fry (83,183). Survivals for accidentally released fry are not included.

## Stock Profile Evaluation

Lyons Ferry origin fall chinook returns continue to be dominated by younger age classes. On average since 1991, age 2 and age 3 fish together, have made up 50 percent or more of a year's return (Table 11a). Females dominate the older age classes of returning Lyons Ferry origin salmon because few females return at age 3 or younger. Few males return at age 5 and older. Age 3 and 4 males tend to be smaller than same age females. Adults from subyearling releases tend to be larger than adults from yearling releases (Appendix C).

**Table 11a.** Mean percentages of Lyons Ferry origin salmon returning by year, age, and sex. Included are transported and volunteer fish processed at Lyons Ferry Hatchery (1991-1997). Refer to table 11b for numbers of fish returning per year.

Sex	Age						Total
	2	3	4	5	6	7	
<b>Means of Percentages</b>							
<b>Male</b>	31.3	21.0	12.4	4.4	0.3	0.0	69.4
SD	17.0	5.6	6.9	3.0	0.4	0.0	
<b>Female</b>	0.0	2.3	20.0	7.9	0.4	0.0	30.6
SD	0.0	2.6	9.9	5.0	0.5	0.0	
<b>Sum%</b>	<b>31.3</b>	<b>23.3</b>	<b>32.4</b>	<b>12.3</b>	<b>0.7</b>	<b>0.0</b>	<b>100.0</b>

### 1996

The 1996 return was comprised primarily of males (68.7%). Jacks (age-2) accounted for 24 percent, age 3 males accounted for 24 percent, and age 4 males accounted for 19 percent of returning fish (Table 11b). However, as a single age/sex class, age 4 females were most numerous, representing 27.9 percent of the entire return in 1996. Less than 4 percent of the return was comprised of females of other ages. Lyons Ferry origin fish tended to be smaller than stray salmon (Figures 2 and 3).

**Table 11b. Age and sex of Lyons Ferry origin salmon processed at Lyons Ferry Hatchery ,1991-1997. Jacks are included with males.**

Year / Sex	Age						Total
	2	3	4	5	6	7	
<b>1991</b>							
Male	257	201	74	65	9	0	606
Female	0	5	134	120	10	0	<u>269</u>
Percent	29.4	23.5	23.8	21.1	2.2	0	875
<b>1992</b>							
Male	153	128	164	22	0	0	467
Female	0	60	255	34	3	1	<u>353</u>
Percent	18.7	22.9	51.1	6.8	0.4	0.1	820
<b>1993</b>							
Male	102	101	105	61	1	0	370
Female	0	22	176	104	0	0	<u>302</u>
Percent	15.2	18.3	41.8	24.6	0.1	0	672
<b>1994</b>							
Male	377	284	83	16	4	0	764
Female	0	4	154	44	10	0	<u>212</u>
Percent	38.6	29.5	24.3	6.2	1.4	0	976
<b>1995</b>							
Male	1,759 <sup>c</sup>	410 <sup>d</sup>	26	130	1	0	2,326
Female	1	93	53	194	3 <sup>c</sup>	1	<u>345</u>
Percent	65.9	18.8	3.0	12.1	0.2	0.0	2,671
<b>1996</b>							
Male	381	374	307	18	3	0	1,083
Female	0	20	441	32	1	0	<u>494</u>
Percent	24.2	25.0	47.4	3.2	0.2	0.0	1,577
<b>1997</b>							
Male	435	402	224	61	0	0	1,122
Female	1	0	347	128	2	0	<u>478</u>
Percent	27.3	25.1	35.7	11.8	0.1	0.0	1,600
<b>Total Fish</b>	<b>3,466</b>	<b>2,104</b>	<b>2,543</b>	<b>1,029</b>	<b>47</b>	<b>2</b>	<b>9,191</b>

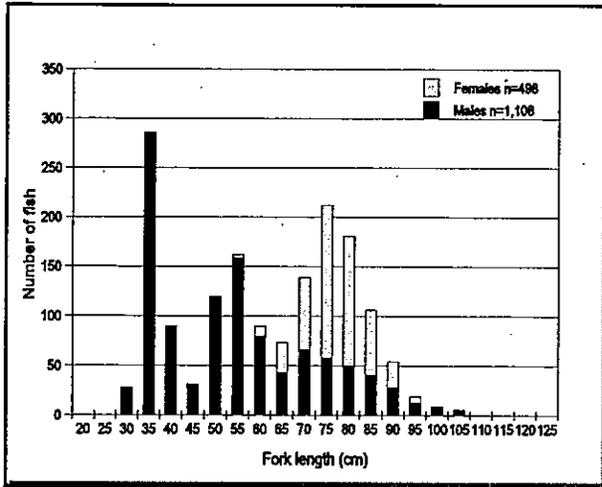


Figure 2. Length frequencies of Lyons Ferry origin fish, 1996.

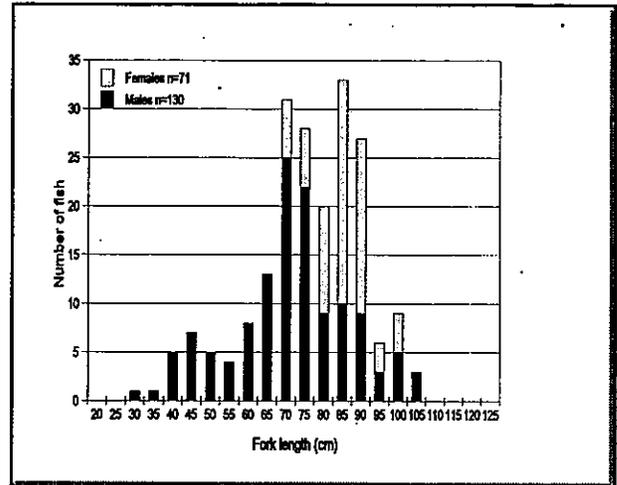


Figure 3. Length frequencies of stray fish, 1996.

### 1997

The 1997 return was also comprised primarily of males (70.1%). Jacks (age-2) accounted for 27 percent and were the most numerous of any age/sex class. Age 3 males accounted for 25 percent and age 4 males accounted for 14 percent of the return (Table 11b). Age 4 females were third most abundant, comprising 21.6 percent of the return. Females of other ages, mainly age 5, accounted for 8.1 percent of the return. Lyons Ferry origin fish tended to be smaller than stray salmon (Figures 4 and 5).

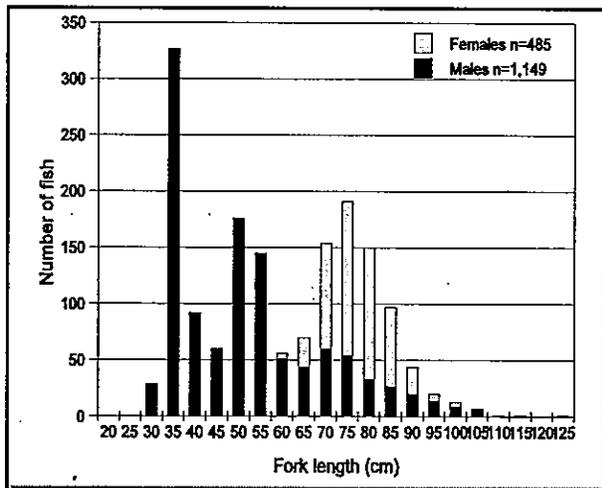


Figure 4. Length frequencies of known Lyons Ferry fish, 1997.

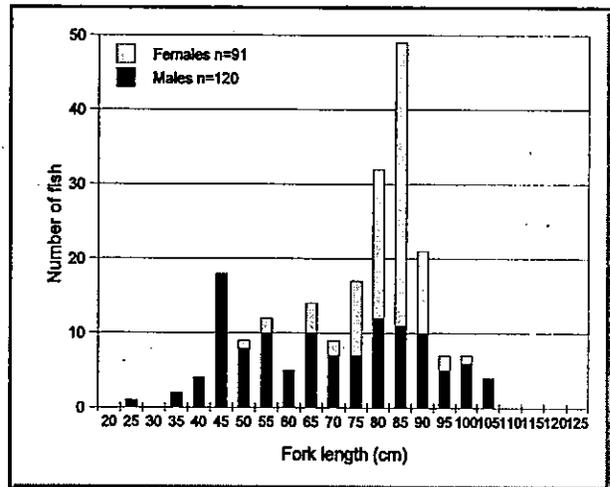


Figure 5. Length frequencies of stray fish, 1997.

## Natural Production

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The WDFW no longer participates in cooperative spawning surveys upstream of LGR Dam. Personnel from Idaho Power and the USFWS jointly survey spawning grounds in the upper Snake, Grande Ronde, and Imnaha Rivers (Garcia et al. 1998). Personnel from the NPT conduct spawning surveys in the Clearwater and Salmon Rivers (Bill Arnsberg, personal communication). Additionally, intensive spawning surveys are conducted in the tailraces of the four Snake River dams (Dauble et al. 1994).

### 1996

WDFW personnel surveyed the Tucannon River on foot weekly from October 23 to December 3, 1996. Surveys generally covered the river from its mouth (above slackwater) upstream to Rk 28. The first 1.3 kilometers of the Tucannon River are deep slackwater from the reservoir and poor habitat; we assume no spawning occurs there. Due to restricted access, we were unable to survey 1.1 kilometers of river between Rk 3.7 and 9.6, and 1.3 kilometers of river between Rk 22.0 and 28.0.

Through most of the season, conditions for surveys were good; during the last two weeks conditions were fair to poor. Forty-three redds, 53 live salmon and 22 carcasses were observed during surveys (Table 12). The total estimated escapement to the Tucannon River in 1996 was 129 fall chinook<sup>12</sup>.

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<sup>12</sup> This estimate was derived assuming three fish per redd.

**Table 12.** Date, locations surveyed, number of redds, and carcasses found during Tucannon River fall chinook spawning surveys in 1996.

Survey date	River kilometer <sup>a</sup>	Redds	Live Fish	Carcasses	
				Females	Males
10-23	9.6 - 3.7	0	0	0	0
10-31 & 11-1	28.0 - 22.0	0	0	0	0
	22.0 - 20.1	1	1	0	0
	20.1 - 9.6	0	0	0	0
	9.6 - 7.1	1	1	0	0
	7.1 - 3.7	2	1	0	0
	3.7 - 1.3	1	2	0	1
11-5&6	22.0 - 17.7	1	0	0	0
	17.7 - 12.7	0	0	0	0
	12.7 - 9.6	3	3	0	0
	9.6 - 7.1	4	1	0	1
	7.1 - 3.7	2	4	0	0
	3.7 - 1.3	0	5	0	0
11-13&17	22.0 - 17.7	0	0	0	0
	17.7 - 12.7	1	1	1	1
	12.7 - 9.6	1	2	0	0
	9.6 - 7.1	0	3	0	0
	7.1 - 3.7	6	2	0	1
	3.7 - 1.3	9	7	1	1
11-22	28.0 - 22.0	0	0	0	0
	22.0 - 17.7	1	0	0	1
	17.7 - 12.7	1	0	0	0
	12.7 - 9.6	0	2	1	0
	9.6 - 9.2	2	7	0	1
11-25&26	22.0 - 17.7	0	0	0	0
	17.7 - 12.7	0	0	0	0
	12.7 - 9.6	1	1	1	0
	9.6 - 7.1	1	4	1	1 <sup>b</sup>
	7.1 - 3.7	2	2	1	0
	3.7 - 1.3	0	0	2	0
12-1&3	12.7 - 9.6	2	1	1	0
	9.6 - 7.1	0	3	1	0
	7.1 - 3.7	1	0	1	1
	3.7 - 1.4	0	0	0	2
<b>Totals</b>		<b>43</b>	<b>53</b>	<b>11</b>	<b>11<sup>b</sup></b>

a River landmarks were as follows: Enrich Bridge (Rk 28.0), Highway 12 Bridge (Rk 22.0), Krouse's Bridge (Rk 20.1), Kessel's Bridge (Rk 17.7), Smith Hollow Bridge (Rk 12.7), Fletcher's Dam (Rk 9.6), Starbuck Bridge (Rk 7.1), Power's Bridge (Rk 3.7), and Highway 261 Bridge (Rk 2.7)

b The sex and origin of one carcass are unknown. Only skin, dorsal, pelvic, and caudal fins were present at recovery.

Spawning density was 6.9 redds/mile (4.3 redds/km) downstream of Rk 9.6 (Fletcher's Dam) in 1996. Redd densities peaked in 1990, and have remained relatively constant since then (Table

13). Fletcher's Dam, identified as a passage barrier, underwent modification to improve fish passage in 1992 (Mendel et al. 1994). Redds, live fish, and carcasses were observed upstream of Fletcher's Dam in 1996.

Table 13. Number of redds in the lower Tucannon River and redd densities below Fletcher's Dam, 1985-1997.

Year	Total redds	Redds below dam	Redds/km <sup>a</sup> below dam	Redds/mile <sup>a</sup> below dam
1985	0	0	0	0
1986	0	0	0	0
1987	16	16	1.9	3.1
1988	26	26	3.1	5.0
1989	48	48	5.8	9.3
1990	61	61	7.3	11.8
1991	50	50 <sup>b</sup>	6.0	9.7
1992	23	21	2.5	4.1
1993	28	21	2.5	4.1
1994	25	25	3.0	4.8
1995	29	28 <sup>c</sup>	3.4	5.4
1996	43	31	4.3	6.9
1997	27	24	3.3	5.4

<sup>a</sup> Redds/km below Fletcher's Dam. We estimate 9.6 km (5.96 miles) from the mouth to the dam. We do not survey the lower 1.4 km because it is deep slackwater from the reservoir and poor habitat; we assume no spawning there. In 1996, we were unable to survey two sections, one 1.1 km and one 1.3 km because of landowner problems. In 1997, we were unable to survey 1.1 km because of landowner problems.

<sup>b</sup> We observed several other redds during the last survey that were not counted because of high turbidity and uncertainty whether they had been counted before. Thus, this should be considered a minimum estimate.

<sup>c</sup> We were unable to survey after the peak of spawning because of high water and turbidity. This should be considered an incomplete estimate.

The 22 carcasses recovered in 1996 included: sixteen wild, five hatchery, and one fish of unknown origin. Three of the wild carcasses were found above Fletcher's Dam on November 17, 22, and 25. Two hatchery fish were sampled November 13 and December 3 above Fletcher's Dam. Three more hatchery fish were recovered below Starbuck Bridge on November 13 and 25, and December 3. Snouts were collected from four of the five hatchery fish; one snout was not recoverable. Three of the carcasses originated from Umatilla Hatchery (BWT), the fourth originated from Klickitat Fish Hatchery (CWT: 63-47-36).

The Palouse River was not surveyed in 1996 because of high, turbid flows during most of the spawning season. A few redds and salmon have been seen there in past years, but conditions are usually poor for observations (Mendel et al. 1994).

## 1997

The Tucannon River was surveyed by WDFW personnel weekly from October 23 to December 12, 1997. The sections of river surveyed and with restricted access were the same as in 1996.

Most of the season, survey conditions were only fair. The river was partially surveyed on November 6 because of poor visibility from heavy rainfall. Twenty-seven redds, 49 live salmon and 19 fall chinook carcasses were observed during spawning surveys (Table 14). One female coho carcass, fully spawned, was recovered on December 4. The total estimated escapement to the Tucannon River in 1996 was 81 fall chinook<sup>13</sup>. Spawning density was 5.4 redds/mile (3.3 redds/km) downstream of Rk 9.6 (Fletcher's Dam).

**Table 14.** Date, location surveyed, number of redds, and carcasses found during Tucannon River fall chinook spawning surveys in 1997.

Survey date	River Kilometer <sup>a</sup>	Redds	Live fish	Carcasses	
				Females	Males
10-23	22.0 - 9.2	0	0	0	0
	7.1 - 1.3	0	0	0	0
11-06	22.0 - 9.2	0	0	0	0
	7.1 - 1.3	0	0	0	0
11-12	22.0 - 17.7	0	0	0	0
	17.7 - 12.7	1	0	0	0
	12.7 - 9.6	0	2	0	0
	9.6 - 9.2	2	0	0	0
	7.1 - 3.7	3	3	0	0
	3.7 - 1.3	1	3	0	0
11-17&18	24.8 - 17.7	0	0	0	0
	17.7 - 12.7	1	0	0	0
	12.7 - 9.6	1	1	0	0
	9.6 - 7.1	3	3	0	0
	7.1 - 3.7	1	4	0	0
	3.7 - 1.3	2	4	1	0
11-24, 25&26	24.8 - 17.7	0	0	0	0
	17.7 - 12.7	0	0	0	0
	12.7 - 9.6	0	0	0	0
	9.6 - 7.1	0	3	2	0
	7.1 - 3.7	6	12	0	0
	3.7 - 1.3	4	5	3	4
12-1&4	4.0 - 3.7	0	3	1 <sup>b</sup>	1
	3.7 - 1.3	1	4	3	3
12-12	9.5 - 9.2	1	0	1	0
	4.0 - 3.7	0	2	0	0
	3.7 - 1.3	0	0	0	0
Totals		27	49	11 <sup>b</sup>	8

<sup>a</sup> River landmarks were as follows: Highway 12 Bridge (Rk 22.0), Krouse's Bridge (Rk 20.1), Kessel's Bridge (Rk 17.7), Smith Hollow Bridge (Rk 12.7), Fletcher's Dam (Rk 9.6), Starbuck Bridge (Rk 7.1), Power's Bridge (Rk 3.7) Highway 261 Bridge (Rk 2.7).

<sup>b</sup> Plus one unmarked coho that was 100 percent spawned out on 12/4 when she was recovered.

<sup>13</sup> This estimate was derived assuming three fish per redd.

The nineteen fall chinook carcasses recovered in 1997 included nine hatchery fish and eleven wild fish. All of the carcasses were found below Fletcher's Dam. The hatchery fish were sampled on November 17, 25, and 26 and December 1 and 4. The wild fish were sampled on November 25 and December 1, 4, and 12. One of the wild fish included a female coho, found fully spawned on December 4. Snouts were collected from seven of the nine hatchery fish to retrieve CWTS. All seven originated from LFH. Snouts were not recovered from the other two hatchery fish. One carcass was determined to be from Umatilla Hatchery because it had a right ventral fin clip in addition to a clipped adipose fin. The origin of the remaining hatchery carcass was not determined.

The Palouse River was not surveyed in 1997 because of high, turbid flows during most of the spawning season.

# **Summary of Fall Chinook Run Size and Composition**

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## **Return to Ice Harbor (IHR) Dam**

**1996**

The total number of fall chinook estimated to have passed IHR Dam in 1996 was 4,662. Of those, 1,431 (31%) fish voluntarily returned to LFH; 1,732 (37%) escaped to LGR Dam and an estimated 129 (2.8%) spawned naturally in the Tucannon River. The remaining 1,370 (29%) fall chinook were not accounted for. This result is within the 27-56 percent estimated losses above IHR obtained in 1992-1995<sup>14</sup>.

**1997**

In 1997, the total number of fall chinook estimated to have passed IHR Dam was 4,621. Of those, 1,194 (26%) fish voluntarily returned to LFH, 1,955 (42%) escaped to LGR Dam and 81 (1.8%) spawned naturally in the Tucannon River. The remaining 1,391 (30%) fall chinook were not accounted for. This result is within the 27-56 percent estimated losses above IHR 1992-1996.

## **Return to Lyons Ferry Fish Hatchery (LFH)**

**1996**

As stated above, voluntary returns to LFH numbered 1,431 fish, representing 31 percent of the estimated escapement over IHR Dam. This was similar to 1994, but less than 1995 when 31 percent and 44 percent, respectively, of the return above IHR voluntarily entered the hatchery. It has only been possible to estimate the percentage of fish that passed upstream of IHR and voluntarily entered the hatchery without the confounding effect of salmon collection at that dam since 1993.

Nearly all the fish that voluntarily entered the hatchery in 1996 were of LFH origin, released on-station. Only 1.6 percent of the volunteers were strays from other hatcheries. Stray salmon originated primarily from Umatilla Hatchery (76% of strays); three salmon (14%, based on

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<sup>14</sup> Salmon "loss" is the difference between the total count at IHR Dam and the sum of counts (or estimates) at various locations to LGR Dam. Possible disposition of missing fish includes fall back at IHR Dam (Mendel et al. 1993), mortality, or spawning in tributaries or tailraces of the lower Snake River dams.

expanded CWT) originated from Klickitat Hatchery. One spring chinook salmon from the Tucannon River also volunteered to the hatchery (Appendix D).

## 1997

Voluntary returns, as indicated above, to LFH numbered 1,194 fish, representing 26 percent of the estimated escapement over IHR Dam. This was the smallest percentage estimated to have voluntarily entered the hatchery since 1994.

Of the fish that voluntarily entered the hatchery, 95.4 percent were of LFH origin released on-station; 4.6 percent were strays from other hatcheries. Unlike previous years, stray salmon originated primarily from Klickitat Hatchery (45%) rather than Umatilla Hatchery (20%). Strays also included spring chinook from Dworshak National Fish Hatchery, Rapid River Hatchery, and Klickitat River Hatchery (Appendix D).

## Return to Lower Granite Dam

In recent years, the WDFW has estimated the Snake River fall chinook run composition, in part, using CWTS and BWTs from marked hatchery salmon collected at LGR Dam and spawned at LFH. A brief account of escapement to, and above Lower Granite Dam is provided here. For complete details and discussion see Mendel and LaVoy 1997 and Mendel 1998.

## 1996

The 1996 count of fall chinook at LGR Dam ( August 18 to December 11) was 1,308 adults, 424 jacks, and an undetermined number of mini jacks (< 30 cm; U.S. Army Corps of Engineers 1996). This adult count was higher than any other since 1979 (Figure 6). The hatchery run totaled 898; adults and jacks numbered 669 and 229, respectively.

Most of the hatchery fish, both adults and jacks, that returned to LGR originated from LFH (Figure 7). However, a significant number were strays (non-Snake River origin), primarily from Umatilla and Klickitat Hatcheries. In contrast to previous years when strays

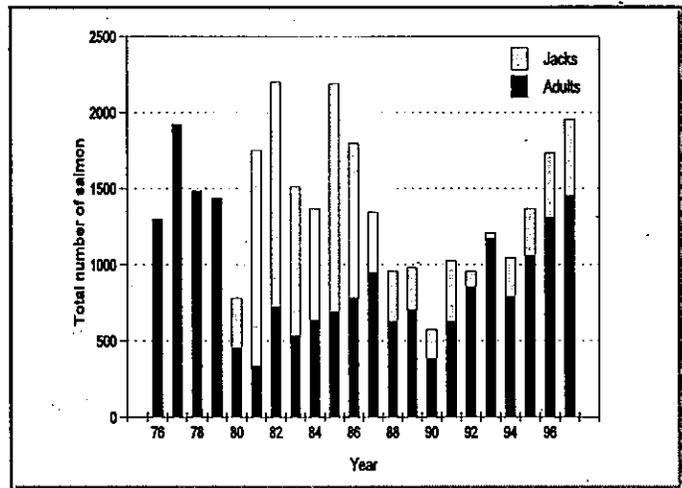


Figure 6. Fall chinook counts at Lower Granite Dam since 1976.

were predominantly from Umatilla Hatchery, the majority of strays in 1996 originated from Klickitat Hatchery. In addition to jacks from LFH, the hatchery jack run to LGR was comprised of fish—all mini jacks ( $\leq 30$  cm)—released from acclimation ponds located at Pittsburg Landing (upstream of LGR).

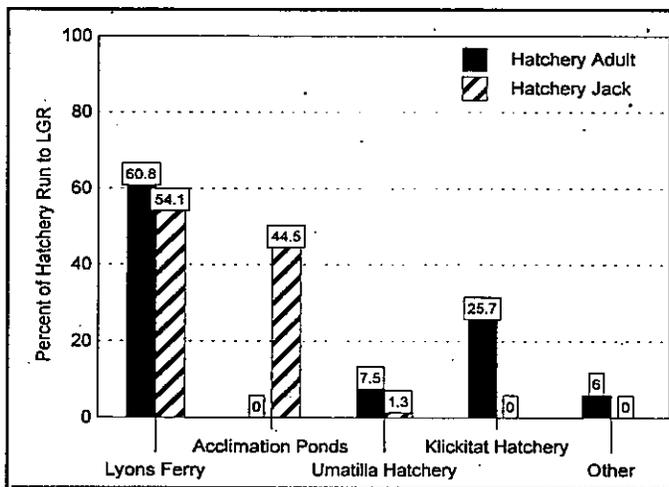


Figure 7. Hatchery fall chinook run composition at Lower Granite Dam, 1996.

### 1997

The 1997 count of fall chinook at LGR Dam ( August 18 to December 5) was 1,451 adults, 504 jacks, and an undetermined number of mini jacks ( $< 30$  cm; U.S. Army Corps of Engineers 1998). The adult count was higher than all other years since 1975 (Figure 6). Hatchery adults and jacks numbered 655 and 479, respectively.

The majority of the adult hatchery fall chinook that returned to LGR were fish from LFH on-station releases (Figure 8). As in 1996, a significant number were strays (non-Snake River origin), primarily from Umatilla and Klickitat Hatcheries. And like 1996, strays from Klickitat Hatchery outnumbered strays from Umatilla Hatchery. Collectively, fish released from acclimation ponds represented only a small percentage of the adult hatchery return to LGR, but accounted for the majority of hatchery jacks, exceeding on-station released fish from LFH.

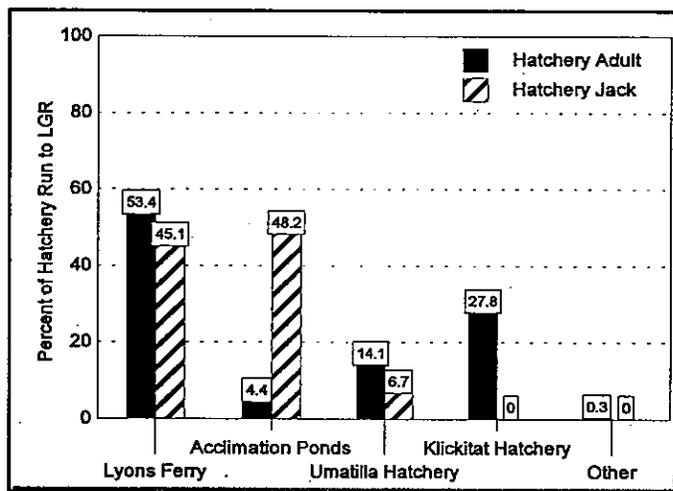


Figure 8. Hatchery fall chinook run composition at Lower Granite Dam, 1997.

## Escapement above Lower Granite Dam

### 1996

Mendel and LaVoy (1997) estimated that escapement, including both natural and hatchery origin fish, above LGR Dam was 919 adult and 368 jack fall chinook in 1996. An estimated 639 adult and 201 jack salmon were of natural origin. Hatchery origin salmon included 162 adults from Klickitat Hatchery, 75 adults from LFH, 43 adults from other hatcheries and 167 jacks from LFH.

### 1997

Estimated escapement of natural and hatchery origin salmon past LGR Dam in 1997 was 1,007 adults and 295 jacks (Mendel 1998). Estimated escapement of natural origin adult and jack salmon was 796 and 17, respectively. The escapement of hatchery origin chinook consisted of 172 adults from Klickitat Hatchery, 20 adults from LFH, 19 adults from other hatcheries and 278 jacks, mostly from LFH.

## Closing Comments

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The use of Lake 2 at LFH for rearing fall chinook was previously identified (Mendel et al., 1996) as complicating evaluation activities hatchery staff are unable to accurately account for mortality due to fish sinking to the bottom of the lake or being removed by predators. Prior to being transferred into Lake 2, all fall chinook are marked and tagged. This provides a total fish count which then becomes the starting point for estimating the number of fish at release. If not corrected for loss, this count could over-estimate the number at release. Conversely, applying an assumed rate of loss could under-estimate the number of fish at release. Accordingly, starting in 1996, SRL staff began snorkeling Lake 2 to recover and enumerate carcasses. To further improve the count of fish at release, counters were installed in the release structure in 1997. This approach failed, however, because the counters severely restricted the movement of large numbers of fall chinook migrating en masse. The counters were removed to prevent fish mortality.

Stray salmon continue to be recovered at LGR and LFH. The percentage of stray adults to LGR has fluctuated between 4 percent and 35 percent and averaged 25 percent since 1992 (Mendel, 1998). In past years, the majority of strays originated from Umatilla Hatchery. Strays from Klickitat Hatchery, first detected in 1994, have steadily increased and now outnumber fall chinook strays from Umatilla Hatchery. The number of salmon straying into LFH is small, but includes spring chinook, fall chinook released from acclimation ponds upstream of LGR, and fall chinook from Umatilla and Klickitat Hatcheries. The removal of non-Snake origin fall chinook from the system as required by the NMFS is only effective to the degree that strays are wire tagged. Only wire tagged fish trigger the trap at LGR.

The ability to pursue optimum size and time of release studies with subyearling fall chinook will require the cooperation and commitment of co-managers. Study design should allow comparisons of size/time at release between same year subyearling releases. The results from comparing size/time at release between groups of fish released in different years are not as likely to provide conclusive answers because of inter-annual variations in flow, ocean conditions, and fishery regimes. Regardless of the release strategies employed, issues such as the type of external marks and how to fund the costs associated with marking or tagging the subyearlings will need to be addressed.

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# **Appendix A: Lyons Ferry Fall Chinook Broodstock Collection and Spawning Protocol**

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## 1996

### Background

The designed production goal for fall chinook salmon at Lyons Ferry Fish Hatchery (LFH) was 9,162,000 subyearling smolts released at 90 fish per pound (fpp). Production capabilities at LFH are limited, however, because of low escapement of fall chinook salmon to the Snake River and the need to cull stray salmon from broodstock. The current production plan for LFH is to release up to 900,000 yearlings at 10 fpp. This strategy provides the best survival potential, as subyearling releases have been documented with very low survival. Releases of yearling salmon at the hatchery and upstream of Lower Granite Dam (LGR) would equal 450,000, respectively, with the on-station release as first priority. Any additional production of Snake River stock would be released as subyearlings at 50-120 fpp.

### IHR Dam Trap Operations

Since the hatchery's inception, Washington Department of Fish and Wildlife (WDFW) personnel trapped fall chinook salmon at Ice Harbor (IHR) Dam for broodstock. The University of Idaho operated the IHR Dam trap in previous years, primarily under directive of the Snake River Fall Chinook Eggbank Program. The primary objective of the trapping program from 1984 to 1993 was collection of adults for direct contribution to Lyons Ferry broodstock. From 1990 to 1993, a related objective of the trap was to cull marked (adipose clipped) stray salmon from Snake River escapement and to collect the 1989 brood salmon produced at LFH. The trap was not used for broodstock collection in 1994 or 1995, nor will it be used in 1996, because its contribution to broodstock has diminished substantially, and stray salmon are not effectively removed at the trap.

### Lower Granite Trap Operations

The fall chinook salmon passage period at LGR Dam is August 18 to December 15. The National Marine Fisheries Service (NMFS) operates an adult trap at the dam. To the extent possible, all wire-tagged or externally marked hatchery chinook salmon (adults, jacks, and minijacks) entering the trap from August 18 to November 30 will be collected for transport to LFH. However, fish with left red or yellow elastomer/filament tags of LFH origin will be allowed to pass upstream. Approximately 100 of the left red elastomer-tagged (VI) fish would be uniquely jaw tagged from throughout the run to determine the number of fish of Lyons Ferry origin that voluntarily return downstream to LFH. Trapping may continue after November 30 if marked salmon continue to arrive at the dam. Tagged hatchery fall chinook salmon will be collected by NMFS, transported, and subsequently processed by WDFW. Salmon will be trapped and anesthetized to determine marks present. Those hatchery fish to be transported will

be given numbered jaw tags and hauled in a 1,200 L aerated, non-refrigerated tank truck, with water obtained from wells at LFH. Some, or all, of the hatchery mini jacks ( $\leq 30$  cm) and jacks (<48 cm fork length) may be killed when trapped at the dam and frozen for later CWT processing at LFH.

### **LFH Trapping**

Salmon that volunteer to LFH will be transferred to the holding pond a minimum of three times a week, to reduce stress to fish. Voluntary, and LGR Dam captured returns will be held separately at LFH to document broodstock composition from each capture location. The hatchery will trap salmon from early September until early or mid-December.

### **Spawning Groups**

Salmon will be mated and accounted for in two distinct groups:

- 1) Marked and unmarked salmon that cannot be confirmed as Lyons Ferry origin will be spawned together as "strays." Unless a fish has a wire-tag in the snout (coded-wire tag [CWT] or blank-wire tag [BWT], or an elastomer tag [VI] behind the left eye, we will assume it is a stray). Salmon identified by CWT, BWT, or fin clip, as not of Lyons Ferry origin will be included in this group. Salmon identified as 1989 brood Lyons Ferry origin will be considered as strays. Fertilized eggs or fry from strays will be transferred as eggs or fry to Klickitat Fish Hatchery, or elsewhere, for subsequent release outside the Snake River Basin.
- 2) Salmon with adipose clips and wire-tags in the snout will have the CWT extracted and read prior to mixing of the gametes. However, salmon that have elastomer/filament tags behind the left eye will be assumed to be of Lyons Ferry origin and their gametes may be used in matings prior to reading the CWT. CWTS would be read later to verify their origins. Salmon known to be of Lyons Ferry origin (excluding 1989 brood) will be spawned together and kept separate from other groups. Progeny from these matings will be retained at Lyons Ferry for subsequent Snake River releases.

### **Spawning Operations**

All adult salmon at LFH will be checked for the presence of wire-tags and external marks. If a large number of jacks are present, approximately 25-50 percent will be sampled for CWT

recoveries during spawning. Salmon will receive unique numbers early in processing for identification and accounting.

Small males (jacks) will be used in the spawning population to take advantage of genetic diversity and increase genetic contribution across all age classes. However, these fish will contribute to matings at a lower proportion than they exist in the hatchery population because selectivity of downstream harvest (almost exclusively adults) and adult mortalities at downstream dams artificially inflates the proportion of jacks in Snake River returns. Also, under natural conditions, jacks would usually not be expected to contribute to a high proportion of salmon matings.

Semen from both jack (males  $\leq 48$  cm fork length) and adult males will be used for fertilizing eggs. We intend to take semen from a portion of the jacks each week throughout the spawning season. Our primary interest in the use of jacks is for matings of known Lyons Ferry origin salmon. However, we will ensure jacks are used to some extent in other matings groups as well. The number of Lyons Ferry origin jacks from which semen will be taken during any week, will be based on the expected portion of the total females that spawn that week, and the goal of having jacks contribute to 10-25 percent of the known Lyons Ferry origin matings. This jack contribution goal would be reduced if the population in the hatchery consisted of few jacks. Conversely, the jack contribution rate would be increased substantially if few adult males were available. Semen will be collected from jacks without regard to fish size, and collected semen from jacks will be used randomly for matings each week. The jack contribution goal may be difficult to achieve logistically because small males continue to enter the population at the hatchery throughout the spawning season, and the number of females of Lyons Ferry origin that are available may not be known until after some matings are completed each week.

We will use single pair matings, with semen from a back-up male whenever possible, for all salmon spawned. Our goal is to ensure that semen from as many different males (including jacks) is used for matings of known Lyons Ferry origin salmon. No male should be used more than twice as the primary male. Fertilized eggs from each female confirmed to be of Lyons Ferry origin (1990-1993 broods) will be incubated in individual trays, using chilled water whenever possible (chiller capacity limited to 40 gpm). Eggs from other females may be pooled (eggs from several females in one incubation tray) within their respective matings groups.

## **1997**

### **IHR Dam Trap Operations**

The trap has not been used for broodstock collection since 1993, nor will it be used in 1997.

## **LGR Trap Operations**

The fall chinook salmon passage period at LGR Dam is August 18 to December 15. The NMFS operates an adult trap at the dam. To the extent possible, all wire-tagged or externally marked hatchery chinook salmon (adults, jacks, and mini jacks) entering the trap from August 18 to November 30 will be collected for transport to LFH. Last year, some of the fish with left red or yellow elastomer/filament tags of LFH origin were allowed to pass upstream. In 1997, all known fall chinook returning from releases at the hatchery (with left red or yellow elastomers) will be collected at LGR Dam and returned to Lyons Ferry because of limited broodstock availability. Trapping may continue after November 30 if marked salmon continue to arrive at the dam. Tagged hatchery fall chinook salmon will be collected by NMFS, transported, and subsequently processed by WDFW. Salmon will be trapped and anesthetized to determine marks present. Those hatchery fish to be transported will be tagged with numbered jaw tags and hauled in a 1,200 L aerated, non-refrigerated tank truck. Some, or all, of the hatchery mini jacks ( $\leq 30$  cm) and jacks ( $<49$  cm fork length) may be killed when trapped at the dam and frozen for later CWT processing at LFH.

## **LFH Trapping**

Salmon that volunteer to LFH will be transferred to the holding pond every day to reduce stress to fish. Voluntary, and LGR Dam captured returns will be held separately at LFH to document broodstock composition from each capture location. The hatchery will trap salmon from early September until early or mid-December.

## **Spawning Groups**

Salmon will be mated and accounted for in two distinct groups:

- 1) Marked and unmarked salmon that can not be confirmed as Lyons Ferry origin will be spawned together as "strays." Unless a fish has a wire tag in the snout (coded-wire tag [CWT] or blank-wire tag [BWT], or an elastomer tag [VI] behind the left eye, we will assume it is a stray). Salmon identified by CWT, BWT, or fin clip, as not of Lyons Ferry origin will be included in this group. Fertilized eggs or fry from strays or unknown origin fish will be transferred as eggs or fry to Klickitat Fish Hatchery, or elsewhere, for subsequent release outside the Snake River Basin.
- 2) Salmon with adipose clips and wire tags in the snout will have the CWT extracted and read prior to mixing of the gametes. However, salmon that have elastomer/filament tags behind the eye will be assumed to be of Lyons Ferry

origin and their gametes may be used in matings prior to reading the CWT. CWTs would be read later to verify their origins. Salmon known to be of Lyons Ferry origin will be spawned together and kept separate from other groups. Progeny from these matings will be retained at Lyons Ferry for subsequent Snake River releases.

### **Spawning and Incubation Operations**

All adult salmon at LFH will be checked for the presence of wire-tags and external marks. If a large number of jacks are present, at least 25-50 percent will be sampled for CWT recoveries during spawning. Salmon will receive unique numbers early in processing for individual fish identification and accounting.

Small males (jacks) will be used in the spawning population to take advantage of genetic diversity and increase genetic contribution across all age classes. However, these fish will contribute to matings at a lower proportion than they exist in the hatchery population because selectivity of downstream harvest (almost exclusively adults) and adult mortalities at downstream dams artificially inflates the proportion of jacks in Snake River returns. Also, under natural conditions, jacks would usually not be expected to contribute to a high proportion of salmon matings.

Semen from both jack (males <49 cm fork length) and adult males will be used for fertilizing eggs. We intend to take semen from a portion of the jacks each week throughout the spawning season. Our primary interest in the use of jacks is for matings of known Lyons Ferry origin salmon. However, we will ensure jacks are used to some extent in other matings groups as well. The number of Lyons Ferry origin jacks from which semen will be taken during any week will be based on the expected portion of the total females that spawn that week, and the goal of having jacks contribute to 10-25 percent of the known Lyons Ferry origin matings. This jack contribution goal would be reduced if the population in the hatchery consisted of few jacks. Conversely, the jack contribution rate could be increased substantially if few adult males were available. Semen will be collected from jacks without regard to fish size, and collected semen from jacks will be used randomly for matings each week. The jack contribution goal may be difficult to achieve logistically because small males continue to enter the population at the hatchery throughout the spawning season, and the number of females of Lyons Ferry origin that are available may not be known until after some matings are completed each week.

We will use single pair matings, with semen from a back-up male whenever possible, for all salmon spawned. Our goal is to ensure that semen from as many different males (including jacks) is used for matings of known Lyons Ferry origin salmon. We do not anticipate live spawning males in 1997. No male should be used more than twice as the primary male.

Fertilized eggs from each female confirmed to be of Lyons Ferry origin will be incubated in individual trays, using chilled water whenever possible (chiller capacity limited to 40 gpm). Fish identification numbers will be attached to each tray of eggs. Eggs from unknown origin females may be pooled (eggs from several females in one incubation tray) within their respective matings groups.

Snake River Lab personnel will assist hatchery personnel with egg picking and counting at "eye up." Eggs from each female will be counted separately to identify number of live and dead eggs (fecundity) per female. A decision will be made later as to whether eggs from several females may be grouped at that time into one tray, or eggs from each female will be kept separately. Eggs or fry from females with moderate or high bacteria kidney disease (BKD) ELISA levels will not be mixed with eggs of below low and low levels. Progeny from high and moderate BKD ELISA females will be ponded together to prevent the spread of BKD. Progeny with high and moderate BKD ELISA may be incorporated into subyearling releases to prevent holding these fish at the hatchery for an extended period.

## **Appendix B: Lyons Ferry Chinook Releases Table**

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Lyons Ferry fall chinook releases with number marked (adipose clipped), tagged (Coded-Wire Tag [CWT]) and unmarked by release year and type.

Release Year Age (brood year)	Release Type <sup>a</sup> Date	Number CWT		Adipose only marked	Number unmarked	Fish /Lb	Type	Location	Color or Brand	% Loss	Other Marks	
		Type <sup>a</sup> Date	Code <sup>b</sup>									
<b>1985</b>												
yearling (83)	direct	4/17	250,831	21/52	1,769	235,125	48,773	10.0				
			<u>83,611</u>	32/18	<u>589</u>	<u>78,375</u>	<u>16,468</u>	10.0				
			334,442		2,358	313,500	65,241					
subyearling (84)	direct	6/6	78,064	32/27	235	100,900	2,354	76.0				
			78,504	32/38	236	101,400	2,369	76°				
			<u>78,417</u>	32/26	<u>236</u>	<u>101,400</u>	<u>2,367</u>	<u>76°</u>				
			234,985		707	303,700	7,090					
<b>1986</b>												
yearling (84)	direct	4/2&3	258,355	28/41	1,821	181,500	55,210	8.0				
		4/4&8				40,274	5,035	8.0	Freeze brand	right anterior	7K-1	
			<u>258,355</u>		<u>1,821</u>	<u>181,500</u>	<u>22,688</u>	8.0				
						403,274	82,933					
subyearling (85)	direct	6/10	49,325	36/38	468		859	58.0				
			49,325	36/39	468		859	58.0				
			49,325	36/40	468		859	58.0				
			49,325	36/41	468		859	58.0				
			49,325	36/42	468		859	58.0				
						81,003	1,157	70.0	Freeze brand	right anterior	T-3	
			<u>246,625</u>		<u>2,340</u>	<u>1,212,200</u>	<u>13,933</u>	87.0				
						1,293,203	19,385					

Appendix B (continued).

Release Year Age (brood year)	Release		Number		CWT		Adipose		Other Marks				
	Type	Date	CWT	Date	only marked	only unmarked	Code	Lbs	Fish /Lb	Type	Location	Color or Brand	% Loss
<u>1987</u>													
yearling (85)	direct	4/14	152,479	41/56	1,075	3,990,636,	4,425	25,592	6.0	Freeze brand	left anterior	7N-1	
						300	3,862	9.0					
						653		69	9.0	PIT tagged by NMFS for migration timing			
			152,479		1,075	76,859		33,948					
yearling (85)	barge	4/16	156,036	41/59	470			22,682	7.0				
<u>1988</u>													
subyearling (86)	direct	6/1	126,076	42/59	2,836	2,675	48.0	2,686	48.0				
			125,570	42/61	2,824	80,484	1,059	76.0	76.0	Freeze brand	left anterior	S-1	
			251,646		5,660	80,484	6,420						
subyearling (86)	barge	6/2	128,283	44/01	1,034	1,821	71.0	1,836	71.0				
			127,715	42/62	1,030	78,200	745	105					
			255,998		2,064	78,200	4,402						
<u>1988</u>													
yearling (86)	direct	4/14	58,970	44/13	237	64,369	15,447	8.0					
			58,735	44/11	236	64,112	15,385	8.0					
						39,952	4,994	8.0		Freeze brand	right anterior	7S-1	
			117,705		473	168,433	35,826						

Appendix B (continued).

Release Year	Release Age (brood year)	Type	Date	Number		CWT Code <sup>b</sup>	Adipose		Fish /Lb	Other Marks		
				CWT	only marked		only unmarked	Location		Type	Color or Brand	% Loss
<b>1988</b>												
<b>Continued</b>												
yearling (86)	barge	4/19	60,523	44/07	213		7,592	8.0				
			<u>60,281</u>	44/08	<u>212</u>		<u>7,562</u>	8.0				
			120,804		425		15,154					
subyearling (87)	direct	6/1	124,345	52/14	374		839,682	18,196	53.0			
			124,394	52/16	374		840,018	18,202	53.0			
			<u>248,739</u>		<u>758</u>		<u>1,759,661</u>	<u>37,907</u>		Freeze brand	right dorsal	R-1
subyearling (87)	barge	6/8	122,850	52/11	2,125		21,246	2,759	53.0			
			122,899	52/13	2,125		21,254	2,760	53.0			
							271,500	3,879	70.0			
							886,300	8,953	99.0			
			<u>245,749</u>		<u>4,250</u>		<u>1,114,000</u>	<u>8,984</u>	124			
							2,314,300	27,335				
<b>1989</b>												
yearling (87)	direct	4/14	57,594	47/56	58		69,249	12,690	10.0			
			57,756	47/52	58		69,443	12,725	10.0			
							39,044	3,904	10.0	Freeze brand- left ant.:	7U-1, 33.4%; 7U-3, 33.3% / left dorsal:	7U-1, 33.3%
			<u>115,350</u>		<u>116</u>		<u>177,736</u>	<u>29,319</u>				
yearling (87)	barge	4/20	59,609	47/55	299		5,991	10.0				
			59,608	47/50	299		5,991	10.0				
			<u>119,217</u>		<u>598</u>		<u>11,982</u>					

Appendix B (continued).

Release Year Age (brood year)	Release Type <sup>a</sup> Date	Number		CWT Code <sup>b</sup>	Adipose only		Number unmarked	Fish /Lb	Type	Location	Other Marks	
		CWT	Date		marked	% Loss					Color or Brand	% Loss
<b>1989</b>												
<b>Continued</b>												
subyearling (88)	direct	6/8	113,285	02/28	2,076	2,075	18,244	1,485	90.0			
			113,193	02/26	2,075		18,244	1,483	90.0			
							828,485	8,663	96.0	Fish per pound is average of six groups of different sized fish.		
							39,991	580	69.0	Freeze brand	left anterior	U-1
							40,025	580	69.0	Freeze brand	right anterior	U-3
			226,478			4,151	944,989	12,791				
<b>1990</b>												
subyearling (88)	barge	6/14	117,168	52/07	3,128	3,121	21,207	1,887	75.0			
			116,935	52/04	3,121		21,208	1,884	75.0			
							173,595	2,755	63.0			
							125,091	1,061	118			
							88,378	982	90.0			
			234,103		6,249		429,479	8,569				
yearling (88)	direct	4/16	56,597	02/37	502		83,264	15,596	9.0			
			55,922	02/35	496		83,264	15,520	9.0			
			112,519		998		166,528	31,116				
yearling (88)	barge	4/17	58,988	02/31	458		18,708	7,105	11.0			
			58,989	02/32	458		18,708	7,105	11.0			
			117,977		916		37,416					
												14,210

Appendix B (continued).

Release Year Age (brood year)	Release Type*	Date	Number CWT		Adipose only marked	Number unmarked	Lbs	Fish /Lb	Type	Location	Color or Brand	% Loss	Other Marks
			Code <sup>b</sup>	Code <sup>b</sup>									
<b>1990 Cont'd</b>													
subyearling (89)	direct	6/6	123,233	55/47	3,601		2,306	55.0					
		6/6	123,640	55/44	3,662		2,315	55.0					
						79,676	1,035	77.0	Freeze brand -right anterior: 50% U-1, 50% U-3 / BWT - nose: 100%				
		6/6				303,255	4,332	70.0	BWT				nose
		6/18				793,349	10,868	73.0	"				"
		6/25				604,205	8,757	69.0	"				"
		7/2				534,174	7,524	71.0	"				"
		7/2				768,312	10,821	71.0	"				"
		7/12				227,413	2,707	84.0	"				"
			246,873		7,263	3,310,384	50,665						
<b>1991</b>													
subyearling (89)	barge	6/8	118,104	55/49	4,716		1,981	62.0					
			119,941	55/50	4,787		2,012	62.0					
			238,045		9,503		3,993						
<b>1992</b>													
subyearling (90)	barge	6/2	111,784	41/43	562		2,293	49.0					
			110,748	41/60	1,345		2,288	49.0					
			222,532		1,907		4,581						
yearling (90)	direct	4/15	104,820	42/09	792		13,201	8.0	VT - behind left eye, red:	50.4% / BWT - left cheek:	49.6%		
						5,125	641	8.0	VT - behind left eye red				
						5,207	651	8.0	BWT - left cheek				
			4,386	43/20			548	8.0	VT - behind left eye:	49.4% / BWT - left cheek:	50.6%		
			218,110	41/18	1,515		27,453	8.0	VT - behind left eye:	49.7% / BWT - left cheek:	50.3%		
			23,954	40/12	113		3,008	8.0	VT - behind left eye:	49.6% / BWT - left cheek:	50.4%		
			351,270		2,420		10,332	45,502					

Appendix B (continued).

Release Year Age (brood year)	Release		Number		CWT Code <sup>b</sup>	Adipose		Number unmarked	Lbs	Fish /Lb	Type	Other Marks			
	Type <sup>a</sup>	Date	CWT	only marked		Location	Color or Brand					% Loss			
<u>1992 cont'd</u>															
yearling (90)	barge	4/17	98,374	42/10	560	10,993	9.0 VT - behind left eye: 51.7% / BWT - left cheek: 48.3%.								
			202,674	41/20	2,566	22,804	9.0 VT - behind left eye: 49.8% / BWT - left cheek: 50.2%.								
			21,137	40/13	268	2,378	9.0 VT - behind left eye: 49.8% / BWT - left cheek: 50.2%.								
			322,185		3,394	36,175									
<u>1993</u>															
yearling (91)	direct	4/12	51,663	46/58	312	4,725	11.0 Elastomer	behind left eye	red	9.6%					
			51,371	46/59	624	4,727	11.0								
			51,370	46/61	206	4,689	11.0 Elastomer	behind left eye	red	9.0%					
			51,887	46/60	104	4,726	11.0								
			51,408	46/31	415	4,711	11.0								
			52,093	46/55	104	4,745	11.0 Elastomer	behind left eye	red	11.6%					
			50,892	46/63	828	4,702	11.0								
			51,410	46/62	310	4,702	11.0 Elastomer	behind left eye	red	4.0%					
			412,094		2,903	37,727									
			yearling (91)	barge	4/19	9,196	37/31	89	108	1,044	9.0 High density ELISA (BKD) group.				
			82,796	46/18	1,351	296	4,691	18.0							
			31,901	47/09	494	493	3,289	10.0							
			33,994	47/06	244	663	3,490	10.0 Elastomer							
			49,656	46/56	2,449	5,211	10.0 Elastomer								
			53,595	46/57	541	4,921	11.0								
			38,460	47/03		139	3,509	11.0 Elastomer							
			38,170	47/05	155	231	3,505	11.0							
			337,768		5,323	1,930	29,660								
subyearling (92)	direct	6/24	203,177	50/12	3,598	3,390	61								

Appendix B (continued).

Release Year	Age (brood year)	Release Type <sup>a</sup>	Release Date	Number		CWT Code <sup>b</sup>	Adipose		Number unmarked	Fish Lbs /Lb	Type	Location	Color or Brand	% Loss
				CWT	Date		only	marked						
<b>1994</b>														
yearling (92)	direct	4/18	53,276	52/24	53	168	4,863	11.0	Elastomer	behind left eye	red	2.5%		
			49,248	49/20	49	155	4,496	11.0	"	"	"	2.5%		
			51,702	49/18	312	4,709	11.0	"	"	"	"	4.0%		
			51,702	49/17	312	4,709	11.0	"	"	"	"	4.0%		
			51,258	49/15	273	4,685	11.0	"	"	"	"	3.2%		
			51,168	49/12	273	4,676	11.0	"	"	"	"	3.2%		
			308,354		1,272	323	28,138							
<b>1995</b>														
yearling (93)	direct	4/17	50,481	47/63	1,831	104	4,765	11.0	Elastomer	behind left eye	yellow	7.0%		
			51,160	47/60	726	4,717	11.0	"	"	"	"	3.8%		
			51,091	52/29	1,149	4,733	11.0	"	"	"	"	4.8%		
			51,260	52/27	413	4,707	11.0	"	"	"	"	5.6%		
			51,316	47/58	104	4,684	11.0	"	"	"	"	5.6%		
			33,736	52/63	135	206	3,074	11.0	"	"	"	3.9%		
			289,044		4,254	414	26,680							
yearling (93)	direct	4/17	73,986	56/40	484	346	9,237	8.0	Elastomer	behind left eye	red	8.1%		
			101,165	51/63	300	13,529	7.5	"	"	"	"	4.1%		
			82,624	56/39	39	195	10,761	8.0	"	"	"	4.5%		
			89,900	51/62	85	11,378	8.0	"	"	"	"	7.2%		
			347,675		908	541	44,905							

Appendix B (continued).

Release Year	Release Type	Date	Number		CWT Code <sup>b</sup>	Adipose		Number unmarked	Lbs	Fish /Lb	Type	Location	Color or Brand	% Loss	
			CWT	only marked		marked	only								
<b>1996</b>															
fry (95)	direct	3/1-31						83,183	186	500					
yearling (94)	direct	4/9-12	196,820	58/44	177				18,762	10.5	Elastomer	behind left eye	red	10.2%	
			207,087	58/45	186				19,740	10.5	"	"	"	"	
			3,230	58/44	3				308	11.0	"	"	"	"	"
			407,137	58/45	366				38,996						
			&												
			113,976	57/12	65				11,108	10.3	Elastomer	behind right eye	blue	17.9%	
<b>1997</b>															
yearling (95)	direct	4/4-26	217,756	63/20	911				9,713	24,583	9.3	Elastomer	behind left eye	red	12.8%
			217,771	63/21	911				9,714	24,585	9.3	"	"	"	"
			435,527		1,822				19,427	49,168					
			67,252	59/57	1,335				4,968	6,876	10.7	Elastomer	behind right eye	green	27.1%
			67,441	59/58	1,338				4,982	6,895	10.7	"	"	"	27.1%
			134,693		2,673				9,950	13,771					
yearling (95)	Big Canyon	4/14-17	71,692	59/59	992				902	7,138	10.3	Elastomer	behind left eye	green	11.7%
			73,110	59/60	1,012				920	7,279	10.3	"	"	"	"
			29,341	59/53	698				3,529	2,894	11.6	"	"	blue	10.4%
			610	60/24	14				73	60	11.6	"	"	"	"
			14,428	60/25	343				1,735	1,423	11.6	"	"	"	"
			189,181		3,059				7,159	18,794					

Appendix B (continued).

Release Year Age (brood year)	Release		Number CWT	CWT Code <sup>b</sup>	Adipose		Number unmarked	Lbs	Fish /Lb	Type	Location	Color or Brand	% Loss
	Type <sup>a</sup>	Date			only marked	only							
subyearling (96)	Big Canyon	6/10-13	119,824	51/20	1,816	7,897	2,028	63.9	BWT	left cheek	-	-	
			113,932	53/16	1,727	7,509	1,928	63.9	"	"	-	-	
			233,756		3,543	15,406	3,956						
1998 yearling (96)	direct	4/3-16	208,388	63/18	3,444	1,854	21,157	10.1	Elastomer	behind left eye	red	15.7	
			200,215	01/63	3,309	1,782	20,327	10.1	"	"	"	"	
			408,603		6,753	3,636	41,484						
Pittsburg	4/13-16	67,539	04/46	886	2,213	7,164	9.9	Elastomer	behind right eye	green	6.7		
		68,055	04/48	892	2,229	7,218	9.9	"	"	"	"		
		135,594		1,778	4,442	14,382							
Big Canyon	4/13-16	15,370	61/26	261	56	1,646	9.5	Elastomer	behind left eye	green	9.4		
		7,492	63/43	516	138	271	30.0	"	"	"	3.2		
		23,742	63/47	403	87	2,543	9.5	"	"	"	9.4		
		12,055	01/10	830	222	436	30.0	"	"	"	3.2		
		58,659		2,010	503	4,896							
Captain John	4/9-15	6,798	03/63	82	47	637	10.9	Elastomer	behind left eye	blue	19.2		
		1,438	04/01	17	10	135	10.9	"	"	"	"		
		60,527	63/45	730	417	5,670	10.9	"	"	"	"		
		61,965	63/46	747	427	5,804	10.9	"	"	"	"		
		130,728		1,576	901	12,246							

<sup>a</sup> Direct releases occurred on-station at Lyons Ferry Hatchery. Barged fish were released immediately downstream of Ice Harbor Dam.  
<sup>b</sup> Pittsburg, Big Canyon, and Captain John are three acclimation sites located above Lower Granite Dam and operated by the Nez Perce Tribe  
<sup>c</sup> All tag codes start with agency code 63.  
<sup>d</sup> Mean length of marked (67fpp) and unmarked (85fpp) differed.  
Study group to test passage at dam.

**Appendix C: Mean Fork Length, Standard Deviation,  
Sample Size and Range for Returning Lyons Ferry  
Origin Fall Chinook Salmon That Had Been Released  
as Subyearlings and Yearlings**

(1987-1993 Broods—Lower Granite [LGR] Dam and Lyons Ferry Fish Hatchery [LFH]).

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**Table 1. Mean (cm) fork length, (standard deviation), sample size, and range for Lyons Ferry fall chinook salmon released as subyearlings. All release locations are included.**

Recovery year	sex	Brood year <sup>a</sup>					
		1997	1996	1992	1990	1989	1988
1993 <sup>b</sup>	male				68.8 (5.89) 42 <sup>b</sup> 58-85	80.7 (10.31) 105 44-104	
	female				70.5 (5.16) 20 62-79	80.7 (5.55) 176 64-94	76.5 (14.89) 2 66-87
1994 <sup>b</sup>	male			44.7 (3.92) 134 36-54	81.0 (4.41) 67 71-90	87.0 (7.16) 27 <sup>c</sup> 69-101	86.0 (12.13) 16 61-105
	female					85.6 (4.08) 44 71-92	
1995	male			64.4 (8.03) 180 46-87		101.6 (6.69) 8 87.5-107	- (-) 1 104.0
	female			67.8 (4.44) 79 54-78		101.6 (5.51) 19 82-102	104.0 (2.08) 3 <sup>d</sup> 84-88
1996	male			79.8 (12.33) 68 <sup>b</sup> 54-102		- (-) 1 103	
	female			77.8 (6.22) 126 61.5-90		83.4 (7.04) 24 70-95	
1997	male			94.8 (23.68) 6 59-121			
	female			85.9 (5.61) 12 75-93			

<sup>a</sup> There were no subyearling groups released for brood years 1991, 1993, 1994, or 1995.

<sup>b</sup> Includes BWTs

<sup>c</sup> Plus one fish with no length measurement.

<sup>d</sup> Three BWTs.

**Table 2. Mean (cm) fork length (standard deviation), sample size and range for Lyons Ferry fall chinook salmon released as yearlings.**

Recovery year	sex	Brood Year								
		1995	1994	1993	1992	1991	1990	1989	1988	1987
1993 <sup>a</sup>	male						33.4 (2.56) 102 28-35	51.9 (6.09) 58 40-66	82.3 (11.41) 61 45-99	- (-) 1 77
	female							64.0 (15.56) 2 53-75	79.6 (6.12) 102 67-94	
1994 <sup>a</sup>	male				35.0 (2.89) 241 <sup>b</sup> 29-51	53.2 (5.10) 283 <sup>c</sup> 42-82	73.3 (9.91) 55 35-91		84.7 (10.75) 4 76-98	
	female					59.0 (2.71) 4 57-63	72.9 (5.29) 86 <sup>b</sup> 58-86		80.5 (7.96) 10 67-92	
1995 <sup>d</sup>	male			35.4 (2.40) 1782 22-47 <sup>e</sup>	55.4 (4.97) 230 41-71.5	75.8 (8.62) 26 51-90	76.8 (10.60) 122 57-105			
	female			- (-) 1 75.0	61.4 (3.82) 14 56-68	75.0 (5.75) 53 60-90	75.1 (5.93) 175 54.5-95		- (-) 1 80.0	
1996 <sup>f</sup>	male		33.7 (2.24) 380 <sup>g</sup> 24-47	51.0 (4.86) 374 37-65.5	72.2 (8.71) 238 <sup>b</sup> 54-98	89.2 (7.50) 18 77-105	80.0 (4.24) 2 77-83			
	female			60.3 (5.78) 20 54-80	73.8 (5.20) 314 56-92	83.0 (6.31) 32 76-92	- (-) 1 95			
1997 <sup>h</sup>	male	33.6 (2.08) 434 <sup>i</sup> 27.5-40	49.6 (4.57) 402 28-68	70.5 (8.33) 224 48-93	86.6 (11.98) 55 56.5-104					
	female	- (-) 1 70		72.9 (5.56) 347 54.5-89	80.6 (7.15) 116 57-97	90.0 (17.68) 2 77-102				

<sup>a</sup> Includes BWTs.

<sup>b</sup> Plus one fish with no length measurement.

<sup>c</sup> Plus two fish with no length measurement.

<sup>d</sup> Plus 37 males and 3 females of Lyons Ferry origin with elastomers, but without CWTS or BWTs (includes 27 fish killed at LGR).

<sup>e</sup> Plus four fish with no length measurements. One fish of the 1,782 was recorded as 72 cm.

<sup>f</sup> Plus 27 males and 5 females of Lyons Ferry origin with elastomers, but with lost CWTS or no CWTS. Mean fork lengths include 8 fish sacrificed at LGR.

<sup>g</sup> Includes four fish sacrificed at LGR.

<sup>h</sup> Plus 28 males and 7 females of Lyons Ferry origin with elastomers, but with lost CWTS or no CWTS. Mean fork lengths include 8 fish sacrificed at LGR.

<sup>i</sup> Plus one fish with length measurement of 31-35 cm FL.

## **Appendix D: Coded–Wire Tag Recoveries at Lyons Ferry Fish Hatchery in 1996**

(and expansions according to our data to include all fish released from Lyons Ferry Hatchery).  
(VOL=voluntary return to the hatchery, LG=hailed from L. Granite Dam.)

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Table 1. Recoveries of Lyons Ferry origin Coded-Wire Tags (CWTs) at Lyons Ferry Hatchery in 1996.

Vol	LG	Total	CWT Codes	Release Source	Brood Year	CWT (T)	No. Ad-only (A)	No. Unmarked (U)	Expansion Rate ((T+A+U)/T)	Expanded Recovery		
										Vol	LG	Ttl
1	1	1	63	31 Lyons Ferry	91	9,196	89	108	1.02	1	0	1
1	1	1	63	18 Lyons Ferry	90	218,110	1,515	0	1.01	1	0	1
2	2	2	63	20 Lyons Ferry	90	202,674	2,566	0	1.01	2	0	2
1	1	1	63	41 Lyons Ferry	90	110,748	1,345	0	1.01	1	0	1
2	2	2	63	18 Lyons Ferry	91	82,796	1,351	296	1.02	2	0	2
6	2	8	63	31 Lyons Ferry	91	51,408	415	0	1.01	6	2	8
6	6	6	63	55 Lyons Ferry	91	52,093	104	0	1.00	6	0	6
3	3	3	63	56 Lyons Ferry	91	49,656	1,094	1,355	1.05	3	0	3
5	5	5	63	57 Lyons Ferry	91	53,595	216	325	1.01	5	0	5
2	2	2	63	58 Lyons Ferry	91	51,663	208	104	1.01	2	0	2
5	2	7	63	59 Lyons Ferry	91	51,371	624	0	1.01	5	2	7
1	1	1	63	60 Lyons Ferry	91	51,887	104	0	1.00	1	0	1
3	3	3	63	61 Lyons Ferry	91	51,370	206	0	1.00	3	0	3
6	6	6	63	62 Lyons Ferry	91	51,410	310	0	1.01	6	0	6
1	1	1	63	63 Lyons Ferry	91	50,892	828	0	1.02	0	1	1
1	1	2	63	5 Lyons Ferry	91	38,170	155	231	1.01	1	1	2
2	2	2	63	6 Lyons Ferry	91	33,994	244	663	1.03	2	0	2
1	1	1	63	9 Lyons Ferry	91	31,901	494	493	1.03	1	0	1
30	9	39	63	58 Lyons Ferry	92	51,316	0	206	1.00	30	9	39
38	8	46	63	60 Lyons Ferry	92	51,160	726	0	1.01	39	8	47
26	10	36	63	63 Lyons Ferry	92	50,481	1,831	104	1.04	27	10	37
38	8	46	63	12 Lyons Ferry	92	51,168	273	0	1.01	38	8	46
45	4	49	63	15 Lyons Ferry	92	51,258	273	0	1.01	45	4	49
57	4	61	63	17 Lyons Ferry	92	51,702	312	0	1.01	57	4	61
38	3	41	63	18 Lyons Ferry	92	51,702	312	0	1.01	38	3	41
34	6	40	63	20 Lyons Ferry	92	49,248	49	155	1.00	34	6	40
51	143	194	63	12 Lyons Ferry	92	203,177	3,598	0	1.02	52	146	198
139	10	149	63	62 Lyons Ferry	93	89,800	85	0	1.00	139	10	149
95	12	107	63	63 Lyons Ferry	93	101,165	300	0	1.00	95	12	107
39	6	45	63	24 Lyons Ferry	92	53,276	53	168	1.00	39	6	45
40	12	52	63	27 Lyons Ferry	92	51,260	413	104	1.01	40	12	52
43	12	55	63	29 Lyons Ferry	92	51,091	1,149	0	1.02	44	12	56
33	9	42	63	63 Lyons Ferry	92	33,736	135	0	1.00	33	9	42
91	10	101	63	39 Lyons Ferry	93	82,624	39	195	1.00	91	10	101
32	5	37	63	40 Lyons Ferry	93	73,986	484	346	1.01	32	5	37
3	7	10	63	12 Lyons Ferry	94	113,976	65	258	1.00	3	7	10
169	4	173	63	44 Lyons Ferry	94	196,604	196	197	1.00	169	4	173
190	4	194	63	45 Lyons Ferry	94	206,860	206	207	1.00	190	4	194
1279	292	1571								1283	295	1578

Table 2. Coded-Wire Tag (CWT) recoveries from stray hatchery fish at Lyons Ferry Fish Hatchery (LFH) in 1996.

Vol	LG	Tota	1	CWT Codes	Release Location	Brood Year	Number CWT (T)	Number Ad-only (A)	Number Unmarked (U)	Expansion Rate ((T+A+U)/T)	Expanded Recovery		
											Vol	LG	Ttl
1	1	1	5	32	52 L. White Salmon	92	47,473	2,450	1,816,978	39.33	0	39	39
1	1	1	6	57	49 Trinity River	92	54,308	710	0	1.01	0	1	1
1	1	1	7	1	26 Umatilla River	92	29,594	834	237,573	9.06	0	9	9
1	1	1	7	6	62 Umatilla River	93	31,239	601	248,206	8.96	0	9	9
1	1	1	7	7	17 Umatilla River	93	32,481	98	157,860	5.86	6	0	6
1	1	1	7	7	20 Umatilla River	93	30,528	193	283,797	10.30	0	10	10
1	1	1	7	7	21 Umatilla River	93	28,474	3,515	274,116	10.75	0	11	11
1	1	1	7	14	60 Umatilla River	91	23,863	927	43,702	2.87	0	3	3
1	1	1	7	54	49 Umatilla River	90	48,481	1,620	49,861	2.06	0	2	2
1	1	1	7	63	30 Umatilla River	92	28,964	816	263,115	10.11	10	0	10
10	10	10	23	27	12 NMFS Pittsburg	94	14,566	591	0	1.04	0	10	10
5	5	5	23	27	13 NMFS Asotin	94	15,205	592	0	1.04	0	5	5
1	1	1	23	30	23 Bonn. Col. Rm 141	92	94,838	4,678	4,578	1.10	1	0	1
2	2	2	63	40	30 Klickitat River	90	75,342	838	2,553,820	34.91	0	70	70
1	1	1	63	45	30 Klickitat River	91	75,888	643	127,269	2.69	0	3	3
1	1	1	63	47	36 Klickitat River	92	76,341	269	1,503,390	20.70	0	21	21
4	4	4	63	47	39 Klickitat River	92	75,797	689	287,514	4.80	0	19	19
1	1	1	63	49	24 Klickitat River	92	72,255	745	2,135,000	30.56	0	31	31
1	1	1	63	53	35 Klickitat River	93	76,204	345	166,451	3.19	3	0	3
1	1	1	63	53	36 Klickitat River	93	74,501	119	2,045,380	28.46	0	28	28
1	1	1	63	48	10 Tucannon R. Spring	92	35,405	871	0	1.02	1	0	1
5	33	38									21	271	292

**Table 3. Other salmon processed at Lyons Ferry Fish Hatchery (LFH) in 1996.**

Vol	LG	Total	Coded-Wire Tag (CWT) Codes			Release Location	Brood Year
With CWT but not adipose clipped.							
1		1	63	47	58	Lyons Ferry	92
1	1	1	63	47	60	Lyons Ferry	92
		1	7	7	16	Umatilla River	93
-----							
Mini jacks (<30cm FL) killed at the adult trap at LGR (5 total).							
	2	2	63	57	12	Lyons Ferry	94
	1	1	63	58	44	Lyons Ferry	94
	1	1	63	58	45	Lyons Ferry	94
	1	1		BWT/RV		Umatilla River	
-----							
Fish (37 total) with "lost" CWTs.							
28		28	(25 with elastomers from Lyons Ferry).				
	9	9	( 1 with elastomer from Lyons Ferry)				
-----							
Fish (16 total) without CWTs, but adipose clipped ("No Tag").							
14		14	(6 with elastomers from Lyons Ferry)				
	2	2	(None with elastomer tags from Lyons Ferry)				
-----							
Fish with BWTs (49 total), all Umatilla River origin.							
15		15	(13 RV or LV clipped and one adipose clipped)				
	34	34	(All RV or LV clipped)				
-----							
Fish (93 total) that were not adipose clipped or CWT/BWT ("None").							
88		88	(11 fish were RV or LV fin clipped)				
	5	5	(All were RV or LV fin clipped)				
147	56	203					
	381		Total of all salmon from Lower Granite Dam.				
1,431			Total of all fish that voluntarily returned.				
		1,812	Grand total of fish processed at LFH.				

## **Appendix E: Coded–Wire Tag Recoveries at Lyons Ferry Fish Hatchery in 1997**

(and expansions according to our data to include all fish released from Lyons Ferry Hatchery).  
(VOL=voluntary return to the hatchery, LG=hailed from L. Granite Dam, YO= yearling onstation release, YB= yearling barge release, SO= subyearling on-station release YP= yearling Pittsburg Landing release, YBC= yearling release at Big Canyon in the Clearwater River)

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Table 1. Recoveries of Lyons Ferry origin CWTs at Lyons Ferry Hatchery in 1997.

Vol	Coded-Wire Tag		Release	Brood Year	Number CWT (T)	Number Ad-only (A)	LG	Total		
	LG	Total								
1	1	63	46	18	Lyons Ferry (YB)	91	82,796	1,351	0	1
	1	63	46	55	Lyons Ferry (YO)	91	52,093	104	1	1
5	9	14	63	47	Lyons Ferry (YO)	92	51,316	0	9	14
8	6	14	63	47	Lyons Ferry (YO)	92	51,160	726	6	14
	5	5	63	47	Lyons Ferry (YO)	92	50,481	1,831	5	5
7	5	12	63	49	Lyons Ferry (YO)	92	51,168	273	5	12
13	8	21	63	49	Lyons Ferry (YO)	92	51,258	273	8	21
19	6	25	63	49	Lyons Ferry (YO)	92	51,487	311	6	25
5	6	11	63	49	Lyons Ferry (YO)	92	51,488	311	6	11
5	4	9	63	49	Lyons Ferry (YO)	92	49,248	49	4	9
2	16	18	63	50	Lyons Ferry (SO)	92	203,177	3,598	16	18
103	44	147	63	51	Lyons Ferry (YO)	93	89,805	80	44	147
106	62	168	63	51	Lyons Ferry (YO)	93	101,161	304	62	168
10	5	15	63	52	Lyons Ferry (YO)	92	53,276	53	5	15
5	13	18	63	52	Lyons Ferry (YO)	92	51,260	413	13	18
4	8	12	63	52	Lyons Ferry (YO)	92	50,915	1,145	8	12
7	7	14	63	52	Lyons Ferry (YO)	92	33,736	135	7	14
98	59	157	63	56	Lyons Ferry (YO)	93	82,618	41	59	157
55	43	98	63	56	Lyons Ferry (YO)	93	73,987	484	43	98
	9	9	63	57	Lyons Ferry (YO)	94	113,977	64	9	9
171	51	222	63	58	Lyons Ferry (YO)	94	196,604	196	51	222
145	24	169	63	58	Lyons Ferry (YO)	94	206,860	206	24	169
4	7	11	63	59	Lyons Ferry (YP)	95	67,252	1,335	8	11
1	12	13	63	59	Lyons Ferry (YP)	95	67,441	1,338	13	14
6	8	14	63	59	Lyons Ferry (YBC)	95	71,692	992	8	14
5	6	11	63	59	Lyons Ferry (YBC)	95	73,110	1,012	6	11
136	33	169	63	63	Lyons Ferry (YO)	95	217,794	872	35	178
167	41	208	63	63	Lyons Ferry (YO)	95	217,810	872	43	218
<b>1,088</b>	<b>498</b>	<b>1,586</b>							<b>504</b>	<b>1,608</b>

Coded-wire tag recoveries at Lyons Ferry Hatchery in 1997 (and expansions according to data reported to Pacific States Marine Fisheries Commission)

(Vol = voluntary return to the hatchery, LG = hauled from Lower Granite Dam.)

Table 2. Coded-Wire Tag (CWT) recoveries from stray hatchery salmon at Lyons Ferry Hatchery in 1997.

Vol	LG	Total	Coded-Wire Tag		Release Location	Brood Year	Number CWT (T)	Number		Total
			(CWT) Codes	Ad-only (A)				Ad-only (A)	LG	
1		1	5	32	Dworshak spr. chin.	93	66,674	4,627	0	1
	1	1	7	7	Umatilla River	93	32,481	98	6	6
	1	1	7	7	Umatilla River	93	31,658	216	10	10
	2	2	7	7	Umatilla River	93	30,528	193	21	21
	2	2	7	7	Umatilla River	93	28,474	3,515	22	22
	2	2	7	7	Umatilla River	93	30,950	586	20	20
1		1	7	13	Umatilla River	95	30,220	387	0	10
	2	2	7	13	Umatilla River	95	28,476	2,331	32	32
	1	1	7	14	Umatilla River	91	23,239	1,635	3	3
1		1	7	59	Umatilla R. spr. chin.	92	20,109	908	0	5
	2	2	10	30	S. F. Salmon R. sum.	93	62,937	1,946	2	2
2		2	10	49	Rapid R. spr. chin.	93	298,404	9,229	0	11
	10	10	23	27	NMFS Pittsburg	94	14,566	591	10	10
	15	15	23	27	NMFS Asotin	94	15,205	592	16	16
	1	1	23	27	NMFS Col. R. Rm 141	94	12,417	0	1	1
	1	1	23	30	NMFS McNary Dam	95	15,001	0	1	1
	1	1	23	30	NMFS McNary Dam	95	15,079	0	1	1
1		1	63	47	Klickitat River-Priest	92	76,341	269	0	21
1		1	63	53	Klickitat R.-spr. chin	92	19,365	235	0	1
	3	3	63	53	Klickitat R.-L. Snake	93	75,273	607	84	84
	4	4	63	53	Klickitat R.-L. Snake	93	76,204	345	13	13
7		3	63	53	Klickitat R.-Priest	93	74,501	119	85	85
	51	58							327	376

**Table 3.** Other salmon processed at Lyons Ferry Fish Hatchery (LFH) or collected at Lower Granite (LGR) Dam in 1997.

Vol	LG	Total	Coded-Wire Tag (CWT) Codes			Release Location	Brood Year
With CWT but not adipose clipped.							
1		1	63	52	24	Lyons Ferry (Y)	92
Mini jacks (=<30cm FL) killed at the adult trap at LGR (8 total).							
	1	1	63	58	45	Lyons Ferry (YO)	94
	2	2	63	59	57	Pittsburg Landing (YP)	95
	1	1	63	59	58	Pittsburg Landing (YP)	95
	1	1	63	59	59	Big Canyon (YBC)	95
	1	1	63	60	25	Big Canyon (YBC)	95
	1	1	63	63	20	Lyons Ferry (YO)	95
	1	1	63	63	21	Lyons Ferry (YO)	
-----							
Fish (34 total) with "lost" CWTs.							
20	6	26	(with left red elastomers from Lyons Ferry)				
1		1	(with right green elastomer from Big Canyon)				
4	2	6	(without other marks)				
	1	1	(RV clipped)				
-----							
Fish (13 total) without CWTs, but adipose clipped ("No Tag").							
7	1	8	(with LR elastomers from Lyons Ferry)				
3	1	4	(without other marks)				
1		1	Ad/Rv clips				
-----							
Fish with BWTs, all Umatilla River origin.							
8	69	77	(All Rv clipped)				
-----							
Fish (59 total) that were not adipose clipped or CWT/BWT ("None").							
52		52	(includes 3 coho)				
	1	1	(no other marks)				
5		5	(Rv clipped)				
1	1		(Lv clipped)				
-----							
Fish (12 total) attributed to LGR-but can't verify with jaw tags							
	9	9	(no marks, "none")				
	1	1	63	56	40	Lyons Ferry (Y)	93
	1	1	63	58	45	Lyons Ferry (Y)	94
	1	1	63	59	60	Big Canyon (Y)	95
-----							
Fish found dead at LG with jaw tags matched (2 fish)							
	1	1	63	59	59	Big Canyon (Y)	95
		1	63	63	20	Lyons Ferry (Y)	95
<u>103</u>	<u>103</u>	<u>206</u>					
	652		Total of all salmon from Lower Granite Dam (excludes one unmarked to LFH).				
1,198			Total of all fish that voluntarily returned (includes one unmarked fish from LGR).				
			<b>1,850 Grand total of fish processed at LFH or collected at LGR.</b>				





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