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Lyons Ferry Hatchery Evaluation
Fall Chinook Salmon
Annual Report: 2006

by Deborah Milks, Michelle Varney
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Washington Department of
FISH AND WILDLIFE
Fish Program
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FPA 09-04

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to

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Lower Snake River Compensation Plan Office
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Abstract

This report summarizes activities by the Washington Department of Fish and Wildlife's (WDFW) Lower Snake River Hatchery Evaluation Program for the period 16 April 2006 through 15 April 2007. We have also included the *Statistical Analysis of 2006 Lower Granite Dam Fall Chinook Run Reconstruction* report funded by the Pacific Salmon Commission's Southern boundary Restoration and Enhancement Fund in order to make it more widely available.

In 2006, WDFW collected 3,679 fish at Lyons Ferry Hatchery (LFH) and Lower Granite Dam (LGR) for broodstock, monitoring and evaluation of our hatchery releases, and to estimate the run size to LGR. This was the fourth year that natural origin fish were integrated into our broodstock. Of the total number of fish contributing to production, 81.1% were Lyons Ferry hatchery origin, 12.2% were natural origin, 5.1% were out-of-basin stray hatchery fish based on scale readings, and 1.6% were of unknown origin.

A total of 2,819,004 green eggs were taken at Lyons Ferry Hatchery, well below the full production goals listed in the *2005-2007 United States v. Oregon Management Agreement*. Survival from green to eye-up was 96.8% with an estimated 1.1% additional loss to ponding.

WDFW released brood year 2005 (BY05) sub-yearlings directly from LFH (202,211 fish), two releases (200,820 and 211,508 fish) into the Snake River near Couse Creek Boat Launch (Rkm 253.7), and two releases (200,432 and 208,733 fish) directly into the Grande Ronde River near the mouth of Cougar Creek. The first Couse Creek release was part of an ongoing direct vs. acclimated study (released from the Captain John acclimation site). An accidental fry (BY05) release of 71,000 fry at 181 fpp occurred on 4 April at LFH. The LFH also released 503,160 yearling fall Chinook (BY05) into the Snake River on site from 2-6 April 2007. Releases of fish into the Snake Basin from 2000 through 2007 are provided.

We surveyed the Tucannon River by foot, covering 91% of the historical spawning area of fall Chinook. We estimated 449 fall Chinook and 11 summer Chinook escaped to the Tucannon River, producing an estimated 153 redds. The return to the Tucannon River was estimated to be 45% inbasin hatchery fish, 14% out-of-basin hatchery fish, 30% natural origin fish, 9% unknown origin fish (hatchery or wild), and 2% summer Chinook.

Smolt-to-adult return estimates for broodyears 1999 through 2005 are presented for fish released by WDFW. Yearlings continue to provide a survival advantage over subyearlings although it is highly variable year to year. We present data showing a survival advantage of onstation subyearlings when compared to direct releases into the Snake River near Couse Creek and the Grande Ronde River.

We adjusted harvest estimates of CWT tagged fish by fishery, sample detection type, and tag loss to fully reflect total take of non-tagged, non-clipped, as well as adipose clipped, and CWT tagged fall Chinook. Analysis was done solely on recoveries of fall Chinook released by WDFW and does not include recoveries of LSRCP fish from the Nez Perce Tribe (NPT), fish released from NPT Hatchery, or fish released from Idaho Power Company programs.

Of the WDFW releases, we estimate that 2,844 fall Chinook were taken in fisheries downstream of the Snake River in 2006. By location, fishers in the Columbia River harvested 38% of the total number harvested and fishers in British Columbia harvested 37%. By fishery, the British Columbia Troll fishery intercepted 28% of all fish harvested. This is the first time we have attempted to expand the CWT data in this manner and although it is preliminary, it shows the importance of doing so to fully reflect and understand the harvest component for mitigation.

Outside of the Snake River basin, 25 of Washington's fall Chinook were intercepted at hatcheries or racks and 40 were recovered on spawning grounds. We estimate that 4,827 LFH/Snake River hatchery origin fall Chinook released by WDFW returned to the Snake River.

Acknowledgments

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 Fish 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, Michael Gallinat, Jule Ponti, and Lance Ross. We also thank the Walla Walla Assessment staff for their help.

We thank the personnel at Lyons Ferry Hatchery for their cooperation with sampling and providing information regarding hatchery operations. A special thanks goes to Steve Rodgers, Dick Rogers, and Brandon Kilmer for their assistance with summarizing hatchery data for this report. We appreciate the assistance of Lynn Anderson and crew at the WDFW Tag Recovery Lab. Thanks also to John Sneva (WDFW) who processed our scale samples.

We appreciate the efforts of Jerry Harmon (NOAA Fisheries) and crew at Lower Granite Dam for trapping, tagging, and documenting fall Chinook salmon for transport to Lyons Ferry Hatchery. We also thank Fred Mensik (WDFW) for providing summarized adult fallback data from the juvenile collection facility at Lower Granite Dam. We also thank Dr. Kirk Steinhorst and George Naughton (University of Idaho), and Bill Arnsberg (NPT) for providing information for the fall Chinook run reconstruction at Lower Granite Dam for 2006.

We thank Glen Mendel, Steve Yundt, Andrew Murdoch, and Craig Busak for reviewing this report and providing valuable comments.

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

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Introduction

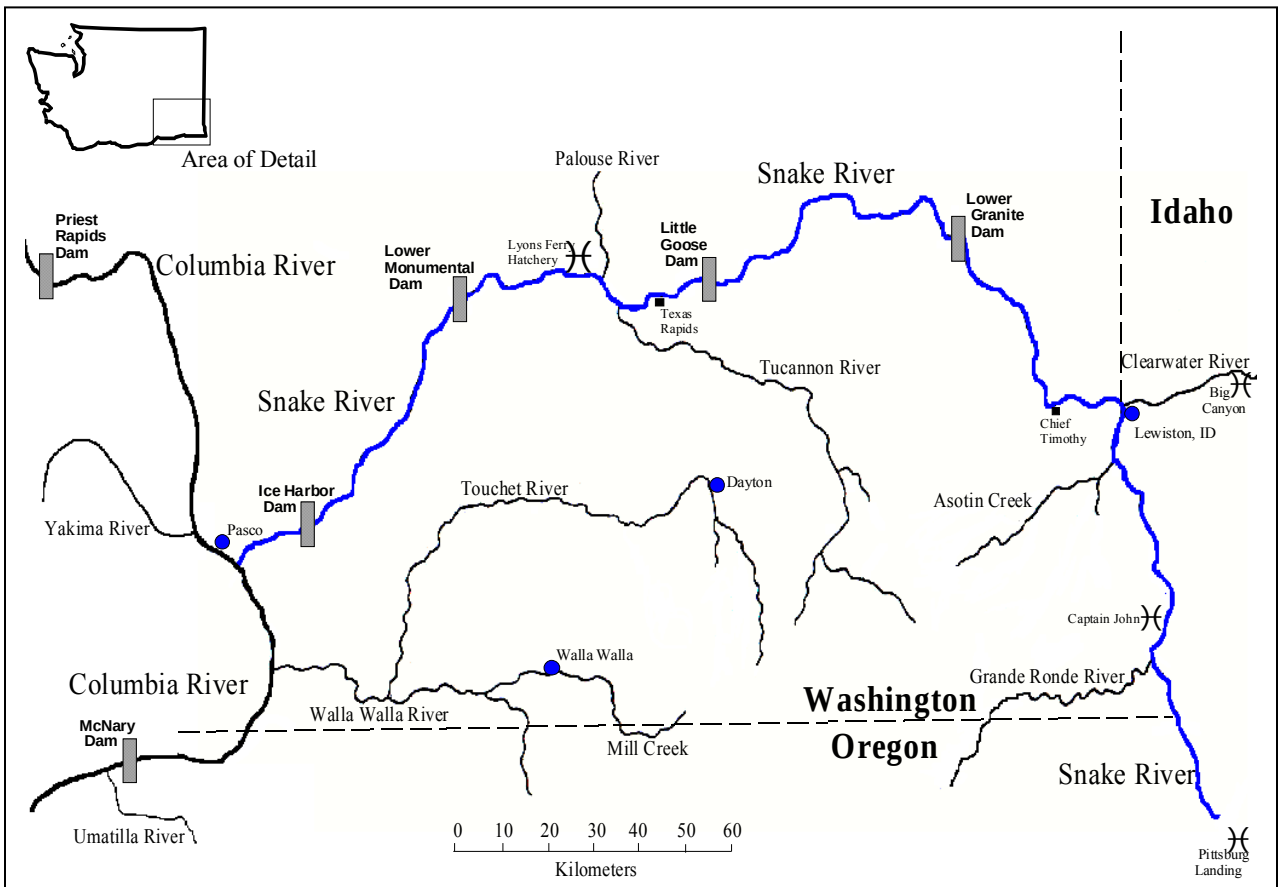
Program Objectives

This report summarizes activities by the Washington Department of Fish and Wildlife's (WDFW) Lower Snake River Hatchery Fall Chinook Evaluation Program for the period 16 April 2006 to 15 April 2007. Washington Department of Fish and Wildlife's (WDFW) Snake River Lab (SRL) staff completed this work with Federal fiscal year 2006 funds provided through the U.S. Fish and Wildlife Service (USFWS), under the Lower Snake River Compensation Plan (LSRCP).

Congress authorized the LSRCP in 1976. As a result of that plan, Lyons Ferry Hatchery (LFH) was constructed and has been in operation since 1984 (Figure 1). One objective of the hatchery was to compensate for an annual loss of 18,300 adult (non-juvenile)[1], 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. This mitigation program was modified in the early 1990s by agreement of the *United States v. Oregon* parties to supplement natural fall Chinook production above Lower Granite Dam (LGR). Currently this is an integrated hatchery program designed to support recovery of the Snake River naturally produced fall Chinook. This action was consistent with the U.S. Endangered Species Act and Washington's Wild Salmonid Policy.

The WDFW has two general goals for its fall Chinook evaluation program: (1) monitor hatchery practices at LFH to ensure quality smolt releases, high downstream migrant survival, and sufficient adult fish contribution to fisheries and escapement to meet the LSRCP compensation goals; and (2) gather genetic information to help maintain the integrity of the Snake River Basin fall Chinook salmon stock (WDF 1994). Our efforts have contributed to evaluating the status of Snake River fall Chinook by monitoring population abundance, spatial distribution, genetics, and life history (sex and age information of returns) as well as by removing strays at LGR on the Snake River to minimize the effects of out-of-basin strays on the population (NMFS 1993). Specific annual program objectives can be obtained from the Snake River Lab Project office.

[1] The LSRCP Special Report refers to adult recoveries. That language was intended to differentiate adults from juveniles in the document (Dan Herrig USFWS, LSRCP, personal communication). The LSCRP mitigation goal was based upon 97,500 fall Chinook counted at McNary Dam in 1958, and with the expectation that 14,363 wild fall Chinook would persist in the Snake River through natural production. At that time adult and jack counts were combined to give a total count. Therefore the mitigation goal consists of jacks and adults, not just adults. Since mitigation goals were set up using window counts at dams, and minijacks (fish < 30 cm total length) are not counted at the dams, they were excluded from the mitigation goal calculations.



	Rkm	Location
Snake River		
	16.1	Ice Harbor Dam
	66.9	Lower Monumental Dam
	95.1	Lyons Ferry Hatchery
	95.7	Lyons Ferry Park
	105.2	Texas Rapids Boat Launch
	113.1	Little Goose Dam
	115.0	Bryan's Landing Boat Launch
	132.3	Central Ferry Park
	173.0	Lower Granite Dam
	210.3	Chief Timothy Park
	253.7	Couse Creek Boat Launch
	263.0	Captain John Acclimation Site
	346.0	Pittsburg Landing Acclimation Site
	397.4	Hells Canyon Dam (not shown)
Clearwater River		
	57.0	Big Canyon Acclimation Site
Grande Ronde River		
	49.4	Mouth of Cougar Creek

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

Broodstock Collection and Management

Fall Chinook are collected at LFH and LGR for broodstock (Appendix A). Each year there is a discrepancy between estimated numbers of fish collected and the numbers of fish processed/ killed (Table 1). The in-season estimate of numbers of fish diverted into the hatchery at LFH is a minimum estimate of the run to LFH. Some of the fish that are trapped at LFH are returned to the river and never used for broodstock (see LFH Trapping Operations below). The discrepancy between the numbers of fish recorded as collected at LGR and the number of fish processed likely occurs because of indistinguishable or overlooked operculum punches (an identifier administered at the LGR fish trap; see below) on fish hauled from LGR. Unaccounted for LGR trapped fish are likely included with processed LFH fish.

Table 1. Number of Chinook initially collected for broodstock from LFH and LGR trapping efforts and how they were accounted for in 2006.

Year	Trap Location	Number Collected/Hauled for Broodstock	Processed (killed)	Returned to Snake River	Difference from Number Collected/Hauled
2006	LFH	2,521	1,961[a]	774	+214
	LGR	1,158	1106	42	-10

[a] Numbers of fish unaccounted for from LGR are assumed to be mixed in with the LFH trapped fish during processing.

Lower Granite Dam Trapping Operations

Trapping protocols for each year are available upon request. In general, prior to transport, NOAA Fisheries staff anesthetized the salmon, gathered length and sex data, and marked the fish with a hole in the operculum prior to release upstream or transport. WDFW personnel then hauled fish to LFH in a 5,678 L aerated tank truck. Fall Chinook were trapped from 1 September through 21 November 2006. An automated trapping system shunted fish into the trap four times each hour, resulting in the trap being open 13% of each hour. In addition, the passive integrated transponder (PIT) tag sort-by-code system was activated and allowed for the trapping of PIT tagged fish encountered that were outside of the scheduled 13% trapping period.

LFH Trapping Operations

The majority of broodstock are collected at LFH. The trap at LFH was in operation 24 hours per day from 6 September through 26 November 2006. Counts were made each day for fish retained and fish returned to the river. In some prior years the trap was not operated full time or for the length of the run. During those years, the numbers of fall Chinook presented in our reports reflect only what was trapped and retained, not what the total number of fish would have been if we had trapped without a break in trapping.

We documented 12,010 trapping events of fall Chinook at the LFH trap in 2006 (Figure 2). Minijacks accounted for the majority of trapping events (9,265). We were unable to determine the number of unique (excluding recaptures) fish that were trapped because there is no marking protocol in place at the hatchery trap. We assume that jacks and minijacks were recaptured multiple times.

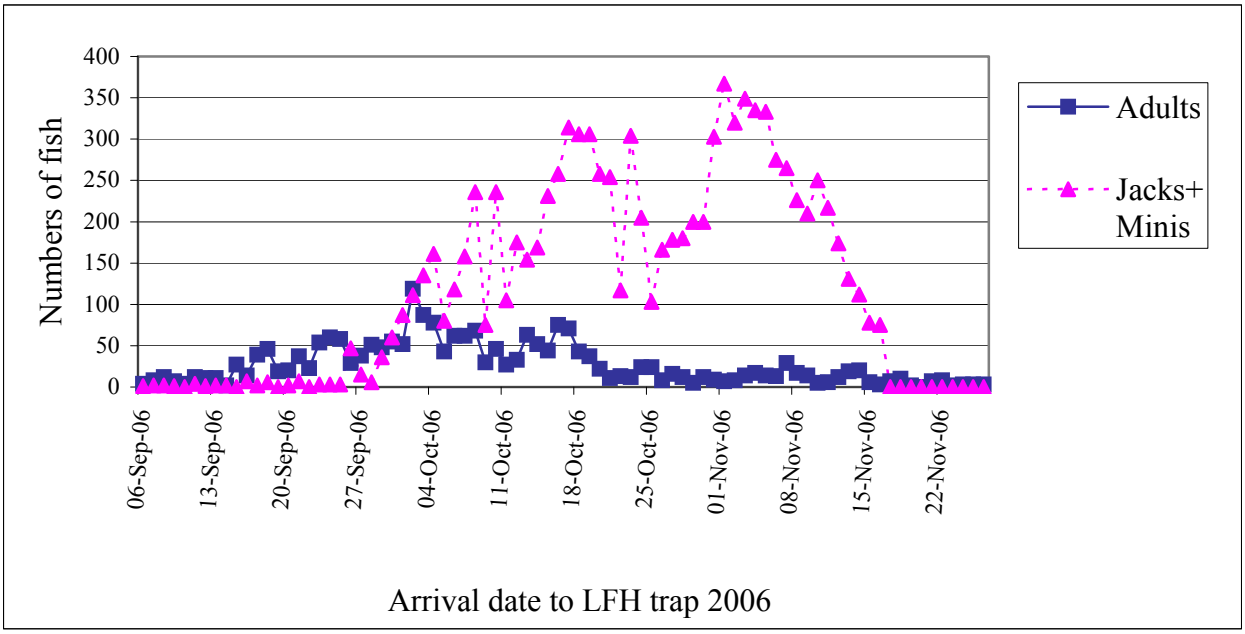


Figure 2. Number of adult and jack fall Chinook arriving at the LFH trap by date, 2006.

Hatchery Operations

Spawning Operations

Spawning and Egg Take

Spawning began the fourth week in October 2006 and continued for seven weeks. Egg take was substantially less than in previous recent years because of low adult return numbers (Table 2). At spawning, ripe fish were killed and their gametes collected and set aside unmixed. All matings were single male/single female crosses. To determine the origin and brood year of fish spawned, snouts containing wires[2] were removed from tagged fish, and scales were collected from unmarked/untagged fish (no wire or visible implant elastomer (VIE) tag). During spawning, CWTs were decoded to verify origin prior to matings. Untagged fall Chinook were mated the same day they were spawned. Origins of untagged fish could not be determined until the following week when the results of scale and PIT tag analysis were compiled. The total number of fish spawned prior to culling is listed in Table 3.

[2] For this report wire refers to all CWT (coded wire tags), Blank wire (non-coded) tags, and Agency only (coded only with agency code) tags.

Table 2. Duration and peak of spawning, eggtake, and percent egg mortality at LFH, 1984-2006.

Year	Spawning duration	Peak of spawning	Total eggtake	Egg mortality to eye-up (%)[a]
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[b]	8.30
1992	Oct 20 - Dec 8	Nov 21	2,265,557[b]	5.96
1993	Oct 19 - Dec 7	Nov 2	2,181,879	6.69
1994	Oct 18 - Dec 6	Nov 8	1,532,404	5.09
1995	Oct 25 - Dec 5	Nov 14	1,461,500	5.64[c]
1996	Oct 22 - Dec 3	Nov 5	1,698,309	4.56
1997	Oct 21 - Dec 2	Nov 4	1,451,823[d]	5.22
1998	Oct 20 - Dec 8	Nov 3	2,521,135	5.08
1999	Oct 19 - Dec 14	Nov 9 &10	4,668,267	9.42
2000	Oct 24 - Dec 5	Nov 7 & 8	4,190,338	5.92
2001	Oct 23 - Nov 27	Nov 13 & 14	4,734,234	6.42
2002	Oct 22 - Nov 25	Nov 12 & 13	4,910,467	3.57
2003	Oct 21 -Dec 2	Nov 10 & 12	2,812,751	3.09
2004	Oct 19 -Nov 22	Nov 9 & 10	4,625,638	3.26
2005	Oct 18 -Nov 29	Nov 15 & 16	4,929,630	3.50
2006	Oct 24 -Dec 5	Nov 7 & 8	2,819,004	3.18

[a] Egg mortality includes eggs destroyed due to positive ELISA values.
[b] An additional 9,000 eggs from stray females were given to Washington State University.
[c] Doesn't include loss from 10,000 stray eggs given to University of Idaho. The egg loss from strays was 8.63% excluding eggs used in fertilization experiments.
[d] Total eggtake includes eggs from one coho female crossed with a fall Chinook.

Table 3. Spawn dates, numbers of fall Chinook, and eggtake of fish spawned at LFH in 2006. (LFH and LGR trapped fish are combined and jacks are included with males).

Spawn Dates	Male[a]	Female[a]	Non-Viable[b]	Eggtake
Oct 24 and 25	41	41	0	162,032
Oct 31 and Nov 1	149	149	0	536,416
Nov 7 and 8	236	239	4	870,000
Nov 14	193	194	0	672,368
Nov 20	112	113	0	408,550
Nov 27	42	42	0	137,847
Dec 5	8	8	0	31,791
Totals	**781**	**786**	**4**	**2,819,004**

[a] Numbers of fish presented include spawned fish whose progeny were later destroyed.
[b] Non-viable females—three were not ripe when killed and one had already spawned in the pond. All four were hatchery origin fish.

In an effort to include natural origin fish in our broodstock, untagged fish were also used in the broodstock. This was the fourth year that Snake River natural origin fish were included in the broodstock. To reduce the genetic impact that out-of-basin strays might have on the hatchery fall Chinook population, unknown origin fish (no wire or VIE) were mated with unknown origin fish

(Appendix B). This mating protocol differs from that of previous years where unknown origin fish were mated exclusively to LFH origin fish. In the few instances where there were not enough unknown origin males available to mate with unknown origin females, we used LFH origin males in the matings.

Seventy percent of the broodstock for the fall Chinook program was collected at the LFH trap, although the majority of the unmarked/untagged fish included in our broodstock were trapped at LGR. One hundred and seventeen females, and 73 males of presumed Snake River natural origin (based upon scale readings) were spawned in 2006 (12% of the broodstock). Nearly all (185 out of 190) of these natural origin fish were hauled from LGR Dam.

Because of adult holding pond constraints (number and size), only fish from one trapping site are processed each spawning day. To increase flexibility and assure the spawning protocol was followed, we continued the practice of holding semen overnight as a reserve for use on the following day if we were short of ripe males that day. Semen can be held overnight and used the following day with only a slight reduction in viability (SRL, unpublished data). The loss resulting from reduction in viability is much less than if we were unable to fertilize at all. Semen from a predetermined number of ripe males was collected and split into two lots. One lot was used the same day it was collected and the other lot was saved for possible use the following day. Semen held over night was stored in individual plastic bags infused with oxygen and placed in a cooler on dry burlap bags above ice.

We used 776 males once and 5 males twice in the 786 matings from which gametes were retained for production. Following procedures described by Busack (2007) we calculated the effective number of male breeders ($N_{b,\,m}$) at 775 using the following equations:

> A reasonable constant-size assumption is that the number of offspring equals the number of egg lots (N_{egg_lots}). In this case:
>
> $$\mu_t = N_{egg\_lots}/N_{tot} = 786/781 = 1.006$$
>
> where μ_t is the mean gametic contribution of a randomly chosen individual and N_{tot} is the total number of male breeders used. So the male N_b can be calculated:
>
> $$N_{b,m} \approx (N_{tot} - 1/\mu_t)/(((N_1 N_2)/(N_1 + 2N_2)^2) + 1) = 775$$
>
> where N_1 is the number of males used one time and N_2 is the number of males used two times.

The effective male breeders is 98.6% of the census number of males, or 99.2% of the male $N_{b,\,m}$ that would have been achieved if enough males had been available to avoid reuse of males. The spawning protocol discourages multiple uses of individual males. There was small reduction in $N_{b,\,m}$ in 2006, but if the practice were done more, the effect would be commensurately greater.

Of the fish spawned, 81.1% were LFH origin, 12.2% were natural origin, 5.1% were strays based on scale readings, and 1.6% were of unknown origin because their scales could not be read or the wire was lost (Figure 3). These percentages include fish that were spawned for the Idaho Power

Company (IPC) mitigation agreement as well as the LSRCP program. The majority of hatchery fish spawned came from LFH yearling releases (81.4% of the LFH origin fish). Adults from LFH subyearling releases contributed 18.6%. Jacks (all origins) were used in 4.1% of the matings. Our spawning protocol indicates that jacks should be included in about 10% of the matings, but are not to exceed 25% of the matings.

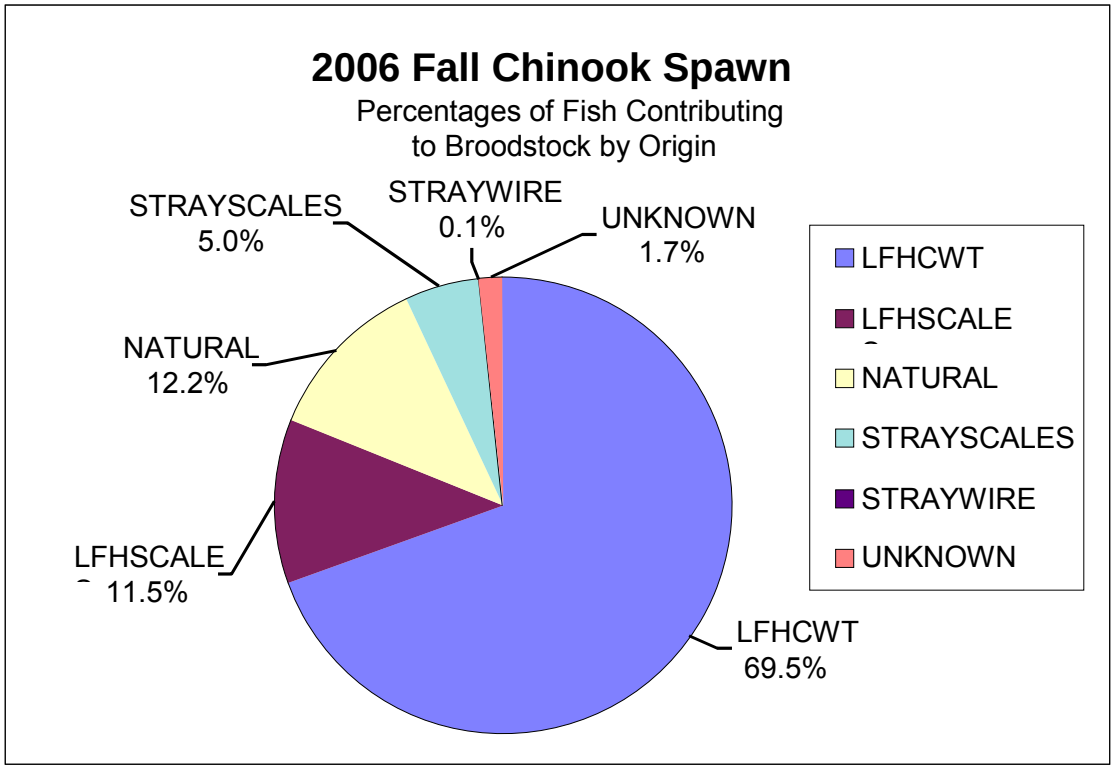


Figure 3. Origin of Fish Contributing to Broodstock.

Information about processed fish that were not spawned is presented in Table 4. Fish of known or presumed LFH origin have been combined with natural Snake River origin fish in the LFH/Snake River category. Twenty-one of the LFH/Snake River mortalities were of natural Snake River origin, five of the natural origin mortalities were summer run Chinook (3 males and 2 females) and the remaining sixteen (9 males and 7 females) were fall Chinook. Fish that were killed outright (surplussed) were generally males needed for run composition but not needed for spawning, or strays from other hatcheries. Thirty-four of the surplussed fish had no wire in their snouts. One of these had a left red VIE designating it as LFH origin. Scale analysis of the remaining unmarked/untagged fish indicated 13 were of natural origin (10 males, 2 jacks and 1 female that was accidentally crushed in the elevator), eight were of Snake River hatchery origin, eight originated from other hatcheries and four scale samples were unreadable.

Table 4. Weekly summary of mortality and surplus Chinook processed at LFH in 2006. (LFH and LGR trapped fish are combined; jacks are included with males).

Week Ending	Mortality				Killed Outright			
	LFH/Snake River[a]		Other/Unknown[b]		LFH/Snake River[a]		Other/Unknown[b]	
	Male	Female	Male	Female	Male	Female	Male	Female
18-Sep		4	2					
24-Sep	2	3	1		3			
01-Oct	8	3	1	3	21		1	
08-Oct	8		2		23			
15-Oct	3	1		2	169		5	
22-Oct	3	5	2	3				
29-Oct	5	6			314	1	11	4
05-Nov	19	7	1		115		4	4
12-Nov	33	4	5		74		6	12
19-Nov	105	7	5	2	59		7	8
26-Nov	173	4	4	1	29		1	3
03-Dec	101	2	4		19		5	2
10-Dec	28				23		1	
Totals	**488**	**46**	**27**	**11**	**849**	**1**	**41**	**33**

[a] Includes known LFH origin (from CWT and/or VIE), and wild or presumed LFH origin (from scale analysis).
[b] Other/Unknown includes fish from other hatcheries based on CWT or scale analysis, spring and summer Chinook, and fish whose origin could not be determined.

Fish Returned to River

We trapped more fish at LFH than were needed for run composition estimates. To ensure representative sampling we continued trapping throughout the run. Fish not needed for broodstock or run composition analysis were returned to the Snake River (Table 5).

Fish trapped at LFH were released either upstream of Little Goose (LGO) Dam at Bryan's Landing (Rkm 115.0), or downstream of LGO at Texas Rapids boat launch (Rkm 105.2). In order to document recaptures, fish received a partial caudal clip prior to transport. Thirty jacks from the first haul on 14 November were transported without caudal clips. Hauling and recapture data from previous years indicated fewer fish were recaptured at LFH when released above LGO Dam (Milks et al. 2006). Of the 710 fish that were top-caudal clipped and released at Bryan's Landing in November, four fish were recaptured at LFH (0.56% recapture rate) and three were recovered in carcass surveys on the Tucannon River. Nine top-caudal clipped fish were collected in the 13% sample at the LGR Dam adult trap. When expanded to account for sample size, an estimated 9.75% of the fish released at Bryan's Landing (69 capture events/710 unique fish hauled and released) had reached LGR Dam by 21 November. Because the LGR trap ceased trapping on November 21, we were not able to document how many more fish continued to move upstream. Fish released at Texas Rapids in December were marked with a bottom-caudal clip. Tucannon River carcass surveys continued through 11 December, however no bottom-caudal-clipped carcasses were recovered.

Excess fish from LGR trapping were transported from LFH and released above LGR Dam at Rooster's Landing (Rkm 221.1). Thirty-seven males and one jack were released on 5 December. They were not marked prior to release. One female (not ripe) and three males were retained until a decision could be made to either hold her for spawning, ship her to NPTH, or return her to the river. On 7 December, all four retained salmon were released above LGR Dam.

Table 5. Release locations, trapping sites, sex, dates, and total number of fish that were hauled back to the Snake River in 2006. Recaptures are included.

			November		December		
Release location	**Trap site**	**Sex**	**14**	**20**	**5**	**7**	**Total**
Bryans Landing	LFH	male	-	147	-	-	147
		jack<53	343	250	-	-	593
		females	-	-	-	-	-
Texas Rapids	LFH	male	-	-	33	-	33
		jack<53	-	-	1	-	1
		females	-	-	-	-	-
Roosters Landing	LGR	male	-	-	37	3	41
		jack<53	-	-	1	-	-
		females	-	-	-	1	1
		Totals	**343**	**397**	**72**	**4**	**816**

Fecundity

We calculated fecundities for several groups of females using methods previously described by Milks et al. (2006). The mean fecundity for fish trapped at LGR and hauled to LFH was 4,178 eggs/female, consisting of hatchery yearling and subyearlings and natural origin fish. For management purposes there are three groups of fish, based upon visual and electronic identification, for which fecundity is of interest: tagged fish (CWT or VIE), unmarked/untagged fish, and adipose fin (AD)-clip only (no wire/no VIE) fish. Tagged fall Chinook (known LFH origin) used in broodstock averaged 3,273 eggs/female and were primarily from yearling releases. Unmarked/untagged fish (hatchery and natural origin) as a whole averaged 4,342 eggs/female, and mean fecundity of the AD-clip only fish, primarily from subyearling releases, was 3,592 eggs/female. Since we are trying to incorporate 10-25% natural origin gametes into production, it is important to estimate fecundity for natural origin females. Natural origin females averaged 4,369 eggs/female.

In addition to examining the origins of individual fish contributing to LFH broodstock, we also looked at the number and percentage of gametes each fish would have contributed (Figure 4). Females with higher fecundities would contribute more genetically by origin than fish with lower fecundities. Each male was assigned a contribution amount based on the fecundity of the female with which he was mated.

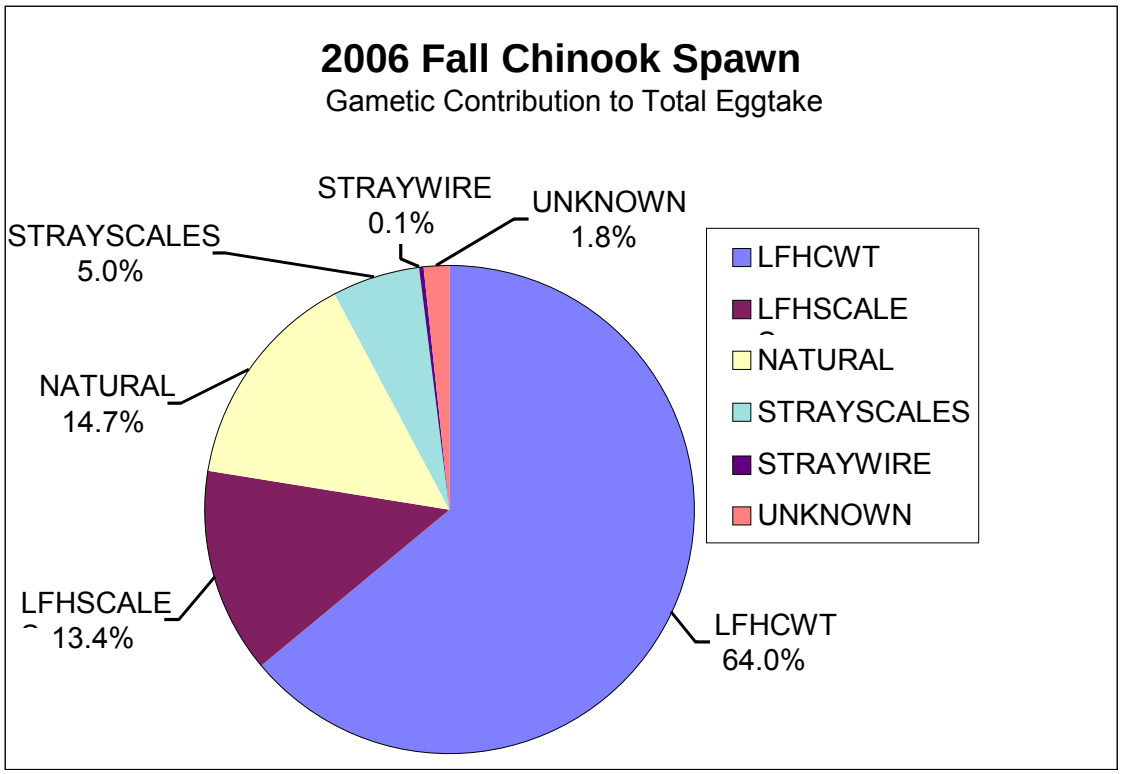


Figure 4. Origin of gametes contributing to LFH broodstock, 2006

Rearing, Marking, and Transfer

Eyed eggs for the LSRCP program were primarily from LFH x LFH, or natural x natural or Snake River Hatchery origin matings. Eggs were assigned to yearling and subyearling programs based on parental crosses (Table 6). Co-managers in the basin agreed to retain stray gametes in an effort to increase eggtake and meet production levels presented in the *United Stats v. Oregon* agreement. Because smolt-to-adult returns from yearling releases are consistently greater than those of subyearling releases, progeny of the four wire-tagged stray males (all from Umatilla releases) were assigned to the subyearling program in an effort to reduce the impact these fish would have when they return. Usually, strays that have wire tags are not used in broodstock. To increase the effect of progeny returning from the natural x natural and natural x Snake R. Hatchery crosses, those progeny were primarily assigned to our yearling program.

Table 6. Origins of fall Chinook and mating crosses contributing eggs to LSRCP Program, 2006.

ORIGIN[a]	REARING PROGRAM SLATED Yearling	Subyearling	PERCENT OF TOTAL PRODUCTION
LFH x LFH	54.9%	75.4%	67.8%
LFH x unknown	0.3%	1.9%	1.3%
Natural x Natural or Snake R. Hatchery	39.6%	6.5%	18.8%
Natural x stray or unknown	5.2%	4.6%	4.8%
Stray x stray or unknown	0.0%	2.7%	1.7%
Stray x LF H	0.0%	8.9%	5.6%
Totals	100.0%	100.0%	100.0%

[a] LFH--Lyons Ferry coded-wire tag, unknown--unmarked/untagged fish with unresolved origins, Snake River Hatchery--scale analysis indicated these fish originated from Snake River Hatchery releases, stray--fish from out-of-basin hatchery releases based on wire tag or scale analysis.

Historical information regarding eggtake, early life stage survival (Table 7), and marking and transfer numbers (Table 8) is provided. The decision to transfer 127,564-eyed eggs to IPC was made after the eggs from week four had been picked and mixed. The parental origins of the transferred eggs were representative of the take for the entire week: 75.8% of the eggs were from LFH x LFH origin matings, 12.4% from LFH x natural origin matings, 2.6% from entirely natural matings and 9.3% from matings in which at least one of the parents was a stray.

Rearing followed standard hatchery procedures that are available upon request. Detailed information regarding type and size of vessels used for rearing can be found in Lyons Ferry Hatchery Annual Reports. Marking was consistent with *United States v. Oregon* recommendations as listed in Appendix C.

Table 7. Eggtake and survival numbers by life stage of Lyons Ferry origin fall Chinook spawned at LFH, broodyears 1996-2006.

Brood Year	Eggs taken	ELISA Loss [a]	Eggs Shipped [b]	Eyed Eggs Retained	Fry ponded	Intended Program
1996	1,433,862	0	0	1,377,202	941,900	Yearling
					419,677	Subyearling
1997	1,184,141	0	0	1,134,641	1,037,221	Yearling
					63,849	Subyearling
1998	2,085,155	0	0	1,978,704	916,261	Yearling
					1,010,344	Subyearling
1999	3,980,455	156,352	0	3,605,482	991,613	Yearling
					2,541,759	Subyearling
2000	3,576,956	53,176	115,891	3,249,377	998,768	Yearling
					2,159,921	Subyearling
2001	4,734,234	144,530	200,064	4,230,432	1,280,515	Yearling
					2,697,406	Subyearling
					125,600	Research
2002	4,910,467	44,900	1,195,067	3,540,000	1,032,205	Yearling
					2,376,251	Subyearling
					73,229	Research
2003	2,812,751	0	250,400	2,476,825	985,956	Yearling
					1,455,815	Subyearling
					0	Research
2004	4,625,638	0	1,053,278	3,413,437	914,594	Yearling
					2,191,102	Subyearling
					184,682	Research
2005	4,929,630	0	1,180,000	3,378,600[c]	980,940	Yearling
					2,078,206	Subyearling
					216,417	Research
2006	2,819,004	0	127,564	2,601,679	961,105	Yearling
					1,640,574	Subyearling
					2,000	Research

[a] Eggs from ELISA positive females were incorporated into the rest of the brood stock in 1996-1998 and 2003-2004.

[b] The destination of shipped eggs prior to 2003 can be found in previous Annual Reports. In 2005, eyed eggs were shipped to Oxbow Hatchery (210,000), Umatilla Hatchery (940,000) and NPTH (30,000). In 2006, eyed eggs were shipped to Oxbow Hatchery.

[c] An additional 154,100 "eyed-eggs" were destroyed as ponded fry in February 2006. These eggs were from matings that included one stray parent.

Table 8. Snake River fall Chinook marked by WDFW and/or transferred from LFH, 2005-2006 brood years.

Brood Year / Age	Release Site	Marking				Transfer		
		Date	Type [a]	Number	Fpp	Date	Number	Fpp
2005	LFH	3/20/06	AD+CWT	202,641	170.0	-	-	-
Subyearling	Couse Creek	4/03/06	AD+CWT	201,547	150.0	-	-	-
	Grande Ronde	4/10/06	AD+CWT	201,474	190.0	-	-	-
	Captain John	3/29/06	AD+CWT	101,380	160.0	5/02/06	101,244	74.1
	Captain John	3/31/06	CWT	100,833	160.0	5/02/06	100,699	74.1
	Captain John	-	-	-	-	5/01/06	305,180	75.0
	CJ-Priority 12	4/18/06	AD+CWT	200,892	190.0	-	-	-
	Big Canyon	3/27/06	AD+CWT	101,796	160.0	5/02/06	101,594	76.0
	Big Canyon	3/29/06	CWT	101,061	160.0	5/02/06	100,861	76.0
	Big Canyon	-	-	-	-	5/04/06	304,723	74.0
	DNFH-COE Research	-	-	-	-	4/11/06	198,900	153.0
Yearling	LFH	9/27/06	CWT+LR	226,853	29-30	-	-	-
	LFH	10/12/06	AD+CWT+ LR	226,973	27-30	-	-	-
	LFH	10/12/06	AD	1,500	27-30	-	-	-
	Captain John	9/27/06	AD+CWT	71,121	33.0	2/05/07	69,916	12.5
	Captain John	10/06/06	CWT	80,245	32.0	2/05/07	80,011	12.5
	Captain John	-	-	-	-	2/05/07	10,000	12.5
	Big Canyon	9/29/06	AD+CWT	70,242	33.0	3/07/07	70,024	11.7
	Big Canyon	10/04/06	CWT	80,157	34.0	3/07/07	79,908	11.7
	Big Canyon	-	-	-	-	3/07/07	10,434	11.7
	Pittsburg Landing	9/25/06	AD+CWT	70,562	34.0	3/05/07	65,760	11.1
	Pittsburg Landing	10/10/06	CWT	80,499	30.0	3/05/07	75,021	11.1
	Pittsburg Landing	2/13/07	AD+CWT	7,045	12.0	3/05/07	7,040	11.1
	Pittsburg Landing	-	-	-	-	3/05/07	2,345	11.1
2006								
Subyearling	LFH	4/16/07	AD+CWT	200,282	163.0	-	-	-
	Captain John	4/10/07	AD+CWT	100,908	200.0	5/08/07	100,783	87.0
	Captain John	4/11/07	CWT	101,107	200.0	5/08/07	100,982	87.0
	Captain John	-	-	-	-	5/08/07	314,307	92.3
	Big Canyon	4/09/07	AD+CWT	100,752	200.0	5/08/04	100,645	76.4
	Big Canyon	4/08/07	CWT	102,344	200.0	5/08/07	102,235	76.4
	Big Canyon	-	-	-	-	5/07/07	310,510	93.5
	Pittsburg Landing	4/03/07	AD+CWT	100,817	200.0	5/09/07	100,344	85.8
	Pittsburg Landing	4/04/07	CWT	101,207	200.0	5/09/07	100,732	85.8
	Pittsburg Landing	-	-	-	-	5/09/07	206,174	108.5
	DNFH-COE Research	-	-	-	-	5/10/07	2,000	100.0

[a] In the mark type column, visible implant elastomers (VIE) are designated by side and then color, i.e. LR denotes left red.

Juvenile Releases and Migration

Data regarding fall Chinook produced at LFH and released exclusively by WDFW are included in this section. Historical releases by WDFW, NPT, IDFG, and NOAA are presented in Appendix D.

2005 Brood Year

Subyearling Release

Subyearlings were released at LFH and two additional sites upstream of LGR Dam in 2006. Prior to transport and release, juveniles from each release group were sampled at LFH to collect size and condition data as well as to evaluate tag loss for marked groups. Some of the fish were PIT tagged to allow collection of migration data through the Snake and Columbia Rivers.

The on-station release of 202,211 subyearlings (2005 broodyear) from LFH occurred at 6:00 pm on 1 June 2006. Fish were sampled on 31 May. Mean fork length was 90.4 mm (SD 9.8) and mean weight was 9.6g (SD 2.9) or 47.2 fish per pound (fpp). The CV for fork length was 10.8 and condition factor (K) was 1.25. Included in the release were 1,500 PIT tagged fish representing general production, and 10,581 fish PIT tagged as part of the COE transportation study. At the time of release, Snake River flow and spill recorded at Lower Monumental Dam was 115.1 kcfs and 19.9 kcfs respectively. The river was muddy and the mean daily water temperature at Lower Monumental Dam was 13.3 °C.

On 4 April 2006, an estimated 71,000 fry (181 fpp) were accidentally released into the Snake River from LFH when a seal along the screen at the bottom of the raceway failed. These fish were originally slated for the yearling program (2007 release). Fry in the subyearling program were used to make up for the loss.

Snake River near Couse Creek

Two groups of BY05 subyearlings were released into the Snake River near Couse Creek Boat Launch (Rkm 253.7). Both groups were marked/tagged with an adipose fin clip and CWT. The first release was part of a study to compare acclimated fish (released from the Captain John acclimation site) to those released directly into the river. The second release should not be used in comparisons between direct and acclimated groups because they were released at a different date than the acclimated fish.

The first group of fish (200,820) was released on 30 May and were 55.6 fpp, estimated using pound counts at release. A week prior to release the fish were sampled to determine individual lengths, weights, and K-factors, and to implant 3,484 PIT tags. Mean fork length was 85.7 mm (SD 7.4) and mean weight was 7.6g (SD 2.2) or 60.0 fpp. The CV for fork length was 8.7 and K was 1.11. An additional 12,081 fish from this group were PIT tagged for the COE transportation study.

The second group (211,508 fish at 50.0 fpp; estimated using pound counts at release.) was released on 22 June. The release number includes 10,874 fish that were PIT tagged for the COE

transportation study. Mean fork length was 93.6 mm (n=340, SD 8.7) and mean weight was 9.4g (SD 2.5) or 48.4 fpp. The CV for fork length was 9.3 and K was 1.11. Fish were sampled on 20 June.

At the time of the releases mean daily Snake River flow and spill recorded at LGR Dam were 116.0 kcfs and 41.2 kcfs for the May release, and 64.5 kcfs and 20.0 kcfs for the June release. Mean daily flow and spill recorded at Lower Monumental Dam for the early release was 116.3 kcfs and 36.8 kcfs, and 65.7 kcfs and 17.3 kcfs for the latter.

Grande Ronde

Two groups of 2005 broodyear subyearlings were released into the Grande Ronde River near the mouth of Cougar Creek from 19-21 June 2006. One group (200,432 fish at 50.7 fpp; estimated using pound counts at release) was marked/tagged with an adipose fin clip and CWT. An associated group of 208,733 unmarked/untagged fish at 50.1 fpp (estimated size from pound counts at release) was released concurrently. Pre-liberation sampling was conducted at LFH on 16 June to gather individual fork lengths, weights, and K-factors. Mean fork length was 92.7 mm (SD 7.4) and mean weight was 9.2 g (SD 2.3) or 49.3 fpp. The CV for fork length was 7.9 and K was 1.13. During the Grande Ronde release, the daily average Snake River flow recorded at LGR Dam ranged 67.5-79.7 kcfs and daily average spill ranged 20.2-20.3 kcfs. Daily average flow and spill recorded at Lower Monumental Dam ranged 66.6-78.13 kcfs and 17.2-23.6 kcfs, respectively.

Yearling Release

We released 503,160 yearling fall Chinook (BY 2005) into the Snake River at LFH between 2-6 April 2007. Two groups of fish were coded-wire-tagged and marked with a red VIE tag behind the left eye. One half of the group was adipose fin-clipped (CWT: 63-35-98) and the other half was not adipose clipped (CWT: 63-35-97). A power outage during tagging resulted in a small group of 1,500 fish having an adipose clip as the only mark. These ad-clipped fish were combined with 48,648 unmarked/untagged fish (surplus from other production groups), and added to the on-station release group in February 2007. Throughout the release, small groups of fish were removed and held in an adjacent raceway for sampling on April 3-6. Mean fork length for all days combined was 159.0 mm (SD 12.1) and mean weight was 42.4 g (SD 10.0) or 10.7 fpp. The CV for fork length was 7.6 and K was 1.04. More specifically, for the Ad+CWT+VIE group, mean fork length was 157.4 mm (SD 10.7) and CV of length was 6.8. The mean weight was 41.1 g (SD 8.9), or 11.0 fpp. The CWT+VIE group had a mean fork length of 161.9 mm (SD 12.8) with a CV of 7.9. The mean weight was 45.1 g (SD 11.5), or 10.1 fpp. During the release, average daily Snake River flow recorded at Lower Monumental Dam ranged from 32.6-59.3 kcfs and the spill ranged from 0.0-23.3 kcfs.

Survival Rates to Release

We used the estimated number of eggs and fish present at life stages in the hatchery for 1990-2005 broods to calculate survival rates within the hatchery environment (Table 9). Survivals are based on an estimated number of green eggs, calculated by subtracting green egg equivalents of eggs/fry not retained for LFH rearing (IPC, NPTH, culled strays) from the total eggtake. For example, the hatchery reported the total number of green eggs taken and how many eyed eggs and fry are shipped or culled. Loss was estimated for green to eyed stage for the whole group, prior to shipping or culling. The number of eyed eggs shipped/culled was then converted into green egg equivalents and subtracted from the total green eggs taken. The resulting estimated number of green eggs was used in the actual life stage survival percentage calculations through release. Survivals for subyearlings and yearlings are the same through ponding because fry are not assigned to yearling or subyearling programs until that time.

Table 9. Estimated survivals (%) between various life stages at LFH for fall Chinook of LFH/Snake River hatchery origin, 1990-2005 brood years.

Brood year	Release stage	Green egg-ponded fry	Ponded fry-release	Green egg-release
1990	Yearling	86.8[a]	94.5	82.1
	Subyearling	86.8[a]	98.0	85.1
1991	Yearling	89.1[a]	94.1	83.8
1992	Yearling	92.7	96.5	89.5
	Subyearling	92.7	98.4	91.2
1993	Yearling	88.0[a]	99.0	87.1
1994	Yearling	92.7	99.3	92.1
1995[b]	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
1997	Yearling	93.0	92.5	86.0
	Subyearling	93.0	97.6	90.8
1998	Yearling	92.4	94.8	87.6
	Subyearling	92.4	95.1	87.9
1999	Yearling	92.4	66.3[c]	61.3[c]
	Subyearling	92.4	95.2	87.9
2000	Yearling	92.8	91.3	84.8
	Subyearling	92.8	94.9	88.1
2001	Yearling	93.6	79.5	74.5
	Subyearling	93.6	97.7	95.8
2002	Yearling	95.3	86.8	82.8
	Subyearling	95.3	94.8	90.3
2003	Yearling	95.5	75.7	72.3
	Subyearling	95.5	95.1	90.8
2004	Yearling	93.0	96.8	90.1
	Subyearling	93.0	97.6	90.8
2005	Yearling	92.2	99.3	91.5
	Subyearling	92.2	104.9	96.7
Yearling mean:	**%**	**92.2**	**89.9**	**82.8**
	SD	2.5	10.0	8.4
Subyearling mean:	**%**	**92.7**	**96.7**	**90.0**
	SD	2.2	3.5	3.5

[a] Based on back calculation to estimate green eggs taken.
[b] 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.
[c] Avian predation of yearlings released at LFH was estimated at 25%. This loss occurred between tagging and release, while fish were in the rearing lake.

Tucannon River Natural Production

Adult Salmon Surveys

Fall Chinook Redd Surveys

SRL personnel have conducted adult salmon surveys on the lower Tucannon River since 1985 (Appendix E). Survey sections generally covered the river from Rkm 1.1 to Rkm 29.0. The first 1.1 kilometers of the Tucannon River are deep slack water from the Snake River's Lower Monumental Dam reservoir and no surveys or estimates are made in that area: the habitat is poor and we presume no spawning occurs there. During 2006, landowner access restrictions prevented the surveying of 1.4 kilometers of river above the Starbuck Bridge within survey section 6 and 0.1 kilometers of river below the Starbuck Bridge within section 5. River conditions for viewing were good throughout the spawning season with low flows and clear water and we were able to survey 91% of the historical spawning area of fall Chinook.

Escapement and Composition

We estimated 449 fall Chinook and 11 summer Chinook escaped to the Tucannon River in 2006. The total Chinook (fall and summer) escapement of 460 to the Tucannon River is based on an expansion factor of three fish per redd (Table 10). Since summer Chinook and fall Chinook build redds in the same sections of the river at similar times we were unable to determine which redds were associated with summer Chinook. Based on the recovery of one spawned out summer Chinook (2.3% of the Chinook recovered), we assumed that at least one redd was from a summer Chinook. We differentiate summer Chinook from fall Chinook based on the recovery of coded-wire-tags.

We believe using three fish per redd as an expansion factor provides a conservative estimate of fish spawning in the Tucannon River. Other methods have been used to estimate adults per redd upstream of LGR based on estimates of adult salmon above the Dam and redd counts from the Clearwater, Snake, Imnaha, Salmon, and Grande Ronde Rivers (Garcia et al. 2005). Garcia estimated 4.7 adults per redd (10 year average). Groves has estimated 3.1 adults per redd since 1993 (Phil Groves, IPC personal communication), using adjustments for over counts of fall Chinook at LGR and pre-spawning mortality estimates from a radio telemetry study on the Snake River (Mendel et al. 1993).

Table 10. Estimated escapement, % stray component in carcasses sampled, and number of redds, and resulting estimates of smolts/redd and total number of migrants from Chinook spawning in the Tucannon River, 2002-2006.

	Escapement		Redd Construction			Success of Spawning	
Year	Estimated escapement[a]	% Strays in carcasses sampled	# Redds observed	# Redds in no access areas (estim)	Total # of Redds (estim)	Estimated smolts/redd[b]	Total Estimated # emigrants[c]
2002	630	35.1[d]	183	27	210	81	17,030
2003[e]	474	65.8[d]	143	15	158	452	71,465
2004	345	29.4[d]	111	4	115	632	72,705
2005	205	60.0	61	7	68	307	20,971
2006[f]	460	9.7	127	26	153	pending	pending

[a] This estimate was derived using three fish per redd.
[b] This estimate was derived using redds counted above the smolt trap and estimates of emigration the following spring.
[c] This estimate was derived using the smolt per redd estimate above the trap and applying it to the total number of redds in the Tucannon River.
[d] Minimum estimate.
[e] Fish in excess of broodstock needs were returned to the Snake River, possibly affecting the magnitude of the run to the Tucannon River.
[f] We estimate 2.3% of the escapement were summer Chinook, based on recovery of one carcass.

In 2006, we collected forty-seven carcasses (Table 11). We collected heads and scales from each carcass and used CWT and scale analysis to determine the age and origin. The composition of the fall Chinook carcasses is listed in Tables 12 and 13, and Appendix F.

Fish with out-of-basin hatchery scale patterns were assigned to the Snake R. hatchery group because CWT recoveries shed doubt on the magnitude of the estimated out-of-basin return using scale determinations. This is a change in methodology from past years when these fish would have been called out-of-basin strays (Milks et al. 2007). Although the Tucannon River is a small, generally accessible river, carcass recovery is hampered by river topography, and predation. Therefore, estimates based on collected carcasses may not accurately represent the stock composition of fish in the River.

Table 11. Date and number of redds and carcasses counted on the Tucannon River in 2006.

	Chinook		Coho	
Week beginning	Redds counted	Carcasses sampled	Redds counted	Carcasses sampled
16 Oct	1	0	0	0
23 Oct	2	0	0	0
30 Oct	0	0	0	0
6 Nov	6	1[a]	0	0
13 Nov	49	3	4	2
20 Nov	40	14	0	0
27 Nov	18	15	0	0
4 Dec	6	8	0	1
11 Dec	5	3	0	0
Totals	**127**	**44[a]**	**4**	**3**

[a] One carcass was a summer Chinook.

Reservoir Rearing

Scale analysis indicated that 30.8% of the Snake River natural origin fish recovered had reared in a Snake River reservoir their first year. We have documented that Snake River hatchery fish are reservoir rearing, but we do not know to what extent because scales have not been collected on wire tagged fish. Conner et al. (2002) suggested that dam construction in the Snake River basin might have altered juvenile fall Chinook salmon life history. Fall Chinook in the Snake River basin currently exhibit two life history types, namely ocean-type and reservoir-type (Connor et al. 2005).

Table 12. Age structure (total age), rearing history and origin of Chinook carcasses sampled on the Tucannon River, 2006.

		Subyearling			Yearling				Reservoir reared			
Origin	Total Age	3	4	5	2	3	4	5	3	4	5	No scale sample
Lyons Ferry Hatchery (CWT)				1	6	3	2	1				
Presumed Snake River Hatchery (scales)										1		
Presumed inbasin hatchery (out-of-basin hatchery scales)		1	4	1								
Snake River Natural (scales)		1	2	6					1	1	2	
Out-of-basin hatchery (CWT BLANK, or 63BLANK wire)							1	2			1[a]	
Presumed out-of-basin Hatchery (yearling by scales)					1							
Incomplete data												5
Totals		**2**	**6**	**8**	**7**	**3**	**3**	**3**	**1**	**2**	**3**	**5**

[a] The 63BLANK wire fish reared in a reservoir or the estuary and reached the ocean as a yearling.

Table 13. Estimated composition of fall Chinook recovered during carcasses surveys on the Tucannon River.

	Percent Composition of Recoveries			
	2005		2006	
Origin	Adults	Jacks (<53cm)	Adults	Jacks (<53cm)
Lyons Ferry Hatchery	11.1	100.0	44.0	75.0
Natural (wild)	22.2		44.0	
Out-of-basin (strays)	66.7		12.0	25.0
Total	**100.0**	**100.0**	**100.0**	**100.0**

Coho

Although we observed no coho actively building redds, we suspected four digs were coho redds (6 redds when expanded for areas not surveyed). We recovered three coho carcasses, but none were female. Scale readings indicated two were hatchery 3-year-old fish and one was a hatchery jack. One of the 3-year olds had a CWT verifying a Clearwater River release. We estimate the coho run to the Tucannon at 18 fish, using a 3 fish/redd calculation.

Juvenile Salmon Emigration

Subyearling Chinook

Juvenile fall Chinook were observed at the smolt trap (Rkm 3.0) from 1 February through 30 June 2006 when the trap was pulled for the season (Gallinat and Ross 2007). Median passage date for fall Chinook at the trap was 27 May. Fish ranged 35-108 mm in length.

We captured 3,073 Chinook, and estimate that 16,364 (12,828-22,412) naturally produced Chinook smolts passed the Tucannon River smolt trap during 2006. Based on the 53 redds estimated above the smolt trap during 2005 we calculated the number of smolts produced per redd was 307. Including estimated juvenile production from below the smolt trap, we estimate that 20,971 naturally produced Chinook smolts left the Tucannon during 2006.

The egg-to-smolt survival of fall Chinook downstream of the smolt trap may be less than above the trap because the river slows, increasing the chance for sediment deposition to smother eggs in the gravel. No data are currently available to determine if such a differential exists for any production year. Because of these concerns, we suggest that production estimates be used cautiously.

Coho

Juvenile coho salmon were incidentally captured at the smolt trap. This was the second year mark-recapture trap efficiency estimates were done for coho to determine if their recapture rates are similar to fall Chinook (Table 14). We trapped 406 coho in the smolt trap, and estimate that 1,510 (991-2,449) naturally produced coho passed our smolt trap in 2006. Emigration numbers were only large enough to estimate recapture efficiency for three weeks during the 2006 emigration, so the estimate should be used cautiously.

Juvenile coho were observed at the smolt trap from 8 March through 30 June, the last day of trapping. The median abundance passage date at the smolt trap was 19 May. Fish ranged from 33-170 mm in length. Two age classes were observed with the majority of the fish being subyearlings. Based on a histogram of fork length data, subyearlings were 33-90 mm and yearlings were larger than 90 mm. We did not observe any fish exhibiting the morphology of a Chinook x coho hybrid.

Table 14. Trapping efficiency estimates for fall Chinook and Coho at smolt trap on the Tucannon River, 2007.

Week ending	Fall Chinook Recapture efficiency	Coho Recapture efficiency
21 May	14.8	unknown
28 May	17.5	29.0
04 June	33.7	25.9
11 June	31.5	15.8
19 June	17.2	unknown
26 June	29.6	unknown

Summary of Fall Chinook Run Size and Composition

Return to LFH

Fish trapped at LFH that were processed (killed) during fall Chinook spawning are listed in Appendix G. Two of the fish processed were minijacks (<30cm). We estimate that 14 of the fish (jacks) listed as trapped at LFH were actually fish trapped at LGR Dam. All fish returned to the Snake River were excluded from the LFH run composition, since they may be included in Tucannon River recoveries or the LGR run composition.

The composition presented in Table 15 is based on data from the fish trapped and processed at LFH (Appendix G). Because not all trapped fish were retained for broodstock, the table may not accurately reflect escapement to LFH or the Snake River run at large. Both Umatilla and Klickitat hatcheries released fish that were identically marked (blank wire tag only). The BLANK wire tag recoveries that were aged indicate that group of fish was either age 3 or age 5. We do not know the origin of the age 3 fish because neither Umatilla nor Klickitat hatchery released BLANK wire tagged fish that year. The age 5 fish are not associated with any CWTs that we recovered. Klickitat Hatchery did release a group of BLANK wire tagged fish from BY00, but those fish were not associated with any CWTs. Although we are unable to determine the release location of the BLANK wire tagged fish, we can identify them as out-of-basin strays.

Table 15. Composition of Chinook trapped and processed (killed) at LFH during 2006.

Origin	Adults	Jacks	Comp of Adults	Comp of Jacks
LFH/Snake River Hatchery[a]	1447	420	94.3%	98.6%
LFH/Snake River natural (wild)	6	1	0.4%	0.2%
Strays (out-of-basin)	56	1	3.6%	0.2%
Hatchery origin (unassigned)	11	4	0.7%	0.9%
Unknown origin (natural or hatchery)	2	0	0.1%	0.0%
Spring or Summer Chinook	13	0	0.8%	0.0%
Totals	1535	426	100.0%	100.0%

[a] Includes fish from LSRCP, NPTH, and IPC programs.

Returns to LGR Dam and Composition of Fish Hauled to LFH from LGR Dam

The run reconstruction to LGR Dam, with bounds around the data, is presented in Appendix H. We thank the Pacific Salmon Commission Southern Fund for funding this project.

Chinook were counted 24 hours per day during August, 16 hours per day September through October, and 10 hours per day from November through 15 December at the counting window (U.S. Army Corps of Engineers, 2006). Window counts estimated 8,048 adults and 6,721 jacks

reached LGR Dam in 2006 (Figure 5). The Chinook passing LGR Dam after 17 August are designated as falls based on arrival date, which is inaccurate because of the overlap between the fall and summer Chinook runs. In addition, fish counts at the dams do not adjust for fish that crossed the dam and fell back through the juvenile bypass system (fallback event) or fish that re-crossed the dam after a fallback event (double counting).

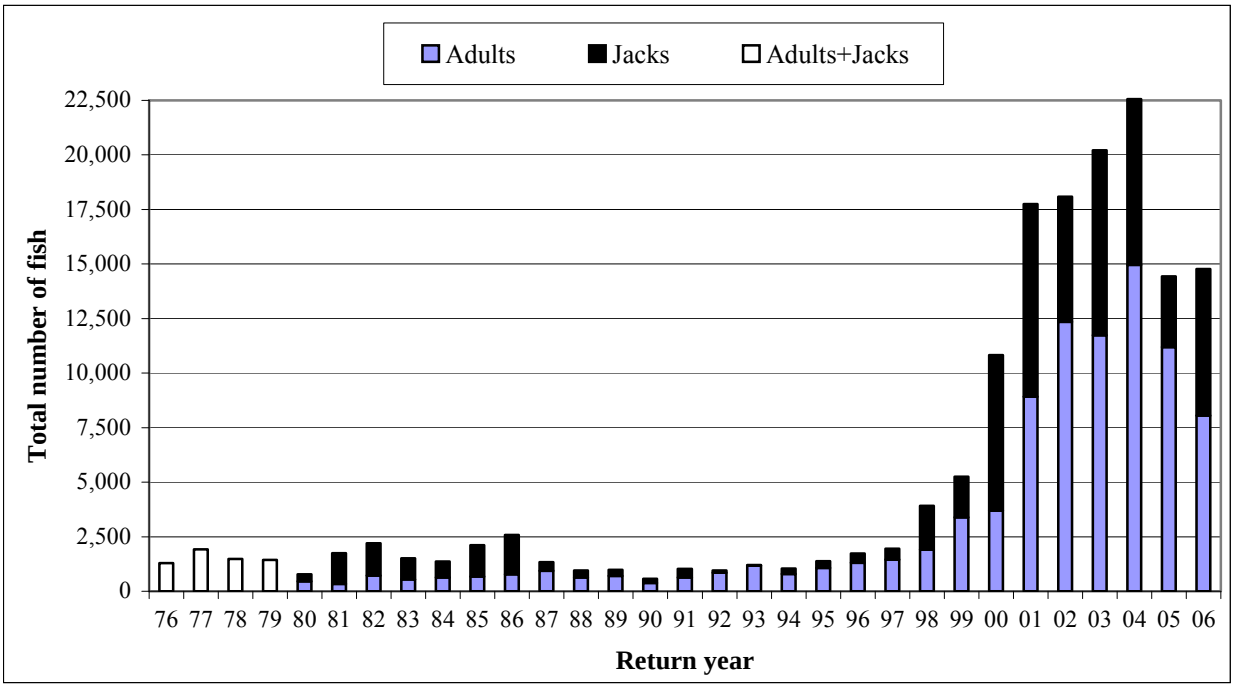


Figure 5. Fall Chinook window counts at LGR Dam, 1976-2006.

Fallbacks were documented from August-December at the juvenile smolt bypass facility, downstream of LGR (Fred Mensik, WDFW, and Mike Halter, COE, personal communication). Fish moving downstream through the LGR Dam forebay that encounter the submersible traveling screens are diverted downstream through the juvenile bypass system and move across a separator. The system separates adults from juveniles to allow adults to be diverted back to the river.

Based on data collected at the LGR juvenile bypass facility, we estimate a total of 845 fallback events occurred at LGR Dam during 2006. Fallback events documented at the juvenile facility during the month of August were not included since data were not recorded regarding run of Chinook encountered (summer Chinook may have been included).

Of the Chinook captured and scanned for wire during juvenile sampling at LGR Dam (Table 16), 97.2% of the jacks were of hatchery origin. The majority (82.5%) of the jacks sampled had a left red elastomer tag indicating they originated from yearling releases downstream of LGR at LFH. Since scales were not taken on the unmarked/untagged group we cannot determine their origin, although we suspect they are hatchery fish.

Table 16. Documented fallbacks of fall Chinook at the LGR juvenile bypass facility.

Sampling protocol and marks	Estimated number of jack fallbacks at Juvenile collection facility	Estimated number of Adult fallbacks at separator	Estimated number of Jack fallbacks at separator
scanned for wire:			
ADCWTLR	173		
CWTLR	175		
ADLR	5		
LR only	6		
Adwire	29		
wire only	30		
AD only	5		
unm/untag/noVI	12		
not scanned for wire:			
ADLR		48	17
AD only		114	54
LR only		17	21
unm/noVI		84	54
Total	435	263	147

The adults and jacks encountered at the separator were examined for size, fin clips, VIE, and operculum punches. We estimate that at least 68.1% of the adults sampled at the separator were of hatchery origin based solely on adipose clips and VIEs, but expect the rate is actually much higher. The use of adipose fin clips as a primary indicator of hatchery origin is no longer a reliable method since many hatchery fish are being released into the Snake River basin without an adipose fin clip. We estimate that at least 63.0% of the jacks collected at the separator were of hatchery origin but the estimate may be as high as 89.4% if the composition of unclipped jacks without VIEs was similar to jacks sampled at the juvenile facility.

Fish hauled from LGR to LFH that were processed (killed) are listed in Appendix G and Table 17. We did not process any minijacks from LGR although one minijack was released at the LGR trap. This would expand to approximately seven minijacks during the trapping period. Additional fish trapped at LGR that were hauled to Nez Perce Tribal Hatchery (NPTH) and specific data about those fish will be included in an upcoming NPT Annual Report (Bill Arnsberg, NPT, personal communication). An estimate of the composition of the fall Chinook run to LGR will require the addition of NPT data to what is presented in this report.

Table 17. Fish trapped at LGR Dam, hauled to LFH, and processed (killed) to determine composition, 2006.

Origin	Adults	Jacks	% of Adults	% of Jacks
LFH/Snake River Hatchery	351	411	51.6	96.5
LFH/Snake River natural (wild)	209	1	30.7	0.2
Strays (out-of-basin)	93	8	13.7	1.9
Hatchery origin (unassigned)	23	4	3.4	0.9
Unknown origin (natural or hatchery)	3	0	0.4	0.0
Summer Chinook	1	2	0.1	0.5
Totals	**680**	**426**	**100.0**	**100.0**

Recoveries of Wire Tagged LFH/Snake River Hatchery Fall Chinook Outside of the Snake River

To document where recoveries of LFH/Snake River hatchery fall Chinook occurred in 2006, we queried the Regional Mark Information System (RMIS) database on 19 May 2008 for all tag recoveries (all tag statuses) of WDFW released LSRCP fall Chinook (Appendix J). Releases of Snake River hatchery fish by the NPT (LSRCP and NPTH programs) and fish associated with the IPC program were not included. Coded-wire tag recoveries were grouped by freshwater and saltwater, then by state, then by recovery site. The freshwater and marine determinations were based upon the RMIS recovery location codes. We report recoveries at hatchery racks, fish traps, and from carcass surveys to show the final locations of fish that strayed or were intercepted outside of the Snake River basin. The remaining fishery recoveries were grouped together. Besides informing managers about the geographic location of harvested or intercepted fall Chinook, these data were the basis for expanded estimates of the contribution of LSRCP fall Chinook to out of Snake R. Basin fisheries (see **Status of Achieving Mitigation**).

Smolt-to-Adult Return Estimates

Appendix K lists smolt-to-adult return (SAR) estimates from our yearling and subyearling production groups grouped by fin clip, (BY99 through BY05), for return years through 2007. These data were derived from recoveries from RMIS and include Snake River run reconstruction estimates of live fish that were wire tagged. Neither dataset was expanded for tag loss, sample detection method, or fishery. When comparing SARs it is important to compare groups based on fin clip, because some ocean fisheries only visually sample fish for fin clips (indicator of presence of a CWT) while others sample every fish electronically regardless of clip. These discrepancies will result in an underestimation of harvest by ocean fisheries for unclipped CWT subyearlings.

Yearling releases (Table 18) continue to provide a survival advantage over subyearling releases (Table 19) although it is highly variable among years. We also present data showing a survival advantage of onstation subyearlings when compared to direct releases into the Snake River near Couse Creek and the Grande Ronde River, although it is based on incomplete broodyear returns.

Table 18. Average percent smolt-to-adult return rates to the Snake River for yearling fall Chinook released by WDFW.

Release site	Age at release	Brood year	Fin clip	Average % SAR	std % SAR	min % SAR	max % SAR
Completed Returns							
LFH	yearling	BY99-01	AD	0.95	0.21	0.72	1.13
Incomplete Returns through return year 2007							
LFH	yearling	BY02-04	AD	0.48	0.17	0.35	0.72
LFH	yearling	BY03-04	No clip	0.50	0.16	0.38	0.61

Table 19. Average percent smolt-to-adult return rates to the Snake River for subyearling fall Chinook released by WDFW.

Release site	Age at release	Brood year	fin clip	Average % SAR	std % SAR	min % SAR	max % SAR
Completed Returns							
LFH	subyearlings	BY99, BY01	AD	0.21	0.06	0.17	0.25
Col. R barged below Bonn[a]	subyearlings	BY00	AD	0.04			
Incomplete Returns through return year 2007							
LFH	subyearlings	BY02-04	AD	0.07	0.02	0.04	0.08
Snake R. near Couse Creek	subyearlings	BY02, BY04	AD	0.02	0.02	0.02	0.05
Grande Ronde R.	subyearlings	BY04	AD	0.04			

[a] Fish barged below Bonneville Dam received head injuries when they were loaded on the barge. There was some immediate mortality when they were loaded, but once the flow was reduced the injuries decreased.

Status of Achieving Mitigation

The long-range goal is to return 32,700 fall Chinook to the Snake River basin, including 18,300 hatchery fish. Furthermore, the long-range harvest goal was 98,100 fall Chinook taken in commercial fisheries and 32,700 fall Chinook taken in sport fisheries (U.S. Army Corps of Engineers 1975) in the Columbia River system and the Ocean. In past reports, the harvest component of mitigation has been overlooked and recoveries of CWTs as downloaded from RMIS have not been expanded to reflect the take of non-CWT fish and non-clipped fish. The following methods of adjusting harvest data are **preliminary** and are our first attempt to account for the total number of Washington's LSRCP mitigation fish that were taken in fisheries. The data presented below are only for fall Chinook released by WDFW that are part of the LSRCP mitigation (Table 20). The adult returns from NPT released fish from LSRCP acclimation sites above LGR Dam are not presented in this report.

Table 20. Contributions WDFW released fall Chinook toward the LSRCP mitigation goals, 2006.

Recovery areas		Fishery	Total[a]
Ocean	Alaska	Sport	3
Harvest		Troll	32
		Purse Seine	2
	British Columbia	Sport	213
		Troll	799
	High Seas	Troll	85
	Washington	Sport	201
		Troll (Non-treaty)	63
		Treaty Troll	243
		Treaty Drift Gillnet	6
	Oregon	Sport	24
		Troll	113
	California	Troll	6
Freshwater	Columbia R.	Below Bonneville-Sport	313
Harvest		Below Bonneville-(non-Treaty) Gillnet	208
		Bonneville-McNary Treaty Gillnet	533
		Hatchery/Trap	25
		spawning ground	40
Escapement to LSRCP area[b]	Snake R.	Return to Snake River	4,977
		Grand Total	**7,885**

[a] Harvest estimates have been adjusted to account for sample detection method, fishery, tagloss, and are fully expanded to reflect total take and escapement of tagged, untagged, AD clipped, and non-fin clipped fall Chinook released by WDFW. Adults are combined with jacks in this table.

[b] Included in the Snake River estimate are estimates of fall Chinook spawning in the Tucannon River, fall Chinook trapped at LFH and used for broodstock, and the run of fall Chinook to LGR Dam.

Harvest Adjustments for Non-Selective Fisheries

Non-selective fisheries retain any fall Chinook captured. Non-selective fisheries include all the commercial and tribal net fisheries. Canada and Alaska sport fisheries are also non-selective. The RMIS database was used to generate estimated (ESTD) harvest data of CWT tagged fish. Fish without CWTs are not reported to RMIS and therefore the harvest estimates must be expanded to reflect total take for mitigation purposes. Adjustments to RMIS harvest data were done differently based upon CWT detection methods listed below.

Visual Detection Method

Visual detection means only adipose fin clipped fish were scanned for wire. Since Canada and Alaska only sample adipose clipped fish but allow take of all fish, we expanded the RMIS estimated recoveries (ESTD) by determining an expansion factor based on release data of each tag code recovered. For example if the tag code recovered was from a release of fish that had ADCWT, CWT only, AD only, and unmarked/untagged fish in the release, we used the following formula to expand harvest data of CWT fish to represent the total take:

ESTD CWTs harvested by fisheries from RMIS x (total # released from that tagcode/ # ADCWT in the release) = ESTD total take

Electronic Detection Method

Electronic detection method scans all fish for wire regardless of fin clip. For this detection type we used the following formula to expand the harvest data of CWT fish to estimate the total take:

ESTD CWTs harvested by fisheries from RMIS x (total # released represented by that tagcode/ (# ADCWT in the release + # CWT in the release) = ESTD total take

Discrepancies Between Detection Methods Reported to RMIS

We found discrepancies in the RMIS data when looking at recoveries of two broodyears of yearling fall Chinook that were index tagged. The data showed that the Tribal gillnet fishery in the Columbia River was sampled using electronic detection. If that were the case we would reasonably expect the numbers of recoveries from the ADCWT fish to be similar to the numbers of recoveries from the non-clipped CWT fish. In both broodyears where there were indexed tagging groups, there were no recoveries from the non-clipped CWT fish. Moreover, at LFH we electronically sample all fish. If the harvest of the AD clipped and no-clip groups occurred differentially, we would expect that recoveries at LFH would reflect those differences; that did not occur. Recoveries from both groups were nearly equal, therefore we presume that the harvest data submitted to RMIS should have indicated visual, not electronic detection type. If electronic detection was used, not only would the expansion rate be less, but also no adjustment would have been made for the lack of recoveries from the non-clipped CWT groups, thus underestimating the LSRCP component.

We adjusted the Columbia River Tribal Gillnet fisheries ESTD harvest of ADCWT groups by applying the formula for visual detections to estimate the total harvest of each tag code. To estimate the total take of non-clipped CWT groups of a different tag code, but from the same broodyear, we used the smolt-to-adult recovery rate of the ADCWT group as surrogates and applied that to the total number of fish released.

Harvest Adjustments for Mark Selective Fisheries

To adjust ESTD harvest of ADCWT groups to reflect the total take in AD selective fisheries we had to account for fish released with an AD clip that were not wire tagged. The Columbia River sport fisheries are mark selective and were expanded using the following formula:

ESTD CWTs harvested by fisheries from RMIS x (total # AD + total # non-clipped fish released from that tag code/ # ADCWT) = ESTD total take

Fall Chinook Run to Lower Granite Dam in 2004

The run reconstruction to LGR was completed 01 May 2009 and is included in Appendix L. Fish were trapped at two trapping rates throughout the season. To distinguish which fish were trapped at each rate, PIT tags were implanted in adults retained for broodstock and for run reconstruction purposes. Unfortunately due to tag loss, there were many fish whose trapping rates had to be estimated. We recommend that PIT tags not be used for this purpose in the future.

Conclusions and Recommendations

The fall Chinook program at LFH requires substantial coordination. The program is currently being managed to meet the requests of Tribal, state, and federal co-managers. Conclusions and recommendations listed below are not in priority order.

1. Hauling excess fish back to the Snake River at the end of the season will continue to occur which will affect run timing and spawning area selection.

   Recommendation: Mark all fish released from the hatchery to allow accounting of them post-release. This will allow us to document the relationship between trapping location, release location, and last noted detection area.

2. The sizes of the adult ponds at LFH limit our flexibility when working fish during spawning. The holding ponds are very large and more fish can be held in the ponds than can be crowded into the fallback channel. Over-crowding fish in the fallback channel causes undue stress, which can lead to pre-spawning mortality. The vessels cannot be divided with crowders because each pond needs to be drained all at once. Also, an open pond must be available for use when fish are returned back to the pond. Since there are only two ponds slated for fish trapped from each location (LFH and LGR), one must be completely emptied before fish can be returned to that pond. In addition, fish that were previously inoculated must be kept separate from new arrivals. Differences in run composition and spawn timing between fish trapped at each location exacerbate the situation. Dividing the ponds would enable us to spawn one pond of LFH trapped fish and one pond of LGR trapped fish on the same day. This would allow us to work within our spawning protocol, and decrease the number of males used multiple times (maximize N_b).

   Recommendation: Divide the adult holding ponds lengthwise to give us more flexibility when processing adults at spawning.

3. Fallback at LGR Dam is known to occur. Data from a 1993 telemetry study indicated fish released as juveniles at LFH occasionally cross LGR Dam when they return as adults, then descend through the system to be trapped at LFH. Likewise, out-of-basin fish have exhibited similar migration patterns. Any fish trapped at LGR and released to continue upstream is operculum punched. However, we have not received complete fallback reporting from COE sampling at the juvenile bypass facility. This incomplete data provides an inaccurate assessment of fallback at the dam, affecting the accuracy of our run-reconstruction and the estimate of true escapement to above the dam.

   Recommendation: Request the COE continue collecting data regarding fallback from fish encountered at the juvenile collection facility and separator located at LGR Dam. Data collected should include operculum punches and VIE color and location on non-juvenile fall Chinook encountered so that we can adjust data used in run reconstruction estimates.

Recommendation: Continue to use fallback data from fish encountered at the juvenile collection facility in the run reconstruction estimates of fish passing LGR.

4. Estimated composition of the run to the Tucannon River may be biased. The sample size of carcasses recovered each year is very small, and the carcasses recovered may not adequately reflect the composition of fish spawning in the Tucannon. Run composition is estimated based on adults recovered. Since we recover more females than males it is possible we are overestimating the older age classes (females) and under estimating the younger age classes (males and jacks).

   Recommendation: Increase carcass recovery efforts to increase the numbers of fish recovered.

5. The release of unmarked/untagged fish into the Snake River may be causing us to underestimate escapement of fish associated with LSRCP mitigation. The absence of CWTs in these fish forces us to depend upon scale analysis to differentiate in-basin (LSRCP or IPC) from out-of-basin fish.

   Recommendation: Adipose clip and/or tag 100% of the LSRCP releases so returns can be accurately estimated and naturally produced fish can be incorporated into broodstock with greater accuracy.

   Recommendation: Begin thermal marking otoliths in all of the fall Chinook produced at LFH. By doing this we would be able to better determine stray rates of untagged fish. Even if our releases were not wire tagged or fin clipped, we would still be able to tell with 100% confidence if a fish were produced by our hatchery. It would take five years before all of the returning LFH hatchery fish would be marked. At that time any hatchery fish, as determined by scale pattern analysis, that did not have an otolith mark would be considered a stray.

   Recommendation: Continue to collect scales on fish from CWT tagged releases in order to refine criteria used to determine origins of unmarked/untagged fish.

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Appendix A: Numbers of Fall Chinook processed at LFH, estimated escapement to the Tucannon River, window counts at IHR, LMO, and LGR Dams: 2002-2006

Appendix A. Numbers of Chinook processed at LFH, estimated escapement to the Tucannon River and window counts at Ice Harbor, Lower Monumental, and Lower Granite dams, 2001-2006.

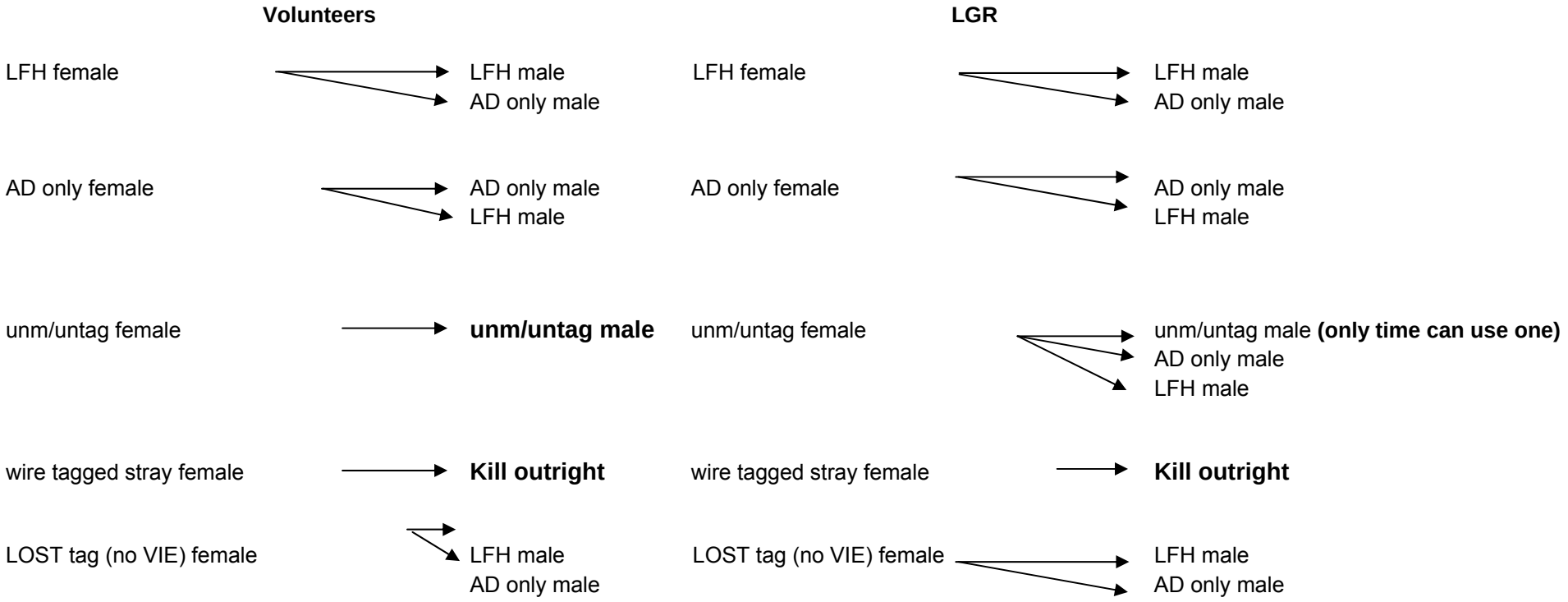
		Daytime Counts				Night Video				Totals	
		Through October		Nov and Dec		Through Oct		Nov and Dec			
Year	Location	Adults	Jacks	Adults	Jacks	Adults	Jacks	Adults	Jacks	Adults	Jacks
2001	IHR Dam	13,516	10,170	119	26	500	609	105	24	14,240	10,829
	LOMO Dam	13,297	8,512	nc	nc	nc	nc	nc	nc	13,297	8,512
	LFH									2,012	268
	Tucannon R.									188	31
	LGR Dam	8,621	8,707	294	127	271	344	193	73	9,379	9,251
2002	IHR Dam	15,248	6,079	71	32	514	360	71	13	15,904	6,484
	LOMO Dam	15,193	6,185	nc	nc	nc	nc	nc	nc	15,193	6,185
	LFH									1,783	482
	Tucannon R.									596	34
	LGR Dam	12,215	5,630	136	97	226	308	86	64	12,663	6,099
2003	IHR Dam	20,998	10,666	nc	nc	nc	nc	nc	nc	20,998	10,666
	LOMO Dam	13,641	8,922	157	134	nc	nc	nc	nc	13,798	9,056
	LFH									2,172	1,264
	Tucannon R.									455	19
	LGR Dam	11,595	8,387	137	94	nc	nc	nc	nc	11,732	8,481
2004	IHR Dam	21,109	11,167	nc	nc	nc	nc	nc	nc	21,109	11,167
	LOMO Dam	19,812	5,921	114	30	nc	nc	nc	nc	19,926	5,951
	LFH									2,863	506
	Tucannon R.									345	0[b]
	LGR Dam	14,560	7,478	400	122	nc	nc	nc	nc	14,960	7,600
2005	IHR Dam	14,677	4,561	nc	nc	nc	nc	nc	nc	14,677	4,561
	LOMO Dam	13,137	3,051	nc	nc	nc	nc	nc	nc	13,137	3,051
	LFH									2,255	473
	Tucannon R.									181	20
	LGR Dam	11,137	3,183	57	53	nc	nc	nc	nc	11,194	3,236
2006	IHR Dam	10,272	6,835	nc	nc	nc	nc	nc	nc	10,272	6,835
	LOMO Dam	11,127	8,769	nc	nc	nc	nc	nc	nc	11,127	8,769
	LFH									2,215	852
	Tucannon R.									377	86
	LGR Dam	7,974	6,551	74	170	nc	nc	nc	nc	8,048	6,721

[a] No counts (nc) were completed at the dam during that time of year.
[b] No jacks were recovered during Tucannon River spawning ground surveys in 2004.

Appendix B: 2006 Spawning Protocol for Mixing of Gametes

Appendix B. 2006 Spawning Protocol for mixing of gametes.

2006 Spawn at LFH
Mixing of gametes at spawning



Incorporate jacks in broodstock up to 15%.
Split each LF male (not jacks) and hold to use for LGR day.

Incorporate jacks in broodstock up to 15%
Reuse LFH origin males as last resort.

Appendix C: United States v. Oregon Production and Marking Table

Appendix C. Table B4 in Interim Management Agreement for Upriver Chinook, Sockeye, Steelhead, Coho, and White Sturgeon. Snake River fall Chinook production for Brood Years 2005-2007 for the Lower Snake River Compensation Program (LSRCP) at Lyons Ferry Hatchery, the Fall Chinook Acclimation Program (FCAP), the Idaho Power Program (IPC) and the Nez Perce Tribal Hatchery (NPTH)

Production Priority	Rearing Facility [2]	Release Number	Release Location	Life stage	Mark
Tier One assumes rearing of 2.2 million subyearlings at Lyons Ferry Hatchery and 1.0 million eggs for IPC program.[7]					
1	Lyons Ferry	450,000	On-station	yearling	225K CWT, AD, VIE 225K CWT, VIE
2	Lyons Ferry	450,000	Pittsburg Landing Captain John Rapids Big Canyon	yearling	Each Group: 70K CWT, AD 80K CWT
3	Lyons Ferry	200,000	On-station	subyearling	200K CWT, AD
4	Lyons Ferry	1,000,000	Big Canyon Captain John Rapids	subyearling	Each Group: 100K CWT, AD 100K CWT
5	IPC [2] (Oxbow)	200,000	Pittsburg Landing Hells Canyon Dam if Priority # 13 is in effect	subyearling	200K CWT, AD
6	IPC (Umatilla)	200,000	Hells Canyon Dam	subyearling	200K CWT, AD
7	IPC (Umatilla)	200,000	Pittsburg Landing Hells Canyon Dam if Priority # 13 is in effect	subyearling	200K CWT, AD if released at Pittsburg and #5 reared at Oxbow 200K AD only if released at Hells Canyon Dam, combine with # 6 if reared at Umatilla
8	Lyons Ferry	400,000 [5]	Direct release @ Captain John Rapids	subyearling	200K CWT, AD
9	Lyons Ferry	200,000	Grande Ronde	subyearling	200K CWT, AD
10	IPC (Umatilla)	400,000	Hells Canyon Dam	subyearling	400K AD
11	Lyons Ferry	100,000	Grande Ronde	subyearling	None, combine with # 9
12	Lyons Ferry	300,000	Grande Ronde And/or Captain John Rapids	subyearling	None if released at Grande Ronde, combine with # 9&11 200K CWT, AD if released at Captain John Rapids
Tier Two assumes rearing of up to 2.6 million subyearlings at Lyons Ferry Hatchery[6,7]					
13	Lyons Ferry	400,000 [3]	Pittsburg Landing	subyearling	100K CWT, AD 100K CWT Combine with # 4
NPTH tier [7]					
1	NPTH	1,000,000	On-station North Lapwai Valley	subyearling	Each Group: 100K CWT, AD 200K CWT
2	NPTH	400,000 [4]	Cedar Flats Luke's Gulch	subyearling	Each Group: 100K CWT, AD 100K CWT
Subtotal Snake Basin		**5,900,000**			

Footnotes for Table B4:

1. Bonneville Power Administration directly or indirectly funds all programs except the IPC program.
2. IPC program may be implemented at IPC Oxbow Hatchery and/or other hatcheries, such as Umatilla Hatchery. Priority 5 production may be implemented at Oxbow Hatchery and, priorities 6, 7 and 10 production may be implemented at Umatilla Hatchery if broodstock shortage limits full implementation of Tier 1.
3. These would replace subyearlings released by IPC under priorities 5 and 7, and all IPC releases would occur at Hells Canyon Dam. These will be combined with the Priority # 4 Big Canyon and Captain John marking groups for harvest evaluation.
4. Early spawning component of NPTH program.
5. Split into two release groups at two locations of 200K each depending on final study design. If so, they will have appropriate tags and AD-clips for evaluation of the study.
6. The parties acknowledge that facilities improvements will be required to achieve all the releases in Tier 2.
7. For Broodstock collected at Lower Granite Dam, the parties will determine annually the broodstock collection protocol.

Appendix D: LFH/Snake River Origin Fall Chinook Releases Table Brood Years: 1999-2005

Appendix D. LFH/Snake River hatchery origin fall Chinook releases with number marked, tagged, and unmarked by release year, rearing strategy, Brood year and type of release.

Release Year	S/Y [a]	Brood Year	Release Location-Type	Release Date	CWT Code	Number of Fish Released [b] AD+CWT	CWT Only	Ad-Clip Only	Unmarked Untagged	FPP	VIE Mark	% VIE	Other
2000	S	1999	BC1-direct	30 May-1 June	no CWT	-	-	-	497,790	40.2			
2000	S	1999	BC1-direct	20-26 Jun	no CWT	-	-	-	392,684	45.0			
2000	S	1999	CJ1-volitional	20-31 May	630168	-	193,476	-	297,557	45.4			
2000	S	1999	CJ1-volitional	15-23 Jun	630169	-	194,717	-	207,097	52.0			
2000	S	1999	LFH-direct	26-26 May	630167	188,125	6,083	2,435	-	45.5			
2000	S	1999	PL1-direct	24-26 May	no CWT	-	-	-	400,156	55.6			
2001	Y	1999	BC1-direct	09-11 Apr	630477	112,933	94	188	-	10.2	LG	94.6	
2001	Y	1999	CJ1-volitional	04-13 Apr	630478	100,461	1,010	505	-	10.1	LB	88.9	
2001	Y	1999	LFH-volitional	01-20 Apr	630476	326,669	10,440	1,648	-	8.7	LR	92.8	
2001	Y	1999	PL1-direct	10-12 Apr	630479	102,980	761	-	-	10.4	RG	86.7	
2001	S	2000	BC1-direct	29 May	630271	-	196,507	-	303,099	53.3			
2001	S	2000	BC1-direct	13 Jun	no CWT	-	-	-	357,362	78.2			
2001	S	2000	CJ1-volitional	26 May	no CWT	-	-	-	501,129	49.5			
2001	S	2000	Col. R.-below BONN Dam-barged	01 Jun	630270	188,085	10,357	1,534		45.7			
2001	S	2000	LFH-direct	03 Jul	no CWT			-	3,994	52.2			
2001	S	2000	PL1-direct	28 May	630272	-	197,182	-	176,888	84.1			
2001	S	2000	Snake R. below HC Dam-Oxbow hatchery-IPC direct	16 May	no CWT	-	-	113,770	-	42.0			
2001	S	2000	Snake R. below HC Dam-Oxbow hatchery- IPC direct	19 Jun	no CWT	-	-	1,450	-	23.0			
2001	S	2000	Research – Snake near Couse Cr – direct	18-26 May	no CWT	-	-	-	74,245				(PIT tag only)

Appendix D. (continued) LFH/Snake River hatchery origin fall Chinook releases with number marked, tagged, and unmarked by release year, rearing strategy, Brood year and type of release.

Release Year	S/Y [a]	Brood Year	Release Location-Type	Release Date	Number of Fish Released [b]					FPP	VIE Mark	% VIE	Other
					CWT Code	AD+CWT	CWT Only	Ad-Clip Only	Unmarked Untagged				
2002	Y	2000	BC1-direct	10-12 Apr	630677	155,827	523	1,440	-	12.9	LG	86.2	
2002	Y	2000	BC1-direct	10-12 Apr	630625	1,661	6	15	-	12.9	LG	86.2	
2002	Y	2000	CJ1-volitional	16 Apr	630183	155,692	4,463	-	-	16.6	LB	80.3	
2002	Y	2000	LFH-volitional	01-11 Apr	631273	421,390	6,612	4,509	-	9.3	LR	93.1	
2002	Y	2000	PL1-direct	15-17 Apr	630678	156,372	2,687	672	-	13.4	RG	83	
2002	S	2001	Snake R. below HC Dam-Oxbow hatchery-IPC direct	21 May	no CWT	-	-	171,120	343	42.3			(incl. 1,000 PIT tagged)
2002	S	2001	BC1-direct	27-28 May	612639	-	197,763	-	297,452	193.0			
2002	S	2001	BC2-direct	18-19 Jun	no CWT	-	-	-	505,674	178.0			(incl. 2,517 PIT tagged)
2002	S	2001	CJ1-volitional	28 May	610106	-	185,010	-	313,917	215			
2002	S	2001	CJ1-volitional	20-28 Jun	610105	-	182,429	-	316,519	152			
2002	S	2001	LFH-direct	24 Jun	630890	188,874	3,373	2,335	-	52.0			
2002	S	2001	PL1-direct	27-29 May	612501	-	199,965	-	199,350	166			
2002	S	2001	Snake R at Roosters Landing-direct	02 Dec	no CWT	-	-	-	24,573	26.0			
2002	S	2001	Snake R. at Chief Timothy-direct	16 Oct	no CWT	-	-	-	29,059	24.6			
2002	S	2001	Research–near Couse Creek–direct	29 May-14 Jun	no CWT	-	-	-	97,916				(PIT tag only)
2003	Y	2001	BC1-direct	14-15 Apr	610119	140,217	3,449	1,665	0	10.6	LG	91.0	
2003	Y	2001	CJ1-volitional	30 Mar-07 Apr	610118	147,987	2,502	1,430	0	10.0	LB	88.9	
2003	Y	2001	LFH-volitional	01-09 Apr	631585	499,387	14,503	4,546	-	9.7	LR	58.7	
2003	Y	2001	PL1-direct	13-14 Apr	610120	136,455	2,195	1,733	0	9.1	RG	84.3	

Appendix D. (continued) LFH/Snake River hatchery origin fall Chinook releases with number marked, tagged, and unmarked by release year, rearing strategy, Brood year and type of release.

Release Year	S/Y [a]	Brood Year	Release Location-Type	Release Date	Number of Fish Released [b]					FPP	VIE Mark	% VIE	Other
					CWT Code	AD+CWT	CWT Only	Ad-Clip Only	Unmarked Untagged				
2003	S	2002	BC1-direct	03 Jun	610122	-	193,255	-	313,233	94.5			
2003	S	2002	CJ1-volitional	28 May	610121	-	196,068	-	316,617	81.3			
2003	S	2002	CJ1-volitional	12 Jun	612654	-	186,937	-	104,465	74.4			
2003	S	2002	LFH-direct	06 Jun	631545	193,848	4,517	1,727	-	50.0			
2003	S	2002	NLV1-volitional	28-31 May	610109	-	77,855	-	9,862	61.3			
2003	S	2002	NLV1-volitional	28-31 May	612657	-	72,009	-	9,146	61.3			
2003	S	2002	NLV1-volitional	28-31 May	612648	-	9,303	-	1,178	61.3			
2003	S	2002	NLV1-volitional	28-31 May	612649	-	9,259	-	1,172	61.3			
2003	S	2002	NPTH1-volitional	02-04 Jun	610107	-	193,643	-	5,989	38.2			
2003	S	2002	NPTH2-volitional	19-20 Jun	610110	-	97,932	-	17,032	81.4			
2003	S	2002	PL1-direct	04 Jun	610123	-	189,782	-	200,401	129.6			
2003	S	2002	Snake R. at Roosters Landing-direct	04 Mar	no CWT	-	-	-	33,500	1200			
2003	S	2002	Snake R. at Couse Cr. boat launch-direct	09 Jun	631391	96,073	2,631	1,315	-	40.4			
2003	S	2002	Snake R. below HC Dam-Oxbow hatchery- IPC direct	22 May	no CWT	-	-	199,246	-	46.6			(incl. 10,000 PIT tagged)
2003	S	2002	Snake R. below HC Dam-Umatilla hatchery-–IPC direct	15-16 May	no CWT	-	-	332,226	-	41.4			(incl. 3,000 PIT tagged)
2003	S	2002	Research – near Couse Creek - direct	28 Mar-05 Jun	no CWT	-	-	53,583	-				(AD+PIT tagged)
2004	Y	2002	LFH-direct	12-14 Apr	632167	425,316	2,397	18,376	266	9.9	LR	90.4	
2004	Y	2002	PL1-direct	12-13 Apr	612502	143,257	1,488	186	186	9.9	RG	81.9	
2004	Y	2002	CJ1-volitional	02-07 Apr	612503	150,569	192	-	-	9.1	LB	86.0	
2004	Y	2002	BC1-direct	14-15 Apr	612659	106,657	270	-	-	9.4	LG	91.3	

Appendix D. (continued) LFH/Snake River hatchery origin fall Chinook releases with number marked, tagged, and unmarked by release year, rearing strategy, Brood year and type of release.

Release Year	S/Y [a]	Brood Year	Release Location-Type	Release Date	Number of Fish Released [b]								
					CWT Code	AD+CWT	CWT Only	Ad-Clip Only	Unmarked Untagged	FPP	VIE Mark	% VIE	Other
2004	S	2003	LFH-direct in evening	21 Jun	631786	195,046	2,209	4,279	-	51.1			
2004	S	2003	BC1-direct	03 Jun	612500	-	198,190	-	275,366	79.6			
2004	S	2003	CJ1-volitional	29 May-01 Jun	612600	-	192,649	-	308,090	55.3			
2004	S	2003	PL2-direct	31 May	no CWT	-	-	-	197,687	48.2			(Incl. 2,496 PIT tagged)
2004	S	2003	PL1-Oxbow hatchery-IPC-direct	24 May	106973	37,473	-	-	-	54.3			
2004	S	2003	PL1-Oxbow hatchery-IPC-direct	24 May	107976	67,080	-	-	-	54.3			
2004	S	2003	PL1-Oxbow hatchery-IPC-direct	24 May	108076	64,894	-	-	-	54.3			
2004	S	2003	Snake R. below HC Dam-Oxbow hatchery-IPC direct	28 May	no CWT	-	-	9,957	-	48.0			(AD+ PIT tagged)
2004	S	2003	NPTH1-direct	04-11 Jun	612675	-	163,830	-	5,766	55.2			
2005	Y	2003	PL1-direct	13-14 Apr	610146	-	79,281	-	1,126	9.9			
2005	Y	2003	PL1-direct	13-14 Apr	610149	69,598	420	279	2	9.9			
2005	Y	2003	BC1-direct	04-05 Apr	610145	-	72,589	-	1,938	10.4			
2005	Y	2003	BC1-direct	04-05 Apr	610147	63,039	253	1,683	7	10.4			
2005	Y	2003	LFH-direct	28-30 Mar	631769	213,142	4,565	240	-	9.4	LR	83.4	
2005	Y	2003	LFH-direct	28-30 Mar	631770	-	218,150	-	623	9.4	LR	84.1	
2005	Y	2003	LFH-direct	28-30 Mar	632368	16,365	33	82	-	9.4	LR	86.7	
2005	S	2004	BC1-direct	30-31 May	612504	96,630	98,657	1,377	313,562	55.3			
2005	S	2004	CJ1 Acclimated [vs. CC]-volitional	28-31 May	610154	94,164	87,888	9,015	314,020	46.8			
2005	S	2004	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	28 April	106676	53,548		4,726		61.5			

Appendix D. (continued) LFH/Snake River hatchery origin fall Chinook releases with number marked, tagged, and unmarked by release year, rearing strategy, Brood year and type of release.

Release Year	S/Y [a]	Brood Year	Release Location-Type	Release Date	Number of Fish Released [b]								
					CWT Code	AD+CWT	CWT Only	Ad-Clip Only	Unmarked Untagged	FPP	VIE Mark	% VIE	Other
2005	S	2004	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	28 April	109370	21,094		1,861		61.5			
2005	S	2004	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	28 April	100471	20,578		1,816		61.5			
2005	S	2004	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	28 April	106776	54,047		4,769		61.5			
2005	S	2004	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	28 April	107176	24,709		2,180		61.5			
2005	S	2004	PL1-Umatilla hatchery-IPC-direct	25-26 May	073336	211,302	-	186,402	-	50.4			
2005	S	2004	Snake R. below HC Dam-Umatilla hatchery-IPC-direct	8-12 May	no CWT	-	-	394,055	-	63.0			
2005	S	2004	NPTH1-volitional	17 May	612669 612672	106,079	140,171	-	115,326	120.8			
2005	S	2004	NPTH1-volitional	17 May	610108 612670	101,580	194,334	-	154,046	115.3			
2005	S	2004	NPTH1-volitional	17 May	no CWT	-	-	-	57,764	110.0			
2005	S	2004	Research Transport Study (NOAA)-direct			-	-	-	-	-			
2005	S	2004	Couse Creek Direct [vs. CJ1 Accl.]	26 May	610155	183,401	1,937	14,853	-	49.2			
2005	S	2004	Snake R. at Couse Creek boat launch-direct	23 May	no CWT	-	-	-	234,030	59.0			
2005	S	2004	Grande Ronde R. -direct	25 May	632782	191,868	610	8,050	244	56.0			
2005	S	2004	Grande Ronde R. unmarked-direct	24 May	no CWT	-	-	-	281,688	66.0			
2005	S	2004	LFH-direct	27 May	632787	195,367	934	3,870	-	51.0			

Appendix D. (continued) LFH/Snake River hatchery origin fall Chinook releases with number marked, tagged, and unmarked by release year, rearing strategy, Brood year and type of release.

Release Year	S/Y [a]	Brood Year	Release Location-Type	Release Date	Number of Fish Released [b]								
					CWT Code	AD+CWT	CWT Only	Ad-Clip Only	Unmarked Untagged	FPP	VIE Mark	% VIE	Other
2006	Y	2004	LFH-direct	5-10 April	633283	223,151	1,489	213	-	9.8	LR	92.5	
2006	Y	2004	LFH-direct	5-10 April	633284	-	220,952	-	4,195	10.3	LR	89.6	
2006	Y	2004	PL1-direct	05 April	610150	66,987	-	2,516	-	10.3			
2006	Y	2004	PL1-direct	05 April	610153	-	77,644	-	2,410	10.3			
2006	Y	2004	BC1-direct	12-13 April	610148	66,732	-	1,965	-	9.3			
2006	Y	2004	BC1-direct	12-13 April	610144	-	59,465	-	1,636	9.3			
2006	Y	2004	CJ1-volitional	11-14 April	610151	70,185	-	490	-	8.9			
2006	Y	2004	CJ1-volitional	11-14 April	610152	-	78,156	-	2,291	8.9			
2006	S	2005	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	02 May	109477	66,879	-	1,091	-	80.3			PIT 12,084
2006	S	2005	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	02 May	109577	68,040	-	1,110	-	80.3			
2006	S	2005	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	02 May	108977	41,257	-	673	-	80.3			
2006	S	2005	Snake R. below HC Dam-Umatilla hatchery-IPC-direct	09-10 May	none	-	-	330,172	1,993	80.3			23,969(AD+ PIT tagged)
2006	S	2005	PL1-Umatilla hatchery-IPC-direct	22-24 May	094419	185,413	-	211,654	-	52.5			PIT 24,162
2006	S	2005	CJ1-volitional	25-29 May	610177	-	99,366	-	306,594	45.6			PIT 2,792
2006	S	2005	CJ1-volitional	25-29 May	610176	98,699	-	2,313	-	45.6			PIT 695
2006	S	2005	BC1-direct	25-26 May	610175	-	98,994	-	304,613	56.7			PIT 46,698
2006	S	2005	BC1-direct	25-26 May	610174	97,763	-	3,336	-	56.7			PIT 11,697
2006	S	2005	Couse Creek Direct [vs. CJ1 Accl. Study]	30-31 May	633583	195,701	262	4,463	394	55.6			PIT 11,995

Appendix D. (continued) LFH/Snake River hatchery origin fall Chinook releases with number marked, tagged, and unmarked by release year, rearing strategy, Brood year and type of release.

Release Year	S/Y [a]	Brood Year	Release Location-Type	Release Date	Number of Fish Released [b]								
					CWT Code	AD+CWT	CWT Only	Ad-Clip Only	Unmarked Untagged	FPP	VIE Mark	% VIE	Other
2006	S	2005	Couse Creek Direct (late release)	22 June	610178	207,606	1,076	2,153	673	50.0			PIT 10,872
2006	S	2005	LFH-direct (accidental release)	04 April	none	-	-	-	71,000	181.0			
2006	S	2005	LFH-direct	01 June	633582	200,369	789	789	263	52.3			PIT 12,095
2006	S	2005	GRR Direct	19-21 June	633584	196,630	335	3,467	208,733	50.6			PIT 25,357
2006	S	2005	Research Transport Study (NOAA) Snake River Release-direct	10 May-03 June	none	-	-	-	229,097	115.0			PIT 229,063
2006	S	2005	Research Transport Study (NOAA) BC1-direct	19 June-09 July	none	-	-	-	150,374	83.0			PIT 109,506
2006	S	2005	NPTH-North Lapwai Valley Accl.	17 May	612707	-	98,670	-	1,148	72.3			
2006	S	2005	NPTH-North Lapwai Valley Accl.	17 May	612671	99,438	-	490	-	72.3			
2006	S	2005	NPTH-Site 1705	6-15 June	612709	-	197,659	-	134,787	59.0			PIT 3,007
2006	S	2005	NPTH-Site 1705	6-15 June	612698	99,163	-	488	-	59.0			
2006	S	2005	NPTH-Cedar Flats Accl.	13 June	612653		16,077	-	187	32.9			PIT 4,984
2006	S	2005	NPTH-Cedar Flats Accl.	13 June	612660	-	9,401	-	109	32.9			-
2006	S	2005	NPTH-Lukes Gulch Accl.	13 June	612655	-	25,099	-	292	36.6			PIT 4,971
2007	Y	2005	LFH-direct	2-6 April	633598	226,442	-	1,805	24,143	11.0	LR	87.8	
2007	Y	2005	LFH-direct	2-6 April	633597	-	220,825	5,489	24,457	10.1	LR	85.5	
2007	Y	2005	PL1-direct	16-17 April	612505	64,106	-	128	2,291	10.0			PIT 4,966
2007	Y	2005	PL1-direct	16-17 April	612510		72,805	-	476	10.0			
2007	Y	2005	PL1-direct	16-17 April	612661	6.863	-	-	14	10.0			
2007	Y	2005	BC1-direct	18-19 April	612507	67,891	-	-	-	10.0			PIT 4,874
2007	Y	2005	BC1-direct	18-19 April	612508	-	77,220	-	10,369	10.0			

Appendix D. (continued) LFH/Snake River hatchery origin fall Chinook releases with number marked, tagged, and unmarked by release year, rearing strategy, Brood year and type of release.

Release Year	S/Y [a]	Brood Year	Release Location-Type	Release Date	Number of Fish Released [b]								
					CWT Code	AD+CWT	CWT Only	Ad-Clip Only	Unmarked Untagged	FPP	VIE Mark	% VIE	Other
2007	Y	2005	CJ1-volitional	13 April	612506	69,180	-	112	9,911	10.0			PIT 3,995
2007	Y	2005	CJ1-volitional	13 April	612509	-	78,588	-	708	10.0			

[a] S/Y indicates subyearling or yearling rearing strategy.
[b] Numbers presented do not necessarily match hatchery records for fish per pound because of reporting constraints for the hatchery. Release information for some NPT release sites that had multiple CWT codes was estimated by WDFW based upon proportions of fish at tagging since those data were not available at the time this report was printed.

Appendix E: Tucannon River Survey Sections 2006 and Historical Escapement Estimates

Appendix E. Table 1. Description and length of sections, survey length, percent of reach surveyed, estimated total number of Chinook redds in the Tucannon River, 2006.

Section	Description	Length of section (Rkm)[a]	Length of section surveyed (Rkm)	% of productive reach surveyed [b]	Chinook Estimated total # of Redds
1	Mouth of Tucannon R. to hwy 261 Bridge	2.8	1.7	100	13
2	Highway 261 Bridge to smolt trap	0.2	0.2	100	1
3	Smolt trap to Powers Bridge	0.5	0.5	100	10
4	Powers Bridge to hog barns	1.2	1.2	100	12
5	Hog barns to Starbuck Bridge [c]	2.5	2.4	100	38
6	Starbuck Bridge to Fletcher's Dam [d]	2.7	1.3	48	48
7	Fletcher's Dam to Smith Hollow	2.9	2.9	100	10
8	Smith Hollow to Ducharme's Bridge	4.4	4.4	100	18
9	Ducharme's Bridge to Highway 12 Bridge	5.5	5.5	100	4
10	Highway 12 Bridge to Brines Rd. Bridge [e]	6.2	4.9	100	0
	Totals	**29.0**	**25.1**	**91**	**153[f]**

[a] Section lengths measured using Maptech, Terrain Navigator Pro version 6.0 software.
[b] Percentage is based upon length of stream that is presumed to successfully produce fry.
[c] Decreased section length by 0.3 Rkm in 2005.
[d] Increased section length by 0.3 Rkm in 2005.
[e] Formerly Enrich Bridge.
[f] Includes an estimated 4 summer Chinook redds based on percent of Chinook carcasses that were summers.

Appendix E, Table 2. Estimated escapement, % stray component of the run, and number of redds, and resulting estimates of smolts/redd and total number of migrants from fall Chinook spawning in the Tucannon River, 1985-2001.

	Escapement		Redd Construction			Success of Spawning	
Year	Estimated escapement [a]	% Strays in fish sampled[b]	# Redds observed	# Redds in no access areas (estim)	Total # of Redds (estim)	Estimated smolts/redd [c]	Total Estimated # emigrants [d]
1985[e]	0	No sampling	0	No estim	0	unknown	unknown
1986[f]	2[g]	No sampling	0	No estim	0	unknown	unknown
1987	48	0	16	0	16	unknown	unknown
1988	78	0	26	0	26	unknown	unknown
1989	150	27.9	48	2	50	unknown	unknown
1990	186	30.8	62[h]	0	62	unknown	unknown
1991	150	20.0	50	0	50	unknown	unknown
1992	69	0	23	0	23	unknown	unknown
1993	84	6.3	28	0	28	unknown	unknown
1994	75	28.0	25	0	25	unknown	unknown
1995	87	33.3	29	0	29	unknown	unknown
1996	144	95.5	43	5	48	0.6[i]	29
1997	93	5.3	27	4	31	712	22,076
1998	132	7.1	40	4	44	15	666
1999	87	9.1	21	8	29	441	12,799
2000	60	27.8	19	1	20	468	9,352
2001	219	14.9	65	8	73	336	24,545

[a] This estimate was derived using three fish per redd.
[b] Minimum estimate.
[c] This estimate was derived using redds counted above the smolt trap and estimates of emigration the following spring. Estimates began in 1997 when the smolt trap was moved to its current position at Rkm 3.0, at an area low enough in the system to trap fall Chinook.
[d] This estimate was derived using the smolt per redd estimate above the trap and applying it to the total number of redds in the Tucannon River.
[e] Based on one survey completed 12/17/85.
[f] Based on one survey completed 11/18/86.
[g] Two carcasses counted but not sampled.
[h] Correction of number of redds observed that was presented in the 1990 Annual Report.
[i] Flood event occurred January of 1997, nearly eliminating all the progeny from the 1996 spawn.

Appendix F: Salmon Carcass Recoveries from, and Estimated Composition of Chinook to the Tucannon River 2006

(Origin states origin, brood year, age at release, and release site (LF01SCJA is a LFH hatchery origin fish from the 2001 brood year, released as a subyearling, from the Captain John Acclimation facility)).

Appendix F. Estimated composition and age of carcasses collected in the Tucannon River in 2006.

			Composition of carcasses			
Origin [a]	**CWT and Scale Age/Rearing**	**CWT/ marks**	**M**	**F**	**J [b]**	**Total**
LFH/Snake River hatchery origin FCH:						
	LF/Snake River hatchery origin (CWT):					
	LF01SCJA	610106		1		1
	LF01YO	631585		1		1
	LF02YO	632167		2		2
	LF03YO	631769	2			2
		631770	1			1
	LF04YO	633283			4	4
		633284			1	1
	Lost tag assigned to 633283				1	
	LFH/Snake River Hatchery Origin (Unmarked/Untagged):					
	Hatchery subyearling res rear age 4	NONE		1		1
	Presume inbasin, scales similar to stray patterns (Unmarked/Untagged)					
	Hatchery subyearling age 3	NONE	1			1
	Hatchery subyearling age 4	NONE	1	3		4
	Hatchery subyearling age 5	NONE	1			1
	Assigned to presumed inbasin from incomplete data			1		
LFH/Snake River Natural Origin (Wild) FCH:						
	Wild subyearling age 3	NONE	1			1
	Wild subyearling age 4	NONE	1	1		2
	Wild subyearling age 5	NONE	2	4		6
	Wild subyearling res rear age 3	NONE		1		1
	Wild subyearling res rear age 4	NONE	1			1
	Wild subyearling res rear age 5	NONE		2		2
	Assigned to Wild from unmarked/untagged			1		
	Assigned to wild from incomplete data			2		
Out-of- Basin (Snake R.) Stray FCH:						
	Klickitat (CWT or 63BLANK wire):					
	Subyearling res rear age 5	63BLANK		1		1
	Bonneville (CWT):					
	BONN01YUMA	093627	1			1
	Hatchery Stray (BLANK or 09BLANK wire):					

Origin [a]	CWT and Scale Age/Rearing	CWT/ marks	Composition of carcasses M	F	J [b]	Total
	Hatchery yearling age 4	BLANK		1		1
	Hatchery yearling age 5	09BLANK		1		1
	Presume Stray (fish left over after assigned inbasin yrl)				2	2
Summer Chinook (Hatchery CWT)						
	SIMILKAMEEN00SUMCHSIMILK	630996		1		1
		Chinook Total:	**12[d]**	**24[d]**	**8**	**44**
Coho (Hatchery)						
	COHO03DNFHCLRWATER	612683	1			1
	Hatchery yearling age 2	Ad Only			1	1
	Hatchery yearling age 3	NONE	1			1
	Coho Total:		**2**	**0**	**1**	**3**

[a] Origin states origin, brood year, age at release, and release site (LF01SCJA is a LFH hatchery origin fish from the 2001 brood year, released as a subyearling, from the Captain John Acclimation facility)
[b] Jacks are <53cm fork length.
[c] Although forty-four Chinook carcasses were collected, one untagged adult did not have any sex, clip, VI, or scale data.
[d] Chinook total includes the adult carcass of unknown sex that was assigned to the F column.

Appendix G: Salmon Processed at LFH in 2006

(LFH=voluntary return to Lyons Ferry Hatchery, LGR=fish trapped at Lower Granite Dam. Age/Rearing states origin, brood year, age at release, and release site (LF00SBCA is a LFH hatchery origin fish from the 2000 brood year, released as a subyearling, from Big Canyon Acclimation site).

Appendix G. Origin, CWT, and number of fish removed from the Snake River and retained at LFH for spawning/run composition purposes in 2006.

			TRAP LOCATION						
			LGR			LFH			
Origin	Age / Rearing [a]	CWT / Marks	Adults	Jacks<53	Total	Adults	Jacks<53	Total	Grand Total
LFH/Snake River Hatchery Origin:									
	LFH/Snake River Hatchery Origin (CWT):								
	LF00SBCA	630271	1		**1**				**1**
	LF00SPLA	630272	1		**1**				**1**
	LF00YO	631273	4		**4**	6		**6**	**10**
	LF01SBCA	612639	3		**3**	2		**2**	**5**
	LF01SCJA	610105	2		**2**	1		**1**	**3**
		610106	1		**1**				**1**
	LF01SO	630890	3		**3**	1		**1**	**4**
	LF01YBCA	610119	1		**1**				**1**
	LF01YCJA	610118	1		**1**	2		**2**	**3**
	LF01YO	631585	5		**5**	85		**85**	**90**
	LF01YPLA	610120				2		**2**	**2**
	LF02SBCA	610122	1		**1**	3		**3**	**4**
	LF02SCCD	631391	1		**1**				**1**
	LF02SCJA	612654				2		**2**	**2**
	LF02SO	631545	5		**5**	7		**7**	**12**
	LF02SPLA	610123	1		**1**				**1**
	LF02YBCA	612659	3		**3**	5		**5**	**8**
	LF02YCJA	612503	2		**2**	7		**7**	**9**
	LF02YO	632167	15		**15**	343		**343**	**358**
	LF03SBCA	612500	8		**8**	1		**1**	**9**
	LF03SCJA	612600	6		**6**	2		**2**	**8**
	LF03SIPCPA	106973	1		**1**				**1**
		107976	1		**1**				**1**
	LF03SO	631786	4		**4**	19		**19**	**23**
	LF03YBCA	610145	5	3	**8**	8		**8**	**16**
		610147	9	1	**10**	7	2	**9**	**19**

Appendix G. (Continued) Origin, CWT, and number of fish removed from the Snake River and retained at LFH for spawning/run composition purposes in 2006.

			TRAP LOCATION						
			LGR			LFH			
Origin	Age / Rearing [a]	CWT / Marks	Adults	Jacks<53	Total	Adults	Jacks<53	Total	Grand Total
	LF03YO	631769	33	10	**43**	435	31	**466**	**509**
		631770	36	3	**39**	377	53	**430**	**469**
		632368	1		**1**	47	2	**49**	**50**
	LF03YPLA	610146	7	2	**9**	3	1	**4**	**13**
		610149	10	4	**14**				**14**
	LF04SBCA	612504		7	**7**		1	**1**	**8**
	LF04SCCD	610155		4	**4**		1	**1**	**5**
	LF04SCJA	610154	1	2	**3**				**3**
	LF04SGRRD	632782	1	2	**3**				**3**
	LF04SIPCHC	107176	1	1	**2**				**2**
	LF04SIPCPA	100471		1	**1**				**1**
		106776		1	**1**				**1**
		109370	1		**1**				**1**
	LF04SO	632787		5	**5**	1	13	**14**	**19**
	LF04YBCA	610144		24	**24**		3	**3**	**27**
		610148		32	**32**				**32**
	LF04YCJA	610151		57	**57**		5	**5**	**62**
		610152		72	**72**		6	**6**	**78**
	LF04YO	633283		62	**62**		147	**147**	**209**
		633284		65	**65**		141	**141**	**206**
	LF04YPA	610150		19	**19**		2	**2**	**21**
		610153		26	**26**		1	**1**	**27**
	NPTH02SLVA	610109	1		**1**				**1**
	NPTH02SO1	610107	1		**1**				**1**
	NPTH02SO2	610110	6		**6**	2		**2**	**8**
	NPTH03SA	612675	3		**3**	1		**1**	**4**
	NPTH04SA	610108	1		**1**				**1**
		612669		2	**2**		1	**1**	**3**

Appendix G. (Continued) Origin, CWT, and number of fish removed from the Snake River and retained at LFH for spawning/run composition purposes in 2006.

			TRAP LOCATION						
			LGR			LFH			
Origin	Age / Rearing [a]	CWT / Marks	Adults	Jacks<53	Total	Adults	Jacks<53	Total	Grand Total
		612672		3	3				3
LFH/Snake River Hatchery Origin (VIE elastomer):									
	Hatchery yearling age 3	ADLR				2		2	2
		LOST TAG (LR)				1		1	1
		LR ONLY	1		1				1
	Hatchery yearling age 4	ADLR				13		13	13
		LR ONLY				1		1	1
	Hatchery yearling age 5	ADLR				1		1	1
	Hatchery yearling unknown age	ADLR				1		1	1
		LOST TAG (LR)				2	5	7	7
		LR ONLY				1		1	1
		LOST TAG (ADLR)		1	1	10	2	12	13
LFH/Snake River Hatchery Origin (Ad Only):									
	Hatchery subyearling age 2	AD ONLY	1		1				1
	Hatchery subyearling age 3	AD ONLY	1		1	2		2	3
	Hatchery subyearling age 4	AD ONLY	3		3				3
	Hatchery subyearling age 5	AD ONLY	1		1				1
	Hatchery subyearling res rear age 2	AD ONLY	1	1	2				2
	Hatchery subyearling res rear age 4	AD ONLY	1		1				1
	Hatchery subyearling res rear age 6	AD ONLY	1		1				1
	Hatchery yearling age 3	AD ONLY					1	1	1
	Hatchery yearling age 4	AD ONLY	2		2	12		12	14

Appendix G. (Continued) Origin, CWT, and number of fish removed from the Snake River and retained at LFH for spawning/run composition purposes in 2006.

			TRAP LOCATION						
			LGR			LFH			
Origin	Age / Rearing [a]	CWT / Marks	Adults	Jacks<53	Total	Adults	Jacks<53	Total	Grand Total
LFH/Snake River Hatchery Origin (Unmarked/Untagged):									
	Hatchery subyearling age 2	NONE	1	1	**2**	1	2	**3**	**5**
	Hatchery subyearling age 3	NONE	37		**37**	7		**7**	**44**
	Hatchery subyearling age 4	NONE	28		**28**	6		**6**	**34**
	Hatchery subyearling age 5	NONE	16		**16**	6		**6**	**22**
	Hatchery subyearling res rear age 3	NONE	17		**17**				**17**
	Hatchery subyearling res rear age 4	NONE	20		**20**	1		**1**	**21**
	Hatchery subyearling res rear age 5	NONE	28		**28**	3		**3**	**31**
	Hatchery subyearling res rear age 6	NONE	1		**1**				**1**
	Hatchery yearling age 3	NONE	1		**1**				**1**
	Hatchery yearling age 4	NONE	2		**2**	4		**4**	**6**
	Hatchery yearling age 5	NONE	1		**1**	4		**4**	**5**
LFH/Snake River Natural Origin (Wild):									
	Wild subyearling age 2	NONE	1	1	**2**	2	1	**3**	**5**
	Wild subyearling age 3	NONE	13		**13**	1		**1**	**14**
	Wild subyearling age 4	NONE	59		**59**	1		**1**	**60**
	Wild subyearling age 5	NONE	25		**25**	1		**1**	**26**
	Wild subyearling res rear age 3	NONE	20		**20**				**20**
	Wild subyearling res rear age 4	NONE	60		**60**	1		**1**	**61**
	Wild subyearling res rear age 5	NONE	28		**28**				**28**
	Wild subyearling res rear age 6	NONE	3		**3**				**3**

Appendix G. (Continued) Origin, CWT, and number of fish removed from the Snake River and retained at LFH for spawning/run composition purposes in 2006.

			TRAP LOCATION						
			LGR			LFH			
Origin	Age / Rearing [a]	CWT / Marks	Adults	Jacks<53	Total	Adults	Jacks<53	Total	Grand Total
Out-of- Basin (Snake R.)-Strays									
	Umatilla (CWT):								
	UMA00SUMA	093255	1		1				1
	UMA01SUMD	093502				1		1	1
	UMA02SUMA	093759	1		1				1
	UMA03S	094027				2		2	2
	UMA03S	094028	1		1				1
	UMA03S	094029				2		2	2
	UMA03S	094030	1		1	1		1	2
	Klickitat (CWT or 63BLANK wire):								
	KLICK02S	631796	1		1				1
	63BLANK	63BLANK				1		1	1
	Bonneville (CWT):								
	BONN04YUMA	092039		1	1				1
	BONN00YUMA	093346				1		1	1
	BONN01YUMA	093628				1		1	1
	BONN03STANNERCR	093750				1		1	1
	BONN02YUMA	093909				2		2	2
	BONN02YUMA	093910				2		2	2
	BONN03YUMA	094053	1		1				1
	Priest Rapids (CWT):								
	PRIEST01COL	631382	1		1				1
	Hatchery Stray (BLANK or 09BLANK wire):								
	Unmarked:no scales taken	09BLANK	3		3	6		6	9
	no scales taken	BLANK		4	4	8		8	12
	Subyearling age 4	BLANK				1		1	1
	Unknown age	BLANK				5		5	5
	Yearling age 2	BLANK		3	3		1	1	4

Appendix G. (Continued) Origin, CWT, and number of fish removed from the Snake River and retained at LFH for spawning/run composition purposes in 2006.

			TRAP LOCATION						
			LGR			LFH			
Origin	Age / Rearing [a]	CWT / Marks	Adults	Jacks<53	Total	Adults	Jacks<53	Total	Grand Total
	Yearling age 3	BLANK				1		1	1
	Yearling age 4	BLANK	3		3	9		9	12
	Yearling age 5	BLANK	1		1	1		1	2
	Yearling age 6	BLANK				1		1	1
	Ad-clipped:Yearling age 3	BLANK				1		1	1
Hatchery Stray (Ad Only):									
	Stray hatchery subyearling age 5	AD ONLY	1		1				1
	Stray hatchery subyearling age 4	AD ONLY	6		6				6
Hatchery Stray (Unmarked/Untagged):									
	Stray hatchery subyearling age 2	NONE	2		2				2
	Stray hatchery subyearling age 3	NONE	29		29	6		6	35
	Stray hatchery subyearling age 5	NONE	2		2				2
	Stray hatchery subyearling age 4	NONE	39		39	3		3	42
Unassigned Hatchery Origin:									
	Unassigned hatchery origin	AD ONLY					1	1	1
	Unreadable scales	AD ONLY				2		2	2
	Unreadable scales	NONE	23		23	5	2	7	30
	LOST Wire	Ad+Wire		1	1	4		4	5
	LOST Wire	No Clips+Wire		3	3		1	1	4
Unknown Origin (Natural or Hatchery):									
	Unreadable scales	NONE				1		1	1
	scales not taken	NONE	3		3	1		1	4

Appendix G. (Continued) Origin, CWT, and number of fish removed from the Snake River and retained at LFH for spawning/run composition purposes in 2006.

			TRAP LOCATION						
			LGR			LFH			
Origin	Age / Rearing [a]	CWT / Marks	Adults	Jacks<53	Total	Adults	Jacks<53	Total	Grand Total
Spring/Summer Chinook									
	Spring Chinook (CWT):								
	CLEARWATER02SPCHLOCHSAW	107275				1		**1**	**1**
	LOOKINGGLASS02SPCHIMNAHA	093822				2		**2**	**2**
	LOOKINGGLASS03SPCHIMNAHA	094033				1		**1**	**1**
	Summer Chinook (CWT):								
	MCCALL02SUMCHSALMON	103275				1		**1**	**1**
		103375				2		**2**	**2**
	WDFW02SUMCHCOLRIVER	631007	1		**1**				**1**
	WDFW04SUMCHCOLRIVER	632864		1	**1**				**1**
	WENATCHEE03SUMCHWENATCH	632581		1	**1**				**1**
	Summer Chinook Natural (Wild):								
	Wild subyearling res rear age 4	NONE				3		**3**	**3**
	Wild subyearling res rear age 5	NONE				3		**3**	**3**
		Chinook Total:	**680**	**426**	**1106**	**1535**	**426**	**1961**	**3067**
Coho (Hatchery)									
	NPTEC03YLAPCLRWATER	612686				1		1	1
	Hatchery yearling age 3	NONE				2		2	2
		Grand Total:	**680**	**426**	**1106**	**1538**	**426**	**1964**	**3070**

[a] Age/Rearing states origin, brood year, age at release, and release site (LF00SBCA is a LFH hatchery origin fish from the 2000 brood year, released as a subyearling, from Big Canyon Acclimation site

Appendix H: Statistical Analysis of 2006 Lower Granite Dam Fall Chinook Run Reconstruction

(Report for the Pacific Salmon Commission Southern Boundary Restoration and Enhancement Project: Lower Granite Fall Chinook Run Reconstruction Assistance).

Statistical Analysis of 2006 Lower Granite Dam Fall Chinook Run Reconstruction

Report for PSC Southern Boundary Restoration and Enhancement Fund Project:

Lower Granite Fall Chinook Run Reconstruction Assistance (Phase 2)

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August 11, 2007

I. Background

In Phase 1 of this study, we developed bootstrap confidence intervals for groups, including wild fish, of fall Chinook salmon, *Oncorhynchus tshawytscha*, returning to Lower Granite dam near Lewiston, ID and Clarkston, WA. This statistical analysis depended on 3 data sets—daily window counts at the dam, data collected from fish trapped at the dam, and data from fish processed at Lyons Ferry Hatchery or the Nez Perce Tribal Hatchery. The result was 90% confidence intervals for each group.

The window count data were used to estimate the numbers of adults and jacks arriving at the dam before and after the trap at the dam was operated. In this case, window counts supplied numbers from August 18th to September 5 and from November 21st to December 15th. The trap was run from September 6th to November 20th. Since the trap was open 13% of the time, dividing the numbers of fish trapped by 13% provides an estimate of fish arriving at the dam for the trapping period. Data collected on trapped fish include sex, length, markings, presence or absence of coded wire tags and PIT tags, and approximately 66% of the untagged fish were scale sampled for age and origin determinations. Some trapped fish were released at the dam and the rest were transported to the hatcheries for processing. More observations were made at the hatcheries of sex, length, and markings and, in addition, coded wire tags were retrieved and read and PIT tags were read and recorded. Scales were collected on all untagged fish. The processing data were used to assign group origin (including wild) to each fish. Fish released at the dam during the trapping period were assigned origins from scale samples taken at the trap.

The group proportions were also applied to fish arriving before and after trapping with the exception of determining numbers of wild fish. Wild fish arrive at the dam earlier than hatchery fish in general (Figure 1). Expanding the wild fish proportions from the trapping period to pre- and post-trapping window counts would not accurately portray the run timing of wild fish.

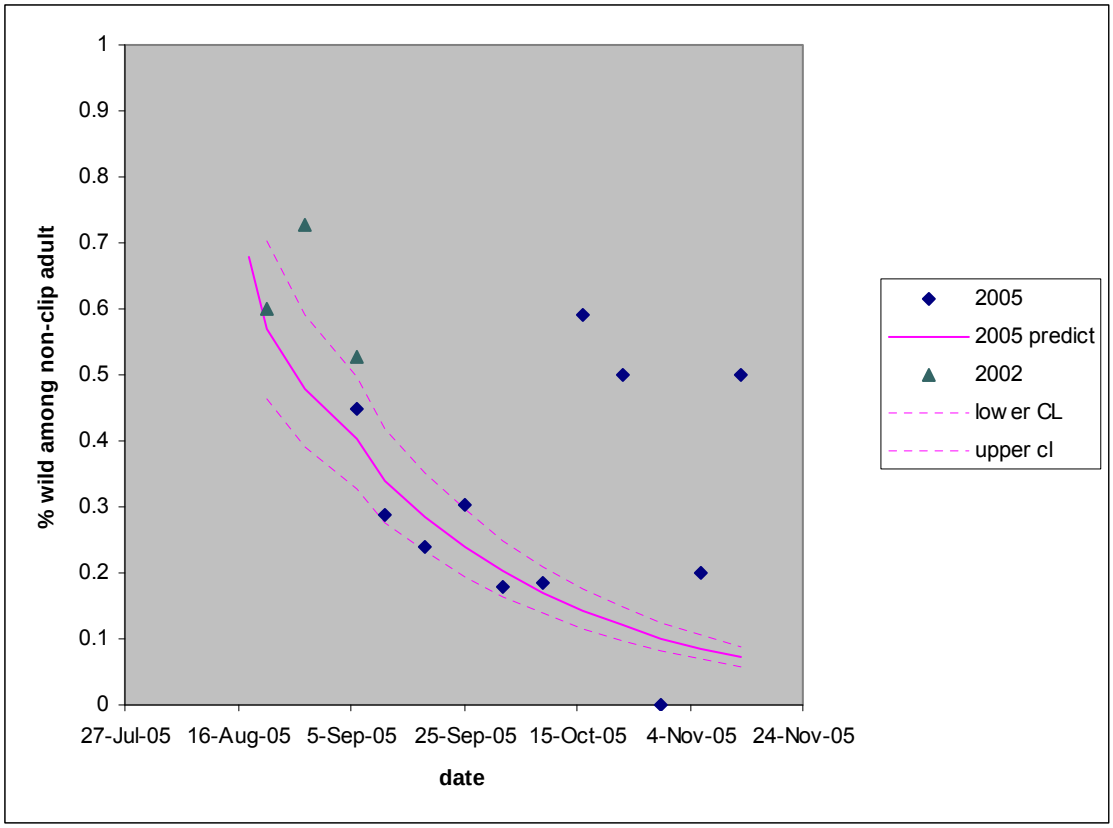
The numbers of wild fish arriving during pre- and post-trapping was estimated by fitting an exponential regression to the % wild among unmarked fish during trapping and projecting the percentages to the weeks before and after trapping. The percent wild among unmarked fish was determined from scale samples taken from approximately 2 out of 3 trapped fish. Given these estimates of % wild adults and jacks before and after trapping by week, the numbers of wild adults and jacks were found by multiplying the expanded window counts of unmarked adults and jacks by the percentage.

After subtracting the numbers of wild adults and jacks pre- and post-trapping, the group proportions were applied to the remaining fish to complete the overall run reconstruction. The result was an estimate of numbers of fish returning to Lower Granite dam by group. In 2005, the total number of fall Chinook returning was estimated to be 13985 with a 90% confidence interval of (13434, 14523).

The literature review reported in the Phase 1 report described various approaches to run reconstruction, but no other run reconstruction process was found that parallels this one. The detailed window count, trap, and processing data sets available for this study were unique as far as we can determine. In 2006, Flynn, Punt, and Hilborn published a paper in the Canadian

Journal of Fisheries and Aquatic Sciences describing a run reconstruction method for Bristol Bay sockeye. That paper described methods for estimating run timing more than run composition.

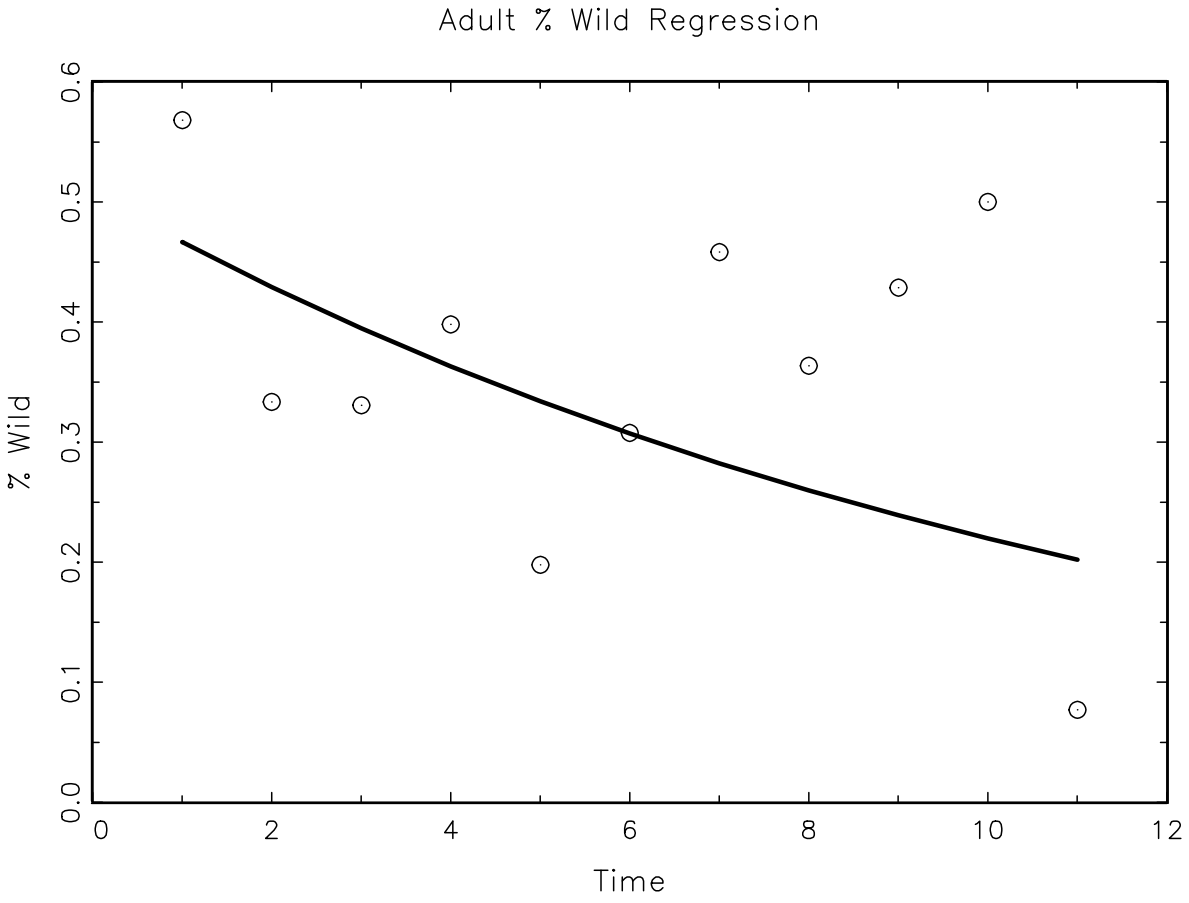
Figure 1. Regression of % wild versus week for adults for 2005 (from Henry Yuen, USFWS).



II. Validation of the bootstrap calculations

The run reconstruction process for the 2006 run was similar to the process used for the 2005 run with a few exceptions. The pre-trap period in 2006 ran from August 18th to August 31st. The trap was run from September 1st to November 21st. The post-trapping period was November 22nd to December 15th. For 2006 we partitioned adults into female and male so 3 sex categories (F,M,Jack) were used. Additionally, we provide confidence intervals for aggregates of groups as well as individual groups.

Figure 2. Exponential decay regression of proportion wild among unmarked adults, 2006.



The regressions for unmarked fish for 2006 confirm that the proportion of wild fish among unclipped fish declines as the season progresses (Figures 2 and 3). The details of the regression calculations for percent of wild fish are detailed on the Wild trap tab of LGRfallchinook.xls. The two points in the upper right corner of the adult regression plot were proportions based on only 4 and 7 fish and were omitted from the regression. The numbers of estimated wild fish before the trapping period was 218 adults and 84 jacks. The numbers of estimated wild fish after the trapping period was 2 adults and 0.3 jacks. These numbers were relatively minor when compared to the total number of wild fish in the run (3744).

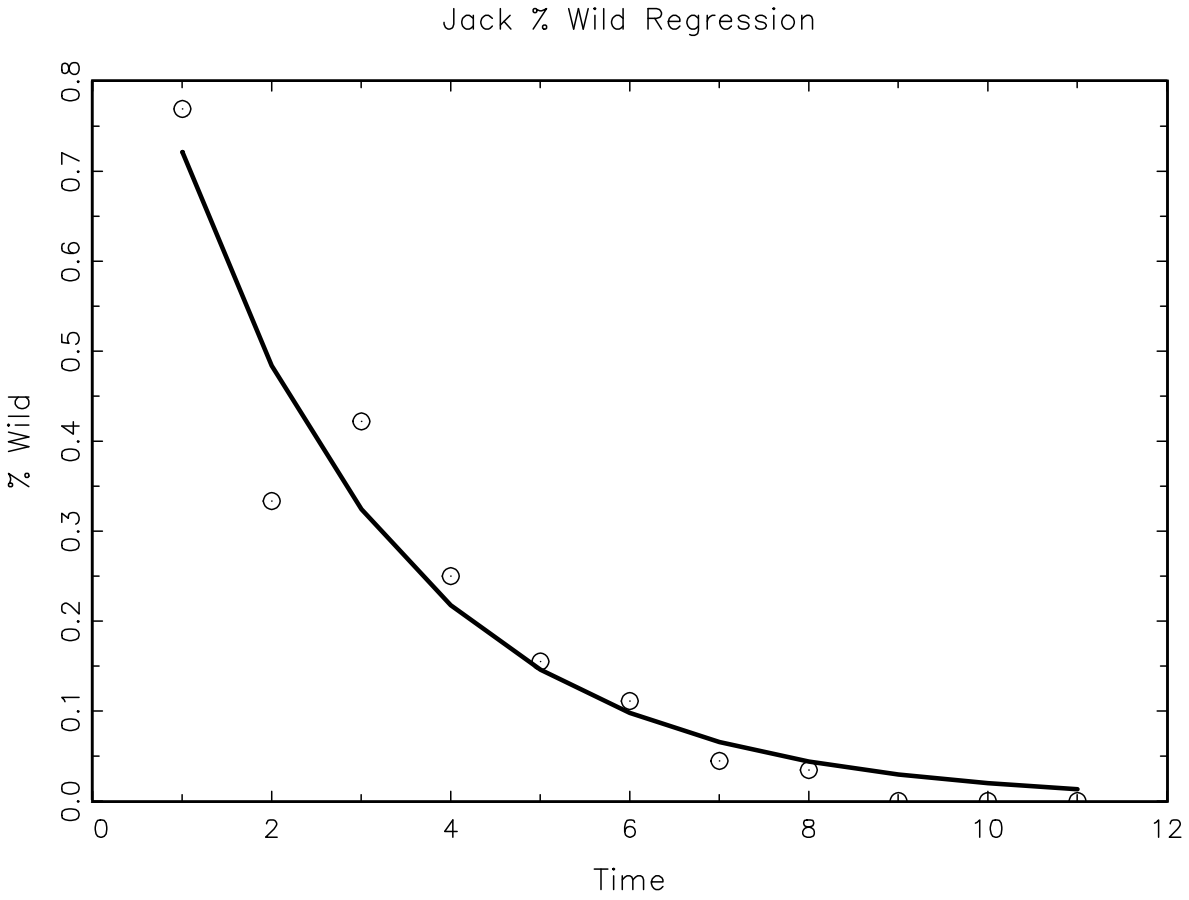
The inputs required to run the GAUSS program were:

Window counts—daily numbers of nonclipped and clipped adults and daily numbers of nonclipped and clipped jacks. Minijacks (fish <30 cm) were not counted at the window.

Trap data—date, week, sex, clip/noclip, coded wire tag presence or absence, PIT tag presence and number, and origin by scale sample. Note that the length of the fish was used to verify adult, jack, and minijack status, but was not read into the program. Minijacks were not included in the analysis.

Estimated Run Composition—numbers of females, males, and jacks for each group. Pre- and post-trapping composition combined with run estimate during trapping.

Figure 3. Exponential decay regression of proportion wild among unmarked jacks, 2006.

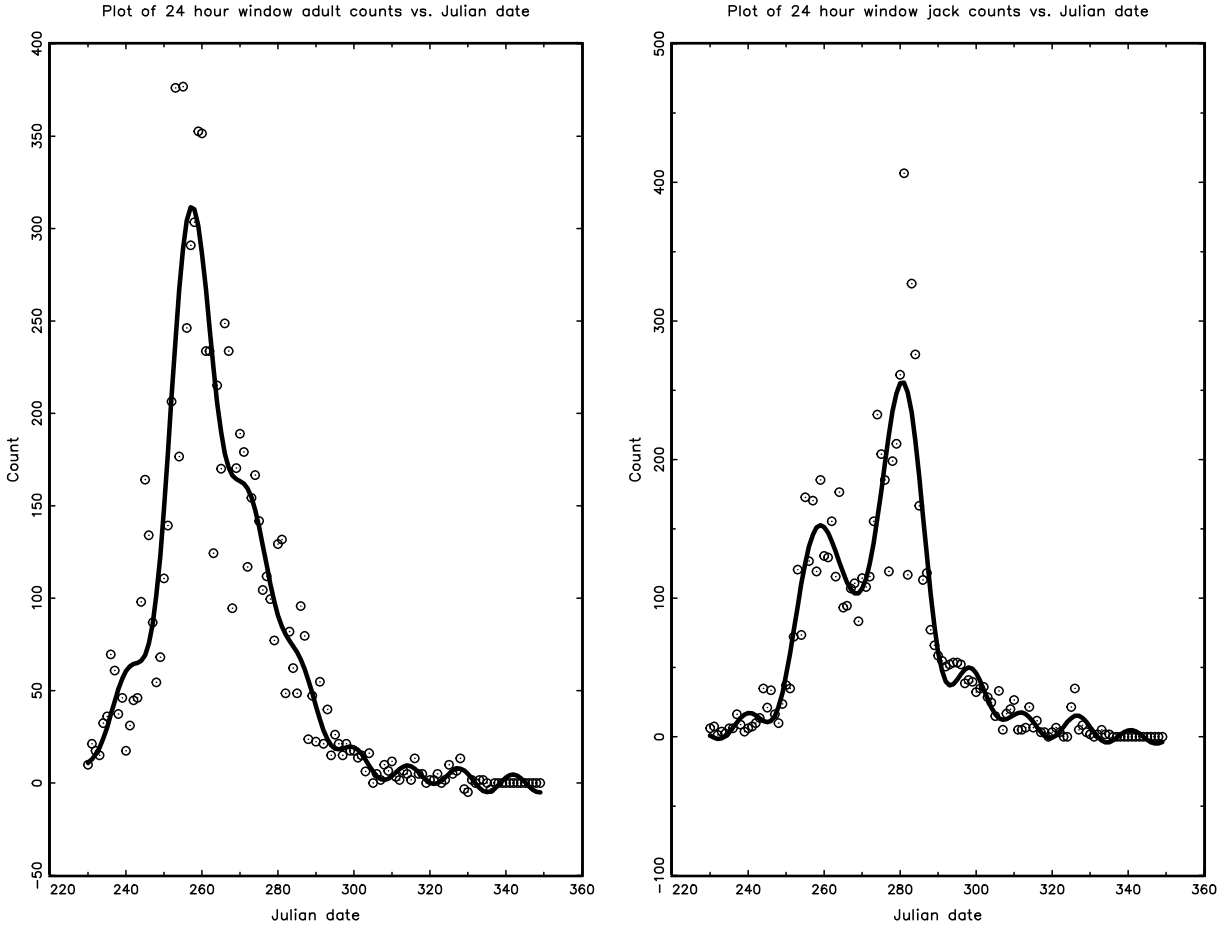


The bootstrap calculations as described in the Phase 1 report consisted of three parts. First a nonparametric bootstrap was applied to the window counts. This was done by fitting a model to the daily counts for adults and jacks, taking bootstrap samples of the residuals, and producing bootstrapped counts by adding the bootstrapped residuals to the daily model values. The model used is a 15 term fast Fourier transform (Figure 4). The bootstrapped daily counts were summed to obtain pre- and post-trapping estimates of numbers of adults and jacks arriving at the dam.

Second, a nonparametric bootstrap sample was taken from the trapping data base. In 2006, the number of fish trapped at the dam during the 13% trapping period was 1950. The estimate of numbers of fish arriving at the dam during the trapping period was 1950/0.13 = 15000. The number of bootstrap samples taken from the trapping database was obtained by generating a

binomial random variable from a binomial with n=15000 and p = 0.13. The average number of bootstrap samples taken was 1950 with a standard deviation of 41.

Figure 4. Daily window counts and 15 term FFT model, 2006.



The bootstrap estimate of numbers of fish arriving at Lower Granite dam, N*, was the sum of the numbers of adults and jacks from the pre- and post-trapping bootstrap window counts and the number of bootstrap samples taken from the trapping database divided by 0.13.

Third, the composition of the bootstrapped run was found by taking a parametric multinomial sample for each of the N* fish. That is, we compute a multinomial trial N* times where the probabilities of a fish having come from any group was the proportion of that group in the 2006 run. Thus each fish was assigned a group at random in proportion to the percentages of each group in the run. In any bootstrap cycle, the composition will vary, but in general will follow the multinomial probability law governed by the group percentages calculated for this year's run.

1000 bootstrap samples were generated. Given the original data, we had 1001 values for 1) numbers of fish arriving pre-trap, 2) numbers of fish arriving during trapping, 3) numbers of fish arriving post-trap, and 4) the numbers of each group returning. By adding the pre-trap, trap, and post-trap numbers, we also had 1001 values for total fish returning to Lower Granite. By ordering each sequence of 1001 numbers, we computed the 90% lower and upper confidence

interval for that quantity by locating the 5th and 95th quantile of the ordered list. For 2006, the values for numbers of fish returning appear in Table 1.

The confidence intervals for numbers returning overall and during trapping meet the goal of knowing the numbers of fish returning within 10% (the numbers in parentheses in Table 1 were 10% lower or higher than the estimates). The numbers of fish returning pre- and post- trapping were not known within 10%. The pre-trapping confidence interval target was 526 to 642. The calculated confidence interval of 475 to 695 was wider. The post-trapping confidence interval target was 73 to 89. The calculated confidence interval was 27 to 142. Because they only make up 4% of the total estimate, their imprecision does not greatly affect the precision of the overall estimator. This year's analysis shows that the bootstrap confidence intervals were valid and should be useful to the researcher and manager.

Table 1. Numbers of fall Chinook arriving at Lower Granite dam, 2006.

Time period	**Estimate**	Lower CI (10%)	Upper CI (10%)
Pre-trapping	**584**	475 (526)	695 (642)
Trap period	**15000**	**14400** (13500)	**15469** (16500)
Post-trapping	**81**	27 (73)	142 (89)
2006 Season	**15665**	**15079** (14098)	**16117** (17232)

Finding confidence intervals for individual groups was a more challenging undertaking. The 2006 90% confidence intervals for groups appear in Table 2. There were 109 groups. Although the bootstrap algorithm produces confidence intervals for each group, the results were not as precise as desired. A few of the confidence interval endpoints were within 10 percent of the estimate. This implies that we know the true number for those groups within 10% with 90% confidence. Estimates whose confidence intervals were within 10% of the estimate were marked with an *. Those estimates whose confidence intervals were within 20% of the estimate were marked with an **. Return groups with around 300 returns were generally known within 10%. Return groups with around 100 returns were often known within 20%. Smaller return groups were hard to estimate.

Table 2. 90% confidence intervals by group for numbers of fall Chinook to Lower Granite 2006.

Stock	L	F	U	L	M	U	L	J	U
LF04SPL1-IPCPA 073336	0	**0**	0	0	**0**	0	10	**17**	24
BONN04YUMA 092039	0	**0**	0	0	**0**	0	11	**18**	25
UMA00SUMA 093255	0	**0**	0	3	**8**	13	0	**0**	0
UMA02SUMA 093759	4	**8**	13	0	**0**	0	0	**0**	0
UMA03S 094028	0	**0**	0	10	**16**	24	0	**0**	0
UMA03S 094030	0	**0**	0	10	**16**	23	0	**0**	0
BONN03YUMA 094053	0	**0**	0	4	**9**	14	0	**0**	0
09BLANK yrl age 5 09BLANK	16	**25**	33	0	**0**	0	0	**0**	0
LF04SIPCHC 100471	0	**0**	0	0	**0**	0	5	**9**	14
LF04SIPCHC 106676	0	**0**	0	4	**9**	14	5	**10**	15
LF04SIPCHC 106776	0	**0**	0	0	**0**	0	19	**28**	37
LF03SIPCPA 106973	4	**8**	13	4	**9**	13	0	**0**	0
LF04SIPCHC 107176	0	**0**	0	4	**9**	13	12	**19**	26
LF03SIPCPA 107976	0	**0**	0	4	**8**	13	0	**0**	0
LF04SIPCHC 109370	0	**0**	0	4	**9**	14	0	**0**	0
LF01SCJA 610105	35	**45**	56	0	**0**	0	0	**0**	0
LF01SCJA 610106	15	**22**	30	0	**0**	0	0	**0**	0
NPTH02SO1 610107	4	**8**	14	0	**0**	0	0	**0**	0
NPTH04SA 610108	0	**0**	0	7	**12**	19	0	**0**	0
NPTH02SLVA 610109	5	**9**	14	0	**0**	0	0	**0**	0
NPTH02SO2 610110	37	**48**	60	5	**10**	15	0	**0**	0
LF01YCJA 610118	10	**16**	23	0	**0**	0	0	**0**	0
LF01YBCA 610119	10	**16**	23	0	**0**	0	0	**0**	0
LF02SBCA 610122	33	**43**	54	0	**0**	0	0	**0**	0
LF02SPLA 610123	10	**17**	24	0	**0**	0	0	**0**	0
LF04YBCA 610144	0	**0**	0	0	**0**	0	209	**236****	262
LF03YBCA 610145	4	**8**	13	62	**77****	92	24	**33**	42
LF03YPLA 610146	0	**0**	0	86	**102****	118	23	**32**	42
LF03YBCA 610147	0	**0**	0	73	**89****	104	17	**25**	34
LF04YBCA 610148	0	**0**	0	0	**0**	0	305	**338***	369
LF03YPLA 610149	0	**0**	0	126	**147****	167	23	**32**	41
LF04YPA 610150	0	**0**	0	0	**0**	0	189	**213****	238
LF04YCJA 610151	0	**0**	0	0	**0**	0	779	**835***	883
LF04YCJA 610152	0	**0**	0	0	**0**	0	917	**975***	1027
LF04YPA 610153	0	**0**	0	0	**0**	0	289	**320***	351
LF04SCJA 610154	0	**0**	0	15	**22**	31	86	**102****	119
LF04SCCD 610155	0	**0**	0	4	**9**	14	26	**36**	45
LF03SBCA 612500	66	**81****	96	143	**165****	186	0	**0**	0
LF01SPLA 612501	10	**16**	23	0	**0**	0	0	**0**	0
LF02YPLA 612502	37	**49**	60	0	**0**	0	0	**0**	0
LF02YCJA 612503	38	**48**	59	4	**8**	13	0	**0**	0
LF04SBCA 612504	0	**0**	0	34	**44**	55	231	**261****	290

* within 10% with 90% confidence ** within 20% with 90% confidence

Table 2 continued	L	F	U		L	M	U		L	J	U
LF03SCJA 612600	73	**88****	105		135	**157****	177		0	**0**	0
LF01SBCA 612639	31	**41**	52		13	**21**	28		0	**0**	0
LF02SCJA 612654	18	**26**	34		0	**0**	0		0	**0**	0
NPTH02SLVA 612657	4	**9**	14		0	**0**	0		0	**0**	0
LF02YBCA 612659	10	**16**	23		17	**24**	33		0	**0**	0
NPTH04SA 612669	0	**0**	0		0	**0**	0		22	**31**	40
NPTH04SA 612672	0	**0**	0		0	**0**	0		32	**42**	52
NPTH03SA 612675	25	**34**	44		0	**0**	0		0	**0**	0
LF00SBCA 630271	8	**14**	20		0	**0**	0		0	**0**	0
LF00SPLA 630272	6	**11**	17		0	**0**	0		0	**0**	0
LF01SO 630890	10	**16**	23		3	**8**	13		0	**0**	0
LF00YO 631273	23	**32**	41		0	**0**	0		0	**0**	0
PRIEST01SCOL 631382	33	**43**	54		0	**0**	0		0	**0**	0
LF02SCCD 631391	0	**0**	0		4	**8**	13		0	**0**	0
LF02SO 631545	23	**32**	42		4	**8**	13		0	**0**	0
LF01YO 631585	66	**81**	97		0	**0**	0		0	**0**	0
LF03YO 631769	23	**32**	42		351	**387***	423		96	**115****	133
LF03YO 631770	16	**24**	32		368	**401***	435		38	**50**	61
LF03SO 631786	10	**16**	23		31	**42**	52		0	**0**	0
KLICK02S 631796	4	**8**	13		0	**0**	0		0	**0**	0
LF02YO 632167	106	**126****	143		39	**51****	63		0	**0**	0
LF03YO 632368	0	**0**	0		10	**16**	23		0	**0**	0
LF04SGRRD 632782	0	**0**	0		11	**17**	24		43	**55**	67
LF04SO 632787	0	**0**	0		4	**9**	14		47	**60**	73
LF04YO 633283	0	**0**	0		0	**0**	0		592	**638***	681
LF04YO 633284	0	**0**	0		0	**0**	0		638	**690***	733
BLANK yrl age 2 BLANK	0	**0**	0		0	**0**	0		52	**65**	79
BLANK yrl age 4 BLANK	10	**16**	23		4	**8**	13		0	**0**	0
BLANK yrl age 5 BLANK	23	**33**	43		4	**8**	13		0	**0**	0
Inbasin unm/untag hatchery sub age 2 by scales- est unassociated Nez Perce Tribal Hatchery	0	**0**	0		0	**1**	2		1	**4**	8
Inbasin unm/untag hatchery sub age 2 by scales- est unassociated Couse Creek Direct	0	**0**	0		3	**7**	12		30	**40**	51
Inbasin unm/untag hatchery sub age 2 by scales- est unassociated Grande Ronde Direct	0	**0**	0		9	**15**	21		68	**84****	99
Inbasin unm/untag hatchery sub age 3 by scales- est unassociated Pittsburg Landing (non IPC)	0	**0**	0		24	**33**	42		0	**2**	4
Inbasin unm/untag hatchery sub age 5 by scales- est unassociated Big Canyon 2nd release	124	**145****	165		23	**32**	41		0	**0**	0
Inbasin AD only hatchery sub age 2 by scales- est unassociated Hells Canyon IPC	0	**0**	0		6	**12**	18		69	**85****	101

* within 10% with 90% confidence ** within 20% with 90% confidence

Table 2 continued	L	F	U		L	M	U		L	J	U
Inbasin unm/untag hatchery sub age 2 by scales-unknown release site	0	**0**	0		30	**41**	51		209	**233***	261
Inbasin unm/untag hatchery sub age 3 by scales- unknown release site	0	**0**	0		443	**483***	520		15	**23**	31
Inbasin unm/untag hatchery sub age 4 by scales- unknown release site	231	**261****	288		322	**356***	386		0	**0**	0
Inbasin unm/untag hatchery sub age 5 by scales- unknown release site	201	**226****	249		38	**49**	62		0	**0**	0
Inbasin AD only hatchery sub age 3 by scales (not IPC)- unknown release site	0	**0**	0		3	**7**	11		0	**0**	0
Presumed IPC-Inbasin AD only hatchery sub age 4 by scales	31	**42**	53		9	**16**	23		0	**0**	0
Presumed IPC-Inbasin AD only hatchery sub age 5 by scales	11	**17**	24		0	**0**	0		0	**0**	0
Presumed IPC-Inbasin AD only hatchery sub age 6 by scales	4	**8**	13		0	**0**	0		0	**0**	0
Unknown hatchery yrl age 3 unm/untag	0	**0**	0		1	**4**	7		3	**7**	11
Unknown hatchery yrl age 4 unm/untag	11	**17**	24		4	**9**	14		0	**0**	0
Unknown hatchery yrl age 5 unm/untag	4	**9**	14		4	**8**	14		0	**0**	0
Unknown hatchery yrl age 4 AD only	13	**20**	27		2	**6**	10		0	**0**	0
Unknown hatchery yrl age 5 AD only	10	**16**	23		0	**0**	0		0	**0**	0
Possible HSTRAY unm/untag sub age 2 scales	0	**0**	0		18	**25**	34		111	**130****	149
Possible HSTRAY unm/untag sub age 3 scales	104	**123****	142		326	**358***	390		3	**8**	13
Possible HSTRAY unm/untag sub age 4 scale	299	**332****	363		165	**188****	210		0	**0**	0
Possible HSTRAY AD only sub age 2 scales	0	**0**	0		4	**8**	13		5	**9**	15
Possible HSTRAY AD only sub age 4 scales	46	**58****	70		4	**8**	13		0	**0**	0
Possible HSTRAY AD only sub age 5 scales	3	**8**	13		0	**0**	0		0	**0**	0
PIT tag unm/untag inbasin hatchery sub age 4-Research near Couse Creek	4	**9**	14		0	**0**	0		0	**0**	0
PIT tag unm/untag inbasin hatchery res rear age 5-Research near Couse Creek	4	**9**	13		0	**0**	0		0	**0**	0
WILD res rear age 2 scales	0	**0**	0		0	**0**	0		334	**369***	399
WILD res rear age 3 scales	0	**0**	0		252	**282***	308		33	**44**	57
WILD res rear age 4 scales	353	**387***	418		262	**291***	319		0	**0**	0
WILD res rear age 5 scales	295	**326***	356		41	**53**	66		0	**0**	0
WILD res rear age 6 scales	19	**28**	36		0	**0**	0		0	**0**	0
WILD sub age 2 scales	0	**0**	0		18	**26**	35		476	**519***	557
WILD sub age 3 scales	35	**46**	56		161	**186***	207		0	**0**	0
WILD sub age 4 scales	457	**498***	532		261	**291***	318		0	**0**	0
WILD sub age 5 scales	208	**234***	260		57	**71***	84		0	**0**	0
PIT tag unm/untag inbasin late migrant age 5-WILD res rear scales	4	**9**	15		0	**0**	0		0	**0**	0
PIT tag unm/untag presumed inbasin (H or W) late migrant age 4-WILD res rear scales	4	**9**	14		4	**9**	14		0	**0**	0

* within 10% with 90% confidence ** within 20% with 90% confidence

While individual researchers are very interested in the returns for a particular group, managers are more likely to be interested in the bigger picture. We calculated confidence intervals for strays (out-of-basin), Snake River hatchery fish, and wild fish by age (Table 3). Confidence intervals for small numbers of fish were still imprecise. For example, the confidence interval for male out of basin subyearling age 3 fish is 24 to 43. The desired limits would be 30 to 36. For larger numbers of fish, the goal of knowing the true number of fish returning within 10% with a confidence of 90% was met. For example, for female Snake River hatchery subyearlings of age 3, the confidence interval was 319 to 382. The desired limits were 316 to 386. We were 90% confident that the true number of age 3 female Snake River hatchery subyearlings was within 10% of the estimate of 351.

Table 3. 90% intervals for groups collapsed into stray, Snake River hatchery, and wild, 2006.

Stock/rearing type/total age	L	F	U		L	M	U		L	J	U
out-of-basin hatchery subyearling age 3	0	0	0		24	33	43		0	0	0
out-of-basin hatchery subyearling age 4	10	16	23		0	0	0		0	0	0
out-of-basin hatchery subyearling age 5	32	43	54		0	0	0		0	0	0
out-of-basin hatchery subyearling age 6	0	0	0		4	8	13		0	0	0
out-of-basin hatchery yearling age 2	0	0	0		0	0	0		69	83	97
out-of-basin hatchery yearling age 3	0	0	0		7	13	19		3	7	11
out-of-basin hatchery yearling age 4	41	54	66		15	23	31		0	0	0
out-of-basin hatchery yearling age 5	67	82	97		10	17	24		0	0	0
OUT OF BASIN	**172**	**196**	**221**		**77**	**93**	**108**		**74**	**89**	**106**
Snake R. hatchery subyearling age 2	0	0	0		222	248	274		1182	1254	1311
Snake R. hatchery subyearling age 3	319	351	382		1198	1261	1322		24	32	42
Snake R. hatchery subyearling age 4	839	896	952		549	593	637		0	0	0
Snake R. hatchery subyearling age 5	507	546	583		93	110	127		0	0	0
Snake R. hatchery subyearling age 6	24	33	44		0	0	0		0	0	0
Snake R. hatchery yearling age 2	0	0	0		0	0	0		4100	4245	4381
Snake R. hatchery yearling age 3	52	65	78		1156	1220	1282		258	288	315
Snake R. hatchery yearling age 4	212	239	264		68	83	99		0	0	0
Snake R. hatchery yearling age 5	96	114	132		0	0	0		0	0	0
Snake R. hatchery yearling age 6	23	32	41		0	0	0		0	0	0
SNAKE R. HATCHERY	**2175**	**2276**	**2363**		**3390**	**3516**	**3635**		**5636**	**5818**	**5994**
Snake R. Wild reservoir reared age 2	0	0	0		0	0	0		335	369	400
Snake R. Wild reservoir reared age 3	0	0	0		253	282	311		33	44	55
Snake R. Wild reservoir reared age 4	361	396	427		271	300	330		0	0	0
Snake R. Wild reservoir reared age 5	303	336	365		41	53	65		0	0	0
Snake R. Wild reservoir reared age 6	19	28	36		0	0	0		0	0	0
Snake R. Wild subyearling age 2	0	0	0		18	26	35		477	519	552
Snake R. Wild subyearling age 3	34	46	57		162	186	207		0	0	0
Snake R. Wild subyearling age 4	459	498	534		262	291	321		0	0	0
Snake R. Wild subyearling age 5	207	234	258		56	71	84		0	0	0
SNAKE R. WILD	**1456**	**1536**	**1610**		**1144**	**1209**	**1268**		**880**	**931**	**984**

III. "What if" analysis and the program

Having verified that the GAUSS program was stable and robust by applying it to a second year's data, we next ask if it was flexible enough to ask interesting questions about choices that can be made about counting, trapping, and processing. Since one can build any 3 data sets for the program as described above (window counts, trap data, and composition), any return and sampling protocol can be simulated easily.

For example, suppose the run was twice the size it was in 2005 or 2006. By combining all of the window counts for 2005 and 2006 and combining the trapping databases, we simulated a run that was the size of both years combined. Assuming the female/male ratios were the same for both years and the combined composition resembles the 2006 composition, we adopted the composition from 2006 for the composition data set. All of the estimates were within 10% of the truth with 90% confidence except for out-of-basin males and jacks (Table 4). For out-of-basin males the target confidence interval was 154 to 188. The calculated confidence interval was 149 to 194, slightly larger. For jacks the target confidence interval was 149 to 183. The calculated confidence interval was 144 to 184.

Table 4. 90% confidence intervals on *combined* data sets from 2005 and 2006.

GROUP	lower	Female	Upper		lower	Male	upper		lower	Jack	upper
OUT OF BASIN	328	**362**	394		149	**171**	194		144	**166**	185
SNAKE R. HATCHERY	4061	**4212**	4346		6295	**6506**	6681		10439	**10766**	11037
WILD	2728	**2843**	2946		2138	**2320**	2372		1637	**1724**	1797
GRAND TOTAL (F,M,J)	28191	**28987**	29586								

The program also has a second "what if" option built into it. The program allows an arbitrary trapping rate to be set and confidence intervals can be found using that trapping rate with the current trapping data.

Table 5. 90% confidence intervals with the trapping rate at 13%, 2006.

Group/rearing type/total age	lower	Female	upper		lower	Male	upper		lower	Jacks	upper
OUT OF BASIN	171	**196**	219		76	**93**	108		74	**89**	105
SNAKE R. HATCHERY	2161	**2276**	2372		3349	**3516**	3651		5569	**5818**	6013
WILD	1448	**1536**	1613		1134	**1209**	1271		872	**931**	987

The 2005-2006 trapping rate was 13%. Does it make a difference if the trapping rate was higher or lower? We compared 13% to 6% and 20% trapping rates for groups collapsed to out-of-basin, Snake R. hatchery, and wild. If the trapping rate was set to 6%, the out of basin confidence intervals were comparable to the results found when the actual trapping rate of 13% was used. The other confidence intervals were generally wider. For example, the confidence interval for

the grand total was 14696 to 16293. The results obtained with the 13% sampling rate were 15079 to 16117.

Table 6. 90% confidence intervals if trapping rate was 6%, 2006.

GROUP	lower	female	Upper	Lower	Male	upper	lower	jack	upper
OUT OF BASIN	169	**196**	220	75	**93**	109	73	**89**	105
SNAKE R.HATCHERY	2110	**2276**	2391	3276	**3516**	3685	5442	**5818**	6064
WILD	1422	**1536**	1621	1111	**1209**	1278	856	**931**	990
GRAND TOTAL (F,M,J)	14696	**15665**	16293						

If the trapping rate was set to 20%, the confidence intervals should be shorter. In some cases they were and in some cases they were not. Underlined values in Table 7 were tighter under 20% sampling when compared to the same confidence limits under 13%. The most notable improvement in confidence interval width was for the grand total.

Table 7. 90% confidence intervals if trapping rate was 20%, 2006.

GROUP	lower	female	upper	lower	male	upper	lower	jack	upper
OUT OF BASIN	172	**196**	218	76	**93**	108	74	**89**	104
SNAKE R. HATCHERY	2173	**2276**	2366	3378	**3516**	3624	5620	**5818**	5981
WILD	1455	**1536**	1606	1145	**1209**	1274	876	**931**	985
GRAND TOTAL (F,M,J)	15212	**15665**	16034						

IV. Comparison of 2005 and 2006 results

The individual groups were not comparable in 2005 and 2006, but we could compare the confidence intervals for out-of-basin, Snake River hatchery, and wild groups for the two years. During 2005 we only had adult and jack estimates so female and male data from 2006 were collapsed to adults for comparisons in Table 8. The run estimate was 12% higher in 2006 (13985 vs. 15665).

Table 8. Comparison of 2005 and 2006 90% confidence intervals.

Group	L	Adults	percent	U	L	Jacks	percent	U
2005								
	1286	**1367.1**	**11.7%**	1446	126	**148.1**	**6.3%**	168
	6876	**7162.4**	**61.5%**	7446	1784	**1880.4**	**80.1%**	1986
	2986	**3108.6**	**26.7%**	3252	288	**318.7**	**13.6%**	350
GRAND TOTAL (adults+jacks)	13434	**13985**		14523				
2006								
	258	**288**	**3.3%**	317	73	**89**	**1.3%**	105
	5593	**5792**	**65.6%**	5959	5624	**5818**	**85.1%**	5981
	2631	**2746**	**31.1%**	2847	873	**931**	**13.6%**	981
GRAND TOTAL (adults+jacks)	15079	**15665**		16117				

The proportions of Snake River hatchery fish were comparable for both years for both adults and jacks. The proportions of out-of-basin and wild fish were different for adults. There were relatively fewer out-of-basin adults in 2006 and more wild fish.

All but one of the confidence intervals in this table show that we know the true numbers of fish arriving at Lower Granite dam in these categories within 10%. For out-of-basin adults in 2006, the confidence interval was 258 to 317. The target confidence interval was 259 to 317. We were just outside the lower target. At the out-of-basin, hatchery, and wild level, sampling was adequate in both years.

In 2005 the coefficient of variation (CV) of the estimate was std error/estimate = 323.4/13985 = 2.3%. In 2006 the CV was 315.9/15665 = 2.0%. The precision for both years was comparable.

V. Discussion

The statistical intervals documented in this report were sensitive enough to detect differences in run sizes and gross composition in 2005 and 2006. The confidence intervals for total fish returning (13434 to 14523 and 15079 to 16117) do not overlap. The numbers of strays, Snake River hatchery, and wild fish can be seen to be different in the 2 years.

Interestingly, the proportion of jacks returning to Lower Granite dam was different in the two years. For 2005, the proportion was 2347/13985 = 17.5% and for 2006 the proportion was 6839/15665 = 43.6%. The confidence intervals for jacks do not overlap for the two years.

It was clear from the 2005 and 2006 analyses that we were not able to precisely estimate the numbers of fish returning by group in all cases. The confidence interval lower and upper limits for each group rarely were within 10% of the estimate. We do much better at the out-of-basin, hatchery, wild/age level (Table 3). We do even better at the out-of-basin, hatchery, wild level (Tables 5 and 8). We know the total numbers of fish returning within 10%.

In retrospect, constructing the run composition by female, male, and jack was a decided improvement in 2006. Since age at return and thus composition of females are different from males, the estimates were greatly improved by dividing adults in to females and males for the calculations. Managers need to know sex as well as age, The drawback to this separation of adults into female and male is that some of the individual numbers were smaller and, hence, our confidence intervals did not meet the 10% target. Where the numbers were adequate, however, we did a good job of estimating returns by sex and age.

References

Flynn, Lucy, Andre Punt, and Ray Hilborn (2006) A hierarchical model for salmon run reconstruction and application to the Bristol Bay sockeye salmon (*Oncorhynchus nerka*) fishery. Can. J. Fish. Aquat. Sci.63: 1564-1577.

Steinhorst, Kirk, Deborah Milks, and Bill Arnsberg (2006) Statistical Analysis of 2005 Lower Granite Dam fall Chinook Run Reconstruction. Report to the Pacific Salmon Commission Southern Boundary Restoration and Enhancement Fund, 15 pp.

APPENDIX A. Program listing (available upon request)

APPENDIX B. Example input data

****
Window counts—note that these are RAW counts, not expanded
****

Date	week	Non-Clipped Adult	Clipped Adult	Non-Clipped Jack	Clipped Jack
18-Aug	1	6	2	4	1
19-Aug	1	12	5	3	3
20-Aug	1	10	4	1	0
21-Aug	1	13	-1	2	1
22-Aug	1	21	5	2	0
23-Aug	1	24	5	5	0
24-Aug	1	49	7	3	2
25-Aug	2	44	5	12	1
26-Aug	2	24	6	7	0
27-Aug	2	33	4	2	1
28-Aug	2	13	1	4	1
29-Aug	2	23	2	6	0
30-Aug	2	32	4	7	1
31-Aug	2	30	7	10	1
1-Sep	3	60	25	17	11
2-Sep	3	101	31	14	3
3-Sep	3	98	16	23	4

****

Trap data

****

Trap Date	Week	SpeciesAbbr	Run	SamplePct	REL/HAUL	Sexr	FL_cm	Clip	Wire	Recap?	PITTag	CWT	Origin_ScaleData
9/1/2006	3	CHIN	FALL	13	LFH	M	54	NO	N	FALSE			H
9/1/2006	3	CHIN	FALL	13	LFH	F	83	NO	N	FALSE			
9/1/2006	3	CHIN	FALL	13	LFH	F	84	NO	N	FALSE			W
9/1/2006	3	CHIN	FALL	13	REL	J	52	NO	N	FALSE			W
9/2/2006	3	CHIN	FALL	13	LFH	M	54	NO	N	FALSE			
9/2/2006	3	CHIN	FALL	13	LFH	M	66	NO	N	FALSE			W
9/2/2006	3	CHIN	FALL	13	LFH	M	69	NO	N	FALSE			
9/2/2006	3	CHIN	FALL	13	LFH	M	72	NO	N	FALSE			H
9/2/2006	3	CHIN	FALL	13	LFH	F	73	AD	N	FALSE			
9/2/2006	3	CHIN	FALL	13	LFH	F	77	NO	N	FALSE			H
9/2/2006	3	CHIN	FALL	13	LFH	F	80	AD	Y	FALSE			
9/2/2006	3	CHIN	FALL	13	LFH	F	86	NO	N	FALSE			W
9/2/2006	3	CHIN	FALL	13	LFH	F	94	NO	N	FALSE			W
9/2/2006	3	CHIN	FALL	13	LFH	F	96	NO	N	FALSE			W
9/2/2006	3	CHIN	FALL	13	REL	J	45	NO	N	FALSE			W
9/3/2006	3	CHIN	FALL	13	LFH	J	46	NO	Y	FALSE			
9/3/2006	3	CHIN	FALL	13	LFH	J	48	NO	Y	FALSE			
9/3/2006	3	CHIN	FALL	13	LFH	M	67	NO	N	FALSE			H
9/3/2006	3	CHIN	FALL	13	LFH	M	67	NO	N	FALSE			W
9/3/2006	3	CHIN	FALL	13	LFH	M	75	NO	N	FALSE			W
9/3/2006	3	CHIN	FALL	13	LFH	F	78	NO	N	FALSE			
9/3/2006	3	CHIN	FALL	13	LFH	M	78	NO	N	FALSE			
9/3/2006	3	CHIN	FALL	13	LFH	F	78	NO	N	FALSE			W
9/3/2006	3	CHIN	FALL	13	LFH	M	80	NO	N	FALSE			W
9/3/2006	3	CHIN	FALL	13	LFH	F	80	NO	N	FALSE			W
9/3/2006	3	CHIN	FALL	13	LFH	M	84	NO	N	FALSE			
9/3/2006	3	CHIN	FALL	13	LFH	M	85	NO	N	FALSE			
9/3/2006	3	CHIN	FALL	13	LFH	F	88	NO	N	FALSE			HSTRAY

****

Estimated run composition—this example was used to produce the CIs for Table 3

****

Origin_CWT	Females	Males	Jacks
out-of-basin hatchery subyearling age 3	0	33	0
out-of-basin hatchery subyearling age 4	16	0	0
out-of-basin hatchery subyearling age 5	43	0	0
out-of-basin hatchery subyearling age 6	0	8	0
out-of-basin hatchery yearling age 2	0	0	83
out-of-basin hatchery yearling age 3	0	13	7
out-of-basin hatchery yearling age 4	54	23	0
out-of-basin hatchery yearling age 5	82	17	0
Snake R. hatchery subyearling age 2	0	248	1254
Snake R. hatchery subyearling age 3	351	1261	32
Snake R. hatchery subyearling age 4	896	593	0
Snake R. hatchery subyearling age 5	546	110	0
Snake R. hatchery subyearling age 6	33	0	0
Snake R. hatchery yearling age 2	0	0	4245
Snake R. hatchery yearling age 3	65	1220	288
Snake R. hatchery yearling age 4	239	83	0
Snake R. hatchery yearling age 5	114	0	0
Snake R. hatchery yearling age 6	32	0	0
Snake R. Wild reservoir reared age 2	0	0	369
Snake R. Wild reservoir reared age 3	0	282	44
Snake R. Wild reservoir reared age 4	396	300	0
Snake R. Wild reservoir reared age 5	336	53	0
Snake R. Wild reservoir reared age 6	28	0	0
Snake R. Wild subyearling age 2	0	26	519
Snake R. Wild subyearling age 3	46	186	0
Snake R. Wild subyearling age 4	498	291	0
Snake R. Wild subyearling age 5	234	71	0

Appendix I: Addendum to Statistical Analysis of 2006 Lower Granite Fall Chinook Run Reconstruction

Addendum to:

Statistical Analysis of 2006 Lower Granite Dam Fall Chinook Run Reconstruction

Report for PSC Southern Boundary Restoration and Enhancement Fund Project:

Lower Granite Fall Chinook Run Reconstruction Assistance (Phase 2)

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August 20, 2007

Uncertainty related to origin of fish after CWT and unassociated assignments

Addendum 1 lists the final groupings of untagged hatchery fish that were not assigned to CWT or unassociated hatchery release groups. Each of the individual groups in Addendum 1 were included in Table 2, but the final assignments were not apparent from the name of the groups.

The "Inbasin unm/untag hatchery fish from unknown release sites" and "AD only hatchery fish from unknown release sites" (Addendum 1) were assigned to the Snake R. Hatchery group in Table 3. Since unassociated releases in the Snake R. did not have CWTs associated with them, SARs of fish from similar sites but from different return years were used to estimate their returns. It is possible that we underestimated the number of unassociated returns and the unm/untag fish in this group are actually from unassociated releases. In addition, because of uncertainty related to scale analysis, we suspect some proportion of these fish may be from out of basin, but we do not know to what extent.

The "Possible HSTRAY unm/untag sub" and "Possible HSTRAY AD only sub" groups were assigned to the Snake R. Hatchery group (Table 3) because CWT recoveries shed doubt on the magnitude of the estimated out of basin return using scale determinations. It is also possible that some of the Snake R. hatchery subyearlings reared at Umatilla Hatchery and Oxbow hatcheries (unassociated releases) were identified as HSTRAY by scale analysis. We do not have enough scale data from CWT fish from those hatcheries to determine if the scales have patterns similar to out of basin fish. Then again, it is possible that these fish were from out of basin unassociated releases, but we have no way of telling if that was the case.

The "Unknown hatchery yrl" were assigned to the out of basin group in Table 3. There is a lot of uncertainty regarding this group. Releases of yearling fall Chinook in the Snake R. basin have been essentially 100% marked or tagged over recent years. Yearling fall Chinook are also reared at Bonneville Hatchery but they are supposed to be 100% marked as well. Another option would be that the fish are untagged yearling releases of summer Chinook from the upper Columbia River. Scale analysis can only determine the age of the yearling hatchery fish, not origin so we rely solely on CWT data to determine the origin of yearlings.

There are many uncertainties related to scale analysis. Efforts are being made to continue to refine scale analysis for origin determinations. It is important that representative tag groups continue for each hatchery release to minimize uncertainty related to estimating the run composition at LGR.

Addendum 1. Presumed origins of untagged hatchery fish that could not be assigned to CWT or unassociated hatchery release groups.

Final groupings	Scale origins	Run Reconstruction Assignments	Individual groups (from Table 2)
Snake R. Hatchery	Inbasin hatchery	Presumed Inbasin (unknown hatchery)	Inbasin unm/untag hatchery sub age 2 by scales-unknown release site
			Inbasin unm/untag hatchery sub age 3 by scales-unknown release site
			Inbasin unm/untag hatchery sub age 4 by scales-unknown release site
			Inbasin unm/untag hatchery sub age 5 by scales-unknown release site
			Inbasin AD only hatchery sub age 3 by scales (not IPC)-unknown release site
		Presumed IPC	Presumed IPC-Inbasin AD only hatchery sub age 4 by scales
			Presumed IPC-Inbasin AD only hatchery sub age 5 by scales
			Presumed IPC-Inbasin AD only hatchery sub age 6 by scales
	Possible HSTRAY (hatchery)	Presumed Inbasin (unknown hatchery)	Possible HSTRAY unm/untag sub age 2 scales
			Possible HSTRAY unm/untag sub age 3 scales
			Possible HSTRAY unm/untag sub age 4 scales
		Presumed IPC	Possible HSTRAY AD only sub age 2 scales
			Possible HSTRAY AD only sub age 4 scales
			Possible HSTRAY AD only sub age 5 scales
Out of basin	Unknown hatchery	Presumed stray (unknown hatchery)	Unknown hatchery yrl age 3 unm/untag
			Unknown hatchery yrl age 4 unm/untag
			Unknown hatchery yrl age 5 unm/untag
			Unknown hatchery yrl age 4 AD only
			Unknown hatchery yrl age 5 AD only

Differences between determination of origins in 2005 and 2006 datasets

In 2005, HSTRAY fish were assigned out of basin, which is different from what was done for 2006 after discrepancies were noted in blind tests. Origins for other fish were assigned in the same manner each year. This report compares the statistical confidence intervals for out of basin, Snake River hatchery, and Snake River wild adults and jacks. Although the differences in estimates are partly due to differences in HSTRAY assignment, the assessment of precision as measured by the confidence interval widths is still relevant.

Appendix J: Recoveries of Wire Tagged LFH/Snake River Hatchery Origin Fall Chinook Outside of the Snake River Basin in Return Year 2006

(Includes recoveries of fish from the following release sites: LFH onstation and Couse Creek Boat Launch on the Snake River, and the Grande Ronde near the Cougar Creek, downloaded from RMIS 5/19/08. This data was not expanded for tag loss, sample detection method, or fishery.)

Appendix J. Locations and estimated totals of LFH/Snake River origin wire-tagged fish recovered during 2006. Based upon 5/19/08 download of CSV file from RMIS. Wire recoveries reported in this table are from the following release sites: Lyons Ferry Hatchery on-station and Couse Creek Boat Launch on the Snake River, and the mouth of Cougar Creek on the Grande Ronde River. Data for untagged fish associated with the wire-tagged fish are not included. This data was not expanded for tag loss, sample detection method, or fishery.

			Subyearling Brood Year					Yearling Brood Year						
Area	**Locale [a]**	**Recovery Location**	**2001**	**2002**	**2003**	**2004**	**Total**	**2000**	**2001**	**2002**	**2003**	**2004**	**Total**	**Grand Total**
Freshwater	COL	Hatchery Rack	0	0	0	1	1	0	0	0	6	0	6	7
		Umatilla R. Trap	0	0	0	0	0	0	0	0	17	0	17	17
		Carcass Survey	0	0	0	0	0	0	0	38	0	0	38	38
		Gillnet	9	18	3	5	35	2	98	320	129	7	556	590
		Sport Fishery	4	0	0	0	4	0	8	54	36	0	99	103
	OR	Sport Fishery	0	0	0	1	1	0	0	0	0	1	1	2
Freshwater Total			**13**	**18**	**3**	**7**	**41**	**2**	**106**	**413**	**189**	**8**	**717**	**758**
Ocean	AK	Sport Fishery	0	0	0	0	0	3	0	0	0	0	3	3
		Mixed Commercial	15	0	0	0	15	3	10	2	1	0	17	32
	BC	Sport Fishery	0	4	10	0	15	0	53	68	35	0	156	171
		Mixed Commercial	0	2	16	0	18	0	93	171	112	0	376	394
	CA	Mixed Commercial	0	0	0	0	0	0	0	6	0	0	6	6
	OR	Sport Fishery	0	0	6	0	6	0	2	5	11	0	18	24
		Mixed Commercial	0	0	0	0	0	0	26	78	2	0	106	106
	WA	Sport Fishery	0	0	0	0	0	0	3	39	157	0	199	199
		Mixed Commercial	2	0	0	0	2	2	7	50	6	0	65	66
		Treaty Troll	0	0	23	0	23	0	15	82	120	0	216	239
	HS	Mixed Commercial	0	0	0	0	0	0	0	13	71	0	84	84
Ocean Total			**17**	**7**	**55**	**0**	**78**	**8**	**209**	**514**	**515**	**0**	**1246**	**1325**
Grand Total			**31**	**24**	**58**	**7**	**119**	**10**	**315**	**927**	**703**	**8**	**1963**	**2082**

[a] COL=Columbia River, AK=Alaska, BC=British Columbia, CA=California, OR=Oregon, WA=Washington, HS=High Seas.

Appendix K: Smolt-to-Adult Return Estimates for BY1999-BY2005 Fall Chinook Released as Part of LFH Production

(SAR=smolt-to-adult returns, SN=Snake River, COL=Columbia River, AK=Alaska, BC=British Columbia, CA=California, OR=Oregon, WA=Washington, HS=High Seas. Estimated SAR's are complete (through age 6) for BY1999-BY2001). Estimates are based upon RMIS download on 06/25/08 (recoveries through 2007 return year), recoveries at LFH, estimated returns to the Tucannon River, and estimated returns to LGR Dam from the run reconstruction. All estimates are based on CWTs and are not expanded for tag loss, sample detection method, or fishery.)

Appendix K, Table 1. Smolt-to-adult returns of Adipose clipped subyearling fall Chinook released by WDFW.

					Freshwater				Ocean								
Release site	**BY**	**CWT**	**total WIRES at release**	**Data**	**SN**	**COL**	**OR**	**Fresh Total**	**AK**	**BC**	**CA**	**COL**	**HS**	**OR**	**WA**	**Ocean Total**	**Grand Total**
Completed returns																	
Lyons Ferry	1999	630167	194,208	**SAR (%)**	**0.25**	**0.05**		**0.30**	**0.02**	**0.03**		**0.00**	**0.00**	**0.02**	**0.04**	**0.11**	**0.41**
Hatchery-direct			45.5fpp	OBS'D	364	45		409	10	17		1	1	9	33	71	480
				EST'D	484	102		586	36	63		5	3	29	81	217	803
	2001	630890	192,247	**SAR (%)**	**0.17**	**0.04**		**0.21**	**0.02**	**0.01**		**0.00**		**0.01**	**0.01**	**0.05**	**0.26**
			52.0 fpp	OBS'D	165	35		200	8	9		1		6	9	33	233
				EST'D	319	77		396	32	27		3		15	19	96	493
Columbia River	2000	630270	198,442	**SAR (%)**	**0.04**	**0.05**		**0.09**	**0.01**	**0.03**	**0.01**			**0.01**	**0.01**	**0.07**	**0.16**
Barged to below			45.7fpp	OBS'D	81	35		116	6	17	3			6	10	42	158
Bonneville Dam				EST'D	82	97		179	22	54	13			19	26	134	313
Incomplete Returns																	
Lyons Ferry	2002	631545	198,365	**SAR (%)**	**0.08**	**0.01**		**0.10**		**0.01**				**0.00**	**0.01**	**0.02**	**0.12**
Hatchery-direct			50.0fpp	OBS'D	90	11		101		5				3	8	16	117
				EST'D	163	29		192		13				7	18	37	229
	2003	631786	197,255	**SAR (%)**	**0.07**	**0.01**		**0.08**	**0.00**	**0.02**				**0.00**	**0.01**	**0.04**	**0.12**
			51.1 fpp	OBS'D	55	6		61	2	12				2	3	19	80
				EST'D	143	19		162	3	48				8	23	82	244
	2004	632787	196,301	**SAR (%)**	**0.04**	**0.00**		**0.04**		**0.00**	**0.00**				**0.00**	**0.01**	**0.05**
			51.0 fpp	OBS'D	22	2		24		1	1				2	4	28
				EST'D	81	4		85		5	2				4	12	97
	2005	633582	201,158	**SAR (%)**		**0.02**		**0.02**	**0.00**	**0.00**		**0.00**	**0.01**		**0.00**	**0.01**	**0.03**
			52.3 fpp	OBS'D		9		9	1	1		1	1		2	6	15
				EST'D		34		34	1	5		2	12		4	24	57
Snake River near	2002	631391	98,704	**SAR (%)**	**0.05**	**0.01**		**0.05**	**0.00**	**0.01**		**0.00**			**0.00**	**0.02**	**0.07**
Couse Creek			40.4 fpp	OBS'D	10	3		13	1	2		1			3	7	20
(direct vs acclim)				EST'D	46	7		53	4	7		5			4	20	73
	2004	610155	185,338	**SAR (%)**	**0.02**	**0.01**	**0.00**	**0.03**		**0.00**		**0.00**	**0.01**		**0.00**	**0.01**	**0.05**
			49.0 fpp	OBS'D	6	6	1	13		2		1	1		2	6	19
				EST'D	42	15	1	58		8		3	12		3	27	84

Appendix K, Table 1. continued

Release site	BY	CWT	total WIRES at release	Data	SN	COL	OR	Fresh Total	AK	BC	CA	COL	HS	OR	WA	Ocean Total	Grand Total
Incomplete returns																	
Snake River near	2005	633583	195,963	**SAR (%)**		**0.01**		**0.01**		**0.01**			**0.01**	**0.00**	**0.00**	**0.02**	**0.03**
Couse Creek			55.6 fpp	OBS'D		6		6		2			1	2	2	7	13
(direct vs acclim)				EST'D		25		25		11			12	4	4	31	55
Snake River near	2005	610178	208,682	**SAR (%)**		**0.00**		**0.00**									**0.00**
Couse Creek			50.0 fpp	OBS'D		2		2									2
(late release)				EST'D		8		8									8
Grande Ronde	2004	632782	192,478	**SAR (%)**	**0.04**	**0.01**		**0.05**		**0.00**					**0.01**	**0.01**	**0.05**
Direct			56.0 fpp	OBS'D	8	4		12		3					4	7	19
				EST'D	69	18		87		8					10	18	105
	2005	633584	196,965	**SAR (%)**		**0.00**		**0.00**									**0.00**
			50.6 fpp	OBS'D		2		2									2
				EST'D		8		8									8

Appendix K, Table 2. Smolt-to-adult returns of Adipose clipped and non-clipped CWT tagged yearling fall Chinook released by WDFW.

					Freshwater						Ocean								
Release site	**BY**	**CWT**	**total WIRES at release**	**Data**	**SN**	**COL**	**CA**	**OR**	**WA**	**Fresh Total**	**AK**	**BC**	**COL**	**CA**	**HS**	**OR**	**WA**	**Ocean Total**	**Grand Total**
Completed Returns																			
Lyons Ferry	1999	630476	337,109	**SAR (%)**	**0.72**	**0.25**		**0.00**		**0.97**	**0.01**	**0.25**	**0.01**	**0.01**	**0.00**	**0.12**	**0.18**	**0.60**	**1.57**
Hatchery			8.7fpp	OBS'D	1,518	342		1		1,861	13	180	15	5	11	149	231	604	2,465
AD clip				EST'D	2,424	841		1		3,266	43	841	47	22	13	421	624	2,010	5,277
	2000	631273	428,002	**SAR (%)**	**0.99**	**0.21**		**0.00**		**1.20**	**0.01**	**0.17**	**0.01**	**0.01**	**0.00**	**0.16**	**0.16**	**0.52**	**1.72**
			9.3fpp	OBS'D	2,150	353		1		2,504	12	223	11	10	14	221	301	792	3,296
				EST'D	4,243	883		1		5,127	36	724	47	37	17	664	699	2,224	7,352
	2001	631585	513,890	**SAR (%)**	**1.13**	**0.24**	**0.00**	**0.00**	**0.00**	**1.37**	**0.01**	**0.18**	**0.01**	**0.01**	**0.00**	**0.13**	**0.19**	**0.53**	**1.91**
			9.7fpp	OBS'D	3,624	570	1	4	1	4,200	13	212	15	8	10	288	410	956	5,156
				EST'D	5,801	1,236	17	4	1	7,059	40	940	56	30	12	671	988	2,737	9,795
Incomplete Returns																			
Lyons Ferry	2002	632167	427,713	**SAR (%)**	**0.35**	**0.15**				**0.50**	**0.01**	**0.07**		**0.00**	**0.01**	**0.03**	**0.07**	**0.19**	**0.69**
Hatchery			9.9 fpp	OBS'D	1,080	252				1,332	10	90		2	10	45	141	298	1,630
AD clip				EST'D	1,484	655				2,139	29	318		6	24	116	320	813	2,952
	2003	631769	217,707	**SAR (%)**	**0.72**	**0.25**				**0.97**	**0.02**	**0.21**	**0.00**	**0.01**	**0.01**	**0.05**	**0.19**	**0.50**	**1.47**
			9.4fpp	OBS'D	756	179				935	19	143	3	8	4	43	164	384	1,319
				EST'D	1,576	544				2,120	52	456	11	25	22	105	415	1,085	3,205
		632368	16,398	**SAR (%)**	**0.48**	**0.38**				**0.86**		**0.30**			**0.01**	**0.09**	**0.44**	**0.84**	**1.70**
			9.4fpp	OBS'D	54	17				71		14			1	5	19	39	110
				EST'D	78	62				140		49			1	15	72	138	278
	2004	633283	224,640	**SAR (%)**	**0.37**	**0.09**		**0.00**		**0.46**	**0.00**	**0.04**	**0.01**	**0.00**	**0.02**	**0.02**	**0.08**	**0.17**	**0.63**
			9.8 fpp	OBS'D	229	62		1		292	1	20	6	1	4	17	71	120	412
				EST'D	837	204		1		1,042	1	83	19	4	52	47	169	374	1,416
	2005	633598	226,442	**SAR (%)**											**0.00**			**0.00**	**0.00**
			11.0fpp	OBS'D											1			1	1
				EST'D											7			7	7
Lyons Ferry	2003	631770	218,150	**SAR (%)**	**0.61**	**0.01**				**0.62**	**0.00**	**0.12**			**0.02**		**0.11**	**0.25**	**0.87**
Hatchery			9.4fpp	OBS'D	674	21				695	1	99			7		126	233	928
No clip				EST'D	1,332	28				1,360	1	255			48		242	547	1,907

Appendix K, Table 2. continued.

					Freshwater						Ocean								
Release site	**BY**	**CWT**	**total WIRES at release**	**Data**	**SN**	**COL**	**CA**	**OR**	**WA**	**Fresh Total**	**AK**	**BC**	**COL**	**CA**	**HS**	**OR**	**WA**	**Ocean Total**	**Grand Total**
Incomplete Returns																			
Lyons Ferry	2004	633284	220,952	**SAR (%)**	**0.38**					**0.38**		**0.01**	**0.01**		**0.01**	**0.00**	**0.06**	**0.09**	**0.47**
Hatchery			10.3fpp	OBS'D	226					226		6	5		1	2	62	76	302
No clip				EST'D	840					840		23	13		12	5	142	195	1,035

Appendix L: Run Reconstruction of Fall Chinook to Lower Granite Dam in 2004

(The final report to the Technical Advisory Committee regarding the run to LGR in 2004.)

To: Interested Parties.

From: Debbie Milks (WDFW), Henry Yuen (USFWS), Stuart Ellis (CRITFC), Bill Arnsberg (NPT), and Bill Young (NPT)

Date: May 1, 2009

Subject: 2004 Snake River fall Chinook run reconstruction to Lower Granite Dam

2004 Snake River Fall Chinook Run Reconstruction to Lower Granite Dam

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2004 run composition to Lower Granite Dam

A total of 15,845 fall Chinook passed the counting window (i.e. arriving at) at Lower Granite Dam (LGR) in 2004 of which 2,315 were wild (natural origin). This data does not include returns to the Tucannon River or estimates of fish trapped and killed at Lyons Ferry Hatchery because they are all downstream of Lower Granite Dam.

The composition of the fall Chinook arriving at LGR by release group with details on tag code, age, release age and site is summarized in Table 1. The release groups are wild (natural spawn) fall Chinook, LFH fall Chinook, supplementation/mitigation fall Chinook released above LGR and out-of-Snake-River-basin strays. In our summaries we show reservoir rearing estimates for wild fish, but not for hatchery fish. Reservoir rearing refers to a fish that naturally has a subyearling life history pattern, that ends up remaining in freshwater for another year, essentially leaving as a yearling. Data indicates reservoir rearing occurs with hatchery fish as well but we do not know to what extent so that data is not included here.

Table 1. Composition of fall Chinook to LGR Dam by CWT, origin, and age 2004. Note: the stray from Feather River Net Pen was not expanded.

CWT	ORIGIN	Program	Age from CWT	Male	Female	Jacks from size
CWR recoveries and associated no-wire recoveries						
631013	LF98YCJA	LSRCP	age 6	0	8	0
631213	LF98YO	LSRCP	age 6	8	8	0
630168	LF99SCJA1	LSRCP	age 5	0	11	0
630169	LF99SCJA2	LSRCP	age 5	0	503	0
630478	LF99YCJA	LSRCP	age 5	0	16	0
630167	LF99SO	LSRCP	age 5	0	58	0
630476	LF99YO	LSRCP	age 5	23	291	0
630479	LF99YPA	LSRCP	age 5	0	8	0
093206	BONN99YUMA	Stray	age 5	0	8	0
093207	BONN99YUMA	Stray	age 5	0	8	0
630170	KLICK99SO	Stray	age 5	0	33	0
630271	LF00SBCA	LSRCP	age 4	23	54	0
630677	LF00YBCA	LSRCP	age 4	62	100	0
630183	LF00YCJA	LSRCP	age 4	93	132	0
630270	LF00SB	LSRCP	age 4	0	15	0
631273	LF00YO	LSRCP	age 4	426	829	0
630272	LF00SPA	LSRCP	age 4	8	230	0
630678	LF00YPA	LSRCP	age 4	289	217	0
062665	CALFEATHERRIVER00SNETPEN	Stray	age 4	0	1	0

CWT	ORIGIN	Program	Age from CWT	Male	Female	Jacks from size
093253	UMA00SA	Stray	age 4	0	25	0
093346	BONN00YUMA	Stray	age 4	39	106	0
610119	LF01YBCA	LSRCP	age 3	124	31	7
612639	LF01SBCA	LSRCP	age 3	286	39	59
610105	LF01SCJA2	LSRCP	age 3	324	132	37
610106	LF01SCJA1	LSRCP	age 3	86	39	24
610118	LF01YCJA	LSRCP	age 3	364	47	39
630890	LF01SO	LSRCP	age 3	241	342	0
631585	LF01YO	LSRCP	age 3	1720	171	271
610120	LF01YPA	LSRCP	age 3	247	0	8
612501	LF01SPA	LSRCP	age 3	229	31	12
093501	UMA01SA	Stray	age 3	8	0	0
093502	UMA01SD	Stray	age 3	16	0	0
093503	UMA01SA	Stray	age 3	16	0	0
610122	LF02SBCA	LSRCP	age 2	8	0	156
612659	LF02YBCA	LSRCP	age 2	0	0	78
631391	LF02SCCD	LSRCP	age 2	7	0	50
610121	LF02SCJA1	LSRCP	age 2	12	0	100
612503	LF02YCJA	LSRCP	age 2	0	0	279
612654	LF02SCJA2	LSRCP	age 2	37	0	101
631545	LF02SO	LSRCP	age 2	94	0	133
632167	LF02YO	LSRCP	age 2	0	0	124
610107	NPTH02SO1	NPTH	age 2	12	0	84
610109	NPT02SNLVA	NPTH	age 2	0	0	85
610110	NPTH02SO2	NPTH	age 2	50	0	149
612648	NPT02SNLVA	NPTH	age 2	0	0	69
610123	LF02SPA	LSRCP	age 2	0	0	69
612502	LF02YPA	LSRCP	age 2	0	0	101
093760	UMA02SD	Stray	age 2	0	0	50
093910	BONN02YUMA	Stray	age 2	0	0	22
09BLANK	09BLANK unknown age	Stray		93	0	0
09BLANK	09BLANK YRL AGE 3	Stray	age 3	8	0	0
63BLANK	63BLANK	Stray		31	0	0
BLANK	BLANK unknown age	Stray		109	201	8
BLANK	BLANK WIRE SUB AGE 5	Stray	age 5	0	8	0
BLANK	BLANK WIRE YRL AGE 4	Stray	age 4	0	8	0
BLANK	BLANK WIRE YRL AGE 5	Stray	age 3	8	0	0
Non-Snake River hatchery fish by scales-unassignable to release site						
	AD ONLY STRAY SUB AGE 2		age 2	29	0	64
	AD ONLY STRAY SUB AGE 3		age 3	54	17	0
	AD ONLY STRAY SUB AGE 5		age 5	0	17	0
	AD ONLY STRAY YRL AGE 2		age 2	0	0	14
	AD ONLY STRAY YRL AGE 4		age 4	0	20	0
	AD ONLY STRAY YRL AGE 5		age 5	0	7	0
	UNM/UNTAG STRAY HATCHERY SUB AGE 2		age 2	28	0	43
	UNM/UNTAG STRAY HATCHERY SUB AGE 3		age 3	70	9	0

CWT	ORIGIN	Program	Age from CWT	Male	Female	Jacks from size
	UNM/UNTAG STRAY HATCHERY SUB AGE 5		age 5	42	212	0
	UNM/UNTAG STRAY HATCHERY YRL AGE 3 MALE		age 3	14	0	0
	UNM/UNTAG STRAY HATCHERY YRL AGE 4 MALE		age 4	14	43	0
	UNM/UNTAG STRAY HATCHERY YRL AGE 5 MALE		age 5	14	9	0
	AD ONLY SUB AGE 5 -presume stray		age 5	0	20	0
Estimated unassociated returns from Snake River hatchery releases						
	UNM/UNTAG HATCHERY SUB AGE 3-unassoc-BC01S2		age 3	32	287	5
	UNM/UNTAG HATCHERY SUB AGE 4 -unassoc-BC00S2		age 4	18	100	0
	UNM/UNTAG HATCHERY SUB AGE 4 -unassoc-CJ00S1		age 4	29	163	0
	UNM/UNTAG HATCHERY SUB AGE 5 -unassoc-PIT99S1		age 5	27	62	0
	UNM/UNTAG HATCHERY SUB AGE 5 -unassoc-BC99S1		age 5	74	170	0
	UNM/UNTAG HATCHERY SUB AGE 5 -unassoc-BC99S2		age 5	176	403	0
	AD ONLY SUB AGE 2 -unassoc-HC02SIPC1-umatilla rear		age 2	26	0	41
	AD ONLY SUB AGE 2 -unassoc-HC02SIPC1-oxbow rear		age 2	36	0	57
	AD ONLY SUB AGE 3-unassocHC01SIPC-oxbow rear		age 3	102	40	0
	AD ONLY SUB RES REAR AGE 4-HC00SIPC1-oxbow rear		age 4	14	7	0
wild						
	WILD SUB AGE 2		age 2	8	0	68
	WILD SUB AGE 3		age 3	56	32	0
	WILD SUB AGE 4		age 4	8	143	0
	WILD SUB AGE 5		age 5	72	528	0
	WILD SUB AGE 6		age 6	8	0	0
	WILD SUB RES REAR AGE 2		age 2	0	0	60
	WILD SUB RES REAR AGE 3		age 3	80	16	34
	WILD SUB RES REAR AGE 4		age 4	64	574	0
	WILD SUB RES REAR AGE 5		age 5	72	468	0
	WILD SUB RES REAR AGE 6		age 6	0	24	0
total hatchery				5897	5295	2339
total wild				368	1786	161
total				6265	7080	2500

Estimating composition of run to Lower Granite Dam during the trapping period

Trapping began on September 2 and ended on November 24 (Appendix 1). The trap was set to open four times each hour, resulting in fish being trapped 15% of the time, 24 hours per day between Septeber2 and September 9. There were two interruptions in the trap operation so the effective trap rate for September 3 and 5 was 13.75% (see Appendix for details). The trap rate was 13% from September 9 to September 24.

Databases used for estimates

In this report, trap data refers to data collected at the LGR Trap and processing data refers to data collected from fish hauled to and processed at LFH and NPTH (Appendix 2). While there is more sampling data in the processing database, only the trap database has information on date of arrival at LGR for fish. Thus the former is used to estimate composition and the latter is used to estimate run timing. The trap data also is the only place where data can be found for fish released directly from the trap at LGR.

The differences between the trap and processing data are apparent when estimating sex ratios, adult to jack ratios, and even species. Early in the season it is difficult to distinguish males from females so it is not uncommon to find more females in the processing data than in the trap data. In addition, fish may fit the jack size criteria at the trap but 2 months later they may fit the adult criteria due to kipe development. Some fish identified as fall Chinook at the trapping site were later reclassified as summer Chinook when their CWTs were processed.

Trapping data

The trapping data was used to the following purposes:

- Estimate the numbers of fish hauled to LFH.
- Determine the hatchery/wild composition per week based on scales collected at the trap which in turn was used to create a regression so window counts of unmarked fall Chinook adults and jacks during pre and post trapping periods could be divided into wild and unmarked hatchery estimates.
- Estimate the composition of the released fish from the trap at Lower Granite Dam

Processing data

The processing data was used to estimate the release strategy and age composition of the majority of fish arriving at LGR during the trapping period that were hauled to the hatcheries.

The various origins enumerated include natural origin, Lyons Ferry Hatchery, Idaho Power Company (IPC) mitigation releases, supplementation program releases, and out-of-basin (strays). The composition of the various release strategies was determined from the various marks consisting of CWT, Blank Wire Tags (BWT), Agency wire tags (09BLANK or 63BLANK), PIT tags, Ad-clips, and VIE tags. For example:

- AD-only (no other marks or tags) subyearling (either stray or non-stray as determined from scale patterns) = IPC. The strays were presumed to be IPC because no other ad-only subyearling fall Chinook are produced in the basin and the estimated number of AD only fish associated with CWT releases was 5 fish. Since none of the release groups totaled one fish between the groups, all fish were assigned to IPC mitigation. Some of the IPC fish were reared at Umatilla, hence may cause the scale patterns to indicate an out of basin stray),
- Fish with left red (LR) VIE are from LFH yearling on-station releases,
- Fish with left blue (LB) VIE are from Captain John Acclimation Facility yearling releases,
- Fish with right green (RG) VIE are from Pittsburg Landing Acclimation Facility yearling releases,
- Fish with left green (LG) VIE are from Big Canyon Acclimation Facility yearling releases.

Resolving differences between the Trapping and Processing databases

To distinguish between the two trapping rates, fish trapped at LGR during the 15% trapping period were given a PIT tag. Because of PIT tag loss (see PIT tag issues below) there were fish that we were unable to assign to a trapping rate (unknown trap rate group). To assure that the correct numbers of fish were expanded for each trapping period we had to use the LGR trap data to determine the numbers of fish hauled to the hatcheries in each trapping period. Adjustments to the processing data were made so the total numbers of fish in each trapping period were the same as the trapping data (Appendix 3).

Estimating composition of run to Lower Granite Dam during the trapping period

Estimating composition of wire tag group

Wire tagged groups are processed separately from untagged groups. Fish with wires that were undecoded because the tag was lost or the fish was released, had their composition estimated based on recovered/decoded wires, based on sex, clip, and VI. All fish with wire tags were hatchery origin. Blank wire tags and agency wire tags are not coded wire tags. Blank wire tags and agency wire tags that were recovered were considered strays from non-Snake River releases, since Snake River basin releases do not use Blank or Agency wire.

Estimating hatchery/wild composition of no-wire fish

Untagged processed fish had origin and age determined from a combination of scale analysis (John Sneva, WDFW), PIT tags, VI tags, and presence/absence of ad-fin clip. Some unmarked untagged strays, all natural origin, and some summer Chinook were identified solely from the scale analysis. Any fish with an ad-clip or a VI tag was considered to be hatchery origin. Fish whose scales were not readable were partitioned into the untagged groups according to sex, age, presence/absence of ad-clip, and VI data.

Origins were estimated for fish whose scales were not readable by using the composition of the readable scales to determine hatchery and wild origins and ages. To determine which releases contributed to the untagged hatchery returns we assign untagged fish to their associated CWTs based on juvenile release data. If any hatchery fish are left after we subtract them from the untagged hatchery fish group then we estimate the number of fish that came from untagged releases, "unassociated". To estimate extent of returns of these "unassociated" fish smolt-to-adult returns of CWT fish from the same release location although from different years may be used. Any fish remaining after those estimates are made are placed in an "unknown" category. In years where the stray rate is low based on CWT returns we may estimate that these remaining unknown fish are from inbasin untagged hatchery releases but we cannot determine which release site released the fish.

Origin and age of fish during trapping period

The composition was estimated from fish released at the Lower Granite Trap and was combined with the composition data generated from fish processed at the hatcheries to come up with an overall comp of the run during the trapping period. Table 2 presents the composition of the fish in the trap samples.

Table 2. Composition of fish in 2004 trap samples, expended for trap rate.

			CWT recoveries expanded for trap rate				Associated recoveries expanded for trap rate		
CWT	ORIGIN	Program	Age from CWT	Male	Female	Jacks from size	Male	Female	Jacks from size
CWR recoveries and associated no-wire recoveries									
631013	LF98YCJA	LSRCP	age 6	0	8	0	0	0	0
631213	LF98YO	LSRCP	age 6	8	8	0	0	0	0
630168	LF99SCJA1	LSRCP	age 5	0	11	0	0	0	0
630169	LF99SCJA2	LSRCP	age 5	0	15	0	0	482	0
630478	LF99YCJA	LSRCP	age 5	0	15	0	0	0	0
630167	LF99SO	LSRCP	age 5	0	30	0	0	27	0
630476	LF99YO	LSRCP	age 5	23	141	0	0	146	0
630479	LF99YPA	LSRCP	age 5	0	8	0	0	0	0
093206	BONN99YUMA	Stray	age 5	0	8	0	0	0	0
093207	BONN99YUMA	Stray	age 5	0	8	0	0	0	0
630170	KLICK99SO	Stray	age 5	0	15	0	0	17	0
630271	LF00SBCA	LSRCP	age 4	23	53	0	0	0	0
630677	LF00YBCA	LSRCP	age 4	61	99	0	0	0	0
630183	LF00YCJA	LSRCP	age 4	92	130	0	0	0	0
630270	LF00SB	LSRCP	age 4	0	7	0	0	7	0
631273	LF00YO	LSRCP	age 4	421	819	0	0	0	0
630272	LF00SPA	LSRCP	age 4	8	15	0	0	212	0
630678	LF00YPA	LSRCP	age 4	122	215	0	164	0	0
062665	CALFEATHERRIVER00SNETPEN	Stray	age 4	0	1	0	0	0	0
093253	UMA00SA	Stray	age 4	0	8	0	0	17	0
093346	BONN00YUMA	Stray	age 4	38	46	0	0	59	0
610119	LF01YBCA	LSRCP	age 3	123	31	7	0	0	0
612639	LF01SBCA	LSRCP	age 3	283	38	31	0	0	28
610105	LF01SCJA2	LSRCP	age 3	320	130	31	0	0	6
610106	LF01SCJA1	LSRCP	age 3	85	38	15	0	0	8
610118	LF01YCJA	LSRCP	age 3	360	46	38	0	0	0

			CWT recoveries expanded for trap rate				Associated recoveries expanded for trap rate		
CWT	ORIGIN	Program	Age from CWT	Male	Female	Jacks from size	Male	Female	Jacks from size
630890	LF01SO	LSRCP	age 3	137	38	0	101	300	0
631585	LF01YO	LSRCP	age 3	1699	169	269	0	0	0
610120	LF01YPA	LSRCP	age 3	244	0	8	0	0	0
612501	LF01SPA	LSRCP	age 3	76	31	7	150	0	5
093501	UMA01SA	Stray	age 3	8	0	0	0	0	0
093502	UMA01SD	Stray	age 3	15	0	0	0	0	0
093503	UMA01SA	Stray	age 3	15	0	0	0	0	0
610122	LF02SBCA	LSRCP	age 2	8	0	92	0	0	63
612659	LF02YBCA	LSRCP	age 2	0	0	77	0	0	0
631391	LF02SCCD	LSRCP	age 2	7	0	23	0	0	26
610121	LF02SCJA1	LSRCP	age 2	8	0	38	5	0	61
612503	LF02YCJA	LSRCP	age 2	0	0	277	0	0	0
612654	LF02SCJA2	LSRCP	age 2	23	0	38	14	0	61
631545	LF02SO	LSRCP	age 2	31	0	62	62	0	71
632167	LF02YO	LSRCP	age 2	0	0	123	0	0	0
610107	NPTH02SO1	NPTH	age 2	8	0	23	5	0	61
610109	NPT02SNLVA	NPTH	age 2	0	0	23	0	0	61
610110	NPTH02SO2	NPTH	age 2	31	0	85	18	0	63
612648	NPT02SNLVA	NPTH	age 2	0	0	8	0	0	61
610123	LF02SPA	LSRCP	age 2	0	0	8	0	0	61
612502	LF02YPA	LSRCP	age 2	0	0	100	0	0	0
093760	UMA02SD	Stray	age 2	0	0	8	0	0	42
093910	BONN02YUMA	Stray	age 2	0	0	8	0	0	14
09BLANK	09BLANK unknown age	Stray		92	0	0	0	0	0
09BLANK	09BLANK YRL AGE 3	Stray	age 3	8	0	0	0	0	0
63BLANK	63BLANK unknown age	Stray		30	0	0	0	0	0
BLANK	BLANK unknown age	Stray		107	199	8	0	0	0
BLANK	BLANK WIRE SUB AGE 5	Stray	age 5	0	8	0	0	0	0
BLANK	BLANK WIRE YRL AGE 4	Stray	age 4	0	8	0	0	0	0

			CWT recoveries expanded for trap rate				Associated recoveries expanded for trap rate		
CWT	ORIGIN	Program	Age from CWT	Male	Female	Jacks from size	Male	Female	Jacks from size
BLANK	BLANK WIRE YRL AGE 5	Stray	age 3	8	0	0	0	0	0
Non-Snake River hatchery fish by scales-unassignable to release site									
	AD ONLY STRAY SUB AGE 2	Stray	age 2	29	0	64			
	AD ONLY STRAY SUB AGE 3	Stray	age 3	54	17	0			
	AD ONLY STRAY SUB AGE 5	Stray	age 5	0	17	0			
	AD ONLY STRAY YRL AGE 2	Stray	age 2	0	0	14			
	AD ONLY STRAY YRL AGE 4	Stray	age 4	0	20	0			
	AD ONLY STRAY YRL AGE 5	Stray	age 5	0	7	0			
	UNM/UNTAG STRAY HATCHERY SUB AGE 2	Stray	age 2	27	0	43			
	UNM/UNTAG STRAY HATCHERY SUB AGE 3	Stray	age 3	69	9	0			
	UNM/UNTAG STRAY HATCHERY SUB AGE 5	Stray	age 5	42	210	0			
	UNM/UNTAG STRAY HATCHERY YRL AGE 3 MALE	Stray	age 3	14	0	0			
	UNM/UNTAG STRAY HATCHERY YRL AGE 4 MALE	Stray	age 4	14	43	0			
	UNM/UNTAG STRAY HATCHERY YRL AGE 5 MALE	Stray	age 5	14	9	0			
	AD ONLY SUB AGE 5 -presume stray	Stray	age 5	0	20	0			
Estimated unassociated returns from Snake River hatchery releases									
	UNM/UNTAG HATCHERY SUB AGE 3-unassoc-BC01S2	LSRCP	age 3	32	284	5			
	UNM/UNTAG HATCHERY SUB AGE 4 -unassoc-BC00S2	LSRCP	age 4	17	98	0			
	UNM/UNTAG HATCHERY SUB AGE 4 -unassoc-CJ00S1	LSRCP	age 4	28	161	0			
	UNM/UNTAG HATCHERY SUB AGE 5 -unassoc-PIT99S1	LSRCP	age 5	27	61	0			
	UNM/UNTAG HATCHERY SUB AGE 5 -unassoc-BC99S1	LSRCP	age 5	74	168	0			

			CWT recoveries expanded for trap rate				Associated recoveries expanded for trap rate		
CWT	ORIGIN	Program	Age from CWT	Male	Female	Jacks from size	Male	Female	Jacks from size
	UNM/UNTAG HATCHERY SUB AGE 5 -unassoc-BC99S2	LSRCP	age 5	174	398	0			
	AD ONLY SUB AGE 2 -unassoc-HC02SIPC1-umatilla rear	IPC	age 2	26	0	40			
	AD ONLY SUB AGE 2 -unassoc-HC02SIPC1-oxbow rear	IPC	age 2	36	0	57			
	AD ONLY SUB AGE 3-unassocHC01SIPC-oxbow rear	IPC	age 3	101	40	0			
	AD ONLY SUB RES REAR AGE 4-HC00SIPC1-oxbow rear	IPC	age 4	14	7	0			
wild									
	WILD SUB AGE 2		age 2	8	0	61			
	WILD SUB AGE 3		age 3	53	30	0			
	WILD SUB AGE 4		age 4	8	137	0			
	WILD SUB AGE 5		age 5	69	506	0			
	WILD SUB AGE 6		age 6	8	0	0			
	WILD SUB RES REAR AGE 2		age 2	0	0	53			
	WILD SUB RES REAR AGE 3		age 3	77	15	30			
	WILD SUB RES REAR AGE 4		age 4	61	550	0			
	WILD SUB RES REAR AGE 5		age 5	69	448	0			
	WILD SUB RES REAR AGE 6		age 6	0	23	0			

Estimating composition of run to Lower Granite Dam before and after the trapping period

Use window for counts during pre and post trapping period

Nighttime/video counts were not made in 2004. We took the daily 16-hour direct window counts and 10 hour video counts and expanded the clipped and non clipped counts separately for 10 minute hourly breaks (direct counts) and 6 hour shortfall in video counts for the adults and jacks separately and then expanded each count by 0.965 to account for night time passage[3]. The expansions were summed before rounding. Expanding the window counts this way will make the counts not match the total counts provided by WDFW (Steve Richards) to the COE.

Correct database for summer Chinook

The trap database contained 14 summer Chinook (Appendix 4): 12 adults (4 clipped and 8 un-clipped) and 2 Jacks (both un-clipped). These fish were removed from the trap database. These fish were also expanded by the appropriate trap rate for the date of capture and then the expanded numbers were subtracted from the same day's 24-hour window counts. The summer Chinook expanded to 85 adults and 15 jacks. Two non-clipped adult summer Chinook were hauled to LFH, all other summer Chinook were released above Lower Granite.

Correct database for recaptures

Some of the fish released from the LGR trap were later recaptured and released again. All recaptures occurred during the 13% trap rate period. These fish were removed from the trap database (Table 3).

[3] WindowVsTrap2004LGR012907.xls

Table 3. Estimated unique numbers of fall Chinook released from the LGR trap, 2004.

Summary of Fall Chinook Released from LGR Trap in 2004 during 15% trap period				
	Unknown origin	Wild	Hatchery	Total
Fish labled as released	0	10	14	24
Recaptures	0	0	0	0
Fish to count as released	0	10	14	24
Summary of Fall Chinook Released from LGR Trap in 2004 during 13% trap period				
	Unknown origin	Wild	Hatchery	Total
Fish labled as released	35	79	54	168
Recaptures	31	38	20	89
Fish to count as released	4	41	34	79
Summary of Fall Chinook Released from LGR Trap in 2004 during combined trapping periods				
	Unknown origin	Wild	Hatchery	Total
Fish labled as released	35	89	68	192
Recaptures	31	38	20	89
Fish to count as released	4	51	48	103

Reconcile difference in jack proportions between window counts and trap samples

The proportion of fall Chinook jacks in the trap did not match the proportion of jacks observed during window counts (Table 4).

Table 4. Comparison of fall Chinook jack proportions in 2004 window counts and trap sample

	Window count	Trap sample
adult	12,340	19,291
jack	6,271	3,422
total	18,611	22,714
% jack	33.7%	15.1%

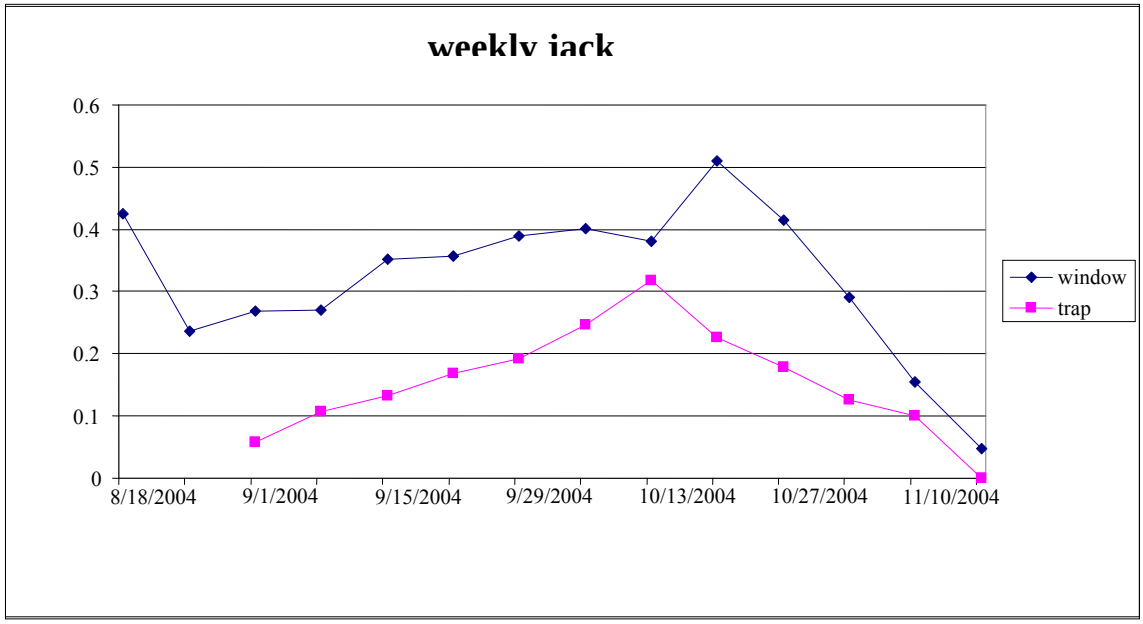

Figure 1. Comparison of 2004 jack proportions in trap sample with window counts.

The proportions of jacks in the trap samples were considered more accurate than the proportions from the window counts (Figure 1). Fish in the trap were measured (fork length) whereas fall Chinook size estimates are made as fish swam between two pieces of tape placed on the fish counting window. Therefore in Table 5 we adjusted the pre trapping period window counts of jacks to match the trap proportions but did not change the ad-clip proportions (which would have affected the estimate of wild fish). No change was required for the post trapping period window counts because none were observed.

Table 5. Pre trapping period window counts adjusted for difference between window and trap jack proportions in 2004.

	original window count	adjusted marked & unmarked numbers	adjustment for unmarked fish
Adults			
clip	56	70	
no clip	174	218	1.254014
total	230	288	
Jacks			
clip	22	10	
no clip	83	37	0.447145
total jacks	106	47	

Estimating the numbers of wild fish arriving at Lower Granite Dam before and after trapping period

To estimate the hatchery-wild composition during the pre-trapping period, we presumed wild fish returned earlier than hatchery fish. The last year we were able to begin trapping on August 18 was during the 2002 run. Data from 2002 is presented in Figures 2 and 3 for compare with the pre-trapping estimates for 2004. The 2002 data was not used to fit the regression.

To build the data used in the regression we estimated the proportion of wild fish in the unmarked return to LGR by week. The scales that were used for this part of the analysis were from the trap database because they could be associated with an arrival date at the trap. Of the unmarked fish, some are known to be hatchery fish based on presence of wire, VIE, or scale readings, and some are known to be wild fish through scale analysis. Unmarked untagged fish whose scales were unreadable are of unknown origin. We assumed that these unknown origin unmarked untagged fish had the same wild/hatchery proportion as fish whose scales had origin determinations.

We used an exponential decay regression of % wild Chinook among the non-ad-clipped fish over time in the trap data to estimate the proportion of non ad-clip fish in the window counts that is wild for the period prior and after trapping (Figures 2 and 3).

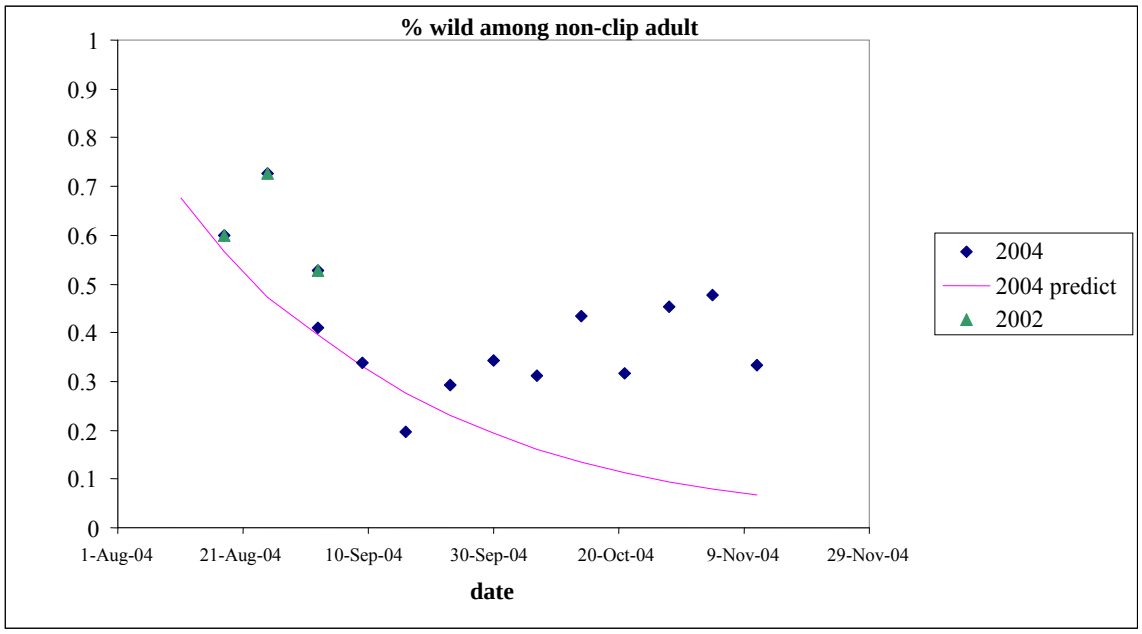

Figure 2. Expected trend in % wild among non-clip adult in 2004. 2002 data was not used to fit the curve.

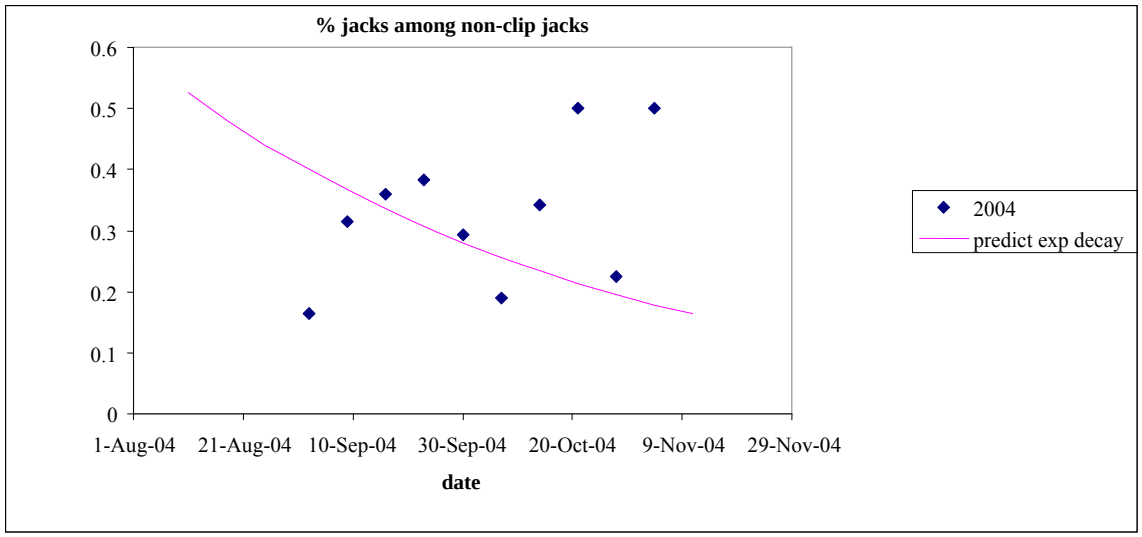

Figure 3. Expected trend in % wild among non-clip jacks in 2004.

We applied the modeled wild-hatchery proportions to the window counts from the pre- and post-trapping period and estimate that 107 wild fall Chinook arrived before trapping and 0 arrived after the trapping period (Table 6).

Table 6. Estimated number of wild and hatchery fall Chinook arriving at LGR before and after the 2004 trapping period.

	Adults by length		Jacks by length	
	wild	hatchery	wild	hatchery
pre-trap	90	128	17	20
post-trap	0	8	0	0

Composition of fish arriving at Lower Granite Dam during the pre-and post trapping period

The age composition of the wild fish estimated during trapping (processing data combined with fish released at LGR data) was applied to the estimated number of wild fish arriving before the trapping period. This was done because many more fish were scale sampled at the hatcheries than were collected at the trap.

It was presumed that the hatchery fish arrived in the same proportions pre- and post-trapping as they did during trapping. The age composition of the hatchery fish estimated during trapping (processing data combined with fish released at LGR data) was applied to the estimated number of hatchery fish arriving before and after the trapping period.

Total wild and hatchery fish arriving at Lower Granite Dam

Compositions of fish estimated for the pre, during, and post trapping periods were combined, resulting in the run estimate of fish arriving at LGR (Table 1).

Estimating the run past Lower Granite Dam

The total run past LGR is estimated by subtracting fallbacks or known downstream passage), the numbers of fish trapped at LGR that were hauled to the hatcheries and killed. Since recaptured fish were already removed from the run data there aren't any adjustments needed for that group.

Subtract known downstream passage

The *Juvenile Bypass/Collection Facility* has an adult separator located below LGR Dam. The separator is part of the Juvenile Collection facility that collects fish moving downstream. The separator diverts adult sized fish away from the *Juvenile Collection Facility* and directly into the river. Since all of the fish observed at the Juvenile bypass facility originated from above LGR they are considered fallbacks because they had already been in the estimate of fish past LGR.

Table 7 summarizes the minimum number of fall Chinook adults and jacks diverted into the river through the adult separator. Except for the *Juvenile Bypass Facility*, we did not attempt to estimate any other fallback for 2004 as we did not have any data to estimate the numbers of fish that may have passed downstream via turbines, locks, spillway, etc. Downstream passage through the ladder is subtracted from the window counts.

Table 7. Total estimate of ad-clipped and unclipped fish passing downstream through the adult separator3 in 2004.

	Adult			Jack		
2004	**Clip**	**Un-clip**	**Total**	**Clip**	**Un-Clip**	**Total**
September	94	45	139	60	22	82
October	203	93	296	155	27	182
Total	297	138	435	215	49	264

Data from Fred Mensik (LGR Juvenile Collection Facility)

Estimated spawning escapement

The numbers of hatchery fall Chinook that were trapped at Potlatch or volunteered into NPTH (Table 8) were subtracted from the fall Chinook that passed LGR to obtain the spawning escapement. No wild fish were removed above LGR in 2004.

Table 8. Hatchery fish Removed from the river above Lower Granite Dam either by trapping at Potlatch or volunteers to NPTH in 2004.

Location	Hatchery Adult	Hatchery Jack	Wild Adult	Wild Jack	Total
Potlatch Trap	1	0	0	0	1
NPTH	541	173			724
Volunteers			8	2	
Total	542	173	8	2	725

Discussion

PIT tag Issues

Fish collected in the trap during the 15% trapping period were PIT tagged in 2004 in an effort to help identify fish collected at different trap rates more accurately. This was separate from fish that are PIT tagged as Juveniles or at other locations as adults. Unmarked/untagged fish were PIT tagged so scales and measurements could be collected at time of spawning rather than trapping. This was done in an effort to reduce workload for trapping crew.

It was not possible to track each PIT tagged fish tagged at the trap for several reasons. There were problems with recording PIT tag numbers. Some was done by hand with only the last four digits recorded. Some recording errors likely occurred. Some other PIT tagged fish were simply not found again, possibly due to some level of tag loss or reader errors. Some fish (especially females) are believed to lose PIT tags at spawning as tags have been recovered in incubation trays where they were mixed with eggs and also at the bottom of holding ponds.

We decided to not try and account for missing PIT tag data and fish and only use PIT tag data that can be tracked. This has the effect of sub sampling the trapped portion of the run.

Some PIT tagged fish were returned to the river below LGR and were not re-trapped at the dam. Due to time constraints associated with PIT tag data accounting, we advise this method not be used in the future.

Appendix

Appendix 1. Chronology of window counts and trapping

August 18: Start counting fall Chinook 20 hours per day at the Lower Granite Dam window.

August 26: Start sort by code for University of Idaho. The sort by code diverted two fish into the trap: one on 8/27 and one on 8/29. One fish was operculum punched and the other fish was not. Both fish were released upstream with radio tags. Both were unmarked and not CWT tagged. Neither was seen again.

September 2: Begin trapping at a 15% rate 24 hours/day. All unmarked untagged fish were PIT tagged and was transferred to LFH. Any previously marked/tagged fish were also transferred to LFH but not PIT tagged.

September 3: Corps of Engineers turned off trap for two hours because of lack of section 10 permit. Adjustment the trap rate: 1 - 2/24 hours = 91.7%. There were no hourly trap counts so cannot adjust % trap rate using trap timing profile. If 10 fish in trap, then expanded number = 11 fish.

September 5: Trap was turned off for two hours because tanks were full and truck was not available to haul fish to LFH. We decided based on daily counts and trap rates that this has a negligible effect on the data and would be ignored.

For September 3 and 5, trap was operated for 22 hours instead of 24 hours. 22/24= 0.9167 (8 15% target trap rate x 0.9167 = 13.75% actual trap rate for these two days. For the 6 other days, the trap rate was 15%.

September 10: Trapping was changed to 13% to avoid overwhelming the trap. Continue to PIT tag all unmarked untagged fish but not any previously marked/tagged fish.

September 14: Start PIT tagging only every third unmarked/untagged fish due to shortage of PIT tags. Because of the change to 13% trap rate, Debbie Milks PIT tagged the marked/tagged fish that were in the pond at LFH that were captured during the 15% trapping schedule. This was done to ensure these fish could be separated from the marked/tagged fish that were caught later. This operation had a high tag loss rate with only 76 of 100 PIT tags found later during scale collection.

October 19: Begin release of unmarked/untagged males and jacks because they were not needed for broodstock. Released fish were left operculum punched and scales were taken from every third fish.

October 27: Protocol was modified to clarify retention of caudal clipped fish (previous captures or volunteers). If no caudal clip present then all females and wire tagged fish were retained. If top caudal clip present (LFH volunteers), then wire tagged fish only were retained (others were all supposed to be males). If bottom caudal clip present (previously trapped and transported from LGR), then only wire tagged fish were retained. Scales were taken and left operculum punch given to released fish.

November 4: Release protocol was modified so that adipose-clip only females were retained. Wire tagged fish were still retained as well. Left operculum punch was given to any released fish.

November 24: Trapping ends.

December 15: Stop counting fall Chinook at the Lower Granite Dam window.

Appendix 2. Chronology of fish hauls

September 2-8: Fish were hauled to LFH.

September 9-16: Fish were hauled to NPTH. These fish were all PIT tagged so they can be identified as captured at the 15% trap rate (marked and unmarked fish).

September 17-20: Fish were hauled to LFH.

September 21-22: Fish were hauled to NPTH.

September 23-November 22: Fish were hauled to LFH.

Appendix 3. Unknown trap rate assignments.

Assignments of fish that were returned to the river from LFH were assigned to the 13% and 15% trap rates based on information about sex and wire status from the trapping and processing databases. Clip status of these fish was also estimated. It was necessary to make some adjustments in the wire status and sex of some of the fish. The process is outlined in spreadsheet named *LFH2004CWT AND NPT04 ver10.xls*.

Appendix 3 Table 1. Assigned composition of fish in 2004 unknown trap rate group released from LFH.

	13% trap rate			15% trap rate			
	Male	Female	Jack	Male	Female	Jack	total
clip	46	2	5	3	1	1	58
no clip	290	37	55	21	14	10	427
total	335	40	60	25	14	11	485

Appendix 4. Summer Chinook

The trap database contained 14 Summer Chinook: 12 adults (4 clipped and 8 un-clipped) and 2 Jacks (both un-clipped). These fish were removed from the trap database. These fish were also expanded by the appropriate trap rate for the date of capture and then the expanded numbers were subtracted from the same day's 24-hour window counts. The summer Chinook expanded to 85 adults and 15 jacks. Table 12 shows the counts corrected for summer Chinook.
Two non-clipped adult summer Chinook were hauled to LFH, all other summer Chinook were released above Lower Granite.

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