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Lyons Ferry Hatchery Evaluation
Fall Chinook Salmon
Annual Report: 2005

by Deborah Milks, Michelle Varney,
Jeromy Jording, and Mark Schuck

Washington Department of
FISH AND WILDLIFE
Fish Program
Science Division

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to

U.S. Fish and Wildlife Service
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Executive Summary

This report summarizes activities by the Washington Department of Fish and Wildlife's (WDFW) Lower Snake River Hatchery Evaluation Program from 16 April 2004 to 15 April 2005.

Fall Chinook salmon broodstock were obtained from the Lyons Ferry Hatchery (LFH) ladder from 7 September until 18 November and the adult fish trap at Lower Granite (LGR) Dam from 6 September until 20 November.

Fall Chinook were spawned at LFH from 18 October to 29 November with the peak spawn days occurring during the 15th and 16th of November. We processed 2,709 adults and jacks trapped at LFH, 964 adults and jacks trapped at LGR, and returned 89 fish to the Snake River. Many (29.5%) of the males were used multiple times due to mating protocol constraints.

This was the third year that Snake River natural origin fish were included in broodstock (5.3 % of the fish spawned). In addition this was the first year strays were purposely used in broodstock (3.2 % of broodstock) since 1989. These changes occurred because of co-manager and NOAA agreements that strays should be kept to less than 5% of the broodstock.

We collected 4,929,630 green eggs. Egg mortality to eye-up was 4.6% and 1,180,000 eyed eggs were shipped to other hatcheries resulting in 3,562,700 eyed eggs available for production. In February 2006, 154,100 fry (progeny of matings in which one parent was a stray) were destroyed and 30,000 fry from these crosses were shipped to NPT. Following an additional 2.89% (103,037) sac-fry loss, total fry ponded for production in rearing ponds was 3,275,563.

In 2005, WDFW released a total of 1,116,852 subyearlings (2004 BY) into the Snake River at LFH and Couse Creek boat launch, and the Grande Ronde River near the mouth of Cougar Creek. An additional 1,203,000 were transferred to other agencies. Survival of subyearlings from green egg to transfer and release was 90.8%. We also released 224,853 yearlings (2003 BY) with a CWT, adipose clip, and a red VIE behind the left eye, and 225,147 fish with a CWT and red VIE behind the left eye from LFH in April of 2006. Survival of yearlings from green egg to release was 90.1%.

WDFW staff conducted adult salmon surveys on the lower Tucannon River between 24 October and 6 December 2005. Redd counts were expanded to account for areas not walked. We estimate the total number of redds at 67, and escapement was 201 fish based on an estimate of 3 fish per redd. The composition of 10 fall Chinook carcasses recovered indicate the majority of

adults spawning in the Tucannon were our-of-basin strays (66.7%). Only one jack was recovered and it was of LF/Snake River hatchery origin.

Naturally produced juvenile fall Chinook (BY04) were observed at the Tucannon River smolt trap (Rkm 3.0) from 31 January through 30 June 2005. Based on 2005 smolt trap estimates and 2004 fall Chinook redd counts downstream of the trap, we estimated that 72,705 naturally produced fall Chinook smolts emigrated from the Tucannon.

The run of fall Chinook to LGR Dam was 11,638 adults and 2,347 jacks. The composition of the reconstructed run for LF/Snake River hatchery, LF/Snake River natural, and out-of-basin strays was 64.7%, 24.5%, and 10.8%, respectively. This is the first year bounds were placed around these estimates.

LSRCP returns of LF/Snake River hatchery origin fish to the Snake River basin (LFH, LGR, Tucannon River) totaled 8,476 adults and 2,276 jacks which was only 58.8% of the number required to meet mitigation.

Take of ESA listed LF/Snake River hatchery origin fall Chinook totaled 3,072 fish (including 33 returned to the Snake River), and 252 (38 returned to the Snake River) LF/Snake River natural origin fish.

LF/Snake River hatchery fall Chinook have a high fidelity to the Snake River. Of the 4,285 fish with CWTs recovered outside of the Snake River, approximately 0.1% of the fish were recovered at hatcheries, 1.2% at hatchery racks, and 0.1% during carcass surveys. The majority of recoveries outside the Snake River basin were in fisheries. The majority of ocean recoveries of adults from yearling and subyearling smolt releases occurred in British Columbia and Washington waters.

Introduction

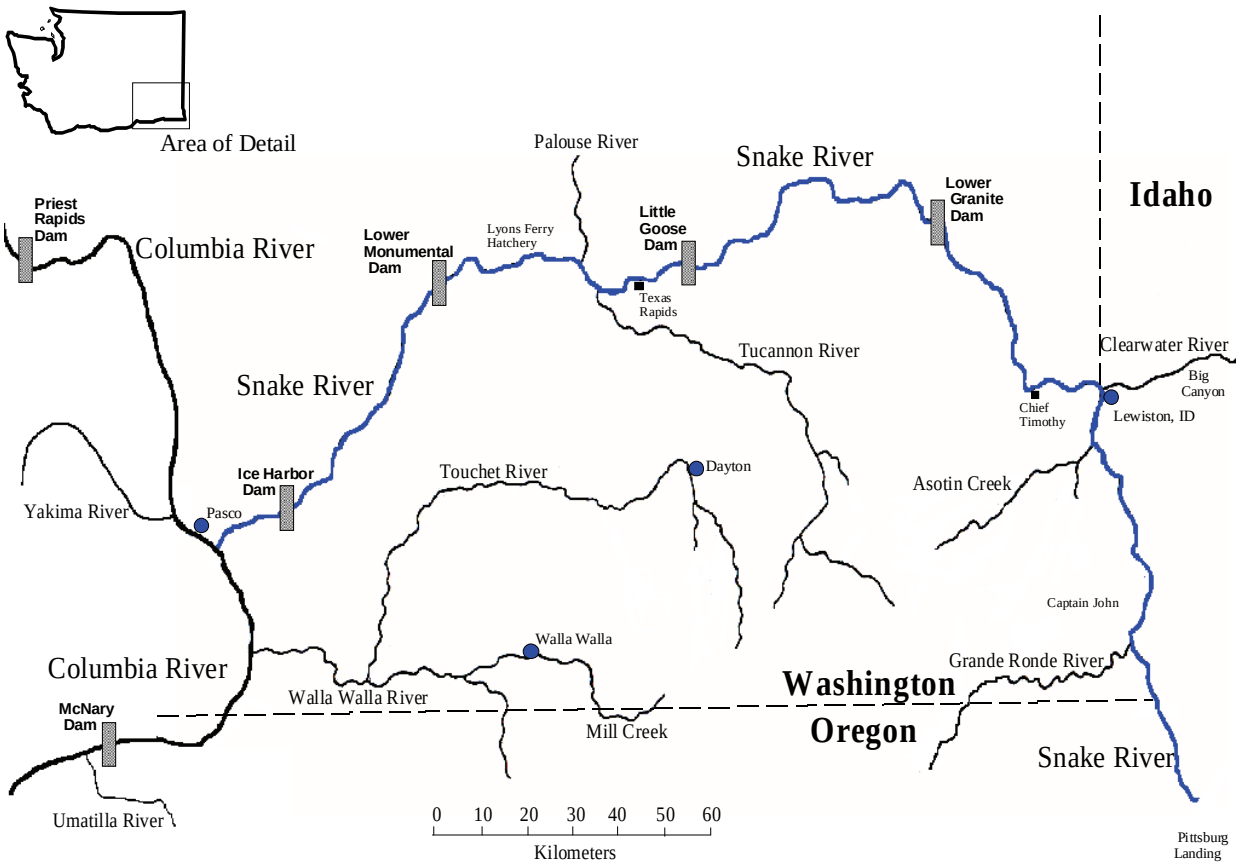
Program Objectives

This report summarizes activities by the Washington Department of Fish and Wildlife's (WDFW) Lower Snake River Hatchery Fall Chinook Evaluation Program from 16 April 2005 to 15 April 2006. WDFW's Snake River Lab (SRL) staff completed this work with Federal fiscal year 2005 and 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 estimated annual loss of 18,300 adult[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). This action was consistent with the U.S. Endangered Species Act and Washington's Wild Salmonid Policy.

The WDFW has two general goals in 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 of returns) as well as removing some hatchery 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 has language referring to adult recoveries. That language was intended to differentiate adults from juveniles in the document (Dan Herrig personal communication). The LSCRP mitigation goal was based upon 97,500 fall Chinook counted at McNary Dam in 1958 and expected 14,363 fall Chinook to 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 minijacks (fish < 30 cm total length) are not counted at the dams, they were excluded from the calculations that determined the mitigation goal.



	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 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 shunted back to the river and never used for broodstock (see LFH Trapping Operations below). 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 on fish hauled from LGR Dam. The fish trapped at LGR Dam that are unaccounted for at processing are likely included in the number of LFH fish processed overall.

Table 1. Number of Chinook initially collected for broodstock from trapping efforts at LFH and LGR Dam and how they were accounted for in 2005.

Year	Trap Location	Number Collected/Hauled for Broodstock	Processed (killed)	Returned to Snake River	Difference from Number Collected/Hauled
2005	LFH	2,561	2,713[a]	15	+167
	LGR Dam	1,053	965	74	-14

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

Lower Granite Dam Trapping Operations

Trapping protocols are listed in Appendix B. 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 or transport. WDFW personnel then hauled the fish to LFH in a 5,678 L aerated tank truck. A systematic automated trapping of 13% of the run at LGR Dam was conducted 6 September through 20 November.

LFH Trapping Operations

The majority of broodstock is collected at LFH. The trap at LFH was open daily from 7 September through 18 November. Arrival estimates were made daily 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 only reflect what was trapped and retained that day, not what the full amount of fish would have been if we had trapped daily.

We documented 9,009 trapping events of fall Chinook at the LFH trap in 2005 (Figure 2). Jacks accounted for the majority of trapping events (6,840). We were unable to determine the unique (excluding recaptures) number of fish that were trapped because there is not a marking protocol in place at the hatchery trap. We assume that jacks were recaptured multiple times but we do not know to what extent.

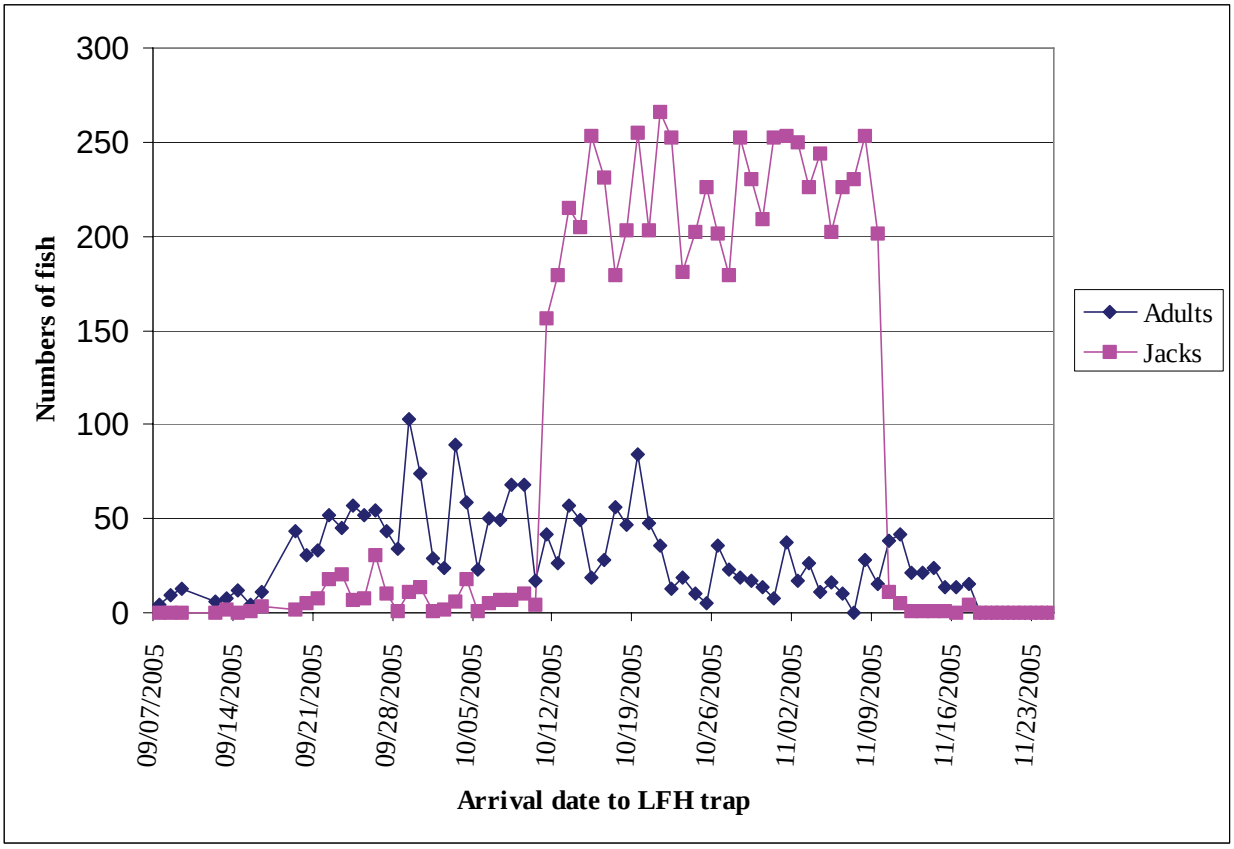


Figure 3. Number of adult and jack fall Chinook arriving at the LFH trap by date.

Hatchery Operations

Spawning Operations

Spawning and Egg Take

Spawning began the third week in October and continued for seven weeks (Table 2). The total number of fish spawned prior to culling is listed in Table 3. In an effort to include natural origin fish in our broodstock, untagged fish were used in broodstock. To reduce the likelihood of a stray being crossed with a natural origin fish, all unknown origin fish were mated exclusively with known coded-wire tagged (CWT) or visual implant elastomer (VIE) tagged Lyons Ferry (LF) origin fish.

At spawning, ripe fish were killed and their gametes collected and set aside unmixed. All matings consisted of a single male/single female cross (Appendix B). To determine the origin and brood year of fish spawned, CWTs were removed from tagged fish and scales were removed from untagged fish. During spawning, CWTs were decoded so origins were known prior to matings. The origins of untagged fish were not determined until the scale samples were analyzed and PIT tag codes researched, which usually occurred one week after spawning.

Spawning protocol guidelines discourage multiple uses of males. Unfortunately, since the mating protocol specified mating known (CWT or VIE tagged) LF origin fish with unknown origin fish, we were often male limited and had to use males multiple times. The differences between run composition of fish trapped at LFH and LGR Dam compounded this problem. The majority of LFH trapped fish were wire tagged or VIE (visual implant elastomer) tagged while the fish trapped at LGR Dam had a greater percentage of unmarked/untagged fish. There were not enough LF origin fish (by wire tags or VIEs) to mate with the unmarked/untagged fish on the days that LGR fish were spawned. Because of adult holding pond constraints (number and size), only fish from one trapping site can be processed each day, limiting our ability to mate LF origin fish with unknown origin fish. Because it was difficult to estimate the number of females we anticipated spawning the following day, we frequently underestimated the number of males that would be needed. This limitation resulted in the use of some males up to three times.

Table 2. Duration and peak of spawning, eggtake, and percent egg mortality at LFH, 1984-2005.

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

[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 spawned, and eggtake of fish spawned at LFH in 2005. (LFH and LGR trapped fish are combined, jacks are included with males).

Spawn Dates	Male[a]	Female[a]	Non-Viable[b]	Eggtake
Oct 18	10	9	1	29,700
Oct 25 and 26	55	57	1	183,300
Nov 1 and 2	289	330	1	1,077,264
Nov 8 and 9	404	545	3	1,814,166
Nov 15 and 16	273	425	9	1,376,424
Nov 22	121	126	1	376,276
Nov 29	25	26	0	72,500
Totals	**1,177**	**1,518**	**16**	**4,929,630**

[a] Numbers of fish presented include spawned fish whose progeny were later destroyed. Prior to 2005 this table represented LF origin fish retained and culled fish were recorded as killed outright. The change to this table was made so this report would match the LFH adult report submitted to Olympia.
[b] Non-viable females--not ripe when killed and includes one natural origin fish.

Since semen can be held overnight and used the following day with only a slight reduction in viability (Mendel and Milks, unreported data), semen from ripe LF origin males was split into two lots. One lot was used the same day as collected and the other lot was saved for the following day. Semen to be held over night was stored in individual plastic bags infused with oxygen and placed in a cooler on ice. Burlap bags were positioned between the samples and the ice to prevent freezing of the semen.

We retained gametes from 1,447 matings. We estimate 773 males were used once, 300 males twice, and 24 males three times. Two of the matings did not have an male ID number written down so we do not know if those males were already used in prior matings or if it was the first time they were used. For the following estimation (Busack 2006) we presumed the males were not used in prior matings. We estimate that the effective number of male breeders ($N_{b,\,m}$) was 953 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:
$\mu_t = N_{egg\_lots}/N_{tot} = 1447/1097 = 1.319$

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:

$$N_{b,\,m} = (N_{tot}-1/\mu_t)/(((N_1N_2+N_2N_3+4N_1N_3)/(N_1+2N_2+3N_3)) + 1)$$

where N_1 is the number of males used one time, N_2 is the number of males used twice, and N_3 is the number of males used three times.

Calculated effective male breeders is 86% of the census number of males and 65% of the male $N_{b,\,m}$ that would have been achieved if enough individual males had been available.

This was the third year that Snake River natural origin fish were included in the broodstock. Eighty-one females, 87 males, and three jacks of presumed Snake River natural origin (based upon scale readings) were included as part of broodstock. Nearly all (168 fish) of the natural origin fish were hauled from LGR Dam.

This was the first year that strays were purposely included in broodstock since 1989. This decision was made because of uncertainty related to the accuracy of scale analysis in differentiating between in-basin and out-of-basin fish. At the end of the season, co-managers agreed that progeny resulting from known LF x stray (based on scale analysis) crosses would be included in production at a level not to exceed 5%, and the remainder would be destroyed. State

policy prevented the culling of stray gametes until the end of the season to assure eggtake needs were met in-basin and out-of-basin.

Of the total number of fish spawned, 90.7% were LF origin, 5.3% were natural origin, 3.2% were strays based on scale readings, and 0.8% were of unknown origin (unmarked/untagged or AD clip no wire fish) because their scales could not be read. These percentages include fish that were spawned for the Idaho Power Company (IPC) mitigation agreement as well as the LSRCP program. Jacks (all origins) were used in 7.5% 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.

Eyed eggs for the LSRCP program were primarily (78.7%) from LF x LF origin matings with 12.0% of the eggs coming from natural x LF origin matings and 9.3% from stray x LF origin matings. Eggs were assigned to yearling and subyearling programs based on parental crosses. Because smolt-to-adult returns from yearling releases are consistently greater than those of subyearling releases, no eggs resulting from stray matings were assigned to the yearling program; 5% of the eggs contributing to the yearling program were from natural x LF crosses and the remaining 95% from LF x LF crosses. The majority of eggs slated for the subyearling program were from LF x LF origin matings (71.7%); the remainder was comprised of LF x natural origin matings (15%) and LF x stray matings (13.3%).

We calculated fecundities for several groups of females using methods previously described by Milks et al. (2006). For management purposes the mean fecundity for the fish trapped at LGR and hauled to LFH was 3,453 eggs/female. To assist with trapping protocols three groups of fish are of interest based upon visual and electronic identification: tagged fish (CWT or VIE), unmarked/untagged fish, and AD only (no wire) fish. Tagged fall Chinook (known LFH origin) used in broodstock averaged 3,225 eggs/female, unmarked/untagged fish (hatchery and natural origin) as a whole averaged 3,644 eggs/female. The fecundity of the one AD only fish we sampled was 3,038 eggs/female.

Since we are trying to incorporate natural origin gametes into production at 10-20%, it is important that fecundity be estimated for natural origin females also. Natural origin females averaged 3,920 eggs/female. More detailed data regarding fecundity associated with origin, age at return, and life history strategy (reservoir rearing) will be presented in a future report.

Information pertaining to processed fish that were not spawned is presented in Table 4.

Table 4. Weekly summary of mortality, and surplus fall Chinook processed at LFH in 2005. (LFH and LGR trapped fish are combined; jacks are included with males).

Week	Mortality		Killed Outright	
Ending	Male	Female	Male	Female
18-Sep			1	
25-Sep	1	1	21	
02-Oct	1		23	
09-Oct	3	1	10	
16-Oct	1	2	22	
23-Oct	3	5	106	3
30-Oct	48	7	65	7
06-Nov	61	15	73	21
13-Nov	22	31	110	35
20-Nov	55	21	47	33
27-Nov	13	5	40	6
04-Dec	12		33	3
Totals	**220**	**88**	**551**	**108**

We trapped more fish at LFH and LGR than were needed for run composition. To ensure representative sampling we continued trapping throughout the run. Excess fish were returned to the river on 29 November (Table 5). All fish were released at Bryan's Landing, located above Little Goose Dam at Rkm 113.1. Excess fish from LFH trapping were not marked when released because the trap at LGR Dam was closed and would not be able to enumerate recaptures. Unfortunately, since the fish were not marked we were unable to determine what proportion of the fish could be accounted for during spawning ground surveys in the Tucannon River. In the future, all released fish should be marked for accounting purposes.

Table 5. Release location, trapping sites, sex, and total number of fish that were hauled back to the Snake River on 29 November 2005. Recaptures are included.

Release location	Trap site	Sex	Number of Fish
Bryan's Landing	LFH	male	14
		jack<53 cm	0
		females	1
	LGR	male	71
		jack<53 cm	1
		females	2
Total			**89**

To accommodate reporting requirements in our Section 10 permit, the final disposition of LF/Snake River hatchery and LF/Snake River natural origin fish are listed in Table 6. Fish culled because they were mated with a stray have been removed from the broodstock category and are now listed as culled. Broodstock listed in the table below contributed to production while fish listed under the Mortality/KO/Culled were fish that died, were killed, or were culled. Out-of-basin strays are not included in the table below.

There were many wire tagged jacks killed outright to determine which releases were contributing to the large number of returning jacks. Of the 472 jacks listed, 417 were less than 40 cm in length. Of those, 153 were less than 35 cm, and only two were less than 30 cm (minijack). The majority of jacks less than 40 cm were from on-station releases of yearling from LFH.

Table 6. ESA Listed Snake River hatchery and natural origin fall Chinook Take during Spawning operations at LFH, 2005.

	Number of Snake River Origin Fall Chinook Processed at LFH								
	Broodstock			**Mortalities & KO / Culled**			**Returned to Snake River**		
	F	**M**	**J**	**F**	**M**	**J**	**F**	**M**	**Total**
Natural	81	87	3	3	38	2	1	37	252
Lyons Ferry Hatchery (CWT and/or VIE)	1,177	841	79	116	94	467	1	8	2,783
Snake River Hatchery (scales)	142	69	8	12	31	3	1	23	289
Grand Total	**1,400**	**997**	**90**	**131**	**163**	**472**	**3**	**68**	**3,324**

Incubation, Rearing, Marking, and Transfer

Historical information regarding eggtake, early life stage survival (Table 6) and marking and transfer numbers (Table 7) are provided. Transfers to IPC consisted of 85% of the eggs coming from LF x LF origin matings, 5% LF x stray matings, and 10% from LF x natural origin matings. These eggs were shipped off-station before a decision was made as to what would be retained for LSRCP production. All eggs transferred to the Nez Perce Tribal Hatchery (NPTH) came from LF x stray matings. These eggs were used to supplement their production while remaining within the 5% stray guideline for total eggtake at NPTH.

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, brood years 1996-2005.

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[a]	1,053,278	3,421,751	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

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

Table 8. Snake River fall Chinook marked by WDFW and/or transferred from LFH, 2004-2005 brood years.

Brood Year	Release Site	Marking				Transfer		
		Date	Type	Number	Fpp	Date	Number	Fpp
2004								
Subyearling	LFH	4/07/05	AD+CWT	200,810	160.0	-	-	-
	Couse Cr.	3/30/05	AD+CWT	201,262	170.0	-	-	-
	Gr. Ronde	4/18/05	AD+CWT	202,116	150.0	-	-	-
	BC	4/12/05	AD+CWT	99,875	150.0	5/03/05	257,881[b]	77.6
	BC	4/12/05	CWT	100,232	150.0	5/03/05	259,051[b]	77.6
	CJ	3/22/05	AD+CWT	103,823	170.0	5/03/05	256,716[b]	69.7
	CJ	3/22/05	CWT	100,733	170.0	5/03/05	249,018[b]	69.7
	DNFH-COE Research	-	-	-	-	4/11/05	175,524	180.0
	USF&W-COE	-	-	-	-	2/04/05	3,310	662.0
	Research	-	-	-	-	4/18/05	1,500	100.0
	NOAA-Research							
Yearling	LFH	9/20/05	AD+CWT+ LR	225,213	30.0	-	-	-
	LFH	9/28/05	CWT+ LR	225,507	25.0	-	-	-
	CJ	9/30/05	AD+CWT	70,952	20.0	2/06/06	70,769	12.6
	CJ	10/04/05	CWT	80,763	20.0	2/06/06	80,554	12.6
	BC	10/12/05	AD+CWT	70,494	20.0	3/01/06	70,308	11.7
	BC	10/17/05	CWT	62,568	20.0	3/01/06	62,402	11.7
	PL	9/22/05	AD+CWT	70,750	24.0	2/27/06	70,479	11.8
	PL	9/14/05	CWT	80,000	24.0	2/27/06	79,694	11.8
2005								
Subyearling	LFH	3/20/06	AD+CWT	202,641	170.0	-	-	-
	Couse Cr.	4/03/06	AD+CWT	201,547	150.0	-	-	-
	Gr. Ronde	4/10/06	AD+CWT	201,474	190.0	-	-	-
	CJ	3/29/06	AD+CWT	101,380	160.0	5/02/06	101,244	74.1
	CJ	3/31/06	CWT	100,833	160.0	5/02/06	100,699	74.1
	CJ	-	-	-	-	5/01/06	305,180	75.0
	CJ-Priority 12	4/18/06	AD+CWT	200,892	190.0	-	-	-
	BC	3/27/06	AD+CWT	101,796	160.0	5/02/06	101,594	76.0
	BC	3/29/06	CWT	101,061	160.0	5/02/06	100,861	76.0
	BC	-	-	-	-	5/04/06	304,723	74.0
	DNFH-COE Research	-	-	-	-	4/11/06	198,900	153.0

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

[b] Unmarked fish were combined with the tagged fish in the raceways. At transfer, the estimated number transferred as unmarked for BC was 317,178 and for CJ was 301,751.

Juvenile Releases and Migration

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.

2004 Brood Year

Subyearling Releases

Subyearlings were released at LFH and two additional sites upstream of LGR Dam in 2005. 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 Passive Integrated Transponder (PIT) tagged to allow collection of migration data through the Snake and Columbia Rivers.

The on-station release of 2004 brood subyearlings (200,171) from LFH occurred at 11:15 am on 27 May 2005. Fish were sampled on 25 May. Mean fork length was 92.7 mm (SD 8.6) and mean weight was 8.9 g (SD 2.6) or 51.1 fish per pound (fpp). The CV for fork length was 9.3 and the condition factor (K) was 1.08. Included in the release were 1,498 fish that were PIT tagged on 12 May. At the time of release, Snake River flow and spill recorded at Lower Monumental Dam was 91.0 kcfs and 3.1 kcfs respectively.

Snake River near Couse Creek

Two groups of 2004 broodyear subyearlings were released into the Snake River near Couse Creek Boat Launch during May 2005. The unmarked/untagged group (234,030) was released on 23 May. Fish were sampled on 20 May. Mean fork length was 86.6 mm (SD 10.6) and mean weight was 7.7 g (SD 2.8) or 59.2 fpp. The CV for fork length was 12.2 and K = 1.13. The other release group (200,191) was marked/tagged with an adipose fin clip and CWT and released at 12:30 pm on 26 May. These marked fish are part of a study to compare acclimated fish (released from the Captain John acclimation site) to those released directly into the river. The release number includes 3,465 fish that were PIT tagged. Mean fork length was 93.3 mm (SD 8.7) and mean weight was 9.3 g (SD 2.7) or 49.0 fpp. The CV for fork length was 9.3 and K = 1.11. Fish were sampled on 25 May.

At the time of Couse Creek releases, Snake River flow and spill recorded at LGR Dam was 122.8 kcfs and 37.1 kcfs, respectively, for the unmarked group and 98.8 kcfs and 14.0 kcfs for the marked group. Snake River flow and spill recorded at Lower Monumental Dam was 119.6 kcfs and 24.3 kcfs, respectively, for the unmarked group and 101.3 kcfs and 13.8 kcfs for the marked group.

Grande Ronde

Two groups of 2004 broodyear subyearlings were released into the Grande Ronde River near the mouth of Cougar Creek during May 2005. An unmarked/untagged group (281,688) was released on 24 May. Fish were sampled on 23 May. Mean fork length was 76.1 mm (SD 15.4) and mean weight was 5.5 g (SD 3.4) or 66.0 fpp. The CV for fork length was 20.2 and K = 1.08. Fish in the other release group (200,772) were marked/tagged with an adipose fin clip and CWT and released on 25 May. Mean fork length was 89.0 mm (SD 11.6) and mean weight was 8.1 g (SD 2.9) or 56.0 fpp. The CV for fork length was 13.1 and K = 1.09. Fish were sampled on 25 May.

At the time of Grande Ronde releases, Snake River flow and spill recorded at LGR Dam was 116.2 kcfs and 30.3 kcfs, respectively, for the unmarked group and 100.9 kcfs and 15.8 kcfs for the marked group. Snake River flow and spill recorded at Lower Monumental Dam was 116.6 kcfs and 21.6 kcfs, respectively, for the unmarked group and 102.6 kcfs and 9.3 kcfs for the marked group.

Yearling Releases

Two groups of 2004 BY yearling fall Chinook were released into the Snake River at LFH from 5-10 April 2006. All fish were coded-wire-tagged and marked with a red VIE tag behind the left eye. One group (224,853 fish) was adipose fin-clipped (CWT: 63-32-83) and the other (225,147 fish) was not adipose clipped (CWT: 63-32-84). Throughout the release, small groups of fish were removed and held in an adjacent raceway for sampling on 10 April. Mean fork length was 163.6 mm (SD 12.2) and mean weight was 45.1 g (SD 9.9) or 10.1 fpp. The CV for fork length was 7.5 and K = 1.01. During the release, Snake River flow and spill recorded at Lower Monumental Dam ranged from 119.5-131.5 kcfs and 40.7-40.0 kcfs respectively.

Survival Rates to Release

We used the estimated number of eggs and fish present at life stages in the hatchery for 1990-2004 broods to calculate survival rates within the hatchery environment (Table 8). 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, in 2005 the hatchery reported 4,929,630 green eggs being taken. An estimated 1,378,018 green eggs were shipped or destroyed at later stages of development, leaving 3,551,612 green eggs to be used in the actual life stage survival percentage calculations. 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, 1990-2004 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
Yearling mean:	**%**	**92.2**	**89.2**	**82.2**
	SD	2.6	10.0	8.4
Subyearling mean:	**%**	**92.8**	**96.1**	**89.5**
	SD	2.3	2.6	2.9

[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).

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

Tucannon River Natural Production

Adult Salmon Surveys

Fall Chinook Redd Surveys

WDFW personnel have conducted adult salmon surveys on the lower Tucannon River since 1985 (Table 10). Survey sections generally covered the river from Rkm 1.1 to Rkm 29.0 (Appendix E). 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 for that area. The habitat is poor in this area and we presume no spawning occurs there. During 2005, landowner access restrictions prevented the surveying of 1.4 kilometers of river above the Starbuck Bridge (section 6). The lengths of river sections were measured using Maptech Terrain Navigator Pro, version 6.0. The change in methodology of measurement has changed the river kilometer (Rkm) associated with some of the landmarks.

This report presents adjusted historical redd counts, which include estimates of redds in sections we were unable to survey due to landowner restrictions or water events. For sections that were partially surveyed, redds/Rkm for that section were used to estimate redds in the portions that were not surveyed. For whole sections that were not surveyed, redd densities for the adjacent section upstream or downstream with habitat most similar to the section was used. Only limited spawning occurs above section 10 resulting in only a few years being adjusted for that section. Data prior to 1996 were not adjusted for section 10. In years surveys were cut short because of high flows and turbid water, estimates were based on percent of redds completed during that time of year for that section, using data collected during years prior to 2003. Data from 2003-2005 were not used when estimating run timing because LFH returned fish to the Snake River, skewing the Tucannon run timing toward the end of the season.

Estimating the number of fall Chinook spawning in the Tucannon River is becoming increasingly difficult with the increase in numbers of Coho that are spawning in the Tucannon. Similarities in spawning locations and spawn timing have been documented. Although the river conditions for viewing were good throughout the spawning season with low flows and clear water, it was difficult to distinguish fall Chinook redds from Coho redds. Based on our best assignment of redds by species, the ratio of fall Chinook redds to coho redds was 1.5:1.

Table 10. 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, 1985-2005.

	Escapement		Redd Construction			Success of Spawning	
Year	Estimated escapement[a]	% Strays in escapement estimate	# Redds observed	# Redds in no access areas (estim)	Total # of Redds (estim)	Estimated smolts/redd[b]	Total Estimated # emigrants[c]
1985[d]	0	unknown	0	No estim	0	unknown	unknown
1986[e]	2[f]	unknown	0	No estim	0	unknown	unknown
1987	48	Pending	16	0	16	unknown	unknown
1988	78	Pending	26	0	26	unknown	unknown
1989	150	Pending	48	2	50	unknown	unknown
1990	186	Pending	62[g]	0	62	unknown	unknown
1991	150	Pending	50	0	50	unknown	unknown
1992	69	Pending	23	0	23	unknown	unknown
1993	84	Pending	28	0	28	unknown	unknown
1994	75	Pending	25	0	25	unknown	unknown
1995	87	Pending	29	0	29	unknown	unknown
1996	144	Pending	43	5	48	0.6[h]	29
1997	93	Pending	27	4	31	712	22,076
1998	132	Pending	40	4	44	15	666
1999	87	Pending	21	8	29	441	12,799
2000	60	Pending	19	1	20	468	9,352
2001	219	Pending	65	8	73	336	24,545
2002	630	Pending	183	27	210	81	17,030
2003[i]	474	Pending	143	15	158	452	71,465
2004[j]	345	Pending	111	4	115	632	72,705
2005	198	Pending	61	5	66	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. 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.

[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] Based on one survey completed 12/17/85.

[e] Based on one survey completed 11/18/86.

[f] Two carcasses counted but not sampled.

[g] Correction of number of redds observed that was presented in the 1990 Annual Report.

[h] Flood event occurred January of 1997, nearly eliminating all the progeny from the 1996 spawn.

[i] Fish in excess of broodstock needs were returned to the Snake River, possibly affecting the magnitude of the run to the Tucannon River. Estimated smolts/redd and the total estimated emigrants have been corrected since the last report (2003 and 2004 Annual Report).

[j] Estimated number of smolts/redd and total emigrants has been corrected since the last report (2003 and 2004 Annual Report).

Escapement and Composition

The total escapement to the Tucannon River is based on an expansion factor of three fish per redd. We believe this 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 Dam based on estimates of adult salmon above LGR 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 Dam and pre-spawning mortality estimates as indicated in a radio telemetry study on the Snake River (Mendel et al. 1993).

Although the Tucannon River is a small river, locating carcasses can be difficult because of removal by predators (e.g. river otter), or carcasses washing into deep holes where they are difficult to see and recover (Table 11). We collect heads and scales from each carcass to determine origin from CWT and scale readings (Tables 12 and 13). Composition of the run (Table 13 and Appendix F) is determined by applying the composition of the carcasses recovered, to the estimated escapement into the Tucannon River. The majority of fish recovered in the Tucannon each year are females, with some males, and a few jacks. We do not know if this is the actual composition of run to the Tucannon or if there is bias in the data due to limited carcass sampling. There is an adult weir on the Tucannon but it is not located downstream far enough to address this question.

Table 11. Date and number of fall Chinook and Coho redds and carcasses counted in the Tucannon River in 2005.

	Chinook		Coho	
Week beginning	**Redds counted**	**Carcasses sampled**	**Redds counted**	**Carcasses sampled**
24-Oct	4	0	15	1
31-Oct	2	0	5	1
07-Nov	14	1	12	0
14-Nov	19	4	2	0
21-Nov	14	0	3	2
28-Nov	6	4	1	2
05-Dec	2	1	2	1
Totals	**61**	**10**	**40**	**7**

Natural origin fish have not been DNA tested to determine origin, although scale pattern analysis indicates these fish are more similar to in-basin Chinook than out-of-basin fish. For information regarding the assignment of fish to specific origins please refer to Appendix F.

Any hatchery yearling recoveries from unmarked/untagged/no VIE fish are assumed to be strays, since all LF/Snake River hatchery origin fish have been AD/CWT/VIE tagged. Strays from out-of-basin releases were often BLANK wire tagged although one of the fish had a CWT indicating it originated from the Little White Salmon National Fish Hatchery. We do not know where the BLANK wire tag fish originated. The last release of BLANK wire tagged yearlings from Bonneville Hatchery were BY99 released in 2001, which does not match the age of the BLANK wire tag recovery as determined by scale aging. Agency wire tagged yearlings (09 BLANK) were released by Bonneville Hatchery into the Umatilla River. Klickitat hatchery also released 09BLANK wire tagged subyearlings from BY00 and BY01.

Table 12. Age structure (total age) of fall Chinook carcasses sampled on the Tucannon River. 2005.

	Subyearling		Yearling			Reservoir reared	No sample
Origin	**Age 3**	**Age 4**	**Age 2**	**Age 3**	**Age 4**	**Age 5**	**Unknown**
Lyons Ferry Hatchery (by CWT)			1		1		
Natural (wild by scales)		1				1	
Blank Wire Tag (BLANK)					1		
Umatilla River (09BLANK)					2		1
Out-of-basin hatchery	1			1			
Totals	1	1	1	1	4	1	1

There was a shift in the run composition to out-of-basin fish to the Tucannon River in 2005. Less fish were returned to the river than in 2004, so we anticipated the run composition would return to what was estimated prior to 2004. We did not mark the fish when we released them so we do not know if their release had an effect on the run composition in the Tucannon.

Table 13. Estimated run composition of fall Chinook in the Tucannon River, 2005.

	Percent Composition of Run	
	2005	
Origin	**Adults**	**Jacks (<53cm)**
Lyons Ferry Hatchery	11.1	100
Natural (wild)	22.2	
Out-of-basin (strays)	66.7	
Total	**100**	**100**

Coho

Forty redds were observed which expands to 41 total coho redds when we estimate redd construction in areas not surveyed. Seven carcasses were collected, and scale readings indicated six were hatchery yearling 3-year-old fish. One of those fish had a CWT although only the first four digits (6101) were readable. We believe this fish was released into the Clearwater River by the NPT. The seventh fish was unmarked and untagged, and of unknown origin.

Juvenile Salmon Emigration

Juvenile fall Chinook were observed at the smolt trap (Rkm 3.0) from 31 January through 30 June 2005 when the trap was pulled for the season (Gallinat and Ross, 2006). The date when the median number of fall Chinook passed the trap was 18 May.

We captured 11,691 fall Chinook, and estimate that 47,416 (38,364-61,754) naturally produced fall Chinook smolts passed the Tucannon River smolt trap during 2005 (Gallinat and Ross, 2007). The trapped fish ranged from 30-115 mm in length. Based on 75 redds estimated above the smolt trap during 2004 we calculated the number of smolts produced per redd was 632 fish. Including juvenile production from below the smolt trap we estimate that 72,705 naturally produced fall Chinook smolts left the Tucannon during 2005.

The survival of fish downstream of the smolt trap may be less than the survival of fish above the trap because the river is slow flowing with high sediment load. 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. Numbers of coho trapped in the past have been low but in 2005, larger numbers of coho were intercepted. This was the first year mark-recapture trap efficiency estimates were done for coho (Table 14) to determine if their recapture rates are similar to fall Chinook.

We captured 1,298 coho and estimate that 2,947 (2,104-4,262) naturally produced coho passed the smolt trap in 2005. Emigration numbers were only large enough to estimate recapture efficiency for three weeks during the 2005 emigration. Those efficiencies were applied to the entire coho migration, so the estimates should be used cautiously.

Juvenile coho were observed at the smolt trap from 16 February through 26 June. The date when the median number of coho passed the trap was 12 May. Fish trapped ranged from 35-152 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 35-90 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, 2005.

Week ending	Fall Chinook Recapture efficiency (%)	Coho Recapture efficiency (%)
22 May	26.0	unknown
29 May	15.0	unknown
6 June	41.0	44.8
13 June	26.5	17.4
20 June	25.0	18.2

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 (<30 cm). We estimate that 14 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. Moreover, these fish were not reported to the Regional Mark Information System (RMIS).

The composition presented in Table 15 is based on data from the fish trapped and processed at LFH. 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 tagged only). Scale analysis from the BLANK wire tag recoveries that were aged indicated that group of fish to be either age 3 or age 5. We do not know the origin of the age 3 fish because neither 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. If the age 5 BLANK wire tagged fish are from that group, they are of Priest Rapids stock. 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 2005.

Origin	Adults	Jacks	Comp of Adults	Comp of Jacks
LF/Snake River Hatchery	2006	457	89.6%	96.6%
LF/Snake River natural (wild)	4	0	0.2%	0.0%
Strays (out-of-basin)	204	14	9.1%	3.0%
Hatchery origin (unassigned)	18	1	0.8%	0.2%
Unknown origin (natural or hatchery)	4	1	0.2%	0.2%
Summer Chinook	4	0	0.2%	0.0%
Totals	2240	473	100.0%	100.0%

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

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, 2005). Window counts estimated 11,194 adults and 3,236 jacks reached LGR Dam in 2005 (Figure 4). The Chinook passing LGR Dam after 17 August are designated as falls based on arrival date, which may be inaccurate because of the overlap between the fall and summer Chinook runs. In addition, fish counts 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).

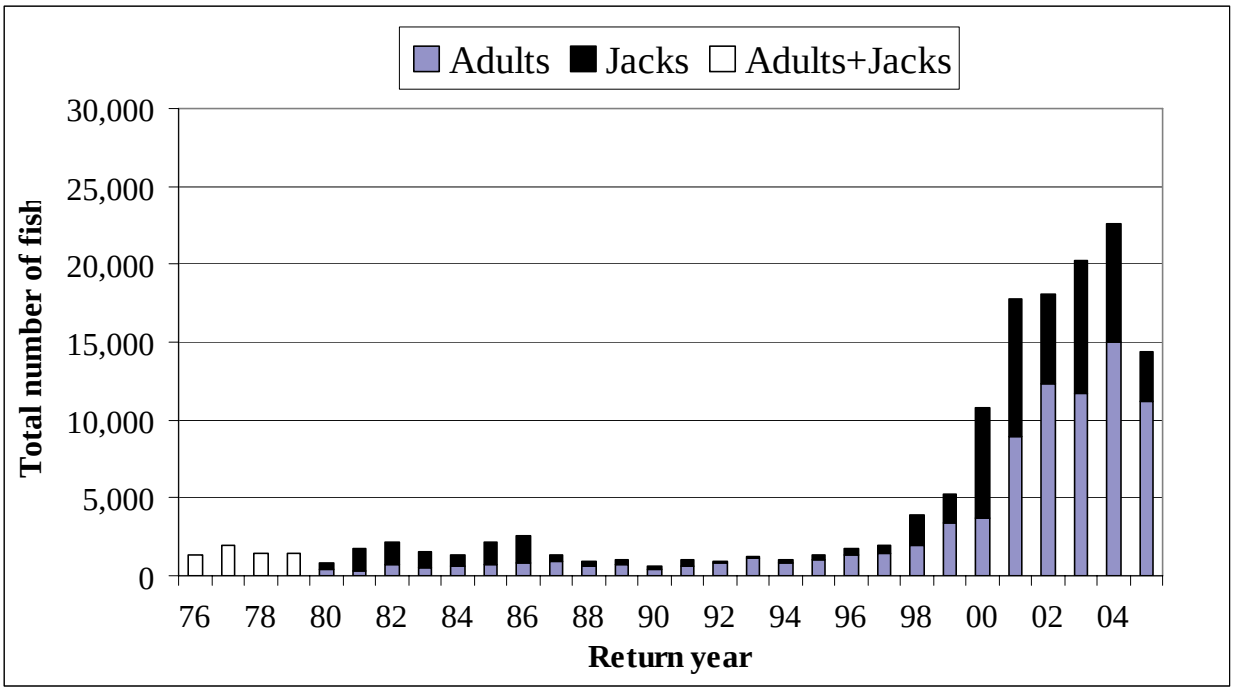


Figure 4. Fall Chinook window counts at LGR Dam, 1976-2005.

Fallbacks were documented from August-October at the juvenile smolt project facility, downstream of LGR (Fred Mensik, WDFW, 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. Any fish small enough to fit through the separator grating (pipes) are shunted to the juvenile facility for potential sampling.

Fallback events (one jack) documented at the separator during the month of August will not be included since data were not recorded regarding run of Chinook encountered (summer Chinook may have been included). Combining detections of fallback events at the separator, the occurrence of adult/jack/minijacks in samples at the juvenile facility (Table 16), and a sampling rate expansion, we estimate 156 adult (106 clipped and 50 unclipped), 179 jack (87 clipped and 92 unclipped) and one minijack (unclipped) fallback events occurred in 2005.

Table 16. Numbers of Chinook sampled at LGR juvenile facility by clip, CWT, elastomer, size, and sample rate, 2005.

			Sample rate			
			100%		25%	
Fin Clip	CWT	Elastomer	Jack	Minijack (<30cm)	Jack	Total
Ad clip	N	N	5			5
	Y	LR	36		1	37
		N	9		1	10
Ad Total			**50**		**2**	**52**
No Clip	N	LR	6			6
		N	4		1	5
	Y	LR	31		2	33
		N	5	1		6
No Clip Total			**46**	**1**	**3**	**50**
Grand Total			96	1	5	102

Of the fish that were captured and sampled at the juvenile facility at LGR Dam, 72.6% had a left red elastomer tag indicating they originated from yearling releases at LFH. We estimate that 93.2% of the jacks that were sampled at the juvenile collection facility were of hatchery origin. Scales were not taken on the unmarked/untagged group, therefore we could not determine their origin.

The adults and jacks encountered at the juvenile separator were only examined for size and fin clip. We estimate at least 67.9% of the adults sampled at the separator were of hatchery origin based solely on adipose clips, but expect the rate is actually greater. The use of adipose clips as a sole indicator of hatchery origin is no longer a reliable method since many hatchery fish are being released into the Snake River basin without an associated fin clip. We estimate 92.1% of the jacks collected at the separator were of hatchery origin based on the composition of unclipped jacks sampled at the juvenile facility. Data were not collected regarding operculum punches so we do not know if these fish were counted at the LGR trap during sampling for the run reconstruction. Likewise, we do not know if these fish re-crossed the dam after falling back or if they continued downstream. Since the fish released above LGR were not a random sample of the run, we cannot use operculum-punched fish to estimate fallback. For 2006, we will

request the COE collect additional data to allow a higher degree of precision in run reconstruction estimates of escapement above LGR Dam.

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, 2005.

Origin	Adults	Jacks	Comp of Adults	Comp of Jacks
LF/Snake River Hatchery	476	100	55.7%	90.9%
LF/Snake River natural (wild)	205	5	24.0%	4.5%
Strays (out-of-basin)	148	4	17.3%	3.6%
Hatchery origin (unassigned)	3	1	0.4%	0.9%
Unknown origin (natural or hatchery)	22	0	2.6%	0.0%
Summer Chinook	1	0	0.1%	0.0%
Totals	**855**	**110**	**100.0%**	**100.0%**

Table 18 summarizes run reconstruction estimates of numbers of fall Chinook to LGR in 2005. These estimates are unique numbers of fish and have been adjusted for fallback and recapture events. **These estimates are for fish to LGR not past LGR.** 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.

Table 18. Run Reconstruction estimates of numbers of fall Chinook to LGR Dam during 2005.

Origin	Adults	Jacks	Comp of Adults	Comp of Jacks
LF/Snake River Hatchery	7,163	1,880	61.5%	80.1%
LF/Snake River natural (wild)	3,109	319	26.7%	13.6%
Strays (out-of-basin)	1,367	148	11.7%	6.3%
Totals	**11,638**	**2,347**	**100.0%**	**100.0%**

Final Location of Wire Tagged LFH/Snake River Hatchery Fall Chinook

To document where recoveries of LFH/Snake River hatchery fish occurred in 2005, we queried the RMIS database on 17 April 2007 for all tag recoveries (all tag statuses) of LSRCP released fish. Snake River recoveries are not included in this summary but can be derived by combining estimates from the Tucannon River (Appendix F), recoveries of fish trapped at LFH (Appendix G), and the run reconstruction to LGR (Appendix H). The run reconstruction to LGR Dam also includes data from fish trapped at LGR and hauled to NPTH.

In Appendix I, coded wire tag recoveries were grouped by freshwater and saltwater, then by state, then by recovery site. We report recoveries at hatcheries, racks, and carcass surveys to show the final locations of fish that strayed outside of the Snake River basin. The remaining fishery recoveries were grouped together.

Comparing yearling data with subyearling data is difficult since the two groups of fish were marked differentially; yearlings are 100% ADCWT, while subyearlings included unmarked/untagged, wire tagged without a fin clip, as well as ADCWT groups. Some ocean fisheries only visually sample fish for fin clips (indicator for presence of a CWT) while others sample electronically for wire tags. This may result in an underestimation of harvest by ocean fisheries for unclipped CWT subyearlings. To address this, paired releases of ADCWT and CWT tagged fish in Snake River groups began in 2005. Future reports will document the differences in estimating harvest for ADCWT groups versus CWT only groups.

LF/Snake River hatchery fall Chinook have a high fidelity to the Snake River. Of the 4,285 fish recovered outside of the Snake River, approximately 0.1% of the fish were recovered at hatcheries, 1.2% at hatchery racks, and 0.1% during carcass surveys. The majority of recoveries outside the Snake River basin were in fisheries. The majority of ocean recoveries of adults from yearling and subyearling smolt releases occurred in British Columbia and Washington waters.

Status of Mitigation Requirements

Combining run reconstruction estimates to LGR Dam with recoveries at LFH and estimated returns to the Tucannon River provides the best estimate of Snake River basin mitigation returns (tagged and untagged fish). The combined numbers are presented in Table 19. Only fall Chinook that were part of the LSRCP releases are included in the table. Fall Chinook from NPTH and IPC releases are excluded.

We estimate that 8,476 adult and 2,276 jack LF/Snake River hatchery origin fall Chinook returned to the Snake River in 2005. This represents 58.8% of the LSRCP mitigation goal. However, we suspect the LSRCP compensation component of the run is underestimated. Scale analysis of unmarked/untagged fish was used to differentiate in-basin (LSRCP origin) from out-of-basin strays. The number of unmarked/untagged out-of-basin strays estimated based on CWT recoveries does not account for the number of strays estimated from scale readings. Therefore, it is possible that some of the untagged fish were misidentified as strays when they should have been identified as in-basin fish.

Table 19. Estimated number of LF/Snake River hatchery origin fall Chinook to the Snake River in 2005 contributing to LSRCP goals.

Size	LFH processed	Tucannon River[a]	Run to LGR[b]	Total to Snake
Adults	1,996	19	6,461	8,476
Jacks	455	20	1,801	2,276
Total	2,451	39	8,262	10,752

[a] Estimated run to the Tucannon River.
[b] Run reconstruction estimate to LGR Dam (not past LGR).

Smolt-to-Adult Return Estimates

Smolt-to-adult return estimates were not completed in time for this report. Estimates of SARs will be presented in the upcoming 2006 Annual report.

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 prioritized.

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

Recommendation: Mark all excess fish prior to release. This will allow us to document and evaluate the affect of hauling on trapping location, release location, and final spawning or recovery location.

The sizes of the adult ponds at LFH limit our options 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 separately from the 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 two of the adult holding ponds lengthwise to give us more flexibility when processing adults at spawning.

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 collect additional data on fish encountered at the juvenile collection facility and separator located at LGR Dam. We will request they document operculum punches on non-juvenile fall Chinook encountered so that we can adjust data used in run reconstruction estimates. In addition we will request that the VIE color and location be documented on non-juvenile fall Chinook encountered on the separator.

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

Data from carcass surveys on the Tucannon may be biased. The sample size of carcasses recovered each year is very small. Our concern is that the carcasses recovered do 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). We do not know if the composition is accurate or if it is biased due to recovery methods.

Recommendation: Compare sex ratio of carcasses recovered from the Tucannon with sex ratio for the run at LGR. Report the differences in a future report.

Recommendation: Conduct more carcass surveys to increase sample size.

Recommendation: Consider constructing and operating an adult weir near the mouth of the Tucannon River to address sampling and escapement biases.

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: Consider tagging of the LSRCP releases so returns can be accurately estimated.

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

Hatchery minijacks and jacks from LFH constitute a significant portion of the fall Chinook returns to the Snake River during most years, but some years the run is dominated by minijacks and jacks.

Recommendation: Evaluate historical LFH fall Chinook returns by age and size at release in an effort to determine the cause of early returns and how to potentially control them in the future.

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Appendix A: Fall Chinook Run to LFH, IHR, LMO, and LGR Dams: 2002-2005

(Numbers of fall Chinook observed at Snake River Dams and numbers of fall Chinook trapped and processed at LFH. LGR trapped fish that were processed at LFH are listed under LGR Dam data with COE window counts).

Appendix A. Numbers of Chinook processed at LFH and window counts at Ice Harbor, Lower Monumental, and Lower Granite dams, 2000-2005.

		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
2000	IHR Dam	6,485	9,864	48	59	167	502	46	29	6,746	10,454
	LOMO Dam	5,447	9,701	nc [a]	nc	nc	nc	nc	nc	5,447	9,701
	LFH									1,821	558
	LGR Dam	3,635	6,947	59	183	88	316	44	83	3,826	7,529
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
	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
	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
	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
	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
	LGR Dam	11,137	3,183	57	53	nc	nc	nc	nc	11,194	3,236

[a] No counts (nc) were completed at the dam during that time of year.

Appendix B: Fall Chinook Broodstock Collection, Spawning and Mating Protocol 2005

LGR Trap Operations

Trapped fish meeting criteria for collection will be transported (~70% to LFH and 30% to NPTH). Scan all fall Chinook (FCH) for wire and PIT tags. Any fish hauled to LFH or NPTH must be given 1-right operculum punch. All released fish must be given 1-left operculum punch and be scale sampled prior to release.

Collect and haul:

- All wire-tagged FCH adult and jacks (31-52 cm)
- Two-out-of-three unmarked/untagged Adult FCH. Collect scales on 50% of these fish
- All AD Only (no wire) Adult FCH

PASS:

- Every third unmarked/untagged Adult FCH
- All unmarked/untagged FCH jacks
- All AD Only (no wire) jack FCH
- All mini-jacks (30 cm or less)

LFH Trap Operations

Fish retained for broodstock collection will be transferred to the holding pond every day to reduce stress to fish. Fish captured at LFH will be held separately from fish collected at LGR Dam.

- Collect all adults and jacks
- Collect and sacrifice approximately 100 fish (<40cm FL) throughout the run for CWT analysis
- Count and record the number of fish returned to the river each day

Sampling During Spawning

- Collect, retrieve and decode wire from 100% of LFH trapped and LGR trapped wire-tagged fish
- Collect scale samples from all fish without wire (AD only, VIE only, or unmarked/untagged)
- Scan all fish for PIT tags
- Females will be weighed each spawning day as time allows

Matings

Jacks are to be used in no more than 10% of the matings. Gametes from wire-tagged strays will be discarded. Mating crosses:

- Known LF (CWT and/or VIE) x known LF
- AD Only x known LF
- Unmarked/untagged x known LF

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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).[1]

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. This is likely 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: 1999-2004

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

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

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

Release Year	Age	Brood Year	Release Location-Type	Release Date	CWT Code	Number of Fish Released				FPP	VIE Mark	% VIE
						AD+CWT	CWT Only	Ad Clip Only	Unmarked Untagged			
2001	subyearling	2000	Snake R. below HC Dam-Oxbow hatchery-IPC direct	16 May	no CWT	-	-	113,770	-	42.0		
2001	subyearling	2000	Snake R. below HC Dam-Oxbow hatchery- IPC direct	19 Jun	no CWT	-	-	1,450	-	23.0		
2001	subearling	2000	Research – Snake near Couse Cr – direct	18-26 May	no CWT	-	-	-	74,245	(PIT tag only)		
2002	yearling	2000	BC1-direct	10-12 Apr	630677	155,827	523	1,440	-	12.9	LG	86.2
2002	yearling	2000	BC1-direct	10-12 Apr	630625	1,661	6	15	-	12.9	LG	86.2
2002	yearling	2000	CJ1-volitional	16 Apr	630183	155,692	4,463	-	-	16.6	LB	80.3
2002	yearling	2000	LFH-volitional	01-11 Apr	631273	421,390	6,612	4,509	-	9.3	LR	93.1
2002	yearling	2000	PL1-direct	15-17 Apr	630678	156,372	2,687	672	-	13.4	RG	83
2002	subyearling	2001	Snake R. below HC Dam-Oxbow hatchery-IPC direct	21 May	no CWT	-	-	171,120	343	42.3	(incl 1,000 ADPITtags)	
2002	subyearling	2001	BC1-direct	27-28 May	612639	-	197,763	-	297,452	193.0		
2002	subyearling	2001	BC2-direct	18-19 Jun	no CWT	-	-	-	505,674	178.0	(incl 2,517 PIT tags)	
2002	subyearling	2001	CJ1-volitional	28 May	610106	-	185,010	-	313,917	215		
2002	subyearling	2001	CJ1-volitional	20-28 Jun	610105	-	182,429	-	316,519	152		
2002	subyearling	2001	LFH-direct	24 Jun	630890	188,874	3,373	2,335	-	52.0		
2002	subyearling	2001	PL1-direct	27-29 May	612501	-	199,965	-	199,350	166		
2002	subyearling	2001	Snake R at Roosters Landing-direct	02 Dec	no CWT	-	-	-	24,573	26.0		

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

Release Year	Age	Brood Year	Release Location-Type	Release Date	CWT Code	Number of Fish Released				FPP	VIE Mark	% VIE
						AD+CWT	CWT Only	Ad Clip Only	Unmarked Untagged			
2002	subyearling	2001	Snake R. at Chief Timothy-direct	16 Oct	no CWT	-	-	-	29,059	24.6		
2002	subyearling	2001	Research–near Couse Creek–direct	29 May-14 Jun	no CWT	-	-	-	97,916	(PIT tag onlyl)		
2003	yearling	2001	BC1-direct	14-15 Apr	610119	140,217	3,449	1,665	0	10.6	LG	91.0
2003	yearling	2001	CJ1-volitional	30 Mar-07 Apr	610118	147,987	2,502	1,430	0	10.0	LB	88.9
2003	yearling	2001	LFH-volitional	01-09 Apr	631585	499,387	14,503	4,546	-	9.7	LR	58.7
2003	yearling	2001	PL1-direct	13-14 Apr	610120	136,455	2,195	1,733	0	9.1	RG	84.3
2003	subyearling	2002	BC1-direct	03 Jun	610122	-	193,255	-	313,233	94.5		
2003	subyearling	2002	CJ1-volitional	28 May	610121	-	196,068	-	316,617	81.3		
2003	subyearling	2002	CJ1-volitional	12 Jun	612654	-	186,937	-	104,465	74.4		
2003	subyearling	2002	LFH-direct	06 Jun	631545	193,848	4,517	1,727	-	50.0		
2003	subyearling	2002	NLV1-volitional	28-31 May	610109	-	77,855	-	9,862	61.3		
2003	subyearling	2002	NLV1-volitional	28-31 May	612657	-	72,009	-	9,146	61.3		
2003	subyearling	2002	NLV1-volitional	28-31 May	612648	-	9,303	-	1,178	61.3		
2003	subyearling	2002	NLV1-volitional	28-31 May	612649	-	9,259	-	1,172	61.3		
2003	subyearling	2002	NPTH1-volitional	02-04 Jun	610107	-	193,643	-	5,989	38.2		
2003	subyearling	2002	NPTH2-volitional	19-20 Jun	610110	-	97,932	-	17,032	81.4		
2003	subyearling	2002	PL1-direct	04 Jun	610123	-	189,782	-	200,401	129.6		
2003	subyearling	2002	Snake R. at Roosters Landing-direct	04 Mar	no CWT	-	-	-	33,500	1200		

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

Release Year	Age	Brood Year	Release Location-Type	Release Date	CWT Code	Number of Fish Released				FPP	VIE Mark	% VIE
						AD+CWT	CWT Only	Ad Clip Only	Unmarked Untagged			
2003	subyearling	2002	Snake R. at Couse Cr. boat launch-direct	09 Jun	631391	96,073	2,631	1,315	-	40.4		
2003	subyearling	2002	Snake R. below HC Dam-Oxbow hatchery- IPC direct	22 May	no CWT	-	-	199,246	-	46.6	(incl 10000 ADPIT tag)	
2003	subyearling	2002	Snake R. below HC Dam-Umatilla hatchery-–IPC direct	15-16 May	no CWT	-	-	332,226	-	41.4	(incl 3000 ADPIT tag)	
2003	subyearling	2002	Research – near Couse Creek - direct	28 Mar-05 Jun	no CWT	-	-	53,583	-	(AD+PIT tag)		
2004	yearling	2002	LFH-direct	12-14 Apr	632167	425,316	2,397	18,376	266	9.9	LR	90.4
2004	yearling	2002	PL1-direct	12-13 Apr	612502	143,257	1,488	186	186	9.9	RG	81.9
2004	yearling	2002	CJ1-volitional	02-07 Apr	612503	150,569	192	-	-	9.1	LB	86.0
2004	yearling	2002	BC1-direct	14-15 Apr	612659	106,657	270	-	-	9.4	LG	91.3
2004	subyearling	2003	LFH-direct in evening	21 Jun	631786	195,046	2,209	4,279	-	51.1		
2004	subyearling	2003	BC1-direct	03 Jun	612500	-	198,190	-	275,366	79.6		
2004	subyearling	2003	CJ1-volitional	29 May-01 Jun	612600	-	192,649	-	308,090	55.3		
2004	subyearling	2003	PL2-direct	31 May	no CWT	-	-	-	197,687	48.2	(incl 2,496 PIT tags)	
2004	subyearling	2003	PL1-Oxbow hatchery-IPC-direct	24 May	106973	37,473	-	-	-	54.3		
2004	subyearling	2003	PL1-Oxbow hatchery-IPC-direct	24 May	107976	67,080	-	-	-	54.3		
2004	subyearling	2003	PL1-Oxbow hatchery-IPC-direct	24 May	108076	64,894	-	-	-	54.3		
2004	subyearling	2003	Snake R. below HC Dam-Oxbow hatchery-IPC direct	28 May	no CWT	-	-	9,957	-	48.0	(AD+ PIT tag)	
2004	subyearling	2003	NPTH1-direct	04-11 Jun	612675	-	163,830	-	5,766	55.2		
2005	yearling	2003	PL1-direct	13-14 Apr	610146	-	80,316	-	91	9.9		

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

Release Year	Age	Brood Year	Release Location-Type	Release Date	CWT Code	Number of Fish Released				FPP	VIE Mark	% VIE
						AD+CWT	CWT Only	Ad Clip Only	Unmarked Untagged			
2005	yearling	2003	PL1-direct	13-14 Apr	600149	57,274	-	12,743	282	9.9		
2005	yearling	2003	BC1-direct	04-05 Apr	610145	-	72,805	-	1,722	10.4		
2005	yearling	2003	BC1-direct	04-05 Apr	610147	63,007	-	1,715	260	10.4		
2005	yearling	2003	LFH-direct	28-30 Mar	631769	213,142	4,565	240	-	9.4	LR	83.4
2005	yearling	2003	LFH-direct	28-30 Mar	631770	-	218,150	-	623	9.4	LR	84.1
2005	yearling	2003	LFH-direct	28-30 Mar	632368	16,365	33	82	-	9.4	LR	86.7
2005	subyearling	2004	BC1-direct	30-31 May	612504	96,630	98,657	1,377	313,562	55.3		
2005	subyearling	2004	CJ1 Acclimated [vs. CC]-volitional	28-31 May	610154	94,164	87,888	9,015	314,020	46.8		
2005	subyearling	2004	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	28 April	106676	53,548		4,726		61.5		
2005	subyearling	2004	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	28 April	109370	21,094		1,861		61.5		
2005	subyearling	2004	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	28 April	100471	20,578		1,816		61.5		
2005	subyearling	2004	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	28 April	106776	54,047		4,769		61.5		
2005	subyearling	2004	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	28 April	107176	24,709		2,180		61.5		
2005	subyearling	2004	PL1-Umatilla hatchery-IPC-direct	25-26 May	073336	211,302	-	186,402	-	50.4		
2005	subyearling	2004	Snake R. below HC Dam-Umatilla hatchery-IPC-direct	8-12 May	no CWT	-	-	394,055	-	63.0		
2005	subyearling	2004	NPTH1-volitional	17 May	612669 612672	106,079	140,171	-	115,326	120.8		

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

Release Year	Age	Brood Year	Release Location-Type	Release Date	CWT Code	Number of Fish Released				FPP	VIE Mark	% VIE
						AD+CWT	CWT Only	Ad Clip Only	Unmarked Untagged			
2005	subyearling	2004	NPTH1-volitional	17 May	610108 612670	101,580	194,334	-	154,046	115.3		
2005	subyearling	2004	NPTH1-volitional	17 May	no CWT	-	-	-	57,764	110.0		
2005	subyearling	2004	Research Transport Study (NOAA)-direct			-	-	-	-	-		
2005	subyearling	2004	Couse Creek Direct [vs. CJ1 Accl.]-direct	26 May	610155	183,401	1,937	14,853	-	49.2		
2005	subyearling	2004	Snake R. at Couse Creek boat launch-direct	23 May	no CWT	-	-	-	234,030	59.0		
2005	subyearling	2004	Grande Ronde R. -direct	25 May	632782	191,868	610	8,050	244	56.0		
2005	subyearling	2004	Grande Ronde R. unmarked-direct	24 May	no CWT	-	-	-	281,688	66.0		
2005	subyearling	2004	LFH-direct	27 May	632787	195,367	934	3,870	-	51.0		
2006	yearling	2004	LFH-direct	5-10 April	633283	223,151	1,489	213	-	9.8	LR	92.5
2006	yearling	2004	LFH-direct	5-10 April	633284	-	220,952	-	4,195	10.3	LR	89.6
2006	yearling	2004	PL1-direct	5 April	610150	66,987	-	2,516	-	10.3		
2006	yearling	2004	PL1-direct	5 April	610153	-	77,644	-	2,410	10.3		
2006	yearling	2004	BC1-direct	12-13 April	610148	66,732	-	1,965	-	9.3		
2006	yearling	2004	BC1-direct	12-13 April	610144	-	59,465	-	1,636	9.3		
2006	yearling	2004	CJ1-volitional	11-14 April	610151	70,185	-	490	-	8.9		
2006	yearling	2004	CJ1-volitional	11-14 April	610152	-	78,156	-	2,291	8.9		

* 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 2005

Appendix E. Description and length of sections, survey length, percent of reach surveyed, total number of redds in the Tucannon River, 2005.

Section	Description	Length of section (Rkm)[a]	Length of section surveyed (Rkm)	% of productive reach surveyed[b]	Chinook Total # of Redds	Coho Total # of Redds
1	Mouth of Tucannon R. to hwy 261 Bridge	2.8	1.7	100	11	3
2	Highway 261 Bridge to smolt trap	0.2	0.2	100	4	0
3	Smolt trap to Powers Bridge	0.5	0.5	100	3	1
4	Powers Bridge to hog barns	1.2	1.2	100	10	1
5	Hog barns to Starbuck Bridge [c]	2.5	2.5	100	7	12
6	Starbuck Bridge to Fletcher's Dam [d]	2.7	1.3	48	12	2
7	Fletcher's Dam to Smith Hollow	2.9	2.9	100	7	3
8	Smith Hollow to Ducharme's Bridge	4.4	4.4	100	6	10
9	Ducharme's Bridge to Highway 12 Bridge	5.5	5.5	100	5	9
10	Highway 12 Bridge to Hines Rd. Bridge[e]	6.2	4.9	79	2	0
	Totals	**29.0**	**25.1**	**87**	**67**	**40**

[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.

Appendix F: Fall Chinook Processed from, and Estimated Run Composition to the Tucannon River 2005

(Origin column notes origin, brood year, age at release, and release site (LF99YO is a LFH hatchery origin fish from the 1999 brood year, released as a yearling, on-station at LFH)).

Appendix F. Composition and age of carcasses collected in the Tucannon River 2005 and estimated run composition.

Origin / Age/Rearing	CWT/ marks	Composition of carcasses M	F	J <53cm	Total	Estimated composition of escapement Adults	Adults (%)	Jack	Jack (%)	Total	Total (%)
LF/Snake River hatchery origin:											**20**
LF/Snake River hatchery origin (CWT):											
LF01YO	631585		1		1	19	11.1			19	
LF03YO	631769			1	1			20	100	20	
LF/Snake River Natural origin (wild scales):											**20**
Wild subyearling age 4	NONE		1		1	20	11.1			20	
Wild subyearling res rear age 5	NONE		1		1	20	11.1			20	
Out-of-basin (hatchery strays):											**60**
(BLANK or Agency wire):	09BLANK (no clip)		3		3	59	33.3			59	
	BLANK (no clip)	1			1	20	11.1			20	
(CWT):											
LTL White Salmon NFH sub age 4	0501030106	1			1	20	11.1			20	
Unreadable CWT, Yearling age 3	61**** (ADCWT)	1			1	20	11.1			20	
		3	6	1	**10**	178		20		**198**	

Appendix G: Salmon Processed at LFH in 2005

(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 (LF99SO is a LFH hatchery origin fish from the 1999 brood year, released as a subyearling, on-station at LFH).

Appendix G.
Origin, CWT, and number of fish removed from the Snake River and retained at LFH for spawning/run composition purposes in 2005.

			Trapping Location						
			LGR			LFH			
Origin	Age/Rearing	CWT/marks	Adults	Jacks<53	LGR Total	Adults	Jacks<53	LFH Total	Grand Total
LF/Snake River Hatchery origin:									
LF/Snake River Hatchery origin (CWT):									
	LF00SB	630270				3		**3**	**3**
	LF00SBCA	630271	2		**2**	1		**1**	**3**
	LF00YBCA	630677	3		**3**	1		**1**	**4**
	LF00YCJA	630183	3		**3**	2		**2**	**5**
	LF00YO	631273	26		**26**	219		**219**	**245**
	LF00YPLA	630678	5		**5**	2		**2**	**7**
	LF01SBCA	612639	11		**11**	4		**4**	**15**
	LF01SCJA	610105	18		**18**	1		**1**	**19**
	LF01SCJA	610106	11		**11**				**11**
	LF01SO	630890	8		**8**	27		**27**	**35**
	LF01SPLA	612501	6		**6**	1		**1**	**7**
	LF01YBCA	610119	6		**6**	5		**5**	**11**
	LF01YCJA	610118	15		**15**	5		**5**	**20**
	LF01YO	631585	64	1	**65**	1168		**1168**	**1233**
	LF01YO - LOST TAG (age from scales)					1		**1**	**1**
	LF01YPLA	610120	5		**5**				**5**
	LF02SBCA	610122	6		**6**				**6**
	LF02SCCD	631391	1		**1**	1		**1**	**2**
	LF02SCJA	610121	4		**4**				**4**
	LF02SCJA	612654	7		**7**	2	1	**3**	**10**
	LF02SO	631545	4		**4**	26		**26**	**30**
	LF02SPLA	610123	3		**3**				**3**
	LF02YBCA	612659	5		**5**	9		**9**	**14**
	LF02YCJA	612503	12	1	**13**	5		**5**	**18**
	LF02YO	632167	14		**14**	410	59	**469**	**483**
	LF02YPLA	612502	8		**8**	5		**5**	**13**
	LF03SBCA	612500		5	**5**		2	**2**	**7**
	LF03SCJA	612600		2	**2**		2	**2**	**4**
	LF03SIPCPA	107976		2	**2**				**2**
	LF03SO	631786		3	**3**	4	21	**25**	**28**
	LF03YBCA	610145		9	**9**		7	**7**	**16**

Appendix G. (Continued)
Origin, CWT, and number of fish removed from the Snake River and retained at LFH for spawning/run composition purposes in 2005.

			Trapping Location						
			LGR			LFH			
Origin	Age/Rearing	CWT/marks	Adults	Jacks<53	LGR Total	Adults	Jacks<53	LFH Total	Grand Total
	LF03YBCA	610147		6	**6**		8	**8**	**14**
	LF03YO	631769		30	**30**		187	**187**	**217**
	LF03YO	631770		21	**21**		157	**157**	**178**
	LF03YO	632368		1	**1**		2	**2**	**3**
	LF03YPLA	610146		4	**4**		1	**1**	**5**
	LF03YPLA	610149		5	**5**				**5**
	LF99SCJA	630168	1		**1**				**1**
	LF99SO	630167				1		**1**	**1**
	LF99YO	630476	2		**2**	6		**6**	**8**
	NPT02SNLVA	610109				1		**1**	**1**
	NPTH02SO1	610107	1		**1**				**1**
	NPTH02SO2	610110	9		**9**	6	1	**7**	**16**
	NPTH03SA	612675		3	**3**		1	**1**	**4**
LF/Snake River Hatchery origin (VIE elastomer):									
	Hatchery yearling age 3	ADLR				21	1	**22**	**22**
	Hatchery yearling age 4	ADLR				10		**10**	**10**
	Hatchery yearling age 5	ADLR				2		**2**	**2**
	Hatchery yearling unknown age	ADLR				1	1	**2**	**2**
	Hatchery yearling unknown age	LOST TAG (ADLR)				15	2	**17**	**17**
	Hatchery yearling unknown age	LOST TAG (ADLB)	1		**1**				**1**
	Hatchery yearling unknown age	NO TAG (LR)				1		**1**	**1**
	Hatchery yearling age 5	LR only				1		**1**	**1**
LF/Snake river Hatchery origin (Ad only):									
	Hatchery subyearling age 3	AD ONLY	2		**2**	2		**2**	**4**
	Hatchery subyearling age 4	AD ONLY	1		**1**				**1**
	Hatchery subyearling res rear age 3	AD ONLY				1		**1**	**1**
	Hatchery subyearling res rear age 4	AD ONLY	1		**1**				**1**
LF/Snake River Hatchery origin (unm/untag subs):									
	Hatchery subyearling age 2	NONE		1	**1**	1	2	**3**	**4**
	Hatchery subyearling age 3	NONE	25		**25**	4	2	**6**	**31**
	Hatchery subyearling age 4	NONE	46		**46**	10		**10**	**56**
	Hatchery subyearling age 5	NONE	1		**1**	2		**2**	**3**
	Hatchery subyearling res rear age 2	NONE		5	**5**				**5**
	Hatchery subyearling res rear age 3	NONE	13		**13**	2		**2**	**15**

Appendix G. (Continued)
Origin, CWT, and number of fish removed from the Snake River and retained at LFH for spawning/run composition purposes in 2005.

			Trapping Location						
			LGR			LFH			
Origin	Age/Rearing	CWT/marks	Adults	Jacks<53	LGR Total	Adults	Jacks<53	LFH Total	Grand Total
	Hatchery subyearling res rear age 4	NONE	81		**81**	12		**12**	**93**
	Hatchery subyearling res rear age 5	NONE	10		**10**	5		**5**	**15**
	Hatchery subyearling res rear age 6	NONE	1		**1**				**1**
LF/Snake River Hatchery origin (PIT tag):									
	LF-COE research near CC by PIT tag sub age 3		3		**3**				**3**
	LF-COE research near CC by PIT tag sub age 4		8		**8**				**8**
	LF-COE research near CC by PIT tag sub age 5		1		**1**				**1**
	LF-COE research near CC by PIT tag sub res rear age 3		2		**2**				**2**
	LF-COE research near CC by PIT tag sub res rear age 4		15	1	**16**				**16**
	LF-COE research near CC by PIT tag sub res rear age 5		2		**2**				**2**
	LF-IPC near HC Dam AD ONLY hatchery sub age 3		1		**1**				**1**
	LF-NOAA Research near PLAP by PIT tag sub age 3		2		**2**				**2**
LF/Snake River Natural origin (wild):									
	Wild subyearling age 2	NONE		3	**3**				**3**
	Wild subyearling age 3	NONE	65		**65**	2		**2**	**67**
	Wild subyearling age 4	NONE	38		**38**				**38**
	Wild subyearling age 5	NONE	7		**7**				**7**
	Wild subyearling age 6	NONE	1		**1**				**1**
	Wild subyearling res rear age 2	NONE		1	**1**				**1**
	Wild subyearling res rear age 3	NONE	29	1	**30**	1		**1**	**31**
	Wild subyearling res rear age 4	NONE	42		**42**				**42**
	Wild subyearling res rear age 5	NONE	22		**22**	1		**1**	**23**
	Wild subyearling res rear age 6	NONE	1		**1**				**1**
Out-of-basin (strays):									
Umatilla (CWT):									
	UM00YUMA	093346	3		**3**	7		**7**	**10**
	UMA00SUMA	093255	1		**1**				**1**
	UMA01SUMA	093501				2		**2**	**2**
	UMA01SUMA	093503				2		**2**	**2**
	UMA01SUMD	093502				1		**1**	**1**
	UMA01SUMD	093504	1		**1**				**1**
	UMA02SUMD	093760				1		**1**	**1**
	UMA02SUMD	093762				2		**2**	**2**
	UMA03S	094027				1		**1**	**1**

Appendix G. (Continued)
Origin, CWT, and number of fish removed from the Snake River and retained at LFH for spawning/run composition purposes in 2005.

			Trapping Location						
			LGR			LFH			
Origin	Age/Rearing	CWT/marks	Adults	Jacks<53	LGR Total	Adults	Jacks<53	LFH Total	Grand Total
	UMA03S	094029				1	1	**2**	**2**
	UMA03S	094030					1	**1**	**1**
Klickitat (CWT or 63BLANK wire):									
	63BLANK	63BLANK (no clip)	6		**6**	2		**2**	**8**
	KLICK01SO	631395	1		**1**				**1**
	KLICK02S	631797	1		**1**				**1**
Bonneville (CWT):									
	BONN01YUMA	093627	1		**1**	2		**2**	**3**
	BONN02YUMA	093909				1		**1**	**1**
	BONN02YUMA	093910				1		**1**	**1**
	BONN99YUMA	093206				1		**1**	**1**
Hatchery Stray (BLANK or 09BLANK wire):									
	Unknown age	09BLANK (no clip)	12		**12**	32		**32**	**44**
	Unknown age	09BLANK (AD)	1		**1**	1		**1**	**2**
	Yearling age 3	BLANK (no clip)				1		**1**	**1**
	Yearling age 5	BLANK (no clip)				1		**1**	**1**
	Unknown age	BLANK (AD)	1	1	**2**	5		**5**	**7**
	Unknown age	BLANK (no clip)	13	2	**15**	64	1	**65**	**80**
	Unknown age	BLANK (unknown)				2		**2**	**2**
Hatchery Stray (Ad clipped):									
	Stray hatchery subyearling age 3	AD ONLY	30		**30**	1		**1**	**31**
	Stray hatchery subyearling age 4	AD ONLY	12		**12**	2		**2**	**14**
	Stray hatchery yearling age 2	AD ONLY		1	**1**				**1**
	Stray hatchery yearling age 3	AD ONLY				4	2	**6**	**6**
	Stray hatchery yearling age 4	AD ONLY	2		**2**	4		**4**	**6**
	Stray hatchery yearling age 5	AD ONLY				1		**1**	**1**
Hatchery Stray (unm/untag):									
	Stray hatchery subyearling age 2	NONE	5		**5**	4	8	**12**	**17**
	Stray hatchery subyearling age 3	NONE	33		**33**	19		**19**	**52**
	Stray hatchery subyearling age 4	NONE	13		**13**	13		**13**	**26**
	Stray hatchery subyearling age 5	NONE				1		**1**	**1**
	Stray hatchery yearling age 3	NONE				4	1	**5**	**5**
	Stray hatchery yearling age 4	NONE	8		**8**	9		**9**	**17**
	Stray hatchery yearling age 5	NONE	4		**4**	12		**12**	**16**

Appendix G. (Continued)
Origin, CWT, and number of fish removed from the Snake River and retained at LFH for spawning/run composition purposes in 2005.

			Trapping Location						
			LGR			LFH			
Origin	Age/Rearing	CWT/marks	Adults	Jacks<53	LGR Total	Adults	Jacks<53	LFH Total	Grand Total
Unassigned hatchery origin:									
		AD ONLY	3		**3**	1		**1**	**4**
		LOST TAG (AD)		1	**1**	16	1	**17**	**18**
		LOST TAG (no clip)							
		NO TAG (AD)				1		**1**	**1**
Unknown Origin (natural or hatchery):									
	Scales not taken or unreadable	NONE	22		**22**	4	1	**5**	**27**
Spring/Summer Chinook (CWT):									
	SIMILKSUMMERCHIN	630996	1		**1**	3		**3**	**4**
	SIMILKSUMMERCHIN yrl age 4	630996				1		**1**	**1**
Grand Total			855	110	**965**	2240	473	**2713**	**3678**
Coho (hatchery):									
	NPT03YPotlatchRiver	612647		1	**1**				**1**
	Hatchery yearling age 3	NONE				2		**2**	**2**

Appendix H: Statistical Analysis of 2005 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 2005 Lower Granite Dam Fall Chinook Run Reconstruction

Report for PSC Southern Boundary Restoration and Enhancement Fund Project:

Lower Granite Fall Chinook Run Reconstruction Assistance

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I. Background and Literature Review

The purpose of run reconstruction is to assess the numbers of fish returning from various origins, i.e., to divide the gross numbers of fish returning into different stocks and release groups. This information is useful for salmon managers to gauge the success of various smolt and pre-smolt groups originating 2 to 6 years prior. Although run reconstructions are reported in a number of publications, very little statistical assessment has been carried out. Most, but not all, run reconstruction studies report numbers of fish of each stock without standard errors or confidence intervals. Beamesderfer, et al. (1997) report confidence intervals for mean return numbers for 22 index stocks by using annual data over 22 to 53 years (depending on location). Roettiger, Harper, and Chikowski (2002) collected data from a stratified random sample and were able to obtain confidence intervals using standard sample survey formulae.

Simulation and modeling is sometimes used for run reconstruction. Generally no precision is attached to the numbers. Templin, Collie, and Quinn (1994) used a migration model to predict stock numbers by reconstructing a probable sequence leading to observable counts. In other cases, historical and current data from a variety of sources are combined to reconstruct the run (see for example English, K.K., W. J. Gazey, D. Peacock, and G. Oliver (2004)). Gable (2002) used discriminant analysis of scale data for run reconstruction, but discriminant analysis does not provide estimates of precision of numbers for each stock.

The run reconstruction studied in this report deals with a single year and allocates fish returning to Lower Granite Dam on the Snake River of Washington, USA to various stocks and/or release groups on the basis of coded wire tags, adipose fin clips, PIT tags, and scale samples collected on a subset of the run. The end result is an estimate of numbers and origins of fall Chinook returning including wild fish. Numbers are reported for adults and jacks. Both the estimates of numbers of adults and jacks returning and of the group composition are a result of statistical sampling. The purpose of this study is to evaluate the statistical properties of the estimators obtained for the 2005 run. Bootstrap methods were used to derive confidence intervals on return numbers and composition.

II. Conceptual Development

Run reconstruction at Lower Granite Dam is based primarily on three data sets, 1) fish counts past the window at the dam, 2) data collected on fish trapped at the dam, and 3) detailed fish data derived from processing fish trapped at Lower Granite Dam and hauled to Lyons Ferry Hatchery (LFH) or Nez Perce Tribal Hatchery (NPTH).

In 2005, window counts of fall Chinook started on August 18 and ended on December 15. From August 18 to October 31, the window was staffed for 50 minutes per hour from 4 a.m. to 8 p.m. Data collected from 24-hour window counts in 2000-2002 show that 96.5% of the fish arrive at the window during those 16 hours. A 24-hour estimate of fish arrival from August 18 to October 31 is obtained by dividing the daily counts by 5/6 to convert them to a full 16 hours and then dividing by 0.965 to convert them to 24 hours. From November 1 to December 15, video cameras were used to record fish passage at the window for 10 hours per day. Dividing these daily numbers by 10/16 converts them to 16-hour counts which are then divided by 0.965 to

generate daily counts. The window count data show numbers of adults and jacks with and without adipose (ad) fin clips.

The trap at Lower Granite was opened four times an hour during each 24-hour period from September 6 to November 20 so that the trap was open 13% of the time. Daily trap counts are expanded to 24-hour counts by dividing by 0.13. Data collected on each fish in the trap includes among other variables trap date, sex (F,M,jack), fork length, clip/no-clip, other marks and tags, presence/absence of coded wire tag, and origin based on scale samples for a portion of unclipped, unmarked fish.

The data collected on fish processed at the hatcheries included coded wire tag information, sex (F,M,jack), fork length, VIE tag information, adipose fin clip status, operculum punch information, PIT or radio tag status, and origin from scale data for a portion of untagged, unmarked fish.

Run composition data are derived from the detailed data collected at the hatcheries for those fish trapped during September 6 to November 20 and by allocation of unmarked, untagged fish using a set of heuristic allocation rules.

Bootstrap confidence intervals were derived for numbers of each group of fish returning (including wild fish) via parametric and nonparametric bootstrap samples of the three data sets described above along with a multinomial parametric bootstrap sample of composition.

From September 6 to November 20 there were two estimates of numbers of fish returning--window counts and trap counts. The window counts were derived from complete enumeration of 80% (5/6 x 0.965) of the fish. It is reasonable to assume that these counts provide more accurate return data than the trapping data, which comprise only 13% of the returning fish. This may be true, but we have to assume that there were no errors in window counts and that the 5/6 and 0.965 multipliers are the correct expansion factors. The 5/6 multiplier is clearly defensible. The 0.965 depends on the accuracy of the 2000-2002 data and its appropriateness for 2005. While the trap counts represent only 13% of the returning fish, the expansion obtained by dividing counts by 0.13 follows from assuming systematic random sampling each hour for the entire 24 hours.

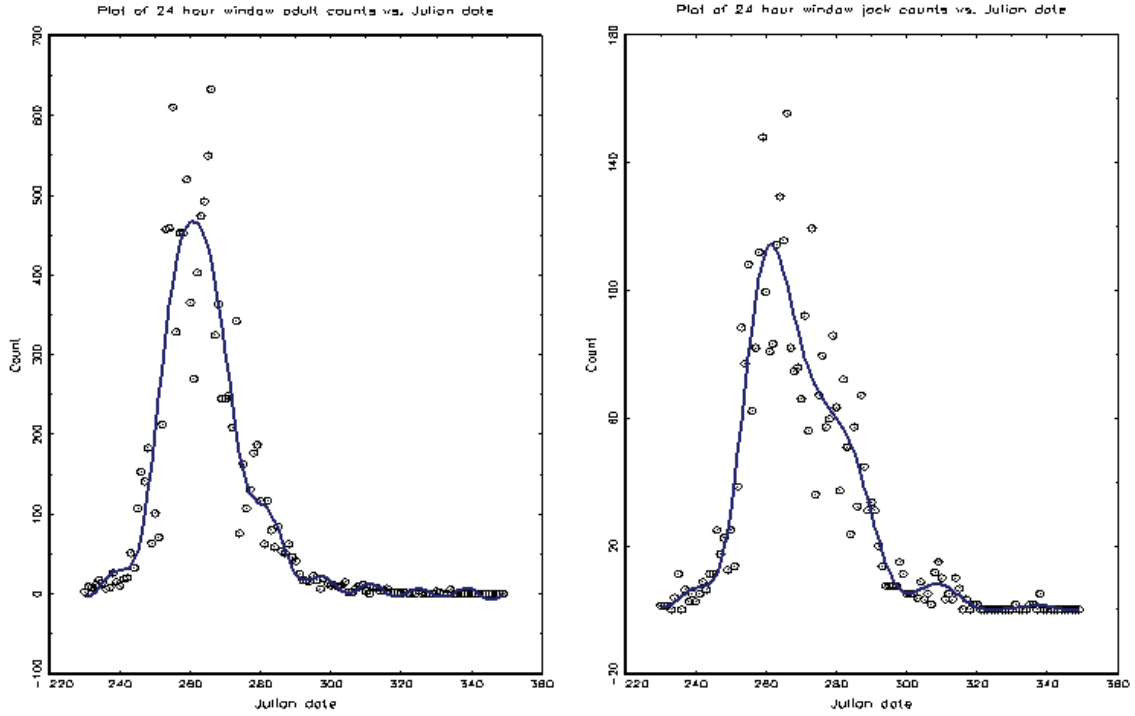
One difficulty in evaluating the window counts is that we have only one realization of the time series of daily returns from August 18 to December 20. One can't select bootstrap samples from a single sample. If we assume that the window count time series represents a biological process observed with noise (see Figure 1), then we can model the process and bootstrap the noise. The fish return time series takes a predictable form. Few fish arrive before and after the trapping period. During the trapping period the window counts rise rapidly, peaking in the third week in September and falling off just as rapidly thereafter. The sampling variation (noise) depends on time period—pre-trapping, peak, after peak, and after trapping.

A 15 term Fourier series was fitted to the adult and jack window data and then the residuals were bootstrapped after dividing them into 4 subsets—pre-trapping, peak, post peak, and post-trapping (see Figure 1). Bootstrapped residuals were added to the Fourier model of returns to get

bootstrap window counts for each day. Each bootstrap cycle produces daily counts, which can be summed to get estimates of season long returns and returns pre-trapping and post-trapping. By ordering the bootstrap estimates of total returns for the season and taking the $100\alpha/2$-th and $100(1-\alpha/2)$-th ordered value, we get a $100(1-\alpha)\%$ confidence interval on numbers of fish returning based on window counts. A similar process gives confidence intervals for pre- and post-trapping returns.

Bootstrapping the trap data is somewhat more straightforward. A parametric bootstrap sampling process was used to represent the variability inherent in trapping 13% of the fish. In each bootstrap cycle, a bootstrap number of fish trapped was generated from a binomial distribution, X~binomial (n ,0.13) where n is the estimate of number of fish caught in the trap based on this year's trap data. That many records were then sampled from the 1,689(total number of fish trapped during 13%, includes fish released at the trap) records in the trapping database with replacement. Note that the number of records selected can be greater or less than 1,689 depending on the value of X.

Figure 1. Daily window counts and fast Fourier transform model fit



The hatcheries processed 1,423 Lower Granite fish. For each cycle of the bootstrap process, 1,423 records were randomly selected with replacement from the processed fish database.

Finally the composition database consists of numbers of fish for each of 99 groups of fish. These numbers were converted to proportions, which were used for multinomial sampling. The number of adults (n_A) and jacks (n_J) generated was determined from the numbers of adults and jacks in the current bootstrap copy of the processed fish data base. So n_A multinomial samples were generated in 99 categories where proportions are taken from the observed proportions in the run reconstruction, i.e., $(X_1,\ldots,X_{99})$~Multinomial$(n_A,p_{1A},\ldots,p_{99A})$ A similar multinomial sample

was generated for jacks. Given these bootstrapped numbers of each group for adults and jacks, a bootstrap proportion of each group for adults and jacks is found by dividing each group number by the total (for adults or jacks respectively). These bootstrap proportions are then multiplied by the current bootstrap estimate of the total run size (hybrid total) to produce bootstrap estimates of the numbers of each group returning.

The number of bootstrap samples was set at 1,000. The process described above produced 1,000 time series of window counts, 1,000 trapping data bases consisting of a variable number of trapped fish determined from a binomial number of fish trapped, 1,000 copies of the hatchery fish processing data base with each copy consisting of 1,423 records, and 1,000 copies of the percent composition database (along with bootstrap estimates of numbers returning by group).

Using each copy of the window time series, 1,000 before trapping, after trapping, and total window counts were calculated. Using each bootstrap copy of the trapping database, 1,000 estimates of the number of fish arriving during trapping were calculated. The percent jacks and other numbers needed to perform the regression for wild fish during the pre-trapping period were also calculated. And for both adults and jacks, 1,000 regressions of % wild versus week were calculated. When the regression was undefined, the numbers of pre-trapping wilds was set to 0. Using each bootstrap copy of the processed fish database, numbers of adults and jacks for the multinomial bootstrap of composition were then calculated. The composition bootstrap sampling produced two 1,000 by 99 matrices of % compositions--each row consisting of percent of adults or jacks of each of 99 groups. Finally, numbers of each group for adults and jacks were produced by multiplying the hybrid window/trap estimates of adults and jacks by the percent compositions producing two 1,000 by 99 matrices of numbers of adults or jacks of each category.

We now have 1,001 estimates of each quantity required for the run reconstruction--the estimates from the original data and 1,000 bootstrap estimates. In particular we have 1,001 estimates of before trapping, after trapping, and total window counts. We have 1,001 estimates of numbers of adults and jacks trapped. We have 1,001 estimates of numbers of each sex and origin for processed fish. We have 1,001 numbers of adults and jacks for each of 99 groups.

To get a bootstrap confidence interval for any estimate, e.g., total fish arriving at Lower Granite based on the hybrid window/trap estimator, we order the 1,001 values and locate the 5 and 95 percentage points. These two values give the 90% confidence interval--in this case for total numbers of fall Chinook arriving at the dam.

III. Results

We present 90% confidence intervals for numbers of fish arriving at Lower Granite Dam based on window counts (Table 1). We are 90% confident that the true numbers of adults arriving at the Lower Granite window is between 10,840 and 12,383. Similar statements hold for each entry in the table.

Table 1. Window count estimates of fall Chinook to Lower Granite Dam with lower and upper confidence intervals.

Estimator	Adults (lower, upper)	Jacks (lower, upper)	Total (lower, upper)
2005 Season	11608 (10840,12383)	3410 (3176,3605)	15018 (14192,15801)
Pre-trapping	803 (577,1042)	166 (138,194)	969 (745,1207)
Trap period	10785 (10048,11487)	3240 (3027,3449)	14025 (13250,14764)
Post-trapping	20 (7,78)	4 (-6,13)	24 (4,85)

From the 13% trapping data we get estimates of numbers of adults and jacks arriving at Lower Granite Dam from September 6 to November 20--the trapping period. These numbers are combined with window count data before and after trapping (Table 1) to give a "hybrid" estimate of total numbers of adults and jacks arriving at Lower Granite Dam. For 2005, the estimate for adults arriving during the trapping period is 10,815 with a 90% confidence interval of (10346, 11238). The estimate for jacks is 2,178 with a confidence interval of (1962, 2377). When combined with the pre-trapping value of 803 and the post-trapping value of 20, we get an adult estimate of 11,638 with a 90% confidence interval of (11107, 12140). The hybrid estimate of jacks is 2,347 (166+4+2177) with a 90% confidence interval of (2133, 2549). Adults and jacks together totaled 13,985 with a confidence interval of (13434, 14523).

Table 2. Trap count estimates of fall Chinook to Lower Granite Dam with lower and upper confidence intervals.

Estimator	Adults (lower, upper)	Jacks (lower, upper)	Total (lower, upper)
Trapping	10815 (10346, 11238)	2177 (1962, 2377)	12992 (12477, 13446)
Hybrid	11638 (11107, 12140)	2347 (2133, 2549)	13985 (13434, 14523)

The window estimate of adults during the trapping period (10,785) is similar to the trapping estimate of adults (10,815). The window (3,240) and trap (2,177) estimates of number of jacks arriving during the trapping period differ in point estimates as well as confidence intervals.

The point estimate of numbers of wild fish (adults and jacks) is found by taking the trap estimate of adult and jack wild fish and adding regression estimates from pre-trapping window counts and window estimates from post-trapping. The value obtained for 2005 is 2,939 (2,835 adults and 104 jacks). The 90% confidence interval is (2566, 7388).

Run composition numbers and confidence intervals are given in Table 3. The origin listed below is abbreviated. The hatchery of origin can be LF (Lyons Ferry), NPTH (Nez Perce Tribal Hatchery), KLICK (Klickitat), UM (Umatilla), BONN (Bonneville) or unknown. The brood year consists of the last two digits of the year. Smolt age at release is either listed as sub (subyearling) or yrl (yearling) or res reared (reservoir reared in river and migrated as a yearling). The next few digits indicate the release site where O indicates an on-station release from the hatchery listed in the prefix. Other release sites include UM (Umatilla River), BC (Big Canyon on the Clearwater R.), CJ (Captain John Rapids on the Snake R.), PL (Pittsburg Landing on the Snake R.), and CC (near Couse Creek on the Snake R.). The next abbreviation is either a D or an A indicating direct release or release from an acclimation pond. The 1 and 2 listed at the end of

the code indicate the first release or the second release from the same site that year. For instance, LF01SBCA1 means Lyons Ferry Hatchery produced, broodyear 2001, subyearling release, from Big Canyon acclimation facility. Likewise LF01SBCA2 unm/untag unassociated indicates the same hatchery, broodyear, smolt age at release and release site as listed above but this is the second release from that site and it was an unmarked/untagged release that was not associated with a CWT release group.

The groups with the largest return were: LF01SBCA2 (unassociated) with 1,175 adults. Because these fish were not associated with a CWT group the estimate is not as solid as those with CWTs. Current tagging protocols are designed to minimize the number of unassociated groups released. The intent is to have all releases associated with a CWT but unassociated releases may occur if tagged and untagged fish are not the same size at release.

The next largest return of adults was from LF01YO (Lyons Ferry hatchery origin broodyear 01 yearling released on-station) with 901 adults, WILD subs age 3 with 871 adults in the return, followed by LF01SCJA12 with 730 adults.

Table 3. Composition of fall Chinook return to Lower Granite Dam with 90% CI.

Stock	Origin by CWT or scales	CWT	Adults	Lower limit	Upper limit	Jacks	Lower limit	Upper limit
out-of-basin	STRAY-09BLANK unknown hatchery	09BLANK	139.3	82	198.7	0	0	0
out-of-basin	STRAY-63BLANK unknown hatchery	63BLANK	49.2	17.7	87	0	0	0
out-of-basin	STRAY-BLANK unknown hatchery	BLANK	139.3	85.7	198.9	37	0	82.9
out-of-basin	STRAY-Presumed Umatilla Hatchery-09BLANK sub age 5	09BLANK	8.2	0	26.8	0	0	0
out-of-basin	STRAY-KLICK01S	631395	58.6	26.3	100.1	0	0	0
out-of-basin	STRAY-KLICK02S	631797	97.8	52.9	148.9	0	0	0
out-of-basin	STRAY-UMA00SUMA	93255	8.2	0	26.9	0	0	0
out-of-basin	STRAY-UMA01SUMA	93501	8.2	0	27	0	0	0
out-of-basin	STRAY-UMA01SUMD	93504	8.2	0	26.1	0	0	0
out-of-basin	STRAY-UMA03SUMA	94030	8.4	0	26.6	0	0	0
out-of-basin	STRAY-Presumed Bonneville Hatchery 09BLANK yrl age 4	09BLANK	16.4	0	37.2	0	0	0
out-of-basin	STRAY-Presumed Bonneville Hatchery BLANK yrl age 4	BLANK	8.2	0	27.3	0	0	0
out-of-basin	STRAY-Presumed Bonneville Hatchery BLANK yrl age 5	BLANK	32.8	8.9	63.4	0	0	0
out-of-basin	STRAY-BONN00YUMD	93346	41	9.2	73.9	0	0	0
out-of-basin	STRAY-BONN01YUMD	93627	8.4	0	26.9	0	0	0
out-of-basin	Presumed STRAY unknown hatchery LOST tag yrl age 3 CWT only	LOST	8.2	0	27	0	0	0
Snake R. Hatchery	LF02SCCD	631391	33	8.9	64.5	0	0	0
Snake R. Hatchery	LF00YO	631273	322.6	234.8	418	0	0	0
Snake R. Hatchery	LF01YO	631585	901.3	748.5	1043.2	10.7	0	35.3
Snake R. Hatchery	LF02YO	632167	189.6	122.6	263.1	0	0	0
Snake R. Hatchery	LF03YO	631769	0	0	0	339	222.9	454.4
		631770	0	0	0	268.6	166.6	377.2
		632368	0	0	0	9.8	0	34.2
Snake R. Hatchery	LF99YO	630476	16.6	0	37.2	0	0	0
Snake R. Hatchery	LF01SO	630890	82.4	37.8	129.3	0	0	0
Snake R. Hatchery	LF02SO	631545	41.4	9.3	72.6	0	0	0
Snake R. Hatchery	LF03SO	631786	0	0	0	41.7	0	86.7
Snake R. Hatchery	NPTH02SNLVA	610109	8.2	0	26.7	0	0	0
Snake R. Hatchery	NPTH02SO1	610107	8.4	0	27.2	0	0	0
Snake R. Hatchery	NPTH02SO2	610110	96.2	46.5	147.7	0	0	0
Snake R. Hatchery	NPTH03SA	612675	0	0	0	40	0	84.8

Stock	Origin by CWT or scales	CWT	Adults	Lower limit	Upper limit	Jacks	Lower limit	Upper limit
Snake R. Hatchery	LF00YCJA	630183	25.9	8.4	54.6	0	0	0
Snake R. Hatchery	LF01YCJA	610118	231.2	160.3	308.4	0	0	0
Snake R. Hatchery	LF02YCJA	612503	112.8	63.5	166.1	19.3	0	51.8
Snake R. Hatchery	LF00SCJA1 unm/untag (unassociated)		19.1	0	45.2	0	0	0
Snake R. Hatchery	LF01SCJA1	610106	382.9	282.9	475.5	0	0	0
Snake R. Hatchery	LF01SCJA2	610105	729.5	593.1	866.4	0	0	0
Snake R. Hatchery	LF02SCJA1	610121	171.4	106.7	242	0	0	0
Snake R. Hatchery	LF02SCJA2	612654	119.8	71	174.8	8.8	0	34.5
Snake R. Hatchery	LF03SCJA	612600	0	0	0	150.8	75.6	235.6
Snake R. Hatchery	LF99SCJA	630168	16.8	0	37.5	0	0	0
Snake R. Hatchery	LF99SBCA1 unm/untag (unassociated)		0	0	0	0	0	0
Snake R. Hatchery	LF99SBCA2 unm/untag (unassociated)		0	0	0	0	0	0
Snake R. Hatchery	LF00SBCA1	630271	41.7	17.1	74.5	0	0	0
Snake R. Hatchery	LF00SBCA2 unm/untag (unassociated)		126.9	72.6	189.7	0	0	0
Snake R. Hatchery	LF01SBCA1	612639	430.8	333	533.9	0	0	0
Snake R. Hatchery	LF01SBCA2 unm/untag (unassociated)		1174.7	997	1337.5	0	0	0
Snake R. Hatchery	LF02SBCA	610122	193.2	126.3	266.3	0	0	0
Snake R. Hatchery	LF03SBCA	612500	0	0	0	161.7	87	253.2
Snake R. Hatchery	LF00YBCA	630677	32.8	8.9	64.1	0	0	0
Snake R. Hatchery	LF01YBCA	610119	73.7	36	120.5	0	0	0
Snake R. Hatchery	LF02YBCA	612659	49.4	17.8	86.4	0	0	0
Snake R. Hatchery	LF03YBCA	610145	0	0	0	114.1	47	185.1
		610147	0	0	0	83.6	29.4	156.8
Snake R. Hatchery	LF00YPLA	630678	69	27.4	111.2	0	0	0
Snake R. Hatchery	LF01YPLA	610120	60.3	26.8	100.6	0	0	0
Snake R. Hatchery	LF02YPLA	612502	92.2	46.1	139.2	17.2	0	49.2
Snake R. Hatchery	LF03YPLA	610146	0	0	0	47.8	0	95.8
		610149	0	0	0	58.1	15.5	115.1
Snake R. Hatchery	LF99SPLA1 unm/untag (unassociated)		0	0	0	0	0	0
Snake R. Hatchery	LF01SPLA	612501	165.4	105.3	231.2	0	0	0
Snake R. Hatchery	LF02SPLA	610123	101.1	54.3	154.2	0	0	0
Snake R. Hatchery	LF03SPLA1 unm/untag (unassociated)		8.9	0	26.9	426.7	302.2	560.6
Snake R. Hatchery	LF03SIPCPLA	107976	0	0	0	19.9	0	51
		108076	0	0	0	19.9	0	53

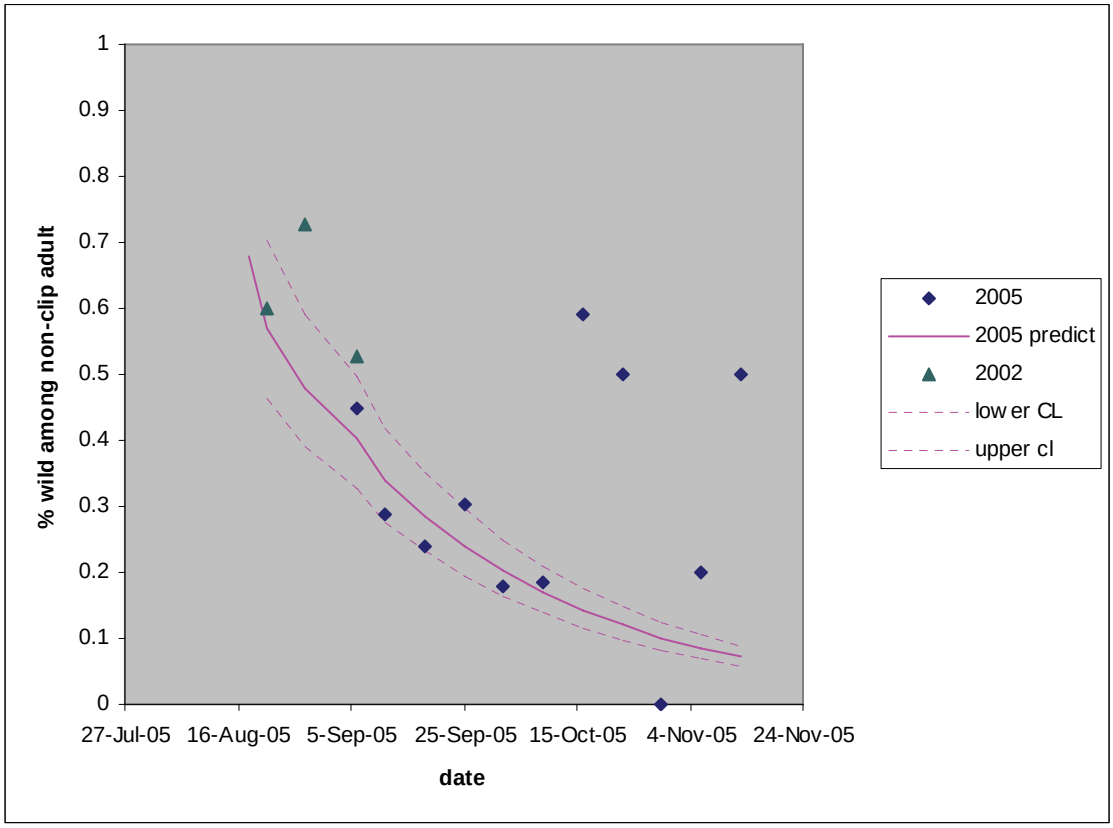
Stock	Origin by CWT or scales	CWT	Adults	Lower limit	Upper limit	Jacks	Lower limit	Upper limit
Snake R. Hatchery	LF-COE research near Couse Cr. by PIT tag sub age 4		24.6	0	54.3	0	0	0
Snake R. Hatchery	LF-COE research near Couse Cr. by PIT tag sub res rear age 3		16.4	0	37.3	0	0	0
Snake R. Hatchery	LF-COE research near Couse Cr. by PIT tag sub res rear age 4		16.4	0	36.8	0	0	0
Snake R. Hatchery	LF-COE research near Couse Cr. by PIT tag sub res rear age 5		8.2	0	26.9	0	0	0
Snake R. Hatchery	LF-NOAA research near PLA by PIT tag sub age 3		16.4	0	36.5	0	0	0
Snake R. Hatchery	LF-IPC near HC Dam AD only hatchery sub age 3		8.2	0	26.8	0	0	0
Snake R. Wild	WILD sub age 2		18.1	0	44.3	123.9	50.5	204
Snake R. Wild	WILD sub age 3		870.8	727.8	1019	17.7	0	50.4
Snake R. Wild	WILD sub age 4		632.5	504.5	762.6	0	0	0
Snake R. Wild	WILD sub age 5		71.5	28.2	115.4	0	0	0
Snake R. Wild	WILD sub age 6		9	0	27.5	0	0	0
Snake R. Wild	WILD sub res rear age 2		0	0	0	70.8	18.3	127
Snake R. Wild	WILD sub res rear age 3		507.1	398	629.4	106.3	45.7	181.8
Snake R. Wild	WILD sub res rear age 4		687.5	559.6	816.7	0	0	0
Snake R. Wild	WILD sub res rear age 5		286.3	204.8	371	0	0	0
Snake R. Wild	WILD sub res rear age 6		8.8	0	26.9	0	0	0
Snake R. Wild	PIT tag WILD sub age 3		8.5	0	26.9	0	0	0
Snake R. Wild	PIT tag WILD sub age 4		8.5	0	26.9	0	0	0
out-of-basin	STRAY unm/untag hatchery yrl age 2		0	0	0	8.5	0	32.7
out-of-basin	STRAY unm/untag hatchery yrl age 3		17	0	37.2	0	0	0
out-of-basin	STRAY unm/untag hatchery yrl age 4		85.7	44.9	128.9	0	0	0
out-of-basin	STRAY unm/untag hatchery yrl age 5		61.2	26.6	102.3	0	0	0
out-of-basin	STRAY unm/untag hatchery sub age 2		51.4	18.1	85.1	102.6	40.6	169.5
out-of-basin	STRAY unm/untag hatchery sub age 3		415.9	320.4	518.1	0	0	0
out-of-basin	STRAY unm/untag hatchery sub age 4		69.5	27.8	116	0	0	0
Snake R. Hatchery	In-basin unm/untag hatchery sub age 3		362.7	268.4	454.1	42.7	0	87.5
out-of-basin	STRAY AD only hatchery yrl age 4		17.3	0	38	0	0	0
out-of-basin	STRAY AD only hatchery yrl age 5		8.7	0	26.5	0	0	0
Snake R. Hatchery	Presumed IPC-AD only STRAY hatchery sub age 2		8.7	0	27.1	0	0	0
Snake R. Hatchery	Presumed IPC-AD only STRAY hatchery sub age 3		346.4	256.3	433.9	0	0	0
Snake R. Hatchery	Presumed IPC-AD only STRAY hatchery sub age 4		103.9	55.9	157.9	0	0	0

Stock	Origin by CWT or scales	CWT	Adults	Lower limit	Upper limit	Jacks	Lower limit	Upper limit
Snake R. Hatchery	Presumed IPC-AD only hatchery sub age 3		52	18.2	91	0	0	0
Snake R. Hatchery	Presumed IPC-AD only hatchery sub age 4		43.3	17.4	80.3	0	0	0
Snake R. Hatchery	Presumed IPC-AD only hatchery sub res rear age 4		26	0	54.4	0	0	0
		TOTALS	11,638			2,347		

IV. Discussion

From a statistical viewpoint, the most difficult calculation is the calculation of wild fish during the pre-trapping period. The start date for trapping at LGR is dictated by water temperatures. Generally, early season water temperatures are too high to allow handling or trapping of fall Chinook. While trapping at that time would be best for run reconstruction purposes, it would not be best for the fish. The methodology used for estimates during the pre-trapping period has two issues. Chinook biologists consider the window estimate of jacks to be too high because jack determinations occur as fish swim past pieces of tape on the counting window, allowing for visual error. The number of jacks estimated from the trapping data is more accurate because fish are physically measured. This claim is supported by the larger estimates of jacks in the window count table above (Table 1) compared to the trap count table (Table 2). For this reason the pre-trap window counts are adjusted so that there is the same percentage of jacks in the pre-trap window sample as in the trapping sample collected from September 6 to November 20--17%. The second issue is that there is evidence (see Figure 2 below) that the proportion of wild fish in the non-clipped fish is higher early in the season than later. For this reason the weekly %wild in non-clipped fish is regressed against week and the resulting curve is used to predict pre-trap wild fish.

Figure 2. Regression of % wild versus week for adult fall Chinook at Lower Granite Dam (Henry Yuen, USFWS, personal communication).



In the run reconstruction document, data from 2005 is used for the regression but some of the 2005 data are omitted (points in the upper right portion of the graph). Data from 2002 is overlaid in Figure 2 for comparison with the 2005 estimate for the pre-trapping period. While this regression makes sense when a human can look at the trend and make decisions, it is not clear that the process works under bootstrap simulation. In a number of cases, the records selected at random from the trapping database do not lead to a reasonable regression. In these cases, the number of wild fish cannot be estimated or are estimated too high. Since the numbers of wild fish reported above (2,939) is over 20% of the fish returning, we have reason to be concerned about the accuracy of the regression. On the other hand, the number of wilds estimated pre-trap (301 adults and 32 jacks) is only about 10% of the wild fish reported. This means that the pre-trap estimate of wild fish contributes only about 2% of the overall run. Although a minor component, it would be worth finding another way to deal with this problem.

The second item of interest from a statistical viewpoint is the difference between the window count and hybrid estimates of numbers of jacks—3,392 and 2,347. The confidence intervals don't even overlap. This difference in jack counts carries over into the season estimates—15,020 and 13,985--a difference of over 1,000 fish. This is worth further investigation.

Confidence intervals for numbers of fish in each group are wider for larger groups than smaller groups. This suggests a somewhat constant coefficient of variation. For small groups, the lower limit was often 0.

The larger variability seen for groups with more fish is seen in Tables 1 and 2 as well. The standard error for jacks from window counts is 133. The coefficient of variation is 3.9% (100 x 133/ 3392). For adults the standard error is 457 with a coefficient of variation of 3.9% also (100 x 457/ 11,629). For trapping data, one gets a coefficient of variation of 5.8% (100 x 126/ 2,177) for jacks and 2.5% (100 x 272 / 10,815) for adults. These relatively constant coefficients of variation indicate that it is harder to estimate large groups with the same precision as one gets for small groups of fish. The variability in the estimates increases as the estimate increases.

Given that the precision with which we know numbers of fish returning is not constant, it is more important to estimate precisely the numbers of a group with a small return as opposed to a group with many fish returning. For these data, this appears to be what is happening.

Another year's analysis will help us understand the behavior of the point and interval estimates derived in this run reconstruction of fall Chinook to Lower Granite Dam. To this point, researchers have viewed run reconstruction as an accounting exercise--usually implemented in spreadsheet form. It is important to understand the statistical properties of such estimates. The 2005 analysis was a good first step.

It is important that we have statistically sound estimates. Reconstructing the run is time consuming and complicated. It requires input and time from several people who are busy with other duties during the time the work needs to be done. If methods were standardized and funds were available for a dedicated person to coordinate the work, the results could be published in a more timely fashion.

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Appendix I: Final Location of Wire Tagged LFH/Snake River Hatchery Origin Fall Chinook in Return Year 2005

(**This summary is solely for wire tagged recoveries of LSRCP fish**.)

Appendix I. Locations and estimated totals of LFH/Snake River origin wire tagged fish recovered during 2005. Based upon RMIS downloads from 4/17/07 of CSV files. (Note: **Estimates to the Snake River are not included)**

			Subyearling Brood Year					Yearling Brood Year						
Area	**Locale***	**Recovery Location**	**2000**	**2001**	**2002**	**2003**	**Total**	**1999**	**2000**	**2001**	**2002**	**2003**	**Total**	**Grand Total**
Freshwater	COL	Priest Rapids Hatchery								1			1	1
		Ringold Springs Hatchery									2	1	3	3
		Three Mile Dam (Umatilla R.)								1	24	25	50	50
		Wind River-Carcass Survey								6			6	6
		Combined Fisheries	3	28	18	1	50	3	222	551	99	10	885	935
Freshwater Total			**3**	**28**	**18**	**1**	**50**	**3**	**222**	**558**	**125**	**36**	**944**	**994**
Ocean	AK	Combined Fisheries		15	4	2	21		17	30	1	1	49	70
	BC	Combined Fisheries	6	80	20	8	114	12	314	761	43		1130	1244
	CA	Combined Fisheries							6	34			40	40
	HS	Combined Fisheries			4		4		4	6	13		22	26
	OR	Combined Fisheries		6	5		11	3	83	506	45		636	647
	WA	Combined Fisheries		92	52		144	5	204	857	54		1119	1263
Ocean Total			**6**	**193**	**84**	**10**	**293**	**19**	**627**	**2195**	**155**	**1**	**2,997**	**3,291**
Total			**9**	**221**	**102**	**11**	**343**	**22**	**849**	**2753**	**281**	**37**	**3,942**	**4,285**

* (COL=Columbia River, AK=Alaska, BC=British Columbia, CA=California, OR=Oregon, WA=Washington, HS=High Seas. Data for untagged fish associated with the wire tagged fish are not included.)

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