Lyons Ferry Hatchery Evaluation
Fall Chinook Salmon
Annual Report: 2016

by

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Cooperative Agreements
F14AC00010

November 2018

Citation of this publication: Milks, D., and A. Oakerman. 2018. Lyons Ferry Hatchery Evaluation Fall Chinook Salmon Annual Report: 2016. Washington Department of Fish and Wildlife, Olympia, WA. http://www.fws.gov/lsnakecomplan/reports/WDFWreports.html

Executive Summary

This report summarizes activities by the Washington Department of Fish and Wildlife's (WDFW) Lyons Ferry Hatchery (LFH) Evaluation Fall Chinook Salmon Program for the period 16 April 2016 through 15 April 2017.

During 2016, WDFW collected 2,603 fish at Lower Granite Dam (LGR) for broodstock, monitoring and evaluation of our hatchery releases, and to estimate the run composition at LGR.

In 2016, we spawned 1,227 females for an estimated total green eggtake of 4,951,188; numerically more than full production goals listed in the 2008-2017 *United States v. Oregon* Management Agreement, but well within precision levels expected from large production hatcheries. At the end of the season, 52 females and 66 males were returned to the Snake River to spawn. Green egg to eye-up survival was 97.3%. Based on hatchery records, overall average fecundity of females was 4,080 eggs/female. At LFH, of the 653 males spawned, 361 fish were used multiple times to minimize the use of jacks, and to incorporate larger/older fish in the broodstock. The estimated proportion of natural origin (pNOB) fish (as determined from run-reconstruction methodologies) in the LFH broodstock was 26%. The pNOB estimated from Parental Based Tagging sampling of the broodstock was 35%, with the difference created by the multiple use of unmarked/untagged males, some of which are natural origin and therefore contributing to the overall number of natural origin fish in the broodstock.

In 2016, fork lengths in both yearling and subyearling adult returns were highly variable and there was considerable overlap between each of the salt water ages. Normally, fish from yearling production have been consistently larger than subyearlings at the same salt water age. Females from both yearling and subyearling programs consistently return at greater lengths than males of the same salt water age class. Minijacks (0-salt) returned from yearling releases only at 6.6% of the return. Yearling releases returned 1-salt jacks (11.1%) and jills (1.3%), while subyearlings returned no jills, and 6.9% returned as jacks.

Hatchery staff released BY15 subyearlings into the Snake River at LFH and into the Grande Ronde River (GRR) near Cougar Creek in 2016 and BY15 yearlings into the Snake River at LFH in 2017. All WDFW release groups (subyearling and yearling) were represented by a coded wire tag (CWT) group as identified in the *US v. Oregon* production tables, and also received passive integrated transponder (PIT) tags. PIT tags in 29,945 of the released onstation yearlings (BY15) and 19,990 of the released subyearlings (BY15) will be used to monitor adult and jack returns in-season, monitor overshoot rates to LGR, and potentially estimate total contribution to the LSRCP are (above Ice Harbor Dam).

In the spring of 2016 a smolt trap was operated on the Tucannon River to estimate juvenile production of fall Chinook salmon, as well as other species within the basin. Trapping estimates of fall Chinook salmon passing the smolt trap (33,135) were expanded for areas below the smolt trap location based on redds observed below the smolt trap location. The total estimate of Snake River fall Chinook salmon emigrating from the Tucannon River was 47,487 from the 2015 spawners with production estimated at 148 smolts/redd. In the fall of 2016, the Tucannon River was surveyed for spawning fall Chinook salmon. An estimated 269 fall Chinook salmon redds

were constructed in the river, resulting in an estimated spawning escapement of 807 fall Chinook salmon.

The run size of natural origin fish estimated to reach LGR was 9,741 fish $\geq$ 53 cm fork length and 1,194 fish 30 cm to <53 cm fork length. The remaining portion of the run consisted of 27,676 fish $\geq$ 53 cm fork length and 14,643 fish 30 cm to < 53 cm fork length, all likely hatchery origin from LFH, Fall Chinook Acclimation Project (FCAP), Idaho Power Company (IPC), and Nez Perce Tribal Hatchery (NPTH). The stray rate of out of basin fish to LGR was estimated at 0.9% for fish $\geq$ 53 cm fork length and 0.0% for fish 30 cm to <53 cm fork length.

We calculated that a minimum of 26,163 fish or (28.6%) of the total LSRCP downriver mitigation goal (91,500 fish) was met in 2016 (WDFW and FCAP releases combined). This estimate includes: returns to the Snake River (WDFW and FCAP), fully expanded (Coded Wire Tag (CWT) tagged and untagged) harvest recoveries outside of the Snake River (WDFW only), and unexpanded harvest recoveries of the FCAP releases with CWTs outside of the Snake River.

The LSRCP escapement goal (18,300 hatchery fish) to the Snake River Basin was exceeded (104%) in 2016 (WDFW and FCAP). An estimated 5,164 true jacks and jills (1-salt) and 13,774 adults (2-5 salt) contributed to the returns. An additional 2,570 minijacks (0-salt) were also estimated to have returned to the Snake River, but do not count toward the mitigation goal.

Fall Chinook salmon WDFW released into the Snake River at LFH, into the Snake River near Couse Creek (CCD), and into the GRR, resulted in harvest of 1,794 fish in sport fisheries and 4,176 in commercial/tribal fisheries in 2016. WDFW released fish were also recovered at hatcheries (10 at Chief Joseph, 7 at Priest Rapids, 8 at Bonneville and 2 at Salmon River) and on spawning grounds (4 in the Chelan River, 42 in the Columbia River at Hanford reach and 2 in the Lewis River) outside of the Snake River Basin. Of the total number of fish recovered outside of the Snake River, 69.1% came from commercial/tribal fisheries, 29.7% from sport fisheries, 0.8% from spawning ground surveys, and 0.4% were from hatcheries.

The top five catch areas for yearlings returning in 2016 were located in the Columbia River (49%), in the ocean off the coasts of British Columbia (22%), Washington (20%), Alaska (5%), and Oregon (4%). The top five catch areas for subyearlings returning in 2016 were located in the Columbia River (50%), in the ocean off the coasts of British Columbia (27%), Washington (12%), and Alaska (9%) and Oregon (2%). Overall, the single largest fishery was the Zone 6 Gillnet fishery which harvested 26.5% of all the fish recovered outside of the Snake River Basin, and the catch consisted primarily of fish released as yearlings.

Two methodologies for estimating returns to the Snake River were compared; PIT tags and CWTs released from LFH. In 2016, yearlings 0-salt through 2-salt returns PIT tag estimates were 3.0 times greater than the CWT estimates. PIT tag estimates for 3-salt and 4-salt were slightly less than estimates derived from CWT expansions. For subyearlings, PIT tag estimates were less for all returns except for 3-salt compared to CWT estimates. Overall averages for both yearling and subyearling returns were variable by salt age.

Endangered Species Act (ESA) section 10 (a)(1)(A) Permit # 16607 was revised in June 2015 and is now referred to as permit # 16607 (amended). Overall we were within allowances of

direct take of listed Snake River fall Chinook salmon for adult returns in 2016 and juvenile releases in 2017.

Acknowledgments

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

We would like to thank the Snake River Lab staff: Joe Bumgarner, Jerry Dedloff, Michael Gallinat, Jule Keller, Lance Ross, Ashly Beebe, Sara Windsor, Bridget Sloat, Carolyn Whitney, and staff from the Dayton Fish Management office for their help in collecting the data.

We thank the personnel at LFH for their cooperation with sampling and providing information regarding hatchery operations. Thanks also to John Sneva (WDFW) for aging scales collected at LFH and LGR for the run reconstruction and broodstock aging.

We appreciate the efforts of Darren Ogden (NOAA Fisheries) and crew at LGR for trapping, tagging, and documenting fall Chinook salmon for transport to LFH. We also thank Allan Martin (COE) for providing summarized fallback data from the juvenile collection facility at LGR. We also thank Bill Young (NPT), Stuart Rosenberger (Idaho Power) for their assistance in estimating the run composition estimate at LGR in 2016, and Ben Sandford (NOAA) for bootstrapping the data to get bounds around the estimates.

We thank Joe Bumgarner, Jeremy Trump, Alf Haukenes, and Rod Engle for reviewing a draft of this report and providing valuable comments.

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

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Introduction

Program Objectives

This report summarizes activities by the Washington Department of Fish and Wildlife's (WDFW) Lyons Ferry Hatchery (LFH) Fall Chinook Salmon Evaluation Program from 16 April 2016 to 15 April 2017. WDFW's Snake River Lab (SRL) evaluation staff completed this work with federal fiscal year 2016/2017 funds provided through the U.S. Fish and Wildlife Service (USFWS), under the Lower Snake River Compensation Plan (LSRCP).

This hatchery program began in 1984 after construction of LFH (Figure 1) and is part of the LSRCP program authorized by Congress in 1976. The purpose of the LSRCP is to replace adult salmon, steelhead and rainbow trout lost by construction and operation of four hydroelectric dams on the Lower Snake River in Washington. Specifically, the stated purpose of the plan was:

> *"…[to]….. provide the number of salmon and steelhead trout needed in the Snake River system to help maintain commercial and sport fisheries for anadromous species on a sustaining basis in the Columbia River system and Pacific Ocean" (NMFS & USFWS 1972 pg. 14.)*

Subsequently in 1994, additional authorization was provided to construct juvenile acclimation facilities (Fall Chinook Acclimation Project – FCAP) for fall Chinook salmon that would

> " … protect, maintain or enhance biological diversity of existing wild stocks."

Numeric mitigation goals for the LSRCP were established in a three step process (COE 1974). First, the adult escapement that occurred prior to construction of the four dams was estimated. Second, an estimate was made of the reduction in adult escapement (loss) caused by construction and operation of the dams (e.g. direct mortality of smolts resulting in reduced adult abundance and loss to mainstem spawning habitat). Last, a catch to escapement ratio was used to estimate the future production that was forgone in commercial and recreational fisheries as result of the reduced spawning escapement and natural production. LSRCP adult return goals were expressed in terms of the adult escapement back to, or above the project area.

For fall Chinook salmon, the escapement to the Snake River below Hells Canyon (HCD) Dam prior to construction of four lower Snake River dams was estimated to be 34,400. Construction and operation of the dams was expected to cause a reduction in the spawning escapement in two ways: 1) the slack water reservoirs created behind the dams was expected to eliminate spawning grounds for 5,000 adults, and 2) 15% of the smolts migrating past each dam were expected to die (48% cumulative mortality).

These factors were expected to reduce the adult escapement by 18,300[1]. This number established the LSRCP fall Chinook salmon escapement mitigation goal back to the project area (Snake River). This reduction in natural spawning escapement was estimated to result in a reduction in the coast-wide commercial/tribal harvest of 54,900 adults, and a reduction in the recreational fishery harvest of 18,300 adults below the project area. In summary the expected total number of adults (excludes minijacks but includes jacks) that would be produced as part of the LSRCP mitigation program was 91,500 (Table 1).

Table 1. Fall Chinook salmon goals as stated in the LSRCP mitigation document.

Component	Number of adults [a]
Escapement to project area	18,300
Commercial harvest	54,900
Recreational harvest	18,300
Total hatchery fish	**91,500**
Maintain natural origin population	**14,363**

[a] As defined in the LSRCP document, "adults" include adults and jacks, but not minijacks.

Since 1976 when the LSRCP was authorized, many of the parameters and assumptions used to size the hatchery program and estimate the magnitude of benefits have changed.

- The survival rate required to deliver a 4:1 catch to escapement ratio has been less than what was originally assumed, and this has resulted in fewer adults being produced.
- The listing of Snake River fall Chinook salmon and Snake River Steelhead under the Endangered Species Act has resulted in significant curtailment of commercial, recreational and tribal fisheries throughout the ocean and mainstem Columbia River. This has resulted in a higher percentage of the annual hatchery run returning to the project area than was expected.
- Three hatchery programs artificially propagate Snake River fall Chinook salmon. Two of the programs, LSRCP(includes LFH and FCAP) and NPTH, are integrated programs aimed at increasing natural-origin fish abundance and harvest using supplementation and harvest mitigation releases, respectively. Fish released at LFH and FCAP facilities consist of both subyearling and yearling life stages, and while NPTH releases are subyearlings only. Information about the NPTH is presented in NPT annual reports and is not presented here. The third program administered by IPC is primarily mitigation for lost production due to construction of the Hells Canyon Complex (HCC), and consists of subyearling releases.

[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, USFW, personal communication). The LSCRP mitigation goal was based upon 97,500 fall Chinook counted at McNary Dam (MCN) 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.

Releases occur at 10 locations throughout the Snake River basin, with most release located above Lower Granite Dam (LGR). The three programs are highly coordinated in their operations, including broodstock collection at LGR and fish transfers among facilities. A single out of basin hatchery facility is used (Irrigon Hatchery) in addition to the inbasin facilities and acclimation sites. Marking of hatchery-origin fish is guided by a Snake River Basin Fall Chinook Salmon Production Program Marking Justification white paper (Rocklage and Hesse 2004). Mark types and quantities have been adopted under the 2008-2017 *United States v. Oregon* Management Agreement (*United States v. Oregon* 2008). At full production levels, 76% of the hatchery produced fish are marked/tagged in some manner, with ~ 50% marked with an adipose fin clip. If changes occur, there is a notification process that needs to be followed per the permit #16607 issued from NOAA-Fisheries and amended in 2015 (NMFS 2015).

In summary, the LSRCP (LFH and FCAP) and IPC overall program goals are as follows:

- The LSRCP program is to mitigate for decreased numbers of fall Chinook salmon harvested and returning to the Snake River due to the construction of the lower Snake River Dams with the presumption that the natural population will remain at 14,363. The first action taken for the LSRCP fall Chinook salmon mitigation program was the egg bank effort to keep this population from becoming extirpated. The conservation of this stock including both demographics and genetic integrity is paramount under the LSRCP. The Snake River fall Chinook salmon program has been a conservation effort from the beginning. .

- The goal of the IPC program is to replace adult fall Chinook salmon lost to the construction and ongoing operation of the HCC by releasing 1,000,000 smolts annually.

- The immediate goal of the FCAP is a concerted effort to ensure that the Snake River fall Chinook salmon above LGR are not extirpated. FCAP is part of the LSRCP mentioned in item 1 above, but accounting for adults is done separately by NPT. Long-term goals of the project are

    1. Increase the natural population of Snake River fall Chinook salmon spawning above LGR.
    2. Sustain long-term preservation and genetic integrity of this population.
    3. Keep the ecological and genetic impacts of non-target fish populations within acceptable limits.
    4. Assist with the recovery of Snake River fall Chinook salmon.
    5. Provide harvest opportunities for both tribal and non-tribal anglers.

- There has been substantial effort made to maintain the population's genetic structure and diversity as well as rebuild adult returns of both hatchery and natural origin salmon through supplementation efforts by WDFW and the co-managers. The LSRCP program at LFH has been guided by the following objectives:

    1. Maintain and enhance natural populations of native salmonids
    2. Establish broodstock(s) capable of meeting eggtake needs,
    3. Return adults to the LSRCP area which meet designated goals
    4. Improve or re-establish sport and tribal fisheries.

While recognizing the overarching purpose and goals established for the LSRCP and changes since the program was authorized, the following objectives for the beneficial uses of adult returns have been established for the period through 2017 (*United States v. Oregon* 2008):

1. Contribute to coast-wide ocean fisheries in accordance with the Pacific Salmon Treaty.

2. Contribute to the recreational, commercial and/or tribal fisheries in the mainstem Columbia River consistent with agreed to abundance-based harvest rate schedules established in the 2008–2017 *US v. Oregon* Management Agreement.

3. Spawn enough fish to retain 4.45 million eggs (WDFW 2014) to assure that production goals as stated in 2008–2017 *US v. Oregon* Management Agreement are met. Fecundities vary annually depending upon return age classes, but generally 1,300 spawned females make production goals. In order to produce enough fish to meet the original LSRCP harvest goals; 1) many more fish would need to be trapped, spawned, and reared, or 2) smolt to adult survivals would need to be increased dramatically. Major infrastructure additions would need to occur at LFH for additional production and changes to the 2008–2017 *US v. Oregon* Management Agreement production tables would need to occur in order to meet the original LSRCP harvest mitigation goals.

4. Estimate the numbers of returns of LSRCP, FCAP, NPTH and IPC program hatchery fish to the Snake River basin (below and above LGR), and estimate the numbers of natural origin fish escaping to spawn above LGR. To accomplish this, an additional 1,300-2,000 CWT fish must be recovered for run reconstruction at LGR.

5. To provide tribal and non-tribal fisheries in the Snake River consistent with co-manager goals, ESA constraints and permits, and the Columbia River Management Plan.

6. To contribute to hatchery and natural-origin return goals identified in the draft Snake River Fall Chinook Management Plan.

Hatchery Origin Return Goals

- Interim total return goal based on current production levels and survival is 15,484 hatchery origin fish above Lower Monumental Dam (LMO), which is comprised of 9,988 from LSRCP, 3,206 from NPTH, and 2,290 from IPC. Returns are estimated in-season to LMO and not to Ice Harbor Dam (IHR) (located closer to the mouth of the Snake River) because Columbia River salmon dip into the Snake River, cross the dam, then fall back below the dam causing an overestimate of fall Chinook salmon to the Snake River.

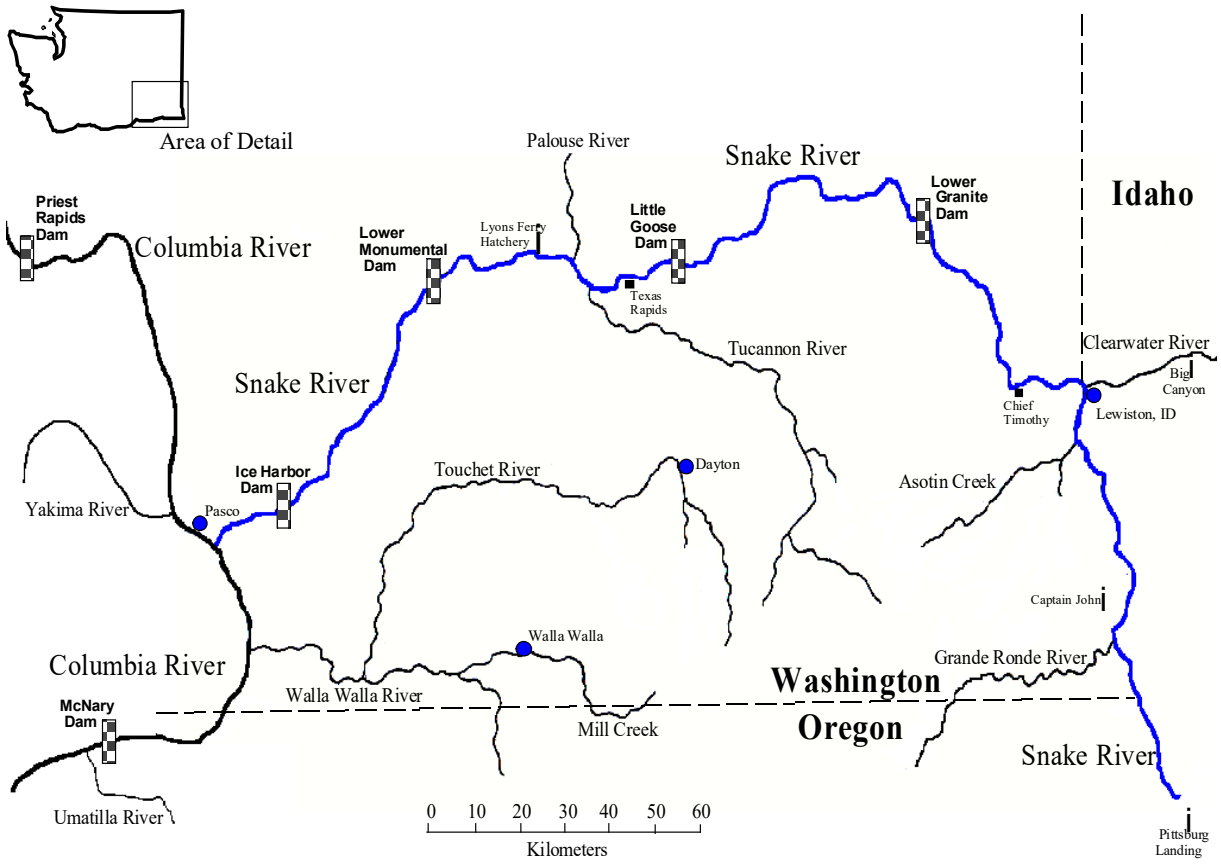
- The long-term total return goal is for a total return 24,750 hatchery-origin fish above LMO, which is comprised of 18,300 from LSRCP, 3,750 from NPTH, and 2,700 for IPC.

Natural-Origin Return Goals

- Achieve Endangered Species Act (ESA) delisting by attaining interim population abundance in the Snake River Evolutionary Significant Unit (ESU) of at least 3,000 natural-origin spawners, with no fewer than 2,500 distributed in the mainstem Snake River (as recommended by the Interior Columbia Technical Recovery Team).

- Interim short-term restoration goal is to achieve a population of 7,500 natural-origin fall Chinook (adults and jacks) salmon above LMO.

- Long term restoration goal is to achieve a population of 14,363 natural-origin fall Chinook (adults and jacks) salmon above LMO.



Rkm	Location
0.0	Snake River mouth
16.1	Ice Harbor Dam
66.9	Lower Monumental Dam
95.1	Lyons Ferry Hatchery
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)
0.0	Clearwater River mouth
57.0	Big Canyon Acclimation Site
0.0	Grande Ronde River mouth
49.4	Cougar Creek

Figure 1. The Lower Snake River Basin showing locations of Lyons Ferry Hatchery, acclimation sites, and major tributaries in the area.

Broodstock Collection and Management 2016

In 2016, fall Chinook salmon were collected at LGR for broodstock (Appendix A). Each year there is a small discrepancy (<2%) between estimated numbers of fish collected and the numbers of fish processed/killed (Table 2). 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 are shunted back to the river and never used for broodstock. The discrepancies are likely data recording errors.

Table 2. Numbers of fall Chinook salmon initially collected at LGR for broodstock, evaluation, and run construction needs in 2016.

Year	Trap location	Number collected/hauled for broodstock	Processed (killed)	Returned to Snake River	Difference from number collected/hauled
2016	LGR	2,603	2,441	118	44

Lower Granite Dam Trapping Operations

In 2016, fall Chinook salmon trapping at LGR began 12 August while transport to LFH didn't commence until 18 August. Fall Chinook salmon were captured by systematically opening the trap 19% of each hour until the trap closed for the season on 20 November. The arrival timing of males and females collected for broodstock at LGR and hauled to LFH are provided in Figure 2 (note: gaps in the lines presented in Figure 2 represent periods of no trapping due to the higher water temperatures, or fish did not meet broodstock selection criteria for the particular time period). Broodstock goals were met by 11 October but trapping continued throughout the run. Trapping protocols for 2016 are presented in Appendix B. Historical trapping rates and operation dates of systematic sampling at LGR are presented in Appendix C. In general, NOAA Fisheries at LGR staff anesthetized the salmon, gathered length and sex data, and indicated if the fish had a fin clip, wire tag or a PIT tag.

Fish collected at LGR for broodstock, run reconstruction, and monitoring and evaluation purposes were hauled to LFH and NPTH with a goal of a 70:30 split. Sorting of broodstock prior to spawning is an essential task for determining the sex composition and lengths of fish on hand. Both of these enumerations are used to modify trapping and spawning protocols in-season. In 2016, approximately 64.0% of the salmon collected for broodstock and for run reconstruction needs, were shipped to LFH and 36.0% were hauled to NPTH.

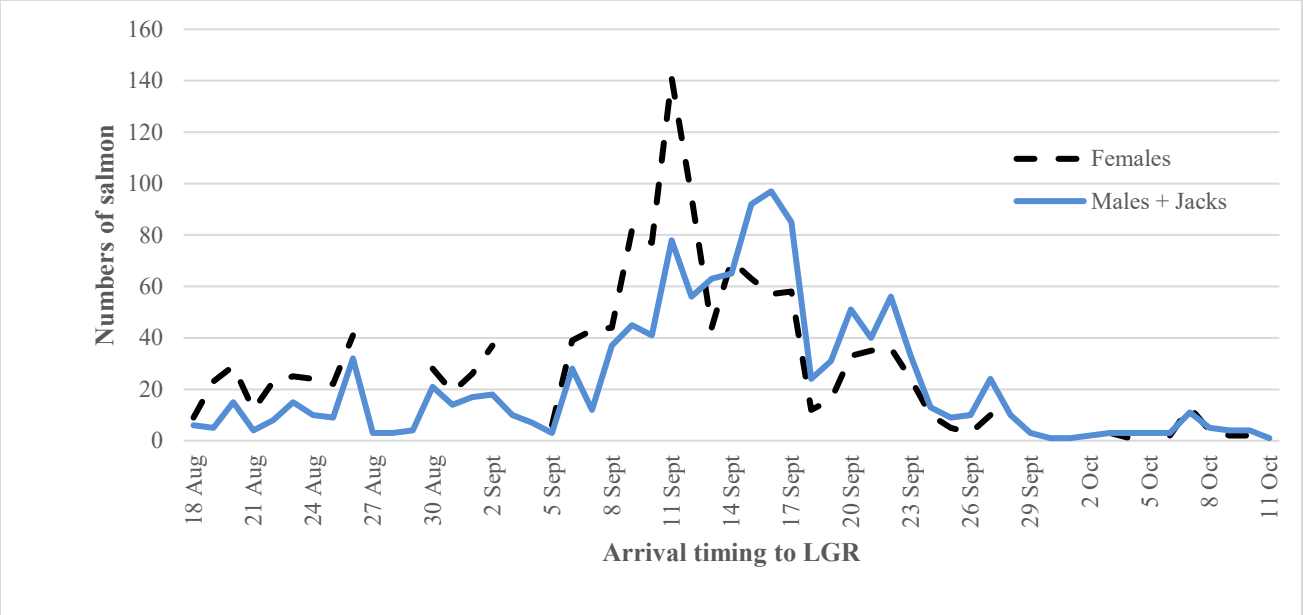


Figure 2. Arrival timing of fall Chinook salmon at LGR that were hauled to LFH in 2016.

Hatchery Operations 2016

Spawning Operations

Spawning and Egg Take

The ponds at LFH holding fish transported from LGR had approximately 0.6:1 sex ratio (males:females) in the adults (70 cm or greater), and 5.1:1 sex ratio (males:females) for fish less than 70 cm. Size criteria for mating was set at 70 cm to potentially reduce the number of unmarked/untagged jacks used for broodstock. Mate selection and spawning protocols changed weekly according to the numbers of males ripe during the spawn day and to allow for maximum use of unmarked/untagged fish from LGR, older aged males ($\geq$ 2-salt), and subyearlings. The 2016 mating protocol at LFH is presented in Appendix D.

The duration, peak of spawning, eggtake, and percent egg mortality (Table 3), numbers of fish spawned (Table 4), and the number killed outright or died in the pond (Table 5) are provided. Natural origin fish used for broodstock were identified based on PIT tags recovered from fish seined and tagged as juveniles or by DNA results obtained later. Fish not used for broodstock did not have DNA samples taken. These fish were identified as natural origin by PIT tags and underestimate the numbers of natural origin fish processed. Milt from unmarked/ untagged males held overnight (1 Nov and 8 Nov) were used in matings the following day. The goal was to maximize the use of unmarked/untagged fish during spawning as a way to maximize the proportion of natural origin fish in matings. Composition of fish processed at LFH is presented in Appendix E. In 2016, the eggtake goal for LFH was attained.

Table 3. Duration and peak of spawning, egg take, and percent egg mortality at LFH, 1984-2016.

Year	Spawn duration Begin	Spawn duration End	Peak of spawning	Total egg take	Egg take fully covered through *US v. Oregon* priority number [a]	Egg take partially covered *US v. Oregon* priority number	Egg mortality to eye-up (%)[b]
1984	8 Nov	5 Dec	21 Nov	1,567,823	-	-	21.6
1985	2 Nov	14 Dec	7 Nov	1,414,342	-	-	4.0
1986	22 Oct	17 Dec	19 Nov	592,061	-	-	4.0
1987	20 Oct	14 Dec	17 Nov	5,957,976	-	-	3.8
1988	18 Oct	6 Dec	12 Nov	2,926,748	-	-	3.4
1989	21 Oct	16 Dec	11 Nov	3,518,107	-	-	5.8
1990	20 Oct	8 Dec	6 Nov	3,512,571	-	-	8.3
1991	15 Oct	10 Dec	12 Nov	2,994,676[c]	-	-	8.3
1992	20 Oct	8 Dec	21 Nov	2,265,557[c]	-	-	6.0
1993	19 Oct	7 Dec	2 Nov	2,181,879	-	-	6.7
1994	18 Oct	6 Dec	8 Nov	1,532,404	-	-	5.1
1995	25 Oct	5 Dec	14 Nov	1,461,500	-	-	5.6[d]
1996	22 Oct	3 Dec	5 Nov	1,698,309	-	-	4.6
1997	21 Oct	2 Dec	4 Nov	1,451,823[e]	-	-	5.2
1998	20 Oct	8 Dec	3 Nov	2,521,135	-	-	5.1
1999	19 Oct	14 Dec	9 & 10 Nov	4,668,267	-	-	9.4
2000	24 Oct	5 Dec	7 & 8 Nov	4,190,338	-	-	5.9
2001	23 Oct	27 Nov	13 & 14 Nov	4,734,234	-	-	6.4
2002	22 Oct	25 Nov	12 & 13 Nov	4,910,467	-	-	3.6
2003	21 Oct	2 Dec	10 & 12 Nov	2,812,751	8	9	3.1
2004	19 Oct	22 Nov	9 & 10 Nov	4,625,638	16	17	3.3
2005	18 Oct	29 Nov	15 & 16 Nov	4,929,630	16	17	3.5
2006	24 Oct	5 Dec	7 & 8 Nov	2,819,004	8	9	3.2
2007	23 Oct	3 Dec	13 & 14 Nov	5,143,459	17	-	3.3
2008	21 Oct	25 Nov	4 & 5 Nov	5,010,224	17	-	3.7
2009	20 Oct	18 Nov	9 & 10 Nov	4,574,182	17	12,14[f]	4.7
2010	19 Oct	30 Nov	16 Nov	4,619,533	16	17	2.7
2011	18 Oct	21 Nov	7 & 8 Nov	4,723,501	10&15&17[g]	11-14,16	3.5
2012[h]	16 Oct	13 Nov	6 Nov	4,526,108	5,7-9,11,13,15,16	6,10,17	3.1
2013	22 Oct	3 Dec	5 & 6 Nov	4,565,660	10,13,15,16	11,17	2.6
2014	22 Oct	18 Nov	12 & 13 Nov	4,787,615	17	-	3.6
2015	27 Oct	23 Nov	3 & 4 Nov	4,569,472	17	-	2.8
2016	25 Oct	21 Nov	1 & 2 Nov	4,951,188	17	-	2.7

[a] Priority levels as listed in the 2008-2017 *US v. Oregon* Management Agreement production tables (Appendix F).
[b] Egg mortality includes eggs destroyed due to high ELISA values.
[c] An additional 9,000 eggs from stray females were given to Washington State University.
[d] Does not 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.
[e] Total egg take includes eggs from one coho female crossed with a fall Chinook salmon.
[f] Priority levels 12 and 14 did not meet production goal. However, overall production in the subyearling group was more than required.
[g] Fully covered through priority 10 and priorities 15 and 17 were also fully covered.
[h] Priorities 12 and 14 are not included this year forward as the Transportation Study has ended.

Table 4. Spawn dates, numbers of fall Chinook salmon spawned, and weekly egg take at LFH in 2016. (Jacks are included with males).

Spawn Dates	Hatchery and Unknown Origin Males [a]	Natural Origin Males	Hatchery and Unknown Origin Females [a]	Natural Origin Females	Non-Viable [b]	Egg Take
25-Oct	72	25	142	65	0	834,210
1 & 2 Nov	125	60	290	106	4	1,568,952
8 & 9 Nov	89	46	215	113	4	1,320,528
15-Nov	107	96	177	84	0	1,078,713
21-Nov	9	26	15	20	0	148,785
Totals	**402**	**253**	**839**	**388**	**8**	**4,951,188**

[a] Numbers of fish presented include spawned fish whose progeny were later destroyed.

[b] Non-viable females—not ripe when killed.

Table 5. Weekly summary and origins of mortality and surplus fall Chinook salmon processed at LFH in 2016. (Jacks are included with males).

Week ending	Mortality						Killed Outright					
	LF/Snake R. [a]		Natural		Other/Unknown[b]		LF/Snake R. [a]		Natural		Other/Unknown[b]	
	M	F	M	F	M	F	M	F	M	F	M	F
17-Sep	2	3	0	0	2	4	0	1	0	0	0	0
24-Sep	1	2	0	0	1	3	0	0	0	0	0	0
1-Oct	1	4	0	0	1	5	0	0	0	0	0	0
8-Oct	2	6	0	0	2	16	0	0	0	0	0	0
15-Oct	4	8	0	0	2	7	0	0	0	0	0	0
22-Oct	1	5	0	0	8	10	0	0	0	0	0	0
29-Oct	5	5	0	0	7	7	230	2	0	0	13	1
5-Nov	3	3	0	0	7	4	64	0	0	0	12	1
12-Nov	3	1	0	0	3	1	1	0	0	0	1	0
19-Nov	9	0	0	0	6	0	2	1	0	0	1	0
26-Nov	8	3	0	0	1	0	39	0	0	0	6	0
Totals	**39**	**40**	**0**	**0**	**40**	**57**	**336**	**4**	**0**	**0**	**33**	**2**

[a] Includes known LFH or NPTH origin (from CWT and/or VIE), and PIT tagged fish of Snake River hatchery origin.

[b] Includes undetermined hatchery yearlings by scales, hatchery strays by scales or wire, regenerated scales, and Lost and No tags.

Fish Returned to River

Fish from LGR that were not needed for broodstock were returned to the Snake River near LFH on 21 November (Table 6). Fish were scanned for PIT tags, scales were taken to determine age composition, and the top of the caudal fin was clipped. Co-managers agreed in-season that these fish could be returned to the Snake River near LFH instead of above LGR due to the number released and that it would not affect run reconstruction estimates as the LGR trap had already closed for the season. We believe that all of these fish remained in the reservoirs between LMO and LGR, or went into the Palouse River since none were observed from carcass recoveries in the Tucannon River.

Table 6. Estimated composition of fall Chinook salmon released into the Snake River near LFH at the end of the season in 2016.

Origin	Release age	Origin estimation method	Salt water age	Total age	Females	Males+Jacks	Total
Hatchery	Unknown	Clip/Wire	-	-	37	19	56
Unknown	Unknown		-	-	15	47	62
Totals					52	66	118

Effective Hatchery Population Size

To determine the effective population size of hatchery fall Chinook production in the Snake River, the number of males and females used at both LFH and NPTH were combined. At both hatcheries, older aged males were mated with multiple females, in part, to prevent an unintentional decline in age at maturity, but also to more closely mimick what occurs in nature (Hankin 2009). In 2016, a total of 1,645 females and 936 males were spawned at both LFH and NPTH. Of the 936 males spawned, 432 were used multiple times to:

- maximize the number of larger, older aged adults used in crosses
- select fish with a greater chance of a subyearling life history,
- increase the number of natural origin fish used, and
- reduce the number of jacks used in the broodstock,

Due to the multiple use of males, procedures described in Busack (2007) were used to estimate the effective number of male breeders at both hatcheries. Based on that, the effective number of male breeders at both hatcheries combined was 704.

Total effective hatchery population size was calculated by the following formula:

Total effective hatchery population size = (4 x (effective number of male breeders x total number of females in matings))/(effective numbers of male breeders + total number of females in matings)

$$1973 = (4 \times (704 \times 1645)) / (704 + 1645)$$

For the Snake River hatchery fall Chinook salmon population, the targeted minimum effective population size is 1,000. The critical threshold is thought to be around 500 (personal communication with Craig Busack PhD, NOAA fisheries). Based on the number of spawned fish at both LFH and NPTH since 2005, the program has been above the targeted minimum in all years (Figure 3). The general decline in the estimated hatchery effective population size observed since 2011 can be attributed to the multiple use of larger/older males in broodstock at both facilities, with less emphasis on spawning younger and smaller males which was a common practice prior to 2011.

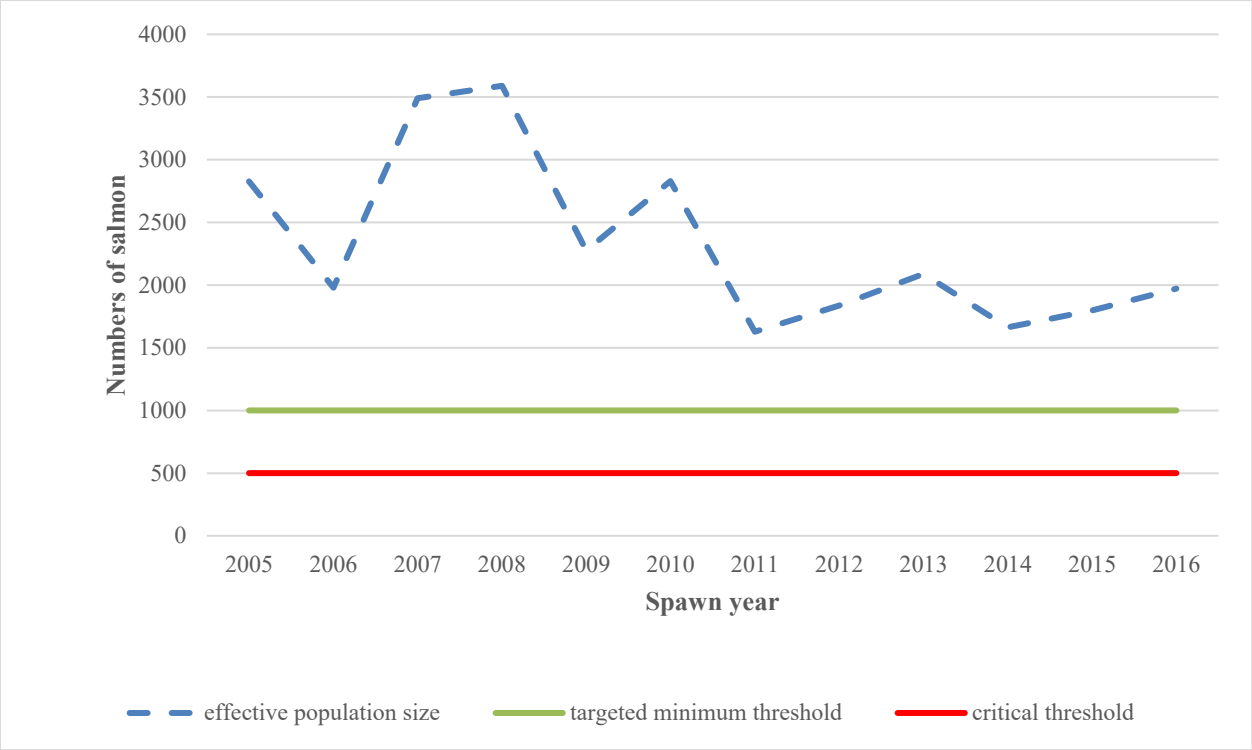


Figure 3. Estimated effective population size of the Snake River fall Chinook salmon spawned from both LFH and NPTH.

Broodstock Profile

This was the sixth year fin tissue for DNA analysis was taken from all fish contributing to broodstock, including those that were spawned but not used (Appendix G). This was the first year DNA results were used to determine origin. DNA was used in conjunction with CWT and PIT tags to determine Snake R hatchery and Snake R natural origins. This was the fifth year scales were taken from all fish contributing to broodstock in order to determine salt age and rearing type subyearling, yearling, or reservoir reared subyearlings). Otoliths were also taken from the majority of unmarked/untagged fish (spawned and unspawned) hauled from LGR by staff from the University of Idaho to determine where fall Chinook salmon are rearing in the Snake River Basin using isotopic analysis of otoliths (Hegg 2013).

Beginning in 2010, concentrated effort is occurring to spawn older/larger sized males and females because of the large number of jacks and jills that had been used in the past and possible heritability of that trait. While not a completely accurate representation of the overall genetic contribution of larger fish to the broodstock, due to some larger males being used repeatedly, it provides a relative representation that can be used in future years when examining changes in age composition (Figure 4–Figure 9). The origin composition of fall Chinook salmon used for broodstock at LFH in 2016 are presented in Figure 10. Including DNA results to determine origin, unknown origin fish used in broodstock decreased by 95.0% (Figure 11). Length frequencies of fall Chinook salmon used for broodstock at LFH in 2016 is presented in Figure 12. Males used multiple times are counted multiple times in both figures and unknown origin includes inbasin hatchery, out-of-basin hatchery (stray) and natural origin fish.

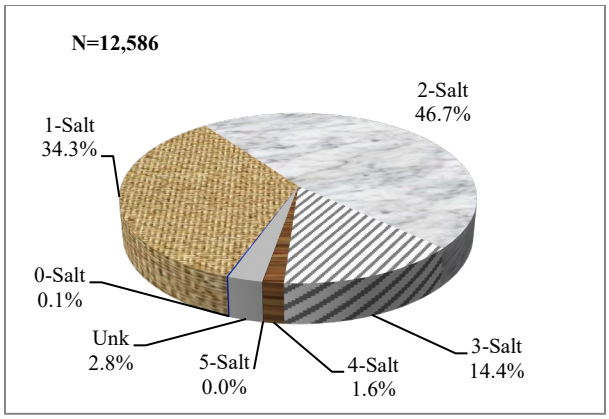


Figure 4. Salt age composition of all broodstock 2005 – 2009.

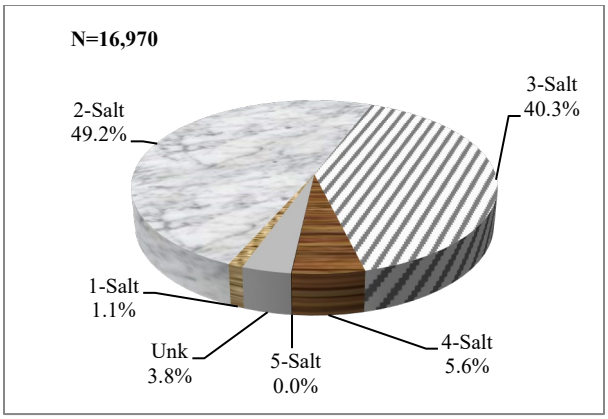


Figure 5. Salt age composition of all broodstock 2010 – 2016.

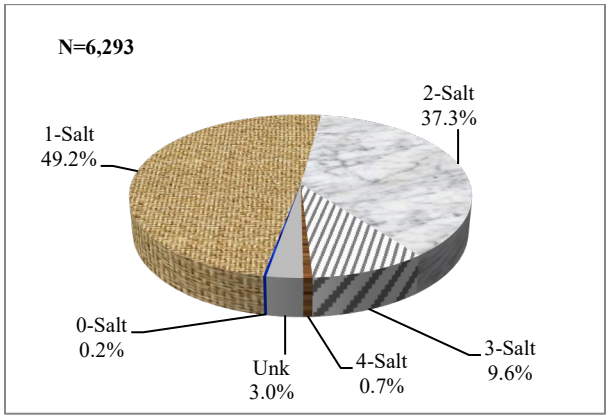


Figure 6. Male salt age composition of broodstock 2005 – 2009.

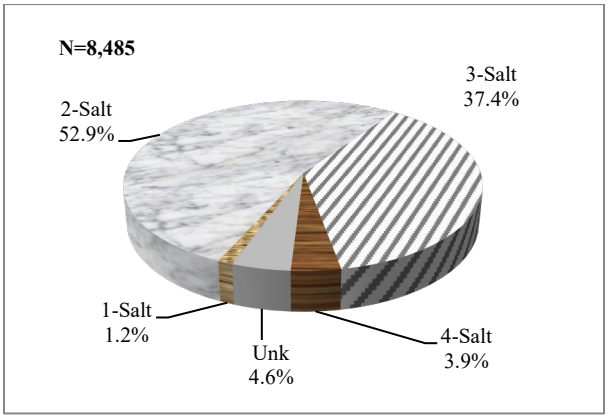


Figure 7. Male salt age composition of broodstock 2010 – 2016.

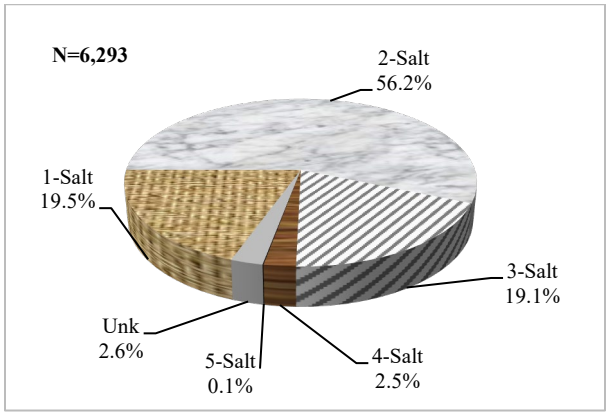


Figure 8. Female salt age composition of broodstock 2005 – 2009.

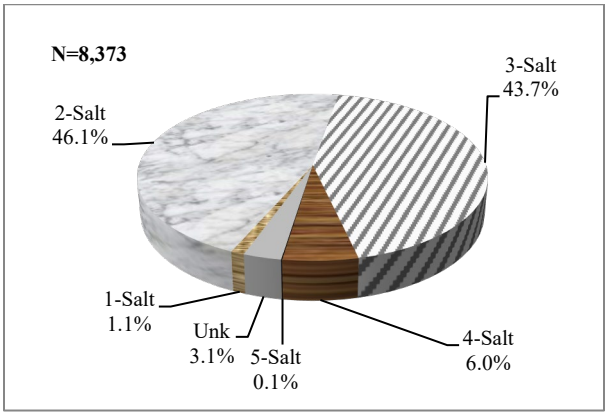


Figure 9. Female salt age composition of broodstock 2010 – 2016.

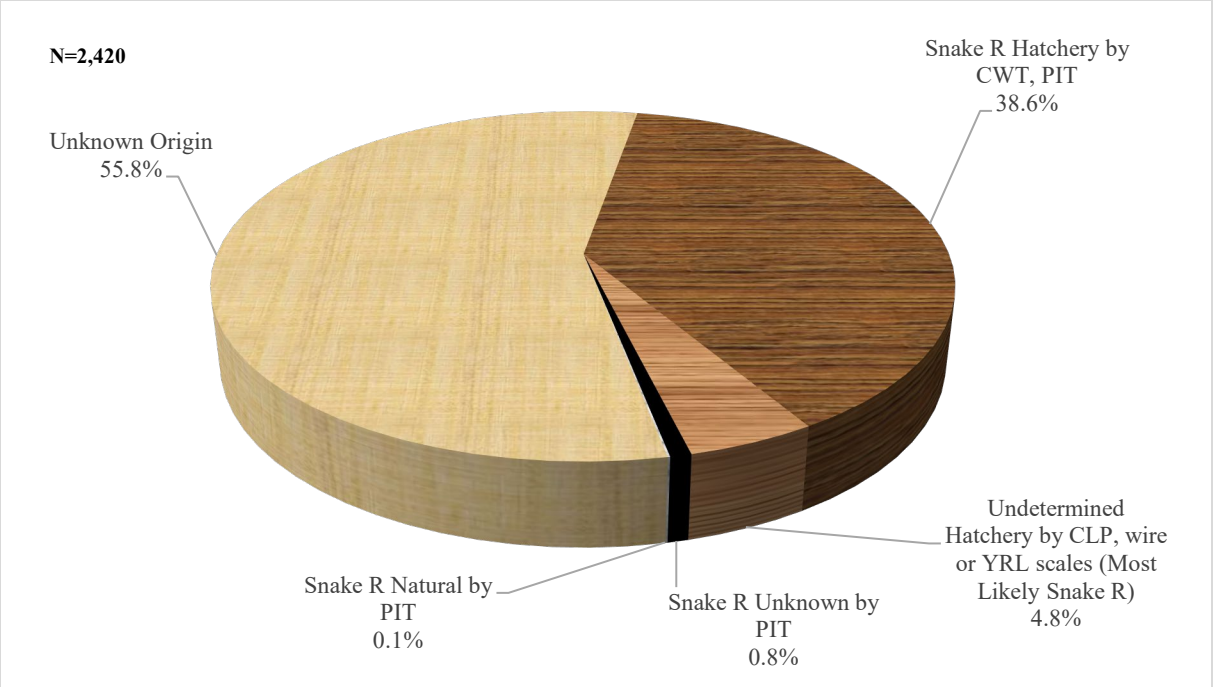


Figure 10. Percentages by fish origin <u>WITHOUT DNA RESULTS</u> contributing to fall Chinook salmon broodstock at LFH during 2016.

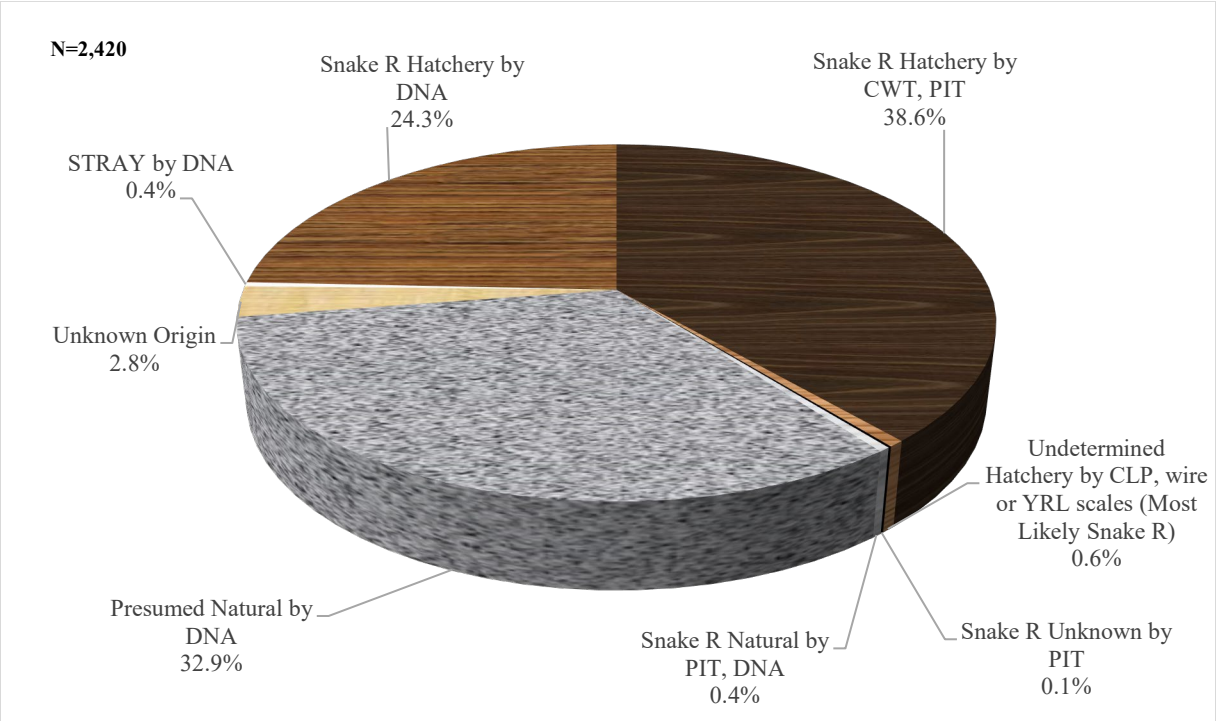


Figure 11. Percentages by fish origin <u>WITH DNA RESULTS</u> contributing to fall Chinook salmon broodstock at LFH during 2016.

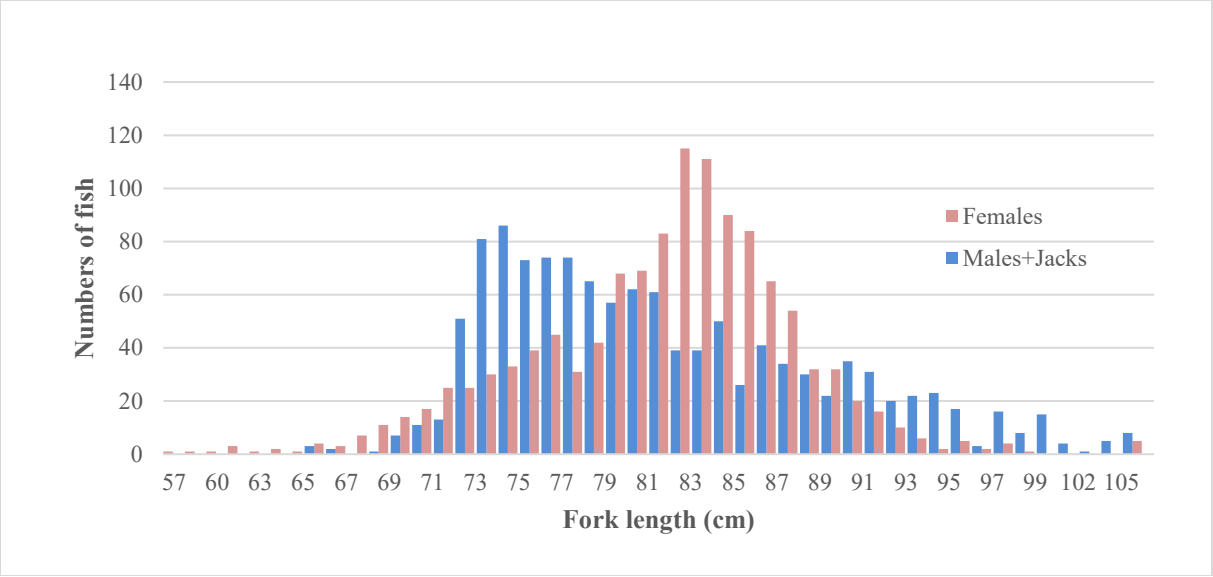


Figure 12. Fork lengths of fall Chinook salmon used as broodstock at LFH in 2016.

Males used in broodstock

Males hauled to LFH were trapped at LGR throughout the run (Figure 13), though a slightly higher percentage of males were trapped earlier in the season as compared to the overall return.

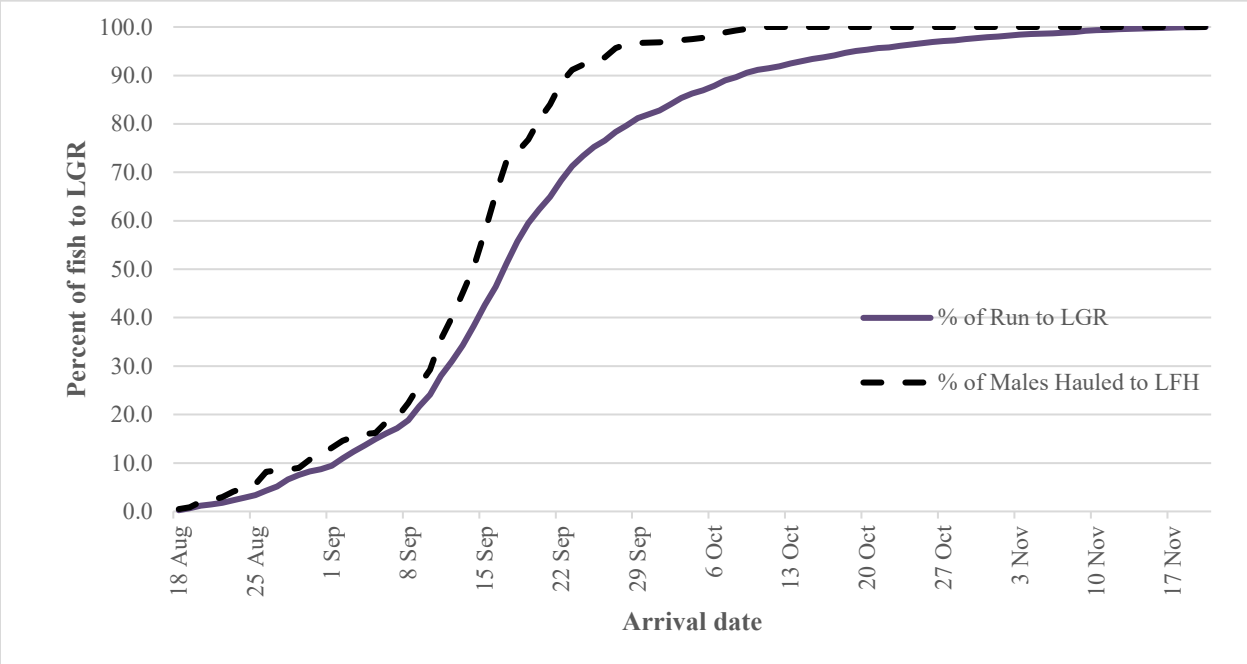


Figure 13. Arrival timing of male fall Chinook salmon at LGR compared to the arrival dates of fall Chinook salmon hauled to LFH during 2016.

Origin, including release site information, was determined for 32.2% of the males spawned based on CWT or PIT tag data and 25.7% from DNA. An additional 0.8% of the males were identified as hatchery origin based AD clip, lost/unreadable tags, or yearling scales with a hatchery check. Males that were unmarked/untagged represent 42.3% of the males spawned with 91.5% of those determined as natural by DNA. Of the total number of males spawned, 83.6% were from subyearlings, 6.1% were from yearlings, with the remaining 10.3% from unknown age or reservoir reared fish (Table 7).

Table 7. Origin and age of males that contributed to production at LFH, 2016.

	Times each male was used for mating								
Origin determination method / age	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total unique**
Snake R hatchery by CWT, PIT									
reservoir reared 3 salt (age5)	0	0	2	0	0	0	0	0	**2**
subyearling reservoir reared 2 salt (age4)	1	0	0	0	0	0	0	0	**1**
subyearling 2 salt (age3)	27	12	10	1	0	0	0	0	**50**
subyearling 3 salt (age4)	30	33	27	3	1	1	0	0	**95**
subyearling 4 salt (age5)	7	9	7	1	0	0	0	0	**24**
yearling 2 salt (age4)	5	5	11	0	1	0	0	0	**22**
yearling 3 salt (age5)	1	3	5	0	0	0	0	0	**9**
Presumed Snake R hatchery by DNA									
reservoir reared 3 salt (age5)	0	0	1	0	0	0	0	0	**1**
subyearling reservoir reared 2 salt (age4)	5	0	0	0	0	0	0	0	**5**
subyearling reservoir reared 3 salt (age5)	0	0	1	0	0	0	0	0	**1**
subyearling 2 salt (age3)	19	14	5	0	0	0	0	0	**38**
subyearling 3 salt (age4)	36	28	27	3	1	0	0	0	**95**
subyearling 4 salt (age5)	5	8	2	0	0	0	0	1	**16**
yearling 4 salt (age6)	1	0	0	0	0	0	0	0	**1**
unknown rear (age2)	0	0	2	0	0	0	0	0	**2**
unknown rear (age3)	2	1	1	0	0	0	0	0	**4**
unknown rear (age4)	2	0	0	0	0	0	0	0	**2**
Presumed STRAY by DNA									
subyearling 3 salt (age4)	0	0	1	0	0	0	0	0	**1**
yearling 3 salt (age5)	0	0	1	0	0	0	0	0	**1**
unknown rear (age4)	0	1	0	0	0	0	0	0	**1**
Undetermined hatchery by clip, wire or yearling scales									
subyearling 2 salt (age3)	0	0	1	0	0	0	0	0	**1**
subyearling 3 salt (age4)	0	0	1	0	0	0	0	0	**1**
yearling 3 salt (age5)	3	0	0	0	0	0	0	0	**3**
Snake R unknown by PIT									
reservoir reared 2 salt (age4)	0	0	1	0	0	0	0	0	**1**
Snake R presumed natural by PIT, DNA									
reservoir reared 2 salt (age4)	1	0	0	0	0	0	0	0	**1**
reservoir reared 3 salt (age5)	0	1	0	0	0	0	0	0	**1**
subyearling 3 salt (age4)	1	1	0	0	0	0	0	0	**2**
subyearling 4 salt (age5)	1	0	0	0	0	0	0	0	**1**
unknown age	0	0	1	0	0	0	0	0	**1**
Presumed natural by DNA									
reservoir reared 1 salt (age3)	1	1	0	0	0	0	0	0	**2**
reservoir reared 2 salt (age4)	12	2	2	0	0	0	0	0	**16**

Table 7. Origin and age of males that contributed to production at LFH, 2016.

	Times each male was used for mating								
Origin determination method / age	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total unique**
Presumed natural by DNA									
reservoir reared 3 salt (age5)	1	3	1	0	0	0	0	0	**5**
subyearling 2 salt (age3)	30	13	5	0	0	1	0	0	**49**
subyearling 3 salt (age4)	69	39	24	2	0	0	0	0	**134**
subyearling 4 salt (age5)	8	9	2	0	0	0	0	0	**19**
yearling 2 salt (age4)	1	0	2	0	0	0	0	0	**3**
unknown age	11	6	2	0	0	0	0	0	**19**
Unknown origin									
reservoir reared 2 salt (age4)	1	0	0	0	0	0	0	0	**1**
subyearling 2 salt (age3)	2	0	0	0	0	0	0	0	**2**
subyearling 3 salt (age4)	9	1	6	0	0	0	0	0	**16**
subyearling 4 salt (age5)	0	1	1	0	0	0	0	0	**2**
unknown age	0	1	1	0	0	0	0	0	**2**
Total unique males	**292**	**192**	**153**	**10**	**3**	**2**	**0**	**1**	**653**

Females Used in Broodstock

Females hauled to LFH were trapped at LGR throughout the season (Figure 14), though more females were trapped earlier in the season as compared to the overall return. Origin including release site information was determined for 42.7% the females spawned based on CWT or PIT tag data and 22.8 based on DNA. An additional 0.4% of the females were identified as hatchery origin based either on an AD clip, lost/unreadable tags or yearling scales with a hatchery check. Females that were not tagged or clipped represent 34.1% of the females spawned. Of the females that were not tagged or clipped, 93.9% were determined to by natural by DNA. The estimated age composition and origins of females contributing to broodstock at LFH are listed in Table 8. Similar to the males used in broodstock, of the total number of females spawned, 77.5% were from subyearlings, 12.1% were from yearlings, and the remaining 10.4% were from unknown age or reservoir reared fish.

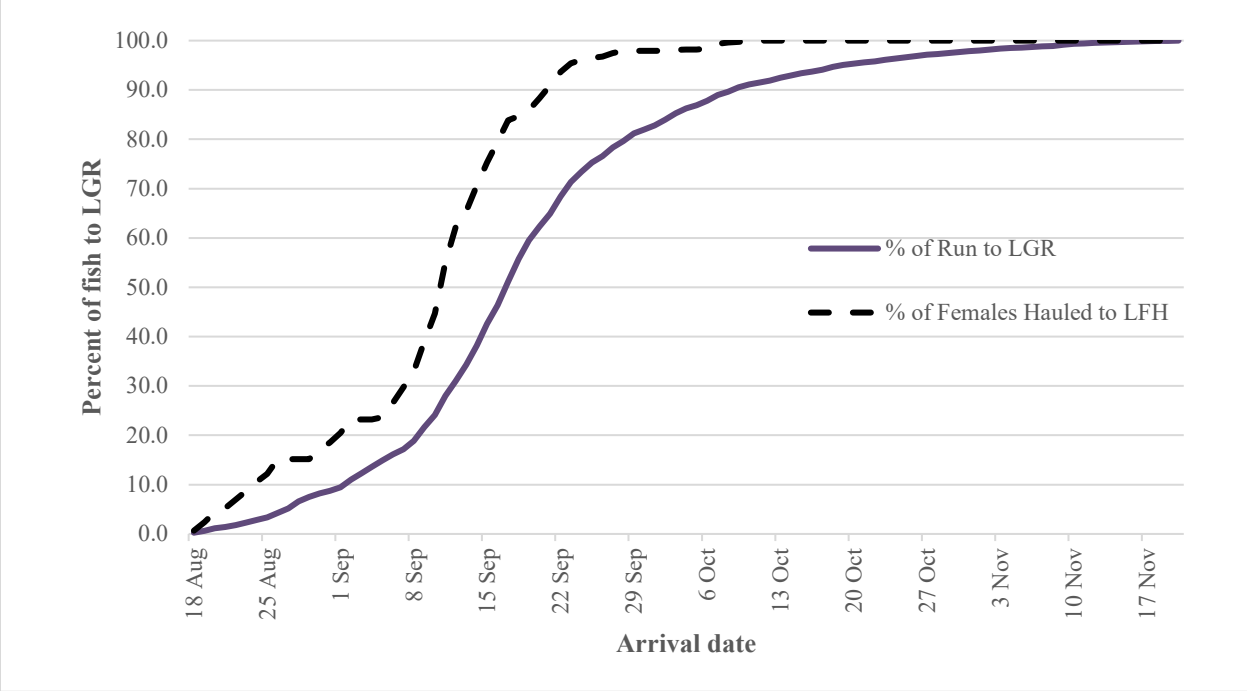


Figure 14. Arrival timing of female fall Chinook salmon at LGR compared to arrival dates of fall Chinook salmon hauled to LFH during 2016.

Table 8. Origins and age of females that contributed to production at LFH, 2016.

Origin and determination method	Age	Number of females
Snake R hatchery		
Snake R hatchery by CWT or PIT	subyearling reservoir reared 1 salt (age3)	**1**
	subyearling reservoir reared 2 salt (age4)	**6**
	subyearling reservoir reared 3 salt (age5)	**4**
	subyearling 2 salt (age3)	**57**
	subyearling 3 salt (age4)	**251**
	subyearling 4 salt (age5)	**55**
	yearling 1 salt (age3)	**2**
	yearling 2 salt (age4)	**76**
	yearling 3 salt (age5)	**65**
Presumed Snake R hatchery by DNA	reservoir reared 3 salt (age5)	**16**
	subyearling reservoir reared 2 salt (age4)	**4**
	subyearling reservoir reared 3 salt (age5)	**1**
	subyearling 2 salt (age3)	**17**
	subyearling 3 salt (age4)	**159**
	subyearling 4 salt (age5)	**66**
	yearling 4 salt (age6)	**2**
	unknown rear (age4)	**3**
	unknown rear (age5)	**6**
Out-of-basin hatchery		
STRAY by DNA	subyearling 3 salt (age4)	**1**
Undetermined hatchery		
Undetermined hatchery by clip, wire or yearling scales with a hatchery check	subyearling 3 salt (age4)	**4**
	subyearling 4 salt (age5)	**1**
Presumed natural		
Presumed natural by DNA	reservoir reared 2 salt (age4)	**20**
	reservoir reared 3 salt (age5)	**31**
	subyearling 2 salt (age3)	**8**
	subyearling 3 salt (age4)	**216**
	subyearling 4 salt (age5)	**77**
	subyearling 5 salt (age6)	**4**
	yearling 2 salt (age4)	**1**
	yearling 3 salt (age5)	**1**
	unknown age	**30**
Unknown origin		
Unknown origin	reservoir reared 3 salt (age5)	**2**
	subyearling 2 salt (age3)	**2**
	subyearling 3 salt (age4)	**11**
	subyearling 4 salt (age5)	**8**
	unknown age	**2**
Total		**1,210**

Lengths by Age of CWT fall Chinook salmon that are part of the LSRCP Program Compared to Strays

Data presented below consists of LSRCP, FCAP, and out of basin strays with CWTs, and includes fish used as broodstock, fish killed outright, non-viable fish, and dead in pond fish. While the length at age data allow for comparisons by sex, hatchery, and juvenile life history, these data do not represent the age composition of the population because of size selective (non-random) hauling protocols at LGR. It should also be noted that subyearlings classified as 1-salt include some fish that reservoir reared. Size at age of return was calculated for wire tagged yearling (Table 9) and subyearling (Table 10) LSRCP releases (including FCAP) and out-of-basin strays processed by WDFW. Recoveries of fish that are part of IPC and NPTH programs are not included below. The sizes at age of return of LSRCP fish were not different than the sizes of out-of-basin strays processed. Historical sizes at age of return LSRCP program fish are provided in Appendix H.

Table 9. Sex, origin, and median fork length by age at return of LFH CWT fall Chinook salmon processed in 2016 by WDFW that were part of hatchery yearling juvenile releases.

			Total age at return				
Sex	**Origin**	**Fork length**	0-salt	1-salt	2-salt	3-salt	4-salt
Male	LFH	*N*	53	66	41	15	-
		Median (cm)	39	58	73	78	-
		Range (cm)	32-46	46-71	54-86	71-86	-
	Stray	*N*	-	-	-	-	-
		Median (cm)	-	-	-	-	-
		Range (cm)	-	-	-	-	-
Female	LFH	*N*	-	10	86	66	1
		Median (cm)	-	62	72	80	-
		Range (cm)	-	57-67	62-81	68-89	88
	Stray	*N*	-	-	-	-	1
		Median (cm)	-	-	-	-	-
		Range (cm)	-	-	-	-	88

Table 10. Sex, origin, and median fork length by age at return of LFH CWT fall Chinook salmon processed in 2016 by WDFW that were part of hatchery subyearling juvenile releases.

			Age at return				
Sex	**Origin**	**Fork length**	0-salt	1-salt	2-salt	3-salt	4-salt
Male	LFH	*N*	-	47	77	44	3
		Median (cm)	-	51	68	79	94
		Range (cm)	-	35-68	57-81	69-97	75-95
	Stray	*N*	-	-	-	7	-
		Median (cm)	-	-	-	77	-
		Range (cm)	-	-	-	62-87	-
Female	LFH	*N*	-	-	23	109	14
		Median (cm)	-	-	70	81	85
		Range (cm)	-	-	57-77	68-91	79-90
	Stray	*N*	-	-	1	-	3
		Median (cm)	-	-	-	-	84
		Range (cm)	-	-	73	-	78-87

Fecundity

In 2016, individual fecundities were determined and weights taken on the first 50 females each day of spawning. With the inclusion of PBT and the ability to determine origin of nearly all fish used in the broodstock (full broods represented in 2016), it became possible to determine the origin of all unmarked/untagged females used in the broodstock. As such, monitoring was set in place to gather fecundity data for both hatchery and natural origin fish of varied ages and life history strategies (yearling or subyearling) for comparison.

Fecundity was estimated by counting and weighing 100 live eggs, applying the weight/egg calculation to the total weight of the live eggs, applying a 4% correction factor for water retention in the live eggs, and then adding in counted dead eggs. Reproductive effort (ratio of gamete biomass to total body mass) was calculated for each female and used to determine which females might have lost some eggs prior to spawning (Knudsen et al 2008). Females whose eggs weighed less than 10% of the total body weight were removed from the analysis. Females generally contributed 19% of their body weight toward egg production but not more than 25% (Figure 15).

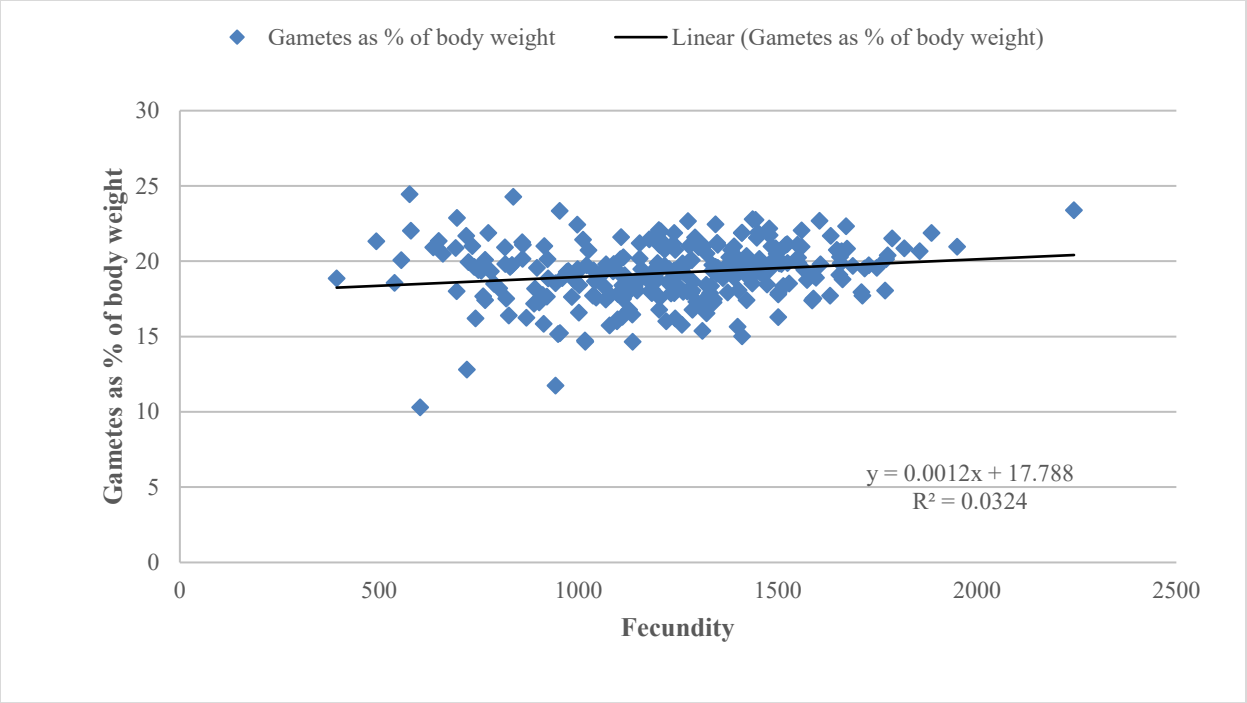


Figure 15. Gametes as percent of body weight for CWT hatchery broodstock at LFH in 2016.

Fecundity relationships were evaluated for Snake River hatchery yearling, subyearling, and subyearling reservoir reared groups as well as Snake River natural (determined by PBT analysis) subyearling and reservoir reared subyearlings (Figure 16-Figure 18). Fork length more reliably predicted fecundities for hatchery yearling salmon than for hatchery subyearling salmon. Fork length for hatchery salmon more reliably predicted fecundities than natural salmon. Fecundities were highly variable (1,712-5,986 eggs/fish) and were best predicted using fork lengths. Based on hatchery records, overall average fecundity of LGR trapped females combined was 4,080 eggs/female. This estimate was derived after egg picking when the estimated number of green eggs taken (prior to egg picking) was corrected based on actual counts and weights of eggs collected. These fecundities are only of fish retained for broodstock and not the average fecundity of females returning to the Snake River Basin due to trapping and broodstock spawning protocols that minimize jills from being included in broodstock.

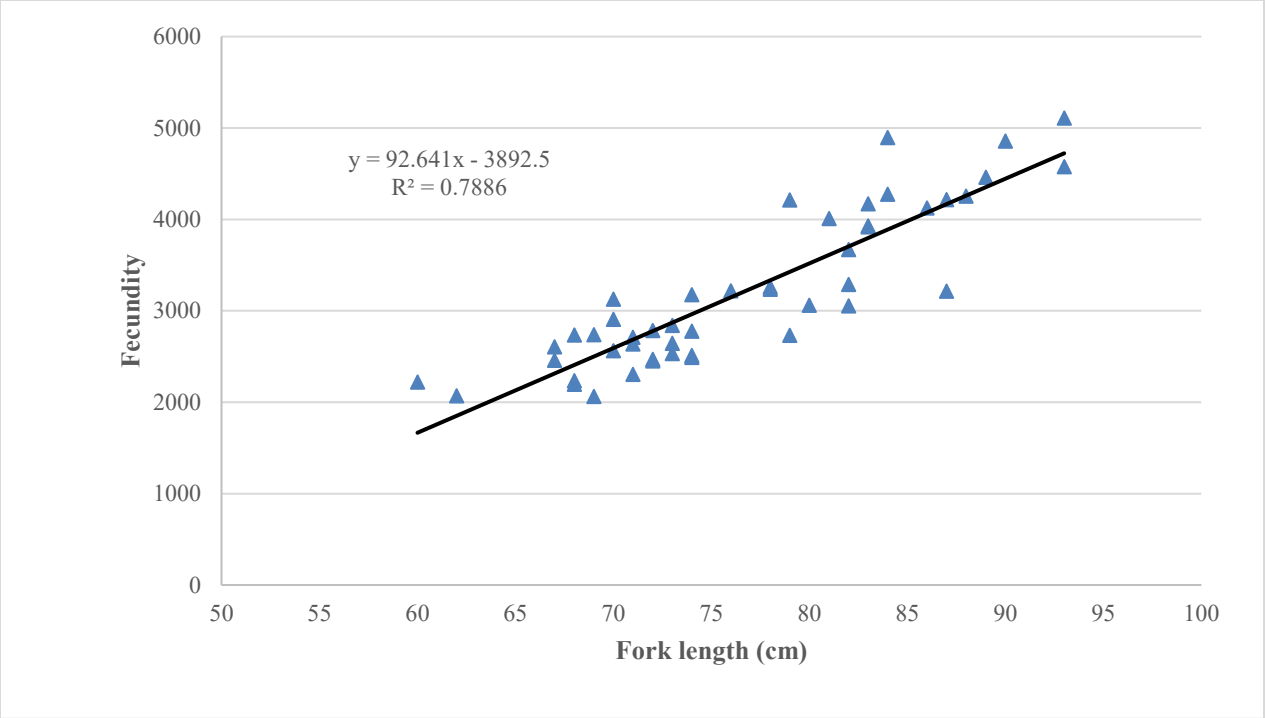


Figure 16. Yearling hatchery salmon fork length to fecundity relationships in 2016.

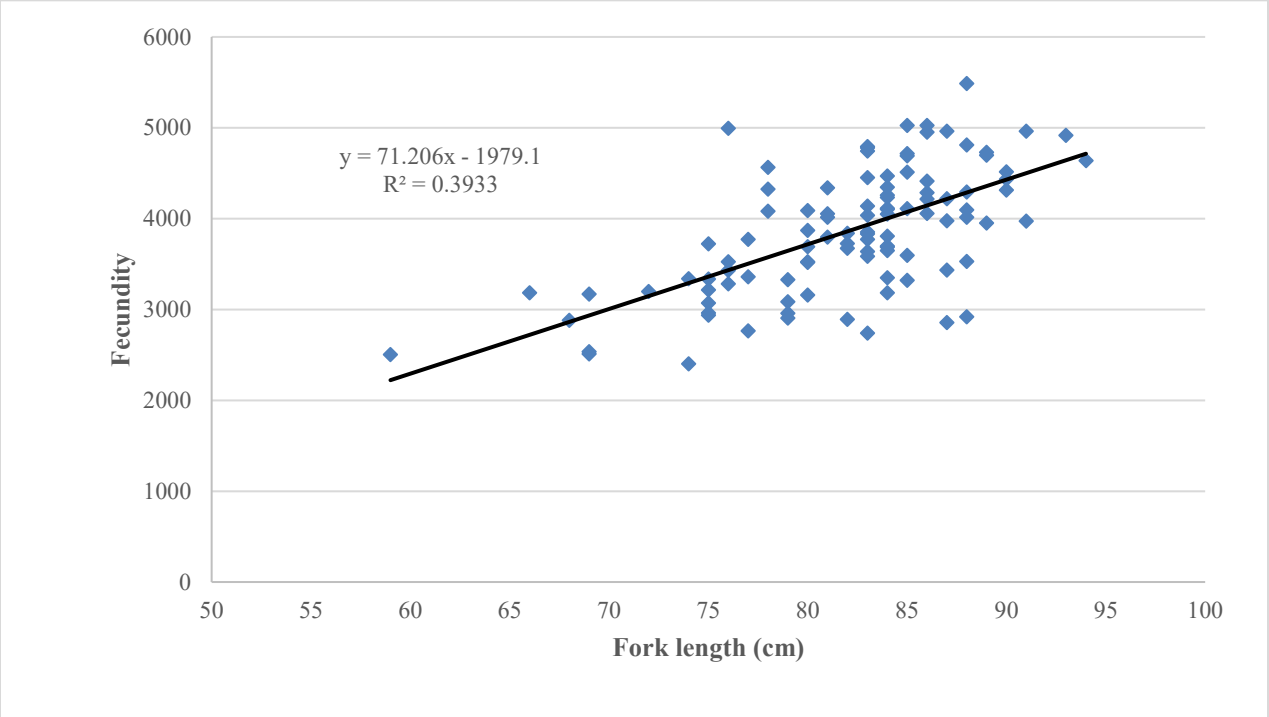


Figure 17. Subyearling hatchery salmon fork length to fecundity relationships in 2016.

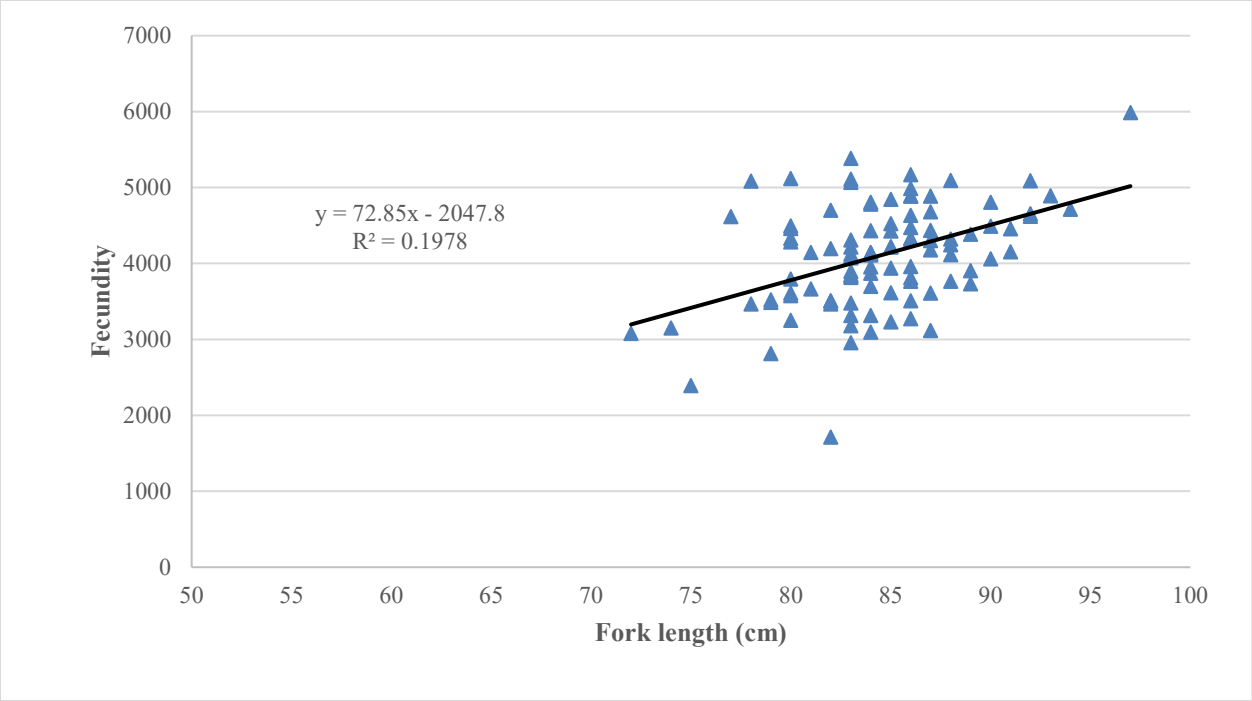


Figure 18. Subyearling and reservoir reared subyearling natural salmon fork length to fecundity relationships in 2016.

Inclusion of Natural Origin Fish

This was the fourteenth year that unmarked/untagged fall Chinook salmon were included in broodstock. The estimated percent natural origin fish used in WDFW broodstock (pNOB) was 26% (Figure 19), slightly below the 30% target. The overall pNOB for LFH and NPTH combined was also 26%. To estimate pNOB, a dataset was constructed to reflect all parents contributing to production. Males used with multiple females were included multiple times. To estimate natural origin fish, unmarked/untagged fish were split into multiple categories by sex and age based on scales. Unmarked/untagged fish with unknown scale age were estimated based on the composition of the scales that were aged in each category from the broodstock. After aging was estimated for all unmarked/untagged fish (natural origin and hatchery origin) trapped at LGR, each age and sex category was summed and multiplied by the proportion of natural origin fish of the same category using run reconstruction estimates. The final formula for pNOB = (total number estimated natural parents/total number of parents) x100. PBT results show pNOB at 35%, exceeding the 30% target (Figure 19).

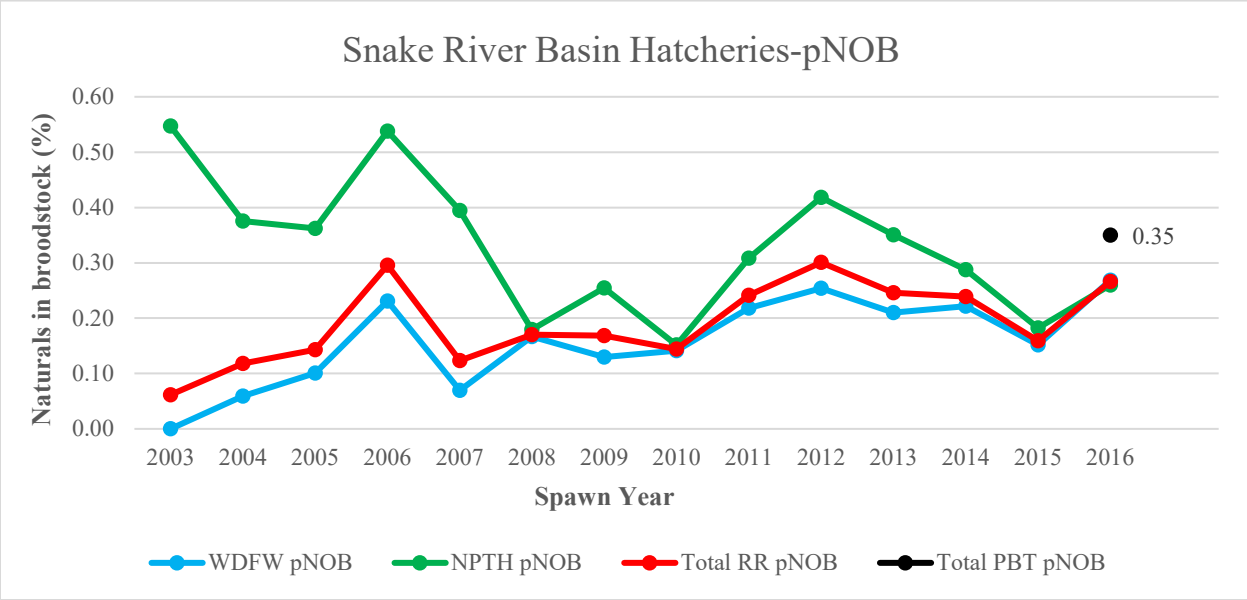


Figure 19. Estimated percent natural origin parents in broodstock at LFH, NPTH, and overall for Snake River basin hatchery production, 2007-2016.

Jacks and Jills in Broodstock

As described previously, WDFW has implemented a size selective mating protocol, with one of the main goals to reduce and/or eliminate the contribution/influence of mini-jacks, jacks, and jills in the broodstock. We calculated saltwater age for wire tagged fish by subtracting 1 from the total age of subyearlings and 2 from the total age of yearlings. This method overestimates saltwater ages for subyearlings since reservoir rearing is not taken into consideration. Untagged fish are scale sampled and reservoir rearing is used to estimate salt water age. Between 2000 and 2009, percent of contribution of jacks and jills in broodstock averaged a minimum estimate of 62.3% (Appendix I). Intensive monitoring/screening of jacks and jills present in the broodstock began in 2010 in order to minimize their contribution to future production (Table 11). This monitoring and subsequent management action has reduced the total matings of 0-salt and/or 1-salt parentage by 96.5% within the last seven years.

Table 11. Number of matings of minijacks, jacks, and jills contributing to broodstock at LFH, 2010-2016, during size-selective mating protocols.

Year	0-salt	1-salt jack	1-salt jill	Number of matings containing jack x jill mating	% of total matings with 0-salt and/or 1-salt parentage
2010	0	38	2	0	3.2
2011	0	50	37	3	6.7
2012	0	2	3	0	0.4
2013	0	9	45	1	4.3
2014	0	0	0	0	0.0
2015	0	2	1	0	0.1
2016	0	5	3	0	0.6
Average	**0**	**15.1**	**13.0**	**0.6**	**2.2**

Inclusion of Strays in Broodstock

The WDFW goal is to fully exclude strays from broodstock to maintain the genetic integrity of the fall Chinook salmon LFH produces. In years where broodstock may be limited, it was agreed that 5% strays may be included. Beginning in 2007, the year with the highest number of strays included in broodstock was 2013 at 3.3% (Table 12). To assure productions goals were met as mandated in the 2008-2017 *United States v. Oregon* Management Agreement, nine stray females were spawned in 2016 and gametes were retained until the end of the spawning season. When it was verified that production goals could be met without including the strays, the progeny of the strays were culled.

Table 12. Historical use of out of basin strays in broodstock: 2007-2016.

Year	Total number of matings	Matings including Stray males[a]	Matings including Stray females	Number of matings containing stray x stray mating	% of total matings with stray parentage
2007	1,458	3	7	0	0.7%
2008	1,309	1	0	0	0.1%
2009	1,293	0	1	0	0.1%
2010	1,238	3	9	0	1.0%
2011	1,251	0	6	0	0.5%
2012	1,184	0	1	0	0.1%
2013	1,240	6	59	1	5.2%
2014	1,162	0	0	0	0.0%
2015	1,200	0	24	0	1.9%
2016	1,210	0	0	0	0.0%
Average	1,255	**1**	**11**	**0**	**0.9%**

[a] Males used multiple times are included multiple times.

Rearing and Marking and Tagging

Information regarding egg taken, egg loss, eggs culled, eggs shipped or retained, and numbers of fish ponded is included in Table 13. Historical egg take and ponding information is listed in Appendix J. Rearing followed standard hatchery procedures as described in the Snake River fall Chinook salmon HGMP available at http://www.fws.gov/lsnakecomplan/Reports/HGMPreports.htm. Detailed information regarding type and size of vessels used for rearing can be found in LFH Annual Reports available at http://www.fws.gov/lsnakecomplan/Reports/WDFWreports.html.

Table 13. Eggs taken and survival numbers by life stage of fall Chinook salmon spawned at LFH, brood years 2010-2015.

Brood year	Eggs taken	Egg loss	Eggs destroyed[a]	Eggs shipped	Eyed eggs retained	Fry ponded	Intended program
2011	4,723,501	165,001	0	1,785,600	2,772,900	960,000	Yearling
						1,812,900	Subyearling
2012	4,526,108	141,608	0	1,480,000	2,904,500	1,010,000	Yearling
						1,894,000	Subyearling
2013	4,565,660	119,550	0	1,558,800	2,887,310	980,000	Yearling
						1,907,310	Subyearling
2014	4,787,615	177,415	96,700	1,540,000	2,973,500	1,000,000	Yearling
						1,978,500	Subyearling
2015	4,569,472	127,974	132,098	1,540,000	2,769,400	930,000	Yearling
						1,839,400	Subyearling
2016	4,951,188	121,359	61,346	1,540,000	3,228,483	1,008,647	Yearling
						1,995,000	Subyearling

[a] Eggs culled due to ELISA results, strays, jills or jacks matings.

Marking and tagging of fish was consistent with the 2008- 2017 *US v. Oregon* Management Agreement. Yearling (BY15) fish were ADCWT marked/tagged and CWT tagged from 7-20 July. After marking and tagging, all but 34,000 fish were diverted to the rearing lake. Approximately 17,000 ADCWT fish were diverted into one raceway and 17,000 CWT only fish were diverted into a second raceway. Staff performed tag and fin clip quality control checks from a sample of each group immediately prior to their PIT tagging, and subsequent movement to the rearing lake (Table 14).

Subyearlings (BY15) released at LFH were ADCWT marked/tagged from 4-11 April. All subyearlings were kept in raceways prior to release. Staff performed tag and fin clip quality control checks from a sample of each raceway prior to PIT tagging and release.

Subyearlings released into the Grande Ronde River (GRR) were ADCWT marked/tagged from 30 March at Irrigon Fish Hatchery. All subyearlings were kept in two raceways prior to release (marked/tagged and unmarked/untagged). Staff performed tag and fin clip quality control checks from a sample of each raceway prior to PIT tagging and release (Table 14).

Table 14. Numbers of fall Chinook salmon sampled by WDFW for marking and tagging quality control checks.

Brood year /age	Release site	Mark type	CWT	Number sampled	AD/ CWT	AD only	CWT only	Unmarked/ untagged
2015 Yearling	LFH	ADCWT	637040	1,851	1,834 (99.1%)	13 (0.7%)	4 (0.2%)	0 (0.0%)
	LFH	CWT only	637041	1,932	0 -	0 -	1,925 (99.6%)	7 (0.4%)
2015 Subyearling	LFH	ADCWT	636882	2,099	1,947 (92.8%)	127 (6.0%)	10 (0.5%)	15 (0.7%)
	GRR	ADCWT	637037	1,952	1,873 (96.0%)	75 (3.8%)	4 (0.2%)	0 (0.0%)

Staff PIT tagged 29,945 BY15 onstation yearlings and 19,990 BY15 onstation subyearlings for the purpose of monitoring, outmigration timing, adult returns in-season, and to compare two methods (CWTs vs PIT tags) of estimating smolt-to-adult survivals (SARs). The tag lists for each release group were submitted to PTAGIS and fish were assigned to monitor mode to allow them to be treated like non-PIT tagged fish when intercepted at dams. Initial tag loss and mortalities of the yearlings could not be collected and scanned for PIT tags, as the fish were diverted directly into the earthen rearing pond at the time of tagging where they remained until release. After release, the pond and outlet structure were scanned for shed tags or tags from mortalities. A total of 402 shed tags (1.3%) from BY15 were detected, leaving an estimated 29,543 PIT tags representing the onstation yearling release.

PIT tagged BY15 onstation subyearlings were returned directly to the raceways following PIT tagging. Tagging events resulted in 138 mortalities (0.7%). Staff collected and reinserted 99 of those tags, leaving an estimated 19,951 PIT tags representing the onstation subyearling release.

Staff also PIT tagged 3,000 BY15 subyearlings at Irrigon Fish Hatchery for the sole purpose to monitor outmigration timing. Tagging events resulted in 4 mortalities (0.1%) of which those PIT tags were reinserted prior to release into the GRR.

Juvenile Releases

Brood year 2015

Subyearling

Subyearling fall Chinook salmon at LFH were released 31 May 2016. Fish were measured and weighed prior to release (Table 15). Upon visual inspection the fish appeared in good condition, with no external signs of BKD, pop-eye, descaling, or sexual precocity. An estimated 202,460 fish were released as an ADCWT group. Hatchery staff conducted pound counts and calculated the release at 53.8 fish/lb (fpp). Fish used in the pound counts were set aside for SRL staff to subsample for individual lengths and weights (Table 15). Individual length/weight samples taken by SRL staff and average pound counts taken by LFH staff were very similar. The release occurred during a decreasing hydrograph in the Snake River. Historical releases from 2009 forward of subyearlings by WDFW, NPT, and IPC are provided in Appendix K.

Subyearling fall Chinook salmon reared at Irrigon FH were released into the GRR on 31 May 2015. An estimated 208,039 fish were released as an ADCWT group and 221,850 were released as unmarked/untagged. Fish were measured, weighed, and visually appeared in good condition, with no external signs of BKD, pop-eye, descaling, or sexual precocity at the time of release. ODFW staff provided pound counts and the release was calculated at 49.4 fpp, similar to what was calculated from individual length/weight sampling from SRL staff. The release occurred during a decreasing hydrograph in the GRR.

Table 15. Length and weight data from subyearling fall Chinook salmon (BY15) sampled by WDFW and released into the Snake and Grande Ronde rivers during 2016.

Length/weight data	Snake R at LFH	Grande Ronde R at Cougar Creek
Sample date	31 May	27 May
CWT Code	637038	637037
Number sampled	237	421
Avg. length (mm)	87	92
Median length	88	92
Range of lengths	75-100	69-112
SD of lengths	4.6	6.1
CV of length (%)	5.3	6.7
Avg. weight (g)	8.4	9.5
SD of weight	1.3	1.8
Avg. K factor	1.25	1.22
FPP	53.8	47.7

Yearling

Yearling fall Chinook salmon at LFH were released from 3 to 5 April 2016, with peak emigration occurring on 3 and 4 April. Fish were measured and weighed prior to release (Table 16). Upon visual inspection, the fish appeared in good condition, with no external signs of BKD, pop-eye, descaling, or sexual precocity. An estimated 233,687 fish were released from the ADCWT group, and 224,871 were released from the CWT only group. Hatchery staff set aside fish throughout the release for SRL staff to subsample for individual lengths and weights (Table 16). Individual length/weight samples and pound count were very similar. The rearing lake was fully drained 5 April with the last few fish leaving the release structure that day. The release occurred during an increasing hydrograph in the Snake River. Historical releases from 2010 to the present for yearlings by WDFW and NPT are provided in Appendix K.

Table 16. Length and weight data from yearling fall Chinook salmon (BY15) released at LFH in 2017.

	Yearlings	
Length/weight data	**ADCWT**	**CWT only**
Sample date(s)	3-5 April	3-5 April
CWT code	637040	637041
Number sampled	203	202
Avg. length (mm)	156	155
Median length	157	155
Range of lengths	128-187	115-191
SD of lengths	10.6	11.1
CV of length (%)	6.8	7.2
Avg. weight (g)	43.0	41.3
SD of weight	8.5	8.7
Avg. K factor	1.06	1.06
FPP	10.5	11.0

Survival Rates to Release

The estimated number of eggs and fish present at varying life stages in the hatchery were used for 2010-2014 broods to calculate survival rates within the hatchery environment (Table 17). The original in-hatchery survival goal for LFH production was calculated as 80% [(9,160,000 juveniles/11,450,000 eggs) x 100] (USACOE 1975) and has been achieved each year for yearlings since 2003 and yearly since 1990 for subyearlings (Appendix L).

Table 17. Estimated survivals (%) between various life stages at LFH for fall Chinook salmon, 2011-2015 brood years.

Brood year	Release stage	Green egg-ponded fry	Ponded fry-release[a]	Green egg-release
2011	Yearling	95.0	102.1	97.7
	Subyearling	95.0	98.2	96.4
2012	Yearling	95.9	99.9	95.8
	Subyearling	95.9	97.0	93.0
2013	Yearling	97.4	94.6	91.2
	Subyearling	97.4	97.6	94.1
2014	Yearling	95.2	97.1	92.5
	Subyearling	95.2	98.5	93.8
2015	Yearling	94.6	100.1	94.7
	Subyearling	94.6	99.5	94.2
Yearling mean:	**%**	**95.6**	**98.8**	**94.4**
	SD	**1.1**	**2.9**	**2.6**
Subyearling mean:	**%**	**95.6**	**98.2**	**94.3**
	SD	**1.1**	**0.9**	**1.3**

[a] Survival estimates exceed 100% due to inventory tracking methodologies used at LFH.

Migration Timing

The PTAGIS website (www.ptagis.org) was queried for GRR and onstation subyearling and yearling releases. Interrogation summaries were used to populate Table 18-Table 20. Migration speed generally increased for all releases as fish moved downstream through the system (Figure 20 and Figure 21), although, for some unknown reason, the subyearling release from the GRR slowed their migration at IHR, then increased their speed through the lower Columbia River.

Table 18. Migration timing of BY15 PIT tagged subyearlings released near Cougar Creek in the GRR in 2016.

	Detection Facilities						
	LGR	**LGO[a]**	**LMO**	**IHR**	**MCN**	**JDD[a]**	**BONN[a b]**
Number Detected	**336**	**322**	**51**	**61**	**60**	**59**	**34**
Mean Travel Days from GRR[c]	12	14	15	24	19	22	24
Median Passage Date	11 Jun	13 Jun	14 Jun	22 Jun	18 Jun	22 Jun	23 Jun
First Detection Date	5 Jun	6 Jun	10 Jun	13 Jun	14 Jun	16 Jun	18 Jun
Last Detection Date	16 Jul	7 Jul	6 Jul	15 Jul	13 Jul	1 Jul	6 Jul
10% of Run Passage Date	8 Jun	10 Jun	11 Jun	14 Jun	15 Jun	18 Jun	19 Jun
90% of Run Passage Date	17 Jun	21 Jun	20 Jun	9 Jul	23 Jun	25 Jun	27 Jun
TDG on Median Date of Passage (%)[d]	110.3	110.4	116.3	111.9	115.9	113.2	114.2
Outflow on Median Date of Passage (kcfs)[d]	53.1	59.9	38.9	37.2	199.1	166.1	195.7
Spill on Median Date of Passage (kcfs)[d]	20.3	17.6	25.1	11.4	100.0	49.3	96.2

[a] LGO=Little Goose Dam, JDD=John Day Dam, BONN=Bonneville Dam.
[b] TDG, outflow and spill for BONN are detected six miles downstream at Warrendale.
[c] Travel days are from the date of release.
[d] Detections are from the tailrace of each dam.

Table 19. Migration timing of BY15 PIT tagged subyearlings released at LFH in 2016.

	Detection Facilities				
	LMO	**IHR**	**MCN**	**JDD**	**BONN[a]**
Number Detected	**1,116**	**360**	**923**	**595**	**431**
Mean Travel Days from LFH[b]	8	12	13	18	17
Median Passage Date	9 Jun	14 Jun	13 Jun	17 Jun	17 Jun
First Detection Date	1 Jun	4 Jun	7 Jun	8 Jun	12 Jun
Last Detection Date	6 Jul	19 Jun	24 Jun	14 Nov[c]	27 Jun
10% of Run Passage Date	4 Jun	8 Jun	10 Jun	13 Jun	15 Jun
90% of Run Passage Date	14 Jun	14 Jun	17 Jun	21 Jun	21 Jun
TDG on Median Date of Passage (%)[d]	117.5	111.4	115.0	112.5	114.9
Outflow on Median Date of Passage (kcfs)[d]	60.5	45.2	216.4	171.2	223.3
Spill on Median Date of Passage (kcfs)[d]	24.0	13.6	86.6	68.4	96.0

[a] TDG, outflow and spill for BONN are detected six miles downstream at Warrendale.
[b] Travel days are from the date of release.
[c] Six fish were detected beginning 19 September. Since subyearlings do not return as 0-salt fish, those fish are believed to be reservoir rearing.
[d] Detections are from the tailrace of each dam.

Table 20. Migration timing of BY15 PIT tagged yearlings released at LFH in 2017.

	Detection Facilities				
	LMO	**ICH**	**MCN**	**JDD**	**BONN[a]**
Number Detected	**6,217**	**5,064**	**3,924**	**5,635**	**930**
Mean Travel Days from LFH[b]	7	9	16	19	21
Median Passage Date	7 Apr	10 Apr	18 Apr	22 Apr	24 Apr
First Detection Date	3 Apr	4 Apr	6 Apr	8 Apr	9 Apr
Last Detection Date	5 May	12 May	7 Jun	4 Jun	28 May
10% of Run Passage Date	3 Apr	6 Apr	9 Apr	12 Apr	14 Apr
90% of Run Passage Date	19 Apr	20 Apr	29 Apr	29 Apr	3 May
TDG on Median Date of Passage (%)[c]	120.4	120.2	121.4	122.0	122.0
Outflow on Median Date of Passage (kcfs)[c]	137.7	133.1	344.8	362.8	387.8
Spill on Median Date of Passage (kcfs)[c]	60.1	92.8	220.3	115.9	179

[a] TDG, outflow and spill for BONN are detected six miles downstream at Warrendale.
[b] Travel days are from the date of release.
[c] Detections are from the tailrace of each dam.

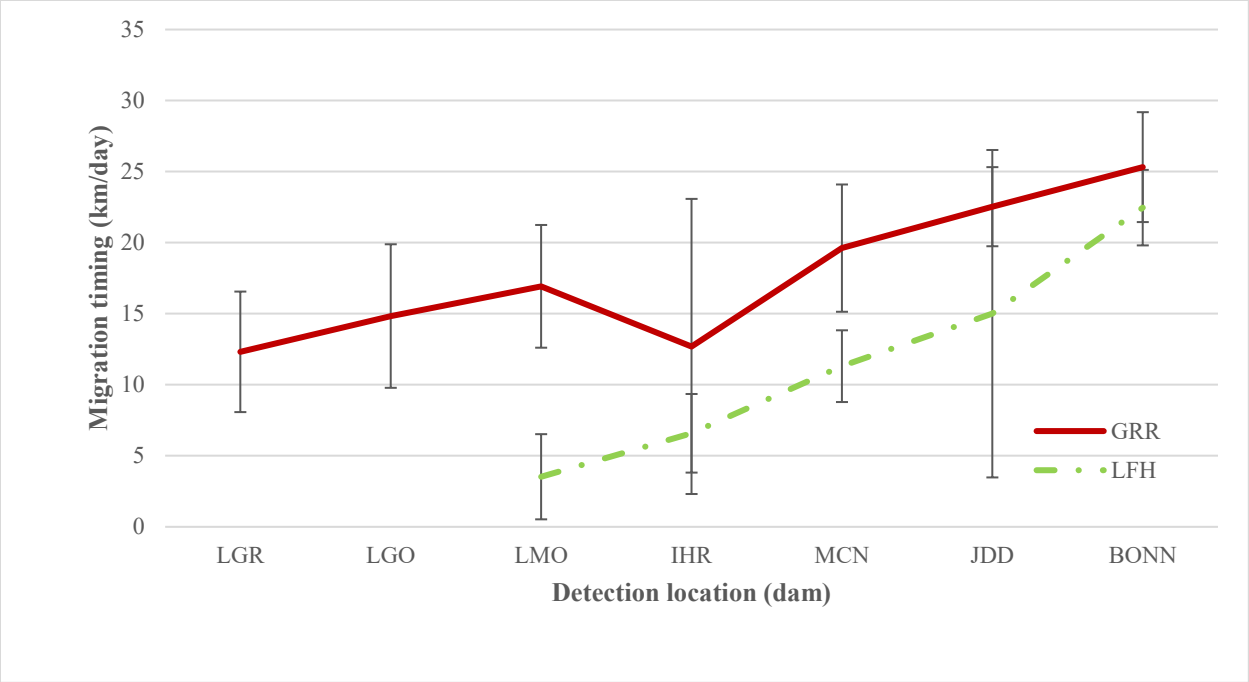


Figure 190. Migration speed of BY15 LFH and GRR subyearling fall Chinook salmon as they passed Snake and Columbia River dams in 2016.

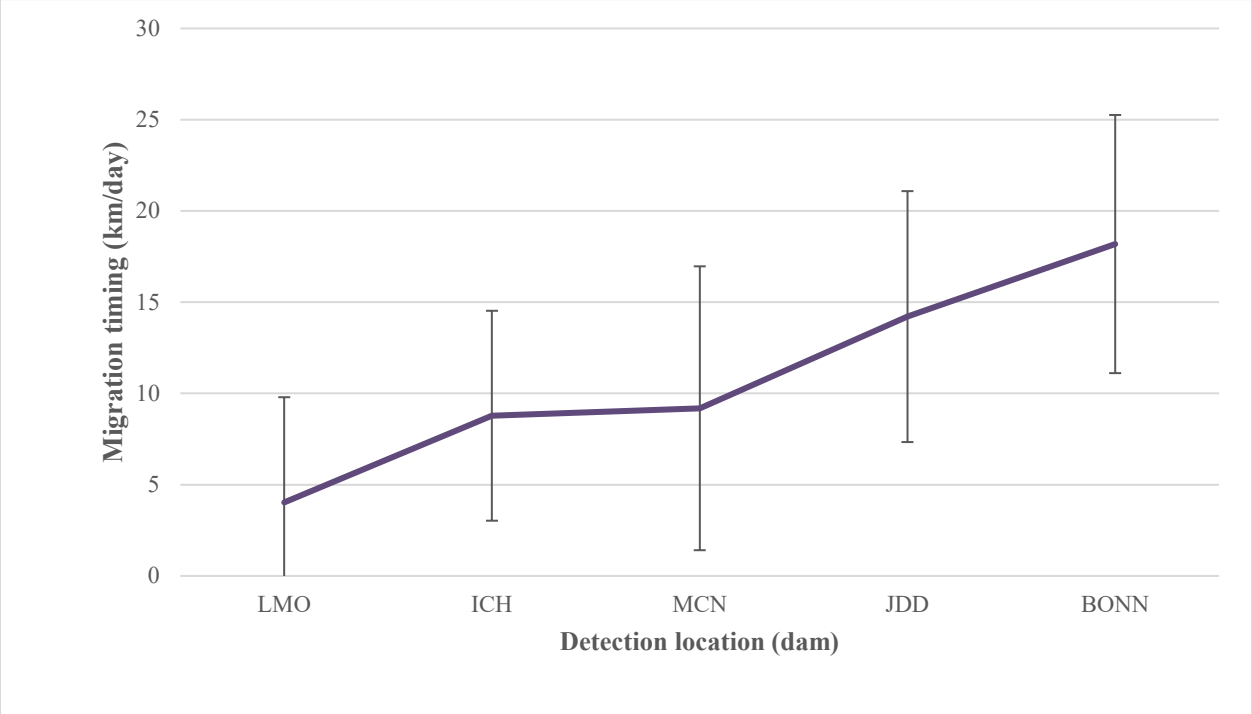


Figure 201. Migration speed of BY15 LFH yearling fall Chinook salmon as they passed Snake and Columbia River dams in 2017.

Tucannon River Natural Production 2016

Adult Salmon Surveys

Fall Chinook Salmon Redd Surveys

WDFW personnel have conducted spawning ground surveys for fall Chinook salmon on the lower Tucannon River since 1985 (Appendix M). Survey sections in 2016 covered the river from river kilometer (rkm) 1.1-33.6. The first 1.1 rkms of the Tucannon River is deep slack water from the Snake River's LMO Dam reservoir and no surveys or estimates are made for that area; the habitat is poor in this area and it is presumed no spawning occurs there. During 2016, landowner access restrictions prevented the surveying of 1.5 rkms above the Starbuck Bridge within survey sections 5 and 6 (Appendix M). Regular weekly surveys began the week of 23 October and continued until week of 27 November. Surveys were suspended for the remainder of the season due to high flows and low visibility.

A total of 207 redds (from all species) were counted in the Tucannon River (Table 21). Redd surveys typically occur through the third week of December. Due to high flows and low temperatures, the last week surveyed was the last week of November. We estimate an additional 67 redds occurred in sections of river not surveyed due to access restrictions from landowners or weeks not walked due to weather conditions. Redds built in inaccessible sections were estimated by calculating redds/km in an adjacent surveyed section and applying it to the non-surveyed area. An estimated 269 fall Chinook and 7 coho salmon redds were constructed in the Tucannon River during 2016.

Table 21. Date and number of redds and carcasses counted on the Tucannon River in 2016.

	Total redds [a]	Carcasses sampled	
Week beginning	Chinook & Coho [b]	Chinook	Coho
23 Oct	14	2	0
30 Oct	39	2	1
06 Nov	54	19	0
13 Nov	48	25	0
20 Nov	38	22	0
27 Nov	14	13	0
Totals	**207**	**83**	**1**

[a] Observed redds not expanded for sections with access restrictions.
[b] Chinook & Coho redd data estimated through visual counts were combined.
[c] High flows and low visibility prevented surveys from being completed this week.

Escapement and Composition of the Fall Chinook Salmon Run in the Tucannon River

The total escapement to the Tucannon River is based on an expansion factor of three fish/redd. We believe this expansion factor provides a conservative estimate of fish spawning in the Tucannon River. Based on that expansion, we estimated 807 fall Chinook and 21 coho salmon escaped to the Tucannon River (Table 22). We recovered 83 fall Chinook salmon carcasses (10.3%) of the estimated total spawning escapement to the Tucannon River. Coho salmon carcasses were also recovered on the Tucannon River and can be found in Appendix M.

Table 22. Estimated escapement, redd construction, and resulting estimates of smolts/redd and total number of emigrants from fall Chinook salmon spawning in the Tucannon River, 2001-2016.[a]

			Redd construction [a]			Success of spawning		
Brood year	Estimated escapement [b]	% Strays in carcasses sampled	# Redds observed	# Redds in no access areas (est.)	Total # of redds (est.)	Estimated smolts/redd [c]	Total # estimated emigrants [d]	Adult progeny to escapement ratio
2001	219	14.9	65	8	73	336	24,545	0.63
2002	630	35.1	183	27	210	81	17,030	0.05
2003	474	65.8	143	15	158	460	72,656	0.04
2004	345	29.4	111	4	115	631	72,655	0.03
2005	198	60.0	61	5	66	320	21,170	0.17
2006 [e]	460	9.7	127	26	153	289	44,296	0.04
2007	326	7.0	93	16	109	Unknown [f]	Unknown [f]	0.53
2008	763	16.5	209	45	254	20	5,030	0.03
2009 [g]	756	10.7	217	35	252	147	36,991	0.35
2010	972	27.0	281	43	324	76	24,315	0.13
2011	906	4.2	278	24	302	67	20,331	0.20 [h]
2012	1,623	4.9	256	285 [i]	541	231	124,951	0.03 [j]
2013	1,158	8.5	261	125 [i]	386	24	9,262	0.01 [k]
2014	909	10.6	265	38	303	514	155,791	Pending
2015	1,518	8.9	295	211 [i]	506	148	47,487	Pending
2016	807	6.0	202	67	269	2 [l]	538 [l]	Pending

[a] Numbers presented in this table may be different from prior reports and represent the most accurate estimates of escapement and production in the Tucannon to date.
[b] These estimates were derived using three fish per redd and no adjustments were made for super imposition of redds.
[c] This estimate was derived using redds counted above the smolt trap and estimates of emigration the following spring.
[d] This estimate was derived using the smolt per redd estimate above the trap and applying it to the total number of redds in the Tucannon River.
[e] Includes approximately 2.3% summer Chinook in escapement that contributed to production estimate.
[f] No estimate was made because the smolt trap sampling box had a hole in it and fish escaped
[g] First year of using new methodology to estimate proportion of fall Chinook salmon redds based upon proportions of fall Chinook salmon in carcass recoveries. Excludes one summer Chinook salmon redd located below the smolt trap.
[h] Estimate through age 4 returns.
[i] Adjustment includes estimates for weeks not walked due to temperature and water conditions.
[j] Estimate through age 3 returns.
[k] Estimate through age 2 returns.
[l] Low numbers are likely due to unusually high water events.

The methodology used to estimate run composition of fall Chinook salmon in the Tucannon River was modified in 2012 to account for carcass recovery bias. Generally, more recoveries of females occur than males, primarily because females remain in the vicinity of redds when they die. The numbers of females in the composition were expanded to match the estimated number of redds, presuming 1 redd/female. The remainder of the run composition was based on the origins of males and/or jacks per redd. Recovered CWT and scale analysis were used to determine the origin and age of each carcass**.** Compositions of recovered carcasses are presented in Table 23-Table 25.

Females represented 62.9% of the recoveries; primarily adult 2-salt and 3-salt fish. Tissue samples (fin clips or skin samples from the head) were collected and archived from 11 fall Chinook salmon (genetic sample numbers 16NI1, 16NI2-16NI12) and one coho salmon (16NJ21).

Table 23. Composition of wire tagged carcasses recovered and estimated run composition of fall Chinook salmon on the Tucannon River, 2016.

				Raw totals			Expanded to the run			
	Clip	CWT origin	CWT	F	M ≥53cm	M <53cm	F	M ≥53cm	M <53cm	Total
Inbasin wire fish	AD	LF11YO	636443	1	0	0	5.0	0.0	0.0	5.0
		LF12SO	636574	0	2	0	0.0	19.4	0.0	19.4
		LF12YO	636583	2	0	0	9.9	0.0	0.0	9.9
		LF12YO	636584	10	3	0	49.8	29.1	0.0	78.9
		LF13YO	636740	1	0	0	5.0	0.0	0.0	5.0
		LF13YO	636741	8	2	0	39.9	19.4	0.0	59.3
		LF14YO	636886	0	0	1	0.0	0.0	71.4	71.4
	NO	LF11YO	636443	3	1	0	14.9	9.7	0.0	24.6
		LF12SO	636574	2	0	0	9.9	0.0	0.0	9.9
		LF12SBCA	220336	1	0	0	5.0	0.0	0.0	5.0
		LF12YO	636583	8	3	0	39.9	29.1	0.0	69.0
		LF12YO	636584	1	0	0	5.0	0.0	0.0	5.0
		LF13SO	636737	1	0	0	5.0	0.0	0.0	5.0
		LF13YO	636740	8	4	1	39.9	38.8	71.4	150.1
		LF13YO	636741	1	0	0	5.0	0.0	0.0	5.0
		LF14YO	636886	0	1	0	0.0	9.7	0.0	9.7
Out-of-basin	AD	09BLANK	090909	0	1	0	0.0	9.7	0.0	9.7
		UMA11SUMA	090684	0	1	0	0.0	9.7	0.0	9.7
	NO	BONN10YUMA	090489	1	0	0	5.0	0.0	0.0	5.0
		UMA12SUMA	090684	1	0	0	5.0	0.0	0.0	5.0
		UMA12SUMA	090682	1	0	0	5.0	0.0	0.0	5.0
Totals				**50**	**18**	**2**	**249.2**	**174.6**	**142.8**	**566.6**

Table 24. Composition of untagged carcasses recovered and estimated run composition of fall Chinook salmon on the Tucannon River, 2016.

			Raw totals			Expanded to the run			
Origin	Clip	European age	F	M ≥53cm	M <53cm	F	M ≥53cm	M <53cm	Total
Hatchery	AD	0.2	0	1	0	0.0	9.7	0.0	9.7
		Unknown	1	0	0	5.0	0.0	0.0	5.0
Unknown	NO	0.1	0	0	1	0.0	0.0	71.4	71.4
		0.2	0	1	0	0.0	9.7	0.0	9.7
		0.3	0	1	0	0.0	9.7	0.0	9.7
		0.4	1	0	0	5.0	0.0	0.0	5.0
		Unknown	2	5	1	9.9	48.6	71.4	129.9
Totals			**4**	**8**	**2**	**19.9**	**77.7**	**142.8**	**240.4**

Table 25. Estimated composition of the fall Chinook salmon run to the Tucannon River by salt water age and origin, 2016.

	0 salt	1 salt		2+ salt			% of
Origin	Minijack	True jack	True jill	Adult F	Adult M	Total	return
Snake River hatchery (wire)	81.1	129.6	89.8	144.4	87.3	532.2	65.9%
Presumed Snake River hatchery (AD clip or yearling scales)	0	0	0	5.0	9.7	14.7	1.8%
Out-of-basin hatchery (wire)	0	0	0	15.0	19.4	34.4	4.3%
Unknown origin	0	142.8	0	14.9	68.0	225.7	28.0%
Totals	**81.1**	**272.4**	**89.8**	**179.3**	**184.4**	**807.0**	**100.0%**
% of return	**10.05%**	**33.75%**	**11.13%**	**22.22%**	**22.85%**		

Juvenile Salmon Emigration

Fall Chinook Salmon

Juvenile fall Chinook salmon (BY15) were observed at the Tucannon River smolt trap (rkm 3.0) from 11 January through 5 July 2016 (Figure 22). The last day of trapping before the trap was pulled for the season was 8 July (Gallinat and Ross 2017). Trapping efficiency for fall Chinook salmon ranged from 14.4% to 33.7% (Table 26). Median passage date for fall Chinook salmon was 26 May. Staff captured 6,058 fall Chinook salmon and estimate that 33,135 (95% C.I. = 29,532-37,943) naturally produced fall Chinook salmon parr and smolts passed the smolt trap during 2016. Based on 224 redds estimated above the smolt trap during 2015, an estimated 2 smolts/redd were produced. The low number is likely due to high water events. After including potential production from redds below the smolt trap in 2015, an estimated 47,487 naturally produced fall Chinook salmon parr and smolts left the Tucannon during 2016.

Staff PIT tagged 1,023 naturally produced fall Chinook salmon at the smolt trap from 12 April through 22 May 2016 to monitor the outmigration. Lengths ranged from 70-105 mm with a mean of 81 mm and median of 80 mm. Migration timing and average speed of migration of naturally produced fall Chinook salmon leaving the Tucannon River to the Snake and Columbia River dams are presented in Table 27 and Figure 23, respectively.

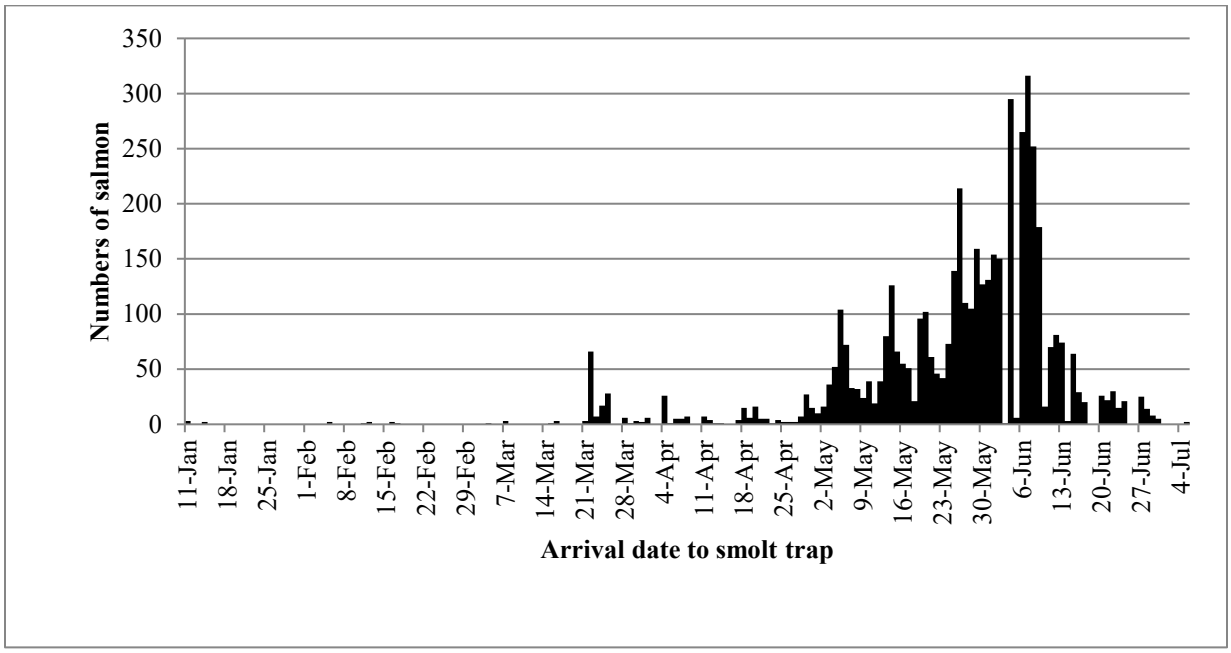


Figure 212. Distribution of the timing of juvenile natural origin fall Chinook salmon trapped on the Tucannon River in 2016.

Table 26. Trapping efficiency estimates for fall Chinook and coho salmon at the smolt trap on the Tucannon River in 2016.

Week beginning	Fall Chinook recapture efficiency	Coho recapture efficiency
20 Mar	unknown	50.0%
27 Mar	unknown	0.0%
03 Apr	unknown	0.0%
10 Apr	0.0%	25.0%
17 Apr	unknown	11.1%
24 Apr	unknown	50.0%
01 May	17.4%	23.9%
08 May	15.2%	7.1%
15 May	21.2%	0.0%
22 May	20.3%	20.0%
29 May	19.8%	0.0%
05 Jun	14.4%	0.0%
12 Jun	16.3%	unknown
19 Jun	33.7%	unknown
26 Jun	27.7%	unknown
03 Jul	0.0%	unknown

Table 27. Migration timing of naturally produced fall Chinook salmon leaving the Tucannon River in 2016.

	Detection Facilities				
	LMO	**ICH**	**MCN**	**JDD**	**BONN[a]**
Number Detected	**134**	**88**	**88**	**39**	**18**
Mean Travel Days from TUC[b]	2	6	12	20	20
Median Passage Date	17 May	24 May	27 May	3 Jun	7 Jun
First Detection Date	5 May	10 May	8 May	18 May	17 May
Last Detection Date	27 May	6 Jun	11 Jun	22 Sep	16 Jun
10% of Run Passage Date	7 May	15 May	7 May	22 May	18 May
90% of Run Passage Date	23 May	26 May	5 Jun	8 Jun	12 Jun
TDG on Median Date of Passage (%)[c]	116.9	116.7	113.3	114.3	115.5
Outflow on Median Date of Passage (kcfs)[c]	71.6	90.2	202.7	178.5	249.9
Spill on Median Date of Passage (kcfs)[c]	42.0	35.8	81.7	54.1	100.1

[a] TDG, outflow and spill for BONN are detected six miles downstream at Warrendale.
[b] Travel days are from the date of release.
[c] Detections are from the tailrace of each dam.

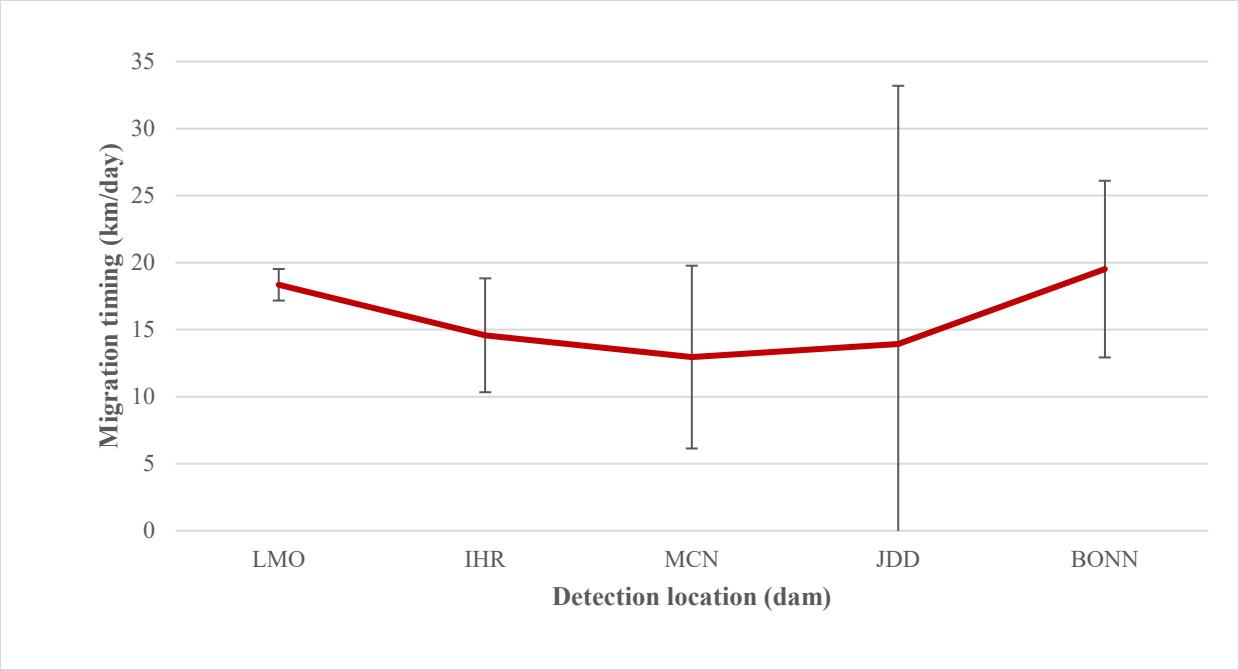


Figure 223. Migration speed of BY14 Tucannon River natural origin fall Chinook salmon s in 2016.

Fall Chinook Salmon Run Size and Composition 2016

Returns to LGR and Composition of Fish Returning to LGR

Chinook salmon (all runs) were counted 24 hours per day 15 June through 30 September and 16 hours per day from 1 October through 31 December at the counting window at LGR (U.S. Army Corps of Engineers, 2016). Fish are measured by total length (TL) at fish passage windows. Window counts (day and night) estimated 47,080 fall Chinook salmon (≥ 30 cm TL) reached LGR in 2016 (Figure 24), which includes 12,366 "jacks" by size (30 cm-55 cm TL). Chinook passing LGR after 17 August are designated as fall Chinook salmon based on arrival date, which may be inaccurate because of the overlap between the fall and summer Chinook salmon runs. In addition, fish counts do not include fish less than 30 cm long, or adjust for fish that crossed the dam and fell back through the juvenile bypass system, spillway, turbines, or locks, some of which may have reascended the ladder and were double counted.

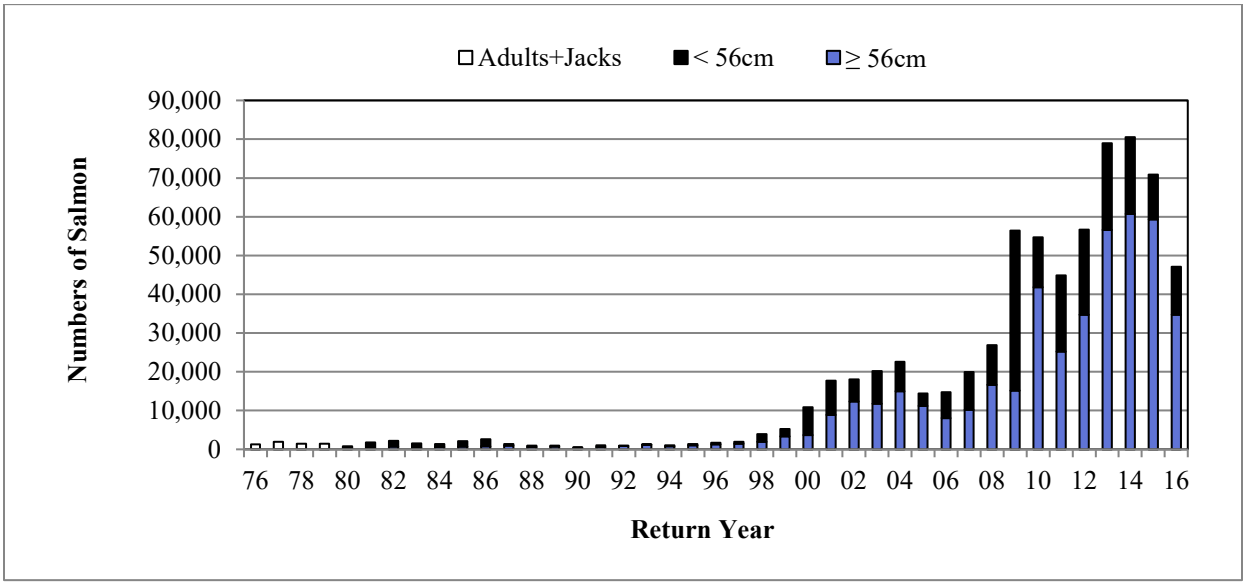


Figure 234. Fall Chinook salmon window counts at LGR, 1976-2016.

The fall Chinook salmon run reconstruction technical team estimated 45,062 fall Chinook salmon (24.3% wild, 75.0% inbasin hatchery, and 0.7% out of basin hatchery) reached LGR in 2016 (Table 28), after accounting for reascension and fallback. The final run estimate to LGR was 4.3% less than window count estimates documented at www.fpc.org. The fall Chinook salmon run reconstruction technical team consists of staff from NPT, WDFW, IPC, NOAA, and the Columbia River Inter-Tribal Fish Commission (CRITFC). The estimates were bootstrapped by Ben Sandford of NOAA and confidence intervals were derived for the dataset. Females, regardless of size, were summarized together and males were summarized according to fork length (30 cm - <53 cm and ≥ 53 cm). Data was grouped by total age as requested by TAC. The data does not specifically show true jacks because age 2 fish consist of minijacks (0-salt yearlings) and jacks (1-salt subyearlings) and age 3 fish consist of jacks (1-salt yearlings) and adults (2-salt subyearlings).

Table 28. Estimated composition, standard errors, and confidence intervals for fall Chinook salmon reaching LGR during 2016.

Estimates					Bootstrap standard error					Bootstrap 95% Confidence Interval Upper CI, Lower CI				
Total Run by Origin														
Origin	**F**	**M ≥53cm**	**M <53 cm**	**Total ≥53cm**	**Origin**	**F**	**M ≥53 cm**	**M <53 cm**	**Total ≥53cm**	**Origin**	**F**	**M ≥ 53cm**	**M <53 cm**	**Total ≥53 cm**
Total wild	4456	5285	1194	9741	Total wild	342	406	276	515	Total wild	3732, 5020	4444, 6054	597, 1693	8693, 10680
Total hatchery	13033	14643	6451	27676	Total hatchery	366	412	298	511	Total hatchery	12325, 13757	13871, 15503	5902, 7085	26688, 28730
Totals	17489	19928	7645	37417	Totals	229	240	169	177	Totals	17005, 17928	19482, 20397	7320, 7989	37059, 37755
Run by origin and age														
Origin	**F**	**M ≥53cm**	**M <53 cm**	**Total ≥53cm**	**Origin**	**F**	**M ≥53cm**	**M <53cm**	**Total ≥53cm**	**Origin**	**F**	**M ≥53cm**	**M <53 cm**	**Total ≥53 cm**
Wild age 2	67	310	1019	377	Wild age 2	20	106	278	108	Wild age 2	32, 109	73, 497	423, 1510	143, 567
Wild age 3	1069	3343	170	4412	Wild age 3	148	312	31	354	Wild age 3	763, 1360	2699, 3942	119, 241	3670, 5087
Wild age 4	2517	1592	6	4109	Wild age 4	286	249	6	369	Wild age 4	1965, 3043	1114, 2093	0, 21	3386, 4845
Wild age 5	764	28	0	792	Wild age 5	157	127	0	203	Wild age 5	429, 1050	-243, 254	0, 0	354, 1150
Wild age 6	39	12	0	51	Wild age 6	14	8	0	16	Wild age 6	11, 65	0, 29	0, 0	17, 80
Hat age 2	20	735	6007	755	Hat age 2	13	148	332	149	Hat age 2	0, 47	467, 1045	5348, 6714	484, 1061
Hat age 3	1682	7342	405	9024	Hat age 3	185	384	110	439	Hat age 3	1319, 2041	6604, 8156	210, 648	8176, 9883
Hat age 4	8288	5071	40	13359	Hat age 4	345	342	42	479	Hat age 4	7649, 8975	4426, 5722	0, 145	12409, 14346
Hat age 5	2863	1327	0	4189	Hat age 5	218	192	0	288	Hat age 5	2449, 3321	970, 1716	0, 0	3642, 4776
Hat age 6	28	0	0	28	Hat age 6	15	0	0	15	Hat age 6	1, 61	0, 0	0, 0	1, 61
Stray age 2	0	0	0	0	Stray age 2	0	0	0	0	Stray age 2	0, 0	0, 0	0, 0	0, 0
Stray age 3	21	0	0	21	Stray age 3	14	0	0	14	Stray age 3	0, 52	0, 0	0, 0	0, 52
Stray age 4	72	123	0	195	Stray age 4	25	41	0	47	Stray age 4	20, 114	47, 211	0, 0	100, 292
Stray age 5	31	15	0	46	Stray age 5	19	16	0	24	Stray age 5	10, 78	0, 60	0, 0	10, 104
Stray age 6	10	0	0	10	Stray age 6	11	0	0	11	Stray age 6	0, 41	0, 0	0, 0	0, 41
StrayAWT	20	30	0	50	StrayAWT	14	22	0	26	StrayAWT	0, 51	0, 86	0, 0	10, 114
Stray Wild	0	0	0	0	Stray Wild	0	0	0	0	Stray Wild	0, 0	0, 0	0, 0	0, 0

[a] AWT refers to agency wire tag with a 09 agency code.

Fallbacks at the LGR Juvenile Collection Facility

A total of 2,742 fallback events were counted at the juvenile collection facility (Table 29) and the separator (Table 30) located below LGR. These fallback events occur when fish encounter the traveling screens that bypass fish away from the turbines and shunt them to the juvenile collection facility. Fish can also fallback over the spillway, go through the turbine slot or navigation lock, but we did not estimate fallback for those routes.

Table 29. Documented fallbacks of Chinook salmon at the LGR juvenile collection facility during 2016 by clip and wire.

Run	Clip	Wire	<30cm	30-53cm [a]	Grand total
Chinook [b]	AD	No wire	1	0	1
		Wire	0	3	3
		Unknown	7	214	221
	No clip	No wire	0	1	1
		Wire	2	10	12
		Unknown	4	286	290
Fall Chinook salmon total			**14**	**514**	**528**

[a] Category does not differentiate males from females, although they are likely males.
[b] The run of Chinook is not identified during sampling and may include summer run Chinook.

Fish encountered at the juvenile separator were examined for size, fin clips, and operculum punches. Of the fish < 53 cm, at least 36.6% were hatchery origin, although we expect the actual number of hatchery fish was greater because unclipped fish were not scanned for wire at the separator. Likewise, at least 40.5% of the fish ≥ 53 cm were of hatchery origin based solely on adipose clips.

Table 30. Composition of fallbacks of Chinook at the LGR separator in 2016 by clip and length.

Clip	<53cm [a]	≥53 cm [a]	Grand total
AD Clip	328	534	862
No Clip	568	784	1352
Grand Total	**896**	**1,318**	**2,214**

[a] Category includes males and females.

Characteristics of fall Chinook salmon reaching LGR Dam

The following data summaries derived from the fall Chinook salmon handled at the LGR adult trap. These data include hatchery and natural origin fall Chinook salmon.

Sex Ratio

The estimated 2016 return, based on run reconstruction estimates, consisted of 61.5% males, including jacks. The sex ratio of the return based on the trap sample was calculated at 1.6 males+jacks/female. After removal of fish for broodstock, fish passing LGR were 71.4% males resulting in 2.5 males+jacks/female.

Length Frequencies

Salmon trapped at LGR were measured and numbers of fish at each length were expanded by the trapping rate on the day they were captured to represent the overall run at that size during that day (Figure 25). Median fork length for males and females was 61 cm and 77 cm, respectively.

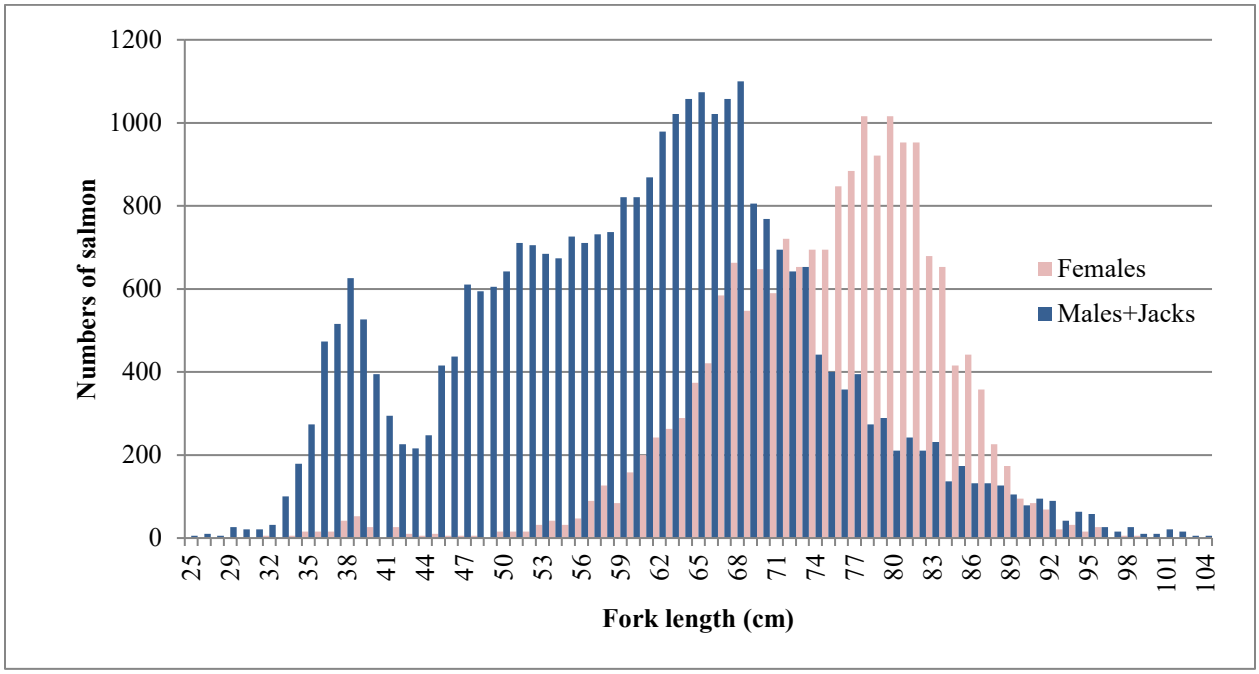


Figure 245. Estimated length frequencies of the fall Chinook salmon run to LGR by sex in 2016.

Fallback Rates of Onstation Releases at LGR

Fallback rates for fall Chinook salmon that are released onstation at LFH (both yearling and subyearling) are being assessed through a fidelity and fallback radio telemetry study that is scheduled to run through 2017. Results of fallback rates for LFH onstation releases, as well as other inbasin fall Chinook salmon, will be presented once the study is completed.

Status of Mitigation Requirements

Overall Mitigation Level

To estimate the overall mitigation return, certain caveats of the data are required. Salt water age was estimated by subtracting 1 from the total age of subyearlings and subtracting 2 from the total age of yearlings. These estimates underestimate jacks and overestimate adults because they do not take into account reservoir rearing of the subyearling component. Estimated recoveries of WDFW releases outside of the Snake River are fully expanded, but the FCAP recoveries only include CWT recoveries and are not expanded to account for untagged fish associated with those groups or adjusted for detection method. Mitigation numbers presented in this report are therefore considered minimum estimates. The Regional Mark Processing Center (RMPC) website, www.rmpc.org, was queried on 21 December 2017 for the 2016 returns of CWT tagged fish associated with the LSRCP (FCAP and WDFW releases).

A minimum estimated 26,163 (28.6%) of the total LSRCP mitigation goal of 91,500 fish was achieved in 2016. An additional 7,047 fall Chinook salmon were recovered outside of the Snake River basin.

Returns to the Project Area

The LSRCP mitigation goal of 18,300 fish returning to the Snake River was exceeded in 2016 (Table 31). An estimated 19,116 (104% of the LSRCP project goal) fall Chinook salmon (adults+jacks) returned from WDFW and FCAP releases into the Snake River. Combining recoveries of fish harvested below LGR, killed at LFH, the carcasses recovered on Tucannon River and the estimated run to LGR provides the best estimate of mitigation returns (tagged and untagged fish). These estimates do not include inbasin hatchery returns from the IPC and the NPTH programs.

Harvest in the Project area

In 2016, anglers in Washington were allowed a daily harvest of six adipose-clipped adult fall Chinook salmon and six jacks. In Idaho, anglers were also allowed a daily limit of six adipose-clipped adults, but there were no limits (number or fin clips) for jack retention in Idaho.

On the Snake River (Washington and Idaho combined), there were 609 CWT recoveries (expanded or not expanded)reported in the Regional Mark Information System (RMIS) database from LSRCP and FCAP releases, with 12 captured below LGR (Table 32). IDFG did not report expanded harvest estimates and Tribal harvest was not reported at all.

Table 31. Estimated returns of LSRCP (WDFW and FCAP) fall Chinook salmon to the Snake River and levels of mitigation goals met in 2016.

	Saltwater age								
	0-salt	1-salt			2-5 salt				
Location	Mini-jack [a]	Jack[b]	Jill[c]	Unknown sex	Adult F	Adult M	Unknown sex	Total (Adult +Jack)	% of LSRCP goal to the Snake River
Harvested FCH below LGR [d]	0	0	0	10	0	0	2	12	0.1
Run to the Tucannon R.	81	130	90	0	149	97	0	547	2.5
Run to LGR [e] (wire+nowire)	2,489	4,749	185	0	7,193	6,430	0	18,557	101.4
Total	**2,570**	**4,879**	**275**	**10**	**7,342**	**6,430**	**2**	**19,116**	**104.0**

[a] Minijacks are males that did not spend a year in salt water.
[b] Jacks are males that spent 1 year in salt water.
[c] Jills are females that spent 1 year in salt water.
[d] Harvest includes recoveries of fish released by WDFW and FCAP.
[e] Estimated run to LGR for LSRCP (includes surrogates part of the transportation study) and FCAP releases and includes fish hauled to LFH and NPTH for processing as well as fish released from the dam.

Table 32. Unexpanded Snake River basin recoveries in 2016 of wire tagged fall Chinook salmon released by WDFW as reported to RMIS. Estimates include LSRCP and FCAP releases.

		0-salt	1-salt	2+salt	Total OBSD	% Catch
Freshwater sport location		Minijack				by location
Below LGR	Snake R Mouth-IHR	0	0	0	0	0
	Snake R IHR-LMO	0	0	0	0	0
	Snake R LMO-LGO	0	0	2	2	0.3
	Snake R LGO -LGR	0	10	0	10	1.6
Above LGR	Snake R basin above LGR	5	91	501	597	98.0
Totals		**5**	**101**	**503**	**609**	

Recoveries Outside of the Snake River Basin

Approximately 7,047 (9.6%) of the 73,200 downriver fish harvest goal was met through returns from LSRCP and FCAP releases in 2016. An estimated 5,966 salmon (8.2% of the harvest goal) were harvested outside of the Snake River Basin from WDFW releases (onstation at LFH, CCD, and GRR) after expanding for sampling methodologies reported and including associated untagged fish estimated in catches (fully expanded estimates). An additional 1,081 CWT tagged fish (adults and jacks) from FCAP releases were reported to RMIS (not fully expanded for untagged fish harvested or adjusted for detection method), although we do not include them further in this report.

Estimates of harvest for fish released by WDFW are listed in Table 33 – Table 35 and do not include recoveries of fish released by the NPT (LSRCP-FCAP or NPTH programs) or ODFW or IDFG (IPC program).

Outside of the Snake River Basin, the majority (51.0 %) of recoveries reported to RMIS occurred in saltwater locations and 49.0% occurred in freshwater locations, with 69.1% coming from commercial/tribal fisheries, 29.7% from sport fisheries, 0.8% from spawning ground surveys on the Hanford reach, and 0.4% were from hatcheries. Harvest primarily occurred in the ocean off the coasts of Washington, British Columbia, and Oregon, but the single largest fishery contributor to harvest was the Zone 6 Tribal Gillnet fishery which accounted for 23.5% of all the fish harvested in 2016.

Harvest Adjustments for Non-Selective Fisheries and Errors in Reporting Detection Method

Non-selective fisheries retain any fall Chinook salmon captured, and include all the current commercial and tribal net fisheries. The Washington and Oregon sport fisheries in the Columbia River, and Canadian and Alaskan sport fisheries are also non-selective. The only mark selective fisheries impacting the Snake River fall Chinook salmon is in the Snake River Basin. The RMIS database was used to generate estimated (ESTD) harvest data of CWT tagged fish. Fish without CWTs are not reported to RMIS and therefore the CWT harvest estimates must be expanded by their associate release groups to reflect total harvest for mitigation purposes. Adjustments to RMIS harvest data were calculated differently based upon CWT detection methods listed below.

Proofing Data Reported to RMIS for Errors Regarding Detection Method

Since onstation yearling releases at LFH consist of two different tag codes and mark types each year, it is possible to determine if reporting agencies are accurately reporting detection methods. For instance, if a fishery is non-selective and detection method is reported as visual, it would be expected that only tag codes associated with AD clipped fish would be reported. In 2016, many of the fisheries (particularly sport and Columbia River gillnet) only report as visual. This type of reporting under estimates harvest in those fisheries, because if the sampling was electronic, there would not be any expansions done for unclipped fish with a tag code. Extensive comparisons and adjustments were performed to assure fish contributing to LSRCP mitigation were accounted

for. This was validated by looking at ocean fisheries where ADCWT groups were caught at similar rates as CWT only groups for each brood year. This was also confirmed by comparing run reconstruction estimates by brood year, and clip. Corrections for this reporting were done using the following formula:

For each run year: Corrected CWT only harvest of tag code #1 by fishery and brood year=(ESTD harvest of ADCWT tag code #2/Total number of tag code # 2 wires released)*(Total number of tag code #1 wires released)

Next we expand the total number of wires to include untagged fish using the methods described in the following sections for non-selective fisheries.

Expansions to Account for Untagged Fish Harvested in Non-Selective Fisheries

Visual Detection Method

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

ESTD CWTs harvested by fisheries from RMIS x (total # released that were associated with a tag code/# ADCWT in the release) = Revised ESTD total harvest

Electronic Detection Method

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

ESTD CWTs harvested by fisheries from RMIS x (total # released that were associated with a tag code/(# ADCWT in the release + # CWT in the release) = Revised ESTD total harvest

Adjustment summary

For WDFW releases, Columbia River harvest estimated harvest was increased by a factor of 1.38, primarily because of misreporting fish as electronically detected when it appears that they were visually detected. Estimated ocean harvest was increased by a factor of 1.10, primarily due to AK and BC reporting as visually detected. The overall adjustment resulted in 1,092 more fish harvested than were reported to RMIS, if only the ESTD were summed, and no expansions were made for untagged fish harvested.

Table 33. Fully expanded recovery estimates of tagged and untagged fall Chinook salmon recovered in the Columbia River Basin (freshwater areas) during 2016 for WDFW releases. Jacks and minijacks included in the estimates.

		Yearlings			Subyearlings							Total recoveries	
		LFH			LFH		CCD		GRR				
Recovery area	Fishery/ Hatchery/ River	EST CWT	EST CWT adj [a]	Total EST wire+ no wire[b]	EST CWT	EST wire+no wire	EST CWT	EST wire+no wire	EST CWT	EST wire+no wire	Total EST wire+no wire[b]	Grand Total EST CWT	Grand Total EST wire+no wire
COL R Gillnet	Zone 6 Tribal Net	510	1,008	1,011	217	217	84	85	109	109	411	920	1,422
	Zone 1-5 Non-tribal Net	228	458	459	98	98	48	48	52	52	199	426	658
COL R Sport	Zone 1-5 Sport	190	250	251	37	37	10	10	39	39	86	276	337
Commercial Seine	Zone 1-5 Commercial Seine	21	21	21	6	6	1	1	1	1	8	29	29
Estuary Sport	COL R Estuary	268	268	268	51	51	16	16	22	22	89	357	357
Freshwater	Drano Lk	17	34	34	0	0	0	0	0	0	0	17	34
Sport	COL R-Hanford Reach	4	4	4	7	7	0	0	7	7	14	18	18
	Little White Salmon R	8	16	16	0	0	0	0	0	0	0	8	16
	Mid-Columbia R Sport	7	7	7	2	2	0	0	1	1	3	10	10
Hatchery	Chief Joseph	10	10	10	0	0	0	0	5	0	0	15	10
	Priest Rapids	1	1	1	2	2	0	0	4	4	6	7	7
	Bonneville (ODFW)	8	8	8	0	0	0	0	0	0	0	8	8
	Salmon R (ODFW)	1	2	2	0	0	0	0	0	0	0	1	2
Spawning Ground	Chelan R	0	0	0	4	4	0	0	0	0	4	4	4
	COL R-Hanford Reach	0	0	0	0	0	0	0	42	42	42	42	42
	Lewis R	2	2	2	0	0	0	0	0	0	0	2	2
River Seine (non-Columbia)	River Seine (non-Columbia)	2	4	4	0	0	0	0	0	0	0	2	4
	Totals	**1,277**	**2,094**	**2,098**	**424**	**424**	**159**	**160**	**282**	**277**	**862**	**2,142**	**2,960**

[a] Estimate adjusted for unclipped CWT fish caught in nonselective fisheries using visual detection method and electronic detections where unclipped CWT fish were not harvested at the same rate as the ADCWT fish

[b] Estimate adjusted for untagged fish caught in nonselective fisheries.

Table 34. Fully expanded recovery estimates of tagged and untagged fall Chinook salmon in areas outside of the Snake River Basin (saltwater areas) during 2016 for WDFW releases. Jacks and minijacks are included in the estimates.

		Yearlings			Subyearlings							Total recoveries	
		LFH			LFH		CCD		GRR				
Region	Fishery	EST CWT	EST CWT adj	Total EST wire + no wire	EST CWT	EST wire + no wire	EST CWT	EST wire + no wire	EST CWT	EST wire + no wire	Total EST wire + no wire	Grand Total EST CWT	Grand Total EST wire + no wire
AK	Ocean Gillnet	2	4	4	0	0	0	0	0	0	0	2	4
	Ocean Seine	8	16	16	3	3	0	0	0	0	3	11	19
	Ocean Sport	7	10	10	9	9	0	0	7	7	16	23	26
	Ocean Troll	90	176	176	58	58	55	55	31	31	144	234	320
BC	Ocean Sport	3	3	3	0	0	0	0	0	0	0	3	3
	Ocean Troll	629	629	629	146	146	89	89	69	69	304	933	933
	Sport (private)	156	314	315	99	99	26	26	36	36	161	317	476
CA	Ocean Troll	3	6	6	0	0	0	0	0	0	0	3	6
	Sport (private)	12	24	24	0	0	0	0	0	0	0	12	24
HS	Trawl (CA/OR/WA)	3	3	3	0	0	0	0	1	1	1	4	4
OR	Estuary Sport	1	1	1	0	0	0	0	1	1	1	2	2
	Ocean Sport	25	25	25	0	0	0	0	0	0	0	25	25
	Ocean Troll	163	163	163	8	8	12	12	6	6	26	189	189
WA	Ocean Sport	394	394	394	35	35	2	2	35	35	72	466	466
	Treaty Troll	306	306	306	27	27	21	21	18	18	66	372	372
	Ocean Troll (non-treaty)	147	147	147	35	35	17	17	16	16	68	215	215
	Totals	**1,949**	**2,221**	**2,223**	**420**	**420**	**222**	**222**	**220**	**220**	**862**	**2,811**	**3,085**

Table 35. Fully expanded recovery estimates (tagged and untagged) of 2016 returns by region, rear type, and release location for fall Chinook salmon released by WDFW. Jacks and minijacks are included in the estimates.

	Yearlings		Subyearlings								Yearlings and Subyearlings combined	
	LFH		LFH		CCD		GRR		Total subyearlings			
Region	ESTD wire+no wire	Recovery comp by region %	ESTD wire+no wire	Recovery comp by region %	ESTD wire+no wire	Recovery comp by region %	ESTD wire+no wire	Recovery comp by region %	ESTD wire+no wire	Recovery comp by region %	ESTD wire+no wire	Recovery comp by region %
COL R.(freshwater)	2,098	49%	424	50%	160	42%	277	56%	861	50%	2,959	49%
AK	206	5%	70	8%	55	14%	38	8%	163	9%	369	6%
BC	947	22%	245	29%	115	30%	105	21%	465	27%	1,412	23%
CA	30	1%	0	0%	0	0%	0	0%	0	0%	30	0%
COL R (marine)	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
HS	3	0%	0	0%	0	0%	1	0%	1	0%	4	0%
OR	189	4%	8	1%	12	3%	7	1%	27	2%	216	4%
WA	847	20%	97	11%	40	10%	69	14%	206	12%	1,053	17%
Total recoveries	**4,320**		**844**		**382**		**497**		**1,723**		**6,043**	
Recoveries by rear type	**71%**								**29%**			

Total Age of Yearling and Subyearlings Recovered Outside of the Snake River Basin

The Columbia River was the primary area fish were recovered outside of the Snake River for both yearling and subyearling production groups (Table 36-Table 39). Fish from ADCWT yearling production and ADCWT subyearling production released into the Snake River at LFH were primarily recovered as age 4 fish, subyearlings from CCD production were recovered as age 2 fish and subyearlings released into the GRR were recovered as age 3 fish. Adjustments were not made to the original data presented by RMIS as ESTD in the tables below and do not include untagged fish.

Table 36. Final locations of ADCWT yearling fall Chinook salmon released onstation at LFH to areas outside of the Snake River basin in 2016 by total age, based on estimated recoveries reported to RMIS as of 12/21/17.

Brood year: Total age: Tag code: ADCWT at release: Total released (wires+nowire):	2013 3 (Jack) 636741 219,396 227,447	2012 4 636584 247,714 250,892	2011 5 636444 240,413 243,649	2010 6 636080 246,918 249,062	A+J Totals	Non-Snake R. recovery location comp %
AK	2	22	77	6	107	4.9%
BC	21	316	164	6	507	23.0%
CA	8	4	3	0	15	0.7%
COL	211	594	208	5	1018	46.3%
HS	0	1	0	0	1	0.0%
OR	1	81	16	0	98	4.5%
WA	83	312	60	0	455	20.7%
Grand Total	326	1,330	528	17	2,201	
Percent of recoveries out-of-basin	**14.8%**	**60.4%**	**24.0%**	**0.8%**		

Table 37. Final locations of ADCWT subyearling fall Chinook salmon released onstation at LFH to areas outside of the Snake River Basin in 2016 by total age, based on estimated recoveries reported to RMIS as of 12/21/17.

Brood year: Total age: Tag code: ADCWT at release: Total released (wires+nowire):	2014 2 (Jack) 636882 189,788 219,359	2013 3 636737 203,004 209,972	2012 4 636574 210494 211,599	2011 5 636417 198,228 200,900	A+J Totals	Non-Snake R. recovery location comp %
AK	0	5	57	8	70	8.3%
BC	0	73	158	14	245	29.0%
CA	0	0	0	0	0	0.0%
COL	22	143	242	17	424	50.2%
HS	0	0	0	0	0	0.0%
OR	0	3	5	0	8	0.9%
WA	0	20	75	2	97	11.5%
Grand Total	22	244	537	41	844	
Percent of recoveries out-of-basin	**2.6%**	**28.9%**	**63.6%**	**4.9%**		

Table 38. Final locations of ADCWT subyearling fall Chinook salmon released into the Snake River near Couse Creek to areas outside of the Snake River Basin in 2016 by total age, based on estimated recoveries reported to RMIS as of 12/21/17.

Brood year:	2012	2011	2010		Non-Snake R. recovery location comp
Total age:	2 (Jack)	3	4		
Tag code:	636575	636418	635997		
ADCWT at release:	202,159	194,955	200,945	A+J	
Total released (wires+nowire):	205,300	199,300	202,300	Totals	%
AK	55	0	0	55	14.5%
BC	108	7	0	115	30.3%
CA	0	0	0	0	0.0%
COL	155	0	3	158	41.6%
HS	0	0	0	0	0.0%
OR	12	0	0	12	3.2%
WA	39	1	0	40	10.5%
Grand Total	369	8	3	380	
Percent of recoveries out-of-basin	**97.1%**	**2.1%**	**0.8%**		

Table 39. Final locations of ADCWT subyearling fall Chinook salmon released into the Grande Ronde to areas outside of the Snake River Basin in 2016 by total age, based on estimated recoveries reported to RMIS as of 12/21/17.

Brood year:	2014	2013	2012	2011	2010	2009		Non-Snake R.
Total age:	2 (Jack)	3	4	5	6	7		recovery
Tag code:	636883	636739	636576	636419	635999	635182		location
ADCWT at release:	199,938	191,711	216,159	192,996	199,460	197,252	A+J	comp
Total released (wires+nowire):	456,101	403,926	400,543	384,000	397,428	386,840	Totals	%
AK	0	7	29	2	0	0	38	7.6%
BC	0	47	51	7	0	0	105	20.9%
CA	0	0	0	0	0	0	0	0.0%
COL	18	142	87	27	3	5	282	56.2%
HS	1	0	0	0	0	0	1	0.2%
OR	1	2	4	0	0	0	7	1.4%
WA	6	18	45	0	0	0	69	13.7%
Grand Total	26	216	216	36	3	5	502	
Percent of recoveries out-of-basin	**5.2%**	**43.0%**	**43.0%**	**7.2%**	**0.6%**	**1.0%**		

Estimated Returns to the Snake River using PIT tags and CWTs

PIT tags have been used inseason to assist with estimating returns to the Snake River and to estimate returns to areas below LGR. Over the years, broodstock trapping protocols have focused more on LGR in an effort to increase natural origin fish in broodstock, and less on trapping at LFH. With these changes, fish homing to LFH may not be fully estimated using only returns to the Tucannon River and trapping at LGR because the fish might be remaining in the reservoir waiting for entry into LFH. In addition, fish less than 30 cm FL (mini-jacks – generally all from the yearling programs) are not counted at LGR nor are the traps equipped to contain these fish. To fully monitor returns, PIT tags will be used to assess all age classes, regardless of size.

To address these concerns, we compared two methods of estimating returns to the Snake River: 1) PIT tag detections at return and 2) estimated returns of CWT fish. PIT tag detections of our onstation releases were downloaded 19 July 2017 from www.ptagis.org. Comparisons of estimates of returns from juveniles released as yearlings are presented in Table 40 and Table 41 and Figure 26. Subyearlings are presented in Table 42 and Table 43 and Figure 27. Data highlighted in red (CWT tables) are based on fish sampled in 2013, during the last 40% of the return due to delays at LGR caused by warm water temperatures which prevented trapping, and may therefore be biased.

By using PIT tagged returns of yearling fall Chinook salmon released at LFH, we estimated on average 5.2 times and 4.2 times greater return estimates of 0-salt and 1-salt fish, respectively. Conversely, 0.8 times less return of 2+salt fish were estimated using PIT tags compared to estimates using conventional CWT estimates when all years were combined. This is the fifth year of returns from the PIT tagged subyearlings released at LFH. Total survival for subyearlings using PIT tags resulted in 0.8 times less 1-salts and 0.7 times less 2+salt fish, when all the years were combined, than estimated by using CWTs.

Table 40. Return and survival estimates to the Snake River for yearling fall Chinook salmon released at LFH estimated using PIT tag detections in the Snake River through 2016.

Brood year	0-salt	1-salt	2-salt	3-salt	4-salt	Total Return to Date (1-4 salts)
2006	4.0%	1.7%	0.8%	0.0%	0.0%	2.5%
	18,284	7,728	3,601	201	-	11,530
2007	0.4%	0.7%	0.3%	0.1%	0.0%	1.1%
	1,804	3,319	1,413	289	17	5,039
2008	0.6%	0.9%	0.5%	0.0%	0.0%	1.4%
	2,788	4,439	2,344	160	-	6,942
2009	0.4%	0.5%	0.4%	0.1%	0.0%	1.0%
	2,018	2,313	1,925	543	0	4,781
2010	0.4%	1.3%	0.9%	0.1%	0.0%	2.3%
	2,102	6,321	4,532	410	0	11,263
2011	0.6%	0.9%	1.0%	0.1%	-	2.0%
	2,900	4,458	5,078	318		9,855
2012	0.5%	0.4%	0.3%	-	-	0.7%
	2,684	1,857	1,418			3,275
2013	0.6%	0.8%	-	-	-	0.8%
	3,116	3,697				3,697
2014	0.8%	-	-	-	-	0.0%
	3,901					0
Average	0.92%	0.90%	0.60%	0.07%	0.00%	1.31%
	4,400	4,267	2,902	320	6	6,265

Table 41. Return and survival estimates to the Snake River for yearling fall Chinook salmon released at LFH estimated using CWT recoveries and return estimates of live fish through 2016. Cells highlighted in red indicate possible biased data due to trapping restrictions during 2013.

Brood year	0-salt	1-salt	2-salt	3-salt	4-salt	Total return to date (1-4 salts)	Total release (wire+nowire)	Tag codes
2006	0.7%	2.2%	0.9%	0.0%	0.0%	3.1%	459,634	634092
	3,435	10,188	4,103	160	0	14,451		633987
2007	0.1%	0.5%	0.6%	0.1%	0.0%	1.2%	455,152	634680
	420	2,241	2,688	321	1	5,251		634681
2008	0.1%	0.6%	0.4%	0.1%	0.0%	1.1%	478,852	635165
	531	3,014	2,114	279	0	5,407		635166
2009	0.2%	0.5%	0.6%	0.1%-	0.0%	1.2%	463,729	635510
	1,097	2,165	2,948	298	0	5,411		635564
2010	0.2%	1.0%	0.7%	0.2%	0.0%	1.8%	490,000	636079
	1,128	4,842	3,387	742	20	8,992		636080
2011	0.7%	0.4%	0.7%	0.1%	-	1.2%	489,500	636443
	3,658	1,818	3,248	682		5,748		636444
2012	0.4%	0.3%	0.3%	-	-	0.6%	503,273	636583
	1,922	1,427	1,403			2,830		636584
2013	0.1%	0.2%	-	-	-	0.2%	452,373	636740
	436	881				881		636741
2014	0.2%	-	-	-	-	-	487,177	636885
	745							636886
Average	0.30%	0.71%	0.60%	0.10%	0.00%	1.30%		
	1,486	3,322	2,842	414	4	6,121	475,521	

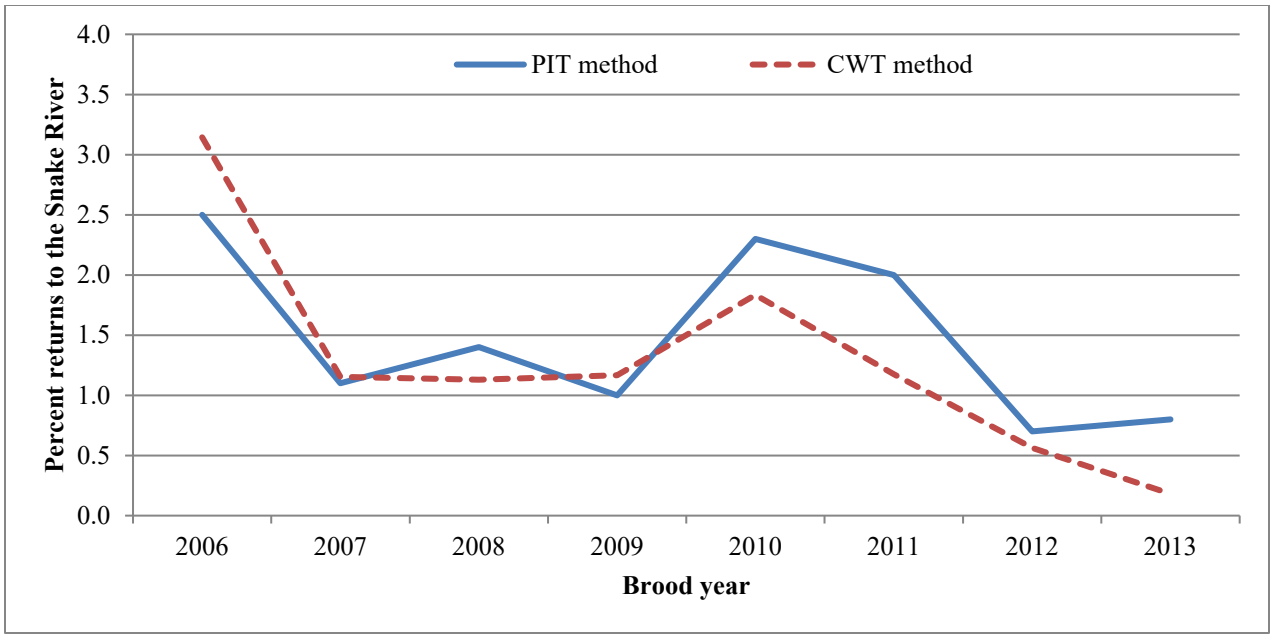


Figure 256. Percent survival of yearling releases from LFH to the Snake River using CWTs and PIT tags through return year 2016 for 1-4 salt fish.

Table 42. Return and survival estimates to the Snake River for subyearling fall Chinook salmon released at LFH estimated using PIT tag detections in the Snake River through 2016.

Brood year	0-salt	1-salt	2-salt	3-salt	4-salt	Total Return to Date (1-4 salts)
2011	0.0%	0.1%	0.3%	0.1%	0.0%	0.5%
	0	252	504	242	0	997
2012	0.0%	0.1%	0.3%	0.1%	-	0.5%
	0	278	685	107		1,070
2013	0.0%	0.1%	0.2%	-	-	0.3%
	0	105	463			568
2014	0.0%	0.2%	-	-	-	0.2%
	0	375				375
2015	0.0%	-	-	-	-	0.0%
	0					0
Average	0.00%	0.13%	0.27%	0.10%	0.00%	0.30%
	0	253	551	175	0	753

Table 43. Return and survival estimates to the Snake River for subyearling fall Chinook salmon released at LFH estimated using CWT detections in the Snake River through 2016. Cells highlighted in red indicate possible biased data due to trapping restrictions during 2013.

Brood year	0-salt	1-salt	2-salt	3-salt	4-salt	Total Return to Date (1-4 salts)	Total release (wire+nowire)	Tag codes
2011	0.0%	0.1%	0.1%	0.2%	0.0%	0.4%		
	0	242	206	424	25	899	200,900	636417
2012	0.0%	0.2%	0.4%	0.2%	-	0.8%		
	0	467	843	487		1,797	211,599	636574
2013	0.0%	0.1%	0.2%	-	-	0.3%		
	0	230	321			551	209,972	636737
2014	0.0%	0.2%	-	-	-	0.2%		
	0	491				491	219,359	636882
2015	0.0%	-	-	-	-	-		
	0					-	202,460	637038
Average	0.00%	0.15%	0.23%	0.20%	0.00%	0.43%		
	0	358	457	456	25	935	202,460	

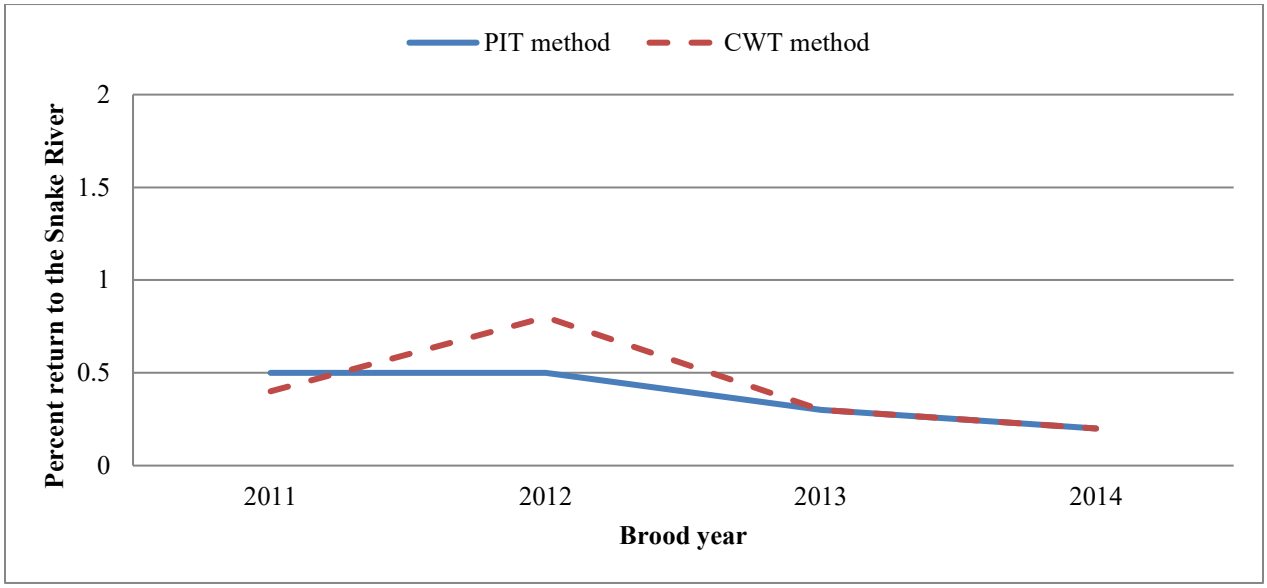


Figure 26. Percent returns of subyearling releases from LFH to the Snake River using CWTs and PIT tags through return year 2016 for 1-4 salt fish.

Estimated Returns above Bonneville Dam using PIT tags and CWTs

Similar to the preceding section, we estimated returns of fall Chinook salmon above Bonneville Dam in the Columbia and Snake rivers using PIT tags (all detections at or above Bonneville Dam) or CWTs (all recoveries above Bonneville Dam). PIT tag detections for yearlings resulted in an average 6.2 times and 4.1 times greater 0-salt and 1-salt survival estimates, and nearly equal 2+ salt survival estimates than occurred by using CWT estimation methods when all years were combined (Table 44 and Table 45, Figure 28). Total survival for subyearlings using PIT tags resulted in 0.8 times less 1-salts and 0.8 times less 2+salt fish than estimated by using CWTs when all years were combined (Table 46 and Table 47, Figure 29).

Table 44. Total return and survival estimates of yearling fall Chinook salmon released at LFH estimated using PIT tag detections in the Snake and Columbia rivers through 2016.

Brood year	0-salt	1-salt	2-salt	3-salt	4-salt	Total survival estimate (1-4 salts)
2006	4.8%	2.1%	1.4%	0.1%	0.0%	3.6%
	21,916	9,814	6,260	402	0	16,476
2007	0.5%	0.8%	0.6%	0.1%	0.0%	1.5%
	2,417	3,830	2,741	426	17	7,013
2008	0.7%	1.1%	0.7%	0.0%	0.0%	1.8%
	3,516	5,185	3,143	231	18	8,576
2009	0.6%	0.5%	0.8%	0.2%	0.0%	1.5%
	2,810	2,468	3,586	916	0	6,970
2010	0.6%	1.6%	1.3%	0.1%	0.0%	3.0%
	2,840	7,848	6,502	591	0	14,941
2011	1.0%	1.0%	1.3%	0.1%	-	2.4%
	4,944	4,978	6,201	587	-	11,766
2012	0.8%	0.4%	0.4%	-	-	0.9%
	4,069	2,127	2,195	-	-	4,322
2013	0.9%	0.9%	-	-	-	0.9%
	4,177	4,177	-	-	-	4,177
2014	1.0%	-	-	-	-	0.0%
	4,819	-	-	-	-	0
Average	1.21%	1.05%	0.93%	0.10%	0.00%	1.73%
	5,723	5,053	4,375	526	7	8,249

Table 45. Total return and survival estimates of yearling fall Chinook salmon released at LFH estimated using freshwater CWT recoveries above Bonneville Dam and return estimates of live fish through 2016. Cells highlighted in red indicate possible biased data due to trapping restrictions during 2013.

Brood year	0-salt	1-salt	2-salt	3-salt	4-salt	Total survival estimate (1-4 salts)	Total release (wire+nowire)	Tag codes
2006	0.8%	2.4%	1.4%	0.1%	0.0%	3.8%	459,634	634092
	3,639	11,153	6,283	248	3	17,687		633987
2007	0.1%	0.6%	0.9%	0.1%	0.0%	1.6%	455,152	634680
	456	2,623	4,116	473	10	7,222		634681
2008	0.1%	0.7%	0.6%	0.1%	0.0%	1.4%	478,852	635165
	531	3,555	2,911	412	0	6,878		635166
2009	0.3%	0.5%	0.9%	0.1%	0.0%	1.5%	463,729	635510
	1,167	2,299	4,066	455	0	6,820		635564
2010	0.2%	1.1%	1.0%	0.2%	0.0%	2.3%	490,000	636079
	1,149	5,317	4,862	949	20	11,148		636080
2011	0.8%	0.4%	0.8%	0.2%	-	1.4%	489,500	636443
	3,712	2,177	4,047	827		7,051		636444
2012	0.4%	0.3%	0.4%	-	-	0.7%	503,273	636583
	1,922	1,578	1,783			3,361		636584
2013	0.1%	0.2%	-	-	-	0.2%	452,373	636740
	437	1,015				1,015		636741
2014	0.2%	-	-	-	-	-	487,177	636886
	772					-		636885
Average	0.33%	0.78%	0.86%	0.13%	0.00%	1.61%	475,521	
	1,532	3,715	4,010	561	7	7,648		

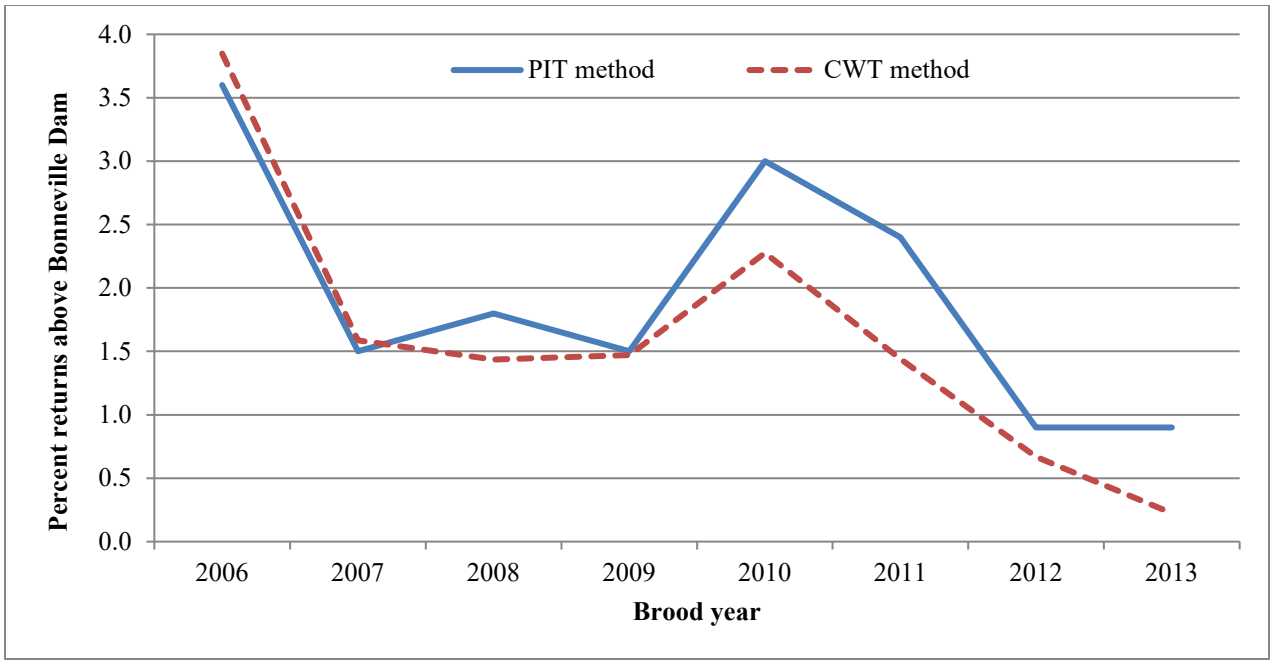


Figure 27. Percent return of yearling fall Chinook salmon released at LFH to areas above Bonneville Dam, including the Snake River, through return year 2016 for 1-4 salt fish.

Table 46. Total return and survival estimates of subyearling fall Chinook salmon released at LFH estimated using PIT tag detections in the Snake and Columbia rivers through 2016.

Brood year	0-salt	1-salt	2-salt	3-salt	4-salt	Total survival estimate (1-4 salts)
2011	0.0%	0.2%	0.3%	0.2%	0.0%	0.7%
	0	322	655	373	10	1,360
2012	0.0%	0.2%	0.3%	0.1%	-	0.6%
	0	332	738	214		1,284
2013	0.0%	0.1%	0.3%	-	-	0.3%
	0	126	599			726
2014	0.0%	0.2%	-	-	-	0.2%
	0	452				452
2015	0.0%	-	-	-	-	0.0%
	0					0
Average	0.00%	0.18%	0.30%	0.15%	0.00%	0.36%
	0	308	664	294	10	764

Table 47. Total return and survival estimates of subyearling fall Chinook salmon released at LFH estimated using freshwater CWT recoveries above Bonneville Dam and return estimates of live fish through 2016. Cells highlighted in red indicate possible biased data due to trapping restrictions during 2013.

Brood year	0-salt	1-salt	2-salt	3-salt	4-salt	Total survival estimate (1-4 salts)	Total release (wire+nowire)	Tag codes
2011	0.0% 0	0.1% 251	0.2% 302	0.2% 489	0.0% 36	0.5% 1,080	200,900	63641 7
2012	0.0% 0	0.2% 482	0.5% 957	0.3% 605	-	1.0% 2,045	211,599	63657 4
2013	0.0% 0	0.1% 231	0.2% 406	-	-	0.1% 231	209,972	63673 7
2014	0.0% 0	0.2% 502	-	-	-	0.2% 502	219,359	63688 2
2015	0.0% 0	-	-	-	-	- -	202,460	63703 8
Average	0.00% 0	0.15% 367	0.30% 555	0.25% 547	0.00% 36	0.45% 965	202,460	

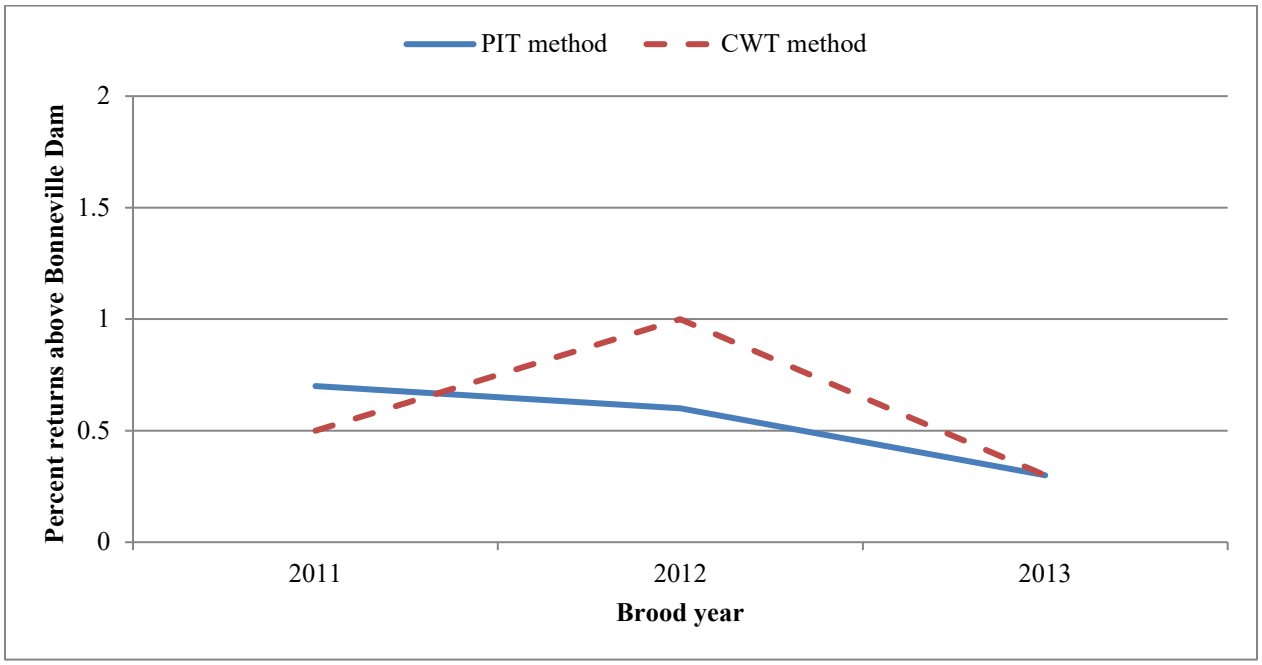


Figure 29. Percent return of subyearling fall Chinook salmon released at LFH to areas above Bonneville Dam, including the Snake River, through return year 2016 for 1-4 salt fish.

Direct Take of Listed Snake River fall Chinook Salmon During Fall of 2016 and Spring of 2017

Adult estimates for permit #16607 for LFH production and permit #16615 for NPTH production have been combined in the tables below. Direct take consists of adults spawned in 2016 at LFH and NPTH (highlighted in green), and eggs/loss/release data associated with BY16 subyearlings released in 2017 and BY15 yearlings released in 2017 that were part of LSRCP, LSRCP-FCAP, and IPC programs. Direct takes of listed Snake River fall Chinook salmon were calculated in Table 48 and Table 49 and were generally within limits. The number of unmarked/untagged juveniles released by these programs totaled 1,349,796 fish, which are not included in the table below.

Table 48. Proposed permissible direct take and actual take of listed Snake River fall Chinook salmon adults returning in 2016 and juveniles released in 2017 for fish cultural purposes for the LFH, IPC, and FCAP programs. Red cells indicate take exceeded permitted limit and green cells combine take from LFH and NPTH programs.

		Annual take of listed fish by life stage							
		Egg/fry		Juvenile or smolt		Adult [b]		Carcass	
Type of Take	Mark [a]	Limit	Take	Limit	Take	Limit	Take	Limit	Take
Observe or harass [c]	No fin clip	0		0		1,000	0	0	
	AD clip	0		0		1,000	0	0	
Collect for transport [d]	No fin clip	0		0		0		0	
	AD clip	0		0		0		0	
Capture, handle, and release [e]	No fin clip	0		0		0		0	
	AD clip	0		0		0		0	
Capture, handle, tag/marked/tissue sample, and release [f]	No fin clip	0		810,455	912,752	1,500 [j]	80	0	
	AD clip	0		2,335,000	2,203,335	1,100 [j]	38	0	
Intentional lethal take [g]	No fin clip	0	132,098	0		2,600 [h]	2,341	0	
	AD clip	0		0		2,200 [h]	708	0	
Unintentional lethal take [i]	No fin clip	7.5%	5.3%	7.5%	0.3%	500	115	0	
	AD clip	7.5%	5.3%	7.5%	0.3%	450	61	0	

[a] "No fin clip" salmon include hatchery-origin and natural –origin fish. The majority of unclipped fish are hatchery origin.

[b] For purposes of this permit, adults are defined as fall Chinook salmon that are at least 3 years old that have spent at least 2 years in the ocean. Fish that spend only one year in the ocean, called "jacks" or "1-salts," represent a natural life history and are thought to contribute to natural production at a low but relatively constant level. These fish are almost exclusively males (females are called "jills"). Jack returns are highly variable and cannot be accurately forecasted. In-season management and take monitoring will classify fish less than 53 cm (FL) as jacks. Post-season reporting will be based on estimated ocean age. Adult take limits are based on programmatic needs-broodstock number and run-reconstruction numbers – and limits to the overall sampling rate, of the run at age, at the LGR trap and/or supplemental trapping efforts at Lyons Ferry Hatchery and Nez Perce Tribal Hatchery are not to exceed 20%. Any non-lethal take of jacks during trapping efforts is permitted.

[c] Contact with listed fish that could occur from migration delay at dam or traps. Specifically, this refers to fish trapped at LFH and returned to the river without handling, the vast majority being clipped and/or tagged hatchery fish.

[d] Take associate with weir or trapping operations where listed fish are captured and transported, These levels represent full broodstock collection at LGR – see intentional lethal take below.

[e] Take associated with weir or trapping operations where listed fish are captured, handled, and released upstream or downstream.

[f] Take of juveniles due to tagging/marking/PIT tagging prior to release and does not include 1,349,796 unclipped and untagged fish released by LSRCP and LSRCP-FCAP programs. The number shown assumes full production through priority 17 (able B4B. U.S. v. Oregon agreement [2009]) and does not include NPTH production. This number could vary depending on annual egg takes and survival in the hatchery.

[g] Intentional mortality of listed fish as broodstock only. Values represent total need for all program components (LFH, FCAP, NPTH, and IPC). Priority collection occurs at the LGR trap, alternative collection at LFH and NPTH.

[h] Take goal for natural-origin fish for broodstock is 1500 adults. Jacks can compose up to 10% of total broodstock collection

[i] Unintentional mortality from operation of adult traps, including loss of fish during trapping, transport, and holding prior to spawning or release back into the wild after broodstock sorting. Also includes estimates of in-hatchery incubation and rearing mortality, by life-stage. Adult mortality estimates based on 15% prespawning mortality, including adult trapping, holding, and transport.

[j] Adult fish in excess to broodstock needs that are returned to the river from the LFH and the NPTH. These fish are typically fin clipped for re-capture identification.

Table 49. Proposed permissible direct take and actual take of listed Snake River fall Chinook salmon adults returning in 2016 and juveniles released in 2017 for RM&E activities associated with the LFH fall Chinook salmon programs not directly related to fish culture. Red cells indicate take exceeded permitted limit and green cells combine take from LFH and NPTH programs.

		Annual take of listed fish by life stage							
		Egg/fry		Juvenile or smolt		Adult		Carcass	
Type of Take	Mark	Limit	Take	Limit	Take	Limit	Take	Limit	Take
Observe or harass [a]	No fin clip	0				200	223	0	
	AD clip	0				600	150	0	
Collect for transport [b]	No fin clip	0		0		0		0	
	AD clip	0		0		0		0	
Capture, handle, and release [c]	No fin clip	0		Up to 15% of natural juvenile production not to exceed 25,000 fish [h]	264			10	0
	AD clip	0						10	0
Capture, handle, tag/mark/tissue sample, and release [d]	No fin clip	0		2,700 [h]	524	4,000[i]	2,623	100	50
	AD clip	0				2,500[i]	3,386	300	34
Removal (e.g. broodstock) [e]	No fin clip	0		0		0		0	
	AD clip	0		0		0		0	
Intentional lethal take [f]	No fin clip	0		0		1,000[i]	177	0	
	AD clip	0		0		1,000[i]	178	0	
Unintentional lethal take [g]	No fin clip	0		300 [h]	14	0		0	
	AD clip	0		100 [h]	0	0		0	

[a] Contact with live, ESA-listed fish through juvenile and adult spawning surveys on the Tucannon River and adult spawning surveys on Asotin Creek.
[b] Take of listed fish for transportation only.
[c] Take associated with smolt trapping operations where listed fish are captured, handled, and released. Adult numbers represent adults captured, handled, and released from juvenile trapping operations.
[d] Take associated with adult and juvenile sampling and monitoring projects. These include; adult fall Chinook salmon trapped, handled, sampled, tagged and released from adult trapping facilities and weirs, carcass sampling during spawning ground surveys on the Tucannon River and Asotin Creek, and juvenile fall Chinook salmon captured, handled, sampled, tagged, and released from juvenile trapping, netting, and electro-fishing projects.
[e] RM&E activities do not include broodstock collection.
[f] Intentional mortality of hatchery fish as a result of run reconstruction needs. These are coded-wire tagged hatchery fish.
[g] Unintentional mortality of listed fish, including loss of fish during smolt trapping.
[h] WDFW activities associated with emigrant studies using rotary screw trap and spawning ground surveys on the Tucannon River.
[i] Adults (non-jacks) used for run reconstruction at LGR trap.
[j] Take associated with spawning ground surveys on Asotin Creek located above LGR Dam.

Conclusions and Recommendations

The fall Chinook salmon program at LFH requires substantial coordination among a variety of State, Federal and Tribal agencies. The program is being managed to meet the goals and objectives of Tribal, state, and federal co-managers. Conclusions and recommendations listed below are not prioritized and represent only the opinion of WDFW Snake River Lab Evaluation staff.

1. The Snake River fall Chinook salmon run reconstruction methodologies were changed in 2013. Previous estimates at LGR using these new methods were reworked back to 2004. Prior to 2004, sub-sampling of VIE tagged fish with CWTs occurred at LFH which will require additional adjustments to the method, and have not been attempted at this time.

Recommendation: Assist the Snake River fall Chinook salmon Run Reconstruction group in developing methodologies to address sampling changes that occurred prior to 2004.

Recommendation: Continue to assist with documentation of historical methodologies used to develop run estimates.

2. Estimates of returns using PIT tags compared to CWTs vary by age at return, and by juvenile life history rearing type. Tagging (PIT or CWT) constitutes a significant program cost annually and methods for monitoring and evaluating program performance need to be cost efficient in times of decreasing budgets. Multiple years of comparisons have occurred from prior tagging and will continue to occur over the next few years as adults return.

Recommendation: Continue to evaluate and summarize the use of both types of tagging to determine if some optimum proportion of PIT and CWT could be used to accurately portray fish performance and reduce tagging costs.

Recommendation: Re-evaluate the number of PIT tags currently being used to monitor yearling and subyearling production.

3. In 2016, PBT sampling at LGR was able to detect all inbasin hatchery returns which allows more precise (in theory) estimates of the numbers of natural origin fish in the overall return, and those that contribute to broodstock.

Recommendation: Work with the Snake River fall Chinook salmon run reconstruction technical group to derive run reconstruction estimates based solely on PBT results and compare with standardized run reconstruction estimates. Continue these comparisons for 5 years to determine if the run reconstruction based on CWTs is valid for profiling the return, or if another more accurate methodology should be adopted for the future.

4. In prior years, evaluation staff monitored annual fecundities (by fork length) of fall Chinook salmon. Nearly all prior fecundity estimates consisted of hatchery origin fish, as few natural

origin fish were included in the broodstock. With PBT, natural origin fish can now be identified. There is an interest to determine if natural origin fish have similar fecundities as compare to hatchery origin fish, as a difference could alter broodstock collection criteria, and the information may be useful for other researchers estimating natural origin productivity.

Recommendation: Begin fecundity estimates of fish used for broodstock by origin, age, and release site. This will be a 5 year evaluation which will compare fecundities of hatchery fish to wild fish, by age (as determined by PBT, PIT, scale analysis, and CWTs). This evaluation will identify differences in fecundity from subyearling releases, yearling releases, and reservoir reared fish.

Literature Cited

Busack, C. 2007. The Impact of Repeat Spawning of Males on Effective Number of Breeders in Hatchery Operations. Aquaculture (2007), doi:10.1016/j.aquaculture.2007.03.027.

DeHart, M., J. McCann, B. Chockley, E. Cooper, H. Schaller, S. Haeseker, R. Lessard, C. Petrosky, E. Tinus, E Van Dyke, and R. Ehlke. 2015. Comparative Survival Study of PIT-tagged Spring/Summer/Fall Chinok, Summer Steelhead, and Sockeye, 2015 Annual Report. Comparative Survival Study Oversight Committee and Fish Passage Center Report to Bonneville Power Administration, BPA Project 1996-020-00.

Gallinat, M. P., and L.A. Ross. 2017. Tucannon River Spring Chinook Salmon Hatchery Evaluation Program, 2016 Annual Report. Washington Department of Fish and Wildlife Fish Program Report to U. S. Fish and Wildlife Service, Boise, ID.

Hankin, D.G., L J. Fitzgibbons, and Y. Chen. 2009. Unnatural random mating policies select for younger age at maturity in hatchery Chinook salmon (*Oncorhynchus tshawytscha*) populations. Can. J. Fish. Aquat. Sci. 66: 1505–1521 (2009).

Heath, D. D., C. W. Fox and J. W. Heath. 1999. Maternal effects on offspring size: variation through early development of Chinook salmon. Evolution 53 (5): 1605-1611.

Hegg, J. 2013. Spatial and Temporal Variation in Juvenile Salmon Life History: Implications of Habitat Alteration. Master of Science Thesis, University of Idaho, Moscow, ID.

Herrig, Dan. 2006. Personal communication, LSRCP project manager.

Knudsen, C. M., S. L. Schroder, C. Busack, M. V. Johnston, T. N. Pearsons, and C. R. Strom. 2008. Comparison of Female Reproductive Traits and Progeny of First-Generation Hatchery and Wild Upper Yakima River Spring Chinook Salmon. Transactions of the American Fisheries Society 137:1433-1445.

Milks, D., M. Varney, J. Jording, and M. Schuck. 2007. Lyons Ferry Hatchery Evaluation Fall Chinook Salmon Annual Report: 2005. Washington Department of Fish and Wildlife, Olympia, WA. Report #FPA 07-04.

Milks, D., M. Varney, and M. Schuck. 2009. Lyons Ferry Hatchery Evaluation Fall Chinook Salmon Annual Report: 2006. Washington Department of Fish and Wildlife, Olympia, WA. Report #FPA 09-04.

Milks, D., A. Grider, M. Varney, and M. Schuck. 2011. Lyons Ferry Hatchery Evaluation Fall Chinook Salmon Annual Report: 2007-2008. Washington Department of Fish and Wildlife, Olympia, WA. Report #FPA 11-02.

Milks, D., A. Grider, and M. Schuck. 2011. Lyons Ferry Hatchery Evaluation Fall Chinook Salmon Annual Report: 2009. Washington Department of Fish and Wildlife, Olympia, WA. http://www.fws.gov/lsnakecomplan/Reports/WDFWreports.html.

Milks, D., A. Grider, and M. Schuck. 2012. Lyons Ferry Hatchery Evaluation Fall Chinook Salmon Annual Report: 2010. Washington Department of Fish and Wildlife, Olympia, WA. http://www.fws.gov/lsnakecomplan/Reports/WDFWreports.html.

Milks, D., A. Grider, and M. Schuck. 2013. Lyons Ferry Hatchery Evaluation Fall Chinook Salmon Annual Report: 2011. Washington Department of Fish and Wildlife, Olympia, WA. http://www.fws.gov/lsnakecomplan/Reports/WDFWreports.html.

Milks, D. and A. Oakerman. 2014. Lyons Ferry Hatchery Evaluation Fall Chinook Salmon Annual Report: 2012. Washington Department of Fish and Wildlife, Olympia, WA. http://www.fws.gov/lsnakecomplan/Reports/WDFWreports.html.

Milks, D. and A. Oakerman. 2015. Lyons Ferry Hatchery Evaluation Fall Chinook Salmon Annual Report: 2013. Washington Department of Fish and Wildlife, Olympia, WA. http://www.fws.gov/lsnakecomplan/Reports/WDFWreports.html.

Milks, D. and A. Oakerman. 2016. Lyons Ferry Hatchery Evaluation Fall Chinook Salmon Annual Report: 2014. Washington Department of Fish and Wildlife, Olympia, WA. http://www.fws.gov/lsnakecomplan/Reports/WDFWreports.html.

Milks, D. and A. Oakerman. 2018. Lyons Ferry Hatchery Evaluation Fall Chinook Salmon Annual Report: 2015. Washington Department of Fish and Wildlife, Olympia, WA. http://www.fws.gov/lsnakecomplan/Reports/WDFWreports.html.

NMFS (United States Department of Commerce) and USFWS (Bureau of Sport Fisheries and Wildlife, United States Department of Interior). 1972. A Special Report on the Lower Snake River Dams: Ice Harbor, Lower Monumental, Little Goose, and Lower Granite in Washington and Idaho.

NMFS. 1993. Biological Opinion for 1993 Hatchery Operations in the Columbia River Basin.

Rocklage, S., J.A. Hesse. 2004. Snake River Basin Fall Chinook Salmon Production Program Marking Justification. Pre-Decisional White Paper from the Nez Perce Tribe for *US v. Oregon* TAC/PAC Review.

United States v. Oregon Management Agreement. 2008. United States v. Oregon Management Agreement 2008-2017.

U.S. Army Corps of Engineers. 1975. Special report: Lower Snake River Fish and Wildlife Compensation Plan. Walla Walla, WA.

U.S. Army Corps of Engineers. 2016. Annual fish passage report, 2014. Columbia and Snake Rivers for salmon, steelhead, shad and lamprey. Northwestern Division, U.S. Army Corps of Engineers, Portland, OR and Walla Walla, WA.

WDF (Washington Department of Fisheries). 1994. Lower Snake River Compensation Plan, Snake River Hatchery Evaluation Program five-year plan 1994-1998. Washington Department of Fisheries, Olympia, WA

WDFW (Washington Department of Fish and Wildlife). 2014. Lyons Ferry Complex Annual Operations Plan for the period of October 1, 2014 – September 30, 2015.

Appendix A: Fall Chinook Salmon Run to LFH, IHR, LMO, and LGR Dams: 2012-2016

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

Appendix A: Table 1. Numbers of fall Chinook salmon processed at LFH and window counts at IHR, LMO, and LGR dams, 2012-2016.

		Daytime counts				Night video [a]				Totals [b]	
		Through Oct		Nov and Dec		Through Oct		Nov and Dec			
Year	Location	Adults	Jacks	Adults	Jacks	Adults	Jacks	Adults	Jacks	≥ 53 cm FL	< 53 cm FL
2012	IHR	38,546	21,554	nc [c]	nc	nc	nc	nc	nc	38,546	21,554
	LMO	33,518	22,883	nc	nc	nc	nc	nc	nc	33,518	22,883
	LFH									193	6
	LGR	34,060	21,814	628	176	nc	nc	nc	nc	34,688	21,990
2013	IHR	57,850	19,133	nc	nc	nc	nc	nc	nc	57,850	19,133
	LMO	53,399	23,031	nc	nc	nc	nc	nc	nc	53,399	23,031
	LFH									1,025	42
	LGR	55,839	22,019	726	376	nc	nc	nc	nc	56,565	22,395
2014	IHR	61,389	17,944	nc	nc	nc	nc	nc	nc	61,389	17,944
	LMO	51,402	23,836	nc	nc	nc	nc	nc	nc	51,402	23,836
	LFH									0	0
	LGR	59,753	19,250	934	557	nc	nc	nc	nc	60,617	19,869
2015	IHR	62,978	10,008	nc	nc	nc	nc	nc	nc	62,978	10,008
	LMO	54,394	15,844	nc	nc	nc	nc	nc	nc	54,394	15,844
	LFH									234	9
	LGR	58,662	11,177	638	350	nc	nc	nc	nc	59,300	11,527
2016	IHR	36,713	13,066	nc	nc	nc	nc	nc	nc	36,713	13,066
	LMO	33,090	15,038	nc	nc	nc	nc	nc	nc	33,090	15,038
	LFH									0	0
	LGR	34,315	12,002	399	364	nc	nc	nc	nc	34,714	12,366

[a] Night counts occurred during 18-31 August.
[b] Total from LFH consist of killed fish that were identified at processing as LFH trapped.
[c] No counts (nc) were completed at the dam during that time of year.

Appendix B: Trapping and Sampling Protocols at LGR Adult Trap for 2016

2016 Fall Chinook Salmon Trapping/Sampling Protocols at LGR

by

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Stuart Rosenberger, IPC
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August 3, 2016

The following protocol presumes 24 hour trapping 7 days per week: The trapping rate will be set at 19% and kept at that level throughout the season, if possible. If the trap is swamped with fish: Shut down the trap for an hour or so but clearly identify in the data when the trap was shut down and when it was started up again. Do not shut down and stay shut down for the rest of the day because we need to have a pre and post shut down sample so we can average them to estimate what passed during the shutdown.

If trapping is changed to 4 hours per day operation, any fish collected during that time MUST receive an operculum punch on the right side if they are hauled to the hatcheries.

Scales sampled at the LGR Trap for run reconstruction needs will be mounted by WDFW/COE staff at LGR and sent to Olympia every two weeks. An additional two staff will be provided by WDFW as part of the Snake River Fall Chinook Salmon Fidelity and Fallback Study (radio telemetry) funded by BPA.

In an effort to reduce the numbers of jacks and jills hauled to the hatcheries and to reduce the numbers of fish sacrificed with wire for run reconstruction purposes the following protocols were approved by co-managers in the basin on 8/3/2016. The sub-sampling of fish should allow for ample recoveries for evaluation purposes and fecundity monitoring.

2016 Fall Chinook Salmon Trapping/Sampling Protocols

Protocols:

1) These protocols presume a 24 hour/day, 7 days per week trapping at 19%. Fish trapped during a 24 hour 7 day a week trapping period will not be operculum punched. If the trapping protocol is changed to only 4 hours per day, all fish hauled to the hatcheries must receive an operculum punch on the right side (ROP).

2) This is the fourth year females will not be inoculated. Males will not be inoculated either. (WDFW's fish will not be inoculated, but NPT's fish might be. We do not know at this time)

3) Sort by code fish follow the same haul/release protocol below unless the tag action code indicates that the fish should be radio tagged and released.

4) LFH will haul 70% of the fish trapped fish ≥70 cm and the NPT will haul 30%.

5) All wire tagged males <70 cm will be held separately in a tank and hauled to LFH.

6) Wire tagged females <70 will be added to the tank of "LARGE" fish and either hauled to LFH and NPTH.
7) Unmarked/untagged females <70 will be added to the tank of "LARGE" fish and hauled to LFH.

8) Jacks suspected of being summers will need to be subsampled for wires.

Wire tagged fish:

Fork Length	Action
≥ 70cm	Haul all wires (no scales collected), DNA sample all
<70 cm	Haul 1 out of 4 wires (put F in with "LARGES" for LFH and NPT and M go into "SMALLS" tank for LFH), DNA sample all
	Release 3 out of 4 wires (no scales collected), DNA sample all

Untagged fish:

Fork Length	Action
≥ 70 cm	Haul all fish (collect scales, 1 in 3 will be processed) data will be used to document arrival timing and profile the run for reconstruction needs. DNA sample all.
<70 cm	Haul 1 out of 4 F to LFH, release 3 out of 4 (collect scales, 1 in 3 will be processed) data will be used to monitor fecundity, document arrival timing and profile the run for reconstruction needs. Release all M (collect scales, 1 in 3 will be processed).DNA sample all.

2016 Fall Chinook Salmon Trapping Protocol
September 12, 2016

Changes to prior protocol are highlighted

Protocol changes effective September 13:

Males: ≥70 cm, Haul ALL regardless of marks or tags
Females: ≥ 80 cm, Haul ALL regardless of marks or tags

Males: <70 cm, Haul 1 out of 5 WIRES, PASS unmarked/untagged, PASS AD only, PASS PIT tag only
Females: < 80 cm, Haul 1 out of 5 WIRES, PASS unmarked/untagged, PASS AD only, PASS PIT tag only

2016 Fall Chinook Salmon Trapping Protocol
September 22, 2016

Changes to prior protocol are highlighted

Protocol changes effective September 22, starting with the next trap check after 11:00 am:

Males: ≥70 cm, Haul ALL regardless of marks or tags
Females: ≥ 83 cm, Haul ALL regardless of marks or tags

Males: <70 cm, Haul 1 out of 5 WIRES, PASS unmarked/untagged, PASS AD only, PASS PIT tag only
Females: < 83 cm, PASS ALL (WIRES, unmarked/untagged, AD only, PIT tag only)

2016 Fall Chinook Salmon Trapping Protocol
September 26, 2016

Changes to prior protocol are highlighted

Protocol changes effective September 27:

Males: ≥75 cm, Haul ALL regardless of marks or tags
Females: ≥ 83 cm, Haul 30 to LFH and 100? To NPTH (regardless of marks or tags), then pass the rest

Males: 74-50 cm, PASS ALL

Males: <50 cm, Haul 1 out of 10 WIRES, PASS unmarked/untagged, PASS AD only, PASS PIT tag only
Females: < 83 cm, PASS ALL

Appendix C: Systematic Sampling Rates at Lower Granite Dam 2003-2016

Appendix C Table 1. Dates, times, and trapping rates of fall Chinook salmon at LGR, 2003-20162003-2015.

Year	Date opened trap	Trap rate (%)	Date trap closed	Date/time trapping rate changed	Modified trapping rate (%)	Date/time trapping rate changed	Adjusted trapping rate (%)	Date trap closed
2003	9 Sept	11	-	-	nc [a]	-	nc	19 Nov
2004	2 Sept	15	3&5 Sept [b]	10 Sept	13	-	nc	22 Nov
2005	6 Sept	13	-	-	nc	-	nc	20 Nov
2006	1 Sept	13	-	-	nc	-	nc	21 Nov
2007	1 Sept	20	-	-	nc	-	nc	20 Nov
2008	24 Aug 8:00 am [c]	20	-	12 Sept 2:52 pm	12	26 Sept 3:00 pm	10	21 Nov
2009	18 Aug 7:37 am	12	-	9 Sept 7:25 am	9	-	nc	15 Nov
2010	22 Aug 11:05 am	12	10 Sept-10:50 am [d] 18 Sept-10:50 am [b]	18 Sept 3:00 pm	10	-	nc	18 Nov
2011	18 Aug 10:30 am	10	-	-	nc	-	nc	21 Nov
2012	28 Aug 10:36 am	15	-	-	nc	-	nc	19 Nov
2013	23 Sept 10:07 am	12	27 Sept- 3:00 pm [e]	1 Oct 2:22 pm	15	8 Oct 2:22 pm	20	24 Nov
2014	18 Aug 9:54 am	100	19&20 Aug [f] 22-29 Aug [f]	1 Sept 8:38 am	10	2 Oct 7:40	8	11 Nov
2015	22 Aug 7:55 am	100	23-26 Aug [f] 29 Aug [f]	31 Aug 8:39 am	12	-	nc	22 Nov
2016	18 Aug 8:28 am	19	-	-	nc	-	nc	20 Nov

[a] No change (nc) was made to the trapping rate.
[b] Trap was closed down for two hours each day.
[c] Trap was operated between 8-8:30 am, then 12:30-12:55 pm, then 2:20-3:02 pm on 24 Aug due to water temperature restrictions. Full operation began 25 August
[d] Trap was closed down at 10:50 am for three hours due to large numbers of fall Chinook salmon.
[e] Trap was closed down at 3:00 pm for two hours due to large numbers of fall Chinook salmon.
[f] Trap closed down due to high water temperatures.

Appendix D: Trapping, Mating and Sampling Protocols at Lyons Ferry Hatchery 2016

2016 Trapping, Mating, and Sampling Protocols at LFH

It is unlikely that trapping will need to occur at LFH during 2016. LFH may start up the volunteer trap if a shortfall of females being collected at LGR happens.

All fish from LGR will be combined and held in ponds, regardless of size.

Sorting protocol

Count and sex all fish: 1) Males and females $\geq$ 75, 2) Males and females <75. This will be done to determine how many times males $\geq$ 75 would need to be used to cover the females on hand, and to get an accurate female count.

Count new arrival females returned to the pond during the spawn day for inventory.

Sampling protocol

Fin clips for DNA: take sample on every fish so data can be used for run reconstruction purposes, as well as profiling broodstock. Only enter the fish ID number on the DNA sheet with the tissue sample. Try to get a piece of fin no larger than the size of the nail on your little finger. We are shooting for connective tissue between the rays for the DNA so it is important that the sample be from a healthy fin.

Scales: taken on all fish

Female broodstock total body weights
1st week of spawning: document total weights, prior to spawning, of the first 50 females that have a CWT and the first 50 females that are unmarked/untagged (appear wild) and note fish ID number

2nd week-4th week: weigh first 25 females that have a CWT and 25 females that are unmarked/untagged each spawn day

Carcasses for nutrient enhancement: After otoliths are taken from the carcasses, a tote of fish will be filled and dumped into a bin next to the loading dock. These fish will be frozen separately and taken to the Tucannon River for nutrient enhancement after ELISA testing. Multiple totes may be used for this purpose if manageable.

Mating protocol at LFH

Our goals are to maximize the use of potentially natural origin fish and larger/older aged fish and to exclude jills and strays from broodstock.

All wire tagged males must have their CWTs decoded before they are used in a mating. Males >75 cm will be noted on the semen bag with a "B" to note they are large and may be used multiple times.

Stray males will be culled based on CWTs. If broodstock limited, up to 60 stray females may be spawned and retained, presuming 1,202 matings are needed to make production. Any male used on a stray female must also be used on another female that will be retained for production (inbasin hatchery origin, or untagged unknown origin).

Wire tagged Males verified as adults can be used on multiple females.

Untagged Males $\geq$75 cm can be used on multiple females.

Untagged Males 70-74 cm will only be used in 1 x 1 crosses unless there is a shortage of males.

Males <70 cm will not be used in matings unless they are verified as adults. Size criteria's may be adjusted in season.

Fecundity monitoring and Jills

All females will be spawned when ripe and the gametes will be held in incubators until we can determine if we have enough adult females to offset the culling, and to monitor fecundity. Staff from Snake River Lab will provide hatchery staff with a list of female ID numbers of strays and jills to facilitate tray marking, and possible future culling. In the unlikely event that we have an unmarked/untagged jill, eggs will be retained for production. If we have enough adult females to make production goals, after eye up and fecundity estimation, hatchery origin jills will be culled. Jills verified by CWTs will be spawned with males of a larger fork length. Any male used on a jill must also be used on a larger or older aged fish that will be retained for production. This will be done to ensure if the jill is culled or a fry plant is made, the gametes from the male will still contribute elsewhere in production.

Fecundity monitoring: Snake River Lab staff will provide hatchery staff with a list of female ID numbers that will be used in the fecundity monitoring.

Red tape will indicate potential culls.
Green tape will indicate Fecundity monitoring.
Red+green tape: hatchery jill used in fecundity monitoring, will be culled after egg picking.

Appendix E: Salmon Processed and Killed at LFH in 2016

(Age/Rearing states origin, brood year, age at release, and release site (LF12SO is a LFH hatchery origin fish from the 2012 brood year, released as a subyearling, onstation at LFH).

Appendix E Table 1: Estimated composition of non-wire tagged salmon trapped at LGR that were hauled to LFH and killed during 2016.

Age/Origin Determinations by Method	< 53 cm Males	Females	≥53 cm Males	Grand Total
Snake R. hatchery res rear age 5(3salt) by PIT tag	0	0	3	3
Snake R. hatchery sub age 2(1salt) by PIT tag	1	0	0	1
Snake R. hatchery sub age 4(3salt) by PIT tag	0	0	1	1
Snake R. hatchery sub age 5(4salt) by PIT tag	0	2	8	10
Presumed Snake R. hatchery res rear age 4(2salt) by DNA	0	4	3	7
Presumed Snake R. hatchery res rear age 5(3salt) by DNA	0	16	2	18
Presumed Snake R. hatchery sub res rear age 4(2salt) by DNA	0	0	1	1
Presumed Snake R. hatchery sub res rear age 5(3salt) by DNA	0	1	0	1
Presumed Snake R. hatchery sub age 3(2salt) by DNA	0	17	37	54
Presumed Snake R. hatchery sub age 4(3salt) by DNA	0	155	92	247
Presumed Snake R. hatchery sub age 5(4salt) by DNA	0	63	16	79
Presumed Snake R. hatchery yearling age 4(2salt) by DNA	0	0	1	1
Presumed Snake R. hatchery yearling age 6(4salt) by DNA	0	1	1	2
Presumed Snake R. hatchery unknown rear (2salt) by DNA	0	0	3	3
Presumed Snake R. hatchery unknown rear (3salt) by DNA	0	7	6	13
Presumed Snake R. hatchery unknown rear (4salt) by DNA	0	8	2	10
STRAY sub age 4(3salt) by DNA	0	1	1	2
STRAY yearling age 5(3salt) by DNA	0	0	1	1
STRAY unknown rear (3salt) by DNA	0	0	1	1
Unknown hatchery AD res rear age 3(2salt) by scales	0	1	0	1
Unknown hatchery AD age 2(1salt) by scales	0	0	1	1
Unknown hatchery AD age 3(2salt) by scales	0	2	5	7
Unknown hatchery AD age 4(3salt) by scales	0	11	4	15
Unknown hatchery AD age 5(4salt) by scales	0	3	0	3
Unknown hatchery unknown rear/age by AD clip	0	1	1	2
Unknown hatchery yearling age 3(1salt) by scales	0	1	0	1
Unknown hatchery yearling age 4(2salt) by scales	0	0	1	1
Unknown hatchery yearling age 5(3salt) by scales	0	0	3	3
Snake R. presumed natural res rear age 3(2salt) by PIT tag, DNA	0	0	1	1
Snake R. presumed natural res rear age 4(3salt) by PIT tag, DNA	0	0	1	1
Snake R. presumed natural sub age 4(3salt) by PIT tag, DNA	0	0	2	2
Snake R. presumed natural sub age 5(4salt) by PIT tag, DNA	0	0	1	1
Snake R. presumed natural unknown rear/age	0	0	1	1
Presumed natural res rear age 3(1salt) by DNA	0	0	2	2
Presumed natural res rear age 4(2salt) by DNA	0	20	16	36
Presumed natural res rear age 5(3salt) by DNA	0	31	5	36
Presumed natural sub age 3(2salt) by DNA	0	8	49	57
Presumed natural sub age 4(3salt) by DNA	0	216	134	350
Presumed natural sub age 5(4salt) by DNA	0	77	19	96
Presumed natural sub age 6(5salt) by DNA	0	4	0	4

Appendix E Table 1: Estimated composition of non-wire tagged salmon trapped at LGR that were hauled to LFH and killed during 2016.

Age/Origin Determinations by Method	< 53 cm Males	Females	≥53 cm Males	Grand Total
Presumed natural yearling age 4(2salt) by DNA	0	1	3	4
Presumed natural yearling age 5(3salt) by DNA	0	1	0	1
Presumed natural unknown rear/age by DNA	0	30	19	49
Snake R. unknown res rear age 4(2salt) by PIT tag	0	0	1	1
Snake R. unknown sub age 4(3salt) by PIT tag	0	0	1	1
Unknown origin res rear age 4(2salt) by scales	0	1	2	3
Unknown origin res rear age 5(3salt) by scales	0	2	1	3
Unknown origin age 2(1salt) by scales	0	0	2	2
Unknown origin age 3(2salt) by scales	1	5	14	20
Unknown origin age 4(3salt) by scales	0	36	37	73
Unknown origin age 5(4salt) by scales	0	17	5	22
Unknown origin age 6(5salt) by scales	0	0	1	1
Unknown origin unknown rear/age	0	14	7	21
Total	**2**	**757**	**518**	**1,277**

Appendix E Table 2: Estimated composition of wire tagged salmon that were trapped at LGR, hauled to LFH, and killed during 2016.

Origin by CWT	CWT	<53 cm Males	Females	≥53 cm Males	Grand Total
LF10YO	636080	0	1	0	1
LF11SBCA	220328	0	0	1	1
	220329	0	2	1	3
LF11SCCD	636418	0	1	0	1
LF11SCJA	220326	0	1	0	1
	220327	0	1	0	1
LF11SGRRD	636419	0	2	0	2
LF11SIPCHC	090587	0	1	0	1
LF11SIPCHC-OXBOW	100201	0	3	0	3
LF11SPLA	220324	0	1	0	1
	220325	0	2	1	3
LF11YBCA	220331	0	5	0	5
	220333	0	3	0	3
LF11YCJA	220332	0	7	3	10
	220335	0	6	1	7
LF11YO	636443	0	23	7	30
	636444	0	12	2	14
LF11YPLA	220330	0	4	1	5
	220334	0	8	1	9
LF12SBCA	220142	0	7	6	13

Appendix E Table 2: Estimated composition of wire tagged salmon that were trapped at LGR, hauled to LFH, and killed during 2016.

Origin by CWT	CWT	<53 cm Males	Females	≥53 cm Males	Grand Total
	220144	0	15	3	18
LF12SCCD	636575	0	17	4	21
LF12SCJA	220141	0	6	6	12
	220143	0	12	6	18
LF12SGRRD	636576	0	7	2	9
LF12SIPCHC	090703	0	8	1	9
LF12SO	636574	0	18	7	25
LF12SPLA	220145	0	9	4	13
	220146	0	11	5	16
LF12YBCA	220336	0	2	2	4
	220341	0	11	2	13
LF12YCJA	220338	0	6	4	10
	220339	0	3	2	5
LF12YO	636583	0	19	16	35
	636584	0	34	9	43
LF12YPLA	220337	0	8	4	12
	220340	0	3	2	5
LF13SBCA	220342	0	5	12	17
	220345	0	3	7	10
LF13SCJA	220343	0	3	6	9
	220346	0	1	5	6
LF13SCJA2	636738	0	0	10	10
LF13SGRRD	636739	0	1	10	11
LF13SIPCHC	090818	0	2	2	4
LF13SO	636737	0	4	15	19
LF13SPLA	220344	0	3	2	5
	220347	0	1	10	11
LF13YBCA	220348	1	0	3	4
	220351	0	0	3	3
LF13YCJA	220350	0	0	9	9
	220353	2	0	6	8
LF13YO	636740	1	3	13	17
	636741	1	5	20	26
LF13YPLA	220349	0	1	4	5
	220352	1	1	2	4
LF14SBCA	220356	3	0	1	4
	220357	1	0	1	2
LF14SCJA	220354	2	0	2	4
	220355	1	0	0	1
	220360	1	0	1	2

Appendix E Table 2: Estimated composition of wire tagged salmon that were trapped at LGR, hauled to LFH, and killed during 2016.

Origin by CWT	CWT	<53 cm Males	Females	≥53 cm Males	Grand Total
LF14SGRRD	636883	4	0	4	8
LF14SIPCHC	090888	2	0	0	2
LF14SO	636882	8	0	7	15
LF14SPLA	220358	4	0	1	5
	220359	1	0	3	4
LF14YBCA	220361	1	0	0	1
	220366	1	0	0	1
LF14YCJA	220363	21	0	0	21
	220364	5	0	0	5
LF14YO	636885	10	0	0	10
	636886	7	0	0	7
LF14YPLA	220362	6	0	0	6
	220365	3	0	0	3
NPTH11SCFA	220215	0	7	3	10
	220216	0	1	2	3
NPTH11SLGA	220213	0	2	3	5
	220214	0	4	2	6
NPTH11SNLVA	220218	0	4	0	4
	220224	0	11	5	16
NPTH11SO	220217	0	6	3	9
	220223	0	14	1	15
NPTH12SCFA	220221	0	15	5	20
	220222	0	19	7	26
NPTH12SLGA	220219	0	14	10	24
	220220	0	25	3	28
NPTH12SNLV	220225	0	16	13	29
	220231	0	31	22	53
NPTH12SO	220226	0	21	7	28
	220232	1	31	8	40
NPTH13SCFA	220233	1	4	11	16
	220235	0	6	4	10
NPTH13SLGA	220234	1	6	11	18
	220236	0	3	20	23
NPTH13SNLVA	220238	0	2	7	9
	220240	0	4	11	15
NPTH13SO	220237	0	5	13	18
	220239	0	8	18	26
NPTH14SCFA	220227	5	0	0	5
	220228	2	0	1	3
NPTH14SLGA	220229	3	0	0	3

Appendix E Table 2: Estimated composition of wire tagged salmon that were trapped at LGR, hauled to LFH, and killed during 2016.

Origin by CWT	CWT	<53 cm Males	Females	≥53 cm Males	Grand Total
	220230	4	0	1	5
NPTH14SO	220245	0	0	1	1
	220246	2	1	0	3
	220248	4	0	0	4
BON10YUMA	090491	0	1	0	1
UMA11SUMA	090586	1	0	0	1
	090654	1	0	0	1
	090655	1	0	0	1
UMA12SUMA	090682	0	0	2	2
	090683	0	0	1	1
	090684	0	0	1	1
	090686	0	0	1	1
	090705	0	0	2	2
UMA13SUMA	090817	0	1	0	1
09BLANK	Stray/unknown age	0	1	1	2
IDFG14YCLWSUMCH	100313	1	0	0	1
LOST TAG	LFH by DNA age 4(3salt)	0	0	1	1
	LFH by DNA age 5(3salt)	0	1	0	1
	LFH by DNA age 5	0	1	0	1
	unknown	1	1	8	10
Total		**115**	**578**	**471**	**1,164**

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

Appendix F Table B4B. Revised production table listing Snake River fall Chinook salmon production priorities for LFH per the 2008-2017 *US v. Oregon Management Agreement*, Table *B4B*, and agreed upon by members of the SRFMP for Brood Years 2008-2017.

Priority	Production program				
	Rearing facility	**Number**	**Age**	**Release location(s)**	**Marking [a]**
1	Lyons Ferry	450,000	1+	Onstation	225KADCWT 225K CWT
2	Lyons Ferry	150,000	1+	Pittsburg Landing	70K ADCWT 80K CWT only
3	Lyons Ferry	150,000	1+	Big Canyon	70K ADCWT 80K CWT only
4	Lyons Ferry	150,000	1+	Captain John Rapids	70K ADCWT 80K CWT only
5	Lyons Ferry	200,000	0+	Onstation	200K ADCWT
6	Lyons Ferry	500,000	0+	Captain John Rapids	100K ADCWT 100K CWT only 300K Unmarked
7	Lyons Ferry	500,000	0+	Big Canyon	100K ADCWT 100K CWT only 300K Unmarked
8	Lyons Ferry	200,000	0+	Pittsburg Landing	100K ADCWT 100K CWT only
9	Oxbow	200,000	0+	Hells Canyon Dam	200K ADCWT
10	Lyons Ferry	200,000	0+	Pittsburg Landing	200K Unmarked
11	Lyons Ferry	200,000	0+	Captain John Rapids 2nd Release	200K ADCWT
~~12~~	~~DNFH/Umatilla~~	~~250,000~~	~~0+~~	~~Transportation Study[b,c]~~	~~250K PIT Tag only~~
13	Irrigon[d]	200,000	0+	Grande Ronde River	200K ADCWT
~~14~~	~~DNFH/Umatilla~~	~~78,000~~	~~0+~~	~~Transportation Study[b,c]~~	~~78K PIT tag only~~
15	Umatilla	200,000	0+	Hells Canyon Dam	200K ADCWT
16	Irrigon[d]	200,000	0+	Grande Ronde River	200K Unmarked
17	Umatilla	600,000	0+	Hells Canyon Dam	600K AD only
TOTAL	**Yearlings**	**900,000**			
	Subyearlings	**3,200,000[e]**			

Footnotes for Table B4B:

[a] The Parties expect that fisheries conducted in accordance with the harvest provisions of this Agreement will not compromise broodstock acquisition. If broodstock acquisition is nevertheless compromised by the current mark strategy and as a result of implementation of mark selective fisheries for fall Chinook salmon in the ocean or Columbia/Snake River mainstem, the Parties will revisit the marking strategy during the course of this Agreement.

[b] Production of transportation study surrogates is in effect for five brood years. After this group of fish has been provided for five years the transportation study group will be removed from the table and the groups of fish below will move up one step in priority. If eggs available for subyearling production are 1.2M or less, production of the transportation study surrogate group will be reduced to 250K or be deferred for that year. The PAC will review broodstock collected and projected egg take and make a recommendation to the policy group on whether to provide 250,000 fish or defer by November 1.

[c] USACOE Transportation Study natural-origin surrogate groups direct stream released into the Clearwater and mainstem Snake River.

[d] For logistical purposes, fish may be reared at Irrigon (LSRCP).

[e] Total does not include 328,000 from Transportation Study.

Appendix G: LFH 2016 Broodstock PBT Tissue Samples

Appendix G Table 1: Lyons Ferry Hatchery 2016 broodstock PBT tissue samples by fish ID number.

Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID
0001	22078	0062	22118	0117	22158	0165	22199
0002	22079	0063	22119	0118	22160	0166	22200
0003	22080	0066	22120	0119	22161	0167	22201
0004	22081	0067	22121	0122	22162	0168	22202
0005	22082	0068	22122	0123	22163	0169	22203
0006	22083	0071	22123	0124	22164	0170	22204
0007	22084	0072	22124	0125	22165	0171	22205
0008	22085	0075	22125	0126	22166	0172	22206
0009	22086	0076	22126	0127	22167	0174	22207
0010	22087	0078	22127	0128	22168	0175	22208
0011	22088	0079	22128	0129	22169	0176	22209
0012	22089	0080	22129	0131	22170	0177	22210
0013	22090	0081	22130	0133	22171	0178	22211
0014	22091	0082	22131	0134	22172	0179	22212
0015	22092	0083	22132	0135	22173	0180	22213
0016	22093	0084	22133	0136	22174	0181	22214
0017	22094	0085	22134	0137	22175	0182	22215
0020	22095	0086	22135	0138	22176	0183	22216
0022	22096	0087	22136	0139	22177	0184	22217
0024	22097	0089	22137	0141	22178	0185	22218
0025	22098	0090	22138	0142	22179	0186	22219
0026	22099	0091	22139	0143	22180	0188	22220
0028	22100	0092	22140	0144	22181	0189	22221
0029	22101	0096	22141	0147	22182	0191	22222
0030	22102	0097	22142	0148	22183	0192	22223
0031	22103	0099	22143	0149	22184	0193	22224
0036	22104	0100	22144	0151	22185	0201	M5601
0038	22105	0101	22145	0152	22186	0202	M5603
0039	22106	0102	22146	0153	22187	0203	M5602
0040	22107	0103	22147	0154	22188	0204	1001
0041	22108	0104	22148	0155	22189	0205	1002
0045	22109	0105	22149	0156	22190	0206	1003
0049	22110	0106	22150	0157	22191	0207	M5604
0051	22111	0107	22151	0158	22192	0208	M5605
0052	22112	0111	22152	0159	22193	0209	M5606
0055	22113	0112	22153	0160	22194	0210	M5607
0057	22114	0113	22154	0161	22195	0211	1004
0059	22115	0114	22155	0162	22196	0212	1005
0060	22116	0115	22156	0163	22197	0213	1007
0061	22117	0116	22157	0164	22198	0214	1008

Appendix G Table 1: Lyons Ferry Hatchery 2016 broodstock PBT tissue samples by fish ID number.

Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID
0215	1006	0256	1019	0299	1058	0339	1095
0216	1009	0258	1030	0300	1055	0340	1071
0217	M5609	0259	1018	0301	1066	0341	M5645
0218	M5611	0260	M5632	0302	1067	0342	1076
0219	M5608	0261	M5627	0303	1049	0343	1083
0220	M5610	0262	M5625	0304	1052	0344	1082
0221	1010	0263	M5634	0305	1047	0345	M5646
0222	1011	0264	M5624	0306	M5640	0346	M5647
0223	M5613	0265	1034	0307	1051	0347	1096
0224	M5614	0266	M5635	0308	1050	0348	1098
0225	M5612	0268	1033	0309	1069	0349	1099
0226	M5615	0269	1031	0310	M5642	0350	M5649
0227	M5617	0270	1038	0311	1072	0351	1100
0228	1012	0271	M5633	0312	M5643	0352	1102
0229	1014	0272	1035	0313	1070	0353	M5650
0230	M5616	0273	1039	0314	1068	0354	1103
0231	1015	0274	1032	0315	1048	0355	1101
0232	1013	0275	1036	0316	1075	0356	1097
0233	1017	0276	1042	0317	1046	0357	M5655
0234	1016	0277	1043	0318	M5644	0358	M5654
0235	M5620	0278	1037	0319	M5639	0359	1106
0236	M5618	0279	M5636	0320	1077	0360	1108
0237	M5622	0280	1045	0321	1079	0361	M5651
0238	M5619	0281	1040	0322	M5641	0362	1105
0239	M5621	0282	1041	0323	1078	0363	1107
0241	M5623	0283	M5637	0324	1074	0364	M5653
0242	M5628	0284	1044	0325	1073	0365	M5648
0243	M5626	0285	M5638	0326	1081	0366	1104
0244	1024	0287	1027	0327	1084	0367	M5652
0245	1025	0288	1060	0328	1085	0368	M5656
0246	1023	0289	1059	0329	1086	0369	M5657
0247	M5629	0290	1053	0330	1087	0370	1109
0248	1022	0291	1056	0331	1088	0371	1110
0249	M5630	0292	1057	0332	1089	0372	1111
0250	1028	0293	1061	0333	1090	0373	M5659
0251	1020	0294	1063	0334	1091	0374	M5658
0252	1026	0295	1062	0335	1092	0375	1112
0253	1021	0296	1065	0336	1093	0376	1113
0254	1029	0297	1064	0337	1080	0377	M5660
0255	M5631	0298	1054	0338	1094	0378	M5661

Appendix G Table 1: Lyons Ferry Hatchery 2016 broodstock PBT tissue samples by fish ID number.

Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID
0379	M5662	0419	1145	0459	1168	0499	1201
0380	1118	0420	1141	0460	1169	0500	1196
0381	1114	0421	M5675	0461	1170	0501	1203
0382	1117	0422	1143	0462	M5688	0502	M5696
0383	1115	0423	1147	0463	M5689	0503	1206
0384	1116	0424	1146	0464	1171	0504	1208
0385	1120	0425	M5673	0465	1174	0505	1200
0386	1119	0426	1149	0466	1173	0506	1207
0387	1121	0427	M5674	0467	1172	0507	M5695
0388	M5663	0428	1148	0468	1176	0508	1205
0389	M5664	0429	M5676	0469	1175	0509	1204
0390	M5665	0430	M5677	0470	1177	0510	22500
0391	M5666	0431	M5678	0471	1178	0511	2001
0392	1122	0432	M5679	0472	1179	0512	2002
0393	M5667	0433	M5680	0473	1180	0513	2003
0394	M5668	0434	1157	0474	1181	0514	M5701
0395	M5670	0435	1158	0475	1182	0515	2004
0396	M5671	0436	1153	0476	1183	0516	2007
0397	M5669	0437	1154	0477	1184	0517	M5707
0398	1123	0438	1156	0478	1185	0518	M5703
0399	M5672	0439	1150	0479	1186	0519	M5706
0400	1127	0440	1155	0480	1187	0520	M5700
0401	1124	0441	1152	0481	1188	0521	M5710
0402	1125	0442	1151	0482	M5693	0522	M5712
0403	1126	0443	M5681	0483	M5691	0523	2010
0404	1128	0444	M5682	0484	M5690	0524	M5702
0405	1129	0445	M5683	0485	1189	0525	2011
0406	1130	0446	M5684	0486	M5692	0526	2009
0407	1131	0447	1159	0487	1190	0527	M5704
0408	1134	0448	1160	0488	1191	0528	M5711
0409	1132	0449	1161	0489	1193	0529	M5714
0410	1133	0450	1162	0490	1195	0531	M5716
0411	1135	0451	1163	0491	1194	0532	M5715
0412	1136	0452	1164	0492	1192	0533	2013
0413	1137	0453	1165	0493	M5694	0534	M5718
0414	1138	0454	M5686	0494	1197	0535	M5719
0415	1139	0455	M5687	0495	1202	0536	2012
0416	1140	0456	M5685	0496	1199	0537	2014
0417	1142	0457	1167	0497	1198	0538	M5720
0418	1144	0458	1166	0498	M5697	0539	M5717

Appendix G Table 1: Lyons Ferry Hatchery 2016 broodstock PBT tissue samples by fish ID number.

Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID
0540	2019	0580	M5731	0620	2054	0660	M5766
0541	M5723	0581	M5728	0621	2053	0661	M5765
0542	2016	0582	M5734	0622	M5754	0662	2081
0543	M5699	0583	M5729A	0623	2050	0663	2082
0544	2017	0584	M5735	0624	2058	0664	2083
0545	M5721	0585	2036	0625	2059	0665	M5767
0546	M5722	0586	2037	0626	2060	0666	22539
0547	2018	0587	M5736	0627	2052	0667	22542
0548	2008	0588	2038	0628	2061	0668	2084
0549	2015	0589	2039	0629	2051	0669	M5771
0550	M5713	0590	2040	0630	M5755	0670	2085
0551	M5708	0591	M5737	0631	M5759	0671	M5770
0552	M5724	0592	2041	0632	M5756	0672	M5772
0553	2005	0593	2042	0633	M5757	0673	M5769
0554	M5725	0594	2043	0634	M5758	0674	M5773
0555	2006	0595	M5738	0635	M5760	0675	2086
0556	M5705	0596	2045	0636	2068	0676	2087
0557	M5709	0597	2044	0637	2070	0677	M5768
0558	2020	0598	M5741	0638	M5764	0678	M5775
0559	M5698	0599	M5743	0639	2069	0679	M5776
0560	2022	0600	M5739	0640	2074	0680	2092
0561	M5726	0601	M5742	0641	2077	0681	2090
0562	2021	0602	M5746	0642	M5762	0682	M5774
0563	2024	0603	M5745	0643	2072	0683	2091
0564	2023	0604	M5744	0644	2075	0684	2089
0565	2025	0605	2047	0645	2073	0685	2088
0566	2026	0606	M5740	0646	M5763	0686	22549
0567	M5729	0607	2046	0647	2076	0687	22550
0568	2029	0608	2048	0648	2079	0688	22551
0569	2033	0609	M5749	0649	2080	0689	M5777
0570	2027	0610	M5747	0650	M5761	0690	M5778
0571	2032	0611	2049	0651	2066	0691	2093
0572	2028	0612	M5748	0652	2078	0692	M5779
0573	M5732	0613	M5750	0653	2071	0693	M5780
0574	2034	0614	M5751	0654	2067	0694	M5781
0575	2030	0615	M5752	0655	2064	0695	M5782
0576	2035	0616	2055	0656	2065	0696	2095
0577	M5733	0617	2056	0657	2062	0697	2097
0578	2031	0618	M5753	0658	2063	0698	M5783
0579	M5730	0619	2057	0659	22534	0699	2101

Appendix G Table 1: Lyons Ferry Hatchery 2016 broodstock PBT tissue samples by fish ID number.

Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID
0700	2103	0740	2139	0780	M5801	0820	M5806
0701	2100	0741	2129	0781	2160	0821	M5807
0702	2107	0742	2135	0782	2166	0822	M5808
0703	2106	0743	2131	0783	2163	0823	M5810
0704	M5784	0744	2125	0784	M5800	0824	M5809
0705	2108	0745	2113	0785	2165	0825	M5811
0706	2110	0746	2099	0786	2167	0826	2192
0707	M5785	0747	2109	0787	2164	0827	2193
0708	2104	0748	2112	0788	M5799	0828	2194
0709	2102	0749	2098	0789	2168	0829	2195
0710	2105	0750	2096	0790	M5794	0830	M5812
0711	2111	0751	M5793	0791	2171	0831	2196
0712	2115	0752	2094	0792	2169	0832	2197
0713	2116	0753	2142	0793	M5798	0833	2198
0714	2120	0754	M5791	0794	2170	0834	2199
0715	2122	0755	2143	0795	2172	0835	2200
0716	22554	0756	M5792	0796	M5802	0836	2201
0717	2114	0757	2123	0797	2175	0837	2202
0718	2121	0758	2145	0798	2173	0838	M5813
0719	2118	0759	2144	0799	M5805	0839	M5815
0720	M5786	0760	2149	0800	2174	0840	M5819
0721	2119	0761	2148	0801	2177	0841	M5814
0722	M5787	0762	2147	0802	M5804	0842	M5822
0723	2124	0763	2146	0803	2178	0843	2203
0724	2117	0764	M5796	0804	2176	0844	2205
0725	2126	0765	2150	0805	M5803	0845	M5823
0726	2127	0766	M5795	0806	2179	0846	2204
0727	M5790	0767	22555	0807	2180	0847	2207
0728	M5789	0768	2151	0808	2181	0848	M5824
0729	2128	0769	2152	0809	2182	0849	2214
0730	2130	0770	2154	0810	2184	0850	2217
0731	2133	0771	2156	0811	2186	0851	M5821
0732	M5788	0772	2157	0812	2187	0852	2213
0733	2134	0773	M5797	0813	2190	0853	2218
0734	2136	0774	2158	0814	2188	0854	2215
0735	2137	0775	2153	0815	2189	0855	2223
0736	2138	0776	2155	0816	2191	0856	2224
0737	2140	0777	2159	0817	2185	0857	M5820
0738	2132	0778	2162	0818	2183	0858	2219
0739	2141	0779	2161	0819	22562	0859	M5818

Appendix G Table 1: Lyons Ferry Hatchery 2016 broodstock PBT tissue samples by fish ID number.

Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID
0860	2221	0900	2250	0940	M5846	0980	M5840
0861	2208	0901	M5825	0941	2276	0982	2296
0862	2209	0902	M5838	0942	2278	0983	M5869
0863	M5826	0903	2251	0943	M5849	0984	2297
0864	2210	0904	2257	0944	2280	0985	M5842
0865	2206	0905	2259	0945	2283	0986	2303
0866	2226	0906	2253	0946	2284	0987	2302
0867	M5829	0907	M5837	0947	M5853	0988	M5866
0868	2228	0908	2247	0948	M5855	0989	2306
0869	2225	0909	2258	0949	2273	0990	2308
0870	2230	0910	2239	0950	2287	0991	2307
0871	2216	0911	2263	0951	M5858	0992	2304
0872	M5830	0912	2256	0952	2281	0993	M5873
0873	2231	0913	2260	0953	2279	0994	M5877
0874	M5831	0914	2265	0954	2277	0995	2312
0875	2229	0915	2266	0955	2286	0996	M5878
0876	2232	0916	2262	0956	M5856	0997	2310
0877	M5816	0917	2264	0957	M5857	0998	2317
0878	M5817	0918	2254	0958	2285	0999	2319
0879	2227	0919	2261	0959	M5860	1000	M5859
0880	2220	0920	2242	0960	2282	1001	M5876
0881	2222	0921	2255	0961	2291	1002	2320
0882	2211	0922	2245	0962	M5863	1003	2321
0883	2212	0923	2235	0963	2288	1004	M5870
0884	M5832	0924	2238	0964	M5861	1005	2326
0885	2233	0925	2243	0965	2290	1006	2325
0886	M5833	0926	2248	0966	2275	1007	M5854
0887	2236	0927	2249	0967	2292	1008	M5872
0888	2240	0928	M5839	0968	M5850	1009	2327
0889	M5835	0929	M5841	0969	2289	1010	M5874
0890	2234	0930	M5845	0970	2295	1011	2324
0891	M5828	0931	2267	0971	M5862	1012	2323
0892	M5827	0932	M5844	0972	2298	1013	2322
0893	2241	0933	2268	0973	2299	1014	M5880
0894	M5834	0934	2269	0974	2294	1015	2318
0895	2244	0935	M5847	0975	M5867	1016	2328
0896	2246	0936	2271	0976	2293	1017	2330
0897	2237	0937	M5848	0977	M5851	1018	2329
0898	M5836	0938	2272	0978	2300	1019	M5881
0899	2252	0939	2274	0979	2270	1020	2331

Appendix G Table 1: Lyons Ferry Hatchery 2016 broodstock PBT tissue samples by fish ID number.

Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID
1021	M5868	1061	M5888	1101	M5894	1213	3009
1022	M5875	1062	2315	1102	22569	1214	3012
1023	2314	1063	2347	1103	2357	1215	3014
1024	M5879	1064	2363	1104	2389	1216	M5897
1025	2332	1065	M5889	1105	2369	1217	3013
1026	M5852	1066	2355	1106	22570	1218	3015
1027	2333	1067	2354	1107	2394	1219	M5902
1028	2338	1068	2358	1108	22571	1220	3018
1029	2337	1069	2356	1109	2316	1221	M5901
1030	2335	1070	2359	1110	2397	1222	3021
1031	2336	1071	M5886	1111	22572	1223	3022
1032	2334	1072	2361	1112	2400	1224	M5904
1033	2339	1073	M5890	1113	2399	1225	3011
1034	2340	1074	2367	1114	2398	1226	3010
1035	M5883	1075	2368	1115	2393	1227	M5903
1036	2342	1076	2365	1116	2396	1228	3020
1037	2341	1077	2376	1117	M5871	1229	3023
1038	2301	1078	22566	1118	2391	1230	3019
1039	2346	1079	2372	1119	2311	1231	3024
1040	2344	1080	M5892	1120	2392	1232	M5905
1041	M5843	1081	2380	1121	2366	1233	3027
1042	M5882	1082	M5891	1122	2390	1234	3030
1043	M5884	1083	2375	1123	2388	1235	M5906
1044	2351	1084	2371	1124	2382	1236	3028
1045	22563	1085	2378	1125	2395	1237	M5907
1046	2348	1086	2384	1126	M5865	1238	3029
1047	2349	1087	2385	1127	2373	1239	3031
1048	22565	1088	2343	1128	M5864	1240	M5909
1049	22564	1089	2383	1201	3001	1241	3032
1050	2313	1090	2387	1202	M5895	1242	M5910
1051	2352	1091	2381	1203	3002	1243	3033
1052	2353	1092	2379	1204	M5896	1244	3034
1053	M5887	1093	M5893	1205	3003	1245	M5911
1054	2350	1094	2374	1206	3017	1246	3035
1055	2305	1095	22567	1207	M5898	1247	3036
1056	M5885	1096	2377	1208	3005	1248	M5908
1057	2362	1097	22568	1209	M5899	1249	3037
1058	2345	1098	2386	1210	3006	1250	3004
1059	2360	1099	2364	1211	3008	1251	M5913
1060	2309	1100	2370	1212	M5900	1252	3039

Appendix G Table 1: Lyons Ferry Hatchery 2016 broodstock PBT tissue samples by fish ID number.

Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID
1253	3038	1293	M5933	1333	M5938	1373	3125
1254	M5915	1294	3058	1334	M5941	1374	3116
1255	3041	1295	3061	1335	3090	1375	3127
1256	M5912	1296	M5935	1336	3091	1376	3115
1257	3025	1297	3057	1337	M5940	1377	3128
1258	3040	1298	3064	1338	3093	1378	3126
1259	M5916	1299	M5931	1339	3094	1379	3123
1260	3026	1300	3062	1340	M5939	1380	3131
1261	3007	1301	3065	1341	3095	1381	3099
1262	M5917	1302	M5929	1342	M5945	1382	3129
1263	3016	1303	3066	1343	3092	1383	3132
1264	M5921	1304	3069	1344	3096	1384	3134
1265	3043	1305	3071	1345	3097	1385	3135
1266	3042	1306	M5934	1346	M5946	1386	3130
1267	M5919	1307	3072	1347	3098	1387	3133
1268	3044	1308	M5932	1348	3100	1388	3124
1269	3045	1309	M5928	1349	3104	1389	M5950
1270	M5920	1310	3074	1350	3102	1390	M5951
1271	3046	1311	3076	1351	3106	1391	M5949
1272	M5922	1312	3073	1352	3107	1392	M5948
1273	3049	1313	3075	1353	3101	1393	M5953
1274	3047	1314	3067	1354	3103	1394	M5954
1275	M5918	1315	3070	1355	3108	1395	3136
1276	3048	1316	3077	1356	3105	1396	3137
1277	M5924	1317	3068	1357	3110	1397	M5955
1278	3050	1318	3063	1358	M5942	1398	3138
1279	M5926	1319	M5936	1359	3109	1399	3140
1280	M5927	1320	3079	1360	3114	1400	M5952
1281	3051	1321	3080	1361	M5947	1401	3142
1282	3053	1322	3082	1362	3112	1402	3143
1283	M5914	1323	3078	1363	M5943	1403	3141
1284	3052	1324	M5937	1364	3113	1404	3147
1285	M5923	1325	3083	1365	3118	1405	3146
1286	3055	1326	3084	1366	M5944	1406	3148
1287	3054	1327	3085	1367	3119	1407	3149
1288	M5925	1328	3087	1368	3121	1408	3144
1289	3056	1329	3088	1369	3117	1409	M5956
1290	3059	1330	3089	1370	3111	1410	3153
1291	M5930	1331	3086	1371	3122	1411	M5958
1292	3060	1332	3081	1372	3120	1412	M5960

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Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID
1413	3156	1453	M5974	1493	3204	1533	M5993
1414	M5959	1454	3182	1494	3206	1534	3236
1415	3158	1455	M5967	1495	3207	1535	3237
1416	M5962	1456	3181	1496	3199	1536	M5995
1417	3163	1457	M5976	1497	3208	1537	3238
1418	3161	1458	3183	1498	3205	1538	3239
1419	3165	1459	3184	1499	3209	1539	3240
1420	3166	1460	3188	1500	3210	1540	M5996
1421	M5965	1461	M5961	1501	3212	1541	3244
1422	3167	1462	3189	1502	3213	1542	M5997
1423	3168	1463	M5968	1503	3211	1543	3241
1424	3170	1464	3179	1504	3215	1544	M5994
1425	M5969	1465	3187	1505	3216	1545	M5991
1426	3171	1466	3186	1506	3214	1546	3246
1427	3169	1467	3193	1507	3218	1547	3243
1428	M5970	1468	3139	1508	3217	1548	3248
1429	3162	1469	3178	1509	3219	1549	3245
1430	M5966	1470	3190	1510	3220	1550	3253
1431	3157	1471	3154	1511	3221	1551	3247
1432	3159	1472	3185	1512	3222	1552	3242
1433	3172	1473	3191	1513	3223	1553	3249
1434	M5964	1474	3194	1514	3224	1554	3251
1435	3173	1475	3192	1515	3225	1555	3252
1436	3160	1476	3145	1516	3226	1556	3254
1437	M5957	1477	M5978	1517	3227	1557	3254A
1438	3174	1478	M5977	1518	M5985	1558	3250
1439	3151	1479	M5980	1519	3228	1559	3259
1440	M5963	1480	3196	1520	M5989	1560	M5998
1441	3164	1481	M5981	1521	3229	1561	M6005
1442	M5971	1482	3197	1522	M5988	1562	3263
1443	3155	1483	M5979	1523	M5987	1563	M6008
1444	M5973	1484	3195	1524	M5986	1564	3256
1445	3152	1485	3198	1525	3230	1565	M6002
1446	3175	1486	M5983	1526	3232	1566	3268
1447	3176	1487	3201	1527	M5990	1567	22576
1448	3150	1488	M5984	1528	3234	1568	M6013
1449	M5972	1489	3200	1529	3233	1569	3257
1450	3177	1490	3202	1530	3231	1570	3271
1451	M5975	1491	M5982	1531	M5992	1571	M6007
1452	3180	1492	3203	1532	3235	1572	3273

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Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID
1573	M6001	1613	3304	1654	3328	1694	4024
1574	M6006	1614	M6022	1655	3331	1695	M6052
1575	M6012	1615	3275	1656	3278	1696	4018
1576	3284	1616	M6025	1657	3329	1697	4028
1577	3282	1617	M6021	1658	3322	1698	M6055
1578	3281	1618	3303	1659	3308	1699	4029
1579	M5999	1619	3269	1660	3326	1700	4031
1580	M6015	1620	3264	1661	3267	1701	M6059
1581	M6016	1621	3261	1662	3287	1702	4032
1582	3289	1622	M6026	1663	3277	1703	M6043
1583	M6003	1623	M6028	1664	3274	1704	4033
1584	3286	1624	3310	1665	3266	1705	4037
1585	M6010	1625	3311	1666	3260	1706	M6060
1586	3285	1627	3320	1667	3258	1707	4045
1587	M6014	1628	3319	1668	3262	1708	M6049
1588	3280	1629	M6027	1669	3255	1709	4046
1589	3272	1630	3314	1670	M6000	1710	M6045
1590	3276	1631	M6029	1671	M6030	1711	4026
1591	M6019	1632	3312	1672	4001	1712	M6057
1592	M6011	1633	3313	1673	4002	1713	4051
1593	M6020	1634	3316	1674	4003	1714	4050
1594	3293	1635	3307	1675	M6032	1715	M6048
1595	3265	1636	3317	1676	4004	1716	4052
1596	M6018	1637	3318	1677	4008	1717	4047
1597	M6017	1638	3309	1678	4010	1718	4060
1598	M6023	1639	3315	1679	M6037	1719	4039
1599	3297	1640	3292	1680	4007	1720	M6063
1600	3295	1641	3321	1681	4013	1721	4058
1601	3298	1642	3323	1682	M6039	1722	M6065
1602	3299	1643	3327	1683	M6040	1723	M6068
1603	M6024	1644	3324	1684	4011	1724	4041
1604	M6004	1645	3270	1685	M6041	1725	4053
1605	3296	1646	3330	1686	4006	1726	4054
1606	3301	1647	3325	1687	M6031	1727	M6069
1607	3300	1648	3283	1688	4019	1728	4056
1608	M6009	1649	3288	1689	4016	1729	4049
1609	3305	1650	3279	1690	4020	1730	M6075
1610	3306	1651	3291	1691	M6047	1731	M6071
1611	3294	1652	3290	1692	M6042	1732	4040
1612	3302	1653	3332	1693	4023	1733	4042

Appendix G Table 1: Lyons Ferry Hatchery 2016 broodstock PBT tissue samples by fish ID number.

Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID
1734	4036	1774	4067	1814	4092	1854	M6137
1735	4061	1775	4070	1815	4097	1855	4122
1736	4048	1776	M6100	1816	4108	1856	4123
1737	M6087	1777	4069	1817	4104	1857	M6136
1738	M6061	1778	4071	1818	M6121	1858	4126
1739	M6034	1779	4072	1819	4110	1859	M6132
1740	M6084	1780	M6092	1820	4106	1860	4129
1741	4044	1781	4073	1821	4096	1861	4128
1742	M6073	1782	4074	1822	M6122	1862	M6128
1743	M6080	1783	4075	1823	M6123	1863	M6134
1744	M6079	1784	M6109	1824	4099	1864	4127
1745	M6086	1785	4076	1825	4109	1865	4117
1746	M6078	1786	M6104	1826	4101	1866	M6125
1747	M6070	1787	M6095	1827	4105	1867	M6106
1748	M6064	1788	M6114	1828	4077	1868	4125
1749	4025	1789	M6113	1829	M6127	1869	4124
1750	M6081	1790	M6105	1830	M6129	1870	4130
1751	M6035	1791	M6090	1831	4082	1871	M6124
1752	M6083	1792	4083	1832	4107	1872	22583
1753	M6067	1793	M6099	1833	4078	1873	M6120
1754	22581	1794	M6118	1834	4086	1874	M6116
1755	4055	1795	4084	1835	M6131	1875	M6115
1756	M6076	1796	M6103	1836	4090	1876	4103
1757	M6085	1797	4088	1837	4087	1877	M6112
1758	M6082	1798	4085	1838	M6130	1878	M6119
1759	4009	1799	M6108	1839	4111	1879	M6110
1760	M6088	1800	4081	1840	4112	1880	M6102
1761	M6062	1801	4080	1841	M6133	1881	4066
1762	M6058	1802	M6107	1842	4079	1882	M6101
1763	M6089	1803	4091	1843	4114	1883	M6093
1764	M6091	1804	4093	1844	4113	1884	M6096
1765	M6072	1805	4089	1845	4115	1885	M6094
1766	4062	1806	4094	1846	4116	1886	M6066
1767	M6074	1807	4095	1847	4118	1887	M6053
1768	4063	1808	4098	1848	M6126	1888	4059
1769	4065	1809	M6111	1849	M6135	1889	4038
1770	M6077	1810	4102	1850	4120	1890	4043
1771	M6097	1811	M6117	1851	4119	1891	4030
1772	4064	1812	4100	1852	M6138	1892	4057
1773	4068	1813	M6098	1853	4121	1893	M6051

Appendix G Table 1: Lyons Ferry Hatchery 2016 broodstock PBT tissue samples by fish ID number.

Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID
1894	M6044	1934	4153	1974	M6183	2014	22584
1895	4034	1935	4155	1975	4183	2015	M6176
1896	4027	1936	M6158	1976	4182	2016	4161
1897	M6054	1937	M6153	1977	M6185	2017	M6164
1898	M6056	1938	4157	1978	M6182	2018	4165
1899	4035	1939	4158	1979	4185	2019	M6162
1900	M6046	1940	M6165	1980	4186	2020	M6167
1901	4022	1941	M6166	1981	M6186	2021	4163
1902	4021	1942	4160	1982	4189	2022	4159
1903	4014	1943	4164	1983	M6188	2023	4162
1904	M6036	1944	M6168	1984	4187	2024	4149
1905	M6050	1945	M6151	1985	4188	2025	4148
1906	4012	1946	4167	1986	4184	2026	M6155
1907	M6038	1947	4170	1987	M6181	2027	4145
1908	4005	1948	4168	1988	4179	2028	M6147
1909	M6033	1949	M6156	1989	4181	2029	M6143
1910	M6139	1950	M6160	1990	M6189	2030	M6144
1911	4015	1951	4171	1991	4176	2031	M6192
1912	4017	1952	4172	1992	M6187	2032	4190
1913	M6140	1953	4166	1993	M6173	2033	M6200
1914	4131	1954	4169	1994	4178	2034	4194
1915	4135	1955	4156	1995	M6184	2035	4192
1916	M6142	1956	M6141	1996	M6148	2036	M6202
1917	4133	1957	4146	1997	M6191	2037	4197
1918	4132	1958	M6159	1998	M6146	2038	4193
1919	4141	1959	4144	1999	M6174	2039	M6201
1920	4137	1960	M6171	2000	4180	2040	4195
1921	M6145	1961	4139	2001	M6190	2041	M6199
1922	4142	1962	4154	2002	M6177	2042	4196
1923	4143	1963	4152	2003	M6193	2043	M6204
1924	M6149	1964	M6170	2004	M6195	2044	4191
1925	M6152	1965	M6161	2005	M6178	2045	4200
1926	M6154	1966	4140	2006	M6179	2046	M6206
1927	4147	1967	M6172	2007	M6194	2047	4202
1928	4138	1968	4134	2008	M6180	2048	4204
1929	M6157	1969	4174	2009	M6197	2049	M6211
1930	4151	1970	4175	2010	M6196	2050	4205
1931	4136	1971	M6169	2011	M6175	2051	4203
1932	4150	1972	4173	2012	M6163	2052	M6209
1933	M6150	1973	4177	2013	M6198	2053	4212

Appendix G Table 1: Lyons Ferry Hatchery 2016 broodstock PBT tissue samples by fish ID number.

Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID
2054	M6203	2094	4234	2134	4258	2174	M6259
2055	4207	2095	M6223	2135	4250	2175	M6258
2056	M6210	2096	4230	2136	4248	2176	M6249
2057	4208	2097	4239	2137	4247	2177	5013
2058	M6208	2098	M6225	2138	4249	2178	5014
2059	4211	2099	4235	2139	4245	2179	5015
2060	4209	2100	4232	2140	4246	2180	M6260
2061	M6205	2101	M6227	2141	5003	2181	5016
2062	4201	2102	4237	2142	5002	2182	M6262
2063	4210	2103	M6220	2143	M6251	2183	M6261
2064	M6213	2104	4231	2144	M6250	2184	5017
2065	4198	2105	M6235	2145	5005	2185	M6264
2066	M6215	2106	4242	2146	M6242	2186	5018
2067	4199	2107	4241	2147	5009	2187	M6263
2068	4214	2108	M6233	2148	M6254	2188	22591
2069	M6207	2109	4240	2149	5007	2189	M6265
2070	4215	2110	M6232	2150	5008	2190	M6266
2071	M6214	2111	4233	2151	5004	2191	5019
2072	4213	2112	4236	2152	M6244	2192	5020
2073	4216	2113	M6234	2153	M6252	2193	M6267
2074	M6216	2114	4219	2154	5010	2194	M6268
2075	4217	2115	M6230	2155	M6253	2195	M6271
2076	M6217	2116	M6226	2156	M6255	2196	M6272
2077	4206	2117	4228	2157	5011	2197	M6273
2078	4220	2118	M6231	2158	5006	2198	5021
2079	M6212	2119	4243	2159	M6248	2199	M6270
2080	4223	2120	M6228	2160	M6246	2200	5023
2081	M6219	2121	4244	2161	M6256	2201	5022
2082	4224	2122	4238	2162	M6241	2202	5026
2083	M6222	2123	M6229	2163	M6257	2203	5024
2084	4227	2124	4253	2164	M6243	2204	M6274
2085	4225	2125	4252	2165	5001	2205	5027
2086	M6224	2126	4255	2166	M6240	2206	5029
2087	4226	2127	4251	2167	M6238	2207	5028
2088	M6221	2128	4256	2168	M6237	2208	M6269
2089	4221	2129	4254	2169	M6245	2209	M6277
2090	4222	2130	4257	2170	5012	2210	M6276
2091	4218	2131	4259	2171	M6239	2211	M6275
2092	M6218	2132	4260	2172	M6247	2212	5025
2093	4229	2133	4261	2173	M6236	2213	5030

Appendix G Table 1: Lyons Ferry Hatchery 2016 broodstock PBT tissue samples by fish ID number.

Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID	Genetic ID	Fish ID
2214	5031	2216	5033	2217	5035	2218	5034
2215	5032						

Appendix H: Historical Size at Age of Return of CWT LSRCP Origin Fish Processed by WDFW: 1985-2015

(Size at return of fish processed may not represent the full run depending upon trapping and sampling protocols. WDFW and LSRCP releases are included. Historical recoveries (1985-1987) of subyearling fall Chinook salmon released from Hagerman National Fish hatchery are not included. Caution must be taken when comparing historical data because of changes in the program including addition of releases upstream of LGR. Another item for consideration is the BY89 which was progeny from broodstock consisting of a large proportion of strays. Although the BY89 is presented in Appendix I, they were never used as broodstock when they returned.)

Appendix H Table 1: Size at age of return in 1985-1990 by sex for CWT LSRCP fish processed by WDFW that were from yearling production.

Return year	Sex		Total age at return					
			2(Minijack)	3(Jack)	4	5	6	7
1985	Male	N=	1870	-	-	-	-	-
		Median (cm)	**35**	**-**	**-**	**-**	**-**	**-**
		Range (cm)	29-53	-	-	-	-	-
	Female	N=	15	-	-	-	-	-
		Median (cm)	**35**	**-**	**-**	**-**	**-**	**-**
		Range (cm)	30-40	-	-	-	-	-
1986	Male	N=	48	636	-	-	-	-
		Median (cm)	**36**	**57**	**-**	**-**	**-**	**-**
		Range (cm)	31-40	37-70	-	-	-	-
	Female	N=	-	15	-	-	-	-
		Median (cm)	**-**	**63**	**-**	**-**	**-**	**-**
		Range (cm)	-	50-73	-	-	-	-
1987	Male	N=	241	88	552	-	-	-
		Median (cm)	**36**	**54**	**80**	**-**	**-**	**-**
		Range (cm)	29-49	40-64	41-100	-	-	-
	Female	N=	1	1	867	-	-	-
		Median (cm)	**-**	**-**	**78**	**-**	**-**	**-**
		Range (cm)	35	66	46-98	-	-	-
1988	Male	N=	225	239	55	110	-	-
		Median (cm)	**35**	**55**	**68**	**97**	**-**	**-**
		Range (cm)	26-43	35-66	55-93	55-111	-	-
	Female	N=	-	2	42	165	-	-
		Median (cm)	**-**	**-**	**74**	**88**	**-**	**-**
		Range (cm)	-	64-67	58-90	54-106	-	-
1989	Male	N=	81	226	203	21	3	-
		Median (cm)	**34**	**54**	**70**	**85**	**92**	**-**
		Range (cm)	30-46	33-66	44-93	63-105	84-94	-
	Female	N=	-	4	200	38	4	-
		Median (cm)	**-**	**64**	**75**	**82**	**93**	**-**
		Range (cm)	-	58-66	54-89	60-93	76-104	-
1990	Male	N=	293	75	71	57	2	-
		Median (cm)	**34**	**54**	**73**	**93**	**-**	**-**
		Range (cm)	28-40	43-62	58-93	62-102	103-109	-
	Female	N=	-	2	120	94	1	1
		Median (cm)	**-**	**-**	**75**	**83**	**-**	**-**
		Range (cm)	-	54-61	56-86	68-94	84	89

Appendix H Table 2: Size at age of return in 1991-1996 by sex for CWT LSRCP fish processed by WDFW that were from yearling production.

Return year	Sex		Total age at return					
			2(Minijack)	3(Jack)	4	5	6	7
1991	Male	N=	-	197	71	44	8	-
		Median (cm)	**-**	**52**	**73**	**94**	**89**	**-**
		Range (cm)	-	31-65	45-88	61-109	86-101	-
	Female	N=	-	2	123	89	9	-
		Median (cm)	**-**	**-**	**73**	**81**	**92**	**-**
		Range (cm)	-	57-74	60-86	56-95	79-103	-
1992	Male	N=	129	-	161	22	-	-
		Median (cm)	**34**	**-**	**73**	**89**	**-**	**-**
		Range (cm)	29-39	-	46-110	60-102	-	-
	Female	N=	-	-	241	34	1	-
		Median (cm)	**-**	**-**	**71**	**80**	**85**	**-**
		Range (cm)	-	-	55-90	68-94	85	-
1993	Male	N=	102	58	-	60	1	-
		Median (cm)	**33**	**51**	**-**	**85**	**-**	**-**
		Range (cm)	28-41	40-68	-	51-99	77	-
	Female	N=	-	2	-	102	-	-
		Median (cm)	**-**	**-**	**-**	**80**	**-**	**-**
		Range (cm)	-	53-75	-	67-94	-	-
1994	Male	N=	241	283	54	-	4	-
		Median (cm)	**35**	**53**	**75**	**-**	**83**	**-**
		Range (cm)	29-51	36-82	42-91	-	76-98	-
	Female	N=	-	4	86	-	10	-
		Median (cm)	**-**	**58**	**73**	**-**	**79**	**-**
		Range (cm)	-	57-63	58-86	-	67-92	-
1995	Male	N=	1781	230	26	122	-	-
		Median (cm)	**35**	**55**	**78**	**78**	**-**	**-**
		Range (cm)	22-47	41-72	51-90	57-105	-	-
	Female	N=	-	14	53	175	-	1
		Median (cm)	**-**	**61**	**75**	**75**	**-**	**-**
		Range (cm)	-	56-68	60-90	55-95	-	80
1996	Male	N=	380	374	238	18	2	-
		Median (cm)	**33**	**51**	**72**	**90**	**-**	**-**
		Range (cm)	27-47	37-66	54-98	77-105	77-83	-
	Female	N=	-	20	314	32	1	-
		Median (cm)	**-**	**60**	**74**	**83**	**-**	**-**
		Range (cm)	-	54-80	56-92	70-92	95	-

Appendix H Table 3: Size at age of return in 1997-2002 by sex for CWT LSRCP fish processed by WDFW that were from yearling production.

Return			Total age at return					
year	Sex		2(Minijack)	3(Jack)	4	5	6	7
1997	Male	N=	434	401	224	55	-	-
		Median (cm)	**34**	**50**	**70**	**90**	**-**	-
		Range (cm)	28-40	37-68	48-93	57-104	-	-
	Female	N=	-	-	347	116	2	-
		Median (cm)	**-**	**-**	**73**	**82**	**-**	-
		Range (cm)	-	-	55-89	57-97	77-102	-
1998	Male	N=	136	1770	289	136	2	-
		Median (cm)	**35**	**52**	**70**	**88**	**-**	-
		Range (cm)	22-43	33-73	45-97	56-121	96-98	-
	Female	N=	1	142	301	351	3	-
		Median (cm)	**-**	**57**	**73**	**84**	**77**	-
		Range (cm)	34	49-78	49-91	61-106	76-82	-
1999	Male	N=	358	394	570	42	10	-
		Median (cm)	**36**	**53**	**69**	**88**	**96**	-
		Range (cm)	30-49	37-70	45-95	63-104	76-108	-
	Female	N=	-	14	741	96	27	-
		Median (cm)	**-**	**61**	**72**	**85**	**89**	-
		Range (cm)	-	49-70	53-86	64-96	74-99	-
2000	Male	N=	412	1066	188	97	1	-
		Median (cm)	**36**	**59**	**70**	**88**	**-**	**-**
		Range (cm)	28-44	34-72	55-95	59-110	86	-
	Female	N=	-	110	292	249	4	-
		Median (cm)	**-**	**64**	**77**	**82**	**92**	-
		Range (cm)	-	54-74	54-89	58-94	91-92	-
2001	Male	N=	14	858	221	29	3	1
		Median (cm)	**34**	**57**	**75**	**91**	**97**	**-**
		Range (cm)	32-40	39-74	57-98	69-103	84-103	78
	Female	N=	-	60	614	111	13	-
		Median (cm)	**-**	**63**	**77**	**84**	**92**	-
		Range (cm)	-	52-76	55-95	65-98	79-100	-
2002	Male	N=	219	471	241	35	2	-
		Median (cm)	**35**	**55**	**74**	**98**	**85**	-
		Range (cm)	27-51	40-67	51-96	71-112	73-97	-
	Female	N=	-	6	505	94	3	-
		Median (cm)	**-**	**64**	**77**	**86**	**86**	-
		Range (cm)	-	60-80	51-93	73-97	84-87	-

Appendix H Table 4: Size at age of return in 2003-2008 by sex for CWT LSRCP fish processed by WDFW that were from yearling production.

Return year	Sex		Total age at return 2(Minijack)	3(Jack)	4	5	6	7
2003	Male	N=	690	846	232	24	-	-
		Median (cm)	**35**	**54**	**72**	**88**	**-**	-
		Range (cm)	27-53	31-78	47-90	62-105	-	-
	Female	N=	-	63	269	158	3	-
		Median (cm)	**-**	**62**	**76**	**83**	**90**	-
		Range (cm)	-	45-68	52-88	68-101	85-96	-
2004	Male	N=	329	1444	259	21	3	-
		Median (cm)	**36**	**59**	**69**	**95**	**99**	-
		Range (cm)	30-43	40-74	31-97	60-113	86-101	-
	Female	N=	-	249	513	104	4	-
		Median (cm)	**-**	**64**	**74**	**84**	**88**	-
		Range (cm)	-	44-84	57-91	65-98	70-95	-
2005	Male	N=	438	472	346	69	1	-
		Median (cm)	**36**	**58**	**71**	**84**	**-**	**-**
		Range (cm)	29-47	43-71	50-96	60-106	84	-
	Female	N=	-	55	917	192	7	-
		Median (cm)	**-**	**64**	**77**	**81**	**83**	-
		Range (cm)	-	50-82	52-90	61-95	74-90	-
2006	Male	N=	660	964	109	8	-	-
		Median (cm)	**35**	**59**	**71**	**75**	**-**	-
		Range (cm)	28-45	41-80	56-86	67-95	-	-
	Female	N=	-	125	266	88	8	-
		Median (cm)	**-**	**65**	**76**	**84**	**85**	-
		Range (cm)	-	49-74	60-88	70-99	74-96	-
2007	Male	N=	281	1759	285	5	-	-
		Median (cm)	**33**	**60**	**73**	**83**	**-**	-
		Range (cm)	27-56	42-79	52-98	76-92	-	-
	Female	N=	-	513	780	35	2	-
		Median (cm)	**-**	**63**	**76**	**83**	**-**	-
		Range (cm)	-	50-83	58-96	75-93	80-84	-
2008	Male	N=	1244	723	120	6	-	-
		Median (cm)	**35**	**57**	**75**	**82**	**-**	-
		Range (cm)	28-54	32-79	59-99	75-100	-	-
	Female	N=	-	75	494	58	-	-
		Median (cm)	**-**	**65**	**78**	**83**	**-**	-
		Range (cm)	-	57-80	60-97	62-92	-	-

Appendix H Table 5: Size at age of return in 2009-2014 by sex for CWT LSRCP fish processed by WDFW that were from yearling production.

Return year	Sex		Total age at return					
			2(Minijack)	3(Jack)	4	5	6	7
2009	Male	N=	43	1293	130	5	-	-
		Median (cm)	**34**	**59**	**74**	**89**	**-**	-
		Range (cm)	29-42	39-75	56-92	76-96	-	-
	Female	N=	-	545	389	11	1	-
		Median (cm)	**-**	**65**	**77**	**85**	**-**	-
		Range (cm)	-	53-88	61-90	80-92	80	-
2010	Male	N=	137	201	161	4	1	-
		Median (cm)	**35**	**59**	**77**	**93**	**-**	-
		Range (cm)	30-56	48-77	50-105	84-100	89	-
	Female	N=	-	20	504	20	-	-
		Median (cm)	**-**	**67**	**79**	**86**	**-**	-
		Range (cm)	-	53-74	55-98	72-92	-	-
2011	Male	N=	165	457	155	7	-	-
		Median (cm)	**35**	**57**	**72**	**85**	**-**	**-**
		Range (cm)	32-45	41-72	60-89	78-102	-	-
	Female	N=	-	142	526	53	2	-
		Median	**-**	**64**	**76**	**80**	**-**	**-**
		Range	-	55-79	63-90	66-91	80-87	-
2012	Male	N=	342	438	120	6	-	-
		Median (cm)	**35**	**56**	**69**	**84**	**-**	-
		Range (cm)	28-67	32-69	51-92	56-94	-	-
	Female	N=	-	24	475	59	2	-
		Median (cm)	**-**	**63**	**76**	**83**	**-**	**-**
		Range (cm)	-	50-68	62-89	72-95	77-86	-
2013	Male	N=	260	263	193	10	-	-
		Median (cm)	**35**	**57**	**71**	**79**	**-**	**-**
		Range (cm)	29-54	38-73	52-88	68-90	-	-
	Female	N=	-	60	393	62	1	-
		Median (cm)	**-**	**61**	**72**	**78**	**-**	**-**
		Range (cm)	-	49-85	62-83	68-91	82	-
2014	Male	N=	59	103	100	4	-	-
		Median (cm)	**33**	**55**	**70**	**74**	**-**	**-**
		Range (cm)	29-45	43-68	53-87	57-77	-	-
	Female	N=	-	7	202	12	-	-
		Median (cm)	**-**	**59**	**74**	**82**	**-**	**-**
		Range (cm)	-	54-64	50-84	72-92	-	-

Appendix H Table 6: Size at age of return in 2015 by sex for CWT LSRCP fish processed by WDFW that were from yearling production.

2015	Male	N=	54	66	41	15	-	-
		Median (cm)	**39**	**58**	**73**	**78**	-	-
		Range (cm)	32-46	46-71	54-86	71-86	-	-
	Female	N=	-	10	85	66	1	-
		Median (cm)	-	**62**	**72**	**80**	-	-
		Range (cm)	-	57-67	62-81	68-89	88	-

Appendix H Table 6: Size at age of return in 1985-1990 by sex for CWT LSRCP fish processed by WDFW that were from subyearling production.

Return year	Sex		Total age at return						
			1(Minijack)	2(Jack)	3	4	5	6	7
1985	Male	N=	-	-	-	-	-	-	-
		Median (cm)	**-**	**-**	**-**	**-**	**-**	**-**	-
		Range (cm)	-	-	-	-	-	-	-
	Female	N=	-	-	-	-	-	-	-
		Median (cm)	**-**	**-**	**-**	**-**	**-**	**-**	-
		Range (cm)	-	-	-	-	-	-	-
1986	Male	N=	-	34	-	-	-	-	-
		Median (cm)	**-**	**45**	**-**	**-**	**-**	**-**	-
		Range (cm)	-	32-55	-	-	-	-	-
	Female	N=	-	-	-	-	-	-	-
		Median (cm)	**-**	**-**	**-**	**-**	**-**	**-**	-
		Range (cm)	-	-	-	-	-	-	-
1987	Male	N=	-	24	80	-	-	-	-
		Median (cm)	**-**	**44**	**65**	**-**	**-**	**-**	-
		Range (cm)	-	37-51	49-76	-	-	-	-
	Female	N=	-	-	37	-	-	-	-
		Median (cm)	**-**	**-**	**72**	**-**	**-**	**-**	-
		Range (cm)	-	-	58-81	-	-	-	-
1988	Male	N=	-	153	29	27	-	-	-
		Median (cm)	**-**	**45**	**61**	**88**	**-**	**-**	-
		Range (cm)	-	32-57	48-74	62-100	-	-	-
	Female	N=	-	-	2	32	-	-	-
		Median (cm)	**-**	**-**	**-**	**81**	**-**	**-**	-
		Range (cm)	-	-	74-76	66-99	-	-	-
1989	Male	N=	-	6	112	19	5	-	-
		Median (cm)	**-**	**44**	**63**	**81**	**100**	**-**	-
		Range (cm)	-	43-50	41-76	57-95	96-105	-	-
	Female	N=	-	-	42	50	5	-	-
		Median (cm)	**-**	**-**	**72**	**81**	**85**	**-**	-
		Range (cm)	-	-	59-79	58-92	74-93	-	-
1990	Male	N=	-	6	8	50	17	-	-
		Median (cm)	**-**	**49**	**63**	**92**	**101**	**-**	**-**
		Range (cm)	-	45-55	50-70	57-101	83-110	-	-
	Female	N=	-	-	3	105	16	-	-
		Median (cm)	**-**	**-**	**63**	**84**	**92**	**-**	**-**
		Range (cm)	-	-	59-69	62-99	65-103	-	-

Appendix H Table 7: Size at age of return in 1991-1996 by sex for CWT LSRCP fish processed by WDFW that were from subyearling production. (Fish highlighted in red were returns of BY89 subyearlings, progeny of broodstock with a high stray component)

Return			Total age at return						
year	Sex		1(Minijack)	2(Jack)	3	4	5	6	7
1991	Male	N=	-	45	10	4	19	1	-
		Median (cm)	**-**	**46**	**63**	**77**	**101**	**-**	**-**
		Range (cm)	-	40-56	49-95	72-88	84-109	98	-
	Female	N=	-	-	3	11	31	1	-
		Median (cm)	**-**	**-**	**70**	**80**	**90**	**-**	**-**
		Range (cm)	-	-	68-73	68-89	73-98	92	-
1992	Male	N=	-	24	59	3	-	-	-
		Median (cm)	**-**	**47**	**67**	**80**	**-**	**-**	**-**
		Range (cm)	-	40-54	48-79	70-83	-	-	-
	Female	N=	-	-	21	14	-	2	1
		Median (cm)	**-**	**-**	**71**	**76**	**-**	**-**	**-**
		Range (cm)	-	-	61-84	61-88	-	79-99	92
1993	Male	N=	-	-	42	23	-	-	-
		Median (cm)	**-**	**-**	**69**	**84**	**-**	**-**	**-**
		Range (cm)	-	-	58-85	68-99	-	-	-
	Female	N=	-	-	20	44	2	-	-
		Median (cm)	**-**	**-**	**71**	**80**	**-**	**-**	**-**
		Range (cm)	-	-	62-79	72-89	66-87	-	-
1994	Male	N=	-	134	-	27	4	-	-
		Median (cm)	**-**	**45**	**-**	**86**	**89**	**-**	**-**
		Range (cm)	-	36-54	-	69-101	83-103	-	-
	Female	N=	-	-	-	67	7	-	-
		Median (cm)	**-**	**-**	**-**	**81**	**88**	**-**	**-**
		Range (cm)	-	-	-	71-90	82-92	-	-
1995	Male	N=	-	-	180	-	8	1	-
		Median (cm)	**-**	**-**	**64**	**-**	**103**	**-**	**-**
		Range (cm)	-	-	46-87	-	88-107	104	-
	Female	N=	-	-	79	-	19	-	-
		Median (cm)	**-**	**-**	**69**	**-**	**89**	**-**	**-**
		Range (cm)	-	-	54-78	-	82-102	-	-
1996	Male	N=	-	-	-	68	-	1	-
		Median (cm)	**-**	**-**	**-**	**82**	**-**	**-**	**-**
		Range (cm)	-	-	-	54-102	-	103	-
	Female	N=	-	-	-	126	-	-	-
		Median (cm)	**-**	**-**	**-**	**79**	**-**	**-**	**-**
		Range (cm)	-	-	-	62-90	-	-	-

Appendix H Table 8: Size at age of return in 1997-2002 by sex for CWT LSRCP fish processed by WDFW that were from subyearling production.

Return year	Sex		Total age at return						
			1(Minijack)	2(Jack)	3	4	5	6	7
1997	Male	N=	-	-	-	-	5	-	-
		Median (cm)	**-**	**-**	**-**	**-**	**107**	-	**-**
		Range (cm)	-	-	-	-	76-121	-	-
	Female	N=	-	-	-	-	12	-	-
		Median (cm)	**-**	**-**	**-**	**-**	**87**	-	**-**
		Range (cm)	-	-	-	-	75-93	-	-
1998	Male	N=	-	69	-	-	-	-	-
		Median (cm)	**-**	**46**	**-**	**-**	**-**	-	**-**
		Range (cm)	-	35-58	-	-	-	-	-
	Female	N=	-	-	-	-	-	-	-
		Median (cm)	**-**	**-**	**-**	**-**	**-**	-	**-**
		Range (cm)	-	-	-	-	-	-	-
1999	Male	N=	-	-	146	-	-	-	-
		Median (cm)	**-**	**-**	**62**	**-**	**-**	-	**-**
		Range (cm)	-	-	44-89	-	-	-	-
	Female	N=	-	-	45	-	-	-	-
		Median (cm)	**-**	**-**	**70**	**-**	**-**	-	**-**
		Range (cm)	-	-	60-76	-	-	-	-
2000	Male	N=	-	634	-	37	-	-	-
		Median (cm)	**-**	**46**	**-**	**80**	**-**	**-**	**-**
		Range (cm)	-	34-64	-	57-94	-	-	-
	Female	N=	-	-	-	101	-	-	-
		Median (cm)	**-**	**-**	**-**	**80**	**-**	-	**-**
		Range (cm)	-	-	-	59-91	-	-	-
2001	Male	N=	-	515	567	-	3	-	-
		Median (cm)	**-**	**46**	**66**	-	**99**	-	**-**
		Range (cm)	-	32-61	42-89	-	93-100	-	-
	Female	N=	-	-	375	-	26	-	-
		Median (cm)	**-**	**-**	**70**	**-**	**88**	-	**-**
		Range (cm)	-	-	57-87	-	75-93	-	-
2002	Male	N=	-	181	434	144	-	-	-
		Median (cm)	**-**	**43**	**65**	**83**	**-**	-	**-**
		Range (cm)	-	35-55	40-91	60-101	-	-	-
	Female	N=	-	-	130	499	-	-	-
		Median (cm)	**-**	**-**	**71**	**82**	**-**	-	**-**
		Range (cm)	-	-	55-81	50-99	-	-	-

Appendix H Table 9: Size at age of return in 2003-2008 by sex for CWT LSRCP fish processed by WDFW that were from subyearling production.

Return			Total age at return						
year	Sex		1(Minijack)	2(Jack)	3	4	5	6	7
2003	Male	N=	-	148	63	33	3	-	-
		Median (cm)	**-**	**43**	**64**	**80**	**100**	-	**-**
		Range (cm)	-	32-54	47-78	67-100	98-108	-	-
	Female	N=	-	-	11	91	21	-	-
		Median (cm)	**-**	**-**	**70**	**82**	**90**	-	**-**
		Range (cm)	-	-	63-73	65-97	78-97	-	-
2004	Male	N=	-	73	162	4	-	-	-
		Median (cm)	**-**	**49**	**62**	**72**	**-**	-	**-**
		Range (cm)	-	34-58	41-78	57-73	-	-	-
	Female	N=	-	-	41	27	10	-	-
		Median (cm)	**-**	**-**	**68**	**81**	**87**	-	**-**
		Range (cm)	-	-	56-77	51-88	59-99	-	-
2005	Male	N=	-	39	39	22	2	-	-
		Median (cm)	**-**	**47**	**65**	**74**	**-**	**-**	**-**
		Range (cm)	-	38-58	51-78	62-93	70-100	-	-
	Female	N=	-	-	16	61	4	2	-
		Median (cm)	**-**	**-**	**70**	**79**	**87**	**-**	**-**
		Range (cm)	-	-	65-81	70-89	86-94	82-88	-
2006	Male	N=	-	38	26	4	1	-	-
		Median (cm)	**-**	**48**	**63**	**85**	**-**	**-**	**-**
		Range (cm)	-	38-56	56-76	69-91	80	-	-
	Female	N=	-	-	14	16	12	2	-
		Median (cm)	**-**	**-**	**73**	**80**	**84**	**-**	**-**
		Range (cm)	-	-	63-81	73-89	65-95	87-89	-
2007	Male	N=	-	520	31	2	-	-	-
		Median (cm)	**-**	**48**	**68**	**-**	**-**	-	**-**
		Range (cm)	-	34-57	53-82	69-83	-	-	-
	Female	N=	-	-	16	16	3	-	-
		Median (cm)	**-**	**-**	**70**	**79**	**81**	-	**-**
		Range (cm)	-	-	67-75	73-87	77-86	-	-
2008	Male	N=	-	75	376	1	1	-	-
		Median (cm)	**-**	**48**	**68**	**-**	**-**	-	**-**
		Range (cm)	-	31-55	46-85	65	89	-	-
	Female	N=	-	-	176	5	-	-	-
		Median (cm)	**-**	**-**	**73**	**78**	**-**	-	**-**
		Range (cm)	-	-	55-82	69-85	-	-	-

Appendix H Table 10: Size at age of return in 2009-2014 by sex for CWT LSRCP fish processed by WDFW that were from subyearling production.

Return			Total age at return						
year	Sex		1(Minijack)	2(Jack)	3	4	5	6	7
2009	Male	N=	-	611	17	28	-	-	-
		Median	**-**	**48**	**67**	**78**	**-**	-	**-**
		Range	-	39-61	52-80	63-107	-	-	-
	Female	N=	-	-	16	102	-	-	-
		Median	**-**	**-**	**73**	**83**	**-**	-	**-**
		Range	-	-	65-80	70-94	-	-	-
2010	Male	N=	-	51	216	-	2	-	-
		Median	**-**	**51**	**68**	**-**	**-**	-	**-**
		Range	-	42-64	52-88	-	88-90	-	-
	Female	N=	-	-	185	4	6	-	-
		Median	**-**	**-**	**74**	**85**	**89**	-	**-**
		Range	-	-	65-84	78-86	79-99	-	-
2011	Male	N=	-	204	40	17	-	-	-
		Median	**-**	**47**	**68**	**80**	**-**	**-**	-
		Range	-	34-60	53-81	61-86	-	-	-
	Female	N=	-	1	48	122	-	-	-
		Median	**-**	**-**	**72**	**82**	**-**	**-**	-
		Range	-	45	61-86	63-99	-	-	-
2012	Male	N=	-	371	627	7	2	-	-
		Median	**-**	**48**	**65**	**75**	**-**	**-**	**-**
		Range	-	35-62	41-85	65-84	81-88	-	-
	Female	N=	-	-	255	56	10	-	-
		Median	**-**	**-**	**71**	**80**	**82**	**-**	**-**
		Range	-	-	54-82	72-88	70-92	-	-
2013	Male	N=	-	10	116	42	-	-	-
		Median	**-**	**46**	**69**	**75**	**-**	**-**	**-**
		Range	-	41-58	51-78	62-99	-	-	-
	Female	N=	-	-	104	95	2	-	-
		Median	**-**	**-**	**70**	**78**	**-**	**-**	**-**
		Range	-	-	57-80	65-89	90	-	-
2014	Male	N=	-	48	80	49	-	-	-
		Median	**-**	**48**	**67**	**76**	**-**	**-**	**-**
		Range	-	42-59	53-78	57-100	-	-	-
	Female	N=	-	-	18	133	4	-	-
		Median	**-**	**-**	**73**	**79**	**83**	**-**	**-**
		Range	-	-	64-76	71-89	81-86	-	-

Appendix H Table 11: Size at age of return in 2015 by sex for CWT LSRCP fish processed by WDFW that were from subyearling production.

2015	Male	N=	-	24	81	34	1	-	-
		Median	-	**46**	**65**	**78**	-	-	-
		Range	-	37-57	52-84	64-95	85	-	-
	Female	N=	-	-	39	153	12	-	-
		Median	-	-	**72**	**80**	**84**	-	-
		Range	-	-	61-78	63-88	77-87	-	-

Appendix I: Historical number of matings of minijacks, jacks and jills contributing to broodstock at LFH 2000-2009

Prior to size mating protocol

Appendix I Table 1: Historical number of matings of minijacks, jacks, and jills contributing to broodstock at LFH, 2000-2009, prior to selective size mating protocol.

Year	0-salt	1-salt jack	1-salt jill	Number of matings containing jack x jill mating	% of total matings with 0-salt and/or 1-salt parentage
2000	195	609	157	127	80.4
2001	9	876	67	47	67.6
2002	4	480	11	9	24.7
2003	3	527	78	63	74.5
2004	28	943	254	204	77.3
2005	14	611	57	25	45.4
2006	1	519	121	91	70.0
2007	0	1138	480	408	83.0
2008	0	345	80	30	30.2
2009	1	539	503	143	69.6
Average	**26**	**659**	**181**	**115**	**62.3**

Appendix J: Egg Take and Early Life Stage Survival Brood Years: 1990-2011

Appendix J Table 1: Egg take and survival numbers by life stage of Lyons Ferry origin fall Chinook salmon spawned at LFH, brood years 1990-2011.

Brood year	Eggs taken	Egg loss [a]	Eggs destroyed [b]	Eggs shipped[c]	Eyed eggs retained	Fry ponded	Intended program
1990	1,103,745	0		0	1,011,998	729,311	Yearling
						228,930	Subyearling
1991	906,411	0		0	828,514	807,685	Yearling
						0	Subyearling
1992	901,232	0		0	855,577	624,961	Yearling
						210,210	Subyearling
1993	400,490	0		0	363,129	352,461	Yearling
						0	Subyearling
1994	583,871	0		0	553,189	542,461	Yearling
						0	Subyearling
1995[d]	1,056,700	0		0	1,022,700	847,241	Yearling
						112,532	Subyearling
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
2004	4,625,638	0		1,053,278	3,421,751	914,594	Yearling
						2,191,102	Subyearling
						184,682	Research
2005	4,929,630	0		1,180,000	3,562,700[e]	980,940	Yearling
						2,078,206	Subyearling
						216,417	Research
2006	2,819,004	0		127,564	2,601,679	961,105	Yearling
						1,640,574	Subyearling
						2,000	Research
2007	5,143,459	0		1,761,500	3,212,900[f]	960,900	Yearling
						1,894,933	Subyearling
2008	5,010,224	0		1,810,800	2,969,200	1,000,000	Yearling
						1,969,200	Subyearling
2009	4,574,182	0		1,507,300	2,853,020	977,667	Yearling
						1,875,353	Subyearling
2010	4,619,533	124,433	0	1,630,000	2,865,100	980,000	Yearling
						1,885,100	Subyearling
2011	4,723,501	165,001	0	1,785,600	2,772,900	960,000	Yearling
						1,812,900	Subyearling

[a] Eggs from ELISA positive females were incorporated into the rest of the broodstock in 1997-1998 and 2003-2004.
[b] Eggs culled due to ELISA results, stray or stray mate, and jill or jack mate.
[c] Includes eyed eggs shipped for research.
[d] An overage of 58,500 fish was found during marking. This number was added (unexpanded) to total green and eyed eggs and fry ponded. Also includes 83,183 fry up to ponding that were accidentally released as strays. Back calculated to estimate 32,088 eggs for subyearlings and 91,808 eggs for escaped fry (resulting in 847,241 ponded for yearling release).
[e] This number includes 154,100 eyed-eggs that were destroyed as ponded fry and 30,000 eyed-eggs that were shipped as fry to NPTH in February 2006.
[f] This number includes 364,983 eyed-eggs that were destroyed as ponded fry in January and February 2007.

Appendix K: LFH/Snake River Origin Fall Chinook Salmon Releases Brood Years: 2008-2015

Appendix K Table 1: LFH/Snake River hatchery origin fall Chinook salmon releases with number marked, tagged, and unmarked by release year and type.

Release year	S/Y[b]	Brood year	Release location-type	Release date	CWT code	Number of fish released [a] AD clip +CWT	CWT only	AD clip only	No clip or CWT	Total Released	FPP	PIT Tagged [c]
2009	S	2008	LFH	2 June	634995	191,407	823	8,230	235	200,695	51.7	1,509
2009	S	2008	Couse Creek Direct [vs. CJ1 Accl. Study]	26 May	634996	187,434	488	11,967	855	200,744	46.5	13,740
2009	S	2008	GRR-extras	2-3 June	612676	165,146	1,191	6,024	9,039	181,400	50.0	0
2009	S	2008	CJ1	26 May	610180	100,383	-	-	-	100,383	57.0	2,645
2009	S	2008	CJ1	26 May	610183	99,521	-	-	325,006	424,527	57.0	11,186
2009	S	2008	BC1	26 May	610179	100,093	-	-	-	100.093	62.5	2,901
2009	S	2008	BC1	26 May	610182	-	99,332	-	275,443	374,775	62.5	10,862
2009	S	2008	PL1	24 May	610181	95,227	-	5,012	-	100,239	59.3	3,320
2009	S	2008	PL1	24 May	610184	-	99,727	-	216,025	315,752	59.3	10,457
2009	S	2008	GRR-direct	28-29 May	634997	193,275	535	7,892	239,348	441,050	67.1	27,764
2009	S	2008	NPTH-Cedar Flats Accl.	9 June	612760	-	100,760	-	1,202	101,962	59.7	7,104
2009	S	2008	NPTH-Cedar Flats Accl.	9 June	612761	95,840	-	2,296	-	98,136	59.7	6,838
2009	S	2008	NPTH-Lukes Gulch Accl.	10 June	612762	-	98,025	-	11,008	109,033	51.6	7,276
2009	S	2008	NPTH-Lukes Gulch Accl.	10 June	612763	98,486	-	2,359	-	100,845	51.6	6,730
2009	S	2008	NPTH-North Lapwai Valley Accl.	15 May	612766	-	182,328	-	213,149	395,477	85.3	2,381
2009	S	2008	NPTH-North Lapwai Valley Accl.	15 May	612738	97,751	-	2,341	-	100,092	85.3	602
2009	S	2008	NPTH-Site 1705	8-12 June	612739	90,953	-	27,725	-	118,678	51.5	559
2009	S	2008	NPTH-Site 1705	8-12 June	612697	-	181,522	-	328,615	510,137	51.5	2,404
2009	S	2008	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	8 May	107582	53,095	-	16,465	-	69,560	54.7	5,090
2009	S	2008	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	8 May	107682	66,322	-	-	-	66,322	54.7	4,854
2009	S	2008	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	8 May	107482	66,957	-	-	-	66,957	54.7	4,900
2009	S	2008	Snake R. below HC Dam-Umatilla hatchery-IPC-direct	12-14 May	090228	233,692	-	569,793	-	803,485	60.2	55,488
2009	S	2008	Snake R. at Couse Creek-Surrogates	18 May-5 June	none	-	-	-	239,050	239,050		237,741
2009	S	2008	Clearwater R. at BC-Surrogates	29 June-17 July	none	-	-	-	91,621	91,621		91,015
2010	Y	2008	LFH	12-15 April	635166	250,814	169	2,542	678	254,203	9.8	13,479
2010	Y	2008	LFH	12-15 April	635165	-	221,376	-	3,273	224,649	9.8	13,487
2010	Y	2008	CJ1	5 April	220305	70,925	-	1,284	-	72,209	8.0	8,922

Appendix K Table 1: LFH/Snake River hatchery origin fall Chinook salmon releases with number marked, tagged, and unmarked by release year and type.

Release year	S/Y[b]	Brood year	Release location-type	Release date	CWT code	Number of fish released [a]						
						AD clip +CWT	CWT only	AD clip only	No clip or CWT	Total Released	FPP	PIT Tagged [c]
2010	Y	2008	CJ1	5 April	220300	-	81,467	-	961	82,428	8.0	10,184
2010	Y	2008	BC1	14 April	220303	70,043	-	1,993	-	72,036	9.0	8,925
2010	Y	2008	BC1	14 April	220302	-	79,756	-	1,907	81,663	9.0	10,117
2010	Y	2008	PL1	13 April	220304	70,834	-	984	-	71,818	9.3	8,902
2010	Y	2008	PL1	13 April	220301	-	80,417	-	1,244	81,661	9.3	10,123
2010	S	2009	LFH	25 May	635180	198,457	1,068	2,803	-	202,328	52.4	0
2010	S	2009	CJ1	24 May	220309	100,778	-	392	-	101,170	47.0	7,376
2010	S	2009	CJ1	24 May	220308	-	102,167	-	325,440	427,607	47.0	31,174
2010	S	2009	BC1	25 May	220307	100,461	-	441	-	100,902	52.3	7,587
2010	S	2009	BC1	25 May	220306	-	101,207	-	309,127	410,334	52.3	30,855
2010	S	2009	PL1	24 May	220311	100,537	-	765	-	101,302	50.5	7,725
2010	S	2009	PL1	24 May	220310	-	100,619	-	203,120	303,739	50.5	23,162
2010	S	2009	Couse Creek Direct [vs. CJ1 Accl. Study]	24 May	635181	199,326	926	2,381	529	203,162	58.0	15,445
2010	S	2009	GRR Direct	24 May	635182	197,252	-	2,868	186,720	386,720	42.0	30,488
2010	S	2009	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	6 May	104383	50,433	-	4,609	-	55,042	47.0	4,208
2010	S	2009	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	6 May	100142	64,144	-	5,862	-	70,006	47.0	5,352
2010	S	2009	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	6 May	106482	61,977	-	5,664	-	67,641	47.0	5,171
2010	S	2009	Snake R. below HC Dam-Umatilla hatchery-IPC-direct	25-27 May	090331	208,330	1,242	476,055	-	685,627	46.3	50,036
2010	S	2009	NPTH-Cedar Flats Accl.	14 June	612764	-	74,939	-	14,328	89,267	48.3	6,737
2010	S	2009	NPTH-Cedar Flats Accl.	14 June	612765	97,930	-	1,214	-	99,144	48.3	7,482
2010	S	2009	NPTH-Lukes Gulch Accl.	9 June	612747	-	99,116	-	415	99,531	44.4	8,208
2010	S	2009	NPTH-Lukes Gulch Accl.	9 June	612748	98,220	-	1,218	-	99,438	44.4	8,201
2010	S	2009	NPTH-North Lapwai Valley Accl.	14 May	220201	-	164,981	-	200,716	365,697	81.2	2,424
2010	S	2009	NPTH-North Lapwai Valley Accl.	14 May	220202	99,024	-	1,228	-	100,252	81.2	665
2010	S	2009	NPTH-Site 1705	7 June	220200	99,100	-	1,229	-	100,329	54.2	577
2010	S	2009	NPTH-Site 1705	7 June	612772	-	199,710	-	236,960	436,670	54.2	2509
2010	S	2009	Snake R. at Couse Creek-Surrogates	17 May- 4 June	none				197,569	197,569		195,493
2010	S	2009	Clearwater R. at BC-Surrogates	21 June- 9 July	none				116,162	116,162		114,017
2011	Y	2009	LFH	12-15 April	635564	226,621	462	308		227,391	9.9	14,927

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Release year	S/Y[b]	Brood year	Release location-type	Release date	CWT code	Number of fish released [a] AD clip +CWT	CWT only	AD clip only	No clip or CWT	Total Released	FPP	PIT Tagged [c]
2011	Y	2009	LFH	12-15 April	635510	-	236,175	-	163	236,338	9.9	14,935
2011	Y	2009	CJ1	1 April	220315	71,407	-	867	-	72,274	10.3	8,862
2011	Y	2009	CJ1	1 April	220314	-	80,830	-	1,482	82,312	10.3	10,092
2011	Y	2009	BC1	14 April	220317	71,096	-	286	-	71,382	9.9	8,300
2011	Y	2009	BC1	14 April	220312	-	89,325	-	1,637	90,962	9.9	10,577
2011	Y	2009	PL1	12 April	220316	69,415	-	2,766	-	72,181	9.5	8,218
2011	Y	2009	PL1	12 April	220313	-	93,103	-	1,126	94,229	9.5	10,729
2011	S	2010	LFH	1 June	635998	200,502	283	1,415		202,200	50.0	0
2011	S	2010	CJ1	22 May	220119	100,967		200		101,167	45.3	8,037
2011	S	2010	CJ1	22 May	220120		100,986		314,327	100,986	45.3	32,992
2011	S	2010	BC1	25 May	220117	100,622		200		100,822	51.0	8,111
2011	S	2010	BC1	25 May	220115		100,748		307,576	408,324	51.0	32,847
2011	S	2010	PL1	23 May	220121	100,987		201		101,188	49.0	8,044
2011	S	2010	PL1	23 May	220122		100,999		211,097	100,999	49.0	24,811
2011	S	2010	Couse Creek Direct [vs. CJ1 Accl. Study]	2-3 June	635997	200,945	971	384		202,300	49.0	16,459
2011	S	2010	GRR Direct	24 May	635999	199,460	134	1,206	196,628	397,428	79.5	32,441
2011	S	2010	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	5 May	100153	167,137		15,769	11,903	194,809	48.2	14,927
2011	S	2010	Snake R. below HC Dam-Irrigon hatchery-IPC-direct	24-26 May	090447	195,414	397	435,100	7,989	638,900	81.0	36,925
2011	S	2010	NPTH-Cedar Flats Accl.	15 June	220205		103,007		323	103,330	54.5	8,244
2011	S	2010	NPTH-Cedar Flats Accl.	15 June	220206	96,604		5,622		102,226	54.5	8,155
2011	S	2010	NPTH-Lukes Gulch Accl.	14 June	220207		99,115		5,364	104,479	50.2	8,283
2011	S	2010	NPTH-Lukes Gulch Accl.	14 June	220208	101,688		1,315		103,003	50.2	8,166
2011	S	2010	NPTH-North Lapwai Valley Accl.	14 May	220203		202,265		206,799	409,064	75.0	2,392
2011	S	2010	NPTH-North Lapwai Valley Accl.	14 May	220204	99,174		1,282		100,456	75.0	588
2011	S	2010	NPTH-Site 1705	7-15 June	220210		201,980		224,365	426,345	52.5	2,412
2011	S	2010	NPTH-Site 1705	7 June	220209	94,893		5,523		100,416	52.5	568
2011	S	2010	NPTH late release-Site 1705	6-11 July	220211		99,907		313	100,220	93.0	1,038
2011	S	2010	NPTH late release-Site 1705	6-11 July	220212		94,673		91,694	186,367	93.0	1,931
2011	S	2010	Snake R. at Couse Creek-Surrogates	23 May-10 June	none				201,412			200,549
2011	S	2010	Clearwater R. at BC-Surrogates	20 June-8 July	none				114,356			111,580
2012	Y	2010	LFH	10-13 Apr	636080	246,918	660	495	989	249,062	10.4	14,930

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Release year	S/Y[b]	Brood year	Release location-type	Release date	CWT code	Number of fish released [a]						
						AD clip +CWT	CWT only	AD clip only	No clip or CWT	Total Released	FPP	PIT Tagged [c]
2012	Y	2010	LFH	10-13 Apr	636079		236,056		4,882	240,938	10.4	14,908
2012	Y	2010	CJ1	28 Mar	220321	72,233		432		72,665	10.3	8,881
2012	Y	2010	CJ1	28 Mar	220320		81,042		1,427	82,469	10.3	10,080
2012	Y	2010	BC1	12 Apr	220323	74,973		903		75,876	9.7	8,441
2012	Y	2010	BC1	12 Apr	220318		86,184		1,554	87,738	9.7	9,760
2012	Y	2010	PL1	11 Apr	220322	79,519		316		79,835	9.4	8,777
2012	Y	2010	PL1	11 Apr	220319		90,110		1,177	91,287	9.4	10,036
2012	S	2011	LFH	29-30 May	636417	198,228	261	2,270	141	200,900	50.0	19,943
2012	S	2011	CJ1	21 May	220326	101,194		202		101,396	47.0	20,586
2012	S	2011	CJ1	21 May	220327		100,818		303,514	404,332	47.0	20,469
2012	S	2011	BC1	23 May	220329	101,565				101,565	46.0	20,555
2012	S	2011	BC1	23 May	220328		101,327		308,737	410,064	46.0	20,507
2012	S	2011	PL1	22 May	220324	100,850		405		101,255	47.0	16,497
2012	S	2011	PL1	22 May	220325		100,500		200,645	301,145	47.0	16,373
2012	S	2011	Couse Creek Direct [vs. CJ1 Accl. Study]	29-30 May	636418	194,955	658	3,548	139	199,300	54.0	16,313
2012	S	2011	GRR Direct	24 May	636419	192,996		9,723	181,281	384,000	48.0	32,432
2012	S	2011	Snake R. below HC Dam-Oxbow hatchery-IPC-direct	3 May	100201	187,146		15,135		202,281	48.0	14,910
2012	S	2011	Snake R. below HC Dam-Irrigon hatchery-IPC-direct	22-24 May	090587	200,844	273	587,232	12,051	800,400	46.0	36,927
2012	S	2011	NPTH-Lukes Gulch Accl.	13 June	220213	94,079		5,305		99,382	49.6	8,179
2012	S	2011	NPTH-Lukes Gulch Accl.	13 June	220214		99,570		495	100,065	49.6	8,236
2012	S	2011	NPTH-Cedar Flats Accl.	12 June	220215	96,099		1,276		97,375	51.7	8,110
2012	S	2011	NPTH-Cedar Flats Accl.	12 June	220216		95,710		5,771	101,481	51.7	8,451
2012	S	2011	NPTH-North Lapwai Valley Accl.	8&30 May	220224		191,699		268,454	460,153	115/54	2,440
2012	S	2011	NPTH-North Lapwai Valley Accl.	8&30 May	220218	98,697		4,363		103,060	115/54	546
2012	S	2011	NPTH-Site 1705	11-15 June	220223		202,095		291,091	493,186	51/53	4,877
2012	S	2011	NPTH-Site 1705	11-15 June	220217	103,487		1,813		105,300	51/53	1,041
2012	S	2011	Snake R. at Couse Creek-Surrogates	21 May-8 June	none				227,992	227,992		226,786
2012	S	2011	Clearwater R. at BC-Surrogates	18 June-6 July	none				96,273	96,273		92,963
2013	Y	2011	LFH	10-12 Apr	636444	240,413	809	809	1,618	243,649	10.2	14,675
2013	Y	2011	LFH	10-12 Apr	636443		243,085		2,766	245,851	10.2	14,531
2013	Y	2011	CJ1	1 Apr	220335	71,930		580		72,510	9.5	1,372

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Release year	S/Y[b]	Brood year	Release location-type	Release date	CWT code	Number of fish released [a] AD clip +CWT	CWT only	AD clip only	No clip or CWT	Total Released	FPP	PIT Tagged [c]
2013	Y	2011	CJ1	1 Apr	220332		89,993		720	90,713	9.5	1,716
2013	Y	2011	BC1	17 Apr	220333	71,973		580		72,553	9.8	1,369
2013	Y	2011	BC1	17 Apr	220331		85,359		1,005	86,364	9.8	1,629
2013	Y	2011	PL1	16 Apr	220334	71,679		564		72,243	9.7	1,285
2013	Y	2011	PL1	16 Apr	220330		88,908		1,761	90,669	9.7	1,612
2013	S	2012	LFH	10 May	636574	210,494	138	967		211,599	68.0	19,772
2013	S	2012	CJ1	17 May	220141	101,234				101,234	47.0	1,497
2013	S	2012	CJ1	17 May	220143		100,631		297,721	398,352	47.0	1,489
2013	S	2012	BC1	22 May	220142	100,804		202		101,006	44.0	1,505
2013	S	2012	BC1	22 May	220144		99,807		301,474	401,281	44.0	1,488
2013	S	2012	PL1	20 May	220145	100,673		404		101,077	44.0	1,495
2013	S	2012	PL1	20 May	220146		101,085		195,865	296,950	44.0	1,495
2013	S	2012	Couse Creek Direct [vs. CJ1 Accl. Study]	9-10 May	636575	202,159	2,012	1,006	123	205,300	68.0	2,985
2013	S	2012	GRR Direct	21 May	636576	216,159	430	861	183,093	400,543	49.5	3,000
2013	S	2012	Snake R. below HC Dam-Irrigon hatchery-IPC-direct	20-22 May	90703	228,054	156	651,123	413	879,746	50.4	2,994
2013	S	2012	NPTH-Cedar Flats Accl.	10 June	220221		101,113		10,899	112,012	49.4	1,570
2013	S	2012	NPTH-Cedar Flats Accl.	10 June	220222	97,468		4,384		101,852	49.4	1,427
2013	S	2012	NPTH-Lukes Gulch Accl.	11 June	220219		94,062		11,357	105,419	48.5	1,545
2013	S	2012	NPTH-Lukes Gulch Accl.	11 June	220220	96,387		2,524		98,911	48.5	1,450
2013	S	2012	NPTH-North Lapwai Valley Accl.	10 May	220231		199,689		194,398	394,087	85.0	2,374
2013	S	2012	NPTH-North Lapwai Valley Accl.	10 May	220225	100,435		1,015		101,450	85.0	611
2013	S	2012	NPTH-Site 1705	7 June	220232		194,561		387,401	581,962	74.0	2,532
2013	S	2012	NPTH-Site 1705	13 June	220226	97,477		7,154		104,631	74.0	455
2014	Y	2012	LFH	8-11 April	636583		250,362		2,019	252,381	9.6	14,876
2014	Y	2012	LFH	8-11 April	636584	247,714	1,673	502	1,003	250,892	9.6	14,886
2014	Y	2012	CJ1	1 April	220338		86,972		350	87,322	9.9	530
2014	Y	2012	CJ1	1 April	220339	76,256		306		76,562	9.9	464
2014	Y	2012	BC1	17 April	220336		86,380		580	86,960	8.8	526
2014	Y	2012	BC1	17 April	220341	75,180		1,274		76,454	8.8	463
2014	Y	2012	PL1	14 April	220337		88,140		295	88,435	9.0	533
2014	Y	2012	PL1	14 April	220340	76,657		774		77,431	9.0	466
2014	S	2013	LFH	3 June	636737	203,004	402	5,896	670	209,972	50.0	19,969

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Release year	S/Y[b]	Brood year	Release location-type	Release date	CWT code	Number of fish released [a]					FPP	PIT Tagged [c]
						AD clip +CWT	CWT only	AD clip only	No clip or CWT	Total Released		
2014	S	2013	CJ1	21 May	220346	101,241		2,801		104,042	47.0	1,024
2014	S	2013	CJ1	21 May	220343		99,142		308,643	407,785	47.0	975
2014	S	2013	BC1	22 May	220345	94,950		9,588		104,538	49.7	1,023
2014	S	2013	BC1	22 May	220342		98,628		324,660	423,288	49.7	966
2014	S	2013	PL1	20 May	220347	100,063		1,404		101,467	53.0	1,008
2014	S	2013	PL1	20 May	220344		99,455		199,946	299,401	53.0	989
2014	S	2013	CJ 2nd Release	6 June	636738	185,799		5,352		191,151	53.4	1,999
2014	S	2013	GRR Direct	21 May	636739	191,711	434	9,983	201,798	403,926	48.9	2,999
2014	S	2013	Snake R. below HC Dam-Irrigon hatchery-IPC-direct	19 May	090818	191,092	525	717,974	2,023	911,614	49.4	3,000
2014	S	2013	NPTH-Cedar Flats Accl.	10 June	220235		99,344		50,375	149,719	49.7	1,181
2014	S	2013	NPTH-Cedar Flats Accl.	10 June	220233	102,430		740		103,170	49.7	813
2014	S	2013	NPTH-Lukes Gulch Accl.	10 June	220236		103,285		50,399	153,684	47.6	1,203
2014	S	2013	NPTH-Lukes Gulch Accl.	10 June	220234	100,870		729		101,599	47.6	795
2014	S	2013	NPTH-North Lapwai Valley Accl.	11 June	220240		202,383		110,492	312,875	63.5	1,501
2014	S	2013	NPTH-North Lapwai Valley Accl.	11 June	220238	100,911		1,770		102,681	63.5	492
2014	S	2013	NPTH-Site 1705	11 June	220239		207,537		215,099	422,636	52.5	1,605
2014	S	2013	NPTH-Site 1705	11 June	220237	102,898		744		103,642	52.5	394
2015	Y	2013	LFH	6-8 April	636740		221,511		3,415	224,926	9.7	14,848
2015	Y	2013	LFH	6-8 April	636741	219,396	732	6,294	1,025	227,447	9.7	13,268
2015	Y	2013	CJ1	1 April	220353	72,145				72,145	9.6	470
2015	Y	2013	CJ1	1 April	220350		80,656		324	80,980	9.6	528
2015	Y	2013	BC1	10 April	220351	72,369		145		72,514	9.7	466
2015	Y	2013	BC1	10 April	220348		81,558		808	82,366	9.7	529
2015	Y	2013	PL1	9 April	220352	72,595		144		72,739	9.6	467
2015	Y	2013	PL1	9 April	220349		82,413		324	82,737	9.6	531
2015	S	2014	LFH	18 May	636882	189,788	429	21,922	7,220	219,359	58.0	19,906
2015	S	2014	CJ1	19 May	220355	95,493		6,312	102,311	204,116	49.6	8,363
2015	S	2014	CJ1	19 May	220354		96,612	17,161	220,490	334,263	49.6	13,695
2015	S	2014	BC1	21 May	220357	95,796		6,332	102,866	204,994	58.0	748
2015	S	2014	BC1	21 May	220356		94,575	28,759	219,163	342,497	58.0	1,250
2015	S	2014	PL1	13 May	220359	97,130		4,897	87,285	189,312	60.6	10,513
2015	S	2014	PL1	13 May	220358		96,274	1,084	111,340	208,698	60.6	11,590
2015	S	2014	CJ 2nd Release	5 June	220360	208,078		7,238	3,274	218,590	48.2	2,000

Appendix K Table 1: LFH/Snake River hatchery origin fall Chinook salmon releases with number marked, tagged, and unmarked by release year and type.

Release year	S/Y[b]	Brood year	Release location-type	Release date	CWT code	Number of fish released [a] AD clip +CWT	CWT only	AD clip only	No clip or CWT	Total Released	FPP	PIT Tagged [c]
2015	S	2014	GRR Direct	18 May	636883	199,938	222	7,541	248,400	456,101	48.9	2,986
2015	S	2014	Snake R. below HC Dam-Irrigon hatchery-IPC-direct	11-13 May	090888	244,342	268	800,547	1,110	1,046,267	55.2	3,000
2015	S	2014	NPTH-Cedar Flats Accl.	2 June	220227		103,380		58,302	161,682	63.0	1,002
2015	S	2014	NPTH-Cedar Flats Accl.	2 June	220228	101,234		1,499	58,100	160,833	63.0	996
2015	S	2014	NPTH-Lukes Gulch Accl.	29 May	220230		102,539		59,367	161,906	66.4	1,000
2015	S	2014	NPTH-Lukes Gulch Accl.	29 May	220229	101,549		890	59,167	161,606	66.4	999
2015	S	2014	NPTH-Site 1705	4 June	220248		200,997		154,619	355,616	65.7	1,323
2015	S	2014	NPTH-Site 1705	4 June	220245	102,279	1,810	503	77,123	181,715	68.7	676
2015	S	2014	NPTH-Site 1705	29 May	220247		203,450		50,290	253,740	70.9	1,314
2015	S	2014	NPTH-Site 1705	29 May	220246	101,866	2,045	479	24,953	129,343	67.7	670
2016	Y	2014	LFH	4-6 April	636885		231,744		8,559	240,303	10.7	14,852
2016	Y	2014	LFH	4-6 April	636886	238,940	661	6,744	529	246,874	10.2	14,867
2016	Y	2014	CJ1	1 April	220364	70,821		135	1,083	72,039	9.7	427
2016	Y	2014	CJ1	1 April	220363		91,267		1,394	92,661	9.7	549
2016	Y	2014	BC1	8 April	220366	71,112		141	563	71,816	10.0	461
2016	Y	2014	BC1	28 March-8 April	220361		80,995		640	81,635	10.0	525
2016	Y	2014	PL1	7 April	220365	70,212		1,267	421	71,900	9.5	462
2016	Y	2014	PL1	7 April	220362		81,524		160	81,684	9.5	524
2016	S	2015	LFH	31 May	637038	187,799	964	12,250	1,447	202,460	53.8	19,951
2016	S	2015	CJ1	25 May	220367		100,540		202,711	303,251	54.8	15,467
2016	S	2015	CJ1	25 May	220368	99,210	598	1,793	104,383	205,984	54.8	10,506
2016	S	2015	BC1	26 May	220369		100,349		199,392	299,741	50.2	1,188
2016	S	2015	BC1	26 May	220370	98,974	1,011	1,420	99,593	200,998	50.2	797
2016	S	2015	PL1	20 May	220371		99,175		98,928	198,103	57.0	12,964
2016	S	2015	PL1	20 May	220372	98,913	1,199	1,798	98,073	199,983	57.0	13,088
2016	S	2015	CJ 2nd Release	10 June	220373	193,377	4,480	1,100	26	198,983	48.2	2,000
2016	S	2015	GRR Direct	31 May	637037	199,620	426	7,993	221,850	429,889	49.4	2,997
2016	S	2015	Snake R. below HC Dam-Irrigon hatchery-IPC-direct	16-18 May	091013	247,014	393	792,552	1,226	1,041,185	50.2	2,998
2016	S	2015	NPTH-Cedar Flats Accl.	6 June	220243		102,279		11,776	114,055	57.4	995
2016	S	2015	NPTH-Cedar Flats Accl.	6 June	220244	101,775	1,334	287	11,579	114,975	57.4	1,003
2016	S	2015	NPTH-Lukes Gulch Accl.	6 June	220241		101,622		9,781	111,403	50.9	994

Appendix K Table 1: LFH/Snake River hatchery origin fall Chinook salmon releases with number marked, tagged, and unmarked by release year and type.

Release year	S/Y[b]	Brood year	Release location-type	Release date	CWT code	Number of fish released [a]						
						AD clip +CWT	CWT only	AD clip only	No clip or CWT	Total Released	FPP	PIT Tagged [c]
2016	S	2015	NPTH-Lukes Gulch Accl.	6 June	220242	101,522	1,386	293	9,587	161,606	50.9	1,006
2016	S	2015	NPTH-Site 1705	7-8 June	220255		201,269		165,851	367,120	57.4	1,530
2016	S	2015	NPTH-Site 1705	7-8 June	220254	101,505	2,946	1,034	164,819	270,304	57.4	1,126
2016	S	2015	NPTH-Site 1705	7-8 June	220251		106,506		4,960	111,466	57.4	464
2016	S	2015	NPTH-Site 1705	7-8 June	220250		95,713		4,940	100,653	57.4	419
2016	S	2015	NPTH-Site 1705	7-8 June	220249	101,709	1,128	295	6,397	109,529	57.4	456
2016	S	2015	IHR gate well						3,000	3,000		
2017	Y	2015	LFH	3-5 April	637041		224,056		815	224,871	11.0	14,780
2017	Y	2015	LFH	3-5 April	637040	231,541	505	1,641		233,687	10.5	14,762
2017	Y	2015	CJ1	31 March	220376		84,661		3,656	88,318	10.7	807
2017	Y	2015	CJ1	31 March	220377	68,105	1,957	652		70,714	10.7	646
2017	Y	2015	BC1	11 April	220374		78,532		776	79,308	11.1	795
2017	Y	2015	BC1	11 April	220379	65,641	2,451	1,771		69,863	11.1	701
2017	Y	2015	PL1	7 April	220375		78,402		1,981	80,383	9.9	818
2017	Y	2015	PL1	7 April	220378	68,151	1,876	7,211		70,496	9.9	718

[a] 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.

[b] S/Y indicates subyearling or yearling rearing strategy.

[c] Numbers of fish PIT tagged are included in the Number of Fish Released categories.

Appendix L: Historical Estimated Survivals (%) Between Various Life Stages at LFH Brood Years: 1990-2010

Appendix L Table 1: Estimated survivals (%) between various life stages at LFH for fall Chinook salmon of LFH/Snake River hatchery origin.

Brood year	Release age	Green egg-ponded fry	Ponded fry-release	Green egg-release
1990	Yearling	86.8	94.5	82.1
	Subyearling	86.8	98.0	85.1
1991	Yearling	89.1	94.1	83.8
1992	Yearling	92.7	96.5	89.5
	Subyearling	92.7	98.4	91.2
1993	Yearling	88.0	99.0	87.1
1994	Yearling	92.7	99.3	92.1
1995	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	61.3
	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	98.1	91.9
2002	Yearling	95.3	86.8	82.8
	Subyearling	95.3	94.8	90.3
2003	Yearling	95.5	75.7	72.3
	Subyearling	95.5	95.1	90.8
2004	Yearling	93.0	96.8	90.1
	Subyearling	93.0	97.6	90.8
2005	Yearling	92.2	99.3	91.5
	Subyearling	92.2	104.9	96.7
2006	Yearling	95.7	95.4	91.3
	Subyearling	95.7	100.2	95.5
2007	Yearling	95.8	95.4	91.4
	Subyearling	95.8	100.3	95.5
2008	Yearling	95.8	95.3	91.3
	Subyearling	95.8	107.1	89.4
2009	Yearling	94.1	98.3	92.5
	Subyearling	94.1	100.2	94.0
2010	Yearling	96.4	101.9	98.2
	Subyearling	96.4	98.9	95.4
Yearling mean:	**%**	**93.0**	**91.6**	**85.2**
	SD	**2.6**	**9.3**	**8.7**
Subyearling mean:	**%**	**93.5**	**97.2**	**90.9**
	SD	**2.3**	**3.3**	**3.5**

Appendix M: Tucannon River Survey Sections and Historical Escapement

Appendix M Table 1: Description and length of sections, survey length, percent of reach surveyed, and estimated total number of fall Chinook salmon redds in the Tucannon River, 2015.

Section	Description	Length of section (km)[a]	Length surveyed (km)	% of productive reach surveyed [b]	Estimated total # of redds [c]
1	Mouth of Tucannon R to highway 261 Bridge	2.8	1.7	100	42
2	Highway 261 Bridge to Smolt trap	0.2	0.2	100	9
3	Smolt trap to Powers Bridge	0.5	0.5	100	40
4	Powers Bridge to upper hog barns	1.2	1.2	100	47
5	Hog barns to Starbuck Br.	2.5	2.4	96	25
6	Starbuck Br. To Fletchers Dam	2.7	1.3	48	22
7	Fletcher's Dam to Smith Hollow	2.9	2.9	100	12
8	Smith Hollow to Ducharme's Sheep Ranch Br.	4.4	4.4	100	26
9	Ducharme's Bridge to Highway 12	5.5	5.5	100	17
10	Highway 12 to Brines Bridge	6.2	6.2	100	0
11	Brines Bridge to 4.7 km above Brines Bridge	4.7	4.7	100	0
	Total	**33.6**	**31.0**	**95**	**244**

[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] Counted redds were expanded based on percent of reach surveyed to estimate total number of redds.

Appendix M Table 2: Estimated escapement, % stray component of the run, and number of redds (observed and estimated), estimates of smolts/redd, and total number of emigrants from fall Chinook salmon spawning in the Tucannon River, and parent to progeny ratios, 1985-2000.

	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]	Adult progeny/ parent ratio
1985[d]	0	unknown	0	No estim	0	unknown	unknown	Unknown
1986[e]	2[f]	unknown	0	No estim	0	unknown	unknown	Unknown
1987	48	0	16	0	16	unknown	unknown	Pending
1988	78	0	26	0	26	unknown	unknown	Pending
1989	150	27.9	48	2	50	unknown	unknown	Pending
1990	186	30.8	62[g]	0	62	unknown	unknown	Pending
1991	150	20.0	50	0	50	unknown	unknown	Pending
1992	69	0	23	0	23	unknown	unknown	0.22[h]
1993	84	6.3	28	0	28	unknown	unknown	1.17[h]
1994	75	28.0	25	0	25	unknown	unknown	0.56
1995	87	33.3	29	0	29	unknown	unknown	0.50
1996	144	95.5	43	5	48	0.6[i]	29	0.06
1997	93	5.3	27	4	31	712	22,076	0.71
1998	132	7.1	40	4	44	15	666	0.40
1999	87	9.1	21	8	29	441	12,799	0.67
2000	60	27.8	19	1	20	468	9,352	0.47

[a] These preliminary estimates were 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 salmon.
[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] Data is incomplete for returns of progeny.
[i] Flood event occurred January of 1997, nearly eliminating all the progeny from the 1996 spawn.

Escapement and Composition of Coho Run to the Tucannon River in 2016

Coho produced an estimated 5 redds when expanded for areas not surveyed. One unmarked, untagged age 3 male coho carcass was recovered resulting in a 6.7% sample of the total Coho escapement estimate. A tissue sample (fin clip or head tissue) was collected and archived.

Juvenile Coho Emigration

Juvenile coho salmon were also captured at the Tucannon River smolt trap. Mark-recapture trap efficiencies were calculated, but were highly variable. Excluding the invalid tests, efficiencies averaged 20.8% during the trapping period (Table 26). Staff captured 219 coho and estimate that 1,024 (95% C.I. = 690–1,509) naturally produced coho parr and smolts passed the Tucannon River smolt trap during 2016. Juvenile coho were observed at the smolt trap from 21 March through 9 June. Median passage date was 3 May. Staff took fork lengths and weights on all 219 fish which ranged from 55-160 mm in length, with a mean of 117 mm and median of 120 mm. Weights ranged from 1.9-43.0 g. with a mean of 18.2 g and a median of 18.5 g. K-factors ranged from 0.51-1.40, with a mean of 1.09 and median of 1.08.