Lyons Ferry Hatchery Evaluations: Fall Chinook Salmon Annual Report - (2018 Return/2019 Releases)

by

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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 to include 2018 spawning and 2019 releases of yearlings and subyearlings.

The estimated run size of natural origin fall Chinook salmon to reach Lower Granite Dam (LGR) was 6,140 fish $\geq$ 57 cm fork length and 223 fish 30- <57 cm fork length. The remaining portion of the run consisted of 9,813 hatchery origin fish $\geq$ 57 cm and 4,493 hatchery origin fish 30-< 57 cm. All hatchery origin fall Chinook salmon were from LFH, the Fall Chinook Acclimation Project (FCAP), Idaho Power Company (IPC), and Nez Perce Tribal Hatchery (NPTH) releases. The stray rate of out of basin fish to LGR in 2018 was estimated at 0.6%.

During 2018, WDFW collected 2,295 fish at LGR for broodstock, monitoring and evaluation of our hatchery releases, and to estimate the run composition at LGR.

In 2018, LFH staff spawned 1,254 females for an estimated total green eggtake of 4,754,622; numerically more than full production goals listed in the 2018-2027 *United States v. Oregon* Management Agreement, but well within precision (+/- 10%) levels expected from large production hatcheries. At the end of the season, 56 females and 66 males were returned to the Snake River to spawn naturally. Green egg to eye-up survival was 96.7%. Of the 835 males spawned at both LFH and NPTH, 383 fish were used multiple times to minimize the use of jacks, and to incorporate larger/older fish in the broodstock.

Individual fecundity estimates ranged from 1,363-6,254 eggs/female. Natural origin subyearlings had the highest average at 3,988, followed by subyearling hatchery (3,762) and yearling hatchery (3,166).

The estimated proportion of natural origin fish in broodstock (pNOB) (as determined from run-reconstruction methodologies or Parental Based Tagging, PBT) in the LFH broodstock was 29.7% or 36.3%, respectively. We believe the difference is created by the multiple use of unmarked/untagged males, some of which are natural origin and therefore contributing to the higher pNOB rate in the broodstock.

In 2019, hatchery staff released BY18 subyearlings into the Snake River at LFH and into the Grande Ronde River (GRR) near Cougar Creek, and BY17 yearlings were released into the Snake River at LFH. 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 each also received passive integrated transponder (PIT) tags to monitor survival and migration rate through the hydro system.

Beginning 21 October 2018, staff conducted fall Chinook salmon redd surveys in the lower Tucannon River. A total of 173 redds were counted and an additional 29 redds were estimated due to landowner restrictions resulting in 202 fall Chinook redds. Based on three fish/redd, the estimated number of fall Chinook spawners in the Tucannon River in 2018 was 606. Of the estimated total fall Chinook spawning escapement, 15.5% were recovered and sampled.

In the spring of 2019, a smolt trap was operated on the Tucannon River to estimate juvenile production of fall Chinook salmon, as well as other species. Captures of fall Chinook salmon passing the smolt trap were expanded by trapping efficiencies and for redds that occur below the smolt trap. Total fall Chinook salmon emigrating from the Tucannon River was estimated at 44,142. Productivity (smolts/redd) from spawning was estimated at 218 smolts/redd.

In 2018, we estimate that a minimum of 4,765 (26%) returning adults/jacks that were from WDFW releases only contributed to the LSRCP project area mitigation goal (18,300 fish). This estimate includes returns to LGR, and total fish estimated that remained between Ice Harbor Dam and LGR from harvest and spawning ground surveys in the Tucannon River. An alternative estimate to the project area based on PIT tag conversions from Ice Harbor Dam to LGR was also calculated (5,319 adult/jacks; 29.1%). We estimate that a minimum of 8,229 (8.9%) returning adults/jacks that were from WDFW releases only contributed to the total LSRCP downriver mitigation objective (91,500 fish). This estimate includes returns to the Snake River and fully expanded harvest recoveries outside of the Snake River.

Fall Chinook salmon reared at LFH and released into the Snake River at LFH, near Couse Creek (CCD) in the mainstem Snake River, or into the GRR contributed to harvest outside the Snake River Basin in both sport (1,054) and commercial/tribal fisheries (2,404) in 2018. WDFW released fish were also recovered at hatcheries outside of the Snake River Basin (three at Priest Rapids, one at Ringold Springs, one at Naselle, and one at Bonneville). Of the total number of fish recovered outside of the Snake River, 69.3% came from commercial/tribal fisheries, 30.5% from sport fisheries and 0.2% were from hatcheries.

The top five catch areas for yearlings (Y) and subyearlings (S) returning fall Chinook salmon from WDFW only releases in 2018 were located in the Columbia River (Y=36.3%, S=36.3%), in the ocean off the coasts of British Columbia (Y=22.7%, S=30.4%), Washington (Y=30.2%, S=13.4%), Oregon (Y=5.7%, S=7.5%) and Alaska (Y=2.7%, S=10.2%). Overall, the single largest fishery was the Zone 6 Gillnet fishery in the Columbia River which harvested 19.1% of all WDFW only released fall Chinook salmon recovered outside of the Snake River Basin, and the catch consisted primarily of yearling releases.

Endangered Species Act (ESA) section 10 (a)(1)(A) Permit # 16607 was revised in the summer of 2018 and is now referred to as permit # 16607-2R (amended). Overall, we were within allowances of direct take of listed Snake River fall Chinook salmon for adult returns in 2018 and juvenile releases in 2019.

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: Todd Miller, Michael Gallinat, Jule Keller, Lance Ross, Eric Randell, Brent Burns, Rachel Rillera 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 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 2018, and Ben Sandford (NOAA) for bootstrapping the data to get bounds around the estimates.

We thank 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 to include BY 2018 spawning, and both yearling and subyearling releases occurring in 2019. WDFW's Snake River Lab (SRL) evaluation staff completed this work with federal fiscal year 2018/2019 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 to all possible areas (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 and/or assumed objectives as stated in the LSRCP mitigation document.

Component	Number of adults [a]
Escapement to project area goal	18,300
Commercial harvest objective	54,900
Recreational harvest objective	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 (ESA) 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, in the Grande Ronde River, and FCAP facilities consist of both subyearling (all locations) and yearling (LFH only) life stages, while NPTH releases are subyearlings only. Information about the

[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.

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. Releases from all of these programs occur at 10 locations throughout the Snake River basin, with most releases 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. One out-of-basin hatchery facility is used (Irrigon Hatchery) in addition to the in-basin facilities and acclimation sites. Mark types and quantities have been adopted under the 2018-2027 *United States v. Oregon* Management Agreement (*United States v. Oregon* 2018). At full production levels, 53% of the hatchery produced fish are marked with an adipose (AD) and tagged with a coded wire tag (CWT). If changes to marking/tagging occurs, there is a notification process that needs to be followed per the permit #16607 – 2R issued from NOAA-Fisheries and amended in 2018 (NMFS 2018).

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 2027 (*United States v. Oregon* 2018):

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 2018–2027 *US v. Oregon* Management Agreement.

3. Spawn enough fish to retain 4.45 million eggs (WDFW 2018) to assure that production goals as stated in 2018–2027 *US v. Oregon* Management Agreement are met. Fecundities vary annually depending upon return age classes, but generally 1,300 spawned females make production goals (Table 2).

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.

Table 2. Snake River fall Chinook salmon production priorities for the LSRCP at LFH, FCAP and IPC per the *US v. Oregon management agreement* for Brood Years 2018-2027.

	Production program				
Priority	**Rearing facility**	**Release Number**	**Age**	**Release location**	**Marking/Tagging [1]**
1	Lyons Ferry	450,000	1+	Onstation	450KADCWT
2	Lyons Ferry	450,000	0+	Captain John	200K ADCWT, 250K no clip
3	Lyons Ferry	450,000	0+	Big Canyon	200K ADCWT, 250K no clip
4	Lyons Ferry	500,000	0+	Onstation	200K ADCWT, 300K no clip
5	Lyons Ferry	400,000	0+	Pittsburg Landing	200K ADCWT, 200K no clip
6	Lyons Ferry	200,000	0+	Captain John 2	200K ADCWT
7	Lyons Ferry	200,000	0+	Big Canyon 2	200K ADCWT
8	Lyons Ferry	200,000	0+	Pittsburg Landing 2	200K ADCWT
9	Irrigon	1,000,000	0+	Salmon River [2]	200K ADCWT, 800K no clip
10	Irrigon	200,000	0+	Grande Ronde River	200K ADCWT
11	Lyons Ferry	200,000	0+	Onstation	200K no clip
TOTAL	**Yearlings**	**450,000**			
	Subyearlings	**3,800,000**			

[1] For all Snake River Fall Chinook hatchery programs, tissue samples are collected annually from broodstock and incorporated into a parentage- based tagging (PBT) baseline. The hatchery programs effectively 'tag' ~90-100% of annual releases. All release sites and groups will be PIT tagged and differentially PBT marked/tagged. PBT will be utilized for all fish, including those marked "no clip". No clip means no adipose fin clip and no CWT wire mark.
[2] Beginning in 2018, the releases of subyearlings at Hells Canyon Dam will be moved to the Salmon River. Several Parties are actively participating in the re-licensing of Idaho Power Company's Hells Canyon Complex and its operations. Idaho Power Company's mitigation responsibilities, including production numbers and release locations are a subject of these discussions.

Hatchery Origin Return Goals

- 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.

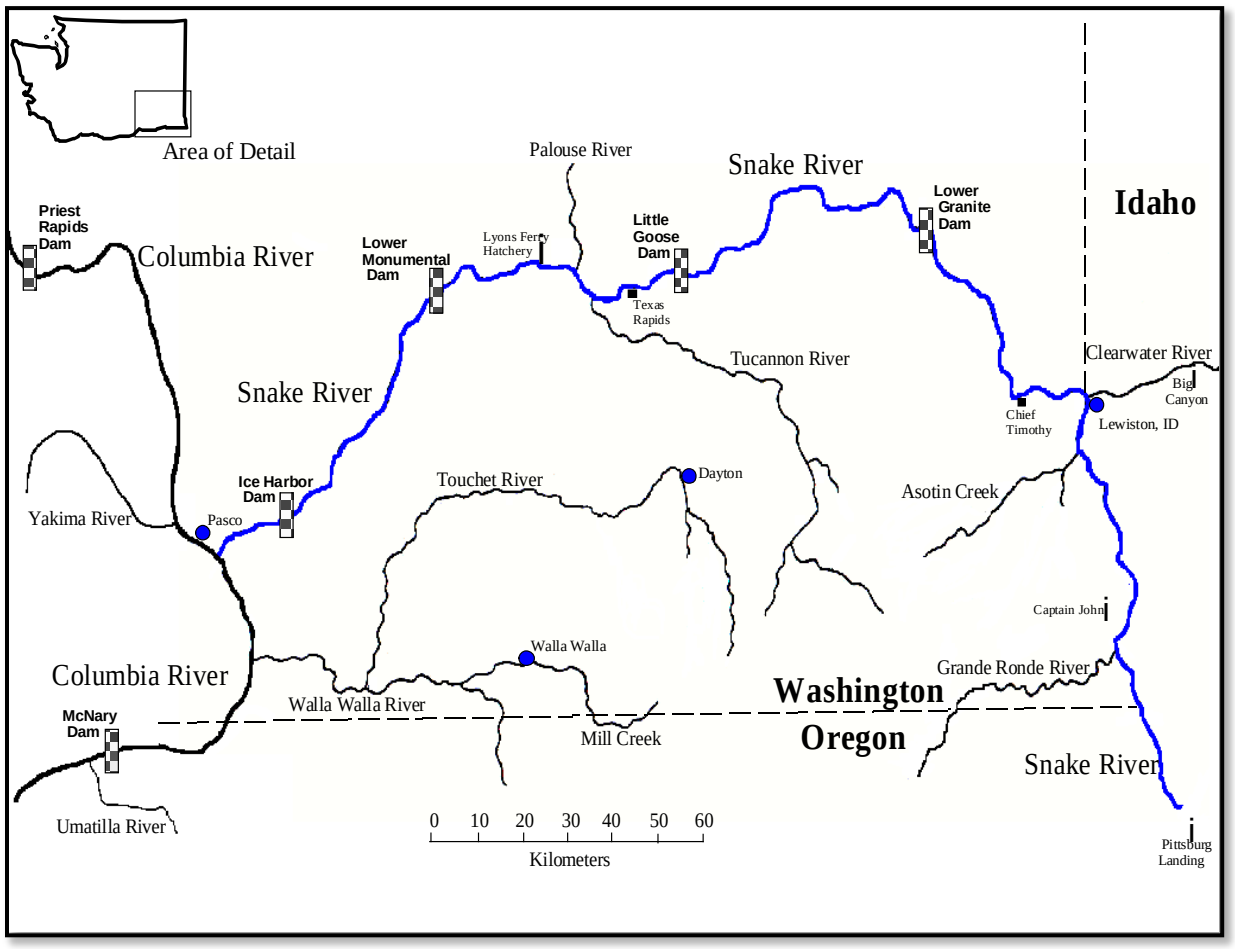

Figure 1. The Lower Snake River Basin showing locations of Lyons Ferry Hatchery, acclimation sites, and major tributaries in the area.

2018 Fall Chinook Salmon Run Size and Composition

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, 2018). Fish are visually measured and grouped by total length (TL) at fish passage windows. Window counts (day and night) estimated 21,897 fall Chinook salmon (≥ 30 cm TL) reached LGR in 2018 (Figure 2), which includes 4,993 "jacks" by size (30 cm-55 cm TL).

Chinook salmon 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.

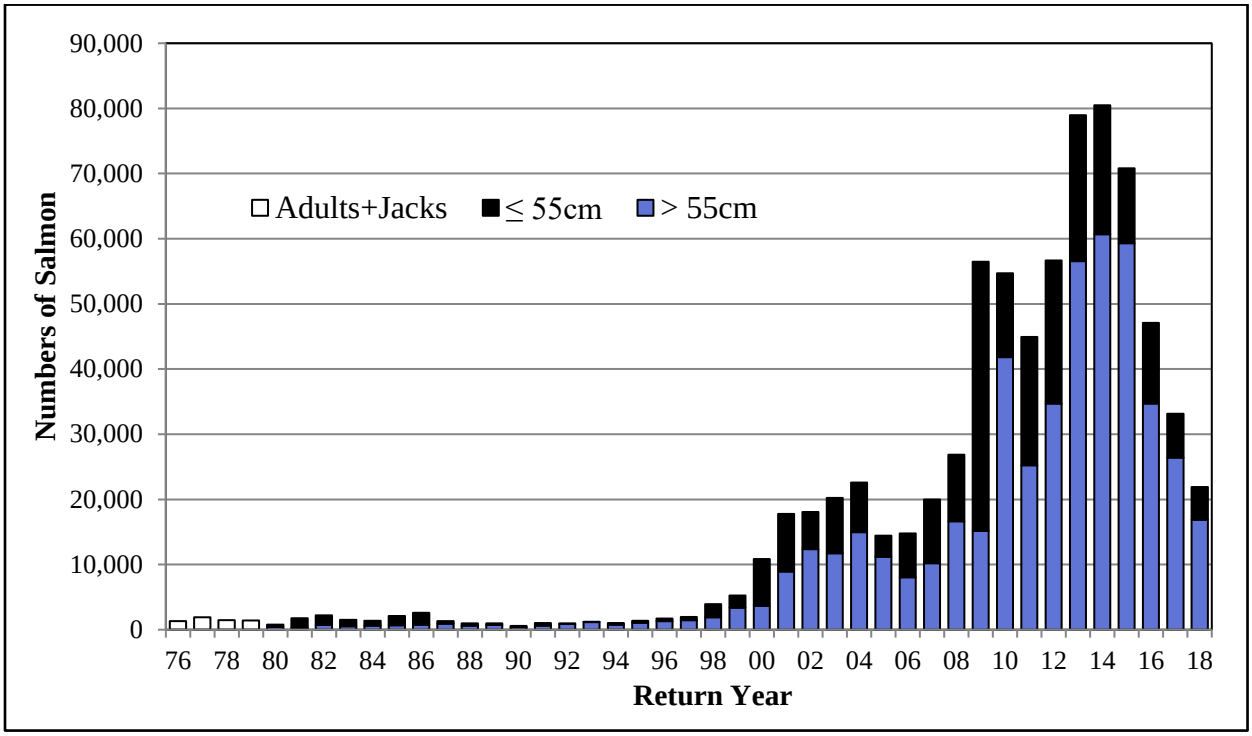

Figure 2. Fall Chinook salmon window counts at LGR, 1976-2018.

The Snake River fall Chinook salmon run reconstruction technical team annually estimates the run to LGR, and consists of staff from NPT, WDFW, IPC, NOAA, and the Columbia River Inter-Tribal Fish Commission (CRITFC) (Table 3). The estimates derived were bootstrapped by Ben Sandford of NOAA and confidence intervals were applied to the point estimates. Note: the fall Chinook salmon run reconstruction team uses a slightly different length criteria (30-56 cm fork length, and $\geq$ 57 cm) compared to the COE window counts. This was done based recovered CWT's that suggested the size range should be modified to better describe adults, jacks and mini-jack returns. The fall Chinook salmon run reconstruction technical team estimated 20,790 (including males <57 cm) fall Chinook salmon (30.6% wild, 68.8% inbasin hatchery, and 0.6% out of basin hatchery) reached LGR in 2018. The final run estimate to LGR was 5.1% less than window count estimates documented at www.fpc.org. Females, regardless of size, were summarized together and males were summarized according to fork length (30-56 cm and $\geq$ 57 cm). The data is 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 3. Estimated composition, standard errors, and confidence intervals for fall Chinook salmon, males (M) and females (F) reaching LGR during 2018.

Estimates					Bootstrap standard error					Bootstrap 95% Confidence Interval Upper CI, Lower CI				
Total Run by Origin														
Origin	**F**	**M ≥57cm**	**M <57 cm**	**Total ≥57cm**	**Origin**	**F**	**M ≥57 cm**	**M <57 cm**	**Total ≥57cm**	**Origin**	**F**	**M ≥ 57cm**	**M <57 cm**	**Total ≥57 cm**
Total wild	2,588	3,552	223	6,140	Total wild	296	268	282	388	Total wild	2622, 3789	3306, 4366	40, 1195	6273, 7790
Total hatchery	5,361	4,572	4,493	9,932	Total hatchery	286	263	267	355	Total hatchery	9298, 10416	7385, 8405	2735, 3801	17033, 18451
Totals	7,949	8.123	4,717	16,073	Totals	191	176	133	183	Totals	12712, 13458	11332, 12053	3603, 4140	24425, 25139
Run by origin and age														
Origin	**F**	**M ≥57cm**	**M <57 cm**	**Total ≥57cm**	**Origin**	**F**	**M ≥57cm**	**M <57cm**	**Total ≥57cm**	**Origin**	**F**	**M ≥57cm**	**M <57 cm**	**Total ≥57 cm**
Wild age 2	19	42	145	61	Wild age 2	10	18	176	21	Wild age 2	1, 41	8, 82	-205, 490	21, 106
Wild age 3	703	2,520	73	3,224	Wild age 3	72	140	20	157	Wild age 3	564, 847	2247, 2797	34, 115	2899, 3520
Wild age 4	1,644	952	5	2,596	Wild age 4	119	92	5	149	Wild age 4	1424, 1885	765, 1113	0, 16	2296, 2886
Wild age 5	254	37	0	292	Wild age 5	38	26	0	46	Wild age 5	181, 332	-14, 87	0, 0	209, 383
Wild age 6	-32	0	0	-32	Wild age 6	26	0	0	26	Wild age 6	-92, 4	0, 0	0, 0	-92, 4
Hat age 2	11	32	3,983	43	Hat age 2	8	14	228	16	Hat age 2	0, 29	8, 65	3559, 4437	15, 79
Hat age 3	482	1,899	489	2,381	Hat age 3	76	160	103	171	Hat age 3	335, 638	1567, 2214	300, 693	2031, 2700
Hat age 4	4,344	2,387	21	6,732	Hat age 4	151	132	21	188	Hat age 4	4061, 4644	2148, 2656	0, 65	6371, 7120
Hat age 5	417	175	0	592	Hat age 5	57	45	0	73	Hat age 5	306, 529	95, 272	0, 0	445, 733
Hat age 6	57	9	0	66	Hat age 6	41	9	0	42	Hat age 6	0, 149	0, 29	0, 0	3, 163
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	0	0	0	0	Stray age 3	0	0	0	0	Stray age 3	0, 0	0, 0	0, 0	0, 0
Stray age 4	48	71	0	119	Stray age 4	19	25	0	31	Stray age 4	14, 88	0, 0	0, 0	64, 184
Stray age 5	0	0	0	0	Stray age 5	0	0	0	0	Stray age 5	0, 0	0, 0	0, 0	0, 0
Stray age 6	0	0	0	0	Stray age 6	0	0	0	0	Stray age 6	0, 0	0, 0	0, 0	0, 0
Stray AWT	0	10	0	0	Stray AWT	0	0	0	0	Stray AWT	0, 0	0, 0	0, 0	0, 0
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.

Characteristics of fall Chinook salmon reaching LGR Dam

The following figures use data from hatchery and natural origin fall Chinook salmon handled at the LGR adult trap.

Sex Ratio

The 2018 run reconstruction estimate consisted of 79.9% males+jacks. The sex ratio of the return was calculated at 3.9 males+jacks/female. After removal of fish for broodstock, fish passing LGR were 66.3% males resulting in 2.0 males+jacks/female.

Length Frequencies

Every salmon trapped at LGR was measured and the number of fish at each length were expanded by the trapping rate on the day they were captured to represent the overall run of fall Chinook salmon at that size during that day (Figure 3). Median fork length for males (which included jacks and minijacks) was 60.0 cm with a mean of 56.3 cm. Median fork length for females was 74.1 cm with a mean of 73.0 cm.

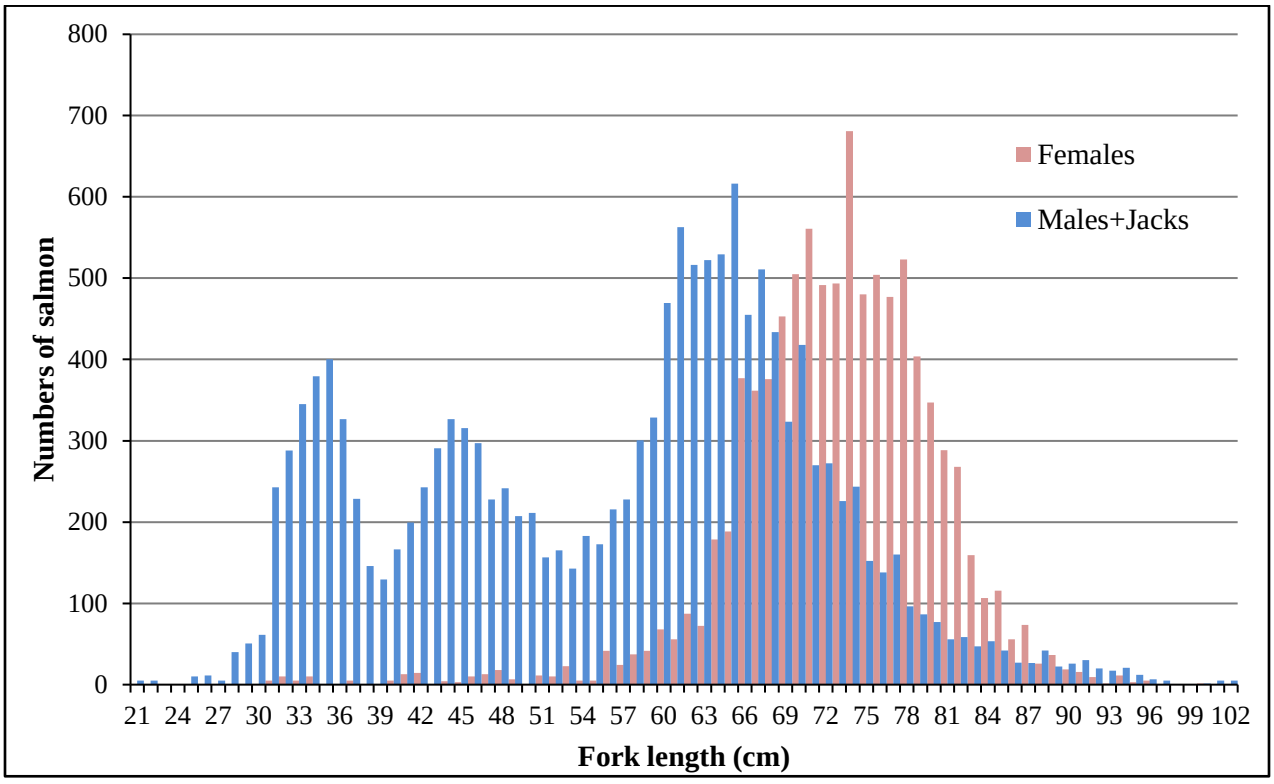

Figure 3. Estimated length frequencies of the fall Chinook salmon run to LGR by sex in 2018.

Trapping and Broodstock Management 2018

Lower Granite Dam Trapping Operations 2018

In 2018, fall Chinook trapping and hauling at LGR began 18 August. Two trapping rates were used during the season (18 Aug – 6 Sept = 70%, 7 Sept – 18 Nov = 20%). The arrival timing of males and females collected for broodstock at LGR and hauled to LFH is provided (Figure 4). Broodstock goals were met early on in 2018, but trapping continued throughout the run. Trapping protocols are presented in Appendix A. Historical trapping rates and operation dates of systematic sampling at LGR are presented in Appendix B. In general, NOAA Fisheries staff anesthetized the salmon, and gather length, sex, fin clip, and the presence of wire or PIT tag. Of the 6,683 salmon trapped at LGR, approximately 34.3% were hauled to LFH and 13.2% were hauled to NPT for the fall Chinook salmon broodstock program and run reconstruction needs.

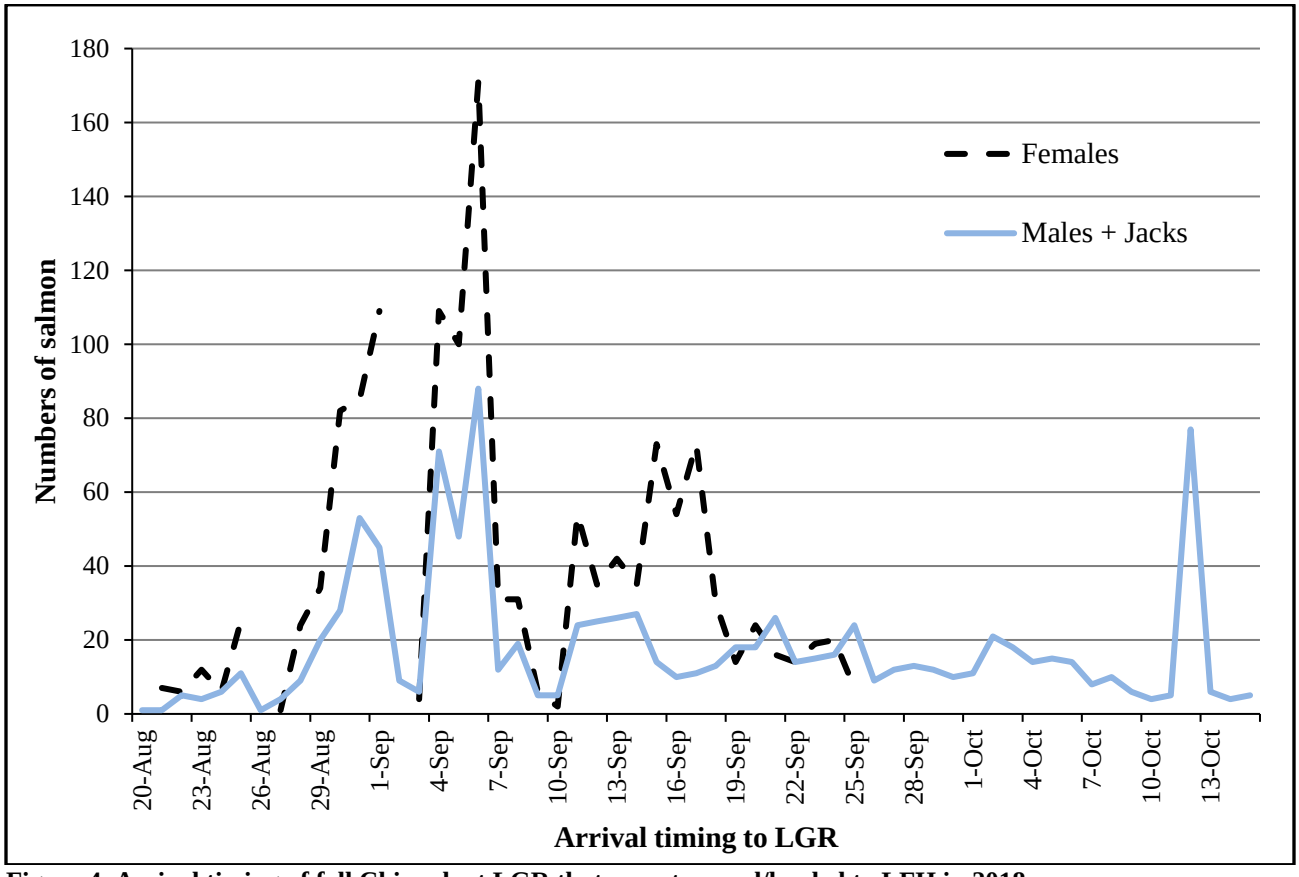

Figure 4. Arrival timing of fall Chinook at LGR that were trapped/hauled to LFH in 2018.

Broodstock Collection and Management 2018

Fall Chinook salmon are collected at LGR for broodstock (Appendix A). Each year there is a discrepancy between estimated numbers of fish collected and the numbers of fish processed/killed (Table 4). The discrepancies are likely data recording errors, and are generally small. In 2018, the percent discrepancy was only 0.4%.

Table 4. Numbers of fall Chinook initially collected at LGR for broodstock, evaluation, and run construction needs in 2018.

Year	Trap location	Number collected/hauled for broodstock	Processed (killed)	Returned to Snake River	Difference from number collected/hauled
2018	LGR	2,295	2,164	122	9

Hatchery Operations 2018

Spawning Operations

Spawning and Egg Take

Fish transported from LGR to the adult holding ponds at LFH had approximately 0.4:1 sex ratio (males:females) in the adults (70 cm or greater), and 7.6:1 sex ratio for fish less than 70 cm. Most of the fish collected that were < 70 cm were not intended to be used in the broodstock but were for CWT's to use in the run reconstruction. Size criteria for mating males was set at 70 cm to reduce the number of all jacks (hatchery and natural origin) 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 larger, older aged, unmarked/untagged fish from LGR.

The duration, peak of spawning, eggtake, and percent egg mortality (Table 5), numbers of fish spawned (Table 6), and the number killed outright or died in the pond are provided (Table 7). Natural origin fish used for broodstock were identified post-spawning based on PIT tags recovered and Parental Based Tagging (PBT) results obtained at the end of the season. Milt from unmarked/untagged males held overnight (23 and 30 Oct and 6 Nov) were used in matings the following day as a way to maximize the use of unmarked/untagged fish. Composition of fish processed at LFH is presented in Appendix C. In 2018, eggtake goals were attained for LFH as required by the production priorities table per the 2018-2027 US v. Oregon Management Agreement (Page 107).

Table 5. Duration and peak of spawning, egg take, and percent egg mortality at LFH, 1984-2018.

Year	Spawn duration Begin	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
2017	24 Oct	28 Nov	7 Nov	4,685,575	17	-	5.4
2018	23 Oct	14 Nov	30 Oct	4,754,622	11	-	3.3

[a] Priority levels as listed in the 2008-2017 *US v. Oregon* Management Agreement production tables.

[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 eggs from stray females 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 6. Spawn dates, numbers of fall Chinook salmon spawned, and weekly egg take at LFH in 2018. (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
23 & 24 Oct	29	19	122	38	0	617,153
30 & 31 Oct	72	29	309	136	2	1,654,491
6 & 7 Nov	177	144	248	180	2	1,660,491
14 Nov	59	56	106	115	1	822,261
Totals	**337**	**248**	**785**	**469**	**5**	**4,754,622**

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

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

Table 7. Weekly summary and origins of mortality and surplus fall Chinook processed at LFH in 2018.

Week ending	Mortality						Killed Outright					
	LF/Snake R.[a]		Natural		Other/Unknown[b]		LF/Snake R.		Natural		Other/Unknown	
	F	M	F	M	F	M	F	M	F	M	F	M
1 Sep					2	1						
8 Sep	2				3							
15 Sep												
22 Sep	2					1						
29 Sep												
6 Oct					5							
13 Oct					2							
20 Oct					2	1						
27 Oct	3				1	1	1	196		1		21
3 Nov					1		1	17	1			
10 Nov		2			1	2	1	6		2	3	2
17 Nov		1					8	20			2	5
Totals	**7**	**3**	**0**	**0**	**17**	**6**	**11**	**239**	**1**	**3**	**5**	**28**

[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

Collected broodstock not needed to fulfill program needs were returned to the Snake River at LFH on 15 November (Table 8). Fish were scanned for PIT tags, CWT and presence of an AD clip 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.

Table 8. Estimated composition of fall Chinook salmon released into the Snake River near LFH at the end of the season in 2018.

Origin	Release age	Origin estimation method	Salt water age	Total age	Females	Males+Jacks	Total
Hatchery	Unknown	Clip/Wire/Scales	-	-	3	7	10
Unknown	Unknown		-	-	53	59	112
Totals					56	66	122

Effective Hatchery Population Size

To determine the effective population size of hatchery fall Chinook salmon production in the Snake River, the number of males and females used at both LFH and NPTH were combined. At both hatcheries, larger males were mated with multiple females to more closely mimic what occurs in nature (Hankin 2009). In 2018, a total of 1,669 females and 835 males were spawned at both LFH and NPTH. Of the 835 males spawned, 383 were used multiple times to:

- maximize the number of larger and 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. The estimate of effective male breeders at both hatcheries combined in 2018 was 506.

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)

$$1553 = (4 \times (506 \times 1669)) / (506 + 1669)$$

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 5). Between 2005 and 2010, the number of fish used for broodstock varied between 2,000 and 3,500 fish/year. Since 2011, when the change the was made to spawn older and larger sized males multiple times (instead of spawning jacks which was common practice prior to 2011), the number of fish used for spawning dropped to between 1,500 and 2,000 fish annually, and has remained fairly stable.

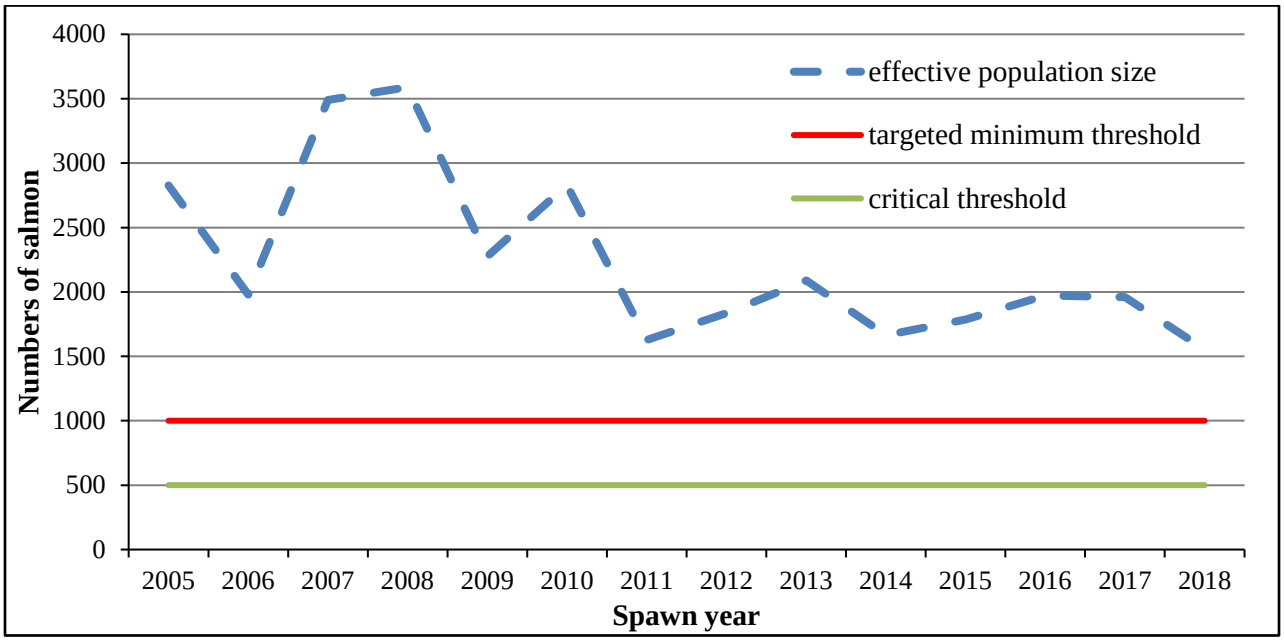

Figure 5. Estimated effective population size of the Snake River fall Chinook salmon spawned from both LFH and NPTH.

Broodstock Profile

Since 2011, fin tissues have been taken from all fish contributing to broodstock, including those that were spawned but later not used for crosses. Those not used were removed from the dataset and not genotyped. WDFW genotypes the samples before sending the results to Idaho Department of Fish and Game (IDFG) Eagle Genetics lab. This was the third year PBT results were used to determine origin. PBT was used in conjunction with CWT and PIT tags to determine origin. Since 2012, scales have been taken on 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) by staff from the University of Idaho to determine where natural origin fall Chinook salmon are rearing in the Snake River basin based on strontium levels (Hegg 2013).

A concentrated effort has occurred since 2010 to spawn older and larger sized males and females because of the large number of jacks and jills that had been used in the past. Salt water age composition of fish used as broodstock are summarized pre and post protocol change in 2010 (Figure 6–Figure 11). The origin of fall Chinook salmon used for broodstock at LFH in 2018 is presented in Figure 12. By utilizing PBT results to determine origin, unknown origin fish used in broodstock decreased by 97.1% (Figure 13). Length frequencies of fall Chinook salmon used for broodstock at LFH in 2018 are presented in Figure 14. Males used multiple times are captured in both figures. Unknown origin can include both hatchery and natural origin fish. Median length was 79 cm for females and 77 cm for males. An estimated 24.9% of the males and 23.0% of the females were returns from yearling releases.

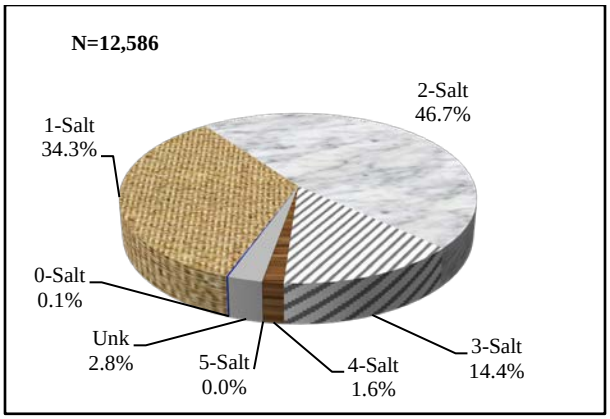

Figure 6. Salt age composition of all broodstock 2005 – 2009.

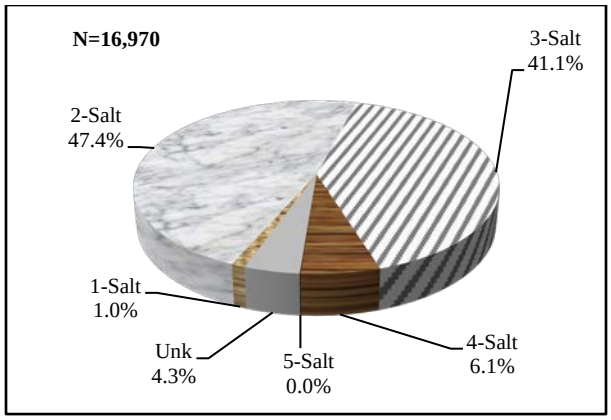

Figure 7. Salt age composition of all broodstock 2010 – 2018.

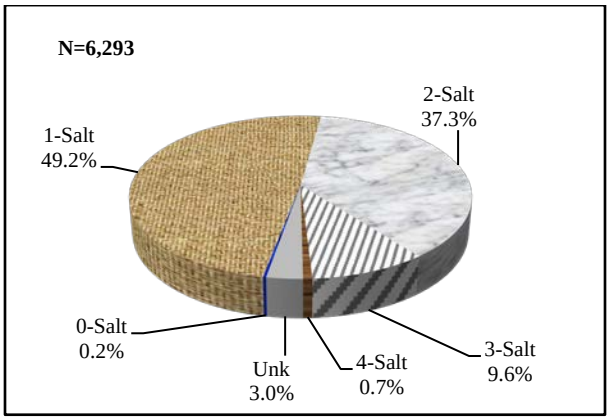

Figure 8. Male salt age composition of broodstock 2005 – 2009.

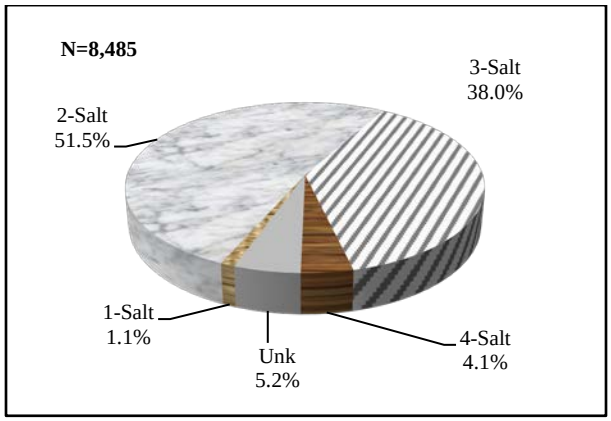

Figure 9. Male salt age composition of broodstock 2010 – 2018.

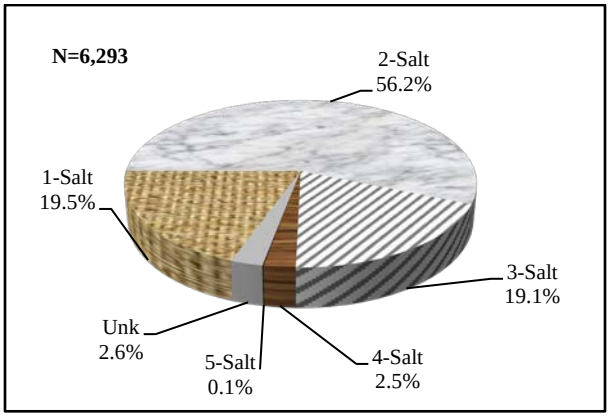

Figure 10. Female salt age composition of broodstock 2005 – 2009.

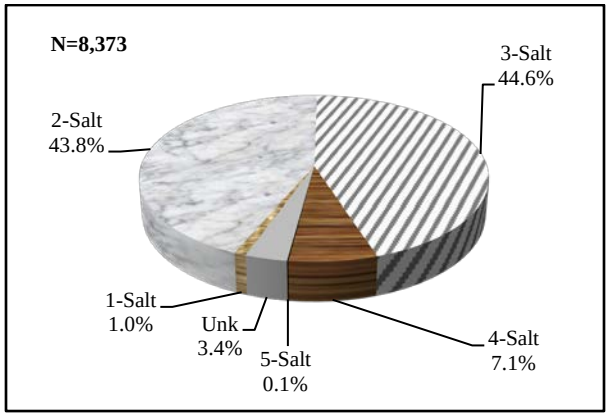

Figure 11. Female salt age composition of broodstock 2010 – 2018.

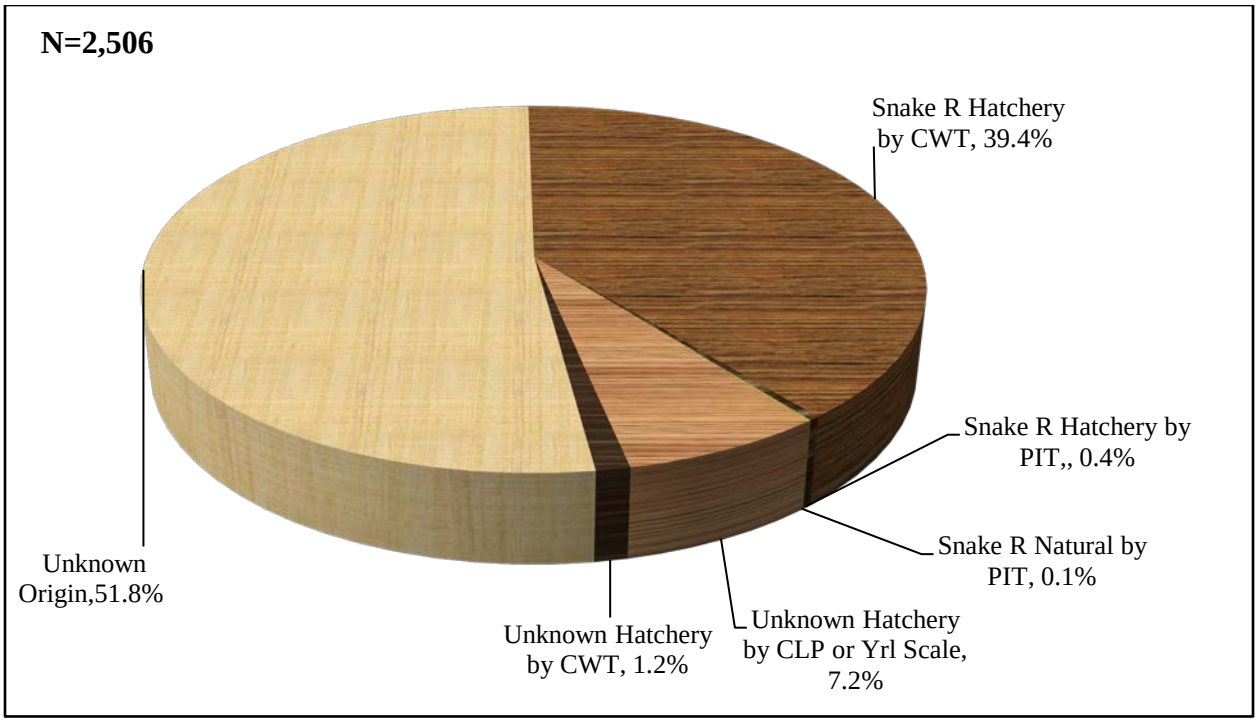

Figure 12. Percentages by fish origin <u>WITHOUT PBT RESULTS</u> contributing to fall Chinook salmon broodstock at LFH during 2018.

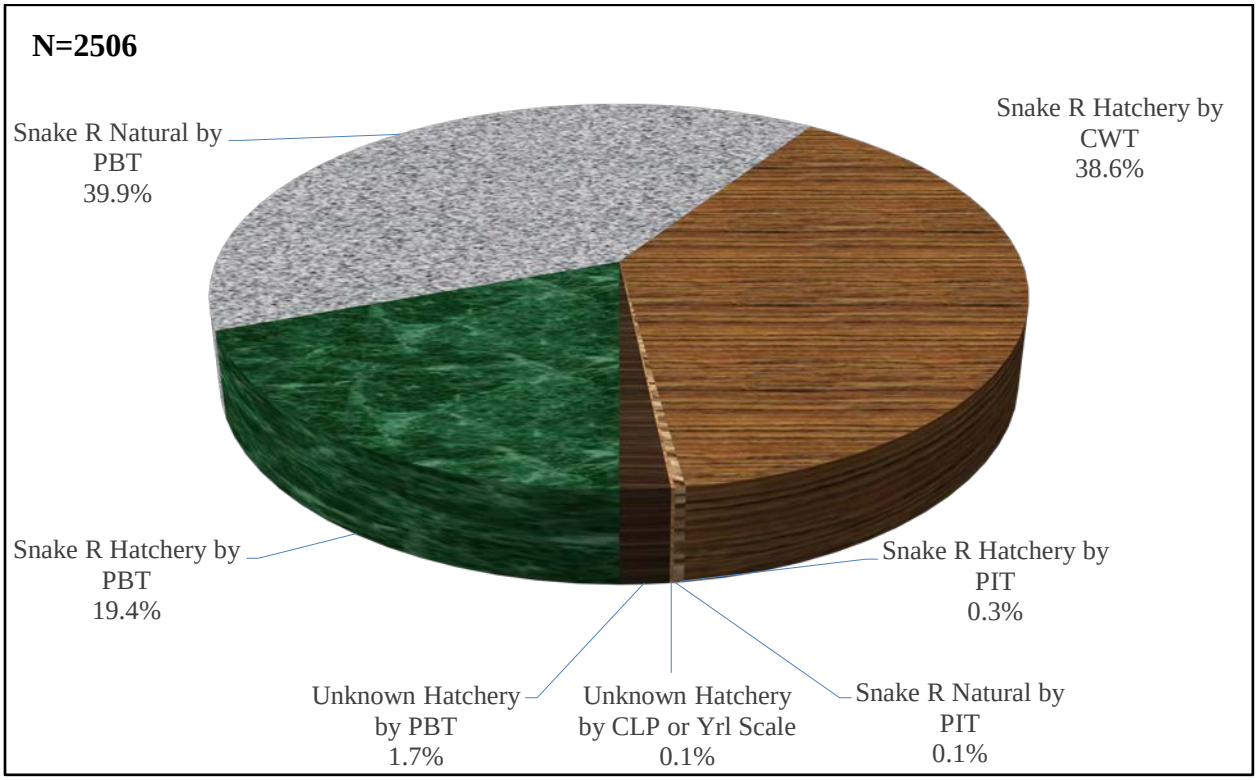

Figure 13. Percentages by fish origin <u>WITH PBT RESULTS</u> contributing to fall Chinook salmon broodstock at LFH during 2018.

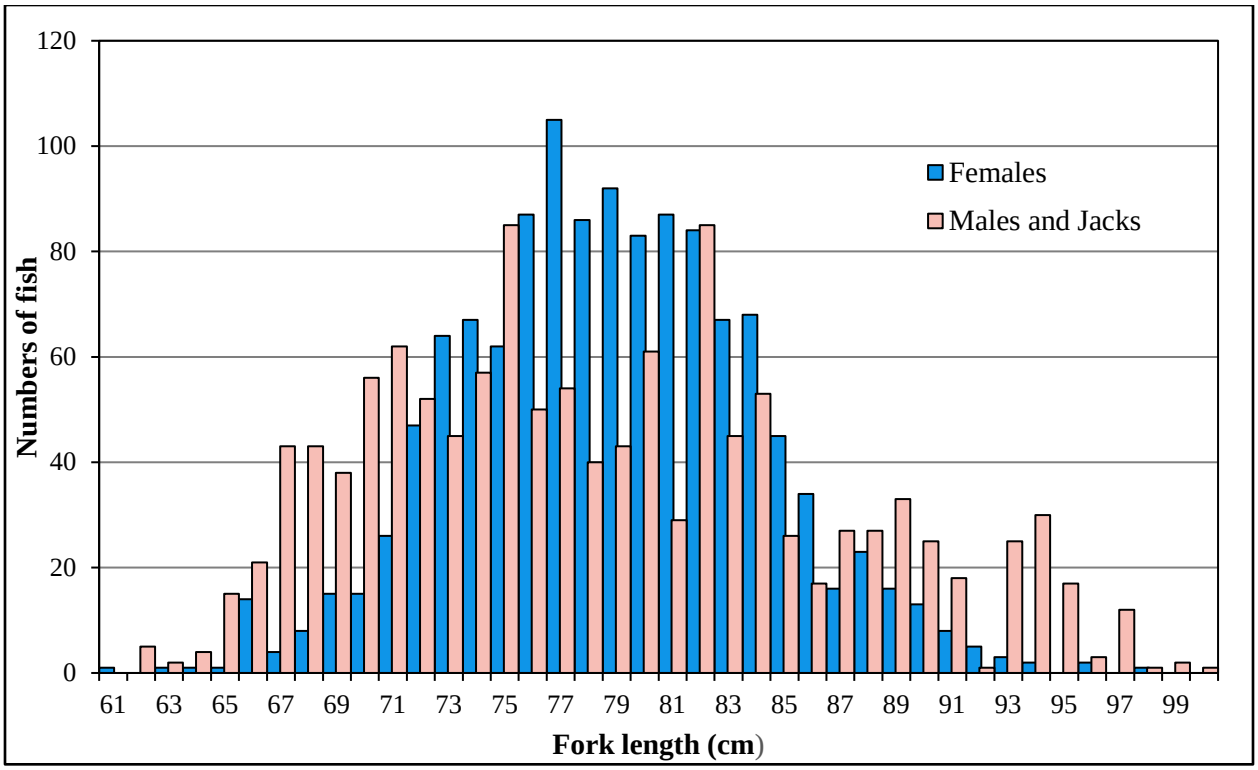

Figure 14. Fork lengths of fall Chinook salmon used as broodstock at LFH in 2018.

Males Used in Broodstock

Origin, including release site information, was determined for 39.2% of the males spawned based on CWT or PIT tag data and 16.2% from PBT. An additional 2.1% of the males were identified as unknown hatchery origin based PBT, AD clip, lost/unreadable tags, or scale patterns with a hatchery check. Males that were unmarked/untagged represent 42.5% of the males spawned with 99.6% of those determined as natural origin by PBT. Of the total number of males spawned, 60.9% were from subyearlings, 25.7% were from yearlings, with the remaining 13.4% from unknown age or reservoir reared fish as determined by scale analysis (Table 9). As noticeable in the table, a few males were used on more than 6 different females. Some miscommunication between evaluation and hatchery occurred one day during spawning and resulted in some males being spawned with seven, nine, 10 or 11 different females. The goal was not to exceed six females. Since this time, and depending on the number of males available, the goal is not to exceed three or four females per male.

Table 9. Origin and age of males that contributed to production at LFH, 2018.

Origin determination method / age	Times each male was used for mating										Total unique
	1	**2**	**3**	**4**	**5**	**6**	**7**	**9**	**10**	**11**	
Snake R Hatchery by CWT, PIT											
subyearling 2 salt (age3)	38	11	2			1		1			**53**
subyearling 3 salt (age4)	17	7	9		1	3		3			**40**
subyearling 4 salt (age5)	1	1									**2**
yearling 2 salt (age4)	62	33	22	1	4	4		1			**127**
yearling 3 salt (age5)	5										**5**
Snake R Hatchery by PBT											
reservoir reared 3 salt (age5)						1					**1**
subyearling 2 salt (age3)	13	8	7	1	1						**30**
subyearling 3 salt (age4)	20	5	7		2	4		5	1		**44**
subyearling 4 salt (age5)	1	1	1								**3**
yearling 2 salt (age4)	2	1	2								**5**
yearling 4 salt (age6)	1										**1**
unknown age	6	2		1		1					**10**
Undetermined Hatchery by clip, wire or yearling scales											
subyearling 3 salt (age4)			1								**1**
Unknown Hatchery by PBT											
subyearling 2 salt (age3)	3	2									**5**
subyearling 3 salt (age4)	1	1	2					1			**5**
unknown age		1									**1**
Snake R Natural by PBT											
reservoir reared 1 salt (age3)				1							**1**
reservoir reared 2 salt (age4)	13	9	7	1		1				1	**32**
reservoir reared 3 salt (age5)	1		1					1			**3**
subyearling 2 salt (age3)	48	7	12		2	1					**70**
subyearling 3 salt (age4)	38	28	18	2	2	4	2	2	1		**97**
subyearling 4 salt (age5)	1	1	1								**3**
yearling 1 salt (age3)	1										**1**
yearling 2 salt (age4)	4	3				1					**8**
yearling 3 salt (age5)		2									**2**
unknown age	9	13	4	2	1			1			**30**
Snake R Natural by PIT											
subyearling 2 salt (age3)	1										**1**
Total unique males	**286**	**136**	**96**	**9**	**13**	**21**	**2**	**15**	**2**	**1**	**581**

Females Used in Broodstock

Origin, including release site information, was determined for 42.1% the females spawned based on CWT or PIT tag data and 19.4% based on PBT. An additional 1.2% of the females were identified as unknown hatchery origin based PBT. Females that were not tagged or clipped represent 37.3% of the females spawned. Of the females that were not tagged or clipped, 96.7% were determined to be natural by PBT. The estimated age composition and origins of females contributing to broodstock at LFH are listed in Table 10. Similar to the males used in broodstock, of the total number of females spawned, 62.9% were from subyearlings, 24.9% were from yearlings, and the remaining 12.2% were from unknown age or reservoir reared fish.

Table 10. Origins and age of females that contributed to production at LFH, 2018.

Origin determination method	Age	Number of females
Snake River hatchery		
Snake R hatchery by CWT or PIT	subyearling reservoir reared 3 salt (age5)	**1**
	reservoir reared 3 salt (age5)	**1**
	subyearling 2 salt (age3)	**25**
	subyearling 3 salt (age4)	**195**
	subyearling 4 salt (age5)	**22**
	subyearling 5 salt (age6)	**3**
	yearling 2 salt (age4)	**261**
	yearling 3 salt (age5)	**19**
	yearling 4 salt (age6)	
Snake R hatchery by PBT	subyearling 2 salt (age3)	**43**
	subyearling 3 salt (age4)	**158**
	subyearling 4 salt (age5)	**11**
	yearling 2 salt (age4)	**19**
	unknown rear	**12**
Undetermined hatchery		
Unknown hatchery by PBT	reservoir reared 2 salt (age 4)	**2**
	subyearling 2 salt (age3)	**2**
	subyearling 3 salt (age4)	**9**
	yearling 2 salt (age4)	**1**
	yearling 3 salt (age5)	**1**
Snake River natural		
Snake River Natural by PBT	subyearling reservoir reared 2 salt (age4)	**1**
	reservoir reared 2 salt (age4)	**91**
	reservoir reared 3 salt (age5)	**11**
	reservoir reared 4 salt (age6)	**1**
	subyearling 2 salt (age3)	**28**
	subyearling 3 salt (age4)	**258**
	subyearling 4 salt (age5)	**34**
	yearling 2 salt (age4)	**9**
	yearling 3 salt (age5)	**1**
	unknown age	**33**
Snake River natural by PIT	yearling 3 salt (age5)	**1**
Total		**1,253**

Fecundity

Individual fecundities were counted on a subsample of broodstock. Fecundity was estimated by counting and weighing 100 live eggs, applying the weight/egg calculation to the total weight of the live eggs, adding in counted dead eggs, and applying a 4% correction factor for water retention. 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 egg mass 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 no more than 34%.

Fecundity relationships were evaluated for Snake River hatchery yearling, subyearling, and subyearling reservoir reared groups as well as Snake River natural origin subyearling and reservoir reared subyearlings (from PBT results) (Figure 15). Generally, fork lengths reliably predict fecundities for all rearing types of fall Chinook salmon but were highly variable (1,363-6,254 eggs/fish) in all groups. Subyearling natural origin average fecundity was highest at 3,988 (mean FL 81cm), followed by subyearling hatchery fish at 3,762 (mean FL 79 cm) with yearling hatchery fish the lowest at 3,166 (mean FL 75 cm). Based on hatchery records, average fecundity of all females was 3,777. 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 the collection of jills and concentrate on larger sized females for broodstock.

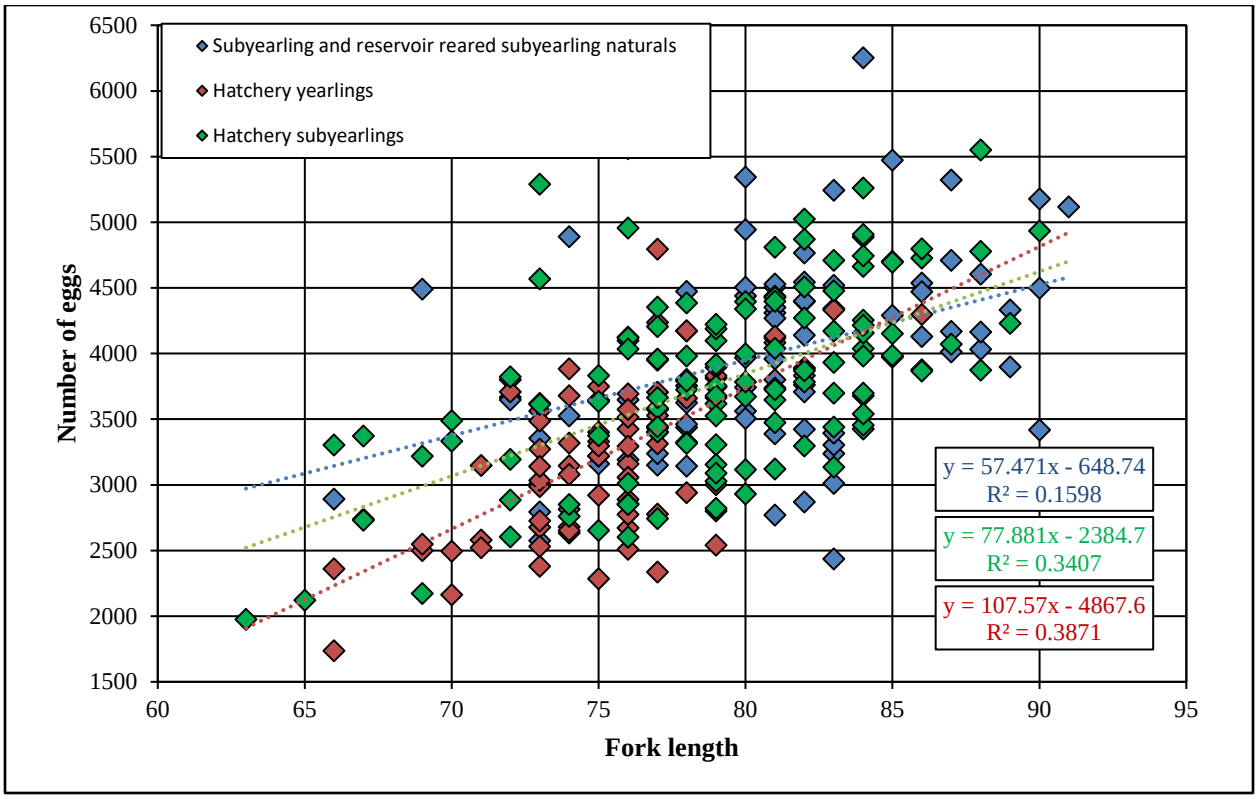

Figure 15. Fall Chinook salmon fork length to fecundity relationships in 2018.

Inclusion of Natural Origin Fish

Unmarked/untagged fall Chinook salmon were incorporated into the broodstock beginning in 2002. To estimate pNOB, a dataset was constructed to reflect all parents contributing to production, broken into size categories by mark/clip, and used the same information estimated at LGR from the run reconstruction to estimated natural origin fish in the broodstock. Males used with multiple females were included multiple times. In 2018, the estimated percent natural origin fish used in WDFW broodstock (pNOB) was 29.7% (Figure 16), slightly below the 30% target. The overall pNOB for LFH and NPTH combined was 29.4%. The PBT results in 2018 estimated pNOB at 36.3%, exceeding the 30% target (Figure 16).

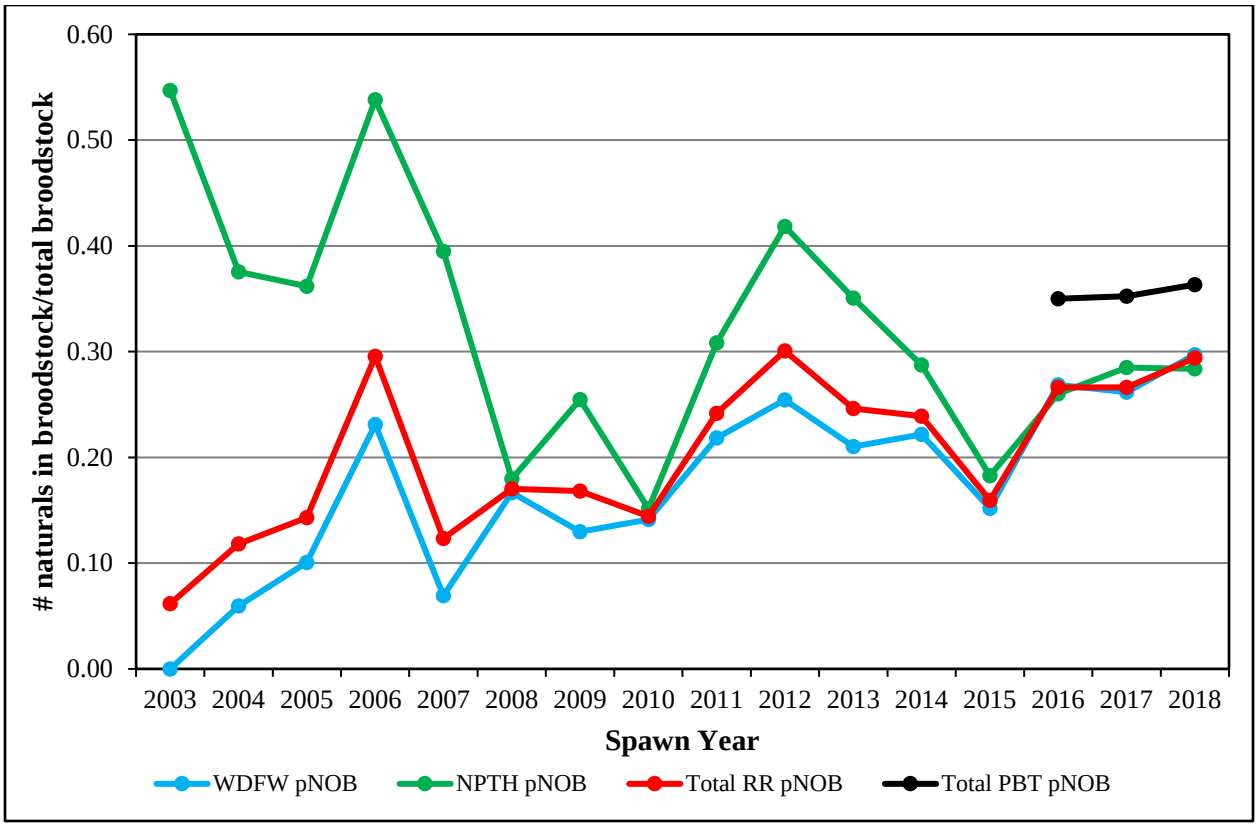

Figure 16. Estimated percent natural origin parents in broodstock at LFH, NPTH, and overall for Snake River basin hatchery production, 2003-2018.

Jacks and Jills and Stray Fall Chinook Salmon in Broodstock

As described above, WDFW has implemented a size selective collection and mating protocols, with one of the main goals to reduce 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. Jacks and jills in broodstock should be considered minimum estimates because of the above explanation of potential biases in our estimates created by reservoir reared fish. Intensive monitoring of jacks and jills began in 2010 in order to minimize their contribution. This monitoring and subsequent management action has reduced the total matings with 0 and/or 1-salt parentage by 96.3% within the last eight years (Appendix D).

The WDFW goal is to fully exclude strays from broodstock to maintain the genetic integrity of the fall Chinook salmon LFH produces. In cases where we are broodstock limited, it was agreed that strays may be included in spawners up to 5%. To assure productions goals were met as

mandated in the 2018-2027 *United States v. Oregon* Management Agreement, seven stray females were spawned and the gametes were retained until the end of the spawning season. When it was verified that production goals could be met, the strays were culled. Strays retained as broodstock over the years are presented in Appendix D. Males used multiple times are included multiple times in the Appendix D table.

Juvenile Rearing and Marking and Tagging

Information regarding eggs taken, egg loss, eggs culled, eggs shipped or retained, and numbers of fish ponded is included in Table 11. Historical egg take and ponding information is listed in Appendix E. 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 11. Eggs taken and survival numbers by life stage of fall Chinook salmon spawned at LFH, brood years 2014-2018.

Brood year	Eggs taken	Egg loss	Eggs culled [a]	Eggs shipped	Eyed eggs retained	Fry ponded	Intended program
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
2017	4,685,575	212,043	48,940	1,541,282	2,883,310	930,000	Yearling
						1,912,017	Subyearling
2018 [b]	4,754,622	158,706	18,863	1,315,510	3,261,543	484,356	Yearling
						2,761,054	Subyearling

[a] Eggs culled due to ELISA results, stray, jill or jack matings.

[b] The decrease in yearling production, and increase in subyearling production, is a reflection of the new 2018-2027 US v. Oregon Management Agreement

Marking and tagging of fish was consistent with the 2018- 2027 *US v. Oregon* Management Agreement. LFH yearling (BY17) fish were ADCWT marked/tagged from 7-18 July. After marking and tagging, all but ~12,000 fish (~6,000 ADCWT, ~6,000 CWT only) were diverted to the rearing lake. Staff performed tag and fin clip quality control checks from a sample of each group immediately prior to their movement to the rearing lake following PIT tagging (Table 12).

Subyearling (BY18) were ADCWT marked/tagged 18-22 March. All subyearlings were diverted to the rearing lake once the yearlings were released. Staff performed tag and fin clip quality control checks from a sample of each group prior to transfer into the rearing lake.

GRR (BY18) fish were ADCWT marked/tagged on 18-21 March. Fish were kept in raceways prior to being trucked to their release site on the Grande Ronde River near Cougar Creek.

Table 12. 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 clipped only	CWT only	Unmarked/ untagged
2017								
Yearling	LFH	ADCWT	637398	1,977	1,960 (99.14%)	10 (0.51%)	1 (0.05%)	6 (0.30%)
Yearling	LFH	CWT only	637397	1,944	1932 (99.38%)	12 (0.62%)	0 (0.00%)	0 (0.00%)
2018								
Subyearling	LFH	ADCWT	637422	484	477 (98.55%)	4 (0.83%)	3 (0.62%)	0 (0.00%)
Subyearling	GRR	ADCWT	637199	1,002	906 (90.42%)	83 (8.28%)	10 (1.00%)	3 (0.30%)

Survival Rates to Release

The estimated number of eggs and fish present at life stages in the hatchery were used for 2015-2019 release years to calculate survival rates within the hatchery environment (Table 13). The original survival goal for the program was 80% [(9,160,000 subyearling juveniles/11,450,000 eggs) x 100] from USACOE 1975. The survival goal has been achieved each year for yearlings since 2003 and yearly since 1990 for subyearlings (https://www.fws.gov/lsnakecomplan/Reports/LSRCPreports.html).

Table 13. Estimated survivals (%) between various life stages at LFH for fall Chinook salmon, 2013-2017 yearling brood years and 2014-2018 subyearling broodyears.

Brood year	Release stage	Green egg-ponded fry	Ponded fry-release [a]	Green egg-release
2013	Yearling	97.4	94.6	91.2
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
2016	Yearling	94.9	87.3	82.8
	Subyearling	94.9	94.2	94.2
2017	Yearling	92.2	95.4	88.0
	Subyearling	92.2	96.7	89.2
2018	Subyearling	94.4	98.9	93.3
Yearling mean:	**%**	**95.0**	**94.1**	**89.1**
	SD	**1.9**	**6.5**	**6.0**
Subyearling mean:	**%**	**94.4**	**98.9**	**93.4**
	SD	**1.3**	**1.5**	**2.6**

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

Juvenile Releases

Yearling fall Chinook salmon at LFH were released from 12 to 13 March 2019, with peak emigration occurring on 12 March. Fish (~200 per release group) were measured, weighed, and visually appeared in good condition, with no external signs of BKD, pop-eye, descaling, or sexual precocity. An estimated 225,552 fish were released from the ADCWT group, and 218,255 were released from the CWT only group, 1,151 were released as adipose only, and 2,045 were released as unmarked untagged. Hatchery staff set aside fish throughout the release for SRL staff to subsample for individual lengths and weights (Table 14). Individual length/weight samples and pound count were very similar to that obtained by hatchery staff. The release occurred during an increasing hydrograph. Historical yearling releases from 2010 to 2018 by WDFW, IPC and NPT can be found at https://www.fws.gov/lsnakecomplan/Reports/WDFWreports2.html. Releases from 2019 are provided in Appendix F.

Subyearling fall Chinook salmon at LFH were released 28 to 29 May 2019. Fish were measured and weighed and visually appeared in good condition, with no external signs of BKD, pop-eye,

descaling, or sexual precocity. However, mortality in the rearing lake was increasing just prior to release, and while fish looked healthy, they appeared to be stressed based on their behavior in the release structure during sampling/PIT tagging. An estimated total of 201,013 fish were released as an ADCWT group, 1,686 were released as CWT only, 1,264 were released as adipose only, and 539,931 were released as unmarked untagged. Hatchery staff conducted pound counts and calculated the release at 56.1 fish/lb (fpp) at release. Individual length/weight samples were identical to the pound counts obtained by hatchery staff (Table 14). The release occurred during an increasing hydrograph.

Subyearling fall Chinook salmon reared at Irrigon FH were released into the GRR on 30 May 2019. An estimated 191,602 fish were released as an ADCWT group, 2,115 were released as CWT only, 17,553 were released as adipose only, and 634were unmarked/untagged. Fish were measured, weighed, and visually appeared in good condition, with no external signs of BKD, pop-eye, descaling, or sexual precocity. ODFW staff provided pound counts and the release size was calculated at 46.7 fpp, compared 47.4 fpp from what was calculated from individual length/weight sampling from SRL staff (Table 14). The release occurred during an increasing hydrograph.

In addition to the standard WDFW releases that occur, in 2019 WDFW also released an additional 168,037 (79,013 ADCWT and 89,024 CWT only) yearling production from one of the rearing lakes. Due to Marmes Pumping station failure in October 2019 and the resultant loss water at LFH, all FCAP yearling production, which were in raceways, were transferred to on open rearing lake to conserve water at the hatchery (the rearing lakes requires less water than raceways). As such, all six CWT codes that were destined for the FCAP releases were mixed. Further, a harsh late winter and poor road conditions prevented the NPT from getting the Pittsburg Landing acclimation site operational in 2018 and hampered some of the transfers to the Big Canyon and Captain John acclimation sties. Therefore, all of the Pittsburg Landing production, and a small portion of the Big Canyon/Captain John yearling production were released at LFH on 12-13 March 2019.

Table 14. Length and weight data from fall Chinook salmon released at LFH or in the GRR in 2019.

	Yearling		Subyearling	
Length/weight data	**ADCWT**	**CWT only**	**Snake R at LFH**	**GRR at Cougar Creek**
Sample date(s)	12 March	12 March	28 May	30 May
CWT code	637398	637397	637422	637420
Number sampled	203	207	207	204
Avg. length (mm)	151	153	88	95
Median length	150	151	88	94
Range of lengths	120-182	125-184	69-106	80-111
SD of lengths	10.5	11.7	7.1	5.1
CV of length (%)	7.0	7.7	8.1	5.3
Avg. weight (g)	39.2	40.5	8.1	9.6
SD of weight	8.5	9.8	7.6	1.7
Avg. K factor	1.13	1.12	1.14	1.12
FPP	11.6	11.2	56.1	47.4
Precocious (%)	0.0%	0.0%	0.0%	0.0%

PIT Tagging and Migration Timing

Staff have routinely PIT tagged the on-station yearling and subyearling releases for the purpose of monitoring outmigration timing, estimating adult returns in-season, and to compare two adult return/survival estimation methods (CWTs vs PIT tags). PIT Tag lists for each release group are submitted to PTAGIS and fish were assigned to monitor mode to allow them to be treated like non-PIT tagged fish when intercepted at the mainstem dams.

Staff PIT tagged 10,000 BY17 yearlings. Initial tag loss and mortalities of the PIT tagged yearlings could not be determined as the fish were diverted directly into the earthen rearing pond where they remained until release. The rearing lake was not scanned for shed/lost PIT tags in 2019.

A total of 20,000 BY18 subyearlings were PIT tagged at the release structure as fish were being released into the Snake River. A few mortalities occurred following tagging so only 19,971 fish with PIT tags were released in 2019. SRL and IPC staff PIT tagged 4,500 BY18 subyearlings at Irrigon fish hatchery for the sole purpose to monitor outmigration timing of the GRR release. There were three mortalities in the GRR PIT tag group prior to release; PIT tags were not reinserted, resulting in 4,497 released into the GRR.

The PTAGIS website (www.ptagis.org) was queried on 8 October 2019 for GRR and onstation yearling and subyearling releases. Interrogation summaries were used to populate Tables 15 and 16. Migration speed generally increased for all releases as fish moved downstream through the system.

Table 15. Migration timing of PIT tagged fall Chinook released at LFH in 2019.

	Detection Facilities				
Yearlings released at LFH	**LMO**	**IHR**	**MCN**	**JDD**	**BONN [a]**
Number Detected	4,439	2,009	675	1,612	408
Median Travel Days from LFH [b]	13	17	29	27	29
Median Passage Date	25 Mar	29 Mar	10 Apr	8 Apr	10 Apr
First Detection Date	14-Mar	25 Mar	28 Mar	24 Mar	28 Mar
Last Detection Date	7-May	8 May	11 May	20 May	19 May
10% of Run Passage Date	22 Mar	27-Mar	3-Apr	4-Apr	7-Apr
90% of Run Passage Date	2 Apr	8-Apr	19-Apr	21-Apr	27-Apr
TDG on Median Date (%)[c]	104.8	113.3	119.2	106.7	109.4
Outflow on Median Date (kcfs)[c]	78.0	83.3	305.7	187.6	357.3
Spill on Median Date (kcfs)[c]	0.0	28.4	176.1	0.0	140.7
	Detection Facilities				
Subyearlings released at LFH	**LMO**	**ICH**	**MCN**	**JDD**	**BONN [a]**
Number Detected	2,144	703	648	611	855
Median Travel Days from LFH [b]	3	5	9	15	19
Median Passage Date	31 May	2 Jun	6 Jun	12 Jun	16 Jun
First Detection Date	29-May	30 May	31 May	3 Jun	10 Jul
Last Detection Date	11-Jul	12 Jul	5 Jul	12 Jul	10 Jul
10% of Run Passage Date	30 May	31-May	4-Jun	6-Jun	9-Jun
90% of Run Passage Date	2 Jun	6-Jun	19-Jun	24-Jun	25-Jun
TDG on Median Date of Passage (%)[c]	120.8	122.3	118.8	116.9	114.5
Outflow on Median Date of Passage (kcfs)[c]	131.6	150.8	290.0	82.4	191.4
Spill on Median Date of Passage (kcfs)[c]	43.3	96.6	176.1	58.0	95.3

[a] TDG, outflow and spill for BONN are detected six miles downstream at Warrendale.

[b] Travel days are calculated from the date of release.

[c] Detections are from the tailrace of each dam.

Table 16. Migration timing of PIT tagged fall Chinook released near Cougar Creek in the GRR in 2019.

	Detection Facilities						
Subyearlings released in the GRR	**LGR**	**LGO**	**LMO**	**IHR**	**MCN**	**JDD**	**BONN [a]**
Number Detected	**256**	**212**	**82**	**78**	**81**	**118**	**135**
Median Travel Days from GRR [b]	14	22	23	31	27	32	29
Median Passage Date	13 Jun	21 Jun	22 Jun	30 Jun	26 Jun	30 Jun	28 Jun
First Detection Date	2 Jun	5 Jun	6 Jun	13 Jun	13 Jun	12 Jun	14 Jun
Last Detection Date	3 Oct	9 Aug	13 Jul	13 Aug	16 Jul	16 Aug	22 Jul
10% of Run Passage Date	5 Jun	8 Jun	8 Jun	21 Jun	20 Jun	20 Jun	19 Jun
90% of Run Passage Date	28 Jun	5 Jul	6 Jul	10 Jul	9 Jul	14 Jul	13 Jul
TDG on Median Date of Passage (%)[c]	116.8	111.7	112.9	111.8	117.2	114.8	115.5
Outflow on Median Date of Passage (kcfs)[c]	86.6	63.4	66.9	44.6	185.6	152.5	178.0
Spill on Median Date of Passage (kcfs)[c]	40.7	19.3	16.6	13.4	106.2	53.2	95.0

[a] TDG, outflow and spill for BONN are detected six miles downstream at Warrendale.

[b] Travel days are calculated from the date of release.

[c] Detections are from the tailrace of each dam.

The on-station (both yearling and subyearling) and GRR subyearling releases have been PIT tagged for a number of years. In the following section we provide survival to the first dam of encounter (LGR or Lower Monumental) and migration speed estimates to the first dam of encounter on the Snake River (LGR or Lower Monumental), and the first and last dam of encounter on the Columbia River (McNary and Bonneville)(Figures 17-25). Downstream survival estimates were derived using PitPro (Version 4.19.8).

Survival of GRR fish to LGR is generally around 80% (Figure 18). For the years provided of this release group, migration speed has increased in the last few years, likely due to higher flow and increased spill at the mainstem dams since 2016 (Figure 19–Figure 20).

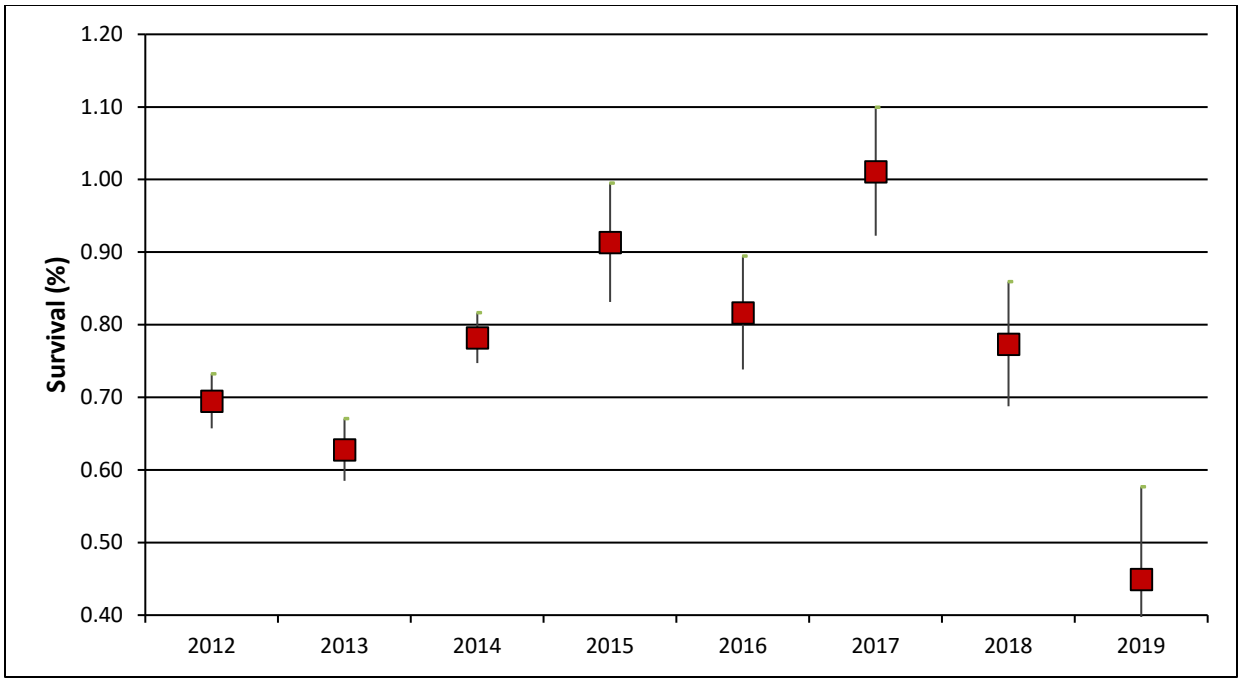

Figure 17. Survival and standard error of Snake River fall Chinook subyearlings released into the Grande Ronde River near Cougar Creek to Lower Granite Dam, 2012-2019 migration years.

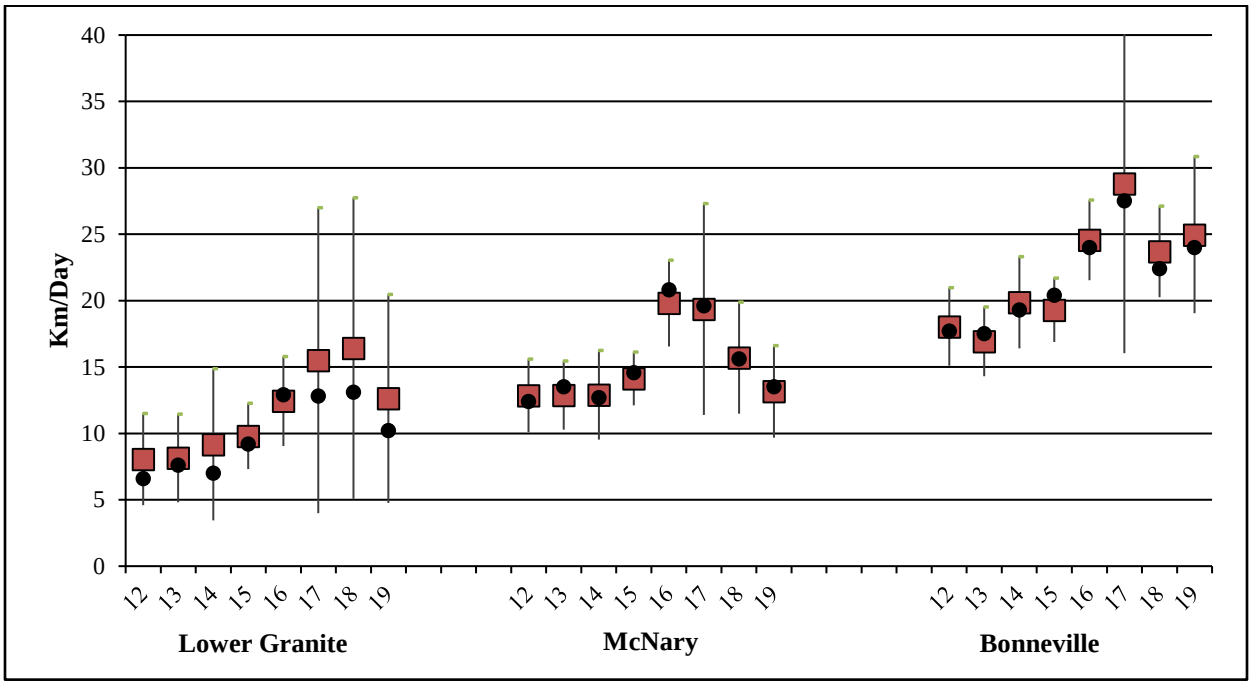

Figure 18. Average travel speed (Km/day with S.D.) and median travel speed (black dot) of Snake River fall Chinook subyearlings released into the Grande Ronde River near Cougar Creek to Lower Granite, McNary, and Bonneville Dams, 2012-2019 migration years.

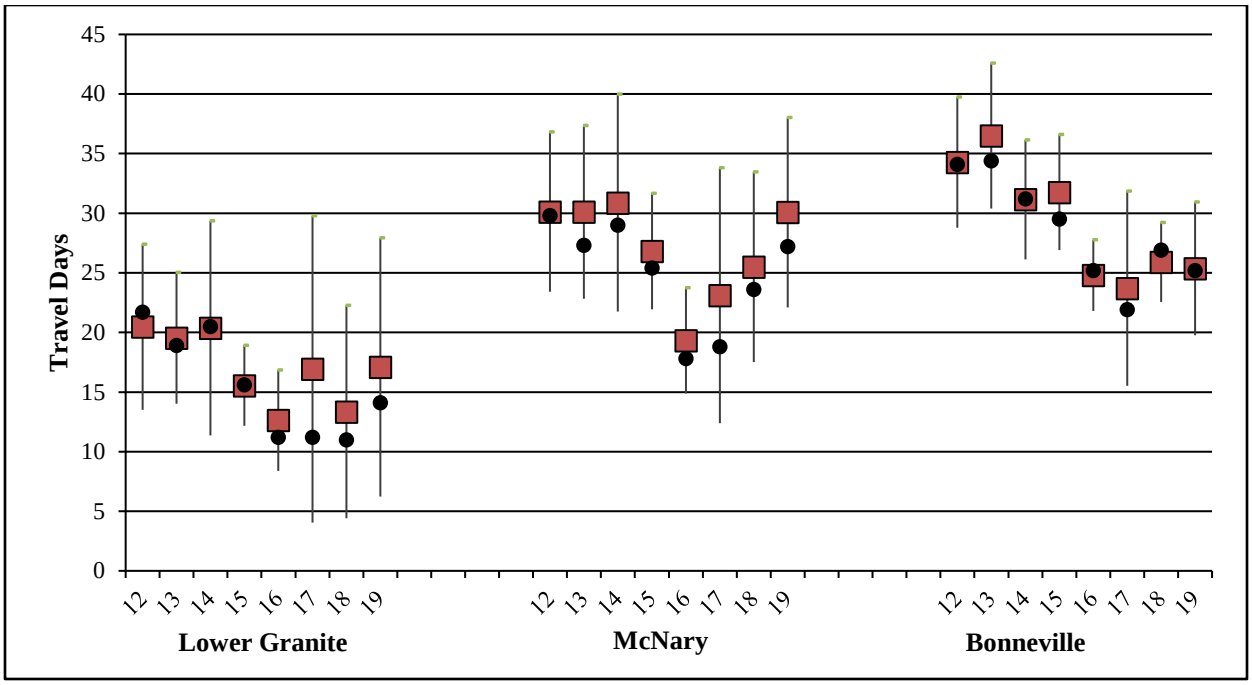

Figure 19. Average travel days (S.E.) and median travel days (black dot) of) of Snake River fall Chinook subyearlings released into the Grande Ronde River near Cougar Creek to Lower Granite, McNary, and Bonneville Dams, 2012-2019 migration years.

Survival of the on-station subyearling release to Lower Monumental Dam is generally around 80%, while survival to McNary has generally been around 50% (Figure 21). Survival to Bonneville Dam has varied considerably and have generally been around 30%. For the years provided, migration speed has increased in the last few years, likely due to higher flow and increased spill at the mainstem dams since 2016 (Figure 22– Figure 23).

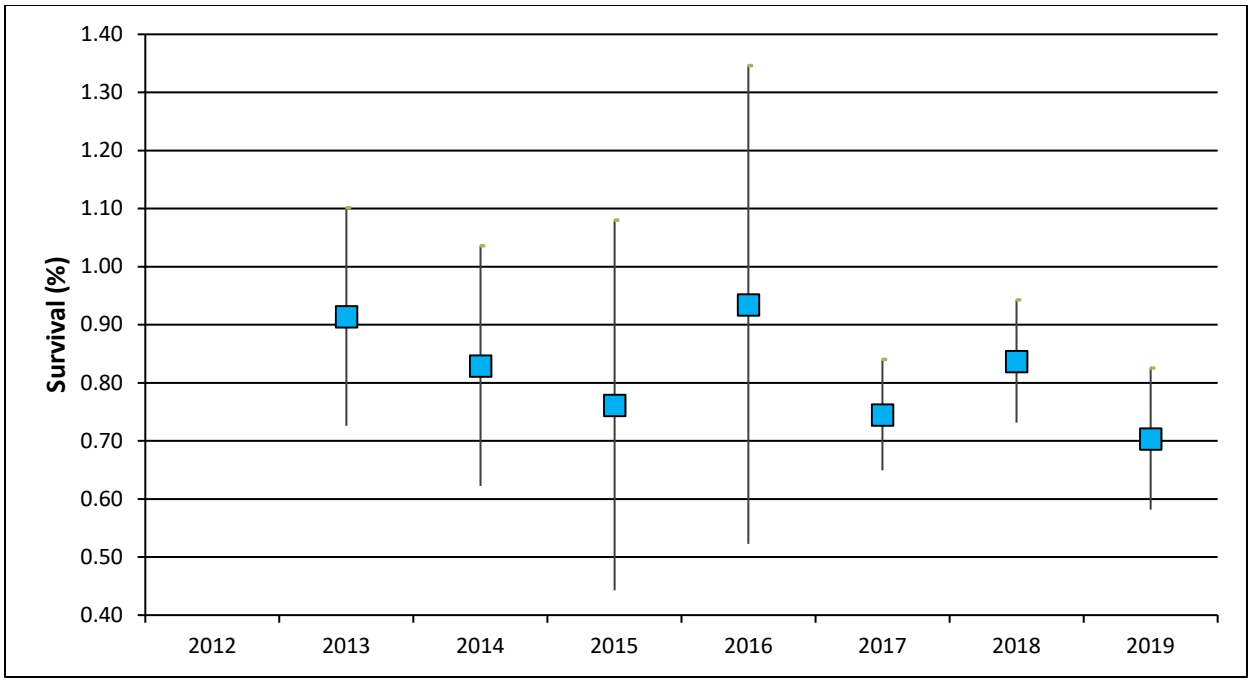

Figure 20. Survival and standard error of Snake River fall Chinook subyearlings released into the Snake River at Lyons Ferry Hatchery to Lower Monumental Dam, 2013-2019 migration years. Note: 2012 estimates were not valid.

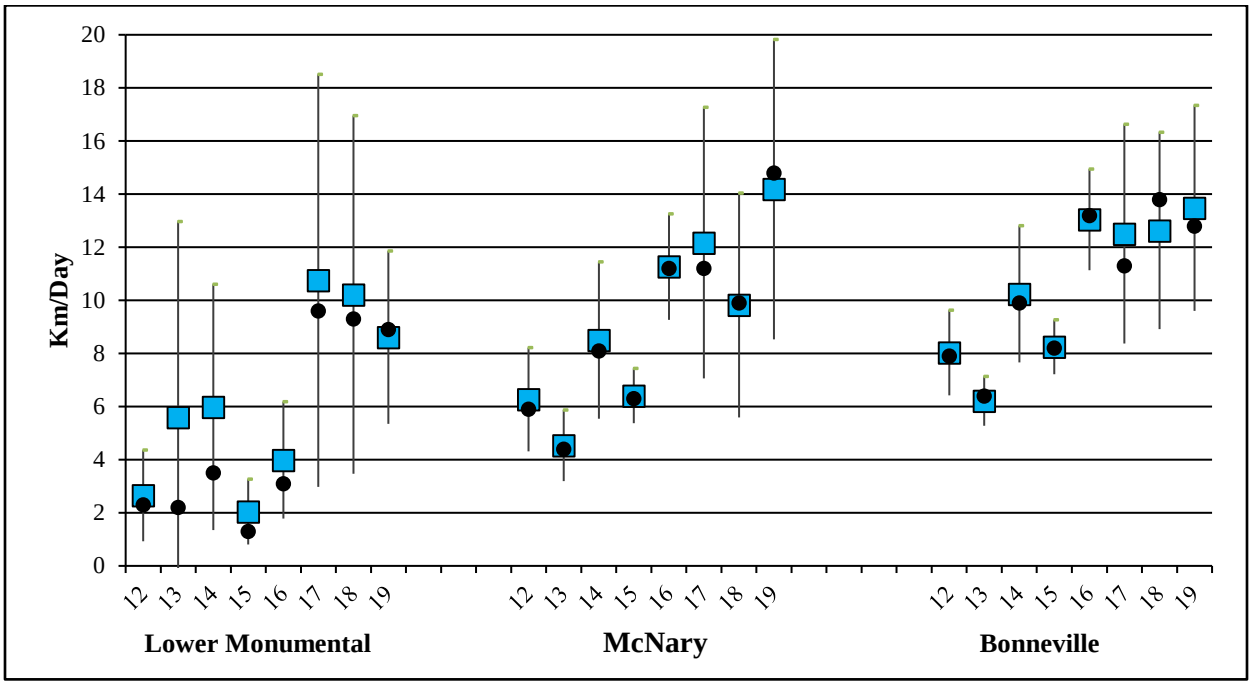

Figure 21. Average travel speed (km/day with S.E.) and median travel speed (black dot) of Snake River fall Chinook subyearlings released into the Snake River at Lyons Ferry Hatchery to Lower Monumental, McNary, and Bonneville Dams, 2012-2019 migration years.

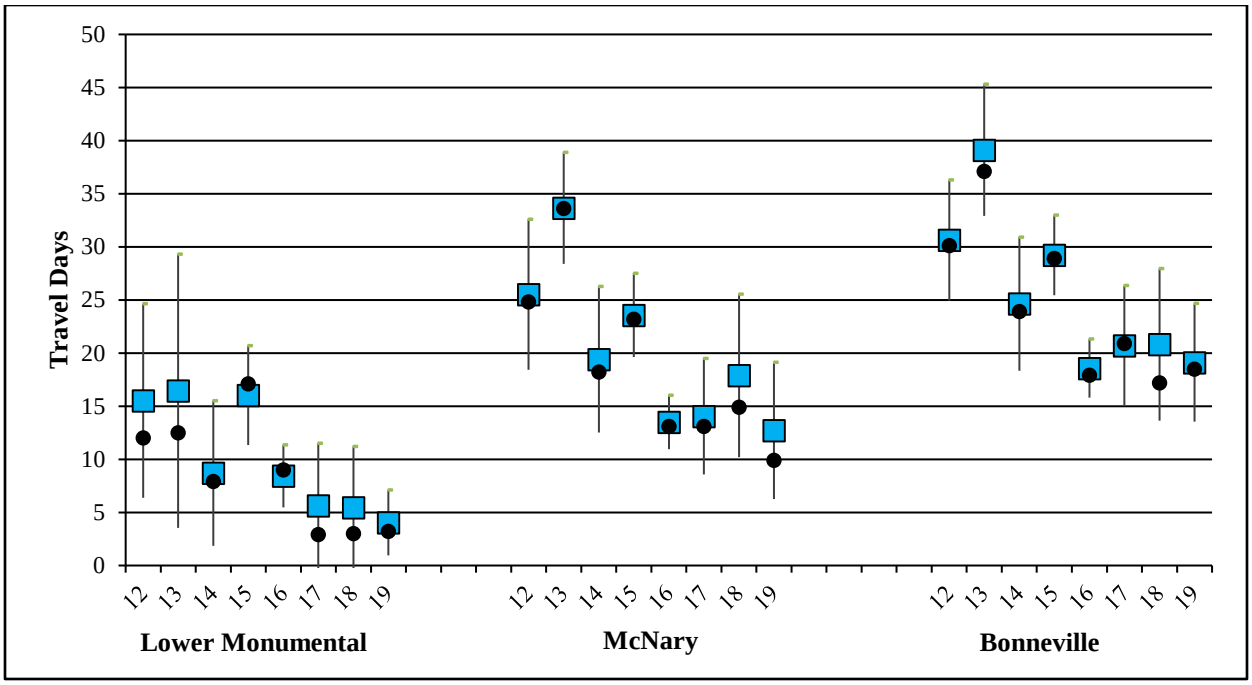

Figure 22. Average travel days (S.E.) and median travel days (black dot) of Snake River fall Chinook subyearlings released into the Snake River at Lyons Ferry Hatchery to Lower Monumental, McNary, and Bonneville Dams, 2012-2019 migration years.

Survival of the on-station yearling release to Lower Monumental Dam is generally around 90%, while survival to McNary has generally been around 80% (Figure 24). Survival to Bonneville Dam has varied considerably but has generally been around 50%. Contrary to the subyearling groups which showed increase travel rates, yearling migration speed had generally remained constant over the years provided (Figure 25– Figure 26). This could be due to the fact they are released about 1.5 months earlier in the spring where flows and spill are sometimes lower than in the later spring months.

Survival and travel speeds in the 2019 yearlings were the lowest for the years reported and are likely as result of 1) release of these fish in mid-March compared to their normal release during the first or second week or April, and 2) fish appeared to be stressed at release.

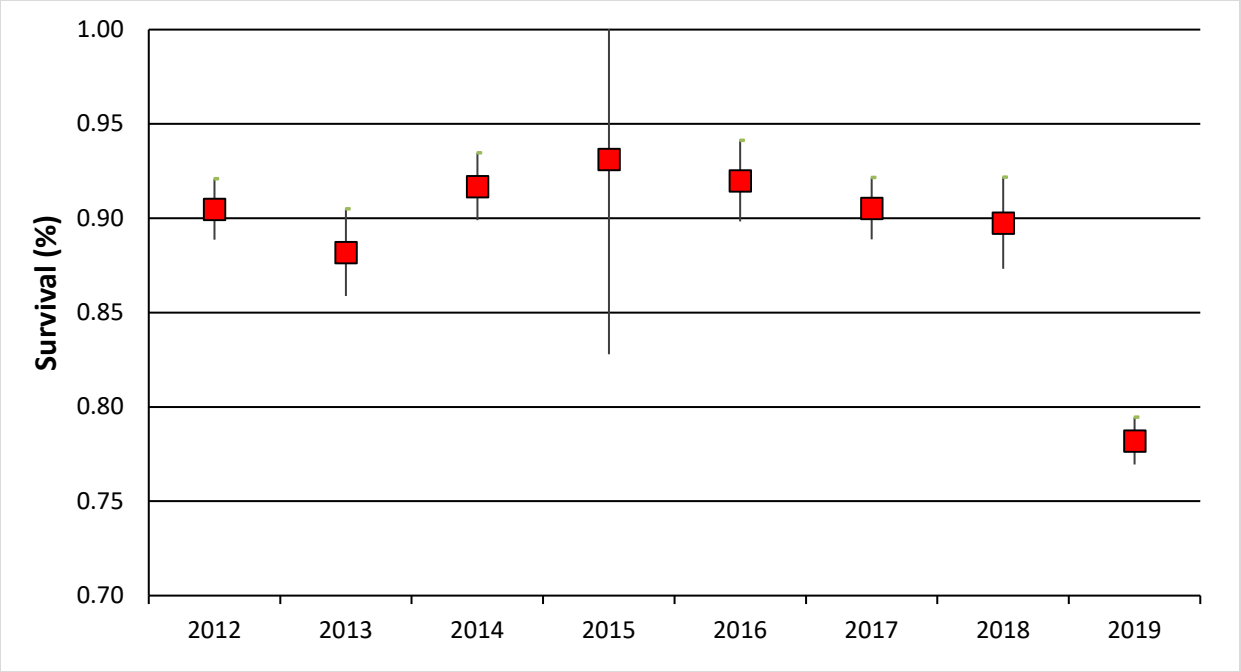

Figure 23. Survival and standard error of Snake River fall Chinook yearlings released into the Snake River at Lyons Ferry Hatchery to Lower Monumental Dam, 2012-2019 migration years.

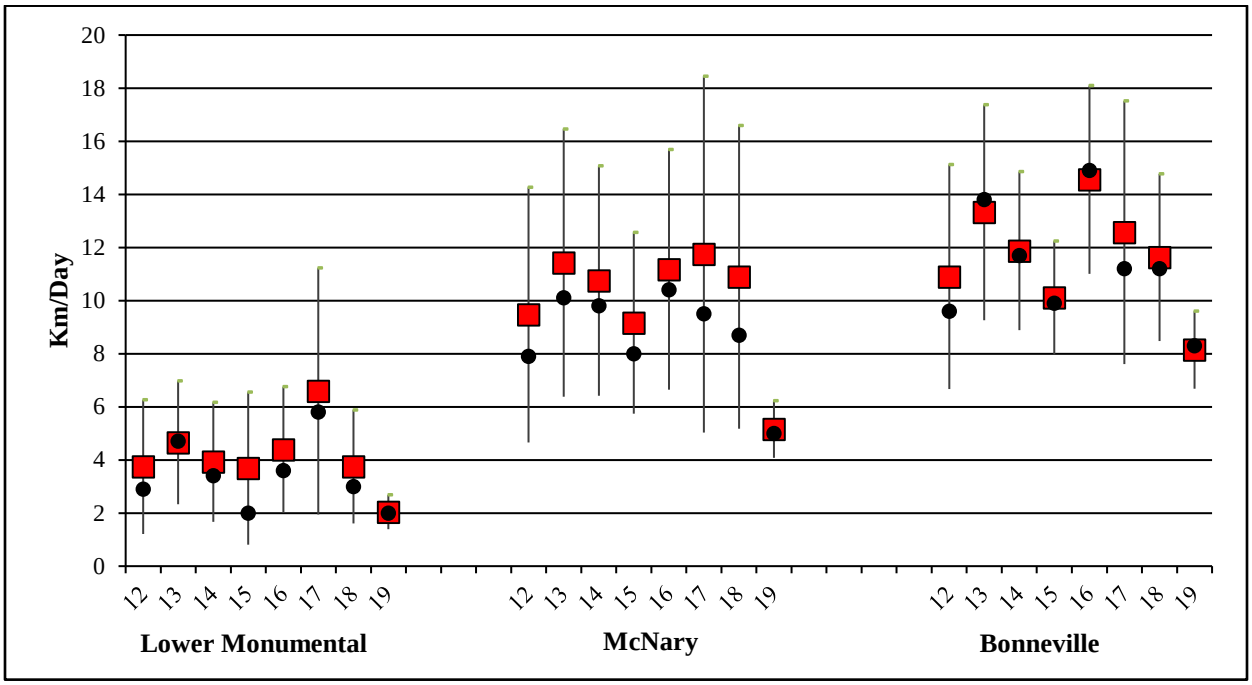

Figure 24. Average travel speed (km/day with S.E.) and median travel speed (black dot) of Snake River fall Chinook yearlings released into the Snake River at Lyons Ferry Hatchery to Lower Monumental, McNary, and Bonneville Dams, 2012-2019 migration years.

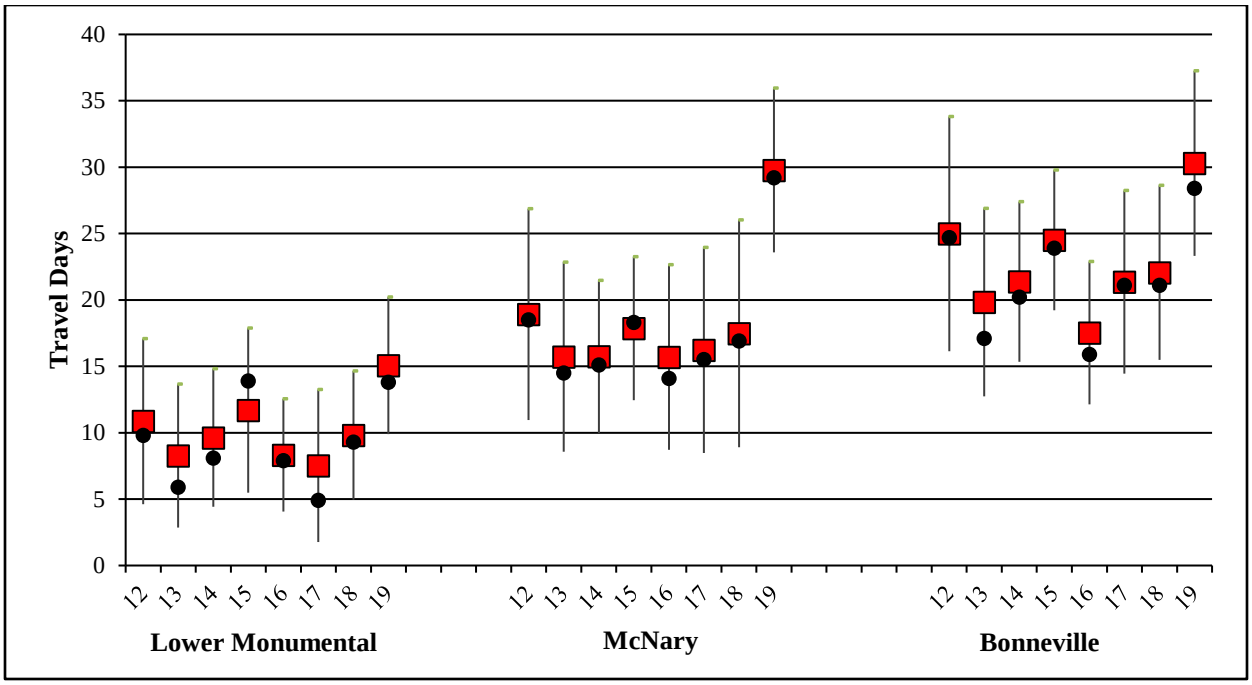

Figure 25. Average travel days (S.E.) and median travel days (black dot) of Snake River fall Chinook yearlings released into the Snake River at Lyons Ferry Hatchery to Lower Monumental, McNary, and Bonneville Dams, 2012-2019 migration years.

Tucannon River Natural Production 2018

Spawning Ground Surveys

WDFW personnel have conducted spawning ground surveys for fall Chinook salmon on the lower Tucannon River since 1985 (Appendix G). Survey sections in 2018 covered the river from river kilometer (rkm) 1.1-32.5 The first 1.1 rkms of the Tucannon River are deep slack water from the Snake River's LMO Dam reservoir and no surveys or estimates are made for that area. In addition the spawning habitat is poor in this area and it is presumed no spawning occurs there. During 2018, landowner access restrictions prevented the surveying of 1.5 rkms above the Starbuck Bridge within survey sections 5 and 6 (Appendix G). Regular weekly surveys began the week of 21 October and continued until 2 January.

A total of 180 redds (from all species) were counted in the Tucannon River (Table 17) and we estimate an additional 29 redds occurred in sections of river not surveyed due to access restrictions from landowners in 2018. Redds built in landowner restricted sections were estimated by calculating redds/km in an adjacent surveyed section and applying it to the non-surveyed area. An estimated 202 fall Chinook salmon and 7 coho salmon redds were constructed in the Tucannon River during 2018.

Table 17. Date and number of salmon redds and carcasses counted on the Tucannon River in 2018.

	Total redds [a]	Carcasses sampled	
Week beginning	**Chinook & Coho [b]**	**Chinook**	**Coho**
Prespawn survey 23 Sept	1	1	0
21 Oct	2	0	0
28 Oct	11	0	0
4 Nov	49	4	0
11 Nov	40	14	0
18 Nov	34	18	0
25 Nov	20	13	0
2 Dec	16	27	0
9 Dec	7	7	0
16 Dec	0	2	0
Postspawn survey 30 Dec	0	1	0
Totals	**180**	**87**	**0**

[a] Observed redds not expanded for sections with access restrictions.

[b] Chinook & coho salmon redd data estimated through visual counts were combined.

Escapement and Composition of Fall Chinook 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 the three fish/redd expansion factor we estimated 606 fall Chinook salmon spawned in the Tucannon River in 2018 (Table 18). Staff recovered 87 fall Chinook salmon carcasses (14.4%) of the estimated total spawning escapement to the Tucannon River. There were no coho salmon carcasses recovered on the Tucannon River in 2018.

Table 18. Estimated escapement, redd construction, and resulting estimates of smolts/redd and total number of emigrants from fall Chinook salmon spawning in the Tucannon River, 2001-2018.[a]

		Redd construction			Success of spawning	
Brood year	Estimated escapement [b]	# Redds observed	# Redds in no access areas (est.)	Total # of redds (est.)	Estimated smolts/redd [c]	Total # estimated emigrants [d]
2001	219	65	8	73	336	24,545
2002	630	183	27	210	81	17,030
2003	474	143	15	158	460	72,656
2004	345	111	4	115	631	72,655
2005	198	61	5	66	320	21,170
2006 [e]	460	127	26	153	289	44,296
2007	326	93	16	109	Unknown [f]	Unknown [f]
2008	763	209	45	254	20	5,030
2009[g]	756	217	35	252	147	36,991
2010	972	281	43	324	76	24,315
2011	906	278	24	302	67	20,331
2012	1,623	256	285[h]	541	231	124,951
2013	1,158	261	125[h]	386	24	9,262
2014	909	265	38	303	514	155,791
2015	1,518	295	211[h]	506	148	74,869
2016	807	202	67	269	29	7,907
2017	678	201	25	226	135	30,491
2018	606	173	29	202	218	44,142

[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] Estimates were derived using three fish per redd; no adjustments were made for super imposition of redds.
[c] Estimate was derived using total redds estimated above the smolt trap and the estimated emigration the following spring as measured at the smolt trap.
[d] Estimate was derived using the smolt/redd estimate 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] Adjustment includes estimates for weeks not walked due to temperature and water conditions.

Generally, more recoveries of females occur than males, primarily because females remain in the vicinity of their redds when they die. Females represented 51.9% of the recoveries in the Tucannon River; primarily 2-salt and 3-salt fish. Tissue samples (fin clips or skin samples from the head) were collected and archived from 66 fall Chinook salmon (genetic sample numbers 18OJ01-18OJ23 and 18OJ25-18OJ67). Composition of the run consisted of 58.1% Snake River hatchery by wire, 9.0% out-of-basin by wire, 12.0% hatchery by AD clip or yearling scales and 20.9% unknown origin.

Juvenile Salmon Emigration

Fall Chinook Salmon (2019 Outmigration Year)

Juvenile fall Chinook salmon (BY18) were observed at the Tucannon River smolt trap (rkm 3.0) from 10 January through 10 July 2019 (Figure 27). The last day of trapping was 12 July. No fall Chinook were PIT tagged at the trap during the 2019 outmigration year. Trapping efficiency for fall Chinook salmon ranged from 0.0% to 23.9%. Staff captured 4,025 (including 65 mortalities) fall Chinook salmon in 2019. It was undetermined if the smolt trap was the cause of the mortalities. It was estimated that 36,717 (95% C.I. = 28,907-48,036) parr/smolts passed the trap during 2019. Based on 168 redds estimated above the smolt trap during 2018 spawning ground surveys, an estimated 218 smolts/redd were produced. After including potential production from redds below the smolt trap in 2018 (34 additional redds), an estimated 44,142 naturally produced fall Chinook salmon parr/smolts left the Tucannon during 2019.

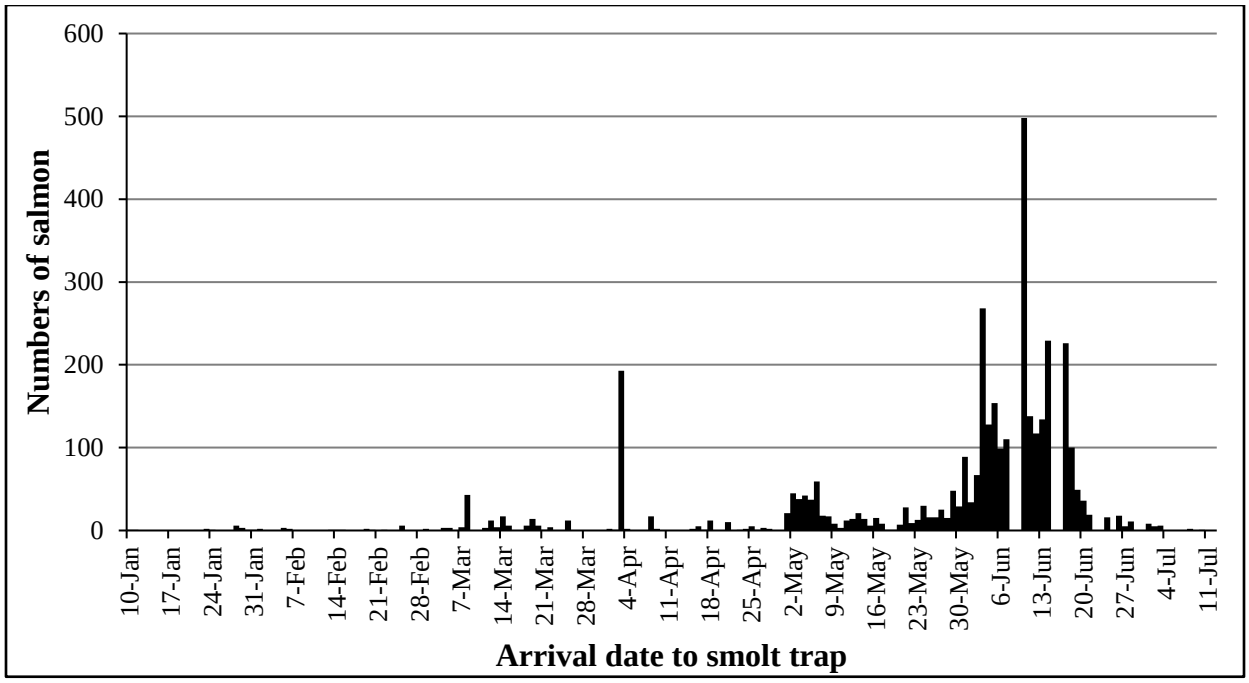

Figure 26. Migration timing of natural origin juvenile fall Chinook salmon captured at the Tucannon River smolt trap in 2019.

Status of Mitigation Requirements

Overall Mitigation Level

To estimate the overall mitigation return (to the project area, or total), 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. The Regional Mark Processing Center (RMPC) website, www.rmpc.org, was queried on 18 December 2019 for the 2018 returns of CWT tagged fish associated with WDFW releases.

An estimated minimum 8,229 (8.9%) of the total LSRCP original mitigation objective of 91,500 fall Chinook salmon released by WDFW was achieved in 2018 with 3,464 of those recovered outside of the Snake River Basin.

Returns to the Project Area

An estimated minimum 4,765 fall Chinook salmon (adults+jacks) returned from WDFW releases into the project area, contributing 26.0% of the total LSRCP mitigation goal of 18,300 in 2018 (Table 19). 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 in-basin hatchery returns from the FCAP, IPC and the NPTH programs.

Table 19. Estimated returns of fall Chinook salmon released by WDFW to the Snake River and levels of mitigation goals met in 2018.

	Saltwater age						
	0-salt	1-salt		2-4 salt		Total ESTD (Adult+Jack)	% of LSRCP goal to the Snake River
Location	Minijack [a]	Jack [b]	Jill [c]	Adult F	Adult M		
Harvested FCH below LGR	63	13	3	25	14	55	0.3%
Estimated run to the Tucannon R.	0	44	15	207	89	355	1.9%
Run to LGR [d] (wire+nowire)	343	1,078	14	1,769	1,243	4,104	22.4%
Total	**406**	**1,223**	**21**	**2,002**	**1,519**	**4,765**	**26.0%**

[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] Estimated run to LGR Dam for LFH, GRR and Couse Creek releases including fish hauled to LFH and NPTH for processing as well as fish released from the dam.

An alternative method to determine project area returns is under evaluation. In this method, we use the conversion rate of WDFW released PIT tagged fish (yearling and subyearling (separated by jack or adult), and release location (upstream or downstream of LGR), and the estimated number of those same groups at LGR from the run reconstruction (Table 20). Based on this method for 2018 returns, we estimate 5,319 fall Chinook salmon (adults+jacks) returned to the project area (above Ice Harbor Dam - IHD). This estimate is 554 more fish to the project area than calculated from above, and represents 29.1% of the total LSRCP mitigation goal. The reasons for the difference could include underreported harvest, fish spawning in other locations (in the tailraces below the dams, Palouse River or other Snake River tributaries), underrepresented returns to the Tucannon River (since we use a conservative estimate of 3 fish/redd), and natural mortality between Ice Harbor and LGR. In theory, this method would appear to make sense; however, prior years' estimates have not been compared to fully determine if this methodology is sound.

Table 20. Estimated LSRCP project area (above Ice Harbor Dam) returns of WDFW released fall Chinook salmon based on the run reconstruction estimate at LGR and PIT tag conversions from IHD to LGR in 2018.

	LGR Run Reconstruction Estimate		Conversion of PIT Tagged Fish from IHD to LGR		Total Return above Ice Harbor Dam	
Group	Jack	Adult	Jack	Adult	Jack	Adult
LFH Yearling	305	2423	0.615	0.785	496	3086
LFH Subyearling	273	340	0.500	0.935	546	363
GRR Subyearling [a]	387	392	0.900	0.985	430	398
Totals					**1,472**	**3,847**

[a] PIT tag conversions based on average conversion of PIT tagged Snake River Fall Chinook salmon released above LGR that returned in 2018 (WDFW, NPT, FCAP and IPC releases).

Harvest in the Project area

In 2018, anglers in Washington were allowed a daily harvest of six adipose-clipped adult fall Chinook salmon and an unlimited number of jacks (clipped or unclipped).

On the Snake River (Washington and Idaho combined), there were an estimated 160 CWT recoveries (expanded or not expanded) reported in the Regional Mark Information System (RMIS) database from WDFW releases, with 55 (34.4%) captured below LGR (Table 21).

Table 21. Estimated Snake River basin harvest recoveries in 2018 of wire tagged fall Chinook salmon released by WDFW as reported to RMIS on 12/18/2019.

Freshwater sport location		0-salt Minijack	1-salt Jack	1-salt Jill	2-4 salt Adult F	2-4 salt Adult M	Total ESTD Adult+Jack	% Catch by location
Below LGR	Snake R LMO-LGO	63	13	3	25	14	55	34.4%
Above LGR	Snake LGR-ID				27	28	55	34.4%
	Snake R above HWY12		8		5	3	16	10.0%
	Snake R below Salmon R		16	2	14	2	34	21.2%
Totals		**63**	**37**	**5**	**71**	**47**	**160**	

Recoveries Outside of the Snake River Basin

In 2018, approximately 3,464 (4.7%) of the original 73,200 downriver fish harvest objective 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). For a greater description of methods used to expand CWT recoveries, see Oakerman et al 2018.

Estimates of harvest for fish released by WDFW are listed in Tables 22-24and 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, more than half (63.7%) of recoveries reported to RMIS occurred in saltwater locations and 36.3% occurred in freshwater locations. Of the total recoveries in 2018, 69.3% came from commercial/tribal fisheries, 30.5% from sport fisheries and 0.2% were from hatcheries. Harvest primarily occurred in the ocean off the coasts of Washington, British Columbia, and Oregon, and in the Columbia River from the mouth to McNary Dam, but the single largest harvest fishery was the Zone 6 Tribal Gillnet fishery which accounted for 20.8% of all the fish harvested in 2018.

Table 22. Fully expanded recovery estimates of tagged and untagged fall Chinook salmon recovered in the Columbia River Basin (freshwater areas) during 2018 for WDFW releases. Minijacks are not 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 1-5 Non-tribal Net	58	112	112	8	8			11	11	19	19	131
	Zone 6 Tribal Net	363	662	663	38	38			19	19	57	57	720
COL R Sport	Zone 1-5 sport	99	161	162	23	23			17	17	40	40	202
	Bonneville Pool	4	4	4							0	0	4
	John Day Pool	2	2	2							0	0	2
Estuary Sport	COL R Estuary	177	177	177	9	9			6	6	15	15	192
Hatchery	Priest Rapids			0	2	2			1	1	3	3	3
	Ringold Springs			0	1	1					1	1	1
	Naselle	1	1	1							0	0	1
	Bonneville	1	1	1							0	0	1
	Totals	**705**	**1,120**	**1,122**	**81**	**81**	**0**	**0**	**54**	**54**	**135**	**135**	**1,257**

[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 23. Fully expanded recovery estimates of tagged and untagged fall Chinook salmon in areas outside of the Snake River Basin (saltwater areas) during 2018 for WDFW releases. Minijacks are not 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	Unknown Sport	4	4	4	4	4					4	8	8
	Unknown Troll	58	81	81	17	17			17	17	34	92	115
BC	Ocean Troll	416	416	416	38	38	3	3	38	38	79	495	495
	Ocean Rod and Reel	3	3	3							0	3	3
	Sport (private)	177	284	284	21	21			13	13	34	211	318
CA	Ocean Troll			0					4	4	4	4	4
COL	Marine Sport	68	68	68	4	4					4	72	72
HS	Trawl (CA/OR/WA)	4	4	4							0	4	4
OR	Ocean Sport	52	52	52					4	4	4	56	56
	Ocean Troll	125	125	125	15	15			9	9	24	149	149
WA	Marine Sport	188	188	188	10	10			3	3	13	201	201
	Treaty Troll	365	365	365	6	6					6	371	371
	Ocean Troll (non-treaty)	380	380	380	8	8			23	23	31	411	411
	Totals	**1,840**	**1,970**	**1,971**	**123**	**123**	**3**	**3**	**111**	**111**	**237**	**2,077**	**2,208**

Table 24. Fully expanded recovery estimates (tagged and untagged) of 2018 returns by region, rear type, and release location for fall Chinook salmon released by WDFW. Minijacks are not 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)	1,122	36.3%	81	39.7%		0.0%	54	32.7%	135	36.3%	1,257	36.3%
AK	85	2.7%	21	10.3%		0.0%	17	10.3%	38	10.2%	123	3.6%
BC	703	22.7%	59	28.9%	3	100.0%	51	30.9%	113	30.4%	816	23.6%
CA		0.0%		0.0%		0.0%	4	2.4%	4	1.1%	4	0.1%
COL (marine)	68	2.2%	4	2.0%		0.0%		0.0%	4	1.1%	72	2.1%
HS	4	0.1%		0.0%		0.0%		0.0%	0	0.0%	4	0.1%
OR	177	5.7%	15	7.4%		0.0%	13	7.9%	28	7.5%	205	5.9%
WA	934	30.2%	24	11.8%		0.0%	26	15.8%	50	13.4%	984	28.4%
Total recoveries	**3,092**		**204**		**3**		**165**		**372**		**3,464**	
Recoveries by rear type	**89.3%**								**10.7%**			

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 25). Fish from yearling and subyearling production released into the Snake River at LFH were primarily recovered at age 4. Fish released into CCD were only recovered at age 5 as releases ceased in 2013. Subyearlings released into the GRR were also primarily recovered as age 4 fish.

Table 25. Final locations of ADCWT yearling and subyearling fall Chinook salmon released at LFH, CCD or in the GRR to areas outside of the Snake River basin in 2018 by total age, based on estimated recoveries reported to RMIS as of 10/17/19.

Brood year:	2016	2015	2014	2013	2012	Non-Snake R. recovery location	
Yearling FCH released at LFH							
Total age:		**3 (Jack)**	**4**	**5**	**6**		
Tag codes:		**637040/637041**	**636886/636885**	**636741/636740**	**636584/636583**	**Total**	**%**
AK		4	70	11		85	2.75%
BC		43	616	41	3	703	22.74%
COL		78	1063	48		1189	38.45%
HS			4			4	0.13%
OR		5	166	6		177	5.72%
WA		22	859	51	2	934	30.21%
Grand Total		152	2778	157	5	3,092	
Percent		**4.92%**	**89.84%**	**5.08%**	**0.16%**		
Subyearling FCH released at LFH							
Total age:	**2 (Jack)**	**3**	**4**	**5**			
Tag code:	**637198**	**637038**	**636882**	**636737**		**Total**	**%**
AK			21			21	10.29%
BC		8	51			59	28.92%
COL	1	15	69	1		86	42.16%
OR			15			15	7.35%
WA		9	14			23	11.27%
Grand Total	1	32	170	1		204	
Percent	**0.49%**	**15.69%**	**83.33%**	**0.49%**			

Brood year:	2016	2015	2014	2013	2012	Non-Snake R. recovery location	
Subyearling FCH released at CCD							
Total age:				**5**			
Tag code:				**636575**		**Total**	**%**
BC				3		3	100.00%
Grand Total				3		3	
Percent				**100.00%**			

Subyearling FCH released at GRR							
Total age:	**2**	**3**	**4**	**5**			
Tag code:	**637199**	**637037**	**636883**	**636739**		**Total**	**%**
AK			13	4		17	10.30%
BC			51			51	30.91%
CA			4			4	2.42%
COL	1	6	44	3		54	32.73%
OR			13			13	7.88%
WA		3	23			26	15.76%
Grand Total	1	9	148	7		165	
Percent	**0.61%**	**5.45%**	**89.70%**	**4.24%**			

Direct Take of Listed Snake River fall Chinook Salmon During Fall of 2017 and Spring of 2018

Adult estimates for permit #16607 for LFH production and permit #16615 for NPTH production have been combined in the tables below. These "take" tables are in the format used during the time the work was conducted. Take tables were updated following the 2018 NOAA consultation of the program during the summer of 2018 (Section 10 Permits 16607-2R and 16615-2R). In addition, during consultation, it was agreed that additional reporting requirements were needed for the program and covered under the Terms and Condition section of the Section 10 permits, with the timeframe beginning in 2018. The information required in Section 10 permit 16607-2R as specified in the Special Conditions, Research, Monitoring, and Evaluation section (page 9-10) and the Permit Reporting and Reauthorization Requirements (C-5a, i-ix). Information needed is included as tables in this document or was obtained and cited from the following documents (see lists below):

Direct take consists of adults spawned in 2018 at LFH and NPTH (highlighted in green), and eggs/loss/release data associated with BY18 subyearlings released in 2019 and BY17 yearlings released in 2019 that were part of LSRCP, LSRCP-FCAP, and IPC programs. Direct takes of listed Snake River fall Chinook salmon were calculated in Table 26 and Table 27 and were generally within limits. The number of unmarked/untagged juveniles released by these programs totaled 2,105,026 fish, which are not included in the tables below.

Additional information can also be found in reports provided by Nez Perce Tribe, and are referred to in the Conditions Table (Table 28) provided below.

1. Nez Perce Tribe Snake River Fall Chinook Salmon Monitoring and Evaluations Report (**M&E Report**)
2. 2018 Snake River Fall Chinook Salmon Spawning Summary Report (**Redd Report**)
3. Final abundance and composition of Snake River Fall Chinook salmon returning to Lower Granite Dam in 2018 (**Run Recon Report**)
4. 2018 NPTH SR fall Chinook production report (**Production Report**)

Table 26. Proposed permissible direct take and actual take of listed Snake River fall Chinook salmon adults returning in 2018 and juveniles released in 2019 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.

Type of Take	Mark [a]	Annual take of listed fish by life stage							
		Egg/fry		Juvenile or smolt		Adult [b]		Carcass	
		Limit	Take	Limit	Take	Limit	Take	Limit	Take
Observe or harass [c]	No fin clip	0		0		Up to 20% of entire run	0	0	
	AD clip	0		0		Up to 20% of entire run	0	0	
Capture, handle, tag/marked/tissue sample, and release [d]	No fin clip	0		2,222,222	462,788	1,820[e]	142	0	
	AD clip	0		2,500,000	2,299,434	780[h]	21	0	
Intentional lethal take [f]	No fin clip	0	18,863	1,000 (Health Sampling)	0	Up to 3,800[h]	1,806	0	
	AD clip	0		0		Up to 2,200[h]	653	0	
Unintentional lethal take [g]	No fin clip	7.50%	6.69%	7.50%	2.87%	Trapping – 1%	0.00%	0	
						Holding – 15%	0.22%		
	AD clip	7.50%	6.69%	7.50%	2.87%	Trapping – 1%	0.00%	0	
						Holding – 15%	0.40%		

a. "No fin clip" salmon include hatchery-origin and natural-origin fish. The majority (~66%%) of the unclipped fish are hatchery-origin.
b. For purposes of this permit, adults and jacks include all fall Chinook salmon that include fall Chinook salmon that have spent at least 1 year in the ocean. . Post-season reporting will be based on estimated ocean age. Adult take limits are based on programmatic needs - broodstock numbers and run-reconstruction numbers - and limits to the overall sampling rate, of the run at large. .
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. Final proportions will be based on post-season run data.
d. Take of juveniles due to tagging/marking/PIT tagging prior to release. Note, 2,222,222 unclipped juvenile estimate includes fish PIT tagged.
e. Intentional mortality of listed fish as broodstock only and includes fish spawned but not used because nonviable gametes or adults culled due to out of basin origin. Values represent total need for all program components (LFH, FCAP, NPTH, and IPC). The number shown assumes full production through priority 11 (*U.S. v. Oregon* agreement [2018] and does not include NPTH production. This number could vary depending on annual egg takes and survival in the hatchery and includes a 10% buffer for hatchery flexibility. Priority collection occurs at the LGR trap, alternative collection at LFH and NPTH or South Fork Clearwater River weir.

f. Take goal for natural-origin fish for broodstock is 1,500 adults. Jacks can compose up to 10% of total broodstock collection, and are included in this take limit. Based on run predictions and attempt to maximize pNOB. 4,010 total brood are needed for full production, but may include a variation of clipped and unclipped to meet pNOB and brood targets. Note that proportions will change based on run composition and the new US v Oregon tagging table changes that go into effect for BY 2018.
g. Unintentional mortality of listed fish from operation of adult traps, including loss of fish during trapping, transport, and holding prior to spawning or release back into the wild following broodstock sorting. Also provided are estimates of in-hatchery incubation and rearing mortality rates, by life-stage. Egg and fry mortality include loss due to culling based on fish health issues and/or culling of progeny of strays at the end of the season. Adult mortality estimates are based on a 15% prespawning mortality, including adult trapping, holding, and transport.
h. Adult fish in excess to broodstock needs that are returned to the river from the LFH and the NPTH. These fish are typically marked for re-capture identification.

Table 27. Proposed permissible direct take and actual take of listed Snake River fall Chinook salmon adults returning in 2018 and juveniles released in 2019 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				Unlimited[a]	103	0	
	AD clip	0				Unlimited[a]	97	0	
Capture, handle, and release [c]	No fin clip	0		Up to 15% of natural juvenile production not to exceed 25,000 fish[h]	413	20	0	10	0
	AD clip	0		10	0			10	0
Capture, handle, tag/mark/tissue sample, and release [d]	No fin clip	0		3,000[h]	444	Up to 8,500[i]	2,267	Unlimited	38
	AD clip	0				Up to 8,500[i]	1,238	Unlimited	36
Intentional lethal take [f]	No fin clip	0		0		1,000	63	0	
	AD clip	0		0		Up to 2,000	157	0	
Unintentional lethal take [g]	No fin clip	0		300[h]	19	0		0	
	AD clip	0		100[h]	0	0		0	

a. Observation of live, ESA-listed fish through juvenile and adult spawning surveys on the Tucannon River and adult spawning surveys on Asotin Creek.
c. Take associated with smolt trapping operations where listed fish are captured, handled, and released.
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, and juvenile fall Chinook salmon captured, handled, sampled, tagged, and released from juvenile trapping, netting, and electro-fishing projects. Carcass sampling during spawning ground surveys on the Tucannon River and Asotin Creek is unlimited.
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 and jacks used for run reconstruction at LGR trap.

Table 28. Terms and Conditions for WDFW Section 10 Permit #16607-2R (2018).

Conditions	Response or reference for requested information
Annual adult return estimates for all ESA-listed salmonids encountered at the Lower Granite Dam adult trap.	See ESA permit 21951; Lower Granite Dam trapping permit (NOAA)
Fall Chinook salmon escapement to Lyons Ferry Hatchery, Nez Perce Tribal Hatchery and the South Fork Clearwater Weir (once in operation) by origin (marked, tagged, unknown and unmarked adults);	The LFH trap was not operated in 2018. Escapement to NPTH provided in **NPTH Production Report**. The South Fork Clearwater trap was not operated in 2018.
Annual estimates of fall Chinook salmon escapement, and fall Chinook salmon redd counts, in natural spawning areas	Fall Chinook salmon escapement to the Tucannon River is provided in Table 18 in this report. Fall Chinook salmon escapement to natural spawning areas above LGR are described the **NPTH M&E report**. Fall Chinook salmon redd counts above LGR are described in the **NPTH M&E report** and in the **NPT Redd report**
Carcass recovery data, including numbers, sex ratios, fish stock origin, mark observations, tributary location, and age class	Carcass recovery data from the Tucannon River is provided in page 49 in this report. Carcass recovery data above LGR provided by NPT in the **M&E report** Hatchery Fraction section (page 20) and the "carcass" tab provided by NPT Permit Spreadsheet.
Number and origin of all fall Chinook salmon retained during broodstock collection and their final disposition	Number and origin of broodstock retained at Lyons Ferry Hatchery are provided in Tables 6-10, pages 22 - 31 in this report. For the number of broodstock retained and their disposition by NPTH, see the **NPT M&E report**. Also see the joint agency **Run Recon report** for additional information.

Trends in the relative, total annual abundances of natural- and hatchery-origin fall Chinook salmon escaping to the Snake River Basin upstream of Lower Granite Dam, and observations of any apparent effects of the hatchery program on fall Chinook salmon escapement and spawning distributions in the Snake River Basin	See the joint Agency **Run Recon report** for trends in total abundance of natural- and hatchery-origin fall Chinook salmon escaping to Lower Granite Dam; see "escapement" tab for trends in abundance of natural- and hatchery-origin fall Chinook escaping above Lower Granite Dam and; also see the **Redd report** for trends in index of abundance (redd counts) above Lower Granite Dam.
Unintentional injuries or mortalities of listed spring/summer, and fall Chinook salmon, steelhead, and sockeye that result from all operational activities	Captures of fall Chinook juveniles during RM&E activities by WDFW (Tucannon Smolt trapping) are provided in the smolt trapping section of this report (pages 50-51). Incidental trapping of juveniles (spring Chinook or steelhead) in the Tucannon River are covered under other Section 10 reports. Incidental trapping of ESA-listed adult steelhead, spring Chinook salmon and sockeye salmon at LFH is not available as the trap did not operate in 2018.

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: As time allows, assist the Snake River fall Chinook salmon Run Reconstruction group in developing methodologies to address sampling changes that occurred prior to 2004.

Recommendation: As time allows, continue to assist with documentation of historical methodologies used to develop run estimates.

2. As of 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. Beginning with the 2019 release year, all Snake River fall Chinook salmon releases will be identified by a PBT mark group for each release site.

Recommendation: In the future, 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 CWT based run reconstruction estimates. Compare run reconstruction estimates between PBT and CWT tag methods. Following these comparisons, begin discussions regarding the future use/need of CWT's for Snake River fall Chinook salmon. Work with FINS technical team to upload incubation data with intended release site in order to reference future returns by origin for the PBT analysis.

3. 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: Continue fecundity estimates of fish used for broodstock by origin, age, and release site through run year 2020. In the 2020 annual report, provide a complete summary of this 5-year evaluation on fecundities.

4. Fish from yearling programs have consistently shown to have higher SAR rate than subyearlings. However, yearlings have a high rate of 0-salt and 1-salt returns whereas subyearlings do not return as 0-salt fish and have minimal returns of 1-salt fish. As of 2019, releases of yearlings above LGR have been ceased, but releases at LFH will continue for the foreseeable future.

Recommendation: Continue to compare return information from yearling and subyearling release groups at LFH. Based on results and management priorities, discuss with the relevant parties to decrease or eliminate the yearling releases from LFH in the future.

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Appendix A: Trapping and Sampling Protocols at LGR Adult Trap for 2018

2018 Fall Chinook Trapping/Sampling Protocols at LGR

August 17, 2018

Protocols:

1) These protocols presume a 24 hour/day, 7 days per week trapping at 70%. All fish hauled to hatcheries must receive an operculum punch on the right side (ROP) and if trapping changes to only 4 hours per day (100% trap rate), all fish hauled to the hatcheries must receive an operculum punch on the left side (LOP).

2) Males and females will not be inoculated.

3) All fish > 70 cm will be hauled to LFH and NPTH. LFH will haul 70% and the NPT will haul 30%.

4) Wire tagged males <70 cm hauled to LFH.

5) Wire tagged females <70 will be hauled to LFH and NPTH under the normal 70/30 split. Based on water quality conditions, fish hauled for NPT brood may be held at LFH.

6) Unmarked/untagged females <70 will be hauled to LFH.

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

8) Only scale sample fish released from the trap. Do not scale sample hauled fish.

9) DNA sample all fish trapped regardless if hauled to the hatchery or released.

Wire tagged fish:

Fork Length	Action
≥ 70cm	Haul all wires (DNA sample all)
<70 cm	Haul 1 out of 4 wires (put F in with "LARGES" for LFH and NPT and M go into tank for LFH), DNA sample all Release 3 out of 4 wires (DNA sample all)

Untagged fish:

Fork Length	Action
≥ 70 cm	Haul all fish (DNA sample all).
<70 cm	Haul 1 out of 4 F to LFH (DNA sample all). Release 3 out of 4 F (collect scales and DNA). Release all M (collect scales and DNA).

September 6, 2018
Changes to prior protocol are highlighted

Protocols:

1) These protocols presume a 24 hour/day, 7 days per week trapping at 20%. Fish trapped during a 24 hour 7 day a week trapping period will not be operculum punched. If the systematic sampling rate is changed, all fish hauled to hatcheries must receive two operculum punches on the right side (ROP) and if trapping changes to only 4 hours per day (100%trap rate), all fish hauled to the hatcheries must receive an operculum punch on the left side (LOP).

September 9, 2018
Changes to prior protocol are highlighted

Protocols:

1) These protocols presume a 24 hour/day, 7 days per week trapping at 20%. Fish trapped during a 24 hour 7 day a week trapping period will not be operculum punched. If the systematic sampling rate is changed, all fish hauled to hatcheries must receive two operculum punches on the right side (ROP) and if trapping changes to only 4 hours per day (100%trap rate), all fish hauled to the hatcheries must receive an operculum punch on the left side (LOP).

2) Males and females will not be inoculated.

3) All males > 70 cm will be hauled to LFH and NPTH. LFH will haul 70% and the NPT will haul 30%.

4) Wire tagged males <70 cm hauled to LFH.

5) All females <70 will be hauled to LFH.

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

7) Only scale sample fish released from the trap. Do not scale sample hauled fish.

8) DNA sample all fish trapped regardless if hauled to the hatchery or released.

September 18, 2018

Changes to prior protocol are highlighted

Wire tagged fish:

Fork Length	Action
≥ 67cm	Haul all male wires (DNA sample all) Release all females
<67 cm	Haul 1 out of 4 wires (DNA sample all) Release 3 out of 4 wires (DNA sample all)

Untagged fish:

Fork Length	Action
≥ 67 cm	Haul all males (DNA sample all)
≥ 70 cm	Haul all females (DNA sample all)
<67 cm	Haul 1 out of 4 F to LFH (DNA sample all) Release 3 out of 4 F (collect scales and DNA) Release all M (collect scales and DNA)

September 25, 2018

Changes to prior protocol are highlighted

Wire tagged fish:

Fork Length	Action
≥ 67cm	Haul all male wires (DNA sample all) Release all females
<67 cm	Haul 1 out of 4 male wires (DNA sample all) Release 3 out of 4 male wires (DNA sample all) Release all females (DNA sample all)

Untagged fish:

Fork Length	Action
≥ 67 cm	Haul all males (DNA sample all) Release all females (DNA sample all)
<67 cm	Release all males (collect scales and DNA) Release all females (collect scales and DNA)

October 8, 2018

Changes to prior protocol are highlighted

Wire tagged fish:

Fork Length	Action
≥ 70cm	Haul all male wires (DNA sample all) Release all females
<70 cm	Haul 1 out of 4 male wires (DNA sample all) Release 3 out of 4 male wires (DNA sample all) Release all females (DNA sample all)

Untagged fish:

Fork Length	Action
≥ 70 cm	Haul all males (DNA sample all) Release all females (DNA sample all)
<70 cm	Release all males (collect scales and DNA) Release all females (collect scales and DNA)

Appendix B: Systematic Sampling Rates at Lower Granite Dam 2003-2018

Appendix B Table 1. Dates, times, and trapping rates of fall Chinook salmon at LGR, 2003-2018.

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
2017	18 Aug 7:45 am	20	-	13 Sept	33	22 Sept	20	19 Nov
2018	18 Aug 7:00 am	70	-	8 Sept	20		nc	18 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 C: Salmon Processed and Killed at LFH in 2018

Appendix C Table 1: Estimated composition of non-wire tagged salmon trapped at LGR, hauled to LFH, and killed during 2018.

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		1		1
Snake R. hatchery subyearling age 3(2salt) by PIT tag		1		1
Snake R. hatchery subyearling age 4(3salt) by PIT tag		5		5
Presumed Snake R. hatchery res rear age 5(3salt) by DNA			1	1
Presumed Snake R. hatchery subyearling age 3(2salt) by DNA		43	29	72
Presumed Snake R. hatchery subyearling age 4(3salt) by DNA		154	44	198
Presumed Snake R. hatchery subyearling age 5(4salt) by DNA		9	3	12
Presumed Snake R. hatchery yearling age 4(2salt) by DNA		11	1	12
Presumed Snake R. hatchery unknown rear by DNA		11	10	21
Unknown hatchery res rear age 3(2salt) by DNA		2		2
Unknown hatchery subyearling age 2(1salt) by DNA	3			3
Unknown hatchery subyearling age 3(2salt) by DNA		2	9	11
Unknown hatchery subyearling age 4(3salt) by DNA		17	10	27
Unknown hatchery subyearling age 5(4salt) by DNA		2	1	3
Unknown hatchery yearling age 4(2salt) by DNA		2		2
Unknown hatchery unknown rear/age by DNA	2	6	2	10
Presumed natural subyearling age 3(2salt) by PIT tag			1	1
Presumed natural yearling age 4(3salt) by PIT tag		1		1
Presumed natural res rear age 3(1salt) by DNA			1	1
Presumed natural res rear age 4(2salt) by DNA		91	32	123
Presumed natural res rear age 5(3salt) by DNA		11	3	14
Presumed natural res rear age 6(4salt) by DNA		1		1
Presumed natural subyearling age 3(2salt) by DNA		28	71	99
Presumed natural subyearling age 4(3salt) by DNA		260	99	359
Presumed natural subyearling age 5(4salt) by DNA		34	3	37
Presumed natural res rear subyearling age 3(1salt) by DNA		1		1
Presumed natural yearling age 3(1salt) by DNA			1	1
Presumed natural yearling age 4(2salt) by DNA		9	8	17
Presumed natural yearling age 5(3salt) by DNA		1	2	3
Presumed natural unknown rear/age by DNA		33	30	63
Unknown origin res rear age 5(3salt) by scales		2		2
Total	**5**	**738**	**361**	**1,104**

Appendix C Table 2. Estimated composition of wired salmon trapped at LGR, hauled to LFH, and killed in 2018. (Age/Rearing states origin, brood year, age at release, and release site (LF16SO is a LFH hatchery origin fish from the 2016 brood year, released as a subyearling, onstation at LFH)

Origin by CWT	CWT	Females	<53 cm Males	≥53 cm Males	Grand Total
LF13SBCA	220342			1	1
	220345	2			2
LF13SCJA	220346	2			2
LF13SCJA2	636738	1			1
LF13SO	636737	2			2
LF13SPLA	220347	1			1
LF13YBCA	220348	1		2	3
	220351	2			2
LF13YCJA	220350	3			3
LF13YO	636740	7		2	9
	636741	6		2	8
LF13YPLA	220352	1			1
LF14SBCA	220356	7		1	8
	220357	10		4	14
LF14SCJA	220354	18		2	20
	220355	2		3	5
	220360	9		1	10
LF14SGRRD	636883	18		3	21
LF14SIPCHC	090888	12			12
LF14SO	636882	26		5	31
LF14SPLA	220358	7		2	9
	220359	6		5	11
LF14YBCA	220361	17		7	24
	220366	15		7	22
LF14YCJA	220363	30		19	49
	220364	17		9	26
LF14YO	636885	69		43	112
	636886	91	1	55	147
LF14YPLA	220362	15		12	27
	220365	13		4	17
LF15SBCA	220369	2		6	8
	220370	2		9	11
LF15SCJA	220367	3		6	9
	220368	1		2	3
LF15SCJA2	220373			2	2
LF15SIPCHC	091013	4	1	6	11
LF15SO	637038	1		15	16
LF15SPLA	220371	3		4	7
	220372	2		8	10

Origin by CWT	CWT	Females	<53 cm Males	≥53 cm Males	Grand Total
LF15YBCA	220374			2	2
LF15YCJA	220376			2	2
	220377		3	1	4
LF15YO	637040		5	3	8
	637041	1	5	9	15
LF15YPLA	220378			1	1
LF16SBCA	220383		3	1	4
	220386		2	1	3
LF16SCJA	220380		1	1	2
	220381		4		4
LF16SGRRD	637199	1	7		8
LF16SO	220382		6		6
	637198		8		8
LF16SPLA	091138		2		2
	220384		4		4
	220385		2		2
LF16YBCA	220388		5		5
	220391		4		4
LF16YCJA	220389		7		7
	220392		16		16
LF16YO	637202		7		7
	637203		11		11
LF16YPLA	220387		6		6
	220390		7		7
NPTH12SCFA	220222	1			1
NPTH12SO	220226	2			2
NPTH13SCFA	220233	2			2
	220235	4		1	5
NPTH13SLGA	220234	2			2
NPTH13SNLVA	220238	3			3
	220240	1		1	2
NPTH13SO	220237	1			1
	220239	1		1	2
NPTH14SCFA	220227	5		3	8
	220228	5		3	8
NPTH14SLGA	220229	16		4	20
	220230	15		1	16
NPTH14SO	220245	7			7
	220246	5			5
	220247	21		6	27
	220248	10		5	15

Origin by CWT	CWT	Females	<53 cm Males	≥53 cm Males	Grand Total
NPTH15SCFA	220243	4		7	11
	220244	1		7	8
NPTH15SLGA	220241	2	1	2	5
	220242		1	10	11
NPTH15SO	220249			3	3
	220250	1		3	4
	220251			2	2
	220254	1		6	7
	220255			3	3
NPTH16SCFA	220253		1		1
NPTH16SLGA	220261		2		2
	220262		1		1
NPTH16SO	220256		2		2
	220257		6		6
	220260		1		1
BONN14YUMA	090944	1		2	3
	090945	1		2	3
	090946	1		1	2
COHO_16YDNFHCLRWATER	220020		1		1
Total		**562**	**140**	**357**	**1,017**

Appendix D: Historical Use of Minijacks, Jacks, Jills and Strays in Broodstock at LFH

Appendix D Table 1. Number of matings of minijacks, jacks, and jills contributing to broodstock at LFH 2000-2009 and 2010-2018 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
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**
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
2017	0	22	14	0	2.8
2018	0	5	0	0	0.4
Average	**0**	**14.8**	**11.7**	**0.4**	**2.1**

Appendix D Table 2. Historical use of out of basin strays in broodstock: 2007-2018.

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%
2017	1,285	1	0	0	0.1%
2018	1,253	0	0	0	0.0%
Average	1,257	**1**	**9**	**0**	**0.8%**

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

Appendix E: Egg Take and Early Life Stage Survival Brood Years: 1990-2013

Appendix E Table 1: Egg take and survival numbers by life stage of Lyons Ferry origin fall Chinook salmon spawned at LFH, brood years 1990-2013.

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	0	1,011,998	729,311	Yearling
						228,930	Subyearling
1991	906,411	0	0	0	828,514	807,685	Yearling
						0	Subyearling
1992	901,232	0	0	0	855,577	624,961	Yearling
						210,210	Subyearling
1993	400,490	0	0	0	363,129	352,461	Yearling
						0	Subyearling
1994	583,871	0	0	0	553,189	542,461	Yearling
						0	Subyearling
1995[d]	1,056,700	0	0	0	1,022,700	847,241	Yearling
						112,532	Subyearling
1996	1,433,862	0	0	0	1,377,202	941,900	Yearling
						419,677	Subyearling
1997	1,184,141	0	0	0	1,134,641	1,037,221	Yearling
						63,849	Subyearling
1998	2,085,155	0	0	0	1,978,704	916,261	Yearling
						1,010,344	Subyearling
1999	3,980,455	156,352	0	0	3,605,482	991,613	Yearling
						2,541,759	Subyearling
2000	3,576,956	53,176	0	115,891	3,249,377	998,768	Yearling
						2,159,921	Subyearling
2001	4,734,234	144,530	0	200,064	4,230,432	1,280,515	Yearling
						2,697,406	Subyearling
						125,600	Research
2002	4,910,467	44,900	0	1,195,067	3,540,000	1,032,205	Yearling
						2,376,251	Subyearling
						73,229	Research
2003	2,812,751	0	0	250,400	2,476,825	985,956	Yearling
						1,455,815	Subyearling
2004	4,625,638	0	0	1,053,278	3,421,751	914,594	Yearling
						2,191,102	Subyearling
						184,682	Research
2005	4,929,630	0	0	1,180,000	3,562,700[e]	980,940	Yearling
						2,078,206	Subyearling
						216,417	Research
2006	2,819,004	0	0	127,564	2,601,679	961,105	Yearling
						1,640,574	Subyearling
						2,000	Research
2007	5,143,459	0	0	1,761,500	3,212,900[f]	960,900	Yearling
						1,894,933	Subyearling
2008	5,010,224	0	0	1,810,800	2,969,200	1,000,000	Yearling
						1,969,200	Subyearling
2009	4,574,182	0	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

Appendix E Table 1: Egg take and survival numbers by life stage of Lyons Ferry origin fall Chinook salmon spawned at LFH, brood years 1990-2013.

Brood year	Eggs taken	Egg loss [a]	Eggs destroyed [b]	Eggs shipped[c]	Eyed eggs retained	Fry ponded	Intended program
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

[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 F: LFH/Snake River Origin Fall Chinook Salmon Releases in 2019

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

Release year	S/Y [c]	Brood year	Release location-type	Release date	CWT code	Number of fish released [b]					FPP	PIT Tagged [d]
						AD clip +CWT	CWT only	AD clip only	No clip or CWT	Total Released		
2019	Y	2017	LFH	12 Mar	637398	225552	115	1151	690	227508	11.6	5000
2019	Y	2017	LFH	12 Mar	637397		218140		1355	219495	11.2	5000
2019	Y	2017	CJ1	4 April	220398	22456				22456	10.2	235
2019	Y	2017	CJ1	4 April	220395		25613			25613	10.2	268
2019	Y	2017	CJ1	4 April	220396	22439				22439	10.2	235
2019	Y	2017	CJ1	4 April	220393		25592			25592	10.2	268
2019	Y	2017	CJ1	4 April	220397	22430				22430	10.2	235
2019	Y	2017	CJ1	4 April	220394		24651			24651	10.2	258
2019	Y	2017	LFH (PL GROUP)	12-13 March	220398	26354				26354	13.3	0
2019	Y	2017	LFH (PL GROUP)	12-13 March	220395		30059			30059	13.3	0
2019	Y	2017	LFH (PL GROUP)	12-13 March	220396	26335				26335	13.3	0
2019	Y	2017	LFH (PL GROUP)	12-13 March	220393		30034			30034	13.3	0
2019	Y	2017	LFH (PL GROUP)	12-13 March	220397	26324				26324	13.3	0
2019	Y	2017	LFH (PL GROUP)	12-13 March	220394		28931			28931	13.3	0
2019	Y	2017	BC1	3 April	220398	21346				21346	12.0	231
2019	Y	2017	BC1	3 April	220395		24347			24347	12.0	263
2019	Y	2017	BC1	3 April	220396	21330				21330	12.0	230
2019	Y	2017	BC1	3 April	220393		24326			24326	12.0	263
2019	Y	2017	BC1	3 April	220397	21321				21321	12.0	230
2019	Y	2017	BC1	3 April	220394		23433			23433	12.0	253
2019	S	2018	CJ1	9 May	220509	199024		1990	262804	463818	56.0	25979
2019	S	2018	BC1	8 May	220511	197200		5127	265551	467878	57.9	11086
2019	S	2018	LFH	28-29 May	637422	201013	1686	1264	539931	743894	56.1	19960
2019	S	2018	PL1	10 May	220513	196832	394	1968	203752	402946	53.6	13005
2019	S	2018	CJ2	31 May	220510	205483		2055	785	208323	45.8	4499
2019	S	2018	BC2	2 Jun	220512	203647	815	3666	1000	209128	51.7	4490
2019	S	2018	PL2	24 May	220514	204182	409	409	3540	208540	57.7	4295
2019	S	2018	Snake River Near Grande Ronde	30 May	637420	191602	2115	17553	634	211904	50.0	4496
2019	S	2018	Cherry Lane Boat Ramp	27 Mar					70125	70125	500.0	
2019	S	2018	NPTH-Site 1705-MF Clearwater R	11 Jun	220272	102870	2031	778	317378	423057	74.0	4500
2019	S	2018	NPTH-Lukes Gulch Accl.-SF Clearwater R	30 May	220271	101920	2195	1059	172064	277238	71.0	4500
2019	S	2018	NPTH-Cedar Flats Accl.-Selway R	10 Jun	220258	103476	3402	1078	151796	259752	55.0	4497

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

Release year	S/Y [c]	Brood year	Release location-type	Release date	CWT code	Number of fish released [b]					FPP	PIT Tagged [d]
						AD clip +CWT	CWT only	AD clip only	No clip or CWT	Total Released		
2019	S	2018	NPTH-North Lapwai Valley Accl.	6 May	220270	100673	2280	5357	123322	231632	150.0	0
2019	S	2018	Salmon R	14 May	91286	209044	2128	20337	824984	1056493	56.0	4500

[a] Due to limited water availability, BY17 FCAP yearlings were combined and reared in an earthen pond at LFH. Inclement weather prevented the Pittsburg Landing release group from being transported to their respective acclimation site and were released onsite at LFH. This is the final year for FCAP yearling releases.
[b] Numbers presented do not necessarily match hatchery records for fish per pound because of reporting constraints for the hatchery.
[c] S/Y indicates subyearling or yearling rearing strategy.
[d] Numbers of fish PIT tagged are included in the Number of Fish Released categories.

Appendix G: Tucannon River Survey Sections and Historical Escapement

Appendix G 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, 2018.

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	30
2	Highway 261 Bridge to Smolt trap	0.2	0.2	100	3
3	Smolt trap to Powers Bridge	0.5	0.5	100	40
4	Powers Bridge to upper hog barns	1.2	1.2	100	25
5	Hog barns to Starbuck Br.	2.5	2.4	96	28
6	Starbuck Br. To Fletchers Dam	2.7	1.3	48	54
7	Fletcher's Dam to Smith Hollow	2.9	2.9	100	7
8	Smith Hollow to Ducharme's Sheep Ranch Br.	4.4	4.4	100	11
9	Ducharme's Bridge to Highway 12	5.5	5.5	100	3
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	1
	Total	**33.6**	**31.0**	**95**	**202**

[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 G Table 2: Estimated escapement, % stray component of the run, and number of redds (observed and estimated) in the Tucannon River, 1985-2000.

Escapement			Redd construction		
Year	Estimated escapement [a]	% Strays in escapement estimate	# Redds observed	# Redds in no access areas (estimate)	Total # of Redds (estimate)
1985 [b]	0	unknown	0	No estimate	0
1986 [c]	2 [d]	unknown	0	No estimate	0
1987	48	0.0	16	0	16
1988	78	0.0	26	0	26
1989	150	27.9	48	2	50
1990	186	30.8	62 [e]	0	62
1991	150	20.0	50	0	50
1992	69	0.0	23	0	23
1993	84	6.3	28	0	28
1994	75	28.0	25	0	25
1995	87	33.3	29	0	29
1996	144	95.5	43	5	48
1997	93	5.3	27	4	31
1998	132	7.1	40	4	44
1999	87	9.1	21	8	29
2000	60	27.8	19	1	20

[a] Estimates were derived using three fish per redd.
[b] Based on one survey completed 12/17/85.
[c] Based on one survey completed 11/18/86.
[d] Two carcasses counted but not sampled.
[e] Correction of number of redds observed that was presented in the 1990 Annual Report.