Lyons Ferry Hatchery Evaluations: Fall Chinook Salmon Annual Report (2019 Return/2020 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 2019 spawning and 2020 releases of yearlings and subyearlings.

The estimated run size of natural-origin fall Chinook salmon to reach Lower Granite Dam (LGR) was 6,558 fish $\geq$ 57 cm fork length and 942 fish 30- <57 cm fork length. The remaining portion of the run consisted of 9,950 hatchery-origin fish $\geq$ 57 cm and 4,248 hatchery origin fish 30-< 57 cm. Nearly 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 estimated stray rate of out-of-basin fish to LGR in 2019 was estimated at ~0.5%.

During 2019, WDFW collected 2,353 fish at LGR for broodstock, monitoring and evaluation of our hatchery releases, and to estimate the run composition at LGR.

In 2019, LFH staff spawned 1,151 females for an estimated total green eggtake of 4,670,644; 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, 122 females and 131 males were returned to the Snake River to spawn naturally. Green egg to eye-up survival was 96.9%. Of the 519 males spawned at LFH, 480 were used multiple times to minimize the use of jacks, and to incorporate larger/older fish in the broodstock.

Based on the PBT identification, fecundity relationships were evaluated for three groups: hatchery yearling, hatchery subyearling, and natural-origin subyearling. Generally, fork lengths reliably predict fecundities in all groups but were highly variable (1,667-6,140 eggs/fish). Of the sampled hatchery yearlings, mean fork length and fecundity was 76.7 cm and 3,202 eggs/female (N=19). Subyearlings (hatchery and natural origin) averaged 79.3 cm and 3,901 eggs/female (N=110), and 82.3 cm and 4,140 eggs/female (N=87), respectively.

The estimated proportion of natural-origin fish in broodstock (pNOB) in the LFH broodstock (as determined from run-reconstruction methodologies or tissue sampled collected from spawned fish) was 38.0% or 40.0%, respectively. We believe the difference between the two estimates 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 2020, hatchery staff released BY19 subyearlings into the Snake River at LFH and into the Grande Ronde River (GRR) near Cougar Creek, and BY18 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 *United States v. Oregon* production tables, and each also received passive integrated transponder (PIT) tags to monitor survival and migration rate through the hydro system. Releases can also be identified by Parental Based Tagging (PBT) methods as individual females for each release group were tracked through the rearing cycle. Estimated survival and travel speed to the first dam of encounter for each of the release groups was lower in 2020 compared to previous years.

Beginning the week of 20 October 2019, staff conducted fall Chinook salmon redd surveys in the lower Tucannon River. A total of 167 redds (fall Chinook and Coho) were counted and an additional 30 redds were estimated due to landowner restrictions. Total estimated fall Chinook salmon redds equaled 160. Based on three fish/redd, the estimated number of fall Chinook spawners in the Tucannon River in 2019 was 480. Of the estimated total fall Chinook spawning escapement, 13.5% were recovered and sampled.

In the spring of 2020, 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 1,657. Productivity (smolts/redd) from spawning was estimated at 10 smolts/redd.

In 2019, we estimate that a minimum of 2,626 (14.4%) 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 based on PIT Tag conversions. We estimate that a minimum of 3,983 (4.4%) returning adults/jacks that were from WDFW releases only contributed to the total LSRCP downriver mitigation objective (91,500 fish). This estimate includes all returns to the Snake River Basin and fully expanded recoveries outside of the Snake River.

Fall Chinook salmon reared at LFH and released into the Snake River at LFH or in the GRR contributed to harvest outside the Snake River Basin in both sport and commercial/tribal fisheries in 2019. Of the total number of fish recovered outside of the Snake River, 59.2% came from commercial/tribal fisheries, 37.3% from sport fisheries, 0.8% were from hatchery collections, and 2.7% were recovered in spawning ground survey areas.

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 2019 and juvenile releases in 2020.

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, Dane Kiefel, Jule Keller, Lance Ross, Brent Burns, Rachel Rillera, Addie Donohue 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 Andrew Claiborne (WDFW) and his staff at the scale aging lab in Olympia for aging scales collected at LFH, LGR, and Nez Perce Tribal Hatchery for the run reconstruction and broodstock.

We appreciate the efforts of Darren Ogden (NOAA Fisheries) and crew at LGR for trapping, tagging, and documenting fall Chinook salmon for transport to LFH. We also thank Bill Young (NPT) and 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 confidence intervals around the estimates.

We thank Alf Haukenes (WDFW) and Rod Engle (USFWS) 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

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 2019 spawning, and both yearling and subyearling releases at Lyons Ferry or in the Grande Ronde River occurring in 2020. WDFW's Snake River Lab (SRL) evaluation staff completed this work with federal fiscal year 2019/2020 funds provided through the U.S. Fish and Wildlife Service (USFWS), under the Lower Snake River Compensation Plan (LSRCP).

Definition of LSRCP Project Area and Measurement of Goal

The LSRCP project area starts at Ice Harbor Dam extending to Lower Granite Dam and is inclusive of the Walla Walla Basin, a Columbia River Basin tributary in SE Washington adjacent to the Snake River basin. This is inclusive of WDFW steelhead and spring Chinook programs for the LSRCP program (USFWS 2020). Measurement of the LSRCP fall Chinook salmon program goal is for adult returns ***to*** the project area starting at Ice Harbor Dam (IHD).

Program Goals and Objectives

This program began in 1984 after construction of LFH and is part of the LSRCP program authorized by Congress in 1976. The purpose of the LSRCP is to replace adult salmon and steelhead 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.

To determine the fall Chinook salmon goal, the escapement to the Snake River below Hells Canyon (HCD) Dam prior to construction of the four lower Snake River dams was estimated to be 34,400. Dam construction and operation was expected to reduce the spawning escapement in two ways: 1) the slack water reservoirs created by the dams was expected to eliminate spawning area 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, which in turn became the return goal for the program. Further, 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 an additional reduction in the recreational fishery harvest of 18,300 adults outside the project area. In summary, the expected total number of adults to all possible areas 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/Tribal 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 Nez Perce Tribal Hatchery (NPTH), are integrated programs aimed at increasing natural-origin fish abundance and harvest using supplementation and harvest mitigation releases. Fish released at LFH, consist of both subyearling and yearling releases while the Grande Ronde River, FCAP facilities, and NPTH releases are subyearlings only starting with BY2018 (*United States v. Oregon* 2018). Information about the FCAP and NPTH programs are presented by the NPT in their annual reports toward BPA and LSRCP funding requirements and are not provided here. The third program, administered by the Idaho Power Company (IPC), is primarily mitigation for lost production due to construction of the Hells Canyon Complex (HCC), and consists of subyearling releases in the lower Salmon River, ID. Releases from all these programs occur at 10 locations throughout the Snake River basin, with most releases located above Lower Granite Dam (LGR) (Figure 1). All 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 Oregon) in addition to the in-basin facilities and acclimation sites.

- Mark/Tag types and quantities have been adopted under the 2018-2027 *United States v. Oregon* Management Agreement (*United States v. Oregon* 2018 – Table 2). At full production levels, ~53% of the hatchery produced fish are marked with an adipose (AD) fin clip 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).

Hatchery Origin Return Goals

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

Natural-Origin Return Goals

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

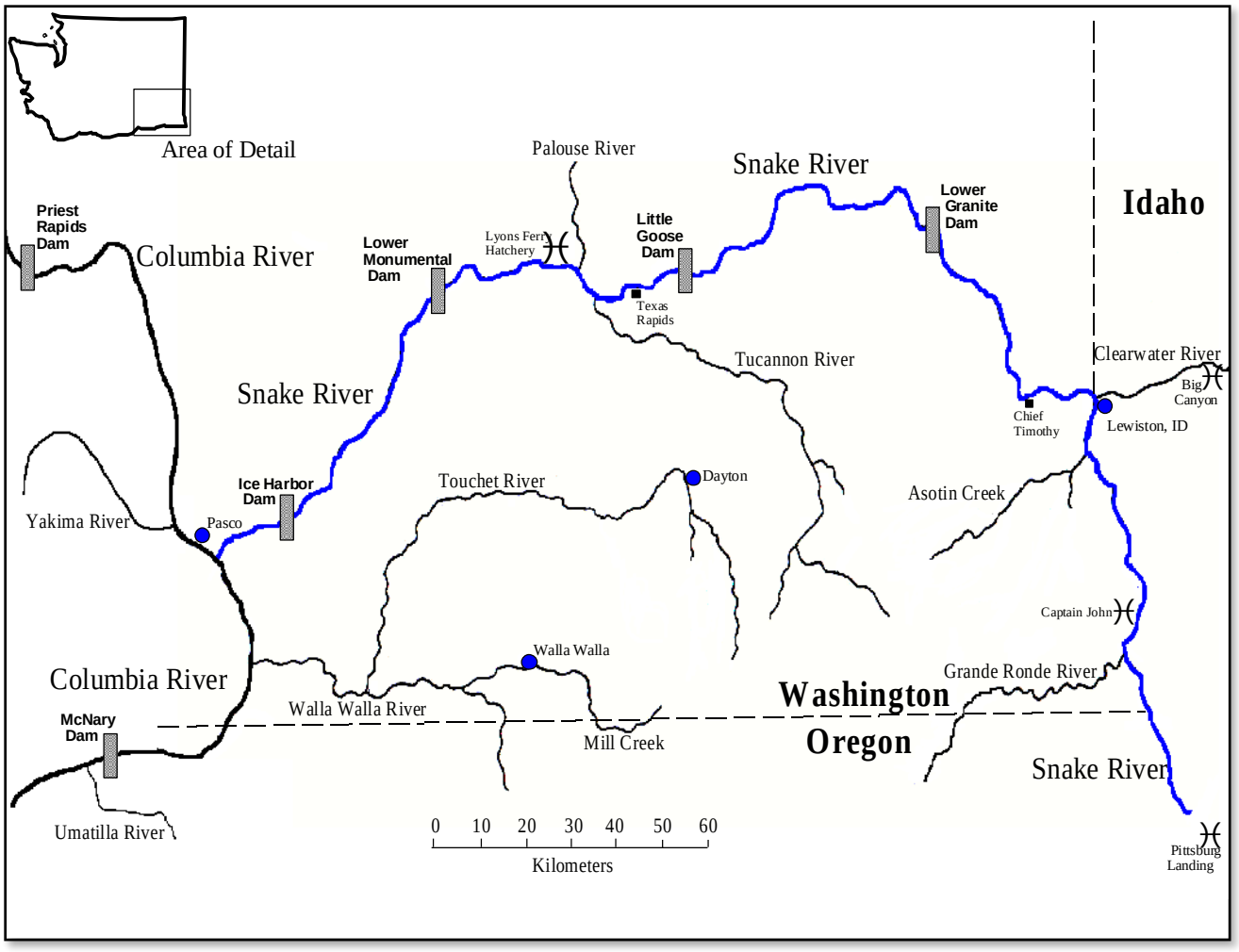

Figure 1. The Lower Snake River Basin showing locations of Lyons Ferry Hatchery, acclimation sites, and major tributaries in the area.

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+	On-station	450K ADCWT
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+	On-station	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+	**On-station**	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.

2019 Fall Chinook Salmon Run Size and Composition

Returns to LGR and Composition of Fish Returning to LGR

Chinook salmon (all runs) were counted at the LGR counting window. Fish are visually measured and grouped by total length (TL) at fish passage windows. Window counts (day and night) estimated 21,790 fall Chinook salmon ($\geq$ 30 cm TL) reached LGR in 2019 (Figure 2), which includes 6,013 "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 summer and fall 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 re-ascended the ladder and were double counted.

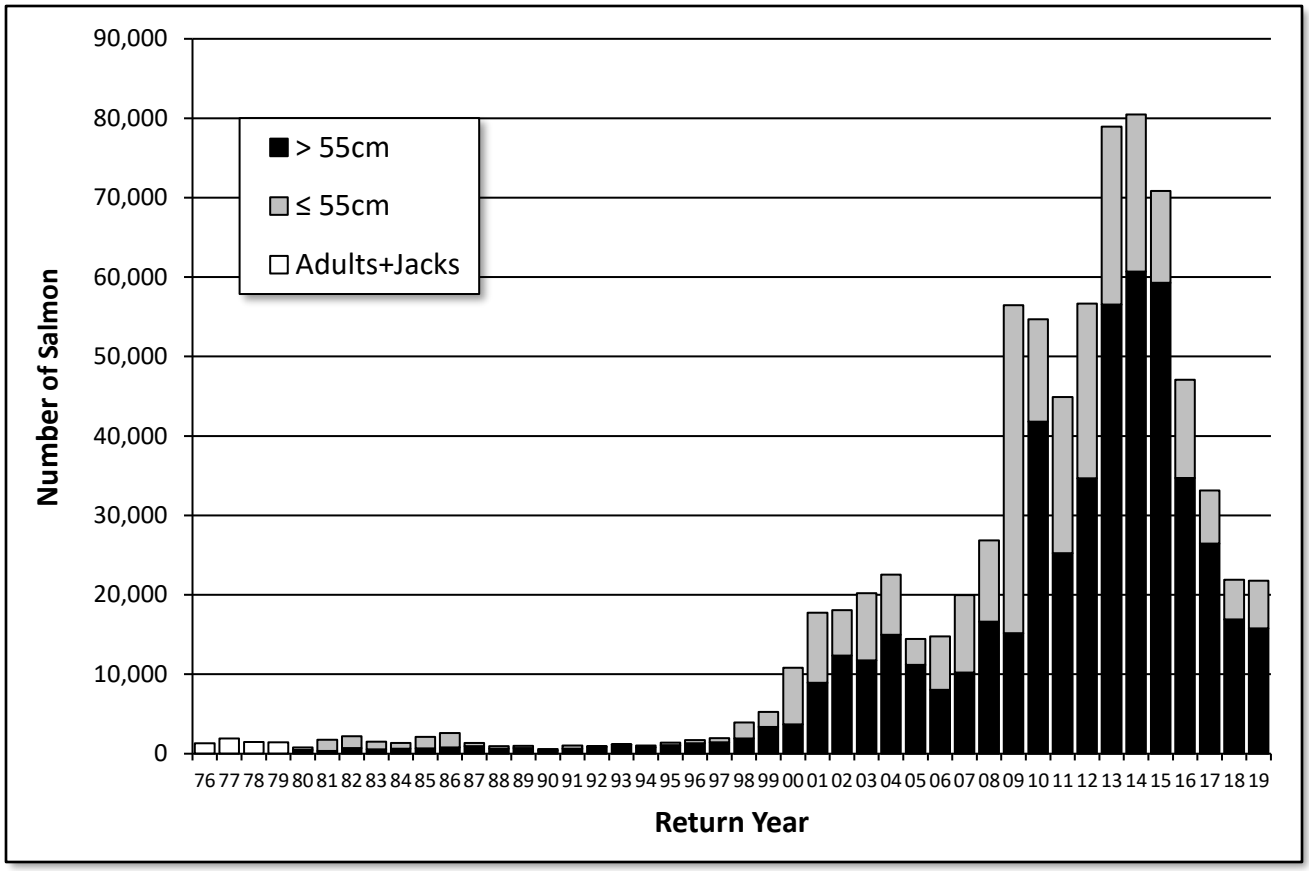

Figure 2. Fall Chinook salmon window counts at LGR, 1976-2019.

The Snake River fall Chinook salmon run reconstruction technical team annually estimates the run to LGR and consists of staff from WDFW, NPT, IPC, NOAA, and the Columbia River Inter-Tribal Fish Commission (CRITFC). The estimates derived were bootstrapped by Ben Sandford of NOAA, with confidence intervals applied to the point estimates (Table 3). 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 on 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 21,697 (including males <57 cm) fall Chinook salmon reached LGR in 2019. An estimated 30.2% were natural-origin, 69.4% were in-basin hatchery-origin, and 0.4% out-of-basin hatchery-origin. The final run estimate to LGR was 0.4% 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 the Technical Advisory Committee (TAC) for forecasting future runs. 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 2019.

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	2,757	3,801	942	6,558	Total wild	153	155	211	212	Total wild	2,426-3,041	3,502- 4,133	533-1,384	6,097-6,952
Total hatchery	5,407	4,543	4,248	9,950	Total hatchery	174	166	248	220	Total hatchery	5,064-5,732	4,228-4,871	3,761-4,761	9,534-10,394
Totals	8,164	8,344	5,189	16,508	Totals	144	146	129	131	Totals	7,862-8,417	8,041-8,627	4,956-5,462	16,218-16,738
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	41	69	810	110	Wild age 2	30	22	210	37	Wild age 2	-25-93	31-115	399-1246	36-181
Wild age 3	326	1,895	124	2,221	Wild age 3	84	126	29	151	Wild age 3	139-472	1,653-2,126	69-184	1,887-2,481
Wild age 4	2,184	1,789	2	3,973	Wild age 4	125	105	2	158	Wild age 4	1,928-2,431	1,586-2,005	0-8	3,670-4,298
Wild age 5	214	48	5	262	Wild age 5	35	26	5	44	Wild age 5	144-280	-1-102	0-16	168-350
Wild age 6	-9	0	0	-9	Wild age 6	6	0	0	6	Wild age 6	-22-0	0-0	0-0	-22-0
Hat age 2	52	75	3,879	126	Hat age 2	30	26	261	40	Hat age 2	7-124	28-128	3,362-4,392	57-211
Hat age 3	1,386	2,695	361	4,082	Hat age 3	120	170	64	201	Hat age 3	1,151-1,624	2,371-3,019	243-506	3,692-4,491
Hat age 4	3,451	1,524	8	4,975	Hat age 4	158	133	6	202	Hat age 4	3,156-3,761	1,258-1,793	0-21	4,576-5,349
Hat age 5	456	205	0	661	Hat age 5	52	49	0	72	Hat age 5	361-558	118-313	0-0	534-812
Hat age 6	28	0	0	28	Hat age 6	17	0	0	17	Hat age 6	0-66	0-0	0-0	0-66
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	6	9	0	15	Stray age 3	6	9	0	11	Stray age 3	0-18	0-30	0-0	0-40
Stray age 4	0	35	0	35	Stray age 4	0	20	0	20	Stray age 4	0-0	0-9	0-0	0-79
Stray age 5	17	0	0	17	Stray age 5	10	0	0	10	Stray age 5	0-40	0-0	0-0	0-40
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	12	0	0	12	Stray AWT	8	0	0	8	Stray AWT	0-29	0-0	0-0	0-29
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.

Fall Chinook salmon arriving at LGR Dam

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

Sex Ratio

The 2019 run reconstruction estimate consisted of 62.4% males+jacks. The sex ratio of the return was calculated at 1.7 males+jacks/female. After removal of fish for broodstock, fish passing LGR were 65.9% males+jacks, resulting in sex ratio of 1.9 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 was 61.0 cm with a mean of 58.6 cm. Median fork length for females was 76 cm with a mean of 74.6 cm.

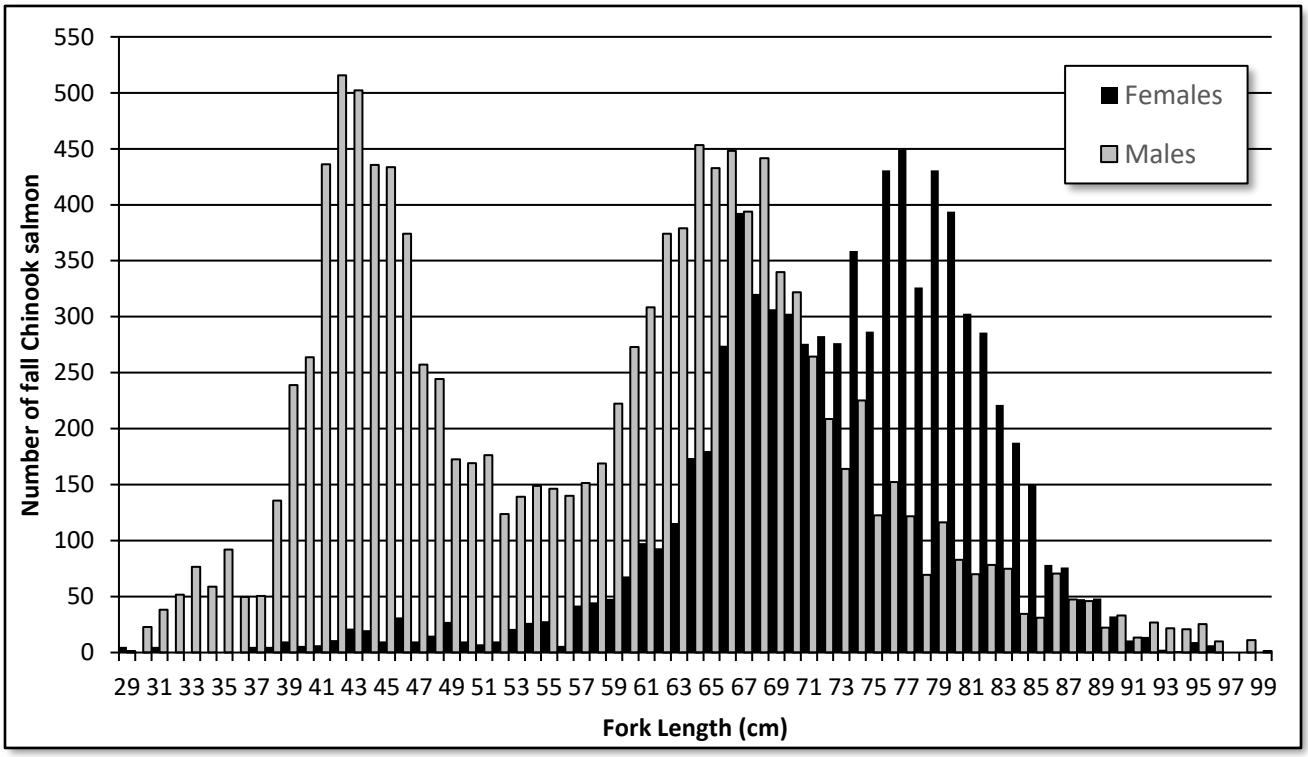

Figure 3. Estimated length frequencies of the fall Chinook salmon run to LGR by sex in 2019.

Trapping and Broodstock Management 2019

Lower Granite Dam Trapping Operations 2019

In 2019, fall Chinook trapping and hauling at LGR began 18 August. Four trapping rates were used during the season and a brief hiatus due to high water temperatures (18 Aug – 5 Sept = 70%, 6 Sept = 20%, 8:06 am on 6 Sept – 4:00 pm on 12 Sept = 0%, 12 Sept – 16 Sept = 100%, 17 Sept – 12 Nov = 20%). The arrival timing of males and females collected for broodstock at LGR and hauled to LFH is provided (**Error! Not a valid bookmark self-reference.**). Broodstock collection goals were met by early October, with most of the fish trapped after that time passed upstream for natural spawning. Trapping protocols and changes that occurred in 2019 are presented in **Error! Reference source not found.**. 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 6,758 salmon trapped at LGR, approximately 35.0% were hauled to LFH and 13.2% were hauled to NPT for the fall Chinook salmon broodstock program and run reconstruction needs.

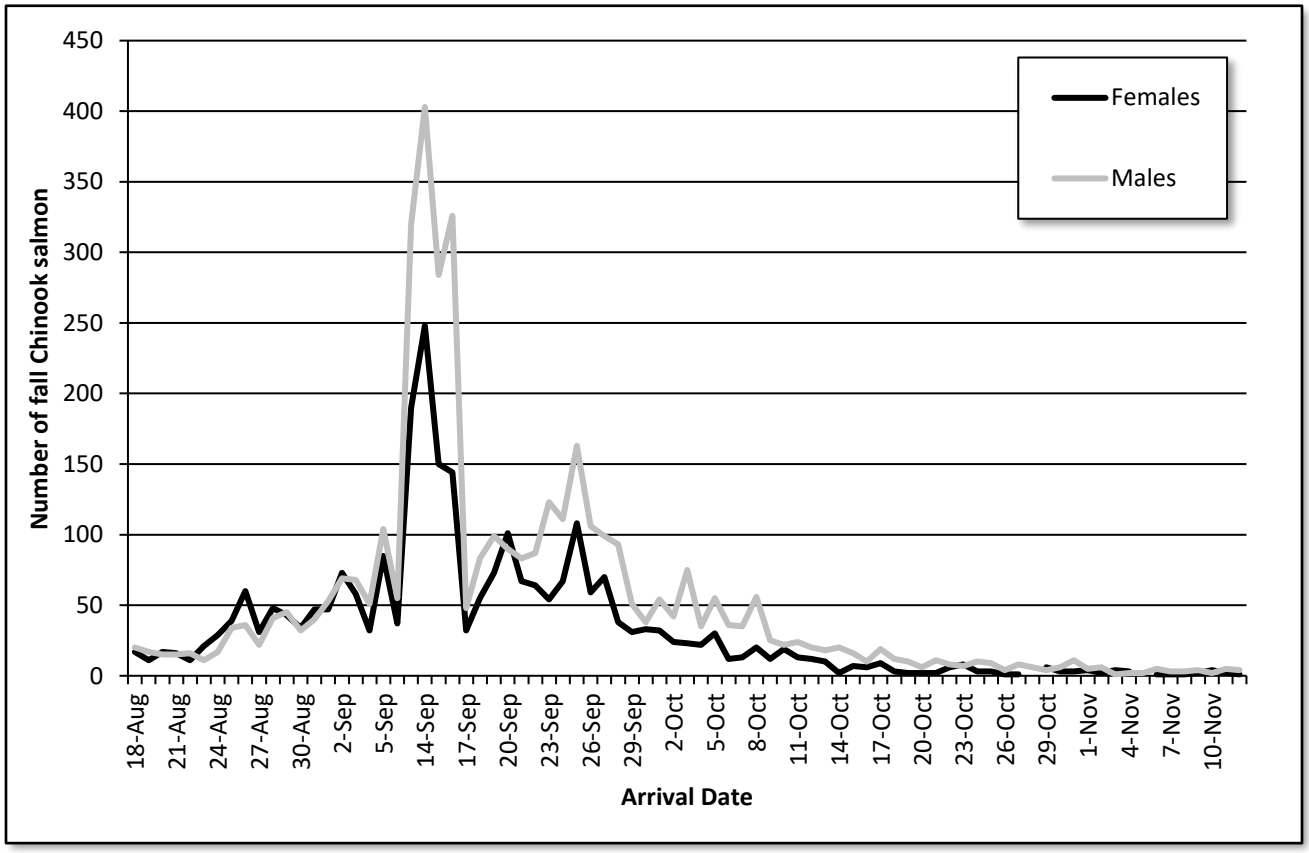

Figure 4. Arrival timing of fall Chinook at LGR that were trapped/hauled to LFH in 2019.

Broodstock Collection and Management 2019

In 2019, all fall Chinook salmon collected for broodstock were trapped at LGR. No fish were trapped at LFH in 2019. Each year there is a discrepancy between estimated numbers of fish collected/hauled to LFH and the numbers of fish processed/killed (Table 4. **Numbers of fall Chinook initially collected at LGR for broodstock, evaluation, and run construction needs in 2019.**). The discrepancies are likely data recording errors.

Table 4. Numbers of fall Chinook initially collected at LGR for broodstock, evaluation, and run construction needs in 2019.

Year	Trap location	Number collected/hauled for broodstock	Spawned, killed, or dead in pond fish processed at LFH	Returned to the Snake River at LFH	Difference from number collected/hauled
2019	LGR	2,353	2,067	253	33

Hatchery Operations 2019

Spawning Operations

Spawning and Egg Take

Fish transported from LGR to the adult holding ponds at LFH had approximately 0.46:1 male:female sex ratio in the adults (70 cm or greater), and 1.6:1 male:female 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 recovery to use in the run reconstruction. Size criteria for mating males was set at 70 cm to reduce the number of 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 and peak of spawning (Figure 5), eggtake, and percent egg mortality (

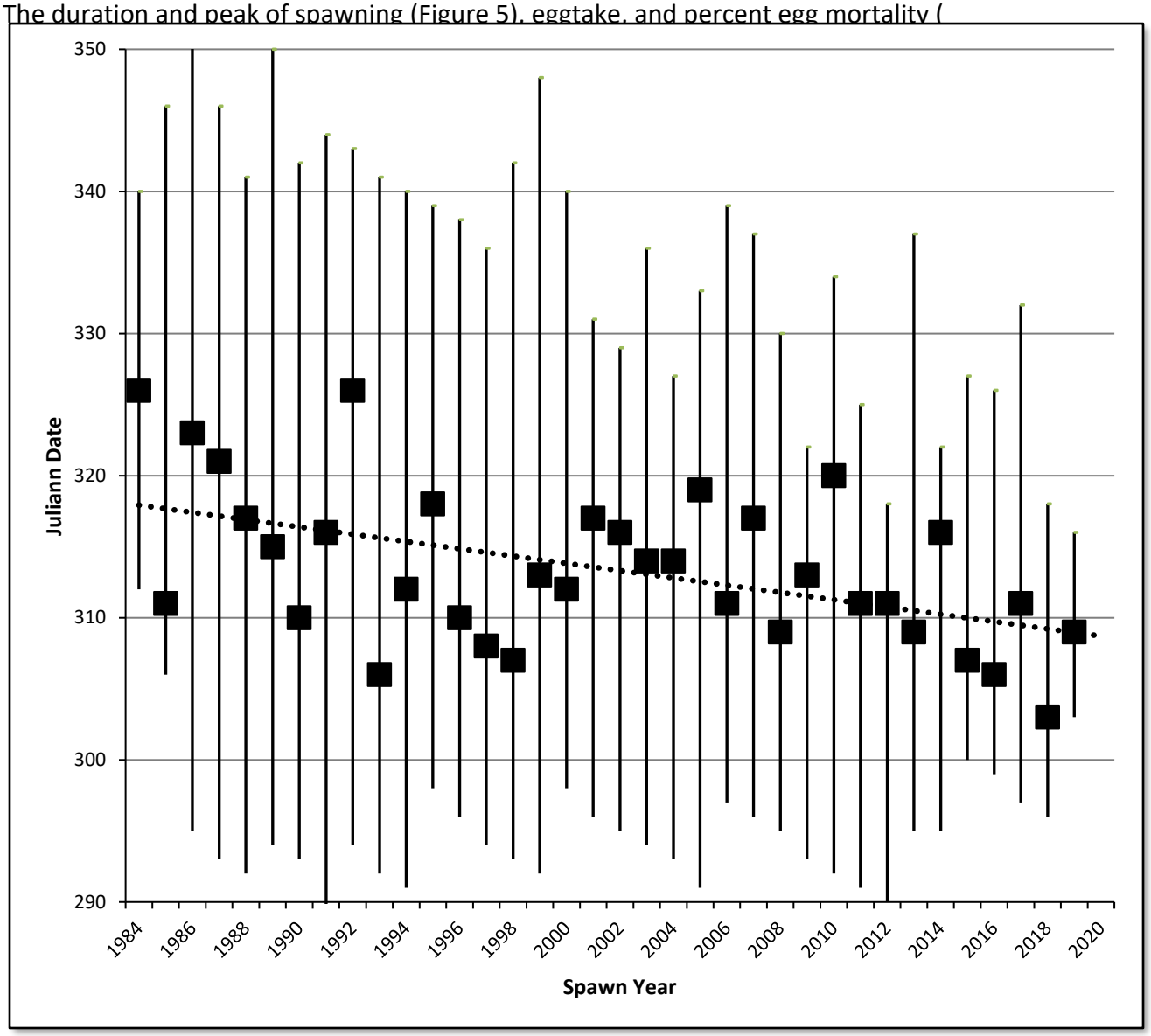

Figure 5. Start, end, and peak spawn days for fall Chinook salmon spawning at LFH, 1984-2019.

Table 5. Egg take and percent egg mortality at LFH, 1984-2019.), numbers of fish spawned (

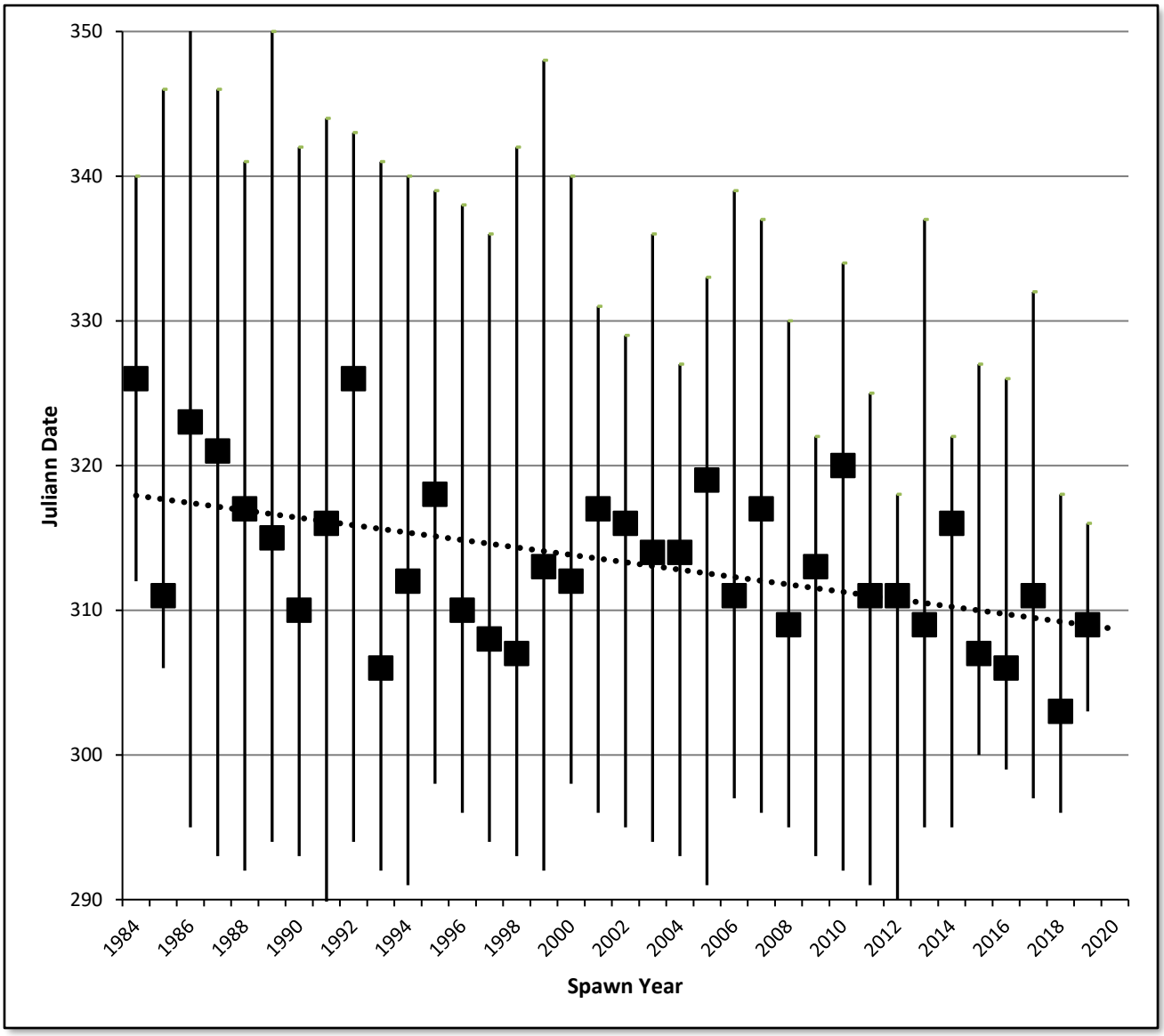

Figure 5. Start, end, and peak spawn days for fall Chinook salmon spawning at LFH, 1984-2019.

Table 5. Egg take and percent egg mortality at LFH, 1984-2019.

Spawn Year	Total eggtake	Egg mortality to eye-up (%) a	Spawn Year	Total eggtake	Egg mortality to eye-up (%) a
1984	1,567,823	21.6	2002	4,910,467	3.6
1985	1,414,342	4.0	2003	2,812,751	3.1
1986	592,061	4.0	2004	4,625,638	3.3
1987	5,957,976	3.8	2005	4,929,630	3.5
1988	2,926,748	3.4	2006	2,819,004	3.2

1989	3,518,107	5.8	2007	5,143,459	3.3
1990	3,512,571	8.3	2008	5,010,224	3.7
1991	2,994,676 b	8.3	2009	4,574,182	4.7
1992	2,265,557 b	6.0	2010	4,619,533	2.7
1993	2,181,879	6.7	2011	4,723,501	3.5
1994	1,532,404	5.1	2012	4,526,108	3.1
1995	1,461,500	5.6 d	2013	4,565,660	2.6
1996	1,698,309	4.6	2014	4,787,615	3.6
1997	1,451,823 c	5.2	2015	4,569,472	2.8
1998	2,521,135	5.1	2016	4,951,188	2.7
1999	4,668,267	9.4	2017	4,685,575	5.4
2000	5,143,459	5.9	2018	4,754,622	3.3
2001	4,734,234	6.4	2019	4,670,644	3.1

a Egg mortality includes eggs destroyed due to high ELISA values.

b An additional 9,000 eggs from stray females were given to Washington State University.

c 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.

d Total egg take includes eggs from one coho female crossed with a fall Chinook salmon.

Table 6. Spawn dates, numbers of fall Chinook salmon spawned, and weekly egg take at LFH in 2019. (Jacks are included with males).

	Males			Females			

), and the number killed outright or died in the pond are provided (

Spawn Dates	Hatchery Origin [ab]	Natural Origin	Unknown Origin	Hatchery Origin [ab]	Natural Origin	Unknown Origin	Egg Take
22 Oct	36	26	1	102	50		599,574
29 & 30 Oct	97	64		295	137	1	1,759,389
5 Nov	115	68		243 (1)	120		1,474,767
12 Nov	64	49		122	81		836,914
Totals	312	207	1	762	388	1	4,670,644

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

[b] Numbers include Presumed Snake R, Unknown Hatchery and Stray Hatchery by DNA.

). Peak spawn timing has shifted about 1-week earlier over time, and the duration of spawning has decreased. Many factors are likely responsible for this shift, some likely due to 1) trapping location (use of Ice Harbor, Lyons Ferry or Lower Granite or any combination of the three in any given year), 2) trapping earlier at Lower Granite since water temperature issues have mostly

been resolved, and 3) having more fish available for broodstock compared to earlier years where the program was often broodstock limited and every fish needed to be spawned.

Ten females (3 natural-origin and 7 presumed Snake River origin) were non-viable. 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 these unmarked/untagged fish. Composition of fish processed at LFH in 2019 is presented in Appendix C. In 2019, eggtake goals were attained for LFH as required by the production priorities table per the 2018-2027 US v. Oregon Management Agreement (Table 2).

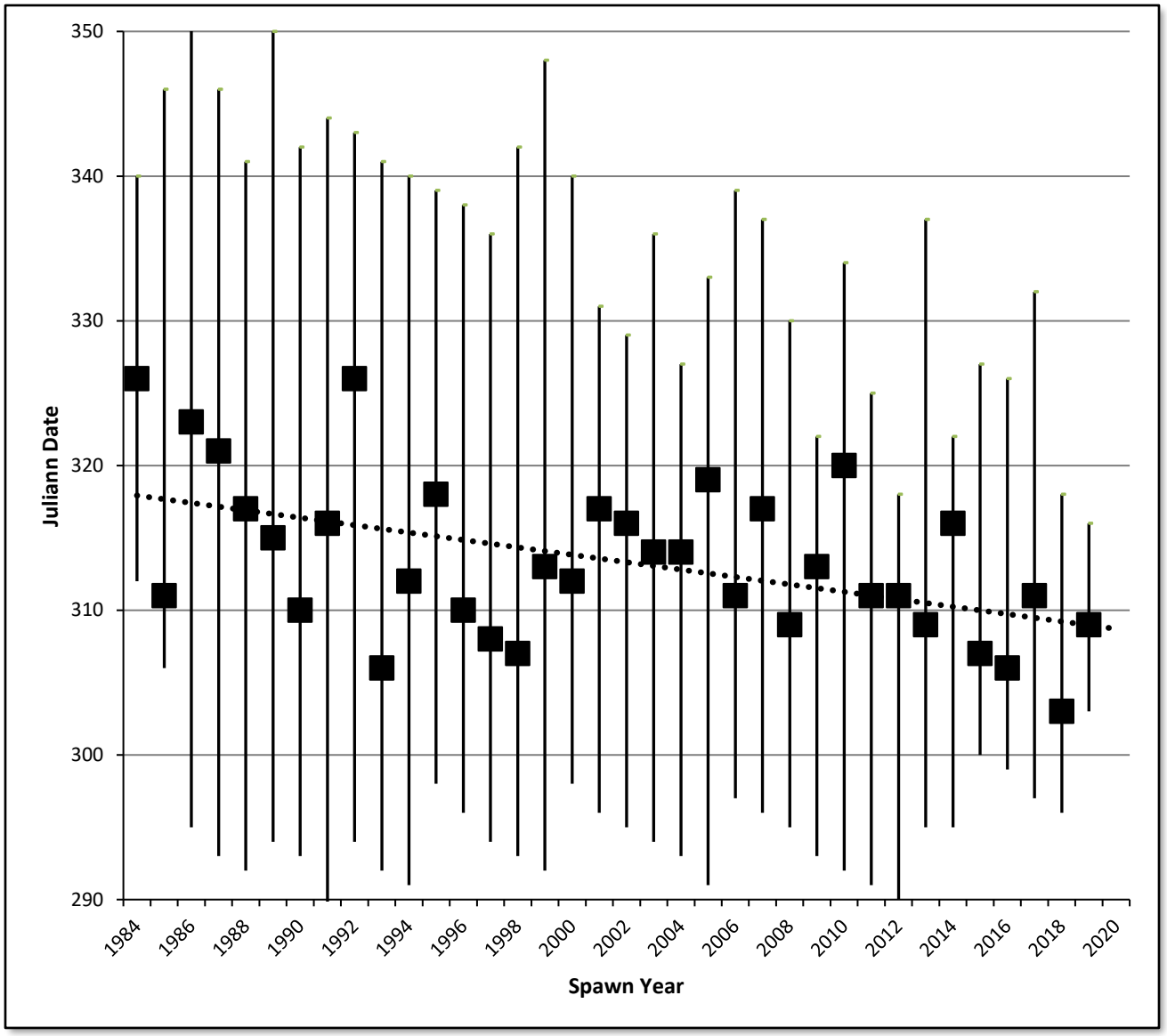

Figure 5. Start, end, and peak spawn days for fall Chinook salmon spawning at LFH, 1984-2019.

Table 5. Egg take and percent egg mortality at LFH, 1984-2019.

Spawn Year	Total eggtake	Egg mortality to eye-up (%) [a]	Spawn Year	Total eggtake	Egg mortality to eye-up (%) [a]
1984	1,567,823	21.6	2002	4,910,467	3.6
1985	1,414,342	4.0	2003	2,812,751	3.1
1986	592,061	4.0	2004	4,625,638	3.3
1987	5,957,976	3.8	2005	4,929,630	3.5
1988	2,926,748	3.4	2006	2,819,004	3.2
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1990	3,512,571	8.3	2008	5,010,224	3.7
1991	2,994,676 [b]	8.3	2009	4,574,182	4.7
1992	2,265,557 [b]	6.0	2010	4,619,533	2.7

1993	2,181,879	6.7	2011	4,723,501	3.5
1994	1,532,404	5.1	2012	4,526,108	3.1
1995	1,461,500	5.6 [d]	2013	4,565,660	2.6
1996	1,698,309	4.6	2014	4,787,615	3.6
1997	1,451,823 [c]	5.2	2015	4,569,472	2.8
1998	2,521,135	5.1	2016	4,951,188	2.7
1999	4,668,267	9.4	2017	4,685,575	5.4
2000	5,143,459	5.9	2018	4,754,622	3.3
2001	4,734,234	6.4	2019	4,670,644	3.1

[a] Egg mortality includes eggs destroyed due to high ELISA values.

[b] An additional 9,000 eggs from stray females were given to Washington State University.

[c] 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.

d Total egg take includes eggs from one coho female crossed with a fall Chinook salmon.

Table 6. Spawn dates, numbers of fall Chinook salmon spawned, and weekly egg take at LFH in 2019. (Jacks are included with males).

	Males			Females			
Spawn Dates	**Hatchery Origin [ab]**	**Natural Origin**	**Unknown Origin**	**Hatchery Origin [ab]**	**Natural Origin**	**Unknown Origin**	**Egg Take**
22 Oct	36	26	1	102	50		599,574
29 & 30 Oct	97	64		295	137	1	1,759,389
5 Nov	115	68		243 (1)	120		1,474,767
12 Nov	64	49		122	81		836,914
Totals	312	207	1	762	388	1	4,670,644

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

[b] Numbers include Presumed Snake R, Unknown Hatchery and Stray Hatchery by DNA.

Table 7. Weekly summary and origins of mortality and surplus fall Chinook processed at LFH in 2019.

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
24 Aug					2	1						
31 Aug					1	1						
7 Sept					1	1						
14 Sep					1	2						
21 Sep	1				2	1						
28 Sep	1	1	1		5							
5 Oct					1	1						
12 Oct	1				1							
19 Oct		3										
26 Oct	1						1	195			1	17
2 Nov	2				1		2	23			1	6
9 Nov	4		1				1	7	1			5
16 Nov	1		1			1	38	44			4	8
Totals	**11**	**4**	**3**	**0**	**15**	**8**	**42**	**269**	**1**	**0**	**6**	**36**

[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 scale, wire, DNA, 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 12 November (Table 8. **Estimated composition of fall Chinook salmon released into the Snake River near LFH at the end of the season in 2019.**). Fish were scanned for PIT tags, CWT and presence of an AD clip. 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 2019.

Origin	Release age	Origin estimation method	Females	Males+Jacks	Total
Hatchery	Unknown	Clip	28	22	50
Lyons Ferry Hatchery	Subyearling	PIT Tag	1	-	1
Unknown	Unknown		93	109	202
Totals			122	131	253

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 2019, a total of 1,580 females and 784 males were spawned at both LFH and NPTH. Of the 784 males spawned, 563 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 (N_{em}) at both hatcheries. The estimate of N_{em} at both hatcheries combined in 2019 was 666.

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

$N_e = (4 \times (N_{em} \times \text{number of spawned females}))/(N_{em} + \text{number of spawned females})$

$$1874 = (4 \times (666 \times 1580)) / (666 + 1580)$$

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 66). The general decline in the estimated hatchery effective population size observed since 2011 can be attributed to the multiple use of larger/older males in broodstock at both facilities, with less emphasis on spawning younger and smaller males (at a 1:1 spawning ratio) which was a common practice prior to 2011.

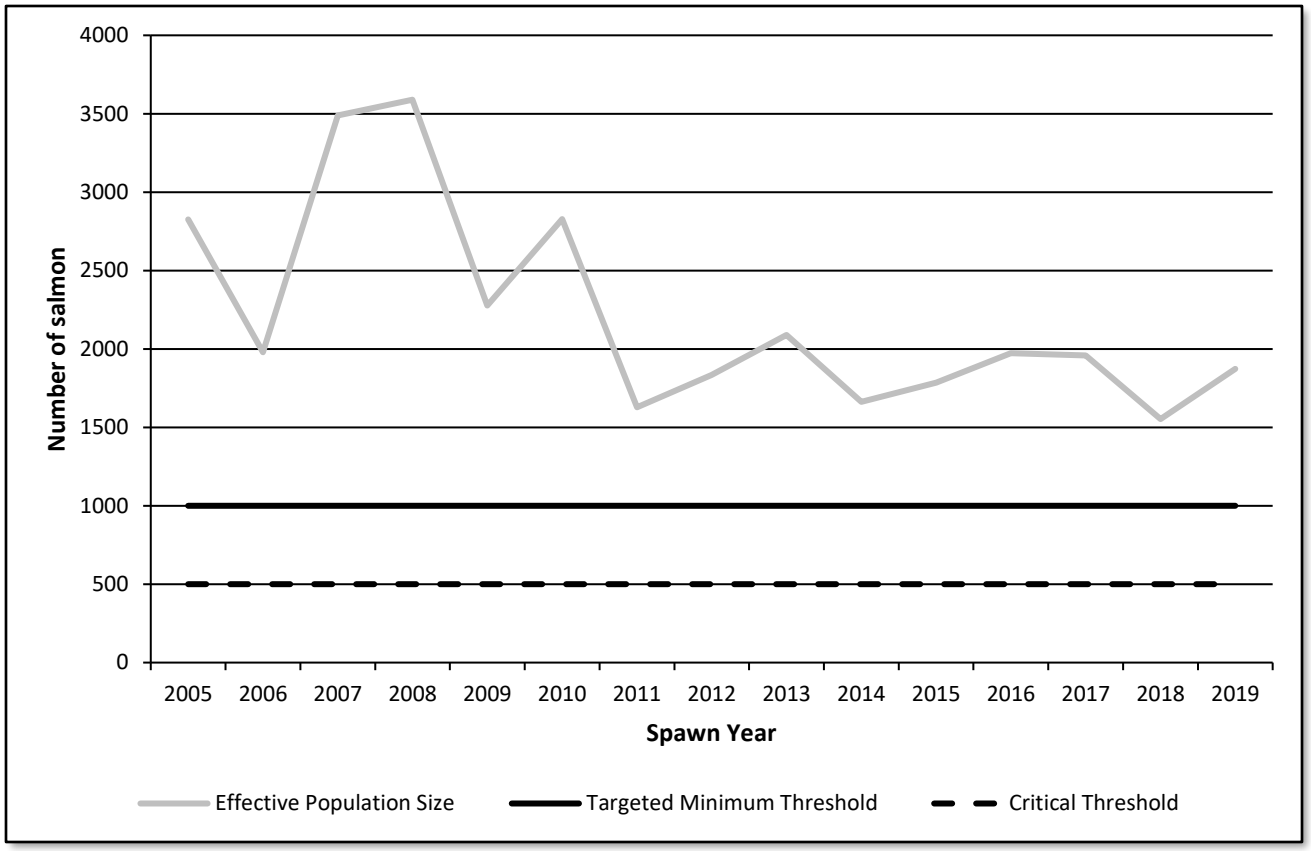

Figure 6. Estimated effective population size of the Snake River fall Chinook salmon spawned from both LFH and NPTH.

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. This was the fourth year PBT results, in conjunction with CWT and PIT tag recoveries were used to determine origin of the broodstock (Figure 7). 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 a sub-sample of unmarked/untagged fish (spawned and unspawned) by staff from the University of Idaho. This was done to determine where natural origin fall Chinook salmon are rearing in the Snake River basin based on strontium levels (Hegg 2013).

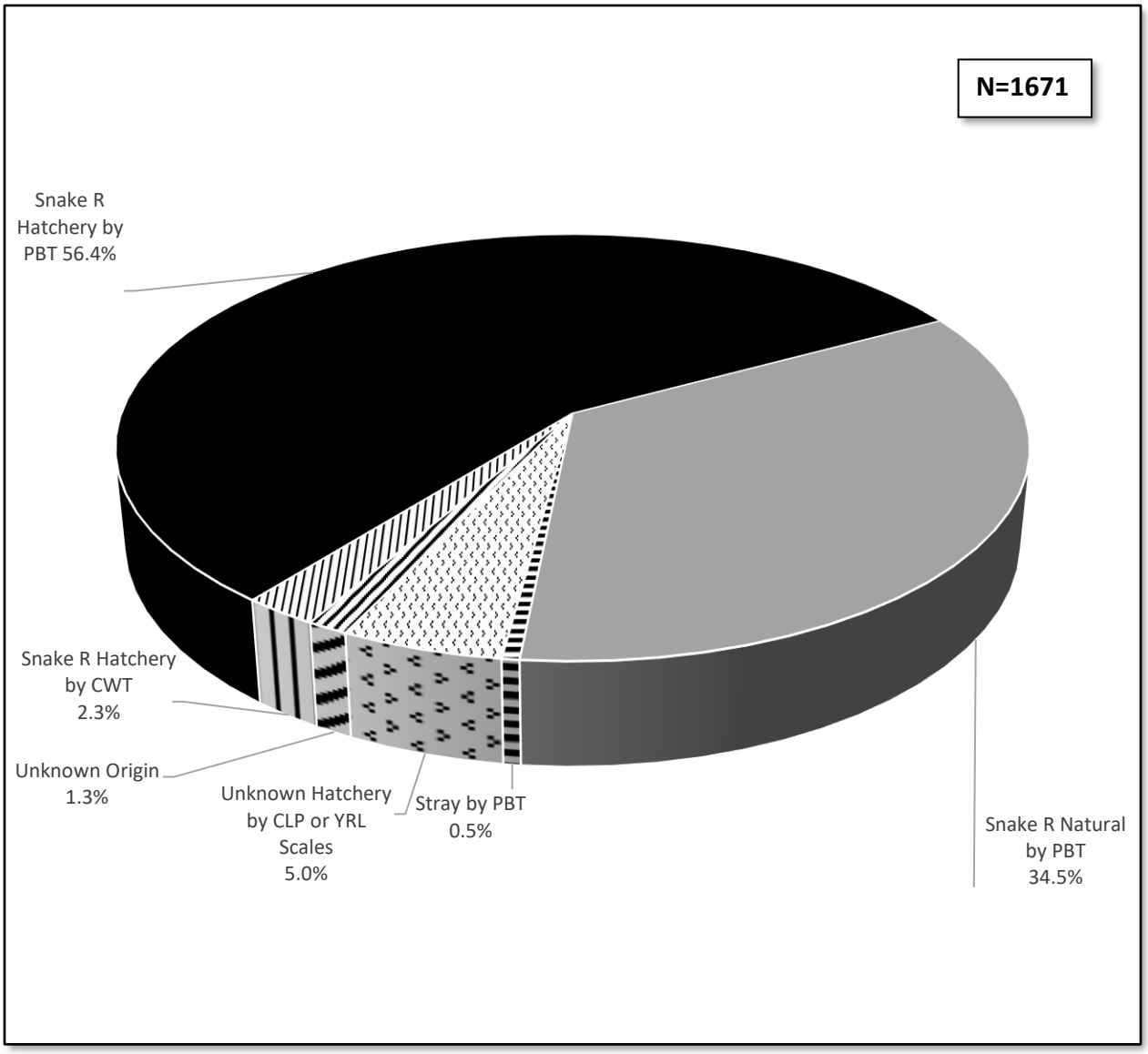

Figure 7. Percentages by fish origin with PBT results contributing to fall Chinook salmon broodstock at LFH during 2019.

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 (**Error! Reference source not found.**Length frequencies of fall Chinook salmon used for broodstock at LFH in 2019 are presented in **Error! Reference source not found.**9. Males used multiple times are captured in this figure. Unknown origin can include both hatchery and natural origin fish. Median length was 78 cm for females and 78 cm for males. An estimated 11.5% of the males and 16.4% of the females were returns from yearling releases.

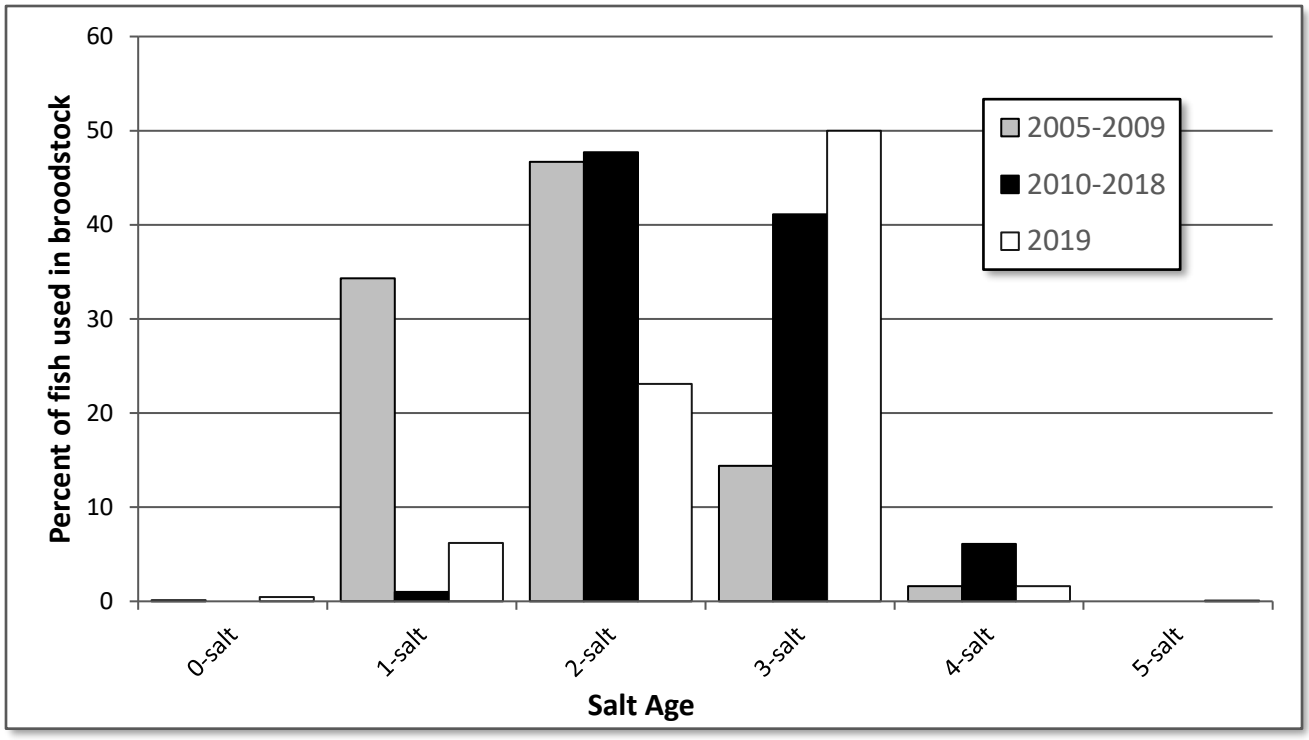

Figure 8. Percentages of salt ages of Snake River fall Chinook salmon spawned from both LFH and NPTH.

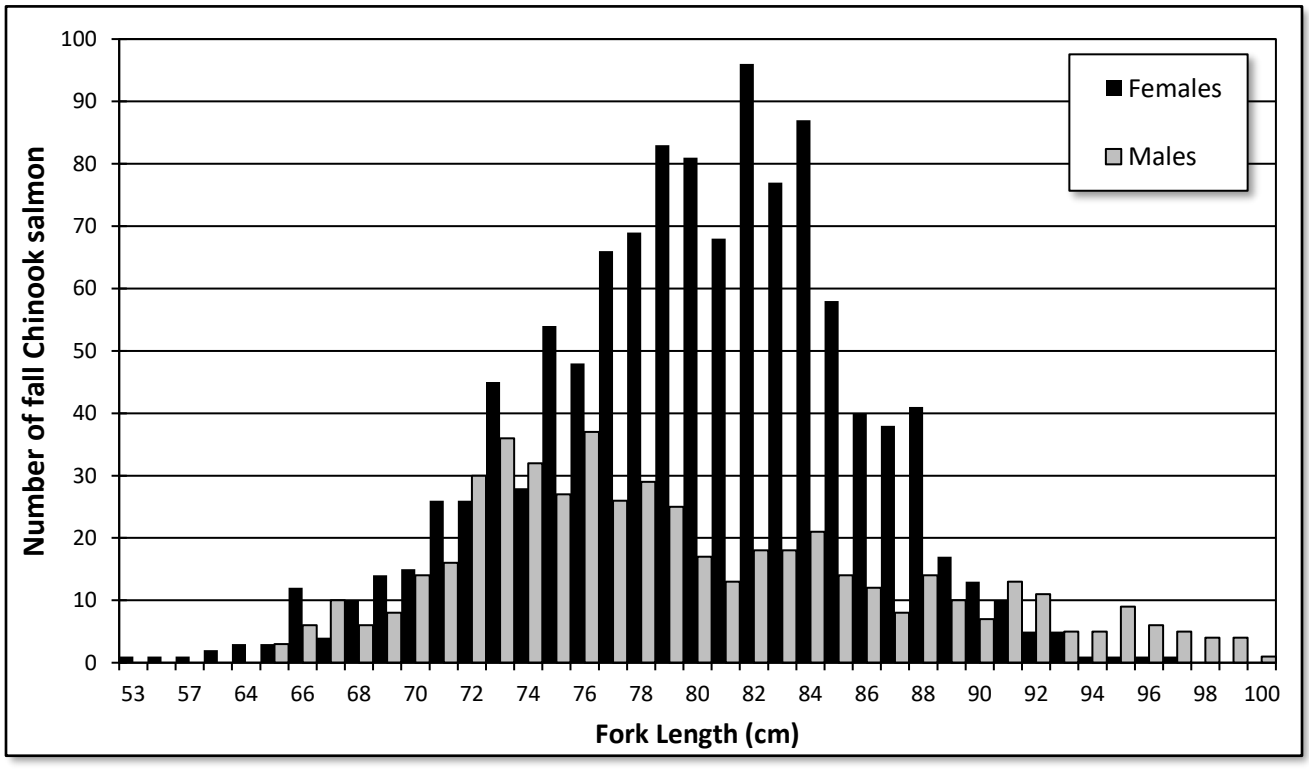

Figure 9. Fork lengths of fall Chinook salmon spawned as broodstock at LFH in 2019.

Males Used in Broodstock

Origin, including release type information, was determined for 2.1% of the males spawned based on CWT or PIT tag data. Based on PBT 53% of the males were identified as Snake River hatchery origin, 38.2% were identified as Snake River natural origin, and 1% were identified as stray origin. An additional 3.9% of the males were identified as unknown hatchery origin based on AD clip, lost/unreadable CWT tags, or yearling scale patterns. Another 1.9% were identified as unknown origin due to individuals failing to genotype, intact adipose and no CWT present. Of the total number of males spawned, 73.3% were from subyearlings, 11.5% were from yearlings, with the remaining 15.2% from unknown rear type. The goal was not to exceed three or four females per male; there was one instance where a male used 6 times (Table 9. Origin and age of males that contributed to production at LFH, 2019.

Table 9. Origin and age of males that contributed to production at LFH, 2019.

	Times males used in spawning							
Origin determination method / age	**1**	**2**	**3**	**4**	**5**	**6**	**Total unique**	**% of Males Used**
Snake R Hatchery by CWT, PIT							**11**	**2.1%**
subyearling 2 salt (age3)		2	2				**4**	
subyearling 3 salt (age4)		2	1				**3**	
yearling 2 salt (age4)	2		1				**3**	
yearling 3 salt (age5)		1					**1**	
Snake R Hatchery by PBT							**275**	**53.0%**
subyearling 2 salt (age3)	9	63	18				**90**	
subyearling 3 salt (age4)	5	78	33	4			**120**	
subyearling 4 salt (age5)			1				**1**	
yearling 2 salt (age4)	1	16	7				**24**	
yearling 3 salt (age5)		9	3	1			**13**	
unknown age	2	11	13	1			**27**	
Undetermined Hatchery by clip, lost/unreadable wire or yearling scales							**20**	**3.9%**
subyearling 3 salt (age4)			1				**1**	
yearling 2 salt (age4)	1	12	3				**16**	
yearling 3 salt (age5)		2	1				**3**	
Stray by PBT							**5**	**1.0%**
subyearling 3 salt (age4)	2	2					4	
unknown age			1				**1**	
Snake R Natural by PBT							**198**	**38.2%**
subyearling 2 salt (age3)	4	13	10				**27**	
subyearling 3 salt (age4)	12	84	20	2			**118**	
subyearling 4 salt (age5)	1	1	1				**3**	
unknown age	1	29	17	2		1	**50**	
Unknown Origin							**10**	**1.9%**
subyearling 2 salt (age3)		2					**2**	
subyearling 3 salt (age4)	1	4	2				**7**	
unknown age or rear			1				**1**	

Total unique males	**41**	**331**	**136**	**10**	**1**	**519**	

Females Used in Broodstock

Origin, including release type information, was determined for 20.5% the females spawned based on CWT or PIT tag data. Based on PBT 60.3% of the females were identified as Snake River hatchery origin, 0.35% were identified as stray origin (Table 10). An additional 5.5% of the females were identified as unknown hatchery origin based on AD clip, lost/unreadable CWT tags, or yearling scale patterns. Another 0.96% were identified as unknown origin due to individuals failing to genotype, intact adipose and no CWT present. Of the total number of females spawned, 78.9% were from subyearlings, 16.4% were from yearlings, with the remaining 4.7% from unknown rear type.

Table 10. Origins and age of females that contributed to production at LFH, 2019.

Origin determination method	Age	Number of females	% of females used
Snake River hatchery		**694**	**60.3%**
Snake R hatchery by CWT or PIT	subyearling 2 salt (age3)	**8**	
	subyearling 3 salt (age4)	**17**	
	yearling 2 salt (age4)	**2**	
Snake R hatchery by PBT	subyearling 2 salt (age3)	**102**	
	subyearling 3 salt (age4)	**408**	
	subyearling 4 salt (age5)	**11**	
	subyearling 5 salt (age6)	**1**	
	yearling 1 salt (age3)	**1**	
	yearling 2 salt (age4)	**66**	
	yearling 3 salt (age5)	**59**	
	Unknown age	**19**	
Undetermined hatchery		**67**	**5.8%**
Stray Hatchery by PBT	subyearling 3 salt (age 4)	**2**	
	yearling 3 salt (age 5)	**2**	
Unknown Hatchery by CLP or Scales	subyearling 3 salt (age4)	**5**	
	yearling 2 salt (age4)	**41**	
	yearling 3 salt (age5)	**16**	
	Unknown age	**1**	
Snake River natural		**379**	**32.9%**
Snake River Natural by PBT	subyearling 2 salt (age3)	**4**	
	subyearling 3 salt (age4)	**320**	
	subyearling 4 salt (age5)	**20**	
	yearling 2 salt (age4)	**2**	
	unknown age	**33**	
Unknown Origin		**11**	**0.96%**
Unknown	subyearling 3 salt (age4)	**10**	
	unknown age	**1**	
Total		**1,151**	

Fecundity

Beginning in 2016, we started an evaluation to determine if fecundity differed by origin (Milks et al 2018). Hatchery spring Chinook from the Tucannon River have significantly lower fecundity compared to natural origin adults at the same age and length (Gallinat 2020). Since we can determine the origin of all unmarked/untagged females by PBT, it seemed prudent to determine if the same relationship existed in the fall Chinook program.

In 2019, individual fecundity was counted on a subsample of broodstock and 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%.

Based on the PBT identification, fecundity relationships were evaluated for three groups: hatchery yearling, hatchery subyearling, and natural-origin subyearling (**Error! Reference source not found.**0). Generally, fork lengths reliably predict fecundities in all groups but were highly variable (1,667-6,140 eggs/fish). Of the sampled hatchery yearlings, mean fork length and fecundity was 76.7 cm and 3,202 eggs/female (N=19). Subyearlings (hatchery and natural origin) averaged 79.3 cm and 3,901 eggs/female (N=110), and 82.3 cm and 4,140 eggs/female (N=87), respectively.

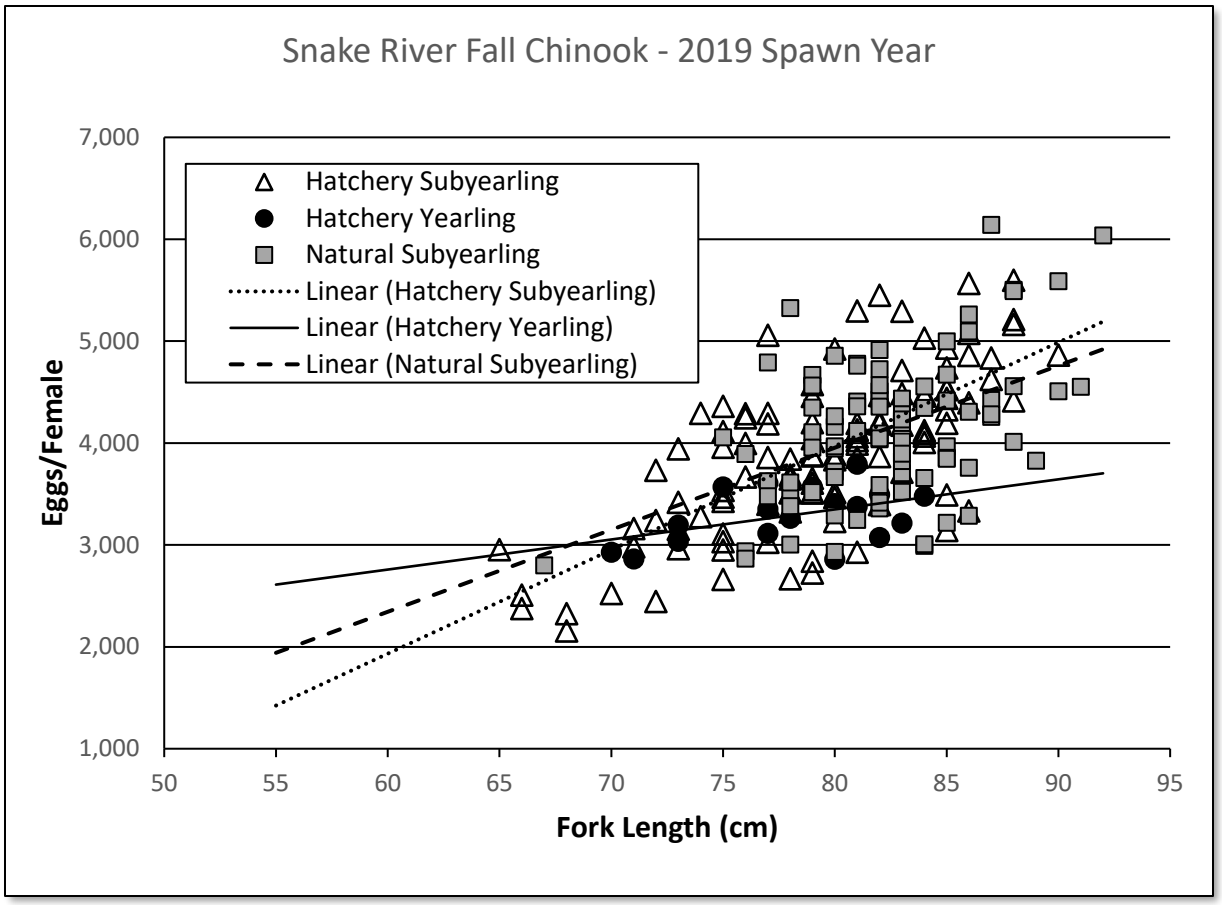

Figure 10. Fall Chinook salmon fork length to fecundity relationships in 2019.

Inclusion of Natural Origin Fish

Unmarked/untagged fall Chinook salmon were incorporated into the broodstock beginning in 2002 (Figure 11). To estimate pNOB, a dataset was constructed to reflect all parents that had the potential to contribute to production, broken into size categories by mark/clip, and used estimated at LGR from the run reconstruction method to estimated natural origin fish in the broodstock. Since 2016, a separate estimate of pNOB based on the fish spawned, including males that may have been used more than once. The pNOB estimates from the hatchery spawning have generally been higher than what is predicted from the run reconstruction due to the multiple use of males, especially since we target the multiple use of unmarked/untagged (more likely to be natural origin) males, which would in theory increase pNOB. In 2019, the estimated pNOB in the WDFW broodstock was 38.0% (Figure 1111). The overall spawned hatchery pNOB for LFH and NPTH combined was 40.0% and was identical to that predicted pNOB by the run reconstruction method.

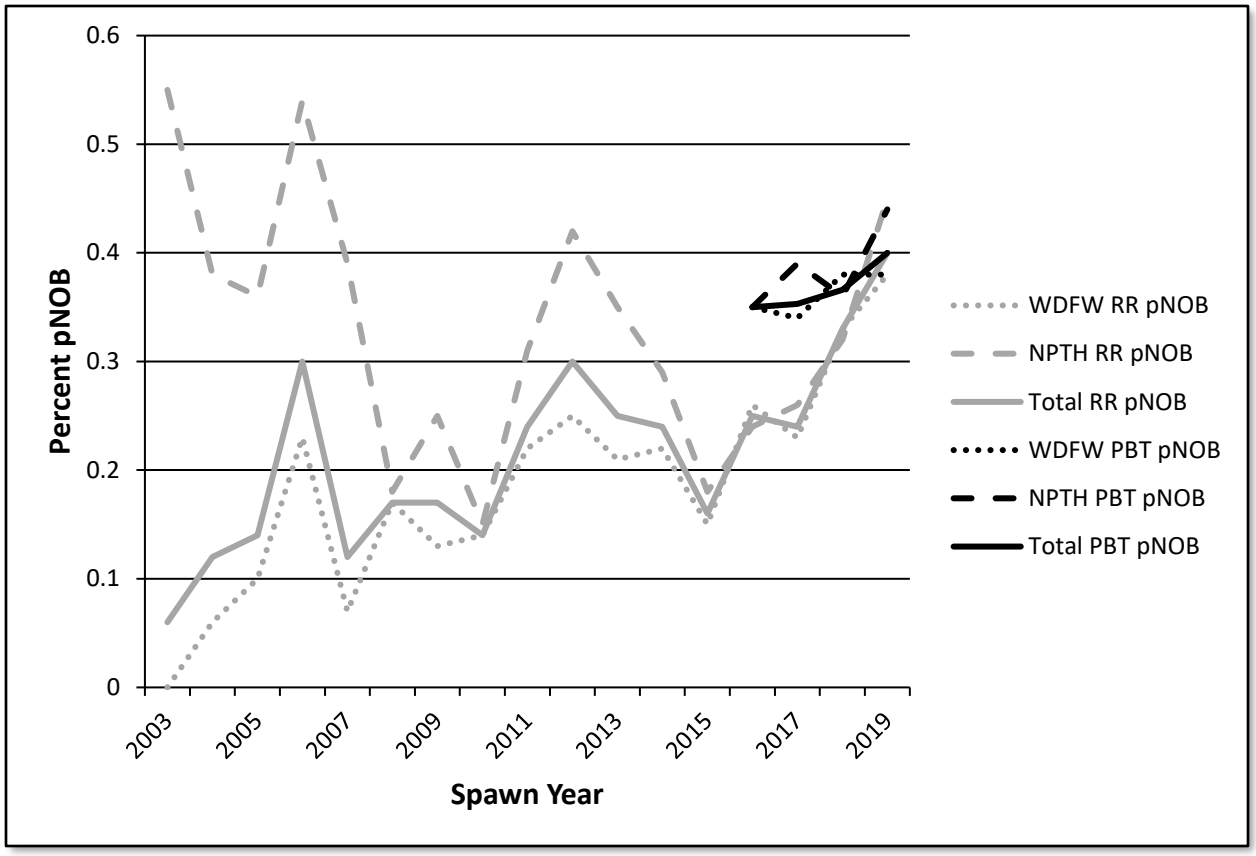

Figure 11. Estimated percent natural origin parents in in the broodstock (pNOB) at LFH, NPTH, and overall for Snake River basin hatchery production combined, based on the run reconstruction estimated or by PBT results from spawned fish at the hatchery, 2003-2019. The pNOB target for the program is 30%.

Jacks and Jills and Stray Fall Chinook Salmon in Broodstock

As described above, WDFW has implemented a size selective collection and mating protocol, 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 has the potential to overestimate saltwater ages for subyearlings since reservoir rearing is not taken into consideration. Untagged fish are scale sampled and reservoir rearing is used to estimate the correct 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 98.2% within the last eight years (Appendix D: Historical Use of Minijacks, Jacks, Jills and Strays in Broodstock at LFH).

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: Historical Use of Minijacks, Jacks, Jills and Strays in Broodstock at LFH. Males used multiple times are included multiple times in Appendix D.

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 Marking and tagging of fish was consistent with the 2018- 2027 *US v. Oregon* Management Agreement. LFH yearling (BY18) fish were 100% ADCWT marked/tagged from 9-24 July. Staff performed tag and fin clip quality control checks from a sample during the release from the rearing lake just prior to PIT tagging (Table 12).

A portion of the subyearling (BY19) were ADCWT marked/tagged 24-27 March. All subyearlings (marked/tagged and unmarked/untagged) were diverted to the rearing lake once the yearlings were released. Due to where the fish were being reared and marked/tagged, it was not possible tag and fin clip control checks after all tagging was complete. Instead, we had to use the initial loss as sampled by the tagging crews for this release in 2020.

GRR (BY19) fish were ADCWT marked/tagged on 18-22 March. Fish were kept in raceways prior to being trucked to their release site on the Grande Ronde River near Cougar Creek.

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.

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GRR (BY19) fish were ADCWT marked/tagged on 18-22 March. Fish were kept in raceways prior to being trucked to their release site on the Grande Ronde River near Cougar Creek.

Table 11. Eggs taken and survival numbers by life stage of fall Chinook salmon spawned at LFH, brood years 2014-2019.

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
2019	4,687,449	143,141	23,489	1,332,784	3,171,230	614,284	Yearling
						2,704,713	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

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
2018								
Yearling	LFH	ADCWT	637603	599	589 (98.33%)	10 (1.67%)	0 (0.00%)	0 (0.00%)
2019								
Subyearling	LFH	ADCWT	637758	1047	515 (96.80%)	2 (0.19%)	2 (0.19%)	2 (0.19%)
Subyearling	GRR	ADCWT	637759	559	8 (98.57%)	0 (0.00%)	0 (0.00%)	0 (0.00%)

In Hatchery 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, 2013-2018 yearling brood years and 2014-2019 subyearling brood years.

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	Yearling	95.3	91.9	86.7
	Subyearling	94.4	98.9	93.3
2019	Subyearling	94.7	100.1	94.8
Yearling mean:	**%**	**94.9**	**94.4**	**89.3**
	SD	**1.7**	**4.4**	**4.3**
Subyearling mean:	**%**	**94.3**	**98.0**	**92.9**
	SD	**1.1**	**2.3**	**2.1**

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

Juvenile Releases

Yearling fall Chinook salmon were released at LFH from 16-17 March 2020 (Table 14). At the time of release, fish (~200) were measured and weighed. Per NOAA Permitting, staff also look for and record any signs of sexual precocity; none were observed. Staff also looked for, but didn't visually observe any signs of BKD, pop-eye, or descaling in this group. An estimated total of 438,314 yearling fall Chinook were released, with approximately 430,997 that were ADCWT marked/tagged, and 7,317 were adipose only and had no CWT. Size at release was estimated at 11.1 fish/lb (fpp). Releases in 2020 were again earlier than in previous years, and well before any increasing hydrograph. Historical yearling and subyearling releases from 2010 to 2019 by WDFW, IPC and NPT can be found at https://www.fws.gov/lsnakecomplan/Reports/WDFWreports2.html. All WDFW fall Chinook releases from 2020 are provided in Appendix F.

Subyearling fall Chinook salmon at LFH were released 11 and 12 May 2020. On the first day of release, a subsample of fish were measured and weighed (Table 14). Per NOAA Permitting, staff also look for and record any signs of sexual precocity; none were observed. Staff also looked for, but didn't visually observe any signs of BKD, pop-eye, or descaling in this group. An

estimated total of 695,585 were released, with 200,017 as an ADCWT group, 384 CWT only, 384 adipose fin clip only, and 494,253 were released as unmarked untagged. Size at release was estimated at 55.2 fpp. The release occurred during an increasing hydrograph.

Subyearling fall Chinook salmon reared at Irrigon FH were released into the GRR on 27 May 2020. An estimated total of 225,585 were released, with 222,357 as an ADCWT group, and the remaining 3,228 were released as adipose fin clip only. A day prior to release, a subsample of fish were measured and weighed (Table 14). Per NOAA Permitting, staff also look for and record any signs of sexual precocity; none were observed. Staff also looked for, but didn't visually observe any signs of BKD, pop-eye, or descaling in this group. ODFW staff provided pound counts and the release size was calculated at 50.5 fpp, compared to 48.1 fish/lb (fpp) from what was calculated from individual length/weight sampling from SRL staff. The release occurred during an increasing hydrograph.

Table 14. Length and weight data from fall Chinook salmon released at LFH or in the GRR in 2020.

	Yearling	Subyearling	
Length/weight data	**Snake R at LFH**	**Snake R at LFH**	**GRR at Cougar Creek**
Sample date(s)	16-17 March	11-12 May	27 May
CWT code	637603	637758	637759
Number sampled	215	426	202
Avg. length (mm)	156	89	95
Median length	155	90	95
Range of lengths	96-190	74-109	80-109
SD of lengths	13.0	5.5	5.8
CV of length (%)	8.3	6.2	6.1
Avg. weight (g)	40.8	8.2	9.4
SD of weight	10.2	1.7	1.8
Avg. K factor	1.05	1.14	1.09
FPP	11.1	55.2	48.1
Precocious (%)	0.0%	0.0%	0.0%

PIT Tagging, Migration Timing, Travel Speed and Survival

Staff have routinely PIT tagged a subset of the on-station yearling and subyearling releases, and the GRR releases for the purpose of either monitoring outmigration timing, estimating adult returns in-season, and to apply a conversion rate between Ice Harbor and Lower Granite dams for purpose of back-calculating the run reconstruction estimates to the project area (see section below on returns to the project area). PIT tag lists for each release group are submitted

to PTAGIS and all 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 BY18 yearlings on 16 March and 20,000 BY19 subyearlings on 11 May. Tagged fish were held for one day in the release structure raceway following tagging, and then released directly to the Snake River. The raceway holding the fish overnight was covered with netting for protection, and then scanned for shed tags after the PIT tagged fish were released. Shed tags recovered were re-inserted into new fish and released that day. SRL and IPC staff PIT tagged 4,500 BY19 subyearlings in late April 2019 at Irrigon fish hatchery, along with 4,500 PIT tags for the IPC release in the Salmon River. The PTAGIS website (www.ptagis.org) was queried on 8 October 2020 for all three release groups. Interrogation summaries were used to populate Table 1515 and 16.

Table 15. Migration timing of PIT tagged fall Chinook released at LFH in 2020.

Yearlings released at LFH	Detection Facilities				
	LMO	**IHR**	**MCN**	**JDD**	**BONN [a]**
Number Detected	**574**	**389**	**576**	**445**	**446**
Median Travel Days from LFH [b]	18.0	28.7	31.4	38.74	42.4
Median Passage Date	4/1	4/12	4/14	4/22	4/25
First Detection Date	3/23	3/25	3/29	4/3	4/9
Last Detection Date	4/28	5/2	5/15	6/1	5/18
10% of Run Passage Date	3/25	3/30	4/8	4/15	4/19
90% of Run Passage Date	4/15	4/21	4/24	4/30	5/2
TDG on Median Date (%)[c]	122	114	116	115-117	117-120
Outflow on Median Date (kcfs)[c]	45	59	135	170	201
Spill on Median Date (kcfs)[c]	0	38	74	91	133
Subyearlings released at LFH	**Detection Facilities**				
	LMO	**ICH**	**MCN**	**JDD**	**BONN [a]**
Number Detected	**645**	**666**	**977**	**1105**	**1056**
Median Travel Days from LFH [b]	5.4	9.2	16.5	16.9	20.3
Median Passage Date	5/16	5/20	5/27	5/28	5/31
First Detection Date	5/12	5/14	5/15	5/18	5/20
Last Detection Date	7/1	6/23	7/1	9/11	7/5
10% of Run Passage Date	5/13	5/15	5/20	5/21	5/23
90% of Run Passage Date	5/30	6/1	6/11	6/10	6/11
TDG on Median Date of Passage (%)[c]	123	124	124	119-120	121-124
Outflow on Median Date of Passage (kcfs)[c]	97	120	311	339	371
Spill on Median Date of Passage (kcfs)[c]	67	90	217	149	148

[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 several years. In the following section we provide estimated survival and migration speed to the first dam of encounter (LGR or Lower Monumental), and the first and last dam of encounter on the Columbia River (McNary and Bonneville), respectively (Figures 12-17). Downstream survival estimates for all groups were derived using PitPro (Version 4.19.8).

Survival of GRR fish to LGR has averaged about 80% (Figure 13), though the last two years survival has been estimated in the 50-60% range. Migration speed has decreased in the last few years and probably explains a portion of the lower survival rates observed (Figure 14).

Table 16. Migration timing of PIT tagged fall Chinook released near Cougar Creek in the GRR in 2020.

	Detection Facilities						
Subyearlings released in the GRR	**LGR**	**LGO**	**LMO**	**IHR**	**MCN**	**JDD**	**BONN [a]**
Number Detected	**1536**	**244**	**73**	**53**	**153**	**142**	**149**
Median Travel Days from GRR [b]	30.8	27.1	33.0	36.0	27.2	32.5	37.1
Median Passage Date	6/27	6/23	6/29	7/2	6/23	6/28	7/3
First Detection Date	5/31	6/1	6/7	6/11	6/9	6/10	6/10
Last Detection Date	8/2	8/4	7/28	8/85	7/22	8/13	8/15
10% of Run Passage Date	6/6	6/8	6/17	6/18	6/17	6/16	6/18
90% of Run Passage Date	7/6	7/1	7/14	7/20	7/6	7/14	7/11
TDG on Median Date of Passage (%)[c]	120	116	119	115	120	116	120
Outflow on Median Date of Passage (kcfs)[c]	75	91	68	75	328	316	322
Spill on Median Date of Passage (kcfs)[c]	44	29	17	23	181	167	96

[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.

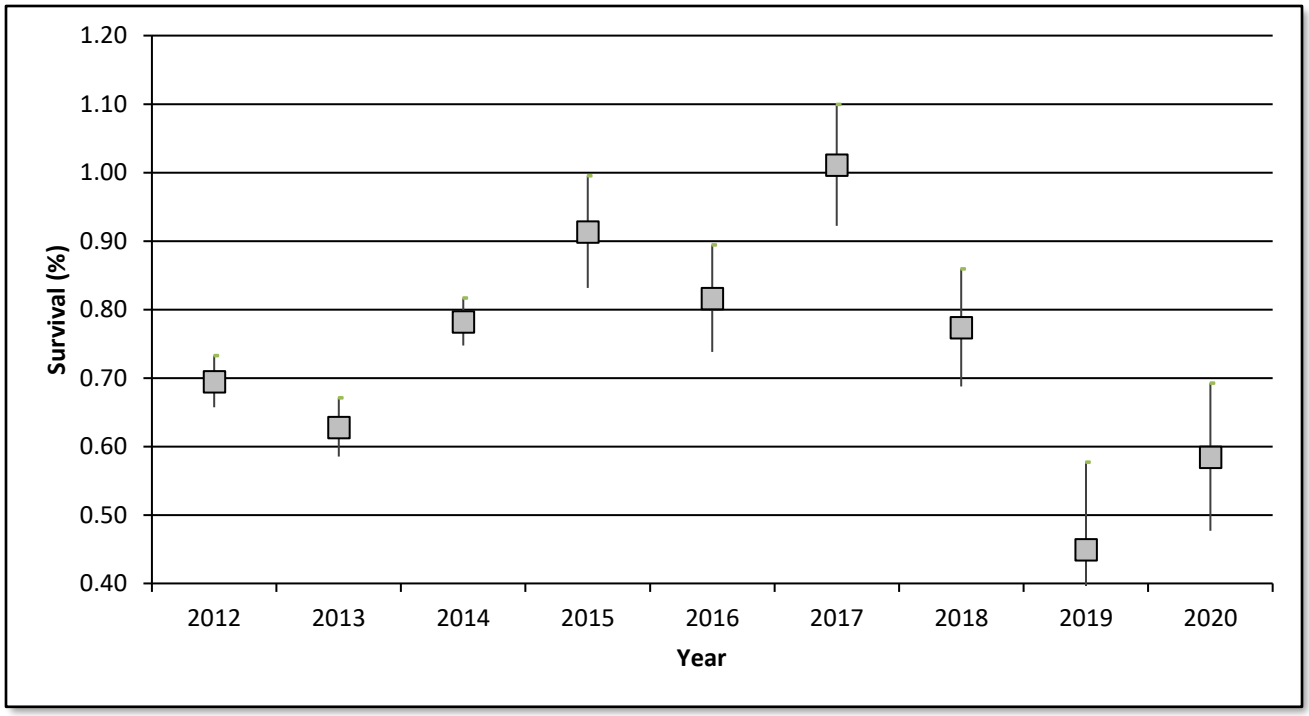

Figure 12. Survival and standard error of Snake River fall Chinook subyearlings released into the Grande Ronde River near Cougar Creek to Lower Granite Dam, 2012-2019 migration years.

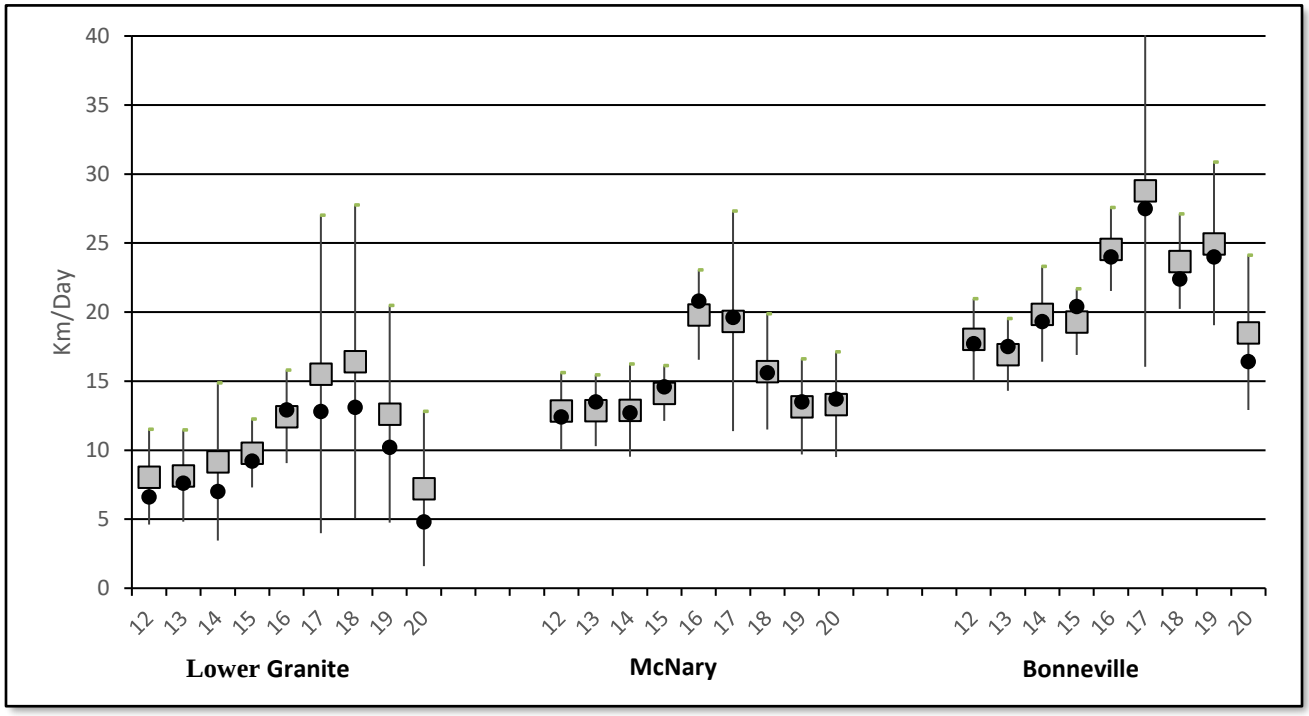

Figure 13. Average travel speed (Km/day with S.D.) and median travel speed (black dot) of Snake River fall Chinook subyearlings released into the Grande Ronde River near Cougar Creek to Lower Granite, McNary, and Bonneville Dams, 2012-2019 migration years.

Survival of the on-station subyearling release to Lower Monumental Dam has has slightly declined in recent years to 70% (Figure 15). Migration speed has also decreased in the last few years, and again likely explains the slightly lower survival to Lower Monumental Dam (Figure 15).

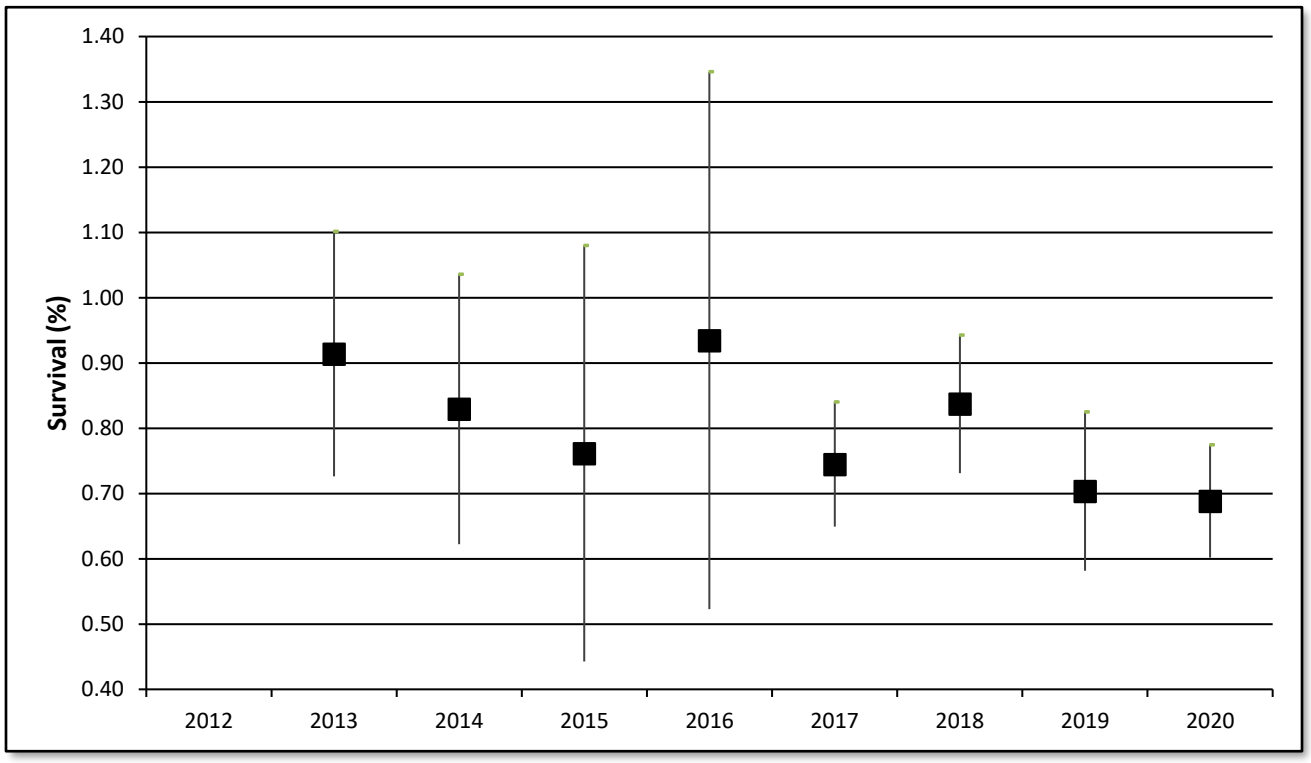

Figure 14. Survival and standard error of Snake River fall Chinook subyearlings released into the Snake River at Lyons Ferry Hatchery to Lower Monumental Dam, 2013-2019 migration years. Note: 2012 estimates were not valid.

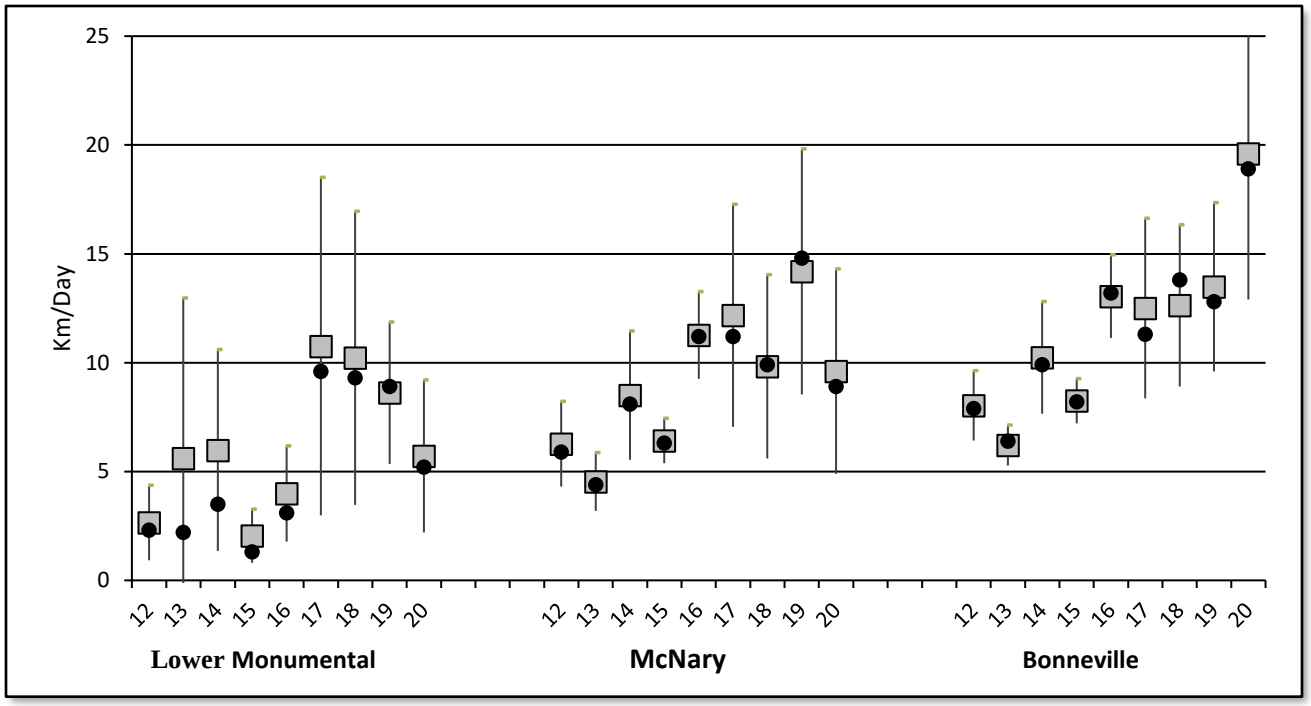

Figure 15. Average travel speed (km/day with S.E.) and median travel speed (black dot) of Snake River fall Chinook subyearlings released into the Snake River at Lyons Ferry Hatchery to Lower Monumental, McNary, and Bonneville Dams, 2012-2019 migration years.

Survival of the on-station yearling release to Lower Monumental Dam was generally around 90% until recently (Figure 17). Yearling migration speed had generally remained constant over the years except the last two migration years (Figure 18). Yearlings are released about 1.5 months earlier in the spring compared to the subyearling releases and flows and spill are usually lower than later spring months. Survival and travel speeds in both the 2019 and 2020 released yearlings were the lowest for the years reported and are likely as result of these fish being released in mid-March compared to their previous normal release time during the first or second week or April.

The reason the release data was moved up for this group of fish was a direct result to changes that were made to the fall Chinook program during the re-negotiation of the 2018-2027 US v Oregon agreement. With an increase to the subyearling on-station release (200K to 700K), staff could utilize the large rearing lake for the final 1.5-2 months of subyearling rearing – which we think will have great benefit to their post-release survival. To take advantage of that, it was decided to advance the release time of yearlings by about two weeks. While survival to Lower Monumental Dam has dropped off, it's unclear if this will lead to poorer adult returns in the future. If it appears to have negatively affected smolt-to-adult survival, a change of release timing may be necessary.

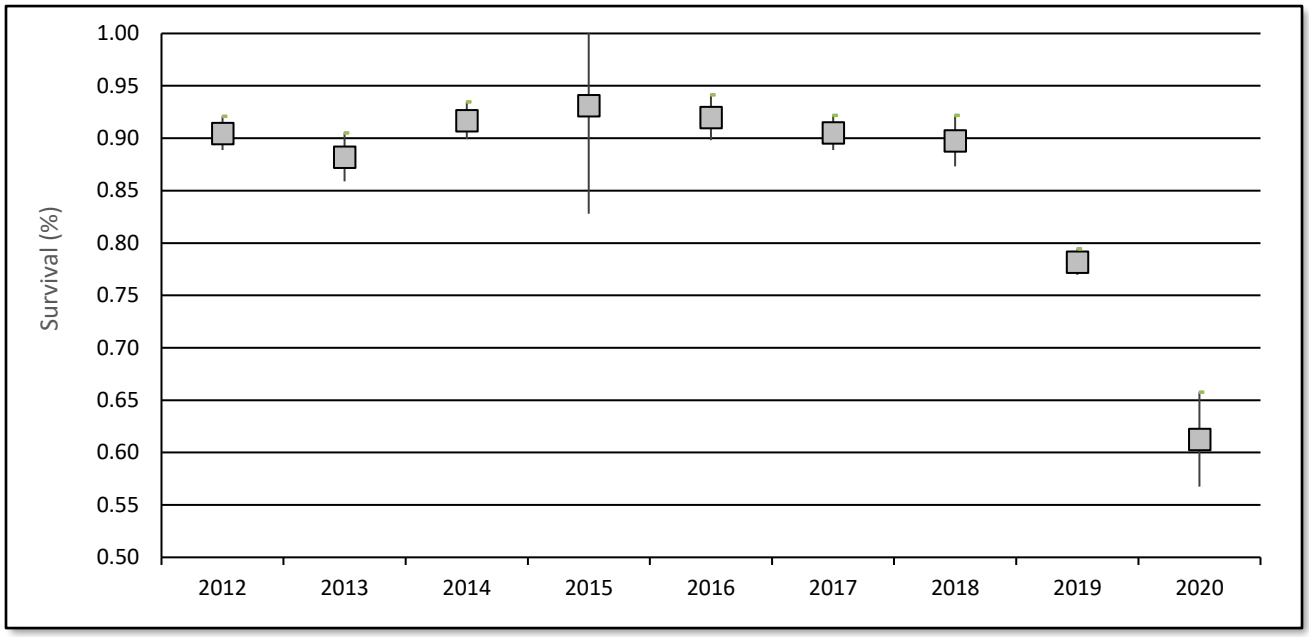

Figure 16. Survival and standard error of Snake River fall Chinook yearlings released into the Snake River at Lyons Ferry Hatchery to Lower Monumental Dam, 2012-2020 migration years.

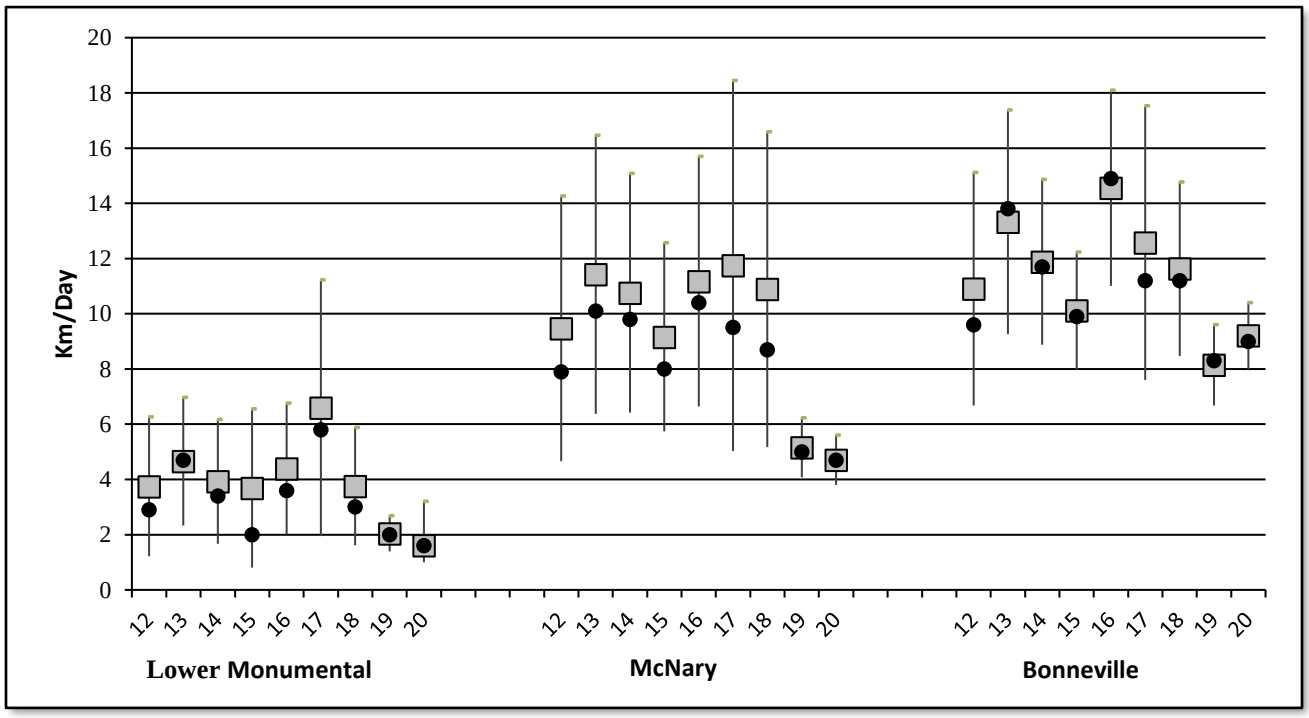

Figure 17. Average travel speed (km/day with S.E.) and median travel speed (black dot) of Snake River fall Chinook yearlings released into the Snake River at Lyons Ferry Hatchery to Lower Monumental, McNary, and Bonneville Dams, 2012-2020 migration years.

Tucannon River Natural Production 2019

Spawning Ground Surveys

WDFW personnel have conducted spawning ground surveys for fall Chinook salmon on the lower Tucannon River since 1985 (**Error! Reference source not found.**). Survey sections in 2019 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 Lower Monumental Dam reservoir and no surveys or estimates are made for that area. Because of the slow, deep flow in that area, spawning is considered minimal. During 2019, landowner access restrictions prevented the surveying of 1.5 rkms a little below and above the Starbuck Bridge within survey sections 5 and 6 (**Error! Reference source not found.**). Regular weekly surveys began the week of 20 October and continued until the week of 15 December.

A total of 167 redds (combination of fall Chinook and Coho) were counted in the surveyed areas Tucannon River (Table 177) and we estimate an additional 30 redds occurred in sections not surveyed. An estimated total of 197 total redds (160 fall Chinook salmon and 37 coho salmon redd)s were constructed in the Tucannon River during 2019.

Table 17. Date and number of salmon redds and carcasses counted on the Tucannon River in 2019.

Week beginning	Total redds [a] Chinook & Coho [b]	Carcasses sampled Chinook	Coho
Prespawn survey 20 Oct	0	0	0
27 Oct	0	0	1
3 Nov	12	1	4
10 Nov	46	4	4
17 Nov	75	9	5
24 Nov	20	13	1
1 Dec	13	17	9
8 Dec	0	11	0
15 Dec	1	10	1
Totals	**167**	**65**	**25**

[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 the Fall Chinook Salmon Run in the Tucannon River

The total escapement to the Tucannon River is based on an expansion factor of three fish/redd. We believe this expansion factor provides a conservative estimate of fish spawning. Based on the expansion factor we estimated 480 fall Chinook salmon spawned in the Tucannon River in

2019 (Table 188). Staff recovered 65 fall Chinook salmon carcasses (13.5%) of the estimated total spawning escapement. A total of 25 coho salmon carcasses were recovered in 2019. The run of fall Chinook salmon into the Tucannon is highly correlated with the overall fall Chinook run into the Snake River Basin (Figure 18).

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, 2001-2019.[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
2019	480	139	21	160	10	1,657

[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.

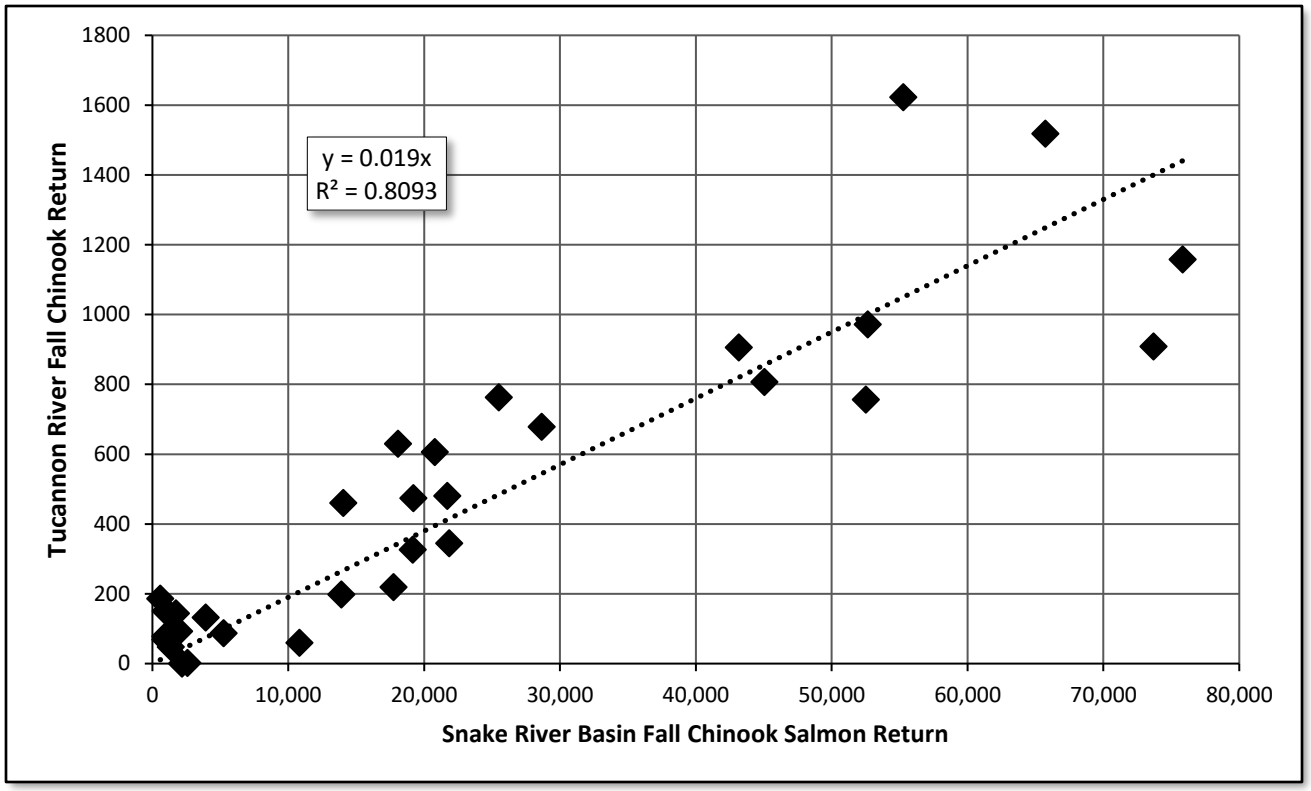

Figure 18. Relationship of the overall Snake River fall Chinook return compared to estimated returns to the Tucannon River.

Generally, more recoveries of females occur than males, primarily because females remain in the vicinity of their redds when they die. Females represented 60.3% of the recoveries in the Tucannon River; primarily 2-salt and 3-salt fish. Composition of the run consisted of 41.2% Snake River hatchery by wire, 5.0% out-of-basin by wire, 26.2% hatchery by AD clip or yearling scales and 27.5% unknown origin.

Juvenile Salmon Emigration

2020 Outmigration Year

Juvenile fall Chinook salmon (BY19) were captured at the Tucannon River smolt trap (rkm 3.0) from 26 February (newly emerged fry) through 26 June 2020 (Figure 1919). The last day of trapping was 09 July. No fall Chinook were PIT tagged at the trap during the 2020 outmigration year. From the middle of May to the end of June, the mean size of fall Chinook migrants were 115 mm and 22.2 g (K-factor 1.19). The estimated peak of out-migration was 12 June, with 160 migrants passing the trap. Trapping efficiency for fall Chinook salmon ranged from 11.1% to 25.6%. Staff captured only 283 (including 3 mortalities) fall Chinook salmon in 2020, with the limited production most likely from a 30-year flood event that occurred in early February.

Juvenile production of fall Chinook from the Tucannon River can be highly influenced by high stream flow events in the winter/early spring (Figure 20). Juvenile production can also be influenced by redd superimposition during large run years (mostly observed in lower river below the town of Starbuck) and sediment input from Pataha Creek in some years.

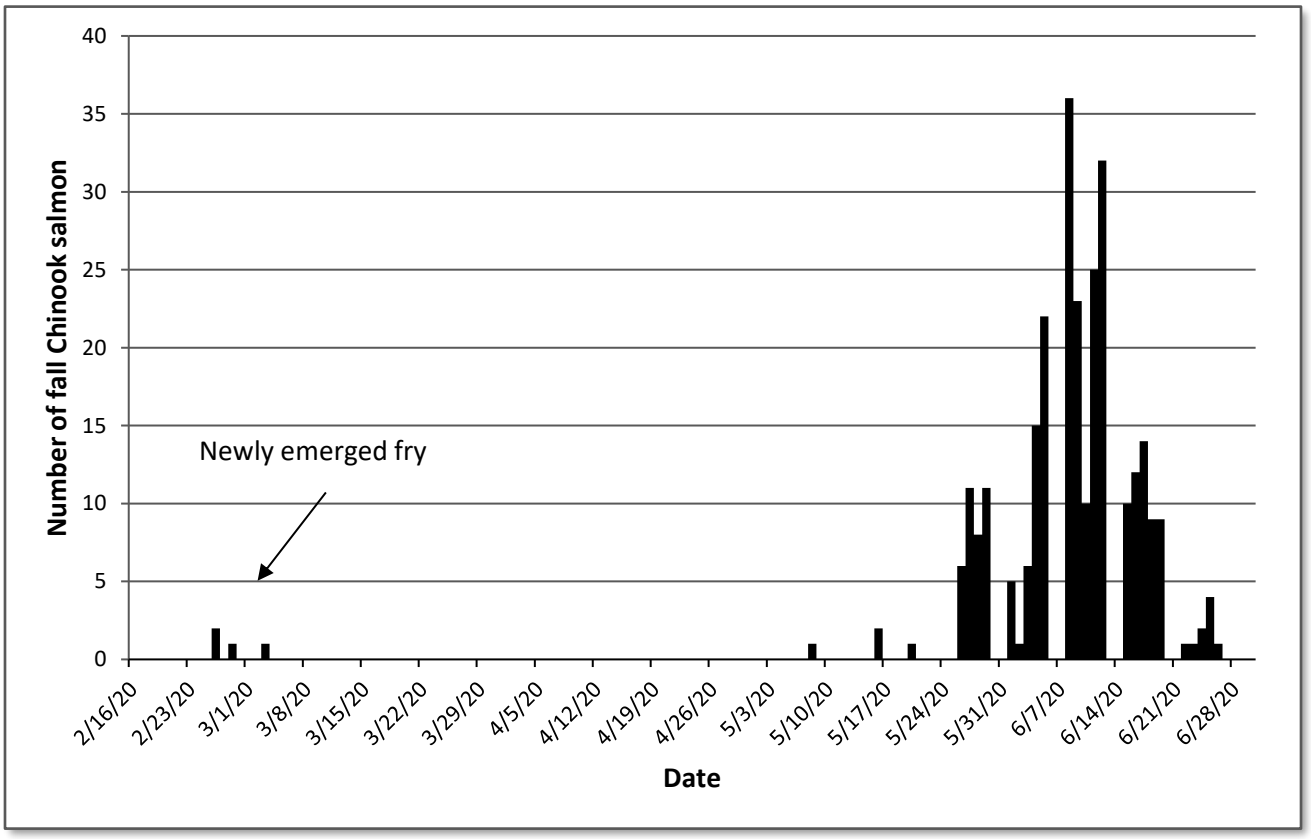

Figure 19. Migration timing of natural origin juvenile fall Chinook salmon captured at the Tucannon River smolt trap in 2020.

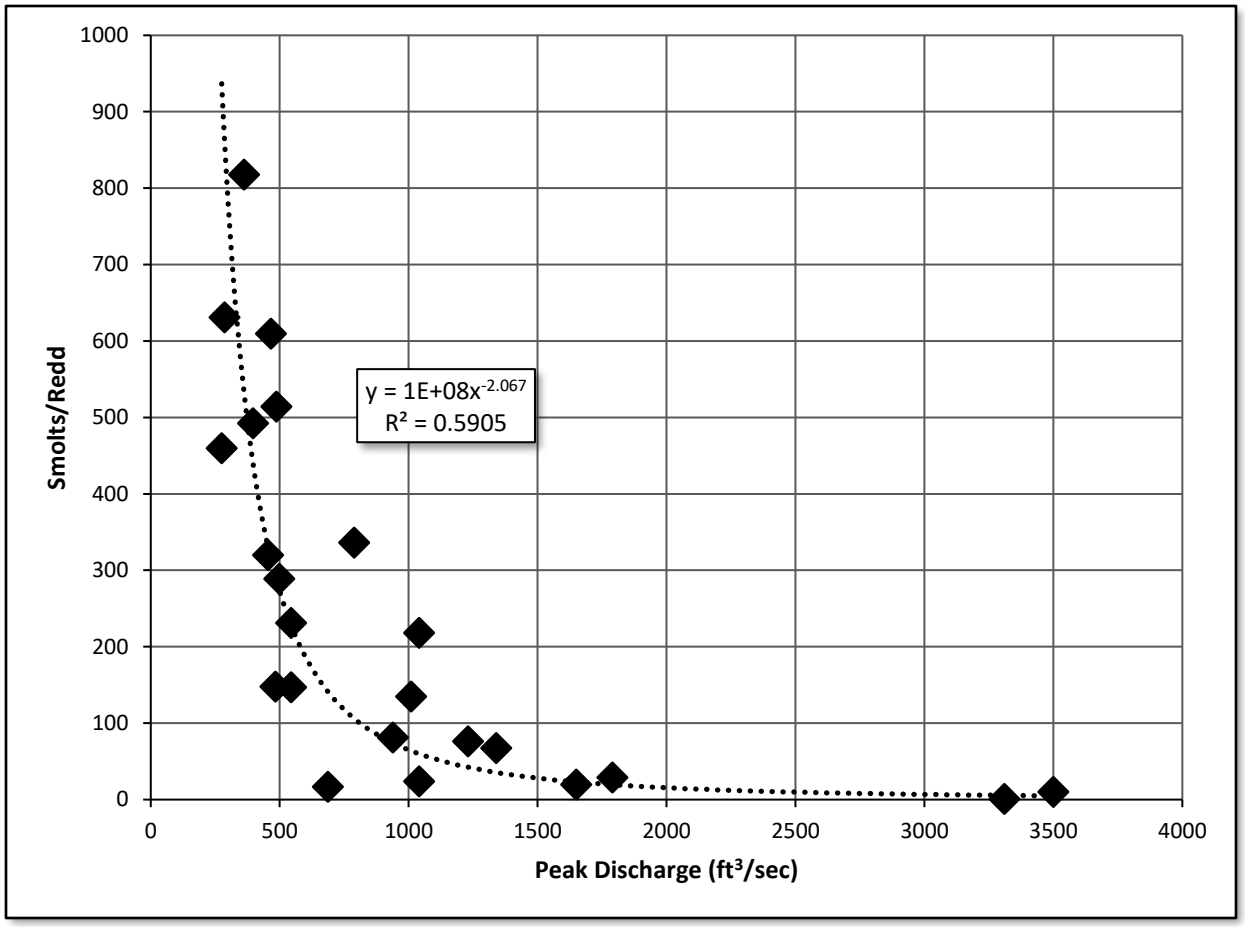

Figure 20. Peak discharge during fall Chinook incubation in the Tucannon River versus the estimated smolt/redd determined at the Tucannon River smolt trap.

We estimated that 1,337 (95% C.I. = 981-1,824) parr/smolts passed the trap during 2020. Based on 128 fall Chinook salmon redds estimated above the smolt trap during 2019 spawning ground surveys, an estimated 10 smolts/redd were produced. After including potential production from redds below the smolt trap in 2019 (32 additional redds), we estimated that 1,657 naturally produced fall Chinook salmon parr/smolts left the Tucannon River during 2020.

Project Area Returns and Total Returns

As defined in the introduction, project area returns are to be calculated to the number of fish passing Ice Harbor Dam. Strays from other Columbia River basin releases (Umatilla, Priest Rapids, Ringold, Klickitat, etc…) are known to cross Ice Harbor Dam (Mendel et al 1993), and therefore inflate the number of fall Chinook counted into the Snake River. The number of strays that reach LGR are considerably lower (generally <1%). Furthermore, the adult trap and sampling that occurs at LGR provides the best location to make an estimate of true Snake River origin fall Chinook salmon. The systematic random sample of the fall Chinook run at LGR has been occurring since 2002, and provide the best dataset to estimate project area returns, as long as an estimate can be derived for fall Chinook that never make it back to LGR.

In the past, additional recoveries of fall Chinook from the Tucannon River and Lyons Ferry adult trapping could be added to the estimate at LGR to estimate total project area returns. However, these estimates likely fell short of the true number due to fish spawning in locations that aren't regularly surveyed (in the tailraces below the dams, Palouse River), or from fishery removals. Another method that can be used to back-calculate the LGR run reconstruction estimate is through the use of PIT tags, and their conversion rate from Ice Harbor to LGR. Hatchery origin fall Chinook salmon released above LGR have very high conversion rates (>95%), while the releases from LFH are more variable (yearlings ~50%, subyearling ~80%). By applying year specific PIT tag conversion rates to the LGR run reconstruction estimate, project area returns can easily be derived.

Other Assumptions

To estimate return (to the project area, or total) of WDFW releases, certain assumptions were applied:

- Salt water age of returning groups were estimated by subtracting one from the total age of subyearlings and subtracting two from the total age of yearlings. These estimates potentially underestimate jacks and overestimate adults because it does not take into account the potential reservoir rearing of the subyearling component. However, for LFH on-station and GRR releases of subyearlings, the component that holds over for another year in the reservoir appears to be relatively small, minimizing the overall effect.

- Only AD+CWT marked/tagged fish were used to estimate returns. For many years, CWT only releases occurred in the on-station release of yearlings. Electronic sampling in areas outside the Snake River has been inconsistent or completely lacking (ocean

fisheries). As such, determining returns from CWT only tagged fish was problematic and time consuming (Milks et al, 2016). Since this is a slightly different method than what was done previously, prior estimates of project area returns and total returns that were reported in previous fall Chinook annual reports were updated for inclusion within this report.

- The Regional Mark Processing Center (RMPC) website, www.rmpc.org, was queried on 11 January 2021 for any 2019 returns of CWT tagged fish associated with WDFW releases. Generally, most submissions to the RMPC database for the 2019 run year should have been finalized and submitted by this date.

In Tables 19-24 below, CWT recoveries were summed in a variety of ways to provide a more in-depth look at specific recoveries locations or recovery types. Totals from the tables may not add up to the same numbers provided in Table 19 or Table 20 due to rounding of estimates.

Returns to the Project Area

An estimated 2,922 fall Chinook salmon (adults+jacks) returned from WDFW releases into the project area in 2019, contributing to 16.0% of the LSRCP project area mitigation goal of 18,300 (Table 19). The return in 2019 was the lowest estimated since 2006, most likely due to poorer ocean conditions that have been experienced in the last few years. These estimates **do not include** in-basin hatchery returns from the FCAP, IPC and the NPTH programs.

Table 19. Project area returns of WDFW released Snake River fall Chinook salmon, 2003-2019 return years.

Run Year	LFH on-station yearling	LFH on-station subyearling	Grande Ronde subyearling	Couse Creek subyearling	Total return	Percent of goal
2003	3,503	225			3,728	20.4%
2004	7,680	393		37	8,110	44.3%
2005	3,101	188		34	3,323	18.2%
2006	2,439	208	155	102	2,904	15.9%
2007	6,832	1,055	551	619	9,057	49.5%
2008	3,896	1,263	296	861	6,316	34.5%
2009	16,968	3,269	725	1,823	22,785	124.5%
2010	11,719	2,137	1,326	1,207	16,389	89.6%
2011	11,830	1,439	1,180	865	15,314	83.7%
2012	9,240	1,932	1,877	1,555	14,604	79.8%
2013	11,277	2,153	1,188	1,211	15,829	86.5%
2014	7,895	1,570	1,557	1,254	12,276	67.1%
2015	8,724	1,592	1,582	616	12,514	68.4%
2016	4,209	1,412	1,326	383	7,330	40.1%
2017	2,588	472	1,305	44	4,409	24.1%
2018	3,616	714	807	0	5,137	28.1%
2019	1,843	452	627		2,922	16.0%

Total Returns

An estimated 4,278 fall Chinook salmon (adults+jacks) returned from WDFW releases in 2019, contributing 4.7% of the combined project area goal and out-of-basin objectives (91,500 - **Error! Reference source not found.** 20). Total returns in 2019 were the lowest in the time series provided in Table 20, most likely due to poorer ocean conditions that have been experienced in the last few years. These estimates **do not include** in-basin hatchery returns from the FCAP, IPC and the NPTH programs.

Table 20. Total returns of WDFW released Snake River fall Chinook salmon, 2003-2019 return years.

Run Year	LFH on-station yearling	LFH on-station subyearling	Grande Ronde subyearling	Couse Creek subyearling	Total return	Percent of goal
2003	6,350	483			6,833	7.5%
2004	11,353	620		37	12,010	13.1%
2005	6,527	337		52	6,916	7.6%
2006	4,803	316	155	116	5,390	5.9%
2007	10,704	1,178	664	751	13,297	14.5%
2008	6,398	1,953	523	1,465	10,339	11.3%
2009	23,428	3,703	1,003	2,392	30,526	33.4%
2010	19,826	3,111	1,576	1,911	26,424	28.9%
2011	17,507	2,160	1,717	1,545	22,929	25.1%
2012	13,852	2,873	3,575	2,290	22,590	24.7%
2013	16,463	3,263	2,963	2,518	25,207	27.5%
2014	15,063	2,535	2,899	2,224	22,721	24.8%
2015	13,853	2,295	3,270	1,115	20,533	22.4%
2016	8,800	2,283	2,121	777	13,981	15.3%
2017	5,887	1,084	2,451	110	9,532	10.4%
2018	6,878	960	1,187	3	9,028	9.9%
2019	2,804	658	816		4,278	4.7%

Harvest in the Project Area

In 2019, fall Chinook fisheries were open on the Snake River, including the boundary waters between Washington/Idaho, and in the Clearwater River. Recoveries of WDFW releases were reported in the Regional Mark Information System (RMIS) database or obtained from WDFW Dayton Fish Management files (not uploaded yet due to delays of submission from COVID-19 work restrictions) from these areas in 2019. The estimated CWT recoveries were expanded by the tag rate for each WDFW release group and provided below (Table 21).

Table 21. Estimated (and fully expanded by tag rate) Snake River basin harvest recoveries in 2019 of wire tagged fall Chinook salmon released by WDFW as reported to RMIS on 1/11/2021, or from WDFW Fish Management Files.

Group	1-Salt	2-4 Salt	Total ESTD	% by Group
LFH Yearling	14	94	108	***92.3%***
LFH Subyearling	1	8	9	***7.7%***
GRR Subyearling	0	0	0	***0.0%***
Total (All Groups)	***15***	***102***	***117***	

Recoveries by Region

From the download options in the RMIS database, CWT recoveries can be grouped into large geographic regions which is useful because Snake River fall Chinook are recovered from California to Alaska, and within the Columbia River Basin. The majority (82.2%) of estimated CWT recoveries come from the Columbia River Basin (Table 22), followed next by recoveries off the coast of Washington (9.5%), followed by recoveries from British Columbia (4.5%), and all other regions accounting for less than 2%.

Table 22. Fully expanded recovery estimates of tagged and untagged fall Chinook salmon recovered in all areas during 2019 for WDFW releases. Minijacks are not included in the estimates.

	LFH – 1+		LFH – 0+		GRR – 0+		1+ and 0+ Combined	
Region	EST total recoveries	% by region	EST total recoveries	% by region	EST total recoveries	% by region	EST total recoveries	*Percent by region*
Freshwater (Columbia Basin)	1,970	78.3%	573	87.9%	729	89.5%	3,272	***82.1%***
CA	0	0.0%	0	0.0%	4	0.5%	4	***0.1%***
OR	62	2.5%	6	0.9%	2	0.2%	70	***1.8%***
WA	309	12.3%	26	4.0%	45	5.5%	380	***9.5%***
BC	134	5.3%	22	3.4%	24	2.9%	180	***4.5%***
AK	42	1.7%	25	3.8%	11	1.3%	78	***2.0%***
HS	0	0.0%	0	0.0%	0	0.0%	0	***0.0%***
Totals	***2,517***	***63.2%***	***652***	***16.4%***	***815***	***20.5%***	***3,984***	

Recoveries in the Ocean

Within the ocean, CWT recoveries can be split into a variety of fishery types, with the most common being Troll (both Treaty and non-Treaty), Gillnet/Seine fisheries, Trawl (salmon captured as bycatch), and Sport. For the WDFW releases, 64% of the estimated CWT recoveries

were recovered from the troll fisheries (both types), followed by sport fisheries at 33.4%, with gillnet/seine and trawl fisheries making up less than 3% of the recoveries (Table 23).

Table 23. Fully expanded recovery estimates of tagged and untagged fall Chinook salmon recovered in the Ocean during 2019 for WDFW releases. Minijacks are not included in the estimates.

		LFH – 1+		LFH – 0+		GRR – 0+			
Region	Fishery	AD+CWT recoveries	Total EST [a]	AD+CWT recoveries	Total EST	AD+CWT recoveries	Total EST	*Grand Total*	*%*
CA	Troll					2	4.3	***4***	0.6%
	Sport								0.0%
OR	Troll	17	33.8	6	6.2			***40***	5.6%
	Trawl	1	2.0					***2***	0.3%
	Sport	13	25.7			1	2.2	***28***	3.9%
WA	Troll	32	64.6			3	6.4	***71***	10.0%
	Troll (Treaty)	59	117.0	11	15.3	6	13.0	***145***	20.4%
	Gillnet/Seine								0.0%
	Trawl								0.0%
	Sport	64	127.4	5	10.7	12	26.0	***164***	23.1%
BC	Troll	51	101.2	6	10.0	3	6.5	***118***	16.6%
	Troll (Treaty)	8	16.0					***16***	2.3%
	Gillnet/Seine								0.0%
	Sport	8	16.3	11	11.8	8	17.3	***45***	6.3%
AK	Troll	19	38.2	19	20.3	1	2.2	***61***	8.6%
	Gillnet/Seine	2	4.0	4	4.2	4	8.7	***17***	2.4%
	Sport								0.0%
HS	Trawl								0.0%
Totals		***274***	***546***	***62***	***79***	***40***	***87***	***711***	
	Fishery Type	**AD+CWT recoveries**	**Total EST [a]**	**AD+CWT recoveries**	**Total EST [a]**	**AD+CWT recoveries**	**Total EST [a]**	***Grand Total***	***%***
All Regions Combined	Troll	186	371	42	52	15	32	455	64.0%
	Gillnet/Seine	2	4	4	4	4	9	17	2.4%
	Trawl	1	2	0	0	0	0	2	0.3%
	Sport	77	169	5	23	13	46	237	33.4%

[a] Estimate has been adjusted for unclipped CWT only, and any other unmarked/untagged fish at release.

Recoveries in the Columbia River Basin (excluding the Snake River)

Within the Columbia River, CWT recoveries can be split into a variety of fishery types (Gillnet and sport) and zones (Estuary, Zone 1-5, and Zone 6), other hatcheries and on the spawning ground (SGS). For the WDFW releases a total of 649 CWTs were recovered in 2019 in the Columbia River Basin (excluding the Snake River basin - Table 24). Gillnet fisheries (both types) accounted for nearly 59% of recoveries, followed by sport fisheries at 37%. Recoveries at other hatcheries accounted for <1.% of the Columbia Basin recoveries.

Table 24. Fully expanded recovery estimates of tagged and untagged fall Chinook salmon recovered in the Columbia River Basin (all freshwater areas – but excluding Snake River Basin recoveries) during 2019 for WDFW releases. Minijacks are not included in the estimates.

Recovery area	Fishery/Hatchery/River	LFH – 1+		LFH – 0+		GRR – 0+		*Grand Total*	*%*
		AD+CWT recoveries	Total EST [a]	AD+CWT recoveries	Total EST	AD+CWT recoveries	Total EST		
COL R Gillnet	Zone 1-5 Non-tribal Net	21	42.4	4	4.3			***47***	7.3%
	Zone 6 Tribal Net	138	276.9	20	21.4	17	35.9	***334***	51.9%
COL R Sport	COL R Estuary	18	35.7	29	41.5	7	15.1	***92***	14.3%
	Zone 1-5 sport	23	45.7	19	39.9	24	51.9	***138***	21.4%
	Zone 6 Sport	5	10.0					***10***	1.6%
Hatchery	Priest Rapids			2	2.1			***2***	0.3%
	Bonneville	1	2.0	1	1.0			***3***	0.5%
SGS	Hanford Reach			17	17.6			***18***	2.7%
Totals		***207***	***413***	***92***	***128***	***48***	***103***	***643***	

[a] Estimate has been adjusted for unclipped CWT only, and any other unmarked/untagged fish at release.

Smolt-to-Adult Survival Rates (SAR and SAS)

Within the original Special Report - Lower Snake River Fish and Wildlife Compensation Plan (COE 1975), smolt-to-adult return rates (SAR) to the defined project area for fall Chinook were assumed to be 0.2%. This assumed rate, along with brood needs based on fecundity, egg-to-smolt survivals, numbers of smolts, and fpp at juvenile release were used to size the hatchery program at Lyons Ferry. Of course, since that time, additional hatchery fall Chinook production programs in the Snake River have been added, and changes as to how the hydrosystem is managed (bypass and spill) is much different than what was occurring in 1970's.

At LFH, yearling and subyearling releases have occurred almost annually since 1985. Early in the program, yearling fall Chinook survived much better than subyearlings (Bugert et al 1997 – about a 10 fold difference). With management changes to the hydropower system (bypass and spill), and changes to the subyearling release size, survival rate differences between yearling and subyearling releases is much closer. For LFH releases, subyearlings perform on average about ½ as well as yearling releases back to the project area when both adult and jack returns are used (Table 25). However, yearling releases are known to produce proportionally more mini-jacks and jacks per adult compared to subyearling releases. When jacks are removed, the average difference is about 1/3. Other WDFW subyearling release locations upstream of LGR have also occurred, these survived at a lower rate compared to the LFH on-station release of subyearlings (Table 25). This is likely a result of migration distance differences.

Table 25. Smolt-to-adult return (SAR) rates to the LSRCP project area for yearling (LFH 1+) and subyearling (LFH 0+ - LFH On-station release; GRR 0+ - Grande Ronde River release; CCD 0+ - Couse Creek release) fall Chinook salmon by WDFW, 2002-2016 release years.

Release Year	Adults and Jacks Combined				Adults Only			
	LFH 1+	LFH 0+	GRR 0+	CCD 0+	LFH 1+	LFH 0+	GRR 0+	CCD 0+
2002	1.34%	0.22%			0.83%	0.18%		
2003	1.28%	0.11%		0.08%	0.33%	0.05%		0.04%
2004	0.16%	0.06%			0.07%	0.04%		
2005	0.83%	0.07%	0.06%	0.03%	0.39%	0.03%	0.02%	0.01%
2006	1.54%	1.16%	0.25%	0.44%	0.41%	0.71%	0.14%	0.30%
2007	0.90%	0.19%			0.49%	0.08%		
2008	4.85%	2.42%	0.45%	1.19%	1.63%	1.09%	0.29%	0.53%
2009	2.01%	0.28%	0.21%	0.23%	1.12%	0.14%	0.13%	0.20%
2010	2.55%	1.08%	0.76%	0.61%	0.99%	0.66%	0.64%	0.61%
2011	1.71%	1.52%	0.20%	1.07%	0.90%	1.06%	0.12%	0.75%
2012	2.45%	0.47%	0.48%	0.26%	0.94%	0.33%	0.48%	0.26%
2013	1.85%	1.00%	0.30%	0.48%	1.10%	0.67%	0.24%	0.37%
2014	1.08%	0.38%	0.25%		0.44%	0.24%	0.23%	
2015	0.62%	0.44%	0.39%		0.31%	0.22%	0.27%	
2016	0.93%	0.13%	0.01%		0.67%	0.12%	0.01%	
Average	***1.61%***	***0.64%***	***0.32%***	***0.49%***	***0.71%***	***0.37%***	***0.23%***	***0.34%***

As shown in the adult return sections above, Snake River fall Chinook are harvested from a variety of locations and fisheries. Generally, about 35-50% of the returns are taken before they return to the project area. This is reflected in the differences between the SAR and SAS rates for each release group in Tables 25 and 26.

Table 26. Total Smolt-to-adult survival (SAS) rates for yearling and subyearling fall Chinook salmon by WDFW, 2002-2016 release years.

Release Year	Adults and Jacks Combined				Adults Only			
	LFH 1+	LFH 0+	GRR 0+	CCD 0+	LFH 1+	LFH 0+	GRR 0+	CCD 0+
2002	1.42%	0.30%			1.42%	0.26%		
2003	2.04%	0.15%		0.11%	0.86%	0.08%		0.07%
2004	0.50%	0.11%			0.34%	0.08%		
2005	1.65%	0.08%	0.08%	0.05%	0.98%	0.04%	0.05%	0.03%
2006	2.16%	2.09%	0.37%	0.73%	0.76%	1.49%	0.26%	0.56%
2007	1.51%	0.24%			0.94%	0.13%		
2008	7.24%	3.13%	0.52%	1.73%	3.08%	1.75%	0.36%	1.01%
2009	3.25%	0.46%	0.35%	0.41%	2.02%	0.30%	0.27%	0.37%
2010	3.64%	1.71%	1.50%	1.41%	1.73%	1.28%	1.36%	1.15%
2011	2.77%	2.16%	0.39%	1.85%	1.76%	1.66%	0.31%	1.51%
2012	4.06%	0.78%	1.01%	0.47%	2.25%	0.63%	0.99%	0.46%
2013	3.06%	1.49%	0.57%	0.82%	2.07%	1.14%	0.49%	0.70%
2014	1.89%	0.61%	0.35%		1.10%	0.46%	0.32%	
2015	1.29%	0.70%	0.68%		0.83%	0.46%	0.54%	
2016	1.66%	0.20%	0.02%		1.31%	0.18%	0.02%	
Average	***2.54%***	***0.95%***	***0.53%***	***0.84%***	***1.43%***	***0.66%***	***0.45%***	***0.65%***

Direct Take of Listed Snake River fall Chinook Salmon During Fall of 2019 and Spring of 2020

Adult estimates for permit #16607 for LFH production and permit #16615 for NPTH production have been combined in the tables below. These ESA "take" tables are in the format used during the time the work was conducted. 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 2019 at LFH and NPTH (highlighted in green), and eggs/loss/release data associated with subyearling and yearling releases (BY18) released in either 2019 or 2020 that were part of LSRCP, LSRCP-FCAP, and IPC programs. Direct takes of listed Snake River fall Chinook salmon were calculated in Table 2727 and Table 28 below and were within limits. The number of unmarked/untagged juveniles released by these programs (subyearling and yearling) totaled 1,929,100 are also 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 297) provided below.

1. Nez Perce Tribe Snake River Fall Chinook Salmon Monitoring and Evaluations Report (**M&E Report**)
2. 2019 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 2019 (**Run Recon Report**)
4. 2019 NPTH SR fall Chinook production report (**Production Report**)

Table 27. Proposed permissible direct take and actual take of listed Snake River fall Chinook salmon adults returning in 2019 and juveniles released in 2020 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 e]	No fin clip	0		2,222,222	1,929,100	1,820	See Table 25		
	AD clip	0		2,500,000	1,226274	780	See Table 25		
Intentional lethal take [f g]	No fin clip	0	23,489	1000 (health sampling	28	Up to 3,800	2,172	0	
	AD clip			0		Up to 2,200	658	0	
Unintentional lethal take [h]	No fin clip	7.50%	4.18%	7.50%	3.63%	Trapping – 1%	0.00%	0	
						Holding – 15%	1.12%		
	AD clip					Trapping – 1%	0.03%	0	
						Holding – 15%	0.09%		

a. "No fin clip" salmon include hatchery-origin and natural-origin fish. The majority (50%-65%) of the unclipped fish are hatchery-origin.
b. For purposes of this permit, adults and jacks include all fall Chinook salmon that have spent at least 1 year in the ocean. Post-season reporting will be based on estimated ocean age. Adult/jack 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, these rows refer to fish trapped at LFH only and returned to the river without handling (recycled fish at the LFH trap/ladder). Based on previous years trapping, the vast majority of these fish being clipped and/or tagged hatchery fish. Final proportions will be based on post-season run data.
d. Take of juveniles due to the standard rearing of fish at the hatchery once fish have been ponded to the rearing vessels (start of rearing cycle). These numbers also include fish marked/tagged and PIT Tagged.
e. Specifically refers to Adults/jacks that are captured/handled and released upstream of Lower Granite Dam (subsample of entire fall Chinook run). The limits provided in this table are a subset of the total number of fish trapped at Lower Granite to meet broodstock needs. These fish were determined to not be needed for broodstock. However, these fish are needed for the RM&E (Table 25). Since a sample of the entire run is needed for run reconstruction purposes (RM&E), actual take numbers (total number of fish trapped at Lower Granite Dam) are provided in Table 25 for reference.
f. Includes eggs/fry that were culled for a variety of reasons (age (jills), disease – mostly BKD, overproduction, or Snake River basin fall Chinook that were crossed with strays (determined prior to egg eye-up)) . Includes fish that were sacrificed during the rearing cycle for fish health sampling. Type of clip for each of these categories is not essential and/or available based record keeping from fish health or when eggs are culled.
g. Per agreement, the take goal for natural-origin fish for broodstock is 1,500 adults/jacks. Based on run predictions and attempt to maximize pNOB. ~4,010 total brood are needed for full production but may include a variety of clipped and unclipped fish. However, to provide flexibility and to ensure broodstock needs are met, up to 6,000 fish may be collected for broodstock (LFH +NPTH combined). These will be counted as fish targeted for broodstock collection (generally these will be fish ≥70cm; but could be smaller in some years depending on the run) based on annual Lower Granite Dam Trapping Protocols). These do not include fish (generally <70cm, but could be smaller in some years depending on the run) used for the purpose of run-reconstruction (see Table 25). Note: future proportions of clipped and unclipped fish will change based on run composition and the new US v Oregon tagging table changes that go into effect for BY 2018.
h. 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 (egg/fry = egg loss to the eyed up stage, and from the eyed up stage to fry ponding). Rearing mortality rates are estimated based on the fry ponded to final release numbers. 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/jack trapping mortality are just fish that died in the adult trap(s) (Lower Granite and/or Lyons Ferry) and based on the total number of fish trapped. Adult/jack holding mortality are fish that died during transport to Lyons Ferry, and any mortalities in the pond (DIPS) prior to or during the spawning season.

Table 28. Proposed permissible direct take and actual take of listed Snake River fall Chinook salmon adults returning in 2019 and juveniles released in 2020 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]		0	
	AD clip	0				Unlimited [a]		0	
Capture, handle, and release [b]	No fin clip	0		Up to 15% of natural juvenile production not to exceed 25,000 fish [f]	280	20	0	10	0
	AD clip	0		10	0			10	0
Capture, handle, tag/mark/tissue sample, and release [c]	No fin clip	0		3,000 [f]	0	Up to 8,500 [g]	2,284	Unlimited [h]	19
	AD clip	0				Up to 8,500 [g]	1,233	Unlimited [h]	44
Intentional lethal take [d]	No fin clip	0		0		1,000	169	0	
	AD clip	0		0		Up to 2,000	219	0	
Unintentional lethal take [e]	No fin clip	0		300 [f]	3	0		0	
	AD clip	0		100 [f]	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. Since "0" or "unlimited", do not report.
b. Take associated with smolt trapping operations where listed fish are captured, handled, and released.
c. 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.
d. Intentional lethal mortality of hatchery fish as a result of run reconstruction needs. These includes mostly coded-wire tagged hatchery fish (clipped or unclipped) that will generally be <70cm in length (see previous Table – footnote g), but will also include fish <70 that **did not** have a CWT.
e. Unintentional mortality of listed fish, including loss of fish during smolt trapping.
f. WDFW activities associated with emigrant studies using the rotary screw trap on the Tucannon River (either total captures, or PIT Tagging), and any unintentional mortality during smolt trapping.
g. Adults and jacks used for run reconstruction at Lower Granite Dam adult trap. These totals should reflect the run at large at LGR that were sampled and released upstream.
h. Carcass sampling on the Tucannon River. Some carcass samples are unknown clip (head only, or missing portions of the body to positively identify). Unknown clipped fish have been put in the "No fin clip" tally.

Table 29. 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 2019.
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 on page 32 in this report. Carcass recovery data above LGR provided by NPT in the **M&E report** Hatchery Fraction section 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 9-10, pages 17-18 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 35-37). 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 the LFH adult trap is not available as the trap did not operate in 2019.

Conclusions and Recommendations

The fall Chinook salmon program at LFH is being managed to meet the goals and objectives of State, Tribal and Federal co-managers and requires substantial coordination. 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. 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 in-basin hatchery returns which allows more precise (in theory) estimates of natural origin fish in the overall return, and those that contribute to broodstock. Beginning with the 2019 release year and into the future, all Snake River fall Chinook salmon releases will be identified by a PBT mark group at 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 may influence broodstock collection criteria at LGR, and this

information may be useful for other Snake River basin researchers estimating natural origin productivity.

Recommendation: Continue to estimate fecundity 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 Snake River Fall Chinook yearling programs have generally shown a higher SAR rate as compared to subyearling releases. However, yearlings have a very 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 ceased, but releases of yearlings at LFH have continued.

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 2019

2019 Fall Chinook Trapping/Sampling Protocols at LGR

August 18, 2019

Protocols:

1) **This protocol assumes a 24 hour/day, 7 days per week trapping at 70% continuing through September 6th, and then dropping to 20% through the end of the season.**

   A**ll fish hauled to hatcheries during the 70% trapping period must receive an operculum punch on the left side (LOP), with no operculum punches applied during the 20% trapping period.**

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 (1 out of 3 trapped).

5) Wire tagged FEMALES <70 will be hauled to LFH and NPTH (1 out of 3 trapped) under the normal 70/30 split.

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 3 wires (put F in with "LARGES" for LFH and NPT and M go into tank for LFH only), DNA sample all Release 2 out of 3 wires (DNA sample all)

Untagged fish:

Fork Length	Action
≥ 70 cm	Haul all fish (DNA sample all).
<70 cm	Haul 1 out of 3 F to LFH (DNA sample all). Release 2 out of 3 F (collect scales and DNA). Release all M (collect scales and DNA).

September 12, 2019

Changes to prior protocol are highlighted

Protocols:

1) **This protocol assumes a 24 hour/day, 7 days per week trapping at 100% continuing through September 16th, and then dropping to 20% through the end of the season.**

   A**ll fish hauled to hatcheries during the 70% trapping period must receive an operculum punch on the left side (LOP), with no operculum punches applied during the 20% trapping period.**

September 17, 2019

Changes to prior protocol are highlighted

Protocols:

1) This protocol assumes a 24 hour/day, 7 days per week trapping at 20% through the end of the season.

   A**ll fish hauled to hatcheries during the 70% trapping period must receive an operculum punch on the left side (LOP), with no operculum punches applied during the 20% trapping period.**

September 29, 2019

Changes to prior protocol are highlighted

Wire tagged fish:

Fork Length	**Action**
≥ 70cm	Haul all wires for LFH (DNA sample all) Haul all males for NPT Release all female wires for NPT
<70cm	Haul 1 out of 3 wires for LFH (DNA sample all) Release 2 out of 3 wires for LFH (DNA sample all) Release all for NPT

Untagged fish:

Fork Length	**Action**
≥ 70 cm	Haul all fish for LFH (DNA sample all) Haul all males for NPT Release all females for NPT (collect scales and DNA)
<70 cm	Haul 1 out of 3 females to LFH (DNA sample all) Release 2 out of 3 females (collect scales and DNA) Release all males (collect scales and DNA)Release all M (collect scales and DNA)

October 3, 2019

Changes to prior protocol are highlighted

Wire tagged fish:

Fork Length	Action
≥ 70cm	Haul all males for LFH (DNA sample all) Haul all males for NPT Release all female wires for NPT
≤ 80cm	Haul all females for LFH
< 70cm	Haul 1 out of 3 wire males for LFH (DNA sample all) Release 2 out of 3 wire males for LFH (DNA sample all) Release all for NPT
< 80cm	Haul 1 out of 3 wire females for LFH (DNA sample all) Release 2 out of 3 wire females for LFH (DNA sample all) Haul males for NPT down to 70cm Release all females for NPT

Untagged fish:

Fork Length	Action
≥ 70 cm	Haul all males for LFH (DNA sample all) Haul all males for NPT Release all females for NPT (collect scales and DNA)
> 80 cm	Haul all females for LFH
< 70 cm	Release all males (collect scales and DNA)
< 80 cm	Haul 1 out of 3 females to LFH (DNA sample all) Release 2 out of 3 females (collect scales and DNA)

October 25, 2019

Changes to prior protocol are highlighted

LGR Trap rate remains at 20%.
Broodstock and run reconstruction needs have been met so all fish will be released at LGR.
DNA will continue to be taken on all fall Chinook trapped.
Scales will be taken on untagged fish released.

Appendix B: Systematic Sampling Rates at Lower Granite Dam 2003-2019

Appendix B Table 1. Dates, times, and trapping rates of fall Chinook salmon at LGR, 2003-2019.

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
2019	18 Aug	70	6-12 Sept 8:06 am [f]	6 Sept	20	12 Sept 4:00pm 17 Sept	100 20	12 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 2019

(Age/Rearing states origin, brood year, age at release, and release site (LF19SO is a LFH hatchery origin fish from the 2019 brood year, released as a subyearling, onstation at LFH).

Appendix C Table 1: Estimated composition of non-wire tagged salmon trapped at LGR, hauled to LFH, and killed during 2019.

Age/Origin Determinations by Method	< 53 cm Males	Females	≥53 cm Males	Grand Total
Snake R. hatchery subyearling age 3(1salt) by PIT tag		1		1
Snake R. hatchery res rear age 4(2salt) by DNA		1		1
Snake R. hatchery res rear age 5(3salt) by DNA		1		1
Snake R. hatchery subyearling age 3(2salt) by DNA		51	50	101
Snake R. hatchery subyearling age 4(3salt) by DNA		184	82	266
Snake R. hatchery subyearling age 5(4salt) by DNA		4	1	5
Snake R. hatchery yearling age 3(1salt) by DNA		1		1
Snake R. hatchery yearling age 4(2salt) by DNA		5	3	9
Snake R. hatchery yearling age 5(3salt) by DNA		6	2	8
Snake R. hatchery unknown rear/age by DNA		19	27	46
Stray hatchery subyearling age 4(3salt) by DNA			3	3
Stray hatchery unknown rear/age by DNA			1	1
Unknown hatchery res rear age 4(2salt) by CLP or scales		37	11	48
Unknown hatchery res rear age 5(3salt) by CLP or scales		15	2	17
Unknown hatchery subyearling age 3(2salt) by CLP or scales	1		2	3
Unknown hatchery subyearling age 4(3salt) by DNA		5	1	6
Unknown hatchery yearling age 4(2salt) by DNA		4	5	9
Unknown hatchery yearling age 5(3salt) by DNA		1	1	2
Unknown hatchery unknown rear/age by CLP or scales	2	30	25	57
Presumed natural subyearling age 3(2salt) by DNA		4	27	31
Presumed natural subyearling age 4(3salt) by DNA		324	118	442
Presumed natural subyearling age 5(4salt) by DNA		20	3	23
Presumed natural yearling age 4(2salt) by DNA		2		2
Presumed natural unknown rear/age by DNA		33	50	83
Unknown origin subyearling 2(1salt) by CLP or scales	1			1
Unknown origin subyearling 3(2salt) by CLP or scales	4		6	10
Unknown origin subyearling 4(3salt) by CLP or scales		13	8	21
Unknown origin unknown rear/age	1	109	127	237
Total	**8**	**871**	**558**	**1,435**

Appendix C Table 2. Estimated composition of wired salmon trapped at LGR, hauled to LFH, and killed in 2019.

Origin by CWT	CWT	Females	<53 cm Males	≥53 cm Males	Grand Total
LF14SBCA	220356	1			1
LF14SGRRD	636883	1			1
LF14SO	636882	2			2
LF14SPLA	220358			1	1
LF14YBCA	220361	9		3	12
LF14YCJA	220363	10			10
	220364	5			5
LF14YO	636885	8		5	13
	636886	15		6	21
LF14YPLA	220362	2			2
	220365	4			4
LF15SBCA	220369	10		1	11
	220370	13		2	15
LF15SCJA	220367	12		5	17
	220368	10		3	13
LF15SCJA2	220373	6		1	7
LF15SGRRD	637037	2			2
LF15SIPCHC	091013	13			13
LF15SO	637038	11		4	15
LF15SPLA	220371	7		1	8
	220372	9		2	11
LF15YBCA	220374	3		2	5
	220379	1			1
LF15YCJA	220376	3		4	7
	220377	6		4	10
LF15YO	637040	28		13	41
	637041	30		18	48
LF15YPLA	220375	3		5	8
	220378	1		1	2
LF16SBCA	220383	3		3	6
	220386	3		5	8
LF16SCJA	220380	5		7	12
	220381	2	1	1	4
LF16SGRRD	637199	4		5	9
LF16SO	220382	3		6	9
	637198	2		6	8
LF16SPLA	091138	9		6	15
	220384	3		3	6
	220385	7		3	10
LF16YBCA	220388		1	2	3
	220391		3	4	7
LF16YCJA	220389		2	5	7
	220392			5	5
LF16YO	637202		4	3	7
	637203	2	4	3	9
LF16YPLA	220387	1	2		3
	220390	4	1		5
LF17SBCA	220504		6		6
	220505		7		7
LF17SCJA	220502		4		4

Origin by CWT	CWT	Females	<53 cm Males	≥53 cm Males	Grand Total
	220503		7	1	8
	220508		6		6
LF17SGRRD	637395		11		11
LF17SO	637394		7		7
LF17SPLA	220507		1	1	2
	220506		7		7
LF17SSAL	091185		18	2	20
LF17YLCPB	220393		3		3
	220395		2		2
	220396		2		2
	220398		1		1
LF17YO	637397		2		2
	637398		1		1
NPTH13SNLVA	220240	2			2
NPTH14SLGA	220230	1			1
NPTH14SO	220247	2			2
	220248			1	1
NPTH15SCFA	220243	15		6	21
	220244	15		6	21
NPTH15SLGA	220241	17		4	21
	220242	22		3	25
NPTH15SO	220249	25		4	29
	220250	24		5	29
	220251	10		4	14
	220254	10		1	11
	220255	27		3	30
NPTH16SCFA	220252	7		14	21
	220253	4		11	15
NPTH16SLGA	220261	4		9	13
	220262	3		4	7
NPTH16SO	220256	5		8	13
	220257	5		16	21
	220259			10	10
	220260			4	4
NPTH17SLGA	220271		12		12
NPTH17SO	220266		3		3
NPTH17SNLVA	220258		3		3
BONN14YUMA	090944	2		1	3
BONN15YUMA	091005			1	1
KLICK16SO	637194			1	1
KLICK15SO	636965			1	1
PRIEST16SCOLR	637181	1			1
PAHSIMEROI16YO	100366			1	1
Total		**480**	**123**	**281**	**884**

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 2010-2019 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
2019	0	0	1	0	0
Average	**0**	**13.3**	**10.6**	**0.4**	**2.1**

Appendix D Table 2. Historical use of out of basin strays in broodstock: 2007-2019.

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%
2019	1,151	5	4	0	0.8%
Average	**1,249**	**1.5**	**8.5**	**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

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
						1,885,100	Subyearling
2011	4,723,501	165,001	0	1,785,600	2,772,900	960,000	Yearling
						1,812,900	Subyearling
2012	4,526,108	141,608	0	1,480,000	2,904,500	1,010,000	Yearling
						1,894,000	Subyearling
2013	4,565,660	119,550	0	1,558,800	2,887,310	980,000	Yearling
						1,907,310	Subyearling

[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 2020

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

						Number of fish released [a]						
Release year	S/Y [b]	Brood year	Release location-type	Release date	CWT code	AD clip +CWT	CWT only	AD clip only	No clip or CWT	Total Released	FPP	Planned PIT Tagged
2020	Y	2018	LFH	16-Mar	637603	430,997		7,317		438,314	11.0	10,000
Total yearling releases						***430,997***		***7,317***		***438,314***		***10,000***
2020	S	2019	CJ1	23-Mar	220195	250,626	948	158	217,234	468,966	51.7	13,500
2020	S	2019	LFH	24-Mar	637758	200,017	384	384	494,253	695,038	55.2	20,000
2020	S	2019	BC1	17-Mar	220197	200,098	757	126	259,833	460,814	55.9	4,500
2020	S	2019	PL1	9-Mar	220199	200,082	757	126	202,220	403,185	54.2	13,500
2020	S	2019	PL2	12-Mar	220282	204,975	776	129	259	206,139	53.7	4,500
2020	S	2019	BC2	19-Mar	220198	200,089	757	126	253	201,225	56.3	4,500
2020	S	2019	CJ2	25-Mar	220196	202,286	766	128	255	203,435	45.1	4,500
2020	S	2019	GRR Direct	27-May	637759	222,357	0	3,228		225,585	50.5	4,500
2020	S	2019	NPTH-Site 1705-MF Clearwater R	5-Jun	220273	101,077	3,358	368	694,279	799,082	58.3	4,500
2020	S	2019	NPTH-Lukes Gulch Accl.-SF Clearwater R	15-May	220275	103,758	1,893	486	49,241	155,378	85.1	4,500
2020	S	2019	Cedar Flats Acclimation	8-Jun	220276	102,338	1,127	485	110,351	214,301	55.2	4,500
2020	S	2019	North Lapwai Valley Acclimation	5-May	220277	104,278	2,426	680	135,211	242,595	76.0	4,500
2020	S	2019	Salmon	14-May	091459	214,539	547	2,733	826,274	1,044,093	48.9	4,500
Total subyearling releases						***2,306,520***	***14,496***	***9,157***	***2,989,663***	***5,319,836***		***92,000***

[a] Numbers presented do not necessarily match hatchery records for fish per pound because of reporting constraints for the hatchery.

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

Appendix G: Tucannon River Survey Sections and Historical Escapement

Error! Reference source not found.**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, 2019.**

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	1.7	1.7	100	31
2	Highway 261 Bridge to Smolt trap	0.15	0.15	100	1
3	Smolt trap to Powers Bridge	0.7	0.7	100	30
4	Powers Bridge to upper hog barns	1.45	1.45	100	15
5	Hog barns to Starbuck Br.	2.4	2.1	87.5	38
6	Starbuck Br. To Fletchers Dam	2.7	1.4	51.9	35
7	Fletcher's Dam to Smith Hollow	3.0	3.0	100	2
8	Smith Hollow to Ducharme's Sheep Ranch Br.	4.6	4.6	100	6
9	Ducharme's Bridge to Highway 12	5.7	5.7	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	0
	Total	**33.3**	**31.7**	**95.2**	**161**

[a] Section lengths measured using Google Earth Pro.
[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 Error! Reference source not found.**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.

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