Lyons Ferry Hatchery Evaluations: Fall Chinook Salmon Annual Report (2022 Return/2023 Releases)

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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 2022 spawning and 2023 releases of yearlings and subyearlings.

The estimated run size of natural-origin (NOR) fall Chinook salmon to reach Lower Granite Dam (LGR) was 6,222 fish $\geq$ 57 cm fork length and 652 fish 30- <57 cm fork length. The remaining portion of the run consisted of 32,879 hatchery-origin (HOR) fish $\geq$ 57 cm and 3,122 HORs 30-< 57 cm. Nearly all HOR 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 2022 was estimated at ~1.5%.

During 2022, based on the final number of fish processed at LFH for the season, WDFW collected 2,389 fish at LGR for broodstock, monitoring and evaluation of our hatchery releases, and to estimate the run composition at LGR.

In 2022, LFH staff spawned 1,827 females for an estimated total green egg take of 4,746,926; 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 artificial production programs. At the end of the season, 43 females and 29 males were returned to the Snake River to spawn naturally. Of the 594 males spawned at LFH, 445 were used multiple times to minimize the use of jacks, and to incorporate larger, older fish in the broodstock.

The estimated proportion of NOR fish in all LFH and NPTH broodstock (pNOB), as determined from PBT was 20.4%. The estimated proportion of natural origin spawners (pNOS) by run reconstruction methods was 16.6%. Beginning in 2022, estimates for pNOB were no longer calculated by run reconstruction efforts. Instead, it will be calculated from genetic samples from fish collected for broodstock.

In 2023, hatchery staff released yearling and subyearling fall Chinook into the Snake River at LFH and subyearlings into the Grande Ronde River near Cougar Creek. 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.

Beginning the week of 18 October 2022, staff conducted fall Chinook salmon redd surveys in the lower Tucannon River. A total of 557 redds (fall Chinook and Coho) were counted and an additional 127 redds were estimated due to landowner access restrictions. Total estimated fall Chinook salmon redds equaled 524. Based on three fish/redd, the estimated number of fall Chinook spawners in the Tucannon River in 2022 was 1521. Of the estimated total fall Chinook spawning escapement, 19.8% were recovered and sampled.

In the spring of 2023, 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 50,716. Productivity (smolts/redd) from spawning was estimated at 97 smolts/redd.

In 2022, we estimate that a minimum of 11,604 (63.4%) returning adults and jacks that were from WDFW releases 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 17,216 (18.8%) returning adults/jacks that were from WDFW releases contributed to the total LSRCP 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 Grande Ronde River (GRR) contributed to multiple fisheries (troll, sport, net) within the ocean and in the Columbia River in 2022. Of the total returns in 2022, harvest from the various ocean and Columbia River fisheries accounted for ~36% of the return.

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 (SRFCH) for adult returns in 2022 and juvenile releases in 2023. Discussions with NOAA-Fisheries on consistency and ease in reporting of ESA take for SRFC is ongoing.

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, Ethan Grennan, Elizabeth Kennedy, Nell McGuan and staff from the Dayton Fish Management office and the Clarkston Field office for their help in collecting fall Chinook data.

We thank all the hatchery personnel at LFH for their cooperation with sampling and providing information regarding hatchery operations. Thanks also to the collaboration efforts of the genetic labs analyzing tissue samples collected at LFH, LGR and Nez Perce Tribal Hatchery (NPTH). A special thanks to the teams of Todd Seamons (WDFW Genetic Lab), Rebekah Horne and Meghan Moore (Columbia River Inter-Tribal Fisheries Commission (CRITFC Genetic Lab), Matt Cambell, Jesse McCane, and Audrey Harris (Idaho Department Fish and Game (IDFG Genetic Lab). Additional gratitude 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 and for the run reconstruction analysis and profiling the age of broodstock.

We especially appreciate the efforts of Darren Ogden (NOAA Fisheries) and the 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), and John Powel (IDFG) for their assistance in estimating the run composition at LGR for the 2022 run year, and Ben Sandford (NOAA) for bootstrapping the data, providing 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, and most importantly, we thank the U.S. Fish and Wildlife Service, Lower Snake River Compensation Plan Office, for providing funding and support 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 2022 spawning, and both yearling and subyearling releases at LFH or in the Grande Ronde River that occurred in 2023. WDFW's Snake River Lab (SRL) evaluation staff completed this work with federal fiscal year 2022/2023 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 (IHR) extending to Lower Granite Dam (LGR) and is inclusive of the Walla Walla Basin, a Columbia River Basin tributary in SE Washington adjacent to the Snake River basin. This area 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 adults and jacks returning to the project area which starts at IHR.

Program Goals and Objectives

The Snake River fall Chinook (SRFCH) program at LFH began in 1984 after construction of LFH was completed 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 for SRFCH (Fall Chinook Acclimation Project – FCAP) 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 LSRCP SRFCH mitigation goal, the escapement to the Snake River below Hells Canyon Dam (HCD) prior to construction of the four lower Snake River dams was estimated at 34,400. Lower Snake River 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 SRFCH adult escapement by 18,300, which in turn became the adult mitigation goal for the program. Further, this reduction in natural spawning escapement was estimated to result in a harvest reduction to areas outside of the Snake River Basin: 1) coast-wide commercial/tribal harvest of 54,900 adults, and 2) recreational fishery harvest of 18,300 adults (Table 1). 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. Fall Chinook salmon LSRCP adult [a] return goals and/or assumed objectives.

Component	Number of adults
Escapement to project area goal	18,300
Outside of Snake River Basin Commercial/Tribal harvest objective	54,900
Outside of Snake River Basin Recreational harvest objective	18,300
Total Hatchery Origin (HOR) fish	**91,500**
Maintain Natural Origin (NOR) population	**14,363**

[a] As defined in the LSRCP documentation, "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 at LFH and estimate the magnitude of benefits have changed.

- The listing of SRFCH 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 originally expected.
- Currently, three hatchery programs artificially propagate SRFCH. Two of the programs, LSRCP (includes LFH and FCAP) and Nez Perce Tribal Hatchery (NPTH), are integrated programs aimed at increasing natural-origin (NOR) 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 to BPA and LSRCP 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 Dam Complex (HCC), and consists of subyearling releases in the Salmon River (Idaho) near Hammer Creek. Releases from all these programs occur at 10 locations throughout the Snake River basin, with most releases located above LGR (Figure 1). All programs are highly coordinated in their operations, including broodstock collection at LGR and egg/juvenile fish transfers among facilities. One out-of-basin LSRCP 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, not including NPTH production, ~53% of the hatchery-origin (HOR) produced fish are marked with an adipose (AD) fin clip and a portion are tagged with coded wire tags (CWT). If changes to marking/tagging occurs, there is a notification process that needs to be followed per permit #16607 – 2R issued to WDFW from NOAA-Fisheries and amended in 2018 (NMFS 2018).

HOR Return Goals

- In the early 2000s, as part of developing a management plan for SRFCH, Snake Basin co-managers developed an adult return goal for HOR fall Chinook to the Snake Basin. This adult return goal combined the various mitigation goals from the hatchery programs into a combined number for the basin. The LSRCP funded hatchery production has an established adult mitigation goal of 18,300 adults to the project area (above IHR) and the NPTH program has an adult return goal of 3,750 adults above Lower Monumental Dam. The IPC funded production has mitigation responsibility of releasing 1,000,000 juveniles annually, with no adult goal. For the combined goal, we added the current LSRCP funded program releases (LFH (including the Grande Ronde release) and all FCAP) – Note: a SAR of 0.56% would return 18,300 to the project area from all LFH and FCAP releases. Using the same survival assumptions for the current IPC program would result in an adult return of 5,600. Combining these two with the NPTH adult goal (3,750) would result in a total HOR goal of 27,650.

NOR Return Goals

- Achieve ESA delisting by attaining interim population abundance in the Snake River Evolutionary Significant Unit (ESU) of at least 3,000 NOR SRFCH spawners (adults and jacks),

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 NOR SRFCH (adults and jacks) above IHR
- Long term restoration goal is to achieve a population of 14,363 NOR SRFCH (adults and jacks) above IHR.

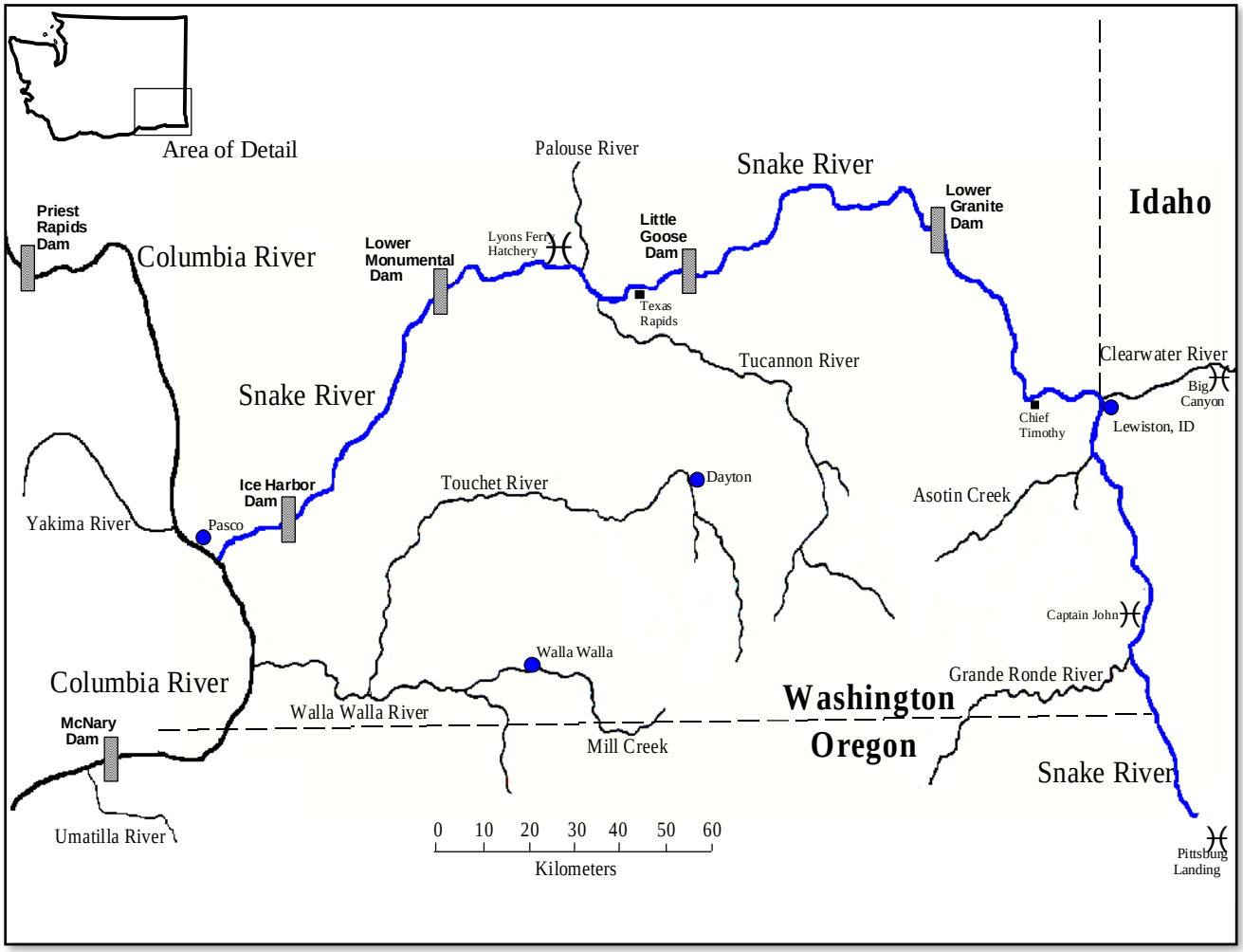

Figure 1. The Lower Snake River Basin showing locations of LFH, some of the SRFCH acclimation sites, and major tributaries in the area.

Table 2. SRFCH production priorities for the LSRCP at LFH, FCAP and IPC per the *US v. Oregon Management Agreement* for brood years 2018-2027.

Priority	Rearing facility	Release Number	Age	Release location	Marking/Tagging [1]
1	LFH	450,000	1+	On-station	450K ADCWT
2	LFH	450,000	0+	Captain John	200K ADCWT, 250K no clip
3	LFH	450,000	0+	Big Canyon	200K ADCWT, 250K no clip
4	LFH	500,000	0+	On-station	200K ADCWT, 300K no clip
5	LFH	400,000	0+	Pittsburg Landing	200K ADCWT, 200K no clip
6	LFH	200,000	0+	Captain John 2	200K ADCWT
7	LFH	200,000	0+	Big Canyon 2	200K ADCWT
8	LFH	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	LFH	200,000	0+	On-station	200K no clip
TOTAL	**Yearlings**	**450,000**			
	Subyearlings	**3,800,000**			

[1] For all SRFCH 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 were 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.

2022 Fall Chinook Salmon Run Size and Composition

Returns to LGR and Composition of Fish Returning to LGR

Chinook salmon (spring, summer, and fall runs) were counted at the LGR counting window in 2022. Fish are visually measured and grouped by total length (TL) at fish passage windows. Window counts (day and night) estimated 54,952 SRFCH ($\geq$ 30 cm TL) reached LGR in 2022 (Figure 2), which includes 8,779 "jacks" by size (30 cm-55 cm TL). Chinook salmon passing LGR after 17 August are designated as SRFCH based on arrival date, which may be inaccurate because of the overlap between the summer Chinook and fall Chinook 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.

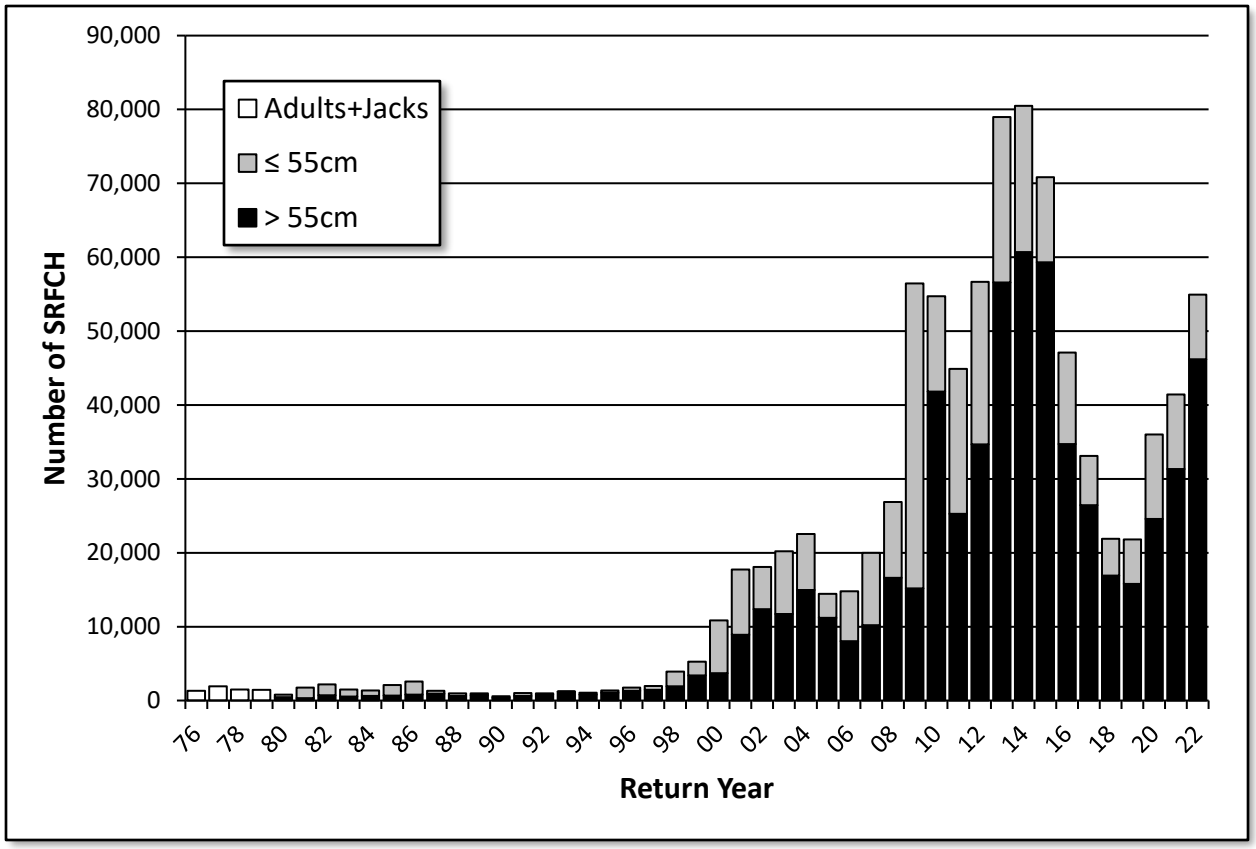

Figure 2. Snake River Fall Chinook salmon window counts at LGR, 1976-2022.

The SRFCH 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 SRFCH run reconstruction team uses a slightly different length criteria (30-56 cm fork length, and ≥ 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 adult, jack, and mini-jack returns. The SRFCH run reconstruction technical team estimated 42,875 adult, jack, and mini-jack (including males <57 cm) SRFCH reached LGR in 2022. For adults and jacks only, an estimated 16.0% were natural-origin, 84.0% were in-basin hatchery-origin, and 1.5% were out-of-basin hatchery-origin. The final run estimate to LGR was 22.0% 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 (jacks) and ≥ 57 cm (adults). 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).

In 2022, a combination of high trap rates in the early part of the season and size selection for larger fish for brood stock resulted in an over-representation of older fish in a short amount of time. This sample did not properly represent the run at large that is typically captured in the run reconstruction methods. This situation pushed preliminary PBT-based run reconstruction methods to be developed and relied upon instead of coded wire tags (CWT). Tissue samples were collected from all fall Chinook sampled at LGR, a random sample was analyzed for hatchery origin parentage (for the 60% trap rate period 1 of 9 tissue samples were analyzed and for the 18% trap rate period 1 of 3 samples were analyzed). From this analysis, based on PBT tag expansion, hatchery AD and hatchery AI fish were removed from the unassigned fish. The remaining fish were unknown hatchery and natural-origin fish. From this the run reconstruction team was able to estimate the Snake River fall Chinook run at large. For more information see *Snake River Chinook salmon Lower Granite Dam run reconstruction report; return year 2022,* Young et al. 2023.

Table 3. Estimated composition, standard errors, and confidence intervals for Snake River fall Chinook salmon, males (M) and females (F) reaching LGR during 2022.

	Females	Males	Jacks (<57 cm)	Adults	Totals
Total natural	2,927	3,295	652	6,222	6,874
Total hatchery	12,040	20,839	3,122	32,879	36,001
Totals	14,966	24,135	3,774	39,101	42,875
Natural age 2	2	8	497	10	507
Natural age 3	545	2,512	154	3,057	3,210
Natural age 4	2,124	709	1	2,832	2,834
Natural age 5	254	67	0	321	321
Natural age 6	2	0	0	2	2
Hat age 2	36	17	2,662	53	2,715
Hat age 3	3,671	15,732	435	19,403	19,839
Hat age 4	7,450	4,481	11	11,930	11,941
Hat age 5	705	138	0	843	843
Hat age 6	0	0	0	0	0
Stray age 2	0	0	0	0	0
Stray age 3	10	243	14	253	267
Stray age 4	136	186	0	323	323
Stray age 5	31	42	0	73	73

Fall Chinook salmon arriving at LGR Dam

The following sections use data collected from HOR and NOR SRFCH handled at the LGR adult trap.

Sex Ratio and Length Frequencies

Out of all the fall Chinook sampled at the LGR trap (expanded by the daily trap rate), 28,513 (64.8%) were considered males (includes adults, jacks and minijacks), and 15,433 (35.1%) were considered female based on their morphological characteristics. Based on the expanded sample, the sex ratio of the fish sampled at LGR was estimated at 1.8:1 M:F. After removal of fish for broodstock, the sex ratio SRFCH upstream of LGR 2:1 M:F.

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 62.0 cm with a mean of 61.5 cm. Median fork length for females was 73.0 cm with a mean of 73.0 cm.

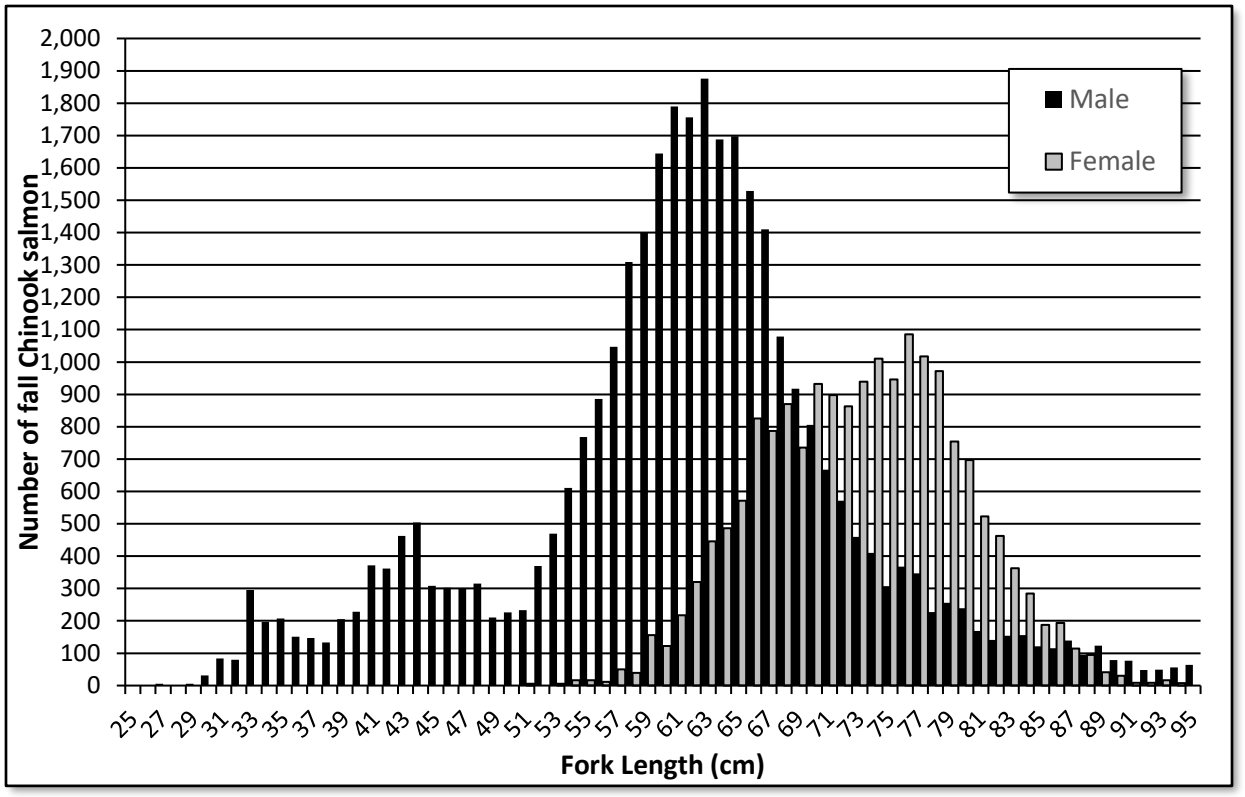

Figure 3. Estimated length frequencies of SRFCH sampled (and expanded by the daily trap rate) at the LGR adult trap in 2022.

Trapping and Broodstock Management 2022

Lower Granite Dam Trapping Operations 2022

In 2022, fall Chinook trapping and hauling at LGR began 18 August. Two trapping rates were used during the season (18 Aug – 29 Aug = 60%, 30 Aug – 12 Nov = 18%). These trapping rates were agreed to by the Snake River basin managers in an attempt to address multiple objectives: 1) collect more natural-origin and older aged fall Chinook for broodstock because they return in greater numbers at the front end of the run, 2) achieve the 30% pNOB target for the hatcheries, and 3) attempt to remain at a 20% or less handle rate impact on natural origin steelhead at LGR (steelhead generally return later than the fall Chinook). The arrival timing of males and females collected for broodstock at LGR and hauled to LFH is provided (Figure 4). In 2022, fish collected for broodstock were not completely representative of the overall run to LGR. The majority of broodstock collection goals were met by the end of September, with most of the fish trapped after that time passed upstream for natural spawning. Trapping protocols and changes that occurred in 2022 are presented in Appendix A. Historical trapping rates and operation dates of systematic sampling at LGR are presented in Appendix B. In general, NOAA Fisheries staff anesthetized the salmon, gather length, sex, fin clip, and the presence of wire or PIT tag.

Of the 11,226 salmon trapped at LGR, approximately 21.5% were hauled to LFH and 7.3% were hauled to NPTH to satisfy brood and run reconstruction needs. The program collected over 50% of the needed female brood (For LFH and NPTH) by August 27th. By September 22nd, 100% of the female brood collection was complete and the run at large was only 39% complete. The remainder of male brood and fish needed for run reconstruction efforts were complete by October 7th when the run at large was 89% complete.

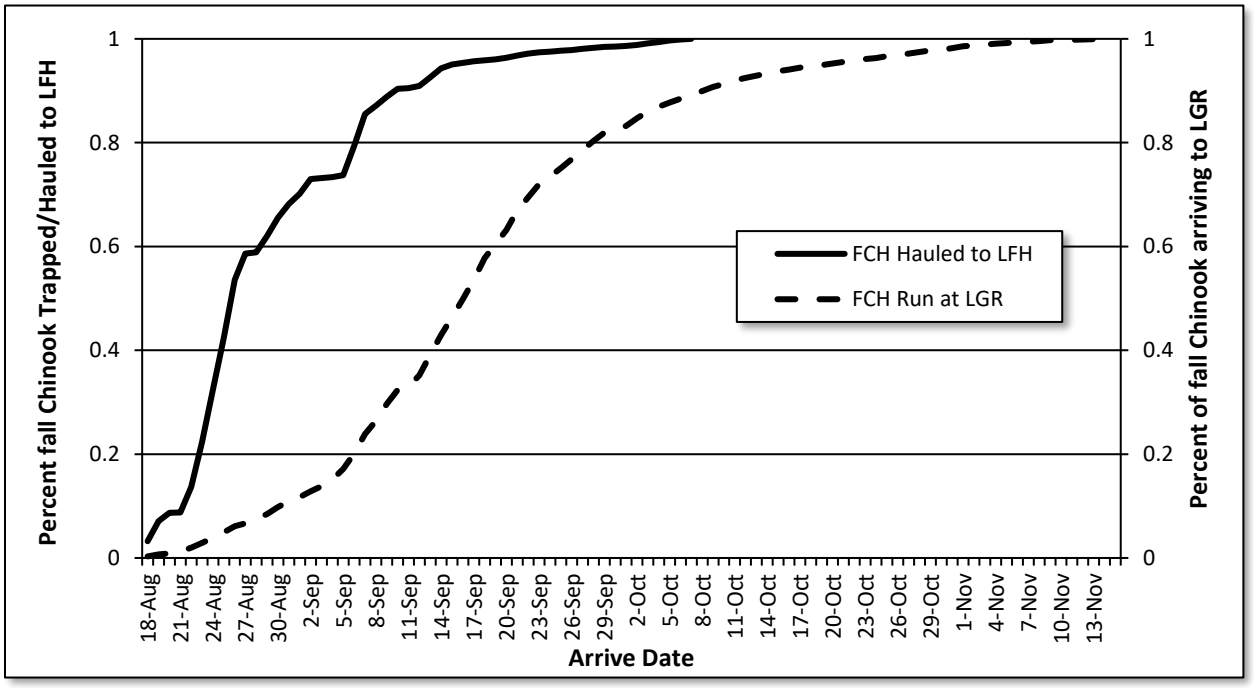

Figure 4. Percent of fall Chinook at LGR that were trapped/hauled to LFH in 2022 compared to the overall return.

Broodstock Collection and Management 2022

In 2022, all fall Chinook salmon collected for broodstock were trapped at LGR. No fish were trapped at LFH or NPTH in 2022. There were 2,389 fish collected and hauled for broodstock, of these 2,317 were spawned, killed onsite or dead in the pond, all fish were processed at LFH. There were 72 fish that were returned to the river and were released at LFH. Each year there is a small discrepancy between the reported number of fish collected and hauled to LFH and the number of fish processed and killed at LFH**.** The discrepancies are likely data recording errors at either location.

Hatchery Operations 2022

Spawning Operations

Spawning and Egg Take

Fish transported from LGR to the adult holding ponds at LFH had approximately 0.52:1 M:F sex ratio in the adults (70 cm or greater), and 12.2:1 M:F sex ratio for fish less than 70 cm. Most of the fish collected that were < 70 cm (mostly jacks and minijacks) were not intended for broodstock use but were for CWT representation in the run reconstruction. Size criteria for mating males was set at 70 cm to reduce the number of potential jacks (HOR and NOR) used for broodstock. Mate selection and spawning protocols changed weekly according to the number of males ripe during the spawn day and to allow for maximum use of larger, older aged, unmarked/untagged fish.

The total egg take and percent egg mortality by year (Table 4), duration and peak of spawning (Figure 5), numbers of fish spawned (Table 5), and the number killed outright or died in the pond are provided (Table 6). Peak spawn timing has shifted approximately 1-week earlier since the program's inception in 1984, and the duration of spawning has decreased compared to early years in the program. Many factors are likely responsible for this shift:

1) Variable trapping locations (IHR, LFH or LGR) over the years or any combination of the three in any given year have provided broodstock.

2) Trapping earlier at LGR in more recent years and bringing brood to LFH earlier could alter spawn timing. Holding water temperatures at LFH are significantly cooler than the Snake River in August and September.

3) Broodstock availability compared to earlier years where the program was often broodstock limited and every fish was needed to fulfill program egg take goals.

Due to the events in 2021 reported in Bumgarner and Fortier (2023), spawning for the 2022 fall Chinook season began a week earlier than previous years to test an egg bank for any mechanical malfunction. There were no malfunctions observed. Fourteen females (one NOR, nine Snake River HOR, three unknown origin, and one stray HOR by PBT) were non-viable. Natural-origin fish used for broodstock were identified post-spawning based on PIT tags, the lack of a CWT recovered, and PBT results obtained at the end of the season. Composition of fish processed at LFH in 2022 is presented in Appendix C. In 2022, egg take goals were attained for LFH as required by the production priority table per the 2018-2027 *US v. Oregon* Management Agreement (Table 2).

Table 4. Egg take and percent egg mortality of fall Chinook salmon at LFH, 1984-2022.

Spawn Year	Total egg take	Egg mortality to eye-up (%) [a]	Spawn Year	Total egg take	Egg mortality to eye-up (%) [a]	Spawn Year	Total egg take	Egg mortality to eye-up (%) [a]
1984	1,567,823	21.6	1997	1,451,823 [c]	5.2	2010	4,619,533	2.7
1985	1,414,342	4.0	1998	2,521,135	5.1	2011	4,723,501	3.5
1986	592,061	4.0	1999	4,668,267	9.4	2012	4,526,108	3.1
1987	5,957,976	3.8	2000	5,143,459	5.9	2013	4,565,660	2.6
1988	2,926,748	3.4	2001	4,734,234	6.4	2014	4,787,615	3.6
1989	3,518,107	5.8	2002	4,910,467	3.6	2015	4,569,472	2.8
1990	3,512,571	8.3	2003	2,812,751	3.1	2016	4,951,188	2.7
1991	2,994,676 [b]	8.3	2004	4,625,638	3.3	2017	4,685,575	5.4
1992	2,265,557 [b]	6.0	2005	4,929,630	3.5	2018	4,754,622	3.3
1993	2,181,879	6.7	2006	2,819,004	3.2	2019	4,670,644	3.1
1994	1,532,404	5.1	2007	5,143,459	3.3	2020	4,603,680	3.1
1995	1,461,500	5.6 [d]	2008	5,010,224	3.7	2021[e]	4,989,169	23.9
1996	1,698,309	4.6	2009	4,574,182	4.7	2022	4,746,926	2.6

[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.

[e] The high egg mortality in 2021 was isolated to a single bank of incubators at LFH which were used for a portion of egg take three and all egg take four. Eggs from take three that were in another bank of incubators were fine and had typical mortality levels. The reason for the high mortality in this single bank of incubators was never determined. Egg survival tests were conducted prior to the 2022 SRFCH spawn in this bank of incubators and mortality was again at a low level and the same as previous years.

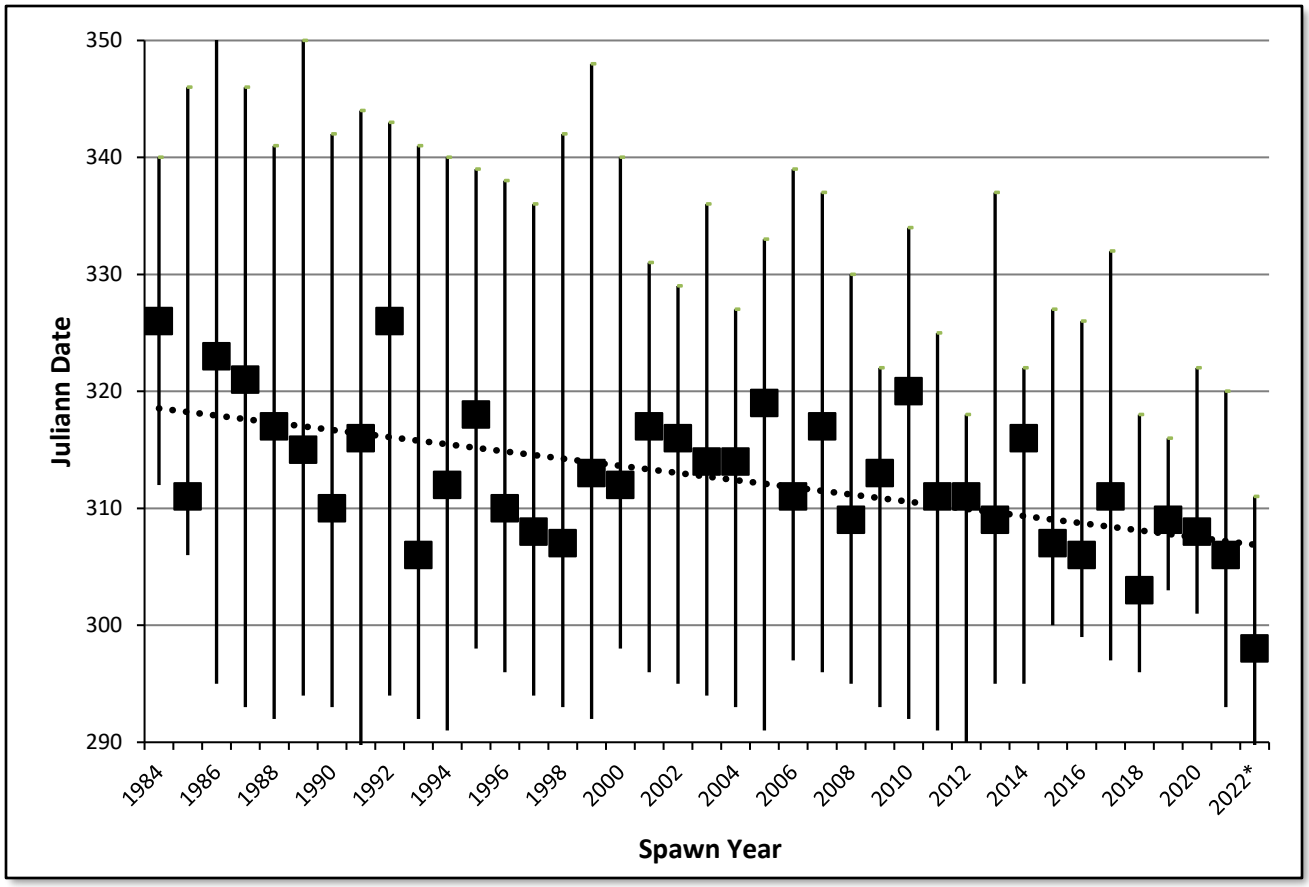

Figure 5. Start, end, and peak spawn days for fall Chinook salmon spawning at LFH, 1984-2022.

* Due to high egg loss in 2021, spawning started a week prior to normal spawn timing to test the egg bank with high egg loss.

Table 5. Spawn dates, numbers of fall Chinook salmon spawned, and weekly egg take at LFH in 2022. Jacks are included with males.

	Males			Females			
Spawn Dates	HOR [ab]	NOR	Unknown Origin	HOR [ab]	NOR	Unknown Origin	Egg Take
11 Oct	21	4		57	3		225,539
18 Oct	96	9		171	32		764,019
25 Oct	164	36		350	78		1,667,567
1 Nov	143	49	2	261	119		1,478,809
7 Nov	46	26		106	53		610,992
Totals	**469**	**124**	**2**	**947**	**285**		4,746,926

[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 PBT.

Table 6. Weekly summary and origins of mortality and surplus fall Chinook salmon processed at LFH in 2022.

Week ending	Mortality				Killed Outright					
	LF/Snake R [a]		Other/Unknown [b]		LF/Snake R.		NOR		Other/Unknown	
	F	M	F	M	F	M	F	M	F	M
20 Aug	1									
27 Aug			4	7						
3 Sept	1		4	1						
10 Sept	2		4							
17 Sep	2	2	6	3						
24 Sep	2	2	4	1						
1 Oct	2	1	8	4						
8 Oct	1		6	2						
15 Oct	2		9	1		222		1	1	30
22 Oct	3	1	6		1	28			1	4
29 Oct		1	2	3		12		1		1
5 Nov		1	3	6	4	8		1		1
12 Nov		2	2	1		6	1			
19 Nov	1	1	2	4	13	15			1	2
Totals	**17**	**11**	**60**	**33**	**18**	**291**	**1**	**3**	**3**	**39**

[a] Includes known LFH or NPTH origin from CWT or PIT tag detection of Snake River HOR.

[b] Includes undetermined HOR and NOR yearlings by scales, HOR strays by scale, CWTs, regenerated scales, and Lost and No CWTs. Most of these are likely NOR SRFCH, but since a fin clip for PBT is not taken during mortality sampling, origin is undetermined.

Fish Returned to River

Collected broodstock not needed to fulfill broodstock or run-reconstruction needs were returned to the Snake River at LFH on 15 November (Table 7). 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 expected number released and that it would not affect run reconstruction estimates as the LGR trap had already closed for the season.

Table 7. Estimated composition of SRFCH released into the Snake River near LFH at the end of the season in 2022.

Origin	Marks/Tags	Females	Males + Jacks	Total
Hatchery	Ad Clip/No CWT	3	2	5
Unmarked/Untagged	Ad Intact/No CWT	40	27	67
Totals		**43**	**29**	**72**

Effective Hatchery Population Size

To determine the effective population size of HOR SRFCH production, the number of males and females spawned at both LFH and NPTH were combined. At both hatcheries, sometimes the

larger males were mated with multiple females to mimic more closely what occurs in nature (Hankin 2009). In 2022, a total of 1,938 females and 1,171 unique males were spawned at both facilities combined. Of the 1,171 males spawned, 767 were used multiple times to:

- Increase the number of larger and older aged adults used in crosses,
- increase the number of NOR 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 2022 was 921. Total effective hatchery population (N_e) size was calculated by the following formula:

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

$$(4 \times (922 \times 1{,}938)) / (922 + 1{,}938) = 2{,}499$$

For the SRFCH 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 6). There is a general decline in the estimated hatchery effective population size observed from 2011-2020, due to the use of older/larger males multiple times in broodstock at both facilities. With less emphasis on spawning younger and smaller males (at a 1:1 spawning ratio), modifications to spawning protocols beginning in 2021 that has helped increase the hatchery effective population size by limiting the amount of times a male is used.

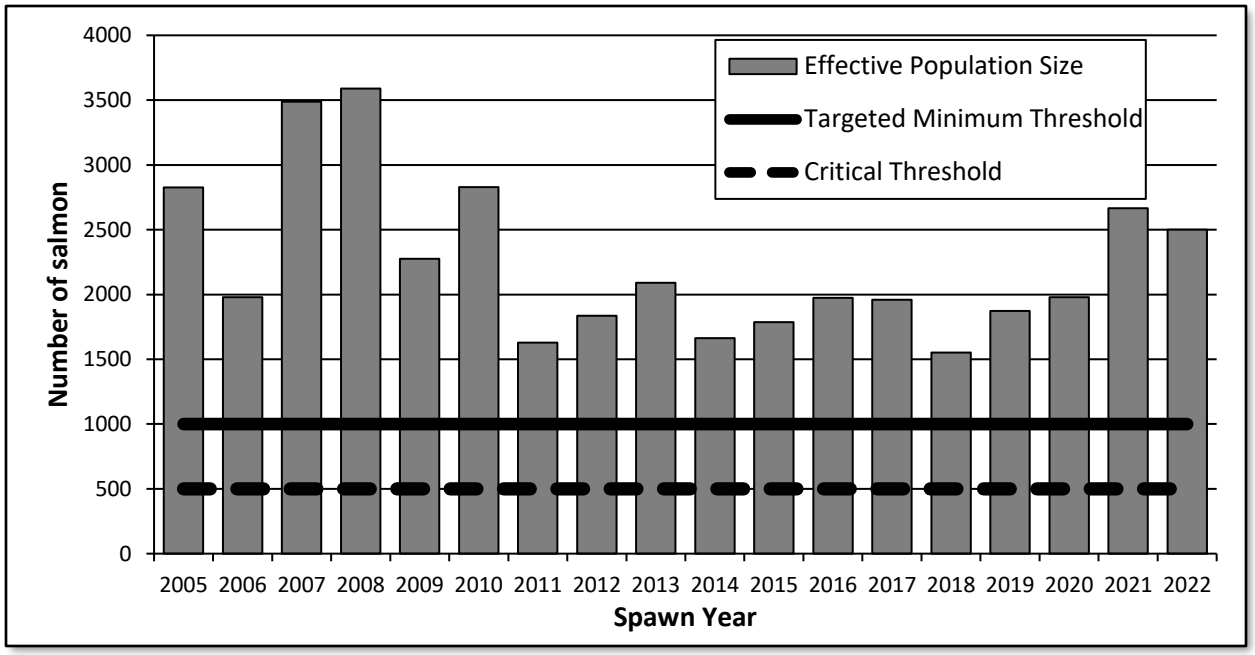

Figure 6. Estimated effective population size of the SRFCH salmon spawned from both LFH and NPTH.

Broodstock Profile

Since 2011, fin tissues have been taken from all fish contributing to broodstock. This was the sixth year PBT results, in conjunction with CWT recoveries, were used to determine origin of the broodstock (Figure 7). Since 2012, scales had been taken on all fish contributing to broodstock to determine salt age and rearing type (subyearling, yearling, or reservoir reared subyearlings). However, starting in 2020, scales were not taken on fish with CWTs to reduce data redundancy and save resources.

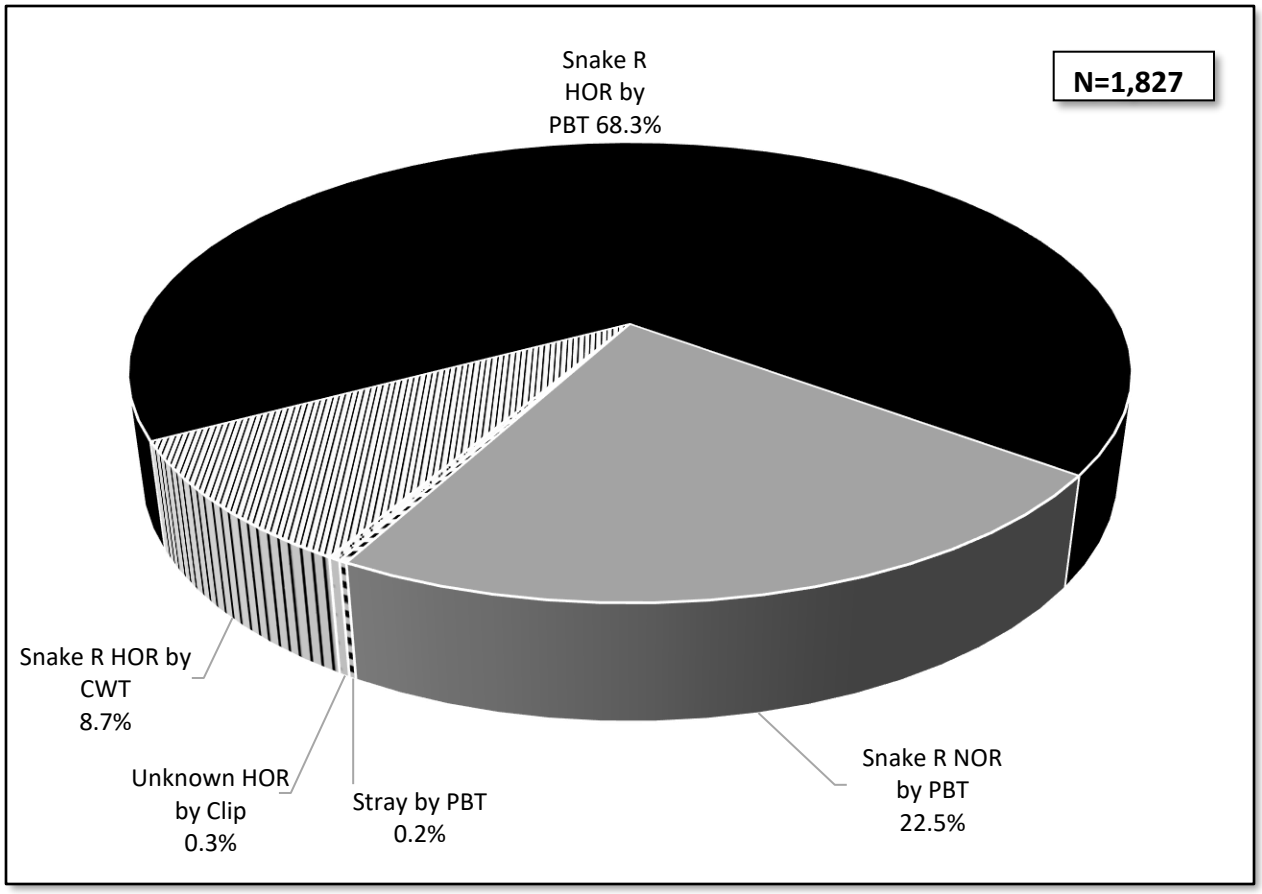

Figure 7. Percentages by fish origin (determined by PBT and CWT methodologies) contributing to fall Chinook salmon broodstock at LFH during 2022.

A concentrated effort has occurred since 2010 to spawn older, larger sized males and females because of the large number of jacks and some jills that had been used in the past. Saltwater age composition of fish used as broodstock are summarized pre- and post-protocol change in 2010 (Figure 8). In 2022, due to egg loss the previous year, as a precaution almost all fish were used during the spawning process. Length frequencies of SRFCH used for broodstock at LFH in 2022 are presented in Figure 9. Males used multiple times during spawning are captured in this figure. Unknown origin can include both HOR and NOR fish, there were not any fish used for broodstock identified as unknown origin in 2022. Median length of fish used for broodstock was 80 cm for females and 83 cm for males. In 2022, an estimated 1.3% of the males and 5.3% of the females were returns from yearling releases.

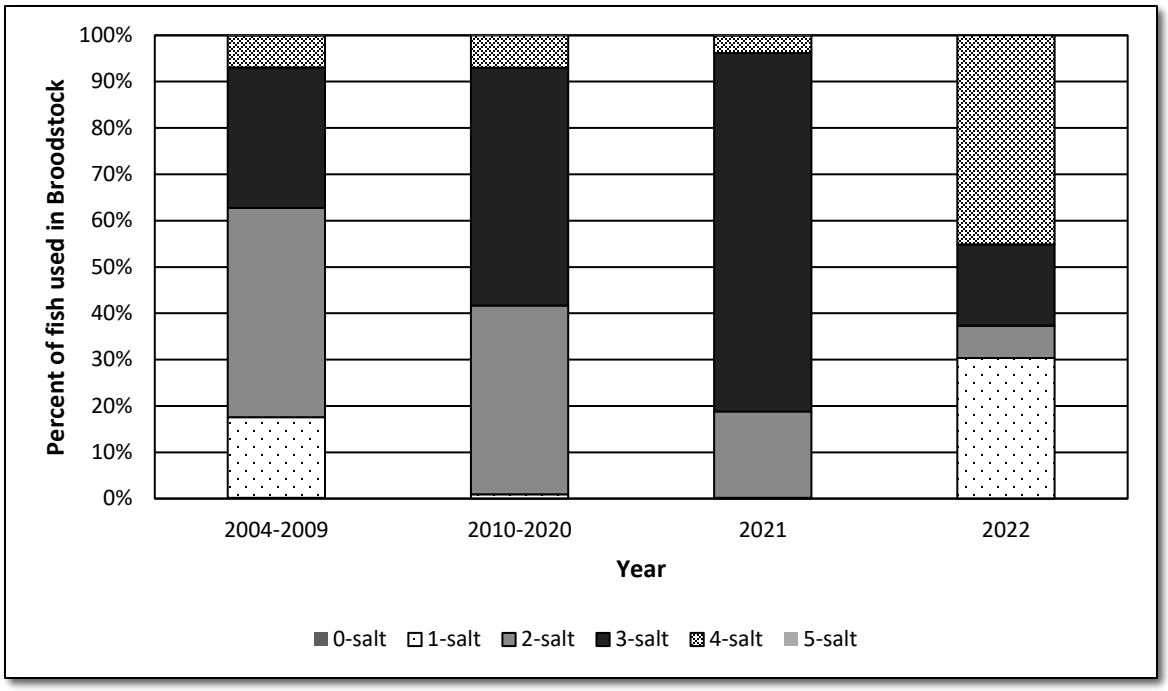

Figure 8. Percentages of salt ages of fall Chinook salmon spawned at LFH before and after changes in broodstock spawning protocols. Brood years 2021 and 2022 are provided for specific reference.

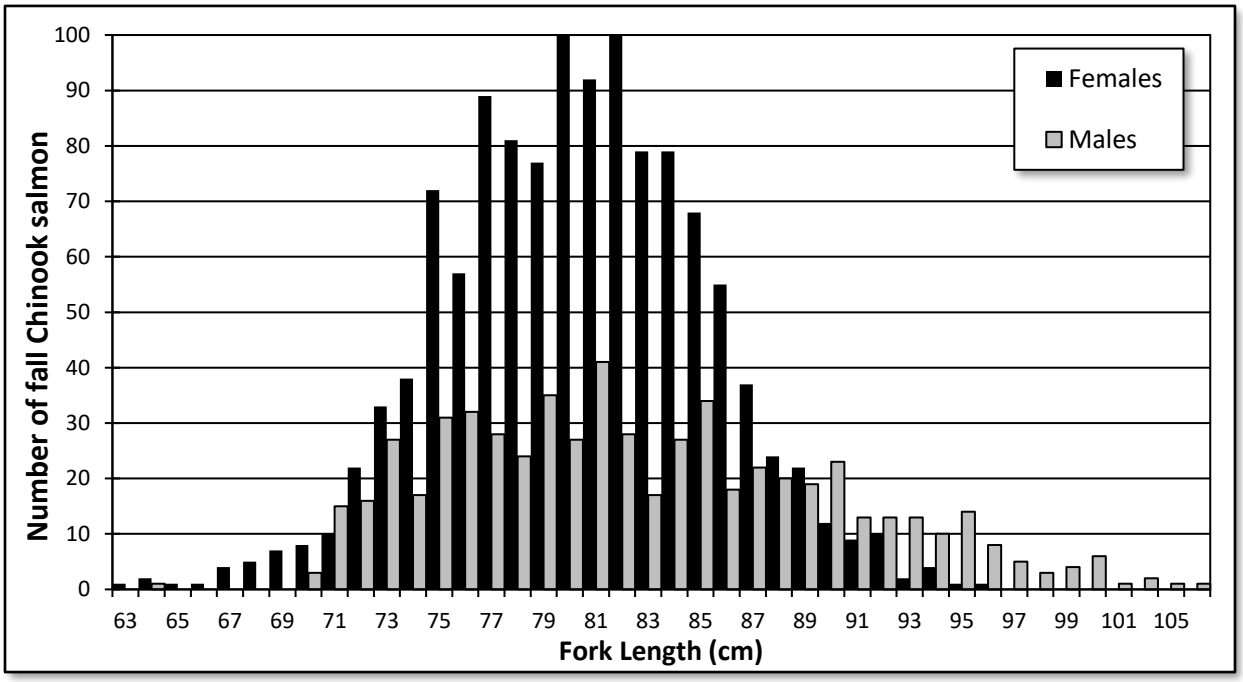

Figure 9. Fork lengths of fall Chinook salmon spawned as broodstock at LFH in 2022.

Males and Females Used in Broodstock

Origin was determined for both male and female fall Chinook contributing to production in 2022. Based on PBT or CWT data, 78.5% of the males spawned were determined to be Snake River HOR. Based on PBT 20.9% of the males were identified as Snake River NOR. An additional 0.3% of the males were identified as unknown HOR based on AD clip, lost/unreadable CWT tags, or yearling scale patterns. Another 0.3% were identified as unknown origin due to individuals failing to genotype, intact adipose and no CWT present. At the start of spawning, the goal was not to exceed four females per male; however, one male was used 5 times, two males were used 6 times (Table 8). Like the males, based on PBT or CWT data, 76.1% of the females spawned were Snake River HOR, with PBT determining that 23.1% of the females were Snake River NOR. Another 0.3% were determined to be stray HOR based on PBT or CWT data (Table 8). None of the females were identified as unknown origin due to individuals failing to genotype, intact adipose and no CWT present.

Table 8. Origin of males and females that contributed to production (by PBT or CWT) at LFH, 2022.

Origin determination method	Times each fish was used for mating							
	1	**2**	**3**	**4**	**5**	**6**	**Total unique**	**% Used**
				Males				
Snake R Hatchery	138	210	103	13			**466**	**78.5%**
Snake R Natural	10	62	51			2	**124**	**20.9%**
Unknown Hatchery	1		1		1		**2**	**0.3%**
Stray Hatchery							**0**	**0.0%**
Unknown Origin		1	1				**2**	**0.3%**
Total unique males	**149**	**273**	**156**	**13**	**1**	**2**	**594**	
				Females				
Snake R Hatchery	937						**937**	**76.1%**
Snake R Natural	285						**285**	**23.1%**
Unknown Hatchery	6						**6**	**0.5%**
Stray Hatchery	4						**4**	**0.3%**
Unknown Origin	0						**0**	**0.0%**
Total unique females	**1,232**						**1,232**	

Inclusion of NOR fish in broodstock

Inclusion of NOR unmarked/untagged fall Chinook salmon were incorporated into the broodstock beginning in 2002 (Figure 10). To estimate the proportion of natural origin brood (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 the estimated NOR at LGR from the run reconstruction method. Since 2016, a separate estimate of pNOB has been derived based on the fish spawned, including males that were used more than once, with origins

determined from a combination of PBT, CWT and PIT tags. The pNOB estimates from spawning have generally been higher than what was 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 NOR) males, which would in theory increase pNOB. Historically, figure 10 showed a comparison of how the two estimates tracked, moving forward only the PBT estimate will be reported. In 2022, the estimated pNOB in the WDFW broodstock was 19.6% (Figure 10). The overall spawned hatchery pNOB for LFH and NPTH combined was 20.4% and the predicted proportion of natural origin spawners (pNOS) by the run reconstruction method, 16.6%. Beginning in 2022, estimates for pNOB were no longer calculated by run reconstruction efforts. Estimates will continue to be calculated through PBT methods.

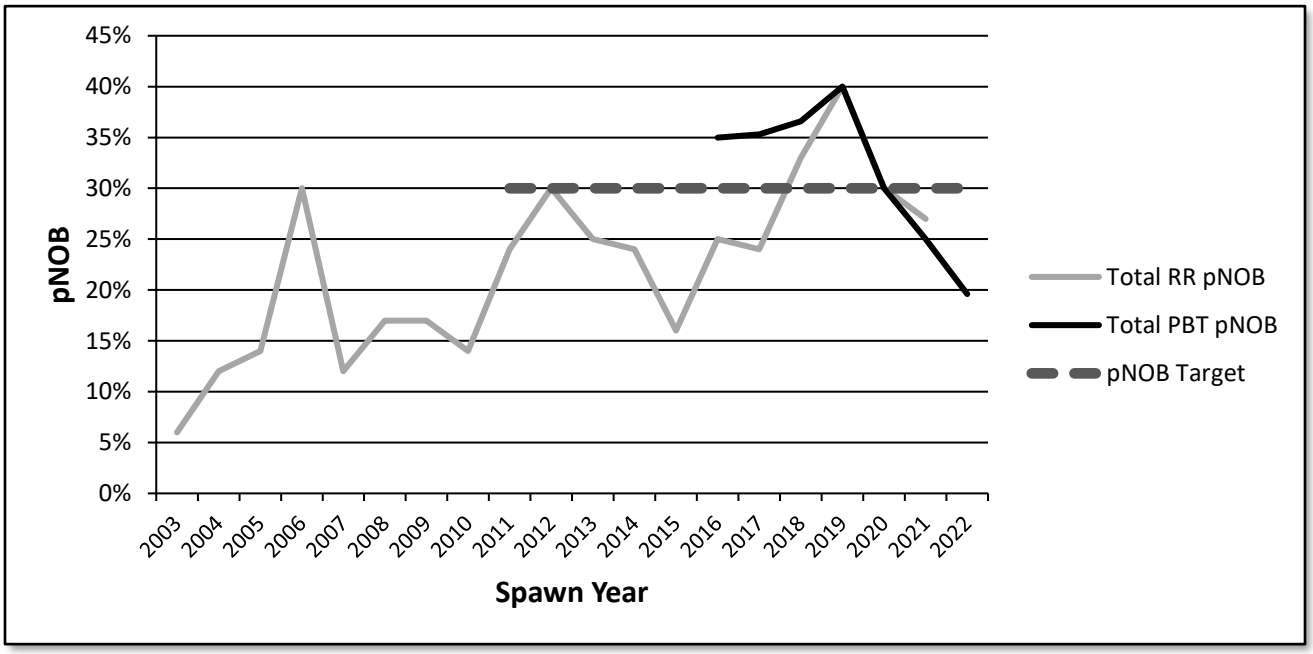

Figure 10. Estimated percent NOR parents in the broodstock (pNOB) at LFH and NPTH combined, based on the run reconstruction estimate (2003-2021) or by PBT results from spawned fish at the hatchery, 2003-2022. The pNOB target for the program is 30%. Beginning in 2022, the run reconstruction estimate is no longer estimating pNOB.

Jacks and Jills and Stray Fall Chinook Salmon in Broodstock

As described previously, 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. Limited use of jacks and jills in the broodstock began in 2010 to minimize their overall contribution. This management action has reduced the total matings with 0 and/or 1-salt parentage by 97% over the last 12 years (Appendix D).

The WDFW preferred goal is to fully exclude strays from broodstock to maintain the genetic integrity of the SRFCH salmon that LFH produces. In cases where we are broodstock limited, it was agreed that strays may be included up to 5% of the spawners. To assure productions goals were met as mandated in the 2018-2027 *United States v. Oregon* Management Agreement, four females were designated as strays by PBT assignment after spawning occurred, there were no stray males spawned. These females were spawned and the gametes were retained. Due to high egg loss in the previous year, all viable gametes from strays were kept as a failsafe to the program to fulfill production goals. The overall average of stray x stray crosses is 0.6% of the total production from years 2007-2022. Strays retained as broodstock over the years are presented in Appendix D. 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 are included in Table 9. Historical egg take and ponding information is listed in Appendix E. Rearing followed standard hatchery procedures as described in the SRFCH salmon HGMP available at the LSRCP website. Further detailed information regarding type and size of vessels used for rearing SRFCH can be found in LFH Annual Reports available at the LSRCP website. http://www.fws.gov/office/lower-snake-river-compenstation-plan/library

Marking and tagging of fish was consistent with the 2018- 2027 *US v. Oregon* Management Agreement. The LFH yearling (BY21) fish were 100% ADCWT marked/tagged in the early summer of 2022. Staff performed tag and fin clip quality control checks from a sample prior to release from the raceway (Table 10). A portion of the subyearling release group (BY22) were ADCWT marked/tagged in the spring of 2023. All on-station release subyearlings (marked/tagged and unmarked/untagged) were diverted to the rearing lake after the yearlings were released in late March. Subyearling fall Chinook (BY22) reared at Irrigon FH were ADCWT marked/tagged in the spring of 2023 and released in late May.

Table 9. Eggs taken and survival numbers by life stage of fall Chinook salmon spawned at LFH, brood years 2015-2022.

Brood year	Eggs taken	Egg loss	Eggs culled [a]	Eggs shipped	Eyed eggs retained	Fry ponded	Intended program
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	720,237	Yearling
						3,783,377	Subyearling
2020	4,603,680	141,273	58,258	1,311,219	3,092,930	462,636	Yearling
						2,493,880	Subyearling
2021	4,704,700	1,193,437	0 [c]	0 [c]	3,511,263	469,700	Yearling
						2,923,404	Subyearling
2022	4,611,400	109,139	15,207	1,376,246	3,110,808	467,774	Yearling
						2,778,560	Subyearling

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

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

[c] Due to egg loss, all eggs were kept. None of the eggs were culled or shipped.

Table 10. Numbers of fall Chinook salmon sampled by WDFW for marking and tagging quality control checks.

Brood Year	Group	Release site	Mark type	CWT	Number sampled	AD/ CWT	AD clipped only	CWT only	Unmarked/ untagged
2021	Yearling	LFH	ADCWT	638417		3366	33	6	7
						(98.7%)	(0.97%)	(0.18%)	(0.21%)
2022	Subyearling	LFH	ADCWT	638438		561	16	0	0%
						(97.2%)	(2.8%)	(0.0%)	(0.00%)
2022	Subyearling	GRR	ADCWT	638057		1435	209	3	0
						(96.9%)	(2.9%)	(0.18%)	(0.0%)

In Hatchery Survival Rates to Release

The estimated number of eggs and fish present at life stages in the hatchery were used for 2015-2022 release years to calculate survival rates within the hatchery environment (Table 11). The original survival goal for the program was 80% [(9,160,000 subyearling juveniles/11,450,000 eggs) x 100] from USACE 1975. Prior to 2021, the survival goal had been

achieved each year for yearlings since 2003 and each year for subyearlings since 1990 (Table 11).

Table 41. Estimated survivals (%) between various life stages at LFH for fall Chinook salmon, 2014-2022 subyearling and yearling brood years.

Brood year	Subyearling Green egg-ponded fry %	Yearling Green egg-ponded fry %	Subyearling Ponded fry-release [a] %	Yearling Ponded fry-release [a] %	Subyearling Green egg-release %	Yearling Green egg-release %
2014	95.2	95.2	98.5	97.1	93.8	92.5
2015	94.6	94.6	99.5	100.1	94.2	94.7
2016	94.9	94.9	94.2	87.3	94.2	82.8
2017	92.2	92.2	96.7	95.4	89.2	88.0
2018	94.4	95.3	98.9	91.9	93.3	86.7
2019	95.2	95.2	100.0	86.9	82.7	82.7
2020	95.0	95.0	99.9	86.0	94.0	82.0
2021	76.0	NA	75.1	NA	56.9	NA
2022	96.2	96.2	88.0	93.3	84.7	89.8
Mean	**92.7**	**92.7**	**96.0**	**89.6**	**89.1**	**89.6**
SD	**6.5**	**6.5**	**8.5**	**7.9**	**13.2**	**7.9**

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

Fish Health Sampling

Fish health sampling at LFH on SRFCH occurs occasionally or as needed. In the last few years, and for BY21 yearlings or BY22 subyearlings, no disease issues occurred. Currently, pre-transfer fish health sampling is required for all FCAP program fish since we are transferring them to another agency and across state boundaries. For the on-station releases at LFH, no pre-liberation fish health sampling occurs. However, WDFW plans on re-initiating pre-liberation fish health sampling for all transfer/release groups (and all species at LFH) in the near future.

Juvenile Releases

Yearling fall Chinook salmon were released at LFH from 30 March through 1 April 2023 (Table 12). At the time of release, a sample of fish were measured and weighed (n=424). 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 434,010 were released, with approximately 428,159 that were ADCWT, 4198 were adipose only, an additional 763 were CWT only due to tagging error, and 890 were released as unmarked/untagged. Size at release was estimated at 10.0 fish/lb (fpp). Releases in 2023 were later than the last three years but align with historical releases pre-2020. Historical yearling and subyearling releases from 2010 to 2023 by WDFW, IPC and NPT are available upon request to WDFW. All WDFW fall Chinook releases from 2023 are provided in Appendix F.

Subyearling fall Chinook salmon at LFH were released 9-10 May 2023. On the first day of release, a subsample of fish (n=424) were measured and weighed (Table 12). The unmarked/untagged group was mixed with the ADCWT group when tagging occurred. Staff performed QC's, however due to either sampling error or trailer error, QC data did not match the tagging trailer data. All the subyearling groups were averaged to get an overall tagging loss and poor clip rate, this was then applied to the tagging trailer numbers. 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 765,331 were released, with 201,852 as an ADCWT group, 1,536 CWT only, 276 adipose fin clip only, and 561,667 were released as unmarked untagged. Size at release was estimated at 51.5 fpp. The release occurred during a slightly increasing hydrograph in the Snake River.

Subyearling fall Chinook salmon reared at Irrigon FH were released into the GRR on 25 and 26 May 2023. An estimated 245,823 were released, with 214,181 as an ADCWT, 31,194 adipose fin clip only, 448 were CWT only, and non were unmarked/untagged. A day prior to release, a subsample of fish (n=223) were measured and weighed (Table 12). The tagging trailer ran out of wire but continued to AD clip, because of this QC data was adjusted. 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 45.0 fpp, compared to 48.6 fpp calculated from individual length/weight sampling from SRL staff.

Table 52. Length and weight data from fall Chinook salmon released at LFH or in the GRR in 2023.

Length/weight data	Yearling Snake R at LFH	Subyearling Snake R at LFH	Subyearling GRR at Cougar Creek
Sample date(s)	30-31 March	8 May	28 April
CWT code	638417	638438	638057
Number sampled	424	424	223
Avg. length (mm)	159	89	94
Median length	160	90	95
Range of lengths	125-196	78-111	78-111
SD of lengths	11.0	5.3	6.4
CV of length (%)	6.9	5.9	6.8
Avg. weight (g)	43.8	8.2	NA9.3
SD of weight	9.4	1.6	2.0
Avg. K factor	1.07	1.14	1.10
FPP [a]	10.3	51.5	48.6
Precocious (%)	0.0%	0.0%	0.0%

[a] The fish/lb sample shown here for the yearlings differs from what is reported by hatchery staff as a final number. Throughout each release at LFH, multiple pound count samples are taken by hatchery staff and are likely more accurate than the single

sample taken by evaluation staff. However, the subyearling sample by Evaluation staff, and that from LFH hatchery staff were the same.

PIT Tagging, Migration Timing, Travel Speed and Survival

Staff have routinely PIT tagged a subset of the LFH and GRR releases for the purpose of juvenile survival estimates, monitoring outmigration timing, estimating adult returns in-season, and estimating conversion rates between IHR and LGR for the 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, thereby representing the entire release group during out-migration.

Staff PIT tagged 10,000 BY21 yearlings on 30 March and 15,000 BY22 subyearlings on 8 May 2023. Tagged fish were held for one day in the release structure raceway following tagging, and then released directly to the Snake River. Before fish were released the following day, mortalities were collected and scanned for PIT tags. The holding raceway was then immediately scanned for shed tags after the PIT tagged fish were released to the river. Any tags from mortalities, or shed tags recovered were re-inserted into new fish and released the same day. SRL and IPC staff PIT tagged 4,500 BY22 subyearlings in late April 2023 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 August 2023 for the two LFH on-station releases and GRR release in 2023. Interrogation summaries were used to populate Tables 14-16.

Table 63. Migration timing of PIT tagged yearling fall Chinook released at LFH in 2023. Dam abbreviations are as follows: LMO – Lower Monumental, IHR – Ice Harbor, MCN – McNary, JDD – John Day, and BONN – Bonneville.

Yearlings released at LFH	LMO	IHR	MCN	JDD	BONN [a]
Number Detected	**123**	**162**	**416**	**225**	**378**
Median Travel Days from LFH [b]	12.8	14.1	21.8	28.9	32.3
Median Passage Date	4/12	4/14	4/21	4/28	5/2
First Detection Date	4/1	4/7	4/9	4/16	4/17
Last Detection Date	4/30	5/7	5/7	5/26	5/27
10% of Run Passage Date	4/7	4/9	4/14	4/20	4/24
90% of Run Passage Date	4/18	4/20	4/28	5/5	5/6
TDG on Median Date (%)[c]	119	115.9	114.6	116.8	112.8
Average Discharge on Median Date of Passage (kcfs)[c]	76.3	60.2	143.6	152.6	259.5
Spill on Median Date (kcfs)[c]	63.7	61.0	136.4	153.8	269.8

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

Table 74. Migration timing of PIT tagged subyearling fall Chinook released at LFH in 2023. Dam abbreviations are as follows: LMO – Lower Monumental, IHR – Ice Harbor, MCN – McNary, JDD – John Day, and BONN – Bonneville.

Subyearlings released at LFH	LMO	ICH	MCN	JDD	BONN [a]
Number Detected	**2,250**	**838**	**663**	**247**	**402**
Median Travel Days from LFH [b]	5.4	9.9	14.2	18.9	21.8
Median Passage Date	5/14	5/18	5/23	5/27	5/30
First Detection Date	5/19	5/12	5/15	5/19	5/20
Last Detection Date	6/16	6/4	6/11	6/20	6/17
10% of Run Passage Date	5/11	5/16	5/17	5/21	5/25
90% of Run Passage Date	5/9	5/23	5/27	6/3	6/6
TDG on Median Date of Passage (%)[c]	118.6	124.5	126.8	120.5	113.7
Avg Discharge on Median Date of Passage (kcfs)[c]	110.3	149.0	406.1	296.0	281.5
Spill on Median Date of Passage (kcfs)[c]	42.3	109.7	297.1	159.0	149.4

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

Table 85. Migration timing of PIT tagged subyearling fall Chinook released at GRR in 2023. Dam abbreviations are as follows: LMO – Lower Monumental, IHR – Ice Harbor, MCN – McNary, JDD – John Day, and BONN – Bonneville.

Subyearlings released at LFH	LGR	LGO	LMO	ICH	MCN	JDD	BONN [a]
Number Detected	**1,956**	**188**	**80**	**52**	**74**	**79**	**105**
Median Travel Days from LFH [b]	26.4	13.0	31.5	37.5	30.8	34.2	26.4
Median Passage Date	6/20	6/7	6/25	7/1	6/24	6/28	6/20
First Detection Date	5/28	5/31	6/2	6/6	6/6	6/9	6/5
Last Detection Date	7/11	7/21	7/10	7/17	7/11	7/17	6/16
10% of Run Passage Date	6/3	6/3	6/5	6/15	6/12	6/15	6/15
90% of Run Passage Date	7/1	7/1	7/6	7/9	7/7	7/8	7/6
TDG on Median Date of Passage (%)[c]	116.0	118.9	117.0	113.2	116.8	115.9	105.5
Avg Discharge on Median Date of Passage (kcfs)[c]	63.4	90.2	44.6	44.4	151.7	160.4	173.5
Spill on Median Date of Passage (kcfs)[c]	60.5	56.2	17.0	109.7	97.3	56.3	95.5

[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 11-16). For most years provided below, downstream survival estimates for all groups were derived using DART (http://www.cbr.washington.edu/dart), but PITPRO is used on certain instances. PITPRO incorporates mortalities and recaptures into the estimated calculation, and occasionally will

provide a valid survival estimate where DART doesn't. Comparison of survival estimates from these two programs when both are available are generally within a percent or two.

Survival to LGR from the GRR releases average about 75% but have varied widely over time from 45% to 100% (Figure 11). Migration speed to LGR has also decreased in the last few years and may explain the slightly lower survival to LGR (Figure 12).

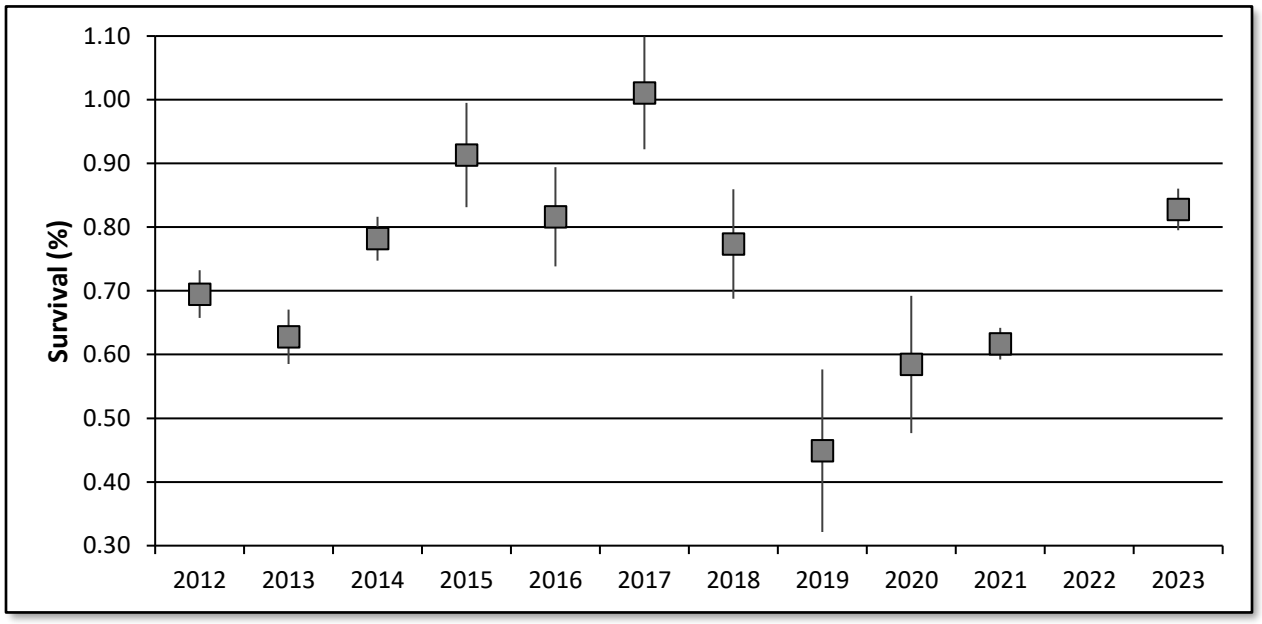

Figure 11. Survival and standard error of SRFCH subyearlings released into the Grande Ronde River near Cougar Creek to LGR, 2012-2023 migration years. Note: Due to egg loss for BY21, there is no release group for 2022.

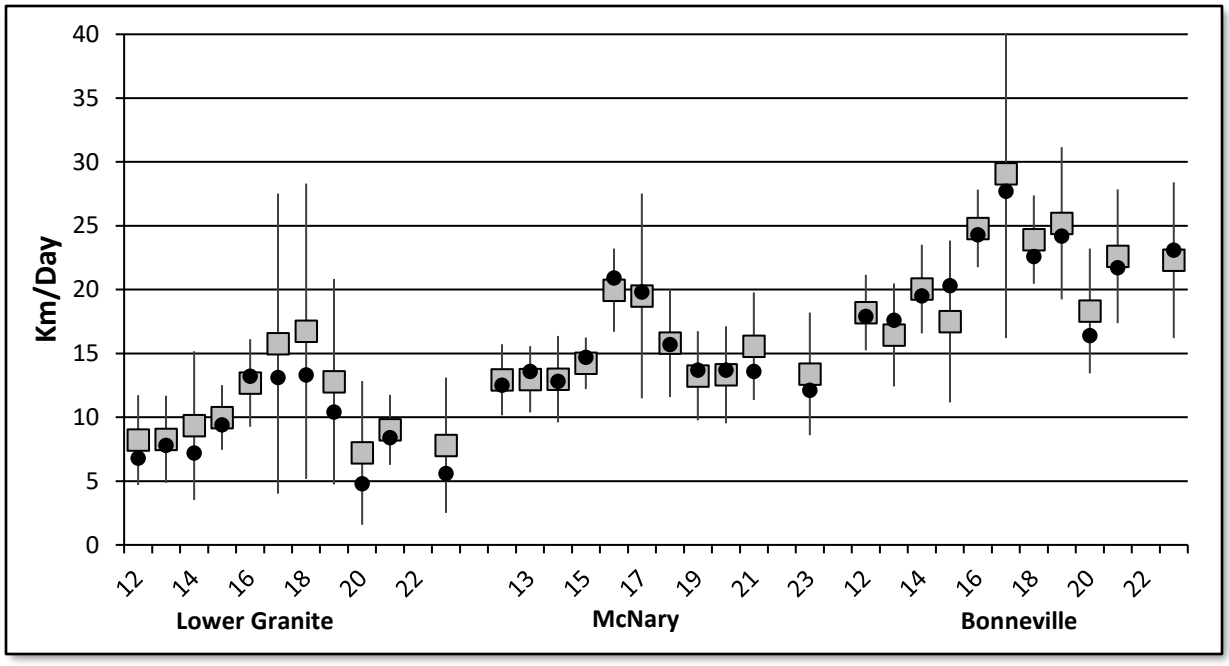

Figure 12. Average travel speed (Km/day with S.D.) and median travel speed (black dot) of SRFCH subyearlings released into the Grande Ronde River near Cougar Creek to LGR, McNary, and Bonneville Dams, 2012-2023 migration years. Note: Due to egg loss in BY21 there is no release group for release year 2022.

Survival of the on-station subyearling release to Lower Monumental Dam has declined in recent years (Figure 13). Migration speed has also decreased in the last few years and may explain the slightly lower survival to Lower Monumental Dam (Figure 14).

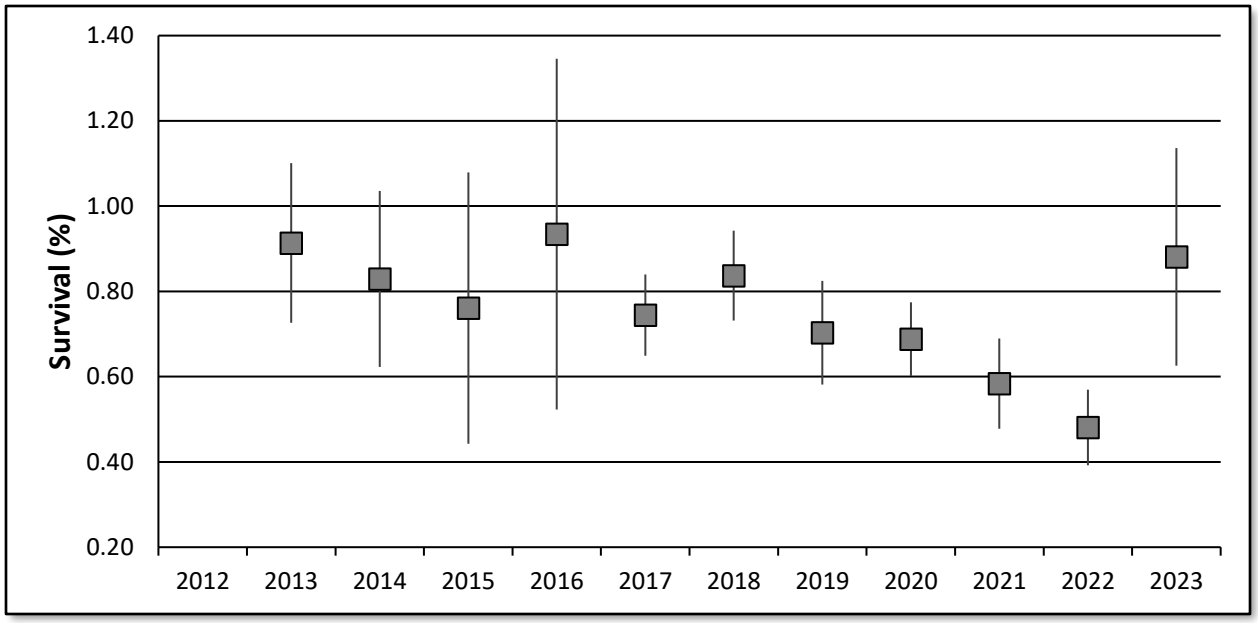

Figure 13. Survival and standard error of SRFCH subyearlings released into the Snake River at LFH to Lower Monumental Dam, 2013-2023 migration years. Note: An estimate for 2012 could not be generated. 2021 and 2023 estimates from DART were not valid. PITPRO represents those estimates.

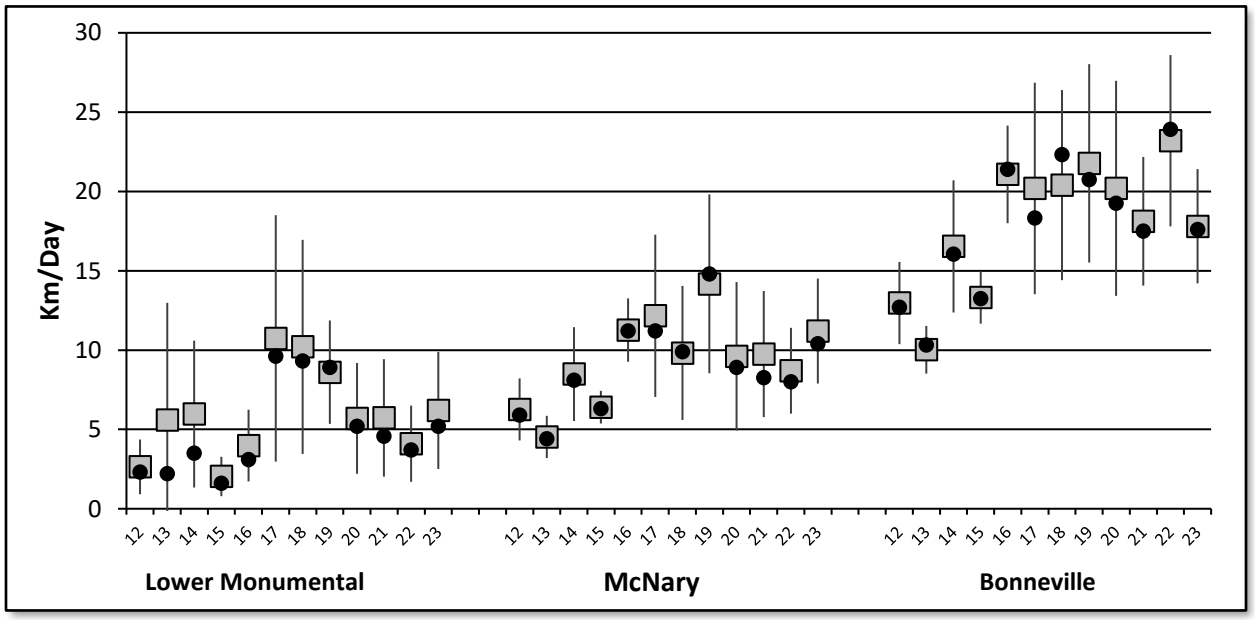

Figure 14. Average travel speed (km/day with S.E.) and median travel speed (black dot) of SRFCH subyearlings released into the Snake River at LFH to Lower Monumental, McNary, and Bonneville Dams, 2012-2023 migration years.

Survival of the on-station yearling release to Lower Monumental Dam was generally around 90% except from 2019-2022 (Figure 15). Yearling migration speed had generally remained constant over the years except the last four migration years (Figure 16). 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 for 2023 was higher than the previous four years (Figure 15). Historically, yearling releases were in the second week of April, however from 2019-2022 releases were mid-March, in 2023 the yearling release moved back to the beginning of April. Travel speed was similar to 2022 to Lower Monumental and McNary and slightly higher to Bonneville (Figure 16).

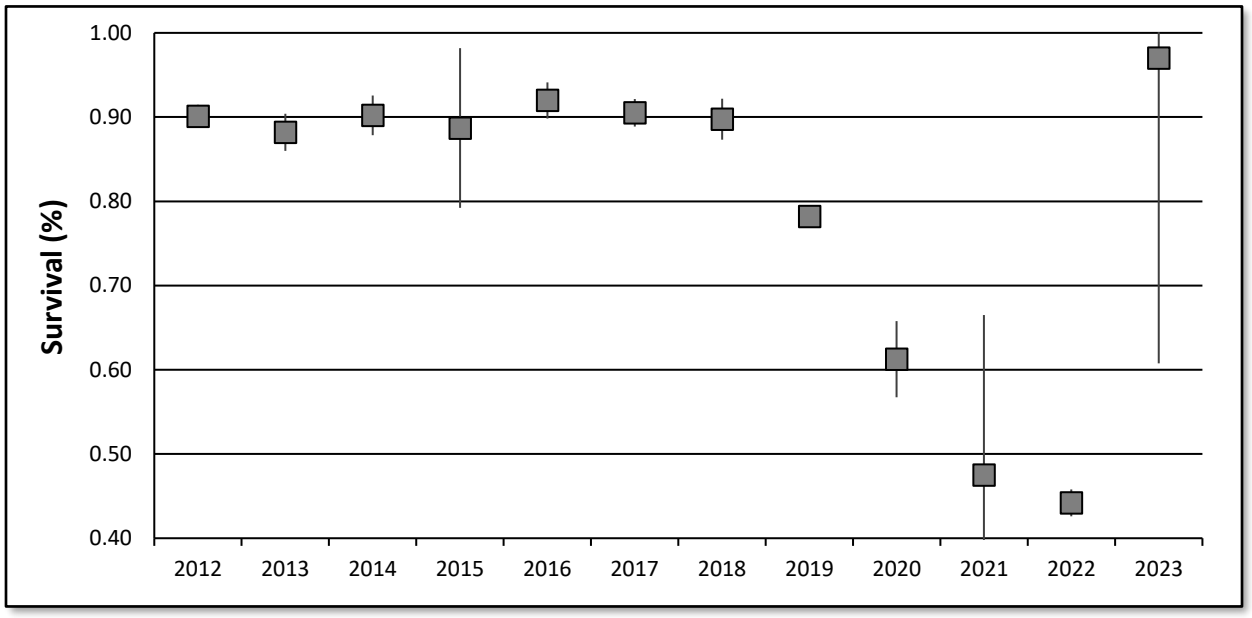

Figure 15. Survival and standard error of SRFCH yearlings released into the Snake River at LFH to Lower Monumental Dam, 2012-2023.

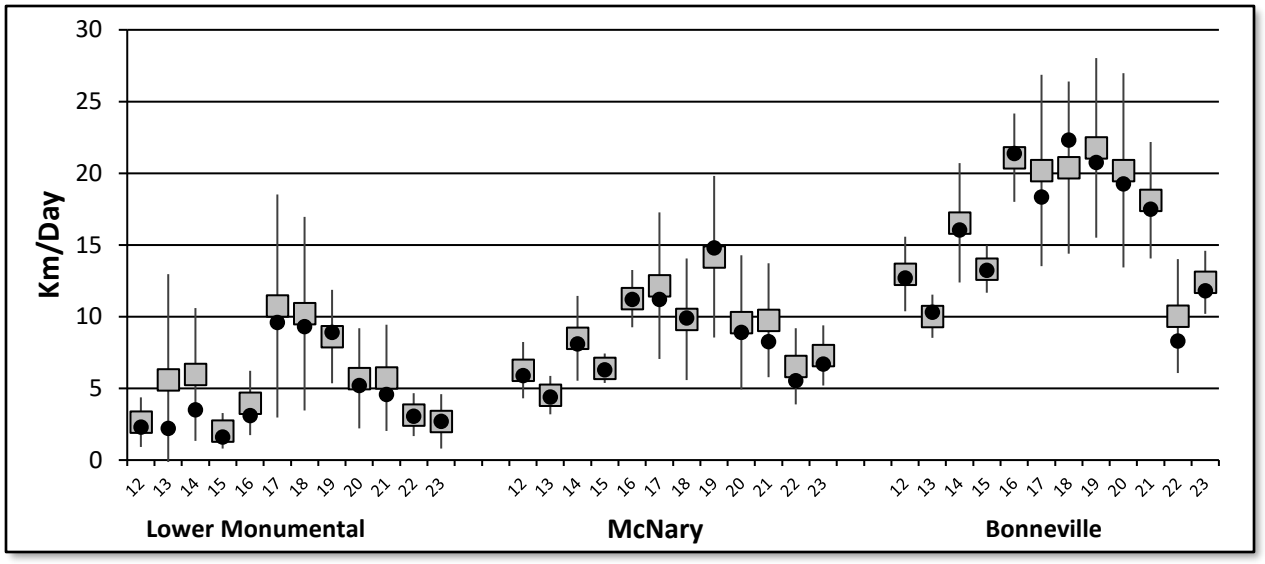

Figure 16. Average travel speed (km/day with S.E.) and median travel speed (black dot) of SRFCH yearlings released into the Snake River at LFH to Lower Monumental, McNary, and Bonneville Dams, 2012-2023 migration years.

The reason why the yearling release date was moved forward was a direct result of changes that were made to the SRFCH 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 one of the large rearing lakes for the final 1.5-2 months of subyearling rearing – which we hypothesized would benefit their post-release survival. To take advantage of that, it was decided to advance the release time of yearlings by about two weeks. While reported survival to Lower Monumental Dam has dropped off considerably in the last four years, it's unclear if these estimates are completely valid. Since yearling fall Chinook are released generally 2-3 weeks prior to when the extended bypass screens are set in place at the dams, survival estimates are likely being biased low because many fish are passing the dams without being detected in the bypass facilities. Given that possibility, survival estimates to other downstream locations were also generated using DART to see if releasing this group of fish earlier has potentially had a negative effect on overall survival. Based on estimates to locations downstream, it does appear that previous years releases may be somewhat lower, but not to the extent as indicated by the survivals to Lower Monumental Dam (Figure 17). As of 2022, WDFW decided to move the yearling release back to approximately March 31, closer to when historical releases occurred.

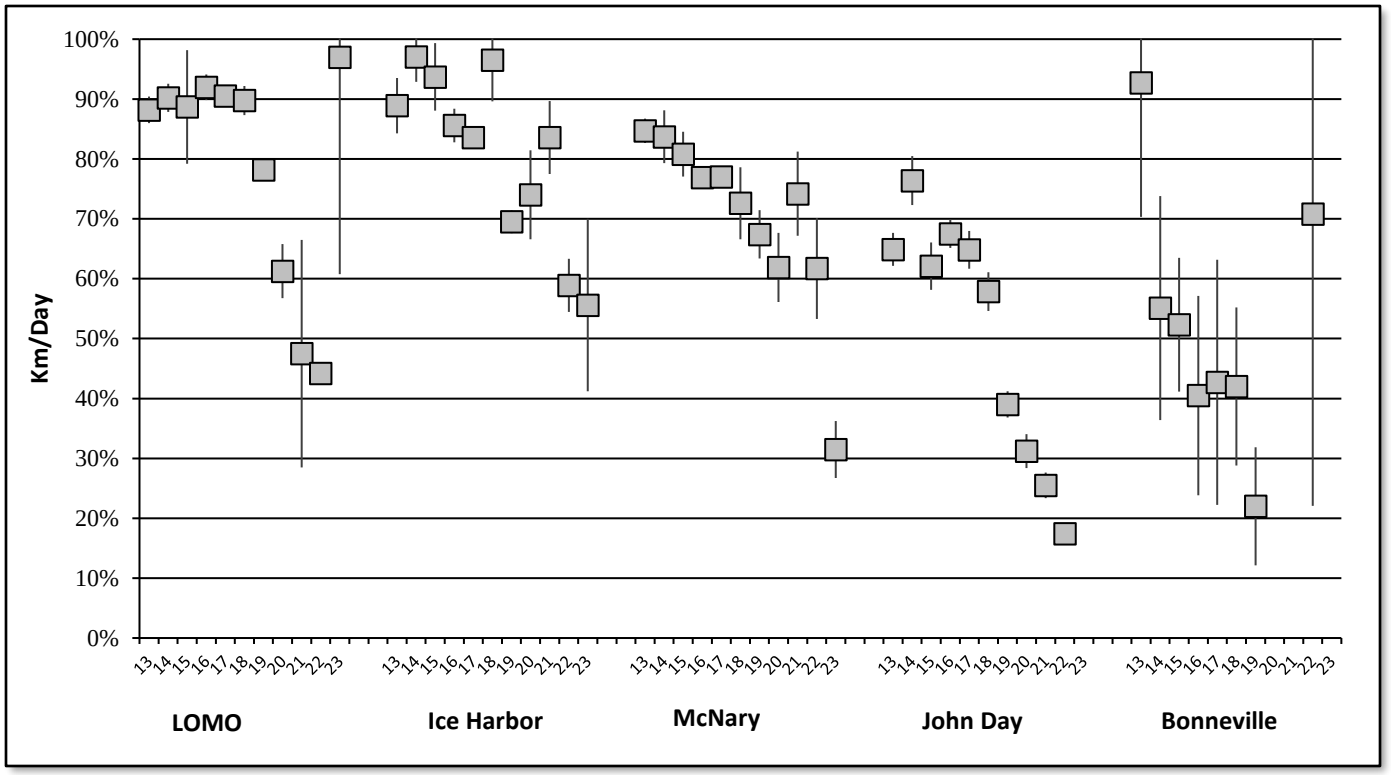

Figure 17. Survival and standard error of SRFCH yearlings released into the Snake River at LFH to Lower Monumental Dam (LOMO), Ice Harbor, McNary, John Day, and Bonneville Dams, 2012-2023 migration years.

Tucannon River Natural Production 2022

Spawning Ground Surveys

WDFW personnel have conducted spawning ground surveys for fall Chinook salmon on the lower Tucannon River since 1985 (Appendix H). Survey sections in 2022 covered the river from river kilometer (rkm) 1.1-22.4. 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 river flow in that area, spawning is considered minimal. During 2022, landowner access restrictions prevented the surveying of 1.6 rkms near the Starbuck Bridge within survey sections 5 and 6 (Appendix H). Regular weekly surveys began the week of 18 October and continued until the week of 13 December.

A total of 557 redds (combination of fall Chinook and coho) were counted in the surveyed areas of the Tucannon River (Table 15). Through our redd expansion of 3 fish/redd and based on the

number of redds in adjacent survey sections it was estimated an additional 127 redds occurred in sections not surveyed. An estimated total of 684 total redds (524 fall Chinook salmon and 160 coho salmon redds) were constructed in the Tucannon River during 2022.

Table 96. Date and number of salmon redds and carcasses counted on the Tucannon River in 2022.

Week beginning	Total redds [a] Chinook & Coho [b]	Carcasses sampled Chinook	Coho
Prespawn survey 18 Oct	13	0	1
25 Oct	148	3	3
1 Nov	99	27	6
8 Nov	7	93	32
15 Nov	160	78	26
22 Nov	57	46	9
29 Dec	56	17	7
6 Dec	17	27	6
13 Dec	0	10	1
Totals	**557**	**301**	**91**

[a] Observed redds not expanded for sections with access restrictions, or not surveyed at all.

[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

Previously, the estimated number of fall Chinook redds to the Tucannon River was based on the composition of redds (Chinook or coho) estimated by; 1) surveyor assignment of what species made a particular redd, or 2) from the proportions of carcasses recovered for the season. However, a standard method wasn't adopted. In 2020, evaluation staff began comparing three different methods to determine the most consistent way to provide an estimate of fall Chinook and coho for the future. These three methods are: 1) based on the proportion of fall Chinook and coho at the Lower Monumental Dam window counts and applied to the total number of redds, 2) based on individual redd determination from surveyors, and 3) based on the proportion of Chinook and coho carcass recovered. Fall Chinook and coho overlap in spawn timing and determining if a redd is a fall Chinook or coho can be difficult as most coho and 2-salt subyearling fall Chinook return at a similar size with similarly sized redds. Further, high flow events also cause issues with redd identification, especially when gravel scouring occurs or when water clarity is affected. These conditions make it difficult to identify new versus old redds, or clearly seeing redds for identification purposes. The percent carcass recovery method can be biased by high water events, lack of carcasses due to predation or observers missing them, and misidentification. After our comparison, we believe utilizing the Lower Monumental Dams counts applied to total number of redds as the most accurate and consistent representation for the years compared. The annual difference between the three estimation methods are minimal (Figure 18). Table 17 has been updated from previous reports to show

the updated redds, escapement (3 fish/redd), and juvenile productivity in the Tucannon River based on the Lower Monumental Dam counts.

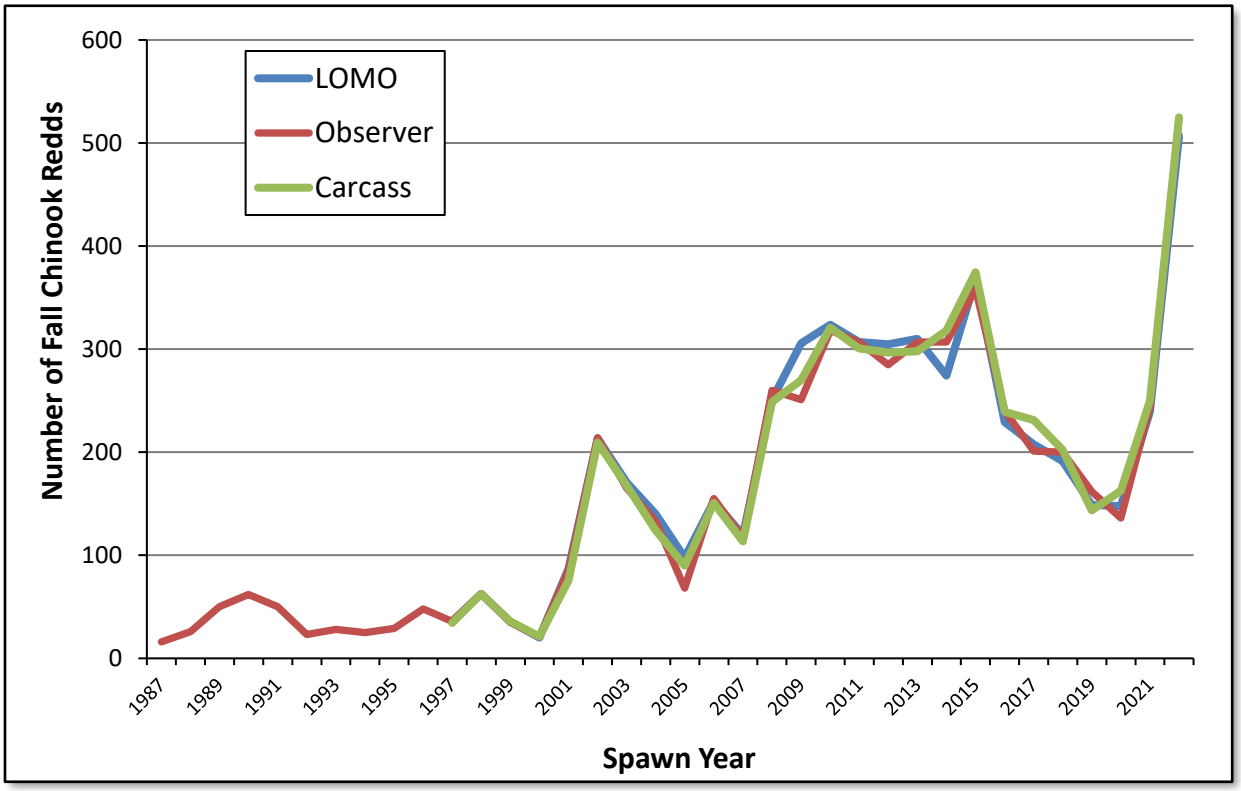

Figure 18. Estimated fall Chinook salmon redds in the Tucannon River based on three estimation techniques. The LOMO method uses the proportion of fall Chinook to coho at Lower Monumental Dam, the Observer methods uses "redd origin" as determined by surveyors, and the Carcass method relies on the proportion of fall Chinook to coho carcasses recovered from surveys.

Based on historical methods, total escapement to the Tucannon River is based on an expansion factor of three fish/redd. This expansion factor provides a conservative estimate of fish spawning. Based on the Lower Monumental Dam proportion method we estimated 1521 fall Chinook salmon spawned in the Tucannon River in 2022, the highest return to date (Table 16). Staff recovered 301 fall Chinook salmon carcasses (~19.8%) of the estimated total spawning escapement. A total of 530 coho salmon were estimated to have spawned, of which 91 carcasses (~17%) were recovered in 2022. The run of fall Chinook salmon into the Tucannon is typically correlated with the overall fall Chinook run into the Snake River Basin, except for 2022 (Figure 19).

Table 107. Estimated escapement, redd construction, and resulting estimates of smolts/redd and total number of emigrants from fall Chinook salmon spawning in the Tucannon River, 2001-2022, based on Lower Monumental Dam proportion method of redd origin. [a]

Brood year	Estimated escapement [b]	# Redds observed	# Redds in no access areas and other adj (est.)	Total # of redds (est.)	Estimated smolts/redd [c]	Total # estimated emigrants [d]
2001	261	65	12	87	271	23,577
2002	640	185	29	213	92	19,582
2003	511	143	22	170	421	71,693
2004	421	126	8	140	500	70,070
2005	293	61	7	98	215	20,995
2006	457	128	27	152	293	44,563
2007	359	103	15	120	Unknown [f]	Unknown [f]
2008	753	223	46	251	19	4,834
2009	917	200	29	306	121	36,956
2010	971	290	29	324	76	24,659
2011	921	280	27	307	66	20,199
2012	914	256	28	305	394	120,033
2013	930	287	20	310	31	9,458
2014	822	270	37	274	569	156,073
2015	1,103	324	34	368	127	46,702
2016	688	218	22	229	35	7,945
2017	623	177	254	208	102	21,094
2018	574	172	28	191	230	43,972
2019	447	140	21	149	11	1,666
2020	443	119	17	148	567	77,046
2021	719	231	13	240	175	42,657
2022	1,521	426	98	524	97	50,716

[a] Numbers presented in this table are 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.

[f] No estimate was made because the smolt trap sampling box had a hole in it and fish escaped.

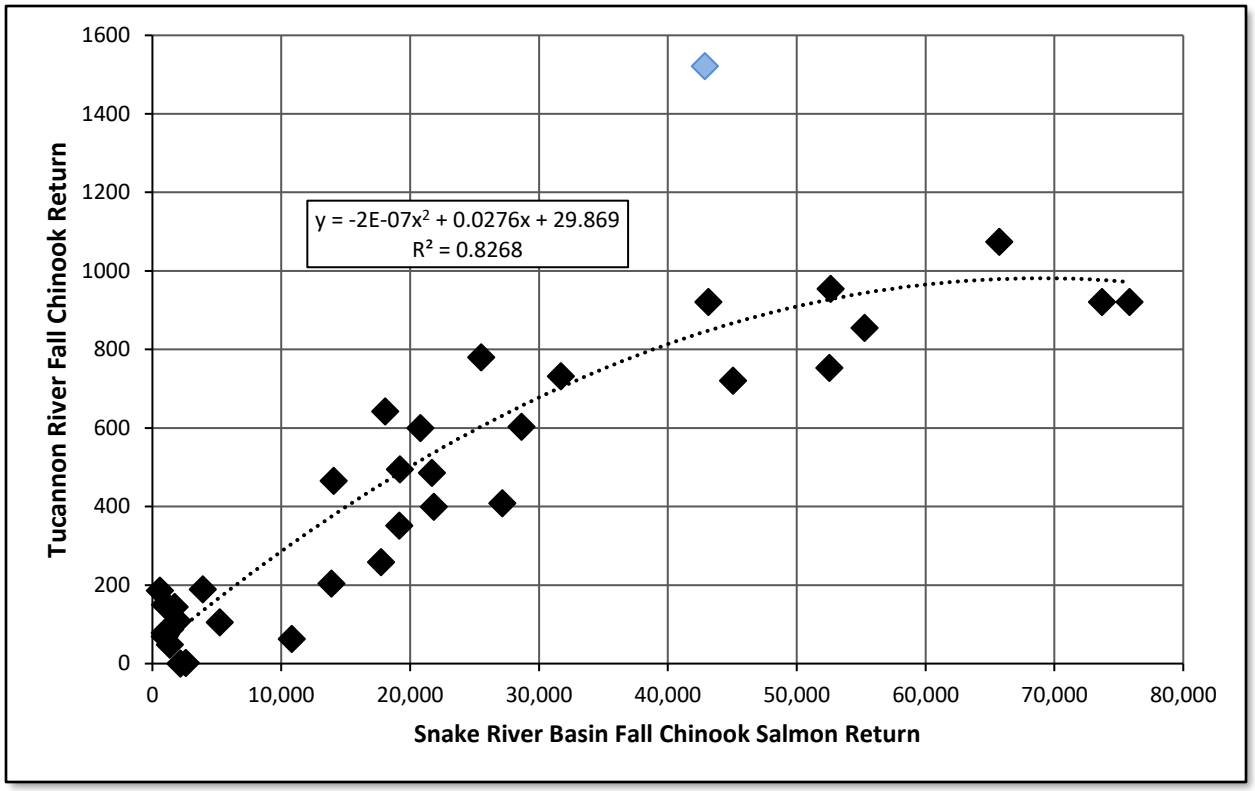

Figure 19. Relationship of the overall SRFCH return compared to estimated returns to the Tucannon River. Blue outlier represents 2022.

Generally, more recoveries of females occur than males, primarily because females remain in the vicinity of their redds when they die. In 2022 females represented 50.5% of the recoveries in the Tucannon River: primarily 2-salt and 3-salt fish. Males represented 38.2% of the recoveries; primarily 2-salt and 3-salt fish. Unknown sex represented 11.3% of the recoveries. Staff were unable to determine the species of 19 carcasses. Composition of the run consisted of 34.6% Snake River hatchery by coded wire tag, 5.6% out-of-basin by wire, 17.6% unknown hatchery origin by AD clip, yearling scales or lost coded wire tag, and 36.5% unknown origin (unmarked/untagged fish that could be hatchery or natural origin), another 5.3% are of unknown clip with no coded wire tag.

Juvenile Salmon Emigration

2023 Outmigration Year

Juvenile fall Chinook salmon (BY22) were captured at the Tucannon River smolt trap (rkm 3.0) from 15 February through 28 June 20232 (Figure 20). The last day of trapping was 30 June. Most fish captured in the trap from February into the middle of May were newly emerged fry. Being so small, these fish are not used for trap efficiency tests, so the estimated number

passing the trap provided below is a minimum. No fall Chinook were PIT tagged at the trap during the 2023 outmigration year. From the middle of May to the end of June, the mean size of fall Chinook migrants were 67 mm and 5.2 g (K-factor 1.23). Trapping efficiency for fall Chinook salmon ranged from 12.05% to 38.80%. Staff captured 11,542 (including 84 mortalities) fall Chinook salmon in 2023. Juvenile production of fall Chinook from the Tucannon River can be highly influenced by high stream flow events in the winter/early spring (Figure 21). Juvenile production can also be influenced by redd superimposition during large run years (mostly observed in lower river below the town of Starbuck, WA) and sediment input from Pataha Creek in some years.

From the middle of May to the end of July, we estimated that 47,522 (95% C.I. = 2,874-53,620) parr/smolts passed the trap. This estimate does not include fish that we captured but were too small to run efficiency trials for, so this estimate is a minimum. Based on 491 fall Chinook salmon redds estimated above the smolt trap during 2022 spawning ground surveys, an estimated 97 smolts/redd were produced. After including potential production from redds below the smolt trap in 2023 (33 additional redds), we estimated that a minimum of 50,716 naturally produced fall Chinook salmon parr/smolts left the Tucannon River during 2023.

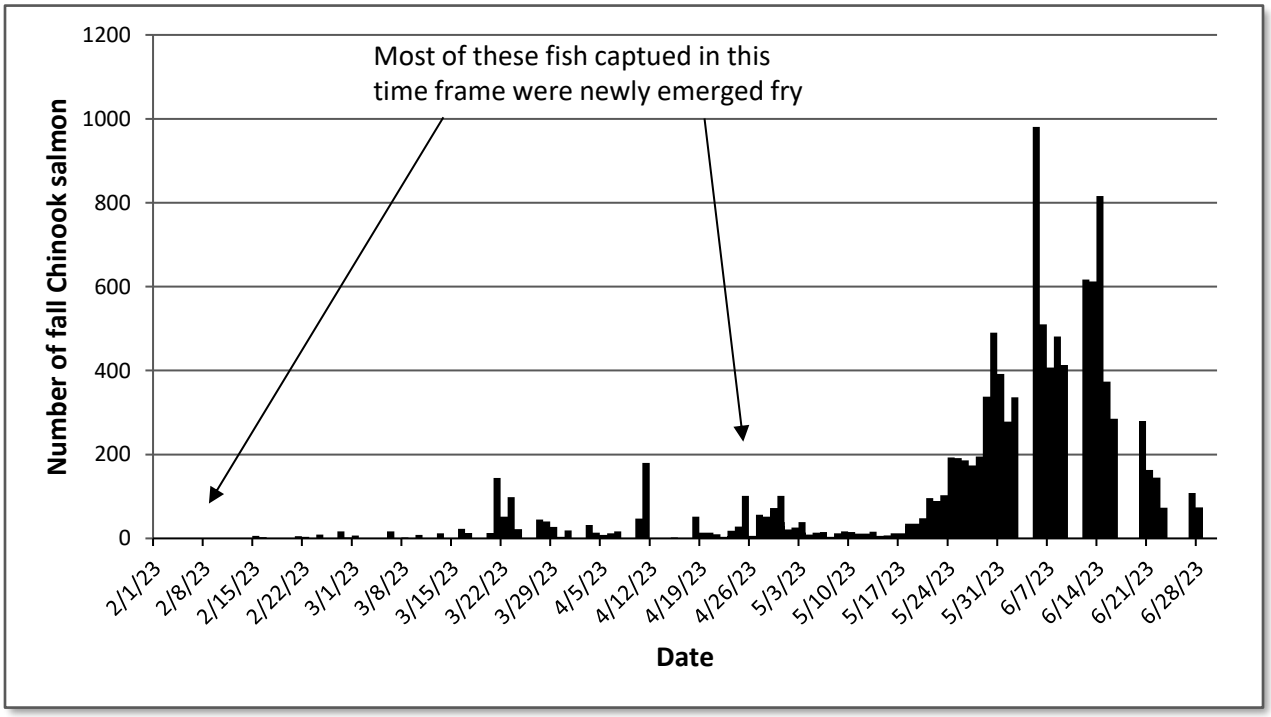

Figure 20. Migration timing of NOR juvenile fall Chinook salmon captured at the Tucannon River smolt trap in 2023.

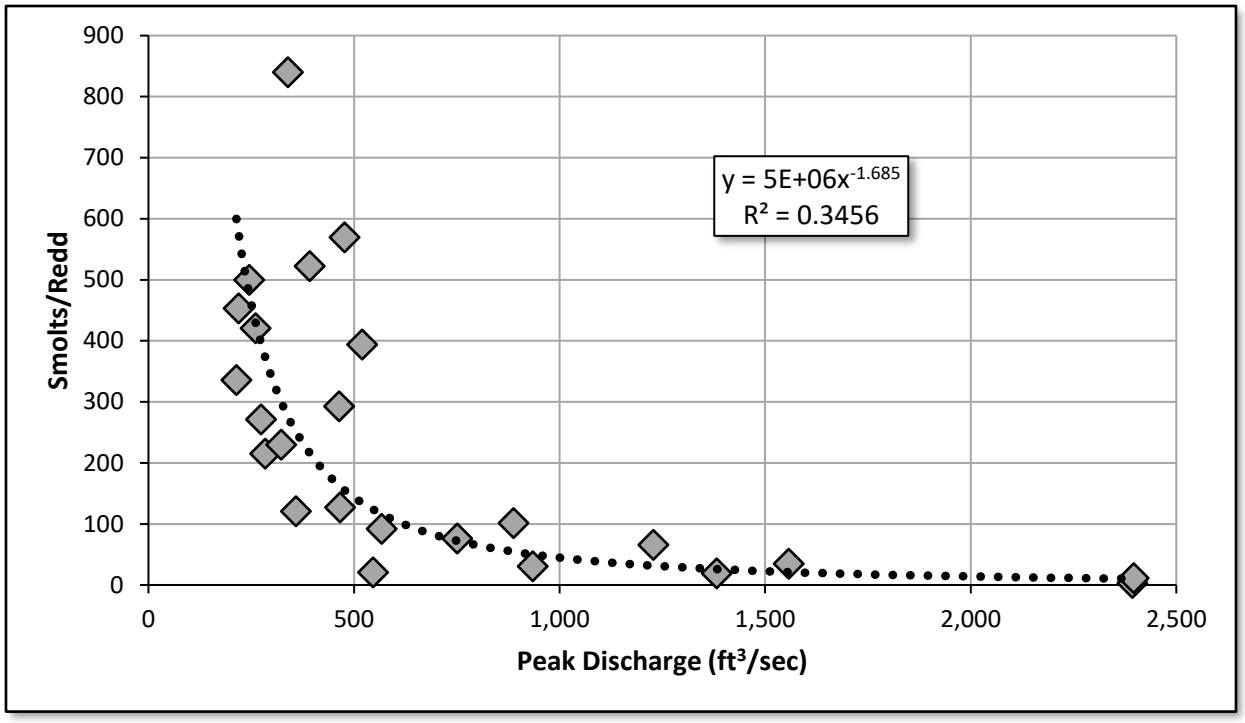

Figure 21. Peak discharge during fall Chinook incubation in the Tucannon River versus the estimated natural log of smolt/redd determined at the Tucannon River smolt trap.

Project Area Returns and Total Returns

As defined in the introduction, project area returns are calculated from the number of SRFCH salmon passing IHR. Strays from other Columbia River basin releases (Umatilla, Priest Rapids, Ringold, Klickitat, etc…) are known to cross IHR (Mendel et al 1993), and therefore inflate the number of fall Chinook counted into the Snake River, especially from IHR and Lower Monumental dams. 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 SRFCH salmon. The systematic random sample of the fall Chinook run at LGR has been occurring since 2002 and provides 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 LFH 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 using PIT tags, and their conversion rate from IHR to LGR. Hatchery origin fall Chinook salmon released above LGR have very high conversion rates (generally >97%), 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 – most importantly to the LFH on-station releases that return to LGR, project area returns to IHR can be estimated.

Assumptions

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

- Saltwater 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 consider 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 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 8 December 2023 for any 2022 returns of CWT tagged fish associated with WDFW releases. Generally, most submissions to the RMPC database for the 2022 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 18 or Table 19 due to rounding of estimates.

Returns to the Project Area

An estimated 11,604 fall Chinook salmon (adults+jacks) returned from WDFW releases into the project area in 2022, contributing to 63.4% of the LSRCP project area mitigation goal of 18,300

(Table 17). The return in 2022 was the highest estimated since 2016. Low return years are 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 release programs, except for the 2019 release year where some of the FCAP fish were released at LFH.

Table 118. Project area returns of WDFW released SRFCH salmon, 2003-2022 return years. The LSRCP Project Area goal is 18,300.

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	401		37	8,111	44.3%
2005	3,101	188		34	3,323	18.2%
2006	2,439	208	62	8	2,724	14.9%
2007	6,832	1,054	257	596	8,740	47.8%
2008	3,896	1,263	142	861	6,162	33.7%
2009	16,968	3,268	600	1,823	22,659	123.8%
2010	11,719	2,137	1,297	1,207	16,360	89.4%
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	12,277	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	910	807	0	5,333	29.1%
2019	1,843	452	627		2,922	16.0%
2020 [a]	1,066	1,110	1,403		3,579	19.6%
2021 [a]	1,975	2,655	1,244		5,874	21.1%
2022	4,617	6,507	480		11,604	63.4%

[a] These estimates include fish that were part of the FCAP program that were released at Lyons Ferry in 2019. Pittsburg landing was not operated that year, and some fish destined for Captain Johns or Big Canyon were also released on-site at LFH, all due to weather conditions.

Total Returns

An estimated 17,216 fall Chinook salmon (adults+jacks) returned from WDFW releases in 2022, contributing 18.8% of the combined project area goal and out-of-basin objectives (91,500 – Table 18). These estimates **do not include** in-basin hatchery returns from the FCAP, IPC and the NPTH programs, except for the 2019 release year where some of the FCAP fish were released at LFH.

Table 19. Total returns of WDFW released SRFCH salmon, 2003-2022 return years. The LSRCP total mitigation target would be 91,500 adults and is inclusive of the 18,300 LSRCP Project Area goal.

Run Year	LFH on-station yearling	LFH on-station subyearling	Grande Ronde subyearling	Couse Creek subyearling	Total return	Percent of Total Mitigation
2003	6,350	483			6,833	7.5%
2004	11,353	469		37	11,859	13.0%
2005	6,527	329		52	6,908	7.5%
2006	4,803	316	62	30	5,211	5.7%
2007	10,704	1,178	370	729	12,981	14.2%
2008	6,398	1,953	368	1,465	10,184	11.1%
2009	23,428	3,703	878	2,392	30,401	33.2%
2010	19,826	3,111	1,548	1,911	26,396	28.8%
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	6,874	1,156	1,187	3	9,220	10.1%
2019	2,804	661	816		4,281	4.7%
2020 [a]	1,797	1,341	1,969		5,107	5.6%
2021 [a]	3,217	3,491	1,891		8,599	9.4%
2022	8,617	7,529	1,069		17,216	18.8%

[a] These estimates include fish that were part of the FCAP program that were released at Lyons Ferry in 2019. Pittsburg landing was not operated that year, and some fish destined for Captain Johns or Big Canyon were also released on-site at LFH, all due to weather conditions.

Harvest in the Project Area

In 2022, 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 (including the FCAP fish released at LFH in 2019) were reported in the Regional Mark Information System (RMIS) database from these areas in 2022. The estimated CWT recoveries were expanded by the tag rate for each WDFW release group and provided below (Table 19).

Table 120. Estimated (and fully expanded by tag rate) Snake River basin harvest recoveries in 2022 of wire tagged fall Chinook salmon released by WDFW as reported to RMIS on 12/18/2023.

Group	1-Salt	2-4 Salt	Total ESTD	% by Group
LFH Yearling	19	533	552	***54.9%***
LFH Subyearling	12	337	349	***34.7%***
GRR Subyearling	2	102	104	***10.4%***
Total (All Groups)	***33***	***972***	***1005***	

Recoveries by Region

From the download options in the RMIS database, CWT recoveries can be grouped into large geographic regions which is useful because SRFCH are recovered from California to Alaska, and within the Columbia River Basin. The majority (63.8%) of estimated CWT recoveries come from the Columbia River Basin (Table 21), followed next by recoveries in Washington, off the coast of British Columbia, and Alaska (18.5%, 8.7%, and 5.9% respectively), and all other regions accounting for the remaining 3.8%.

Table 131. Fully expanded recovery estimates of tagged and untagged fall Chinook salmon recovered in all areas during the 2022 run year 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)	2,613	***60.9%***	1,026	***21.4%***	371	***10.2%***	4,010	***63.2%***
CA	15	***0.4%***	16	***30.2%***	22	***41.5%***	53	***0.8%***
OR	90	***2.1%***	71	***33.0%***	25	***13.1%***	186	***2.9%***
WA	927	***21.6%***	189	***15.9%***	55	***5.3%***	1,171	***18.5%***
BC	431	***10.1%***	62	***10.1%***	56	***10.4%***	549	***8.7%***
AK	214	***5.0%***	70	***17.2%***	92	***21.3%***	376	***5.9%***
HS	0	***0.0%***	0	***0.0%***	3	***100%***	3	***0.05%***
Totals	***4,290***	***67.6%***	***1,434***	***22.6%***	***624***	***9.8%***	***6,348***	

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 that returned in 2022, nearly 75% of the estimated CWT recoveries were recovered from the troll fisheries (both types), followed by sport fisheries at 23.84%, with gillnet/seine and trawl fisheries making up less than 5% of the recoveries (Table 22).

Table 142. Fully expanded recovery estimates of tagged and untagged fall Chinook salmon recovered in the Ocean during the 2022 run year for WDFW releases. Minijacks are not included in the estimates.

Region [a]	Fishery	LFH – 1+ Total Estimate	LFH – 0+ Total Estimate	GRR – 0+ Total Estimate	*Grand Total*	*%*
CA	Troll	10	7	22	***39***	***1.7%***
	Sport	5	9		***14***	***0.6%***
OR	Troll	54	58	19	***131***	***5.6%***
	Trawl				***0***	***0.0%***
	Sport	36	13	6	***55***	***2.4%***
WA	Troll	144	30	5	***179***	***7.7%***
	Trawl				***0***	***0.0%***
	Troll (Treaty)	557	83	38	***678***	***29.1%***
	Mixed Net and Seine	1			***1***	***0.04%***
	Sport	224	75	11	***310***	***13.3%***
BC	Troll	267	45	28	***340***	***14.6%***
	Sport	147	7	25	***179***	***7.7%***
	Troll (Treaty)	16	10	3	***29***	***1.24%***
	Mixed Net and Seine	1			***1***	***0.04%***
AK	Troll	206	64	90	***360***	***15.4%***
	Gillnet/Seine	7	6	2	***15***	***0.6%***
	Troll (Treaty)				***0***	***0.0%***
HS	Trawl			3	***3***	***0.13%***
Totals		***1675***	***407***	***252***	***2,334***	
	Fishery Type	**Total Estimate**	**Total Estimate**	**Total Estimate**	***Grand Total***	
All Regions Combined	Troll	1256	298	205	***1759***	***75.3%***
	Gillnet/Seine	9	6	2	***17***	***0.7%***
	Trawl			3	***3***	***0.1%***
	Sport	411	104	42	***557***	***23.8%***

[a] Regions defined: CA = California; OR = Oregon; WA = Washington; BC = British Columbia; AK = Alaska; HS = High Sea

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 2022 run, the following summary is provided (excluding recoveries in the Snake River basin (Table 23)). As with previous years, most recoveries come from the Columbia River Net Fisheries (55.4%), with sport fisheries accounted for about 42.3%, and fish recovered at other hatcheries of fish traps outside of the Snake River basin at 2.2%.

Table 153. 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 the 2022 run year for WDFW releases. Minijacks are not included in the estimates.

Recovery area	Fishery/Hatchery/River	LFH – 1+ Total Estimate [a]	LFH – 0+ Total Estimate [a]	GRR – 0+ Total Estimate [a]	*Grand Total*	*%*
COL R Gillnet	Zone 1-5 Commercial	226	66	32	***324***	***11.1%***
	Zone 6 Tribal Net	982	184	133	***1299***	***44.3%***
COL R Sport	COL R Estuary	464	176	42	***752***	***25.7%***
	Zone 1-5 sport	268	63	24	***379***	***12.9%***
	Zone 6 Sport	74	0	2	***102***	***3.5%***
	Handford Reach	0	0	0	***0***	***0.0%***
	Freshwater Net	1	0	0	***1***	***0.03%***
	Freshwater Sport	0	4	4	***8***	***0.3%***
Hatchery	Bonneville	1	0	0	***1***	***0.03%***
	Priest Rapids	0	1	2	***3***	***0.1%***
SGS	Hanford Reach	31	30	0	***31***	***2.1%***
Totals		***2047***	***595***	***288***	***2930***	

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 SRFCH were assumed to be 0.2%. This assumed rate, along with brood needs based on fecundity, egg-to-smolt survivals, numbers of smolts, and fish per pound at juvenile release were used to size the hatchery program at LFH. Since that time, additional hatchery SRFCH production programs in the Snake River have been added, and changes with hydrosystem operations (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 better than subyearlings, almost 10 times better (Bugert et al 1997). With management changes to the hydropower system (bypass and spill, and summer flow augmentations from Dworshak Reservoir), and changes to the subyearling release size, survival rate differences between yearling and subyearling releases became negligible. For LFH releases, subyearlings perform on average about ½ as well as yearling releases back to the project area when jack returns are excluded, smolt-to-adult returns for yearlings are 0.46% and subyearlings are 0.21% (Table 24). However, yearling releases are known to produce proportionally more mini-jacks and jacks per adult compared to subyearling releases. When jacks are included, the average SAR performance difference is about 1/3

between subyearlings (0.35%) and yearlings (1.07%). Other WDFW subyearling release locations upstream of LGR have also occurred, these generally survive at a lower rate compared to the LFH on-station release of subyearlings (Table 24). Migration distance and predation are potential factors that could contribute to the differences observed between upstream and below LGR release sites.

As shown in the adult return sections, SRFCH 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 24 and 25.

Table 164. 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, 2002-2019 release years.

Release	Adults and Jacks Combined				Adults Only			
Year	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%	0.02%	0.01%	0.39%	0.03%	0.02%	0.01%
2006	1.54%	1.16%	0.12%	0.75%	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%	0.85%	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%	0.46%	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%	
2017	0.39%	0.24%	0.26%		0.27%	0.16%	0.16%	
2018	0.21%	0.18%	0.38%		0.17%	0.12%	0.28%	
2019	0.14%	0.50%	0.79%		0.09%	0.42%	0.66%	
Average	***1.45%***	***0.59%***	***0.29%***	***0.55%***	***0.62%***	***0.35%***	***0.26%***	***0.34%***
Geomean	***1.07%***	***0.35%***	***0.19%***	***0.30%***	***0.46%***	***0.21%***	***0.17%***	***0.20%***

Table 175. Total Smolt-to-adult survival (SAS) rates for yearling and subyearling fall Chinook salmon by WDFW, 2002-2019 release years.

Release	Adults and Jacks Combined				Adults Only			
Year	LFH 1+	LFH 0+	GRR 0+	CCD 0+	LFH 1+	LFH 0+	GRR 0+	CCD 0+
2002	2.06%	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%	0.05%	0.02%	0.98%	0.04%	0.05%	0.03%
2006	2.16%	1.67%	0.24%	1.21%	0.76%	1.19%	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%	1.42%	1.73%	1.28%	1.36%	1.15%
2011	2.77%	2.16%	0.39%	1.86%	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%	0.68%	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%	0.19%	0.02%	
2017	0.63%	0.28%	0.36%		0.45%	0.20%	0.26%	
2018	0.31%	0.31%	0.54%		0.26%	0.25%	0.44%	
2019	0.36%	0.56%	1.10%		0.54%	0.48%	0.96%	
Average	***2.23%***	***0.83%***	***0.55%***	***0.89%***	***1.26%***	***0.59%***	***0.47%***	***0.65%***
Geomean	***1.66%***	***0.50%***	***0.37%***	***0.50%***	***1.04%***	***0.35%***	***0.32%***	***0.40%***

Direct Take of Listed Snake River fall Chinook Salmon During Fall of 2022 and Spring of 2023

"Take" estimates for permit #16607-2R for LFH production and permit #16615-2R for NPTH production are reported annually in the WDFW Fall Chinook report to LSRCP and other reports (see list below and Table 26). The Section 10 "Take" tables were updated following the 2018 NOAA consultation of the program (Section 10 Permits 16607-2R and 16615-2R). In 2021, new WDFW staff were attempting to fill out the Section 10 "take" tables for this annual report. Due to some inconsistent, and awkward footnote language associated with the tables, WDFW and NPT staff reached out to NOAA Fisheries for clarification. During those discussions with NOAA Fisheries, it was decided that restructuring of the "take" table and associated footnotes needed to occur, making them more similar/consistent with other Snake River Basin permits (e.g., NE Oregon/SE Washington spring Chinook permits). In a few places, fall Chinook "take" limits will need adjustments. In July 2021 WDFW and NPT staff submitted updated versions of the Fall Chinook Section 10 "take" tables to NOAA Fisheries. To date, agency schedules have not yet aligned to continue the discussion and finalize the Section 10 "take" tables for these two permits.

To complete this report per contract requirements, estimates of "take" associated with this program for the 2019 to 2022 spawns and juvenile releases from 2020-2023 will be reported in future WDFW Fall Chinook reports to LSRCP. In addition, during consultation, it was agreed that additional reporting requirements were needed to cover the Terms and Condition section of the Section 10 permits and Section 7 Biological Opinion reporting requirements, with the timeframe beginning in 2018. The information required is provided 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 list and Table 25).

Additional information can also be found in reports provided by the NPT and are referred to in the Conditions Table (Table 25) provided below.

1. Snake River Basin Adult Chinook and Steelhead Monitoring Annual Report.
2. 2022 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 2022 (**Run Recon Report**)
4. 2022 NPTH SR fall Chinook production report (**Production Report**)

Table 186. 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 LGR adult trap.	See ESA permit 21951; LGR trapping permit (NOAA)
Fall Chinook salmon escapement to LFH, NPTH and the South Fork Clearwater Weir (once in operation) by origin (marked, tagged, unknown and unmarked adults);	The LFH trap was not operated in 2022. Escapement to NPTH provided in **Snake River Basin Adult Chinook and Steelhead Monitoring Annual Report**. The South Fork Clearwater trap was not operated in 2022.
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 17 in this report. Fall Chinook salmon escapement to natural spawning areas above LGR are described the **Snake River Basin Adult Chinook and Steelhead Monitoring Annual Report**. Fall Chinook salmon redd counts above LGR are described in the **Snake River Basin Adult Chinook and Steelhead Monitoring Annual Report** and the **Snake River Fall Chinook Salmon Spawning Summary .**
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 Table 16 in this report. Carcass recovery data above LGR provided by NPT in the **Snake River Basin Adult Chinook and Steelhead Monitoring Annual Report** 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 LFH are provided in Table 8, page 19 in this report. For the number of broodstock retained and their disposition by NPTH, see the **Snake River Basin Adult Chinook and Steelhead Monitoring Annual Report**. Also see the joint agency **Run Recon report** for additional information.

Conditions	Response or reference for requested information
Trends in the relative, total annual abundances of NOR and HOR fall Chinook salmon escaping to the Snake River Basin upstream of LGR, 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 NOR and HOR fall Chinook salmon escaping to LGR; see "escapement" tab for trends in abundance of NOR and HOR fall Chinook escaping above LGR and see the **Snake River Fall Chinook Salmon Spawning Summary** for trends in index of abundance (redd counts) above LGR.
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 36-38). 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 2022.

Recommendations and Conclusions

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. As of 2016, PBT sampling at LGR was able to detect all in-basin hatchery returns which allows more precise (in theory) estimates of NOR fish in the overall return, and those that contribute to broodstock. Beginning with the 2019 release year and into the future, all SRFCH salmon releases will be identified by a PBT mark group at each release site.

Recommendation: In the future, work with the SRFCH salmon run reconstruction technical group and Snake Basin geneticists to derive run reconstruction estimates based solely on PBT results. Continue discussions regarding the future tagging levels/use/need of CWT's for SRFCH salmon and the needs for downstream fisheries. In addition, continue to work with the FINS technical team to upload fall Chinook spawning, rearing and release data to reference future returns by origin for the PBT analysis.

2. Fish from SRFCH 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 generally have lower returns of 1-salt fish. Beginning in 2020, releases of yearlings above LGR were ceased, but the release of yearlings at LFH have continued. A Snake River Basin wide discussion was initiated by WDFW to discuss the possible elimination of future yearling releases at LFH, with additional subyearling production (released at LFH, but also in other locations above LGR) so no net loss of returns would occur (Adult + Jack combined), and downriver or ocean fisheries should not be negatively impacted. A "white paper" was completed in the spring of 2022. Following that, all Snake Basin parties agreed to move a proposal forward through the Production Advisory Committee to eliminate the yearling releases at LFH beginning with brood year 2023, with additional subyearling production at LFH and upstream of Lower Granite Dam.

Recommendation: Continue to follow the progress of the PAC proposal through the Policy forum in 2024. Adjust the plan as needed per Policy direction. Continue to work with NOAA Fisheries when possible, to help complete consultation requirements so the change can occur with brood year 2024.

3. Since the late 1980's, WDFW evaluation staff have been conducting redd surveys in the lower Tucannon River to count and estimate fall Chinook redds. Beginning in 1997, coho salmon began returning to the Snake River basin from Tribal re-introduction efforts in the Columbia/Snake rivers. At that same time, WDFW staff began to periodically recover coho salmon carcasses and "observe" what were thought to be coho redds (based on size and location in the stream). However, it soon became apparent that some fall Chinook redds (made by "jills" from the hatchery yearling releases, or smaller 2-salt subyearlings) were in similar stream locations and with redd sizes similar to what are typically thought of as coho redds. These "observational" redd designations are further complicated by varied stream conditions and observer experience.

Over the past few years, evaluation staff have revisited all previous fall Chinook/coho spawning ground survey data. A standard methodology was developed to consistently 1) estimate redds in locations that can't be surveyed due to landowner access issues, and 2) when surveys are incomplete because of high stream flow conditions that sometimes happen near the end of the season. As part of this standardization process, it was discovered that the proportion of fall Chinook to coho salmon counted at the Lower Monumental Dam fish ladder are very similar to what has been estimated in the Tucannon River as determined from carcass or "observational" redd estimates. This is significant because nearly all the coho salmon returning to the Snake River are not destined for the Tucannon River. Coho salmon natural production in the Tucannon River as determined by smolt trap catches would suggest that not many would likely return as adults.

Conclusion: As explained earlier in the report, WDFW evaluation staff completed their evaluation of all three possible estimation methods. To provide consistent and more reliable estimates in the future, it was decided to adopt the proportion of fall Chinook to coho from Lower Monumental Dam window counts applied to the total number of estimated redds. However, with the 2022 year returning higher compared to this trend with a strong stock composition brood years 2018 and 2019; staff will continue to make observational notes regarding redd origin, and recovered carcasses will continue to provide a back-up should we start to see more deviations from the current relationship.

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Appendix A: Trapping and Sampling Protocols at LGR Adult Trap for 2022

2022 Fall Chinook Trapping / Sampling Protocols at LGR
August 18, 2022

Protocols:

1) This protocol assumes a 24 hour/day, 7 days per week trapping at 60% continuing through September 6th, and then dropping to 18% through the end of the season.

   60% trapping period : WILL RECEIVE an operculum punch on the left side (LOP)
   18% trapping period: NO operculum punch.

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 FEMALES >29cm to <70cm will be hauled to LFH and NPTH (1 out of 4 trapped).

5) Wire tagged MALES >29cm to <70cm will be hauled to LFH only (1 out of 4 trapped).

6) Only scale sample non-Wire tagged fish released from the trap. Do not scale sample hauled fish.

7) DNA sample all fish trapped (hauled or released).

WIRE TAGGED FISH

Fork Length	Action
≥ 70cm	Haul all fish (DNA sample all)
>29cm to <70cm	Haul 1 out of 4 wire tagged FEMALES for LFH and NPT [100% DNA] Haul 1 out of 4 wire tagged MALES for LFH (LFH only tank) [100% DNA] Released wire tagged Males and Females (3 of 4) [100% DNA]

UNTAGGED FISH :

Fork Length	Action
≥ 70cm	Haul all fish (DNA sample all)
>29cm to <70cm	Release All [100% Scale, 100% DNA]

2022 Fall Chinook Trapping / Sampling Protocols at LGR
Protocol Change to Begin
August 30, 2022

Protocols:

1) This protocol assumes a 24 hour/day, 7 days per week trapping. The trap had been operating at a 60% trap rate (through August 29th). The trap rate was dropped on August 30th to 18%, and will continue at this rate through the end of the season.

   60% trapping period : WILL RECEIVE an operculum punch on the left side (LOP)
   18% trapping period: NO operculum punch.

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 FEMALES >29cm to <70cm will be hauled to LFH and NPTH (1 out of 4 trapped).

5) Wire tagged MALES >29cm to <70cm will be hauled to LFH only (1 out of 4 trapped).

6) Only scale sample non-Wire tagged fish released from the trap. Do not scale sample hauled fish.

7) DNA sample all fish trapped (hauled or released).

WIRE TAGGED FISH

Fork Length	Action
≥ 70cm	Haul all fish (DNA sample all)
>29cm to <70cm	Haul 1 out of 4 wire tagged FEMALES for LFH and NPT [100% DNA] Haul 1 out of 4 wire tagged MALES for LFH (LFH only tank) [100% DNA] Released wire tagged Males and Females (3 of 4) [100% DNA]

UNTAGGED FISH :

Fork Length	Action
≥ 70cm	Haul all fish (DNA sample all)
>29cm to <70cm	Release All [100% Scale, 100% DNA]

2022 Fall Chinook Trapping / Sampling Protocols at LGR
Protocol Change to Begin
September 7th, 2022

Protocols:

1) 24 hour/day, 7 days per week trapping at 60% continuing through August 29th, and then 18% through the end of the season.

   60% trapping period : RECEIVED an operculum punch on the left side (LOP)
   18% trapping period: NO operculum punch.

2) Males and females will not be inoculated.

3) All fish ≥ 80 cm will be hauled to LFH and NPTH. LFH will haul ~70% and the NPT will haul ~30%.

4) All fish ≥ 70 cm to 79 cm will be passed upstream, DNA sample all, scale sample non-Wire tagged fish.

5) Wire tagged FEMALES >29cm to <70cm will be released from the trap.

6) Wire tagged MALES >29cm to <70cm will be hauled to LFH only (1 out of 4 trapped).

7) Only scale sample non-Wire tagged fish released from the trap. Do not scale sample hauled fish.

8) DNA sample all fish trapped (hauled or released).

WIRE TAGGED FISH

Fork Length	Action
≥ 80cm	Haul all fish (DNA sample all)
≥ 70 cm to 79 cm	Pass upstream, (100% DNA, no scale sample)
>29cm to <70cm	Haul 1 out of 4 wire tagged MALES for LFH (LFH only tank) [100% DNA] Released wire tagged Males and Females (3 of 4) [100% DNA] Release ALL wire tagged FEMALES [100% DNA]

UNTAGGED FISH :

Fork Length	Action
≥ 80cm	Haul all fish (DNA sample all)
≥ 70 cm to 79 cm	Pass upstream, (100% Scale, 100% DNA)
>29cm to <70cm	Release All [100% Scale, 100% DNA]

2022 Fall Chinook Trapping / Sampling Protocols at LGR
Protocol Change to Begin
September 16th, 2022

Protocols:

1) 24 hour/day, 7 days per week trapping at 60% continuing through August 29th, and then 18% through the end of the season.

   60% trapping period : RECEIVED an operculum punch on the left side (LOP)
   18% trapping period: NO operculum punch.

2) Males and females will not be inoculated.

3) All fish ≥ 80 cm will be hauled to LFH and NPTH. LFH will haul ~70% and the NPT will haul ~30%.

4) All fish ≥ 70 cm to 79 cm will be passed upstream, DNA sample all, scale sample non-Wire tagged fish.

5) Wire tagged FEMALES >29cm to <70cm will be released from the trap.

6) Wire tagged MALES >29cm to <70cm will be hauled to LFH only (1 out of 4 trapped).

7) Only scale sample non-Wire tagged fish released from the trap. Do not scale sample hauled fish.

8) DNA sample all fish trapped (hauled or released).

WIRE TAGGED FISH

Fork Length	Action
≥ 80cm	Haul all fish to NPT (DNA sample all)
≥ 70 cm to 79 cm	Pass upstream, (100% DNA, no scale sample)
>29cm to <70cm	Haul 1 out of 8 wire tagged MALES for LFH (LFH only tank) [100% DNA] Released wire tagged Males and Females (3 of 4) [100% DNA] Release ALL wire tagged FEMALES [100% DNA]

UNTAGGED FISH :

Fork Length	Action
≥ 80cm	Haul all fish to NPT (DNA sample all)
≥ 70 cm to 79 cm	Pass upstream, (100% Scale, 100% DNA)
>29cm to <70cm	Release All [100% Scale, 100% DNA]

Appendix B: Systematic Sampling Rates at Lower Granite Dam 2003-2022

Appendix B Table 1. Dates, times, and trapping rates of fall Chinook salmon at LGR, 2003-2022.

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
2020	18 Aug	80	-	2 Sept	18	-	nc	12 Nov
2021	18 Aug	70	3-6 Aug 7:30am [f]	2 Sept	18	-	nc	18 Nov
2022	18 Aug	60	-	30 Aug	18	-	nc	15 Nov

[a] No change (nc) was made to the trapping rate.

[b] Trap was closed 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 at 10:50 am for three hours due to large numbers of fall Chinook salmon.

[e] Trap was closed at 3:00 pm for two hours due to large numbers of fall Chinook salmon.

[f] Trap closed due to high water temperatures.

Appendix C: Salmon Processed and Killed at LFH in 2022

(Age/Rearing states origin, brood year, age at release, and release site (LF22SO is a LFH HOR fish from the 2022 brood year, released as a subyearling, on-station at LFH).

Appendix C Table 1: Estimated composition of non-wire tagged salmon trapped at LGR, hauled to LFH, and killed during 2022.

Age/Origin Determinations by Method	Females	< 53 cm Males	≥53 cm Males	Grand Total
Snake R. HOR				**712**
Subyearling	461		231	692
Yearling	2		2	4
Unknown rear/age	9		7	16
Snake R. NOR				**414**
Subyearling	177		2	179
Yearling	29			29
Unknown rear/age	81		125	206
Unknown HOR				**33**
Subyearling	11	1	8	20
Yearling			1	1
Unknown rear/age	5	2	5	12
Stray HOR				**5**
Subyearling	3			3
Yearling				
Unknown rear/age	2			2
Unknown Origin				**152**
Subyearling	42	2	21	65
Yearling	3			3
Unknown Origin Unknown rear/age	51		33	84
Total	**876**	**5**	**435**	**1316**

Appendix C Table 2. Estimated composition of wired salmon trapped at LGR, hauled to LFH, and killed in 2022.

Origin by CWT	CWT	Females	<53 cm Males	≥53 cm Males	Grand Total
LF16YBCA	223091	1			1
LF16YPLA	220390	1			1
LF17SBCA	220504	3			3
	220505	2			2
LF17SCJA	220502	2			2
	220503	1			1
	220508	2			2
LF17SGRRD	637395	1			1
LF17SO	637394	1			1
LF17SPLA	220506	1			1
	220507			1	1
LF17SSAL	091185	4		1	5
LF17YLCPB	220393	3		1	4
	220395	1		1	2
	220396	2			2
	220398	1			1
LF17YO	637398	3			3
LF18SBCA	220511	28	2	19	49
	220512	7	2	4	13
LF18SCJA	220509	79	1	47	127
	220510	19		6	25
LF18SGRR	637420	51	1	16	68
LF18SIPCSAL	091286	53	1	31	85
LF18SO	637422	27		14	41
LF18SPLA	220513	67	2	24	93
	220514	10		7	17
LF18YO	637603	62	39	31	132
LF19SBCA	220197	1	22	2	25
	220198		8	1	9
LF19SCJA	220195	1	21	3	25
	220196	1	8	1	10
LF19SGRR	637759		3	1	4
LF19SIPCSAL	091459	2	25	7	34
LF19SO	637758	3	24	12	39
LF19SPLA	220199	4	25	5	34
	220282		18	2	20
LF19YO	637762		7		7
LF20SBCA	220291		2		2
	220292		3		3
LF20SCJA	220289		3		3
	220290		8		8
LF20SGRR	637941		1		1
LF20SIPC	091579		7		7
LF20SO	637940		1		1
LF20SPLA	220293		5		5
	220294		2		2
LF20YO	637944		13		13
NPTH17SLGA	220271	5			5
NPTH17SNLVA	220258	4			4
NPTH17SO	220266	1			1

Origin by CWT	CWT	Females	<53 cm Males	≥53 cm Males	Grand Total
	220268	1		2	3
NPTH18SLAP	220270	6	1	3	10
NPTH18SLGA	220269	25		13	38
NPTH18SO	220267	9		6	15
	220272	13		13	26
NPTH19SCFA	220276		7		7
NPTH19SLGA	220275		2		2
NPTH19SNLVA	220277		2		2
NPTH19SO	220273		3		3
PAH_SP20	100510		2		2
UMA18SUMA	091177	1			1
LOST TAG	99999	4	14	1	19
Total		**513**	**285**	**275**	**1,073**

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 2010-2022 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
2020	0	0	0	0	0
2021	0	0	3	0	0.2
2022	**0**	**0**	**0**	**0**	**0.0**
Average	**0**	**10.2**	**8.4**	**0.3**	**1.4**

Appendix D Table 2. Historical use of out of basin strays in broodstock: 2007-2022.

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%
2020	1,107	4	2	0	0.5%
2021	1,216	3	8	0	0.9%
2022	**1,232**	**0**	**4**	**0**	**0.3%**
Average	**1,237**	**1.6**	**7.8**	**0.06**	**0.01%**

[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 LFH origin fall Chinook salmon spawned at LFH, brood years 2000-2013.

Brood year	Eggs taken	Egg loss [a]	Eggs destroyed [b]	Eggs shipped [c]	Eyed eggs retained	Fry ponded	Intended program
2000	3,576,956	53,176	0	115,891	3,249,377	998,768	Yearling
						2,159,921	Subyearling
2001	4,734,234	144,530	0	200,064	4,230,432	1,280,515	Yearling
						2,697,406	Subyearling
						125,600	Research
2002	4,910,467	44,900	0	1,195,067	3,540,000	1,032,205	Yearling
						2,376,251	Subyearling
						73,229	Research
2003	2,812,751	0	0	250,400	2,476,825	985,956	Yearling
						1,455,815	Subyearling
2004	4,625,638	0	0	1,053,278	3,421,751	914,594	Yearling
						2,191,102	Subyearling
						184,682	Research
2005	4,929,630	0	0	1,180,000	3,562,700[e]	980,940	Yearling
						2,078,206	Subyearling
						216,417	Research
2006	2,819,004	0	0	127,564	2,601,679	961,105	Yearling
						1,640,574	Subyearling
						2,000	Research
2007	5,143,459	0	0	1,761,500	3,212,900[f]	960,900	Yearling
						1,894,933	Subyearling
2008	5,010,224	0	0	1,810,800	2,969,200	1,000,000	Yearling
						1,969,200	Subyearling
2009	4,574,182	0	0	1,507,300	2,853,020	977,667	Yearling
						1,875,353	Subyearling
2010	4,619,533	124,433	0	1,630,000	2,865,100	980,000	Yearling
						1,885,100	Subyearling
2011	4,723,501	165,001	0	1,785,600	2,772,900	960,000	Yearling
						1,812,900	Subyearling
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 were 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 2023

Appendix F Table 1: LFH/Snake River HOR fall Chinook releases with number marked, tagged, and unmarked by release year and type. [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	PIT Tagged
2023	Y	2021	Lyons Ferry Hatchery	1-Apr	638417	428,159	763	4,198	890	434,010	10.2	10,000
Total yearling releases						***428,159***	***763***	***4,198***	***890***	***434,010***		***10,000***
2023	S	2022	Lyons Ferry Hatchery	24-May	638438	201,852	1,536	276	561,667	765,331	51.5	15,000
2023	S	2022	Captain John 1st	1-Jun	220034	201,755	1,536	274	258,034	461,599	49.1	25,999
2023	S	2022	Big Canyon 1st	10-May	220039	201,872	1,536	274	248,571	452,253	55.6	11,091
2023	S	2022	Pittsburg Landing 1st	3-May	220037	202,380	1,540	275	206,148	410,343	54.5	26,000
2023	S	2022	Pittsburg Landing 2nd	24-May	220038	201,247	1,531	274	17,768	220,820	53.0	4,492
2023	S	2022	Big Canyon 2nd	31-May	220036	200,172	1,523	272	10,803	212,770	53.8	4,497
2023	S	2022	Captain John 2nd	1-Jun	220035	201,061	1,530	273	8,821	211,685	49.6	4,496
2023	S	2022	Grand Ronde River Direct [c]	25-May	638057	214,181	448	31,194	0	245,823	45.0	4,500
2023	S	2022	NPTH-Site 1705-MF Clearwater R	10-May	220412	100,229	2,796	980	559,728	663,733	55.5	4,496
2023	S	2022	NPTH-Lukes Gulch Accl.-SF Clearwater R	6-Jun	220415	102,053	3,083	852	180,185	286,173	47.3	4,375
2023	S	2022	Cedar Flats Acclimation	13-Jun	220414	98,855	4,084	559	121,100	224,598	55.0	4,227
2023	S	2022	North Lapwai Valley Acclimation	10-May	220413	98,082	2,609	768	154,588	256,047	65.7	4,466
2023	S	2022	Salmon River Direct Stream	16-May	090011	206,290	676	1,184	900,040	1,108,190	47.8	4,500
Total subyearling releases						***2,230,029***	***24,428***	***37,455***	***3,227,453***	***5,519,365***		***128,139***

[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.

[c] This release is typically 100% ADCWT, however for 2023 it was 87% ADCWT due to a malfunction with the tagging trailer.

Appendix G: Tucannon River Survey Sections and Historical Escapement

Appendix G Table 1: Description and length of sections, survey length, percent of reach surveyed, and estimated total number of fall Chinook salmon redds in the Tucannon River, 2022.

Section	Description	Length of section (km)[a]	Length surveyed (km)	% of productive reach surveyed [b]	Estimated total # of redds [c]
1	Mouth of river to Highway 261 Bridge	1.7	1.7	100	31
2	Highway 261 Bridge to Smolt trap	0.15	0.15	100	2
3	Smolt trap to Powers Bridge	0.7	0.7	100	31
4	Powers Bridge to Starbuck Br.	3.85	3.55	100	137
5[d]					
6	Starbuck Br. To Fletchers Dam	2.7	1.4	51.9	93
7	Fletcher's Dam to Smith Hollow	3.0	3.0	100	37
8	Smith Hollow to Ducharme's Bridge.	4.6	4.6	100	40
9	Ducharme's Bridge to Highway 12	5.7	5.7	100	42
10	Highway 12 to Brines Road Bridge	6.2	6.2	100	13
11	Brines Road Bridge to King Grade	4.7	4.7	100	0
	Total	**33.3**	**31.7**	**95.2**	**426**

[a] Section lengths were 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.
[d] Section 4 and 5 data were combined together for data purposes

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

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

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