

Lyons Ferry Hatchery Evaluations: Fall Chinook Salmon Annual Report (2020 Return/2021 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 2020 spawning and 2021 releases of yearlings and subyearlings.

The estimated run size of natural-origin (NOR) fall Chinook salmon to reach Lower Granite Dam (LGR) was 8,068 fish \geq 57 cm fork length and 667 fish 30- <57 cm fork length. The remaining portion of the run consisted of 19,270 hatchery-origin (HOR) fish \geq 57 cm and 5,608 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 2020 was estimated at \sim 0.12%.

During 2020, WDFW collected 2,478 fish at LGR for broodstock, monitoring and evaluation of our hatchery releases, and to estimate the run composition at LGR.

In 2020, LFH staff spawned 1087 females for an estimated total green eggtake of 4,603,680; 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, 89 females and 66 males were returned to the Snake River to spawn naturally. Green egg to eye-up survival was 96.9%. Of the 641 males spawned at LFH, 374 were used multiple times to minimize the use of jacks, and to incorporate larger, older fish in the broodstock.

Based on the PBT identification, fecundity relationships were evaluated for four groups over a five-year period: hatchery origin (HOR) yearling, reservoir reared (RR) yearlings, hatchery origin (HOR) subyearling, and natural origin (NOR) subyearling. Based on the evaluation, HOR yearlings had consistently lower fecundities by fork length compared to other groups.

The estimated proportion of NOR fish in broodstock (pNOB) in the LFH broodstock (as determined from run-reconstruction methodologies or tissue sampled collected from spawned fish) was 32.0% or 31.0%, respectively.

In 2021, hatchery staff released subyearlings into the Snake River at LFH and 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 2020, staff conducted fall Chinook salmon redd surveys in the lower Tucannon River. A total of 155 redds (fall Chinook and Coho) were counted and an additional 26 redds were estimated due to landowner restrictions. Total estimated fall

Chinook salmon redds equaled 136. Based on three fish/redd, the estimated number of fall Chinook spawners in the Tucannon River in 2020 was 408. Of the estimated total fall Chinook spawning escapement, 28.4% were recovered and sampled.

In the spring of 2021, 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 5,855. Productivity (smolts/redd) from spawning was estimated at 567 smolts/redd.

In 2020, we estimate that a minimum of 3,514 (19.2%) returning adults and jacks that were from WDFW releases only contributed to the LSRCP project area mitigation goal (18,300 fish). This estimate includes returns to LGR, and total fish estimated that remained between Ice Harbor Dam and LGR based on PIT Tag conversions. We estimate that a minimum of 4,040 (4.4%) returning adults/jacks that were from WDFW releases only 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 harvest within the ocean in both sport and commercial/tribal fisheries in 2020.

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 2020 and juvenile releases in 2021. However, "takes" have not been reported at this time as WDFW and NPT is currently working with NOAA Fisheries on a new Section 10 "Take" Table that will be easier to populate and interpret. "Takes" that occurred in 2019 and 2020 will be reported in future reports.

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.

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We thank the personnel at LFH for their cooperation with sampling and providing information regarding hatchery operations. Thanks also to Andrew Claiborne (WDFW) and his staff at the scale aging lab in Olympia for aging scales collected at LFH, LGR, and Nez Perce Tribal Hatchery for the run reconstruction 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) for their assistance in estimating the run composition at LGR for the 2020 run year, and Ben Sandford (NOAA) for bootstrapping the data to get confidence intervals around the estimates.

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Table of Contents

Table of Contents	i
List of Tables	iii
List of Figures	v
List of Appendices	vii
Introduction	1
Definition of LSRCP Project Area and Measurement of Goal	1
Program Goals and Objectives.....	1
2020 Fall Chinook Salmon Run Size and Composition.....	5
Returns to LGR and Composition of Fish Returning to LGR.....	5
Fall Chinook salmon arriving at LGR Dam	8
Sex Ratio.....	8
Length Frequencies.....	8
Trapping and Broodstock Management 2020	9
Lower Granite Dam Trapping Operations 2020.....	9
Broodstock Collection and Management 2020	10
Hatchery Operations 2020.....	11
Spawning Operations.....	11
Spawning and Egg Take.....	11
Fish Returned to River	13
Effective Hatchery Population Size	14
Broodstock Profile.....	15
Males and Females Used in Broodstock	18
Fecundity.....	18
Inclusion of NOR fish in broodstock.....	22
Jacks and Jills and Stray Fall Chinook Salmon in Broodstock.....	23
Juvenile Rearing and Marking and Tagging	23
In Hatchery Survival Rates to Release	25
Fish Health Sampling.....	25
Juvenile Releases	25
PIT Tagging, Migration Timing, Travel Speed and Survival	27
Tucannon River Natural Production 2020	34
Spawning Ground Surveys	34
Escapement and Composition of the Fall Chinook Salmon Run in the Tucannon River	34
Juvenile Salmon Emigration.....	36
2021 Outmigration Year	36
Project Area Returns and Total Returns	39
Assumptions.....	39
Returns to the Project Area	40
Total Returns.....	41
Harvest in the Project Area.....	42

Recoveries by Region	43
Recoveries in the Ocean	43
Recoveries in the Columbia River Basin (excluding the Snake River)	44
Smolt-to-Adult Survival Rates (SAR and SAS)	46
Direct Take of Listed Snake River fall Chinook Salmon During Fall of 2020 and Spring of 2021	48
Conclusions and Recommendations	51
Literature Cited	53

List of Tables

Table 1. Fall Chinook salmon LSRCP adult ^a return goals and/or assumed objectives.....	2
Table 2. SRFCH production priorities for the LSRCP at LFH, FCAP and IPC per the <i>US v. Oregon Management Agreement</i> for brood years 2018-2027.....	5
Table 3. Estimated composition, standard errors, and confidence intervals for fall Chinook salmon, males (M) and females (F) reaching LGR during 2020.	7
Table 4. Numbers of fall Chinook initially collected at LGR for broodstock, evaluation, and run construction needs in 2020.....	10
Table 5. Egg take and percent egg mortality of fall Chinook salmon at LFH, 1984-2020.....	12
Table 6. Spawn dates, numbers of fall Chinook salmon spawned, and weekly egg take at LFH in 2020. Jacks are included with males.	13
Table 7. Weekly summary and origins of mortality and surplus fall Chinook salmon processed at LFH in 2020.....	13
Table 8. Estimated composition of fall Chinook salmon released into the Snake River near LFH at the end of the season in 2020.....	14
Table 9. Origin of males and females that contributed to production at LFH, 2020.	18
Table 10. Eggs taken and survival numbers by life stage of fall Chinook salmon spawned at LFH, brood years 2015-2020.....	24
Table 11. Numbers of fall Chinook salmon sampled by WDFW for marking and tagging quality control checks.....	24
Table 12. Estimated survivals (%) between various life stages at LFH for fall Chinook salmon, 2014-2020 subyearling and yearling brood years.	25
Table 13. Length and weight data from fall Chinook salmon released at LFH or in the GRR in 2021.	26
Table 14. Migration timing of PIT tagged yearling fall Chinook released at LFH in 2021.	27
Table 15. Migration timing of PIT tagged subyearling fall Chinook released at LFH in 2021.	28

Table 16. Migration timing of PIT tagged fall Chinook released near Cougar Creek in the GRR in 2021.	28
Table 17. Date and number of salmon redds and carcasses counted on the Tucannon River in 2020.	34
Table 18. Estimated escapement, redd construction, and resulting estimates of smolts/redd and total number of emigrants from fall Chinook salmon spawning in the Tucannon River, 2001-2020, based on observer estimation of redd origin. ^a	35
Table 19. Project area returns of WDFW released SRFCH salmon, 2003-2020 return years. The LSRCP Project Area goal is 18,300.....	41
Table 20. Total returns of WDFW released SRFCH salmon, 2003-2020 return years. The LSRCP total mitigation target would be 91,500 adults and is inclusive of the 18,300 LSRCP Project Area goal.....	42
Table 21. Estimated (and fully expanded by tag rate) Snake River basin harvest recoveries in 2020 of wire tagged fall Chinook salmon released by WDFW as reported to RMIS on 03/01/2022.....	43
Table 22. Fully expanded recovery estimates of tagged and untagged fall Chinook salmon recovered in all areas during 2020 for WDFW releases. Minijacks are not included in the estimates.....	43
Table 23. Fully expanded recovery estimates of tagged and untagged fall Chinook salmon recovered in the Ocean during 2020 for WDFW releases. Minijacks are not included in the estimates.....	44
Table 24. Fully expanded recovery estimates of tagged and untagged fall Chinook salmon recovered in the Columbia River Basin (all freshwater areas – but excluding Snake River Basin recoveries) during 2020 for WDFW releases. Minijacks are not included in the estimates.	45
Table 25. Smolt-to-adult return (SAR) rates to the LSRCP project area for yearling (LFH 1+) and subyearling (LFH 0+ - LFH On-station release; GRR 0+ - Grande Ronde River release; CCD 0+ - Couse Creek release) fall Chinook salmon by WDFW, 2002-2017 release years.	47
Table 26. Total Smolt-to-adult survival (SAS) rates for yearling and subyearling fall Chinook salmon by WDFW, 2002-2017 release years.	47
Table 27. Terms and Conditions for WDFW Section 10 Permit #16607-2R (2018).....	49

List of Figures

Figure 1. The Lower Snake River Basin showing locations of LFH, acclimation sites, and major tributaries in the area.....	4
Figure 2. SRFCH window counts at LGR, 1976-2020.....	6
Figure 3. Estimated length frequencies of SRFCH sampled (and expanded by the daily trap rate) at the LGR adult trap in 2020.	9
Figure 4. Percent of fall Chinook at LGR that were trapped/hailed to LFH in 2020 compared to the overall return.	10
Figure 5. Start, end, and peak spawn days for fall Chinook salmon spawning at LFH, 1984-2020.	12
Figure 6. Estimated effective population size of the SRFCH salmon spawned from both LFH and NPTH.	15
Figure 7. Percentages by fish origin with PBT results contributing to fall Chinook salmon broodstock at LFH during 2020.	16
Figure 8. Percentages of salt ages of SRFCH salmon spawned from both LFH and NPTH.	17
Figure 9. Fork lengths of fall Chinook salmon spawned as broodstock at LFH in 2020.	17
Figure 10. Snake River Fall Chinook salmon fork length to fecundity relationships in 2016 to 2020 by origin and rearing type.	20
Figure 11. Box-Whisker plots of Snake River fall Chinook fecundity estimates by grouped size ranges. Whiskers show the minimum and maximum, the shaded box represent the 25-75% quartiles of data, with mean and median represented by the (X) or (--) inside the box.	21
Figure 12. Estimated percent NOR parents in in the broodstock (pNOB) at LFH, NPTH, and overall for Snake River basin hatchery production combined, based on the run reconstruction estimate or by PBT results from spawned fish at the hatchery, 2003-2020. The pNOB target for the program is 30%.....	22

Figure 13. Survival and standard error of SRFCH subyearlings released into the Grande Ronde River near Cougar Creek to LGR, 2012-2021 migration years.....	29
Figure 14. 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, 2012-2021 migration years.	29
Figure 15. Survival and standard error of SRFCH subyearlings released into the Snake River at LFH to Lower Monumental Dam, 2013-2021 migration years. Note: 2012 and 2021 estimates were not valid.	30
Figure 16. 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, 2012-2021 migration years.	31
Figure 17. Survival and standard error of SRFCH yearlings released into the Snake River at LFH to Lower Monumental Dam, 2012-2021 migration years.....	32
Figure 18. 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, 2012-2021 migration years.	32
Figure 19. Relationship of the overall SRFCH return compared to estimated returns to the Tucannon River.....	36
Figure 20. Migration timing of NOR juvenile fall Chinook salmon captured at the Tucannon River smolt trap in 2021.....	37
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.....	38

List of Appendices

Appendix A: Trapping and Sampling Protocols at LGR Adult Trap for 2020.....	55
Appendix B: Systematic Sampling Rates at Lower Granite Dam 2003-2020.....	61
Appendix C: Fecundity Evaluation 2016-2020.....	63
Appendix D: Salmon Processed and Killed at LFH in 2020.....	67
Appendix E: Historical Use of Minijacks, Jacks, Jills and Strays in Broodstock at LFH.....	71
Appendix F: Egg Take and Early Life Stage Survival Brood Years: 1990-2013.....	73
Appendix G: LFH/Snake River Origin Fall Chinook Salmon Releases in 2021.....	75
Appendix H: Tucannon River Survey Sections and Historical Escapement.....	77

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 2020 spawning, and both yearling and subyearling releases at LFH or in the Grande Ronde River that occurred in 2021. WDFW's Snake River Lab (SRL) evaluation staff completed this work with federal fiscal year 2020/2021 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 the hatchery 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 (Fall Chinook Acclimation Project – FCAP) for SRFCH 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 SRFCH 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 return 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

^aAs defined in the LSRCP document, “adults” include adults and jacks, but not minijacks.

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

- The survival rate required to deliver a 4:1 catch to escapement ratio has been less than what was originally assumed, and this has resulted in fewer adults being produced.
- The listing of 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, ~53% of the hatchery-origin (HOR) produced fish are marked with an adipose (AD) fin clip and a portion tagged with a coded wire tag (CWT). If changes to marking/tagging occurs, there is a notification process that needs to be followed per the permit #16607 – 2R issued from NOAA-Fisheries and amended in 2018 (NMFS 2018).

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 IHD) 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. 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.

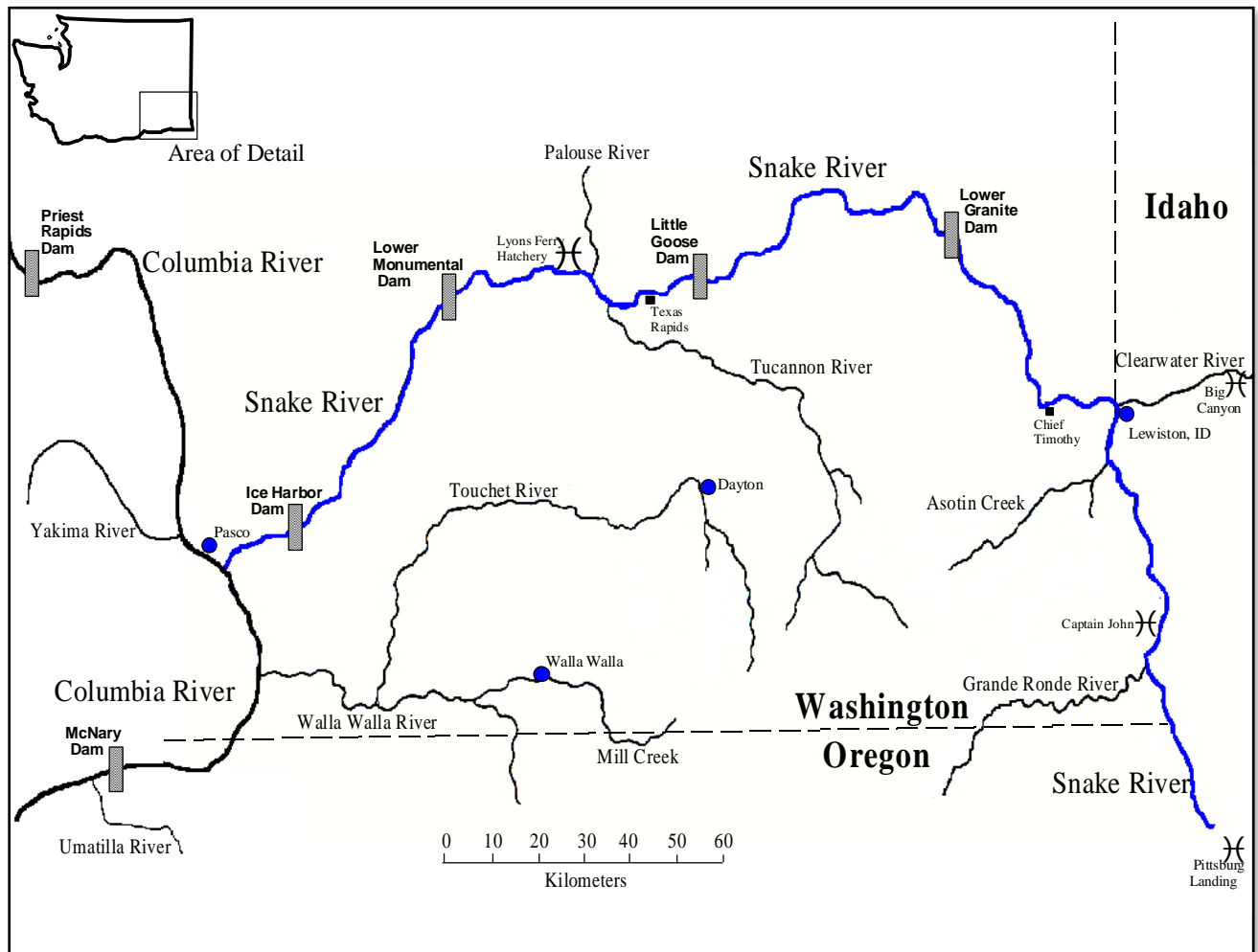


Figure 1. The Lower Snake River Basin showing locations of LFH, acclimation sites, and major tributaries in the area.

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 will be moved to the Salmon River. Several Parties are actively participating in the re-licensing of Idaho Power Company’s Hells Canyon Complex and its operations. Idaho Power Company’s mitigation responsibilities, including production numbers and release locations are a subject of these discussions.

2020 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 2020. Fish are visually measured and grouped by total length (TL) at fish passage windows. Window counts (day and night) estimated 24,558 SRFCH (≥ 30 cm TL) reached LGR in 2020 (Figure 2), which includes 11,443 “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.

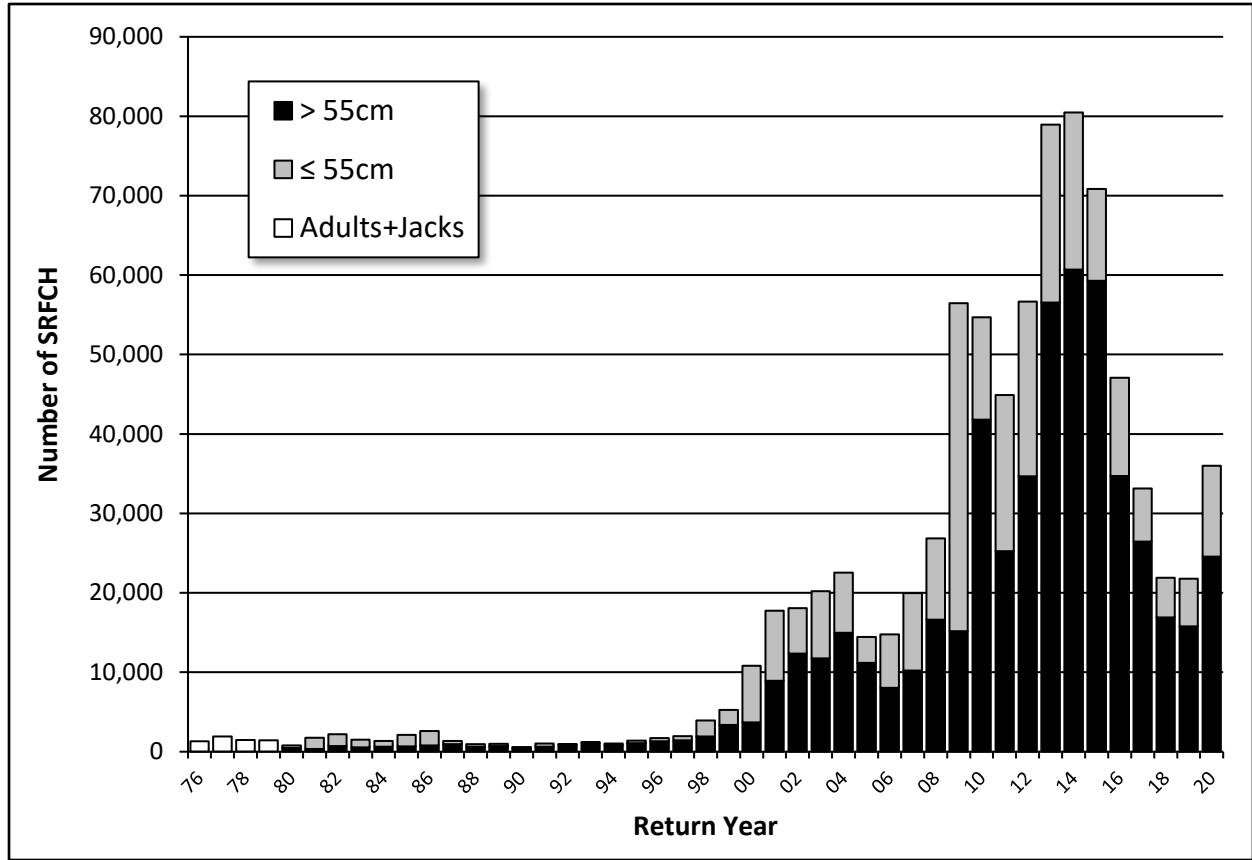


Figure 2. Snake River Fall Chinook salmon window counts at LGR, 1976-2020.

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 estimates derived were bootstrapped by Ben Sandford of NOAA, with confidence intervals applied to the point estimates (Table 3). 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 33,617 adult, jack, and mini-jack (including males < 57 cm) SRFCH reached LGR in 2020. For adults and jacks only, an estimated 30.2% were natural-origin, 69.4% were in-basin hatchery-origin, and 0.4% out-of-basin hatchery-origin. The final run estimate to LGR was 0.4% less than window count estimates documented at www.fpc.org. Females, regardless of size, were summarized together and males were summarized according to fork length (30-56 cm and ≥ 57 cm). The data is grouped by total age as requested by the Technical Advisory Committee (TAC) for forecasting future runs. The data does not specifically show true jacks because age 2 fish consist of minijacks (0-salt yearlings), and jacks (1-salt subyearlings) and age 3 fish consist of jacks (1-salt yearlings) and adults (2-salt subyearlings).

Table 3. Estimated composition, standard errors, and confidence intervals for fall Chinook salmon, males (M) and females (F) reaching LGR during 2020.

Estimates					Bootstrap standard error					Bootstrap 95% Confidence Interval (Upper CI, Lower CI)				
Total Run by Origin														
Origin	F	M ≥57cm	M <57 cm	Total ≥57cm	Origin	F	M ≥57 cm	M <57 cm	Total ≥57cm	Origin	F	M ≥ 57cm	M <57 cm	Total ≥57 cm
Total wild	3183	4885	673	8068	Total wild	231	302	363	364	Total wild	2746, 3660	4317, 5491	18, 1467	7382, 8826
Total hatchery	8186	11084	5608	19270	Total hatchery	255	326	381	373	Total hatchery	7659, 8658	10458, 11701	4851, 6303	18499, 19963
Totals	11369	15969	6280	27337	Totals	188	205	166	168	Totals	10989, 11728	15559, 16399	5964, 6615	27002, 27663
Run by origin and age														
Origin	F	M ≥57cm	M <57 cm	Total ≥57cm	Origin	F	M ≥57cm	M <57cm	Total ≥57cm	Origin	F	M ≥57cm	M <57 cm	Total ≥57 cm
Wild age 2	53	72	468	126	Wild age 2	17	71	362	73	Wild age 2	22, 90	-73, 209	-188, 1250	-22, 268
Wild age 3	1625	4072	187	5698	Wild age 3	178	290	34	335	Wild age 3	1242, 1948	3531, 4702	114, 244	5062, 6406
Wild age 4	1198	754	18	1952	Wild age 4	169	123	10	203	Wild age 4	895, 1570	484, 970	0, 40	1541, 2359
Wild age 5	299	-14	0	286	Wild age 5	53	46	0	70	Wild age 5	204, 410	-106, 69	0, 0	147, 416
Wild age 6	7	0	0	7	Wild age 6	7	0	0	7	Wild age 6	0, 22	0, 0	0, 0	0, 22
Hat age 2	24	365	5474	388	Hat age 2	13	99	388	100	Hat age 2	4, 53	163, 579	4683, 6159	183, 608
Hat age 3	1999	7151	109	9150	Hat age 3	213	358	40	408	Hat age 3	1588, 2448	6476, 7901	35, 197	8330, 9984
Hat age 4	5799	3366	6	9164	Hat age 4	233	199	7	302	Hat age 4	5340, 6230	2982, 3773	0, 23	8538, 9749
Hat age 5	350	177	0	527	Hat age 5	69	69	0	96	Hat age 5	206, 486	66, 333	0, 0	337, 724
Hat age 6	14	5	0	19	Hat age 6	15	5	0	16	Hat age 6	0, 56	0, 15	0, 0	0, 57
Stray age 2	0	0	0	0	Stray age 2	0	0	0	0	Stray age 2	0, 0	0, 0	0, 0	0, 0
Stray age 3	0	21	18	21	Stray age 3	0	15	17	15	Stray age 3	0, 0	0, 60	0, 55	0, 60
Stray age 4	0	0	0	0	Stray age 4	0	0	0	0	Stray age 4	0, 0	0, 0	0, 0	0, 0
Stray age 5	0	0	0	0	Stray age 5	0	0	0	0	Stray age 5	0, 0	0, 0	0, 0	0, 0
Stray age 6	0	0	0	0	Stray age 6	0	0	0	0	Stray age 6	0, 0	0, 0	0, 0	0, 0
Stray AWT	0	0	0	0	Stray AWT	0	0	0	0	Stray AWT	0, 0	0, 0	0, 0	0, 0
Stray Wild	0	0	0	0	Stray Wild	0	0	0	0	Stray Wild	0, 0	0, 0	0, 0	0, 0

^a AWT refers to agency wire tag with a 09 agency code.

Fall Chinook salmon arriving at LGR Dam

The following sections use data collected from hatchery and NOR fall Chinook salmon handled at the LGR adult trap.

Sex Ratio

Of all the fall Chinook sampled at the LGR trap (expanded by the daily trap rate), 25,938 (67.3%) were considered males (includes adults, jacks and minijacks), and 12,579 (32.7%) 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 1.9:1 M:F. After removal of fish for broodstock, the sex ratio SRFCH upstream of LGR was 2.3:1 M:F.

Length Frequencies

Every salmon trapped at LGR was measured and the number of fish at each length were expanded by the trapping rate on the day they were captured to represent the overall run of fall Chinook salmon at that size during that day (Figure 3). Median fork length for males was 60.0 cm with a mean of 58.3 cm. Median fork length for females was 71.0 cm with a mean of 72.2 cm.

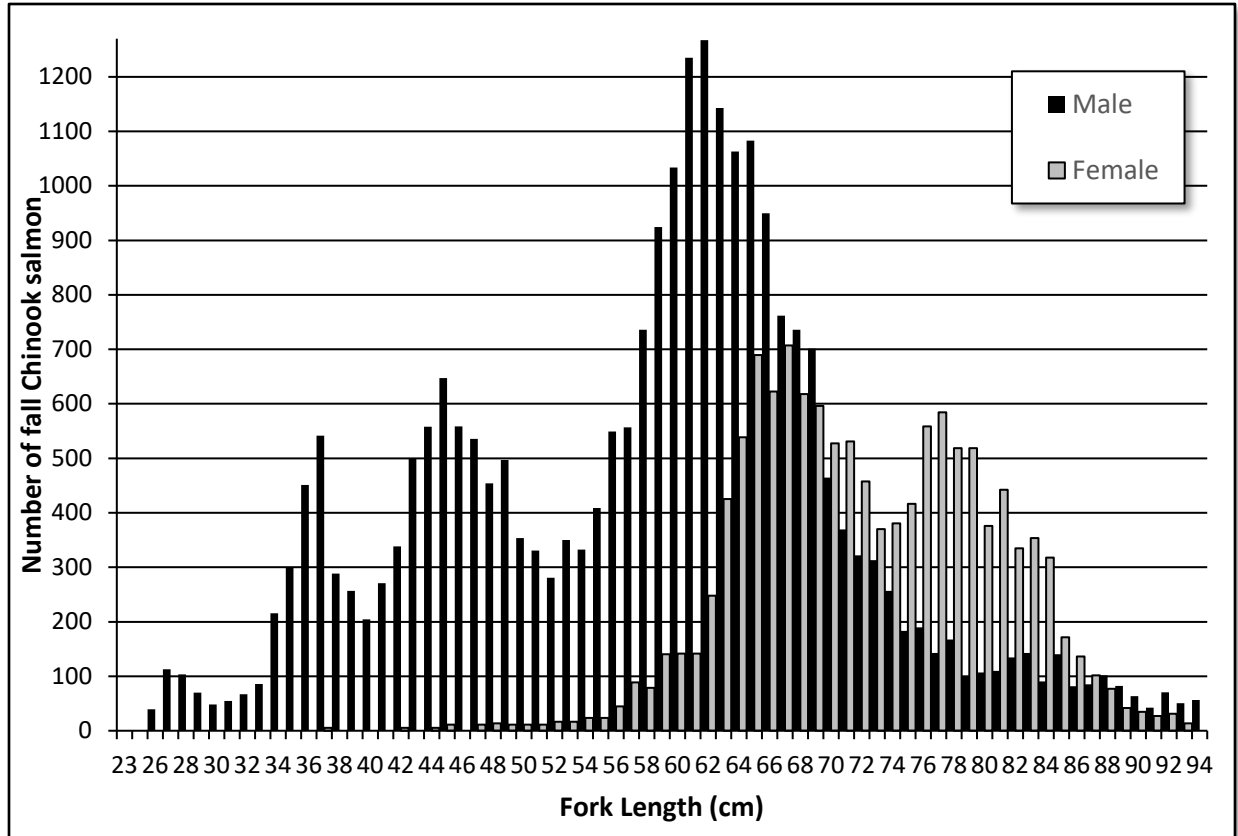


Figure 3. Estimated length frequencies of SRFCH sampled (and expanded by the daily trap rate) at the LGR adult trap in 2020.

Trapping and Broodstock Management 2020

Lower Granite Dam Trapping Operations 2020

In 2020, fall Chinook trapping and hauling at LGR began 18 August. Two trapping rates were used during the season (18 Aug – 1 Sept = 80%, 2 Sept – 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 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) trying to remain at a 20% or less handle rate impact on natural origin steelhead at LGR (steelhead generally return a little later than the fall Chinook). No interruptions to trapping due to high water temperatures occurred in 2020. The arrival timing of males and females collected for broodstock at LGR and hauled to LFH is provided (Figure 4). Broodstock collection goals were met by early October, with all the fish trapped after that time passed upstream for natural spawning. Trapping protocols and changes that occurred in 2020 are presented in Appendix A. Historical trapping rates and operation dates of systematic sampling at LGR are presented in

Appendix B. In general, NOAA Fisheries staff anesthetized the salmon, and gather length, sex, fin clip, and the presence of wire or PIT tag. Of the 9,928 salmon trapped at LGR, approximately 25.0% were hauled to LFH and 9.1% were hauled to NPT to satisfy broodstock and run reconstruction needs.

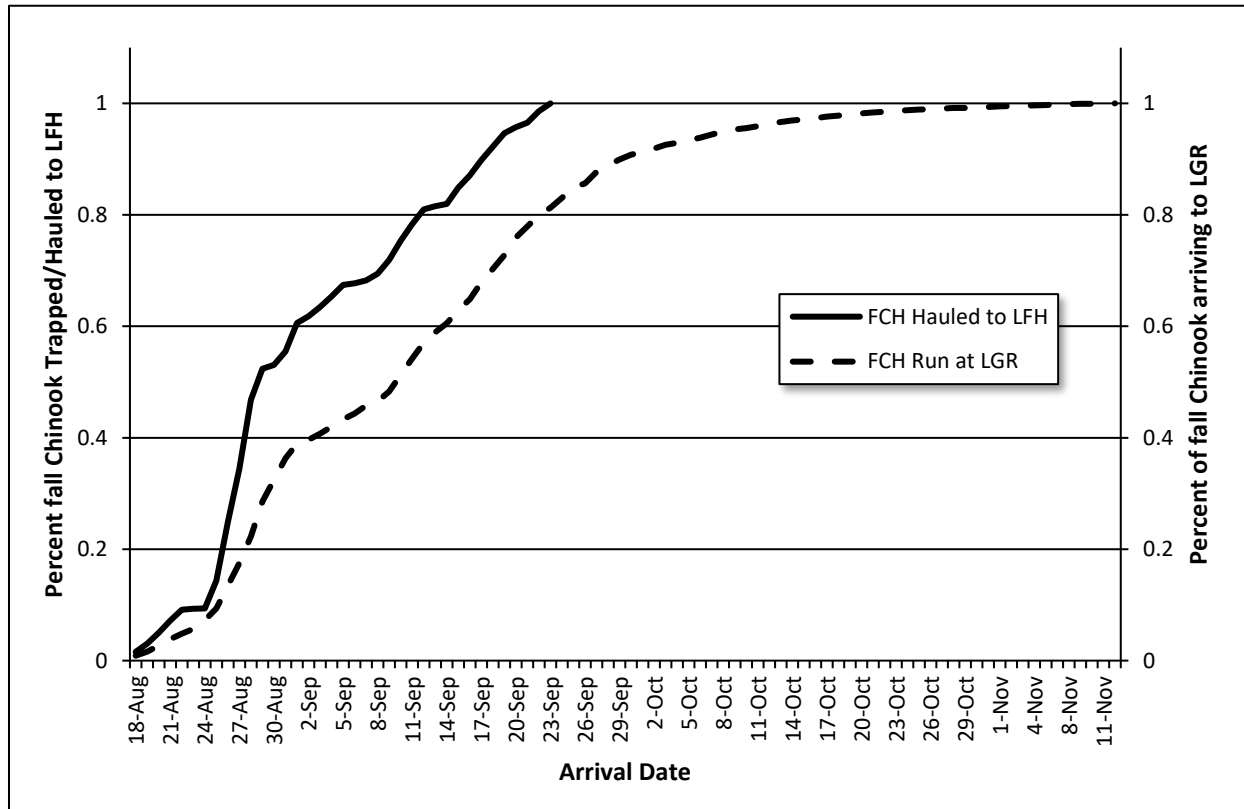


Figure 4. Percent of fall Chinook at LGR that were trapped/hailed to LFH in 2020 compared to the overall return.

Broodstock Collection and Management 2020

In 2020, all fall Chinook salmon collected for broodstock were trapped at LGR. No fish were trapped at LFH in 2020. 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 (Table 4). The discrepancies are likely data recording errors at either location.

Table 4. Numbers of fall Chinook initially collected at LGR for broodstock, evaluation, and run construction needs in 2020.

Year	Trap location	Number collected/hailed for broodstock	Spawned, killed, or dead in pond fish processed at LFH	Returned to the Snake River at LFH	Difference from number collected/hailed
2020	LGR	2,478	2,312	155	11 (0.44%)

Hatchery Operations 2020

Spawning Operations

Spawning and Egg Take

Fish transported from LGR to the adult holding ponds at LFH had approximately 0.61:1 M:F sex ratio in the adults (70 cm or greater), and 9.5:1 M:F sex ratio for fish less than 70 cm (which mainly includes jacks and mini-jacks sampled for run reconstruction needs). Most of the fish collected that were < 70 cm were not intended to be used in the broodstock but were for CWT recovery to use in the run reconstruction. Size criteria for mating males was set at 70 cm to reduce the number of potential jacks (HOR and NOR) used for broodstock. Mate selection and spawning protocols changed weekly according to the numbers of males ripe during the spawn day and to allow for maximum use of larger, older aged, unmarked/untagged fish from LGR.

The duration and peak of spawning (Figure 5), eggtake, and percent egg mortality (Table 5), numbers of fish spawned (Table 6), and the number killed outright or died in the pond are provided (Table 7). 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 location IHR, LFH or LGR or any combination of the three in any given year have provided brood stock.
- 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 eggtake goals.

In 2020, seven females (two NOR and five Snake River HOR) were non-viable. Natural-origin fish used for broodstock were identified post-spawning based on PIT tags and Coded Wire Tags (CWT) recovered and Parental Based Tagging (PBT) results obtained at the end of the season. Composition of fish processed at LFH in 2020 is presented in Appendix C. In 2020, eggtake goals were attained for LFH as required by the production priorities table per the 2018-2027 US v. Oregon Management Agreement (Table 2).

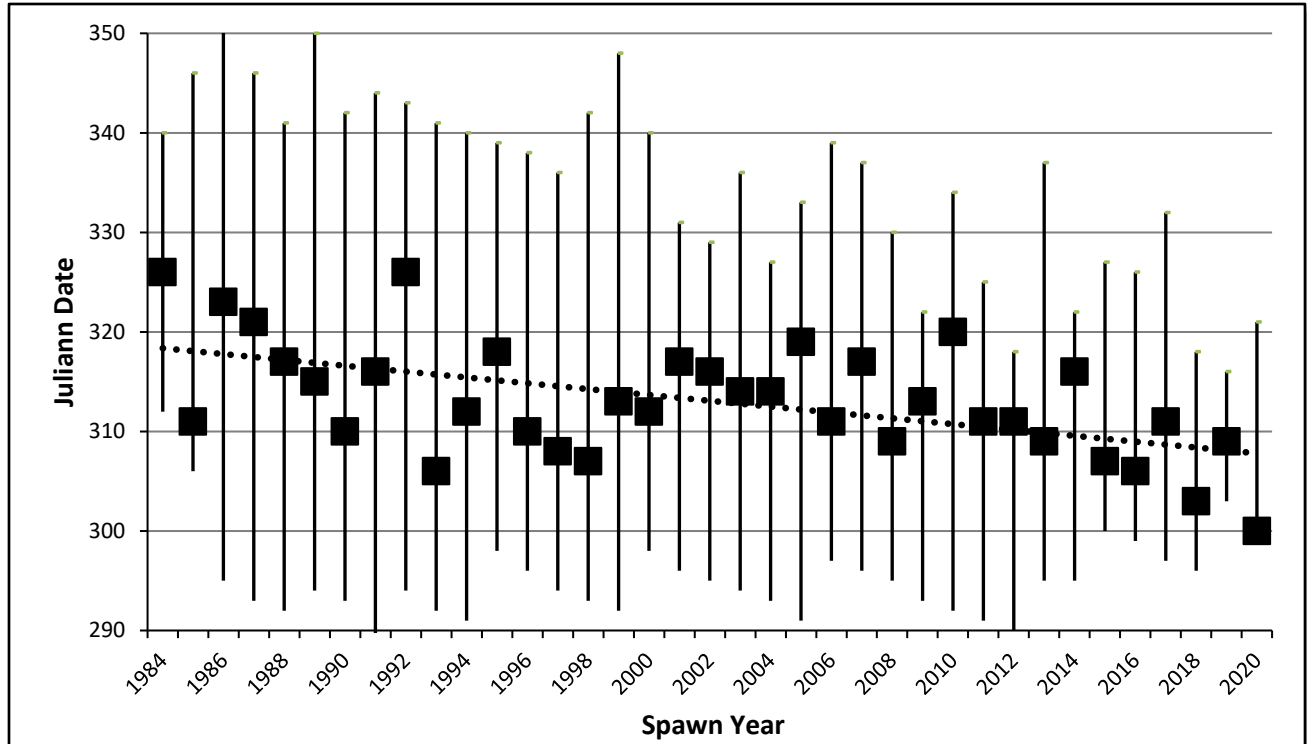


Figure 5. Start, end, and peak spawn days for fall Chinook salmon spawning at LFH, 1984-2020.

Table 5. Egg take and percent egg mortality of fall Chinook salmon at LFH, 1984-2020.

Spawn Year	Total eggtake	Egg mortality to eye-up (%) ^a	Spawn Year	Total eggtake	Egg mortality to eye-up (%) ^a	Spawn Year	Total eggtake	Egg mortality to eye-up (%) ^a
1984	1,567,823	21.6	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			
1996	1,698,309	4.6	2009	4,574,182	4.7			

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

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

^c Does not include loss from 10,000 eggs from stray females given to University of Idaho. The egg loss from strays was 8.63% excluding eggs used in fertilization experiments.

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

Table 6. Spawn dates, numbers of fall Chinook salmon spawned, and weekly egg take at LFH in 2020. Jacks are included with males.

Spawn Dates	Males			Females			Egg Take
	HOR ^{ab}	NOR	Unknown Origin	HOR ^{ab}	NOR	Unknown Origin	
27 Oct	181	61	4	363	129		2,097,510
3 Nov	154	68		243	99		1,434,480
9 Nov	72	71		147	77		946,590
17 Nov	5	25		14	15		125,100
Totals	412	225	4	767	320		4,603,680

^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 7. Weekly summary and origins of mortality and surplus fall Chinook salmon processed at LFH in 2020.

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
29 Aug		1	4	1						
5 Sept			1							
12 Sept										
19 Sep		1	1	2						
26 Sep			2	1						
3 Oct		1	1	1						
10 Oct	1		2							
17 Oct		1								
24 Oct	1		1	1						
31 Oct		3	1	5	10	245			2	13
7 Nov			1	2	4	60	2	1		7
14 Nov		5		6	3	8		1		
21 Nov	1	12	2	4	62	80	1		1	3
Totals	3	24	16	23	79	393	3	2	3	23

^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 program needs were returned to the Snake River at LFH on 17 November (Table 8). 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 8. Estimated composition of fall Chinook salmon released into the Snake River near LFH at the end of the season in 2020.

Origin	Origin estimation		Females	Males+Jacks	Total
	method				
Hatchery	Ad Clip		26	38	64
Unmarked/Untagged	Ad Intact/No CWT		63	28	91
Totals			89	66	155

Effective Hatchery Population Size

To determine the effective population size of HOR fall Chinook salmon production in the Snake River, 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 2020, a total of 1,504 females and 924 unique males were spawned at both facilities combined. Of the 924 males spawned, 449 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 2020 was 738. Total effective hatchery population (N_e) size was calculated by the following formula:

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

$$(4 \times (738 \times 1,504)) / (738 + 1,504) = 1,980$$

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

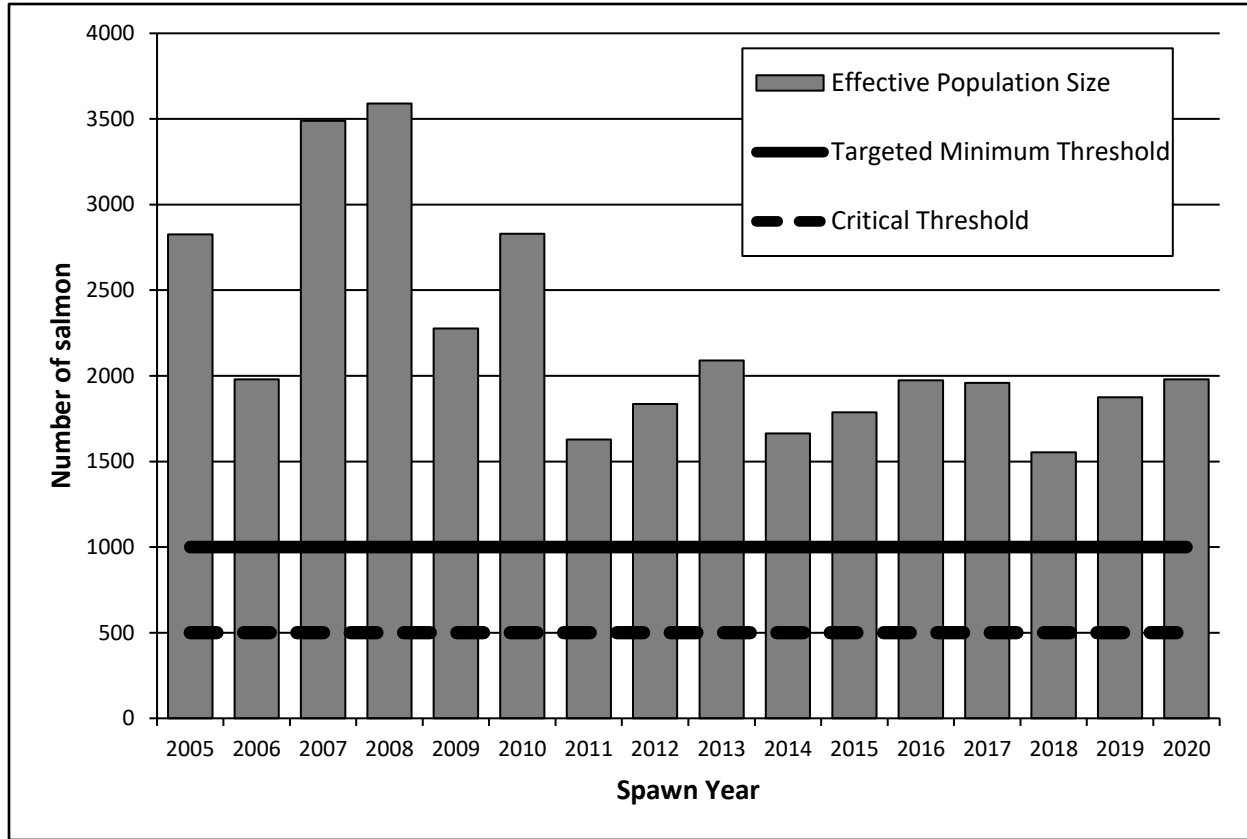


Figure 6. Estimated effective population size of the SRFCH salmon spawned from both LFH and NPTH.

Broodstock Profile

Since 2011, fin tissues have been taken from all fish contributing to broodstock. This was the fifth year PBT results, in conjunction with CWT and PIT tag recoveries that 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, in 2020, scales were not taken on fish with CWTs since it was somewhat redundant, and to save resources. In addition, due to WDFW working restrictions in 2020 from COVID-19, otolith samples were not taken by staff from the University of Idaho. Typically, this was done to determine where NOR fall Chinook salmon are rearing in the Snake River basin based on strontium levels (Hegg 2013).

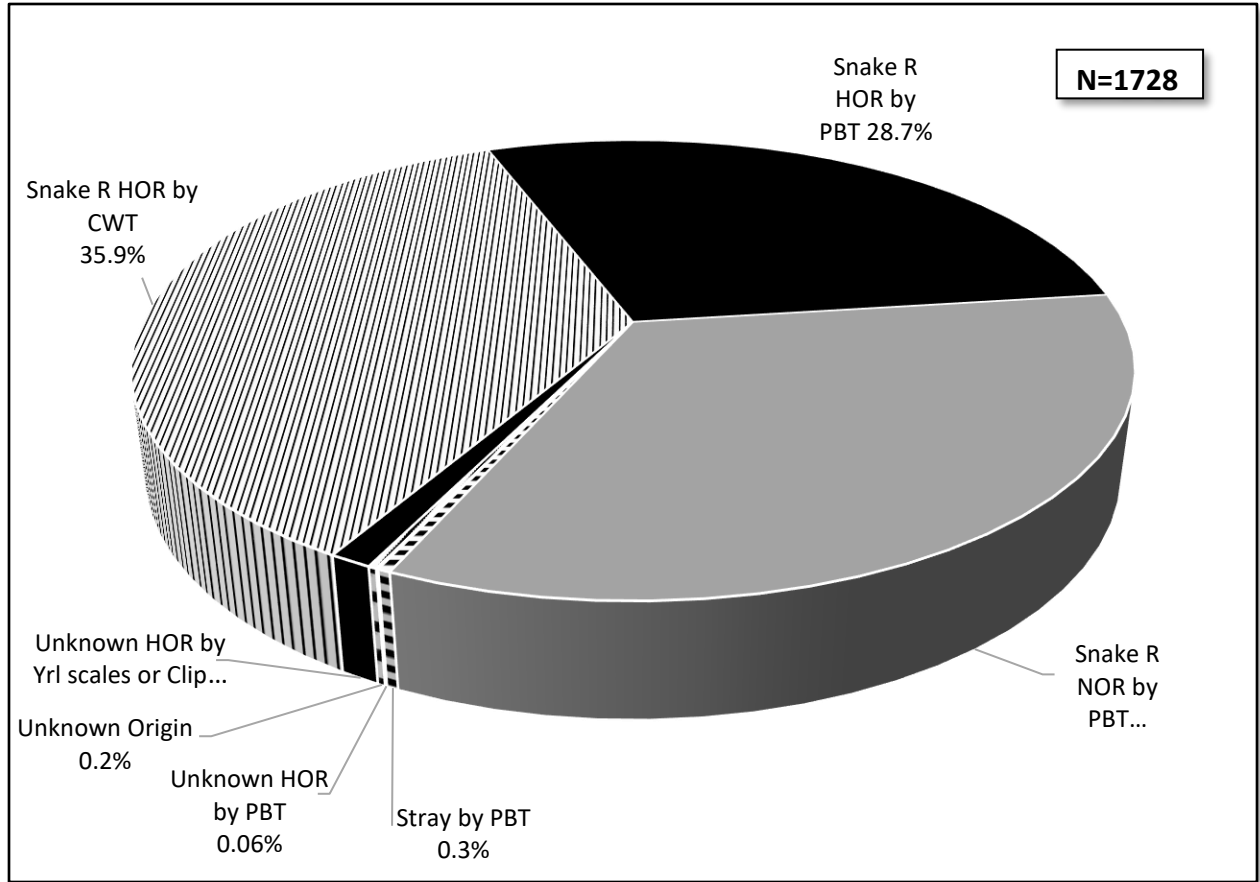


Figure 7. Percentages by fish origin with PBT results contributing to fall Chinook salmon broodstock at LFH during 2020.

A concentrated effort has occurred since 2010 to spawn older and 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). Length frequencies of fall Chinook salmon used for broodstock at LFH in 2020 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. Median length was 81 cm for females and 80 cm for males. An estimated 1.8% of the males and 3.8% of the females were returns from yearling releases.

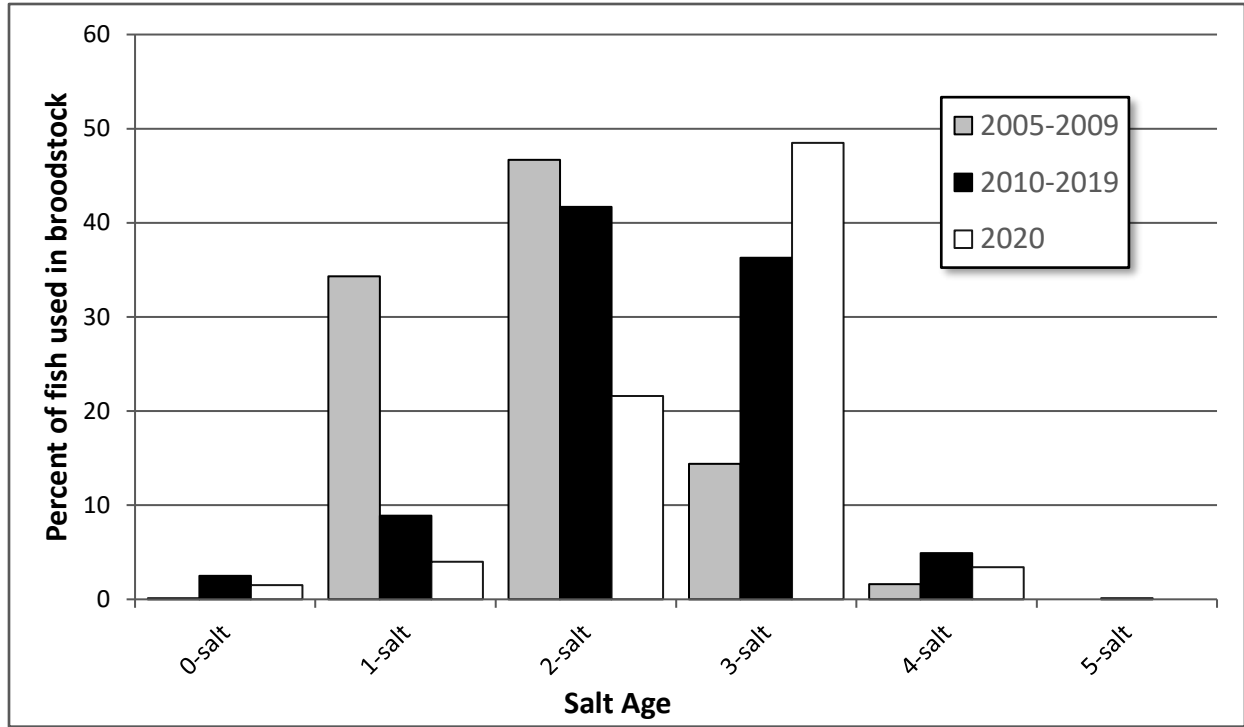


Figure 8. Percentages of salt ages of fall Chinook salmon spawned from both LFH and NPTH before and after changes in brood stock collections. Brood year 2020 is provided for specific reference.

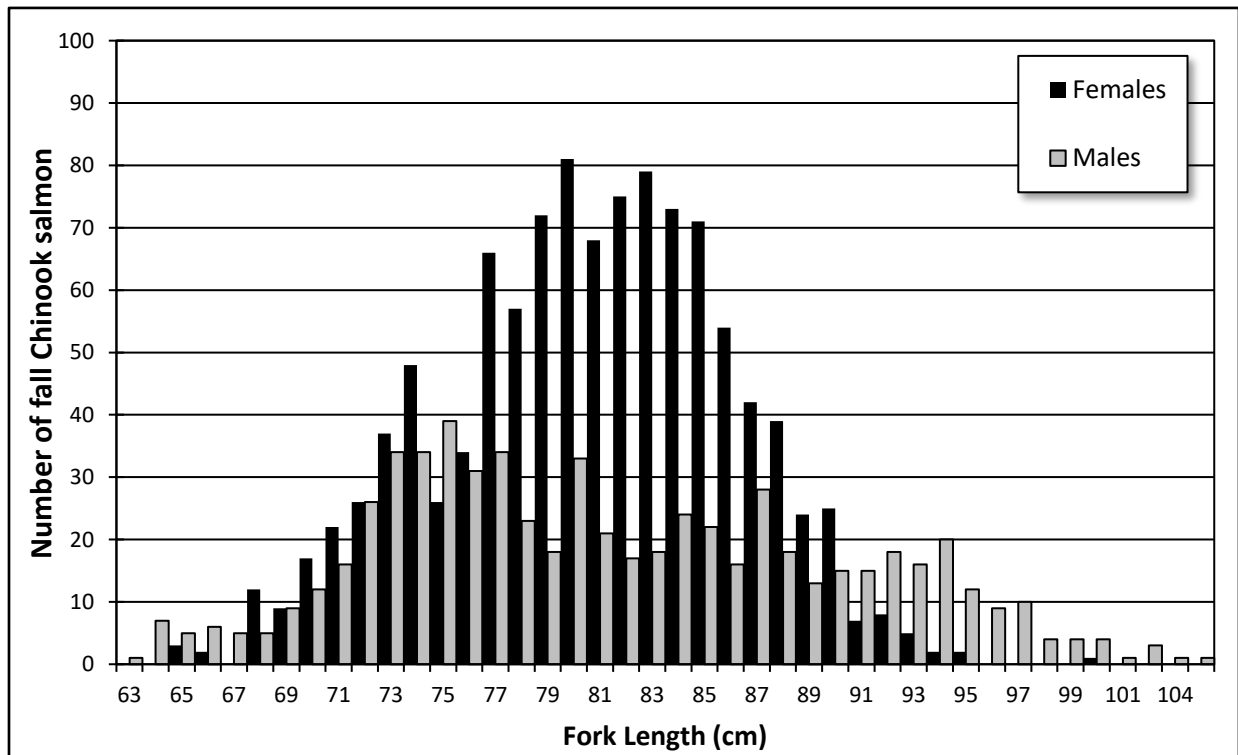


Figure 9. Fork lengths of fall Chinook salmon spawned as broodstock at LFH in 2020.

Males and Females Used in Broodstock

Origin was determined for both male and female fall Chinook contributing to production in 2020. Based on PBT, CWT, or PIT tag data 60.1% of the males spawned were determined to be Snake River HOR. Based on PBT 37.3% of the males were identified as Snake River NOR. An additional 1.4% of the males were identified as unknown HOR based on AD clip, lost/unreadable CWT tags, or yearling scale patterns and 0.62% were identified as stray HOR based on PBT, PIT tag or CWT data. Another 0.62% were identified as unknown origin due to individuals failing to genotype, intact adipose and no CWT present. The goal was not to exceed three or four females per male; seven males were used 6 times (Table 9). Origin was determined for 67.4% the females spawned to be Snake River HOR based on PBT, CWT or PIT tag data. PBT determined 31.4% of the females were Snake River NOR. An additional 1.0% of the females were identified as unknown HOR based on AD clip, lost/unreadable CWT tags, or yearling scale patterns. Another 0.1% were determined to stray HOR based on PBT, CWT, or PIT tag data (Table 9).

Table 9. Origin of males and females that contributed to production at LFH, 2020.

Origin determination method	Times each male was used for mating						Total unique	% Used
	1	2	3	4	5	6		
Males								
Snake R Hatchery	199	148	30	1		7	384	60.1%
Snake R Natural	61	149	29				239	37.3%
Unknown Hatchery	7	3					10	1.4%
Stray Hatchery	2	2					4	0.62%
Unknown Origin		3	1				4	0.62%
Total unique males	269	305	60	1	0	7	641	
Females								
Snake R Hatchery	733						733	67.4%
Snake R Natural	341						341	31.4%
Unknown Hatchery	11						11	1.0%
Stray Hatchery	2						2	0.1%
Unknown Origin	0						0	0.0%
Total unique females	1,087						1,087	

Fecundity

Beginning in 2016, we started an evaluation to determine if fecundity differed by origin and rearing type (Milks et al 2018). Hatchery spring Chinook from the Tucannon River have significantly lower fecundity compared to NOR adults at the same age and length (Gallinat 2020). Since 2016, it's been possible to determine the origin of all HOR and NOR

unmarked/untagged females from PBT. As such, it seemed prudent to determine if the same relationship existed for the SRFCH program.

From 2016 to 2020, individual fecundities were estimated on a subsample of the total broodstock. Fecundity was estimated by counting and weighing 100 live eggs, applying the weight/egg calculation to the total weight of the live eggs, adding in counted dead eggs, and applying a 4% correction factor for water retention in the total live egg weight sample. Not all fecundities estimated were used in the evaluation as it was readily apparent that some fish were partial spawns (given the length:fecundity relationship). All known HOR CWT fish (yearling and subyearling) determined to be SRFCH in origin were included, with scale ages used to determine if some of the subyearling HORs were reservoir reared (making them more like yearlings). All NORs and some HORs (unmarked/untagged) were determined using the PBT results, with scales again used to determine rearing type (yearling or subyearling). Non-CWT (but AD clipped) HORs were included if PBT results indicated they were SRFCH in origin, again with scale used to determine rearing type. Any fish that had insufficient data to positively determine origin (SRFCH only) or rearing type were excluded from the analysis. Graphical results by individual year are provided in Appendix C.

Based on the above identification criteria, fecundity relationships were evaluated for four groups (HOR subyearling and yearling, and NOR subyearling and yearling) in all five years: (Figure 10). Fork lengths were correlated to total eggs in all groups but were highly variable for any given size (1,470-6,599 eggs/fish). The slopes of the regression lines for all group were tested for statistical difference, but none were found to be significantly different ($P = 0.32$ to 0.68). We also tested for differences in regression elevations (where the slope of the line crosses the y-axis) and found that HOR yearlings were significantly lower to the other three groups ($P < 0.001$ in all three comparisons). To better observe the differences compared to the scatter plot in Figure 10, sizes were grouped by 5cm intervals and compared using box-whisker plots (Figure 11). In nearly every size range category, HOR yearling females have consistently lower fecundity compared to the other groups.

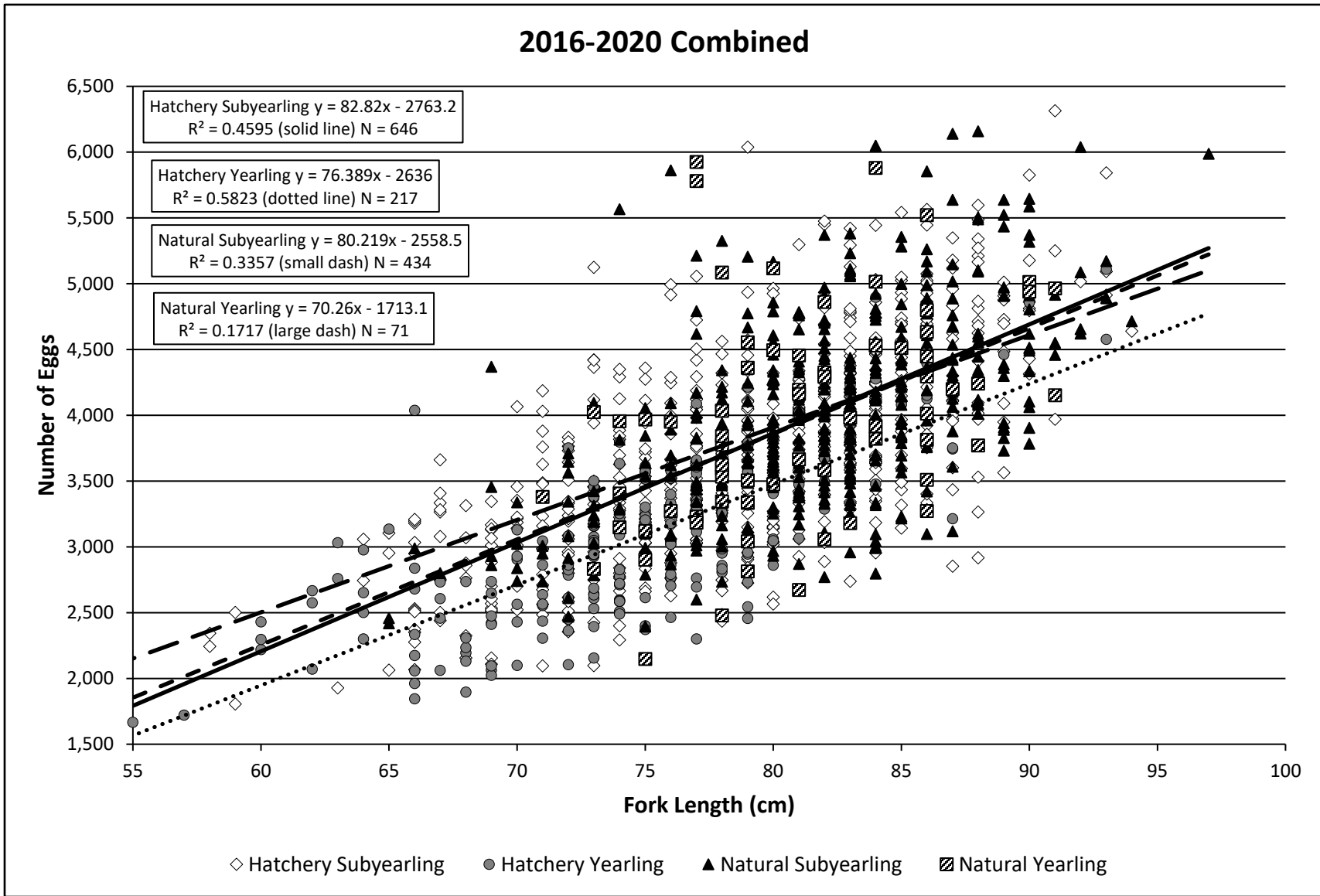


Figure 10. Snake River Fall Chinook salmon fork length to fecundity relationships in 2016 to 2020 by origin and rearing type.

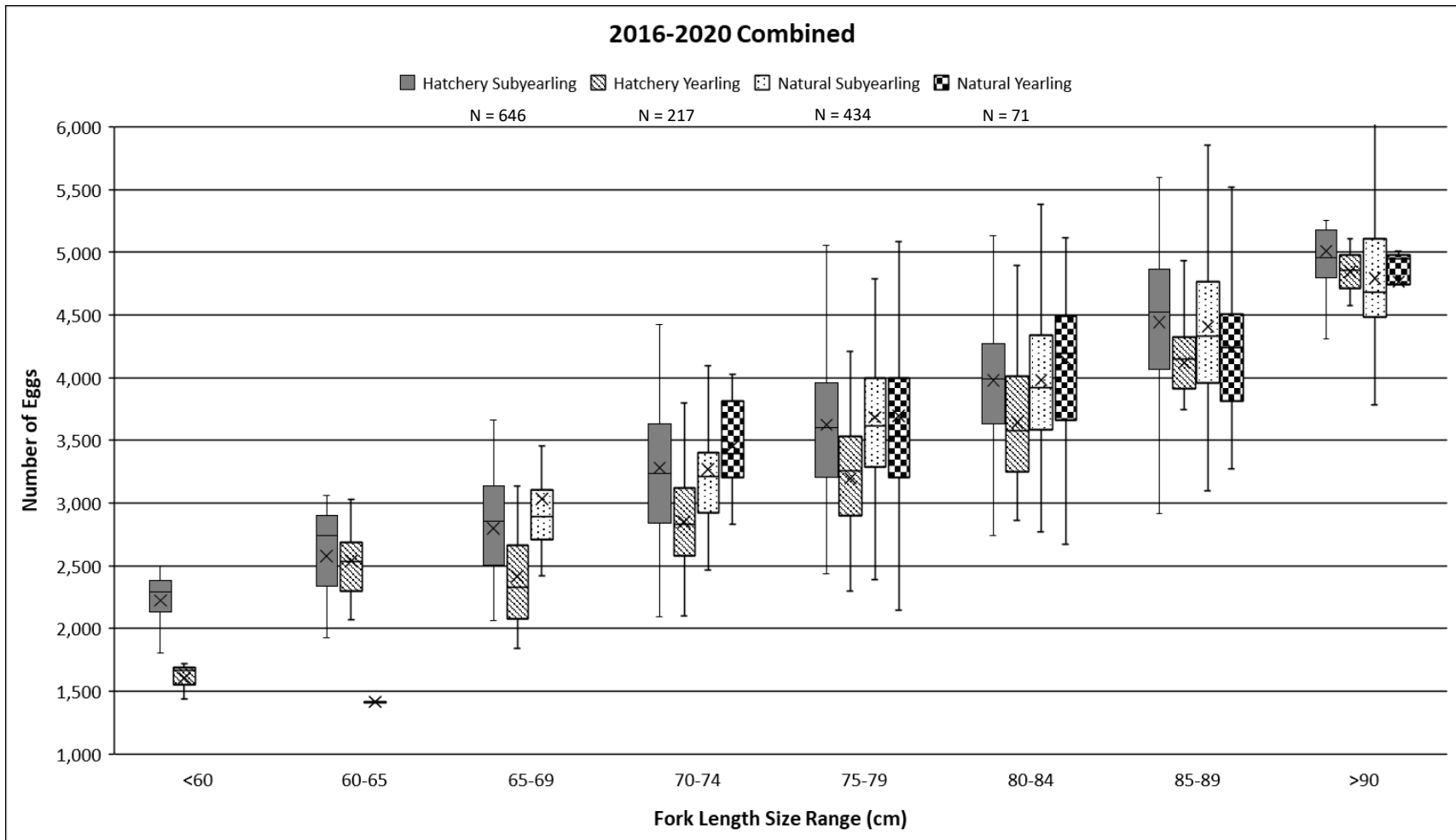


Figure 11. Box-Whisker plots of Snake River fall Chinook fecundity estimates by grouped size ranges. Whiskers show the minimum and maximum, the shaded box represent the 25-75% quartiles of data, with mean and median represented by the (X) or (--) inside the box.

Inclusion of NOR fish in broodstock

Inclusion of NOR unmarked/untagged fall Chinook salmon were incorporated into the broodstock beginning in 2002 (Figure 12). 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 estimated at LGR from the run reconstruction method to estimated NOR fish in the broodstock. Since 2016, a separate estimate of pNOB based on the fish spawned, including males that were used more than once. 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. In 2020, the estimated pNOB in the WDFW broodstock was 32.0% (Figure 12). The overall spawned hatchery pNOB for LFH and NPTH combined was 31.0% and was almost identical to that predicted pNOB by the run reconstruction method.

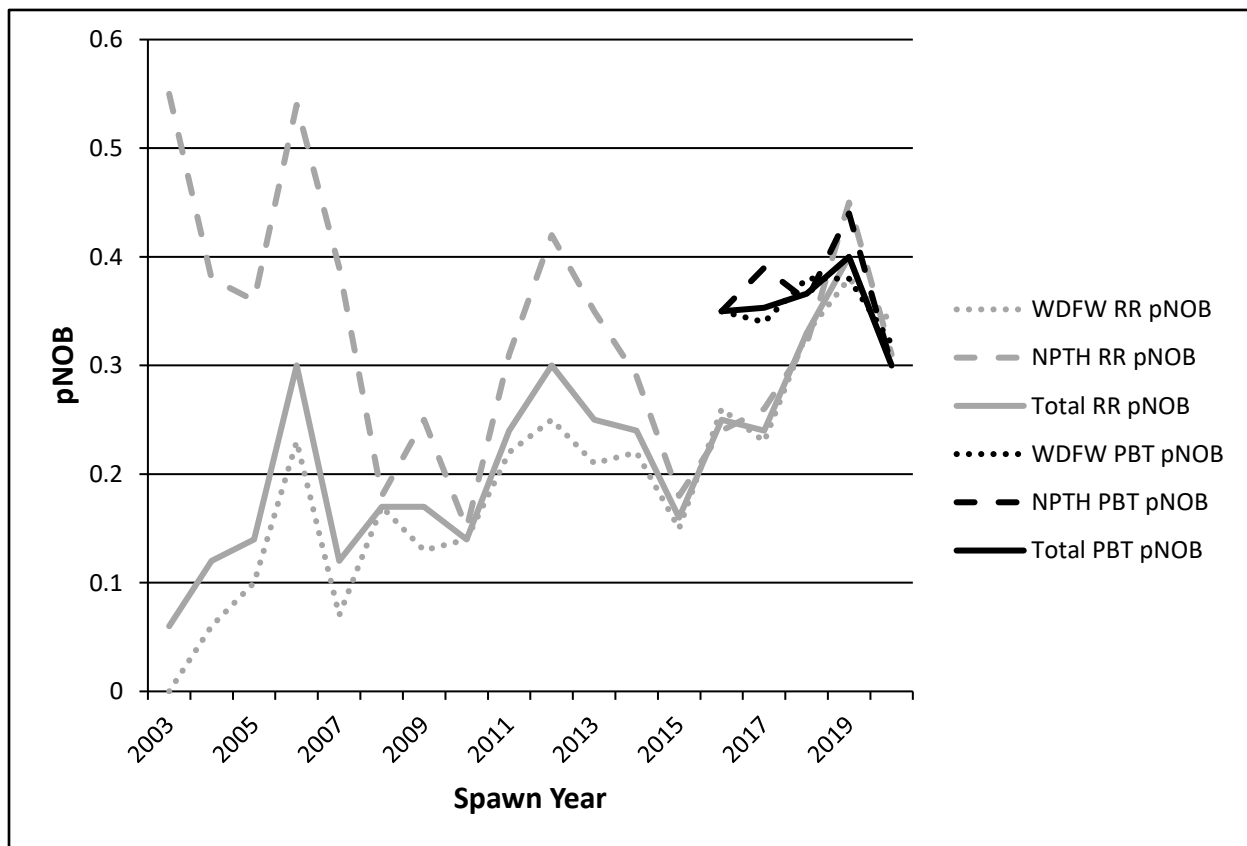


Figure 12. Estimated percent NOR parents in the broodstock (or pNOB) at LFH, NPTH, and overall for Snake River fall Chinook salmon hatchery production combined, based on the run reconstruction estimate or by PBT results from spawned fish at the hatchery, 2003-2020. The pNOB target for the program is 0.3 or 30%.

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. Intensive monitoring of jacks and jills in the broodstock began in 2010 to minimize their overall contribution. This monitoring and subsequent management action has reduced the total matings with 0 and/or 1-salt parentage by 97% within the last 11 years (Appendix D).

The WDFW 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 production goals were met as mandated in the 2018-2027 *United States v. Oregon* Management Agreement, seven stray females were spawned and the gametes were retained until the end of the spawning season. When it was verified that production goals could be met, the strays were culled. Strays retained as broodstock over the years are presented in Appendix D. Males used multiple times are included multiple times in 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 10. 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 LSRCPC website. Further detailed information regarding type and size of vessels used for rearing SRFCH can be found in LFH Annual Reports available at the LSRCPC website. <http://www.fws.gov/office/lower-snake-river-compensation-plan/library>

Table 100. Eggs taken and survival numbers by life stage of fall Chinook salmon spawned at LFH, brood years 2015-2020.

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 1,839,400	Yearling Subyearling
2016	4,951,188	121,359	61,346	1,540,000	3,228,483	1,008,647 1,995,000	Yearling Subyearling
2017	4,685,575	212,043	48,940	1,541,282	2,883,310	930,000 1,912,017	Yearling Subyearling
2018 ^b	4,754,622	158,706	18,863	1,315,510	3,261,543	484,356 2,761,054	Yearling Subyearling
2019	4,687,449	143,141	23,489	1,332,784	3,171,230	614,284 2,704,713	Yearling Subyearling
2020	4,603,680	141,273	58,258	1,311,219	4,515,433	467,822 2,521,837	Yearling 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

Marking and tagging of fish was consistent with the 2018- 2027 US v. Oregon Management Agreement. The LFH yearling (BY19) fish were 100% ADCWT marked/tagged in the early summer of 2020. Staff performed tag and fin clip quality control checks from a sample prior to release from cast-netting fish from the rearing lake (Table 11).

A portion of the subyearling (BY20) were ADCWT marked/tagged in the spring of 2021. All subyearlings (marked/tagged and unmarked/untagged) were diverted to the rearing lake after the yearlings were released in late March. The GRR (BY20) fish were ADCWT marked/tagged in the spring of 2021 at Irrigon Fish Hatchery. Fish were kept in raceways prior to being trucked to their release site on the Grande Ronde River near Cougar Creek.

Table 11. 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
2019	Yearling	LFH	ADCWT	637762	1,027	1,000 (97.3%)	21 (2.0%)	6 (0.58%)	0 (0.00%)
2020	Subyearling	LFH	ADCWT	637940	888	864 (97.30%)	20 (2.25%)	4 (0.45%)	0 (0.0%)
2020	Subyearling	GRR	ADCWT	637941	1,219	1,190 (97.6%)	27 (2.21%)	1 (0.08%)	1 (0.08%)

In Hatchery Survival Rates to Release

The estimated number of eggs and fish present at life stages in the hatchery were used for 2015-2020 release years to calculate survival rates within the hatchery environment (Table 12). The original survival goal for the program was 80% [(9,160,000 subyearling juveniles/11,450,000 eggs) x 100] from USACE 1975. The survival goal has been achieved each year for yearlings since 2003 and yearly since 1990 for subyearlings.

Table 12. Estimated survivals (%) between various life stages at LFH for fall Chinook salmon, 2014-2020 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	94.8
2020	95.0	NA	99.9	NA	94.0	NA
Mean	94.4	94.6	97.2	93.1	90.7	89.9
SD	1.1	1.2	2.1	5.4	4.3	4.9

^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 BY19 yearlings or BY20 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 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 22-23 March 2021 (Table 13). At the time of release, a sample of fish were measured and weighed (n=425). 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 400,124 were released, with approximately 390,122 that were ADCWT, 8,002 were adipose only, an addition 2,000 were CWT only due to marking error, none were released

as unmarked/untagged. Size at release was estimated at 9.6 fish/lb (fpp). Releases in 2021 were again earlier than in previous years, and well before any increasing hydrograph in the Snake River. Historical yearling and subyearling releases from 2010 to 2020 by WDFW, IPC and NPT are available upon request to WDFW. All WDFW fall Chinook releases from 2021 are provided in Appendix F.

Subyearling fall Chinook salmon at LFH were released 18 and 19 May 2021. On the first day of release, a subsample of fish (n=423) were measured and weighed (Table 13). 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 559,654 were released, with 544,528 as an ADCWT group, 2,521 CWT only, 12,605 adipose fin clip only, and none were released as unmarked untagged. Size at release was estimated at 50.4 fpp. The release occurred during a slightly increasing hydrograph in the Snake River.

Subyearling fall Chinook reared at Irrigon FH were released into the GRR on 28 and 29 May 2021. An estimated total of 173,108 were released, with 168,990 as an ADCWT group, 3,834 adipose fin clip only, 142 were CWT only, and 142 were unmarked/untagged. A day prior to release, a subsample of fish (256) were measured and weighed (Table 13). 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 48.0 fpp, compared to 47.8 fpp calculated from individual length/weight sampling from SRL staff. The release occurred during a slightly increasing hydrograph in the Grande Ronde River.

Table 133. Length and weight data from fall Chinook salmon released at LFH or in the GRR in 2021.

Length/weight data	Yearling Snake R at	Subyearling Snake R at	Subyearling GRR at
	LFH	LFH	Cougar Creek
Sample date(s)	22-23 March	18-19 May	28-29 May
CWT code	637762	637940	637941
Number sampled	425	423	256
Avg. length (mm)	159	94	94
Median length	159	94	94
Range of lengths	132-187	77-107	68-112
SD of lengths	10.9	5.0	8.8
CV of length (%)	6.9	5.4	9.4
Avg. weight (g)	46.8	9.0	9.5
SD of weight	9.5	1.5	2.5
Avg. K factor	1.16	1.08	1.14
FPP	9.7	50.4	47.8
Precocious (%)	0.0%	0.0%	0.0%

PIT Tagging, Migration Timing, Travel Speed and Survival

Staff have routinely PIT tagged a subset of the LFH yearling and subyearling releases, and the GRR releases for the purpose of either monitoring outmigration timing, estimating adult returns in-season, and to estimate a conversion rate between IHR and LGR for purpose of back-calculating the run reconstruction estimates to the project area (see section below on returns to the project area). PIT tag lists for each release group are submitted to PTAGIS and all fish were assigned to monitor mode to allow them to be treated like non-PIT tagged fish when intercepted at the mainstem dams.

Staff PIT tagged 10,000 BY19 yearlings on 21 March and 15,000 BY20 subyearlings on 18 May. Tagged fish were held for one day in the release structure raceway following tagging, and then released directly to the Snake River. The holding raceway was immediately scanned for shed tags after the PIT tagged fish were released to the river. Shed tags recovered were re-inserted into new fish and released the same day. SRL and IPC staff PIT tagged 4,500 BY20 subyearlings in late April 2021 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 6 August 2021 for all three release groups. Interrogation summaries were used to populate Tables 14, 15 and 16.

Table 144. Migration timing of PIT tagged yearling fall Chinook released at LFH in 2021.

Yearlings released at LFH	LMO	IHR	MCN	JDD	BONN ^a
Number Detected	931	749	695	283	550
Median Travel Days from LFH ^b	12.4	17.8	21.9	33.0	36.3
Median Passage Date	4/3	4/8	4/12	4/23	4/27
First Detection Date	3/25	3/28	4/2	4/2	4/9
Last Detection Date	5/1	5/4	5/12	5/27	5/20
10% of Run Passage Date	3/30	4/2	4/7	4/18	4/21
90% of Run Passage Date	4/17	4/19	4/23	5/5	5/4
TDG on Median Date (%) ^c	102	114	115	116	NA
Outflow on Median Date (kcfs) ^c	56	61	130	151	181
Spill on Median Date (kcfs) ^c	37	39	70	83	123

^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 155. Migration timing of PIT tagged subyearling fall Chinook released at LFH in 2021.

Subyearlings released at LFH	LMO	ICH	MCN	JDD	BONN ^a
Number Detected	290	206	288	378	445
Median Travel Days from LFH ^b	6.1	13.4	17.8	20.9	21.9
Median Passage Date	5/24	5/31	6/4	6/7	6/8
First Detection Date	5/19	5/20	5/23	5/27	5/28
Last Detection Date	6/7	6/29	6/27	6/29	7/3
10% of Run Passage Date	5/20	5/24	5/27	6/3	6/4
90% of Run Passage Date	5/31	6/6	6/9	6/13	6/14
TDG on Median Date of Passage (%) ^c	118	116	113	108	116
Outflow on Median Date of Passage (kcfs) ^c	60	66	294	294	266
Spill on Median Date of Passage (kcfs) ^c	42	44	204	146	132

^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 13-18).

Downstream survival estimates for all groups were derived using DART

(<http://www.cbr.washington.edu/dart>).

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

Table 166. Migration timing of PIT tagged fall Chinook released near Cougar Creek in the GRR in 2021.

Subyearlings released in the GRR	LGR	LGO	LMO	IHR	MCN	JDD	BONN ^a
Number Detected	1742	69	39	118	38	85	97
Median Travel Days from GRR ^b	44.6	45.9	53.0	56.2	54.3	59.3	58.9
Median Passage Date	6/14	6/15	6/22	6/26	6/24	6/29	6/28
First Detection Date	6/3	6/5	6/8	6/10	6/12	6/13	6/13
Last Detection Date	7/2	7/3	6/30	7/1	7/4	7/15	7/13
10% of Run Passage Date	6/8	6/9	6/13	6/14	6/13	6/17	6/17
90% of Run Passage Date	6/20	6/25	6/28	6/29	6/29	7/3	7/3
TDG on Median Date of Passage (%) ^c	118	113	119	116	110	115	117
Outflow on Median Date of Passage (kcfs) ^c	42	50	35	40	202	219	206
Spill on Median Date of Passage (kcfs) ^c	24	31	17	12	115	79	96

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

^b Travel days are calculated from the date of release.

^c Detections are from the tailrace of each dam.

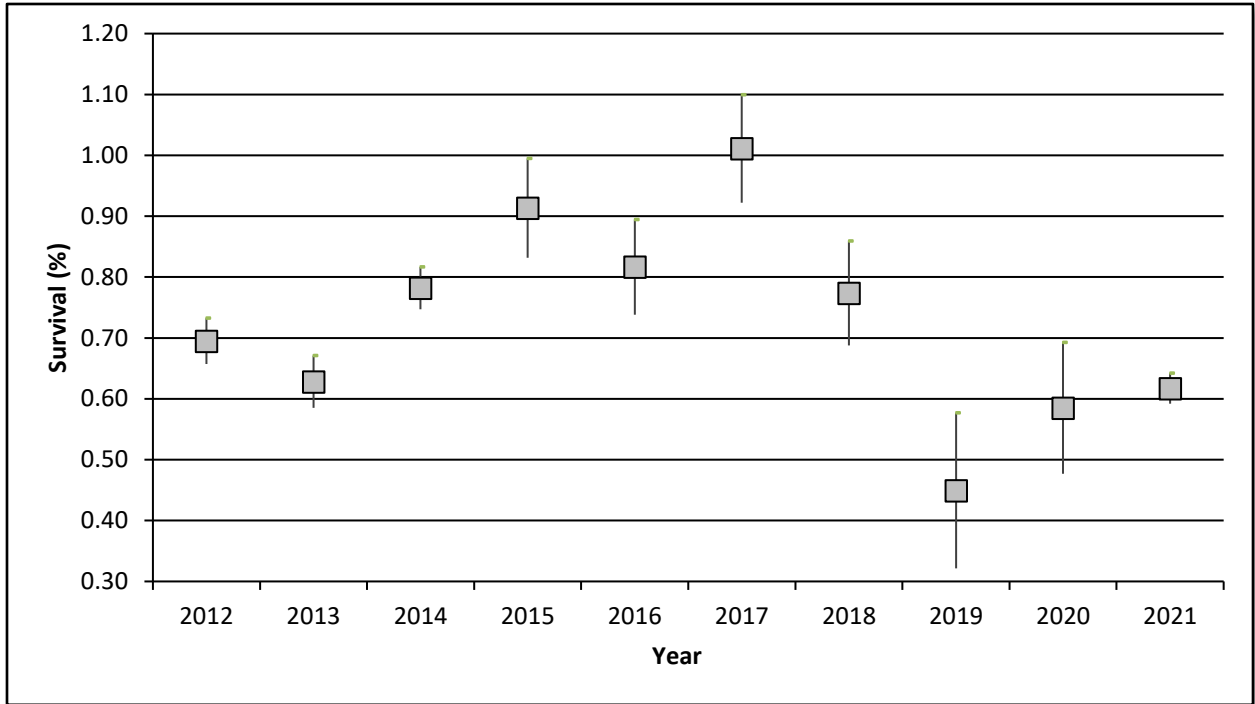


Figure 13. Survival and standard error of SRFCH subyearlings released into the Grande Ronde River near Cougar Creek to LGR, 2012-2021 migration years.

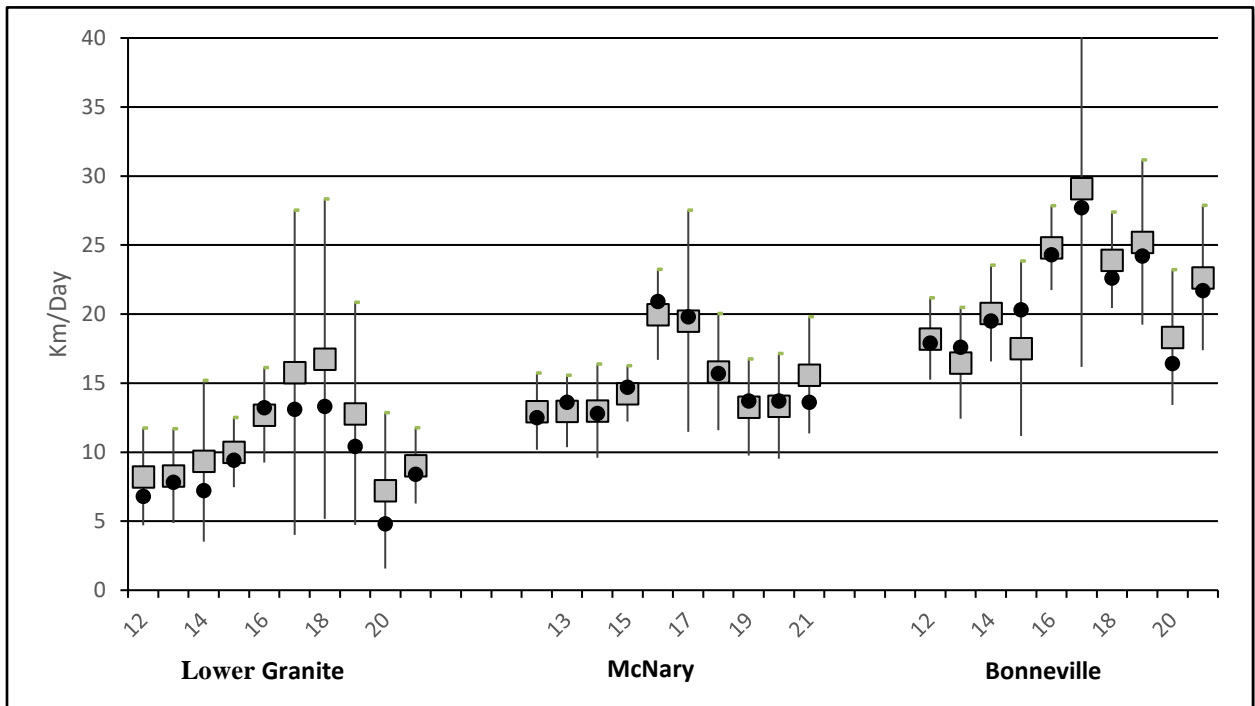


Figure 14. Average travel speed (Km/day with S.D.) and median travel speed (black dot) of SRFCH subyearlings released into the Grande Ronde River near Cougar Creek to LGR, McNary, and Bonneville Dams, 2012-2021 migration years.

Survival of the on-station subyearling release to Lower Monumental Dam has slightly declined in recent years to 70% (Figure 14). Migration speed has also decreased in the last few years, and likely explains the slightly lower survival to Lower Monumental Dam (Figure 15).

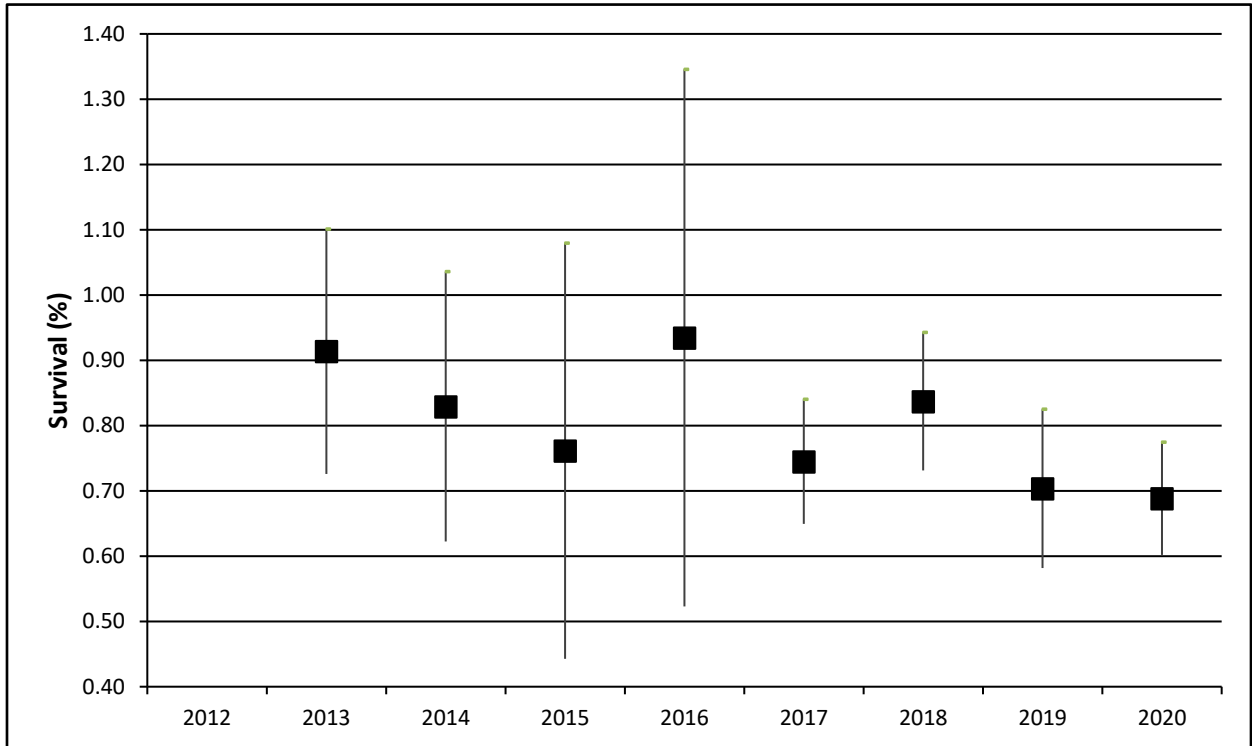


Figure 15. Survival and standard error of SRFCH subyearlings released into the Snake River at LFH to Lower Monumental Dam, 2013-2021 migration years. Note: 2012 and 2021 estimates were not valid.

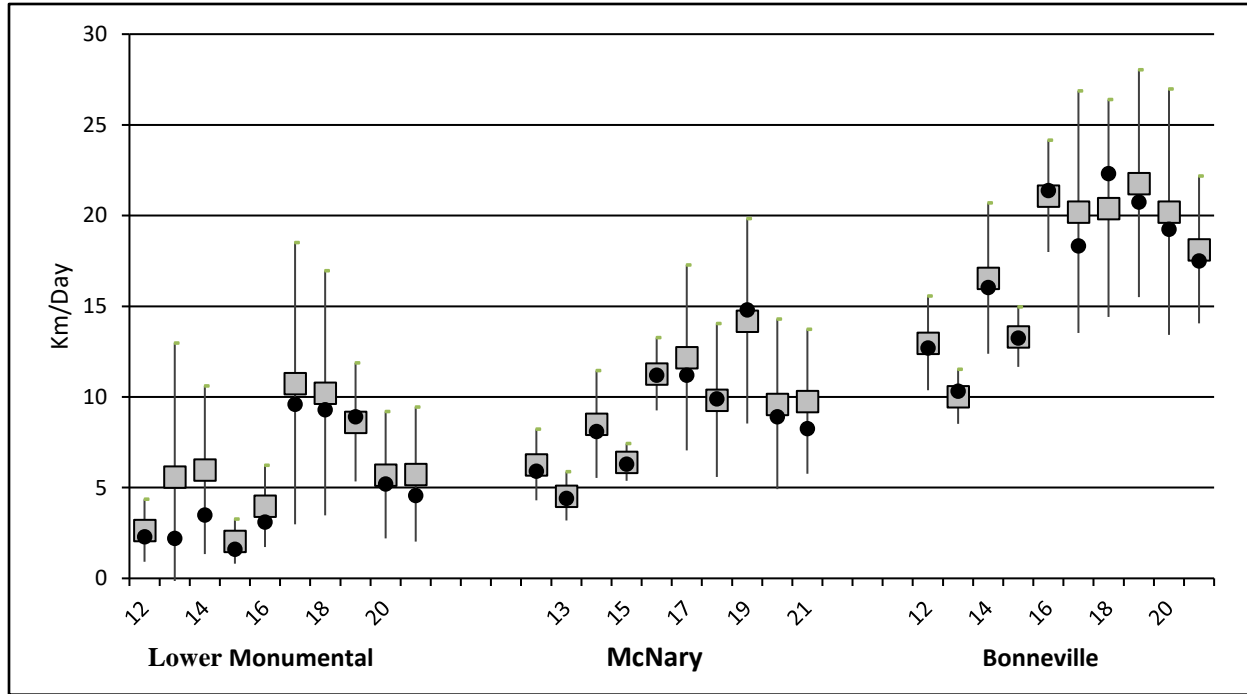


Figure 16. Average travel speed (km/day with S.E.) and median travel speed (black dot) of SRFCH subyearlings released into the Snake River at LFH to Lower Monumental, McNary, and Bonneville Dams, 2012-2021 migration years.

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

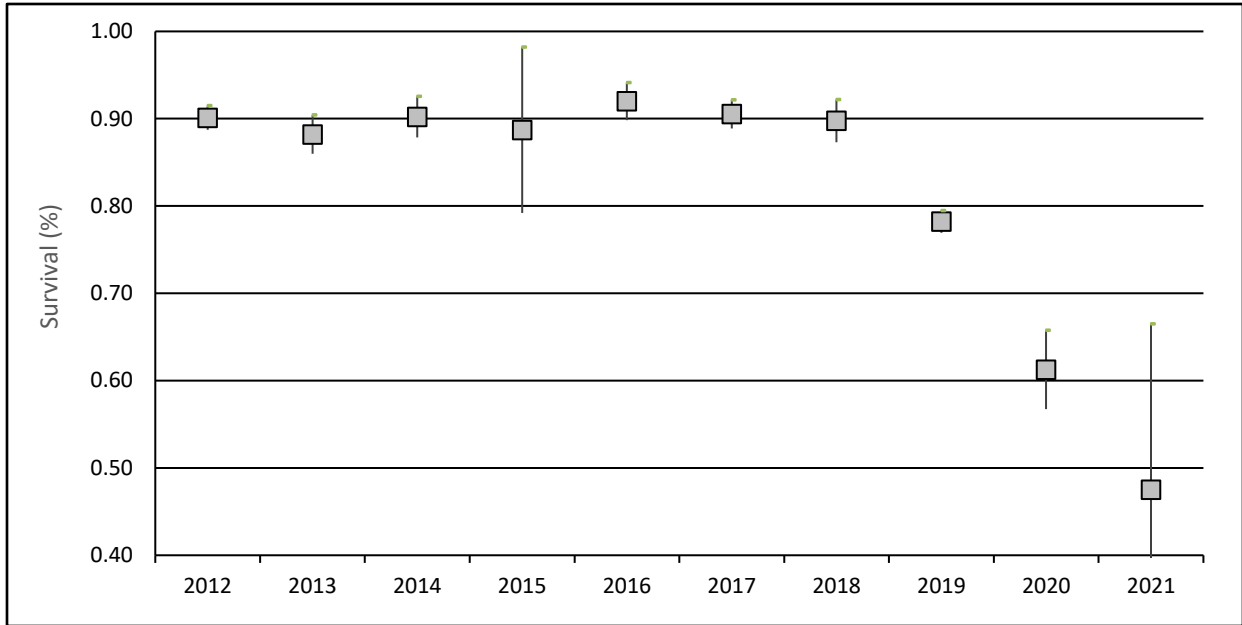


Figure 17. Survival and standard error of SRFCH yearlings released into the Snake River at LFH to Lower Monumental Dam, 2012-2021 migration years.

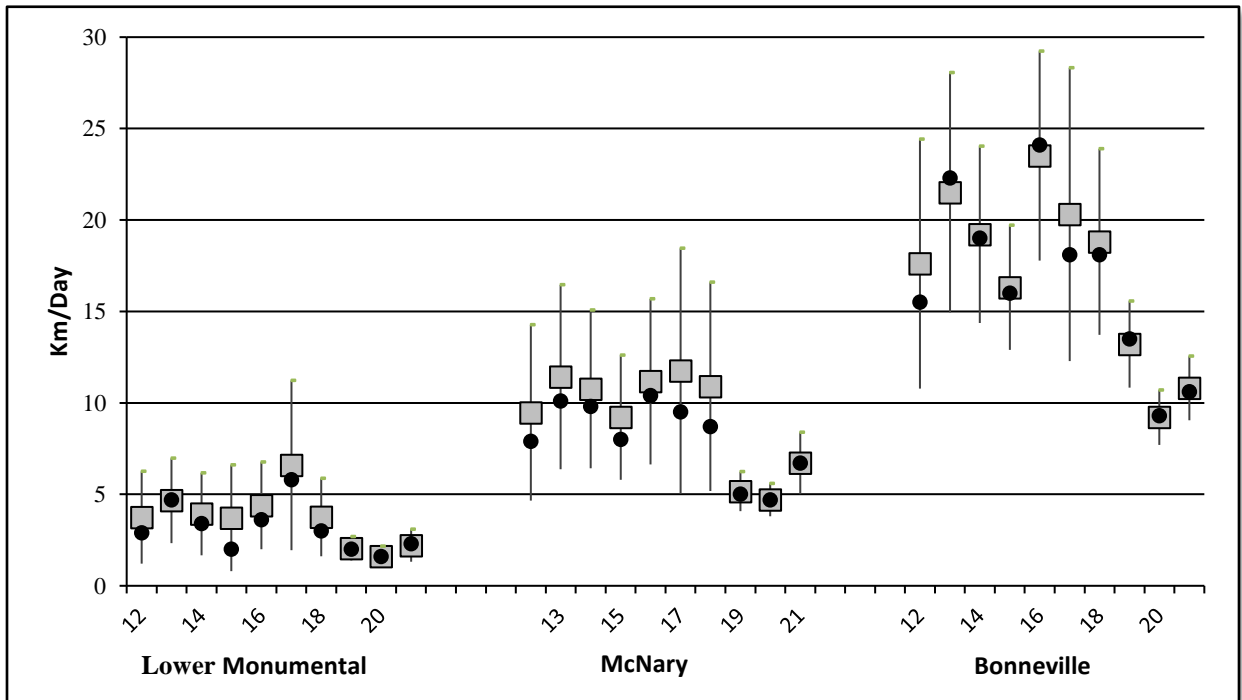


Figure 18. Average travel speed (km/day with S.E.) and median travel speed (black dot) of SRFCH yearlings released into the Snake River at LFH to Lower Monumental, McNary, and Bonneville Dams, 2012-2021 migration years.

The reason this release date was moved up for this group of fish was a direct result to changes that were made to the fall Chinook program during the re-negotiation of the 2018-2027 US v Oregon agreement. With an increase to the subyearling on-station release (200K to 700K), staff could utilize the large rearing lake for the final 1.5-2 months of subyearling rearing – which we think will have great benefit to their post-release survival. To take advantage of that, it was decided to advance the release time of yearlings by about two weeks. While reported survival to Lower Monumental Dam has dropped off considerably in the last three years, it's unclear if these estimates are valid. Since yearling fall Chinook are released generally 2-3 weeks prior to when transportation starts, survival estimates to other locations are likely not effected that much from possible transportation at Lower Monumental. Given that, survival estimates to other downstream locations have been generated using DART to see 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 the last three years releases may be somewhat lower than previous, but not to the extent as indicated by the survivals to Lower Monumental Dam. Staff will continue to monitor survivals of this group into the future and make changes to the release time of this group if warranted in the future.

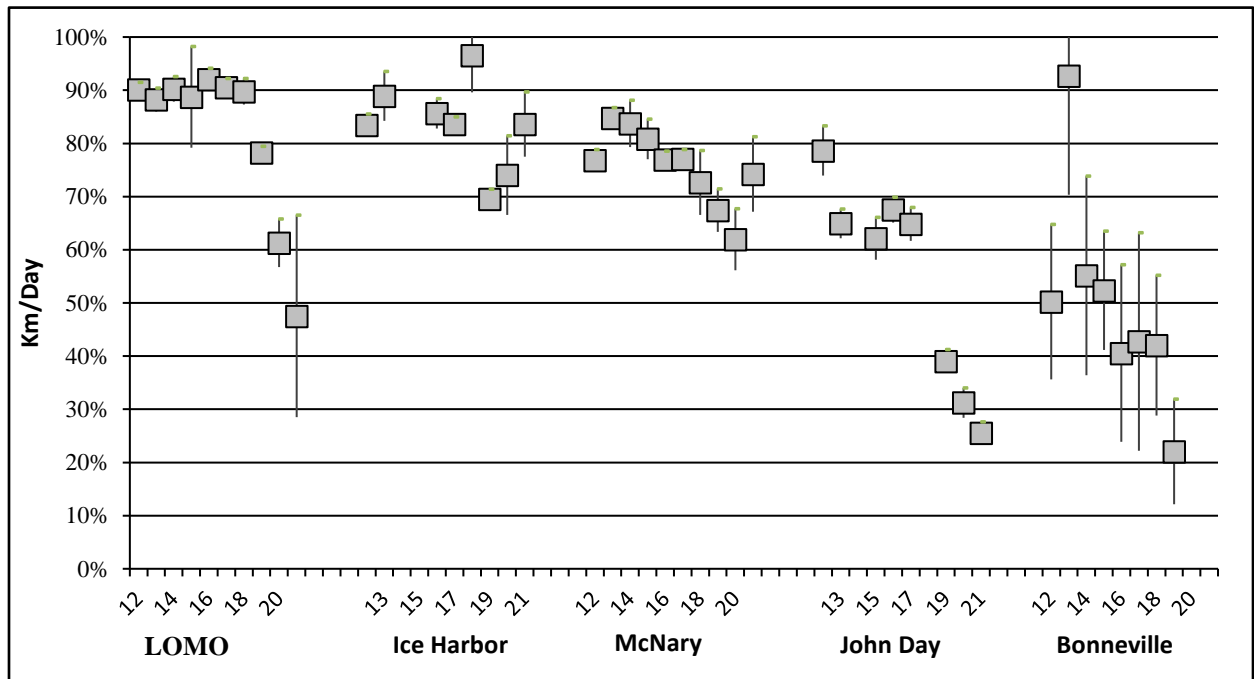


Figure 19. Survival and standard error of SRFCH yearlings released into the Snake River at LFH to Lower Monumental Dam, 2012-2021 migration years.

Tucannon River Natural Production 2020

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 2020 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 flow in that area, spawning is considered minimal. During 2020, landowner access restrictions prevented the surveying of 1.6 rkms a little below and above the Starbuck Bridge within survey sections 5 and 6 (Appendix H). Regular weekly surveys began the week of 25 October and continued until the week of 13 December.

A total of 155 redds (combination of fall Chinook and Coho) were counted in the surveyed areas of the Tucannon River (Table 17) and we estimate an additional 26 redds occurred in sections not surveyed. An estimated total of 180 total redds (136 fall Chinook salmon and 44 coho salmon redd)s were constructed in the Tucannon River during 2020.

Table 177. Date and number of salmon redds and carcasses counted on the Tucannon River in 2020.

Week beginning	Total redds ^a	Carcasses sampled	
	Chinook & Coho ^b	Chinook	Coho
Prespawn survey 18 Oct	0	0	0
25 Oct	11	2	0
1 Nov	39	5	3
8 Nov	39	14	3
15 Nov	0	0	0
22 Nov	45	51	3
29 Dec	14	30	2
6 Dec	5	14	1
13 Dec	2	0	0
Totals	155	116	12

^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

The total escapement to the Tucannon River is based on an expansion factor of three fish/redd. We believe this expansion factor provides a conservative estimate of fish spawning. Based on the expansion factor we estimated 408 fall Chinook salmon spawned in the Tucannon River in 2020 (Table 18). Staff recovered 116 fall Chinook salmon carcasses (28.4%) of the estimated

total spawning escapement. One-hundred and thirty-two coho salmon were estimated to have spawned, but only 12 coho salmon carcasses (9.1%) were recovered in 2020. The run of fall Chinook salmon into the Tucannon is highly correlated with the overall fall Chinook run into the Snake River Basin (Figure 19).

Table 188. Estimated escapement, redd construction, and resulting estimates of smolts/redd and total number of emigrants from fall Chinook salmon spawning in the Tucannon River, 2001-2020, based on observer estimation 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	258	65	21	86	336	24,545
2002	642	183	31	214	81	18,895
2003	495	143	22	165	460	72,656
2004	399	111	22	133	632	72,705
2005	204	61	7	68	321	21,177
2006	465	127	26	155	290	44,304
2007	351	100	17	117	Unknown ^f	Unknown ^f
2008	780	209	42	251	20	5,030
2009	753	200	51	251	165	37,425
2010	954	281	37	318	80	24,834
2011	921	272	35	307	68	20,251
2012	855	255	30	285	425	120,205
2013	921	253	54	307	29	9,116
2014	921	264	43	307	594	158,561
2015	1,074	295	63	358	184	50,991
2016	720	202	38	240	35	7,931
2017	603	176	25	201	116	21,276
2018	600	172	28	200	287	46,183
2019	486	139	23	162	10	1,671
2020	408	118	18	136	567	77,046

^a Numbers presented in this table may be different from prior reports and represent the most accurate estimates of escapement and production in the Tucannon to date.

^b Estimates were derived using three fish per redd; no adjustments were made for super imposition of redds.

^c Estimate was derived using total redds estimated above the smolt trap and the estimated emigration the following spring as measured at the smolt trap.

^d Estimate was derived using the smolt/redd estimate and applying it to the total number of redds in the Tucannon River.

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

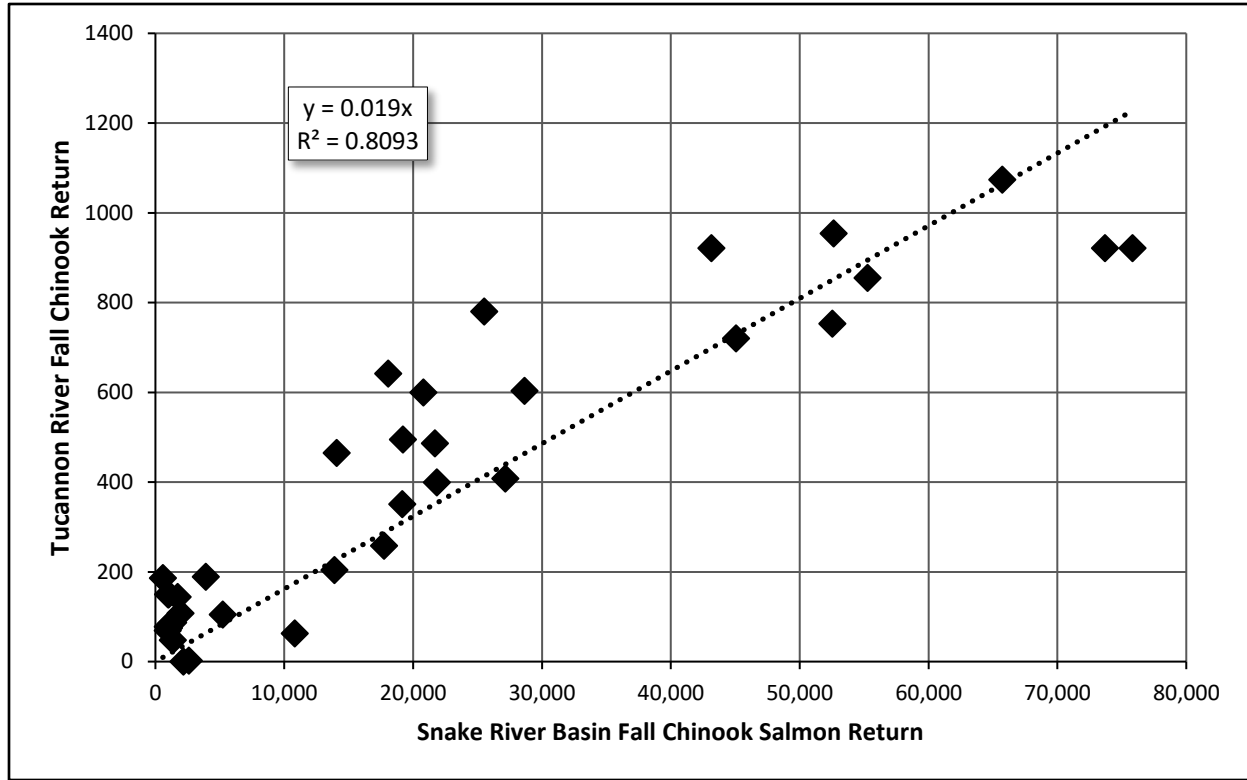


Figure 20. Relationship of the overall SRFCH return compared to estimated returns to the Tucannon River.

Generally, more recoveries of females occur than males, primarily because females remain in the vicinity of their redds when they die. However, in 2020 females represented 39.6% of the recoveries in the Tucannon River: primarily 2-salt and 3-salt fish. Males represented 51.7% of the recoveries; primarily 2-salt and 3-salt fish. Unknown sex represented 8.6% of the recoveries. Composition of the run consisted of 65.1% Snake River hatchery by wire, 2.8% out-of-basin by wire, 8.5% unknown hatchery origin by AD clip or yearling scales and 23.6% unknown origin (unmarked/untagged fish that could be hatchery or natural origin).

Juvenile Salmon Emigration

2021 Outmigration Year

Juvenile fall Chinook salmon (BY20) were captured at the Tucannon River smolt trap (rkm 3.0) from 2 February (newly emerged fry) through 29 June 2021 (Figure 20). The last day of trapping was 07 July. No fall Chinook were PIT tagged at the trap during the 2021 outmigration year. From the middle of May to the end of June, the mean size of fall Chinook migrants were 79 mm and 6.7 g (K-factor 1.26). The estimated peak of out-migration was 29 May, with 425 migrants passing the trap. Trapping efficiency for fall Chinook salmon ranged from 3.63% to 9.79%. Staff

captured 5,846 (including 58 mortalities) fall Chinook salmon in 2021. 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.

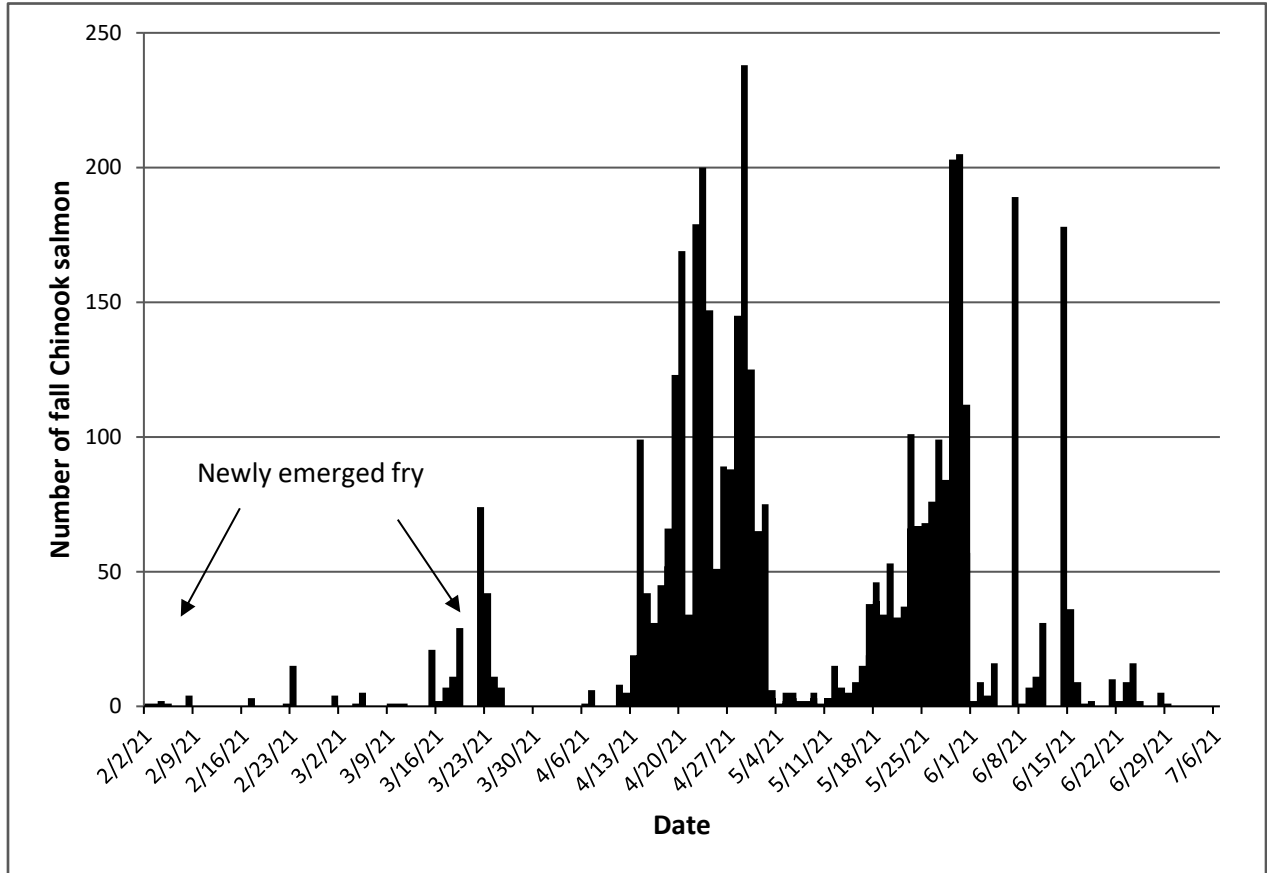


Figure 21. Migration timing of NOR juvenile fall Chinook salmon captured at the Tucannon River smolt trap in 2021.

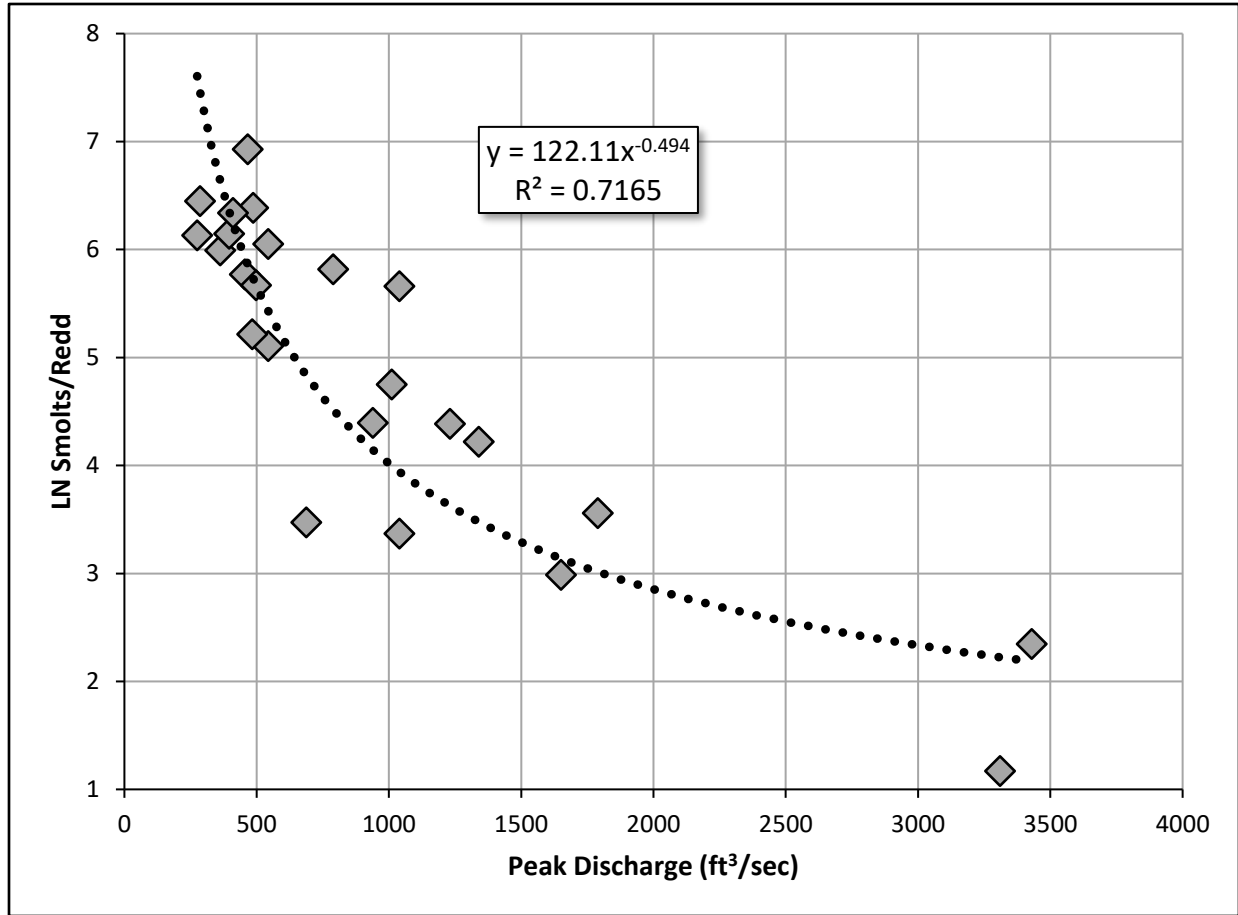


Figure 22. Peak discharge during fall Chinook incubation in the Tucannon River versus the estimated natural log of smolt/redd determined at the Tucannon River smolt trap.

We estimated that 64,583 (95% C.I. = 52,764-79,802) parr/smolts passed the trap during 2021. Based on 114 fall Chinook salmon redds estimated above the smolt trap during 2020 spawning ground surveys, an estimated 567 smolts/redd were produced. After including potential production from redds below the smolt trap in 2020 (22 additional redds), we estimated that 77,046 naturally produced fall Chinook salmon parr/smolts left the Tucannon River during 2021.

Project Area Returns and Total Returns

As defined in the introduction, project area returns are to be calculated to the number of Snake River fall Chinook 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. The number of strays that reach LGR are considerably lower (generally <1%). Furthermore, the adult trap and sampling that occurs at LGR provides the best location to make an estimate of true Snake River origin fall Chinook salmon. The systematic random sample of the fall Chinook run at LGR has been occurring since 2002 and provide the best dataset to estimate project area returns, as long as an estimate can be derived for fall Chinook that never make it back to LGR.

In the past, additional recoveries of fall Chinook from the Tucannon River and 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 (>95%), while the releases from LFH are more variable (yearlings ~50%, subyearling ~80%). By applying year specific PIT tag conversion rates to the LGR run reconstruction estimate, project area returns to Ice Harbor Dam 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 slightly different method than what was done previously, prior estimates of project area returns and total returns that were reported in previous fall Chinook annual reports were updated for inclusion within this report.

- The Regional Mark Processing Center (RMPC) website, www.rmhc.org, was queried on 1 March 2022 for any 2020 returns of CWT tagged fish associated with WDFW releases. Generally, most submissions to the RMPC database for the 2020 run year should have been finalized and submitted by this date.

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

Returns to the Project Area

An estimated 3,579 fall Chinook salmon (adults+jacks) returned from WDFW releases into the project area in 2020, contributing to 19.6% of the LSRCP project area mitigation goal of 18,300 (Table 19). The return in 2020 was the second lowest estimated since 2006, most likely due to poorer ocean conditions that have been experienced in the last few years. These estimates **do not include** in-basin hatchery returns from the FCAP, IPC and the NPTH programs.

Table 199. Project area returns of WDFW released SRFCH salmon, 2003-2020 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	723	807	0	5,146	28.1%
2019	1,843	452	627		2,922	16.0%
2020	1,066	1,110	1,403		3,579	19.6%

Total Returns

An estimated 5,077 fall Chinook salmon (adults+jacks) returned from WDFW releases in 2020, contributing 5.6% of the combined project area goal and out-of-basin objectives (91,500 – Table 20). Total returns in 2020 were the second lowest in the time series provided in Table 20, most likely due to poorer ocean conditions that have been experienced in the last few years. These estimates **do not include** in-basin hatchery returns from the FCAP, IPC and the NPTH programs.

Table 200. Total returns of WDFW released SRFCH salmon, 2003-2020 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	6,878	969	1,187	3	9,037	9.9%
2019	2,804	658	816		4,278	4.7%
2020	1,772	1,340	1,965		5,077	5.6%

Harvest in the Project Area

In 2020, fall Chinook fisheries were open on the Snake River, including the boundary waters between Washington/Idaho, and in the Clearwater River. Recoveries of WDFW releases were reported in the Regional Mark Information System (RMIS) database from these areas in 2021. The estimated CWT recoveries were expanded by the tag rate for each WDFW release group and provided below (Table 21).

Table 211. Estimated (and fully expanded by tag rate) Snake River basin harvest recoveries in 2020 of wire tagged fall Chinook salmon released by WDFW as reported to RMIS on 03/01/2022.

Group	1-Salt	2-4 Salt	Total ESTD	% by Group
LFH Yearling	64	142	206	53.4%
LFH Subyearling	115	39	154	39.9%
GRR Subyearling	0	26	26	6.7%
Total (All Groups)	179	207	386	

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 (89.6%) of estimated CWT recoveries come from the Columbia River Basin (Table 22), followed next by recoveries off the coast of Washington (3.1%), followed by recoveries from British Columbia (2.5%), and all other regions accounting for less than 5%.

Table 222. Fully expanded recovery estimates of tagged and untagged fall Chinook salmon recovered in all areas during 2020 for WDFW releases. Minijacks are not included in the estimates.

Region	LFH – 1+		LFH – 0+		GRR – 0+		1+ and 0+ Combined	
	EST total recoveries	% by region	EST total recoveries	% by region	EST total recoveries	% by region	EST total recoveries	Percent by region
Freshwater (Columbia Basin)	1,226	86.1%	1,234	92.4%	1,760	90.3%	4,220	89.6%
CA	0	0.0%	0	0.0%	0	0.0%	0	0.0%
OR	34	2.4%	17	1.3%	15	0.8%	66	1.4%
WA	57	4.0%	28	2.1%	63	3.2%	148	3.1%
BC	43	3.0%	16	1.2%	58	3.0%	117	2.5%
AK	64	4.5%	40	3.0%	54	2.8%	158	3.4%
HS	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Totals	1,424	30.2%	1,335	28.4%	1,950	41.1%	4,709	

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 2020, nearly 66% of the estimated CWT recoveries were recovered from the troll fisheries (both types), followed by

sport fisheries at 26.3%, with gillnet/seine and trawl fisheries making up less than 10% of the recoveries (Table 23).

Table 233. Fully expanded recovery estimates of tagged and untagged fall Chinook salmon recovered in the Ocean during 2020 for WDFW releases. Minijacks are not included in the estimates.

Region ^a	Fishery	LFH – 1+	LFH – 0+	GRR – 0+	Grand Total	%
		Total Estimate	Total Estimate	Total Estimate		
CA	Troll	0	0	0	0	0.0%
	Sport	0	0	0	0	0.0%
OR	Troll	28	17	6	51	10.9%
	Trawl	1	0	2	3	0.6%
	Sport	6	0	6	12	2.6%
WA	Troll	12	15	21	48	10.2%
	Troll (Treaty)	6	1	17	24	5.1%
	Gillnet/Seine	0	0	0	0	0.0%
	Trawl	0	4	0	4	0.9%
	Sport	29	8	12	49	10.4%
BC	Troll	27	13	29	69	14.7%
	Troll (Treaty)	0	0	0	0	0.0%
	Gillnet/Seine	0	0	0	0	0.0%
	Sport	16	3	29	48	10.2%
AK	Troll	49	22	43	114	24.3%
	Gillnet/Seine	5	19	6	30	6.4%
	Sport	14	0	4	18	3.8%
HS	Trawl	0	0	0	0	0.0%
Totals		193	102	175	470	
	Fishery Type	Total Estimate	Total Estimate	Total Estimate	Grand Total	
All Regions Combined	Troll	123	68	117	308	65.8%
	Gillnet/Seine	5	19	6	230	6.4%
	Trawl	1	4	2	7	1.5%
	Sport	65	6	52	123	26.3%

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 2020 run, the following summary is provided (excluding recoveries in the Snake River basin (Table 24). As with previous years, most recoveries come from the Columbia River Net Fisheries (73.1%), with sport fisheries accounted for about 17%, and fish on the spawning grounds in the Handford Reach area accounting for nearly 8%.

Table 244. 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 2020 for WDFW releases. Minijacks are not included in the estimates.

Recovery area	Fishery/Hatchery/River	LFH – 1+	LFH – 0+	GRR – 0+	Grand Total	%
		Total Estimate ^a	Total Estimate ^a	Total Estimate ^a		
COL R Gillnet	Zone 1-5 Non-tribal Net	89	24	32	145	13.1%
	Zone 6 Tribal Net	361	63	242	666	60.0%
COL R Sport	COL R Estuary	54	4	16	74	6.7%
	Zone 1-5 sport	23	28	10	61	5.5%
	Zone 6 Sport	0	0	2	2	0.2%
	Hanford Reach	32	4	15	51	4.6%
Hatchery	Priest Rapids	1	1	17	19	1.7%
	Ringold Springs	0	4	2	6	0.5%
	Bonneville	0	0	0	0	0.0%
SGS	Hanford Reach	51	0	35	86	7.8%
Totals		611	128	371	1,110	

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

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

At LFH, yearling and subyearling releases have occurred almost annually since 1985. Early in the program, yearling fall Chinook survived much better than subyearlings (Bugert et al 1997 – about a 10-fold difference). With management changes to the hydropower system (bypass and spill), and changes to the subyearling release size, survival rate differences between yearling and subyearling releases is much closer. For LFH releases, subyearlings perform on average about ½ as well as yearling releases back to the project area when jack returns are excluded (Table 25). 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 performance difference is about 1/3 between subyearling and yearling adults. Other WDFW subyearling release locations upstream of LGR have also occurred, these survived at a lower rate compared to the LFH on-station release of subyearlings (Table 26). Migration distance differences and perhaps predation are likely factors for the differences observed between 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 25 and 26.

Table 255. 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, 2002-2017 release years.

Release Year	Adults and Jacks Combined				Adults Only			
	LFH 1+	LFH 0+	GRR 0+	CCD 0+	LFH 1+	LFH 0+	GRR 0+	CCD 0+
2002	1.34%	0.22%			0.83%	0.18%		
2003	1.28%	0.11%		0.08%	0.33%	0.05%		0.04%
2004	0.16%	0.06%			0.07%	0.04%		
2005	0.83%	0.07%	0.02%	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%	0.38%	0.25%		0.44%	0.24%	0.23%	
2015	0.62%	0.44%	0.39%		0.31%	0.22%	0.27%	
2016	0.93%	0.13%	0.01%		0.67%	0.12%	0.01%	
2017	0.39%	0.24%	0.26%		0.27%	0.16%	0.16%	
Average	1.53%	0.61%	0.29%	0.55%	0.68%	0.36%	0.23%	0.34%

Table 266. Total Smolt-to-adult survival (SAS) rates for yearling and subyearling fall Chinook salmon by WDFW, 2002-2017 release years.

Release Year	Adults and Jacks Combined				Adults Only			
	LFH 1+	LFH 0+	GRR 0+	CCD 0+	LFH 1+	LFH 0+	GRR 0+	CCD 0+
2002	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%	
Average	2.46%	0.88%	0.50%	0.89%	1.37%	0.62%	0.44%	0.65%

Direct Take of Listed Snake River fall Chinook Salmon During Fall of 2020 and Spring of 2021

“Take” estimates for permit #16607 for LFH production and permit #16615 for NPTH production are reported annually in the WDFW Fall Chinook report to LSRCP and other reports (see list below and Table 27). 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 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 submitted an 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 tables for these two permits.

To complete this report per contract requirements, estimates of “take” associated with this program for the 2020 spawn and 2021 juvenile releases will be reported in the next WDFW Fall Chinook report to LSRCP.

In addition, during consultation, it was agreed that additional reporting requirements were needed covered under 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 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 27).

Additional information can also be found in reports provided by the Nez Perce Tribe and are referred to in the Conditions Table (Table 27) provided below.

1. Nez Perce Tribe Snake River Fall Chinook Salmon Monitoring and Evaluations Report (**M&E Report**)
2. 2020 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 2020 (**Run Recon Report**)
4. 2020 NPTH SR fall Chinook production report (**Production Report**)

Table 277. 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 2020. Escapement to NPTH provided in NPTH Production Report . The South Fork Clearwater trap was not operated in 2020.
Annual estimates of fall Chinook salmon escapement, and fall Chinook salmon redd counts, in natural spawning areas	Fall Chinook salmon escapement to the Tucannon River is provided in Table 18 in this report. Fall Chinook salmon escapement to natural spawning areas above LGR are described the NPTH M&E report . Fall Chinook salmon redd counts above LGR are described in the NPTH M&E report and in the NPT Redd report
Carcass recovery data, including numbers, sex ratios, fish stock origin, mark observations, tributary location, and age class	Carcass recovery data from the Tucannon River is provided on Table 17 in this report. Carcass recovery data above LGR provided by NPT in the M&E report Hatchery Fraction section and the "carcass" tab provided by NPT Permit Spreadsheet.
Number and origin of all fall Chinook salmon retained during broodstock collection and their final disposition	Number and origin of broodstock retained at LFH are provided in Table 9, page 18 in this report. For the number of broodstock retained and their disposition by NPTH, see the NPT M&E report . Also see the joint agency Run Recon report for additional information.
Trends in the relative, total annual abundances of 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	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 Redd report for

Conditions	Response or reference for requested information
salmon escapement and spawning distributions in the Snake River Basin	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	<p>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.</p> <p>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 2020.</p>

Conclusions and Recommendations

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

1. 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 and compare with standardized CWT based run reconstruction estimates. Following these comparisons, begin discussions regarding the future tagging levels/use/need of CWT's for SRFCH salmon. 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 have lower returns of 1-salt fish. As of 2019, releases of yearlings above LGR have ceased, but the release of yearlings at LFH have continued. A Snake River Basin wide discussion has been initiated for managers to discuss the possible elimination of future yearling releases at Lyons Ferry, with additional subyearling production (released at LFH, but also in other locations above LGR) so not net loss of returns occur (Adult + Jack combined), and downriver or ocean fisheries should not be negatively impacted.

Recommendation: Continue to meet with Snake Basin managers on this topic. Adjust the PAC proposal per co-manager agreement and make changes to production (potentially planned for the 2023 brood cycle).

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 sized similar to what were typically thought of as coho redds. These “observational” redd designations are further complicated by varied stream conditions and observer experience. All previous estimates for Tucannon fall Chinook were then derived based either on known carcass recoveries or “observational” redd designations, whichever was felt to be the most reliable for a given year.

Over the past year, evaluation staff have revisited all previous fall chinook/coho spawning ground survey data. A standard methodology was developed to 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 production in the Tucannon River as determined by smolt trap catches would suggest that not many would likely return as adults.

Recommendation: Continue to evaluate all three estimation methods. Determine which method is most appropriate or provide all three estimates which will give a range of values.

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WDFW (Washington Department of Fish and Wildlife). 2018. Lyons Ferry Complex Annual Operations Plan for the period of October 1, 2017 – September 30, 2018.

Appendix A: Trapping and Sampling Protocols at LGR Adult Trap for 2020

2020 Fall Chinook Trapping/Sampling Protocols at LGR August 18, 2020

Protocols:

- 1) This protocol assumes a 24 hour/day, 7 days per week trapping at 80% continuing through September 6th, and then dropping to 18% through the end of the season.

All fish hauled to hatcheries during the 80% trapping period will receive an operculum punch on the left side (LOP) and will not receive an operculum during the 18% trapping period.

- 2) Males and females will not be inoculated.
- 3) All fish ≥ 70 cm will be hauled to LFH and NPTH. LFH will haul ~70% and the NPT will haul ~30%.
- 4) Wire tagged MALES <70cm and >29cm will be hauled to LFH (1 out of 3 trapped).
- 5) Wire tagged FEMALES <70 and >29cm will be hauled to LFH and NPTH (1 out of 3 trapped) under the normal 70/30 split.
- 6) Unmarked/untagged females <70 and >29cm will be hauled to LFH.
- 7) Fish >25cm and <29cm will be included in the adult database.
- 8) Jacks suspected of being summers will need to be subsampled for wires.
- 9) Only scale sample fish released from the trap. Do not scale sample hauled fish.
- 10) DNA sample all fish trapped regardless if hauled to the hatchery or released.

Wire tagged fish:

Fork Length	Action
≥ 70 cm	Haul all fish (DNA sample all)
< 70cm and >29cm	Haul 1 out of 3 wires for LFH and NPTH. M go into tank for LFH only), DNA sample all Release 2 out of 3 wires (DNA sample all)

Untagged fish:

Fork Length	Action
≥ 70 cm	Haul all fish (DNA sample all). Haul 1 out of 3 F to LFH (DNA sample all). Release 2 out of 3 F (collect scales and DNA).
< 70cm and >29cm	Release all M (collect scales and DNA).

2020 Fall Chinook Trapping/Sampling Protocols at LGR September 2, 2020

Protocols:

- 1) This protocol assumes a 24 hour/day, 7 days per week trapping at 80% continuing through September 1st, and then dropping to 18% from September 2nd through the end of the season.

All fish hauled to hatcheries during the 80% trapping period will receive an operculum punch on the left side (LOP) and will not receive an operculum during the 18% trapping period.

- 2) Males and females will not be inoculated.
- 3) All males fish ≥ 70 cm will be hauled to LFH and NPTH. Females >70 cm will be subsampled at a 2/3 rate, with 2 females collected, and 1 female passed upstream. LFH will haul $\sim 70\%$ and the NPT will haul $\sim 30\%$.
- 4) Wire tagged MALES <70 cm and >29 cm will be hauled to LFH (1 out of 3 trapped).
- 5) Wire tagged FEMALES <70 and >29 cm will be hauled to LFH and NPTH (1 out of 3 trapped) under the normal 70/30 split.
- 6) Unmarked/untagged females <70 and >29 cm will be hauled to LFH.
- 7) Fish >25 cm and <29 cm will be included in the adult database.
- 8) Jacks suspected of being summers will need to be subsampled for wires.
- 9) Only scale sample fish released from the trap. Do not scale sample hauled fish.
- 10) DNA sample all fish trapped regardless if hauled to the hatchery or released.

Wire tagged fish:

Fork Length	Action
≥ 70 cm	Haul all Males (DNA sample all), Haul 2/3 Females (DNA sample all), and pass 1/3 females upstream
< 70 cm and >29 cm	Haul 1 out of 3 wires for LFH and NPTH. M go into tank for LFH only), DNA sample all Release 2 out of 3 wires (DNA sample all)

Untagged fish:

Fork Length	Action
≥ 70 cm	Haul all Males (DNA sample all), Haul 2/3 Females (DNA sample all), and pass 1/3 females upstream
< 70 cm and >29 cm	Haul 1 out of 3 F to LFH (DNA sample all). Release 2 out of 3 F (collect scales and DNA). Release all M (collect scales and DNA).

2020 Fall Chinook Trapping/Sampling Protocols at LGR September 9, 2020

Protocols:

- 1) This protocol assumes a 24 hour/day, 7 days per week trapping at 80% continuing through September 1st, and then dropping to 18% from September 2nd through the end of the season.

All fish hauled to hatcheries during the 80% trapping period will receive an operculum punch on the left side (LOP) and will not receive an operculum during the 18% trapping period.

- 2) Males and females will not be inoculated.
- 3) All males ≥ 70 cm will be hauled to LFH and NPTH. Females >70 cm will be subsampled at a 2/3 rate, with 2 females collected, and 1 female passed upstream. LFH will haul $\sim 70\%$ and the NPT will haul $\sim 30\%$.
- 4) Wire tagged MALES <70 cm and >29 cm will be hauled to LFH (1 out of 3 trapped).
- 5) All wire tagged FEMALES <70 and >29 cm will be passed upstream.
- 6) All Unmarked/Untagged MALES and FEMALES <70 and >29 cm will be passed upstream.
- 7) Fish >25 cm and <29 cm will be included in the adult database.
- 8) Jacks suspected of being summers will need to be subsampled for wires.
- 9) Only scale sample fish released from the trap. Do not scale sample hauled fish.
- 10) DNA sample all fish trapped regardless if hauled to the hatchery or released.

Wire tagged fish:

Fork Length	Action
≥ 70 cm	Haul all Males (DNA sample all), Haul 2/3 Females (DNA sample all), and pass 1/3 females upstream
< 70 cm and >29 cm	Release all Females (DNA sample all). Haul 1 out of 3 Male wires to LFH only (DNA sample all) Release 2 out of 3 Male wires (DNA sample all)

Untagged fish:

Fork Length	Action
≥ 70 cm	Haul all Males (DNA sample all), Haul 2/3 Females (DNA sample all), and pass 1/3 females upstream
< 70 cm and >29 cm	Release all Males and Females (collect scales and DNA).

2020 Fall Chinook Trapping/Sampling Protocols at LGR September 16, 2020

Protocols:

- 1) This protocol assumes a 24 hour/day, 7 days per week trapping at 80% continuing through September 1st, and then dropping to 18% from September 2nd through the end of the season.

All fish hauled to hatcheries during the 80% trapping period will receive an operculum punch on the left side (LOP) and will not receive an operculum during the 18% trapping period.

- 2) Males and females will not be inoculated.
- 3) All males ≥ 70 cm will be hauled to LFH and NPTH. Females >70 cm will be subsampled at a 2/3 rate, with 2 females collected, and 1 female passed upstream and hauled to LFH only. NPTH does not need anymore females for the remainder of the season. On NPTH haul days, pass all females.
- 4) Wire tagged MALES <70 cm and >29 cm will be hauled to LFH (1 out of 3 trapped).
- 5) All wire tagged FEMALES <70 and >29 cm will be passed upstream.
- 6) All Unmarked/Untagged MALES and FEMALES <70 and >29 cm will be passed upstream.
- 7) Fish >25 cm and <29 cm will be included in the adult database.
- 8) Jacks suspected of being summers will need to be subsampled for wires.
- 9) Only scale sample fish released from the trap. Do not scale sample hauled fish.
- 10) DNA sample all fish trapped regardless if hauled to the hatchery or released.

Wire tagged fish:

Fork Length	Action
≥ 70 cm	Haul all Males (DNA sample all), Haul 2/3 Females (DNA sample all) to LFH, and pass 1/3 females upstream. DO NOT collect any more females for NPTH
< 70 cm and >29 cm	Release all Females (DNA sample all). Haul 1 out of 3 Male wires to LFH only (DNA sample all) Release 2 out of 3 Male wires (DNA sample all)

Untagged fish:

Fork Length	Action
≥ 70 cm	Haul all Males (DNA sample all), Haul 2/3 Females (DNA sample all) to LFH, and pass 1/3 females upstream. DO NOT collect any more females for NPTH
< 70 cm and >29 cm	Release all Males and Females (collect scales and DNA).

2020 Fall Chinook Trapping/Sampling Protocols at LGR September 24, 2020

Protocols:

- 1) This protocol assumes a 24 hour/day, 7 days per week trapping at 80% continuing through September 1st, and then dropping to 18% from September 2nd through the end of the season.

All fish hauled to hatcheries during the 80% trapping period will receive an operculum punch on the left side (LOP) and will not receive an operculum during the 18% trapping period.

- 2) Starting on September 23rd, all fall Chinook (regardless of size, wire tagged, etc) will be passed upstream. Broodstock numbers have been met for both NPTH and LFH.
- 3) Scale and DNA sample all untagged fish released from the trap, DNA sample only all wire tagged fish released from the trap.

WIRE TAGGED FISH:

Fork Length	Action
≥ 70cm	Release all Males and Females (collect DNA).
< 70cm and >29cm	Release all Males and Females (collect DNA).

UNTAGGED FISH:

Fork Length	Action
≥ 70cm	Release all Males and Females (collect scales and DNA).
< 70cm and >29cm	Release all Males and Females (collect scales and DNA).

Appendix B: Systematic Sampling Rates at Lower Granite Dam 2003-2020

Appendix B Table 1. Dates, times, and trapping rates of fall Chinook salmon at LGR, 2003-2020.

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

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

^b Trap was closed for two hours each day.

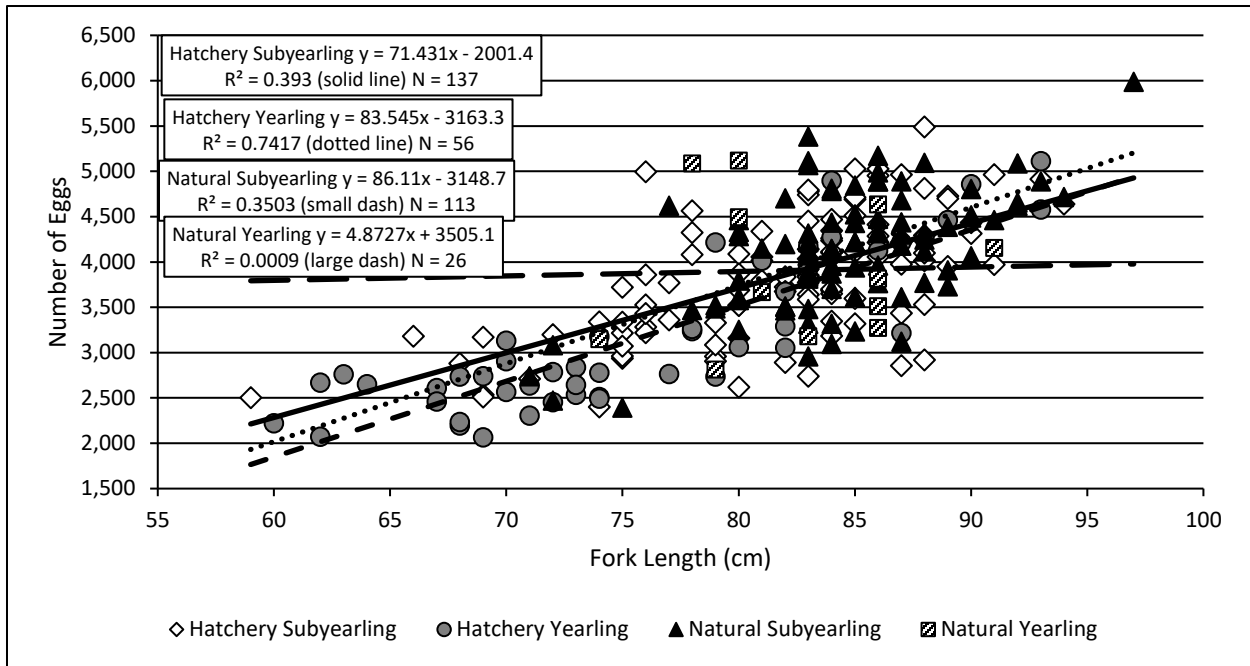
^c Trap was operated between 8-8:30 am, then 12:30-12:55 pm, then 2:20-3:02 pm on 24 Aug due to water temperature restrictions. Full operation began 25 August

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

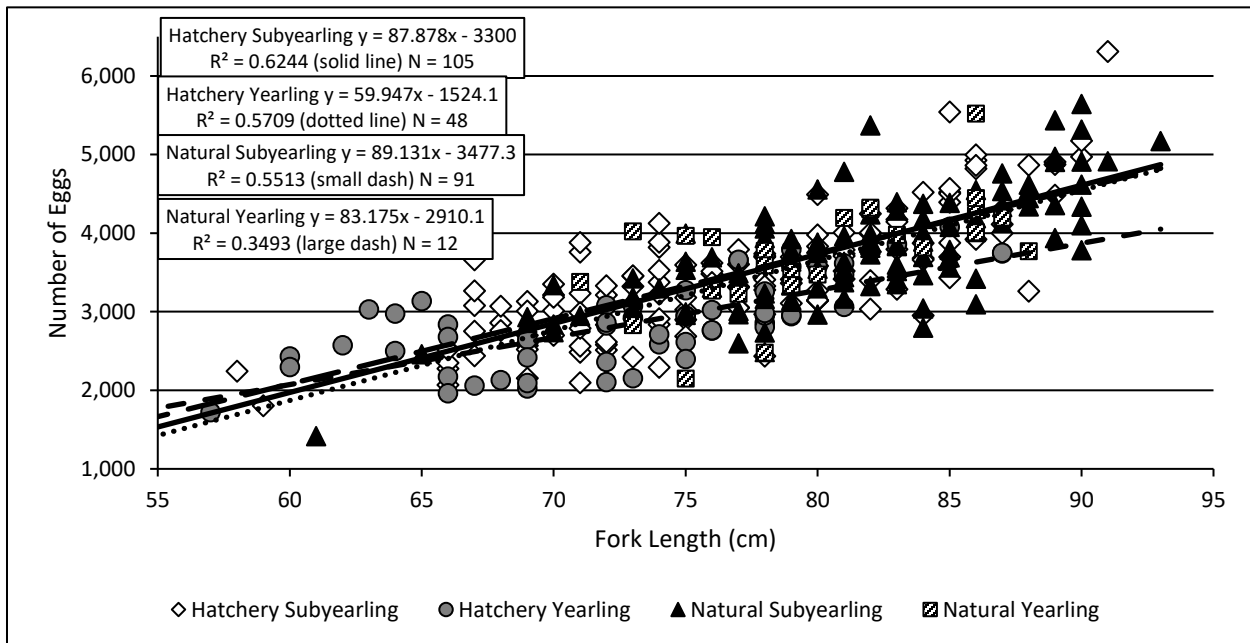
^e Trap was closed at 3:00 pm for two hours due to large numbers of fall Chinook salmon.

^f Trap closed due to high water temperatures.

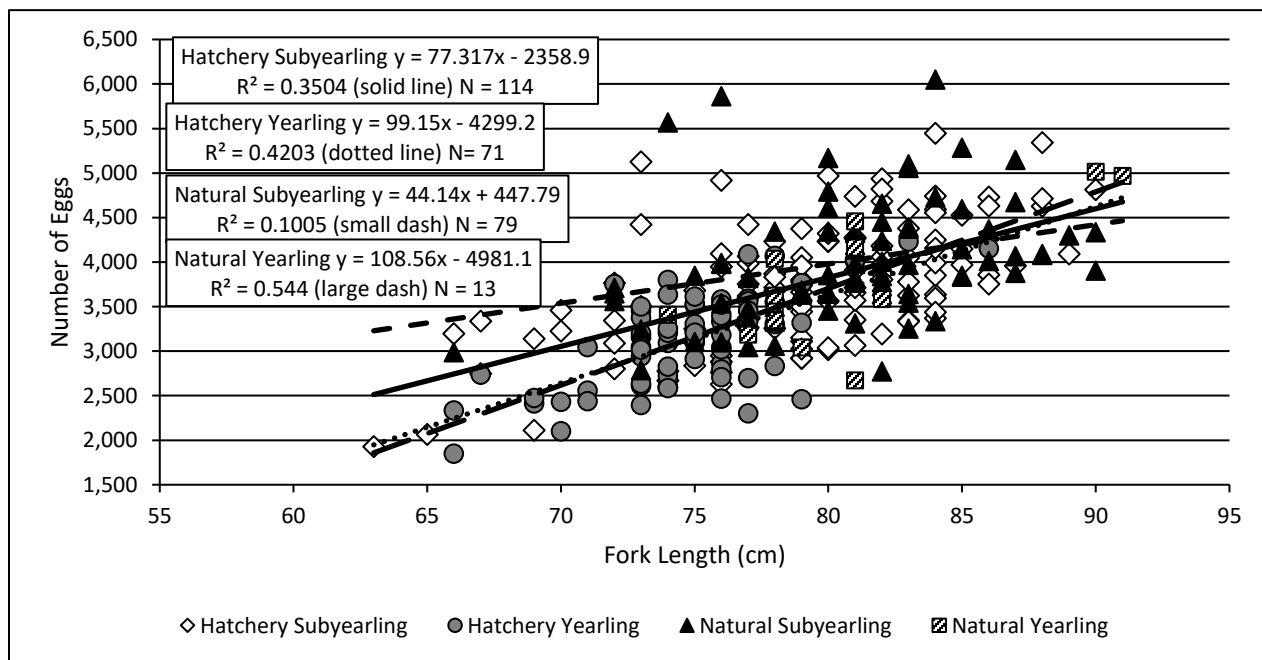
Appendix C: Fecundity Evaluation 2016-2020



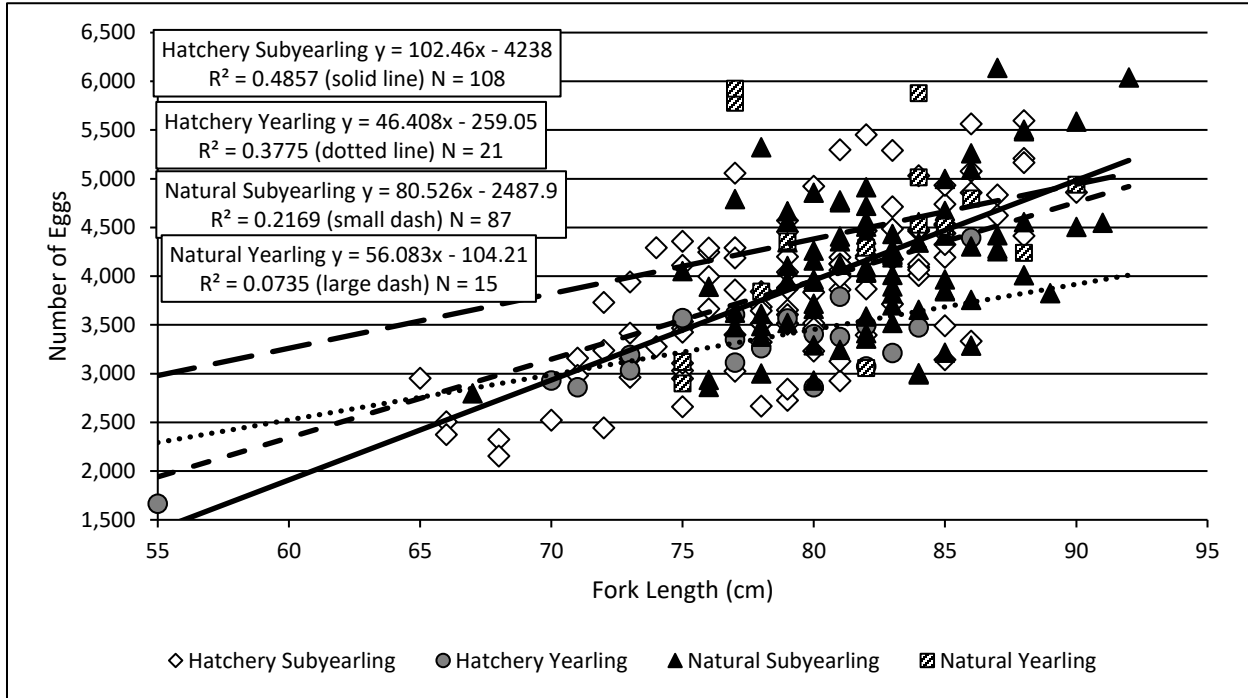
Appendix C Figure 1. Estimated total fecundity in 2016.



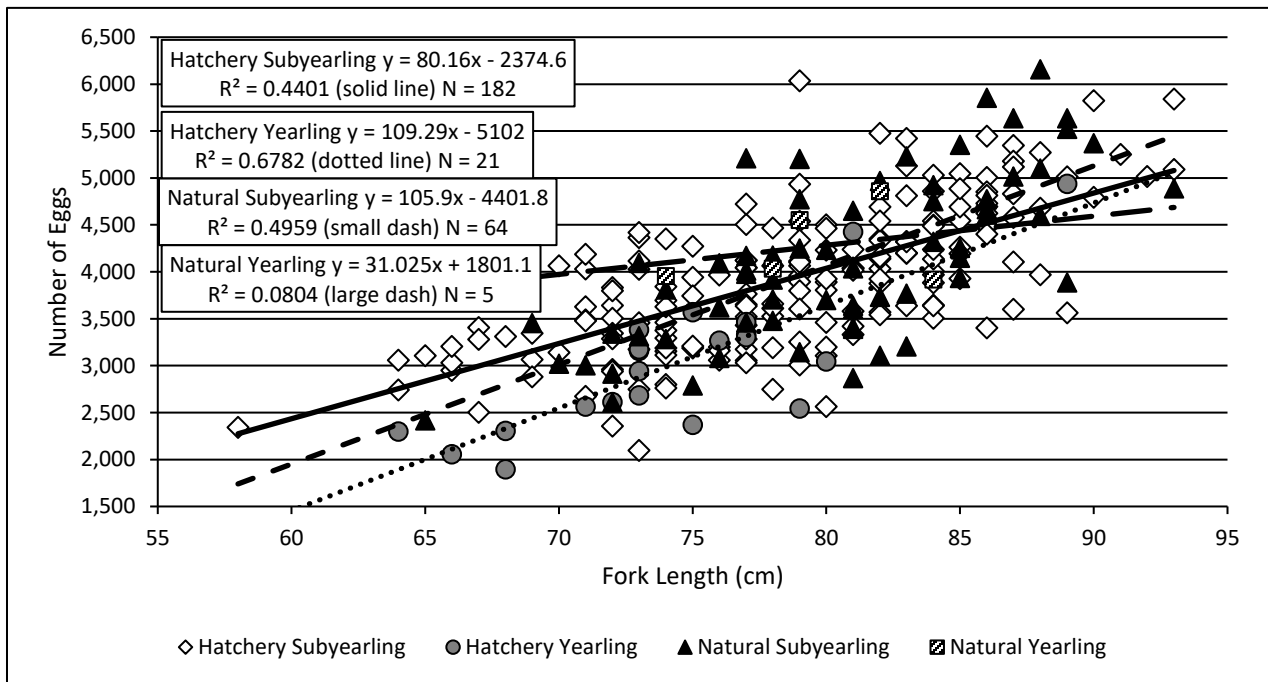
Appendix C Figure 2. Estimated total fecundity in 2017.



Appendix C Figure 3. Estimated total fecundity in 2018.



Appendix C Figure 4. Estimated total fecundity in 2019.



Appendix C Figure 5. Estimated total fecundity in 2020.

Appendix D: Salmon Processed and Killed at LFH in 2020

(Age/Rearing states origin, brood year, age at release, and release site (LF20SO is a LFH HOR fish from the 2020 brood year, released as a subyearling, on-station at LFH).

Appendix D Table 1: Estimated composition of non-wire tagged salmon trapped at LGR, hauled to LFH, and killed during 2020.

Age/Origin Determinations by Method	Females	< 53 cm Males	≥53 cm Males	Grand Total
Snake R. HOR by PBT				499
Subyearling	256		124	380
Yearling			2	2
Unknown rear/age	60		57	117
Snake R. HOR by PIT				1
Subyearling			1	1
Yearling				
Unknown rear/age				
Stray HOR by PBT				6
Subyearling	1			1
Yearling	1			1
Unknown rear/age			4	4
Unknown HOR by CLP or scales				65
Subyearling	11		10	21
Yearling				
Reservoir Reared	21		14	35
Unknown rear/age	2	2	5	9
Snake R. NOR				552
Subyearling	260		155	415
Yearling				
Unknown rear/age	65		72	137
Unknown Origin				44
Subyearling	9	1	15	25
Yearling				
Unknown Origin Unknown rear/age	7	1	11	19
Total	693	4	470	1167

Appendix D Table 2. Estimated composition of wired salmon trapped at LGR, hauled to LFH, and killed in 2020.

Origin by CWT	CWT	Females	<53 cm Males	≥ 53 cm Males	Total
LF14YBCA	220361	1			1
	220366			1	1
LF15SBCA	220369			1	1
	220370	2		1	3
LF15SCJA	220367			2	2
LF15SO	637038	2			2
LF15SPLA	220371	1			1
LF15YBCA	220374			1	1
LF15YCJA	220376	3		1	4
	220377			1	1
LF15YO	637040	3			2
	637041	7			4
LF15YPLA	220375			1	1
	220378	1			1
LF16SBCA	220383	17		2	19
	220386	9		6	15
LF16SCJA	220380	10		3	13
	220381	4		1	5
LF16SGRRD	637199	18		7	25
LF16SO	220382	19		4	23
	637198	15		6	21
LF16SPLA	091138	17		9	26
	220384	3		4	7
	220385	5		1	6
LF16YBCA	220388	12		9	21
	220391	4		3	7
LF16YCJA	220389	6		1	7
	220392	2		5	7
LF16YO	637202	12		15	27
	637203	7		18	25
LF16YPLA	220387	10		5	15
	220390	2		1	3
LF17SBCA	220504	2		8	10
	220505	4		16	20
LF17SCJA	220502			9	9
	220503	5		14	19
	220508	1		11	12
LF17SGRRD	637395	4		27	31
LF17SO	637394	2		13	15
LF17SPLA	220506	1		10	11
	220507	3		14	17
LF17SSAL	091185	10		38	48
LF17YLCPB	220393		2		2
	220394		2		2
	220395		2		2
	220397		1		1
LF17YLCPB	220398		3		3
LF17YO	637397		6		6
	637398		6		6
LF18SBCA	220511		8		8

Origin by CWT	CWT	Females	<53 cm Males	≥ 53 cm Males	Total
	220512		9		9
LF18SCJA	220509		12		12
	220510		7		7
LF18SGRR	637420		15		15
LF18SIPCSAL	091286		13		13
LF18SO	637422		8		8
LF18SPLA	220513		7		7
	220514		15		15
LF18YO	637603		51		51
LOOKINGGLASS16YSPIMNAHA	091094			1	1
	091095			1	1
NPT18SO	220267		4		3
NPTH15SLGA	220241	1			1
	220242	2			2
NPTH15SO	220249	1			1
	220250	3			3
	220251			1	1
	220254	1			1
	220255	3		2	5
NPTH16SCFA	220252	35		21	56
	220253	46		8	54
NPTH16SLGA	220261	40		24	64
	220262	36		18	54
NPTH16SO	220256	33		17	50
	220257	24		13	37
	220259	19		9	28
	220260	16		7	23
NPTH17SLGA	220271	1		13	14
NPTH17SNLVA	220258	5		20	25
NPTH17SO	220266	2		7	9
	220268	3		11	14
NPTH18SLAP	220270		1		1
NPTH18SLGA	220269		8		8
NPTH18SO	220272		1		1
IDFG15YSUMCHMCCALL	200126	1		1	2
IDFG18YSUCLEARWATER	100444		1		1
RINGOLDSPRINGS17SSPRINGSCR	091255			1	1
SAWTOOTH18YSPRSALMONR	100452		1		1
UMA17SUMA	091184			1	1
UMA17YUMA	091277		1		1
YAKA17YSPCLEELUM	190538			1	1
Total		505	185	453	1,143

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

Appendix E Table 1. Number of matings of minijacks, jacks, and jills contributing to broodstock at LFH 2000-2009 and 2010-2020 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
Average	0	12.1	9.6	0.4	1.7

Appendix E Table 2. Historical use of out of basin strays in broodstock: 2007-2020.

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%
Average	1,239	1.6	8.1	0	0.8%

^a Males used multiple times are included multiple times.

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

Appendix F 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 2,159,921	Yearling Subyearling
2001	4,734,234	144,530	0	200,064	4,230,432	1,280,515 2,697,406 125,600	Yearling Subyearling Research
2002	4,910,467	44,900	0	1,195,067	3,540,000	1,032,205 2,376,251 73,229	Yearling Subyearling Research
2003	2,812,751	0	0	250,400	2,476,825	985,956 1,455,815	Yearling Subyearling
2004	4,625,638	0	0	1,053,278	3,421,751	914,594 2,191,102 184,682	Yearling Subyearling Research
2005	4,929,630	0	0	1,180,000	3,562,700 ^e	980,940 2,078,206 216,417	Yearling Subyearling Research
2006	2,819,004	0	0	127,564	2,601,679	961,105 1,640,574 2,000	Yearling Subyearling Research
2007	5,143,459	0	0	1,761,500	3,212,900 ^f	960,900 1,894,933	Yearling Subyearling
2008	5,010,224	0	0	1,810,800	2,969,200	1,000,000 1,969,200	Yearling Subyearling
2009	4,574,182	0	0	1,507,300	2,853,020	977,667 1,875,353	Yearling Subyearling
2010	4,619,533	124,433	0	1,630,000	2,865,100	980,000 1,885,100	Yearling Subyearling
2011	4,723,501	165,001	0	1,785,600	2,772,900	960,000 1,812,900	Yearling Subyearling
2012	4,526,108	141,608	0	1,480,000	2,904,500	1,010,000 1,894,000	Yearling Subyearling
2013	4,565,660	119,550	0	1,558,800	2,887,310	980,000 1,907,310	Yearling 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 average of 58,500 fish was found during marking. This number was added (unexpanded) to total green and eyed eggs and fry ponded. Also includes 83,183 fry up to ponding that were accidentally released as strays. Back calculated to estimate 32,088 eggs for subyearlings and 91,808 eggs for escaped fry (resulting in 847,241 ponded for yearling release).

^e This number includes 154,100 eyed-eggs that were destroyed as ponded fry and 30,000 eyed-eggs that were shipped as fry to NPTH in February 2006.

^f This number includes 364,983 eyed-eggs that were destroyed as ponded fry in January and February 2007.

Appendix G: LFH/Snake River Origin Fall Chinook Salmon Releases in 2021

Appendix G 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	Planned PIT Tagged
2021	Y	2019	Lyons Ferry Hatchery	22-Mar	637762	390,122	2,000	8,002		400,124	9.6	10,000
Total yearling releases						390,122	2,000	8,002		400,124		10,000
2021	S	2020	Captain John 1 st	13-May	220289	201,013	1,505	0	264,814	467,332	47.7	25,788
2021	S	2020	Lyons Ferry Hatchery	18-May	637940	544,528	2,521	12,605	0	559,654	50.4	15,000
2021	S	2020	Big Canyon 1 st	18-May	220291	200,563	1,629	250	255,592	458,034	58.8	11,023
2021	S	2020	Pittsburg Landing 1 st	5-May	220293	198,992	2,230	1,622	203,772	406,616	54.7	25,647
2021	S	2020	Pittsburg Landing 2 nd	26-May	220294	198,336	976	488	0	199,800	46.5	4,450
2021	S	2020	Big Canyon 2 nd	2-June	220292	198,728	940	268	0	199,936	48.1	4,467
2021	S	2020	Captain John 2 nd	3-June	220290	198,942	1,144	343	0	200,429	42.0	4,450
2021	S	2020	Grande Ronde River Direct	28-May	637941	168,990	142	3,834	142	173,108	47.8	4,500
2021	S	2020	NPTH-Site 1705-MF Clearwater R	10-June	220274	102,307	1,161	840	672,668	776,976	55.5	4,433
2021	S	2020	NPTH-Lukes Gulch Accl.-SF Clearwater R	8-June	220279	102,693	1,138	840	174,345	279,016	50.0	4,390
2021	S	2020	Cedar Flats Acclimation	7-June	220278	101,221	615	1,148	143,579	246,563	49.9	4,438
2021	S	2020	North Lapwai Valley Acclimation	4-May	220280	103,917	1,274	957	142,000	248,148	60.7	4,500
2021	S	2020	Salmon River Direct Stream	28-May	091579	222,316	1,042	1,667	795,608	1,020,633	50.0	4,500
Total subyearling releases						2,542,545	16,316	24,862	2,652,520	5,236,245		117,586

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

^b S/Y indicates subyearling or yearling rearing strategy.

Appendix H: Tucannon River Survey Sections and Historical Escapement

Appendix H 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, 2020.

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	19
2	Highway 261 Bridge to Smolt trap	0.15	0.15	100	3
3	Smolt trap to Powers Bridge	0.7	0.7	100	10
4	Powers Bridge to upper Hog Barns	1.45	1.45	100	18
5	Hog Barns to Starbuck Br.	2.4	2.1	87.5	38
6	Starbuck Br. To Fletchers Dam	2.7	1.4	51.9	25
7	Fletcher's Dam to Smith Hollow	3.0	3.0	100	10
8	Smith Hollow to Ducharme's Bridge.	4.6	4.6	100	3
9	Ducharme's Bridge to Highway 12	5.7	5.7	100	9
10	Highway 12 to Brines Road Bridge	6.2	6.2	100	1
11	Brines Road Bridge to King Grade	4.7	4.7	100	0
Total		33.3	31.7	95.2	136

^a Section lengths measured using Google Earth Pro.

^b Percentage is based upon length of stream that is presumed to successfully produce fry.

^c Counted redds were expanded based on percent of reach surveyed to estimate total number of redds.

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

^a Estimates were derived using three fish per redd.

^b Based on one survey completed 12/17/85.

^c Based on one survey completed 11/18/86.

^d Two carcasses counted but not sampled.

^e Correction of number of redds observed that was presented in the 1990 Annual Report.



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