# SPRING CHINOOK SALMON HATCHERY MITIGATION IN S.E. WASHINGTON STATE

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## Introduction

Mitigation Goal

The Water Resources Act of 1976 authorized the establishment of the Lower Snake River Compensation Plan (LSRCP) to replace adult salmon and steelhead lost by construction and operation of the Snake River hydroelectric dams. During the mitigation negotiations it was determined that 2,400 spring Chinook Salmon (2% of passage at McNary Dam) annually escaped into the Tucannon River. The Tucannon River spring Chinook Salmon hatchery mitigation program was designed to escape 1,152 adults to the Tucannon River (replacement of the 48% loss attributed to the construction and operation of the dams), with the expectation that the remaining 1,248 adults (52%) would come from natural production. It was assumed that 4,608 (4 x escapement goal) Tucannon spring Chinook Salmon would be harvested below the project area (project area defined as above Ice Harbor Dam). Using an assumed smolt-to-adult return (SAR) of 0.87%, it was originally determined that an annual release of 132,000 yearling smolts would accomplish this goal.

The co-managers agreed to increase the conventional supplementation goal to 225,000 yearling smolts annually beginning with the 2006 brood year (BY) in the attempt to increase adult returns and come closer to achieving the LSRCP mitigation goal. Size at release was also increased to 38 g fish (12 fish/lb.) beginning with the 2011 BY. In theory, both actions should have increased adult hatchery salmon returns back to the river, however, it does not appear that these actions will produce enough adult returns to reach the LSRCP adult mitigation goal (1,152).

Because of the poor performance of the Tucannon spring Chinook program, the Washington Department of Fish and Wildlife (WDFW) and the LSRCP, along with the co-managers, have initiated an additional hatchery spring Chinook Salmon program in SE Washington. A program using Carson stock spring Chinook Salmon has been implemented in the Touchet River (250,000 smolt release goal), with the first smolt releases occurring in 2020 (2018 BY) from the Dayton Acclimation Pond on the Touchet River. Adult returns from the Tucannon and Touchet programs combine will be used to measure contribution towards the LSRCP spring Chinook Salmon mitigation goal for Washington.

Since 2020 was the first release year of the Touchet Spring Chinook program, the first return of adults was in 2022. Based on PIT tag detections, we estimated that 175-210 adults returned to the Touchet River in 2022. The WDFW will continue to monitor adult returns via PIT tag detections/expansions, Walla Walla basin fishery monitoring, and spawning ground surveys in the Touchet River in the future.

**NOTE** Due to the limited time that the Touchet spring Chinook Salmon program has been in existence, no additional information will be provided in this summary. All information provided below will be solely for the Tucannon Spring Chinook Salmon Program. Additional information from the Tucannon spring Chinook Salmon Program can be found in annual reports at: https://www.fws.gov/media/washington-dept-fish-and-wildlife.

## Tucannon Management Objectives

The Lower Snake River Major Population Group (MPG) is comprised of two populations (Tucannon River and Asotin Creek). The Asotin Creek spring Chinook Salmon population is considered to be extirpated. The management objectives for the Tucannon River spring Chinook Salmon population are: 1) Meet the LSRCP mitigation goal, 2) Restore and maintain fisheries (long-term goal = 2,400-3,400 hatchery and natural fish), 3) Restore and maintain the natural population (population viable threshold of 750 natural origin fish over a 10-year geometric mean), and 4) Minimize impacts of hatchery fish on the natural population.

## Location and Hatchery Facilities

The Tucannon River flows into the Snake River between Little Goose and Lower Monumental Dams approximately 622 rkm from the mouth of the Columbia River (Figure 1). Lyons Ferry Hatchery (LFH) is located on the Snake River and is used for broodstock holding, spawning, egg incubation, and early juvenile rearing. The Tucannon Fish Hatchery (TFH) is located at rkm 59 on the Tucannon River and is used for broodstock collection at the adult trap and juvenile over-winter rearing before release. Historically, pre-smolts were transported to Curl Lake Acclimation Pond (about 7 rkm upstream of TFH) in February for acclimation and volitional release. Currently, a number of different release strategies are being investigated in attempts to increase adult returns and the overall survival of hatchery releases.

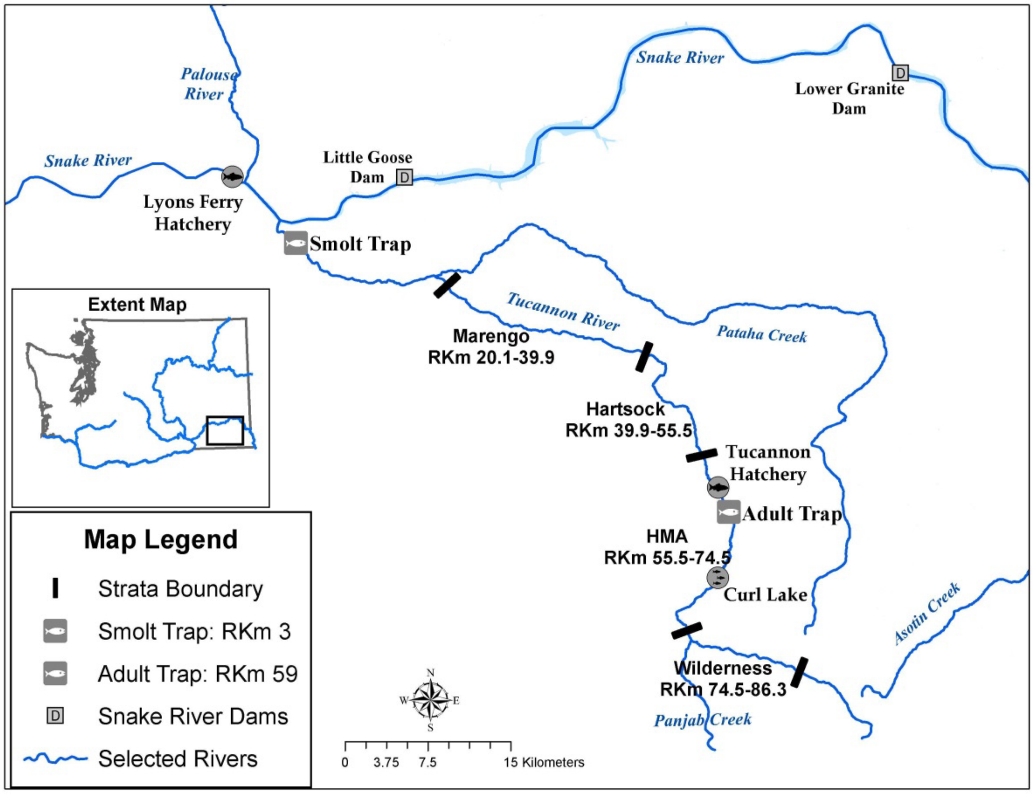


**Figure 1. Location of the Tucannon River, Lyons Ferry Hatchery, and Tucannon Fish Hatchery within the Snake River basin in Washington State.**

## Fish Health, Production, and Adult Returns

The Tucannon River stock was derived from fish captured at the Tucannon River Hatchery adult trap representing fish that were endemic to the Tucannon River. The original broodstock goal was to collect 100 adults for the production of 132,000 smolts annually from 1986-2005. The broodstock goal was revised beginning with the 2006 BY to account for lower-than-expected SARs. The new goal is to collect 170 adults to meet the new smolt production/release goal of 225,000.

Broodstock are typically injected with antibiotics (erythromycin) as a prophylactic for the prevention of Bacterial Kidney Disease (BKD). Broodstock females are screened for BKD using Enzyme Linked Immunosorbent Assay (ELISA). During 2017, the decision was made to suspend antibiotic injections due to drug license restrictions. Higher ELISA values were the result (Figure 2). Tulathromycin (Draxxin) was used after this with mixed results before we reverted back to erythromycin during 2020 (Figure 2).

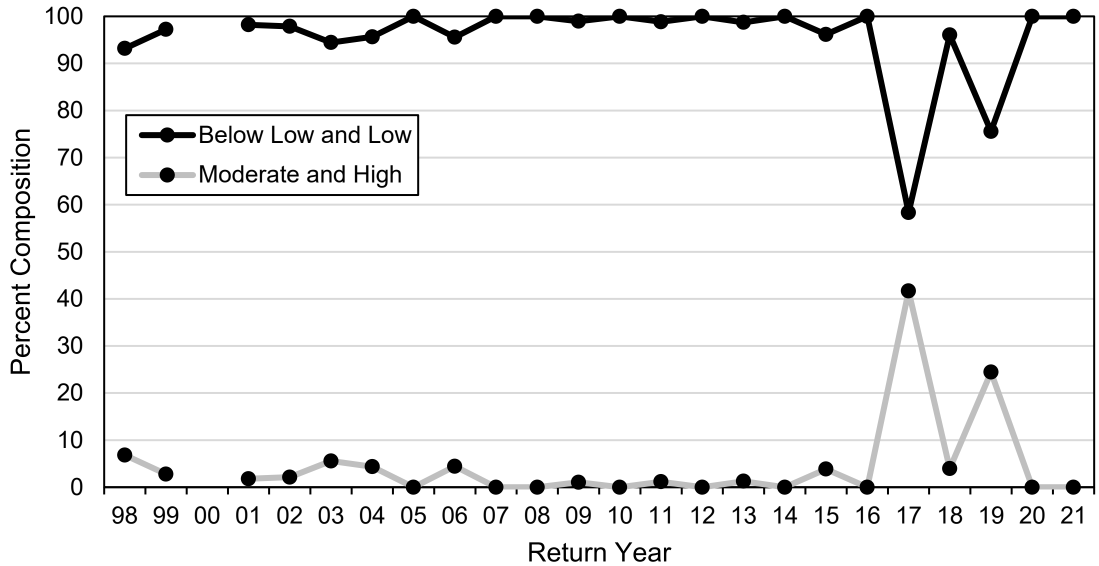


**Figure 2. Historical Below Low and Low, and Moderate and High ELISA values for Tucannon River spring Chinook Salmon female broodstock for the 1998 to 2021 return years.**

Broodstock pre-spawn mortality was high during the beginning of the program when fish were held at TFH (Figure 3). Fish were held at LFH beginning with the 1992 BY and mortalities fell sharply due to lower water temperatures and pathogen free water. High pre-spawn mortality rates were experienced again in 2019 when fish were held at TFH while LFH was undergoing water supply repairs (Figure 3).

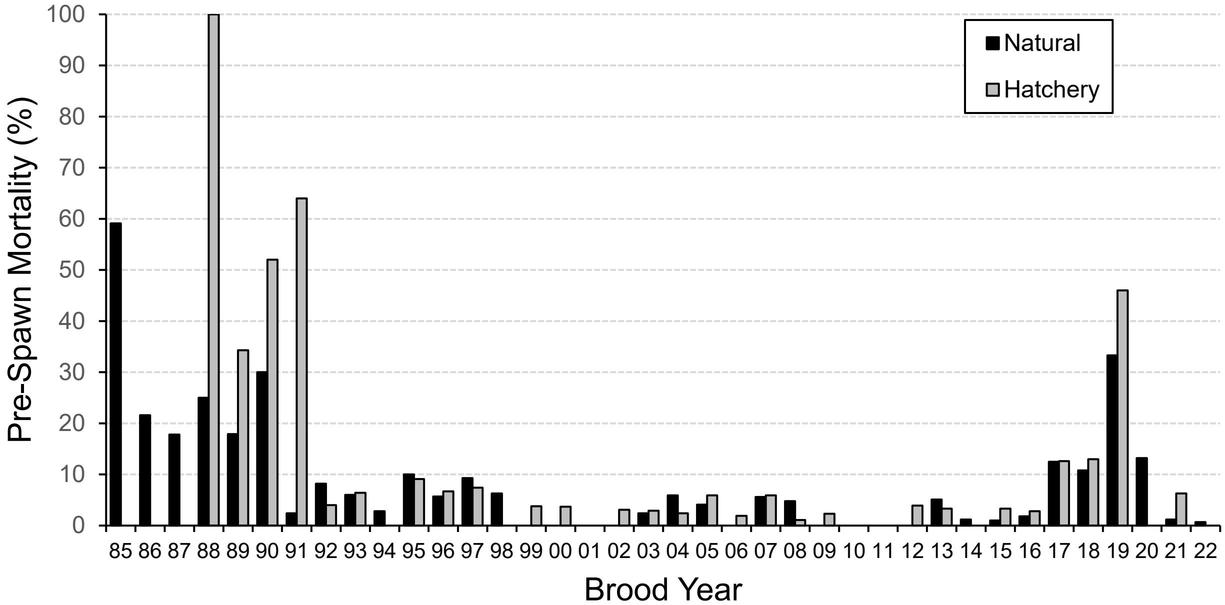


**Figure 3. Pre-spawn mortalities (%) of natural and hatchery origin Tucannon River spring Chinook Salmon broodstock for the 1985-2021 brood years.**

For a variety of reasons our smolt production goals have not always been met (Figure 4). A short-term captive broodstock was initiated in 1997 to supplement the standard production of smolts following very low returns in the mid-1990s (Gallinat et al. 2022a). Beginning with the 2006 BY, the tribal co-managers and WDFW agreed to increase the smolt production goal from 132,000 to 225,000 yearling smolts due to low hatchery-origin SARs (Figure 4).

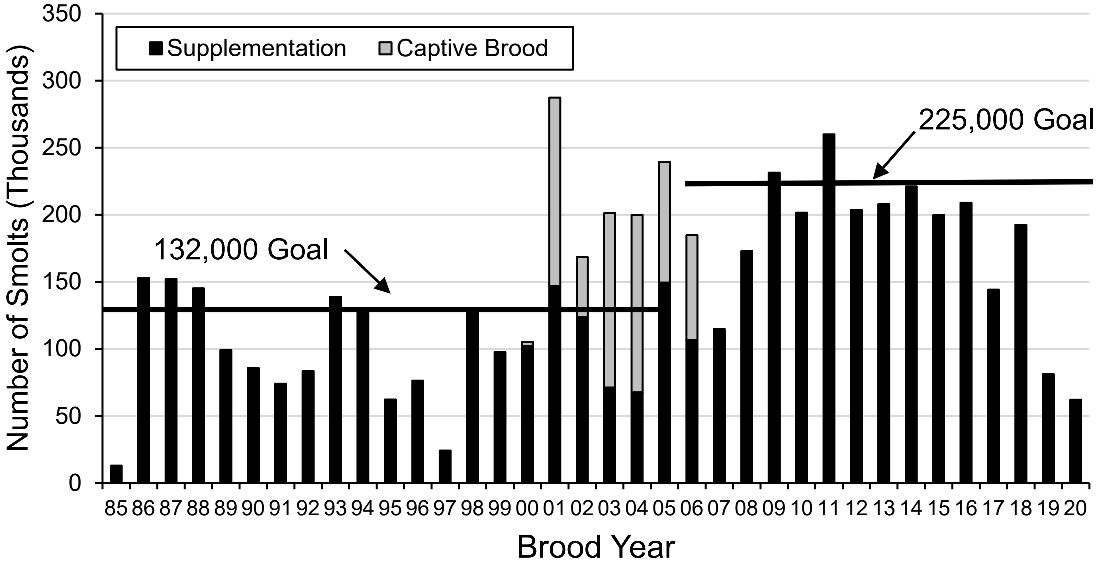


**Figure 4. Number of smolts produced by brood year for both the conventional hatchery supplementation and captive broodstock programs.**

Returning PIT tagged adults/jacks from the program have been detected overshooting the Tucannon River (Gallinat and Kiefel 2022). From 2005-2021, 132 (22.8%) of the returning PIT tagged spring Chinook Salmon were detected upstream (Table 1). Generally, about 70% of the fish that overshoot make it back to the Tucannon River. Returning spring Chinook overshooting the Tucannon River continues to be a concern, especially if they are unable to return to the Tucannon River, or if they are in a more compromised state (e.g., injuries from additional dam crossings, added energy expenditure, etc.), and may partially explain why this population has been slow to respond to recovery and supplementation actions.

**Table 1. Number and origin of PIT tagged Tucannon River spring Chinook Salmon returns that overshot the Tucannon River (includes fish that were last detected returning downstream towards the Tucannon River) and also detected at Lower Granite Dam (LGR) that stayed above LGR Dam.**

| Tag years | # Adult detections Bonneville | Initial # adults above Tucannon | Initial overshoot rate | Percent natural | Percent hatchery | # Adults above LGR | Percent natural | Percent hatchery | Overshoot rate (%) |
|---|---|---|---|---|---|---|---|---|---|
| 2005-2009 | 150 | 20 | 13.3 | 35.0 | 65.0 | 14 | 42.9 | 57.1 | 9.3 |
| 2010-2014 | 319 | 80 | 25.1 | 37.5 | 62.5 | 12 | 41.7 | 58.3 | 3.8 |
| 2015-2019 | 109 | 32 | 29.4 | 3.1 | 96.9 | 7 | 0.0 | 100.0 | 6.4 |
| 2005-2019 | 578 | 132 | 22.8% | | | 33 | | | 5.7% |

Both the number and distribution of redds has varied over the years (Figure 5). During low run years, the majority of fish have been collected at the adult trap due to the early life history survival advantages in the hatchery.

While we have come close during years with good ocean conditions, we have not met the hatchery mitigation goal of 1,152 (Figure 6). Natural origin fish have only met the 1,248 goal once (Figure 6). Hatchery strays (primarily from the Umatilla River) in the Tucannon River have increased in recent years (Gallinat and Kiefel 2022) and have been above the 5% stray rate deemed acceptable by NOAA Fisheries (Figure 7). These high stray rates are a concern since they could lead to outbreeding depression.

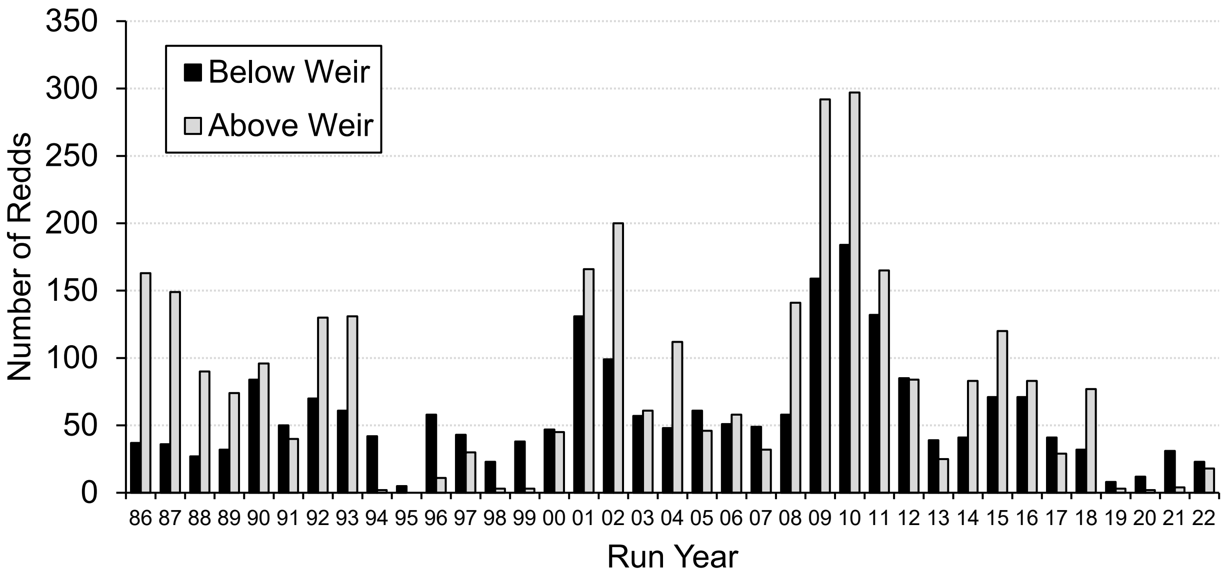


**Figure 5. Number of spring Chinook Salmon redds above and below the adult trap on the Tucannon River for the 1986-2022 run years.**

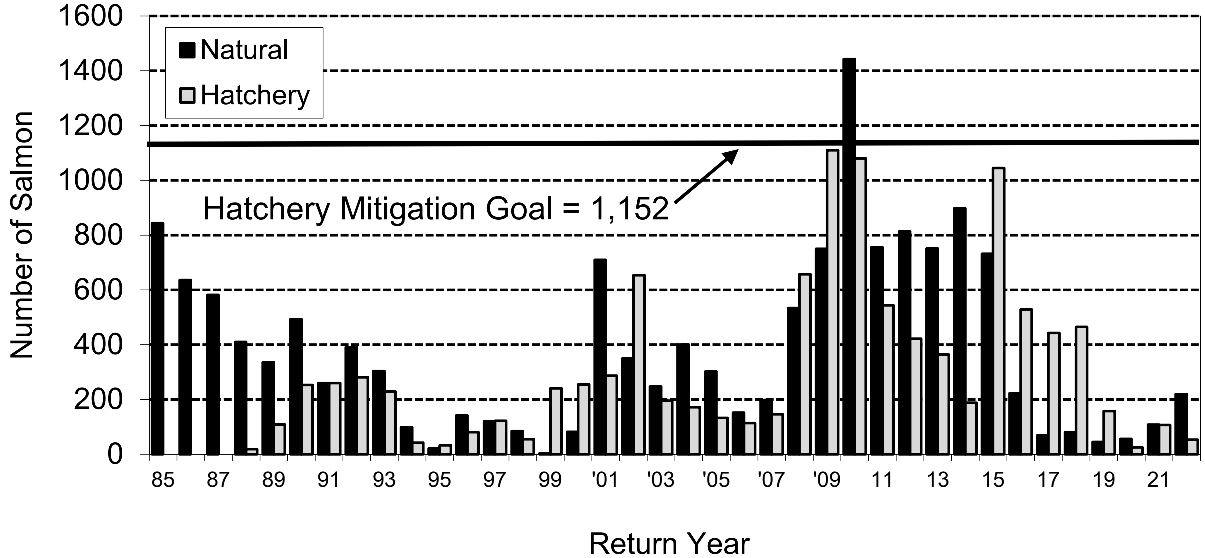


**Figure 6. Total escapement by origin for Tucannon River spring Chinook Salmon for the 1985-2022 return years.**

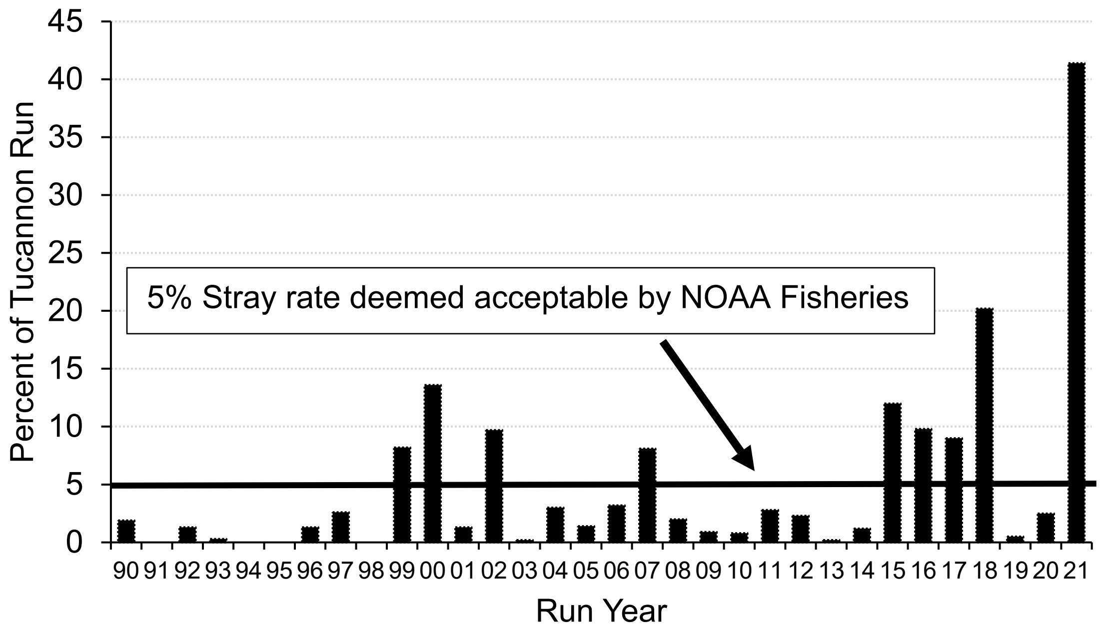


**Figure 7. Percent hatchery stray composition of the Tucannon River spring Chinook run for the 1990 to 2021 run years.**

The long-term restoration goal for the State of Washington is to provide a total return of between 2,400-3,400 hatchery and natural origin spring Chinook Salmon back to the Tucannon River (SRSRB 2006) that should include at least 750 natural origin fish over a 10-year geometric mean [minimal viable population (MVP) abundance level] (ICTRT 2008). Natural origin returns had been increasing and making progress towards the 750 goal (Figure 8), but decreased in recent years (2016-2021), primarily due to poor ocean conditions. The Proportionate Natural Influence (PNI) for the population is typically above 0.50 and averaged 0.63 from 1985 to 2022.

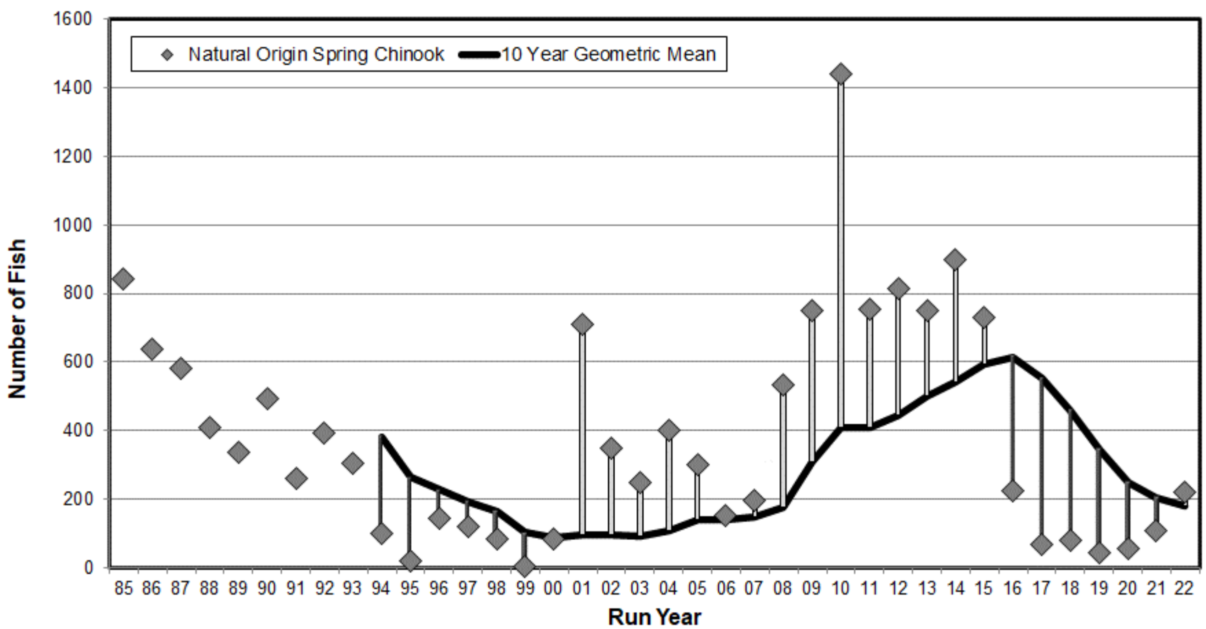


**Figure 8. Tucannon River spring Chinook Salmon natural origin returns with the moving ten-year geometric mean (black line) for the 1985-2022 run years.**

Natural origin SARs have consistently been higher than hatchery origin SARs (Figure 9). The mean natural origin SAR for the 1985-2018 BYs was 2.19 with jacks included (2.07 without jacks) and the mean hatchery origin SAR was 0.23 with jacks (0.18 without jacks) over the same time period (Figure 9). Based on the current mean hatchery SAR of 0.23% it would take a hatchery program of over 500,000 smolts to meet the mitigation goal of 1,152 hatchery fish.

Recoveries of coded-wire tag show that the majority of fish are recovered in the Tucannon River with limited harvest and very few straying to other river systems (Figure 10).

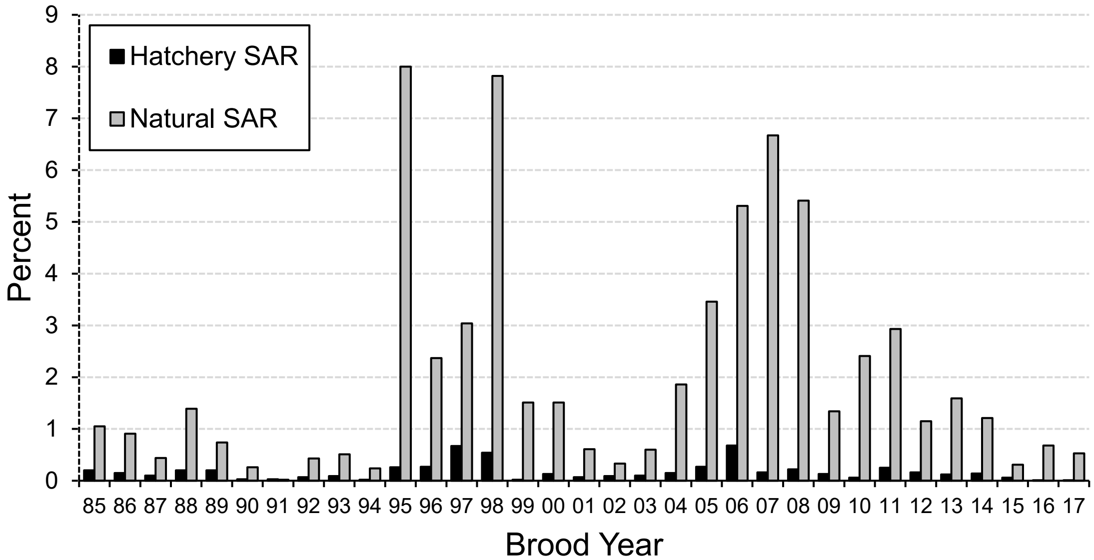


**Figure 9. Comparison of smolt-to-adult returns (SAR) of hatchery and natural origin Tucannon River spring Chinook Salmon for the 1985 to 2017 brood years (jacks excluded).**

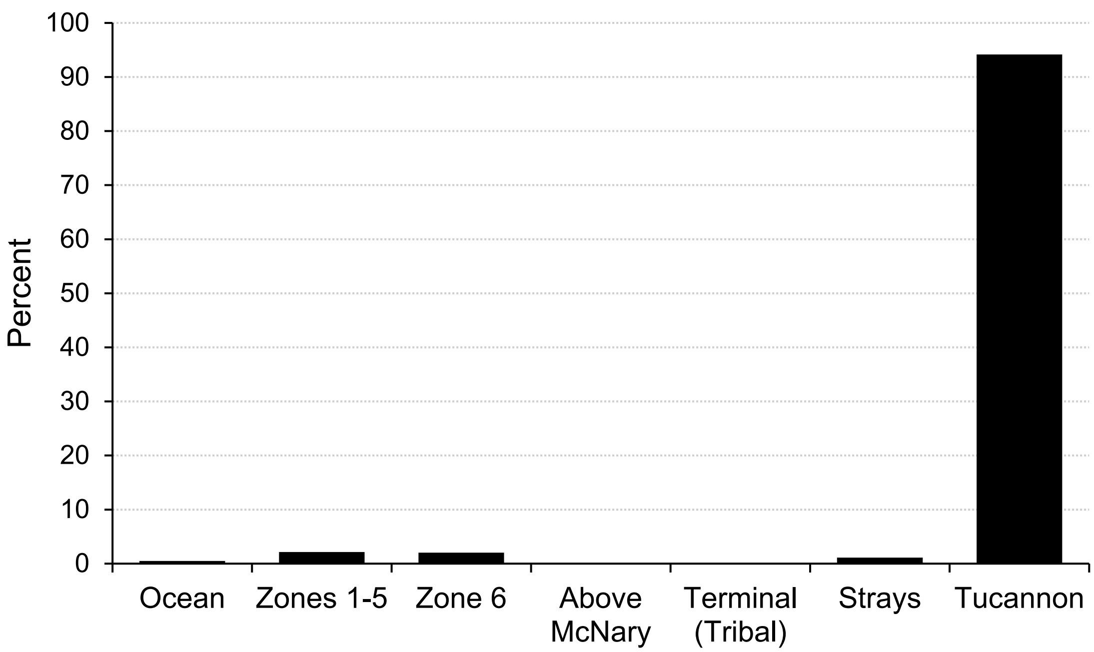


**Figure 10. Percentage of Tucannon River spring Chinook Salmon coded-wire tag recoveries by fishery zone/location for the 1985-2016 BY releases. (Note: No adipose clip for hatchery fish from the 2000 BY to present.)**

Overall survival of hatchery salmon to return as adults has been higher than for naturally reared fish because of the early-life survival advantage. Based on adult returns from the 1985-2017 BYs (Figure 11), naturally reared salmon produced only 0.63 adults for every spawner, while hatchery reared fish produced 1.81 adults (based on geometric means). Why the natural origin fish are typically not replacing themselves is the most pressing question for this population since extinction is inevitable for this population should this situation continue.

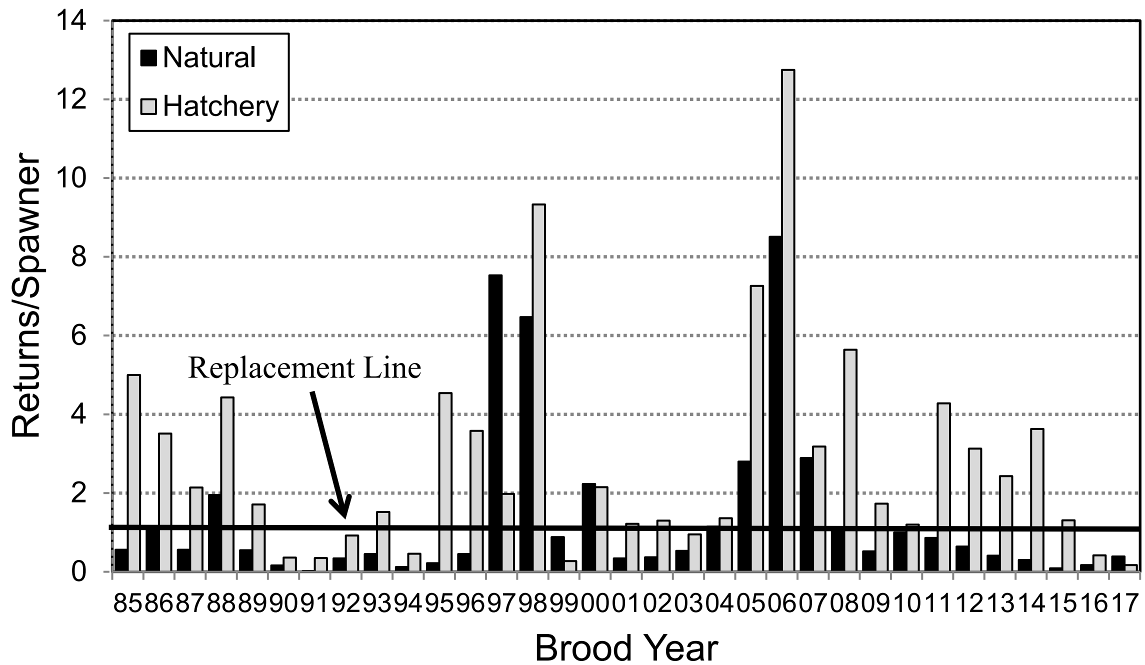


**Figure 11. Returns per spawner (with replacement line) for the 1985-2017 brood years (2017 incomplete brood year).**

## LFH vs. TFH Reared Comparisons

The Hatchery Scientific Review Group recommended developing long-term rearing capabilities within the Tucannon River Subbasin as one of their recommendations for this program (HSRG 2009). This recommendation was based on questions that were raised as to whether hatchery rearing for the majority of their early life at LFH affected their survival and ability to home back to the Tucannon River. To answer those questions, approximately 30,000 eggs were transferred to TFH for incubation and rearing for three BYs (2011-2013) for comparison to LFH reared fish. To avoid potential bias in recovery rates between the two release groups (Zhou 2002, Murdoch et al. 2010), PIT tag detections of migrating smolts and returning adults were used to compare performance. Each group was tagged with a unique CWT and a subset (Target of 7,500) from each group was PIT tagged (Table 2).

Juvenile Emigration Survival

Survival probabilities were estimated by the Cormack-Jolly-Seber methodology using the Survival Under Proportional Hazards (SURPH) 3.0 computer model. To determine significant differences in survival probabilities between groups the Likelihood Ratio Test statistic was used. Estimated emigration survival probabilities from Curl Lake to Lower Monumental Dam were not significantly different ($P > 0.05$) between the two groups (Table 2).

**Table 2. Release number, size at release (g), and number of Tucannon River hatchery spring Chinook Salmon PIT tagged by brood year (BY) for each rearing location and SURPH survival probabilities from Curl Lake Acclimation Pond to Lower Monumental Dam for the 2011 to 2013 brood years.**

| Rearing Location | BY11 | BY12 | BY13 |
|---|---|---|---|
| **LFH Group** | | | |
| Number released | 230,391 | 180,493 | 184,425 |
| Size at release | 33 g | 32 g | 37 g |
| CWT | 63/64/41 | 63/65/85 | 63/67/42 |
| Number PIT tagged (Target 7,500) | 7,493 | 7,478 | 7,479 |
| **TFH Group** | | | |
| Number released | 29,573 | 23,017 | 23,434 |
| Size at release | 33 g | 32 g | 37 g |
| CWT | 63/64/42 | 63/65/86 | 63/67/43 |
| Number PIT tagged (Target 7,500) | 7,494 | 7,471 | 7,482 |
| **SURPH Survival Probabilities** | | | |
| LFH reared group (S.E.) | 0.56 (0.03) | 0.63 (0.02) | 0.49 (0.06) |
| TFH reared group (S.E.) | 0.56 (0.03) | 0.65 (0.02) | 0.55 (0.06) |
| Likelihood Ratio Test Statistic | 0.0594 | 0.4089 | 0.5022 |
| Degrees of freedom | 1 | 1 | 1 |
| *P*-value | 0.808 | 0.523 | 0.479 |

Adult Returns

Returning PIT tagged fish were assumed to be mature the year they entered freshwater after being in the marine environment. Smolt-to-adult survival (SAS) was calculated as the total number of fish that were detected within the Columbia and Snake River watersheds and smolt-to-adult return (SAR) was calculated as the number of fish detected in the Tucannon River (Table 3). Differences in SAS and SAR rates between groups were tested using a nonparametric Mann-Whitney (Wilcoxon) test due to the concern about non-normality due to small sample sizes (Zar 1996). Neither SAS ($P$ = 0.82) nor SAR ($P$ = 0.51) were significantly different between the two groups. The results did not show a significant benefit in either survival or homing back to the Tucannon River by rearing fish at TFH. In fact, the LFH reared group returned more adults (age 4+) than the TFH reared group (Table 3). Based on these findings, it was decided to continue to use LFH for spawning, incubation, and early life rearing.

**Table 3. Returning PIT tagged spring Chinook Salmon detected by age in the Columbia-Snake River system for smolt-to-adult survival (SAS) and detected in the Tucannon River for smolt-to-adult return (SAR) for the LFH and TFH reared groups (2011-2013 brood years) of Tucannon River spring Chinook Salmon.**

| | Age 2 | Age 3 | Age 4 | Age 5 | Total Detections | SAS | Tucannon Detections | SAR |
|---|---|---|---|---|---|---|---|---|
| LFH BY11 | 6 | 5 | 16 | 1 | 28 | 0.37% | 21 | 0.28% |
| TFH BY11 | 7 | 2 | 8 | 0 | 17 | 0.23% | 9 | 0.12% |
| LFH BY12 | 21 | 8 | 9 | 0 | 38 | 0.51% | 11 | 0.15% |
| TFH BY12 | 18 | 12 | 6 | 0 | 36 | 0.48% | 15 | 0.20% |
| LFH BY13 | 22 | 2 | 10 | 0 | 34 | 0.45% | 9 | 0.12% |
| TFH BY13 | 23 | 6 | 5 | 0 | 34 | 0.45% | 8 | 0.11% |

## Optimum Size at Release

We PIT tagged 95,256 Tucannon River hatchery origin spring Chinook Salmon with known FL (range 73-212 mm) categorized into five length classes (< 120, 120-139, 140-159, 160-179, and ≥ 180 mm FL) over eight BYs (2006-2013) to examine how size at release affected SAS rate back to the Columbia/Snake River system and SAR rate back to the Tucannon River (Gallinat et al. 2022b). We used this information to determine an optimum size range at release to maximize adult returns back to the Tucannon River and determine if the program target SAR of 0.87% was achieved by any of the length classes.

Return of hatchery adults (age-4 and older) for both SAS and SAR peaked for the 140-159 mm release size (Figures 12 and 13). Smaller size at release resulted in lower survival and fish larger than this size range matured prematurely either as minijacks or jacks and the majority never made it back to the Tucannon River (Figure 13). Based on this study, to maximize adult returns, hatchery smolts from the Tucannon River spring Chinook Salmon hatchery program should be released in the 140-159 mm range (33 to 49 g). None of the length classes came close to reaching the adult SAR target of 0.87% (SAR for 140-159 mm at release was 0.15%). The expectation that changes to smolt size would lead to reaching the 0.87% SAR target is unrealistic for this population under current hatchery rearing and environmental conditions.

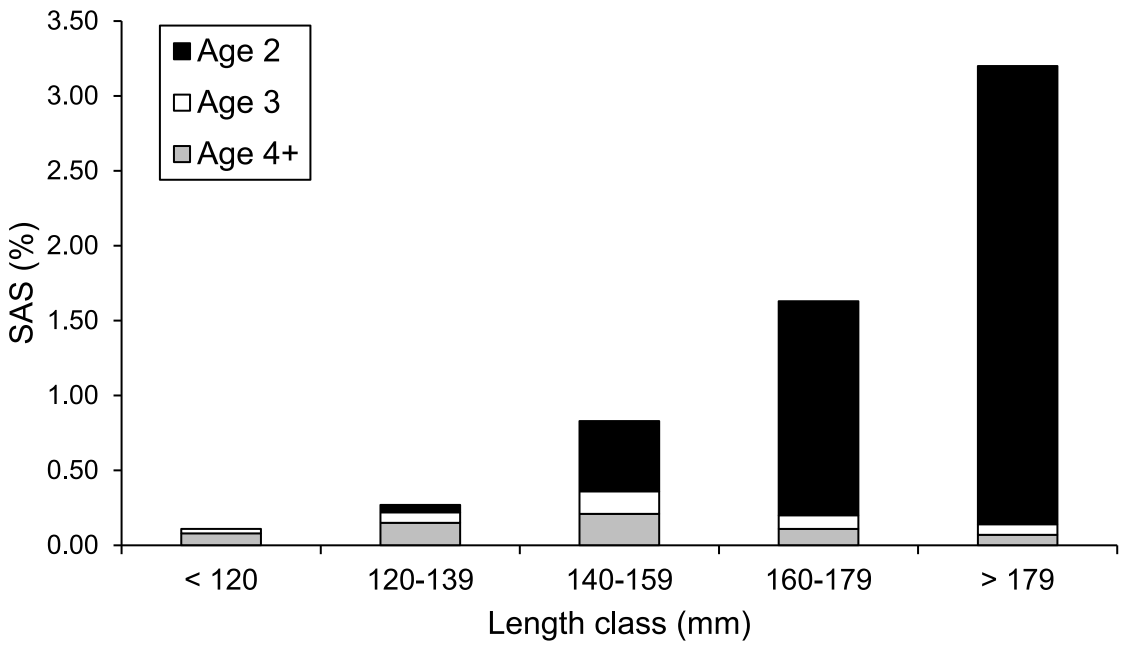


**Figure 12. Smolt-to-adult survival (SAS) for ages 2, 3 and 4+ of hatchery origin Tucannon River spring Chinook Salmon from the 2006 to 2013 brood years that were categorized by length (mm) at release and were detected returning back to the Columbia/Snake River system based on PIT tag detections.**

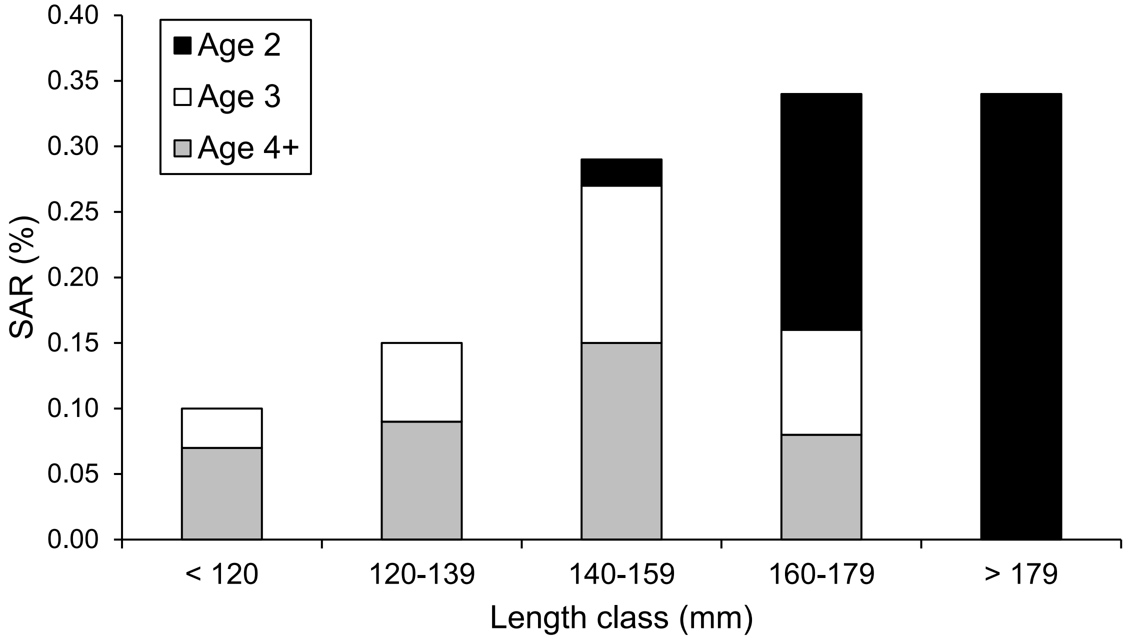


**Figure 13. Smolt-to-adult returns (SAR) for ages 2, 3 and 4+ of hatchery origin Tucannon River spring Chinook Salmon from the 2006 to 2013 brood years that were categorized by length (mm) at release and were detected returning back to the Tucannon River based on PIT tag detections.**

## Is the Hatchery Program Lowering Natural Productivity?

Sampling in recent years has shown unexplained decreases in the number of smolts-per-redd (an indicator of in-river productivity) for Tucannon River spring Chinook Salmon (Figure 14). This led to questions as to whether the hatchery program was having a deleterious effect on the natural population and its productivity. Several factors such as run size, proportion of hatchery origin strays, proportion of hatchery origin spawners on the spawning grounds (pHOS), and redd distribution are all known to affect in-river productivity and we examined those factors in the attempt to determine the cause.

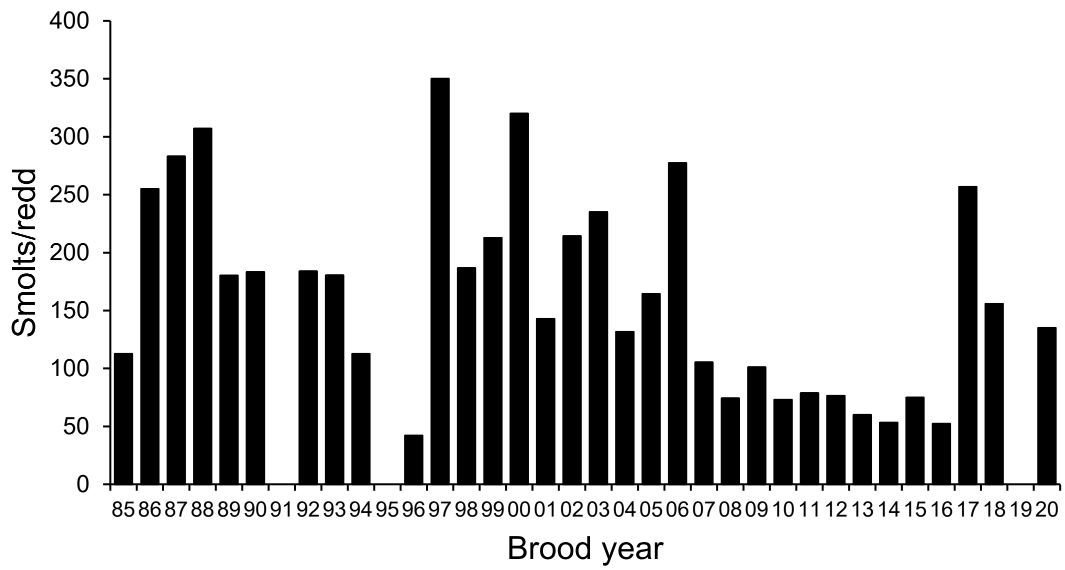


**Figure 14. The number of natural-origin Tucannon River spring Chinook Salmon smolts-per-redd by brood year.**

A multiple stepwise regression (backward selection) was used to examine the following seven variables to examine if they had a significant effect on the number of smolts/redd. The seven variables were:

1) Proportion of redds below the trap.
2) Proportion of redds above the trap.
3) Proportion of hatchery strays in the run.
4) Proportion of redds Marengo and downstream (poor habitat).
5) Proportion of redds in the Wilderness and HMA (best habitat).
6) Proportion of hatchery origin fish on the spawning grounds (pHOS).
7) Annual escapement level.

None of the variables were significant with the exception of annual escapement, suggesting a density-dependent effect. The equation of the fitted model was:

Smolts per redd = 211.51 – 0.076*Escapement ($R^2 = 27.4$; $P < 0.01$)

We are seeing density-dependent effects, even though current escapement numbers are well below historical levels. Large escapement years are producing smaller juvenile migrants on average and smaller returns are producing larger migrants (Figure 15). The larger fish from the smaller runs have higher SARs (Figure 16) and also are generally above replacement (Figure 17). It appears that the population is hitting a "productivity ceiling" in environmental capacity that is limiting spring Chinook Salmon in the Tucannon River and halting progress towards reaching restoration goals, even though current escapement numbers are below historical levels. Comparable to the hatchery fish described earlier, obtaining a larger size also appears critical to insure survival and subsequent adult returns for natural origin fish. To enhance the productivity of natural origin fish we have started a stream nutrient enrichment program that began with the 2016 BY (2018 emigration year) using fall Chinook Salmon carcasses as a surrogate for Tucannon River spring Chinook Salmon. We are cautiously optimistic this program has been beneficial to the productivity of the natural population by increasing the number of smolts per redd and overall smolt size (Figures 18 and 19).

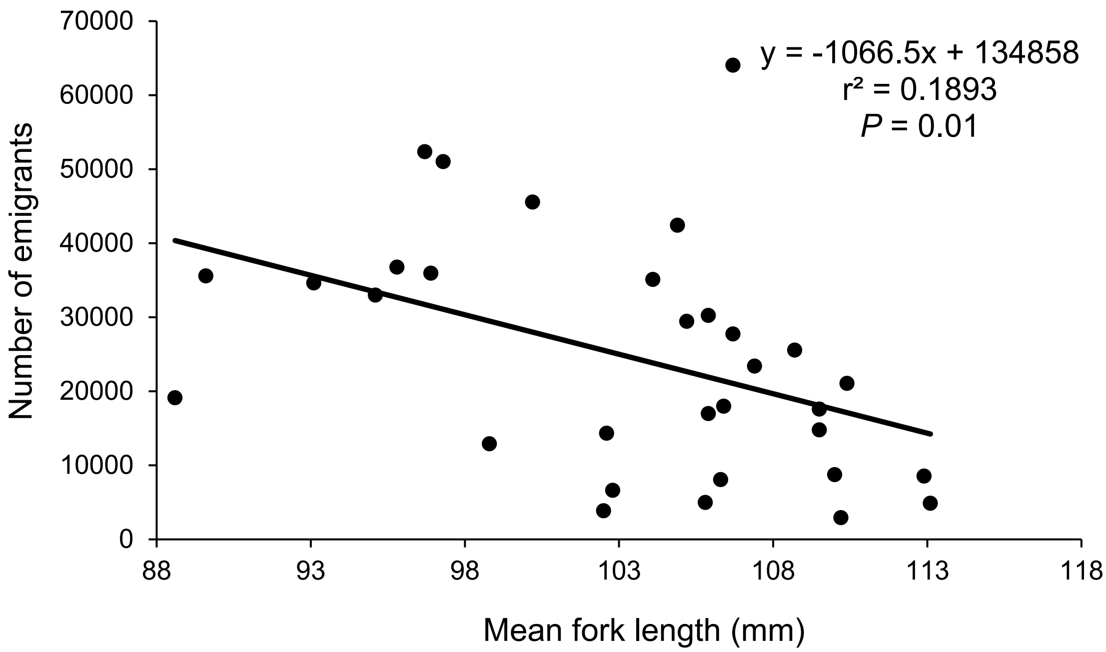


**Figure 15. Relationship between the number of emigrating Tucannon River spring Chinook Salmon smolts and mean fork length (mm) of smolts sampled at the Tucannon River smolt trap for the 1985 to 2018 brood years.**

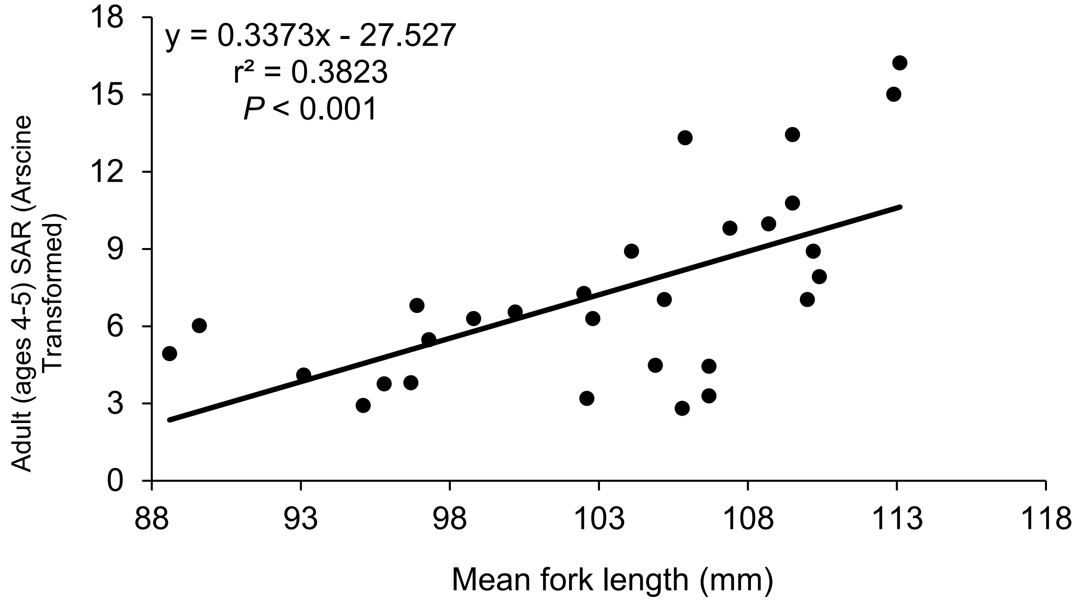


**Figure 16. Mean fork length (mm) of natural-origin Tucannon River spring Chinook Salmon smolts sampled at the Tucannon River smolt trap regressed against the arcsine square root transformation of adult (ages 4-5) smolt-to-adult return (SAR) for the 1985 to 2015 brood years.**

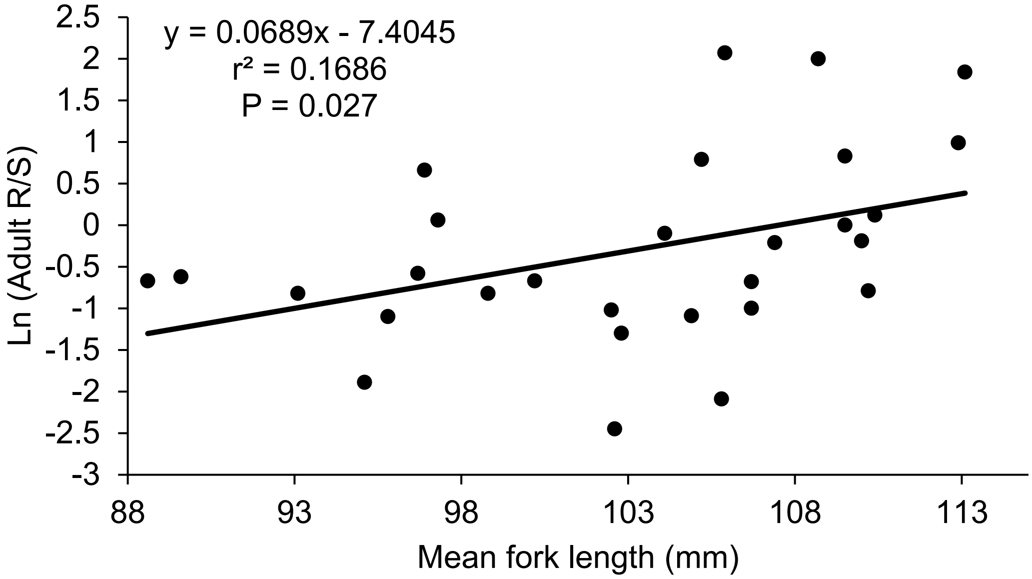


**Figure 17. Mean fork length (mm) of Tucannon River spring Chinook Salmon smolts sampled at the Tucannon River smolt trap by brood year regressed against the natural log of adult (ages 4-5) returns per spawner for the 1985 to 2015 brood years.**

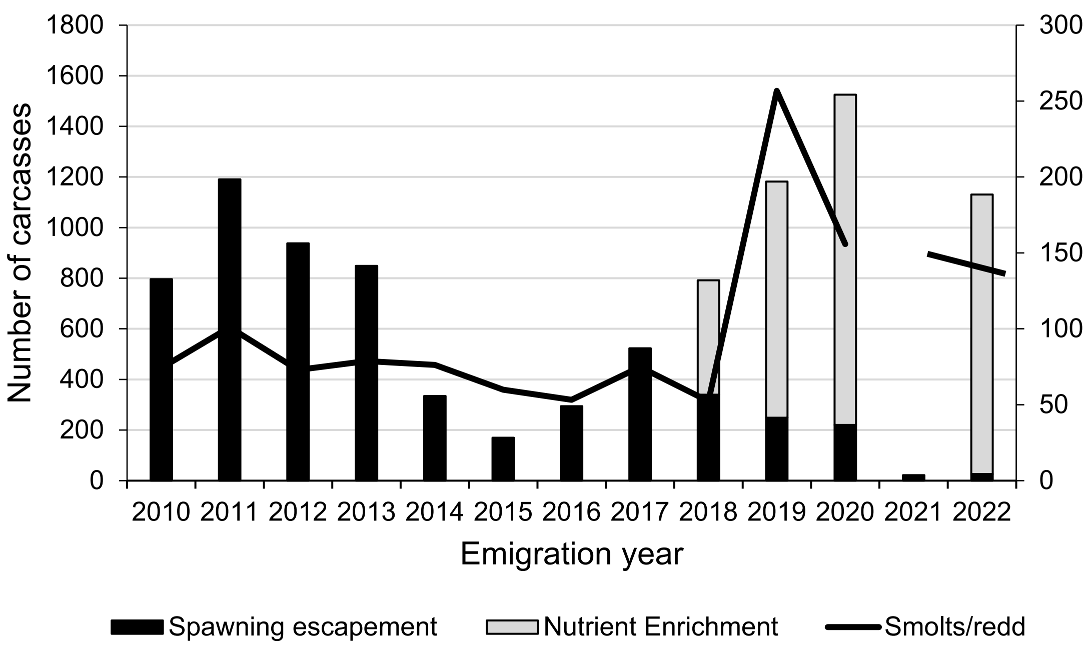


**Figure 18. Tucannon River spring Chinook Salmon smolts/redd prior to and after stream nutrient enrichment. Estimated number of carcasses are based on the spawning escapement (black bars) and stream nutrient enrichment efforts (gray bars). [Note: An emigration estimate was not possible for the 2019 BY (2021 emigration year).].**

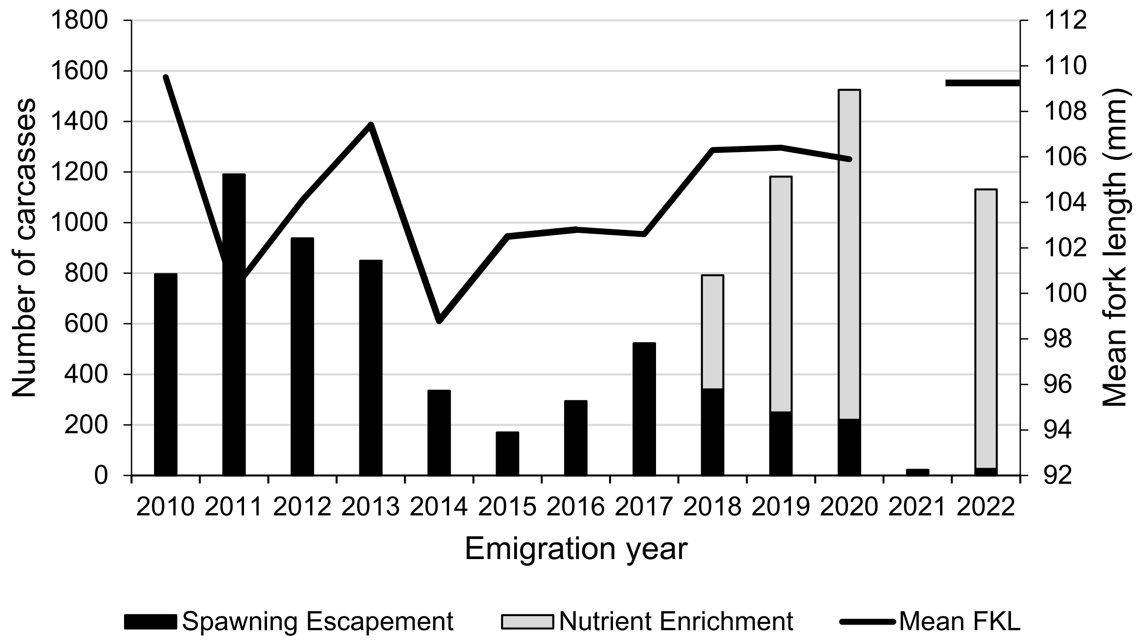


**Figure 19. Graph of mean fork length (mm) of Tucannon River spring Chinook Salmon smolts from the Tucannon smolt trap (April – May) prior to and after stream nutrient enrichment. Estimated number of carcasses are based on the spawning escapement (gray bars) and stream nutrient enrichment efforts (black bars).**

## Reference Stream Comparisons

In an effort to characterize efficacy of the Tucannon hatchery program we compared trends in the numbers of total spawners returning to the Tucannon River to reference streams using methods described by Hillman et al. (2017). Reference streams in this instance refers to unsupplemented populations of spring Chinook Salmon that had years of historical data before the Tucannon program was initiated as well as continuous data during the Tucannon program. A simple linear regression of total spawner data was used to further screen reference streams to include only those populations that shared similar trend characteristics during the pre-supplementation period. As a result, after examining 26 populations of Snake River spring Chinook Salmon, only seven had a time series adequate to compare to the Tucannon and only three shared similarities during the before supplementation period to support inclusion in further analysis. These populations were Big Creek, Loon Creek, and the Secesh River in Idaho.

Each of these reference populations was then compared first by calculating the differences between the Tucannon population and each reference population for each year before and after the Tucannon program was implemented (T-R). Next the relative difference between the Tucannon population and each reference population was calculated (T/R). Data were log transformed before these determinations. Finally, means for each of these metrics (T-R, T/R) for the before and after periods were compared using a t-test to determine if supplementation provided any improvement to total spawner abundance. The results were inconsistent. The supplemented Tucannon River spring Chinook Salmon outperformed one reference stream, Loon Creek (T-R) but underperformed the Secesh River population (Figure 20).

Finding reference streams proved to be a challenge in this exercise and generally weaker relationships between the Tucannon River and reference populations were observed relative to those reported by Hillman et al. (2017) which may contribute to the outcome. Ultimately there are also challenges with using multiple pairwise tests when making inferences that are overcome in modelling exercises performed by Scheuerell et al. (2015) that suggest that the impact of supplementation may be smaller than other drivers to the variability in population response over time.

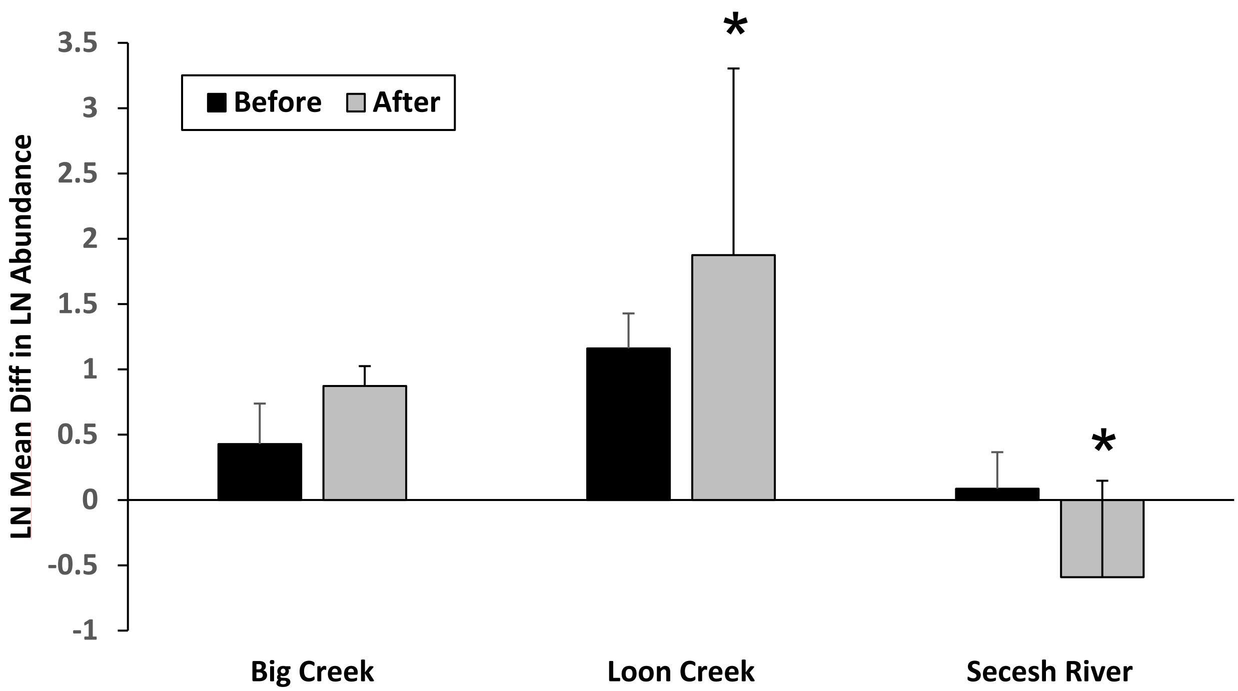


**Figure 20. Comparison of the Tucannon River spring Chinook Salmon population with the Big Creek, Loon Creek, and Secesh River populations using the before vs. after period approach (BACI). An asterisk denotes a significant difference.**

## Future Alternative Rearing and Release Strategies

Because of the continued low adult returns back to the Tucannon River due to adverse environmental conditions (e.g., poor ocean conditions, drought, floods, hydrosystem migration corridor, habitat, etc.) and resulting hatchery production that has been well below program goals, WDFW and the co-managers are currently looking at three different hatchery rearing and release strategies in an effort to increase adult returns and improve survival. These three strategies are: 1) Tucannon River Release and Barging Comparison, 2) Captive Broodstock, and 3) Hatchery Release below Bonneville Dam.

Tucannon River Release and Barging Comparison

Survival within the Tucannon River itself from the point of hatchery release to detection at Lower Monumental Dam shows potential for improvement. Average survival to Lower Monumental Dam from Curl Lake Acclimation Pond or TFH has been less than 60% based on DART PIT tag survival estimates. Over the next few years when sufficient hatchery production is available, we will examine three different release strategies (Direct Stream Release at TFH, Direct Stream Release at the Mouth, and Barge Transportation) by PIT tagging a minimum of 15,000 fish per group in an attempt to determine if significant improvements in adult returns and survival rates can be achieved. The study will be conducted for a minimum of three BYs with PIT tag detections from returning adults used to determine significant differences among the release groups.

Fish used for this study will be transferred from LFH to TFH in October. This is to ensure that all groups will be treated similarly over the fall/winter months prior to PIT tagging and allow for ample imprinting to the Tucannon River to minimize straying upon adult return. The potential shift to future releases lower in the river, or from barging, could have consequences (survival, adult trapping, and spawning distributions) that are not fully appreciated at this time, hence the study. Barging has been shown to affect homing abilities for both Chinook Salmon and steelhead (Quinn 1993; Keefer et al. 2008; Keefer and Caudill 2014; Bond et al. 2017). Management actions to account for some of these (hauling returning adults upstream, additional trapping locations for broodstock collection/hauling, etc.) may have to be implemented.

For the 2022 release, due to limited juvenile production available, we partially implemented this strategy by releasing fish at TFH and at the mouth of the Tucannon River. Both groups were over-wintered at TFH as described above, and each group received 20,000 PIT tags for evaluation. Based on DART PIT tag survival estimates to downstream locations, the release at the mouth appears to have performed better. However, the real determination will be with overall adult returns and their return distribution within the Tucannon River.

Captive Broodstock (Safety-Net)

If funding can be obtained, a captive broodstock program will be re-initiated, and will be nearly identical to the previous Tucannon River spring Chinook Salmon Captive Broodstock Program (see Gallinat et al. 2009). The WDFW and the co-managers are proposing this action to provide a safety-net to reduce the risk of catastrophic loss of this population. The goal will be to collect

290,000 eggs/year from captive females when three complete age classes (ages 3 to 5) are spawned concurrently. These eggs are expected to produce 150,000 yearling smolts for release into the Tucannon River at full production. Excess production above this amount could be released into Asotin Creek which is part of the same Ecologically Significant Unit (ESU) as the Tucannon River population and is considered to be functionally extirpated based on the lack of adult returns over many years.

Hatchery Release Below Bonneville Dam

If approved by NOAA Fisheries, and if additional funding can be obtained, another strategy that may be employed to improve survival and increase adult returns would be to acclimate and release Tucannon River hatchery spring Chinook Salmon smolts at a hatchery below Bonneville Dam. Currently, WDFW is proposing to use Kalama Falls Hatchery (KFH) on the Kalama River, approximately 124 rkm from the mouth of the Columbia River. Juvenile fish would be transported from LFH in late October for 5 to 6 months of acclimation on Kalama River water to maximize imprinting. Fish transported to KFH would be tagged with CWT and given a unique mark to visually distinguish them from other stocks in the lower Columbia River. The acclimated smolts would be released in late March/early April. The size of the program would be capped at no greater than 50% of Tucannon River hatchery production, or up to 100,000 smolts, whichever is less, depending on KFH capacity and NOAA approval. Returning adults will be collected at the KFH adult trap and transported back to LFH. If necessary, available adults would be used to fulfill shortfalls to Tucannon River broodstock needs to produce 225,000 smolts or will be outplanted into the upper Tucannon River to increase the number of fish that are naturally spawning to increase natural production.

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