

# **Investigation of Yearling Chinook Hatchery Production as a Conservation Strategy for West Coast Vancouver Island Chinook**

Final Report to the Pacific Salmon Commission's Southern Endowment Fund Committee

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## **INTRODUCTION**

The traditional strategy for Chinook salmon enhancement at West Coast Vancouver Island (WCVI) hatcheries is to rear and release subyearling Chinook smolts, conforming to the prevailing 'ocean-type' life-history pattern observed in the natural origin WCVI Chinook populations. Hatcheries have also experimented with using alternative rearing strategies including transitional 'sea-pen' rearing whereby subyearling smolts spend a brief period of additional feeding/rearing in the marine environment before release, and 'yearling' Chinook smolt releases (Dobson 2017). While the use of these latter strategies appear to result in increased survival of the smolts, they are more expensive, and present more risks to wild WCVI Chinook through straying and potential domestication.

Natural-origin WCVI Chinook salmon are currently at low abundances and are considered to be a stock group of conservation concern, limiting domestic and bilateral fisheries. Implementing hatchery techniques that have the potential to address freshwater production as a limiting factor in order to increase their abundance and productivity may improve the current status of WCVI Chinook populations.

Past research on yearling Chinook hatchery production has mainly focused on the relative effectiveness of this strategy as a means to increase overall production (Dobson 2017, Riddell 2017). However, more recently this strategy is being considered as a tool for stocks of extreme conservation concern, such as those at very low levels of abundance or that are vulnerable to year class failures due to increasing variability in marine conditions. Application of yearling releases, in conjunction with subyearling releases, may serve to accelerate stock recovery and mitigate against year class failures when ocean entry conditions are poor.

## **PROJECT OBJECTIVES**

The utility of yearling Chinook enhancement as a conservation tool for WCVI Chinook salmon is being investigated on Stamp River/Robertson Creek Hatchery (RCH) Chinook salmon. The overall objective of this study is to address information gaps on the efficacy of yearling-type hatchery releases for ocean-type Chinook populations in comparison with standard release practices. This project will assess whether there are significant differences in a) marine survival, b) age at maturity, c) body size at return, and d) marine distribution, between the yearling and subyearling release strategies. Consideration of yearling enhancement as a strategy for hatchery supplementation of Chinook populations of extreme conservation concern will require a thorough understanding of the outcomes of this strategy on biological attributes that contribute to the overall productivity and likelihood of recovery of the population. Apart from these objectives, information on relative reproductive success and fitness of returning yearling and subyearling hatchery fish will also be assessed in future studies to better understand efficacy of these strategies in restoring and supplementing natural Chinook populations on WCVI.

The study results will lead to improved decision making and a better understanding of the risks and benefits of using a Yearling juvenile release strategy as a component of a comprehensive conservation plan for Chinook populations of concern.

## **METHODS**

Paired releases of adipose fin clipped and coded-wire tagged (CWT) yearling and subyearling Stamp River/RCH Chinook salmon were completed for brood year (BY) 2018. The subyearling release group was represented by the Pacific Salmon Treaty (PST) exploitation rate indicator group at Robertson Creek Hatchery, which has successfully undertaken that program annually since 1972.

The yearling release group was incubated and reared at Nitinat River hatchery, where a secure and disease-free water source, combined with a chiller system, was used to delay and regulate their growth to mimic the size/growth of yearlings in the natural environment. In addition, the yearling Chinook group were reared at lower than normal tank loading densities to minimize stress.

On December 5, 2018, 115,432 eyed Chinook eggs from RCH were transported to Nitinat River Hatchery and incubated in chilled water (~ 4 °C). On May 1, 2019 approximately 110,674 fry were ponded, and fed at 1.5% body weight (bw) per day, 7 days/wk until they reached a weight of 1 gram. The feeding rate was reduced to 6 days/wk until tagging, after which it was further reduced to 1% bw with alternating feed days. Fry were adipose clipped and coded-wire tagged (AD/CWT) from August 21-29, 2019. On November 7, 2019, approximately 96,344 yearling Chinook fry were transported back to Robertson Creek Hatchery at a size of 13.3 g. This was 2 months earlier than the previous year due to space restrictions at Nitinat Hatchery. At RCH, the fry were fed a reduced ration (25%) 2 days per week, to target a release size of ~20 g. The subyearling group were reared on ambient surface water at RCH, and fed following feeding guidelines recommended by the feed manufacturer. Feeding rates were adjusted regularly based on rearing temperatures and fish size (weight) from weekly sampling.

The procedures described in detail in Nichols & Hillaby (1990) were followed for implanting CWTs into juvenile Chinook. Juveniles were starved for 48 hours prior to marking and tagging and were anaesthetized in small batches in a solution of Tricaine Methanesulphonate (TMS) and water in preparation for marking. Following anaesthetization, the adipose fin of each juvenile was excised with surgical scissors, and then delivered to the Mark IV tagging machine for insertion of a CWT in the nose cartilage. Following the procedure, tagged juveniles were retained and monitored for CWT retention as per procedures outlined in Nichols & Hillaby (1990).

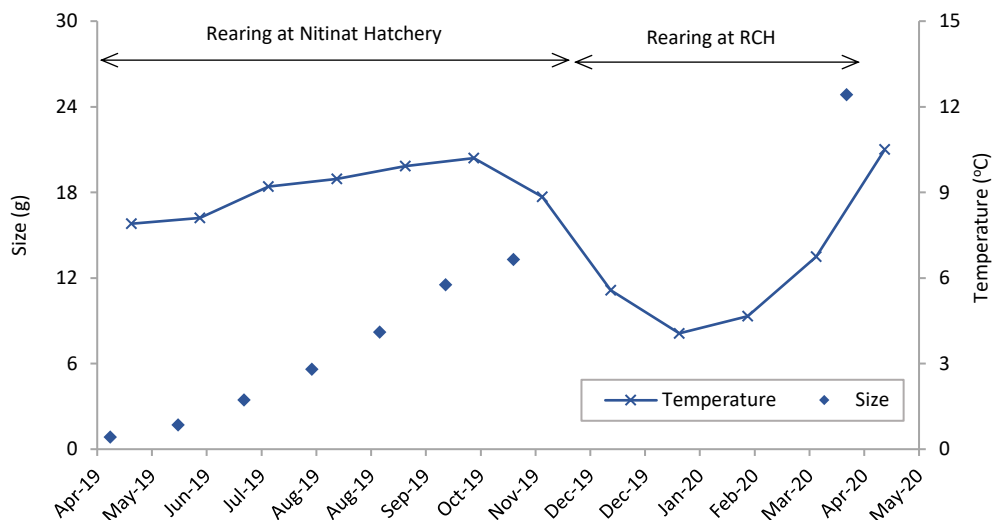
Parental broodstock sampling for Bacterial Kidney Disease (BKD) as well as Infectious Haematopoietic Necrosis (IHN) was conducted by the DFO Fish Health Laboratory. Sampling of the yearling Chinook juveniles for pathogen screening (bacteriology, virology, and histology) was completed prior to release.

## RESULTS

Approximately 394,941 brood year 2018 Chinook subyearling juveniles were adipose fin clipped and coded-wire tagged from May 3-26, 2019 using ten different tag codes. A total of 4.98 million sub-yearling Chinook was released from Robertson Creek Hatchery between May 16 and 28, 2019, at an average size of 4.5 grams. Between April 10 and 17, 2020, approximately 94,303 juveniles in the yearling group were released from Robertson Creek Hatchery at an average size of 24.84 g (Table 1). Both the subyearling and yearling groups were released directly into the Stamp River. Growth of the yearling juveniles at Nitinat and Robertson Creek hatcheries is illustrated in Figure 1 with mean weekly rearing temperatures at the two sites.

**Table 1. Summary of the yearling and subyearling adipose fin clipped and coded-wire tagged (AD/CWT) groups for brood year 2018 Stamp River Chinook released at Robertson Creek Hatchery.**

Release Group	Number AD/CWT marked	Marking Date	Tag Codes	AD/CWT Released	Total Released	Date of Release	Mean Size at Release (g)
Yearling	98,281	Aug 21-29, 2019	184574, 182776	94,303	94,303	April 10-17, 2020	24.84
Subyearling	394,941	May 3-26, 2019	181387, 185790, 185888, 182191, 183980, 184091, 184890, 184891, 184892, 184893	394,854	4,983,952	May 16 - 28, 2019	4.5



**Figure 1. Mean monthly water temperature and average size (in grams) during rearing of the BY 2018 yearling Chinook juveniles at Nitinat and Robertson Creek hatcheries, from ponding in May 2019 to release in April 2020.**

## DISCUSSION

For both the current study (BY 2018), and for BY 2017, healthy AD/CWT yearling Chinook were successfully released from Robertson Creek Hatchery. Total numbers released each year were within 90% of the target of 100K tagged yearlings required to effectively assess this production strategy; tag retention was >99% in both years. Overall survival from eyed egg to yearling release was 82% for BY 2018, and 89% for BY 2017.

Results from the subyearling and yearling Chinook releases will be monitored and assessed through the recovery of CWTs in fishery and escapement strata beginning in fall 2020 and continuing through to fall 2024. Results from yearling releases will be compared with both its brood cohort (released a year earlier) and with its release cohort (released in the same year, but of the next brood year). To date, data collection and results have been limited to BY 2015 and 2016 subyearling and yearling releases and recoveries in 2017 -2019 from the earlier (pre-PSC funded) studies. Once the project is complete, the results from the two years of this (PSC) project plus the 2 years of work that precede the PSC funded study, will provide information that will be used on an annual basis in hatchery and stock recovery planning for WCVI moving forward indefinitely. In the long term, evidence of significant environmental changes may require reassessment of this study to confirm results are still valid, but overall it is expected that the information obtained will benefit WCVI Chinook management for the foreseeable future.

**APPENDIX**  
**Financial Expenditure Summary**

Details of expenditures registered in the DFO financial system at fiscal year-end.

**Pacific Salmon Commission (PSC)**

**Project Code: 57959    2018-2019 Expenditures**

<b>Total Funding from PSC</b>	<b>\$ 29,000.00</b>
CWT Tagging Contractor	\$ 15,568.19
Fish Food	\$ 5,000.00
Electricity to pump well water	\$ 6,000.00
<b>Total Expenditures</b>	<b>\$ 26,568.19</b>
<b>Balance</b> <i>(refunded to PSC)</i>	<b>\$ 2,431.81</b>

## REFERENCES

Dobson, D. 2017. Evaluation of alternate enhancement strategies and release locations for Chinook: Robertson Creek Hatchery, Sarita and Nahmint rivers and Philips River. Unpublished manuscript.

Nichols, T.L., and J.E. Hillaby. 1990. Manual for Coded-Wire Tagging and Fin-Clipping of Juvenile Salmon at Enhancement Operations Facilities. Prepared under contract #90SB.FP501-7-0060/A to Supply and Services Canada by Streamline Consulting Services Limited

Riddell, B 2017. Review of rearing strategies (subyearling and yearling) for south coast fall Chinook salmon. Unpublished manuscript.