

# **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

**2019**

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## **INTRODUCTION**

The traditional strategy for Chinook salmon enhancement at West Coast Vancouver Island (WCVI) hatcheries is to rear and release under-yearling, or 0+ aged 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 under-yearling smolts spend a brief period of additional feeding/rearing in the marine environment before release, and 'yearling' or 1+ aged 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 under-yearling 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 under-yearling 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 under-yearling 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 under-yearling Stamp River/RCH Chinook salmon were completed for brood year (BY) 2017. The under-yearling release group is 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 29 November 2017, 102,423 eyed Chinook eggs from RCH were transported to Nitinat River Hatchery and incubated in chilled water (3.5 – 4 °C). Following 4 months of incubation, approximately 99,295 fry were ponded on April 2, 2018. The fry were placed on a modified feeding regime to regulate growth. Initially the fry were fed at 1.5% body weight (bw) per day, 7 days/wk, which was reduced to 1% bw/day for 6 days of feeding two weeks after ponding. When fish reached a weight of 1.5 g, the number of days fry were fed was further reduced to a regime of 2 days on feed/1 day off feed. Between 12 June and 30 August 2018, approximately 94,234 fry were marked and CWT'd.

In January 2019 the feed rate was increased to 1.5% bw/day. Fry were transported back to Robertson Creek Hatchery on 22-24 January 2019 at an average size of 13.6g for an additional 3 months of rearing and imprinting in a raceway. During this period fry were given a reduced feed ration (25%) 2 days per week until release.

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, and pathogen screening (bacteriology, virology, and histology) of juveniles from both release groups was completed prior to release.

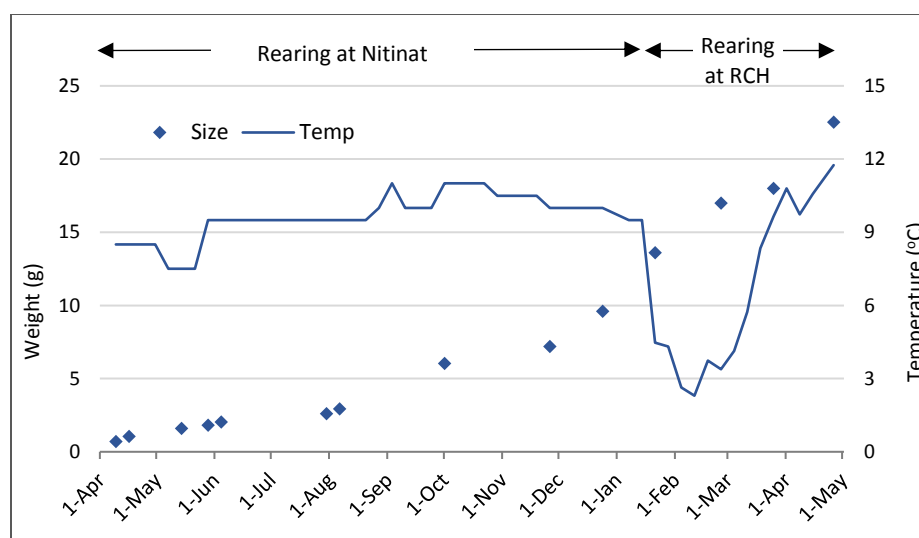
## RESULTS

Approximately 543,873 brood year 2017 Chinook under-yearling juveniles were adipose fin clipped and coded-wire tagged between 13 April and 10 May 2018 using thirteen different tag codes. The under-yearling group, comprising 542,600 fry, was released from Robertson Creek Hatchery between 16 and 30 May 2018 at an average size of 6.01 g.

Approximately 91,100 juveniles in the yearling group were released from Robertson Creek Hatchery on 26 April 2019 at an average size of 22.51 g (Table 1). 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 under-yearling adipose fin clipped and coded-wire tagged (AD/CWT) groups for brood year 2017 Stamp River Chinook released at Robertson Creek Hatchery.**

Release Group	Number AD/CWT'd	Marking Date	Tag Codes	Tag Retention (%)	Number CWT fry Released	Date of Release	Mean Size at Release (g)
Yearling	94,234	June 12- Aug 30, 2018	185286, 185287	99.76	91,101	26/04/19	22.51
Under-Yearling	94,058	Apr 13 - May 10, 2018	183679	99.88	93,940	7/5/18	6.37
	143,290		183887, 184885, 185095, 185096	99.91	143,164	30/5/18	6.81
	155,635		183888, 184882, 184883, 184884, 185097	99.6	154,983	25/5/18	5.94
	150,890		185094, 185294, 185295	99.75	150,515	16/5/18	5.11
	<b>543,873</b>					<b>542,602</b>	



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

## **DISCUSSION**

The results from this study will be monitored and assessed through the recovery of CWTs in fishery and escapement strata beginning in fall 2018 and continuing through to fall 2024. To date, data collection and results have been limited to brood year 2015 under-yearling and yearling Chinook releases and recoveries in 2017 and 2018 from the earlier (pre-PSC funded) studies. Once the project is complete, the results from the two years of this project plus the 2 years of this 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>\$28,000</b>
CWT Tagging Contractor	\$14,479.74
Fish Food	\$11,000.00
Electricity to pump well water	\$2,520.26
<b>Total Expenditures</b>	<b>\$28,000.00</b>
<b>Balance</b> <i>(refunded to PSC)</i>	<b>\$0</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 (under-yearling and yearling) for south coast fall Chinook salmon. Unpublished manuscript.