Potential Long-Term Measures to Support SRKW Recovery

Salmon Enhancement

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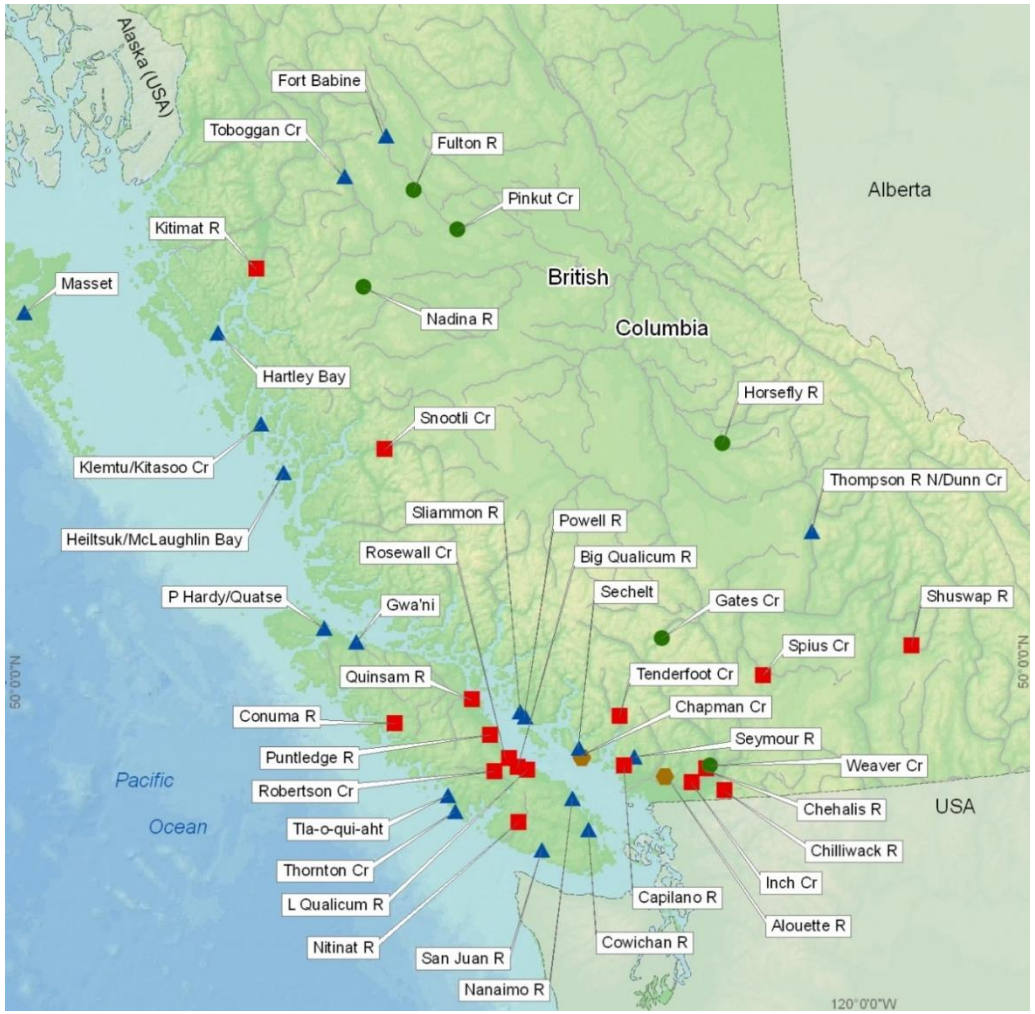
Salmonid Enhancement Program (SEP)

- The Salmonid Enhancement Program (SEP) plays a key role in DFO's work to conserve and manage Pacific salmon stocks. The program's activities aim to:
  - rebuild vulnerable salmon stocks;
  - provide harvest opportunities;
  - provide assessment information necessary to manage stocks;
  - work with First Nations and coastal communities to improve fish habitat and sustain salmon populations; and
  - fulfil key international obligations for Canada under the Pacific Salmon Treaty.

Salmonid Enhancement Program (SEP)

- DFO-SEP currently produces Chinook salmon at 16 DFO operated facilities, 11 facilities funded through contribution agreements, and on a smaller scale by some of its partners at 25 Public Involvement Program facilities
- All DFO-SEP production operates in the context of legislative, treaty, and policy guidelines:
  - The Wild Salmon Policy
  - Pacific Salmon Treaty
  - DFO-SEP Risk Management Guidelines
  - Fish Health Management Plans
  - Aquaculture regulations
  - Introductions and Transfers Committee (ITC)



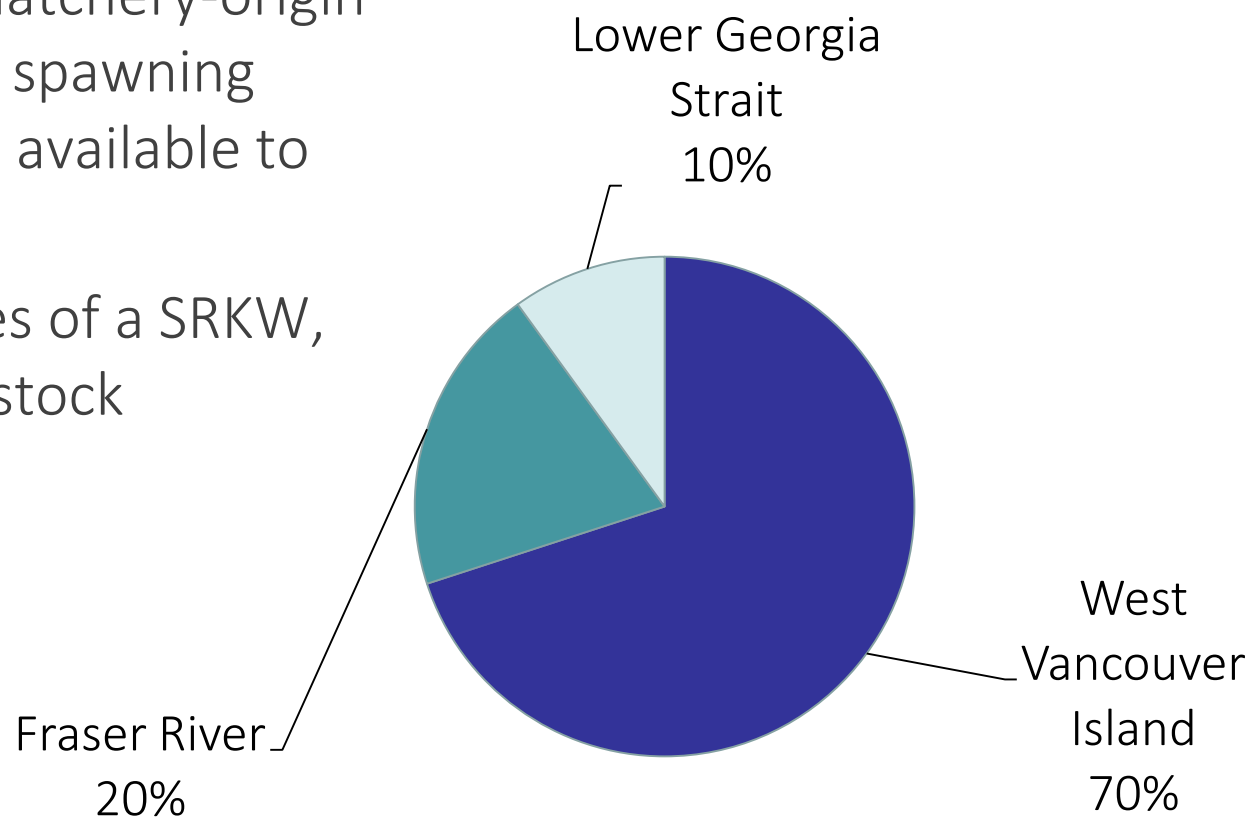
Canada

DFO-SEP's Role in SRKW Recovery

- SRKW are specialized salmon predators that predominantly consume Chinook salmon, along with Coho and Chum at different times of the year
- There are three hatchery enhancement strategies that DFO-SEP can use to increase prey abundance for SRKW:
  1. Hatchery enhancement to increase Chinook marine abundance where there is a scientifically supportable expectation of benefit to SRKW
  2. Investigations into release strategies to increase survival rates or increase age-at return
  3. Stock rebuilding through hatchery enhancement in conjunction with habitat restoration and harvest measures on stocks of importance

DFO-SEP's Role in SRKW Recovery - Hatcheries

- In southern BC ~100,000-300,000 hatchery-origin Chinook contribute to fisheries and spawning escapement annually, and could be available to SRKW
- Not all Chinook are equal in the eyes of a SRKW, prey sample analysis shows strong stock preferences



Ranking of Canadian Stocks

- Chinook stocks were ranked by NOAA, ranking is based on: presence in SRKW diet, consumption during times of reduced body condition, degree of spatial and temporal overlap, and status of Chinook population abundance

Stock Group	Run Type	Rivers or Stocks in Group	NOAA Priority Score (out of 5)
Strait of Georgia	Fall	Fraser Fall (Harrison, Chilliwack), Lower Strait (Cowichan, Nanaimo), Upper Strait (Klinaklinim, Wakeman)	4.63
Fraser	Spring	Spring 5_2 (Mid & Upper Fraser), Spring 4_2 (L Thompson, Louis Cr)	4.25
Fraser	Summer	Summer 4_1 (S Thompson, Shuswap), Summer 5_2 (Chilko, Nechako)	2.88
WCVI	Fall	Robertson Creek	1.38
Northern BC	Spring	Skeena, Nass	0.00
Central BC	Summer	Atnarko, Rivers Inlet, Dean River	0.00

Hatchery Enhancement

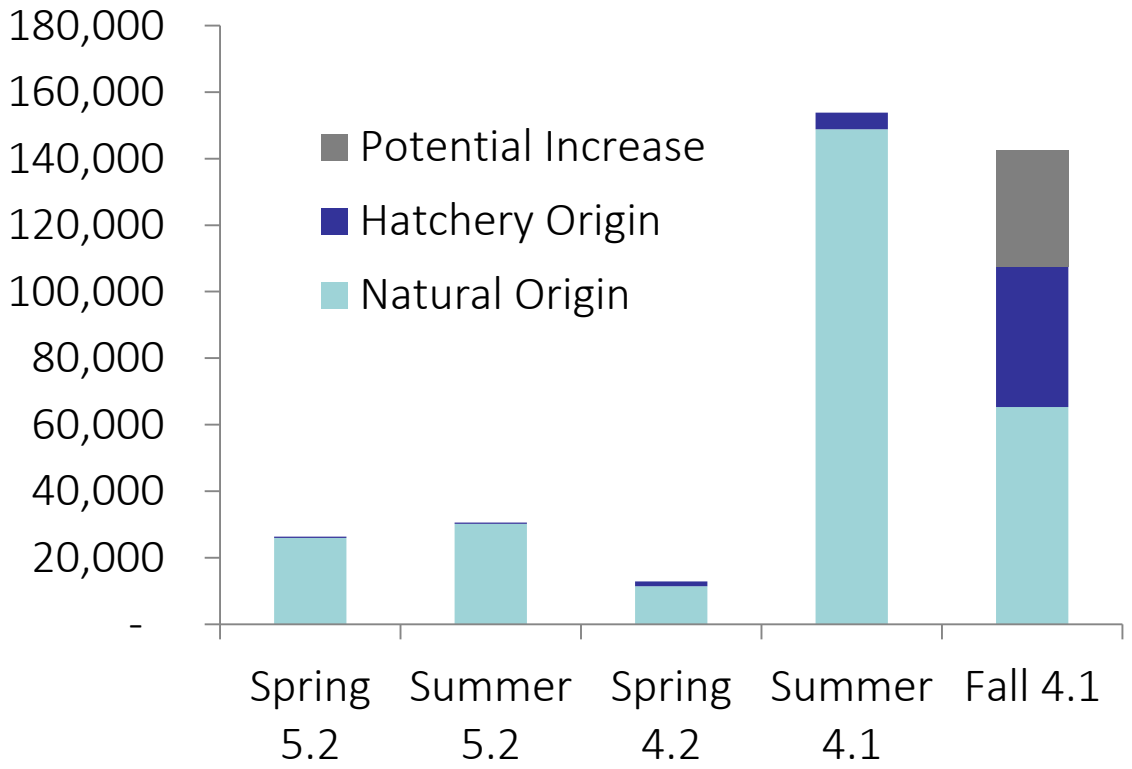
- To address the threat of insufficient prey for SRKW, DFO-SEP will increase marine abundance of Chinook salmon through incremental, strategic and targeted hatchery production over 5-years
- Criteria for evaluating potential production for SRKW must consider:
  - Priority SRKW prey stocks (NOAA 2018);
  - Potential hatchery-wild interactions;
  - Existing facility capacity and broodstock availability;
  - Impacts on international harvest management agreements; and
  - If there is the potential to evaluate the success of the program.
- Evaluation of these criteria demonstrated that Fraser fall Chinook from Chilliwack River Hatchery is the most suitable stock for increased production to support SRKW

Why Chilliwack Chinook?

- They are a large bodied Chinook, available to SRKW year round
- This stock has the highest survival rate in the province
- Fraser Falls are the highest ranked stock group in the NOAA model
- Minimal hatchery wild interactions
  - Chilliwack river does not have a naturally spawning population, it is a transplant from Harrison river, and stray rates are quite low
- There is capacity and expertise at Chilliwack River Hatchery to increase production by 1 Million
- Continental shelf distribution limits the impacts on international harvest management agreements
- This stock has been genetically tagged since 2013; DNA collected from forage events can be analyzed to determine if SRKW consume these hatchery fish

Expected Outcomes

- The 1 million Jv release is expected to result in 35,000 additional adult Chinook annually
- This enhancement will increase the total abundance of Fraser Fall Chinook by 30%
- Washington State is also increasing production to support SRKW recovery
  - Increased production from Chilliwack Hatchery will account for ~17% of new adults in Georgia Strait
- Funding is available until 2024, and will increase the total number of adult Chinook in SRKW critical habitat through 2029



Alternative Release Strategies

- DFO- SEP is continuing to explore strategies to increase survival rates, age of return and efficiency of the program
  - It takes years to determine the success/value of release trials (minimum 10 years)
  - Often results are stock specific

- DFO-SEP is participating in a cross-border hatchery experiment working group, exploring the results of past and present release strategies

Alternative Release Strategies

- Previous and ongoing work has been conducted to evaluate and review alternative release strategies to support production objectives. This includes:
  - Release timing
  - Release age
  - Release size
  - Release location
  - Seapens
- Each strategy comes with different level of risk, benefits and challenges
- In the context of different policies and regulatory requirements, DFO-SEP aims to select the most effective strategy to responsibly meet the enhancement objectives

Supporting Chinook Rebuilding

- DFO-SEP supports the rebuilding of several Chinook stocks, the majority of this work is in the Fraser

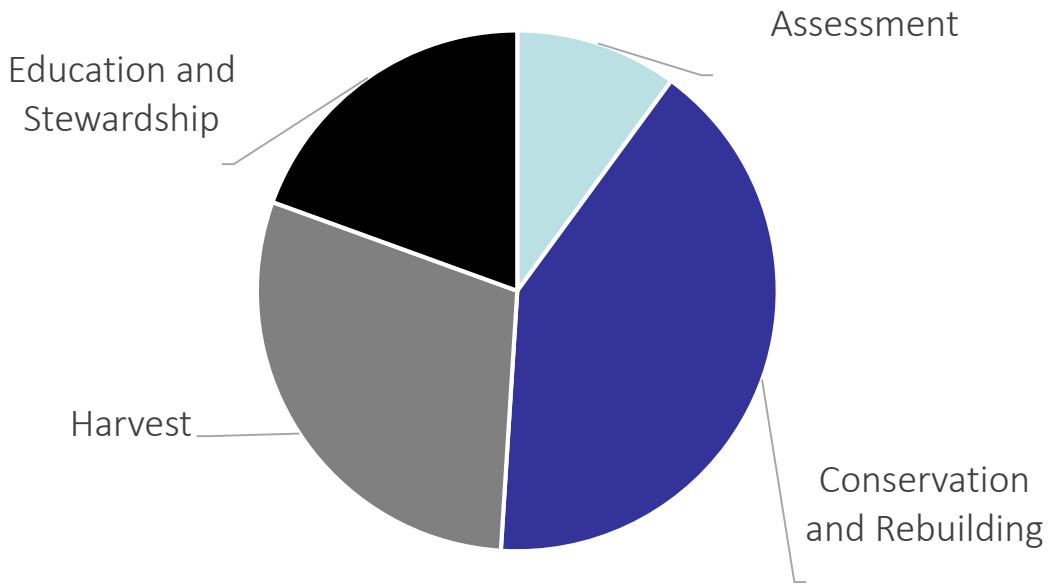


Figure 1. Total lines of production by objective

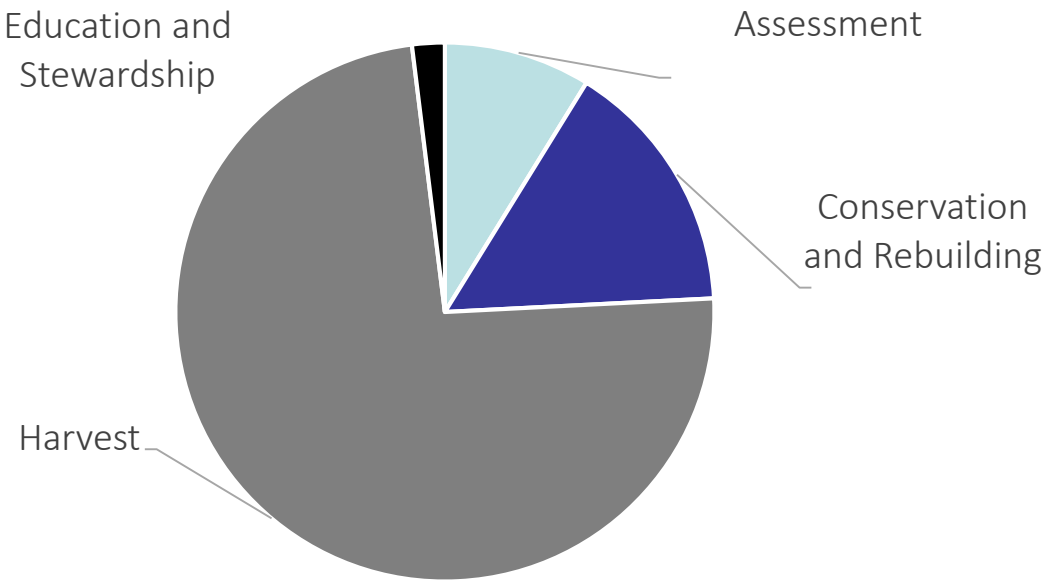


Figure 1. Total target release by objective

Supporting Chinook Rebuilding

- Rebuilding initiatives should be integrated with Fisheries Management, Stock Assessment, and needs to consider the habitat and freshwater limitations of the system in question
- Examples of rebuilding initiatives in the Fraser include:
  - Coldwater River Chinook
  - Salmon River Chinook
  - Spius Creek Chinook
  - Bonaparte River Chinook
  - Nahatlatch River Chinook
  - Chilliwack River Spring Chinook
  - Portage Creek Chinook

Is DFO-SEP Considering Enhancement Elsewhere?

- DFO has a process for evaluating enhancement projects
- Planning begins 12 months in advance of the brood year and is linked to the development of the Integrated Fisheries Management Plan
- Potential new enhancement projects can be brought to the attention of DFO Area Staff and SEP Community Advisors, who will assist in their evaluation
  - When considering new production defining the objective is important. DFO Area staff can work with groups to determine if DFO-SEP can achieve the enhancement objective while meeting policies, legislation, guidelines, and regional priorities

Next Steps – 2020 Enhancement Proposals

- DFO-SEP is only considering increased production for 2019 out of Chilliwack hatchery
  - Other populations may meet one or more stock selection criteria but none meet all the criteria to the same degree
- Recommendations from the Prey Availability TWG for SEP or SEP-supported hatchery enhancement will be considered in SEP's 2020 production planning process and reviewed in the 2020 salmon Integrated Fisheries Management Plan

Questions?

Alternative Release Strategies: Examples

- Cheakamus: Fed Fry vs Smolt 1+
  - Early results show Smolt 1+ program have older age-at-return, and higher exploitation rates
- Capilano River Release vs. Seapen
  - First three years of returns show inconsistent survival rate results, and seapen fish for 3x more likely to stray
- Shuswap: Smolt 0+ vs Smolt 1+
  - Fish health concerns resulted in this program being terminated after 4 years
  - Initial returns indicate Smolt 1+ survival rates were no better than the Smolt 0+ release
- Big Qualicum Hatchery: Delayed Release
  - Only 2 years of returns, preliminary results are very promising, indicating a higher survival rate

Alternative Release Strategies - Seapens

- Seapens reduce mortality associate with freshwater out-migration, enabling juvenile salmon to acclimate to saltwater in controlled conditions
  - For certain stocks (not all) this strategy results in increased survival rates
- Seapen reared salmon do not imprint on their natal stream as well as river release strategies, resulting in higher stray rates
  - This has negative implications for neighbouring wild stocks
  - Seapen placement is critical