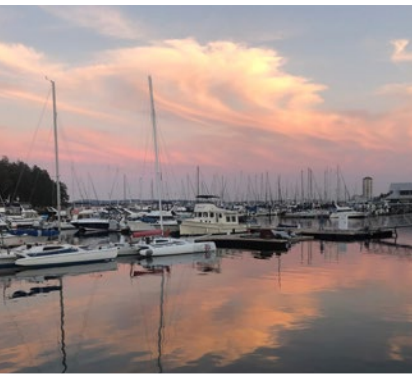
PACIFIC SALMON FOUNDATION



COMMUNITY HATCHERY INTERVIEW REPORT

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EXECUTIVE SUMMARY

The British Columbia Salmon Restoration and Innovation Fund (BCSRIF; Project Number BCSRIF-2019-136) awarded the Pacific Salmon Foundation (PSF) funding to support an independent assessment of Salmonid Enhancement Program (SEP) hatchery program effectiveness. Two of the goals of this assessment were to: a) evaluate the effectiveness of hatchery facilities (including major operations, community hatcheries and spawning channels) and b) develop recommendations and guidelines to assist SEP programming, infrastructure investments and incorporation of methodologies, strategies and tools to increase effectiveness in major and community hatcheries.

Community Involvement Program (CIP) hatcheries provide volunteer-led environmental stewardship, education, and economic development via hatcheries and community engagement. As part of the PSF assessment, a review of CIP hatcheries was conducted to determine how best to support these programs and improve their effectiveness where necessary.

The objectives of the CIP hatchery review were to:

1. **Summarize the practices, hatchery needs and goals, challenges, and opinions from a subset of CIP hatcheries including Community Economic Development Program (CEDP), Designated Public Involvement Facility (DPI), and Public Involvement Program (PIP);**
2. **Determine each hatchery's objectives and evaluate the success of each hatchery at meeting its objectives;**
3. **Produce a list of recommendations based on the interviews to increase the effectiveness of CIP hatcheries (where necessary).**

This review was initiated through interviews with DFO's Community Advisors (CA) across the province and their guidance was used to create a list of CIP hatcheries to include. Information was then collected by interviewing community representatives managing 32 hatcheries with a standardized set of questions. The information was collated, summarized, and subsequently categorized to translate over 80 hours of interviews.

A summary of needs was completed for each hatchery and common challenges were identified. Over 70% of hatcheries stated that their current funding was insufficient, with many others identifying issues with data feedback, water, and communication with DFO. We also included information on additional programs and experiments that the hatcheries would like to conduct in the future, underscoring the willingness of many facilities to improve and adapt.

From the data collected and suggestions taken directly from the interviews, a list of recommendations was created. For DFO, we suggested that they: improve funding, support staff availability and communication; update technology and data sharing and revise current practices. There is an essential need to improve the capacity of these hatcheries for marking and monitoring. Without this investment, these community groups can not follow certain management practices since they can not identity hatchery-produced fish, and their effectiveness in terms of fish production and/or cost-benefits can not be quantified. For hatcheries we suggested they ensure compliance with stated Best Management Practices; but looking to the future, there is also need for development of staff recruitment and training in their communities.

We believe that these recommendations address the common concerns presented by hatchery participants and provide a basis for reform and refinement to improve the effectiveness of the CIP. This report serves as a snapshot of the status of CIP hatcheries at the time of interviews, fall 2021, and a basis for future program improvement.

KEY FINDINGS

DEVIATIONS FROM PRODUCTION PLAN

- While not numerous relative to the large number of annual release projects, there are a number of situations reported where there are deviations from the approved Production Plan. It appears that many of these are minor and/or unavoidable. However, some of these deviations may be more significant and it is unclear as to whether they are approved or supported by DFO; these deviations may have the potential to result in unintended negative consequences.

DEVIATIONS FROM BEST MANAGEMENT PRACTICES (BMPS)

- **Broodstock origin:**
  - Most CIP facilities do not apply external marks that enable identification of hatchery-produced salmon (i.e., adipose clipping) during brood collection. Other marking from thermally marked otoliths, parentage-based tagging (PBT) and coded wire tags (CWT, without adipose clips) are not useful during broodstock collection as they require processing after broodstock collection.
  - Thus, many community hatcheries are unable to distinguish hatchery fish from wild fish. This prohibits meeting Best Management Practices defined by SEP and may result in effects to the genetics of local salmon population.
  - Participants reported use of hatchery fish in broodstock to meet their egg targets and some reported using hatchery fish to minimize loss of returning wild fish.
  - A review of broodstock collection guidelines and practices is merited as repeated use of these excepts will increase the risks of genetic change in natural fish.

- **Collection Methods:**
  - Two facilities mentioned snagging fish with treble hooks, equipment specifically prohibited by the BMPs, to collect adult fish from redds (spawning nests of salmon). This was explained as a way of targeting ripe fish when the water was too high for other methods.

- **Fertilization:**
  - Many participants emphasized the importance of achieving high spawning success (high fertilization rates), as this reduced concerns related to achieving egg targets, but few noted the genetic impacts of their spawning protocols.
  - Some hatcheries used bulk fertilization or high male to female ratios for pink and chum salmon. Such spawning practices are contrary to SEP's spawning guidelines.
  - One participant mentioned that they selectively bred larger fish together. This is not a recommended practice but may merit future study.

- **Biosecurity:**
  - The standards from the BMPs state that all eggs should be disinfected with Ovadine™ to reduce the risk of vertical diseases transmission and does not provide any exceptions. However, one facility said that they believed Ovadine™ hardened the eggs and have been choosing not to disinfect their eggs in recent years with no perceived detriment to their fish.
  - Several facilities mentioned using disinfecting footbaths at certain locations in their hatcheries, but many did not.

- **Marking and Tagging:**
  - When adipose clipping, tricaine methanesulfonate (TMS) was often mentioned as the anaesthetic of choice; but some facilities reported using clove oil. The BMPs state that clove oil is a known carcinogen and is not approved as a fish anaesthetic.
  - According to SEP (2019), all Southern BC coho released for harvest objectives should have PBT (Parental-Based Tagging, a DNA recognition tool) and be adipose clipped, however this was not the case. Several facilities in Southern BC are currently releasing all their salmon unmarked, including coho.
  - Marking/tagging is not widely applied to Public Involvement Projects and prohibits recognition of hatchery vs wild fish in broodstock collections, and severely limits any evaluation of the PIP program. Marking is better in the Community Economic Develop Program but exceptions exist here also.

HATCHERY OBJECTIVES

- Hatchery interviewees rarely used the same nomenclature, even when discussing production objectives, making comparison of objectives challenging.
- Many facilities said that their objective was to enhance local systems or to provide fish but did not identify a specific objective. The general objective 'to enhance local populations' could be interpreted to be consistent with objectives for harvest and/or rebuilding; however, supporting harvest and supporting rebuilding are not the same thing. A lack of clarity on the objective can lead to misunderstanding, mismatches of expectations, and has the potential to lead to unintended consequences.
- There also were numerous non-alignments in the understanding of the education and stewardship objectives. This is not likely to be a significant risk factor in terms of hatchery operations, but there may be value in more consistent interpretations between DFO and community hatcheries in how these categories should be defined and assessed, allowing for consistency and comparability across the community hatchery system.
- Participants frequently identified additional stewardship activities that demonstrate the diversity of activities conducted by community projects. Valuable contributions from these communities but not accounted for in any evaluation of effectiveness.
- Overall, we found that there are some notable differences in the understanding of the objectives for community hatcheries between DFO and the community hatchery operators, and many cases where the objectives noted in the Production Plan were not in accord with those reported by the community hatchery operators.

ACHIEVEMENT OF OBJECTIVES

- Without formal criteria for assessment, it is challenging to determine whether the hatcheries are meeting their objectives.
- The majority (22 of 32) of hatcheries we assessed had a stewardship objective specified in the Production Plan. All hatcheries with this objective did some form of stewardship activities but some did more than others.
- To assess the effectiveness of hatchery production for harvest, rebuilding, or conservation, hatchery-produced fish must be identifiable. Based on the releases of salmon in 2021 from the interviewed facilities, only 16% of release groups from Public Involvement facilities and 24% of CDP facilities applied external marks that would enable identification. The majority of the marking was applied to yearling coho smolts.

- Marking of Chinook and chum salmon was very limited in the 2021 releases. Based on release groups defined by species and release stage, there were zero of 18 groups in the PIP facilities and only 6 of 66 groups in the CDP facilities. The latter includes two hatcheries identified as Chinook indicator groups for regional stock assessment.
- To determine if rebuilding is occurring due to hatchery contributions or due to increase in natural abundance caused by other factors, it is necessary to distinguish between and monitor the returns of hatchery and wild fish. Given the above comments, there are numerous situations where the contribution of hatchery fish to rebuilding cannot be determined.
- There was only one hatchery out of the 32 included that had conservation as the primary objective, and releases were tagged with PBT in that facility.
- Some of the hatcheries interviewed conducted no form of marking or tagging on any of their fish released. Most of these facilities were in the BC North Coast region, and they all released coho.
- According to SEP (2019), all Southern BC coho should have PBT and be adipose clipped however this was not the case.
- Most of the hatcheries that do not mark, or tag fish cited a lack of funding as the main limitation. These activities can be cost and resource intensive, but the data captured are invaluable for hatchery programs. Some of the hatcheries noted they would be interested in implementing such programs but this would require additional resources and funding.
- While not used as an evaluation measure, we were interested in the 'most significant contribution' attributed to each community hatchery program interviewed. Each hatchery manager and CA were asked to define their hatchery's most important contributions (MIC) to their local community and watershed. Frequently, the top MIC differed between the hatchery and CA answers indicating that there were different perceptions on the relative value or benefit of the hatchery between DFO and the hatcheries.

NEEDS SUMMARY

- Funding was the most common challenge for the included CIP hatcheries with 72% of facilities stating that level of funding was a significant problem. The other three commonly cited challenges included a lack of feedback from data submitted to DFO (44%), difficulty with water (temperature, amount, etc. 31%), and poor communication with DFO (22%).
- The Needs Summary also highlights that DFO capacity is limiting from a community hatchery perspective. Support from SEP technical staff is generally considered insufficient and technical support for community hatcheries is inconsistent and variable.
- Training opportunities for community hatcheries are not meeting the needs of the facilities. For example, fish health training is offered for major operations facilities but not for community programs.
- Many community hatchery representatives expressed that they feel under-appreciated. There were many comments that the hatcheries had good relations with their CA but felt that more senior DFO people did not understand or appreciate their work leading them to feel that DFO overall was not recognizing, supporting and valuing their volunteer work.
- There were several concerns raised about DFO's reliance on antiquated data management technology and interviewees suggested this reduced effectiveness at different levels. There were also concerns regarding receiving timely responses on data submitted to DFO. Several hatcheries were frustrated with the lack of information returned to them after submitting data.
- Interviewees had many suggestions for specific ways that data sharing could benefit their practices, almost all of which would require some form of updated technology.

ACRONYMS

ATUs ..... Accumulated Thermal Units
BKD ..... Bacterial Kidney Disease
BMP ..... Best Management Practices
BC ..... British Columbia
BCSRIF ..... British Columbia Salmon Restoration and Innovation Fund
CA ..... Community Advisor
CEDP ..... Community Economic Development Program
CIP ..... Community Involvement Program
CWT ..... Coded Wire Tag
DFO ..... Fisheries and Oceans Canada
DPI ..... Designated Public Involvement Facility
FSC ..... Food, Social and Ceremonial
IFMP ..... Integrated Fisheries Management Plan
INT ..... Interior (region)
LFR ..... Lower Fraser River (region)
MIC ..... Most Important Contribution
NC ..... BC North Coast (region)
PAR ..... Pacific Aquaculture Regulation
PBT ..... Parentage-based Tagging
PIP ..... Public Involvement Program
PIT ..... Passive Integrated Transponder
PNI ..... Proportionate Natural Influence
PSF ..... Pacific Salmon Foundation
SEP ..... Salmonid Enhancement Program
SC ..... BC South Coast (region)
TMS ..... Tricaine Methanesulfonate

Photo by: Benjamin Fortini

INTRODUCTION

Discussions about the use of salmon hatcheries and differences between hatchery and wild salmon have existed for a long time in British Columbia, and the issue of hatchery effectiveness is increasingly topical. In light of this context, there is value in analysis of current salmon enhancement to inform ongoing operations and future investments.

The Pacific Salmon Foundation was provided a grant under the BC Salmon Restoration and Innovation Fund to undertake a science-based review of hatchery results in the DFO Pacific Region including community hatcheries and major facilities operated by DFO. This review is intended to guide and improve program effectiveness, as well as provide factual data that will aid in dealing with requests for new or different production.

PSF organized the overarching review into three components:[1]

1. **Reviewing cutting-edge research and molecular tools to better understand and improve the survival of hatchery-reared salmon in the future;**
2. **Evaluating hatchery release strategies used in past years and the resulting marine survival of hatchery-released salmon; and**
3. **Studying the effectiveness of hatcheries and interactions with wild Pacific salmon populations across BC**

Component 3 has been further broken down into five sections:

1. **Systematic literature review**
2. **Role of community hatcheries**
3. **Trends in biological traits**
4. **Hatchery effectiveness**
5. **Hatchery-wild interactions**

This report addresses the second part of component 3 – the role of community hatcheries. In BC, the federal Department of Fisheries and Oceans (DFO), runs "major" salmon enhancement facilities that account for the majority of salmon hatchery production. However, there are also a significant number of "community" hatcheries that are also important contributors to salmon enhancement. The "major" facilities run by DFO, and the "community" hatcheries have some notable differences in factors such as scale, operating capacity, resources, etc. so we have separated the review of the "community" hatcheries from the "major" facilities in recognition of those differences.[2] The information from this report will be incorporated into our overall comprehensive review.

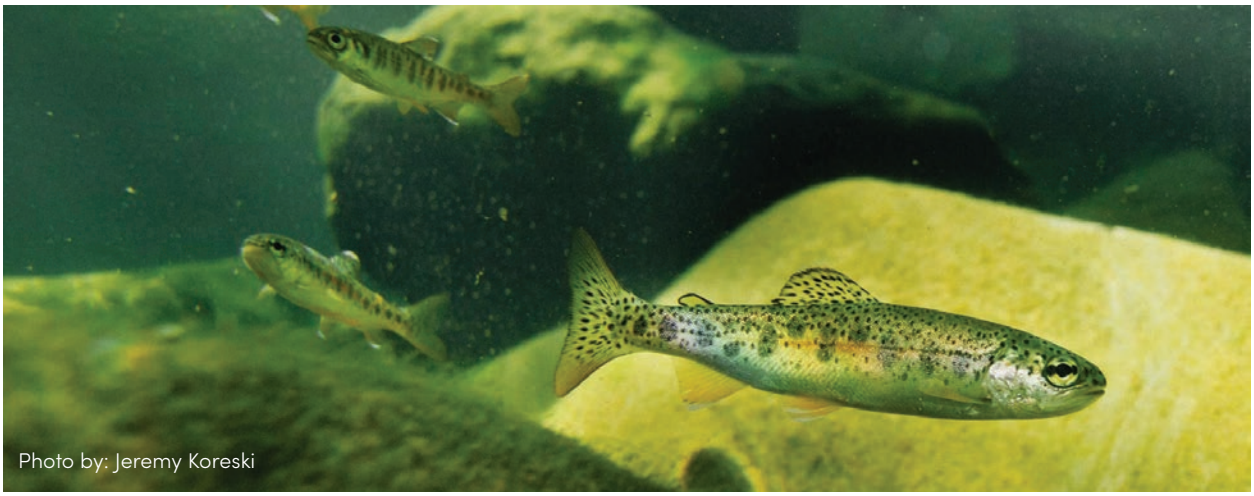

Photo by: Jeremy Koreski

1. All components of this comprehensive review are available as reports at www.marinescience.ca/hatchery-effectiveness/reports-and-products/
2. There are a small number of hatcheries in BC and Yukon that are not funded or operated by DFO. These hatcheries are not included in this review (e.g. Yukon Energy – Whitehorse Rapids hatchery, Percy Walkus Hatchery, ONA Hatchery).

Pacific salmon are one of the most prolific and important marine resources in British Columbia. Almost 10,000 spawning populations of Pacific salmon have been identified in British Columbia, with population sizes ranging from a few fish to several million (Slaney et al. 1996). They occur in over 1,000 rivers in BC and Yukon, with approximately 75% of salmon production coming from the Skeena, Nass, and Fraser Rivers (DFO 2021a). As a way of bolstering this resource, Canada has a long history of using artificial culture and habitat restoration (enhancement) to manage Pacific salmon stocks. From 1894 until 1938, sockeye salmon were enhanced by placing eggs or fry into lakes but this had few demonstrable results (Mackinlay et al. 2004). After years of planning and consultation, the Salmonid Enhancement Program (SEP) was initiated in 1977 by the Department of Fisheries and Oceans Canada (DFO) (Larkin 1974, Pearse 1994). When SEP was established in 1977, the ultimate objective was doubling the commercial catch of Pacific salmon (DFO 2009). Later, SEP evolved to include conservation and habitat restoration, and priorities shifted towards restoration of depressed coho and Chinook stocks (Pearse 1994). Most recently, SEP is guided by four immediate outcomes (SEP 2018):[3]

- Enhanced salmon support harvest,
- Enhanced salmon support stock recovery, rebuilding and assessment,
- Restored habitat and community stewardship support salmon sustainability, and
- Partnerships and volunteerism support salmon rebuilding and stewardship.

SEP uses various methods such as spawning channels, habitat restoration, freshwater enrichment, and hatcheries to increase the production of Pacific salmon. Of the SEP owned, operated or supported hatcheries, over 80% of the projects are run as community involvement programs. These community-based hatcheries produce approximately 26% of all salmon release targets from hatcheries in British Columbia, excluding spawning channels that would numerically overwhelm releases from hatcheries. Figure 1 is based on juveniles released in 2021 and is based on SEP's 2019 and 2020 Production Plans.

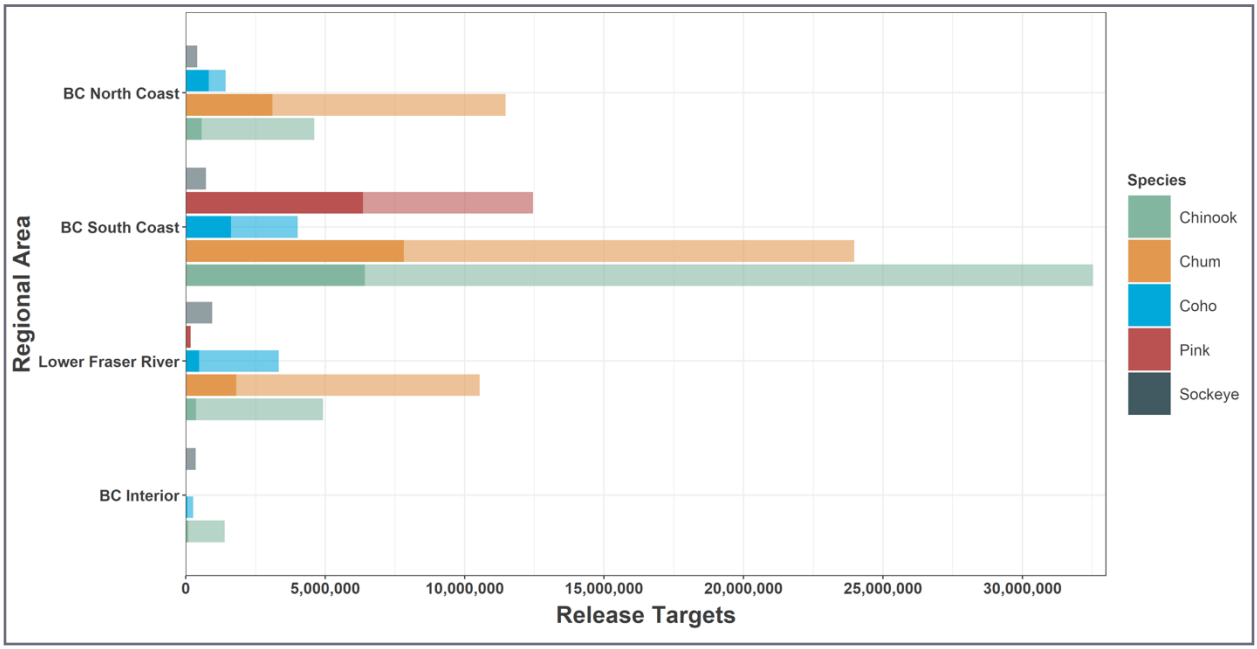

Figure 1: Primary target releases from the 2019 (yearling fish released in 2021) and 2020 (under-yearling fish released in 2021) Production Plans.

All spawning channel releases (plus Natural Emerging, and Eggs) in these Plans were removed as they overwhelm the numbers for the other species. The darker bars represent community hatchery (CEDP, PIP, DPI) target releases and the lighter bars represent the total releases from all hatcheries (includes community hatcheries plus the DFO operated major facilities).

3. https://waves-vagues.dfo-mpo.g.ca/Library/4074016x.pdf

THE SEP COMMUNITY INVOLVEMENT PROGRAM (CIP)

The SEP Community Involvement Program provides resources (e.g. funding, equipment), expertise, and support to community organizations for the stewardship, restoration and enhancement of salmon in BC and the Yukon. This work is supported by 15 DFO Community Advisors stationed throughout the DFO Pacific Region, and a small team of centralized technical and support staff at DFO.

There are two primary hatchery components in the current Community Involvement Program (CIP): the Community Economic Development Program (CEDP), and the Public Involvement Program (PIP). These designations are carryovers from the earlier days of SEP, when the objectives and priorities were different than currently. These titles may not be particularly meaningful in today's context, but the designations remain, largely for administrative reasons. To generalize, the CEDP hatcheries tend to be larger and have more production than the PIP hatcheries. Many of the CEDP programs involve and are operated by First Nations but this is not always the case.

COMMUNITY HATCHERY FUNDING

Funding for the CIP hatcheries has been provided through contracts since SEP's inception in 1977. Contracts were the preferred method of funding as they ensure that the operators of each hatchery meet the necessary requirements to continue receiving financial support while also placing the responsibility of insurance, operations, and land-use on the hatcheries (DFO 2009). Contracts provide regular funding year to year which is intended to allow these community hatcheries to execute consistent programs. The CEDP group of hatcheries currently receives a yearly allocation of $3,340,0004 which funds 17 hatcheries. Individual facilities typically receive a yearly allocation of $50,000 – $200,000 to run their hatcheries and are intended to help restore depleted salmon while also supporting communities with investment and employment opportunities (DFO 2019). The DPI/PIP funds 126 projects with $540,000[4]. In addition to contracts from SEP, many CIP hatcheries receive funding and support from their local communities, increasing capacity and enabling delivery of additional programs. This external fundraising is the responsibility of the local hatchery operators and varies significantly depending on location and staff.

COMMUNITY HATCHERY GUIDANCE, OVERSIGHT AND OPERATIONS

Community hatchery operations are guided by a set of Best Management Practices (BMP, SEP 2016[5]) and annual Production Plans. The Production Plans set levels of juvenile production and the BMPs provide guidance for each step of rearing until release. The Production Plan also specifies objectives for each line of production that must correspond with SEP objectives (Conservation, Rebuilding, Assessment, Harvest, Stewardship, and Education). Additionally, the Production Plan includes primary and alternate production targets, the former being production that occurs yearly unless issues arise and the latter as a contingency to replace other lines of production if necessary. DFO's Community Advisors act as the liaison between SEP and the community-based programs, plus there are DFO-SEP staff that provide expertise to support community hatcheries and participate in data management and production planning for facilities in their area.

Photo by: Benjamin Fortini

4. These amounts come from SEP Contribution Agreements for the 2019 – 2020 fiscal year.
5. https://publications.gc.ca/collections/collection_2016/mpo-dfo/Fs144-43-2013-eng.pdf

Community hatcheries are important in their local community province-wide and contribute to other community activities than just fish production. Community hatcheries are often focal points for community stewardship, education, engagement, habitat restoration, monitoring and other activities that connect community directly to Pacific salmon. Canada's Wild Salmon Policy, which guides the protection and conservation of Pacific salmon, advocates for developing community involvement, habitat restoration and rebuilding in priority areas, all of which are functions of CIP hatcheries (DFO 2005a). There is substantial public support for activities carried out by community hatcheries such as volunteer-led environmental stewardship, education, and economic development via hatcheries (DFO 2009). "There is little danger that a vigorous program will lack the element of public interest that is the vital prerequisite of public participation. It is hard to imagine otherwise." Larkin accurately predicted over 40 years ago (Larkin 1974). The CIP has generated a great amount of public interest, demonstrated by the approximately 2000 volunteers and 145 thousand hours volunteered at community hatcheries (DFO 2019). This public interest is an invaluable benefit from community involvement projects, as it leads to engagement and public understanding, and builds local support for the conservation and future sustainability of salmon.

However, the dependence on community support, both in volunteering and in financial contributions, has put some of these programs' existence at risk. Concern has been expressed about continued participation of volunteers as dependence on their engagement and economic pressures increase.

REGULATION OF COMMUNITY HATCHERIES

The salmon production for each hatchery is specified in the Production Plan, which may be adjusted over time depending on local salmon needs and priorities. These Production Plans are used by DFO as the basis for a Pacific Aquaculture Regulation (PAR) licence for each project. Under the Fisheries Act (2018), all salmon hatcheries in BC require a PAR licence to operate.

The Production Plan is determined through an integrated planning process and sets upper bounds for target levels of salmon releases from each hatchery; however, these targets are not always met. DFO collates annual releases for each hatchery by species, location and life stage, and reports releases annually in the Post-Season Production Tables as part of the annual Integrated Fisheries Management Plan.

In addition to requiring PAR licences, each hatchery must also be licenced under the BC Water Sustainability Act for water use (surface water and ground water), and to discharge effluent. The entities that hold the water licence for each hatchery vary, and can include local landowners, DFO, or a local community organization.

Photo by: Benjamin Fortini

PURPOSE AND OBJECTIVES OF THIS REPORT

We are fast approaching the long-term 50-year time horizon for evaluating enhancement technologies as suggested by Hilborn and Winton (1993). More recent evaluations have also concluded that there is a need for a thorough assessment of hatcheries in BC (Riddell et al. 2013). Further, to our knowledge there are no published reviews of the SEP supported community hatcheries (A. Silverstein pers. comm. 2022). Consequently, the Pacific Salmon Foundation, based on their extensive experience working with community salmon projects since 1989, and their recent research on juvenile salmon survival in the Salish Sea Marine Survival Project (www.marinesurvivalproject.com), proposed an independent, science-based review of hatcheries in Canada's SEP. The study was funded by the British Columbia Salmon Restoration and Innovation Fund (Project Number BCSRIF-2019-136). As noted in the Introduction section of this report, this study focuses on the Community Involvement Program (CIP) hatcheries funded and/or supported by DFO's Salmonid Enhancement Program.

The review of CIP facilities was done through interviews with 32 different hatcheries across the province (Appendix 1). Our objectives were to:

1. Summarize the hatchery practices, needs, goals, challenges, and opinions from a subset of CIP hatcheries including CEDPs, and PIP (includes DPIs);
2. Determine each hatchery's overall goals and evaluate the success of each hatchery at meeting its objectives (note that each hatchery has fish production objectives that may vary over time but also have stewardship and education objectives specific to a community);
3. Produce a list of recommendations based on the interviews to make CIP hatcheries as effective as possible.

This work was done to determine how best to support community hatchery programs in the future to achieve their goals of stewardship, stock assessment, salmon enhancement, and community-based habitat restoration (Government of Canada 2021).

METHODS

INTERVIEW PARTICIPANTS

As noted earlier in this report, community hatcheries are supported by SEP Community Advisors. All Community Advisors were contacted via email or phone and 14 of the 15 CAs in British Columbia were interviewed (Appendix A2). Due to changing scope in the initial stages of the project, one CA was not interviewed.

The CAs that were interviewed recommended a list of 35 hatcheries in the CIP to include in this review. No concrete criteria for inclusion were provided to the CAs and choosing which hatcheries from their area to include was ultimately up to them. Of the initial 35 hatcheries recommended by the CAs, participants from 32[6] were interviewed and included (Appendix A3). The location of hatcheries interviewed is presented in Appendix A4. Of the remaining three community hatcheries included in the initial list, one (Deep Cr, Kitsumkalum River) is not operated by SEP and was excluded, while the other two (Little Campbell R, Kennedy R) had unforeseen circumstances arise that prevented an interview from occurring during the allotted period.

6. The number of projects involved is a reasonable sample of the CIP hatchery projects. Interviews included 79% of CDP projects contributing to releases during 2021, and 36% of the PIP projects. The count of PIP projects excluded the many small school projects. These values were extracted from the 2021 Post-season summary from SEP.

STRUCTURED INTERVIEW PROCESS

Structured interviews were conducted with the understanding that they would best enable data to be collected at the required level of resolution, and in a similar manner from all participants. It also was important that participants were able to clarify if questions were not well understood; participants came from a wide variety of backgrounds in work experience and education and likely would not all interpret questions in the same way. The structured interviews were also accessible from a technological standpoint because, at minimum, all that was needed was access to email (for the questions and other materials) and a phone. We also hoped that personal interviews would allow for sensitive and more candid information could be provided. Structured interviews were used for both CA and hatchery/community staff, and each utilized a specific list of questions (Appendix B1 for CA interview questions, Appendix B2 for Hatchery interview questions).

Community Advisor Interviews

Each CA was provided the questions for their interview and the questions for the hatchery interviews prior to the meeting. The interviews were conducted by Zoom video calls from June – September 2021. On average, the CA interviews took just under two hours. At the onset of the conversation, each CA was asked which community hatcheries in their area should be included in the review. Once the list was determined, a standardized set of questions was asked sequentially about each included hatchery. The questions were created to gather background information to provide context for the subsequent hatchery interviews as well as to collect data that may not be available to the hatchery staff. Some questions also served as a means of comparison to determine if there were any discrepancies in responses between the CA and the hatcheries in their area. Each interview was recorded, and notes were taken during the interview for later reference.

Hatchery Interviews

Following each CA interview, each hatchery participant was emailed three documents which provided the list of interview questions, a privacy and data use statement, and a summary of this project (Appendix B2: Hatchery interview questions Appendix B3: Privacy and data use statement, Appendix B4: Project summary provided to each participant). The interviews were conducted either by Zoom video call, phone call, or in-person meeting over a seven-month period from July 2021 until January 2022. On average, the hatchery interviews took about an hour and a half. Following the first month of interviews, revisions were made to the questionnaire to clarify and better organize the questions. Some participants provided written answers within the interview questions document prior to the interview and were only asked follow-up questions necessary to complete the document. Some participants, who had been previously included in an earlier hatchery review conducted by PSF, were asked an amended list of questions as some information was already available from the initial interviews. Each interview was recorded, and notes were taken for later reference.

In-person Hatchery Visits

In November of 2021, select hatcheries were visited in-person. The choice of hatcheries to visit was made by the project lead and senior PSF staff with the intention of **a)** capturing a diversity of CIP facilities, **b)** attending hatcheries that had not completed online interviews, and **c)** following a logical route. The final itinerary included nine community hatcheries that ranged significantly in their capacity and operations (Appendix A3). Although a visit was planned, Four Mile Creek was not visited due to inclement weather causing unsafe driving conditions. The majority of the hatchery participants had been interviewed remotely prior to the visit but both the Seymour R Hatchery and Nanaimo R Hatchery managers had not yet participated and were therefore interviewed during their respective visits. The visits included tours of the facilities and hands-on involvement in certain facets of hatchery operations. The in-person visits allowed for greater understanding and provided important personal perspective.

DATA ANALYSIS

Due to the number of interviews conducted and the resources available, the interviews were not fully transcribed. Instead, notes were taken during the interviews and revised and amended post-interview from the recording when necessary. These notes were reformatted into Excel spreadsheets and subsequently coded into categories. This categorization was implemented so that data could be more easily compared and summarized. Data on release targets collected during interviews were compared to those listed in the 2019 (for yearling smolts) and 2020 (for all other targets) Production Plans (DFO 2021a). Release and transfer targets were taken from the "Release/ Transfer Stage" column of the Production Plans (Excel files). Releases were later modified as specified in Deviations from Production Plans. Comparison of the categorized data and visualization was done using R version 4.0.4 (R Core Team 2021).

METHODOLOGICAL CONSIDERATIONS

Interview Response Bias

One possible limitation of the project is that CA and hatchery staff may overly emphasize certain aspects of their programs and underreport others. This may be shaped by their assumptions about PSF or concerns about what information may be shared more widely. As mentioned above, the participants were from a wide variety of backgrounds and interpretation of the questions varied. When confusion about questions arose, the interviewer offered clarification by rewording questions and providing examples of other participants' answers. Providing examples was used to better explain questions but may have unintentionally introduced bias through suggestion. Best efforts were made to control for these potential biases by having a structured list of interview questions that were asked sequentially and as consistently as possible.

Photo by: D. Swainson

RESULTS

The following information provides a snapshot of current practices within the interviewed CIP hatcheries at the time of the interview in fall 2021. This provides context for the recommendations that follow and summarizes information and practices. A comprehensive report of the data collected during the interviews is provided in Appendix C.

DEVIATIONS FROM PRODUCTION PLANS

There were 22 cases where information about community hatchery releases provided by the community hatchery interviewees conflicted with those stated in the 2019 and 2020 Production Plans (Table 1). Specific release numbers were not asked of the hatcheries and so were not compared. Comparisons were only made for the planned and actual release by project, species and life stages. Some hatcheries explained that the release targets served as a maximum target that was not always met, especially in areas where broodstock collection was challenging. Additional information was provided by the CA interviews and CAs and hatchery managers were directly contacted if discrepancies could not be otherwise resolved. More detailed information about deviations can be found in Appendix C: Interview Results.

Table 1: Deviations from the 2019 and 2020 Production Plan primary release life strategies.

Note: If it was not specifically stated there was a deviation from the stated release life stage, "None" was used for the actual life stage released.

Hatchery	Region	Production Plan Release	Actual Release	Explanation
ALLCO Hatchery	LFR	Sockeye Fed Fry	None	The release was proposed but not conducted.
ALLCO Hatchery	LFR	None	Pink Unfed Fry	Included in interviews (and on the 2021 Production Plan)
Cowichan R Hatchery	SC	Chinook Smolt 0+	Chinook Fed Fry	Released smaller fish to reduce potential for competition with wild fish
Fanny Bay Hatchery	SC	Pink Unfed Fry	None	Historically supplied by Quinsam but no releases in this brood year
Grist Goesen Hatchery	LFR	Coho Unfed Fry	Coho Fed Fry	Hatchery coordinator and CA confirmed fed fry release
Gwa'ni Hatchery	SC	Pink Unfed Fry	None	Not very abundant and resource dependent (Nimpkish River)
Hartley Bay Hatchery	NC	Chum Fed Fry	None	Difficulty with broodstock collection
Hartley Bay Hatchery	NC	Coho Smolt 1+	None	Insufficient water for summer rearing
Klemtu Hatchery	NC	Coho Fed Fry	None	Manager and CA only mentioned releasing coho from seapens
Marble River Hatchery	SC	Coho Smolt 1+	None	Have not released coho in many years
McLoughlin Hatchery	NC	Chum Seapen	Chum Fed Fry	Seapens have been decommissioned
McLoughlin Hatchery	NC	Coho Seapen 1+	Coho Smolt 1+	Seapens have been decommissioned

Hatchery	Region	Production Plan Release	Actual Release	Explanation
Nanaimo R Hatchery	SC	Chinook Unfed Fry	None	Error on the Production Plan (confirmed with DFO)
Nanaimo R Hatchery	SC	Pink Unfed Fry	None	All pink are released from seapens
Oldfield Cr Hatchery	NC	Chum Fed Fry	None	Suspended until incubation recirculation is fixed
Seymour R Hatchery	LFR	None	Pink Unfed Fry	Included in interviews (and on 2021 Production Plan)
Spruce City Hatchery	INT	Chinook Smolt 0+	None	All Chinook released as fed fry
Spruce City Hatchery	INT	Pink Unfed Fry	None	Only releasing Chinook
Tahsis Hatchery	SC	Chinook Smolt 0+	None	Only releasing Chinook from seapens
Thornton Cr Hatchery	SC	Coho Smolt 1+	None	Difficult to justify keeping staff over the summer for a small release target
Tofino Hatchery	SC	Chinook Seapen 0+	None	Seapens were last operational in 2009

Given that there are 290 individual projects (species, life stage, location) in the 2021 release records, these few deviations indicate a very low error rate and strong coherence between SEP regional planning and the conduct of these projects. However, some of the reported deviations may be significant and could result in unintended consequences.

DEVIATIONS FROM BEST MANAGEMENT PRACTICES

The CIP BMPs provide a comprehensive outline on each step of the rearing process for community hatcheries (SEP 2016). This allowed us to compare current practices based on data gathered from the interviews to BMP. The deviations below are intended to highlight discrepancies so that they may be addressed.

Broodstock Origin

Many of the hatcheries expressed interest in protecting wild fish during brood collection but some were seemingly misinformed on how best to achieve that. Genetic impacts on wild populations are an important consideration for hatchery projects and they can be partially mitigated with appropriate broodstock collection (Flagg et al. 2000). Hatchery-origin broodstock may not represent the gene pool of the wild population, and selecting them as broodstock may impact the future genetic diversity of the local population (Doyle et al. 2001). The vast majority of hatcheries either prioritized using wild fish or used them exclusively, following the BMPs. The hatcheries that were able to distinguish the origin of their fish could only do so with coho or Chinook (both species for Toboggan Cr and Tofino) because they are the only species that are externally marked for hatchery assessment at the included facilities. Only 3 of the interviewed hatchery projects (Cowichan, Toboggan Cr, and Tofino) noted that they could identity hatchery-produced Chinook and coho salmon during broodstock collection (Table 21) and another 11 projects could identify coho salmon during brood collection; but the latter is associated with the mass-marking of coho salmon for mark selective fisheries and provided the added benefit to identify hatchery coho during brood collection. Overall, given that these facilities will deal with Chinook,

coho, and chum salmon, Table 21 indicates that a minority of facilities could identify first generation hatchery produced adults from wild adults. This depended entirely on external marking (i.e., adipose clipping), as results from thermally marked otoliths, parentage-based tagging (PBT) and coded wire tags (CWT) are not available before brood is collected and fertilized. Some participants explained that although wild fish were preferred, hatchery origin fish were sometimes taken so they could meet their egg targets. There were exceptions to this. One hatchery member explained that they took all returns regardless of origin due to difficulty collecting sufficient broodstock while another stated that they actually prioritize using hatchery fish because they want to kill fewer wild fish that have returned to spawn. In specific cases, hatchery origin fish may be used proportionately to capture rates but there are no circumstances mentioned in the BMPs where solely using hatchery fish is recommended. The limitations to identifying hatchery produced fish in broodstock collection is a significant limitation to meeting BMPs, particularly when restoring depressed populations of salmon.

Collection Methods

Almost all brood collection methods mentioned in the interviews were consistent with the BMPs but methods vary depending on location, access, and river conditions. Some hatcheries stated that they have needed to change methods due to changing flow conditions in their systems. One hatchery explained that they have switched to using a fence instead of more intensive in-river collection due to an aging volunteer population. Many facilities use a combination of methods which allows for broodstock capture in different areas and during different river conditions. The only method of collection mentioned that deviated from the BMPs was snagging. Two facilities mentioned using treble hooks, equipment specifically prohibited by the BMPs, to snag adult fish from redds. This was explained as a way of targeting ripe fish when the water was too high for other methods but fails to consider the wellbeing of the salmon, especially those that are not successfully retrieved. Methods for brood capture that cause undue stress, particularly snagging, should be avoided to prioritize fish welfare and to promote successful offspring as directed by the BMPs.

Fertilization

Many participants emphasized the importance of spawning success, particularly in cases where they had limited egg targets, but few mentioned any consideration of the genetic impacts of their spawning protocols.

Based on the BMPs, 1 male to 1 female spawning is the recommended method of fertilization but 2 to 1 (using two separate males to fertilize one female) and matrix spawning (subdividing eggs from multiple females and fertilizing each lot with a male in a matrix design) are also acceptable in specific cases. The most common methods reported were either a 1:1 or 2:1 males per female. When using 2M:1F, many hatcheries described a situation where Female A would be fertilized with Male A and B and Female B would be fertilized with Male B and C and so forth. This was explained, by participants and in the BMPs, to be a way of ensuring fertilization in case a milt sample was infertile or contaminated. Some hatcheries used bulk fertilization or high male to female ratios for pink and chum salmon. They explained that eggs were going to be combined for incubation regardless and bulk fertilization was less time consuming (the eventual mixing of eggs for incubation is irrelevant how eggs are fertilized)

Combining milt prior to fertilization substantially reduces the number of effective breeders and can inadvertently select for certain life history traits (Withler and Beacham 1994, Campton 2004). Reducing effective breeders leads to less diverse genetic material being passed to subsequent generations. BMPs are explicit that milt should not be pooled under any circumstances. The BMP also states that mating of fish should be random and hatcheries should not select for specific characteristics in breeding pairs. One participant mentioned that they selectively bred larger fish together which does not align with BMPs.

Biosecurity

Establishing and maintaining biosecurity is extremely important as disease outbreaks can have consequences beyond the individual hatchery (Scarfe and Palić 2020). The CIP BMPs outline fish health and biosecurity standards required of community hatcheries.

The standards from the BMPs state that all eggs should be disinfected with Ovadine™ to reduce the risk of vertical diseases transmission and does not provide any exceptions. Although the majority of facilities complied with this fish health standard, one facility said that they believed Ovadine™ hardened the eggs and have been choosing not to disinfect their eggs in recent years with no perceived detriment to their fish. Several facilities mentioned using disinfecting footbaths at certain locations in their hatcheries, but many did not. Footbaths were included in the BMPs as a biosecurity standard to follow and should be used at all CIP facilities.

Marking and Tagging

Since the mid-1970s, clipping the adipose fin of salmonids has been used as an identifier for salmon produced in hatcheries; most frequently to denote a coded-wire tag in the snout of the salmon that identifies the brood year and source of the fish). When adipose clipping, tricaine methanesulfonate (TMS) was often mentioned as the anesthetic of choice however some facilities reported using clove oil instead. The BMPs state that clove oil is a known carcinogen that is not approved as a fish anaesthetic.

In certain areas, coho are to be marked with an adipose clip to enable mark selective fisheries. These fisheries allow retention of 'marked' (adipose clipped) fish but unmarked fish must be released. According to SEP (2019), all Southern BC coho released for harvest objectives should have PBT (parentage-based tagging, a DNA recognition tool) and be adipose clipped however this was not the case. Several facilities in Southern BC currently release all of their salmon unmarked, including coho. Multiple other hatcheries did not report using PBT for their coho, but do adipose clip, so that it is possible to distinguish between hatchery and wild fish. However, PBT would enable confirmation of the hatchery of origin.

It should be noted that releasing unmarked fish could be consistent with conservation objectives since these fish would have a lower harvest impact and may have a greater chance of returning to local spawning populations. However, although the value of marking fish may vary with objectives, no marking or PBT assessment means we are unable to evaluate the effectiveness of these projects.

In the hatchery projects that were interviewed, the limitations of marking were very apparent in the 2021 release file. In CDP facilities, the interviews included 122 projects defined by species, life stage at release, and facility; but only 29 releases were associated with marking (8 releases with CWT and adipose clips, plus 18 adipose-only coho marking, and 3 release groups of steelhead trout). In PIP's, the interviews included 49 release groups but only 8 groups were marked including two CWT and adipose-clipped coho 1+ smolts and 6 adipose-only coho releases. No Chinook or chum were marked in the PIP interviews included in 2021 releases.

Photo by: Benjamin Fortini

LIFE STAGE AND RELEASE WEIGHT

For each species reared in hatcheries, there are life stages at release, time of release, and size at release that historically have shown best survival and production. In most cases, these characteristics mimic the natural life-history of each species, but rearing strategies have also been developed through hatchery experience. Information about life stages released from facilities was collected primarily from the hatchery interviews. When hatchery interviewees did not explicitly state the life stage of releases, the 2019 and 2020 Production Plans were used to supplement the information. All discrepancies between the hatchery interview information and the Production Plan were verified with the hatchery participant or CA.

Life Stage

Life stages of species released across BC/Yukon (Table 2) and from each region (Table 3) are included below. For information regarding the specific release numbers at each stage, see Appendix C: Interview Results. Note that releases of juveniles are usually deliberately intended to be similar to the natural life-history of each species in each region.

Table 2: Species and life stage contributions for all hatcheries included.

Species	Life Stage	Percent
Chinook	Fed Fall	**0.10%**
Chinook	Fed Fry	**4.60%**
Chinook	Seapen 0+	**1.30%**
Chinook	Smolt 0+	**17.80%**
Chum	Fed Fry	**36.70%**
Chum	Seapen	**6.70%**
Chum	Unfed	**5.40%**
Coho	Fed Fall	**0.30%**
Coho	Fed Fry	**5.30%**
Coho	Seapen 1+	**0.10%**
Coho	Smolt 1+	**3.20%**
Coho	Unfed	**0.10%**
Pink	Seapen	**6.80%**
Pink	Unfed	**11.50%**

Table 3: Species and life stage contributions for each region and all hatcheries included.

Area	Species	Life Stage	Percent
BC Interior	Chinook	Fed Fry	60%
	Coho	Smolt 1+	40%
BC North Coast	Chinook	Fed Fall	1%
	Chinook	Fed Fry	1%
	Chinook	Smolt 0+	5%
	Chum	Fed Fry	47%
	Chum	Seapen	26%
	Coho	Fed Fall	1%
	Coho	Fed Fry	12%
	Coho	Seapen 1+	1%
	Coho	Smolt 1+	6%
	Coho	Unfed	1%
BC South Coast	Chinook	Fed Fry	6%
	Chinook	Seapen 0+	2%
	Chinook	Smolt 0+	22%
	Chum	Fed Fry	31%
	Chum	Seapen	4%
	Chum	Unfed	7%
	Coho	Fed Fall	0%
	Coho	Fed Fry	3%
	Coho	Smolt 1+	2%
	Pink	Seapen	9%
	Pink	Unfed	14%
Lower Fraser River	Chinook	Smolt 0+	7%
	Chum	Fed Fry	69%
	Coho	Fed Fry	11%
	Coho	Smolt 1+	4%
	Pink	Unfed	8%

Release Weight

The release weights for each species and life stage combination were requested from each participant. There was variation in accuracy between answers as some evidently provided true release weights from past years whereas others provided the approximate weights at which they strived to release their salmon. This likely explains why the average weight from the interviews does not match exactly with the average weight for interviewed hatcheries from DFO data (Figure 2). Information on average weights derived from the interviews was similar to the averages from the DFO data for most categories, indicating that the reported weights were accurately reported and validating the comprehensive data reported in Appendix C.

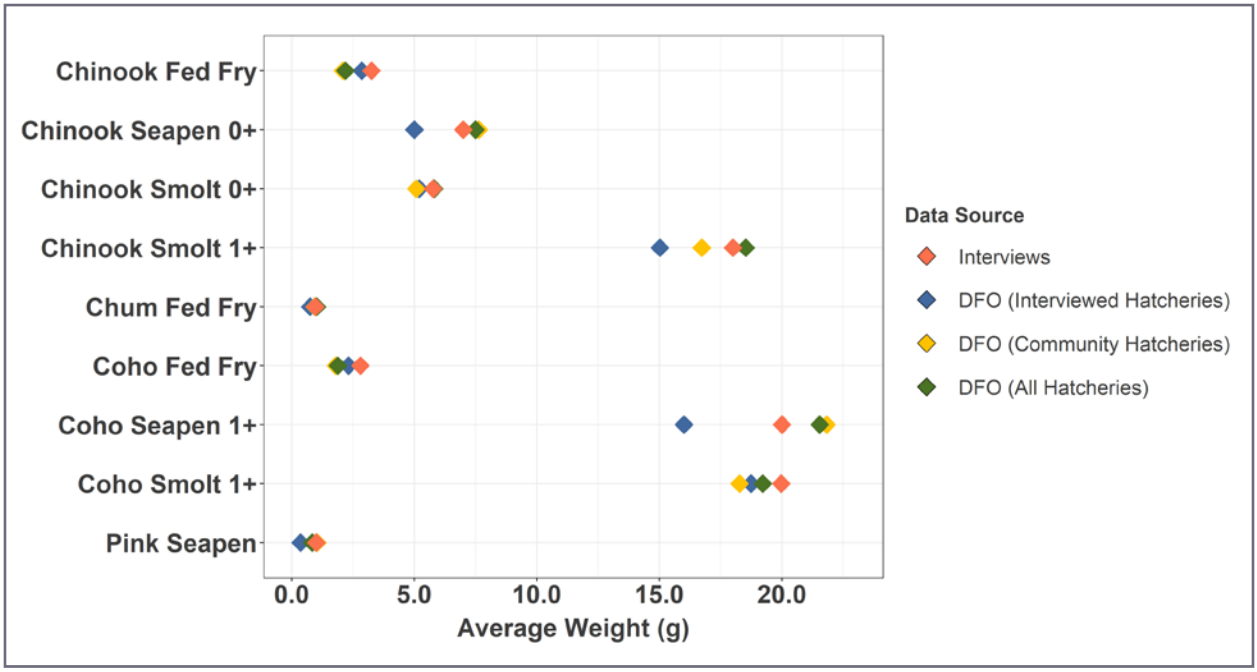

Figure 2: Average release weight comparison for each species and life stage combination from the interview data (orange) and 2020 DFO release data for interviewed (blue), community (CEDP, PIP, and DPI; yellow), and all (green) hatcheries.


Photo by: Benjamin Fortini

HATCHERY OBJECTIVES

COMPARISON OF OBJECTIVES

Each line of production at a CIP hatchery is associated with an objective in the SEP Production Framework (2018). Some facilities may have multiple lines of production with different objectives, sometimes even for the same species. The Production Plan was the only comprehensive resource available that provided objectives for all CIP hatcheries and release groups. The explanation of each production objective were taken from the SEP production planning framework to accurately represent the context for each objective (SEP 2018):

Harvest: Enhancement for fisheries that are reliant on enhanced production, and would disappear or become severely constrained in the absence of enhancement. This includes harvest opportunities for First Nations, recreational, or commercial fisheries. When the objective is to provide a targeted-fishery opportunity, production targets may be set to consider both natural spawning and harvest requirements.

Rebuilding: Enhancement of a stock that is below apparent carrying capacity. This includes rebuilding depleted populations and mitigating for habitat loss.

Conservation: Enhancement of a stock highly at risk of extirpation or extinction in order to prevent extinction and preserve the genetic diversity of the population. This objective is also suitable for populations with low abundance when the habitat is unable to support a self-sustaining population or a vulnerable stock that DFO has identified as a regional priority (e.g., through development of an approved conservation/recovery strategy, or through categorization by DFO as a stock of concern). This includes re-establishing locally extinct populations.

Assessment: Fish production for the purpose of achieving SEP assessment objectives, including supporting Pacific region assessment priorities, such as the Pacific Salmon Treaty. Fish produced for assessment are typically part of a larger production group that also addresses another objective such as harvest. In a few instances however, fish are produced solely for marking for Pacific region assessment purposes.

Stewardship and Education: Fish produced for stewardship or educational purposes at levels that are considered to have a low risk of impacts to natural production or other populations.

The objectives from the Production Plan were assembled and filtered for repeats to serve as a basis for comparison with the objectives gathered from the interviews. Those with stewardship/education objectives were divided and considered separately as stewardship and education.

Hatchery representatives were asked about their objectives, and each provided at least one. Frequently, these differed or were less specific from those provided by SEP for several reasons. Primarily, hatcheries were not solely referring to production objectives and included other hatchery activities in the discussion. The participants also rarely used the same nomenclature, even when discussing production objectives, making comparison challenging. Best efforts were made to determine which were enhancement objectives and assign them appropriately to the categories from the Production Plans (Figure 3). Many hatcheries said that their objective was to enhance local systems or to provide fish but did not identify the specific objective and were thus categorized as “General Enhancement”. Hatcheries that mentioned goals related to community involvement or education programs were categorized as Stewardship and/or Education. The data for this comparison were taken from the question focused on goals and achievement. Grist Goesen was the only facility where the hatchery interviewees did not state a specific objective.

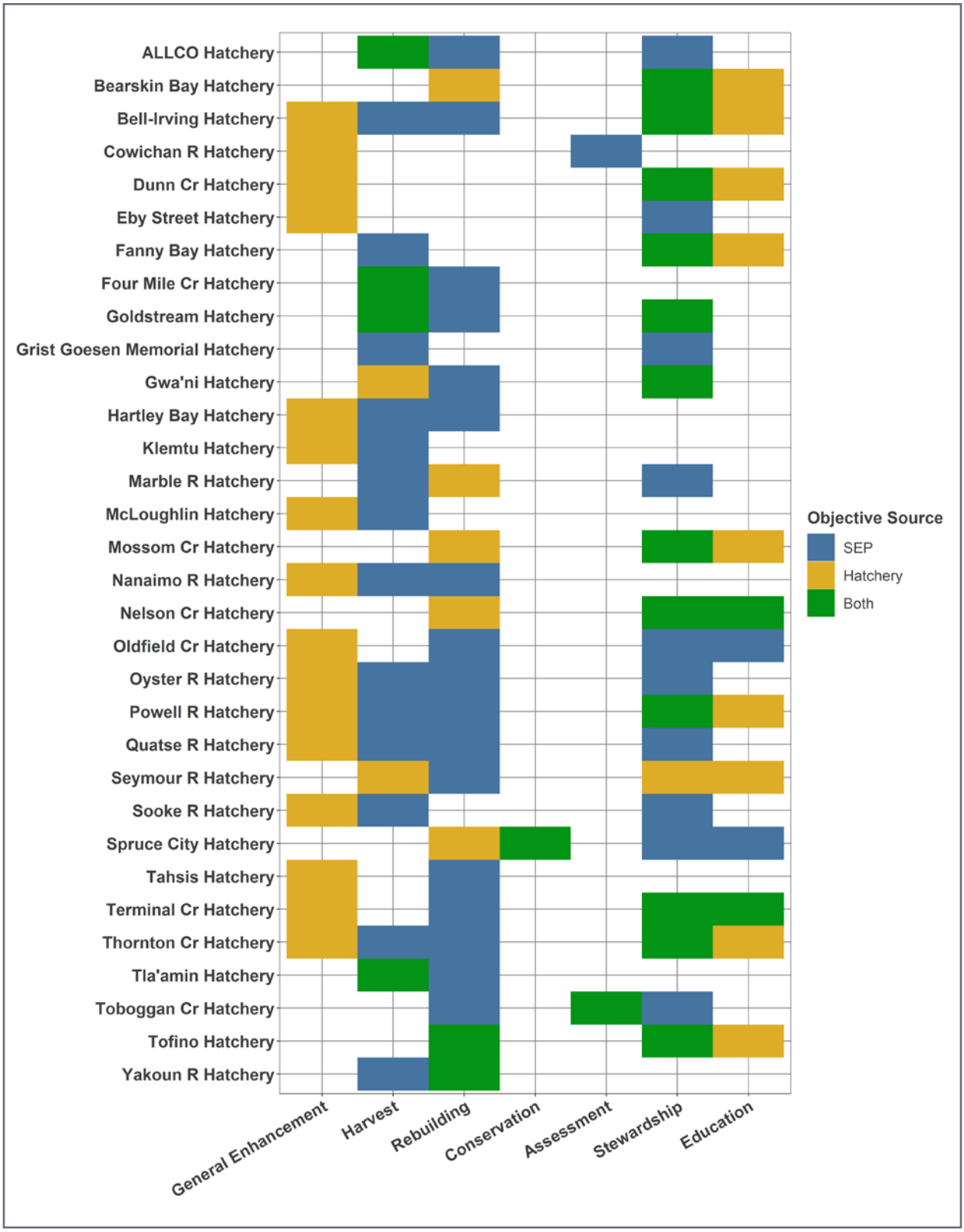

Figure 3: Production objectives for included hatcheries designated by SEP compared to those reported in the community hatchery interviews. The **blue rectangles** represent objectives from the 2019 and 2020 Production Plans and the **yellow rectangles** represent the objectives from the hatchery interviews. The **green rectangles** indicate alignment between the SEP and the hatchery participant's reported objectives.

The comparison of objectives identified differences between SEP objectives for these community projects and the understanding of the community hatchery operators; but these differences may simply indicate differences in terminology used and/or may in-part be due to the way the question was asked (see Appendix B2, question #1). The differences do indicate though some value in ensuring that DFO and the community hatcheries have a common understanding and a need to better clarify objectives with this sample of CIP hatchery projects. For example, the frequency of the General Enhancement objective in Figure 3 indicates that most interviewees did not specify their production objectives.

Overall, we suggest that Figure 3 indicates some notable differences in the understanding of the objectives for community hatcheries between DFO and the community hatchery operators, and many cases where the objectives noted in the Production Plan are not what the community hatchery operators report. The general objective 'to enhance local populations' could be interpreted to be consistent with objectives for Harvest and/or Rebuilding (this would apply to all except 4 cases); however, supporting harvest and supporting rebuilding are not the same thing, and a lack of clarity on the objective can lead to misunderstanding, mismatches of expectations, and has the potential to lead to unintended consequences.

We also note there are numerous non-alignments in the understanding of the Education and Stewardship objectives. This is not likely to be a significant risk factor in terms of unintended consequences, but there may be value in more consistent understandings between DFO and community hatcheries in how these categories should be defined and assessed, so that there can be consistency and comparability across activities that demonstrate the diversity of activities conducted by these community projects, such as employment at Oyster R, hatchery reconstruction at Oldfield Cr, improving hatchery practices at Grist Goesen, research at Thornton Cr, and rockslide removal at Seymour R. There were 8 of the interviewed facilities that did not include any objectives outside of those related to production.

ACHIEVEMENT OF OBJECTIVES

Without formal criteria for assessment, it is challenging to determine whether these hatcheries are meeting their objectives. We attempted to provide some metrics for achievement based on information from the hatchery interviews, scoring objectives when possible. Stewardship and Education were scored based on the categories of community involvement activities conducted by the hatchery. Supporting Stock Assessment was scored on the number of categories of stock assessment information that were collected by each hatchery. Harvest, Rebuilding and Conservation were not scored but rather evaluated on whether the hatchery had the ability to determine their achievement. This was done simply by including information on their marking and tagging practices.

Assessment of Achievement of Objectives

Each hatchery was asked if they believed they were achieving their specified goals. This information was simplified and summarized to provide an overall metric of achievement for each hatchery. A score of 3 was given for the hatcheries that had no issues and believed they were completely successful in their specific objectives. We reduced the score to a 2 if there were minor issues with achievement and to a 1 if the interviewee(s) did not believe that they were successfully achieving their goals. Because there was subjectivity in determining the score, the reason for a deduction to a score of 2 or 1 is included in the table below (Table 4).

Table 4: Hatchery self-assessment score for achievement of hatchery production objectives.

Hatchery	Score	Reason for deduction
ALLCO Hatchery	3	NA
Bearskin Bay Hatchery	3	NA
Bell-Irving Hatchery	3	NA
Cowichan R Hatchery	3	NA
Dunn Cr Hatchery	2	Want to take more fish to compensate for mortality
Eby Street Hatchery	2	Limited number of fish produced
Fanny Bay Hatchery	3	NA
Four Mile Cr Hatchery	3	NA
Goldstream Hatchery	2	Coho issues in Craigflower Cr, poor Chinook returns and no eggs
Grist Goesen Memorial Hatchery	3	NA
Gwa'ni Hatchery	2	No chum returning
Hartley Bay Hatchery	2	Low returns on river, difficult to collect enough broodstock
Klemtu Hatchery	1	Unable to achieve production targets
Marble R Hatchery	2	Data are poor, broodstock difficult to collect
McLoughlin Hatchery	2	Could not collect chum data last year (low return and COVID)
Mossom Cr Hatchery	2	Declining spawners based on historical records
Nanaimo R Hatchery	3	NA
Nelson Cr Hatchery	2	Public involvement decreased due to COVID
Oldfield Cr Hatchery	3	NA
Oyster R Hatchery	1	Does not seem like they are meeting objectives, want to produce more fish
Powell R Hatchery	3	NA
Quatse R Hatchery	1	Do not think they are meeting objectives (poor river conditions, no gains on restocking the system, poor stock assessment)
Seymour R Hatchery	2	Rockslide negatively impacted salmon population
Sooke R Hatchery	3	NA
Spruce City Hatchery	2	Still seeing declining stocks
Tahsis Hatchery	3	NA
Terminal Cr Hatchery	3	NA
Thornton Cr Hatchery	2	Unable to assess certain systems
Tla'amin Hatchery	2	Limited funding, want to produce more fish for the needs of the community
Toboggan Cr Hatchery	3	NA
Tofino Hatchery	3	NA
Yakoun R Hatchery	3	NA

Stewardship and Education

Every facility included in this evaluation carries out some form of community outreach and engagement, whether through environmental stewardship, education programs, advocacy with their local community and/or government, or additional activities to promote participation from the community. The definition of 'Stewardship and Education' used by SEP in the Production Plan is somewhat narrow, so we chose to highlight the diversity of community activities that may be included under Stewardship and Education for this review. We used the following categories to describe the broad range of Stewardship and Education objectives and activities at community hatcheries:

- Environmental stewardship includes habitat monitoring, restoration work, and other activities that benefit the conditions for salmon locally.
- Education includes all educational activities whether hosted at the hatchery or in local school programs.
- Advocacy includes interactions with government or other organizations where the hatchery provides advice, information, or support regarding salmon.
- Additional outreach activities differ across communities but include special event days, public salmon releases, and open houses.

To assess "Stewardship and Education", we rated each hatchery for each of the categories (Table 5). If they had activities that corresponded to the category, we scored it as a 1, and if not a zero. There was no consideration given to the success of these programs or the number of activities in each category. Rating a level of involvement would likely introduce subjectivity and bias and would require a more intimate knowledge of how SEP values these specific community involvement programs.

Some hatcheries mentioned escapement enumeration programs as an additional program but those were accounted for in the assessment section. Some hatcheries also mentioned that certain programs were suspended due to ensuring the safety of staff and volunteers during the pandemic. If the hatchery indicated that the program was temporarily on hold due to the pandemic, we included those activities as active and they were included and counted towards the hatchery's community involvement score (Table 5). If other past programs were mentioned that are not currently being conducted for reasons other than the pandemic, they were not included.

The majority (22 of 32) of hatcheries we assessed did have a Stewardship objective specified in the Production Plan. All hatcheries with this objective performed some level of stewardship activities but some did more than others.

Photo by: Benjamin Fortini

Table 5: Community involvement information for hatcheries with a specified Stewardship objective in the Production Plans.

Hatchery	Environmental Stewardship	Education	Advocacy	Additional Outreach	Score
ALLCO Hatchery	Yes	Yes	Yes	Yes	4
Bearskin Bay Hatchery	No	Yes	Yes	No	2
Bell-Irving Hatchery	Yes	Yes	Yes	Yes	4
Dunn Cr Hatchery	Yes	Yes	No	Yes	3
Eby Street Hatchery	Yes	Yes	No	Yes	3
Fanny Bay Hatchery	Yes	Yes	Yes	Yes	4
Goldstream Hatchery	Yes	Yes	Yes	Yes	4
Grist Goesen Memorial Hatchery	No	No	Yes	Yes	2
Gwa'ni Hatchery	Yes	Yes	No	Yes	3
Marble R Hatchery	Yes	Yes	No	Yes	3
Mossom Cr Hatchery	Yes	Yes	Yes	Yes	4
Nelson Cr Hatchery	Yes	Yes	Yes	Yes	4
Oldfield Cr Hatchery	No	Yes	No	Yes	2
Oyster R Hatchery	No	Yes	No	Yes	2
Powell R Hatchery	Yes	Yes	Yes	Yes	4
Quatse R Hatchery	Yes	Yes	Yes	Yes	4
Sooke R Hatchery	No	Yes	Yes	Yes	3
Spruce City Hatchery	Yes	Yes	Yes	Yes	4
Terminal Cr Hatchery	Yes	Yes	Yes	Yes	4
Thornton Cr Hatchery	Yes	Yes	Yes	Yes	4
Toboggan Cr Hatchery	No	Yes	Yes	Yes	3
Tofino Hatchery	No	Yes	Yes	No	2

Supporting Stock Assessment

One of the objectives of the DFO SEP hatchery system is to produce marked salmon (e.g. coded wire tagged and adipose fin clip) for domestic and international stock assessment programs. The intent of these assessment programs is to estimate the distribution, harvest impacts by age, and exploitation rate of these populations. The marking and enumeration programs for these populations has been reviewed and approved by international committees. Most of this work is done at the DFO major facilities, but there are 2 community hatcheries that produce fish for the purpose of supporting these stock assessment programs (Cowichan R and Toboggan Creek).

A summary of the activities that support the Stock Assessment objective at these 2 facilities is listed in Table 6. The quality and consistency of assessment methods was not evaluated for each facility.

Table 6: Assessment data collected by hatcheries with an Assessment objective.

Hatchery	Escapement Data	Enhanced Contribution	Straying	Wild	Score
Cowichan R Hatchery	Camera, Deadpitch, DIDSON, Enumeration fence, PIT tag array	Yes	Yes	Yes	**4**
Toboggan Cr Hatchery	Deadpitch, Enumeration fence, Flyover assessment, Walk assessment	Yes	Yes	Yes	**4**

Photo by: Benjamin Fortini

Harvest, Rebuilding and Conservation

To assess value of enhancement for Harvest, Rebuilding, or Conservation, hatchery fish must be identifiable. Due to the lack of criteria available, this section does not indicate how successful each hatchery has been at each objective but instead addresses which hatcheries are able to evaluate their success.

Harvest

There were 18 hatcheries that had Harvest objectives on the Production Plan, of which the majority marked or tagged at least one released species (Table 7: Marking and tagging information for hatcheries with a Harvest objective.). However 52% of these facilities did not mark or tag at least one of the species, making monitoring their contribution to harvest.

Table 7: Marking and tagging information for hatcheries with a Harvest objective.

Hatchery	Species	Type of Mark/Tag
ALLCO Hatchery	Chinook (CN)	No marking
ALLCO Hatchery	Coho	Adipose clip, PBT
Bell-Irving Hatchery	Coho	Adipose clip, PBT
Bell-Irving Hatchery	Chum	No marking
Fanny Bay Hatchery	Coho	Adipose clip, PBT
Fanny Bay Hatchery	Chum	No marking
Four Mile Cr Hatchery (San Juan R)	Chinook	Thermal
Goldstream Hatchery	Chum	No marking
Goldstream Hatchery	Coho	Adipose clip, PBT, PIT Tags
Grist Goesen Hatchery (Coquitlam)	Coho	Adipose clip
Hartley Bay Hatchery	Coho	No marking
Klemtu Hatchery	Chum	No marking
Klemtu Hatchery	Coho	No marking
Marble R Hatchery	Chinook	Thermal
Marble R Hatchery	Coho	Adipose clip, PBT
McLoughlin Hatchery	Chum	No marking
McLoughlin Hatchery	Coho	No marking
Nanaimo R Hatchery	Chum	No marking
Nanaimo R Hatchery	Pink	Thermal
Oyster R Hatchery	Pink	No marking
Powell R Hatchery	CN, Co, Chum	No marking
Quatse R Hatchery	Coho	Adipose clip, PBT
Quatse R Hatchery	Pink	No marking
Sooke R Hatchery	Chinook	Thermal, PBT
Sooke R Hatchery	Coho	Adipose clip
Thornton Cr Hatchery	Chinook	CWTs, PIT tags, PBT
Tla'amin Hatchery (Sliammon R)	Chinook	PBT
Tla'amin Hatchery (Sliammon R)	Chum	No marking
Yakoun R Hatchery	CN, Coho	No marking

Rebuilding

Of the 19 facilities with a Rebuilding objective on the Production Plan, barely half (16 of 29 in Table 8: Marking and tagging information for hatcheries with a Rebuilding objective.) were marked or tagged to enable assessment of hatchery return/contributions. To determine if rebuilding is occurring due to enhancement or due to increases in natural abundance caused by other factors, it is necessary to distinguish between hatchery and wild salmon and to monitor the total return over time.

Table 8: Marking and tagging information for hatcheries with a Rebuilding objective.

Hatchery	Species	Type of Mark/Tag
ALLCO Hatchery	Chum	No marking
Bell-Irving Hatchery	Chum	No marking
Bell-Irving Hatchery	Coho	Adipose clip, PBT
Four Mile Cr Hatchery	Chinook	Thermal
Goldstream Hatchery	Coho	Adipose clip, PBT, PIT Tags
Gwa'ni Hatchery	Chinook	Thermal
Gwa'ni Hatchery	Chum	Thermal
Hartley Bay Hatchery	Chum	No marking
Nanaimo R Hatchery	Chinook	Thermal, PBT, PIT tags
Nanaimo R Hatchery	Chum	No marking
Nanaimo R Hatchery	Coho	Adipose clip
Oldfield Cr Hatchery	Chum	No marking
Oyster R Hatchery	Chinook	PBT
Oyster R Hatchery	Chum	No marking
Oyster R Hatchery	Coho	Adipose clip, PBT
Powell R Hatchery	Chum	No marking
Quatse R Hatchery	Pink	No marking
Seymour R Hatchery	Chum	No marking
Seymour R Hatchery	Coho	Adipose clip
Tahsis Hatchery	Chinook	Thermal, PBT
Terminal Cr Hatchery	Chum	No marking
Thornton Cr Hatchery	Chinook	CWTs, PIT tags, PBT
Thornton Cr Hatchery	Chum	No marking
Thornton Cr Hatchery	Coho	Adipose clip, PBT
Tla'amin Hatchery	Coho	Adipose clip, PBT
Toboggan Cr Hatchery	Chinook	CWT, Adipose clip, PBT
Tofino Hatchery	Chinook	CWTs, Adipose clip, PBT
Tofino Hatchery	Chum	No marking
Yakoun R Hatchery	Chinook	No marking

Conservation

There was only one hatchery that had Conservation as the primary objective. Releases were assessed using parentage-based tagging (a DNA analysis tool). Consequently, the success of families within the hatchery and/or in marine survival can be assessed but monitoring of production at sea or in catches can not be assessed without sampling and DNA analyses.

Table 9: Marking and tagging information for hatcheries with a Conservation objective.

Hatchery	Species	Type of Mark/Tag
Spruce City Hatchery	Chinook	PBT

MOST IMPORTANT CONTRIBUTION

While not used as an evaluation measure, we were interested in the 'most significant contribution' attributed to each community hatchery program interviewed. Each hatchery manager and CA were asked to define their facilities' most important contributions (MIC) to their local community and watershed (Figure 4). For many hatcheries, multiple contributions were provided, a testament to the perceived importance of these local hatcheries. These responses were simplified and categorized to facilitate comparison (Figure 4).

Frequently, the top MIC differed between the hatchery and CA answers. For CAs, Education (34%), Community Involvement (31%), and Stewardship (31%) were the most common categories reported. Hatcheries most frequently included Salmon Enhancement (56%), Education (43%), and Public Awareness (34%). Education was the category with the most consistency between CAs and practitioners. Public Awareness, Food, Social and Ceremonial (FSC), and Stewardship all had some overlap, but all other categories had a maximum of one point of intersection between CAs and hatcheries. Given the use of different terminologies (e.g. Stewardship, Community Involvement and Public Awareness are inter-related; General Enhancement may refer to Rebuilding and Harvest objectives etc.), use of a standardized vocabulary would be useful to ensure that both community hatcheries and DFO are aligned in their objectives.

Photo by: Benjamin Fortini

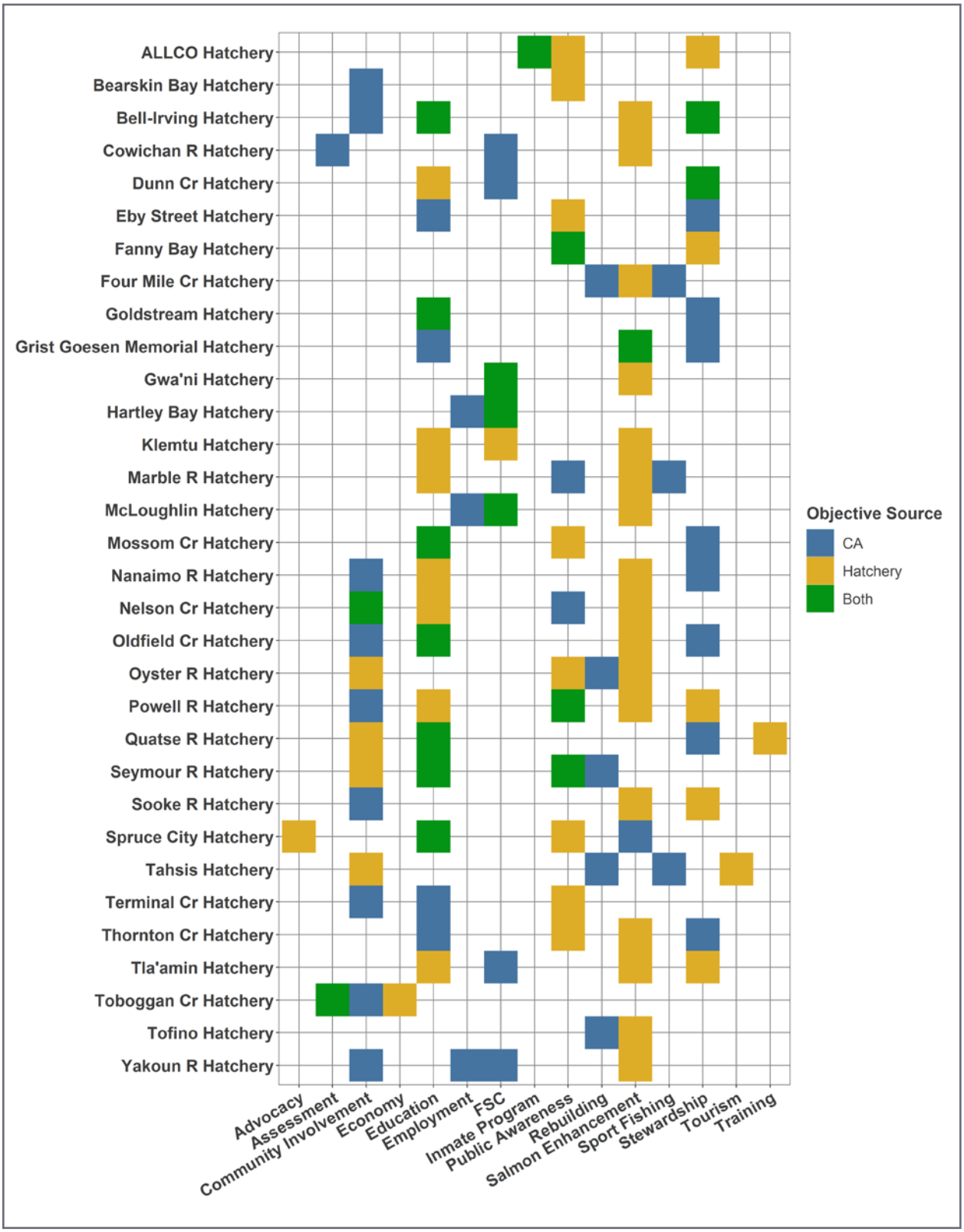

Figure 4: The most important contribution that each hatchery makes to their local community and/or watershed as stated in the hatchery and CA interviews.

The **blue rectangles** represent the most important contribution based on the CA interviews and the **yellow** represent the most important contribution based on the hatchery interviews. The **green rectangles** show where the CA and hatcheries were aligned in their terminology.

ASSESSING EFFECTIVENESS OF COMMUNITY HATCHERIES

The ability to assess the effectiveness of hatchery production is important to any hatchery program. Determination of hatchery contribution to escapement and the proportion of wild fish can inform production planning and evaluations. Availability of these data can lead to a better informed and better operated hatchery program. Details on the marking of fish from community hatcheries is reported in Appendix C: Interview Results, and we include some notable points from that section here as they relate directly to the ability to assess effectiveness of community hatcheries.

Some of the hatcheries interviewed conducted no form of marking or tagging on any of their fish released (Table 26 in Appendix C). Most of these facilities were in the BC North Coast region, and they all released coho. According to SEP (2019), all Southern BC coho should have PBT and be adipose clipped however this was not the case. Nelson Cr, Powell R, and Terminal Cr are all in Southern BC and all of their salmon, including coho, were released as unassociated, unmarked releases. Nelson Cr and Terminal Cr were releasing 18,000 and 8,500 coho respectively, so their unmarked coho releases are relatively small. However, Powell R was releasing 260,000 unmarked coho to the Southern BC area.

Most of the facilities that do not mark or tag fish cited a lack of funding as the main limitation. It can be cost and resource intensive however the data that are returned are invaluable for hatchery programs. It is challenging to measure the proportion of a population that is of natural origin (PNI, see Withler et al. 2018) of a system and maintain the genetic integrity of the stock if there is no way of distinguishing between hatchery and wild fish. It is also important to know if hatchery released fish are being caught and how many of them end up in the spawning escapement, which can only be accomplished with marking or tagging. Some of the hatcheries noted that they would be interested in implementing a marking and/or tagging program but this would require resources and funding.

If greater information on hatchery returns is desired, marking or tagging and implementation of assessment programs where they are lacking in community hatcheries would be required.

Photo by: Benjamin Fortini

NEEDS SUMMARY

COMMON CHALLENGES

A comprehensive needs summary derived from interviews is provided in Appendix D: Comprehensive Needs Summary, and common challenges are highlighted below to allow comparison between hatcheries (Table 10) and for future discussion. Funding was the most common challenge for the included CIP hatcheries with 72% of facilities stating that it was a primary issue. The other three commonly cited challenges included a lack of feedback from data submitted to DFO (44%), difficulty with water (temperature, amount, etc. 31%), and poor communication with DFO (22%). The remaining topics presented (if any) were all included under "Other". The regional location of each facility appeared unrelated to the challenges listed, suggesting that CIP hatcheries face similar challenges across their range.

Table 10: Summary of common challenges for each interviewed hatchery.

A Yes indicates that the hatchery has challenges in that category and a No indicate that they did not specify an issue. Hatcheries were grouped into four regional areas: BC Interior (INT), Lower Fraser River (LFR), BC South Coast (SC), or BC North Coast (NC). The total percentages indicate how many of the included facilities stated a challenge in that category.

Hatchery	Area	Funding	Data Feedback	Water Issues	Communication Issues with DFO	Other
ALLCO Hatchery	LFR	Yes	No	Yes	No	No
Bearskin Bay Hatchery	NC	No	Yes	Yes	No	No
Bell-Irving Hatchery	LFR	Yes	No	Yes	Yes	Yes
Cowichan River Hatchery	NC	Yes	No	No	Yes	No
Dunn Cr Hatchery	INT	Yes	No	No	No	No
Eby Street Hatchery	NC	No	No	No	No	Yes
Fanny Bay Hatchery	NC	No	No	Yes	Yes	No
Four Mile Cr Hatchery	NC	Yes	No	Yes	No	No
Goldstream Hatchery	NC	No	No	No	Yes	Yes
Grist-Goesen Memorial Hatchery	LFR	No	No	No	No	Yes
Gwa'ni Hatchery	NC	Yes	No	No	No	Yes
Hartley Bay Hatchery	NC	Yes	No	Yes	Yes	Yes
Klemtu Hatchery	NC	Yes	No	No	No	Yes
Marble R Hatchery	NC	Yes	Yes	No	No	Yes
McLoughlin Hatchery	NC	Yes	Yes	No	No	Yes
Mossom Creek Hatchery	LFR	Yes	Yes	No	No	Yes
Nanaimo River Hatchery	NC	Yes	Yes	No	No	No
Nelson Cr Hatchery	LFR	No	No	Yes	Yes	Yes
Oldfield Creek Hatchery	NC	Yes	No	No	No	Yes
Oyster R Hatchery	NC	Yes	Yes	Yes	No	Yes
Powell River Hatchery	NC	Yes	No	No	No	Yes

Hatchery	Area	Funding	Data Feedback	Water Issues	Communication Issues with DFO	Other
Quatse R Hatchery	NC	Yes	No	No	No	Yes
Seymour River Hatchery	LFR	Yes	Yes	No	No	No
Sooke R Hatchery	NC	No	Yes	No	No	Yes
Spruce City Hatchery	INT	Yes	No	No	Yes	Yes
Tahsis Hatchery	NC	Yes	Yes	Yes	No	Yes
Terminal Cr Hatchery	LFR	No	No	No	No	Yes
Thornton Cr Hatchery	NCs	Yes	Yes	No	No	No
Tla'amin Hatchery	NC	Yes	Yes	No	No	No
Toboggan Creek Hatchery	NC	No	Yes	Yes	No	Yes
Tofino Hatchery	NC	Yes	Yes	No	No	Yes
Yakoun R Hatchery	NC	Yes	Yes	No	No	No
TOTALS		**72%**	**44%**	**31%**	**22%**	**66%**

ADDITIONAL CAPACITY / NEW ACTIVITIES

The included hatcheries were asked whether there were any additional activities or experiments that they would be interested in conducting (Table 11). Some of the hatcheries that were not interested in new activities said that they were already at capacity and did not have time for anything else, while others noted that they were content with their current situation and not interest in changing it. However, most hatcheries were interested in new experiments, with some open to suggestions, and others with specific experiments in mind. Many did not go into detail regarding their plans for new activities or experiments and therefore only simple descriptions are included in the table below.

Table 11: Details of new activities or experiments of interest to hatchery interviewees.

Hatchery	New activities	New experiments
ALLCO Hatchery	No (No more capacity)	Open to ideas
Bearskin Bay Hatchery	Increase stream restoration, Improve assessment	Open to ideas
Bell-Irving Hatchery	No (No more capacity)	Citizen science water sampling
Cowichan River Hatchery	No (Sufficient programming)	In-river net pen rearing of fry
Dunn Cr Hatchery	Did not provide answer	No
Eby Street Hatchery	Unfed coho fry program in the spring	No
Fanny Bay Hatchery	Increase involvement for young people, Increase collaboration with upper Rosewall, Sanctioned fry salvage program	Open to ideas
Four Mile Cr Hatchery	Increase involvement for young people, Add adult education program, Add classroom incubation, Paint storm drains	Open to ideas

Hatchery	New activities	New experiments
Goldstream Hatchery	Increase research involvement	Soldier fly diet, Salt diet, Tank directionality study, Hatchery stressors/impacts, Fish pain study, Rearing environment complexity study
Grist-Goesen Memorial Hatchery	Coquitlam R Chinook program	Incubation and rearing of Chinook from Coquitlam R
Gwa'ni Hatchery	Seapen program for chum	No
Hartley Bay Hatchery	Increase and improve assessment	Open to ideas
Klemtu Hatchery	pink fry program with heated water	Rearing pink with heated water and homemade food
Marble R Hatchery	Improve river monitoring	Size and time of release experiments
McLoughlin Hatchery	No	No
Mossom Creek Hatchery	Employ full-time education staff, Expand volunteer recruitment and training, Host a BioBlitz	Dr. Scott Hinch (UBC) coho PIT tag study
Nanaimo River Hatchery	No (No more capacity)	Open to ideas
Nelson Cr Hatchery	pink fry program	Feed fish using insect food, Clip coho smolts during spring trapping, Start scales and PBT sampling
Oldfield Creek Hatchery	No	Counting fence in Oldfield Cr
Oyster R Hatchery	Increase science capacity	Open to ideas
Powell River Hatchery	Find alternative methods of outreach and revenue	Larger tubs to finish rearing
Quatse R Hatchery	Improve river monitoring	Water quality monitoring, Improve enumeration and assessment, Otolith monitoring, Eelgrass monitoring and transplant, Local freshwater sponge study
Seymour River Hatchery	Improve habitat in estuary, Improve monitoring using Ocean Tracking Network technology	Use Ocean Tracking Network to follow fish through a whole life cycle
Sooke R Hatchery	Genetic studies on broodstock, Selective breeding experiments	No
Spruce City Hatchery	No (Have asked and received no answer from DFO)	No (Endangered stocks)
Tahsis Hatchery	No (No more capacity)	No
Terminal Cr Hatchery	Juvenile trapping program	Adding gravel in restored areas, Adding additional spawning channel
Thornton Cr Hatchery	Improve water monitoring, CWT program for all Chinook, Investigate BKD in local river, Investigate Steelhead reduction after landslide	Water quality monitoring, Fish held in hatchery or in tubes study, Adding branches to rearing containers, Loading density study
Tla'amin Hatchery	Increase community involvement, Finalize marine management plan, Expand operations for increased food fish	Incubation and rearing directly in race-ways
Toboggan Creek Hatchery	No (No more capacity)	Temporary fence for Chinook collection, Inducing unripe fish with injections
Tofino Hatchery	No (No more capacity)	No (Busy with other work)
Yakoun R Hatchery	Increase production	No

The limitation of community hatchery funding was by far the most heavily critiqued aspect of the CIP program. Most hatcheries (72%) stated that they did not have enough funding to deliver on their core programs. The CIP was described by one hatchery as "being left to wither on the vine". Some hatcheries said that the funding for specific infrastructure or improvements was more easily accessible, but operational funding (e.g., fish food, insurance, utilities) was difficult to procure. This apparent lack of funding influences and limits the hatchery operations but also negatively impacts things like succession for hatchery managers and capacity for additional activities. The funding situation also generates a negative perspective of DFO, regardless of successes elsewhere in the program.

There are many factors that affect the monetary needs of facilities, for example the age and current state of infrastructure, the reliance on electricity for operations, and the amount of funding each hatchery is able to raise from local businesses and groups.

In 1994, capital costs to upgrade facilities comprised about 11% of the budget and costs for upgrades were projected to increase by 5 – 10% each year (Pearse 1994). If this projection was realized and the budget remained consistent, in 2021, the upgrade costs would be between approximately 41% and 144% of the budget. The SEP CIP budget has not been increased to match these inflationary pressures, and this has left the SEP CIP with less relative funding to distribute to community hatcheries. The cost of refurbishing existing infrastructure has limited the ability to redistribute financial resources and that there is a high risk that infrastructure deterioration will exceed the ability to maintain these properties (DFO 2009).

Examples where the need has superseded available funding can be seen throughout the CIP program. At Quatse River hatchery, a qualified and trained manager cost about 12% of budget in 1982 but now this manager would require approximately 50% of their operations budget. According to a tool on the Bank of Canada website, inflation has increased the value of the Canadian dollar by 353.09% since the beginning of the SEP program in 1977 ("Inflation Calculator" 2021). This means that for every $1 of funding received in 1977, the hatcheries would need over $4.5309 dollars today for an equivalent investment. Some hatcheries also deal with increases that are out of their control, such as the cost of insurance unexpectedly doubling this year at Quatse River hatchery. Sooke also reported that their insurance had increased and now takes up approximately one third of their budget. All of these factors suggest that funding increases are necessary but unfortunately, many of the included facilities stated that their budget had not increased for a long time (Table 12).

Table 12: Comments related to funding allocations from the hatchery interviewees.

Hatchery	Funding Comments
Bell-Irving Hatchery	No change in decades
Cowichan River Hatchery	No change in 22 years
Four Mile Cr Hatchery	No change since 1980s
Gwa'ni Hatchery	Funding was frozen
Klemtu Hatchery	Decreased in the last 20 years
McLoughlin Hatchery	No change in years
Nanaimo River Hatchery	No change in 17 years
Powell River Hatchery	No change in 40 years
Quatse R Hatchery	No change from 1982 to 2021
Seymour River Hatchery	No change since inception
Thornton Cr Hatchery	No change in 32 years
Tofino Hatchery	No change in 30 years

Retention of and attracting new staff to work for community hatcheries is also an issue due to lack of funding. Powell R has had to decrease their staff by half due to the decreased spending power of the funding they receive. Several hatcheries, including Gwa'ni, Yakoun R and Tahsis, all have concerns about succession. One hatchery contact mentioned that no-one wants to work at the hatchery because they can make more at the local fast-food restaurant with less responsibility. Paying staff livable wages was a challenge for several facilities. As a result of this, many of the people we spoke with felt undervalued and underappreciated. Multiple hatcheries wanted to communicate that DFO needs to continue to invest in community facilities and that it is extremely challenging to continue their programs with the funding received.

Many of the included hatcheries expressed frustration in seeking and applying for alternative funding sources to supplement their allocation from SEP. Lengthy and convoluted application processes were an issue for some whereas simply finding sources of funding was difficult for others. Many of these facilities view fundraising as outside the scope of hatchery work. From the information provided in the interviews, it appeared that fundraising activities were less necessary in the past but are now commonly a necessary task.

There was also a lack of information regarding hatchery-specific budgets which made any cost effectiveness evaluation impossible. We attempted to find the budgets by facility, but public documents only provided the total allocation to CEDP and PIP without including the specifics of each contract. Even with exact contributions from DFO, the amount of money from fundraising and other sources could not be quantified without explicitly asking each hatchery. Without accurate budgets for each community program, we were unable to assess the cost of production and community involvement for the included facilities.

These funding tensions and under-funding constraints have the potential for negative impacts should they continue, including:

A. limits to fish production and decades of experience from community workers

B. loss of diversity of community groups across BC

C. poor reflection on SEP by community members (taxpayers)

D. risk to human health & safety at hatcheries

E. mounting capital costs and hatchery risks

POTENTIAL SOLUTIONS

Funding limitations are a major issue affecting the majority of community hatcheries, and a number of ideas were raised on how this could be improved. Two community groups suggested using data to determine which hatcheries should receive an increase in funding based on concrete metrics. These metrics would be defined by SEP and based on their priorities for the CIP. The metrics should be publicly disclosed and accessible so that hatcheries are able to understand the funding framework and can attempt to meet the criteria if they are in need of funding. However, the limitations of monitoring that we have identified in these projects would certainly limit any quantitative basis for assessment; and CIP community programs are also important for community engagement that would also have to be included.

To source additional money, the immediate response is always for DFO to contribute more but building a broader basis for financial support should also be considered. Presently (and since 1989), many community groups receive some funding through PSF and the Recreational Fisheries Conservation Stamp[7] (https://psf.ca/blog/2022-23-salmon-conservation-stamp/). Since 2013, 100% of this annual stamp income is provide to the Pacific Salmon Foundation to support their Community Salmon Program. Consequently, any increased value from the current $6.25 per year, could be provided to these projects[8].

7. There is also an equivalent program for commercial fishing for salmon, but vast majority of funds from the conservation stamp are from the recreational sector.

8. PSF has requested an increase several times but seldom receive any recognition of this effort.

Another option for increasing funding is to make fundraising more accessible. Many participants asked for a list of potential funders to be provided, with Sooke R suggesting that all CIP facilities publicly disclose their funding sources. Another option to consider is running additional outreach programs. This brings in potential donors from outside of the regular hatchery participants. Thornton Cr said that fundraising should be done by "putting the cart in front of the horse". In other words, spend money on events that increase participation, and you will gain more funding from the participants. If CIP hatcheries are expected to fundraise, providing a BMP equivalent specifically for fundraising would be helpful for many of the hatcheries that were interviewed.

However, the PSF notes that fund raising requires effort, communication, and steady outreach; all efforts that would add to the tasks of these community groups. Plus, requesting donations for a project supported by government will generate pointed questions about the extent of government support. Possibly a new approach could be the establishment of a 'charitable giving centre' for BC/Yukon community-based enhancement and outreach. A centre could receive funds and provide tax receipts plus address correspondence about other sources of income, activities, and diversity of the overall CIP. Charitable giving is deductible from provincial and federal income tax.

The other notable power of our communities is that they are the electoral base in our democracy. The reality of support needed by community salmon programs annually is a trivial sum within the budget for this province; but there are many other organizations that also can make that same claim. However, salmon are the backbone of our natural ecosystems, with tremendous social, ecological and economic importance; and they are the official symbol of BC.

With the ongoing issues of succession and sufficient payment for hatchery staff and considering the remote location of many of the CIP hatcheries, finding suitable staff may continue to be a challenge, regardless of funding levels. A succession planning program, possibly based on recruiting local persons and training, is strongly advised to sustain and deliver an effective community salmon program.

Photo by: Benjamin Fortini

IMPROVE SUPPORT STAFF EXPERTISE AND AVAILABILITY

Community Advisors

The community advisors of each hatchery provide essential assistance and act as a liaison with Regional SEP staff. The interviewed staff spoke very highly of their CAs and the support that they provided. However, several facilities mentioned that they wished that the role of CAs was the same as in the past. These participants wished their CA was more available for hands-on help at the hatchery and to increase their time in the field. Bell Irving interviewees stated that CAs are the ultimate mentors for community hatcheries, but they have become administrators. They also mentioned that DFO expects too much from their CAs, a sentiment echoed by Mossom Cr. From the interviews with CAs, it appeared that CA role and expertise varies across the province, dependent on their amount of experience. This likely results in a lack of consistency in the technical support and guidance available to community hatcheries. A few of the included facilities mentioned that they felt like their CA was not sufficiently knowledgeable to support all facets of their operation. This is a great detriment to these programs, especially considering that the CAs are often the only point of contact with SEP.

Other Support Staff

Several of the included facilities requested further support from other experts in the SEP program, beyond their CAs. This was not because the CA was not fulfilling their role but rather because more specific expertise would be better suited to support specific activities. Most commonly mentioned was the desire for increased access to a SEP biologist. As examples, Goldstream was interested in specific guidance on how to carry out adaptive management and Marble R was interested on how to optimize return rates. This knowledge is outside of the scope of a CA but could be gained through biological assessment and subsequent recommendations. Concerns have previously been raised regarding the lack of technical support from biologists and engineers available to community hatcheries (DFO 2009).

Potential Solutions

We suggest that the technical support for community hatcheries is reviewed and subsequently specified and standardized across the province so that all CIP facilities receive sufficient support.

Regarding additional support staff, both Mossom Cr and Thornton Cr suggested that more site visits from experts and DFO administrators would be beneficial. This would enable specific advice and oversight from the different experts and hopefully increase the appreciation and support of CIP hatcheries from administrators. Tla'amin suggested that access to DFO engineers would allow them to improve the overall protection of salmon in their area. Some hatcheries, including Klemtu, Thornton Cr, and Gwa'ni, said that they would benefit from further education and training in hatchery practices. Hartley Bay mentioned that their manager was sent to Victoria for training in the early days of their program (~30 years ago). Thornton Cr said that fish health training was offered for major operations facilities but not for community programs.

A succession and mentoring plan has been previously suggested, with emphasis on community advisors and scientific and technical staff (DFO 2009). We recommend that access to support from SEP staff is increased and that methods for contacting support staff are streamlined and communicated to community hatchery staff. We also suggest that training opportunities are designed and provided for CIP hatcheries to improve knowledge and consequently the practices at these facilities. Community hatcheries differ in many ways (release numbers and sizes, location, community support, etc.) and site-specific guidance from experts is likely necessary.

IMPROVE COMMUNICATIONS

There were several issues raised with respect to the levels of hatchery communication with SEP, particularly with SEP staff in more senior administrative roles. Almost all of the included hatcheries noted that the level of communication and support from their CA was sufficient. However, the most commonly discussed concern was a feeling of being unappreciated by SEP for the significant amount of work that is carried out, especially since that is often compounded by insufficient funding. Because these concerns are multifaceted, there is no single suggestion that will solve all communication issues, but these concerns should be recognized and addressed.

Limited communication between hatcheries and administrators is evident when comparing interview data with some of the information made available by SEP. As noted in the section Deviations from Production Plans, there were several deviations in actual releases compared to those included on the Production Plan. We acknowledge that the actual release numbers vary from year to year but the concern is that there are differences between planned releases and actual releases by species and life stage (Table 1).

Some of the issues with communication stemmed from CIP hatcheries wanting more information and guidance from SEP. Cowichan R suggested that conversations with SEP would be more effective than them simply dictating what is expected. Similarly, Dunn Cr and Grist Goesen were frustrated that SEP made decisions for them without consulting the local staff who are experts on their situation and area. Dunn Cr requested guidance on how to make hatcheries more effective and improve capacity. Mossom Cr simply wanted volunteering to be recognized, supported, and valued by DFO. These examples illustrate the issues that hatcheries had with the general communication from SEP. Conversations with these hatcheries during production planning and other times, could result in them feeling recognized and appreciated by SEP, as well as obtaining access to expert knowledge to educate decisions.

Some participants suggested tangible products that could assist with improving communication and feedback. Dunn Cr suggested creating timelines of deliverables for the hatcheries and Tla'amin and Yakoun R proposed the creation of guidelines for hatchery practices and environmental stewardship. Both Goldstream and Thornton Cr recommended recurring hatchery reviews. Implementing the ideas around guidelines could allow for more effective hatchery practices by encouraging hatcheries to closely follow thoughtfully created procedures. Although recurring reviews could be time intensive, they would increase accountability with hatcheries, especially if practices were regularly compared to the proposed guidelines and objectives.

An additional comment, noted by Cowichan R, was the importance of using accessible language. They shared that it was occasionally challenging to navigate and understand the paperwork and information that they were provided because of the scientific jargon often used. Because of the great variety in education and background of hatchery staff and volunteers, more consideration should be used when writing documents for community volunteers and users.

UPDATE TECHNOLOGY AND DATA SHARING

There were several concerns raised about DFO's reliance on antiquated data management technology and interviewees suggested this reduced effectiveness at different levels. There were also concerns regarding receiving timely responses on data submitted to DFO. These issues are related, and investment and upgrades in technology would enable a more effective data management system.

Several hatcheries were frustrated with the lack of information returned to them after submitting data. As an example, Oyster R explicitly said that they wished information came more freely from DFO. Some said that they felt their data collection efforts were unappreciated and not used effectively. If this is indeed the case, hatcheries should be notified so that they are not wasting effort that could be better spent on other activities. However, many hatcheries are very keen to collect data on their fish and the systems they monitor, especially when there is reciprocity and transparency in the process. The current lack of transparency leads some hatcheries to believe that DFO is making poor management decisions. Providing timely feedback to the hatcheries, even if it is relatively simple and unprocessed, would strengthen relationships with several of these facilities.

Interviewees had many suggestions for specific ways that data sharing could benefit their practices, almost all of which would require some form of updated technology. Some of these ideas were methods to better share information between hatcheries. Bearskin Bay suggested creating a network to ask questions of other managers. Similarly, Nelson Cr suggested investing in an information sharing platform to enable learning from other community hatcheries. Because tools are expensive and some are only used for short periods during the year, Thornton Cr thought it would be beneficial to have a hatchery tool bank where items could be pooled and borrowed when necessary. Other hatcheries wanted improvement in data sharing with the public. Both Spruce City and Grist Goesen proposed a central databank for hatchery data. This could provide a central location to upload their data, include information on past restoration projects, and make more hatchery data publicly available. Some hatchery data are already available in the annual post season report (e.g., actual releases and marking). Grist Goesen suggested that updating the data submission system specifically would be of enormous benefit to CAs since they spend a lot of their time entering data from their hatcheries. Implementing some form of data sharing would be beneficial for CIP hatcheries across the province. It would enable simpler data distribution to SEP and to the public, decreasing the workload for CAs and encouraging public and academic participation through easily available data.

REVISE CURRENT PRACTICES

Clarify Production Objectives

As illustrated in Figure 3, many of the included hatcheries listed enhancement as one of their goals but most did not specify the objecitve for this enhancement. Communicating the true production objectives would provide clarity for hatcheries and may enhance cooperation and commitment.

Improve Assessment

Improving assessment of salmon returns and the conditions in freshwater habitats through community programs could provide important data for DFO and other user groups. This has been suggested elsewhere (DFO 2005b) but there is room to expand and improve the role of community hatcheries. As seen in the Harvest, Rebuilding and Conservation section, some of the included hatcheries do no marking or tagging of any of their released fish, making assessment of objectives impossible. There is also the challenge of accurately enumerating returns even if the fish are marked. We cannot measure the success of the production contribution of hatcheries by how many fish are released without information on what fraction survive to contribute to harvest or to returning spawners. There is no direct way to evaluate the effectiveness of production without these data and therefore, no baseline with which to compare when attempting to adapt or improve practices. Some facilities noted that they have a goal to improve marking and assessment for their releases, typically so that they could better evaluate the success of their releases. However, they mentioned that improving these programs often required resources, expertise, and funding. For the facilities that are not marking, the limitations was frequently limited resources of staff and funds. It may not be necessary to mark every release from community hatcheries but to better evaluate production at community hatcheries, targeted investments could quickly improve marking and assessment programs.

Improve Experimental and Research Capacity

As noted previously in the Additional Capacity section, many of the included hatcheries are interested in being involved in various experiments. Many hatcheries with a history of experimentation did so with the intention of benefitting the local fish populations. CIP facilities are an untapped resource for experiments and research. Because of their comparatively low releases compared to major facilities, running experiments at a community hatchery is simpler and less consequential if desired outcomes are not met. Using community facilities as the testing grounds should be considered[9] and maybe a means to supplement their support funds.

To investigate hatcheries from an academic standpoint, collaboration with universities and other research institutions could be facilitated. This is already occurring at some facilities, including Goldstream and Mossom Cr. Fostering those connections, potentially by providing contact information for willing hatcheries to labs that are interested in salmon research, would be beneficial for the participating hatcheries and the academic institutions.

Ensure Compliance with Best Management Practices

Because many community hatcheries have been operating for decades and the long terms of many hatchery managers, practices at some facilities may not be best practices for fish culture but rather "what has always been done". In some cases, this is due to a lack of communication. One hatchery stated that they wished there was a how-to manual for community hatcheries. This already exists in the form of the CIP BMPs, but the participant was not aware of this information. Advice for revising certain practices and adhering to the CIP BMPs should be raised as an issue of greater importance to ensure the health of hatchery fish.

Some practices occurring do not comply with the CIP BMPs (see the Deviations from Best Management Practices section for details). Greater emphasis should be put on following the BMPs in the areas identified earlier in this report. Deviations may have long-term genetic impacts on local stocks that may not be immediately evident to hatcheries. Effort should be put into reminding hatchery staff and volunteers that the BMPs exist and should be followed unless otherwise discussed with their CA or SEP biologists.

Photo by: Benjamin Fortini

9. It is noted that research at community facilities will be limited by facilities available and water capacity. These issues would have to be considered during research design.

DISCUSSION

In 1978, in the early days of the DFO Salmonid Enhancement Program, Romeo LeBlanc, then the Minister of Fisheries and Oceans made a speech to the BC Wildlife Federation. That speech contained two quotes that are noteworthy in today's context when considering community hatcheries:

> **"The enhancement program's real long-term success will be measured not so much by the miles of spawning channels as by the respect of generation after generation visiting these channels and salmon streams and rivers like the Adams."**

> **"The real investment of the Salmon' Enhancement Program is in — not for, but in — the people of British Columbia."**

Our review focuses a lot of attention on the salmon production aspects of community hatcheries. However, the objectives laid out in the DFO Production Plan and the production of salmon at community hatcheries do not tell the whole story of the benefits and value of community hatcheries, and the production of salmon may not be the most important achievement of some community hatcheries. Community hatcheries are often the hub for salmon in their community. They showcase through the hatchery the wonder of salmon, resulting in a public that is interested and engaged. They teach people about salmon and their habitat, and how we can protect and support our salmon for future generations.

The resources provided to DFO to support community hatcheries have declined significantly over the last 20+ years. DFO has tended to communicate that there have been no "cuts" to community hatchery funding, and while this seems to be generally true, there has been a huge loss of funding capacity due to inflation. This is a major issue that causes difficulty for DFO and for community hatcheries, and which has been compounded by new requirements for community hatcheries e.g. implementing and reporting to meet fish health regulations, water licensing costs etc. - all activities that community hatcheries did not have to deal with when these programs were started. The idea of "doing more with less" is not a viable way for DFO or community hatcheries to operate.

Increasing funding from government sources is one option to help to resolve some of the funding issues. Calls for this type of increase have tended to be directed to DFO, but other federal agencies and provincial Ministries have mandates that link strongly to the work of community hatcheries. There are possibilities within government authorities to use directed revenue generating ideas such as the very successful BC Parks license plates where funds could be directed to community hatcheries. There are also possibilities to develop partnerships and arrangements with public utilities, and the private sector. As an example, the Percy Walkus hatchery in Rivers Inlet is operated by the Wuikinuxv First Nation with funding support from private fishing lodges and technical and operating support provided by the Pacific Salmon Foundation.

Interviewees suggested that DFO has found it difficult to convey unpopular but necessary views to community hatcheries. They noted that DFO does not want to alienate or leave community hatchery volunteers feeling that their work is not valued, but some community hatcheries have very deep ties to what they are doing and push back when DFO brings in new operating standards or disagrees with their salmon enhancement objectives.

Some community hatcheries feel that DFO does not listen to them because DFO does not agree with, support or fund the same level of salmon production as their hatchery would like to undertake, or support other needs or priorities they are seeking support for. This ties to the misalignment between some community hatcheries and DFO on what the objectives and benefits are from their hatchery, and to the limits on resources available to support community hatcheries.

Many community hatcheries want to do more for salmon, with some being particularly focused on increasing the number of salmon they produce. There is much more than producing fish that community hatcheries can and are doing that benefits salmon — but this is sometimes seen as secondary. Monitoring, population assessment, habitat restoration, watershed condition monitoring, identification of critical habitats, etcetera, are all valuable. Supporting these activities may exceed the value of producing more salmon.

It is apparent from our interviews that CAs and hatcheries can see the objectives and priorities of community hatcheries differently. This is another source of frustration and disconnect, where DFO and the community hatcheries are not fully aligned. This disconnect has grown over time as DFO staff capacity to support hatcheries has declined.

There are significant gaps in the assessment component of community hatchery operations. There are numerous examples where hatchery produced fish are not marked, which makes it impossible to follow certain BMPs for broodstock collection, or to assess contribution to objectives such as harvest or rebuilding and impossible to assess interactions between fish released from community hatcheries and wild salmon. This raises an important question for DFO and for community hatcheries — if it is not possible to evaluate effectiveness and results, how do you know if the objectives are being met, and does it make sense to continue producing the fish? These limitations exist in the CDP and PIP components of the Community Involvement Program.

There is a need for a new and shared vision and purpose for community hatcheries. Some community hatcheries are operating with a leading edge understanding of their operations, while others are still operating based on understandings and assumptions from the past. This renewed vision would provide clarity on priorities/benefits/objectives and ensure these are commonly understood between DFO and our salmon communities.

Photo by: Benjamin Fortini

RECOMMENDATIONS

These recommendations are based on common issues mentioned by hatchery contacts during the interviews as well as areas for improvement noted during PSF's review of the collected data. The recommendations are intended to broadly address common concerns and suggest opportunities for reform and improvement. The recommendations are primarily based on the interviews with hatchery participants as we solicited input on how to improve their programs, whereas the DFO perspective was not solicited during the CA interviews. The interviews conducted with CAs were to provide context for the subsequent hatchery interviews and not to recommend improvements to their own DFO programs. These recommendations are not prioritized.

1. There is a need for a new common vision and purpose for community hatcheries. The operating context for community hatcheries has changed a lot over the years, and the interviews highlighted many circumstances where the hatchery's understanding of their objectives, results or important contributions differed from DFO's. This new common vision should offer clarity on what community hatcheries are well suited for and what they are not, provide clarity on priorities/benefits/objectives for community hatcheries, and ensure these are shared and commonly understood between DFO and the hatcheries.
2. All salmon enhancement conducted at community hatcheries needs to have clear production objectives, and these objectives should be shared and commonly understood by DFO and the hatchery. Many facilities said that their objective was to enhance local systems or to provide fish but did not identify the specific objective. In addition to objectives for the production of salmon, these community-based hatcheries also have many other benefits such as education, stewardship, public engagement, etc. and these should be included in the operating objectives for each hatchery.
3. Community hatcheries must follow Production Plan targets and Best Management Practices. While our review indicates that there is high compliance with the Production Plan and BMPs, there were notable deviations. There would be benefits to increased interaction and check-ins between DFO and the hatcheries to ensure that these are being followed.
4. Improved assessment is necessary. Unless there is a strong reason to the contrary[10], hatchery fish need to be identifiable via appropriate marking, tagging, etc. This should enable assessment of the hatchery objectives, evaluation of hatchery-wild interactions, and enable compliance to BMP. There is no direct way to evaluate the effectiveness of production without these data and therefore, no baseline to compare against when attempting to evaluate success, adapt or improve practices.

Photo by: Benjamin Fortini

10. For example, not clipping the adipose fin from coho salmon in southern BC would reduce the harvest of these fish in mark-selective fisheries if Conservation is the primary objective. Parentage-based DNA monitoring could be used to assess the contribution of these coho to the local natural populations.

5. Funding is a problem that leads to other issues including reduced staffing, poor infrastructure, operational shortcuts, etc. DFO should consider additional funding for community hatcheries. The value in terms of stewardship, education and public awareness is very high. Additionally, new, alternative or additional funding models should be considered. Examples include: increasing the salmon conservation stamp, a BC salmon licence plate, a third party fundraising partnership for all community hatcheries, etc.
6. Support from SEP technical staff was noted as being lower than the hatcheries feel they need. We suggest that the technical support for community hatcheries is reviewed and subsequently specified and standardized across the province so that all CIP facilities receive consistent and sufficient support.
7. Training for community hatchery staff is not meeting the current needs. We suggest training for community hatchery operators be reviewed, standardized and identified as a priority for funding.
8. It would be beneficial for each hatchery to have an annual review done jointly with DFO to assess how operations and outcomes aligned with objectives.
9. Additional support for data management, analysis and availability would benefit DFO, the hatcheries and other stakeholders and interests. As the central entity, it would be beneficial for DFO to update data tools and data systems to facilitate efficient and effective data transfer and management. Additionally, many hatcheries are unsure as to what happens with the data they submit, and that their data collection efforts were unappreciated and not used effectively. There appears to be a need for DFO to improve communication with hatcheries on what data are required, how they are used, and to provide any feedback on the data that the hatcheries are providing.

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CONCLUSIONS

Community hatcheries were developed when SEP was first established in 1977. One of the key benefits of investing in community involvement was the expectation that it would lead to increased awareness and appreciation by the public for salmon, and that this would help to ensure that the public would be part of ensuring a viable future for salmon. While this idea is still applicable today, a lot has changed since SEP began.

DFO resourcing to fund and support community hatcheries has eroded over time. Even though many of these hatcheries have been running for more than 40 years, there are many circumstances where understanding of objectives differ between SEP and the community hatcheries; there are major gaps in the ability to assess how well a hatchery is meeting the objectives; and there is increasing frustration from the community hatcheries about a lack of support from DFO.

There is a need for a review and re-commitment to the community hatchery model in BC. There is a need for:

- Clarity on what community hatcheries are well suited for, and what they are not.
- Clarity on objectives, ideally tying these to watershed and/or conservation unit scale salmon plans.
- Full alignment and compliance with Production Plan and BMPs.
- Appropriate assessment of community hatchery salmon production to ensure it is aligned with the original objectives and is not resulting in undesired hatchery-wild interactions.
- Transparency on funding and priorities.
- A review of the current funding model, and exploration of additional complementary approaches for funding and support for community hatcheries.

These projects have tremendous support in their communities. They have provided many benefits to salmon and the people of BC. We hope to see the care, attention and the hard work of these community hatcheries continue into the future.

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APPENDICES

APPENDIX A: HATCHERY INFORMATION

Appendix A1. Hatcheries Included in the CIP Hatchery Review

Table 13: Hatcheries included in the CIP Hatchery Review.

Hatchery	Project	Type	Area	Hatchery Contact	CA	CA Area	Website
ALLCO Hatchery	Alouette R	DPI	LFR	Chris McMillan	Scott Ducharme	CA - N Side Fraser R, Burnaby to Mission	alouetteriver.org/allco-fish-hatchery
Bearskin Bay Hatchery	Northern Trollers	PIP	NC	Brad Yonkman	Erin Harris	CA - Haida Gwaii	
Bell-Irving Hatchery	Kanaka Cr	DPI	LFR	Darin McClain	Scott Ducharme	CA - N Side Fraser R, Burnaby to Mission	keeps.org/hatchery
Cowichan R Hatchery	Cowichan R	CDP	SC	JR Elliot	Melissa Nottingham	CA - Lower Van Is, Cowichan R & southern Gulf Islands	cowichantribes.com/member-services/fisheries
Dunn Cr Hatchery	Thompson R N	CDP	INT	Tina Donald, Don Guitard	Melissa Hack	CA - Central Interior, Boston Bar to 100 Mile	www.simpcw.com/simpcw-fisheries.htm
Eby Street Hatchery	Eby Street	PIP	NC	Dirk Bothmann	Rob Dams	CA - Northern Interior & N Coast	
Fanny Bay Hatchery	Fanny Bay/GSVI	DPI	SC	Judy Ackinclose	Laura Terry	CA - Central E&W Van Is, Nanoose to Oyster R & Gold R to Tahsis	www.fbses.ca
Four Mile Cr Hatchery	San Juan R	CDP	SC	Lisa Margetish	Melissa Nottingham	CA - Lower Van Is, Cowichan R & southern Gulf Islands	
Goldstream Hatchery	Gold-stream R	DPI	SC	Peter McCulley	Melissa Nottingham	CA - Lower Van Is, Cowichan R & southern Gulf Islands	www.goldstreamhatchery.ca
Grist Goesen Memorial Hatchery	Poco Hatchery	PIP	LFR	Brian Simonson	Scott Ducharme	CA - N Side Fraser R, Burnaby to Mission	pcdhfc.com/grist-goesen-memorial-hatchery
Gwa'ni Hatchery	Gwa'ni	CDP	SC	Hank Nelson	Dave Davies	CA - N Van Is & surrounding Mainland Inlets	
Hartley Bay Hatchery	Hartley Bay Cr	CDP	NC	Stan Robin-son	Rob Dams	CA - Northern Interior & N Coast	

Hatchery	Project	Type	Area	Hatchery Contact	CA	CA Area	Website
Klemtu Hatchery	Kitasoo Cr	CDP	NC	Brent Mason	Ian Douglas/ Holly Willgress	CA - Central Coast, Cape Caution to Caamano Sound, east to Tatla Lake	klemtu.com/kitasoo-band/programs-2/salmon-enhancement-program/
Marble R Hatchery	P Hardy/ Marble	DPI	SC	Deb Anderson	Dave Davies	CA - N Van Is & surrounding Mainland Inlets	quatsehatchery.ca/marble-river-hatchery/
McLoughlin Hatchery	Heiltsuk	CDP	NC	Andrea Larson	Ian Douglas/ Holly Willgress	CA - Central Coast, Cape Caution to Caamano Sound, east to Tatla Lake	
Mossom Cr Hatchery	Mossom Cr	PIP	LFR	Kevin Ryan	Brian Smith	CA - Burrard Inlet, Indian Arm, Vancouver	www.mossomcreek.org
Nanaimo R Hatchery	Nanaimo R	CDP	SC	Brian Banks	Erica Blake	CA - Central W Coast of Van Is, east to Nanaimo, south to Chemainus	www.nanaimoriverhatchery.ca
Nelson Cr Hatchery	Nelson Cr	PIP	LFR	Jan Moger	Malcolm Wigham	CA - West Vancouver, Howe Sound to Anderson L	www.urbanstreams.org/nelsoncreekhatchery/
Oldfield Cr Hatchery	Oldfield Cr	PIP	NC	John Trew	Rob Dams	CA - Northern Interior & N Coast	
Oyster R Hatchery	Oyster R	DPI	SC	Lyle Edmunds	Laura Terry	CA - Sunshine Coast & Howe Sound, Port Mellon to Desolation Sound	oysterriverenhancement.org
Powell R Hatchery	Powell R	CDP	SC	Shane Dobler	Laura Terry	CA - Sunshine Coast & Howe Sound, Port Mellon to Desolation Sound	www.prsalmon.org
Quatse R Hatchery	P Hardy/ Quatse	CDP	SC	Grant Anderson, Steve Lacasse	Dave Davies	CA - N Van Is & surrounding Mainland Inlets	quatsehatchery.ca
Seymour R Hatchery	Seymour R	CDP	LFR	Marc Guimond	Brian Smith	CA - Burrard Inlet, Indian Arm, Vancouver	seymoursalmon.com

Hatchery	Project	Type	Area	Hatchery Contact	CA	CA Area	Website
Sooke R Hatchery	Sooke R	DPI	SC	Andy Schell	Melissa Nottingham	CA - Lower Van Is, Cowichan R & southern Gulf Islands	www.sookesalmon enhancement.com
Spruce City Hatchery	Spruce C Wldlf Ass	PIP	INT	Dustin Snyder	Guy Scharf	CA - Central Interior, N of 100 Mile & northeastern BC	scwa.bc.ca
Tahsis Hatch-ery	Tahsis R	DPI	SC	Don Beamin	Laura Terry	CA - Sunshine Coast & Howe Sound, Port Mellon to Desola-tion Sound	villageoftahsis.com/ business/tahsis-salmon-enhancement-society
Terminal Cr Hatchery	Terminal Cr	PIP	LFR	Don McQueen	Malcolm Wigham	CA - West Vancouver, Howe Sound to Anderson L	www.bowenhatchery.org
Thornton Cr Hatchery	Thornton Cr	CDP	SC	Dave Hurwitz	Erica Blake	CA - Central W Coast of Van Is, east to Nanaimo, south to Chemainus	www.thorntoncreek hatchery.com
Tla'amin Hatchery	Sliammon R	CDP	SC	Lee George	Laura Terry	CA - Sunshine Coast & Howe Sound, Port Mellon to Desolation Sound	
Toboggan Cr Hatchery	Toboggan Cr	CDP	NC	Kris Bulloch	Natalie Newman	CA - Smithers & Northwestern BC	smitherschamber.com/ business-directory/ toboggan-creek-salmon-steelhead-enhancement-society
Tofino Hatchery	Tofino	DPI	SC	Doug Palfrey	Erica Blake	CA - Central W Coast of Van Is, east to Nanaimo, south to Chemainus	tofinosalmonhatchery.com
Yakoun R Hatchery	Old Massett	CDP	NC	Darren Edgars	Erin Harris	CA - Haida Gwaii	oldmassettvillagecouncil. com/economic-development/salmon-enhancement-program/

Appendix A2. CA Interviewee

Table 14: Table of CA interviewees. Hatcheries are from one of four regional areas: BC Interior (INT), Lower Fraser River (LFR), BC South Coast (SC), or BC North Coast (NC).

CA	Region	Area	Suggested Hatcheries	Date	Duration
Dave Davies	SC	North Vancouver Island & Surrounding Mainland Inlets	Gwa'ni, Marble R, Quatse R	2021-06-23	1H 22M 57S
Melissa Nottingham	SC	Lower Vancouver Island, Cowichan River & southern Gulf Islands	Cowichan R, Four Mile Cr, Goldstream R, Sooke R	2021-07-06, 2021-08-11	2H 36M 38S
Melissa Hack	INT	Central Interior, Boston Bar to 100 Mile	Dunn Cr	2021-07-07	1H 4M 29S
Tyler Thibault	LFR	South Side Fraser River to Boston Bar	Little Campbell R (Not included)	2021-07-08	30M 17S
Guy Scharf	INT	Central Interior, North of 100 Mile & Northeastern BC	Spruce City	2021-07-12	43M 33S
Ian Douglas	NC	Central Coast, Cape Caution to Caamano Sound, East to Tatla Lake	Klemtu, McLoughlin	2021-07-12	58M 31S
Erica Blake	SC	Central West Coast of Vancouver Island, East to Nanaimo, South to Chemainus	Nanaimo R, Kennedy R (Not included), Thornton Cr, Tofino	2021-07-15, 2021-07-21, 2021-07-29	4H 58M 56S
Malcolm Wigham	LFR	West Vancouver, Howe Sound to Anderson Lake	Nelson Cr, Terminal Cr	2021-07-15	49M 50S
Laura Terry	SC	Sunshine Coast & Howe Sound, Port Mellon to Desolation Sound	Fanny Bay, Oyster R, Powell R, Tahsis, Tla'amin	2021-07-23, 2021-07-26	5H 48M 16S
Erin Harris	NC	Haida Gwaii	Bearksin Bay, Yakoun R	2021-08-09	48M 36S
Rob Dams	NC	Northern Interior & North Coast	Eby Street, Deep Cr (Not included), Hartley Bay, Oldfield Cr	2021-08-11, 2021-08-19	2H 44M 59S
Natalie Newman	NC	Smithers & Northwestern BC	Toboggan Cr	2021-08-16	1H 3M 7S
Scott Ducharme	LFR	North Side Fraser River, Burnaby to Mission	ALLCO, Bell Irving, Grist Goesen	2021-09-24	1H 53M 14S
Brian Smith	LFR	Burrard Inlet, Indian Arm, Vancouver	Seymour R, Mossom Cr	2021-09-29	1H 27M 19S

Appendix A3. Hatchery Interviewees

Table 15: Table of Hatchery Interviewees. Hatcheries are from one of four regional areas: BC Interior (INT), Lower Fraser River (LFR), BC South Coast (SC), or BC North Coast (NC).

Hatchery	Hatchery Contact	CA	Region	Date	Method	Duration
Gwa'ni Hatchery	Hank Nelson	Dave Davies	SC	2021-07-07	Remote	2H 32M 10S
Dunn Cr Hatchery	Tina Donald, Don Guitard	Melissa Hack	INT	2021-07-09, 2021-08-05	Remote	1H 42M 56S
Terminal Cr Hatchery	Don McQueen	Malcolm Wigham	LFR	2021-07-19	Remote	1H 40M 36S
Nelson Cr Hatchery	Jan Moger	Malcolm Wigham	LFR	2021-07-27	Remote	1H 29M 55S
Goldstream Hatchery	Peter McCulley	Melissa Nottingham	SC	2021-07-29	In-Person	2H 9M 37S
Tofino Hatchery	Doug Palfrey	Erica Blake	SC	2021-08-04, 2021-08-05	Remote	1H 54M 40S
Thornton Cr Hatchery	Dave Hurwitz	Erica Blake	SC	2021-08-06, 2021-08-12	Remote	3H 59M 27S
Marble R Hatchery	Deb Anderson	Dave Davies	SC	2021-08-17	Remote	2H 11M 53S
Bearskin Bay Hatchery	Brad Yonkman	Erin Harris	NC	2021-08-20	Remote	1H 6M 32S
Tahsis Hatchery	Don Beamin	Laura Terry	SC	2021-08-23, 2021-08-26	Remote	2H 24M 23S
Oyster R Hatchery	Lyle Edmunds	Laura Terry	SC	2021-09-03, 2021-09-24	Remote	3H 0M 28S
Tla'amin Hatchery	Lee George	Laura Terry	SC	2021-09-17	Remote	1H 42M 10S
Fanny Bay Hatchery	Judy Ackinclose	Laura Terry	SC	2021-09-21	In-Person	2H 10M 37S
Powell R Hatchery	Shane Dobler	Laura Terry	SC	2021-09-23	Remote	46M 46S
Spruce City Hatchery	Dustin Snyder	Guy Scharf	INT	2021-09-23	Remote	1H 43M 44S
Sooke R Hatchery	Andy Schell	Melissa Nottingham	SC	2021-09-29	Remote	33M 52S
Bell-Irving Hatchery	Darin McClain	Scott Ducharme	LFR	2021-10-08	Remote	2H 41M 10S
Klemtu Hatchery	Brent Mason	Ian Douglas	NC	2021-10-12	Remote	2H 22M 13S

Hatchery	Hatchery Contact	CA	Region	Date	Method	Duration
Grist Goesen Memorial Hatchery	Brian Simonson	Scott Ducharme	LFR	2021-10-20	Remote	40M 44S
Mossom Cr Hatchery	Kevin Ryan, Ruth Foster, Rod MacVicar, Neil Laffra	Brian Smith	LFR	2021-10-22	Remote	37M 31S
Oldfield Cr Hatchery	John Trew	Rob Dams	NC	2021-10-22	Remote	1H 34M 3S
Toboggan Cr Hatchery	Kris Bulloch	Natalie Newman	NC	2021-11-10	Remote	3H 2M 13S
Seymour R Hatchery	Marc Guimond	Brian Smith	LFR	2021-11-22	In-Person	37M 38S
Nanaimo R Hatchery	Brian Banks	Erica Blake	SC	2021-11-24	In-Person	28M 19S
Hartley Bay Hatchery	Stan Robinson	Rob Dams	NC	2021-12-13	Remote	1H 44M 41S
Four Mile Cr Hatchery	Lisa Margetish	Melissa Nottingham	SC	2021-12-17	Remote	3H 4M 39S
ALLCO Hatchery	Chris McMillan	Scott Ducharme	LFR	2021-12-20	Remote	1H 30M 2S
Cowichan R Hatchery	JR Elliot	Melissa Nottingham	SC	2021-12-22	Remote	1H 36M 39S
Quatse R Hatchery	Grant Anderson, Steve Lacasse	Dave Davies	SC	2022-01-10	Remote	1H 3M 22S
Eby Street Hatchery	Dirk Bothmann	Rob Dams	NC	2022-01-14	Remote	1H 21M 10S
Yakoun R Hatchery	Darren Edgars	Erin Harris	NC	2022-01-18	Remote	1H 13M 44S
McLoughlin Hatchery	Andrea Larson	Ian Douglas	NC	2022-01-25	Remote	1H 9M 54S

Photo by: Benjamin Fortini

Appendix A4. Maps of Hatchery Locations

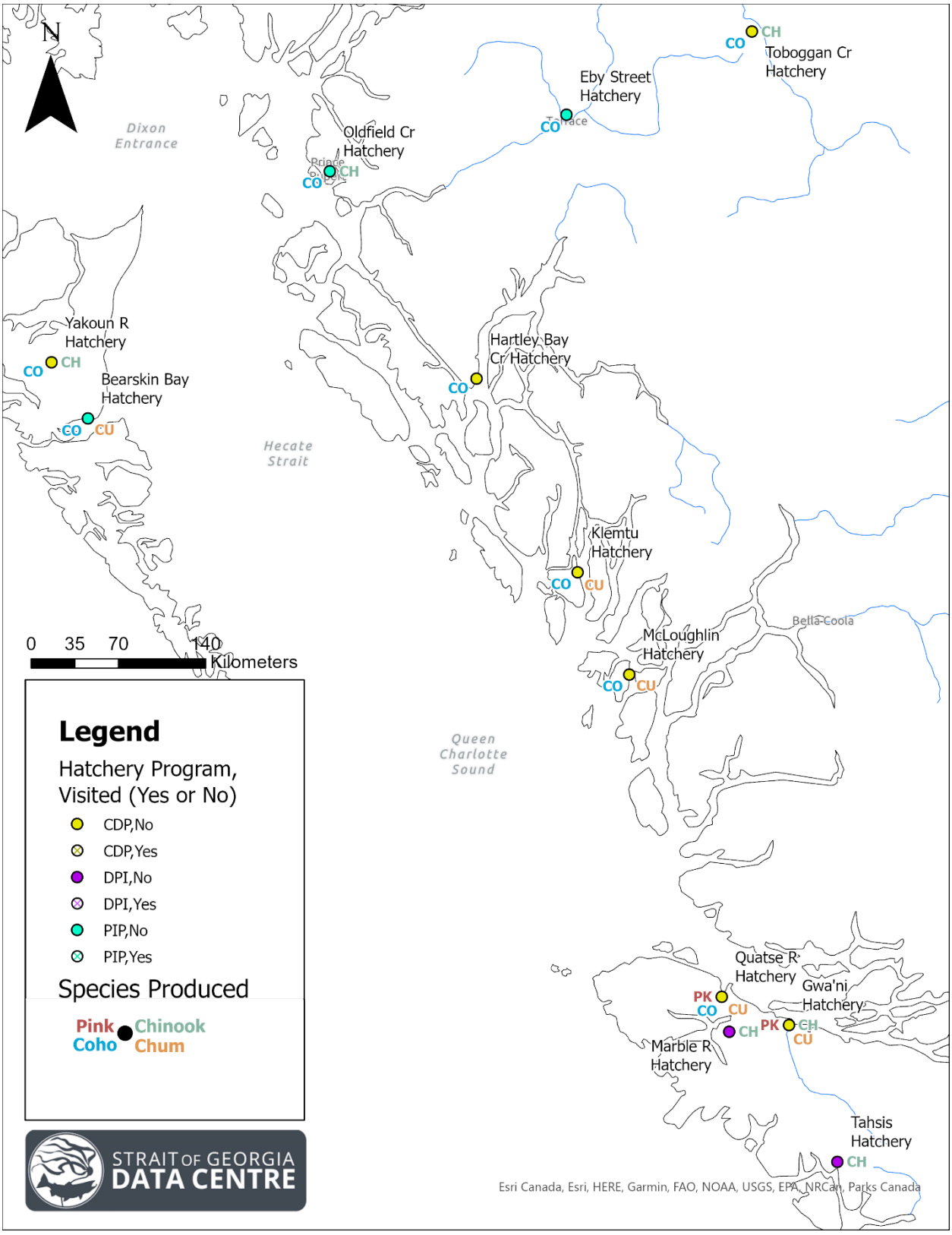


Figure 5: Map of community hatcheries in Northern BC and the species produced at each.

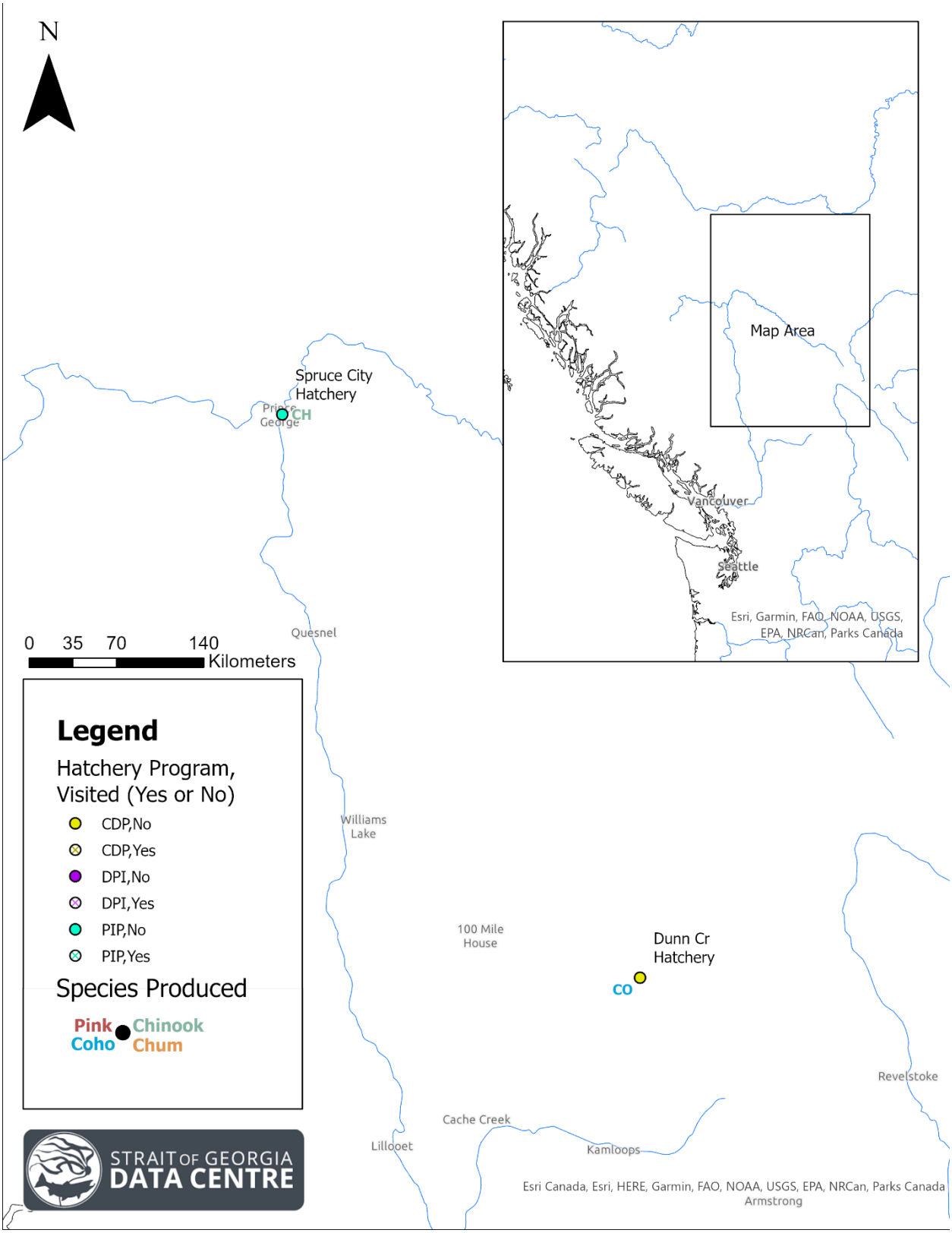


Figure 6: Map of community hatcheries in Central BC with the species produced at each.

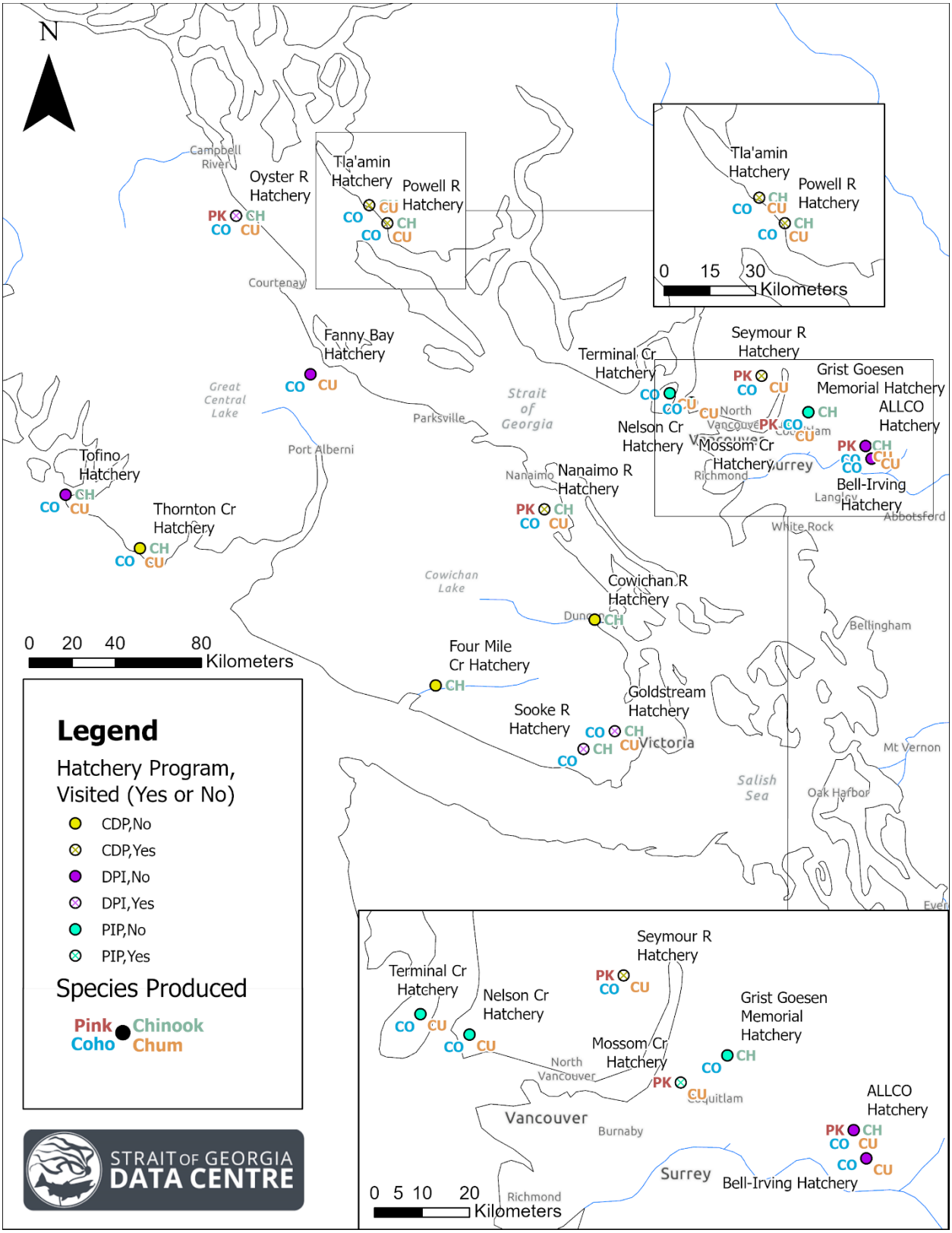


Figure 7: Map of community hatcheries in Southern BC with species produced at each.

Appendix A5. Hatchery Release Sites

Table 16: Release sites for species reared at hatcheries included in the review.

Hatchery	Species	Release Site	Latitude	Longitude
ALLCO Hatchery	Chinook	Alouette River S	49.264546	-122.707354
	Chinook	Coquitlam River	49.226489	-122.805561
	Chum	Alouette River S	49.264546	-122.707354
	Coho	Alouette Lake	NA	NA
	Coho	Alouette River S	49.264546	-122.707354
	Pink	Alouette River S	49.264546	-122.707354
Bearskin Bay Hatchery	Chum	South Bay Creek	53.15986	-132.06553
	Chum	Crabapple Creek	53.253739	-132.111286
	Coho	Jungle Creek	53.369195	-131.928369
	Coho	Leander Creek	53.33	-131.94
	Coho	Tarundl Creek	53.242216	-132.146802
	Coho	Honna River	53.250559	-132.13567
Bell-Irving Hatchery	Chum	Kanaka Creek	49.200398	-122.585166
	Coho	Kanaka Creek	49.200398	-122.585166
	Coho	McFadden Creek	49.21	-122.5
Cowichan R Hatchery	Chinook	Cowichan River	48.753551	-123.637015
Dunn Cr Hatchery	Coho	Dunn Creek	51.458766	-120.145802
	Coho	McTaggart Creek	51.411724	-120.128969
Eby Street Hatchery	Coho	Zymacord River	54.491789	-128.727914
Fanny Bay Hatchery	Chum	Wilfred Creek (Coal)	49.483268	-124.798312
	Chum	Rosewall Creek	49.467123	-124.777713
	Coho	Wilfred Creek (Coal)	49.483268	-124.798312
	Coho	Rosewall Creek	49.467123	-124.777713
	Pink	Wilfred Creek (Coal)	49.483268	-124.798312
Four Mile Cr Hatchery	Chinook	San Juan River	48.560082	-124.398795
Goldstream Hatchery	Chinook	Goldstream River	48.484573	-123.547893
	Chum	Goldstream River	48.484573	-123.547893
	Coho	Goldstream River	48.484573	-123.547893
	Coho	Tetayut Creek	48.5917	-123.3947
	Coho	Douglas Creek	48.2935	-123.201
	Coho	Tod Creek	48.558977	-123.462832

Hatchery	Species	Release Site	Latitude	Longitude
Grist Goesen Memorial Hatchery	Chinook	Coquitlam River	49.226489	-122.805561
	Coho	Coquitlam River	49.226489	-122.805561
Gwa'ni Hatchery	Chinook	Woss River	50.222987	-126.638797
	Chinook	Woss Lake	NA	NA
	Chinook	Nimpkish River Low	50.566897	-126.979485
	Chum	Nimpkish River Low	50.566897	-126.979485
Hartley Bay Hatchery	Coho	Hartley Bay Creek	53.427157	-129.253838
	Coho	Hartley Bay Lake	NA	NA
Klemtu Hatchery	Chum	Kitasoo Creek	52.58785	-128.523733
	Coho	Trout Bay	52.59	-128.52
Marble R Hatchery	Chinook	Quatsino Sound	NA	NA
	Chinook	Marble River	50.537763	-127.518781
	Chinook	Benson River	50.419416	-127.371601
McLoughlin Hatchery	Chum	McLoughlin Bay	NA	NA
	Coho	McLoughlin Bay Creek	52.136839	-128.148001
Mossom Cr Hatchery	Chum	Mossom Creek	49.299501	-122.868376
	Coho	Mossom Creek	49.299501	-122.868376
	Pink	Schoolhouse/South	NA	NA
	Pink	Mossom Creek	49.299501	-122.868376
Nanaimo R Hatchery	Chinook	Chemainus River	48.900156	-123.678442
	Chinook	Nanaimo River	49.137895	-123.895778
	Chinook	First Lake/GSVI	49.094713	-124.160438
	Chum	Nanaimo River	49.137895	-123.895778
	Coho	Second Lake/GSVI	NA	NA
	Coho	First Lake/GSVI	49.094713	-124.160438
	Coho	Nanaimo River	49.137895	-123.895778
	Coho	Napoleon Creek	49.069389	-123.865054
	Coho	Nanaimo River Up	49.137895	-123.895778
	Pink	Nanaimo River	49.137895	-123.895778
	Pink	Brandon Island	49.206944	123.957222
	Pink	Gallows Point	49.17	-123.91

Hatchery	Species	Release Site	Latitude	Longitude
Nelson Cr Hatchery	Chum	Nelson Creek/GSMN	49.356377	-123.268604
	Coho	Eagle Creek	NA	NA
	Coho	Cypress Creek/GSMN	NA	NA
	Coho	McDonald Creek	NA	NA
	Coho	Nelson Creek/GSMN	49.356377	-123.268604
	Coho	Hadden Creek	NA	NA
	Coho	Rogers Creek	49.255565	-124.810057
	Coho	Lawson Creek	NA	NA
Oldfield Cr Hatchery	Chinook	Kloiya Creek	54.248133	-130.192636
	Coho	Oldfield Creek	54.310713	-130.311257
	Coho	Diana Creek	54.237072	-130.156031
Oyster R Hatchery	Chinook	Oyster River	49.874217	-125.113161
	Chum	Oyster River	49.874217	-125.113161
	Coho	Oyster River	49.874217	-125.113161
	Pink	Oyster River	49.874217	-125.113161
Powell R Hatchery	Chinook	Haslam Lake	NA	NA
	Chinook	Lang Creek	49.776873	-124.370715
	Chum	Lang Creek	49.776873	-124.370715
	Coho	Blackwater Creek/QCI	NA	NA
	Coho	Anderson Creek/Lang	49.776873	-124.370715
	Coho	Haslam Creek	49.079568	-123.862874
Quatse R Hatchery	Coho	Quatse River	50.698539	-127.479799
	Coho	Waukwaas Creek	50.587972	-127.416179
	Coho	Cluxewe River	50.611554	-127.175952
Seymour R Hatchery	Chum	Seymour River/GSMN	49.303041	-123.025067
	Coho	Seymour Above Dam	49.303041	-123.025067
	Coho	Hurry Creek	49.43	-122.96
	Coho	Burrard Inlet	49.29	-122.97
	Coho	Seymour River/GSMN	49.303041	-123.025067
	Pink	Seymour River/GSMN	49.303041	-123.025067
	Steelhead	West Vancouver Lab	49.33	-123.23
Sooke R Hatchery	Chinook	Sooke River	48.384883	-123.700099
	Coho	Demamiel Creek	48.389896	-123.709121
Spruce City Hatchery	Chinook	Endako River	NA	NA
	Chinook	Nechako River	53.918356	-122.71521

Hatchery	Species	Release Site	Latitude	Longitude
Tahsis Hatchery	Chinook	Tahsis Inlet	49.924492	-126.65828
Terminal Cr Hatchery	Coho	Killarney Creek	NA	NA
	Coho	Grafton Lake	NA	NA
	Coho	Explosives Creek	NA	NA
	Coho	Killarney Lake	NA	NA
	Coho	Terminal Creek	49.385419	-123.343329
	Pink	Killarney Creek	NA	NA
Thornton Cr Hatchery	Chinook	Toquart Lake	NA	NA
	Chinook	Thornton Creek	48.967015	-125.56259
	Chum	Salmon Creek/SWVI	48.978293	-125.574066
	Chum	Thornton Creek	48.967015	-125.56259
	Chum	Twin River E	48.952036	-125.443446
Tla'amin Hatchery	Chinook	Sliammon River	49.895329	-124.604671
	Chum	Sliammon River	49.895329	-124.604671
	Coho	Sliammon Lake	NA	NA
Toboggan Cr Hatchery	Chinook	Bulkley River Up	54.394978	-126.708296
	Coho	Toboggan Creek	54.940672	-127.316895
Tofino Hatchery	Chinook	Bedwell Estuary	49.363142	-125.777336
	Coho	Kootowis Creek	49.090778	-125.724996
Yakoun R Hatchery	Chinook	Yakoun River	53.647109	-132.203352
	Coho	Yakoun River	53.647109	-132.203352

Photo by: Benjamin Fortin

APPENDIX B: SUPPORTING DOCUMENTS

Appendix B1. CA Interview Questions

Name of CA: _____

Area: _____

Hatchery Name: _____

CEDP/PIP: _____

Hatchery Location: _____

Hatchery Information:

- Who would be the best person to interview from this hatchery? What would be the best way of contacting them?
- Are there any considerations or sensitivities that I should be aware of?
- Is there anything that the hatchery managers may not know that you believe would be relevant to our review?
- In your opinion, what is the most important contribution that this hatchery makes to the community?
- Does this hatchery have a relationship with other facilities in your area? How does this networking affect the involved facilities?

Objectives:

- What species are being enhanced?
- For each species, why is the population being supplemented (e.g., conservation, rebuilding, assessment, harvest)?
- For each species, is this objective being met? How is this assessed?
- What are the production targets for each species? How were they established and have these changed over time?

Marking and Assessment:

- For each species, do you have information on the enhanced contribution of spawners to the systems in which you release juveniles? Where is this information available?
- Are there any assessments of 'straying' in the enhanced system, or in streams nearby (e.g., escapement surveys of clipped carcasses, otolith surveys, CWTs etc.)?
- Is there any information on wild fish (adult and/or juvenile) in the enhanced systems (e.g., size, timing, abundance, etc.)?

Broodstock:

- What are the spawning protocols for this facility? What are they based on?

Release:

- For each species, what is the basis of the current time and size at release that is used?

Data Collection:

- What data do you collect on salmon and where does this information get sent? Do you know where these data are ultimately stored (e.g., digital database, printed copy in a filing cabinet, etc.)?
  - Are data on rearing strategies recorded and submitted?
  - Are data on in-facility survival rates recorded and submitted?
  - Are any biodata on broodstock or wild fish (e.g., sex, size, fecundity, age, genetic samples) collected? How are they recorded and submitted?
  - Are adult escapements estimated for each system and species that you enhance? If so, how are they recorded (e.g., SEP mark-recapture programs, STAD AUC counts, fence or partial fence, peak live/dead) and submitted?
  - Are environmental data (e.g., river discharge/temp) collected and how is this information gathered? How are they recorded and submitted?
  - Are there any information/data/documents that you collect here that does not get submitted? How are these data managed?
  - Are there any other relevant data that are collected? What is it and how is it recorded and submitted?
- Do you believe that the information and data that are collected are being used effectively? Does feedback from these data inform hatchery practices?

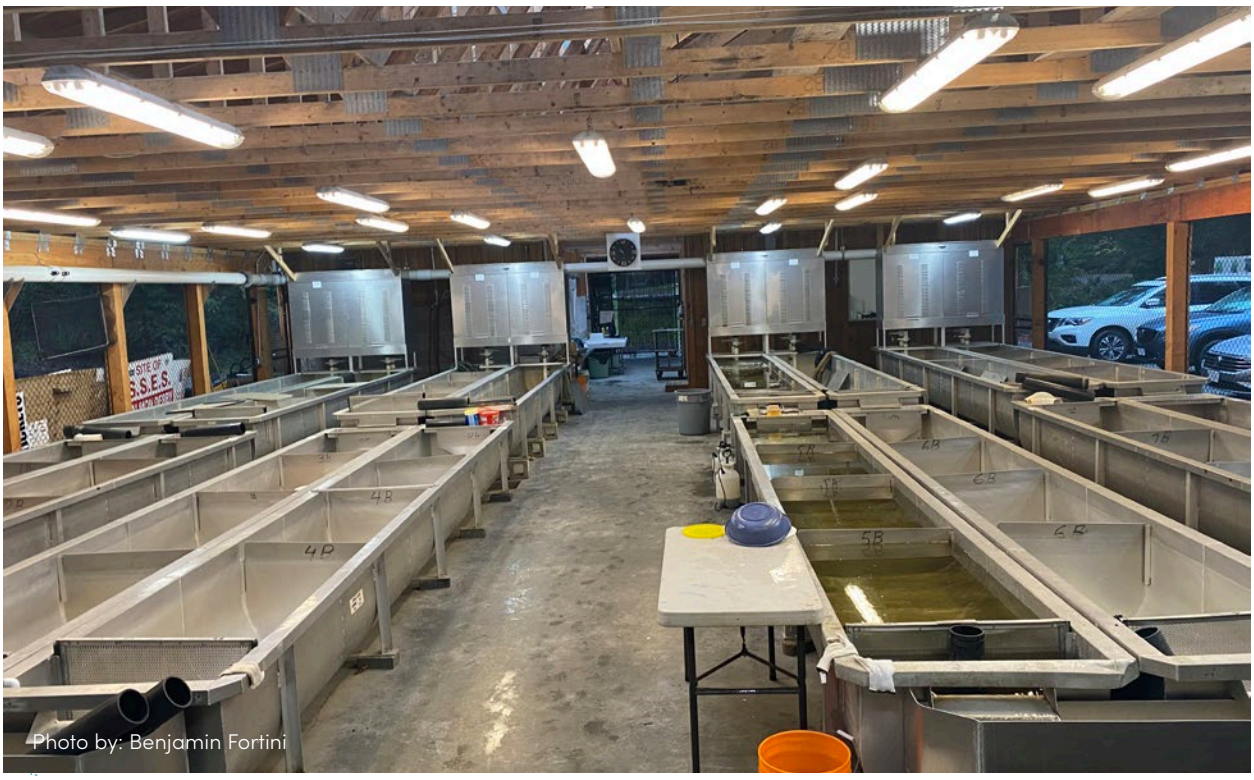


Photo by: Benjamin Fortini

Appendix B2. Hatchery Interview Questions

Objectives:

- What are the current goals of this hatchery? What are you trying to achieve?
  - Do you believe that you are achieving these goals?
  - How is this being assessed?
- Are there other activities and programs that you would like to conduct at your hatchery?
  - What would you need to start and maintain these activities and programs?

Community Involvement:

- Does this hatchery support any environmental stewardship programs? Please described these programs.
- Does this hatchery support any formal or informal education programs? Please described these programs.
- Does this hatchery advocate for salmon with local government and community organizations? Please described this advocacy.
- Are there any additional programs (external to fish production) or events that your hatchery conducts? Please described these programs and/or events.
- In your opinion, what is the most important contribution that this hatchery makes to the local community and/or watershed?

Marking and Assessment:

- Do you mark (i.e., adipose fin clip, thermal marking) or tag (e.g., CWT, PIT) the fish you release? What proportion?
  - If you mark or tag fish, please describe your procedure.
  - If you mark or tag fish, do you run any tag loss estimates? Do you have any concerns about this data?

Broodstock:

- For each species, what is the protocol for broodstock collection and where are they collected?
  - Is there anything unique about how broodstock are collected at this facility?
  - Do you record the proportion of hatchery origin fish collected for broodstock? How are these fish identified?
  - What biological data are collected from broodstock (e.g., sex, length, fecundity, age, genetic samples)?
  - Have broodstock collection methods changed over time? Please provide details.
- How are eggs fertilized after gamete collection?

Rearing:

- Could you please describe the rearing process from egg to release for each species reared at this facility?
  - What containers are fish held in at each stage?
  - What water source is used? How much do temperatures vary within a season and between years?
  - What are your typical egg to fry survival rates?
  - At what life-stage are fish released?
  - Do you use seapens? If so, how long are fish held before release?
- Are there any predator concerns at the hatchery? Are there any actions that are taken to address predation? Are there any needs surrounding anti-predator infrastructure?
- Are there any biosecurity protocols that this hatchery undergoes to manage fish health (e.g., fish vaccination, fish quarantine, water treatment, etc.)? Are there any needs for improving the biosecurity of the facility?
- In your observations, have there been notable changes in fish condition, health, etc. over the last decade?

Release:

- How are your fish released? Why is that the release strategy that is used? Please provide any additional information on how/where your fish are released (e.g., trucked a certain distance to release site, sedative used for transport, direct in-river releases, night-time releases, etc.)

Experiments:

- Have there been any experiments on different rearing conditions?
  - Are these specific experiments or routine annual comparisons?
  - Who conducted these experiments?
  - What was tested in these experiments?
- Are you aware of any other restoration work (e.g., woody debris removal, addition of spawning gravel, etc.) that may have been conducted in the watershed?
- Are there any experiments that you have considered running and have not yet? Why have they not been completed?

Data Collection:

- What data do you collect on salmon and where does this information get sent? Do you know where these data are ultimately stored (e.g., digital database, printed copy in a filing cabinet, etc.)?
  - Are data on rearing strategies recorded and submitted?
  - Are data on in-facility survival rates recorded and submitted?
  - Are adult escapements estimated for each system and species that you enhance? If so, how are they recorded (e.g., SEP mark-recapture programs, STAD AUC counts, fence or partial fence, peak live/dead) and submitted?
  - Are environmental data (e.g., river discharge/temp) collected and how is this information gathered? How are they recorded and submitted?
  - Are there any information/data/documents that you collect here that does not get submitted? How is this data managed?
  - Are there any other relevant data that are collected? What is it and how is it recorded and submitted?
- Do you believe that the information and data that are collected are being used effectively? Does feedback from this data inform hatchery practices?

Hatchery Operations:

- How long have you been working at this hatchery and what is your role?
- How many paid staff does this hatchery employ?
- How many people regularly volunteer at this hatchery?
- How long has this hatchery been operating?
- Have there been any major changes to the facility operations (e.g., rearing density, diets, rearing cover, etc.) and/or assessment procedures (e.g., marking/tagging effort, etc.) since opening?
- List the top challenges that your facility faces in running an effective operation? How would these rank in order of importance?
- Are there any unmet needs in this hatchery (e.g., infrastructure, knowledge, skills, etc.)? What additions would most improve operations at your facility?
- Are there any changes you'd like to see the hatchery make in the next 5 years? What would you like to achieve?

Opinion:

- Do you have any advice for us in conducting this community hatchery effectiveness review? Are there assessments that you would like to see done that we could assist with?
- What are your greatest concerns for salmon in your watershed?
- Do you believe that you are sufficiently supported by SEP and other sources? Do you have any immediate capital needs for this facility (e.g., infrastructure for rearing or adult holding, tools for assessment, etc.)?
- What role do community hatcheries play in SEP? What do you view as the value of this hatchery in the greater context of SEP?

Appendix B3. Privacy and Data Use statement Provided to each Participant

As part of the hatchery effectiveness review conducted by the Pacific Salmon Foundation (PSF), we are conducting a series of interviews with community hatchery managers to explore and take inventory of community hatchery practices and expert knowledge. This review is being conducted in partnership with the Department of Fisheries and Ocean Salmonid Enhancement Program (SEP) and the British Columbia Salmon Restoration and Innovation Fund (BCSRIF) and therefore, the products compiled from this interview process will ultimately be delivered to them.

By consenting to participate in the interview, you are agreeing to be recorded and agreeing that the data collected can be used to create products for the review. Because of the diversity of community hatcheries, including the source of information is relevant and important in most cases. However, to encourage open and honest discourse, we reserve the right to maintain the anonymity of the interviewees. There may be some questions, e.g., within the Hatchery Operations and Opinion sections (as well as others), that you would prefer to answer without association of your name and hatchery: for these, we will ensure that anonymity is maintained. The information may still be compiled and presented generically but will not include any identification of the interviewee or the hatchery. If you have any questions or concerns about this, please do not hesitate to contact Benjamin Fortini (bfort@shaw.ca).

APPENDIX C: INTERVIEW RESULTS

Many hatcheries expressed interest in knowing what was being done at other similar facilities and although this knowledge is known by the individual CAs and hatchery staff, it is not publicly available. This section comprehensively captures most of the data from the interviews and any data considerations are mentioned explicitly in each subsection.

Personnel

Experience

To provide context for the interviews, each participant was asked about their position at the hatchery and the commencement of their hatchery program (Table 17). Most participants were the managers of the hatchery and had an average of about 23 years of experience. The most experienced person (Peter McCulley at Goldstream) had been a part of the hatchery for 46 years and the newest participant (Brian Simonson at Grist Goesen) had been at the hatchery for three years. Many had contributed to the hatchery in various roles before they assumed their current positions. Operations at many of the included hatcheries were initiated between 1977 and 1983, a time of major growth and expansion for the early SEP (Hilborn and Winton 1993). The oldest included hatchery is Cowichan River Hatchery, which started in 1975, before SEP had even officially begun. The newest is Spruce City Hatchery, which restarted in 2016 after a push within the local wildlife club by the newly appointed Director of Stock Rebuilding Programs, Dustin Snyder.

There was no information about the work experience of the participant at Tahsis resulting from a slightly modified interview due to a time conflict. Certain questions were prioritized, and the questions were completed by a follow-up interview with their CA, Laura Terry.

Table 17: Participant's experience and the duration of the program for each included community hatchery. Time in current role and total time at Hatchery are in years.

Hatchery	Hatchery Contact	Current role	Time in Current Role	Total Time at Hatchery	Starting year of Hatchery
ALLCO Hatchery	Chris McMillan	Instructor	2	16	1978
Bearskin Bay Hatchery	Brad Yonkman	Hatchery Manager	7	7	1996
Bell-Irving Hatchery	Darin McClain	Hatchery Manager	12	12	1983
Cowichan R Hatchery	JR Elliot	Hatchery Manager	22	43	1975
Dunn Cr Hatchery	Tina Donald	Hatchery Administrator	22	22	1983
Eby Street Hatchery	Dirk Bothmann	Chairman of Enhancement Society	5	15	1998
Fanny Bay Hatchery	Judy Ackinclose	Hatchery Manager	26	26	1995
Four Mile Cr Hatchery	Lisa Margetish	Hatchery Manager	3	22	1977
Goldstream Hatchery	Peter McCulley	Hatchery Manager	46	46	1977
Grist Goesen Memorial Hatchery	Brian Simonson	Hatchery Coordinator	3	3	1980
Gwa'ni Hatchery	Hank Nelson	Hatchery Manager	40	42	1989
Hartley Bay Hatchery	Stan Robinson	Hatchery Manager	34	34	1979
Klemtu Hatchery	Brent Mason	Hatchery Manager	6	20	1981

Hatchery	Hatchery Contact	Current role	Time in Current Role	Total Time at Hatchery	Starting year of Hatchery
Marble R Hatchery	Deb Anderson	Hatchery Manager	Not included in interview	40	1981
McLoughlin Hatchery	Andrea Larson	Hatchery Manager	18	20	1977
Mossom Cr Hatchery	Kevin Ryan	President	6	6	1976
Nanaimo R Hatchery	Brian Banks	Hatchery Manager	17	17	1979
Nelson Cr Hatchery	Jan Moger	Co-manager	3	6	1991
Oldfield Cr Hatchery	John Trew	Director of Maintenance	8	8	1984
Oyster R Hatchery	Lyle Edmunds	Hatchery Manager	9	10	1983
Powell R Hatchery	Shane Dobler	Hatchery Manager	30	30	1982
Quatse R Hatchery	Steve Lacasse	Chairman of Board of Directors	10	30	1981
Seymour R Hatchery	Marc Guimond	Hatchery Manager	2	23	1977
Sooke R Hatchery	Andy Schell	Hatchery Manager	40	40	1981
Spruce City Hatchery	Dustin Snyder	Director of Stock Rebuilding Programs	6	7	2016
Tahsis Hatchery	Don Beamin	Hatchery Manager	Not included in interview	Not included in interview	1983
Terminal Cr Hatchery	Don McQueen	Co-manager	3	7	1982
Thornton Cr Hatchery	Dave Hurwitz	Hatchery Manager	7	7	1981
Tla'amin Hatchery	Lee George	Hatchery Manager	21	35	1977
Toboggan Cr Hatchery	Kris Bulloch	Hatchery Manager	4	4	1984
Tofino Hatchery	Doug Palfrey	Hatchery Manager	36	36	1985
Yakoun R Hatchery	Darren Edgars	Hatchery Manager	32	32	1979

Employment

The employment and volunteer support for the CIP projects varied widely between groups (Table 18, Table 19, Table 20). The most striking difference was that the CEDP hatcheries were able to employ staff to run operations whereas the majority of DPI and PIP projects relied almost entirely on volunteers. Most facilities had good volunteer participation, with an average of 17 (excluding Powell R) regular volunteers per hatchery. This discrepancy is likely due to the amount of funding that these hatcheries receive and therefore the amount that can be allocated towards paying staff.

CEDP

Every included CEDP hatchery had at least one staff member employed at the hatchery full time and averaged 1.28 full-time staff (Table 18). Nanaimo R employed the most at four full-time staff which enables them to meet their release targets of Chinook, chum, coho and pink and engage in other activities outside of production. Several hatcheries were also supported by seasonal and part-time workers to support the hatchery during busier times of the year such as broodstock collection in the fall.

For example, Thornton Cr hired 10 additional seasonal staff to support broodstock collection to ensure a safe and timely process. It was difficult to distinguish if participants were referring to part-time staff that worked seasonally or part-time staff that were employed year-round as this was not explicitly asked during the interviews. Most CEDP groups also had significant volunteer support from their community, exemplified by Powell R having 165 volunteers on record (note that other facilities reported the regular number of volunteers rather than the total). The CEDP hatcheries had an average of approximately 13 regular volunteers per hatchery (excluding Powell R). Some facilities, namely Cowichan R, Dunn Cr, Hartley Bay, and McLoughlin, had no volunteer support and were entirely operated by paid staff.

Table 18: Employment information for included Community Economic Development Program (CEDP) hatcheries organized by full-time staff, part-time staff, seasonal staff, and regular volunteers in that order. Hatcheries are from one of four regional areas: BC Interior (INT), Lower Fraser River (LFR), BC South Coast (SC), or BC North Coast (NC).

Hatchery	Regional Area	Full-Time Staff	Part-Time Staff	Seasonal Staff	Regular Volunteers
Nanaimo R Hatchery	SC	4	0	2	40
McLoughlin Hatchery	NC	3	0	4	0
Seymour R Hatchery	LFR	3	0	1	20
Gwa'ni Hatchery	SC	3	0	1	6
Powell R Hatchery	SC	3	0	0	165*
Cowichan R Hatchery	SC	3	0	0	0
Dunn Cr Hatchery	INT	2	3	0	0
Quatse R Hatchery	SC	2	1	3	40
Yakoun R Hatchery	NC	2	0	6	0
Klemtu Hatchery	NC	2	0	5	25
Four Mile Cr Hatchery	SC	2	0	4	15
Tla'amin Hatchery	SC	2	0	0	5
Toboggan Cr Hatchery	NC	1	1	2	10
Thornton Cr Hatchery	SC	1	0	10	20
Hartley Bay Hatchery	NC	1	0	5	0

* total number of volunteers on record rather than regular volunteers

DPI

DPI hatcheries relied primarily on volunteers, although some had sufficient funding to compensate staff (Table 19). ALLCO is a unique situation because they run an inmate program out of the Fraser Regional Correctional Centre as a means of providing employment opportunities and rehabilitating inmates from the prison. They have two full-time correctional staff that are paid by the prison to oversee their hatchery operations, with the bulk of the program is carried out by inmates. Because of evident issues with security and safety, they are also unique in having no volunteer support. Paid employment for the remaining DPI facilities is limited. Oyster R had two full-time staff, Tofino had a full-time hatchery manager and Bell-Irving had one staff-member part time. Tofino hired five seasonal staff to support brood capture for a short time each fall. Otherwise, there are no paid employees at the DPI facilities included in this review. Volunteer support is therefore extremely important at these hatcheries, averaging just over 20 regular volunteers per facility. Goldstream had created an important hub for community involvement and reported having 90 regular volunteers supporting their program.

Table 19: Employment information for included Designated Public Involvement Program (DPI) hatcheries organized by full-time staff, part-time staff, seasonal staff, and regular volunteers in that order. Hatcheries are from one of four regional areas: BC Interior (INT), Lower Fraser River (LFR), BC South Coast (SC), or BC North Coast (NC).

Hatchery	Regional Area	Full-Time Staff	Part-Time Staff	Seasonal Staff	Regular Volunteers
Oyster R Hatchery	SC	2	0	0	35
ALLCO Hatchery	LFR	2	0	0	0
Tofino Hatchery	SC	1	0	5	6
Bell-Irving Hatchery	LFR	0	1	0	7
Goldstream Hatchery	SC	0	0	0	90
Sooke R Hatchery	SC	0	0	0	20
Marble R Hatchery	SC	0	0	0	12
Fanny Bay Hatchery	SC	0	0	0	10
Tahsis Hatchery	SC	0	0	0	4

PIP

The PIP hatcheries included in the review get the vast amount of their support from volunteers although there were a few exceptions to this (Table 20). Bearskin Bay had two full-time staff, Mossom Cr had two part-time staff and Oldfield Cr employed a seasonal worker twice a year for broodstock collection and releases through a DFO contract. These hatcheries are unique since they were the only PIP hatcheries included that have any paid staff. Otherwise, PIP hatcheries were entirely volunteer operated and had a minimum of 10 regular volunteers with an average of just over 20 per hatchery.

Table 20: Employment information for included Public Involvement Program (PIP) hatcheries organized by full-time staff, part-time staff, seasonal staff, and regular volunteers in that order. Hatcheries are from one of four regional areas: BC Interior (INT), Lower Fraser River (LFR), BC South Coast (SC), or BC North Coast (NC).

Hatchery	Regional Area	Full-Time Staff	Part-Time Staff	Seasonal Staff	Regular Volunteers
Bearskin Bay Hatchery	NC	0	1	0	35
Mossom Cr Hatchery	LFR	0	1	0	30
Oldfield Cr Hatchery	NC	0	0	1	12
Eby Street Hatchery	NC	0	0	0	22
Spruce City Hatchery	INT	0	0	0	20
Nelson Cr Hatchery	LFR	0	0	0	19
Grist Goesen Memorial Hatchery	LFR	0	0	0	14
Terminal Cr Hatchery	LFR	0	0	0	10

CURRENT PRACTICES

Broodstock

Biodata

The biodata information included below was created by combining data from the CA and hatchery interviews (Table 21). There were some discrepancies between the two lists, but the lists were combined regardless. This was done because there were some hatcheries who stated they were not fully aware of the data collected during brood capture since their CA is present and is often responsible for collecting biodata. Additionally, we did not specifically ask questions about each type of biodata (e.g., fecundity, length, etc.) so it was difficult to know if categories were excluded intentionally or simply missed. Sex was removed as a category as all hatcheries must determine the sex of the collected brood. The hatcheries that reported collection of age data are categorized as such with the addition of the term "scales" in Table 21 below, because scales are typically used to determine age. The amount of biodata collected from broodstock for each hatchery varied and did not seem to be related to the type of hatchery or funding level. There was some association between the biodata collected and the individual CA. Many participants collected biodata as instructed by their CA; thus hatcheries served by a particular CA tended to collect similar biodata. However, this was not universal and likely varied due to capacity at each hatchery. Some facilities expressed the desire to collect additional biodata but noted a lack of necessary capacity. Many hatcheries were disappointed with the lack of feedback from DFO in response to the biodata submitted.

Broodstock Origin

About half of the facilities were able to identify if the salmon they collected were wild or hatchery origin (Table 21). This depended entirely on external marking (i.e., adipose clipping), as results from thermally marked otoliths, parentage-based tagging (PBT) and coded wire tags (CWT) are not available before brood is collected and fertilized. Knowing the origin of broodstock is important for measuring proportionate natural influence (PNI) and ensuring that the genetic integrity of each system is maintained (Withler et al. 2018).The hatcheries that were able to distinguish the origin of their fish could only do so with either coho or Chinook because they are the only species (with the exception of sockeye) that are typically externally marked. The vast majority either prioritized using wild fish or used them exclusively. This is consistent with the CIP Best Management Practices (BMPs) (SEP 2013). Some facilities explained that although wild fish were preferred, hatchery origin fish were sometimes taken so they could meet their release targets. The exceptions to this were Mossom Cr and Tla'amin. Mossom Cr explained that they took all returns regardless of origin due to difficulty with brood capture. Tla'amin said that they actually prioritize using hatchery fish because they want to kill fewer wild fish that are returning to spawn. Thornton Cr is now adipose clipping their coho but the program is too recent to have any clipped fish returning. At Tahsis, they were asked to cull any externally marked fish. Since they only do thermal marking, these fish were certainly strays from other enhanced systems.

Photo by: Nicole Christiansen

Fertilization Ratios

The fertilization ratios used at each hatchery varied (Table 21). Species were included in the table when that information was provided in the interview. The most common ratios were either a 1 to 1 male to female ratio or 2 males per female. When using 2M:1F, many hatcheries described a situation where Female A would be fertilized with Male A and B and Female B would be fertilized with Male B and C and so forth. This was explained to be a way of ensuring fertilization in case one of the milt samples was infertile or contaminated. Some hatcheries used bulk fertilization or high male to female ratios for pink and chum salmon. They explained that eggs were going to be combined for incubation regardless and bulk fertilization was less time consuming.

There was no information provided for Terminal Cr or Nelson Cr hatcheries as their fish are collected elsewhere and transferred in. This is addressed in more detail in Transfer-In Targets.

Table 21: Information gathered from the interviews and categorized regarding broodstock biodata, origin (whether they differentiate between hatchery and wild fish and prioritize taking one over the other, species in brackets are differentiated during collection due to external marking), and the fertilization ratios of the collected gametes.

Hatchery	Biodata	Broodstock Origin (H vs W)	Priority	Fertilization Ratio
ALLCO Hatchery	BKD, DNA, Fecundity, Length, Scales	Yes (Coho)	Prioritize using wild fish	1M:1F
Bearskin Bay Hatchery	Fecundity	No		1M:1F
Bell-Irving Hatchery	DNA, Fecundity, Length	Yes (Coho)	Prioritize using wild fish	1M:1F
Cowichan R Hatchery	DNA, Length, Otoliths, Scales	Yes (Chinook)	Prioritize using wild fish	1M:1F
Dunn Cr Hatchery	BKD, Fecundity, Length, Scales	No		2F:1M
Eby Street Hatchery	BKD, DNA, Fecundity, Length, Scales	Yes (Coho)	Prioritize using wild fish	2M:1F
Fanny Bay Hatchery	BKD, Fecundity, Length	Yes (Coho)	Prioritize using wild fish	2M:1F
Four Mile Cr Hatchery	DNA, Fecundity, Length, Otoliths, Scales, Weight	No		2M:1F
Goldstream Hatchery	DNA, Length, Scales	Yes (Coho)	Try to keep PNI <50%	2M:1F (Coho), 5F:1M (Chum)
Grist Goesen Memorial Hatchery	DNA, Fecundity, Scales	Yes (Coho)	Prioritize using wild fish	2M:1F
Gwa'ni Hatchery	DNA, Fecundity, Length, Otoliths, Scales, Weight	No		Not mentioned in interview
Hartley Bay Cr Hatchery	Fecundity, Length	No		3M:1F
Klemtu Hatchery	BKD, DNA, Scales	No		Bulk (Chum), 1M:1F (Coho)
Marble R Hatchery	DNA, Fecundity, Length, Otoliths, Scales, Weight	No		1M:1F

Hatchery	Biodata	Broodstock Origin (H vs W)	Priority	Fertilization Ratio
McLoughlin Hatchery	BKD, DNA, Fecundity, Scales	No		Bulk (Chum), 2M:1F (Coho)
Mossom Cr Hatchery	Fecundity	Yes (Coho)	Use hatchery and wild fish	1M:1F (Chum), 2M:1F (Coho), 2M:1F (Pink)
Nanaimo R Hatchery	BKD, DNA, Fecundity, Heads, Length, Otoliths, Scales	Yes (Coho)		1M:1F
Nelson Cr Hatchery	Do not collect broodstock	Do not collect broodstock		Do not collect broodstock
Oldfield Cr Hatchery	BKD, Fecundity, Length, Scales	No		2M:1F
Oyster R Hatchery	DNA, Fecundity	Yes (Coho)		Bulk (Pink), 1M:1F (Chinook)
Powell R Hatchery	Fecundity, Length, Weight	No		2M:1F
Quatse R Hatchery	BKD, DNA, Fecundity, Length, Otoliths, Scales, Weight	Yes (Coho)	Only use wild fish	2M:1F
Seymour R Hatchery	DNA, Fecundity, Length	Yes (Coho)		2M:1F
Sooke R Hatchery	Girth, Length, Otoliths, Scales	No		2M:1F
Spruce City Hatchery	BKD, DNA, Fecundity, Length	No		Not mentioned in interview
Tahsis Hatchery	DNA, Fecundity, Length, Otoliths, Scales	No		Bulk
Terminal Cr Hatchery	Do not collect broodstock	Do not collect broodstock		Do not collect broodstock
Thornton Cr Hatchery	BKD, DNA, Fecundity, Length, Scales	No		2M:1F
Tla'amin Hatchery	Scales	Yes (Coho)	Prioritize using hatchery fish (to kill fewer wild fish)	Bulk (Chum), 1M:1F (Coho)
Toboggan Cr Hatchery	BKD, DNA, Fecundity, Heads, Length, Scales	Yes (Coho and Chinook)	Prioritize using wild fish	2M:1F (Coho), 3M:1F (Chinook)
Tofino Hatchery	DNA, Heads, Length, Otoliths, Scales	Yes (Coho and Chinook)	Prioritize using wild fish	1M:1F
Yakoun R Hatchery	DNA, Fecundity, Length	No		2M:1F

Broodstock Holding

Many facilities need to hold some of the collected broodstock to allow them to ripen so that eggs and milt could be easily expressed. Some hatcheries held their fish in-river and some held them in rearing containers at the hatchery. For in-river holding, a variety of methods were used such as holding fish in net pens (Oyster R) or using holding tubes (Thornton Cr and Gwa'ni). These holding methods ensure that fish stay in the same location and are protected from predators while they reach sufficient maturity. Fish that are held at the hatchery are often sorted by sex and by ripeness. Interestingly, Powell R did this in their brood facility using an industrial pully rail system above a series of adjustable tanks. Some hatcheries, including Bearskin Bay and Tahsis, spawned ripe broodstock directly at the river and transport eggs and milt back to the hatchery for fertilization. This facilitates transport but introduces more contamination risks than spawning in a controlled environment.

Broodstock Transport

Transporting broodstock back to the hatchery is occasionally a time-consuming and challenging task. As mentioned, some participants simplified this by taking ripe eggs and milt at the river so that whole fish did not need to be transported. This is especially important at Tahsis where the embankment is so steep, trucks require winches to get back up from the river. Most hatcheries said that they transported their fish back to the hatchery site using boats or trucks with oxygenated transport tanks. Because of the remote location of the collection site, Marble R used a transport tank attached to a helicopter to transport their broodstock. This allowed them to collect enough eggs to meet their target, weather and river permitting, but is quite expensive.

Collection Method

Because it was not explicitly asked, not all participants provided information about how fish were caught but for those that did, their responses are included (Table 22). Broodstock capture methods varied amongst hatcheries and were often interchangeable depending on the people available and the conditions of the river. Some hatcheries stated that they have needed to change methods due to changing flow conditions in their systems. Goldstream explained that they have switched to using a fence instead of more intensive in-river collection due to an aging volunteer population. Many facilities used a combination of methods which allows for broodstock capture in different areas and during different river conditions. Once the broodstock had been collected and determined to be ripe, they were killed and eggs and milt extracted.

Some hatcheries, including Bell Irving, Tla'amin and Powell R, said that they made efforts to collect broodstock throughout the run. Some facilities, like ALLCO and Tla'amin, mentioned that they try to take 30% of the returns to their systems to allow for sufficient wild spawners.

Table 22: Broodstock capture methods for the included community hatcheries.

Hatchery	Capture Method
ALLCO Hatchery	Fish fence, Fish trap, Seine net
Bearskin Bay Hatchery	Seine net
Eby Street Hatchery	Seine net
Fanny Bay Hatchery	Hatchery returns, Seine net
Four Mile Cr Hatchery	Fish fence, Fish trap
Goldstream Hatchery	Floating weir
Grist Goesen Memorial Hatchery	Angling, Seine net
Klemtu Hatchery	Dip net, Fish fence

Hatchery	Capture Method
Marble R Hatchery	Seine net
McLoughlin Hatchery	Fish trap
Mossom Cr Hatchery	Dip net, Fish fence
Oldfield Cr Hatchery	Angling, Seine net
Oyster R Hatchery	Fish trap, Seine net
Powell R Hatchery	Fish fence, Hatchery returns
Seymour R Hatchery	Angling, Fish fence, Seine net, Tangle net
Sooke R Hatchery	Angling, Dip net, Fish trap, Seine net
Spruce City Hatchery	Seine net
Tahsis Hatchery	Seine net
Thornton Cr Hatchery	Dip net, Gill net, Hatchery, Seine net
Tla'amin Hatchery	Fish fence
Toboggan Cr Hatchery	Angling, Snagging
Yakoun R Hatchery	Angling, Seine net, Snagging

Incubation and Rearing Containers

Incubation Containers

The incubation and rearing containers used by CIP hatcheries included in the interviews varied across the province (Table 23). Most hatcheries used heath trays (a type of upwelling incubators) for their Chinook and coho eggs and bulk incubators (large boxes that can hold many eggs at once) for their chum and pink eggs. There were some deviations from these main two methods with some hatcheries using moist incubators, Kitoi boxes, upwelling incubators, siphon boxes, Atkin cells, keeper boxes, and circular incubators for incubating their eggs. Some of these categories of incubators may overlap and the nomenclature depended on the participant.

Rearing Containers

For the rearing of fry and smolts, most hatcheries used similar rearing containers (Table 23). The most common were Capilano troughs or some variation such as super troughs or rectangular troughs which are both similar but larger. Raceways were also sometimes used which have a greater capacity than the troughs, but some hatcheries expressed challenges with cleaning them since they are commonly made from concrete. This issue was resolved at Nanaimo R by coating their raceways with a smooth waterproof liner for easier cleaning. Both troughs and raceways have the advantage of providing high water exchange with relatively low flow so that small fish do not expend too much energy fighting against high-velocity water. Another category of rearing containers used were circular tubs or Swedish tubs. These have the advantage of generally being self-cleaning and can provide variable flow that can be adjusted for different sizes of juvenile salmon. The final category of rearing containers used were net pens and earthen ponds. These containers have the advantage of being more similar to the natural environment which allows for supplementary food such as insects to come in and for the fish to be better adapted to the environments they will eventually be released into. They also are inexpensive to maintain as there is typically no power output required for water exchange.

Some hatcheries described first ponding their fish into one rearing container and transferring them to another after marking or after a certain size was reached to lower densities. Secondary rearing was most used for coho yearling smolts because they spend the most time at the hatchery and get to the largest sizes at the hatchery, but may be used for other species as well.

As with the incubation containers, there is limited literature on which rearing containers are preferable. The rearing containers used at hatcheries were often said to be based on availability and donations from other hatcheries and limited by the space and water supply available on-site.

Table 23: Incubation and rearing containers used at each included hatchery.

Hatchery	Incubation	Rearing	Secondary Rearing
ALLCO Hatchery	Bulk incubators, Heath trays	Capilano troughs, Circular tubs	
Bearskin Bay Hatchery	Heath trays	Capilano troughs	
Bell-Irving Hatchery	Heath trays, Upwelling incubators	Capilano troughs	Earthen ponds
Cowichan R Hatchery	Bulk incubators, Heath trays	Raceways	
Dunn Cr Hatchery	Heath trays	Capilano troughs	Raceways
Eby Street Hatchery	Heath trays	Capilano troughs	Raceways
Fanny Bay Hatchery	Not mentioned in interview	Circular tubs	Burrows ponds
Four Mile Cr Hatchery	Bulk incubators, Heath trays, Upwelling incubators	Capilano troughs, Circular tubs	Freshwater net pens
Goldstream Hatchery	Heath trays	Circular tubs	
Grist Goesen Memorial Hatchery	Heath trays	Capilano troughs	Circular tubs
Gwa'ni Hatchery	Bulk incubators	Swedish tubs	
Hartley Bay Hatchery	Heath trays	Capilano troughs	Circular tubs
Klemtu Hatchery	Bulk incubators, Heath trays, Kitoi boxes	Capilano troughs	
Marble R Hatchery	Not mentioned in interview	Capilano troughs, Circular tubs, Freshwater net pens	Seapens
McLoughlin Hatchery	Atkin cells, Heath trays, Keeper boxes, Kitoi boxes	Capilano troughs	
Mossom Cr Hatchery	Heath trays	Capilano troughs	Circular tubs, Seapens
Nanaimo R Hatchery	Bulk incubators, Heath trays, Siphon box	Capilano troughs, Circular tubs, Freshwater net pens, Raceways	Earthen ponds
Nelson Cr Hatchery	Heath trays	Capilano troughs	
Oldfield Cr Hatchery	Heath trays	Capilano troughs	
Oyster R Hatchery	Heath trays, Moist incubators	Not mentioned in interview	
Powell R Hatchery	Bulk incubators, Heath trays	Capilano troughs, Circular tubs	
Quatse R Hatchery	Bulk incubators, Heath trays	Capilano troughs	Freshwater net pens
Seymour R Hatchery	Bulk incubators, Heath trays	Capilano troughs	Earthen ponds

Hatchery	Incubation	Rearing	Secondary Rearing
Sooke R Hatchery	Heath trays	Capilano troughs, Circular tubs	
Spruce City Hatchery	Heath trays	Super troughs	
Tahsis Hatchery	Heath trays	Raceways	
Terminal Cr Hatchery	Heath trays	Capilano troughs, Powell River tanks	
Thornton Cr Hatchery	Bulk incubators, Heath trays	Capilano troughs, Raceways	
Tla'amin Hatchery	Bulk incubators, Circular incubators, Heath Trays	Capilano troughs	Circular tubs
Toboggan Cr Hatchery	Heath trays, Moist incubators	Capilano troughs, Rectangular troughs	Earthen ponds
Tofino Hatchery	Not mentioned in interview	Capilano troughs, Raceways	
Yakoun R Hatchery	Heath trays	Freshwater net pens	

Water

Water temperature and availability is one of the most important factors to consider when rearing fish in a hatchery. Most of the participants used gravity-fed systems but some had access to pumped water from wells on the hatchery site or from other sources. The gravity-fed systems relied entirely on surface water from rivers, streams, lakes and reservoirs. Some hatcheries, including ALLCO, described issues with heavy siltation during winter storms and high runoff, which is especially of concern while rearing eggs. There are solutions to this, such as settling reservoirs and filters, but these are not practical for all hatcheries. Other issues mentioned by interviewees included ice and freezing pipes and intakes that had to be manually cleared so that flow could continue, as was the case at Oyster R.

Because of the variety of water sources and the hatchery locations across the province, the temperature of the water varied greatly. Many interviewees expressed concerns for temperature and water flow at the hatchery, especially during the drier and hotter summer months. On the other hand, sufficiently warm water is also important because the growth and development of salmonids, specifically during the egg and alevin stages in early life, are dictated by accumulated thermal units (ATUs). The progression through early life stages varies between species but takes longer if the water is colder. Some hatcheries address this by heating their water (e.g., Seymour R) or using a mix of groundwater (that is more consistently temperate throughout the year) and surface water (e.g., Nanaimo R).

According to the CIP BMPs, the ideal temperature range for salmonids is between 3°C and 18°C (SEP 2013). This is achievable for most facilities at most times of the year either through use of surface water, groundwater or a combination of the two. Water source and the yearly maximum and minimum temperatures were asked of each hatchery. All included hatcheries are within the ideal range for at least some of the year but some fall above or below it at the extremes (Figure 8). Some hatcheries had multiple water sources and therefore had multiple ranges shown on the figure.

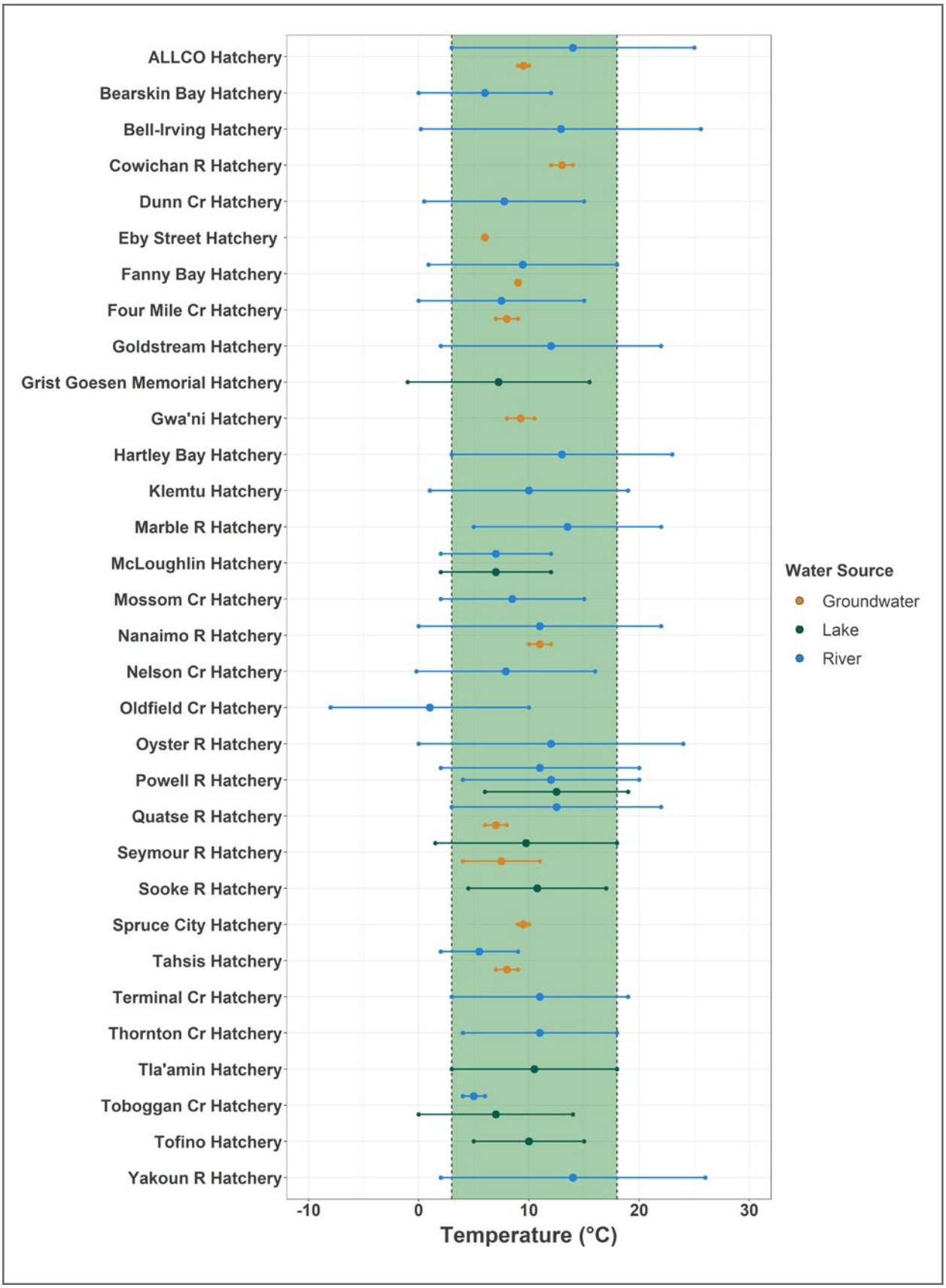


Figure 8: Rearing water temperatures for community hatcheries. The green window is the ideal temperature for rearing salmon according to the CIP BMPs (SEP 2013).

On-site Survival Rates

Interviewees were asked about average survival rates from egg to release in their hatcheries (Table 24). When hatcheries provided a survival rate range, the average was taken to simplify comparison. If participants said that survival was in the "high 80s" or "high 90s", they were given an 87% or 97% respectively. Because the managers were asked about average survival rate, many of these numbers were likely estimates and may not accurately reflect survival in a given year. A higher survival rate is clearly favorable and so participants likely provided relatively high estimates to reflect positively on their hatcheries. The information provided shows that most fish are surviving until release and that enhancement efforts are increasing juvenile survival rates to be much higher than they would be in the wild, which ranged from 1.5 – 8.6% for egg-to-smolt survival (Chinook, sockeye, coho) and 7 – 9% for egg-to-fry (pink, chum) (Bradford 1995). Some hatcheries mentioned that there are years with high mortality due to disease or fungus outbreaks. For example, Goldstream said that their survival rate was only 20% when they were dealing with Saprolegnia spores and Dunn Cr said that theirs fell to 49% due to bacterial gill disease. Some also mentioned incidences with water, whether through interrupted flow or heavy silt, which caused higher mortality. When such events have occurred, CAs have been contacted for advice on how best to proceed.

Table 24: Egg to release survival rates provided by community hatchery interviewees. Species were included when provided during the interview.

Hatchery	Species	Survival Rate
Marble R Hatchery	Unspecified	98.50%
Nelson Cr Hatchery	Unspecified	97.80%
Grist Goesen Memorial Hatchery	Unspecified	97%
Thornton Cr Hatchery	Coho	96%
Gwa'ni Hatchery	Unspecified	95%
Powell R Hatchery	Chum	95%
Spruce City Hatchery	Chinook	95%
Tofino Hatchery	Unspecified	95%
Mossom Cr Hatchery	Unspecified	94.60%
Sooke R Hatchery	Chinook	94%
ALLCO Hatchery	Unspecified	93.50%
Powell R Hatchery	Chinook	93%
Terminal Cr Hatchery	Coho	93%
Thornton Cr Hatchery	Chinook	93%
Fanny Bay Hatchery	Unspecified	92.50%
Bell-Irving Hatchery	Coho	92%
Goldstream Hatchery	Unspecified	92%
Yakoun R Hatchery	Chinook	92%
Yakoun R Hatchery	Coho	92%
Powell R Hatchery	Coho	91.50%
Oldfield Cr Hatchery	Coho	90%

Hatchery	Species	Survival Rate
Oldfield Cr Hatchery	Chinook	90%
Oyster R Hatchery	Unspecified	90%
Quatse R Hatchery	Unspecified	90%
Tahsis Hatchery	Unspecified	90%
Toboggan Cr Hatchery	Coho	90%
Toboggan Cr Hatchery	Chinook	90%
Bearskin Bay Hatchery	Unspecified	89%
Klemtu Hatchery	Coho	89%
Cowichan R Hatchery	Unspecified	88.50%
Dunn Cr Hatchery	Unspecified	87.50%
Nanaimo R Hatchery	Coho	87.50%
Tla'amin Hatchery	Chinook	87.50%
Bell-Irving Hatchery	Chum	87%
Eby Street Hatchery	Unspecified	87%
Four Mile Cr Hatchery	Unspecified	85%
Tla'amin Hatchery	Chum	85%
Tla'amin Hatchery	Coho	82.50%
Thornton Cr Hatchery	Chum	82%
Hartley Bay Hatchery	Unspecified	80%
Seymour R Hatchery	Unspecified	80%
Sooke R Hatchery	Coho	77.30%
McLoughlin Hatchery	Unspecified	Depends on the year

Biosecurity

All of the included hatcheries had certain biosecurity protocols to maintain fish safety. Many took simple and effective biosecurity measures like using hand sanitizer regularly and keeping tools separate for each rearing container. Most facilities used Ovadine for disinfecting their eggs. Yakoun R said that they believed Ovadine hardened the eggs and have been choosing not to disinfect their eggs in recent years with no detriment to their fish. For cleaning equipment and tools, hatcheries typically used either Ovadine or Virkon. Virkon was also often used in foot mats at the entrance of certain areas to clean the shoes of staff and volunteers. When dealing with fungus, Parasite-S was often used but some hatcheries instead treated their fish with salt. For issues with bacterial gill disease, Chloramine-T was typically used. Several facilities that did seapen releases mentioned vaccinating their fish for Vibrio. Sending in BKD samples, especially for coho, and culling eggs when necessary was also relatively common.

Marking and Tagging

Marking and tagging juveniles is a particularly important part of releasing hatchery fish. Not only does it allow for assessment of enhanced contribution in hatchery systems, but it can also be used to specifically target hatchery fish in fisheries. The type of marking and tagging done at each hatchery was compared between the hatchery and CA interviews and any discrepancies were investigated and revised. Differences in reported parentage-based tagging (PBT) were ignored because many hatcheries reported collecting DNA as part of the biodata collection from broodstock, but most did not specify what it was for. There were no concerns about tag loss at any of the facilities. When adipose clipping, tricaine methanesulfonate (TMS) was often mentioned as the anesthetic of choice however some facilities reported using clove oil instead.

Unassociated Releases

Some of the hatcheries interviewed conducted no form of marking or tagging on any of their fish released (Table 25). Most of these facilities were in the BC North Coast region, and they all released coho. According to SEP (2019), all Southern BC coho should have PBT and be adipose clipped however this was not the case. Nelson Cr, Powell R, and Terminal Cr are all in Southern BC and all of their salmon, including coho, were released as unassociated, unmarked releases. At the time of interviews, Nelson Cr and Terminal Cr were releasing 18,000 and 8,500 coho respectively, so their unmarked coho releases are relatively small. However, Powell R was releasing 260,000 unmarked coho to the Southern BC area.

Most of the facilities that do not mark or tag fish cited a lack of funding as the main limitation. Although cost and resource intensive, marking and tagging allow for data that is invaluable for hatchery programs. It is challenging to measure the PNI of a system and maintain the genetic integrity of the stock if there is no way of distinguishing between hatchery and wild fish. It is also important to know if hatchery released fish are being caught and how many of them end up in escapement, which can only be accomplished with marking or tagging. Some of the hatcheries said that they would be interested in implementing a marking and/or tagging program but this would require resources and funding.

Some of the hatcheries mark or tag certain species that they release but also have unassociated releases (Table 25). The unmarked/unassociated releases consist primarily of pink and chum but both ALLCO and Grist Goesen release their Chinook unmarked. If greater information on hatchery returns is desired, implementing a marking or tagging program in these facilities for these species would be beneficial.

Table 25: Community hatcheries that do not mark or tag the specified species of released salmon.

Hatchery	Species	Explanation
ALLCO Hatchery	Chinook, Chum, Pink	
Bearskin Bay Hatchery*	Coho, Chum, Pink	Would like to implement
Bell-Irving Hatchery	Chum, Pink	
Dunn Cr Hatchery*	Coho	Lack funding
Fanny Bay Hatchery	Chum	
Goldstream Hatchery	Chum	
Grist Goesen Memorial Hatchery	Chinook	
Hartley Bay Hatchery*	Coho	Lack funding
Klemtu Hatchery*	Coho, Chum	Lack funding, would consider implementation with funding
McLoughlin Hatchery*	Coho, Chum	Uncertain why it stopped

Hatchery	Species	Explanation
Mossom Cr Hatchery	Chum, Pink	Fry are too small at time of release
Nanaimo R Hatchery	Chum	
Nelson Cr Hatchery*	Coho, Chum	Believes fish are released too small
Oldfield Cr Hatchery*	Chinook, Coho, Chum	Do not have expertise
Oyster R Hatchery	Chum, Pink	
Powell R Hatchery*	Chinook, Coho, Chum	Lack funding, would consider implementation with funding
Quatse R Hatchery	Pink	
Seymour R Hatchery	Chum, Pink	
Terminal Cr Hatchery*	Coho, Chum	Would like to implement if returns are sufficient
Thornton Cr Hatchery	Chum	
Tla'amin Hatchery	Chum	
Tofino Hatchery	Chum	
Yakoun R Hatchery*	Chinook, Coho	No explanation provided

* Hatcheries that do not mark or tag any of the salmon that they release

Pink and chum

Only two of the included community hatcheries marked their chum or pink salmon and both did so with thermal otolith marking (Table 26). Because chum and pink are typically released at a small size, adipose clipping or inserting CWTs would be challenging. Thermal marking is not size dependent and can be done before the fish have hatched. Although marking these species is uncommon, it does allow for improved data collection and was used to determine enhanced contribution in the Nanaimo R watershed by recovering pink carcasses to collect otolith samples.

Chinook

Most facilities that released Chinook salmon were marking or tagging them (Table 26). Chinook were marked and tagged using every common method available and sometimes had multiple used in concert. PBT is the least cost and effort intensive as data can be taken from broodstock before fertilization. Thermal marking is also relatively easy to implement since it can be done in bulk. However, thermal marking is limited by access to two different water sources that differ in temperature enough to clearly mark the otoliths and is a multi-day event. Thermal marking Chinook took about 9 days at Sooke R and up to 21 days at Tahsis. In Canada, an adipose clip indicates the presence of a CWT in Chinook salmon (SEP 2019). This requirement increases the cost and effort of marking programs because they must insert CWTs into all Chinook salmon that are adipose clipped and vice versa. One program said that they wished they could just adipose clip their Chinook because inserting CWTs was costly and required greater effort but this suggestion was declined by their CA. Passive integrated transponder (PIT) tags were used in certain systems on a subset of the released Chinook (5000 for both Cowichan R and Thornton Cr). These tags can be read by antennae positioned in rivers or elsewhere and collect data on fish migration and returns without requiring the collection of carcasses. PIT tags can passively provide a significant amount of information on returning salmon and are a valuable tool in systems or stocks needing greater assessment.

Coho

All coho released from hatcheries that were marked or tagged were adipose fin clipped (Table 26). All hatchery coho in Southern BC should be adipose clipped and sampled for PBT (Salmonid Enhancement Program 2019). However, Grist Goesen, Mossom Cr, Nanaimo R, and Seymour R hatchery did not report using PBT for their coho. Because the fish are adipose clipped, one can distinguish between hatchery and wild fish but with PBT, one can confirm the hatchery of origin of the fish. This would allow for straying between systems to be evaluated and should be implemented when possible. Only two hatcheries (Eby Street and Toboggan Cr), both on the North Coast, marked their coho salmon with CWTs and only one (Goldstream) had a PIT tagging program for coho. A few facilities, including Eby Street and Mossom Cr, had contractors or DFO volunteers come in and do the marking and tagging for them.

Table 26: Community hatcheries that mark or tag released salmon.

Hatchery	Type of Mark/Tag	Species
Cowichan R Hatchery	Adipose Clip, CWTs, Thermal, PIT Tags	Chinook
Four Mile Cr Hatchery	Thermal	Chinook
Goldstream Hatchery	PBT	Chinook
Gwa'ni Hatchery	Thermal	Chinook
Marble R Hatchery	Thermal	Chinook
Nanaimo R Hatchery	Thermal, PBT, PIT tags	Chinook
Oyster R Hatchery	PBT	Chinook
Sooke R Hatchery	Thermal, PBT	Chinook
Spruce City Hatchery	PBT	Chinook
Tahsis Hatchery	Thermal, PBT	Chinook
Thornton Cr Hatchery	CWTs, PIT tags, PBT	Chinook
Tla'amin Hatchery	PBT	Chinook
Toboggan Cr Hatchery	CWT, Adipose Clip, PBT	Chinook
Tofino Hatchery	CWTs, Adipose Clip, PBT	Chinook
Gwa'ni Hatchery	Thermal	Chum
ALLCO Hatchery	Adipose Clip, PBT	Coho
Bell-Irving Hatchery	Adipose Clip, PBT	Coho
Eby Street Hatchery	Adipose Clip, PBT, CWTs	Coho
Fanny Bay Hatchery	Adipose Clip, PBT	Coho
Goldstream Hatchery	Adipose Clip, PBT, PIT Tags	Coho
Grist Goesen Memorial Hatchery	Adipose Clip	Coho
Marble R Hatchery	Adipose Clip, PBT	Coho
Mossom Cr Hatchery	Adipose Clip	Coho
Nanaimo R Hatchery	Adipose Clip	Coho
Oyster R Hatchery	Adipose Clip, PBT	Coho
Quatse R Hatchery	Adipose Clip, PBT	Coho
Seymour R Hatchery	Adipose Clip	Coho
Thornton Cr Hatchery	Adipose Clip, PBT	Coho
Tla'amin Hatchery	Adipose Clip, PBT	Coho
Toboggan Cr Hatchery	Adipose Clip, CWTs, PBT	Coho
Tofino Hatchery	Adipose Clip, PBT	Coho
Nanaimo R Hatchery	Thermal	Pink

Releases and Transfers

Deviations from the 2019 and 2020 Production Plans

The following are detailed discrepancies between the interview data and the Production Plan. These deviations have been compared explicitly with the intention of highlighting where production planning should be modified or where issues should be addressed with hatcheries. These hatcheries are otherwise producing the fish that have been specified on the Production Plan.

Releases

BC North Coast

Hartley Bay has production targets for both chum fry and coho yearling smolts, neither of which they are currently releasing. Stan Robinson (Hatchery Manager) said that they have difficulty collecting enough chum broodstock in the river to run the program, and water temperature and flow prevent them from keeping coho smolts over the summer. Both releases were removed from the release data used in this report. According to the Production Plan, Klemtu should be releasing coho fed fry. Based on the information from the interviews with Ian Douglas (CA) and Brent Mason (Hatchery Manager), they only release coho from seapens. The coho fed fry releases were removed from the production plan release data that were used in Figures 10-13.

According to the Production Plan and Ian Douglas (CA), McLoughlin should be releasing chum fed fry and coho yearling smolts from seapens. Andrea Larson (Hatchery Manager) explained that the previous seapens were unsafe and have been decommissioned. They are currently rebuilding a seapen for the coho. These releases were recategorized as chum fed fry and coho yearling smolts instead of seapen releases.

On the Production Plan, Oldfield Creek has release targets for chum fry. Rob Dams (CA) explained that the chum program has been suspended until incubation recirculation is working because otherwise there are issues with the temperature of the water. The chum fry were removed from the release data.

BC South Coast

The Production Plan for Cowichan River notes a release of Chinook as sub-yearling smolts, but JR Elliot (Hatchery Manager) said that they release them as two different sizes of fry. He explained that they now try to release them closer to the size of wild fish because when they released them larger in the past, they were observed eating wild Chinook. The release stage was modified to fed fry in the report data. Fanny Bay has a release target for pink unfed fry but this program is no longer occurring according to Judy Ackinclose (Hatchery Manager). The pink were being supplied by Quinsam hatchery but releases were dialed back to zero in 2021. The pink unfed fry releases were removed from the report data.

Gwa'ni has a release target for pink unfed fry according to the Production Plan and Dave Davies (CA). Hank Nelson (Hatchery Manager) did not provide any information on pink other than to say that they are not very abundant and the release target is resource dependent. From the information gathered, they are not currently releasing pinks and the line of production was removed. Marble River should be releasing coho yearling smolts according to the Production Plan, but Deb Anderson (Hatchery Manager) said that they have not released coho in many years. According to Dave Davies (CA), coho are not collected unless they are collecting Chinook because it is too expensive to do one without the other. Coho yearling smolts were removed from the release data for Marble River.

There is a release target for unfed Chinook fry at Nanaimo River but after clarifying with Erica Blake (CA), this seems to be an error on the Production Plan. There is also a release target for pink unfed fry, but the interview information stated that all pink are released from seapens. These production lines were removed.

Tahsis is supposed to release Chinook sub-yearling smolts but according to the interviews with Don Beamin (Hatchery Manager) and Laura Terry (CA), they only release Chinook from seapens. The production line for Chinook sub-yearling smolts was removed from the release data.

In the Production Plans, there is a line for the production and release of coho yearling smolts from Thornton Creek. Dave Hurwitz (Hatchery Manager) did not mention them during the interview and Erica Blake (CA) stated that it was difficult to justify keeping staff over the summer to release them. Therefore, coho yearling smolts were removed from their release data.

Doug Palfrey (Hatchery Manager) from Tofino mentioned using seapens but upon clarification with Erica Blake (CA), they were last operational in 2009. This discrepancy may be due to the manager referring to their use in years past. The release data for Tofino seapen Chinook was removed.

Lower Fraser River

ALLCO should be releasing sockeye fed fry according to the Production Plan but this is currently a proposed program that has not been implemented yet. From the interviews, they are also releasing pink unfed fry but this is not included on the 2020 Production Plan. It is included in the 2021 Production Plan so it is possible that the hatchery was referencing future production when they mentioned a pink release. The sockeye fed fry release has been removed from the release data for this report.

Grist Goesen had a release target for coho unfed fry. Brian Simonson (Hatchery Coordinator) and Scott Ducharme (CA) noted that these coho were actually released as fed fry. The life stage of release for this coho target should be modified from unfed to fed fry.

The Production Plan includes a coho fed fry release for Mossom Creek but after clarifying with Brian Smith (CA) and Kevin Ryan (Founder) at the hatchery, that program is not currently running. Therefore, this line of production was removed.

From the interview with Seymour River, they should be releasing pink unfed fry but this was not included in the 2020 Production Plan. The 2021 Production Plan includes it and the interview may have been referencing future production.

Bell-Irving has a release target for pink fry, but Scott Ducharme (CA) and Darin McLain (Hatchery Manager) expressed difficulties with the program. Scott said that broodstock collection has been difficult and Darin explained that they have not had pink in years. Pink fry at Bell-Irving was removed from the release data.

BC Interior

Spruce City has Production Plan release targets for Chinook sub-yearling smolts and pink unfed fry, neither of which they are currently releasing. According to the interviews, they are only rearing and releasing Chinook and all are released as fed fry. Both of these targets were removed from the report's release data.

Photo by: Nicole Christiansen

Release Targets

Only "Primary" production targets were included because including "Alternative" strategies adds redundancy by occasionally counting releases twice. For the following information, only releases are included and therefore not all production at the hatchery may be comprehensively included. Because they were not discussed in the interviews, eyed egg releases were also removed from the release data. There were only eyed egg targets for chum and all facilities that had a release target for eyed eggs also released them as fed fry. Primary releases from each facility are summarized in Table 27. For specific information on release locations see Appendix A5. Hatchery Release Sites.

Table 27: Species and life stage information contributions for each hatchery of all included hatcheries. Hatcheries are from one of four regional areas: BC Interior (INT), Lower Fraser River (LFR), BC South Coast (SC), or BC North Coast (NC).

Hatchery	Area	Species	Life Stage	Percent
ALLCO Hatchery	LFR	Chinook	Smolt 0+	24%
		Chum	Fed Fry	65%
		Coho	Fed Fry	7%
		Coho	Smolt 1+	4%
Bearskin Bay Hatchery	NC	Chum	Fed Fry	62%
		Coho	Fed Fry	38%
Bell-Irving Hatchery	LFR	Chum	Fed Fry	80%
		Coho	Fed Fry	12%
		Coho	Smolt 1+	9%
Cowichan R Hatchery	SC	Chinook	Fed Fry	100%
Dunn Cr Hatchery	INT	Coho	Smolt 1+	100%
Eby Street Hatchery	NC	Coho	Smolt 1+	100%
Fanny Bay Hatchery	SC	Chum	Fed Fry	82%
		Coho	Smolt 1+	18%
Four Mile Cr Hatchery	SC	Chinook	Smolt 0+	100%
Goldstream Hatchery	SC	Chinook	Smolt 0+	8%
		Chum	Fed Fry	60%
		Coho	Fed Fall	12%
		Coho	Smolt 1+	20%
Grist Goesen Memorial Hatchery	LFR	Chinook	Smolt 0+	42%
		Coho	Fed Fry	42%
		Coho	Smolt 1+	17%
Gwa'ni Hatchery	SC	Chinook	Smolt 0+	8%
		Chum	Fed Fry	70%
		Chum	Seapen	22%
Hartley Bay Hatchery	NC	Coho	Fed Fry	100%
Klemtu Hatchery	NC	Chum	Seapen	96%
		Coho	Seapen 1+	4%

Hatchery	Area	Species	Life Stage	Percent
Marble R Hatchery	SC	Chinook	Seapen 0+	9%
		Chinook	Smolt 0+	91%
McLoughlin Hatchery	NC	Chum	Fed Fry	98%
		Coho	Smolt 1+	2%
Mossom Cr Hatchery	LFR	Chum	Fed Fry	48%
		Coho	Smolt 1+	4%
		Pink	Unfed	48%
Nanaimo R Hatchery	SC	Chinook	Fed Fry	2%
		Chinook	Smolt 0+	17%
		Chum	Unfed	24%
		Coho	Fed Fry	3%
		Coho	Smolt 1+	2%
		Pink	Seapen	52%
Nelson Cr Hatchery	LFR	Chum	Fed Fry	78%
		Coho	Fed Fry	22%
Oldfield Cr Hatchery	NC	Chinook	Fed Fry	33%
		Coho	Fed Fall	26%
		Coho	Fed Fry	22%
		Coho	Smolt 1+	11%
		Coho	Unfed	7%
Oyster R Hatchery	SC	Chinook	Smolt 0+	3%
		Chum	Fed Fry	31%
		Coho	Fed Fry	2%
		Coho	Smolt 1+	2%
		Pink	Unfed	61%
Powell R Hatchery	SC	Chinook	Fed Fry	12%
		Chinook	Smolt 0+	51%
		Chum	Fed Fry	27%
		Coho	Fed Fry	10%
Quatse R Hatchery	SC	Chum	Fed Fry	4%
		Coho	Smolt 1+	10%
		Pink	Unfed	86%
Seymour R Hatchery	LFR	Chum	Fed Fry	83%
		Coho	Fed Fry	13%
		Coho	Smolt 1+	4%

Hatchery	Area	Species	Life Stage	Percent
Sooke R Hatchery	SC	Chinook	Smolt 0+	11%
		Chinook	Smolt 0+	68%
		Coho	Fed Fry	21%
Spruce City Hatchery	INT	Chinook	Fed Fry	100%
Tahsis Hatchery	SC	Chinook	Seapen 0+	100%
Terminal Cr Hatchery	LFR	Chum	Fed Fry	59%
		Coho	Fed Fry	8%
		Pink	Unfed	33%
Thornton Cr Hatchery	SC	Chinook	Fed Fry	14%
		Chinook	Smolt 0+	7%
		Chum	Fed Fry	77%
		Coho	Fed Fry	2%
Tla'amin Hatchery	SC	Chinook	Smolt 0+	6%
		Chum	Fed Fry	45%
		Chum	Unfed	45%
		Coho	Fed Fry	4%
Toboggan Cr Hatchery	SC	Chinook	Fed Fall	41%
		Coho	Smolt 1+	41%
		Coho	Unfed	18%
Tofino Hatchery	SC	Chinook	Smolt 0+	48%
		Chum	Fed Fry	38%
		Coho	Fed Fry	14%
Yakoun R Hatchery	NC	Chinook	Smolt 0+	64%
		Coho	Fed Fry	10%
		Coho	Smolt 1+	26%

Photo by: Nicole Christiansen

BC North Coast

McLoughlin and Klemtu released the most salmon in the region with approximately 1,800,000 and 1,100,00 fish respectively (Figure 9). The rest of the facilities released fewer fish with the smallest targets being Toboggan Cr releasing 85,000 and Eby Street releasing 50,000. Of the eight included community hatcheries from the BC North Coast, coho were produced at every hatchery with a cumulative release of just over 800,000 coho. Chum dominated production in the region with a cumulative release target of just over 3,000,000. Three facilities also had targets for Chinook but in relatively small amounts with a cumulative release of just over 300,000 salmon. None of the facilities on the North Coast are currently releasing any pink or sockeye salmon.

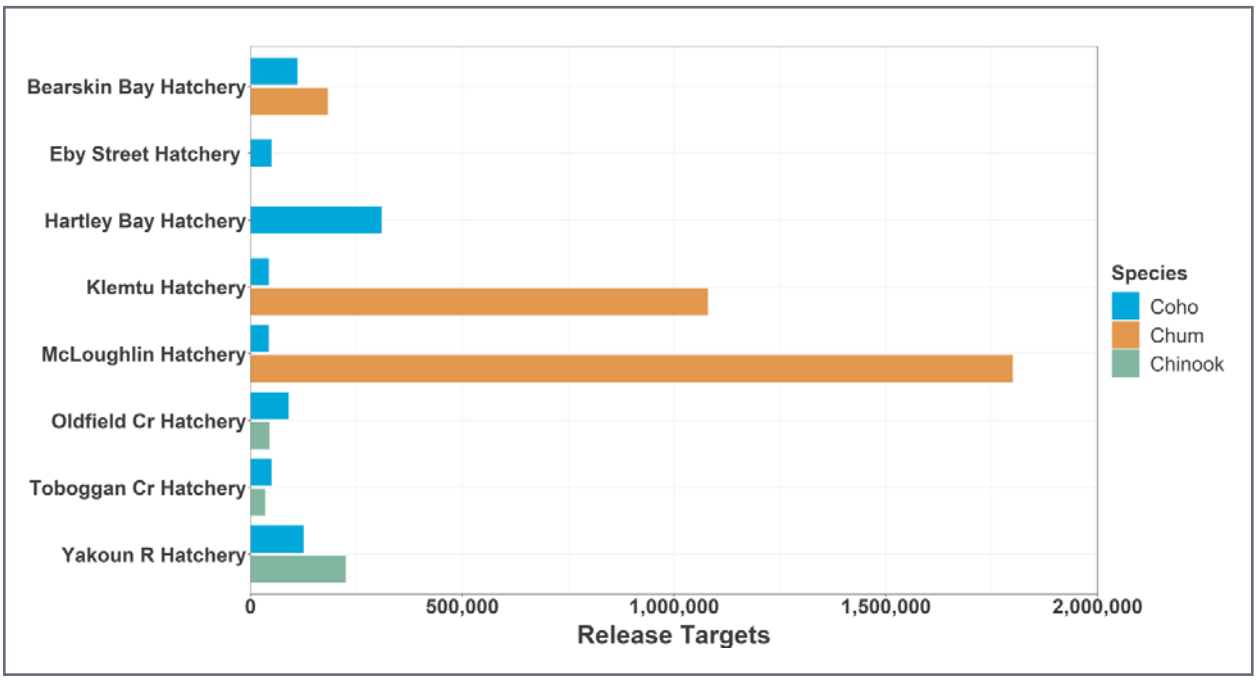


Figure 9: Release targets for the community hatcheries from the BC North Coast region. Release data was derived from the 2019 and 2020 IFMP Production Plans and modified based on information from the hatchery and CA interviews.


Photo by: Nicole Christiansen

BC South Coast

Gwa'ni released the most fish in the area at just over 4,100,000 million total releases per year (Figure 10). Nanaimo R, Powell R, and Quatse R were close behind at 3,800,000 million for Nanaimo R and approximately 2,500,000 for the other two facilities. Tahsis and Fanny Bay contributed the least to fish production in the area with 300,000 and 330,000 salmon released respectively. For the BC South Coast hatcheries, chum had the greatest cumulative release target with just under 9,400,000 being released each year. Chinook and pink were not far behind with release targets in the region of about 6,500,000 and 5,100,000 respectively. There were substantially fewer coho released with all 15 south coast hatcheries releasing a bit over 1,300,000 coho salmon.

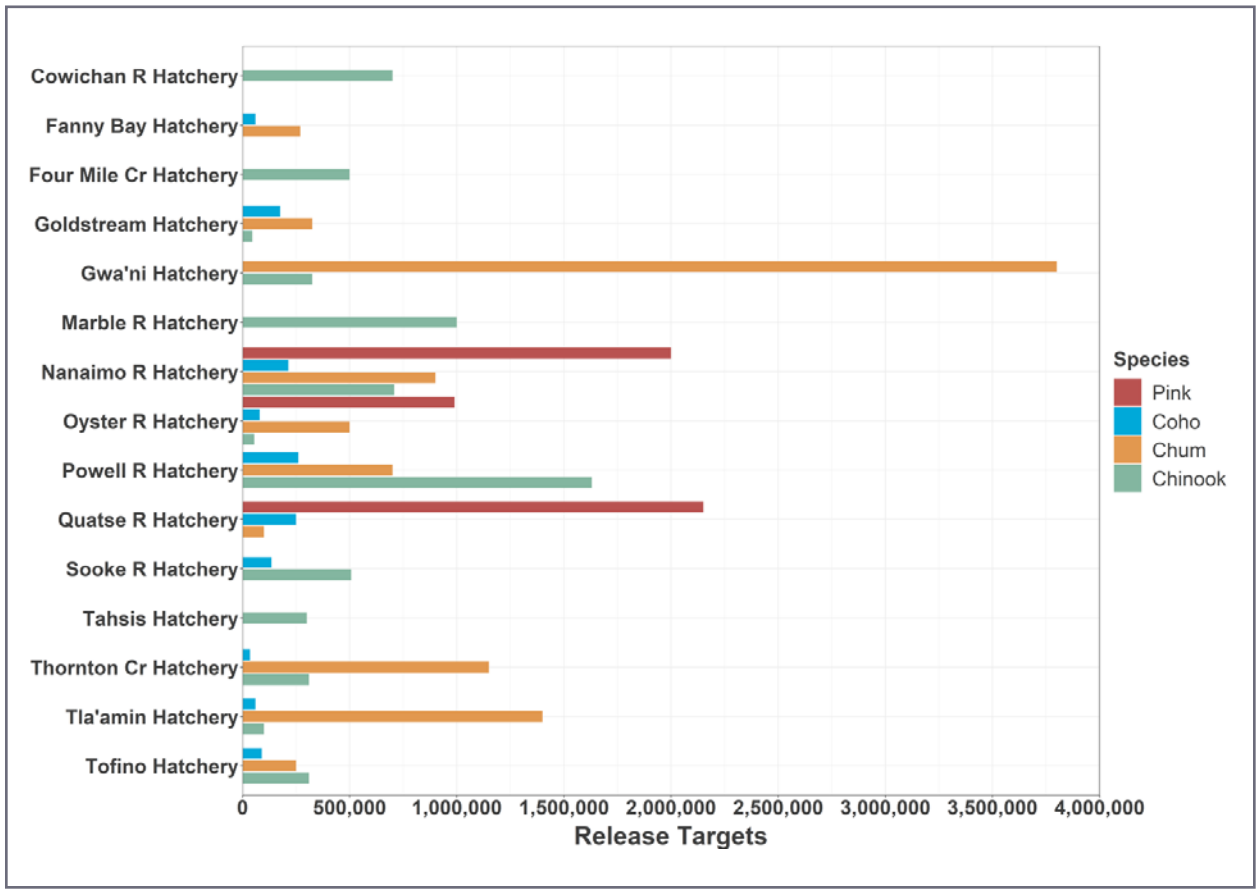
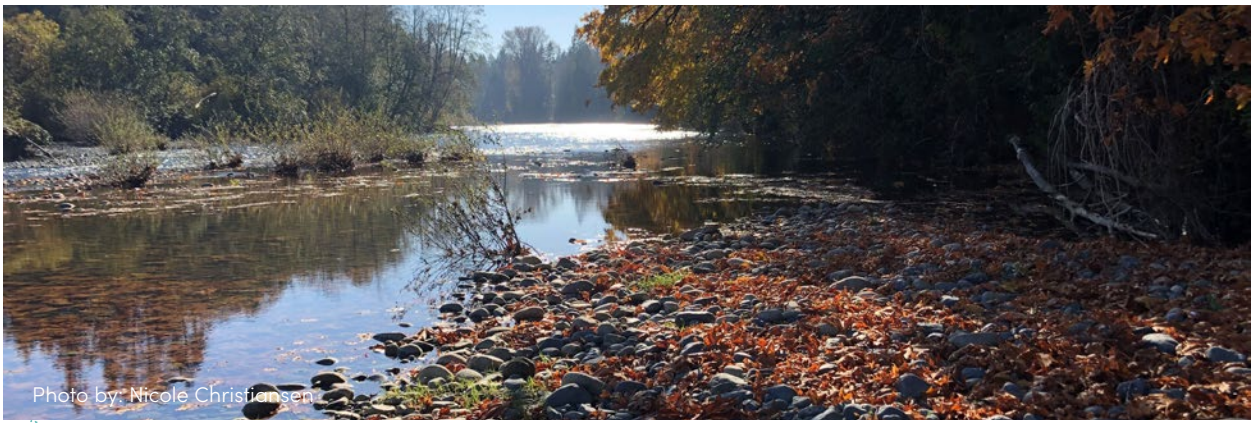


Figure 10: Release targets for the community hatcheries from the BC South Coast region. Release data were derived from the 2019 and 2020 IFMP Production Plans and modified based on information from the hatchery and CA interviews.



Lower Fraser River

Seymour R had the largest cumulative release target and produced just over 1,000,000 salmon per year (Figure 11). ALLCO was next with 620,000 salmon released. Nelson Cr, Terminal Cr, and Grist Goesen had a combined release target of under 500,000 and individually did not contribute substantially to releases in the region. In the Lower Fraser River region, the hatcheries released more chum, at just over 1,900,000, than any other species. There were 240,000 pink and just over 400,000 coho released. The target for Chinook releases is 200,000 reared at two hatcheries.

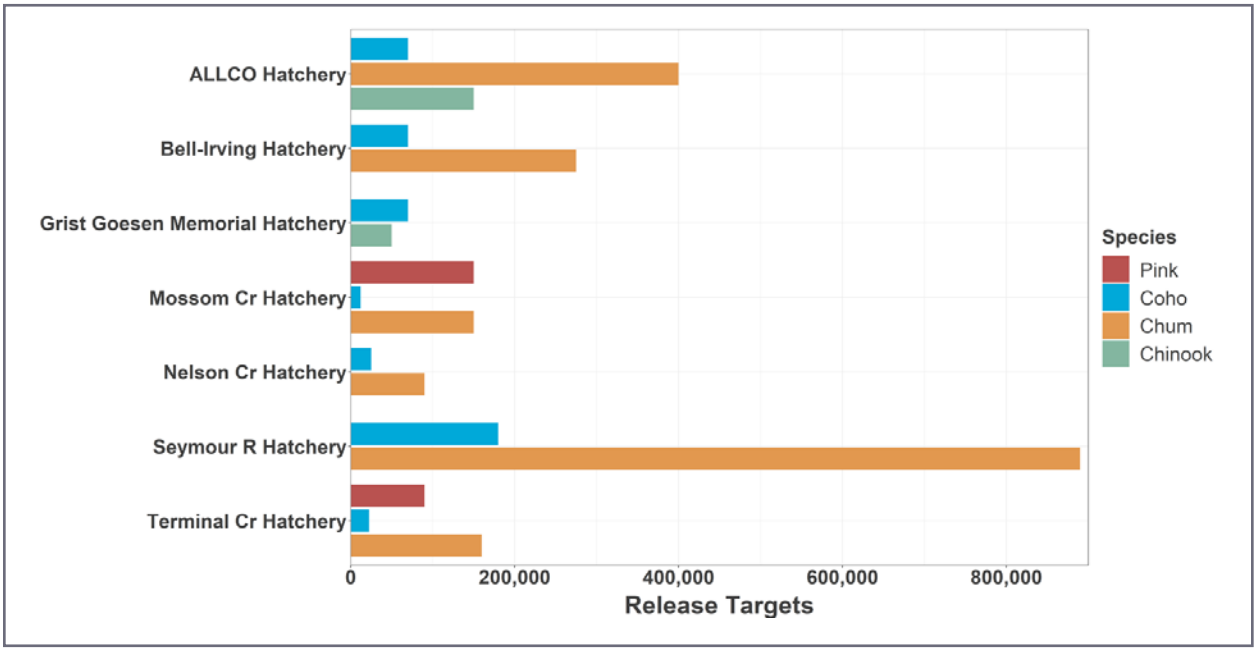


Figure 11: Release targets for the community hatcheries from the Lower Fraser River region. Release data were derived from the 2019 and 2020 IFMP Production Plans and modified based on information from the hatchery and CA interviews.

BC Interior

There were only two hatcheries included that were from the BC Interior region and each produced only one species (Figure 12). Dunn Cr was responsible for all 30,000 of the coho and Spruce City releases 44,500 Chinook each year. Neither produce any pink or chum salmon.

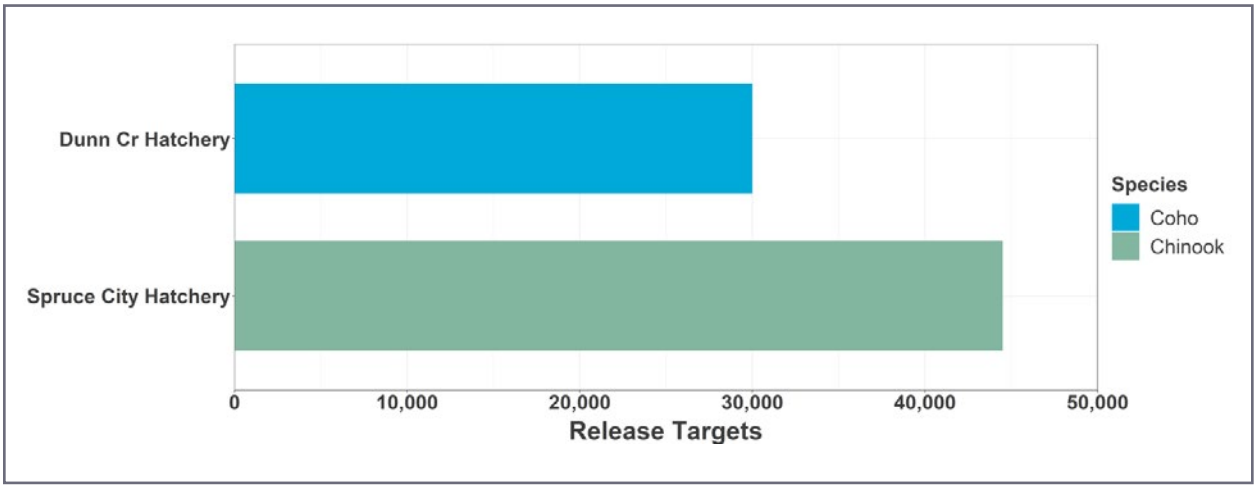


Figure 12: Release targets for the community hatcheries from the BC Interior region. Release data were derived from the 2019 and 2020 IFMP Production Plans and modified based on information from the hatchery and CA interviews.

Transfer Targets

We did not explicitly ask a question about Transfers during the interviews so these targets could not be revised as done with the release targets. These values are taken directly from the Production Plans and have not been modified. Based on the many deviations of release targets from the Production Plan, the transfer targets should be considered tentatively.

Transfer-In Targets

Some of the hatcheries have lines on the Production Plan corresponding to receiving transfers from other facilities (Figure 13). Often, transfers are used when the existing stock of that species in the system is extremely depleted, or it is difficult to collect sufficient broodstock.

These transfers are primarily done at the egg stage so that the receiving hatchery takes on most of the work associated with rearing the fish, but Grist Goesen receives Chinook fry from Chilliwack R and Sooke R receives Chinook smolts from Nitinat R. Most of the transfers come from major SEP facilities however Deadman R (not included in the interviews) and Alouette R (ALLCO) are both CIP facilities that transfer salmon to some of the CIP hatcheries.

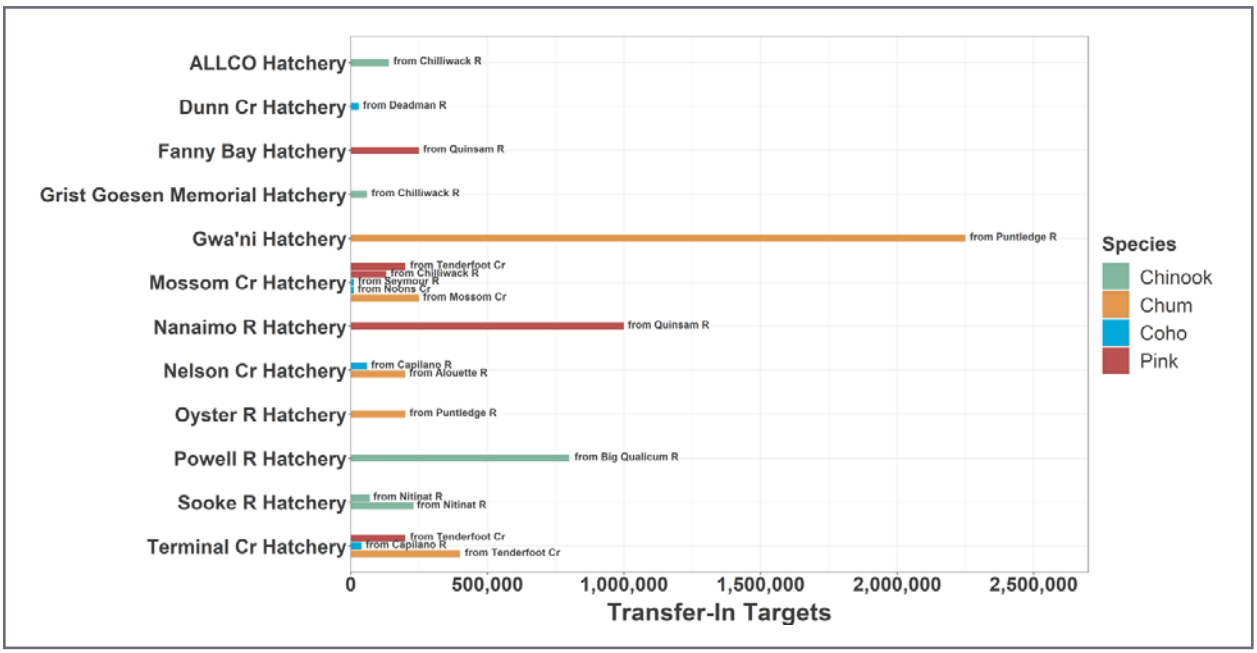


Figure 13: Transfer-in targets for the community hatcheries. Transfer data were derived from the 2019 and 2020 IFMP Production Plans.


Photo by: Nicole Christiansen

Transfer-Out Targets

Transfers out of hatcheries were filtered to create a two separate lists; one for transfers to other facilities and another for transfers to other projects that reared salmon specifically for schools and education centres. Many of the included hatcheries that were involved with education had numerous transfer targets to schools and other education centres and these are included later in the report in section Education. The remaining hatcheries that transferred fish to other facilities for production were included below (Figure 14).

Goldstream supports smaller hatchery programs on the Gulf Islands with chum salmon (Figure 14). Goldstream also transfers some coho to the Saanich seapens. It is interesting that this is a transfer-out as most seapen releases are simply indicated by "Seapen" in the life stage column of the Production Plan. Interestingly, Dunn Cr rears coho for Deadman R as they receive a transfer of eggs from them and send them a transfer of coho smolts. As apparent on the transfer-in figure (Figure 13), ALLCO hatchery transfers chum eggs to Nelson Cr.

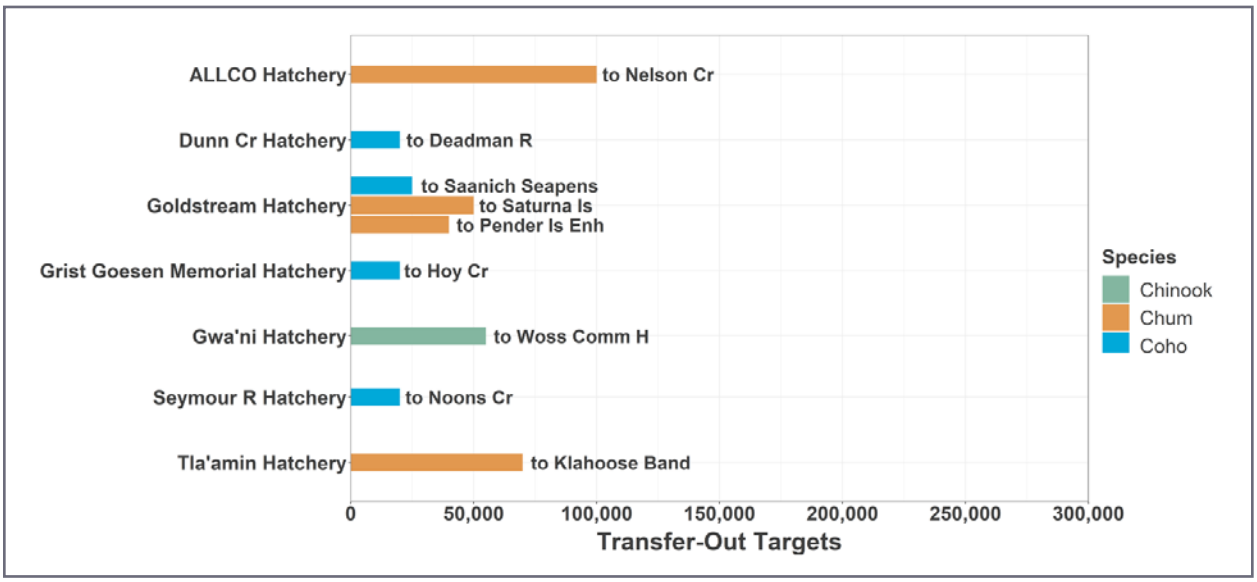


Figure 14: Transfer-out targets for the community hatcheries. Transfer data were derived from the 2019 and 2020 IFMP Production Plans.

Photo by: Benjamin Fortini

Release Information

Release Weight and Life Stage

The following release information was collected primarily from the hatchery interviews. Because it was not explicitly asked, many CAs did not provide information pertaining to release sizes but the data that were provided were compared with the information from the hatcheries to ensure consistency. When hatcheries did not explicitly state the life stage of releases, the 2021 Production Plan was used to supplement the information. All discrepancies between the hatchery interview information and the Production Plan were resolved through referencing the CA interview documents or verifying with the hatchery participant or CA. There are some uncertainties in the data as it was not explicitly clarified if the provided weights were targets or actual measured release weights. For seapen release sizes, it was often unclear whether the sizes mentioned were for the fish entering into the seapen or exiting from it. Most pink releases were excluded because they were released as unfed fry and were not often weighed before release.

The longer the salmon reared in the hatchery (e.g., yearling smolts), the larger they were at release (Figure 15). For seapen releases, it was often unspecified whether the sizes mentioned were for the fish entering into the seapen or exiting from it and attempts to clarify were unsuccessful. Most pink releases were excluded because they were released as unfed fry and were not often weighed before release. There was only one data point provided for pink seapen, coho seapen, and Chinook yearling smolt release sizes which were released from Nanaimo R, Klemtu and Toboggan Cr, respectively. All of the fed fry and seapen chum and pink were relatively small at release weighing 5g or less. The Chinook sub-yearling smolts were slightly larger but had some overlap in size with the Chinook fed fry. Yearling smolts for both Chinook and coho were among the largest fish released along with the coho yearling seapen and Chinook sub-yearling seapen releases.

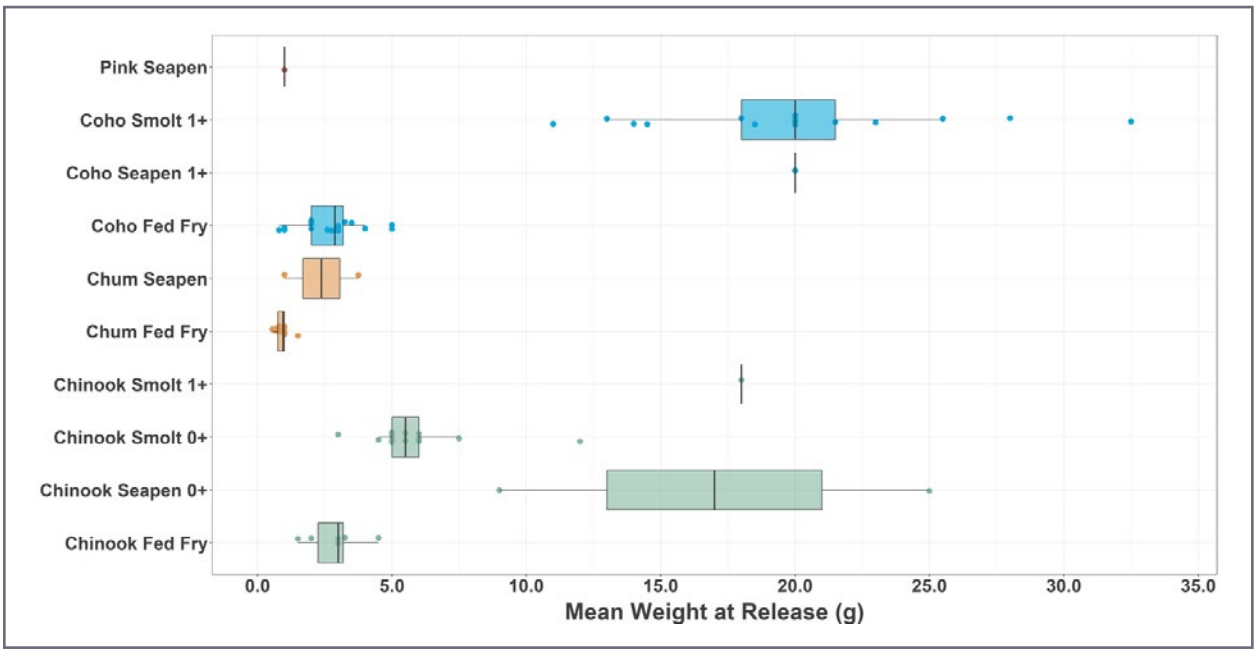


Figure 15: Mean weight of release for each life stage and species that were released from community hatcheries in BC according to hatchery interviews. Only one datum was provided for pink Seapen, coho Seapen 1+, and Chinook Smolt 1+ release sizes and therefore a boxplot could not be created for those combinations.

The average weight for each species and life stage combination were compared to data from the 2020 DFO releases to determine a benchmark for comparison purposes (Table 28). For the following sections, we specifically chose to compare the reported weights to the mean weight from community hatcheries. The average weights from the interviews were all relatively similar to those provided in the DFO data. The inaccuracy may have been introduced due to certain participants providing averages across years or approximate target weights.

Table 28: Average release weight (in grams) for each species and life stage combination from interview data and 2020 DFO releases for included (interviewed), community (CEDP, PIP, and DPI), and all SEP hatcheries.

Species	Life Stage	Interview	Included (DFO)	Community (DFO)	All (DFO)
Chinook	Fed Fry	3.25	2.86	2.09	2.19
Chinook	Seapen 0+	7	5	7.63	7.49
Chinook	Smolt 0+	5.77	5.2	5.08	5.81
Chinook	Smolt 1+	18*	15.02	16.73	18.52
Chum	Fed Fry	0.96	0.75	0.94	1.02
Coho	Fed Fry	2.8	2.31	1.79	1.88
Coho	Seapen 1+	20**	16	21.82	21.54
Coho	Smolt 1+	19.97	18.74	18.27	19.22
Pink	Seapen	1***	0.36	1.04	0.83
Pink	Seapen	1***	0.36	1.04	0.83

*Only released at one facility (Toboggan Cr); **Only released at one facility (Klemtu); *** Only released at one facility (Nanaimo R)

Chinook

Chinook sub-yearling smolts rear until their first spring and are typically released at 5.08g from community hatcheries (average: 5.77g; Figure 16). The exception was Four Mile Cr where Chinook sub-yearling smolts averaged 12g at release. This may be because they rear their Chinook smolts in lake net pens for a significant portion of their rearing where, presumably, the fish have access to additional natural food sources. Nanaimo R release both Fall and Summer Chinook with the Fall fish released slightly smaller.

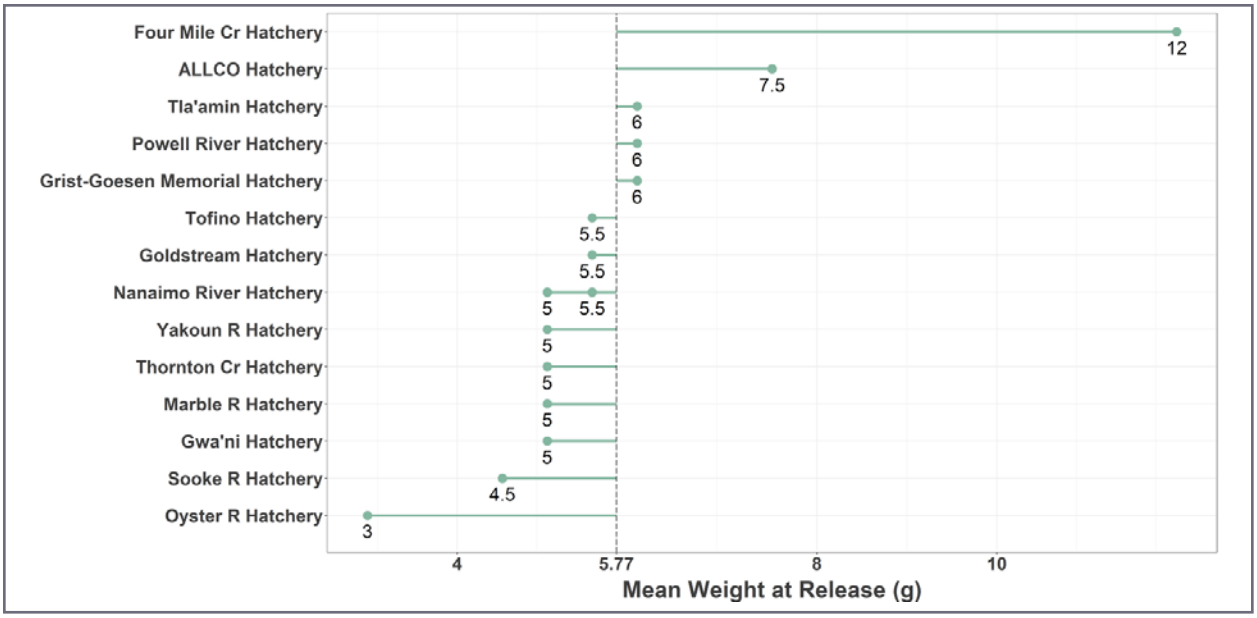


Figure 16: Mean weight at release for Chinook sub-yearling smolts compared to an overall mean release weight of 5.77g. Data were gathered from interviews with community hatcheries.

Interviewees noted that Chinook fry had an average fry release weight of 3.25g (Figure 17) but are typically released at 2.09g from all community hatcheries. Cowichan has two different times of release a month apart which accounts for the two different release sizes. The hatchery manager stated he was not sure where this originated but believed it helped avoid freshwater predation.

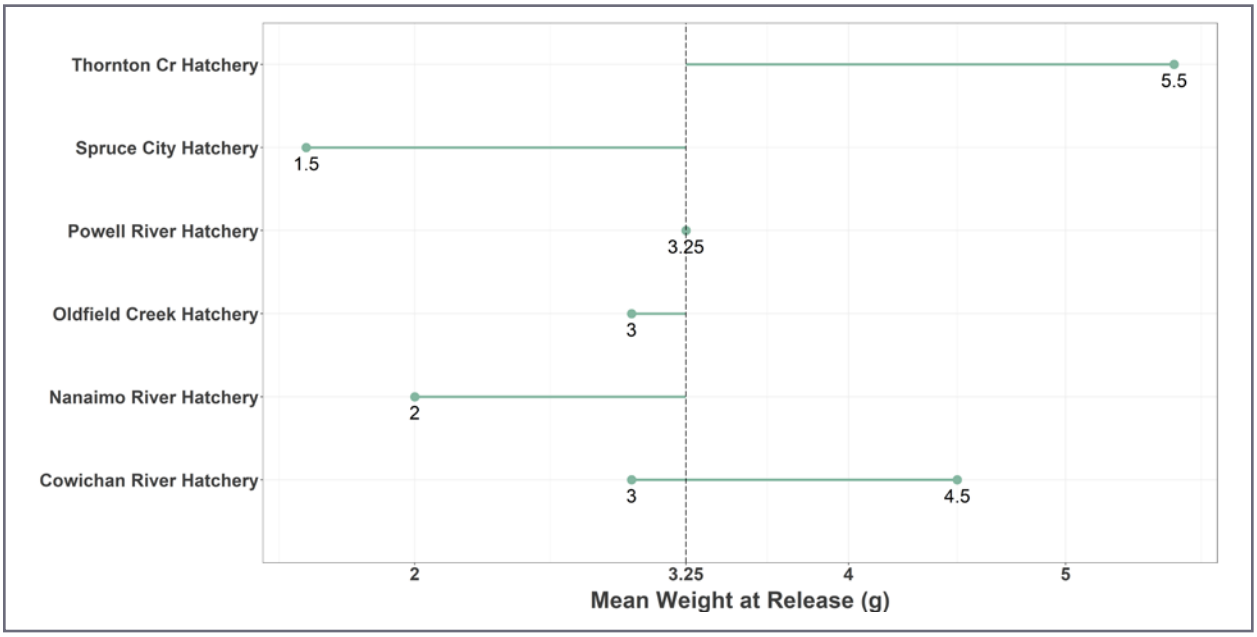


Figure 17: Mean weight at release for Chinook fry compared to an overall mean release weight of 3.25g. Data were gathered from interviews with community hatcheries.

Toboggan Cr is the only included hatchery to release Chinook yearling smolts (at ~ 18g on average) that are raised for a year in freshwater. Across community facilities, these fish are released at 16.73g. Some facilities reared their Chinook sub-yearling smolts in seapens. The slight overlap between the release size of Chinook smolts and fry was noted and attributed to different growing conditions in different areas of the coast (Figure 18).

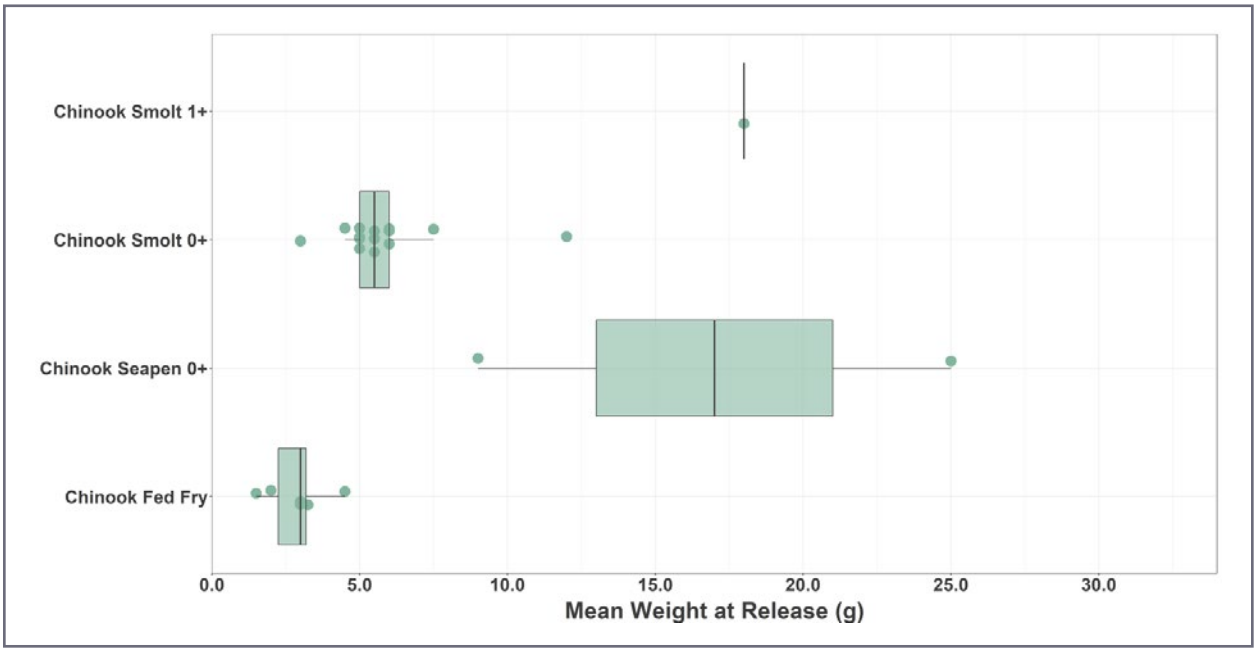


Figure 18: Mean weight of release for each life stage of Chinook that were released from included hatcheries as reported in community hatchery interviews.

Coho

Yearling smolts are kept in the hatchery for over a year to rear in freshwater and grow to the appropriate size for release. This long rearing period is more resource intensive and costly than that used for most other species. The typical size of release from community hatcheries suggested by DFO in the Production Plan is 18.27g. Most interviewed hatcheries released their coho smolts slightly larger with an average of ~20g (Figure 19). Exceptions include Oldfield Cr and Toboggan Cr, where cold water temperatures during the winter may account for their smaller than average sizes at release (Figure 8). The smolts at Nanaimo R are also smaller in size despite being raised on well-water, which is more temperate year-round. Seymour R hatchery heats their rearing water, which could explain the larger size at release of their coho yearlings. They also ran experiments that determined rearing fewer fish to a large size was a viable strategy (see Release Experiments). Bell-Irving produces smolts for two different systems and holds back one release until June, resulting in a larger size at release. The large range in the release sizes for coho yearling smolts can be explained by whether the hatcheries use surface or ground water, the variation in surface water temperature, use of heating or cooling systems, delayed releases, or different feed ratios amongst other factors. Klemtu was the only facility interviewed that released their coho from seapens.

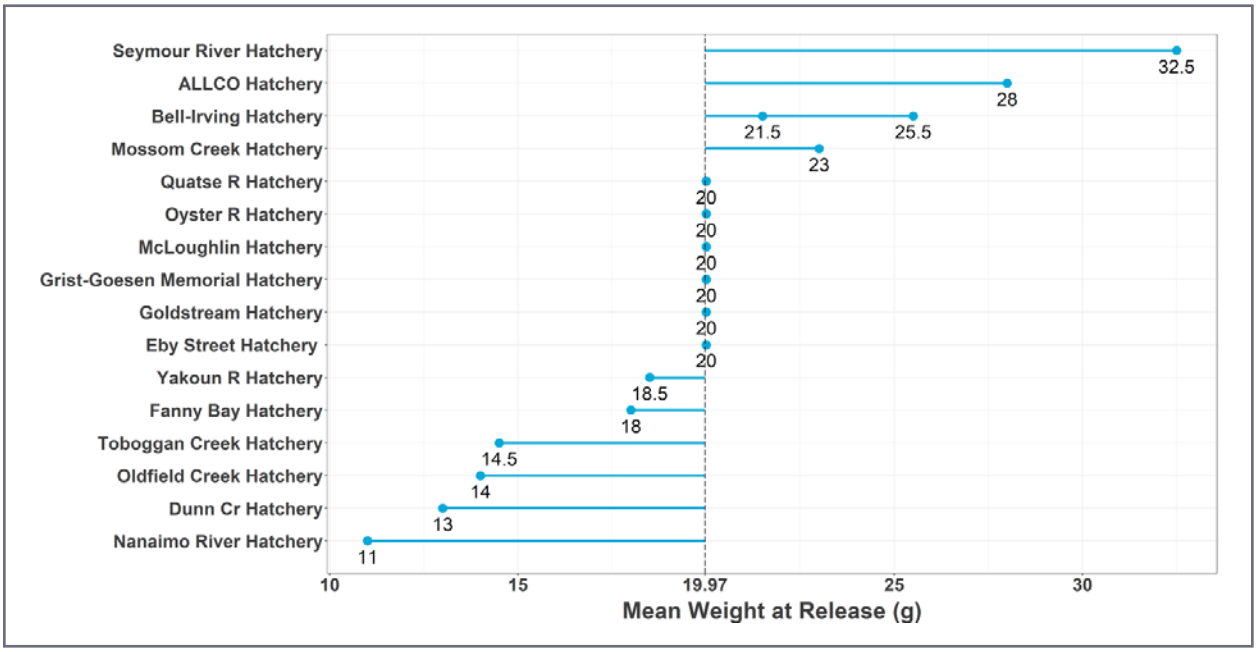


Figure 19: Mean weight at release for coho yearling smolts compared to an overall mean release weight of 19.97g. Data were gathered from interviews with included community hatcheries.


Photo by: Benjamin Fortini

Community hatcheries release coho fry at an average of 1.79g in their first spring or early-summer to rear in freshwater before smolting and making their way to the ocean. The average release weight for coho fry from included hatcheries is ~3g (Figure 20), which is considerably smaller than the smolts that spend an extra year in the hatchery. ALLCO releases their fry at two different sizes based on whether they are adipose clipped or not, with the unclipped fish released at a smaller size. Toboggan Cr releases unmarked and unfed coho fry to a lake however weight data are not recorded, therefore these releases were not included in the data. In general, there was no clear explanation for the variance in release sizes between the coho fry. Some managers expressed that rearing coho to the fry life stage was easier because the shorter rearing period meant a reduced summer workload. Others mentioned that coho fry were the only option due to water availability and temperature in the summer. Given the substantial difference in rearing periods for yearling and fry, there was no overlap in release sizes (Figure 21).

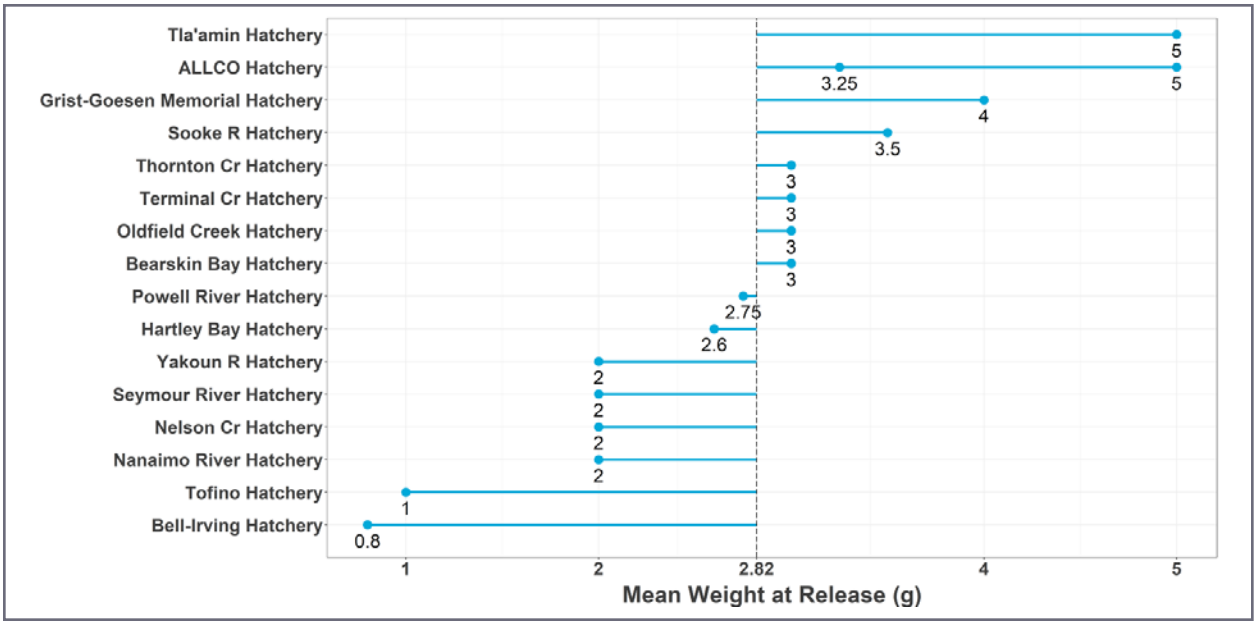


Figure 20: Mean weight at release for coho fry compared to an overall mean release weight of 2.8g. Data were gathered from interviews with included community hatcheries.

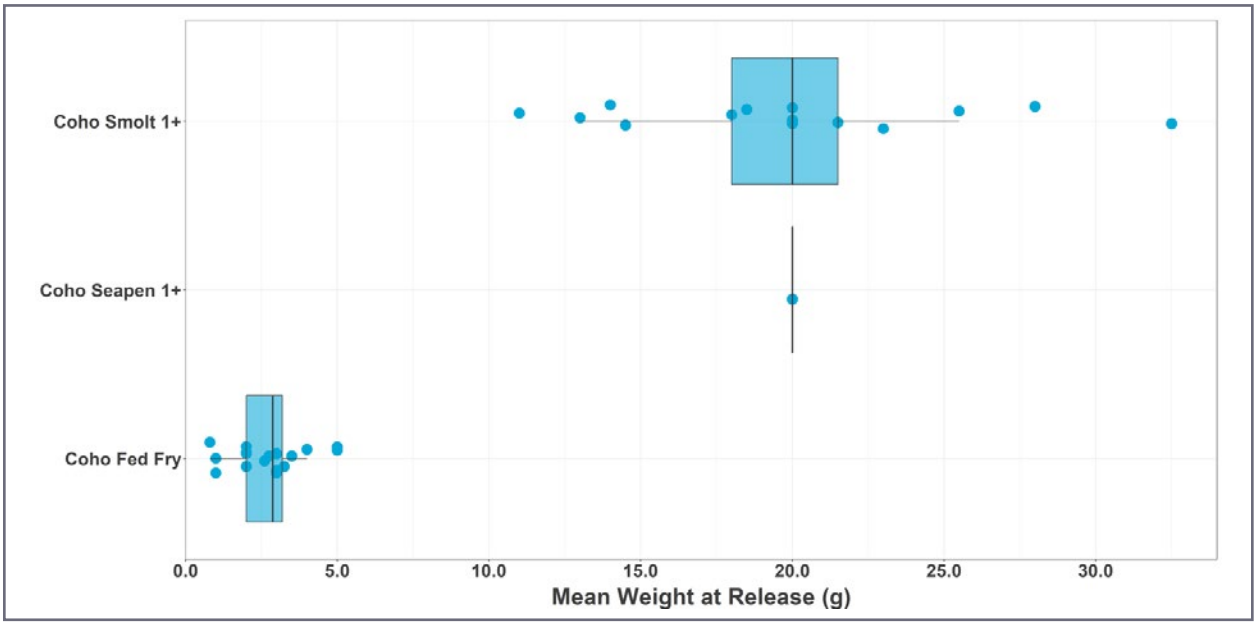


Figure 21: Mean weight of release for each life stage of coho that were released from included hatcheries. Data were gathered from interviews with included community hatcheries.

Chum and pink

Chum are typically released as fry between at 0.94g from community hatcheries, making the reported average of 0.96g marginally larger than expected (Figure 22). This may be due to the limited feeding and thus limited weighing of these fish before release leading to increased approximation of values.

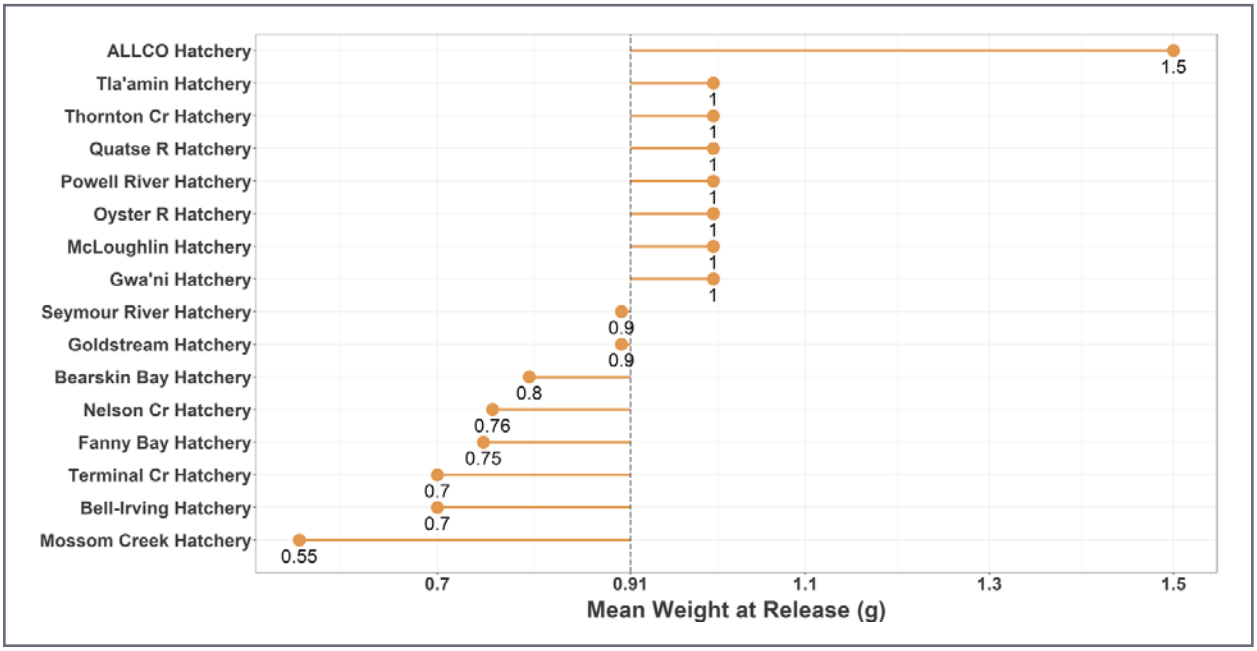


Figure 22: Mean weight at release for chum fry compared to an overall mean release weight of 0.96g. Data were gathered from interviews with included community hatcheries.

Pink salmon naturally migrate to the ocean immediately upon emergence and consequently they are often released as unfed fry. Several participants explained that unfed releases were based on timing and maturation rather than a target weight. Without a target weight, the fish are rarely weighed before release to limit handling. This was the case with all of the hatcheries releasing pink salmon with the exception of Nanaimo R who reared their fry until 1g (Figure 22) and then loaded them into seapens before direct release into saltwater. Every other hatchery that reared pink (Mossom Cr, Seymour R, Quatse R, Oyster R, and ALLCO) released their pink unfed fry directly into freshwater. Two facilities (Nanaimo R and Tla'amin) released their chum as unfed fry. Because the specified hatcheries released their fish as unfed fry, the weights were not provided, and they were not included in Figure 23.


Photo by: Benjamin Fortini

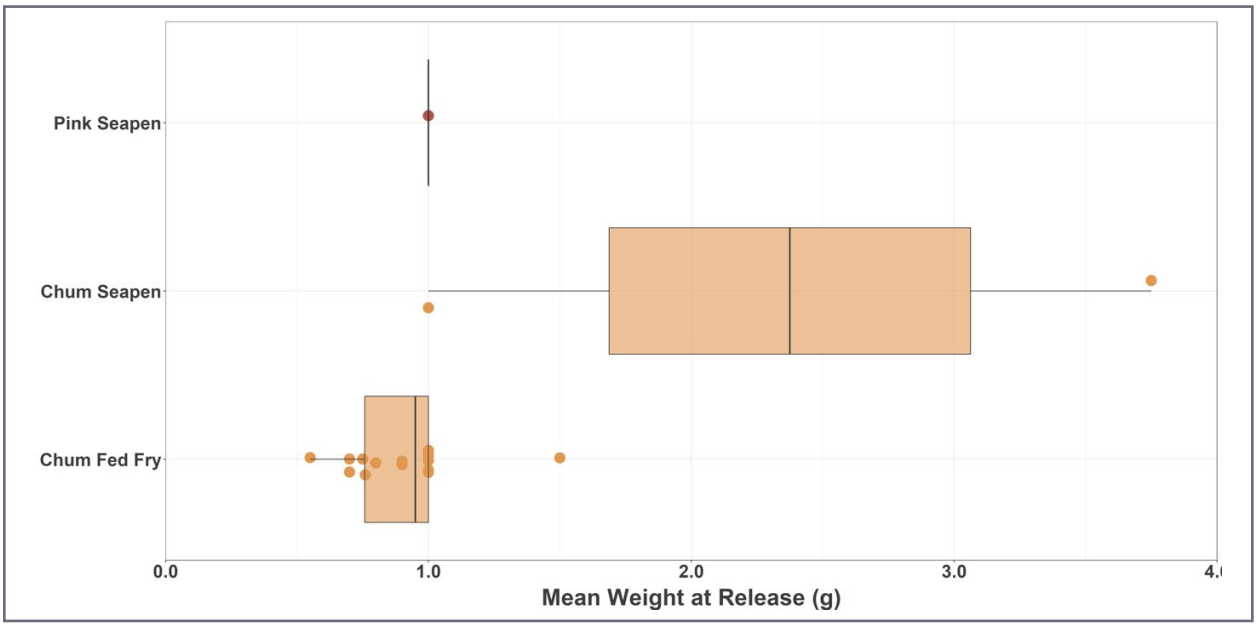


Figure 23: Mean weight of release for each life stage of chum and pink that were released from included hatcheries. Data were gathered from interviews with included community hatcheries.

Release Type

At the time of release, hatchery salmon are either forced out of the hatchery, allowed to leave volitionally over time, or transported to the release location. Most of the facilities used forced releases when releasing their salmon (Table 29). A combination of both release types was used by 10 of the facilities, releasing some species and life stages by force and allowing some to leave when ready. Of the hatcheries using forced releases for their salmon, many used transport tanks on the back of trucks and subsequently release by hose into the appropriate river or creek. These transport tanks are oxygenated, and some participants mentioned adding Vidalife as a mucus protectant for the fish during transport. When fish do not need to travel as far, hatcheries used buckets and wheelbarrows to manually load their fish into the wild. Thornton Cr suggested that when using buckets for release, it is important to use black or dark coloured buckets to prevent the fish from rapidly changing to a lighter colour and therefore increasing the risk of predation. In some situations, fish needed to be transported to remote areas. To overcome this, a few managers described using vinyl totes and backpacking the fish to release locations. Because of the remoteness of Hartley Bay, they typically hire a helicopter fit with a monsoon bucket to release their fish. Only Gwa'ni hatchery released their fish completely volitionally. They open camlocks and allow their fish to leave the Swedish tubs directly into the channel when physiologically ready. Some other hatcheries have similar release systems, typically involving removing a barrier to connect the salmon to the wild and allowing them to leave the rearing area whenever they desire.


Photo by: Benjamin Fortini

Table 29: Summary of release type for each included hatchery. When available, the species for each release type were specified.

Hatchery	Release Type	Species
ALLCO Hatchery	Forced	Unspecified
Bearskin Bay Hatchery	Forced	Unspecified
Bell-Irving Hatchery	Both	Unspecified
Cowichan R Hatchery	Forced	Chinook
Dunn Cr Hatchery	Forced	Coho
Eby Street Hatchery	Forced	Coho
Fanny Bay Hatchery	Volitional	Coho
Fanny Bay Hatchery	Forced	Chum
Four Mile Cr Hatchery	Forced	Chinook
Goldstream Hatchery	Both	Unspecified
Grist Goesen Memorial Hatchery	Forced	Unspecified
Gwa'ni Hatchery	Volitional	Unspecified
Hartley Bay Hatchery	Forced	Coho
Klemtu Hatchery	Forced	Unspecified
Marble R Hatchery	Forced	Chinook
McLoughlin Hatchery	Forced	Chum, Coho
Mossom Cr Hatchery	Forced	Chum, Coho, Pink
Nanaimo R Hatchery	Volitional	Coho
Nanaimo R Hatchery	Forced	Chinook, Chum, Pink
Nelson Cr Hatchery	Forced	Unspecified
Oldfield Cr Hatchery	Forced	Chinook, Coho
Oyster R Hatchery	Volitional	Chinook, Chum, Pink
Oyster R Hatchery	Forced	Coho
Powell R Hatchery	Forced	Chinook, Coho
Quatse R Hatchery	Forced	Chum, Pink
Seymour R Hatchery	Volitional	Coho
Seymour R Hatchery	Forced	Chum, Pink
Sooke R Hatchery	Forced	Unspecified
Spruce City Hatchery	Forced	Chinook
Tahsis Hatchery	Forced	Chinook
Terminal Cr Hatchery	Forced	Unspecified
Thornton Cr Hatchery	Both	Unspecified
Tla'amin Hatchery	Volitional	Chum, Chinook
Tla'amin Hatchery	Forced	Coho
Toboggan Cr Hatchery	Volitional	Coho
Toboggan Cr Hatchery	Forced	Chinook, Coho
Tofino Hatchery	Forced	Chinook, Coho
Yakoun R Hatchery	Forced	Unspecified

Seapen Release

Out of the included hatcheries, seven of the 32 used seapens for rearing at least one of their salmon species (Table 30). Some hatcheries said that they used seapens in the past but no longer do for a variety of reasons (infrastructure degraded, concerns about growth rate, etc.). Both Thornton Cr and Yakoun R expressed interest in starting a seapen program but did not provide rationale as to why. Because of the effort involved, some hatcheries expressed that they had put their seapen program on hold because of staffing and volunteer issues from COVID-19. Both Mossom Cr and Seymour R rear a portion of their coho yearling smolts in seapens prior to release but interestingly, neither hatchery had seapen releases included on the Production Plan.

Table 29: Summary of release type for each included hatchery. When available, the species for each release type were specified.

Hatchery	Duration (weeks)	Species
Gwa'ni Hatchery	4 - 5.5	Chum
Klemtu Hatchery	8	Chum
Marble R Hatchery	6	Chinook
Mossom Cr Hatchery	2	Coho
Nanaimo R Hatchery	4	Pink
Seymour R Hatchery	2	Coho
Tahsis Hatchery	3	Chinook

Release Timing

The basis for release timing was discussed with the CA for each hatchery. The CIP BMPs suggest basing time of release on the wild outmigration (SEP 2013); however, this was not often provided as the basis during interviews. Rather, the basis for release time fell broadly into two camps: prior knowledge or environmental conditions. Many cited historic precedents and local knowledge. Others said that the releases timing was based on local conditions such as weather conditions, the spring freshet, and ensuring water flow was sufficient. Few explicitly stated that the choice of release timing did not include any consideration for the outmigration timing of wild stocks. To limit predation, fish were often released at dusk or at night. A small number of hatcheries also said they monitored the tide and tried to release fish during high tide so that the fish had sufficient water depth for their downstream migration.

Photo by: Benjamin Fortini

Assessment

The ability to assess returns is of great value to any hatchery program. Escapement and information on wild fish returns enables monitoring of returns to a system and can inform Production Planning based on the timing and number of returns. Knowing the enhanced contribution of spawners in an area allows for the hatchery influence on the natural system to be determined. Evaluating straying can inform hatchery practices such as rearing the fish on surface water rather than groundwater to facilitate imprinting. Such information leads to a better informed and better operated hatchery program. Therefore, we collated information on escapement monitoring, straying, wild monitoring, and whether enhanced contributions to the system were assessed. Facilities were then given a score from 0-4 based on the number of these assessment metrics collected (Table 14). Not all assessment methods could be assessed for each facility, so this score is a crude metric.

Escapement Enumeration

Data on escapement enumeration was combined from the hatchery and CA interviews (Table 31). There were some differences between the answers of the two separate interviews, but they were generally consistent. In some cases, the hatchery was not directly involved with the escapement enumeration so the specifics were only provided by the CA. Many of the methods and tools used were common among hatcheries. Stream walks and swims were often used, and some hatcheries mentioned having additional contracts for carrying out those activities. Data captured from those assessments are most reliable when gathered annually by the same contractor. Data can be limited by stream flow and turbidity in the water and surveys can only be done during certain periods. Collecting deadpitch is relatively common but does not provide a very accurate estimate of escapement since many carcasses can be lost to scavengers or high flow rates, in addition to other issues (e.g. size and sex selectivity of deadpitch sampling). Using enumeration fences was another common practice which allows for accurate enumeration and often has the added advantage of facilitating broodstock collection. These were sometimes used in conjunction with fish traps but could be used separately as well. Other methods such as DIDSON were also used and can provide accurate data but require initial investment and for the hatchery to have sufficient and consistent power.

Other Assessment

Other possible assessment metrics include data on enhanced contributions (proportion of hatchery fish in the returns), straying (data on hatchery fish from different systems), and data on wild returns. However, these methods were only discussed with the CAs and we were unable to verify which were successfully implemented. For this reason, the categories other than escapement data were kept as simple yes or no answers (Table 31).

Table 31: Assessment information collected by each hatchery and a corresponding score. The score is simply based on whether the hatchery was able to qualitatively assess each included category. The hatcheries were organized by their assessment score values. Data were gathered from interviews with community hatcheries and CAs. These data represent a snapshot of the assessment information that was able to be collected at the time of the interviews.

Hatchery	Escapement Data	Enhanced Contribution	Straying	Wild Fish Data	Assessment Score
ALLCO Hatchery	Enumeration fence	Yes	Yes	Yes	4
Bell-Irving Hatchery	Enumeration fence, Fish traps	Yes	Yes	Yes	4
Cowichan R Hatchery	Camera, Deadpitch, DIDSON, Enumeration fence, PIT tag array	Yes	Yes	Yes	4

Hatchery	Escapement Data	Enhanced Contribution	Straying	Wild Fish Data	Assessment Score
Seymour R Hatchery	CPUE assessment, Mark recapture assessment	Yes	Yes	Yes	4
Toboggan Cr Hatchery	Deadpitch, Enumeration fence, Flyover assessment, Walk assessment	Yes	Yes	Yes	4
Tofino Hatchery	Boat surveys, Swim assessment, Walk assessment	Yes	Yes	Yes	4
Eby Street Hatchery	Flyover assessment	Yes	No	Yes	3
Fanny Bay Hatchery	Hatchery returns, Walk assessment	Yes	No	Yes	3
Four Mile Cr Hatchery	Enumeration fence, Swim assessment	Yes	No	Yes	3
Oyster R Hatchery	Fish traps, Swim assessment	Yes	No	Yes	3
Sooke R Hatchery	Swim assessment	Yes	Yes	No	3
Tahsis Hatchery	Swim assessment	Yes	No	Yes	3
Tla'amin Hatchery	Enumeration fence, Swim assessment	Yes	No	Yes	3
Bearskin Bay Hatchery	Enumeration fence, Walk assessment	No	No	Yes	2
Gwa'ni Hatchery	DIDSON, Fish traps, Swim assessment	No	No	Yes	2
Hartley Bay Hatchery	Walk assessment	No	No	Yes	2
Mossom Cr Hatchery	Mark recapture assessment	No	No	Yes	2
Nanaimo R Hatchery	Deadpitch, DIDSON, Swim assessment	Yes	No	No	2
Nelson Cr Hatchery	Walk assessment	No	No	Yes	2
Spruce City Hatchery	Flyover assessment, Walk assessment	No	No	Yes	2
Thornton Cr Hatchery	Swim assessment, Walk assessment	No	No	Yes	2
Dunn Cr Hatchery	Electronic counter, Enumeration fence, Walk assessment	No	No	No	1
Klemtu Hatchery	Deadpitch	No	No	No	1
Marble R Hatchery	Swim assessment	No	No	No	1
Oldfield Cr Hatchery	No escapement data	No	No	Yes	1

Hatchery	Escapement Data	Enhanced Contribution	Straying	Wild Fish Data	Assessment Score
Powell R Hatchery	Enumeration fence, Video	No	No	No	1
Quatse R Hatchery	DIDSON	No	No	No	1
McLoughlin Hatchery	No escapement data	No	No	No	0
Terminal Cr Hatchery	No escapement data	No	No	No	0
Yakoun R Hatchery	No escapement data	No	No	No	0

Community Involvement

Community Involvement

Every facility does some form of community involvement, whether through environmental stewardship, education programs, advocacy with their local community and/or government, or additional outreach outside of fish rearing that promote participation from the community. Environmental stewardship includes habitat monitoring, restoration work, and other environmental work done at the hatchery. Although stewardship is not strictly community involvement, it can include members from outside of the hatchery and generate interaction with the public. Education is a straightforward category and includes all educational activities whether hosted at the hatchery or in local school programs. Advocacy includes any relationship with the local government or other organizations where the hatchery provides advice, information, or support regarding salmon. Additional outreach activities are variable and depended on the hatchery but include special event days, public salmon releases, and open houses. Some hatcheries mentioned escapement enumeration programs as an additional program but those were already accounted for in the assessment section and thus were excluded from the table below (Table 33). Some hatcheries also mentioned that certain programs were suspended due to ensuring the safety of staff and volunteers from the pandemic. If specific information on the programs was provided, they were included. If other past programs were mentioned that are not currently being conducted for reasons other than the pandemic, they were excluded.

The capacity for these different types of programs depends on multiple factors, some of which are not within the control of the hatchery. The more funding, and therefore more staff, that a hatchery has allows for a dedicated position to manage outreach activities and provide greater levels of community programming. The proximity of the hatchery to larger populations and ease of access creates a larger pool of potentially interested community members to draw upon for volunteers, funding, and participation in activities hosted at the hatcheries. Hatcheries that have greater release targets must allocate more time and resources towards fish production, reducing what can be done for other activities. All these factors play into a hatchery's capacity for community involvement.

Environmental Stewardship

Of the hatcheries interviewed, many participated in some form of stewardship activities (Table 33). The most common activity was monitoring the local watershed. In terms of restoration work, opening spawning channels and rearing pools was mentioned by multiple hatcheries. Some also participated in more large-scale projects such as vegetation restoration and restoration of the rivers after landslides. A few hatcheries mentioned fertilizing the local freshwater systems to promote algal growth and provide more food for higher trophic levels. Many of the hatcheries that are doing more intensive environmental monitoring and restoration often collaborate with community groups that are focused on those type of activities.

Education

For education, all included hatcheries except for one ran an education program (Table 33). Grist Goesen stated that they currently had no public education program and did not provide any further explanation. Many facilities ran hatchery tours and on-site activities that served as field trips for local schools but most of these were suspended due to COVID-19 safety concerns. Many also participated in education through supplying eggs and expertise for classroom incubation programs. Several of the classroom incubation programs were done through the Salmonids in the Classroom and Stream to Sea programs that are supported by DFO. Most of the hatcheries supplied either chum or coho eggs but Dunn Cr and Spruce City transfer Chinook (Table 32). Powell R explained that they felt the DFO programs were outdated and therefore created their own education program and classroom incubator. Their incubator has the advantage of being smaller, quieter, and less costly to make than the standard classroom incubator. Numerous programs also included specific First Nations education that incorporated knowledge like local language and tradition.

Table 32: School and education program transfer targets from included community hatcheries.

Hatchery	Species	Transfer Project	Life Stage	Total Transfer
ALLCO Hatchery	Chum	to Maple Ridge Sch	Egg	2000
	Chum	to West Van Sch	Egg	
Bearskin Bay Hatchery	Coho	to Haida Gwaii Sch	Egg	1400
Bell-Irving Hatchery	Chum	to Burnaby Sch	Egg	2000
	Chum	to Coquitlam Sch	Egg	2000
	Chum	to Maple Ridge Sch	Egg	2000
	Chum	to Mission Sch	Egg	1900
	Chum	to New West Sch	Egg	2000
	Chum	to Vancouver Sch	Egg	2000
Dunn Cr Hatchery	Chinook	to Pr George (Mackenzie) Sch	Fry	
	Chinook	to Quesnel R Research Centre	Egg	50
	Coho	to Deadman R	Fry	10000
	Coho	to Kamloops Sch	Egg	4800
	Coho	to Pr George (Mackenzie) Sch	Egg	80
Eby Street Hatchery	Coho	to Coast Mtn (Terrace) Sch	Egg	600
Fanny Bay Hatchery	Coho	to Comox Valley Sch	Egg	2000
	Coho	to Qualicum Sch	Egg	200

Hatchery	Species	Transfer Project	Life Stage	Total Transfer
Goldstream Hatchery	Chinook	to Shaw Centre	Smolt	80
	Chum	to Gulf Is Sch	Egg	2200
	Chum	to Saanich Sch	Egg	3000
	Chum	to Sooke Sch	Egg	4600
	Chum	to Victoria Sch	Egg	13000
	Coho	to Cowichan Valley Sch	Egg	500
	Coho	to Gulf Is Sch	Egg	1800
	Coho	to Saanich Sch	Egg	5100
	Coho	to Saltspring Is	Egg	5500
	Coho	to Sooke Sch	Egg	3500
	Coho	to Victoria Sch	Egg	4400
Gwa'ni Hatchery	Chum	to Vanc Is North Sch	Egg	200
Klemtu Hatchery	Coho	to Central Coast Sch	Egg	100
McLoughlin Hatchery	Coho	to Central Coast Sch	Egg	100
Mossom Cr Hatchery	Chum	to Reed Point/Ioco	Fry	1.00E+05
	Coho	to Reed Point/Ioco	Smolt	24000
Nanaimo R Hatchery	Chum	to Nanaimo Sch	Egg	100
	Coho	to Nanaimo Sch	Egg	
Oldfield Cr Hatchery	Coho	to Pr Rupert Sch	Egg	2600
Oyster R Hatchery	Coho	to Campbell R Sch	Egg	70
	Coho	to Comox Valley Sch	Egg	400
Powell R Hatchery	Coho	to Powell R Sch	Egg	540
Quatse R Hatchery	Coho	to Vanc Is North Sch	Egg	750
Seymour R Hatchery	Chum	to North Van Sch	Egg	10000
	Coho	to Morten Cr	Egg	7000
	Coho	to Mossom Cr	Egg	
	Coho	to North Van Sch	Egg	2500
	Coho	to Reed Point/Ioco	Smolt	7500
Sooke R Hatchery	Coho	to Sooke Sch	Egg	1200
Spruce City Hatchery	Chinook	to Nechako Lks (Vanderh) Sch	Egg	4000
	Chinook	to Pr George (Mackenzie) Sch	Egg	4000
Tahsis Hatchery	Chinook	to Vanc Is West (Gold R) Sch	Egg	100
Toboggan Cr Hatchery	Coho	to Bulkley Val Sch	Egg	1300
Tofino Hatchery	Coho	to Alberni Sch	Egg	400
Yakoun R Hatchery	Coho	to Haida Gwaii Sch	Egg	100

Advocacy

Most of the included hatcheries said that they advocated for salmon in their local areas (Table 33). Some simply promoted awareness of salmon and habitat stewardship while others were more focused on direct advocacy. In many cases, this was done by providing a voice for salmon in their municipal governments but sometimes extended to the provincial and federal government as well. Some groups also advocated directly for salmon with other stakeholders such as forestry, developers, and fish and game groups in their areas. There were also quite a few hatcheries that interacted with First Nations groups to collaborate on activities and provide information on salmon.

Additional Outreach

The majority of hatcheries ran additional outreach activities from their hatcheries (Table 33). For example, many hatcheries participated in River's Day and some participated in Earth Day. One of the largest of these events was the River Never Sleeps festival hosted by Fanny Bay that has had up to 600 people in attendance. There were also many hatcheries that had events for public fry and smolt releases where the public could come and release fish back into the local watershed. Some hatcheries also ran community programs that were completely unrelated to salmon and served as a gathering place for their communities. Gwa'ni hosts traditional ceremonies for the birth of newborns in the community and Toboggan Cr hosts a weekly baseball game on the property. Many of these additional outreach activities served as a means of fund raising and bringing awareness to the hatchery.

Hatchery Score

In the four previously mentioned categories, each included hatchery was given a score (Table 33). If they had some activities that corresponded to the category, they received a one and if not, they received a zero. Most had a Community Score of 4 and none had an overall score of zero. Interestingly, none of the PIP facilities scored less than two, even though they have the least amount of funding. As with the assessment scores in Other Assessment section, there was no evaluation of the success of these programs or the number of activities in each category. If this scoring were to be done more rigorously, one could score the different levels of involvement differently (e.g., hatcheries that create education programs could score higher than hatcheries that only offer school tours). However, that level of evaluation introduces undue subjectivity and bias and would require a more intimate knowledge of how SEP values these specific community involvement programs.

Table 33: Community involvement information collected by each hatchery and a corresponding score. The score is simply based on whether the hatchery was able to assess each included category. The hatcheries were organized by their community involvement score values. Data were gathered from interviews with included community hatcheries.

Hatchery	Stewardship	Education	Advocacy	Additional Outreach	Community Score
ALLCO Hatchery	Yes	Yes	Yes	Yes	4
Bell-Irving Hatchery	Yes	Yes	Yes	Yes	4
Fanny Bay Hatchery	Yes	Yes	Yes	Yes	4
Goldstream Hatchery	Yes	Yes	Yes	Yes	4
Hartley Bay Hatchery	Yes	Yes	Yes	Yes	4
Mossom Cr Hatchery	Yes	Yes	Yes	Yes	4
Nelson Cr Hatchery	Yes	Yes	Yes	Yes	4
Powell R Hatchery	Yes	Yes	Yes	Yes	4
Quatse R Hatchery	Yes	Yes	Yes	Yes	4

Hatchery	Stewardship	Education	Advocacy	Additional Outreach	Community Score
Seymour R Hatchery	Yes	Yes	Yes	Yes	4
Spruce City Hatchery	Yes	Yes	Yes	Yes	4
Terminal Cr Hatchery	Yes	Yes	Yes	Yes	4
Thornton Cr Hatchery	Yes	Yes	Yes	Yes	4
Tla'amin Hatchery	Yes	Yes	Yes	Yes	4
Dunn Cr Hatchery	Yes	Yes	No	Yes	3
Eby Street Hatchery	Yes	Yes	No	Yes	3
Gwa'ni Hatchery	Yes	Yes	No	Yes	3
Marble R Hatchery	Yes	Yes	No	Yes	3
Nanaimo R Hatchery	No	Yes	Yes	Yes	3
Sooke R Hatchery	No	Yes	Yes	Yes	3
Toboggan Cr Hatchery	No	Yes	Yes	Yes	3
Bearskin Bay Hatchery	No	Yes	Yes	No	2
Cowichan R Hatchery	No	Yes	No	Yes	2
Grist Goesen Memorial Hatchery	No	No	Yes	Yes	2
Klemtu Hatchery	Yes	Yes	No	No	2
Oldfield Cr Hatchery	No	Yes	No	Yes	2
Oyster R Hatchery	No	Yes	No	Yes	2
Tofino Hatchery	No	Yes	Yes	No	2
Four Mile Cr Hatchery	No	Yes	No	No	1
McLoughlin Hatchery	No	Yes	No	No	1
Tahsis Hatchery	No	Yes	No	No	1
Yakoun R Hatchery	No	Yes	No	No	1

Photo by: D. Swainson

Environment

Many of the hatcheries were stewards of their local environments and watersheds. Their operations as hatcheries are inherently linked to the environment and conditions in their area and many are acutely aware of any changes. Therefore, their concerns for local salmon are worth noting and are often supported by a wealth of knowledge unavailable to outside observers.

Predation

Predation was an issue that many of the included hatcheries dealt with but almost all believed it was well managed. Some hatcheries, like Bearskin Bay and Mossom Cr, were entirely fenced in or indoors so there were no predator concerns. The most commonly mentioned issues were with otters and mink because they were very challenging to keep out of rearing containers and were not easily deterred. Once they found accessible food, they would continue to return so they were often trapped and relocated or disposed of. Birds, especially kingfishers and mergansers, were also problematic for many of the hatcheries. Predator netting and mesh were sufficient at most facilities to keep them at bay. Some participants explained that they were not bothered by occasional losses to birds because it taught their fish predator avoidance. There were also several mentions of predation before and after hatchery rearing, mainly by seals and sea lions. Tla'amin stated that the local sea lions remained in the area year-round because of the abundance of food, in-part a result of the presence of hatchery fish. After fish were released, there were some concerns about trout predation, but several hatcheries mitigated this by releasing fish in batches and in the dark to give them a better chance of reaching the ocean.

Environmental Data

Almost all participants collected environmental data (Table 34). The exceptions were Klemtu and McLoughlin that said no additional data were collected. Water temperature was excluded as a category from this since it is mandatory for monitoring ATUs. Howeve, many hatcheries collected additional data on water, such as water quality (dissolved oxygen, pH, salinity, turbidity, etc.) or hydrology (flow, water level, etc.). A portion of these facilities had hydrometric stations run by the government that collect data on water quantity and quality. Some also collected weather data such as air temperature or rainfall. A few hatcheries had weather stations nearby where more thorough data were collected and provided upon request.

Restoration

The extent of participation in restoration work in the local area was also captured from the interviews (Table 34). Most of the hatcheries had done some restoration work at some point during the hatchery's tenure. Some hatcheries created channels and pools off the main stem of the river to increase spawning habitat. Others installed fish ladders and removed obstacles to allow salmon access to additional areas. Where flow was high and flooding often occurred, gravel was replaced in areas that had been scoured to provide a more hospitable environment for eggs. These activities did not necessarily overlap with environmental stewardship (see Environmental Stewardship) because this section includes all restoration activities, not just the projects that were active at the hatcheries.

Change in Fish Condition

All participants were asked if they had observed any changes in fish condition over the last decade (Table 34). Many hatcheries reported that they had not seen any consistent change in the condition of returning fish. Some hatcheries explained that fish condition changed yearly and did not seem to shift directionally. The most common change was the increase of fungus, disease, and parasites on returning fish. The changing climate likely plays a role as increasing water temperatures have been shown to increase susceptibility to infectious disease for Pacific salmon (Miller et al. 2014). The increased parasites may be due to greater Atlantic salmon aquaculture since infection by sea lice has been demonstrated to be significantly greater near fish farms (Krkošek et al. 2005). Some hatcheries expressed concern about fish farms in their area harming wild salmon. Another relatively common observation was that the returning fish were smaller. This is also supported by the literature as sizes of both wild and hatchery salmon are smaller in much of the Northeast Pacific (Ohlberger et al. 2018). However, not all changes were negative, and a few facilities reported improved salmon health for their returns. Although anecdotal, many of these observed changes in condition align with the current literature.

Greatest Concern for Salmon

All participants were asked what their greatest concern for salmon was in their area (Table 34). Each interviewee's answers were coded into categories. The answers that were provided often encompassed multiple concerns and were categorized as such. The most common concern was insufficient salmon habitat. This included issues with urban development, concerns about forestry changing the local hydrology, and misuse of sensitive areas by landowners or recreational users. There were also many participants that expressed concerns with overfishing. Some participants were concerned about in-river fishing while others worried about overfishing by commercial and recreational groups in the ocean. Both climate change and insufficient water were also principal concerns. When participants spoke about climate change, they often expressed worry about the longevity of their programs due to the rapidly changing climate. Insufficient water is likely a symptom of climate change but was reported to be an acute issue for many hatcheries, especially in the summers. Some participants also said that the lack of water was delaying and decreasing returns to the rivers.

Table 34: Environmental data collation and concerns gathered from the hatchery interviews.

Hatchery	Environmental Data	Fish Condition	Restoration Work	Greatest Concern
ALLCO Hatchery	Dissolved oxygen, Water quality	Smaller (Chum)	Yes	Flooding, Habitat, Water temperature
Bearskin Bay Hatchery	Yes	Easily stressed (Chum)	Yes	Insufficient returns
Bell-Irving Hatchery	Weather station data	No change	Yes	Climate change, Habitat
Cowichan R Hatchery	Yes	Smaller (Chinook) but normal now	Yes	Habitat
Dunn Cr Hatchery	Dissolved oxygen, Flow, Water quality	More sea lice (Coho), Bigger (Coho)	No	Climate change, Overfishing
Eby Street Hatchery	Dissolved oxygen	No change	No	Politics
Fanny Bay Hatchery	Flow, River condition, Water level	Improved health	Yes	Habitat
Four Mile Cr Hatchery	Air temperature	Smaller eggs (Chinook), More 4- and 5-year-olds (Chinook)	Yes	Habitat, Mismanagement, Overfishing

Hatchery	Environmental Data	Fish Condition	Restoration Work	Greatest Concern
Goldstream Hatchery	Dissolved oxygen	Increased fungus	Yes	Climate change
Grist Goesen Memorial Hatchery	Dissolved oxygen	No change	Yes	Habitat, Overfishing
Gwa'ni Hatchery	Hydrometric data	No change	Yes	Flooding, Habitat
Hartley Bay Hatchery	Air temperature, Dissolved oxygen	More damage (Coho), Smaller (Coho and Pink)	No	Insufficient returns, Mismanagement, Overfishing
Klemtu Hatchery	None collected	Smaller (Coho and Chum)	Yes	Overfishing, Predation, Water temperature
Marble R Hatchery	Air temperature, Water level	No change	Yes	Mismanagement, Overfishing
McLoughlin Hatchery	None collected	More parasites (Coho)	No	Development, Overfishing
Mossom Cr Hatchery	Dissolved oxygen, pH, Rainfall, Water quality, Weather	No change	Yes	Habitat
Nanaimo R Hatchery	Flow, Hydrometric data, Water Survey Canada data	Smaller (Chinook), More males	No	Climate change, Flooding, Insufficient water
Nelson Cr Hatchery	Water quality	More soft-shelled eggs	Yes	Habitat, Pollution
Oldfield Cr Hatchery	Dissolved oxygen, Environment Canada data, Turbidity	Less BKD	No	Insufficient returns
Oyster R Hatchery	Flow, Hydrometric data, Water level	Low returns (Chinook) but better now	Yes	Climate change, Habitat, Insufficient water, Water temperature
Powell R Hatchery	Air temperature, Flow, pH, Rainfall, Salinity, Turbidity, Weather	No change	Yes	Mismanagement, Overfishing
Quatse R Hatchery	Dissolved oxygen, Weather station data	Increased fungus	Yes	Insufficient water, Overfishing, Water temperature
Seymour R Hatchery	Flow, Metro Vancouver data	Increased fungus	Yes	Climate change, Predation
Sooke R Hatchery	Dissolved oxygen, Water quality	Smaller (Chinook and Coho)	Yes	Insufficient returns, Insufficient water, Predation
Spruce City Hatchery	Flow, pH	No change	Yes	Habitat, Mismanagement, Overfishing

Tahsis Hatchery	Flow, Juvenile sampling (estuary), Water quality	Smaller (Chinook)	Yes	Climate change, Insufficient water
Terminal Cr Hatchery	Air temperature	Fewer bacterial problems	Yes	Insufficient water, Water temperature
Thornton Cr Hatchery	Air temperature, Rainfall	More fungus, Delayed ripening, Increased disease (Chum)	Yes	Genetics, Habitat, Overfishing, Predation
Tla'amin Hatchery	Flow, Water quality	Increased sea lice, Increased BKD (Coho)	Yes	Insufficient water, Predation, Water temperature
Toboggan Cr Hatchery	Dissolved oxygen, Flow	Increased BKD, Increased fungus, Increased fishing damage, Increased deformities (Coho), Soft eggs (Chinook)	Yes	Genetics, Habitat, Insufficient water, Water temperature
Tofino Hatchery	Hydrometric data	Smaller (Chinook)	Yes	Climate change, Mismanagement, Overfishing
Yakoun R Hatchery	Rainfall, Water quality	Increased sea lice (Coho)	Yes	Overfishing

Experiments

Several of the hatcheries have conducted experiments at their hatcheries. These are done to improve hatchery practices and to overcome specific issues. They have been placed into broad categories below with the experiment described in the first line and the outcomes following. The participants were not asked for a great level of detail on their experiments and so this overview is a complete inclusion of the information provided. There were other "experiments" mentioned during the interviews, but they did not have outcomes and therefore were not included here.

Environmental Experiments

- Tried lake fertilization using bombers (Gwa'ni)
  - Lake fertilization has now become a regular event
- Trapped and relocated fish past a barrier into upper Terminal Cr (Terminal Cr)
  - The relocation demonstrated that habitat there is good quality

Fertilization and Incubation Experiments

- Needed to take milt but did not have any females to fertilize so stored it in the fridge for 4 days (Oldfield Cr)
  - The milt was still viable and had 95% spawning success
- Cryogenically froze Chinook milt for future years with insufficient males (Oyster R)
  - Had no issues with spawning using the frozen milt
- Fertilized the largest females with the largest males in recent years (Tahsis)
  - Seems to have increased the size of returning fish
- Trialed using moist incubators instead of heath trays (Toboggan Cr)
  - Moist incubators improved survival
- Trying different loading volumes for heath trays (Bearskin Bay)
  - Loading the trays at 75% had the best survival

Rearing Container Experiments

- Rearing chum in seapens (Gwa'ni)
  - Increased survival rates
- Tried to raise fish in a variety of containers (Powell R)
  - Atkin cells were most effective for primary incubation
  - Secondary incubation was best using bulk incubators that mimic Atkin cells/heath trays
  - Beneficial to use bigger tubs to grow fish at their final stages
- Had issues with lack of water flow and oxygen in corners of rearing containers so they installed baffles (Quatse R)
  - The baffles improved flow and increased fish health
- Rearing in large rectangular troughs instead of Capilano troughs (Toboggan Cr)
  - Improved fish health
- Rearing Chinook in outdoor ponds instead of indoor containers (Toboggan Cr)
  - Chinook prefer the deep areas in the outdoor ponds

Rearing Practice Experiments

- Issues with asymmetry in fish from swimming in one direction so now they periodically switch the direction of flow (Goldstream)
  - No longer have concerns about the asymmetry
- Added salt to the fish food diet and monitored growth (Goldstream)
  - The growth rate was suppressed during rearing but is accelerated once the fish are in the ocean
- Tried rearing Chinook eggs from Chilliwack R (Grist-Goesen)
  - Had a mass mortality event at the zip up stage and could not determine a cause
- Experimented with whether to use Ovadine rinses or not (Marble R)
  - Found that it was fine to use Ovadine, but it must be timed properly
  - Exposing the eggs for too long can cause harm
- Adding coarse salt in a burlap bag to kill fungus in adult coho broodstock (Tla'amin)
  - Worked well for fungus control
  - Would like to implement it with a tank of saltwater instead of the burlap bag

Release Experiments

- Released fish at different times and life stages (Nanaimo R)
  - Now release unfed chum fry instead of fed fry to reduce mortality
  - Now release more natural Chinook in Chemainus R for better survival
- Had issues with predation from coho smolts on chum (Oyster R)
  - Now release chum lower into the river to try to avoid predators
- Released fewer (50,000 instead of 80,000) larger fish (30% larger) later by 1 month (Seymour R)
  - Similar average escapement to before but still use the later and larger strategy
- Used to release Chinook fry above the falls (Sooke R)
  - Now only release fry below the falls and have not observed any noticeable change
- PIT tag study of three different release locations at three different sizes for Chinook (Thornton Cr)
  - Ongoing

APPENDIX D: COMPREHENSIVE NEEDS SUMMARY

Each participant was asked to describe their top challenges, needs, and the changes they would like to make in the next 5 years. If SEP or other sources wanted to support and improve community hatchery programs, this list would be a reasonable place to start. As with the rest of this report, this captures a snapshot in time and may not represent these facilities accurately long-term. Because of this, this information should either be acted on quickly or reassessed through communicating with hatchery staff.

ALLCO Hatchery

Current Challenges

- Water management
  - Dam on river determines water flow
- High water
  - Intakes fill with sand/silt because covers get ripped off when water is high
- Funding
  - Limits certain projects

Needs (Infrastructure/Tools)

- Rebuild earthen ponds
  - Want to add more permanent gates and concrete instead of wood
  - Improve drains
  - Reinforce banks
  - Make them safer and easier to use
- Get bigger rearing tubs
  - Would allow for lower rearing densities
- Replace old equipment

Strengths

- Grants are always approved when applied for
- Very supportive CA
- Think that submitted data are well used and receive feedback on performance

Bearskin Bay Hatchery

Current Challenges

- Amount of water
  - Must release fry earlier than desired
- Data feedback
  - Do not receive much information back from DFO regarding submitted information

Goals

- Establish a marking and assessment program
  - Would help determine hatchery fish returns
  - Would require DFO expertise, equipment, and additional funding
- Increase stream restoration work
- Improve data collection and make better use of data

Strengths

- Support is adequate

Bell-Irving Hatchery

Current Challenges

- Extreme weather events
  - Rain and flooding events
  - Highest water temperature they have recorded in recent years
  - Big snowfall has knocked down trees on property
- Water quality
  - Issues with illegal dumping in the upper watershed
- Declines in vegetation due to development in the area
- Managing people
  - Have many volunteers with different personalities and ideas
- Funding
  - Has not changed in decades and is not sufficient
  - DFO continues to ask for more work to be done with no increase in compensation
- Communication with DFO
  - DFO higher-ups seem apathetic to their contribution

Goals

- Expand citizen science water sampling program

Needs (Infrastructure/Tools)

- Replace old infrastructure
  - Replace earthen ponds
  - Replace pump house
- Add storage shed
- Add covers over rearing troughs
- Add ground water supply
  - Necessary with extreme summer temperatures

Needs (Other)

Improved funding for manager's salary

Strengths

- Believe that submitted data are used effectively
  - Think that less emphasis should be put on numbers and more should be on observations and details

Photo by: Mitch Miller

Cowichan R Hatchery

Current Challenges

- Funding
  - Cost of hydro and fish food cannot be controlled
  - Budget has not changed in 22 years
- Equitable pay scale
  - Pay is very low compared to major hatcheries
  - Employees deserve raises
- Communication with DFO
  - Would like to collaborate with DFO rather than change decisions after they have already been made

Goals

- Increase production
  - Want to do the maximum that can be done safely
  - Cowichan Tribes would benefit with more food fish
  - DFO would benefit with more returns to an indicator system
- Experimentally rear and feed fry in net pens in the river
  - Would want to determine the effect on straying

Strengths

- DFO major facilities engineer has fixed multiple issues and has been very helpful
- Good support from CA

Dunn Cr Hatchery

Current Challenges

- Funding
  - Must prioritize certain purchases
  - Materials are scrounged and reused

Goals

- Increase capacity for rearing Chinook
  - Would need a more stable water temperature
- Rent the house on property (once built) as a gathering area
  - Alternative revenue source

Needs (Infrastructure/Tools)

- Repair flood damage
- Build additional infrastructure
  - Trail for hatchery access
  - Complete house on property to use as a gathering area
  - Could be rented as an alternative revenue source
  - New pump
  - Signage and barrier at lake to prevent vehicle access
  - Bridge over the creek
  - Bathrooms for guests
  - Well for groundwater
  - Shop for construction work
  - Storage sheds
- Get a new truck
- Improve fire protection

Eby Street Hatchery

Current Challenges

- Volunteer scheduling

Future Goals

- Release unfed coho fry in the spring
  - Would need a cooling system for another heath tray to delay the hatch
- Enhance other creeks and streams in the area
  - Would need increased water availability

Strengths

- Well supported and have funding for projects when needed
- CA manages data and lets them know what needs to be done

Fanny Bay Hatchery

Current Challenges

- Water usage
- Communication with DFO
  - Lack of appreciation for volunteers
  - Limited interaction and communication with higher-ups
  - CAs limited in what they can do

Goals

- Improve communication with DFO
  - Would like greater technical support from Resource Restoration Unit
- Increase involvement with young people
  - Would need capacity to transport them to the hatchery
- Increase collaboration with upper Rosewall site
- Establish a sanctioned fry salvage program
  - Would need CA support

Needs (Infrastructure/Tools)

- Install a pump for well water

Strengths

- Sufficient funding from other sources
- Receive good feedback from STAD data and annual reports from SEP

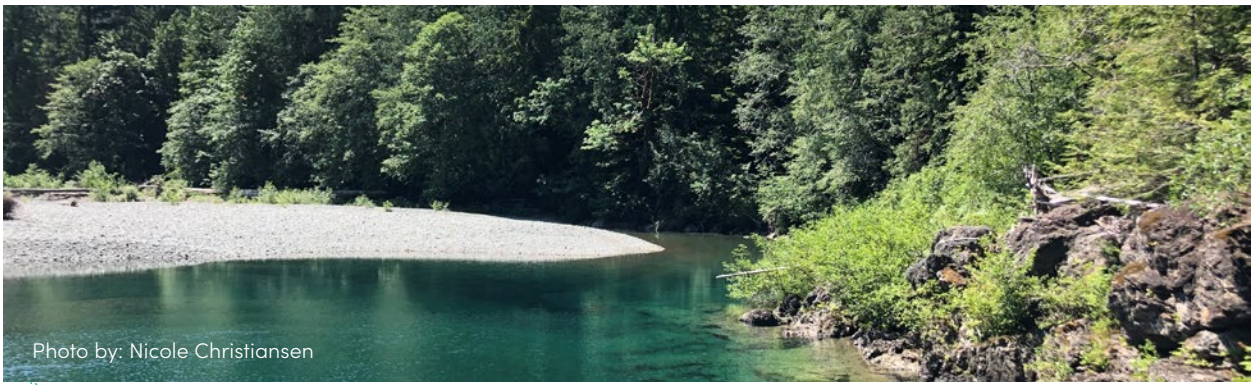


Photo by: Nicole Christiansen

Four Mile Cr Hatchery

Current Challenges

- Erosion on-site
    - Causes issues with water flow
- Funding
    - Has not changed since the 1980s and is insufficient
    - No money coming in from April – July or August
        - Difficult to go without pay for an extended time

Goals

- Secure funding for replacing and upgrading infrastructure
- Add classroom incubation program
- Increase community involvement in the hatchery
    - Increased involvement for young people
    - Adult education programs

Needs (Infrastructure/Tools)

Replace and upgrade infrastructure

- Roofs on hatchery buildings
- Water turbine
- Aeration tower
- Fish fence
- New floats for freshwater net pens
- Winch to load/unload equipment at docks

- Repair and rehang waterline on canyon wall
- Get a trailer and heavy equipment for the hatchery
    - Currently loaned by a former employee
- Improve signage at net pens
- Paint storm drains in community to increase salmon awareness

Strengths

- Get some material and monetary donations from the community
- Receive feedback on submitted data but it is mostly from stock assessment

Goldstream Hatchery

Current Challenges

- Communication with DFO
    - Does not seem to value community hatcheries
    - Less involvement
    - Less recognition
    - Have proposed projects (e.g., phytoplankton monitoring) and have not received DFO support
    - No longer receive SEP annual reports
    - Funding cut in the 1990s
        - Goldstream has sufficient funding from other sources
    - Would like to see more boots on the ground in resource restoration unit
- Role of CAs
    - Used to advocate for programs but are now more bureaucratic and focused on delivering policy
    - Office-bound instead of out working with volunteers
- Aging participant demographics
    - Challenging to find young people to get involved

Goals

- Greater involvement with local First Nations
  - Currently in progress
  - Want to establish co-management of salmon
- Increase research at hatchery
  - Would require funding and students to do the research
- Additional experimentation
  - Soldier fly diet
  - Salt diet
  - Tank swimming direction
  - Hatchery stressors and impacts
  - Fish pain
  - Rearing environment complexity

Strengths

- Receive feedback on submitted data from Stock Assessment Division

Grist Goesen Memorial Hatchery

Current Challenges

- Training participants
  - Improving skills, knowledge, abilities, leadership, transition planning
  - Create online training with videos and assessments
- Hatchery operation software
  - Do not believe that submitted data are being used effectively due to the systems that DFO chooses to use

Goals

- Develop electronic online hatchery software
  - Improve standard operating procedures for:
    - Production
    - Broodstock Capture
    - Egg takes and Incubation
    - Rearing and Release
    - Member scheduling
    - Education
    - Project monitoring
  - Would like to share with other facilities once created and tested
  - Start another Chinook rearing program
    - Would like to try with eggs from Coquitlam R

Needs (Infrastructure/Tools)

- Get internet on-site
- Upgrade from 8-foot to 10-foot tubs
  - Would prevent the early release of coho
- Add and replace infrastructure
  - Extend roof over rearing troughs
  - Replace inflow/outflow valves
- Get another oxygen meter

Gwa'ni Hatchery

Current Challenges

- Funding
  - Has been frozen for years
  - No benefits
  - Low pay
- Training new employees
  - Would be good to have formal training
- Security
  - Someone must take the nightshift to ensure the hatchery is safe
- Succession
- Lack of tools
  - Challenging to keep up with property maintenance without proper tools

Goals

- Secure funding for equipment
- Start a water sampling program
  - Will help improve lake fertilization
- Get additional resources for tourism
- Spread the idea of net pen rearing
- Fertilize other local lakes
- Add to education program
  - Information about incubation and lake enrichment
- Bring chum back to the river
  - Seapen program
    - Would need a water jet cleaner and improved predator netting

Needs (Infrastructure/Tools)

- Equipment
  - Tool for trimming bushes
  - Fish transporter
  - Water jet cleaner for net pens
  - Cleaning tool for Swedish tubs
  - Improved fence for DIDSON
- Get a tractor

Hartley Bay Hatchery

Current Challenges

- Water system
  - Currently entirely gravity fed
  - No filtration
- Funding
  - Would like to have another staff member
  - Increase assessment capacity
  - Repair and replace aging infrastructure
- Remote location
  - No local hardware store for repairs
  - Takes a month for fish food to arrive

- Communication with DFO
    - Would like more support and collaboration from DFO
    - Want to understand the plans and intentions of DFO higher-ups
    - Do not receive sufficient feedback from DFO

Goals

- Learn more from other hatcheries to improve practices
    - Speak with bigger facilities to learn what they are doing
- Improve escapement estimates in the territory
    - Would require additional funding

Needs (Infrastructure/Tools)

- Expand the incubation room
- Improve water intake
    - Current one is wood and is rotting
- Improve water filtration

Klemtu Hatchery

Current Challenges

- Funding
    - Things are increasingly expensive
    - Budget has continually declined
    - Need more people power
    - Very little support from local community
- Training
    - No training opportunities or education provided for hatchery staff

Goals

- Increase rearing capacity
- Run experimental pink rearing program
    - Rear them in heated tubs to grow them quickly
    - Feed them homemade fish food
    - Would need a water heater

Needs (Infrastructure/Tools)

- Build and repair infrastructure
    - Gathering area near hatchery
    - Winch system at dock
    - Seapen
        - Beginning to deteriorate
    - Fish fence
- Get new waders
    - Only have money for lower quality but then constantly need to repair/replace them
- Need more Capilano troughs to meet current quota

Strengths

- Great advice and support from DFO to work through issues

Marble R Hatchery

Current Challenges

- Broodstock collection
  - Cannot collect fish 1 out of 3 years due to high flow
- Funding
  - Operational funding is difficult than funding for specific projects
  - Hydro bill is expensive
  - Helicopter for fish transfer is expensive
- Data feedback
  - Does not believe DFO is using submitted data effectively
  - No one seems to be analyzing data for each hatchery and river

Goals

- Determine a broodstock collection method that works regardless of river height
- Reduce the cost of the hydro bill
  - Would like to receive a discount
- Restock the river to historic levels
- Allow people to harvest fish in the area
- Improve river monitoring
  - Would require additional funding and input from Stock Assessment
- Run size and time of release experiments
  - Would provide a more accurate release target

Strengths

- Supported well by their CA
- Good guidance and information from DFO

McLoughlin Hatchery

Current Challenges

- Pandemic
  - Difficult to find extra staff to support egg takes
- Finding a reliable supplier of limestone
  - Used to buffer incubation water
- Funding
  - Has not changed in 20 years
  - No longer reflects the needs of the hatchery

Goals

- Better monitoring of local First Nation's catches

Needs (Infrastructure/Tools)

- Replace aging infrastructure
  - Some buildings have been there for 40 years
  - 2 new seapens
- Repair hatchery site
  - Stairs in the facility
  - Cement cracks in walkways

Strengths

- Getting by with what they currently have

Mossom Cr Hatchery

Current Challenges

- Funding
  - Small contribution from DFO does not cover essential operating costs
  - Spend majority of time securing grants and funding
  - Challenging to find operational funding
- Finding and keeping qualified volunteers
  - COVID-19 has shut the facility to the public for the past two years
- Succession
  - Difficult to replace the hatchery manager
- Data feedback
  - Do not get feedback on submitted data from DFO but providing data is a requirement

Goals

- Review operations information
  - Should have more specific details for volunteers
- Establish stable annual funding
  - Either private or government source
- Find new young volunteers
  - Core volunteers have been around for a long time
  - Need people able to do physical labour and devote time
- Host another BioBlitz event
- Employ full-time education staff
  - Would require additional funding
- Run a coho PIT tag study
  - Collaboration with Dr. Scott Hinch

Nanaimo R Hatchery

Current Challenges

- Funding
  - Has not increased in 17 years
  - Difficult to keep up with inflation and pay staff appropriately
  - Projects get funded but money for operations is difficult
- Data feedback
  - Do not get feedback on submitted data from DFO

Goals

- Adapt practices to the changing environment
  - Important to determine environment's impacts on fish

Strengths

- Good information and knowledge provided by DFO

Nelson Cr Hatchery

Current Challenges

- Water supply
  - Pipe follows canyon wall
  - If canyon wall collapsed the hatchery would be without water
- Communication with DFO
  - Certain creeks could not support the recommended amount of fry
  - Targets need to be updated
- Remote hatchery site
  - Difficult to get to hatchery in the winter

Goals

- Re-establish salmon in local creeks
- Start pink fry rearing program
  - Would need an egg transplant from another watershed
- Collect additional biodata
  - Scale samples and PBT to determine fish origin
- Clip coho smolts during spring trapping
- Experimentally feed fish with insect food

Needs (Infrastructure/Tools)

- Equipment
  - Fin clipping gear
  - eDNA sampling kits
  - Rubberized nets

Strengths

- Feel supported sufficiently

Oldfield Cr Hatchery

Current Challenges

- Hatchery repairs
  - Significant funding required to fix landslide damage
  - Concerned about whether the hatchery will reopen
- Broodstock collection
  - Need appropriate river flow
  - Need sufficient people
- Funding
  - Wishes they did not have to beg for money
  - Want more funding for salaries
  - Want a steadier flow of money
  - Have the bare minimum of funding to continue operations

Needs (Infrastructure/Tools)

- Replace old Capilano troughs with circular tubs
- Get new intake system to establish a reliable water source
- Add enumeration fence to Oldfield Cr

Strengths

- Great support from their CA

Oyster R Hatchery

Current Challenges

- Water supply
  - Gravity fed flow cannot be controlled
  - Flow is sometimes insufficient
  - Issues with freezing in winter
- Didymo algae
  - Difficult to control until water gets cold
  - Clogs filters
- Funding
  - Operational funding is insignificant
- Location in regional park
  - Need approval from multiple stakeholders to change things
- Data feedback
  - Would like to receive more feedback on scale and otolith data

Goals

- Get power at the hatchery
  - Would require infrastructure and funding
- Start thermal marking releases
  - Would need increased funding and capacity
- Increase science capacity
  - Would need additional funding
  - Would like to be able to process otoliths, scales, and water quality in-house

Needs (Infrastructure/Tools)

- Build infrastructure
  - Raceway below hatchery to directly release chum
  - Additional channel with a river intake
  - Back-up water supply

Powell R Hatchery

Current Challenges

- Funding
  - Chronic underfunding and no increase since the program's inception 40 years ago
  - Had to cut employees from 5 to 2.5
  - Spend increasingly significant amount of time fundraising
  - Need to address current funding levels
- Program representation
  - Need assistance in advocating for program
  - Being squeezed for more administration and underfunded work from DFO
  - Applied for BCSRIF funding to improve brood and education facility
  - Did not receive funding due to concerns that Powell R wanted to produce more salmon, but that is untrue
- Ocean stock mismanagement
  - Poor fisheries enforcement
  - Failures of stock assessment program
  - Trickle down effects as hatcheries are asked to participate in studies to explain declines

Goals

- Increase staffing
- Grow the education program
- Determine alternative sources of outreach and revenue
- Experiment with larger tubs to finish rearing salmon

Quatse R Hatchery

Current Challenges

- Funding
  - Fixed income since 1982
  - Needs to be sufficient to train and maintain qualified staff
  - Operational costs far exceed additional revenue sources
    - Mandatory insurance more than doubled this year
  - No cost recovery for supplying data
- Maintaining fish production numbers
  - Difficult with changing climate and river conditions

Goals

- Find a new qualified and trained hatchery manager
  - Concerned that a proper salary would be unaffordable
- Pursue green initiatives
  - Electric trucks
  - Renewable energy sources for power
- Improve water access
  - More consistent water temperature
  - Better pressure
- Increase river monitoring
  - Would require field monitoring equipment and funding for personnel
  - Important to collect long term data due to climate change
- Re-establish enumeration and stock assessment
- Start processing otoliths on-site
  - Would require equipment and staff
- Establish an eelgrass monitoring and transplant program
- Research freshwater sponges in the area

Seymour R Hatchery

Current Challenges

- Funding
  - Insufficient
  - No increase since program's inception
  - Fundraising is well supported but very time consuming
  - Operational funding is difficult to raise
  - No pension or benefits
  - Cost of living is high in the Vancouver area
- Data feedback
  - Do not get feedback on submitted data from DFO
  - Would be interested to receive feedback on PBT data

Goals

- Get expert support on specifics of hatchery operations
- Get more support for habitat restoration
  - Less support and expertise in recent years
- Increase operational funding
- Monitor outgoing fish using Ocean Tracking Network
  - Would require additional funding for tags

Needs (Infrastructure/Tools)

- Build additional infrastructure
  - Continue to support spawning and rearing opportunities in the watershed
- Improve habitat in estuary
  - Would require design and additional funding

Strengths

- Good support from their CA

Sooke R Hatchery

Current Challenges

- Broodstock collection
  - High flow makes collection difficult
  - Heavy rain flattens collection fence and makes seining challenging
  - Cannot add channels because high flow reworks the path of the river every year
- Data feedback
  - Unsure how submitted data has been used to benefit their operation

Goals

- Study genetics for coho and Chinook broodstock
  - Would require interested students
- Experiment with selective breeding to better enhance salmon
- Need DFO to sort out water regulations with the province and communicate this with the hatcheries
  - Concerned that establishing water treatment for hatchery discharge would be extremely expensive

Spruce City Hatchery

Current Challenges

- Unique situation
  - Practices are more similar to major operations due to endangered stock
  - Comprehensive major operations manual is not accessible
  - Would like more information specific to their unique situation
  - Lack of communication from DFO
  - Held to a higher standard because they restarted the hatchery more recently and feels that everyone is not held to the same standard
- Specific support
  - Not available in area
  - Need support from vets and biologists
  - Complex operation and do not want to make avoidable mistakes
- Funding

Goals

- Increase funding
  - Add a paid staff member
  - Hydro bill is expensive
- Find an expert source for hatchery practices
  - Would be beneficial to have a helpline for specific questions
- Improve data collection and assessment
  - Would need materials and staff
  - Would partner with a university and contribute more to science
- Look into effluent treatment
  - Outflow from hatchery currently goes directly into the river

Strengths

- Good support from their CA

Tahsis Hatchery

Current Challenges

- Climate change
  - Well water is warming
  - Insufficient rain prevents fish from coming upstream
  - Uncertainty around fish returns
- Succession
  - Aging core volunteers
  - Need recruitment of younger people to support the hatchery and eventually take over
- Funding
  - Insufficient for basics like insurance and hydro
- Data feedback
  - Would like to receive feedback on otolith and swim count data

Goals

- Increase engagement with young people
- Increase funding
- Increase returns
- Start coho and pink programs

Needs (Infrastructure/Tools)

- Build infrastructure
  - New net pen structure
  - Back-up generator
- Get equipment
  - Hatchery truck
  - Bigger boat

Strengths

- Good support from the community

Terminal Cr Hatchery

Current Challenges

Dependence on other parties

- Very dependent on DFO for funding and expertise
- Dependent on other hatcheries for eggs

Goals

- Expand juvenile trapping program
- Add additional gravel to restored areas
- Create additional spawning channels

Needs (Infrastructure/Tools)

- Build and replace infrastructure
  - Flow measurement device at hatchery
  - Camera in creek to collect data
  - New water intakes
  - Wells to continue production over the summer
  - Replace fish ladder
- Improve infrastructure to allow more habitat access
  - Redesign fish ladder for use by all species
  - Bridge inaccessible gap in a local creek

Strengths

- Feel well supported

Thornton Cr Hatchery

Current Challenges

- Funding
  - Insufficient funding with a budget that has not changed in 32 years
  - Need living wages for staff
    - Major operation facilities are paid year-round indexed wages and get pensions
  - Money to CWT all Chinook released from hatchery
  - Funds to repair and replace infrastructure
- Data feedback
  - Do not get feedback on submitted data from DFO and want to feel more included

Goals

- Do more training in fish health
  - Would like to shadow major operations program
- Increase information sharing between facilities
- Find a source of expert advice for community hatcheries
- Raise wages to living wages
- Start to CWT, PBT and adipose clip all Chinook
  - Would need additional funding
- Continue PIT tag study
- Improve water monitoring
  - Want to establish baseline water data
- Investigate bacterial kidney disease in local river
- Investigate Steelhead decline following the landslide
- Run experiments
  - Holding unripe fish in different containers
  - Adding branches while rearing for cover
  - Different loading densities

Needs (Infrastructure/Tools)

- Repair dam
- Upgrade water supply
- Get another vehicle for the hatchery

Strengths

- Good scientific and moral support from DFO through their CA and STAD

Photo by: Nicole Christiansen

Tla'amin Hatchery

Current Challenges

- Funding
  - Need more for operations and expansion
- Staffing
- Insufficient infrastructure
  - Want to deliver best possible care for fish
  - Need more support with acquiring infrastructure and tools to upgrade the 44-year-old facility
  - Felt as though DFO did not sufficiently support a waterline removal but then took undue credit for the project
- Data feedback
  - Have only received feedback twice in 21 years on submitted data from DFO

Goals

- Improve assessment
  - First nation does their part in assessment, but DFO wants the data for free
- Expand operations to enhance other systems
- Increase food fish availability for community
- Increase rearing and incubation capacity
- More involvement with government and First Nation issues
- Increase community involvement
- Finalize marine management plan
- Experimentally incubate and rear fish directly in raceways
  - Eliminates handling

Needs (Infrastructure/Tools)

- Build infrastructure
  - New bulk incubators
  - New piping for rearing tubs
  - Fiberglass box for saltwater
  - Updated rearing facility
  - Rebuilding dam at lake
- Update hatchery equipment
  - Currently 44 years old

Toboggan Cr Hatchery

Current Challenges

- Knowledge
  - Did not have training from past manager and has no fish background
  - Difficult to problem solve quickly
- Water flow
  - Have lost some fish due to intake issues
- Staffing
  - Difficult to find part time staff
- Data feedback
  - Would like to understand what submitted data are useful and what is a waste of time
  - Believes that some of the submitted data is used well and some is not

Goals

- Maintain consistent practices for quality long term data
- Use a temporary fence for broodstock collection
- Experimentally induce unripe fish with injections

Needs (Infrastructure/Tools)

- Upgrade and improve infrastructure
- Remove treated wood in hatchery
    - Improves biosecurity and watershed health

Strengths

- Feel very lucky that they are sufficiently supported with funding
    - Only assessment funding has increased

Tofino Hatchery

Current Challenges

- Funding
    - Receive just enough to cover essentials
    - Spend a lot of time fundraising
    - No budget change in 30 years
    - Think that they should be running a much simpler program considering the level of funding, but they do not think that a simpler program would be meaningful
- Chinook returns
- Data feedback
    - DFO gets busy and does not provide feedback on submitted data

Needs (Infrastructure/Tools)

- Get a new hatchery truck
- Get a new outboard motor for the boat

Yakoun R Hatchery

Current Challenges

- Funding
    - Been an issue since early 1990s
    - Unable to pay seasonal workers appropriate wages
    - Insufficient operational funding
- Data feedback
    - Challenging to get feedback on submitted data from DFO
    - Requested feedback and it took two years to receive it

Goals

- Increase funding for higher wages
- Increase release targets for Chinook and coho
    - Will help supplement high fishing pressure on the west coast of Vancouver Island

Needs (Infrastructure/Tools)

- Build infrastructure
    - Rodent-free on-site living facility
    - New storage buildings

Strengths

- Get enough support from their CA when it is requested

Photo by: Eiko Jones

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