PSSI Science Project Reporting Template

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| ⚠️ | The PSSI Implementation Team is compiling a technical report to demonstrate the important research and advancements made by the Science Branch through the PSSI funding. The technical report will include a 3-4 page summary (including graphics and figures) for each project to show their key results and findings. Please fill in the following fields and sections for your project to be included in the report. Feel free to include and draw from any reports or presentations previously created through your research.  A plain language science bulletin will also be created to follow up on last year’s “[DFO Pacific Region Science Bulletin, 2024. New research and monitoring for Pacific salmon and their ecosystems](https://publications.gc.ca/collections/collection_2025/mpo-dfo/Fs141-15-2024-eng.pdf).” While the first bulletin introduced project backgrounds, methods, and timelines, this new bulletin will highlight the projects’ results, key findings, and conclusions with links to reports and data available. The bulletin will include a 1-2 page summary for each project gleaned from the content entered below.  **⏱️ Completed forms are due January 7, 2026.**  \*Please include or send separately any graphics or pictures (with photo credits) that will help promote the projects. |

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| **📁 PART 1: PROJECT METADATA** |

## 📋General Project Information

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| **Project ID (number)** | **Project Title** |
| 2426 | Sakinaw Sockeye Juvenile Research on Measures to Increase Marine Survival |
| **Project Leads** | **Collaborations and External Partners** |
| Kevin Pellett  Karalea Filipovic  Nicolette Watson | shíshálh Nation |
| **Location (if applicable)** |
| Sakinaw Lake |

## 🐟Geographic and Stock Information

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| **Salmon species (if applicable)** | **Waterbodies (if applicable)** |
| Sockeye | Sakinaw Lake, Malaspina Strait |
| **Life history phases (if applicable)** | **Region** |
| Juvenile, Adult | Sunshine Coast |
| **Stock (if applicable)** | **Population (if applicable)** |
| ECVI/Mainland Sockeye Salmon | Sakinaw Lake Sockeye |
| **Conservation Unit (if applicable)** |  |
| Sakinaw (SEL-11-07) |  |

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| **🧰 PART 2: PROJECT METRICS** |

## 🎯Project Outputs

Include any anticipated outputs denoted as (in progress). Please include links to any outputs available online so they can be referenced in the report.

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| **List scientific publications and technical reports (with links)** |
| Sakinaw Sockeye Juvenile Research on Measures to Increase Marine Survival (In Progress) |
| **List datasets generated (with links)** |
| **Sakinaw Transport Tags [2022-2025].xlsx (yearly transported tag codes)**  **Sakinaw PIT Tag Codes & Detects\_All Years.xlsx (all Sakinaw PIT tagged smolts)**  **Sakinaw [2024-2025] SummerFall PIT Detects.xlsx (yearly detection file of returning adults)** |
| **Describe dataset locations and data management systems** |
| **Saved on shared drive. (\\ent.dfo-mpo.ca\dfo-mpo\GROUP\PAC\Reg\_Shares\Operations\SCA)** |
| **List code, programs, or other software created (with links)** |
| **N/A** |
| **List communication or social media products** |
| N/A |
| **List and describe field work completed** |
| 2023-2025   * PIT tag smolts during peak migration from Sakinaw Lake * Load smolts into transport containers on a boat * Transport smolts ~5 km out into Malaspina Strait and release into marine waters   2025-2027   * Monitor summer adult returns for PIT tags from transport release groups |
| **List and describe samples collected/analyzed (number of samples)** |
| N/A |
| **List and describe large capital assets or equipment acquired** |
| N/A |
| **📝 PART 3: WRITTEN CONTENT** |

## 📌 Highlights

Please summarize in 2-3 bullets:

* The main idea of the project
* Key findings
* Implications of these findings for salmon and decision-makers
* For a more technical audience, but still as plain language as possible

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| * Main Idea:   + This project tests the hypothesis that early marine survival of Sakinaw Sockeye is negatively impacted by local predation at the Hodgson Island pinniped haul-out shortly after smolts enter the marine environment. If correct, smolts transported via boat past Hodgson Island, into Malaspina Strait, would have higher marine survival than smolts that outmigrate from Sakinaw Lake and pass the haul-out on their own. Marine survival is assessed by comparing the adult returns from PIT tagged transported smolts and hatchery PIT tagged fry and smolts released in the lake. * Key Findings:  1. PIT tagging sample size objectives were achieved (1000-2500 tags)   Table 1: The number of PIT tagged and transported Sakinaw Sockeye Smolts each year of the project and the dates of releases.   |  |  |  | | --- | --- | --- | | **Year** | **Date** | **PIT Tagged & Transported** | | 2023 | May 15-17 | 2659 | | 2024 | May 6-9 | 4845 | | 2025 | May 6-8 | 243\* |   \* Infrastructure issues at the Sakinaw Lake dam prevented enough smolts from being trapped for the project.   1. Transporting via aerated tanks on a boat is a successful method for moving smolts past the pinniped haul-out (Hodgson Island). Survival to release was over 99% and release condition and behavior was observed to be excellent. 2. Marine survival comparisons are still being monitored, with the 2024 transport group returning as adults in summer 2026. Preliminary results from the 2023 transport group indicate that survival was not improved for the transported smolts, with only 1 PIT tagged transport fish returning to the lake as an adult.  * Implications:   + Early marine survival may not be the limiting factor for this population. If transport returns continue to be low in the 2026 adult return, the recommendation would be to not pursue smolt transport as a restoration tool for Sakinaw Sockeye. See Insights and Next Steps for more detail. |

## 🌐Background

Please provide 1-2 paragraphs to summarize

* The relevant biological, environmental, and/or management context
* What knowledge gap or demand were you trying to fill?
* Collaboration and partner relationships

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| Sakinaw Sockeye have been listed as endangered with COSEWIC since 2003, and a *Species at Risk Act* Recovery Potential Assessment (RPA) was completed in 2017 (Ramshaw et al. 2019). The RPA cited low marine survival as the greatest limiting factor in recovery, with predator abundance and assumed predation on smolts and adults ranked as high risk, with a critical level of impact. Perpetually low marine survivals are preventing recovery such that the persistence of the population is entirely dependent on a captive brood program.  Sakinaw Sockeye smolts out-migrate from Sakinaw Lake each spring into the Malaspina Strait and Strait of Georgia. Localized marine predation is considered a major limiting factor for the survival of this stock. On water surveys (since 2019) of pinnipeds from the estuary to the seal haul-outs on Hodgson Islands (approximately 2km from the estuary, Figure 1) have observed approximately 100-350 harbour seals in the area during the spring out-migration.  This project was started as a pilot (2022) in collaboration with shíshálh Nation to test the hypothesis that the Hodgson Island harbour seal population is negatively affecting smolt survival, and subsequently adult returns. The goal of the project is to transport and release smolts past the seal haul-out and then compare marine survival rates between transported smolts and those out-migrating naturally. The pilot project began with a low number of smolts transported in small trial releases to test the effect of handling, Passive Integrated Transponders (PIT) tagging, and increased osmoregulation on fish.    The initial proposal indicated a minimum of 1,000 and up to 2,500 PIT tagged sockeye are recommended per year such that a 1% survival will yield a total of 10-25 tag returns. Return rates of less than 1% may be too low to justify operationalizing this activity long term. Return rates for smolts entering the estuary naturally are well documented through annual census programs so additional tagging of a control group is not necessary. |

## 🛠️ Methods and Findings

Please insert a few paragraphs to summarize:

* Main methods used
* Products and tools produced
* Advancements in methodology, technology, and application
* Advancements in communication and knowledge transfer
* Key results and information generated

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| **Methods**  All sockeye smolts outmigrating from Sakinaw Lake encounter a smolt fence with a slide and overhead camera. A portion or all smolts can be directed into a trap box (6x6x3’ aluminum framed) depending on slide configuration (Figure 2). For the purpose of this project the slide was set to 100% capture to meet tagging goals.  Smolts were tagged with Biomark APT12 PIT Tags (12 x 2.12 mm, 0.1 g). Following sedation with TMS (Tricaine methanesulfonate), the tags are injected into the body cavity with an individual pre-loaded 12-guage needle and a Biomark MK 25 implanter. Tagged fish were then scanned and recorded via Biomark BioLogic DCM digital board, Biomark hand scanner, and a bluetooth connected tablet (Figure 3). Tag insertion and fish handling techniques described in the Columbia River PIT Tag Marking Procedures Manual (Columbia Basin Fish & Wildlife Authority PIT Tag Steering Committee, 1999) were modified slightly. As per recommendations from the DFO Veterinarian, the procedure for tagging was to insert the needle ahead of the pelvic girdle along the midline and inject the tag forward. Air bubblers and ice were used in each tagging bin to keep water temperatures cool and well oxygenated. Following tagging, smolts were returned to the trap box for recovery.  Smolts were held in recovery for a minimum of three hours before the transportation process began. At high-tide, shíshálh Nation’s 30’ Landing Craft was brought into the estuary, where six large plastic garbage bins on board were filled with saltwater and frozen water bottles (500ml). At the smolt fence & trap box, eight waterproof backpacks (dry bags) were filled with ~5 gallons of water and 50 smolts (Figure 4). Smolts were carried 900 m down to the beach, where they were transported to the Landing Craft via 12’ skiff with electric motor. Smolts were then poured into the garbage bins with 20 mg/L of O2 from an oxygen tank (Figure 5). Smolts were then transported and released in the Malaspina Strait.  **Key Results**   1. PIT tagging sample size objectives were achieved (1000-2500 tags). It was determined that sample size objectives could be met during the peak of smolt outmigration under normal operating conditions, as seen in 2023 & 2024, with the number of fish PIT tagged exceeding the goal of 2500 (Table 1). 2. Transporting via aerated tanks on a boat is a successful method for moving smolts past the pinniped haul-out (Hodgson Island). Survival to release was over 99% and release condition and behavior was observed to be excellent.    * Challenges included high water temperatures during tagging and transport. This was mitigated with ice and a start date earlier in May. 3. Marine survival comparisons are still being monitored, with the 2024 transport group returning as adults in summer 2026. Preliminary results from the 2023 transport group indicate that survival was not improved for the transported smolts, with only 1 PIT tagged transport fish returning to the lake as an adult. |

## 💡Insights

Please insert a few paragraphs to summarize:

* What this project has added to knowledge about salmon populations, health, or ecosystems.
* How this project informs salmon management:
  + decisions
  + policy guidance
  + trade-offs
  + planning
* Addition of knowledge to understanding:
  + limiting factors/stressors/threats/ pathways of effects/risks
  + biologically significant thresholds
  + cumulative impacts
* Sources of uncertainty

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| This project was an exploration of new options to restore the Sakinaw Sockeye population to a self-sustaining run. It was conducted at a pilot scale to avoid making large investments in equipment or infrastructure before understanding the effectiveness of smolt transport as a tool to increase adult returns.  Given the timelines of the project in relation to the biology of the population we don’t yet have all of the results in hand. Preliminary findings from the first group of ~2,600 smolts suggests this is not an effective tool at increasing survival due to low (1) returns in 2025. A second cohort of over 5000 tags is expected to return in summer 2026 and will confirm these results.  Assuming a similarly low return in 2026 the recommendation is to not pursue smolt transport as a restoration tool for Sakinaw Sockeye. If the results are taken at face value they do raise some important discussion points and potential future directions. For example, early marine survival may not be the limiting factor for this population and later stage mortality may be more important than previously thought. Further investigations should focus on the hypothesis that late stage mortality is an important factor for this population based on the known milling behavior in the terminal area. It has been well documented that Sakinaw Sockeye adults school and stage in the bay while waiting for optimal migration conditions. These are typically described as a high tide at night with sufficient water levels which only occur on specific days within key migration months (e.g. July). Prolonged staging could be exposing this population to higher levels of predation than for example Fraser bound Sockeye and should be specifically evaluated.  Moreover; stock composition data from the Johnstone Strait test fishery indicate Sakinaw Sockeye are regularly encountered each season. Although numbers are low (<10/yr) the probability of this occurring should be near zero when comparing current escapements (low hundreds) to Fraser River run size (low millions; or 1 in 10,000). This suggests there are more adults enroute to Sakinaw than expected providing additional support for the above hypothesis. |

## ⏩ Next Steps

Please insert 1-2 paragraphs to summarize:

* Remaining knowledge gaps and recommendations for future studies
* How can/should the project findings be operationalized for salmon conservation and management?

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| Following the recommendations above, here are a few directions to go with respect to future work:   * Revisit Sockeye test fishing data and conduct a run reconstruction to estimate the pre-terminal abundance of Sakinaw Sockeye relative to escapement. * Work with test fishing crews in 2026 to scan some or all of the test fishing catch with a PIT antenna as sets are spilled during enumeration (underway). Tags in adults should be at a maximum this year and any IDs detected can be compared to results from the river to estimate survival. * Increase monitoring of staging behavior in the bay particularly in the month of July (peak season). Consider installation of fixed SONAR stations in the bay to look for evidence of predation, particularly at night as fish attempt river entry. Overhead camera installations with zoom capability may also be useful. * Consider PIT tagging clipped adults in the test fishery to test the above hypothesis. This should be combined with DNA sampling to ensure they are Sakinaw origin fish. Alternatively; consider applying acoustic tags and receivers to see where mortality is occurring. Sakinaw Sockeye may stand out in the catch given their relatively small size and adipose clip. Dip netting individuals out of the bunt could be explored. Sorting entire sets is not feasible unless the boat is chartered specifically for that activity.   At this time the recommendation is to avoid operationalizing smolt transport activities to support recovery of Sakinaw Sockeye. It also brings into question the utility of similar activities that are designed to mitigate high early marine survival (e.g. net pens). |

## 📈 Tables and Figures

Please provide captions and numbering for any tables and figures. Graphics can be copied below or e-mailed separately.

* Include a brief caption with each figure and table in the box below
* Number each table and figure, and include references in the above sections where appropriate.
* 1-3 figures are recommended per project

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| Table 1: The number of PIT tagged and transported Sakinaw Sockeye Smolts each year of the project and the dates of releases.   |  |  |  | | --- | --- | --- | | **Year** | **Date** | **PIT Tagged & Transported** | | 2023 | May 15-17 | 2659 | | 2024 | May 6-9 | 4845 | | 2025 | May 6-8 | 243\* |   \* Infrastructure issues at the Sakinaw Lake dam prevented enough smolts from being trapped for the project.    Figure 1. Map of the study area with the Hodgson Island haul out, Sakinaw Lake counting fence, and approximate release location.    Figure 2. Smolt dewatering slide at the Sakinaw Lake outlet with flash board for camera counts (left) and trap box with smolts ready to be tagged (right).    Figure 3. PIT tagging process at the Sakinaw Lake fence with pre-loaded trays, marking gun and hand held scanner in action.    Figure 4. Smolts being transferred into a waterproof backpack for transport to the skiff and landing craft.    Figure 5.Transporting and releasing fish aboard the landing craft. |

## 📈 References

Include full references for any publications referenced in other sections. Please format references in Harvard style according to Instructions to Authors for the *Canadian Journal of Fisheries and Aquatic Sciences*, at [Canadian Science Publishing](https://cdnsciencepub.com/journal/cjfas/authors#guidelines).

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| Columbia Basin Fish and Wildlife Authority PIT Tag Steering Committee. 1999. PIT tag marking procedures manual. Available from <https://wiki.ptagis.org/images/6/60/MarkingProceduresManual.pdf>  Brock Ramshaw, Wilf Luedke and Josh Korman. 2019. [Recovery Potential Assessment for the Sakinaw Lake Sockeye Salmon (Oncorhynchus nerka)](https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/4088563x.pdf). Can. Sci. Advis. Sec. Res. Doc. ISSN 1919-5044. |