Policy Lessons and Indigenous Governance: Providing a Basis for a Successful Salmon Reintroduction Framework in the Upper Columbia River

By: Alexandra Dufort
Supervisor: Melissa Marschke
Second Reader: Nathan Young
University of Ottawa Institute of the Environment
Master of Environmental Sustainability
April 15th, 2023

Abstract

Since the construction of the Grand Coulee Dam on the Columbia River in the mid 1900s, the passage of anadromous salmon to the Upper Columbia River Basin has been completely hindered. Studies have determined that there remains viable habitat for these species of salmon in the Upper Columbia which could support natural reproduction. The Columbia River Salmon Reintroduction Initiative (CRSRI), an Indigenous-led program, is now working to reintroduce these salmon to their historic habitat for the betterment of the ecosystem and cultural and economic well-being of the local Indigenous communities that once depended on them. A provincial policy – the British Columbia Wild Salmon Policy, and a Canadian law – the federal *Species at Risk Act* – are examined to assess their potential use to a governance system for reintroduced salmon of the Upper Columbia River Basin. Indigenous rights and land claims also provide support for First Nation's constitutional rights to manage resources on their traditional territory. In this paper, I argue that First Nations led governance is a must in this reintroduction scenario; First Nations are well placed to lead a management program that equally takes into account Indigenous knowledge, western science, and community input. Necessary considerations for this governance framework are also outlined, citing explicitly defined long-term goals and management plans (such as distribution and abundance objectives, extent of commitment to management, and criteria to determine when salmon have been fully re-established), the consideration of potential consequences (potential implications with protection status of other species, political consequences, etc.), and iterative processes as main focus points. Key recommendations include establishing an advisory board made up of Indigenous groups, researchers, and stakeholders to implement a community-based program that works collaboratively with federal and provincial governments and programs as well as NGOs to implement the necessary biological, socioeconomic, organizational, managerial, and political strategies.

Key Terms: Upper Columbia River Basin, salmon reintroduction, First Nations led governance

Table of Contents

1. Introduction

1.1 Background

The Upper Columbia River Basin (also referred to as the Upper Columbia), that is, the portion of the Columbia River and its tributaries above the US/Canada border, has historically been an ecologically, economically, and culturally significant watershed for the peoples of the area, particularly the First Nations communities. Prior to the arrival of settlers, the Columbia River was widely used by First Nations as a route for travel between fishing villages to trade and gather and was also a crucial resource for fish, particularly salmon (Nelitz et al., 2007). BC First Nations have depended on the river's aquatic resources since time immemorial. The fish of the Columbia River have been integral to their culture and well-being and fisheries in general have been a pillar for the economies of BC First Nations communities (First Nations Fisheries Council, 2022). Since the construction of dams in the 1900s however, passage for anadromous salmon (salmon who migrate to and from the ocean) to the Upper Columbia has been completely blocked.

Historically, the Columbia River was the stream with the largest number of Chinook Salmon (*Oncorhynchus tshawytscha*) in the world (Sheer, 1999; Washington Department of Fisheries, 1959). Along with the abundance of Sockeye Salmon (*Oncorhynchus nerka*), White Sturgeon (*Acipenser transmontanus*), and Steelhead (*Oncorhynchus Mykiss*), the Upper Columbia River basin held an ample number of fish (Nelitz et al., 2007). Salmon runs prior to contact with settlers are estimated to have supplied the Okanagan and Lakes tribes with 5,000,000 lbs of salmon, and the Ktunaxa with 2,500,000 lbs of salmon, annually (Scholz et al., 1985). Archeological sites near Kettle Falls, a historic fishing village south of the USA/Canada border, even found artifacts such as projectile points, net sinkers, and salmon bones as old as 7000 B.C., exhibiting evidence of not only

salmon presence 9000 years ago, but also of the importance of fishing in the area (Scholz et al., 1985).

Post-settlement in the 1800s, there are accounts from settlers noting an abundance of salmon throughout the Columbia River. Salmon were documented in the Arrow Lakes, Revelstoke, Blaeberry River, and everywhere in between (See Appendix 1 for map of the Upper Columbia and its tributaries). Explorer David Thompson recorded spawning of large salmon weighing up to 25lbs in 1807 in a tributary to Windermere Lake (Belyea, 2007) and in 1865 a surveyor named Walter Moberly described First Nations spearing salmon near Revelstoke when traversing the Arrow lakes (Moberly, 1885). Evidence of salmon in the Upper Columbia continued into the early 1900s but started to taper as dams were put in place. Total salmon catch in the Columbia River plummeted from a record high of 43,000,000 lbs in 1883 to approximately 5,800,000 lbs in 1954 (Marts and Sewell, 1960).

The purpose of this paper is to explore the current initiative to reintroduce salmon into the Upper Columbia River basin and analyze how policy lessons paired with Indigenous governance can provide a framework for successful reintroduced salmon governance in the watershed. After further background information on the extirpation of the salmon and the reintroduction efforts to date, the approach used to reach these objectives is outlined.

1.2 Hydroelectric Development

Two power dams were built in the early 1900s at Upper and Lower Bonnington, followed by the Horseshoe Dam in 1916, and then several others including the Bonneville Dam in 1938 (Appendix 2). The Lower Bonnington Dam on the Kootenay River was renewed in 1924 which

began to hamper salmon movement, but fish were able to reach the tailrace of the upper dam. Once a third dam was implemented at Slocan, BC, salmon were completely blocked from reaching their spawning beds (Dauble and Watson, 1990). Migrating salmon often used the large cascades and rapids of the Columbia River when returning to their natal streams and mainstem habitats. These areas were thus important fishing locations for harvesting migrating salmon, however many were inundated by dams. For example two major fishing locations located in the US portion, Kettle Falls and Celilo Falls, were flooded by dams in 1941 and 1957 respectively (Dauble and Watson, 1990).

The Grand Coulee Dam, located below the Canada/U.S. border in Washington State, was completed in 1941. Prior to the Grand Coulee Dam, many of the lakes in the Upper Columbia River basin acted as nursery lakes for sockeye salmon. Sockeye were found in the Upper and Lower Arrow Lakes, Slocan Lakes, and there is speculation that they may have used Kinbasket, Windermere, and Columbia Lakes (Appendix 1) (Scholz et al., 1985). Chinook salmon were found in many areas throughout the basin, including the mainstem of the Columbia River, the Pend d'Oreille River, the Kootenay River, and Slocan River (Scholz et al., 1985; CRSRI, 2022). The eventual total blockage of salmon movement to the Upper Columbia was due to the Grand Coulee Dam. After 1946, no more sightings of salmon were recorded at or beyond the dam (Nelitz et al., 2007). The Grand Coulee Fish Maintenance Project transported the last of the migrating anadromous salmon in the Upper Columbia to four tributaries that enter the river below the dam between 1939 and 1947 (Fish and Hanavan, 1948).

1.2.1 The Columbia River Treaty

In response to a devastating flood in 1948 in Oregon and an increase in power demand, the Columbia River Treaty, a transboundary water management agreement between Canada and the United States, was ratified in 1964. The Treaty entailed that Canada would provide flood control of the Columbia River by building three dams; the Duncan, Hugh L. Keenleyside, and Mica (Appendix 2) in exchange for a share of downstream power. Meanwhile the Libby Dam located in the U.S. was also built which flooded across the Canadian border (Government of British Columbia, 2023). The majority of the Treaty rights and obligations fall to the Province of British Columbia, meaning the province must be consulted prior to terminating or amending the Treaty. Approximately 270,000 acres of Canadian habitat have been inundated by the Treaty dams, and over two thousand residents (including First Nations) have been displaced. With 10 years notice, the Treaty can be unilaterally terminated after September 2024 – currently, the treaty is under review by both countries (Government of British Columbia, 2023).

Although the final nail in the coffin, dams are not the singular factor to blame in the decimation of salmon in the Upper Columbia River basin. Salmon population numbers had been declining since the 1800s due to land use such as logging and farming, as well as commercial fishing of salmon (Nelitz et al., 2007). Recent and current studies are reporting that there remains viable habitat for these species in the Upper Columbia River basin which has the potential to support high numbers of spawners and juvenile rearing, meaning natural reproduction is likely possible throughout the basin (Bussanich et al., 2017; Bond et al. 2019).

1.3 Salmon Reintroduction

Salmon reintroduction efforts in the Upper Columbia River basin have been growing since the 1990s, when the Canadian Columbia River Inter-Tribal Fish Commission (CCRIFC) was established under a Memorandum of Understanding between the Ktunaxa/Kinbasket Tribal Council, the Shuswap Nation Tribal Council, and the Okanagan Bands, representing Indigenous communities with territories along the Upper Columbia River basin. The CCRIFC's goal is to restore salmon productivity to the Columbia River on both sides of the border and they have thus spearheaded projects for the reintroduction of salmon species (Nelitz et al., 2007). The Ktunaxa, Syilx Okanagan, and Secwepemc Nations joined together to implement the CCRIFC's efforts and began to undergo planning to reintroduce salmon above Chief Joseph and Grand Coulee Dams as part of an Upper Columbia United Tribes (UCUT) plan (CRSRI, 2022).

In the United States there is the Columbia River Inter-Tribal Fish Commission (CRITFC), which created a salmon recovery plan called the spirit of the salmon (Wy-Kan-Ush-Mi Wa-Kish-Wit). In 1999, the Upper Columbia Salmon Recovery Board was formed. Since then, many projects and partnerships have been created to address this issue and to return anadromous salmon runs to "sustainable, harvestable levels" (CRSRI, 2022). An agreement was signed in 2019 by the three First Nations and the federal and provincial governments to restore salmon to the Upper Columbia, and hence the Columbia River Salmon Restoration Initiative (CRSRI) was born. The CRSRI is Indigenous-led and their work is guided by the Indigenous Nation-chaired Executive Working Group Implementation Team, Technical Working Group, Indigenous knowledge Guidance Committee, and Communications Advisory Group. A three-year renewable commitment was signed in 2019 by the five governments of the Initiative which states that they shall work together

to determine the best mode of action to reintroduce salmon to the Upper Columbia River basin. Their hope for the future is to bring the salmon home and re-establish their stocks for the betterment of Indigenous, environmental, and local well-being (CRSRI, 2022).

The CRSRI outlines areas that are to be considered for reintroduction efforts alongside management actions: upstream and downstream passage for salmon (i.e. passage structures and technologies), donor stocks (use of hatcheries, and reintroduction/release strategies), flow management and hydro-electric activities, habitat assessment, restoration, enhancement, ecosystem interactions and risks (e.g., competition, predation, endangered species, pathogen transfer, and ecosystem linkages), and finally climate change interactions and influences (CRSRI, 2022).

1.4 Approach

All of these plans to reintroduce salmon into the Upper Columbia River basin pose the question: how will the newly introduced salmon be protected and governed? Current policies in place for the protection of salmon in British Columbia and Canada will be examined as well as examples of salmon policies and reintroduced species policies in order to outline where there are current gaps/potential issues and what frameworks have worked best in similar scenarios. Approaches to Indigenous-led governance will also be discussed and potential policy considerations for the protection of re-established salmon will then be suggested.

2. Freshwater and Salmon Governance

2.1 Canadian Governance Systems

British Columbia's freshwater systems are not regulated by one single entity, their governance is decentralized. The same therefore goes for the governance of salmon, as many of the laws and policies for freshwater ecosystems affect the regulation of their aquatic species (Alexander et al., 2019). Most of the constitutional laws affecting both are at the federal level and are spread across many different departments such as Fisheries and Oceans Canada (DFO), Environment and Climate Change Canada (ECCC), and Natural Resources Canada (NRC), to name a few. Canadian federal and provincial laws as well as Indigenous legislation that pertain to salmon conservation and management are listed in Table 1.

The current governance structure in place for the conservation of Pacific Salmon falls under the Wild Salmon Policy (WSP). This policy does not however specifically address landlocked or re-introduced salmon, an important gap as the reintroduced Upper Columbia River salmon may be confined to that section of the river basin, depending on whether or not technologies for the upstream and downstream passage of fish are implemented at Grand Coulee Dam and other major dams in the upper reaches of the Columbia River. In this section, the implications of threatened/endangered species legislation on salmon conservation policy will be discussed, the WSP will be outlined and analyzed using the literature, and then an example of a re-introduced landlocked salmon governance structure will be considered, as well as the First Nations laws and rights, salmon governance structures in other countries, and transboundary water management tools.

Table 1. *Indigenous, Provincial, and Federal legislation pertaining to salmon governance in Canada; self-created.*

Indigenous	Provincial	Federal
• Comprehensive Land Claims • Indigenous Laws • Indigenous Rights and Title • United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)	• Columbia River Treaty • Riparian Areas protection Act • Environmental Management Act • Wild Salmon Policy	• Canada Water Act • Fisheries Act • Canadian Environmental Protection Act • Species at Risk Act (SARA) • International River Improvement Act • International Boundary Waters Treaty Act

2.1.1 Threatened and Endangered Species Legislation

The *Species at Risk Act* (SARA) in Canada is a federal commitment that provides legal protection of wildlife species listed under the act. Species can be listed as threatened, of special concern, endangered, or extirpated. Under the SARA, there are prohibitions that make it an offence to "damage or destroy the residence (e.g. nest or den) of one or more individuals of a species listed in Schedule 1 of SARA as an endangered or threatened species, or as an extirpated species if a recovery strategy has recommended the reintroduction of the extirpated species into the wild in Canada" (Environment Canada, 2007). Under this definition, reintroduced Upper Columbia River salmon could be protected under the SARA. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) is responsible for surveying species' vulnerability status and using the results to keep the species listed under SARA up to date. COSEWIC examines hatchery-supported salmon units separately from populations with little or no hatchery assistance.

There has been debate over the effectiveness of listing salmon stocks as threatened or endangered. In their 2006 paper, Lackey et al. contemplate the usefulness of listing Pacific Salmon

under legislation like SARA or the *Endangered Species Act* (ESA) in the US, implying that such policy tools can be controversial when it comes to such a complex issue as the Columbia salmon decline, stating that "for the salmon technocrat, providing useful scientific information to assist decision makers takes place on a battlefield of intractable policy alternatives, complex and contentious scientific challenges, and confused roles" (Lackey et al., 2006b, p. 48). Using these types of acts to protect salmon can elicit political backlash since enacting them can sometimes directly affect private landowners who face restriction of the use of their own property or halt any type of development; and these legal battles can wind up in court for years. This is partly why it is important to engage with local stakeholders and keep an open line of communication to address their needs and to educate on the importance of the return of such a historically significant salmon population. Local stewardship and advocacy can go great lengths in convincing the public to care for a certain species.

2.1.2 Wild Salmon Policy

Canada's Policy for the Conservation of Wild Salmon, or the Wild Salmon Policy (WSP), is a federal policy under the department of Fisheries and Oceans Canada (DFO) that aims to protect and conserve the 'wild' salmon of BC by maintaining "healthy and diverse populations of salmon that will support sustainable fisheries now and meet the needs of future generations" (Fisheries and Oceans Canada, 2005, p.*v*). In the WSP salmon are considered "wild" if they were born of naturally spawning parents and lived out their entire life cycle in the wild. The WSP states that "the requirement in the definition that a wild salmon must complete more than one full generation in the wild safeguards against potential adverse effects resulting from artificial culture" (Fisheries and Oceans Canada, 2005, p.1), however the definition of what constitutes "wild"

salmon is still up for debate among the fisheries sector in BC and around the globe, i.e. whether hatchery salmon are to be considered wild or not (Berseth and Matthews, 2020). Under the definitions of what constitutes wild salmon, stocked salmon deriving from hatcheries released into the Upper Columbia River basin, and salmon relocated from below the dams on the Columbia River, may not be eligible to be listed as a conservation unit, and therefore would not be protected under the WSP.

The main strategy used in the WSP to try to achieve its goals is the protection and preservation of genetically diverse populations by creating 'conservation units' (CUs) that reflect genetically and/or geographically distinct salmon populations that would likely not recolonize naturally if lost (within an acceptable timeframe), maintaining habitat integrity, and implementing sustainable fisheries management practices. Set indicators are used to evaluate ecosystem health and viability as salmon habitat. Salmon harvest planning is modified based on yearly salmon abundance assessments that use knowledge from salmon studies on marine survival and biological condition in addition to the habitat assessments. Social and economic costs are considered when conservation measures are needed and if these costs are considered too great, the Minister of Fisheries and Oceans can decide against taking action or can limit the action taken. Status of CUs is to be monitored closely and compared against set benchmarks to assess a unit's health through metrics such as abundance and spawning ability. If these metrics do not meet a certain standard, restoration measures such as habitat enhancement and harvesting cutbacks are to be considered (Canada's Policy for Conservation of Wild Salmon, 2005).

The policy claims to honor Canada's obligations to First Nations in its decision-making processes in that it will support Indigenous salmon governance "aimed at facilitating collaboration" (Wild Salmon Policy Implementation Plan 2018-2022, 2018). Part of the WSP 2018-2022 implementation plan is to work with local partners and fund coastal ecosystem restoration projects from the Coastal Restoration Fund (CRF), which would not cover a landlocked salmon conservation project. The newly introduced salmon in the Upper Columbia River basin will need to be protected and monitored which will require continuous planning and management for many decades, necessitating a large amount of funding.

As things stand, the Columbia River is not included in any conservation units in the WSP since there have been no salmon there in several decades. In fact, there is no mention of landlocked salmon in the WSP. In 2008, DFO listed 420 distinct CUs, per Pacific Salmon species they are divided as 32 pink salmon CUs, 39 chum salmon CUs, 43 coho salmon CUs, 68 chinook salmon CUs, and 238 sockeye salmon CUs. CUs are described as: "A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-establish naturally within an acceptable time frame, such as a human lifetime or a specified number of salmon generations. The delineation of CUs relies on genetic traits, biogeographic distribution, life-history characteristics, and local knowledge (e.g. IKS), where available" (WSP Implementation Plan 2018-2022, 2018). Once there is an established population of salmon in the Upper Columbia River basin, they may fit under this description as they would certainly not be able to re-establish naturally if extirpated once again and would have a unique distribution. 'Ecotypologies', life history, and genetics are the main characteristics used to decipher CUs, therefore the Upper Columbia River

salmon must be ecologically and genetically diverse from salmon in other CUs to be listed as their own (Fisheries and Oceans Canada, 2008).

The status of CUs are determined using a set of indicators divided into four classes: abundance, trends in abundance, distribution of spawning, and fishing mortality. From there, benchmarks are identified that determine when the biological production status of a CU has significantly changed (see Table 2 for the WSP's strategies and steps) (Canada's Policy for Conservation of Wild Salmon, 2005; WSP Implementation Plan 2018-2022, 2018).

Table 2. *Table outlining the strategies and action steps of the WSP (Canada's Policy for Conservation of Wild Salmon, 2005).*

1. Standardized monitoring of wild salmon status • Identify Conservation Units • Develop criteria to assess CUs and identify benchmarks to represent biological status • Monitor and assess status of CUs
2. Assessment of habitat status • Document habitat characteristics within CUs • Select indicators and develop benchmarks for habitat assessment • Monitor and assess habitat status • Establish linkages to develop an integrated data system for watershed management
3. Inclusion of ecosystem values and monitoring • Identify indicators to monitor status of freshwater ecosystems • Integrate climate and ocean information into annual salmon management processes
4. Integrated strategic planning • Implement an interim process for management of priority CUs • Design and implement a fully integrated strategic planning process for salmon conservation
5. Annual program delivery • Assess the status of Conservation Units and populations • Plan and conduct annual fisheries • Plan and implement annual habitat management activities • Plan and implement annual enhancement activities
6. Performance review • Conduct post-season review of annual workplans • Conduct regular reviews of the success of the WSP

Figure 1 depicts the correlation between spawning abundance and distribution, and the level of management efforts. Given this information, a newly introduced and vulnerable population of salmon in the Upper Columbia River basin would likely be on the higher end for the extent of management intervention. The inclusion of the reintroduced salmon in the WSP would provide federal protection over the species, however it would be of the utmost importance that focus not be taken away from Indigenous-led efforts. The implementation plan (2018) states that "Plans cannot succeed without support for implementation and monitoring. Partnerships are key to the implementation of management actions and may require cross-jurisdictional integrated plans". Funding should be given to the projects being led and implemented by Indigenous and local community leaders and stakeholders on the ground and must be adequate for the level of monitoring needed (Norton-Arnold and Company, 2005).

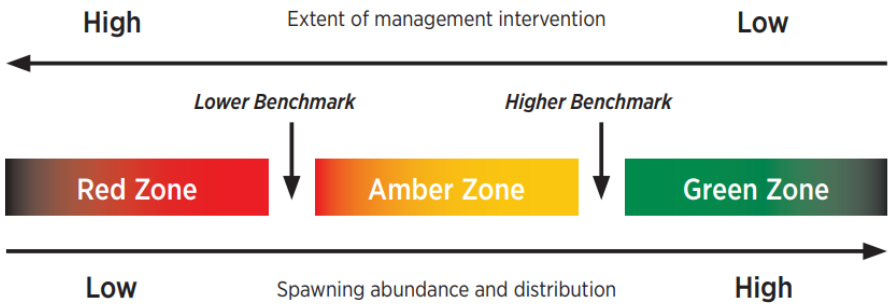


Figure 1. *Sliding scale of benchmark "zones" going from red (low benchmark) to green (high benchmark) for conservation units of salmon and the correlation to spawning abundance and management intervention from the Wild Salmon Policy Implementation Plan (2018).*

The WSP has faced some criticism over the years, some noting that the plan focused heavily on objectives and outcomes but not specific management actions (Norton-Arnold and Company, 2005; Pacific Salmon Foundation, n.d.). The management plan developed for the Skeena River, BC, is considered the main template for implementing the WSP, which has helped guide DFO in the

right direction for achieving key objectives. The Salmon Watersheds Program partnered with First Nations, local NGOs, DFO, the Province of BC, and community members to advance methodologies for the implementation of the WSP which have now been further applied to the Nass River and other watersheds in BC and could be expanded to the Upper Columbia in the future.

When the WSP was being drafted, DFO met with 60 First Nations representatives and stakeholders to discuss the proposal. Some key takeaways from the meeting were that the role of First Nations and stakeholders in defining benchmarks needs to be standardized, a conservation unit based management structure must be agreed upon with local communities, existsing work and data must be presented and used in decision-making, threats and future trends, such as threats to other species and affects to sectors outside of fisheries (such as agriculture and land-use planning) must be considered, the value of salmon (environmentally and culturally) must be communicated to the public, and lastly focus should not solely be on monitoring and identifying problems, but also on defining tangible steps to solving any problems discovered (Norton-Arnold and Company, 2005).

2.1.3 Landlocked Salmon Policy

Only anadromous salmon are considered in Canadian federal salmon conservation policies (Canada's Policy for Conservation of Wild Atlantic Salmon and the Wild Salmon Policy). Conservation policies of landlocked salmon in Canada are mainly divested to the provincial governments, as opposed to coastal salmon which fall completely under the regulation of the Federal Government. The Federal Government has authority over coastal and inland fisheries and the protection of fish and fish habitat under the *Fisheries Act* (DFO and the Ministry of Natural

resources and Forestry (MNRF)), and the Provincial Government has authority over its natural resources. Conservation authorities are at the provincial level as well.

One good example of landlocked salmon management of reintroduced salmon species is the Atlantic Salmon population of Lake Ontario. The original population of Atlantic Salmon in Lake Ontario went extinct after the 19th century, and then in 2006, public, private, and non-governmental organizations (NGOs) came together to reintroduce the species lost (Government of Ontario, 2021). The lake is stocked with hatchery salmon every year with the goal to have a self-sustaining population by 2025. The restoration and conservation efforts of these salmon are led by the Ontario Federation of Anglers and Hunters (OFAH) and the MNRF along with over 40 partners including conservation authorities, NGOs, private landowners, local clubs and the public (Government of Ontario, 2021). The Lake Ontario Atlantic Salmon Restoration Program (ASRP) works with the MNRF and conservation authorities to collect data on the salmon populations as well as the physical stream environments in order to identify potential restoration or water quality enhancement needs and inform decision making. There is also an "angler diary program" wherein anglers help provide fish data such as adult salmon distributions and fish survival rates (Lake Ontario Atlantic Salmon Restoration Program, 2023). The salmon of Lake Ontario are not listed under SARA. Aside from their current monitoring and restoration practices along with the restocking through education programs, the ASRP does not currently have future management or monitoring strategies outlined, however they are set to release a 5-year plan to guide the program between 2021 and 2025 that has yet to be released (Lake Ontario Atlantic Salmon Restoration Program, 2023).

A clear long-term monitoring plan is a must in cases of reintroduction for ongoing best results. The ways in which humans do and will interact with the ecosystem must be acknowledged when considering future restoration goals for them to be realistic. The ASRP does not seem to recognize the ways in which management decisions and human activities influence the ecosystem and rather focuses solely on increasing the species' population (Glass, 2010), something that the CRSRI should be cautious of. The ASRP is however an example of a reintrodutcion program where the salmon are managed and conserved without the use of the SARA or government policy.

2.1.4 First Nations Rights, Laws, and Governance

Under the Canadian Constitution, First Nations have protected inherent and Treaty rights which involve the right to accustomed governance on traditional lands and waters and their resources (Assembly of First Nations, 2018). Two examples where First Nations have exercised this right are the Listuguj Mi'gmaq First Nation Government Law on Fisheries and Fishing in New Brunswick, and the Nisga'a Fisheries regulations in Northwest BC. The former governs salmon fishing and conservation in the Restigouche River, and the latter constitutes of several fishing regulations under the *Nisga'a Fisheries and Wildlife Act* for all harvesting in K'alii Aksim Lisims (The Nass River) including that of salmonid species (Nisga'a Lisims Government, 2013).

There is also Aboriginal land title; previous court rulings such as the Delgamuukw v. British Columbia case helped to outline Indigenous authority over their traditional territory in BC and all of Canada. The case was opened by the Wet'suwet'en First Nations and the Gitxsan of Northwestern BC in order to establish jurisdiction over 58,000km^2 of land and water after BC's Supreme Court ruled that First Nations' rights to land were to be abolished (Delgamuukw v. British

Columbia, 1997). The Supreme Court ruling for the case established that Aboriginal rights and title cannot be abolished, confirmed oral testimony as a legitimate form of evidence, and reaffirmed the right for Indigenous peoples to use the resources of the land and waters they have title over. This case set a precedent for other court rulings that followed including the Tsilhqot'in decision in 2014 which further secured Aboriginal land title in BC for lands not included in treaties (Hernandez, 2020).

International law such as the UN Declaration on the Right of Indigenous Peoples (UNDRIP) also serves to protect indigenous rights. Article 32(1&3) of UNDRIP states that "Indigenous peoples have the right to determine and develop priorities and strategies for the development or use of their lands or territories and other resources" and that "states shall provide effective mechanisms for just and fair redress for any such activities, and appropriate measures shall be taken to mitigate adverse environmental, economic, social, cultural or spiritual impact" (UNDRIP, 32(1&3), 2007).

2.2 Salmon Conservation Policies in Other Countries

A country with a concrete example of salmon conservation policy is Norway, with its plethora of salmon rivers that hold the worlds largest spawning ground for Atlantic salmon (Liu et al., 2011). In Norway, the Ministry of Environment leads on the protection of wild salmon and escaped farmed salmon, and their main management goal is to set certain spawning targets for each individual river. Norway's *Nature Diversity Act* (2009) aims to "protect biological, geological and landscape diversity and ecological processes through conservation and sustainable use, and in such a way that the environment provides a basis for human activity, culture, health and well-being, now and in the future" and states that "special management and protection measures, including total protection, [may be prescribed] for a population of a

species if it is believed to have distinctive genetic characteristics" (*Nature Diversity Act*, S.25) . Fishing rights follow a landowner structure, and the fisheries management system consists of gear restrictions, closed areas, and closed seasons. Landowners own the section of river on their property and are given authorization by the state to sell fishing licenses to anglers (Liu et al., 2011).

It is important to look to our neighbours as well - the United States - since it is with them that we share the most bodies of water. Similarly to Canada, the US has several federal acts, treaties, and policies in place for the conservation of salmon such as the 1985 Pacific Salmon Treaty, a commitment by the US and Canada to protect salmon fisheries, and the ESA that protects threatened and endangered species. Salmon in the US are largely protected by the Environmental Protection Agency (EPA) and salmon governance also revolves around evolutionarily significant units (United States Environmental Protection Agency, 2022).

2.3 Transboundary Water Management

When speaking of the reintroduction of salmon into the Upper Columbia, the Canadian portion of the river is the main focus, and the reintroduction initiative is above the Canada/US border, however even if the salmon do not have passage across the dams, they will still have free range of any uninterrupted river, which spans southward to the Grand Coulee Dam in Washington State approximately 167km below the border. The management and conservation of the species and their habitat will therefore need to be a joint effort between both countries. Thankfully, there is the Boundary Waters Treaty (BWT), signed in 1909 to resolve transboundary watershed issues, the treaty established the International Joint Commission (IJC) to facilitate transboundary water

governance through the *International Boundary Waters Treaty Act* and other means (International Joint Commission, 2023a). The BWT ensures that both sides of a water system that cross the border follow the same rules, so that benefits are felt equally, and has regulations in place to resolve any disputes between the two countries. For example, both countries must agree not to pollute the water if the pollution will damage property or negatively affect people in the other country and must also consult one another through the IJC when planning any project that may affect the water levels or flows (Environment and Climate Change Canada, 2022). The IJC has authority to impose binding conditions to ensure compliance with their conditions.

The IJC runs the International Watersheds Initiative (IWI) that promotes solving transboundary water issues through the help of local communities and stewardship and runs on the belief that an ecosystem should be managed as a whole entity rather than managed based on human-made boundaries. IJC boards across both countries implement this strategy through IWI projects that promote improved resource management, better communication, and scientific studies (International Joint Commission, 2023b). Such a project could benefit work done by the CRSRI when planning for future watershed management and protection in relation to the salmon. Local communities along the entire river above the Coulee Dam will need to work together to gather scientific data and implement a conservation management strategy.

3. Reintroduced Species Policy

3.1 Key Considerations

In the present instance, identifying clear long-term objectives for reintroduced salmon is of central importance. It is necessary when planning reintroduction to consider potential pros and

cons ahead of time and find a way to achieve compromise with potential issues at hand. Wildlife reintroduction must consider social, economic, and political factors, and has been widely discussed and debated in the past. Some criticize reintroduction for pulling funding from other causes but reintroduction has proven to have the potential to bring in a lot of money to local communities, particularly for 'attractive' species such as salmon. For example, wolf reintroduction in Yellowstone has been estimated to bring in 18 million dollars of net benefit to the surrounding communities within the first year due to increased visitation to the area, resulting in 110 million dollars in twenty years (Enochs, 1997). Typically, when a reintroduction program is suggested, as in our case, it is for a species who's need for recovery efforts stems from anthropogenic causes, thus becoming a moral and ethical dilemma.

Aside from the political, social, and economic aspects to consider, the requirements for the species to flourish must of course be properly understood (Enochs, 1997). Data must show that the area of reintroduction is suitable for the species' needs. If this data is not available, funding must be put into studies to assess the habitat. If the habitat, in this case the Columbia River and its tributaries, has areas in need of restoration in order for the salmon to thrive, funding must go towards this as well as future environmental monitoring efforts. Species such as the salmon of the Columbia River that were extirpated prior to our modern knowledge of the ecosystem's ecology are particularly tricky since their preferred habitat within the system is somewhat unknown. This however presents a unique opportunity to allow the salmon themselves to reveal their ecological needs and preferred habitat within this system (Hirzel et al., 2004). Salmon may be a good species for this type of experiment since they have a high degree of dispersal and will therefore seek out the most suitable conditions. This pertinent information on species preference can thus be

collected as data and used to guide future releases in ongoing reintroduction programs (Hirzel et al., 2004).

3.2 Reintroduced Species Management Frameworks

Falk and Olwell (1992) outlined considerations to be made when creating a reintroduction program framework and divided them into four categories (Table 3).

Table 3. *Key considerations for a species reintroduction framework split into four categories. From Falk and Olwell (1992).*

Categories	Considerations
Objective	Have a clearly described rationale and long-term goals for the proposed program.
Strategy	Consideration of all potential consequences, including potential implications with protection status of other species and habitat of the area.
Managerial	Outline specific areas where the reintroduction will take place and who will lead the monitoring and maintenance of the new populations.
Biological	Have thorough understanding of how the reintroduction will be carried out from a biological perspective and how those actions will support the long-term goals.

Falk and Olwell further suggested that strategic and political consequences should be considered from the onset of the process alongside the biological considerations and technicalities, noting that these things can often be an afterthought. This mistake can result in projects that are not efficient nor cost-effective and is counter-productive to long-term success.

Moreover, the success of a program heavily relies on a goal-oriented framework. Questions to be answered relating to program goals that are pertinent to the salmon reintroduction are: are

pre-extirpation distribution and abundance the objective? If so, a specific point in the species history must be chosen as the goal for the re-established population. What influenced the historical population's distribution and abundance prior to extirpation? Once restoration has been accomplished, what is the extent of commitments to management? What criteria will be used to determine if the population has fully re-established? Will management continue indefinitely, or will there be a set point when the population will be left to survive naturally? Is the goal for the population to be maintained in perpetuity? And if so, what will need to be put in place to ensure this maintenance? (Falk and Olwell, 1992). These are but a few examples of specific management questions that need to be answered prior to the commencement of a reintroduction initiative.

Similarly, reading et al. (2002) created a model for successful reintroduction that is split into four separate variables: 1) biological considerations, which include all things relating to ecology, genetics, and the technical aspects of reintroduction (reintroduction techniques such as ensuring there is a reliable source population, choosing and preparing a release site(s), and genetic considerations; 2) issues with power and authority, it is important to be aware of the interplay between all actors (federal laws, organizations, traditional roles, etc.) and for them to be cognisant of their roles to limit power struggles; 3) organizational aspects, as understanding the organizational system being used (including organization philosophies, legislation, policies, and types of workers involved) is extremely beneficial to the program. Reintroduction programs can bureaucratize quickly due to external pressures and thus familiarity with policy, standard operating procedures, and public relations is of utmost importance; and 4) socioeconomic considerations, as the public's attitude towards the species and conservation efforts greatly affects the success of a reintroduced species' survival. Local support of the initiative is imperative.

Values and perceptions that stakeholders hold can be better understood through a pre-emptive analysis of socioeconomic aspects. The animal's perceived significance or worth, be it spiritual, economic, ecological, recreational, or otherwise, influences the public's sentiments around reintroduction efforts and should therefore be a predominant concern of the reintroduction framework. The attitude towards reintroduction can also be affected by the reluctance of some towards listing a species as threatened or endangered due to the restrictive nature of the SARA hence proper consideration must be given to this decision. See Figure 2 for further considerations within each of the variables of this framework.

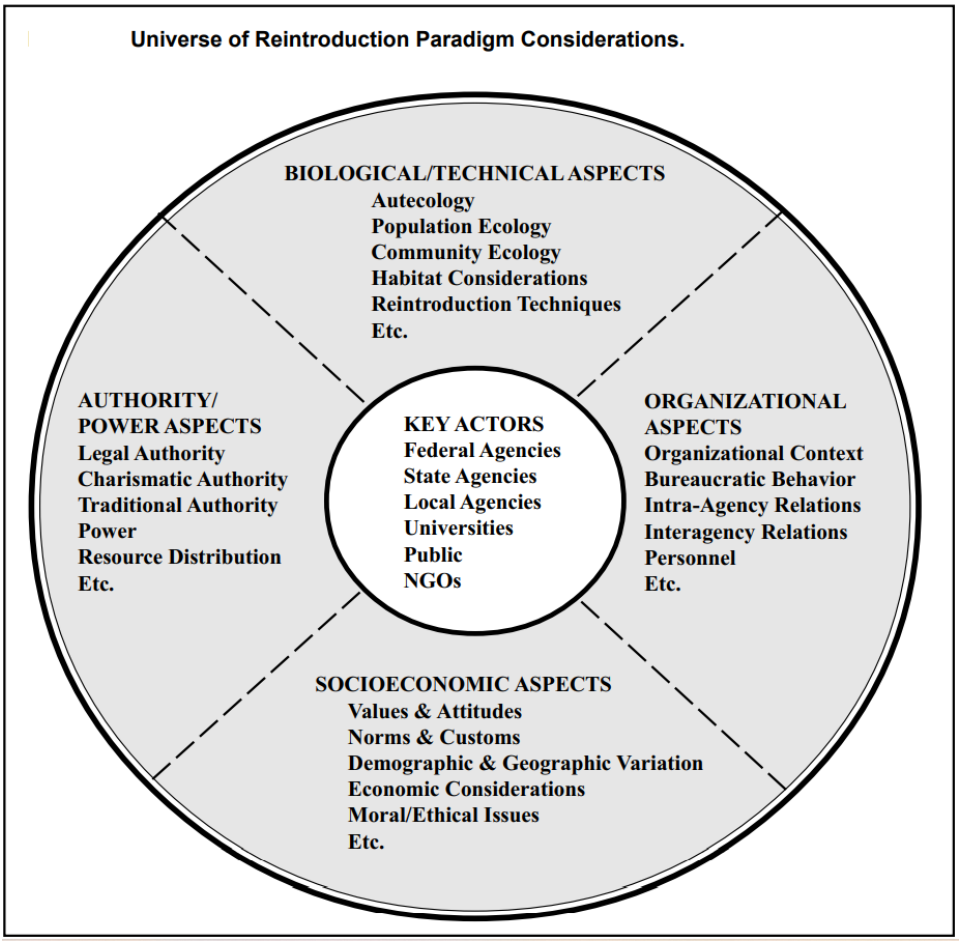


***Figure 2**. Reintroduction paradigm considerations from Reading et al. (2002).*

Both Reading et al. and Falk and Olwell's frameworks differ slightly in logistics however both philosophies are analogous. Both are goal-oriented frameworks that emphasize the importance of considering and thoroughly assessing *all* aspects that impact a reintroduction initiative: the biological, socioeconomic, organizational, managerial, and political. A similar framework with an Indigenous-led focus would be beneficial to the CRSRI (see Table 4 in the discussion).

4. Indigenous-led Resource Governance

4.1 Required Consideration of Indigenous Knowledge

In Canada there are twenty-four Comprehensive Land Claim Agreements (CLCAs), accounting for approximately 50% of the country's land mass (Alexander et al., 2019). The purpose of CLCAs are to address wrongs made by the Canadian Government against Indigenous peoples and uphold Indigenous rights and title to their traditional lands. Many federal acts pertaining to environmental protection require the "consideration" of Indigenous knowledge in the decision-making process. Such acts which pertain to the situation at hand include the *Impact Assessment Act*, the *Species at Risk Act*, and the *Canadian Environmental Protection Act.* For example, the *Impact Assessment Act* states that "[…] the review panel, in determining the effects that are likely to be caused by the carrying out of the designated project, took into account and used any Indigenous knowledge provided with respect to the designated project" (*Impact Assessment Act*, 2019, s.51(d)). An acknowledgment of Indigenous knowledge is not enough, as it serves only to appease formal requirements rather than actually give Indigenous peoples any power.

4.2 Role/Importance of First Nations in Governance

It is becoming more widely accepted that there is a moral and ethical responsibility to not only consult, but actively involve Indigenous communities in any research, monitoring, or management of activities occurring on their traditional territory. This is a much-needed shift in the narrative, as natural resource management has mainly been run on a paternalistic and colonial bureaucratic structure that maintains the minimization of true Indigenous involvement, resulting in a failing system (Alexander et al., 2019; Procter, 2020; Reid et al., 2020). Community-led and Indigenous-led resource governance is thus becoming more implemented in the world of environmental management. In fact, the use of multiple knowledge systems such as Indigenous knowledge and local knowledge along with the typical route of western science has been shown to strengthen and build trust for decision making and governance, however the actual implementation of this has proven difficult in practice (Alexander et al., 2019; Chapman and Schott, 2020; Cooke et al., 2021).

Inidgenous knowledge is typically obtained from elders and leaders in First Nations communities through storytelling and inter-generational information (Kinch et al., 2022). Although the salmon of the Upper Columbia have been extirpated for decades, stories from elders in the community and those with inter-generational knowledge tell stories of the salmon that can be incredibly valuable to creating a salmon reintroduction initiative, such as where within the basin specific salmon species were found. It is not necessary however for the First Nations of the area to have specific knowledge about the salmon of this particular watershed system, as their general depth of traditional ecological knowledge is indispensable on its own.

In the words of the First Nations Fisheries Council; "[First Nations] have always honoured, protected, harvested, and managed aquatic resources in line with their inherent rights, Indigenous knowledge, and traditional laws" (First Nations Fisheries Council, 2022). A framework for any process involving reconciliation must include Indigenous peoples from the outset, and their intellectual and legal traditions must be at the forefront (McGregor, 2020). An important distinction between Indigenous views and western science is that Indigenous beliefs require the acknowledgment that all of nature is alive and deserving of entitlement, therefore reconciliation is not only between man and man but also between man and all entities of nature. Indigenous governance entails Indigenous environmental justice, and an important aspect of healing must take place as trust has been broken between Indigenous peoples and the state, as well as the relationship between peoples and the land (McGregor, 2020). The implementation of this type of environmental justice may seem unrealistic to some, however these concepts are not new and have begun to be implemented elsewhere in the world, such as in New Zealand and Bolivia, where the Whanganui River is recognized as having personhood and a Law of the Rights of Mother Earth has been passed.

Indigenous formulations of the concept of reconciliation must be recognized and implemented, rather than reconciliation being defined by non-indigenous institutions, which is how things have operated up until this point (McGregor, 2020). A key aspect of this is to allow for Indigenous-led governance of resources that are crucial to the cultural, spiritual, and economic well-being to the First Nations of the area. Indigenous sovereignty in the realm of environmental management is becoming a more mainstream concept in policy, with approaches such as Two-

Eyed Seeing and co-production fighting their way into discussions of environmental governance, but there is still a long way to go until these practices become commonplace.

4.3 Potential Co-governance Frameworks

After decades of exploitation and a colonial-mindset-driven environmental management system, respect and proper jurisdiction to First Nations is a necessity. A lot of research has gone into the best methods to "incorporate" Indigenous knowledge with western science. It is this notion of "incorporating" or "integrating" however, that has proven inadequate when it comes to environmental research, management, and decision and policy making, as it still perpetuates unequal power dynamics and colonial tendencies (Chapman and Schott, 2020; Cooke et al., 2021). The mere integration of Indigenous knowledge into policy decisions can and has resulted in knowledge appropriation and the loss of cultural identity (Chapman and Schott, 2020). The recent preferred approaches that seemingly properly embrace and apply Indigenous voices are ones which hold all ways of knowing with equal weight. The two prominent approaches in western literature are Two-Eyed Seeing (*Etuaptmumk* in Mi'kmaw) and co-production, which are fairly interchangeable. Examples of how the concepts have been implemented in the recent past will be outlined.

Two Eyed Seeing is when two or more forms of knowledge co-exist and compliment one another, rather than one being assimilated into the other, and places emphasis on giving First Nations the ability to advocate for themselves. Two-Eyed Seeing and co-production both require that all knowledge sources be weighted and used equally and aim to bridge the gap between knowledge and action (Chapman and Schott, 2020; Cooke et al., 2021; Reid et al., 2020). Both

approaches propose that the work be conducted collaboratively and inclusively throughout every step of the process; that is research, data collection, and implementation.

Reid et al. (2020) examined three case-studies where Two-Eyed Seeing approaches were put to practice and each study exhibited a particular facet of the method; (1) co-developing questions, (2) documenting and mobilizing knowledge, and (3) co-producing insights and decisions. The case studies and their respective facets to Two Eyed Seeing are described below.

First, a community-based monitoring program for the Northwest Territories' Slave River Delta, for which indigenous community members, academics, and other groups (Mantyka-Pringle et al., 2017) arranged a participatory modelling approach, was considered by Reid et al. In this case study, growing concerns about impacts to the fish of the river caused by resource development upstream were addressed through the creation of the Slave River Delta Partnerhsip made up of three First Nations, three Métis organizations, two towns, research institutes, and government entities. They put together a workshop with over 100 participants to develop key questions in line with Western science and Indigenous knowledge, to which Mantyka-Pringle et al. then offered responses. Western science indicators were collected via field observations and document reviews, and the basis for the Indigenous indicators were informed via informant interviews with Elders. Through this participatory modelling, co-developed questions were created and Mantyka and co-authors were able to provide answers to the questions through a 'power-neutral approach'.

In the second case study, consilience of Indigenous knowledge and modern science for a collection of habitat indicators of ecosystem change was examined in the Saskatchewan River Delta by Abu et al. (2019). The Saskatchewan River Delta also has anthropogenic activities causing

several direct and indirect issues to its hydrology and wildlife. In this scenario, a community-academic partnership was also formed due to concern with a goal to value and use Indigenous knowledge and Western science equally to understand ecosystem changes in the Delta. Abu et al. evaluated this approach with the following questions: "(a) How can we learn about long-term social-ecological change from diverse knowledge holders? (b) How can we provide for the coexistence of plural forms of knowledge while engaging in respectful critique? and (c) How can we document the relative contribution each knowledge system provides and explain how each helps to fill in the gaps of the other?". The authors identified Two-Eyed Seeing as the best guiding framework to address the first two questions. To address the final question, three sources of evidence for ecosystem change were identified; Indigenous knowledge from informant interviews with Elders and harvesters (including historical events) which were presented to and reviewed by community members, Province of Saskatchewan archival records on historical events, related policies, and past system changes, and finally, scientific information obtained using scientific instruments and field data.

The final case study was by Giles et al. (2016) - this time on the East Coast of Canada – in which the authors assess examples of bringing together different experiences as a means for decision making with respect to a fishery. The study focuses on the Eskasoni First Nation in *Unama'ki*/Cape Breton Island, who are heavily immersed in fishing activities. In the study the *Unama'ki* Institute of Natural Resources, Dalhousie University researchers, commercial fishers, and Eskasoni First Nation representatives examined the use of Indigenous knowledge in policy-level decision making in the Eskasoni's American eel (*Anguilla rostrata*; *Kataq* in Mi'kmaw) fishery. The American eel was listed as threatened by COSEWIC in 2012, prompting its consideration to be listed under the

Species at Risk Act (SARA), which specifies that "the traditional knowledge of the aboriginal peoples of Canada should be considered in the assessment of which species may be at risk and in developing and implementing recovery measures" (Species at Risk Act, 2002). However, the implementation of indigenous knowledge into government policy has proven difficult, which is what Giles and their co-authors specifically wanted to analyze. Through interviews with Ekasoni eel fishers and COSEWIC and SARA government officials, it was found that the Mi'kmaq knowledge system was not reflected in management decisions (Giles et al., 2016). In this process it was found that government perspective on "integrating" Indigenous knowledge into policy is difficult due to specific barriers such as citing issues, data ownership, conceptual problems, and miscommunication (issues of trauma and mistrust between Mi'kmaq and the Government). Regardless of these perceived barriers however, Giles et al. found there was room for opportunity, pointing to Two-Eyed Seeing as a framework for co-governance in the scenario of bringing Mi'kmaq knowledge (and henceforth any Indigenous knowledge) into COSEWIC and SARA processes through community advisory boards and scenario-building activities.

The Two-Eyed Seeing model mitigates many losses as they greatly broaden the scope of information and stray away from the usual unilateral methods, increasing legitimacy and credibility (Cooke et al., 2021). It is emphasized in the conclusion of Reid et al.'s paper that the Two-Eyed Seeing approach enacted in fisheries governance can not only improve policy and management, but that it holds the ability to also improve power relations and create methods which respect differences rather than simply acknowledging them, and it is through this that ways of knowing can be united. Indeed, in order to truly harmonize multiple ways of knowing, whether

in fisheries governance or otherwise, all voices must be heard, respected, and used in the implementation process.

Cooke et al. (2021) point out that involving many ways of knowing can at times be criticized as a threat to "scientific inquiry and processes that impede the independence of knowledge generators" (p.90). They argue however that this can be mitigated by engaging resource users as partners and by ensuring the process is iterative (Figure 3). Chapman and Schott (2020) suggest that co-governance plans should include a governance board of representatives made up of researchers, Indigenous groups, and anticipated resource users, with members selected by each group. The board must agree upon a governance structure with roles and responsibilities explicitly laid out and periodic meetings should be held with stakeholders to maintain a clear set of objectives and an open line of communication. Furthermore, predetermined milestones should be set and checked to ensure ethical standards continue to be adhered to. Chapman and Schott call this a coevolution framework rather than coproduction, stating that the key difference between the two are that the former directly addresses knowledge appropriation and power imbalance with an emphasis on providing training and practical experience in research, governance, and monitoring.

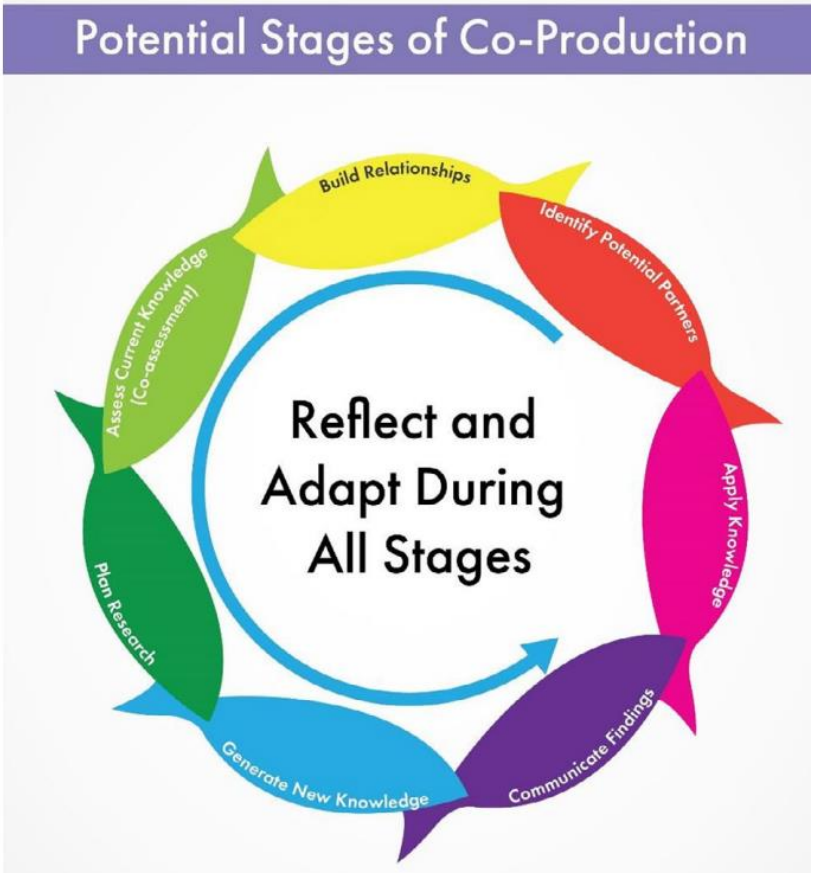


Figure 3*. Potential stages of co-production from Cooke et al. (2021) depicting the process as cyclical with "continual reflection and adaptation".*

4.4 Role of First Nations Fisheries Council

In the instance of governance of reintroduced salmon in the Upper Columbia River basin, collaboration with the First Nations Fisheries Council (FNFC) would be necessary. The FNFC brings together and builds capacity for BC First Nations to have their perspectives heard by decision makers and allow them to be directly involved in Pacific fisheries aquatic resource management, making it more straight forward for First Nations priorities to be delivered to the government in a coherent message (First Nations Fisheries Council, 2022). The FNFC has several partnerships that support persuasive communication, facilitating the collaboration between First Nations, government, and industry needed for effective resource governance. For example the council has

Commitment to Action partnership agreements in place with Fisheries and Oceans Canada, the Canadian Coast Guard, Environment and Climate Change Canada, and Transport Canada, as well as a Memorandum of Understanding for First Nations engagement with provincial ministries (First Nations Fisheries Council, 2022).

4.5 Indigenous Governance Programs

4.5.1 Land Guardians

The Land Needs Guardians Program facilitates Indigenous leaders to be working on the ground to enforce and manage protected areas and monitor development projects, as well as maintain cultural sites. Land Guardians work implements both Indigenous knowledge and ways of knowing and western science, using both historical knowledge from elders and current data collection to inform themselves on how best to protect lands, waters, and the species within (Land Needs Guardians, 2022). This program allows for Indigenous governance of their own lands and waters which not only benefits the ecosystems but also allows for Indigenous peoples to remain connected to their ancestral lands and culture in their work. Such a program could be very useful in the future conservation management and monitoring phases of the salmon reintroduction process.

4.5.2 Conservation Through Reconciliation Partnership

The Conservation through Reconciliation Partnership (CRP) launched in 2019 and aims to shift the focus of conservation away from colonial strategies towards Indigenous-led approaches that are based in Indigenous knowledge systems, laws, and relationships. It is co-hosted by the ISAAK OLAM Foundation, the Indigenous Leadership Initiative, and the University of Guelph. The

CRP is a network of Indigenous leadership, conservation agencies, communities, organizations and academia that work together to implement Indigenous conservation practices such as Indigenous Protected and Conserved Areas (IPCAs), using recommendations outlined by the Indigenous Circle of Experts's report *We Rise Together.* The report provides guidance for Canada to reach its protected area targets of 17% protected terrestrial area and 10% coastal and marine area by December 2020, a target that was since updated in 2021 through a G7 nations approved Nature Compact to protect 30% of land (including freshwater) and ocean by 2030. The CRP thus supports the implementation of the *We Rise Together* report recommendations within the conservation sector and aids in the development of IPCAs (Conservation through Reconciliation Partnership, 2022). IPCAs are a great way to protect and conserve ecosystems where First Nations have the primary governing role and are not cut off from using their lands as with typical protected areas.

4.6 Indigenous-led reintroduction of salmon in the Okanagan River Basin

The Syilx Okanagan Nation, represented by the Okanagan Nation Alliance (ONA), is comprised of seven First Nations communities in BC and one in Washington State. The existence of salmon in the Syilx traditional watershed (the Okanagan River basin) is imperative to the wellbeing and cultural wellness of the peoples of these communities (Blanchet et al., 2022). The salmon of the Okanagan River basin were nearly extirpated in the late 1900s which kickstarted a program led by the Syilx Okanagan Nation to restore their populations in the 1990s. The ONA assessed risks associated with the reintroduction of sockeye salmon and considered options for reintroduction with help from DFO and the BC Ministry of Forests, lands, and Natural Resource Operations (Blanchet et al., 2022). Since the Okanagan River crosses the United States-Canada border like the Columbia River, the restoration program needed to assert Syilx rights and title as well as negotiate

with both the BC provincial government and the Canadian federal government, as well as the governments in Washington State. Consultation with other First Nations with territory along the Okanagan River basin was also necessary. Legislation and obligations from international trade agreements and treaties also needed to be considered and honoured, such as the Pacific Salmon Treaty and the Columbia River Treaty (Blanchet et al., 2022).

A pilot project ran from 2000 to 2003 which conducted risk assessments and program design, which eventually led to the 12-year reintroduction of Sockeye salmon into Skaha Lake, a Syilx-led initiative which began in 2004. The initiative focused on community engagement that included: social gatherings, ceremony and Nsyilxcen language transmission; community participation in regional water management and flow decisions; design and development of fish passages through hydroelectric dams, and salmon habitat restoration. Through this program there have been releases of sockeye salmon fry (the life stage of salmon after the larval stage when salmon begin to eat on their own) every year since 2015. These fry are raised at a Syilx Okanagan Nation hatchery, however there is also an educational component to the program called Fish in Schools (FinS) that allows kids in regional schools to raise salmon fry in the classroom and release them at an annual release ceremony (Blanchet et al., 2022). Depending on the number of returning salmon, the ONA organizes a communal harvest and distributes fish to communities, and participatory and recreational fishing is allowed so long as it follows sustainable guidelines as part of a food security model (ONA, 2017).

5. Current Salmon Management Gaps

Despite billions of dollars put towards conservation efforts and management for salmon, under current salmon management frameworks, many salmon populations are still declining (Gayeski et al., 2018; Lackey, 2010). Therefore it is clear that this framework is not doing what it is meant to and should perhaps then not be the scheme used for the future reinstated population of the Upper Columbia. There is also steadily growing knowledge of salmon science (ecology, genetics, physiology, etc.), however populations in the areas mentioned in this report (across Canada, in the Northwest United States, in Norway), and many other areas around the world, are still not recovering. This points to a knowledge-policy gap; however it seems as though this gap has eluded most regions given the amount of effort put into salmon conservation. Gayeski et al. (2018) indicate that this gap is due to the failure of policies in acknowledging that each population of salmon is uniquely adapted to its natal habitat and should therefore each have their own unique policies. The reason it may have elduded practitioners is likely due to the fact that there is little literature on this knowledge-policy gap overall, resulting in misguided practices.

Management policies discussed in this paper do recognize the importance of locally adapted salmon populations (the WSP and Norway's *Nature Diversity Act*) however it is argued that these policies are not fully implemented and enforced (Gayeski et al., 2018). The knowledge-policy gap is typically due to the failure of councils to follow scientific data and recommendations to use pro-active and precautionary policies rather than reactive ones. Salmon management and conservation often places focus on maximum sustainable yield and methods of achieving this that are contradictory to salmon science. Despite our vast knowledge of salmon ecology, salmon management has often been unsuccessful. Gayeski et al. indicate that place-based management

is the solution since salmon are a “locally adapted” species and thus require a locally based management structure. They suggest that management actions should reflect the local salmon population’s specific characteristics.

Further to these points, the authors indicate that using hatchery programs to enhance salmon populations regardless of the state of the habitat will be unsuccessful. They say monocultural generic broodstock hatcheries are used to redirect attention from the real issues that need fixing such as loss of habitat due to dams, reservoirs, and water extraction. Fish from hatcheries cause issues when added into ‘wild’ salmon populations because they interbreed which results in reduced fitness, even in one generation. However if the salmon introduced into the Upper Columbia are the only population present and will be landlocked, this concern with regards to using hatchery salmon is irrelevant.

6. Discussion

Although there is vast knowledge, both scientific and traditional, on the life-cycle and ecology of salmon, restoring salmon populations in the Upper Columbia River basin will entail immense efforts. BC’s Wild Salmon Policy currently protects all “wild salmon” in the province, however given the uncertainty around whether the reintroduced salmon would fall under the description of a “wild” or genetically distinct population, and since landlocked salmon are not mentioned in the policy, the salmon may not be protected under the WSP unless amendments are made (see Table 5 in section 6.3). Even if the salmon are protected under the WSP, there will need to be a policy framework for the implementation of salmon management and conservation on the ground.

Given the information outlined and discussed throughout this paper, essential policy considerations for such a framework will be summarized and discussed here.

Decision-makers must use all available and relevant resources when creating policies for them to be well-rounded, trustworthy, and reflective of the groups implementing them, resulting in more structurally sound governance (Alexander et al., 2019). Conservation policies must also focus on being proactive versus reactive to avoid any consequences possible, saving energy and money in the long run. Below are the main aspects of this paper to be considered when creating a conservation program for the reintroduced salmon in the Upper Columbia River basin.

6.1 First Nations to lead on decision-making and governance

This scenario is a unique opportunity to start off on the right foot. Indigenous-led governance for reintroduced salmon in the Upper Columbia River where First Nations once thrived off of salmon pre-colonial settlement is the only ethically, morally, and ecologically wise way to begin fully reconciling the damages caused decades ago and the continued damage to this day. It is an important first step to decolonializing the current standard for aquatic resource management in BC, and all over the country.

First Nations have protected inherent and Treaty rights under the Canadian Constitution that comprise of the right to accustomed governance on their traditional lands and waters and their resources and these rights must be upheld and applied in real scenarios. Moreover, it has been affirmed that Indigenous rights and title grant First Nations the right to use the resources of the land and waters they have title over. The “consideration” of Indigenous knowledge needs to shift to an Indigenous-led governance structure for the governance of salmon on traditional lands. This

is a crucial piece as it is a step towards healing the broken trust between First Nations and the state and true environmental justice. This type of reconciliation must be on Indigenous terms rather than follow a colonially defined version of reconciliation as state-led management "exacerbates colonial legacies and entrenches inequities" (Silver et al., 2022, p.175).

Use of an Indigenous-led governance framework such as Two-Eyed Seeing or co-production which requires that First Nations advocate for themselves, and that Indigenous knowledge and other forms of knowledge be weighted equally in all steps of the process, from research to decision-making to management implementation and to monitoring. This can include interviews with elders, advisory boards made up of researchers, Indigenous groups, and stakeholders, and community-based monitoring programs (Table 4).

In Section 3, two reintroduction management frameworks are introduced (Table 3 and Figure 2) and five categorical management variables that must be considered are pulled from both: biological, socioeconomic, organizational, managerial, and political. How Indigenous governance can be integrated into each of these variables is outlined in Table 4.

***Table 4**. Reintroduction management variables pulled from both frameworks discussed in section 3 and corresponding actions to ensure Indigenous governance integration in each. Self-created using information from Falk and Olwell (1992); Reading et al. (2002); Chapman and Schott (2020); Reid et al. (2020); and Cooke et al. (2021).*

Reintroduction Management Variables	Indigenous Governance Integration
Biological	Western science indicators collected via field observations and document reviews, and the basis for Indigenous indicators informed via informant interviews with Elders and other First Nations community members Community-based monitoring programs
Socioeconomic	Emphasize importance of salmon to the First Nations communities Funding should be given to the projects being led and implemented by Indigenous and local community leaders
Organizational	Partnerships with First Nations communities, locals, NGOs, and governments that prioritize open communication and iterative processes
Managerial	Clearly identify how First Nations will lead the reintroduction and the subsequent monitoring and maintenance of the population
Political	Bringing Indigenous knowledge into processes through advisory boards made up of researchers, Indigenous groups, and stakeholders

Future Indigenous-led monitoring and protection of the salmon can be accomplished with the aid of programs such as the Land Guardians and the Conservation Through Reconciliation Partnership. The entire process should be iterative in order to adapt to any new information provided in any step and to maintain open lines of communication. Figure 3 by Cooke et al. (2021) depicts a framework for using Indigenous knowledge, emphasizing this iterative process for acquiring and applying knowledge and building partnerships. This ongoing process can happen in tandem with the aforementioned reintroduction frameworks to ensure the continued use of Indigenous-focused approaches. Budgeting, i.e., ensuring that enough funding is applied for is a must since knowledge co-production is a lengthy and costly process requiring a lot of long-term interactions for knowledge exchange (Cooke et al., 2021).

The CRSRI is an Indigenous-led initiative and the legislation put in place to protect the salmon once reintroduced should follow suit. In the words of the First Nations Fisheries Council (2022): "True reconciliation must acknowledge that for nearly 150 years, Crown legislation and policies have stripped First Nations of their ability to govern and manage fisheries, and severely restricted their access to the aquatic resources on which they depend."

6.2 Assessment of listing the salmon under SARA

It must be determined if the salmon would be listed under SARA and how this will affect their conservation and management. COSEWIC will examine hatchery-supported salmon populations separately from populations without hatchery supplementation, therefore depending on what methods are used to reintroduce the salmon (hatchery vs. "wild" anadromous salmon passage) will determine how the salmon are viewed under COSEWIC and SARA (Table 5). First Nations should lead the decision on whether or not to list the salmon under SARA through the use of a community board led by First Nations groups. Protecting salmon under SARA can restrict land-owners' land usage as well as recreational use of the ecosystem and therefore should be given careful consideration. Stakeholders and resource users must be consulted throughout the entire process of governance planning.

6.3 Assessment of listing salmon under the WSP

The WSP states that it shall honour Canada's obligations to First Nations in its decision-making processes and that it will support Indigenous-led salmon governance, work with local partners, and fund local restoration projects. If it is pushed for the restored salmon population in the Upper Columbia to be classified as a conservation unit under the WSP, Indigenous collaboration is necessary. Funding through the WSP for restoration works would be greatly

beneficial, however amendments to the policy would likely need to be made for the reintroduced salmon if they are landlocked (no dam passage mechanisms implemented, and/or if they are hatchery-based. Part of the CRSRI's reintroduction efforts is to consider the implementation of downstream and upstream passage technologies on the major dams which completely block anadromous salmon passage. If these technologies are implemented then it needs to be considered whether or not the populations once confined to below the Grand Coulee Dam will become a new CU once dispersed throughout the Upper Columbia.

First Nations could partner with the Salmon watersheds program as well as NGOs and the federal and provincial governments to implement the WSP if possible, like First Nations did with the Skeena River salmon. First Nations and stakeholders should be front and center in defining conservation benchmarks. Species in the salmon food chain must be considered and protected, and other sectors aside from fisheries (agriculture, forestry, and land-use) should be considered when creating a salmon protection and habitat restoration scheme. Stakeholder and local engagement must not be a second thought. If the salmon are not listed as a CU, a watershed-based management should be considered.

Table 5 compares the WSP to the SARA, outlining the key considerations for both mentioned throughout the paper, and summarizing the main aspects for each that will play a role in determining whether or not they are viable tools to be used for the protection and management of the reintroduced salmon. If it is determined that the salmon can be protected under the WSP or listed under the SARA, the key considerations listed in Table 5 need to be weighed to determine

whether or not these avenues would be more helpful in the long-run compared to not using either, which is also an option.

***Table 5**. Key considerations when contemplating the use of the Wild Salmon Policy or the Species at Risk Act for the protection of reintroduced salmon in the Upper Columbia River basin, as well as points indicating it would be possible (for) and points indicating it might not be possible (against) to use these strategies. Self-created using information from Canada's Policy for Conservation of Wild Salmon (2005); WSP Implementation Plan 2018-2022 (2018); Fisheries and Oceans Canada (2008); and Environment Canada (2007).*

Law/Policy	Key considerations	For	Against
WSP	○ Whether or not salmon will be considered "wild" ○ Whether or not salmon will remain landlocked ○ Upper Columbia River salmon must be ecologically and genetically diverse from salmon in other CUs to be listed as their own. ○ Protects the salmon but its ultimately up to the minister of fisheries to decide for or against taking conservation action when weighing social and economic costs.	○ Reintroduced salmon fit description of CUs because they were extirpated and are unlikely to re-establish naturally. ○ According to figure 1, the salmon would likely qualify for high level of management efforts under WSP.	○ Does not specifically address landlocked or re-introduced salmon. ○ Salmon considered "wild" if they were born of naturally spawning parents and lived out their entire life cycle in the wild therefore hatchery salmon may not qualify. ○ Columbia River not included in any conservation units in the WSP since there have been no salmon there in several decades.
SARA	○ Can elicit political backlash since enacting SARA can sometimes directly affect landowners. ○ Listing salmon under SARA can facilitate conservation efforts	○ Extirpated species being reintroduced can be listed under SARA	○ COSEWIC examines hatchery-supported salmon units separately from populations with little or no hatchery assistance

6.4 Other considerations

The long-term monitoring and management plan must be explicitly defined, from specific goals to considerations such as future human-ecosystem interactions and how they can affect restorations outcomes. Focus should be on the interplay of every mechanism that will affect the population, such as politics, land-usage, and management decisions, rather than focusing solely on the biological aspects of increasing the species population. All potential consequences must also be outlined from the outset and minimized accordingly, such as the implications associated with listing under SARA, or effects to other protected species in the ecosystem, and any political consequences that may arrise. A solid monitoring plan must be created which addresses the length of the monitoring and maintenance plan, the ins and outs of management roles and responsibilities, pre-determined milestones with check-ins, data collection methods, and explicitly defined long-term goals plans such as distribution and abundance objectives, extent of commitment to management, and criteria to determine when salmon have been fully re-established. Data on the status of the population and the ecosystem must continuously be collected to understand how the program is doing and to help inform restoration decisions as the years go on. The angler diary program used by the ASRP is a good citizen science method to use which is cost-effective as a surplus to scientific data collection. Attention should also be given to where the salmon end up after release, as this is pertinent species preference information that can inform future release locations as well as where stream restoration efforts should be focused. Lastly, the policy framework must ensure collaboration with the US on conservation of the US section of the river and the salmon within it through the IJC and the International Watersheds Initiative.

7. Conclusion

Policy lessons learned from past and current salmon governance around the world and in Canada can help guide a new framework for the governance of reintroduced salmon in the Upper Columbia River basin. Depending on the methods employed to reintroduce the salmon, be it hatchery supplementation or new upstream and downstream passage technologies, systems already in place such as the Wild Salmon Policy, the *Species at Risk Act*, and Indigenous Rights and Title may be used to help manage the salmon and their protection. The Columbia River Salmon Reintroduction Initiative is led by First Nations and the governance structure for the salmon should follow suit. Rather than only consideration First Nations Input, it will be most beneficial for First Nations to lead a management program that equally takes into account Indigenous knowledge, western science, and community input. Long-term goals and a long-term management and monitoring plan must be explicitly defined, considering all potential outcomes and consequences, and the process must remain iterative to adapt to any new information acquired. It is recommended that an advisory board made up of Indigenous groups, researchers, and stakeholders be used to implement a community-based program. The program can work collaboratively with federal and provincial governments and programs as well as NGOs to implement the necessary strategies. Work through the IJC can ensure that salmon protection extends to the United States section of the Columbia River.

References Cited

Alexander, S. M., Provencher, J. F., Henri, D. A., Taylor, J. J., Lloren, J. I., Nanayakkara, L., ... & Cooke, S. J. (2019). Bridging Indigenous and science-based knowledge in coastal and marine research, monitoring, and management in Canada. *Environmental Evidence*, *8*(1), 1-24.

Assembly of First Nations. (2018, May 18). *First Nations fishing rights - fact sheet*. Retrieved March 8, 2023, from https://www.afn.ca/first-nations-fishing-rights-fact-sheet/

Belyea, B. (2007). *Dark Storm Moving West*. University of Calgary Press. Canada. Retrieved from https://canadacommons.ca/artifacts/1873104/dark-storm-moving-west/2622523/ on 25 Apr 2023.

Berseth, V., & Matthews, R. (2020). How "wild" are hatchery salmon? conservation policy and the contested framing of nature in Canada and the United States. *Environment and Planning E: Nature and Space*, *4*(3), 1077–1098. https://doi.org/10.1177/2514848620945315

Blanchet, R., Willows, N., Johnson, S., & Batal, M. (2022). Enhancing cultural food security among the syilx okanagan adults with the reintroduction of Okanagan Sockeye Salmon. *Applied Physiology, Nutrition, and Metabolism*, *47*(2), 124–133. https://doi.org/10.1139/apnm-2021-0321

Bond, M. H., Nodine, T. G., Beechie, T. J., & Zabel, R. W. (2019). Estimating the benefits of widespread floodplain reconnection for Columbia River Chinook Salmon. *Canadian Journal of Fisheries and Aquatic Sciences*, *76*(7), 1212–1226. https://doi.org/10.1139/cjfas-2018-0108

Bussanich, R., Bellingham, L., and Mlarch, G.K. (2017). Tributary Assessment of Potential Sockeye, Chinook, and Steelhead Spawning Habitat in the Upper Columbia River, Canada, for Prioritizing Salmon Reintroduction. 60.

Chapman, J. M., & Schott, S. (2020). Knowledge coevolution: generating new understanding through bridging and strengthening distinct knowledge systems and empowering local knowledge holders. *Sustainability Science*, *15*(3), 931-943.

Columbia River Salmon Reintroduction Initiative. CRSRI | Bringing the Salmon Home. (2022, November 10). Retrieved January 30, 2023, from https://columbiariversalmon.ca/about/the-initiative/

Conservation through Reconciliation Partnership. (2022). CRP Website. Retrieved April 5, 2023, from https://conservation-reconciliation.ca/about-us-1

Cooke, S. J., Nguyen, V. M., Chapman, J. M., Reid, A. J., Landsman, S. J., Young, N., ... & Semeniuk, C. A. (2021). Knowledge co-production: A pathway to effective fisheries management, conservation, and governance. *Fisheries*, *46*(2), 89-97.

Dauble, D. D., & Watson, D. G. (1990). Spawning and abundance of fall chinook salmon (Oncorhynchus tshawytscha) in the Hanford reach of the Columbia River, 1948--1988. https://doi.org/10.2172/7051730

Delgamuukw v. British Columbia. (1997). CanLII 302 (SCC), [1997] 3 SCR 1010. retrieved on March 9th, 2023 from: https://canlii.ca/t/1fqz8

Enochs, C.R. (1997). Gone Today, Here Tomorrow: Policies and Issues Surrounding Wildlife Reintroduction. *Hastings Environmental Law Journal (4)1.* Gone Today, Here Tomorrow: Policies and Issues Surrounding Wildlife Reintroduction (uchastings.edu)

Environment Canada. (2007). A Guide to the Species at Risk Act (SARA): Information for Federal Land Managers. Retrieved on March 07, 2023 from: Microsoft Word - SARAYOU GUIDE Federal Land Managers EN .doc (canada.ca)

Environment and Climate Change Canada. (2022, September 2). *Canada-US boundary waters treaty*. Canada.ca. Retrieved March 11, 2023, from https://www.canada.ca/en/environment-climate-change/corporate/international-affairs/partnerships-countries-regions/north-america/canada-united-states-boundary-waters-treaty.html

Falk, D.A., & Olwell, P. (1992). Scientific and policy considerations in restoration and reintroduction of endangered species. *Rhodora (94)879:287-315.*

First Nations Fisheries Council. (2022, April 21). Retrieved April 24, 2023, from https://www.fnfisheriescouncil.ca/

Fish, F.F., Hanavan, M.G. (1948). A report upon the grand coulee fish-maintenance project 1939-1947. *The Quarterly Review of Biology*, *24*(4), 369–369. https://doi.org/10.1086/397271

Fisheries and Oceans Canada. (2005). *Canada's policy for conservation of wild pacific salmon*. Retrieved from Government of Canada website: DFO WSP2 JUN 06 w/covers (dfo-mpo.gc.ca)

Fisheries and Oceans Canada. (2008*). Framework for characterizing conservation units of pacific salmon (oncorhynchus spp.) for implementing the wild salmon policy.* Canadian Science Advisory Secretariat. Retrieved January 24, 2022 from: SAR-AS2008_052_e (psf.ca)

Fisheries and Oceans Canada. (2016). *Integrated biological status of southern British Columbia Chinook salmon (oncorhynchus tshawytscha) under the wild salmon policy.* Retrieved

January 23, 2022 from: Integrated Biological Status of Southern British Columbia Chinook Salmon (Oncorhynchus tshawytscha) Under the Wild Salmon Policy (publications.gc.ca)

Fisheries and Oceans Canada. (2017). *The 2017 Fraser sockeye salmon (oncorhynchus nerka) integrated biological status re-assessment under the wild salmon policy.* Retrieved January 23, 2022 from: The 2017 Fraser Sockeye Salmon (Oncorhynchus nerka) integrated biological status re-assessment under the Wild Salmon Policy (publications.gc.ca)

Fisheries and Oceans Canada. (2018). *Wild Salmon Policy 2018-2022 Implementation Plan*. Fisheries and Oceans Canada, Vancouver, BC. Canadian Science Advisory Secretariat.

Gayeski, N. J., Stanford, J. A., Montgomery, D. R., Lichatowich, J., Peterman, R. M., & Williams, R. N. (2018). The failure of Wild Salmon Management: Need for a place-based Conceptual Foundation. *Fisheries*, *43*(7), 303–309. https://doi.org/10.1002/fsh.10062

Glass, C. (2010). *An Evaluation of the Reintroduction of Atlantic Salmon to Lake Ontario and its Tributaries* (Master's thesis, University of Waterloo).

Government of British Columbia. (2023, January 16). *Columbia River Treaty*. Columbia River Treaty | Government of British Columbia. Retrieved January 24, 2023, from https://engage.gov.bc.ca/columbiarivertreaty/

Government of Ontario. (2021). *Ontario's provincial fish strategy*. ontario.ca. Retrieved February 28, 2023, from https://www.ontario.ca/page/ontarios-provincial-fish-strategy

Hernandez, J. (2020, February 13). *How a landmark B.C. Court case set the stage for wet'suwet'en anti-pipeline protests | CBC News*. CBCnews. Retrieved March 10, 2023, from https://www.cbc.ca/news/canada/british-columbia/delgamuukw-court-ruling-significance-1.5461763#:~:text=What%20is%20the%20Delgamuukw%20case%3F%20The%20Delgamuukw%20decision,of%20land%20and%20water%20in%20northwest%20British%20Columbia.

Hirzel, A., Posse, B., Oggier, P., Crettenand, Y., Glenz, C., & Arlettaz, R. (2004). Ecological requirements of reintroduced species and the implications for release policy: The case of the bearded vulture. *Journal of Applied Ecology*, *41*(6), 1103–1116. https://doi.org/10.1111/j.0021-8901.2004.00980.x

Impact Assessment Act. (S.C., 2019, C-28). Retrieved from the Justice Laws website: Impact Assessment Act (justice.gc.ca)

International Joint Commission. (2023a). *The Boundary Waters Treaty of 1909*. Retrieved March 11, 2023, from The Boundary Waters Treaty of 1909 | International Joint Commission (ijc.org)

International Joint Commission. (2023b). *International Watersheds Initiative*. Retrieved March 11, 2023, from International Watersheds Initiative | International Joint Commission (ijc.org)

Kinch, R. A., Bobilya, A. J., Daniel, B., & Duncan, S. (2022). Indigenous storytelling, Cherokee traditional ecological knowledge, and place-based education. *Journal of Outdoor Recreation, Education, and Leadership*, *14*(4), 55–70. https://doi.org/10.18666/jorel-2022-11601

Lackey, R.T. (2000). Restoring wild salmon to the Pacific Northwest: chasing an illusion? Department of Fisheries and Wildlife. Oregon State University, Corvallis, OR. Pp. 91-143 in *What we don't know about Pacific Northwest fish runs: an inquiry into decision-making*.

Lackey, R. T. (2003). Pacific Northwest Salmon: Forecasting their status in 2100. *Reviews in Fisheries Science*, *11*(1), 35–88. https://doi.org/10.1080/16226510390856529

Lackey, R.T., Lach, D.H., Duncan, S.L. (2006a). Policy options to reverse the decline of wild pacific salmon. *Fisheries.* 31(7):344-351.

Lackey, R.T., Lach, D.H., Duncan, S.L. (2006b). Wild salmon in Western North America: The historical and policy conext. Pp.13-55 in: *Salmon 2100: The Future of Wild Pacific Salmon.*

Lake Ontario Atlantic Salmon Restoration Program. (2023). *Home*. Lake Ontario Atlantic Salmon Restoration Program. Retrieved February 28, 2023, from http://www.bringbackthesalmon.ca/history/#recoverynow

Land Needs Guardians. (2022). *What guardians do*. Retrieved March 15, 2023, from https://landneedsguardians.ca/what-guardians-do

Liu, Y., Olaussen, J.O., Skonhoft, A. (2011). Wild and farmed salmon in Norway – A review. *Marine Policy. 35(3).* 413-418. https://doi.org/10.1016/j.marpol.2010.11.007

Mantyka-Pringle, C. S., Jardine, T. D., Bradford, L., Bharadwaj, L., Kythreotis, A. P., Fresque-Baxter, J., Kelly, E., Somers, G., Doig, L. E., Jones, P. D., & Lindenschmidt, K.-E. (2017). Bridging science and traditional knowledge to assess cumulative impacts of stressors on ecosystem health. *Environment International*, 102, 125– 137. https://doi.org/10.1016/j.envint.2017.02.008

Marts, M. E., & Sewell, W. R. D. (1960). The conflict between fish and power resources in the Pacific Northwest. *Annals of the Association of American Geographers*, *50*(1), 42–50. https://doi.org/10.1111/j.1467-8306.1960.tb00327.x

McGregor, D. (2020). Reconciliation and Environmental Justice. *Reconciliation, Transitional and Indigenous Justice*, 100–109. https://doi.org/10.4324/9781003035268-10

Moberly, W. (1885). *The rocks and rivers of British Columbia*. London: H. Blacklock.

Nature Diversity Act. (2009). Norway Ministry of Environment. Retrieved March 15, 2023, from https://www.regjeringen.no/en/dokumenter/nature-diversity-act/id570549/

Nelitz, M., Porter, M., and Marmorek, D.R. (2007). Scoping Document to Assess the Feasibility, Impacts, and Benefits (FIBs) of Restoring Anadromous Salmon to the Canadian Reaches of the Upper Columbia River. Prepared for Upper Columbia Aquatic Management Partnership (UCAMP) by ESSA Technologies Ltd. Vancouver, BC.

Nisga'a Lisims Government. (2013). *Nisga'a fisheries and wildlife act*. Nisga'a Fisheries and Wildlife Act | Nisga'a Lisims Government. Retrieved March 8th, 2023, from https://www.nisgaanation.ca/legislation/nisgaa-fisheries-and-wildlife-act

Norton-Arnold and Company. (2005). Wild Pacific Salmon Policy Forum 3 Summary Report. Forum held: December 8, 2005 Burnaby, British Columbia Submitted to: Department of Fisheries and Oceans.

ONA. (2017). Okanagan Nation Alliance. Retrieved on March 4th, 2023 from https://www.syilx.org/.

Pacific Salmon Foundation. (n.d.). *The wild salmon policy*. Salmon Watersheds Program. Retrieved January 24, 2023, from https://salmonwatersheds.ca/wsp/

Procter, A. (2020). Elsewhere and otherwise: Indigeneity and the politics of exclusion in Labrador's Extractive Resource Governance. *The Extractive Industries and Society*, *7*(4), 1292–1300. https://doi.org/10.1016/j.exis.2020.05.018

Reading, R.P., Clark, T.W., & Kellert, S.R. (2002). Towards an Endangered Species Reintroduction Paradigm. *Endangered species UPDATE 19(04):142-146.*

Reid, A. J., Eckert, L. E., Lane, J. F., Young, N., Hinch, S. G., Darimont, C. T., Cooke, S. J., Ban, N. C., & Marshall, A. (2020). "Two-eyed seeing": An indigenous framework to transform Fisheries Research and Management. *Fish and Fisheries*, *22*(2), 243–261. https://doi.org/10.1111/faf.12516

Scholz, A., O'Laughlin, K., Geist, D., Peone, D., Uehara,J., Fields, L., Kleist, T., Zozaya, I., Peone, T., and Teesatsukie, K. (1985). Compilation of information on salmon and steelhead total run size, catch and hydropower related losses in the Upper Columbia River Basin, above Grand Coulee Dam. Upper Columbia United Tribes Fisheries Center, Eastern Washington University, Department of Biology, Cheney, Washington.

Sheer, M. (1999). An Assessment of Fall Chinook Salmon (*Oncorhynchus tschawytscha*) Spawning Habitat for Present and Pre-impoundment River Conditions in a Section of the John Day Reservoir, Columbia River. Oregon State University, Corvallis.

Silver, J. J., Okamoto, D. K., Armitage, D., Alexander, S. M., Atleo (Kam'ayaam/Chachim'multhnii), C., Burt, J. M., Jones (Nang Jingwas), R., Lee, L. C., Muhl, E.-K., Salomon, A. K., & Stoll, J. S. (2022). Fish, people, and systems of power: Understanding and disrupting feedback between colonialism and fisheries science. *The American Naturalist*, *200*(1), 168–180. https://doi.org/10.1086/720152

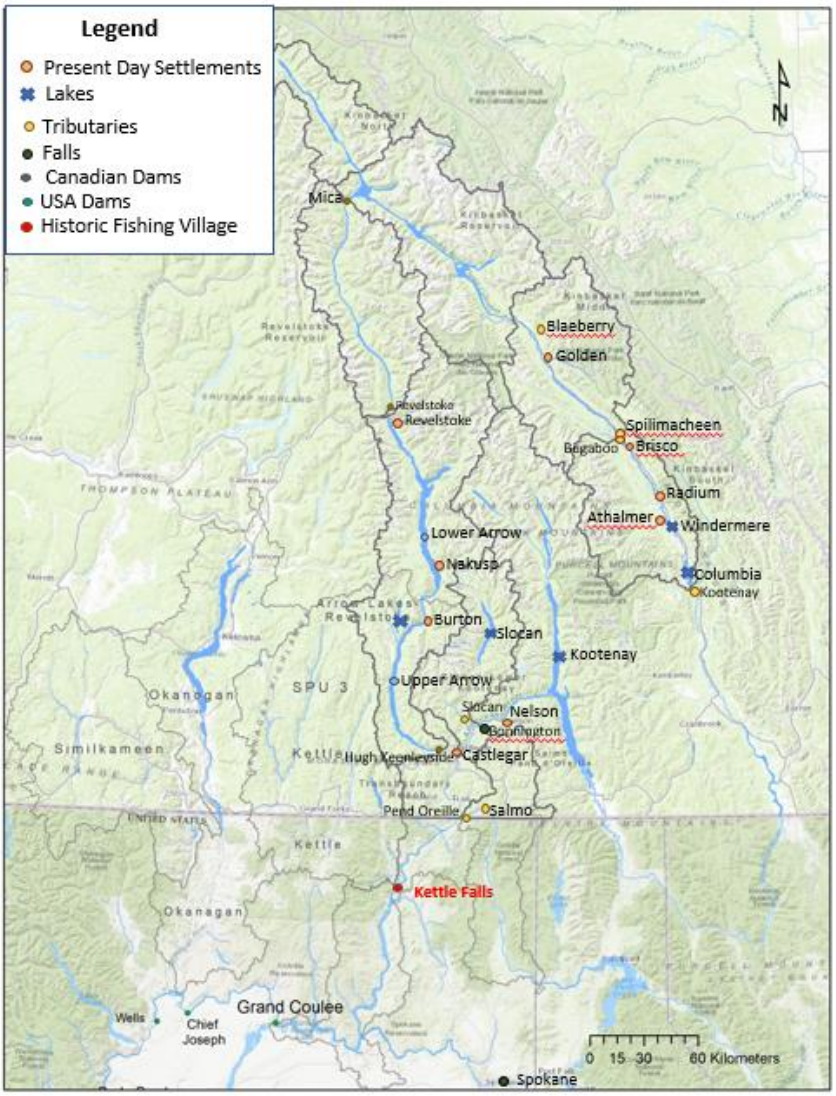
UN General Assembly, *United Nations Declaration on the Rights of Indigenous Peoples: resolution / adopted by the General Assembly*, 2 October 2007. Retrieved on March 8, 2023 from: UNDRIP_E_web.pdf

United States Environmental Protection Agency. (2022). *Chinook Salmon*. EPA. Retrieved March 13, 2023, from https://www.epa.gov/salish-sea/chinook-salmon#what-is-being-done

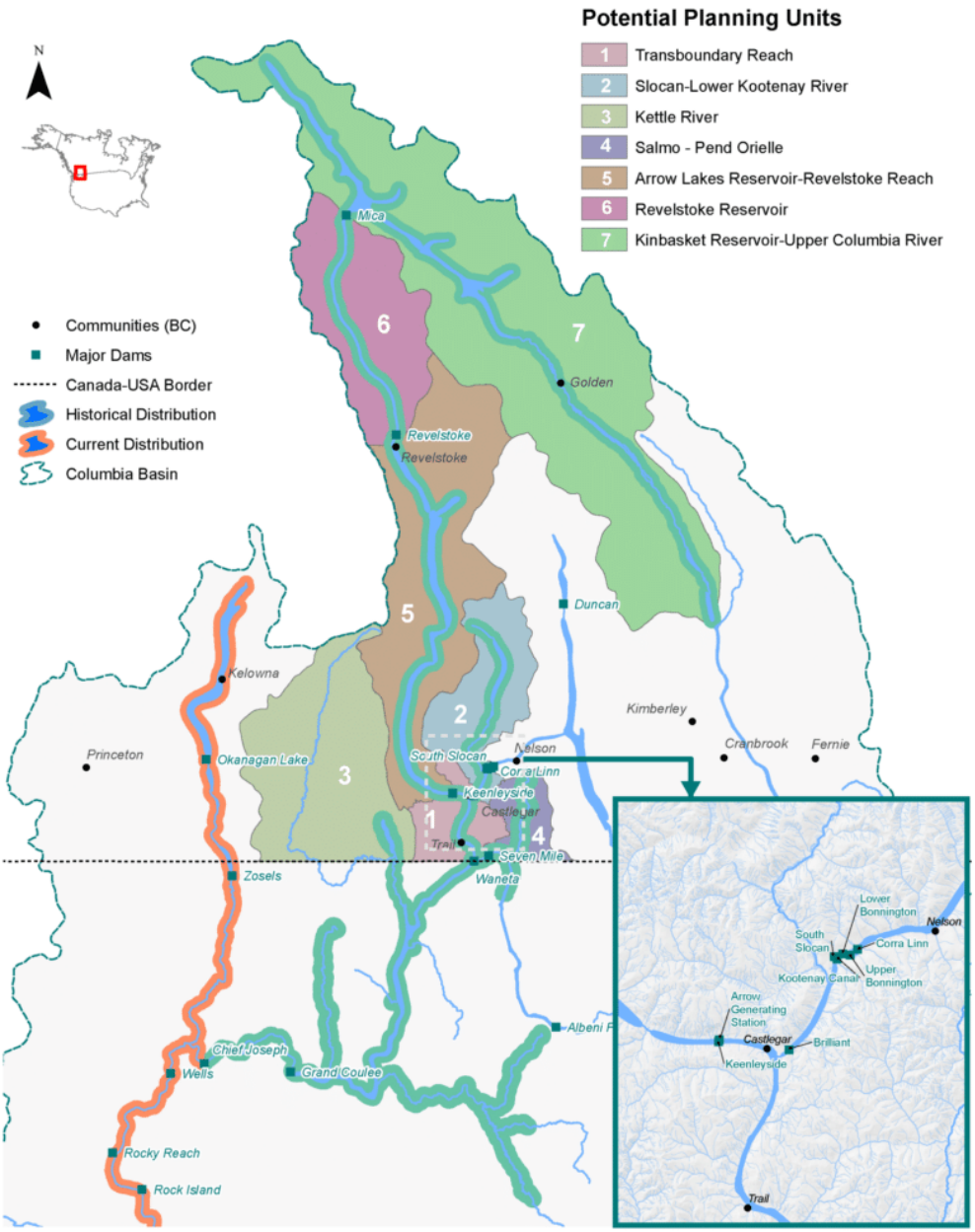
Washington Department of Fisheries. (1959). Contributions of Western states, Alaska and British Columbia to salmon fisheries of the North American Pacific Ocean, including Puget Sound, Straits of Juan de Fuca and Columbia River. Washington State Department of Fisheries.

White, D. D., & Hall, T. E. (2006). Public understanding of science in Pacific Northwest Salmon recovery policy. *Society & Natural Resources*, *19*(4), 305–320. https://doi.org/10.1080/08941920500519172

Appendix



Appendix 1. Map of Upper Columbia River Basin and its major lakes and tributaries as well as settlements along the watershed and large dams. Kettle falls historic fishing village also indicated. Self-created.



Appendix 2. Map from *Bringing the Salmon Home: Columbia River Salmon Reintroduction Initiative* (2022) website displaying the Columbia River Basin and its major dams, as well as the historic and current distribution of salmon (Chinook and Sockeye). The outlined potential planning units are distinct portions of the upper Columbia River that represent natural environmental and anthropogenic transitions for the purpose of facilitating planned works by the CRSRI.